UV FLUORESCENCE IN A CRITICALLY ENDANGERED ISOPOD, *PSEUDOLAUREOLA ATLANTICA* (VANDEL, 1977)

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ABSTRACT

The Critically Endangered Spiky Yellow Woodlouse, *Pseudolaureola atlantica* (Vandel, 1977), has been found to display fluorescence under ultraviolet (UV) light. This has only been documented in one other woodlouse species and provides a unique opportunity to develop a hitherto underutilised and novel survey technique; particularly useful for a rare species in sensitive habitat.

INTRODUCTION

Fluorescence has been noted in a number of invertebrate taxa; scorpions are the most readily recognised group to exhibit fluorescence under ultraviolet (UV) light (e.g. Gaffin *et al.,* 2012). There has been an increase in studies of fluorescence in terrestrial invertebrates, including spiders (Andrews *et al*., 2007), and a number of insects, and many invertebrate groups exhibit some fluorescence (Welch *et al.,* 2012). While many papers look at interactions between fluorescing individuals (Zimmer *et al*., 2002, Guillermo-Ferreira *et al*., 2013), the utility of fluorescence in aiding species detection during surveys has not yet been sufficiently documented.

The Critically Endangered Spiky Yellow Woodlouse, *Pseudolaureola atlantica* (Vandel, 1977) (Isopoda: Armadillidae), is endemic to St Helena, a UK Overseas Territory in the South Atlantic Ocean (Fig. 1). It is one of four species in the genus; the others occur in Madagascar, New Caledonia and South West Australia (Schmalfuss, 2004). *P. atlantica* is restricted to cloud forest habitat on the upper parts of the High Central Ridge, commonly known as the 'Peaks'. It is usually found on vegetation above ground; originally thought to occur on the fern understorey of Black Cabbage Tree (*Melanodendron integrifolium*) woodland, specifically Black Scale Fern (*Diplazium filamentosum*) (Havery *et al*., 2016), but now confirmed to be present on other fern and tree species. In 2015 it was thought that the *P. atlantica* population had become restricted to a single location, approximately the size of a tennis court, but subsequent surveys across the Peaks have revealed a number of new locations.

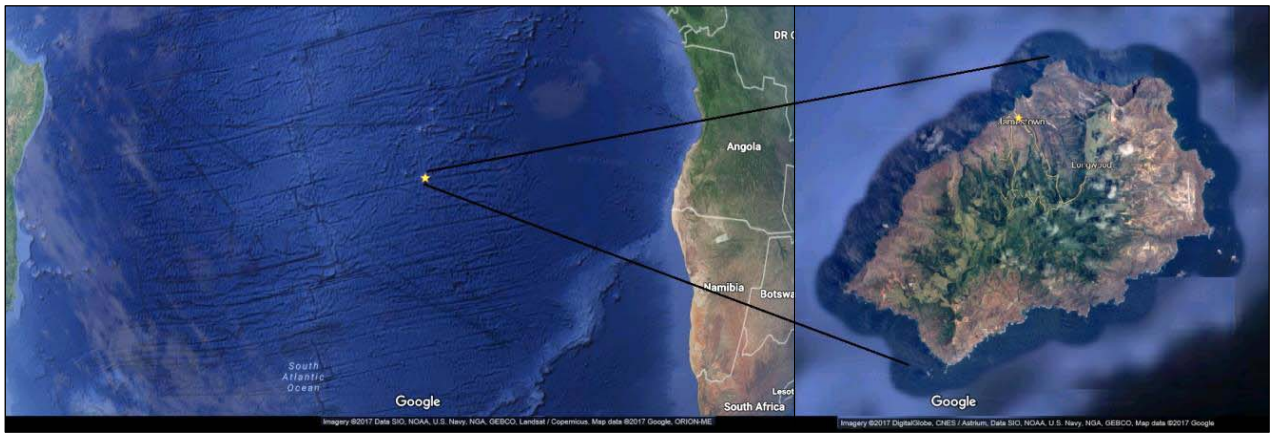

FIGURE 1: Geographic location of St Helena Island, a UK Overseas Territory in the South Atlantic
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St Helena's cloud forest vegetation is highly sensitive, vulnerable to erosion and invasive species, and the terrain and access is difficult, making standard survey techniques difficult to apply. Also, despite their vivid yellow colouration, *P. atlantica* is cryptic against the fern fronds that it is regularly found on, with its spiky outline helping to camouflage it and reduce its detection (Figs. 2A & 2B).

The fluorescence of *P. atlantica* under UV had been previously reported (P. Lambdon, pers. comm.) and was initially investigated by the author to confirm this account. To date, there is only one known study on fluorescence in a woodlouse species; *Mesoniscus graniger* (Frivaldsky, 1863), a cave dwelling species found in Central and Eastern Europe (Giurginca *et al*., 2015).

FIGURE 2: *Pseudolaureola atlantica* A) Two *P. atlantica* on St Helena Tree Fern *Dicksonia arborescens*; B) Close up of an individual Spiky Yellow Woodlouse

FIGURE 3: General habitat photographs
A) Black Cabbage Tree; B) St Helena Tree Fern; C) St Helena Dogwood

SEARCH METHODS

Across the Peaks accessibility varies and care is required to move around away from established paths. This makes it difficult to establish standard search methodologies. There is little deadwood to search and pitfall traps are also inappropriate for this apparently arboreal and rare species.

Daylight searches for this species primarily involve point counts along set routes utilised as transects through the vegetation (Fig. 3). The use of these transects restricts the extent of survey but also prevents excessive habitat disturbance. Single searches at other locations have been undertaken to investigate the extent of *P. atlantica* presence, but repeated visits to numerous locations have been avoided.

Ten minute searches using binoculars are employed for counts in trees, and five minute point searches for areas which can be physically investigated, following methods used in initial searches by fieldworkers for Darwin Initiative Project DPLUS029 'Conserving cloud forest species and their associated invertebrates'. These were found to usually reveal the presence of *P. atlantica* with little difference in numbers between 5 and 10 minute manual searches.

ULTRAVIOLET (UV) TORCH USE

An initial test on identified *P. atlantica* individuals with a small UV torch showed that they did display fluorescence and that this could be used to establish an effective search technique, but that a stronger torch was required. Once procured, an OxyLED 51 LED torch was used for general searches for *P. atlantica* and to conduct five minute UV searches, undertaken in line with the daytime point count technique. A daytime survey was conducted then replicated at night to compare the detection of individuals by eye against fluorescing individuals under the UV torch.

A general walk with the UV torch was undertaken on 1.3 km of public paths on the Peaks where the species could potentially occur. This gave the opportunity to search large amounts of apparently suitable vegetation either side of the path, where the terrain is relatively easy. *P. atlantica* had not been recorded in vegetation adjacent to paths prior to this survey.

Access during the hours of dark are restricted to clear and well-known locations only. The fluorescence of other invertebrate species was also assessed as and when they were found.

RESULTS

Pseudolaureola atlantica displays strong fluorescence (Fig. 4) under UV light (wavelength 395 nm). The use of the UV torch substantially increased the number of individuals located compared to daylight searches. In an initial observation survey, 33 individuals were located in a single five minute point count, where it was originally suspected there may be up to a dozen individuals. It is believed that the UV torch picks up all individuals within 2 metres provided that the vegetation is thoroughly searched. *P. atlantica* appear to exist in discrete 'pockets' within the habitat, and there still seems to be large areas of potential habitat devoid of *P. atlantica*, although access issues makes this difficult to conclusively prove.

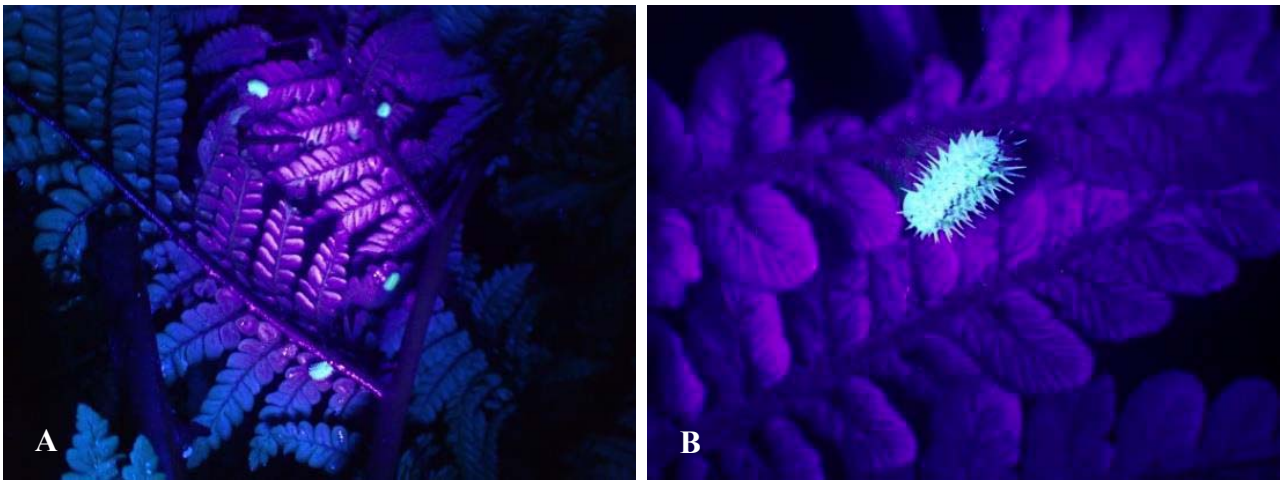

FIGURE 4: The fluorescence of *Pseudolaureola atlantica*
A) *P. atlantica* detected on St Helena Tree Fern under UV light; B) Individual *P. atlantica* fluorescence.

It was found that a second apparently undescribed woodlouse species also fluoresces; this displayed a striped pattern distinct from that of the *P. atlantica*. Other species found during the survey, including isopods and the iconic endemic Golden Sail Spider *Argyrodes mellissi* did not exhibit fluorescence. Searches with the UV light located individuals 2 metres away, and juveniles were also easily seen.

The replication of survey techniques in day and at night has provided a useful indication of the accuracy of the daytime searches (see Fig. 5); generally more individuals were detected with UV light than during daytime searches in two identified *P. atlantica* locations.

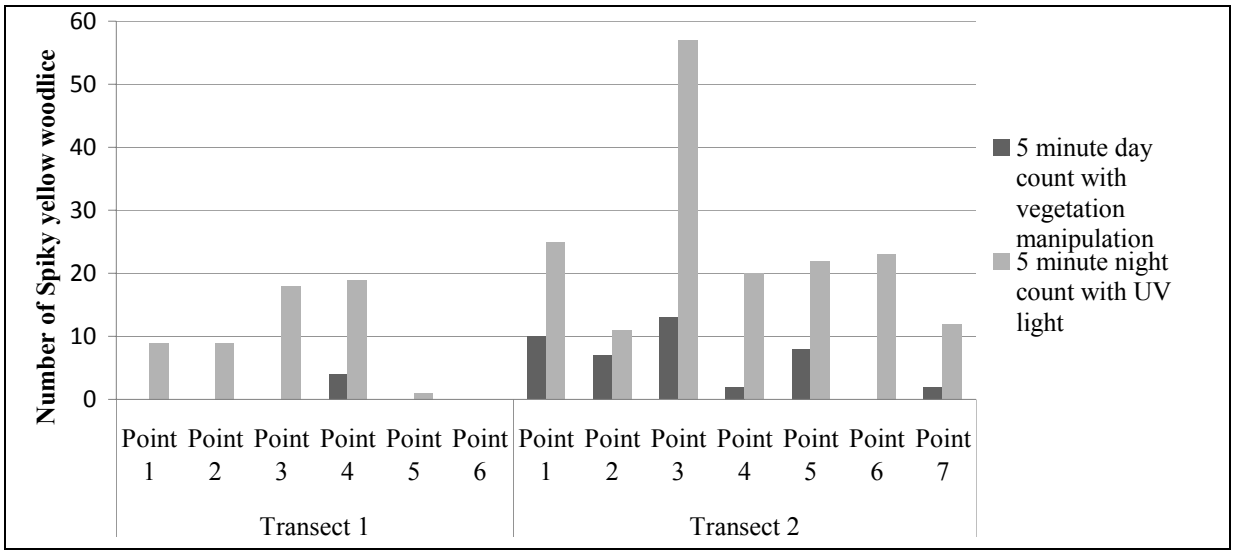

FIGURE 5: Comparison of day and night (UV) surveys for *Pseudolaureola atlantica*

Prior to UV searches no *P. atlantica* had been observed in vegetation along public paths on the Peaks. Walking steadily using the UV torch *P. atlantica* were found on 20 m of path, approximately 50 metres from the closest known location at that time. A five minute timed count was undertaken and 22 individuals were located. This species is under protection from the St Helena Environmental Protection Ordinance (2016) and while knowledge of their locations will help to inform management actions, disturbance of this Critically Endangered species is actively discouraged.

DISCUSSION

The fluorescence of *P. atlantica* under UV has resulted in detection being far easier at night than during the day, where despite its bright yellow appearance it blends into the vegetation. Individuals can be confidently detected at a greater distance at night, even including small juveniles. This method also helped remove observer bias stemming from targeted searching of areas considered to be most suitable habitat as the UV light can be rapidly shone over all vegetation in an area, although the structure of low vegetation still limits visibility in some areas.

Interestingly, several individuals were identified on non-native plant species, something not found previously. While numbers are generally low (up to three individuals), they have been found on Whiteweed (*Austroeupatorium inulifolium*), Bilberry Tree (*Solanum mauritianum*), Bramble (*Rubus pinnatus*), Spoor (*Pittosporum* sp.) and even New Zealand Flax (*Phormium tenax*). This suggests that there is less specificity to its preferences and requirements than originally suspected.

During first few uses of the UV torch, additional locations for the species were found. This makes it an

essential tool for investigating its distribution. While the technique helps to increase the knowledge about population numbers and distribution – with minimal disturbance – its use is limited to areas which can be accessed safely at night, therefore must still be used in conjunction with daytime surveys.

As well as providing a better estimate of presence of *P. atlantica* in some locations, using UV lights also gives more confidence in confirming its absence. Another night walk was undertaken in an area that appeared suitable for the species but where individuals had not yet been found; over 150 metres of potential *P. atlantica* habitat was surveyed but no individuals were found. The specific needs of this species are still not fully understood, and the identification of areas where it is definitely absent, as well as present, is a useful step towards identifying these requirements.

The fluorescence of other species was tested as they were found. None have yet been found to exhibit the strong fluorescence of *P. atlantica*, except for a small apparently undescribed woodlouse species, which was found to have fluorescent stripes. Interestingly, parts of St Helena Tree Fern (*Dicksonia arborescens*), specifically dead or dying fronds, were also found to also display fluorescence, but no direct link can yet be made between this and the fluorescence of *P. atlantica*.

If further rare or cryptic isopods, or other invertebrates, are found to display strong fluorescence then there would be great potential in employing this simple survey technique. UV light has been used to assess coral recruitment (Piniak *et al*., 2005) but has so far been under-utilised as a search technique in research. Investigation into which species are fluorescent is a primary requirement, but the use of a UV torch would be a quick and cheap screening tool to identify potential candidates. It must also be stated that sites, as well as species, should be evaluated on an individual basis for the suitability and applicability of night working.

This paper highlights both an unusual trait found for a woodlouse, but also the potential benefits of novel survey techniques. This may have wide ranging implications for survey work on other fluorescent invertebrates, particularly for iconic species, in those locations where minimal physical disturbance is desirable, or where collection of specimens is inappropriate due to their rarity.

ACKNOWLEDGEMENTS

We would like to thank Phil Lambdon for originally testing the technique.

We are extremely grateful to Lourens Malan, Environmental Management Division (EMD) of St Helena Government (SHG) for extensive field support and advice, including *P. atlantica* population information found through Darwin Plus project DPLUS029.

Andrew Darlow for fieldwork support and Mike Jervois of EMD for help and advice.

Rob Adams, Sasha Bargo, Martin Collins, Liza Fowler, Cynthia Llas and Colin Richards who supported the night fieldwork.

Sarah Havery from Royal Society for the Protection of Birds (RSPB) for extensive support, advice and guidance, and providing a field camera and the UV torch.

Mark Bushell from Bristol Zoological Society for support and provision of high quality head torches to facilitate better night survey work.

Stefano Taiti for advice on woodlice.

This study was conducted as part of the project 'Conserving the Spiky Yellow Woodlouse and Black Cabbage Tree Woodland' DPLUS025 funded by the Darwin Plus Initiative, with additional funding from the RSPB.

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