From tourist to resident: first breeding record of *Pantala hymenaea* (Odonata: Anisoptera: Libellulidae) in British Columbia, Canada

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The Odonata (dragonflies and damselflies) are among the most recognisable insects, with 6400 species described across the world (Paulson *et al*. 2023). British Columbia (BC), Canada hosts 88 species; the naiads of 85 are known to develop into adults in the province (Cannings 2002). Of the remaining three species, *Archilestes californicus* McLachlan is a recent immigrant from Washington State, United States of America (Cannings and Pym 2017) that is assumed to reproduce and overwinter. *Tramea lacerata* Hagen and *Pantala hymenaea* (Say) (Anisoptera: Libellulidae) are usually considered summer visitors to the region, although the former is regularly observed mating and ovipositing at many sites on southern Vancouver Island (Cannings 2022). *Pantala hymenaea* records are much scarcer: few adults are recorded, and only one ovipositing female has been sighted (Cannings 2002, 2022). Evidence for naiad development or adult emergence of *P. hymenaea* has, until now, never been documented in BC. This note describes the first record of *P. hymenaea* successfully reproducing in the province.

The south campus research pond facility at the University of British Columbia (UBC) (49.24745° N, 123.23277° W) consists of 20 individual ponds (Figure 1). Each rectangular pond is 15 m wide by 25 m long, with a shallow end (10–30 cm) and a deep end (6 m; see Arnegard *et al*. 2014 for a schematic). They are unmanipulated, persist year-round, and are used for different experiments at different times. Each pond varies substantially in its water clarity and the presence and type of aquatic vegetation. Some ponds are clear and densely populated with submerged (stonewort: *Chara* sp. (Charophyceae)), standing (cattail: *Typha* sp. (Typhaceae)), and floating plants (Arnegard *et al*. 2014), whereas others are turbid and contain only deeply submerged plants. Although the threespine stickleback, *Gasterosteus aculeatus* Linnaeus (Scorpaeniformes: Gasterosteidae), is the intended inhabitant of the ponds, other vertebrates such as the Pacific tree frog, *Pseudacris regilla* (Baird and Girard) (Anura: Hylidae), and the American bullfrog, *Lithobates catesbeianus* (Shaw) (Anura: Ranidae) are regularly seen. Large predatory aquatic insects include species in the Hemiptera families Notonectidae, Corixidae, Gerridae, Nepidae, and Belostomatidae. However, the most commonly encountered insects are the Odonata; per Khalifa (2021), species known to breed include members of the Lestidae (*e.g*., *Lestes disjunctus* Sélys), Coenagrionidae (*e.g., Enallagma boreale* Sélys, *Ischnura*

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cervula Sélys), Aeshnidae (*e.g., Anax junius* (Drury), *Rhionaeschna multicolor* (Hagen)), and Libellulidae (*e.g*., *Libellula forensis* Hagen, *Sympetrum illotum* (Hagen)).

Figure 1. The current south campus research pond facility. The facility is comprised of 20 independent and permanent ponds.

On 18 August 2023, the team from the Spencer Entomological Collection at the Beaty Biodiversity Museum (SEM, UBC) and DJL searched for insects in and around the ponds. While collecting naiads of *Libellula forensis* and *Libellula quadrimaculata* Linnaeus from several ponds, DJL captured two anomalous final-instar naiads from Pond 12 (Figure 2). Their morphology did not match that of any dragonfly species observed from the ponds before, suggesting that the species might be new to the area. The unknown naiads were taken to the lab where, upon closer inspection, one had its labial mask musculature retracted and the wing-buds enlarged and spread. These features indicated a late–final instar naiad preparing for metamorphosis (Corbet 1999; Lee *et al*. 2018), so it was placed in a beaker of dechlorinated tap water with a piece of plastic mesh as an emergence support. The other specimen evidently was an early–final instar naiad and, therefore, was housed in a pre-existing dragonfly naiad rearing system (Lee *et al*. 2018). On 29 August, the late–final instar naiad successfully metamorphosed into an adult and was identified as a female *P. hymenaea* according to Cannings (2002). The other naiad, now also identified as *P. hymenaea*, had transitioned to the late-final stage but failed to metamorphose successfully on 4 September. On 30 August, DJL revisited the research ponds to search for more individuals and, although no live naiads were sighted, numerous *P. hymenaea* exuviae were found clinging to the plastic mesh covering one of the water-overflow vents in Pond 12 (Figure 3). An adult dragonfly, trapped under the mesh, was swiftly rescued and identified as a newly emerged male *P.*

hymenaea. The exuvia, lab-emerged adult female, and wild-caught adult male were pinned and deposited in the Beaty Biodiversity Museum (SEM-UBC ODO-9264, 9265, and 9266 respectively; Figure 4). The naiad that failed to metamorphose was preserved as part of DJL's personal collection. On 20 September, Karen Needham (SEM Beaty Biodiversity Museum, UBC) and DJL surveyed the pond facility to look for *P. hymenaea* in ponds other than Pond 12 and discovered exuviae on the plastic mesh covering in Ponds 11 and 20 (one and two exuviae, respectively). In addition to the exuvia of the reared specimen, 13 exuviae were collected from Pond 12; five of these have been deposited in the Beaty Biodiversity Museum (SEM-UBC ODO-9267 to SEM-UBC ODO-9271, inclusive), and seven have been deposited in the Royal BC Museum collection (single ethanol vial, ENT023-002925). That the exuviae were found in at least three different ponds may indicate several females visiting and ovipositing in the area.

Figure 2. Pond 12 where the *Pantala hymenaea* naiads were discovered. There is a noticeable lack of standing and floating aquatic vegetation that would typically be used for emergence by dragonfly naiads.

Although the naiad of *P. hymenaea* has been described in detail (*e.g.,* Kennedy 1923, Landwer and Sites 2006), it is worth highlighting features that distinguish this species from the other dragonflies that inhabit the research ponds. Although the size of the *P. hymenaea* naiads is similar to that of *L. forensis* and *L. quadrimaculata* (DJL, unpublished data), the prominent lateral spines on the ninth abdominal segment of the former species are unique among the dragonfly species known to inhabit the research ponds. Of the naiads collected and observed from the research ponds over the years, *P. hymenaea* is also the only species to have distinct black spots on the dorsal surface of the eighth (lateral) and ninth (mid-dorsal) abdominal segments (Figure 4). An

undocumented but interesting feature of *P. hymenaea* may be its excellent ability to jet water from its rectum, although many genera of Anisoptera can do this (Corbet 1999). When startled, these naiads were able to jet away as fast as Aeshnidae naiads, whereas *L. forensis* and *L. quadrimaculata* were noticeably more sluggish (DJL, unpublished data). This potential difference in jetting ability between *P. hymenaea* and some libellulid species is perhaps linked to differences in locomotion behaviour (predator avoidance, hunting strategy, or substrate preference) and warrants further research.

Figure 3. Two *Pantala hymenaea* exuviae on the mesh covering of the water overflow vent in Pond 12. Eleven exuviae were found on this single mesh.

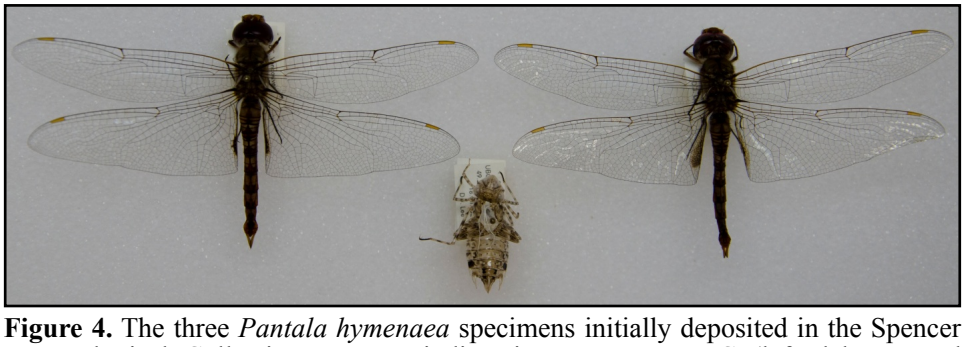

Figure 4. The three *Pantala hymenaea* specimens initially deposited in the Spencer Entomological Collection, Beaty Biodiversity Museum, UBC (left: lab-emerged female SEM-UBC ODO-9265; centre: exuvia SEM-UBC ODO-9264; right: wild-caught male SEM-UBC ODO-9266).

Pantala hymenaea ranges from southern Canada, through much of the United States to the Caribbean, and south to Argentina. In Canada, the species is known from south-coastal BC and Ontario east to New Brunswick and Nova Scotia;

there are isolated records in Manitoba and Alaska (Paulson 2009, 2011). The species reproduces in eastern Canada (Cannings *et al*. 2024). In the West, until now, it had been reported breeding as far north as Grant and Benton counties in the Columbia Basin of Washington State (Paulson 2022), roughly 380 km southeast of the Vancouver locality.

Pantala hymenaea breeds in ponds and slow-flowing streams, often in shallow, newly formed wetlands, temporary ponds, and human-built water bodies, especially those that lack fish (Paulson 2011). Some of these water bodies contain aquatic vegetation; some do not (Walker and Corbet 1975). Of the three ponds where *P. hymenaea* exuviae were collected, Pond 20 contains a permanent threespine stickleback population, while Ponds 11 and 12 housed sticklebacks until early July 2023. Given that mature naiads were collected in mid-August, *P. hymenaea* naiads likely completed much of their development with fish still present in all three ponds. Ponds 11, 12, and 20 are also largely devoid of aquatic vegetation; there is no standing or floating vegetation, and the *Chara* sp. are fully submerged, deep underwater. The presence of *P. hymenaea* in these specific ponds may not be a coincidence; the absence of exposed vegetation largely excludes odonate species that oviposit in plant material and instead promotes those that oviposit directly in the water. These latter species, mostly in the Libellulidae, would directly benefit from reduced competition, and the observed high mobility of *P. hymenaea* naiads perhaps might allow them to outcompete other libellulid species and successfully grow to adulthood.

This note records the first *P. hymenaea* naiads in BC. However, the adult dragonflies are no strangers to the province, having first been sighted by RAC in his garden in Victoria on 23 July 1988 (Cannings 1988). In his observation, he stated that the species' appearance "was not a surprise... given the northern expansion of the species range" and, later, predicted increased sightings in the region following climate warming (Cannings 2002). Indeed, adults of *P. hymenaea* have since been seen five more times (three photographed) in BC between 2004 and 2021 (Cannings 2022), and there were two additional sightings in Richmond and Langley in 2023 (iNaturalist 175055054 and 187796016). Of particular interest is the sighting on 29 June 2021 by Rassim Khelifa (Khelifa 2021), who spotted a lone individual at the same south campus research ponds where the naiads were discovered two years later. The naiads collected and described here are almost certainly the progeny of adults that visited the ponds in 2023, rather than of those from past years. The naiads of *P. hymenaea* are capable of completing development in a single summer (Kennedy 1923), and the emerged adults evidently migrate south out of the province, leaving no progeny to overwinter (Cannings 2002, 2022). Although DJL did not observe any *P. hymenaea* adults at the ponds in the summer of 2022, the sightings in 2021 and 2023 indicate that this species may be repeatedly visiting this location. We surveyed the ponds on 10 July and 30 August 2024 but no adults or exuviae were found, suggesting that *P. hymenaea* does not yet breed annually here.

For decades, the south campus research ponds have proven an ideal location for insects to live and reproduce. The first facility was constructed in 1991 and informally dedicated to Dr. Geoffrey G.E. Scudder, Head of the UBC Department of Zoology (1976–1991), who played a crucial role in constructing the ponds (D. Schluter, personal communication; Figure 5). The original facility,

comprised of multiple permanent ponds, provided safe and reliable breeding grounds for aquatic and terrestrial insects alike, and even after its closure in 2011 (D. Schluter, personal communication), its role as a habitat for species diversity continues in the current research ponds established in 2008.

Figure 5. The name plaque originally created and presented by Dr. Dolph Schluter to Dr. Geoffrey G.E. Scudder in 1991. The plaque is still displayed on the research station in the current pond facility.

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