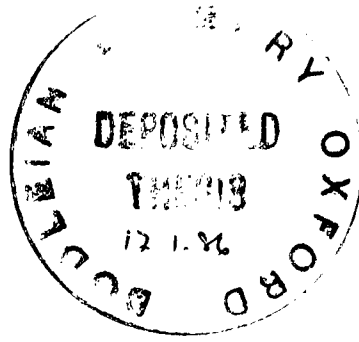




FACTORS AFFECTING THE STATUS OF THE CHOUGH IN BRITAIN,
WITH OBSERVATIONS ON ITS BEHAVIOUR.

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ABSTRACT

This thesis aims to fill gaps unfilled by the recent upsurge in Chough studies. These are: the classification and functional analysis of aspects of their behaviour, examining feeding preferences in relation to land management, finding how literary attitudes towards them developed and obtaining quantitative insights into their past distribution to apply to possible explanations for their status changes.

Three pairs near Llangranog, Dyfed were observed and findings were complemented with analysis of RSPB film offcuts.

All observed behaviours were defined and classified according to social context and frequency of use. Of 45 behaviours seen, 21 had not previously been recorded. Single-link cluster diagrams were presented to illustrate observed postures and comparable corvid postures.

Three aspects of their social behaviour were further examined: Food-begging by juveniles and females was related to time since fledging and copulation date respectively. Begging success depended on technique repertoire, which increased with time; increased foraging group size decreased the individual's vigilance time spent, with an earlier detection of potential tourist disturbance; wing-flicking did not occur with short flights nor after flights due to disturbance. It was frequent after landing while as frequent before take-off as during foraging excepting tourist disturbed flights. Ritualised forms of wing-flicking and bill-wiping formed the basis of Chough communication. Flow diagrams and canal models describing the functional organisation of these behaviours are presented.

Choughs feed on short, mainly grass swards maintained by grazing, exposure and occasionally, cutting.

When given the Jackdaw's old name, Choughs acquired their thieving reputation and were also regarded as fire-raisers until the 1830's. Distribution and abundance from 1750 to 1982 were estimated at county and national level. Their status was not significantly affected by climate. Grazing artificially boosted their numbers, agricultural changes and persecution from 1750 until 1940 caused their decline.

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CHAPTER 1

GENERAL INTRODUCTION

Until the late 1970's, the Chough enjoyed the dubious distinction of being one of the least understood and poorly researched of Britain's resident birds. Considering its relative rarity (Schedule 1 in the Wildlife and Countryside Act, 1981), it was a matter of some urgent concern that even the fundamentals of its feeding and breeding biology were poorly understood, and current knowledge of its population in Britain and Ireland was too uneven to be of much value.

At the time, most data came from casual and non-quantitative observations of breeding (eg Campbell 1946, Williamson 1959 and Cowdy 1962), feeding (eg Turner 1959, Morgan 1971, Dawson 1975 and Holyoak 1967) and behaviour (eg Holyoak 1972). Some of the work published was misleading. For example, Cowdy (1973) stated that ants formed a major part of the Chough's diet. This is not the case, except during a period in late Summer. Thus the Chough's ecological requirements could not be ascertained to a satisfactory level. Likewise the only detailed population survey (Rolfe 1966 for Britain and Cabot 1965 for Ireland) was carried out after the exceptionally severe Winter of 1962-3 and a number of its figures are in conflict with surveys carried out before and afterwards. Figures obtained by the BTO/IWC Survey of 1968-71 (Sharrock 1976) were too widely bracketed for comparison with previous surveys. A number of detailed surveys were subsequently carried out on a county level (Harrop 1970, Donovan 1972 and Roderick 1978) but these were very brief surveys and not carried out in the same year.

Since 1978, the situation has changed markedly. There has been a considerable expenditure of research effort by a number of workers to make good these deficiencies. Feeding behaviour and diet have been examined by

Bullock (1980), Haycock and Bullock (1982), Roberts (1982a, 1983), Warnes (1983a) and Sharrock (1984) and breeding by Bullock (1980), Warnes (1983a) and Monaghan and Thompson (1984). These studies have been used as a basis to ascertain the Chough's conservation and management needs. In 1982 the first fully systematic survey of Chough breeding was undertaken and published by Bullock et al. (1983a, b, c, d) and Warnes (1983b), alongside much supplementary data on habitat usage and breeding dynamics. In addition Roberts (in prep.) has studied their movements and mortality. The above work has covered the immediate research requirements for building an effective basis for the species' conservation.

There remain a number of poorly investigated areas: the classification and functional analysis of their behaviour, especially relating to vigilance behaviour and the effect of human disturbance; their past distribution and the reasons for changes in their status; and past attitudes towards Choughs, as gleaned from English literature. Thus, the overriding aim of this thesis has been to attempt to fill these gaps to the same depth of coverage as the other fields. In attempting to achieve this end, this work is also concerned with the development of methods for producing and utilising the information required.

The results of this work are presented in 5 relatively self-contained Chapters. In Chapter 2, a classification system for all Chough social, sexual, antagonistic and maintenance behaviour is developed. Each observed behaviour is defined (and where possible, illustrated) and classified into its functional contexts. The results are further classified using the techniques devised by Bayens (1979) and Van Rhijn (1981) in order to be able to compare the difference between various postures and to attempt a comparison of a set of behaviours in all British corvid species.

Chapter 3 aims to examine the functional roles of various aspects of Chough behaviour and to produce for the first time a quantitatively based

description of these behaviours. In particular vigilance, begging and communication are examined with simple descriptive flow diagrams adapted from the canal models of fish vigilance developed by Carlestead (1983a, b) and the state-space approaches by, for example, Sibly and McFarland (1976). These 'models' are purely descriptive in showing the organisation of sequences of responses to a set of known circumstances, as opposed to quantitatively based descriptive and predictive models of behaviour. A different approach to communication behaviour and the role of ritualisation than previously undertaken is made by examining the Chough's social behaviour from the viewpoint of its two most distinctive behaviours the wing-flick and the bill-wipe. Because of the wide range of behaviours examined and the diverse nature of this work, each aspect is divided into separate sections with their own introductions and discussions. A general discussion at the end of the Chapter aims to integrate the work and examine its value from the view of Chough behaviour research and behaviour research in general.

Because the Chough feeding ecology has been adequately studied, Chapter 4, on feeding will be restricted to comparative work in order to support and supplement those previously published findings.

A comprehensive study of a given species's past distribution and the factors that affect it needs to take into account the attitudes to the species in contemporary literature. No detailed research into the role of any bird in English literature has been undertaken to the level whereby the reasons for attitudes conveyed in literature towards that species and their changes can be adequately understood. In Chapter 5, a comprehensive analysis of the literary history of the Chough in English writings is attempted. Apart from references in Cornish and Welsh, the Chough was not recognised to be an inherently British bird until shortly before 1450 and the word 'Chough' was used to describe the Jackdaw. The word 'Chough' was

not exclusively used for Choughs until the late 17th Century. The reasons for this and the attitudes conveyed by works at various times are examined alongside the consequences relating to the Chough's relationship with Man. Previous examinations of animals in literature have been found wanting (eg Yapp 1979, 1982 and Clutton-Brock 1984) due to a lack of knowledge of either the literary or the scientific side of the research requirements, often combined with an inability to draw/^{on}the full resources of an unfamiliar discipline. This chapter will therefore utilise an interdisciplinary approach in explaining the literary attitudes found.

Research into the Chough's past distribution has been piecemeal and as a result, applying it to uncertain data on possible causes for these status changes has produced unsatisfactory results (eg Bullock 1980 and Bullock et al. 1983a). In Chapter 6, all known and available data on the Chough's past distribution is collated in an attempt to produce a quantitative estimate of its population changes and to relate these to climate, persecution by Man and changes in grassland management. The Chapter will aim to investigate quantitative relationships between status changes of the Choughs and these factors and to examine the feasibility of such an approach in other species.

To conclude, this thesis aims to fill outstanding gaps in our understanding of the Chough, especially with the view to obtaining data for the 'Birds of the Western Palearctic', and to examine the viability of the methods employed in attempting to achieve this aim.

CHAPTER 2

CLASSIFICATION OF BEHAVIOURS

2:1:1	Introduction
2:1:2	Aims
2:1:3	Methods
2:2:1-11	Base components; components used in a number of contexts
2:3:1-9	Behaviours used in maintenance
2:4:1-6	Foraging behaviour
2:5:1-16	Sexual behaviour; Male/Female
2:6:1-2	Sexual behaviour; Adults and juveniles
2:7:1-8	Antagonistic behaviour
2:8:1-2	Comparisons with previous observations
2:9:1-4	Posture classifications
2:10	A simple ethnogram for Chough social behaviour
2:11	Discussion

'The Chough is easily tamed, and a prettier sight than three or four of the birds, with their bright red legs and bills, strutting about on a well mown lawn, can scarcely be believed.'

'Instances we believe, are on record of Choughs being taught to speak, but Shakespeare appeared to have entertained no great opinion of their talking powers.'

James Harting, The Ornithology of Shakespeare, 1864.

CHAPTER 2

CLASSIFICATION OF BEHAVIOURS

2:1:1 Introduction

Although Holyoak (1972) and Bullock (1980) studied the behaviour of the Chough in general, their work and supplementary observations provided by Whittaker (1947), Ryves (1948), Williamson (1959), Cowdy (1962), Goodwin (1976), Coombs (1978) and Warnes (1983a) have not been of a systematic enough nature to provide a comprehensive classification of Chough behaviour.

With the recent systematic description of Magpie social behaviour by Baeyens (1979), and the information on other British corvids available from Goodwin (1976), Coombs (1978) and Lockie (1956), the data on Chough behaviour enables a comparison with other corvids to be undertaken. Van Rhijn (1981) developed a behaviour component system for classifying the behaviour of the Black-headed Gull, whereby the body of the gull was broken down into 4 component units: body axis, carpal joints, neck and bill and each unit was allocated a number of variant postures. For example, there were 4 different positions the carpal joints could be in, from fully tucked in, to fully outstretched. This is the first attempt at systematically classifying postures in a form that allows quantitative comparisons of postures to be made. It contains the potential for adaptation to other species and further to allow posture comparison on an interspecific level.

2:1:2 Aims

The main aim is to describe and classify the basic behaviour components used by Choughs and to describe and classify their social and maintenance behaviours and obtain a rough estimate of their frequency of use.

Secondary aims are as follows; to devise a single link component

classification system utilising a minimal number of variants, but sensitive enough to include and differentiate the behaviour repertoire of the Chough in detail, and to compare a number of postures using all British corvids; to use this system to compare some aspects of corvid behaviour on a quantitative basis. Finally, a simple ethnogram was to be attempted, relating social behaviours observed to a simplified set of postures used by the Chough.

2:1:3 Methods

Choughs were observed in the Loctyn area from December 1981 to April 1984 for a total of about 350 Chough-hours. All behaviours, and their components were recorded, described and diagrams of postures used made. Frequency of observations was recorded on a 4 point scale: (i) at least once every 5 hours, (ii) at least once every 25 hours, (iii) at least once every 100 hours and (iv) at least once every 350 hours. Seasonality of observation of behaviours was also noted.

Postures and actions such as wing-flicking had to be visible to the human eye (with or without binoculars) and thus had to last for at least $\frac{1}{2}$ a second. Where possible, postures were confirmed by drawing them from projected offcuts from the RSPB film "The Commendable Crow" (1979). Posture data were obtained using film taken in Snowdonia and Anglesey with an Arriflex D.L. 16mm camera and examined on a L.S.C. Vedette monitor.

Diagram^matic classification of postures was made by utilising 4 elements of variation in the Chough's body; tail; head; body axis; and carpal joints. Postures for other corvids were obtained from the sources cited in the introduction, and adapted to fit the 4 point system.

An ethnogram was constructed by classifying the occurrences of each behaviour with each of a number of simplified postures that were designed to cover over 90% of observations of behaviours recorded.

2:2 BASE COMPONENTS; COMPONENTS USED IN A NUMBER OF CONTEXTS

2:2:1 Wing-flick (wf.)

Wings lifted to maximum height with synchronous uplift of tail, wings held in air, tail rises to peak, rapid return of wings with slower return of tail (i).

2:2:2 Sub Wing-flick (s.wf.)

Wings lifted to { maximal height, no discernible tail movement, and wings then returned to resting posture (i, fig 2:2).

2:2:3 Look (l.)

Head raised so that bill is elevated at least 90 degrees from axis of body. Two types recognised; (i) short look; where posture held for .25-.75 second (ii) full look, where held for 1 second or longer, (i).

2:2:4 Close (c.)

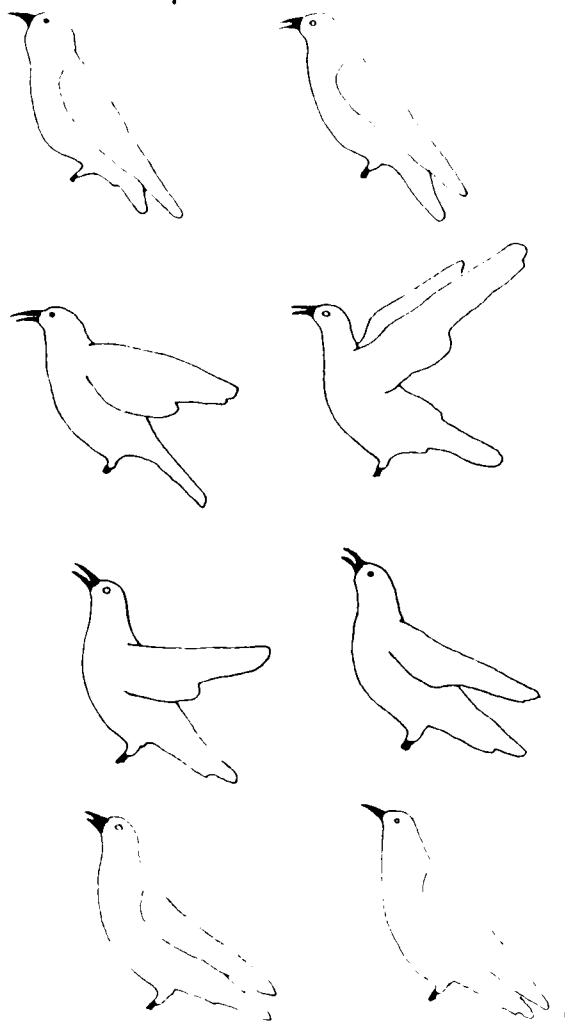
Head orientated towards potential feeding site, bird being either still or walking. In each case, followed by 'peck' or 'look' components (i).

2:2:5 Bill-wipe (BW.)

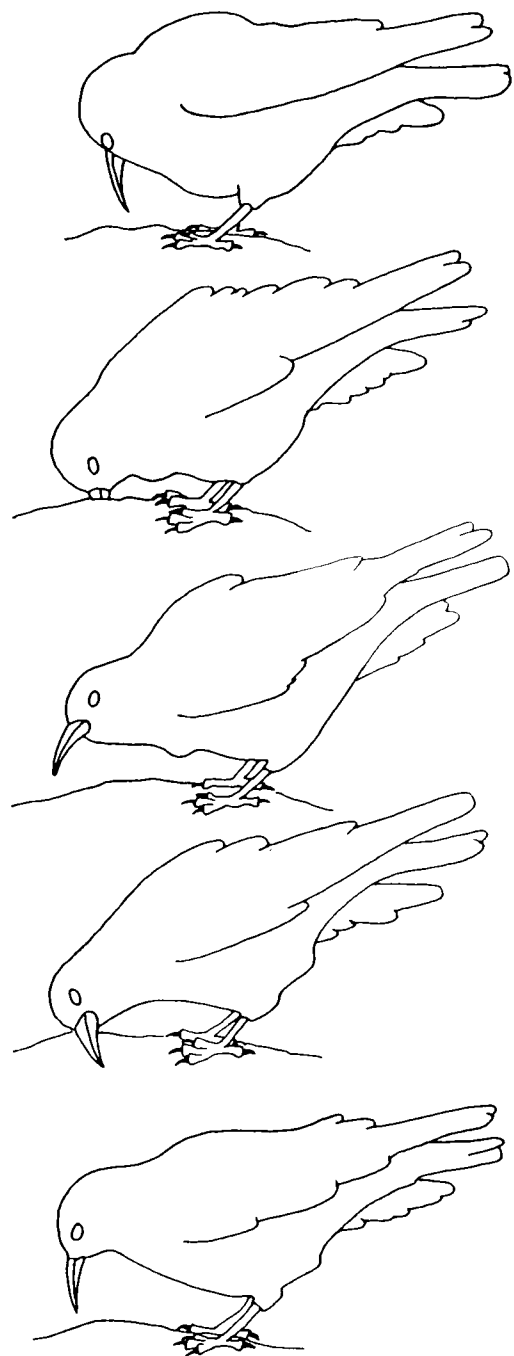
Body and head orientated towards rock/branch/vegetation. Head moved so that alternate sides of bill are wiped along the substrate, starting at the base of the bill and finishing at its tip (i, fig 2:3)

2:2:6 Forward (f.)

Body flattened, horizontal to ground, head and tail in line (i).

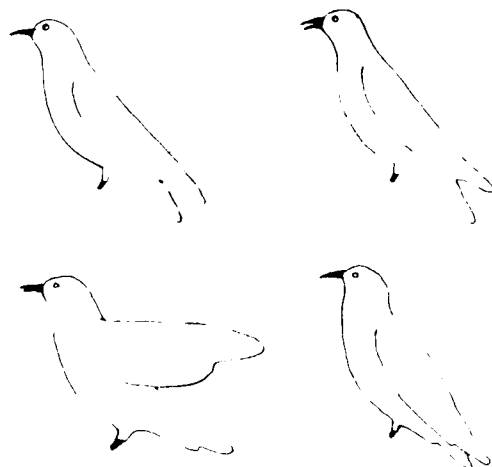


(a) Wing-flick call(2:2:11).



(b) Bill-wipe (2:2:5).

FIGURE 2:1.
COMMON CHOUGH BEHAVIOUR COMPONENTS.



(c) Sub Wing-flick (2:2:2).

2:2:7 Full Forward (f.f.)

As in 2:2:6, but feathers sleeked back and slight dip of head to present a narrower profile (ii).

2:2:8 Crouch (c.)

Legs tucked in, body points upright, head upwards and feathers ruffled (ii).

2:2:9 Forage Look Posture

Standard resting etc posture. Body 30° from the ground, neck upright (i).

2:2:10 Upright

As with 2:2:9. but body 40-55° from ground (i).

2:2:11 Wing-flick Call (wf.c.)

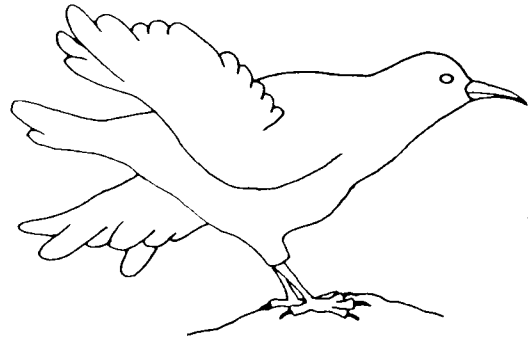
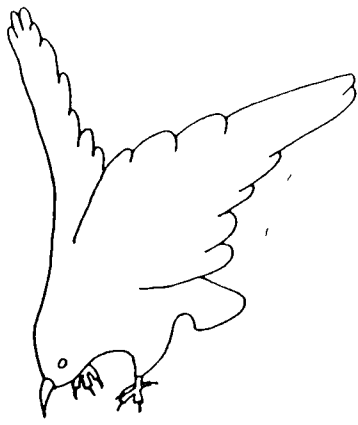
Wing-flicks as in 2:2:1 and calls when wings are fully extended (i, fig 2:3).

2:3 BEHAVIOURS USED IN MAINTENANCE**2:3:1 Bill-wipe (qv 2:2:5) Where it does not involve other components**

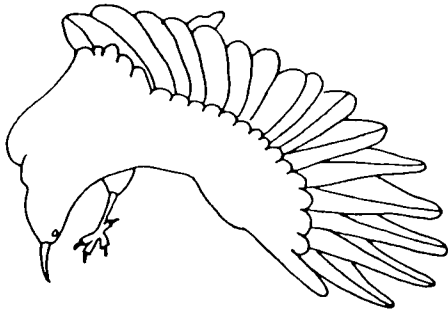
- a) After faecal sac removal at nest, on rocks or grass (i, breeding seasons).
- b) Cleaning of soiled bill during foraging, or on landing at foraging area, on rock, branch or vegetation (i).
- c) At roost, final cleaning of bill, on rock (i).

2:3:2 Preen

Arrange and oil feathers by nibbling and stroking action of bill. Head

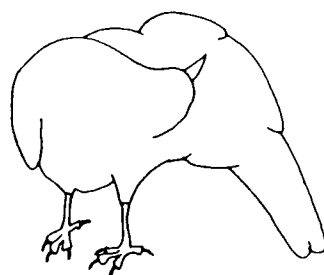
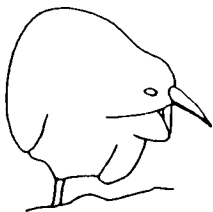
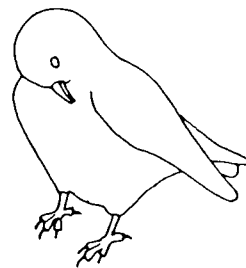
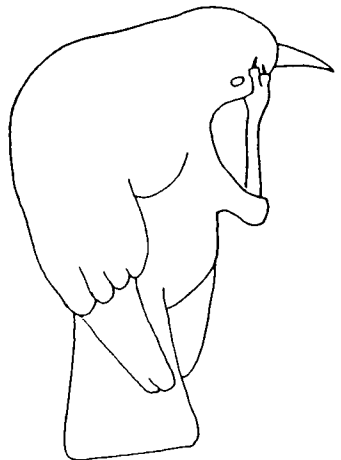
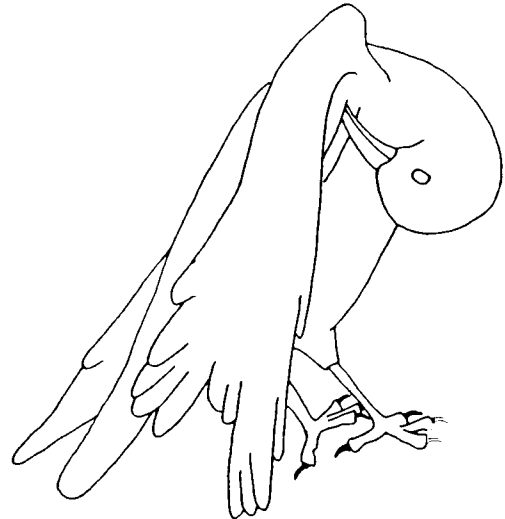


(b) Wing Ruffle (2:3:7).



(a) Wing Stretch (2:3:6).

FIGURE 2:1.
MAINTENANCE ACTIVITIES.



(c) Preen (2:3:2).

and neck areas scratched by feet (i, fig 2:2).

Occurs during foraging and at the roost. Also in a primarily sexual context when Allopreening (qv. 2:5:2).

2:3:3 "Sunning"

Faces sun with body axis in line of sun, thus presenting minimal surface area to sun. Wings opened $\frac{1}{2}$ way out and held still. Where shade available

- a) During foraging in area without shade (iv).

2:3:4 Passive Anting

Sits in area occupied by ants, spreads out wings $\frac{1}{2}$ to full along ground to allow ants access.

- a) During foraging (iv).

2:3:5 Active Anting

As for 2:3:4, except introduces ant to underparts and underside of wings with bill. Two instances; 30,35 seconds in duration (iv).

- a) During foraging.

2:3:6 Wing Stretch (ws.)

One wing fully extended horizontally, held for 1-5 seconds and retracted (i, fig 2:2).

- a) During foraging.
- b) Access for bill during preening.
- c) Access for foot during preening.
- d) Access for bill in active anting.

2:3:7 Ruffle (r.)

Shaking of body with consequent loosening of feathers (i, fig 2:2).

- a) During foraging
- b) After anting (2:3:5,6)
- c) After preening (2:3:2)

2:3:8 Wing-flick (wf. qv. 2:2:1)

Maintenance of wing condition (i).

- a) During foraging.
- b) After 'full flight'.

2:3:9 Sub Wing-flick (swf. qv. 2:2:2)

Maintenance of wing condition (i).

- a) During foraging.
- b) During roosting.
- c) After preening (2:3:2).
- d) After ruffle (2:3:9).
- e) After wing stretch (2:3:7).

2:4 FORAGING BEHAVIOUR

2:4:1 Look (2:2:3)

2:4:2 Close (2:2:4)

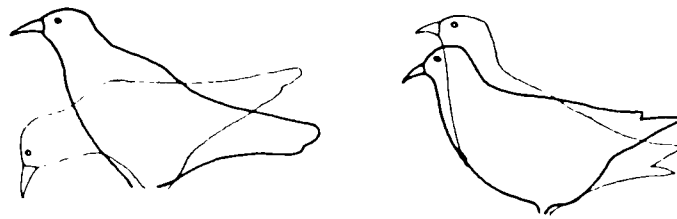
2:4:3 Bill Wipe (2:2:5)

2:4:4 Peck (p.)

Bill brought down to ground, opening 0.08-0.12 seconds before reaching the surface, and brought up closed until next component, except in case of prey being encountered, when bill partially opened before swallow (2:4:5) component (i, fig 2:3).

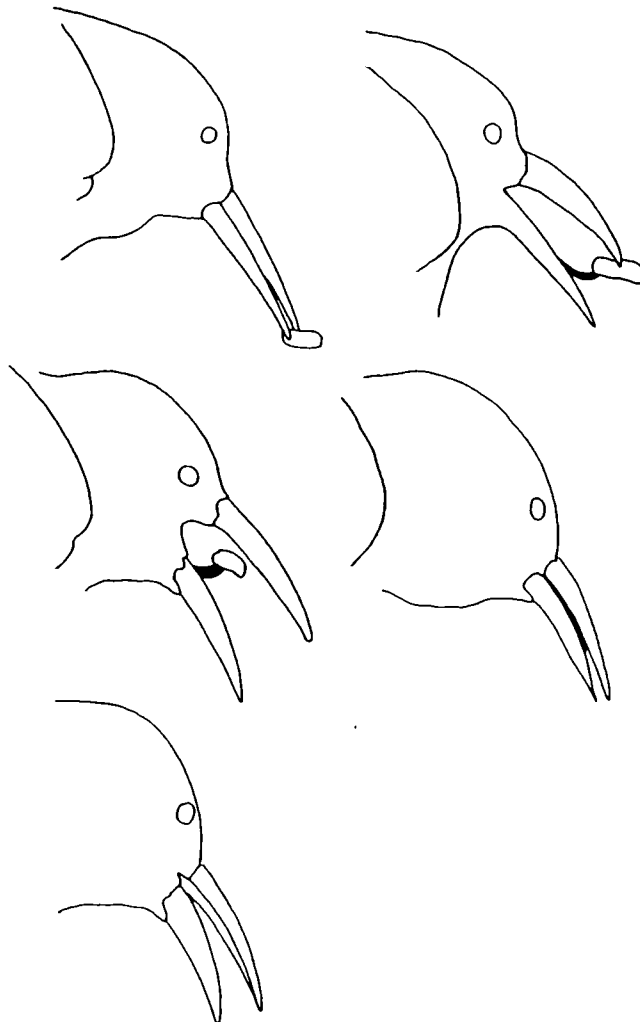
2:4:5 Swallow (sw.)

(Typical example used; insect larvae). Prey held for .4-.48 second at



(a) Peck (2:4:4).

FIGURE 2:3.
FORAGING BEHAVIOURS.



(b) Swallow (2:4:5).

tip of bill, taken inside bill by tongue, head movement of .08 second, with occasional secondary opening of .04-.12 second if prey not correctly placed to be swallowed (i, fig 2:3).

2:4:6 Wing-flick Call (wf.c.)

Used prior to ending of foraging sessions in two social contexts (i).

- a) Prior to joining Choughs calling to it in the air.
- b) Prior to flying away from approaching tourists.

2:5 SEXUAL BEHAVIOUR; MALE/FEMALE

2:5:1 Preen

- a) By male or female after unsuccessful courtship food beg by female (iii).

2:5:2 Allopreen (a.)

More effective preening of head and neck than foot preening (2:3:2).

- a) Simultaneous; male and female (figure 2:4).
- b) Reciprocal; male follows female or vice versa.
- c) Singular; one to another (figure 2:4).

Occurs in following sexual contexts;

- a) During foraging (ii).
- b) After sexually assertive wing flick/call (2:5:3) display by both sexes (2:5:16) (iv).
- c) After courtship feeding (ii).

2:5:3 Wing-flick/Call (wf.c.)

Wing-flick (2:2:1) with call component as wings reach and remain

at peak.

- a) Sexual assertion by either sex of pair during foraging (i).

2:5:4 Display Bill-wipe (BW.)

As for 2:2:5, but bill does not touch any substrate, amplitude of movement is greater and movements constant and obviously stereotyped, is a sexually derived version of the maintenance bill wipe.

- a) On a post as in 2:5:7 and 2:5:8 by male some days prior to copulation. Wipes are divided by crouched look components (iv).
- b) On ground, by males in pair after attacking Ravens near nest or certain cases of close presence of tourists or Herring Gulls (iv).

2:5:5 Mutual Bill-wipe (m.BW.)

Pair face each other and bills touch for 1 to 3 strokes reaching from tip to halfway down the bill. Appears that strokes^{are}/always restricted to one side of bill, and thus, no alternation.

- a) During foraging (iii).
- b) After agonistic interaction with intruder in breeding season and area (iv).
- c) After successful female food beg (iii).

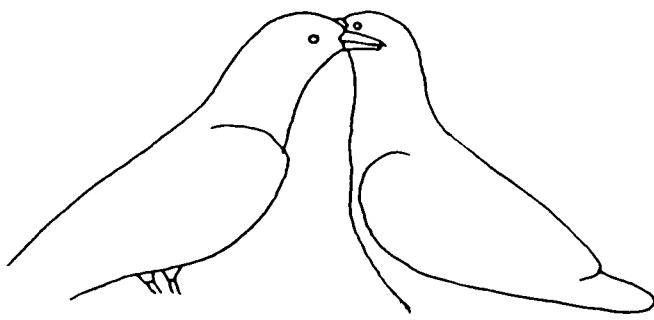
2:5:6 Male Wing Stretch (ws.)

Prior to copulation, male walks, wings $\frac{1}{2}$ to fully stretched, head and tail horizontal or downwards. Display punctuated with foraging bouts, and calling when wings held still. 35-45 seconds in duration.

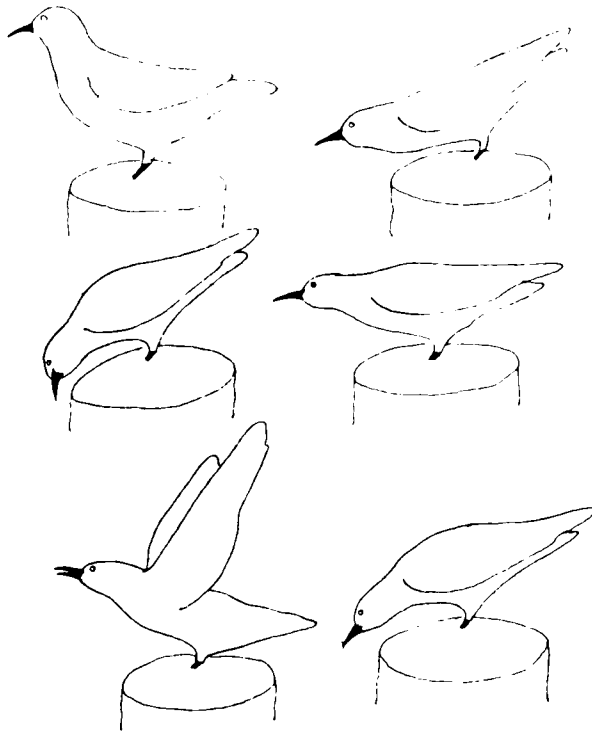
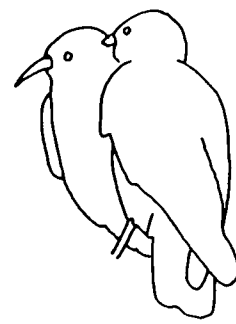
- a) During foraging, before copulation (iii).

2:5:7 Bill-wipe, Wing-flick, Call Display (BW.wf.c.)

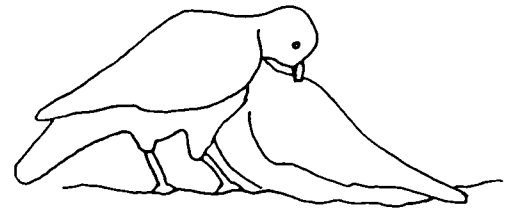
By male 1-3 days before copulation, on post. Male 'wipes' same side of



(a) Allopreen (2:5:2). Simultaneous allopreen.

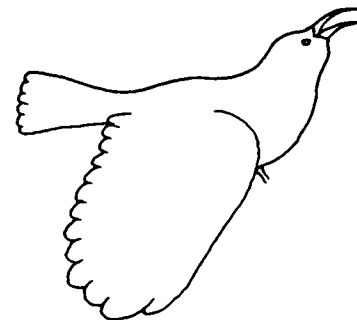


(b) Bill-wipe, Wing-flick, Call Display (2:5:7).



(a) Singular allopreening.

FIGURE 2:4.
SEXUAL BEHAVIOUR MALE/FEMALE.



(c) Copulation, Male
Precopulatory (2:5:9).



(d) Female Nest Chatter (2:5:13).



(e) Copulation, Female
aquiescence (2:5:10).

bill on post, in air, wing flicks, calls and repeats, 'wiping' other side of bill.

- a) By male some days before copulation (iii, figure 2:4).

One case of female using display when observed mate using the display (iv).

2:5:8 Bill-wipe, Call Display (BW.c.)

By female, on post, 1-3 days prior to copulation. As for 2:5:7 but no wing flick. Variant involves holding wings $\frac{1}{2}$ way out for .5-1 second between bill wipe and call components.

- a) By female, some days before copulation (iv).

2:5:9 Male Precopulatory (pc.)

Male in presence of mate spreads wings, shaking, holds head and bill down and tail erect at 45°. Male walks around in vicinity of female. Wide range of variants observed. Has not been seen immediately before copulation, but see Warnes (1983a) (iii, figure 2:4).

2:5:10 Copulation

No displays immediately before (0-10 minutes) copulation observed.

Pair foraging, female spreads wings, flattens body, holds posture and flicks tail upwards, and aligns towards male. Male in turn aligns to female, advancing towards female from the rear and mounts female with occasional wing flicks (s.wf., probably for balance). Resumes normal foraging posture, dismounts and both forage (iv, figure 2:4).

2:5:11 Female Food Beg, Simple

Female in upright posture faces mate. If within 2m, walk, or if 2-10m flies to male and faces male with submissive (2:2:8) posture in some cases opening wings $\frac{1}{2}$ to $\frac{1}{2}$ way out, and fluttering wings while keeping tail

still. Continues until male responds or ignores, then both forage.

- a) During foraging (ii).

2:5:12 **Female Food Beg, Horizontal**

Female aligns towards mate. Spreads wings $\frac{1}{2}$ to full, opens bill, head down, tail up and quivers wings, advancing towards male. Male responds by walking to female and female crouches into full submissive posture (qv. 2:2:8) as male feeds her. If no male response, both forage, female begging for a maximum of twenty seconds.

- a) During foraging (ii).

2:5:13 **Nest Chatter**

When pair in nest area, call made to each other involving short uplift of head, head being kept horizontal when no call made, groups of calls range from 1-9 per session. Female has higher frequency and rate of usage.

- a) In nest when incubating eggs (-, figure 2:4).

2:5:14 **Bowed Pair Greeting**

Breeding pair in post breeding flock, walk up to each other and simultaneously lower bodies into forward (2:2:6) posture. Then both bills touch, on occasion extending into mutual bill wipe (2:5:5).

- a) Post breeding foraging groups (iii).

2:5:15 **Sexually Assertive Wing-flick Calling**

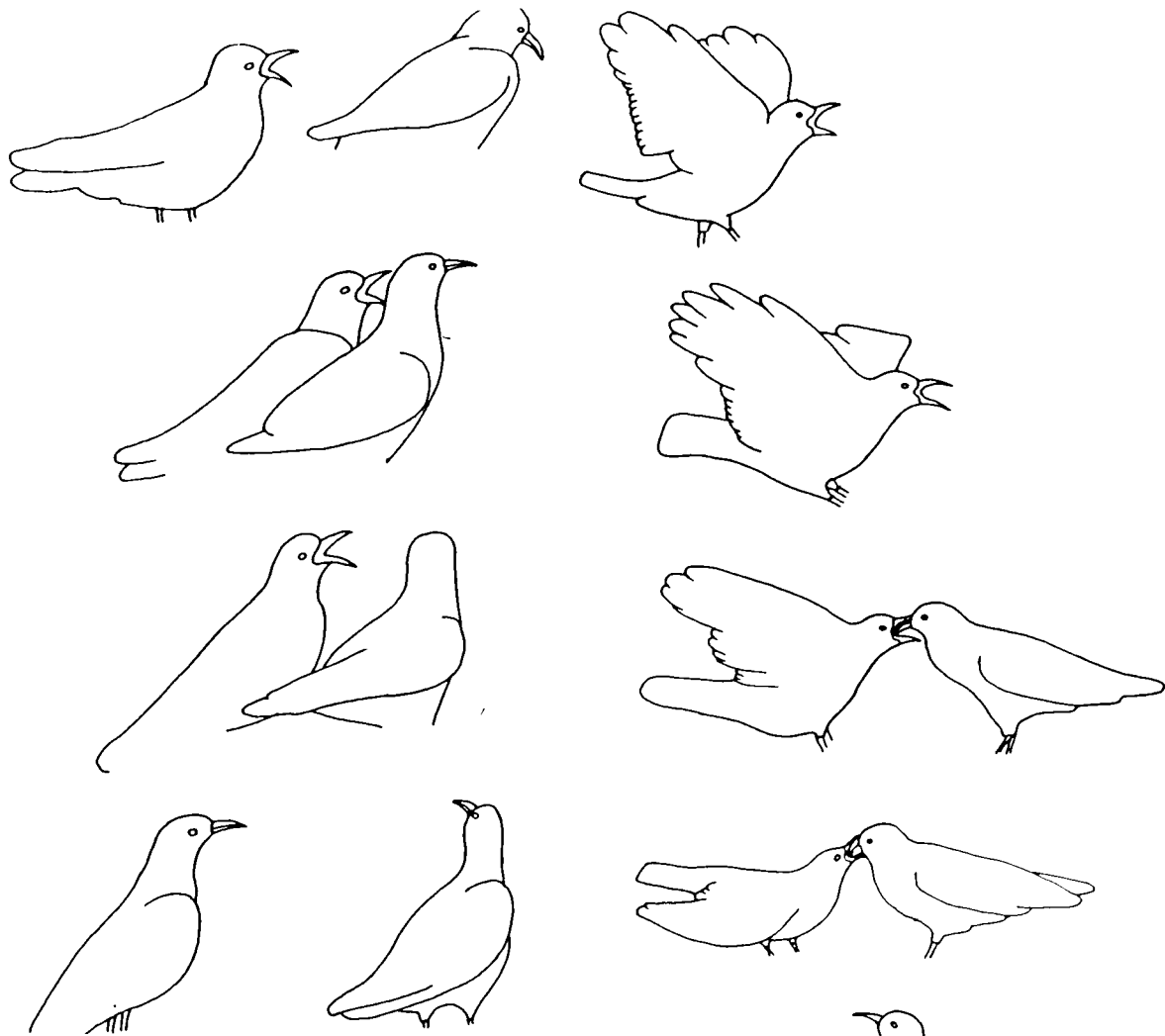
Male and female wing-flick call at each other (2:2:11).

- a) While foraging during breeding season (ii).

2:6 SEXUAL BEHAVIOUR; ADULTS AND JUVENILES

2:6:1 Juvenile Begging Displays

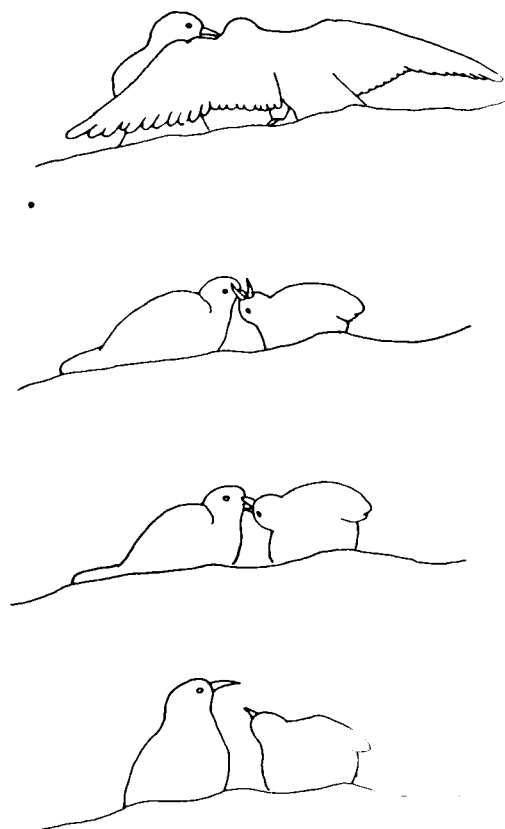
- a) Dip call; Juvenile on slope or mound directly above adult. Dips body while calling, with a total of 3 body dips on only observed instance, calling stops after final dip (iv).
- b) Adjacent follow; juvenile in proximity of adult, calling at 1.5-2 calls/second. No specific orientation to adult, and upright posture maintained throughout attempt (i, figure 2:5).
- c) Face; using b), juvenile follows alongside adult while calling (ii).
- e) Run adjacent; using d) except involves rapid run to adult before following it alongside (iii).
- f) Face run; using c) juvenile is 1 + m in front of adult, runs up to adult before starting calling (iii, figure 2:5).
- g) Wing flutter; juvenile faces adult, bill open and holds wings $\frac{1}{2}$ out and wings are held with a very slight flutter (iv, figure 2:5).
- h) Wf. Face; as in g) except uses s.wf. (2:2:2) component (iv, figure 2:5).
- i) Wf. adjacent run; as in h), juvenile 1 + m away from adult, runs up to it, flicking wings until nearer adult and resumes h) display (iii).
- j) Upright wing spread; Juvenile on ant mound, as adult approached, juvenile extended wings to $\frac{1}{2}$ way out, shaking them and bill held open (iv).
- k) Forward thrust; juvenile faces adult, stretches wings to $\frac{1}{2}$ way, crouches and opens bill, thrusting it at adult's bill (iv).
- l) Rapid call, Rapid call wing quivver; similar to b), except higher frequency of calling and occasionally use of wing quivver (iii).



(a) Adjacent (2:6:1,b).

FIGURE 2:5.
SEXUAL BEHAVIOURS; ADULT/JUVENILE.
JUVENILE BEGGING DISPLAYS.

(b) Face Run (2:6:1,f).



(c) Wing Flutter (2:6:1,a)

2:6:2 **Adult Responses**

- a) Ignore; continues to forage (i).
- b) Exclude; where already feeding another juvenile, 4 responses observed; (i) Adult and 'paired juvenile' face each other and bills touch. (ii) Adult faces other juvenile and wf. at it. (iii) As for (i) but Adult wf., while bills touch. (iv) Adult walks towards other juvenile in upright posture causing juvenile to walk backwards, until leaves proximity of 'begging pair' (ii).
- c) Adjacent feeding; positive response to attempts e) and d). Adults turns neck to face juvenile, bodies remaining parallel and opens bill, juvenile turns bill to it and adult regurgitates (iii).
- d) Frontal feeding; adult faces juvenile, juvenile crouches and as for c) (ii).

2:7 **ANTAGONISTIC BEHAVIOUR**

2:7:1 **Forward** (2:2:6) (i, figure 2:6).

2:7:2 **Full Forward** (2:2:7) (ii, figure 2:6).

2:7:3 **Crouch; Appeasement** (2:2:8) (ii, figure 2:6).

2:7:4 **High Full Forward**

Male faces bird, assumes full forward, extends legs fully upright and walks towards bird until it retreats.

- a) By breeding pair against Raven near nest (iv).

2:7:5 **Displacement of Foraging Individual**

- a) Circle exclusion: intruder lands beside resident, faces it and wf. at it while both circle round for 2-3 seconds, until resident leaves (iii).
- b) Frontal wf. Crouch; Intruder walks up to resident, assumes (2:2:7)

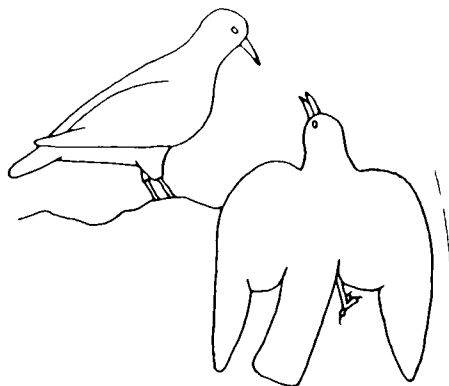
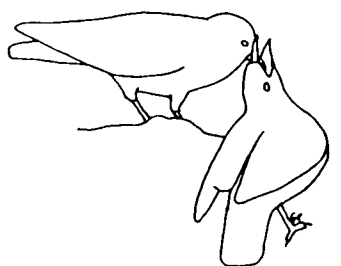
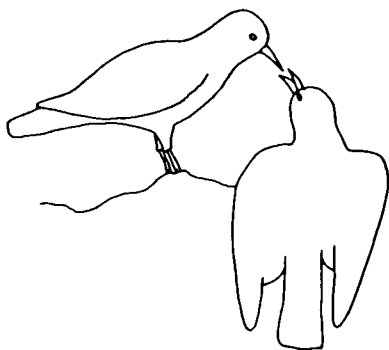


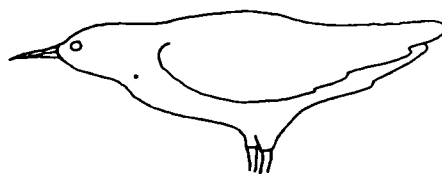
FIGURE 2:5 (continued).
JUVENILE BEGGING DISPLAYS.



(d) Wing-flick Face (2:6:1,h).



(a) Forward (2:7:1).



(b) Full Forward (2:7:2).

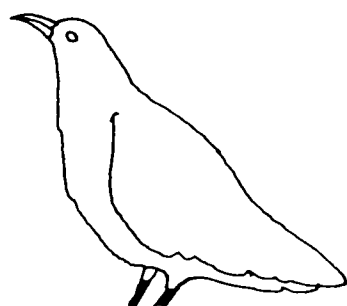


FIGURE 2:6
ANTAGONISTIC POSTURES.

full forward and wf. at resident, maintaining display until resident at least 1 metre away (iv).

c) Walk crouch; as in (b) except wf. while walking up to resident (iv).

d) Wing flap frontal; lands near resident, walks up and assumes (2:2:6) forward posture, flapping wings until resident leaves (iv).

2:7:6 Upright Bill Thrust

Bird faces other bird and each in upright (2:2:10) posture thrusts bill at each other's heads while walking forward until one retreats.

a) Between Chough individuals and intruding Crow while foraging (ii).

2:7:7 Upright Wing Flick

Walks up to other bird, faces it, in upright posture, and wf. (2:2:1) once, other bird retreats.

a) By male of pair, to non breeder close to male (iv).

2:7:8 Flight Displays

a) Simple swoop; flies in to where individual is, so that individual (i) retreats to avoid contact - other Choughs and Oystercatchers (ii) steps back and faces bird making it move on, Choughs (iii).

b) Loop-swoop; individual being chased, feigns changes of direction a number of times before rapidly looping in the air so as to be behind chaser and thus able to swoop^{at}/it in turn, - against chasing Crows and Ravens.

c) Mobbing; follows bird, gradually swooping closer and closer until bird has to take evasive action - against Buzzard.

2:7:9 Bow

Individual uses forward posture and bows head at other individual (iv).

2:8 COMPARISONS WITH PREVIOUS OBSERVATIONS

2:8:1 Introduction

As no systematic work on Chough behaviour has previously been attempted, comparison is of a piecemeal nature. Bullock (1980) studied various behaviours, Warnes (1983a) examined breeding behaviour and Holyoak (1972) concentrated on antagonistic behaviour. Additional observations are included in Whittaker (1947), Ryves (1948), Williamson (1959), Cowdy (1960, 1962) and Goodwin (1976). In this section, a complete listing of all known behaviours is made by adding the findings of this study to previous observations. Where these observations are not found in this study, the behaviours will be defined as far as the literature will allow, and finally a comparison of behaviour definitions and attributions is made.

2:8:2 A Listing of all Observed Behaviours

Main studies	1	Warnes (1983a)
	2	Bullock (1980)
	3	Holyoak (1972)

	This study	1,2,3	Other Observations
COPULATION			
Simple	✓	3	Whittaker (1947)
With wing quiver	.	3	
WF. afterwards	.	1	
FEMALE BEGGING			
Simple	✓	.	
Wing quiver	✓	1,2,3	
After allopreen	.	3	
Male W. quiver after	.	.	Ryves (1948)
M.BW after	✓	.	
Nest chatter	.	.	On film "The Commendable Crow" RSPB 1979
JUVENILE BEGGING			
Simple	✓	1,2,3	Cowdy (1960, 1962)
Variants	✓	.	
WING FLICKING			
Land	✓	2	
Flight intention	✓	3	Goodwin (1976)
Antagonistic	✓	.	
WF.C. vigilance	✓	2	
WF.C. assertive	✓	3	
BW.WF.C.	✓	.	
After preen	✓	.	
While foraging	✓	2	
Sub WF.	✓	.	
ANTAGONISTIC			
Upright bill down	.	3	
High full frontal	✓	.	
Full forward	✓	3	
Forward	✓	3	
Bow	✓	.	Williamson (1959)
Full forward, bill open	✓	3	
Upright bill thrust	✓	.	
Upright WF.	✓	.	
Peck	✓	2	Williamson (1959)
Bill-wipe	✓	3	
Crouch appease	✓	1,2,3	
MAINTENANCE		.	
Preen	✓	2,3	
Sunning	✓	2	
Passive anting	✓	3	
Active anting	✓	.	
Dust bathing	.	2	
WING STRETCH			
Male WS. Display	✓	1	
Male before copulation	✓	2	
Flight intention/vigilant	✓	.	
Appease/Bow	✓	1,2	
Maintenance	✓	.	

	This study	1,2,3	Other Observations
WING FLUTER			
Male when female BW.	✓	.	
Male display	✓	.	
Appease	.	.	Goodwin (1976)
Antagonistic	.	2	Williamson (1959)
BILL WIPE			
Bowed pair greeting	✓	.	
Bill shake	✓	.	
Forage, maintenance	✓	1,2,3	
After faecal sac rem.	✓	.	
Fence display	✓	.	
BW. display	✓	.	
MBW. sexual	✓	1	
MBW. after attack	✓	.	
Allopreen	✓	1,2,3	Whittaker (1947) Cowdy (1962) Williamson (1959)
TOTAL BEHAVIOURS OBSERVED:54	45	1;9 2;15 3;17	

2:8:3 Behaviours not Observed in this Study

From 2:8:2, it can be seen that 9 behaviours out of a total of 54 were from outside this study. A number of these behaviours are combinations of behaviours defined in the previous sections but not observed in such combinations in this study. They will be defined^{as} fully as their records in the literature will allow;

SEXUAL BEHAVIOUR; MALE/FEMALE (2:5)

a) Copulation with Wing Flick (Warnes 1983a)

Previous to copulation, male precopulatory display (2:3:10) seen. This has not^{been} observed immediately prior to copulation in Loctyn. After Standard Copulation (2:5:11), male dismounted and both birds wing flick^{ed} before resuming feeding.

b) Copulation; Female Wing and Tail Quiver (Holyoak 1972)

Observed on four occasions. Female squats on ground as in 2:5:11, partly open wings, tail held horizontally and quiver slightly. Male mounts,

and flutters wings occasionally. Male dismounts and preens, forage or flies away. Male wing quiver may be for balance purposes as opposed to any distinct sexual role.

c) Female "Food Begs" After Allopreen (Holyoak 1972)

Observed on two occasions. Bird had bowed and then allopreened another, was seen to regurgitate food and present it to the other, who took it and swallowed it. This appears to be a case of food presentation rather than simple food begging. It is presumed that the presenter was the male.

d) Nest Chatter (2:5:14)

No mention in literature, so included in main descriptions. Only observed from an offcut of the film "The Commendable Crow", where female initiates 'Nest Chatter' when male enters breeding area. Offcut showed this being used at nest prior to egg hatching.

e) Male Wing Quiver After Food Beg (Ryves 1948)

Observed in remnant Cornish population in 1940's. After successful food beg and male regurgitation of food, male observed to quiver wings as female swallows food, and immediately afterwards.

ANTAGONISTIC BEHAVIOUR (2:7)

a) Upright Bill Down (Holyoak 1972)

Seen in captive bird. Upright posture (2:2:10) with bill held down. Only used against other species (eg Magpie in adjacent cage).

b) Bill Wiping in Fights (Holyoak 1972)

No description given; may refer to display Bill Wipes in a social context which had been misinterpreted by the observer eg BW.WF.C display (2:5:7) and BW. display (2:5:9).

c) Bow Wing Flutter (Williamson 1959, Bullock 1980)

An elaboration of the antagonistic bow (2:7:8). Bullock (1980) describes it with wings fluttering while calling ('skurr' and 'piaow' not

heard in other contexts). Williamson (1959) observed a protracted fight after one bird bow wing fluttered at other using apparently the antagonistic bow. In Bullock's case the bird was at one stage flat on the ground.

d) Appease Wing Flutter (Goodwin 1976)

No posture given. Probably, therefore an elaboration of the appease crouch (2:7:3) combined with wing fluttering or quivering.

2:9 POSTURE CLASSIFICATIONS

2:9:1 Criteria

Van Rhijn (1981), used a system based on 4 points, each further subdivided as follows: body axis (3), carpal joints (4), neck (5), and bill (4). This gave a total of 240 possible postures. On the basis of film analysis and taking any position held for 0.2 of a second or more, he obtained a total of 114 postures (47.5% of the possible total). This reflects the importance of neck and bill position in the social^{behaviour}/of the Black-headed Gull (see for example Tinbergen, 1959). In Choughs, and in particular in other corvids such as the Magpie and the Raven, the position of the tail with respect to the body axis is of more importance than the neck, and the bill shows a narrower range of positions used. Thus a simplified system based upon the following points was used:

- (a) Carpal joints. Fully up (i) to fully in (iv).
- (b) Body axis. Upright (i) to hunched (iv).
- (c) Bill. Upwards (i) to downwards (iii).
- (d) Tail. Upwards (i) to downwards (iii).

Thus, in toto, there were 144 possible combinations. Since there are 4 points of difference, if a cluster diagram of the various postures linked by the single points of differences is required, / ^{these postures} require to be subdivided for presentation on a 3-dimensional basis. This was done by producing cluster diagrams for each of the body axis variants, namely;

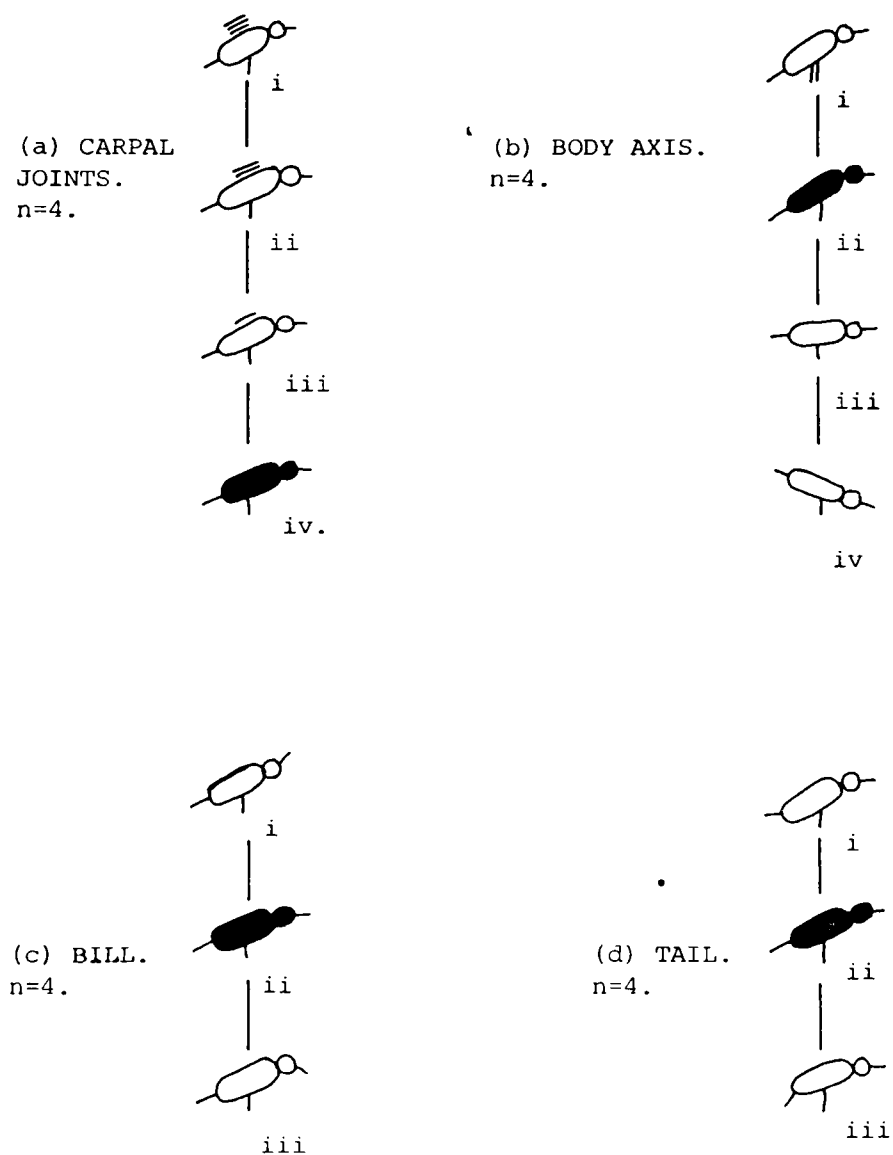
FIGURE 2:9:1.

VARIATIONS IN THE POSTURES OF THE CHOUGH.

A CLASSIFICATION SYSTEM BASED ON 4 POINTS OF VARIATION.

TOTAL NUMBER OF POSSIBLE VARIATIONS IS $4 \times 4 \times 3 \times 3 = 144$.

IN EACH CASE, THE STANDARD REST POSTURE IS SHOWN IN BLACK.



Upright, Forage, Forward and Hunched. Each of them thus had a total of 36 possible combinations, giving the overall total of 144 combinations.

Figure 2:9:1 illustrates the set variations for each of the 4 classifying points.

2:9:2 Postures observed used by the Chough

Due to the constraints of eye viewing, and the consequent need for postures to be maintained for a longer period, the range of postures obtained was smaller than that found in the Black-headed Gull by Van Rhijn (1981). In all, 56 postures out of a possible 144 were observed (38.9%). This may also reflect a narrower range of postures used by the Chough.

Figure 2:6:2 illustrated all postures observed, differentiating them on the basis of single links each representing a one point difference. The figure shows that for a posture to change from having, for example, a tail-up component to a tail-down component, the tail would have to move to the tail-level position before reaching tail-down. Thus, tail-up and tail-down are separated by two points of difference which is the equivalent of two links on the cluster diagram. The tail-level component in this case would only be recorded where it was held for $\frac{1}{2}$ of a second or more. If the tail was simply to move from up to down without any intermediate posture being maintained, then the particular combination of components recorded for that behaviour would not include tail-level.

Table 2:9:1 below shows the distribution of the variations within each point, both from the viewpoint of $\frac{\text{being}}{\text{a proportion of the maximum possible}}$ number of variations, and as a proportion of those observed.

Table 2:9:1

Point	Variant	n. Possible Combinations	n. Seen	Proportion of Possible Number	Proportion of Point
Tail	(i)	)	12	.25	.21
	(ii)	) 48	39	.81	.70
	(iii)	)	5	.10	.09
Bill	(i)	)	18	.36	.32
	(ii)	) 48	24	.50	.43
	(iii)	)	14	.29	.25
Carpal joints	(i)	)	13	.36	.23
	(ii)	) 36	13	.36	.23
	(iii)	)	11	.31	.21
	(iv)	)	17	.47	.30
Body axis	(i)	)	9	.25	.16
	(ii)	) 36	15	.42	.27
	(iii)	)	22	.61	.39
	(iv)	)	8	.22	.14

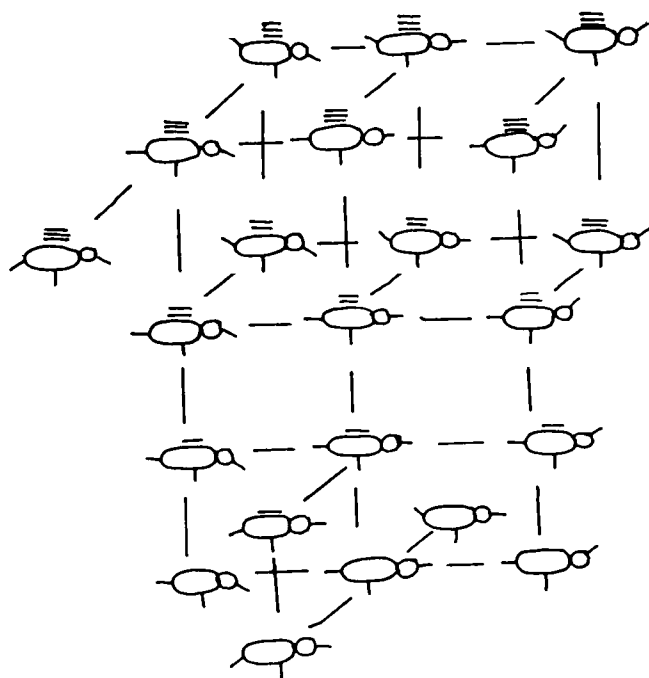
These results demonstrate that it is the relative lack of variation in the tail postures that are responsible for the low number of variations seen. If the standard rest/forage posture (blackened in Fig. 2:9:1) is regarded as the 'normal' posture taken by a Chough and it is assumed that the variants for each point are even in proportion^{to each other}, then while the frequency of variants in; bill ($x^2=1.19$, $P>.20$ $df=1$), carpal joints ($x^2=0.78$, $P>.20$, $df=2$) and body axis ($x^2=4.33$, $P>.10$, $df=2$) away from the normal posture configuration are not significantly lower than the mean frequency, variants in tail ($x^2=12.39$, $P<.001$, $df=1$) are significantly lower. Thus, while the range of variants in the tail point as opposed to the neck point may be more apposite for comparative corvid ethology, it somewhat restricts the number of posture combinations used by the Chough in such an analysis due to the relatively low frequency of utilisation of its variants.

2:9:3 Comparative Corvid Ethology

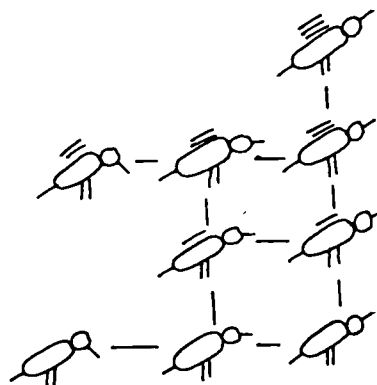
Using the literature summarised in the introduction to this Chapter,

FIGURE 2:9:2.

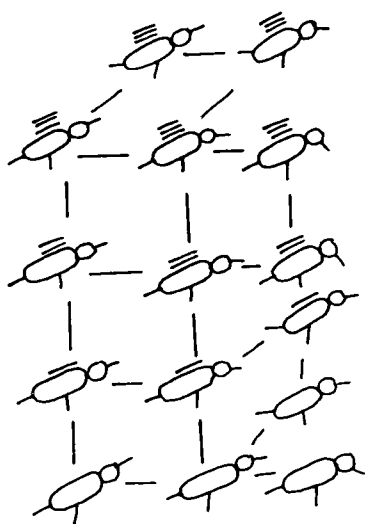
A SINGLE-LINK CLUSTER DIAGRAM SHOWING ALL OBSERVED POSTURE VARIANT COMBINATIONS. POSTURE COMBINATIONS ARE SUB-DIVIDED BY BODY AXIS VARIANT.



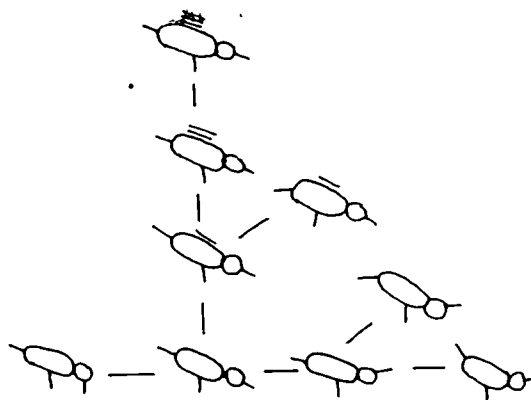
(a) FORWARD (iii).
n=22. MAX. POSSIBLE
is 36, SO 61% OF VARIANTS
SEEN.



(b) UPRIGHT (i).
n=9. MAX. POSSIBLE IS 36,
SO 25% OF VARIANTS SEEN.



(c) FORAGE (ii).
n=15. MAX. POSSIBLE IS 36,
SO 42% OF VARIANTS SEEN.



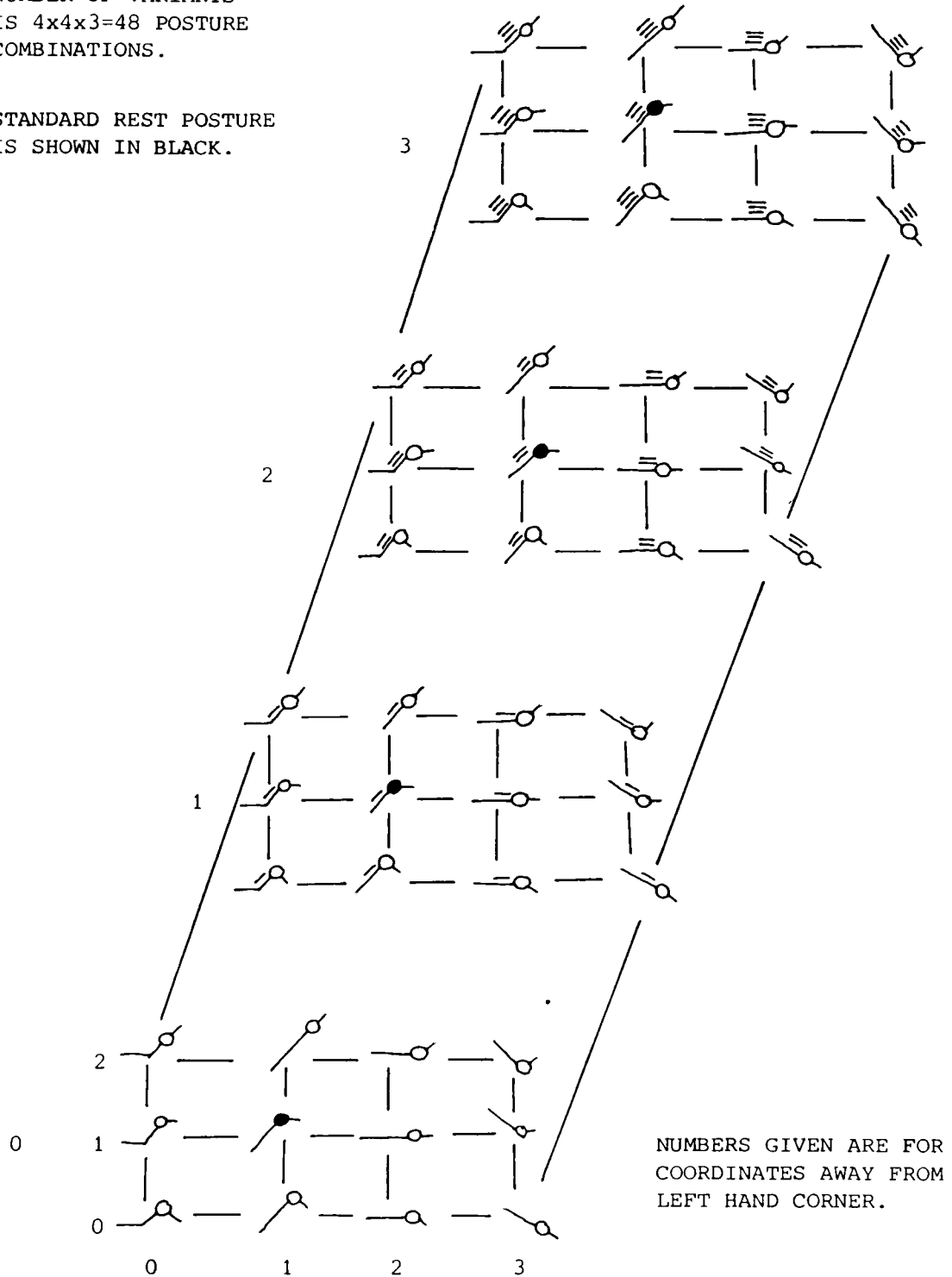
(d) HUNCHED (iv).
n=8. MAX. POSSIBLE IS 36,
SO 22% OF VARIANTS SEEN.

FIGURE 2:9:3.

A SIMPLIFIED DIAGRAM OF POSTURE COMPONENT VARIANTS, USING 3
VARIANTS TO ALLOW FOR A 3-DIMENSIONAL PRESENTATION.

NUMBER OF VARIANTS
IS $4 \times 4 \times 3 = 48$ POSTURE
COMBINATIONS.

STANDARD REST POSTURE
IS SHOWN IN BLACK.



comparative work was carried out using British corvids and the 4 point classification system outlined in 2:6:1. Four behaviours were examined: female pre-copulatory posture, male pre-copulatory posture, forward antagonistic and submissive postures. The paucity of data on the Jay meant that male pre-copulatory and the submissive posture could not be included. If an entirely visual and quantitative comparison of postures is to be attained, all postures have to be linked by one variant link of the four posture points defined in 2:6:1. Since four variants is beyond the capabilities of a three dimensional single link representation as shown in figure 2:6:3, it would appear that the system would have to be limited to three points. As it happens, in each case only three points of variation were used for each posture and thus no compromise was needed. As a basis of comparison, the standard rest posture defined in 2:6:2 was included in each diagram, so that deviation from a consistent 'norm' could be examined. In the case of male pre-copulatory (figure 2:6:5) it could only be included where the carpal joints were at variant (ii).

The diagrams, shown in figure 2:6:4 to 2:6:7 operate on the premise of three assumptions:

(i) Hooded and Carrion Crows have the same posture repertoire, with respect to the postures used here.

(ii) Fluffing of feathers (breast, nape and head) not included.

(iii) Bill opening not included.

The first assumption holds, but fluffing is used by all six species in least one posture of their submissive repertoire, and by the Jackdaw and Jay in escalated forms of the forward antagonistic posture. Bill opening is used by the Raven in its forward submissive posture and by the Carrion Crow and Raven in the forward antagonistic postures. While bill opening may be disregarded in the context of the whole body posture, fluffing of feathers does appreciably alter the external morphology of the bird. Thus this

failing in the assumptions has to be borne in mind.

Two methods of quantitatively differentiating and comparing interspecific posture variation are used. In both, each difference on the single link cluster diagram scores one unit whether in terms of ^{each} point or variation of a point. Thus for carpal joints, there is a two point difference between variants (i) and (iii).

Differences are scored firstly in terms of units of deviation from the standard rest posture, and secondly from the point 0,0,0 in each single link cluster diagram (eg, the bottom left hand corner). Each link equals one unit along the appropriate coordinate axis (x,y or z). Where more than one posture for any species is recorded, in order to eliminate any bias in deciding which posture is the most 'correct', the mean of the combined scores for all the species' postures are used. In each set of results, the various corvid species are ranked in terms of units of difference from (a) the standard posture and (b) from the zero set of coordinates. These results are shown in table 2:9:2.

The zero coordinate system is somewhat arbitrary in operation since it does not provide a basis for the comparison of various postures, which can be done with the standard rest posture. In either case, the values obtained simply indicate the total amount of divergence from a set point as opposed to the exact nature of the differences (eg. has the body axis gone up or down?).

The single link system can also be used to compare behaviours within a species. Thus the differences between the male and female pre-copulatory posture, and the antagonistic and submissive posture of each species can be compared. In table 2:9:2, it is apparent that there are always 2-3 points of difference between submissive and aggressive postures in the British corvids (excluding the Jay), thus ensuring that there is enough difference between each posture to ensure that they can be clearly differentiated by

the protagonists. On the other hand, while the Jackdaw and Raven show either no or very little intrasexual divergence in their pre-copulatory postures, the other British corvids exhibit a marked degree of sexual dimorphism in these postures. Thus the method can effectively quantify differing relationships between postures and the sexes which can also be compared on the interspecific level.

2:9:4 Further Directions for Comparative Corvid Ethology

So far, this section has concentrated on comparing different corvid species or sexual and postural differences. This system may have a potential for comparing behaviour repertoire differences (if any) in the various subspecies of the Chough and Alpine Chough. None of the subspecies of the Chough apart from P.p. pyrrhocorax nor either of the Alpine Chough subspecies have been adequately researched for such work, if at all. Therefore this section will simply discuss its potential. Tinbergen (1953) outlined the basis for relating the behaviours of animals to their environments. In the context of the Chough and the Alpine Chough, the ecological circumstances of each subspecies could be compared (summarised in Vaurie 1959), and postures differentiated on the single link cluster diagrams. Subspecies names are given from Vaurie (1959) and Howard and Moore (1980).

Table 2:9:2

		Deviation from Standard Posture		Deviation from X,Y,Z=0,0,0,
♂ Pre-cop.	2	C.Crow	2	Jackdaw
	3	Chough (2,4)		C.Crow
		Magpie		Rook
	4	Rook	2.5	Chough (2,3)
		Raven	3	Raven
		Jackdaw		Magpie

♀ Pre-cop.	4	Raven	1	Jay
		Jay	2	Jackdaw
		C.Crow	3	C.Crow
		Jackdaw		Raven
	5	Magpie	4	Rook
		Rook		Magpie
	6	Chough	5	Chough
Submissive	1	Chough	1	Chough
	1	C.Crow	2	C.Crow (1,3)
		Magpie	2.5	Raven (1,4)
	1.5	Rook (0,3)		Rook (2,3)
	2.5	Raven (4,1)	3	Magpie
	3	Jackdaw		Jackdaw
Forward-	0	Jay	1	Jay
	1.25	Rook (1,1,1,2)	1.25	Rook (2,2,1,0)
		Jackdaw (1,1,1,2)	1.75	Jackdaw (3,2,2,0)
	2.33	Magpie (2,2,3)	2.33	Magpie (4,2,1)
	2.5	Chough (2,3)	3	Chough (4,3,2)
	3	C.Crow		Raven
		Raven	4	C.Crow
Intersexual Difference:		Submissive/Antagonistic Difference		
0	Jackdaw		2	C.Crow
1	Raven	close	2.25	Jackdaw (2,2,4,1) consistent
4	Rook	strongly	2.5	Rook (2,2,2,4) level of
	Chough	differ	3	Chough (2,3,4) differentia-
	Magpie			Raven tion
6	C.Crow			Magpie (2,3,4)

For Choughs, the British and Breton race P.p. pyrrhocorax, is the only subspecies to occupy sea cliffs. P.p. barbarus lives inland in the Canaries (Cullen et al 1952) and Morocco (Pineaus and Giraud-Audine 1977). P.p. erythroramphus lives in the Alps, Iberia and Italy (Guichard 1962, Mayaud 1933, Lovari 1976, 1978 and Sorci et al. 1971). P.p. docilis in Eastern Europe (Matyejev 1955) to Arabia and Iran. The last three subspecies live in Alpine to arid upland areas, P.p. barbarus being in the most arid areas, somewhat similar to P.p. brachypus in Northern China and North East Asia except that the latter has considerable spatial isolation. Similarly, P.p. himalayanus (Schaffer 1938, North India, Himalayas and West China) and P.p.

FIGURE 2:9:4.

FEMALE PRE-COPULATORY
POSTURES, IN SIMPLE 3-D
FORMAT. STANDARD REST
POSTURE IN BLACK.

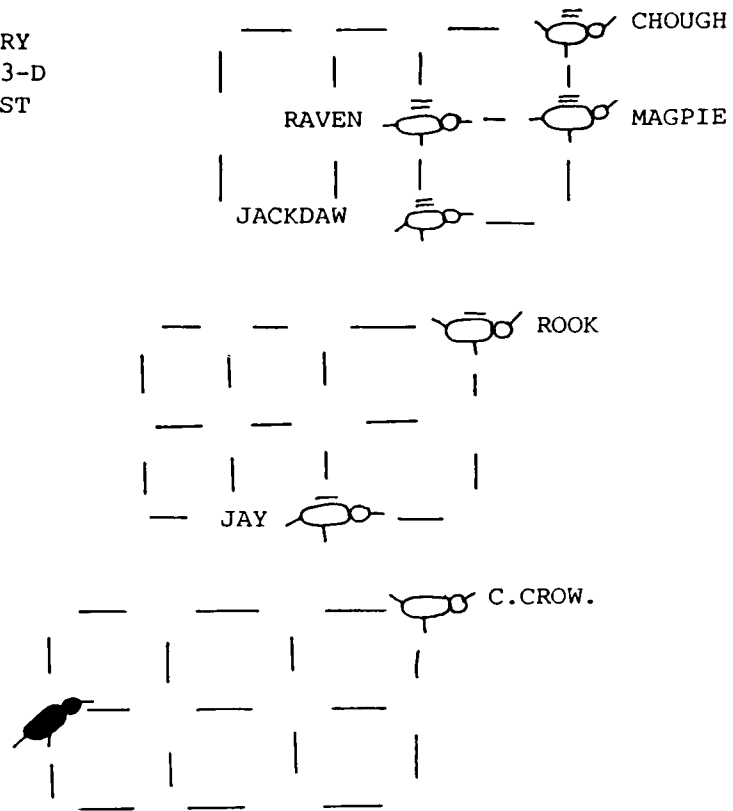


FIGURE 2:9:5.

MALE PRE-COPULATORY
POSTURES IN SIMPLE 3-D
FORMAT. STANDARD REST
POSTURE IN BLACK.

NO DATA FOR JAY AVAILABLE.

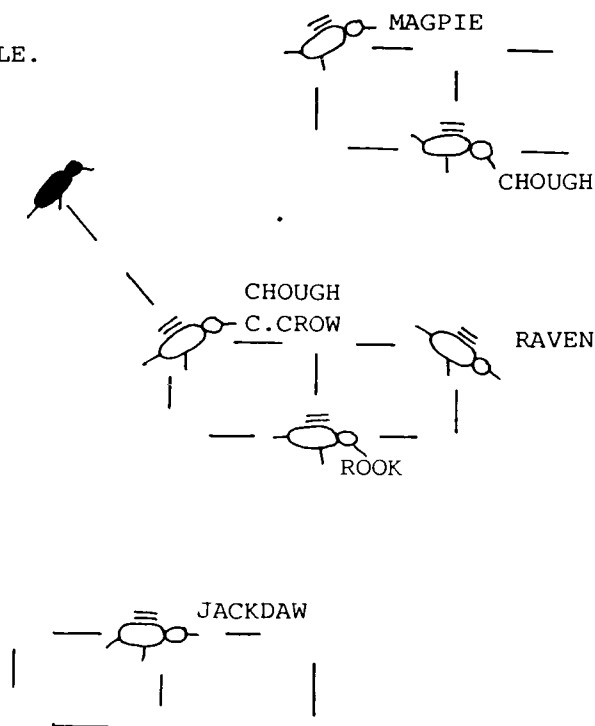


FIGURE 2:9:6.
 FORWARD ANTAGONISTIC POSTURES
 IN SIMPLE 3-D FORMAT. STANDARD REST
 POSTURE IN BLACK.

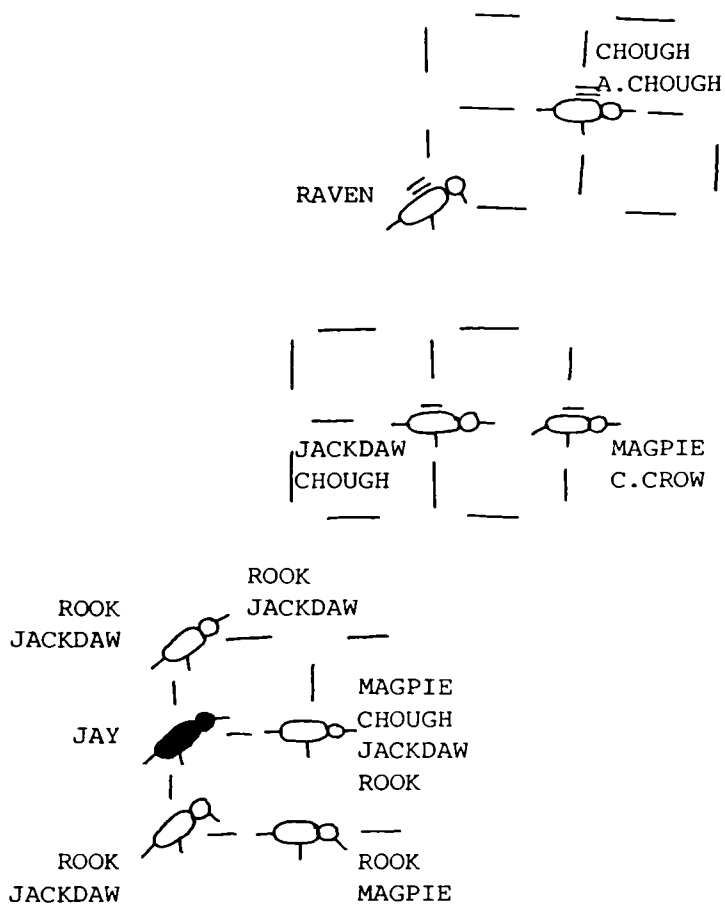
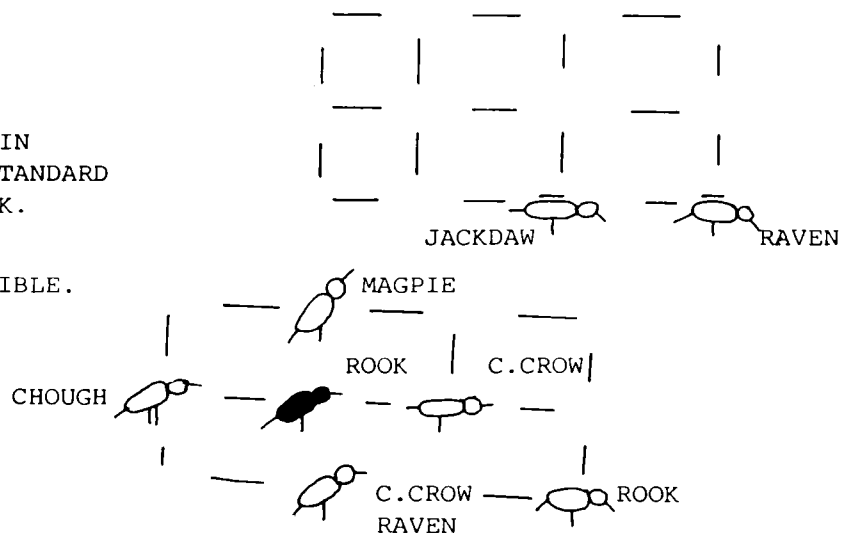


FIGURE 2:9:7.
 SUBMISSIVE POSTURES IN
 SIMPLE 3-D FORMAT. STANDARD
 REST POSTURE IN BLACK.

NO DATA FOR JAY AVAILABLE.



centralis (Central Asia, Pakistan, North West India and the Pamirs) live in Alpine to semi-arid habitats but are spatially separated from the European subspecies. P.p. baileyi (Brown 1967) in Ethiopia is the most isolated of all, the nearest population to it being some 1,500 miles to the North, and being isolated since the last glacial retreat. Its habitat is comparable to the semi-arid habitats. For the Alpine Chough, P.graculus graculus is found in Europe, North Africa and the Caucasus, and P.g. digitatus in Iran, Central Asia and the Himalayas.

In each case, the subspecies is distinct from the others in terms of habitat or in terms of habitat combined with spatial temporal isolation.

Holyoak (1972) argues that behavioural similarities between the Chough and the Alpine Chough are of more importance than physical similarities in demonstrating their relatedness. A full study of the subspecies of each species could provide backing for this view.

2:10 A SIMPLE ETHNOGRAM FOR CHOUGH SOCIAL BEHAVIOUR

Baeyens (1979) constructs an ethnoqram based upon 8 postures that allowed for pre-defined degrees of posture plasticity, accounts for over 90% of postures used in the social posture repertoire of the Magpie. In order to achieve this, she did not take into account any variations in the positions of the carpal joints.

From the most common categories shown in table 2:8:1, combined with field observations and elimination of variations in the carpal joints and tail, a total of 8 postures of the Chough were obtained. These covered about 95% of social behaviours observed, and are shown in figure 2:10:1. Sixteen social behaviours from the definitions in 2:4 were assembled, covering all social behaviours, and with the 8 postures outlined, gave a total of 128 combinations shown in table 2:10:1.

FIGURE 2:10.

A SIMPLE ETHNOGRAM SHOWING THE RELATION
BETWEEN 8 MAIN CHOUGH POSTURES AND
SOCIAL BEHAVIOURS.

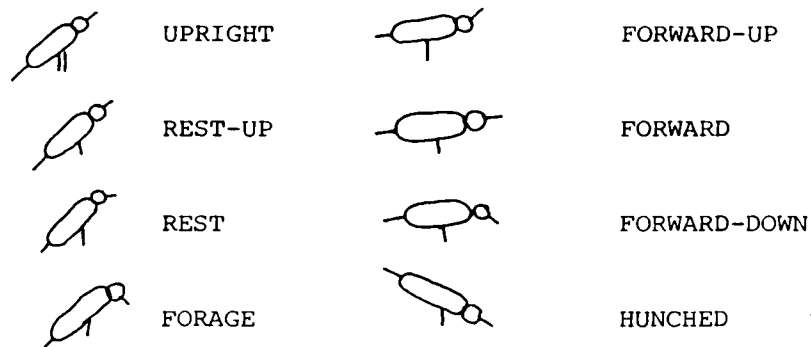
* = 10% or more of
observations.

+ = 5-10%

- = less than 5%.

(Postures shown exclude any variation
in position of the tail or carpal joints)

CHOUGH POSTURES:



	UPRIGHT	REST-UP	REST	FORAGE	FORWARD-UP	FORWARD	FORWARD-DOWN	HUNCHED
m Bill-wipe		-	*	+				
Allopreen			*	*	*			
Bill-shake	*							
Bow pair greeting							*	*
BW.Wf.C		*				-	+	*
Bill-wipe		-	+				*	*
Wing-flicking	*	*	*	+				
Juv. food beg	*	*	+		*			
♀ courtship beg	*	*			*			
♂ courtship feed				*				
♀ copulation					*			
♂ copulation			*	*				
♂ wing-flutter					*		*	
Antag. display			+	*		*	*	*
Antag. attack			+			*	*	
Appease	*	*	+					

2:11 DISCUSSION

Since this Chapter is limited in terms of time spent and equipment used in comparison to the work of Baeyens (1979) and Van Rhijn (1981) there are a number of differences in the work's emphasis. Without film analysis of long sequences of behaviour, only the more visible postures and their variants could be recorded at an acceptable level of certainty. Thus the ethnogram presented in 2:10 is simpler in scope than that of Baeyens's (1979) for Magpies while less posture variants are presented in 2:9, and are more qualitatively assessed than^{by}/Van Rhijn (1981) for the Black-headed Gull. The small number of postures with tail variants from the normal position noted in 2:9 was the principal factor reducing the number of postures discerned. This is probably because tail position is less readily discerned than body axis, carpal joints and bill variants. A comparison of film analysis of Chough postures and these results would be of value in determining the relative accuracy of such unaided field work.

Combining the field observations with prior work, a total of 54 behaviours and behaviour combinations were categorised. 45 were seen in this study of which 21 had not previously been recorded. In the literature, 33 behaviours and behaviour combinations were found, 9 of which were not seen in this study. Combining all these allows the fullest possible account of Chough behaviour in the light of current research to be presented.

Chough and Alpine Chough behaviour was outside the scope of this Chapter. However, as listed in Appendix 4, some research on Alpine Chough behaviour has been published. Since posture data are more limited, further observations producing comparative results would be required before comparative work on all European corvids could be undertaken. In particular, the Jay, Siberian Jay, Azure-winged Magpie and Nutcracker need more field data. With the geographical variation and isolation of the subspecies of Choughs and Alpine Choughs outlined in 2:9:4 there is

potential for work on the sub-specific level. At present, no behavioural research has been carried out on any but the nominate races. Working at such a level may reveal differences between postures in subspecies that are too slight for the above system to adequately discern.

The comparative corvid ethology work demonstrated patterns of differentiation between 2 sets of postures. While the male and female Ravens and Jackdaws have relatively similar pre-copulatory postures, the other corvids show strong intersexual differentiation. On the other hand, there was a relatively consistent degree of differentiation between the forward antagonistic and the submissive posture in all corvids. Therefore, not only can postures be used for interspecific comparison, they can also be compared with other postures and the degree of differentiation used as a basis for further analysis of differences between various species. One problem this section demonstrated was the wide degree of variation of postures available, for example the forward antagonistic posture. Using an average of all variants is not particularly satisfactory since there may be further postures and their relative frequency of use and exact semantic meaning are not known.

Van Rhijn (1981) points out that postures can vary in species from being highly stereotyped to an almost continuous variation. In the case of observed Chough behaviours, this was seen to be related to the behaviour and its context of utilisation. The male pre-copulatory display (2:5:9) contained 11 variants in the 4 point variation system. Likewise, sexually motivated bill-wiping occurred in 3 differing combinations of components (2:5:4, 7 and 8). On the other hand, wing-flick calling occurred as a stereotyped set and sequence of postures and behaviour elements.

With the detailed studies of behaviour repertoires at both the subspecific and the specific level, as attained here for P.p. pyrrhocorax, the simplified comparative systems developed in this Chapter

could be of value in obtaining a rapid and simple comparative analysis of behaviour. Its use at the subspecific level will not be known until suitable data becomes available.

CHAPTER 3

BEHAVIOUR SYSTEMS

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- 3:2 METHODS
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 - 3:3:2 Aims
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- 3:6 GENERAL DISCUSSION ON BEHAVIOUR SYSTEMS

'see them bend forward on red legs to probe and dig with their curved bills or watch the hen shiver her wings to prompt the cock to feed her. There he gently bills her crown and neck. How marvellously these Choughs fly!'

Desmond Nethersole-Thompson.
Highland Birds, Inverness. 1971.

CHAPTER 3

BEHAVIOUR SYSTEMS

3:1 INTRODUCTION AND AIMS

In Chapter 2, a relatively comprehensive classification of Chough behaviour with reference to the frequency of use, seasonality and social and sexual contexts was outlined. The Chapter also noted that no systematic work on the Chough's behaviour had previously been attempted. This appears also to be the case when examining Chough social and reproductive behaviour where with some exceptions there is no quantitative data available. Quantitative work has been carried out on aspects of tourist disturbance (Bullock 1980), flocking (Warnes 1983a) and breeding behaviour (Bullock 1980 and Warnes 1983a). But in the main, all behaviour research has been concentrated in feeding behaviour (eg Bullock 1980, Roberts 1982, 1983, Warnes 1983a, and Bullock *et. al.* 1983a) which will be discussed in Chapter 4. Contributions by previous workers will be discussed under the appropriate sections on aspects of Chough behaviour.

This chapter will be divided into three relatively self-contained sections on various aspects of Chough behaviour; food begging, vigilance and disturbance, and wing-flicking and bill-wiping.

.

The main aim of this chapter is to provide a quantitatively based account of those aspects of Chough behaviour that are particularly distinctive (as in its use of wing-flicking and bill-wiping) or merit wider comparative work with other species such as vigilance and food begging techniques. Where possible, models and flow diagrams will be made in order to provide a descriptive account of the organisation and causation of these behaviours.

3:2 METHODS

Methods for each section are given in their respective sections. This part will simply outline the identification techniques used for sexing and ageing individual birds in this study. Birds from four nest sites used the study area;

Nest A South of Llangranog

L On Loctyn Peninsula

B East of Loctyn. Contained Bardsey ringed male

(Helper 1982-83, breeding male 1984)

C 2 miles North of Loctyn (rarely recorded at Loctyn)

Individuals, especially post-breeding adults were identified by wing and tail patterns, of which an index was kept and regularly revised to enable constant identification. All paired males were found to be visibly larger than females. Initial sexing was carried out by watching courtship, courtship feeding and copulatory behaviour on the assumption that the male carried out its correct roles. Site locations of birds could be noted by flights to nests, roosts and in the case of site B, the coloured ringed male. Juveniles were conspicuously different in appearance until the breeding season, from July to September by colour of features and bill, and in the Winter by size. Non-breeding individuals could be distinguished by reference to behaviour, wing and tail patterns, and a process of elimination from a small population of individuals on the basis of location, orientation of joining or departing flight, sex and presence/absence of the Bardsey colour ring.

Where the normal area population did not normally exceed 12 individuals as in the Loctyn area, it was found that a satisfactory classification of the population into adult/juvenile, and paired male/paired female and non breeding adults was quite practicable along the above guidelines.

Because of the comparative rarity of the Chough and its category 1 status in the Wildlife and Countryside Act 1981, all observations were made in a manner that would not disturb individuals at any time. This entailed a reduction in watching time due to avoiding encountering the birds in any way that might disturb them, but the large distance (60-100m) between the observer and the Choughs ensured that behaviours seen were not affected by the birds being conscious of any disturbance. All work on vigilance and behaviour in the presence of tourists was undertaken by watching tourists encounter the Choughs as and when they occurred.

3.3 FOOD BEGGING

3.3.1 Introduction

This section is concerned with the active soliciting of food by one individual from another where both individuals are present in the foraging area. Food-begging in this context has two separate roles; firstly, before egg-laying mated females beg for food from their paired male as a part of pair bond formation and later, enhancement behaviour, and secondly, fledged juveniles beg for food from their parents after leaving the nest and before their transition to independent feeding.

Courtship feeding by the paired male before egg-laying and incubation in some species plays a secondary role in the female's food intake (Krebs, 1970) and may be used by the female to assess the male's ability to feed the hatched young (Nisbet, 1977). By the postures adopted, in the case of Chough courtship feeding (they are analogous to the sexual solicitation postures, see Chapter 2 and Appendix 1:6), it appears that the primary role in Choughs is for that of pair reinforcement. This differs from the feeding of the post-fledged young which occupies a purely functional role; that of providing them with an adequate nutrient intake during the time prior to their being fully independent feeders. Thus it represents a pay-off between

encouraging them to forage upon their own while ensuring they receive enough food to survive (Davies, 1976, 1978).

3:3:2 Aim

The primary aim of this section was to provide an account of the various strategies used by the begging individual and the responses observed towards them. From this and previous observations of Chough (Cowdy 1962, Holyoak 1972, Bullock 1980, Warnes 1983a), postures and behaviours were defined and described in Chapter 2, Sections 4-6.

From this basis, the functional roles of various strategies used were examined in the context of time (in relation to copulation and after fledging), their effectiveness in obtaining food, and in the case of juveniles, their social status. From functional data obtained, it was intended to first construct simple flow diagrams showing the relationship between the various components of food-begging, and then to construct diagrams integrating these to, as far as possible, physiological and temporal controls and feeding requirements, these diagrams being taken from the viewpoint of (a) courtship feeding females, (b) begging juveniles and (c) the 'provider', the mated male or paired adult.

3:3:3 Methods

Begging attempts by paired females were recorded, classifying type of beg used and outcome with respect to the day of observed copulation. In 1982 and 83, pair L were observed, and in 1984 pair B. All observations were carried out on foraging areas; in 1982 and 83, these were 21-3 and 27, and in 1984, 39 (see figure 4:3:3).

For juveniles; method, success and date after fledging were recorded. Where there were two juveniles competing for attention, the individuals were

differentiated into paired juvenile (present with adult) and intruding juvenile, and the respective outcomes of their begging attempts recorded.

For the feeding individual in each case, it was noted whether the bird was foraging at the time and if in the 5 seconds prior to begging, had encountered prey while foraging.

Results

3:3:4 Courtship feeding

Thirty eight/^{different}cases of female courtship food-begging were observed; 15 in 1982, 13 in 1983 and 11 in 1984. The male responded by either feeding the female by placing freshly encountered prey into her opened mouth, or by ignoring her. Two begging methods were used by the female; the simple beg (2:5:12) and the full beg (2:5:13). Fourteen simple begs were observed, none of which the male responded to ($P=0$, $n=14$) and 24 full begs were seen, of which 14 resulted in the female being fed ($P=0.58$, $n=24$). Full begging was therefore the more effective strategy in obtaining food from the male ($\chi^2=19.33$ $P<0.001$, $df=1$).

Four sets of begging data were obtained with respect to the known dates of copulation: more than 3 days before copulation, during the day(s) of copulation, up to 3 days after copulation and 3 and more days after copulation. Table 3:3:1 summarises these results, and shows that a transition from simple to full begging was observed during this period ($\chi^2=14.36$, $P<0.001$, $df=3$);

Table 3:3:1 Begging techniques in relation to date of copulation

Copulation date and begging methods	Method			
	Date	Simple	Full	P. Full
	<-3	11	0	0.0
	0	1	9	0.9
	1-2	2	5	0.71
	≥3	0	10	1.0

This is shown in a graph in Figure 3:3:1.

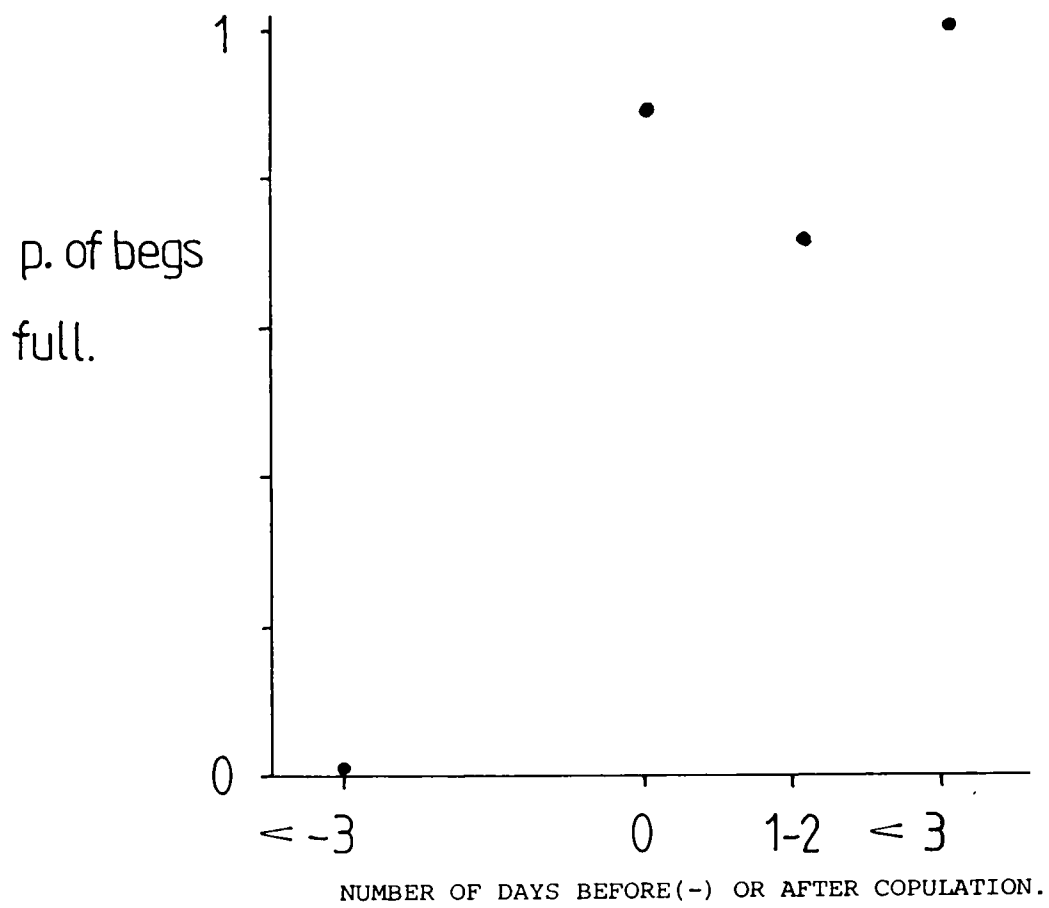


FIGURE 3:3:1.

PROPORTION OF FEMALE BEGS BEING
OF THE FULL FORM IN RELATION TO
THE DATE OF COPULATION.

The change from simple to full begging method coincides with an increased frequency of begs and an increased overall rate of food intake as a result of begging. Table 3:3:2 summarises the change of begging success against time. From figure 3:3:2 it appears that the increased frequency was not significantly related to time after copulation ($r > .20$, $n=4$), the overall rate of successful begs was nearly so ($r < .10$, $n=4$), especially after copulation.

Table 3:3:2 Begging rates in relation to date of copulation

Date	Observation time(s)	Attempts			P. Begs +ve	Begs per 1000 S.	
		+ve	-ve	Σ		+ve	all.
<-3	9240	0	11	11	0.00	0.00	1.19
0	6195	5	5	10	0.50	0.81	1.61
1-2	5808	5	2	7	0.71	0.86	1.21
≤ 3	3533	4	6	10	0.40	1.13	2.83
Σ	24776	14	24	38	0.37	0.57	1.53

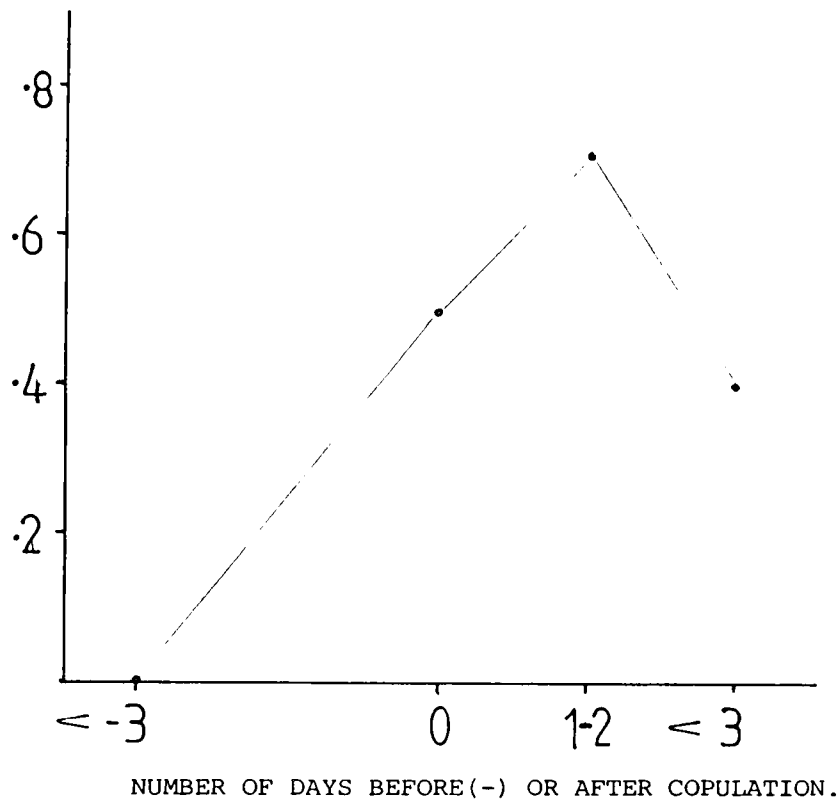
Although the proportion of begs that were successful did not show any relation to time (fig. 3:3:3) this was compensated for by the increased frequency of begging causing the increased successful begging rate seen in figure 3:3:2.

There were no observations of unpaired females begging either at a mated male or any non-breeding male, nor of any paired females begging to males other than their mates. Thus the courtship feeding role is in the Chough firmly within the pair, and observations showed no part played by any nest helpers present (the occurrence of nest helpers is discussed in Appendix 2). No instances of courtship feeding were observed during long sessions of preening or vigilance by the male or at the roost. This indicates the discriminatory nature of the female's begging; it is only done when there is a possibility of the male obtaining food that can then be given to the female. All instances ($n=38$) occurred where the pair were within 10m of each other and the male either actively foraging or about to start foraging.

FIGURE 3:3:3.

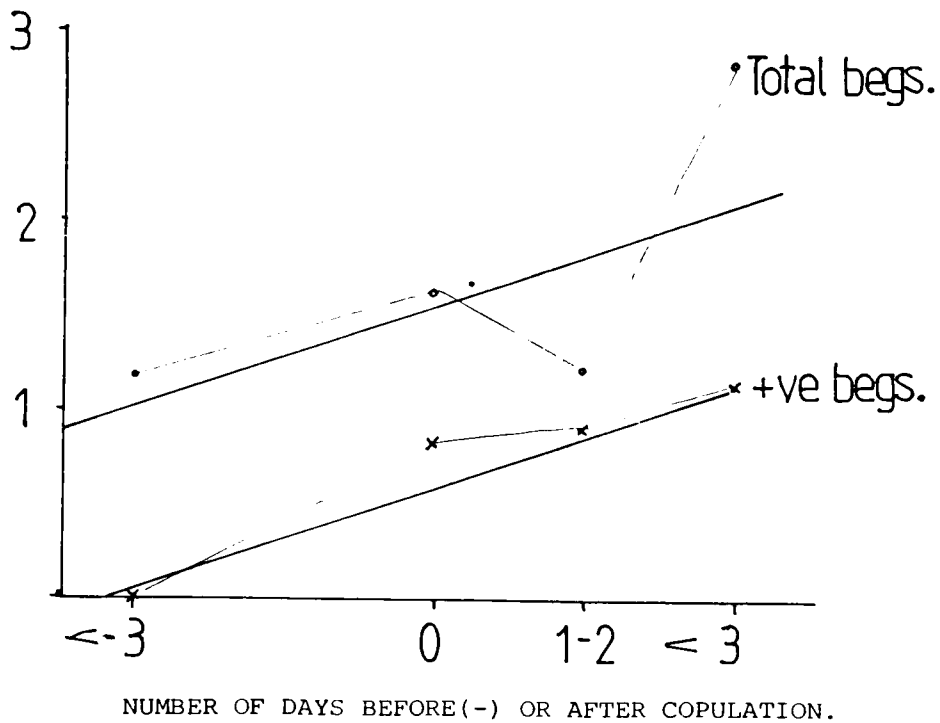
p.of begs +ve.

PROPORTION OF FEMALE FOOD BEGS RESULTING
IN FEEDING IN RELATION TO DATE OF COPULATION



Begs per 1000 s.

FIGURE 3:3:2.



FREQUENCY OF BEGGING ATTEMPTS AND FEEDINGS
BY THE FOOD BEGGING FEMALE IN RELATION TO
THE DATE OF COPULATION.

The female applied the two methods in a total of 4 different ways; (i) posture assumed while remaining still, or walking less than 1m to the male, also used where male flew to female, (ii) assume posture and run up to 2.5m to male, (iii) face male and fly to male, 2-10m distant, and on landing assume posture, and (iv) where female foraging on own and male landing after flying in from another area, female runs to male and begs as soon as male starts foraging. Eight out of the 10 possible combinations were used, and are listed in table 3:3:3.

Table 3:3:3 Begging techniques used and their success rates

Combination	Outcome of beg		Σ	p. +ve
	+ve	-ve		
Full beg on male arrival	0	1	1	0.0
Simple beg on male arrival	0	1	1	0.0
Fly to male, full beg	2	0	2	1.0
Fly to male, simple beg	0	2	2	0.0
Male fly to female, full beg	2	0	2	1.0
Run to male, simple beg	0	2	2	0.0
Static, full beg	10	9	19	0.53
Static, simple beg	0	9	9	0.0
Beg on male arrival	0	2	2	0.0
Fly to male	2	2	4	0.50
Full beg, male or female fly	4	0	4	1.0
Static beg	10	8	28	0.36

That the male did not respond to female begs of either technique (n=2) immediately after landing, is expected under the premise that since foraging had not been initiated, the male could not feed the female. The female begging at the time is due to extended periods of separation from the male (5 and 11 minutes). Where the male flies to the full begging female, all begs were responded to with feeding as would be expected (p=1.0, n=2) where the male actively moves towards the begging partner. Although the probability of a beg involving flight by either partner ending in the female being fed (P=0.75, n=6) is higher than that of static begs (P=0.36, n=28), the latter involve a higher rate of food intake overall due to their higher frequency of use.

3:3:5 Juvenile begging

The nestlings fledged in nest site B in 1982 were examined in the foraging area 27. The young first left the nest on the 6th and 7th of July, and between July the 10th and 29th, a total of 259 begging attempts were recorded in 8 observation sessions.

Begging methods used by the juveniles are defined in 2:6:1, a-h. Three adult responses were observed: (i) ignore juvenile, (ii) feed juvenile and (iii) attack juvenile after excessive and/or intrusive begging. These are described in 2:6:2. Results per observation session are shown in table 3:3:4.

Table 3:3:4 Juvenile begging techniques and adult responses

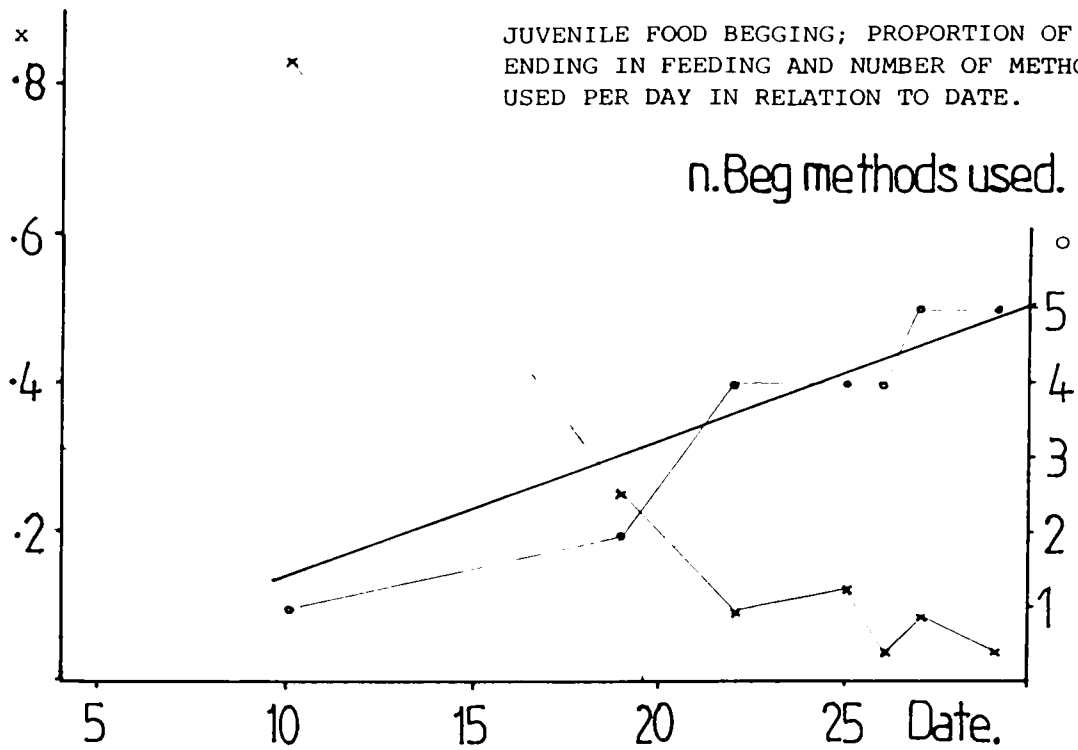
Date	Days since fledged	n. Methods used by juv.	Adult response			P of attempts +ve
			+ve	-ve	attack	
10-July	3	1	5	1	0	0.833
19	12	2	6	18	0	0.250
21	14	(1)	1	0	0	(1.00)
22	15	4	2	18	2	0.091
25	18	4	4	29	0	0.121
26	19	4	1	23	0	0.042
27	20	5	8	87	1	0.083
29	22	5	2	50	1	0.038
Σ		8	29	226	4	0.112

Because the 21st of July only had one begging attempt recorded, this was not included in any trend analysis in order not to distort the results due to small sample size. Although figure 3:3:4 shows that the overall proportion of positive responses fell with time, it did not fall consistently ($r > .20$, $n=7$). The number of begging methods used per observation day increased with time from fledging, (figure 3:3:4, $r < .001$, $n=7$) and thus, as shown in figure 3:3:5, there was an inverse relation between the number of begging methods used per observation day, and the proportion of successful begs ($r < .05$, $n=7$).

p. +ve Begs.

FIGURE 3:3:4.

JUVENILE FOOD BEGGING; PROPORTION OF BEGS ENDING IN FEEDING AND NUMBER OF METHODS USED PER DAY IN RELATION TO DATE.

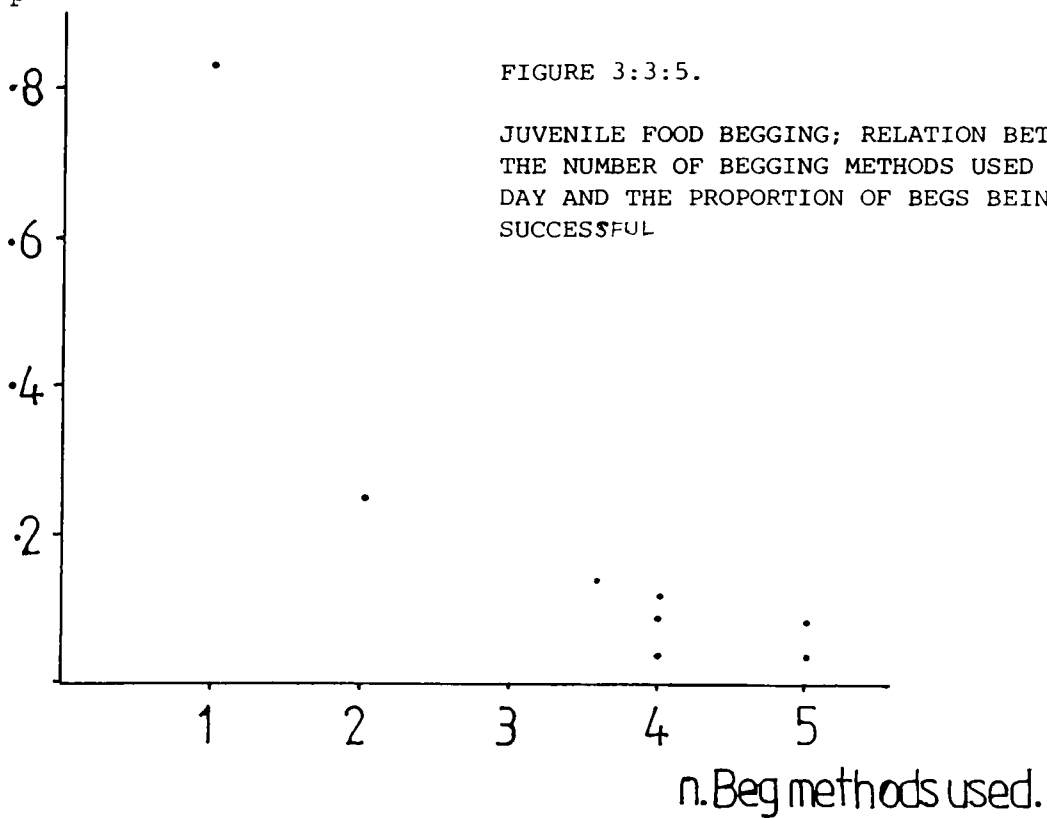


(JULY. FLEDGED ON THE 7th.)

p. +ve BEGS.

FIGURE 3:3:5.

JUVENILE FOOD BEGGING; RELATION BETWEEN THE NUMBER OF BEGGING METHODS USED EACH DAY AND THE PROPORTION OF BEGS BEING SUCCESSFUL



There was also a relation between the success of methods of begging against time. Table 3:3:5 summarises the individual method results. Where a juvenile's begging attempt is returned by an attack, it can be regarded as an unsuccessful beg in the sense that the juvenile has failed to obtain any food. The adults' response under these circumstances also indicates that either the presence of the juvenile at that time was not wanted, or that the method of begging used was not well received by the adult.

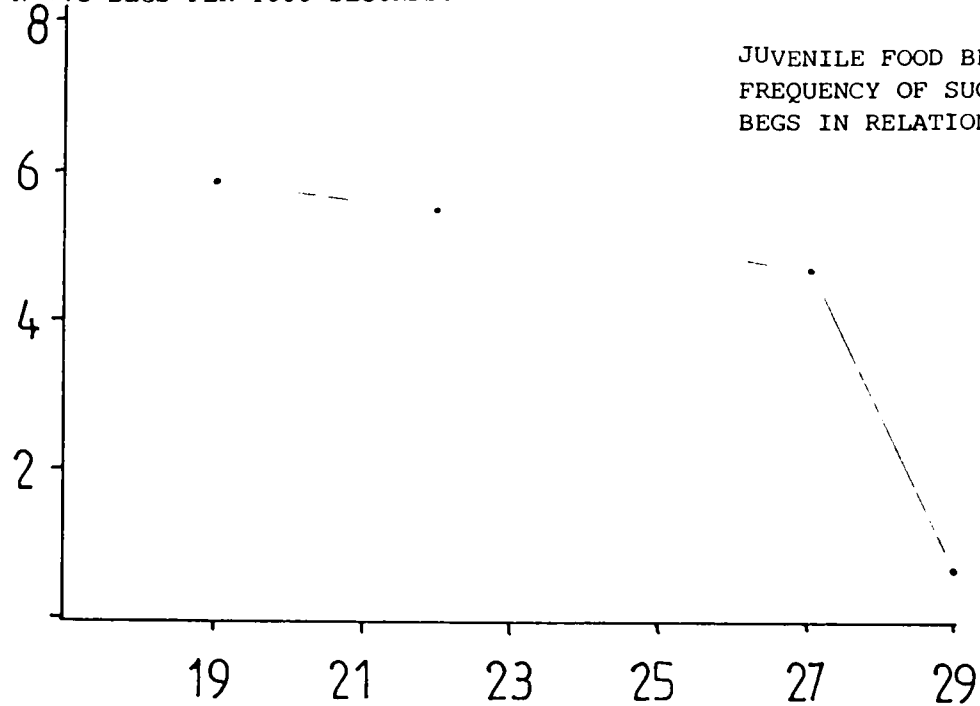
Table 3:3:5 shows that method (1) is the most consistently used (P.O.706, n=259). The two days in which it was not used both had small sample sizes (n=6, and n=1), and on the 22nd of July, it retained the proportion seen on other large sample observations if method (5) and (6), which are variants, are combined. But on only 3 of the 6 sample days with method (1) begging was food obtained with this method. On these days, the success rate was 5.9% (n=24, 19th July), 3.8% (n=33, 25th July) and 4.2% (n=96, 27th July). The overall success rate for method (1) was 3.16% (n=189). Methods 3 and 7 had nil success rates (n=10, n=8 respectively), while methods 4, 6 and 8 had sample sizes of under 5 and thus cannot be used for comparison. Method 2 had a success rate of 9% (n=49) but also 6.1% of begs resulted in attacks from the adult. For method 5, 12.5% of attempts ended either in success or an attack from the adult (n=8). Thus method 2 had a higher success rate than both method (1) and the other 6 methods combined ($\chi^2=66.81$, $P<0.001$, $df=1$) but was also 4.49 times more likely to result in an adult attack.

There would appear to be little to commend using methods 1 and 7 except for the fact that these can be used continuously, without any specific need to be positioned near the adult except to make the juvenile's presence known. They also carry a nil probability of an adult attack. Thus, their indiscriminate and continual usage represents low effort outlay for a low return.

Table 3:3:5 Responses to begging methods
3 sets of response given; n. +ve response/n. -ve,/n. attacks

METHOD	DAY →	10	19	21	22	25	26	27	29	Σ
(1) Adjacent, follow			1/16/0		0/5/0	1/25/0	0/17/0	3/68/0	0/43/0	5:184:0
(2) Face, face run		5/1/0	5/2/0	1/0/0	1/6/1	2/0/0	1/3/0	4/9/1	1/5/1	20:26:3
(3) Wf. Adjacent, Wf. Adjacent run.						0/4/0	0/1/0	0/4/0	0/1/0	0:10:0
(4) Wf. face						1/0/0				1:0:0
(5) Rapid call.					1/6/1					1:6:1
(6) Rapid call, wing quiver.					0/1/0					0:1:0
(7) Run adjacent, run follow							0/2/0	0/5/0	0/1/0	0:8:0
(8) Wing flutter.								1/1/0	1/0/0	2:1:0

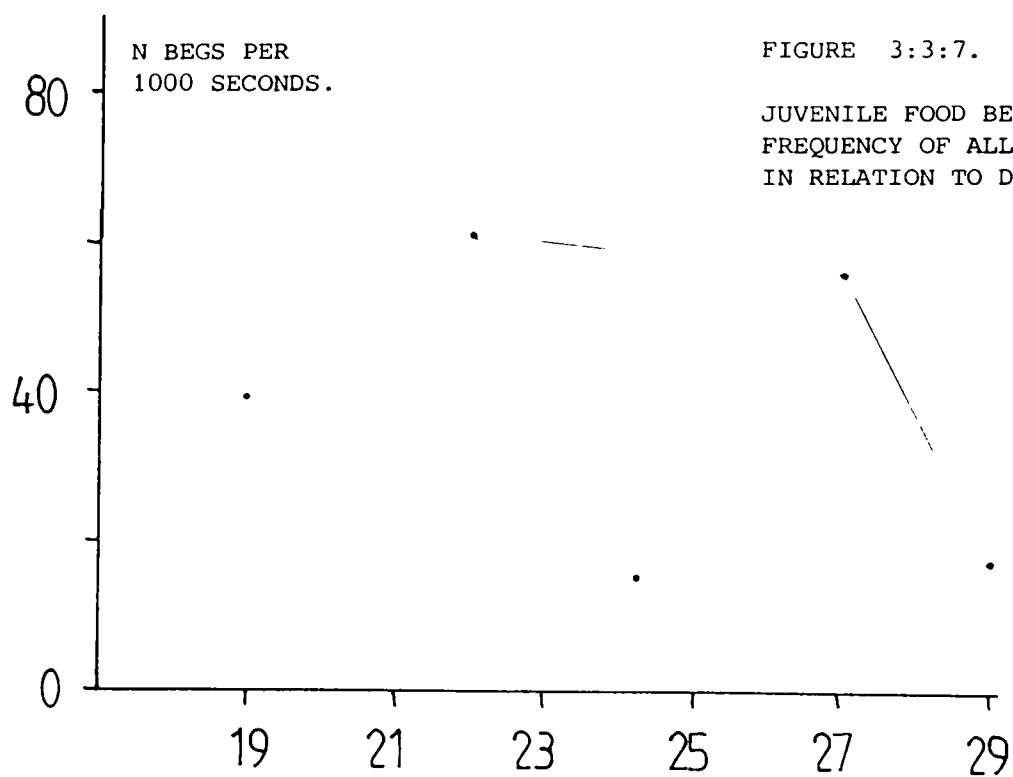
N +ve BEGS PER 1000 SECONDS.



DATE. (JULY. FLEDGED ON THE 7th)

FIGURE 3:3:6.

JUVENILE FOOD BEGGING;
FREQUENCY OF SUCCESFUL
BEGS IN RELATION TO DATE.



DATE. (JULY. FLEDGED ON THE 7th)

FIGURE 3:3:7.

JUVENILE FOOD BEGGING;
FREQUENCY OF ALL BEGS
IN RELATION TO DATE.

Methods 2-6 and 8 involve a more specific effort both in using behaviour components directed specifically at soliciting food and by having to be positioned in a specific manner in relation to the adult. Thus they cannot be used in such a continuous manner, and represent concerted efforts to solicit food. There is also the question of the low frequency of use but high reward rates for methods 4, 5 and 8, and their small number of days seen (1, 1 and 2 respectively). It is probable, that as in the case of 5, juvenile their use has been discouraged, by the adult attacking the/ for any more than the occasional usage of such assertive methods. Table 3:3:6 compares the rate of begging rates per 1000 seconds on 4 days.

Table 3:3:6 Begging rates and success rates

Date	time(s)	n. begs	n. +ve	begs/ 1000 secs.	+ve begs/ 1000 secs.
19	510	20	3	39.12	5.83
22	360	22	2	61.17	5.44
27	1710	96	8	56.17	4.67
29	2940	53	2	17.99	0.67

High rates of disturbance by the presence of tourists (see 3:4:4) prevented more continuous observation samples being made.

There is no overall trend for begging rate against date ($r > .20$, $n=4$) as shown on figure 3:3:7. Figure 3:3:6 illustrates that the fall in successful begging rate is continuous, but it is not significantly continuous ($r > .20$, $n=4$). The feeding rate is lower on the 29th of July than for the 19th, 22nd or 27th (χ^2 288.62 $P < .001$, $df=2$), indicating a change in begging success at around that time due to (a) a decrease in the beg rate (χ^2 209.49 $P < .001$, $df=2$) and (b) the adult response.

The decrease in beg rates was partly due to a simultaneous improvement in independent foraging ability, and the willingness of the juvenile to forage as indicated by the number of pecks observed per 1000 seconds. In table 3:3:7, foraging is examined in both individuals continually begging/or in the presence of an adult, and in those who spent the observation period

on their own.

Table 3:3:7 Foraging by juveniles

Date	beg/on own	time(s)	n. pecks	Pecks per 1000 S.	n. swallows	swallows per 1000 S.
19	beg	510	21	41.18	0	0
27	beg	1380	56	40.58	0	0
27	on own	870	71	81.61	0	0
29	beg	1200	336	280.00	0	0
29	on own	1740	1710	982.76	4	2.29
Σ	beg	3090	413	133.66	0	0
Σ	on own	2610	1781	682.38	4	1.53
Σ	overall	5700	2194	384.91	4	0.70

Juveniles in the presence of an adult show a lower peck rate than those on their own (χ^2 1800.8, $P < 0.001$, $df=1$). The begging juvenile on the 29th of July had a higher peck rate than for the 19th or the 27th and the solitary juvenile had a peck rate on the 29th 12.0 times higher than that of the 27th. In each case on the 27th and 19th, no food was encountered while foraging, and thus begging was a more rewarding strategy in terms of food input, but on the 29th, the begging bird obtained 1.67 food inputs per 1000 seconds ($t=1200$ s. $n=2$ feeds) while the foraging juvenile obtained an encounter rate of 2.29 per 1000 seconds ($t=1740$ s., $n=4$). On the assumption that the food input of a prey encounter at the time equalled that of a successful beg, this means that on the 29th of July, independent feeding was a more efficient strategy in terms of food input. These results have to be treated with care due to the small sample sizes.

After the 19th, each adult would only tolerate the presence of one individual juvenile at a time. Begging by two juveniles that approach the adult simultaneously would cause the adult to leave the vicinity by either running or flying away ($n=5$). When the adult was associated with a single juvenile, it formed a 'begging pair'. These pairs were found to be flexible in the sense that the juveniles changed after a period of time. In 2743 seconds of observation on the 19th and 21st of July, 5 such exchanges were observed; 1 per 549 seconds on the basis of feeding rates for the 19th of

July, this represented 1 exchange each 3.20 successful juvenile begs (n=16).

An individual juvenile that is not in a 'begging pair' may attempt to force away the paired juvenile in order to take its place. Depending on the intruder's method of attempting to oust the other juvenile, the feeding adult would either ignore the intruder or actively exclude it from the immediate area. No intrusions were observed to succeed.

The role of antagonistic behaviour in juvenile-juvenile and juvenile-adult begging pair conflicts is discussed in Section 5:4. Thus, only an outline of appropriate results will be given here. Of 17 intrusion attempts recorded on the 26th and 27th of July, 12 were ended by the begging pair wing flicking at the intruder, 1 by the adult facing the intruder (in these cases, warning the intruder), 3 ended by the begging pair ignoring or walking away from the intruder (avoidance of intruder) and 1 by the adult physically attacking the intruder until it left.

3:3:6 Functional Organisation of Begging Behaviours

The aim of the three models presented here is to describe food begging behaviour from the three aspects discussed in this section (courtship feeding, juvenile begging and the feeding of begging partners) in relation to the sequential organisation of events outlined in field observation, motivating factors and controls incorporated within each system.

In each case the model is preceded by one or more flow diagrams of observed behaviours. These are intended to summarise the results obtained in this section, ^{and} place events in their observed sequences with brief descriptions where required. The flow diagrams start with the individual concerned entering the foraging area. This is quite often the case when watching Choughs in the field, as opposed to their being continually in one small foraging area. In order to maintain the simplicity of these models, they will all operate under the assumption that the individual concerned is

always present in the foraging area and forages continuously when not involved in begging behaviour.

The main difference between courtship feeding and juvenile food begging is in their motivation. Juvenile begging is primarily concerned with obtaining food and the alleviation of hunger while ^{the juvenile} learns to forage effectively for itself. Courtship feeding has two roles; sexual behaviour and providing food for the female to form eggs. Hunger and food intake are therefore secondary with respect to the sexual role. The differences between the two is reflected in the degree of discrimination shown by the begging partner. In female courtship feeding, only 2 out of the 38 observed attempts were carried out when the mate was not actively foraging. Juvenile food begging on the other hand was indiscriminate; the very presence of the appropriate adult was sufficient to initiate begging.

The models to be presented are as follows:

- (a) CHUNDER. Model to show response of individual to begging by begging partner. Begging partner is defined as the individual's mate (female) or a post fledged juvenile.
- (b) COURT-FED. Model to show organisation of courtship feeding behaviour by mated female around time of copulation.
- (c) JUV-BEG. Model to show organisation of food begging behaviour by post fledged juveniles.

Each model will be explained in the order shown above. The explanation will consist of the flow diagram, characteristics of the model, specific assumptions on which the model is based and an explanatory key of the symbols used.

(a) CHUNDER

Flow diagrams of observed behaviour were made for the adult in the presence of a fledged juvenile (figure 3:3:8) and for the male in the presence of its mate (figure 3:3:9). From these, a combined diagram of

FIGURE 3:3:8.

ORGANISATION OF RESPONSES BY THE PARENT CHOUGH TO THE JUVENILE'S
FOOD BEGGING.

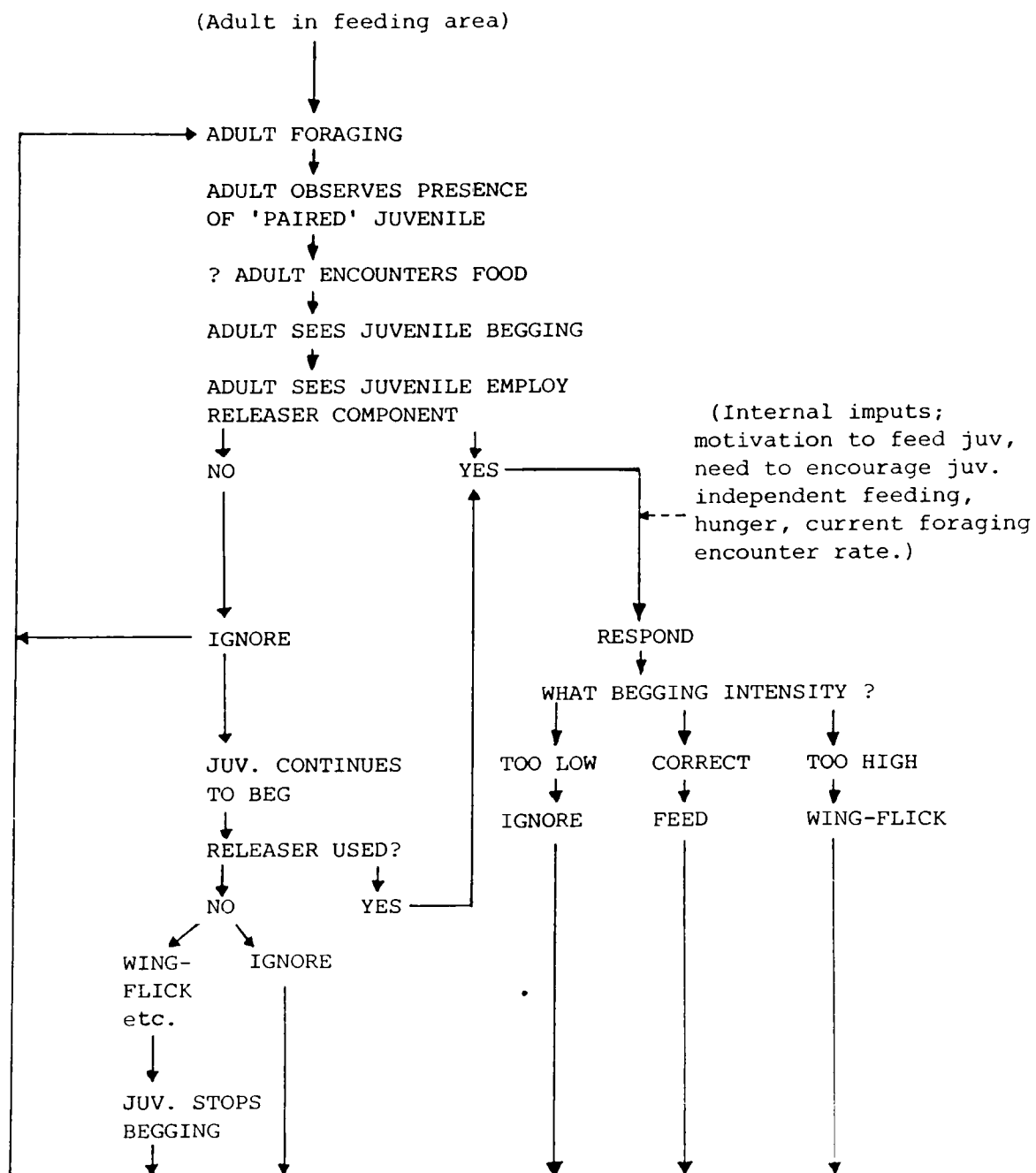
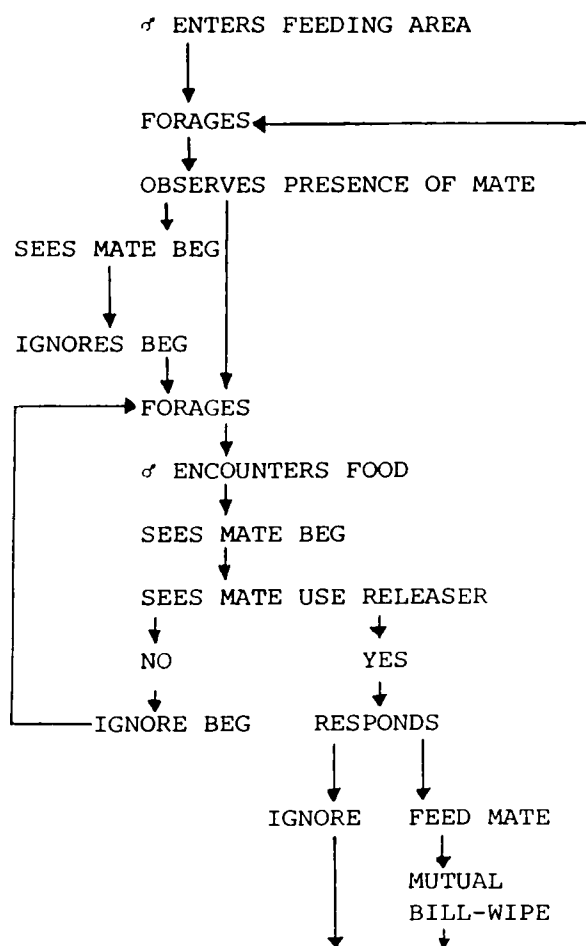
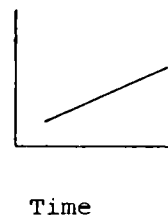


FIGURE 3:3:9

ORGANISATION OF RESPONSES BY THE MALE TO ITS
MATE'S COURTSHIP FOOD-BEGGING.



p. of mate using
releaser



This system is based on the assumption that the development of the female's begging repertoire and the use of the full beg are responsible for regulating the male response as opposed to the mate only responding after copulation.

organisation of responses to begging by the begging partner (figure 3:3:10) was made. This combined diagram included some responses to juvenile begging which do not occur in courtship feeding responses. These were, the exclusion of juveniles by wing-flicking when the juvenile begs at an excessive intensity or repeatedly begs. Changes also occur in the individual's motivation to respond to begging. In the case of the adult (cf. JUV-BEG) it decreases with time, while in the mate there appears to be a peak response period (cf. COURT-FED), with periods of lower responsiveness before and afterwards. The changes in begging repertoire with time also differed; for juveniles it became larger with time, while for courtship feeding, there was a change from simple to full begging by the female. In figure 3:3:10 and in the diagram of the model (figure 3:3:11) the elements unique to juvenile begging and the temporal changes in motivation and input of begging repertoire are clearly differentiated. In the individual and combined flow diagrams, it is assumed that the individual concerned has to see a releaser before it will feed the begging partner. Thus one or more components of a successful beg have to induce the individual to respond, for example the gape or wing movements. Evidence was provided in female courtship begs, where the simple beg had no success, while the full beg had a 58% success rate. One or more elements in the full beg posture that did not occur in the simple beg appear to be acting as releasers. Unlike the models for the begging partners, this model has no system of checks or negative feedbacks and thus operates as a simple loop with various response sections built in.

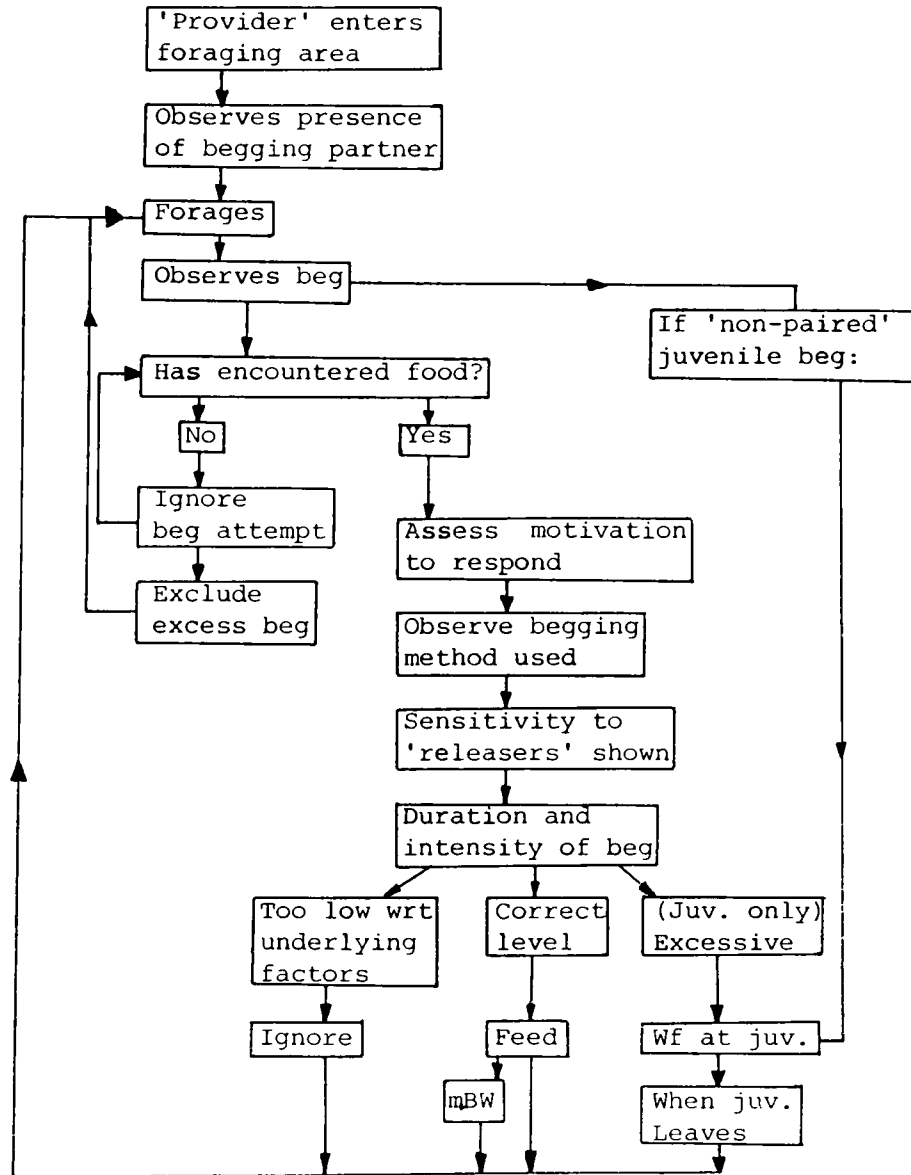
Assumptions

(i) Individual will only feed begging partner when it has encountered food during foraging.

(ii) Does not take into account the hunger of the individual.

FIGURE 3:3:10.

A COMBINED FLOW DIAGRAM BASED ON FIGURES 3:3:8 AND 3:3:9 TO SHOW RESPONSES OF A FORAGING INDIVIDUAL TO FOOD BEGGING BY ANOTHER INDIVIDUAL.



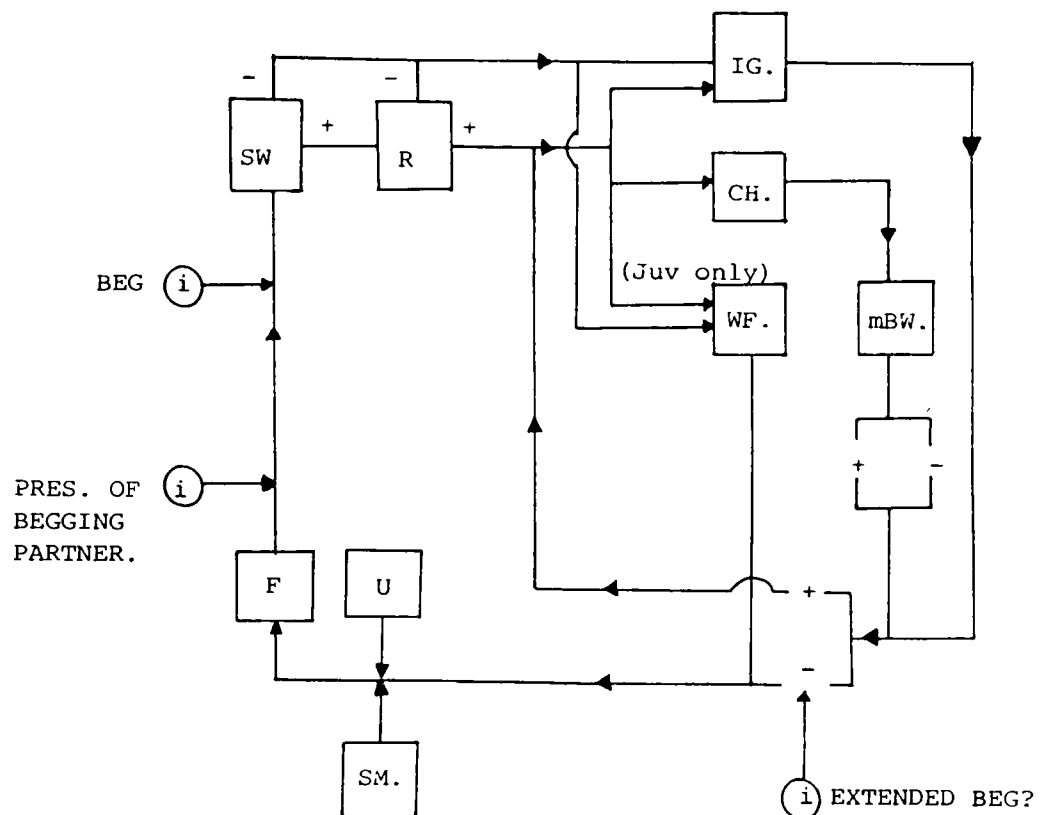


FIGURE 3:3:11
A COMBINED FLOW DIAGRAM OF ORGANISATION OF RESPONSES TO BEGGING
BY MATED FEMALES AND JUVENILES.

Extended begging and Wing-flick exclusion apply only to juvenile
food begging.

Explanation of symbols are given in the key in 3:3:6(a).

(iii) Individual will only feed its begging partner and therefore has to identify the begging partner before responding to any begging attempts.

(iv) No vigilance against extra begging juveniles or removal system included. Thus assumes only 1 bird whether its begging partner or not will beg at any one time.

(v) Individual will not ignore excessive begging by the juvenile, and will respond by either feeding it or wing-flicking at it.

(vi) Begging partner must show releaser element(s) in its begging behaviour before the individual will feed it.

(vii) Motivation to respond to juvenile begging decreases with time after fledging. This can also be seen as a time related increase in the individual's desire to encourage independent feeding in the juvenile.

(viii) After wing flicking at juvenile, no begging for a short while.

KEY

F : Forage. Individual foraging.

U : 'General Motivating Factor' (see Carlestead 1983a).

SM: 'Sexual Motivation'. Motivation for breeding and feeding young.

i : External input. 3 here; presence of begging partner, observing that begging partner is begging and observing that begging continues after ignoring beg or feeding begging partner.

SW: Swallow. Individual encounters food while foraging and swallows it. If does not swallow food, will not feed begging partner.

R : Releaser. Individual needs to see releaser element(s) of begging posture before can include feed in its selection of responses.

IG: Ignore. Ignores begging attempt.

CH: Chunder. Feeds begging partner.

WF: Wing flick. At juvenile that has begged to an excessive extent.

MBW: Mutual bill wipe. Individual and begging partner may mutually bill wipe after the individual has fed its begging partner.

(b) COURT-FED

A flow diagram of observed sequences of behaviour in the courtship feeding female was made (figure 3:3:13). Where appropriate, numerical data on the frequency of observation of various elements were included, and graphs of the transition from simple to full begging (from figure 3:3:1) were incorporated into the diagram. Courtship feeding in the foraging area was noted in 15 observation days ($n=38$ cases) ± 10 days from date of copulation, where the pair were seen together. In 146 days outside this time where a mated pair were seen together, there were no cases of courtship feeding observed in the foraging area. The physiological basis of internal motivation for courtship (as a part of sexual motivation) is described by Hinde (1965) and Farner and Lewis (1971). The simple beg system does not employ the progressive build up of posture seen in the full beg system, and thus in both the flow diagram and the model is represented in a single line overriding the various stages involved in the full begging posture formation. By the way that the method of begging gradually change from simple to full, it is possible that the female is learning that this is the more effective form of beg in obtaining a positive response.

Assumptions

(i) Hunger of female is not taken into account. Thus foraging efficiency and regularity of encountering prey by foraging and courtship feeding not included.

(ii) Female is in a monogamous mated pair, up to 10 days before or after copulation.

(iii) Nest helpers (if any) play no role in courtship feeding.

(iv) Female constantly present in foraging area, and forages while not attempting courtship feeding behaviours.

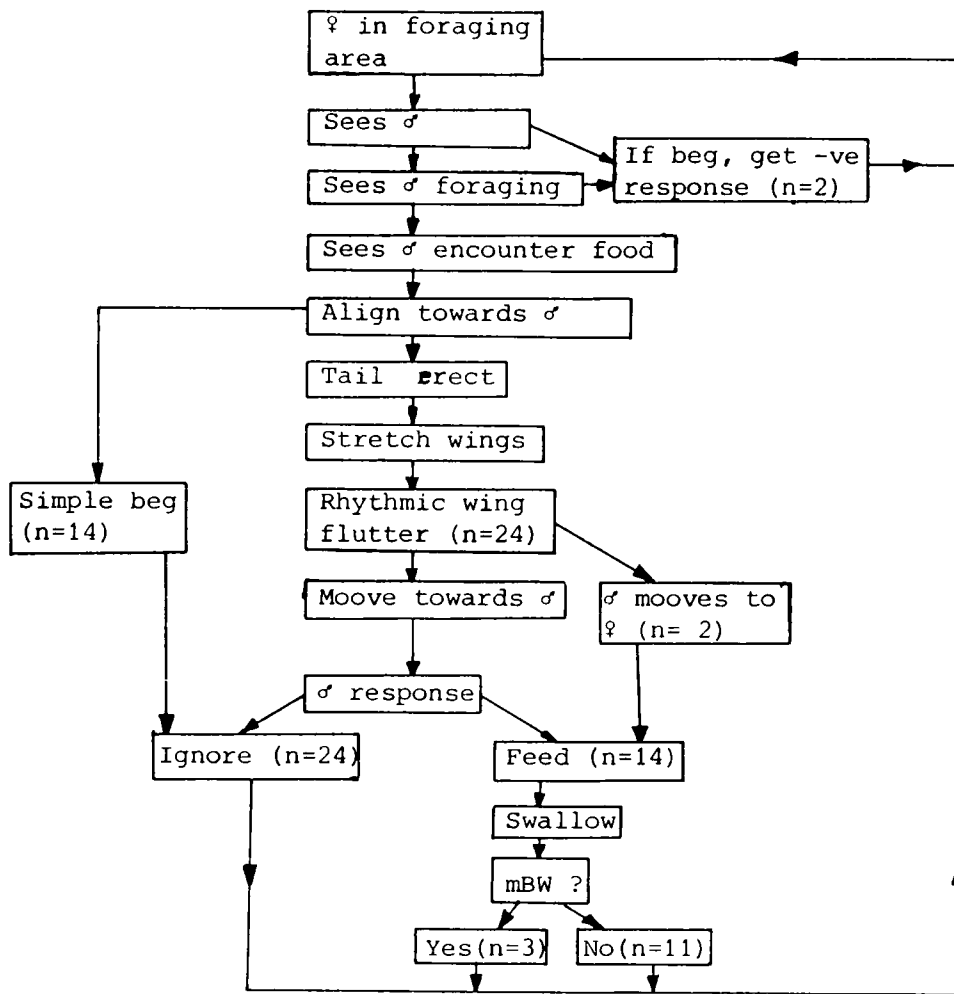
(v) Female will only attempt to beg when sees mate foraging and encountering prey.

FIGURE 3:3:13.

COURT-BEG I.
FEMALE FOOD BEGGING.

FIELD OBSERVATIONS OF THE SEQUENTIAL ORGANISATION OF FEMALE
COURTSHIP FOOD BEGGING.

KEY: Numbers in brackets refer to the number of field observations.



(vi) Does not take into account the cases where the male went to the female after female assumed full begging posture.

KEY

i Inputs: Sexual motivation - day length and presence of male are responsible for initiating sexual motivation.

Inputs: ♂ Prox. Male in foraging area, up to 10m from female.

♂ For. Male seen foraging.

♂ Seen SW? Male seen encountering food.

P. Rel. to ♂. Female's position relative to that of male at various stages of build up to full begging posture.

♂ Acc. State. Male seen to respond to begging.

♂ Chunder. Male gives food to female.

♂ MBW. Male initiates or reciprocates Bill wiping with female.

For: Forage. Female forages.

"R": Releaser. Sexual motivation acts as releaser to motivate courtship feeding behaviour.

'r': releaser for mutual Bill wipe after successful courtship feed.

A : Align. Align to mate.

S1 : Position check after align.

P : Position and posture. Assume begging posture.

S2 : Check position and posture.

M : Move, towards mate.

S3 : Check position relative to mate while moving, and maintenance of posture.

SB : Simple Beg. Simple beg in front of mate.

B : Beg. In posture and in front of mate, begging.

S4 : Check maintenance of begging posture and position.

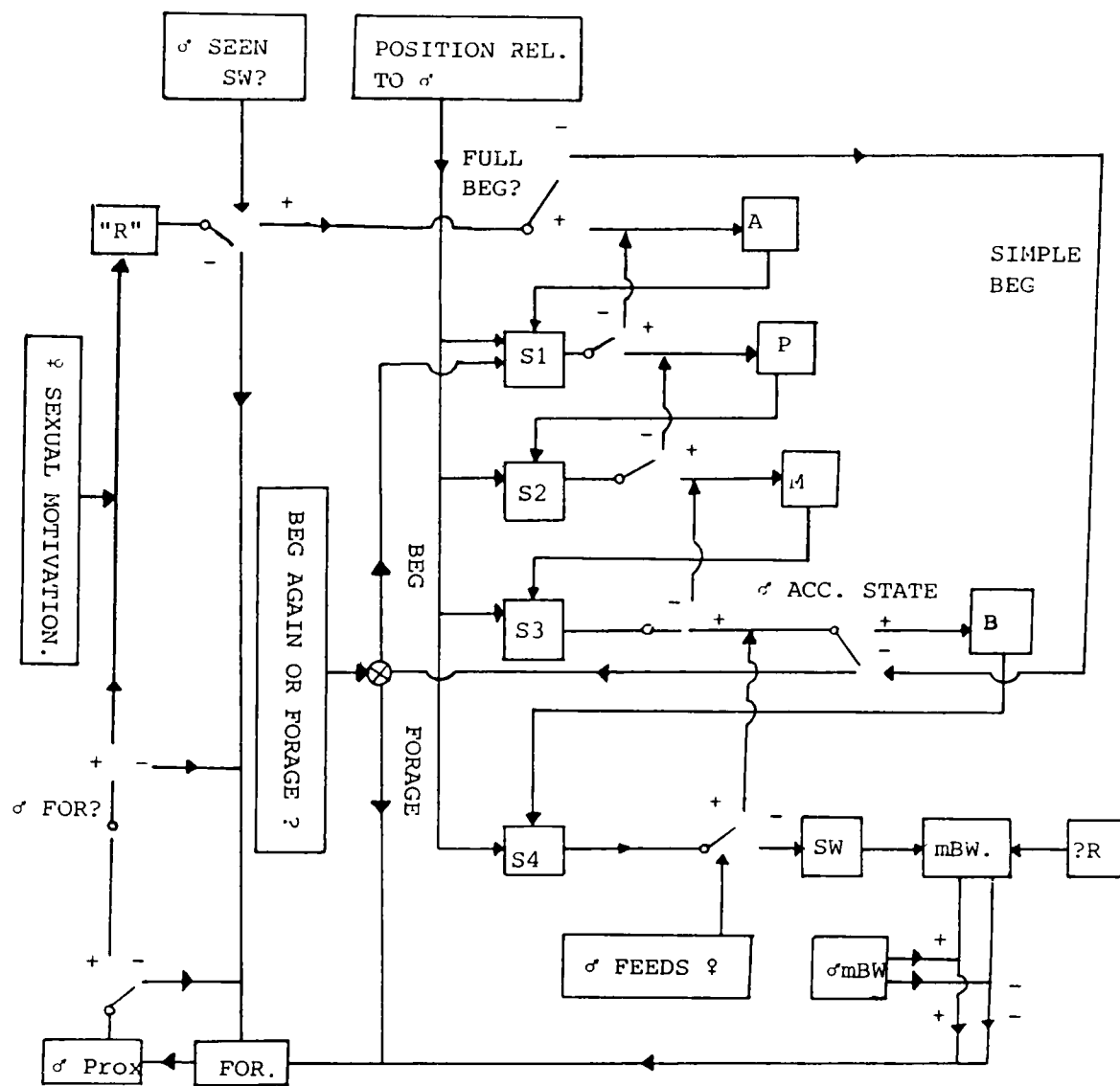


FIGURE 3:3:14

COURT BEG II
ORGANISATION OF THE PAIRED FEMALE'S FOOD BEGGING BEHAVIOUR.

A KEY TO THE SYMBOLS USED IS SHOWN IN SECTION 3:3:6 (b).

(c) JUV-BEG

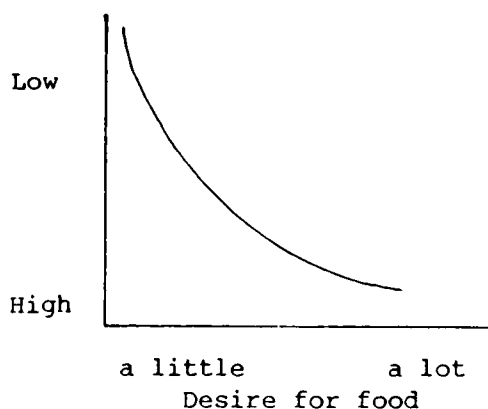
A flow diagram of observed sequences of juvenile food begging was made (figure 3:3:15). Numerical data was added where appropriate and graphs showing temporal changes in begging techniques and success adapted from figures 3:3:4 to 3:3:7 were appended where appropriate.

Hunger is the primary motivating factor for the post-fledged juvenile before it is fully capable of independent feeding. This is reflected by the inclusion of a comparative assessment of food intake via food begging and independent foraging. Hunger counts for the indiscriminate nature of the juvenile's food begging and its occasional willingness to beg at levels of intensity that risk adult attacks. Such behaviour is analogous to the 'indifference curve' devised by McCleery (1978). Figure 3:3:17 adapts it to the circumstances of juvenile food begging.

Figure 3:3:17

An 'indifference curve' for juvenile food-begging.

Risk of
adult
attack



Where the adult does attack, the juvenile stops begging for an undetermined period of time.

The model takes into account the assessment of begging strategies with respect to begging repertoire development, hunger and risk. Foraging ability is regarded as a continually increasing ability to locate and secure prey coupled with an increasing motivation to forage as reflected in the frequency of pecks with respect to all behaviours.

Assumptions

(i) Post fledged juvenile, with recognisable adult that will feed it

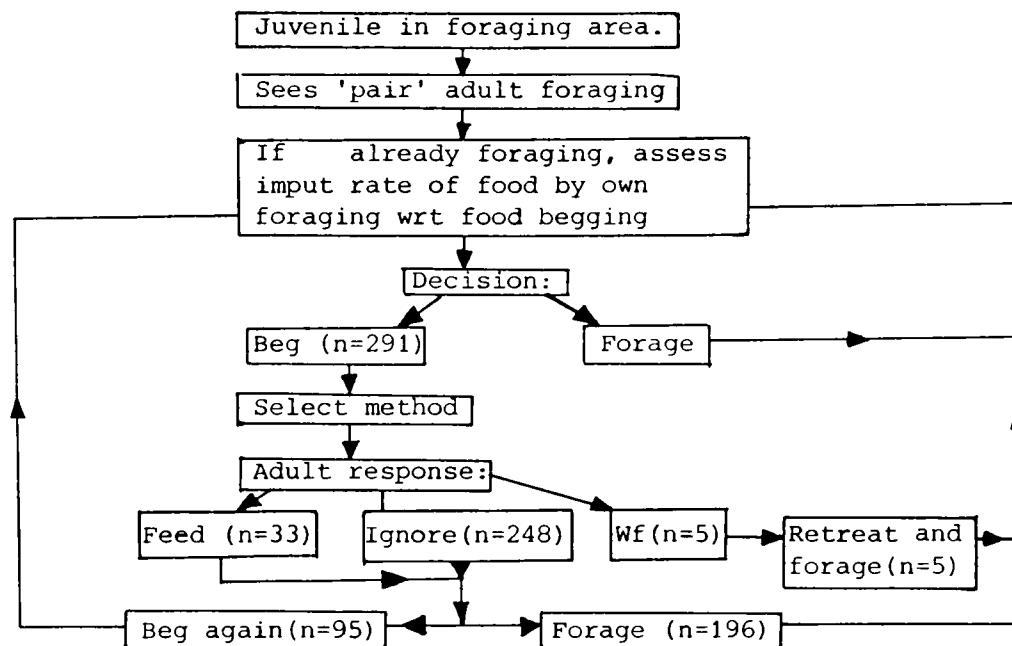
FIGURE 3:3:15.

JUV BEG I.

JUVENILE FOOD BEGGING.

FIELD OBSERVATIONS OF THE SEQUENTIAL ORGANISATION OF
JUVENILE FOOD BEGGING.

KEY: Numbers in brackets refer to the number of field observations.



A KEY TO THE SYMBOLS USED IS SHOWN IN SECTION 3:3:6 (c).

(depending on feeding motivation).

(ii) No other young involved in begging for food with this particular adult when the juvenile is begging for food from it.

(iii) Foraging ability not developed to level where full independent feeding is a more rewarding strategy and thus juvenile ceasing to beg for food.

(iv) No account taken of hormonal and internal motivational controls beyond that of the 'general motivating factor' and hunger.

KEY

U : 'General Motivating Factor.

H-t: Hunger, and time. Hunger increases with time elapsed since previous input of food. Thus greater the hunger, greater the innovation for begging and preparedness to change strategy with respect to risk as shown on the indifference curve.

i : External inputs: Presence of adult in foraging area.

" : Position of adult in area with relation to juvenile.

" : Adult response to juvenile's food begging attempt.

B : Beg.

EB : Extended Beg. Begging continues after adult ignores beg.

M : Move. Towards adult.

S1 : Check position in relation to adult.

SM : Select begging method.

S2 : Assessment of position and method while begging before any response from the adult.

+ : Adult feeds juvenile.

- : Adult ignores juvenile.

wf : Adult wing-flicks at juvenile.

EB>F?: Choose to continue begging with an extended beg, or start foraging.

F : Forage, independently for food.

FA : Foraging Ability. Ability to locate, discriminate and obtain food.

PR : Peck Rate. Measured in pecks per 1000 seconds during both foraging and food begging sessions.

FER: Encounter Rate for obtaining prey during independent foraging.

BER: Encounter Rate for obtaining prey during food-begging.

B>F?: Choose whether to forage or beg as method most likely to obtain food. In effect, a comparison of the encounter rates for each method.

3:3:7 Discussion

This discussion will concentrate on three aspects of the data obtained in this section: A comparison of the roles played by the courtship feeding and the juvenile begging systems of the Chough; an evaluation of the contribution this work has made to our understanding of Chough food-begging and an examination of any aspects of this work which may have added new insights into contemporary knowledge of food-begging.

There appears to be a substantial interspecific difference in the role of courtship feeding, with some species mainly using it at the time of egg laying and others at the date of copulation. Tasker and Mills (1981) found the maximum rate of courtship feeding in Red-billed Gulls to be around the date of copulation and feeding continued up to the date of egg laying, being mainly carried out at the nest. Blue Tits used courtship feeding at the time of egg laying and away from the nest; Royama (1966) regarded it as a primary source of food for the female and Krebs (1970) found that the female could obtain food at 2.5 times the foraging rate when it begged at that time. Brown (1967) observed that the maximum rate of courtship feeding in Lesser Black-backed Gulls occurred from 1 to 10 days prior to egg laying.

Thus, courtship feeding is used for supplementing the female's food intake at the time of egg laying and as a part of sexual behaviour for assessing the male's ability to feed possibly the female at the nest, and certainly the young before they can forage independently (Nisbet 1977). Since feeding at the nest could not be examined due to visibility problems, Chough courtship feeding at the time of copulation was examined. In Blue Tits, Krebs (1970) observed that the female used a posture similar to juvenile food begging. This was also the case with the Chough although it also resembled the female's sexual solicitation posture. This is similar to ^{the findings of} Hailman (1958) and Verheyen ⁽¹⁹⁷⁰⁾ /, who along with other authors, Feare (1984) concluded that in the Starling, courtship feeding played a primarily sexual role. Since at the time of copulation, and in the 10 days before and after it the female was foraging normally, a supplementary diet would not be needed. Courtship feeding in the Chough was only seen to be successful during and after the copulation period. The results suggest that this is more related to techniques used since the effective 'full beg' was not used prior to copulation. Thus, the 'simple beg' may be lacking a releaser element that the male needs to encounter before it will feed the female.

This need to develop an effective begging strategy may explain the ambiguous nature of the data; if the female is assessing the male's feeding ability why were there no cases of the male feeding the female before copulation? The increasing rate of male feeding after copulation may indicate ^{that} /the male is preparing to contribute a substantial part of the female's energy needs for egg laying and incubation. On this basis, it may be that the male only responds after copulation since there is a specific physiological need for the female to increase her food intake. This is the opposite to the view that food begging is a form of assessing the male's feeding ability, and may override the distinction between the two begging techniques since the male would then ignore any full begs prior to

copulation. Examination of courtship feeding at a visible nest site would be required for further insights.

The role of juvenile feeding is more straight-forward. Until a juvenile is capable of foraging independently at a rate equal to its nutritional requirements, it depends on the adults for at least a part of its nutritional intake. As Davies (1978) points out, the adult has to assess when to encourage independent foraging, either by assessing the chick's foraging ability or by the current feeding conditions. If it becomes 'mean' too early, the chick will die, if too late then it is wasting its own time and energy. Each would represent a loss of parental investment. Davies, working on Spotted Flycatchers (1976) and Great Tits (1978) observed that this 'meanness' is carried out by making it unprofitable for the young to beg with respect to independent foraging. There is a transition period where both strategies are used until the chick is fully independent. While the Spotted Flycatcher adult left the chick to learn for itself how to forage, Wood Pigeon squabs required a social stimulus to peck at grain (Wortis, 1969). The Spotted Flycatcher lives in a cryptic habitat (broad-leaved woodland), while Wood Pigeons feed in flocks in the open. Thus it is possible that the social role adults play in stimulation of independent feeding may play a part in the causation and maintenance of flock feeding. Gregarious feeding is also related to vigilance considerations as discussed in Chapter 3, Section 4. Choughs also feed often in flocks in the open, and the adults remain in the young's vicinity throughout the transition period, suggesting a similar form to the Wood Pigeon.

It was noted that although some methods of juvenile begging (eg Face, Rapid call and Wing Quiver) were more effective than for example the adjacent beg, they also carried a higher probability of the adult attacking the juvenile. Here, there may be a pay off between probability of getting

fed and the adult attacking the juvenile which is regulating the juvenile's choice of begging strategy.

Passerines and pigeons have relatively short post-fledging transitions to independent feeding when compared to gulls and terns. Wortis (1969) found Wood Pigeon squabs to be fully independent after 21 days and Spotted Flycatchers ^{are independent} by 25 days (Davies 1976). This study found examples of full independent feeding by 26-29 days. On the other hand, Sandwich Terns although able to feed themselves continued to beg after 7-9 months (Dunn 1972), and Herring Gulls continued to beg until 70-138 days, depending on brood size (Holley 1982) with isolated cases of high intensity begging up to 460 days and low intensity begging up to 513 days. In the case of the Herring Gull, Burger (1981) believes ^{that} the young terminate begging since he observed adults returning to the old nest site with food even though the young were in the foraging area.

Whitaker (1947), Williamson (1959), Cowdy (1962), Holyoak (1972), Bullock (1980) and Warnes (1983a) record instances of courtship feeding in Choughs. Holyoak's descriptions of courtship feeding agree with this study except that he also describes two cases occurring after allopreening. The above work contains no data on frequency, success or timing of courtship feeding in the Chough.

Warnes (1983a) notes a juvenile being fed by adults 7 days after fledging while another was not fed about a month after fledging. Cowdy (1960, 1962) notes social stimulation of independent feeding by adult Choughs leaving unearthed food for the young to pick up 6 days after fledging and that young were not fed 11 days after fledging. This is probably due to watching a small number of unsuccessful begs since this section shows that there is a low frequency of feeds after 22 days when the adults still contribute a major part of the juvenile's food intake. Holyoak (1972) notes full independent feeding after 28-35 days with mainly

independent foraging after 21 days. Begging techniques described by Holyoak are similar to Adjacent, Face and Wing quiver. No quantitative data on frequency or success of begging was obtained from the above sources. Thus while courtship feeding in the Chough appears to play a primarily sexual role at the time of copulation, it is suggested that towards egg laying, the supplementing of the female's diet may become more important. The rate of feeding was more regulated by the development of begging technique than other considerations in the time immediately around copulation. The lack of a male response to female begging attempts before copulation appears to indicate that the female did not use this to assess the potential mate's ability to feed her and the young.

Juvenile begging is similar to that of other passerines and pigeons in time duration and the socially stimulated transition to independent foraging is likely to be related to the adults' foraging in small groups in an open habitat.

This section has ^{presented} /for the first time quantitative data on various aspects of Chough food begging especially relating to temporal considerations and the frequency, development and success of begging in relation to techniques used.

The comparative work on development and success of various begging techniques in females and juveniles has not been undertaken before. This is probably due to the fact that the Chough has a wide repertoire of begging behaviours and its high visibility when foraging make it ideally suited to such a study. The flow diagrams of begging behaviour from the viewpoint of both the begging individual and its feeding partner may be of value in the development of quantitative models describing begging behaviour as demonstrated previously by Norton-Griffiths (1969). However, as he points out, much work will be required before models that can be used for giving quantitative predictions, of in his case the Oystercatcher, can be developed.

3:4 VIGILANCE BEHAVIOUR AND DISTURBANCE

3:4:1 Introduction

McFarland (1981) defines vigilance as "an animal's state of readiness to detect certain specified events occurring unpredictably in the environment." In this study, Choughs encountered 3 potentially dangerous species; Man, Ravens and Peregrine falcons. Man's role as a predator is discussed in the context of indirect and direct persecution in Chapter 6, Section 6. Ravens play an uncertain role, they are not predators on adult Choughs, but they may take eggs and young (Bullock, 1980). Peregrines are predators upon airborne adults and there are occasional records of remains of Choughs being found in their eyries (Graham 1890, Gilbert 1937, Baxter and Rintoul 1953, Penhallurick 1978 and Ratcliffe 1980), but as Gilbert (1937) and Ryves (1948) point out, the frequency of kills appears to be low. Little Owls (Rolfe, 1966), rats and foxes (Rolfe, 1966) and ferrets and cats (Warnes, 1983a) are regarded as predators on young Choughs but no interactions between these species and Choughs were observed in the study period, and they are thus outside the scope of this section.

By their behaviour in the presence of Man, Ravens and Peregrines, Choughs strongly indicate that they regard these three species as potentially dangerous. In the context of this section therefore, vigilance behaviour will be regarded as being used by Choughs to maintain a safe distance between themselves and potentially dangerous organisms while allowing the maximal safe time to be spent in maintenance and foraging while in the foraging area.

On this basis, a Chough has been disturbed when it changes its behaviour in order to be vigilant in the presence of a potential danger, and as a result of the vigilance behaviour assesses the threat to be of such a nature that it has to leave the immediate vicinity. With the presence of

large numbers of tourists in the Loctyn area, disturbance due to the presence of tourists can become a factor affecting the feeding preferences of Choughs. Although this has been previously noted (Bullock, 1980) no quantitative study of the effects of disturbance by tourists has been made.

3:4:2 Aims

Because of the relative scarcity of the Chough, and its limited distribution in open areas, often in national parks or in areas of outstanding natural beauty, in the holiday season, it is subjected to a high frequency of tourist visiting. For their effective management, an understanding of the effects of tourist on the distribution in space and time of feeding behaviour is required.

Vigilance zones and minimum flight distances have been fairly well studied in the Chough, and thus there is scope for a comparative examination of disturbance distances by tourists in differing areas, and for finding out about their regulating factors. This will be further applied to examine vigilance and disturbance with relation to Ravens and Peregrines in order to include a functional study of the behaviour components involved in vigilance and their relation to normal foraging behaviour and specific vigilance behaviour. The circumstances responsible for motivating Choughs to attack potential predators will be examined where detail allows.

The final aim is to construct a canal model showing the functional relation of motivating factors involved in vigilance and the decision making process before making a response to each type of potential threat.

3:4:3 Methods

The areas used by tourists were examined in order to record their frequency and distribution of usage in relation to seasons and Chough feeding areas. Disturbance distances for tourists were obtained by noting

the minimum distance between Choughs and oncoming tourists before the Choughs would fly. These were recorded in metres, at 5m intervals, coupled with regular checks against known distances to ensure^{that} estimations were accurate. With the minimum flight distance obtained, each footpath was bracketed with a disturbance zone on 1:10000 scale maps in order to ascertain if Choughs fed there or not, and to calculate the physical extent of the disturbed and undisturbed areas.

In each case of any observed disturbance, the usage of bill-wiping and any form of wing-flick calling prior to take off was recorded. The number of potential predators and Choughs were noted, along with any interaction by the Chough or the predator with any other species present. The nature of the flight, if any was also recorded (either rapid, 'scramble' flight or the normal method), and the length of each foraging session was compared with those that had ended by Choughs leaving for reasons other than disturbance.

Vigilance in undisturbed flocks was examined by recording the frequency and length of look components during foraging in individuals and pairs, and the frequency of looking in larger flocks.

Wing-flick behaviours were further examined by examining their frequency of use in post disturbance landings, and where there were low levels of disturbance that caused increased vigilance behaviour, but not flight.

3:4:4 Vigilance Behaviour

Two types of looking component were observed; (i) the short look, where the bird holds its head in the look posture for less than 0.75s (mean $0.48 \pm .32$, $n=20$ from film observations), and (ii) the long look where a continual looking movement is used for over 1 second. No direct responses to disturbance were observed after a short look. Therefore responses to

disturbance appear to occur either after a long look or where a short look has been extended into a long one.

The amount of time spent looking during foraging was calculated by adding together all look sessions of 1+ seconds, and as shown in table 3:4:1, averaged at 10% of foraging time in both individuals and pairs.

Table 3:4:1 Vigilance in Individual and Paired Foraging Choughs

	Solitary	Pair	Overall (per individual bird)
n. short looks	86	265	351
n. long looks	38	207	261
total n. looks	144	474	617
time spent long looks (s)	132	500	632
% of time vigilant	10.53%	9.90%	10.08%
looks per 1000 seconds (Σ)	114.56	94.52	98.37
mean long look time (s)	2.28	2.39	2.38
% of looks long	40.28%	43.67%	42.95%
observation time (s)	1257	5015	6272

The vigilance time and percentage of long looks remained constant. The change in the frequency of looking was due to the reduction in number of short look components. For groups of Choughs, the number of looks during foraging and after preening while in the foraging area was noted. This is shown in Table 3:4:2.

Table 3:4:2 Frequency of look components. Looks per 1000 seconds included in brackets.

Group size	n. looks after preening (per 1000 S.)	n. looks while foraging (per 1000 S.)	total	time (seconds)
1	2 (1.59)	142 (111.97)	144 (114.56)	1257
2	37 (4.51)	781 (95.12)	818 (99.63)	8210
3	5 (1.66)	148 (49.19)	153 (50.83)	3009
4	3 (1.91)	80 (51.02)	83 (52.93)	1568

Group size	n. looks after preening (per 1000 S.)	n. looks while foraging (per 1000 S.)	total	time (seconds)
5	6 (3.49)	81 (47.07)	87 (50.56)	1721
6	7 (7.48)	66 (61.68)	73 (69.16)	1070
Total for 3-6	21 (2.85)	375 (50.89)	396 (53.75)	7368

The look frequency for pairs is consistent with that found in table 3:4:1. From group numbers of 3-6, there is no relationship between group size and look frequency ($r > .20$, $n=4$), instead it remains approximately constant at a rate of 53.75 looks per 1000 seconds. Since these values are for each individual bird within the group, the overall frequency of looking for the group increases with group size.

These two sets of data are combined in table 3:4:3, to give the time span between the start of each vigilance session.

Table 3:4:3 Vigilance frequency

n. Choughs	short look	long look	Σ
1	14.62	21.67	8.73
2	18.92	24.23	10.03
3-6	32.60	43.34	18.61

Look sessions were shorter than those of foraging sessions and thus served to divide foraging sessions with vigilance at approximate frequencies, as shown in table 3:4:4.

Table 3:4:4 Duration of look and forage sessions per bird, in pairs and solitary birds

Behaviour	time (seconds)									
	0-5	6-10	11-15	16-20	21-30	31-40	41-50	51-60	61-70	Σ
Forage	176	131	50	30	42	16	11	4	3	481
look	456	13	2	1	0	0	0	0	0	473
Σ	632	144	52	31	42	16	11	4	3	956

Under normal foraging circumstances, in 95 cases of Choughs encountering food, 87 were followed by vigilance (91.16%), 2 by stepping to another foraging patch (2.11%) and 6 by immediately resuming foraging (6.32%). In instances of foraging in snow covered ground, 7 cases of Choughs encountering food were all immediately followed by the resumption of foraging.

3:4:5 Human Disturbance

Distribution of tourists in the tourist season was recorded by noting tourist movements in the Loctyn area on 69x5 hour recording days from March to September 1982. A total of 834 movements were observed. Movement by a group was defined as one group of tourists walking from the start to the finish of one section of footpath. Their movements are summarised in table 3:4:5. 86.9% of these movements (n=729) took place on path 1, between the resort of Llangranog and the Loctyn headland. This was used for either sightseeing, or for access to the beach of Traethdinas Loctyn. Figure 3:4:1 shows the location of the 4 main footpaths, and the tourist groups seen using

Table 3:4:5 Tourist Movements, March to September 1982

FOOTPATH	DESTINATION	n.	n/day	Σ n.	Σ n./day	%
(1)	Loctyn	265	3.89	725	10.66	86.9
	Headland	230	3.38			
	Yns Loctyn	15	0.22			
	Llangranog	164	2.32			
	Ciliau	33	0.45			
(2)	Loctyn	26	0.38	67	0.98	8.0
	Llangranog	37	0.54			
	Pendinas- Loctyn	4	0.06			
(3)	Ciliau	11	0.16	28	0.41	3.4
	Pendinas- Loctyn	5	0.07			
	Llangranog	12	0.18			

(4)	Ciliau	14	0.21			
	Loctyn	18	0.26	32	0.47	3.8
	Σ	834	12.26			

each in both directions per observation day. In a total of 150 observation days from 1981-1984, 1144 groups of tourists were observed. Table 3:4:6 summarises their frequency per observation day in monthly (and where appropriate, half monthly) groups. Out of these observations, 97.99% of groups ($n=1121$) were seen between March and September (mean 11.11 ± 11.09 per day, 103 observation days) while from November to February, 2.01% of all groups were seen (mean 0.51 ± 2.03 per day, 47 observation days). The high season of late June to September accounted for 81.03% of groups (14.26 ± 12.25 per day, 65 observation days) with a total of 926 groups observed.

Five hundred and twenty-three sessions were observed until the Choughs flew from the field in which they were foraging in to another. Of these, 137 of the departures were as a result of the birds flying due to tourist disturbance (26%). When the frequency of disturbance is compared with the number of groups of tourists in the area, as shown in table 3:4:7, it is apparent that the frequency of foraging sessions being disturbed is related to the tourist pressure ($r < 0.001$, $n=15$), which is illustrated in figure 3:4:2.

Table 3:4:6 Tourist groups seen in Loctyn area

Period	n. observation days	n. groups observed	n. groups/day
12-81	14	0	0.0
1-82	12	0	0.0
3 + 4-82	20	94	4.7)
5-82	3	16	5.3)
6-82	6	54	7.7)
(i) 7-82	10	76	7.6) Tourist
(ii) 7-82	10	153	15.3) Season
(i) 9-82	8	80	10.0)
(ii) 9-82	10	81	8.1)
11-82	3	0	0.0
12-82	3	0	0.0
1-83	6	18	3.0



FIGURE 3:4:2.

RELATION BETWEEN THE FREQUENCY OF TOURIST VISITING
IN THE STUDY AREA AND THE PROBABILITY OF A CHOUGH'S
FORAGING SESSION ENDING DUE TO TOURIST DISTURBANCE.

Period	n. observation days	n. groups observed	n. groups/day
2-83	2	0	0.0
3-83	6	31	5.2)
4-83	8	53	6.6)
6+(i)7-83	8	172	21.5)Tourist
(ii) 7-83	5	141	28.5)Season
8-83	4	118	29.5)
9-83	4	52	13.0)
12-83	4	2	0.5
1-84	4	3	0.75
Σ	150	1144	7.63

Table 3:4:7

Period	n. foraging sessions	n. foraging sessions disturbed	<u>n. for. disturbed</u> n. for. sessions
12-81	21	0	0
1-82	24	0	0
3+4-82	100	6	0.06
5-82	20	6	0.3
6-82	20	0	0
(i) 7-82	13	3	0.26
(ii) 7-82	65	37	0.56
(i) 9-82	51	25	0.49
(ii) 9-82	34	10	0.32
11-82	3	0	0
12-82	0	-	-
1-83	8	0	0
2-83	4	0	0
3-83	48	8	0.16
4-83	43	10	0.23
6+(i)7-83	23	14	0.6
(ii) 7-83	11	7	0.63
8-83	7	4	0.56
9-83	25	7	0.36
12-83	3	0	0
1-84	0	-	-
Σ	523	137	0.26

For 101 foraging sessions in areas without cover, which were ended by tourist disturbance, the minimum distance for flight was found to be $34.95 \pm 6.34\text{m}$ ($n=101$). This flight distance, as table 3:4:8 shows, remained constant irrespective of the size of the tourist group or the number of Choughs present.

Table 3:4:8 Minimum flight distance and Chough and tourist group size

tourist group size	n. incidents	min. flight dist (m)	Chough group size	n. incidents	min. flight dist (m)
1	35	37.9 ± 6.25	1	26	34.0 ± 7.49
2	49	32.6 ± 6.18	2	22	35.4 ± 5.56
3	9	32.6 ± 5.65	3	13	31.5 ± 5.72
4	6	33.3 ± 7.53	4	9	33.3 ± 4.41
5	2	35.0 ± 7.01	5	9	33.9 ± 8.94
Σ	101	34.95 ± 6.34	6	18	32.2 ± 5.02
			7	3	40.0 ± 0
			8	1	40.0 ± 0
			Σ	101	34.95 ± 6.34

Where cover was responsible for preventing the Choughs seeing the tourists until they were nearer to the Chough than in areas without cover, minimum flight distances decreased. In heavy cover, it was $22.3 \pm 7.51\text{m}$ ($n=18$) and in medium cover $32 \pm 5.40\text{m}$ ($n=10$). Thus the presence of heavy cover significantly affected minimum flight distance ($\chi^2 10.78$ $P < 0.01$, $df=1$).

When Jackdaws were foraging in the vicinity of Choughs, Choughs would follow Jackdaws if they left due to tourist disturbance in 12 out of the 13 observed incidents. This means that in 92.3% in these cases, the Chough minimum flight distance was $50.9 \pm 10.61\text{m}$ ($n=12$), thus larger than the standard distance, and similar to the Jackdaws' larger minimum flight distance of $48.75 \pm 5.56\text{m}$ ($n=8$). Thus, the presence of Jackdaws caused the increase of Chough minimum flight distance ($\chi^2=7.35$, $P < 0.01$ $df=1$) without there being any difference vice versa. In these incidents, the Jackdaws were approximately the same distance as the Choughs from the tourists. There were 4 incidents where the Choughs were more than 10m from the Jackdaws with respect to the tourists (mean $73.75 \pm 4.79\text{m}$ from the tourists),^{and} the Choughs did not respond to the Jackdaw flight.

Where the Chough is able to fully observe the gradual approach of tourists, there is a 0.56 probability of their wing-flick calling ($n=62$) in the 10 seconds preceding flight. These trends for Chough group size were

examined in 3:6:5, where no relation between Chough group size and the number of wing-flick calls used was found, but the proportion of take-offs with wing-flick calls before increased with group size ($r < 0.05$, $n=7$). Table 3:4:9 shows that the probability of wing-flick calls before flight, and the number of wing-flick calls used per incident remained constant in relation to tourist group size.

Table 3:4:9 Wing-flick call usage and tourist group size

n. tourists	n. incidents	p. wf. call.	n. wing flick calls
1	25	0.48	3.18 ± 2.56
2	21	0.57	3.90 ± 2.40
3+	4	0.50	4.00 ± 0.00
Σ	50	0.52	3.56 ± 2.19

The probability of wing-flick calling, and the number of times they were used per incident, were reduced in incidents caused by Jackdaw take-offs, or where there was more cover than normal, as shown in table 3:4:10.

Table 3:4:10 Wing-flick call usage in non standard circumstances (tourist disturbance)

	n.	p. wf. call	n. wing flick calls	
Jackdaw take-off	12	0.0	0.00	$n=0$
Heavy cover	16	0.06	1.00 ± 0	$n=1$
Medium cover	10	0.20	2.50 ± 1.08	$n=2$
Standard cover	74	0.56	3.11 ± 1.73	$n=28$

Tourist disturbance was responsible for a reduction in the average duration of foraging sessions, from 25.89 ± 21.83 minutes ($n=55$) to 15.64 ± 12.07 minutes ($n=14$). To see if this reduction in feeding duration is reflected by Choughs avoiding areas with a high frequency of tourist use, the frequency of foraging trips per hectare in disturbed and non disturbed areas were compared. The extent of each area is shown on figure 3:4:3, and the disturbed area was calculated as a band of land running 35m, from each side of the footpath, excepting areas where the Chough would not see

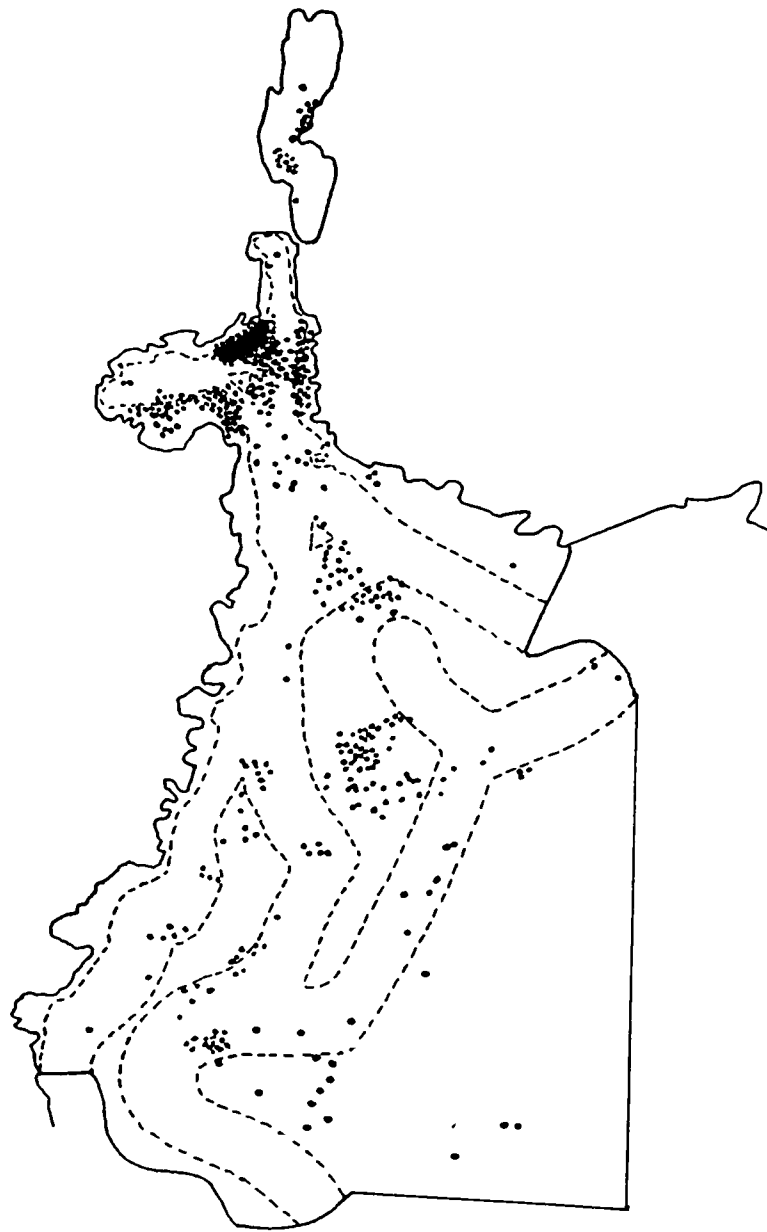


FIGURE 3:4:3.

RELATION BETWEEN CHOUGH FEEDING DISTRIBUTION IN THE
THE STUDY AREA AND THE DISTRIBUTION OF TOURIST USED
FOOTPATHS.

Dots indicate observations of Chough foraging.
Shaded area represents a 35m visible area around
each footpath where Choughs could see passing tourists.

tourists on the footpath due to obscuring features. The census area was of 39.16 Ha. in extent, of which 14.47 Ha. was within the disturbed area band, and 24.69 Ha. outside it. Feeding data were obtained by classifying the placement of general feeding records from Chapter 4, Sections 3-4, as inside or outside the disturbance area, and subdividing them into tourist season, and out of tourist season dates, as summarised in table 3:4:11.

Table 3:4:11 Foraging preferences in relation to tourist disturbance

	n. forage within disturbed area	n. forage outside disturbed area	Σ
Nov-Feb	38	46	84
Mar-Sep	326	189	515
Σ	364	235	599
	n. forage/Ha. within disturbed area	n. forage/Ha. outside disturbed area	
Nov-Feb	2.63	1.86	2.14
Mar-Sep	22.56	7.65	13.15
Σ	25.19	9.51	15.29

These results indicate that there is a preference towards the areas within the disturbance zone, and that this preference is increased during the tourist season ($\chi^2 = 29.38$, $P < 0.001$, $df=1$). In Chapter 4, it is shown that predator distribution is also unaffected by tourist distribution and thus does not affect Chough distribution with relation to tourist use. Thus other factors including foraging preferences are assessed by the Chough as being more important than the frequency of disturbance. These other factors are discussed in Chapter 4, Section 4, and Chapter 6, Section 6.

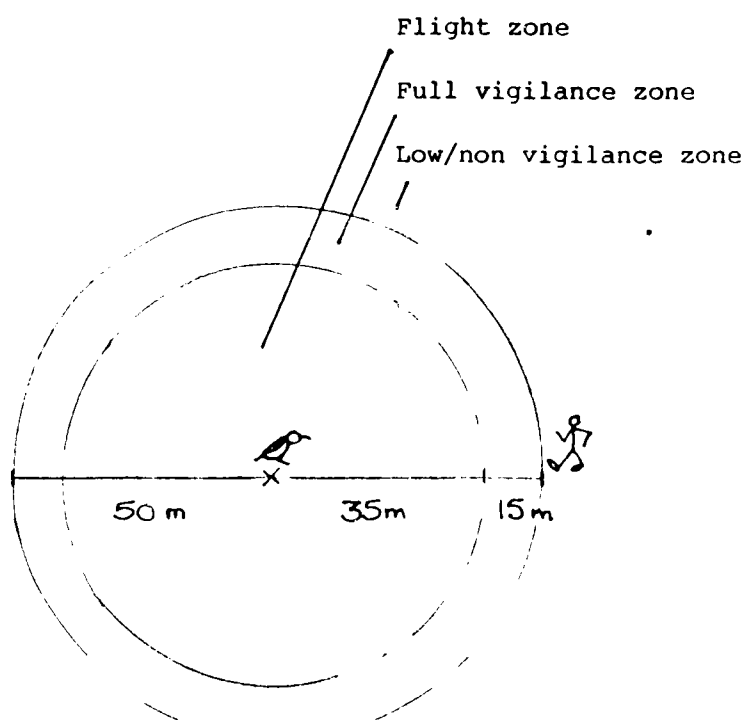
3:4:6 Vigilance in relation to human disturbance

In the previous part of this section, and in section 6:5, it was noted that the frequency of flights preceded by wing flick calls when human disturbance was the cause, increased with Chough group size. The similar pattern of increased proportion of flights being preceded by wing flick calls where the approach of tourists is clearer due to less cover indicates that this may be due to Choughs responding to the presence of oncoming

tourists before they reach the minimum flight zone. In order to examine this, the frequency of vigilance sessions at the level of the entire group was compared with the proportion^{of} wing flick calling before flight and the probability of an oncoming tourist being seen in the zone between the area of no response to a tourist's presence, and the minimum flight distance zone.

The number of seconds between each look component for solitary Choughs from table 3:4:1 and for 2 and 3+ Choughs from table 3:4:2, can be re-expressed into time between each look component for the entire group by dividing the time between each look component by the number of Choughs in the group. The speed of an average tourist was estimated at 1m per second, and the intermediate vigilance zone to have an extent of 15m. Thus, it takes the average tourist, on the assumption of a direct approach, 15 seconds to cross the intermediate zone as shown in figure 3:4:4.

Figure 3:4:4 Vigilance zones



In table 3:4:12 the probability of the Chough seeing the tourist in the 15m zone is calculated as

$$1 - \frac{(\text{time between each look(s)})}{(15 \text{ seconds})}$$

Table 3:4:12

n. Choughs in group	time(s) between each look	Probability of Choughs seeing tourist in vigilance zone
1	8.69	0.42
2	4.98	0.67
3	6.29	0.58
4	4.72	0.69
5	3.77	0.75
6	3.14	0.79
7-10 (ave. 9)	2.09	0.86

In figure 3:4:5, it can be seen that the probability of seeing a tourist in the vigilance zone is related to the number of Choughs present in the group ($r < 0.01$, $n=7$), and figure 3:4:6 shows that the probability of seeing a tourist in the vigilance zone is related to the probability of wing flick calling prior to flight ($r < 0.1$, $n=7$) at just below a significant level. This confirms the role of an intermediate zone serving for Choughs to prepare and signal an above average indication of their probability of flight, as opposed to the rapid flight where the tourist is seen inside the minimum flight zone.

3:4:7 Predators; Ravens and Peregrines

Choughs foraging would continue to do so in the presence of Ravens on the ground, even if 10m away ($n=8$), but would show a 72.9% probability of flying if an airborne Raven was seen in the air less than 100m away. Chough responses to the airborne presence of Ravens are summarised in table 3:4:13.

FIGURE 3:4:5.

PROBABILITY OF CHOUGHS SEEING TOURIST IN 15 SECONDS.

RELATION BETWEEN CHOUGH FORAGING GROUP SIZE AND THE PROBABILITY OF ONE OR MORE OF THE GROUP SEEING AN APPROACHING TOURIST IN 15 SECONDS IN THE VIGILANCE ZONE.

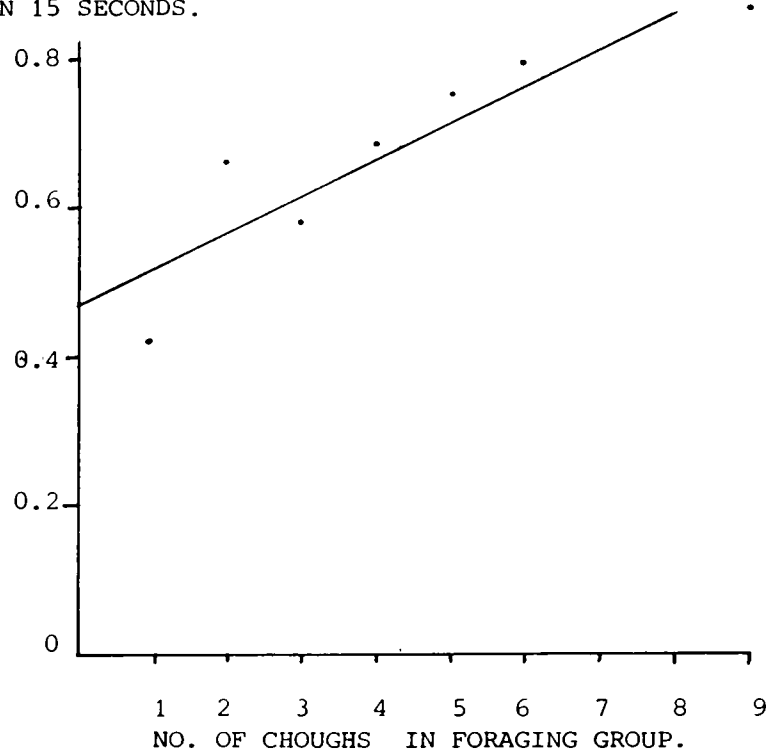


FIGURE 3:4:6.

PROB. OF CHOUGHS SEEING TOURIST IN 15 SECONDS.

RELATION BETWEEN PROBABILITY OF CHOUGHS SEEING ONCOMING TOURISTS AND THE PROPORTION OF GROUPS WING-FLICK CALLING BEFORE FLIGHT.

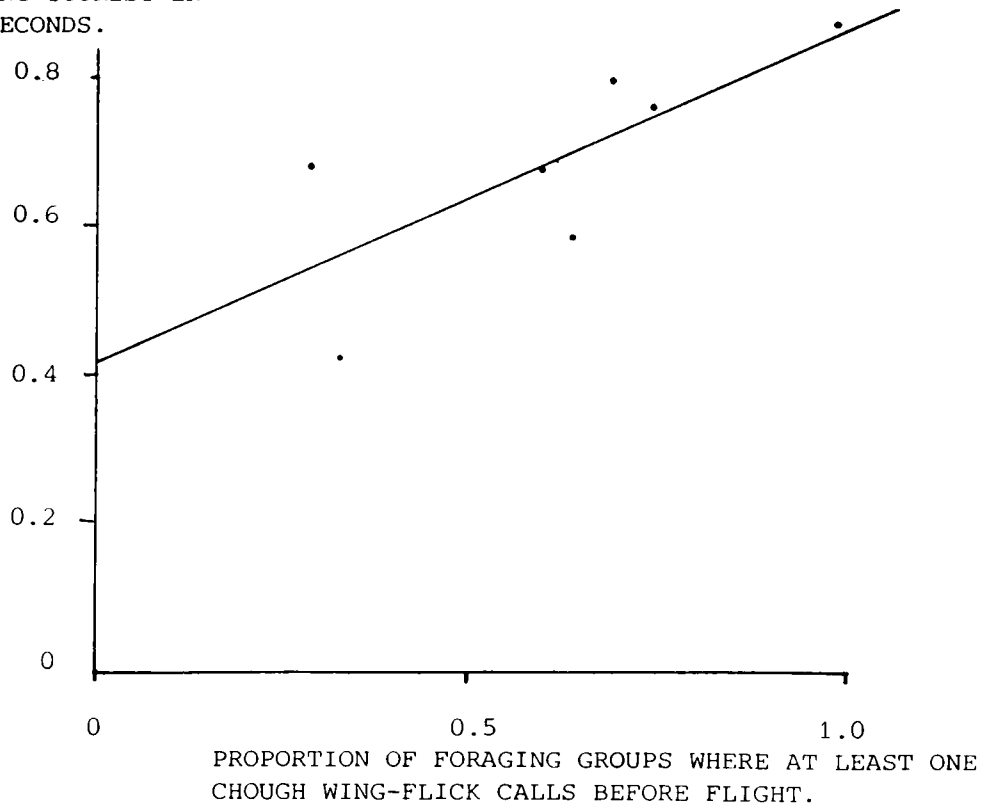


Table 3:4:13

Chough-Raven distance (m)	response of Chough:			Σ
	no movement	fly	Vigilance	
0-50	5 (14.3%)	25 (71.4%)	5 (14.3%)	35
51-100	1 (7.7%)	10 (76.9%)	2 (15.4%)	13
101-150	0	0	2 (100%)	2
151 +	8 (100%)	0	0	8
Σ	14	35	9	58

The 'no movement' response in cases where Ravens were less than 100m away normally took the form of the Chough not apparently moving. At over 150 metres, it meant that the Chough did not respond to the presence of the airborne Raven. The 10-15m zone represented the intermediate zone between flight and no response, and consisted of the Chough looking constantly at the Raven until it was over 150m away, or if less than 100m, flight.

During the breeding season, when the nest was occupied, there were 5 cases of Ravens flying near nest site L. In each case, the Raven was chased away, and there was a further case of a Raven on the ground being driven away from the area around nest L. Outside the breeding area (27, in the case of L), during the breeding season, there were 17 cases of airborne chases seen, in which 13 resulted in Ravens chasing Choughs, and in 4, Choughs chasing Ravens.

As with tourist disturbance, the average duration of foraging was reduced when Choughs left the area due to the presence of airborne Ravens. In this case, foraging sessions ending due to disturbance were 9.25 ± 6.92 minutes long ($n=8$) compared with 25.89 ± 21.83 minutes ($n=55$).

Sixteen cases of Choughs foraging and responding to the presence of Peregrines in the air were recorded. In 3, the Chough remained still, at an average minimum distance of 31.61 ± 2.89 m. In 10 cases the Chough 'scrambled' at an average minimum distance of 58 ± 12.29 m, and in 3 cases, vigilance in the form of continual looking was seen at an average minimum distance of 166.67 ± 28.83 m. The results are in nature similar to those of

the response to the presence of Ravens, except that the distance zones have increased in size.

Aspects of interspecific antagonistic interactions are discussed in Appendix 2.

3:4:8 VIGMOD. A Canal Model of Chough Vigilance Behaviour

The aim of VIGMOD is to illustrate the functioning of vigilance behaviour in the Chough in relation to inputs from tourists and potentially dangerous predators. VIGMOD represents a simple adaptation of Carlestead's (1983a, 1983b) canal model of the organisation of responses to intruders in cichlid fish. Because of the small number of potential predators, and the limited range of responses by the Chough shown in this section, it was possible to elaborate the workings of Carlestead's model. Thus, specific inputs, circumstances and responses under a set of assumptions that cover most eventualities during foraging and maintenance behaviour could be incorporated.

Symbols, layout and terminology, wherever possible have been retained from Carlestead's model. The main changes are in the differentiation of the response sections into including specific responses. Here, responses to intruders are a specific set of behaviours intended to remove the intruder from a specified area. Any other response is channelled into the response to potentially dangerous disturbance section which is subdivided into 5 levels, on an ascending level of danger.

The model operates on a series of negative feedback loops, working on the principle of maintaining a homeostatic norm for the foraging etc. individual in relation to the presence of potential dangers, both to itself and its young.

Key to symbols used in model; Where symbols are marked *, symbols are essentially similar to those in Carlestead 1983a, except where indicated.

- *U : 'General motivating factor'.
- SC : Sexual characters. Physiological basis of sexual motivation, controlled by hormones, and regulated by day length, age and presence of mate for timing of breeding.
- *C : Check. A feed back loop in order to re-evaluate the output of the intruder removal system before further response is made.
- *E : Evaluation of action effectiveness. Examines results of the response taken in context of their intended aim; removal of intruder or avoidance of danger.
- *i/I : Intruder. Peregrine or Raven.
- *d/D : Potentially dangerous disturbance. Peregrine, Raven or tourists. Also 'second rank' disturbances by fact that foraging Choughs respond to being swooped by them: Buzzard, Kestrel, Carrion Crow and Herring Gull.
- *F : Fear system. Underlies sexual and general motivating factors.
- *Fi/Fd: Output of the fear system. Used in assessing whether circumstances relating to presence of Peregrine or Raven constitute a need to remove the intruder from the area, not only by the overriding of the need versus potential risk, but by the individual's fear of the intruder.
- *Pi/Pd: Persistence of response to intrusion or potentially dangerous disturbance. Whether to respond to input, or if it proves to be suitably transient, to ignore it.
- *T : Territorial intrusion. Where the intruder has penetrated the individual's territorial area. In the case of VIGMOD, this is taken to mean the breeding area.
- *D : Danger. Danger from interacting with the potentially dangerous disturbance.

- *T>D? : Assessment as to whether the extent of the intrusion into T is greater threat to individuals fitness (reproductive effort) than the potential danger of interacting with the intruder.
- *Ri : Response to the intruder. If system has passed to this stage, only response available is to attack or interact with intruder so as to effect a spatial displacement of intruder from area T.
- *Rd : Response to potentially dangerous disturbance. Five levels of response were observed. These are classified separately after this key.
- *Si : Spatial displacement of intruder with respect to T as a result of Choughs response, Ri.
- *Sd : Spatial displacement (if any) of the Chough with respect to the potentially dangerous disturbance as a result of response, Rd, to input, d.
- D w.r.t.d: Displacement with respect to disturbance. Indicates that Chough has responded to disturbance in manner intended to displace itself from source of disturbance.
- BA : Intruder inside breeding area T. Assumed to form an area of not more than 100m from the nest site.
- BS : Intrusion taking place during breeding season. Here from April to July.
- Di,Dd : Distance of intruder or disturbance from the nest site and foraging individual respectively.

Assumptions Relating to Working of VIGMOD

For the intruder exclusion system, individual must be in a mated pair. The role of helpers in this system (if any) is not known.

Does not take into account attacks on species that do not constitute a threat to the breeding site.

No habituation to the presence of intruders, or disturbances. This is

in
unlike Carlestead 1983a, but was found to hold. See Section 4:8.

Does not take into account any form of interspecific intrusions or attacks.

Excludes flights due to inanimate disturbances (eg Jet 'planes).

Responses to Potentially Dangerous Disturbances

Five levels of response were observed and are classified in an ascending order of severity and immediacy of danger.

(i) Low level vigilance. No wing-flick calling or vigilance related bill-wiping. May involve increased frequency and duration of look component. Seen where tourists are more than 50m distant, or where Ravens are flying past more than 150m away (n=8). Overall wing-flick rate 4.56 per 1000 seconds (n=220). Increased looking to the extent of a substantial reduction in foraging noted in 9 cases where Ravens 15-1000m distant and in 3 cases of Peregrine presence at an average distance of 166m.

(ii) Full vigilance. Reduction in time spent foraging, or in maintenance behaviours. Increase in both wing-flick and wing-flick calling frequencies, to an overall rate of 72.96 per 1000 seconds (n=155). Seen where tourists are between the 50m and 34.95 ± 6.34 m (n=101) zones, thus not causing flight. Three cases where tourists never went inside inner zone but remained in full vigilance zone for a total of 2,124.5 seconds. In 1 further case, a Chough (in a pair) bill-wiped, a total of 4 bill-wipe groups where a tourist was 35-40m distant. Bill-wiping was also noted in close proximity of a swooping Herring Gull (n=1) and a Raven 100m distant (n=1).

(iii) Flight. Take-off that has been preceded by wing-flick calling or continual and extended looking. Follows after full vigilance, the tourists having been observed in the vigilance zone prior to entering the minimum flight distance zone. Apart from 3 cases involving Ravens (average distance = 133m), all cases involved tourist disturbance. Probability of this

response increases with group size due to increased overall vigilance (Section 4:6, $r < 0.01$ $n=7$) meaning greater probability of detection of disturbance within vigilance zone. Wing-flick call rate in 10 seconds prior to flight of 163.76 per 1000 seconds ($t=740$ seconds) compared to normal undisturbed flight figure of 7.28 per 1000 seconds ($t=1510$ seconds).

(iv) Scramble. Sudden, rapid and where 2+ individuals involved, simultaneous take-off without prior indication of take-off by either wing-flick calling, bill wiping or extended looks. In the oncoming presence of Peregrines, this took place at an average distance of $58 \pm 12.29\text{m}$ ($n=10$) and from 25-100m for Ravens ($n=35$). For Raven presence, the three cases noted in (iii) mean an overall wing-flick call rate of 4.62 per 1000 seconds, lower than the normal pre-flight rate. If those three are reclassified as 'take-offs' then no wing-flick calls were noted prior to scramble take-offs, as was the case with Peregrines. Scramble flights were observed after Choughs were dived at by other species. In no case were they preceded with wing flick calls. These were: Buzzard ($n=4$), Carrion Crow ($n=74$), Herring Gull ($n=2$) and Kestrel ($n=16$). With the presence of tourists, the degree of cover obscuring the tourists' advance lowered the probability of their being observed in the vigilance zone and thus increased the probability of scramble flight. In medium cover, wing flick calling rate fell to 72 per 1000 seconds ($n=4$) and in heavy cover it was 13.64 per 1000 seconds ($n=22$). The number of wing-flick calls per incident fell accordingly. This indicates a greater urgency before take-off due to the decreased time of vigilance created by the cover, thus making type (iii) take-off impossible. No wing-flick calls were observed where Choughs scrambled due to Jackdaw take-offs while tourists were still outside the vigilance zone ($n=12$). The input of Jackdaws scrambling must have overridden the normal vigilance procedure.

(v) Freeze. In cases where Choughs are foraging and a Raven or a Peregrine flew overhead at a close range after having been previously unsighted (eg by flying over a ridge, or round a cliff face) the individual bird(s) may not scramble-fly but remain on the ground and not move. This occurred when Ravens were 15-50m distant (n=6) and Peregrines 31.67 ± 2.89 m (n=3) distant. The freeze response presents an acceptable alternative to scramble flight since if the Chough flew it would be close to the potential predator, while by remaining on the ground it can be inconspicuous for at least long enough for the bird to be a greater distance away, or discourage a swooping attack since a dive on the ground may be dangerous to the predator if it hits the ground.

Reponse to Intruders

For the Chough to interact with a Peregrine or a Raven, a high risk of injury is involved. Thus the benefits accruing must outweigh the possible costs to a suitable degree. The only circumstances under which this occurred was in the defence of the young. Ravens could attack the young in the nest, and Peregrines take the newly fledged young. Two considerations, spatial (proximity of predator to young) and temporal (during appropriate part of the breeding season) have to be satisfied before a potentially dangerous disturbance can be regarded as an intrusion.

For Ravens, interactions outside the breeding season resulted in scramble, low vigilance or freeze responses (n=23). Inside the breeding season, but outside the breeding area, interactions resulted in low vigilance or scramble (n=12). In the breeding season and within the breeding area, eight interactions resulted in 2 Chough scrambles, 5 airborne chases by the Chough and 1 attack on a Raven on the ground by a Chough. There was a 0.75 probability (n=8) of the Chough attacking the Raven when these two conditions were satisfied, compared with a 0.0 probability (n=35)

when they were not. In the 2 cases of Chough scrambles, either the fear system or the danger element overrode the removal system.

In the case of Peregrines, there were no field observations of Choughs attempting to remove Peregrines. But in the BBC film 'Beyond the Edge' ('The Natural World', 1984) a pair of Choughs mobbed a Peregrine that was less than 100m from their newly fledged young until the Peregrine left. Bullock (1980) observed 1 case of a juvenile Peregrine being mobbed by a flock and in another instance, a Chough dived at a Peregrine. The Peregrine is a greater danger to adult Choughs than Ravens and thus there is a lower probability of a Chough attacking them for the same benefit level.

There were also 2 cases of Choughs mobbing a Buzzard above the 'B' nest site area in 1984 until it left. There is no evidence of Buzzards taking young, eggs or adults. This may be a simple case of interspecific territoriality or an example of a 'better safe than sorry' policy with regards to all raptors.

Working of VIGMOD

The model is shown in figure 3:4:7.

From the descriptions of responses above, it can be seen from the negative feedback system that up to three different responses a sequence until the Chough assessed that an appropriate response had been made with respect to the input.

The system also incorporates differing responses to different types of disturbance, thus the short time span in observing a tourist emerge through heavy cover without preliminary vigilance overrides the normal first two stages of vigilance behaviour.

Three main sequences result as shown in table 3:4:15.

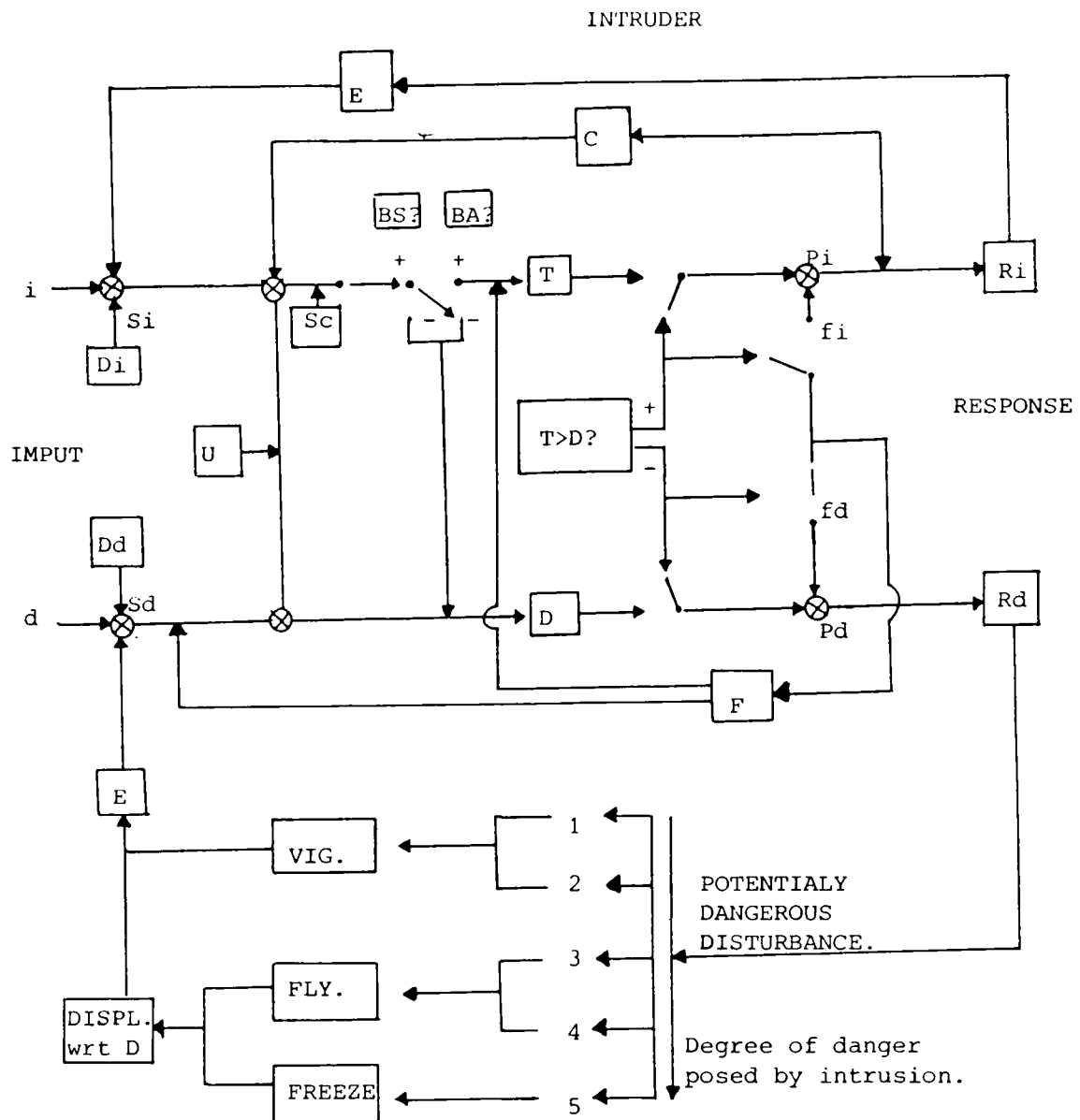


FIGURE 3:4:7.

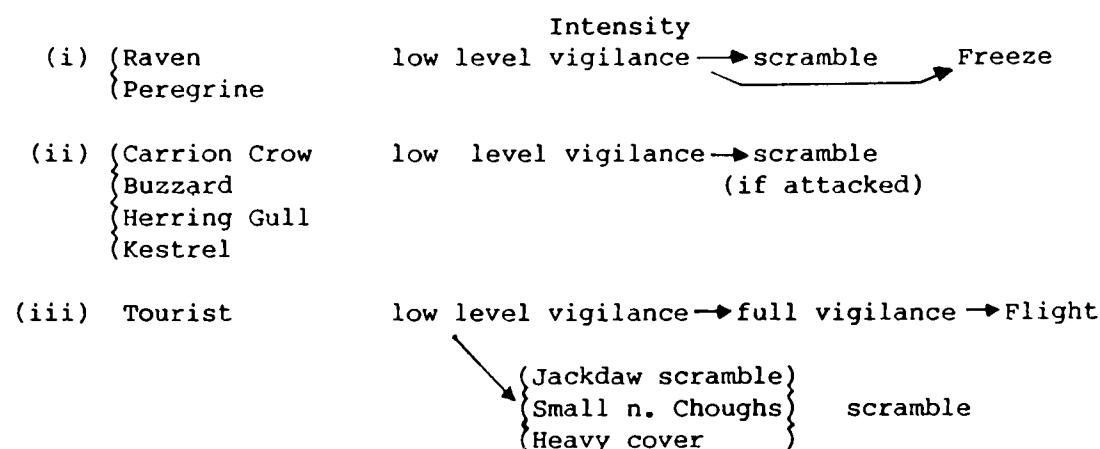
VIGMOD. A CANAL MODEL OF THE ORGANISATION OF THE CHOUGH'S VIGILANCE BEHAVIOUR .

A key to the symbols used in this model is included in section 3:4:8.

Levels of response to potentially dangerous disturbances:

- 1; Low level vigilance.
- 2; Full vigilance.
- 3; Flight.
- 4; Scramble.
- 5; Freeze.

Table 3:4:15 Responses to Specific Inputs in Sequence



3:4:8 Discussion

In this study, an average minimum flight distance of $34.95 \pm 6.34\text{m}$ from tourists was obtained. This is close to Bullock's (1980) figure of $30 \pm 12\text{m}$ on South Stack. But at Bardsey (Gatehouse and Morgan 1972, Cowdy 1984), 'A disused quarry in North Wales' (Whittaker 1947), Ramsey (Metcalf person. comm.) and the Calf of Man (Gosler person. comm.) minimum flight distances of 9.5-11m were observed. Habitat differences do not account for the discrepancies nor would the possibility that some of the authors simply noted the shortest flight distance since these figures are too consistent for such explanations. Since these figures are for island bird observatories and a disused quarry, the Choughs there were less used to humans as being potential threats. Armstrong (1956) notes that in Arctic islands, birds are more likely to attack people where they have not previously encountered terrestrial mammals. This is also the case in sparsely inhabited islands such as Foula, Shetlands (person. obs.) where skuas and terns will readily attack people and sheep near their breeding areas rather than fly away. Armstrong (1950) observed the same in Arctic Terns even outside their breeding colonies. Although the Chough would therefore appear ideally suited to detailed studies on the effect of habitat and isolation on vigilance, this cannot be recommended apart from the purely passive sense of observing other people disturbing them by accident on

account of their comparative rarity.

On the conservation side, the main question is 'how detrimental are tourists to Choughs, especially in the breeding season?' The fact that Choughs mainly fed in the areas of highest tourist frequency even at the height of the tourist season indicates that they did not consider the potential costs of disturbance great enough to warrant foraging in other areas, tourist disturbance did not displace their potential predators the Raven and the Peregrine (As shown in Chapter 4) and thus predator distribution was not a contributing factor to the Choughs' choice of foraging areas. It was found that increased tourist frequency led to a reduction in the duration of each foraging session and an increased probability of the foraging session being ended due to disturbance. But breeding success was the same as in non-disturbed areas (eg. Bardsey) and the number of pairs had increased from 1-2 pairs in 1975 to 3 during the study period even though tourist frequency also increased. This indicates that the present level of tourist disturbance is not significantly detrimental to the Chough population in Loctyn, but beyond a certain, as yet unknown, point it may be so. Choughs appear to regard tourists as a lesser threat than Peregrines and Ravens as indicated by their shorter flight distances and the use of a gradual take-off incorporating the wing-flick call vigilance system, compared to the 'scramble' flight from a long distance with avian predators. In anthropomorphic terms, it appears that the Chough regards tourists as a nuisance and the Raven and Peregrine as a real threat. Owens (1977) found that Brent Geese were more vigilant in wildfowling areas, but their minimum flight distance decreased as the season progressed. He found that 11.7% of their feeding time was lost due to disturbance, 48% of which was caused by the presence of humans.

Two particular factors affect vigilance behaviour in birds; group size and habitat. Bertram (1978) reviewed the advantages of feeding in groups

and concluded that increases in group sizes up to a point are accompanied by an increased probability of detecting the potential predator and a decrease in the vigilance required by each individual bird. Murton (1971) believed that 'local enhancement' - birds gathering in a good feeding area - was the primary cause of group feeding but this has been disputed by Lazarus (1972) and others. Citing specific cases, decreases in vigilance time by individuals with a commensurate increase in foraging time has been noted by Bertram (1980) for Ostriches, Lazarus (1977) for White-fronted Geese, Drent and Swierstra (1977) for Barnacle Geese, Powell (1974) for Starlings and Lazarus (1979) for Quelea. Individuals within the flock appear to scan independently of each other in for example, House Sparrows (Elcavage and Caraco, 1983) and increase of group size results in an increased inter-scan time (Elgar, Burren and Posen, 1984). Grouping together also occurs at times of potential threat as noted in Eider ducklings and young Redshanks by Goss-Custard (1970) and in Yellow-eyed Juncos by Caraco, Martindale and Pulliam (1980). Greig-Smith found that minimum flight distances in Barred Ground-doves increased with group size, showing that increased overall vigilance leads to earlier detection.

Grzybowski (1983) concluded that grassland birds are gregarious in open habitats due to their greater visibility there and Caraco, Martindale and Pulliam (1980) found Yellow-eyed Juncos to be more vigilant when in open habitats. But Metcalfe (1984a) found that Purple Sandpipers and Turnstones increased their vigilance on rocky shores because of the increased risk of being caught there unawares by a predator. The grouping together of Choughs so that they are all visible to each other, and other individuals joining the flock appears to agree with the need for flocking vigilance in open habitats.

The use of the wing-flick call behaviour in Chough vigilance in certain circumstances (mainly tourists approaching) is an intriguing contrast to

that of a number of birds. Davis (1975) found that in Wood Pigeons, flights caused by disturbances were not preceded by any pre-flight posture, and in Jackdaws, Lorenz (1935) observed that rapid flight by one individual would cause the rest of the flock to take-off. Greig-Smith (1981a) concluded that Barred Ground-doves froze before take-off in order to assess whether to fly or not. Thus these species did not use any form of intermediate response to disturbances prior to take-off. Indeed, as Daanje (1950) points out, wing-flicking before flight in undisturbed conditions is widespread amongst Passerines. These points are discussed in greater detail in Chapter 3, Section 6. The differing response by Choughs to the presence of various airborne raptors and corvids is reflected by the Herring Gulls' response to harriers and Golden Eagles. Baerends (1970) found that the gulls would ignore Hen Harriers, show slight alarm in the presence of Montagu's Harriers and general alarm and flight even in the distant presence of Marsh Harriers and eagles. He also found that with ground predators, take-off distance was related to the size and potential threat of the predator. This agrees with the widely differing responses of Choughs to tourists and Peregrines and Ravens compared to the greater levels of indifference to the presence of Carrion Crows and Buzzards, which are also discussed in Appendix 2, Section 5. Curio (1975) found that Pied Flycatchers would only mob presented patterns where they resembled birds which were a genuine threat. This shows these species have the ability to ^{assess} accurately and rapidly appropriate responses to various birds in order not to waste time on general responses to all raptors and corvids.

VIGMOD was presented as a descriptive canal model based on the canal model devised by Carlestead (1983a and b) for the organisation of responses to intruders by cichlid fish. Vigilance in the context of VIGMOD is an attempt to explain vigilance as being a pay-off between time spent foraging, assessing whether an intruder is a threat, can be ignored or needs to be

removed and the need to keep an appropriate distance away from any potential predators. Vigmod did not take into account the Chough's hunger which may be an important factor in regulating vigilance behaviour. Kenward (1978) found that Goshawks attacked Wood Pigeons just before dusk since at that time they are searching hardest for food. Krebs (1980) states that in Great Tits, the relation between hunger and time spent looking up is direct so that hungry birds are less vigilant. Thus, a fully descriptive model would have to include a hunger factor, for which data were not obtained in this study.

Lendrem (1982) and Hart and Lendrem (1984) developed a purely mathematical model for the prediction and description of variation in vigilance in groups to predators using varying frequencies of attack and predation strategies which use the prey's behaviour to time their attack. This represents a widely embracing development of Pulliam's (1973) model which was the first to algebraically demonstrate how prey group size can effect predator detection.

What Vigmod achieves is in its ability to present a wide ranging set of responses to different types of intrusion including a graded set of threats so that the Chough's response can be expressed as a sequence of behaviours relative to the potential danger posed by each intrusion. In this sense it is a purely descriptive model / ^{in which} quantitative data is used to support the observed sequences of responses.

3:5 BILL-WIPING AND WING-FLICKING

3:5:1 Introduction

Research into the functional evolution of signalling behaviour in animals has been conducted along two lines. These are: classical ethology, with an emphasis on the ritualisation of behaviours, and the selfish/cynical gene approach, based on communication being used as a form of manipulation.

In classical ethology, animal signals are examined from the viewpoint of their being ritualised forms of foraging and maintenance behaviours (Tinbergen 1953, 1964, Lorenz 1966, Huxley 1966). Cullen (1966) states that the ritualisation of displays reduces the possibility of their being interpreted in an incorrect or conflicting manner since any ambiguity in signals is avoided. By the use of a small number of behaviours in combination, a large repertoire of signals can be obtained (Wilson, 1975). The open habitat occupied by Choughs is reflected by the emphasis on visual display in their signalling behaviour. This is analogous to woodland bird (Barnard, 1983) and Roe deer (Loudon, 1978) behaviours.

The selfish gene/cynical gene approach (Dawkins and Krebs, 1978) views signals as being forms of communicating fighting abilities, which can be manipulated to suit the sender's needs. Thus they are used to maximise the sender's reproductive fitness with respect to the intended receiver. Taken to its extreme (Dawkins, 1976, 1982), signals can appear to be visual extensions of the individual's phenotypes, that exist to be pitted against each other.

Both of the above approaches examine behaviours in the context of the entire body posture. Thus, these approaches regard the individual components of behaviour as being secondary to the body posture. In this section, these individual components will take a primary role with respect to whole body postures. Specific components of behaviour and their ritualised forms can be examined to observe any inter-relations between form and functions of behaviours, and how behaviour components can interact.

This section is also concerned with the semantic (reviewed by Krebs and Dawkins, 1984) conveyance of Shannon information (Shannon and Weaver, 1949). That is conveying information about events that are out of the ordinary, and the maximisation of the amount of information that can be conveyed to the reactor (Marler, 1959).

The breaking down of semantic information into simple components is analogous to linguistic research (reviewed by Hawkes, 1977). In particular, structuralism and semiotics aim to reduce communication into its most effectively comparable and thus simplest components. By dividing the signifier from the receiver, post-structuralism aims to reduce communication into single units of information (Eagleton, 1983). By substituting behaviours for linguistic communication, this sections applies such a structuralist approach to ethology.

The Chough makes particular use of two maintenance-based behaviours for signalling. These are; the wing-flick and the bill-wipe. These and their derived forms are defined and illustrated in Chapter 2:4. Ritualised forms of these behaviours are also found in other passerines: Bill-wiping in Zebra Finches (Morris, 1957), and Wing-flicking in Magpies (Baeyens, 1979) and Stonechats (Greig-Smith, 1982), being typical examples. The extensive use of these behaviours in the Chough's repertoire makes them well suited for this study.

3:5:2 Aims

This section aims to investigate the circumstances under which each behaviour and its derived forms are used, and to what effect it is a signalling device. From this, it is intended to find how each behaviour relates to the others and the extent of their functional deviation from the original maintenance behaviour. Data obtained will be applied to flow diagrams in an attempt to describe the motivation and regulation of these behaviours in certain circumstances.

3:5:3 Methods

Behaviours using any actual or derived form of wing-flicking or bill-wiping were observed, classified and defined (2:4). The time of year

and social circumstances were recorded, with particular reference to whether it was observed (a) up to 10 seconds prior to take off, (b) up to 10 seconds after landing and (c) while on the ground between periods (a) and (b).

In each instance, the number of Choughs present, the presence of any other birds or tourists, and, where known, the identity and relation of the signaller to any of the receivers were recorded. To examine the frequency of usage, Real-time recordings of behaviours were made using an Olympus Pearlcorde 3072 recorder.

Since differences in frequency of behaviours were noted with respect to flight distance, flights were classified as either being 'full flights', or where 50m or less, 'sub flights'. The latter mainly covered flights within a particular field, and where if a flock was involved, the 'sub flying' bird did not leave the sight of others.

On the ground, observations were classified into 5 social contexts: (a) antagonistic, (b) sexual, (c) maintenance, (d) vigilance and (e) foraging.

For bill-wiping, numbers of bill wipes used were counted on 2 levels. Firstly, the number of strokes of the bill in each uninterrupted series of strokes, and secondly, the number of groups of strokes used in a series. Each group of strokes was divided from the next by another behaviour, normally a look component, or an occasion wing flicking or calling. Frequency analysis of bill-wiping behaviour was limited owing to the low frequency of their occurrence (eg 8 in 17,424 seconds from March to April 1984).

Another method of recording the frequency of these behaviours was used for comparative purposes. An individual was watched once every 10 seconds and its behaviour at that instant recorded. This was used to obtain comparative data for differing group sizes of Choughs.

Results

3:5:4 Wing-flicking on landing

Results are summarised in table 3:5:1 parts (i)-(vii). Six categories of landings were recognised, with a total of 629 landings recorded.

Table 3:5:1 Chough Landings

(i) No other individuals on ground

N. Choughs	n. land	n. with wf.c	n.wf.c used	P. of land with wf.c	wf.c per landing	
1	79	61	86	0.77	1.41	
2	118	100	150	0.85	1.50	
3	34	21	31	0.62	1.48	
4	10	8	11	0.80	1.38	24:19:25: 0.79:1.32
5	14	11	14	0.79	1.27	
6	10	9	11	0.90	1.22	25:21:30: 0.84:1.43
7	3	2	3	0.67	1.50	
8	4	3	5	0.75	1.67	
9	3	3	5	1.00	1.67	
10+	5	4	6	0.80	1.50	
Total	280	221	322	0.79	1.46	

(ii) After disturbance

N. Choughs	n. land	n. with wf.c	n.wf.c used	P. of land with wf.c	wf.c per landing	
1	7	0	0	-	-	
2	34	1	1	0.03	1.00	
4	4	0	0	-	-	
5	15	0	0	-	-	
7	11	0	0	-	-	
Total	71	1	1	0.01	1.00	

(iii) Land on preening etc. post.

N. Choughs	n. land	n. with wf.c	n.wf.c used	P. of land with wf.c	wf.c per landing	
1	6	0	0	-	-	
2	4	0	0	-	-	
3	3	0	0	-	-	
4	4	0	0	-	-	
Total	17	0	0	-	-	

(iv) Subflights

N. Choughs	n. land	n. with wf.c	n.wf.c used	P. of land with wf.c	wf.c per landing	
1	62	4	4	0.06	1	
2	63	9	9	0.14	1	
3	4	0	0	-	-	} 23:0:0-
5	19	0	0	-	-	
6	6	0	0	-	-	} 10:0:0-
10	4	0	0	-	-	
1 joins gp.	5	0	0	-	-	
Total	163	13	13	0.079	1.00	

(v) Female food begging flight

6	0	0	-	-

(vi) Choughs join others on ground

N. Choughs on ground	n. land	n. with wf.c	n.wf.c used	P. of land with wf.c	wf.c per landing	
1	14	9	10	0.64	1.11	
2	22	12	24	0.55	2.00	
3	11	6	9	0.55	1.50	
4	6	1	1	0.17	1.00	} 22:4:4:
5	16	3	3	0.19	1.00	
6	5	1	1	0.20	1.00	} 23:7:7
7	3	0	0	-	-	
8+	15	6	6	0.40	1.00	

Choughs on ground joined by:

N. Choughs landing					
1	65	27	36	0.42	1.33
2	18	7	13	0.39	1.86
3	9	4	5	0.44	1.25
Total	92	38	54	0.41	1.42

(vii) Overall Total:

629	272	390	0.43	1.43

Overall, there was a high frequency of wing-flicking after landing from a full flight. This was not the case for subflights or flights after disturbance. Table 3:5:2 re-expresses these results into wing flicks

observed per 1000 seconds of observation.

Table 3:5:2

	time (s)	n. wing-flicks	wf. per 1000 S.
Full flight	2800	322	115.00
Sub flight	1630	13	7.98
After disturbance	780	1	1.41

The number of Choughs involved in a landing had no significant effect on the number of wing-flicks used per landing ($r > 0.20$, $n=6$) or their frequency of use ($r > 0.20$, $n=6$) as shown in Figure 3:5:1. When Choughs were landing on an area where there were already Choughs present, this did not hold. The number of Choughs landing did not affect the frequency of wing flicking (58.69 per 1000 seconds, $t=920$ seconds, $n. wf=58$, table 3:5:1, vi.), but an increased number of Choughs on the ground reduced the frequency and number of wing-flicks used as shown in figure 3:5:2. Thus increasing numbers of Choughs on the ground have a depressive effect on the frequency of wing flicking, and reduces the number of wing-flicks used to only 1 in groups of 4 or more.

The 1983 data ^{is divided} into groups for breeding season (March to June) post breeding (July to September) and Winter (November to February) in table 3:5:3.

Table 3:5:3

Period	n. landings	n. with wf	$\Sigma n. wf$	p. wf land	n. wf per land	wf per 1000 S.
Nov-Feb	8	7	15	0.88	2.14	187.50
March-June	70	53	96	0.76	1.81	137.14
July-Sept	73	59	82	0.81	1.39	112.33
Σ	151	119	193	0.79	1.62	127.82

From these figures, there is a higher frequency of wing-flicking during the winter (x^2 31.47, $P < .001$, $df=1$) and the number of wing-flicks used per landing is lower during the post breeding period than for the rest of the year (x^2 9.62, $P < .001$, $df=1$).

Table 3:5:1 (iii) and (iv) show 2 aspects of the functional role of wing-flicking on landing. Part (iii) demonstrates that an element of

FIGURE 3:5:2.

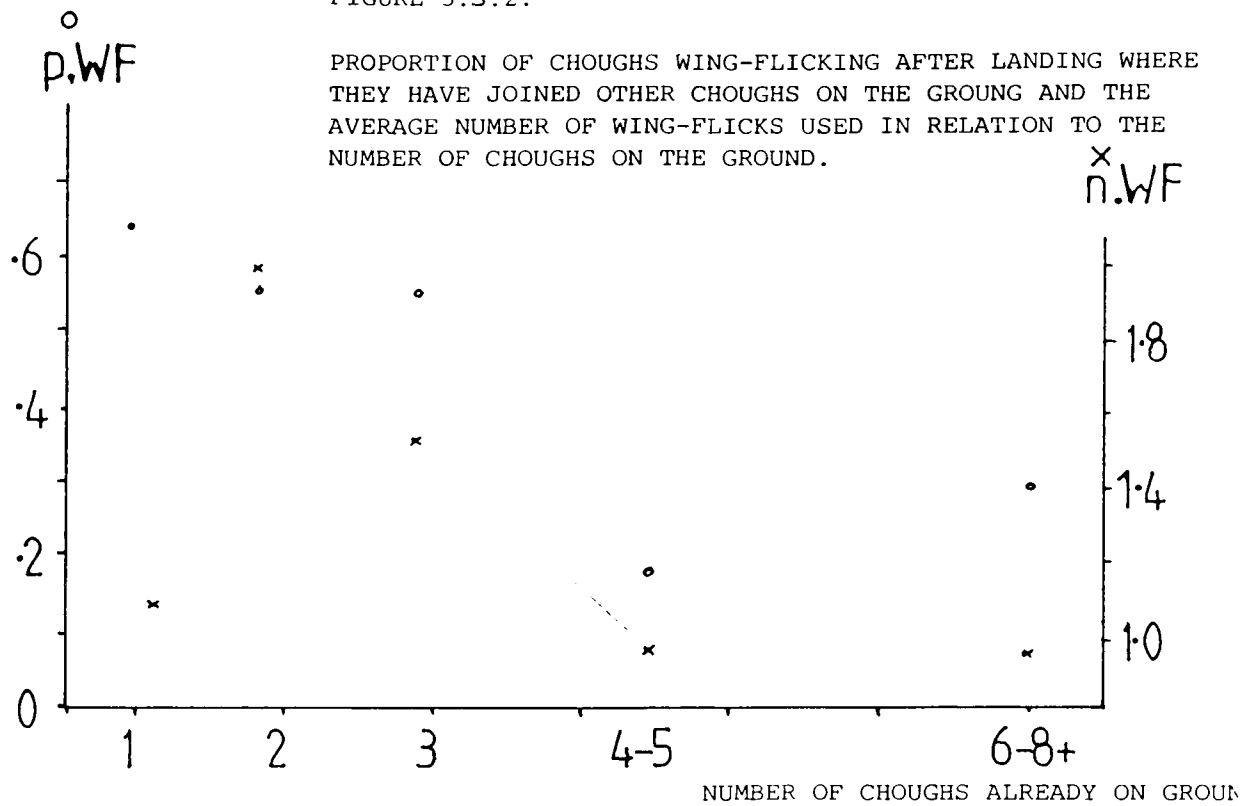
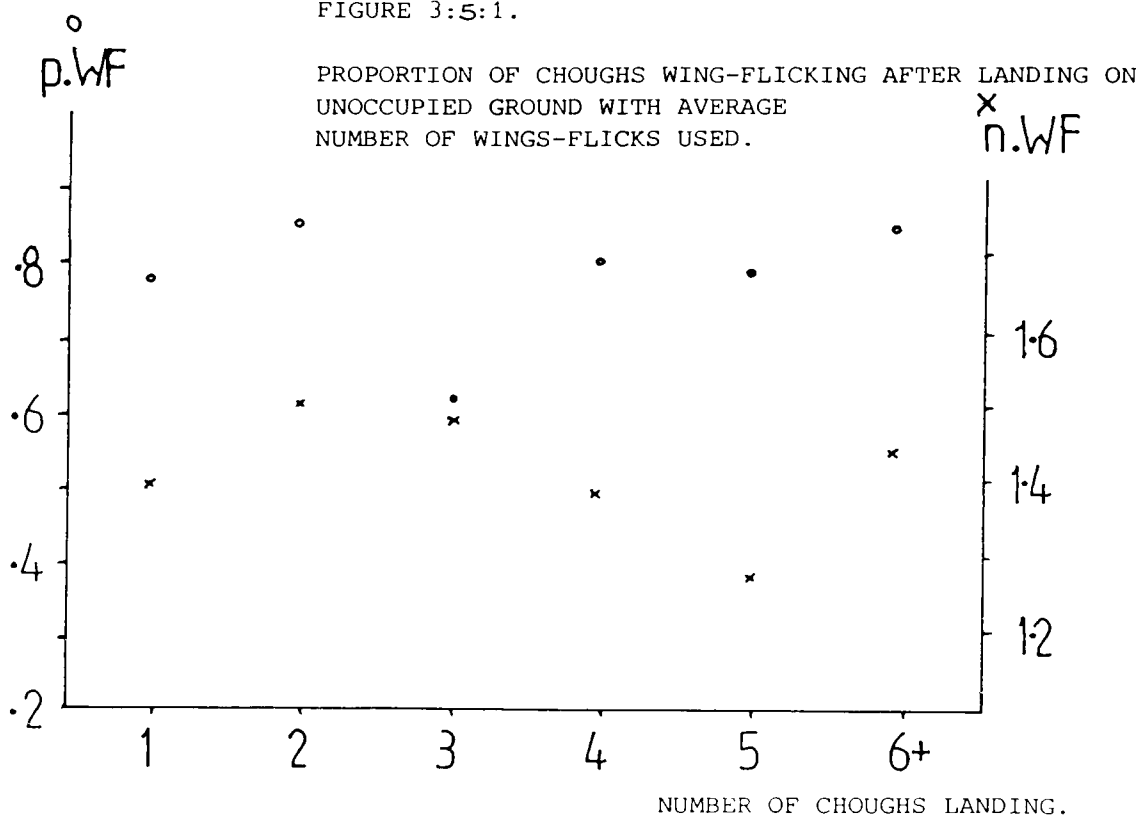


FIGURE 3:5:1.



balance is involved in wing-flick landings. When landing on awkward surfaces such as a steep cliff face or a fence pole, wing-flicks are not used ($n=12$) in order not to disturb balance. This remained the case even when adjacent individuals landing on a flat surface were wing-flicking. Part (iv) demonstrates that the nature of the flight affects the frequency of wing-flicking, as also shown in Table 3:5:2, as it is used at a low frequency after short flight. This indicates that there is a lower functional need to wing-flick after a short flight than after a full flight.

Evidence for a sexual role in wing-flicking after landing by pairs was obtained by observing the female's delaying of wing-flicks until the male had done so (table 3:5:4). There were no cases of the male waiting for the female to wing-flick where the male had landed first ($n=32$).

Table 3:5:4 Characteristics of delayed and non-delayed wing-flick landings

	n. landings	n. with wf	Σn wf	p. wf land	n. wf per land	wf per 1000 S
♀	15	15	27	1	1.80	180.0
delay ♀	15	15	23	1	1.53	183.0
wf: ♂+♀	30	30	50	1	1.67	166.7
no. ♀ ♂	11	11	16	1	1.45	145.5
delay: ♀	11	6	7	0.55	1.11	63.6
♂+♀	22	17	23	0.77	1.35	104.6

Thus while the male would not delay wing-flicking when landing first ($n=32$), 57.7% of female first landings ($n=26$) involved such a delay. The ^{were} 'no delay' landings/where the female either wing-flicked before the male landed ($n=6$) or did not wing-flick ($n=5$). Males wing-flicked more often in female first landings (χ^2 5.65, $P<0.05$, $df=1$), while there were no significant differences between the delay and no delay figures as shown by the frequency of wing-flicking (χ^2 1.35, $P>.20$, $df=1$).

The above results suggest that the presence of the male within a mated pair may act as a social or sexual releaser for the female's post landing wing-flicking, when the male wing-flicks. This may be partly responsible

for the absence of wing-flicking by females after courtship feeding flights (table 3:5:1, v). But this may be more due to the functional effect of the short distance (2-6m) of the flights and thus similar to subflight.

In all cases of landings, only the standard type of wing-flick was observed in the 10 seconds immediately after landing.

3:5:5 Wing-flicking at take off

Results are summarised in table 3:5:5. A total of 556 take-offs were observed, and were classified into 7 sections. The wing-flicks observed prior to take off were all found to be standard wing-flicks combined with the call component as defined in 2:4:6 (n=120).

In normal full flight take-off, wing-flick calls were rarely used (7%, n=151) and were not seen at all in sub-flights (n=58). As shown in figure 3:5:3, frequency of use in full flight declined with number of Choughs in the flock, and was not used in flocks of 3 or more. A corresponding decline in the number of wing-flick calls per incident was also observed (table 3:5:5, i). The overall number of wing-flick calls used per occurrence of wing-flick calling (1.1 n=10) was lower than the number of wing-flicks used per wing-flick landing (1.46, n=221).

'Scramble' take-offs (3:5:5, iii) were those incidents when 2 or more Choughs took off rapidly, within 1 second of each other, and with no prior behaviour, vigilance or wing-flick calling to indicate an increased probability of flight. No wing-flick calls were recorded in the 73 observed incidents, which were caused by sudden sounds ('Exocet' Missiles in March, 1982), tourists emerging from cover within the minimum flight of $34.95 \pm 6.34\text{m}$ (n=101, 3:4:5), and Jackdaws taking off nearby (3:4:5). A number of scramble flights occurred for no discernible reason.

A high proportion of the flights due to the presence of potentially dangerous intruders (Ravens and Peregrines) or because of interactions with

FIGURES 3:5:3-5; RELATION BETWEEN FORAGING GROUP SIZE AND THE PROPORTION OF CHOUGH TAKE OFFS PRECEDED BY WING-FLICKS AND THE AVERAGE NUMBER OF WING FLICKS USED IN THREE DIFFERENT SOCIAL CONTEXTS.

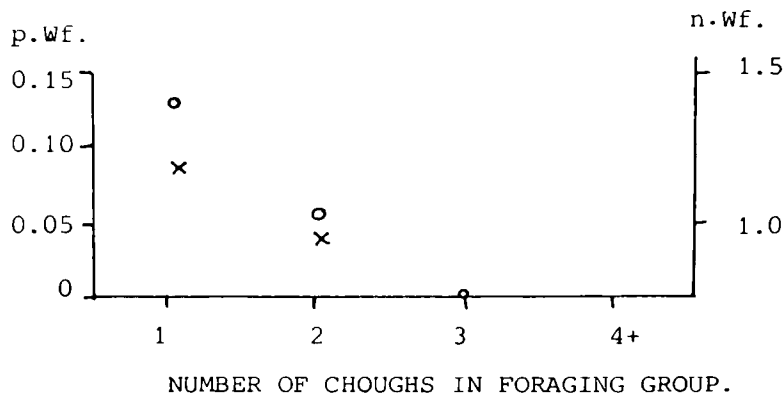


FIGURE 3:5:3.

FULL FLIGHT,
UNDISTURBED
TAKE OFF.

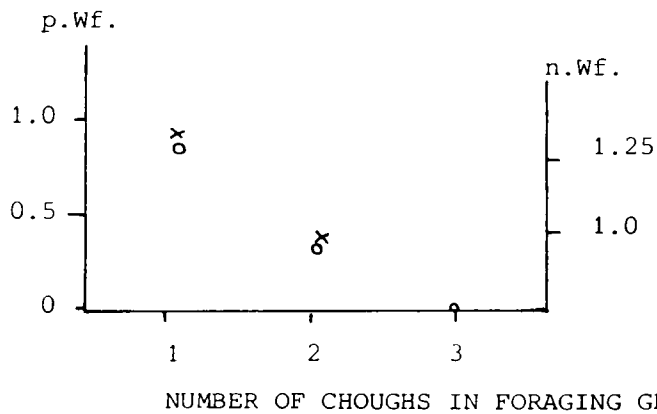


FIGURE 3:5:4.

JOIN OTHER
CHOUGHS IN
THE AIR.

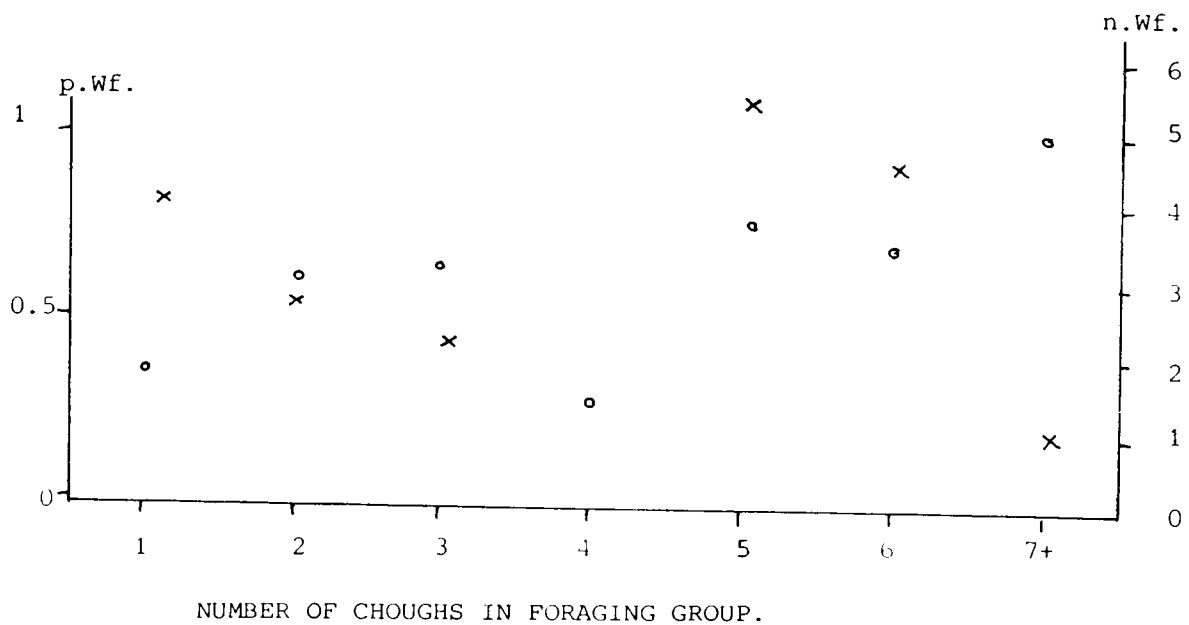


FIGURE 3:4:5.

TAKE OFF DUE TO
TOURIST DISTURBANCE.

other species (table 3:5:5, vii) were also 'scramble' flights, without prior indication of take off, and rapid spatial displacement. In the presence of Ravens, the frequency of wing-flick calling before flight at 4.62 per 1000 seconds, was comparable with the frequency before normal take offs (table 3:5:6).

Two sets of circumstances were observed under which a high frequency of wing-flick calling was recorded prior to flight. These were; before joining other Choughs in the air, and before flying from the gradual approach of tourists.

Table 3:5:5 CHOUGH TAKE-OFFS

(i) standard flight, no visible reasons for take off

N. Choughs	n. take off	n. with wf.c	n. wf.c used	P. of take off with wf.c	wf.c per take off
1	30	4	5	0.13	1.25
2	89	6	6	0.07	1.00
3	9	0	0	-	-
4	4	0	0	-	-
5	13	0	0	-	-
6	6	0	0	-	-
Total	151	10	11	0.07	1.10

(ii) join other Choughs in air

N. Choughs	n. take off	n. with wf.c	n. wf.c used	P. of take off with wf.c	wf.c per take off
1	8	7	16	0.88	2.29
2	6	2	2	0.33	1.00
Total	20	9	18	0.45	2.00

(iii) 'scramble' take off

N. Choughs	n. take off	n. with wf.c	n. wf.c used	P. of take off with wf.c	wf.c per take off
2	8	0	0	-	-
3+	29	0	0	-	-
because of jackdaws scramble:	20	0	0	-	-
because of jet plane:	16	0	0	-	-
Total	73	0	0	-	-

(iv) female begging flight (sub)

♀→♂	6	1	1	0.17	1.00

(v) subflight

N. Choughs	n. take off	n. with wf.c	n. wf.c used	P. of take off with wf.c	wf.c per take off
1	19	0	0	-	-
2	27	0	0	-	-
3	12	0	0	-	-
Total	58	0	0	-	-

(vi) interaction with other species

Species	N. Choughs	n. take off	n. with wf.c	n. wf.c used	P. of take off with wf.c	wf.c per take off
Buzzard	2	2	0	0	-	-
	4	4	0	0	-	-
C. Crow	1	4	0	0	-	-
	2	24	0	0	-	-
	3	28	0	0	-	-
Kestrel	3	7	0	0	-	-
	4	4	0	0	-	-
Peregrine	1	1	0	0	-	-
	2	4	0	0	-	-
Herring Gull	2	2	0	0	-	-
Raven	1	12	1	1	0.08	1.00
	2	17	1	1	0.06	1.00
	4	4	1	1	0.25	1.00
	4	4	0	0	-	-
	5	5	0	0	-	-
	9	9	0	0	-	-
	7	5	0	0	-	-
	3	2	0	0	-	-
	4	4	0	0	-	-
	6	4	0	0	-	-
	12	1	0	0	-	-
	14	1	0	0	-	-
Raven total:		65	3	3	0.04	1.00
Overall total:		174	3	3	0.02	1.00

(vii) Human disturbance (Standard Cover, see 3:4:5)

N. Choughs	n. incidents	n. with wf.c	P. incidents wf.c	n. incidents where n. wf.c counted	n. wf.c counted	n. wf.c per incident
1	15	5	0.33	4	16	4.00
2	15	9	0.60	9	24	2.60
3	11	7	0.64	7	15	2.14
4	14	4	0.29	0	-	-
5	4	3	0.75	3	16	5.33
6	13	9	0.69	3	14	4.67
7+	2	2	1.00	2	2	1.00
Totals:	74	39	0.53	28	87	3.11

When joining other birds in the air, 88% of solitary Choughs would wing-flick call (n=8), with 2.29 wing-flick calls per incident. Where 2 birds were on the ground, 33% would wing-flick call (n=6) and use 1 wing-flick call. Wing-flick calling was not observed in groups of 3 or more (n=6). This is shown in figure 3:5:4, and thus there is a relation between the occurrence of wing-flick calling and Chough numbers on the ground in these circumstances ($r < 0.1$, $n=3$) at a just below significant level. While the presence of Choughs in the air acts as a releaser for wing-flick calling, the presence of other Choughs on the ground inhibits it, as also seen in standard take offs.

When tourists are seen to approach foraging etc. Choughs in a gradual manner, there is an even probability of any Chough wing-flick calling before take off (53%, $n=74$, table 3:5:5, vi). * When they do so, the number of wing-flick calls is high (3.11 ± 1.73 , $n=87$). The probability of an individual wing-flick calling increased with flock size ($r < 0.05$, $n=7$) as shown in figure 3:5:5. There was no relation between the number of wing-flick calls used and flock size ($r > .20$, $n=7$). Table 3:5:6 summarises the frequency of wing-flick calls in the 10 seconds before take off (Tourist disturbance figure for number of wing-flick calls obtained by multiplying n incidents where wing-flick call seen with average n wing-flick calls per incident for those incidents where numbers of

wing-flick calls were noted).

Table 3:5:6

	time (S)	n. wing flick calls	wing-flick calls per 1000 S.
Full flight	1510	11	7.28
Subflight	730	0	0
Scramble flight	580	0	0
Join other Choughs	200	18	90.00
Tourist disturbance	740	121	163.76

These results agree with the proportions of flights being preceded by wing-flick calls, showing a low frequency for normal take off, and a higher frequency prior to joining other Choughs in the air or when disturbed gradually by tourists.

Although 1 wing-flick call was observed before a female courtship feeding flight (17%, n=1, table 3:5:5, iv) the sample size is too low to attribute any significance to this.

Since only 6 pre-flight wing-flick calls were observed in pairs before flight, no investigation into sexual roles in wing-flick calling within pairs in this context could be made.

3:5:6 Wing-flicking on the ground

This covers all observations in the period between the 10 seconds immediately after landing and the 10 seconds prior to take off.

The following deviations from the standard wing-flick component were observed (with Chapter 2 definitions number given): male pre-copulatory (2:5:9), female copulation position (2:5:10), female courtship beg (2:5:11 + 12), bill wipe, wing-flick call display (2:5:7), sub wing-flick (2:2:2), wing-flick call (2:2:11), male wing stretch (2:5:6), wing stretch (2:3:6), ruffle (2:3:7) and forms of juvenile food begging (2:6:1). Most of these behaviours occurred at too low a frequency to be observed during the timed observations, and can thus only be listed with the times observed during periods of general field observation. More common behaviours, where results

FIG 3:5:5; PREENS PER 1000 SECONDS-CONTINUAL OBSERVATION.

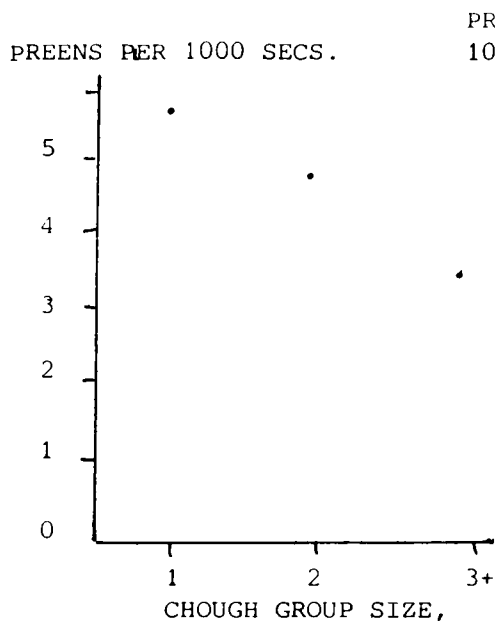
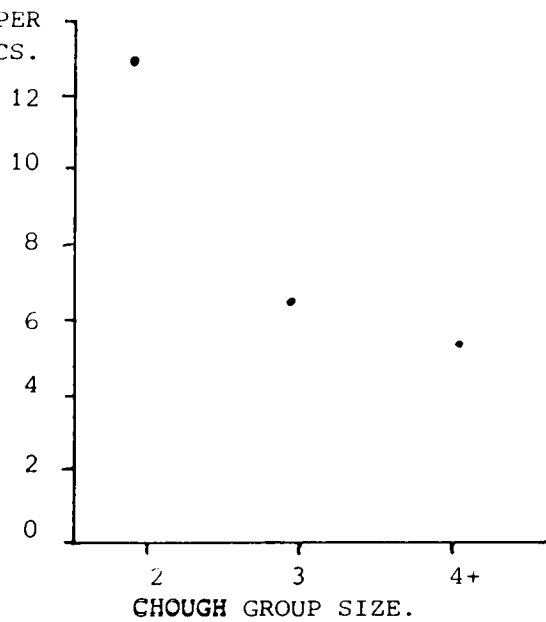


FIG 3:5:6; PREENS PER 1000 SECONDS- SPOT OBSERVATIONS.



Wf. PREENS / 1000 SECS.

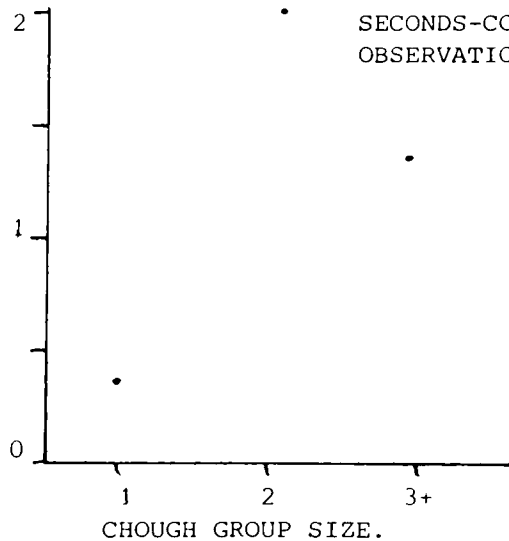


FIG 3:5:7; PREENS ENDING WITH WING-FLICKS PER 1000 SECONDS-CONTINUAL OBSERVATION.

FIG 3:5:8; PREENS ENDING WITH WING-FLICKS PER 1000 SECONDS-SPOT OBSERVATION.

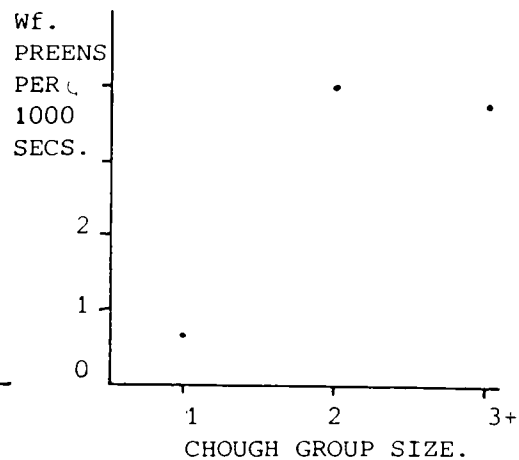
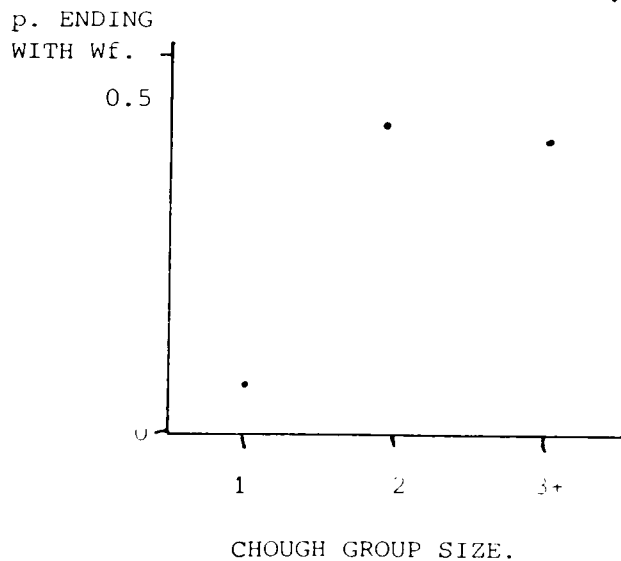


FIG 3:5:9; p. OF PREENS ENDING WITH A WING-FLICK.



FIGURES 3:5:5-9; RELATION BETWEEN CHOUGH FORAGING GROUP SIZE AND A NUMBER OF ASPECTS OF FORAGING BEHAVIOUR.

allow, are included with the frequency-based results.

Table 3:5:7 summarises the results of the continual observations of behaviours from taped recordings. Table 3:5:8 summarises the results from 36100 seconds of observations taking one observation every 10 seconds and thus recording 3610 seconds of actual data. In the context of this work,^{continual observation} was not successful since the frequency of wing-flicking and its derived behaviours is substantially higher than that of the continual observations. This is due to observer bias in this system distorting results in favour of (a) unusual (b) short-duration and (c) conspicuous behaviour, thus strongly biased in favour of wing-flick behaviours. With respect to such behaviours as foraging and looking. Thus the data from table 3:5:7 was used for all work on frequencies.

The results from table 3:5:7 show that solitary and groups of 2 Choughs have a higher frequency of wing-flicking and subwing flicking (χ^2 448.88, $P < .001$, $df=1$) and a higher rate of these behaviours and wing-flick calling (χ^2 493.87, $P < .001$, $df=1$) than larger groups. The sample size for wing-flick calling was too small for any comparisons on their own.

The presence of tourists which were close enough to be responsible for causing increased vigilance but not flight, and other corvid species, where 1-2 Choughs were foraging, caused changes in wing-flicking frequencies as shown in table 3:5:9.

Table 3:5:9

	n. wing-flicks (all types)*	time (S)	wf. per 1000 S.
Jackdaw	4	786	5.09
Carrion Crow	8	840	7.59
Tourists	155	2124	72.97

*wing-flick, sub wing-flick, wing-flick call.

Sample sizes for Jackdaws and Carrion Crows are too low for analysis except when combined, they show a higher wing-flicking frequency than

found for single and groups of 2 Choughs ($x^2=10.7$ P .01, df=1). Wing-flick frequency in the presence of tourists was substantially higher (x^2 1026.07, P .001, df=1).

Table 3:5:7 Continual behaviour observation, per bird.
Lower sets, rates per 1000 seconds.

N. Choughs	Wing flick	Sub wing flick	Wing flick call	Wing stretch	Wing ruffle	t (S)	Σ
1	16	4	1	7	4	6100.5	32
	2.62	0.66	0.16	1.25	0.66		3.25
2	44	52	17	29	31	25807.0	173
	1.70	2.01	0.66	1.12	1.20		6.70
3-10	7	3	2	3	0	15709.5	15
	0.45	0.19	0.13	0.19	0		0.95
Σ	67	59	20	39	35	47617.0	210
	1.41	1.24	0.42	0.82	0.74		4.41

Table 3:5:8 Components based on 10 second instantaneous observation

N. Choughs	Wing flick	Wing flick call	Wing stretch	Wing ruffle	t (S)	Wing flick & wing flick call per 1000 S.
2	7	3	4	2	460	22.4
3	7	0	0	6	862	8.1
4-5	0	0	0	0	294	0
6-10	2	0	1	2	1140	1.8
11-15	3	0	0	1	694	4.3
16-17	1	0	0	1	155	6.5
Σ	20	3	5	12	3610	6.4

Actual observation time 36100 seconds

Individual component frequencies for Choughs in the presence of tourists are shown in table 3:5:10.

Table 3:5:10

time (S)	Wing flick and sub wing flick	Wing flick call	Wing stretch	Preen
2124	28	127	4	8
per 1000 S	13.17	59.79	1.88	3.76

The results so far shown all exclude wing-flicks that occur in the 10 seconds after preening sessions. The frequency of these wing-flicks can be expressed in two ways: (a) as wing-flicks per 1000 seconds for the 10 second period after preening, and (b) as wing-flicks per 1000 seconds of

overall timed observations. Table 3:5:11 summarises data from the 229 preening sessions observed, of which 74 ended with a wing-flick. In 1 case, 2 wing-flicks were used after a preen.

Table 3:5:11

n. preens: n. preens observed
preens per 1000 seconds
n. preens + wf: n. preens + wf observed
n. per 1000 seconds overall observation
n. per 1000 seconds in 10 second period
after preen

N. Choughs	t (S)	N. Preen	N. preens and wing flick	percentage preens with wf.
1	8224.5	48 5.84	3 0.36 6.25	6.3
2	25870.0	127 4.92	51 1.98 40.16	40.2
3-10	15709.5	55 3.50	21 1.34 38.18	38.2
Σ	49741.0	229 4.60	74 1.49 32.31	33.5

Average number of wing-flicks used per post-preen wing-flick session was 1.01 ± 0.11 ($n=74$). Although, as also discussed in Appendix 1, the frequency of preens declines with increased group size but not significantly ($r > .20$, $n=3$), as shown in figures 3:5:5 and 3:5:6, the frequency of wing-flicks per preen for individual birds was lower than for any group sizes (χ^2 228.85, $P < .001$, $\text{df.}=2$) after preening, 1.49 per 1000 seconds ($n=74$) represents a substantial proportion of the wing-flicks recorded by Choughs on the ground. Thus, as table 3:5:12 shows, combining them into the totals found for wing-flicks, sub wing-flicks, and wing-flick calls give a total figure for all main forms of wing-flicking observed during ground observation sessions under standard vigilance conditions.

Table 3:5:12 Wing-flick Frequencies Per 1000 Seconds

n. Choughs	Combined wf., wf.c + s.wf from table 3:5:7	Post preen wf.	Total Wing-flicks
1	3.44 (n=21)	0.36 (n=3)	3.80 (n=24)
2	4.37 (n=113)	1.95 (n=51)	6.45 (n=164)
3-10	0.77 (n=12)	1.34 (n=21)	2.01 (n=33)
Total	3.07 (n=146)	1.49 (n=74)	4.56 (n=220)

The overall frequency of 4.56 wing flicks per 1000 seconds does not significantly differ from the frequency of wing-flick calling prior to full and sub-flights (5.26 per 1000 seconds, $n.wf. = 11$, $t = 2240$ seconds) and full, sub and scramble flights (3.90 per 1000 seconds, $n.wf. = 11$, $t = 2920$ seconds), and thus demonstrate that wing-flicks before flight can not be used to predict these three forms of flight ($\chi^2 0.46$, $P > .20$, $df=1$).

Table 3:5:13 summarises seasonal variations in overall wing-flick frequencies, using data obtained in 1983.

Table 3:5:13

Period	Combined n. wf.	Time (s)	Wing-flicks per 1000 s.
Nov-Feb	2	1530	1.37
March-June	65	9289.5	6.99
July-Sept	86	19716.0	4.36
Total	153	30435.5	5.03

The overall rate is similar to that obtained in table 3:5:12 for 1982-1984. The frequency of wing-flicking in the breeding season is higher than for other times of the year ($\chi^2 26.04$, $P < .001$, $df=1$), while during the Winter it is at its lowest ($\chi^2 22.55$, $P < .001$, $df=1$).

Wing-flicking and its derivatives were, as mentioned above, used in behaviours other than maintenance, vigilance and foraging. They were also used in food begging (3:3:4 and 3:3:5), sexual behaviour (Appendix 1) and antagonistic behaviour (Appendix 2). These sections examine the role of wing-flicking behaviours in their respective social contexts. Thus, this section will examine them purely from the viewpoint of being behaviours with

wing-flicks or their derivatives involved.

In female courtship feeding, all begging attempts involved wing flick derivatives: the simple beg where wings are extended and quivered, and the full, horizontal beg, the wings are fully extended and quivered. Results are shown in full in 3:4:4. During the period in which courtship feeding was observed, table 3:5:14 outlines the relative success of each method, in terms of numbers, and frequency per 1000 seconds of observation.

Table 3:5:14

	+ve beg	not fed	t(seconds)
Simple beg	0	14	
	0.0	0.57	
Full beg	14	10	
	0.57	0.40	
Σ	14	24	
	0.57	0.97	24776

Thus the type using the most escalated form of wing-flick derived behaviour obtained food from the male while the form without^{any} wing-flick derived behaviour did not.

In juvenile begging for food from adults, Section 3:3:5 found a total of eight begging methods used in 286 attempts, of which 33 were successful. Four methods involved wing-flick derived behaviours, which are shown in table 3:5:15.

Table 3:5:15

	+ve beg	not fed	p. successful
Wing flick, adjacent	0	10	0.0
Wing flick, face	1	0	1.0
Rapid call, wing quiver	0	1	0.0
Wing flutter/quiver	3	4	0.43
Σ	4	15	0.21

Because of the relation between time from fledging and begging success and techniques used (as shown in 3:3:5) the sample sizes here are too small for comparative work. But the success rate of 0.21 is higher than the overall rate of 0.12. Paradoxically, these methods were used less frequently than the other methods, and when comparing frequency of use, on

the five days when one or more of these methods were used, their frequency of use was below what would have been expected (χ^2 22.41, $P < .001$, $df=4$). In two cases, during March 1984 prior to copulation (3-7 days before) a high rate of wing-flick calling was observed in the 'B' pair before extended allopreening sessions. The wing-flick calling component came after the look component during foraging, where normally the bird resumed foraging. In this case, the sequence ran; look/wing-flick call/forage. The frequency of wing-flick calling inclusions in the standard forage/look/forage sequence was examined by comparing the frequency of wing-flick calling up to 10 minutes before and 10 minutes after allopreening whenever the birds were visible. Also, frequency examination was carried out on the pair when they were in a foraging group, and on their own on the same day as the main set of recordings were done (table 3:5:16). The results show that the rate of wing-flick calling outside the two 10 minute periods (1.18 per 1000 seconds, $n=6$) was higher than that normally found in pairs (0.66 per 1000 seconds, $n=17$), but the scale of difference in comparison to the pre-allopreen figures is not significant since during the breeding season, all wing-flick rates were found to be higher than for the rest of the year (see table 3:5:13). The wing-flick call rate for both sexes in the 10 minute period after allopreening (1.25 per 1000 seconds, $n=2$) was the same as outside these 2 periods. The proportion of forage/look/forage sequences with a wing-flick call component was roughly similar (0.0098, $n=6$ and 0.0171, $n=2$ respectively) but sample sizes were too small for further comparison.

Thus only in the 10 minute period prior to allopreening was the wing-flick call rate higher than at other times (χ^2 2717.3, $P < 0.001$, $df=2$) and at all times it was more frequent in the female of the 'B' pair than the male (χ^2 7.94, $P < 0.01$, $df=1$).

There was one other case of wing-flick calling being used in sexual behaviour before a meeting of a pair (Pair 'B'); where the female wing-flick

Table 3:5:16

Wing-flick Call Frequencies and Allopreening in
Pair B. Frequency per 1000 seconds in brackets.

		Time (s)	Forage- look- forage	Forage-look -wing-flick call-forage	P. wing-flick call
Pre- Allopreen	♂	595	43 (72.27)	20 (33.61)	.318
	♀	580	32 (55.17)	57 (98.28)	.640
Post- Allopreen	♂	1050	132 (125.71)	0 (0)	.00
	♀	545	73 (133.94)	2 (3.70)	0.027
Pair on Own	♂	1138	79 (69.42)	2 (1.76)	0.025
	♀	1138	95 (88.48)	2 (1.76)	0.021
Pair in Group	♂	1569	104 (66.28)	0 (0)	0
	♀	1217	67 (55.05)	2 (1.64)	0.029
Total	♂	4352	358 (82.26)	22 (5.05)	0.058
	♀	3480	267 (76.72)	63 (18.10)	0.191
	♂+♀	7832	625 (79.80)	85 (10.85)	0.119

called for approximately 25 seconds before flying to the male and unsuccessfully attempting a simple-type courtship feeding beg.

During March to April from 1982-4, the following wing-flick derived sexual postures were observed:

Female wing stretch and flutter (n=3),

Male wing stretch (n=5),

Male pre-copulatory (n=4),

Male Bill-wipe, wing-flick, call display (n=6),

Female Bill-wipe, call display, wings held out (n=1, during a male Bill-wipe, wing-flick call display),

These displays are fully examined in Appendix 1 and defined in Chapter 2:4.

Wing-flicking in antagonistic encounters was observed in 2 contexts: for displacing an individual, usually from a feeding site (appendix 2) and in the exclusion of an 'excess' begging juvenile (3:3:5).

Two types of wing-flicking were used in the exclusion of unwanted begging juveniles; a conventional wing-flick while facing the juvenile, and to face the juvenile, crouching horizontally and fluttering the wings which are held half way out. If successful, the juvenile would leave, if not, the juvenile would wing-flick back. Twenty encounters were observed, and are shown in table 3:5:17.

Table 3:5:17 Excess Juvenile Exclusion by Adult Wing-flicking

n. Wing-flicks used	Outcome		Σ
	Juvenile leaves	Juvenile retaliates	
1	5	2	7
2	2	0	2
3	2	0	2
Both use 2 wing flicks	1	0	1
Wing flutter	8	0	8
Σ	18	2	20

The two cases/ in which the juvenile wing-flicked back each involved 1 wing-flick, and were immediately followed by a successful adult retaliation

at an escalated level. In one case a wing flutter, and in the other, 3 wing-flicks.

There were three cases where an adult displaced another adult from its feeding site by facing it and wing-flicking ($\Sigma 6$ wing-flicks, mean 2, $n=3$).

In another case, the bird present at the feeding site wing-flicked back, and both wing-flicked at each other. The 'resident' wing-flicked 3 times, and the intruder 4 times. The intruder displaced the resident. One juvenile attacked a second juvenile by facing it and wing-flicking. The second juvenile retaliated by pecking at it, and wing-flicking back. This fight lasted for 6-7 seconds until they were separated by an adult. Two other antagonistic encounters involved wing flicks, or derived behaviours. The mated 'B' pair were foraging in April 1984 when an outside male landed by the 'B' female and wing-flicked at her. The 'B' male chased him away. A juvenile was preening near an adult male ('L'), and on rapidly stretching out a wing was attacked by the 'L' male.

Appeasement (2:2:8) behaviour in juveniles normally involved crouching with feathers ruffled. If the adult ignored this, the juvenile would spread its wings $\frac{1}{2}$ rd. the way out and flutter them. This was successful in all cases ($n=3$).

3:5:7 Bill-Wiping Behaviours

A total of 50 bill-wiping sessions were observed, involving 118 groups of bill-wipes which consisted of 335 strokes of the bill. In addition, there were 4 cases of bill-wiping related to vigilance or antagonistic behaviour, 13 involving nest sanitation, and a number of derived forms in sexual displays, mutual bill-wiping and allopreening between adults and juveniles, and mated pairs. Table 3:5:18 shows the frequency of bill-wiping sessions per 1000 seconds of timed observation, and table 3:5:19 shows the number of wiping groups and strokes used per bill-wiping session.

In comparison with wing-flicking on the ground, the frequency for bill-wiping on the ground at 0.85 sessions per 1000 seconds is low. The difference between the full observation results, and the spot observation results makes the 10 seconds spot observation technique

Table 3:5:18 Frequency of Bill-Wiping Sessions

	t(s)	n. Bw.	Bw. per 1000 sec.
On ground	33926.0	29	0.85
Solitary land	760	6	7.89}
2 land	1180	1	0.85}
3+ land	830	4	4.82}
			3.97
Solitary land on post	60	5	83.33}
2+ land on post	110	5	45.45}
			58.82
Solitary take-off	300	0	0 }
2 take-off	890	1	1.12 }
3+ take-off	320	0	0 }
			0.66
Post disturbance land	710	0	0
Subflight land	1630	0	0
Scramble take-off	730	0	0
Subflight take-off	580	0	0

On ground (10 sec spot analysis)

	t(s)	n	
	3031	10	3.30
	actual t 30310 seconds		
Seasonal variation	t(s)	n. Bw.	Bw. per 1000 sec.
Nov-Feb	2380	3	1.26
Mar-June	21419	14	0.654
July-Sept	12507	8	0.639
Flight from nest -ve faecal sac	130	2	15.38
Flight from nest +ve faecal sac	140	13	92.86
Flight from nest	270	15	55.56

Table 3:5:19 Number of Bill-wipe groups and number of
Bill-wipe strokes used in various observed
social contexts

	n.Bw	n.Bw	n.Bw	<u>n.Bw Groups</u>	<u>n.Bw Strokes</u>	<u>n.Bw Strokes</u>
	Groups	Strokes		n.Bw	n.Bw Groups	n.Bw
Sol.	9	21	70	2.33 ± 1.66	3.33 ± 1.11	7.78 ± 6.85
Pair	8	14	40	1.75 ± 0.71	2.86 ± 0.68	5 ± 2.33
Juvenile	2	2	6	1 ± 0.0	3 ± 0.0	3 ± 0.0
4	4	4	16	1 ± 0.0	4 ± 1.15	4 ± 0.0
5	1	1	2	1 ± 0.0	1 ± 0.0	2 ± 0.0
10	1	4	9	4 ± 0.0	2.25 ± 0.96	9 ± 0.0
Sol. on Post	4	7	25	1.75 ± 0.5	3.57 ± 0.79	6.25 ± 1.71
Sol. on Shrub	1	2	5	2 ± 0.0	2.5 ± 0.71	5 ± 0.0
Pair on Post	3	15	20	5 ± 4.0	3.33 ± 1.11	16.67 ± 12.53
3 on Post	2	9	26	4.5 ± 4.95	2.89 ± 0.78	13 ± 14.14
Sol. Land	6	27	51	4.5 ± 5.36	1.89 ± 0.78	8.5 ± 11.89
Pair Land	1	3	8	3 ± 0.0	2.67 ± 0.58	8 ± 0.0
7 Land	4	5	18	1.25 ± 0.5	3.6 ± 1.34	4.5 ± 1.73
Land	11	35	76	3.18 ± 4.12	2.17 ± 0.95	6.91 ± 8.90
On Ground	29	46	143	1.84 ± 1.25	3.11 ± 1.06	5.72 ± 4.28
On Post/Shrub	10	33	106	3.30 ± 2.98	3.21 ± 0.92	10.60 ± 9.99
Total	50	118	335	2.48 ± 2.59	2.85 ± 1.02	7.06 ± 7.35

unsatisfactory for this work, for the same reasons as discussed in the previous section.

Only one session of bill-wiping was observed prior to take-off, and thus comparisons are difficult, but the overall rate of 0.355 bill wipe sessions per 1000 seconds in the 10 seconds prior to take-off ($n=1$, $t=2820$ seconds) is lower than the ground rate. The overall rate for bill-wiping after landing, as with wing-flicking (3:5:4) was higher than that on the ground or prior to take-off, although the frequency was lower for paired landings than for other group sizes or solitary individuals (χ^2 11.18, $P<.001$, $df=1$). Landings after subflights or disturbances did not involve bill-wipes ($n=234$).

On landing on a fence post, the bill-wipe frequency (especially with single birds) was higher than for any other set of circumstances. The overall landing frequency of 58.52 sessions per 1000 seconds ($t=170$ secs,

n=10) indicates that fence post landings are used primarily for bill-wiping (or bill-wiping displays) due to the good cleaning qualities of wood, and are thus selected in favour of other sites (X^2 1000.4, $P < 0.001$, $df=1$).

Breeding season and post breeding season bill-wipe frequencies were similar, there may have been a higher frequency of bill-wipe sessions in the Winter, but the sample size was too small for a comparison.

The functional value of posts as bill-wiping sites is indicated by the higher number of strokes used per bill-wiping session on posts and shrubs compared to on the ground (X^2 70.31, $P < .001$, $df=1$). This was attained by a combination of higher numbers of bill-wiping groups per session and more strokes per bill-wiping group (table 3:5:19). Individually, the number of bill-wiping groups used in post sessions was only higher than the on ground number, and the number of strokes used per bill-wiping group only higher than for after landing.

Out of 27 observed exits from the breeding cave at 'L' after the young had hatched in 1982, 14 involved the removal of faecal sacs. The faecal sacs (appendix 1) were dropped in flight and afterwards, the Chough would bill-wipe at a higher frequency than for normal landings. The distance between the cave entrance and the cliff edges used would in fact fall within the 'subflight' category. Thus, there was a higher frequency of bill wiping than in either types of flight. In table 3:5:20, the frequency of bill wiping and faecal sac removal is examined by use of a 2 x 2 contingency table.

Table 3:5:20 Bill-wiping frequency and faecal sac removal

	Leaves with faecal sac	Leaves without faecal sac	Σ
Bill-wipe	11	1	12
No bill-wipe	2	13	15
Σ	13	14	27

$$X^2 = 16.38, P < .001, df=1$$

The frequency of bill wipes after landing after faecal sac disposal is comparable to solitary landings on a fence post. Table 3:5:20 demonstrates that there is a higher probability of the Chough bill-wiping after faecal sac removal than after other exits. In both the post landings and faecal sac removal landings, the primary purpose of landing is to immediately bill wipe.

In sexual behaviour, display bill-wiping (where the bill does not touch any surface) was observed on nine occasions in 3 differing contexts.

Male bill-wipe, wing-flick call display (qv 2:5:7).

n. bill wipes	n. times seen	
2	2	
3	1	average n. bill wipes
4	1	per display 3.67 ± 1.63
5	1	
6+	1	

Female bill wipe, call display (2:5:8) n=2, n. bill wipes used; 3,4, mean 3.5.

Female bill wipe, call display, wings held (2:5:8) n=1, n. bill wipes used; 3.

Mutual bill-wiping was observed between adults and juveniles after successful food begging (n=2) and in the mated pair after successful courtship feeding (n=2), and once when the male 'L' had removed a Raven from the feeding area. In this case, the pair allopreened for 6 seconds before 10 seconds of mutual bill-wiping. Afterwards, the male bill-wiped on the ground in 2 groups of 4 and 3 strokes before flying. Mutual bill-wiping was observed on 5 occasions during a total of 18 allopreening sessions between mated pairs. In 4 other instances, mutual bill-wiping preceded allopreening. Allopreening in these cases was started by the pair preening each other's necks.

Three cases of vigilance-related bill-wiping were observed:

Potential threat	Bill-wipe behaviour
Raven, 100m away	(2,2) (2) (1,2,3,1,2,4) w. flick (2,2) fly
Herring Gull, swooping	(3,3,2,3)
Tourist 35-40m away	(4,3,4,4,3)

In the latter two, after the potential threat had moved on, foraging and standard vigilance behaviour (3:4:5) were resumed.

3:5:8 Sequential Analysis of Wing-Flicking and Bill-Wiping

Because an inadequate number of wing-flick calls were obtained during the sequential data-gathering sessions (a total of 7) runs including them were not utilised. A total of 1700 behaviours were recorded in 18,900 seconds of sequential observation. Results and analysis are shown in table 3:5:21.

Table 3:5:21

		Observed frequency Expected frequency X ² and Significance (** P<0.01, *** P<0.001)					
Following Act:	First Act: Forage	Look	Wing Flick	Ruffle	Preen	Bill Wipe	Σ
Forage	-	618 494.48 24.7	19 58.9 83.75***	10 22.0 14.42	13 75.7 302.59***	6 14.9 13.7	666
Look	593 498.8 3.14	-	59 74.6 4.10	16 27.9 8.79	88 95.9 0.71	13 18.9 2.63	767
Wing- flick	44 38.4 0.72	36 43.7 1.64	-	3 1.9 0.37	8 6.7 0.21	1 1.3 0.10	92
Ruffle	19 13.3 1.71	6 15.3 13.9	1 1.8 0.64	-	6 2.3 2.26	1 0.5 0.27	33
Preen	11 48.32 126.6***	85 55.0 10.57	12 6.55 2.48	4 2.45 0.60	-	2 1.8 0.03	114
Bill- wipe	4 11.2 12.96	19 12.8 2.05	0 1.52 0	1 0.6 0.48	4 1.9 1.05	-	28
Σ	671	764	91	34	117	23	1700

Since sequences using the same acts are omitted, expected frequencies are calculated using the formulae devised by Lemon and Chatfield (1971) and as discussed by Lewis and Gower (1980), only differences significant to $P < 0.01$ or greater are regarded as ^{significant} because of the degree of error inherent in this technique. Because of the relatively low frequency of wing-flicking and maintenance behaviours in comparison to foraging and vigilance, the latter 2 occurred at too high a frequency with respect to the former behaviours for many significant divergences from expected frequencies to occur. Those that do indicate that wing-flicks have a lower-than-expected probability of being followed by foraging and that there is a low frequency of interactions between preening and foraging.

3:5:9 Some Functional Models of Wing Flicking Behaviours

3:5:9(a) Wing-flicking at take-off and landing

The two flow diagrams that follow aim to illustrate the social and functional factors that motivate wing-flicking at take-off and landing. They are based on data obtained in Section 4:4, 4:5, 4:7 and 4:8 and Section 5:4 and 5:5. Their scope, as discussed in those sections, is limited to wing-flick behaviours in the 10 seconds after landing and the 10 seconds prior to take-off.

Flick I, in figure 3:5:10, shows the landing system. Flick II, in figure 3:5:11, shows the take-off system.

Key to symbols used in Flick I and Flick II.

SIM : Social Inhibition Mechanism. The presence of one or more Choughs acting as an inhibiting factor on wing-flicking in the individual bird. The inhibition effect increases with the number of birds present.

SRM : Social Releaser Mechanism. The presence of one or more Choughs acting as a stimulus to the wing-flicking of an individual bird. Effect increases with the number of birds present.

f : Functional reason for the absence of wing-flicking. For example, in landing on a fence post, in order to maintain balance and in scramble flight where the need to leave rapidly overrides the wing-flick calling vigilance system (see VIGMOD, 3:4:7).

O : No wing flicks, or at low frequency.

wf/wf.c: High frequency of wing-flicks or wing-flick calls.

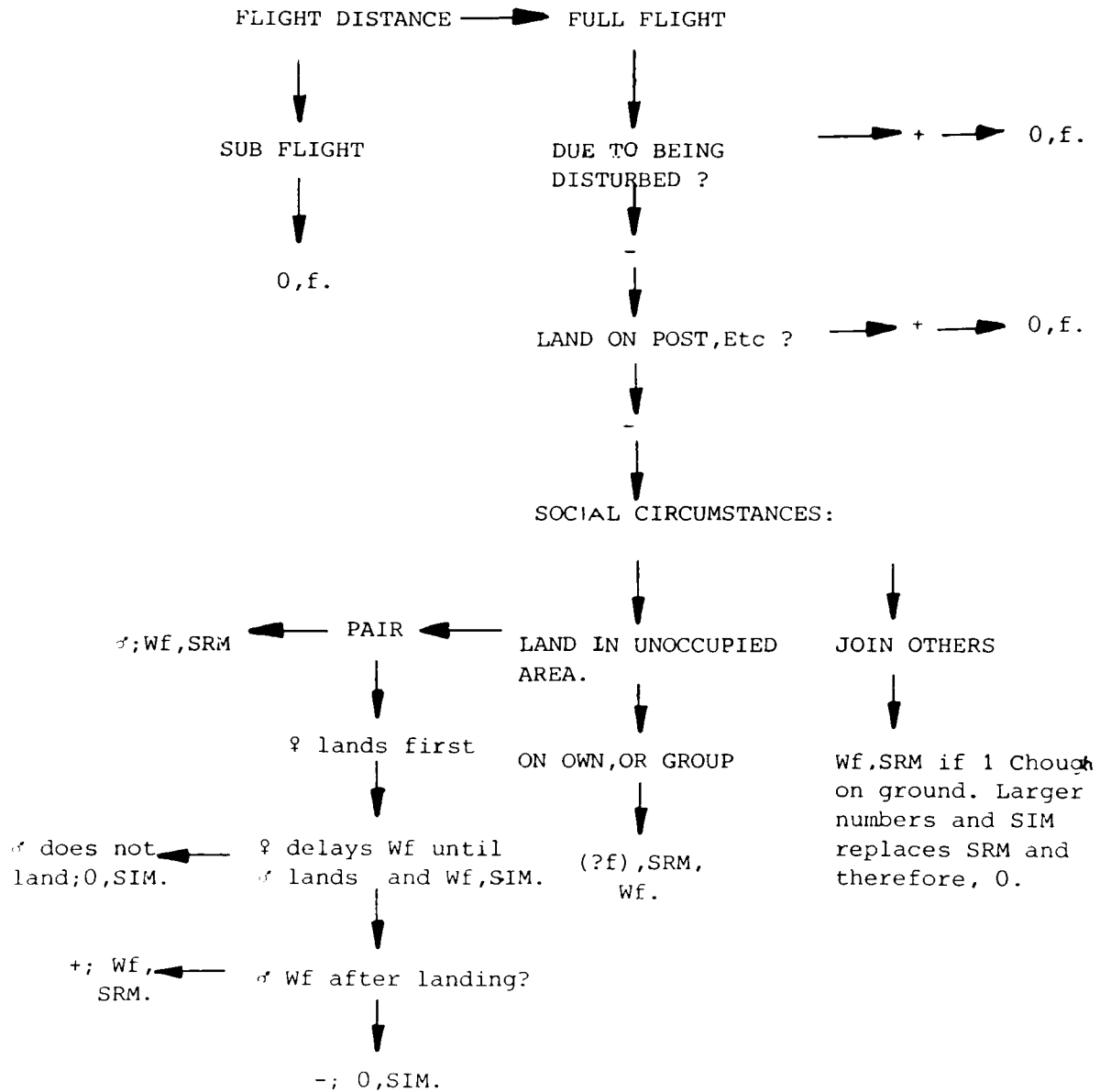
Reasoning behind arrangements of Flick I, landing.

FIGURE 3:5:10.

FLICK-I.

A FLOW DIAGRAM OUTLINING THE MOTIVATING CIRCUMSTANCES REGULATING THE USE OF WING-FLICKING BY THE CHOUGH IN THE 10 SECOND PERIOD AFTER LANDING.

KEY: 0= Low probability of wing-flicking.
Wf= High probability of wing-flicking.
f= Functional inhibition of wing-flicking.
SIM= Social inhibition mechanism(see text).
SRM= Social releaser mechanism (see text).



(i) After short flight, wings have not been used enough to need to wing-flick, a functional inhibition. Possible social inhibition since presence of individual in foraging area already known and flight does not involve the leaving of this area.

(ii) Landing after disturbance, no wing-flick due to functional inhibition. Need to leave previous area overrides all standard behaviours before during and immediately after flight, and possibly to conceal presence from predator.

(iii) Landing on steep rock, fence post etc., no wing-flick due to functional inhibition in order to maintain balance.

(iv) If land on ground on own or in group of 3 or more, wing-flick. Functional basis after flight. No quantifiable evidence of social releases related to flock size. If mated pair landing and ♀ lands first, ♀ delays wing-flicking until ♂ lands and wing-flicks. ♀ thus inhibited from until the ♂ lands and wing-flicks acts as a releaser mechanism. If ♂ does not wing-flick, ♀ will not, and therefore continues to be inhibited from wing-flicking.

(v) If Choughs present in area where incoming Chough(s) land, frequency of wing-flicking on landing decreases with number of birds on ground irrespective of size of incoming group; social inhibition.

Reasoning behind arrangement of Flick II, take-off.

(i) Before subflight, no wing-flick call due to short distance of flight; Functional inhibition.

(ii) Before full flight, low frequency of wing-flick calling if solitary, falling to none in groups of 3 or more; social inhibition. Where Choughs are present also in the air and are calling to those on the ground, high frequency of wing-flick calling by solitary bird on the ground, falling to low frequency if 2 on ground and none if 3 or more. Presence of calling Choughs in air acts as social releaser, other Choughs on the ground act as

social inhibitors, and thus a payoff between the effect of the two. Where Choughs in the air are not calling, no wing-flick calling, thus the calling is the releaser element.

(iii) With the exception of 3 cases involving the presence of Ravens, all flights due to other bird species and sudden noises (Exocet testing and Jet 'planes for example), no wing-flicking for functional reasons. This is because of need to leave rapidly and not to reveal intention of taking-off to any potential predator.

(iv) Where tourists are seen to gradually approach, low frequency of wing-flick calling in solitary birds rising as group size increases. Number of wing-flick calls used not related to group size. Functional reason due to greater probability of tourists being seen in full vigilance zone (3:4:6). Possible social releaser in groups of indicating need to be ready to fly.

(v) Where Jackdaws are foraging near Choughs, and tourists approach the vigilance zone and Jackdaws leave before tourists enter full vigilance zone; functional inhibition of normal vigilance procedures. Response is the same as in (iii), with a high probability of a scramble take-off.

(vi) As with the presence of tourists being more effectively detected by larger number of Choughs, the amount of cover obscuring the approach of tourists affects the chance of the tourists being seen inside the full vigilance zone. The higher the degree of cover, the less probability of the oncoming tourists have of being seen and thus the frequency of wing-flick calling prior to take-off decreases.

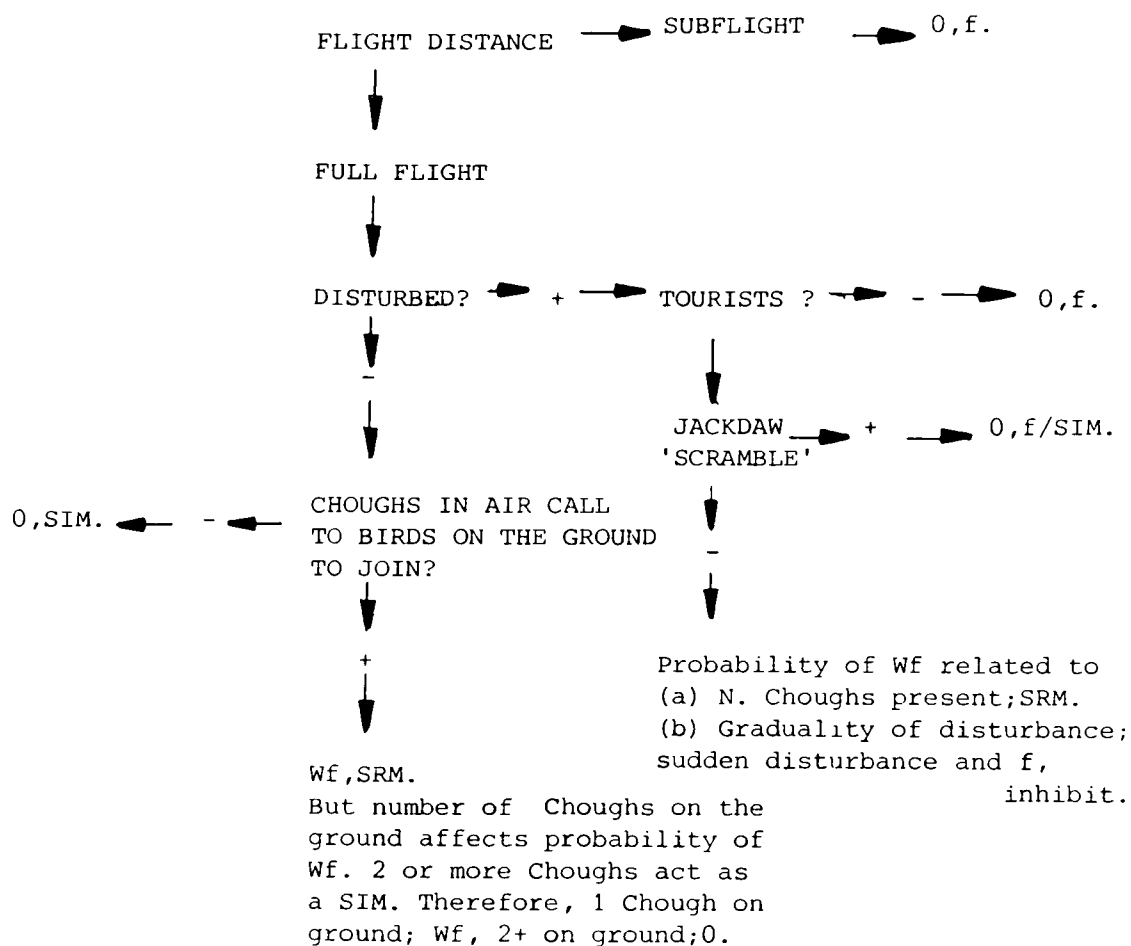
3:5:10 Discussion

This discussion will examine the roles of ritualised and unritualised forms of wing-flicking and bill-wiping in Choughs and other birds. In particular it will look at the circumstances in which the forms of these

FIGURE 3:5:11.

FLICK II.

A FLOW DIAGRAM OUTLINING THE MOTIVATING CIRCUMSTANCES REGULATING THE USE OF WING- FLICKING IN THE 10 SECOND PERIOD PRIOR TO TAKE OFF.



KEY: 0= Low probability of wing-flicking.
Wf= High probability of wing-flicking.
f= Functional inhibition of wing-flicking.
SIM= Social inhibition of wing-flicking.
SRM= Social releasing of wing-flicking.

behaviours are used, how they are combined and what messages they may convey.

Wing-flicking is commonly seen in birds as a normal flight intention movement. Daanje (1950) notes wing-flicking being used for such purposes most commonly in Blackbirds as well as a number of other passerines including Blue and Great Tits, Chiffchaffs and Willow Warblers. He also cites one instance where a Teal wing-flicked before flight. Moynihan (1963) observed wing-flicking in Green-backed Sparrows and Davis (1975) concluded that in Wood Pigeons it was used in flights not caused by disturbance. Andrew (1956) believed that wing-flicking was used by birds to make their imminence of flight conspicuous. Similarly, the Kittiwake has a pre departure flight call when it is undisturbed (Daniels, *et al.* 1984). Wing-flicking after landing has been noted in Corn Buntings (Andrew 1956) Vermilion Flycatchers (Smith 1967), Eastern Phoebe (Smith 1969) and the Stonechat (Greig-Smith 1982). Greig-Smith also observed post-landing tail raising in Spotted Flycatchers, Bullfinches, Blackbirds and Magpies.

However, this study concluded that while wing-flicking is commonly used by Choughs after landing, it is rarely used before take-off except in certain vigilance and social contexts. This is similar to Greig-Smith's (1982) observations on Stonechats. The relation between wing-flicking and disturbance is the opposite to that noted by Davis (1975) in Wood Pigeons, and mentioned above. Assuming that the earlier observations were not in error, there would appear to be substantial interspecific variation in the role of wing-flicking in landing and take-off. It may be that some observers disturbed their birds, causing them to wing-flick before take-off, but that was not the case with Davis (1975).

Andrew (1961) in a review of courtship and reproductive fighting behaviour, does not cite any examples using bill-wiping or wing-flicking. In the subsequent literature there are a number of such cases. Ellis (1966)

observed antagonistic wing-flicking in Starlings and a unique derived form, a slowed-down version called the wing flail, used in mate attraction. Feare (1984) notes the male Starling wing-flicking when copulating, probably to aid balance. Roell (1978) observed antagonistic wing-flicking in Jackdaws, and Baeyens in a detailed study of Magpie behaviours recorded 5 horizontal and 2 vertical forms in antagonistic encounters. They may also play a sexual role as noted by Coombs (1978). Tail and wing-flicks have been seen in the Jay by Goodwin (1952, 1956) and in Rook antagonistic encounters by Rooks (Coombs 1978). The Carrion Crow appears to be the only other species to use wing/tail flicks for vigilance (Charles 1972) although this is inhibited as with the Chough in cases of high alarm. Using visual means of indicating alarm like wing-flicks differs from the alarm call where the signaller is often invisible to any potential receivers both predators and potential prey.

Bill-wiping as a form of bill cleaning is widely recorded, and its frequency of usage is related to bill dirtying (eg. in Chaffinches, Rowell 1961). In Chaffinches and Zebra Finches, the display bill wipe does not touch any substrate and has a shorter amplitude and fewer strokes than the normal bill-wipe (Hinde 1953, Morris 1954, 1957). Feare (1984) regarded a Starling's bill-wiping as a signal to other individuals that it had ceased foraging. The display bill-wipe has been recorded in a range of contexts: male courtship by birds of paradise (Tinbergen 1940), Zebra Finches (Morris 1954) and Chaffinches (Hinde 1953); in Chaffinch winter fighting (Hinde 1953); as a submissive behaviour by Starlings (Feare 1984) and possibly in Magpie antagonistic display (Baeyens 1979).

The data in this section showed that Choughs use less strokes in the display form than when bill-wiping after landing, on a post or when foraging, in agreement with Morris (1954) above. But the wide variation in the number of strokes in displays indicates that there is no 'typical

intensity' in these displays compared to Morris (1957) for Zebra Finches. Mutual bill-wiping and allopreening are regarded as having a primarily sexual role in birds (eg Feare 1984 for Starlings).

The role of calls in wing-flick behaviour does not appear to have been studied previously, so comparisons cannot be made. It is of interest to note that no observations of bill wiping and wing-flicking combined have been recorded.

Previous work on wing-flicking and bill-wiping in Choughs has been of a qualitative nature. Holyoak (1972) incorrectly regarded the wing-flick call as a flight intention movement. Wing-flicking by the copulating male, possibly for balance was observed by Warnes (1983a). Allopreening, mutual bill-wiping and maintenance bill-wiping have been widely recorded (Whittaker 1947, Williamson 1959, Cowdy 1967, Holyoak 1972, Bullock 1980 and Warnes 1983a), antagonistic wing-flicks and flutters by Williamson (1959), Holyoak (1972) and Bullock (1980) and submissive wing-flicking by Goodwin (1976). Bullock (1980) observed vigilance wing-flick calling, wing-flicking after landing and wing-flicks during foraging. Holyoak (1972) notes antagonistic bill-wiping and sexually assertive wing-flick calls.

This section has thus provided the first quantitatively based account of Chough bill-wiping and wing-flicking and the examination of their range of roles and forms in any species, especially with reference to social contexts.

In Chough wing-flicking and bill-wiping, the unritualised form is used for maintenance. Otherwise, it is used in combination or in a ritualised form. As shown in Figure 3:5:12, the standard components are only seen for maintenance in bill wiping and for that and antagonistic behaviour in wing-flicking. In all other social contexts, ritualised forms of the behaviours are used. Figures 3:5:13 and 3:5:14 for bill-wiping and wing-flicking respectively, divide the behaviours into 4 functional

FIGURE 3:5:16

DENDROGRAM SHOWING THE POSTUALTED RELATIONSHIP BETWEEN THE VARIOUS RITUALISED FORMS OF WING-FLICK AND BILL-WIPE DERIVED BEHAVIOURS, THEIR COMBINATIONS AND RELATIVE DEGREES OF RITUALISATION.

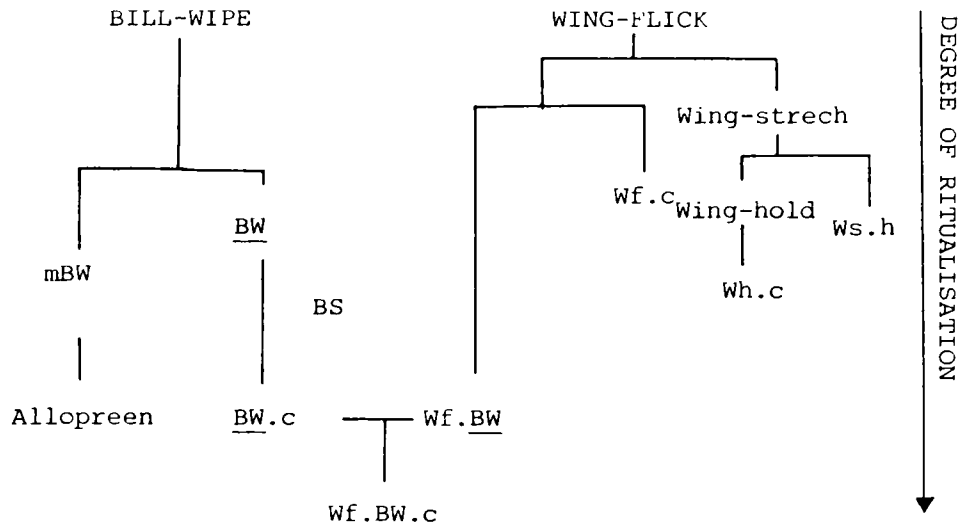
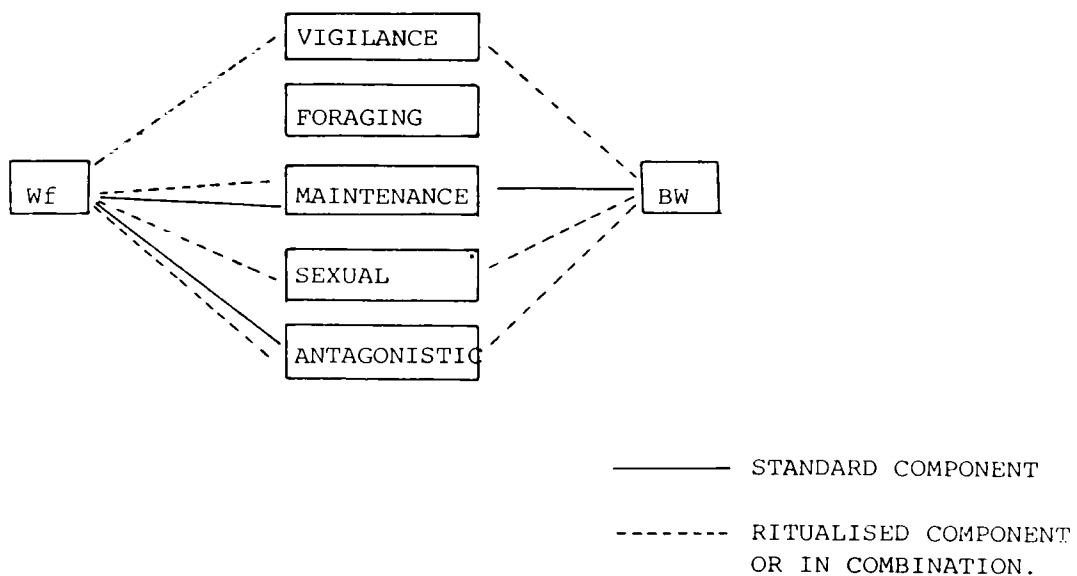


FIGURE 3:5:12

DIAGRAM SHOWING THE USE OF WING-FLICKING AND BILL-WIPING IN VARIOUS SOCIAL CONTEXTS IN EITHER THEIR STANDARD FORM OF IN COMBINATION WITH OTHER BEHAVIOURS AND IN RITUALISED FORMS.



FIGURES 3:5:13-14.

A CLASSIFICATION OF BILL-WIPE AND WING-FLICK DERIVED BEHAVIOURS
IN RELATION TO FUNCTIONAL CONTEXT AND THEIR DEGREE OF
RITUALISATION WITH RESPECT TO THE MAINTENANCE BEHAVIOUR FORMS.

FIGURE 3:5:13.

BILL-WIPE DERIVED BEHAVIOURS.

Functional context:	Degree of ritualisation: →
MAINTENANCE	BW
SEXUAL+MAINTENANCE	mBW A
DISPLAY+MAINTENANCE	BW(after landing)
SEXUAL DISPLAY	<u>BW</u> <u>BW.c</u> Wf. <u>BW.c</u>
	BS

FIGURE 3:5:14

WING-FLICK DERIVED BEHAVIOURS.

Functional context:	Degree of ritualisation: →
MAINTENANCE	Wf s.Wf Ws
SEXUAL+MAINTENANCE	Wf.c
DISPLAY+MAINTENANCE	Wf Wf.c
SEXUAL DISPLAY	Wh W.Sh Wh.c Wf. <u>BW.c</u>
	Ws.c W.sh.c

categories of use: maintenance; display with maintenance secondary; sexual display with maintenance secondary and sexual display. In each case, the relative degree of ritualisation of each behaviour is shown by distance from the centre of the diagram. The purely sexual displays are shown as having the greatest degree of ritualisation followed by sexual display with maintenance elements. The role of mutual bill-wiping and allopreening in maintenance is uncertain. In the former, the maintenance element is at most, secondary while Harrison (1966) argues that allopreening is a form of displaced aggressive behaviour since as in the case of the Chough its use is confined to the breeding season. Thus the birds have to do without it for the rest of the year. At those times, Choughs substitute foot preening for allopreening (see Chapter 2:3:2); although it may not be as effective as the latter, it suffices.

The case of a unritualised bill-wipe behaviour being combined with wing-flick calling during a period of extreme vigilance by a pair appears to be displaced behaviour rather than ritualisation. There was no regular order between the three elements as compared to the ritualised bill-wipe, wing-flick, call display using the display form of the bill-wipe.

The maintenance behaviours and their ritualised forms were re-expressed in a dendrogram whereby each unit of behavioural difference as defined in Chapter 2:9 was linked by a single line. All the observed behaviours were linked in this manner alongside their postulated degree of ritualisation from the maintenance forms as shown in Figure 3:5:16. The relations between components shown are made on the assumption that the physical appearance of a component can be used as a guide to its relation to other components. For example, the wing-flick bears the closest resemblance to the wing-stretch since it involves a form of drawn-out movement of the wings in a single motion before the wings return to their folded-in position. Wing held and wing shudder resemble the wing-stretch/^{rather} than the wing-flick and by the degree

of stereotyping of their movements and the sexual displays they are used in, they can be assumed to be ritual derivations from the wing-stretch component. This diagram therefore simply aims to show how components can be related to each other using ritualisation as a classifying criteria.

To examine interactions between the bill-wiping and wing-flicking components, a diagram was made showing the various bill-wipe and wing-flick derived elements and where they were combined (figure 3:5:15). It can be seen from this, that all interactions between the two behaviours use the standard wing-flick and the display wipe form. The standard form of bill-wiping, with the exception of a displacement activity mentioned above, is not combined with other behaviours since it is simply a maintenance behaviour. Likewise, allopreening is a self-contained sexual display. There may be functional reasons preventing the combination of bill-wiping and the various wings-outstretched behaviours, especially regarding movement and balance. Thus the interaction between the two behaviours occurs within specific limits, all directed towards sexual and probably pre-copulatory behaviour.

From the observed contexts of use, responses to them and the conclusions illustrated in Flixmod 1 and Flixmod II, each behaviour was given a postulated semantic meaning. In other words, what does a wing-flick in a given social context mean or appear to mean to other Choughs? In order to achieve this, two restrictive assumptions were needed; (a) giving a signal a meaning in writing requires a degree of anthropomorphic interpretation by the observer and (b) this purely semantic approach is naive in the sense that it fails to take into account the potentially manipulative role of animal signalling as discussed in the introduction, so that each signal is taken to be intended to transmit a 'truth' to be interpreted by the receiver to their presumed mutual benefit. Figure 3:5:17 groups together the signals and their various 'meanings' using the single

WING-FLICK AND DERIVED BEHAVIOURS:

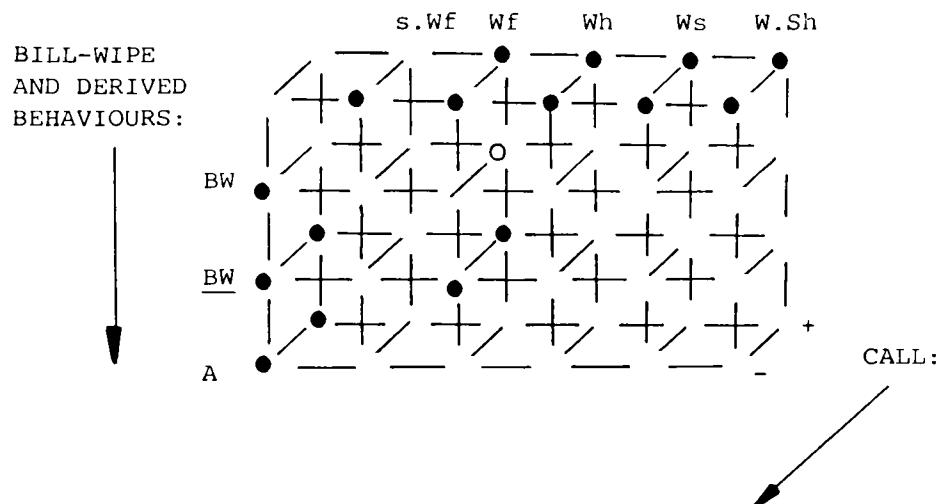


FIGURE 3:5:15.

SINGLE-LINK CLUSTER DIAGRAM SHOWING WHICH VARIANTS OF WING-FLICKING AND BILL-WIPING INTERACT WITH EACH OTHER IN SOCIAL BEHAVIOURS, AND WHETHER IN THE PRESENCE OR ABSENCE OF THE CALLING COMPONENT.

KEY:

- = Verified observation.
- = Uncertain observation, only once seen.

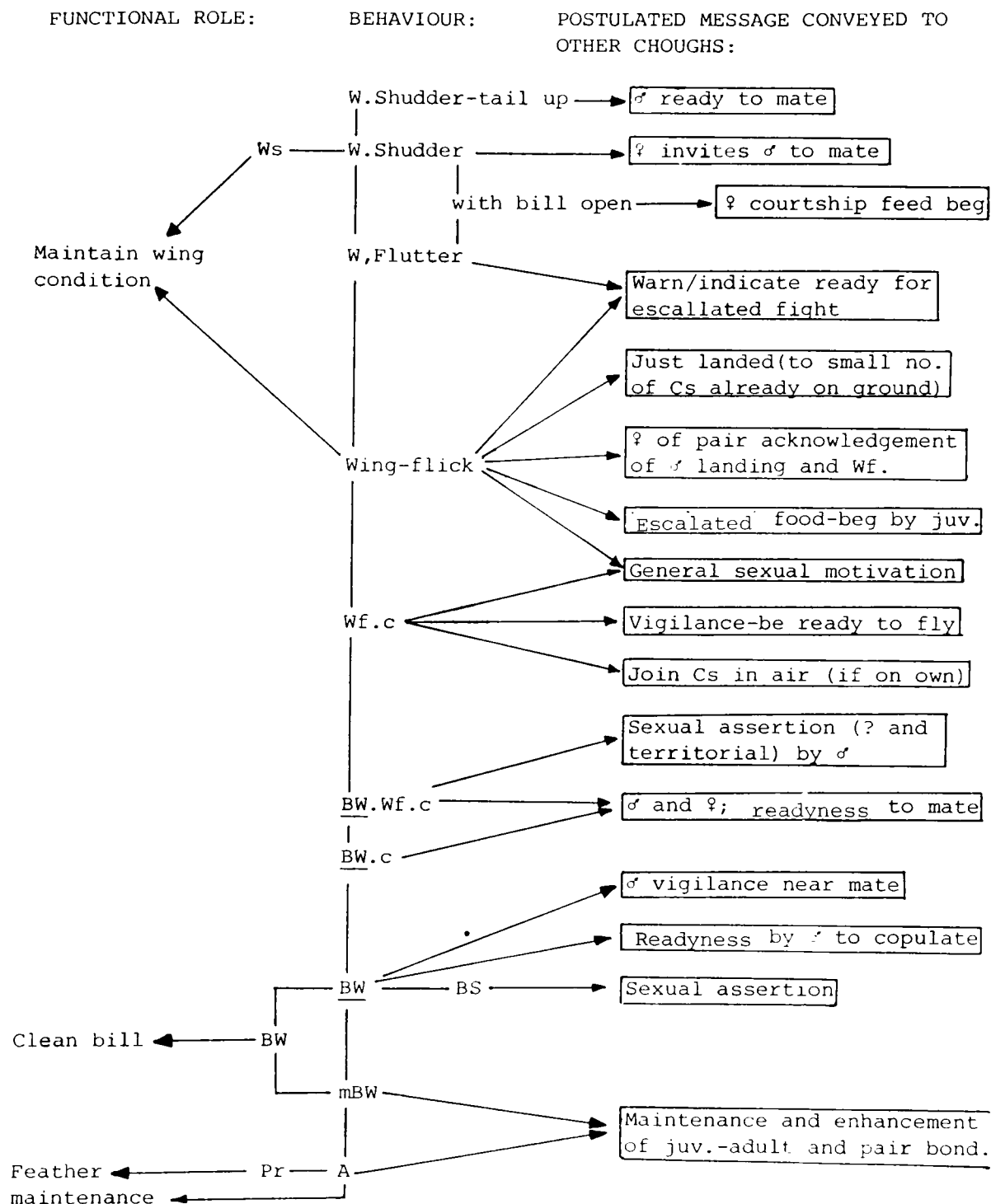
s.Wf= Sub Wing-flick
Wf= Wing-flick
Wh=Wing held
Ws=Wing stretch
W,Sh=Wing shudder.

BW=Bill-wipe
BW=Display Bill-wipe
A=Allopreen.

--No call
+=Call.

FIGURE 3:5:17.

WING-FLICK AND BILL-WIPE DERIVED BEHAVIOURS; A DIAGRAM SHOWING FUNCTIONS AND POSTULATED MESSAGES FOR A NUMBER OF BEHAVIOURS, LINKING THEM ACCORDING TO THE RESEMBLANCE BETWEEN EACH BEHAVIOUR.



link technique described in Chapter 2:9 for linking behaviours. The maintenance roles of the unritualised behaviours are also given. This diagram attempts, within the limited field of wing-flick and bill-wipe derived behaviours to present elements of the Chough's social 'vocabulary' of signals.

Flick 1 and Flick II in section 3:5:9 presented evidence for the social and sexual inhibition and stimulation of the transmission of wing-flick behaviours before take-off and after landing. This indicates that not only a behaviour transmits messages according to social context, but also that the contexts can affect their transmission. The two models had a very restricted descriptive scope, simply ascribing for the presence or absence of wing-flicking during two 10 second periods. The sheer range of social contexts that may affect wing-flicking and bill-wiping outside these periods means that further descriptive models would also have to have a narrow scope, with the ultimate aim of some form of integration.

This section has demonstrated that a specific enquiry into aspects of an animal's behaviour components can be rewarding in that it can obtain a better understanding of the role and functioning of these components, the conditions of their usage and an insight into aspects of a birds communication system which can show how messages relate to the degree of ritualisation of their behaviour component signals. Work on the entire behavioural repertoire of a bird based upon a broad spectrum of component specific investigations could provide rewarding insights into the 'vocabulary' of birds and the role of avian semantics.

3:6 GENERAL DISCUSSION ON BEHAVIOUR SYSTEMS

Because of the Chough's scarcity and its protected status, the work on Chough behaviour systems in this Chapter has been of a non-manipulative, distant observational nature. Thus examinations of the organisation of

behaviour were based on adapting prior experimental research (e.g. Carlestead 1983a, 1983b for vigilance), using restrictive assumptions, supporting the findings on a qualitative basis and limiting the models to a descriptive (and therefore non-predictive) role. The models and flow diagrams intend to show how the various observed units of behaviour interact with each other in relation to internal and external inputs.

As pointed out in Chapters 4 and 6, there is little probability of substantial increases in the Chough's population without the necessary changes in habitats and thus remaining too scarce for any experimental form of behaviour research. Some of the ideas put forward in this Chapter could be adapted, tested and taken further by applying them to more common species.

The Chough was well suited to vigilance behaviour research. The clear distinction between the look and the foraging components and the range of responses to disturbances coupled with a relatively large number of incidents produced a useful body of data. The role of hunger and day time were not examined. This could be undertaken through detailed observations on the relation between prey encounter rates, time and vigilance.

The food begging data was more constrained by a lack of data on the internal states of the individuals; hunger will play a role in a begging birds motivation with regards to intensity, frequency and duration of begging while hunger and prey encounter rate will affect the response of its potential provider. Exact recording of prey intake in field conditions poses problems at 50 metres but the value of such data is a sufficient incentive. Data on hormonal motivation in the field cannot be obtained and one has to assume^{that} they are similar to those^{from} laboratory studies discussed in Barnard (1983).

Observations on the variants of wing-flicking and bill-wiping behaviour and their postulated meanings are by their nature speculative since they depend on what behaviours occurred during the study as opposed to a

continual examination of one or a group of birds. Such a study was carried out on juvenile Jackdaws by Daniels & Easton (1985) in ^{which} the possible meanings of all vocalisations from 0-100+ days after hatching were examined. Vocalisations in the Chough were not studied, since the author considered his partial deafness could lend an unacceptable degree of uncertainty to the results. While the range of variants observed was probably close to the Chough's entire repertoire, responses were only partially studied. Film analysis would be needed for interpreting exact sequential organisation of responses to each behaviour and for obtaining an insight into which components of these behaviours convey their intended messages.

Observations on other aspects of behaviour were placed in appendices 1 and 2 in order not to disrupt the development of ideas in the 3 sections. They are of value in complementing studies on social and reproductive behaviour, especially for providing quantitative data. They are also provided as a database for the forthcoming section in the Birds of the Western Palearctic. Before Bullock (1980), Warnes (1983a) and this study, the section would have been rather thin.

It was noted in 3:4:9 that there may be explanations for the temporal variation in mate response to female food begging. Thus further work would be required in order to examine the use and success of full begging postures by females prior to copulation in order to ascertain whether copulation date or begging technique are the primary determinants of male food begging response.

Taking into account the inherent limitations on manipulation and experimentation, the Chough was well suited to observational study. The open habitat allowed for continual work on behaviours of a highly visual nature. This chapter has demonstrated that substantial qualitative insights into the functional organisation of behaviour and their albeit anthropomorphised meanings can be obtained with such techniques. The

results show/^{that}there is scope for further research into aspects of Chough
behaviour and with suitable alternative species, for a more rigorous mode of
applying these techniques.

CHAPTER 4
NOTES ON FEEDING

CONTENTS

- 4:1:1 Introduction
- 4:1:2 Aim
- 4:1:3 Methods
- 4:2 Chough Feeding
- 4:3 Corvid and Starling Feeding
- 4:4 Distribution of Raptors
- 4:5 Discussion

'nor is the flesh good to eat, for it feeds much on fish and carrion; it is counted little better than a kite, for it is of ravenous quality,'

Daniel Defoe, A Tour through the Whole Island of Great Britain. 1769.

CHAPTER 4

NOTES ON FEEDING

4:1:1 Introduction

Unlike the other areas of Chough biology examined in this study, most aspects of Chough feeding have been intensely ^{by others} investigated. This is because the overriding need in early Chough research was to understand their feeding and habitat requirements in order to implement proposals for their conservation at a time (1978 onwards) when the only population data published (Rolfe 1966, Sharrock 1976) suggested that the British population was in a worse state than the 1982 survey revealed. This recent research is illustrated by the fact that since 1980, 14 papers have been published that refer to Chough feeding and their conservation and management needs.

The general conclusion of this work has been that the most important habitats are short grass, coastal heath and maritime thrift and grass areas. Tipulid larvae were found to be a major component of the Chough's diet with ants being of importance in late summer. It was also found that the competition from other birds did not occur at any detrimental level.

4:1:2 Aims

This section aims to provide comparative feeding data in order to substantiate the findings of the previous work. Differences in habitat due to management will be emphasised in order to allow the combined feeding data to be as widely embracing as possible. Furthermore, reasons underlying the habitat preferences observed will be examined by looking at appropriate aspect of Chough feeding data.

4:1:3 Methods

The 13 habitat categories devised by Bullock (1980) and also used by Roberts (1983) were simplified into 6 categories to concentrate on the role of grazing and exposure in the choice of feeding sites by Choughs and their potential competitors. Table 4:1:1 outlines the defining criteria and extent of each of these habitats. Since the habitat categories used by Bullock and Roberts were not quite the same, they are presented separately in the appropriate column with Bullock's categories being put first

Table 4:1:1 Simplified habitat categories used in this chapter.

Habitat	Symbols Used by Bullock/Roberts	Extent in HA	% of area	Comments
Heath	$H^6, H^{10}, H^r / H^{gu}, H^{gb}, H^m.$	16.25	24.1	All heathland etc. areas with 20% or more of surface covered by gorse, heather or bracken.
Long Grass	$H^h, / P^w$	26.00	38.5	Grass over 5cm, Sporadically Grazed.
Short Grass	$H^h, F^e / P^g, H^g$	13.50	20.0	Grass 1-5cm high, grazed.
Rock Dominant	M^s, M^r	6.25	9.2	50% of surface rock, bare soil on cliff and coast.
'Sheep Bare'		4.75	7.0	Areas of short grass and bare soil in rough grass area.
Thrift	$M^f, M^h / M^g$	0.75	1.1	Coastal areas where more than 20% of surface covered by thrift
Not Included	$H^o, H^6 / F^{gc}, P^p, P^h, M^r, M^s$	-	-	-
TOTAL	-	67.5	99.9	-

The strongly differing emphasis in this classification, being biased towards grazing regime reflects the conclusions of Bullock (1980) and other workers discussed in chapter 6: Section 6 who concluded that sheep grazing plays an important role in Chough feeding site preferences.

A map was drawn to show the extent of the feeding study area (figure 4:1:1) and a route drawn so that all parts of the study area could be seen during one circuit of the area. This formed the basis of the feeding census

FIGURE 4:1:1

EXTENT OF FEEDING STUDY AREA AND
ROUTE TAKEN FOR FEEDING CENSUS.

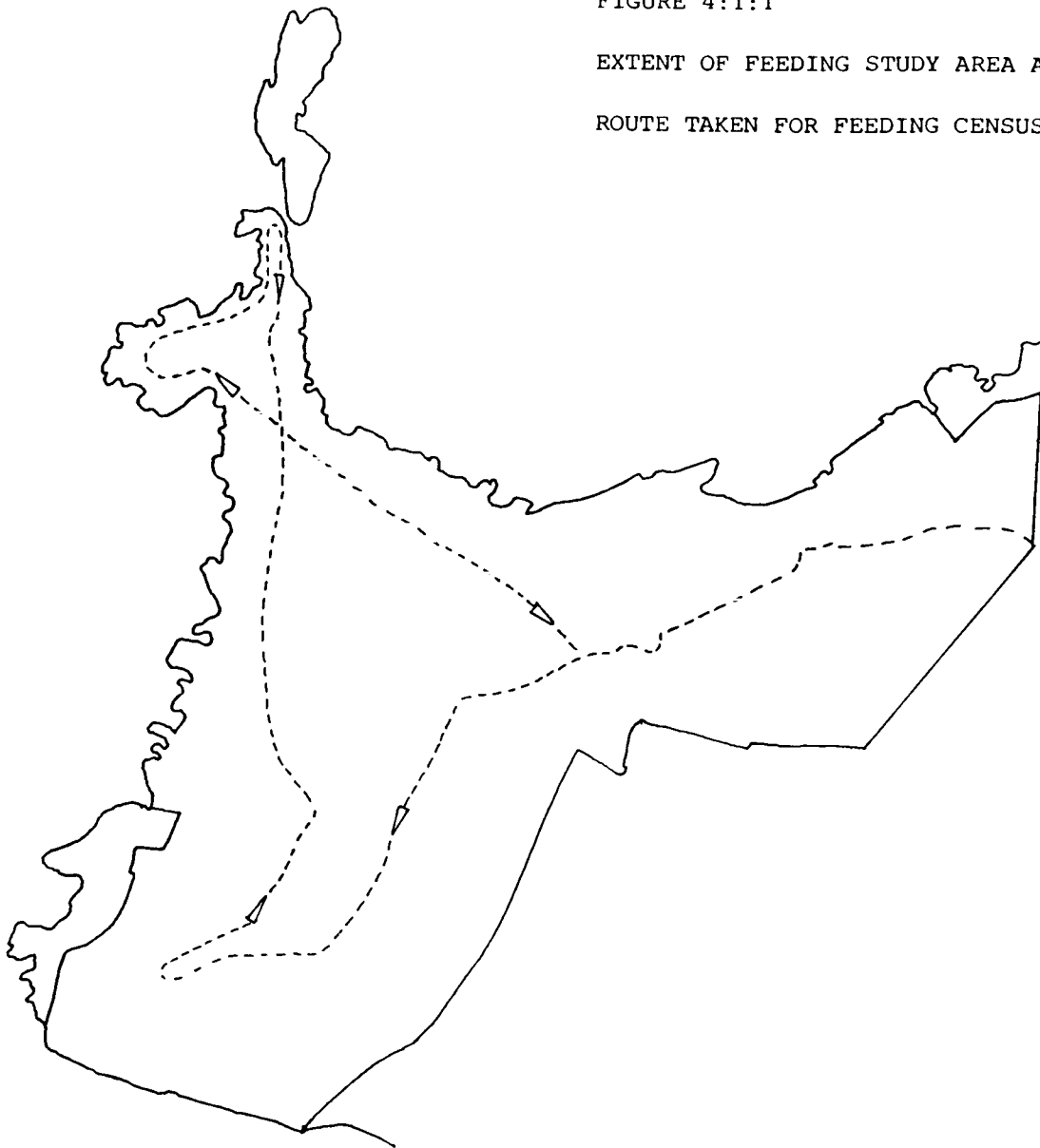
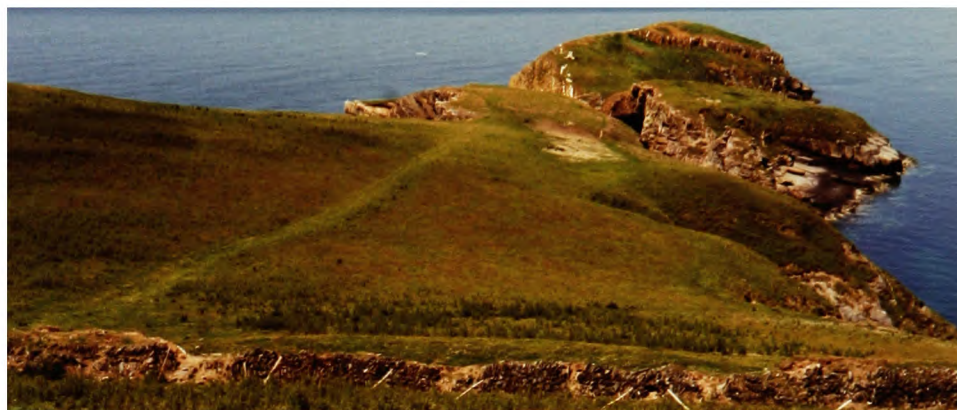


PLATE 1.

HABITAT TYPES IN THE
LOCTYN AREA, AS DEFINED
IN TABLE 4:1:1.



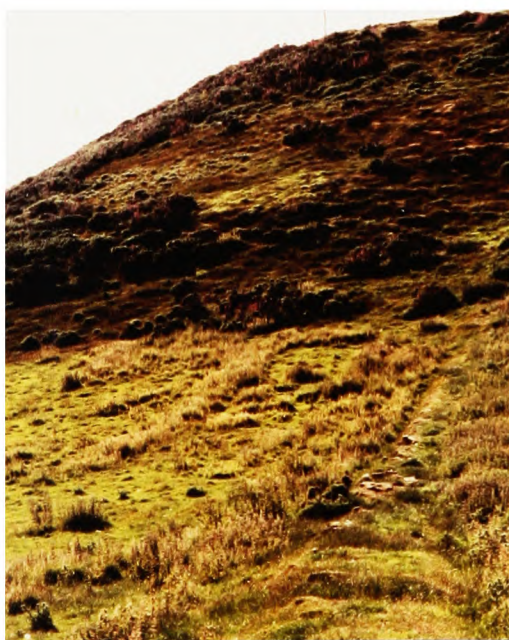
(a) Long grass in foreground. Heath and recently cut heath in the background.



(b) Long grass in foreground with short grass and 'sheep bare' in background.



(c) Rock dominant, with thrift on cliff edge.



(d) Heath and 'sheep bare' patches.



(e) Long grass and heath.

PLATE 2.

VEGETATION TYPES IN
THE LOCTYN AREA.



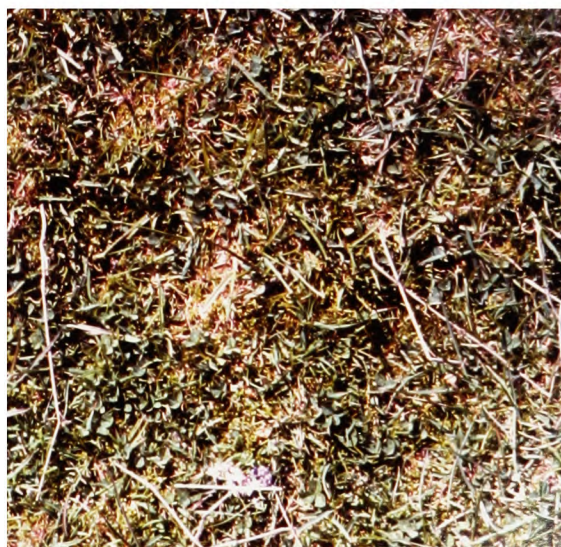
(a) 'Sheep bare' patches.



(b) Thrift clump, after probing.



(c) Long grass.



(d) Short grass.

walk and resembles the transects used by Bullock and Roberts.

The extent of each habitat type was recorded in figure 4:1:2 and from this, the size of each habitat in ha. was estimated. By examining the 1888 25" ordnance survey in comparison with the 1966 edition and the results of the habitat study work, it was possible to see where changes had taken place over the last 95 years with respect to the extent of rough grazing and heath in comparison to the more intensively grazed areas. The results of this study are shown in figures 4:1:3 and 4:1:4.

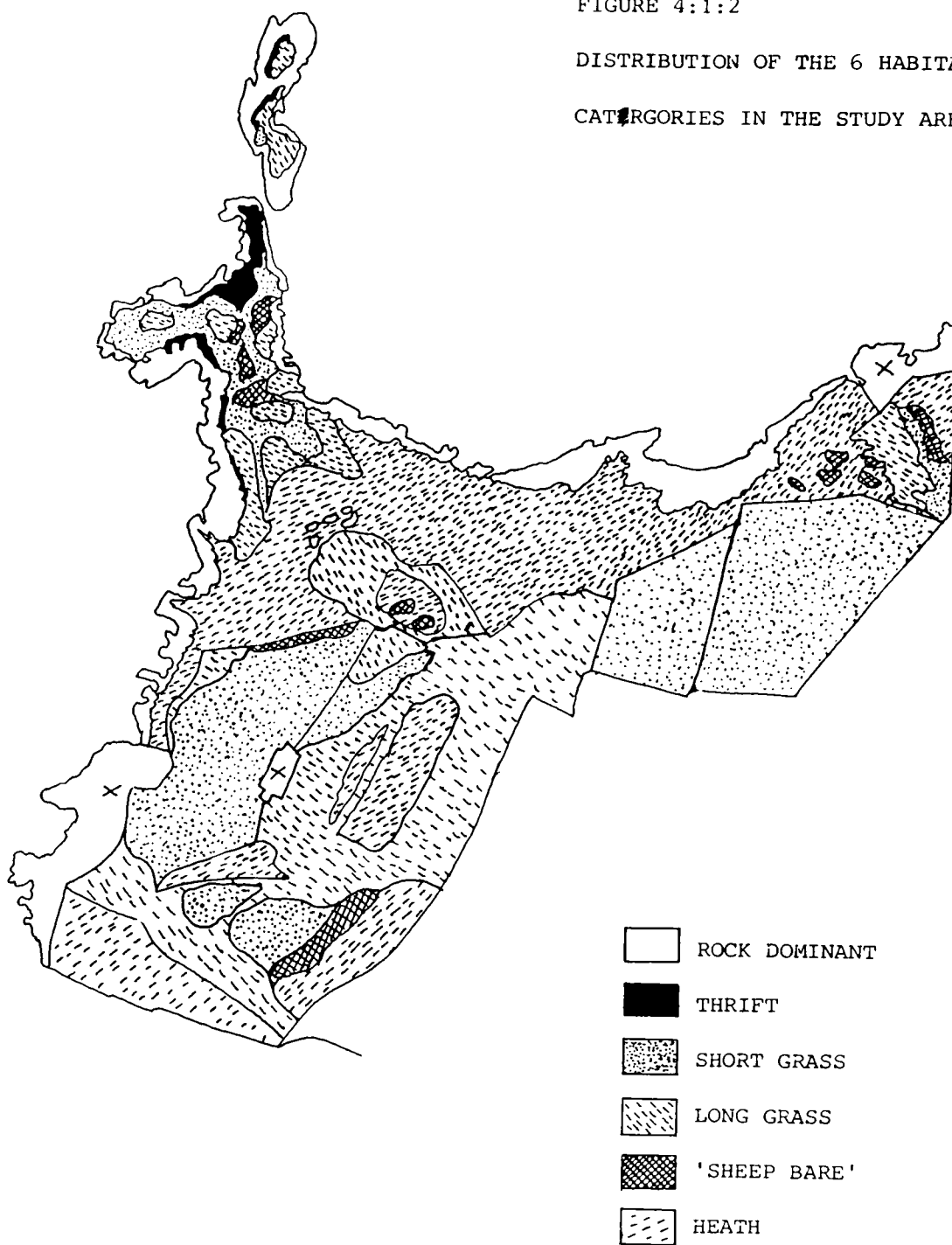
Loctyn farm is owned by the National Trust and its land management is controlled. Here, improvement consists of the addition of NPK fertiliser and seeding with Lolium perenne. Semi-improved areas are counted as short grass or as 'sheep bare' areas since they are subjected to similar grazing intensities with management restricted to occasional mowing to limit the extent of thistles and nettles. Rough pastures with long grass have only sporadic grazing.

Heath and stubble burning are sporadic and irregular. There were no areas of stubble in the study site. In Loctyn the last instances of heath burning were in the dry summers of 1975 and 1976. After an area of coastal heath immediately to the north of Loctyn was mentioned by the Nature Conservancy Council in its intended plans for the setting up of a 'Heritage Coast' the farmer burnt and cleared parts of the heath, and blasted a road down the site in order to capitalise on its enhanced tourist potential.

The daily census work noted the numbers and locations of the following bird species with regard to their habitat preferences; raptors (including those seen in the air), Starlings, Ravens, Carrion Crows, Rooks, Jackdaws, Jays and Magpies. In the case of Choughs, where one or more were seen feeding, they were observed for the duration of the foraging session in order to ascertain the number of Chough minutes (minutes seen x number of birds present) spent in each habitat.

FIGURE 4:1:2

DISTRIBUTION OF THE 6 HABITAT
CATEGORIES IN THE STUDY AREA.



SCALE; 1:10 000.

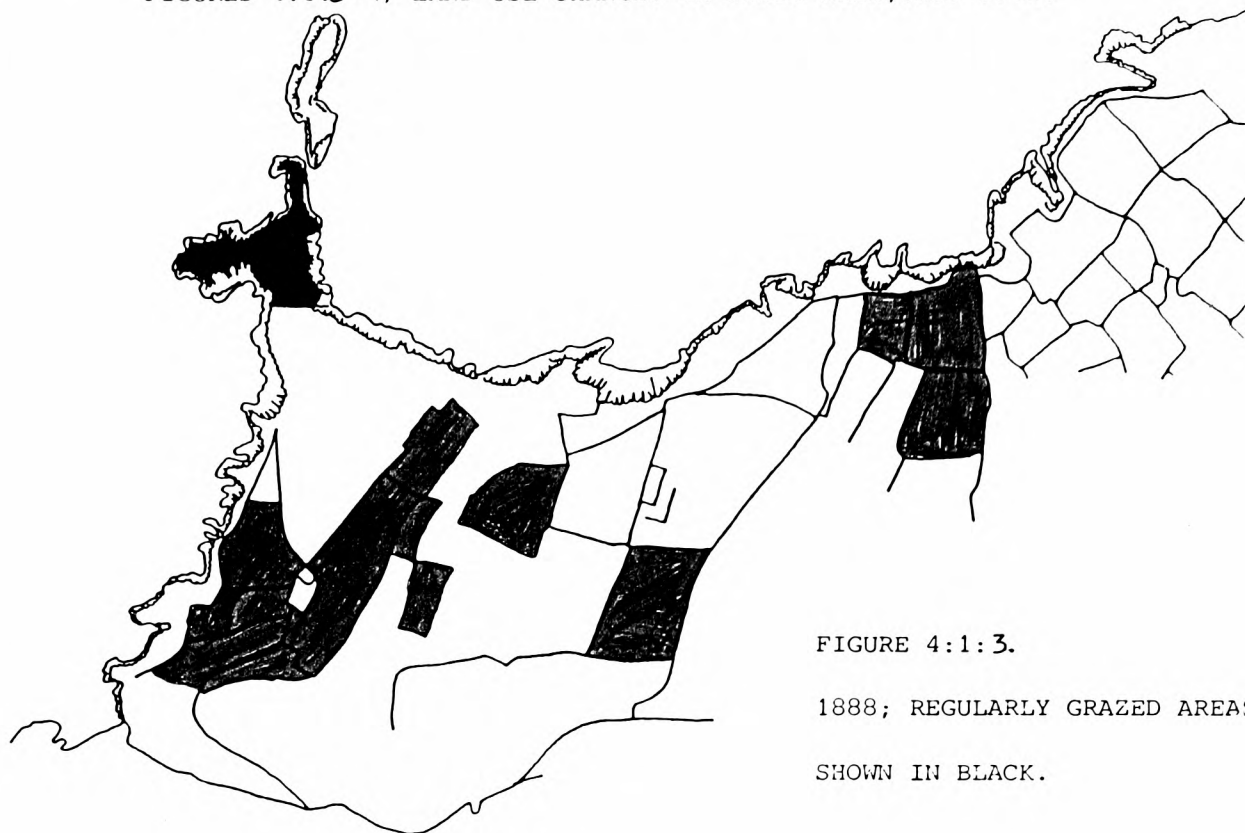


FIGURE 4:1:3.

1888; REGULARLY GRAZED AREAS
SHOWN IN BLACK.

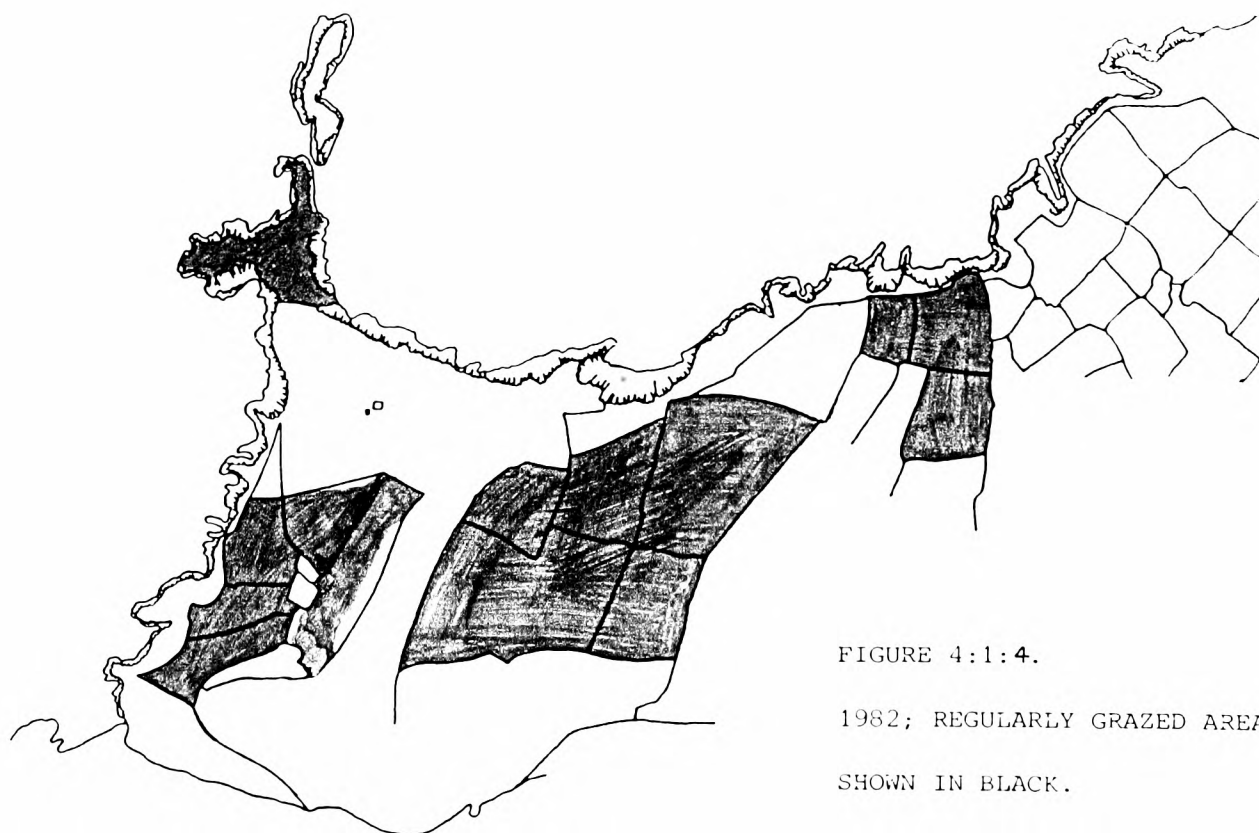
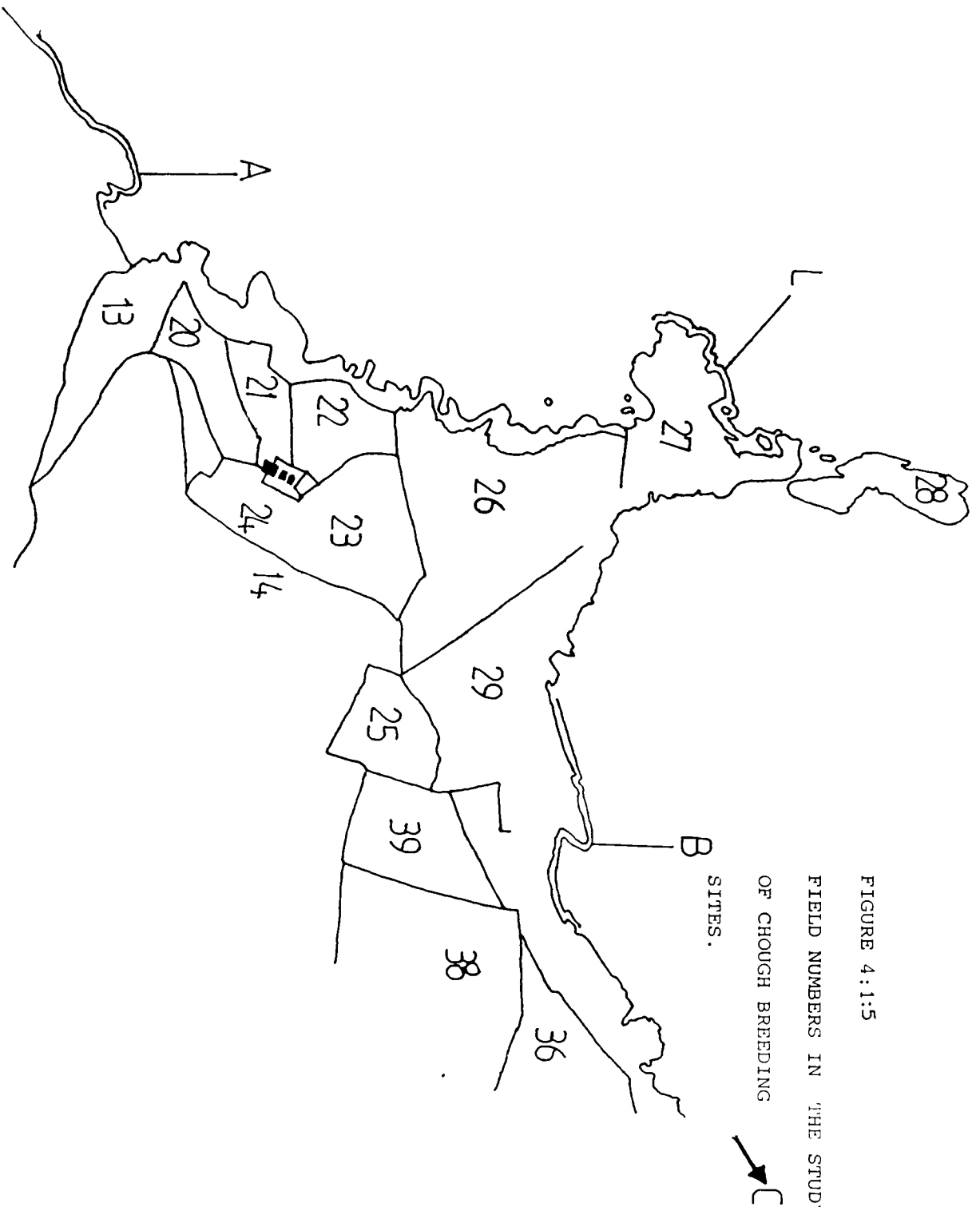


FIGURE 4:1:4.

1982; REGULARLY GRAZED AREAS
SHOWN IN BLACK.



A number of soil cores were taken using a 10cm soil core to the depth of 2cm in order to obtain an estimate of the frequency of tipulid larvae in certain habitats. Ease of ^{the Chough's} probing bill penetrating ^{the top} 2cm of soil was examined by seeing how many blows using a Griffin soil compressometer set at 2Kg/cm² were required for the tip of the instrument to penetrate 2cm of soil. These blows were made at an angle of 30° from the soil surface in order to simulate the angle of the Chough's bill when foraging (See 6:4:4.).

Ingram, Salmon and Condry (1966) provide a summary of the status of birds in the area, with more recent data being found in surveys and reports in 'Nature in Wales'. Other birds of indirect significance to the Chough were observed in the Loctyn area during the study, and their estimated populations are given below:

	<u>Summer</u>	<u>Winter</u>
Fulmar	10-99	-
Oystercatcher	1-9	1-9
Herring Gull	10-99	10-99
Lesser Black-backed Gull	1-9	10-99
Greater Black-backed Gull	1-9	1-9

Metcalf (person. comm.) estimated the rabbit population between Llangranog and Cwmttydu (see figure 4:1:5) to be between 2000 and 3000 individuals. Myxomatosis appears to play only a limited role in their population regulation. He also estimates that there are 50-55 foxes in the area. Both estimates are based on shooting returns.

Plates 1 and 2 illustrate the various habitat types found in the Loctyn area and their component floras.

RESULTS

4:2 CHOUGH FEEDING

Table 4:2:1 gives the number of Chough-minutes of feeding observed in the 6 habitat categories during the study. The lack of winter feeding data is partly due to less fieldwork being carried out during this time (29 observation days for November to February, 53 for March to May, 44 for June

to August and 23 for September), but also appears to be due to the birds foraging away from the area in a winter flock sometimes with the Cwmtydu pair and occasionally the pairs near Mwnt to the South (Thomas, person. comm.).

Table 4:2:1 Chough-minutes foraging on each habitat through the year.

Habitat: Months:	Rock dom.	Short grass	Long grass	Thrift	'Sheep bare'	Heath	Σ
11-2	312	252	0	184	1	0	749
3-5	387	5705	1	476	184	69	6822
6-8	598	2000	235	69	1601	2091	6594
9	557	2316	5	1078	1930	126	6092
Σ	1854	10273	241	1807	3716	2286	20177
(%)	(9.2)	(51.3)	(1.2)	(9.0)	(18.5)	(11.4)	

The 6-8 figure for heath includes 2050 Chough-minutes in 1983 all on an area of heather that had been mowed in the previous month. In order to indicate the actual degree of selection of each habitat, the results were re-expressed as Chough-minutes spent per HA of each habitat, using the habitat area estimates from Table 4:1:1. These are summarised in Table 4:2:2.

Table 4:2:2 Chough-minutes foraging per HA for each habitat and season

Habitat: Months:	Rock dom.	Short grass	Long grass	Thrift	'Sheep bare'	Heath
11-2	49.8	18.6	0	245.3	0.2	0
3-5	51.2	424.6	0.1	634.6	39.2	4.2
6-8	84.4	146.6	9.0	82.0	336.1	128.1
9	78.1	171.5	0.1	1432.6	480.3	7.7
Σ	283.5	760.3	9.1	2394.5	855.8	140.1

With 51.3% of the overall feeding time, short grass was the main habitat used by Choughs in the area. The second most commonly used habitat, 'sheep bare', a variant of short grass, was slightly favoured in relation to area and was a primary feeding habitat from June to September. Thrift, rock dominant and short grass were the primary habitats during winter. These maritime habitats were used as secondary feeding areas throughout the rest of the year. As mentioned above, the results for heath were distorted by the 1983 data. Unlike the regenerating coastal heath which was the primary

FIGURE 4:2:1

DISTRIBUTION OF CHOUGH FEEDING SITES

FROM MARCH TO MAY.

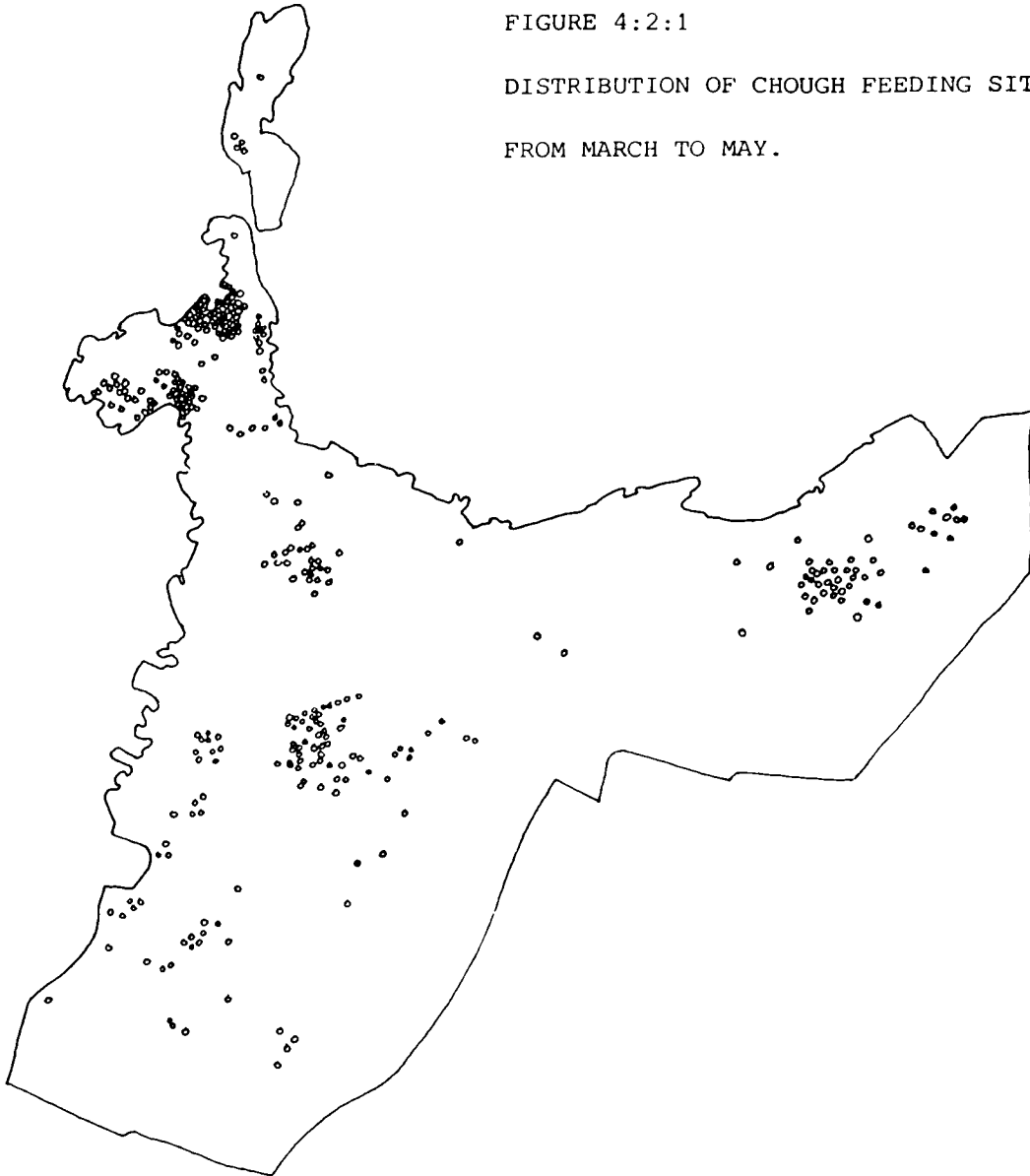


FIGURE 4:2:2

DISTRIBUTION OF CHOUGH FEEDING SITES

FROM JUNE TO AUGUST.

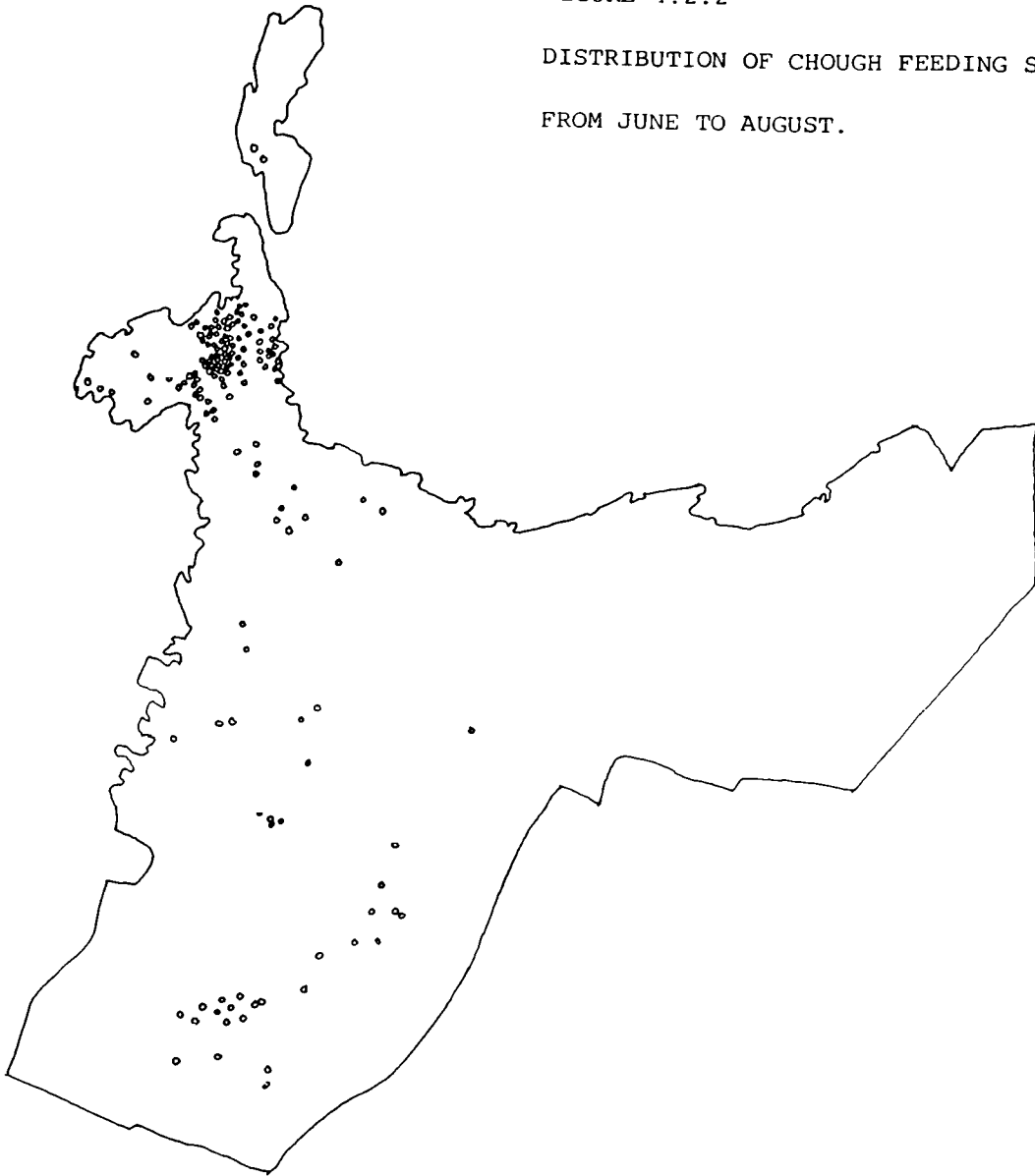


FIGURE 4:2:3

DISTRIBUTION OF CHOUGH FEEDING
SITES DURING SEPTEMBER.

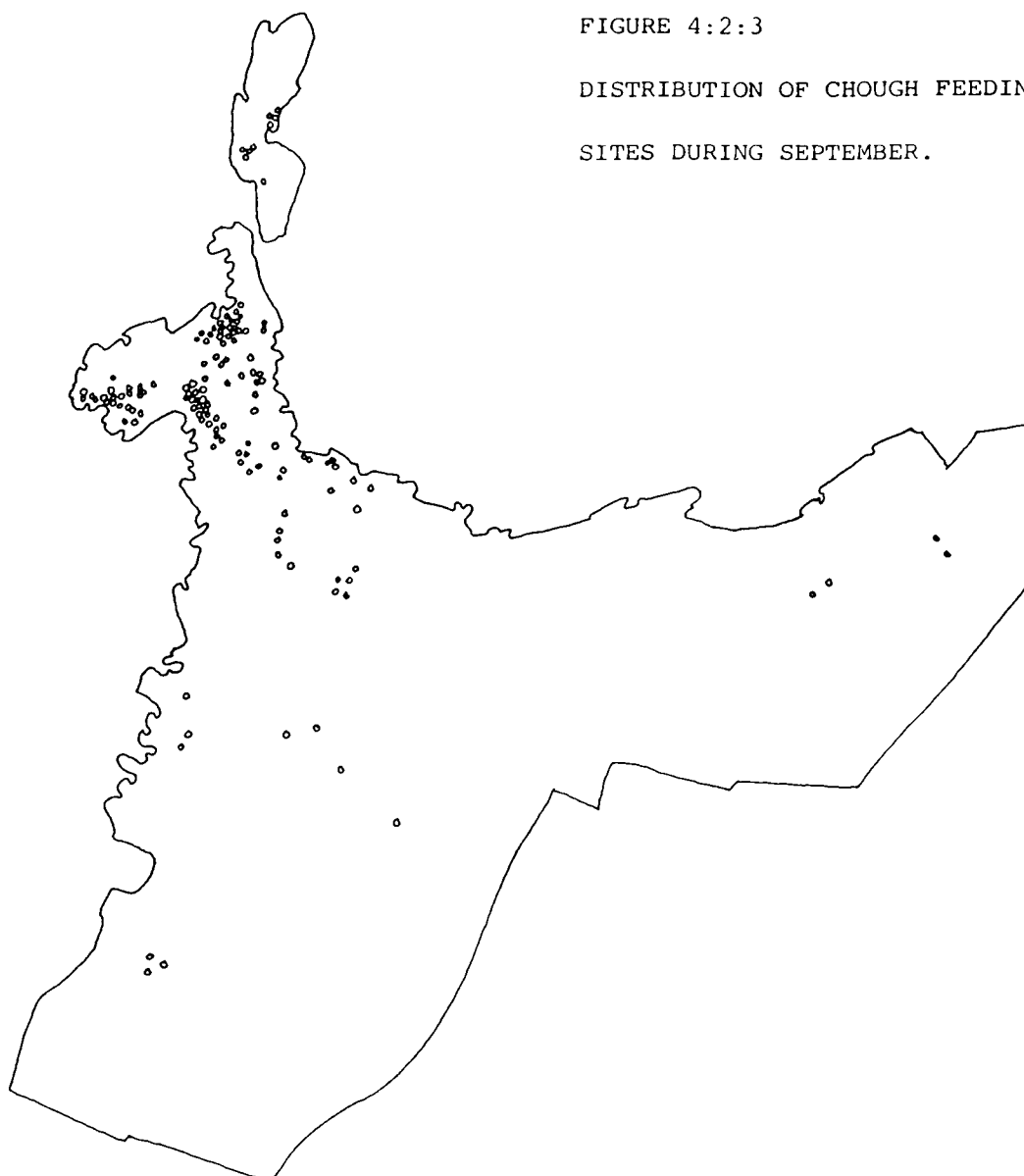
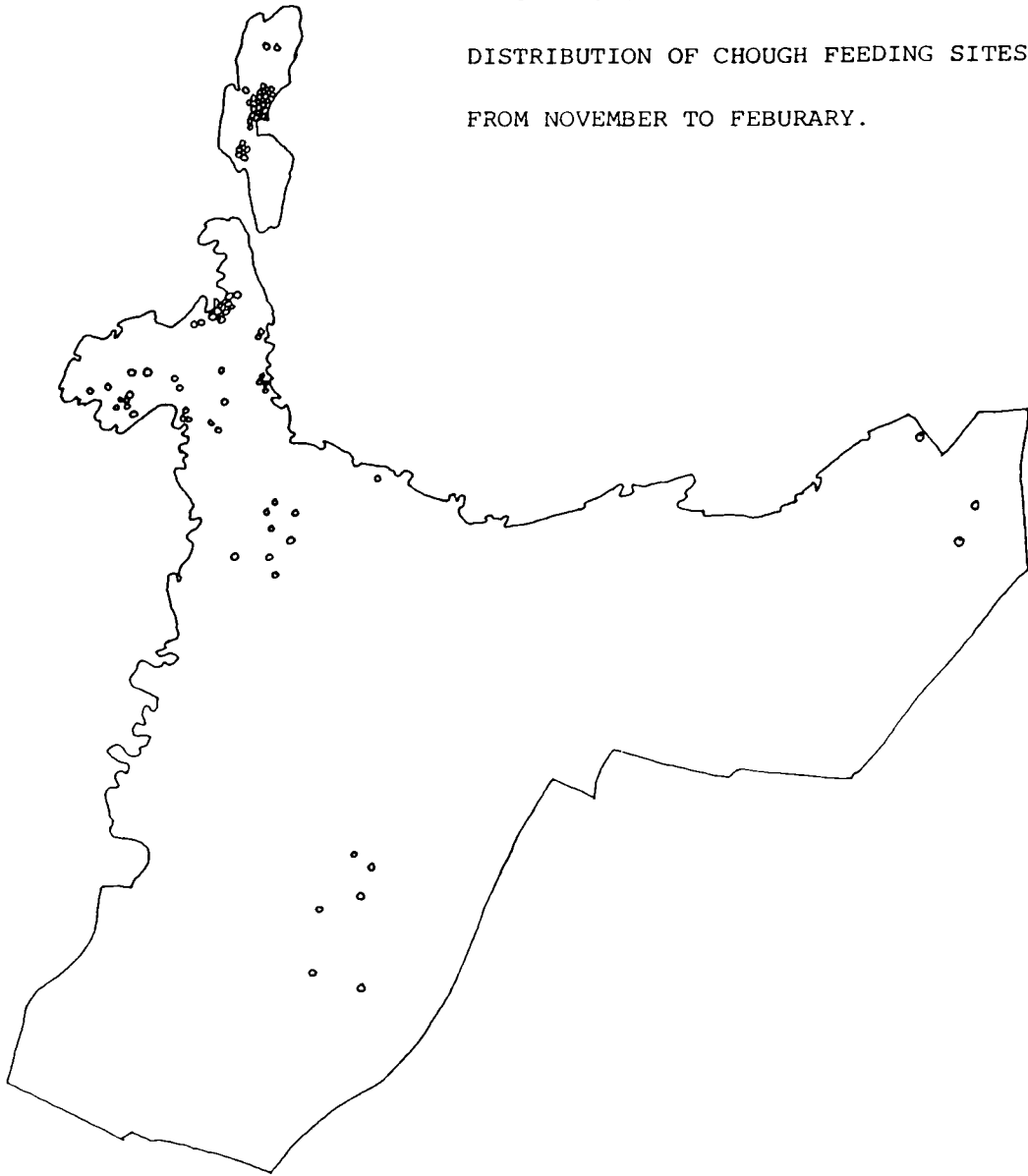


FIGURE 4:2:4

DISTRIBUTION OF CHOUGH FEEDING SITES

FROM NOVEMBER TO FEBURARY.



habitat at South Stack, Anglesey (Bullock 1980), the Loctyn heath was all at least 6 years old consisting either of closely clumped gorse or gorse, bracken and heather interspersed with rank grass. When available, the freshly cut heath became a temporary primary habitat. The cut area extended to 1.8 HA giving a usage rate of 1222 Chough-minutes/HA for this period, a figure only exceeded by thrift in September.

Figures 4:2:1 to 4:2:4 show the distribution of Chough feeding observations in the above month's groupings. The circles do not give any indication of the size of the foraging group nor of the duration of the foraging session and thus the relative distribution of observations may differ from the quantitative data above.

These results indicate a preference for habitats with little or short foliage due to management (cutting and grazing) or exposure. In Chapter 6:6, figure 6:6:1 summarises the effect of grazing and exposure on a coastal plant community. The differences between grazed and ungrazed habitats were examined using the methods outlined in 4:1:3. These results which are shown in chapter 6:6 demonstrated that grazed soil had a greater number of tipulid larvae, was easier to penetrate and had larger amounts of sheep dung. Because of their relevance to the matter of sheep grazing and Chough populations, it was decided to integrate the data with the other findings on sheep grazing in that section.

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4:3 CORVID AND STARLING FEEDING IN LOCTYN

Figures 4:3:1 to 4:3:7 summarise the distribution of feeding observations from the census data. Data presented as observations per habitat category in table 4:3:1 and observations per HA of habitat in table 4:3:2.

Table 4:3:1 Corvid and Starling Feeding Observations from the Census

SPECIES	SEASON	FLOCK SIZE	ROCK DOM.	SHORT GRASS	LONG GRASS	THRIFT	'SHEEP BARE'	HEATHER	
JACKDAW	11-2	1-5		3	3	2		4	
		6-10			1		1		
		11+							
	3-5	1-5	2	15	13	1	2	2	
		6-10	3	5	1	2	3	3	
		11+		24	6	3	8	4	
	6-8	1-5		20	10	1	2	4	
		6-10		1	8	2			
		11+		1	4	1			
	9	1-5				1			
		6-10			3				
		11+	1	2	3	3	1	3	
Σ			6	91	52	16	17	20	
RAVEN	11-2	1	4	3	7	1		1	
		2-5	2	2	11	2		1	
	3-5	1	5	15	10		2	5	
		2-5	11	24	18			6	
	6-8	1	4	2	10	1	1	5	
		2-5	6	3	10	1	1	7	
	9	1		3	5	1		1	
		2-5	2	4	10	2	1	7	
	Σ			34	57	81	8	5	33
	CARRION CROW	11-2	1	3	1	1	2	1	1
2-5			1	4	7	1		2	
3-5		1	2	5	1		1	5	
		2-5	2	18	12	2	4	17	
6-8		1	1	8	6	5	3	1	
		2-5	2	7	8	1	2	2	
9		1	1	1	2			1	
		2-5	1	2	2			1	
Σ			13	46	39	11	11	30	
STARLING	11-2	1-5		2	2				
		6-10		1					
		11+		4	6		3		
	3-5	1-5							
		6-10		2					
		11+		3	1				
	6-8	-							
	9	-							
	Σ			0	12	9	0	3	0

FIGURE 4:3:1

DISTRIBUTION OF JACKDAW FEEDING SITES.

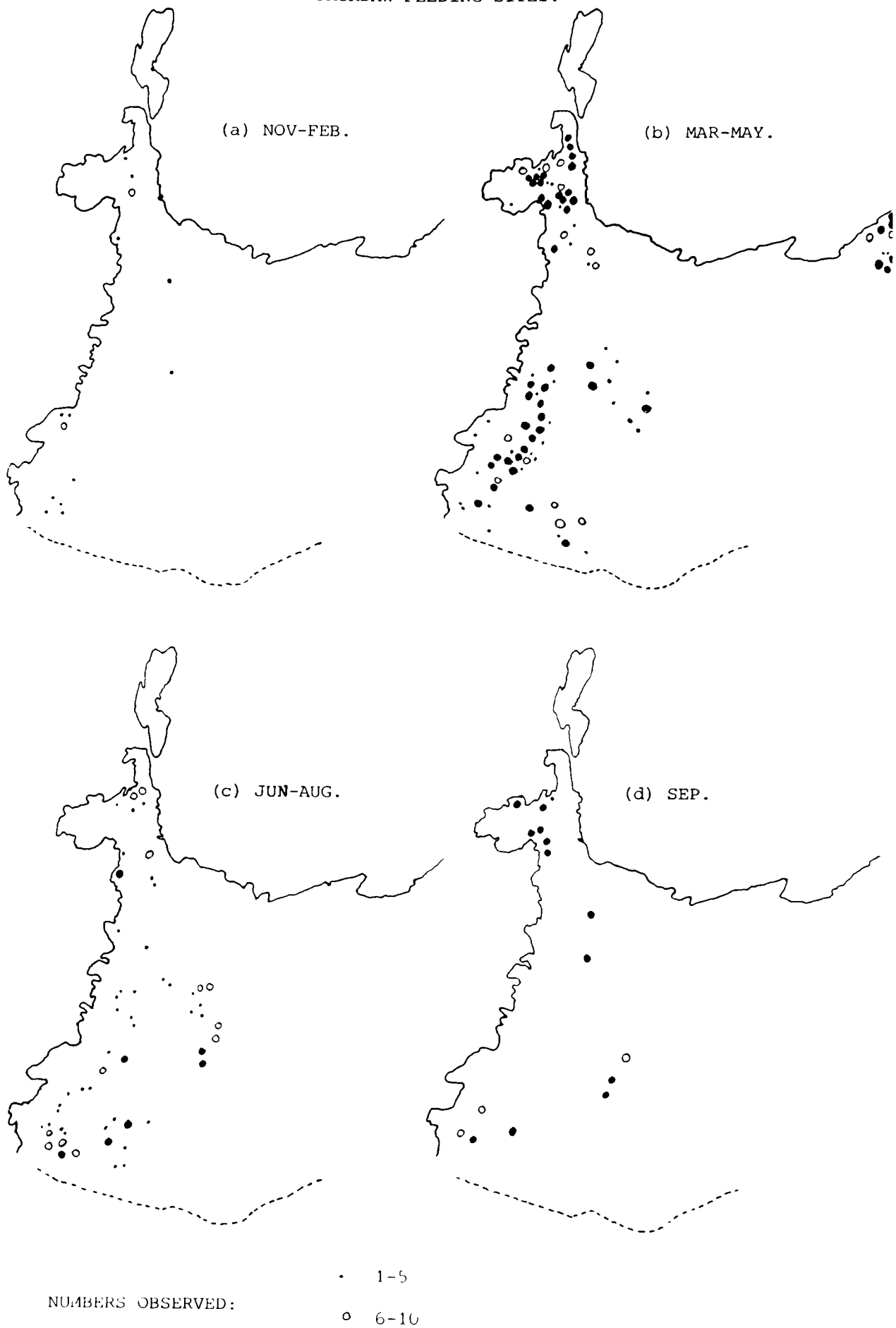
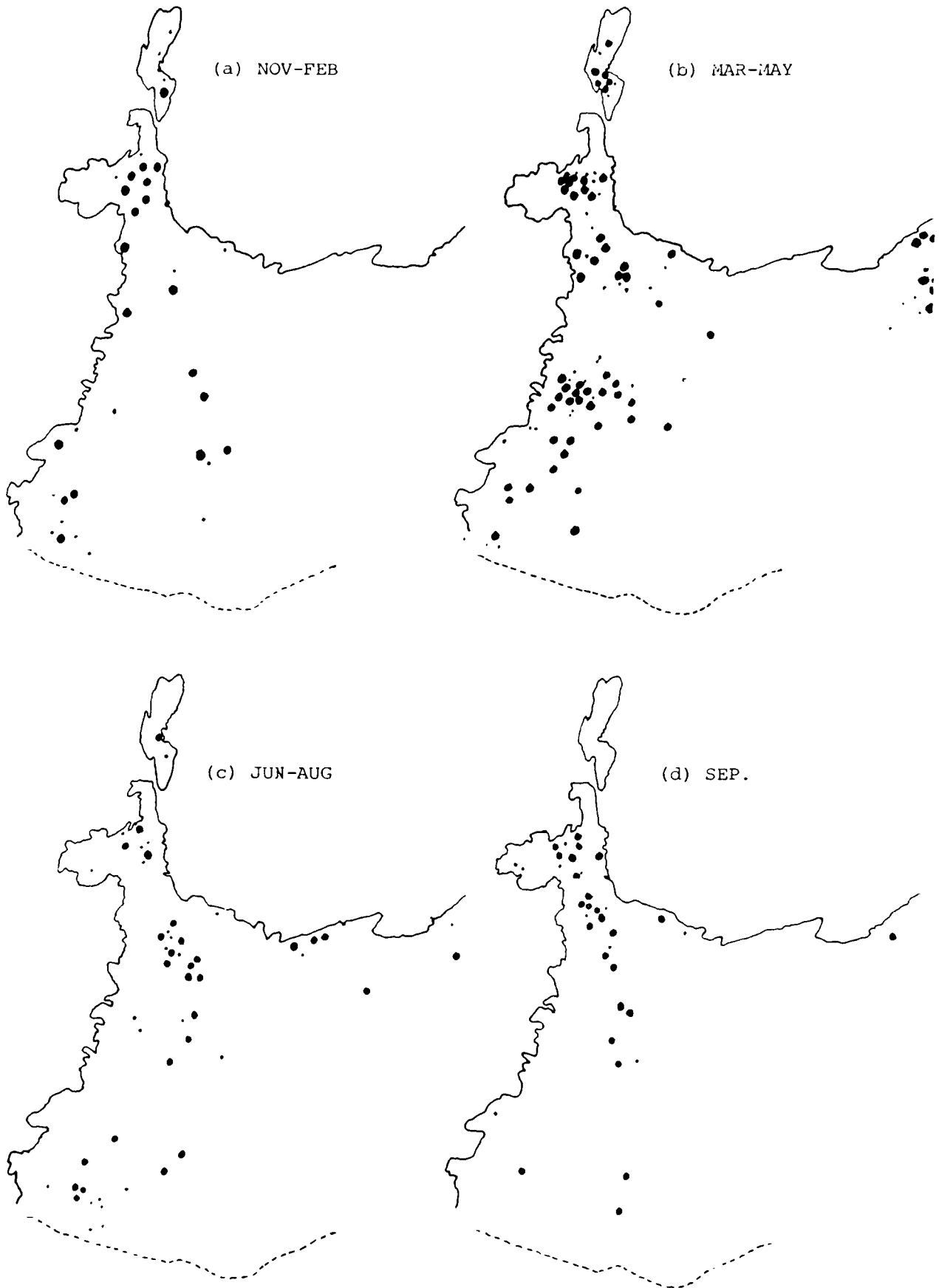


FIGURE 4:3:2

DISTRIBUTION OF RAVEN OBSERVATIONS.



NUMBERS OBSERVED: • 1
 ● 2-5

FIGURE 4:3:3

DISTRIBUTION OF CARRION CROW FEEDING SITES.

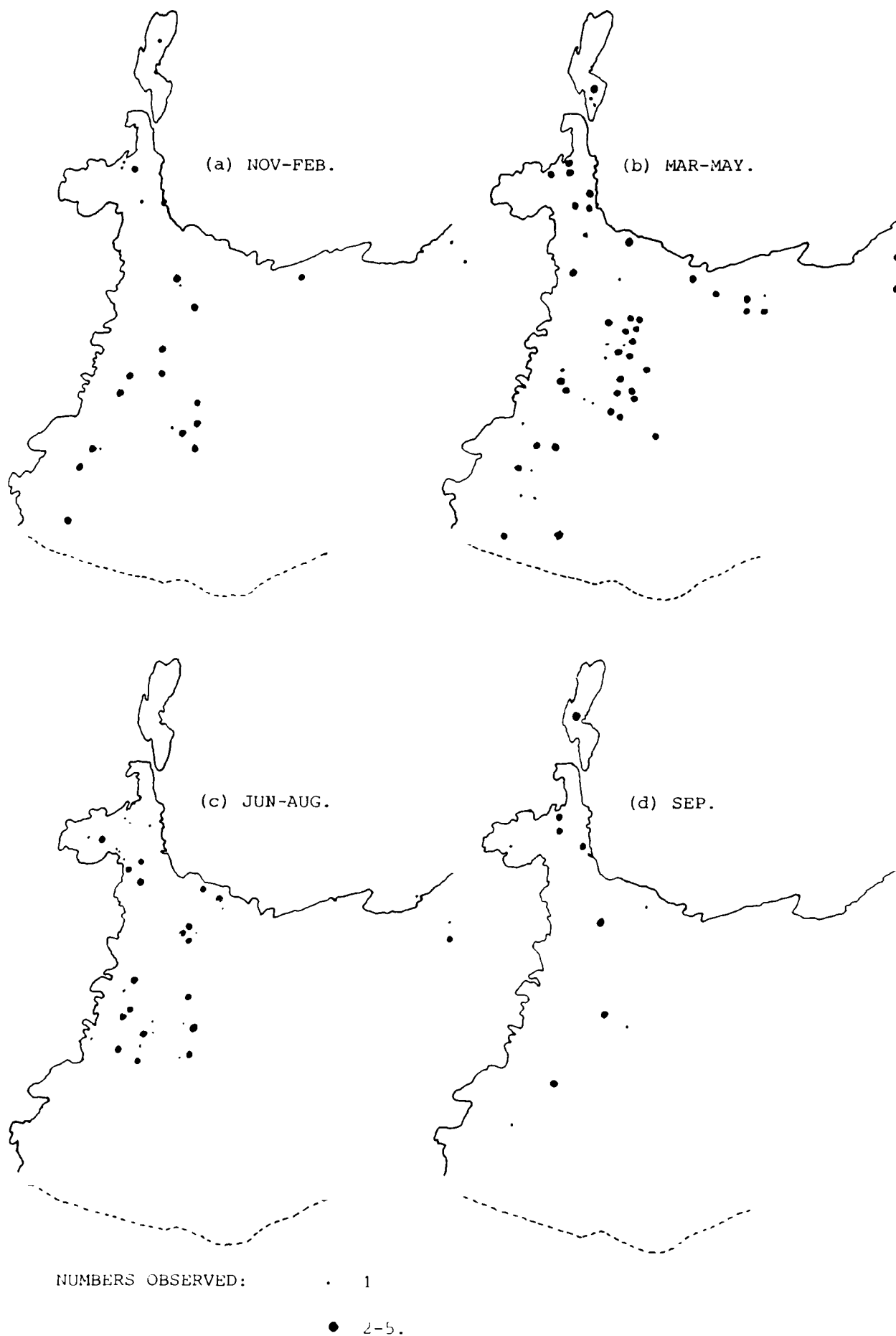


FIGURE 4:3:4

DISTRIBUTION OF ROOK FEEDING SITES.

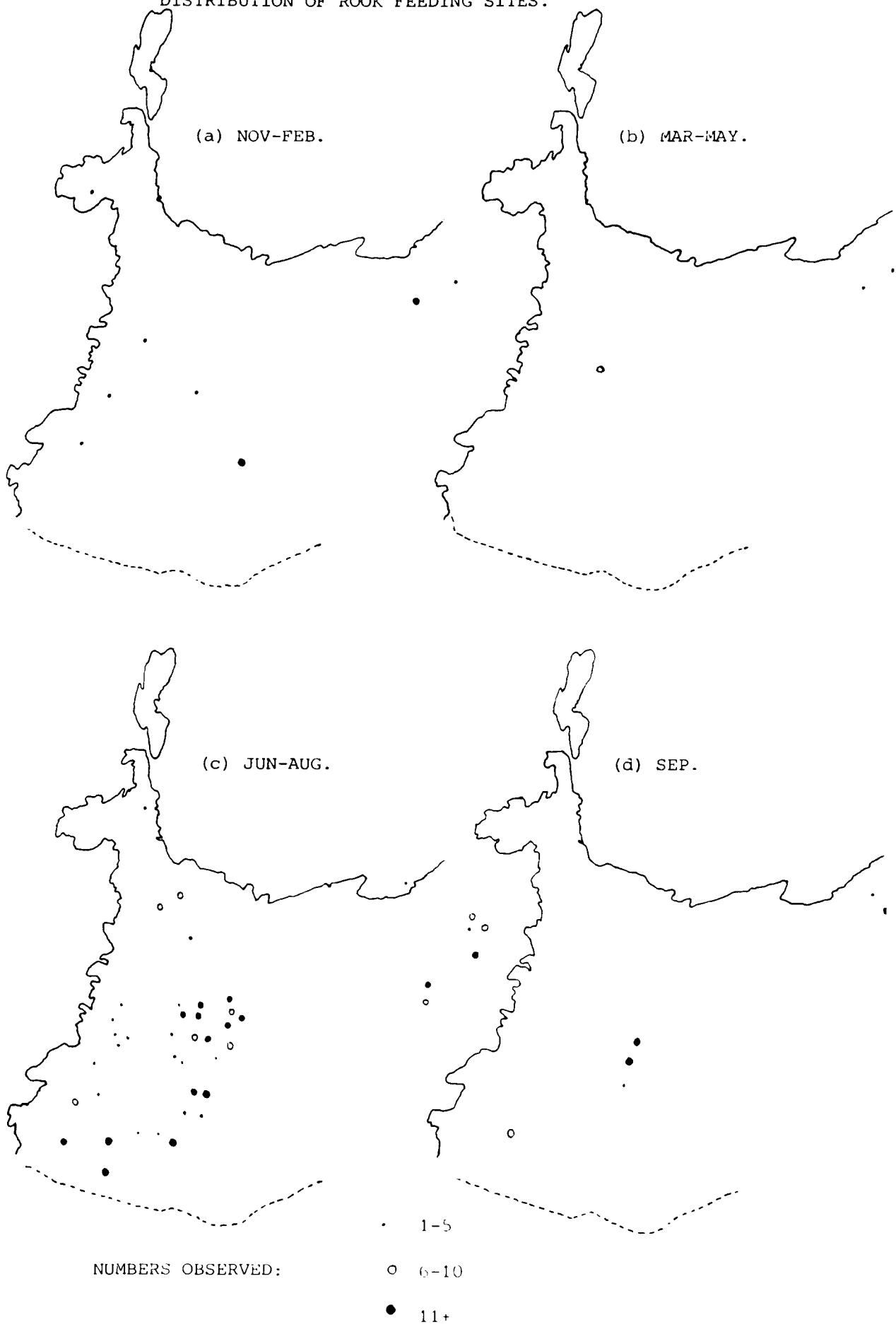
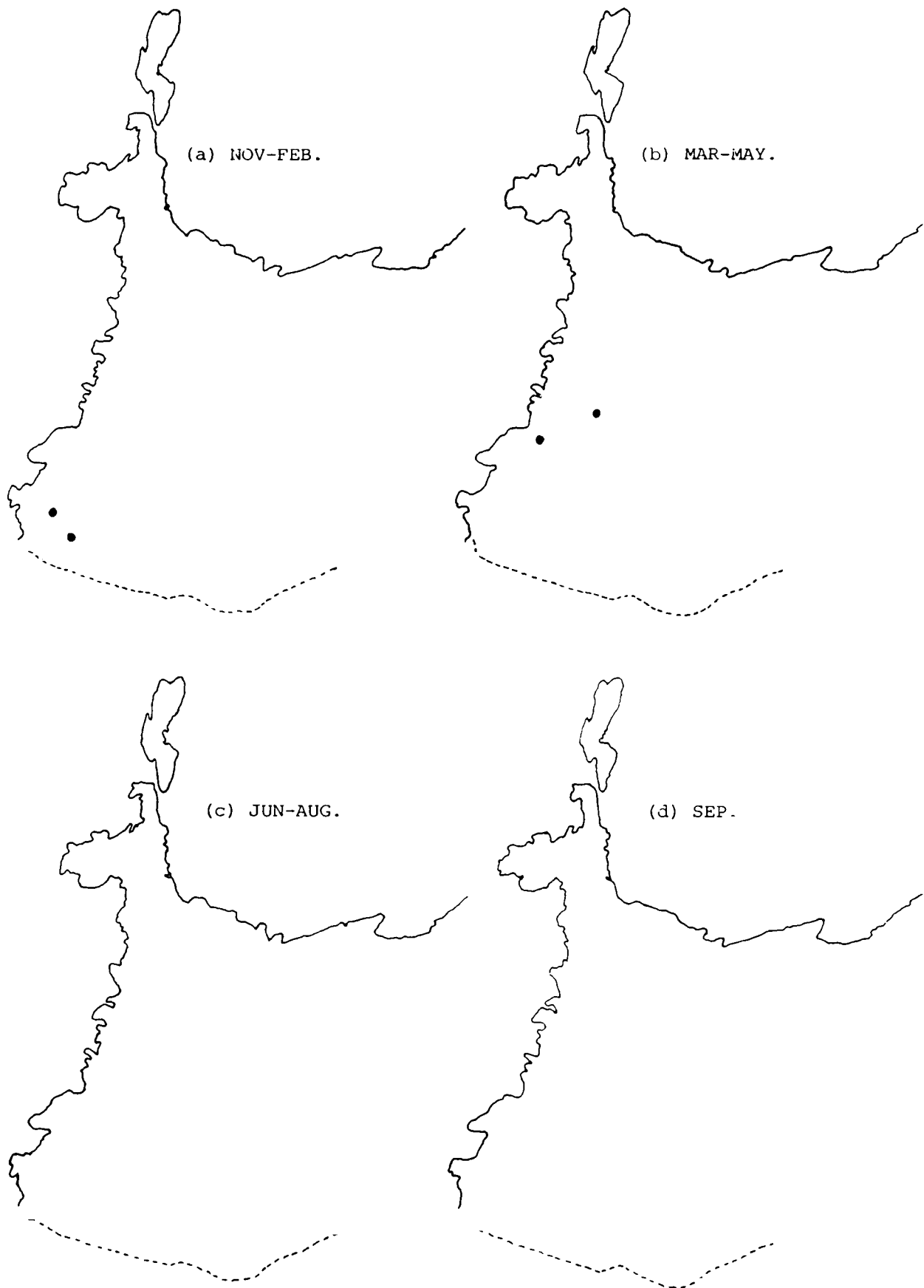


FIGURE 4:3:6

DISTRIBUTION OF JAY FEEDING SITES.



NUMBERS OBSERVED:

•

1.

FIGURE 4:3:5

DISTRIBUTION OF MAGPIE FEEDING SITES.

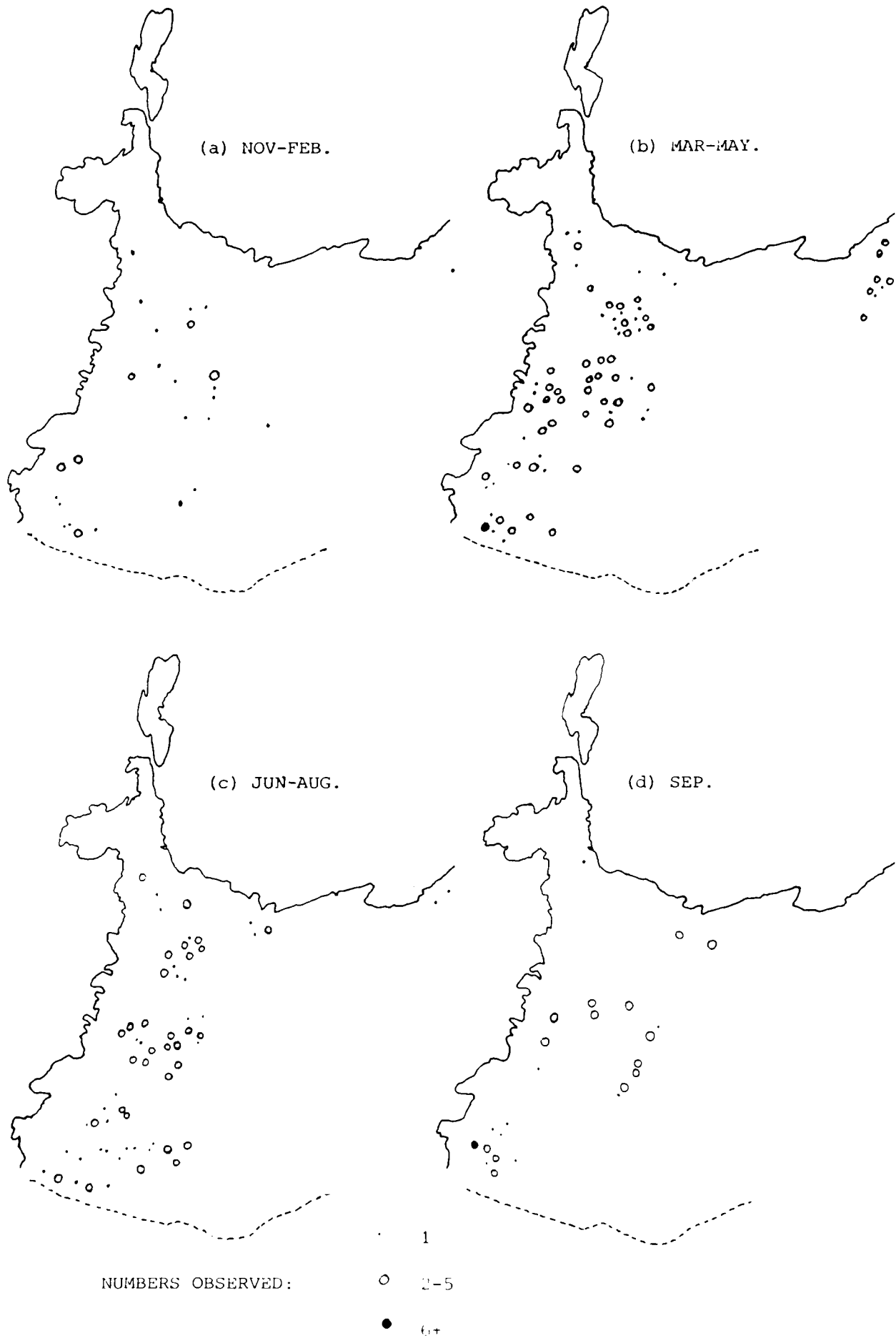
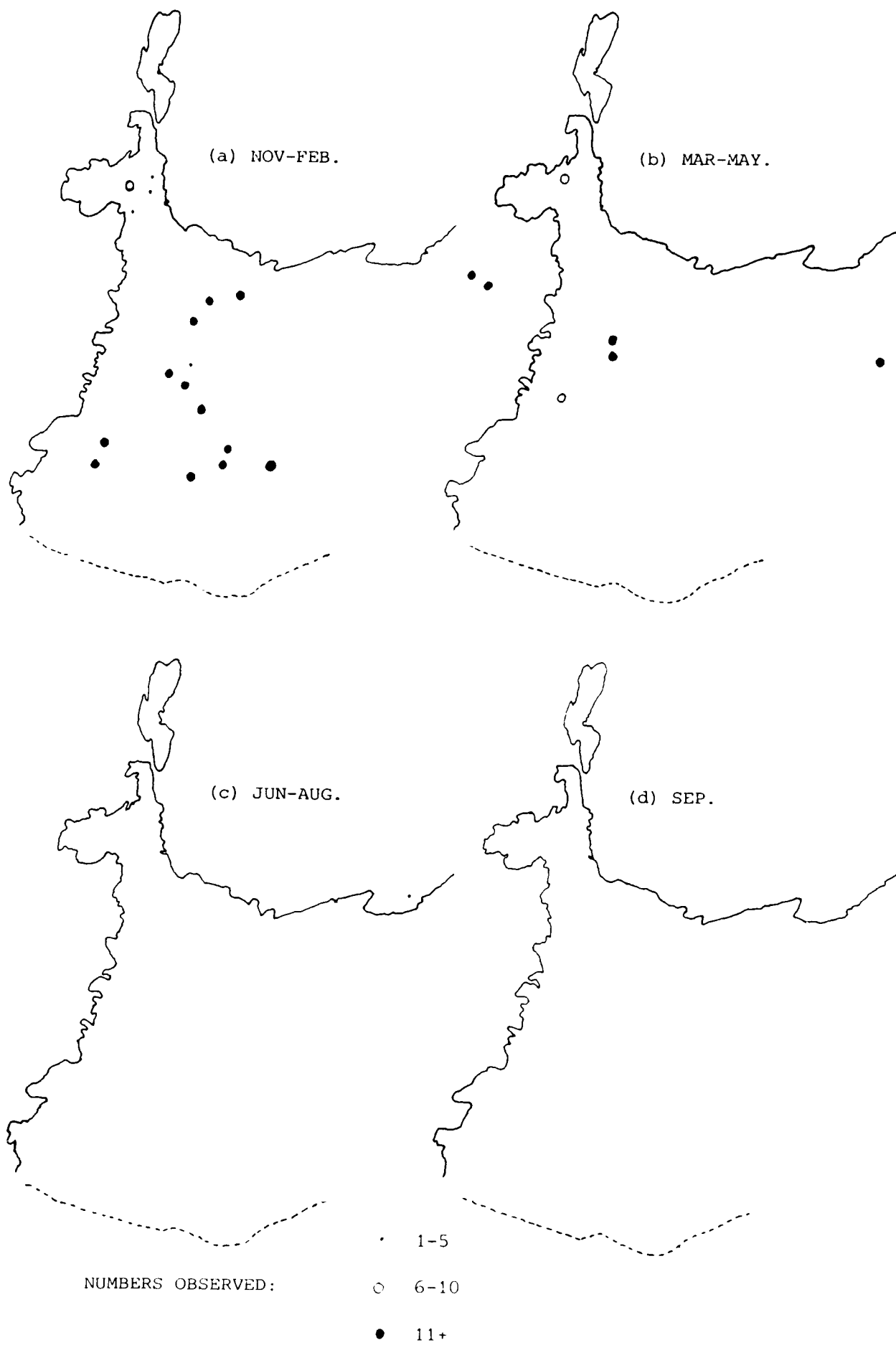


FIGURE 4:3:7

DISTRIBUTION OF STARLING FEEDING SITES.



SPECIES	SEASON	FLOCK SIZE	ROCK DOM.	SHORT GRASS	LONG GRASS	THRIFT	'SHEEP BARE'	HEATHER
JAY	11-2	1			2			
	3-5	1		1	1			
	6-8	1						
	9							
	Σ		0	1	3	16	0	0
MAGPIE	11-2	1	2	9	6			2
		2-5	1	4	1			
		6+						
	3-5	1	2	17	6		7	5
		2-5	3	18	12		11	3
		6+						2
	6-8	1		7	14		7	6
		2-5	1	9	11		5	7
		6+						
	9	1		5	4			
		2-5		4	8			2
		6+			1			
	Σ		9	73	63	0	30	27
ROOK	11-2	1-5		5	1			
		6-10						
		11+		1	1			
	3-5	1-5		4				
		6-10		1				
		11+						
	6-8	1-5		11	7			1
		6-10		2	7			
		11+		3	11			1
	9	1-5		1	2			
		6-10		1				
		11+		1	2			
	Σ		0	30	31	0	0	2

 Σ 863

Carrion Crows and Jackdaws were observed in the 'Sheep bare' areas to a comparable extent to the Chough. 37% of the Chough feeding sessions were ended due to Crow interference (15 directly, 28 due to Crow swooping see Appendix 1, 5.). While Jackdaws and Choughs readily followed each other to foraging sites, and apparently shared vigilance (see Chapter 3:4:5 and Appendix 1, 5.). Jackdaws, Carrion Crows and Ravens were also often observed in the thrift area while no other species were. The presence of Ravens disrupted 3.7% of Chough foraging sessions (n=43). Most other Corvids used the heath and long grass habitats more than Choughs. Rock

dominant was little used except by the Carrion Crow. Jays and Starlings were rarely found in the study area.

Table 4:3:2 Corvid and Starling Feeding

Habitat:	Number of observations per HA of habitat.					
	Rock dom.	Short grass	Long grass	Thrift	'Sheep bare'	Heath
Species:						
Jackdaw	0.96	6.74	2.00	21.39	3.77	1.23
Raven	5.60	4.22	3.11	10.61	1.05	2.03
C. Crow	2.80	3.41	1.50	14.60	2.31	1.84
Starling	0	0.88	0.34	0	0.63	0
Jay	0	0.07	0.11	0	0	0
Magpie	1.60	5.41	2.42	0	6.31	1.67
Rook	0	2.29	1.15	0	0	0.12

4:4 DISTRIBUTION OF RAPTORS

169 Sightings of raptors were obtained during the study period. Their approximate locations are shown in figure 4:4:1. Four species were observed; Peregrines (29 sightings), Kestrels (56 sightings), Buzzards (83 observations) and a solitary Merlin. Kestrel and Buzzard sightings were mainly confined to the heath and grassland habitats around the Loctyn Farm area while Peregrines were mainly seen around the Loctyn peninsula and the North Coast.

Cases of disturbance are shown in table 4:4:1.

Table 4:4:1 Chough disturbances by the presence of raptors.

	n. disturbances.	n. disturbances / n. observations.
Peregrine	10	0.348
Buzzard	1	0.012
Kestrel	0	0

The distribution of tourists (see Chapter 3:4:5) did not appear to affect the distribution of any of these species.

4:5 DISCUSSION

Detailed studies on Chough feeding and habitat use have been carried out in Bardsey (Roberts, 1982a, 1983), South Stack (Bullock, 1980) and Islay (Warnes, 1983a), and complemented with a large set of feeding observations in Britain and Ireland during 1982 (Bullock *et al.*, 1983a). All published

references relating to Chough feeding are listed in appendix 4. In Islay and Loctyn, the main habitat used was the regularly grazed grassland (also observed on Islay by Monaghan and Thompson, 1984), with upland grassland the main habitat type in Bardsey. Burnt and young heather replaced grassland as the main habitat in the South Stack. Haycock and Bullock (1982) noted that on two sites in the Isle of Man, recently burnt areas of heathland were selected by Choughs in preference to their normal short grass habitat. The general habitat information from 1982 again indicated the importance of rough grass without giving any indication of grazing intensity. Only in this study and in Warnes (1983a) were distinctions made in relation to the grazing regime. No instances of beach feeding were observed on Loctyn, and very little on Islay. In Bardsey and to a lesser extent on South Stack, it was a major habitat during winter. All studies apart from Islay indicated that maritime turf and rock dominant areas are an important habitat, especially in winter. There was no fully improved farmland in Loctyn. Elsewhere, it was little used in Bardsey and South Stack but along with cow pats and arable land, a secondary habitat during winter in Islay.

Habitat choice was affected by availability. As noted by More (1983) these studies indicate a bias towards regularly grazed, unimproved grassland and young heathland (after burning or cutting) as primary habitats with seasonal use of maritime habitats.

Bullock (1980) demonstrated that even during hard winters, the Chough feeding rates observed were more than adequate to sustain themselves with levels of disturbance similar to those noted in this study.

In table 4:5:1, main and secondary dietary items from the above studies are summarised.

Table 4:5:1 Main Components of Chough Diet.

Oats; 2° all year (Islay), 1° winter (Islay).
 Scarabid Beetles; 1° in spring (Bardsey), 1° June to August (Islay),
 1° in October (South Stack).
 Dipteran Larvae; 2° all year (Islay, South Stack), 1° winter (South Stack).

Ants; 1° in summer (Bardsey, South Stack).

Earwigs; 1° in winter (Islay).

Other Coleoptera (including tipulids); 1° in spring and autumn (Bardsey),

1° in winter and summer (South Stack), 1° all year except summer (Islay).

Hepalilus moth larvae; 2° in spring (Bardsey, South Stack).

Coelopa, Orchestia; 2° in late autumn, possibly winter (Bardsey).

The wide variation in Chough diets can be related to habitat availability and usage. Roberts (1982a, 1983) regarded the Bardsey Chough's diet as being less catholic than in other areas, and Warnes (1983a) notes the taking of grain as replacing the need for winter beach feeding. Morgan (1971) had also observed tide line feeding in Bardsey. Cowdy (1973) was in error to assume that ants are the main item of their diet. In fact they are taken seasonally in some areas when the ground is too hard for probing. Although Warnes (1983a) only noted a low frequency of ants being taken in Islay, they were regarded as more important there by Mitchell and Cameron (1979). Scarabid beetles were a main item in Llyn, Pembrokeshire (Donovan, 1972) and grasshoppers in Ireland (Cotton, 1980). Dung is probably a more important habitat especially in winter than is assumed; Warnes (1983a) observed feeding on sheep and cattle dung in Islay. Sheep dung has been also observed being used in Wales by Dawson (1975) and Bullock (1980), Bardsey (Gatehouse and Morgan, 1972), Loctyn (this study), and India (Ali, 1949), horse dung in Loctyn (this study) and Yak dung in Tibet (Whistler, 1941). Blowfly larvae were seen being taken from a cow carcass by Dawson (1975). Turner (1959) found that captive Choughs when presented with a choice of earthworms and coleopteran larvae always took the latter. In general, the Chough's diet is narrower than that of other British Corvids (Holyoak, 1968). The role of ploughed and arable land is unclear. Until recently, only isolated instances of Choughs following ploughs had been recorded (Seebohm 1883, Hudson 1902, Wilkinson 1916 and Warnes 1983a) but Sharrock (1984) regularly observed Irish Choughs feeding on freshly ploughed land in the spring and also from September to November. Thus, ploughing creates a transient habitat (although reducing arthropod diversity and

abundance, see Jackson and Raw, 1966) and in the case of Islay, arable land can be of seasonal importance. In all other cases there is little evidence of it having any value and therefore it represents an overall habitat loss.

The results shown in chapter 6:6:4 demonstrate a relationship between tipulid larva frequency and grazing, that grazed and maritime grass have a greater penetrability than ungrazed grass and that grazing intensity and dung density are related. Grass length plays two roles; shorter grass is more accessible for feeding on soil surface insects using either a rapid pecking motion (for ants) or picking (for beetles) as described by Holyoak (1967b, 1972). Ease of access allows more efficient deep probing to the normal depth of 2cm or beyond (Bullock, 1980) for tipulids and other larvae. Burnt and cut heath are more open than old heath swards as Haycock and Bullock (1982) found; they are easier to probe than short grass, and fire-scorched caterpillars were taken. The role ^{that} sward height and density plays in assessment of feeding areas and their value is not known.

Bullock (1980) compared habitat usage of other Corvids to the Chough. South Stack and Loctyn findings are compared in table 4:5:2.

Table 4:5:2 Corvid Habitat Preferences.

	South Stack	Loctyn
Carrion Crow	1°; farmland, 2°; maritime.	1°; farmland, 2°; heath, maritime.
Rook	1°; farmland.	1°; farmland.
Jackdaw	1°; farmland, 2°; maritime.	1°; farmland, 2°; maritime
Magpie	1°; farmland, 2°; heath.	1°; farmland, 2°; heath.
Raven	1°; maritime, 2°; heath.	1°; farmland, maritime, 2°; heath.

The sets of feeding preferences are somewhat similar. Warnes (1983a), noted that Starlings often fed near Choughs but the absence of interspecific antagonism argues against competition. Out of 1144 observed foraging periods, 106 were ended by the presence of or attacks by Raptors or Corvids; 1.4% of periods being ended by raptors and 7.4% by corvids. The overall level of 9.1% is below the level of any significant interference.

This Chapter has aimed to complement the more detailed studies of other

workers. Combining the applied aspects of this work, the habitats can be classified in terms of their value in relation to their management regimes as shown in table 4:5:3.

Table 4:5:3 Habitat and Management.

Habitat Type	Habitat	Management	Value
Maintained; of value	Maritime grass	Exposure, grazing	1° seasonal
	Short grass	Grazing	1° all year
	Burnt heath	Burning	1° when available
	Cut heath	Cutting	1° when available
Climax; of value	Maritime grass	Exposure	1° seasonal
	Beach	-	1° seasonal
	Rock dominant	Exposure	1° seasonal
Climax; low value	Heath	Low exposure	? when young
	Long grass	Low exposure	-
Maintained; low value	Arable	Ploughing, improvement	? Seasonal, 1°; Islay
	Long grass	Low grazing	-
	Short grass	Improvement	-

Only a small part of the Chough's habitat needs are filled by unmanaged habitats. Outside winter, most feeding takes place on farmland or managed heath, indicating that man plays a positive role in their conservation. More (1983) argues that although fertilisation reduces soil invertebrate density it makes sheep farming economically feasible in marginal areas. There is a need to maintain a balance between heath extent and quality and grazed areas since coastal heath is a declining habitat (Bullock, 1980). Controlled burning in exposed areas such as Loctyn can cause erosion (Tallis, 1964) and, if too frequent, a reduction in invertebrate density and grassland formation (Ward, 1972). In such cases, cutting may be a viable alternative, as heath regeneration is rapid and soil exposure comparable to burnt heath. As discussed in Chapter 6:6, long term prospects for the Chough depend on habitat retention and maintenance tempered by the need to conserve other coastal species. Recolonisation will not take place in areas where grazing has been abandoned such as North Cornwall (Darke, 1971), so management changes will be required if substantial expansions of the Chough's breeding range are to be desired.

CHAPTER 5
LITERARY ATTITUDES TOWARDS CHOUGHS

CONTENTS

- 5:1 General Introduction, Aims and Methods
- 5:2 Background Sources; the Classics
- 5:3 Old English Literature and Glossaries
- 5:4 Middle English Literature and Glossaries
- 5:5 'Choughs and Daws'; the Changing of
 'Chough's' Meaning
- 5:6 'The Thefe the Chowgth'; Adverse Literary
 Epithets
- 5:7 Shakespeare; 'Chough's Language,
 Gabble Enough and Good Enough.'
- 5:8 Jackdaws and Choughs in Recent Writings
- 5:9 General Discussion

'How fearful and dizzy 'tis to cast one's eyes so low!
The Crows and Choughs that wing the midway air
Show scarce as gross as beetles;'

King Lear.
William Shakespeare, 1604-5.

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5:1 GENERAL INTRODUCTION, AIMS AND METHODS

5:1:1 Introduction

In order to evaluate the effect of Man on the Status of the Chough in Britain and in particular, in England, the development of Man's attitudes towards Choughs prior to the first estimates of their population (1750-1800, see 6:4:4) needs to be understood. Changes during the period of maximum persecution (1820-1939, see 6:7) are further examined, and followed through to the relative enlightenment of recent years, and the consequent partial recovery of Chough numbers (see 6:4).

Previous investigations on Man's literary attitudes towards animals have been attempted from the viewpoint of all animal species in a specified area and time. For example, Thomas (1983) examines human attitudes towards the entire compass of 'the natural world' in Great Britain from 1500 to 1800. Such an approach necessity limits the number of references to each individual species. Although a particular theme may be examined in some depth, the theme will be investigated through a number of species. Thus although each individual species may play a differing role in the development of this theme, the generalised treatment used prevents this being researched. For example, when Thomas (1983) refers to the shooting of Choughs as vermin in the Eighteenth Century, the actual bird mentioned is in fact the Jackdaw, Chough at the time being a vernacular word for Jackdaw, as discussed in this Chapter.

As a result, previous examinations have not been able to examine comprehensively the causation and development of a particular theme in human attitudes towards any single species. They have been further constrained by a general lack of references from the original sources of many themes, found in the classics. They have also omitted to examine the reputations of birds in literature

as anthromorphic interpretations of behaviour and similar natural

phenomena that can be explained on a rational and scientifically sound basis.

The frequency of mentions in early natural histories of the Chough being a fire raiser and a thief makes it an ideally suited species for such an investigation. Both epithets seem apparently absurd to the modern naturalists, but were at the time taken as fact. Thus this Chapter will be of value not only in examining such themes, but also to see if it is viable to approach the development of ideas about nature by concentrating on one or two species.

5:1:2 **Aims**

The principal aim of this Chapter is to examine Man's relationship with the Chough in Britain through attitudes conveyed in literary, scientific and ecclesiastical writings. In addition, the development of ideas behind these opinions will be examined.

This Chapter has a number of secondary aims. These are: to see if a detailed investigation into such a specific subject is viable when utilising an interdisciplinary approach combining both literary criticism and scientific ornithology; to see if such an approach is more effective than investigations on a multispecific level; to create a basis for a more wide reaching examination of Man's relations with birds as expressed in contemporary literature; and to look at the causal factors in the development of opinions and ideas relating to early scientific and literary ornithology.

5:1:3 **Methods**

All known references to the Chough in English writings and the classics were examined, alongside information on the underlying causes responsible for the formation of any attitudes expressed. This was taken to include all

references in scientific and ecclesiastical works and folk lore, and the development of the word 'Chough' and the connotations that the word conveyed at various times.

The word 'Chough' was used to describe the Jackdaws until circa 1500, and prior to 1446, there was no English word to describe the Chough proper, so it was also necessary to undertake a similar investigation into the literature of the Jackdaw from classical sources to the present day. Thus, there was also an emphasis on identifying the species in each reference in order to distinguish between the two. From the above, attitudes towards each species were compared. This emphasised how the literary reputation of the Jackdaw affected that of the Chough, both indirectly, by the association of the two species and directly, by the interaction of literary views upon the two species when the meaning of the word 'Chough' was changed.

References to the two species were obtained through a number of approaches: (1) Dictionaries based upon citation of illustrative examples, in particular; *The Thesaurus Linguae Latinae* (in progress), *Novum Glossarium Mediae Latinae* (1880-), *The Oxford Anglo-Saxon Dictionary* (Bosworth and Toller 1898, Toller 1921, and Campbell 1972), *The Middle English Dictionary* (Kurath et al., 1954-), *A Dictionary of the English Language* (Johnson 1755, 1760, 1824), *The Oxford Etymological Dictionary* (Skeat 1879), *A Dictionary of Archaic and Provincial words from the 14th century* (Halliwell 1899), and *The Oxford English Dictionary* (Murray 1888-1930). Definitions of words were treated with caution. For example, in Lewis and Short (1979) 'Pyrrhocorax' is first defined as a Red-billed Chough, and is followed by Pliny's account of a Yellow-billed (Alpine) Chough.

In order to examine the development of the words Chough and Jackdaw, and their meaning from the Latin *Monedula/Gracculus* (for Jackdaw) and *Pyrrhocorax* (for Chough), all early dictionaries and glossaries were examined. Examples being; latin to Old English (Aelfric's 10th Century

Glossary, Wright 1857), Latin to Middle English ('promptorium parvulorum' 1440, Mayhew 1908), and Italian to Early Modern English (Florio, 'World of Words' 1598, 1611).

Further references were obtained through checking all glossaries and indexes of the publications of the Early English Text Society, the Camden Society and the Surtees Society, all known concordances of Early Modern to recent writers (eg. Shakespeare in Spevack 1977), Medieval nature poems, bestiaries, and illuminated manuscripts (eg. Yapp 1978, 1981), natural histories (eg. Turner 1544), books of arms (eg. Upton ante 1446) and word lists (Ray 1675, Lhuyd 1707).

Secondary sources were found in manuscripts of a geographical, historical or ornithological nature in the collections of the Bodleian, Alexander and British Museum Libraries. All references to 'daw' were further checked in order to ascertain the exact meaning. This was needed since the word 'daw' also meant 'to dawn' from ante 1200 to circa 1500, and thus the word 'daw' conveyed a dual meaning for 100 to 150 years.

Findings were divided into 7 Sections, 4 being chronological, following the evolution of the word 'Chough' and its connotations in (i) the classics, (ii) Old English, (iii) Middle English and (iv) Early modern to present. Attitudes to the Jackdaw between 1580 and 1620 were investigated via citations in the works of Shakespeare and their sources. Two further sections examine the interrelationship of the words 'Chough' and 'daw', and the development of the Chough's 'reputation' for fire raising, theft and a fondness of glitter.

Table 5:1:1 defines the abbreviations that are used in the text in order to aid brevity.

Table 5:1:1

c... circa; ± 25 years from a given date.

a... ante; up to 25 years prior to a given date.

MSS... manuscriptS.

MS... manuscript, followed by its catalogue number.

Cl1th... century; 11th century.

Chough (=Jackdaw)... Where the text mentions the word
'Chough' and is in fact referring
to the Jackdaw.

5:2 BACKGROUND SOURCES; THE CLASSICS

5:2:1 Introduction and Aims

This section aims to collate all references to Choughs and Jackdaws in Greek and Roman natural histories and references to Choughs and Jackdaws in the classics that were subsequently translated into English or referred to in English literature prior to 1800. In each case, the most recent accurate translation into English is given.

Thomas (1983) points out that until well into the eighteenth century, opinions in the classics, where available to later authors, were taken as sacrosanct. Thus their influence is of considerable importance since many writings in English are based on opinions that are traceable either directly or indirectly to these sources.

5:2:2 Aristotle and Pliny

A comprehensive survey of the references to Choughs and Jackdaws in Greek and Latin literature is outside the scope of this work. Thus, only sources which are subsequently repeated in English literature will be discussed. Wentworth-Thompson (1895, 1936) and Thesaurus Linguae Latinae (1973, 1979, in prep) list all references in Greek and Latin literature.

Aristotle (according to Barnes (1982) written 335-332 BC) and Pliny (c77BC, Carey et al., 1949) provide accounts of the two species which formed the basis of descriptive accounts until the eighteenth century.

Aristotle in the 'History of Animals' (XI, xxiv. 617b, line 16);

κολοιῶν σ' ἔστιν ^{εἶδη} τρία, ἓν μὲν ὁ κορακίας οὗτος ὅσον κορώνη,

(Dittmeyer 1907). Translated by Wentworth-Thompson (1910) as 'of daws there are three species. One is the Chough; it is as large as the crow, but has a red beak'.

Three references are found in Pliny's 'Natural History' in Book X, the original text (reprinted Rackham 1960), the first translation, by Holland (1601) and a recent translation (Rackham 1960) follow;

- (1) 77: octavum citra lapidem ab eo ^{inmensa alioqui finitimo} Insubrum tractu examina graculorum monedularumque (cui soli avi furacitas argenti aurique praecipue mira est).

XXIX: And yet in the neighbour quarters of the Insubrians near adjoining, ye shall have infinite and innumerable flocks and flights of Choughes and Jackdaws: the veriest theeves, nay the onely theeves of all other birds, especially for silver and gold, that it is a wonder to see what means they will make to steal and filch it.

XLI: And similarly Jays and Jackdaws - a bird whose unique fondness for stealing especially silver and gold is remarkable - through swarming in enormous numbers in the adjacent region of Insubrians.

- (2) 133: Capitur circa Alpes etiam, ubi et phalacrocoraces, avis Balarium insularum peculiaris, sicut Alpium pyrrhacorax luteo rostro niger et praecipua sapore lagopus.

XLIIX: THE NAMES AND NATURES OF MANY BIRDS

...AND AMONG THE Alpes: where also the plungeons of Bald-Ravens bee, which heretofore were thought proper and peculiar unto the Baleare Islands: live the Pyrrhacorax (ie: the Red Raven) with the yellow bill, was supposed to breed onely among the Alpes; and with it, the Lagopus, a daintie bird and most pleasant on the dish.

LXVIII: RARE BIRDS FOR THE TABLE

...It is even caught in the neighbourhood of the Alps, where also Cormorants occur, a bird specially belonging to the Balearic Islands, as the Chough, black with a yellow beak, and the particularly tasty willow-grouse belong to the Alps.

- (3) 111: ambulant aliquae, ut cornices; saliunt aliae, ut passeress,
merulae;

XIIXL: OF THE GAIT AND FLIGHT OF BIRDS

Some walk their stations, as Crows and Choughs; others hop and skip, as Sparrows and Ousels.

LIV: FLIGHT AND GAIT OF VARIOUS SPECIES OF BIRDS

Some walk, as crows; others hop, as sparrows and blackbirds,...

Three points arise: Pliny in (2) is referring to the Alpine Chough while Aristotle refers to the Chough; the use of the word 'Chough' instead of 'Jackdaw' for Monedula and Cornices in Holland (1601), and is regarding the Jackdaw as a thief. Pliny's yellow bill was to confuse "field naturalists" for centuries (eg Pennant, 1776) who could not reconcile field observations with the accepted truth of the classics. The latter two form the basis of this section, and their legacy considered in subsequent sections (especially 4, 5, 6).

5:2:3 Development of Monedula and Graculus

The earliest references to Monedula use the spelling Monerula (Thesaurus Linguae Latinae 1973-9), Oxford Latin Dictionary 1968-82) which was used by T. Maccus Plautus (died 184 BC) in Captivi (Nixon 1916) and as a term of endearment in Asinaria (Nixon 1937).

All subsequent references use the form Monedula with its monetary association. The first known case is in Cicero (106-34 BC), Pro Flacco xxxi, 76; 'cum vero coronam auream litteris imponebant, re rera non plus aurem tibi quam monedula committebant'. Malpet (1567) translates this as; 'I would commit money to the custodie no more than I would to a Daw'. Whether this oration was responsible for the change in the use of the word or was simply reflecting contemporary usage is not known. The only prior example is in Greek (Lucian 'Fugitivi' 30,3, Macleod 1980). But the use of this quotation as an illustrative example is beyond doubt; the best example

being in the 'Metamorphoses' of Ovid (43 BC - 17 AD) Book 7, 48; (Innes 1961) 'accepto, quod avara poposcerat auro, mutata/in avem, quae nunc quoque diligit urum, nigra pede nigris velata monedula pennis'. Innes (1970) translates this ; 'and the land which Thracian Arne wickedly betrayed. After this girl had received the gold she greedily demanded, she was changed into a bird, the black-footed, black-winged Jackdaw, and even as a bird she still loves gold'.

With one exception (the thieving Graculus and the statue of Priapus LXI, 10. Martin 1914), the usage of the form Gracculus is not associated with thieving, but the 'reputation' of the Jackdaw (and thus, by mistranslation of the word, the Chough) as a thief in literature until recent years was set. In Horace's 'Epistles' (Wilkins 1937), the form Cornicula is used.

In section 8, an examination of Early Modern to Modern literature, translations of Ovid, Homer and Vergil are compared to show the effect of contemporary attitudes and understanding ^{upon} / their translations.

Apart from the references in Aristotle and Pliny, there are no references to the Chough in Greek and Latin literature.

5:3 OLD ENGLISH REFERENCES. 5:3:1 Introduction and Aims

There are no references to Choughs in Anglo-Saxon literature or Old English glossaries. This may reflect the literary and heraldic connections between Choughs and the Celtic culture which was at this time concentrated in Cornwall, Wales and Strathclyde. It is therefore possible that the majority of birds referred to in Anglo-Saxon writings reflect those parts of England which they had invaded, and more importantly, those species that they were familiar with in their homeland, in Germany. All references found as a result, refer to Chough (= Jackdaw).

This section aims therefore to list all known references to Choughs (=

Jackdaws) in Old English in order to provide a basis for the study of the development of the word 'Chough' during this period, and where possible, to place the word in its appropriate literary context.

5:3:2 Choughs in Place Names

The form Ca is only found in place names, where it is combined with other elements (Smith 1956, Campbell 1972). These are cited in Kemble's (1845) 'Codex diplomaticus Aevi saxonici' and de Gray Birch's (1893) 'Cartularium saxonicum';

- (1) Grant by Aethelwulf... land at Chert/Chart in Kent, 18 May 843, (CS vol ii, no 442) 'qui in nostra saxonica lingua denbera rocantur detigden lidigen meredenn uddanhan cadaca hrygc heorattleag hpitan'.
 - (2) Grant by Eadgar... land at Wyttnange/ Witney at River Wensisc/Windrush Oxford 969 (CDAS vol iii, p48, CS vol iii no. 1230) 'and lang broces on ða myðy of ðas gemyðon on ceahhan mere, ðonon on Lythlan eor ðbeorg'.
 - (3) Statement by Oswald, Archbishop of York... lands taken from Ofley, Ripon and Sherborn Co York, 972 (CS vol iii no 1230) 'þis is genumen of scireburnan cearedes holm healf. ʒ capuda healt ʒ gisferþes daell hyrðe aefre into scireburnan. ʒ healfe scne þe gelyreþ into scireburnan'.
- As an example, the second quote roughly translates to '...and long use assured of the land where the Ceahhan (meaning Jackdaw) Stream joins the sea.' The old English Ceahhetan means 'to laugh loud or to laugh in a cackling manner' (Toller, 1921), indicating that the saxon naming of Jackdaw refers to their garrulity.

5:3:3 Glossaries

GLOSSARY SOURCES;
 Wu; Wücker (1884)
 Wr; Wright (1857)
 Sw; Sweet (1885)
 C ; Cockaye (1864)
 S ; Somner (1659)

DATE	SOURCE	LATIN	OE
C 7-8	Epin/Erf; SW	Cornicula	Chyae/Ciae Cyhae
C 8	Wr	Grallus	hroc
C 8	Codex St Galli: C	Garrula	hroc
C 10	Aelfric: S,Wr,Wu	Gracculus,vel Monedula	Ceo
C 10-11	Wu	Cornicula	Cio
C 10-11	Wu	Grallus	hroc
C 11	Wu	Cornicula	Cio
C 11	Wr	Graullus	hroc (2 glosses)
C 11	Wr	Cornicula	Cyo

C 11	Wr	Grallus	hroc
C 11	Wr	Graucolus	hroc
C 11	Wr	Grallur	hroc

Whether the bird 'hroc' is in fact intended to be a Jackdaw is open to question since all references in Bosworth and Toller (1898), Toller (1921) and Campbell (1972) in fact refer to the Rook.

The use of the form Ca as a place name element indicates that the Jackdaw was regarded as distinctive and familiar enough by the Anglo Saxons to be used as a descriptive feature in local geography. From the 7th Century to the mid 10th Century, the phonetic forms 'ca/cae' were used. Later uses, from the 10th to the 11th Century, used the form 'ceo'. This indicates that a gradual evolution in the spelling and the pronunciation of the Anglo-Saxon word for Jackdaw took place in the development of Old English.

5:4 MIDDLE ENGLISH.5:4:1 Introduction and Aims

Whereas prior to the Norman Conquest, Old English and Latin were used in official matters, after 1066 English was not used in the workings of the Church and the State. In its place, Latin and French were used, and English was relegated to being the everyday language of those people without a place in the official business of contemporary society. Middle English was thus to remain a vernacular language until the end of the 14th Century.

As a result, many of the texts cited in this section must have been intended for being read to those who knew no French or Latin. The 'Canterbury Tales' by Chaucer (1387-1400) mark the return of English as the language of all classes in England. By the start of the House of Tudor and the Early Modern period (1500-1800) the ascendancy of English over French was complete. Thus for the purposes of this section the period covered ranges from 1066 to 1500.

This section aims to examine the development of 2 Chough (= Jackdaw)

epithets; 'the Chough is mad' and 'the Chough is the devil' that were not used in later writings except as verbal fossils. It further aims to trace the origins of the phrase Cornish Chough, and its contemporary meanings. Finally, all Latin to English translations found are listed in order to summarise changes in the word 'Chough' during the period.

5:4:2 Origins of the word 'Chough', 2 early epithets

This period is marked by the emergence of the word 'Jackdaw' (covered in Section 5), the first mentions of Choughs via heraldic literature and a consolidation of the legends of thieving propensities.

Earliest references to Chough (= Jackdaws) are based on the theme of being the devil, or at least devilish; presumably because of its black appearance and by implication from its garrulous habits. Both elements come from religious tracts; the *Ancrene Riwe/Wisse* - a book of instruction for nuns, and the *Lives of the Saints*, form the South English legendary.

Six known manuscripts of *Ancrene Riwe/Wisse* occur (Dobson 1975). The earliest: *Ancrene Riwe* BM Cotton Cleopatra C vi 1227-8 (Dobson 1972), BM Royal 8 C1 (pre 1247, Baugh 1956) which is similar to the BM Nero A XIV, 1230-1250 (possibly later, Day 1952), do not contain any mention of the bird. The *Corpus Christi* Cambridge MS 402, 1228-30 (Tolkien 1962) reads;

þe hen hwen ha haveð ileid. Ne con bute Cakelin and hwit bizet
ha prof kimeð þe KAVE ananriht ʒreave hire hire eairen. ʒfret of þ
schulde forð bringe cwike briddes. Al riht al swa þe CAVE deouel
bereð awai from cakelinde ancres... (M 66-7). This was
translated into modern English by Salu (1955) as:

THE CUSTODY OF THE SENSES

What does the hen achieve by that? The Chough comes at once and takes her eggs away from her, and eats the eggs which should have brought forth living birds. In just the same way the Chough, that is the devil, steals from cackling anchoresses...

The other MS versions, MS Pepys 2498, al400 (Zetterson 1976), refer to the keme which Kurath *et al.* (1965-) regarded as a weasel, and BM Cotton Titus D IVIII, 1225-1250 (Mack 1962) refers to the Jeape.

The Corpus text is considered to be a revision of the Cotton Cleopatra MSS which is thought to be directly descended from the now lost original text written between 1190-1225 (Dobson 1976) and so the reference to the Chough (= Jackdaw) is probably an interpolation by an individual scribe, re-interpreted by later writers as in MS Pepys and MS Titus.

In the lives of the saints, 1305-10, BM MS Harley 227, and Corpus Christi Cambridge MS 145 (Furnivall 1862), the theme is re-introduced under the passage on St Edmund the confessor; (lines 184-6)

As hi come in a gret faleye; blake monkes he sez
As hit crowen and chozen were; felo bi þ'eiranhez
A lute blac sac an pez hit were; among hem þis foweles, here

Furnivall (1862) summarises this as; 'How the devils like a flock of Choughs and Crows, tossed about the soul of a dead sinner of stagrene'. In other versions - Lydgate (1461), MS Ashmole 46, and BM Cotton Julius C IX (Evelyn & Hill 1956a, 1956b, 1959) - the word monkes is substituted by foweles.

While there is no evidence in either work of any influence from the classics, this is more apparent in the later middle English writers. Alain and Chaucer's 'Parliment of Foweles' are discussed in Section 6. In Chaucer's 'Wife of Bath' (1387-1400 according to Coghill 1951), in the prologue, lines 231-2 from the Hengwrt MS 154, Aberystwyth (Blake 1980);

A wys wyf, if that she kan hir good, Shal bere hym on hond the
cow is wood. Translated by Blake (1980) to; "a wise wife, if she
knows what is good for her, shall persuade him that the Chough is
out of its mind".

This is part of a fable where the Chough (= Jackdaw) tells the husband of his wife's infidelity, the wife convinces him that she is in the right and the husband wrings the bird's neck. According to Skeat (1900) it is based on contemporary medieval tales, often based on parrots, and in that form is mirrored in the Manciple's tale (Robinson, 1933, Blake 1980). The Glasgow MS (Manly & Rickert 1940) uses the word 'cok' instead of 'cow' but this would appear to be an error by the scribe since all previous and subsequent editions such as the Caxton printings (?1478, ?1484, ?1492, 1498) use the 'cow' form.

None of the other known MS versions cover this section. Roy and Barlowe (1528 'Rede Me'), a dissident religious work, use the saying in a 'brefe dialoge betwene two Prestes, watkyn and letraye'.

W: How come they to kynred fo nye
 L: Because they can flatter and lye
 Makyng belev the cove is wode
 W: They cannot lye though they wolde.

In Awdelay's (1565) 'Fraternite fo Vacabondes', the fourteenth of his 25 orders of knaves is;

"Gyle Hather is he, that will stand by his maister when he is at dinner, and byd him beware that he eate no raw meate, because he would eate it himselfe, this is a pickthanke knave, that would make his maister beleve that the cove is wode".

In each case the use is in the broadest sense correct but the spelling and word usage archaic with respect to the rest of the text, thus using it as a verbal fossil or standardised saying as opposed to a part of the text.

John de Trevisa has two translations to his name referring to Choughs (= Jackdaws); 'Plychronican Randulphi Higden' is discussed in Section 5, and Bartholomeus de Glanville's 'þe proprietatibus Rerum', a 1398, a work of natural history (BM MS Add 27944, Kurath et al. 1954-) has:

fol. 141 b/a "...alle foules of raveyne kynde as chowghes, crows rookes and ravenes and pyes of þe which aristotles saw..."

fol. 324 a/b ...choughes hunteþ by day and eteþ oule eiren, and þe oule eteþ þe Choughs eyren by night and fighteþ þ^o foze alkey eiper wiþ oþer by cause of here eyren as arisiotel seiþ...

Although Aristotle also mentioned the existence of Choughs, it merits no mention in Trevisa, demonstrating the lack of knowledge about the bird at the time. The work also shows a complete dependence on previously published ideas, and the consequent stagnation of innovatory thought in medieval ornithology.

The Chough (= Jackdaw) and Owls theme is restated in 'Hortus Sanitatis' (5 editions from 1490-1517, plus 2 undated editions), and as shown in the transliteration by Seager (1896, 1972) below, Chaucer's 'cow is wode' also appears:

Book ii, Chapter LXXX

The Daw fights with the Owl, because the owl has but weak sight by day; for this reason, the Daw carries off the Owl's eggs and eats them. Its flesh causes itching in the head, for itself loves to be scratched on the head.

Book ii, Chapter LX

It is said to go mad often; so that it often hangs itself in the forked branches of trees.

Maunderville's 'Travels' c1400, BM Cotton Titus CXvi, and Hamelius (1919) mentions Chough (= Jackdaw) in a collective sense, in Chapter 9 from Cairo to Sinai. Confirming this to be Jackdaws, the habitat in the area is unsuitable for Choughs and well outside any known range of distribution, (Voos 1960, Atlas, Birds of Western Palaertic 1982);

And þat plentee have bei the myracle of god for the ravenes and the crowes and the choughes and the oþer foules of the countre assemblen þem þere every gear and flen þider as in Pilgrymage And eoerych of þem bryngeth a braunche of the Bayes or of Olyue in ere bekes in Stede of Offfryng...

The passage goes on to describe how they make olive oil from twigs. This may have some relation to latin accounts and fables about Jackdaws and olives (Wentworth Thompson 1895). Hamelius (1919) regards this as a mistranslation and adaptation of various sources.

The song/verse 'Today' 1400- (a 1500, Wright 1857) is the first known verse to include collections of birds including the Chough (= Jackdaw) yet avoiding the order laid out by Alain/Chaucer (Section 6). For the sake of brevity, only the appropriate latin elements from the BM Harleian MS 1002 are included; folio 72r

To day in the dawnyng,
 I hyrde the fowles syng,
 The names of hem it likyt me to myng:
 The parterygge, the fesant, and the Sterlgnge,
 The quayle, and the goldefyng, and the lapwyng.
 The thrusche, the maveys, and the wodewale,
 The jaye, the popynjaye, and the nyghtyngale,
 The notthache, the swalowe, and the sernow,
 The chawze, the cucko
 monedula entnti
 The rooke, the revyn, and the crow.
 Athong alle the fowles that madengle,
 The reremouse and the owle cowde I not see.

5:4:3 The Cornish Chough

The first references to Cornish Choughs per se come from heraldic literature and verse using heraldic allusions. Because of the strong Cornish connotations, only Cornishmen were allowed to bear arms featuring Choughs until the sixteenth century (Warnes 1983a).

The term Cornish Chough was used until the eighteenth century in order to prevent confusion with Chough (= Jackdaw). The first heraldic mention occurs in Nicholas Upton al446 'De Studio Militari'. A published version of the original (quoted below) came out in 1651, the earliest MS is Ashmole 806 dated c1450, made at the request of Duke Humphrey of Gloucester who died in February 1446.

LIB IV DE GRACULO

Graculus avis est que eciam monedula vocator secundum quodfam. Quam multi falso opinantur eandem aven ette garrulum, cum magna instantia inter fe dittherant garrulus + graculus. Nam garrulus ex diver sis plumis in colore fit distinctus, graculus vero avis est unuis coloris, hoc est nigri per totum corpus. De genere enim cornicus est graculus, licet minor sil corpore. Libenter nidificat informinibus altorum turrium, + hoc in magna multitudine. Optime enim aves iste libi invicem compatiunur. Avis auten nimium clamosa, maximea tempore coitus, sunc nateuius seminan cibatur. Carnes enim pullorum ejoscom eftibiles sunt, maxime tamen quando exoriantur. Istarum autem qvium diserse sunt quando excoriantur. Istarum autem avium diverise sunt nature. Nam quedam in rostris + pedibus sunt nigre, quarum major est habundantia. Alie autem sunt que in rostris + tibiis rubescunt, que graciliones sunt. Et hee specialtier in cornubia reperiuntur, quas aliquando nobiles de cornubia in Armis suis partant, ut est notum: sic ergo sicut a nomine est argumentandum, ut F. de legatis ii, L. nonaliter XVI. q prima, fi cupis: sica patria argumentare proflumus. C. de epi & de. l. decernumus, & F. de officio prefect, vobis, L. studentibus Item aliquando per signa ducimur ad cognitionem siganti, ut C. de Latina lihertate coll L. l. Ø fed & qui. Item per figua exteriora infertiora demonstratur F de supellectili legata, L. labio F. de Edilico edicto, L. fl. tamen & ei qui Quod eliam probat magister Historaum terico Regum in principio, opi agit de mort David, dicens quod viri bellatones in signia exteriora cognosci poterant portantes quales essent, sic ergo in laudem gentis + patrie Cornubiensis, que gens recte a Trojanis traxit origine, ab immitatione, ut creditor, ad hue perfevrat, quidam antiquissimi mobiles ipisus patriae istas aves in Armis suis portant, que quidem aves specialiter illa patria sunt reperte.

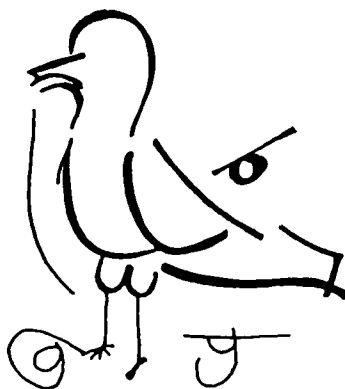


FIGURE 5:4;1.

THE CHOUGH IN HERALDIC ILLUSTRATION ;THE ARMS OF "THE LORD SCROPPE"
CIRCA 1449 (FROM BARNARD 1925) .

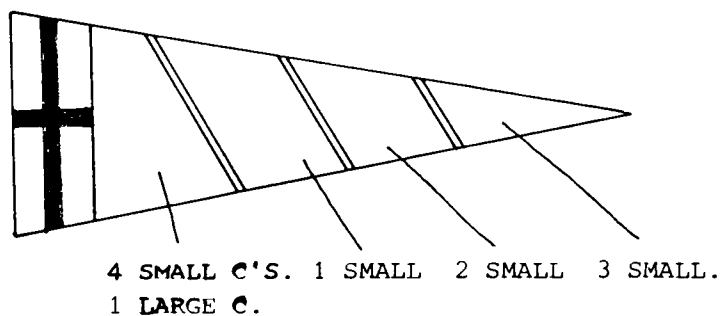


FIGURE 5:4:2.

THE CHOUGH IN HERALDIC ILLUSTRATION ; THE STANDARD OF "THE LORD
SKROUP" IN THE MID FITHEENTH CENTURY (FROM J.BENTLY, EXCERPTA
HISTORICA 1831) .

The MS Ashmole 806 is in English and is a *précis*, and thus does not go into individual birds; the same applies to the first printed version which is included in Dame Juliana Verners 'Boke of St Albans' 1486 under the section 'Here begynnyth the blathynge of armes'. The first complete translation was by Blount c1500 MS Eng Mit d. 27, transcribed by Barnard (1900-1931, 1931) MS Eng Misc C. 152 F 1-783.

OFF THE CHOWGHE

The chowghe is a byrde of blacke colowre all the body, so most lesse than a crow, he byldeth hys nest gladly in holes of hyghe turrettes, and soodoth a grete multitude to gether of them, for one of them can suffer a nother and be content to company to gether very well. They be very clamorouse byrdes and full of crying, and specyall in type off generation, and than the male fedyth the female. The chekens of them be goode mete. When they be slegne. Ther be dyverse kyndes of thes byrdes for some by blacke in ther byllys and legges, wherof ther is great abundance; and some be rede in ther bylles and fete, which be smaller than the other and but few of number. They be most in cornwall, and dynote gentylmen, as hit is knowyn well ynoghe, ware wont to bere them in armes which was a token that they off Cornwall cam of the troians; ffor thes byrdes was ffounde pryncypally in troye, and therefore as yett meny auncgent men in sygne therof bere the same byrdes in ther aremes.

Two points are apparent from the account: firstly, that the author was presumably unacquainted with the accounts of Aristotle and Pliny since the latin 'gracilones' is used instead of *pyrrhocorax* (derived from the Greek *πυρροκόραξ*). Gaza's translation into Latin of *Historia Naturae* was not written until 1447 (earliest printed edition 1476). Secondly, those accounts, as in nature, indicate that the Chough is larger than the Jackdaw not the other way round, as stated by Upton. Upton may well have been acquainted with their works but did not recognise the *pyrrocorax* as the Chough. To this, the first English work to describe the Chough, there were subsequently many references. The 'Trevelyan Papers' vol. 1, prior to 1558, (Collier 1857) in 1449 include:-

The Cornysse (Trevilian) chawgh offt w^t his trayne
Has made our 'Egull Rex, blynde.

Trevilian, or John Trevelyan of Cornish nobility, and Rex, King Henry

VI, relating to a petition requesting the removal of certain persons from the King's presence. Lord Scrope of Bolton also bore the Chough on his standard, thus the usage of allusive names based on heraldic symbols has some degree of overlap. The first reference to him comes from 'Verses on the battle of Towton, 29 March 1461' *Archaeologia* XXIX (1842), MS Trinity College, Dublin D.4.18 (432);

The Fisse Hoke cam into þe felde, w^t ful egre mode,
 So did þe cornyssh chowghe, and brougt forth all hir brode;
 þer was the Black Ragged staf, þt is boþe trewe and goode
 þe Brideid Horse, þe watyr Bouge by þe Horse stode.
 Blessid be the tyme, þat ever God speid that floure!

Greene (1935, 1977) dates this verse as c1460 and includes the spelling 'cornyssh chowghe', thus possibly derived from a differing source. His title was used in King Edward IV's French expedition of 1475 (Barnard 1925, MS Coll Arms 2.M.16) where he is listed under Barons;

The Lord Scroppe - 20 La } at
 A 200 Cornyche chowe } 45

Meaning he supplied 20 men-at-arms +200 archers. His first wife, Jean, was the daughter of William, fourth Baron Fitzhugh who also bore a Cornish Chough on his arms. The Wroxtton MS refers to him as 'The Lord scropitton. Ye Cornsse Crowe' implying that the 'Cornish' prefix was distinctive enough to indicate which bird, within the corvids. The Paston letters of Edward IV (letter 1, (1494) Fennes 1787), state 'he died in 1494 after injuries in action; "Fitz water and Lord Scrop sore hurt".

An armoury of mid C15 (Ancestor iii 1912, BM Harley 2169) shows contemporary differentiation of Choughs and Jackdaws;

20) Six pieces azure with three dowys, with springs in their beaks in the azure pieces.

46) Gold two Corynysch Chowys with beke and fet rede.

Collective names of Choughs (= Jackdaws) were also found in contemporary accounts. In Berner's 'Boke of St Albans' (1486) under 'The companyes of bestys and foules' there is a "Chaterynge of Choughes" similar

Table 5:4:4 Middle English Glossaries and Translations

(1) Translations

Date	Source		
1385	Higden/Trevisa	Monedula	Chouzhe
1432	Higden/Harl 2261	Monedula	Dawe
1482	Higden/Trevisa/Caxton	Monedula	Chowes; Chough
1939	MS St John's camb HI	Monedula	Chowze
end C14	MS Cotton Tib Dviii	Monedula	Chouzwe
start C15	MS Harl 1900	Monedula	Chouzes

(2) Glossaries

P: Promptorium Parvulorum (1440)
 C: Catholicon Anglicum (1483)
 A: Anglo Latin version of C (1470)
 Wr: Wright (1857)

Date	Source		
C14	Wr	Monedula	Chowze
1440	P	Monedula	Cadow
1440	P	Monedula	Koo
1440	P	Monedula	Cough
1440	P	M/Nodula	Coo bryd
1440	P	Monedula	Koo byrde
C15	Wr	Hec Nodula	Ae kaa
C15	Wr	Monedula	Kowe
1470, 1483	A,C	Monedula	Kaa
1483	C	Nodula	Kae
late C15	Wr	Nodus	a Roke
		Monedula	

The final glossary carries on the uncertain translation grallus = hroc found in the Old English glossaries.

to an a1450 (Allen 1930), "A chattering of Choughes" which recalls Upland's 'rejoiner' (1402, see Section 5); "Chidyng with blasfemie or Chyteryng as chowes'. For either bird, the collective name well summarises much of the medieval observations on them.

5:4:5 Identity of pre 1446 'Choughs'

All Old English and Middle English references to Choughs can be confirmed as referring to Jackdaws on the basis of the following evidence.

(i) The word 'Chough' is an onomatopaeia. Both the Jackdaw and the Chough make 'Chough' like calls, but the Jackdaw's is more similar to 'chough' while the Chough's call sounds more like 'chow'.

(ii) References to place names in O.E. treatises refer to habitats that would not be occupied by Choughs.

(iii) Latin to English glossaries in Old and Middle English translate *Graculus* or *Monedula* into various forms of *Ca* or Chough.

(iv) The distinction between the two species in Upton's (a1446) account, and the universal Middle English use of the prefix 'Cornish' when referring to the Chough proper.

Thus the two species can be identified in these references with a satisfactory degree of confidence.

5:5 'CHOUGHS AND DAWS', THE CHANGING OF 'CHOUGHS' MEANING

5:5:1 Introduction and Aims

Until 1402, forms of the word Chough were the only words used in English to describe the Jackdaw. The emergence of the word daw in the 15th century meant that until the 17th century, both Chough and daw were used to describe the Jackdaws. As the previous section has shown, from c1449 Choughs were described by the form Cornish Chough.

This section aims to trace the development and changes of meaning

conveyed by the word 'daw', and how it replaced 'Chough' in being used to describe the Jackdaw. The inclusion of the epithet 'Jack' into the name is also discussed.

5:5:2 Origins of the Word 'daw'

First usage of the word 'daw' originates from the Old Lower German word Ca-dawe (Murray 1880). In Middle English, the word was used to mean dawn. The first example of this being in Lazamon's 'Brut' (a1225 (a1200) Brock and Leslie 1963); 'A marven po hit dawede + dai com to folke' and subsequently, by (for example) Palerne c1350 (Madden 1832, Skeat 1867); 'til it dawed to day 7 funne to 0p rise'. Barbour c1375 (1616 and 1790 editions, Skeat 1870) and Mallory c1440 (? a1400 , 1498, Brook 1865). In late Middle English and during the Early Modern period (as defined by Thomas 1983), this usage died out, the last example being in c1500 (Stevens 1961, Preston 1975, BM Add MS 5465), and it was instead used to signify a fool; 'Dawish, and brainlesse, cruell and murderers' (Hyrde 1592). Examples rang in time from Towneley (a1500 (a1460) ed. England and Pollard 1897) to Bale (1543) and Smythe (1596). When the word became commonly used for Jackdaw, the 'foolish' connotation was often used, especially by Shakespeare as shown in 5:7.

The first usage of daw to mean Jackdaw was in a word play by Upland in his 'Rejoinder' to Friar Daw Topias (1402, Rolls series 1861);

Cursynges and falseglose,
Chidyng with blasfemie or chyteryng as chowzes.
Thow saist thi name is Daw, it may rith wel be so ffor thous has
condiciounes of a (tame) chowze.
He chiterith and he bribith all that he may gete; this he doth
indeed asseye of hem that knowith.
Jack Dawe, thou blaberist blasfemies, and reasons has thou non;

Not only does Upland call Daw a Chough (= Jackdaw) but he may be alluding to the 'Chough is the devil' element in the Ancrone Riwe discussed in 5:4:2. The combination 'Jack Dawe' was not to be used again until Bale (1543). The effect of this new word usage can be judged in part by looking

at two translations of the 'Polychronicon Randulpho Higden' (Lumby 1872).

Two relevant sections occur;

(i) (P. 306) '"Ave Ceasar, victor, imperator". Miratus Ceasar officiosam avem, viginti millibus numorum emit eam... Quid videns quidam pauper sutor stagebat un monedulam, instituet ad consimilem salutationem'.

Trevisa translated this in 1387 (MS St Johns Cambridge HI, dated 1393, Lumby 1872) to;

"þanne a poor sowtere founded to teche a chouzhe to speke and seie þe same salutation; and whan he hadde spende what he hadde, hope travaille and cost". But at þe last þe chouzhe bygan to speke and seide þe same salutation, and Cesar passed by and seide hit and seide "we have þ (at home) such salutations i-nowe". "Alas", quod þe chouzhe, as it fel in her mynde, "al is lost, boþe travayle and cost". An Cesar lowth, and bouzte þe chouzhe derer þan eny of al þe opere'.

In an anonymous translation of 1432 (Ms Harl 2261, Lumby 1872) daw(e) is used instead of chouzhe;

'A poor sowter perceyvenge that, informed a daw(e) to speke in lykewise; which was wounte to say the bridde was not willenge to speke. "Nou such specke and attendunce is perechede". After that the daw(e) perceyvenge to come to the place of her maister, saluted him lykewise...'. (2) (p307) 'Appolinaris discipulus petri, Ravennam nuper missus, passus est. In cujus natali corvi, cornices, monedulae et omni parte undique confluentes, singulis annis quasi ex conducto conerunt quibus eadem die'. Trevisa translates this as; 'Appolinaris, Peter his disciple at was some time i-send to Ravenna, suffereþ deth. Everiche zere in his forte day ravons, crows and chouzhes comeþ þider to glidres out of everiche side, and it were covenant y-made; and þat day as it were by custome as i-zere hem'. In MS Harl 2261, this was translated as; 'The disciple of Peter, Apollinaris by name, suffered passion, sende to Ravenna but a lytelle season atore; in whose day the ravens, crows and dawes gedre þer a grete multitude, to whom the carion of an horse is ziffen as a consuetude'.

A point of interest here is the relative constancy of the form Daw(e) compared to the Chough. For, in the other MS versions of Trevisa's translation, a number of other forms are found;

MS	(1)	(2)
Harl MS 1900 start C15	Chouzhe	Chouzes
Cotton Tib D vii end C14	Chouzwe	Chouzwes
Caxton 1482 folio	Chough	Chowes

5:5:3 Dual Use of Daw and Chough

The overall change of use of Chough (= Jackdaw) to daw/Jackdaw was slow and irregular as the glossaries at the end of this section show, the next translation to use daw being in the 'Catholicon Anglicum' of 1470/1483; 'A Dawe, Monedula' (Herrtage 1881, BM MS Add 15,562). By 1543, Bale implies that its usage must have become commonplace;

'If euerye pope schuld have home ageyne the fedder he hath put unto, yt yt schuld be a very naked monstre, not at all unlyke Ynto isopes choughe, whom we commonlye call Iack dawe'. A note in the margin states;

'A creature of the popes creation', thus restating the Chough (= Jackdaw) and the devil theme in the Ancren Riwe/Wisse and St Edmund MSS, discussed in Section 4. It is probably for the better that this theme has not been subsequently taken up, for as Chapter 6, Section 7, demonstrates^{that} persecution was at too high a level without the added effects of religious persecution.

John Heywood's poem 'Of a Daw', no 26 in his 'The first hundred Epigram' (1556, and Munsterberg 1980 for a modern version) made full use of the dual meaning of bird and fool;

With a croossebowe late in hand readie bent
To shoote at a daw in a tree, I went.
Saying to one by: I will assaie to hit
Yonder I see a daw, if shee will sit.
She is, if she sit, a daw indeede (quoth he)
But if she sit not, what is she than saide he?
A daw also (said I). Than said he I see,
Whether a daw syt, or whether a daw flee,
Whether a daw stand, or whether a daw crie,
In what case so ever a daw, persever
A daw is a daw, and a daw shall be ever.

The author wrote a number of other epigrams on Jackdaws, which are quoted in Section 8. The duality of Chough and Jackdaw use at this time is best seen in Shakespeare, and discussed in detail in Section 7. Further evidence for the form Jackdaw gaining ground is found in contemporary etiquette books, for example Wilson's 'The Arte of Rhetorique' (1556) refers to faults in pronunciation; 'Some grontes like a hogge, some cackels lyke

Henne, or a Jack Dawe'. Thus again a reference to its garrulity, as in Florio's 'A worlde of Wordes' (1598), an Italian - English dictionary. 'Gracchiare' is translated to 'to cackle as a Chough: to raile, to prate; to tattle' and 'Gracchia; the bird we call a Chough, or a dawe. Also a blab, a pratler, a tatler'. But the change of use was at the time limited to the more literate elements, since the greater linguistic conservatism of provincial dialects meant a slower change: Penhallurick (1978) cites a case of Chough (= Jackdaw) being used in Devon in 1768, while ⁱⁿ remote villages in Cornwall such as Mousehole, Chough is still used for Jackdaw, and Cornish Chough for the now locally extinct species (Penhallurick 1978, Darke 1971). The more archaic form 'Caddowe' (see Section 8) was in use in rural areas last century. Wright (1898, 1970) cites ten variants of Caddow, mainly from Norfolk and Suffolk, and also in Lincolnshire and Yorkshire. No subsequent surveys have been made, so its status is uncertain.

The occasional incorrect use by the supposedly 'better informed' is shown in a lecture by Ruskin (1832, 1852);

'but left his warehouses without a roof. The rain floods your warehouse, the rats frolic in it, the spiders spin in it, the Choughs build in it, the wall plague frets and festers in it, and still you weave, weave'.

This may be a reference to Choughs nesting in ruined buildings, eg Goldsmith (1774, et infra); 'it frequents rocks, old Castles and Churches by the sea-side' but not many old factories occur by the sea, especially near Manchester. Thus Ruskin was either ignorant of the usage change, or used a verbal fossil to support his imagery.

Returning to the duality of usage, a good example is found in Malpet's (1567) 'A Greene Forest';

Of the Caddesse or Chosse

The Cadesse was first called Monecula (sic) and is now called Monedula because it in finding money and golde hideth it. And upon this Tullie in his oration had for Valerius Flaccus hitteth him home with the like.

'Non tibi pecunia est committe~~ndum~~ndum quam Monedulae.

I would commit money to thy custodie no more than I would to a daw'.

From 1556, the spelling 'daw' becomes increasingly the norm as seen in an anonymous lute madrigal of 1606 (Munsterburg 1980); 'The little daw, ka-ka he cried'. The same applies to the form Jackdaw. Holland's (1601) translation of Pliny (see section 2) is spelt 'jackdawe' Merrett (1666) is the first to use the modern spelling, as did Ray (1675) in his lists in the 'collection of English words, with catalogues of English birds and Fishes'. Such was the standing of Ray and Willoughby in contemporary ornithology, that their spellings were often used by subsequent authors.

At the same time, with the (jack) daw form coming into vogue, a number of writers applied it as a suffix to the Chough, in the form Cornish daw. This usage was popular with travelling writers in accounts of visits to Cornwall; for example Mundy (1654, Penhallurick 1978) and Taylor (1649) who found them near Redruth;

I saw nothing strange to me but a few Cornish Dawes (or Choughes) with his red bills and legs: they saluted me upon the wing; just in the language of our Jack Dawes about London, ka, ka'.

With the Chough in decline, and an even more advanced decline in the usage of the word, it may have appeared to late seventeenth century authors that 'daw' was more evocative than 'Chough' in conveying the bird's physical impression. Hunt (1815) mentions Chough-Daw and Chauk Daw. The latter was derived from a local Cornish name 'Chauk' (Penhallurick 1978, Greenoak 1979). Lhuyd (1709) mentions another form 'tshawk' as well as Cornish Daw. The Scottish form 'ka' for Jackdaw, used by Stewart (1571-7, Turnbull 1858) was used by Sibbald (1684); where Monedula was translated to 'jackdaw, kae' and the Chough as the 'Cornwall kae'. The latter reflects the lack of contemporary knowledge about the Chough's distribution since at the time it

was relatively widespread in Scotland.

None of these forms held, probably due to the increasing recognition of the substantial differences between the two species. Forms like the Red legged Crow/Chough (Montague 1802, 1813, 1830) and the Cornish Chough have lasted better, being more appropriate, especially the latter, since, not surprisingly, it is a popular form of usage in Cornwall.

5:6 THE THEFE THE CHOWGTH; ADVERSE LITERARY EPITHETS

5:6:1 Introduction and Aims

Unlike the 'Chough is mad' and 'Chough is the devil' epithets attached to Choughs (= Jackdaw) in Middle English Writings, the 'thief the Chough' epithet not only continued to be used in the Early Modern Period, it also was used for the Chough proper. Two new epithets were added in this period; a fondness of glitter and fire-raising habits. These 3 epithets were responsible for giving the Chough a poor reputation in many works of natural history. What is of interest is the fact that some of these works included the most respected contemporary naturalists (eg Pennant 1776 and Montague 1802) and thus were widely believed. Thus, the low esteem in which these books held the Chough may have played an important role in initiating and sustaining the persecution of the Chough (see 6:7:4).

All references to these epithets in works of natural history need to be examined, noting which authors omit to mention them, and which authors simply borrow the epithets from another source. Thus the origin, sustenance and ending of these epithets are examined alongside the causal factors for their usage, and how such obvious untruths can gain currency in works of natural history.

5:6:2 Origins: Fire and Theft

From Camden's (1586) 'Britanica' to Selby's (1833) 'British

Ornithology' most accounts of the Chough referred to its habits of stealing, fire raising and its attraction to glitter. As a result, / ^{Choughs} were held in low esteem as best seen by Defoe (1769) when writing about Land's End in Cornwall in 1724;

'Upon this remote part of the island we saw great numbers of that famous kind of Crow which is known by the name of the Cornish Chough, or Chough so the country people call them: They are the same kind, which are found in Switzerland among the Alps, which Pliny pretended, were peculiar to those mountains, and calls the Pyrrhocorax; the body is black, the legs, feet and bill a deep yellow, almost to a red; I could not find that it was affected with any good quality it had, nor is the flesh good to eat, for it feeds much on fish and carrion; it is counted little better than a kite, for it is of ravenous quality, and is very mischievous; it will steal and carry away anything it finds about the house, that is not too heavy, tho' not fit for its food; as knives, forks, spoons and linen cloths, or whatever it can fly away with, sometimes they say it has stolen bits of firebrands or lighted candles, and lodged them in the stacks of corn, and the thatch of barns and houses, and set them on fire; but this I had only on oral tradition'.

The inaccuracy of this account can be shown by, for example, the diet; in fact they feed mainly on soil arthropods (Roberts 1982a), and the yellow bill is only found in Pliny's Alpine Chough; the Chough has a red bill. Penhallurick (1978) cites a number of sixteenth century cases where confusion between Pliny's 'truth' and nature reigned. The association of corvids with fire appears to begin with Pliny mentioning crows setting thatch alight in Rome, and in the Chronicle of London 1089-1483, which notes that in 1202 'ther were seyen fowles fleyeng in the Eyre beryng in hire billes brennyng coles, that brenned many houses' (BM Cotton MS Nero CXI, Thomas and Thornley 1938, 1983). According to Ellis Davidson (1976), legends about Roman soldiers using birds to carry lighted sticks in order to burn down houses may have originated from their use of carrier pigeons. This story reappears in Nordic Mythology and French Medieval legends. Cam (1916) records a legend of sparrows being used to carry lighted tinder in an attack on ninth century Cirencester. The town was apparently called 'Sparrowcester' for a period after the attack. Burton (1957) in an

investigation into the Phoenix legend, supplements this with anecdotal observations of Rooks using burning embers for anting at woodmen's fires. Since this article has no references, its value is uncertain, as hot embers could damage flight feathers. On the other hand, damp hay stored in haystacks will light spontaneously due to metabolising anaerobic bacteria. This has long been known in farming lore, and before the role of rain and bacteria were understood, stories of crows and fire would appear a plausible explanation. The analogy can be further extended to cover freshly thatched buildings. As well as ^{fire raising by} Rooks, there is a Scottish story of this taking place with Jackdaws, by Stewart (1531-5, Turnbull 1858);

'Wes brynt ilk stik, I can nocht tell zow how;
And sum man said, as I can trow that best
With ane fyre brand ane ka buir till ber hest
That ws brynt, alls far as tha had feill'.

Such occasional incidents real or imagined, are all that is required to fuel a folk tradition, and the connection of these events appears more plausible than Burton's. The Chough's red bill may have been taken as a symbol of fire-brand carrying. There are no accounts of Choughs (= Jackdaw) fire-raising (eg Turner 1544, Malpet 1567) nor any others of Jackdaws doing this. All accounts appear to stem from Cornwall, the traditional stronghold of Choughs, and literature about them. In this area, they played a prominent enough role in country people's lives (see Darke 1971, Penhallurick 1978) to feature actively in their folklore. The two most important accounts are based in Cornwall; firstly Camden's (1586 et infra) 'Britannica' in his section on Cornwall, as translated by Holland (1610, 1637);

'In the rocks underneath and also along the shore every where breedeth the Pyrhocorax, a kind of crow with bill and feet red, and not as Plinie thought, proper to the Alpes onely. This bird the inhabitants have found to be an incendiarie, and theevish beside: For oftentimes it secretly conveith fire-sticks setting their houses a-fire, and closely filcheth and hideth little pieces of money'.

Although substantially rewritten, subsequent translation by Oldys

(c 1700), Gibson (1695) and Gough (1789) do not change this story.

Although many authors have erroneously stated that Camden's material on Cornwall is taken from Carew's 'survey of Cornwall' (1602), this is not the case, as they must have assumed that Holland's (1610) translation was the first edition. Carew's account is even less favourable;

'Amongst which, Jackdaws (the second slander of our county) shall pass for company, as frequenting their haunt, though not their diet. I mean not the Common Daw, but one peculiar to Cornwall, and there through termed a Cornish Chough: his bill is sharp, long and red, his legs of the same colour his feathers black, his conditions when kept tame, ungracious, in filching and hiding money, and such short ends, and somewhat dangerous in carry sticks of fire'.

It appears that these passages formed the basis of subsequent accounts of fire and theft. In contrast to the plagiarism of many C17-18 natural history books, those which relied on verifiable information and field observation omit these. This is the case in Willoughby's (1676) 'Ornithologiae' ^{Libri Tres.} (translated 1678 by Ray). Borlase (1758) was one of the first naturalists to directly question the Chough's 'reputation' by stating that many of its 'crimes' are in fact committed by the Jackdaw, and continues with a somewhat contradictory statement; 'but certain it is that our ancestors thought it (and very deservedly so) in a different manner'. This may be a reference to Camden (1586) and Carew (1602), but that does not explain the transfer of blame from the Chough to the Jackdaw. It is likely that the Chough's 'reputation' lingered on until the 1830's due to the esteem in which Pennant's 'British Zoology' (1766, 1768, 1776) was held. He mentions fire raising, and later thieving, and appears to be influenced by Camden (1586) ^{and} DeFoe (1769).

5:6:3 Theft

Figure 5:9:1 summarises the development of each 'crime'. Although often put together, it can be seen that their origins are disparate. The thieving habits described in the classics (Section 2) were taken up by Isidore of

Seville in 'Origin Etymologium' (602-632, Skeat 1900);

'Monedula dicitur quasi mone-tula, quae cum aurum inuenit aufert et occulat', which translated into English means: 'The Jackdaw is spoken of as a money-taker, seeking along with stealing gold and hiding it'. Alain de Lille (1128-1203) restates this theme, combined with the classification of Aristotle and Pliny (Wright, 1872); 'Illic cornix... Illic pica... Illic Monedula, la trocinio laudibili reculas thesaurizans, innatae a varitiae argumenta monstrabat'.

Moffat (1908) translated this as;

'The crow predicted things to come in the excitement of vain chatter. The dubiously coloured magpie kept up a sleepless attention to argument. The Jackdaw treasured trifles of its commendable thieving, showing the signs of inborn avarice'.

Hugh Bryce wrote 'Image du Monde' in c1245, it was translated into English in the fourteenth century, and rewritten and printed as the 'Mirror of the World' in 1480 by Caxton (see also Prior 1912);

'Of the maner of birdes of this forsaide countress: The chowe whan she fyndeth gold or sylver of her nature she hydeth and bereth it away. And who somtyme heereth her voys, it semeth proprely that she speketh'.

These two accounts form the background sources to Chaucer's (c1381) 'Parliament of Foules'. 14 MS texts are known (Brewer 1972) alongside Caxton's edition of 1477-8. Three of the texts use 'Crow' instead of 'Choughe', due probably to errors in writing. These texts are MS Cambridge Univ. Library Gg.4.27 and Ff.1.6 and MS St John's Oxford LVII. MS Pepys 2006 Magdalene College, Cambridge on the other hand uses the modern spelling of Chough. The other texts run as follows:

'The thefe þe chowgh, and eke the ianglyng pye'.

'Bombardier' (1944) states that the Alain/Chaucer classification of birds was kept until Ray and Willoughby's attempts at a scientific classification (1676, 1678). The influence in literary works relating to nature was even longer lived. In 'The Romance of Duke Roland and Sir Otuel of Spayne' (1440, Herrtage 1880, BM Add MS 31,042), the combination of Chough (= Jackdaw) and Magpie are used; 'Coo ne pye that there comes none', and in Shakespeare's (1606) 'Macbeth' as shown in section 7. Drayton, in 'The

Owle' (1604) uses the line directly;

'The theevish Dawe and the dissembling Pye,
That onely live upon the poorers spoyle'.

Swift's (1706, 1736) 'The description of a SALAMANDER' cites Pliny as the main source, while using the Alain/Chaucer coupling;

'As pies and Daws are often styl'd
With christian Nick-names, like a
Child'.

Thus, the importance of ^{The} 'Parliament of Fouls' is in its giving the thieving legend a literary base, and being the first reference to use the English Chough (= Jackdaw) as opposed to the latin forms. Upland's (1402) 'Rejoinder' (section 5) could be regarded as implying thievish behaviour in using the Chough (= Jackdaw) as a symbol of bad habits.

Isidore's (602-632) influence is seen in the 'Speculum Naturale' of Vincentius Bellovais (c13) which introduces Jackdaws with (1493 edn);

'Monedula dictur q̄si monetula q̄ cū aurū ī venit au fert
coccul lat. Unde cicero p vateriano Flacco. Nō Plus aurum libi
cō monedule cōmittēdū est. Monedula q̄si monetā tollēs.'

Thus simply restating Cicero's oration discussed in Section 5:2:3. The Jackdaw was well recognised as a pest in Britain at the time (Durham Account Rolls 1410-13, Surtees soc. ii, iii, 1898, 1900);

'Pro exclusione (n) odularum ab ecclesia, 3s. 4d'.

Thus only the Jackdaw was regarded as a thief, as shown in Turner's (1554) 'Avium praecipuarum' (Translation, Evans 1903);

'Now the first kind of Graculi, which the Greeks called Korakias, is the Pyrrhocorax of Pliny and the Cornish Chough of Englishmen... the second sort... monedula... which alone of birds as Pliny says, steals. The three kinds do not all steal gold, - only the second (Monedula) does'.

The account is full of contradictions, at one point the Chough has a red bill (Aristotle), at another it is yellow (Pliny)! But at least the 'reputations' of Chough and Jackdaw are clearly differentiated.

The final 'crime' of the Chough (= Jackdaw) was stated by Skelton in Phyllyp Sparrowe (1508, pr. 1550);

'And the churlys the chowgh
The route and the kowgh'.

A churl being a creature of low birth, recalling both the thieving 'reputation' and possibly, Upland's attack on Friar Daw Topias (1402) discussed in Section 5:2.

5:6:4 Transfer of Epithets to the Chough

With the publication of Camden (1586, 1610) and Carew (1602) the 'reputation' was transferred to the Chough. This appears to be because Latin sources were used as the basis of distribution, taxonomic and descriptive data, while the academically disregarded English language and literary sources were used to convey habits and popular contemporary attitudes about the birds. With the pattern set by Camden and Carew, the changes in word use summarised in Section 5 are made irrelevant because of the conservative nature of changing ideas in 'literary naturalists' books. Books using material borrowed from other books to the exclusion of all others (for example Bewick's (1793) dependence on Buffon 1780) meant that changes would not be reported. This is illustrated by Shakespeare's dual use of Chough and Daw and the confusion stem^ming from this, as discussed in Section 7. All this was overlain by a disinclination to be seen to be at odds with the accepted wisdom as written in the classics (Aristotle/Pliny), even where a mistake had been made in substituting Pyrrhocorax for Monedula.

The legal and agricultural consequences of this are discussed in Chapter 6, Section 7. Few people disagreed, apart from Borlase (1758). The habit of Cornish people keeping Choughs as pets (Montague 1802, 1813, 1830) may have helped reinforce the stories, since it is only to be expected that a ground-foraging bird will pick at objects when kept in a confined space. Glitter can be assumed to be a brief way of referring to gold and silver as in DeFoe (1724, 1769).

The legacy of the Chough being incorrectly labelled a pest may have contributed to its ultimate extinction in Southern England. Certainly, being regarded as agricultural vermin while being a local and declining species in the eighteenth and nineteenth century as a result of misattributions did not play any beneficial role.

5:7 SHAKESPEARE, 'CHOUGHS' LANGUAGE, GABBLE ENOUGH AND GOOD ENOUGH'

5:7:1 Introduction and Aims

The plays of Shakespeare contain a total of 14 references to Choughs and Daws, 7 each, of which all but 1 appear to refer to Jackdaws. Thus the works are of value in obtaining an insight into contemporary attitudes towards Jackdaws. The one unclear reference, a 'Chough' in 'King Lear' may also contain a clue to the extent of the Chough's distribution in Southern England at the time (1605).

This section aims to list all references to Choughs and Daws in Shakespeare's works, alongside any variants that occur in the Quarto (Q) and Folio (F1, F2 etc) editions of his work. Where possible all sources are included, and the contemporary opinions conveyed by each passage discussed. Since previous students have been unable to come to any firm conclusions as to the identity of the Chough in 'King Lear', all aspects will be fully examined in order to attempt a conclusive identification.

5:7:2 Plays and Sources

- (1) 'Henry VI Part 1' (1590, Caincross, 1962) II, iv, Warwick;
'But in these sharp quilllets of the law,
Good faith, I am no wiser than a daw.
- (2) 'Love's Labour's lost' (1594/5, rev. 1597, David 1956) V, ii.
'Spring' verse ii;
'When shepherds pipe on oaten straws,
And merry larks are ploughman's clocks,
When turtles tread, and rooks and daws,
And maidens bleach their summer smocks'.

- (3) 'A Midsummer Night's Dream' (1596-6, Brooks 1979) III, ii, Puck;
 'As wild geese that the creeping fowler eye,
 Or russet - pated Choughs, many in sort,
 Rising and cawing at the gun's report,
 Sever themselves and madly sweep the sky'

Q, F, F3: Russet - ated Choughs. F2 Ruffed - pated Choughes.

- (4) 'Much Ado About Nothing' (1598-79, Humphreys 1981) II, iii, Beatrice;
 'Yea, just so much as you may take upon a knife's Point and
 choke a daw withal.
 You have no Stomach, signior, fare you well'.

- (5) 'Hamlet' (1599-1601, Jenkins 1982) V, ii, Hamlet;
 'Tis a chuff, but, as I say, spacious in the possession of
 dirt'.

Q2, F Chowgh.

- (6) 'Twelfth Night' (1601, Lothian and Craik 1975) III, iv, Haluolio;
 'At your request
 Yes Nigtingales answer Daws'.

- (7) 'Troilus and Cressida' (1602, Palmer 1982) I, ii, Pandarus;
 'Asses, fools, dolts, Chaff and bran,
 Chaff and bran; Porridge after meat. I could live in the eyes
 of Troilus.
 Ne'er look, ne'er look, the Eagles are gone; crows and daws,
 crows and daws. I had rather be such a man as Troilus'.

- (8) 'All's well that Ends well' (1603-4, Hunter 1959) IV, i, First
 Lord;
 Not to know what we speak one to another; so we seem to know it
 is to know straight our purpose - Chough's language; gabble
 enough and good enough'.

- (9) 'Othello' (1604, Ridley 1958) I, i, Iago
 'For when my outward action does demonstrate
 The native act, and figure of my heart,
 In complement extern, 'tis not long after,
 But I will wear my heart upon my sleeve
 For doves to peck at: I am not what I am'.

Q1 Doves, Q2, F Dawes.

Standard practice is to use 'daw' but Lyly (translated 1580), the
 source, refers to Turtle doves;

'carry thy heart on the back of thy hand, and thy tongue in thy
 palme, ... I can better take a blister of a nettle, than a prick
 of a Rose; more willing than a Raven should peck out mine eyes
 than a Turtle pecke at them'.

It is doubtful that this refers to 'Lives of the Saints' (1305-10,
 Furnivall 1862) discussed in 2:4. If Shakespeare intended a direct

referral, then Folio and Q2's daw are both typographical errors. The change may have been to reflect upon contemporary opinions on the Jackdaw, as Stevens (1973) comments; 'S. would scarcely have degraded the amiable tribe of doves to such an office, nor is the mention of them at all suitable to the harsh turn of Iago's speech.' It may be that the typesetter agreed, and regarded 'dove' as an error in the script. At this time, Jackdaws were regarded as birds of prey, and with the Kite, the only ones held in low esteem. Also, would a Turtle dove be regarded as capable of harming a heart? The contrast between striking imagery and a 'commonsense' interpretation, means that the bird's true identity remains unknown (perhaps best left to each reader's discretion).

- (10) 'King Lear' (1604-5, Muir 1952) IV, vi, Edgar;
 'Come on Sir; here's the place: stand still. How fearful And
 dizzy 'tis to cast one's eyes so low!
 The crows and Choughs that wing the midway air
 Show scarce as gross as beetles; halfway down
 Hangs one that gathers sampire; dreadful trade!'

F1, 2, 3; Crowes and Choughes, F4: Crows and Choughs, Q:
 Samphire.

- (11) 'Macbeth' (1606, Muir 1965) III, iv,
 'It will have blood, they say: blood will have blood
 Stones have been known to more, and tress to speak:
 Augures and understood relations, have
 By magot-pies, and Choughs, and Rooks brought forth
 The secret'st man of blood - what is the night?'
- (12) 'Coriolanus' (1605-10, poss 1608, Brockbank 1976), iv, V, 3rd
 servant
 'I'th' city of kites and crows? What an ass it is! Then thou
 dwellest with daws too?'
- (13) 'The Tempest' (? 1612, Kermode 1958) II, i,
 'As well as she sleeps; lords that can prate
 As amply and unnecessarily
 As this Gonzalo; I could myself make
 A chough of as deep chat. O, that you bore
 The mind that I do!'

See also 'All's well'. Three other sources exist; 'Erasmus of
 Rotterdam' (Translated Wilson 1688); 'lest those choughs chatter at me',
 'Return from Parnassus' (1598-1601, Leishman 1949) II, Ingenioso;

'Pity it is that gentler wits should breed, where thick-skin chuffes laugh at a schollers needle', and in 'The Marriage of wit and wisdom' (1579, Halliwell, 1846), Idlensis; 'Ah, that drable, she can cackel like a cadowe';

- (14) 'The Winter's Tale' (1611, Pattard 1963) IV, i, Autolycus; 'the old man come in with a whoo-blub against his daughter and the king's son, and scared by choughs from the chaff'.

The 'New Variorum', 'Arden' and 'New Arden' texts provide a summary of C18-20 criticism. The above quotations are from the 'New Arden' edition.

All references, apart from 'King Lear' and 'Love's Labour's lost' convey an unfavourable impression. Apart from 'King Lear' all refer unambiguously to Jackdaws, although the 'Chough of deep chat' in 'The Tempest' would still be an appropriate epithet for the Chough. Last century, there was much debate over the meaning of 'russet-pated' in 'A Midsummer Night's Dream' (see Harting 1860, Newton 1890 and Furness 1895) based on the incorrect assumption that 'pated' was an error for 'patted' and using the contemporary meaning of russet as a form of red, thus meaning red-footed. This argument fails since even today's definition of russet does not cover bright colours, and in Shakespeare's time, it in fact meant grey; 'Faune, tane, rosset, russet or tawnie colour' (Junius 1567), 'Gray, light russet, grizzle, ash coloured, hoarie, whitish' (Florio, 1611). In 'Hamlet', chuff refers (see 2:6) to a fool or churl, or ill-mannered clown. The play on the word fool is used in 'All's Well Ends Well' and 'The Tempest' to combine with the bird's garrulity, consequently being a foolish talker. The other plays' references to implied inland locations, and feeding on grain and chaff, point to their being Jackdaws.

5:7:3 King Lear

Thus 'King Lear's' Chough is the only one with an uncertain identity. If the bird is a Chough, it is important in demonstrating the maximal extent of the Chough's British distribution (3:1). This topic has been widely

discussed (for example; Harting 1860, Newton 1890, Furnivall 1880, Arden Shakespeare, 1930, Muir 1952, Bullock 1978 and Greenoak 1979), but each has been hampered by a narrow compass of information. The discussion below is intended to cover all aspects of the subject.

(1) Suitability of habitat:

Dover cliffs housed a pair of escaped Choughs (Pennant 1776) which survived as a colony until the 1800's (3:1, Kent), when the population was in decline nationally. The site is ideal for both Choughs and Jackdaws, being similar to the once-occupied cliffs at Beachy Head (3:12).

(2) Other records for the Dover Cliff area:

The only other records before Pennant (1776) come indirectly from illuminated manuscripts (Yapp 1978, 1982). Apart from the Alphonso Psalter (Hutchinson 1974, 1970, MS Fitzwilliam, Camb MS 2-1954), which was made in the Welsh Marches in 1309, all relevant illuminated MSS originate from East Anglia, thus classified by Sandler (1974) as the 'Fenland Group' of MSS. Yapp (1981) erroneously goes on to state that this 'strengthens (the) case for their distribution there', this cannot be the case due to the habitat. In fact, the illustrators were trained at Canterbury (Yapp 1981) and thus the natural quality of the MSS would be a clue as to their being drawn from nature, from a native population. The MSS are; a) Peterborough Psalter (c 1300-18, MS 9960-9962, B. Royale, Brussels), b) French Rohan Hours (? 1321-38 BM MS lat 9471, B. Nationale, Paris), c) Holkham Bible Picture Book (? 1327-35, BM MS Add 47682, Hassall, 1954 wrongly describes it as a Blackbird).

To avoid possible confusion with other crows, and Blackbirds, a set of criteria based on the most distinctive visual features of these birds was devised (table 6:7:1). These were selected as being their bill, leg and body colour, and bill and wing shape. In table 5:7:1 these are listed along with their appropriate forms for the Chough. Yapp (1983) discusses simple

methods of identification.

Table 5:7:1

Shape. colour of bill;	long, downcurved and red
Colour of legs;	red (sometimes black is used for all birds)
Colour of body;	all black
Wing shape	in flight only.

The MSS were compared to a verified Chough illustration in 'De Arte Venandi cum Avibus' (1258, Fredrick II of Hohenstaufen, MS Digby, BM 152, a 14th century version) in table 5:7:2. The two British library MSS were compared together, with reproductions of the continental MSS. For the 1258 MSS of 'De Arte', Wood & Fyfe (1955) was used;

Table 5:7:2

✓ conforms to Chough, - cannot be seen, ? uncertain

	Bill colour/shape	Legs	Body	Wings
Alphonso Psalter	✓	✓	✓	-
Peterborough Psalter	✓	✓	✓	-
French Hours	✓	?	✓	-
Holkam Bibe	✓	✓	✓	-
'De Arte'	✓	✓	✓	✓

The quality of the MSS illustrations indicate that the illustrators probably had seen Choughs in nature, as opposed to simply copying from previous MSS. There appear to be no previous illustration of Choughs except in heraldic literature (Woodward 1896, Holm 1688, Jeayes 1905). No information exists as to where the Alphonso Psalter illustrator was trained.

If he was trained at the main Welsh Cathedral, St David's in Pembroke, a large indigenous Chough population would have been nearby.

Merret (1666) gives their distribution as from Dover/Canterbury to Cornwall; 'Coracias: Arist. The Cornish Chough. In omnibus oris maritimis a cornubia ad Doroberinam'. But does this refer to 'King Lear' or the heraldic arms of Canterbury? Since Merrett under 'Graculus vel Monedula' gives the names 'a Jackdaw, a Chough' it appears he underrated the difference between Chough (= Jackdaw) and Chough. The second objection is unlikely since there are no other examples of ^{armorial references} being used in a late 17th century work. Chapter 6:1:2 shows that in the eighteenth century, Choughs occurred from Sussex to Cornwall. Kent, especially around Dover, being the only suitable area to the East of this.

There are two early 18th century texts on birds in Kent. Dale's (1730, based on a MS by Taylor 1676) 'History of Harwick and Dovercourt', concentrates on waterfowl and only mentions 41 species in all. But it would be expected that the Chough would be included when the preface states 'Here I will not give the name of all the Birds... but only such as are either mention (sic) by our Author, or such as are more rare, among which I account all such as frequent the sea'. Perhaps he included the Chough with all corvids, none of which are included. They are not included in a 1759 MS notebook by Austen (BM MS Add 24, 269-70), but this is of little importance since the book concentrates upon the oddities and freaks of nature. If Dale and Merrett are both taken as correct, then Choughs died out at Dover between 1666 and 1730. This is plausible when considering their overall decline from East to West and from populated areas, as shown in 6:2.

(3) Shakespeare's knowledge of the area

Although samphire does not occur at Dover today, Furness (1880) cites several 18th century - 19th century sources; 'sampier... is noted growing at Dover'. The cliff had been extensively used for this 'dreadful trade'. He may have got his information from Camden (1586) for the translation by Gough

(1789) reads; 'soon after you leave Deal, a Ridge of cliffs covered with Crythmus or samphire, runs for about seven miles to Dover'. Geralde's 'Herball' was also written in 1586. ^{It} mentions samphire growing at Dover, and that its leaves are used in salads and sauces. Thus Shakespeare may have used either source. There appears little chance that he visited the area or was given a first-hand account of it by a correspondent.

(4) Association of Crows and Choughs

Both Choughs and Jackdaws will fly with Crows in the wild. The literary association of Crows and Choughs is used by a number of writers; 'St Edmund' (c 1300, BM MS Harl 227, Furnivall 1862); 'As hit crowen and chozen', Higden, trans. Trevisa (c 1380 MS St Johns, Camb, Lumby 1872); 'ravons, crowes and choughes', Bartholomeus De Glanville, trans. Trevisa (c 1398, BM Add MS 27044, Kurath et al. 1954) 'chowghes, crowes, rookes and ravenes', 'Manderville's Travels' (a 1425, BM Cotton Titus CXvi, Hamelius 1919), 'The ravenes and the croes and the choughes', Pliny, trans. Holland (1601) 'crows and choughs'. All as shown in Section 2, 4, and 5 refer to Jackdaws. Shakespeare uses collective names in 'Macbeth' and 'Troilus and Cressida' so the statement could refer to either species, while somewhat favouring by association, the Jackdaw.

(5) Use of the form 'Chough'

Section 5 showed that the form 'Cornish Chough' had been in use since c1449, and thus if Shakespeare intended to use the Chough, he would have used this form. But, 'The Crows and Cornish Choughs, that wheel the midway air' alters the rhythm badly, and even then as 'Cornish Chough' was only sporadically used, it would not have had the immediacy of 'Crows and Choughs'. Although both species are found on cliffs, Jackdaws are also common inland, thus not conveying the image of being at the coast as well as Choughs do.

(6) Conclusions

Shakespeare interchanged the word 'daw' and 'Chough' at will and (excepting for rhyme) without any pattern, to indicate Jackdaws. In 'King Lear' the need for evocative imagery and the circumstantial evidence of the 'Fenland Group' MSS and Merrett (1666), introduce at least an element of doubt as to this 'Chough' being a Jackdaw. What would Shakespeare have gained by referring to a relatively local and obscure species that few in his audience would have heard about? Conversely, it could be argued that the imagery would have provided greater satisfaction for the more learned elements of the public. As a Chough, the effectiveness of the phrase in evoking a verbal picture of being 'at the edge' is greatly enhanced. Thus while it is not possible to draw a firm conclusion today, there must be at least a possibility that he referred to Choughs at Dover.

5:7:4 Attitudes conveyed in Shakespeare's works

The opinion in which Jackdaws were held in Shakespeares eyes was thus almost universally low. In 'Henry VI', and 'Coriolanus', it is taken as a fool, and a foolish talker, in 'The Tempest' and 'All's Well'. It is beneath the station of others in 'Hamlet', 'Twelfth Night' and 'Troilus and Cressida', and a nuisance in 'Much Ado', 'Othello', and 'A Midsummer Nights Dream'. In 'Macbeth' there is the implied sense of evil associated there with all corvids. Thus only in two cases out of fourteen does it emerge with any credit; in *Love's Labour's Lost* it conveys a 'rustic' image of one of the birds of Spring, and whatever species 'King Lear' refers to, is a master of the air.

Thus when the Jackdaw/daw became the universal form for the species, Shakespeare left behind a substantial and lasting body of work with uncharitable descriptions of Chough (= Jackdaws) to be transferred to

Choughs, thus adding to the disfavour they were (see Section 6) wrongly held in by literary naturalists and the like.

5:8 JACKDAWS AND CHOUGHS IN RECENT WRITINGS

5:8:1 Introduction and Aims

This section covers all references to Choughs and Jackdaws from c1500 to the present that have not been discussed in the preceding 3 Sections. It therefore aims to tie up loose ends of themes discussed previously. For example, when the Chough was 'absolved' of its alleged crimes (Section 6) some of these ill and other epithets were returned to the Jackdaw. Thus the development of attitudes held since 1800 is emphasised with its relation to changes in scientific thought and human attitudes towards nature. ^{on page 191} a list of all translations of Chough and Jackdaw from Latin and European languages is given in order to provide a summary of the development of the two words from 1500 to 1800, showing how the present forms gradually emerged.

5:8:2 The Jackdaw

Skelton's (1506, pr. 1550, 1560) 'Phillip Sparrow' continues the collective bird poetry tradition, with cameos of each species. There are two references to the Chough (= Jackdaw), and in the 1550 edition is the line 'The chouclar with his blode bek'. Choquar was a contemporary French form for Chough (Withals, 1566) as with 'chouca rouge' (Palsgrave, 1530). If 'blode' equals red, then this appears a clear reference to the Chough, but the 1560 edition and modern texts (eg Dyce 1843, Henderson 1948) have the line as 'shouelar with his brode bek', an obvious Shoveller. Perhaps the first edition was in error, with the printer 'correcting' either Shouelar/chouclar or brode/blode to make a harmonious line. Other references are;

'And the curlisshe chough
The route and the kough'.

'We may well for goe
The countrying of the coe
The storke he also
That maketh his nest
In chymneys to rest
Within those Walles'.

The churlish Chough was used by Shakespeare in 'Hamlet' (section 7), while 'coe' recalls the Old English 'ceo/cio' (Bosworth and Toller 1898, Toller 1921, Campbell 1972) and the Middle English 'cow' by Chaucer, discussed in Section 4. The obscure form is used in order to rhyme with 'goe', since Jackdaws are instantly recognised as chimney nesters. Bale (1543) restates the themes of foolishness, garrulosity and implied evil in 'Yet a course at the Romyshe Foxe';

'such dawishe dodypols were the parents of him that were born blinde, which would not confess Christ to have healed their son, for fear of displeasing the priests'.

The theme of daw and fool was much used; Heywood (see section 5) further uses ^{the Jackdaw} as a creature of low birth in 'The Woodcocke and the daw' (1556), a foolish talker in 'of a daw pate' (1562) and easily sought, to kill, in 'of seeking a daw' (1562). Thus in Heywood's eyes, a creature unfit to eat and a garrulous fool. It was also trapped as an agricultural pest (see 3.5). Davies (1559, in Johnson 1760) uses the Chough (= Jackdaw) as an ever present if lowly, component of nature;

'If death do quench us quiet, we have great wrong
That daws, and trees, and rocks last so long,
When we must in an instant pass to nought'.

The passage suggests aggravation at the supposed longevity of an inferior creature. Yet the author would be expected to realise how short in reality the Jackdaw's life span is.

The theme of the garrulous Jackdaw stems from Chaucers 'cowe is wood'

(1387-92, Section 4), and gradually acquired anthropomorphic connotations which had in turn been applied to people speaking; "captayne? a capon... a bow cone, a very Jackdaw with his tongue slit" and Holland's (1624-5) appending of Davie's 'scrounge of folly' where

"...those Dawes
 praevaricate the Muses sacred lawes
 And blabber forth, His Funerall In
 Rimes",

Massinger (1623) spelt Chough (= Jackdaw) as 'chuff' and Gifford (1805) comments that Massinger used this to mean 'a coarse unmannered clown'. The garrulous aspect thus developed to the extent where Johnson in his 'Dictionary' (1760, ed. Todd 1824, 1827) defined the Jackdaw as 'A bird taught to imitate the human voice' and Watts (1740), writing on the learning of English, stated 'To impose on a child to get by heart, a long scroll of phrases, without any ideas, is practise fitter for a Jackdaw than for anything that wears the shape of a man'.

The elements of implied evil doing were restated by Bell (1581), who combines it with the medieval fable of the bird (often a Pelican) plucking its breast; 'What mervell it is if the byrdes to pluck their own feathers againe, which they gave before to the Chough; And what should let but that a man being better...' a theme used by Spenser in 'Prosopoeia' (1591, repr. 1612),

'And will to court for shaddowes vaine to seeke,
 Or hope to gaine, himselfe will a daw try;
 That curse God send unto mine enemie'.

Victorian poets built upon these images by references to the devil; 'cloven foot and jackdaw feather' (Shell 'Oedipus Tyrannus' 1820, (Ingpen and Peck, 1927) and the afterlife 'haunted by the wrangling daw' (Tennyson, 'In Memoriam' 1884, Shatto and Shaw 1982, the Lincoln MS has 'jangling daw', in contrast). But, in general, with the gradual realisation of the aesthetic qualities of 'wild nature' (Thomas 1983) that developed towards the

eighteenth century, writers started to use Jackdaws as a component in an idealised rural landscape, an early example being Shakespeare's 'Love's Labour's Lost' discussed in Section 7. Wild in 'Poetica Licentia' (1672) wrote; 'And may the Jackdaws still the steeple hold'. The most powerful examples are found in Thompson's 'The seasons' (published together in 1744), a view of Pastoral England in the Romantic tradition;

From 'Spring' (1727); 'Or the nitid Hues
Which speck then o'er, their modulations mix
Mellufluous, The Jay, the Rook, the Daw
And all the jangling pipes, when heard alone,
Here aid the consort; while the wood-Dove breathes
A melancholy murmur - thro' the whole'.
From 'Summer' (1728); 'The Daw,
The Rook and Magpie, to the grey-grown Oaks.
(That the calm village, in their verdant Arms,
sheltering, embrace) direct their lazy flight;
Where on the mingling Boughs they flit embower'd'.

Images of benign calm, peasants, pastures and nature in harmony. Cowper in his 1741 translation of 'The Odyssey' refers to Daws as 'long-tongued frequenters of the sandy shores', a not unfavourable phrase. In translating Bourne's (1695-1747, published 1826, 1838) 'Cornicula' he regarded it as one of 'these lighter pieces' (letter to Johnson 31-1-1782, King and Ryskamp 1971) but translated with care, because he considered Bourne as 'not all that inferior to Ovid' and 'animated by the spirit of the creatures he describes' (letter to Unwin 23-V-1781, King and Ryskamp 1971). The tone of the poem and translation is most favourable, the final verse runs (King and Ryskamp 1980);

'Thrice happy bird! I too have seen
Much of the vanities of men
And sick of having seen 'em,
Would cheerfully these limbs resign
For such a pair of wings as thine,
And such a head between 'em.'

Thus the wry observer of humanity from its lofty perch has turned the full circle back to Plautus using 'Monerula' as a term of endearment. In nineteenth century writing, Jackdaws were used to evoke a more robust 'wild

nature', playing all day, then to rest; 'Each in its ancient belfry nest' (Keats, 'Eve of St Mark, 1819/1821, 1848, Garrod 1958), and free in the skies to 'Burnish his black to gold in sun and air' (Browning 1875). Tennyson and Carlyle used them to evoke images of 'Old ruinous castles with their ivy and their daws' (Carlyle, 'Life of ~~/~~Sterling' 1852, pr 1872), with the bird's 'windy clamour' through the empty walls (Tennyson, 'Geraint and Enid', 1857, Ricks 1969, and 'Voyage of Maeldune' 1880). Impressions of oncoming dusk, the Jackdaw a black bird upon the black landscape, wild in the night.

Throughout the above themes, the old literary confusion between Choughs and Jackdaws is seen to continue (O'Flaherty 1684, ed. Hardiman 1846; 'Choughs, Rooks, Cornish Choughs with red legs and bills etc', Osbaldistone, 1792; 'Caddowe, a bird otherwise called a Chough or Jackdaw'). Yet in literature it was the Jackdaw that was mainly the thief, while in all natural histories and travel books, it was the Chough. The fool/garrule elements were mainly confined to Jackdaws, especially 'daws'. There were occasions where the two forms are combined, as in Dryden's (1687) 'Hinde and the Panther';

'To crows, like impartial Grace affords,
And Choughs, and Daws, such Republick Birds;
Secur'd with ample privilidge to feed,
Each has his District, and his Bound decreed;
Combin'd in common in'trest with his own'.

The poem is based on Restoration themes, thus the republican territories are deemed to be good enough for corvids, but not the higher creatures. Dryden may be referring to both species but it is unlikely, even though his later translation of Ovid's *Metamorphoses* (1727) translates 'Monedula' as 'daw'.

Thus in the last two centuries, Jackdaws have become symbols of nature to varying degrees of wildness. Any implied evil-doing is more inclined to

evoke the atmosphere of the place rather than the bird itself, and the once foolish talking is now one of the sounds that echo through the poet's impressions of these lands.

5:8:3 Jackdaws; translations from the Classics

Thomas (1983) in 'Man and the Natural World', outlines how translations from the classics reflect contemporary opinions in the way the translators select their words. One example has been seen in the translations of Pliny by Holland (1601) and Rackham (1960) in Section 2.

There are six-pre 1800 translations of Ovid's 'Metamorphoses'. Caxton (1480 MS Magdalene Cambridge, fascimile 1968) translated from a French version and the passage (see Section 2) does not appear. The Cynthian maid Arne who betrays her country for gold is a 'wicked wench' to Golding (1567), 'impious' to Sandys (1626) and 'faithless' to Sewell (1717). By being changed into a Jackdaw, these 'qualities' are transferred to the bird, who 'still hoards up gold, and hides it from the view', (Dryden et al. 1727). As expected, the translations use different names for the Jackdaw; 'Caddowe' (Golding 1567), 'Chough' (Sandys 1626), 'cow' (Sewell 1711, recalling Chaucer 1382-90), 'Daw' (Dryden et al 1717) and 'Jackdaw' (Bailey 1766). In Homer's 'Odyssey', the Jackdaw forms a part of the fauna of a sea shore. Pope (1725) and Cowper (1741) include 'loquacious' and 'long-tongued' respectively, while Ogilby (1765) adds that they 'on sea margents fed'. Again, a wide range of names are used for these coast-living Jackdaws; 'sea-owles' (Chapman ?1614), 'sea-crows' (Hobbes 1675), 'Chough' (Pope 1725, Ogilby 1765), and 'daw' (Cowper 1741). While Homer's Jackdaw exists as a part of the scenery, Ovid's plays a direct role in the passage. Apart from the name changes, the only alterations are in the descriptions of the bird being, incorrectly, all black (Sewell 1717) and its calls. The earlier

references to the ills of Arne are gradually replaced by simple references to the thieving Jackdaw. Sewell (1717) also uses a verbal fossil in 'cow' which has an absurd meaning when, in the argument, he states that Arne turns 'to a Bird... a cow'.

Virgil's (70-19 BC) 'Aeneid' does not contain a reference to the Jackdaw, but the prologue of Gawain Douglas's (1553) translation 'into Scottish metir' (Bodley MS Junius 54) for the 'seuynt boke' includes; 'And kayis keklys, on the rufe abone'. This may have been an allusion to the geese at Troy in the preceding book. The other translations (Caxton 1490, Pitt 1753, Dryden 1697, Andrew 1766, MS Malone 322 Bodley, 1557, and Ogilby 1649) do not include any prologues and no Jackdaws appear.

No other references from the classics and translated between 1500 and 1800 are known to exist in any published forms.

5:8:4 Choughs in scientific thought

The mention of Choughs in scientific literature beyond descriptions and legends grew with the realisation that Choughs and Jackdaws are separate species. This is seen in Bacon's (1627) 'Sylva Sylvarum' where an attempt at classifying nature is made; 'And so in Birds: Kites and Kestrells, have resemblance with Hawkes... Crowes, with Ravens, Dawes and Choughs etc'. Systematic classifications were later made by Ray (1676) Willoughby (1678) and Pennant (1766, 1768, 1776) as described by Rattay-Taylor (1963). Browne (1646, repr. 1982), in 'Pseudodoxia Epidemica', uses their colouration as an example of the inheritance of characters, in an analogy with 'the Blackness of Negroes';

'lastly, if we still be used to particularities, and such as declare how and when the seed of Adam first receive this tincture; we may say that men become black in the same manner... that some Choughs came to have red legs and bills, that crows became pyed'.

Although Merrett (1666) Ray (1676) and Willoughby (1678) all mention that Choughs were found outside Cornwall, it was not until the late eighteenth century that the Cornish Chough place association was broken. This is partly due to a reluctance to question Camden (1586, 1610 etc), the accepted contemporary description of Britain, and also due to no new works on natural history being published between Charleton (1668, 1677; 'quia in cornubia nostra frequens') and Pennant (1766, 1768, 1776) thus no literature existed to build upon their new observations.

Barrington stated in 1771 (printed 1772), in an essay against migration, while supporting winter torpor in birds (see Rattray-Taylor 1963), he discards old notions on the Chough's distribution; 'The plumage therefore and flight of the Fieldfare or Redwing being neither of them very remarkable, it is not at all improbable they may remain in Summer without being attended to, and particularly the Redwing, which scarcely differs in appearance from other thrushes. Thus the Chough is by no means peculiar to Cornwall as is commonly supposed, but is mistaken for the Jackdaw, or Rook'. These arguments are fallacious; does the hoary winter air allow clearer identification? Does the Cornishman have more acute eyesight than all others? It may be that as with Defoe (1724, 1769, see Section 5) and his yellow bills being almost red, naturalists simply 'overlooked' what was not in order.

The paucity of data on Choughs until Yarrel (1843, 1882) and Morris (1855, 1902) published relatively full accounts, was rarely augmented. One example being Goldsmith (1744 et infra).^{He} observed them as 'feeding on grain and insects, living in society, and often suffering general castigation from the flock for the good of the community'. A succinct and sound comment. He is also one of the first naturalists to praise them; he states, 'They are sociable and harmless; they live only upon insects and grain, and wherever

they are, instead of injuring other birds, they seem centinels for the whole feathered creation'. Other observers did not go quite as far. Tonkins's (1811) edition of Carew (1602), annotates the 'slander of this countie' passage by stating; 'although it is given ill character, it is a very beautiful bird, but I suppose, he alludes here to its thievishness which it is noted for'.

But such half-hearted comments were soon to be in the minority, as Victorian writers concerned themselves with the rarity, beauty and symbolic wildness of the bird. Thus Robertson (1858), in writing on natural history, found his delight in seeing them overcome any disquiet at their eating carrion; 'I wish I could explain how every circumstance combined to produce the same feeling and ministered to unity the impression... the rising of the flock of Choughs, which I had surprise at their feast of carrion, with their red beaks and legs, their wild shrill cries, starting in the solitude ad silence... mingled sensations of awe and triumph'. It is this attitude that has prevailed today, as shown in the title of the RSPB's film (1980) on the species; 'The Commendable Crow'.

5:8:5 Choughs and literature

With the belated acceptance by writers of the differing meanings of Chough and Jackdaws, there are few references to Choughs proper in recent writing. Hawker (1846) mentions them in the final verses of 'Echoes from Old Cornwall' (Penhallurick 1978, states that MSS evidence reveals these verses were in fact written by his wife. Other versions exist in Swainson 1883 and Robinson 1883);

'And mark yon bird of sable wing,
Talons and beak all red with blood
The sperit of the long lost king
Passed in that shape from Camlam's flood.

And still, when loudliest howls the storm,
 And darkliest lowels the native sky,
 The King's fierce soul is in that skym
 The warrior - spirit threatens nigh'.

The reference to King Arthur commonly recurs in Cornish/Welsh oral tradition which appears to have never been recorded or written. Greenoak (1979) argues that the Chough was the true guardian of Arthur's Cave, but Hartland (1909) regarded it as the Raven. Armstrong (1930), in a list of Welsh bird names, includes; 'Brian Arthur: Arthur's crow'. There also exists the tale of Choughs coming with the Celts from Troy in Upton (al460, Blount 1500), which is mentioned in Chapter 6:2. Systematic research on Brythonic (Welsh, Cornish, Breton) Celtic oral and literary tradition may reveal further evidence.

During the last 150 years a vogue for 'bird poetry' has produced much work (eg Squire, Ward ?1930-1950, Warner in Mockler 1982), that does not merit serious consideration. There exists one work of substance; Plath's 'Blackberrying' written on the West coast (Plath, 1981), 13 months before her suicide in 1962 (published in 1971), includes the lines;

'Overhead go the Choughs in black, cacophonous flocks -
 Bits of burnt paper wheeling in a brown sky.
 Theirs is the only voice, protesting, protesting.
 I do not think the sea will appear at all.
 The high, green meadows are glowing, as if lit from within'.

In a poem imbued with nature bloated and battered in death and decay. the Chough here exists as a frontier between land and sea. An unpretentious and honest account of their existence on the edge of the Celtic fringe.

5:8:6 Early Modern - 1800 Glossaries and Classifications
(Latin unless otherwise stated):

<u>Date</u>	<u>Source</u>		
c1500	Upton/Blount	Graculo/Monedula	Chouwghe
1510	Hormani	Graculi	Chowghis
1530	Palsgrave	Corneille (Fr.)	Choughe/koo
1530	Ortus Vocabulorum	Nodulus	Kaa
1552	Huolet	Caddowe/choughe	Jackdawe
	"	Jackdaw	Daw
1566	Withals	Nodulus	Caddoe/dawe
	"	Graculus/ graculus	Chough
	"	Monedula	Daw
	"	Phyrrhocorax	Cornish Chough
1567	Junius	Gracculus/ monedula	Ka/Chog
1570	Levins	Cornix	Dawe
1572	Cooper	Macula	Chough/Daw/ Cadess
1580	Daret	Monedula	Dawe/Cadesse
	"	Cornicula	Dawe
1598	Florio	Gracculo/ Graculo (It.)	Dawe/Chough/ Cornish Chough
	"	Gracchia	Chough/Dawe
1601	Pliny/Holland	Pyrrhocorax	Red raven
1611	Cotgrave	Choquar (Fr.)	Chough/ Cornish Chough
1611	Florio	Speluere (It.)	Cornish Chough
	"	Grocillo (It.)	Cornish Chough
	"	Gracchia (It.)	Chough/Jackdawe
1623	Cockeram	Menedule	Chough/Jackdawe

<u>Date</u>	<u>Source</u>		
1666	Merett	Gracculus/ Monedula	Jackdaw/Chough
	"	Coracias	Cornish Chough
1675	Ray	Caddow	Jackdaw
	"	Monedula	Monedula
	"	Coracias/ Pyrrhocorax	Cornish Chough
1677	Charletoni	Cornix	Chough
	"	Coracias/ Pyrrhocorax	Cornish Chough
1688	Holme	Jackdaw/daw	Cadesse/choss
1695	Camden/Gibson	Pyrrhocorax	Cornish Dough
c1700	Cambden (sic)/ Oldys	Pyrrhocorax	Cornish Chough
1707	Lhuyd	Monedula	Chough/Daw
1731	Albin	Monedula	Jackdaw
1759	Camden/Gough	Pyrrhocorax	Cornish Chough
1771	Tunstall	Pyrrhocorax gracculus	Cornish Chough or Daw
1799	Fothergill	Monedula	Jackdaw
	"	Graculus	Red legged Crow

5:9 DISCUSSION

In this Chapter, use has been made of references to Choughs and Jackdaws in subjects ranging from allusive poetry to agricultural advice and in time from the Anglo-Saxon to the modern period. From these sources it was shown that the primary theme in the development of literary attitudes towards the Chough has been the nature and effect of misapprehensions about the species. There is a wide range of reasons for this apparent acceptance of inaccurate beliefs relating to the Chough.

Rattray-Taylor (1963) studied the effect of Man's conservatism of

thought on the development of his understanding of nature. He points out that this has been responsible for holding back the creation and dissemination of new ideas, observations and attitudes about nature. This was in part due to an inability to reconcile observed events within the natural world with appropriate explanations, because the standing body of literature on natural history at that time was taken as an absolute truth. For example, in human anatomy the findings of Galen (AD 179, first printed 1541) although in error, were accepted as beyond question even by Leonardo da Vinci (1510-15, Richter 1952) and were not challenged until 1542 by Vesalius (1543). The works produced by Graeco-Roman writers were thus regarded as being above criticism, whatever obvious errors they may have contained. Without access to the original writings, medieval copies became ever more inaccurate due to errors in copying and translation, coupled with the interpretations and opinions of translators and scribes becoming incorporated into the text. Medieval and Early Modern natural history was thus based on the writings of Aristotle and Pliny. Cook et al. (1934) record that Pliny was unable to evaluate critically accounts sent to him and so accepted myths, stories and rumours as fact. Their work was accepted as sacrosanct until well into the 17th Century, as shown by Holland's (1601) translation of Pliny so that his 'findings' could be made available to a wider public. Medieval authors added to the body of mythical animals; for example, Maundeville's Lamb of Tartary, which he described in 1322 as growing out of trees (Rattrey-Taylor 1963, Hogarth 1984). Contemporary translators were unwilling to point out the inherent contradictions of these works. When Holland translated Pliny (1601) and Camden (1610) he overlooked the fact that Monedula was the thieving Chough (= Jackdaw) in the former and pyrrhocorax in the latter.

Religious and ethical considerations about nature also prevents the advance of ideas. This is shown by the established church's unfavourable

reception of the theory of evolution when put forward by Darwin and Wallace in particular by Wilberforce (as shown in Rattray-Taylor 1963) because of its challenge to the concept of an immutable creation and Man as a separate entity of nature.

The misleading and outdated understanding of natural history was further compounded by the lack of any systematic classification of birds until Ray and Willoughby's (1676, 1678) attempts using habitat as the selected criteria. Before this, as 'Bombardier' (1944) points out, classification was based largely upon the medieval collective bird poems of Alainus (c1150) and Chaucer (1372-82). Coupled with this was the flexible nomenclature of birds as shown in Section 5 whereby 'Monedula' was between 1400 and 1650 given the English names Chough and Daw. As certain epithets were often name-specific as in the 'thieving Chough', the transfer of a name from one species to another would also involve the transfer of that epithet.

The attachment of literary reputations and epithets to bird names is indicative of Man's anthropocentric view of nature between 1400 and 1700 (Thomas 1983). These 'reputations' were the product of a bird's habits, as in the garrulous Chough and Jackdaw, from folk legends such as stories of Choughs guarding King Arthur's cave (Byles 1905, Hartland 1909, Armstrong 1970), or from their appearance or habitats. In each case every aspect of untamed, wild nature had to be attributed to human and preferably domestic qualities. Thus, ground-foraging birds, when kept as pets in houses not surprisingly pick at various objects and will be dubbed as 'thieving and fond of glitter' (Montagu 1813). Some of these epithets can be relatively short lived, as in the case of the 'Chough' (= Jackdaw) is mad'. Others lasted longer or were transferred from one bird to another. Figure 5:9:1 shows the time span of epithet usage in English writings as indicated by first and last references in each case. This figure shows that only the ^{thieving} and garrulous epithets were common to all three of the species-name types

discussed in this Chapter.

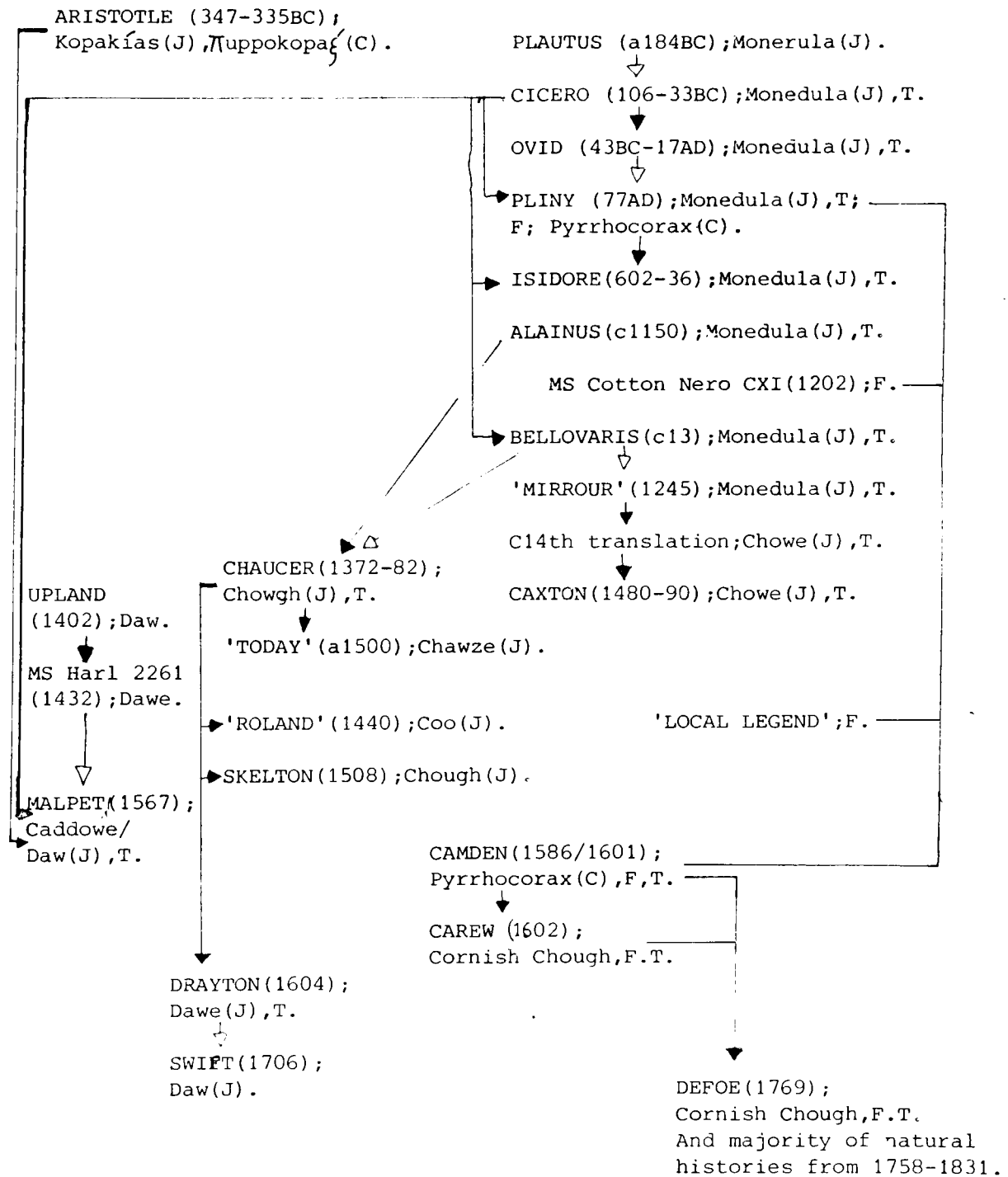
Without the enabling circumstances for scientific thought and enquiry, there was a need to explain natural phenomena in a contemporarily acceptable manner. So, birds were assumed to have the minds of people and their behaviour^{was} attributed to codes of human morality. For example, in Section 6, the spontaneously igniting thatch and haystacks were explained as being caused by Choughs dropping burning embers on them (Camden 1586 et infra). References in the classics (Pliny) and medieval literature (Chronicle of London, 1202, BM MS Cotton Nero CXI) refer to birds in general setting fire to buildings (see also Ellis Davidson 1976). These may have been used by Camden to give credence to his statement that 'local legend' attributed fire raising to Choughs.

To summarise how the factors discussed above relate to each other and the development of the two birds's literary reputations, a flow diagram showing the influences of various sources was made (Figure 5:9:2). The diagram shows the importance of Cicero and Pliny in initiating the 'thieving Jackdaw/Chough (= Jackdaw)' epithet, Camden for the 'thieving Chough' epithet and Isidore and Chaucer for the Chough and Magpie coupling. Although Malpet (1567) uses daw for thief, he also used a number of Chough (= Jackdaw) based names. Thus Drayton (1604) is the first writer to specifically refer to a 'thieving daw'. The importance of Camden's account is that by using the latin *Pyrrhocorax* it unambiguously refers to the Chough indicating that he gave more credence to Chough (=Jackdaw) being the Chough proper, while ignoring the difference between the two birds in the Classics. Such was the esteem that Camden's work was held in that his new and incorrect pronouncement was held as sacrosanct and became fossilised just as Aristotle and Pliny had. As Chapter 6 shows, few natural historians until 1833 were inclined to disagree.

What figure 5:9:2 shows is just how few sources are required for a

FIGURE 5:9:2.

CHOUGH AND JACKDAW EPITHETS;
SOURCES USED AND THEIR DERIVATIONS.



series of erroronous accounts and errors to gain credence, as shown here by Cicero, Chaucer and Camden.

As for the role of literary attitudes in affecting the status of the Chough up until the 19th Century, most references can be regarded as detrimental to their well-being. This is because the accounts gave the impression that Choughs lacked any merits except as pets or when painted upon family crests. In the wild, / ^{their} very existence is portrayed as yet another of the nuisances of untamed nature that need to be brought to book for Man to master his world in a satisfactory manner. Thus, accounts such as Defoe's (1769), who found that Choughs were not 'affected with any good quality', could serve to legitimise and encourage the shooting, trapping of adults and taking of its eggs.

The relationship between the various elements in the development of the Chough's literary reputation have been examined and the causes of various aspects of this 'reputation' explained. This demonstrates that a detailed study of the development of literary attitudes towards a species and their causal factors is feasible on condition that a relatively comprehensive survey of sources and their relevant aspects is undertaken. This method also contains some additional merits. In the case of this study, the question of the identity of the Chough in Shakespeare's 'King Lear' (1605) was fully discussed, showing that there is at least a possibility of the bird being in fact a Chough. Since the site was at Dover in Kent, it is a possible significant addition to their known past breeding range as discussed in Chapter 6:3:4 and 6:4:4 to 6:4:5. The 'birds and fire raising' association was discussed to a more satisfactory extent than has been done previously by eg Burton (1957). Finally, a number of incorrect or ambiguous identifications of Choughs or Jackdaws in manuscripts and references have been clarified, for example the 'russet pated Chough' in Shakespeare's 'A Winter's Tale' (1611), which was confirmed as being in fact

a Jackdaw.

In the introduction, it was stated that the secondary aim of this Chapter was to see if such an interdisciplinary approach could provide a useful insight into an animal's relation with Man. It has been concluded that it can, on condition that coverage is comprehensive in both aspects and sources. A number of contemporary studies in the same field have been made, and their success or failure reflects their application of these conditions. Yapp (1981) regarded the existence of a group of illuminated manuscripts produced in East Anglia with illustrations including Choughs as 'evidence for their once breeding there'. An elementary understanding of their habitat requirements coupled with the fact that East Anglia is one of the least suitable coastal areas in England would have prevented such a

statement. Hogarth (1984), writing about mythical animals, overlooks the fact that these animals often have plausible analogies in the wild, as Yapp (1984) pointed out when citing White (1954) and George (1981) with their examinations of two 14th Century manuscripts (MS 53 Corpus Christi Cambridge and MS 20 Fitzwilliam Museum Cambridge). Clutton-Brock (1984), writing about medieval venery, fails to examine the biological basis for hunting, gives a misleading view of the status of post-medieval hunting, and little on the causal factors responsible for their change. For example, in stating that the laws of Hywel Dda (945) in Wales differ from those of the England of Circa 1086, the primary factor for any difference is the fact that celtic literary tradition meant that all of Hywel Dda's laws were composed in triads. That means groups of three subjects, three animals etc, and these triads were in turn grouped into triads. Finally, the level of research into the history and origins of bird names and meanings is, in general, inadequate due to few researchers covering a wide and complex field. This is shown in Lockwood (1984), who attempts to include the first references to particular bird names and forms in English literature. In the

case of the Chough, Jackdaw and their various forms all of his first references have predecessors which have been discussed in this chapter, examples being: Cadess(e) 1555 not 1573, Cornish Chough 1449 not 1554 and Daw 1402 not 1432-50. More worrying is the fact that he states that bird books in English did not appear until the late 17th Century. In fact Ray (1678) was preceded by Malpet (1567) and Holland's (1601) translation of Pliny. The effect of such errors is that genuine advances in the above studies are diminished due to the doubts cast by examination of specific examples.

By concentrating on one species and covering a wide range of historical, economic and biological aspects, Sheail (1984) was able to produce a substantial and useful 'history' of the Rabbit. Thomas (1983) in covering the whole compass of nature wild and domestic has a few minor errors, for example confusing the Chough (= Jackdaw) for the Chough proper. But in the main, his work is the most ^{reliable} yet produced on human attitudes towards nature within a set time span (1500-1800).

In order to overcome the defects of overgeneralisation, the most effective step to extend studies on attitudes to nature would be to carry out this work at the same level as here on an entire family of bird species. The Crow family is an ideal example with overlapping literary traditions, behavioural, ecological and aesthetic similarities and a potency of imagery that in the eyes of the general public is little diminished today. The more extensive range of sources available for other corvid species would allow a full examination of the development of their literary traditions especially in recent writings. For example in Hoban's (1982) 'Riddley Walker', a novel set in the next Century, where only fragments of today's knowledge and literature have survived, the crow's legends appear at the start and the end of the book but have been distorted into taking the form of other Corvid legends.

As it is, I suggest that the proposals here outlined may form a successful basis for wider research into this subject at the single species level combined with an interdisciplinary approach.

CHAPTER 6

STATUS CHANGES: CAUSES AND EFFECTS

CONTENTS

- 6:1 General Introduction and Aims
- 6:2 Early Records from 900-1750
- 6:3 County Estimates 1750-1982
- 6:4 National Population Estimates and Trends
- 6:5 Movements; Rung Birds and Vagrants
- 6:6 Sheep Grazing and Chough Numbers
- 6:7 Persecution by Man
- 6:8 The Role of Climate
- 6:9 Discussion

'and some be rede in ther bylles and fete, which be smaller than the other and but few of number. The be most in Cornwall, and dynote gentylmen'

'De Studio Militari,' by Nicholas Upton, a1446,
translated by Blount c1500.

CHAPTER 6

STATUS CHANGES; EXTENT, CAUSES AND EFFECTS

6:1:1 Introduction

The question 'What caused the Chough's decline?' has been widely asked, and only tentative answers given. In recent years, a number of workers have discussed this topic, namely Rolfe (1966), Darke (1971), Parslow (1972), Sharrock (1976), Penhallurick (1978), Bullock (1980), Bullock and del-Nevo (1983), Bullock et al. (1983a, 1983b, 1983c, 1983d) and Warnes (1983a, 1983b). In each case, insights were limited by the lack of any accurate data on the past distribution of the Chough and an incomplete body of data on some of the possible causes for the Chough's decline. An examination of a bird's past status and the causes for its changes requires quant^{it}ative data.

As far as it is known, this is the first attempt at systematically recreating the extent and size of a bird's past population, to an acceptable degree of detail over two hundred years. Thus, the work is also a feasibility study for applying such an approach to other species, especially in considering the combination of two sets of quant^{it}ative data in terms of distribution and controlling factors.

Since this chapter is split into seven separate areas of investigation, each section will be prefaced by its own introduction, aims and methods in order to preserve clarity. Thus the aims set out below are simply an overview of the entire chapter's work.

6:1:2 Aims

The main aim of this chapter is to recreate to the highest possible degree of detail, the Chough population in England, Wales and the Isle of Man from 1750 to the 1982 survey. This is done by compiling all known records for each county, thus obtaining population estimates for each county

at intervals of 10 to 20 years, and by combining these to obtain national estimates in 10 yearly intervals. The extent of potentially suitable coastline for Chough breeding is estimated, and compared with the present, and past distribution. In order to obtain an insight into the size of the coastal population under 'ideal' conditions, a calculation of the maximum coastal breeding density is obtained and applied to the extent of potentially suitable coastline. From these results, it is aimed to produce quantitative data about the changes in population on a national basis from 1780-1982.

All records of vagrancies were examined, and those which ^{were} verified, are examined to find the nearest Chough breeding area at the time in order to obtain an insight into the extent of Chough movements. These results were compared with ringing recoveries and sightings from the BTO records and Warnes (1983a). From this, it is aimed to examine the ^{possibility} of Choughs flying to recolonise deserted areas such as Cornwall, thus following up an idea of Bullock's (1980).

The above work would provide a database for applying the findings on three of the most important causes for the Chough's decline; land management changes, persecution and climate.

The section on land management changes will aim to apply feeding studies on the Chough (Bullock 1980, Roberts 1982, Warnes 1983a) to long and short term changes in the farming of coastal lands, especially changes in sheep numbers.

To investigate the effect of persecution, it is aimed to collate and examine all known instances of persecution and to examine the effect of legislation ^{on} the level of persecution and its constituent causes.

The role ^{of} climate will be examined by comparing the long and short term effects of the severity of winter with Chough survivorship, and Summer conditions, on breeding success.

From these studies, it is aimed to obtain an insight into their relative importance in order to see where the most urgent priorities for effective Chough population management lie.

6:2 and 6:3 HISTORIC DISTRIBUTION

6:2/3:1 Introduction

This work embraces Sections 6:2 and 6:3, covering records of the Chough's distribution up to 1750 and up to 1982 respectively. The former is intended to serve as an indication of the nature of early distributional records, as a piecemeal insight into a bird's distribution, and the latter as an attempted quantitative^{it} investigation on status changes with time on a county by county basis.

There have been a number of detailed investigations into the Chough's past status on a county level (Mansell- Pleydell 1888, D'urban 1895 and Penhallurick 1978, for Dorset, Devon and Cornwall respectively) but these have all been limited to a qualitative examination of status changes, and results recorded have been found in each case, incomplete.

6:2/3:2 Aims

To devise and apply a method for estimating the past population of a bird at various times from past records available. To apply data contained in these records for obtaining theoretical data on the maximum density of the bird under ideal conditions. To examine the geographical patterns of distributional changes against time and to investigate the factors that affect the gathering of data on populations (a) at the time and (b) today when using the past records.

6:2/3:3 Methods

All potentially relevant printed books on British natural history 1500

to the present were examined, along with books on travel and topography in appropriate areas, and diaries, journals and publications of authors in potential Chough breeding areas, as well as , printed and cyclostyled reports from local natural history societies from the 19th Century to the present. Potentially relevant manuscripts of books, reports and surveys, notebooks and annotations to books in the British library, Bodleian Library and Alexander Library were examined. Further MSS evidence has been published in a number of recent books devoted to birds in a particular county, for example, Penhallurick (1978) on Cornwall.

From the findings in Chapter 5, all references to Choughs (= Jackdaws) were excluded, and the work on Shakespeare's 'Chough' (5:7:3) was added to the section on Kent.

Since it was apparent that various authors of natural histories prior to the 1850's plagiarised previous works (eg Bewick, 1797 is a near direct copy of Buffon, 1770) the links between all these books from 1446 to 1835 were examined in detail. This was carried out in order to ensure that only new observations on the Chough's distribution were used in the work.

In each book, the accounts of the Chough were examined, and elements of comparable information tabulated. Information was divided into 2 main sections; (a) primary; distribution and (b) secondary; colour and size of bird and any mentions of the fire, theft and glitter themes.

Table 6:2/3:1 summarises the categories of information used.

Table 6:2/3:1

Category:	Elements:
'Fire, theft and glitter';	Any mention
Habitat;	C= 'Cliffs and Castles along the shores'
Picture;	S= contains Sprig held in Chough's bill, B= on branch
Distribution;	

C= Cornwall, D= Devon,
 C/D= Cornwall to Dover,
 W= Wales,
 WC= Western Coast,
 S= Scotland,
 ext= extinctions noted,
 += Other areas implied,
 I= 'Constant Inhabitant
 of our Shores'.

Colour of bill;	Y= Yellow, O= Orange, R= Red, CR= coral red
Size of σ in inches;	1= 15, 2= 16, 3= 16.5, 4= 17
Weight of σ in ounces;	1= 12.5, 2= 13, 3= 14.
Sexual dimorphism;	Any mention
'Tenderness';	Any mention

These findings are summarised in table 6:2:1 in the Section on early distribution. From this data, 4 flow charts showing the dissemination of secondary elements of information in these works were made. These charts combined with a comparison of the distribution data given and any other evidence of authors using particular sources (as for example discussed by Farber, 1982), were used to make a flow chart of information borrowing in accounts on the Chough. This was also included in the Section on early distribution, alongside a summary of the original elements of distribution data contained in these books.

The recording of large flocks can be used to obtain an indication of population size. Appendix 1 records that on occasion, all birds from an area will congregate into a flock. Flock sizes can be converted into number of breeding pairs. In Spring and Summer (until the young are fledged), Chapter 6:3:1 estimates the percentage of the population which are non breeders to be 31.2%. Thus, at this time, the ratio of flock size to number of breeding pairs is 3 to 1. Chapter 6:3:1 also concludes that 2.5-2.8 fledged young are produced per breeding pair (including pairs attempting to breed). Adding this to the breeding population above means that the post-breeding season ratio is 5-6 individuals per breeding pair.

On this basis, a quote referring to 'great numbers' (30-60 individuals) in Spring/Summer would indicate some 7-20 pairs, and in Autumn/Winter some 5-12 pairs.

In this system, the mention of a specific site is taken to refer to a single pair, as for example at Crow Castle, Llangollen (Montague 1802), in 6:3:18.

Where numbers or groupings are referred to for an area, for example in 6:3:16, Knight (1853) finding Choughs 'common and breed at Dunraven' this is taken to refer to 2-5 pairs. A degree of grouping in Chough breeding sites is commonly found. At Loctyn, 3 pairs bred in 1.5 Km of coastline, with the next nearest pair 3 Km to the North. Contemporary maps of each county were examined in order to find which potentially suitable areas could have been overlooked by visiting naturalists. An example is shown for Cornwall in figure 6:3:1. For 'overlooked' areas, where circumstances and habitat requirements allowed, a conservative estimate of the population was made.

When all cited breeding areas in a county have been collated, records are back dated on the assumption that until it becomes extinct, it has been occupied for a considerable time, which (Penhallurick 1978) appears to be the case for Chough nesting. This forms the base population estimate, which is made at the earliest date from which a reasonable level of accuracy (an estimate with less than 50% variation in numbers) can be made. Subsequent population estimates were made with references to extinctions, flock sizes, general comments, and, where they still breed today, comparisons with the 1982 figures, which are taken as the present baseline.

No estimates can be made with any certainty for the inland populations (mainly Carnarfon) because the coastal coverage criteria do not apply. Thus inland areas have to depend strongly on flock size records.

The Chough is well suited for such a survey as this since it has long

been recognised as having a geographically distinct distribution (eg. Barrington 1774), even if earlier authors incorrectly attributed it uniquely to Cornwall and the Alps (eg. Turner 1544). Accounts such as ^{those of} Willoughby (1676) and Ray (1678) take note of its distribution on a county level, something that was not undertaken for many species until the 19th Century.

The work is divided into a quick examination of early distribution records (Section 2), and the county by county estimates up to the present (Section 3). In Section 3, each county entry consists of a discussion about the sources available, the estimates and a listing of all the vagrancies which appear to be genuine. The Section on Cornwall (6:3:1) differs from other county records sections since most records are fully covered in Darke (1971) and Penhallurick (1978). Records not mentioned in these accounts are listed, and all records summarised in 3 maps. These maps show distribution data prior to 1820, and communications in 1756 (figure 6:3:1), distribution from 1800 until extinction (figure 6:3:2) and breeding range changes against time (figure 6:3:3). Section 6:3:1 also utilises trapping data from 19th Century North Cornwall as a basis for recreating the 'ideal' population density for the area which can also be used to obtain figures for the overall population level in England and Wales.

Ireland and Scotland are excluded from this survey since data too thin to make any estimates except for recent years. Available data on their past distribution can be found in Usser and Warren (1900), Baxter and Rintoul (1953), Rutledge (1966), Cabot (1965), Rolfe (1966) Sharrock (1976), Warnes (1983a, 1983b) and Bullock, Drewett and Mickleburgh (1983a, 1983b). By 1750 and certainly by 1800, the populations of North England and the Scottish borders were separated.

6:2 EARLY DISTRIBUTION

Fossils of Choughs (presumably *P.p. pyrrhonorax*) have been found in Devon, Derbyshire and Yorkshire among Eemian (130000 years BC) deposits, and in the South Wales cliffs in middle of upper Pleistocene deposits (Wilmore 1977).

The first mention of a specific area is in the Cornish 'Old vocabulary' (Penhallurick 1978) of circa 1200, where the Chough is aptly called 'Palores' (digger). The first Welsh dictionary, by Davis (1632) does not record this word, instead listing 'Bran big goch' (Red billed crow). But 'Palores' and 'Pulores' are recorded in North Wales by Bolam (1913), and since there is no evidence to suggest it was a borrowing from Cornwall, the word must have been in use at the time the two areas became linguistically divided in the ninth century.

Upton (1460, translated Blount c1500, transcribed Barnard 1900-1931) states that at the time, the Chough as a heraldic symbol was restricted to Cornish gentlemen (see Chapter 5.4 for text), which remained the case until Tudor times. But they were also used by the North Welsh nobility; 'He beareth argent a Cornish Chough proper... A cross engrailed Flory between four such proper. Born by EDWIN lord of ENGLEFIELD in NORTH WALES, he was one of the 15 Tribes, or Houses of greatest account under the WELSH Princes'.^(Holme 1688) Welsh heraldry is poorly researched, so the role of Choughs in arms before the English victory over Wales in 1282 is not known, but it must be assumed that the use of Choughs here predates 1282. There is also the Alphonso Psalter (Hutchinson 1970, 1974) from the Welsh Marches, discussed in Chapter 5, Section 7. The only other early references are linguistic; 'Bran goes Goch' (Red legged crow) in Lhuyd (1707) and 'Bran Arthur' (Arthur's crow; discussed in 2:8) in Alpin (1902). Emery (1977/8, 1982) states that Lhuyd had intended to carry out a systematic natural history of Wales in the late seventeenth century, but it was never completed, and no

records on birds remain.

5:7:3 discussed the provenance of illuminated MSS as tentative evidence that Choughs were resident on the Dover Cliffs at the time of their illustrators being trained, ie 1300-1350. But until Upton (a1460) there was no word in the English language for Chough, reflecting the absence of any literature about it outside heraldry. Upton's reference to Choughs (translated Blount c1500) states they were 'but few in number. They be most in Cornwall'. Few being relative to that of the Jackdaw, and most in Cornwall, not exclusively there as stated by Camden (1586) and subsequent authors. Thus, the most accurate description of their distribution in Britain until Merrett (1666), is as shown in table 6:2:1.

Figures 6:2:1 to 6:2:4 demonstrate the great extent of borrowing by authors. In the 11 mentions of fire, theft and glitter, only one (Borlase 1758) questions its veracity, and the only change in the mentions, the introduction of 'a fondness for glitter' (Walcott 1789) is used by all the 5 subsequent authors. Using the flows of 'information' revealed by these figures, and by comparing distribution data given in each case, figure 6:2:5 'flow of information on Chough distribution a1446-1831' was drawn up. From the above, it was concluded that from the 38 sources examined, only 10 contributed new and relatively up-to-date information on the Chough's distribution. They were:

Upton (a1446)	Pennant (1776 edition)
Camden (1586)	Powhele (1793)
Merrett (1666)	Lewin (1795)
Willoughby (1676)/Ray (1678)	Pulteney (1799)
Berkenhout (1745)	Montague (1802 edition)

These sources could thus be included in the county by county section (6:3:1-23) with an acceptable degree of confidence as to their accuracy.

Table 6:2:1

		FIRE	THEFT	GLITTER	HABITAT	PICTURE	DISTN.	COLOUR	SIZE	WEIGHT	SEXUAL DIMORPHISM	TENDER
UPTON	a1446						C(+)	R				
TURNER	1544						C	Y				
ALDROVANDI	1549					S	C					
BELON	1555						C	R				
GESNER	1555						C	R/Y				
CAMDEN	1586	✓	✓		R		C	R				
CAREW	1602	✓	✓				C	R				
JONSTONUS	1657					S	C					
CHILDREY	1662	✓	✓				C	R				
MERRETT	1666						C/D					
CHARLETON	1668						C(+)	R				
WILLOUGHBY	1676				c/r		C,W,wc	R	3-4	2	✓	
RAY	1678				c/r		C,W,wc	R	3-4	2	✓	
SIBBALD	1684						C,S					
BERKENHOUT	1745						C,F	O	2	2		
BORLAISE	1758		✓				C,W+					
MARTIN	1759	✓	✓				C,F	R				
PENNANT(BZ)	1766	✓					C,F	BOR	1	2		✓
PENNANT(I)	1768	✓			C		C,F	BOR	2	2		✓
TUNSTALL	1771											
GOLDSMITH	1774				C		WC	R				
HAYES	1775				C	B	C,F	R				
WARD	1775						I					
PENNANT(2)	1776	✓	✓		C		C,F,d	BOR	2	2		✓
WALCOTT	1789	✓	✓	✓			C,F,d	R	2			
POWHELE	1793						D					
LEWIN	1795						C,D,W,S,d					
BEWICK	1797	✓	✓	✓			C,D,W,S	R				
FOTHERGILL	1799						C,D,W,S					
PULTENEY	1799						DOR					
STEWART	1801	✓	✓	✓			C,S	R				✓
MONTAGUE(1)	1802	✓	✓	✓			C,D,W ext	CR	4	2		
BUNGAY	1815		✓	✓				R				✓
FORSTER	1817											
SELBY	1821/1833							O			✓	
LATHAM	1822		✓	✓				R	2	3		
FLEMING	1823						WC	O	3	1		
MONTAGUE(2)	1831	✓	✓	✓			C,D,W+ext	OC				
JENYNS	1833							CR	2			

FIGURE 6:2:1.

REFERENCES TO THE CHOUGH BEING A 'TENDER BIRD'.

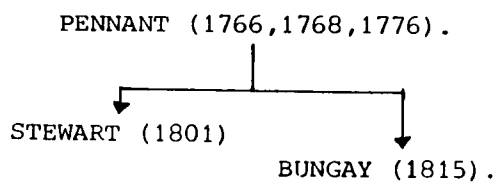


FIGURE 6:2:2.

REFERENCES TO "FIRE, GLITTER AND THEFT".

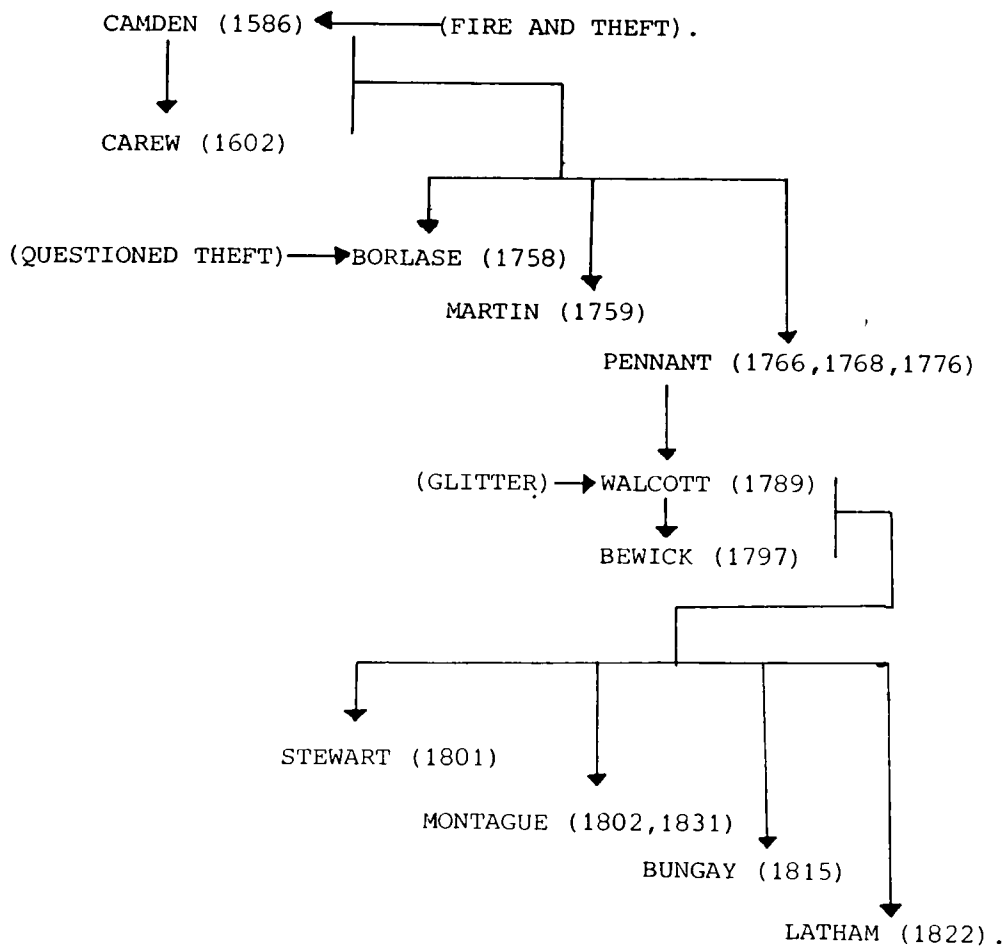


FIGURE 6:2:3.

REFERENCES TO CHOUGHS BEING FOUND IN 'CLIFFS AND CASTLES
ALONG THE SHORE'.

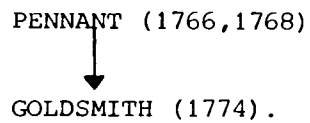


FIGURE 6:2:4.

DESCRIPTIONS OF BILL COLOUR.

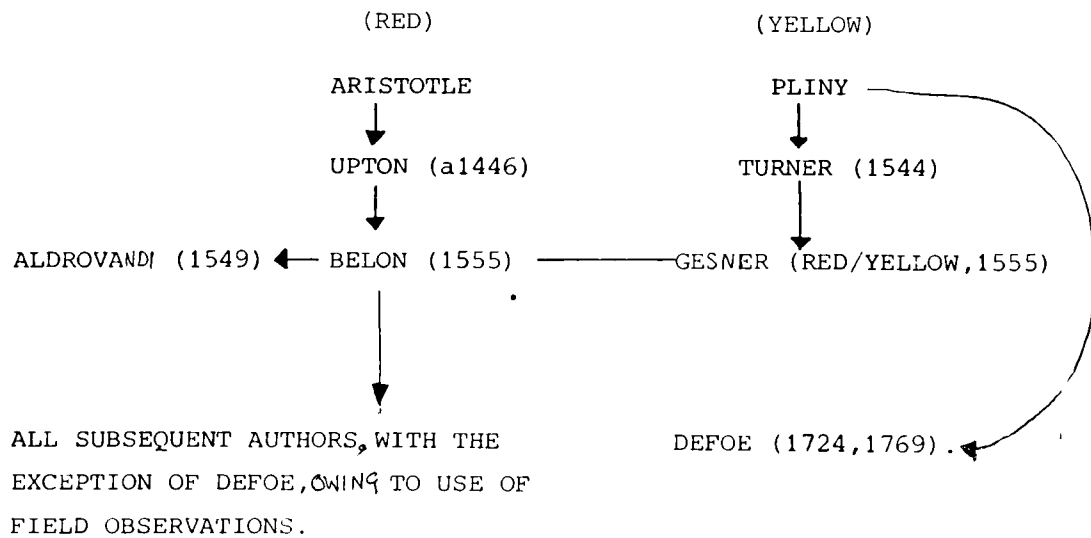
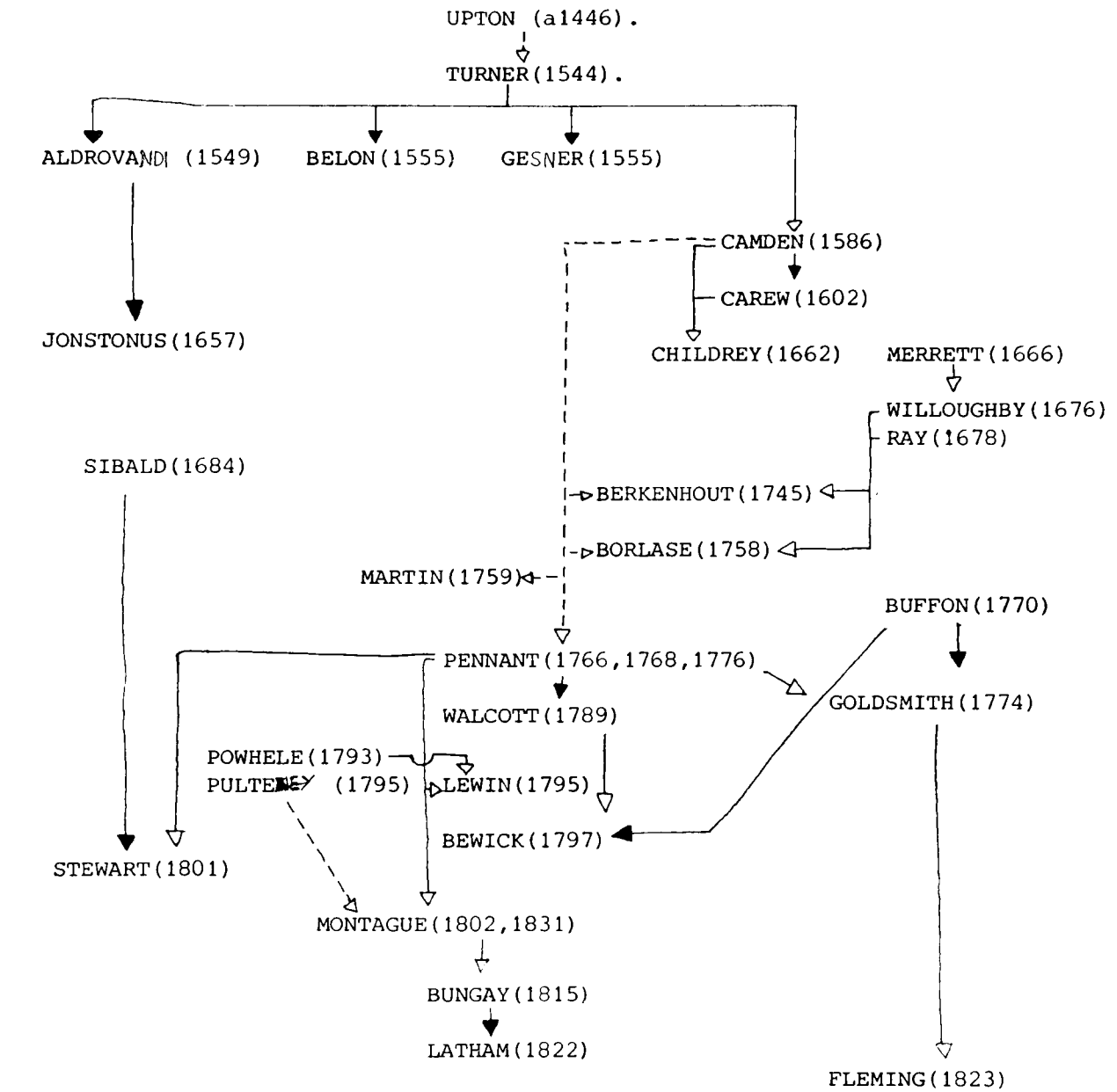


FIGURE 6:2:5.

FLOW OF CHOUGH DISTRIBUTION DATA a1446-1831.



- KEY:
- ➔ DIRECT BORROWING
 - ↘ 1° SOURCE
 - ↗ 2° SOURCE, OR POSSIBLE 1° SOURCE.

6:3 County Population Estimates

6:3:1 Cornwall

Penhallurick (1978) provides the most comprehensive account of the Chough's past status in Cornwall. There is some supplementary MS information in Darke (1971) covering 1900-41. Thus, this section will be limited to including sources not mentioned in the above, and by combining these to reconstruct and interpret the population trends that occur.

Sources which are not covered in Penhallurick (1978) and Darke (1971) are as follows:

Upton (a1446, 1654) translated by Blount (c1500, Barnard 1900-1931)

Camden (1586, 1610 et infra) in his passage on Choughs, refers to their being 'all along these shores' in the section on the St. Michael's Mount area.

The local name 'Market Jew Crow' (see eg Greenoake 1979) comes from the village of Marazion, implying Choughs were present near there in the C17-18.

Defoe's (1724, printed 1768) passage on 'Great Numbers' near the Lands End (5:6).

Clark's (1902) sightings in 1901 of 5 adults East of Tintagel (=1-2 pairs) in June, and 2 adults (=1 pair) at Loswithel in April.

Hudson (1908) confirms the absence of Choughs in the Lands End area by 1900.

Combining all sources, maps were produced to show the early distribution details (figure 6:1:1), post 1800 distribution (figure 6:1:2), and distribution changes against time (figure 6:1:3). The absence of records before 1800 in the Lizard is accounted for^{by} the lack of communications as shown by the lack of roads at this time, illustrated in figure 6:1:1.

FIGURE 6:3:1.
EARLY DATA ON CHOUGH DISTRIBUTION
IN CORNWALL.

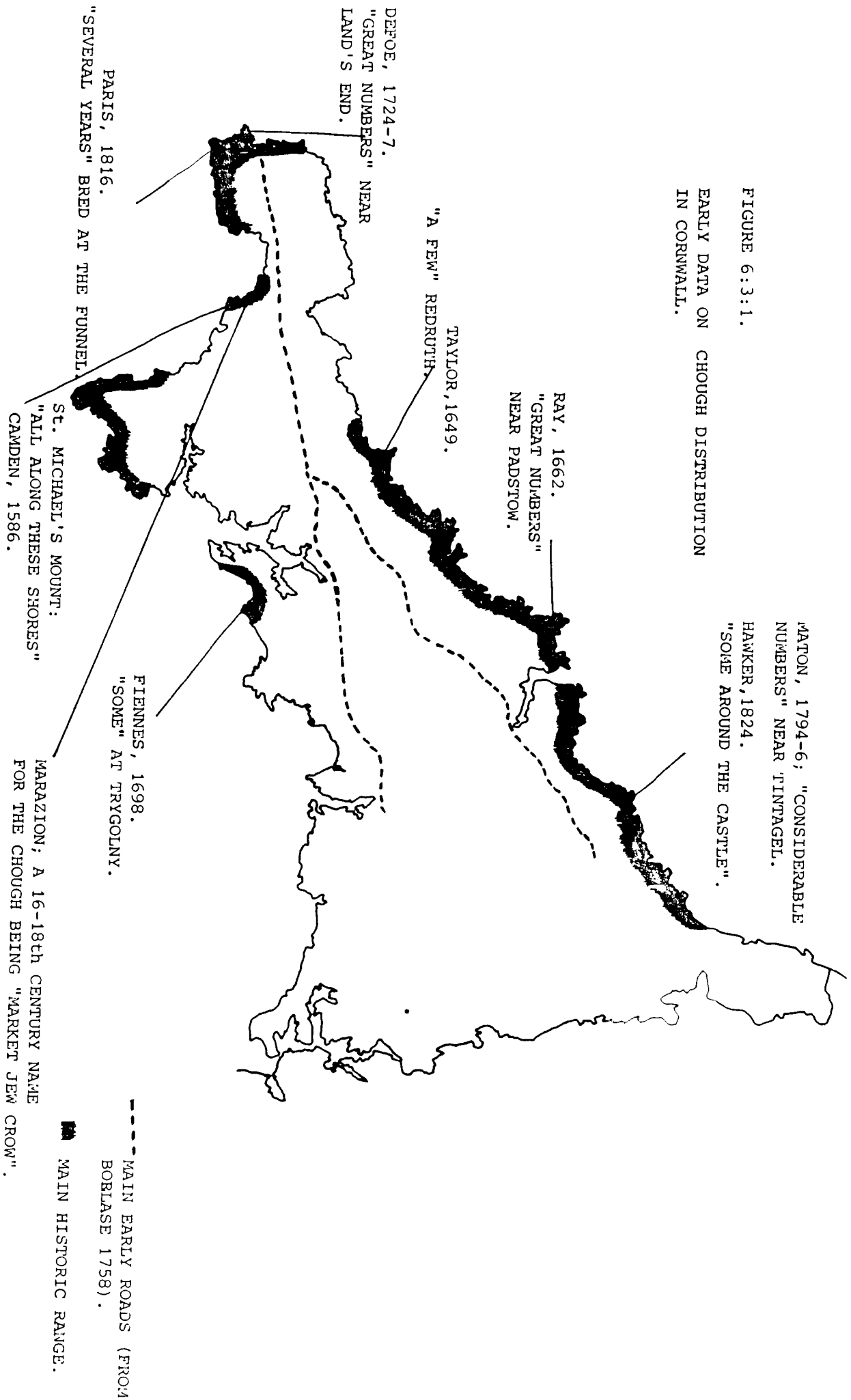


FIGURE 6:3:2.
CORNISH DISTRIBUTION, 1800-1950.

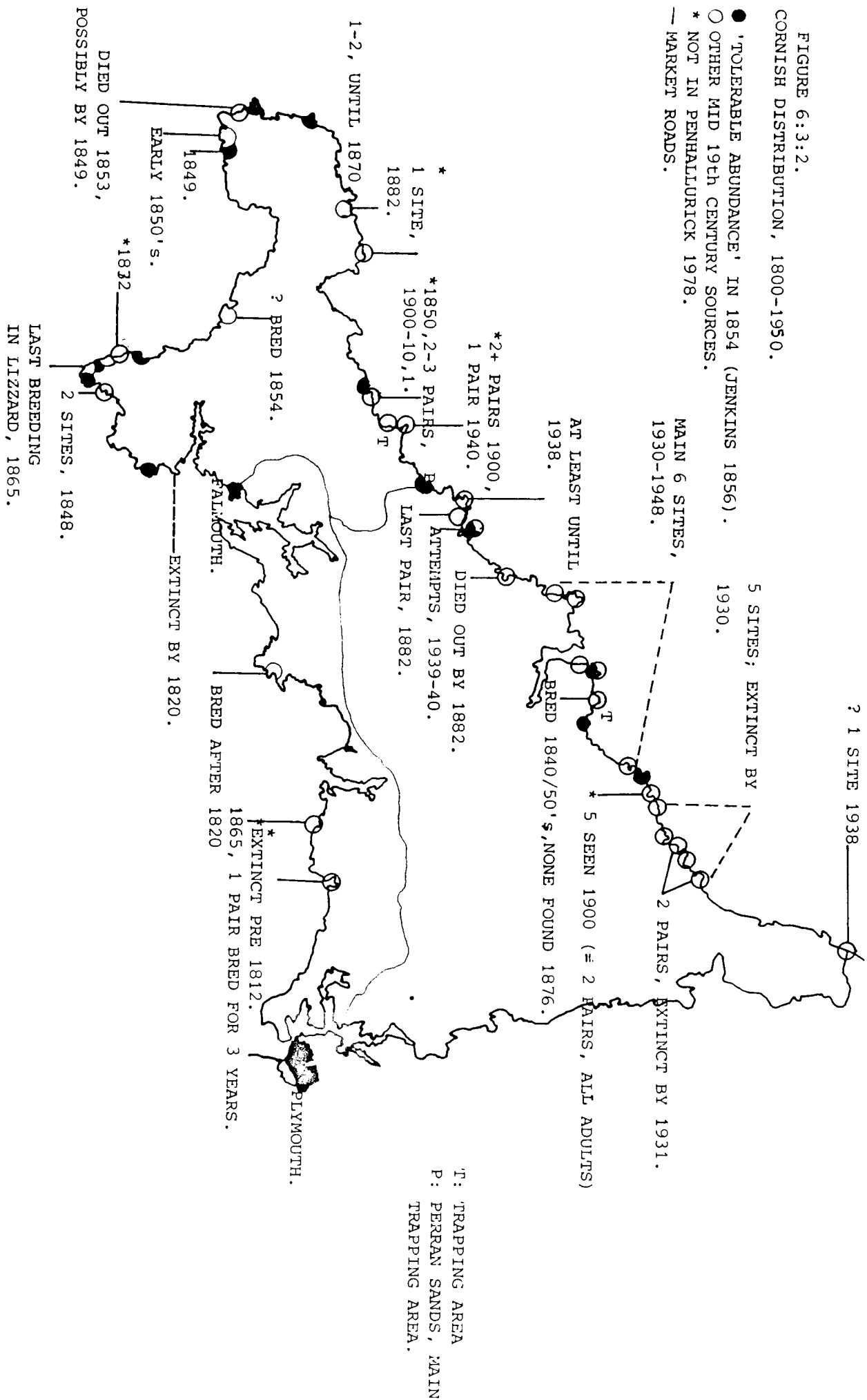
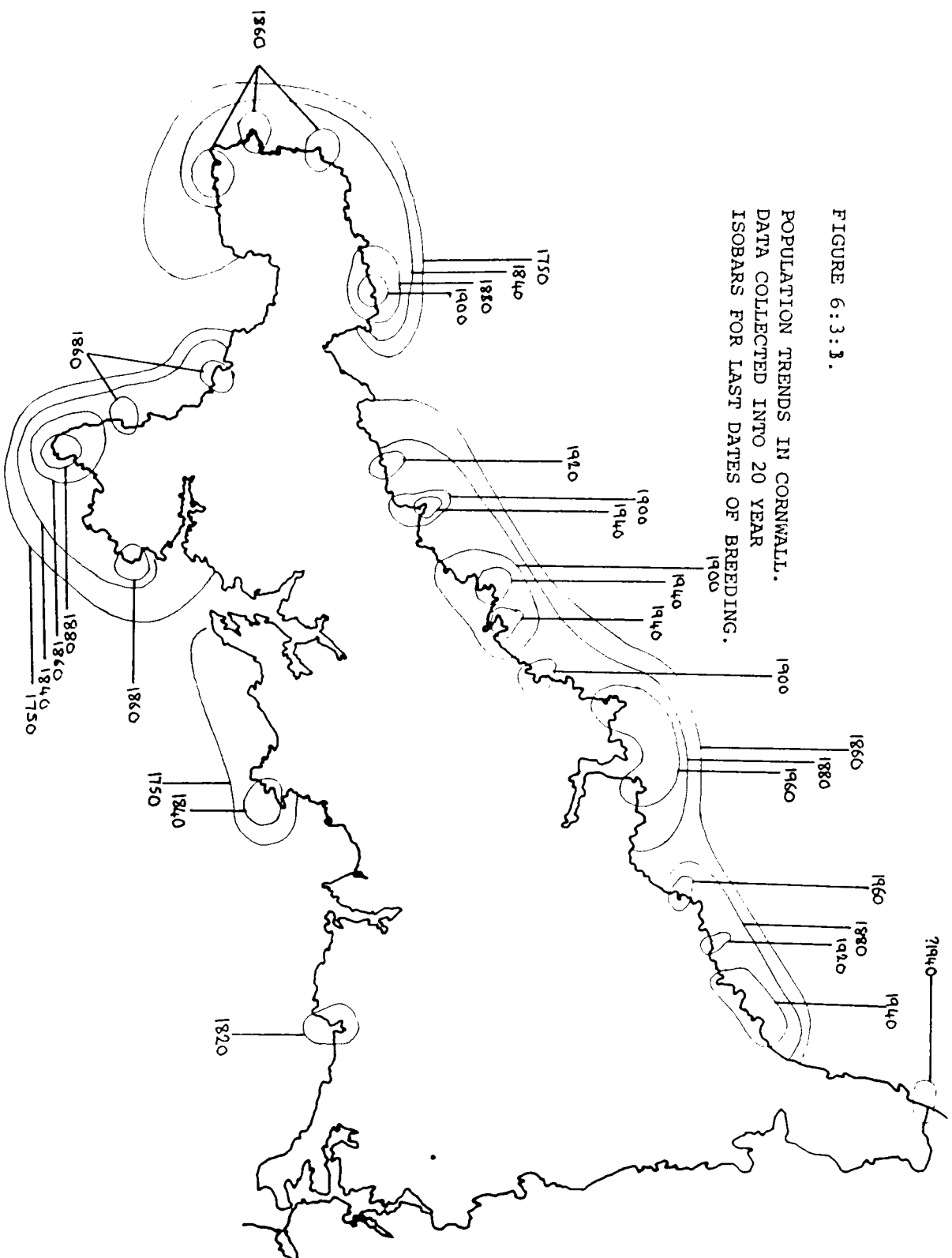


FIGURE 6:3:1.

POPULATION TRENDS IN CORNWALL.
DATA COLLECTED INTO 20 YEAR
ISOBARS FOR LAST DATES OF BREEDING.



From this, the breeding populations can be estimated at:

- 1750	220-270 pairs
- 1800	150-200
- 1830	90-110
- 1850	80-100
- 1860	75-90
- 1880	40-50
- 1900	25-35
- 1915	15
- 1930	6
- 1948	4
after 1948, extinct.	

No subsequent proven cases of breeding have been found. The last (male) individual is presumed to have died in the mid 1970's (Penhallurick 1978).

It appears that the areas with the main concentrations of populations were the North Coast, the Lizard and Lands' End.

One source exists for obtaining an insight into their optimal population level. While breeding estimates are conservative, since they are based upon known sites together with reasonable assumptions on occupied areas, trapping data needs no such recourse to site specific figures.

Bullmore (1866, in Penhallurick 1978) and Rodd (1880) refer to 'several dozen' being taken in traps each year, and assembled on the Perran Sands to be sold at the Plymouth and Falmouth markets, with 'five at any time' being seen at the latter, presumably for the London taxidermy trade. These accounts refer to the trade dying out by the 1870's, reflecting their depletion of the Chough population to the point where large-scale trapping was no longer viable (see Section 7). But during the 1830's to 1850's, this level of cropping must have been a sustainable loss for the Chough population for the trade to have continued over these four decades.

A POPULATION ESTIMATE BASED UPON TRAPPING DATA

Adapting the simple population budget developed by Richford (1978), it is possible to apply these trapping figures to find what population level would have sustained such a trapping intensity.

There exists no statistically useful data on Chough age structure and mortality, but BTO ringing returns (Holyoak 1971, Bullock 1980, BTO person comm, Roberts in prep.) suggest a high juvenile mortality. This is backed by a life table for Choughs in Bullock et al. (1983a). A long adult life is suggested by the time it took the relict population in Cornwall to die out after breeding is assumed to have ceased (Penhallurick 1978, Darke 1971). This suggests a mortality pattern somewhat similar to the Jackdaw, and thus Jackdaw survivorship data from Holyoak (1971) and Richford (1978) is applicable.

Holyoak's (1971) data / ^{are} as follows:

Year	n. recovered	n. alive at start of year	% dying each year
1	267	686	39
2	231	419	55
3	97	188	} 52
4	44	91	
5	27	47	
Σ	666		

Richford (1978) expressed mean production for a sustaining population, P (fledglings per nest per year) as:

$$1 - A = \frac{P \times S^2}{2} \quad \text{where } A \text{ is the proportion of breeding adults that return to breed next year.}$$

and S^2 is the juvenile survival to 2 years. Both Choughs and Jackdaws appear to have delayed first breeding.

What is required, in the context of this study is the 'surplus' production, that is the excess of fledglings produced over the amount required to maintain the population.

This surplus, C_f , = fledglings produced, $f - P$, where f = actual number of fledglings produced each year.

To obtain P this is reexpressed as:

$$\frac{1 - A}{(S^2) \cdot 5} = P$$

A and S^2

From the following data, 2 / values were obtained:

	Richford (1978)	Holyoak (1971)
A	0.42	0.60
S^2	0.47	0.36

Using Jackdaw data, 2 P values are available:

Richford (1978); P = 2.382
 Holyoak (1971); P = 2.22

If r is the number of individuals taken each year in trapping, a sustainable population level for trapping in one area will therefore be $r/f-P$

Thus the sustainable population level, L can be

$$\frac{r}{f-(S^2).5} \text{ pairs.}$$

Holyoak's figures are based upon mainland populations, while Richford's, are from an either stable or increasing island population.

Reliable data for Chough breeding / ^{was} patchy, and had to be collated from a number of sources. Inland breeding figures are excluded since the Cornish population was a coastal breeding one. Four estimates of numbers fledged per pair for all known pairs attempting to breed were made:

- (i) Bardsey Island (from Bardsey Obs. Reports 1953-77, and Phillips person. comm. 1983) for all known sites in years 1953-70, 1973-83; $f = 2.46$ ($n = 94$).
- (ii) Ireland (Bullock et al. 1983a), 2.85 ± 1.04 ($n = 67$).
- (iii) Wales, Coastal (Bullock et al. 1983a) 2.68 ± 1.35 ($n = 160$).
- (iv) Cornwall, Penhallurick (1978) contains breeding data for the last four main sites for 1930-47. Although the data / ^{was} incomplete, it is possible to adapt / ^{the data} in order to obtain an estimate of f ;
 n known clutches ($f = 3.2$), 20
 n where at least probably 1 + fledged, 18
 n where probably none fledged, 9

thus 38 of 47 sites had fledged young = .8 of sites.

this is correction factor for f value of 3.2,

thus true $f = 3.2 \times .8 = 2.56$.

An estimation based upon these figures assumes that;

(a) all areas are accessible to trappers.

(b) although some pairs/areas may have differing intensities of cropping,
overall effect is at maximum sustainable level.

But,

(a) Shooting/egg collecting mortality is not included.

(b) Population is also being affected by decline in sheep farming (6:5).

The persecution and sheep-farming factors would mean that the estimate of the number of pairs would be an underestimate to an unknown extent.

Using Holyoak's (1971) p figure of 2.22, and taking 'several dozen' as being 4-7 dozen, the following estimates are obtained:

	Cornwall	Wales Coastal	Bardsey	Ireland
f	2.56	2.68	2.46	2.85
f-r=c	.34	.46	.24	.63
r				
48	141.2	104.3	200.0	76.2
60	166.4	130.4	250.0	95.5
72	210.2	156.5	300.0	114.3
84	247.0	182.6	350.0	113.3
$\bar{r}$ (=66)	194.2	143.5	275.0	104.8

extent of

In 6:4, the 'ideal distribution' in Cornwall was calculated at 139 miles, of which 80 were occupied by Choughs in 1840 (Lizard, Lands End and the North Coast). Dividing the population figures by 80 miles gives densities of:

Cornwall data	2.43 breeding prs/mile of coast
Welsh Coastal data	1.79 "
Bardsey data	3.44 "
Ireland data	1.31 "

To convert these figures into a total population (number of breeding pairs, and number of non breeding individuals at start of breeding season, in April) each estimate is multiplied by 2 and the percentage of non-

breeders in the population is excluded.

Three sets of data are available (adapted from Bullock et al. 1983a)

	n. breeding pairs x 2	n. non breeders	% non breeders
Isle of Man	109	63	36.6
Wales	281	104.5	27.1
Ireland	1341	619	31.6
Total	1731	786.5	31.2%

Thus to convert breeding pairs into total population of individuals, each estimate is multiplied by $2 + (2 \times .31) = 2.62$ giving:

Cornwall data	508.8	individuals
Welsh Coastal data	375.9	
Bardsey data	720.5	
Ireland data	274.6	

The value of these data will be discussed in 6:4 where they are applied to the estimate of 'optimal population' coastline. These figures represent estimates of findings (a) at a near ideal population level in Cornwall, and (b) at a near ideal breeding density.

6:3:2 LUNDY

Earliest references are in D'urban (1895) where an unspecified source found them nesting 'in vicinity of house' in the 1860's and Chauter (1871) who found them breeding there in that year. Yarrell (1878) possibly using the above, regarded them as 'yet numerous' but Saunders (1899) states that in 1887 he found they had almost disappeared, whereas there 'used to be about forty nests'. This is presumably an exaggeration, but does point to up to ten nests before the 1870's. Loyd (1925) states there were 'a pair or two' in 1888, but by the time of writing, D'urban (1895) found they were extinct, which is also confirmed by Morris (1902). According to Loyd (1922) their demise is locally attributed to the blasting operations on the island in 1872.

From this, the breeding population can be estimated at:

- 1870's 5-10 breeding pairs, with a possibility of more
- 1890 1-2
- after 1890; extinct.

Vagrants:

1 seen Feb to Mar 1952 (Davis 1953)

6:3:3 Hampshire and the Isle of Wight

Kelsall and Munn (1901) regarded Choughs as extinct in Hampshire 'certainly in 1861', probably due to Wise in 1861 stating 'they are seldom seen on the coast of the New Forest'. Page (1900) notes a Mr R. Keynes killing two in Christchurch Bay on 3-1-1871. These were probably first winter birds from Dorset, where about 5 pairs still bred at the time (6:3:8).

No references to Choughs occur in the earliest literature ^{the} on Isle of Wight (eg. Warner 1795). Gould shot specimens at the Needles for Lear to use in 1833 for illustrations in Gould's 'Birds of Europe' (1837). In this book, he states there were 'a few between Freshwater and the Needles'. Kelsall and Munn (1901) and Morey (1909) cite R.H. Fox quoting his father that in 1835 they were found at 'Freshwater and Culver Cliffs', Yarrell (1843, 1845) wrote in 1839 that they occurred from 'Freshwater to Needles on the highest parts of the cliffs'. Hewitson (1836) regarded them as being on 'all the steep rocks and promontories of IOW.' By the 1840's, a sharp decline had taken place. There are no subsequent references to Culver, and Bury in 1844 found 1-2 pairs at Freshwater and 2 from Niton to Blackgang. The latter was confirmed by Martin (1849) who observed one there in May 1848. Meyer (1853) repeats these figures. Last records confirm extinction by 1859 (Moore, Kelsall and Munn 1905) in Freshwater and Blackgang, and 'one or two linger' in the 1860's. The two records of one being seen in 1883 (Cohen 1963) are presumably vagrants (Hadfield 1893). The above records point to a continuous occupation of the chalk cliffs around 1800.

Shooting appears to have played a large role in their decline, as apart from Gould (1837), Brannon (1850) and Cohen (1963) mention regular shooting parties at Freshwater in the 1850's.

From this, the breeding population can be estimated at:

- 1800 20-30 pairs
 - 1840 5-15 pairs
 - 1850 3-5 pairs
 - 1860 1-2 pairs
- after 1860 extinct.

Vagrants:

2 shot Christchurch Bay, Hants 3/2/1871 (Page 1960)
 1 near Cheerfoot Head, Hants 1941 (Cohen 1963)
 1 at Hardle Cliff, Hants 26/5/1963 (Cohen and Taverner 1972)
 2 sightings, 1 dead, Isle of Wight 1883 (Cohen 1963).

6:3:4 Kent

In Chapter 5:7:2, it was concluded that up until the mid/late seventeenth century there was an indigenous Chough population at the Dover Cliffs. There are no eighteenth century records in Berkenhout (1745), Borlase (1758) or Pennant (1766 1768). But in Pennant (1776) and subsequently in Walcott (1789), Lewin (1795) and Bungay (1815) it is noted that 'they came by accident' when a pair from Cornwall 'escaped and stocked these rocks'. The listing in Boys (1792) for birds 'that have fallen under the inspection of the author or his friends at Sandwich or its neighbourhood' embraces the Dover Cliffs or refers to a straggler. The colony never appears to have expanded or prospered and various dates are given for its demise:

Montague (1802, 1831) 'lost'
 Bungay (1815) 'at Dover'
 Latham (1822) 'still breed'
 Pemberton-Barlett (1844) 'rarely met'
 Ticehurst (1909) Specimens allegedly taken prior to 1836 and 1849.

Section 6:2:1 concluded that Bungay (1815) and Latham (1822) are by and large dependent on second-hand information and can therefore be discounted. The specimens in Ticehurst (1909) and Pemberton-Bartlett's (1844, in

Ticehurst, 1909) observations may well refer to records well prior to their attributed dates, and Pemberton-Bartlett (1844) implies a relict population after breeding had ceased; thus breeding ended probably between 1800 and 1810.

6:3:5 Sussex

White's 'Natural History of Selborne' (1786 and subsequent editions) contains the first references to Choughs in Sussex in two widely cited letters. The first, to Barrington in 1770 states '...Cornish Chough builds, I know all along the chalky cliffs of the Sussex shore'. The second, to Pennant in 1771 states 'Cornish Choughs abound and breed on Beachey-Head and on all the cliffs of the Sussex coast'. Pennant did not include this in his 'Zoology' of 1776. There are no other references in the 'Natural History', or the 'Journal' (1931, 1970). Thus, none of the general C18-19 bird books were to mention their Sussex distribution prior to its extinction there.

Markwick (1798, from a paper read in 1795) remarked that 'This bird - 'the Red legged Crow' - frequents the South Downs about Beachy Head and East Bourn, where it is called the Red-billed Jackdaw', the exclusion of mentions for the rest of Sussex implies a contraction in its range. Montague (1802, 1831, see also Yarrell 1876) regarded it as lost by 1802. Whether this is by oversight of a reduced population or not, it is certain they ceased to breed by the 1810s. Woolgar's (1821, in Walpole-Bond, 1938) 'along the Coast. Common at Beachy Head' is probably from White, although Borrer (1891) and Page (1905) accept it without question as the last date for breeding. Mantell (1824) states it is 'common on Beachy Head' but since his source died a few years previously, this could not have been after 1800-1810. Dutton (1864) quotes a shepherd assaying 'Them there red legged crows was at Beachy Head and Bell Trout about 40 years ago' (ie 1820's), Knox (1849) saw them last 'about 20 years previously' (ie 1827-1830, written

1848), and Erredge (1862, in Walpole-Bond, 1938) cites the last sighting from a man who caught prawns at Beachy at circa 1810. It would thus appear that regular breeding ceased by 1810, with possible occasional breeding and a relict population lingering afterwards, accounting for sightings up to 1830. What is certain is that Buckland's 1873 edition of White, where he notes that the Chough 'is now very rare at Beachy Head' is badly out of date!

From this, the breeding population can be estimated as:

- 1780	10-25 pairs
- 1790	5-10
- 1800	2-5
- 1810	1-2
after 1810 extinct.	

Vagrants: (From Walpole-Bond 1938)

Seaford Head	29-i-1868
Midhurst	11-v-1903
Pevensey North	xii-1905
Norton	30-xi-1907
Newhaven	Autumn 1912
Beachy Head	viii-1919.

6:3:6 Yorkshire and Northumberland

An MSS note by Alexander (n.d.) in the Alexander Library, Oxford copy of Saunders and Eagle-Clarke (1927) states 'Bones found in Kirkdale Cave, Yorks.' This is confirmed by Nelson (1907) and Lydekker (1891). Assuming the bones were taken from suitable areas of the coast (eg Flamborough Head, 15 miles to the East) this is evidence of a former breeding population in the North East. As it is, the only other records are of 'Red-legged Daws' in the early C19 at Boulby near Loftus in Cleveland and supposed breeding at Flamborough until near 1861 (Nelson 1907). The former is plausible as a relict population, but the latter date appears too late in the context of other records, so is either an error of dating or implies breeding due to the presence of vagrants.

There are no records of Choughs breeding in Northumbria, the earliest source (MacKenzie 1825) mentions all the other Corvids. Bolam (1912) cites

the nearest area as St. Abb's Head, 8 miles to the North of Berwick-upon-Tweed. They have been noted breeding there by Leslie (1578, in Nelson 1907), Selby (1833) and Hewitson (1846) who found them 'sparingly' there. Although Hancock (1873) regarded them as still breeding, Bolam (1912) is probably correct in stating they became extinct by 1850.

Thus, although it is likely that during the C17th and possibly in the C18th, the Chough was widespread in the North-East, by the time records were made, there was at best, a relict population.

Vagrants:

Hatfield near Sheffield	1844 (Nelson 1907)
Marshall, Yorkshire	Winter 1876 (Nelson 1907)
Durham	1845 (Hogg 1845, in Temperley 1951).

6:3:7 Cumberland, Westmoreland and Lancashire

Hutchinson (1794, reprinted 1974) is the earliest source on Cumberland, and although all other corvids are mentioned, there are no references to Choughs, implying that they must have been scarce at the time. The main area where they were found was Whitehaven, where they were reported as being rare in 1829 and the last 2 or 3 individuals dying out by 1860 (Macpherson and Duckworth 1886, and Macpherson 1892).

In Westmoreland, they were reported breeding 'in former times' at limestone crags 'such as Whitbarrow Scaur' (Lydekker 1895, Farrer and Brownbill 1906). Macpherson (1892) mentions an individual being killed at Whitbarrow between 1862-5 and there are no subsequent records. If this was the last individual in the area, breeding presumably ceased between 1855 and 1865.

More (1865) in Yarrel (1882) implied that breeding was regular in Cumbria and occasional in Westmoreland, but this appears to be some 10 years out of date. No evidence for breeding in Lancashire was found.

Vagrants:

Billinge, near Wigan	ix-1908 (Bell 1908)
Flock at Leasowe, Lancs,	c1870 (Hardy 1941).

6:3:8 Dorset

Merrett (1666), Ray (1676) and Willoughby (1678) imply knowledge of breeding on the Dorset coast. There are no references in Pennant (1766, 1768, 1776) or Lewin (1795), and the first specific reference is in Pulteney (1799); 'This bird breeds on the cliff called White Nose Cliff, Nr. Lulworth, and is seen on the coast in various parts' implying a concentration in the Lulworth area. The other concentration appears to have been around Purbeck; 'on... the noble cliffs of the Isle of Purbeck' (Hewitson 1846). In Purbeck, traditional sites appear to have been at Gadcliffe and Tyneham (Yarrell 1843, 1845). Mansell-Pleydell in Shipp and Gatehouse (1864) found they were 'becoming more rare because of egg collecting' in Purbeck, repeated in more detail in Mansell-Pleydell (1864); 'but it is gradually becoming more rare, owing, to the high price given for its eggs... I have seen Choughs inland during day-time, and returning in small flocks during the evening; but it is now unusual to see two together.' Austen (1855) reported them as 'abundant' at Purbeck, thus the decline would have appeared to start around 1855-60. By the publication of Yarrell (1878) they were extinct. Gould (1873) quotes a recent letter from Glennie, who found them 'pretty frequent', finding 'several pairs in walk of 8 miles between Swanage and Kimmeridge'. This source was probably from the early or mid 1860s.

Mansell-Pleydell (1888) summarises their decline in Dorset as:

1825-40, abound on Purbeck coast.

1865, several pairs near Lulworth.

Harting finds two nests (eggs taken, see Harting 1901, and 'decided against shooting the adults', Harting, 1865).

Still between Swanage and Weymouth in 1860's, but 'shooting old birds has depleted numbers.'

Seacombe cliff near St. Anne's, 1 pair May 1885.

Studland, 1 pair 1887.

Mansell-Pleydell (1888) concluded that they were on the 'eve of extinction' in Dorset. Blathwayt (1933) records the last known nest as being at Studland in 1890. Thompson (1922) states that a collector went to the Lulworth site in 1890 and shot both birds. There were no subsequent records.

Alexander in a MSS note in Mansell-Pleydell (1888) in the Alexander Library, Oxford, observes 'formerly bred at Lulworth Cove; also in tower at Corfe-Castle' but no date is given.

From this, the breeding population can be estimated at:

- 1800	20-30 breeding pairs
- 1850	10-15
- 1870	5
- 1890	1
after 1890 extinct	

Vagrants:

Wyke Regis 10-x-1906 (Blathwayt 1933, Pendergast and Boys 1982)

Osmington Hills xi-1908 (Blathwayt 1933, Pendergast and Boys 1982)

Winspit 25-30-iv-1925 (Blathwayt 1933)

Poole Harbour 1935 (Alexander MSS note in Kelsall and Munn 1905, Alexander Library, Oxford).

6:3:8 Somerset

Ray (1676) and Willoughby (1678) imply knowledge of their breeding in Somerset. The first specific references are of a pessimistic nature; More (1865) refers to their being former breeders, and Smith (1869) to their being 'almost extinct in the county in 1868' mentioning one pair at Bagborough near the Quantock Hills as the only known breeder, with a few at Minehead that were disturbed prior to 1868 by rockfall from quarrying (Yarrell 1878, Palmer and Ballance 1968). The Bagborough pair were shot in 1868 and there was no subsequent breeding there (Yarrell 1882). The Minehead colony was never re-established, and there were certainly no more

breeding there from 1905-1914 (Palmer and Ballance 1968). The above would appear to indicate extinction except for a series of notes cyclostyled by Turner (1913, 1919, 1926):

Summer 1910; 3 young seen Bossington cliffs, Portlock.

August 1878; 2 adults and 5 young, Oare parish, Glenthorne.

1906; 'several seen', breed at Lynton.

1916; last pair abandon nest, at Lynton, go possibly to Devon.

If this Lynton-Bossington colony was overlooked by other observers, as would appear to be the case, then through the period of More (1865) and Smith (1869) there cannot have been more than 10 pairs, and around 5 from 1878 to 1900. Smith (1869) implies a reduction in the Minehead colony prior to the 1860's. The Lynton-Bossington colony must always have been restricted in area, certainly before 1850 to have avoided notice.

From this, the breeding population can be estimated as:

- 1850	10-15 pairs
- 1870	5
- 1900	2
- 1910	1
after 1916 extinct.	

Vagrants: (From Palmer and Ballance 1968) a number of potential escapes have been omitted.

Cheddar	1889	Lympsham	26-i-1935
Avon Gorge	3-vii-1900	Minehead	xii-1926 to i-1937
Dunster	xii-1923	Portlock Weir	'Early' 1929 (Blathweyt 1929)
Cheddar	26-x-1927	Brean Down	24-iv-1937
Portlock	early 1929	Sandford	Winter 1941-2.

6:3:10 Devon

General mentions by Ray (1676), Willoughby (1678), Borlase (1758) and Buffon (1771, 1793). Not mentioned in Berkenhout (1745), Martin (1759), Pennant (1766, 1768, 1776), Hayes (1775) or Walcott (1789). Powhele (1793, reprinted 1977) provides the first account; '... is found in the cliffs and along the shores of Devonshire as well as other maritime counties. "The Cornish Chough is seen in the Northern coasts of Devon." One shot near Modbury 1790 by a son of Captain Gordon... "I have seen the Cornish Chough

near Plymouth" (says Mr Elford), Mr Yonge of Putlfinch... "often observed on the hills along the coast in the (north) Western part of the country." Since the two coasts are well separated, they will be considered in turn:

(a) South Coast

Montague (1798) in a MSS in D'urban (1895) found them 'frequent in South Devon where the cliffs are high'. More (1820, 1837) includes it among his lists of South Devon birds in 1820 and 1837. Bellamy (1839) notes 'is not stationary on the (South) Devon shores, visiting us only in small numbers towards the Winter,' probably referring to first Winter movements from the small number of South Devon sites, which he did not presumably know about. It appears there was no breeding in South East Devon by 1839, which is confirmed by D'urban and Matthew, in Loyd (1925) who found none during many visits between Exmouth and Sidmouth from 1850 to 1880. A number of records exist for South West Devon: Bolt Head, 1 pair nested 1873 (Loyd 1929), Berry Head, 1 pair nested 1880, Foley Cliffs, Banthan, 1 pair nested 1885 (D'urban 1895). The Foley Cliff record is the last known case of breeding in South Devon. Nichols in D'urban (1895) observed occasional breeding from 1870-95, while Dixon (1899) regarded the Berry head site as the last one, and Pidsley (1895) gave no details of 'a few sites', presumably old ones, because of the pressure from collectors. It would appear that if breeding occurred near Plymouth, as implied in Powhele (1793), it finished by 1850 at the latest.

From this, the breeding population can be estimated as:

- 1800 5-10 pairs
- 1860 3-4
- 1880 1-2
- after 1885 extinct.

(b) North Coast

According to Butler (1907, 1908) Ilfracombe to Lynton was the main breeding area, where in 1869 he noted 'great numbers... about the cliffs'. But by 1887, Butler notes that 'a friend had the greatest difficulty in

obtaining eggs at Ilfracombe.' Johns (1862) found they 'breed in the high cliffs near Combe Martin' which is 3 miles East of Ilfracombe. D'urban (1895) states/there 'possibly one or two now at Countisbury Hill and the Valley of Rocks.' No subsequent records for the area exist.

South of Ilfracombe, D'urban (1895) states there remained 'a few' where around 1850 they were 'common'. At Abbotsham, where they 'used to be numerous,' now 'none for years'. By 1895 the two last areas were just South of Ilfracombe at Braughton Burrow, Morthow and Langleith Cove, and from Clovelly to Hartland Point, where he again states 'possibly one or two pairs now'. The only other breeding site was at Little Hangman, where one pair last bred in 1886. After 6 were killed by a sportsman 'wishing to discharge his gun' in 1896, there were no subsequent records for Braunton (D'urban and Matthew 1896). Pidsley (1895) and Dixon (1899), both regarded it as rare, and Page (1904, 1907) mentions, probably via these sources; 'small numbers on the North Coast'. According to Penhallurick (1978) the last record was at Lynton in 1910.

From this, the breeding population can be estimated at:

- 1850	30-40 pairs
- 1870	20-30 pairs
- 1890	5-10
- 1900	3-5
1900-1910	1-2
after 1910	extinct.

There are also a number of unconfirmed reports of breeding, after 1910, for example Alexander and Lack (1944) cite reports of 1-2 pairs lingering in the Hartland Point area until the 1920-1930s. If this is the case, the breeding population was certainly extinct by 1940.

6:3:11 Isle of Man

Chaloner, in King (1656), Townley (1791) and Woods (1811) visited Man and the Calf. Although according to Wilson (1791), Chaloner 'took account of the Calf and was at pains to include all the birds present', there are no

references to Choughs in any of these works. Camden's account of 1586 is based on Harrison (1586, and repeated by Cox 1720, 1731) who mentions only 'Noxious puffins and barnicles.' The absence of any references to Choughs in these sources reflect the prevailing belief that Choughs only exist in Cornwall (eg Carew 1602) and non-systematic accounts whereby only species that interest the author are mentioned. As Barrington (1772) points out, outside Cornwall, Choughs were often mistaken for the Jackdaw. Thus, there are no references in the literature until Jardine (1876) visited Man in 1827. He found Choughs were 'most abundant in the Isle of Man ... has precipitous coasts for at least 2/3rds of circumference ... round these shores, (the Chough) is so common that we once procured nearly 30 specimens in a forenoon.' It is not surprising that numbers declined after this visit. Selby (1833) Hewitson (1840) and Parry (1861) repeat Jardine, but Yarrell (1843) quotes a Mr Wallace as going to the Southern extremity for specimens as they were most secure there. Ralfe (1905) cites Train (1845) as stating^{that} they were very numerous on the Calf. Both point to a contraction in range from the North. The previously wide range is supported by a Mr Taggant who in 1879 at the age of 78 states he remembered seeing Choughs around Douglas when he was a boy eg. 1805-20 (Kermode 1901). Notes prepared for More (1865) written between 1862 and 1864 (Alexander Library, Oxford) record that the Chough 'breeds here, used to do in great numbers, but of late years comparatively scarce'. Pressure from collecting caused therefore a major reduction in numbers, so much so that Yarrell (1882) regarded them as 'formerly resident in the Isle of Man. May still be on the Calf.' This may have been taken from 'Philornis' (1867 who in Ralfe 1905) regarded it as 'probably extinct.' Ralfe (1905) observed flocks of 20 individuals on the South West coast, on the Calf, Chasms and Spanish Head, in April of 1898 and 1899. He also considered there were a few nests on the East coast, and inland in Glen Rushen on slate quarries and the Central Hills. Kermode

(1901) corroborates this with having observed 6-7 behind Peel, 12 around Bradda and 'some' around the Maughold Rocks. Ralfe (1924) found in 1923 that there had been 'no diminution of numbers.' Kerruish (in Bullock et al. 1983c) observed 30-50 birds in post-breeding flocks in the Calf of Man (equivalent to 6-10 pairs) between 1890 and 1940. Ralfe (1933) saw April flocks of 20 (equivalent to 6-7 pairs) in the Calf and South West tip of Man in 1898-9 and 1931-2. He notes that 'some observers even think it increases' in 1933. Ralfe (1912, 1914, 1916) noted a relatively stable population at an inland site between 1877 and 1916 although one nest was robbed in 1915. Williamson (1959) observed a post-breeding flock of 50+ (equivalent to 8-12 pairs) on the Calf. He also gives evidence of continuing persecution at the time, since in 1929 he observed that all the East coast nests were either robbed or the young were shot or stoned to death. In 1938, 2 young were shot 8 weeks out of the nest. Yn Shirragh ny Ree/The Peregrine (1944) notes a flock of 50 on the Calf. Figures 6:1:9 and 6:1:10 are based from returns for the Calf from the Peregrine (1941-1983) and the Calf of Man Observatory Reports (1961-1983) to show recent breeding trends on the Calf. 6:5:3 examines the effect of sheep grazing on breeding numbers on the Calf. Further references were rats taking eggs in 1976, and dry summers in 1975, 1976 and 1981 depleting the availability of *Urpulid* larvae, so that the young were given less suitable food, reducing success, and high rabbit populations in 1978 and 1979 resulting in well-grazed feeding areas increasing success.

Rolfe (1966) estimated there were 14 pairs on Man, plus 6 on the Calf, giving a total population of 20 breeding pairs. He states the population to be 120 ± 10 individuals, which if the 31% non breeding population figure obtained in 6:3:1 is used, points in fact to a population of 27 pairs ± 3 pairs. It appears likely that Rolfe's estimate for 1963 was too small.

Inaccurate data and errors in interpretation have led to some

FIGURE 6:3:4. CALF OF MAN; BREEDING PAIRS.

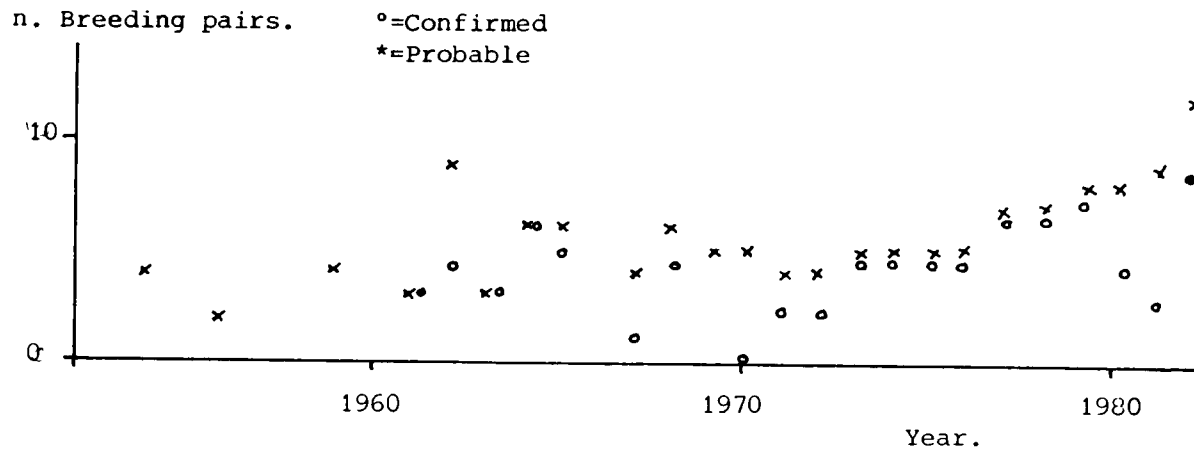
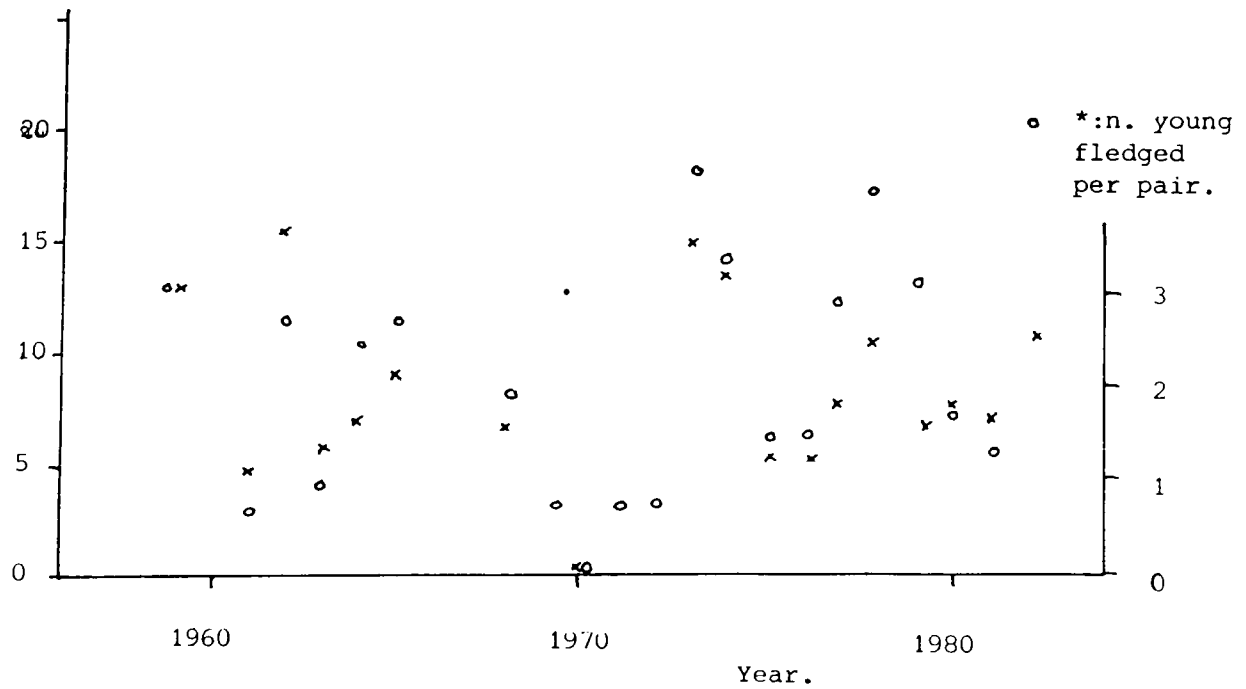


FIGURE 6;3:5. CALF OF MAN; BREEDING RESULTS.

°: n. young fledged.



misleadingly high figures. Kerruish (in Bullock et al 1983c) regarded Rolfe's (1966) estimate of 120 ± 10 individuals as indicating that there were 50 pairs. This, as shown in the preceding paragraph, is not the case. Cullen and Slinn (1975, in Bullock et al 1983c) estimated the population as being between 10 and 99 pairs between 1962 and 1970, without producing any evidence to account for the great variation. The two largest overestimates were
 were Bracegirdle (1964) ^{who} / thought there were 'perhaps over a hundred pairs' in 1962, and Garrad (1972) states there were 200+ pairs present at the time.

Parslow (1973) notes a 'gradual increase since 1963' which agrees with Sharrock (1976).

Bullock (1983a, 1983c) estimated the 1982 population as 49-60 pairs, a substantial increase, partly due to the recovery of numbers on the Calf (see Figure 6:3:4 for breeding numbers, and 6:3:5 for breeding success) and due to the conservative estimate of Rolfe (1966). There is probably a genuine increase in numbers for Man as well.

From this, the breeding population can be estimated at:

- 1820 40-70 pairs
- 1840 20-30
- 1860 5-15
- 1900 10-15
- 1940 15-25
- 1963 25-35
- 1982 49-60.

6:3:12 Wales, General Considerations

While naturalists in England could obtain their information on the distribution and abundance of the Chough from local people, or via the educated gentry and clergy in the area, this was not possible in rural Wales until the mid/late C19 because most people were monoglot Welsh speakers (Pryce 1978a, 1978b). / ^{in contrast} , even at the time of Carew (1602) Cornish was almost extinct as an everyday language, while the gentry were few in number (see for example Merywick 1808, reprinted 1910) compared with English

rural areas, and many of them were monoglot English speakers. / The travel books of Bingley (1800, 1804), Evans (1800), Malkin (1807), Nicholson (1813) and Lewis (1833) were limited in their ornithological scope, and none mention Choughs. This was further compounded by the lack of communications in West and North Wales where commerce either took place on very poor roads of limited extent or via the sea (Jenkins 1983). The availability of information from the Anglicised areas of Pembroke and Glamorgan from the 1850's, appears to be due to the development of an extensive educated bourgeoisie there (Morgan 1982). The scarcity of data at the time is reflected in More's (1865) survey of breeding birds on a country level for England and Wales. Unlike England, where almost all counties were covered, the only Welsh return was from Pembroke (by a Mr J. Tracey).

Lhuyd intended to write a systematic survey of nature in Wales in the late C17, in his projected 'A Natural History of Wales,' but the work was never completed (Emery 1972/3, 1982) and no MSS notes remain for the intended section on ornithology. This work was intended to be done in the 1700's. Lhuyd later (1712-13) made observations in Wales to see if any status changes in birds had taken place since the publication of Ray (1676, 1678). As Choughs are not mentioned here, it can be presumed he did not regard their distribution as being substantially different from that given by Ray.

There appears to have been no mention of Choughs in indigenous Welsh literature (see 5:8:2 and 6:2:4) except in the dictionary of Davies (1601) as Bran Big Goch - 'the red billed crow.' But the use of the word Pulores discussed in 6:2, (Bolam 1913) suggests at least a substantial oral usage.

Neither of the two major books of Welsh natural history, Giraldus Cambrensis's *Itinerarium Kambriae/Descriptio Kambriae* (1191/1194, translated by Thorpe 1978, see Roberts 1982) or Owen's (1603) 'Pembrokeshire' mention Choughs. The former only mentions 17 species and only visited one

potentially suitable area, Lleyrn, while the latter was more concerned with the culinary properties of birds (see 6:7:4).

Ray and Willoughby visited Lleyrn at Aberdaron via the only road of substance in the area during their third itinerary (Ray, published 1846, in Penhallurick 1978) of May to June 1662. As a result, Ray (1676) and Willoughby (1678) are the first authors to mention its distribution in Wales; 'it is found not only in Cornwall but also in Wales.'

Berkenhout (1745) expands this to 'Flint, Caernarvonshire and Anglesey' as does Pennant (1766, 1768, 1776), a native of Flintshire. Borlase (1758), Buffon (1771, 1793), Goldsmith (1774, 1791 et infra), Bewick (1797) and Fothergill (1797) simply state it occurs in Wales. The first site-specific mention is in Montague (1802) for 'Crow Castle' in Llangollen (6:3:18).

The list below gives the dates for first records in each county:

Merioneth	'up to 1865'	Forrest (1907)
Pembroke	1840-1850	Matthew (1894)
Pembroke	1857	Lockley (1949)
Glamorgan	1835	Doddrige Knight (1853)
"	1848	Dillwyn (1848)
Montgomery	1959	Nature in Wales (1961)
Carmarthen	'up to 1920'	Ingram and Salmon (1954)
Carnarfon	1835	Williams (1835)
"	1859-1860	Cordeaux (1866)
Cardigan	1869	Dix (1869)
"	pre 1892	Salter (1895)
Anglesey	1853	Forrest (1907)
Denbigh	pre 1799	Montague (1802)
Monmouth	? 1877	Ingram and Salmon (1937)

Assuming population declines were approximately synchronous ^{with} those in Western England, the lateness of available records means that in many cases, the distribution was well below its maximal level before any estimates can be made. Thus the findings are more open to conjecture than for England and the Isle of Man. This is unfortunate when considering the wider distribution in Wales today, which would have given more scope for comparative research.

6:3:13 Flint

The only mentions are in Berkenhout (1745) and Pennant (1766, 1768, 1776) and copied in Selby (1833), stating that it breeds there. This is given a plausibility by the fact that Pennant was a native of Flintshire (Gurney 1920). The lack of any other references indicate that if Choughs bred there, they died out between 1770 and the early C19.

6:3:14 Monmouth

Ingram and Salmon (1937) state it was 'said to have nested on Skirrid Fawr 60 years previously.' If this is the case, they must have died out around 1880.

Vagrants:

- 3 doubtful records 1880-1895 (Ingram and Salmon 1937)
- 2 records 1959 (Humphreys 1963)
- 1 at Abergavenney 30-ix to 1-x-1972 (Ferns 1977).

6:3:15 Carmarthen

Ingram and Salmon (1954) state it 'nested near Telpyn point until 1920; possibly later.' Although it is not mentioned in the more extensive listing in Barker (1905), a small number or possibly a single nest is plausible, being near Tenby in Pembrokeshire, a recognised Chough colony (Lockley 1949).

Vagrancies:

- 2 seen 'at one locality' v-vi-1969 (Nature in Wales 1969)
- 2, Pendine 1979 (Dyfed Bird Report 1984).

6:3:16 Glamorgan

Doddridge Knight (1853) found that they were 'common and breed at Dunraven'. This is repeated by Cardiff Nat. Soc. (1900, 1925), the latter edition states 'now not seen for over 25 years, at least,' probably an understatement. They probably ceased breeding there between 1870 and 1890.

The main breeding area was along the Gower Peninsula. Dillwyn (1848)

states 'it breeds along the cliffs of Gower.' Grenfell and Thomas (1982) mention there being 3 colonies up to the 1840's: an unknown cliff site, Broughton Bay and Three Chimneys. The latter was abandoned by 1880. Numbers started declining in the middle of the century, Nicholl (1889) stating 'still found in moderate numbers on Gower coast' which was repeated by B.A. Cardiff (1891). Cardiff Nat. Soc. (1900) regarded it as 'local; decreased very much of late ... now reason to fear it is almost extinct.' In fact, extinction appears to have occurred before then; Cardiff Nat. Soc. (1925) estimates extinction as by 1895 or 'a bit beyond'. Tattersall (1936) does not expand on this.

An important factor in their extinction appears to have been the trapping of birds for sale on Swansea market, for sale to French sailors as 'Billy Cocks' which were regarded as a delicacy (Cardiff Nat. Soc. 1900, see also 6:6). This trade must have been relatively small in order not to have immediately eliminated the population.

From this, the breeding population can be estimated at:

- 1840 10-15 pairs
- 1860 6-8
- 1880 2-3
- 1895 1
- after 1896 extinct.

Vagrants:

4, Worms Head vii-1943 (Cardiff Nat. Soc. 1967, 1974)
 Party of 4. Caswell Bay viii-1944 } (Heathcote, Griffin
 1 Aberavon, shot 27-i-1945 } and Salmon 1967)
 1 Margam 25-ii-1957. }
 1 Mumbles Head xii-1972 (Grenfell and Thomas 1982)
 1 Pwll Du Head 20-v-1973 (Nature in Wales 1974).

6:3:17 Montgomery

With the exception of the Montgomeryshire Field Society report of 1951 which states that 1 pair were seen in the county in 1951, the M.F.S. reports of 1930-66 contain no records of Choughs. Nature in Wales (1961) states 1 pair bred in 1959, which implies a new breeding record for the county. Rolfe (1966) found 2 pairs in 1963. Montgomeryshire F.S. Ann. Rep. 1967

°=Confirmed
 *=Probable

FIGURE 6:3:6 MONTGOMERYSHIRE

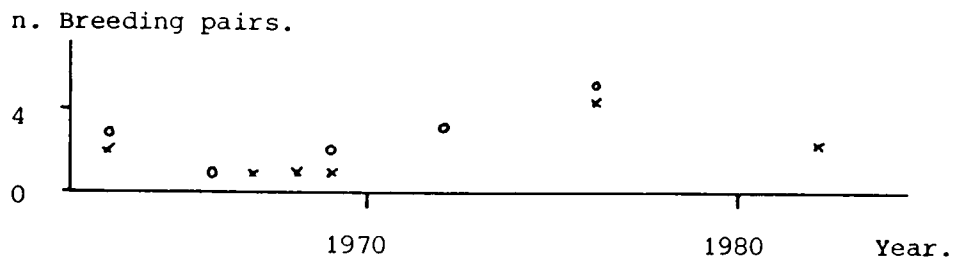


FIGURE 6:3:7 DENBIGH.

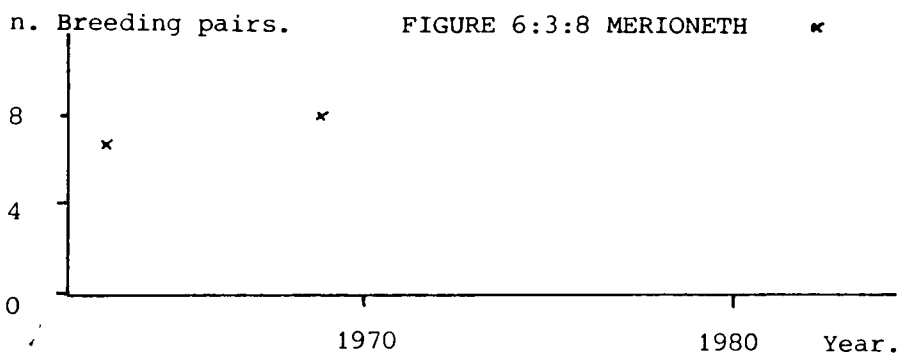
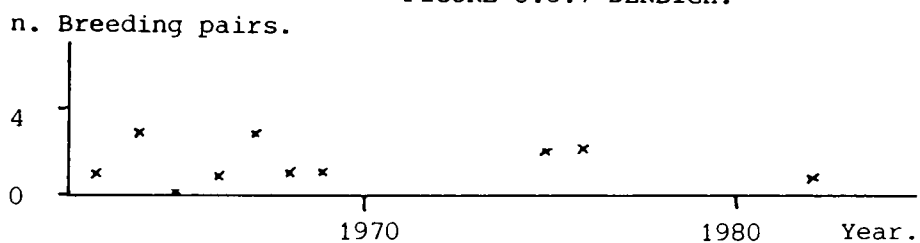


FIGURE 6:3:8 MERIONETH

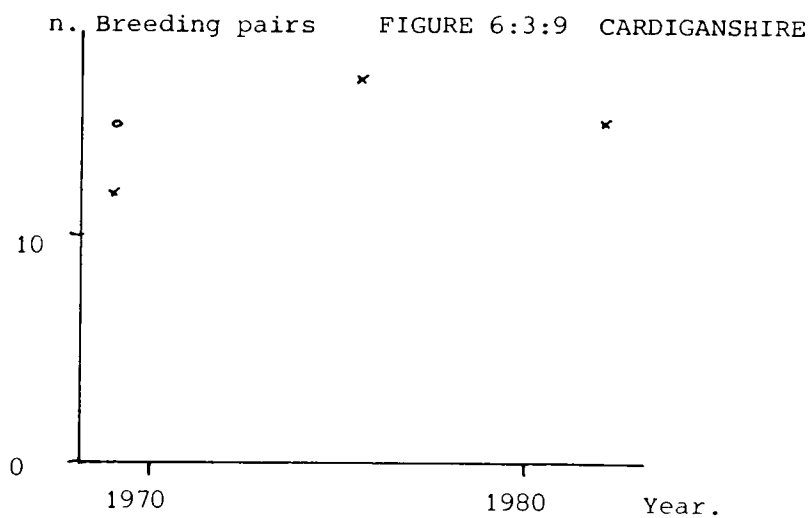


FIGURE 6:3:9 CARDIGANSHIRE

mentions '1 Chough at normal site' and in 1969, '1 at normal site and possible second pair breeding,' confirmed by Harrop (1970). Nature in Wales (1972) mentions a possible 3rd site, and the Montgomeryshire F.S. Ann. Rep. for 1976 mentions 4 sites, plus one possible breeding site. Bullock et al (1983a, 1983d,) found two pairs, pointing to a contraction in breeding numbers.

Thus, over the last 35 years there appears to have been either a recolonisation or a new breeding colony has been established and maintained. Figure 6:3:6 summarises population changes from 1963-1982.

6:3:18 Denbigh

Early records are based on an account in Montague (1802), where he refers to the demise of the 'ainchent site' at Crow Castle in Llangollen where a solitary individual remained for three years after the last clutch had been taken and the mate killed (see also Bolan 1913), thus pointing to breeding ending by 1799 at the latest. The isolation of this site, and its representation as a relict distribution is of interest in that it indicates that the former distribution may have included East Snowdonia and the Berwyn mountains in Denbigh. This is plausible in the context of the known inland distribution found in Scotland in the C18-19 (Baxter and Rintoul, 1953).

Hope-Jones and Roberts (1982) mention without further details, that a pair bred in the county again prior to 1906.

The first recent case of breeding is mentioned by Rolfe (1966) who regarded^{it}/as 'probable' that one pair bred in 1962 and 1963. Harrop (1969), Nature in Wales (1977) and the Cambrian Bird Rep. (1975) provide evidence for subsequent regular breeding, with a population varying between 1 and 3 pairs, as summarised in Figure 6:3:7. Hope-Jones and Roberts (1982) state that one pair has bred in recent years, while Bullock et al. (1983a, 1983d) found one pair in 1982.

6:3:19 Merioneth

Forrest (1907) states that up to 1865 they were 'quite common' and 'C.F.T.' (1871) found them 'breeding in numbers' from Aberystwyth to Harlech. This probably excludes the Borth area, since the habitat there is unsuitable. Salter (1895) found that the 3-4 pairs that 'frequented the bird rock' (near Barmouth) had died out by 1884 and that by 1892, there were none within 20 miles of Aberystwyth. Forrest (1907) considered that the population was limited to 'a few at Towyn' (Sic) and that West Merioneth included a colony of 7 pairs.

There are a number of recent surveys. Rolfe (1966) found 7 pairs in 1963, Harrop (1969) found 8 pairs in 1969, 7 of which were in inland quarries. Nature in Wales/^{reports} (1967-9, 1972-4, 1976) indicate a stable population size. The shift to inland sites (albeit all within 5 miles of the coast) may reflect disturbance on the coast, which is still used for foraging.

Bullock et al. (1983a, 1983d) found 12 pairs, a substantial increase, mainly due to new inland sites. This is at least in part due to a genuine increase in numbers.

From this, the breeding population can be estimated at:

- 1880 15-20
- 1890 10-12
- 1910 7-10
- 1970 7-8
- 1982 12.

Population changes are summarised in figure 6:3:8.

6:3:20 Cardigan

Dix (1869) thought they 'may still be regarded as common round the rocky coasts of Pembroke and Cardigan,' and refers to the pressure from egg collecting. Information from the Aberystwyth area dates back to 1880. Salter (1895, 1900), Ingram, Salmon and Condry (1966) point to a decrease from 5 to 2 pairs by about 1890-1895, staying stable until 1927 (Salter

1927), and then dying out in the 1930's, with a gradual recovery in the 1940's, with a possible breeding north of Aberystwyth (Peach and Miles 1961) followed by a gradual recovery to the late C19 level by 1976 (Roderick 1978), as shown in Figure 6:3:19.

In the South (New Quay to Cardigan Island) there appears to have been 8 pairs around 1956 (Ingram, Salmon and Condry 1966), with two new pairs noted in 1963 (Nature in Wales 1963), giving a total of up to 15 pairs on the coast, as confirmed by the Operation Seafarer records (Dyfed bird report 1967-1971) and Roderick (1978) in 1976. Rolfe (1966) gives totals of 4 coastal and 5 inland sites, the first obviously too small, and the second unconfirmed in any other report. Condry (1950) found no pairs in the Pynllyn/Capel Bangor/Cwm Ystwyth area, while Ingram, Condry and Salmon (1966) noted 1-2 pairs inland, Roderick (1978) found 2 inland pairs in 1976, with 1-2 unconfirmed pairs in the North, which have not been subsequently recorded.

Bullock (1983a, 1983d) found 14 coastal and 2 inland pairs in 1982, a slight reduction, probably attributable to the severe Winter of 1981/2. The underlying trend is of a stable, and possibly increasing population. Surveys are summarised in figure 6:3:9.

From this, the breeding population can be estimated at:

- 1860	15-20 pairs
- 1880	13-18
- 1900	10-15
- 1930	7-10
- 1950	10-12
- 1970	15-17
- 1980	17
- 1982	16.

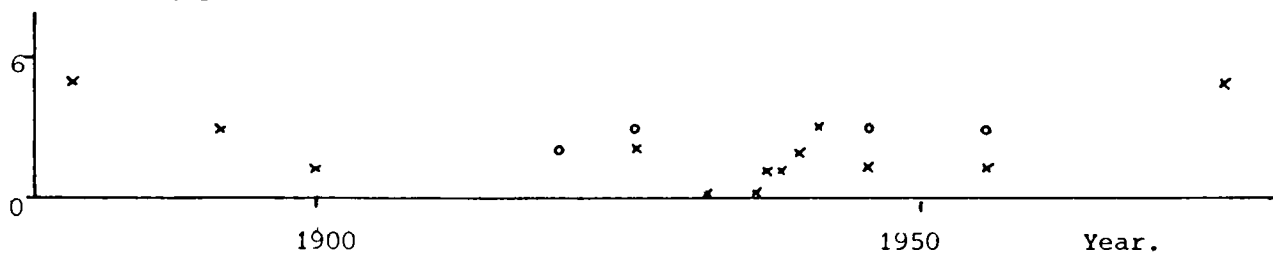
6:3:21 Caernarfon

Forrest (1907) states; 'in Caernarvon (sic) they have decreased wonderfully in last 20 years.' Williams (1835) found them at ^{the} Great Orme 'rather numerous in this neighbourhood and they breed on all the rocks.' This is restated by Parry (1861), and breeding had ceased in the Conway area

n. Breeding pairs.

FIGURE 6:3:10

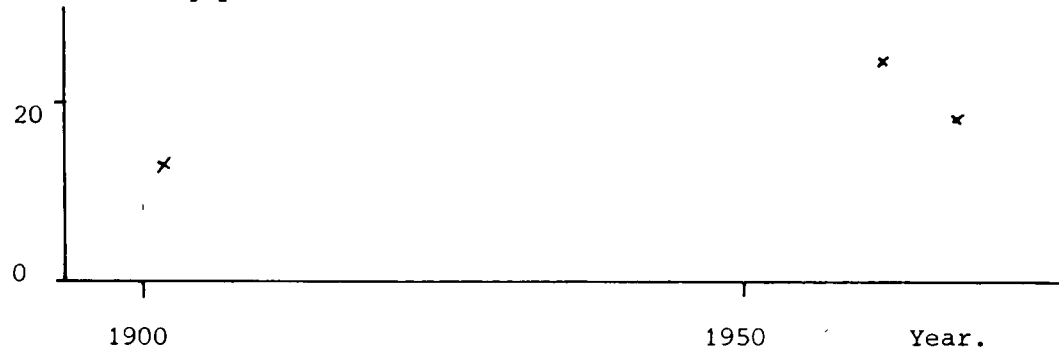
ABERYSTWYTH AREA.



n. Breeding pairs.

FIGURE 6:3:11.

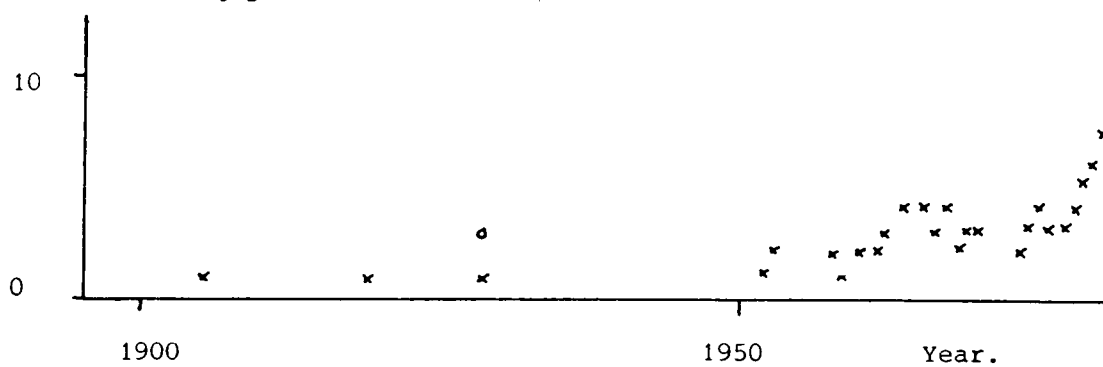
LLEYN.



n. Breeding pairs.

FIGURE 6:3:12.

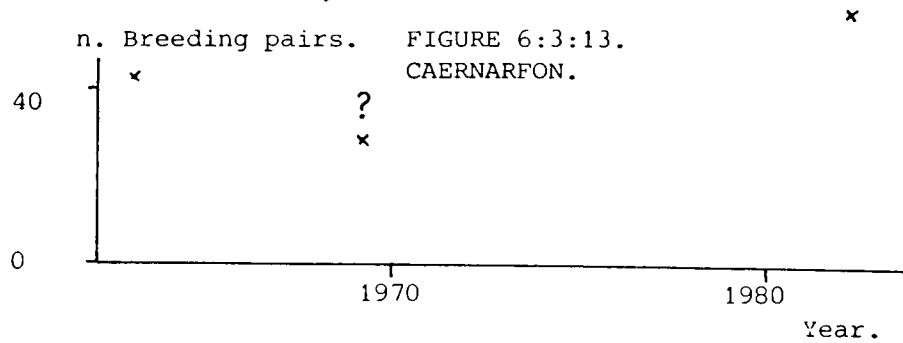
BARDSEY.



n. Breeding pairs.

FIGURE 6:3:13.

CAERNARFON.



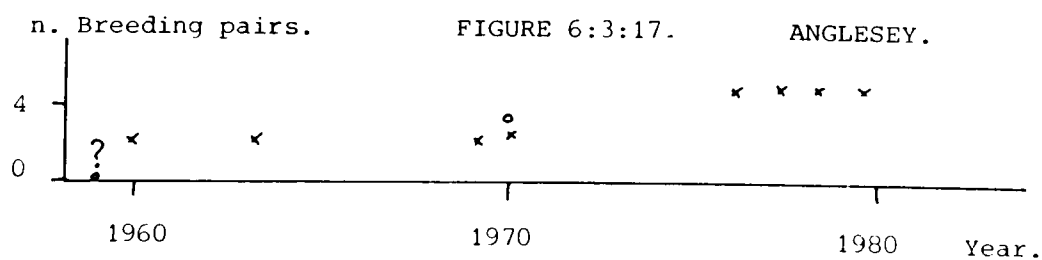
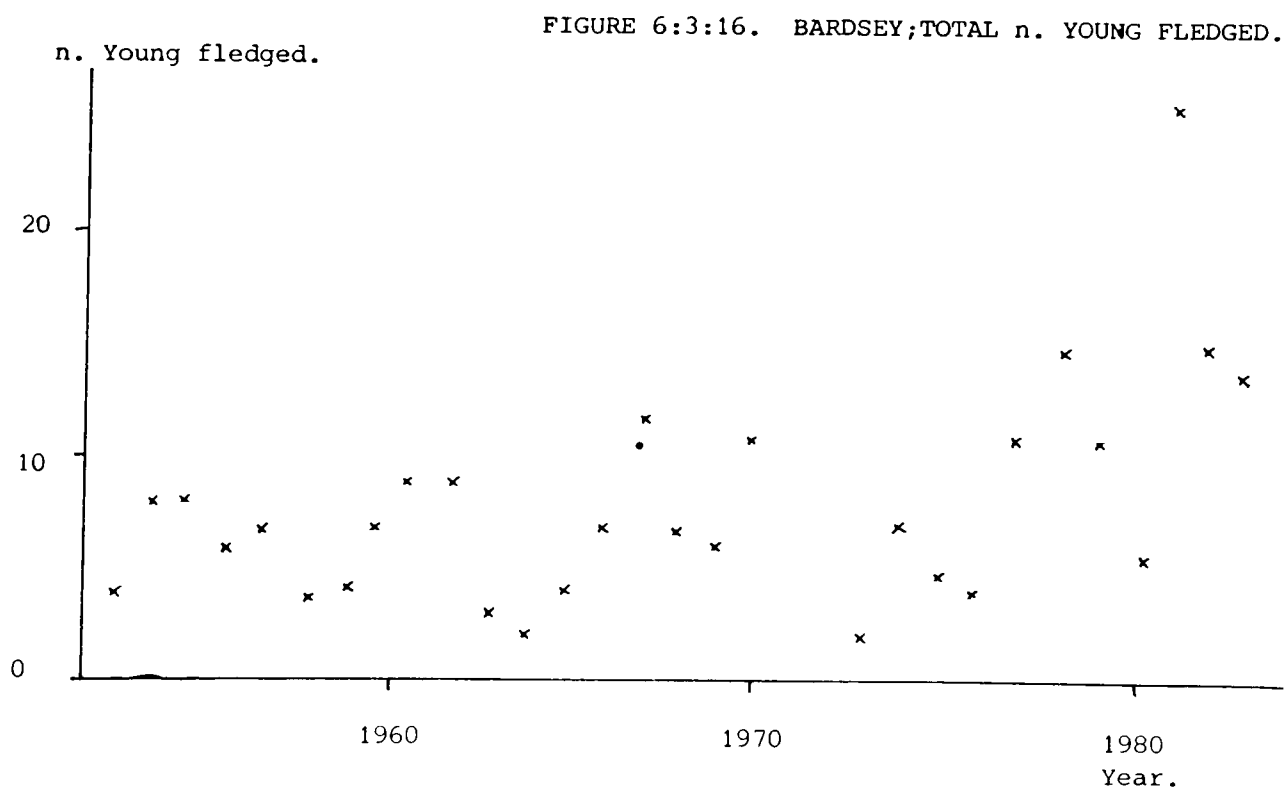
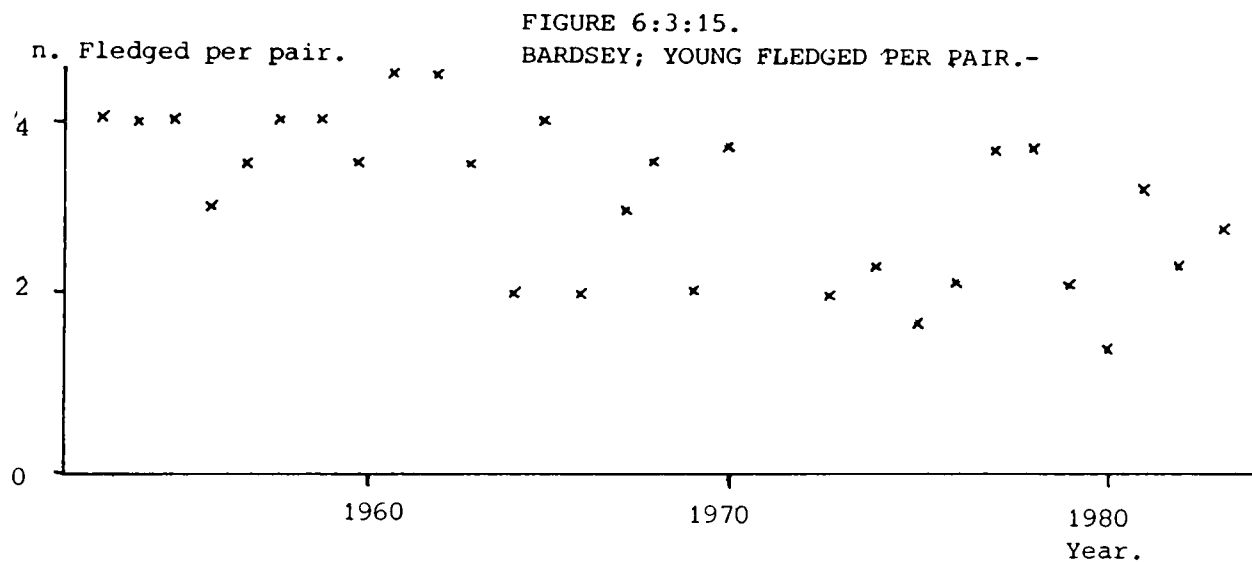
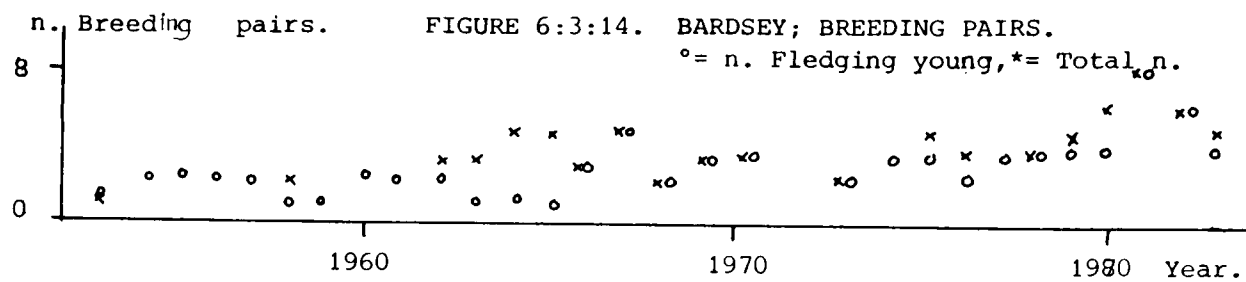
by 1885 (Forrest 1907). There are no known cases of breeding on the St. Tudwall's Islands (Thearle 1951). The main breeding population is in the Lleyn Peninsula.

Alpin (1900, 1901, 1902a, 1902b, 1903, 1905, 1910), Oldham (MS notes in Alpin, 1900-10, Alexander Library, Oxford) and Coward (MS Note in Alpin 1905, Alexander Library, Oxford) made a number of visits to Lleyn and Bardsey, between 1899 and 1910. Bardsey is treated at the end of the section.

In Lleyn, Alpin (1900) noted that in 1899 'the bird is getting very scarce'. In 1901 he saw 4 pairs in Lleyn (1901), and 1902 (1903) at Uwch Mynydd in West Lleyn he found 'only 2 pairs among all this piece of the mainland coast', and notes that eggs were taken here in 1846 and 1852. 2 birds only were found here in the Winter of 1903 (Alpin 1905), the 'Nevin (sic) bird rock colony became extinct in 1901' (Alpin 1910). Oldham (1914) saw 'fair numbers above old haunts.' Forrest (1907) estimated the Lleyn population at about 13-14 pairs. In other areas, he noted the following last dates of breeding: Newhaven and Llanberris quarries; 1894, Conway Mountains; 1898, Pen Maen Mawr; 1901, Penmaenback; 1906. Oldham (1914) saw a flock of 50-60 feeding in 1914, the equivalent of 10-15 pairs. Forrest (1919) notes 6 pairs at Cilan, 2-3 at Abersoch, several in Clynog 'a few years ago' and two new sites, giving a minimum of 10-11 pairs in the late 1910's. Whalley (1954) observed 40-50 just before the breeding season, thus equivalent to 13-16 pairs, in 'a remote valley'.

Surveys in Lleyn in 1963 (Rolfe, 1966) found 24 pairs, and in 1969 (Harrop, 1969) 18 pairs (figure 6:3:11). Since much of Rolfe's field work was based in Carnarfon, it is probable that his figures for the county are the more accurate here, in contrast to, for example, Cardigan (6:3:20).

Cambrian Society (1960) reports a presumed recolonisation of Little Orme with two breeding pairs in 1959 and 1960. Hope-Jones and Dare (1976) give



no more recent figures except for possible breeding on the Great Orme in 1965. These are summarised in figure 6:3:13.

First records for Bardsey come from 'C.F.T.' (1871) who found it 'breeding' there. Alpin (1902a), Coward (1905) saw 1 pair in 1905. Oldham (1914) observed a flock of 10 in 1914. Ticehurst (1919) found 1 and possibly 2 pairs in 1910, and in Forrest (1919), Ticehurst notes 1 family party in 1913. Lloyd (1934) saw 'probably several' in the early 1930's, which was interpreted by the 1955 Bardsey Bird Report as 'up to ten pairs'. 2-3 pairs is more plausible, since Lloyd in fact only saw 1 pair and was told of others. Norris (1953) found 1 pair and 1 family party in 1952. Bardsey Bird Reports (1953-1970, 1973-7) and Phillips (person comm. 1983) provide breeding data for 1953-1970 and 1973-1983. Figure 6:3:12 shows changes in the Bardsey population from 1871 to the present, and Figures 6:3:14 to 6:3:16 show more recent changes in detail. The rise in population since 1958 is attributable in part to the increase in sheep grazing since 1958 (Bullock et al 1983a).

Surveys for Caernarfon; Rolfe (1966) found 42 pairs in 1963, Harrop (1969) found 29 pairs, as mentioned above, this is probably an underestimate, with respect to Rolfe (1966). Bullock et al. (1983a, 1983d) found 51 pairs in 1982, indicating a gradual increase over the last 60 years.

From this, the breeding population can be estimated at:

- 1850 50-70 pairs
- 1900 35-50
- 1910 25-40
- 1967 42
- 1982 51.

6:3:22 Anglesey

First mentioned as breeding by Berkenhout (1745) and subsequently by Pennant (1766, 1768, 1776) and Selby (1833). Data in Forrest (1967) show that Rolfe (1966) is in error in stating that they became extinct in 1865 and did not return until 1960, but this was used by Harrop (1969) and

Bullock (1980). On Puffin Island, the last pair had their nest robbed in 1853 - 3 eggs and 1 chick - (Coward and Oldham 1904) and no subsequent breeding is noted. Bull Bay was last used prior to 1884 (Coward and Oldham 1904) and the last pair to use the main island, Mon, last bred at Tywyn Trewan in 1880 (Forrest 1907). Last breeding on Holyhead Island at South Stack and Aberffraw was in 1890 (Forrest 1907).

No further records exist until the 1960 census of the Cambrian Society (1960) notes 2 pairs, regarding it as 'a gradual increase' and thus implying one pair in 1959, and breeding for a few years previously. Cambrian Society (1962, 1963) found numbers being maintained, Cambrian Bird Report (1970) found 2-3 pairs in 1970 and numbers maintained in the early 1970's (1972, 1973, 1974), with 'several pairs between Almwch and South Stack' in 1975 (1975) and 4 pairs breeding in 1976 (1976). Bullock (1980) found 3 pairs breeding at South Stack in 1976 and 1977, and 2 pairs in 1978.

Bullock et al. (1983a, 1983d) found 8 pairs over all of Anglesey, in 1982, an increase from the 4+ of 1980 (Bullock 1980).

From this, the breeding population can be estimated at:

- 1850 5-10 pairs
- 1860 5-8
- 1880 3-5
- 1890 2
- 1890-1950's extinct.
- prior to 1959 1 pair
- 1960 2
- 1970 3
- 1980 4+
- 1980 8.

6:3:23 Pembroke

Individual islands will be treated separately.

Tracey (1850, 1851) found choughs 'common from Tenby to St. David's Head', Gurney (1857) noted a 'great abundance' at Manorbier Castle. There is little evidence for any substantial inland population, for when Andrews (1865) shot a specimen at Haverfordwest, he asked 'is it rare?', having not

previously encountered them there. It appears there was a decline between 1850 and 1870. This is first referred to by Dix (1869); 'May be still regarded as common round the rocky coast of Pembrokeshire and Cardigan where it is impossible to get at their nests.' Williams (1871) at St. Davids found them 'far from extinct . Less numerous than it was 40 years ago. Seems of late to be on increase.' According to him, local farmers regard it as 'destructive to wheat' and thus 'waged war on them in Winter and Autumn'. He found/^{that} several pairs at St. David's Palace and the tower of St. Mary's College/^{had} 'recently went to cliffs' because of their renovation and its consequent disturbance.

The population appears to have become fragmented due to a greater decline in some areas. Matthew (1894) regarded it as 'fast becoming scarce.' The reference by Blagg (1887, in Lockley 1949) to 'several old Choughs on coast by Giltar' is the last for that area, but the population appears to have stabilised between 1890 and the 1920's, as Ground (1925) remarks to it being 'at least as common in 1924 as in 1894, possibly an increase'. A further contraction in the East between 1938 and 1943 was noted by Lockley (1949); 'in ten years at Tenby not seen, 6 years ago pretty often seen at the cliffs between Tenby and Lydstep, very rarely seen now.' But overall, Lockley (1949) considered it 'probably no scarcer than it was 50 years ago', citing as examples three. ^{nests} at the roof of a cave at St. David's, presumably a colony with its origins in the displacement quoted by Williams (1871).

Islands:

Matthew (1884) states 'all the Isles are tenanted by the Chough', but this may be an exaggeration, since he is never reported as having visited Grassholm where for example W.W.N.T. reports from 1946 to 1977 do not report any breeding. Presumably, it therefore refers to Caldey, Ramsey, Skokholm, Skomer, Gateholm and Midland. The first 4 will be discussed in detail

Perrins (pers. comm. 1984) states that Choughs currently breed on Midland.

(a) Ramsey

Was found by Matthew (1882, 1884a, 1884b) to be breeding 'along the cliffs.' No subsequent records until 1968 when 9 pairs found, and 8 in 1971 (Donovan 1971). Bullock et al (1983a, 1983b) note a decline to 4 pairs by 1975 due to the abandonment of farming (see Cowdy 1973) and that the population had remained constantly at 4 pairs until 1982. This is in conflict with Perrins (Pers. comm. 1981) who states that 8 pairs bred there in 1981. Presumably constant breeding since 1880's to present.

(b) Skokholm

Sporadic breeding. Lockley (1936) cites last known case as being 1 pair in 1928. Subsequent records: 1936 and 1937; 1 pair present, no breeding, 1964; 1 nest, 1965; 1 pair mated then left (Skokholm Bird Obs. Rep. 1936-1939, 1946-1976, Skokholm Island Nature Res. Rep. 1977-1978, Skomer and Skokholm Bull. 1981-1983).

(c) Skomer

Bred 1884 (Matthew 1884), next report is in 1959, when 2 pairs bred (Mylne 1960). Until 1973, each year had 1-3 breeding pairs except 1963 and 1971. (Nature in Wales 1960-1971, Skomer Bird Obs. Rep. 1973-1976). Breeding ceased in 1973, and began again in 1981 with 1 pair, and by 1983, there were 2 pairs (Skomer and Skokholm Bulletin 1981-3). Birds were present every year during this period, thus there may be overlooked cases of breeding. These are summarised in Figures 6:3:18 and 6:3:19.

(d) Caldy

Lockley (1949) notes breeding by 1 pair in 1881 and 1893. White (1924) found no breeding between 1920 and 1922. Sage (1956) cites Lockley as finding 1 pair in 1934. Lockley (1949) found one family party in 1949, with probable breeding in the 1940's. Lockley (1961) found 1 pair. No subsequent data available, thus sporadic breeding.

FIGURE 6:3:18. SKOMER; BREEDING PAIRS.

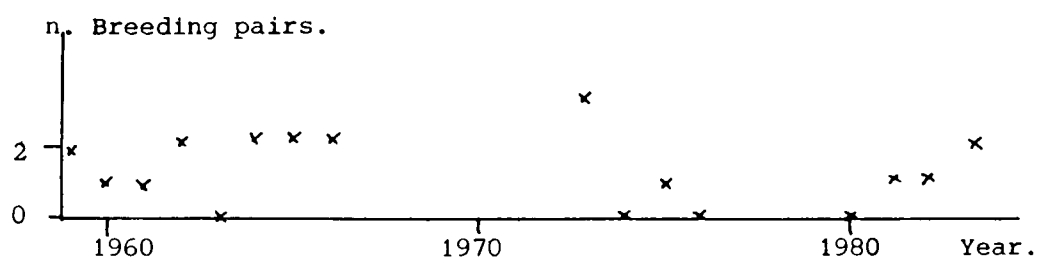


FIGURE 6:3:19. SKOMER; BREEDING RESULTS.

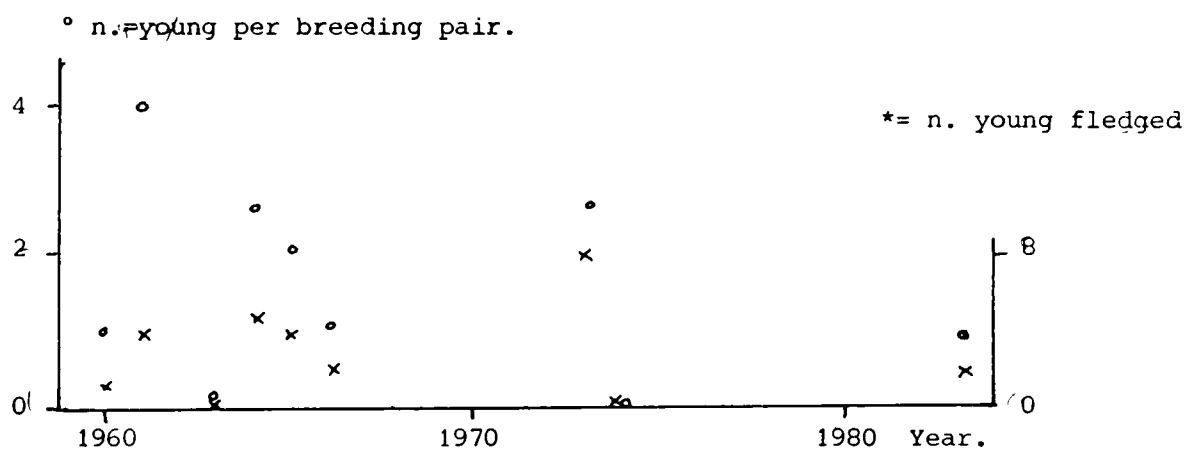


FIGURE 6:3:20. PEMBROKE.

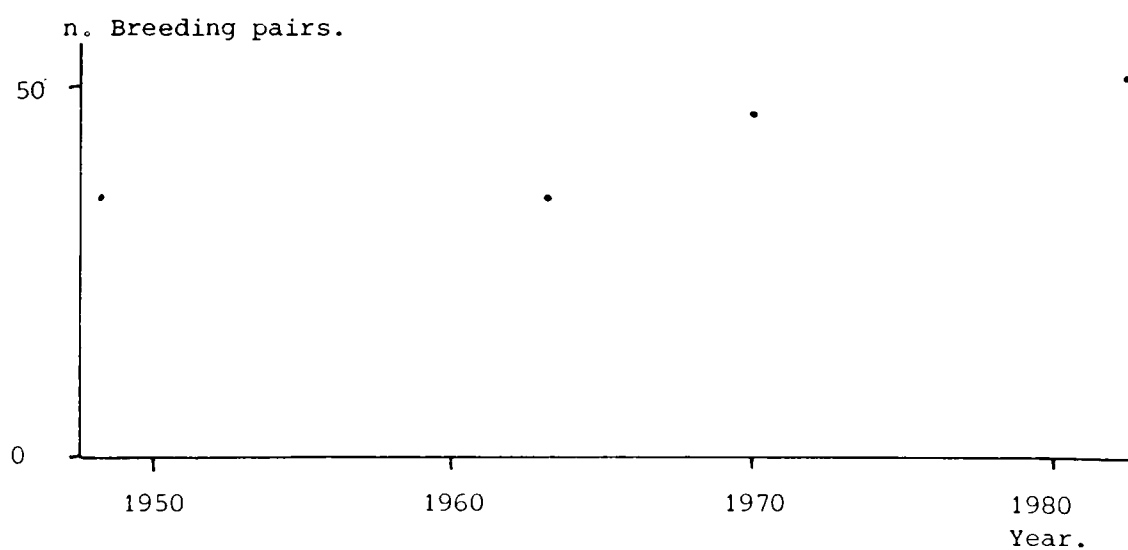
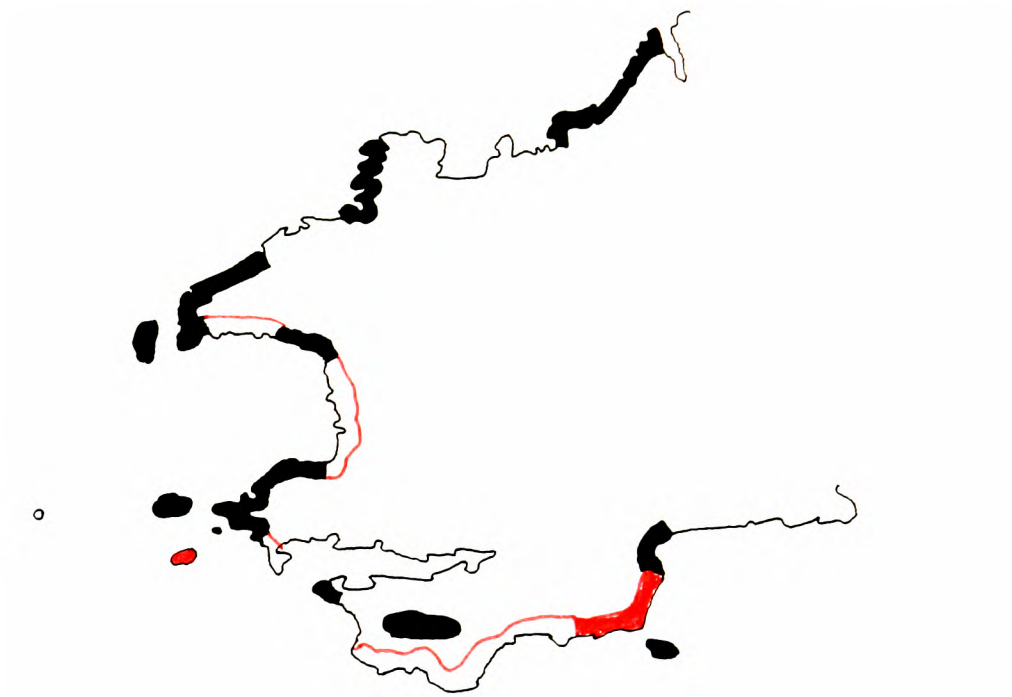


FIGURE. 6:3:21.
GEOGRAPHICAL EXTENT OF CURRENT AND
MAXIMUM POPULATION IN PEMBROKESHIRE.



BLACK; APPROXIMATE EXTENT OF CURRENT POPULATION.
SOLID RED; CONFIRMED PAST EXTENT.
OPEN RED; PROBABLE PAST EXTENT.

Overall, Lockley (1949) found 35 pairs in 1948, and in 1961 (Lockley 1961) 10 pairs from Angle to Caldy. Rolfe (1966) found 33-36 pairs in 1963, with (i), 5 at Little Haven to Dale Fort and (ii), 6 from Elegug Stack to Saundersfoot. Donovan (1971) found 34 pairs on the mainland and 12 on the Islands, giving a total of 46 pairs in 1971, with a reduction in the areas (i) and (ii) given by Rolfe (1966) to 3 and 2 pairs respectively, thus giving cause to question Rolfe's figures.

Bullock et al. (1983a, 1983d) found 49-52 pairs, confirming a gradual increase since 1949. Figure 6:3:20 summarises these changes, and figure 6:3:21 shows the maximum confirmed and probable distribution of the Chough in the C19.

From this, the breeding population can be estimated at:

- 1840 50-80 pairs
- 1850 50-70
- 1860 30-40
- 1900 30-40
- 1948 35
- 1970 46
- 1982 49-52.

6:4 OVERALL TRENDS IN PAST DISTRIBUTION

6:4:1 Introduction

Past attempts to examine the changes in the Chough's distribution have either been limited to a piecemeal collection of data (Rolfe 1966, Bullock 1980, Bullock et al. 1983a) or a relatively comprehensive collection of data on only the county level (eg D'urban 1898, and Penhallurick 1978). There have been no attempts to find the past extent of the Chough in England and Wales, nor to estimate its numbers by direct extrapolation from past records or by a theoretical application of its maximum breeding density.

6:4:2 Aims

This section aims to apply the county by county estimates made in Section 3 on a national basis for numbers of breeding pairs, their extent

and trends in changes of breeding numbers on a national level. The database thus obtained can be utilised to examine the effect of climate, management and persecution on Chough numbers at the time. Furthermore, an insight into the maximum coastal population is attempted by using the breeding density data from nineteenth century records in Cornwall in Section 3:1.

6:4:3 Methods

For overall population trends, each county estimate was placed in a table in 10 year blocks. Where there has been a change between estimates and there are gaps where no estimates have been made (eg for Dorset 1800-1840) it was assumed that the rate of population change was constant and intermediate figures are given. These figures are unshaded in order to separate them from the county estimates. For each 10 year block, all estimates and intermediate figures were collated and the mean of the estimate ranges obtained. From the means, cumulative declines from the 1750 population estimate were taken, along with declines per 10 years and this figure expressed in a percentage form.

Because of the unequal historical distribution of data especially in Wales (discussed in 3:12), the first year where all counties have estimates was 1870, and thus the previous running totals are based on the assumption that prior to the first estimate the population remained stable. Obviously this was not the case. Thus a corrected running total decline was calculated by using only those counties where there had been estimates or intermediate figures for each ten year set. The corrected figures produced a consistently higher rate of decline (χ^2 23.23 df=9 $P>0.01$). Graphs of % decline and number decline in breeding pairs per 10 years were produced, along with a graph for the population level mean estimate for each 10 years.

To obtain an insight into the geographical extent of the Chough

population in the past, all previous records were placed on a map alongside probable records and the current distribution from Sharrock (1976) and Bullock et al. (1983a). The two recent surveys are consistent in geographical extent.

Certain sites are not shown where the Rare Breeding Birds Panel has recommended that either the markings on these two maps be moved or excluded. In the case of this work, the recommendations have been followed by removing records, since displaced records may have a confusing effect when attempting to undertake work of a comparative nature.

The extent of suitable breeding habitat on the coast was obtained by combining the incidence of cliffs of over 25 feet and cliff made of consolidated rock (from Bickmore and Shaw 1963). Where these two criteria were met, the area was regarded as potentially suitable for Chough breeding.

In order to see how geographical distribution has changed with time, site records are re-expressed as final breeding cases in 20 year groups. Sets of breeding data are presented as 20 year contours, thus the 1840 contour means that within its extent, and the next (1860) contour, breeding ceased at all known sites between 1841 and 1860.

Because of the more detailed available information on Cornwall, separate distribution maps and distribution contour maps are shown in 3:1.

In Section 3:1, a set of hypothetical maximum coastal breeding density figures were obtained. By combining these density figures with the extent of potentially suitable coastline for each county, 'ideal maximum' breeding figures for each county can be obtained and compared to the estimates for each county. No suitable method of calculating past inland populations of Choughs was found, so the inland populations of North Wales, and the Lake District had to be excluded from any calculations.

6:4:4 Results

Overall trends

From the overall results as shown in tables 6:4:1 and 6:4:2, three main phases in the Chough population changes are apparent: from 1780-1900, a constant decrease in numbers, from 1900-50 a lower rate of decrease, finally levelling out, and from 1950-82 a constant increase in numbers. The corrected running total figures provide a more sensitive indication of the main period of decline (shown in tables 6:4:3 and 6:4:4). They demonstrate that there were three periods of particularly high rates of decline; 1821-30, 1851-60, and 1871 to 1910. Bullock et al. (1983a) regarded the peak period of losses as between 1846 and 1870. The discrepancy between their estimate and this one partly lies in errors in final breeding dates in Bullock et al. (1983a), where in fact this survey found instances of breeding after their final dates. Bullock et al. (1983a, 1983b, 1983c and 1983d) take a cautious view of population changes prior to the 1982 survey, regarding the levels in the 1940-1960 era as higher than this survey concludes. They do agree that an increase has taken place since Rolfe (1966) surveyed Wales and the Isle of Man in 1963.

Rolfe (1966) estimated the population in 1963 as 119-124 individuals in Wales and 120 ± 10 individuals in the Isle of Man. This section estimates the 1960 figure as 141 pairs and ^{that} for 1970 as 162 pairs. The discrepancy between these data and Rolfe's is in the main due to his assumed under-estimation for the Isle of Man as discussed in 3:11. Rolfe was correct in indicating that at the time Chough populations were still near their lowest ebb as demonstrated in figures 6:4:1 to 6:4:3. Surveys in Wales between 1963 and 1982 (in particular Donovan 1971, Harrop 1971 and Roderick 1978 for Pembroke, North Wales and Ceredigion respectively) pointed to a gradual increase in the breeding population in the late 1960's and throughout the 1970's. With the exception of Ceredigion, where there was a reduction from

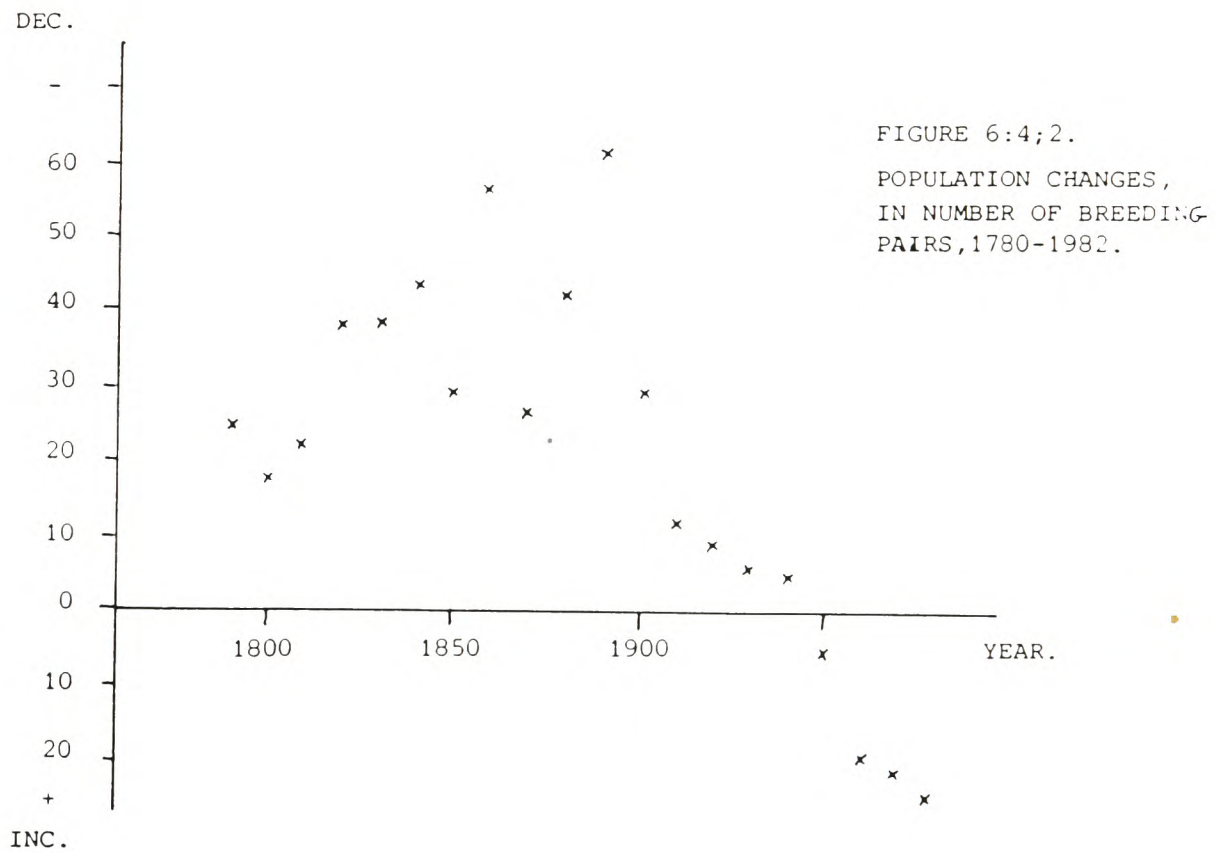
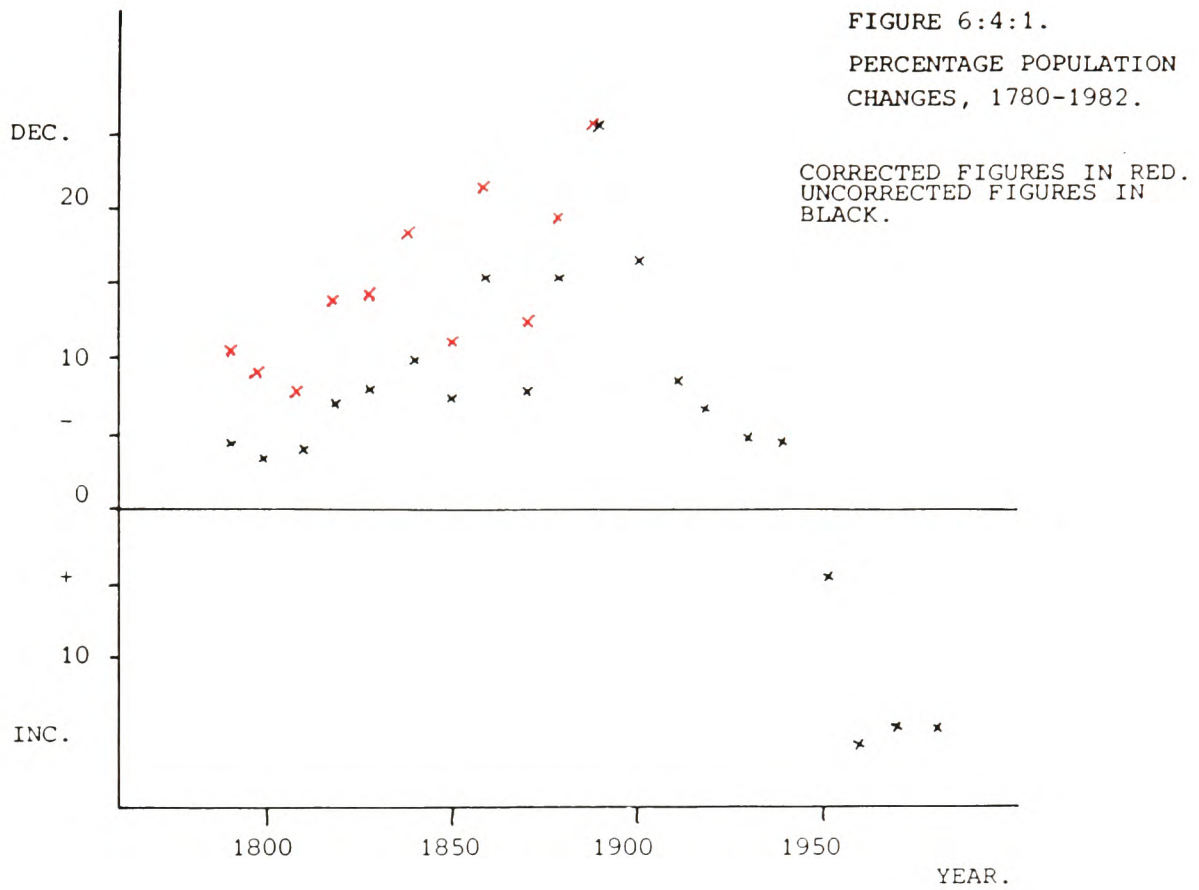
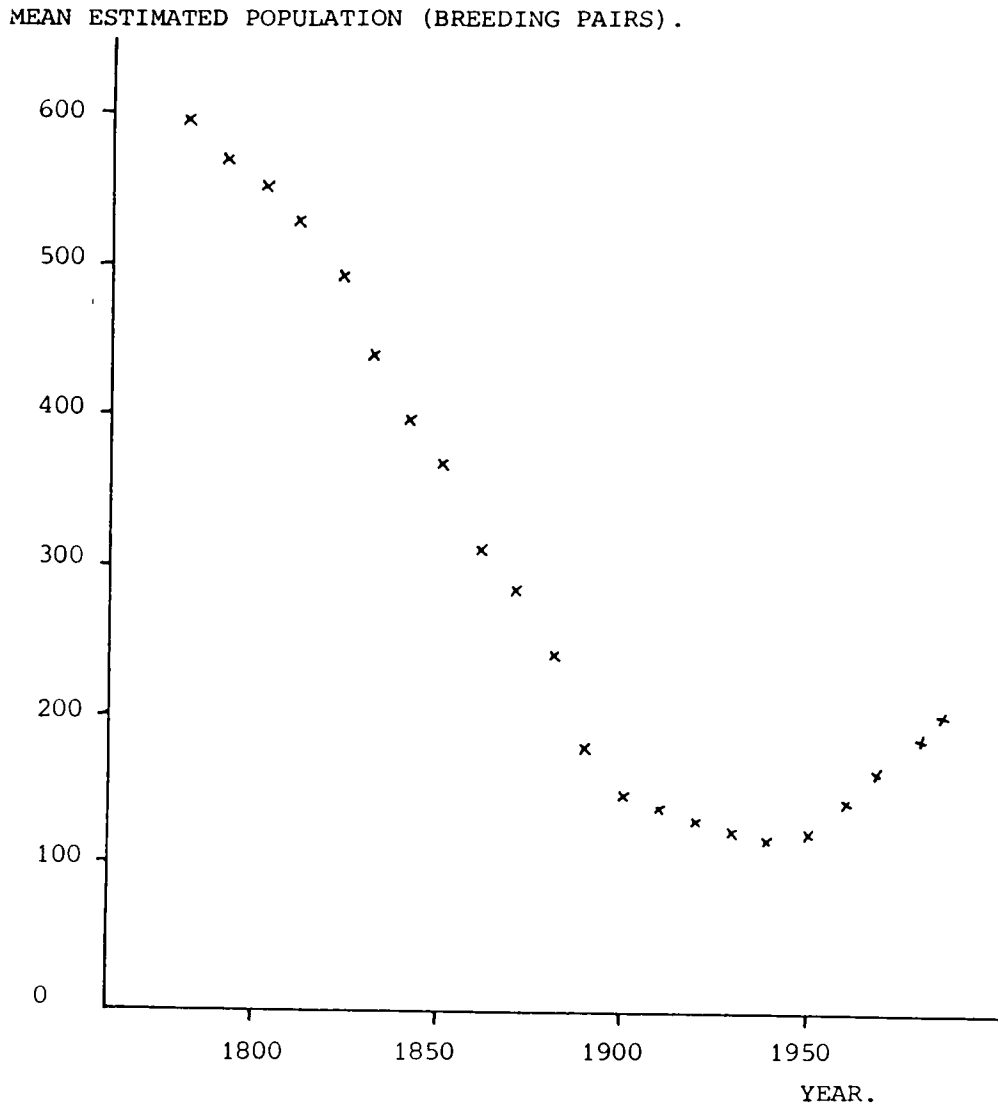


FIGURE 6:4:3.



OVERALL POPULATION ESTIMATES, 1780-1982.

Table 6:4:1 County Estimates from 6:3

	CORNWALL	LUNDY	HAMPSHIRE AND IOW	SUSSEX	DORSET	SOUTH DEVON	NORTH DEVON	ISLE OF MAN	GLAMORGAN	CARDIGAN	CAERNARFON	ANGLESEY	PEMBROKE	MERIONETH	SOMERSET	OTHERS
1750	220-270			10-25												4-7
1780	192-242			5-10												3-6
1790	178-228			2-5												2-4
1800	164-214		20-30	1	20-30	5-10	30-50									
1810	150-200		17-27	0	19-27											
1820	130-170		12-22		16-24			40-70								
1830	110-140		9-19		14-21	4-8		20-30								
1840	90-110		5-15		12-18			20-30	10-15				50-80			2-3
1850	85-105		3-5		10-15		30-40	12-22	8-11	15-20		5-10	50-70		10-15	
1860	80-100		1-2		7-10	3-5	25-35	5-15	6-8	14-18		5-8	30-40		7-12	
1870	75-90	5-10	0		5	2-4	20-30	7-15	4-6	13-18		4-6		15-25	5	
1880	57-90	3-6			3	1-2	12-20	8-15	2-3	12-17		3-5	30-40	15-20	4	1-2
1890	40-50	1-2			1	0	5-10	10-15	1	10-15	50-70	2		10-12	3	
1900	32-42	0			0		3-5	11-17	0	9-13	35-50	0		8-11	2	
1910	25-35						1-2	12-19		8-12	25-40	0		7-10	1	
1920	20-25						0	13-21		7-10	28-40	0			0	0
1930	15							14-23		8-11	31-40	0				
1940	6							15-25		10-11	24-40	0	35			
1950	0							20-30		10-12	37-40	0	40	7		
1960	0							25-35		12-14	41	2	46	8		1
1970								30-45		15-17	42	3	49-55	8		4
1980								45-55		17	48	4-5		10		1
1982								49-60		16	51	8	49-61	12		3

Number of breeding pairs;
Table 6:4:2 Overall Trends

	ESTIMATE	AVE.	Σ DEC.	DEC./ INC.	% DEC./ INC.
1750	509-737	623			
1780	480-708	594	38	38	
90	460-678	569	63	25	4.21
1800	443-659	551	81	18	3.16
10	424-633	528.5	103.5	22.5	4.08
20	395-585	490	142	38.5	7.28
30	359-522	440.5	191.5	39.5	8.06
40	324-469	396.5	235.5	44	9.99
1850	305-429	367	265	29.5	7.44
60	257-363	310	322	57	15.53
70	238-328	283	349	27	8.71
80	202-278	240	392	43	15.19
90	151-205	178	454	62	25.83
1900	127-170	148.5	483.5	29.5	16.57
10	111-161	136	496	12.5	8.41
20	106-148	127	505	9	6.62
30	104-138	121	511	6	4.72
40	105-127	116	516	5	4.13
1950	114-129	121.5	510.5	+5.5	+4.74
60	135-147	141	491	+19.5	+16.05
70	150-174	162	470	+21	+14.89
80	176-196	186	446	+24	+14.81
1982	188-211	199.5	432.5	+13.5	+7.26

Table 6:4:3 Extent of area with population
estimates, by year group

	ESTIMATE RANGE	NEWLY EST. AREAS	TOT. EST. RANGE
1780	205-272		
90	185-242		
1800	168-223	75-120	243-340
10	224-319		
20	195-280	40-70	201-350
30	199-272		
40	163-234	60-95	223-329
1850	204-289	15-25	219-314
60	171-238	15-20	201-258
70	168-223	20-35	188-258
80	152-208	50-70	302-278
90	151-201		

**Table 6:4:4 Corrected figures for
status changes 1780-1890**

	AVE. EST. RANGE	AVE. TOT. EST. RANGE	DEC.	% DEC.
1780	238.5			
90	213.5		25	10.48
1800	195.5	293	18	8.43
10	271.5		22.5	7.68
20	237.5	275.5	38.5	14.18
30	240.5		39.5	14.34
40	198.5	276.5	44	18.29
1850	246.5	261.5	29.5	10.67
60	204.5	222	57	21.79
70	195.5	223	27	12.16
80	180	240	43	19.28
90	176		62	25.83

18 to 17 pairs between 1976 and 1982 (Section 3:20), these increases have continued up until the 1982 survey.

6:4:5 An 'Ideal distribution'; in extent

Figure 6:4:4 shows the extent of cliffs over 25 feet and the distribution of consolidated rock cliffs in England, Wales and the Isle of Man. These areas under the appropriate management regime (Section 5) and degree of exposure, would have adequate feeding habitats at the top of the cliffs or in the immediate vicinity (see Chapter 4:2 and Fuller, 1982). Cliffs over 25 feet are in black, consolidated rocks in red.

Figure 6:4:9 shows the maximum estimated extent of Chough breeding from records. Solid red indicates from direct records, open red by indirect records (by implication and general observations, eg 'all along these shores' for Sussex by White 1771), and black shows current 1970/1982 distribution, with some omissions as discussed above. The effect of these omissions is small, since the most important changes occurred in England where Rare Breeding Birds Panel rulings would have little use.

Figure 6:4:5 combines maximum estimated Chough distribution with the 'ideal distribution'. In South and West England, Wales and the Isle of Man, a high proportion of the potential breeding areas appear to have been

FIGURE 6:4:4.

'IDEAL COASTAL DISTRIBUTION'
QUALIFYING CRITERIA ARE WHERE A
CONSOLIDATED ROCK CLIFF OF OVER 25
FEET OCCURS.

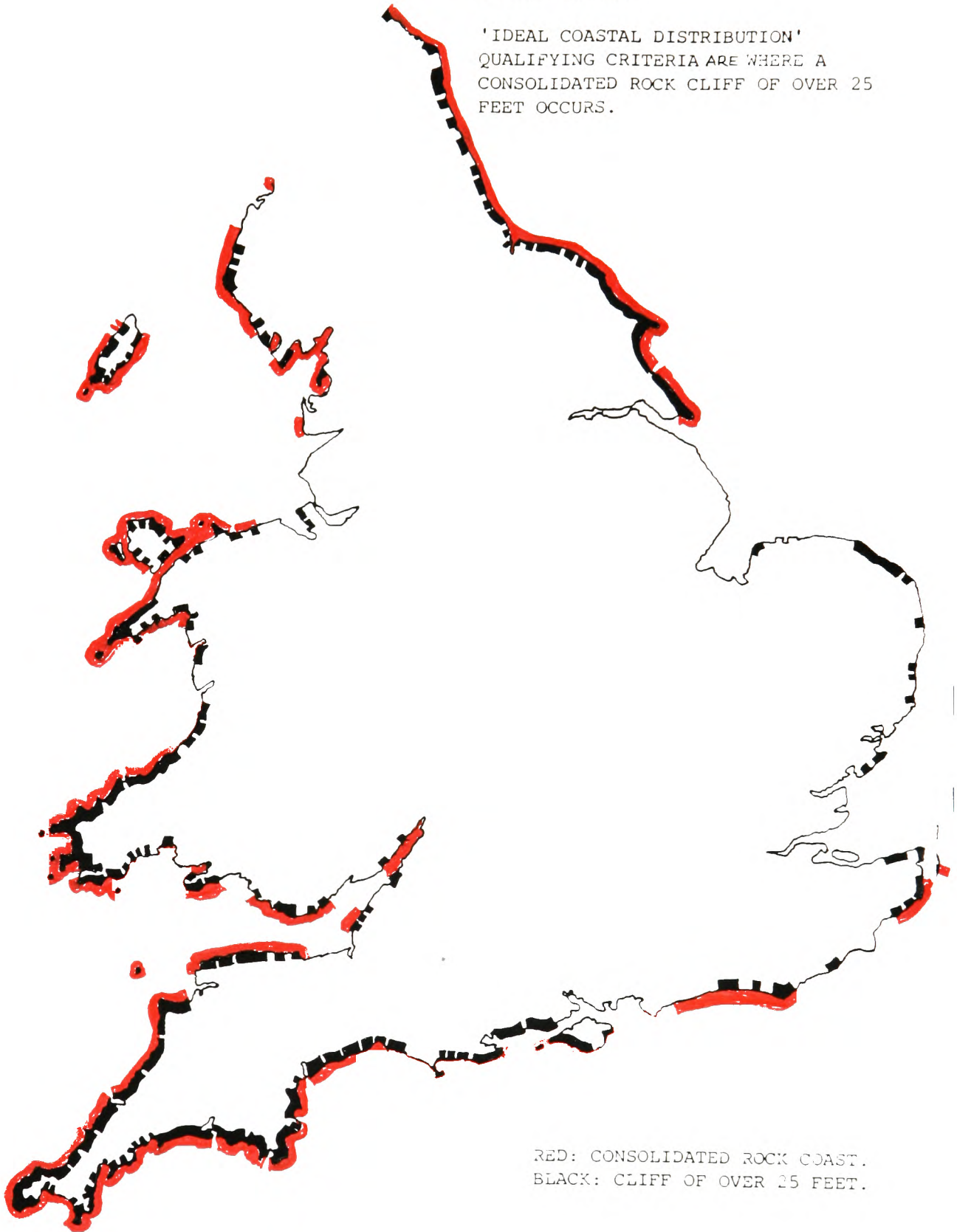


FIGURE 6:4:9.

CURRENT AND PAST DISTRIBUTION
(FOR SECURITY REASONS, CURRENT
DISTRIBUTION IS NOT ENTIRELY
ACCURATE, AND SHOULD THUS BE
REGARDED AS A COMPARATIVE
INDICATOR OF EXTENT OF DISTRIBUTION
AS OPPOSED TO AN EXACT BREEDING
RANGE).

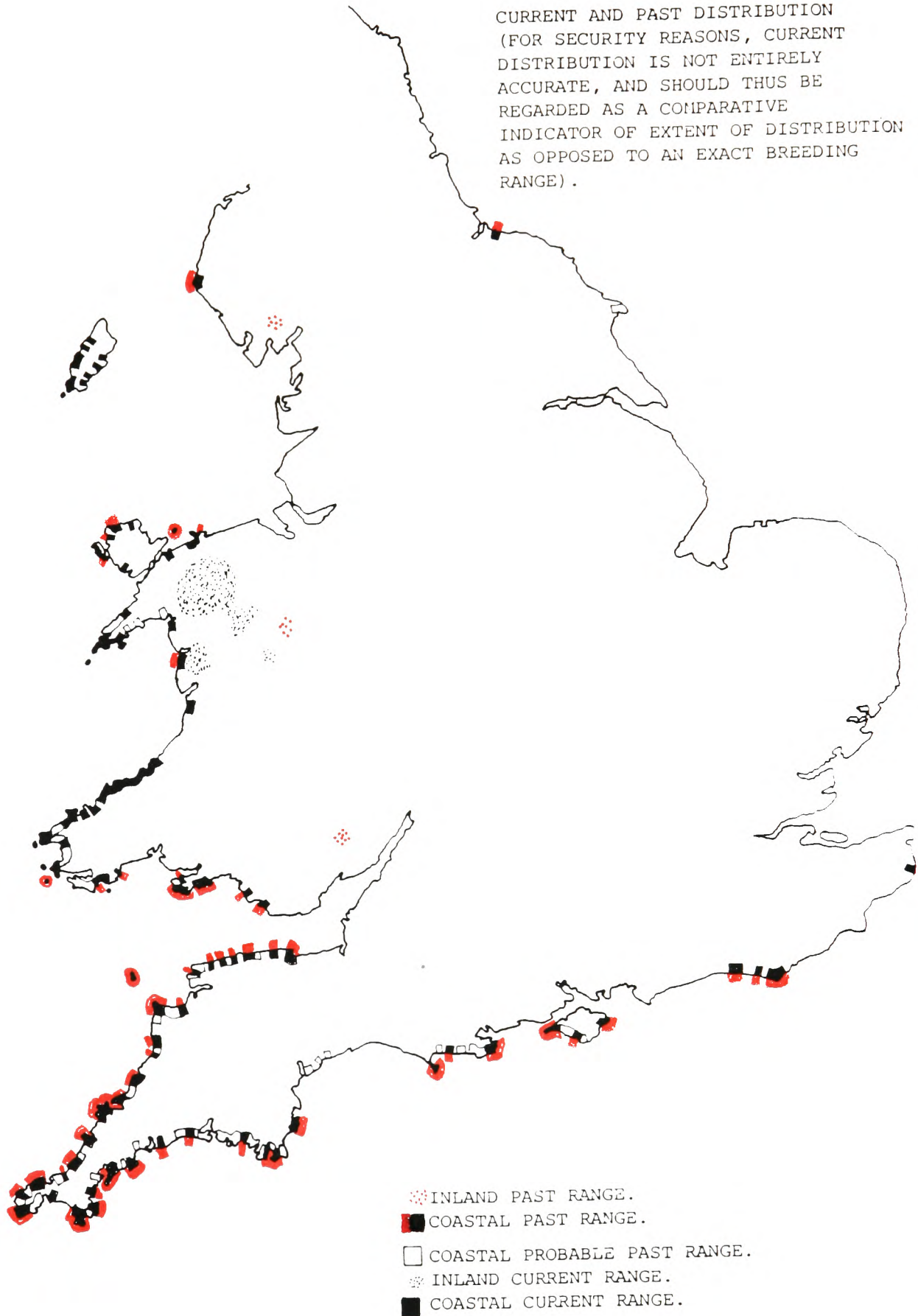


FIGURE 6:4:5.

'IDEAL COASTAL DISTRIBUTION' AS
DEFINED IN FIGURE 6:4:4 COMBINED
WITH ALL KNOWN INSTANCES OF CURRENT
AND PAST BREEDING.



occupied. This is not the case for Northern England, due to the population there being nearly extinct at the time of the first breeding records being made there (section 3:6 and 3:7).

Figure 6:4:6 shows the last breeding date contours for areas where the Chough became extinct. Cornwall was illustrated in figure 6:3:3, section 3:1. Anglesey, and the Isle of Man show the contractions in range before their recoveries in numbers (3:11 and 3:21). West and North Wales are excluded due to most of the population maintaining its extent even when numbers declined.

Bullock (1980) noted a gradual East to West contraction in numbers. This is seen here, but with the addition of a contraction from the extremes of the North and South into the middle areas of Wales and the North coasts of Devon and Cornwall. This trend is secondary to the East to West contraction. What is also apparent is that prior to extinction the pattern is broken up into a series of scattered relict populations that continue to contract up to extinction.

6:4:6 An 'Ideal distribution' in numbers

The Cornish population density estimate (2.43 pairs per mile) and the Welsh coastal density estimate (1.79 pairs per mile) were selected as the sets of data most likely to resemble densities for the whole of England and Wales's coasts. This is because the Irish data/ are derived from too different a set of habitat preferences and geographical circumstances, while Bardsey was considered to be too limited an area for applying to such a broad distributional context.

In table 6:4:5, the extent for the 'ideal coast' for each country is multiplied by the two density estimates to produce two sets of 'ideal' county breeding populations. As an indication to what extent each country population was below its maximum level before the first estimate

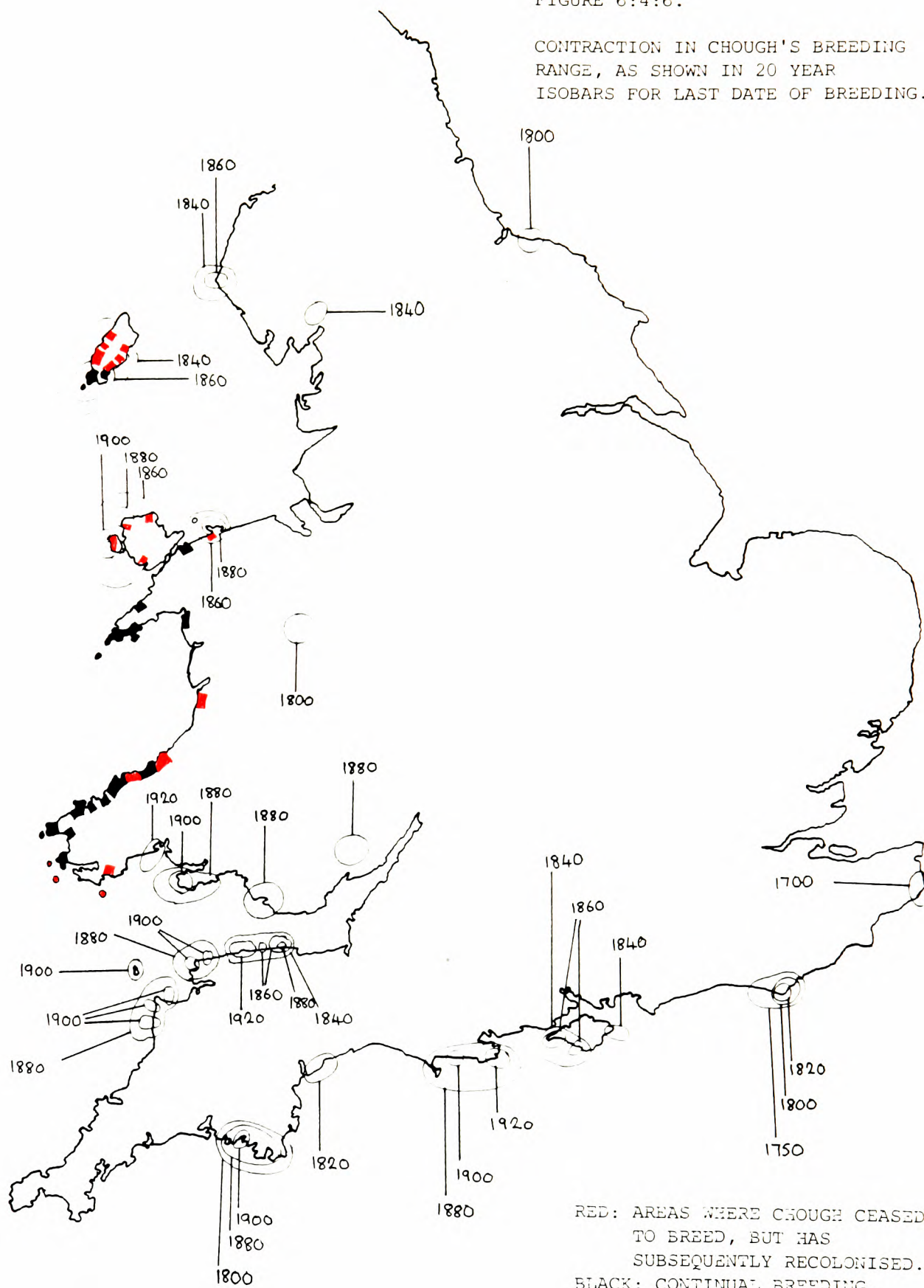
MAX. POPN. AS %
OF IDEAL POPN.

230

*substantial inland population.
[] includes inland popn., thus halve figures given in table.
[]* subsequent recolonisation.

FIGURE 6:4:6.

CONTRACTION IN CHOUGH'S BREEDING
RANGE, AS SHOWN IN 20 YEAR
ISOBARS FOR LAST DATE OF BREEDING.



could be made, the maximum estimate was compared to each 'ideal' estimate. Counties where no population estimate was made were put in a separate group and this group also included Merioneth on account of its substantial inland population. Because of its large coastal population, Carnarfon was included in the former category even though about 50% of the population is inland. As a result the ^{estimated} population/ideal population % should be halved for the Carnarfon results.

The figures show that the maximum estimates as a percentage of the 'ideal' population vary widely, from 74.7% for Cornwall to 6.1% for South Devon, both at 2.43 pairs per mile. To see if this was due to the number of years the county population was to continue before extinction, a regression analysis was made ($r > 0.20$, $n=10$) for county estimates, where the population subsequently became extinct (figure 6:4:7). The regression showed that this was not a significant factor. Comparing first estimate dates to the maximum/ideal population percentages (figure 6:4:8) produced a slightly significant relationship ($r < 0.10$, $n=10$). Thus while some areas had more rapid extinctions than others, and there were some general geographical trends in the pattern of range contraction, there was still a relatively constant overall rate of decline from 1750 onwards.

Combining the 'ideal' figures, two further sets of maximum breeding numbers and individuals can be obtained:

Source	n. breeding pairs	total n. (31% popn.
		non-breeding see 3:1)
'Ideal' @ 1.79 pairs/mile	1383.7	3625.3
'Ideal' @ 2.43 pairs/mile	1878.4	4921.4
Maximum estimate	623.0	1632.3
1982 Survey	199.5	522.7

These figures assume that the Northern counties supported a Chough population at the same density as elsewhere and to the whole extent of their 'ideal' range. If this was the case, the figures point to a very large

FIGURE 6:4:7.

PERCENTAGE.

HIGHEST COUNTY ESTIMATES AS A PERCENTAGE
OF THE 'IDEAL COASTAL' FIGURES IN RELATION
TO TIME BETWEEN ESTIMATE AND EXTINCTION.

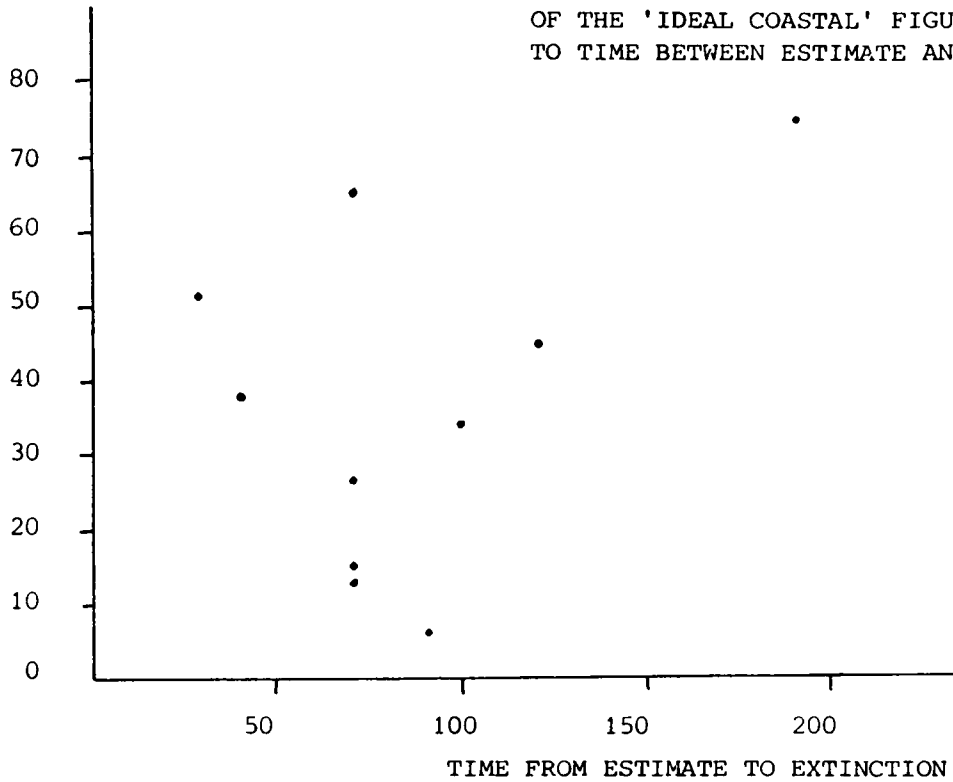
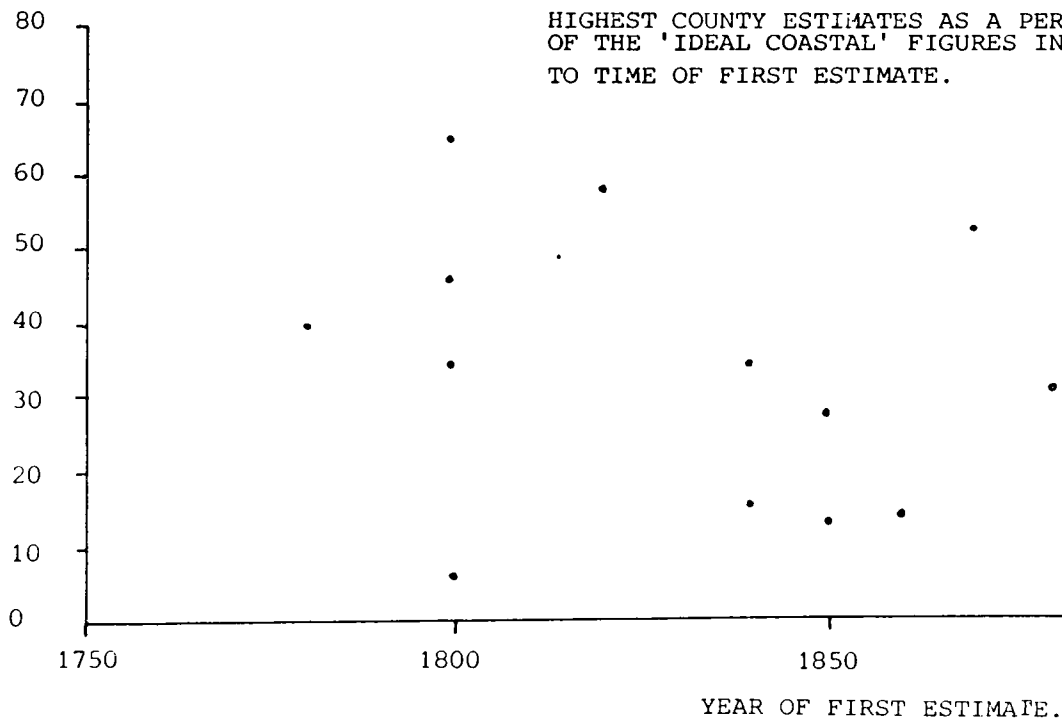


FIGURE 6:4:8.

PERCENTAGE.

HIGHEST COUNTY ESTIMATES AS A PERCENTAGE
OF THE 'IDEAL COASTAL' FIGURES IN RELATION
TO TIME OF FIRST ESTIMATE.



reduction of numbers even up to the start of the nineteenth century in the North.

6:4:7 Discussion

Overall these figures give an insight into how large the Chough population may have been prior to its reduction in numbers. The discrepancy between the maximum estimate and the 'ideal' numbers is partly due to the decline before any estimates could be made and the conservatism of those estimates. Neither Rolfe (1966), Parslow (1973), Sharrock (1976) or Bullock et al. (1983a) make any form of numerical past estimates of Chough numbers. Although Parslow (1973) made a number of hypothetical maps of species' previous distribution (eg. for the Wryneck) there are no comparable examples of a reconstruction of any bird's past distribution.

The main value of this section is in providing a data base from which a quantitative insight into various potential factors in the Chough's decline can be attempted.

6:5 MOVEMENTS

6:5:1 Introduction

Bullock (1980) concluded from examining ringing recoveries up to 1979 that on the basis of a bird ringed in Bardsey that was found dead in Liverpool, 142Km away, it was feasible for Choughs to recolonise England from either Pembrokeshire or from Brittany. Apart from the Bardsey ringed individual that is currently breeding in Loctyn, (Chapter 3:8), which moved 67.5Km to the South East, none of the ringing recoveries or sightings (Warnes, 1983a) were of live birds displaced the requisite distance for a potential recolonisation of Southern England.

6:5:2 Aim

By examining the flight distances of birds recorded in the vagrants sections of each county distribution analysis (see Sections 3:1-23) this section aims to find the potential flight distances of Choughs from areas where the individuals are still alive at the time of their sighting. The figures can then be compared to the ringing recoveries (up to 1983) and sight records of ringed birds in Warnes (1983a), to see what aspects of Chough movements each method emphasises.

6:5:3 Methods

BTO ringing records were collated into area sub-groups and an overall total, splitting results into age groups (on recovery) in years, and whether each movement was of 0-5Km or over 6Km. Distance moved in Km and direction of movement were recorded.

Sight records in Warnes (1983a) were collated and average movements calculated.

For vagrancies, the date and veracity of each vagrancy record was checked. The distance in a straight line to the nearest Chough breeding area, and its direction were obtained by examining the part breeding distribution of the bird at the time (6:3 and 6:4). Such a method is intrinsically conservative in its results because only the distance from the nearest breeding site is used, even though this may be a single, isolated area. Thus results obtained are for minimum movements.

6:5:4 Results

Table 6:5:1 summarises all known live observations of vagrants. Table 6:5:2 shows their average displacement to be $133.69\text{Km} \pm 82.53$ ($n=34$) with 29 out of 35 moving in an East or East South East direction. Westerly movements were not encountered since any such movements would result in

Table 6:5:1

County	Site	Date	County of Nearest Breeding Site at Time	Minimum Movement (Km)	Direction
Lundy	Lundy	1952	Pembroke	33	S
Dorset	Poole Harbour	1935	Cornwall	181.5	E
"	Winspit	1925	"	163.2	E
"	Wyke Regis	1906	Somerset	127.5	ESE
"	Osmington	1908	"	129	ESE
Sussex	Seaford Hd.	1868	Dorset	166.4	E
"	Midhurst	1903	Somerset	267.2	ESE
"	Pevensey North	1905	"	273.6	ESE
"	Norton	1907	"	271	ESE
"	Newhaven	1912	Cornwall	315.2	ESE
"	Beachey Hd.	1919	"	332.8	ESE
Hampshire	Ch. Ch. Bay	1871	Dorset	32	ENE
"	Cheesefoot Hd.	1941	Cornwall	222	E
"	Hardley Cliff	1963	Pembroke	262.5	SE
IOW	Freshwater	1883	Dorset	40	ENE
Somerset	Cheddar	1889	Somerset	63	E
"	Avon Gorge	1900	"	94.5	E
"	Dunster	1923	Pembroke	117	ESE
"	Cheddar	1927	"	127.5	ESE
"	Porlock	1929	"	109.5	ESE
"	Lympsham	1935	"	116.5	ESE
"	Minehead	1936-7	"	114	ESE
"	Sandford	1941-2	"	139.2	ESE
"	Brean Down	1957	"	106.5	ESE
Durham	Durham	1845	Berwick	138	S
Yorkshire	Hatfield	1844	Carnarfon	190.5	E
"	Marsham	1876	"	168	E
Cheshire	Leasowe	1870	"	57	E
Lancashire	Billinge	1908	"	88.5	E
Monmouth	Abergavenny	1972	Pembroke	100.8	SE
Glamorgan	Pwll Du Hd.	1933	"	48	E
"	Worms Hd.	1943	"	28.8	E
"	Caswell Bay	1944	"	64	E
"	Aberavon	1945	"	62.4	E
"	Worms Hd.	1947	"	28.8	E
"	Margam	1957	"	65.6	E
"	Mumbles Hd.	1972	"	60.0	E
"	Pwll Du Hd.	1974	"	48	E

Table 6:5:2

1. Vagrants

Distance:	133.69	Km $\pm$ 82.53 (n = 34)
Direction:	ENE	2
(n = 35)	ESE	14
	SE	2
	E	15
	S	2

2. Sightings of Ringed Individuals

Islay. (5+ months of age)

(Warnes 1983a)

1.0, 0.5, 0.3, 4.0, 3.5, 3.0, 1.5, 2.5, 2.5
 5.0, 0.5, 1.5, 0.5, 0.5, 2.5, 0.5
 Σ 29.8 1.86 Km $\pm$ 1.47 (n = 16)

3. Ringing Recoveries

A) All	Calf of Man	3.79 Km $\pm$ 4.9 (n = 19)
	Bardsey/Amlwch	19.62 Km $\pm$ 38.1 (n = 21)
B) 6+ Km	Calf of Man	9.5 Km $\pm$ 5.1 (n = 6)
movement	Bardsey	38.55 Km $\pm$ 44.2 (n = 10)

4. Maximum Ringed Bird Movements

All from Bardsey

Distance	Direction	Age when recovered
142	ENE	2
67.5	SE	2
37	ENE	3
37	NE	2
32	SE	2

5. Ringing Recoveries: Distance and age when recovered

Distance (Km)

Age (months)	0-5	5-10	10-20	20-30	30-40	40+	Σ
1	12	3	1				16
2	4	2	4	1	2	2	15
3	8	6	3		1		18
Σ	24	11	8	1	3	2	49

birds probably going to Chough breeding areas and would thus not be noted as vagrants.

From the results, South West England would appear to be mainly served by South, South East and East South East movements from Pembrokeshire. Nine movements to England from Pembroke were noted, with an average displacement of $125.08\text{Km} \pm 59.49$. Six movements into Glamorgan from Pembroke were noted, 4 being on the Gower Peninsula with an overall average displacement of $61.6\text{Km} \pm 21.97$.

The live sightings in Islay were of a very small scale in displacements with none over 5Km.

Ringling recoveries showed that movement of Calf of Man birds was limited to the Isle of Man, while Bardsey birds went further, into the mainland with an average movement of $19.62 \pm 38.1\text{ Km}$ ($n=21$) for all recoveries. All the movements of over 30Km in Bardsey birds (table 6:5:5) were by birds of 2 or 3 years old and in an Easterly direction. Age at recovery was evenly distributed between the 1, 2 and 3 year groups with the second year birds displaying the greatest mobility (table 6:5:6).

6:5:5 Discussion

With the Gower 48Km East of Pembroke, and North Devon and Cornwall 56 and 68Km South respectively, each county is well within the $125.08 \pm 85.86\text{Km}$ South East and the $61.6 \pm 62.23\text{Km}$ East average displacement recorded in vagrancies. Long distance movements by ringling recoveries shows that birds of 1-3 years of age are involved. These birds are either sexually mature, or will be so in the next season. Part of the reason for their displacement may lie in their searching for suitable breeding sites. Apart from two cases in Glamorgan all involved individual birds, and obviously the probability of two birds, one male and one female meeting as vagrants in breeding condition in the right habitat are very low. But, as with the case

of the Osprey in Scotland and the Avocet in East Anglia (Gooders 1983) there always is the probability of an adequate number (1 or more pairs) being displaced to the Gower or South West England and subsequently breeding. An analogy can be drawn with the case of the pair who escaped in Kent and recolonised the Dover Cliffs for some 40 years (Pennant 1776, see Section 3:4). What is less certain is the suitability of the habitat for example in Cornwall for Chough breeding today. Section 6 demonstrates that there has been a substantial loss of sheep grazing on the North Cornish Coast and that much of it is today unsuitable for Chough feeding (see Darke 1971).

Using vagrants to study movements has value because of the intrinsically larger sample size^{than ringing recoveries}. Although the exact location of the individual's origin cannot be known minimum movements can be calculated as demonstrated above. Ringing data are limited both in time and extent, while vagrancies embrace all sighted individuals (and those that are shot!) with records starting in 1844.

This section has been deliberately restricted to movements pertaining to potential recolonisation since Roberts (in litt.) is currently examining all other aspects of movements and mortality in the Chough.

6:6 GRASSLAND MANAGEMENT

6:6:1 Introduction

Bullock (1980), Roberts (1982a, 1983) and Warnes (1983a) concluded that Choughs mainly feed on three types of habitat; maritime grassland, grazed rough grassland and heather. Chapter 4 discussed aspects of the suitability of each type of habitat for Chough feeding. Their value to Choughs can be affected by Man in two ways; (i) by his creating or removing the habitat and (ii) by his managing it in a manner which is indirectly suitable for Chough feeding due to the insect population it holds and the accessibility of the prey. Although cattle play a large part in the coastal grazing on Islay,

(Warnes 1983a), in England and Wales, coastal areas, especially in the more upland cliff areas favoured by the Chough, are mainly used for sheep grazing. Thus this section will examine the long and short-term effects of sheep grazing regimes on the feeding quality of maritime and coastal rough grasses. An indication of the importance of sheep grazing is shown by the Chough population changes on the Calf of Man after sheep farming was abandoned in 1958. At the time there were 10 breeding pairs on the Calf. By 1970, there were 4 breeding pairs, none of which produced any young that survived to the fledgling stage. With the reintroduction of sheep after 1969, Chough breeding resumed, and by the 1982 survey there were 7-9 breeding pairs.

Using data obtained in the outline feeding studies (Chapter 4:2) a number of aspects about the relationship between sheep grazing and Chough breeding can be examined, thus aiding the investigation into short-term factors regulating Chough feeding with respect to land management.

Bullock et al. (1983a) mention that long term changes to sheep farming may play a role in the part changes in the Chough's distribution. By combining the population estimates on a county level / ^{with} sheep farming statistics in these counties, an insight can be obtained, for the first time on a quantitative level.

6:6:2 Aims

This section aims to examine factors regulating the short-term suitability of sheep-grazed grasslands by comparing the effects of grazing and exposure on the grasslands and its feeding qualities, then to relate sheep grazing regimes to breeding success on islands where breeding and sheep grazing figures have been available for a number of years.

For long term studies, this section aims to collate historical records giving indications of early trends, and to use official farming returns to

relate to the population estimates produced in Section 3.

6:6:3 Methods

Suitability of grassland was examined by comparing areas of grassland on the Loctyn Peninsula where there was sheep grazing, to an area (Yns Loctyn) which was subjected to identical exposure conditions, but had no grazing. Chough feeding preferences, tipulid frequency, and soil accessibility were compared.

Short-term trends were examined by investigating the effect of sheep density on Chough breeding on the Calf of Man. This is the only area where both have been examined on an annual basis, and partly discussed by various authors in The Peregrine (1970, 1972, 1975, 1976, 1981, 1982), Bullock and del-Nevo (1983) and Bullock *et al.* (1983c). Sheep numbers on Bardsey have rarely been counted so ^{that}/quantitative studies were not possible.

To examine long-term trends, Ministry of Agriculture returns from 1874 were examined to find changes in sheep density and relate them to the county estimates for Chough numbers at the time. Because there are no returns (with one exception, in Sussex in 1801, Hinchinton 1953) prior to this, only reports from agricultural and economic sources can be used to examine the role of sheep farming in the Choughs decline in English counties other than Cornwall.

6:6:4 Feeding Preferences

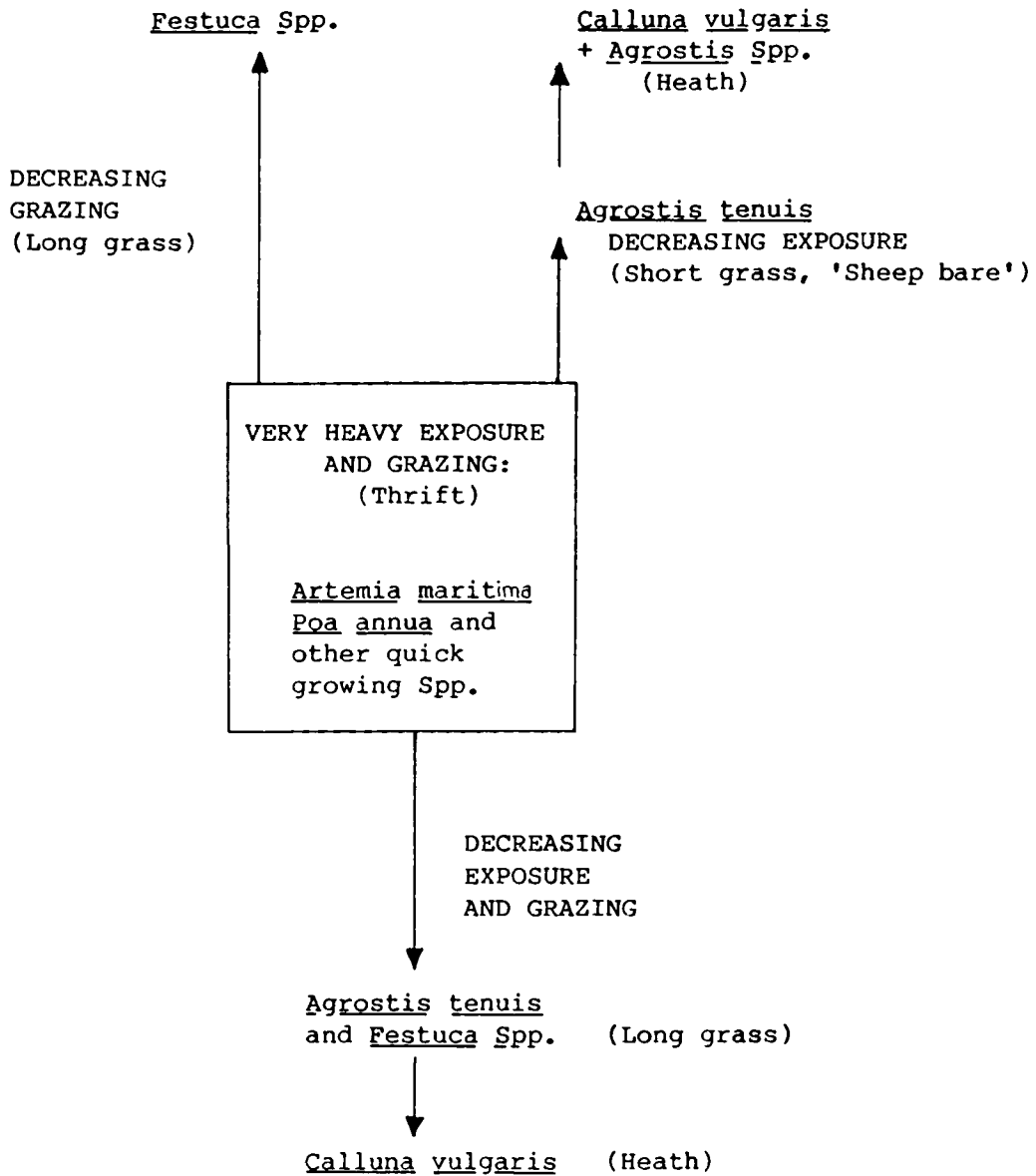
For the Choughs' feeding requirements, an ideal area can be seen as a pay-off between those conditions that suit their potential prey and their accessibility to the Chough's probing bill (c.f. Chapter 4:2). The feeding studies in Chapter 4 concluded that for best access to soil arthropods living down to 2cm in the soil, short grass swathes with bare patches are required. Such types of grassland occur in the Loctyn area in two types:

the maritime grassland with a high frequency of Artemia maritima, and the heavily grazed rough grassland either on the coast or within 200 metres of the coastal cliff.

Gilham (1959) investigated the role of exposure and grazing on coastal ecosystems, and how exposure and grazing interact. Figure 6:6:1 is a version of her diagram showing the above, adapted to the local plant communities, as summarised in 4:1:2. This shows that with high exposure, such as on the Loctyn peninsula, only relatively modest levels of grazing are required to produce a short sward, as compared to the long sward on the equally exposed but ungrazed Yns Loctyn.

But grazing also reduces the abundance and diversity of the invertebrate population. Below ground, Morris (1967, 1968) found a reduction in the arthropod population in the top 2cm of the soil where there was grazing. The top 2cm is the normal extent of Chough probing. Southwood and Van Emden (1967) found a marginal increase in arthropod density with grazing. The effect of ^{grazing} on the above-ground fauna has been more intensively studied (eg. by Cragg 1981, Lutt 1966, Healey 1967, Morris 1968, 1971a, 1971b, 1973, 1981, White 1960, Harper 1971, Dale 1973, Ball 1974, Thomas and Morris 1977, Hutchinson and King 1980, Rawes 1981, Watt 1981a, 1981b, and Moss, Welch and Rothery 1981). These studies conclude that there is a large decrease in species diversity and abundance with increasing grazing pressure. Soil fertilization also reduces species density, but as Moore (1983) points out, it can be an important factor in making the continuance of upland coastal sheep farming economically viable. There is no direct evidence to indicate that above-ground arthropod diversity and abundance affects Choughs' foraging preferences (Bullock 1980, Roberts 1982, Warnes 1983a).

Figure 6:6:1



Adapted from
Gilham (1959).

Comparing Chough foraging trips to the grazed and ungrazed areas produced the following results, based on observations made between 12-1981 and 4-1983, resulting^{from} a total of 358 feeding visits:

Table 6:6:1 Ynys Loctyn: Feeding visits by habitat

	scree/rock	long grass	bare areas	total
Dec-Feb	16	4	6	26
Mar-Oct	10	0	8	18
TOTAL	26	4	14	44

n. feeding
visits on
grassland

		n. visits	size in HA.	visits/HA.
Dec-Feb	(Loctyn	22	3.136	7.02
	(Ynys Loctyn	4	1.307	3.06
Mar-Oct	(Loctyn	292		93.11
	(Ynys Loctyn	0		0
TOTAL	(Loctyn	314		100.13
	(Ynys Loctyn	4		3.06

Choughs were less likely to visit the ungrazed area at any time of year ($\chi^2=126.84$, $df=1$, $P<0.001$). Although the winter sample size was too small to be statistically useful ($\chi^2=2.915$, $df=1$, $P<0.10$) it was noted that in visits to the island there was a marked tendency to visit areas of bare soil (caused by exposure) or rock dominant areas, as opposed to the long grass (4 out of 26 visits were to the grass) while on Loctyn at the time, there were 38 visits to the peninsula, 22 of which were on the short or coastal grass, during the winter, a higher proportion ($\chi^2 8.113$, $df=1$, $P<0.01$).

Thus, where there is a choice between grazed and ungrazed grassland, the Chough will choose the grazed sward. Central place foraging considerations (see Krebs and McCleery for definitions, in Krebs and Davies 1984) are the same for both areas since ^{the main} Chough roost was near the tip of Loctyn and thus opposite the island.

Although it was stated earlier that grazing and fertilization may reduce the number of soil arthropods, this does not appear to be the case for

tipulid larvae, an important constituent of the Chough's late Spring and Summer diet. The feeding studies found (table 6:6:2) the following frequencies of tipulid larvae per 10cm by 2cm soil core in May :

Table 6:6:2 Frequency of tipulid larvae in soil cores

f.

long grass (no visits noted)	0.267 ± 0.543	n=40
short grass (feeding visits noted)	3.225 ± 1.622	n=80

Moreover, short grass and coastal grass are more easily penetrated, allowing the Chough to probe into the soil. To quantify this, the feeding studies used the number of blows at 2Kg/cm^2 on a soil compressometer at 30° from the perpendicular to the plane of the soil (to simulate a Chough peck) to penetrate 2cm of soil. In each case, the soil was wet due to the Winter: 50 probes were made at each sward type over four months, and results are summarised in Table 6:6:3.

Thus it appears that long grass is also more difficult to penetrate than the other two forms of grass.

Secondary reasons for the value of sheep grazing are the direct increase in coelepteran and dipteran populations in the soil due to the input of sheep dung onto the grass (Morris 1971), and the high arthropod density found in sheep dung and directly beneath the dung on the soil (Lawrence 1954, and Jackson and Raw 1966).

It was found that there was more sheep and rabbit dung on the closely cropped areas than in the less grazed areas on the mainland, and none in the island (shown in table 6:6:4).

Table 6:6:4

	grammes dung (wet wt.) per m^2	
long grass	37.6	n=10
short grass	172.0	n=10
maritime grass	69.6	n=10
island grass	0.0	n=10

Thus Choughs appear to have a marked preference for grazed areas to

Table 6:6:3

	DEC	n. blows req. to penetrate 2cm.			Σ
		JAN	FEB	MAR	
Long grass	2.22 ± 1.71 , n=50	1.48 ± 0.69 , n=50	1.24 ± 0.93 , n=50	1.50 ± 0.68 , n=50	1.61 ± 1.14 , n=200
Short grass	1.46 ± 1.13 , n=50	1.10 ± 0.36 , n=50	1.20 ± 0.45 , n=50	1.28 ± 0.57 , n=50	1.26 ± 0.71 , n=200
Maritime grass	1.28 ± 0.61 , n=50	1.50 ± 0.65 , n=50	1.06 ± 0.24 , n=50	1.08 ± 0.64 , n=50	1.23 ± 0.51 , n=200
Σ	1.65	$n=150$ 1.36	$n=150$ 1.17	$n=150$ 1.29	$n=150$ 1.36 $\pm$ 0.63, n=600

.

ungrazed areas of equal exposure, for reasons of food accessibility and the availability of tipulids in Summer and ^{other}/dipteran and coleopteran larvae in the Winter.

6:6:5 Short term trends: the Calf of Man

Bullock et al. (1983a) cite cases where Chough populations fell after the cessation of sheep grazing (Ramsey 1968-1982), or increased alongside a steady increase in the stock density (Bardsey 1958-1982). In the Calf of Man, the breeding population fell when farming was abandoned from 1958 to 1969, and recovered after the re-introduction of sheep (Bullock and del-Nevo 1983, Bullock et al. 1983 c). In the case of the Calf of Man, a relation was suggested between breeding pairs of Choughs and sheep numbers and to an extent this is confirmed. Figure 6:6:2 shows these together, with a regression of $r < .01$, ($n=14$). When sheep numbers were compared to the number of pairs that actually succeeded in raising young to the fledgling stage (figure 6:6:3), this relationship was not found ($r > .2$, $n=14$). Also, when the number of young fledged on the island, and per breeding pair are compared to sheep numbers as in figures 6:6:4 and 6:6:5 respectively no relation was found ($r < .1$, $n=14$ and $r > .2$, $n=14$). This is in part due to the distorting effect of the dry summers of 1975, 1976 and 1981 and heavy rat predation in 1976 (Calf of Man Obs. Reps. 1975, 1976 and 1981) as discussed in section 6:7. It may also be that the effect of sheep grazing upon Chough survival in the winter is greater than its effect on breeding success. Since the Calf and mainland Manx populations are not independent, and Choughs will regularly fly from the Calf to the mainland to feed, this cannot be directly examined.

To examine the short-term delayed effect of management changes, the effect of the previous year's management regime was investigated by comparing the number of breeding pairs, and breeding pairs which fledged

FIGURES 6:6:2-6:6:8; CALF OF MAN. RELATIONSHIP BETWEEN SHEEP STOCKING LEVELS
AND CHOUGH BREEDING SUCCESS FROM 1968 TO 1982.

FIGURE 6:6:2.
N. SHEEP AND N. BREEDING PAIRS.

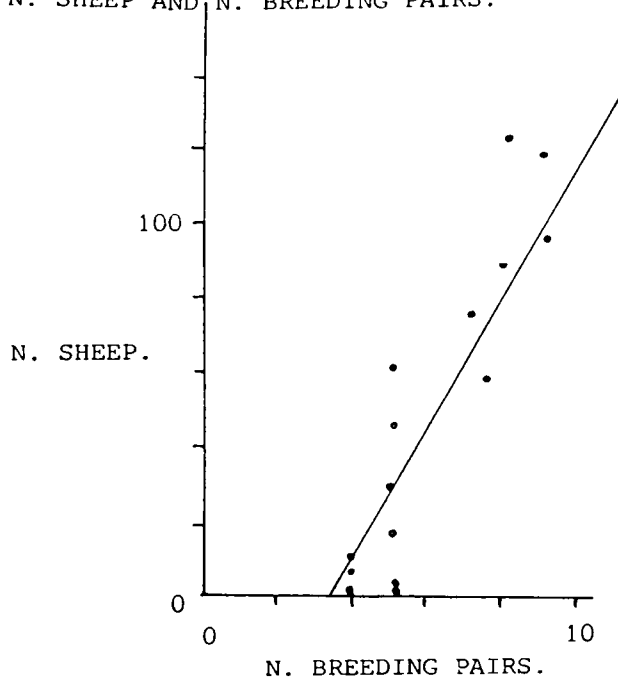


FIGURE 6:6:3.
N. SHEEP AND N. SUCCESSFOLL BREEDING
PAIRS.

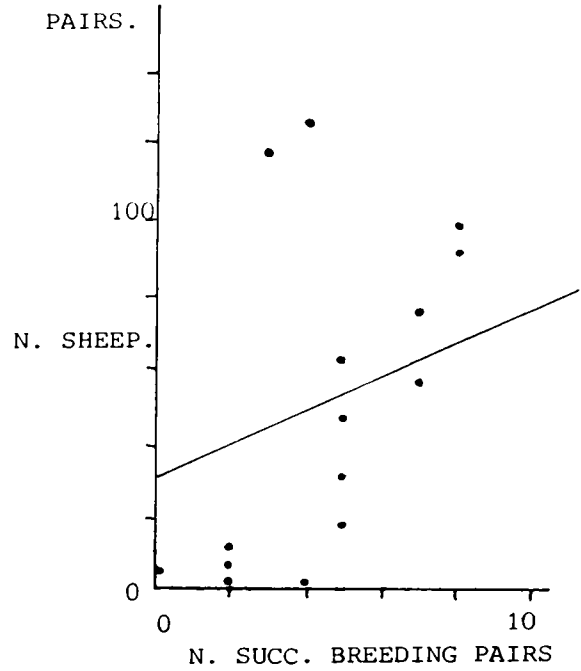


FIGURE 6:6:7.
N. SHEEP IN PREVIOUS YEAR AND
N. BREEDING PAIRS.

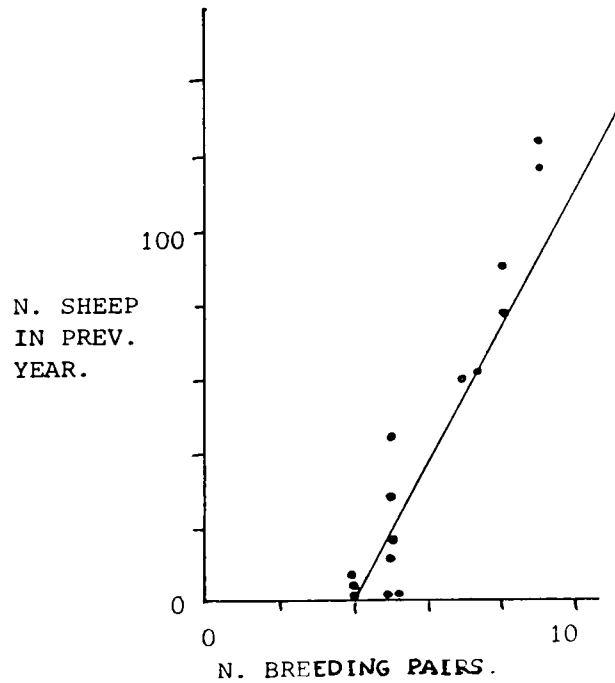


FIGURE 6:6:8.
N. SHEEP IN PREVIOUS YEAR AND
N. SUCC. BREEDING PAIRS.

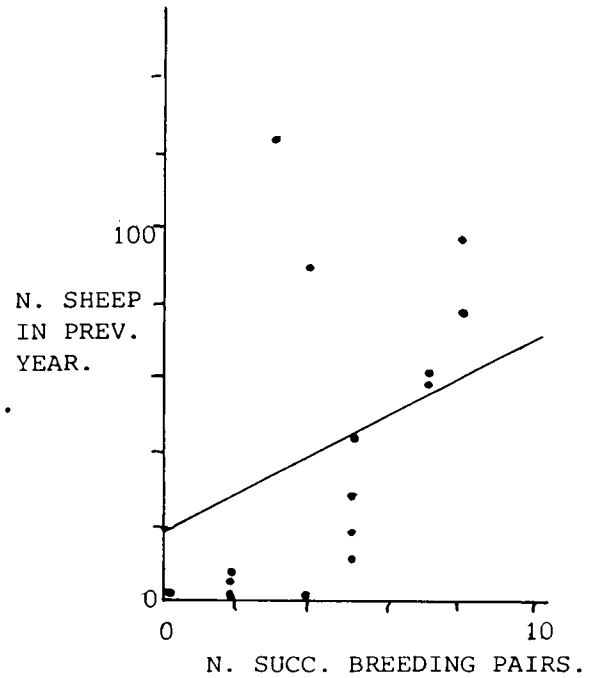


FIGURE 6:6:5.

RELATION BETWEEN NUMBER OF SHEEP AND TOTAL NUMBER OF CHOUGH YOUNG FLEDGED.

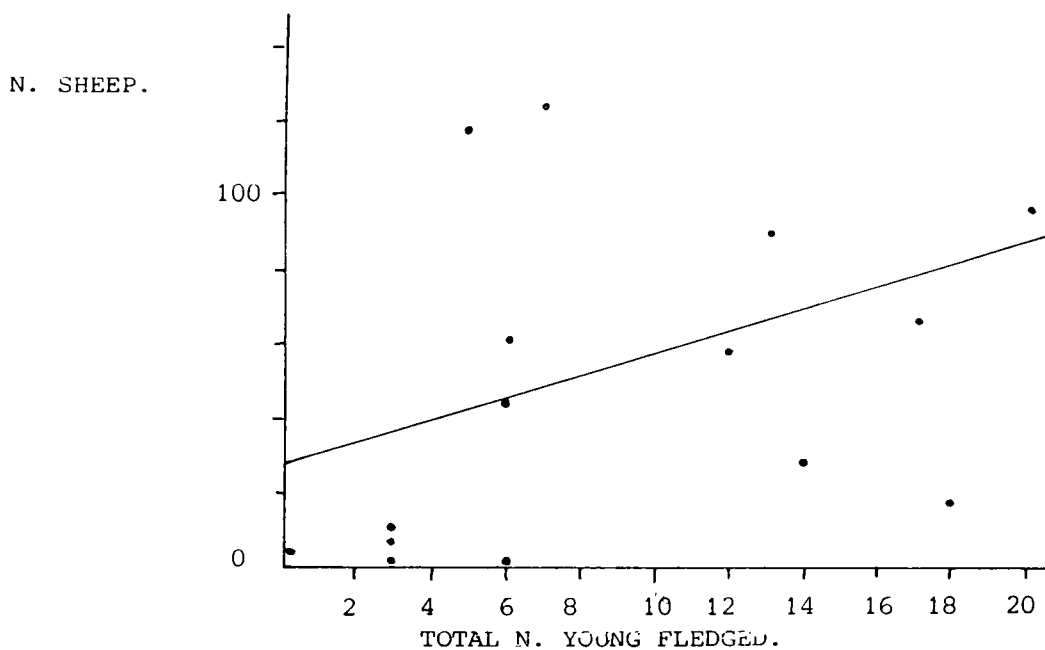


FIGURE 6:6:4.

RELATION BETWEEN NUMBER OF SHEEP AND NUMBER OF CHOUGH YOUNG RAISED.

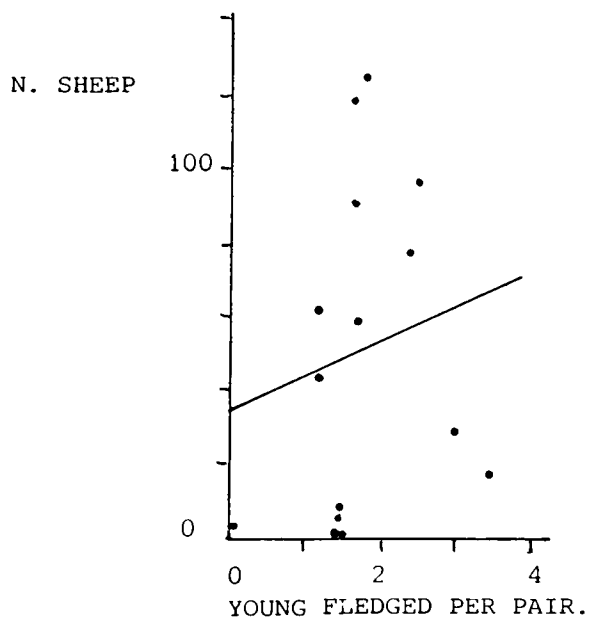
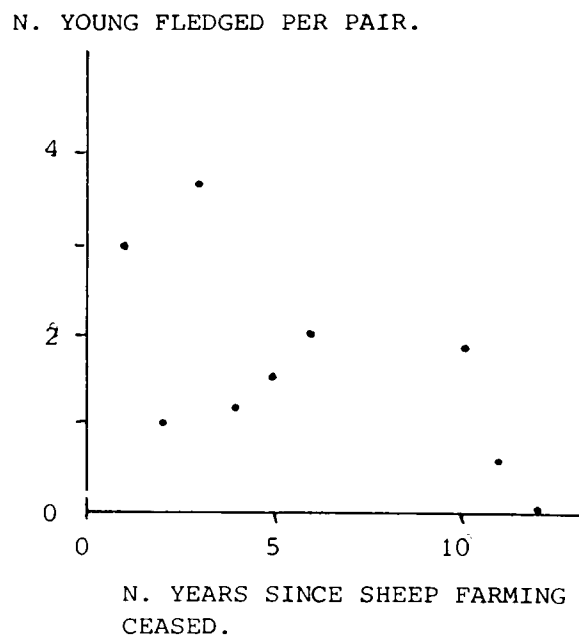


FIGURE 6:6:6.

RELATION BETWEEN CHOUGH BREEDING AND TIME ELAPSED SINCE GRAZING CEASED.



young to the number of sheep on the Calf in the previous year. For the number of successful breeding pairs (figure 6:6:7), there was a slightly improved relation ($r < .2$, $n=14$) but still at an insignificant level. On the other, for the number^{of}/pairs attempting to breed (figure 6:6:8), the relationship was markedly improved to a high degree of significance ($r < .001$, $n=14$).

The actual relation between Chough numbers and the time effect of cessation of sheep farming indicates that a delay of 7-10 years exists before the detrimental effects of habitat reversion substantially affected the Calf of Man breeding population. Figure 6:6:6, shows that 1-6 years after grazing ceased, the number of young fledged per breeding pair did not fall to any notable degree. From 10-12 years after grazing ceased there was a consistent fall in breeding success, so that in the 12th year there was total breeding failure on the Calf. This tallies with the substantial breeding falls noted in Ramsey Island off Pembrokeshire. Here, between 1973 and 1979, some 7-9 years after grazing ceased in 1968, the breeding population fell from 8 to 4 pairs (data adapted from Cowdy 1973, and Bullock *et al.* 1983d). Thus the establishment of a rank grass sward and the consequent growth of heather in areas of the appropriate degree of exposure, around 7-9 years after breeding ceases, appears to be a significant factor in Chough breeding success where there is a lack of suitable alternative sites.

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6:6:6 Long term trends

Here, population estimates obtained in 6:3 and 6:4 will be applied to the available data on sheep farming in the appropriate counties. Since sheep density information supplied by the Ministry of Agriculture (or MAFF) is provided on a county level, comparisons of changes in sheep density to Chough numbers have to be made on the assumption that changes in^{coastal and inland} sheep numbers are at an even level. The first

quantitative information was produced in the ^{Board of Agriculture} Survey of 1874 (Hart 1956, MAFF 1968). Before this, only circumstantial evidence exists. The returns of 1798 and 1801 for the Napoleonic wars did not cover sheep farming except for a Mr. G K Kenyon in Sussex who estimated 346, 589 sheep were present (Hinchinton 1953, Henderson 1952). Other areas only returned records on arable farming, and then to widely varying degrees of completeness (Williams 1950, 1951). Earlier surveys such as King (1696) and Young (1795) gave no numerical figures as regards livestock.

The Sussex returns, as shown in Section 3:5, were at the time of the Chough's extinction (regular breeding ceased by 1810). The high sheep density (0.92 per HA) suggests that persecution and other factors might have been more important than sheep in causing their decline there. This density compares well to recent returns ^{from} where the Chough breeds in Wales (MAFF 1968). Because of the lack of early returns, population changes for Sussex, Dorset, the Isle of Wight and South Devon cannot be examined to see what role sheep farming practices played in the Chough's extinction there. But it is known that prior to 1870, there was a decline in sheep farming due to a trend away from the rotation farming of sheep and barley (for examples on the Dorset chalkland, see Caird 1852). Introduction of fertilizers removed the need for sheep manure, and the high labour cost of sheep rearing compared to arable farming was of importance in the 1870's and after the first World War (Astor ^{& Rowntree} 1938). The overall result was the abandonment of sheep farming in a number of coastal areas. Figure 6:6:9 shows the decline in the South of England from 1874 to 1938 (Hart 1956). Woegan (1811) for example, describes extensive sheep farming around one of what in the nineteenth century, was one of Britain's principal Chough breeding areas, Perran in Cornwall (3:1). Because of the above factors combined with the emigration of farmers to America and, later, Australia due to the agricultural depressions of the 1830's (Rowe 1953) and 1870's (Perry 1972),

there was a decrease of sheep farming in the area. Thus by the 1960's, the entire coastal area had reverted to bracken and bramble (Darke 1971). Another factor affecting coastal areas was the switch in consumer demand to smaller cuts of meat, and especially to lamb, both of which favour mountain sheep as, for example, in North Wales (Hart 1956).

Bullock *et al.* (1983a) discuss the effect of the increase in arable farming between 1846 and 1870 as coinciding with the disappearance of the Chough in many areas. But as 6:3 demonstrates, the main declines in Sussex, South Devon, Dorset and the Isle of Wight had occurred by 1846, and at a national level, the peak of the declines occurred from 1871 to 1900. The main declines in North Devon, Pembroke and Somerset occurred between 1846 and 1870. It would therefore appear that any nineteenth century decline in Chough numbers directly related to sheep farming changes dated from 1830 to the mid 1870's and probably beyond.

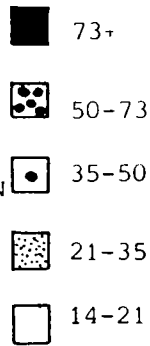
In examining trends with the MAFF returns, only counties with Chough populations at the start and the end of each time comparison period are used, in order to maximise Chough sample sizes and reduce the probability of errors from other sources. Thus for the period 1875-1938, only Cornwall, Pembroke, Ceredigion, Merioneth and Caernarfon are used. For the period 1938-1966, Cornwall is excluded. Population figures for Choughs are taken from 6:3, sheep densities from MAFF 1968. The data shown in table 6:6:5 and percentage changes with time for both in table 6:6:6.

Table 6:6:5

County	1875	1938	1966
Cornwall	600-800	200-400	-
Pembroke	200-400	400-600	400-600
Cardigan	400-600	600-800	1200-1400
Merioneth	1000-1200	1200-1400	1400+
Caernarfon	600-800	1000-1200	1400+

The mean for each range is taken, and the 1400+ figure assumed to represent a mean of 1500. The changes are expressed by the latter date as a

CHANGES IN
SHEEP DENSITY
ON THE COUNTY
LEVEL IN SOUTH
AND SOUTH EAST
ENGLAND BETWEEN
1874 AND 1935



(1); 1935.



2); 1874.



SHEEP PER 100 ACRES.

FIGURES 6:6:10 AND 6:6:11;

RELATION BETWEEN CHANGES
IN SHEEP NUMBERS AND
ESTIMATED CHOUGH NUMBERS
ON A COUNTY LEVEL.

FIGURE 6:6:10.
1875-1938.

SHEEP NUMBERS IN
1938 AS A % OF
SHEEP NUMBERS IN
1875.

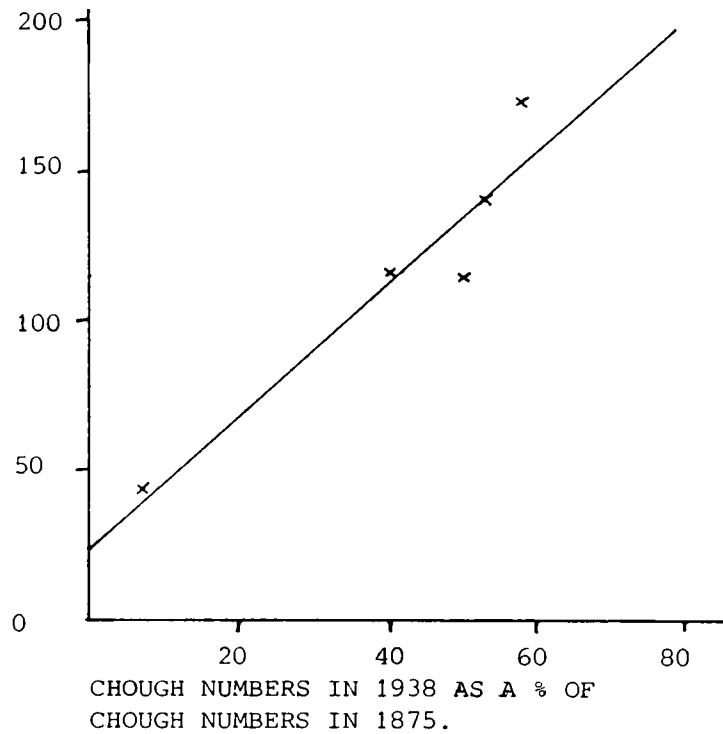
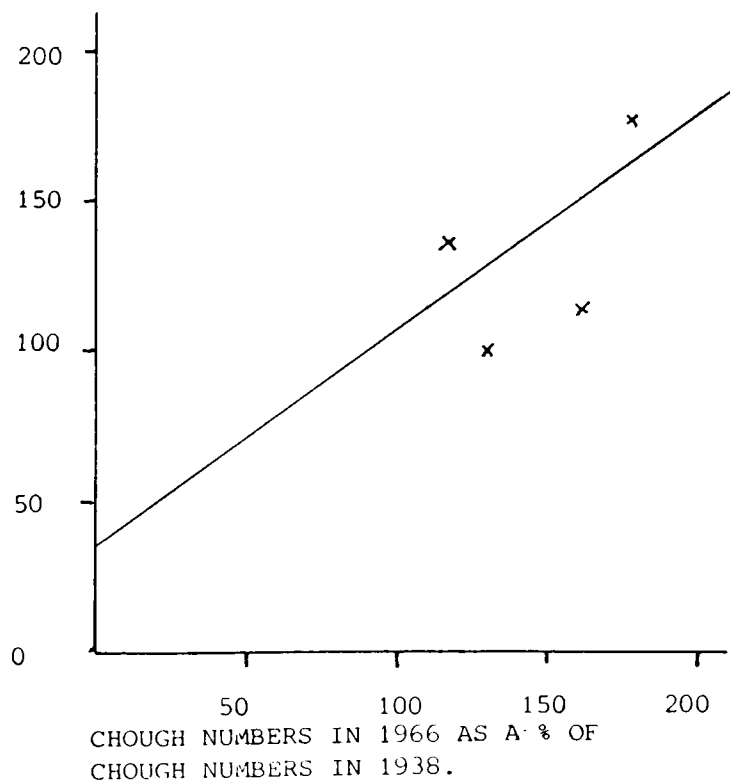


FIGURE 6:6:11.
1938-1966.

SHEEP NUMBERS IN
1966 AS A % OF
SHEEP NUMBERS IN
1938.



percentage of the former return in each case. The same is done with the Chough population estimates:

Table 6:6:6 (wrt = with respect to).

County	SHEEP PER 1000 HA.		N. BREEDING PRS. CHOUGHS	
	% 1938 wrt. 1875	1966 wrt. 1938	% 1938 wrt. 1875	1966 wrt. 1938
Cornwall	42	-	7.2	-
Pembroke	167	100	58.0	131
Cardigan	140	185	53.0	178
Merioneth	116	115	40.0	160
Caernarfon	155	135	40.0	118

These results are shown on figures 6:6:11 and 6:6:12. Regression analysis showed a significant relation for the 1938 wrt. 1875 figures ($r < .01$, $n=5$) but not for the 1966 wrt. 1938 figures ($r > .2$, $n=4$) due^{to} the smaller sample size and greater variance. Nevertheless, the overall trend, and slope of the regression are similar. The fact that between 1875 and 1938 all Chough numbers fell while (with the exception of Cornwall) sheep numbers rose, indicates the importance of other factors at the time affecting Chough numbers, namely persecution (6:6). In the period 1938-66, all Chough numbers increased along with the increases (apart from Pembroke) in sheep density. This reflects the lesser degree of persecution especially after 1954. Both sets of figures show a relative increase in Chough breeding numbers to an increase in sheep densities.

It is of interest to note that when the Chough recolonised Anglesey in 1959 (3:22), there had been an increase from 100-400 sheep/1000 HA in 1875 to 1000-1200 in 1938 and 1200-1400 in 1966 (MAFF 1968), thus helping to create a suitable feeding habitat when they returned. The relict populations in Dorset and Somerset died out during a large decline in sheep density between 1875 and 1938, while the Devon sheep density remained static and that for Glamorgan somewhat increased (see figure 6:6:9). The Chough populations in Dorset, Somerset and Glamorgan were all below 5 pairs by 1878 and would thus have been disproportionately sensitive to other factors (eg

persecution) at the time.

6:6:7 Discussion

This section has examined the role of sheep grazing on Chough numbers at three levels; the Choughs' habitat preferences for foraging, the medium and short term effects in a localised area, and the long term effects on a county by county basis. Quantitative evidence for a relationship between Chough numbers and sheep grazing was found at each level. Choughs showed a preference for sheep grazed grass to ungrazed grass in coastal areas of the same exposure. Reasons for this included greater frequency of tipulid larvae in the top 2cm of the soil, and a greater ease of access to the soil. The number of breeding pairs of Choughs an area can support is in proportion to the number of sheep grazing it. Breeding success in an area is detrimentally affected by the cessation of grazing some 7-12 years afterwards. On a county level, increases in Chough numbers were related to increases in sheep density.

While Holyoak (1967) on the Calf of Man, Bullock (1980) in South Stack, Anglesey and some of my own observations (Chapter 4:2) found that on occasion, coastal heathland played a leading role in feeding habitat provision, at most times rough grazing formed the main feeding habitat (Roberts 1982a, Bullock et al. 1983a, 1983b, 1983c, 1983d, Bullock and del-Nevo 1983, and Warnes 1983a, 1983b). Instances of Chough feeding on arable land are rare (Bullock 1980) and there are only a few reports of Choughs following the plough for insect larvae (Seeböhm 1883, Hudson 1902, Wilkinson 1916, Warnes 1983a and Sharrock 1984). In these ^{above} cases, it would appear that feeding on arable land ^{was} out of necessity rather than by choice, since the above studies indicate a strong bias towards feeding on rough grassland and maritime grass. Roberts (1982a) and Bullock (1980) note shore feeding, especially during severe conditions when the soil is frozen.

Arable land is of limited value to Choughs since ploughing reduces the number of coleopteran, dipteran and tipulid larvae in the soil (Jackson and Raw 1966), all of which are important in Spring and Autumn (Roberts 1982), and the frequency of anthills and their size (King 1981), which are of feeding importance during dry Summers (Roberts 1982). Doncaster (1981) found that ants prefer heavily cropped grasslands whether by rabbits or sheep, and Brian (1977) found this to be even more the case in dry conditions. The lack of grazing was found by Rawes (1981) to result in an increase in plant densities, with a decrease in species diversity. Watt (1981a) found no significant changes in the plant community 4 years after rabbit grazing had ceased, but in a sample area 38 years after rabbit grazing had ceased (Watt 1981b) there was a strong reduction in Festuca and Agrostis to the advantage of Holcus. Festuca and Agrostis form the main grass sward in rough grassland used by Choughs (Chapter 4:2).

Bullock et al. (1983c) found a strong bias in feeding preferences on the Calf of Man, ^{for} areas which were actively being grazed at the time, especially when the area was being grazed by both sheep and cattle. Apart from maintaining a grass sward of only 1-3cm high (thus comparable to the 1-2cm high maritime grass sward), grazing is of importance for the dung input. Not only does this fertilise the soil, but it provides a microhabitat for larvae in the dung. This is of special importance in the Winter, where Warnes (1983a) regards dung as a main provider of food (in insects and undigested grain) when there is a low frequency of larvae in the soil. Feeding in horse dung has been noted in Loctyn (Chapter 4:2), feeding in sheep dung by Gatehouse and Morgan (1973), Bullock (1980), Ali (1949, in India), in this study and by Warnes (1983a), feeding in cow pats has been recorded by Dawson (1975), Bullock (1980) and Warnes (1983a) and even feeding in Yak dung (in Tibet) has been observed (Whistler, 1941). Although Bullock (1980) regards sheep dung as secondary in importance to cow pats for

feeding purposes, Jackson and Raw (1966) note th sheep dung contains 4 times as much invertebrate larvae and adults (in weight) than cow pats do in terms of weight for weight. White (1960) found Dipteran larvae in over 50% of Winter sheep dung samples. The high rate of sheep dung loss in Winter (49% in grassland, White 1960, Dickinson et al. 1981) means that a substantial rate of dung input in Summer and Autumn is required for their value to continue through the Winter. Lawrence (1954) found no substantial differences in the species composition of cow pats to that of sheep dung with respect to the feeding requirements of Choughs.

These studies serve to underline the importance of grazing in Chough breeding areas. The only wild mammal to graze at a substantial level is the rabbit, and its populations are still being affected by Myxamatoxis. For example, the Calf of Man Chough populations fell in 1958-70 due to the abandonment of sheep farming, which was not alleviated by increased rabbit grazing because the ^{rabbit} /population was still very low due to Myxamatoxis. On the other hand, although Chough breeding numbers fell by half on Ramsey (8 pairs with fledged young to 4 pairs) some 7-9 years after sheep farming ceased, breeding did continue at this lowered level due to the presence of rabbits (Cowdy 1973, Doncaster 1981), while the Calf population raising fledged young fell from 5-6 pairs to none.

Sheep numbers in Ireland have recently increased in the Western coastal areas, where Choughs are at least maintaining their breeding numbers (Bullock et al. 1983b). Bullock et al. (1983d) note falls in coastal sheep farming in Western Dyfed. This has not been the case in the Loctyn area, but alongside the ^{likelihood} / for a reduction in grazing in Islay in the near future (Warnes 1983a), what this section concludes is, that a reduction in grazing, especially in sheep grazing in Chough areas, could be detrimental to the Chough in the long term.

6:7 PERSECUTION

'A War of extermination has been waged against it, and the consequences I need not relate'.

(Morris 1855).

6:7:1 Introduction

Persecution is defined for the purposes of this section as; 'direct and intentional interactions between Man (and appliances such as guns and traps) and Choughs that have been detrimental to the Chough population.' That the 'War of Extermination' was responsible for a large number of losses is widely acknowledged, but the extent of these losses is not known. This section will look at the nature and extent of persecution and the consequences of changes in attitudes and legislation, firstly banning pole and gin traps in 1939 (Sheail 1984) and then the more widely reaching Protection of Birds Act 1954 and 1967, and the Wildlife and Countryside Act of 1981. In these, the rarity of the Chough in England and Wales was acknowledged by placing it on Schedule 1, thus providing it with the maximum degree of legal protection.

6:7:2 Aims and Methods

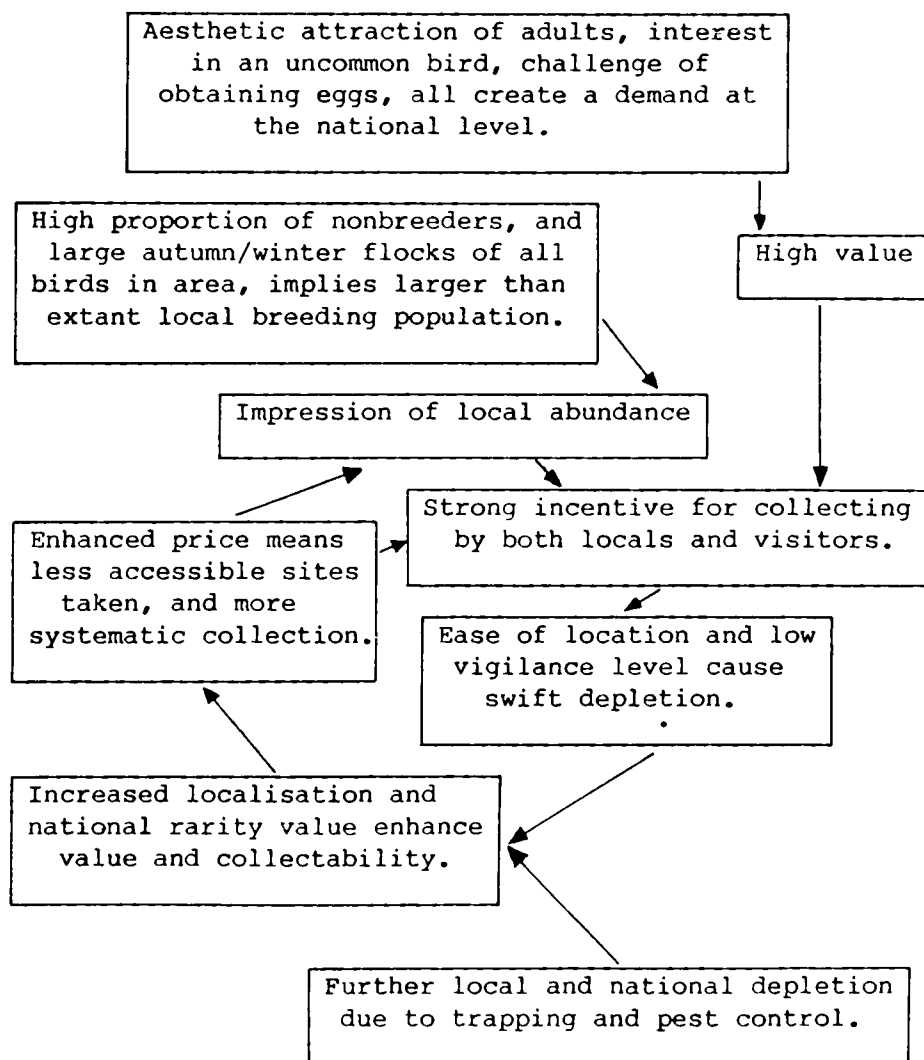
This section aims to investigate the Choughs' particular sensitivity to persecution by examining the underlying causes / for persecution in the context of its being killed for food, as being vermin, trapping, collecting and shooting and its being taken for pets. All known instances of persecution were collated, alongside all known references to their persecution in the above categories. This was in order to find any numerical insight into the scale of persecution could be made, and to examine how the attitudes towards the bird, that were described in Chapter 5, may have been responsible for the nature of their persecution.

6:7:3 Underlying Factors

Although, for example, the Peregrine was subject to more sustained and intense levels of persecution than the Chough in the nineteenth century and the 1940's (Ratcliffe 1980, Gooders 1983), it is the Peregrine that breeds in England today, (Sharrock 1976). The Chough is at an especial disadvantage due to its easy approachability (see Chapter 3:4), the gregariousness of fledged birds, and its high non-breeding population (see Section 2:1).

The flow diagram, figure 6:7:1 relates these ^{factors} to collecting pressures:

Fig 6:7:1



This fits the pattern of localised extinctions observed within the underlying East to West contraction shown in the county records and in

Figure 6:4:6.

In this Section, only direct interactions with Choughs by Man are discussed, as opposed to sheep grazing in 6:5.

6:7:4 Food

The advice given by Pliny (5:2:2) as to Choughs being 'rare birds for the table' appear not to have been taken in medieval and modern Britain. Thomas (1983) argues that this was the case for corvids, because in the eighth century, the church had issued prohibitions against the eating of Jackdaws, Crows, Storks, Beavers and Hares, the latter being associated with a pagan cult. As chapter 5:2-4 and Section 2 of this Chapter show, there being no English word for Chough at the time except Chough (= Jackdaw), they would have been in effect covered by such edicts, especially since few would have differentiated them from other corvids at the time. By 1400 this appears to have been relaxed somewhat, as Upton (a1460, trans. Blount 1500) states; 'Off the Chowghe (= Jackdaw):... the chekens of them be goode mete when they be Sleyne'. With the Reformation, all meats were regarded as lawfully consumable, since the distinction between 'clean' and 'unclean' food was deemed to have ended with the coming of Christ (Thomas 1983). In this respect, the British have been more conservative than the French. There is no mention of either Chough or Jackdaw in Owen's (1603) section on edible birds in Pembrokeshire, nor in Bingley (1816) while Lovell (1661) regarded the Jackdaw as poor food; 'the nourishment is as bad as their condition', while Defoe (1769) wrote in 1724 of the Chough; 'nor is their flesh good to eat'. Timm's (1821) edition of Camden (1586) lists 'Cornish Chough, the most elegant of the crow species' under produce, but this may refer to eggs or stuffed birds or even pets (see Montague 1813) as opposed to being taken for food.

On the other hand, in the nineteenth century, Choughs from the Gower and

possibly from Pembroke were on sale at Swansea market as 'Billy Cocks' which were regarded as a popular delicacy by visiting French seamen (Cardiff Nat. Society 1900). Considering the small and declining population of Chough, in the Gower at the time (6:3:16), this may have played a main part in their extinction there.

Apart from this, there are no references to their being taken for food in Britain, assuming that the birds taken at Perran Sands were for the taxidermy trade (6:3:1, 6:6:5), and are thus discussed separately under trapping.

6:7:5 Pets

Taking Choughs for pets was popular among all classes in Cornwall from before 1572 (Penhallurick 1978), until shortly before their extinction (Ryves 1948). There are no records of their ever having bred as pets, and assuming if they ^{were} taken as unfledged young from the nest, with consequent harm to the adult by disturbance and the abandoning of any untaken young, the effect would have meant a constant removal of young from the wild. References such as Montague's (1813) 'the peasantry attending to them' imply that this was a popular pastime requiring a demand of 10-50 birds a year in the eighteenth century. There are no records of the birds being taken for pets outside Cornwall. Being a small-scale operation, it was probably responsible for no more than increasing pressure on their numbers as opposed to causing local extinction.

6:7:6 Vermin Control

In Britain, the Jackdaw has a long history of being an agricultural pest. ^{The} First reference to this is in the 'Durham Account Rolls' of 1400-13 (Surtees Society 1898, 1900); 'Pro exclusione (n)odularum ab ecclesia, 3s 4d'. Vergil's (1509) 'Historia Anglica' (translation Ms Royal 18CBL, 1548,

Ellis 1846) states; 'crowes and chowghes (= Jackdaw) are everie day in the morning earlie harde clatering in their kinde... being soe harmeful a kinde of birdes, yet are thei spared in that land because thei eate woormes and other vermin, wherof the countrey is the fuller in that it is verie moyste; but in other respectes thei are much more hurtful, for thei doe not onlie devoure corne when it is ripe, but even as it groweth they pull up the sead with there bill... appoynt boyse to drive them away with bowse and arrowse, when with showtinge and clamore thei will not bee feared... in consideration wherof, within our remembrance, an acte of parliment was promolged that such crowes bie all meanse should bea destroyed, a reward beinge assigned to the destroyer'. This final section was appended by the translator, with reference to Act 24 Henry VIII, statute X of 1533 ('Privy Purse expenses' 1529-72) and followed by Act 8, Elizabeth, Chapter 15, 1566, renewed 1572, 1578 (Cox, nd, Wilkinson 1618, Webb1906). The act in fact refers to 'Rookes, Crows and Choughs' but in practice that would mean 'such crowes bie all meanse should be destroyed', or all corvids. The name interchange of Chough and Jackdaw would have also ensured their culling, which, in examples given by Gooders (1983) could be on a large scale. The theme was taken up by agricultural authors such as Harrison (1586) and Tusser (1573, and Hertridge (ed) 1878); 'kill crowe, pie and cadow'. Choughs do in fact eat grain on occasions (Warnes 1983a), but their ground foraging for insects (Holyoak 1971, Bullock 1980) could be mistaken for constant feeding on grain, as for example Carew (1602) and Goldsmith (1772 et infra) believed.

To what extent farmers regarded ^{the} Chough as a nuisance in themselves is uncertain, but Williams (1871) found that Pembrokeshire farmers thought it was 'destructive to wheat' and thus 'war was waged upon them in Winter and Autumn'. The bounty system, for rewarding the killing of crows continued until the nineteenth century, in the 'East Budleigh Overseers Accounts' for 1711-2 (Penhallurick 1978). John Stafford is rewarded 10 shillings for

'killin Chofes', presumably Jackdaws.

The simple association of all crows as vermin may account for recent shooting incidents in Ireland and Anglesey (Bullock 1980). Dawson (1975) observed a family party of six Choughs feeding on blowfly larvae on a ~~cow~~ carcass . The implications of such incidents could be twofold; firstly, the mistaken assumption that they were responsible for mutilating or killing sheep and lambs, and secondly, Bullock (1980) cites a case of a Chough that was apparently killed due to pesticide poisoning, possibly from a treated carcass . In areas with regular inspections of the sheep flock, carcasses would be removed before blowfly larvae would hatch and thus preventing the association developing. In general, farmers today do not regard the Chough as a pest. In West Wales, their presence is regarded as an aesthetic gain in a coastal farm.

The decline of sheep farming in England (Section 6) may therefore have had the effect of changing farmers attitudes to them in the coastal areas. Where they were once harmless birds of the cliffs, the change to wheat farming could have made them pests along with Jackdaws in the eyes of the grain based farmer.

6:7:7 Trapping

Choughs were affected by two forms of trapping; direct, as in the use of baited traps for them on the Perran Sands in Cornwall (Bullmore 1866, Rodd 1880, in Penhallurick 1978) and indirect, when they were caught in gin traps set for rabbits (Ingram and Salmon 1934, Darke 1971, Penhallurick 1978). Darke and a number of correspondents believe that the latter was a causal factor in their decline from the 1920's after direct trapping had ceased. Table 7:2, lists known cases in Cornwall, and a consignment of rabbits from the Pembroke Islands which was found to have three Choughs as well, (Cardiff National Society 1900). By implication, this was not the

only case of rabbit gins taking Choughs in Pembrokeshire. The infrequent use of gins in Mid and North Wales and the Isle of Man with respect to Southern England early this century may have been a factor ensuring their survival there.

The size and effect of the Perran Sands trapping is discussed in 6:3:1. The market specimens which Rodd (1880) mentions seeing ^{as many as} five at any time were probably for the local and national taxidermy trade. It is probable that trapping mainly took place in Autumn and Winter.

The advertisement for specimens in the 'Royal Cornwall Gazette' of 1891 demonstrates that the extent of trapping, which Rodd (1880) had indicated was declining in the 1870's, had declined even further, thus reflecting the great reduction in Chough numbers remaining.

6:7:8 Collecting Eggs, Shooting

Table 6:7:1 shows the taking of eggs and shooting for sport to have been most widespread, especially in the latter half of the nineteenth century. Darke (1971) and Penhallurick (1978) give a number of accounts. The ease of hunting Choughs is demonstrated by a quote given in D'urban and Matthew (1896); 'we heard of six Choughs being killed at a single shot when feeding on a manure heap in Braunton by a sportsman wishing to discharge his gun before returning home' and Walpole-Bond (1914) regarded that it 'may be cautiously approached to within the simplest of shot'. Such accounts give the impression that only mediocre shots would shoot them. Certainly today even without the protection of law, it would not be considered good sport to shoot such an approachable bird.

On the other hand, it was the challenge that Choughs' nests presented, deeply buried in harsh, unforgiving cliffs that lured the Victorian oologist. But with the systematic extent of their collecting, Hewitson (1846), Dix (1869) and Walpole-Bond (1914) among others refer to the only

surviving nests being inaccessible 'even to the expert cragsmen'. But that was no protection against gin and gun.

Egg collecting and shooting pressure were likely to have been at their peak after the spread of railways in the 1860's. This meant that people with less leisure time were able to travel to ^{places which} / had previously been too distant for short visits. This would have greatly affected the mobility of the urban middle classes by enabling them to reach coastal areas for weekend trips. Gooders (1983) states that two developments in gun technology at this time also had a far-reaching effect. The breech load superseded time consuming muzzle loading in the 1850's, and Anson and Deeley introduced the side lock shotgun in the 1860's, to enable even quicker reloading. Both developments greatly increased the fire power of a single gun, thus enabling a single man to shoot as much as a party had in the 1840's. These developments fit with the period of maximal decline (table 6:4:4) between 1860 and 1900.

6:7:9 Persecution, A Causal Factor?

How serious was the effect of persecution? As with sheep farming, the data do not allow firm conclusions to be drawn, but can be examined to see if the extent of shooting, trapping and egg collecting can be related to the rate of decline in the Chough population. In table 6:7:1, all dated records of trapping, egg collecting and shooting are collated under (i) general references and (ii) specific references, together with the % decline from the running total of breeding pairs of Choughs for each 10 year period (from Section 4) and the number of persecution instances that led to the species becoming extinct at that site (eg where there is a reference to their not being observed to breed there within two years of the incident).

Table 6:7:1

	TRAPS		EGGS		SHOT		Σ	n.	%
	G	S	G	S	G	S		ext.	decline
1781-1800	0	0	0	1	0	2	3	1	17
1801-20	0	0	0	0	0	1	1	1	9.3
1821-40	0	0	0	0	1	2	3	0	16.9
1841-60	1	0	4	5	3	0	13	3	21.8
1861-80	2	1	4	4	2	5	18	3	22.6
1881-1900	1	1	0	0	1	3	9	2	38.1
1901-20	1	0	0	2	0	0	3	0	14.9
1921-40	0	3	0	4	0	2	9	3	8.7
1941-60	0	0	0	0	0	0	0	0	+19.8
1961-80	0	0	0	1	0	2	3	0	+30.5
Σ	5	5(9)	8	15(18)	7	16(85+)	60	12	

These records are also shown in table 6:7:2. The data plotted on two graphs:

(a) % decline against no. of general citations per 20 year period.

(b) local extinctions against no. of citations per 20 year period.

Regression analysis showed that there was a relation between the frequency of citations and the rate of decline from the running population total of the Chough ($r < .01$, $n=10$), and a less significant relation between the rate of citations of persecution that are the final record for the Chough at the area (thus being responsible for causing their local extinction) and the frequency of all citations of persecution at that time ($r < .05$, $n=10$). The drawing together of such sets of data is not entirely satisfactory, but it does demonstrate that there may be a link between the decline of the Chough and the frequency of their being killed.

6:7:10 Discussion

In discussing status changes of the Chough in the Isle of Man, Bullock *et al.* (1983c) state that 'it is unlikely that human persecution had any significant effect on the Manx population'. The fall in Chough numbers on Man after Jardine's (1867) visit of 1823 when he 'procured nearly 30

TABLE 6:7:2

REFERENCES TO PERSECUTION IN LITERATURE

[* Indicates last reference to Chough in that locality.]

DIRECT TRAPPING

CORNWALL	RODD (1880) BULLMORE (1886)	Sev. doz. p.a. at Perran
	CHENOWETH in DARKE (1971)	Sands often caught 1900's at Holywell
	CHENOWETH in DARKE (1971)	*Pr taken 1940-5
GOWER/PEMBROKE	CARDIFF NAT. SOC. (1900)	Taken for food for trade at Swansea

INDIRECT TRAPPING

CORNWALL	RYVES (1948)	Circumstantial cases 1930's
	ROWSE-HOSKING/DARKE (1971)	1 trapp in Gin, Holywell 1940
	COX (1942)/DARKE (1971)	*Buckator 2prs? 1920-1930's
PEMBROKE	CARDIFF NAT. SOC. (1900)	3 in rabbit consignment 1900
ANGLESEY	TUNNICLIFFE (1984)	I found 1 in rabbit trap 1948

SHOOTING/EGG COLLECTING

CORNWALL	COUCH (1839)	Declining because of shooting
	RODD (Ms 1852)	*Eggs taken Lands End 1849
	TIMMS (1821)	Listed under 'produce'
	MORRIS (1855)	War of extermination
	RODD (Ms 1852)	Eggs taken Zennor 1852
	PENHALLURICK (1978)	1 shot Looe 1865
	HILL/JOHNS (1863)	Heavy shooting/collecting
	HEWITSON/FOX (1846)	Difficulty in collecting eggs
	L'ESTRAGNE/	
	PENHALLURICK (1978)	*Nest taken Kynance 1865
	ROY. CORNWALL GAZETTE (1870)	Advertisement for taken pair
	ROY. CORNWALL GAZETTE (1891)	Advertisement for specimens
DEVON	CHENOWETH/DARKE (1971)	Eggs taken Hollywell 1900's
	PENHALLURICK (1978)	*Rumps pt. eggs taken 1933 1934
	D'URBAN and MATTHEW (1896)	?
		*Six shot Braunton

SCILLY DORSET	BUTLER (1907, 1908)	'Great difficulty in ob. eggs' 1887.
	PULTERNEY (1793)	1 shot N Devon 1790
	PIDSEY (1895)	Heavy collectin
	PENHALLURICK (1978)	1 shot 1889
	HARTING (1875)	2 nests taken 1865 and 1866
SOMERSET HANTS/IOW	MANSELL-PLEYDELL (1864, 1873)	Rare because of value of eggs
	MANSELL-PLEYDELL (1888)	Shooting of old birds ved. numbers.
	THOMPSON (1922)	Lulworth Cove pair shot, 1890.
	YARRELL (1882)	*Pr shot Bagborough 1868
	GOULD (1837)	Specimens shot 1833, 1835 needles
KENT	PAGE (1900)	2 shot, Christchurch Bay 1861.
	BRANNON/COHEN (1963)	*Shooting parties, Freshwater 1850's
	TICEHURST (1909)	?*Specimens taken on two occasions '30
	JARDINE (1827)	'30 specimens in one forenoon' 1823
	KERMODE (1901)	Heavy collecting
IOM	RALLFE (1916)	Inland nest robbed, 1915
	WILLIAMSON (1959)	2 shot 1938
	WILLIAMSON (1959)	All East Coast nests/ young destroyed 1939
	MACPHERSON (1892)	?*1 killed Whitbarrow 1862-5.
	MONTAGU (1802)	*1 Llangollen, 1 killed, nest taken pre 1799
WESTMORELAND	ALPIN (1903, 1905)	Eggs taken Lleyrn 1852, 1846
	ROLFE (1963)	2 of 10 obs nests taken 1963
	DIX (1869)	Heavy collecting
	BULLOCK (1980)	1 found shot, South Stack 1979
	OLDHAM (1904)	*Nest robbed, Puffin Island 1853
CARDIGAN ANGLESEY	DIX (1869)	Heavy collecting
	ANDREWS (1865)	1 shot Haverford West 1865
	WILLIAMS (1871)	'War waged' 1860's - 1870's
	NAT. WALES (1964)	1 shot 1964
<u>TAKEN FOR PETS</u>		
CORNWALL	CAREW (1572)	1 taken for friend
	CAREW (1602)	Acc. of tame bird
	BORLASE (1752)	Acc. of tame bird
	BORLASE (1757)	Number sent to London, inc pr. in 1757
	MATON (1797)	Very common to see pets
	MONTAGU (1813, 1831)	Acc. of pets by vicar
	MONTAGU (1813)	Acc. of tame bird

PENNANT (1776)
 PENHALLURICK (1978)
 WALPOLE-BOND (1914)
 RYVES (1948)

Pr. escape at Dover Cliff
 Bird kept St. Michaels
 Mount 1892-1900
 Saw captive bird
 Exhibited a few years ago

DISTURBED

SOMERSET

YARRELL (1882)

PEMBROKE

DIX (1869)

CARDIGAN

METCALFE (pc 1981)

*Up to 4 pairs because of
 quarry 1868
 3+ pairs because of
 renovation
 2 pairs because of quarry
 1979

FIGURE 6:7:1. RELATION BETWEEN ESTIMATED STATUS CHANGE AND FREQUENCY OF CITATIONS OF PERSECUTION.

% STATUS CHANGE
PER 10 YEAR PERIOD
FROM ESTIMATES
MADE.

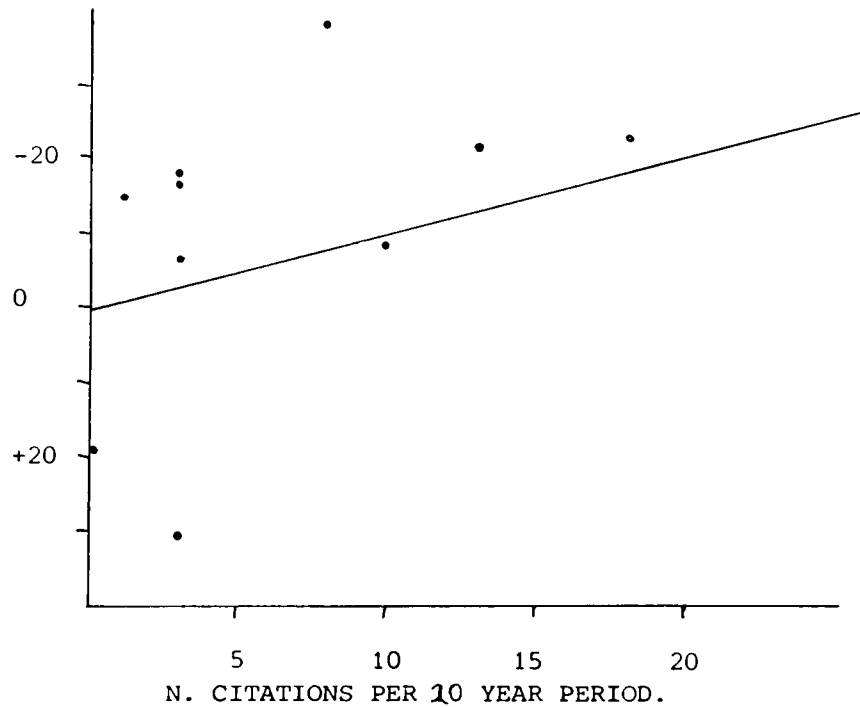
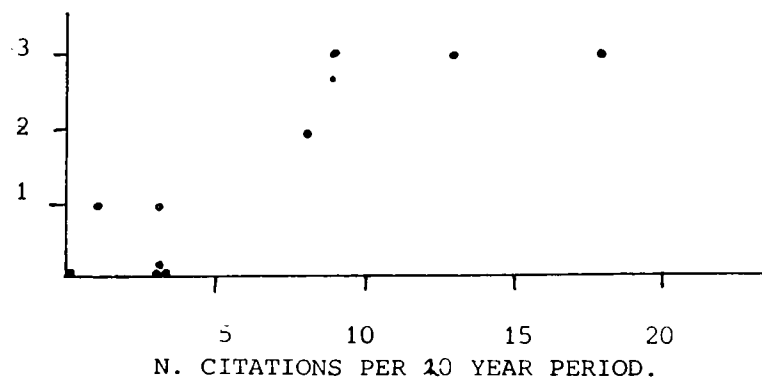


FIGURE 6:7:2. RELATION BETWEEN NUMBER OF LOCAL EXTINCTIONS CAUSED BY PERSECUTION AND FREQUENCY OF CITED PERSECUTIONS.

NUMBER OF LOACL
EXTINCTIONS
CAUSED BY
PERSECUTION
PER 10 YEAR
PERIOD.



specimens in a forenoon', and by implication, the account points to many more being taken, is evidence of the above statement being in error. The effect of shooting, trapping and egg collecting are often underestimated because authors such as Rolfe (1966) and Bullock (1980) did not take into account the aggravating factors demonstrated in figure 6:7:1, and how they create a 'vicious spiral' leading to localised extinctions. Darke (1971) and Penhallurick (1978) are thus more in agreement with such authors as Morris (1855) ^{whose} quote starts this section - who, being alive at the time of this persecution were able to judge its effects for themselves. Persecution is thus not only concerned with large-scale killings, but also the localised losses which if sustained above the harvestable breeding surplus level, as detailed in 6:3:1, can be just as detrimental in causing a gradual but terminal decline.

What is apparent from this section is how localised the pressure of persecution is; one individual, nest, flock or group of nests being taken at a time, with particular pressures varying strongly from region to region. Thus trapping (mainly for taxidermy) was of paramount importance in Cornwall (6:3:1) and probably a significant factor in Pembroke (6:3:23), while their being taken for food was of importance to the Gower population (6:3:16) and possibly also the Pembroke population. With their proximity to London and the Home Counties, there are many accounts of shooting parties in the Isle of Wight (6:3:3) and Dorset (6:3:8), while the Dorset population was subjected to particularly sustained egg collecting.

The role of the Chough as vermin was in the main due to human attitudes towards corvids in general. Although the acts giving bounties for the killing of corvids lapsed by the end of Queen Elizabeth's reign, they were in practice utilised in county areas well into the 18th century. All these acts were superseded by the Game Act of 1831 (Marchant and Watkins 1897). The persecution of corvids continued at this time (Thomas 1983). For the

Chough, there was the added burden of its 'reputation' of being a fire raiser, thief and on occasion, a bird of ill fortune. These were discussed in Chapter 5:6 where they were found to be due to the Chough acquiring these attributes of the Jackdaw and of myth when it was given the Jackdaw's old name, the Caddow or Chough (Chapter 5:5). Its supposedly being vermin was enhanced by occasional observations of Choughs following the plough (eg Seeböhm 1883), erroneous mentions of it being primarily a feeder on grain (Carew 1602, Goldsmith 1772 et infra) and occasional instances of their feeding on carrion (eg Dawson 1975). In the latter case, it appears that the Chough was in fact feeding on blowfly larvae, but there is scant chance of a passing farmer noting that fact. There are still cases of Choughs being killed by farmers today, but they are infrequent, and normally the Chough had been mistaken for another corvid species.

The taking of Choughs by taxidermists and oologists was an unfortunate result of the change in human attitudes between 1500 and 1800 towards nature. Thomas (1983) concluded that by 1800 a large number of wild animals (presumably including the Chough) were regarded by Man as part of the glories of wild nature, existing to be admired and symbols of the rich harvest of the creation. This of course was not the case when wild nature strayed into the crops and market gardens. / Wild nature had a virtue extolled by the late 18th century 'pastoral' movement (see for example Thompson's 'The Seasons' 1744 and Chapter 5:8:2). In the 19th century, it would appear that this admiration of nature was re-expressed into bringing it back inside the house as specimens to look at, for their intrinsic beauty, sporting mementos and reminders of the wild nature that existed outdoors. Their decline from the East may well be accounted by the greater proximity of these counties to London and the Home Counties. With the increase of shooting in extent caused by improvements to road and rail by the 1860's, persecution on the same scale could spread into the West country. Lack of access could account for

the Welsh populations faring better than those in England. Although they were also subjected to heavy collecting, it was mainly done by a small group of resident enthusiasts and farmers as opposed to larger numbers of sportsmen on vacation over and above the local collectors. Thus, some of the factors that hampered research into their past status (6:3:12) may have ensured their survival there.

The more enlightened attitudes coupled with legislative protection are probably responsible for the Chough's survival in Wales this century. Social changes after the two World wars reduced the pressure from ^{game-}keeping interests; above ground gin traps were outlawed in 1939 (Sheail 1984); and Choughs obtained full protection in the 1954 Protection of Birds Act and subsequent Acts. The 1880-1896 Wild Birds Protection Acts (Marchant and Watkins 1897) did not protect the Chough in Winter and were not adequately enforced until the 1940's (Gooders 1983). Trapping continued in Cornwall after the 1939 Act (Darke 1971) but it appears to have ceased in Wales.

urther today such an easily approached and taken bird as the Chough is not regarded as sporting quarry and thus would not be shot even if unprotected by the law. The effect of these Acts and changes in attitudes by the general public and hunters can be seen in the frequency of citations of persecution (from table 6:7:2):

Period	n. citations	citations per 10 years
1841-1900	40	6.67
1901-1940	13	3.25
1941-1980	3	0.75

This is reflected by the rates of population change in these 3 periods; the last being a relatively continuous recovery. Current opinions and legislation have served to reduce persecution to a level where it can be compensated by the surplus production of the current Chough population. This underlines the importance of the direct influence of Man on population levels of the Chough.

6:8 CLIMATE

6:8:1 Introduction

Rolfe (1966) suggested that there was a relationship between the cold Winters and wet Summers from 1820 to 1880 and the Chough's decline. Bullock et al. (1983a) dispute this by stating that the worst periods of sustained cold in the nineteenth century were during 1837-55 and 1878-98 while the greatest fall in Chough numbers was between 1860 and 1880. Both works were hampered by poor detail with regards to the past population of the Chough. Section 4 concluded that the greatest falls in Chough numbers were in 1810-40, 1850-60, and 1870-1900. Climate can affect Chough numbers in two main ways; cold Winters can freeze the ground and thus make insects in the soil inaccessible. This can partly be alleviated by feeding along the tideline on sandy shores (Morgan 1971, Bullock 1980). There are also the physical effects of cold; 5 Choughs were found dead in the Isle of Man after the Winter of 1963 (Rolfe 1966, Bullock 1980) and 2 on Skomer after the Winter of 1981-2 (Perrins person. comm.). In each case the overall effect on numbers was limited (Bullock et al. 1983a). The other way is that dry Summers can limit the availability of insects in the soil because of their detrimental effect on, for example, tipulid eggs and larvae (Bullock 1980, Calf of Man Obs. Reps., 1975, 1976).

If detailed investigations of the past climatic effects on Chough distributions cannot be carried out to a satisfactory degree of accuracy (as further considered in this section), then an examination of recent trends in areas where Choughs are regularly counted, and local weather data is available, may have greater potential. Indeed, Bullock (1980) comments that; 'A detailed study of this sort is keenly awaited'.

6:8:2 Aims

This section aims to see if any element of the climate affects either

breeding success or breeding numbers to an extent that it is a significant factor in long or short term Chough population trends.

6:8:3 Methods:

(i) Short-term trends

Two populations of Choughs have been counted annually since the war; the Calf of Man colony and the Bardsey Island colony. They have been counted from 1953-70 and 1973-83 (Bardsey) and 1959-65 and 1968-83 (Calf). These figures are summarised in Section 3:21 and 3:11 respectively. On Bardsey there has been a gradual increase in the number of sheep and ponies on the island since 1958 (Hayward 1958, Bullock *et al.* 1983a, 1983d). On the Calf, there have been very wide fluctuations in the level of sheep grazing (Calf of Man Obs. Reps. 1970, 1973, 1975, 1976, Sharrock 1976, Bullock and del-Nevo 1983, Bullock *et al.* 1983c). Section 6:5 concluded that stock levels are an important factor in Chough breeding, thus because of these fluctuations, they would interfere to an unacceptable degree with the climate data. This was borne out in a preliminary analysis of Calf of Man climate results. Because of this, only Bardsey data was used.

Climate data was obtained from the 'Monthly Reports' of the Meteorological Office, using Holyhead (the nearest similar area to Bardsey) for 1953-59, and Bardsey from 1960 until records ceased to be taken in 1982. The following weather categories were used:

- (i) average overall temperature (°C) April-June (Breeding season).
- (ii) average rainfall (mm) April-June (Breeding season).
- (iii) average Winter temperature (°C) December-January.
- (iv) minimum Winter temperature (°C) December-January.

Returns were complete except for 1965/6 and 1968/9 for (iii) and 1965/6 for (iv).

For breeding season data, graphs were made of rainfall and average temperature against number of fledged young per breeding pair (including pairs which laid eggs) for each year. For the Winter data, graphs were made of minimal and average temperature against the number of successful breeding pairs after the Winter with respect to the previous breeding season, and the number of fledged young per pair after the Winter with respect to the previous breeding season. The Winter data intended to examine the effect of the Winter on the number of birds capable of breeding, and their ability to raise young to the fledgling stage.

Regression analysis was carried out on the results.

(ii) Long term trends.

Lamb (1977) gives a relatively comprehensive survey of all data on the British climate from 1600-1960. The historic climate data graphs that follow have all been adapted from the data in its appendices. Early climate records were compiled from the Radcliffe Observatory and the Greenwich Observatory, and thus until the mid Nineteenth Century, climate records refer to / the climate of Central England, not the coastal areas. Later data had a wider coverage which / ^{was} based on an overall figure for England and Wales. Graphs of temperature and rainfall data were produced and those which showed the greatest variation between decades, and thus the ability to express climatic changes most clearly were combined with the revised running total population changes produced in Section 4. Regression analysis was carried out as the three potentially most effective combinations.

6:8:4 Results

(i) Bardsey data

Six graphs were produced (figures 6:8:1 to 6:8:6).

(a) Rain, April to June against ^{young} / breeding pair ($r < .001$, $n=26$, figure 6:8:1).

- (b) Mean temperature April to June against yng/breeding pair
($r > .2$, $n=26$, figure 6:8:2).
- (c) Young per breeding pr. wrt. previous year against minimum
temperature December to January ($r > .2$, $n=21$, figure 6:8:3).
- (d) Young per breeding pr. wrt. previous year against mean temperature
December to January ($r > .2$, $n=22$, figure 6:8:4).
- (e) n. pairs with fledged young wrt. previous year against minimum
temperature December to January ($r < .2$, $n=21$, figure 6:8:5).
- (f) n. pairs with fledged young wrt. previous year against mean
temperature December to January ($r > .2$, $n=22$, figure 6:8:6).

Thus, only rainfall during the breeding season and to a lesser extent minimum winter temperatures appear to have any significant effect on the number of young fledged by each breeding pair. In the other cases, other factors such as management changes, food availability and predation coupled with these two factors, are more important in affecting the breeding ability of each pair and the number of pairs able to breed. Human persecution is not a controlling factor here, since all data ^{were} taken while the island is a bird observatory and no cases of shooting or nest raiding have been recorded during this time. Neither is human disturbance a significant factor, the birds showed a much higher degree of tolerance to the presence of people than in the Loctyn or South Stack (Bullock 1980) populations, as discussed in Chapter 3, Section 4.

(ii) Long-term trends

Nine sets of climate data were used and can be seen in figures 6:8:7 to 6:8:13. The 40 year running means, figures 6:8:7 and 6:8:8 are intended to demonstrate gradual trends in Summer and Winter temperature. Figures 6:8:10 and 6:8:11 show relative mildness of Summers and Winters. In 6:8:10, the higher the index number, the wetter the Summers, and in 6:8:11 the greater the number of severe winters in the period in relation to mild

FIGURE 6:8:1. BARDSEY 1953-1981; RELATION BETWEEN BREEDING AND RAINFALL.

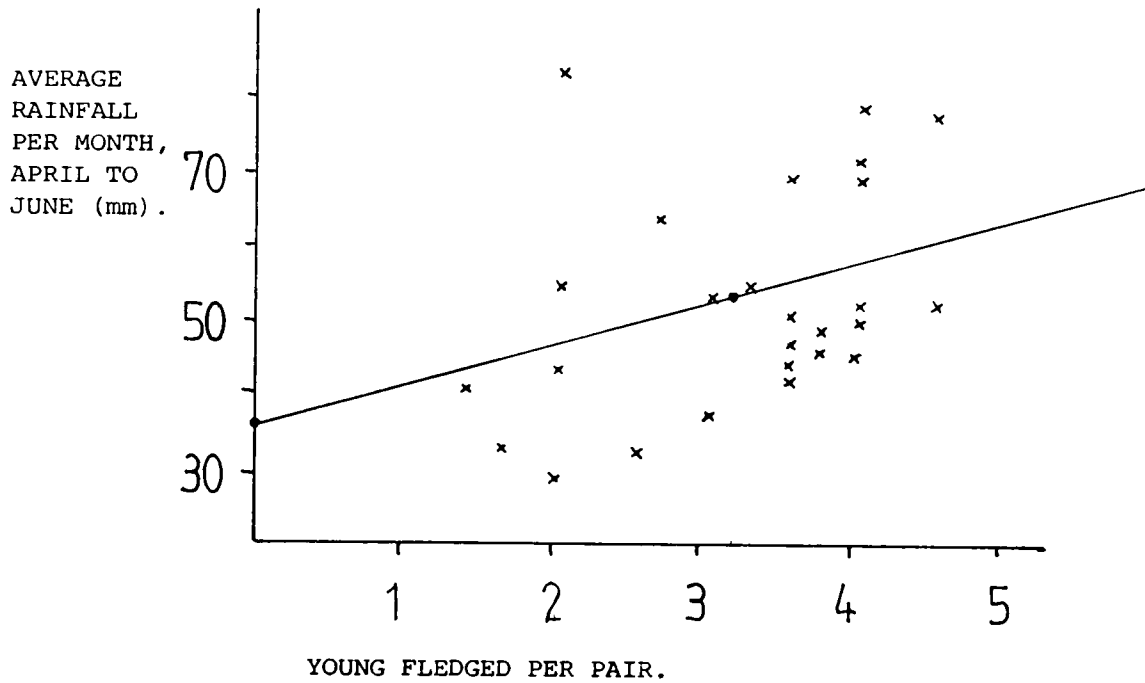
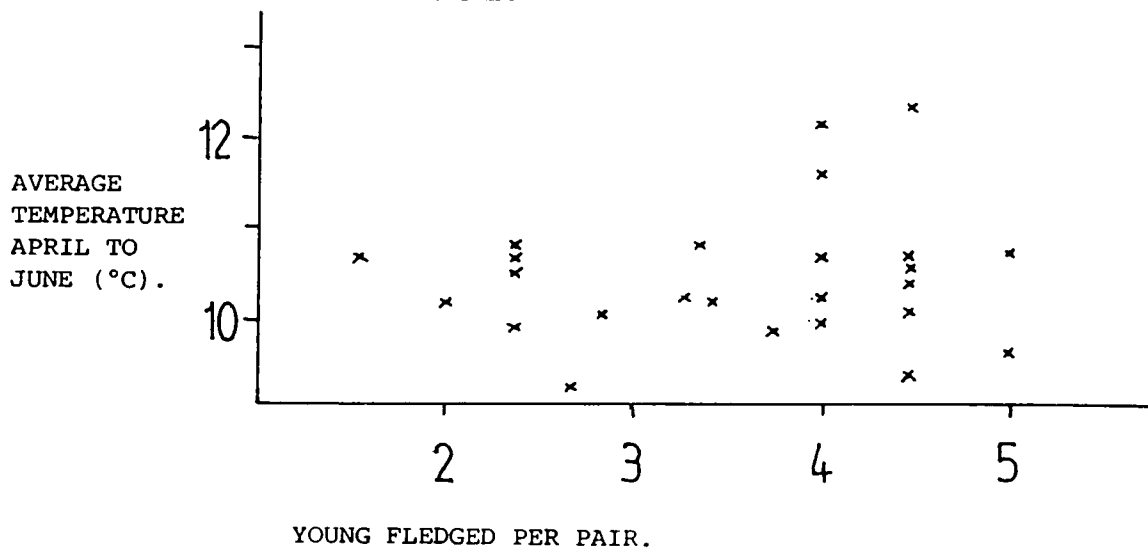
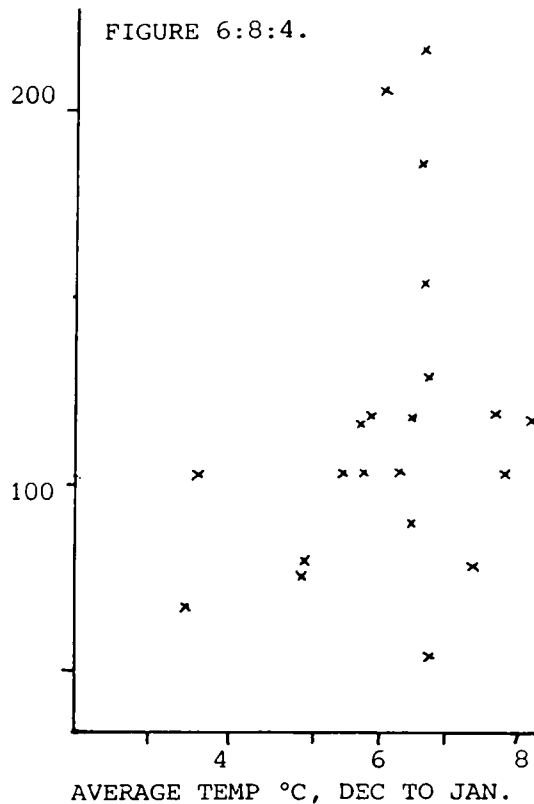
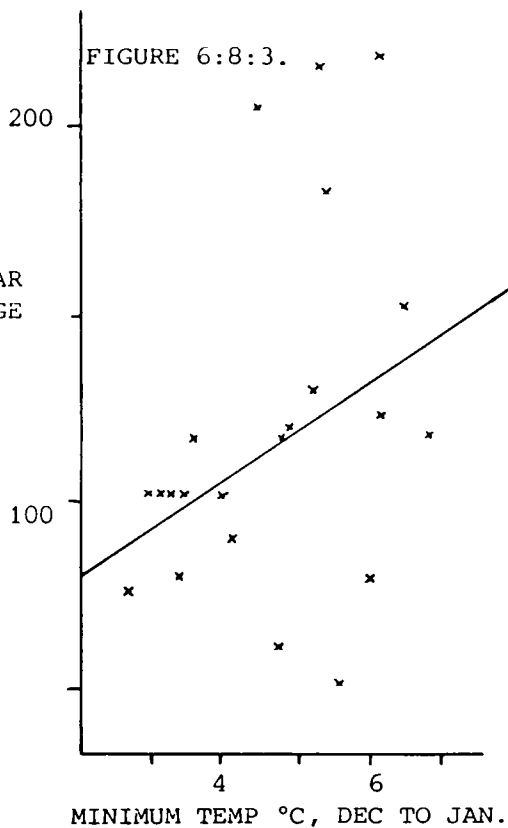


FIGURE 6:8:2. BARDSEY 1953-1981; RELATION BETWEEN BREEDING AND TEMPERATURE.

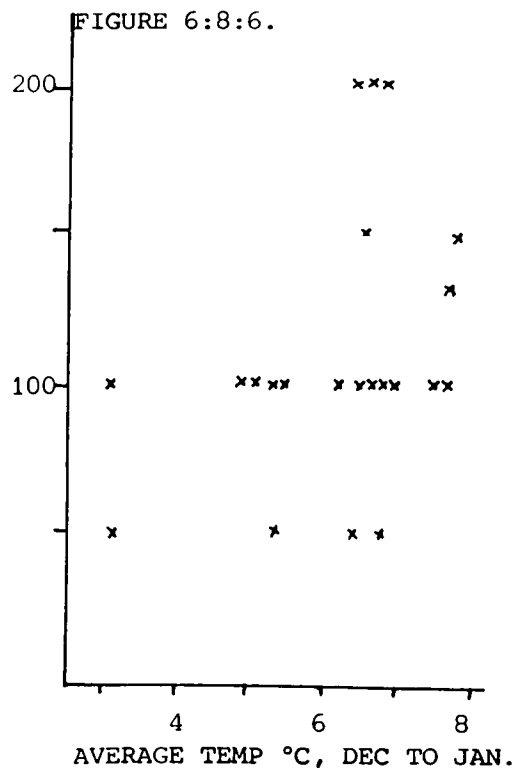
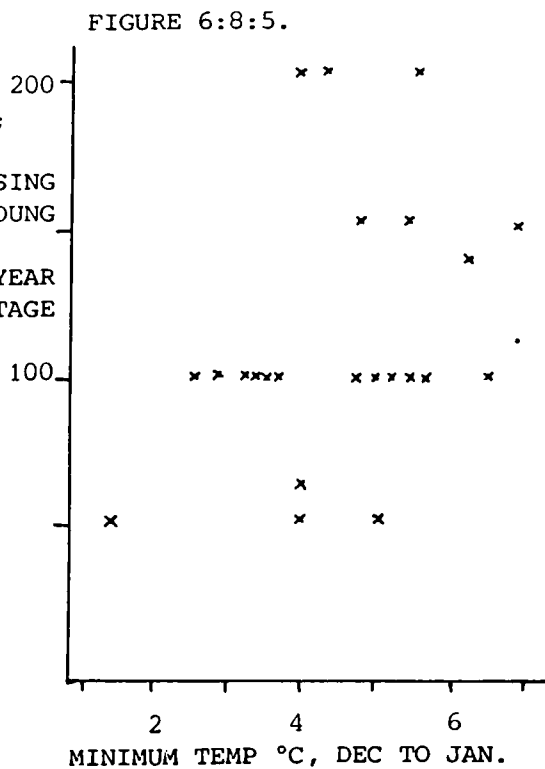


FIGURES 6:8:3-6:8:6. RELATION BETWEEN MINIMUM AND AVERAGE WINTER TEMPERATURE AND BREEDING FROM DATA FROM BARDSEY ISLAND.

FIGURES
6:8:3 and
6:8:4;
YOUNG
FLEDGED PER
PAIR W.R.T.
PREVIOUS YEAR
IN PERCENTAGE
TERMS.



FIGURES
6:8:5
and 6:8:6;
NUMBER OF
PAIRS RAISING
FLEDGED YOUNG
W.R.T
PREVIOUS YEAR
IN PERCENTAGE
TERMS.



40 YEAR RUNNING MEANS FOR TEMPERATURE (DATA FOR CENTRAL ENGLAND).

FIGURE 6:8:7 (G). FOR JUNE.

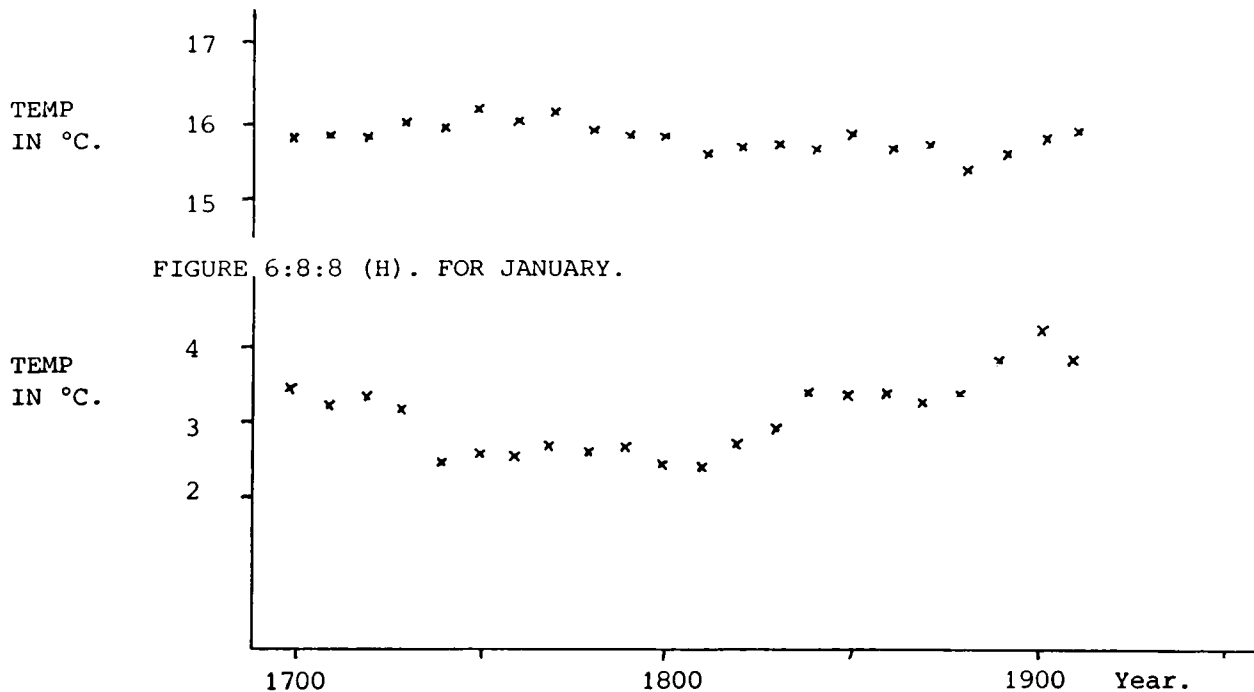


FIGURE 6:8:8 (H). FOR JANUARY.

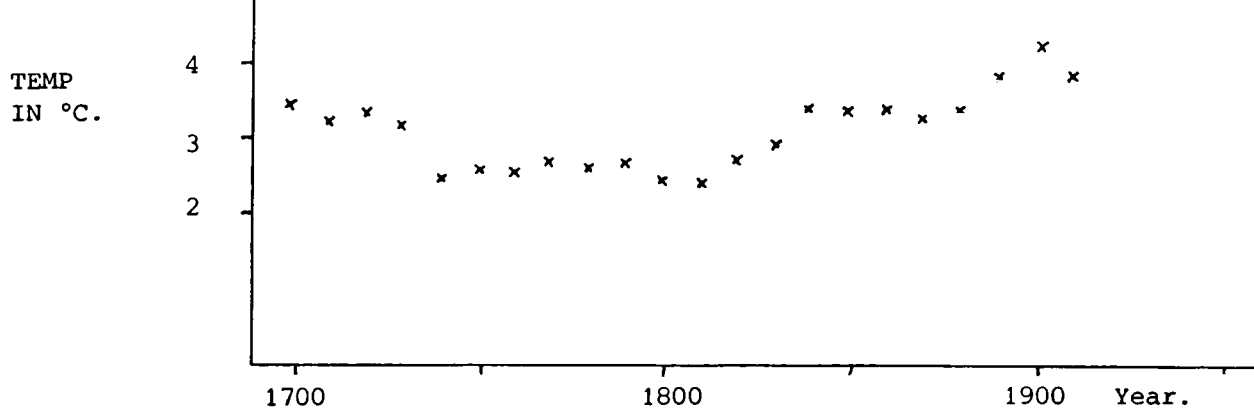
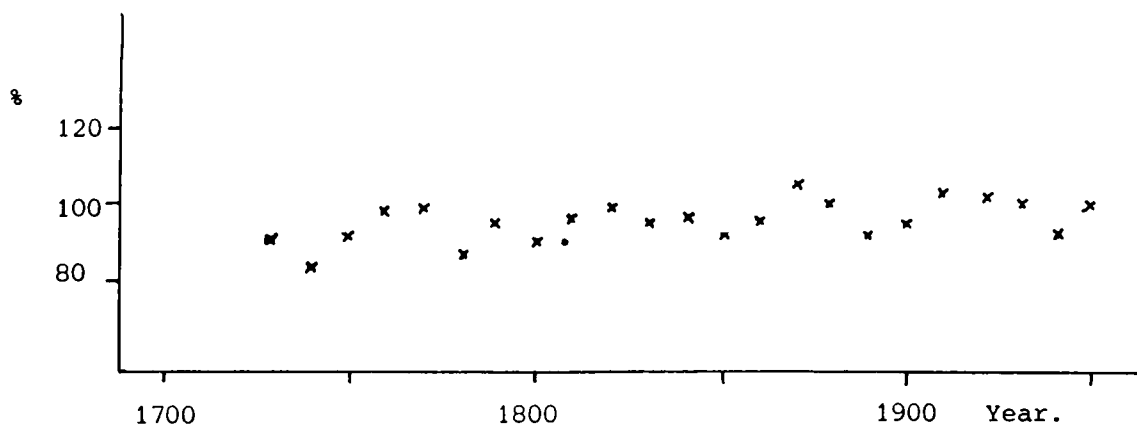


FIGURE 6:8:9 (I).

MEAN ANNUAL RAINFALL WITH RESPECT TO 1900-39 AVERAGE OF 932mm.



ADAPTED FROM LAMB (1977).

FIGURE 6:8:10. CLIMATE DATA FOR ENGLAND AND WALES; SUMMER.

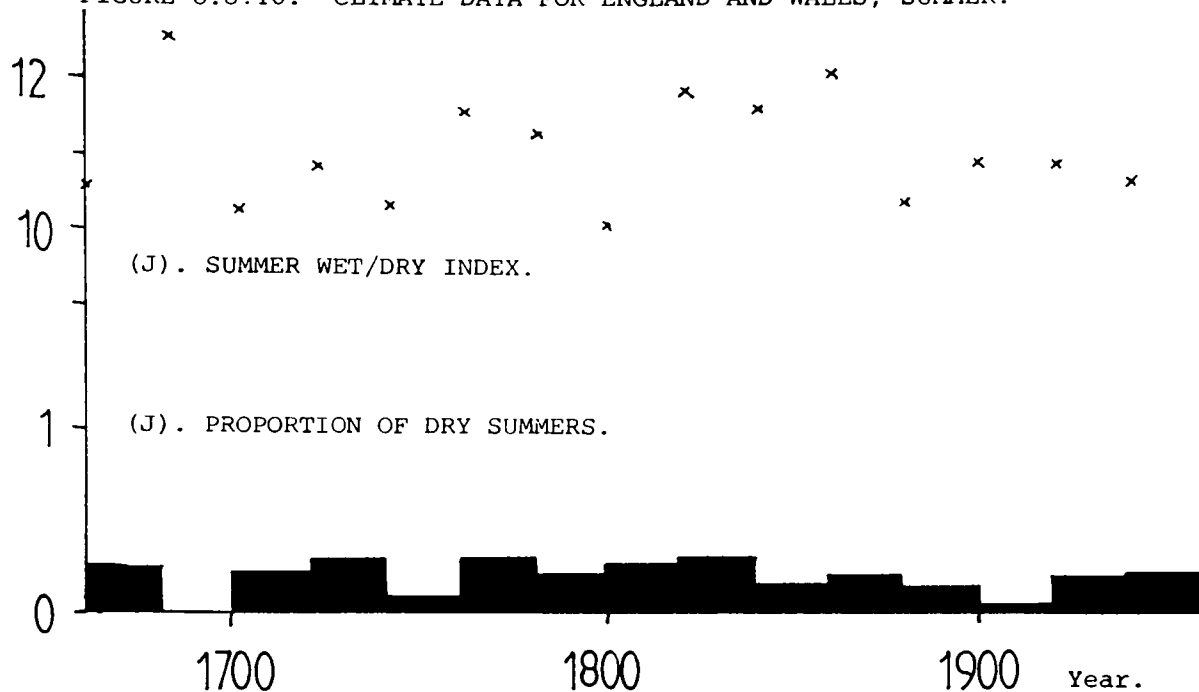
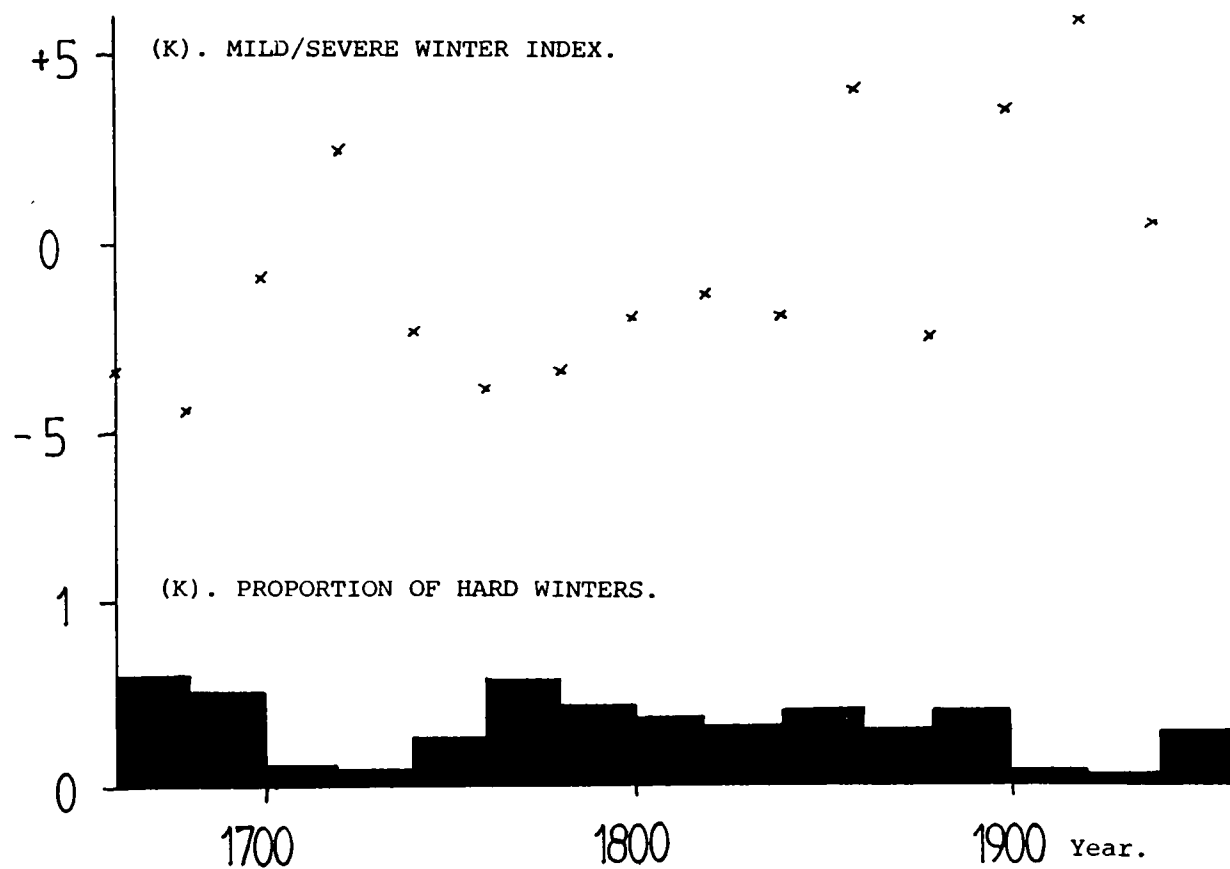


FIGURE 6:8:11. CLIMATE DATA FOR ENGLAND AND WALES; WINTER.



ADAPTED FROM LAMB (1977).

FIGURE 6:8:12 (L).
SEASONAL RAINFALL AVERAGES AS PERCENTAGES OF 1916-50 MEANS.
(1) FROM MARCH TO MAY.

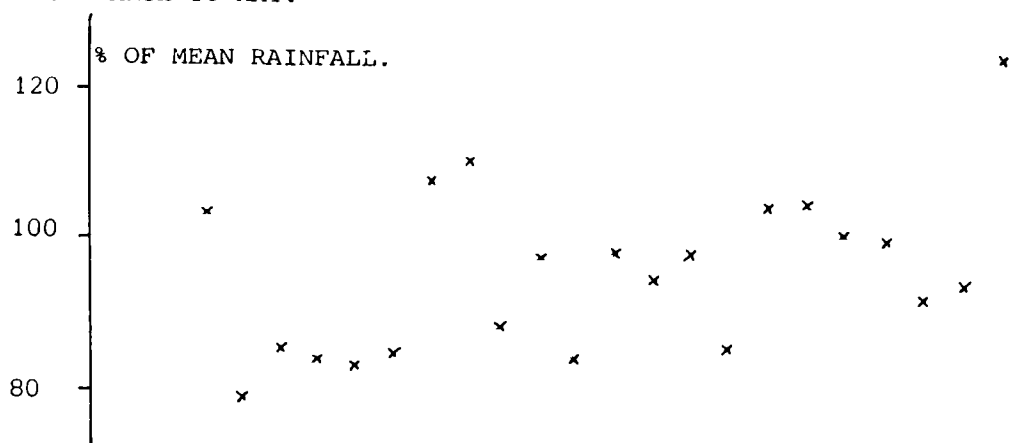
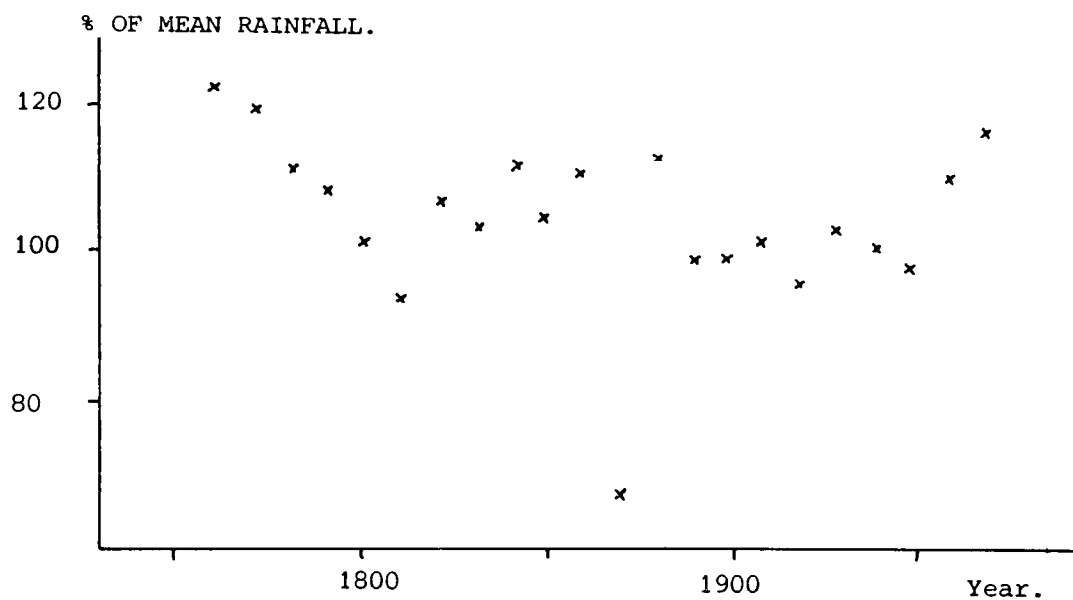


FIGURE 6:8:13 (M).
SEASONAL RAINFALL AVERAGES AS PERCENTAGES OF 1916-50 MEANS.
(2) FROM JUNE TO AUGUST.



ADAPTED FROM LAMB (1977).

Winters.

Three sets of climate data were chosen for further examination. They were:

- (i) % average rainfall March to May (figure 6:8:12).
- (ii) % average rainfall June to August (figure 6:8:13).
- (iii) P. Severe winters (figure 6:8:11).

Data is used in 10 year groups, against the % decline from running totals (calculated in Section 3) for the same times. Results are summarised below in table 6:8:1.

Data is grouped into 10 year blocks since this was the smallest time span for which population estimates could be made to an acceptable degree of accuracy.

Table 6:8:1

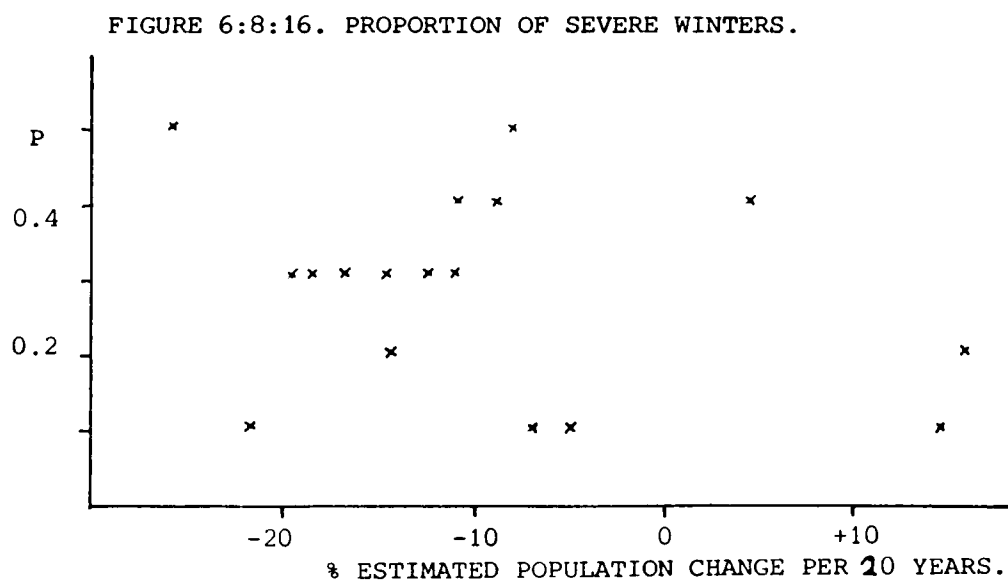
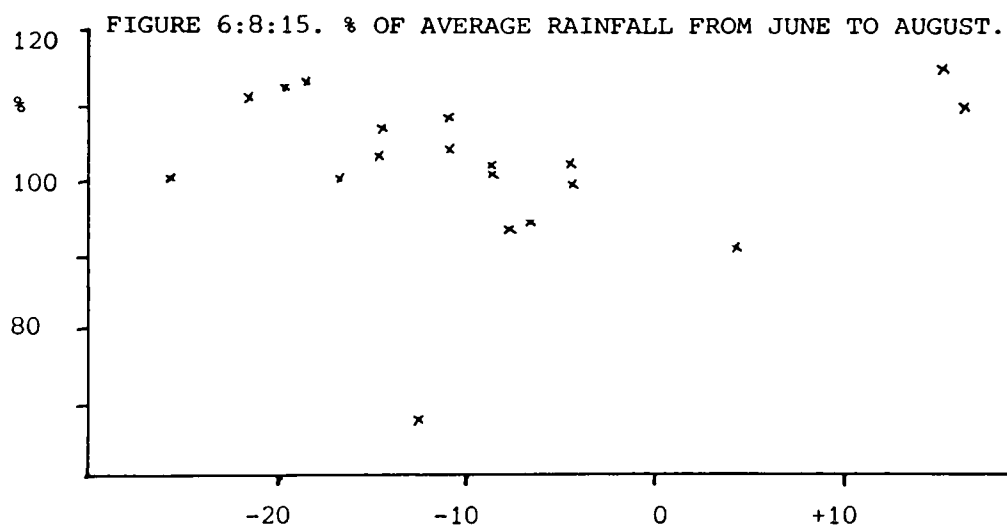
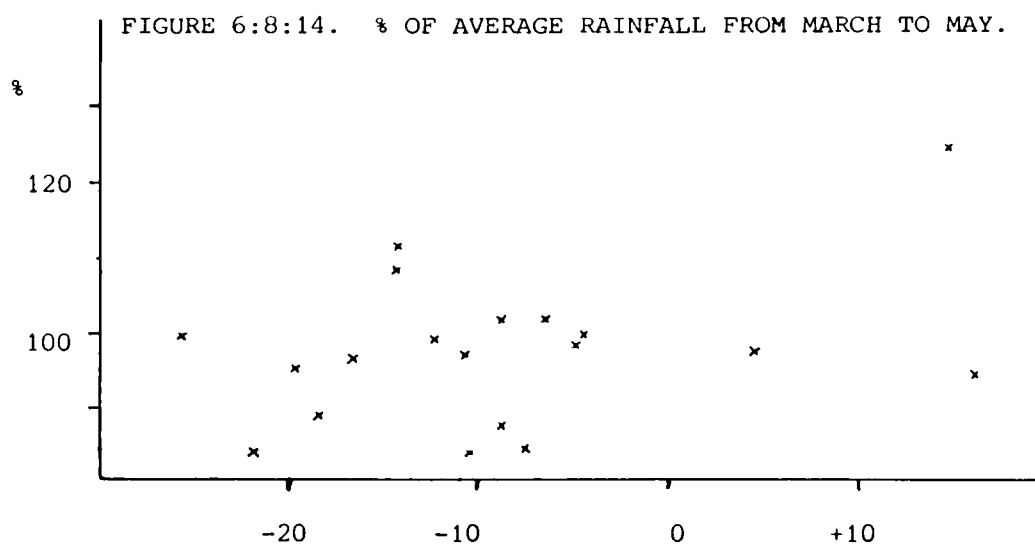
10 year	% decline from running total	P. severe Winters	% of average rainfall:	
			March to May	June to August
1790	10.48	.4	83.5	107.8
1800	8.43	.4	87.9	101.4
1810	7.68	.5	84.2	92.9
1820	14.18	.2	108.1	106.4
1830	14.34	.3	111.2	102.9
1840	18.29	.3	88.9	113.3
1850	10.67	.3	96.8	104.2
1860	21.79	.1	84.0	111.0
1870	12.16	.3	98.9	67.2
1880	19.28	.3	95.0	112.6
1890	25.83	.5	99.4	100.1
1900	16.57	.3	86.7	100.0
1910	8.41	0	102.4	101.7
1920	6.62	.1	102.4	93.8
1930	4.72	.1	98.4	101.8
1940	4.13	0	99.3	99.0
1950	+4.74	.4	97.3	90.8
1960	+16.05	.2	93.8	109.1
1970	+14.89	.1	122.7	114.0

Regression values were as follows:-

- (a) decline against P. severe Winters
($r > .2$, $n=19$, figure 6:8:14).

FIGURES 6:8:14-6:8:16.

RELATION BETWEEN CHANGES IN THE ESTIMATED POPULATION OF THE CHOUGH AND VARIATION IN RAINFALL AND THE FREQUENCY OF SEVERE WINTERS.



- (b) decline against % ave. rainfall March to May
($r > .2$, $n=19$, figure 6:8:15).

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- (c) decline against % ave. rainfall June to August
($r > .2$, $n=19$, figure 6:8:16).

None of these results show any significant relation between the long term climate changes and changes in Chough breeding numbers.

6:8:5 Discussion

The lack of any significant trends for the long term analysis of the effect of climate suggests that although climate may have an effect on Chough breeding numbers, it is less significant than any other factor. This indicates that during the period of decline, persecution and changes in habitat usage were a more important factor. This is underlined by the increase in Chough numbers since the second World War, where the value of conservation has outweighed climatic factors.

Summer rainfall and minimum Winter temperatures appear to have a short-term affect on their breeding success. Dry Summers limit the insect availability as mentioned in the introduction. The dryness of the soil also makes the soil harder and less easy to penetrate (Chapter 4:2), but warmth does help the availability of insects (Williamson 1975). Thus, the ideal climate during the breeding season is a warm period with average to above average rainfall.

Although severe winters may result in an increased mortality of Choughs, they have no significant effect on the number of breeding pairs the next season on Bardsey. But they appear to affect the breeding ability of the Chough to a small extent, since the individual birds may be in poorer condition than normal, and although still able to breed, they are unable to cope to their usual extent with the demands of feeding the young until they have fledged.

Rolfe (1966) found that after the 1963 winter, no Islay Choughs bred in the next year. This was an extreme instance, from which the Islay population has recovered (Warnes 1983a, 1983b). The Welsh and the Irish populations were not affected to the same degree by the 1963 Winter, and indeed, there may have been a slight increase in the West coast of Ireland (Rolfe 1966). Similarly, apart from a decline of one pair in Ceredigion (Roderick 1978, Bullock *et al.* 1983d), there were no declines in the Chough population in 1982 after the severe spell in December 1981 and January 1982 (Bullock *et al.* 1983a).

Although, as Bullock (1980) notes, mountain areas may have been seriously affected by cold winters (due to the lack of alternative feeding sites, in part), it appears that as regards Chough breeding populations, climatic changes only have a significant effect on some short-term aspects.

6:9 DISCUSSION

This section aims to integrate points made in the previous discussions in this chapter and compare them to previous attempts to account for status changes in the Chough. Furthermore, the value of reconstructing a species past status, its accuracy and any relations to causal factors will be considered.

The county estimates from 1750 to 1980 were deliberately kept conservative. Thus there was an inherent possibility of a large increase between the estimates of 1960, 1980 and the first comprehensive survey in 1982. This is partly compensated for by the fact that more recent records did not need to be so conservative as earlier ones due to the greater amount of data available, coupled with a reduced geographical range. In general, the county records appear to be consistent with each other as shown by the regular pattern seen in the declines, and where appropriate, partial recoveries. The declines were asynchronous due to geographical

considerations discussed in 6:7:8 whereby pressure from shooting and collecting was first applied in the areas most accessible to London and other densely populated areas. The East to West contraction was consistent throughout the results as was the pattern of populations becoming fragmented into isolated groups before their eventual extinction (illustrated in Figures 6:3:3 and 6:4:6).

The Chough was shown to be well suited for the recording of its past status. It had a long tradition (starting with Upton 1446) of being a bird found only in certain areas which encouraged an early interest in its distribution (eg Willoughby/Ray 1676, 1678). Once the error of assuming that it was restricted in distribution to Cornwall was overcome as Barrington (1770) noted, naturalists took note of its distribution at first on a county and habitat level, and by the late 18th century, by noting specific breeding areas. The confusion in nomenclature between Choughs and Jackdaws discussed in Chapter 5 does not appear to have affected ^{distribution} records, but data was restricted by the relatively peripheral role the bird played in the lives of local people outside Cornwall and Wales. The folklore of other corvids and their interactions with Man in agriculture ensued that they were more widely recognised by non naturalists than the Chough. This was further compounded by Choughs living in remote areas, thus meaning few naturalists (eg Ray and Willoughby) were able to observe them in the field. This meant that, for example, the Lizard Peninsula in Cornwall, which was probably a major breeding area went unrecorded until 1848 (Penhallurick 1978), by which time they were a relict population there. It is likely that many ^{people} mistook them for Jackdaws. With the increasingly large declines in the 19th century, naturalists recorded their status changes in some detail, especially due to the Chough's unfortunate popularity as a shooting target and object for collecting. The main factor in favour of estimating Chough populations is their limited and distinctive breeding and

foraging habitats. This factor was most noticeable in the coastal areas and enabled quantitative population estimates to be made.

The early distribution / findings were restricted by the paucity of available data to concluding that in the 15th century they were probably more common in Cornwall than in the rest of England. It also found a probable distribution from Kent to Cornwall and in North Wales. The data was mainly via illuminated manuscripts and heraldic works.

The problems of access mostly affected the Welsh and North English estimates. In Wales this was combined with linguistic problems; most people in Coastal Wales were monoglot Welsh speakers until the late 19th century. These two areas had much less data available than South and West England. This meant that estimates for past populations started later for example in Caernarfon (1880) than in Dorset (1800). All county estimates started at times when the population was in decline from an assumed ideal figure. Thus, the theoretical breeding density estimates obtained from 19th century trapping data in Cornwall coupled with appropriate breeding and survivorship data produced a hypothetical ideal breeding density for coastal populations. Applying this to the habitat availability in each county gave an insight into the county population sizes before persecution and the relation between these population estimates and the first county estimates.

Due to the gap between the earliest county estimates (Cornwall 1750 and Sussex 1780) and the first-year group including all counties (1880), the running total estimates had to be corrected by including only those counties for which there were estimates available for that particular time. This resulted in a significantly higher rate of population fall (χ^2 23.23, $p < .01$, $df=9$) than the uncorrected figure which assumed no fall in numbers for a county prior to its first estimates. Because no reliable method for estimating populations in inland areas (eg North Wales) could be devised, and the estimation of extent of populations was more difficult, estimates of

inland populations were not made. As a result there were two sets of data prepared; the uncorrected coastal figures in rates of declines and in numbers of breeding pairs and the corrected coastal figures in rates of decline only.

The periods of maximum decline and their extent were found to differ from those estimated by Rolfe (1966) and Bullock *et al.* (1983a). While they regarded the greatest period of decline to be from 1846-70, this study concludes that there were 2 periods of maximal decline; from 1850-1860 and from 1870 to 1900. The errors in these previous attempts appear to be mainly due to a lack of data, using local extinctions as an indicator of declines as opposed to any quantitative basis. Furthermore, a number of the local extinctions cited in Bullock *et al.* (1983a) are in fact in error, with pairs known to have bred there up to 15 years later than the date given.

Previous studies on the past status of the Chough have been based on the premise that Man has been responsible for causing some great decline in their numbers from some unknown 'natural' level. In fact, the 'ideal' level calculated in this Chapter depends on Man maintaining a high level of sheep grazing in the appropriate coastal areas. Similarly, the Kite that swarmed above the medieval City of London owed its relative abundance at the time to the City's inefficient waste disposal system. Any decline was from an artificially high level. In the case of the Chough, breeding areas would have been limited to mountain and coastal areas where the level of exposure was sufficient to ensure that the grass sward was kept short enough for the Chough to feed efficiently. In such a system 'unspoilt' by Man, not only sheep, horses and cattle would be absent, but there would be no rabbits (introduced by the Romans, Sheail 1984), while deer and hare would be restricted in numbers by a higher level of natural predation. In the study site, there were 2 areas of naturally short grass and bare soil or scree, which combined would be possibly adequate for 1 pair, not the 3 pairs

present. It would therefore be reasonable to envisage that without Man, any 'natural' population level would be about 10-25% of the ideal Coastal population. As far as the Chough is concerned, Man can thus be regarded as both a blessing and a curse.

Indications of the maximal extent of the 'natural' population inland were given in the fossil records outlined in 6:2. The most effective way of examining the Choughs 'natural' population may be to compare other populations (see 2:9 for subspecies, ranges and habitats) where there is no sheep farming or other direct and indirect interactions between Man and the Chough's environment.

A total of 5 factors were found to have a significant relationship with Chough numbers or breeding success. They are listed below in table 6:9:1.

Table 6:9:1

SHORT TERM FACTORS

(1) Rain during breeding season positively affects number of young fledged per breeding pair.

(2) a) Number of sheep in area positively affects number of breeding pairs in a restricted area (eg Calf of Man).

b) Number of sheep in area positively affects number of breeding pairs in a restricted area during the following season.

(3) Choughs show significant preference for foraging on sheep-grazed areas with respect to ungrazed areas.

LONG TERM EFFECTS

(4) a) Frequency of citations of persecution related to frequency of local extinctions.

b) Frequency of citations of persecution related to rate of decline.

(5) Changes in sheep numbers on a county level positively affects Chough breeding numbers.

This table is a summary of the attempts in the chapter to find quantitative relationships between possible factors attributed to changes in the Chough's status and long and short term population changes in the Chough population. No significant relationship was found in any of the other factors. Thus the only way climate appears to have affected Chough numbers may be via habitat alteration. There was no evidence of severe winters affecting Chough numbers except on a short-term basis by increasing mortality. This agrees with other writers (Bullock et al. 1983a, b, c, d, Bullock 1980 and Warnes 1983a, b) that local population declines and higher rates of mortality after the severe Winters of 1962-3 and 1981-2 were rapidly compensated for. This may in part be due to the high non-breeding population discussed in 6:3:1. No evidence was found to suggest that predation (by, for example the Peregrine) or competition (by other corvids, especially in the case of the Jackdaw) occur at any excessive level. ^{present} The/ effect of human disturbance, discussed in chapter 3:4 appears to be little above nuisance value, and Choughs were found to select better feeding areas with high tourist disturbance ^{rather} than poorer areas with less disturbance.

The findings in this chapter indicate that sheep grazing and persecution are the 2 significant factors affecting the Chough's status. Quantifying the extent of persecution is not simple; it involves solitary individuals shooting, trapping and taking eggs often on an irregular basis, and few records exist of the accidental depredations caused by rabbit traps. Apart from the frequency of citations of persecution, the Perran Sands data (Section 3:1) is the only quantitative information available. Status changes in the Choughs coincide well with alterations in the pattern of their persecution: (a) in the early 19th century an increasing rate of decline with improvements in guns and better roads; (b) a high level of decline in the 1860's with the increased access to remote areas provided by the expansion of the railway network; (c) a second and greater maximum rate

of decline caused by increased shooting etc (with cheaper and more efficient shotguns) upon a smaller population, (d) a levelling out of the population as trapping is legislated against, oology declines in popularity, and shooting becomes a discriminating sport concentrating on game, wildfowl and rough shooting in managed areas, and (e) an increase as the trend against persecution is enhanced by protective legislation.

Figure 6:7:1 in Section 6:7, demonstrates the 'vicious spiral' effect of persecution and collecting. When combined with falling sheep numbers, the synergy of the two factors (2 depressive factors combined having a greater effect than when on their own) caused the extinction of the English population. This was also illustrated by the 2 regressions in Section 6:6 for Chough and sheep numbers on a county level. Here, Chough numbers fell in the counties examined between 1871 and 1939. Yet although the slopes of the regressions were the same, Chough numbers rose from 1939^{to}1966. This

not only demonstrates the relationship between Chough breeding numbers and sheep density, but also the overriding effect of persecution.

The findings on grazing in the main agree with ^{that of} Warnes (1983a), Bullock (1980), Bullock and del-Nevo (1983) and Bullock et al. (1983a), except that a delay factor was found to operate on the abandonment of grazing of 7-12 years on Ramsey Island and the Calf of Man, and there was a stronger relationship between Chough breeding numbers and the previous year's sheep numbers than that of the current year. What is now uncertain is how grazing patterns will be affected by changes in the economy of Islay (Warnes 1983a) and in Wales due to the recent imposition of dairy quotas and changes in EEC Agricultural policy. If the latter favours sheep farming, it should reverse the decline in Coastal sheep farming noted by Bullock et al. (1983a). Sharrock (1984) believes that ploughing may not be as detrimental as previously feared, since he notes that Choughs regularly follow the plough in Ireland during April as well as from September to November.

This Chapter has achieved its aim of reconstructing a species' past distribution and accounting for any observed changes to the extent of producing consistent figures and trends on both a county and a national level. It has produced quantitative evidence that the Chough's decline can be attributed to changes in sheep farming, grazing in general and direct and indirect persecution.

CHAPTER 7
GENERAL DISCUSSION

- 7:1 Overall Conclusions of Chapters 2-6.
- 7:2 Some Considerations on the Chough's Status.
- 7:3 Suggestions for Further Research.

'But it is very different with the Rook, the Daw and the Cornish Chough ... They are sociable and harmless; they live only on insects and grain; and wherever they are, instead of injuring other birds, they seem centinels for the whole feathered creation.'

Oliver Goldsmith. A History of the Earth
and Animated Nature. 1774.

7:1 OVERALL CONCLUSIONS FOR CHAPTERS 2-6

CHAPTER 2

- a) Chough behaviours were defined, illustrated and classified in relation to social context and frequency of use by combining film analysis and field observation.
- b) Chough postures and a number of corvid postures were analysed using 4 criteria which were based on variants of; body axis, carpal joints, tail and bill positions.
- c) In field observations, the Chough's tail positions varied less than the other 3 criteria.
- d) Differences between submissive and forward-antagonistic postures in corvids were found to be relatively constant. Wide divergences were found when comparing the male pre-copulatory to the female acceptance/solicitation posture.
- e) A simple ethnogram of Chough social behaviour was presented.

CHAPTER 3

- a) Flow-^{diagrams} describing functional aspects of female and juvenile food-begging and responses to food begging were presented.
- b) In females, the full beg technique was more successful than the simple beg. All instances of feeding took place after copulation.
- c) In juvenile food begging, the diversity of begging techniques increased with time. Positive responses decreased with time and, after 22 days, independent feeding was more effective than food-begging. More assertive techniques resulted in higher response rates but had a greater risk of adult attack.
- d) Vigilance by individual birds decreased with foraging group size, while overall group vigilance increased.

e) Probability of individual birds wing-flick calling before take-off due to gradual tourist approach increased with foraging group size because of their greater overall vigilance.

f) Minimum take-off distance in the presence of tourists was $34.9 \pm 6.3\text{m}$ and was unaffected by Chough group or tourist group size.

g) Tourist disturbance was related to tourist frequency in the area. It did not occur at levels that significantly affected the Chough's selection of foraging sites.

h) Carlestead's (1983a, 1983b) canal model of vigilance behaviour was adapted to Chough vigilance with a number of set responses included for given circumstances.

i) Wing-flicking normally occurred after landing. Before take-off they occurred at the same frequency as during foraging, except when birds were about to join others in the air or where there was gradual tourist disturbance, where the wing-flick call variant was used. Flow diagrams outlining the social and functional regulation of wing-flicking were presented.

j) Bill-wiping was mainly observed during foraging. Stones, shrubs and fence posts were used for bill-wiping and for cleaning the bill after nestling faeces removal.

k) Standard forms of wing-flicking and bill-wiping were used in maintenance behaviour. Ritualised forms and combinations were used for social and sexual behaviour.

l) Postulated meanings for the various forms of ritualised and standard bill-wipe and wing-flick behaviours were drawn together in relation to the visual similarity between each behaviour.

CHAPTER 4

a) Choughs mainly fed on managed habitats where grazing or cutting had kept

a) short open grass or heath sward. Unmanaged habitats under high exposure (thrift and rock dominant) were also favoured, but were smaller in extent.

b) Other Corvids and Starlings did not disturb or compete with Choughs to any significantly detrimental extent.

c) Maintenance of habitats by grazing, cutting and, according to exposure, burning is recommended for aiding the long-term recovery in Chough numbers.

CHAPTER 5

a) Until circa 1600, Jackdaws were called 'Choughs' and had literary associations with theft and greed.

b) In English writings, Choughs per se were first recognised as separate from Jackdaws prior to 1446. At first they were called Cornish Choughs, later Choughs.

c) Jackdaws were normally called 'Daw'^{or}/Jackdaw after 1600. The Chough acquired the Jackdaw's old name along with its associations. It was also regarded as a fire raiser.

d) Until around 1830, the Chough had an unfavourable literary reputation which probably increased its persecution at the time.

e) The development of attitudes towards birds in literature can only be correctly understood through a comprehensive interdisciplinary approach. Such an approach needs to use literary criticism, covering all citations in English writings, their sources, and scientific explanations of each phenomenon mentioned in the above literature.

CHAPTER 6

a) Natural history books from 1550^{to}/1835 were in the main based on plagiarism. New pieces of distributional data have to be selected with careful reference to borrowings in all aspects of each account.

b) By using natural histories, county reports and any MSS data available,

the Chough's past distribution was reconstructed on a basis of distribution and average number of breeding pairs for county levels, and at 10 year population averages on a national level.

c) Trapping returns in Cornwall were applied to a population equation in order to obtain theoretical maximal breeding densities for coastal habitats.

d) Estimates obtained were compared to a theoretical 'ideal' distribution in extent and numbers. Overall population changes from 1780 to the present were compared to changes in climate, sheep farming and persecution.

e) Chough populations were found to be related to sheep grazing densities on both a long-term and a short-term basis. Higher grazing densities increased the number of breeding pairs a breeding area could hold, but not their actual breeding success.

f) The effect of persecution was difficult to quantify, but evidence of relations between the frequency of cited cases of persecution and the frequency of local extinctions and the rate of decline and recovery in population were found. Persecution had / ^{the} greatest effect probably when combined with the decline in coastal sheep farming.

g) Long-term climatic trends were unrelated to changes in Chough numbers. On a short-term basis, minimum Winter temperature affected the number of breeding pairs, a lack of rainfall during the breeding season affected breeding success.

h) Detailed population reconstructions on the basis of a species' distribution and abundance were found to be feasible when a species lived within a distinct habitat and enough data available in relation to its distinctive appearance and criteria were available for determining population estimates from the data. This approach was of value in finding quantitative reasons for status changes in the Chough.

7:2 SOME CONSIDERATIONS ABOUT THE CHOUGH'S STATUS

Owing to what can only be regarded as an accident of history, the Chough acquired an unfavourable literary reputation from circa 1600 to 1830. This led people to believe that it was an intrinsically 'bad' species which, combined with its physical resemblance to corvids regarded as vermin and its occasional eating of grain, meant that it was widely regarded as a pest. Amongst those who did not see it as vermin, its intrinsic aesthetic appeal, local distribution and inaccessibility meant that the eggs and adults were of great value to collectors. These pressures were increased by factors in the mid nineteenth century^{by} the development of the breech loading gun, and the expansion of the railway network^{which} led to many more people being able to reach them, coupled with a greater fire-power. In addition, a decline in coastal sheep farming due to agricultural depressions and a move to arable farming led to substantial reductions in the availability of suitable feeding areas. Increases in arable farming lead to increases of persecution, due to the Chough looking like Jackdaws and Rooks. The farmers could utilise the new firearms coupled with snares and gin trapping whether directly or, indirectly, when intending to take Rabbits.

As a result, the steady rate of decline in distribution and numbers recorded between 1750 and 1860 reached a peak from 1860 to 1900, whereby the English population was reduced to a relict population in North Cornwall. This population could not survive the lower levels of persecution and falls in sheep numbers after 1900, and breeding ceased by 1948. Higher levels of sheep farming, coupled with fewer people and poorer access, meant that the fall in numbers in Wales was smaller and an adequate population remained for a partial recovery, especially after the Second World War when sheep numbers increased and persecution became the exception rather than the norm. The lowering of persecution occurred through legislation, an appreciation of 'wild nature' and the development of a sporting ethos in shooting.

At their present levels/^{at Loctyn}, tourism appears to pose no significant threat to Chough breeding or their choice of feeding areas. This may change if tourism increases, but the relatively small 35/^{metre} minimum flight distance meant that Choughs could feed in one part of the Loctyn peninsula while there were tourists on other parts of it.

There are a number of unconfirmed reports of the Chough breeding in Cornwall and Dorset over the last 10 odd years. Vagrancy data shows that this is perfectly feasible so long as their habitat requirements are met. One/^{may} doubt that such a visible bird has been overlooked, but an element of secrecy must be for the good until adequate recolonisation (if any) has taken place. Management would thus best be restricted to ensuring that sheep farming is encouraged in the area and that local farmers are advised that the Chough can only play a beneficial role in farming. There is little cause for pessimism regarding the Chough's status today. Perhaps the 'ideal' distribution was too high, being aided by Man's habitat creation, introducing livestock and rabbits. The Chough's 'natural' distribution would have been limited to certain rocky coastal and mountain areas where the degree of exposure was great enough to expose short grassland or maritime grassland habitats. The only pre-man records are from upland Derbyshire (See Chapter 6). The gradual increase confirmed by the 1982 Survey indicates that their long-term status is secure as long as suitable land management is maintained.

7:3 SUGGESTIONS FOR FURTHER RESEARCH

The general discussions for Chapters 2 and 3 included a number of ideas for further work on Chough behaviour and comparative corvid ethology on subspecific and specific levels. This section will consider some aspects relating to the findings in Chapter 5 and 6. Research will commence in October 1985 on Chough ecology and genetics at Glasgow University which

overrules the need to make comments on work in feeding and breeding behaviour here.

a) Literary Attitudes. The best way of extending this work would be to examine the literature relating to all British Corvids. 2 out of the 7 corvids have already been examined and, because of their similar appearance, there would be a considerable amount of interchanging and linking in each species' literary reputation. The other corvids, especially the Raven, also have more references in folk tales and Old English writings and, in general, have a more extensive literature. Thus the study could be more detailed and wide-ranging than these studies on the Jackdaw and the Chough.

b) Reconstructions of Past Distributions. Qualitative attempts to varying degrees of accuracy are shown in Parslow (1973) and Sharrock (1976). Summaries of raptor population changes have been carried out in detail on Kites by Newton et al. (1981) and Marsh Harriers by Underhill-Day (1984), but in each case their data only extend back to the species' recovery, due to a paucity of earlier records. Raptors are probably the best birds to study because of their limited populations, relatively easily quantifiable breeding densities, and the considerable interest in their status by earlier naturalists. Shooting returns, coupled with data on extents of sporting habitat, could be used for investigating population changes in game birds to a high degree of detail. Like the Chough, any species investigated needs to occupy a limited habitat, be distinctive, and have a long history of interest in its status. In view of the British bird atlases, it would be an interesting challenge to produce an atlas (with breeding figures) of the past distribution of various species.

c) Myxomatosis. Studies should be initiated in order to examine the importance of Rabbit grazing for habitat maintenance on the coast in relation to Chough feeding, and to find what habitat changes occur when Rabbit populations fall, especially in cliff areas beyond the reach of sheep.

APPENDIX 1

NOTES ON MAINTENANCE, SOCIAL AND REPRODUCTIVE BEHAVIOUR

A1:1 **Introduction**

This section covers various aspects of the Chough's behaviour that do not at present warrant a detailed investigation and are not connected to food begging, foraging, vigilance or antagonistic behaviour. Certain aspects of group size, flocking and reproductive behaviour are the only fields of Chough behaviour to have been examined on a quantitative basis (Bullock 1980 and Warnes 1983a) and therefore it is of interest to be able to undertake comparisons of a quantitative nature with other work on aspects of Chough behaviour.

A1:2 **Aims**

To produce a quantitatively based description of aspects of the behaviour of the Chough in order to enable the account of Chough behaviour in chapters 2 and 3 to be as comprehensive as is feasible within the compass and general aims of the field work. The section further aims to use the data obtained to check on the veracity of previous accounts of Chough behaviour where the work covers subjects in common and to combine these works in order to enhance the scope of this account.

A1:3 **Methods**

Preening, wing maintenance, bill maintenance, anting and sunning behaviours were observed in the field. In chapter 2:3 they were defined and aspects relating to wing-flicking and bill wiping in the context of maintenance were examined in chapter 3 section 5. Sex and group size were recorded and the frequency and type of maintenance behaviour to these and any other potentially significant environmental contexts were noted.

The number of birds in each flying and foraging group, including individual birds were noted with respect to their time of year. Spacing between birds was recorded by looking at the distance between two individuals in a flock of 2 or more foraging birds once every 10 seconds. Distance was measured in Chough body lengths (male approximately 40cm, female approximately 37.5cm). Habitat and date were noted.

All forms of sex-related behaviour were recorded and defined in Chapter 2. Aspects relating to courtship feeding and wing-flick and bill wipe derived behaviours have been discussed in Chapter 3:3 and 3:5. Other aspects of courtship and copulation and the frequency of feeding of the young at the nest were recorded for the purposes of this section.

A1:4 Maintenance Behaviour

Chapter 2:3 defines the various forms of maintenance behaviour observed. This section will expand on these observations. In passive anting (2:3:4) the Chough lies down on the ground and spreads its wings out onto the ground to allow the ants access to the wings and underparts. In active anting, the same posture is used but ants are taken in the Chough's bill (2:3:5) and rubbed on the underside of the wings and the underparts of the body in order to extract formic acid from the ants. Active anting lasted about 30 seconds and 2 instances were observed. In one case, the Chough also rubbed ants on its wing feathers while it was standing up before continuing to rub ants on its underparts while lying down. Anting was terminated by a ruffling of the body and wings; and before foraging, the bill was flicked without touching any surface in a form of a shortened bill wipe.

In bill wiping, ^{rocks,} trees, posts and shrubs are used for their abrasive qualities. Wood is probably an ideal compromise between grass and rock as regards scouring qualities. Six cases of bill wiping on living trees and shrubs were observed; 2 each on Juniper trees,

and regenerating stumps of gorse and heather. When wiping their bills on gorse stumps, instead of the normal alternation pattern of wiping each bill between 2 and 4 times (see 3:5), sharp pecks at the side of the stump were used, with the bird facing downwards while perching on top of the stump. This was confirmed as a maintenance behaviour because no evidence of any insects were found nor was swallowing observed during this behaviour. There was a further case of an individual perching on fencing wire while bill wiping on a dead stump of heather.

Fencing poles and telegraph poles were seen to be used in both display and maintenance bill wiping. When a flock arrived in a foraging area flanked by fencing posts, one or more of the birds would quite often land on the posts and bill wipe (occasionally followed by ruffling or preening) before landing on the ground and foraging. Details of this behaviour are summarised in Chapter 3:5.

Wing stretches, where not connected to any form of sexual display (see 2:3), wing ruffles and wing flaps all appear to be behaviours connected with wing condition maintenance. Table A1:1 summarises their frequency of use in relation to group size. There appears to be a significant reduction in the frequency of use of these behaviours in groups of 3 and more ($\chi^2=698.62$ $P<0.001$, $df=1$) indicating a form of social inhibition. This may be to avoid misinterpretation of these behaviours, as discussed in section 3:5. Other functional interpretations are precluded by the fact that as discussed in section 3:4, increased flock size normally allow an increased frequency of foraging and maintenance behaviour. This would agree with the lower frequency of wing-flick behaviours seen in groups of 3 and more as discussed in section 3:5.

Table A1:1

Instances of purely maintenance based wing actions. Frequency per 1000 seconds of observation given in brackets.

Group Size	Wing Stretch	Wing Ruffle	Wing Flap	Total	Time (Seconds)
1	3 (.49)	4 (.67)	4 (.67)	11 (1.83)	6100.5
2	28 (1.08)	31 (1.20)	1 (.04)	60 (2.32)	25807.0
3-10	2 (.13)	0 (0.0)	1 (.06)	3 (0.19)	15709.5
Σ	33 (.69)	35 (.74)	6 (.13)	74 (1.56)	47617.0

A1:5 Flock Sizes and Spacing

Table A1:2 summarises the flock sizes observed in airborne flocks and foraging groups. 'Flocks' and 'groups' in this context also includes solitary birds. A total of 631 foraging groups and 1013 airborne flocks were observed. Foraging groups were larger than airborne flocks in the post breeding period and roughly the same for the rest of the year. Group size was smallest during the Winter and highest in the post-breeding period. These results are illustrated in figure A1:1 using the same size groupings as ^{does} Warnes (1983a).

Space between individual birds was smallest when only 2 birds were seen together. These were presumably in the main, pairs. The presence of juveniles and unrelated individuals increased the individual distance except in flocks of 9 and more where individual distance was smaller. Results are shown in table A1:3 and illustrated in figure A1:2. In level feeding areas, average spacing remained constant between 5 and 6 body lengths. In rocky areas, as shown in table A1:4 spacing was on average larger at 8.73 body lengths. Thus the individual distance is also affected by the nature of the terrain.

Inter-bird distance
in Chough body lengths.

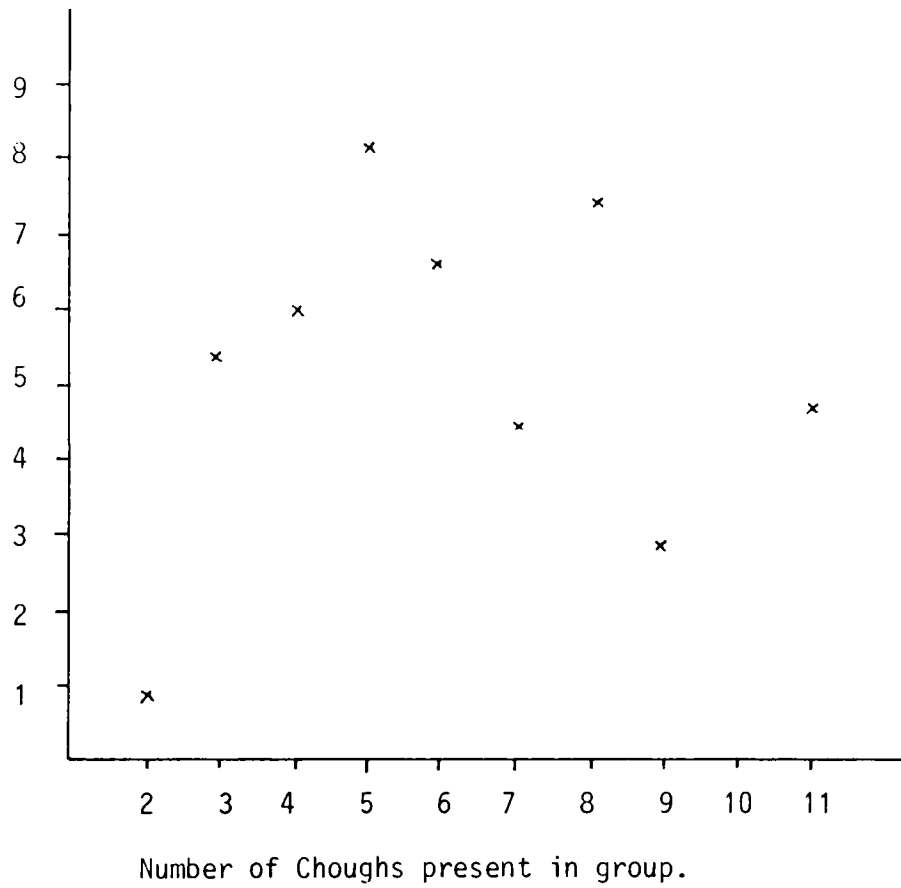


Figure A1.2.

- Relationship between inter-bird distance and the number of Choughs present in a fogaging group.

Table A1:2

Seasonal variation in number of observations of each flock size.

Number of observations per period	Flock Size:-																Average Flock Size;
	1	2	3	4	5	6	7	8	9	10	11	12	15	21	22	25	
(i) Foraging Groups:-																	
11-2	20	33	4	0	2	0	0	0	1	0	0	0	0	0	0	0	1.95 ± 1.24
3-6	122	132	25	30	15	9	1	5	0	0	0	0	0	0	0	0	2.23 ± 1.47
7-9	39	48	28	23	18	41	7	8	3	6	0	6	1	1	1	1	4.33 ± 3.46
(ii) Flocks:-																	
11-2	41	52	5	1	3	0	0	0	0	0	0	0	0	0	0	0	1.75 ± 0.84
3-6	188	250	45	25	13	8	0	5	0	0	0	0	0	0	0	0	2.01 ± 1.19
7-9	94	102	35	35	22	43	15	6	7	6	0	9	1	1	1	1	3.64 ± 3.18

Table A1:3

Group size and spacing (thrift and grass)

Group Size	Spacing	n
2	0.84	70
3	5.33	147
4	5.96	252
5	8.24	123
6	6.53	105
7	4.49	198
8	7.45	105
9	2.89	9
10	-	-
11	4.69	54

Table A1:4

Habitat and spacing

Habitat	Spacing	n
thrift	5.48	182
short grass	5.82	683
long grass	5.16	198
rock	8.73	198
thrift and grass	5.67	1063
Σ	6.12	1261

A1:6 Courtship and Copulation

Courtship and copulatory behaviour were described in Chapter 2. Chapter 3:3:4 examined courtship feeding and the role of wing-flicking and bill wiping were investigated in Chapter 3:5. This section will describe in greater detail the act of copulation by the pair on the basis of field observations.

While the pair are foraging in sight of each other, the female looks at

the male and flattens her body. Her wings are spread out and held still, after this she flickers her tail slightly up and down. The male stops foraging and looks at the female. The female aligns herself so that she faces the male, the male turns towards the female. The female continues to hold wings out and flicker tail as the male moves towards and behind her. The male then stands fully upright and mounts the female, flickering his wings for balance; /at the end of copulation he steps back assuming the standard foraging posture. The female returns to the foraging posture, looks and both resume foraging. From the female flattening her body to the resumption of foraging, copulation took 15-20 seconds.

A1:7 **Breeding**

Davis (1981, Person. Comm.) observed a Bardsey ringed male in the Loctyn area for the first time in the Summer of 1981. Roderick (1982, pers. comm.) observed it in a party of 4+ birds in February 1982. During the breeding season of 1982, the bird was not associated with any of the 3 pairs but appears to have acted as a nest site feeding helper with the B pair in 1983, and was seen with the post-breeding family party on a number of occasions. In 1984 it was mated to the female of the B pair, her previous mate having presumably died. Up to the cessation of field observations, in April 1984 the pair were involved in nest building and similar breeding activities. The Bardsey bird was at this time limping, which is (Bullock et al 1983a) regarded as a symptom of Pseudo-tuberculosis. Thus, the outcome for the breeding season must have been uncertain. In a time span of some 3 seasons, the bird had moved from being an incomer, to nest helper to a paired bird.

At the breeding Site L, visits to the nest by the adults were observed in May 1982 and April 1983. The mean duration between visits were 10.93 ± 8.15 minutes in April and 20.5 ± 13.08 minutes in May, 29% of all visits

(n=17) were by both adults at the same time.

Numbers of fledged young from the nest sites A, L and B (see figure 4:1:5) in 1982 and 1983 were as shown below:

Site	Fledged Juveniles	
	1982	1983
A	2	1
B	3	2
L	?	3

For the 5 known cases, there was an average of 2.2 ± 0.84 fledged young per breeding attempt.

A1:8 Discussion

Goodwin (1953) in a review of corvid anting behaviour made no mention of Choughs. Holyoak (1972) noted a form of passive anting but there are no other records of active anting. Bullock (1980) observed one possible instance of dust bathing.

Witherby et al. (1940) stated that Choughs do not perch on trees or posts. However, Bannerman (1953) and Holyoak (1972) note perching on trees and branches. Apart from the instances of using trees and posts for maintenance and display, 2 cases of 1 and 3 Choughs perching in a Juniper tree were seen. In addition, there was one case of Choughs staying in the shade of a Juniper tree on a hot day, possibly in order to remain cool. It would appear that apart from maintenance and display, trees and posts are only exceptionally used and are not used at all for example in vigilance behaviour. Roberts (1982b) observed a Chough lying on its back for a long time in the sun. This may be a form of sun bathing or dust bathing as noted by Bullock (1980) above. Holyoak (1972) regularly observed Choughs sun bathing by crouching with partly spread wings and raised body plumage.

Bullock (1980) observed a Calluna clump being used for bill wiping, and rocks were also often used. He found that bill wiping most commonly occurred during deep probing into damp soil and peat. Bill wiping was

frequently observed by Holyoak (1972).

Bullock (1980) observed wing stretching every 3-7 minutes during lengthy foraging bouts. This is more frequent than the combined totals for wing stretching, ruffling and flapping observed, even in pairs, at an average frequency of 1 per 7.3 minutes (n=60). He notes that wing-flicking is infrequently used during foraging sessions.

Holyoak (1972) states that preening often follows baths. The form that these baths take is not described. Bullock (1980) found that preening often occurred at the roost, sometimes lasting 3-4 minutes. ^{of the head and neck} Allopreening has been widely observed (see Warnes 1983a for example) but only Holyoak (1972) has observed allopreening of the breast and the flank.

The seasonal trends in flock sizes were similar to those observed by Warnes (1983a) but pairs were less frequent than on Islay except during Winter where in both studies about half of all flock observations consisted of pairs. The larger number of observations of 10 or more birds in a flock especially in Spring and Winter in Islay reflects the larger number of birds present in the Loctyn area.

Warnes (1983a) observed one instance of copulation. This appears to have been more elaborate than the Loctyn observations. Prior to the female spreading her wings, the male spread his. After copulation, both birds wing-flicked before resuming foraging.

Warnes (1983a) found 1 probable and 5 possible nest helpers in a total of 23 pairs in Islay in 1981. This, coupled with the Loctyn case and 1 possible case in Anglesey (Bullock 1980), is strong evidence that Choughs commonly use nest helpers in breeding. Nest helpers are more widespread than was previously thought; Davies (1980) notes helping in over 150 species. The Loctyn bird is almost certainly unrelated to the rest of the Loctyn population since none of the others were observed with colour rings and all fledged birds on Bardsey have been colour ringed since 1973 (Bardsey

Bird Rep. 1973). Reyer (1984) found that in Pied Kingfishers, unrelated
 helpers are only tolerated where feeding conditions are poor. / According to Emlen (1982) helpers are
 characteristic of long-lived birds whose breeding densities are relatively
 saturated . Whether these two observations apply
 to the Loctyn population is uncertain although the breeding density (3 pairs
 in 2Km of coast) is higher than for many areas.

Warnes (1983a) in Islay, observed a feeding interval of 17.24 ± 12.04
 minutes ($n=51$) and out of 55 visits, 38% were by both parents. No
 significant feeding interval time change was found between the 22nd and the
 29th of May. Williamson (1959) on the Isle of Man observed an average
 feeding interval time of 21.17 ± 19.93 minutes ($n = 18$). On the 2 successful
 sites in South Stack, Bullock (1980) observed a mean interval time of 27.82
 ± 7.58 minutes ($n=17$) while an unsuccessful site had an interval time of
 39.47 ± 14.97 minutes ($n = 15$). Although the small sample sizes mean that the
 difference cannot be quantitatively examined, they are evidence of a larger
 feeding interval leading to lower breeding success. In contrast to this
 study and Warnes (1983a), Cowdy (1962) and Whittaker (1947) found that the
 pair always came to the nest together.

Fledgling success was close to that obtained in the 1982 national
 survey, where Bullock et al. (1983a) found an average figure of 2.38 ± 1.40
 ($n=410$) fledged young per nest, but the Welsh coastal figures were higher at
 2.68 ± 1.35 ($n=160$). In Chapter 6:3:2, figures for Bardsey 1953-1970,
 1973-1983 and Cornwall 1930-1947 of 2.46 ($n=94$) and 2.56 ($n=38$) were
 obtained. The small sample size for Loctyn precludes detailed comparisons
 beyond stating that there is marginal evidence for the Loctyn area being
 less productive than some other coastal areas.

APPENDIX 2

ANTAGONISTIC AND INTERACTIVE BEHAVIOUR

A2:1 Introduction

This section covers all observations of antagonistic behaviour where Choughs were involved coupled with any interactions between Choughs and other bird species. Chough-Jackdaw interactions relating to vigilance are covered in 3:4:4 and 3:4:7.

Bullock (1980) observed interactions between Choughs and Jackdaws, Ravens, Peregrines, Kestrels and Carrion Crows. Holyoak (1972) discusses a number of postures used in antagonistic interspecific interactions, without reference to the species or circumstances involved. Williamson (1959) describes a number of conflict behaviours used by adult and juvenile Choughs after the breeding season, as does Bullock (1980). Warnes (1983a) and the above authors mention a number of Chough submissive and appeasement postures.

Holyoak (1972) is correct in stating that the Chough is not 'an aggressive bird by comparison with (the) Carrion Crow, Rook and Jackdaw'. This applies to both inter and intraspecific antagonistic behaviour and partly accounts for the paucity of information on their antagonistic behaviour.

A2:2 Aims

This section aims to classify and describe all intra and interspecific antagonistic interactions involving the Chough and all of their interspecific interactions. From this, it further aims to obtain an insight into how each species' observed reacts to the presence of the Chough and vice versa and the motivation behind these responses.

A2:3 **Methods**

When the Chough was in the presence of another species, the response (if any) to each other was recorded along with the habitat (including in the air) and the circumstances of their interaction such as distance apart and season.

For intraspecific antagonistic interactions, the age of the individuals were recorded along with the outcome and whether one individual was foraging or not. Postures used by the instigator and those used in response to them were recorded.

A2:4 **Intraspecific Antagonism**

In 1982, a total of 68 airborne swoops where one Chough dived at or chased another were observed. Twenty-six were seen from March to April (20 observation days), 11 in July (20 observation days) and 38 in September (18 observation days). None were observed in 1982 outside these months (26 observation days). The September incidents appeared to consist of play behaviour where one individual chased another from the ground or in the air for no apparent reason and both returned to forage when neither would initiate a fresh sequences of chases. In the air, the instigator won 30 out of 32 observed chases, victory being obtained when the loser flew away to avoid further swoops. Bouts fought on the ground were fought either by the instigator walking to the other individual and flapping its wings (n=8) or by pushing the other bird (n=6). Of these 14 bouts, 11 were won by the initiator, a lower proportion (0.79) than in the air (0.94). In one case of an airborne chase, the protagonist landed on a fence post and bill-wiped (3 swoops) before returning to the chase.

When a juvenile or unpaired adult was undertaking an extended foraging session at a feeding site, paired adults would on occasion displace them and forage there (n=30). Five methods of displacement were observed and are

listed in table A2:1.

Table A2:1 Displacement Techniques and Outcomes

Method	Outcome	
	Displacement	No Displacement
Fly at forager	9	3
Walk to forager	12	0
Walk, wing-flick	3	0
Wing-flick fight (qv 3:5:6)	1	0
Push forager away	2	0

The results show that all attacks succeeded excepting 3 flights. In flight attacks, the forager normally flew away, but in these 3, the forager stood upright, facing the incomer and forcing it to move on. In 21 of these attacks the incomer was confirmed as a paired adult (from coloured rings and wing feather patterns) and ⁱⁿ the other 9 cases they were probably paired adults. The success of the attackers probably reflects their social dominance. It is probable that the 3 unsuccessful attacks involved two paired adults.

Excessive begging by juveniles (see 3:3:5) resulted in a response from the adult on 14 occasions. Twice the adult retreated, once the adult pecked at the juvenile while holding its wings open and on 11 occasions the adult faced the juvenile and assumed the full forward posture while flapping its wings at the juvenile. The peck attack and 10 out of the 11 flapping attacks resulted in the juvenile leaving. Thirty-one cases of a juvenile trying to oust a begging juvenile were seen. Three of these were successful in displacing the 'paired' juvenile with the intruder subsequently begging as a consequence. The successful exclusions of the intruder were a result of the adult attacking the intruder or the begging 'pair' leaving the immediate area. Table A2:2 summarises the results of various intruder exclusion strategies.

Table A2:2 Juvenile Intruder Exclusion Strategies

Strategy	Outcome	
	Removal	No Removal
wing flick at intruder once	9	3
wing flick at intruder twice	5	0
wing flick at intruder 3-4 times	3	0
wing flick, full forward posture	8	0
push intruder away	3	0
pair leave area	3	0

The three unsuccessful attacks were repeated using 2 or more wing flicks and were all successful. The juvenile intruder attacked the 'pair' by using wing flicking (n=3), full forward with wings open (n=1) or full forward, facing the 'pair' (n=27).

Juveniles were seen to fight amongst themselves twice, each time 'fencing' with their bills. In one of these cases, the protagonist caused two other juveniles to roll over on the ground while the protagonist flapped its wings. In each case, adults were observed to intervene to stop the fighting.

There was one case of an unpaired male wing flicking at a paired female (female B), the paired male immediately chased the unpaired male away.

A2:5 Interspecific Antagonism and Interactions

(a) Ravens

Chapter 3:4 discussed the role of vigilance and Chough reactions to the presence of airborne Ravens. Both Chough and Raven would chase each other in the air. In the breeding season, Choughs would chase Ravens in the breeding area, and on the ground. Table A2:3 summarises the reactions of Choughs to the presence of Ravens on the ground at a distance of 0-50m.

Table A2:3

Ravens on the Ground; Chough Responses

	Ignore	Vigilance	Scramble (page 78)
Raven on ground	7	0	2
Raven lands	0	0	3
Raven takes off	0	1	3

Thus there was a lower probability of the Chough leaving when there was a Raven on the ground as opposed to being in the air. There was also a higher probability of Chough flight when Ravens were taking-off or landing than when they were the same distance away in the air (χ^2 11.72, $P < .001$, $df=1$). With the exception of one case where the Raven was near the breeding site during the breeding season, Choughs and Ravens did not fight when both were present on the ground. During the breeding season 13 chases, all by Ravens after Choughs were observed outside the breeding area. Inside the breeding area, all five chases involved Choughs going after Ravens.

(b) Peregrines

Vigilance by Choughs while foraging was discussed in 3:4:6. Two incidents of Peregrines attacking airborne Choughs were noted; four Choughs were observed swooping^{on}/each other near the Peregrine eyrie (location withheld), when a Peregrine swooped^{on}/one, missing it by 5 metres. The Choughs rapidly left. A Peregrine once followed a flock of 10 Choughs which bunched tightly together in the air until the Peregrine ceased to fly around them. When the Peregrine flew on, the flock immediately dispersed.

(c) Carrion Crows

Chough response to the airborne presence of Crows was related to area and season. From April to May, the L pair would fly to the nest site if a Crow was seen over the Peninsula ($n=10$) and 3 out of 5 times in the more distant Pendinas Loctyn area. In the Loctyn farm areas, Crows were ignored ($n=7$). Overall, the post breeding flock flew in 12 out of 19 cases where Crows flew overhead. During the breeding season, area affected Chough response (χ^2 8.8, $P < .01$, $df=1$) but not outside the^{season} . The overall

probability of flight was similar (0.63 and 0.59 respectively).

Forty-one Crow swoops on foraging Choughs were observed. Three were ignored, nine resulted in a subflight and after the twenty-nine other cases, the Choughs flew away. Thirty-eight such swoops were observed on foraging Jackdaws; after five they flew ^{a short distance} and in all other cases, they left, thus being more likely to leave than the Chough (χ^2 4.78, $P < .05$, $df=1$).

In three out of eight cases where Crows were seen to take-off near foraging Choughs, the Choughs flew away.

Solitary Crows were observed to fight with Choughs when foraging. The fights involved the protagonists pecking at each other until one retreated. Table A2:4 summarises fight outcomes in relation to Chough numbers involved.

Table A2:4 Chough Numbers and Chough-Crow Fight Outcomes

n. Choughs	Chough(s) win	Crow wins	P. Chough wins
1	0	3	.0)
2	0	6	.0) .0, n=9
3	2	5	.28 n=7
4	2	0	1.0)
5	4	2	.67) .75, n=8
Σ	8	16	.33 n=24

Thus the larger the number of Choughs involved, the greater were their probabilities of forcing the Crow away.

(d) Jackdaws

One hundred and twenty Chough-Jackdaws interactions were observed. One hundred and nineteen of these were non-antagonistic and are summarised in table A2:5.

Table A2:5 Chough-Jackdaw Interactions

Jackdaw lands by foraging Chough	34
Jackdaw lands, Chough subflights	2
Jackdaw lands, Chough leaves	4
Chough lands by foraging Jackdaw	19

Jackdaw leaves, Chough follows	21
Jackdaw leaves, Choughs remain	6
Jackdaw leaves, Chough Wf.c once	1
Jackdaw scramble (tourists) Chough follow	12
Jackdaw scramble (tourists) Chough remain	5
Jackdaw scramble (Raven) Chough follow	1
Chough leaves, Jackdaw follows	6
Chough leaves, Jackdaw remains	1
Chough subflight, Jackdaw follow	7

These interactions are based on interspecific vigilance and joining food foraging areas.

Five cases of Choughs chasing Jackdaws were seen and one of a Jackdaw flying away from the presence of a Chough after a Crow attack. There was one case of a Chough intervening in a Jackdaw flight; the Chough walked up to the fighting birds which then stopped and restarted only to finally stop when swooped at by a Magpie.

(e) Oystercatchers

Two cases of Choughs flying at Oystercatchers to displace them from feeding sites were seen, both successful. Where foraging in the same vicinity Oystercatchers remained when Choughs left due to tourist disturbance, in 13 out of 14 cases.

(f) Herring Gulls

Two cases of Choughs swooping^{on} Herring Gulls were seen. Once the gull took evasive action. A Chough also swooped^{on} a Herring Gull in the air, forcing the bird to leave. These incidents were near site L during the breeding season.

Ten Herring Gull attacks were seen. Twice Choughs were displaced from foraging patches by gulls walking towards them in a forward posture. Three cases of landing displacement and 2 out of 3 swoops by gulls on foraging Choughs also caused them to leave. The other resulted in the Chough bill wiping in vigilance. Two airborne swoops on Choughs were observed.

(g) Buzzards

Twice in the breeding season the B pair mobbed Buzzards until they left

the breeding area. Post-breeding flocks twice mobbed a Buzzard, once forcing it to leave the area.

Two cases of Buzzards flying 60-80m distant caused Choughs to fly away, but in another eleven cases there was no response. Once, a Buzzard swooped a pair who flew away.

(h) Fulmar

Six swoops of 1 to 2.5m distance by Fulmars on Choughs brought no response. A swoop up to 0.5m away made the Chough wing-flick call once.

(i) Kestrel

Kestrel swoops on foraging Choughs caused them to fly away (n=5). Kestrels on the ground brought no response from foraging Choughs, nor did their take-off from 5-15m away (n=3).

A2:6 Discussion

Attacks by Choughs on other feeding Choughs have also been observed by Holyoak (1972) and Bullock (1980). Holyoak (1972) noted a retaliation by the feeding bird (face the intruder with its mouth wide open) which drove the intruder away. When the ground is frozen hard, there is an increased frequency of feeding site fighting (Bullock 1980). Williamson (1959) observed one form of post-breeding play fighting develop into a protracted fight. 'Jousting' in Summer and post-breeding play fights were seen by Bullock (1980). Interactions between Choughs and Ravens and Peregrines are also discussed in Chapters 3:3 and 6:6. Bullock (1980) observed Chough flight in the presence of Peregrines but he also observed 2 cases of Choughs attacking an individual Peregrine as outlined in Chapter 3:3. Choughs on South Stack were even more sensitive to the presence of Ravens than on Loctyn and would fly when the Raven was 200m distant while no Chough attacks on Ravens were recorded. Holyoak (1972) found that in captivity, Choughs would attempt to attack Magpies. Bullock (1980) saw Choughs spar in the air

with a Sparrowhawk, Kestrels and Magpies. They would chase Mistle Thrushes, Oystercatchers, Feral and Wood Pigeons. The presence of feeding Jackdaws, Herring Gulls and Starlings were tolerated Warnes (1983a) also notes Choughs tolerating feeding Starlings. In Winter, Bullock (1980) observed gulls swooping at Choughs when they were on certain cliffs.

The fact that Choughs were widely observed to tolerate Jackdaws and Starlings on their feeding sites indicates that they do not regard them as significant competitors. Attacks on Oystercatchers may be for this reason. Although as noted in the introduction, Choughs are not particularly belligerent birds, these observations indicate that they are able to hold their own in the presence of other corvids and certain raptors especially with regards to defending the nest site and their young.

APPENDIX 3

LIST OF BIRD SPECIES MENTIONED IN TEXT
(LATIN NAMES FROM HOWARD AND MOORE 1980)

Ostrich; *Struthio camelus*
 Fulmar; *Fulmarus glacialis*
 Brent Goose; *Branta bernicla*
 Barnacle Goose; *Branta leucopsis*
 White-fronted Goose; *Anser albifrons*
 Eider; *Somateria mollissima*
 Red Kite; *Milvus milvus*
 Black Kite; *Milvus migrans*
 Marsh Harrier; *Circus aeruginosus*
 Hen Harrier; *Circus cyaneus*
 Montagu's Harrier; *Circus pygargus*
 Goshawk; *Accipiter gentilis*
 Sparrowhawk; *Accipiter nisus*
 Buzzard; *Buteo buteo*
 Golden Eagle; *Aquila chrysaetos*
 Kestrel; *Falco tinnunculus*
 Merlin; *Falco columbarius*
 Peregrine; *Falco peregrinus*
 Oystercatcher; *Hematopus ostralegus*
 Redshank; *Tringa totanus*
 Turnstone; *Arenaria interpres*
 Purple Sandpiper; *Calidris maritima*
 Lapwing; *Vanellus vanellus*
 Lesser Black-backed Gull; *Larus fuscus*
 Herring Gull; *Larus argentatus*
 Black-headed Gull; *Larus ridibundus*
 Red-billed Gull; *Larus novahollandiae*
 Kittiwake; *Rissa tridactyla*
 Sandwich Tern; *Thalasseus sandvicensis*
 Wood Pigeon; *Columba livia*
 Feral Pigeon; *Columba palumbus*
 Barred Ground-dove; *Columba passerina*
 Eastern Phoebe; *Sayornis phoebe*
 Vermilion Flycatcher; *Pyrocephalus rubinus*
 Stonechat; *Saxicola torquata*
 Blackbird; *Turdus merula*
 Redwing; *Turdus iliacus*
 Mistle Thrush; *Turdus viscivorus*
 Chiffchaff; *Phylloscopus collybitus*
 Willow Warbler; *Phylloscopus trochilus*
 Spotted Flycatcher; *Muscicapa striata*
 Great Tit; *Parus major*
 Blue Tit; *Parus caeruleus*
 Yellow-eyed Junco; *Junco hyemalis*
 Green-backed Sparrow; *Arremonops chloronotus*
 Chaffinch; *Fringilla coelebs*
 Zebra Finch; *Poephila guttata*
 Bullfinch; *Pyrrhula pyrrhula*
 House Sparrow; *Passer domesticus*
 Quelea; *Quelea quelea*
 Starling; *Sturnus vulgaris*
 Jay; *Garrulus glandarius*

Siberian Jay; *Perisoreus infaustus*
Azure-winged Magpie; *Cyanopica cyanus*
Magpie; *Pica pica*
Nutcracker; *Nucifraga caryocatactes*
Chough; *Pyrrhocorax pyrrhocorax*
Alpine Chough; *Pyrrhocorax graculus*
Jackdaw; *Corvus monedula*
Carion/Hooded Crow; *Corvus corone*
Rook; *Corvus frugilegus*
Raven; *Corvus cornix*

APPENDIX 4

PRINTED SOURCE MATERIAL ON CHOUGH BIOLOGY

This appendix contains all known printed references on Chough ecology that may be of use to other researchers. A number of them have not been cited in this study, especially the Ibis indexes which refer to a wide range of accounts of their distribution. In order to show what each reference contains, a number of symbols have been included;

- D Distribution
- DB Distribution in Great Britain and Ireland
- F Feeding
- B Behaviour
- R Breeding, reproductive behaviour

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