Ephemeroptera of the Bella Coola and Owikeno Lake watersheds, British Columbia Central Coast

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ABSTRACT

Collection records of Ephemeroptera from the Bella Coola and Owikeno Lake watersheds on the British Columbia central coast are presented for the first time. Twenty-six species, representing eleven genera and five families, are listed along with ecological notes.

INTRODUCTION

The Ephemeroptera (Mayflies) of the British Columbia central coast have not yet been characterized. No published collection records exist for this area (Scudder 1975). Between June 1987 and August 1990, one of the authors (M.W.) collected and identified at least 26 different Ephemeroptera species from the Bella Coola and Owikeno Lake watersheds. This report summarizes the findings.

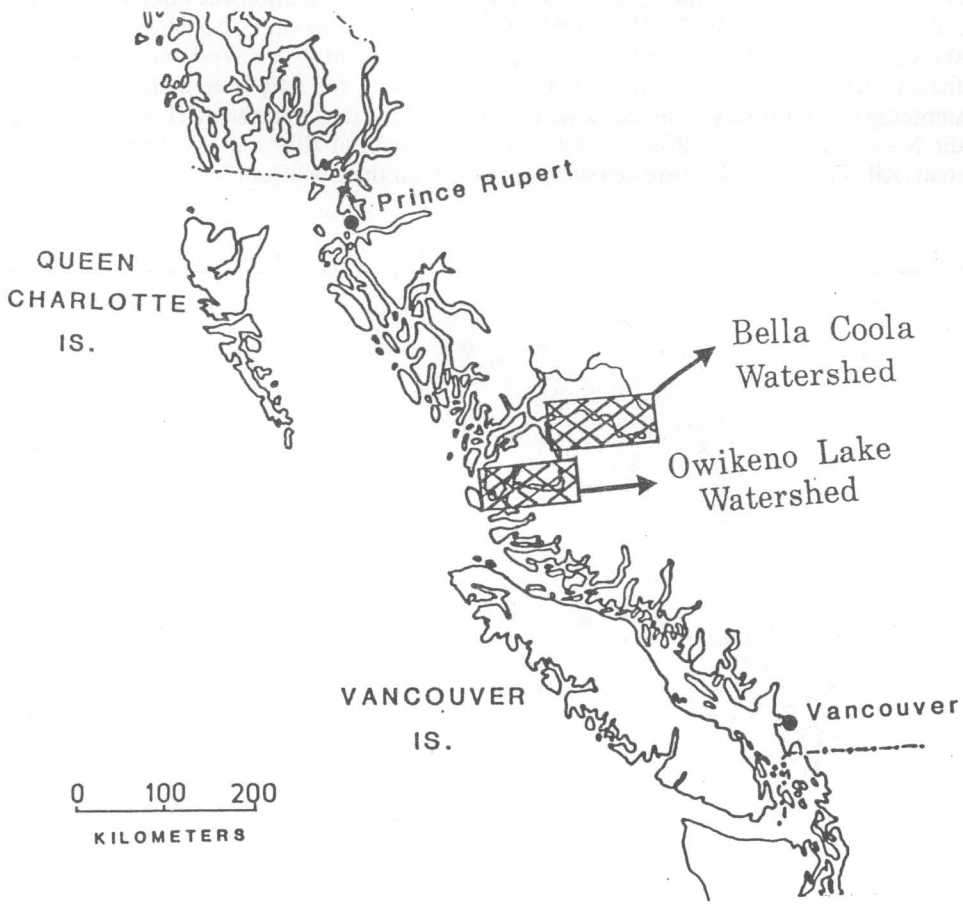

Fig. 1. Pacific Coast of British Columbia showing the location of the Bella Coola and Owikeno Lake watershed areas.

THE STUDY AREA

Mayfly (Ephemeroptera) nymphs and adults were collected from the Bella Coola and Owikeno Lake drainage systems (Fig. 1). These watersheds are situated in the rugged Coast Mountains of British Columbia between latitudes 51°30′ and 52°30′ N, and longitudes 125°15′ and 127°15′ W. This area of the British Columbia central coast features numerous fjords, channels, and mountains which rise sharply from valley bottoms at less than 150 m elevation to peaks exceeding 2,400 m in less than 4 km. Mean annual precipitation exceeds 250 cm. The predominant biogeoclimatic zones in the two watersheds are Coast Western Hemlock at low elevations, Mountain Hemlock at subalpine levels, and Alpine Tundra at the highest elevations (Baer 1973, Leaney and Morris 1981). Highway 20 connects Bella Coola, at the head of North Bentinck Arm with Williams Lake, 480 km to the east but Owikeno Lake is accessible only by boat, plane, or helicopter. Logging roads have been built in many of the main valleys opening into the Bella Coola valley, and into Owikeno Lake, and these provide some access into the terrain.

The Bella Coola River system drains an area of approximately 6,500 km^2, whereas the Owikeno Lake system drains a slightly smaller area (Leaney and Morris 1981). Fig. 2 and 3 show the primary collection sites. There were nine primary collection sites in the Bella Coola watershed, namely: Thorsen Creek, Snootli Creek, Sato Creek, Lower Fish Creek, Salloomt River, Noosgulch River, Nusatsum River, the Atnarko River and spawning channel, and Leech Lake. Sato Creek and Lower Fish Creek are two small creeks located in Hagensborg. There were nine primary collection sites in the Owikeno Lake watershed, namely: Dallery Creek, Ashlum Creek (two sites), Neechanz River, the shores of Owikeno Lake near Genesee Creek, Sheemahant River, Washwash River, and Inziana River (two sites) (Fig. 3.). Benthic sampling for mayfly nymphs and aerial sampling for adults was confined to the lower reaches of the streams and rivers except for the Nusatsum River sampling site located 25 km south of Highway 20 along a logging road. All collection sites were below 500 m except for the Nusatsum River site which was

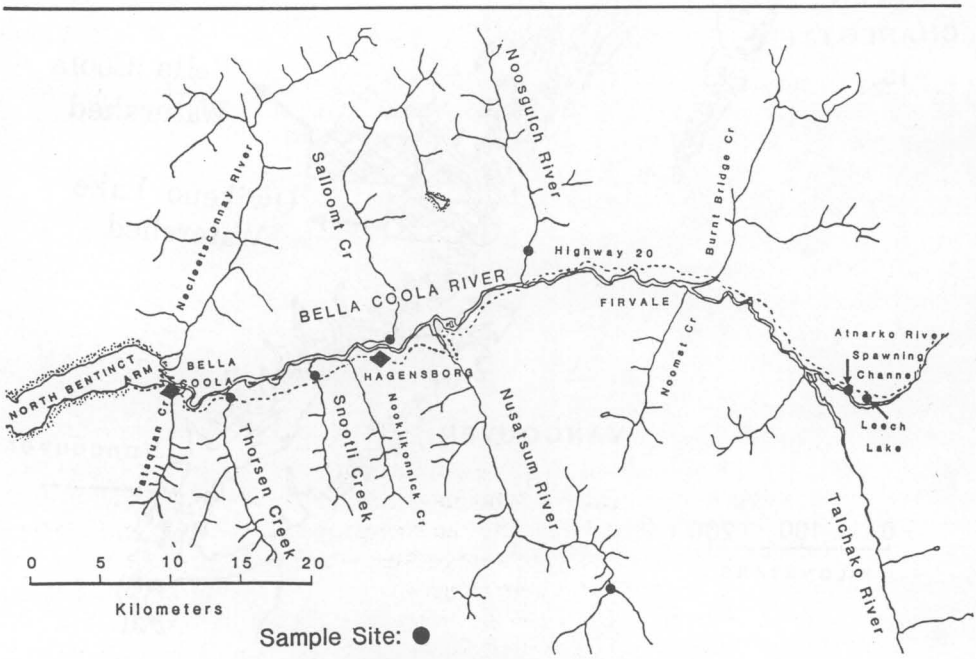

Fig. 2. Bella Coola watershed showing the main collection sites.

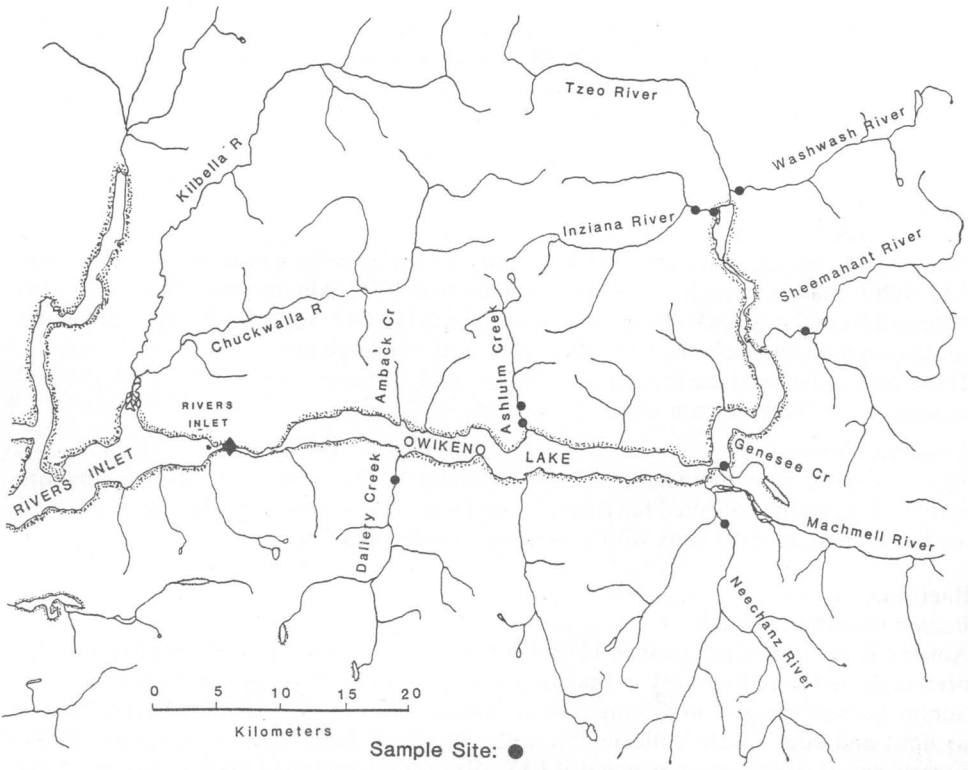

Fig. 3. Owikeno Lake watershed showing the main collection sites.

at approximately 900 m elevation. Most collection sites featured relatively shallow, clear, moderate to fast flowing water with gravel and cobble substrate. The Atnarko River spawning channel has slow to moderate flowing, clear water; Leech Lake is a small, still kettle pond; the Sheemahant River is a moderate to fast flowing river with high glacial silt load. All creeks and rivers sampled are glacier fed, except for the Atnarko River and Leech Lake. The former flows from several large lakes; the latter is fed from spring or ground water (Hynes 1970).

METHODS

From June 1987 to August 1990 mayfly (Ephemeroptera) nymphs and adults were collected from the Owikeno Lake, and Bella Coola River areas. Streams with noticeable flows were sampled using a Surber-type benthic sampler with a mesh size of 1.0 mm. Ponds, lakes and backwater sloughs were sampled with a plankton tow net through submerged vegetation of the littoral zone. Adults were sampled by sweeps through aerial mating swarms, sweeps through stream-side vegetation, and some were also collected by handpicking them from the streamside vegetation (usually females) or cobble and rubble stream banks (usually subimago males and females) (Pennak 1978). Hand constructed emergence traps made with 1.0 mm sized mesh were used from May 1990 to August 1990 in Sato Creek, Lower Fish Creek, and Salloomt Creek collection sites. Mature nymphs from collection sites were introduced into the emergence traps. Traps were checked regularly for emerging subimagos, these were collected in wide mouth jars and reared to imagos at home. Water temperatures were frequently recorded at collection sites with a field thermometer. All specimens were identified with the aid of a Kyowa SDZ-TR stereomicroscope. Articles and keys used for identification were those of Allen and Edmunds (1962, 1963, 1965), Day (1956), Edmunds *et al.* (1976), Edmunds and Allen

(1964), Jensen (1966), Lehmkuhl (1968, 1970a, 1970b, 1971, 1979), McCafferty (1983), Morihara and McCafferty (1979) and Traver (1935). Existing geographic ranges were determined primarily from Allen (1980), Jensen (1966), and Scudder (1975). The specimens were stored in 70% isopropyl alcohol and were given to the Royal British Columbia Museum, Victoria, B.C. for verification and preservation.

SPECIES LIST

Siphlonuridae

Ameletus validus McDunnough

Washwash River, approximately 100 meters upstream from the mouth at Owikeno Lake, 7-IX-1989, mature nymph. Water temperature was 10°C. Mature specimens were also collected from the Atnarko River spawning channel in October of 1990. Typical habitat consists of moderate velocity riffle runs with small and large gravel and cobble substrate. These findings extend the known distribution of *A. validus* in British Columbia northwesterly from the Penticton area.

Ameletus species

Snootli Creek, near the Snootli Creek Hatchery outflow creek, 17-II-1989, mature nymph. Specimens collected have been quite large, 16–18 mm long. Habitat consists of moderate velocity riffle runs with gravel and cobble substrate.

Baetidae

Baetis tricaudatus Dodds

Atnarko River spawning channel, 12-II-1989, mature nymphs. Mature nymphs have also been collected from February to May in the main Atnarko River and in Thorsen Creek. Subimago and imagos were collected in March 1990 in the Atnarko River. Mature nymphs and adults were collected from the Owikeno Lake area in September 1989. Emergence of subimagos was noted, 13-IX-1989, at the mouth of Dallery Creek. Water temperature was 10°C. These subimagos were held to maturity for identification. Typical habitat consists of moderate flow riffle runs with gravel and cobble substrate. These findings extend the known range of *B. tricaudatus* in British Columbia northwesterly from the Salmon Arm area.

Baetis bicaudatus Dodds

Washwash River, approximately 100 meters from the mouth at Owikeno Lake, 23-IX-1989, mature nymphs. Water temperature was 10°C. Mature nymphs were also found in other Owikeno Lake streams throughout September 1989, and the Bella Coola watershed, including the Upper Nusatsum River collection site, 15-VII-1989. Typical habitat consists of moderate flow riffle runs with gravel and cobble substrate. These findings extend the known distribution of *B. bicaudatus* in British Columbia northwesterly from the Lillooet area.

Callibaetis nigritus Banks

Leech Lake, 10-IV-1989, mature male nymph and four male imagos. The mature nymph was collected in submerged weed habitat of the lake shore. The imagos were observed in a mating swarm over the entire one hectare lake surface. Swarm height was between 0.3 to 1.5 meters above the surface. Dragonflies, damselflies, and cutthroat trout were feeding heavily on spent swarmers and emerging subimagos at this time. Nymphs have also been found in other slow flow to stagnant ponds in the Bella Coola watershed, *e.g.*, Millpond along the Salloomt Road near Hagensborg, and Walker Island beaver pond near Snootli Park. Nymphs are most plentiful from fall to spring. These findings extend the known distribution of *C. nigritus* west from the Springhouse, Chilcotin area.

Heptageniidae

Cinygma integrum Eaton

Dump Creek approximately 300 meters upstream from Highway 20 and 200 meters east of Thorsen Creek, 8-II-1989, nymph. Nymphs have also been found from May to July in small feeder creeks near outflows into mainstem creeks and rivers of the Bella Coola watershed. Water temperatures typically range from 9 to 13°C at these sites. Imago males and females were collected throughout June and July 1990 at Sato Creek. On clear, warm evenings, females were observed exhibiting egg depositional behavior. This behavior consisted of the females hovering between 30 to 100 cm above water, then dropping and touching their egg covered abdominal tips to the water surface. Two females repeated this hovering and dropping behavior approximately 30 times before flying vertically upwards and out of sight. Nymphal habitat is characteristically slow to moderate flow riffle runs, usually associated with submerged wood and cobble substrate. These findings extend the known range of *C. integrum* northerly along the Pacific coast from the Alto Lake and Mons areas.

Cinygmula uniformis McDunnough

Atnarko River, 22-IV-1990, mature nymphs, male and female subimagos. Subimagos were reared to imagos. Water temperature was 7°C. Sample area consisted of moderate flow riffle runs with gravel substrate. The range of this species is extended northwesterly from the Penticton area.

Cinygmula species

Atnarko River spawning channel, 11-IV-1989, mature nymphs and male and female subimagos. These specimens vary markedly in size and general body coloration. The sample area consists of moderate flow riffle runs with gravel substrate.

Epeorus (*Ironopsis*) *grandis* McDunnough

Upper Nusatsum River, 1-VII-1989, mature nymphs. Mature nymphs were abundant at this collection site until mid-July. Mature nymphs have also been collected in the lower reaches of Thorsen Creek and the Atnarko River spawning channel. Habitat is characteristically moderate to fast flow riffle runs with gravel and cobble substrate. Upper Nusatsum River, 9-VII-1989 and 15-VII-1989, male and female imagos. The female imagos were collected on streamside vegetation near midday. The male imagos were collected from a small mating swarm over a side channel of the Nusatsum River. The swarm height ranged from 1.5 to 4 meters above the water surface between 1130 to 1500 hours. Water temperature was 11.5°C and weather warm and sunny with cloudy periods. Winds were negligible. These findings extend the known range of this species northwesterly from the Hedley, Seton Lake, and Peachland areas of British Columbia.

Epeorus (*Iron*) *albertae* McDunnough

Atnarko River, approximately 300 meters downstream from Fisheries Pool, 6-VII-1989 and 9-VII-1990, mature nymphs. These specimens were collected from an area of moderate to fast flow with gravel and cobble substrate. Water temperatures were 16 to 17°C and depth approximately 20 to 40 cm. The range for this species is extended northwesterly from the Summerland area.

Epeorus (*Iron*) *longimanus* Eaton

Thorsen Creek, approximately 200 meters downstream from Highway 20 bridge, 2-VII-1989, mature nymphs. Mature nymphs have also been collected from Nusatsum, Salloomt, and Noosgulch Rivers throughout July 1989. Typical habitat consists of fast flow riffles with cobble substrate. A single male subimago was collected on the evening of 28-V-1990 over Sato Creek. These findings extend the known range of *E. longimanus* northerly along the Pacific Coast from the Alta Lake area.

Epeorus (*Iron*) *deceptivus* McDunnough

Ashlum Creek approximately 200 meters upstream from the mouth of Owikeno Lake, 8-IX-1989, mature nymphs. Water temperature was 9.5°C. Noosgulch River approx-

imately 5 kilometers upstream from the mouth at Bella Coola River, 22-VII-1989, mature nymphs. Specimens have also been collected from the Sheemahant River (12-IX-1989), Inziana River (19-IX-1989) (Fig. 3), and the Atnarko River spawning channel (May 1989) (Fig. 1). Habitat is characteristically moderate to fast flow riffle rapids with gravel and cobble substrate. These findings extend the known range of *E. deceptivus* in British Columbia westerly from the Barkerville area.

Epeorus (*Ironodes*) *nitidus* Eaton
Sato Creek, approximately 2 km east of Hagensborg, 30-XI-1989, intermediately developed nymphs. Nymphs were collected in moderate flow, shallow riffles, approximately 10 cm deep, under cobble size rocks of substrate. Water temperature was approximately 5.5°C. The specimens in this nymphal collection range from light gray-brown to darker yellow brown (ochrous) to reddish brown. Specimens range in length from 7 to 10 mm. Wingpads were noticeable but not fully developed. Because of difficulty in identifying these nymphs to species, additional nymphs were collected from Sato Creek and Lower Fish Creek on a monthly basis between December 1989 to July 1990. Nymph maturation was characterized by minimal increase in total length, but progressive development of wingpads. A female subimago was observed emerging at 1500 hours 1-VI-1990 from Lower Fish Creek on a clear, warm day. Water temperature was 8°C. Additional subimagos were collected from emergence traps between 26-V-1990 and 7-VII-1990 and reared to imagos. *E. nitidus* has not previously been listed for British Columbia (Scudder 1975).

Rithrogena hageni Eaton
Salloomt River approximately 1 km upstream from the mouth at the Bella Coola River, 2-VII-1989, single nymph. Additional mature nymphs were collected in July and August 1990. These specimens were collected in moderate to fast riffle runs with gravel and cobble substrate. These specimens extend the range of *R. hageni* in British Columbia northwesterly from Summerland and Steelhead areas.

Rithrogena robusta Dodds
Upper Nusatsum River collection site, 1-VII-1989, mature nymphs. The specimens were collected from fast flow riffle rapids with gravel cobble and boulder substrate. Water temperature was 9 to 10°C. Upper Nusatsum River collection site, 15-VII-1989, two male imagos and two female imagos. A mating swarm consisting of 60 to 70 males and females in a vertical column 3 to 12 meters above the water surface was observed from 1200 to 1600 hours. Weather was sunny and warm with intermittent clouds. There was no wind. Water temperature was approximately 11°C. These specimens extend the known range of *R. robusta* in British Columbia northwesterly from the Keremeos area.

Leptophlebiidae
Paraleptophlebia debilis Walker
Mill pond approximately one km north on Salloomt Road, 31-VII-1989, male imagos. A male swarm was observed and collected over a beaver pond shoreline at approximately 2000 hours on a clear evening. They showed a vertical rise and fall of approximately 40 to 50 cm at a height just above vegetation, *i.e.*, 1 to 2.5 meters above ground level. A similar male swarm was observed near the Walker Island beaver pond near Snootli Creek (14-VII-1989). Lower Fish Creek, 28-VI-1989, four female imagos and one subimago. These females were found on streamside vegetation on the underside of leaves. Owikeno Lake shore, 9-IX-1989, mature nymphs and male imagos. Mature nymphs were collected in the gravel and cobble shallows of the lake shore near the mouths of creeks and rivers. Adults were observed in small swarms along the shoreline until mid-morning in shaded areas. Nymphs have also been found in many of the creeks and rivers in the Bella Coola watershed. Mature nymphs seem more abundant in the quiet backwaters of creeks and rivers, whereas the immature nymphs seem to be more abundant in moderate flow riffle run habitats. These findings extend the known range of *P. debilis* in British Columbia northerly along the Pacific coast from the Agassiz and Nicola Creek areas.

Paraleptophlebia temporalis McDunnough
Atnarko River spawning channel, 5-II-1989, nymphs. Specimens were collected in slow to moderate flow runs with gravel substrates. Sato Creek, 29-V-1990, five female imagos. Weather was warm and sunny but these female imagos were collected in a heavily shaded area of the creek between 1600 and 1630 hours. Water temperature was 9°C. The females were observed exhibiting ovipositing behavior. They would hover 10 to 15 cm over the water surface and then move in quick up and down motions approximately 15 cm distances before dropping to the water surface. These female imagos repeated this sequence several times before they were collected. Collected female imagos had whitish egg masses protruding from their genital openings. These nymph and imago specimens extend the known range of *P. temporalis* in British Columbia northerly along the Pacific coast from the Alto Lake and Mons areas.

Paraleptophlebia vaciva Eaton
Upper Nusatsum River, 2-VII-1990, three male imagos. These were observed and collected from a mating swarm located over a logged clearing approximately 75 meters from the river. Swarm height was between 1.5 to 3 meters above ground level. Weather was clear, sunny, and warm and the specimens were collected between 1000 to 1200 hours. The known range of *P. vaciva* is extended northwesterly from Clinton, Mt. Apex, Hope and Keremeos areas.

Ephemerellidae
Drunella coloradensis Dodds
Upper Nusatsum River collection site, 9-VII-1989, nymphs. Nymphs collected at this time were generally at an intermediate stage of development with small wing pads and were approximately 8 to 10 mm long. Mature nymphs found were approximately 12 to 14 mm long. Washwash River approximately 100 meters upstream from the mouth at Owikeno Lake, 7-IX-1989, mature nymphs, cast and male subimago. All specimens collected at this time were mature and ranged from 11 to 14 mm long. Typical habitat for *D. coloradensis* in these areas consisted of moderate to fast flow riffle runs with gravel and cobble substrate and 10°C water. The range for this species in British Columbia is extended along the Pacific coast northerly from the Capilano River area near Vancouver.

Drunella doddsi Needham
Upper Nusatsum River collection site, 30-VII-1989, mature nymphs and subimagos. Subimagos were observed emerging from a fast flow riffle rapids area at this time. Mature nymphs collected from this area were observed undergoing ecdysis. Water temperature was approximately 13 to 14°C. Mature nymphs of *D. doddsi* have also been collected from numerous creeks and rivers of moderate to fast flow with clean gravel and cobble substrates in the Bella Coola watershed. The finding of these specimens fills a gap between the Kispiox River area and the lower mainland around the Alouette River, Capilano River and Skagit River areas.

Drunella flavilinea McDunnough
Atnarko River approximately 300 meters downstream from Fisheries Pool, 6-VIII-1989, one nymph. This single nymph was collected from a moderate flow riffle run habitat with gravel and cobble substrate. Water temperature was approximately 17°C. At the same site on 9-VII-1990, mature nymphs were collected in abundance. To date we have had no success rearing adults in emergence traps. The presence of *D. flavilinea* in the Atnarko River may be due to the noticeably warmer water temperature of this river compared to other creeks and rivers in the Bella Coola watershed (Jensen 1966). The presence of these specimens in the Bella Coola watershed extends the known range of *D. flavilinea* in British Columbia northerly along the Pacific coast.

Drunella grandis ingens McDunnough
Atnarko River spawning channel, April/May 1989, mature nymphs. Specimens have also been collected from many of the creeks and rivers of the Bella Coola watershed. Typical

habitat consists of slow to moderate flow associated with gravel substrates or among submerged vegetation. Nymphs are abundant in these habitats until June, then are negligible in summer samples except at higher elevations. Immature nymphs were found in samples from October. The range of this species in British Columbia is extended northwesterly from Oliver, Summerland, Penticton, and Peachland areas.

Drunella spinifera Needham
Upper Nusatsum River collection site, 9-VII-1989, mature nymphs. Specimens were collected from moderate to fast flow riffle runs with gravel and cobble substrates throughout July 1989 at this site. The range of this species in British Columbia is extended northerly along the Pacific coast from the Alouette River area.

Ephemerella aurivillii Eaton
Atnarko River spawning channel, IV-1989, mature nymphs. Mature nymphs have also been collected from many other creeks and rivers of the Bella Coola watershed. Specimens are usually collected from moderate flow riffle runs with gravel and cobble substrates. Some specimens have been found in submerged weeds in slow to moderate flow creeks and, in many cases, in association with *D. grandis ingens*. The finding of *E. aurivillii* in the Bella Coola watershed extends the known range northwesterly from the Cache Creek area.

Ephemerella inermis McDunnough
Upper Nusatsum River collection site, 15-VII-1989, nymphs. Specimens were collected from moderate flow riffle runs with gravel and cobble substrates. The finding of *E. inermis* in the Bella Coola watershed extends the range of this species in British Columbia northerly along the Pacific coast from the Alouette River area. Other specimens have come from the Penticton and Shuswap Lake areas.

Ephemerella infrequens McDunnough
Salloomt River, 15-VII-1990, mature nymphs. Two female imagos were reared in emergence traps. Water temperature was 10°C. The range of this species in British Columbia is extended northwesterly from the Seton Lake area.

Serratella tibialis McDunnough
Noosgulch River approximately 300 meters upstream from the mouth at the Bella Coola River, 13-VIII-1989, mature nymphs. Specimens are typically found in moderate to fast flow riffle runs with gravel and cobble substrate. Mature specimens of *S. tibialis* have also been found in samples taken from creeks and rivers of the Owikeeno Lake watershed. They were relatively abundant in samples taken until mid-September; thereafter a decline in numbers collected was noticed. Salloomt River, 26-VII-1990 throughout August 1990, male and female imagos reared in emergence traps. The range of this species in British Columbia has been extended northerly along the Pacific coast from the Mosquito Creek area near Vancouver.

DISCUSSION

Twenty-six Ephemeroptera species in eleven genera and five families were collected from the Bella Coola and Owikeno Lake watersheds in the British Columbia central coast. This preliminary list for the area represents approximately 25 percent of the known provincial fauna. The geographic ranges for nine species are extended north along the British Columbia Pacific coast; for twelve species, they are extended northwesterly; and for two species are extended westerly. The finding of *Drunella doddsi* Needham fills in a gap between the Kispiox River and lower mainland collection sites such as the Capilano River, Alouette River, and Skagit River. *Epeorus* (*Ironodes*) *nitidus* is recorded for the first time in British Columbia. This species has been collected in Oregon, U.S.A. (Jensen 1966). *Drunella flavilinea* and *Epeorus albertae* were found only in the Atnarko River. This river is unique in being warmer (summer range of 16 to 18°C) than the vast majority of rivers and creeks in the central coast (summer range 10 to 14°C). Jensen (1966) had previously noted that both *D. flavilinea* and *E. albertae* occupy the warmer portions of

streams. The finding of bivoltism for *Baetis tricaudatus* in the central coast is consistent with previous reports in other areas (Edmunds *et al.* 1976). There appears to be two or possibly three species of the genus *Cinygmula* indigenous to the area. Mature nymphs of *Cinygmula* have been collected in the spring and fall and several of these vary markedly in size and general body coloration. Hopefully more adult specimens will eventually be collected or reared in an aquarium or emergence trap to verify this premise. It should be pointed out that the majority of sampling sites were below 500 meters altitude, and in moderate to fast flowing glacial streams with gravel and cobble substrate. Future plans include sampling higher elevation streams, rivers and mountain lakes, and also the gathering of more seasonal and quantitative information.

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