Editorial: A Hard Day's Night - What's to be gained from fumbling around in the dark?

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In many cases daily patterns in insect activity are so well defined between night and day there is little doubt about when, or how, an investigator should go about studying them. However, even for some relatively well-studied groups (e.g. Diptera; spiders; beneficial insects; herbivores; pollinators), collecting during the daytime can produce very different results compared with collecting at night (Lewis & Taylor 1964; Janzen 1973; Green 1999; Brown & Schmitt 2001; Devoto 2011; Suter & Benson 2014).

If insect activity is concentrated at a particular time period (e.g. dawn; dusk; noon), sampling can be made more efficient by focussing on a narrower time window. For example, when studying non-native pollinators in Fiji, Prasad & Hodge (2013a) found that the exotic allodapine bee, *Braunsapis puangensis*, showed a clear peak in foraging activity in the middle of the day (although not when it was raining!). In a subsequent biogeographic survey all collecting was performed between 11am and 2pm in order to optimise catches, and also so that any absences were less likely to be explained by the bees being inactive (Prasad & Hodge 2013b).

In the previous issue of *The Weta* (vol. 51), two papers highlighted how knowledge of daily behaviour patterns could help researchers avoid performing surveys at the wrong time of day. Watts et al. (2017) described a survey of Cook Strait giant wētā, *Deinacrida rugosa*, on Matiu/Somes Island. Because these wētā leave their retreats around dusk, and are nocturnal foragers, the authors performed their searches at night. For this species, previous knowledge regarding its natural history and feeding behaviour meant the researchers already knew daytime searches were unlikely to produce meaningful data. In the same issue of *The Weta*, Vink et al. (2017) described new observations of the marine spider *Desis marina*. The authors reported very few specimens were located using a previously-described search technique that involved lifting seaweed holdfasts. However, during night-time searching they observed approximately 50 specimens in just 2.5 hours. Based on these findings, one could envisage any

future field research on *Desis marina* would profit by including some nocturnal survey work.

Some insect-collecting methods, such as pitfall traps, flight interception traps, and Malaise traps, are usually in place for a number of days before the contents are retrieved, and the catch contains both day and night collections. Additional information on insect activity would be obtained if the traps were emptied more often, separating crepuscular, day, and night-time catches (e.g. Chatzimanolis et al. 2004). Obviously visiting and emptying traps two or three times a day would require extra effort for the researcher [although some elaborate 'clockwork' mechanisms have been developed for pitfall traps so that catches from different time periods are kept separate; e.g. Blumberg & Crossley 1988; Buchholz 2009]. But even if the separation of night and day catches was carried out over a short time period, or as a pilot study, this may still produce valuable data indicating that at least some species were active at different times of day.

Some collecting methods are, on the face of it, closely associated with a particular part of the daily cycle. For example, moths represent the largely nocturnal Lepidoptera and are predominantly collected at night using an attractant (e.g. light; bait; 'sugaring'). On the other hand, the day-flying Lepidoptera represented by butterflies can, if the researcher has the required identification skills, be monitored by sight, using linear transects or fixed time searches to give a standardized sample unit. Just as light trapping (for moths, caddisflies, Diptera, etc.) is associated with night-collecting, using variably-coloured sticky traps and pan traps is associated with sampling day-flying insects. However, because light traps are rarely run during the day, the propensity of these traps to attract day-active insects is generally not known. Similarly, it is often assumed that insects respond differently to light reflected off different coloured sticky traps. However, it is rarely (if ever?) checked whether any discrepancies among catches obtained by different coloured traps would also occur during darkness, which would be an interesting phenomenon to report (and then try to explain!).

The local abundance of nocturnally-active insects can be estimated by examining occupation of natural shelters, or by using 'artificial cover objects' (ACOs). Daytime occupation of 'motels', corrugated metal shelters, and baited bathroom tiles has been used to study populations of wētā, katipō and woodlice respectively, and allows estimates of abundance by using

animal counts or the proportions of shelters that are occupied (Bowie et al. 2006; Hodge & Standen 2006; Costall & Death 2010). However, it is important to recognize that the data obtained in this way reflect not only animal abundance, but also their inclination to take shelter in the ACO, and the availability of natural shelters as alternative resting places.

It can generally be assumed that passive collecting methods, such as pitfalls and interception traps, may function with more or less equal efficiency during night and day. However, active (or 'hand') searching for insects at night is clearly not the same process as searching for insects during daytime. Moving around field sites in darkness is inherently more difficult; sampling may be slowed, the 'agility' of the collector may decrease, and taking notes, writing labels, transferring specimens from net or pooter to storage vessels, and pouring preservatives, will all tend to be at least slightly more problematic at night than during the day. The collector's field of view will be limited to that offered by artificial lighting (lanterns, lamps, head torches) and although this may serve to focus the collector's viewpoint, also means animals moving in the peripheral vision may be missed. Frustratingly, the light from a head torch can attract some species that would not appear during daytime samples, and may mean the catch is no longer representative of the immediate sampling area. Conversely, exposure to bright lights can supress typical behaviour of nocturnal species and make them more difficult to locate (Shimoda & Honda 2013).

If differences in species abundance do occur between night and day, then this raises questions about the mechanisms causing these differences. If animals are recorded at *any* time, does this mean they are likely to have been in the general vicinity *all* of the time? If so, differences in their recorded abundance must be due to changes in activity and/or the success of the collecting methods used. If sampling is more or less efficient at different times of day, how and when can we decide that some animals are strictly nocturnal and others totally diurnal? For example, if animals are caught at night but not during the day, how many 'empty' day time samples are required before you can state with a given degree of confidence that the animals are active only at night? (see Hodge & Vink 2017).

We encourage researchers to obtain more data on daily patterns of New Zealand insects. Often, an initial phase of a field entomology research project is used to compare and modify collecting techniques, decide on

minimum sample sizes, and so on, and this development phase could be adapted to include a comparison of day and night-time catches. Although some (or much) of the information obtained might be self-evident, and reinforce knowledge already reported in the literature, with luck some new data or unusual findings may also be gained, and could result in the collecting periods for the main study species becoming more focussed.

Examples of questions that could be easily tested during a pilot study include:

- What differences occur in the observed abundance of target species if hand searching or sweep netting is performed at night compared with day time collecting?
- What do light-traps catch during the day? What time do night-time target species first tend to appear?
- How do the catches of sticky traps and pan traps differ between night and day? Does colour influence night time catches of sticky traps and pan traps?
- What happens to the occupancy rates of ACOs if checked at night compared to being assessed during the day?

In New Zealand, as in many parts of the world, apart from some species deemed important to agriculture, and some other conspicuous species vaunted for conservation status, little tends to be known about the ecology and behaviour of many of the insect species we have in our collections. Knowing an insect's name, where it occurs, and the time of year it was collected, is an obvious first step. With just a little more effort during the collection phase, additional statistics on daily patterns in activity could be obtained, which might just provide an extra line of valuable information on the specimen label.

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