

NATURAL HISTORY AND OBSERVATIONS

New distribution records and range extensions of mosquitoes (Diptera: Culicidae) in British Columbia and the Yukon Territory

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ABSTRACT We report the first records of (Diptera: Culicidae) *Aedes euedes* Howard, Dyar, and Knab and *Coquillettidia perturbans* (Walker) from Canada's Yukon Territory, and the first record of *Aedes decticus* Howard, Dyar, and Knab from British Columbia. We also report range extensions in northern British Columbia for the western treehole mosquito, *Aedes sierrensis* (Ludlow), the common house mosquito, *Culex pipiens* L., and the cool weather mosquito *Culiseta incidens* (Thomson).

Key words: *Aedes decticus*, *Aedes euedes*, *Coquillettidia perturbans*, *Culex pipiens*, Diptera: Culicidae, mosquito distribution

INTRODUCTION

Large-scale mosquito trapping for West Nile virus (WNV) surveillance has yielded several additions to the mosquito fauna of British Columbia (BC) (Peach 2018b). This effort logically focused on the south of the province, where most of the human population is concentrated and where WNV is most likely to occur. In contrast, northern BC and the Yukon Territory have experienced much lower survey effort, with bioblitzes and individual collecting efforts largely responsible for advances in our knowledge of the mosquito fauna in these areas.

Fifty mosquito species (Diptera: Culicidae) are currently known from BC (Peach 2018b), and 31 from the Yukon Territory (Belton and Belton 1990; Peach 2017, 2018a). Here, we present new distribution records and range extensions from recent mosquito collecting efforts, identified using keys to the mosquitoes of BC (Belton 1983), Canada (Wood *et al.* 1979; Thielman and Hunter 2007), and North America (Darsie and Ward 2005), paired with supporting historical records where available and relevant. We highlight the first records of *Coquillettidia perturbans* (Walker) and *Aedes euedes* Howard, Dyar, and Knab from Canada's Yukon Territory, and the first record of *Ae. decticus* from BC. Although some of these records surely represent species that were historically present and simply went undetected, others may represent more recent extensions of northern range limits brought on by changing climate, anthropogenic dispersal, or an increase of synanthropic habitat availability.

***Aedes decticus* Howard, Dyar, and Knab.** *Aedes decticus* Howard, Dyar, and Knab is an uncommon but widely distributed mosquito (Wood *et al.* 1979). It lacks transverse basal bands of pale scales on its abdominal tergites and has yellow and dark scales on its vertex and postpronotum (Wood *et al.* 1979; Darsie and Ward 2005). Little is known of its life history, but it has been reported in sphagnum bogs and other acidic woodland bogs and pools (Mullen 1971). *Aedes decticus* has been reported from New England, regions surrounding the Great Lakes, Labrador, northern Manitoba, and Alaska (Wood *et al.* 1979). *Aedes decticus* has been previously recorded from the Yukon Territory (Belton and

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Belton 1990), but this has been overlooked in recent literature (Darsie and Ward 2005). *Aedes decticus* will take blood meals from humans (Smith 1952), but little is known about what other sources of vertebrate blood it will take.

One adult female *Ae. decticus* was collected as it attempted to feed on DP at Wye Lake, Yukon Territory, on 12 July 2019, and another as it attempted the same at a bog just north of the town of Watson Lake, BC, on 13 July 2019 (Table 1). Two *Ae. decticus* females were collected as pupae in muskeg beside a pull-off on the Alaska Highway in BC, approximately 5 km southeast of Morley Lake, on 12 July 2019, and successfully reared to adulthood. Another adult was collected attempting to feed on DP at Morley Lake, BC, about 100 m south of the BC–Yukon border on 15 July 2019.

Aedes decticus is undoubtedly present on both sides of the border at the Morley Lake location. While the extent of its range is unknown, the extensive spruce forest and boggy conditions present in northern BC and the Yukon likely provide many localised areas of suitable habitat for this species, and such conditions may extend from Alaska to Labrador.

Table 1. Collection records of adult female or pupal mosquitoes from northern British Columbia (BC) and the Yukon Territory (YT). Specimens are housed in ¹the Beaty Biodiversity Museum, University of British Columbia, Vancouver, BC, Canada, or ²the Royal British Columbia Museum, Victoria, BC, Canada.

Species	Location	Area	Coordinates	No. of Specimens	Date
<i>Aedes decticus</i>	Town of Watson Lake, YT	Wye Lake	60.067, –128.703	1 collected ¹	12 July 2019
	Town of Watson Lake, YT	Unnamed bog	60.091, –128.738	1 collected ¹	13 July 2019
	Northern BC	Morley Lake	59.999, –132.109	1 collected ¹	15 July 2019
	Northern BC	SE of Morley Lake	59.963, –132.046	2 collected as pupae ¹	12 July 2019
<i>Aedes euedes</i>	Whitehorse, YT	Helmut's Pond	60.803, –135.097	1 collected ¹	11 July 2019
	Southern YT	Seaforth Creek	60.442, –133.551	1 collected ¹	12 July 2019
	Southern YT	Liard River	60.020, –128.604	1 collected ¹	14 July 2019
<i>Aedes sierrensis</i>	Tanu	Tanu Island, Haida Gwaii	53.025, –131.775	7 collected ¹	2 July 1981
	Gate Creek	Lyell Island, Haida Gwaii	52.667, –131.5	1 collected ¹	2 July 1981
	Skedans	Louise Island, Haida Gwaii	52.964, –131.608	5 collected ¹	3 July 1981
	Hotspring Island	Hecate Strait, Haida Gwaii	52.583, –131.433	3 collected ¹	3 July 1981

Table 1. continued.

Species	Location	Area	Coordinates	No. of Specimens	Date
	Reef Island	Hecate Strait, Haida Gwaii	52.875, -131.52	1 collected ²	4 July 2001
	Reef Island	Hecate Strait, Haida Gwaii	52.875, -131.52	3 collected ²	22 July 2001
	Queen Charlotte City	Haida Gwaii	53.256, -132.087	1 collected ¹	25 July 2019
<i>Culex pipiens</i>	Valemount, BC	Cranberry Marsh/Starratt Wildlife Management Area	52.816, -119.268	1 collected ¹	19 Aug. 2004
	Valemount, BC	Cranberry Marsh/Starratt Wildlife Management Area	52.819, -119.259	1 collected ¹	9 Sept. 2004
	Prince George, BC	Danson Lagoon	53.831, -122.735	2 collected ¹	11 Aug. 2004
	Prince George, BC	Danson Lagoon	53.831, -122.735	8 collected ¹	27 Aug. 2019
<i>Culiseta incidens</i>	Ross Island	Hecate Strait, Haida Gwaii	52.163, -131.121	2 collected ¹	30 June 1981
	Gate Creek	Lyell Island, Haida Gwaii	52.665, -131.466	3 collected ¹	2 July 1981
	Tanu Island	Hecate Strait, Haida Gwaii	52.766, -131.617	1 collected ¹	2 July 1981
	Petrel Islet	Hippa Island, Haida Gwaii	53.551, -133.011	1 collected ¹	24 July 2019
<i>Coquill ettidia perturbans</i>	Wye Lake	Town of Watson Lake, YT	60.065, -128.701	2 collected ¹	12 July 2019
	Albert Creek bird banding station	Upper Liard, YT	60.062, -128.917	3 observed, 2 collected ¹	13 July 2019
	Coal River Lodge	Coal River, BC	59.657, -126.956	2 collected ¹	14 July 2019

***Aedes euedes* Howard, Dyar, and Knab.** *Aedes euedes* Howard, Dyar, and Knab is a large, uncommon mosquito with bands of pale scales on the tarsi and scattered pale scales on the proboscis, cerci, and posterior to the pale basal bands of the abdominal tergites (Wood *et al.* 1979; Belton 1983; Darsie and Ward 2005). It lacks lower mesepimeral setae and possesses reddish brown scales that form a broad mid-dorsal stripe on the scutum (Wood *et al.* 1979; Belton 1983; Darsie and Ward 2005). It is thought to complete only one generation per year and to breed in permanent or semi-permanent pools in a variety of habitats including woodland, marshes, and grassy areas (Wood *et al.* 1979; Westwood *et al.* 1983).

Aedes euedes has been found in BC, Alberta, the Northwest Territories, and Alaska (Wood *et al.* 1979; Belton 1983; Darsie and Ward 2005; Peach 2018b). *Aedes euedes* was thought to likely be present but undetected in the Yukon Territory (Belton and Belton 1990). In summer 2019, adult females were collected trying to bite DP in an open area near wastewater treatment lagoons outside Whitehorse, Yukon Territory, in the forest on the margins of the Liard River, and along the margins of Seaforth Creek where it crosses the Alaska Highway (Table 1). The latter area was a grassy riparian habitat that contained numerous willows and small marshy areas with surrounding northern forest.

These collections represent the first confirmed records of *Ae. euedes* from the Yukon Territory. This species is likely present at low numbers in suitable habitat throughout the territory, as it has been found as far north as the coast of the Arctic Ocean in the neighbouring Northwest Territories (Wood *et al.* 1979).

***Aedes sierrensis* (Ludlow).** The western treehole mosquito, *Aedes sierrensis* (Ludlow), is a multivoltine species that breeds in water-filled holes in trees and can also occasionally be found in water-filled artificial containers rich in plant debris and leaves. Adults are black with striking bands of pale-yellow scales on the legs and patterns of the same on the scutum.

Aedes sierrensis is an aggressive day-biter that takes blood from warm-blooded animals, including humans (Peyton 1956), and is a vector of dog heartworm, *Dirofilaria immitis* (Belton 1983). *Aedes sierrensis* is found over a broad portion of western North America, from California to northern BC (Belton 1983; Darsie and Ward 2005), wherever mature trees with suitable larval habitat are found. However, it was not previously known to occur north of Terrace or on the islands of BC's north coast. Historical specimens in the Royal BC Museum indicate the presence of *Ae. sierrensis* in the vicinity of Haida Gwaii; an additional specimen collected in August 2019 by C. Stinson in Queen Charlotte City confirms the presence of this species in the area (Table 1). The range of *Ae. sierrensis* may also extend northwards into the Alexander Archipelago.

***Culex pipiens* L.** The northern house mosquito, *Culex pipiens* L., is a multivoltine mosquito native to Eurasia that breeds in stagnant and polluted standing water, including ditches, sewage lagoons, and water-filled containers rich in organic material (Wood *et al.* 1979; Belton 1983). Larvae have an elongated siphon and are often found feeding at the water's surface. Adult *Cx. pipiens* are brown with bands of pale scales on the bases of dark abdominal tergites. This species overwinters as nulliparous adult females that take shelter in locations such as sheds, rodent burrows, tree bark, and rock piles until they emerge to feed the following spring.

Culex pipiens blood-feed primarily from birds, although they will feed on humans as well (Wood *et al.* 1979). These feeding habits make *Cx. pipiens* important vectors of West Nile virus (Hamer *et al.* 2008). *Culex pipiens* have also been observed feeding on a variety of nectar sources, including yarrow, *Achillea millefolium*, and common tansy, *Tanacetum vulgare* (Asteraceae) (Peach and Gries 2020). Previously, *Cx. pipiens* had not been reported north of southern BC (Belton 1983; Darsie and Ward 2005); however, in 2004, two specimens were captured in a CDC (Centres for Disease Control) blacklight trap in Valemount, BC, by T. Brown, and two more at a sewage lagoon in Prince George,

BC. Follow-up trapping in 2019 by LP at the Prince George site resulted in the capture of an additional eight adult female *Cx. pipiens* (Table 1). Suspected *Cx. pipiens* were observed by DP in Kitimat during September 2019, but they evaded capture.

It is likely that cold northern winters restrict the northern limits of *Cx. pipiens* distribution. However, because the species will overwinter in heated artificial structures, it is possible that it can be found in human settlements with suitable breeding conditions much farther north than would be expected, because of warm outbuildings and human transportation of equipment or other materials that may contain adults or eggs.

***Culiseta incidens* (Thomson).** The cool weather mosquito, *Culiseta incidens* (Thomson), is BC's most common and widespread mosquito species (Belton 1983). *Culiseta incidens* is a large mosquito with aggregations of dark scales on the wings, very narrow bands of pale scales on the tarsi, and middorsocentral spots of pale scales and bands of dark and pale scales on the scutum (Belton 1983). This mosquito breeds in artificial containers, ditches, polluted water, storm drains, woodland pools, and coastal and riverine rock pools. Females overwinter in warm, dry locations, such as in sheds, under tree bark, in rock piles, or in rodent burrows.

Culiseta incidens is found in almost every part of BC. However, it was not previously known to occur on Haida Gwaii and other islands along the province's north coast. Historical specimens in the Royal BC Museum indicate the presence of *Cs. incidens* on Haida Gwaii and other islands along the north coast; an additional specimen collected in July 2019 by M. Willie confirms the presence of this species in the area (Table 1). Its range may also extend northwards into the Alexander Archipelago.

***Coquillettidia perturbans* (Walker).** The cattail mosquito, *Coquillettidia perturbans* (Walker), is a univoltine mosquito that breeds in shallow bodies of water, such as swamps, marshes, or shallow lakes, with abundant emergent vegetation and a layer of soft mud or peat at the bottom (Carpenter and LaCasse 1955; Wood *et al.* 1979; Belton 1983). Larvae have a highly modified siphon to attach to, and obtain oxygen from, the roots of emergent aquatic plants (Wood *et al.* 1979). This species overwinters anchored to these roots, submerged in mud (Carpenter and LaCasse 1955; Wood *et al.* 1979). *Coquillettidia perturbans* adults possess bands of pale scales on the tarsi, a band of pale scales in the middle of the tibia, and a mix of large, triangular, black and white scales on the wing veins (Carpenter and LaCasse 1955; Wood *et al.* 1979; Belton 1983). Adults have been reported to feed on nectar from flowers of goldenrod (*Solidago* spp.) (Asteraceae), yarrow (*Asclepias millefolium*), milkweed (*Asclepias* spp.), dogbane (*Apocynum* spp.) (Apocynaceae), and more (Sandholm and Price 1962; Grimstad and DeFoliart 1974).

Coquillettidia perturbans is aggressive, mammalophilic, and a vector of West Nile virus (WNV) and eastern equine encephalitis virus (EEEV) (Turell *et al.* 2005). It has often been described as having a southerly distribution (Wood *et al.* 1979; Belton 1983); however, it has previously been recorded as far north as Fort Nelson, BC (Poirier and Berry 2011).

During the July 2019 Yukon Bioblitz, DP collected several adult *Cq. perturbans* females attempting to blood-feed. The specimens were from two locations in the southern Yukon Territory and one location in northern BC (Table 1).

The collections from Upper Liard and Watson Lake represent the first records of this species and genus in the Yukon Territory and are more than 100 km north and 300 km west of Fort Nelson, previously the most northerly known collection record for *Cq. perturbans* (Poirier and Berry 2011). Both locations were shallow bodies of water with ample emergent vegetation, including variegated pond-lily, *Nuphar variegata* (Nymphaeaceae), water horse-tail, *Equisetum fluviatile* (Equisetaceae), and water smartweed, *Persicaria amphibia* (Polygonaceae), and were within the boreal cordillera ecozone (Canadian Council on Ecological Areas 1996).

The collection site at Coal River, BC, was in the forest beside the Alaska Highway, but because many oxbow lakes are present in the area, we believe our specimens may have originated from these.

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