An Independent, Scientific Review of the Biological Opinion (2010) of the Fisheries Management Plan for the Bering Sea/Aleutian Islands Management Areas

Public Meeting

1-2 August, 2012

Seattle, WA USA

Photo by NOAA Fisheries

Steller Sea Lion (*Eumetopias jubatus*)

The North Pacific Fishery Management Council unanimously passed a motion in August 2010 which included the following:

The Council notes concerns and recommendations by their Science and Statistical Committee (on the draft biological opinion) *including:*

- *stating as fact some conclusions that still have a great deal of uncertainty about them such as past conservation methods having a positive impact on reducing the impacts of the fishery exploitation strategy on Steller sea lions";*
- *assumptions underlying the BiOp analysis including biomass projection methodology, biomass apportionment, and nutritional stress as the causal factor for low natality;*

and therefore recommends an independent review of the BiOp.

Review Panel Members

Dr. Andrew Trites, **Marine Mammal Scientist**

Dr. Gunnar Knapp, **Resource Economist**

Mr. Steven Jeffries, **Marine Mammal Scientist (co-chair)**

Dr. David Bernard, **Fisheries Scientist (co-chair)**

- No member of the panel is, or has been, involved in management of groundfish fisheries in the Bering Sea/Aleutian Islands.
- Only Dr. Trites had read the biological opinion (BiOp) prior to our review.
- No member of the panel had read the environmental assessment and regulatory impact review (EA/RIR) prior to our review.

Our Charge in the TOR

The review panel will focus, but not necessarily limit, their review on conclusions in the Final BiOp involving:

- The finding of Jeopardy of Adverse Modification for groundfish fisheries in the Bering Sea/Aleutian Islands (BSAI) management area;
- The likelihood that Reasonably Prudent Alternatives (RPAs) will result in recovery of Steller sea lions in the BSAI area; and
- The likelihood that among all possible RPAs that could result in recovery, the RPAs chosen will incur minimal economic and social costs.

Also, the review panel will evaluate evidence that public comments on the draft BiOp had been addressed in the Final BiOp.

Topics Covered in Our Review

2. **THE BIOP'S STANDARD FOR LIKELIHOOD OF JEOPARDY**
3. **STATISTICAL RELATIONSHIPS BETWEEN FISHERIES AND STELLER SEA LION POPULATIONS**

    Statistical Meta-Analysis w/emphasis on the Foot-Print Analysis

4. **THE BIOP'S EXPLANATION OF THE ECOLOGICAL RELATIONSHIP BETWEEN FISHERIES AND STELLER SEA LIONS**

    Fishery-driven Nutritional Stress: Schematics, Forage Ratios, "Birth Rates", Exposure of Habitat to Fishing, Overlaps, Food-web Dynamics

5. **ALTERNATIVE HYPOTHESES FOR CAUSES OF THE STELLER SEA LION DECLINE**

    The "Junk Food" Hypothesis (Environmentally-driven Nutritional Stress) and Killer Whale Predation

Topics Covered in Our Review

6. **THE BIOP'S ANALYSIS OF EFFECTS OF RPAS**

   Expectations for RPAs and Predicting Responses to RPAs

7. **ECONOMIC ANALYSIS IN THE REGULATORY IMPACT REVIEW**

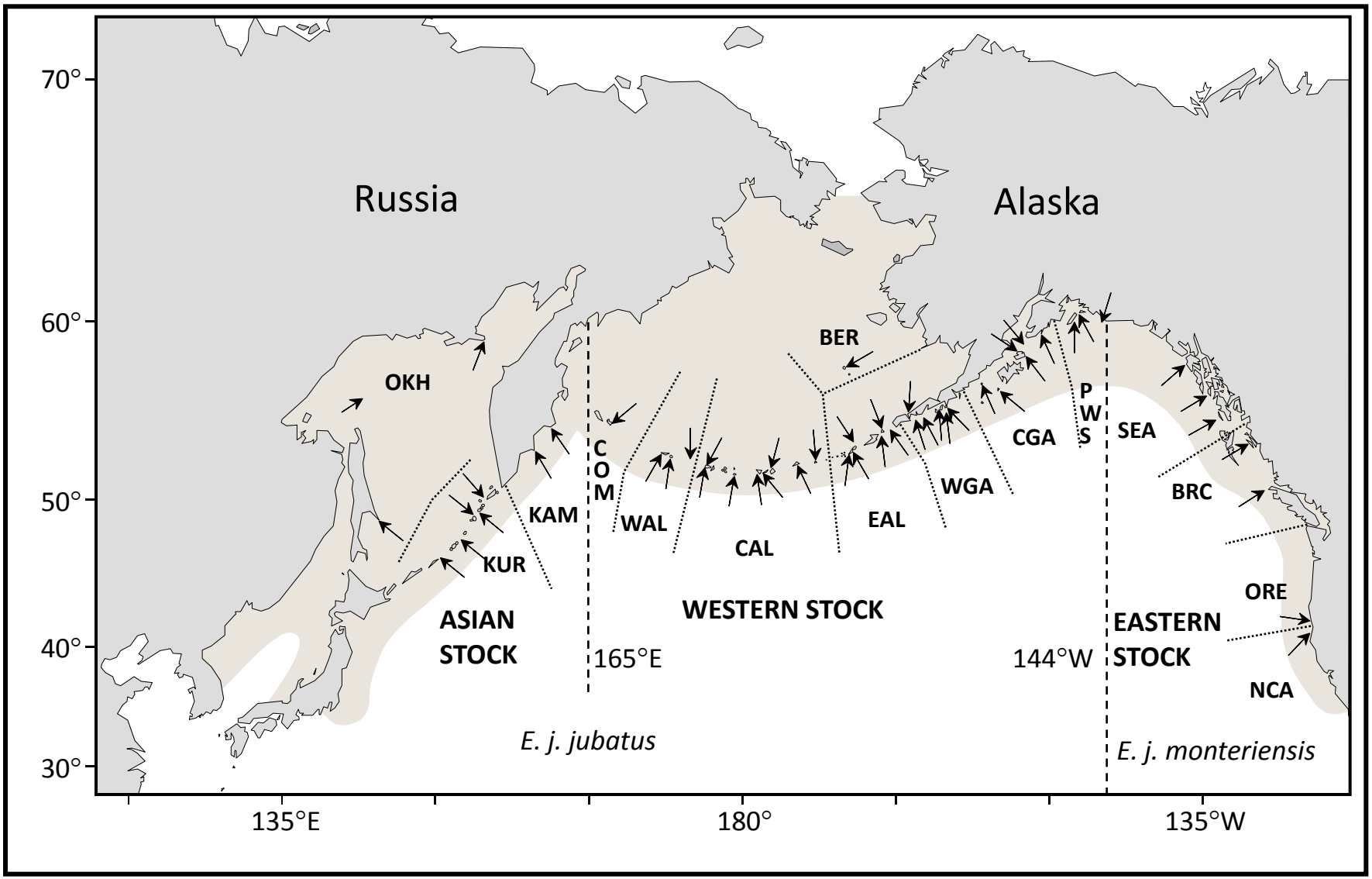
   Cost-benefit Analysis, "Least Adverse Effects", Minimizing Economic/Social Impacts

8. **CONSIDERATION OF PEER AND PUBLIC COMMENTS**

9. **CONCLUSIONS: Fulfilling the TOR**

Bernard, D. R., S. J. Jeffries, G. Knapp and A. W. Trites. 2011. An independent, scientific review of the biological opinion (2010) of the National Marine Fisheries Service fisheries management plan for the Bering Sea/Aleutian Islands management areas. Alaska Department of Fish and Game, Special Publication 11-16, Anchorage.

http://www.adfg.alaska.gov/FedAidPDFs/SP11-16.pdf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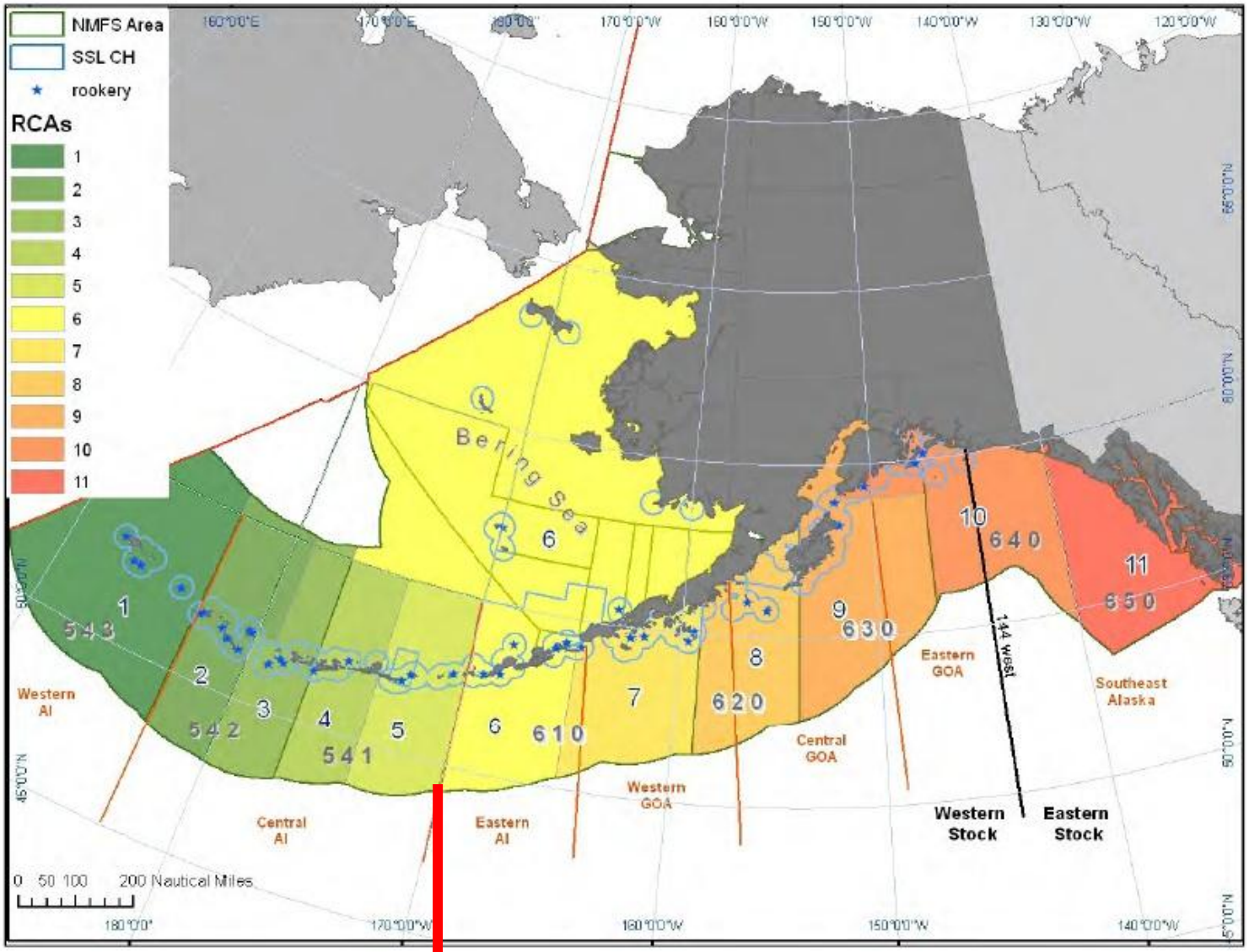


SSL #'s Decreasing | **SSL #'s Increasing**

2a. The BiOp's Standard for Likelihood of Jeopardy

Sec. 7.(a)(2) — Each Federal agency shall, in consultation with and with the assistance of the Secretary, insure that any action authorized, funded, or carried out by such agency … is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species …

Main conclusion in the BiOp:

"… *it is NMFS' biological opinion that the action* (the FMP), *as proposed, is likely to adversely modify the designated critical habitat for the western DPS of Steller sea lion.*" [BiOp, xxxiv]

3. Statistical Relationships between Fisheries and Steller Sea Lion Populations

"At this time with available data, it is not possible to demonstrate a statistically significant relationship between commercial fisheries on pollock, cod, Atka mackerel and arrowtooth flounder and the productivity of Steller sea lions in the western DPS. However, it is also not possible with the available data to conclude that commercial fisheries are <u>not</u> having a significant impact on the recovery of the western DPS of the Steller sea lion." [BiOp, 301]

Statistical Tests ($\alpha = 0.05$): Fishery Statistics/Prey Biomass vs. SSL Demographics

	Type of Relationship:				
	Harmful	Benign	Beneficial		
Calendar Years 1979 – 2002:					
Atka mackerel	0	41	0	Two studies	WDPS or Areas 541-3
Pacific cod	4	48	0	Four studies	WDPS or Areas 541-3
Calendar Years 2000 and later:					
Atka mackerel	0	51	15	Four studies	Areas 541-3
Pacific cod	0	18	1	Two studies	Areas 541-3

4. The BiOp's Explanation of the Ecological Relationship between Fisheries and Steller Sea Lions

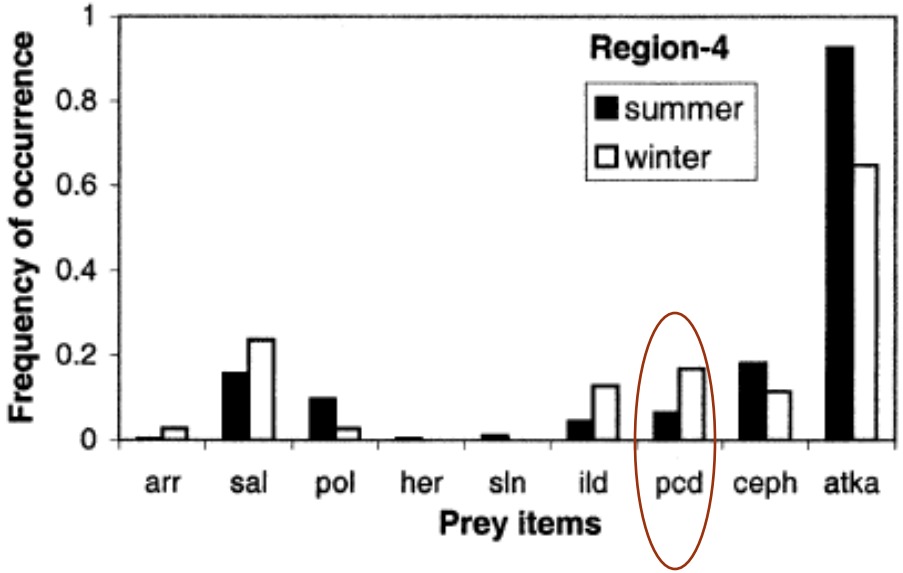
"The most notable indirect effect of commercial fisheries on Steller sea lions is the removal of prey species which could alter the animal's natural foraging patterns and their foraging success rate;" [BiOp, 198]

"A sustained reduction of prey resources across a broad geographic region (i.e., ecosystem) would thus reduce the carrying capacity of Steller sea lions. These potential impacts have generally been referred to as (fishery-driven) *nutritional stress (see Section 3.1.14)."* [BiOp; xxxii, 199, 347]

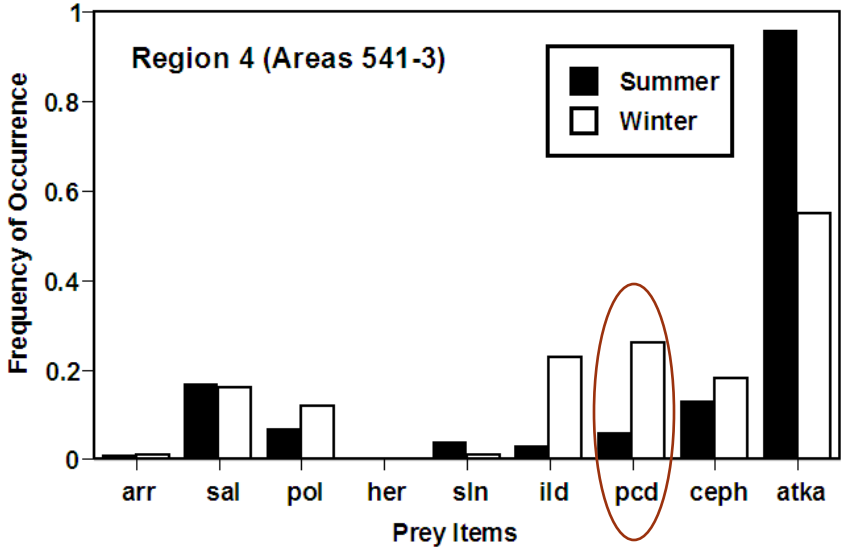
4a. Problems with the BiOp's Ecological Explanation

Scat analyses indicate that Pacific cod is at best a MINOR component of sea lion diets (from information given in the BiOp).

1990-1998: 4273 Samples



1999-2005: 784 Samples



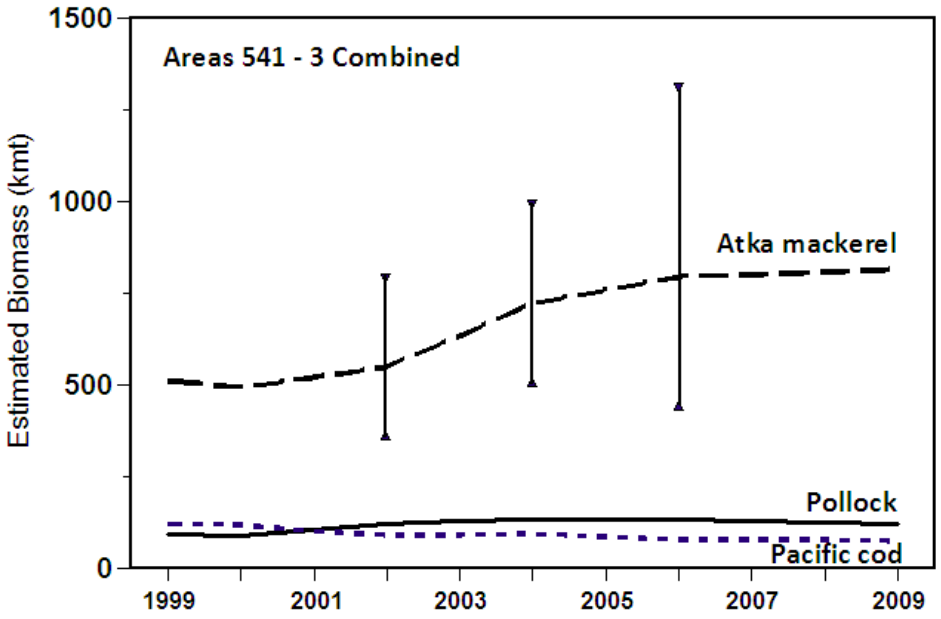
4b. Problems with the BiOp's Ecological Explanation

Stock assessment surveys in Areas 541-3 show fisheries impose a minor annual harvest rate (~8%) on a large biomass of Atka mackerel.

(information given in the BiOp)

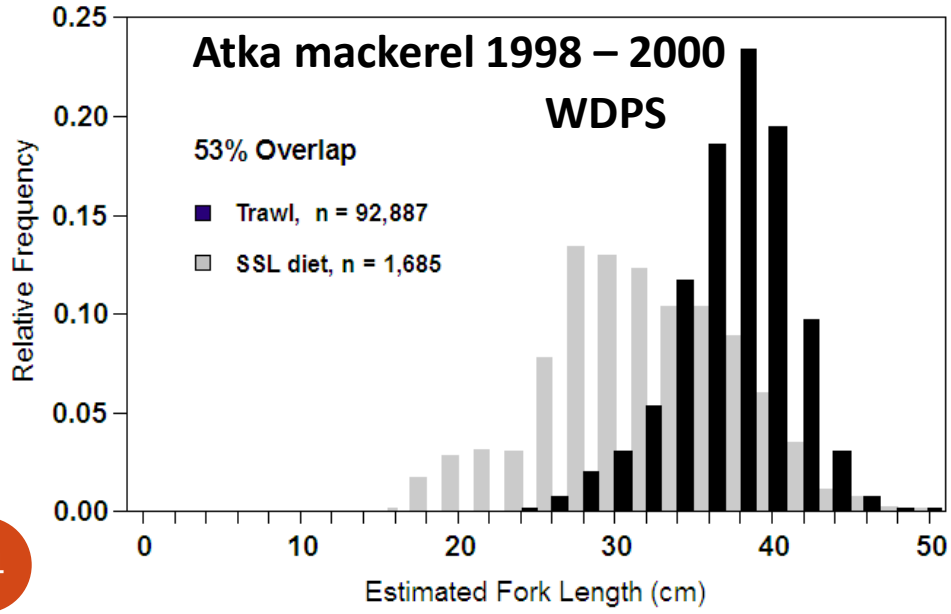
	Pollock	Pacific cod	Atka mackerel
1999	1%	23%	11%
2000	1%	34%	10%
2001	1%	33%	12%
2002	1%	34%	8%
2003	1%	35%	8%
2004	1%	31%	7%
2005	1%	26%	8%
2006	1%	30%	7%
2007	2%	43%	7%
2008	1%	40%	7%
2009	1%	35%	7%
Median	1%	34%	8%

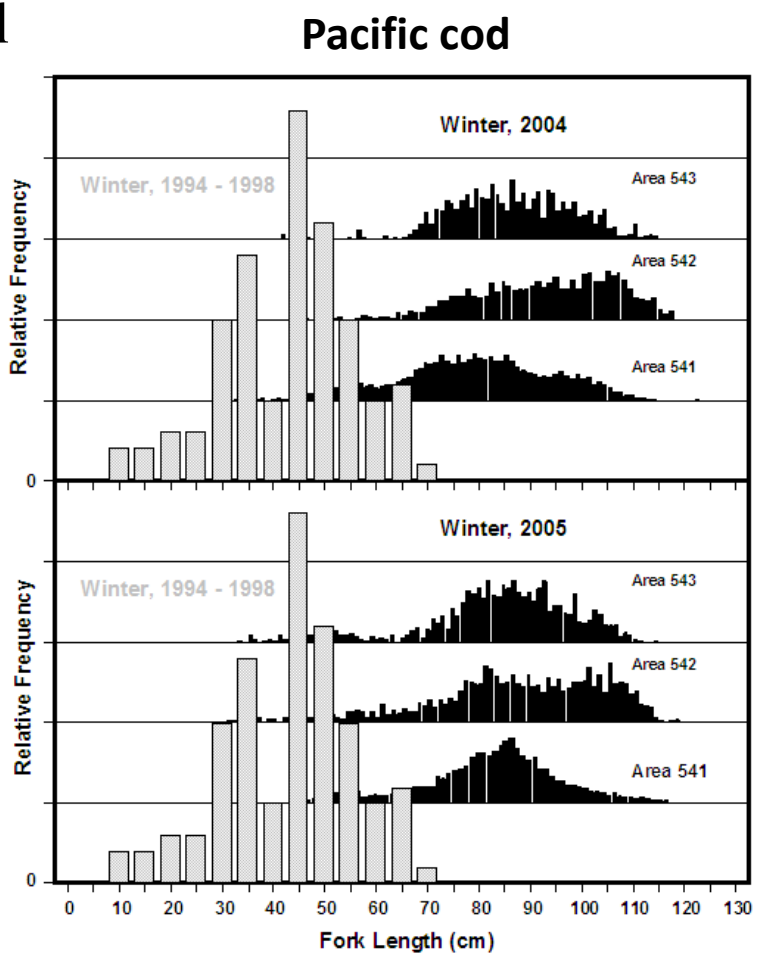
(information NOT given in the BiOp)



4c. Problems with the BiOp's Ecological Explanation

Steller sea lions "out-compete" fisheries for prey by feeding mostly on recruit and pre-recruit Atka mackerel and Pacific cod while fisheries largely catch older fish (information not in the BiOp).





4d. Problems with the BiOp's Ecological Explanation

Forage ratios (available biomass divided by estimated dietary needs) are inversely related to percent changes in abundance of Steller sea lions.

(from information in the BiOp)

Area	Change in Non-Pup Counts 2000-2008	Biomass Eaten by Steller Sea Lions (kt/yr)	Mean Biomass Pollock, Pacific cod, Atka mackerel (kt)	Forage Ratio
543 (WAI)	-7%	17.8	465.5	26.1
542 (CAI)	-2%	53.0	285.3	5.4
541 (CAI)	0%	59.5	267.2	4.5
ALL		130.3	1,018.0	7.8

4e. Problems with the BiOp's Ecological Explanation

Multi-species, food web modeling by NMFS indicated no long-term improvement in sea lion numbers if fisheries for Atka mackerel or Pacific cod are reduced in the western and central Aleutian Islands.

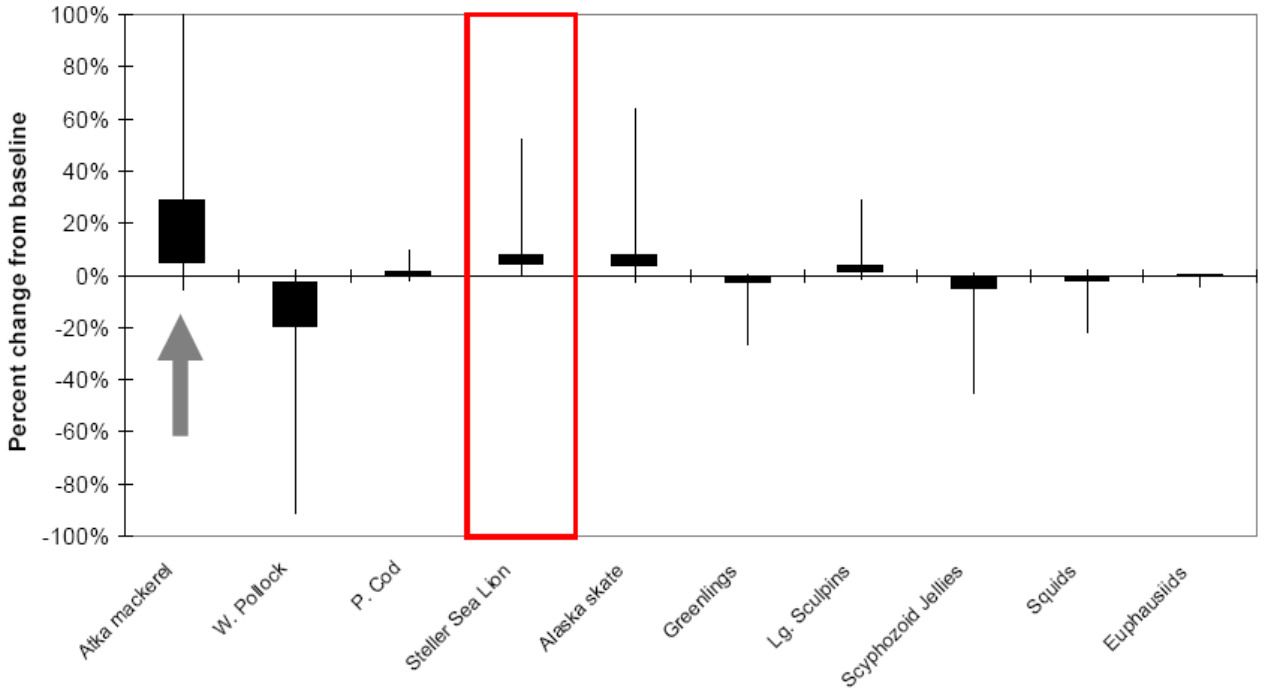
Simulation using multi-species food-web models resulted in a % change of biomass against a baseline from reducing either Atka mackerel or Pacific cod mortality rates by 10 percentage points.

Bars and lines on the next slide show 50% and 95% of results obtained from 500 (virtual) *ecosystems drawn from parameter distributions based on uncertainty in input parameters of biomass, production rates, consumption rates, and diets for the Aleutian ecosystem as described in Aydin et al. (2007).*

Atka mackerel:

Virtual mortality rate reduced 10 percentage points

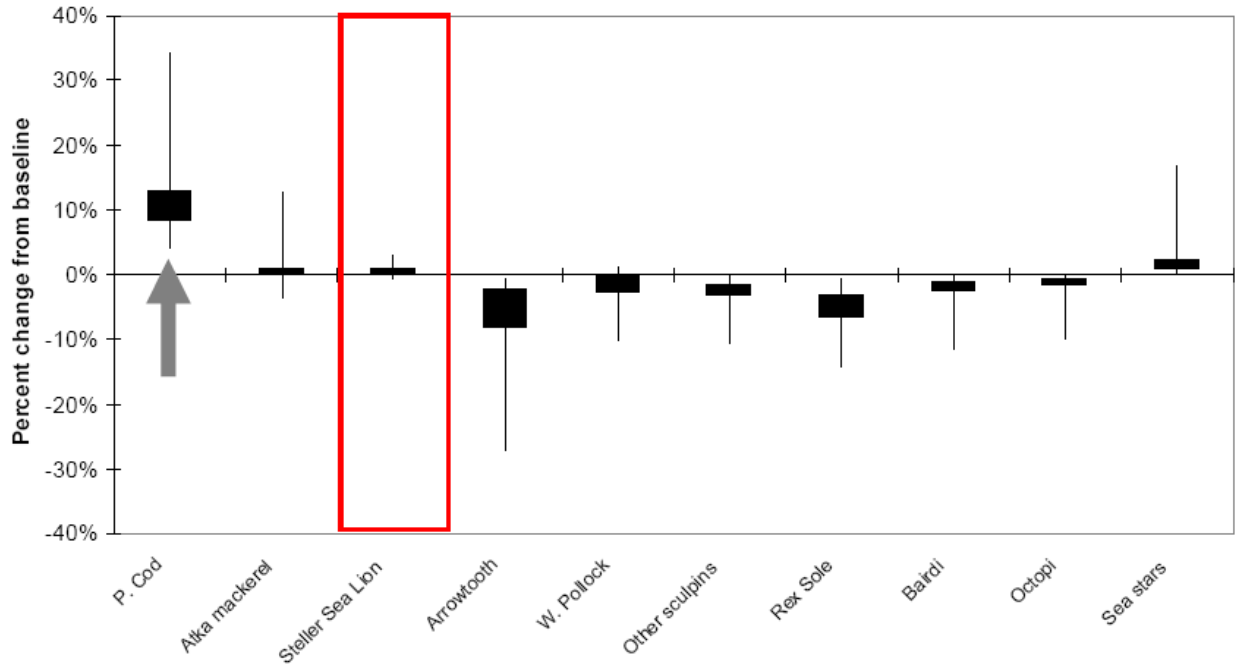
Estimated annual harvest rate in Areas 541-3 averaged 8%.



Pacific cod:

Virtual mortality rate reduced 10 percentage points

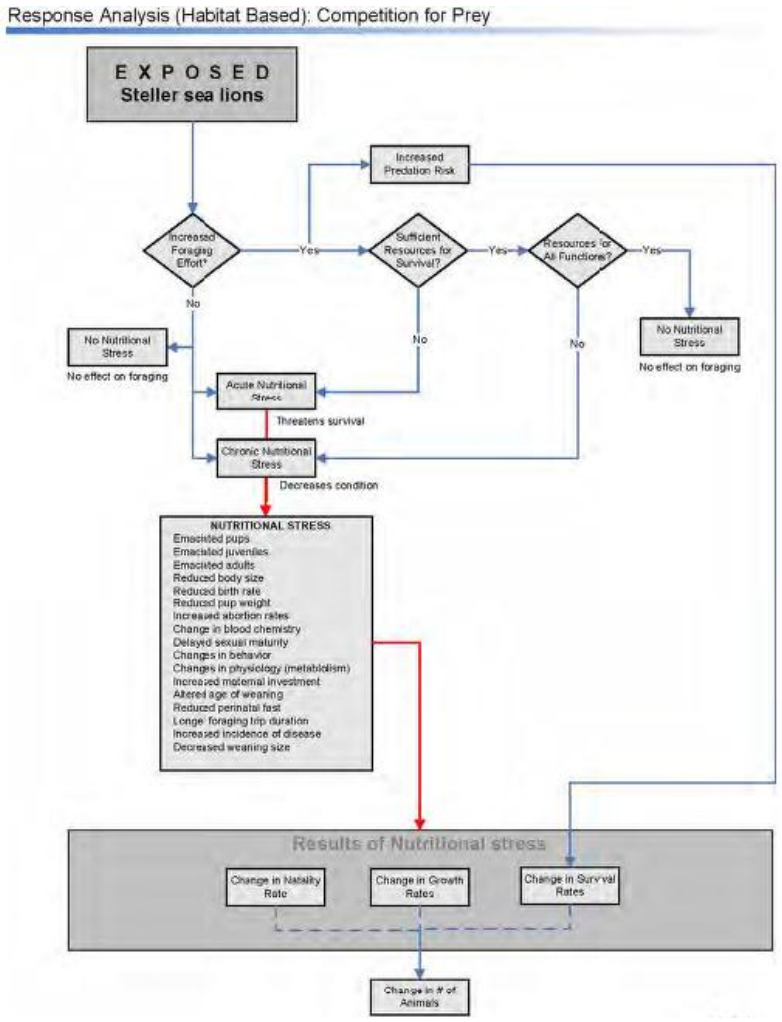
Estimated annual harvest rate in Areas 541-3 averaged 34%.



4f. Problems with the BiOp's Ecological Explanation

Of 33 potential biological effects of fishery-driven nutritional stress listed in the Table 3.17 in the BiOp and summarized in the testing flowchart to the right, also from the BiOp:

1 effect was observed (low birth rate);
11 effects were not observed; and
No data were available on 21 effects.



4g. Problems with the BiOp's Ecological Explanation

Each unresolved problem with the BiOp's ecological explanation:

> *"The most notable indirect effect of commercial fisheries on Steller sea lions is the removal of prey species which could alter the animal's natural foraging patterns and their foraging success rate;"* [BiOp, 198]

reduces the likelihood that the explanation is true, and increases the likelihood that the main conclusion in the BiOp:

> *"… it is NMFS' biological opinion that the action, as proposed, is likely to adversely modify the designated critical habitat for the western DPS of Steller sea lion."*[BiOp, xxxiv]

is false. We concluded that these unresolved problems are sufficient to assure us the action (the FMP) " … is not likely to jeopardize … " under Section 7 (ESA) and that the finding of JAM was unwarranted.

2b. The BiOp's Standard for Likelihood of Jeopardy

The phrase "not likely" is never explicitly defined in the BiOp, but appears to be implicitly defined by NMFS as meaning "not possible":

> *"The possibility that [fisheries removals of prey] may be one of several primary causes of the observed declines in non-pup counts cannot be eliminated."* [BiOp, 354]

> *"Based on all the available evidence, it is not possible to definitively conclude that the fishery north of Unimak Island does not affect foraging efficiency of Steller sea lions within their critical habitat by reducing densities of Pacific cod during winter."* [BiOp, 237]

> *"… I think that what the panel is looking for right now is some kind of precision on numbers, of what "likely" is, and that is not the standard that the agency has to meet. It just has to assure that its actions are not causing jeopardy."* Mr. John Lapore, NOAA General Consul, in testimony on 22 August 2011, Anchorage, AK USA

5a. Alternative Ecological Explanations

Environmentally driven nutritional stress (the "junk-food" hypothesis).

- Quality of diet (diversity) for pups is insufficient for growth in body size
- Mothers suckle longer to compensate, thereby inhibiting new births
- Lower birth rates reduce recruitment rates to sea lion populations

In the BiOp, this alternative explanation was poorly described, incompletely tested, and referenced incorrectly. No judgment as to its relevance to Steller sea lions in the Western and Central Aleutian Islands was provided in the BiOp.

5b. Alternative Ecological Explanations

Predation by killer whales.

> *"The predation of killer whales on Steller sea lions was previously thought to be minor, but recent reevaluations of their abundance suggest that killer whales could be a major source of sea lion mortality"*. [from a report by the National Research Council, 2003]

> "*Mammal-eating killer whales and/or predation from other sources can have considerable impact on SSL populations, particularly when a sub-region is comprised of only small numbers of SSLs.*" [BiOp, 111]

6a. The BiOp's Analysis of Effects of RPAs

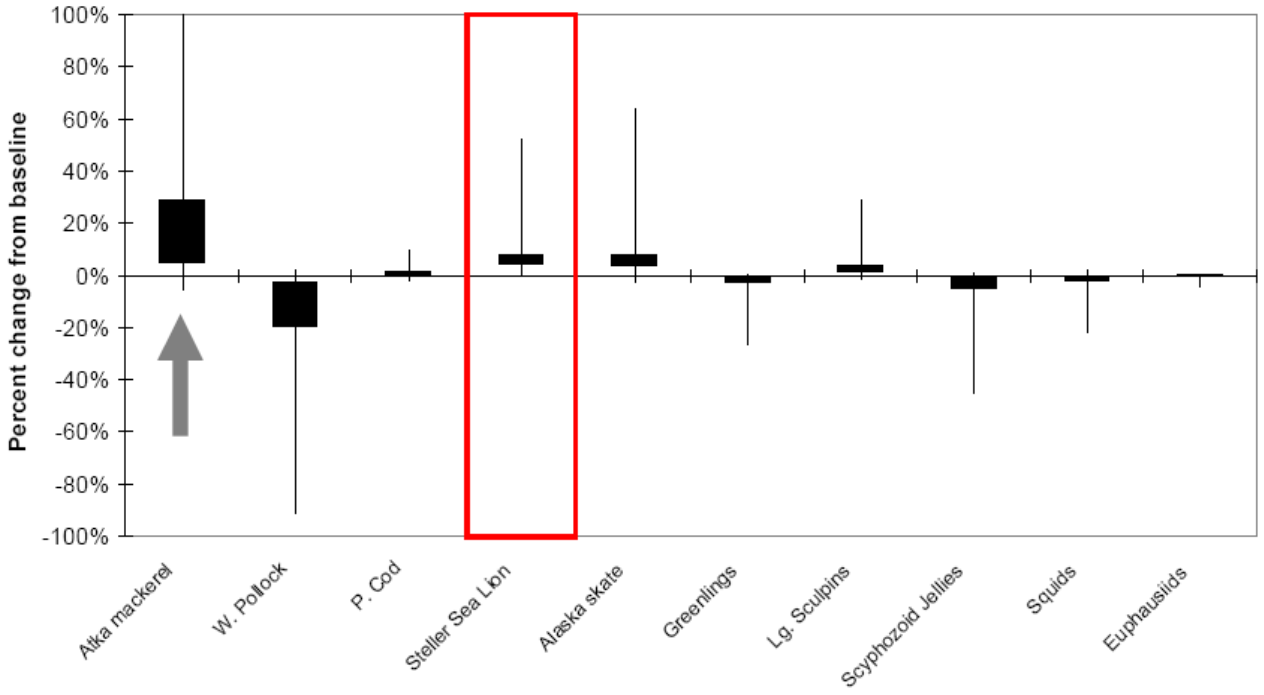
Multi-species, food-web modeling, seemingly required because of the multispecies justification (fishery-driven nutritional stress) in the finding of JAM, was not used to develop RPAs for the Western/Central Aleutian FMP:

> *"Here we note that uncertainties inherent with the assumptions of single-species approaches become magnified in multispecies models. Therefore, NMFS believes that given the information available, it is premature to add more assumptions to the models predicting predator-prey responses and has relied on the results of the single species models to a greater extent than the multispecies models in predicting the effects of the RPA."* [BiOp, 362]

Atka mackerel:

Virtual mortality rate reduced 10 percentage points

Estimated annual harvest rate in Areas 541-3 averaged 8%.



Pacific cod:

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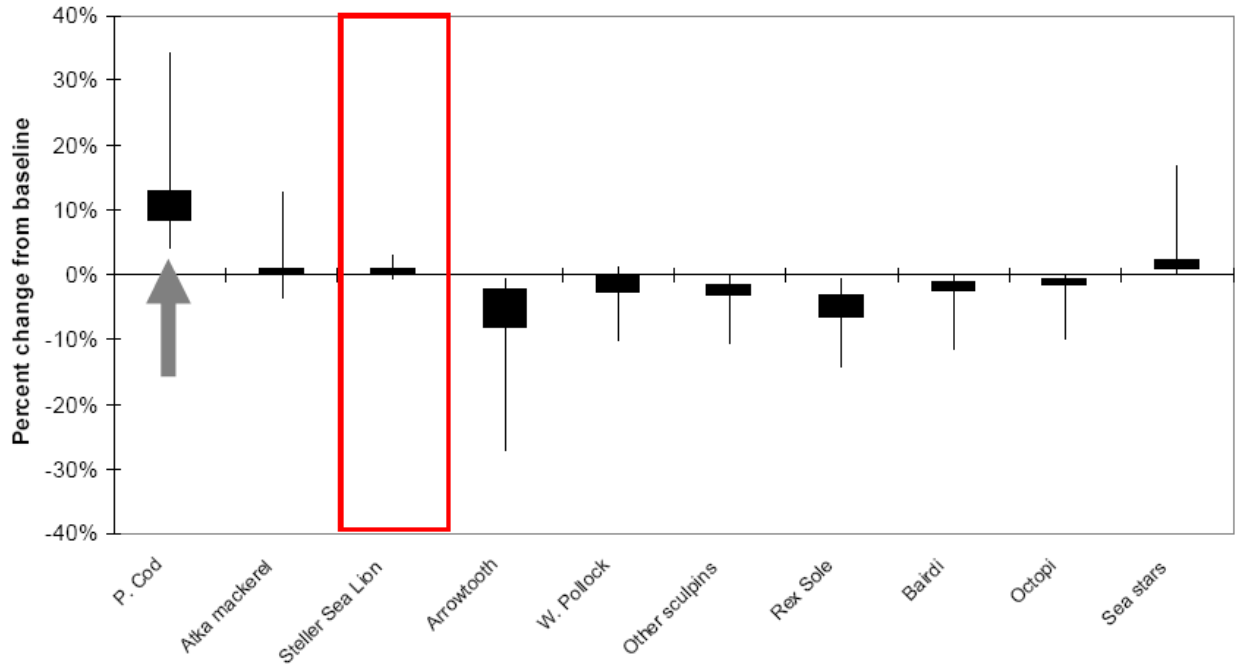
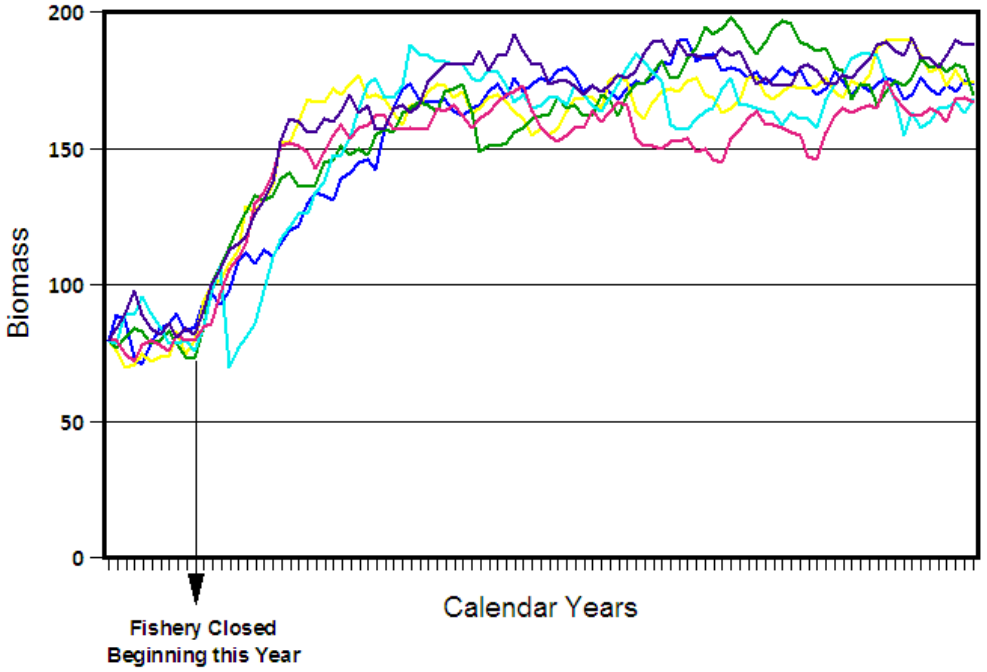


6b. The BiOp's Analysis of Effects of RPAs

Single-species modeling of Atka mackerel and Pacific cod biomass, though inappropriate, was presented in BiOp, but was also not used to develop RPAs as implied on [BiOp, 362]

Stock Model —
- Stochastic on:
  - inputs
  - parameter values
- No density-dependence in:
  - mortality rate
  - recruitment rate
- Independent Recruitment
- No validation



6c. The BiOp's Analysis of Effects of RPAs

Projected effects of RPAs for the Western/Central Aleutians FMP in 2011 are interpolations of the demographics of sea lions in the Eastern Aleutians/Gulf of Alaska Fishery Management Areas (EAI/GOA) coincident with RPAs implemented in 2001 in the EAI/GOA.

However, results from multi-species, food-web modeling by NMFS for the EAI/GOA ecosystem reported in the BiOp indicated RPAs in the EAI/GOA having had no meaningful effect on sea lion numbers:

> *"For Steller sea lions, the model predicts that the cessation of* (all) *fishing* (in the EAI/GOA) *would cause Steller sea lions to increase in biomass (50% confidence intervals* [sic] *is between 2-10% increase). It is important to note that this effect, similar to that for pollock, is also dampened over time."* [BiOp, 253]

7a. Economic Analysis in the Regulatory Impact Review

Determination of the costs of RPAs to industry and local communities in the Environmental Assessment/Regulatory Impact Review (EA/RIR) was reasonably complete, scientifically valid and adequate.

However, the EA/RIR does not provide a cost-benefit analysis of the RPAs proffered in the BiOp.

> The EA/RIR includes an analysis of the economic benefits of full Steller sea lion recovery for the WDPS, but not an analysis of the economic benefits attributable to the RPAs and recovery in the Western/Central Aleutian Islands.
>
> "Willingness-to-Pay" methods were used to determine a benefit for full recovery of the WDPS, estimating the benefit to be many billions of dollars.

7b. Economic Analysis in the Regulatory Impact Review

The BiOp and EA/RIR failed to show that the proffered RPAs would likely minimize economic and social impacts compared with potential alternatives that would likely achieve the same benefits.

Only one set of RPAs (those proffered in the BiOp) was considered in the economic analysis, not a suite of alternatives.

The cost-benefit of an alternative set of RPAs proffered by the North Pacific Management Council was not considered because NMFS judged them as not effecting recovery of sea lions .

However, the chance that RPAs selected in the BiOp might not effect recovery of Stellar sea lions as well, was not considered in the EA/RIR.

Our Charge in the TOR

In our review on the information in the Final BiOp relative to our terms of reference, the panel agreed upon the following:

- The action under consultation (the FMP for the BSAI Fishery Management Area) is not likely to jeopardize the continued existence of the population of Steller sea lions residing in the area, nor destroy or adversely modify the habitat of these Steller sea lions, or of the WDPS as a whole.
- RPAs proffered in the BiOp are not likely to increase numbers of Steller sea lions in the BSAI Fishery Management Area; and
- The cost-effectiveness of RPAs proffered in the BiOp were not projected in the EA/RIR, and given the likely effectiveness of these RPAs, they are not likely to be the alternative with minimal economic and social costs.