Sockeye Salmon (*Oncorhynchus nerka*)

Supporting documentation and summary for Red List assessments at species and subpopulation levels

The Salmonid Specialist Group (SSG) of the Species Survival Commission of IUCN World Conservation Union has been focusing on range-wide status assessments of salmonids. This assessment is an update of the first effort to add an anadromous (that is, sea-run) Pacific salmon to the *IUCN Red List of Threatened Species™*. We considered extinct and extant populations throughout the native range of the species, including the United States of America (States of Washington, Idaho, Oregon and Alaska), Canada (Province of British Columbia, Yukon Territory) and the Russia Federation (Kamchatka, Koryakia, Magadan, Chukotka). We assembled data on range and adult abundance (over 12 years, representing three generations) for Sockeye Salmon (*Oncorhynchus nerka*) from 300 separate spawning sites across the Pacific Rim. Using this database and some additional information, we evaluated the status of anadromous Sockeye Salmon at both global and subpopulation scales according to IUCN Red List criteria version 3.1.

We provide Red List Categories for Sockeye Salmon at both the global population level and for a total of 98 subpopulations defined by freshwater and marine ecoregional groupings and genetic differentiation. The subpopulations, as a result of guidelines stipulated by IUCN, represent coarse units defined by extremely low rates of geneflow (less than or equal to one effective migrant exchanged per year) and, as a result, may contain numerous spawning sites supporting sockeye salmon adapted to specific nursery lakes or river reaches. For our global population assessment, we concluded that the species as a whole is not threatened and, thus, assess its current status as Least Concern. Out of the total of 98 subpopulations making up the global population, we were unable to assess the status of 31 of them and list them as Data Deficient. We identified five subpopulations as Extinct. Of the remaining subpopulations, nearly 31% are assessed as threatened (19 out of a total of 62 evaluated subpopulations), and an additional two as Near Threatened.

We quantified the trend in adult abundance (that is, the rate of change or "change rate") for all spawning sites for which we had data. In some cases we characterized the status of a given subpopulation based on the change rate from a single spawning site. In cases where we had trend data from two or more sites, we estimated the decline rate applied to the subpopulations as the median rate of change across all spawning sites. This change rate was converted to status based on rules established by the IUCN: Vulnerable – 30-50% rate of decline, Endangered – 50-80% rate of decline, and

Critically Endangered – greater than 80% rate of decline. Subpopulations shown to be stable or increasing in abundance were identified as Least Concern. Additional IUCN criteria were applied that relate to extent of range, absolute abundance, and the quality of habitat to arrive at a final listing.

Here we assess two subpopulations as Near Threatened, three as Vulnerable, 12 as Endangered, and four as Critically Endangered. While all of the countries listed above contained threatened subpopulations, the greatest number and concentration of threatened subpopulations were located in the Province of British Columbia, Canada. Two subpopulations in the Columbia River, one that spawns in the USA and the other in Canada, show relative stability in their abundance; however, we have assessed these as Near Threatened given the degree of habitat fragmentation and the degraded quality of their migratory habitat resulting from hydropower development in the region. We present the listings in table form below (Tables 1, 2) and in the form of two maps (Figures 3a, 3b).

The key threats to the species identified by the SSG were:

- Mixed stock fishing leading to over fishing small, less productive populations
- Changing river and ocean conditions that are likely linked to global climate change, expressed in poor marine survival rates and increased incidence of disease in adult spawners
- Negative effects of hatcheries and construction of artificial spawning habitat

It is important to note that in many cases, the causes for declines in some specific Sockeye Salmon subpopulations remain unknown.

Needed conservation measures identified by the SSG include:

- Emphasize the pivotal role that Fisheries and Oceans Canada play in protecting Sockeye Salmon, and encourage them to fully implement their Wild Salmon Policy and underscore the importance of building partnerships to achieve their conservation goals
- Shift fishing pressure from coastal and lower river locations to more terminal, upriver locations to prevent mixed stock fishery effects on small, unproductive populations
- Enact rules that require measuring stock composition of catch in fisheries
- Reform and/or expand current monitoring programs where needed to improve tracking of status at a more localized, spawning site scale
- Curtail or modify enhancement activities that have been shown to lead to declines in neighboring small, unproductive stocks to reduce their threat to wild salmon
- Given we have little, direct control over ocean conditions that may lead to reduced salmon survival rates, pursue new research that focuses on other agents of mortality at different life stages to help illuminate new ways of conserving the species.

Table 1. IUCN Red List assessments for *O. nerka* subpopulations by region.

Region	Total subpopulations	Summary of assessment categories							
		Extinct	Extinct in the Wild	Critically Endangered	Endangered	Vulnerable	Near Threatened	Data Deficient	Least Concern
Russia	12	0	0	0	1	0	0	10	1
Transboundary US/Russia	1	0	0	0	0	0	0	0	1
Alaska	20	0	0	0	1	1	0	10	8
Transboundary (AK/BC or AK/BC/YK)	5	0	0	0	0	1	0	0	4
British Columbia	48	0	0	3	9	1	0	10	25
Transboundary (BC/WA)	5	1	0	0	1	0	1	1	1
State of Idaho	2	1	0	1	0	0	0	0	0
State of Oregon	2	2	0	0	0	0	0	0	0
State of Washington	3	1	0	0	0	0	1	0	1
TOTAL	**98**	**5**	**0**	**4**	**12**	**3**	**2**	**31**	**41**

Table 2. IUCN Red List assessments for *O. nerka* subpopulations in major river/watershed

River / Watershed	Total subpopulations	Summary of assessment categories							
		Extinct	Extinct in the Wild	Critically Endangered	Endangered	Vulnerable	Near Threatened	Data Deficient	Least Concern
Barkley Sound	1	0	0	0	0	0	0	0	1
Bristol Bay	1	0	0	0	0	0	0	0	1
Columbia River	8	5	0	1	0	0	2	0	0
Cook Inlet	1	0	0	0	0	0	0	0	1
Copper River	1	0	0	0	0	0	0	0	1
Fraser River	22	0	0	0	7	0	0	4	11
Kodiak Island	1	0	0	0	0	0	0	0	1
Nass River	2	0	0	0	0	1	0	0	1
Skeena River	8	0	0	2	2	0	0	1	3
Stikine River	1	0	0	0	0	0	0	0	1

Status assessment overview

We evaluated the status of Sockeye Salmon at both global population and subpopulation scales according to IUCN Red List criteria version 3.1 (IUCN 2001). The global population assessment was based on trends in adult abundance across all monitoring sites over a time period of three generations in reference to the thresholds defined under Red List Criterion A2, and on its current spatial distribution relative to 'extent of occurrence' and 'area of occupancy' thresholds defined under Red List criteria B1 and B2 (Table 3). We evaluated the status of Sockeye Salmon at the subpopulation level based on recent trends in abundance across indicator spawning sites relative to the quantitative decline thresholds defined by IUCN (Table 3). In addition, we applied B2 criteria (B2ab(v)) based on area of occupancy, the number of extant locations, and the rate of change in the number of mature individuals. In cases where there has been substantial declines in freshwater habitat quality, we evaluated status against B2b(iii). In addition we documented subpopulations that are 'Extinct' based on literature sources.

Below, we provide documentation on the data used in our Red List assessment, describe the methods used to define subpopulations, and characterize the analytical approaches for quantifying status and trends at the site, subpopulation, and global population levels.

Table 3. Quantitative criteria used for the global population (B1, B2) and the subpopulation (A2, B2 and D) IUCN Red List assessments of sockeye salmon. CR = Critically Endangered, EN = Endangered, VU = Vulnerable. Subpopulations identified by number in the table can be referenced in Appendix 1.

Criterion	Threshold by category		
	CR	EN	VU
A2. Percent decline over last 3 generations	80	50	30
B1. Extent of occurrence (km^2)[a]	100	5,000	20,000
B2. Area of occupancy (km^2)[a]	10	500	2,000
B2a. Number of locations[b]	1	≤ 5	≤ 10
D. Absolute abundance	50	500	1,000

[a]The global population did not qualify for a threatened category. We evaluated specific subpopulations (73, 74, 75) against B2 sub-criteria (B2ab(iii,v)) pertaining to fragmentation, habitat quality and absolute numbers of mature individuals (see IUCN 2001 for details).

[b]Number of Sockeye juvenile nursery lakes and distinct spawning regions within a subpopulation.

Global Population Evaluation

We computed trends in adult abundance of the global population by estimating the median rate of change across all monitoring sites that met certain criteria for data quality throughout their natural range (data sources and analytical approach described below). The Red List Criterion A2 addresses the rate of change in number of adults over a time period of three generations (12 years for Sockeye Salmon). The analysis of the rate of change in abundance for this assessment relied exclusively on escapement date, defined here as that portion of a group of reproductively mature individuals in a given population that pass ('escape') the fishery (coastal or in-river) and are therefore capable of reproducing. IUCN Red List Guidelines (version 8.1, August 2010) suggest the most appropriate method for estimating decline is to determine trends in aggregate abundance, representing an average over all subpopulation weighted by the estimate of size of each subpopulation. We concluded that applying expansion or weighting factors for salmon escapement data are highly uncertain and rarely quantified rigorously. In this assessment we computed trends using the raw, unweighted abundance across all sites and characterized abundance dynamics for the species as a whole by estimating the median rate of change in escapement. While our approach represents a departure from the recommended guidelines, we felt applying weighting factors would introduce significant uncertainty in our assessment.

Commercial and management organizations collect abundance data on Sockeye Salmon but the level of monitoring effort is not uniform across the natural range of the species (see Appendix 1). Therefore, in order to estimate global distribution (area of occupancy and extent of occurrence), we used distributional data from Augerot (2005), which covers the breeding range for the species (i.e., freshwater, relying on approach described in Standards and Petitions Working Group 2010). Distribution for the species was defined for Alaska using the Alaskan Department of Fish and Game Anadromous Waters Catalog (ADFG 2003), for British Columbia using the Department of Fisheries and Oceans' Fisheries Information Summary System (DFO 2001), for the US Pacific Northwest (Washington, Oregon, and Idaho) using Streamnet (2003), and for Russia based on the judgment of local and regional experts, as well as published accounts. Landlocked Sockeye, or Kokanee, exist in Japan but were not considered in this assessment. Occurrence was defined at a watershed scale using HYDRO-1K units (HYDRO-1K, 1998), a globally available GIS basin coverage derived from GTOPO-30 digital elevation model data (GTOPO-30 is based on a 30-arcsecond resolution). Extent of occurrence of the species was estimated from the total area of a convex polygon that encompassed all HYDRO-1K basins where Sockeye Salmon were known at one time to have occurred (*ca*. 150 years before present); area of occupancy was estimated from the sum of the area of all currently occupied HYDRO-1K basins (current refers to approximately 10 years before present). Estimated values were compared to the thresholds defined under Red List criteria B1 and B2 (Table 3).

Subpopulation Evaluation

IUCN recognizes *subpopulations* as geographically or otherwise distinct groups in the global population where there is little demographic or genetic exchange. Subpopulations may, however, contain multiple local populations, which we will refer to in this assessment as *spawning sites.* The subset of all spawning sites that yield abundance data for this assessment will be referred to as *monitoring sites*. A total of 80 subpopulations were identified in the 2008 assessment using a two-tiered, hierarchical approach using geographic and genetic data. A total of 75 of these were identified as extant. In the 2011 amendment, several of the subpopulations were further subdivided based on additional input from the salmon specialists (Pacific Salmon Commission (PSC) and Fisheries and

Oceans Canada (DFO)), resulting in a total of 98 subpopulations, of which 93 are extant. The subpopulations in this assessment are considered independent and reproductively isolated from each other. We used only native subpopulations in our assessments; no introduced subpopulations were included. The five subpopulations that were identified as Extinct were based on Gustafson *et al*. (2007).

We used the Level IV 'Salmon Ecoregions' of Augerot (2005) for our initial *subpopulation* groupings. We refer the reader to Augerot (2005) for more information on salmon ecoregions. First, in order to reduce the candidate set of Level IV ecoregions to the subset containing Sockeye Salmon, we selected only those ecoregions known to support the species. We made finer divisions in large watersheds in British Columbia (specifically the Skeena and Fraser Rivers) based on delineated freshwater ecoregions developed for British Columbia. This provides a broad habitat template that helps capture important ecological variables that drive the process of local adaptation in Sockeye Salmon. The units that result after consideration of marine and freshwater zonation are hereafter referred to as ecoregions. We further subdivided these ecoregions based on evidence of marked genetic differentiation. Specifically, we identified the degree of independence among putative subpopulations within each ecoregion using information on neutral (i.e., non-coding) DNA alleles. While we acknowledge that it is not straightforward to ascribe demographic or geographic distinctness based on observed genetic distances, we feel it is the most appropriate methodology given the scale of our assessment and the paucity of observations of stray rates among the spawning locations considered in this assessment. We acquired data from two sources to identify barriers to gene flow within an ecoregion. Our primary data source was a microsatellite-DNA baseline that represents most of the range of the species (Beacham *et al*. 2006a,b). These data include 300 spawning sites across the US, Canada, Russia and Japan (Figure 1). Our second data source was a matrix of F_{ST} values based on microsatellite-DNA from the Alaska Department of Fish and Game Gene Conservation Lab for 55 spawning sites in Bristol Bay, Alaska (Habicht *et al*. 2007, Figure 1). We determined geographic coordinates for all the spawning sites using a combination of agency information, topographic maps, and input from regional biologists. To determine the degree of differentiation among putative subpopulations, we examined the data as a matrix of F_{ST} values following Cavalli-Sforza chord distances (using PHYLIP v.3.63). We analyzed these data using a computational geometry that identifies both the location and direction of barriers to gene flow (using Monmonier's maximum difference algorithm implemented in BARRIER software; Manni *et al*. 2004).

Ecoregions were subdivided based on the existence of significant barriers to gene flow. This threshold was established at 0.04 F_{ST} across neighbouring spawning sites. We arrived at this threshold by applying the Wright-Fisher island model with the following key assumptions: 1) a census population of 6,000 individuals (computed as the median population size across all spawning sites in our data base), 2) a N_e:N_{census} of 0.2 (Allendorf *et al*. 1997), and 3) a threshold exchange rate between units of <0.5%. We computed barriers based on a network consisting of Thiessen polygons with each genetic sampling point represented at the center of a polygon. Wherever the threshold F_{ST} value was reached between two spawning sites, a barrier was identified in the form of an isopleth with the line centered equidistant from the two spawning sites (i.e. a line derived from one side of a Thiessen polygon). Once barriers were identified, we derived topographic barriers by aligning the geometric lines developed from the network to drainage boundaries based on digital elevation data. This was conducted in a total of eight ecoregions where significant genetic heterogeneity was observed (TRANSBOUNDARY FJORDS; NASS-SKEENA ESTUARY; SKEENA RIVER; HECATE STRAIT-Q.C; PUGET SOUND-GEORGIA BASIN; FRASER RIVER, MIDDLE; FRASER RIVER, LOWER; AND COLUMBIA RIVER).

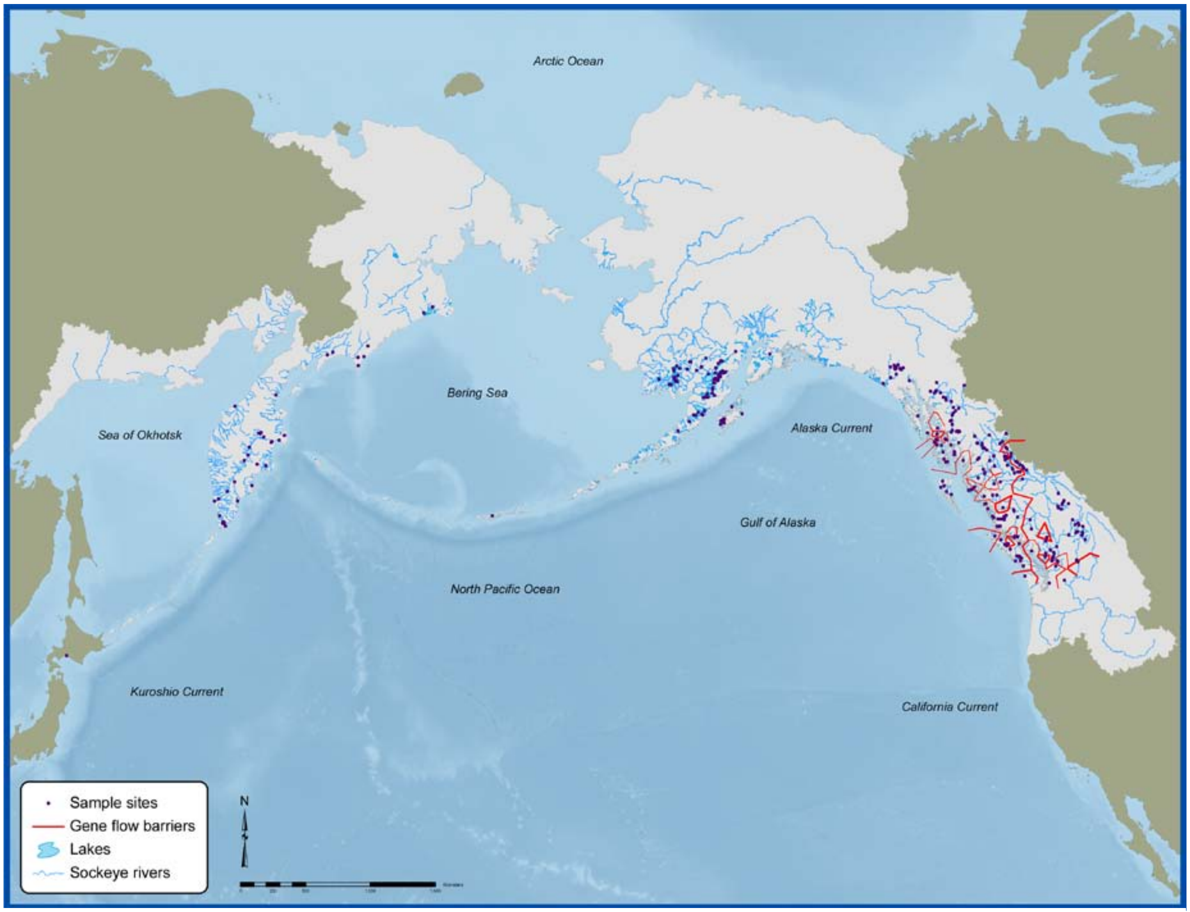

Figure 1. Barriers to gene flow for Sockeye Salmon (*Oncorhynchus nerka*)

Our analysis of barriers to gene flow revealed that heterogeneity among spawning sites exists within the Province of British Columbia and the State of Washington as well as among spawning sites near the transboundary area of the State of Alaska and the Province of British Columbia. This heterogeneity likely results from three phenomena: 1) this region likely served as a primary refugium for the species during the last major glacial period, 2) there is a high degree of reproductive isolation among populations due to the isolation of lakes and the Sockeye's high level of natal-lake fidelity, and 3) the region supports many small lake populations that experience genetic drift (Figure 1). There appears to be much less genetic heterogeneity throughout most of the rest of the species' range, including most of the State of Alaska and the Russia Far East. For example, Bristol Bay Sockeye were relatively homogenous based on our analysis and that reported by Habicht *et al*. (2007). We relied on ecoregional boundaries to define subpopulations throughout Alaska and Russian parts of the species' natural range. Our analysis for the 2008 assessment yielded a total of 80 subpopulations, including five Extinct subpopulations. A total of 50 (Appendix 1) had adequate data for a quantitative assessment of population decline.

Through a combination of solicited written review comments and discussions, we resolved finer subpopulations within the province of British Columbia for the 2011 amendment.. Finer assessment units were strongly recommended by the PSC and DFO, particularly within the Fraser River watershed. Rationale for the finer divisions typically included significant differences in life histories such as run timing or river- versus lake-type juvenile life histories. Divisions were also made to separate areas that were geographically distinct and had large distances between spawning areas.

Changes were made to the Fraser, Skeena and Nass basins as well as to some subpopulations that previously spanned island and mainland freshwater spawning and rearing habitat. For instance, the large “FRASER RIVER, MIDDLE: Stuart to Nahatlatch R” subpopulation, which had previously been defined primarily by the boundary of ecoregion/freshwater zone, was subdivided further into distinct geographic units with large distances between each unit (SP~s 79-83, 85-87, Appendix 1). These geographic units were further subdivided by run timing (e.g., early and late Stuart runs). In another example, the Nass River basin was subdivided into three separate subpopulations with one subpopulation (Nass_Gingit, SP~41, Appendix 1) representing a distinct river type, another (Nass_Upper, SP#40, Appendix 1) representing primarily glacially turbid lake systems, and another (Nass_Coastal, SP#42, Appendix 1) representing coastal lake systems. Finally, a couple of subpopulations were subdivided because the salmon ecoregion from which they were originally derived combined together island and mainland spawning and rearing habitat (because they shared common marine features) that had large distances between these areas as well as distinct terrestrial environments (e.g., the eastern portion of the Haida Gwaii islands was split from the mainland across Hecate Strait, SP#s 51, 52 and 58, Appendix 1). In addition, we thoroughly documented the presence of river-type Sockeye in our designated subpopulations (see footnotes in Appendix 1).

Subpopulation dataset characterization

In order to quantify abundance trends for subpopulations, we used adult-abundance data available for all monitoring sites within its boundary (Figure 2). Data for monitoring sites within subpopulations consist of a series of annual escapement estimates, either in the form of absolute abundance or a standardized index of abundance (e.g., sightings per unit time). Together, ‘escapement’ and ‘catch’ comprise the total number of maturing adults returning to coastal waters. Escapement is therefore the portion of the returning adults that passes (i.e., ‘escapes’) a fishery and reaches the spawning areas, thus potentially contributing to the next generation. Our analysis does not distinguish the type of fishery involved; for example, it does not account for take by commercial, aboriginal, recreational or illegal fisheries. Instead, it treats ‘take’ as part of environmental variation (e.g., McClure *et al*. 2003) or as an agent of ‘natural mortality’. The field methods for estimating escapement vary widely, and include different methods such as aerial and foot surveys, tower, weir, sonar and combinations thereof, as well as different levels of intensity such as a single aerial survey on a river and repeated aerial surveys on another river.

Although we identify monitoring sites as enhanced (through either hatchery releases or the construction of artificial spawning channels) or not enhanced (Figure 2), we do not partition escapement into those adults produced by natural versus artificial means due to lack of adult identification in the majority of cases. Additionally, our evaluation includes datasets originating from escapement monitoring conducted at two levels of biological organization: Tier 3 is higher resolution and includes data on individual spawners on, or in close proximity to, the spawning sites (analogous to populations, local populations, and/or demes), while Tier 2 monitoring represent a more aggregated count of spawners that may represent individuals migrating to more than one spawning site (akin to metapopulations). We treated Tier 3 and Tier 2 data similarly in our assessment; however, in cases where there were nested tiers within a given subpopulation (i.e. where a Tier-2 monitoring effort encompassed one or more Tier3 datasets within the same subpopulation) we used Tier 3 over Tier 2 data due to its finer biological resolution.

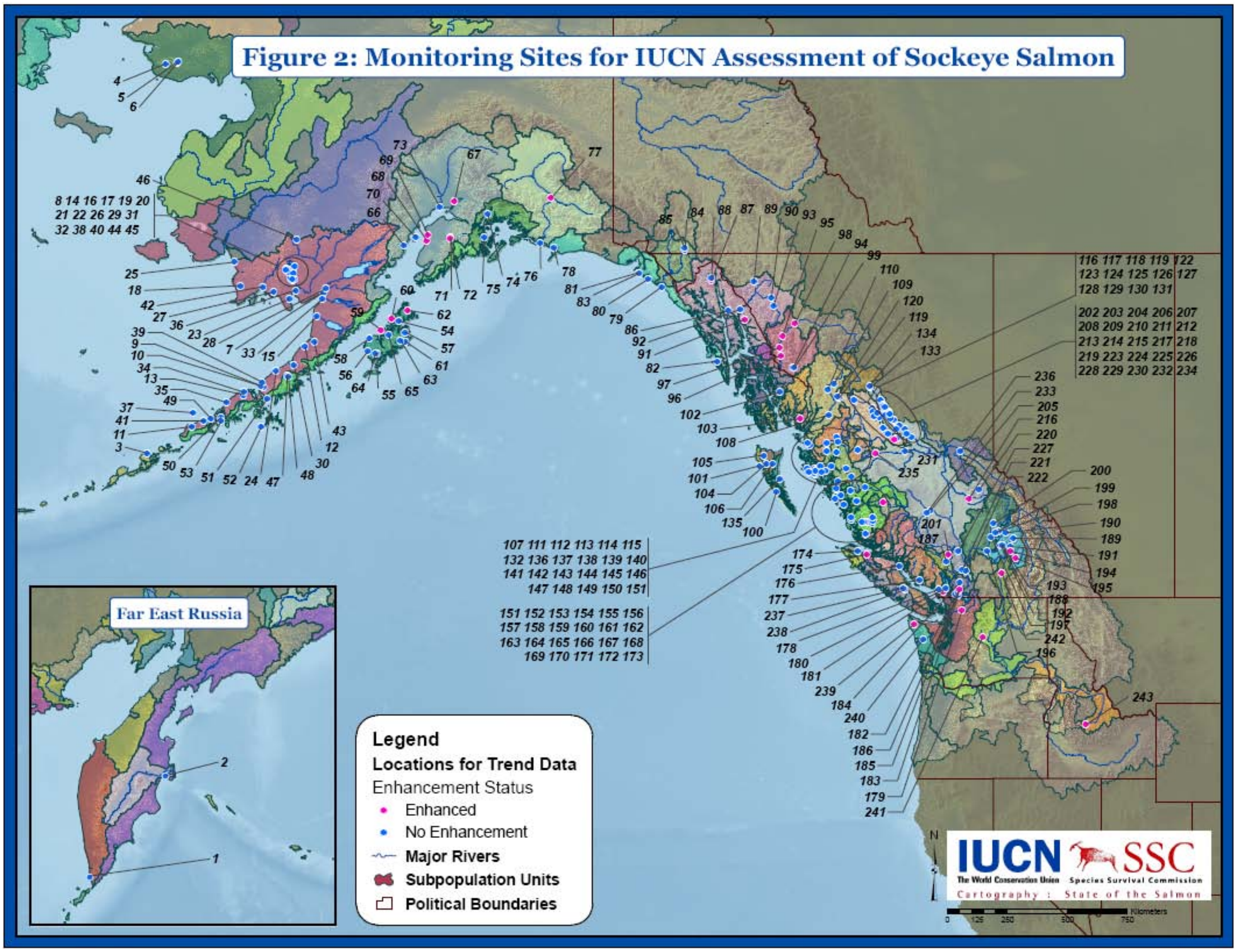

Figure 2. Monitoring sites for IUCN Assessment of Sockeye Salmon

Within subpopulations, we included only those spawning sites that have been monitored using documented methods on a long-term (12 years) and continuous basis (complete data for at least 60% of the time series). We required a minimum of 10 data points (i.e., series that were at least 60% complete) for reliable parameter estimates using linear regression (e.g., Gotelli and Ellison 2004). We determined through a separate analysis that our results are robust to changes in this data gap rule. Given these inclusion criteria, 62 of the 93 delineated, extant subpopulations have adequate data for quantitative assessment (Appendix 1). The 62 subpopulations assessed had escapement time-series data for an average of four monitoring sites (Appendix 1; data sources are listed below).

As a result of creating new subpopulations in the 2011 amendment, we characterized four new subpopulations as Data Deficient (Outer_NWVancouverIs (SP#58), Fraser_ChillwkES (SP#69), Fraser_TasekoES (SP#80), and Fraser_ChilkoES (SP#81), noted in Appendix 1). Fraser_ChillwkES was previously grouped with the Cultus Lake Sockeye subpopulation, the two latter subpopulations were previously grouped within the large Fraser_Middle subpopulation, and Outer_NWVancouverIs was grouped with West Hadai Gwaii subpopulations in the original 2008 assessment. In addition, we followed recommendations by DFO scientists to re-characterize the Fraser_WidgeonL subpopulation

(SP#67) as Data Deficient (it was listed as Vulnerable under D1 criteria in the 2008 assessment). The abundance estimate for this subpopulation was a highly uncertain index, and there is very little confidence around the absolute abundance estimate or the temporal abundance trend for this subpopulation.

Criterion A2: We analyzed recent escapement trends at the scale of individual monitoring sites and scaled these results upwards to characterize the Red List status of subpopulations against criterion A2 (i.e., decline-based where the reduction or its causes may not have ceased or may not be understood or many not be reversible, Table 3; IUCN 2001). Based on input from DFO during the amendment process, we added a number of monitoring sites that were not included by the assessors in the 2008 assessment. These new monitoring sites are indicated in Appendix 2. This amounted to an increase of 32 sites, bringing the total number of monitoring sites to 279. In addition, we sourced our escapement data for all sites in the Fraser River watershed from a different, more reliable source for the 2011 amendment (see below).

There were a number of subpopulations for which escapement data were collected on both an absolute and index basis (Appendix 2). For purposes of this analysis, we estimated the decline rate of the subpopulation as the median rate of change across all monitoring sites within the subpopulation boundary. Thus, all monitoring sites contribute equally to the assessment of each subpopulation, recognizing the importance of maintaining population heterogeneity as fundamental to the conservation of Sockeye Salmon (*sensu* Hilborn *et al*. 2003; Schindler *et al*. 2010). As described above in the context of the global population assessment, this unweighted approach to determining trend is a departure from the guidelines provided by IUCN, but we feel the process of applying weighting in this analysis would introduce significant uncertainty in the assessment given the nature of these data sets. In the following section, we characterize our analysis methods for individual monitoring sites followed by a description of our subpopulation-scaling approach.

Within subpopulations, we estimated the average abundance (i.e., escapement, *N*) change over the most recent three generations (i.e., 12 years) for individual monitoring sites using a least-squares regression approach. Before estimating population change, however, we attempted to minimize the influence of observer variability on results by using a simple error-filtering approach. Computing trends using raw spawner count data is problematic given the counts represent only a single life stage and are therefore not a representative sample of the entire population. Further, escapement data are prone to an unknown but high degree of random observer error (e.g., due to incomplete census information, age-structure variation, methodological limitations, and other factors; Holmes 2001, Holmes and Fagan 2002, Paulsen *et al*. 2007). Given this, we transformed each data series of length *l* years (where *l* = 15 yrs) to one comprised of 4-year running averages and a length *l*-3 (i.e., 12 yrs). We then estimated the average three-generation change in escapement based on the fitted relationship between $\log_e(N)$ and year (*t*); the rate of change across a three-generation time window was estimated based on predicted abundance at *t*=0 and $t=t_{\max}$ [i.e., % change = $(N_{tmax}-N_{t0})/N_{t0}*100$].

Based on a reevaluation of our algorithm, we computed the change rates over a 12 year (t_{max}) time series of smoothed data (rather than using a value of 15 years for t_{max} in the 2008 assessment) to conform better to IUCN guidelines. This resulted in a minor adjustment of the change rates that were reported in the 2008 assessment. Below, we identify how this change to the algorithm resulted in changes to the risk category determinations. In addition, there were a number of PSC and DFO staff members that recommended reporting longer-term trends in the data to provide better context to recent population dynamics. While the IUCN criterion A is explicit in defining the time period to address change rates as 10 years or three generations (whichever is longer), we provide change rates in this amendment for the entire period of record for all sites and subpopulations for context and reference (along with the range of years over which the computed trend applies).

Before scoring three-generation trends for subpopulations against criterion A2 (decline-rate criterion, see Table 3; IUCN 2001), we had to characterize their status quantitatively based on estimated (i.e., regression-based) abundance changes for their constituent monitoring sites. We assigned each subpopulation the three-generation change rate (%) equivalent to the median (i.e. 50th percentile) of its change-rate of the constituent monitoring sites. In application, if the median decline rate for a subpopulation was greater than the A2 threshold for Critically Endangered (CR), Endangered (EN), or Vulnerable (VU), we classified that subpopulation accordingly. A threatened status against criterion A2 was deemed unnecessary otherwise (i.e., Least Concern (LC) was assigned).

***Criterion B2*:** In addition, we applied criterion B to all subpopulations. To be considered threatened under criterion B, it was necessary to determine if the geographic range falls below a certain threshold, if the subpopulation is severely fragmented or know to exist at a limited number of locations, and whether the subpopulation is declining in the number of mature individuals. We conclude that salmon do not undergo "extreme fluctuations" (criterion B2c) and hence we did not consider that criterion in this assessment. Geographic range (i.e., area of occupancy) was estimated for the evaluated subpopulation based on a one square kilometer grid overlaid on all known nursery lakes and river segments identified as spawning and rearing habitat. Locations, as defined by IUCN, "…defines a geographically or ecologically distinct area in which a single threatening event can rapidly affect all individuals of the taxon present". In this assessment, we consider each nursery lake or separate, distinct spawning region as a location. Subpopulations qualify for listing under B2 if the area of occupancy and the number of locations fall below the defined thresholds established by IUCN (Table 3) and the number of mature adults in the subpopulation are known to be in decline (criteria B2ab(v)). The semelparous nature of Pacific Salmon, coupled with variation in the age at maturation, means that the potential negative impacts of events associated with subpopulations having few spawning locations would have to occur over multiple years or have lasting effects to negatively impact the entire subpopulation. Thus, the life history of Sockeye Salmon results in some temporal redundancy which may partly buffer against risks associated with a limited number of locations.

For subpopulations known to have experienced substantial decline in freshwater habitat quality, we applied B2ab(iii). This criterion was applied in cases where there has been extensive hydropower development that has resulted in degraded migratory habitat and altered ecosystem function.

Criterion D: Finally, we considered the absolute number of mature adults (criterion D) in our assessment. If the population estimate, determined as an average escapement count over the past generation, fell below the threshold established by IUCN (Table 3), we identified them as threatened under the appropriate IUCN category.

Status

Global Population Status

At the global population level, Sockeye Salmon are assigned a Red List status of Least Concern (LC). The median rate of change across the 62 assessed subpopulations indicates an expanding global population (9.0% increase over the past three generations), thus there is no evidence of risk to the species under Red List criterion A2. With an estimated geographic range of 11.5 million km^2, there is no evidence of threat to the global population under criterion B1 (Table 3). Similarly, at 1.9 million km^2

of current occupancy (freshwater basin area), there is no evidence of threat under criterion B2 (Table 3). Approximately 7% of the historical range of Sockeye Salmon has been lost due to localized extinction events, but we conclude the species is not threatened globally.

Subpopulation Status

Results: Estimates of $\log_e(N)$ vs. year (t) regression parameter estimates escapement dataset details for each monitoring site assessed appear in Appendix 2 (new sites added since the 2008 assessment are identified in the "New" column, along with new subpopulation identification numbers in the first column). Subpopulation summary statistics (including number of assessed sites, median of full period of record and 3-generation change rates) and status categories against, A, B and D criteria are provided in Appendix 3. We added two new columns to Appendix 3 to include results from the long-term trend analysis, and changes in status (with associated comments) for subpopulations compared to the 2008 assessment. Finally, the Red List Categories assigned to each subpopulation are presented in Appendix 3 and in the form of a map in Figures 3a and 3b. We briefly describe below some broad-scale patterns of our results.

Overview of status*:* A total of 19 subpopulations were determined to be threatened under criterion A2 (six and VU, 10 and EN, three as CR). Consistent with previous qualitative information and expert opinion (see Augerot 2005 for a review), we found that Sockeye populations inhabiting southern portions of their range are in decline whereas those in northerly regions are generally stable (Figure 3a). Subpopulations using lake-river systems in the HECATE STRAIT-Q.C. SOUND, PUGET SOUND-GEORGIA BASIN, SKEENA RIVER and FRASER RIVER ecoregions, for instance, decreased in abundance considerably over the last three generations (Appendix 3, Figure 3b). Towards the northern end of their distribution, Sockeye were generally characterized by stable-to-increasing trends in adult abundance (Appendix 3; for within-subpopulation exceptions at the scale of individual locations, see Appendix 2). There were several notable exceptions to the north-to-south risk gradient, including subpopulations in the Columbia and in eastern Washington State. It should be noted that many of these are supported through some level of hatchery contributions that may mask declines in wild populations (e.g., >200,000 hatchery juveniles released per year in Columbia_Wen (SP#91) and Columbia_Okan (SP#92) subpopulations; Fish Passage Center online hatchery database, www.fpc.org). Further, even within large subpopulations that contain a majority of spawning sites that have stable or increasing abundance, some monitoring sites have experienced abundance declines and remain depressed in recent years.

In addition to abundance decline-based criteria, we considered geographic area in the context of extinction risk. A total of 15 subpopulations were determined to be threatened against criterion B2ab(v) (4 as VU, 11 as EN; Appendix 3). In addition, we determined that subpopulations 91 and 92 (in Columbia_Wen and Columbia_okan subpopulations, respectively) nearly qualified against criterion B2 considering the declining quality of the freshwater habitat supporting these subpopulations, particularly as a result of hydropower development that fragments their habitat and alters natural ecosystem function. We conclude that these two subpopulations qualify as Near Threatened because they nearly qualify against B2ab(iii) criteria (Appendix 3).

In three cases (subpopulations NassSkeena_Hugh, Skeena_Alistair, and Fraser_ChilkoS) criterion B returned the highest threat category based on limited area of occupancy, relatively few locations where the taxon is present, and an observed decline in mature adults (Appendix 3).

Finally, we considered those subpopulations with abundance low enough to qualify for listing against criterion D. We conclude only one subpopulation is considered threatened (CR) against this criterion:

Columbia_Red (SP#93) (Appendix 3).

In summary, we propose two subpopulations to be listed as Near Threatened, three as Vulnerable, 12 as Endangered, and four as Critically Endangered (Appendix 3). Thus nearly 27% of assessed subpopulations are considered threatened against IUCN criteria. Further, 32% of all extant subpopulations are considered Data Deficient, and hence their status is not known. While all of the countries listed above contained threatened subpopulations, the greatest number and concentration of threatened subpopulations were located in the US Pacific Northwest and the Province of British Columbia, Canada. Two subpopulations in the Columbia River, one that spawns in the USA and the other in Canada, show relative stability in their abundance; however, we propose to add them to the Red List as Near Threatened given the degree of habitat fragmentation and the degraded quality of their migratory habitat resulting from hydropower development in the region. Listings for all the subpopulations are presented in Appendix 3 and are displayed in Figures 3a and 3b.

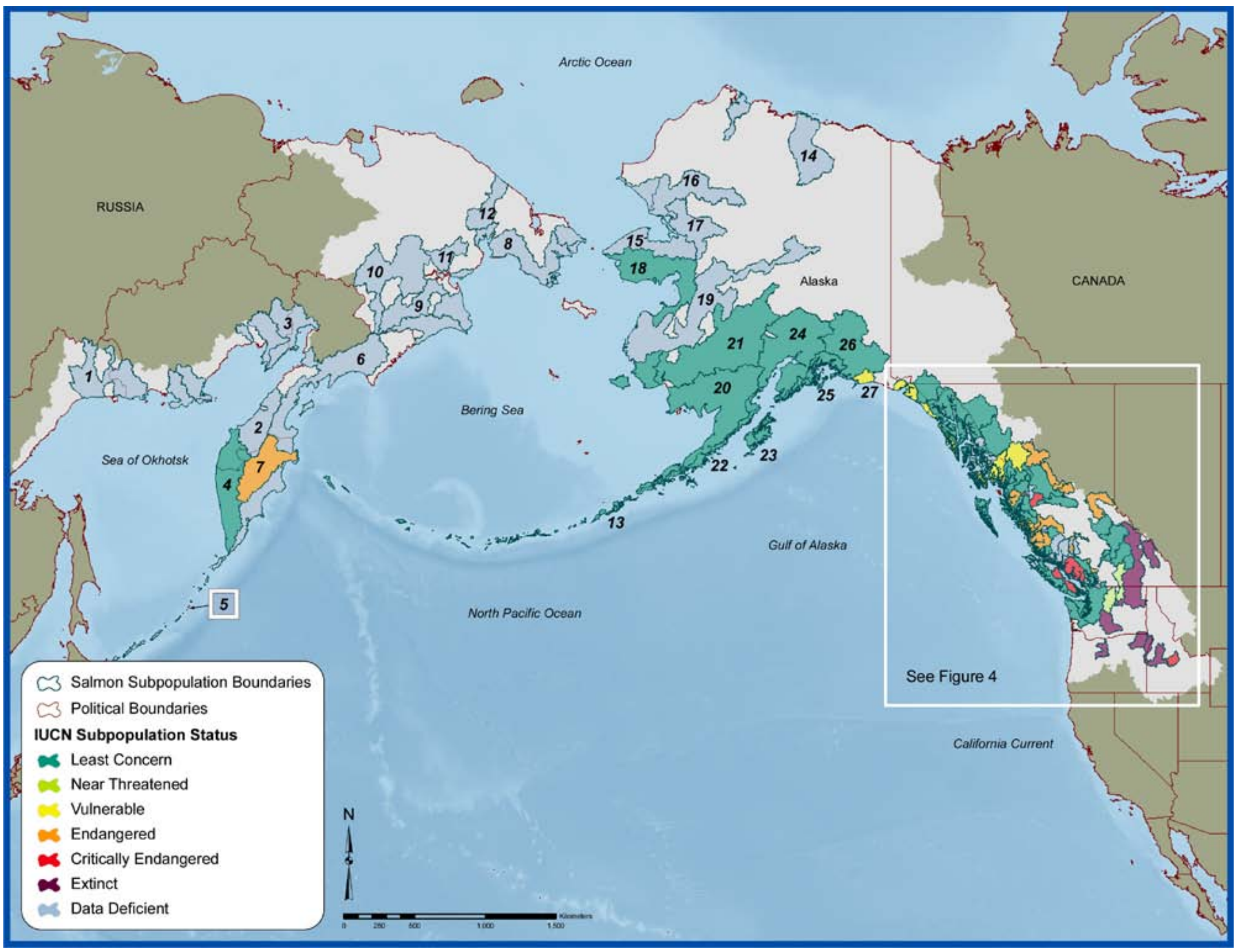

Figure 3a. Status of IUCN Sockeye Salmon subpopulations (North Pacific)

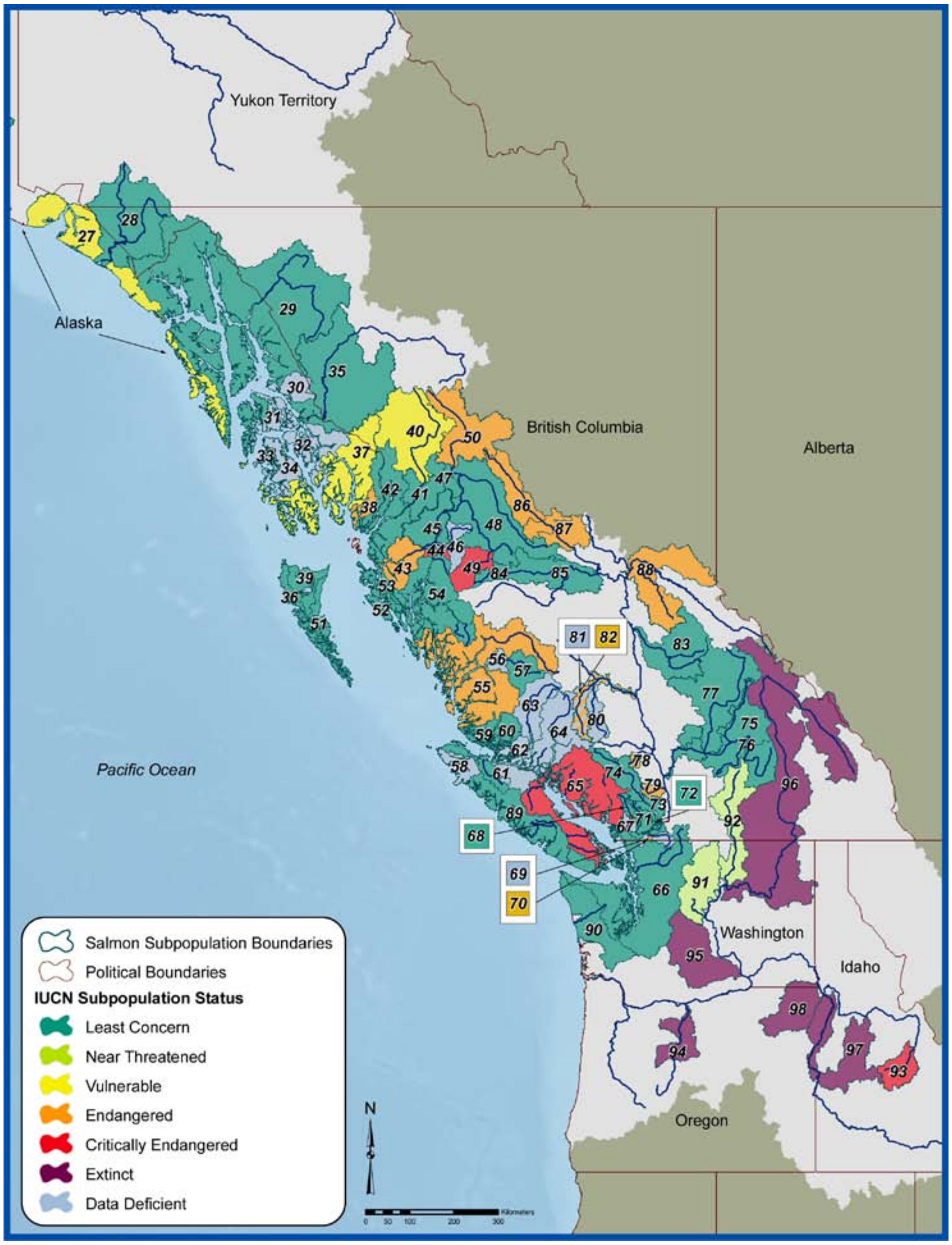

Figure 3b. Status of IUCN Sockeye Salmon subpopulations (southeastern range)

Sensitivity to outliers in estimate of trend

The determination of status based on regression slope is sensitive to outliers, particularly early and late in the time series. An anomalously high record of escapement early in the time series used to determine a trend in abundance can result in a relatively sharp rate of decline over the three generation time period. Two examples demonstrate this effect. The first is Fraser_GatS (SP #78) in the lower Fraser River in British Columbia, and the second is NassSkeena_Hugh (SP # 38) in

Southeast Alaska. Both are identified as threatened in the amendment (both EN), and both have an anomalously high record of abundance early in the time series (1992 return year for NassSkeena_Hugh and 1996 return year for Fraser_GatS). Our analytical approach involving data smoothing minimizes the influence of these outliers, but these observations still have a relatively strong effect on the estimated trend. Threats do exist for both of these populations, and resource agencies have taken actions to recover and conserve these populations (M. Lapointe, Pacific Salmon Commission, pers. comm.; Piston and Brunette 2010), but it is important to acknowledge here that these anomalously high return years early in the time series can have a disproportionate influence on the estimated trend for a subpopulation.

Comparison of Trends Measured over three generations vs. entire time series

As a result of concerns about characterizing status based on abundance trend data over a relatively short recent time period (the past three generations, 12 years), we explored how assessing trends over the entire period of record could place recent trends in a broader, historical context. We carried out the same analysis to determine trend as described above, but in this case used the entire period of record (hereafter referred to as the full series trend). Our estimates of percent change from the beginning to the end of this longer time period were then used to determine how trends differ over the full series versus the most recent three generation period, as described above. Because some of the constituent sites had variable periods of observation, we estimated the period of observation for each subpopulation as the median of the start and end years across all the sites within a given subpopulation. Below we summarize the results.

In aggregate, we found that 12 of the 19 subpopulations identified as threatened based on IUCN A2 criteria had either a less negative trend or a positive trend in abundance over the full series relative to the recent three generation period (SP#s 7, 27, 43, 44, 49, 50, 78, 79, 82, 86, 87, 88; Appendix 3). Conversely, the remaining 7 subpopulations had a more negative trend over the period of record compared to the recent three generation period (SP#s 37, 38, 40, 55, 65, 70, 93; Appendix 3). The difference in trends for the full series vs. the recent three generation period were relatively small (less than 10% difference in slope) for three subpopulations (SP#s 37, 44, and 65; Appendix 3). It is important to emphasize here that the intent of the IUCN criterion A is to characterize recent population dynamics, and hence status determined in this assessment reflects these recent trends. We provide trends over the full series only to provide historical context to these more recent population dynamics.

Key differences in status characterizations between the 2008 assessment and the 2011 amendment:

In short, the amendment process resulted in an expansion of the number of assessed subpopulations (from a total of 80 in the 2008 assessment to a total of 93 in the 2011 amendment) resulting from subdividing subpopulations in the 2008 assessment. A change in the algorithm we used also influenced status in a few cases. In Appendix 3 we identify in the final columns the changes from the 2008 assessment.

In the original 2008 assessment, we concluded that two subpopulations were Near Threatened, three were Vulnerable, 10 were endangered and four were Critically Endangered. Thus we concluded that 35% of all assessed subpopulations were considered threatened against IUCN criteria, and 39% of all extant subpopulations were considered Data Deficient. In contrast, in the present amendment, we conclude that two subpopulations are Near Threatened (total unchanged), three are Vulnerable (total unchanged), 12 as Endangered (2 more than the total in the 2008 assessment), and four are Critically Endangered (total unchanged). This translates into 27% of the assessed subpopulations as threatened (down from 35% in the 2008 assessment), and a total of 32% of the extant subpopulations as data deficient (down from 39% in the 2008 assessment). The Fraser_WidgeonL subpopulation, a river-type sockeye population in the Lower Fraser, was originally listed as threatened in the 2008 assessment against D criteria. During the amendment process, we concluded, based on input from DFO, that the data were not sufficient to characterize the status of this subpopulation due to a lack of accurate abundance data, and hence identify this subpopulation as Data Deficient in the 2011 amendment (Table 2). In addition, two subpopulations created from a larger subpopulation in the Fraser River watershed in the 2008 assessment (Fraser_TasekoES and Fraser_ChilkoES) are characterized as Data Deficient in the 2011 amendment due to a lack of abundance data (Table 2).

Data sources and references

Escapement data sources:

The analysis of decline rates for this assessment relied exclusively on escapement data, defined here as that portion of a group of reproductively mature individuals in a given subpopulation that pass ('escape') the fishery (coastal or in-river) and are capable of spawning. Although we identified subpopulations that are enhanced through either hatchery releases or the construction of artificial spawning channels (Figure 2), we did not partition the escapement data between wild and hatchery- or spawning channel-origin individuals due to data limitations. In addition, we defined subpopulation monitoring at two discrete levels: Tier 3, which represents an individual spawning site, and Tier 2, which represents an aggregate escapement count that integrates numerous spawning sites. For the purposes of our status assessment, we treated both Tier 2 and Tier 3 subpopulations identically in our analysis and criteria evaluation. We sourced data for escapement for all sites in the fraser River watershed from a new source for the 2011 amendment (spreadsheet supplied by DFO, Keri Benner, dated November 2007). This data source replaced data downloaded from a separate DFO data base (NuSEDS, supplied by DFO, Eric Grundman).

Below we identify our sources of data:

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***State of Alaska, USA**:*

University of Washington, Alaska Salmon Program, Seattle, Washington (Contact: T. Quinn)

Natural Resources Consultants, Seattle, Washington (Contact: G. Ruggerone)

Alaska Department of Fish and Game (primarily data obtained from Area Management Reports)

***British Columbia**:*

Department of Fisheries and Oceans, Nanaimo, British Columbia (NuSEDS data base)

LGL, Limited, Sydney, British Columbia (Contact: Karl English)

Spreadsheet, dated November 2007, supplied by Keri Benner, DFO.

***State of Washington, USA**:*

Washington Department of Fisheries and Wildlife (SASI data base)

Columbia River Intertribal Fish Commission, Portland, Oregon, USA (Contact: Jeff Fryer)

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Sockeye Salmon (Oncorhynchus nerka)

Supporting documentation and summary for Red List assessments at species and subpopulation levels: Appendices

The tables in the following appendices accompany the supporting documentation and summary for Red List assessments at species and subpopulation levels for the Sockeye Salmon (*Oncorhynchus nerka*).

Appendix 1: Subpopulation metadata
Appendix 2: Abundance trend and data set details for individual spawning sites assessed within subpopulations
Appendix 3: Subpopulation (Subpop) status based on IUCN Red List Criteria A, B and D
Appendix 4: A list of near threatened and threatened subpopulations of sockeye salmon with identification of key threats specific to each

Appendix 1
Subpopulation (SP) metadata

Assessment status' corresponds to whether or not the status of a given subpopulation could be assessed using quantitative criteria ('DD' = Data Deficient, 'E' = Evaluated, 'EXT' = Extinct).

The value provided under 'Sites assessed' is the number of spawning sites for which trend data were available for the assessment.

The position of the subpopulations are indicated in separate columns (continent, country, and state/province/oblast). Transboundary subpopulations are indicated using slashes, and if listing for the subpopulation is based solely on spawning sites assessed in a single jurisdiction, the names of the continent, country or state/province/oblast where the locations are found are provided in parentheses.

Nomenclature used for full names of Sockeye Salmon subpopulations is based on the following rules: 1) Names in upper case indicate marine/freshwater ecoregional groupings (Augerot *et al*. 2006, BC Provincial freshwater zones); 2) for those ecoregions delineated further based on either genetic divergence criteria or extinct evolutionarily significant units described by Gustafson *et al*. (2007), the ecoregion is followed by a colon and a name in proper case referring to rivers or lakes supporting the species.

Names of water bodies were listed separately if water bodies are distinct, but are separated by a slash if water bodies are contiguous. In cases where more than two water bodies exist as distinct sites in the subpopulation, we either 1) list the two water bodies that bracket the longitudinal extent of their distribution along the river network and separated the names by the word 'to', or 2) provide a regional name. AS = Asia, NA = North America, RUS = Russian Federation, US = United States of America, CAN = Canada, WA = State of Washington, ID = State of Idaho, OR = State of Oregon, BC = Province of British Columbia, YK = Yukon Territory.

Subpopulation short name	Subpop. ID	Subpopulation name	Continent	Country	St./Prov./Oblast	Assessment status	Sites assessed	Comments regarding changes from 2008 assessment
EastArc	14	EASTERN ARCTIC (COLD)	NA	US	AK	DD	0	
EastArcCurr	15	EASTERN ARCTIC CURRENT (WARM)	NA	US	AK	DD	0	
Noatak	16	NOATAK RIVER	NA	US	AK	DD	0	
Kobuk	17	KOBUK RIVER	NA	US	AK	DD	0	
YukonInf	18	YUKON RIVER INFLUENCE	NA	US	AK	E	3	
YukonRiver	19	YUKON RIVER	NA	US	AK	DD	0	
SEBering	20	SOUTHEAST BERING SEA INNER SHELF (BRISTOL BAY)	NA	US	AK	E	38	
Kuskokwim	21	KUSKOKWIM RIVER	NA	US	AK	E	1	
WGulfAlaska	22	ALASKA COASTAL DOWNWELLING, WESTERN GULF OF ALASKA	NA	US	AK	E	6	
Kodiak	23	KODIAK ISLAND	NA	US	AK	E	12	
Cook	24	COOK INLET	NA	US	AK	E	8	
PWS	25	PRINCE WILLIAM SOUND	NA	US	AK	E	2	
Copper	26	COPPER RIVER	NA	US	AK	E	2	
EGulfAlaska	27	ALASKA COASTAL DOWNWELLING, EASTERN GULF OF ALASKA	NA	US	AK	E	6	
TF_Petersburg	30	TRANSBOUNDARY FJORDS: Petersburg Lk/N Kupreanof Is	NA	US	AK	DD	0	
TF_Kah	31	TRANSBOUNDARY FJORDS: Kah Sheets Lk/S Kupreanof Is	NA	US	AK	DD	0	
TF_Mid	32	TRANSBOUNDARY FJORDS: Kunk Lk/E Etolin Is	NA	US	AK	DD	0	
TF_Shipley	33	TRANSBOUNDARY FJORDS: Shipley Lk/N Kosciusko Is	NA	US	AK	DD	0	
TF_South	34	TRANSBOUNDARY FJORDS: South	NA	US	AK	DD	0	
NassSkeena_Hugh	38	NASS-SKEENA ESTUARY: Hugh Smith Lk/Boca de Quadra	NA	US	AK	E	1	
Skeena_Alastair	43	SKEENA R, LOWER: Alastair	NA	CAN	BC	E	2	New subpop split from Skeena_Lower (SKEENA R, LOWER: Kitsukalum, Lakelse, Gitnadoix R)
Skeena_Schul	44	SKEENA R, LOWER: Schulbuckhand	NA	CAN	BC	E	1	New subpop split from Skeena_Lower (SKEENA R, LOWER: Kitsukalum, Lakelse, Gitnadoix R)
Skeena_Kitsmklm	45	SKEENA R, LOWER: Kitsumkalum	NA	CAN	BC	E	1	New subpop split from Skeena_Lower (SKEENA R, LOWER: Kitsukalum, Lakelse, Gitnadoix R)
Skeena_McDon	46	SKEENA R, LOWER: McDonnel Lk/Zymoetz R	NA	CAN	BC	DD	0	
Skeena_Kispiox	47	SKEENA R, MIDDLE: Kispiox R, Club	NA	CAN	BC	E	1	New subpop split from Skeena_Middle (SKEENA R, MIDDLE: Babine, Kispiox)
Skeena_Babine[b]	48	SKEENA R, MIDDLE: Babine	NA	CAN	BC	E	14	New subpop split from Skeena_Middle (SKEENA R, MIDDLE: Babine, Kispiox)
Skeena_Nan	49	SKEENA R, MIDDLE: Nanika Lk/Morice R	NA	CAN	BC	E	1	
Skeena_Upper	50	SKEENA R, UPPER	NA	CAN	BC	E	2	
Hecate_EHGwaii	51	HECATE STRAIT-Q.C. SOUND: East Hadai Gwaii	NA	CAN	BC	E	1	New subpop split from Hecate Strait (HECATE STRAIT-Q.C. SOUND: Hecate Strait)
Hecate_Strait	52	HECATE STRAIT-Q.C. SOUND: Hecate Strait	NA	CAN	BC	E	8	New subpop split from Hecate Strait (HECATE STRAIT-Q.C. SOUND: Hecate Strait)
Hecate_Lowe	53	HECATE STRAIT-Q.C. SOUND: Lowe Lk/Granville Ch	NA	CAN	BC	E	1	
Hecate_Kitl[e]	54	HECATE STRAIT-Q.C. SOUND: Kitimat to Kitlope R	NA	CAN	BC	E	6	

Names of water bodies were listed separately if water bodies are distinct, but are separated by a slash if water bodies are contiguous. In cases where more than two water bodies exist as distinct sites in the subpopulation, we either 1) list the two water bodies that bracket the longitudinal extent of their distribution along the river network and separated the names by the word 'to', or 2) provide a regional name. AS = Asia, NA = North America, RUS = Russian Federation, US = United States of America, CAN = Canada, WA = State of Washington, ID = State of Idaho, OR = State of Oregon, BC = Province of British Columbia, YK = Yukon Territory.

Subpopulation short name	Subpop. ID	Subpopulation name	Continent	Country	St./Prov./Oblast	Assessment status	Sites assessed	Comments regarding changes from 2008 assessment
Hecate_QCS[e]	55	HECATE STRAIT-Q.C. SOUND: Queen Charlotte Sound	NA	CAN	BC	E	22	
Hecate_BCR	56	HECATE STRAIT-Q.C. SOUND: Bella Coola R	NA	CAN	BC	DD	0	
Hecate_Atn[d]	57	HECATE STRAIT-Q.C. SOUND: Atnarko R	NA	CAN	BC	E	1	
Outer_NWVancouverIs	58	OUTER ISLANDS: NW Vancouver Island	NA	CAN	BC	DD	0	New subpop split from QCI_Outer (OUTER GRAHAM ISLAND)
PgtGeorgia_Quatse	59	PUGET SOUND-GEORGIA BASIN: Quatse R/N Vancouver I	NA	CAN	BC	E	1	
PgtGeorgia_Nimpk	60	PUGET SOUND-GEORGIA BASIN: Nimpkish, Mackenzie R	NA	CAN	BC	E	1	
PgtGeorgia_Schoen	61	PUGET SOUND-GEORGIA BASIN: Schoen Ck/Davie R	NA	CAN	BC	DD	0	
PgtGeorgia_Glend	62	PUGET SOUND-GEORGIA BASIN: Glendale Ck/Knight Inl	NA	CAN	BC	DD	0	
PgtGeogria_Klin	63	PUGET SOUND-GEORGIA BASIN: Klinaklini River	NA	CAN	BC	DD	0	
PgtGeorgia_Phil	64	PUGET SOUND-GEORGIA BASIN: Phillips R, Heydon Ck	NA	CAN	BC	DD	0	
PgtGeorgia_Sakinaw	65	PUGET SOUND-GEORGIA BASIN: Village Bay Ck, Sakinaw	NA	CAN	BC	E	2	

Appendix 2
Abundance trend and data set details for individual spawning sites assessed within subpopulations (SP)

The field 'Data type' indicates the type of abundance estimate that was available (T = total, I = Index). 'New' refers to monitoring sites added in the 2010 amendment. The value provided under 'Escapement' is the median observed over the period analyzed. Slope parameter (b_1) estimates (standard error) from the regression of log(Escapement) against time and the associated estimate of 3-generation percent change ('% change') are provided for site-level evaluation. N/A = Data Type not available.

Subpop ID	Site name	Site ID	Latitude	Longitude	Data type	New	All years		Most recent 3 generations			
							Years	% change	Years	Escapement Count (X 1000)	b_1, ln(N) vs. t	% change
4	ozernaya	1	51.499695	156.505173	T		70-04	181	90-04	1300	-0.01	-7
7	azabache	2	56.229115	162.536820	I		85-04	-17	90-04	511	-0.09	-65
13	mclees	3	53.997146	-166.723866	I		90-03	125	90-03	5.2	0.08	125
18	glacial	4	64.863232	-165.704451	I		80-03	196	89-03	0.73	0.02	27
18	grand_central	5	64.895632	-165.077904	I		63-05	360	91-05	0.97	0.01	6
18	salmon	6	64.902445	-165.016002	I		63-05	5095	91-05	6.6	0.17	522
20	alagnak	7	59.004914	-156.855284	T		56-06	695	92-06	828	0.16	509
20	bear_cr	8	59.295708	-158.777410	I		46-05	104	91-05	3.5	-0.02	-24
20	bear_late	9	56.095786	-160.294745	T		80-06	-18	92-06	140	-0.02	-23
20	bear_lk	10	56.143176	-160.443127	T		64-06	80	92-06	367	0	-4
20	christianson	11	54.852568	-164.257405	T		71-05	284	91-05	42	0.04	54
20	cinder	12	57.336335	-158.017439	T		70-06	1712	92-06	46	-0.02	-18
20	davids_late	13	55.848557	-161.413453	T		70-06	311	92-06	4.5	0.01	11
20	eagle_cr	14	59.310227	-158.666222	I		58-05	-43	91-05	0.8	-0.09	-61
20	egegik	15	58.223200	-157.354651	T		56-06	90	92-06	1267	-0.02	-17
20	elva	16	59.580661	-159.052669	I		46-05	-75	91-05	0.095	0	-5
20	fenno	17	59.422082	-158.810201	I		46-05	121	91-05	4.7	0.11	229
20	goodnews	18	59.105661	-161.570374	T		81-05	33	91-05	44	0	-2
20	hansen	19	59.321275	-158.701491	I		47-05	126	91-05	8.4	-0.05	-42
20	happy	20	59.323345	-158.724784	I		46-05	969	91-05	8.6	-0.03	-26
20	hidden_lake	21	59.541101	-158.765084	I		46-05	-15	91-05	2.3	0.16	493
20	ice	22	59.329401	-158.814848	I		46-05	407	91-05	8.3	-0.03	-26
20	igushik	23	58.737602	-158.892969	T		56-06	40	92-06	366	-0.06	-47
20	ilnik	24	56.596966	-159.616139	T		70-06	201	92-06	70	0.03	44

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Subpop ID	Site name	Site ID	Latitude	Longitude	Data type	New	All years		Most recent 3 generations			
							Years	% change	Years	Escapement Count (X 1000)	b_1, ln(N) vs. t	% change
20	kanektok	25	59.763325	-161.921076	I		82-05	19	91-05	27	0.04	53
20	kema	26	59.546494	-158.683613	I		57-05	-85	91-05	0.56	0.14	352
20	kulukak	27	58.933191	-159.773450	I		61-03	143	89-03	19	-0.09	-61
20	kvichak	28	58.985901	-156.902977	T		56-06	-42	92-06	2320	-0.1	-66
20	lynx	29	59.484455	-158.921683	I		46-05	75	91-05	1.9	0.05	76
20	meshik	30	56.764557	-158.626409	T		70-05	529	91-05	56	0.09	155
20	mission	31	59.274982	-158.598957	I		90-05	-40	91-05	1.3	-0.05	-40
20	moose	32	59.641866	-158.581729	I		62-05	-48	91-05	1.9	0.1	201
20	naknek	33	58.727699	-156.977653	T		56-06	100	92-06	1536	0.06	83
20	nelson	34	55.936342	-161.380750	T		81-06	50	92-06	242	0.02	27
20	north	35	55.587722	-162.371438	T		74-05	366	91-05	9	0.06	88
20	nushagak	36	59.029579	-158.311170	T		78-06	-50	92-06	504	0.03	35
20	pick	37	59.550772	-159.063777	I		46-05	-31	91-05	6	0.02	21
20	sandy	38	56.244792	-160.376836	T		70-06	122	92-06	51	-0.04	-35
20	stovall	39	59.458467	-158.635599	I		57-05	-66	91-05	1.2	0.11	223
20	swanson	40	55.021816	-163.614157	I		70-05	1063	91-05	9.7	0.02	24
20	togiak	41	59.075907	-160.338369	T		56-06	121	92-06	189	0.01	16
20	ugashik	42	57.484265	-157.489033	T		56-06	220	92-06	892	-0.04	-33
20	whitefish_big	43	59.266659	-158.685268	I		92-05	16	92-05	0.55	0.01	16
20	yako	44	59.276101	-158.706016	I		46-05	336	91-05	3	0.07	114
21	kogrukluk	45	60.396696	-158.480900	T		76-06	290	92-06	11	-0.02	-21
22	black	46	56.457835	-158.991598	T		52-05	169	91-05	397	-0.01	-12
22	chignik	47	56.415071	-158.945381	T		52-06	35	92-06	290	-0.01	-13
22	lagoon_middle	48	55.094184	-163.204739	I		72-05	1073	91-05	24	0.03	43
22	mortensens	49	55.157149	-162.650696	I		70-05	190	91-05	6.4	0.05	71
22	orzinski	50	55.734877	-160.085480	T		70-05	157	91-05	31	0.04	63
22	thin_point	51	55.032296	-162.639541	I		70-05	599	91-05	25	0.05	72
23	afognak	52	58.081506	-152.829008	T		66-06	1352	92-06	67	-0.16	-83
23	akulura	53	57.127683	-154.039937	T		67-06	196	92-06	12	-0.12	-72

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Subpop ID	Site name	Site ID	Latitude	Longitude	Data type	New	All years		Most recent 3 generations			
							Years	% change	Years	Escapement Count (X 1000)	b_1, ln(*N*) vs. *t*	% change
23	ayakulik	54	57.191128	-154.531780	T		63-06	207	92-06	286	-0.05	-43
23	buskin	55	57.754218	-152.487290	T		90-06	103	92-06	15	0.06	86
23	karluk	56	57.570539	-154.455185	T		76-06	156	92-06	743	0.02	28
23	little_ak	57	57.818412	-153.827920	I		75-06	54	92-06	11	0.11	219
23	malina	58	58.172953	-153.216308	T		68-06	710	92-06	11	0.06	103
23	pasagshak	59	57.476513	-152.474503	I		68-06	580	92-06	8	0.03	42
23	pauls	60	58.390006	-152.340627	T		69-06	86	92-06	23	0	6
23	saltery	61	57.516200	-152.747725	T		76-06	21	92-06	44	-0.01	-13
23	station_upper	62	57.120713	-154.115796	T		69-06	104	92-06	233	-0.02	-17
23	uganik	63	57.669351	-153.389569	I		74-06	-35	92-06	29	0.01	12
24	crescent	64	60.226742	-152.558566	T		75-06	-12	92-06	62	0.09	180
24	fish	65	61.437113	-149.769530	T		70-06	173	92-06	48	-0.06	-47
24	kasilof	66	60.361847	-151.291542	T		75-06	102	92-06	256	0.07	114
24	kenai	67	60.524962	-151.233207	T		68-05	276	91-05	670	0.01	8
24	packers	68	60.449267	-151.911130	T		74-00	68	86-00	30	-0.02	-18
24	russian_early	69	60.461965	-149.983920	T		65-06	633	92-06	40	0.04	61
24	russian_late	70	60.435358	-149.992558	T		63-06	181	92-06	75	0.03	33
24	susitna	71	61.277377	-150.578568	T		77-05	5	91-05	205	-0.02	-18
25	coghill	72	61.070355	-147.921756	T		62-06	-32	92-06	30	0.06	93
25	eshamy	73	60.452550	-148.104349	T		67-06	125	92-06	27	0.05	68
26	copper_delta	74	60.481824	-144.827555	I		71-05	8	91-05	76	0	5
26	copper_upper	75	61.506319	-144.422599	T		78-01	82	87-01	402	0.04	47
27	bering	76	60.176312	-144.274734	I		83-05	-19	91-05	23	-0.05	-39
27	east_alsek	77	59.072662	-138.303315	T		72-05	-25	91-05	47	-0.04	-38
27	italio	78	59.289677	-139.071897	T		72-02	-89	88-02	3.4	-0.05	-44
27	lost	79	59.466352	-139.617275	T		72-06	-32	92-06	2.4	-0.07	-53
27	redoubt	80	56.887975	-135.250376	T		82-06	364	92-06	35	0.06	91
27	situk	81	59.454131	-139.573792	T		76-06	-50	92-06	59	0.02	25
28	klukshu	82	60.116697	-137.024844	T		80-07	-32	93-07	13	0.02	24

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							Years	% change	Years	Escapement Count (X 1000)	b_1, ln(*N*) vs. *t*	% change
28	village_ck	83	60.164363	-137.058777	T		86-07	-64	93-07	2.3	0.03	32
29	auke	84	58.379685	-134.645649	T		63-05	-65	91-05	4	-0.09	-63
29	chilkat[b]	85	59.249674	-135.575031	T		76-04	205	90-04	138	0	5
29	chilkoot	86	59.323887	-135.556934	T		76-05	-57	91-05	51	0.04	58
29	kuthai	87	59.228646	-133.229038	T		92-05	25	92-05	4.8	0.02	25
29	little_trapper	88	58.773196	-132.267946	T		83-05	-2	91-05	12	0.07	120
29	speel	89	58.135158	-133.719951	T		83-05	-42	91-05	7.9	-0.05	-40
29	taku	90	58.424022	-133.971219	T		84-05	15	91-05	108	0.01	14
29	tatsamenie	91	58.534535	-132.142170	T		85-05	31	91-05	6	-0.01	-13
35	bronson[b]	92	56.685565	-131.065519	I		89-05	-85	91-05	0.032	-0.18	-86
35	chutine[b]	93	57.650392	-131.632549	I		84-05	319	91-05	0.17	0.05	70
35	porcupine[b]	94	57.062238	-131.738874	I		84-05	109	91-05	0.085	0.04	52
35	scud[b]	95	57.279144	-131.821805	I		84-05	-46	91-05	0.26	-0.08	-61
35	tahltan	96	58.013904	-130.953155	T		80-06	0	92-06	42	-0.02	-16
35	verret[b]	97	56.692697	-131.002829	I		84-05	-24	91-05	0.15	0.06	101
36	fairfax	98	52.717662	-131.981639	I		80-00	-46	86-00	0.3	-0.03	-25
36	mercer	99	53.583129	-132.900153	I		80-05	25	91-05	2.5	0.06	85
37	mcdonald	100	55.931493	-131.803555	T		82-04	-52	90-04	80	-0.06	-49
38	hugh_smith	101	55.098627	-130.661084	T		82-05	-59	91-05	7.1	-0.05	-41
39	awun	102	53.653060	-132.522533	I		80-05	-38	91-05	3.5	0.05	66
39	naden	103	53.933287	-132.681985	I		80-04	7	90-04	3	-0.01	-10
39	yakoun	104	53.647555	-132.203428	I		80-05	-68	91-05	4.1	-0.01	-13
40	club_upper	105	55.792114	-128.622949	I		80-05	-85	91-05	1	-0.24	-93
40	kwinageese	106	56.193993	-128.795961	I		80-05	-65	91-05	4.1	-0.04	-34
40	meziadin	107	56.024785	-129.148168	T		80-05	10	91-05	180	-0.04	-38
41	gingit[b]	108	55.221973	-129.101975	I		80-05	-53	91-05	1.1	0.06	89
42	diana	109	54.240883	-130.148207	I		81-05	14	91-05	1.8	-0.01	-14
42	shawatlan	110	54.324520	-130.254829	I		80-05	-19	91-05	2	0.1	214
43	alastair	111	54.106656	-129.181535	I		80-03	44	89-03	2.5	-0.1	-66

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Subpop ID	Site name	Site ID	Latitude	Longitude	Data type	New	All years		Most recent 3 generations			
							Years	% change	Years	Escapement Count (X 1000)	b_1, ln(N) vs. t	% change
43	southend	112	54.067854	-129.191469	I		80-05	-5	91-05	4	-0.01	-13
44	schulbuckhand	113	54.362191	-128.573079	I		80-05	-91	91-05	0.7	-0.26	-94
45	kitsumkalum	114	54.517776	-128.663573	I		80-05	3250	91-05	4	0.03	42
47	club_lower	115	55.760199	-128.535575	I		80-05	37	91-05	4	0.06	93
48	babine_four	116	55.419064	-126.688652	I		80-02	-19	88-02	10	0.07	113
48	babine_onethree	117	55.336215	-126.635668	I		80-05	-2	91-05	125	-0.01	-9
48	babine_unacc	118	55.697427	-127.686334	T		80-05	-49	91-05	219	-0.06	-45
48	four_mile	119	54.461485	-125.312683	I		80-05	109	91-05	4	0.06	89
48	fulton[a]	120	54.814205	-126.146263	T		80-05	22	91-05	403	-0.02	-17
48	morrison	121	55.142727	-126.286468	I		80-05	608	91-05	15	0.17	581
48	nine_mile	122	55.208230	-126.585290	I		80-05	304	91-05	1.3	0.08	132
48	pierre	123	54.632885	-125.852741	I		80-05	213	91-05	21	0.06	92
48	pinkut[a]	124	54.445789	-125.459380	T		81-05	-60	91-05	158	-0.11	-71
48	six_mile	125	54.486015	-125.364342	I		80-05	204	91-05	0.7	0.24	1373
48	sockeye_babine	126	54.736354	-126.013952	I		80-05	660	91-05	2.1	0.07	123
48	tachek	127	54.798943	-126.116887	I		80-05	644	91-05	2	0.07	109
48	tahlo	128	55.290509	-126.416623	I		80-05	160	91-05	4.5	0.06	91
48	twain	129	54.609335	-125.811431	I		80-05	46	91-05	7	0.01	16
49	nanika	130	54.093395	-127.476762	I		80-04	482	90-04	15	-0.17	-84
50	azuklotz	131	56.087681	-126.807586	I		80-04	194	90-04	1.8	-0.1	-65
50	salix	132	56.130754	-126.835622	I		80-05	-4	91-05	0.2	-0.06	-45
51	copper_bc	133	53.161241	-131.800567	I		80-04	70	90-04	10	0.09	162
52	curtis	134	53.501057	-129.862886	I		80-04	50	90-04	5	-0.11	-72
52	devon	135	53.453064	-129.772433	I		80-04	69	90-04	3.5	0.02	29
52	keecha	136	53.309463	-129.829560	I		83-04	43	90-04	2	0.04	62
52	kingkown	137	53.510642	-130.296701	I		80-05	219	91-05	2.5	0.19	734
52	kooryet	138	53.341980	-129.882910	I		80-04	227	90-04	2.5	0.09	169
52	mikado	139	53.431862	-129.827212	I		80-05	64	91-05	3	-0.01	-6
52	quitonsta	140	53.378173	-130.186867	I		80-00	-26	86-00	2.5	-0.02	-20

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Subpop ID	Site name	Site ID	Latitude	Longitude	Data type	New	All years		Most recent 3 generations			
							Years	% change	Years	Escapement Count (X 1000)	b_1, ln(N) vs. t	% change
52	tsimtack	141	53.380883	-129.465998	I		80-01	19	87-01	3	0.03	37
53	lowe	142	53.559859	-129.563218	I		80-03	-29	89-03	2.8	-0.03	-29
54	canoona	143	53.073592	-128.569018	I		80-05	85	91-05	1.9	-0.01	-14
54	evelyn	144	53.584658	-128.954829	I		80-05	171	91-05	0.3	0.18	619
54	hartley	145	53.426783	-129.253467	I		80-05	-14	91-05	0.39	0.02	28
54	kemano[b]	146	53.481535	-128.131220	I		80-99	45	85-99	0.1	-0.03	-29
54	kitimat	147	54.017348	-128.658023	I		80-05	20	91-05	2	0.14	345
54	kitlope	148	53.210927	-127.844712	I		80-05	-50	91-05	9.5	-0.07	-52
55	amback	149	51.697365	-127.043532	T		80-05	-94	91-05	10	-0.1	-66
55	ashlulm	150	51.689019	-126.900071	T		80-05	-92	91-05	6.6	-0.07	-53
55	bloomfield	151	52.857016	-128.681975	I		80-05	513	91-05	0.4	0.19	705
55	canoe	152	51.262806	-127.025367	T		80-05	-87	91-05	17	-0.12	-72
55	dallery	153	51.673365	-127.043084	T		80-05	-96	91-05	3.2	0	5
55	elcho[b]	154	52.400625	-127.539457	I		82-02	-4	88-02	0.025	0.14	358
55	genesee	155	51.664611	-126.669874	T		80-05	-99	91-05	0.6	-0.22	-91
55	inziana	156	51.830227	-126.682056	T		80-05	-85	91-05	8.2	-0.11	-69
55	kainet	157	52.755330	-127.882138	I		80-05	12	91-05	1	-0.03	-25
55	kimsquit	158	52.884006	-127.079765	I		80-00	-50	86-00	13	-0.08	-58
55	koeye	159	51.780661	-127.863041	I		80-05	-60	91-05	1	0.12	263
55	kwakwa	160	52.557458	-128.708611	I		80-05	144	91-05	1.5	0.08	141
55	mary_cove	161	52.617416	-128.434522	I		80-02	-14	88-02	0.15	0.09	162
55	namu	162	51.856486	-127.865675	I		81-05	-32	91-05	1	0.07	123
55	neechanz	163	51.647977	-126.692101	I		80-05	-94	91-05	10	-0.16	-83
55	owikeno	164	51.678436	-127.179609	I		80-03	-99	89-03	0.5	-0.31	-97
55	price	165	52.471907	-128.736299	I		80-02	83	88-02	0.4	0.08	149
55	sheemahant	166	51.741488	-126.629357	I		80-99	-84	85-99	83	-0.22	-91
55	smokehouse	167	51.285148	-127.040568	T		80-05	-84	91-05	40	-0.09	-62
55	tankeeah	168	52.297738	-128.261539	T		80-05	-55	91-05	0.44	0.14	387
55	wannock	169	51.680259	-127.255023	I		80-99	-81	85-99	80	-0.18	-86

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Subpop ID	Site name	Site ID	Latitude	Longitude	Data type	New	All years		Most recent 3 generations			
							Years	% change	Years	Escapement Count (X 1000)	b_1, ln(N) vs. t	% change
55	washwash	170	51.853516	-126.665938	I		80-05	-92	91-05	10	-0.08	-56
57	atnarko[b]	171	52.376078	-126.090684	I		80-05	-12	91-05	25	-0.03	-27
59	quatse	172	50.698869	-127.479318	I		80-06	-18	92-06	0.2	0.19	702
60	nimpkish	173	50.566897	-126.978780	I		80-06	-52	92-06	32	0	-2
65	sakinaw	174	49.651585	-124.068779	T		80-06	-100	92-06	0.087	-0.19	-88
65	village_by	175	50.165137	-125.187495	T		80-06	-98	92-06	0.09	-0.3	-96
66	baker	176	48.536315	-121.741403	T		65-06	359	92-06	4.9	0.04	59
68	pitt_upper	177	49.541032	-122.608246	T		38-06	73	92-06	43	0.15	420
70	cultus	178	49.088021	-121.962693	T		38-06	-90	92-06	1.9	-0.1	-66
71	harrison[b]	179	49.216298	-121.945725	I		38-06	-28	92-06	8.6	0.22	998
72	weaver[a]	180	49.313979	-121.875883	T		38-06	422	92-06	49	-0.02	-22
73	big_silver	181	49.576317	-121.828325	I		38-06	140	92-06	4.7	0.25	1513
74	birkenhead	182	50.306353	-122.606714	T		38-06	147	92-06	53	0.01	7
75	anstey	183	51.131952	-118.899606	I		74-06	1018	92-06	1.9	0.07	110
75	cayenne	184	51.320584	-119.319005	I		94-06	-91	94-06	0.16	-0.27	-91
75	eagle_rv	185	50.843125	-119.011359	I		66-06	261824	92-06	2.1	0.01	17
75	mcnomee	186	51.264441	-118.945633	N/A	X	93-06	-90	93-06	0.67	-0.23	-90
75	perry	187	50.995145	-118.689988	N/A	X	92-06	-21	92-06	0.36	-0.02	-21
75	scotch	188	50.907169	-119.492157	T		48-06	22775	92-06	5.1	0.04	63
75	seymour	189	51.238479	-118.959375	I		38-06	2115	92-06	21	0.04	52
75	yard	190	50.907015	-118.820177	N/A	X	94-06	-18	94-06	0.59	-0.02	-18
76	adams_rv	191	50.893904	-119.550471	T		38-06	34	92-06	35	0.13	307
76	anstey_late	192	51.131952	-118.899606	I		42-06	2605	92-06	0.73	0.08	153
76	eagle_rv_late	193	50.843125	-119.011359	I		42-06	65288	92-06	0.34	0.09	173
76	hiuihill	194	50.922427	-119.633256	N/A	X	90-06	84	92-06	0.43	0.11	247
76	hunakwa	195	51.136115	-118.918677	N/A	X	74-06	-44	92-06	0.32	0.14	370
76	little_bc	196	50.866420	-119.599187	I		38-06	5	92-06	9.1	0.14	343
76	momich_late	197	51.333224	-119.420802	N/A	X	42-06	-26	92-06	0.013	0.17	520
76	nikiwkwaia	198	51.741352	-119.144175	N/A	X	82-06	-70	92-06	0.65	-0.05	-40

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Subpop ID	Site name	Site ID	Latitude	Longitude	Data type	New	All years		Most recent 3 generations			
							Years	% change	Years	Escapement Count (X 1000)	b_1, ln(N) vs. t	% change
76	pass_late	199	51.074445	-119.785471	N/A	X	42-06	225	92-06	0.047	0.13	332
76	scotch_late	200	50.907169	-119.492157	T		38-06	120	92-06	1.1	0.12	279
76	seymour_late	201	51.238479	-118.959375	I		42-06	3378	92-06	0.3	0.32	3188
76	shuswap_lk	202	50.953065	-119.189993	N/A	X	38-06	41	92-06	1.9	-0.18	-86
76	shuswap_lower	203	50.688531	-119.059346	I		42-06	48815	92-06	4.7	0.1	192
76	shuswap_middle	204	50.433263	-118.750586	I		50-06	130954	92-06	0.24	0.15	431
76	tappen	205	50.773518	-119.335742	N/A	X	82-06	-94	92-06	0.32	0	2
76	thompson_south	206	50.680403	-120.334400	I		38-06	56	92-06	0.07	-0.17	-84
77	barriere	207	51.173076	-120.139761	I		49-06	903	92-06	0.28	0.09	169
77	fennell	208	51.352431	-119.722840	I		58-06	22941	92-06	8.7	-0.08	-56
77	harper	209	51.319021	-119.879817	I		88-06	51	92-06	0.13	0.01	13
77	raft	210	51.631515	-119.993047	I		38-06	103	92-06	7.2	0.07	117
77	thompson_north	211	50.684331	-120.340206	N/A	X	60-06	2931	92-06	0.85	0.66	145232
78	gates[a]	212	50.551747	-122.473394	T		38-06	154799	92-06	10	-0.1	-67
79	nahatlatch_lk	213	50.007803	-121.714632	I		87-06	-85	92-06	0.49	-0.13	-75
79	nahatlatch_rv	214	49.979164	-121.523489	I		75-06	167	92-06	3.5	-0.06	-49
82	chilko	215	52.094992	-123.461598	T		38-06	282	92-06	562	-0.04	-38
83	blue_lead	216	52.615393	-120.383897	N/A	X	89-06	-89	92-06	2.6	-0.21	-90
83	cameron	217	52.826212	-120.808558	N/A	X	81-06	156	92-06	5.1	-0.09	-64
83	deception	218	52.652532	-120.950284	N/A	X	90-06	6209	92-06	4.4	0.13	314
83	grain	219	52.601421	-121.020212	N/A	X	89-06	1703	92-06	0.57	0.16	510
83	horsefly[a]	220	52.465385	-121.388773	T		38-06	67609	92-06	181	-0.02	-16
83	little_horsefly	221	52.362069	-121.397476	N/A	X	38-06	1389575	92-06	3.9	-0.03	-25
83	mckinley	222	52.288756	-121.070402	T		53-06	57618	92-06	36	-0.01	-7
83	mitchell	223	52.778426	-120.803715	T		38-06	8660789	92-06	89	-0.03	-26
83	moffat	224	52.326700	-121.408701	N/A	X	89-06	-80	92-06	3.2	-0.12	-74
83	penfold	225	52.781368	-120.796072	N/A	X	85-06	5211	92-06	0.23	0.34	4119
83	roaring	226	52.686220	-120.904219	N/A	X	89-06	301	92-06	1.3	0.11	220
83	summit	227	52.614181	-120.342577	N/A	X	77-06	239	92-06	3.4	-0.12	-74

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Subpop ID	Site name	Site ID	Latitude	Longitude	Data type	New	All years		Most recent 3 generations			
							Years	% change	Years	Escapement Count (X 1000)	b_1, ln(N) vs. t	% change
83	wasko	228	52.561681	-121.000620	N/A	X	85-06	1456	92-06	5	0.15	403
84	nadina_es[a]	229	53.978682	-126.503861	T		38-06	81803	92-06	9.6	0.04	50
85	stellako	230	54.056061	-124.884262	T		38-06	329	92-06	138	0.01	12
86	ankwill	231	55.657661	-126.191663	I		49-06	9	92-06	1.2	-0.11	-69
86	bivouac	232	55.075858	-125.568825	I		49-06	84	92-06	0.76	-0.16	-82
86	blackwater	233	55.725247	-126.306397	N/A	X	81-06	-70	92-06	0.11	-0.07	-52
86	blanchette	234	55.276307	-125.751649	I		73-06	111	92-06	0.15	-0.07	-56
86	crow	235	55.284350	-125.997552	I		52-06	329	92-06	0.74	-0.13	-76
86	driftwood	236	55.699305	-126.251302	I		38-06	93491	92-06	3	-0.27	-95
86	dust	237	55.310158	-126.027647	T		49-06	338	92-06	2	-0.13	-77
86	felix	238	54.786640	-125.367637	N/A	X	53-06	1403	92-06	8.6	-0.13	-77
86	fifteen_mile	239	55.331529	-125.766060	I		49-06	177	92-06	0.21	-0.07	-55
86	five_mile	240	55.459548	-125.937040	N/A	X	49-06	149	92-06	0.51	-0.08	-58
86	fleming	241	54.769328	-125.413770	I		38-06	1650356	92-06	0.54	-0.14	-79
86	forfar	242	55.043390	-125.469104	T		38-06	124	92-06	5.5	-0.13	-77
86	forsythe	243	55.543617	-126.089955	I		49-06	-7	92-06	0.53	-0.11	-71
86	french	244	55.658623	-126.167288	N/A	X	69-06	2	92-06	0.43	-0.17	-84
86	frypan	245	55.523834	-126.072579	I		49-06	110	92-06	1.3	-0.1	-66
86	gluske	246	55.057086	-125.514913	T		38-06	254	92-06	3.9	-0.16	-82
86	hooker	247	55.269088	-125.983668	I		77-06	7	92-06	0.26	-0.14	-78
86	hudson	248	55.483510	-125.981012	I		74-06	1156	92-06	0.15	-0.15	-82
86	kazchek	249	54.884924	-125.171909	I		85-06	434	92-06	0.23	-0.11	-69
86	kotsine	250	55.819768	-126.435516	N/A	X	81-06	-93	92-06	0.52	-0.14	-79
86	kynock	251	55.004489	-125.393841	T		38-06	119	92-06	11	-0.12	-73
86	leo	252	55.087108	-125.583987	N/A	X	49-06	-82	92-06	0.91	-0.05	-39
86	lion	253	55.768335	-126.354536	N/A	X	81-06	-44	92-06	0.45	-0.14	-78
86	mcdougall	254	55.230145	-126.002642	N/A	X	73-06	1813	92-06	0.16	-0.13	-76
86	middle_rossette	255	54.968023	-125.335779	N/A	X	87-06	-93	92-06	0.045	-0.14	-78
86	narrows	256	55.169728	-125.718713	I		38-06	850	92-06	2.5	-0.05	-44

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Subpop ID	Site name	Site ID	Latitude	Longitude	Data type	New	All years		Most recent 3 generations			
							Years	% change	Years	Escapement Count (X 1000)	b_1, ln(N) vs. t	% change
86	paula	257	54.782101	-125.386868	I		53-06	2360	92-06	1.6	-0.13	-77
86	point	258	55.231429	-125.972338	I		49-06	768	92-06	0.55	-0.16	-82
86	porter	259	55.779654	-126.379703	N/A	X	81-06	-64	92-06	0.95	-0.09	-64
86	rossette	260	54.968455	-125.340777	N/A	X	38-06	134	92-06	5.7	-0.14	-78
86	sakeniche	261	55.153000	-125.770555	I		49-06	57	92-06	0.42	-0.14	-78
86	sandpoint	262	55.129394	-125.668071	I		53-06	94	92-06	0.98	-0.12	-73
86	shale	263	55.276560	-125.725758	I		38-06	780	92-06	0.93	-0.12	-72
86	sinta	264	55.302202	-126.029647	N/A	X	49-06	3435	92-06	1.6	-0.05	-41
86	twentyfive_mile	265	55.267617	-125.716608	I		49-06	34	92-06	0.54	-0.39	-99
87	kazchek_late	266	54.884924	-125.171909	I		38-06	538	92-06	0.44	-0.11	-70
87	kuzkwa	267	54.788400	-124.879757	T		53-06	153	92-06	3.3	-0.15	-81
87	middle_summer	268	54.867090	-125.120943	N/A	X	38-06	401	92-06	13	-0.14	-79
87	pinchi	269	54.578715	-124.496083	I		53-06	9495	92-06	4.3	0.05	78
87	sakeniche_late	270	55.153000	-125.770555	I		53-06	230	92-06	0.12	-0.14	-79
87	tachie	271	54.663080	-124.776358	T		38-06	12451	92-06	51	-0.13	-77
88	bowron	272	54.058575	-121.823441	I		38-06	-32	92-06	4.8	-0.11	-69
89	gcl	273	49.362885	-124.976530	T		77-06	5	92-06	195	0.05	79
89	sproat	274	49.293011	-124.882433	T		77-06	50	92-06	170	0.01	8
90	pleasant	275	48.035951	-124.381867	I		87-03	172	89-03	0.56	0.12	289
90	quinault	276	47.475295	-123.869074	T		67-05	9	91-05	31	0	-4
91	wenatchee	277	47.569077	-120.588698	T		60-06	-21	92-06	11	0.07	121
92	okanogan	278	48.914567	-119.422997	T		60-06	-46	92-06	26	0.12	291
93	redfish	279	44.168444	-114.899754	T		85-02	-88	88-02	0.002	-0.1	-68

[a] These monitoring sites include the combined counts of the river and associated spawning channel

[b] These monitoring sites count river type sockeye

Appendix 3
Subpopulation (SP) status based on IUCN Red List Criteria A, B and D.

CR = Critically Endangered, EN = Endangered, VU = Vulnerable, LC = Least Concern, NT = Near Threatened.
Up or Down refers to change in listing status relative to length of time series used and relative to the 2008 assessment.

Subpopulation short name	Subpop ID	Sites assessed	% change full time series[a]	% change 3-gen[a]	Full Time Series Trend vs. Three Generation Trend	Overall Red List status	A status (3-gen)	B status	D status	Change relative to 2008 Assessment	Comments on status changes
YukonInf	18	3	360	27		**LC**	LC A2	LC B2ab(v)	LC D1		
SEBering	20	38	95	16		**LC**	LC A2	LC B2ab(v)	LC D1		
Kuskokwim	21	1	290	-21		**LC**	LC A2	LC B2ab(v)	LC D1		
WGulfAlaska	22	6	180	53		**LC**	LC A2	LC B2ab(v)	LC D1		
Kodiak	23	12	130	9		**LC**	LC A2	LC B2ab(v)	LC D1		
Cook	24	8	138	20		**LC**	LC A2	LC B2ab(v)	LC D1		
PWS	25	2	46	81		**LC**	LC A2	LC B2ab(v)	LC D1		
Copper	26	2	45	26		**LC**	LC A2	LC B2ab(v)	LC D1		
EGulfAlaska	27	6	-28	-39	Less Negative	**VU**	VU A2	LC B2ab(v)	LC D1		
NassSkeena_Hugh	38	1	-59	-41	More Negative	**EN**	VU A2	EN B2ab(v)	LC D1		
Skeena_Alastair	43	2	19	-39	Positive vs. Negative	**EN**	VU A2	EN B2ab(v)	LC D1	Up	Splitting
Skeena_Schul	44	1	-91	-94	Less Negative	**CR**	CR A2	EN B2ab(v)	LC D1	Up	Splitting
Skeena_Kitsmklm	45	1	3250	42		**LC**	LC A2	LC B2ab(v)	LC D1	Down	Splitting
Skeena_Kispiox	47	1	37	93		**LC**	LC A2	LC B2ab(v)	LC D1		
Skeena_Babine	48	14	134	91		**LC**	LC A2	LC B2ab(v)	LC D1		
Skeena_Nan	49	1	482	-84	Positive vs. Negative	**CR**	CR A2	EN B2ab(v)	LC D1		
Skeena_Upper	50	2	95	-55	Positive vs. Negative	**EN**	EN A2	EN B2ab(v)	LC D1		
Hecate_EHGwaii	51	1	70	162		**LC**	LC A2	LC B2ab(v)	LC D1		
Hecate_Strait	52	8	57	33		**LC**	LC A2	LC B2ab(v)	LC D1		
Hecate_Lowe	53	1	-29	-29		**LC**	LC A2	LC B2ab(v)	LC D1	Down	Effect of algorithm change (A Criteria from VU to LC, B Criteria from EN to LC)
Hecate_Kitl	54	6	32	7		**LC**	LC A2	LC B2ab(v)	LC D1		
Hecate_QCS	55	22	-83	-54	More Negative	**EN**	EN A2	LC B2ab(v)	LC D1		
Hecate_Atn	57	1	-12	-27		**LC**	LC A2	LC B2ab(v)	LC D1	Down	Effect of algorithm change (A Criteria from VU to LC, B Criteria from EN to LC)
PgtGeorgia_Quatse	59	1	-18	702		**LC**	LC A2	LC B2ab(v)	LC D1		
PgtGeorgia_Nimpk	60	1	-52	-2		**LC**	LC A2	LC B2ab(v)	LC D1		
PgtGeorgia_Sakinaw	65	2	-99	-92	More Negative	**CR**	CR A2	VU B2ab(v)	LC D1		

Appendix 4

List of Near Threatened and threatened subpopulations of Sockeye Salmon, with identification of key threats specific to each

The sources of information used to identify threats are provided in the final column.

Subpopulation short name	Subpop ID	Red List Status	Biological Resource Use (harvest)	Human intrusions/ disturbance (freshwater habitat)	Climate/Weather (ocean conditions)	System Modification		Urbanization	Unknown	Sources of information on key threats
						Dam(s)	Hatchery/ Spawning Channel			
KamRiver	7	**EN**	X, increasing	X	X				X	Bugaev 2007; Dronova and Spiridonov 2008
EGulfAlaska	27	**VU**	X	X[2]	X				X	Eggers *et al*. 2008; Geiger *et al*. 2005; S. Kelley, ADF&G, pers. comm.
NassSkeena_North	37	**VU**	X, declining	X	X		H		X	Geiger *et al*. 2005; Eggers *et al*. 2008; English *et al*. 2004; Eggers *et al*. 2009
NassSkeena_Hugh	38	**EN**	X, declining		X		H[3]		X	Geiger *et al*. 2005; Eggers *et al*. 2008; English *et al*. 2004; Piston and Brunette 2010
Nass_Upper	40	**VU**	X		X				X	Slaney *et al*. 1996; Riddell 2004; Harvey and MacDuffee 2002; K. Hyatt, DFO, pers. comm.
Skeena_Alastair	43	**EN**	X	X	X				X	Slaney *et al*. 1996; Riddell 2004; Harvey and MacDuffee 2002; Gottesfeld and Rabnett 2008; Walters *et al*. 2008; Wood 2001; K. Hyatt, DFO, pers. comm.
Skeena_Schul	44	**CR**	X	X	X				X	Slaney *et al*. 1996; Riddell 2004; Harvey and MacDuffee 2002; Gottesfeld and Rabnett 2008; Walters *et al*. 2008; Wood 2001; K. Hyatt, DFO, pers. comm.
Skeena_Nan	49	**CR**	X	X	X				X	Slaney *et al*. 1996; Riddell 2004; Harvey and MacDuffee 2002; Gottesfeld and Rabnett 2008; Walters *et al*. 2008; Wood 2001; K. Hyatt, DFO, pers. comm.
Skeena_Upper	50	**EN**	X	X	X				X	Slaney *et al*. 1996; Riddell 2004; Harvey and MacDuffee 2002; Gottesfeld and Rabnett 2008; Walters *et al*. 2008; Wood 2001; K. Hyatt, DFO, pers. comm.
Hecate_QCS	55	**EN**	X		X				X	Slaney *et al*. 1996; Riddell 2004; Harvey and MacDuffee 2002; Cosewic 2003; K. Hyatt, DFO, pers. comm.
PgtGeorgia_Sakinaw	65	**CR**			X		H		X	Slaney *et al*. 1996; Riddell 2004; Harvey and MacDuffee 2002; McKinnell *et al*. 2001; K. Hyatt, DFO, pers. comm.
Fraser_CultusL	70	**EN**	X, declining	X	X		H	X	X	COSEWIC 2003; Schubert *et al*. 2002; Cook *et al*. 2004; M. Lapointe, PSC, K. Benner and S. Grant, DFO; pers. comm.
Fraser_GatS	78	**EN**	X, declining	X	X	X	SC		X	M. Lapointe, PSC, K. Benner and S. Grant, DFO; pers. comm.
Fraser_NahatES	79	**EN**	X, declining	X	X				X	M. Lapointe, PSC, K. Benner and S. Grant, DFO; pers. comm.
Fraser_ChilkoS	82	**EN**	X, declining		X				X	M. Lapointe, PSC, K. Benner and S. Grant, DFO; pers. comm.
Fraser_EStuart	86	**EN**		X	X				X	Patterson *et al*. 2008; M. Lapointe, PSC, K. Benner and S. Grant, DFO; pers. comm.
Fraser_StuartS	87	**EN**	X, declining	X	X				X	Patterson *et al*. 2008; M. Lapointe, PSC, K. Benner and S. Grant, DFO; pers. comm.
Fraser_BowronES	88	**EN**	X, declining	X	X				X	M. Lapointe, PSC, K. Benner and S. Grant, DFO; pers. comm.
Columbia_Wen	91	**NT**		X	X	X	H		X	Gustafson *et al*. 2007
Columbia_Okan	92	**NT**		X	X	X	H		X	Gustafson *et al*. 2007; Hyatt and Rankin 1999
Columbia_Red	93	**CR**		X	X	X	H		X	Gustafson *et al*. 2007; D. Scarnecchia, University of Idaho, pers. comm.

[1]Additional input provided by resource agency staff, particularly for populations 70-88 in the Fraser River basin.

[2]Uplift from the 1964 earthquake disturbed much of this region, resulting in isostatic glacial rebound that has been recognized as a factor in reduced sockeye escapement, thus some changes to freshwater habitat are not related to

[3]Hatchery program on Hugh Smith Lake was terminated in 2003.