

1 **Host plant use is driven by microclimate not nutritional quality in a grassland**

2 **butterfly**

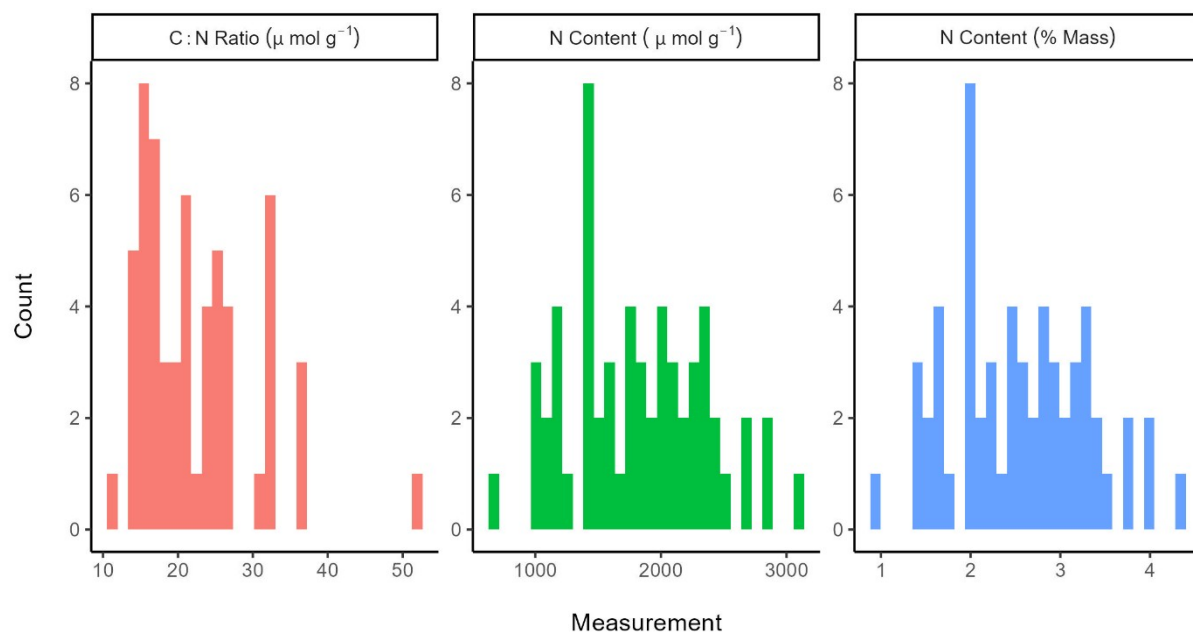
3

4 **SUPPORTING INFORMATION**

5

6 **Host nutritional quality**

7



9 **Figure S1:** Distribution of chemical measurements for *R. acetosa* plants that were analysed. As

10 these were a stratified sample they do not represent the true distribution in the population.

11

12 **Model results relating plant nitrogen content to nutritional quality proxies**

13

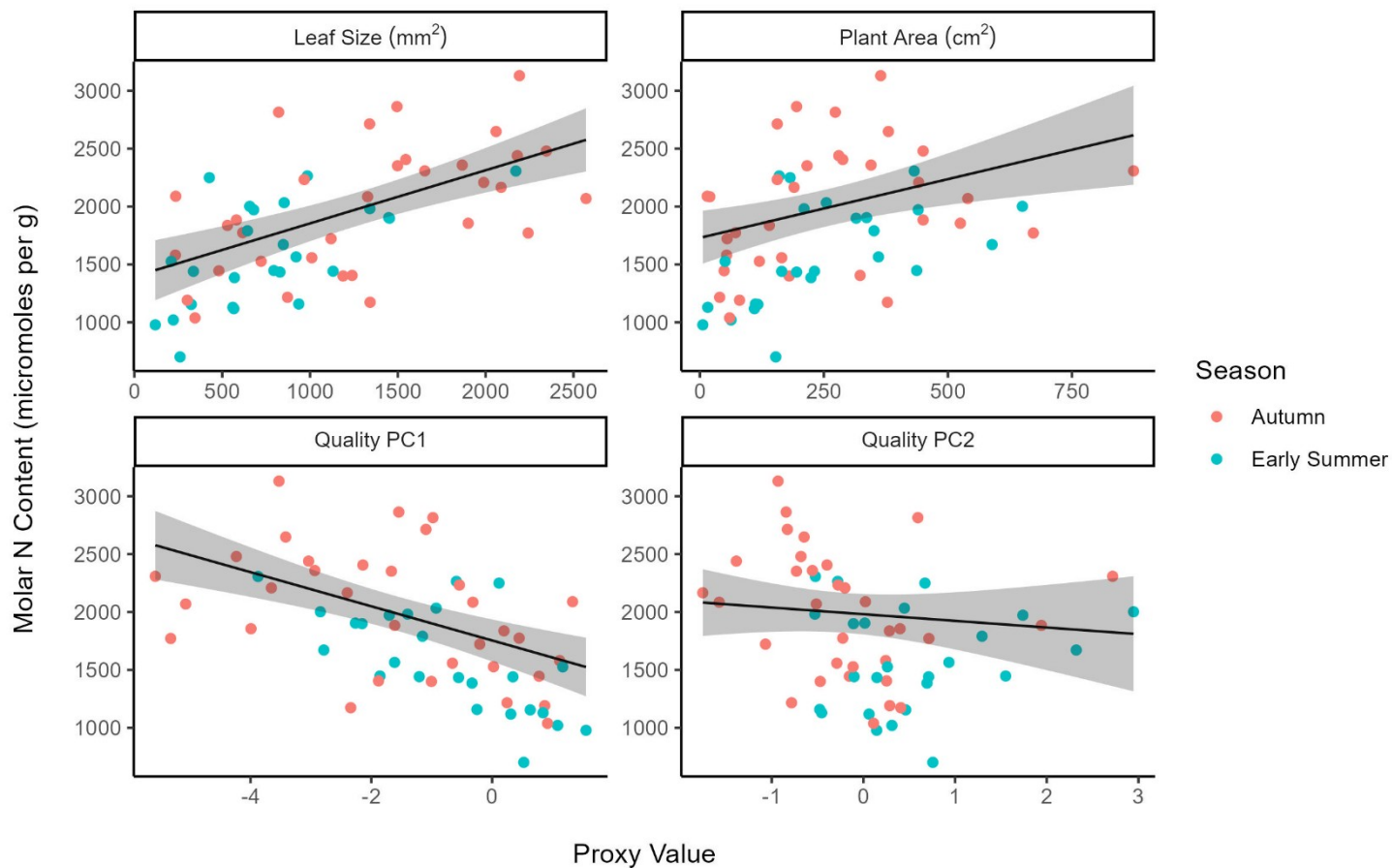
14 **Table S1:** Results of linear models relating plant nitrogen content (micromoles g⁻¹) to the

15 possible proxies assessed.

| Model | Term | β | Standard Error | t | p |
|------------------------|--------------------------------------|---------|----------------|-------|--------|
| Leaf Size + Plant Area | Intercept | 1392.44 | 142.58 | 9.77 | <0.001 |
| | Average Leaf Size (mm ²) | 0.42 | 0.12 | 3.58 | <0.001 |
| | Plant Area (cm ²) | 0.21 | 0.37 | 0.57 | 0.57 |
| | Season | -185.18 | 127.36 | -1.45 | 0.15 |
| Leaf Size | Intercept | 1395.56 | 141.6 | 9.86 | <0.001 |
| | Average Leaf Size (mm ²) | 0.46 | 0.09 | 4.93 | <0.001 |
| | Season | -166.61 | 122.42 | -1.36 | 0.18 |
| Plant Area | Intercept | 1729.49 | 118 | 14.66 | <0.001 |
| | Plant Area (cm ²) | 1.01 | 0.33 | 3.08 | <0.01 |
| | Season | -396.51 | 124.38 | -3.19 | <0.01 |
| Quality PC1 | Intercept | 1754.16 | 92.59 | 18.95 | <0.001 |
| | Quality PC1 | -147.52 | 33.03 | -4.47 | <0.001 |
| | Season | -283.05 | 118.74 | -2.38 | <0.05 |
| Quality PC2 | Intercept | 1980.99 | 89.16 | 22.22 | <0.001 |
| | Quality PC2 | -57.47 | 75.69 | -0.76 | 0.45 |
| | Season | -368.19 | 144.44 | -2.55 | <0.05 |

16

17



19 **Figure S2:** Predicted relationships between host nutritional quality proxies and plant nitrogen
 20 content. Predictions are for autumn and plotted with 95% confidence intervals from models
 21 (results Table S1) alongside the underlying data.
 22

23 **Model results relating plant C:N ratio to nutritional quality proxies**

24 These were qualitatively the same as for plant N content (micromoles g⁻¹) (Table 1 and Table 2),
 25 with average leaf size the best proxy, but plant size adding a small amount of additional
 26 explanatory power.

27

28 **Table S2:** Pearson's correlation coefficients and significance tests for correlation of possible
 29 plant proxies with *R. acetosa* C:N ratio (measured in micromoles g⁻¹).

| Proxy | R | t | DF | p | Lower Confidence Interval | Upper Confidence Interval |
|--------------------------------------|-------|-------|----|--------|---------------------------|---------------------------|
| Average Leaf Size (mm ²) | -0.61 | -5.83 | 56 | <0.001 | -0.75 | -0.42 |
| Plant Area (cm ²) | -0.41 | -3.38 | 56 | <0.001 | -0.61 | -0.17 |
| Quality PC1 | 0.58 | 5.27 | 56 | <0.001 | 0.37 | 0.73 |
| Quality PC2 | 0.17 | 1.32 | 56 | 0.19 | -0.09 | 0.41 |

30

31 **Table S3:** Comparison of models relating plant C:N ratio to different possible proxies.

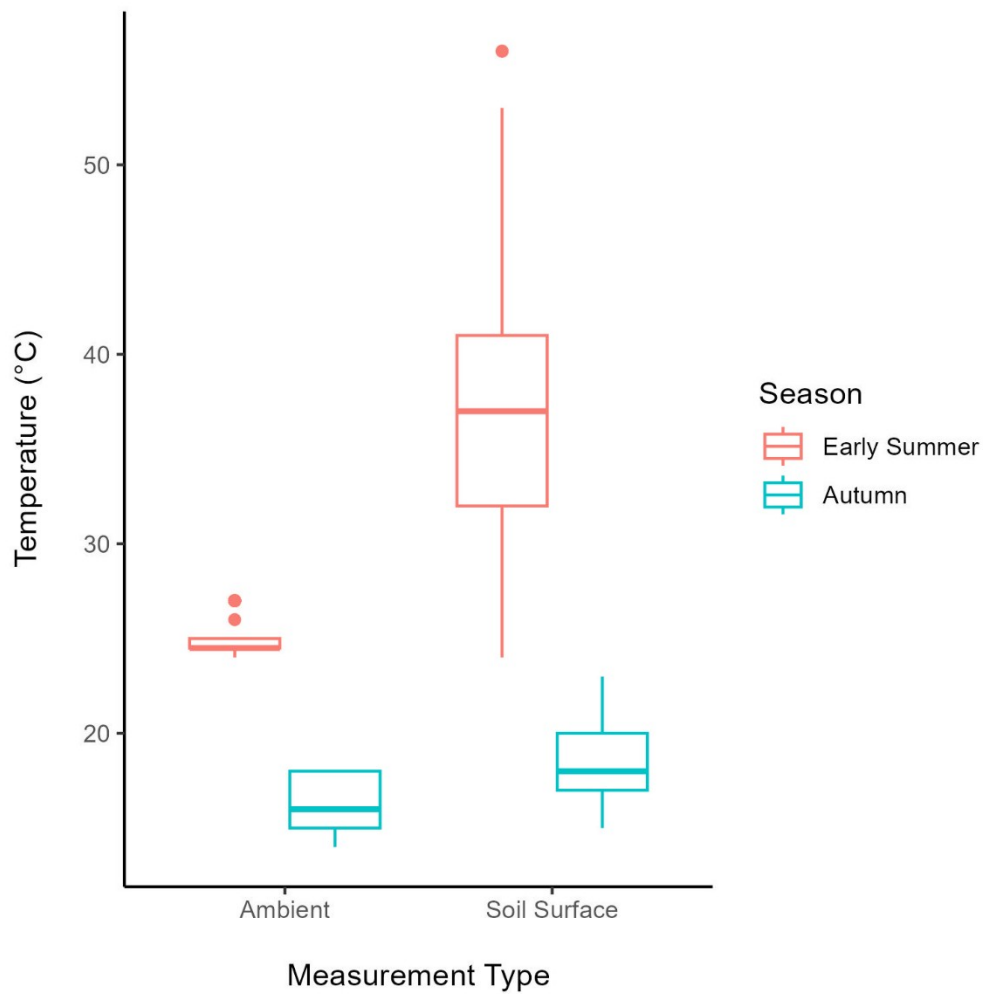
| Proxies | AIC | BIC | R ² |
|------------------------------------------------------------------------|-----|-----|----------------|
| Average Leaf Size (mm ²) and Plant Area (cm ²) | 380 | 391 | 0.4 |
| Average Leaf Size (mm ²) | 379 | 388 | 0.388 |
| Plant Area (cm ²) | 389 | 397 | 0.276 |
| Quality PC1 | 381 | 389 | 0.376 |
| Quality PC2 | 401 | 409 | 0.118 |

32

33

34 Microclimate under *R. acetosa* plants

35



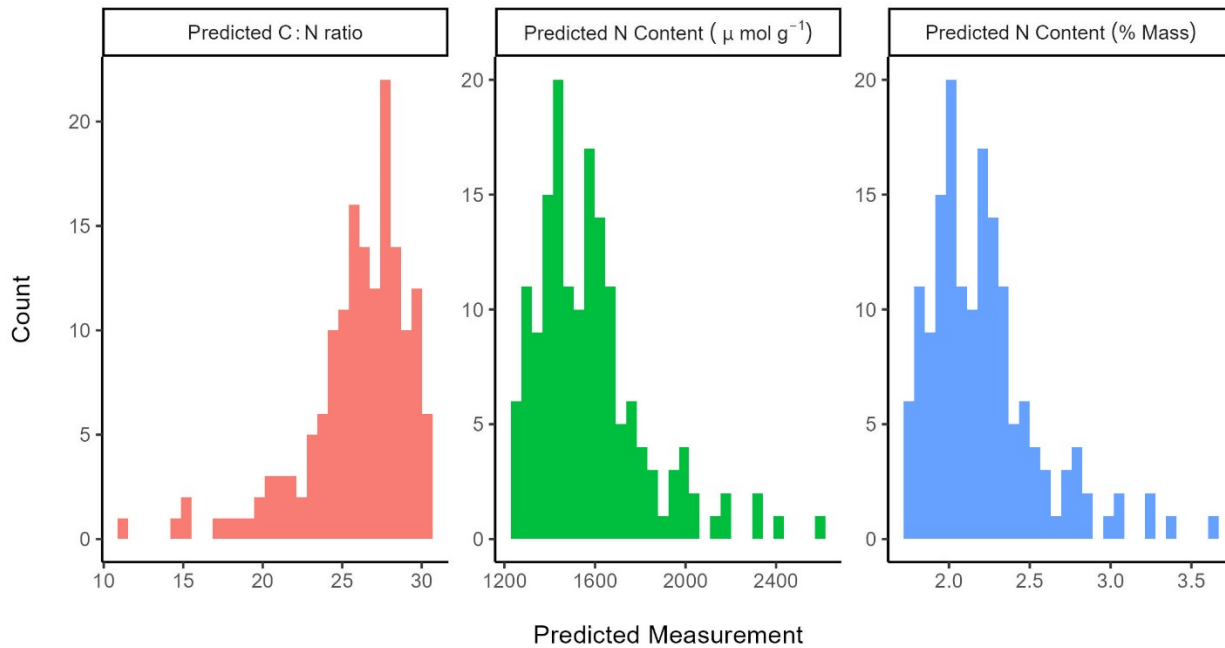
37 **Figure S3:** Differences in ambient temperatures and microclimate temperatures under *R.*
38 *acetosa* plants measured in early summer and autumn. Boxes show the first, second (median)
39 and third quartiles for each measurement, whiskers 1.5 x IQR above the third quartile, and
40 below the first quartile.

41

42

43

44 Predicted quality of *Rumex acetosa* plants



46 **Figure S4:** Predicted C:N ratio and nitrogen contents of *R. acetosa* plants at Shotover Country
47 Park, based on our models of host nutritional quality as a function of average leaf size and plant
48 area. These are plotted for control plants and therefore give a better sense of the likely
49 distribution of measurements within the population, unlike figure S1 which shows a sample of
50 plants stratified by proxies of nitrogen content, therefore giving a far more uniform distribution
51 than is actually present. This shows that most plants were likely to be of low nutritional quality,
52 with larvae suffering from nitrogen deficiency, as most plants are predicted to have C:N ratios
53 higher than the value of 18.1 predicted to be optimal for *L. phlaeas* by Langdon (2024).

54

55

56

57

58 **Models using predicted plant nitrogen content as a measure of host quality, rather than**
59 **average leaf size**

60

61 **Egg-laying model**

62

63 **Table S4:** Outputs from model assessing differences in scaled predicted nitrogen content of
64 occupied and unoccupied *L. phlaeas* host plants in early summer and autumn. To account for
65 uncertainty around predictions, 1/scaled standard error around predicted nitrogen content was
66 used to weight data points in this model.

67

| Term | Estimate | Standard Error | t | p |
|-----------------|-----------------|-----------------------|----------|----------|
| Intercept | 0.72 | 0.09 | | |
| Occupied | 0.13 | 0.13 | 1.01 | 0.31 |
| Season | -1.32 | 0.12 | -11.21 | <0.001 |
| Occupied:Season | -0.03 | 0.17 | -0.17 | 0.86 |

68

69

70

71

72

73

74

75

76

77 **Trade-off Model**

78

79 **Table S5:** Results of model of scaled temperature under *R. acetosa* plants as a function of their
80 scaled predicted nitrogen content and the presence of bare ground (and 1/scaled standard error
81 around predicted nitrogen content as weights). These were qualitatively the same as when we
82 used our proxy for nitrogen content (leaf size) (Figure 2).

83

| Term | Estimate | Standard Error | t | p |
|----------------------------------------|----------|----------------|-------|--------|
| Intercept | -0.29 | 0.06 | | |
| Scaled N content | -0.29 | 0.07 | -3.99 | <0.001 |
| Bare Ground Present | 0.76 | 0.11 | 6.67 | <0.001 |
| Scaled N content : Bare Ground Present | 0.33 | 0.11 | 3.09 | <0.001 |

84