PROVINCIAL FISHERIES RESOURCE, TERRESTIAL AND MARINE MAMMALS, REPTILES AND AMPHIBIANS OF THE SQUAMISH ESTUARY MANAGEMENT PLANNING AREA

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I. INTRODUCTION

The Squamish River estuary has long been recognized for its importance to fish and wildlife resources. This is realized when one considers that the anadromous fish populations of six river systems (the Squamish, Mamquam, Cheakamus, Elaho, Ashlu and Stawamus) depend upon the Squamish estuary for estuarine habitat.
Knowledge of terrestial mammals in the Squamish estuary is limited, but blacktail deer and black bear as well as several other species are known to occur in the area.
Several species of marine mammals occur in the estuary, including harbour seals and killer whales.

This report will serve as a summary of available data on Provincial fisheries resources as well as terrestial and marine mammals, reptiles and amphibians.
Information on these resources is limited. Data gaps have been identified where they are apparent. Information concerning birds in the estuary is not included as this will be compiled by the Canadian Wildlife Service. Saltwater and commercial fisheries resources will be considered by the Fisheries and Marine Service of the Department of Fisheries and Oceans.

II. PROVINCIAL FISHERIES RESOURCES

A. Species Present

The British Columbia Fish and Wildlife Branch is responsible for the protection and management of all freshwater fish, including anadromous trout and char, that occur within the province. A complete list of fish species under provincial jurisdiction that occur in the Squamish estuary is not available. Only a few species are known to occur, as recorded in the existing literature. These are:

Salmo gairdneri (Rainbow trout, Steelhead trout)
Salmo clarki clarki (Coastal Cutthroat trout, Sea-run Coastal Cutthroat)
Salvelinus malma (Dolly Varden char)
Gasterosteus aculeatus (Three-spined Stickleback)
Cottidae (Sculpin)
Petromyzontidae (Lamprey)

Of these species, only the trouts and char are important recreationally.

This is not to imply that the remaining species are considered of little importance, for they may have great importance ecologically. None-the-less, of the limited information that is available, most of it deals with the trouts and char. For this reason, this report will deal primarily with these salmonid species.

B. Biology

Rainbow trout occur in both resident and anadromous (steelhead) forms. Rainbow are spring spawners and all age classes can be found in the system throughout the year. Steelhead migrate upstream to spawn from December through July, with the majority of the run occurring from March to May, peaking in April. Following emergence from the gravel in the summer months, the fry rear from one to three years before migrating downstream to the sea. The downstream smolt migration occurs primarily from March to July with the peak occurring in April (Clark, Pers. Comm. 1980). Most steelhead return to their spawning stream for the first time in their third to sixth year (they spend from one to three years at sea).

Both anadromous and resident coastal cutthroat trout are present in the Squamish system. Resident cutthroat can be found in all age classes throughout the year. Cutthroat are spring spawners, with sea-run fish returning to the rivers in late fall and early winter. Anadromous cutthroat juveniles remain in freshwater for two to three years before migrating to the sea. The downstream migration often coincides with that of juvenile salmon (Scott and Crossman, 1973). Sea-run cutthroat trout usually remain within the influence of the river or go only a short distance to sea. They stay in and near estuaries, sometimes returning to freshwater to feed. Johnston and Mercer (1976) reviewed data on sea-run cutthroat and noted that studies have indicated that these fish stay at sea for varying lengths of time, but virtually all return to freshwater in the same year they migrated out.

Detailed information regarding Dolly Varden char in the Squamish system is limited, but both resident and sea-run forms are present. Dolly Varden are fall spawners. The upstream migration of sea-run fish generally coincides with that of salmon, i.e. from August to November (Clark, 1980). Following emergence in the spring, anadromous Dolly Varden fry spend 2 to 4 years in freshwater prior to migrating to the sea. Scott and Crossman (1973) note that Dolly Varden seaward migration generally occurs from May to June. They also noted that Dolly Varden spend anywhere from 60 to 160 days in the sea and that they usually tend to remain near river mouths or a short distance from them.

C. Distribution

Little is known about the actual distribution of trout and char in the Squamish estuary. Goodman and Vroom (1972) concluded that on the basis of catch size, the old Squamish River channel (middle arm) provides the most favourable habitat for juvenile salmonids.

Levy and Levings (1978) studied the fish community of the Squamish River estuary with emphasis on relative abundance, seasonal changes and feeding habits of salmonids. They consider cutthroat trout and Dolly Varden char to be permanent residents of the estuary. They found that adult cutthroat were present year-round, while juvenile cutthroat utilized the estuary from June to August. Dolly Varden were also present all year, but were not as abundant as cutthroat.

Reynolds (Pers. Comm., 1980) stated that cutthroat trout are present in the middle arm throughout the year. This species and Dolly Varden are thought to be most abundant in May when chinook and pink salmon juveniles are in the estuary.

Although not substantiated by detailed study, it appears that most steelhead juveniles spend little time in the estuary prior to their departure to the sea. This assumption is based on scale analysis which showed marginal estuarine growth periods for Squamish River winter steelhead (Caverly, 1978). However, as part of a two year steelhead investigation of the Squamish River, Clark (1978) captured juvenile steelhead in the Squamish mainstem in October just north of the west delta. These fish were noted to be 3 year old pre-smolts. It could be expected that they would stay in the estuary area until the following April when they would migrate to sea. In both 1978 and 1979, Clark noted the presence of steelhead juveniles in Monmouth Creek, the only west-side tributary in the lower 20 miles of the Squamish River that supports a significant steelhead population.

Small numbers of steelhead, cutthroat, Dolly Varden, sculpin, stickleback, and lamprey were caught by Argue and Armstrong (1977) during a coho smolt tagging program in 1974 and 1975 on Meighn Creek, Tenderfoot Creek and the Little Stawamus River. Steelhead, cutthroat and sculpin were trapped in all three creeks whereas Dolly Varden were only captured in the Little Stawamus River and stickleback only in Meighn Creek. Lamprey were present in both Meighn Creek and the Little Stawamus River. Based on size, most of the trout were judged to be age 1, however, a few cutthroat spawners were captured as well. The authors noted that steelhead smolt migration peaked during or just before the last week in April.

No population estimates are available for cutthroat and Dolly Varden in the Squamish system. Clark (1979) determined the average total run of steelhead in the Squamish River system to be approximately 2000 fish per year. This figure is based on recent creel census data, biophysical study, and statistical harvest analysis. This is a fairly accurate estimate of the number of steelhead that return to the Squamish system each year. An estimate of the number of steelhead smolts migrating through the estuary can be obtained by back-calculating the smolt to adult survival ratio. The Salmonid Enhancement Program (1979) estimates an 8% smolt-to-adult survival for natural steelhead stocks. Based on the estimated return of 2000 adults, the number of steelhead smolts migrating through the estuary each spring would be approximately 25,000 fish.

D. Diet of Trout and Char in the Estuary

Some work relating to diet preferences of fish utilizing the estuary has been done, some of which applies to cutthroat trout and Dolly Varden char. Unfortunately, there is no similar information for steelhead.

Sibert (no date) noted that salmonids and herring, when caught in the inner estuary, depended heavily on amphipods and other benthic invertebrates.

Levy and Levings (1978) analyzed the stomach contents of several salmonid species in the estuary. From 28 samples of cutthroat trout (pooled over a one-year period) they determined that over 50% of the diet was composed of Anisogammarus (an amphipod) with Neomysis (a shrimp) making up over 25%. The rest of the diet consisted of Gnorimosphaeroma (an isopod), Corophium (a tube-dwelling amphipod), fish, and Crangon (a shrimp). Seasonal differences in the diet of cutthroat trout were also investigated. It was found that there is a dramatic shift in feeding behaviour from Anisogammarus in the fall and winter to Neomysis during the summer. No substantiated explanation was offered, but it was suggested that differences in summer tidal patterns at low tide during daylight hours may make Neomysis more vulnerable to predation by fish. A total of 18 Dolly Varden were caught at different times of the year. Pooled samples indicated, in order of decreasing proportion, that the diet consisted of Anisogammarus, Neomysis, fish (mostly juvenile staghorn sculpin) and Crangon. It is interesting to note that Levy and Levings found no cases of predation by cutthroat or Dolly Varden on salmon although Dolly Varden in particular are often considered to be voracious predators of juvenile salmon.

Levings (1972) noted that the southern shorelines of the central and east delta harboured the maximum amphipod biomass, about four times that of the west delta. This correlates well with the observation of Goodman and Vroom (1972) regarding the high incidence of juvenile salmonids in the old Squamish River channel (middle arm), which they feel provides the most favourable habitat for juvenile salmonids in the inner estuary.

Cliff and Stockner (1973) state that the food-chain of paramount importance in the Squamish estuary originates on the inter-tidal marshlands with the production of benthic amphipods, the obvious food preference of juvenile salmonids. They conclude that for every acre of marshland destroyed there is a proportionate loss in carrying capacity for juvenile salmonids in the estuary.

E. The Recreational Fishery

The Squamish River system presently supports a major sport fishery primarily centered on steelhead (and salmon), but which also includes cutthroat trout and Dolly Varden char. Data on resident and sea-run cutthroat and Dolly Varden is not available, but Clark (Pers. Comm., 1980) notes that these species also contribute to the sport fishery.

The steelhead fishery in the Squamish system is considered to be one of the finest in the Lower Mainland area, and one of the better fisheries in the entire province.

The Fish and Wildlife Branch (1980) has assessed adult steelhead return and the steelhead recreational fishery of the Squamish River system (see Table I). This assessment was derived from combined analysis of statistical harvest data, creel census data, and biophysical study.

Table I - Estimates of Average Annual Run Size, Harvest and Escapement of Steelhead in the Squamish River System

Stream	Total(1) Run	Number(2) Killed	Number(2) Released	Total(3) Catch	Angler(2) Effort (Days)	Escapement(1) to Spawning Grounds
Squamish Mainstem	890	292	289	581	3226	598
Cheakamus River	674	158	228	386	2676	516
Mamquam River	284	32	28	60	360	252
Other Tributaries	95	5	4	9	81	90
Total	1943	487	549	1036	6343	1456

(1) Estimates from combined analysis of 5-year harvest data (1974-1979), creel census data, and biophysical study.

(2) Based on 5-year average of harvest analysis data (1974-1979). A reduction of 32.6% has been incorporated for correction of sample return bias.

(3) Sum of number killed and number released.

The social and economic aspects of the Squamish River fishery assumes great importance when one considers the close proximity of the fishery to the Greater Vancouver area, Canada's third largest population centre. It is conceivable that alteration or loss of habitat in the Squamish estuary could have profound effects on

the fish populations of the Squamish system and, in turn, on a large and important sport fishery.

F. Enhancement

Several opportunities for enhancement of steelhead stocks in the Squamish system exist or are being considered. Headwater stocking of Ashlu Creek is to be undertaken as a continuing program beginning this year. Approximately 80,000 steelhead fry raised from upper Squamish River brood stock will be released to barren upstream habitat in Ashlu Creek each year. It is hoped that this program will result in a net increase of 600 fish/year to the Squamish recreational fishery.

There is a possibility of a hatchery being constructed on the Cheakamus River through the Salmonid Enhancement Program. Such a hatchery would be built primarily for enhancement of salmon stocks, but might include facilities for production of approximately 1000 steelhead. Consideration is being given to further enhancing steelhead numbers through a program involving lake pen rearing of fry derived from Squamish brood stock. The fry would be raised in lake pens until the pre-smolt stage and then released to the river. Further details of this enhancement proposal are still conjecture at this point in time.

The feasibility of sea-run cutthroat enhancement is being considered, but no details are available at present. Enhancement of resident cutthroat, sea-run Dolly Varden, and resident Dolly Varden is not being considered at this time.

G. Data Gaps

There appears to be a general lack of knowledge concerning almost all aspects of freshwater species as well as anadromous trout and char in the estuary. Further investigations into all aspects of these fish species would be desirable. Some particular areas that should be investigated are as follows:

1. The life histories of steelhead, cutthroat and Dolly Varden in the estuary with particular reference to the importance of the estuary as a feeding and acclimatization area.
2. Distribution (spatial and temporal), enumeration, age class structure, and diet preferences of trout and char species in the estuary.
3. Degree of use of the estuary by fish other than Squamish River system progeny.
4. Use of the estuary for rearing purposes by juvenile steelhead, cutthroat and Dolly Varden with particular reference to the degree of rearing use by "kick-outs" (displaced juveniles from areas where carrying capacity has been exceeded) and presmolts.

5. A detailed inventory of all fish species occurring in the estuary.

III. TERRESTIAL AND MARINE MAMMALS, REPTILES AND AMPHIBIANS

Very little is known about the mammals, reptiles and amphibians that inhabit the Squamish River estuary and the adjacent uplands within the study area. Visiting and resident species are known, but abundance and habitat utilization patterns are not well understood. Incidental observations and known habitat preferences are the only sources of information. No systematic studies have been done of the mammals, reptiles and amphibians that occur in the estuary.

A. Marine Mammals

Environment Canada (1973) indicates harbour seals (Phoca vitulina richardi), Pacific killer whale (Grampus rectipinna), harbour porpoise (Phocaena vomerina), and northern sea-lion (Eumetopias jubata) as probable visitors to the Howe Sound area. Of these, Bigg (Pers. Comm., 1980) feels that harbour seals and killer whales are regular visitors to upper Howe Sound and the Squamish River estuary.

1. Harbour Seals

Bigg (Pers. Comm., 1980) estimates that twenty to thirty harbour seals frequent the estuary and the main channel of the Squamish River. Bigg has made personal observations in the estuary from 1964 to 1969 and since 1969 has made aerial surveys of haul-out sites in Howe Sound.* He notes that the larger populations of harbour seals occur in southern Howe Sound with haul-out sites at Pam Rocks near Anvil Island and at Popham Island. Defense Island (east of Potlatch Creek) is believed by Bigg to be the closest haul-out site to the Squamish estuary.

Land and Vaudry (1973) regularly observed harbour seals in the Squamish estuary from October 1972 to May 1973. The average number observed was nine but on one occasion a total of sixteen were counted.

According to Bigg (Pers. Comm., 1980), harbour seals are most abundant in the estuary during the spring and summer months (March to June) when Pacific herring (Clupea harengus pallase) and eulachon (Thaleichthys pacificus) are spawning. Herring spawn has not been observed in the Squamish estuary since 1969 (Hoos and Vold, 1975). This reduction in food supply may have affected harbour seal populations using the estuary.

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*Haul-out site: Rocks, sand bars, log booms, etc. that harbour seals climb onto to rest and sun. Areas are chosen where the seals can quickly dive into the water should they be disturbed.

Within the study area Bigg (Pers. Comm., 1980) notes that harbour seal pupping occurs in late July and early August with the nursing of the pups lasting about six weeks following birth. During this time the seals stay near the estuary. Bigg has noticed that log booms in the estuary are used as haul-outs during early morning hours.

2. Killer Whales

Killer whale visits to Howe Sound occur sporadically throughout the year, apparently more for territorial reasons than for feeding on migrating salmon (Bigg, Pers. Comm., 1980). Bigg feels that twenty animals are commonly involved and that as many as sixty may visit the area where they stay in deep water off the delta front.

B. Furbearers

Eight species of furbearers are known to be present in the study area. Land and Vaudry (1973) observed coyote (Canis latrans), river otter (Lutra canadensis), muskrat (Ondatra zebethica), red squirrel (Tamiasciurus hudsonicus) and raccoon (Procyon lotor) tracks in the estuary area. Harris (1972) reports sign of mink (Mustela vision) in the estuary. Forbes (Pers. Comm., 1980) feels that skunk, probably spotted (Spilogale gracilis latifrons), and bobcat (Lynx rufus fasciatus) also utilize the study area.

Other species are suspected in the study area. A lengthy list compiled by Hoos and Vold (1975) from other literature includes many other species, but their presence in the area has not been confirmed by field studies.

Furbearers are likely to be distributed throughout the study area wherever there is suitable habitat. One indication of furbearer use on the central delta of the estuary is the presence of an active registered trapline, Number 103, Region II (Clark, Pers. Comm., 1980).

C. Big Game Animals

Big game animals utilizing the study area include Columbian blacktail deer (Odocoileus hemionus columbianus), black bear (Ursus americanus), and cougar (Felis concolor oregonensis) (Forbes, Pers. Comm., 1980). Reynolds (Pers. Comm., 1980) notes that the more isolated forested flats on the west side of the Squamish River

and on Mamquam Flats provide year-round habitat for both deer and bear. He also notes that the adjacent mountain slopes support deer populations over the summer months. The Fish and Wildlife Branch (1979) identified the upper elevations of the mountains to the east and west of the Squamish estuary as general range for blacktail deer. Cougar are known to prey on the deer in the study area, but like other populations in the estuary, their numbers are presently undetermined (Forbes, Pers. Comm., 1980).

D. Non-Game Animals.

Hoos and Vold (1975) list 34 non-game wildlife species in the Orders of shrews (Insectivora), bats (Chiroptera), rodents (Rodentia), and rabbits/hares (Lagomorpha) that are believed to inhabit the study area.

Animals in this group are probably distributed throughout the study area but their abundance and habitat utilization in the estuary has not been studied.

E. Reptiles and Amphibians

Like non-game animals, herpetiles in the estuary have not been carefully studied. The only available information is a list of nine possible species compiled by Hoos and Vold (1975).

F. Data Gaps

Virtually all aspects of habitat utilization by mammals, reptiles and amphibians in the study area are poorly understood. The following is a partial list of areas that need further investigation (no priority intended):

1. The value of Mamquam Flats and the West Delta as spring forage for deer and as bear habitat.
2. Enumeration of cougar population and their dependency on deer in the study area.
3. Dependency of harbour seals and river otters on the fish populations of the estuary.
4. The value of harvestable furbearers in the study area.
5. A detailed inventory and enumeration of all wildlife species occurring in the study area.

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