Southern Resident Killer Whale Task Force Meeting #3:
Discussion Guide – Prey (Hydro, Habitat, Forage Fish)

The Prey Working Group met on June 25 and July 25, 2018 and identified the following potential actions for **Hydro, Habitat, and Forage Fish** that are presented here for discussion and consideration by the Task Force. Recommended draft actions for Hatchery, Harvest, and Predation are covered in a separate discussion guide. The Working Group evaluated the effectiveness, affordability, and ease of implementation for each action. Appendix A (Considerations Matrices For Evaluating Potential Actions) produced during the Prey working group meeting provides more detail on these actions.

This document is intended to help summarize discussions and potential actions that were discussed at the WG meeting. This document presents some key issues for discussion and consideration so the Task Force may begin to select actions to move forward and to provide further direction to the Working Group. Any comments to improve accuracy of issues discussed or the WG conversation are welcomed.

These actions are NOT in order of priority.

QUESTIONS FOR THE TASK FORCE

For each issue below, please discuss and reply to the following questions:

- Would you like this action to be considered as a Task Force recommendation?
- What questions do you have about this potential action?
- Do you have suggested revisions or clarifications to this action?

HYDROPOWER

Dams can block or impede fish passage, slow the migration rate of juveniles, and alter riverine ecosystems and their function, which negatively affects salmon survival. In the Columbia-Snake river system, juvenile salmon in particular can have a difficult time passing to downstream habitat on their outmigration to the sea. When the current draws juvenile fish into the dam's turbines, fish can be injured or killed when they strike the turbine blades or concrete walls, or implode from the intense pressure generated from falling and spinning water in the turbines. With many fish needing to pass multiple dams (up to nine in the Columbia-Snake system) on their way to the sea, the likelihood of injury or death can be quite high. Even where juvenile fish passage has been improved with new passage technologies and "fish friendly" water and dam management practices, the cumulative toll of passing multiple dams may remain significant. Some dams—some hydro and some not—have no fish passage at all. Dams can be retrofitted to include structural features that help juvenile and adult fish pass through the dam without injury or death. Dams can also be operated to minimize impact on migrating fish. For juveniles, physical changes at dams including bypass chute systems, spillway weirs making it easier for fish to find the entrance to the spillway, surface collectors behind high-head dams, and new turbine designs that are more efficient and fish-friendly, can all help improve survival rates. Adults migration benefits from fish ladders (or multiple fish ladders at large dams), or "trap and haul" facilities at high head dams where regular fish ladders may be infeasible.

The hydroelectric dams (both federal and non-federal) on the Columbia and Snake rivers were a major factor in the listing of 13 stocks of Columbia salmon and steelhead under the Endangered Species Act (ESA) in the 1990s, and continue to be a factor in depressing spring Chinook and other Columbia Basin salmon and steelhead populations. Thanks to improved dam operations and off-site habitat mitigation, some of these listed populations, such as mid-Columbia River steelhead and Snake River fall Chinook, have begun to rebound (but not yet to the point of de-listing), while others, such as upper Columbia spring Chinook and Snake River spring/summer Chinook, remain well below ESA de-listing goals. But even depressed and at risk stocks have responded to some to degree to improved hydrosystem operations (such as increased "spill" over the dams, sometimes over innovative passage routes like adjustable spillway weirs) and tributary and estuary habitat restoration.

The efficacy and trade-offs involved with large-scale changes to dam operations and/or configuration (up to and including lower Snake River dam removal) has been debated among co-managers and stakeholders for decades. The most optimistic assessment of the power of these changes comes from the Comparative Survival Study (CSS). The CSS is a joint project of the Fish Passage Center, Washington, Oregon, and Idaho Fish and Wildlife/Game departments, and the Columbia River Inter-Tribal Fish Commission. The CSS model predicts that high levels of spill (to 125% Total Dissolved Gas) could allow Snake River spring Chinook to approach the Northwest Power and Conservation Council's goal of 4% smolt-to-adult return ratios (SARs), which would allow for relatively rapid recovery compared to current SARs, which are averaging below 1% over the last 20 years. 2% SARs are needed for stable populations, above 2% is needed for population growth. Similarly, the CSS projects that upper Columbia spring chinook would benefit from higher spill levels. The CSS model predicts that lower Snake River dam removal plus high levels of spill at the lower Columbia River dams could result in SARs approaching 6% for Snake River spring chinook, which could triple existing returns on average. NOAA Fisheries' COMPASS model also has examined the effects of increased spill. COMPASS suggests lower levels of benefit with additional spill, and higher risk, due to different assumptions than CSS about "delayed mortality" effects of downstream dam passage as well as greater concern about unintended consequences of higher spill levels such as gas bubble trauma in juveniles and less efficient upstream passage for adult salmon.

Dam removal has been shown to benefit salmon. Within a few months of the removal of the Elwha Dam in northeast Washington, wild and hatchery salmon were using the mainstem and tributaries of the Elwha River; these included 4,000 spawning Chinook in the first season following dam removal. Depending on the type of dam, dam removal can also improve spawning and rearing habitat by flushing or removing existing siltation and preventing future siltation from occurring. It can also support healthy downstream habitat as small rocks, nutrients, and debris are no longer inhibited by the dam. Fish migration survival rates are improved due to safer and faster migrations, and the temperature of the water released from a dam may be cooler downstream once the reservoir no longer exists.

Dam removal, especially of larger facilities, can be a long and cost-intensive process, and the outcomes can vary depending on the river system. As part of a larger study of Columbia and Snake River salmon management alternatives, a National Environmental Protection Act environmental review process is currently underway to examine dam removal against other alternatives on the lower Snake River. A cost-benefit analysis of potential dam removals in the Pacific Northwest does not currently exist, and would aid in the prioritization of potential removal of both large and small dams in terms of their effectiveness for SRKW recovery. This type of analysis could prioritize dams for removal that most benefit Chinook salmon and SRKW, and could address stakeholder perspectives and policy trade-offs, including an assessment of climate change benefits from protecting existing hydropower dams.

The Prey Working Group suggests two potential hydro actions for the Task Force to consider:

Action A: Recommend that Ecology adjust gas caps (match or exceed OR's gas caps) on the Snake and Columbia rivers to allow flexibility to adjust spill regimes, as needed, to benefit Chinook salmon and other salmonids.
Ecology sets limits on the dissolved oxygen (gas) levels in water as it spills over dams. Washington has lower caps than Oregon. If more water is spilled over dams, the gas caps will be exceeded. If Ecology raised the limits similar to Oregon, additional spill could be considered.

Action B: Regional partners review, and where appropriate, revise standards for juvenile survival in rivers associated with dams
Standards for juvenile salmon survival are set by salmon and dam managers for each dam system (federal dams and non-federal dams have different processes for formulating their operation plans; non-federal dams require a license from the Federal Energy Regulatory Commission, while federal dams operations are determined by the agency, such as the Army Corps of Engineers or Bureau of Reclamation, that owns the dam, often in consultation with federal and state natural resource agencies and tribes). Dams are required to adjust their operations if they are not meeting the standards. Revised standards can require increased survival levels for salmonids.

Action C: Increase survival at predation hot spots near dams
Chinook survival near dams and through river systems with multiple dams could be increased through such actions as deterring birds, changing the flows to promote safer salmon passage and suppress non-native or predatory fish populations on-site, and other programs to reduce unnatural levels of predation (other predation actions are in the Predation section).

Action D: Where it helps provide safer passage, improve fish screens to eliminate entrainment in water diversions at dams. Consolidate and reduce water diversions to reduce risks to salmon
Where necessary, dam turbine and water diversion intakes can be screened to avoid "entraining" juvenile or adult salmon. There are also opportunities to reduce water diversions at irrigation dams through irrigation efficiency programs and curtailing extra diversions for hydropower production that could come from other energy sources (e.g., the power subordination called for at Roza Dam as part of the Yakima Basin Integrated Plan). And where water diversions are not reduced, there may be opportunities to divert water for multiple water users at one consolidated water diversion dam rather than several different one (e.g., a project currently underway at Nelson Dam on the Naches River in the Yakima Basin).

Action E: Prioritize and fund re-establishment of runs into currently blocked areas above dams in those areas that can successfully produce more salmon.
State and federal funding for re-establishing – or investigating the feasibility of re-establishing -- salmon runs above dams that block salmon passage could be increased. Examples include a process currently underway to investigate the feasibility of reintroducing salmon above Chief Joseph and Grand Coulee dams on the Columbia River, providing fish passage at Yakima Basin irrigation storage dams that currently block salmon (currently underway at Cle Elum Dam on the Cle Elum River), and completing juvenile passage at Howard Hanson Dam on the Green River (adult passage facilities are already constructed there).

Action F: Remove dams in locations that most benefit Chinook passage
Removal of dams (hydroelectric or others) that will most benefit priority Chinook stocks could be considered. This action could be small (small dams that no longer serve their intended purpose) or large (larger dam or a collection of dams that may still be functioning but are critically important to Chinook).

Summary of Hydropower Actions

Action	E	A	I	Timeline for SRKW Benefits	Supporting and Dissenting Opinions on Ratings (if applicable)	Geographic Specificity Progress	Notes
Action A. *Recommend that Ecology adjust gas caps (match or exceed OR's gas caps) on the Snake and Columbia rivers to allow flexibility to adjust spill regimes, as needed, to benefit Chinook salmon and other salmonids.*	H	M	H	Intermediate	Supporting: • Increased spill leads to increased survival rates of migrating fish. • Even if funds are reallocated away from habitat etc. due to increases in spill, the action has the potential to result in such an improvement to the number of fish successfully migrating that it would be overwhelmingly worth it. Also, other funding sources could be sought to replace those lost. • NEPA process is too slow to benefit the SRKW when they most need it. Dissenting: • Disagreement on science about impacts of increased spill. Dueling models for how much more benefit additional spill provides—more light will hopefully be shed via NEPA over	Applies to Columbia/Snake but could be elsewhere statewide	• Affordability depends on how much is spilled and when (spilling to 125% 24 hours a day would be relatively less affordable, but other amounts of spill, or flexible spill regimes could be medium or high affordability) • Spill regime and gas cap not inextricably linked – TF could recommend changing gas caps without changing spill regimes, which would allow flexibility to use the best available science to decide how much spill is beneficial at specific dams/systems, years, etc. • Barging of fish beyond dams may be a related action that will allow for greater survival of fish under certain dry year conditions.

Action	E	A	I	Timeline for SRKW Benefits	Supporting and Dissenting Opinions on Ratings (if applicable)	Geographic Specificity Progress	Notes
					next 3 years, as well as potential new dam operations during that period. • Increased cost of changes in spill management could reallocate funding currently going to habitat improvements or hatcheries		
Action B. *Regional partners review, and where appropriate, revise standards for juvenile survival in rivers associated with dams*	M	M	L	Intermediate		Applies Statewide	
Action C. *Increase survival at predation hot spots near dams*	M	M	L	Intermediate		Applies Statewide	• Affordability may vary by specific action: reservoir management could be expensive
Action D. *Where it helps provide safer passage, improve fish screens to eliminate entrainment in water diversions at dams. Consolidate and reduce water diversions to reduce risks to salmon*	L	H	H	Intermediate		Applies Statewide	• Opportunity for incremental improvement in relatively small number of rivers
Action E. *Prioritize and fund re-establishment of runs into currently blocked areas above dams in those areas that can successfully produce more salmon.*	H	L	L	Intermediate		See Hydro Action E Matrix for discussion of ongoing and future options	• Effectiveness is variable, depending on location • High affordability and ease of implementation for trap and haul, with variable and uncertain results in terms of fish populations it would restore. Volitional passage is more expensive at some dams (prohibitively so in some cases) and more difficult to implement.
Action F. *Remove dams in locations that most benefit Chinook passage*	H	L	L	Intermediate	• Variable affordability, efficacy, depending on location • Consider SRKW chinook in proposals for new dams • No new dams doesn't account for potential climate change impacts (e.g., hydropower and flood management in places like the Chehalis Basin)	Analysis Pending Statewide	

HABITAT

Productive and protected habitat is critical for naturally spawning salmon to be abundant, diverse, and sustainable, and is necessary for better survival of hatchery salmon as well. Healthy riparian areas with well-connected floodplains help to cool water, allow for diverse in-river habitat to naturally form in dynamic equilibrium, and moderate both peak and low flows. Estuaries are essential nursery areas for young salmon to feed and transition successfully from fresh water to salt water. Marine nearshore habitat is critical for young salmon to hide and grow and also for forage fish production; forage fish feed salmon and the predators that consume salmon when forage fish abundance is low. Fish passage barriers limit salmon's ability to swim upstream into cool, productive spawning and rearing habitat. Water withdrawals for irrigation, residential/commercial use, and other purposes reduce the amount of useable habitat for salmon. Unscreened water withdrawals entrap small salmon in conveyance structures. Stormwater reduces water quality to the point of making it lethal in some areas for some salmon species. Water quality (temperature, nutrients, pesticides, pharmaceuticals, and sediment) impairments reduce the range and survival of salmon. Land use policies can lead to degradation and loss of functioning habitat. Restoring habitat is not keeping up with the rate of loss; regulations are needed to protect what is left while we work to restore what is needed. It is likely less financially expensive to society to protect habitat than restore it once it is gone.

Action A. Increase the implementation & enforcement of existing local, state and federal habitat protection regulations
Government agencies could effectively implement existing habitat protection and land-use management regulations, and improve their enforcement of those statutes and regulations. This is often due to lack of resources to implementation and enforcement agencies, but also requires more consistent application of existing statute and regulations, as well as efficiently coordinated and incentivized permitting processes for habitat protection actions.

Action B. Enhance/change local, state and federal protection regulations, especially for key Chinook/SRKW habitats or areas
Existing regulations could be reviewed and improved to target improved conditions for Chinook and SRKW. Potential examples include, but are not limited to, revisions to new and replacement bulkhead regulations, a strengthened shoreline armoring removal and softening incentive program, enhanced enforcement authority associated with hydraulic project approvals, and Shoreline Management Act and Growth Management Act modifications

Action C. Acquire important Chinook habitat
Land purchase and/or easements are pivotal to protecting critical habitat for certain Chinook salmon life histories, which can allow for increase abundance and diversity of Chinook. This involves land purchases and agreements to protect habitat. This could result in permanent habitat protection and is easily coupled with habitat restoration. Robust programs exist for land acquisition and easement in priority Chinook watersheds that should be enhanced with far greater funding, and targeted towards priority Chinook salmon habitat.

Action D. Accelerate habitat restoration by increasing funding significantly to address current regional priorities, including fish blockages in areas most beneficial to SRKW
Increased funding would allow more rapid implementation of priority habitat restoration efforts in priority Chinook watersheds, with consideration of locations where Chinook productivity cannot be improved without more and/or better nearshore or freshwater habitat, regardless of other actions.

Action E. Create additional or bolster existing habitat protection and restoration incentives for landowners
Many habitat protection or restoration priorities occur on private lands. The toolbox of incentives for landowners to voluntarily protect or restore Chinook habitat could be strengthened and expanded, including enhancing outreach and project management resources for existing programs, enhancing and establishing new financial incentives, and integrating or supporting programs or actions that are important to landowners (such as enhancing agriculture infrastructure). Public lands managed for non-salmon priorities may also benefit from incentives to offset a potential loss associated with salmon restoration.

Summary of Habitat Actions

Action	E	A	I	Timeline for SRKW Benefits	Supporting and Dissenting Opinions on Ratings (if applicable)	Geographic Specificity Progress	Notes
Action A. *Increase the implementation & enforcement of existing local, state and federal habitat protection regulations*	H	M	L	Immediate		Statewide – see Regional Recovery Organizations' priorities	• Any regulation is not a long-term durable fix. Needs to be coupled with significant improvements through acquisition and restoration in habitat
Action B. *Enhance/change local, state and federal protection regulations, especially for key Chinook/SRKW habitats or areas*	H	M	L	Immediate		Statewide – see Regional Recovery Organizations' priorities	• Any regulation is not a long-term durable fix. Needs to be coupled with significant improvements through acquisition and restoration in habitat
Action C. Acquire important Chinook habitat	H	L	L	Immediate for existing habitat; Long-term for habitat needing restoration		Statewide – see Regional Recovery Organizations' priorities	• Effectiveness and affordability depend upon scale. Higher for both for greater amount of habitat.
Action D. Accelerate habitat restoration by increasing funding significantly to address current regional priorities, including fish blockages in areas most beneficial to SRKW	H	L	M	Intermediate for blockages; Long-term for restoration but an action to ensure sustainability for future generations		Statewide – see Regional Recovery Organizations' priorities	• Should consider what projects are currently not on the table because of feasibility (moving I5, BNSF rail line, dams) as an opportunity for the governor to make a significant difference. • This is essential in areas where habitat is at carrying capacity and hatchery production increases are desired.
Action E. Create additional or bolster existing habitat protection and restoration incentives for landowners	M	M	H	Immediate for existing habitat; Long-term for habitat needing restoration		Statewide – see Regional Recovery Organizations' priorities	

FORAGE FISH

The forage fish species discussed by the Prey Working Group as important to Chinook and Southern Residents were sardines, anchovies, herring, smelt and sandlance. Protecting and restoring forage fish spawning habitat is essential for healthy functioning ecosystems and food webs. Estuarine and shoreline habitat is negatively impacted by shoreline development, particularly certain types of habitats, and particularly from hard armoring approaches. Natural shorelines form a migratory pathway for juvenile salmon, which use "pocket estuaries" located at the mouths of streams and drainages, where freshwater input helps them to adjust to the change in salinity, insect production is high, and the shallow waters protect them from larger fish that may prey on them. Currently, armor lines about 27% of Puget Sound's shoreline. Shoreline armor makes a dynamic shoreline static, disrupting many of the natural processes that replenish sand and gravel to beaches and spits of Puget Sound. As a result, sediment supply from bluffs that historically "fed" the beaches of Puget Sound is cut off. Healthy beaches provide spawning habitat for forage fish, which are at the heart of the Puget Sound food web and an important prey species for Chinook and also provide food for Chinook predators, potentially impacting overall Chinook survival. Migrating salmon transition to feeding on forage fish as they grow larger and spend more time in offshore waters. Loss of forage fish spawning beach habitat likely thus contributes to diminished growth and survival of juvenile salmonids. Several programs invest in in softening or removing shore armor, including the Environmental Protection Agency, Counties, and the Estuary and Salmon Restoration Program.

Commercial fisheries for forage fish occur on the coast and within Puget Sound. Some coastal forage fish fisheries (e.g., sardines, anchovy, mackerel, and market squid) are managed through the Pacific Fishery Management Council process, which involves scientific review and include federal catch limits. Other fisheries (e.g., Puget Sound herring) are managed by WDFW and tribal co-managers. The Fish and Wildlife Commission has a policy for forage fish, which was adopted in 1998. It is available at: https://wdfw.wa.gov/commission/policies/c3012.html. In recent years (2015-present), the coastal sardine fishery has been closed due to low stock abundance, but state and tribal fisheries have continued for northern anchovy and herring.

The Prey Working Group suggests two potential forage fish actions for the Task Force to consider:

Action A: Increase forage fish populations through habitat restoration and protection.
Forage fish require different habitat than salmon. For example, some spawn on gravelly beaches where shore armoring interferes. Specific efforts to improve forage fish habitat would ultimately benefit Chinook salmon and SRKW, but it will take time for the benefits to be realized.

Action B: Increase forage fish populations through harvest reductions.
Reduced fishing of forage fish could potentially leave more food for Chinook. However, as with other harvest reductions, treaty rights and impacts on fisheries need to be considered.

Summary table

Action	E	A	I	Timeline for SRKW Benefits	Supporting and Dissenting Opinions on Ratings (if applicable)	Geographic Specificity Progress	Notes
Action A *Increase forage fish populations through habitat restoration and protection*	H	M	H	Intermediate	Supporting • Benefit to reducing predation and increasing salmon survival, but a lot of uncertainty to SRKWs • More forage fish will be more positive than negative (even if some eat the same food at juvenile Chinook) Dissenting • Potential negative feedback loop from forage fish consuming juvenile chinook food (zooplankton) • For harvest—treaty right component, relatively low take related to other species	Focus on Puget Sound	• Consider life history of forage fish relative to size needed for juvenile chinook • Habitat protection for SRKW will directly benefit forage fish • Prey for Chinook are sardines, anchovy, herring, sand lance, and smelt • Habitat impacts from bulkheads in Puget Sound; single family exemption elimination would greatly improve protections. • Need to accelerate any studies of marine food web to be more confident on effect • Forage fish recovery planning process is underway
Action B *Increase forage fish populations through harvest reductions.*	H	H	M	Intermediate	Dissenting • For harvest—treaty right component. Relatively low take related to other species	Outer Coast and Puget Sound	• Forage fish recovery planning process is underway – need to align efforts

Appendix A

The Prey Working Group matrix with more information about each action can be found at this link: Prey Working Group Matrix.