

## THE ODONATA OF THE BROOKS PENINSULA, VANCOUVER ISLAND, BRITISH COLUMBIA\*

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### ABSTRACT

Collection records of Odonata from the Brooks Peninsula, a little-known region on the northwest coast of Vancouver Island, are presented. Twenty species representing eight genera and five families are listed, along with additional ecological notes. The zoogeography of the Odonata of the British Columbia coast is discussed.

### INTRODUCTION

The Odonata of the outer west coast of British Columbia is poorly known; the few available records for the region are listed in Cannings and Stuart (1977), Cannings (1980), Scudder *et al.* (1976), Walker (1953, 1958) and Walker and Corbet (1975). It is notable that virtually no published records of dragonflies exist for Vancouver Island north of the latitude of Campbell River.

In 1981 a multidisciplinary expedition organized by the B.C. Provincial Museum provided an opportunity to study the insects of the Brooks Peninsula, a remote region, inaccessible by road, on the northwestern coast of Vancouver Island. From 31 July to 14 August 1981, a significant collection of dragonflies (244 adults and 242 larvae) was made in this area. This material enables us, for the first time, to compare the fauna of northern Vancouver Island with that of adjacent regions.

### THE STUDY AREA

The Brooks Peninsula is a rugged rectangle of land, 22km long and 10km wide, projecting into the Pacific Ocean from northwestern Vancouver Island (Figure 1). It lies between 50° 05' and 50° 15'N latitude and 127° 37' and 127° 55'W longitude. The precipitous central ridge reaches an elevation of 1000m, and steep valleys, many containing cirque lakes, run to the south and southeast shores. On the headlands the peaks are rounded and lower, reaching 500m, and are scoured by high winds. On the northwest a broad, undulating lowland extends from the central ridge to the shore. Blanket bogs on this lowland provide the best habitats for dragon flies.

Small pools and channels are frequent in the irregular surface peat deposits in these bogs. An open scrub forest of lodgepole pine (*Pinus contorta*), yellow cedar (*Chamaecyparis nootkatensis*) and western red cedar (*Thuja plicata*) dominates the vegetation. Small shrubs such as salal (*Gaultheria*

*shallon*), labrador tea (*Ledum groenlandicum*) and crowberry (*Empetrum nigrum*) are abundant. Sedges, rushes and grasses as well as diverse herbaceous species cover the ground; especially prevalent are *Scirpus caespitosus*, *Eriophorum polystachion* and *Rhynchospora alba*. Liverworts and mosses, particularly *Racomitrium lanuginosum* and *Sphagnum* species, form mats and hummocks.

The larger lakes are less productive, lacking the extensive organic sediments and aquatic plants prevalent in bog waters. Most have rather steep-sided basins with cobbly shores, usually supporting pockets of *Carex*. Kalmia Lake is an example of this type, although it is adjacent to bogs, unlike others such as Gaultheria Lake which lies in a narrower, more heavily forested basin. Cassiope Lake is the most productive of the non-bog water bodies. It is a shallow pond perched on a ridge at 520m bordered by a small subalpine meadow.

### SPECIES LIST

#### LESTIDAE

##### *Lestes disjunctus* Selys

*L. disjunctus* was only just beginning its flight period in late July on the Brooks Peninsula. At Cassiope Lake on 31 July evaporation of a small pool concentrated the remaining water to a puddle 0.3m x 1.0m x 2cm deep; it contained about 150 full-grown larvae which emerged over the next week. Teneral females were present at Gaultheria Lake on 1 August and recently emerged males flew at Toebiter Bog on 6 August. Copulation and oviposition were observed from 7 August (Brasenia Lake) onwards. Eggs were laid mainly well up on the culms of *Juncus oreganus* in both dry and emergent situations. As most localities mature males only were observed before 12:00h; copulation and oviposition peaked at about 14:00h.

#### COENAGRIONIDAE

##### *Enallagma cyathigerum* (Charpentier)

*E. cyathigerum* and *Lestes disjunctus*, the only Zygoptera collected, are both widely distributed on the Brooks Peninsula. Both were numerous in early

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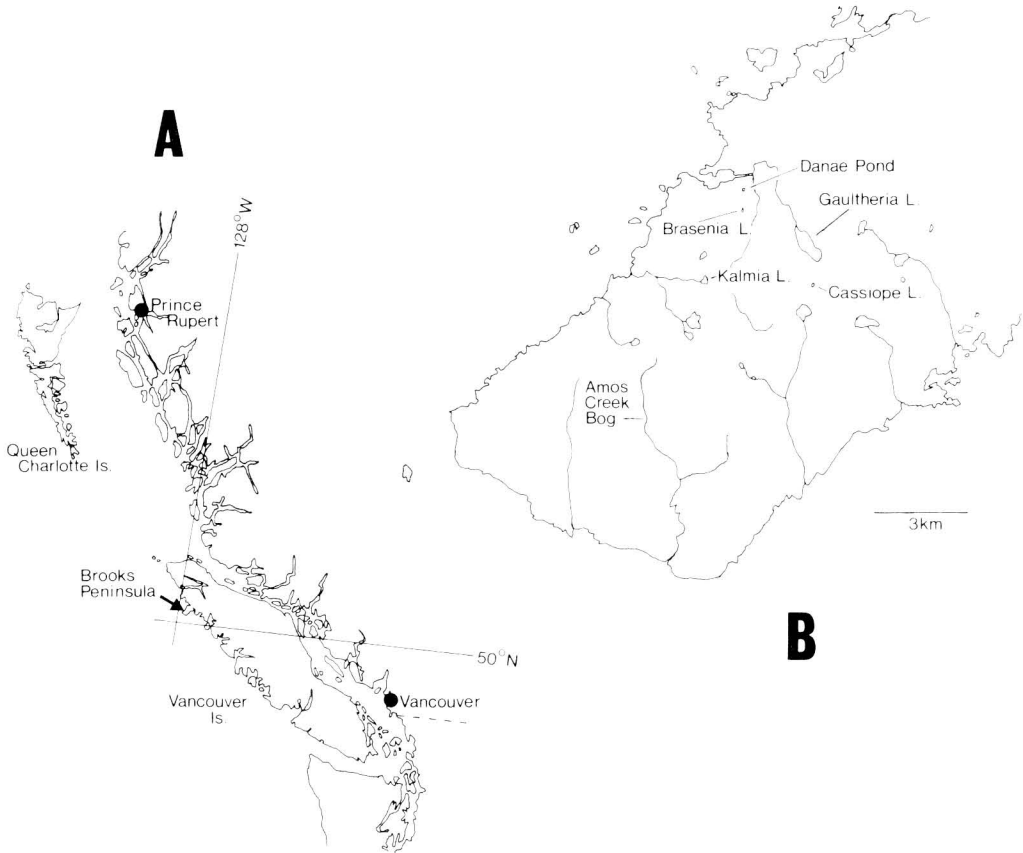


Fig. 1. Study Area. A: Pacific coast of British Columbia showing location of Brooks Peninsula. B: Brooks Peninsula showing main collection sites.

August, although at least part of the *E. cyathigerum* population was mature by the end of July; considerable copulation and oviposition took place at Cassiope Lake on 31 July. In southern British Columbia *E. cyathigerum* emergence usually precedes that of *L. disjunctus* by about six weeks. Immature adults were observed "hilltopping"; specimens were captured on the ridge to the east of Cassiope Lake (700m) on 31 July. Both heterochromatic and homeochromatic phases were present in the female population, some of the latter showing very extensive black pigmentation.

**AESHNIDAE**

***Aeshna eremita* Scudder**

*A. eremita* is the principal dragonfly of the lakes on the Brooks Peninsula in midsummer; oviposition and larval development occurs mainly along the shores of these larger water bodies. A few evidently develop in bog pools (exuviae were collected on 7 August in Brasenia Lake Bog) but this must be a rare occurrence. The species was well into its flight period in early August; all specimens collected were mature. Some observations on temporal activity were made at Kalmia Lake. On 9 August at 20:30h PDT a female oviposited in the algal scum covering

the shoreline stones and males patrolled the water line until 21:30h when it was almost dark. On the mornings of 10 and 11 August males were active at 07:30h, 30 minutes before sunrise and matings occurred as early as 08:35h.

***Aeshna interrupta* Walker**

*A. interrupta* is a common inhabitant of bog ponds on the peninsula. Most males observed flew along the margins of the larger ponds (e.g. Brasenia Lake, Danae Pond) although some larvae and exuviae were collected from bog creek pools. Oviposition was noted on 31 July (Cassiope Lake) and copulation on 6 August (Danae Pond). Most specimens are patterned in the typical coastal form ("*A. interrupta interrupta*"), with lateral thoracic stripes broken into spots, although a few specimens of both sexes show only the posterior stripe broken. This material, like that examined by Cannings (1980) on the northern coast further emphasizes the invalidity of subspecies characterized by variation in thoracic stripes.

***Aeshna juncea* (Linnaeus)**

In the study area *A. juncea* flies in similar habitats to those frequented by *A. interrupta*. In

bogs it is more typical of the larger ponds than the sluggish creek pools, although it is more apt to develop in such pools than is *A. interrupta*. Indeed, *A. juncea* is more widespread than *A. interrupta* and adults and larvae were often found away from bogs (e.g. Headlands Pond, 9 August; The Throne, Mt. Doom, 9 August). On 10 August larvae were found under stones in a dry bog pool with those of *Aeshna sitchensis*, *Somatochlora semicircularis* and *Leucorrhinia hudsonica*. *A. juncea* emerges at least as early as mid July on the Brooks Peninsula (16 June, Prince Rupert [Walker 1958]) since oviposition was noted on 31 July at Cassiope Lake. Emergence continued through early August (6 August, Danae Pond). At 14:15h on 12 August in Brasenia Lake Bog a female oviposited in wet moss clinging to a vertical rock surface on the edge of a drying creek pool.

#### *Aeshna palmata* Hagen

By the end of July on the peninsula *A. palmata* has begun emergence, but most specimens are evidently not sexually mature. Numbers of exuviae were collected in a wide range of habitats from rocky tarns and bog pools to stagnant creek and beach seepage pools. Few adults were captured and no females were seen.

#### *Aeshna sitchensis* Hagen

Detailed observations on the biology of *A. sitchensis* on the Brooks Peninsula are summarized in Cannings (1982). This species is strictly an inhabitant of bogs, males patrolling only where shallow pools had dried during the recent warm weather. Females deposited eggs in the algal mat crusted on the bottom of the dried pools or sometimes in the lower parts of peaty, vertical pool banks. Larvae evidently can survive summer drought in these pool basins; active larvae, both half-grown and almost fully-grown, were found under stones embedded in the dry mud (Cannings 1982).

#### *Aeshna umbrosa* Walker

*A. umbrosa* is closely related to *A. palmata* and shares similar habitats on the peninsula. Adult males were especially prevalent along the deeply incised, sluggish and often intermittent streams dissecting the lowland bogs. Adults were not observed before 5 August, and no copulation or oviposition was noted.

### CORDULIIDAE

#### *Cordulia shurtleffi* Scudder

A single final instar larva of *C. shurtleffi* was collected in *Carex* along the shore of Kalmia Lake on 10 August. The absence of adults from the collection indicates the species' early flight period; in June and early July *C. shurtleffi* is probably one of the common species of the bogs and lakes of the Brooks Peninsula.

#### *Somatochlora albicincta* (Burmeister)

With *Aeshna eremita*, *S. albicincta* is the characteristic anisopteran of the shorelines of the larger lakes on the peninsula. It is also common over the large bog ponds, but seldom ventures in the

drier parts of bogs inhabited by *Aesha sitchensis* and *Somatochlora semicircularis*. Oviposition was observed from 31 July (Cassiope Lake) to 11 August (Kalmia Lake). On 7 August at Brasenia Lake a female oviposited among the floating leaves of *Nuphar polysepalum* and *Brasenia schreberi*, dropping eggs into three or four centimetres of water over flocculent mud. At Kalmia Lake females oviposited both far out in the lake among *Nuphar* leaves and along the shore in two to three centimetres of water over algae-covered stones. In this location egg-laying occurred between 08:20h and 11:20h. At Cassiope Lake a pitfall trap set 60cm from the water's edge and examined on 11 August contained a full-grown larva about to transform into an adult. Specimens of *S. albicincta* are extremely large; a series of 18 males averages 51.4mm in total length (excluding anal appendages) and 33.4mm in hind wing length. Ranges of these two measurements are 49.0-53.0mm and 32.0-35.0mm respectively.

#### *Somatochlora semicircularis* (Selys)

Although usually tolerant of a wide variety of aquatic habitats, *S. semicircularis* on the Brooks Peninsula is restricted to bogs and especially to those parts of bogs containing small drying pools, runnels and streamlets. A male was captured "hilltopping" on the ridge above Cassiope Lake (700m) on 31 July. Most oviposition occurs in mid-afternoon; examples include a female dipping eggs in tiny puddles 10cm in diameter in a dry creek bed at Toebiter Bog (8 August) and another ovipositing in 10cm deep water over soft mud and algae in a bog pool 0.5m in diameter near Kalmia Lake (11 August).

### LIBELLULIDAE

#### *Leucorrhinia glacialis* Hagen

Only two males of *L. glacialis* were collected. One at Brasenia Lake on 7 August was less than three days old; the other, collected at Kalmia Lake on 11 August, was mature. The species is apparently an uncommon inhabitant of bog ponds on the peninsula.

#### *Leucorrhinia hudsonica* (Selys)

*L. hudsonica* was the most collected of the genus in the study area, flying mainly in bogs, but also occurring in small, marshy lakes such as Cassiope Lake (31 July, exuviae). By early August on the peninsula, most of the species' flight period is evidently over. Larvae were found in drying creek pools (Brasenia Lake Bog, 7 August) and under stones embedded in the mud of dried bog pools (Kalmia Lake Bog, 10 August).

#### *Leucorrhinia proxima* Calvert

One male of *L. proxima* was captured at Kalmia Lake, 11 August.

#### *Libellula quadrimaculata* Linnaeus

*L. quadrimaculata* occurred only in lowland bogs but was abundant around the larger ponds in these habitats. Between 16:15h and 16:45h on 5 August at Amos Creek Bog, pairs were mating and females ovipositing in the shallow water at the cen-

tre of a pool. At Kalmia Lake Bog on 11 August males first appeared at 09:30h and females began egg-laying at 11:15h.

*Sympetrum costiferum* (Hagen)

The presence of *S. costiferum* on the Brooks Peninsula is known from only two exuviae, found at Brasenia Lake on 7 August and at Danae Pond on 6 August. Although the species is known to emerge a month earlier than these dates in southern B.C. (Cannings and Stuart 1977), first emergence likely had just occurred.

*Sympetrum danae* (Sulzer)

Of *Sympetrum* species *S. danae* is perhaps the most characteristic of *Sphagnum* bogs, and in such habitats on the Brooks Peninsula it is abundant. In early August the species was well into its flight period although emergence continued throughout the study (Danae Pond, 3 August; Brasenia Lake, 7, 12 August). Oviposition always occurred in tandem flight.

*Sympetrum occidentale* Bartenev

*S. occidentale* is likely a rare species on the Brooks Peninsula as it is not typical of cool climates. Larvae only were collected (Cassiope Lake, 31 July; Brasenia Lake, 7 August; Kalmia Lake Bog, 10 August); emergence evidently had not yet begun. Most initial emergence in southern B.C. does not occur until after the third week of July (Cannings and Stuart 1977).

*Sympetrum madidum* (Hagen)

The distinctive exuviae of *S. madidum* were located at Danae Pond on 6 August. No adults were seen. The species is usually local and not found in large numbers; it would be easily overlooked if emergence had just occurred.

*Sympetrum pallipes* (Hagen)

*S. pallipes* was common in bogs throughout the study. Most of the population was mature, but a teneral female was recorded at Danae Pond on 6 August. Mating and oviposition occurred throughout the study. On 12 August at Brasenia Lake Bog 50 per cent of the oviposition was done by lone females, 25 per cent by tandem pairs and 25

per cent by females being guarded by males close by. Eggs were dropped from a height of 5 to 15 cm into dry parts of the bog dominated by *Carex* and *Sphagnum*. Oviposition peaked about 14:00h.

DISCUSSION

Twenty species in eight genera and five families were collected, four of the species only as larvae or exuviae. This species total is 25 percent of the provincial fauna. Although the study lasted only two weeks, it encompassed the height of the probably short flying period of most local species. Consistently fine weather produced efficient collecting, and all suitable habitats were sampled. We estimate that 80 percent of the total local fauna was observed. In comparison, similar habitat in the Queen Charlotte Islands has to date produced only 13 species while a greater range of habitats and much more extensive collecting on southern Vancouver Island and the Lower Mainland has accounted for 53 species.

The dragonfly fauna of the central and northern coast is predominantly Boreal and Holarctic in distribution with few species having Western, Southwestern or Southern Transcontinental ranges. Table 1 illustrates this zoogeographic pattern. The Holarctic and Boreal components decrease southward and the percentage of species originating in strictly western and southern transcontinental regions increases southwards. The Queen Charlotte Island fauna is completely northern in origin while the Brooks Peninsula fauna is 85 percent so composed (Cordilleran species are a boreal element confined to the western mountains while the Western element includes species with Great Basin, Sonoran or Pacific Coastal origins). Species abundant on the Brooks Peninsula but absent from the Queen Charlotte Islands despite large amounts of suitable habitat include the Boreal *Aeshna interrupta*, the Cordilleran *Somatochlora semicircularis* and the Western *Sympetrum pallipes*. On the Brooks Peninsula the three species of the Western faunal element (*Sympetrum madidum*, *S. occidentale* and *S. pallipes*) are probably near their northern limit on the cool, wet outer coast.

TABLE 1. Percentage composition of the Odonata fauna of various west coast regions in British Columbia based on species distribution.

	Holarctic	Boreal	Cordilleran	Western	Southern Transcontinental
Queen Charlotte Islands (n=13)	23	70	7	-	-
Brooks Peninsula (n=20)	15	60	10	15	-
Southern Vancouver Island (S. of 50 N. lat.) (n=49)	10	27	5	31	27
Lower Mainland (n=51)	10	25	8	33	24

TABLE 2. Ecological separation of species observed as adults.

Habitat	Species (in approximate order of abundance)
Bogs:	
a) large ponds	<u>Lestes disjunctus</u> , <u>Sympetrum danae</u> , <u>Enallagma cyathigerum</u> , <u>Aeshna interrupta</u> , <u>Libellula quadrimaculata</u> , <u>Aeshna juncea</u> , <u>Somatochlora albicincta</u> , <u>Leucorrhinia hudsonica</u> , <u>L. glacialis</u> , <u>L. proxima</u>
b) small pools runnels, often dry	<u>Lestes disjunctus</u> , <u>Sympetrum pallipes</u> , <u>Aeshna sitchensis</u> , <u>Sympetrum danae</u> , <u>Somatochlora semicircularis</u>
c) sluggish creek pools	<u>Aeshna umbrosa</u> , <u>A. juncea</u> , <u>A. interrupta</u> , <u>A. palmata</u> , <u>Somatochlora semicircularis</u>
Lakes	<u>Aeshna eremita</u> , <u>Somatochlora albicincta</u> , <u>Enallagma cyathigerum</u>
Mountain Ponds	<u>Lestes disjunctus</u> , <u>Enallagma cyathigerum</u> , <u>Aeshna juncea</u> , <u>A. interrupta</u> , <u>Somatochlora albicincta</u> , <u>Aeshna palmata</u>
Upper Beach Seepage Pools	<u>Aeshna umbrosa</u>

Table 2 illustrates the ecological separation of species observed as adults. Some species such as *Lestes disjunctus* and *Enallagma cyathigerum* or even *Aeshna juncea* have wide environmental tolerances while others, *Aeshna eremita*, *A. sitchensis* and *Somatochlora semicircularis*, for example, are restricted to circumscribed habitats. Such spatial separation of species may be even more important in cool, often inclement climates such as is found on the Brooks Peninsula than in the more amenable ones to the south and east. It appears that many species here (e.g. *Lestes disjunctus*, *Aeshna palmata*, *Sympetrum costiferum*) begin adult life a month or more later than they do on the south coast or at the same latitude in the B.C. Interior. This shortening of the community's overall flight period

results in a greater overlap of these restricted specific flight periods, perhaps increasing both intra- and interspecific competition.

At the same time the mild but wet climate produces a long larval growing season which may help to explain the large size of some adult specimens, notably those of *Somatochlora albicincta*. It has long been known that this species reaches a greater size in British Columbia than in other parts of Boreal America (Walker and Corbet 1975). Specimens from high elevations in southern B.C. and from sea level in Alaska are considerably smaller than those from sea level on the central B.C. coast (Whitehouse 1941); those from the Brooks Peninsula are as big as, or bigger than, any previously recorded.

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## THE APHIDS (HOMOPTERA:APHIDIDAE) OF BRITISH COLUMBIA

### 11. FURTHER ADDITIONS

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#### ABSTRACT

Ten species of aphids and new host records are added to the taxonomic list of the aphids of British Columbia.

#### INTRODUCTION

The previous seven lists of the aphids of British Columbia (Forbes, Frazer and MacCarthy 1973; Forbes, Frazer and Chan 1974; Forbes and Chan 1976, 1978, 1980, 1981; Forbes, Chan and Footitt 1982) recorded 341 species of aphids collected from 708 different host plants. This comprises 1298 aphid-host plant associations.

The present list adds 10 aphid species (indicated with an asterisk in the list) and 78 aphid-host plant associations to the previous lists. Thirty-five of the new aphid-host plant associations are plant species not in the previous lists. The additions bring the number of known aphid species in British Columbia to 351. Aphids have now been collected from 743 different host plants and the total number of aphid-host plant associations is 1376.

The names of aphids are in conformity with Eastop and Hille Ris Lambers (1976) and are arranged alphabetically by species. The location of each collection site can be determined from the tables of localities in the previous papers.

#### LIST OF SPECIES

##### ADIANTI (Oestlund), SITOBION

*Pellaea glabella* var. *simplex*: Vancouver (CDA), Jul 14/82.

##### ALBIFRONS Essig, MACROSIPHUM

*Lupinus arboreus*: Vancouver (UBC), Jul 15/83.  
*Lupinus nootkatensis* var. *nootkatensis*: Vancouver (UBC), Jul 15/83.

##### AMERICANUM (Riley), ERIOSOMA

*Ulmus americana*: Kelowna, Jun 12/82, Aug 22/81.

##### AQUILEGIAE (Essig), KAKIMIA

*Aquilegia vulgaris*: Vancouver (UBC), Jun 11/79.

##### ASCALONICUS (Doncaster), MYZUS

*Coluta australis*: Vancouver (UBC), May 8/81.  
*Erigeron speciosus* var. *speciosus*: Vancouver (UBC), May 8/81.  
*Potentilla gracilis* var. *glabrata*: Vancouver (UBC), May 8/81.  
*Pulmonaria officinalis*: Vancouver (UBC), Aug 24/79.

##### AVENAE (Fabricius), SITOBION

*Hordeum vulgare*: Vancouver (CDA), Dec 1/80.

##### BETAE Doane, PEMPHIGUS

*Lactuca sativa*: Abbotsford, Aug 23/82.

##### BRACCGII (Gillette), CINARA

*Picea sitchensis*: Terrace, Aug 26/82.

##### BRASSICAE (Linnaeus), BREVICORYNE

*Brassica 'Osaka Red'*: Vancouver (UBC), Oct 2/81.

##### \*CALIFORNICA Hille Ris Lambers,

##### NEARCTAPHIS

*Sorbus aucuparia*: Vancouver, Jul 2/81.

##### CALIFORNICUM (Clarke), MACROSIPHUM

*Salix triandra*: Vancouver (UBC), Jul 15/83.

##### CERASI (Fabricius), MYZUS

*Galium aparine*: Cloverdale, Aug 24/82.  
*Nasturtium officinale*: Vancouver, Mar 1/82.

##### CIRCUMFLEXUM (Buckton), AULACORTHUM

*Fumaria officinalis*: Vancouver (UBC), Aug 18/83.  
*Pilularia globulifera*: Vancouver (UBC), Jun 24/81, Jul 16/81.  
*Scheffera octophylla*: Vancouver, May 25/81.

##### CRACCIVORA Koch, APHIS

*Picea* sp.: Surrey, Aug 23/82.

##### CRATAEGARIUS (Walker), OVATUS

*Origanum vulgare*: Vancouver, Dec 7/81.