NWFSC. 2020. Draft Status review update for Pacific Salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. In prep April 2021.

Puget Sound Chinook and Puget Sound steelhead status review chapters.

PUGET SOUND CHINOOK SALMON ESU

BRIEF DESCRIPTION OF ESU

The ESU includes all naturally spawning populations of Chinook salmon from rivers and streams flowing into Puget Sound including the Strait of Juan De Fuca from the Elwha River, eastward, including rivers and streams flowing into Hood Canal, South Sound, North Sound and the Strait of Georgia in Washington, as well as numerous artificial propagation programs (Figure 98). The Puget Sound Chinook salmon ESU is composed of 31 historically quasi-independent populations, 22 of which are extant (Ruckelshaus *et al.* 2006). The populations are distributed in 5 geographic regions, or major population groups (MPG's), identified by the TRT (PSTRT 2002) based on similarities in hydrographic, biogeographic, and geologic characteristics of the Puget Sound basin.

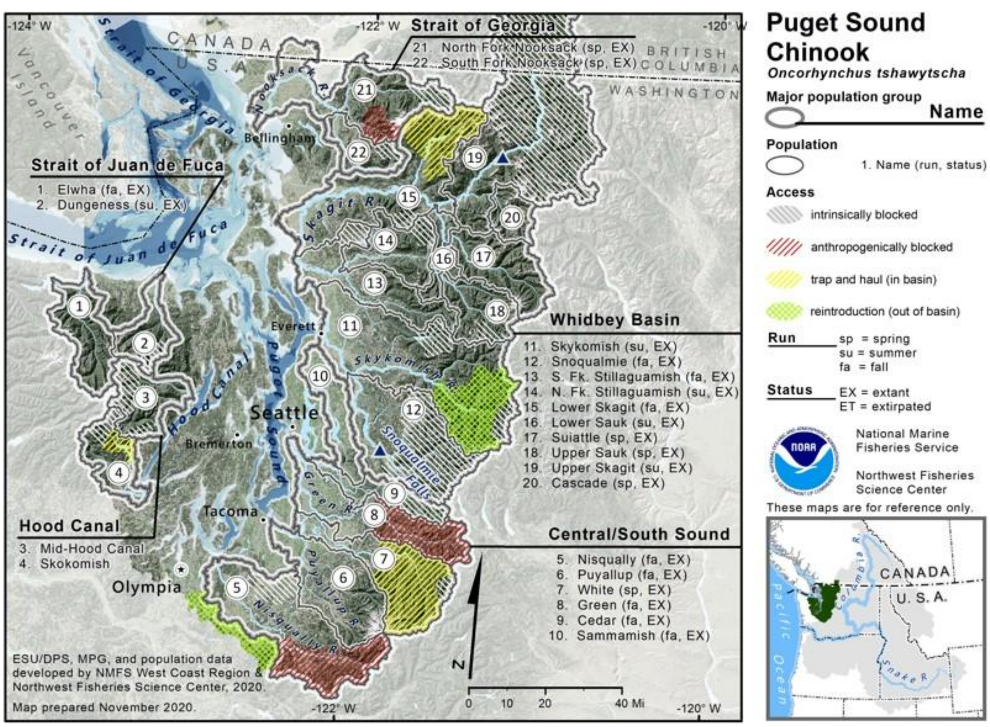

Figure 98. Map of the Puget Sound Chinook salmon ESU's spawning and rearing areas, illustrating populations and major population groups.

SUMMARY OF PREVIOUS STATUS CONCLUSIONS

2005

In the 2005 review (Good *et al*. 2005), the BRT concluded that, overall, the status of natural spawning populations of Puget Sound Chinook salmon was improved relative to the time of the previous status review conducted with data through 1997 (Myers *et al*. 1998). Also, the overall trends in natural spawning escapements for Puget Sound Chinook salmon populations estimated in 2005 remained similar to that presented in the previous status review (data through 1997), with some populations doing marginally better and others worse.

2010

Ford *et al*. (2011) concluded that all Puget Sound Chinook populations were well below the TRT minimum planning range for recovery escapement levels. Most populations were also consistently below the spawner-recruit levels needed for recovery. The exceptions were the Skagit system populations, which tended to have higher status. The Whidbey Basin MPG was also at relatively low risk. The other four MPGs were considered to be at high risk of extinction due to low abundance and productivity values. Their low numbers also contributed to poor spatial distribution of spawners throughout the ESU. Overall, the new information on abundance, productivity, spatial structure and diversity considered in the 2010 review did not indicate a change in the biological risk category since the time of the last BRT status review in 2005.

2015

NWFSC (2015) concluded that all Puget Sound Chinook populations were still well below the TRT minimum planning range for recovery escapement levels. Most populations were also consistently below the spawner-recruit levels identified by the TRT as consistent with recovery. Across the ESU, most populations further declined in abundance since the 2011 status review, and indeed, this decline had been persistent over the previous 7 to 10 years. Productivity remained low in most populations. Hatchery-origin spawners were present in high fractions in most populations outside the Skagit watershed, and in many watersheds the fraction of natural-origin spawner abundances had declined over time. The original Puget Sound Chinook Recovery Plan watershed chapters were completed in 2005 (https://www.fisheries.noaa.gov/resource/document/recovery-plan-puget-sound-chinook-salmon), Habitat Monitoring and Adaptive Management planning documents were completed in 2014 (https://www.psp.wa.gov/salmon-recovery-overview.php), and along with a series of 3 and 4-year work plans, these documents identify the habitat improvement projects planned and completed by the 16 watershed programs with the intention to help progress for Chinook recovery in the ESU. There has been considerable variation in efforts amongst watersheds and their plans, but generally the efforts have been consistent and progressive through challenging funding cycles. In addition, a number of the individual watersheds had begun the process to update their original Recovery Plan Chapters (https://www.psp.wa.gov/salmon-recovery-watersheds.php). The expected benefits of these habitat improvement projects will take years or decades to produce significant improvement in natural population viability parameters. Overall, the 2015 review concluded that new information on abundance, productivity, spatial structure and diversity since the prior review did not indicate a change in the biological risk category.

DESCRIPTION OF NEW DATA AVAILABLE FOR THIS REVIEW

This status report incorporates "best available" Chinook salmon population data through 2018, with data for some populations also available through 2019. Spawning abundance data were obtained from Washington Department of Fish and Wildlife (WDFW) and the Puget Sound tribes as a result of a request for data in the Federal Register, and from individual comanager biologists and staff. Updates for abundance, age, and hatchery contribution data varied from population to population, and were obtained from multiple sources, including the annual postseason harvest reports provided by Washington Dept of Fish and Wildlife (WDFW) and the Puget Sound Treaty Indian Tribes (PSTIT) (WDFW & PSTIT 2015, 2016, 2017, 2018, 2019, 2020), from the WDFW SaSI database, and additional state hatchery data were queried from WDFW's FishBooks database and provided by WDFW staffTribal hatchery data were also provided by individual tribal staff. Where data sources conflicted, data were confirmed as much as possible, through collaborative discussions with both Tribal and state co-managers. It is important to note that data collection and analyses methodologies for both hatchery and natural spawner abundances have changed in some watersheds/populations over the course of the time series analyzed. This creates some uncertainty and potential bias in the calculations of trends.

This status review focuses on data starting in 1980, although some populations have data going back much further. In addition to including additional recent years of spawning data compared to the 2015 status review, this report also incorporates updates and corrections made in past escapement, age, and hatchery contribution data for many of the populations. These corrections typically have been made by individual tribal and/or state co-managers. These data updates and methods are consistent with both the PSTRT's use for determining population viability, and for prior NOAA status reviews. It is important to note that opinions vary among co-managers regarding data quality, for example, regarding estimates of hatchery contributions to spawning grounds in years prior to mass marking.We continue to meet and collaborate with co-managers regarding the development of a single data set, but this data set is not yet fully validated nor agreed upon by all co-managers. We encourage the co-managers to continue this effort and we hope to help resolve the various needs for data management and reporting in the very near future. Please see "Acknowledgements" in the beginning of this document for a list of individuals who helped to improve and validate the data set used for this analyses.

ABUNDANCE AND PRODUCTIVITY

Abundance of the 22 extant natural spawning populations of Chinook salmon in the Puget Sound ESU has varied considerably between populations. Trends in abundance for individual populations are shown in Figure 99. The populations, grouped by MPG and run timing (spring run, summer run or fall run), include: Strait of Georgia MPG (North Fork Nooksack and South Fork Nooksack), Whidbey Basin MPG (Lower Skagit, Upper Skagit, Cascade, Lower Sauk, Upper Sauk, Suiattle, North Fork Stillaguamish, South Fork Stillaguamish, Skykomish, and Snoqualmie), Central/South Puget Sound MPG (Sammamish, Cedar, Green, White, Puyallup and Nisqually), Hood Canal MPG (Skokomish and Mid-Hood Canal), and Strait of Juan de Fuca MPG (Elwha and Dungeness) (Ruckelshaus et al. 2006). The early run timing populations are North and South Forks Nooksack, Cascade, Upper Sauk, Suiattle, in the Strait of Georgia and Whidbey Basin MPGs and White River population in Central/South Puget Sound MPG. Summer runs exist in the Upper Skagit, Lower Sauk, Stillaguamish, Skykomish, and Dungeness, and all other populations are fall runs. Newer genetics data have clarified that the two Stillaguamish populations overlap in spawn timing and distribution, with both summer and fall populations spawning in both forks of the Stillaguamish River (WDFW and PSTIT 2020).

Total abundance in the ESU over the entire time series shows that individual populations have varied in increasing or decreasing abundance. Several populations (North Fork and South Fork Nooksack, Sammamish, Green, White, Puyallup, Nisqually, Skokomish, Dungeness and Elwha) are dominated by hatchery returns. Generally, many populations experienced increases in total abundance during the years 2000-2008, and more recently in 2015-2017, but general declines during 2009-2014, and a downturn again in the two most recent years, 2017-2018

(Figure 99). Abundance across the Puget Sound ESU has generally increased since the last status review, with only 2 of the 22 populations
(Cascade andNorth Fork Stillaguamish) showing a negative % change in the 5-year geometric mean natural-origin spawner abundances since the prior status review (Table 49). Fifteen of the remaining 20 populations with positive % change in the 5-year geometric mean natural-origin spawner abundances since the prior status review have relatively low natural spawning abundances of < 1000 fish, so some of these increases represent small changes in total abundance. Given lack of high confidence in survey techniques, particularly with small populations, there remains substantial uncertainty in detecting trends in small populations.

Fifteen-year trends in log natural-origin spawner abundance were computed over two time periods (1990-2005 and 2004- 2019) for each Puget Sound Chinook population (Table 50). Trends were negative in the latter period for 16 of the 22 populations and for four of the 22 populations (SF Nooksack, SF Stillaguamish, Green and Puyallup) in the earlier period. Thus there is a general decline in natural-origin spawner abundance across all MPGs in the recent fifteen years. Upper Sauk and Suiattle (Whidbey Basin MPG), Nisqually (Central/South MPG) and Mid-Hood Canal (Hood Canal MPG) are the only populations with positive trends, though Mid-Hood Canal has an extremely low population size. Further, no change in trend between the two time periods was detected in SF Nooksack (Strait of Georgia MPG), Green and Nisqually (Central/South MPG). The average trend across the ESU for the 1990-2005 15-year time period was 0.03. The average trends for the MPGs are Strait of Georgia (0.03), Whidbey Basin (0.04), Central/South (0.04), Hood Canal (0.03), and Strait of Juan de Fuca (0.01). The average trend across the ESU for the later 15-year time period (2004-2019) was -0.02. The average trends for the MPGs are Strait of Georgia (-0.02), Whidbey Basin(-0.02), Central/South (-0.02), Hood Canal (-0.02), and Strait of Juan de Fuca (-0.08) (Table 50). The previous status review in 2015 (NWFSC 2015) concluded there were widespread negative trends for the total ESU despite that escapements and trends for individual populations were variable. The addition of the data to 2018 now also shows even more substantially either flat or negative trends for the entire ESU in natural-origin Chinook salmon spawner population abundances.

Chinook salmon productivity in the Puget Sound ESU across the time period (1980-2018) has been variable. Figure 100 shows trends in productivity as estimated by the log of the smoothed natural-origin spawning abundance in year t minus the smoothed natural-origin spawning abundance in year (t-4). Data below zero indicate that natural-origin spawners failed to replace themselves, although in many cases total spawning abundance was maintained through hatchery supplementation (compare red and black lines in Figure 99). Across the Puget Sound ESU, 10 of 22 Puget Sound populations show natural productivity below replacement in nearly all years since the mid-1980's. These include the North and South Forks Nooksack in the Strait of Georgia MPG, North and South Forks Stillaguamish and Skykomish in Whidbey Basin MPG, Sammamish, Green and Puyallup in the Central/South MPG, the Skokomish in the Hood Canal MPG, and Elwha in the Strait of Juan de Fuca MPG. Productivity in the Whidbey Basin MPG populations was above zero the mid-late 1990's, with the exception of Skykomish and North and South Forks Stillaguamish populations. White River population in the Central/South MPG was above replacement from the early 1980's to 2001, but has dropped in productivity consistently since the late 1980's. In recent years, only 5 populations have had productivities above zero. These are Lower Skagit, Upper Skagit, Lower Sauk, Upper Sauk, and Suiattle, all Skagit River populations in the Whidbey Basin MPG. This is consistent with, and continues the decline reported in the 2015 Status Review (NWFSC 2015).

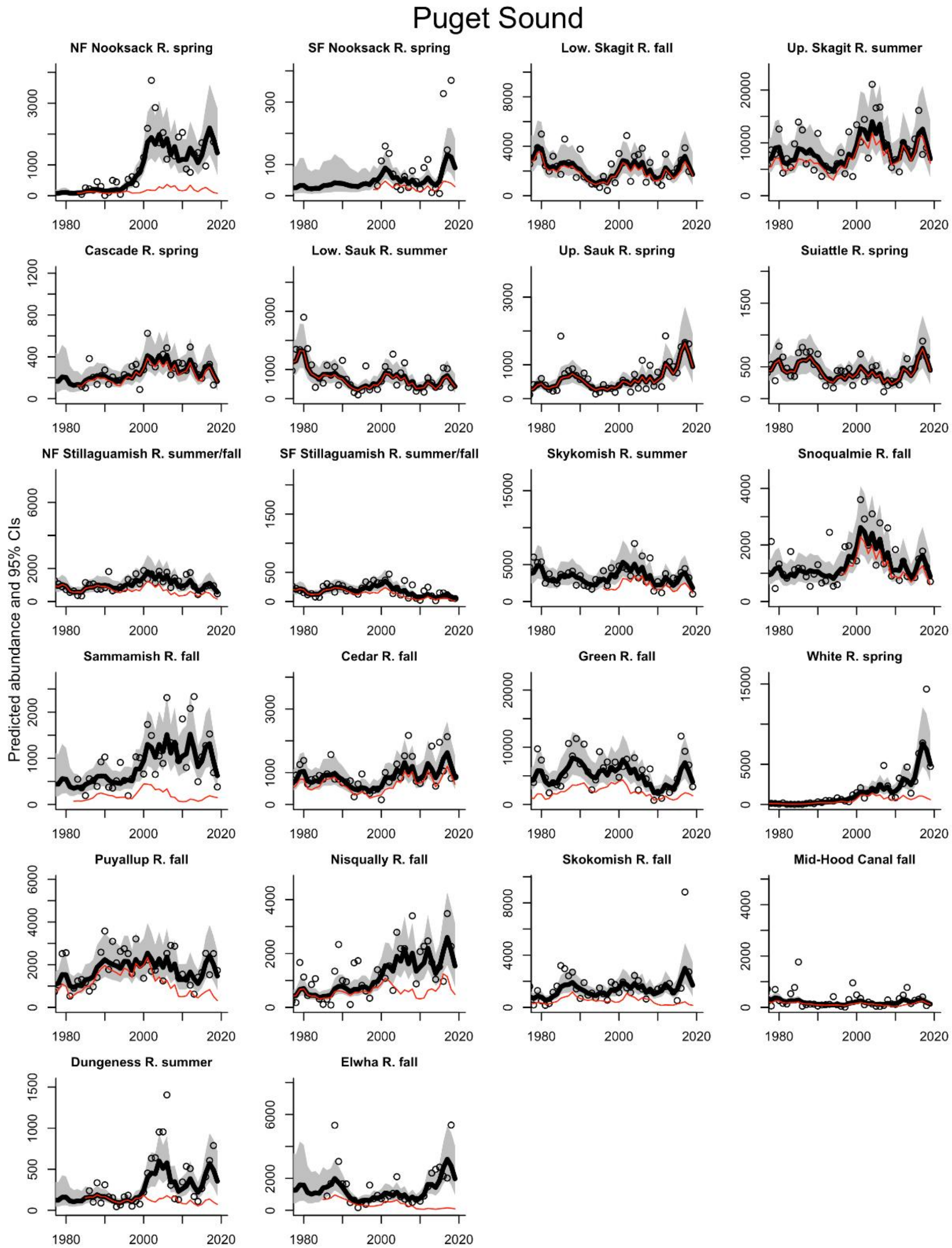

Figure 99. Smoothed trend in estimated total (thick black line) and natural-origin (thin red line) Puget Sound Chinook salmon ESU individual populations spawning abundance. Points show the annual raw spawning abundance estimates.

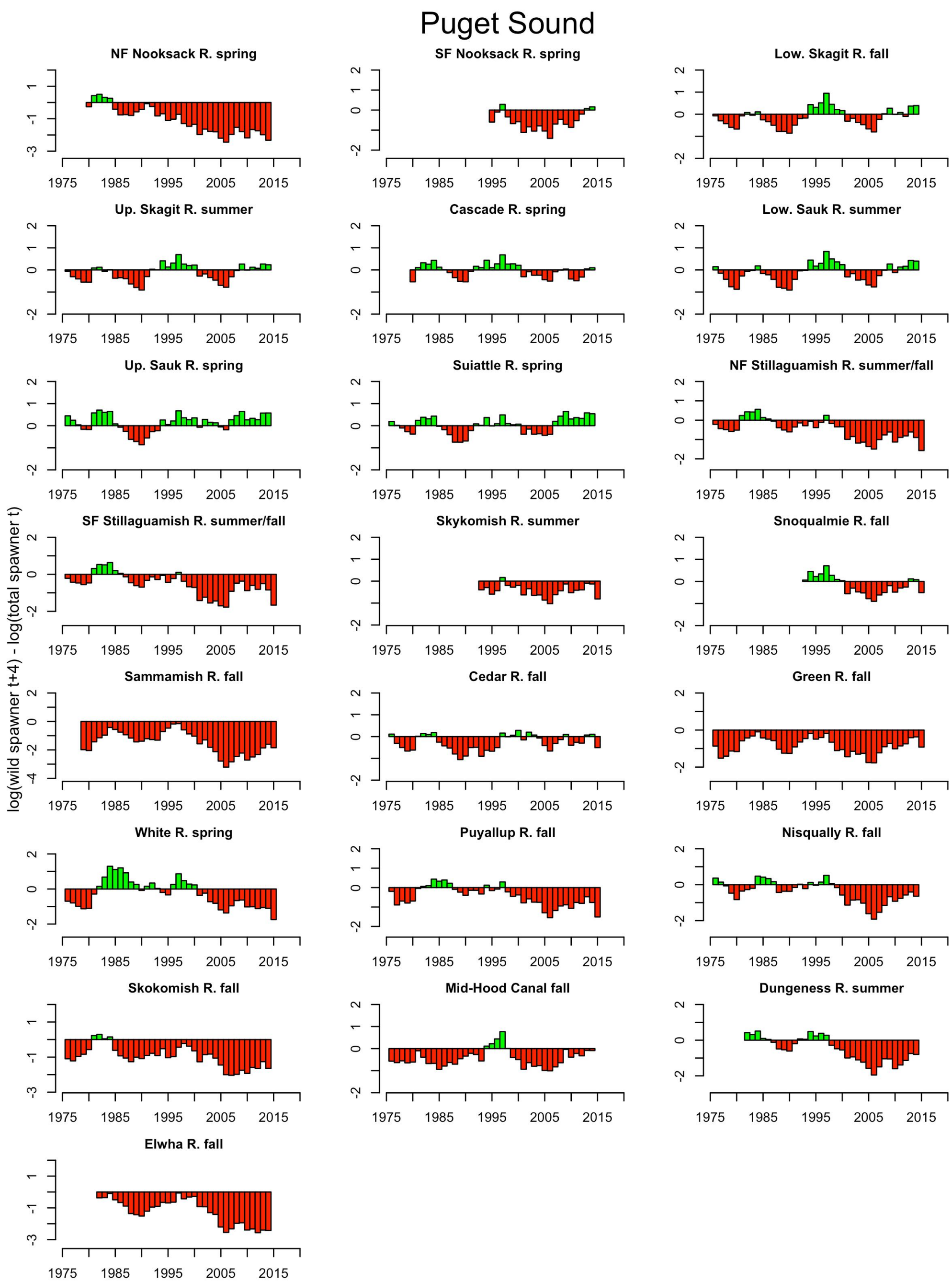
Puget Sound
NF Nooksack R. spring
SF Nooksack R. spring
Low. Skagit R. fall
Up. Skagit R. summer
Cascade R. spring
Low. Sauk R. summer
Up. Sauk R. spring
Suiattle R. spring
NF Stillaguamish R. summer/fall
SF Stillaguamish R. summer/fall
Skykomish R. summer
Snoqualmie R. fall
Sammamish R. fall
Cedar R. fall
Green R. fall
White R. spring
Puyallup R. fall
Nisqually R. fall
Skokomish R. fall
Mid-Hood Canal fall
Dungeness R. summer
Elwha R. fall
log(wild spawner t+4) - log(total spawner t)
1975
1985
1995
2005
2015

Table 49. Five-year geometric mean of raw natural-origin spawner counts. This is the raw total spawner estimate times the fraction natural-origin estimate, if available. In parentheses, 5-year geometric mean of raw total spawner estimates (i.e., hatchery and natural) are shown. A value only in parentheses means that a total spawner estimate was available but no (or only one) estimate of natural-origin spawners was available. The geometric mean was computed as the product of estimates raised to the power 1 over the number of counts available (2 to 5). A minimum of 2 values were used to compute the geometric mean. Percent change between the most recent two 5-year periods is shown on the far right.

Population	MPG	1990-1994	1995-1999	2000-2004	2005-2009	2010-2014	2015-2019	% Change
NF Nooksack R. spring	Strait of Georgia	51 (102)	95 (471)	229 (2186)	275 (1536)	136 (1205)	137 (1553)	1 (29)
SF Nooksack R. spring	Strait of Georgia			44 (87)	22 (41)	13 (35)	42 (106)	223 (203)
Low. Skagit R. fall	Whidbey Basin	1332 (1474)	971 (1035)	2531 (2774)	1916 (2228)	1416 (1541)	2130 (2640)	50 (71)
Up. Skagit R. summer	Whidbey Basin	3970 (5603)	5641 (6185)	10723 (12410)	8785 (10525)	7072 (7457)	9568 (10521)	35 (41)
Cascade R. spring	Whidbey Basin	151 (188)	209 (213)	340 (371)	302 (342)	298 (317)	185 (223)	-38 (-30)
Low. Sauk R. summer	Whidbey Basin	384 (409)	403 (429)	820 (846)	543 (569)	376 (416)	635 (649)	69 (56)
Up. Sauk R. spring	Whidbey Basin	404 (408)	265 (267)	427 (427)	506 (518)	854 (880)	1318 (1330)	54 (51)
Suiattle R. spring	Whidbey Basin	288 (302)	378 (382)	402 (415)	258 (261)	376 (378)	640 (657)	70 (74)
NF Stillaguamish R. summer/fall	Whidbey Basin	731 (913)	677 (1177)	1089 (1553)	493 (1262)	417 (996)	302 (762)	-28 (-23)
SF Stillaguamish R. summer/fall	Whidbey Basin	148 (185)	176 (305)	196 (280)	51 (131)	34 (68)	37 (96)	9 (41)
Skykomish R. summer	Whidbey Basin	(2398)	1497 (3331)	2377 (4849)	2568 (3378)	1689 (2462)	1736 (2806)	3 (14)
Snoqualmie R. fall	Whidbey Basin	(963)	1427 (1279)	2036 (2477)	1308 (1621)	839 (1082)	856 (1146)	2 (6)
Sammamish R. fall	Central/ South PS	197 (576)	149 (564)	336 (1031)	171 (1278)	82 (1289)	126 (879)	54 (-32)
Cedar R. fall	Central/ South PS	385 (562)	276 (497)	379 (646)	1017 (1249)	699 (914)	889 (1253)	27 (37)
Green R. fall	Central/ South PS	2697 (5420)	3856 (7274)	2800 (6542)	1305 (3149)	785 (2109)	1822 (6373)	132 (202)
White R. spring	Central/ South PS	269 (378)	242 (616)	1159 (1461)	839 (2099)	652 (2161)	895 (6244)	37 (189)
Puyallup R. fall	Central/ South PS	2146 (2547)	2034 (2348)	1378 (1794)	1006 (2054)	450 (1134)	577 (1942)	28 (71)
Nisqually R. fall	Central/ South PS	610 (781)	577 (723)	689 (1296)	551 (1899)	481 (1823)	766 (1841)	59 (1)
Skokomish R. fall	Hood Canal	505 (993)	478 (1233)	479 (1556)	500 (1216)	136 (1485)	265 (2074)	95 (40)
Mid-Hood Canal fall	Hood Canal	94 (120)	78 (103)	169 (217)	47 (88)	80 (295)	196 (222)	145 (-25)

Dungeness R. summer	SJF	117 (117)	104 (104)	99 (520)	151 (374)	66 (279)	114 (476)	73 (71)
Elwha R. fall	SJF	428 (673)	275 (735)	491 (995)	140 (605)	71 (1349)	134 (2810)	89 (108)

Table 50. 15-year trends in log wild (natural-origin) spawner abundance computed from a linear regression applied to the smoothed wild (natural-origin) spawner log abundance estimate. Only populations with at least 4 wild spawner estimates are shown and with at least 2 data points in the first 5 years and last 5 years of the 15-year periods. Lower and upper bounds of the 95% confidence intervals of the estimates are in parentheses.

Population	MPG	1990-2005	2004-2019
NF/MF Nooksack R. spring	Strait of Georgia	0.07 (0.04, 0.1)	-0.03 (-0.07, 0)
SF Nooksack R. spring	Strait of Georgia	-0.01 (-0.03, 0.01)	-0.01 (-0.05, 0.03)
Low. Skagit R. fall	Whidbey Basin	0.05 (0.02, 0.08)	0 (-0.03, 0.03)
Up. Skagit R. summer	Whidbey Basin	0.07 (0.04, 0.1)	-0.01 (-0.04, 0.02)
Cascade R. spring	Whidbey Basin	0.06 (0.04, 0.09)	-0.03 (-0.06, -0.01)
Low. Sauk R. summer	Whidbey Basin	0.04 (0.01, 0.08)	-0.01 (-0.05, 0.02)
Up. Sauk R. spring	Whidbey Basin	0.01 (-0.02, 0.05)	0.07 (0.04, 0.1)
Suiattle R. spring	Whidbey Basin	0.01 (-0.01, 0.03)	0.05 (0.01, 0.08)
NF Stillaguamish R. summer/fall	Whidbey Basin	0.02 (-0.01, 0.05)	-0.06 (-0.1, -0.02)
SF Stillaguamish R. summer/fall	Whidbey Basin	-0.01 (-0.04, 0.02)	-0.08 (-0.13, -0.03)
Skykomish R. summer	Whidbey Basin	0.05 (0.01, 0.09)	-0.05 (-0.08, -0.02)
Snoqualmie R. fall	Whidbey Basin	0.08 (0.05, 0.12)	-0.05 (-0.08, -0.02)
Sammamish R. fall	Central/South PS	0.06 (0.02, 0.1)	-0.04 (-0.1, 0.02)
Cedar R. fall	Central/South PS	0.02 (-0.03, 0.07)	0 (-0.02, 0.03)
Green R. fall	Central/South PS	-0.01 (-0.05, 0.02)	-0.01 (-0.06, 0.03)
White R. spring	Central/South PS	0.15 (0.11, 0.18)	-0.02 (-0.05, 0.01)
Puyallup R. fall	Central/South PS	-0.01 (-0.03, 0.01)	-0.06 (-0.1, -0.03)
Nisqually R. fall	Central/South PS	0.03 (0, 0.05)	0.03 (-0.02, 0.07)
Skokomish R. fall	Hood Canal	0.02 (-0.02, 0.05)	-0.09 (-0.14, -0.03)
Mid-Hood Canal fall	Hood Canal	0.04 (0.01, 0.07)	0.06 (0, 0.11)
Dungeness R. summer	Strait of Juan de Fuca	0.01 (-0.02, 0.03)	-0.04 (-0.08, -0.01)
Elwha R. late	Strait of Juan de Fuca	0 (-0.04, 0.04)	-0.11 (-0.17, -0.04)

HARVEST

Puget Sound Chinook are harvested in ocean salmon fisheries, in Puget Sound fisheries, and in terminal fisheries in the rivers. They migrate to the north, so for most of Puget Sound Chinook populations, nearly all of the ocean fishery impacts occur in Canada and Alaska where they are subject to the Pacific Salmon Treaty. Some populations are also harvested at lower rates in the coastal fisheries off Washington and Oregon. Fisheries within Puget Sound are managed by the state and tribal co- managers under a resource management plan. Fishery impact rates vary considerably among MPGs within Puget Sound primarily because of different terminal area management and variable exploitation rates in the Canadian and Alaskan fisheries. For populations in the Hood Canal MPG (Skokomish) and Central/South Sound MPG (Nisqually, White, Puyallup, Green) substantial terminal area fisheries are directed at hatchery fish that are produced largely to support tribal and recreational fisheries. For populations in the Whidbey Basin MPG (Skokomish, Stillaguamish, and Skagit Rivers) and the Strait of Georgia MPG (Nooksack), harvest in the northern fisheries accounts for a large portion of the exploitation.

Chinook populations in Puget Sound generally show a similar pattern of declining exploitation rates in the 1990s and relatively stable-to-increasing exploitation rates since then (Figure 101). This is primarily a result of Canadian interceptions of Puget Sound Chinook off the West Coast of Vancouver Island (WCVI). During the 1990s Canada sharply reduced fisheries off WCVI in response to depressed domestic stocks. Since then, WCVI stock status has improved somewhat and Canadian managers have changed the temporal pattern of fishing to avoid WCVI stocks. This has resulted in increased impacts on Puget Sound stocks. A notable exception to this pattern is the North Puget Sound region (Nooksack, Skagit, Stillaguamish). These stocks migrate through the Strait of Georgia. Canadian stocks in the Strait of Georgia have not recovered and most fisheries in Canadian inside waters for Chinook and coho salmon have been shut down.

The Pacific Salmon Treaty Chinook agreement which took effect in 2009 included 30% reductions in Chinook catch ceilings off WCVI, and 15% reductions in southeast Alaska. The Treaty was revised again in 2018 and a new ten-year agreement (2019-2028) now specifies further reductions in these catch ceilings at low abundances. Since the 1999 PST Chinook agreement, an abundance-based Chinook management regime, under which fisheries are classified as either aggregate abundance-based management (AABM) or individual stock-based management (ISBM) regimes has been in place. AABM fisheries constrain catch to a numerical limit computed from either a pre-season forecast or an in-season estimate of abundance; ISBM fisheries constrain annual impacts, within the fisheries of a jurisdiction, for a naturally spawning Chinook salmon stock or stock group (Pacific Salmon Commission 2020). Goals of the new management regime include, an abundance-based framework, an ability to respond to significant changes in the productivity of Chinook salmon stocks, to preserve biological diversity of the Chinook salmon resource, and to contribute to restoration of depressed stocks (PSC 2020).

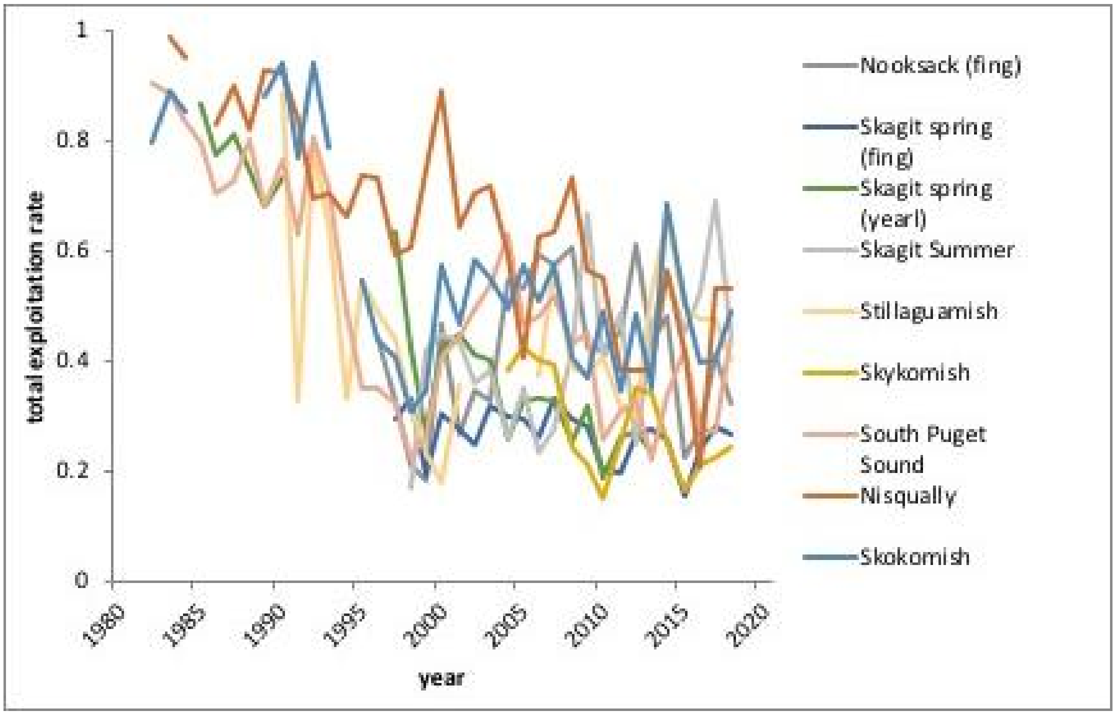

Figure 101. Coded-wire tag-based exploitation rates for PSC Chinook indicator stocks in Puget Sound. From Chinook Technical Committee 2020 Exploitation Rate Analysis, modified to account for mark-selective fisheries in Puget Sound (Jon Carey, pers. comm., PSC CTC ERA 2020).

SPATIAL STRUCTURE AND DIVERSITY

Measures of spatial structure and diversity can give some indication of the resilience of a population to sustain itself. Spatial structure can be measured in various ways, but here we assess the proportion of natural-origin spawners (wild fish) vs. hatchery-origin spawners on the spawning grounds.

We can see a declining trend in the proportion of natural-origin spawners across the ESU starting approximately in 1990 and extending through the present (2018). Figure 102 shows the smoothed trends in the estimated fraction of the natural spawning populations that consist of natural–origin spawners. The populations with the highest fractions of natural-origin spawners across the entire 1980 to 2018 time period are the six Skagit River populations. The Skykomish, Snoqualmie and Cedar populations had lower proportion of natural-origin spawners in the late 1990s, but they have rebounded and stayed between 60-90% since the early 2000s. All other populations vary considerably across the whole time period, and 13 populations (North and South Forks Nooksack, North and South Forks Stillaguamish, Skykomish, Snoqualmie, Sammamish, White, Puyallup, Nisqually, Skokomish, Dungeness and Elwha) show declining trends in the fraction natural-origin estimates. Skykomish, Cedar and Green are the only populations that show more recent trends of increasing fraction natural-origin spawnerabundances.

Evidence of the decline in fraction natural-origin spawner abundance is also shown in Table 51. It is important to note that quality of hatchery contribution data in the earlier time periods, prior to mass marking programs, may be poor, so the long-term trends may lack accuracy in the earlier years. In the Whidbey Basin MPG, the fraction natural-origin abundance has been consistently high in the six Skagit River populations. With ongoing hatchery programs in the Stillaguamish and Snohomish rivers there has been a decrease in five-year mean fraction natural-origin in the last two time periods (2010-2014, and 2015-2019), particularly in the Stillaguamish. Please note, the fraction natural-origin estimates have been removed prior to mass hatchery marking (pre-1997, and 2002-2005) in the Skykomish and Snoqualmie populations data due to concerns by Tribal comanagers regarding data quality.

However, the average five-year mean fraction natural-origin estimates for the entire Whidbey Basin MPG remains relatively consistent across all time periods. The Strait of Georgia MPG (North and South Forks Nooksack) has had increased hatchery influence since the late 1990s and across all time periods. The South Fork Nooksack population has had extremely small wild fish returns through 2015, but have had increased numbers of natural-origin spawners in the last three years relative to increased supplementation program efforts conducted at Skookum Hatchery (WDFW and PSTIT 2020). This population is at high risk of extinction. The Central/South MPG has had decreasing fraction natural-origin estimates in the Sammamish, Green, White, and Puyallup populations, and increases in the Cedar population in the recent three five-year time periods (2005-2009, 2010-2014, 2015-2019) (Figure 102, Table 51). The Nisqually population data represents the total volitional escapement, but in the three most recent years a supplementation program has been instituted with trucking hatchery fish upstream for release on the spawning grounds. This is an effort to supplement natural spawning. In the Hood Canal and Strait of Juan de Fuca MPGs, three of four populations had declining five-year mean fraction natural-origin estimates of fish returns to the spawning grounds. Skokomish had a slight increase in the most recent five-year time period, but still very low fraction natural-origin for the population. This population is heavily impacted by the George Adams hatchery program. Mid-Hood Canal population had a higher five-year mean fraction wild estimate in the most recent time period (2014-2019) because the hatchery supplementation program was ended in the Hamma Hamma River in 2015. Some supplementation fish continued to return through 2019, however, the population has not proven to be self-sustaining and viable and recent returns have been very low (Susewind 2020). Genetics data show this population highly correlated to the George Adams Hatchery stock, and the Green River stock that has been used. State managers conclude from the long-term supplementation program and the genetics composition that if there was an independent population of Chinook salmon that utilized the mid-Hood Canal streams, then it is most certainly extinct at this point in time. Thus, considering populations by MPG, the Whidbey Basin MPG is the only MPG with consistently high fraction natural-origin spawner abundance, in 6 of 10 populations. All other MPG's have either variable or declining spawning populations that have high proportions of hatchery-origin spawners.

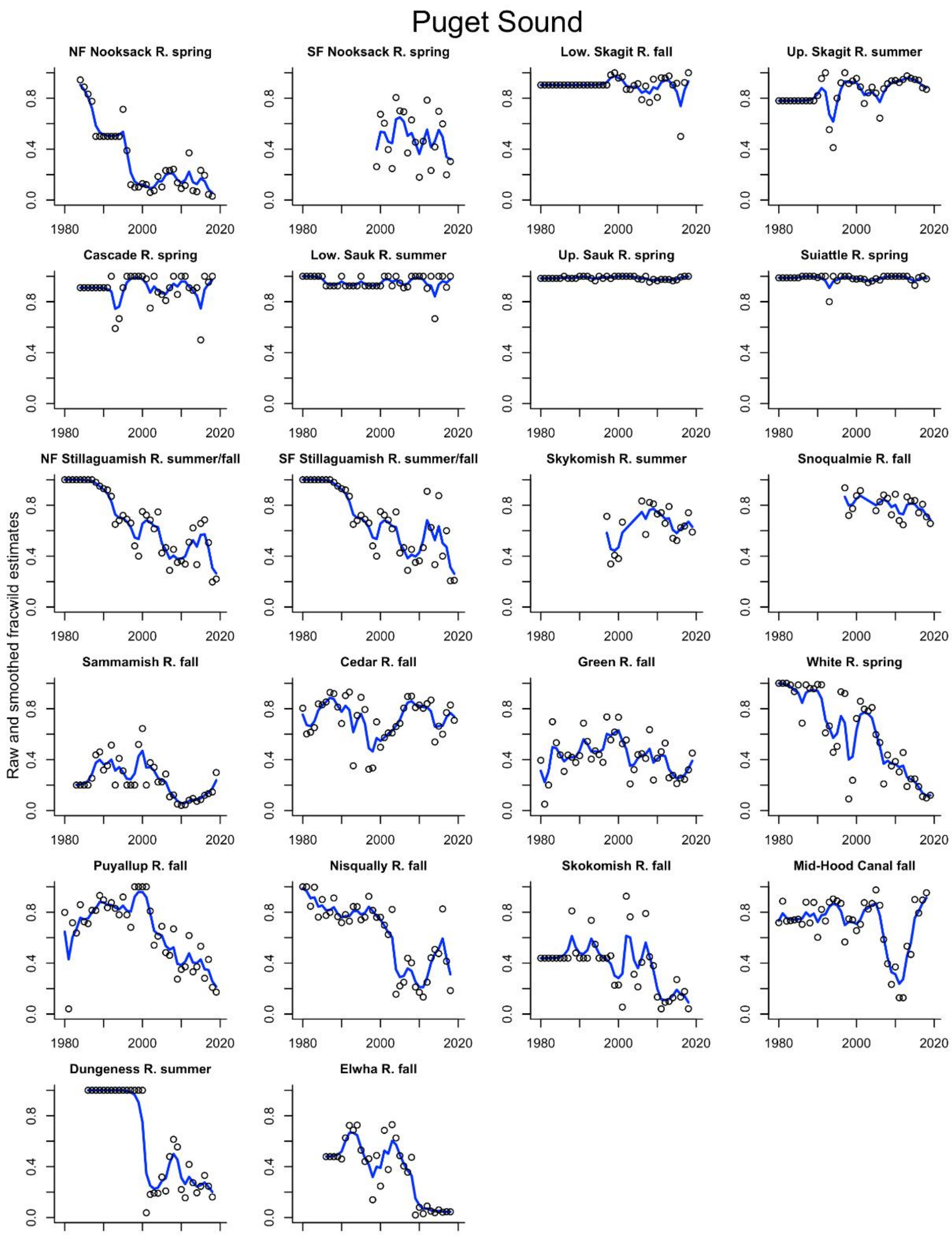

Figure 102. Smoothed trend in estimated fraction of natural-origin spawner abundances (blue line), and annual raw fraction of wild estimates (points).

Table 51. Five-year mean of fraction of natural-origin spawners (sum of all estimates divided by the number of estimates).

Population	1995-1999	2000-2004	2005-2009	2010-2014	2015-2019
NF Nooksack R. spring	0.28	0.11	0.19	0.14	0.13
SF Nooksack R. spring	0.26	0.55	0.57	0.42	0.45
Low. Skagit R. fall	0.94	0.91	0.86	0.92	0.84
Up. Skagit R. summer	0.91	0.87	0.84	0.95	0.91
Cascade R. spring	0.98	0.92	0.89	0.94	0.86
Low. Sauk R. summer	0.94	0.97	0.95	0.91	0.98
Up. Sauk R. spring	0.99	1.00	0.98	0.97	0.99
Suiattle R. spring	0.99	0.97	0.99	0.99	0.97
NF Stillaguamish R. summer/fall	0.59	0.70	0.40	0.43	0.45
SF Stillaguamish R. summer/fall	0.59	0.70	0.40	0.54	0.46
Skykomish R. summer	0.49	0.52	0.76	0.69	0.62
Snoqualmie R. fall	0.81	0.89	0.81	0.78	0.75
Sammamish R. fall	0.29	0.36	0.16	0.07	0.16
Cedar R. fall	0.61	0.59	0.82	0.78	0.71
Green R. fall	0.55	0.47	0.43	0.39	0.30
White R. spring	0.54	0.79	0.43	0.32	0.15
Puyallup R. fall	0.88	0.79	0.52	0.41	0.32
Nisqually R. fall	0.80	0.61	0.30	0.30	0.47
Skokomish R. fall	0.40	0.46	0.45	0.10	0.16
Mid-Hood Canal fall	0.76	0.79	0.61	0.33	0.89
Dungeness R. summer	1.00	0.32	0.43	0.25	0.25
Elwha R. fall	0.41	0.53	0.35	0.06	0.05

BIOLOGICAL STATUS RELATIVE TO RECOVERY GOALS

The Puget Sound TRT provided viability criteria for each population based on historical information and models with which they developed planning ranges for spawner abundance and productivity (PSTRT 2002). They also specified spatial structure and diversity criteria characteristic of low risk populations. The planning ranges are based on estimates of salmon abundance that can be supported by properly functioning habitat at both low productivity and high productivity. They also recommended ESU-level criteria including: the viability status of all populations in the ESU is improved from current conditions, that 2 to 4 Chinook populations in each of the 5 MPG's within the ESU achieve viability, at least 1 population is viable from each major genetic and life history group historically present within each of the 5 MPGs, and that the populations that do not meet the viability criteria for all 4 VSP parameters are sustained in order to provide ecological functions and preserve options for ESU recovery. Additional criteria described habitat conditions that are needed to support viable salmonid populations.

In the Puget Sound Chinook salmon ESU, multiple populations were designated in some river systems. Generally speaking, the data available at that time (including both genetic and spawner abundance) led the TRT to identify some populations based on geographic location of spawning areas. Over the past 15+ years, co-managers have vastly increased the amount and quality of both spawner abundance by area and genetic structure. In a number of river systems, populations that were thought to be geographically isolated have been documented to stray more widely than previously thought (Table 52). Hence we identify these below and give a brief description of each concern relative to management and listing/delisting status. In two cases, Mid-Hood Canal and Sammamish/Cedar, state and tribal co-managers submitted letters to NOAA to consider a formal change in the population identification (Muckleshoot Indian Tribe 2020; Susewind 2020, PNPTC 2020).

Table 52. Population designation issues in Puget Sound Chinook populations for NW Science Center 5-year status review

ESU/DPS	Population(s)	Issue
Puget Sound Chinook Salmon	Mid-Hood Canal	Did the three streams over which this population is designated historically support Chinook salmon?
	Stillaguamish, North Fork and South Fork	Difference is run timing, not geography
	Nooksack, North Fork and South Fork	Difference is run timing, not geography
	Sammamish (and Cedar)	Was this river capable of supporting a self-sustaining population
	Puyallup and White	Difference is run timing, not geography

	Lake Cushman "adfluvial" Chinook	Not currently considered a native remnant or viable independent population. Any reason to update in light of Brenkman 2017, recent genetic samples from Tacoma Power, and new passage facilities in operation?

MID-HOOD CANAL

Washington State and Tribal fishery co-managers have submitted updated information, witha request from WDFW managers for the Mid-Hood Canal Chinook population to be considered as "not an independent population" and as extinct, and a request from PNPTC managers to abstain from such a decision until an ongoing habitat assessment and consideration of a "reintroduction/supplementation program of an appropriate locally adapted natural spawning population" is fully . This would likely be a spring-run Chinook population, rather than the current fall-run population. Both State and Tribal co-managers consider that all of the spawning 'aggregations' that currently exist in the Duckabush, Dosewallips, and Hamma Hamma rivers are not sustainable populations nor independent genetically from the current day Skokomish River population, which is heavily supplemented with Green River fish propagated at George Adams hatchery.

In Ruckelshaus et al. (2006), the TRT offered several alternative population structures for the Mid-Hood Canal population from 3 separate populations (adopted) to Mid-Hood Canal as a subpopulation of a larger Hood Canal population. In the end, the TRT determined that based on historical accounts of Chinook salmon presence, combined with the lack of substantive artificial production (at the time) and the location of the small systems from the nearest major populations (Skokomish and Dungeness), there was a high likelihood that an independent population was historically present in the Mid-Hood Canal systems, in aggregate. See pages 54-57 in Ruckelshaus et al. (2006).

The co-managers provide evidence of spawner abundances and genetic analyses that indicate: 1) the 20 year-long supplementations program, ended in 2015, has not produced a sustainable naturally producing Chinook population, and 2) genetic analyses of the existing Mid-Hood Canal Chinook population indicates genetic similarity to the Skokomish population, including the Green River stock that are used for the George Adams hatchery program (Susewind 2020). The viability parameters of spatial structure and diversity are also discussed above. Recent low spawner abundances despite increased fraction wild estimates in 2018 and 2019 indicate the population cannot be sustained without supplementation. WDFW managers do mention their intention to continue to support habitat restoration and a second attempt to reintroduce Chinook salmon, but of a different brood stock than the previously used Green River/George Adams/Hoodsport stock. The WDFW managers express concern that this population has listing status as "necessary to achieve recovery" for the ESU (i.e. 2-4 populations per MPG)(Susewind 2020). However, the Tribal managers express concern that any potential change in listing status should more broadly consider harvest, habitat, and genetic diversity parameters that they believe have not yet adequately been identified. In particular, they suggest attempting to reintroduce a locally adapted spring-run population if an ongoing analysis of habitat information is determined to support such a population (PNPTC 2020).

SAMMAMISH

Tribal fishery managers (Muckelshoot Indian Tribe) have also submitted updated information and a request for the Sammamish Chinook population to be considered as "not an independent population" and as not distinct from the

Cedar River population. They provide information that any of the spawning 'aggregations' that previously existed in the Sammamish and Issaquah watersheds have been heavily populated by hatchery strays for many years and current spawners cannot be differentiated from Issaquah Creek hatchery or the Cedar River population. Productivity of natural-origin spawner returns indicates that a wild population is not able to persist without the hatchery influence primarily due to poor spawning and rearing habitat in the Sammamish River and its tributaries (Muckleshoot Indian Tribe 2020).

STILLAGUAMISH, NOOKSACK, WHITE AND PUYALLUP RIVERS

State and Tribal co-managers have done considerable genetic mark-recapture work in the Stillaguamish River, North and South forks Chinook populations, over the past decade. They have determined that the previously identified “North Fork” and “South Fork” populations are not in fact geographically isolated as determined in Ruckelshaus et al. (2006). Their data do confirm the presence of two populations of Chinook distinguished by genetic characteristics that are expressed in run timing, summers and falls (WDFW and PSTIT 2020). However the two populations have been determined to overlap in spawn timing and distribution so that both populations spawn in both North and South Forks Stillaguamish River. Escapement is still currently estimated for the geographic units rather than for the individual populations (WDFW and PSTIT 2020).

A similar situation exists in the Nooksack River, North/Middle Forks and South Fork populations, and also in the Puyallup and White Rivers. The TRT previously considered the North/Middle Forks and South Fork two populations (both early run-types) that are geographically isolated, but more concerted efforts to obtain spawner abundance data and carcass samples for genetic analyses have allowed more accurate delineation of the genetic makeup of each spawning aggregate. The White River was determined to have an early run Chinook salmon population that is distinct from the late run population that remained lower in the system in the White River below the diversion dam and in the Puyallup River. Co-managers have done substantial work to obtain more detailed and consistent spawner abundance data and to be able to determine the different components of the populations and their spawning locations. In all cases, data 10-15 years back in time have been re-analyzed and re-tabluated relative to our past data reviews. The new information typically is also used to inform recovery efforts, as well as, fishery management decisions, for these populations somewhat differently than previously designated by the TRT in Ruckelshaus et al. (2006).

While these new data do now exist, they do not change considerations of listing status in this status review document. We acknowledge the co-managers request to reassess and revise the Mid-Hood Canal Chinook population status determination, including differences in opinions for possible solutions. We also commend the co-managers efforts and successes to develop better abundance, productivity, genetic diversity and spatial structure data. A possible approach for which to address these issues would be to convene a technical team and possibly consider the revision of the Puget Sound Chinook recovery plan. Otherwise, review of the overall plan and ESU recovery goals is necessary, particularly as regards consideration of the spatial structure and diversity viability parameters, and specifically relative to the number of populations in each MPG necessary for recovery. Also revision of the associated watershed chapters is necessary to describe updated population and habitat information, as well as, strategies and actions necessary to achieve Chinook recovery in all MPGs of the Puget Sound ESU.

UPDATED BIOLOGICAL RISK SUMMARY

All Puget Sound Chinook salmon populations continue to remain well below the TRT planning ranges for recovery escapement levels. Most populations also remain consistently below the spawner-recruit levels identified by the TRT as necessary for recovery. Across the ESU, most populations have declined in abundance since the last status review in 2016, and indeed, this decline has been persistent over the past 12 to 15 years. Productivity remains low in most populations. Hatchery-origin spawners are present in high fractions in most populations outside the Skagit watershed, and in many watersheds the fraction of spawner abundances that are natural-origin have declined over time. Habitat protection, restoration and rebuilding programs in all watersheds have improved stream and estuary conditions despite record numbers of humans moving into the Puget Sound region in the past two decades. Bi-annual four year work plans document the many completed habitat actions that were initially identified and in the

Puget Sound Chinook salmon recovery plan. The expected benefits will take years or decades to produce significant improvement in natural population viability parameters. Development of a monitoring and adaptive management program was required by NMFS in the 2007 Supplement to the Shared Strategy Recovery Plan, and since the last review the Puget Sound Partnership has completed this, but this program is still not fully functional for providing assessment of watershed habitat restoration/recovery programs, nor of fully integrating the essentially discrete habitat, harvest and hatchery programs. A recent white paper produced by the Salmon Science Advisory Group, of the Puget Sound Partnership concludes there has been “a general inability of monitoring to link restoration, changes in habitat conditions, and fish response at large-scales” (PSP 2021). A number of watershed groups are in the process of updating their Recovery Plan Chapters and this includes prioritizing and updating recovery strategies and actions, as well as assessing prior accomplishments. Overall, new information on abundance, productivity, spatial structure and diversity since the 2015 status review does not indicate a change in the biological risk category since the time of the last BRT status review.

PUGET SOUND STEELHEAD DPS

BRIEF DESCRIPTION OF DPS

This report covers the Distinct Population Segment (DPS) of Puget Sound steelhead (*Oncorhynchus mykiss*). These fish are the anadromous form of *O. mykiss* that occur in rivers, below natural barriers to migration, in northwestern Washington State that drain to Puget Sound, Hood Canal, and the Strait of Juan de Fuca between the U.S./Canada border and the Elwha River, inclusive (Figure 103). The Puget Sound Steelhead Technical Recovery Team (TRT) considered genetic and life-history information from steelhead on the Olympic Peninsula and Washington coast and concluded that there was no compelling evidence to alter the DPS boundary described above.

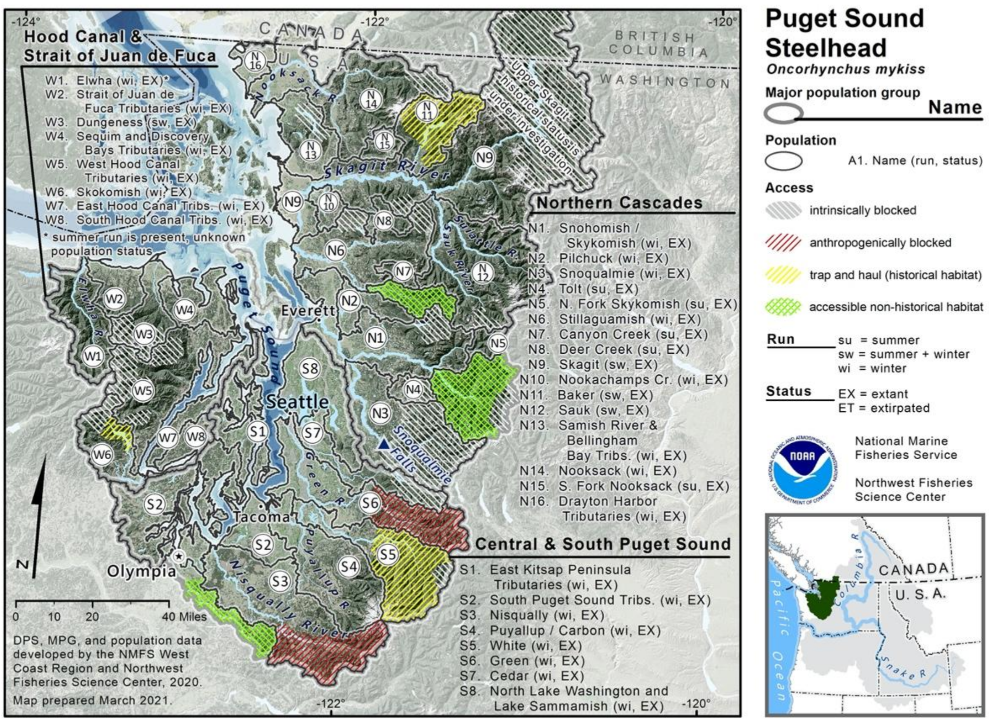

Figure 1. Map of the Puget Sound Steelhead DPS's spawning and rearing areas, identifying 32 demographically independent populations (DIPs) within 3 major population groups (MPGs). The 3 steelhead MPGs are Northern Cascades, Central & South Puget Sound, and Hood Canal & Strait of Juan de Fuca. Areas where dams block anadromous access to historical habitat is marked in red cross-hatching; and areas where historical habitat is accessible via trap and haul programs is marked in yellow cross-hatching. Areas where the laddering of falls has provided access to non-historical habitat is marked in green cross-hatching. Finally, historically inaccessible portions of watersheds are marked in grey and white cross-hatching.

SUMMARY OF PREVIOUS STATUS CONCLUSIONS

2007

The initial review of this DPS—then designated the Puget Sound Steelhead Evolutionarily Significant Unit (ESU)—by a Biological Review Team (BRT) was completed in 1996 as part of a coastwide status review conducted in response to two listing petitions received by NOAA that identified other potentially imperiled steelhead populations in 1993 and 1994 (Busby *et al*. 1996). Subsequent to that BRT review, NOAA issued a determination that listing of Puget Sound steelhead was not warranted (61 FR 41451). In response to a petition to list Puget Sound steelhead received in September 2004, a newly convened BRT completed its report summarizing the status of the Puget Sound Steelhead DPS in June 2007 (Hard *et al.* 2007)). The BRT considered the major risk factors facing Puget Sound steelhead to be widespread declines in abundance and productivity for most natural populations in the DPS (including those in Skagit and Snohomish rivers, previously considered strongholds for steelhead in Puget Sound); the low abundance of all summer-run populations; and continued releases of out-of-DPS hatchery fish from Skamania River-derived summer-run and highly domesticated Chambers Creek-derived winter-run stocks. Most of the populations in the DPS are small, and recent declines in abundance of natural fish have persisted despite widespread reductions in the harvest of natural steelhead in the DPS since the mid-1990s. After considering these and other factors such as reduced complexity of spatial structure, evidence for minor contribution of resident *O. mykiss* to anadromous abundance and productivity, and persistently low marine survival of steelhead from Puget Sound, the BRT concluded that steelhead in the DPS were likely to become at risk of extinction throughout all or a significant portion of their range in the foreseeable future, but were not currently in danger of extinction. Subsequent to the BRT's review, NMFS issued its final determination to list the Puget Sound Steelhead DPS as a threatened species under the ESA on 11 May 2007 (72 FR 26722); the effective date of the listing was 11 June 2007.

2010

The 2010 review of the listed Puget Sound Steelhead DPS concluded that its status had not changed substantially since the 2007 listing (Ford *et al.* 2011). Most populations within the DPS were showing continued downward trends in estimated abundance, a few sharply so, and evidence for low productivity was evident throughout the DPS. For all but a few populations, population growth rates were declining on the order of 3 to 10% annually, and extinction risk for most populations over the foreseeable future was estimated to be moderate to high, especially for those in the Central & South Puget Sound and Hood Canal & Strait of Juan de Fuca major population groups (MPGs). The major risk factors facing Puget Sound steelhead had also not changed substantively since listing. Following the 2010 status review, NMFS proposed critical habitat for Puget Sound steelhead on 14 January 2013 (78 FR 2726); the agency updated its determination of the listing status of the DPS on 14 April 2014 (79 FR 20802).

In 2013, the Puget Sound Steelhead TRT finalized its analyses of Puget Sound steelhead data available through 2011 to identify 32 demographically independent populations (DIPs) and 3 MPGs within the DPS (Myers *et al.* 2015) and develop viability criteria for the DPS (Hard *et al.* 2015). In its viability report, the TRT concluded that the threatened Puget Sound Steelhead DPS is not currently viable. The TRT found that low population viability is widespread throughout the DPS, across all three MPGs, and includes both summer-run and winter-run populations. Steelhead populations throughout the DPS showed evidence of diminished abundance, productivity, diversity, and spatial structure when compared with available historical evidence for the states of each of these salmonid population (VSP) parameters.

2015

The 2015 status review concluded that the biological risks faced by the Puget Sound Steelhead DPS have not substantively changed since the listing in 2007, nor since the 2010 status review. In a parallel risk assessment process, the Puget Sound Steelhead TRT concluded that the DPS was at very low viability, as were all three of its constituent MPGs, and many of its 32 DIPs (Hard *et al.* 2015). Review of abundance trends indicated some minor increases in spawner abundance or improving productivity over the 2-3 years prior to the review; however, most of these improvements were small and abundance and productivity throughout the DPS remained at levels of concern for demographic risk. Recent increases in abundance that were observed in a few populations were within the range of variability observed in the past several years. Trends in abundance of natural spawners remained predominantly negative. Particular aspects of diversity and spatial structure, including limited availability of suitable habitat, were likely to be limiting the viability of most Puget Sound steelhead populations. Reduced harvest and declining hatchery production of both summer- and winter-run steelhead in the DPS were determined to have decreased those risks to natural spawners.

It was noted that the harvest levels for steelhead in Puget Sound were at very low levels, and that further reductions were not possible or would not significantly improve natural escapement. At the time of the review, environmental trends were not favorable to Puget Sound juvenile and adult steelhead survival and the long term effects these conditions were forecast to negatively affect abundance in to the near future. Specifically, the exceptionally warm marine waters in 2014 and 2015 and warm stream temperatures and low summer stream flows observed during 2015 were unfavorable for marine and freshwater survival. These and other environmental indicators pointed to continued warming ocean temperatures, fragmentation or degradation of freshwater spawning and rearing habitat, reduced snowpack, altered hydrographs producing reduced summer river flows and warmer water, and low marine survival for salmonids in the Salish Sea. These conditions were expected to constrain any rebound in VSP parameters for Puget Sound steelhead in the near term.

DESCRIPTION OF NEW DATA AVAILABLE FOR THIS REVIEW

This report considers population data available through 2019 (where available) to review the current status of Puget Sound steelhead. These data were provided by state and tribal comanagers, which included the Washington Department of Fish and Wildlife (WDFW), including its Salmon and Steelhead Stock Inventory and Salmonscape databases, and its district area biologists; Washington tribal biologists; and Northwest Indian Fisheries Commission (NWIFC) biologists. In addition, there have been a number of genetic studies related to Puget Sound steelhead population structure and hatchery-origin steelhead introgression. In most cases, these studies have focused on the influence of non-native hatchery releases on naturally-spawning populations (Warheit 2014, Myers *et al.* 2015, Winans et al. 2017, Larson *et al.* 2018) . Results from a number of ongoing studies focusing on juvenile survival in the Salish Sea have been published since the last review. WDFW also produced a Steelhead at Risk Report (Cram *et al.* 2018), which reviewed many of the viability factors discussed in the Status Review Updates. This report focuses on assessing DPS viability with a subset of the DPS for which updated population data are available. Only 20 populations or population groups had sufficient data for statistical analysis. Using the VSP approach, this assessment includes a basic analyses of abundance and trend data (Abundance and Productivity), in addition to Diversity and Spatial Structure, but does not attempt to replicate the population viability analyses (PVAs) conducted in the previous status review update (NWFSC 2015). Additional analyses of Puget Sound steelhead population demographics, distribution, and habitat is provided by the Puget Sound Steelhead Recovery Plan (NMFS 2019) If a preliminary assessment of the risk factors for this DPS suggest a change in listing status a more thorough analyses by a Biological Review Board would be warranted.

ABUNDANCE AND PRODUCTIVITY

The long-term abundance of adult steelhead returning many Puget Sound rivers has fallen substantially since estimates began for many populations in the late 1970s and early 1980s; however, in the nearer term there has been a relative improvement in abundance and productivity (Figure 104, Figure 105). Of the 20 data sets analyzed, abundance trends were available for 7 of the 11 winter-runs (WR) and only 1 out of the 5 summer-runs (SR) DIPs in the Northern Cascades MPG, 5 of the 8 winter-run DIPs in the Central & South Puget Sound MPG, and 7 of the 8 winter-run DIPs in the Hood Canal & Strait of Juan de Fuca MPG (Table 53). A third of the number of populations lack monitoring and abundance data, in most cases it is likely that abundances are very low. The data submitted only included natural-origin spawners, therefore statistical analyses for natural spawners and total spawners were identical.

NORTHERN CASCADES MPG

Within the Northern Cascades MPG, over the last five years there has been considerable variability in the performance of individual basins. The winter-run populations in the Samish River and Bellingham Bay Tributaries exhibited a 74% increase in the five-year geometric mean abundance, with an average 1,305 natural-origin spawners for the present review period (Table 53). Additonally, this estimate is an underestimate as it does not include tributaries to Bellingham Bay. Winter run DIPs in the Nooksack and Skagit basins exhibited slight increases in their average five-year abundances, although within the 2015-2019 period a negative trend in abundances is evident in the Skagit River populations (Figure 104). The Skagit River data set, which represents five DIPs[1] and may include some summer steelhead red counts, contains the majority of steelhead estimated in this MPG, with a geomean of 7,181 (Table 53). The Stillaguamish River winter run steelhead DIP exhibited a moderate increase in its five-year geomean abundance of 26% (Table 53), although the longer- term trend for this population from abundance levels in the 1980s is strongly downward (Figure 104). Further, the Stilliguamish River abundance estimate is based on an index rather than a total estimate. DIPs in the Snohomish Basin, were stable or negative. The Pilchuck River winter run DIP experienced a 2% increase in five-year geomean, while both the Snohomish/Skykomish and Snoqualmie River winter run DIPs both exhibited 29% decreases in recent five-year geomean abundances. Long term trends, 15-year (2005-2019), were also significantly negative with 8% and 6% annual declines for the Snohomish/Skykomish and Stillaguamish River DIPs, respectively (Table 54).

The Tolt River summer run DIP, the only summer run of five in this MPG for which there was a long term data set, experienced a 63% decline in five-year abundance during the 2015-2019 period. In addition, there has been a negative 4% trend in abundance since 2005. The current five-year geomean for the Tolt River DIP is only 40 spawners, although this represents redds found in between RM 3.3 and 7.8. There no data was provided for the Drayton Harbor Tributaries winter run DIP and four summer run DIPs, South Fork Nooksack, Deer Creek, Canyon Creek, and North Fork Skykomish River. It is assumed that these populations persist, but at very low abundances.

This MPG represents the majority of the abundance for the entire Puget Sound DPS, with a total abundance (based on five-year geomeans) of over 10,000 natural spawners, with several populations having abundances over a 1,000 and others over 250; however, over a third of the populations are not sufficiently monitored to develop population abundance estimates and likely have very low numbers of spawners. Except for the Samish and Bellingham Tributaries DIP and perhaps the Nooksack and Skagit rivers, productivity (based on adult:adult ratios) for most populations was negative (in contrast to the five-year geomean trends), suggesting a downward trend into the near future (Figure 105).

[1] Of the five DIPs in the Skagit River, the abundance estimate only includes the Skagit, and Sauk River DIPs and Nookachamps Creek DIP, estimates are not available for the Baker River DIP (near zero) and the Cascade River DIP.

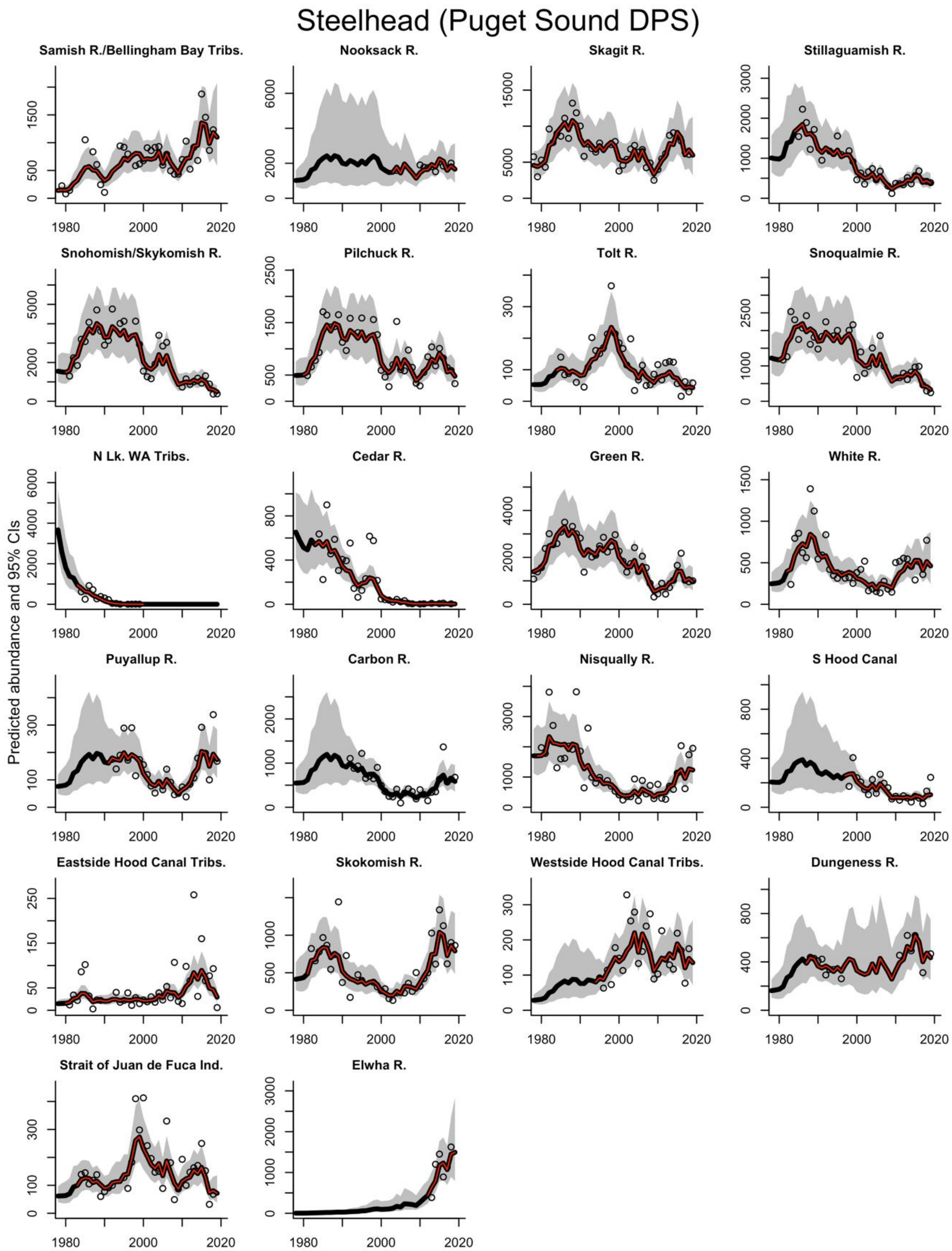

Figure 2. Smoothed trends in estimated total (thick black line) and natural (thin red line) Puget Sound steelhead population spawning abundances. Points show the annual raw spawning abundance estimates. Greyed areas depict the 95% confidence intervals around the

estimates. WR, winter run; SuR, summer run. Lengthy time periods with estimated abundances (black line) should be viewed with caution (see methods section).

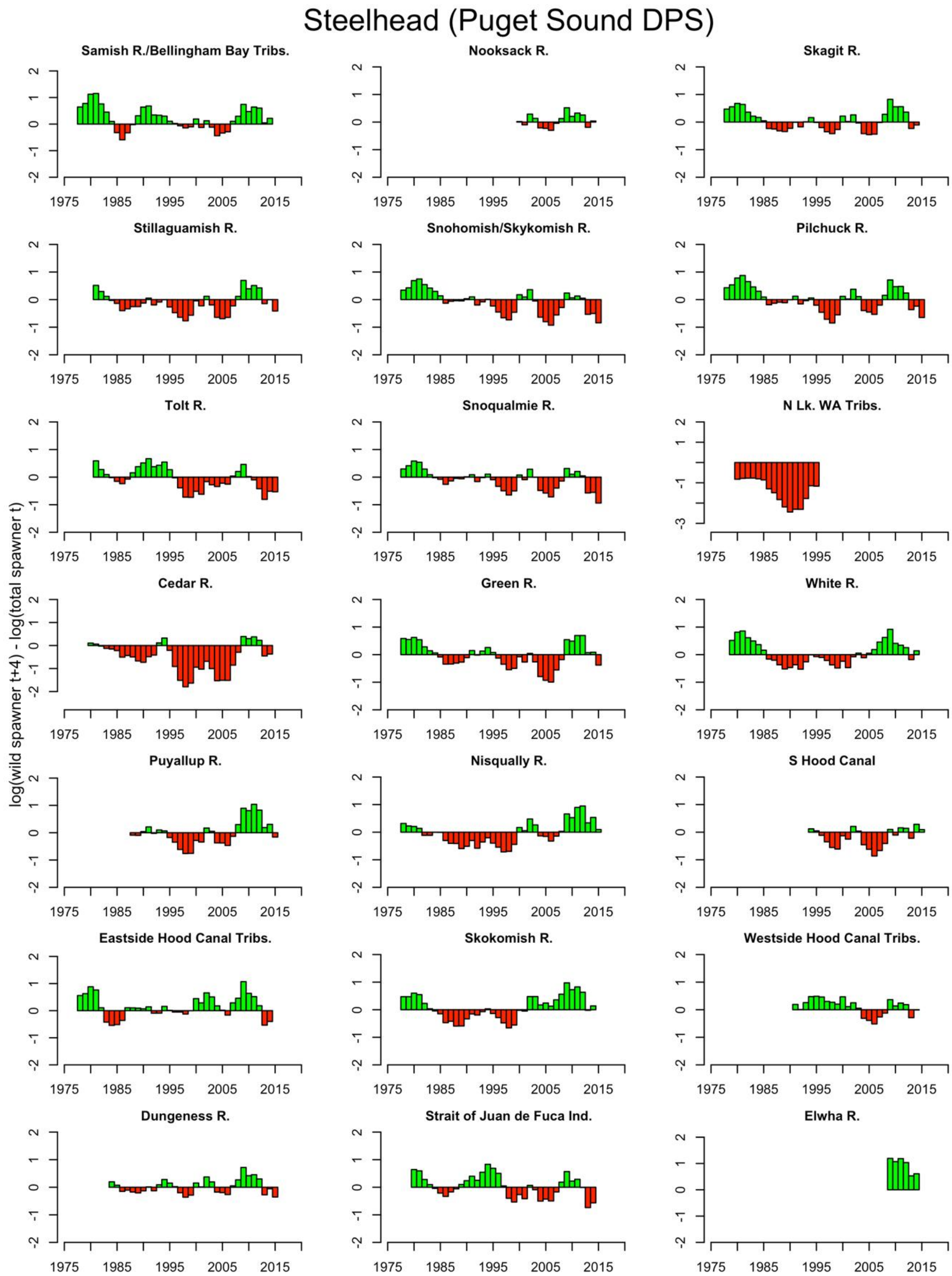

Figure 3. Trends in population productivity of Puget Sound steelhead, estimated as the log of the smoothed natural spawning abundance in year t minus the smoothed natural spawning abundance in year (t + 4).

Table 1. Five-year geometric mean of raw natural spawner counts for Puget Sound steelhead.. The geometric mean was computed as the product of counts raised to the power 1 over the number of counts available (2 to 5). A minimum of 2 values was used to compute the geometric mean. Percent change between the most recent two 5-year periods is shown on the far right. MPG, major population group; NC, Northern Cascades, SCC South and Central Cascades, HCSJF, Hood Canal and Strait of Juan de Fuca, W, winter run; S, summer run. Stillaguamish River, Tolt River, and Eastside, Westside, and South Hood Canal DIP abundances reflect index counts, and Skagit River abundances represent counts from three of the five DIPs (Noockachmaps Cree, Skagit and Sauk rivers).

Population	MPG	1990-1994	1995-1999	2000-2004	2005-2009	2010-2014	2015-2019	% Change
Samish R./Bellingham Bay Tribs. W	NC	316	717	852	535	748	1305	74
Nooksack R. W	NC					1745	1906	9
Skagit R. S and W	NC	7202	7656	5419	4677	6391	7181	12
Stillaguamish R. W	NC	1078	1166	550	327	386	487	26
Snohomish/Skykomish R. W	NC	3629	3687	1718	2942	975	690	-29
Pilchuck R. W	NC	1225	1465	604	597	626	638	2
Snoqualmie R. W	NC	1831	2056	1020	1250	706	500	-29
Tolt R. S	NC	112	212	119	70	108	40	-63
N. Lake WA Tribs. W	SCC	60	4	-	-	-	-	-
Cedar R. W	SCC	241	295	37	12	4	6	50
Green R. W	SCC	2062	2585	1885	1045	662	1289	95
White R. W	SCC	524	311	301	173	514	451	-12
Puyallup R. W	SCC	167	196	93	72	85	201	136
Carbon R. W	SCC	(969)	(800)	(335)	(246)	(290)	(735)	153
Nisqually R. W	SCC	1200	754	409	446	477	1368	187
S. Hood Canal W	HCSJF	97	148	176	145	69	91	32
Eastside Hood Canal Tribs W	HCSJF	27	21	25	37	60	93	55
Skokomish R. W	HCSJF	385	359	205	320	533	958	80
Westside Hood Canal Tribs W	HCSJF		97	208	167	138	150	9

Dungeness R. S and W	HCSJF	356				517	448	-13
Strait of Juan de Fuca Independents W	HCSJF	89	191	212	118	151	95	-37
Elwha R. W	HCSJF					680	1241	82

CENTRAL AND SOUTH PUGET SOUND MPG

Steelhead populations in the Central and South Puget Sound MPG exhibited strongly positive increases in their five-year abundances. Four populations that represent the major basins in this MPG; Green River, Puyallup River, White River, and Nisqually River winter-run DIPs exhibited 94 to 187% increases in five-year abundances (Table 53). Long term (15-year) trends for three of these populations were positive, White, Puyallup, and Nisqually, with annual growth rates of 6-8%, while the Green River DIP long-term trend remained stable at 0% (Table 54). Abundances for the White and Puyallup winter run DIPs remain in the low hundreds and continue to be at some demographic risk, although estimates include counts from only portions of the DIPs. Further, abundances for the Puyallup/Carbon River DIP include data series for the Puyallup and Carbon rivers that could not be combined due to differences in survey protocols. Recent productivity for these four populations has been predominately positive (Figure 105). Two DIPs in the Lake Washington watershed, North Lake Washington Tributaries and Cedar River, had adult abundances near zero, based on fish ladder counts (Chittenden Locks) and Landsburg Dam (Cedar River) and redd counts; however, large numbers of resident *O. mykiss* are found in the Cedar River (Cram *et al.* 2018). Lastly, no information was available for the East Kitsap Peninsula Tributaries and South Puget Sound Tributary DIPs. It is assumed that these populations persist, but at very low levels. Total abundance for this MPG is still in the low 1,000s of fish.

HOOD CANAL AND THE STRAIT OF JUAN DE FUCA MPG

In general, populations in this MPG have experienced an increase in abundance during the 2015-2019 period. The five-year geomean for the Elwha River DIP increase to 1,241 winter run steelhead, an 82% increase over the 2010-2014 period. Productivity estimates for recent brood years have also been strongly positive (Figure 105). In addition, summer run steelhead have been observed in the upper Elwha River, with recent counts in the low hundreds of returning adults (Pess *et al.* 2020). Rather than a recolonization, these fish appear to be reanadromized *O. mykiss* from summer run steelhead originally isolated behind the Elwha and Glines Canyon dams. Although summer run may also persist as residents or at very low abundances elsewhere in the MPG, the Elwha River population is the only extant summer run identified, and although precise data on this "population" is lacking it represents a considerable contribution to the DPS. The Skokomish River winter-run steelhead DIP exhibited a five-year geomean abundance of 958, an 80% increase over the previous five-year period, and represents the second largest DIP in this MPG (Table 53). Further, both the long-term trend, 10% (Table 54), and recent productivity (Figure 105) are both strongly positive. The Dungeness River Summer and Winter DIP abundance was estimated at 408; however this represented a 21% decrease over the previous period (Table 53), longer term trends could not be calculated, but the current abundance level is an improvement over estimates from the 1990s. The remaining populations consist of assemblages of small tributaries with abundances of less than 250 individuals. The three Hood Canal winter run populations (Eastside Hood Canal, South Hood Canal, and Westside Hood Canal) all experienced increases in abundance from 9 to 55% (Table 53), but remain at relatively low population abundances. The Strait of Juan de Fuca Independent Tributaries winter run DIP abundance fell below 100 for its five-year geomean, a 37% decrease over the previous period. Finally, no information was available for the Sequim and Discovery Bay Tributaries winter run DIP. Based on previous monitoring in Snow Creek, a small tributary in this DIP, overall abundance is unlikely more than 100. Overall, this MPG exhibited an increase in abundance related to the expansion of steelhead spawning in the Elwha River and general improvements among populations in Hood Canal. Total abundance, however, was still low to moderate.

Table 2. 14-year trends (slope) in log wild spawner abundance computed from a linear regression applied to the smoothed wild spawner log abundance estimate versus year. In parentheses are the upper and lower 95% CIs. Only populations with at least 4 wild spawner estimates and with at least 2 data points in the first 5 years and last 5 years of the 15-year ranges are shown. MPG, major population group; NC, Northern Cascades, SCC South and Central Cascades, HCSJF Hood Canal and strait of Juan de Fuca, W, winter run; S, summer run.

Population	MPG	1990-2005	2005-2019
Samish R./Bellingham Bay Tribs. Winter	NC	0.04 (0.02, 0.07)	0.05 (0.02, 0.08)
Skagit R. Both summer & winter	NC	-0.03 (-0.04, -0.01)	0.02 (0, 0.07)
Stillaguamish R. Winter	NC	-0.07 (-0.09, -0.04)	0.00 (-0.03, 0.03)
Snohomish/Skykomish R. Winter	NC	-0.05 (-0.07, -0.03)	-0.09 (-0.11, -0.06)
Pilchuck R. Winter	NC	-0.06 (-0.08, -0.03)	0 (-0.03, 0.02)
Snoqualmie R. Winter	NC	-0.04 (-0.06, -0.03)	-0.07 (-0.09, -0.04)
Tolt R. Summer	NC	0.00 (-0.04, 0.04)	-0.04 (-0.06, -0.02)
Cedar R. Winter	SCC	-0.19 (-0.23, -0.14)	-0.11 (-0.16, -0.06)
Green R. Winter	SCC	-0.03 (-0.05, -0.01)	-0.01 (-0.06, 0.03)
White R. Winter	SCC	-0.07 (-0.08, -0.06)	0.07 (0.05, 0.09)
Puyallup R. Winter	SCC	-0.06 (-0.08, -0.04)	0.07 (0.04, 0.11)
Nisqually R. Winter	SCC	-0.1 (-0.11, -0.08)	0.08 (0.04, 0.11)
S. Hood Canal Winter	HCSJF		-0.05 (-0.08, -0.02)
Eastside Hood Canal Tribs. Winter	HCSJF	0.01 (0, 0.03)	0.04 (0, 0.08)
Skokomish R. Winter	HCSJF	-0.06 (-0.07, -0.05)	0.1 (0.08, 0.13)
Westside Hood Canal Tribs. Winter	HCSJF		-0.02 (-0.04, 0.00)
Strait of Juan de Fuca Independents Winter	HCSJF	0.05 (0.01, 0.08)	-0.04 (-0.07, -0.01)
Elwha R. Winter	HCSJF		

HARVEST

Harvest of Puget Sound steelhead is limited to terminal tribal net fisheries and recreational fisheries. In response to declining abundance throughout the 1990s, harvest rates were curtailed in 2003, with "wild" harvest rates reduced to below 10% (NMFS 2018). Recreational fisheries are mark-selective for hatchery stocks, but some natural origin steelhead are encountered with a proportion of those fish subject to hooking mortality and non-compliance. Hatchery steelhead production for harvest is primarily of Chambers Creek winter-run stock (South Puget Sound) and Skamania Hatchery summer-run stock, both of which have been selected for an earlier run timing than natural stocks to minimize fishery interactions. In tribal net fisheries, most indirect fishery impacts occur in fisheries directed at salmon and hatchery steelhead. Some additional impacts occur in pre-terminal fisheries, but these are negligible and data are insufficient to attribute them to individual populations. Consequently, harvest impacts are reported as terminal harvest rates.

Harvest rates differ widely among the different rivers, but all have declined since the 1970s and 1980s. Harvest rates on natural steelhead during the earlier period averaged between 10% and 40%, with some populations in the central and south parts of Puget Sound, such as the Green and Nisqually river populations, experiencing harvest rates over 60%. In recent years, terminal harvest rates have continued to decline, averaging less than 2% over the last five years (Figure 106). In 2018, NMFS approved a resource management plan (RMP) for the Skagit Basin that allowed for the directed take of ESA listed steelhead through both net fisheries and the catch-and-release recreational fishery (NMFS 2018). Under this plan harvest rates would be based on overall escapement.

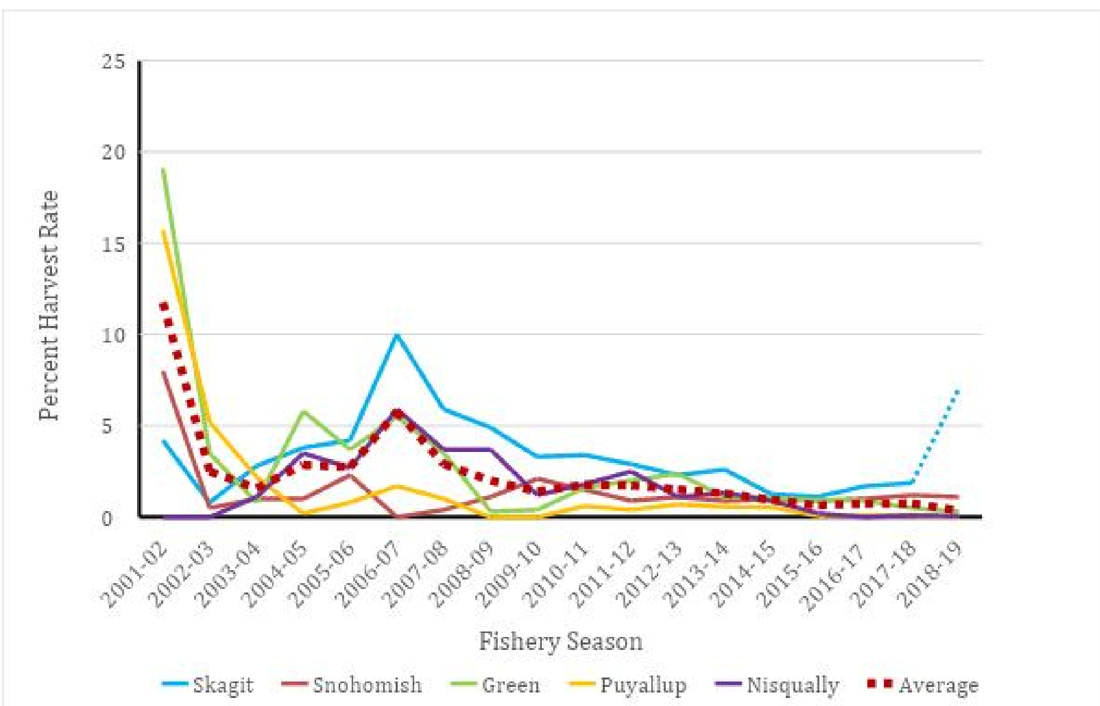

Figure 4. Tribal and non-tribal terminal harvest rate percentages on natural-origin steelhead for five index steelhead populations in Puget Sound 2001-2019. Dotted blue line represents post Skagit RMP harvest rates, which is a sliding scale regime based on pre-season terminal escapement estimates to the Skagit River. Dotted red line represents the average harvest rates across the five populations through 2017, and excludes Skagit for 2018 and 2019. Data from (WDFW & PSIT 2016, 2017, 2018, 2019).

OTHER MORTALITY FACTORS

Steelhead juveniles emigrating from tributaries draining to the Salish Sea face a host of potential predators. Pearson et al (2015) reviewed information related to avian and marine mammal species that may have influenced the decline in Puget Sound steelhead populations. Increases in the abundance of marine mammals, such as harbor seals (*Phoca vitulina*), or avian predators may be related to decreased juvenile steelhead survival (Moore *et al.* 2015); tag studies estimated the survival of wild steelhead from tributaries to the Pacific Ocean at only 16%. Berejikian et al. (2016) further implicated harbor seals as a factor in the poor survival of steelhead smolts in the Salish Sea. A mitigating factor in survival appears to be structures, such as the Hood Canal Floating Bridge, that delay migration and make steelhead smolts more susceptible to predation (Moore *et al.* 2010; Moore *et al.* 2013). Genetic fitness, tributary-specific freshwater effects, and distance traveled in the Salish Sea from tributary to ocean appear to be factors influences survival (Moore and Berejikian 2017). In addition, the introduction of freshwater piscivorous species (e.g. largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieu*), walleye (*Sander vitreus*), etc). may be limiting steelhead viability. Continued increases in the populations of predator species in conjunction with declines in other forage fishes may further reduce the survival of emigrating juvenile steelhead.

SPATIAL STRUCTURE AND DIVERSITY

Abundance and productivity are demographic characteristics of a population that determine its ability to persist into the foreseeable future. Spatial structure and diversity, the other two VSP parameters (McElhany *et al.* 2000), are characteristics that influence a population's ability to persist and evolve over a much longer time course. Spatial structure and diversity consider a population's identifying characteristics—such as utilization of habitat, distribution of spawning aggregations, genetic and phenotypic traits, life-history characteristics such as growth rate, frequency and phenology of reproduction (seasonal run and spawn timing), and age structure. Demographic risks due to low abundance and productivity are typically shorter-term considerations for viability. Spatial structure and diversity buffer a population against short term environmental fluctuations and longe- term climatic change. Compromised spatial structure and diversity are ultimately expressed as longer-term declines in abundance and productivity.

Diversity can be measured through a variety of life history trait metrics, for example: age structure, run timing, spawning. It is difficult, however, to interpret the significance of changes in life history traits under changing environmental conditions. Indeed, the responsiveness of life history traits to environmental change may be a measure of adequate diversity. It is also unclear if the apparent loss of a phenotype is merely an example of plasticity rather than the loss of the underlying genetic diversity. One of the few quantifiable risks to diversity is the loss of locally-adapted traits through introgression by non-native or domesticated hatchery-origin fish.

Abundance information provided for this update only included natural-origin spawners, so we were unable to calculate the contribution of hatchery-origin fish on the spawning grounds. Moreover, information on the proportion of hatchery-origin spawners (pHOS) is rarely obtained in steelhead spawning surveys due to the near absence of carcasses (to identify hatchery marks). In those basins where hatchery-production continues, the magnitude and origin of hatchery releases provides one indicator of the potential risks to diversity.

The Recovery Plan for Puget Sound Steelhead (NMFS 2019b) recognizes that production of hatchery fish of both run types—winter run and summer run—has posed a considerable risk to diversity in natural steelhead in the Puget Sound DPS. Because of the origin and aspects of the propagation history of these fish in Puget Sound, the TRT (Hard *et al.* 2015) considered continued hatchery production of steelhead to represent a major threat to the diversity VSP component for the DPS. Historically, the majority of winter-run broodstocks produced in hatcheries in the DPS were derived from the Chambers Creek stock (southern Puget Sound), which is considered highly domesticated and has been selected repeatedly for early spawn timing for decades, a trait known to be heritable in salmonids (the natural population is now extinct); alternatively, summer-run hatchery broodstock are derived from the long-running Skamania Hatchery stock from the lower Columbia River Basin (i.e., out-of-DPS origin). In response to the risk of introgression between native steelhead populations and hatchery-origin there has been a general decrease in the overall production from several hatcheries. In addition, Chambers Creek releases were discontinued in the Elwha and Skagit River basins during the last five-year period. Chambers Creek programs continue in the Dungeness, Nooksack, Stillaguamish, Snohomish, and Skykomish river basins. Integrated hatchery programs have emerged in place of many of the Chambers Creek programs, these programs incorporate naturally-produced returning adults as broodstocks. Programs are currently underway in the Elwha, Green, and White Rivers, It is planned to discontinue the release of Skamania Hatchery-origin summer run steelhead in the near future from the three programs currently operating. Additionally, there are plans to develop an integrated hatchery broodstock using local summer-run steelhead; currently the plan is to use unmarked summer-run fish returning to the South Fork Skykomish River. The genetic status of naturally returning summer run fish to the Skykomish River is currently being studied, and there will likely be new information forthcoming to better understand the level of legacy introgression by Skamania Hatchery summer run steelhead.

Overall, the risk posed by hatchery programs to naturally spawning populations has decreased during the last five years with reductions in production (especially with non-local programs) and the establishment of locally-sourced broodstock (Figures 107, 108, 109, 110). Unfortunately, whereas competition and predation by hatchery-origin fish can be readily diminished, it is unclear how long it will take to remove the genetic legacy of introgression by natural selection.

For spatial structure, the factors the TRT considered for influence on viability included fraction of suitable rearing and spawning habitat occupied by steelhead in the DPS (as measured by intrinsic potential, a measure of historical production or capacity based on the relationship between suitable habitat area and estimates of historical steelhead density).

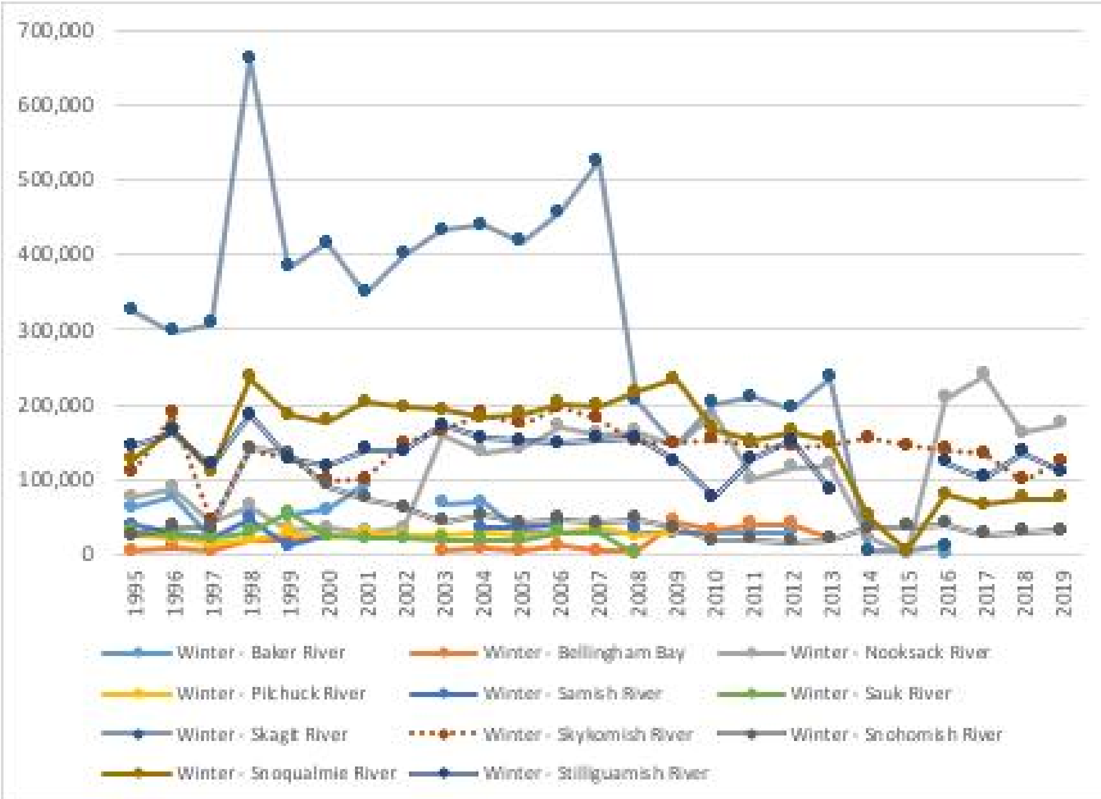

Figure 5. Releases of hatchery-reared winter-run steelhead into rivers in the North Cascades MPG. The majority of these releases are of hatchery stocks not native to the receiving watersheds. In addition, releases of fish weighing less than 2.0 grams were not included. Data from Regional Mark Information System (RMIS: https://www.rmis.org/) accessed 3 June 2020.

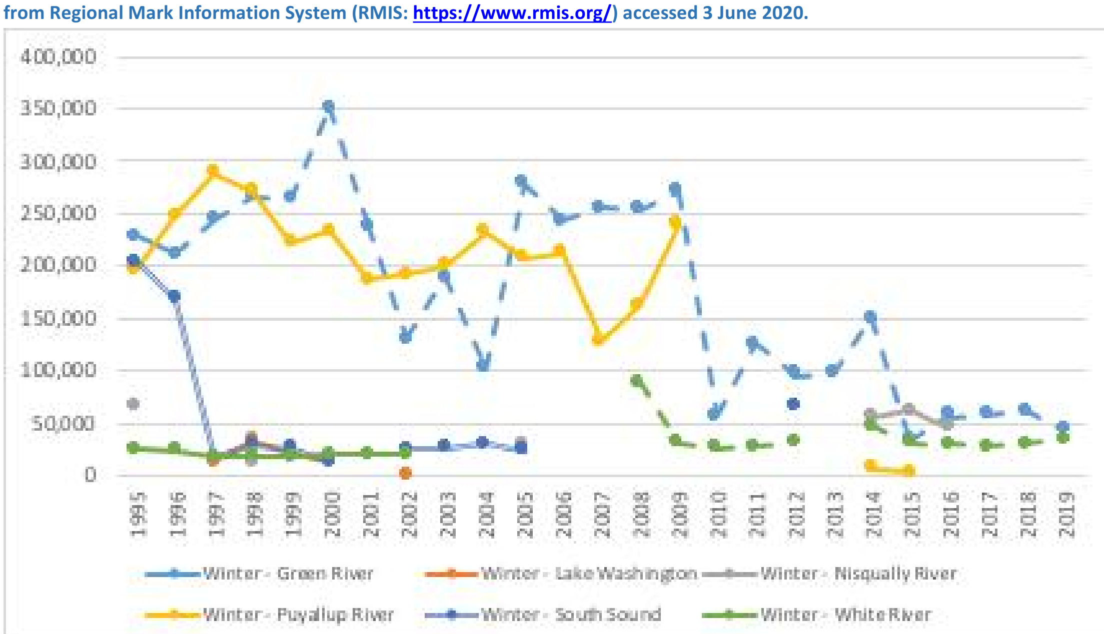

Figure 6. Hatchery releases of winter-run steelhead into rivers of the Central and South Puget Sound MPG from 1995 to 2019. Portions of lines that are dashed indicate that some or all of the fish released were native to that population. In addition, releases of fish weighing less than 2.0 grams were not included. Data from Regional Mark Information System (RMIS: https://www.rmis.org/) accessed 3 June 2020.

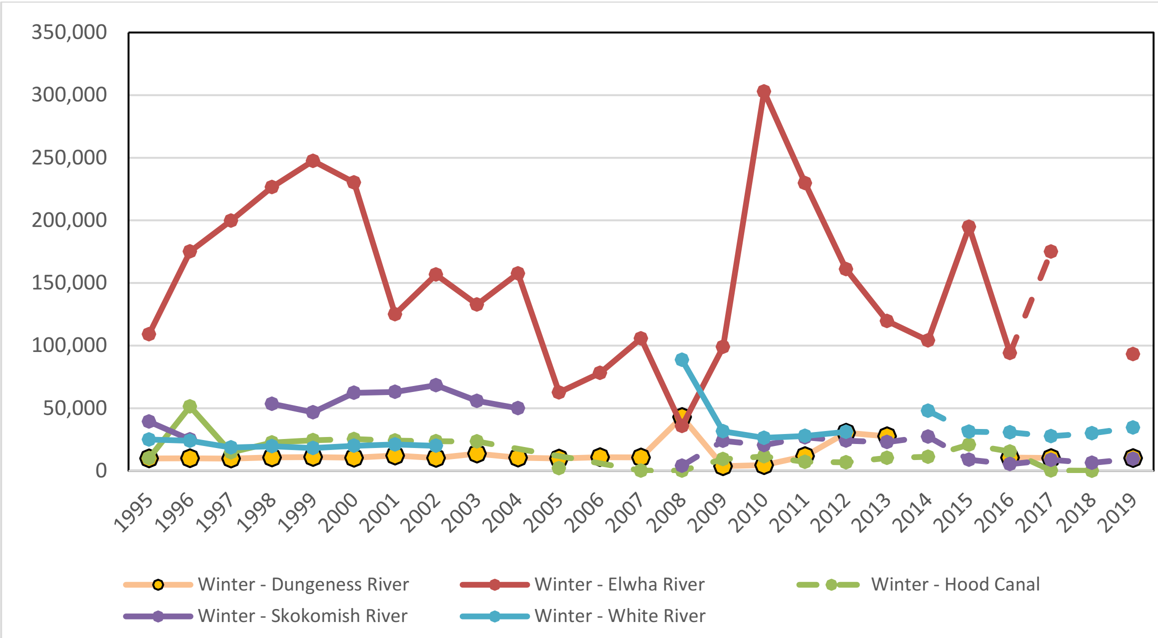

Figure 7. Hatchery releases of winter-run steelhead into rivers of the Hood Canal and Strait of Juan de Fuca MPG from 1995 to 2019. Portions of lines that are dashed indicate that some or all of the fish released were native to that population. In addition, releases of fish weighing less than 2.0 grams were not included. Data from Regional Mark Information System (RMIS: https://www.rmis.org/) accessed 3 June 2020.

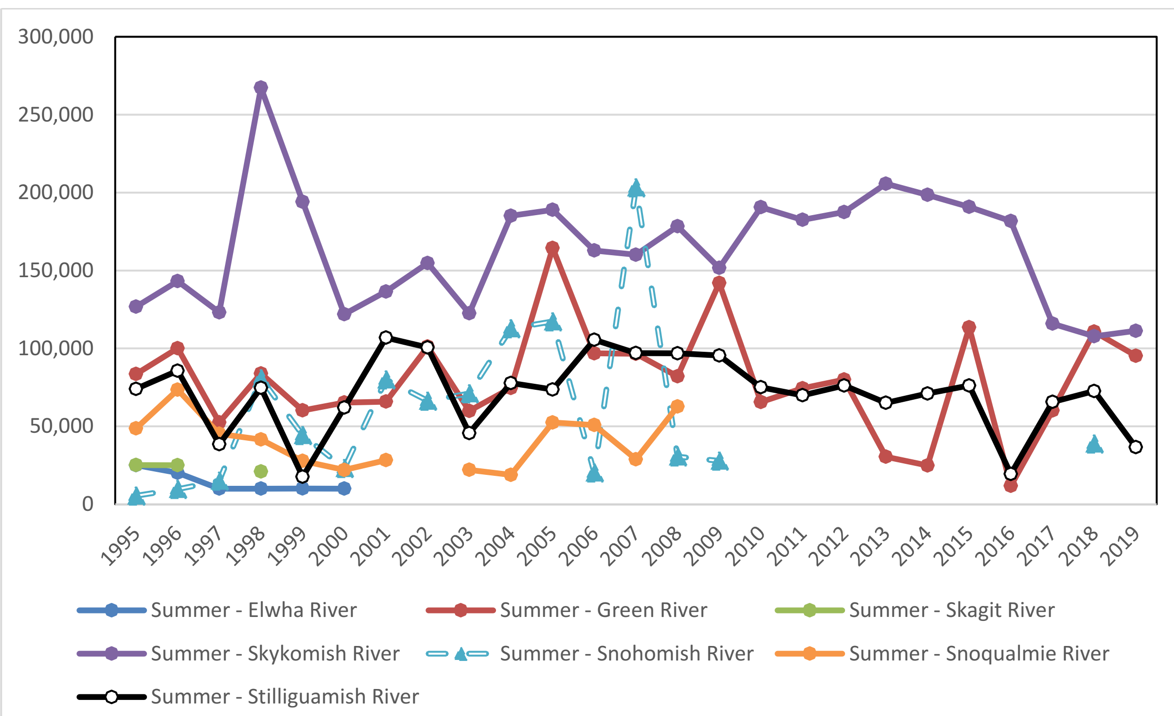

Figure 8. Hatchery releases of summer-run steelhead into Puget Sound DPS rivers from 1995 to 2019. All releases are from hatchery stocks that were founded by out-of-DPS Skamania Hatchery summer-run steelhead. Intermittent releases into other rivers are not shown. In addition, releases of fish weighing less than 2.0 grams were not included. Data from Regional Mark Information System (RMIS: https://www.rmis.org/) accessed 3 June 2020.

For spatial structure there were a number of events that occurred in Puget Sound during the last review period. While the completion of the Elwha and Glines Canyon dam removals in 2014, occurred during the previous period, the response of steelhead to this action is still being evaluated. It is clear; however, that steelhead are accessing much of this newly available habitat (Pess *et al.* 2020). Passage operations have begun on the North Fork Skokomish River to reintroduce steelhead above Cushman Dam, although juvenile collection efficiency is still relatively low further improvements are anticipated. Similarly, improvements in the adult fish collection facility at Mud Mountain Dam (White River) are near completion, with the expectation that improvements in adult survival will facilitate better utilization of habitat above the dam (NMFS 2014a). The recent removal of the diversion dam on the Middle Fork Nooksack Dam (16 July 2020) and the Pilchuck River Dam will provide access to important headwater spawning and rearing habitats. Similarly, the proposed modification of Howard Hanson Dam for upstream fish passage and downstream juvenile collection (NMFS 2019a) in the longer term will allow winter steelhead to return to historical headwater habitat in the Green River. It has been hypothesized that summer-run steelhead may have been residualized above Howard Hanson (Myers et al. 2015), restoring access could restore such a run. The effects of these two projects on abundances will not be evident for some time. Four of the top six steelhead populations identified by Cram et al. (2018) as having habitat blocked by major dams are in the process of having passage restored or improved. While fish passage/collection operations are currently underway in the Baker River for sockeye, coho, and Chinook salmon, returning steelhead are not currently transferred above the Baker River dams. In addition, projects focusing on smaller scale improvements in habitat quality and accessibility are ongoing. Some 8,000 culverts that block steelhead habitat have been identified in Puget Sound (NMFS 2019b), with plans to addressing these blockages being extended over many years. Smaller scale improvements in habitat, restoration of riparian habitat and reconnecting side- or off-channel habitats, will allow better access to habitat types and niche diversification. While there have been some significant improvements in spatial structure, it is recognized that land development, loss of riparian and forest habitat, loss of wetlands, demands on water allocation all continue to degrade the quantity and quality of available fish habitat.

BIOLOGICAL STATUS RELATIVE TO RECOVERY GOALS

The Puget Sound Steelhead Recovery Team was established by NOAA Fisheries and convened in March 2014 to develop a Recovery Plan for the Puget Sound Steelhead DPS. This Recovery Plan was finalized in December 2019 (NMFS 2019b). Recovery targets were calculated using a two-tiered approach adjusting for years of low and high productivity. Abundance information is unavailable for approximately one-third of the DIPs, disproportionately so for summer-run populations. In most cases where no information is available it is assumed that abundances are very low. Some population abundance estimates are only representative of part of the population (index reaches, etc). Where recent five-year abundance information is available, the 30% (6/20) at less than 10% of their High Productivity Recovery Targets (lower abundance target), 65% (13/20) are 10%<x,50%, and 5% (1/20) are 50%<x<100% (Table 55). Although most populations for which data is available experienced an improvement in abundance during the last five years (Figure 104), significant increases in abundance are necessary for all populations to reach even the High Productivity (low abundance) Recovery Targets. A key element to achieving recovery is recovering a representative number of both winter- and summer-run steelhead populations, and the restoration of viable summer-run DIPs would appear to be a long-term endeavor. Alternatively, the relatively rapid reestablishment of summer-run steelhead in the Elwha River does provide a model for potentially reanadromizing summer-run steelhead residualized behind impassable dams. Another diversity element factored into achieving recovery is the proportion of hatchery-origin fish that spawn naturally. Currently, the standard for the proportion of non-native hatchery-origin fish on naturally spawning grounds is 5%.

Table 3. Recent (2015-2019)5-year geometric mean of raw wild spawner counts for Puget Sound steelhead populations and population groups compared with Puget Sound Steelhead Recovery Plan high and low productivity recovery targets (NMFS 2019). (SR) – Summer run. An "*" indicates that the abundance is only a partial population estimate. Abundance is compared to the high productivity individual DIP targets. Colors indicate the relative proportion of the recovery target currently obtained: red (<10%), orange (10%>x<50%), yellow (50%>x<100%), green (>100%).

Major Population Group	Demographically Independent Population	Recent Abundance 2015-2019	Recovery Target High Productivity	Recovery Target Low Productivity
Northern Cascades	Drayton Harbor Tributaries	NA	1,100	3,700
	Nooksack River	1,906	6,500	21,700
	South Fork Nooksack River (SR)	NA	400	1,300
	Samish River & Independent Tributaries	1,305*	1,800	6,100
	Skagit River	7,181*	15,000	
	Sauk River	[1]		
	Nookachamps River	[1]		
	Baker River	NA		
	Stillaguamish River	487*	7,000	23,400
	Canyon Creek (SR)	NA	100	400
	Deer Creek (SR)	NA	700	2,300
	Snohomish/Skykomish River	690	6,100	20,600
	Pilchuck River	638	2,500	8,200

	Snoqualmie River	500	3,400	11,400
	Tolt River (SR)	40*	300	1,200
	North Fork Skykomish River (SR)	NA	200	500
Central and South Sound	Cedar River	<10*	1,200	4,000
	North Lake Washington Tributaries	NA	4,800	16,000
	Green River	1,282	5,600	18,700
	Puyallup Carbon River	136* 735*	4,500	15,100
	White River	451	3,600	12,000
	Nisqually River	1,368	6,100	20,500
	East Kitsap Tributaries	NA	2,600	8,700
	South Sound Tributaries	NA	6,300	21,200
Strait of Juan de Fuca	East Hood Canal Tributaries	93*	1,800	6,200
	South Hood Canal Tributaries	91	2,100	7,100
	Skokomish River	958	2,200	7,300
	West Hood Canal Tributaries	150*	2,500	8,400
	Sequim and Discovery Bay Tributaries	NA	500	1,700
	Dungeness River	408	1,200	4,100

	Strait of Juan de Fuca Independent Tributaries	95*	1,000	3,300
	Elwha River	1,241	2,619	

UPDATED BIOLOGICAL RISK SUMMARY

Consideration of the above analyses indicates that the biological risks faced by the Puget Sound Steelhead DPS have improved somewhat since the Puget Sound Steelhead TRT concluded that the DPS was at very low viability, as were all three of its constituent MPGs, and many of its 32 DIPs (Hard *et al.* 2015). Increases in spawner abundance were observed in a number of populations over the last five years (Figure 104). These improvements were disproportionately found within the South and Central Puget Sound and Strait of Juan de Fuca and Hood Canal MPGs, and primarily among smaller populations. The apparent reversal of strongly negative trends among winter run populations in the White, Nisqually, and Skokomish rivers abated somewhat the demographic risks facing those populations. Certainly, improvement in the status of the Elwha River steelhead (winter and summer run) following the removal of the Elwha dams reduced the demographic and diversity risk for the DIP and MPG. Improvements in abundance were not as widely observed in the Northern Puget Sound MPG. Foremost among the declines were summer and winter run populations in the Snohomish Basin. These populations figure prominently as sources of abundance for the MPG and DPS. Additionally, the decline in the Tolt River summer-run steelhead population was especially of concern given that it is the only population for which we have abundance estimates. The demographic and diversity risks to the Tolt River summer-run DIP are very high. In fact, all summer run steelhead populations in the North Cascades MPG are likely at a very high demographic risk. In spite of improvements in some areas, most populations are still at relatively low abundance levels, with about a third of the DIPs unmonitored and presumably at very low levels.

Continued limits on harvest will facilitate population rebuilding during “good” years and buffer against demographic risks under “bad” years. Artificial propagation programs have undergone major changes in both the quantity and quality of hatchery fish produced. The propoed termination of the non-native Skamania Hatchery origin summer-run steelhead programs represents a major effort to reduce introgression, although the genetic legacy of past hatchery releases remains to be determined. The release of the domesticated Chambers Creek hatchery-origin winter steelhead continues in a limited number of basins. More importantly, integrated programs with locally-sourced broodstocks have been established to assist in recovery. Risks to diversity from hatchery programs continue, but at a reduced level. Furthermore, self-sustaining natural populations of winter-run steelhead persist throughout the Puget Sound DPS, albeit at low abundances, and with a very limited risk of interaction with hatchery-origin steelhead. Overall, the status of summer-run steelhead populations, or the summer-run component of summer/winter populations remains somewhat precarious. For many populations information is absent, and with possible exception of the Elwha River, the remaining populations have critically low abundances and/or varying levels of genetic introgression by out-of-DPS sources. There are a number of planned, ongoing, and completed events that will likely benefit steelhead populations in the future, but have not yet effected changes in adult abundance. Among these, the removal of the diversion dam on the Middle Fork Nooksack River, passage improvements at Mud Mountain Dam, the ongoing passage program in the North Fork Skokomish River, and the planned passage program at Howard Hansen Dam. Dam removal in the Elwha River, and the resurgence of the endemic winter and summer-run steelhead runs have underscored the benefits of restoring passage. The Elwha River scenario is perhaps somewhat unique in that upstream habitat is in pristine condition and smolts emigrate into the Strait of Juan de Fuca and not Puget Sound or Hood Canal. Improvements in spatial structure can only be effective if done in concert with necessary improvements in habitat. Habitat restoration efforts are ongoing, but land development and habitat degradation concurrent with increasing human population in the Puget Sound corridor may results in a continuing net loss of habitat. Recovery efforts in conjunction with improved ocean and climatic conditions have resulted in improved status for the majority of populations in this DPS; however, absolute abundances are still low, especially summer-run populations, and the DPS remains at high to moderate risk.