

Possible cryptic resemblance of male *Hepialus humuli* (L.) to grass inflorescences

“Dusking” is a traditional method of collecting Lepidoptera, which was employed widely in the latter part of the nineteenth and early twentieth centuries, involving netting moths at flight while they are visible, in the hour or so around dusk which straddles full light and full dark. On the 6 June 2016 I was collecting using this method in a grassy meadow (O.S. grid reference NS 997860) near the medieval village of Culross, West Perthshire (VC 87), overlooking the river Forth. The site is immediately adjacent to the estuary shore and a large, man-made ash lagoon, generated by waste materials from the nearby Longannet generating station. Beginning at around 9.45pm, I walked around this area until approximately 11pm. From approximately 10.45pm, I began to notice the eerie white shapes of numerous adult male *Hepialus humuli* exhibiting their characteristic “lekking” behaviour. This behaviour, whereby the insects hover a foot or so above the ground in an irregular, pendulum-like motion, appears to be a means by which the males visually advertise their presence to females (Mallet, 1984. *Zool. J. Linnean Soc.* **79**: 67-82). I observed perhaps a dozen males, but no females.

On 27 June I returned to the same site and while, as before, the evening was mild and overcast with cloud, there was a slight breeze on this occasion, such that the ground-level vegetation was moving appreciably. I embarked on this journey slightly later than before, only arriving at the site by about 10.45pm. Initially I was surprised by the apparent absence of *H. humuli*, attributing this to a lack of activity brought about by the breeze. However, I soon began to realise that, in many instances, what I had hitherto mistaken for the inflorescences (seed-heads) of grass plants moving back and forth in the wind were, in fact, individual male *H. humuli*. Under the prevailing conditions the resemblance was so great that, even after I knew that the insects were present and understood why they were not clearly visible, I still had great difficulty in locating any. On numerous occasions I would suddenly start and advance toward a flash of white that had caught my eye only to discover it was a part of a grass plant, or dismiss some movement which I would later perceive to be a moth.

It occurred to me that perhaps if I was so deceived, it was possible that other animals might also be—including potential predators of this species. Could it be that a contributory factor in the evolution of this species’ peculiar “lekking” behaviour was its secondarily cryptic properties?

This putative male crypsis can be broken down into three elements: (i) white colouration, which resembles the pale, creamy shades of the grass inflorescences, (ii) the height at which the insects fly above the ground, which approximately matches the level of the seed-heads and (iii) the back and forth

flight, which resembles the shaking movement of grass stems in a light wind.

It seems remarkable that all three components could have come together, coincidentally, to give the false impression of a cryptic resemblance evolved by natural selection. Of course, one could argue that, of all the numerous behaviour patterns displayed by Lepidoptera and their variable morphologies, one might expect on occasion to make some purely chance (and false) perception such as this.

However, the population of *H. humuli* on the Shetlands, referred to as *R. thulensis* Newman, provides some evidence which is, I think, suggestive. In contrast to their usual pure white colouration, *thulensis* males are very variable and tend toward being much darker. This is due to the fact that during the flight period it is never dark at the latitude upon which the Shetland Islands rest and so natural selection has favoured generally darker colouration which is less conspicuous to predators in the conditions of full light which prevail (Ford, 1955. *Moths*. Collins). This is important because it demonstrates that where the insects are very conspicuous, the pressure of predation alters the evolutionary balance of selective forces, such that being conspicuous to females now becomes a hindrance, decreasing an individual's chance of survival disproportionately more than the benefit to reproductive rate derived from more readily attracting and mating with a female.

Therefore, as this species usually flies in conditions of semi-visibility it may not be too fanciful to postulate that its typical white colouration and "lekking" behaviour is also the result of a delicate balance of evolutionary forces, but the near-reverse of the situation upon Shetland – that is, a combination of morphology and behaviour principally formed as a means of displaying to females but adjusted so as to be less conspicuous to potential predators.

We might imagine the morphology and behaviour of male *H. humuli* as representing a point on a scale from an hypothetical "optimal display design", incorporating features of behaviour and colouration which maximise the effectiveness (in terms of fecundity) of the "lekking" behaviour, to an hypothetical "optimal crypsis design", possessed of characteristics which maximise inconspicuousness and minimise predation. Typical, mainland-British insects lie more toward the "display" end of this spectrum than do Shetland individuals, because they fly in conditions which apparently partially compensate for their visual conspicuousness—namely, the low light levels. Given the particular conditions on the Shetland Islands, however, the morphology of individuals is not so buffered, and the colouration of males has responded to this adjustment of the pressures of natural selection; hence, these individuals lie more toward the "crypsis" end of the spectrum.

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