

## **Color pattern variation in the puriri moth, *Aenetus virescens* (Lepidoptera: Hepialidae)**

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Many species of Hepialidae are highly variable and often it is impossible to definitively identify specimens based on wing pattern alone. Illustrated examples of extensive wing variation include the Mediterranean species of *Gazoryctra*, *Neohepialiscus*, *Pharmacis*, *Phymatopus*, and *Triodia* (De Freina & Witt 1990) and South American species of *Dalaca*, *Callipielus* (Nielsen & Robinson 1983), and *Aepytus* (Mielke & Grehan 2015). Contrasting patterns appear to be present in most if not all Hepialidae, including those of New Zealand as illustrated by Dugdale (1994). In many cases the range of variation does not receive much attention as hepialid patterns are often complex and many species either lack prominent markings or they are relatively indistinct. An exception to this characterization is the genus *Aenetus* of eastern Indonesia, Australia, New Guinea, New Caledonia, and New Zealand. Most species are large bodied with prominent green forewings of various shades with a superimposed pattern of white or brown spots that often fuse into irregular transverse markings or bands (Simonsen in press). Contrasting variations in colour tone and pattern have been reported and illustrated for *Aenetus cohici* in New Caledonia (Salesene 2010).

The New Zealand species *Aenetus virescens* (Doubleday, 1843) has long been recognized as having distinct morphs. Hudson (1928) illustrated two

principle varieties; a male with predominantly white hind wings and green forewings marked by a transverse band of white spots and other less distinct white markings (Plate XLII) was contrasted with a mottled pattern of many more white markings on the forewing (Plate XLIII). A similar contrast was made between a female mottled with irregular dark brown markings on the forewings and a female with interspersed pale white shading. These contrasts were also illustrated by Gaskin (1966). Hudson (1928) noted that the green ground colour of the male included tones of bluish-green, yellowish green and every intermediate shade and intensity. The white spots are sometimes almost absent and on rare occasions they are replaced by elongate blackish marks, or the forewings are entirely covered by large white spots. This latter morph was considered so distinctive that Quail (1902) labelled it *albo-extremis*. The ground color of both sexes is sometimes replaced by pale orange-brown (Hudson 1928).

While the range of color variation has been noted and major pattern contrasts have been illustrated (Hudson 1928, Dugdale 1994) the overall range of variation has not received detailed attention. The second author (C.C.) examined examples of variation from moths collected at lights on the war memorial monument by Monument Rd, Thames from 2011 to 2015. Following removal of those lights after restoration of the monument, C.C. used street lights at Tararu Rd, Tararu, in 2016 and 2017. This collecting resulted in an extensive array of samples, most of which are males due to the much less frequent occurrence of females at light.

The results of this survey confirm the presence of five principle color morphs: green, bluish-green, yellowish green, pink, and golden-yellow (Figs. 1-5). This ground color may also affect the hindwing coloration to a varying extent. As noted by Hudson (1928), other intermediate shadings occur such as an infusion of pink, particularly over the outer regions of the forewing and posterior of the hindwing in the vicinity of the anal angle (Fig. 6). A further type of variation combines a yellow-green forewing

with a hindwing that is predominantly blue-green with a patch of yellowish orange shading at the anal angle (Fig. 7).

Previously undescribed patterns include a localized orange spot in the central-posterior forewings (Fig. 8) and a gold patch in the anal angle of the hind wings (Fig. 9). In the latter example the hindwings are predominantly green rather than white. The forewing of most male specimens exhibited a distinct oblique transverse band of white spots of varying intensity. In some specimens the white markings are barely discernible (Fig. 3) while other specimens with extensive white mottling conformed to Quail's *albo-extremis* morph (Fig. 10).

Variation in female ground color included olive green (Fig. 11), yellowish green (Fig. 12), and pale green (Fig. 13-14). Hindwings are mostly brown, or reddish brown with green towards the outer margins, but they may also be mostly green and edged with brown along the anal margin (Fig. 13). A combined color and pattern morph with yellow dominating the outer forewing was recorded where darker markings were aligned longitudinally between the veins rather than in the usual transverse alignment (Fig. 14). It is notable that the female morph with white markings has not been found in the Thames area.

These results indicate that wing color and pattern variation includes some distinct morphs, but these may prove to be examples along a continuum of color tone and pattern intensity. Dugdale (1994) found no convincing evidence that particular wing patterns are geographically restricted, but there may be regional differences in the frequency of particular morphs. A possible indication of localized variation is suggested by the absence of *albo-extremis* morphs during two seasons collecting in the Bay of Plenty region (Dugdale, 1994) and the absence of white marked females in more than six years collecting in Thames (C.C pers. obs.). Additional illustrations may be viewed on the web page below, where further examples will be added as they are found:

<http://www.johngrehan.net/index.php/hepialidae/aenetus/aenetus-virescens/virescens-morphs>

Clinton Care would like to collaborate with anyone interested in collecting specimens for his studies on variation, particularly from the far north, Hawke's Bay and the southern North Island.

An additionally intriguing aspect to the variation in *Aenetus virescens* is that the *albo-extremis* form finds its counterpart in the male and female of *A. scripta* (Scott, 1869) in western Australia (Fig. 15) while the single dominant transverse line of white spots is featured in the male of *A. eximus* (Scott, 1869) in eastern Australia (Fig. 16). These different wing pattern similarities may represent a genetic polymorphism within the ancestral *Aenetus* that was retained in the *A. virescens* lineage following its geographic isolation through formation of the Tasman basin.

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Fig. 1. Green morph



Fig. 2. Blue morph



Fig. 3. Yellow-green morph



Fig. 4. Pink morph



Fig. 5. Golden-yellow morph



Fig. 6. Pink infusion morph



Fig. 7. Yellow-green morph with blue-green hindwings edged with orange posteriorly.



Fig. 8. Forewing with orange spot



Fig. 9. Hindwing with gold spot



Fig. 10. *Albo-extremis* morph



Fig. 11. Female green morph



Fig. 12. Female yellow morph



Fig. 13. Female with green hindwings



Fig. 14. Female yellow-green with yellow margin



Fig. 15. *Aenetus scripta* female



Fig. 16. *Aenetus exima* male