Assessment of 2020 mixed-stock fisheries for coho salmon in northern and central British Columbia, Canada via parentage-based tagging and genetic stock identification

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Abstract

Genetic stock identification (GSI) and parentage-based tagging (PBT) are being increasingly applied to salmon fisheries and hatchery broodstock management and assessment in Canada. GSI and PBT were applied to assessment of 2019 coho salmon fisheries northern and central British Columbia (BC), Canada. The catch from northern freezer troll (Area F) and ice boat troll (Area F), recreational catch in Statistical Areas 3/4, the lower Skeena River test fishery at Tyee, and the Heiltsuk First Nation food, social, and ceremonial fishery near Bella Bella on the central coast of BC were sampled. There were 1,223 individuals successfully genotyped from fishery samples and 4 parentage-based tagging identifications made. The large majority of the catch in the northern troll fishery was derived from northern and central coast Conservation Units.

Introduction

Coho salmon (*Oncorhynchus kisutch*) are caught in commercial, recreational, and First Nations fisheries in British Columbia, and determination of the impact of these fisheries is of fundamental importance to status assessment for wild populations and management of large-scale hatchery production. Current and historical assessment of fisheries impacts has been conducted with the application of coded-wire tags (CWTs; Jefferts et al. 1963). CWTs are applied to juvenile fish prior to their hatchery release and recovered from adult fish heads collected from fisheries, hatchery broodstocks, and in-river escapement sampling. Once recovered, the tags are decoded to determine the hatchery origin and age of the individual fish. Originally, only coho salmon marked with a CWT also received an adipose fin clip prior to hatchery release, with the externally-visible clip mark allowing CWT-marked fish to be identified visually and sampled from fisheries or river collections.

Since the late 1990s, all coho salmon released from many hatcheries in southern British Columbia (BC), Washington, and Oregon have received an adipose fin clip (termed mass marking) in order to facilitate mark-selective fisheries intended to harvest hatchery salmon only, with most clipped individuals carrying no CWT. This approach has resulted in reduced exploitation of naturally-spawned coho salmon, especially in sport fisheries, but the presence of many adipose-clipped salmon without a CWT has impaired the efficiency of CWT recovery. In spite of implementation of an electronic tag detection system to pre-screen a portion of the commercial catch to identify salmon with a CWT, the processing of many heads without a CWT from voluntary recreational recoveries and the increasing costs of CWT application and recovery have eroded the effectiveness of the current CWT-based coho salmon assessment program in BC.

Current assessment of coho salmon in BC is based on life history, marine distribution, and exploitation information obtained from CWT 'indicator' populations. The assumption of an indicator population is fundamental to the current CWT program applied to assessment and management of coho and Chinook Salmon (O. *tshawytscha*) in both Canada and the United States of America. The concept of using indicator populations is based on an expectation of biological homogeneity over the geographic region represented by the indicator population. Often, indicator populations are hatchery-supplemented and only a portion of the hatchery-origin component of the population is tagged, and is assumed to be representative of the entire population, both of hatchery- and natural-origin. In particular, tagged indicator populations are used to estimate exploitation rates and fishery contributions.

The fundamental question to consider is whether CWT-based assessment techniques for coho salmon, developed in the past 35 years since the signing in 1985 of the Pacific Salmon Treaty (PST) between Canada and the United States of America, still meets the requirements for fishery management in BC in the 2020s and beyond. In 1998, following a decline in coho salmon abundance which led to severe restrictions of fisheries in BC (Beacham et al. 2001), the Minister of Fisheries and Oceans (DFO) directed that the management of Canadian fisheries was to be conducted with the objective of achieving a zero mortality of stocks of conservation concern. Fisheries were only allowed to be conducted if it could be demonstrated that there was minimal impact on stocks of conservation concern. There was no practical way to obtain this information from CWTs, and thus genetic stock identification (GSI) analysis of mixed-stock fishery samples was the sole method employed. In 2005, the Wild Salmon Policy for Pacific salmon (WSP) was established in Canada with the goal of maintaining and restoring healthy and diverse Pacific salmon populations, making conservation of wild salmon and their habitats the

highest priority for resource management decision-making (DFO, 2005). Under the WSP, wild salmon populations are identified and maintained in Conservation Units (CUs) that are identified based on genetic traits, biogeographic distribution, life-history characteristics, and local knowledge where available.

Beacham (2021) suggested that a genetics-based system of fishery assessment based upon genetic stock identification (GSI) and parentage-based tagging (PBT) was a choice for coho salmon fisheries assessment in BC in the 2020s. As initially proposed by Anderson and Garza (2005) and subsequently outlined by Steele et al. (2019), PBT uses molecular-based approaches to conduct large-scale parentage assignments and has resulted in the unprecedented ability to identify genetically millions of hatchery-origin salmonids. Initial application of a large-scale GSI-PBT system of identification of coho salmon in BC provided high-resolution estimates of stock composition, catch, and exploitation rate by CU or population, providing an alternate and more effective method in the assessment and management of Canadian-origin coho salmon relative to CWTs (Beacham et al. 2019a). A second large-scale application of a combined GSI-PBT approach to coho salmon fishery assessment in BC confirmed that a genetic approach to coho fishery assessment was indeed a viable alternative to CWT-based assessment for BC Coho salmon fisheries (Beacham et al. 2020a). As outlined by Beacham (2021), the PSC considers that the current fishery monitoring, management, and modeling system for coho salmon is based solely on CWT technology, regardless of the limitations of the technology, and by implication is the preferred method for BC coho salmon fishery assessment in the 2020s and beyond.

The overall objectives of the current study were:

1. Obtain samples from commercial and recreational coho salmon fisheries in northern and central British Columbia. These fisheries would include the Area F freezer troll and ice boat troll fisheries, the central coast demonstration troll fishery, and recreational fisheries off Langara and in the central coast of BC.
2. Genotype up to 5,000 coho salmon from these fisheries.
3. Assign individuals sampled in the fisheries to specific CUs for Canada and regional geographic groups for US origin individuals via both parentage-based analysis (PBT) and genetic stock identification.

METHODS

Fishery sample collection

In brief, samples were grouped by general geographic area as outlined by Beacham et al. (2019) (Figure 1). In 2020, for the northern (Area F) freezer troll fishery, selected freezer boats were required to keep heads of all coho salmon caught, with the mark type (adipose fin clipped or not) unknown for an individual head. Upon landing, the heads were counted and checked electronically for CWTs, and randomly sampled to a maximum of 50 heads per delivery. If a CWT was detected, the head was sent to a central CWT head recovery laboratory in Vancouver, BC where in 2020 a tissue sample for DNA extraction was not taken due to Covid19 protocols. Field tissue samples for DNA extraction were taken only from individuals with no CWTs detected, and were the only samples available for 2020 sampling. For the northern ice boat troll fishery, samples of coho salmon with known clip status were obtained as an ancillary aspect of standard Fisheries and Oceans Canada contract catch sampling for CWTs. Both adipose fin clipped and unclipped individuals were examined through this program, with similar sampling protocols as outlined in the northern freezer troll sampling described above. Clipped fish not containing a CWT were sampled in the field through this program, but heads containing a CWT

were sent to the head recovery laboratory in Vancouver, and these CWT-marked individuals did not constitute a part of the analysis due to Covid-19 protocols.

GSI-PBT baseline

When PBT-based sampling of the hatchery broodstocks was originated in 2014, 20 broodstocks from southern BC were included in the analysis, generating a PBT baseline comprising 6,061 genotyped individuals (Beacham et al., 2017). In 2016, the program had expanded to include 30 broodstocks from both northern and southern BC, and included 7,013 genotyped individuals. By 2018, the program had continued to expand to include sampling from 40 hatchery broodstocks in BC, and including 7,805 genotyped individuals. In 2019, 34 hatchery broodstocks encompassing 7,408 coho salmon were genotyped.

As well as the PBT portion of the baseline having expanded, the GSI portion of the baseline was increased beyond the 117 populations and 20,242 individuals genotyped reported by Beacham et al. (2017). As outlined by Beacham et al. (2020b), the combined GSI-PBT baseline applied in the current analysis consisted of 57,982 genotyped coho salmon from 332 populations from Russia, Alaska, BC, Washington, Oregon, and California. Estimates of stock composition by CU as defined under Canada's WSP are possible based solely on GSI (Beacham et al. 2020b), and when combined with assignment of individuals via PBT, provided a powerful technique for assignment of individuals of unknown origin to some populations. Boundaries of the CUs were outlined in Figure 1 in Beacham et al. (2020b).

Genotyping

The detailed procedure for library preparation and genotyping was outlined by Beacham et al. (2017), and a summarized version provided by Beacham et al. (2019a). The process involved loading amplified DNA from 768 individuals (up to 480 amplicons per individual) on an Ion Torrent Proton P1 chip (v3; Thermo Fisher) with an Ion Chef. Two chips are loaded consecutively with one run of the Ion Chef, then loaded on to an Ion Torrent Proton sequencer. Genotyping was conducted using the Torrent Suite Variant Caller® at one SNP site in each amplicon defined by a hotspot file and previously described (Beacham et al., 2019a). Genotypes at all available, predefined SNP sites per individual were assembled to provide multi-locus genotypes that were the basic input for PBT analysis.

Identification of individuals

PBT was used to identify individuals in fishery and broodstock samples by matching the genotype of the individual to the genotypes of prospective parents (COLONY; Jones and Wang, 2010; Wang, 2016). COLONY was utilized to assign offspring to parents, as it can produce assignments even when the one of the parents is putatively missing from the dataset, either due to a missing parental sample, or failure to produce sufficient coverage of the parental genotype from an existing sample.

The baseline for individuals sampled in the 2019 fisheries and hatchery broodstocks included all broodstocks sampled in 2015, 2016, and 2017, with each year class run separately in the COLONY analysis. COLONY was run with all broodstocks sampled each year as a single unit for analysis of fishery and escapement samples, with no differentiation among populations. Although the COLONY assumption of a single population in the parent pool was therefore violated, analysis of known-origin samples indicated that very high levels of accuracy were

achieved in assignments when pooling of potential parents in contributing populations was conducted (Beacham et al., 2019). Two-parent assignments were accepted only when both assigned parents originated from the same population. Two-parent assignments were accepted only when the probability of correct assignment was ≥ 0.85 as determined by COLONY for the parent pair, and single-parent when the probability of assignment was > 0.97. An additional constraint on the single-parent assignment before it was accepted was that both the PBT assignment and GSI assignment corresponded to populations in the same CU. Polygamous mating was assumed for the COLONY analysis. Simple pairwise comparisons between offspring and potential parents were conducted. Genotypes had to be available for at least 150 SNPs for an individual to be retained in the baseline. An estimated genotyping error rate of 1% was used for COLONY assignments. Previously, Beacham et al. (2017) had reported that an average genotyping error rate of 1.07% (1,220 discrepancies in 114,105 comparisons) or an allele error rate of 0.53% (1,220 discrepancies in 228,210 comparisons) was observed over the 304 SNPs scored. The parent pair output file was the basic file used in subsequent analyses.

Results

The catch from northern freezer troll (Area F) and ice boat troll (Area F), recreational catch in Statistical Areas 3/4, the lower Skeena River test fishery at Tyee, and the Heiltsuk First Nation food, social, and ceremonial fishery near Bella Bella on the central coast of BC was sampled. There were 1,425 samples collected from these fisheries, and 1,223 individuals were successfully genotyped from fishery samples. There were four parentage-based tagging identifications made in the 1,223 individuals genotyped. Main contributors to the Area F troll fishery were coho salmon originating from Skeena River, Haida Gwaii, and central coast CUs

(Table 1). The two PBT identifications made in the freezer troll samples were individuals from the Chilliwack River and Eagle River in the Fraser River drainage, and the two PBT identifications observed in the ice boat troll samples originated from the Robertson Creek population on the west coast of Vancouver Island.

Discussion

The original objective of the study was to obtain access to 5,000 samples of coho salmon from north and central coast fisheries, genotype the individuals, and estimate stock compositions of the mixed-stock fishery samples. However, due to the Covid-19 pandemic that arose in early 2020, both fisheries and sampling were restricted in north and central coast. Therefore, substantially fewer samples were collected and genotyped than anticipated. However, for the samples that were collected and genotyped, stock compositions were similar to those observed previously in the fisheries (Beacham et al. 2019, 2020). Due to Covid-19 constraints, we were not able to access samples from the J. O. Thomas head recovery laboratory, and thus any coho salmonthat were marked with coded-wire tags were not included in the samples provided. Notably, these samples had been available in previous years, and had formed part of the analysis of northern and central coast fisheries (Beacham et al. 2019, 2020a). The under-representation of clipped coho in this year's analysis is almost certainly the primary reason for PBT-based IDs to be under-represented in this year's fisheries analysis relative to prior years, as brood sampling for relevant years (2017 mostly) was similar to past sampling efforts.

PBT merged with GSI provided a very powerful and versatile tool that was applied across a broad spectrum of applications for both fisheries and hatchery broodstock assessment. The current study outlined the application of GSI and PBT to identify BC-origin coho salmon to specific Canadian hatcheries and CUs. The advantage of a genetic-based assessment of coho salmon in Canadian fisheries, aside from the economic advantage of being more cost-efficient than the existing CWT program (Beacham 2021), is the flexibility of assessment options that are available with its application. Genetic analysis of fishery samples can continue to provide the routine estimation of exploitation rates and catch at age for current management models, but it also provides the ability to assess fishery impacts on populations or CUs that are invisible to the current CWT program, as they are not currently marked with CWTs (Beacham et al. 2019a). As well as providing routine fishery assessment information, GSI and PBT applied in combination can provide family-specific information on distribution, catch, and productivity currently unavailable with the current CWT program in Canada (Beacham et al. 2019b), and thus provide information on productivity and migration.

References

Beacham, T.D. 2021. Parentage-based tagging combined with genetic stock identification is a cost-effective and viable replacement for coded-wire tagging in large-scale assessments of Canadian salmon fisheries. Fisheries Research in press.

Beacham, T.D., Candy, J.R., Supernault, K.J., Ming, T., Deagle, B., Schultz, A., Tuck, D., Kaukinen, K., Irvine, J.R., Miller, K.M., Withler. R.E. 2001. Evaluation and application of microsatellite and major histocompatibility complex variation for stock identification

of Coho salmon in British Columbia. Transactions of the American Fisheries Society 130: 1116-1155.

Beacham, T.D., Jonsen, K., McIntosh, B., Sutherland, B.J.G., Willis, D., Lynch, C. Wallace, W. 2020a. Parentage-based tagging and genetic stock identification applied in assessing mixed-stock fisheries and hatchery broodstocks for coho salmon in British Columbia, Canada. Canadian Journal of Fisheries and Aquatic Sciences 77: 1505-1517.

Beacham, T.D., Wallace, C., Jonsen, K., McIntosh, B., Candy, J.R., Moore, J.S., Bernatchez, L., Withler, R.E. 2020b. Accurate estimation of Conservation Unit contribution to coho salmon mixed-stock fisheries in British Columbia, Canada using direct DNA sequencing for single nucleotide polymorphisms. Canadian Journal of Fisheries and Aquatic Sciences 77: 1302-1315.

Beacham, T. D., Wallace, C., MacConnachie, C., Jonsen, K., McIntosh, B., Candy, J.R., Devlin, R., & Withler, R. E. 2017. Population and individual identification of coho salmon in BC through parentage-based tagging and genetic stock identification: an alternative to coded-wire tags. Canadian Journal of Fisheries and Aquatic Sciences, 74: 1391-1410.

Beacham, T.D., Wallace, C. Jonsen, K., McIntosh, B., Candy, J.R., Willis, D., Lynch, C., Moore, J.-S., Bernatchez, L., Withler, R.E. 2019. Comparison of coded-wire tagging with parentage-based tagging and genetic stock identification in a large-scale coho salmon fisheries application in British Columbia, Canada. Evolutionary Applications, 12: 230-254. DOI - 10.1111/eva.12711

Fisheries and Oceans Canada (DFO). 2005. Canada's policy for conservation of wild Pacific salmon. 57p. Fisheries and Oceans Canada, 401 Burrard Street, Vancouver, BC, V6C 3S4.

Jefferts, K. B., Bergman, P. K., and Fiscus, H. F. 1963. A coded wire identification system for macro-organisms. Nature, *198*(4879): 460-462. doi:10.1038/198460a0

Jones, O. R., and Wang, J. 2010. COLONY: a program for parentage and sibship inference from multilocus genotype data. Molecular Ecology Resources, *10*(3): 551-555. doi:10.1111/j.1755-0998.2009.02787.x

Wang, J. 2016. Individual identification from genetic marker data: developments and accuracy comparisons of methods. Molecular Ecology Resources, *16*(1): 163-175. doi:10.1111/1755-0998.12452

Table 1. Percentage stock composition by geographic region or CU of 2020 northern Area F freezer troll, Area F ice boat troll fishery, Area 3/4 recreational fishery, lower Skeena River test fishery (Tyee), and central coast First Nation fishery. Standard deviation is in parentheses. N-PBT is the number of individuals identified in the sample via parentage-based tagging.

Region/Conservation Unit	Freezer troll				Ice boat troll				
	Aug. 17-20	Aug. 24	Aug. 31-Sept. 5	Aug 3-4	Aug 10-12	Aug 16-19	Aug 23-29	Sept 1-5	Sept 7-10
Sample size	106	11	57	167	132	98	59	45	25
N-PBT	0	0	2	0	0	2	0	0	0
Southeast Alaska	6.6 (2.7)	10.9 (9.0)	1.8 (1.8)	5.4 (2.0)	1.8 (1.4)	2.1 (1.5)	0.2 (0.8)	5.4 (4.0)	3.7 (4.0)
Alsek River	0.0 (0.0)	0.0 (0.4)	0.0 (0.1)	0.0 (0.0)	0.0 (0.0)	0.0 (0.1)	0.0 (0.1)	0.0 (0.1)	0.0 (0.2)
Taku-Late Timing	0.1 (0.5)	0.0 (1.3)	0.1 (0.6)	0.0 (0.2)	0.0 (0.2)	0.0 (0.4)	0.0 (0.3)	0.5 (1.9)	0.3 (1.5)
Lower Stikine	0.0 (0.2)	0.0 (0.4)	0.0 (0.1)	0.0 (0.0)	0.0 (0.1)	0.0 (0.0)	0.0 (0.1)	0.0 (0.2)	0.0 (0.2)
Lower Nass	0.0 (0.1)	0.0 (0.6)	0.0 (0.2)	0.1 (0.3)	0.0 (0.1)	0.1 (0.5)	0.0 (0.2)	0.0 (0.3)	0.0 (0.4)
Upper Nass	1.1 (1.9)	0.0 (0.6)	0.0 (0.2)	0.5 (1.1)	0.0 (0.2)	0.0 (0.1)	0.0 (0.1)	0.0 (0.1)	0.0 (0.2)
Portland Sound-Observatory Inlet-Portland Canal	0.0 (0.1)	0.0 (0.4)	0.0 (0.2)	0.5 (0.6)	0.0 (0.0)	0.0 (0.0)	0.0 (0.1)	0.0 (0.1)	0.0 (0.2)
Skeena Estuary	0.0 (0.0)	0.0 (0.4)	0.0 (0.1)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.1)	0.0 (0.2)	0.0 (0.2)
Lower Skeena	10. 5 (4.0)	0.0 (1.7)	5.5 (3.0)	2.3 (1.5)	5.4 (2.5)	2.6 (1,9)	2.9 (2.4)	13.1 (5.5)	8.4 (5.8)
Middle Skeena	1.4 (1.3)	7.9 (7.9)	1.7 (1.7)	1.9 (1.7)	2.1 (1.3)	2.1 (1.5)	4.2 (2.7)	0.1 (0.8)	0.0 (0.7)
Upper Skeena	0.1 (0.5)	1.2 (4.0)	0.0 (0.3)	4.2 (2.5)	0.0 (0.2)	0.0 (0.1)	0.0 (0.2)	0.0 (0.3)	0.0 (0.4)
Haida Gwaii-Graham Island Lowlands	24. 6 (4.2)	0.0 (1.4)	4.9 (2.9)	38.1 (3.8)	24.7 (3.8)	36.9 (4.9)	30.3 (6.1)	7.9 (4.0)	0.6 (2.2)
Haida Gwaii-East	3.3 (1.9)	0.0 (1.1)	0.6 (1.5)	2.5 (1.2)	7.0 (2.2)	0.0 (0.3)	1.0 (2.1)	0.0 (0.4)	0.0 (0.6)
Haida Gwaii-West	1.2 (1.1)	0.0 (0.8)	0.6 (1.3)	0.0 (0.1)	0.0 (0.1)	1.0 (1.0)	0.0 (0.2)	0.0 (0.2)	0.0 (0.4)

Northern Coastal Streams	1.1 (1.9)	7.0 (12.0)	0.1 (0.8)	3.2 (2.1)	8.6 (3.5)	9.4 (4.0)	0.5 (1.4)	13.0 (8.3)	8.0 (7.9)
Hecate Strait Mainland	15. 9 (4.0)	9.2 (7.9)	0.3 (1.2)	8.0 (2.9)	2.6 (2.3)	0.9 (1.9)	4.7 (3.9)	0.1 (0.8)	10.2 (6.2)
Mussel-Kynoch	2.6 (2.2)	0.0 (0.6)	11.9 (4.6)	1.3 (2.4)	0.0 (0.1)	9.9 (3.6)	10.8 (4.7)	0.0 (0.3)	0.6 (2.7)
Douglas Channel-Kitimat Arm	20.4 (4.5)	18.2 (15.3)	0.0 (0.5)	8.2 (3.0)	23.8 (4.6)	10.1 (4.3)	0.1 (0.6)	0.0 (0.5)	0.1 (0.7)
Bella Coola-Dean Rivers	1.8 (0.1)	0.0 (1.3)	0.7 (1.4)	4.6 (2.0)	3.5 (2.4)	1.1 (2.0)	7.1 (4.2)	1.3 (2.8)	3.2 (4.7)
Rivers Inlet	0.1 (0.5)	0.3 (3.1)	0.0 (0.4)	5.3 (2.8)	6.8 (3.2)	6.5 (3.5)	0.0 (0.4)	12.9 (6.8)	4.1 (3.8)
Smith Inlet	0.0 (0.1)	0.0 (0.8)	0.0 (0.2)	0.6 (0.6)	0.0 (0.1)	0.0 (0.1)	0.0 (0.2)	0.2 (0.9)	0.0 (0.4)
Southern Coastal Streams-Queen Charlotte Strait-Johnstone Strait-Southern Fjords	1.0 (0.1)	9.2 (11.8)	0.3 (1.4)	8.2 (2.9)	6.0 (2.7)	1.7 (2.7)	2.3 (2.4)	0.1 (0.6)	0.6 (2.3)
Homathko-Klinaklini Rivers	0.0 (0.1)	0.0 (0.9)	0.9 (1.5)	1.1 (1.1)	5.6 (2.3)	0.0 (0.3)	1.6 (2.5)	0.1 (0.7)	0.0 (0.4)
Georgia Strait Mainland	0.1 (0.7)	0.0 (0.9)	3.9 (3.8)	0.0 (0.2)	0.0 (0.3)	0.0 (0.3)	2. (2.0)	1.2 (3.2)	0.1 (1.3)
Howe Sound-Burrard Inlet	0.0 (0.2)	2.1 (5.7)	0.0 (0.4)	0.0 (0.1)	0.0 (0.2)	0.0 (0.4)	4.0 (3.2)	0.1 (0.7)	3.7 (3.9)
East Vancouver Island-Georgia Strait	4.4 (2.4)	11.4 (9.4)	2.1 (3.1)	0.4 (0.7)	0.3 (0.7)	2.1 (2.4)	0.4 (1.3)	26.6 (6.9)	3.9 (4.0)
East Vancouver Island-Johnstone Strait-Southern Fjords	0.0 (0.1)	0.0 (0.4)	0.0 (0.1)	0.0 (0.1)	0.0 (0.1)	0.0 (0.1)	0.0 (0.1)	1.6 (2.1)	0.0 (0.2)
Nahwitti Lowland	0.0 (0.2)	4.9 (7.5)	7.2 (3.8)	0.4 (0.6)	0.1 (0.4)	2.6 (2.3)	14.4 (5.4)	2.0 (3.6)	0.0 (0.7)
West Vancouver Island	0.0 (0.1)	0.5 (3.1)	1.8 (1.7)	0.1 (0.5)	0.0 (0.1)	2.1 (1.5)	0.0 (0.2)	0.1 (1.0)	0.0 (0.6)
Clayoquot	0.0 (0.1)	0.0 (1.2)	0.0 (0.3)	0.2 (0.7)	0.0 (0.1)	0.0 (0.2)	2.5 (2.4)	0.0 (0.4)	0.0 (0.5)
Juan de Fuca-Pachena	0.0 (0.1)	0.3 (2.6)	0.0 (0.5)	0.0 (0.1)	0.6 (0.9)	0.0 (0.2)	0.0 (0.5)	0.1 (0.8)	34.7 (9.9)
Lower Fraser	0.0 (0.3)	0.0 (2.2)	1.9 (1.8)	0.0 (0.2)	0.0 (0.2)	0.8 (1.1)	0.0 (0.5)	0.0 (0.7)	0.0 (1.0)
Lillooet	0.0 (0.1)	0.0 (0.7)	0.0 (0.2)	0.0 (0.1)	0.0 (0.1)	0.0 (0.1)	0.0 (0.1)	0.0 (0.2)	0.0 (0.4)
Fraser Canyon	0.0 (0.1)	0.0 (0.6)	0.0 (0.1)	0.0 (0.0)	0.0 (0.1)	0.0 (0.1)	0.0 (0.1)	0.0 (0.2)	0.0 (0.3)
Interior Fraser	0.0 (0.1)	0.0 (1.0)	0.0 (0.2)	0.0 (0.1)	0.0 (0.1)	0.0 (0.1)	0.0 (0.2)	0.0 (0.3)	0.0 (0.5)

Lower Thompson	0.0 (0.1)	0.0 (1.0)	0.0 (0.2)	0.0 (0.1)	0.0 (0.1)	0.0 (0.1)	0.0 (0.2)	0.0 (0.2)	0.0 (0.4)
North Thompson	0.0 (0.2)	0.0 (1.8)	0.0 (0.4)	0.0 (0.1)	0.0 (0.2)	0.0 (0.2)	0.1 (0.6)	0.0 (0.5)	0.0 (0.9)
South Thompson	0.0 (0.2)	0.0 (1.7)	1.8 (1.7)	0.0 (0.1)	0.0 (0.1)	0.0 (0.2)	1.6 (1.7)	0.0 (0.5)	0.0 (0.8)
Boundary Bay	0.0 (0.1)	0.0 (0.7)	0.0 (0.2)	0.0 (0.1)	0.0 (0.1)	0.0 (0.1)	0.0 (0.2)	0.0 (0.2)	0.0 (0.4)
Northern Puget Sound	0.0 (0.2)	0.0 (1.3)	0.4 (1.3)	0.0 (0.1)	0.0 (0.1)	0.0 (0.3)	0.0 (0.5)	0.4 (1.6)	0.0 (0.9)
Mid-Puget Sound	0.0 (0.1)	0.0 (0.9)	0.2 (1.2)	0.0 (0.1)	0.0 (0.1)	0.5 (1.1)	0.0 (0.2)	0.0 (0.3)	0.0 (0.4)
Southern Puget Sound	0.0 (0.1)	0.0 (1.1)	0.0 (0.2)	0.0 (0.1)	0.0 (0.1)	0.0 (0.2)	0.0 (0.2)	0.0 (0.3)	0.0 (0.5)
Juan de Fuca Strait	0.0 (0.1)	0.7 (3.3)	1.5 (2.2)	0.0 (0.0)	0.4 (0.8)	0.0 (0.2)	0.0 (0.2)	0.0 (0.2)	0.0 (0.3)
Hood Canal	0.0 (0.1)	0.0 (0.8)	0.0 (0.2)	0.0 (0.1)	0.0 (0.1)	0.0 (0.1)	4.1 (2.7)	0.0 (0.4)	1.4 (3.8)
Northern Coastal Washington	0.0 (0.2)	15.4 (10.9)	9.6 (4.2)	0.2 (0.4)	0.0 (0.3)	0.0 (0.3)	1.3 (1.7)	0.0 (0.3)	0.0 (0.5)
Southern Coastal Washington	3.6 (1.8)	0.0 (0.9)	38.3 (6.5)	2.2 (1.2)	0.0 (0.2)	4.5 (2.1)	3.8 (2.6)	13.2 (5.1)	16.3 (7.1)
Columbia River	0.0 (0.2)	0.0 (1.4)	0.0 (0.3)	0.6 (0.6)	0.0 (0.1)	2.7 (1.7)	0.0 (0.3)	0.0 (0.4)	0.0 (0.7)
Oregon	0.0 (0.1)	0.4 (2.8)	1.8 (1.7)	0.0 (0.1)	0.5 (0.7)	0.0 (0.2)	0.0 (0.3)	0.0 (0.4)	0.0 (0.7)
Northern California	0.0 (0.1)	0.0 (0.6)	0.0 (0.1)	0.0 (0.0)	0.0 (0.1)	0.0 (0.1)	0.0 (0.1)	0.0 (0.1)	0.0 (0.3)
California	0.0 (0.1)	0.0 (0.9)	0.0 (0.2)	0.0 (0.1)	0.0 (0.1)	0.0 (0.1)	0.0 (0.2)	0.0 (0.3)	0.0 (0.4)

Table 1 continued.

Region/Conservation Unit	Ice boat troll		Area 3/4 sport						
	Sept 17	Sept 25	June 14-15	June 21-27	June 28-July 4	July 5-11	July 12-18	July 19-25	July 26-31
Sample size	8	4	2	4	10	36	30	79	23
N-PBT	0	0	0	0	0	0	0	0	0
Southeast Alaska	0.0 (1.7)	0.0 (3.1)	1.7 (8.8)	0.0 (3.5)	0.0 (1.7)	0.0 (0.5)	0.1 (1.0)	0.2 (1.2)	0.6 (2.3)
Alsek River	0.0 (0.6)	0.0 (1.9)	0.0 (1.6)	0.0 (1.0)	0.0 (0.4)	0.0 (0.1)	0.0 (0.2)	0.0 (0.1)	0.0 (0.2)
Taku-Late Timing	0.8 (4.0)	0.0 (2.4)	0.0 (4.2)	0.0 (2.6)	0.2 (2.0)	0.1 (0.7)	0.0 (0.5)	3.7 (3.8)	10.7 (7.6)
Lower Stikine	0.0 (0.5)	0.0 (1.0)	0.0 (1.5)	0.0 (0.9)	0.0 (0.6)	0.0 (0.1)	0.0 (0.2)	0.0 (0.1)	0.0 (0.3)
Lower Nass	0.0 (0.9)	0.0 (1.5)	0.0 (2.0)	0.0 (1.5)	0.0 (0.7)	0.0 (0.2)	0.0 (0.3)	0.0 (0.1)	0.0 (0.7)
Upper Nass	0.0 (0.5)	0.0 (1.0)	0.0 (1.6)	0.0 (1.0)	0.1 (1.2)	0.0 (0.2)	0.0 (0.3)	0.0 (0.2)	0.0 (0.8)
Portland Sound-Observatory Inlet-Portland Canal	0.0 (0.7)	0.0 (0.9)	0.0 (1.6)	0.0 (1.0)	0.0 (0.5)	0.0 (0.2)	0.0 (0.2)	0.0 (0.1)	0.0 (0.2)
Skeena Estuary	0.0 (1.6)	0.0 (0.9)	0.0 (1.9)	0.0 (0.9)	0.0 (0.5)	0.0 (0.1)	0.0 (0.2)	0.0 (0.1)	0.0 (0.3)
Lower Skeena	12.5 (10.5)	0.0 (4.0)	0.2 (6.4)	0.0 (3.8)	0.1 (2.1)	5.5 (4.0)	0.1 (1.1)	0.3 (1.0)	4.0 (6.5)
Middle Skeena	0.4 (3.1)	0.0 (3.0)	0.0 (5.2)	0.0 (3.1)	19.7 (11.2)	3.3 (4.9)	7.6 (4.9)	11.8 (4.1)	17.7 (10.8)
Upper Skeena	0.0 (1.2)	0.0 (1.9)	0.0 (3.3)	0.0 (2.1)	0.2 (2.0)	13.2 (7.0)	2.5 (3.1)	4.5 (3.0)	4.1 (7.4)
Haida Gwaii-Graham Island Lowlands	47.3 (16.6)	0.0 (2.9)	0.0 (4.9)	0.0 (3.1)	0.0 (1.6)	0.0 (0.4)	0.0 (0.5)	0.0 (0.2)	0.0 (0.7)
Haida Gwaii-East	0.0 (1.7)	0.0 (2.6)	0.0 (4.2)	0.0 (2.9)	0.0 (1.3)	0.0 (0.4)	0.0 (0.5)	0.0 (0.3)	0.0 (0.7)
Haida Gwaii-West	0.0 (1.1)	0.0 (1.7)	0.0 (2.6)	0.0 (1.8)	0.0 (0.8)	0.0 (0.2)	0.0 (0.3)	0.0 (0.1)	0.0 (0.4)
Northern Coastal Streams	5.1 (9.3)	0.0 (4.2)	2.4 (11.0)	1.0 (6.8)	25.5 (19.5)	8.0 (7.9)	2.8 (5.3)	5.0 (4.6)	2.2 (5.1)
Hecate Strait Mainland	0.0 (1.9)	0.0 (3.6)	48.8 (24.5)	0.0 (3.6)	0.0 (1.6)	21.0 (7.3)	13.2 (6.1)	6.5 5.3)	10.5 (6.7)
Mussel-Kynoch	0.3 (3.1)	0.0 (1.4)	0.0 (2.3)	0.0 (1.2)	0.6 (3.1)	0.0 (0.3)	1.5 (2.8)	8.7 (4.1)	0.0 (0.3)
Douglas Channel-Kitimat Arm	0.0 (0.9)	0.0 (1.3)	14.1 (19.5)	38.5 (27.4)	23.9 (25.2)	26.4 (8.9)	41.1 (10.9)	42.4 (6.7)	41.9 (11.4)

Bella Coola-Dean Rivers	0.0 (1.5)	0.0 (2.6)	4.3 (12.1)	16.1 (21.1)	0.8 (3.8)	22.0 (7.7)	22.1 (9.5)	6.0 (4.3)	0.0 (0.8)
Rivers Inlet	0.1 (2.1)	0.0 (2.5)	4.3 (12.2)	21.2 (29.1)	17.9 (19.2)	0.1 (0.8)	0.1 (0.9)	0.6 (1.5)	0.0 (0.7)
Smith Inlet	0.0 (1.0)	0.0 (1.9)	0.0 (2.7)	0.0 (1.7)	0.0 (0.8)	0.0 (0.3)	0.0 (0.3)	0.0 (0.1)	0.0 (0.5)
Southern Coastal Streams-Queen Charlotte Strait-Johnstone Strait-Southern Fjords	0.5 (3.8)	0.0 (2.6)	11.8 (18.9)	2.7 (10.6)	0.4 (3.4)	0.1 (1.0)	8.3 (6.7)	10.1 (4.3)	2.6 (5.4)
Homathko-Klinaklini Rivers	0.0 (1.1)	0.0 (1.9)	2.4 (9.3)	20.1 (18.9)	0.2 (2.0)	0.1 (0.7)	0.4 (1.9)	0.1 (0.5)	0.0 (0.5)
Georgia Strait Mainland	0.2 (2.0)	0.0 (1.9)	0.0 (2.7)	0.0 (1.8)	0.0 (1.0)	0.0 (0.3)	0.0 (0.4)	0.0 (0.1)	0.0 (0.4)
Howe Sound-Burrard Inlet	0.3 (2.7)	0.1 (3.5)	0.0 (4.8)	0.0 (3.3)	9.3 (13.0)	0.0 (0.5)	0.1 (0.8)	0.0 (0.3)	0.0 (0.8)
East Vancouver Island-Georgia Strait	0.9 (5.1)	76.6 (23.5)	3.7 (12.4)	0.1 (4.1)	1.3 (4.7)	0.0 (0.7)	0.2 (1.5)	0.0 (0.4)	0.0 (1.0)
East Vancouver Island-Johnstone Strait-Southern Fjords	1.3 (4.7)	0.0 (0.8)	0.0 (1.6)	0.0 (0.9)	0.0 (0.5)	0.0 (0.2)	0.0 (0.2)	0.0 (0.1)	0.0 (0.2)
Nahwitti Lowland	6.9 (12.3)	17.2 (17.1)	4.0 (12.5)	0.0 (3.6)	0.0 (1.7)	0.1 (0.9)	0.1 (0.9)	0.1 (0.6)	5.5 (5.6)
West Vancouver Island	9.3 (13.1)	0.0 (2.5)	1.1 (7.0)	0.0 (2.5)	0.0 (1.2)	0.0 (0.4)	0.0 (0.5)	0.0 (0.2)	0.0 (0.5)
Clayoquot	0.0 (1.5)	0.0 (2.2)	0.3 (4.5)	0.0 (2.2)	0.0 (1.1)	0.0 (0.3)	0.0 (0.4)	0.0 (0.2)	0.0 (0.5)
Juan de Fuca-Pachena	13.7 (16.1)	0.1 (2.5)	0.8 (5.8)	0.0 (1.9)	0.0 (1.1)	0.0 (0.3)	0.0 (0.4)	0.0 (0.1)	0.0 (0.5)
Lower Fraser	0.2 (3.4)	0.9 (6.6)	0.0 (8.1)	0.0 (5.0)	0.0 (2.4)	0.0 (0.7)	0.0 (0.9)	0.0 (0.3)	0.0 (1.1)
Lillooet	0.0 (1.0)	0.0 (1.7)	0.0 (2.9)	0.0 (1.9)	0.0 (0.9)	0.0 (0.3)	0.0 (0.3)	0.0 (0.1)	0.0 (0.4)
Fraser Canyon	0.0 (0.8)	0.0 (1.5)	0.0 (2.3)	0.0 (1.4)	0.0 (0.6)	0.0 (0.2)	0.0 (0.3)	0.0 (0.1)	0.0 (0.3)
Interior Fraser	0.0 (1.1)	0.0 (2.2)	0.0 (3.8)	0.0 (2.1)	0.0 (1.2)	0.0 (0.3)	0.0 (0.4)	0.0 (0.1)	0.0 (0.5)
Lower Thompson	0.0 (1.2)	0.0 (2.1)	0.0 (2.9)	0.0 (1.9)	0.0 (1.0)	0.0 (0.3)	0.0 (0.3)	0.0 (0.1)	0.0 (0.5)
North Thompson	0.0 (2.6)	0.0 (4.3)	0.0 (6.5)	0.0 (4.3)	0.0 (2.0)	0.0 (0.6)	0.0 (0.7)	0.0 (0.3)	0.0 (0.9)
South Thompson	0.0 (2.2)	0.0 (3.9)	0.0 (6.4)	0.0 (4.0)	0.0 (1.9)	0.0 (0.6)	0.0 (0.7)	0.0 (0.3)	0.0 (0.9)

Boundary Bay	0.0 (1.2)	0.0 (1.8)	0.0 (3.1)	0.0 (1.7)	0.0 (0.7)	0.0 (0.3)	0.0 (0.3)	0.0 (0.1)	0.0 (0.4)
Northern Puget Sound	0.0 (1.6)	0.4 (3.8)	0.0 (4.2)	0.0 (2.4)	0.0 (1.2)	0.0 (0.4)	0.0 (0.5)	0.0 (0.2)	0.0 (0.6)
Mid-Puget Sound	0.0 (1.4)	0.0 (2.1)	0.0 (3.4)	0.0 (1.9)	0.0 (1.0)	0.0 (0.3)	0.0 (0.3)	0.0 (0.1)	0.0 (0.7)
Southern Puget Sound	0.0 (1.3)	0.0 (2.3)	0.0 (3.6)	0.0 (2.2)	0.0 (1.1)	0.0 (0.3)	0.0 (0.4)	0.0 (0.2)	0.0 (0.5)
Juan de Fuca Strait	0.0 (0.8)	0.0 (1.4)	0.0 (2.2)	0.0 (1.6)	0.0 (0.7)	0.0 (0.2)	0.0 (0.3)	0.0 (0.1)	0.0 (0.3)
Hood Canal	0.0 (1.1)	0.3 (3.9)	0.0 (2.8)	0.0 (2.0)	0.0 (0.7)	0.0 (0.3)	0.0 (0.3)	0.0 (0.1)	0.0 (0.4)
Northern Coastal Washington	0.0 (1.1)	0.0 (2.3)	0.0 (3.0)	0.0 (2.1)	0.0 (1.0)	0.0 (0.3)	0.0 (0.4)	0.0 (0.1)	0.0 (0.4)
Southern Coastal Washington	0.0 (1.1)	4.4 (10.3)	0.0 (2.7)	0.0 (1.8)	0.0 (0.9)	0.0 (0.3)	0.0 (0.3)	0.0 (0.1)	0.0 (0.4)
Columbia River	0.0 (1.8)	0.0 (3.4)	0.0 (5.1)	0.0 (3.1)	0.0 (1.5)	0.0 (0.5)	0.0 (0.5)	0.0 (0.2)	0.0 (0.8)
Oregon	0.0 (1.9)	0.0 (3.3)	0.0 (5.0)	0.0 (3.2)	0.0 (1.6)	0.0 (0.4)	0.0 (0.5)	0.0 (0.2)	0.0 (0.7)
Northern California	0.0 (0.7)	0.0 (1.3)	0.0 (2.4)	0.0 (1.5)	0.0 (0.7)	0.0 (0.2)	0.0 (0.2)	0.0 (0.1)	0.0 (0.4)
California	0.0 (1.1)	0.0 (2.1)	0.0 (3.3)	0.0 (2.1)	0.0 (1.0)	0.0 (0.3)	0.0 (0.3)	0.0 (0.2)	0.0 (0.4)

Table 1 concluded.

Region/Conservation Unit	Area 3/4 sport					Tyee test fishery	Central coast First Nation
	Aug 3-8	Aug 10-13	Aug 16-17	Aug 27	Aug 30	Seasonal	Seasonal
Sample size	37	15	9	7	3	228	28
N-PBT	0	0	0	0	0	0	0
Southeast Alaska	0.4 (1.5)	2.0 (5.5)	0.9 (4.1)	12.3 (14.1)	0.0 (3.8)		0.0 (0.6)
Alsek River	0.0 (0.1)	0.0 (0.3)	0.0 (0.6)	0.0 (0.6)	0.0 (1.2)		0.0 (0.2)
Taku-Late Timing	0.0 (0.4)	3.5 (7.3)	5.4 (8.9)	0.1 (2.2)	3.8 (10.6)		0.0 (0.5)
Lower Stikine	0.0 (0.2)	0.0 (0.5)	0.4 (2.6)	0.0 (0.7)	0.0 (1.2)		0.0 (0.2)
Lower Nass	0.0 (0.2)	0.0 (0.5)	0.1 (1.5)	0.0 (1.3)	0.0 (1.7)		0.0 (0.4)
Upper Nass	0.0 (0.4)	0.0 (0.4)	13.8 (12.7)	0.0 (0.7)	0.0 (1.3)		0.0 (0.2)
Portland Sound-Observatory Inlet-Portland Canal	0.0 (0.1)	0.0 (0.4)	0.0 (0.4)	0.0 (0.6)	0.0 (1.4)		0.0 (0.2)
Skeena Estuary	0.0 (0.1)	0.0 (0.3)	0.0 (0.6)	0.0 (0.6)	0.0 (1.5)	0.0 (0.1)	0.0 (0.2)
Lower Skeena	12.0 (5.5)	7.9 (7.7)	7.5 (11.7)	14.4 (11.3)	2.6 (9.5)	28.5 (3.2)	0.0 (0.8)
Middle Skeena	24.2 (6.8)	29.9 (12.3)	2.2 (6.8)	0.0 (2.2)	0.0 (3.9)	63.6 (3.7)	0.0 (0.6)
Upper Skeena	0.1 (0.7)	1.0 (5.0)	1.2 (5.0)	0.0 (1.4)	0.0 (2.5)	8.0 (2.5)	0.0 (0.4)
Haida Gwaii-Graham Island Lowlands	0.0 (0.4)	0.0 (1.0)	0.0 (1.6)	0.0 (2.0)	0.0 (3.8)		0.0 (0.5)
Haida Gwaii-East	0.0 (0.4)	0.0 (1.1)	0.0 (1.5)	0.0 (1.7)	0.0 (3.3)		0.0 (0.5)
Haida Gwaii-West	0.0 (0.3)	0.0 (0.5)	0.0 (0.9)	0.0 (1.2)	0.0 (2.2)		0.0 (0.3)
Northern Coastal Streams	6.1 (6.2)	12.1 (13.3)	0.1 (2.4)	12.0 (13.7)	77.4 (32.7)		2.9 (4.9)

Hecate Strait Mainland	19.3 (7.3)	10.1 (12.2)	10.9 (9.2)	0.3 (3.3)	1.2 (7.4)	22.4 (8.9)
Mussel-Kynoch	15.9 (6.3)	1.5 (5.3)	0.0 (0.7)	38.0 (22.8)	0.0 (2.0)	0.0 (0.3)
Douglas Channel-Kitimat Arm	17.8 (7.4)	30.0 (19.5)	46.9 (17.3)	11.0 (11.6)	13.5 (23.9)	26.6 (10.1)
Bella Coola-Dean Rivers	1.1 (2.1)	1.2 (4.5)	5.3 (10.1)	0.0 (1.8)	0.2 (3.8)	25.1 (9.0)
Rivers Inlet	0.0 (0.6)	0.4 (2.4)	0.1 (1.9)	10.6 (16.0)	1.2 (8.0)	15.3 (9.4)
Smith Inlet	0.0 (0.3)	0.0 (0.7)	0.0 (1.2)	0.0 (1.2)	0.0 (2.0)	0.0 (0.3)
Southern Coastal Streams-Queen Charlotte Strait-Johnstone Strait-Southern Fjords	0.0 (0.5)	0.0 (1.1)	0.0 (1.6)	0.3 (3.1)	0.0 (3.3)	0.4 (2.0)
Homathko-Klinaklini Rivers	0.0 (0.5)	0.0 (0.7)	0.1 (1.6)	0.0 (1.2)	0.0 (2.2)	0.0 (0.5)
Georgia Strait Mainland	1.4 (2.3)	0.0 (0.6)	0.1 (1.4)	0.0 (1.3)	0.0 (2.1)	0.0 (0.4)
Howe Sound-Burrard Inlet	0.7 (1.8)	0.0 (1.0)	0.2 (2.3)	0.8 (4.4)	0.0 (3.9)	0.0 (0.6)
East Vancouver Island-Georgia Strait	0.1 (0.9)	0.0 (1.4)	0.6 (3.8)	0.0 (2.6)	0.0 (5.4)	0.1 (1.1)
East Vancouver Island-Johnstone Strait-Southern Fjords	0.0 (0.1)	0.0 (0.3)	0.0 (0.5)	0.0 (0.6)	0.0 (1.3)	0.0 (0.2)
Nahwitti Lowland	0.1 (0.8)	0.0 (1.2)	0.2 (2.8)	0.0 (2.3)	0.0 (4.3)	6.8 (6.4)
West Vancouver Island	0.0 (0.3)	0.1 (1.3)	0.0 (1.2)	0.0 (1.6)	0.0 (2.9)	0.0 (0.7)
Clayoquot	0.0 (0.3)	0.0 (0.7)	0.0 (1.2)	0.0 (1.4)	0.0 (2.9)	0.0 (0.5)
Juan de Fuca-Pachena	0.0 (0.5)	0.0 (0.7)	0.0 (1.0)	0.0 (1.3)	0.0 (2.4)	0.0 (0.7)
Lower Fraser	0.0 (0.7)	0.0 (1.7)	3.5 (7.4)	0.0 (3.2)	0.0 (6.1)	0.1 (1.1)
Lillooet	0.0 (0.2)	0.0 (0.5)	0.0 (0.9)	0.0 (1.1)	0.0 (2.2)	0.0 (0.3)

Fraser Canyon	0.0 (0.2)	0.0 (0.5)	0.5 (2.9)	0.0 (1.0)	0.0 (1.8)	0.0 (0.2)
Interior Fraser	0.0 (0.3)	0.0 (0.6)	0.0 (1.1)	0.0 (1.5)	0.0 (2.8)	0.0 (0.4)
Lower Thompson	0.0 (0.3)	0.0 (0.6)	0.0 (1.1)	0.0 (1.2)	0.0 (2.5)	0.0 (0.4)
North Thompson	0.0 (0.6)	0.0 (1.5)	0.0 (2.4)	0.0 (2.6)	0.0 (5.1)	0.0 (0.8)
South Thompson	0.0 (0.5)	0.0 (1.3)	0.0 (2.2)	0.0 (2.5)	0.0 (4.8)	0.0 (0.7)
Boundary Bay	0.0 (0.5)	0.0 (0.6)	0.0 (0.9)	0.0 (1.1)	0.0 (2.1)	0.0 (0.3)
Northern Puget Sound	0.7 (2.0)	0.0 (1.1)	0.0 (1.7)	0.0 (1.6)	0.0 (3.3)	0.0 (0.5)
Mid-Puget Sound	0.0 (0.3)	0.0 (0.7)	0.0 (1.1)	0.0 (1.3)	0.0 (2.6)	0.0 (0.4)
Southern Puget Sound	0.0 (0.3)	0.0 (1.1)	0.0 (1.1)	0.0 (1.4)	0.0 (2.7)	0.0 (0.5)
Juan de Fuca Strait	0.0 (0.2)	0.0 (0.4)	0.0 (0.7)	0.0 (1.0)	0.0 (1.7)	0.1 (0.8)
Hood Canal	0.0 (0.2)	0.0 (0.6)	0.0 (1.0)	0.0 (1.3)	0.0 (2.1)	0.0 (0.3)
Northern Coastal Washington	0.0 (0.3)	0.0 (0.7)	0.0 (1.1)	0.0 (1.4)	0.0 (2.4)	0.0 (0.4)
Southern Coastal Washington	0.0 (0.2)	0.0 (0.6)	0.0 (1.0)	0.0 (1.0)	0.0 (2.2)	0.0 (0.3)
Columbia River	0.0 (0.5)	0.0 (1.1)	0.0 (1.6)	0.0 (2.1)	0.0 (3.8)	0.0 (0.6)
Oregon	0.0 (0.4)	0.0 (1.0)	0.0 (1.6)	0.0 (2.2)	0.0 (4.0)	0.0 (0.6)
Northern California	0.0 (0.2)	0.0 (0.5)	0.0 (0.8)	0.0 (1.0)	0.0 (1.8)	0.0 (0.3)
California	0.0 (0.2)	0.0 (0.7)	0.0 (1.0)	0.0 (1.2)	0.0 (2.6)	0.0 (0.4)

Figure 1 Map indicating geographic locations for fishery sampling and populations for which parentage-based tagging was applied in estimation of stock composition or origins of hatchery broodstocks.