Joint response concerning "no apparent shortage of prey for Southern Resident killer whales" in the Salish Sea

For immediate release
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On October 12, the University of British Columbia (UBC) issued a press release claiming that a newly published study[i] has "debunked" the idea that there are fewer Chinook salmon available during the summer for the endangered Southern Resident killer whales compared to the abundance of fish available to the Northern Resident killer whales.

The UBC press release grossly overstates the findings of the referenced study. The new paper by Sato et al. describes a new methodology for surveying for Chinook salmon in the oceanic environment, but includes too many unknowns and is too small of a data set to come to such a broad-sweeping conclusion. The study and press release also do not fully consider the region-wide decline of Chinook salmon overall, or the fact that both Southern and Northern Resident killer whales have started abandoning core habitat as a result of prey declines.[ii]

Over the last two decades, multiple studies by Canada's Department of Fisheries and Oceans (DFO)[iii] and the U.S. National Oceanic and Atmospheric Administration (NOAA)[iv] have shown that Chinook salmon are of year-round importance to resident killer whales, making up 83-99% of their summer diet. Southern Resident killer whale survival[v] and fecundity[vi] have both been linked to Chinook salmon abundance, and another recent study linked body condition and survivorship of Southern Residents to Salish Sea salmon runs[vii].

Numerous studies support that prey limitation is the primary factor contributing to the decline of the endangered Southern Resident killer whale population.[viii] Recovery plans by both US and Canadian governments also emphasize prey limitation as a key factor in Southern Resident killer whale declines and include the Salish Sea as critical habitat[ix]. NOAA's Southern Resident Killer Whale Priority Chinook Stocks Report lists five Salish Sea runs among the top ten highest ranked priority stocks.[x]

The newly published UBC study used ship-based multifrequency echosounders to survey for Chinook salmon in the Strait of Juan de Fuca, primary Southern Resident habitat, and Johnstone Strait, a region frequented by the Northern Residents. They report that in single surveys from 2018 and 2019, single target detections of Chinook salmon occurred in densities 4-6x higher within Southern Resident killer whale habitat. These acoustic monitoring techniques have been used to detect salmonids in rivers, but have not been widely used in the ocean. This is thus an interesting new technique for surveying prey abundance for resident killer whales, but it comes with a lot of uncertainty.

There are many unknowns with this methodology, which are acknowledged in the paper:
(quotes from the Sato et al. study in italics)

- The single surveys presented here are only one-week snapshots of a months-long salmon return season, and run timings can vary widely from year to year. Additionally, both study areas are dominated by Fraser River Chinook, and the diversion rate of which route fish take to return varies from year to year, so longer-term monitoring would be needed to make any conclusions about overall prey availability.

  "…prey availability for killer whales may be highly variable in shorter time scales (e.g., days to weeks). Long-term continuous measurements are needed to quantify such intra-seasonal variability in prey availability."

- This study looks only at single target detections of fish, removing aggregates of fish from their data. It is unknown if Chinook salmon move in different densities between the two study areas, potentially greatly influencing the results.

  "Understanding prey distributions is therefore essential for better understanding predator–prey interactions and ultimately how ecosystem functions. However, fine-scale variability in biological aggregations, combined with the strong swimming ability and migratory behavior of large prey make it challenging to assess prey distributions for top predators within pelagic ecosystems."

- Using echosounders to identify salmonids at the species and age level in the ocean is an unproven method. While troll and trawl sampling confirmed the presence of Chinook salmon, only 3 of the 67 Chinook caught by trolling and none of the Chinook caught in the midwater trawl would have produced a target strength in the estimated range for a 4 or 5 year-old Chinook salmon presented in Figure 1, if the assumptions used to define potential resident killer whale prey were correct. This suggests that there is a mismatch in the regressions used to identify Chinook using the equation from Love 1977.

  "In our study, we relied on empirical regressions derived from multiple fish species (Love 1977) to estimate the density and sizes of prey in the killer whale habitats. However, target strengths can vary significantly between species (Foote 1979; McClatchie et al. 1996), and we do not know the extent to which the regressions we used may have affected the accuracy of our estimates of prey density and size."

Given the constraints of the study summarized above, the bold claim made by the title of the press release that there is "No apparent shortage of prey for Southern Resident killer whales in Canadian waters during summer" is a clear embellishment and oversimplification of the results. Factors such as the size and energy content of fish and prey density across a wider geographic and temporal scale must also be more fully considered before any broad conclusions can be drawn.

While we agree with the authors that to fully support Southern Resident killer whale recovery we need to look at their year-round diet from all regions, dismissing the importance of Salish Sea Chinook salmon to the whales is counterproductive to the years of research showing the importance of these runs to the whales and the ongoing advocacy to promote recovery of these salmon runs.

Sincerely,

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[i] Sato et al. 2021. "Southern resident killer whales encounter higher prey densities than northern resident killer whales during summer." *Canadian Journal of Fisheries and Aquatic Sciences*. dx.doi.org/10.1139/cjfas-2020-0445

[ii] Overall salmon declines: https://stateofsalmon.wa.gov/statewide-data/salmon/

SRKW declining presence in Salish Sea: Shields et al. 2018. "Declining spring usage of core habitat by endangered fish-eating killer whales reflects decreased availability of their primary prey." *Pacific Conservation Biology* 24: 189-193 doi.org/10.1071/PC17041

NRKW declining presence in Johnstone Strait: Bay Cetology, unpublished data, e.g. https://www.facebook.com/jared.towers.33/posts/10165234850610570

[iii] Ford and Ellis 2006. "Selective foraging by fish-eating killer whales Orcinus orca in British Columbia." *Marine Ecology Progress Series 316: 185-199. doi:10.3354/meps316185*

[iv] Hanson et al. 2010. "Species and stock identification of prey consumed by endangered southern resident killer whales in their summer range." *Endangered Species Research* 11: 69-82 doi.org/10.3354/esr00263

[v] Ford et al. 2010. "Linking killer whale survival and prey abundance: food limitation in the oceans' apex predator?" *Biology Letters* 6: 139-42 doi:10.1098/rsbl.2009.0468

[vi] Wasser et al. 2017. "Population growth is limited by nutritional impacts on pregnancy success in endangered Southern Resident killer whales." *PLOS ONE* 12:e0179824

[vii] Stewart et al. 2021. "Survival of the fattest: linking body condition to prey availability and survivorship of killer whales." *Ecosphere* 12(8) doi.org/10.1002/ecs2.3660

[viii] Lacy et al. 2017. "Evaluating anthropogenic threats to endangered killer whales to inform effective recovery plans." *Scientific Reports* 7: 14119 doi.org/10.5061/dryad.46vq7

[ix] NOAA 2008. "Recovery Plan for Southern Resident Killer Whales." https://repository.library.noaa.gov/view/noaa/15975

DFO 2008 "Recovery Strategy for the Northern and Southern Resident Killer Whales (Orcinus orca) in Canada." https://www.sararegistry.gc.ca/virtual_sara/files/plans/Rs-ResidentKillerWhale-v00-2018Aug-Eng.pdf

[x] NOAA 2018. "Southern Resident Killer Whale Priority Chinook Stocks Report." https://media.fisheries.noaa.gov/dam-migration/srkw_priority_chinook_stocks_conceptual_model_report___list_22june2018.pdf