Blue, red, and yellow insects

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Abstract

Notes are given on yellow, blue, and red examples of 7 species of normally green insects in New Zealand. These records include the orders: Mantodea, Plecoptera, Orthoptera, Hemiptera, and Lepidoptera. Results of a breeding experiment with a yellow praying mantis, *Orthodera ministralis* (Fabricius), are discussed.

Keywords: Mantodea; Plecoptera; Orthoptera; Hemiptera; Lepidoptera; unusual colouration; *Orthodera ministralis*.

INTRODUCTION

The purpose of this paper is to record unusual colouration in 7 species of insect which are normally green, and to review briefly the occurrence of colour morphs in New Zealand fauna.

The insect specimens referred to are in the New Zealand Arthropod Collection held at Entomology Division, DSIR, Auckland and with the Plant Health Station, MAF, Auckland.

THE UNUSUALLY COLOURED SPECIMENS

1. MANTODEA: MANTIDAE, ***Orthodera ministralis*** (Fabricius, 1775)

Two specimens of the green praying mantis have been collected in Auckland recently which are uniformly coloured bright yellow: Greenlane, AK, 1 penultimate female nymph, 1978, and Waiheke I, AK, 1 adult female, May 1980, Mrs St Paul.

The yellow female mantid from Waiheke I was kept in the laboratory and was mated with a green male. She produced 2 oothecae from which 9 nymphs emerged on 16 September 1980; all were a yellowish green. 3 reached adulthood, 2 were female and 1 was a male. Both females were successfully mated with the male, and produced 6 oothecae. During June and July 1981 47 nymphs emerged: 37 were green or yellowish green, and 10 were yellow.

2. PLECOPTERA: EUSTHENIIDAE, ***Stenoperla prasina*** (Newman, 1854)

This species of green stonefly is known to produce yellow specimens: Nelson, NN, 16 January 1963 and 16 December 1969, K. McCarthy and G. A. McNae; Hollyford Valley, FD/WD, 10 January 1967, A. K. Walker; Lake Rotoiti, BR, 2 adults, 8 February 1978, A. K. Walker. *Stenoperla maclellani* Zwick, 1979, confused with *S. prasina* until recently, does not produce colour variants (Zwick 1979).

3. ORTHOPTERA: TETTIGONIIDAE, ***Caedicia simplex*** (Walker, 1869)

Nine bright pink nymphs of various instars of the green katydid have been found: Auckland area—Mt Albert, AK, May 1966 and 1983, G. Day, Titirangi, AK, 3 June 1981 and 9 March 1983, R. Thomas; Wellington, WN, 3 nymphs, April and May 1958, G. W. Ramsay; Hamilton, WO, 13 June 1978; Opotiki, BP, 9 June 1983, I. E.

Sullivan. These pink nymphs are always found on red pigmented plants, e.g., the red variety of ake ake *Dodonaea viscosa* Jacquin 'Purpurea'. These nymphs always develop into green adults.

4. HEMIPTERA: FLATIDAE, ***Siphanta acuta*** (Walker, 1851)

Three turquoise blue adults of the green planthopper have been recorded: Nelson, NN, October and November 1964, Hutchinson and G. W. Ramsay; Mt Albert, AK, October 1983, G. Hall.

5. HEMIPTERA: CICADIDAE, ***Kikihia ochrina*** (Walker, 1858)

A yellow specimen of this green cicada has been found: Waitakere Ra, AK, March 1983, C. J. Green. Two other species of green cicadas have colour variation. Captured specimens of *Kikihia* sp. H of Fleming (1975) showed 30% were yellow. *Kikihia subalpina* (Hudson, 1891) has both yellow and blue-green individuals (J. S. Dugdale pers. comm.).

6. HEMIPTERA: PENTATOMIDAE, ***Nezara viridula*** (Linnaeus, 1758)

Two yellowish orange specimens of the common green vegetable bug have been recorded: Massey, AK, February 1975; Otakanini, AK, March 1979.

7. LEPIDOPTERA: HEPIALIDAE, ***Aenetus virescens*** (Doubleday, 1843)

A vivid yellow male puriri moth has been recorded: Titirangi, AK, October 1980, W. Kemp.

This species normally varies from shades of green through to a sandy colour. 1-2% of the population are yellow (J. S. Dugdale pers. comm.).

DISCUSSION

The colours of insects are often due to a complex mixture of pigments, some of which are concentrated from their diet. These are carotenoids, flavonoids, and anthraquinones, and some are porphyrins made from the breakdown of plant chlorophyll. Insectoverdin is a common green pigment produced by a mixture of blue and yellow compounds. The blue is tetrapyrrole, but sometimes an anthocyanin, and the yellow is a carotenoid. Ommochrome pigments produced from the amino acid tryptophan produce red and yellow colours in Lepidoptera and Hymenoptera (CSIRO 1970).

The fact that the pink nymphs of *C. simplex* have only been found on plants containing red pigments suggests that the nymphs obtain their colouring from the plant. However the pigments of the plant and insect nymph have proved to be different (Ramsay 1960). There is little known about this phenomenon.

The normal green colouration of insects results from a blending of blue and yellow pigments. The yellow colouration (xanthochroism or luteonism) could be caused by the lack of blue pigment and the blue colouration by the lack of yellow pigment.

As shown in the breeding experiment with the praying mantis this colour variation is likely to be hereditary. Presumably these yellow or blue insects are lacking the gene which controls the synthesis of one or other of the pigments needed to produce the usual green colour or alternatively they carry a gene which suppresses the action of this gene.

The yellow colouration possibly is a disadvantage to the insect, for example, predators may see it more readily or in the case of the mantid, its prey may see it. This would limit the spread of the yellow gene within the population. However my breeding experiment shows that a mating between two yellow green mantids produces green, yellow green, and yellow young. This suggests that the yellow green specimens are heterozygous for the colour genes (Sturtevant & Beadle 1962).

Colour morphs occur in vertebrates as well as invertebrates. Amongst the reptiles, 4 species of green gecko have yellow forms, for example *Naultinus elegans elegans* and *Heteropholis manukanus* (Robb 1980).

Within the birds, 4 species of parrot and 4 species of parakeet are known to have yellow forms and occasionally blue forms. Mostly the green colouration is replaced by yellow and less often blue, although the red and violet colours remain as normal. The kea (*Nestor notabilis*) and the kakapo (*Strigops habroptilus*) have yellow forms, with the kakapo also having a greenish blue form. Yellow specimens have also been recorded of the red crowned parakeet *(Cyanoramphus novaezelandiae novaezelandiae)* (Oliver 1955).

In New Zealand it is yet to be proven beyond doubt that colour variation in an insect is due to a particular gene type. The mantid is an easy species to rear, and it could provide interesting information about this phenomenon.

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REFERENCES

CSIRO 1970: "The insects of Australia". Carlton, Victoria, Melbourne University Press. 1037 p.

OLIVER, W. R. B. 1955: New Zealand birds. Wellington, A. H. & A. W. Reed. 673 p.

RAMSAY, G. W. 1960: Unusual colouration of nymphs of the katydid, *Caedicia simplex* (Orthoptera: Tettigonioidea). *Transactions of the Royal Society of New Zealand 88:* 595-596.

ROBB, J. 1980: New Zealand amphibians and reptiles in colour. Auckland, Collins. 158 p.

STURTEVANT, A. H.; BEADLE, G. W. 1962: An introduction to genetics. New York, Dover Publications. 391 p.

ZWICK, P. 1979: Revision of the stonefly family Eustheniidae (Plecoptera), with emphasis on the fauna of the Australian Region. *Aquatic insects 1(1):* 17-50.