CRUISING SINCE 1980

The Boat Company

EXPLORATIONS

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Ms. Watson & Ms. Cleaver:

We submit the following comments responding to your March 2023 discussion prompt and survey regarding the development of a purpose and need and range of alternatives for a programmatic Environmental Impact Statement (EIS) for the groundfish fisheries. The Boat Company is a charitable foundation with a 40 year history of operating in Alaska where it conducts multi-day conservation, education, sport fishing and adventure tours in Southeast Alaska aboard two small cruise vessels. The Boat Company's charitable work focuses on Alaska conservation issues, including efforts to protect and maintain fishery resources and fish habitat which support local fishing economies throughout Alaska.

These comments respond to Question 1: Why does the Council need to reinitiate a Programmatic evaluation at this time?[1] New information about climate change is one of the main reasons why there is a need to update the Programmatic EIS. High latitude coastal ecosystems are particularly vulnerable to climate change impacts.[2] The number and degree of mass mortality events is increasing with some Alaska fish species, particularly those at risk to heat stress.[3]

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[1] The Boat Company thanks the analysts for putting together the survey and will likely submit one or several more comment letters to respond to other survey questions.

[2] Wyllie de Echeverria, V.R. and Thornton, T.F., 2019. Using traditional ecological knowledge to understand and adapt to climate and biodiversity change on the Pacific coast of North America. *Ambio*, *48*(12), pp.1447-1469.

[3] Westley, P.A.H. 2020. Documentation of en route mortality of summer chum salmon in the Koyukuk River, Alaska and its potential linkage to the heatwave of 2019. Ecology and Evolution 2020; 10:10296-10304.

The 2004 PSEIS did not contemplate current conditions. It discussed climate regime shifts that drove ecosystem changes during the 1980s and 1990s.[4] Analyzed climate patterns included shorter-term El Nino effects and longer-term Pacific Decadal Oscillation fluctuations that affected fish distribution, survival, reproduction and recruitment.[5] The PSEIS referenced studies from the 1990s that considered correlations between climate and changes in biomass or recruitment for marine species elsewhere on the Pacific Coast.[6] There were no studies available to inform cause and effect relationships between climate, fishery productivity and ecosystem changes in the Bering Sea and Gulf of Alaska.[7]

The 2004 PSEIS stated that the north Pacific Ocean ecosystem was within the bounds of natural variability.[8] In a 2015 Supplemental Information Report NMFS decided that available information about climate changes observed or studied between 2004 and 2014 did not warrant an updated analysis.[9] NMFS concluded that the 2015 climate remained within the range of natural variability measured over the past thirty years.[10]

There was published research available by 2015 that identified both significant climate change impacts to groundfish fisheries and increasing cumulative impacts from both climate change and groundfish fisheries on ocean ecosystems.[11] Projected impacts were most severe in high latitude oceans: altered geographic distribution of marine organisms, reduced ice cover, especially in summer, displacement or extinction of some colder-water species as other species expand northward, diverse food web effects, reduced juvenile survival of commercial groundfish species and shrinking fish body sizes.[12]

In 2015 Alaska experienced multiple record high temperature events.[13] During the winter of 2015-2016 statewide temperatures exceeded historical averages (1925-2016) by 8.4° F for the whole winter and by 10.9° F from January to April of 2016.[14] 2016, 2018 and 2019 were the warmest years on record, and 2019 was the first year with an annual average state temperature above freezing.[15]

The record air temperatures accompanied one of the most dramatic marine

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[4] NMFS. 2004. Alaska Groundfish Fisheries Final Programmatic Supplemental Environmental Impact Statement (PSEIS) § 3.10.11.
[5] *Id.* § 3.10.14-15.
[6] *Id.* § 3.10.12; 3.10.13.
[7] *Id.* § 3.10.16.
[8] *Id.* § 3.10-1.
[9] NMFS. 2015. Supplemental Information Report at 63.
[10] *Id.* at 61-62.
[11] *See* Costello, M.J. et al. 2010. A census of marine biodiversity knowledge, resources and future challenges. PLoS ONE 5(8):e12110.
[12] Chueng, W.W.L., Lam, V.W.Y, Sarmiento, J.L., Kearney, K., Watson, R., Pauly, D. 2009. Projecting global marine biodiversity impacts under climate change scenarios. Fish and fisheries 10: 235-351; Fogarty, M. et al. 2008. Potential climate impacts on Atlantic cod (Gadus morhua) off the northeastern USA. Mitig. Adapt. Strat. Glob. Change (2008) 13:453-466.
[13] Lader, R., Bidlack, A., Walsh, J.E., Bhatt, U.S. and Bieniek, P.A., 2020. Dynamical downscaling for southeast Alaska: Historical climate and future projections. *Journal of Applied Meteorology and Climatology*, *59*(10), pp.1607-1623.
[14] Walsh, J.E., P.A. Bienek, B. Brettschneider, E.S. Euskirchen, R. Lader & R.L. Thoman. 2017. The exceptionally warm winter of 2015/16 in Alaska. In Journal of Climate 30 (6) 2069-2088.
[15] *Id.*

heat waves experienced to date on the planet.[16] Both the Bering Sea and Gulf of Alaska were exceptionally warm from 2014 to 2016 with record sea surface temperatures and ocean heat content.[17] Gulf of Alaska sea surface temperatures and heat content were both 3.6° F above normal.[18] Another marine heatwave developed in late 2018 and persisted until fall 2019.[19] Scientists project that marine heat waves will become more frequent and intense and what are now extreme heat waves may become common.[20] Since 2014, marine heat waves have become the dominant cause of declared fishery disasters in the U.S. and associated revenue losses.[21]

Marine heatwaves can cause chaos for marine ecosystems and marine biodiversity and the warm phase changed the Gulf of Alaska and Bering Sea marine ecosystems.[22] In the Gulf of Alaska the marine heat wave caused species range shifts and declines in abundance and/or physical condition of forage and commercial fish species.[23] Reduced productivity from the base of the food web on up depressed growth and survival of prey species and many commercial fish species.[24] Some species, such as Pacific cod, experienced precipitous declines following consecutive years of warmer waters.[25]

Warming caused reductions in the extent and duration of Bering Sea sea ice coverage also changed food webs, fish abundance, caused a major northward shift in fish community distribution and likely diminished ecosystem productivity.[26] The sea ice extent in the Bering Sea reached the lowest level on record during the 2017/18

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[16] Suryan et al. 2021. Ecosystem response persists after a prolonged marine heatwave. Scientific Reports (2021) 11:6235.

[17] Walsh, J.E., Thoman, R.L., Bhatt, U.S., Bieniek, P.A., Brettschneider, B., Brubaker, M., Danielson, S., Lader, R., Fetterer, F., Holderied, K. and Iken, K., 2018. The high latitude marine heat wave of 2016 and its impacts on Alaska. *Bull. Am. Meteorol. Soc*, *99*(1), pp.S39-S43

[18] *Id.*

[19] Siddon, E. 2021. Ecosystem Status Report 2021: Eastern Bering Sea, Stock Assessment and Fishery Evaluation Report. North Pacific Fishery Management Council, Anchorage, AK.

[20] Cheung, W.W., Frölicher, T.L., Lam, V.W., Oyinlola, M.A., Reygondeau, G., Sumaila, U.R., Tai, T.C., Teh, L.C. and Wabnitz, C.C., 2021. Marine high temperature extremes amplify the impacts of climate change on fish and fisheries. *Science Advances*, *7*(40), p.eabh0895; Walsh, J.E. et al. 2018; Markon, C., S. Gray, M. Berman, L. Eerkes-Medrano, T. Hennessy, H. Huntington, J. Littell, M. McCammon, R. Thoman and S. Trainor, 2018: Alaska. In: Impacts, risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington DC, USA, pp. 1185-1241.

[21] Bellquist, L., Saccomanno, V., Semmens, B.X., Gleason, M. & J. Wilson. 2021. The rise in climate change-induced federal fishery disasters in the United States. PeerJ 9:e311186.

[22] Cheung, W.W. et al. 2021; Suryan et al. 2021; Siddon, E. 2021.

[23] Suryan et al. 2021; Barbeaux, S.J. et al. 2020.

[24] Ferriss, B.E. and Zador, S. 2021. Ecosystem Status Report 2021: Gulf of Alaska, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council. Anchorage, Alaska 99501.

[25] *Id.;* Barbeaux, S.J., K. Holsman & S. Zador. 2020.

[26] Thoman, R.L., Bhatt, U.S., Bieniek, P.A., Brettschneider, B.R., Brubaker, M., Danielson, S.L., Labe, Z., Lader, R., Meier, W.N., Sheffield, G. and Walsh, J.E., 2020. The record low Bering Sea ice extent in 2018. *Bulletin of the American Meteorological Society*, *101*(1), pp.S53-S58; Hunt, G.L., L. Eisner & N.M. Call. 2021. How will diminishing sea ice impact commercial fishing in the Bering Sea? Arctic, Antarctic and Alpine Research 53:1; Siddon, E. 2021; Fedewa, E.J., T.M. Jackson, J.K. Richar, J.L. Gardner & M.A. Litzow. 2020. Recent shifts in northern Bering Sea snow crab (Chionoecetes opilio) size structure and the potential role of climate-mediated range contraction. Deep–Sea Research II 181-182 (2020) 104878; Szuwalski, C. 2021. An assessment for eastern Bering Sea snow crab. Report, North Pacific Fishery Management Council, 1007 W. 3rd Ave, Suite 400, Anchorage, AK 99501

winter.[27] Four of the highest recorded mean bottom temperatures occurred over the last six years (2016, 2018, 2019 and 2021).[28] The ensuing snow crab collapse was likely "one of the largest losses of marine macrofauna that can be attributed to the marine global heatwave."[29]

Changes in the distribution and productivity of marine species are occurring much more rapidly than for terrestrial animals.[30] Consecutive years of warmer water and associated food web changes are particularly challenging.[31] When fish encounter warmer waters, metabolic demand increases but foraging rates and prey energy often decrease, reducing growth potential and adversely affecting reproduction and activity.[32] Fish are changing the timing of life cycle events, and maturing at smaller sizes as adult fish.[33] The size loss is most dramatic for active fish species - often the main species targeted in commercial fisheries.[34] Decreases in adult body sizes may reduce future fishery yields by 23 percent on average and more for some species.[35]

Other impacts of smaller size include reduced per capita reproductive rates (smaller fish produce smaller eggs, fewer eggs and smaller offspring) and reduced resilience.[36] Larger fish have several survival and population advantages, including fecundity (ability to produce more offspring), longer life spans, more resiliency, and may be better predators – and are better at avoiding predators.[37] The very largest female fish have a disproportionately large role in fish population productivity and replenishment.[38] They produce larger eggs, more eggs, and larger offspring.[39] Egg size can often correlate with recruitment success, so that size declines may reduce the capacity of marine fish to replenish.[40]

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[27] *Id.*

[28] *Id.*

[29] NPFMC. 2023. Rebuilding Plan for Eastern Bering Sea Snow Crab Final Action Analysis. (C1 Snow Crab Rebuilding Analysis February 2023).

[30] Pinsky, M.L. et al. 2021 Fish and fishers in hot water: What is happening and how do we adapt? Population Ecology. 2021: 63:17-26.

[31] Barbeaux, S.J., Holsman, K. and Zador, S., 2020. Marine heatwave stress test of ecosystem-based fisheries management in the Gulf of Alaska Pacific cod fishery. *Frontiers in Marine Science*, *7*, p.703.; Carozza, D.A., Bianchi, D. and Galbraith, E.D., 2019. Metabolic impacts of climate change on marine ecosystems: Implications for fish communities and fisheries. *Global ecology and biogeography*, *28*(2), pp.158-169.

[32] Baudron, A.R., C.L. Needle, A.D. Rijnsdorp and C.T. Marshall. 2014. Warming temperatures and smaller body sizes: synchronous changes in growth of North Sea fishes. In: Global Change Biology (2014). Freitas, C., E.M. Olsen, E. Moland, L. Ciannelli & H. Knutsen. 2015. Behavioral responses of Atlantic cod to sea temperature changes. Ecology and Evolution 2015: 5(10): 2070-2083.

[33] Baudron, A.R., C.L. Needle, A.D. Rijnsdorp and C.T. Marshall. 2014; Pauly, D. & W.W.L. Cheung. 2018. Sound physiological knowledge and principled in modeling shrinking of fishes under climate change. Glob. Change Biol. 2018; 24e15-326

[34] van Rijn, I., Buba, Y., DeLong, J., Kiflawi, M. and Belmaker, J., 2017. Large but uneven reduction in fish size across species in relation to changing sea temperatures. *Global Change Biology*, *23*(9), pp.3667-3674.

[35] Baudron, A.R., et al. 2014.

[36] *Id.*

[37] *Id.*; Barneche, D.R., Robertson, D.R., White, C.R. and Marshall, D.J., 2018. Fish reproductive-energy output increases disproportionately with body size. *Science*, *360*(6389), pp.642-645; Hixon, M.A., Johnson, D.W. and Sogard, S.M., 2014. BOFFFFs: on the importance of conserving old-growth age structure in fishery populations. *ICES Journal of Marine Science*, *71*(8), pp.2171-2185.

[38] Hixon, M.A., Johnson, D.W. and Sogard, S.M., 2014.

[39] *Id.*

[40] *Id.*

Marine heat wave impacts on fisheries alone establishes a need to undertake a comprehensive and programmatic NEPA analysis that includes and analyzes fishery policies that respond to these unprecedented ecosystem changes.[41] Developing proactive strategies through alternatives analyzed in a Programmatic EIS may help to address impacts from more frequent and hotter heat waves. A comprehensive analysis could combine vulnerability assessments, responsive harvest control rules and inform the Council and fishery managers regarding ecosystem productivity and changing spatial and temporal shifts in fishery resources.

The conclusions in the 2004 PSEIS with regard to the cumulative impacts of climate change and bycatch in federal fisheries, particularly salmon, also do not reflect current conditions. Since 2008 and particularly in recent years there have been significant closures of Chinook fisheries throughout Alaska because of escapement failures. For some stocks, bycatch in the groundfish fisheries is the only source of anthropogenic removals. The PSEIS stated that "[i]f individual stocks become so depressed that full closure of direct fisheries is insufficient to enable a rebound in the population, then any additional mortality, including bycatch, could negatively impact the stock."[42] The 2015 Supplemental Information Report concluded that there was no new information available at that time to indicate any significant impact on Chinook or chum salmon to suggest a substantial change in the impacts of the groundfish fisheries."[43]

Due to ongoing changes in abundance and distribution, salmon warrant particular consideration in a programmatic analysis. Salmon use a combination of freshwater, estuarine and marine habitats at different stages of their life cycle, resulting in exposure to multiple climate change related threats.[44] Climate change is already stressing salmon stocks by changing summer and winter stream flows and increasing both marine and freshwater temperatures.[45] Water temperature drives salmon system productivity, influencing spawn timing, incubation, growth, distribution, and abundance.[46] Salmon body sizes are declining across all Alaska

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[41] Estimated revenue losses from the snow and red king crab closures for 2021/2022 seasons are $287.7 million (2022-2023 Crab Disaster Declaration LOS.pdf). The Pacific cod fishery was a declared disaster in 2018 and again in 2020 (https://www.fisheries.noaa.gov/national/funding-and-financial-services/fishery-disaster-determinations). *See also* Barbeaux, S.J., K. Holsman & S. Zador. 2020 (explaining that Pacific cod are one of the most vulnerable commercial groundfish species to negative impacts from a multi-year warming event because of a narrow thermal tolerance).

[42] NMFS. 2004. PSEIS § 3.9-107

[43] NMFS. 2015. Supplemental Information Report at 65.

[44] Cline, T.J., Ohlberger, J. and Schindler, D.E., 2019. Effects of warming climate and competition in the ocean for life-histories of Pacific salmon. *Nature Ecology & Evolution*, *3*(6), pp.935-942.

[45] Pitman, K.J., Moore, J.W., Huss, M., Sloat, M.R., Whited, D.C., Beechie, T.J., Brenner, R., Hood, E.W., Milner, A.M., Pess, G.R. and Reeves, G.H., 2021. Glacier retreat creating new Pacific salmon habitat in western North America. *Nature communications*, *12*(1), pp.1-10; Jones, L.A., Schoen, E.R., Shaftel, R., Cunningham, C.J., Mauger, S., Rinella, D.J. and St. Saviour, A., 2020. Watershed-scale climate influences productivity of Chinook salmon populations across southcentral Alaska. *Global change biology*, *26*(9), pp.4919-4936

[46] Winfree, M.M, E. Hood, S. I. Stuefer, D.E. Schindler, T.J. Cline, C.D. Arp & S. Pyare. 2018. Landcover and geomorphology influence streamwater temperature sensitivity in salmon bearing watersheds in Southeast Alaska. Environ. Res. Lett. 13 (2018).

salmon species because of climate driven changes in age structure – they are smaller mostly because they are returning to reproduce at a younger age than in the past.[47]

Marine heat waves were a primary cause of ten declared salmon fishery disasters caused by unfavorable ocean conditions.[48] Salmon abundance for all species was low in the Gulf of Alaska following the heat wave.[49] There will be extensive closures in 2023 for sport and commercial gillnet fisheries in Cook Inlet because of projected and recent escapement failures for numerous stocks.[50] Western Alaska Chinook populations have collapsed over the past two decades because of multiple factors.[51] Even with complete closures of some fisheries and severe restrictions for others, in many cases too few salmon returned to meet escapement goals for much of the past decade.[52] The western Alaska chum salmon runs reached similarly low levels between 2020 and 2022, with record low runs, commercial and subsistence fishery closures and escapement failures.[53]

It is important to note that many salmon populations have shown considerable resiliency. Many Columbia River Chinook stocks, for example, have had run sizes over the past decade that were more than five times as high as they were during the 1990s, supporting commercial, tribal and recreational fisheries. Chum salmon returns rebounded in southern Alaska after the heat wave. Climate change is likely to increase the amount of freshwater habitat for multiple salmon species in Alaska, particularly in the Gulf of Alaska mainland and western Alaska. It is critical that sufficient spawning salmon return to rivers, and comprehensive analysis of stock-specific climate and fishery impacts in a Programmatic EIS will help to inform management measures needed to sustain salmon fisheries.

In sum, an updated Programmatic EIS that evaluates multiple alternative management responses will help to inform future actions that respond to climate change impacts on Alaska's various fisheries. There is a need to analyze climate change impacts together with groundfish fishery impacts, assess the extent to which climate change may exacerbate other anthropogenic stressors and develop alternative marine conservation strategies to address these impacts.[54]

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[47] Lewis, B., W.S. Grant, R.E. Brenner & T. Hamazaki. 2015. Changes in size and age of chinook salmon returning to Alaska. PLoS ONE 10(6): e0130184; Oke, K.B. et al. 2020. Recent declines in salmon body size impact ecosystems and fisheries. Nature Communications (2020) 11:4155

[48] https://www.fisheries.noaa.gov/national/funding-and-financial-services/fishery-disaster-determinations; State of Alaska. 2021. Letter re: State of Alaska Federal Fishery Disaster Requests.

[49] https://www.facebook.com/ADFGUnderseaWorldOfSalmonAndSharks

[50] Alaska Department of Fish & Game. 2023. Sport Fishing Emergency Order. Emergency Order No. 2-KS-7-15-23. Homer, Alaska. March 2, 2023.

[51] Kuskokwim River Inter-Tribal Fisheries Commission. 2023. 2022 Kuskokwim River Salmon Situation Report; Joint Technical Committee of the Yukon River U.S./Canada Panel. 2022. Yukon River 2021 season summary and 2022 season outlook. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 3A22-01, Anchorage. Von Biela, V.R. et al. 2020. Evidence of prevalent heat stress in Yukon River Chinook salmon. Can. J. Fish. Aquat.Sci. 77: 1878-1892 (2020).

[52] *Id.;* Siddon, E. 2021.

[53] *Id.*

[54] Fogarty, M. et al. 2008; Chueng, W.W.L., Lam, V.W.Y, Sarmiento, J.L., Kearney, K., Watson, R., Pauly, D. 2009.