

## FLIGHT PERIODS AND SEX RATIOS OF NEW ZEALAND COPPERS (LYCAENIDAE)

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### INTRODUCTION

The three New Zealand coppers, *Lycaena salustius* (Fabricius, 1793), *L. feredayi* (Bates, 1867) (= *L. enysii* (Butler, 1876)), and *L. boldenarum* (White, 1862), form an isolated group, until recently (Wise, 1965) placed in the genus *Chrysophanus*.

*L. salustius*, the Common copper, is a very variable species with three main varieties: a large form with pale males and distinctly darker females in the Wellington area of the North Island; a medium sized form with sexes more alike in the South Island; and a small form, again with sexes quite alike, in coastal and high country areas of both islands. The larvae feed on several species of *Muehlenbeckia* and *Rumex* (Purdie, 1882) and the butterfly is common throughout New Zealand, from sea level to nearly 2,000m. *L. feredayi*, the Glade copper, is darker and more constant in size and colour than *L. salustius*. The sexes are practically identical and can only be distinguished in the field by the shape of the abdomen. It is rather local, possibly because the larvae seem restricted to *Muehlenbeckia australis*, but has been recorded in widespread parts of the country from Dunedin to Matamata, where I saw 15 individuals near Crystal Springs on 19 February, 1966. *L. boldenarum*, the Boulder copper, is a very small species. The males appear dark grey with a purple sheen, and the females are pale brown. It is very abundant in dry stony areas, such as river beds, throughout the South Island from sea level to over 2,000m., and occurs in a few places in the North Island. Illustrations of the three species and the most detailed account of their life history are given by Hudson (1928).

At Normandale, a hill suburb of Lower Hutt, the large form of *L. salustius*, with distinct sexes, and *L. feredayi* are almost equally common. Here they present an interesting ecological problem as they obviously occupy the same niche; larvae of both species eat *M. australis*, and the adults feed side by side on the same flowers. In addition, the dark females of *L. salustius* so closely resemble *L. feredayi* in dorsal view that even the butterflies have difficulty in telling each other apart. Interspecific courtship is common, but I have no records of cross mating or hybridization. Apart from their appearance, the main differences between the two species recorded by Hudson (1928) are the longer flight period of *L. salustius* (first week of November to early April, compared with mid November to mid February for *L. feredayi*) and the less marked preponderance of males in *L. feredayi* than in *L. salustius*. Over the past five years I have tried to examine these differences quantitatively.

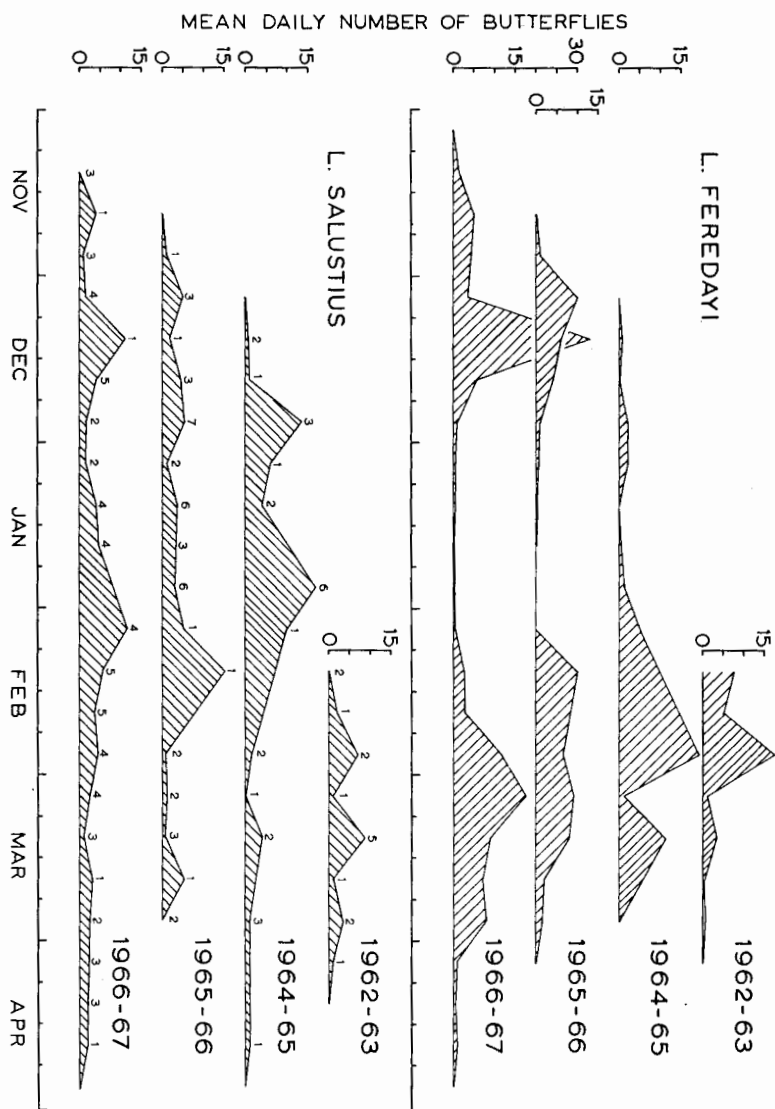


Fig. 1. Flight periods and abundance of *L. feredayi* and *L. salustius* at Normandale in four seasons. The number of days on which butterflies were counted in each week is shown above the graphs for *L. salustius*.



To get some idea of life span and movements, 114 butterflies were individually marked by notching the wings, or noting existing patterns of wear.

During field work at St. Arnaud, Nelson, (2,000 ft. a.s.l.) the South Island forms of *L. salustius* and *L. boldenarum* were studied. All the Common coppers seen in a day at St. Arnaud township or in the adjacent Travers Valley could be recorded as at Normandale, but this was quite impossible for *L. boldenarum* which occurs in enormous numbers on the shingle flats in Travers Valley. I counted 54 on a 3 sq. foot mat of flowering scabweed (*Raoulia* sp.) and this was the only one of several hundred similar plants. Wide areas of the valley must have densities of at least one butterfly to the square foot.

## RESULTS

### Flight Period

The flight period of *L. salustius* and *L. feredayi* at Normandale appeared to start earlier than in each preceding year (Fig. 1), but this might be partly an artifact due to increased searching effort. *L. feredayi* was clearly double brooded in each of the three years, with peak abundance in early December and towards the end of February; very few were seen in January. On the other hand, *L. salustius* reached peak abundance in midsummer, when *L. feredayi* was scarce, but there was much variation between years. The smoothed curve averaging data for all years (Fig. 2) illustrates the different patterns of abundance clearly and also shows that *L. feredayi* tends to start and finish flying a few days earlier than *L. salustius*.

Despite the difference in altitude, the flight period and abundance of *L. salustius* at St. Arnaud were very similar to those at Normandale (compare Fig. 3 and Fig. 1). *L. boldenarum* in the Travers Valley had a longer flight period than *L. salustius* (Fig. 3) but its abundance was not measured.

As individual butterflies live only a few days, the flight period comprises successive waves of insects. Of 114 specimens, of the two species combined, marked in my garden, 36 were seen again for a mean duration of 3 days (Table 1). Movements of marked insects would increase the estimates of life expectancy considerably, but I have no records of movements of more than about 100 yards, and at least one other species of Lycaenid is known to have a small home range and strong homing response (Keller, Mattoni and Seiger, 1966). Because newly emerged and worn insects were marked at random, the average minimum life expectancy on emerging would be twice the observed duration, i.e. 6 days. The two insects which lived for over two weeks had been newly emerged when marked. Several became very worn after only two days; and the general impression was that adults could last for three or four flying days, but that rain or cold weather could extend the life span.

TABLE I

Minimum life span of marked coppers at Normandale, 1965-67.

Re-sighted, days from 1st capture	<b>L. salustius</b>		<b>L. feredayi</b>		Total
	Male	Female	Male	Female	
Same day	5	2	3		10
1	5	2	3		10
2			2		2
3	5				5
4	1	1			2
5	1				1
6		1			1
7	1				1
10			1		1
12	1				1
14	1				1
16	1				1
Totals	21	6	9	0	36
Number marked	64	13	26	11	114

TABLE II.

Monthly sex ratios of **L. salustius** and **L. feredayi** at Normandale, 1965-67.

	<b>L. salustius</b>			<b>L. feredayi</b>		
	Male	Female	% Male	Male	Female	% Male
November	3	0	100	18	1	95
December	53	12	82	56	22	73
January	68	14	83	7	0	100
February	107	22	83	37	17	69
March	15	11	58	61	44	58
April	6	10	38	2	1	67
Totals	252	69	79	181	85	68

**Sex Ratio**

At Normandale for both **L. salustius** and **L. feredayi** the percentage of males declined from almost 100% in November to about 50% at the end of the season in April (Table 2). There seems no reason why the method of recording sex ratios should produce seasonal bias, and the results appear to reflect genuine changes in the populations. The first brood of **L. feredayi** had an observed sex ratio of 81 males:23 females (78% male) and the second brood 100 males:62 females (62% male).

The sex ratio of *L. boldenarum* in the Travers Valley also declined seasonally from 318 males:82 females (80% male) in November to 161 males:89 females (64% male) in February.

Over the whole season, as Hudson (1928) suggested, there seems to be less disparity between the numbers of each sex in *L. feredayi* (68% male) than in *L. salustius* (79% male) at Normandale, but this may not hold in other areas. Thus, in January, the sex ratio of *L. salustius* at St. Arnaud was 34 males:26 females (57% male) and at Scorching Bay, Wellington, 55 males:45 females (55% male), compared with 83% male in the same month at Normandale.

## DISCUSSION

Published references to the flight periods of New Zealand coppers vary widely, possibly because they were studied in different areas. Fereday (1878) gives December to March for both *L. salustius* and *L. feredayi*. Hudson (1928) considered that *L. salustius* had a far longer flight period (first week of November to early April) than *L. feredayi* (mid November to mid February) and Gibbs (1961) emphasised the difference even more by reducing the time of appearance of *L. feredayi* to "from December to February." At Normandale there was no significant difference in the flight periods, although stragglers of *L. salustius* seemed to last a little longer than those of *L. feredayi* in autumn. It is rather curious that at St. Arnaud, and at Cass (Dick, 1940), despite severe frosts *L. salustius* flies for as long as at Normandale, which is practically frost free; while the coastal form in the Wellington area may be seen from early November to May, and Hudson (1928) records that a few adults may overwinter in the Marlborough Sounds.

Hudson (1892) claimed that *L. salustius* was "double brooded and is consequently most abundant in the early summer and in the autumn, few of these merry little insects being seen at midsummer" (a description curiously apt for *L. feredayi* at Normandale), but revised this view in 1928 when he stated, "The perfect insect usually appears about the first week in November. It is commonest in January, and continues abundant until the end of March or beginning of April . . . . it is clear that there must be more than one brood in a season, but I have never been able to discover any line of demarcation between successive broods." This pattern agrees well with that at Normandale (Fig. 2). On the other hand, Hudson (1928) found *L. feredayi* especially abundant between the third week of December and the third week of January, which is when they were practically absent at Normandale. Regional and annual differences probably occur and there is obviously much scope for further work.

Males tend to emerge earlier in the season than females in most lepidoptera. The first female *L. salustius* was seen 16 and 25 days after the first male in 1965 and 1966 respectively, and the first female *L. feredayi* appeared 15 days after the first male in 1966. Ford (1957), discussing two species of *Maniola* with a similar emergence pattern, states: "the death-rate of the early males must be compensated in one of two ways: either the sex-ratio must depart from equality, males being much the commoner, or polygamy must be the rule." This may explain why the preponderance of males of all three New Zealand coppers is greater early in the season, but the mechanism by which it is accomplished is unknown. One possibility is that males live longer than females, which is supported by Table 1, but the numbers recovered are too small to draw any definite conclusions.

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#### REFERENCES

- DICK, R. D., 1940: Observation on insect-life in relation to tussock-grassland deterioration. Preliminary report. *N.Z. Jl Sci. Tech. (A)* **22**: 19-29.
- FEREDAY, R. W., 1878: Supplementary description of species or varieties of Chrysophani (*Lepidoptera rhopalocera*) inhabiting New Zealand. *Trans. Proc. N.Z. Inst.*, **10**: 252-259.
- FORD, E. B., 1957: Butterflies. Collins, London. 368 pp.
- GIBBS, G. W., 1961: New Zealand Butterflies. *Tuatara*, **9**: 65-76.
- HUDSON, G. V., 1892: An elementary manual of New Zealand entomology. West, Newman & Co., London. 121 pp.
- 1928: The butterflies and moths of New Zealand. Ferguson and Osborn, Wellington. 386 pp.
- KELLER, E. C., MATTONI, R. H. T. and SEIGER, M. S. B., 1966: Preferential return of artificially displaced butterflies. *Anim. Behav.*, **14**: 197-200.
- PURDIE, A., 1882: Entomological notes. *N.Z. Jl Sci.* **1**: 94-95.
- WISE, K. A. J., 1965: Nomenclature of some butterfly species. *N.Z. Ent.*, **3**: 18-20.