# SOUTHERN RESIDENT KILLER WHALE PRIORITY CHINOOK STOCKS REPORT

NOAA Fisheries West Coast Region

and

Washington Department of Fish and Wildlife

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# SOUTHERN RESIDENT KILLER WHALE PRIORITY CHINOOK STOCKS

## Outline of Prey Prioritization Conceptual Model

NOAA Fisheries and Washington Department of Fish and Wildlife (WDFW) have developed a framework to identify Chinook salmon stocks that are important to Southern Resident killer whales (SRKW) to assist in prioritizing actions to increase critical prey for the whales. The framework currently includes three factors that contribute to the identification of priority Chinook salmon populations. Note, here "population" could mean management unit, stock, ESU, run, etc. Each of the three factors has a range of scores which affects its weight. For each Chinook population ranging from Southeastern Alaska to California, a total score is calculated by adding up the three individual factor scores. The Chinook salmon populations with the highest total scores are considered the highest priority to increase abundance to benefit the whales. Several sensitivity analyses provided initial help in understanding how the weighting/scoring affects the priority list. The conceptual model, factors, and scoring were reviewed at a workshop sponsored by the National Fish and Wildlife Foundation and modifications were made to incorporate feedback from participants. The factors, scoring and priority list can be adapted as new scientific information becomes available.

The three evaluation factors include:

### FACTOR 1- Observed Part of SRKW Diet

Description and data sources: Prey tissues/scales and fecal samples have been collected from 2004 – present (Hanson et al. 2010, Ford et al. 2016, Hanson et al. in prep). From the prey tissues/scales collected, Genetic Stock Identification (GSI) were run to identify the Chinook stocks in the diet. The majority of samples have been collected in the summer months in inland waters of WA and British Columbia.

<u>Assumption</u>

- Chinook populations that have been observed in the diet will have higher priority than those that have not.

***Caveat***: There is currently no spatial correction factor for sample collection (stocks originating from near the sample locations are more likely to be collected), no correction factor for abundance (more abundant stocks are more likely to be identified in the diet), and no correction factor for potential whale selectivity (older, larger fish more likely to be recovered in scale samples).

**FACTOR 2- Consumed During Reduced Body Condition or Diversified SRKW Diet**

Description and data sources: For the second factor, "Consumed During Reduced Body Condition or Diverse Diet", stocks consumed during times of potential reduced body condition and increased diet diversity receive additional weight.

Since 2008, NOAA's SWFSC has used aerial photogrammetry to assess the body condition and health of SRKWs, initially in collaboration with the Center for Whale Research and, more recently, with the Vancouver Aquarium and $SR^3$. Photogrammetry data has been collected during seven field efforts in five years, including September 2008, 2013, and 2015, and May and September 2016 and 2017 (Durban et al. 2017; Fearnbach et al. 2018). The proportion of Chinook salmon consumed in whales' diet was estimated by season and region (inland vs coastal waters) using the data from prey tissues/scales and fecal samples (Hanson et al. 2010, Ford et al. 2016, Hanson et al. in prep).

Assumptions

- Reduced body condition and diverse diet occurs from Oct through May.
- Whales switch from preferred prey, Chinook salmon, to other salmonids or prey when Chinook are less available.

**FACTOR 3- Degree of Spatial and Temporal Overlap**

Description and data sources: Recent prey mapping from Shelton et al. in press (Coded Wire Tag data) was used to assess the overlap in time and space distribution of individual fall Chinook salmon stocks and SRKWs. The distribution/timing of all Chinook salmon stocks across the whales' range from California to Southwest Vancouver Island (and the inland waters of the Salish Sea) was divided into weighted spatial/temporal areas. Currently, Shelton et al. in press includes detailed information on fall runs. Available data for spring Chinook was included, but detailed analyses of data from spring runs are in progress and will be completed in the next two years, incorporating both recoveries in directed Chinook troll fisheries, and Chinook recovered as bycatch in fisheries not targeting Chinook.

For spring run Chinook we relied on reports from the Chinook Technical Committee of the Pacific Salmon Commission (PSC 2018a, 2018b) and published literature (e.g. Satterthwaite et al. 2013, Wahle et al. 1981, Weitkamp 2010) to assign approximate ocean distributions. For stocks with less information, we assumed that the risk to predation was low in seasons and regions that did not correspond to the return timing and origin of each stock (for example, Columbia spring Chinook are assumed to be most available to whales in winter and spring months near the mouth of the Columbia River, but because of their approximate ocean distribution, they are not available in other regions or seasons – particularly mid-summer to fall). Because of limited recoveries, we also assumed that for stocks returning to the Salish Sea

(Strait of Georgia, Puget Sound), the distribution was similar in the Salish Sea to Southwest Vancouver Island distributions.

The spatial/temporal Areas currently include: 1) Southwest Vancouver Island (WCVI); 2) Salish Sea; 3) Cape Falcon, Oregon north to British Columbia border; 4) Cape Falcon, OR south to Cape Mendocino (northern California); 5) Cape Mendocino, CA to Point Sur, CA. Seasons are defined as: Spring: April-May; Summer: June-July; Fall: Aug-Oct: Winter: November-March. These areas reflect the division of Chinook run timing (approximately), correspond to periods of coded wire tag recoveries in fisheries, and correspond to predictable patterns of SRKW movement. SRKW distribution data was assessed from multiple sources (e.g. Center for Whale Research, The Whale Museum, NWFSC satellite tagging, NWFSC coastal hydrophones, coastal spring/winter NWFSC cruises, other opportunistic observations).

Assumptions

- Chinook salmon stocks that overlap in space and time are potential prey.
- Chinook salmon stocks that have a higher degree of overlap in space and time have a higher priority than stocks that have a relatively lower degree of overlap.
- Weighted spatial/temporal areas accommodate variation in the distribution of SRKW and Chinook salmon

***Caveat***- Coded Wire Tag (CWT) model interpolates movement of stocks seasonally to account for gaps in fishing effort. Also, the hatchery releases going into the CWT model are not comprehensive, but rather model the distribution of major stock groupings. Within regions and run type (e.g. fall Puget Sound), the ocean distribution is assumed to be the same for all watersheds. Smaller release groups, such as those from the San Juan Islands (SJUA in RMIS) were not included in Shelton et al. because of the low recovery rates – though the ocean distribution of these fish is assumed to be similar to those populations originating from Puget Sound. In particular, ocean distributions of spring run stocks tend to be less well understood than fall stocks. We use the best information available but acknowledge that advances in estimates of ocean distribution of many stocks will improve with the completion of on-going research over the course of the next 1-3 years.

**Weight and Scoring**

FACTOR 1

If the Chinook stock was observed >=5% of the whales diet in summer or fall/winter/spring, the stock receives 1 point. If it was not observed in the diet, the stock receives 0 points. This prioritizes stocks observed in the diet compared to those that have not been observed.

FACTOR 2

Current data indicate that both reduced body condition and a diversified diet occur in non-summer months. If a stock is consumed during October through May, it receives 1 point. If it is consumed during June through September, the stock receives 0 points. This prioritizes stocks that are consumed during periods with a higher likelihood of food limitation or stress in the whales' health.

FACTOR 3

For each space/time area described above, if more than 25% of the Chinook stock is distributed in that area, the area receives a sub-score of 2. For areas that contain between 5% and 25% of the Chinook stock, the area receives a sub-score of 1. If an area contains less than 5% of the Chinook stock, it receives a sub-score of 0. The sub-scores for each area are multiplied by an importance weight for each area. The final score for the Chinook stock/population is the sum of the products of the scores and weight for each area normalized such that the highest possible score of a given stock is equal to 3.

Here are the seven space/time combinations included in Factor 3 and their associated weights.

1. WA coast in Winter/Spring; weight = 0.5
2. WA coast in Summer/Fall; weight = 0.5
3. Salish Sea in Winter/Spring; weight = 0.5
4. Salish Sea in Summer/Fall; weight = 0.5
5. OR / N.CA coast in Winter/Spring; weight = 0.25
6. CA coast in Winter/Spring ; weight = 0.25
7. West Coast of Vancouver Island in Winter/Spring; weight = 0.5

The Salish Sea and coastal waters off WA have a 0.5 weight. The areas off British Columbia, OR/North CA and CA have a 0.25 weight. This structure means that the areas of highest SRKW use – the Salish Sea and coastal WA – are treated as twice as important as the other areas.

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## Priority Chinook Stocks Using Conceptual Model

| ESU / Stock Group | Run Type | Rivers or Stocks in Group | Diet Contribution Score (0,1) | Killer Whale Reduced Body Condition or Diverse Diet Score (0,1) | Spatio-Temporal Overlap Score (0 - 3) | |
|---|---|---|---|---|---|---|
| | | | Avg. Factor 1 (see note) | Avg. Factor 2 (see note) | Avg. Factor 3 | Total Score (sum of factors) |
| Northern Puget Sound | Fall | Nooksack, Elwha, Dungeness, Skagit, Stillaguamish, Snohomish | 1 | 1 | 3.00 | 5.00 |
| Southern Puget Sound | Fall | Nisqually, Puyallup, Green, Duwamish, Deschutes, Hood Canal systems | 1 | 1 | 3.00 | 5.00 |
| Lower Columbia | Fall | Fall Tules and Fall Brights (Cowlitz, Kalama, Clackamas, Lewis, others) | 1 | 1 | 2.63 | 4.63 |
| Strait of Georgia | Fall | Lower Strait (Cowichan, Nanaimo), Upper Strait (Klinaklini, Wakeman, others), Fraser (Harrison) | 1 | 1 | 2.63 | 4.63 |
| Upper Columbia & Snake Fall | Fall | Upriver Brights | 1 | 1 | 2.25 | 4.25 |
| Fraser | Spring | Spring 1.3 (upper Pitt, Birkenhead; Mid & Upper Fraser; North and South Thompson) and Spring 1.2 (Lower Thompson, Louis Creek, Bessette Creek) | 1 | 1 | 2.25 | 4.25 |
| Lower Columbia | Spring | Lewis, Cowlitz, Kalama, Big White Salmon | 1 | 1 | 2.25 | 4.25 |
| Middle Columbia | Fall | Fall Brights | 1 | 1 | 2.06 | 4.06 |
| Snake River | Spring-Summer | Snake, Salmon, Clearwater | 1 | 1 | 1.88 | 3.88 |
| Northern Puget Sound | Spring | Nooksack, Elwha, Dungeness, Skagit (Stillaguamish, Snohomish) | 1 | 1 | 1.88 | 3.88 |
| Washington Coast | Spring | Hoh, Queets, Quillayute, Grays Harbor | 1 | 1 | 1.69 | 3.69 |
| Washington Coast | Fall | Hoh, Queets, Quillayute, Grays Harbor | 1 | 1 | 1.69 | 3.69 |
| Central Valley | Spring | Sacramento and tributaries | 1 | 1 | 1.50 | 3.50 |
| Middle & Upper Columbia Spring | Spring | Columbia, Yakima, Wenatchee, Methow, Okanagan | 1 | 1 | 1.31 | 3.31 |
| Middle & Upper Columbia Summers | Summer | | 1 | 1 | 1.31 | 3.31 |

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|---|---|---|---|---|---|---|
| Fraser | Summer | Summer 0.3 (South Thompson & lower Fraser; Shuswap, Adams, Little River, S. Thompson mainstem, Maria Slough in Lower Fraser) and Summer 1.3 (Nechako, Chilko, Quesnel; Clearwater River in North Thompson) | 1 | 0 | 1.88 | 2.88 |
| Central Valley | Fall and Late Fall | Sacramento, San Joaquin | 1 | 1 | 0.75 | 2.75 |
| Klamath River | Fall | Upper Klamath and Trinity | 1 | 1 | 0.75 | 2.75 |
| Klamath River | Spring | Upper Klamath and Trinity | 1 | 1 | 0.75 | 2.75 |
| Upper Willamette | Spring | Willamette | 0 | 0 | 2.25 | 2.25 |
| Southern Puget Sound | Spring | Nisqually, Puyallup, Green, Duwamish, Deschutes, Hood Canal systems | 0 | 0 | 1.88 | 1.88 |
| Central Valley | Winter | Sacramento and tributaries | 0 | 0 | 1.50 | 1.50 |
| North & Central Oregon Coast | Fall | Northern (Siuslaw, Nehalem, Siletz) and Central (Coos, Elk, Coquille, Umpqua) | 0 | 0 | 1.41 | 1.41 |
| West Coast Vancouver Island | Fall | Robsertson Creek, WCVI Wild | 1 | 0 | 0.38 | 1.38 |
| Southern Oregon & Northern California Coastal | Fall | Rogue, Chetco, Smith, lower Klamath | 0 | 0 | 0.75 | 0.75 |
| Southern Oregon & Northern California Coastal | Spring | Rogue | 0 | 0 | 0.75 | 0.75 |
| California Coastal | Fall | Mad, Eel, Russian | 0 | 0 | 0.75 | 0.75 |
| California Coastal | Spring | Mad, Eel, Russian | 0 | 0 | 0.75 | 0.75 |
| Southeastern Alaska | Spring | Taku, Situk, Chilkat, Chickamin, Unuk, Alsek, Stikine | 0 | 0 | 0.00 | 0.00 |
| Northern BC | Spring | Yakoun, Skeena, Nass | 0 | 0 | 0.00 | 0.00 |
| Central BC | mostly Summer | Atnarko, Dean River, Rivers Inlet | 0 | 0 | 0.00 | 0.00 |
| | | | | | | |

Note: Factor 1 and 2 are not literal averages. If a major component of the rivers in the ESU / Stock group had 1 then this was scored a 1. If no major component was scored a 1, this was scored a 0