SHORT COMMUNICATION

POTENTIAL PHYTOPHAGOUS INSECTS OF *PTERIDIUM REVOLUTUM* (BLUME) NAKAI, AN INVASIVE FERN

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26 March 2021 | Vol. 13 | No. 3 | Pages: 18030–18034
DOI: 10.11609/jott.5157.13.3.18030-18034
Potential phytophagous insects of *Pteridium revolutum* (Blume) Nakai, an invasive fern

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Abstract: The article reports an observation on the phytophagous behaviour by the insect larvae of two insect species on a fern, *Pteridium revolutum*, which is fast emerging as an invasive plant species threatening local biodiversity and wildlife in Kerala State, India.

Keywords: Biological control, phytophagous nature, *Pteridium*, Western Ghats.

Bracken ferns (genus *Pteridium*) represent an ancient species complex with a natural worldwide distribution (Der et al. 2009). Notorious as weeds because of its exceptional ability to grow rhizomatosely in dense patches, these ferns are widely reported to overgrow in open fields and pastures (Tryon 1941; Holm et al. 1997). Invasiveness of these clonally growing ferns is attributed to their vigorous vegetative propagation ability and genetic variability (Zhou et al. 2014). *Pteridium revolutum* (Blume) Nakai has reported distribution in diverse ecosystems in India, Sri Lanka, China, Taiwan, southern Japan, Myanmar, the Philippines, Thailand, throughout southeastern Asia, New Guinea, and Australia (Ranil et al. 2010; Deepa et al. 2013). In tropical and subtropical areas of Asia, above 1,000m, *P. revolutum* is perennial with fronds that grow from the robust underground rhizomes, reaching over 1m in height (Zheng et al. 2008).

In Chinese medicine, rhizomes of this fern have uses and the fronds are regarded to be attractive to the landscape (Zhang & Zhang 1986).

Toxic effects on herbivores

Many workers like Smith (1990) and Taylor (1990) have reported that in China, the Bracken Fern *Pteridium* sp. is a very common plant and is often browsed by domestic herbivores, developing several syndromes. Enzootic haematuria, the clinical name of the urinary bladder neoplasia of ruminants (bovine enzootic haematuria), tends to occur persistently in localized bracken infested regions throughout the world. In China, enzootic haematuria of cattle was observed in almost all the provinces where *P. revolutum* occurred, but the disease has not been reported outside of these regions (Leren 1989; Xu 1992). Furthermore, in areas where enzootic haematuria was found, the disease usually occurred in highland or mountainous areas at 950–2,000 m where conditions are suitable for the growth of *P. revolutum* (Xu 1986). Consumption of this fern has also been reported to cause urinary bladder cancer in ruminants. It is also associated with carcinoma of the upper digestive tract of cattle, where it is believed to be caused by the malignant transformation of the bovine papilloma (Jarrett 1987).
The major carcinogen of bracken has been identified as Ptaquiloside, a norsesquiterpenoid glycoside (Niwa et al. 1983; Hirono et al. 1984). This readily undergoes glucose elimination to form an unstable conjugated dieneone intermediate capable of alkylating amino acids and DNA (Fletcher et al. 2011). The mutagenicity (Nagao et al. 1989), clastogenicity (Matsuoka et al. 1989), and carcinogenicity (Hirono et al. 1984) of ptaquiloside have been well demonstrated. Bracken has also been associated with livestock poisoning causing bone marrow damage leading to a fatal hemorrhagic disease of cattle (“Bracken” poisoning), and “bracken staggers” of horses (an effect of thiaminase). Fenwick (1989) had drawn attention to the possibility of indirect consumption of the Bracken carcinogen which may cause or increase the risk of cancer in man.

**Pteridium revolutum**

Rhizomes long-creeping, hairy, subterranean. Stipes and rachises dull yellow brown, bearing abundant non-glandular hairs, stipes 25–60 cm long, 3–6 mm diameter, hard. Laminae broadly ovate or triangular to broader than long, 100 x 30–90 cm, 3-pinnate at base, leathery, dull light green on both surfaces, not mealy on underside. Primary pinnae arising at narrow angles to rachis, the longest 18–60 x 8–45 cm. Secondary pinnae arising at wide angles, the longest 4–25 x 1–4 cm; midribs of primary and secondary pinnae lacking free lobes or wings. Tertiary pinnae all equal in length on each secondary pinna, the longest 0.6–2.5 x 0.3–0.5 cm. Ultimate segments linear, slightly falcate, acute, entire, adnate. Upper lamina surface sparsely hairy along midribs, lower with dense, colourless, spreading, non-glandular hairs throughout. Reflexed lamina margins protecting sori membranous, fimbriate and hairy (Brownsey 1989).

**Natural enemies on Pteridium revolutum**

Generally, the fern is considered unpalatable to many animal and insect species due to the presence of toxic secondary metabolites like ptaquiloside, however, we observed two “natural insect feeders” relishing on bracken population in the Chembra and Thirunelly areas in Wayanad District, Kerala State, India. Similar observations could also be noted at Thrissur District (Vazhachal high altitude region) and Gavi (Periyar Tiger Reserve area) in Kerala State, India. During a survey on the distribution of *Pteridium* in Kerala, insect larvae seen feeding on this fern were collected and carried to the lab for identification. The feeding nature, extent of damage caused etc were carefully observed and recorded.
The collected specimens were later identified as the larvae of two insect species namely, *Spilosoma obliqua* (Lepidoptera: Arctiidae) and *Tetragonus catamitus* (Callidulidae) with the help of insect taxonomists at Kerala Agricultural University (KAU), Kerala State, India.

**Spilosoma obliqua**

*Spilosoma obliqua* Walker (Syn. *Diacrisia obliqua*) (Lepidoptera: Arctiidae), commonly known in Asia as the Bihar hairy caterpillar, is a sporadic but polyphagous plant pest that occurs in Bangladesh, Myanmar, India, Pakistan, and Sri Lanka (Singh & Sehgal 1992). The larvae of this species were found feeding on the frond of the bracken fern in the observed areas.

According to Warad & Kalleshwara (2017), the young larvae are translucent light yellow with dark big head (Plate1). The larval body has number of long hairs arising from dark coloured tubercles. Once fully grown, it is more stout and cylindrical with conspicuous dark anterior and posterior patches. Pupation occurs in the soil. The adults are medium sized brown moths and have pink abdomen with wings pinkish with numerous black spots. The antennae and legs are light brown. The average longevity of the adult male is 4–5 days with an average of 4.40 days. The female is bigger than the male. The abdomen of female is blunt, while the abdomen of male is narrower and pointed.

**Tetragonus catamitus**

*T. catamitus*, though easily identifiable, are difficult to observe in the field but have been reported from Kerala (Sondhi et al. 2018). Since the larvae of *T. catamitus* feed on ferns, they are also known as Fern Moth. Holloway (1998) also mentions that it hosts on genus *Drynaria* and further mentioned that *T. catamitus* in Hong Kong hosts on *Pteridium* (unpublished Initial Environmental Examination Report).

Their eggs are very flat, scale-like (Holloway 1998). Eggs are laid on the underside of fronds or the young stalk of the host plant. Larvae start feeding from the tip of the pinnae and it seems that their strong mandibles help them to eat the central veins. The head and first thoracic segment of the larvae are black and they have well-developed, chitinous, shiny, black prothoracic shields, which are separated by a median green line. The same line splits into two at the base of the head carapace and extends towards the forehead forming a ‘V’ shaped mark. Larvae have grass green, translucent bodies. The head of the observed specimen had two symmetrical pale-whitish triangular patches besides the ‘V’ shaped marking. The head and prothoracic shield on the first thoracic bore several whitish, translucent bristles of various sizes. The pupa is a medium-sized cocoon of an elongated narrow ovate shape, chocolate brown in colour; with a prominent head, which is thickest in the middle, a parallel-sided abdomen forms a cone at the last four segments.

**Potential bio-control agents of Bracken Fern**

Even though Bracken Fern’s foliage has been reported to possess toxicity, we noticed profuse feeding by these two insect larvae in Wayanad District, Kerala State, India. The frond which was being eaten by these two larvae was neither juvenile nor too mature. While *T. catamitus* larvae were observed as feeding on both the veins and leafy portions, *S. obliqua* were avoiding the veins and feeding only on the leaf portion. *S. obliqua* larvae also left a net-like structure around the frond on which it fed. We noticed that *S. obliqua* larvae created more damage compared to *T. catamitus* larvae. The feeding pattern of...
both the larvae was also noticeably different. The larva of *S. obliqua* seems to be concentrating on one frond at a time. As they could not chew the whole frond, some pinnules were left unaffected by the larvae. On the other hand, *T. catamitus* fed at random. Further, the larvae of *T. catamitus* were observed to use the fern frond to make pupa and finally to moth. *S. obliqua* used the fern only for feeding and no sign of any pupa formation in the frond could be seen. The net-like structure caused by the *S. oblique* could make the frond vulnerable in case of forest fire.

**CONCLUSION**

We have observed the ‘invasiveness’ of the Bracken or Eagle Fern *Pteridium revolutum* in the forest ecosystems of Wayanad, Thrissur, and Pathanamthitta districts of Kerala State, India. The threat of this fern is more in the higher altitudes of the Western Ghats landscape, where the unique grassland ecosystem thrives. The phytotoxicity of this ‘weed’ and its impact on native flora and foraging fauna, including wild herbivores must be researched and conclusions drawn to shape their management strategies. As *P. revolutum* possess a long, wide creeping rhizome, its mechanical or physical method of management has severe limitations. On the other hand, any disturbance to its root zone will help the weed to establish more aggressively, *P. revolutum* is also highly resistant to drought and fire, which is another favourable trait of its invasiveness. In the light of these, the potential role of the larvae of *Spilosoma oblique* (Lepidoptera: Arctiidae) and *Tetragonus catamitus* (Callidulidae) to manage this invasive fern merits immediate consideration.

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