

## Identifying opportunities for expert-mediated triangulation in monitoring wildlife trade on social media

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Triangulating information from multiple sources is critical to effective and accurate monitoring of wildlife trade on social media.

## ABSTRACT

Wildlife trade has rapidly expanded on social media platforms in recent years, offering an easy means for traders to access international markets. Investigating this trade activity poses a complex challenge to researchers seeking to understand online trade and moderators seeking to disrupt illicit and harmful activity. Current survey methods frequently rely on text-based searches and focus on posts where the advertisement is explicit. However, such approaches risk overlooking a growing volume of relevant content, particularly outside of social media groups. Here, we used posts created by pages advertising West African birds as a case study to explore the availability of information for making inferences about trade activity on social media; specifically, information indicating that trade activity was occurring or that could be used to infer trade routes. We recorded 400 posts from 12 pages that we inferred either promoted or facilitated wildlife trade, of which only 19.7% were explicit advertisements and only 23.8% contained taxa-related terms. In the remaining 341 posts, profile information was the most common indicator of trade activity, but a variety of indicators were identified across imagery, text and comments. We identified multiple types of geographical information that could help infer trade routes and thus the likely legality of trade, although most were relatively rare and sometimes contradictory. Our findings suggest that triangulating multiple types of information from within, across and beyond posts is vital for effectively identifying and interpreting wildlife trade content on social media. We therefore recommend that expert-mediated triangulation should be integrated within the development and use of automated detection systems and the moderation practices of social media companies.

## INTRODUCTION

Unsustainable and illegal wildlife trade presents a pressing threat to global biodiversity, contributing to the overexploitation of wild populations (Tingley et al. 2017), the spread of invasive species (Reino et al. 2017), and disease transmission (Swift et al. 2007). In the last decade, trade activity has expanded dramatically in online spaces, with social media platforms emerging as one of the most concerning spaces in recent years (Yu & Jia 2015). The popularity and flexibility of these platforms make it easy for traders to advertise and communicate directly with potential buyers worldwide (Lavorgna 2014). Alongside trends of growing affluence (Ding et al. 2008) and exposure to enticing imagery of exotic species (Nekaris et al. 2013), social media could greatly exacerbate the risks posed by wildlife trade.

As threats increase, the importance of understanding and monitoring online wildlife trade has been recognised as key conservation priority, including by CITES (Convention on International Trade in Endangered Species of Wild Flora and Fauna), which has adopted several decision encouraging Parties to monitor wildlife crime linked to the internet (e.g., Decision 18.83). Social media provides new opportunities for monitoring trade activity online. Online surveys can address both legal and illegal trade, including in species that are not currently listed by CITES for which monitoring is less common (Andersson et al. 2021). Recent social media studies have investigated the volume, composition and dynamics of trade in a range of taxa including orchids (Hinsley et al. 2016), ivory (Xu et al. 2020) and birds (Sánchez-Mercado et al. 2019). Many studies have focused on surveying adverts within buy-and-sell groups (e.g., Hinsley et al. 2016; Siriwat et al. 2019), as data collection is made convenient by concentrated activity and a clear trade context. However, considerable trade activity also takes place outside of these virtual marketplaces as publicly-visible content shared with an individual's or business's followers (e.g., Martin et al. 2018; Xu et al. 2020). This 'unconsolidated content' (sensu Stringham et al. 2020) may be particularly important at certain stages in the trade chain, such as confirming the arrival of wholesale shipments (e.g. Martin et al. 2018).

Unconsolidated content presents additional challenges. As posts are not conveniently grouped, a text-search approach using key terms is both common (Morgan & Chng 2018; Xu et al. 2020) and recommended (Stringham et al. 2020). However, this risks omitting posts that do not contain species-related terms, use emojis or do not contain text, which are becoming increasingly common (Xin & Xiao 2019). Furthermore, some studies have limited data collection to posts with a definite intent to sell (Morgan & Chng 2018), as it can be difficult to distinguish trade posts from other similar content posted by breeders or owners. Valuable insights can be gained from examining non-advert posts, as has been done to investigate the dynamics and direction of wholesale shipments in African grey parrots (*Psittacus erithacus*) (Martin et al. 2018). Therefore, current approaches may only be accessing a subset of relevant content.

As the literature surrounding social media and conservation grows, a stronger understanding of different elements of social media data and their uses is being developed. Relevant information may be distributed across multiple elements, including post imagery, profile information and comments (Toivonen et al, 2019). Therefore, understanding what information is available across these elements and their use in making inferences about trade is vital for effectively monitoring and potentially disrupting wildlife trade on social media.

Here, we demonstrate the importance of triangulating information from multiple elements of social media data. Using trade in West African birds as a case study, we conducted an exploratory content analysis of posts created by traders in an unconsolidated context on an internationally popular social media platform with over 2 billion users worldwide, collected through an intelligence-based survey. Our objectives were to explore the availability of information across different elements of social media posts that could be used to make inferences about trade and to evaluate the implications for current research methods. Particularly, we focused on two key inferences that researchers and practitioners may wish to make: is trade activity occurring? And where is it occurring? To address the first point, we looked for indicators that a post promoted or facilitated trade in the study taxa. To

address the second, we looked for geographical information that could help identify trade routes.

## **METHOD**

Between April - June 2020, we manually surveyed posts from 12 public social media pages made between 1<sup>st</sup> June 2016 – 1<sup>st</sup> June 2020 that were identified as trading in West-African birds based on intelligence gathered by the World Parrot Trust. These included ten personal profiles, one business page and one community page. Nine represented exporters in West African countries (Guinea, Senegal and Mali), two represented importers in Asia (Jordan and Pakistan) and one whose location was unknown but suspected to be in West Africa. Pages predominantly showed species not banned by CITES or domestic legislation, suggesting that trade was largely legal, although some posts featured species listed on Appendix I, which could suggest illegal activity in some cases (Appendix S1).

We collected data from any posts that featured or referenced West-African birds or their trade. We assumed that these posts served to promote or facilitate trade and therefore involved trade activity. We included any posts on the page's timeline, including shared posts, profile and cover photo updates, and posts featuring generic images copied from another source, as all could solicit interest from buyers.

We recorded all text in the post, downloaded images, and extracted comments using a comment-exporting service (<https://exportcomments.com/>). We translated text, if necessary, using Google translate (<https://translate.google.com/>). We checked photos with Google reverse image search to identify those copied from another online source. Further details of sample selection, data collection and ethical practice are detailed in Appendix S1.

Data analysis involved a two-step process. First, we identified explicit advertisements, namely posts that contained text indicating an intent to sell birds shown in imagery. Specifically, we identified posts containing the following terms (English or French): 'for sale'; 'available/possible/in stock'; 'buyer'; or posts that mentioned price. We also examined post text for the presence of taxa-related terms for West-African birds, including common or scientific species names and broader taxonomic terms (e.g.,

parrot, turaco). We permitted common name variations and spelling errors but excluded terms that did not clearly identify the animal, including references to birds generally or reference to colour alone, which were noted separately. Text within imagery was not included. This step explored the implications of monitoring approaches that rely on text to detect and identify social media advertisements (e.g. Morgan & Chng 2018; Xu et al. 2020).

For the subset of posts that were not categorised as explicit advertisement, we examined five elements of social media data described by Toivonen et al. (2019): post imagery, post text, profile information, geographic metadata, and comments. Post imagery included all photos and videos. Post text included text in the post body and within imagery. Profile information included the page's name, any profile and cover photos used during the monitoring period, any page description, and the country of birth and current residence where stated. Geographic metadata included geotags, which provided self-reported information on where the post was made. Comments included any publicly visible comments made on the post. As we collected data retrospectively, posts and profiles may have been changed since the posts were created. For each post, we systematically examined data from each element, identified and coded information relevant for making trade inferences, and then recorded if they were present or absent across posts. Profile information was recorded as present for all posts belonging to that page. Some codes were established based on previous literature, including the presence of shipping containers and cargo tracking codes (Martin et al. 2018) or the use of generic trade terms without taxa-related terms (Xu et al. 2020), before we developed further codes through an iterative, inductive process.

First, we identified indicators that could be used to infer that a post promoted or facilitated trade in the study taxa. Geographic metadata did not contain information related specifically to identifying the presence of birds or trade activity and so was excluded from this stage of analysis. A challenge with identifying wildlife trade activity is accurately distinguishing it from unrelated posts containing

similar content such as a photo of pet bird. Therefore, we categorised indicators as one of the following:

- (a) Bird-trade, where trade in birds is clear without requiring context from other indicators;
- (b) Trade, where additional context is needed to infer that it involved birds;
- (c) Birds (specifically study taxa), where additional context is needed to infer trade activity.

For detailed descriptions of indicators that were considered in each category, see Table 1. Each post could contain more than one type of indicator from each element.

We then identified what types of geographical information were present that could be used to determine trade routes. We examined all social media elements, including geographic metadata, for geographic information pertaining to the location of the trader, holding facilities and potential buyers, as well as the routes and destinations of shipments.

Descriptive statistics were summarised by the mean  $\pm$  sd., except for posts per page, which was summarised by the median and interquartile range due to high positive skew in the sample.

## **RESULTS**

We surveyed 400 posts, where the median posts per page was 29.5 (IQR = 9.5-42.8). The sample included 128 shared posts, 46 profile and cover updates, 20 live videos, two posts sharing a bird-market event and one listing in the platform marketplace. Imagery was present in 98.5% of posts ( $n = 394$ ) and post text occurred in 56.3% of posts ( $n = 225$ ), of which 11 only contained emojis; six further posts contained text within imagery. The majority of text was at least partly in English ( $n=152$ ), followed by French ( $n=45$ ) and Arabic ( $n=2$ ). Six pages had a written description on the page dashboard. A total of 1866 comments were collected from 208 posts. An additional 130 comments were not publicly visible.



We identified 79 posts with an explicit intent to sell. The majority of these posts contained taxa-related terms (69.6%, n=55), compared with just under a quarter across all 400 posts (23.8%, n=95). One post made a general request for a buyer but did not name nor show any birds and so was not identified as an explicit advertisement. Birds were referenced generally in 28 posts and in eight posts, African grey parrots were referenced with non-taxonomic terms non-taxonomic terms such as 'greys', 'red', or referenced by eye colour (e.g., 'black eyes').

### **Presence of trade activity**

Fifteen indicators were identified across the remaining 321 non-advertisement posts (Table 1) with an average of  $3.9 \pm 1.1$  indicators per post. Bird-trade indicators were present in 299 posts ( $2.3 \pm 1$  per post), trade indicators were present in 144 posts ( $0.6 \pm 0.77$  per post) and bird indicators were present in 223 posts ( $1 \pm 0.94$  per post). Pages had an average of  $7.9 \pm 1.8$  types of indicator across all the posts. There was considerable overlap in the presence of indicators, with indicators from profile and imagery being co-present in the majority of posts (n = 312) (Fig. 1).

Profile information was the most common source of indicators as all pages contained at least one profile indicator (Fig. 1). It was also the most widespread source of bird-trade indicators, with nine pages expressly stating their involvement in bird trade or showing it in their profile or cover image.

Imagery was the second most frequent source, with indicators present in 312 posts across all pages.

While imagery showing birds in a trade setting occurred in 200 posts from all pages, the use of generic bird photos was not uncommon (Table 1). However, 67% of these posts were created by a single page, whose marketing strategy was to regularly re-share a small number of posts showing birds in holding and generic photos of West-African species. In two posts, African grey parrots were shown speaking in a domestic setting and were not categorised as clearly indicating trade in birds.

Posts without imagery included two requests for transit agent recommendations, one text-only request for a buyer, one link to another page and two links to a bird market event.

Indicators were more common in post text than in comment, occurring in 36% of non-sale posts (n = 116) across 10 pages compared to 25% of posts (n = 81) across 11 pages. However, post text very rarely made it clear that a post involved trade in birds (Table 1). Comments had to be interpreted within the context of the wider post and therefore, no comments were judged to contain bird-trade indicators. However, some comments might be more valuable in making inferences about trade than others. For example, responses from the trader indicate trade activity more strongly than trade enquiries alone.

### **Geographical Information**

Eight types of geographical information were identified across the five elements of social media data, collectively appearing in 180 posts (56%) from 11 pages (Table 2). However, this fell to 23.4% if profile information, which was available for the majority of posts (n = 75), was discarded. Of these 180 posts, 86.1% contained two or more pieces of geographical information (n = 155). Pages contained an average of  $3.3 \pm 2.2$  types of geographic information across all posts from that page. However, geographic information from the same page was sometimes contradictory. For example, one profile stated that the user was based in Côte d'Ivoire but geotags, cargo tracking codes and comments indicated that they exported from Mali.

## **DISCUSSION**

Social media poses a growing challenge to the effective management of wildlife trade but existing methods for monitoring trade increasingly risk capturing only a subset of activity. Our study found that in an unconsolidated context, the majority of trade-related content neither explicitly referenced trade nor used taxa-related terms. This has important implications for the ability of text-dependent methods to effectively detect trade activity on social media. By systematically examining different elements of social media data, we found a diverse range of information that was relevant for making inferences about trade. This demonstrates how traders can flexibly use social media and provides

information regarding the availability of information for making inferences.

Although keyword detection is a common approach for identifying trade, we found that relatively few posts contained taxa-related terms or explicitly referenced trade, consistent with trends seen in other surveys (Xin & Xiao 2019). We permitted spelling errors and common names that may not be included in a search reference list, especially as common names may vary between languages and regions, so the number of posts detected in reality may be even fewer. Explicit advertisements may be less necessary with established follower bases and when questions can be asked directly to the trader. Therefore, posts facilitating illegal activity or violating platform rules could go undetected in predominantly text-based approaches and this is being exploited to avoid detection (Paul et al, 2020). Furthermore, common use generic photos could make it difficult to distinguish posts from similar non-trade content. Fortunately, the majority of posts contained multiple indicators from different elements. For example, comment enquiries about trade occurred in a quarter of posts with no indicator of trade in post text, signalling a potential trade function. Therefore, these issues could be addressed by triangulating information from multiple post elements.

Insights could also be integrated across posts to improve interpretation. Profile information was the most common indicator in our study because it contextualised for all the posts on a page. Evasive marketing strategies that use profile and cover pictures have been identified in other investigations of wildlife trade on social media (Paul et al, 2020). The ubiquity in our sample could be due to sampling bias, as pages with clear indicators would have been easily identifiable during intelligence gathering. However, context can also be provided by other post elements. For example, one trader regularly posted live videos showing their holding facilities. Although only a few explicitly advertised, these provide an advertisement context for other similar posts. Several recent studies have used posts to identify additional relevant posts and pages, such as by expanding the search to other recent posts by the same user (Xu et al 2020) or identifying pages that had interacted with posts already recorded (Martin et al 2018). Triangulating information across posts is particularly important when making

inferences about location. While the trader's location was commonly stated in the profile, this information is self-reported and, in one case, was contradictory to other, less common types of geographic information. This highlights the risks of relying on one source of data that could be outdated, misleading or interpreted out of context.

Automated detection systems are now being developed and used to target online wildlife crime (Di Minin et al. 2019; Lavorgna *et al*, 2020) and are increasingly important for gathering and cleaning vast volumes of data. Our findings highlight the need for such systems to be capable of flexibly analysing and integrating information from different elements within and across posts in order to identify increasingly abundant but less obvious wildlife trade content. Furthermore, in order to determine legality, information including species identity, geographic location, date, evidence of specimen source and relevant local, national and international legislation may need to be integrated and considered (e.g., Martin et al, 2018). This complexity points to the need for manual investigation informed by expert knowledge, which could work in concert with automated processing as part of transdisciplinary projects. While the manual validation of all posts may be unfeasible for large datasets and the extent of validation required will depend on the research question and market context, initially subjecting a random subset of posts to manual analysis could provide vital information and support automated systems in making inferences about trade. Furthermore, automated systems could carry out labour-intensive aggregation and recognition processes in order to identify concerning posts that could then be appraised in greater depth by specialists.

We advocate for the critical importance of expert-mediated triangulation when investigating and monitoring wildlife trade on social media, as such an approach will help identify valuable content that might otherwise be missed. Human investigation and insights should inform and work alongside the development and deployment of automated systems, with careful consideration given to balance the relative contributions, depending on time pressure, the project objectives and thus the desired sensitivity and specificity rates. Such an approach should be integral to the moderation practices of

social media companies to prevent harmful content. We also present this method for analysing social media content as a way of systematically exploring the modalities traders use to promote and facilitate trade and what information is available for making inferences. While our survey only addressed one area of wildlife trade on one platform, future research could use this approach as a basis for comparison between trade in different taxa, regions, types of illicit product or on different platforms. This could then support the development of generalised approaches for tackling harmful content and help identify where specific approaches are needed.

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### **SUPPORTING INFORMATION**

Supplementary details regarding the study methods (Appendix S1) are available online. The authors are solely responsible for the content and functionality of these materials. Queries (other than absence of the material) should be directed to the corresponding author.

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**Table 1.** Description and frequency of coded indicators of wildlife trade activity identified in social media posts<sup>a</sup>

Data Element	Sign Description	Indicator category <sup>b</sup>	Frequency in posts	Frequency in pages
Post Imagery	Study taxa in holding context including enclosures, on perches or being held for display (excluding copied imagery)	BT	188	12
Post Imagery	Transport boxes containing study taxa	BT	66	8
Post Imagery	Transport boxes where taxa were absent or not visible	T	11	2
Post Imagery	A sheet held alongside birds showing visible date	BT	9	3
Post Imagery	Copied images of study taxa, often generic photos of a species.	B	106	8
Post Text	Clear reference to trade or sale of birds (e.g., ‘grey parrots ready for shipment’)	BT	17	4
Post Text	Reference/implication of trade activity without reference to birds, such as references to shipping, arrival, quarantine or providing contact details (e.g., ‘well arrived at destination’)	T	61	6
Post Text	Reference to birds, including species and	B	38	8



taxa names, related terms and birds  
generally, without reference to trade (E.g.,  
'live birds')

Profile	Name or description clearly state involvement in trading or selling of birds	BT	187	7
Profile	Name or description references birds without referencing trade	B	130	4
Profile	Profile or cover photo features birds in holding or in transport boxes	BT	259	9
Profile	Profile or cover photo features generic birds but not in a trade context	B	47	2
Comments	An exchange between a commenter and the trader regarding trade, such as about sale, price, exporting and trade practices (E.g., User: 'export iraq' Trader 'yes')	T	41	8
Comments	The trader using comments to advertise (E.g., 'It's available')	T	4	3
Comments	A commenter enquiring about trade without a direct response (E.g., 'Price?')	T	77	11

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<sup>a</sup> Not all categories are exclusive and a post could contain multiple types of evidence from the same element. Total number of posts = 321.

<sup>b</sup> BT = Bird-trade, T = Trade, B = Birds



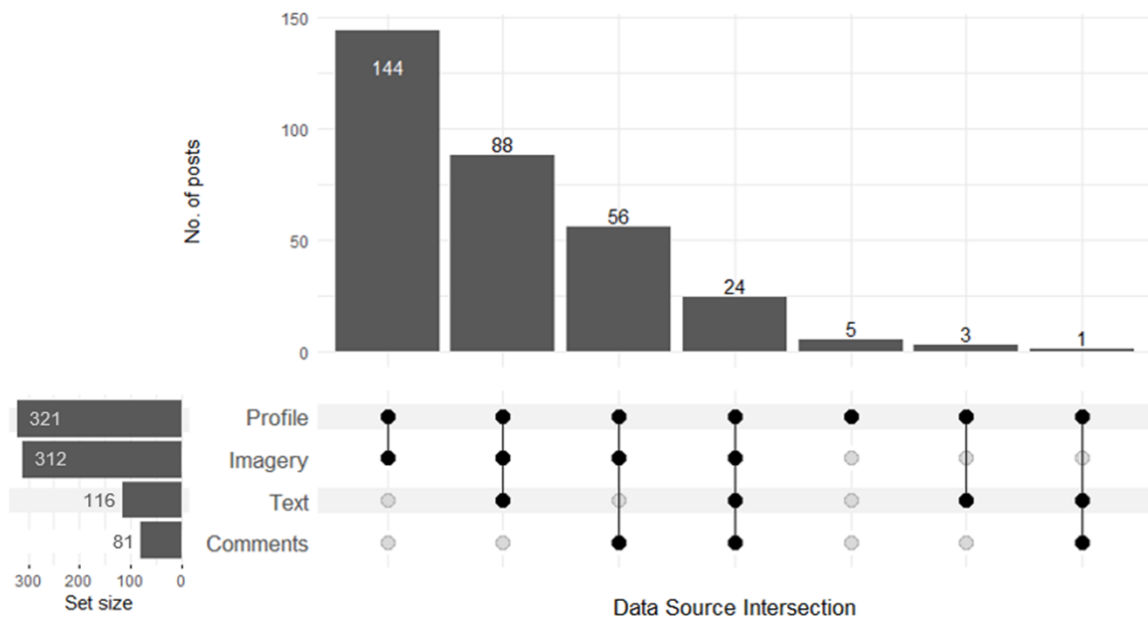
**Table 2.** Description and frequency of information regarding the direction of trade in wild birds identified in social media posts

Data Element	Information Description	Frequency	Frequency
		in posts	in pages
Post imagery	Legible cargo tracking codes that can show the source, transit points and destination of a shipment.	7	3
Post text	The source of birds or shipments; or the transit location where they are being held for further transport. (E.g., ‘Finches from senegal’)	9	4
Post text	The bird or shipment’s destination or locations where birds can be sent (E.g., ‘Shipping to lebanon’, ‘Only for Pakistan’)	14	4
Profile	Location where the trader currently lives, as stated in the profile.	156	7
Profile	Location where the trader is from, as stated in the profile.	149	7
Comments	The source of birds or shipments; or the transit location where they are being held for further transport. (E.g., ‘Location you’ ‘Mali’)	5	3
Comments	Exchange between potential buyer and trader about potential destination.	27	7

(E.g., '...plz send rate cnf karachi')

Geographic metadata	Geotag created by the user indicating the location the post was made or where the featured imagery was taken	30	5
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**Figure 1.** The frequency of posts containing combinations of indicators of trade-related activity from key social media data sources (n =321).