"If Sea Floor Contact by Pelagic Trawl Gear Is Important to the Council . . ."[1]

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September 2023

The first scientifically vetted video of sea floor contact by trawl gear, filmed off the East Coast, dropped like a bomb at a North Pacific Fisheries Management Council (NPFMC) meeting in 1995. Underwater video photography was relatively new at the time. Until then, there had been a lot of sight-unseen conjecture in the management system and a lot of finger-pointing. Yet, the destruction revealed by the visual footage was even more than I had expected. Equally as captivating as the video was the body language of the two men standing between me and the screen. Both of these gentlemen were highly influential trawl industry representatives: one, a Council member, owned two factory trawlers; the other, an Advisory Panel member, owned a large catcher vessel primarily fishing pollock. As the video played out, I watched from behind as their bodies stiffen, necks and shoulders tighten, hands clench tightly behind their backs, fingers twitching intermittently, feet barely shuffling. It was a classically pivotal moment. I felt like I could read colorful expletives in cartoon bubbles above each of their calculating heads.

It was also a gratifying moment. Over the previous 2 years, we had been building Alaska Marine Conservation Council (AMCC) for the express purpose of putting trawl bycatch and habitat impact (which I have always equated to each other) back on the table to be legitimately addressed. Industry lobbyists had successfully sidelined the topic in the Council's agenda, pointing to discards in the Bering Sea pollock fishery as only 5-7% of the total catch. But walleye pollock occur in unbelievably massive aggregations. Using percentages to account for bycatch was a clear diversion from the reality that in the early 1990's total discards in the Bering Sea pollock fishery alone amounted to over 700,000 metric tons, or more than 1.54 billion pounds of living ecosystem – not accounting for the important benthic species and essential living habitat that sifted through the large forward meshes of these mega-trawls never landing on deck. In 1996, Congress saw fit to "minimize" that wonton waste.

Thirty years later, the industry and National Marine Fisheries Service (NMFS), or NOAA Fisheries, label the Alaska pollock fishery as "sustainably managed and responsibly harvested under U.S. regulations" and claim that "The Alaska pollock fishery uses midwater trawl nets that, although sometimes making contact with the bottom, have minimal impact on habitat." They also laud current data that measures bycatch in the Bering Sea pollock fishery at "just 1%", or 34 million pounds of wasted ocean life.[2] How that equates to individuals we will never know but the bycatch

[1] A comment made by NMFS staff and reiterated by a North Pacific Fisheries Management Council (NPFMC) member during the discussion of "pelagic" trawl definition at the June 2023 NPFMC meeting in Sitka, AK.
[2] https://www.fisheries.noaa.gov/species/alaska-pollock#overview

of halibut from both bottom and "pelagic" trawls in the Bering Sea amounts to millions of pounds juvenile fish. And there is currently deep concern over the accuracy of these numbers given the complexity, regular disruption, and limited coverage of the federal observer data-collection program and the reality that the pollock fishery's "pelagic" trawls (not midwater trawls) fish hard on the bottom most of the time with no accounting for "unobserved mortality." Efforts to adequately measure or even account for that repeated devastation, deep on the ocean floor, out-of-sight out-of-mind, have been effectively thwarted by the industrial "pelagic" trawl sector and their lobbyists at every turn. It has only been recently that the Council and NMFS have begun to consider the actual size of these monster nets and how they operate:

- the opening of a "pelagic" net can be up to 1,000 ft. wide and over 100 ft. tall;
- towed with the codend as much as a mile behind the vessel;
- fishing in less than 250 ft. of water on the central EBS and GOA continental shelves;
- at speeds of 3.5-4 knots;
- for as long as 10 hours or more (approx. 35-40 nm).

For the largest nets, that is an approximate minimum footprint of 6.6 square nautical miles for one tow. (Compare that to .01-.02 sq. mi. sampled by NMFS survey nets.) Given the length and catenary of the cables pulling that net, it is impossible for these mega-nets to not be continuously contacting the bottom in such shallow water. There are no regulations controlling the dimensions of "pelagic" nets other than minimum mesh sizes and minimum lengths of the two forward sections relative to individual vessel length. The only confining limits to the overall size of these massive nets that they are regularly dragging across the ocean floor are the horsepower and deck capacity of the vessels, the size of their hydraulic systems, and the width and diameter of the net reels and cable winches. And the only description of their impact on benthic habitat, from a short paragraph in the Bering Sea/Aleutian Islands Crab Fishery Management Plan (BSAI Crab FMP), is that they have a "smoothing effect" on the ocean floor.[3]

Impacts on Habitat and Stock Assessment

In 1981, when I first transferred from the Seattle-based Gulf of Alaska Groundfish Assessment group of NMFS to the Bering Sea Crab Assessment group in Kodiak, AK, I had the dubious honor of witnessing and helping to measure the dramatic decline of red king crab stocks in the eastern Bering Sea (EBS). We tested multiple theories proffered over the next several years to explain the disappearance of millions of red king crab in an area once rich with that prized catch. None adequately accounted for such a radical change, but the list did not include targeted bycatch in the yellowfin sole joint ventures between U.S. trawlers and Russian floating processors. (Dew and McConnaughey 2005) A detailed 70-year historical perspective on essential habitat for Bristol Bay red king crab sheds important light on this mystery. (Dew 2010a)

In 1959, Japan designed a 67,000 sq.km. area of Bristol Bay to protect what they scientifically recognized as essential king crab reproductive habitat from destructive fishing practices. Dew 2010a

[3] https://www.npfmc.org/wp-content/PDFdocuments/fmp/Crab/CrabFMP.pdf page 169

renamed the area the Japanese Broodstock Sanctuary in for historical clarity. The 20,000 sq. km. of the western toe of the Japanese Broodstock Sanctuary, now called the Pot Sanctuary, was collaboratively designed as a sanctuary by the three nations, U.S., Japan, Russia, in 1964 because it was recognized as containing the greatest reproductive potential of the red king crab in the entire region. With the implementation of the Fisheries Conservation and Management Act (the original Magnusson-Stevens Act (MSA)) in 1977, those protective boundaries were dissolved allowing untethered joint ventures to plow through prime red king crab habitat ostensibly targeting yellowfin sole. (You can be certain that those Russian processors did not discard all that crab back into the sea.)

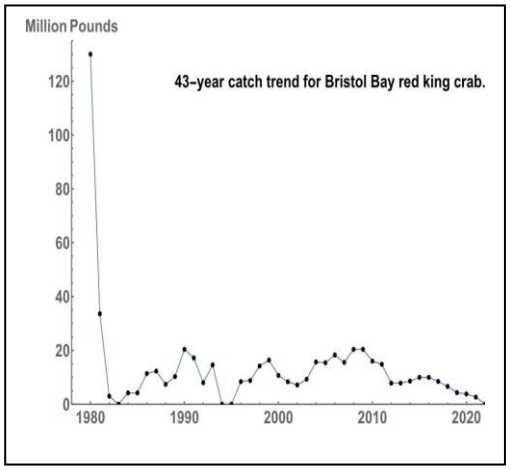


Photo by a NMFS observer of a "red bag" catch onboard a Russian processor in 1981 (Dew and McConnaughey 2005) and a 43-year catch trend for Bristol Bay red king crab, courtesy of Dr. C. Braxton Dew. Note there is a greater amount of king crab than fish sorted on that deck, 80-90% of which are females with egg clutches.

Stories of "red bags," codends stuffed with red king crab, were common knowledge among the fleet and observer coverage was regularly manipulated by the fishermen to hide this activity resulting in litigation against several vessels. As fishermen are well-known for keeping secrets, that information wasn't "leaked" to federal scientists for several years, posited as a rumor, and dismissed by agency scientists as hearsay for lack of "adequate" observer data (and much denial from the trawl sector).

On a personal note, my former husband, fishing for a joint venture on a Kodiak trawler in 1983, was deeply concerned about "plugging the net to the intermediate with red king crab" in Marmot Bay. When the skipper had radioed that report into the owner, the reply came back twice: "No you didn't." Over the years other trawl vessel owners commented to me directly about how they were glad their boats were below the minimum length required to carry fishery observers because they wouldn't want anyone seeing the bags of crab that they hauled onboard. The ability of the trawl industry to obscure their true behavior over all these years within an increasingly complex and sluggish management system is a valuable study in fishermen's ingenuity, political manipulation by powerful lobbyists, and how to influence and redirect the interpretation of "applied" science – and place the burden of proof on natural ecosystems and those who want to conserve them rather than on those creating radical ecological change in search of increasing economic benefit.

The former grandeur of the living abundance of Alaska's ocean ecosystems is beyond human comprehension. Yet, to this day the Council system, under intense industry pressure, continues to allow trawlers to repeatedly plough through foundational sensitive bottom habitat with gargantuan nets – enormous, voracious predators that ocean life has never before encountered and could never have possibly evolved to accommodate – purporting that the impact is minimal and recovery time insignificant, but with limited and questionable data to back up this claim. The expectation being that somehow living, interconnected, magnificent ecosystems can thrive in the wake of repeated, enormously destructive change and continue to contribute billions of dollars annually to industry barons and "the Nation." All this, of course, in the name of "best available science." In truth, they are fishing harder and progressively further afield in order to cover that elusive bottom-line.

Fisheries and Science

Alaska red king crab (RKC) populations are an important case study in the evolution of our scientific understanding of marine fisheries management and the impact of uncontrolled human behavior on ocean ecosystems. It has now been well-established that the original NMFS stock assessment models for RKC were fundamentally flawed due to an inadequate understanding of the biology and behavior of the species and a misuse of statistical tools, resulting in an unwarranted certainty around the estimates of stock size beginning in the mid-1970's. (Dew 2010b) Nonetheless, inaccurate stock assessment tools and faulty biological interpretations do not fully explain the dramatic disappearance of so many crabs between 1980 and 1982 or the subsequent low population levels ever since then (nor the disappearance of snow crab between 2019 and 2022). Although the easy fallback explanation has been posited as climate change, a comprehensive look at RKC life history patterns, distribution, growth, and reproduction (Dew 2008, 2010a,b) in conjunction with the history of trawl fishing activity and gear behavior provides a fuller picture.

Most marine crabs and fishes occur in their highest reproductive concentrations during specific seasons and in specific locations to release their young, be they fertilized eggs or eyed-larvae, into the prevailing currents. This is an evolutionary phenomenon which provides their offspring with the greatest potential to drift in the plankton and arrive at appropriate nursery grounds; then, overtime, migrating back to areas of adult distribution. The scientifically-based Japanese Broodstock Sanctuary was designed on this premise and also included juvenile habitat. Amak Island in southern Bristol Bay (a Critical Habitat Area for the endangered Steller sea lion), is located in what was once the epicenter of the Bristol Bay RKC reproductive population (the 1966-1977 Pot Sanctuary). Trawling for RKC around Amak Island was pioneered by Lowell Wakefield and the Deepsea Trawlers in 1949, prior to the international protection of the RKC broodstock sanctuary. (Dew 2010a) With brood stock protections in place, those stocks rebuilt to support major international fisheries until they were decimated during the joint venture era beginning in 1977. Continuously open to trawling for the last 45 years, that most essential RKC habitat area is now dubbed "Cod Alley" by trawl fishermen and is outside any areas designated to protect crabs and their habitat. Being physically removed from the center of their essential habitat by the continuous presence of large, bottom-fishing mobile gear does not diminish or eliminate the ecological importance of the area to RKC recruitment and abundance as a species.

Appendix F in the BSAI Crab FMP takes a convoluted approach to evaluating the effects of fishing on essential RKC habitat [page 174, 4.1.5.1]. It arbitrarily designates 50% of the distribution of RKC in the entire EBS as "Core Essential Area," ignoring historical international science, and then determines that core habitat reduction caused by trawling is less than 10%. (Assuming "pelagic" trawl gear does not fish on the bottom.) But the authors do note that "the most critical area for . . . spawning is in southern Bristol Bay, where habitat reduction is **over ten percent** [and] additional analysis **may** be beneficial. . ." (Emphasis added) Examination of their Figure 26, however, reveals that estimates of RKC habitat reduction by trawl gear are between 25 and 68% in the area north of Unimak Island, or "Cod Alley."

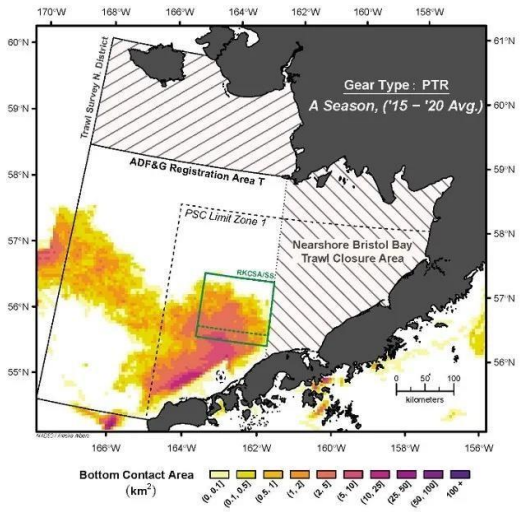
Today there are several so-called "RKC Protection Areas" that restrict bottom trawling, but not necessarily "pelagic" trawls, yet these regulatory protections have little relevance to the most important areas for reproductive success of the species, specifically "Cod Alley." In some of the "protected" areas, restrictions are lifted for periods of time each year to allow for trawl activity. Additionally, there are other deeply troubling aspects of the interaction of the trawl fleet with RKC biology and distribution that need to be emphasized.

Red king crab demonstrate an important trade-off between growth and reproduction. While females RKC are obliged to molt every year in order to mate and fertilize their next clutch of eggs, males begin to skip molting approximately every other year once they reach maturity. A wealth of scientific observations since 1959 (discussed in Dew and McConnaughey 2005; Dew 2008, 2010a) conclude that male RKC cannot molt and mate in the same year. Hard-shelled mature males that don't molt in a particular year, about 50% of the male population, aggregate with the females in shallow water nearer to shore to mate. The 50% of males that will molt and grow that year migrate to the northwest of Amak Island, well outside any areas protected from trawl fishing, and remain concentrated and vulnerable in a relatively small "bachelor" area, recuperating from their winter molt about 100 km away from the mating aggregations. (Fig. 5, Dew 2010a) Dr. C.B. Dew, who dove in frigid Alaska waters with SCUBA more than 900 times over a 12-year period to observe and document RKC in their wild habitat, including over 50 times at night, observed that RKC molt at night in the winter. (Personal communication)

In January and February in the EBS, the molting males spread out from their large communal pods across the sea floor and molt in the long, dark winter nights leaving piles of empty exoskeletons across the bottom to be reincorporated into the ecosystem. (See photo in Figure 6, page 395, Dew 2010a) The evolutionary advantage seems to be that there are few natural nighttime predators during this time of year. Neither cod, which aggregate in the upper water column at night, or pollock which are closer to the bottom at the same time, feed at night. At those higher latitudes in the winter, a 20-hour window of darkness provides cover to complete the molting process.

Unfortunately, there is a catastrophic collision in time and space between molting and recuperating RKC bachelor males and the pollock trawl fleet fishing the A-Season in January and February – historically, a very recent and insatiable nocturnal predator in the ecosystem. As noted above, it is not possible to operate those gigantic nets off the bottom in the less than 250-ft. depths of the central EBS continental shelf. The Alaska Pacific University's FAST Lab data (Stratton and Wilson 2023, figure below) verifies that the "pelagic" trawl pollock fleet has been fishing hard on the

bottom throughout the male RKC molting habitat for years on end. Since pollock aggregate close to the bottom at night and the larger pollock stratify to the bottom of the schools, the fleet targets the larger fish at night on the bottom – where and when the crabs are spread out across the sea floor either molting or foraging. (Dew 2010b)[4] The pollock A-Season is not the only time of the year that RKC are in jeopardy from trawling operations and female RKC have declined precipitously as well.



Pelagic trawl average bottom contact area 2015-2020 during the pollock A season (Source APU FAST Lab). (Stratton and Wilson 2023, Figure 1)

As the graph of the 43-yr catch trend above tragically makes clear, there has been little to no success in rebuilding Bristol Bay RKC stocks to their former abundance since their dramatic decline in 1981. Curiously, it doesn't appear that the NMFS stock assessment authors take the historical population numbers seriously and continue to insist that the stocks are not overfished and overfishing has not occurred, therefore, there has been no official attempt at rebuilding those stocks. The assumed minimal but likely inaccurate bycatch estimates in the trawl fisheries are combined with natural mortality estimates (M) in the population assessment models, not included in fishing mortality (F), and therefore not accounted for in determining overfished status or triggering a rebuilding plan.

But today, in 2023, all RKC fisheries are closed. The BSAI Crab FMP (2021) states that all the BSAI RKC stocks in 2016 were above minimum stock size threshold (MSST), apparently only using data from low abundance years after the population crashed – and functioning under the unfounded assumption that "regime shift" caused the crash. If MSST, below which the fishery is closed, is defined as 50% of B_{MSY} (biomass at maximum sustainable yield), and B_{MSY} is a measure based on the biomass of a theoretical unfished population level, and the EBS RKC fishery catches alone in 1980 exceeded 120 million pounds, then not taking the 70-year scientific history of the fishery into account in the FMP analysis violates the very premise of B_{MSY} and MSST. Applying

[4] It is important to note that Dr. Dew's research (2010b) and 12 years of observations in the wild definitively establish that RKC continue to create massive, multi-aged, mixed-sex pods as mature adults and throughout their lifespan. This alters the statistical interpretation of annual assessment sampling design as well as the assumptions and understanding of population model outputs, yet the Council's BSAI Crab FMP (2021) continues to falsely assert that king crab stop podding when they reach maturity.

National Standard 1 of the MSA, neither Bristol Bay or Gulf of Alaska (GOA) red king crab have been given adequate opportunity to rebuild.[5]

The best scientific conjecture proposed to explain the catastrophic status of EBS RKC, and the Gulf of Alaska as well, is that climate change has altered the ability of the stocks to reach previous levels of abundance, however there is no hard evidence from the natural environment over the last 40 years to support this assumption. Increasing ocean acidity and temperatures are legitimate concerns as climate change advances, but current temperature and acidity data show values well within the tolerance range of this species and definitively negate the hypothesis that climate change has had disastrous effects on RKC population since 1980.[6] Marine species have evolved and adapted to many fluctuations in ocean temperatures and chemistry over geological time, but there has been no cataclysmic event in the current history of fishing in Alaska that would account for such a radical disappearance of RKC over such a short time frame, 2-3 years, other than the introduction of massive bottom-trawling fishing gear. There is, however, plenty of evidence to focus on the combination of stock assessment errors and overfishing, but, most importantly, trawl gear impacts to explain the low abundance levels.

Red king crab in the central Gulf of Alaska, genetically identical to those in Bristol Bay, suffered from a similar fate to the EBS stocks and that fishery has been closed since 1983, concurrent with the growth of the trawl fishery there. There is no federal FMP for RKC in the Gulf, so Essential Fish Habitat (EFH) has not been established there per federal law, and no rebuilding plan that includes habitat protection is in place in federal waters as required by the MSA, again falsely assuming that these stocks are not rebuildable under current environmental conditions.

Appendix E of the 2021 BSAI Crab FMP does discuss the trawl closure areas around Kodiak Island in the Central GOA which were designed in 1993 (by an influential trawl lobbyist) to ostensibly protect reproductive crab habitat. These areas, including Type I no-trawl zones, are still unrestricted to "pelagic" gear and the observer program for this fleet is minimal. Type II areas are only closed to bottom trawling 4 months out of the year, and Type III areas only close for a "recruitment event," meaning the total number of females must increase substantially to a threshold number in areas where crabs are constantly being depleted by trawling before a trawl closure is imposed. There is no definitive scientific justification for the location or usefulness of Type III areas, nor is there any scientific basis for the concept of a "recruitment event." Recruitment is a process not an "event." These designations have not proven useful for protecting and rebuilding the king crab populations in the Kodiak Archipelago, despite the total closure to trawls within state waters, and the species has been relegated to "commercially extinct" status in a region of former unimaginable abundance.

The continuous presence of trawl gear (both bottom trawls and "pelagic" trawls) in crab habitat in both regions has not been recognized by the Council or NOAA Fisheries as the primary cause for the failure of these populations to rebound. It is, nonetheless, impossible to solve this mystery

[5] Caveat: I personally question the validity of MSY as an appropriate tool for fishery management, but it is a legal mandate of the MSA that has been ignored here without concrete justification.

[6] https://www.fisheries.noaa.gov/alaska/science-data/near-real-time-temperatures-bering-sea-bottom-trawl-survey-2023
https://aoan.aoos.org/oa-management-informing-bering-sea-fisheries/

simply by looking at single species population biomass assessments and directed fishing mortality (which, again, does not include crab bycatch mortality in other fisheries), while assuming away the timing, bottom contact, bycatch, and unobserved mortality by the "pelagic" trawl fleet, ignoring the close to 75% unobserved tows by of the smaller "catcher-boat" trawler fleet, and, as in Kodiak, accepting the politically useful but practically and biologically baseless concept of "recruitment events." Every in-depth analysis of the loss of the lucrative RKC fishery in the GOA fails to seriously focus on potential causative factors other than king crab biology, oceanographic oscillations, temperature shifts, or directed fishing pressure, sidestepping the major ecosystem impacts of trawl gear bycatch and habitat alterations. (e.g., Bechtol and Kruse 2009)

There have been several unsubstantiated theories proffered to explain the disappearance of RKC in both the EBS and the Kodiak region – the loss of arguably the most economically valuable fishery resource in the U.S. Exclusive Economic Zone (EEZ). The two most loudly trumpeted by the fishing industry are cod predation and regime shift/climate change.

Pacific Cod

The "hue and cry" out of Kodiak in the mid-80's was that the growing cod stocks in the Central Gulf were preying on molting king crab and not allowing the crab population to rebuild. The trawlers reported catches of cod with guts stuffed with newly molted or soft-shelled crab and demanded that the Council up the cod quota as a means of predator control. A second iteration of that same argument surfaced at the June 2023 Council meeting – this time by Bering Sea fishermen. Curiously, besides the fact that cod don't eat at night when RKC are molting, the gut contents analysis of thousands of cod guts by NOAA Fisheries food web lab (Livingston 1989) showed that even though cod ate juvenile tanner crabs opportunistically, and very few RKC, the numbers of king crabs in cod guts were far too small to account for any significant impact on RKC stocks.

Red king crab and Pacific cod have coexisted in balanced ecosystems for millennia. But the new, voracious nocturnal predator in the system today, bottom-fishing "pelagic" trawls with gaping mouths up to 1,000 feet wide, has managed to deflect scrutiny in this quandary. Fishery observers on "pelagic" trawl vessels report "anecdotally" that they see parts and pieces of molted crab caught up in the forward meshes of these nets as they are reeled on board, some falling to the deck. However, per trawl performance standards regulations, championed by industry at their inception, up until now observers have not been allowed to input "parts of crab" into their database, even if they occur in the subsample of the catch that they measure, because these "parts" may just have been regurgitated by a cod in the net.

When I visualize a 600-1,000 ft.-wide supposedly "pelagic" net plowing through a field of molting or newly-molted foraging crab, it is hard to imagine how any crabs (or any other living thing) can survive, especially when they are tumbled through and under a heavy net that is many times longer than it is wide. Then cod, and other opportunistic feeders, are greeted at daybreak by a tender meal laid out for them in the track left by the trawl – analogous to seagulls trailing after a fishing boat on the surface. Anyone who has ever handled both king crab and Pacific cod know that a king crab has an extremely hard and spiny shell – very uninviting and likely impossible for a cod mouth to penetrate. The jaw of a two-thousand-pound endangered Steller sea lion, however, could crush it

easily. It is worth noting that both the Steller sea lion rookery on Marmot Island in the Gulf of Alaska, the largest in that species' range, and the large Steller sea lion rookery on Amak Island in southern Bristol Bay (in the middle of Cod Alley) occur in historic centers of prime RKC habitat. This is not to imply that endangered sea lions played a part in the decline of RKC, but that trawl fisheries have played a central role in altering the complex ecosystems that these royal marine mammals, and many other species, need to thrive.

Regime Shift and/or Climate Change

The first oceanographic documentation of climate change occurred in the 1970's and was labeled "regime shift." At the time, the scientific assumption was that they were measuring a natural fluctuation, a cyclical change in temperatures, not the almost exponentially increasing long-term anthropogenic trend now acknowledged as climate change. Considering the cyclical population dynamics of marine species, fisheries scientists were encouraged to study the coupling of species fluctuations with so-called regime shift to add a natural and measurable explanation and predictive layer to the stock assessments of commercially important species. Coincidentally, it provided a convenient explanation for the demise of shellfish stocks in the GOA and EBS that let the managers and the fishermen off the hook. Cod populations were said to increase in warmer regimes while shellfish supposedly decreased.

A seminal paper came out of the Kodiak NMFS lab in the mid-1980's documenting a strong correlation, assuming causation, between the disappearance of pink shrimp in the Gulf of Alaska and the timing of the "regime shift." Staff at the lab spent many years working on defining that relationship. When I asked how the massive removals by the shrimp fishery in the 60's and 70's were accounted for in the analysis, the insistence was that temperature data had documented that the real cause of the shrimp disappearing was regime shift and any further discussion was unwarranted. "Regime shift" has since become the Holy Grail of fishermen and scientists explaining away the declines in species after species that have been overfished.

Yet even the shrimp fishermen had complained in the 70's that they were overfishing and asked Fish and Game to intervene. But the insatiable nature of the markets pushed on. When pollock started to show up in their shrimp catches the fishermen knew they had been fishing too hard for too long. (Personal communications) When the fishery finally closed in 1983, there was only one boat out of a previously large Kodiak fleet, the one my fiancé crewed onboard, left trawling for shrimp.

The only tool managers had in their toolbox during the heydays of Alaska shrimp and crab fisheries was catch-per-unit-of-effort or CPUE. CPUE is more a justification to keep fishing, regardless of inherent model limitations, when there is no statistical or economic reason to stop. As one member of the Council's Crab Plan Team quipped in a March 2023 meeting: "CPUE is an exercise in desperate." It has long been criticized as not providing a clue to the measure of true stock abundance but encouraging overfishing instead. Unfortunately, the measure is still in use by NMFS scientist today. CPUE is, however, intuitively useful for costly fishing operations to know when to move to new grounds, tending to keep CPUE measures of abundance high even as the stock continues to plummet. The skill of the fishermen also has a direct effect on the magnitude of that measurement. A thorough review of the history and disappearance of pink shrimp around Kodiak

Island points to overfishing as the likely culprit. Cynically, "regime shift" was also the default culprit when crab stocks crashed around the same time.

Blaming "natural fluctuation" rather than serial depletion as the underlying cause of fisheries declines, American industrial fisheries have historically migrated northward in search of more lucrative fishing opportunities leaving severely altered ecosystems and depressed small coastal fishing communities in their wake. (Orensanz et al. 1998) Even with the development of more sophisticated assessment tools over the last 40 years, the statistical approach to RKC fishery management, and most other species as well, has skewed largely in favor of the trawl industry, assigning unreconcilable error to the vagaries of climate change and ocean acidification – not the repeated unseen damage deep below the sea surface.

So how can we understand and reconcile the very real and increasing strength of climate change and ocean acidification relative to the long-term downward trends in shellfish fisheries? There has been a wealth of laboratory-based scientific investigations testifying to the impacts on crustacean larval, juvenile, and adult growth and survival when exposed to high temperatures and increased acidification, but, as mentioned above, there is no evidence that these studies have translated to any specific negative effect, so far, in wild RKC populations. (Benarsek, et all. 2021) Notwithstanding the fact that in the EBS, ocean acidification and temperature trends are headed in a very precarious direction[7], those critical thresholds have not yet been reached in RKC habitat in Bristol Bay and cannot be assigned culpability in the historic demise of red king crab in Alaska.

By way of contrast, the red king crab that were introduced by the Russians into the Barents Sea in the 1960's have instead flourished over the last 50 years spreading and migrating into new habitat, providing fisheries for the Russians, the Norwegians, and now even the British Isles – during the same period that climate change has been blamed for the inability to rebuild Alaska crab stocks. Ocean warming being a global phenomenon, temperatures in the Barents Sea have risen, on average, 2.7°C per decade over the last 20-40 years, yet RKC have done well there, especially after local overfishing was curtailed. Russian scientists report that RKC recruitment increased with warmer temperatures (Dvoretsky and Dvorretsky 2016), contrary to the prevailing perception of the effects of "regime shift" in Alaska waters.

"Because climate change is so exculpatory and such a good excuse, it provides a perverse disincentive regarding any sacrifice that might impose costs on the fishing industry."[8] Despairingly acquiescing to the "good excuse" of climate change, one member of the Council's Crab Plan Team, in March 2023, labeled the probability of Alaska's RKC populations rebuilding as "hopeful to none."

It is an unfortunate observation that agency scientists and managers, using language that supports the trawl industry, would rather blame Nature, the ocean, or things beyond their control than investigate the possibility that they have been mistaken or mislead – or accept that, when left alone,

[7] https://www.fisheries.noaa.gov/alaska/science-data/near-real-time-temperatures-bering-sea-bottom-trawl-survey-2023
https://aoan.aoos.org/oa-management-informing-bering-sea-fisheries/

[8] C.B. Dew, 2023 Facebook post

life in the ocean is far more resilient than we can comprehend. The clarion call is to accept that we cannot begin to account for the changes observed in EBS or GOA ecosystems without recognizing and effectively curtailing the well-secreted destructive fishing behavior of the very large and powerful corporate trawl industry. And, planning for the potential increasing impacts of climate change effects, we need to be scaling back our industrial fishing behavior to allow the systems, the species, and the coastal fishing-dependent and subsistence communities to adjust and survive.

Valuing Fisheries

For over 40 years, commercial trawl fisheries in the North Pacific EEZ have managed to dismiss their impact on sea floor habitat and premium bottom dwelling creatures like red king crab and Pacific halibut as minimal. Their lobbyists have promoted this falsehood and enabled the destruction by: having significant input into FMP language, regulatory proposals, and proposing quotas or TAC's; manipulating regulatory definitions of pelagic trawl gear and performance standards; and complicating how observer data is collected to hide the inconvenient truth of their actual behavior; and promoting climate change as the cause of all our sorrows. Trawl advocates, both industry lobbyists and government agencies, promote the use of terms like "risk" to [corporate] investments (and government subsidies), economic "efficiency," and "net benefit to the Nation" to deflect attention away from true conservation principles as the over-capitalized fleet renders once complex and dynamic ecosystems unrecognizable, radically altered, and devoid of the diversity of their former bountiful, life-giving potential. We are asked to prioritize the pollock fishery and the mono-cropping of Alaska marine ecosystems to provide fish sticks for American school children and surimi for fake crab for the masses as acceptable goals for our common good. And now the obscene concept of "cost-benefit analysis" applied to sacred life-giving natural systems has crept into discussions at recent Council meetings – i.e., What is the benefit of protecting essential king crab habitat versus the cost in revenue and inconvenience of changing the behavior of the industrial trawl fleet?

So, what are the true economic costs and benefits to the Nation of pollock versus crab fisheries? Setting aside the unmeasurable value of the external costs borne by the ecosystem. According to NOAA Fisheries Office of Science and Technology (OST)[9], the total value of the 2.23 billion pounds of pollock landed in Alaska in 2021 was $371.4 million while 6.03 million pounds of red king crab provided $75 million at the dock. When we convert the value of 1980 red king crab landings, then priced at 0.94/lb., into 2021 dollars using the U.S. Inflation Calculator, the 185.3 million pounds of RKC caught in 1980 in all of Alaska, would have a total landed value of $573.3 million in 2021 dollars, a 54 % increase over 2021's landed pollock value. But, if we argue that red king crab were being overfished in 1980, and assuming half of those landings might have been realized from a long-term, undisturbed, well-managed RKC fishery into 2021, at the 2021 OST landings value of $12.00/lb., that theoretical 92.7 million pounds of red king crab would be worth $1.112 billion today, or potentially 3 times the value of all the pollock landed in 2021.

When you combine the value of the landings of the three major bottomfish species in Alaska, pollock, cod and yellowfin sole in 2021, you arrive at $525 million, or approximately half of the

[9] https://www.fisheries.noaa.gov/foss/f?p=215:200:2323824155175

potential landed value of king crab from a reasonably healthy population. This does not account for rollover economic magnification as RKC is processed and goes to market where it was fetching over $40.00/lb. before the fishery closed. This scenario is not unrealistic given the Barents Sea example and the health of the Bristol Bay RKC stock with the establishment of the Japanese Broodstock Sanctuary.

During the development of the U.S. trawl industry in the 1980's, there had been a lot of rumbling on the docks in Kodiak and at the Council by the trawlers and their lobbyists that they could catch a lot more fish if prohibited species catch (PSC) – crab, halibut, and salmon – didn't get in their way. (Personal observations) A lot of effort was expended figuring out how to account for PSC in order to increase groundfish takes. Today, all of those prohibited species' populations are in dire straits while the pollock fleet has maintained an average annual catch of over 3 billion pounds for the last 20 years, gradually moving west and northward in search of better fishing grounds while their voracious nets swallow up everything in their path. The huge corporate investments in these industrial operations require that they continuously maintain their catch levels regardless of the inconvenience to other fisheries or the ecosystem. The pressure on the Council is to maintain that level of biomass removals. Setting allowable catches as biomass over expansive regions feeds into that industrial agenda and obliterates any sense of localized impacts by the fleet.

Are these the costs we should be managing for? Is this truly the highest "benefit to the Nation?"

The North Pacific has been touted as having the best managed fisheries in the world. That depends, of course, on how you interpret the outcomes. Given the lost value in red king crab alone, much less Bairdi Tanner crab, Dungeness crab, shrimp, halibut, chum and king salmon, I am hard pressed to find a justification for such a high evaluation of the North Pacific Fisheries Management Council or its numbingly convoluted and overly burdensome process. Chalking it all up to environmental variability and climate change doesn't meet muster. Over the years, I have watched clever industry lobbyists dominate committees, complicate the discussion, obscure the facts, deflect focus to other sectors resulting in time-consuming and useless finger-pointing contests, and deftly lobby the congressional budget process to control what parts of the NOAA Fisheries agenda gets funded and, therefore, what scientific investigations go forward and what data actually gets collected. The infrequency of Gulf of Alaska groundfish surveys and the defunding of the Fisheries Oceanography Cooperative Investigations (FOCI) program in the 1980's were cases in point. Yet these same lobbyists have argued that we can't act to restrict trawlers without the data they have made sure are not available.

Together, highly competent fishery biologists and assessment analysts have worked to develop state-of-the-art statistical models for evaluating the population dynamics of Alaska's commercial species, often with limited data. For decades they have labored under legal directive from the MSA to determine a quasi-quantifiable, non-scientific value called MSY for single species stocks – strictly in terms of biomass or B_{MSY}. A lot of resources have been focused on improving the precision of those tools, yet the NPFMC's failsafe fallback position has been to simply not exceed a blunt take of 2.2 million metric tons of total biomass from the entire EBS ecosystem per year. The archaic single-species cookbook cannot and does not account for what it cannot measure nor does it capture the salient nuance that allocating catch as biomass over wide geographic areas clouds over.

Additionally, NOAA Fisheries and Council efforts have been blinded and encumbered by the lack of transparency and the obfuscation of the trawl sector. This blunt and underfunded approach, with limited data and major unchallenged statistical assumptions, leaves too much room for misinterpretation regardless of significant efforts to refine it.

If there was ever an industry that adeptly co-opts and manipulates scientific data, complicates the regulatory structure toward its own agenda, and baffles the public with catchy, media-genic phrases while diverting attention away from troubling facts, it is the well-heeled fishing interests operating with subtle interference in fishery assessments and data interpretations and with skillful deflection of federal agency oversight. Tactics all too common throughout the prevailing corporate-political-industrial complex in our world today enable the largest, most destructive industrial fishery in the country, if not the world, to be certified as "sustainable" by the propaganda arm of the largest corporate conglomerate of the international seafood industry.

"*Wild Alaska Pollock*" is apparently an industry standard for sustainability according to the Marine Stewardship Council.

But the federal government cannot be left off the hook. This has been a decades-long cooperative partnership. The current management "cookbook" was originally written in tight coordination with industry. (Finley 2011) We are now coming to terms with the true consequences of the original 1976 fisheries act that seeded and subsidized the development of the industrial trawl sector, giving it *carte blanche* to the EEZ with the goal of capitalizing on the wealth to be realized in the 200-mile coastal jurisdiction established with that same action. NOAA Fisheries was given the conflicting goals of developing, supporting, and promoting trawl fisheries while simultaneously defending conservation. It is time to rip off the masks of obfuscation and take a hard look at the difficult truths that lie beneath. Climate change is having real effects in our world today, but all the strong evidence, not discounting directed fishing pressure, points to non-target fishing mortality and habitat destruction as the principle causes of the major losses we have experienced with Alaska's premium, iconic species. The last 40+ years of widespread trawling on sensitive benthic habitat is a destructive predicate to the devolving changes Alaska's marine ecosystems are likely to experience going forward without critical course correction. It is time to learn how to behave, at all levels.

After 12 years working as a fishery biologist on federal fisheries stock assessment surveys throughout Alaska, and 20 years living and fishing in one of the largest fishing communities in the country, it is my assessment that attempting meaningful measurements of the vastness of ocean life in order to create a quantifiable crystal ball of fishery productivity, and therefore annual catch at industrial levels, is a fool's errand. What we need is an all-new approach to managing fishing behavior (not an easy task) and appropriate fishing gear – managing for what the gear encounters and minimizing unwanted changes to the ecosystem. A new approach that comes from, and is for, informed, conscientious fishermen, not corporate interests seeking ownership of ocean resources. We need collective commitment to evolve beyond the outdated, destructive industrial model and to learn how to act responsibly while receiving, not taking, the abundant offerings of our long-misunderstood Ocean. Reaching back to the wisdom of the ages as our anchor, with advancing technology, we can develop new, non-invasive tools to create and evaluate indices of abundance, minimize fishing impacts, and further both conservation and sustainable fishing communities. We

need to take far less, only what we need, and manage for, and value, what the fishing gear encounters.

If we are going to manage for the true economic value of North Pacific fisheries, an accurate "cost-benefit analysis" would argue for removing all trawl activity from historical crab grounds, dramatically reducing the size and location of the trawl fleet's footprint while focusing on overall ecosystem health. Given the Barents Sea example, if we are patient enough to allow the ecosystem to reset itself, in 15-20 years we can have a vibrant, flourishing ecosystem again, full of not only crabs and halibut, shrimp and salmon, but the living diversity of the past that seabirds and marine mammals evolved to depend upon as well. A wild ocean that can support the fishing and subsistence communities that respect and depend upon her abundance. This rewilding will take patience. Pessimism about the distressing potentials of climate change is not an excuse, but it is a cynical industrial tool.

Once we reengage with the universal values of honesty, integrity, truth, and reverence for the sacredness of all life, rather than sacrificing them at the altar of veiled greed and the capitalist-industrial worldview, we can begin to come into balance and harmony with the life-giving gifts our generous Mother Ocean provides for us.

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