Evaluating the Impact of Reasonable and Prudent Alternatives for the Management of the BSAI and GOA Groundfish Fisheries on the Western Stock of Steller Sea Lion

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INTRODUCTION

The Endangered Species Act (ESA) requires that all Federal agencies insure that action taken by their agency does not jeopardize the continued existence or adversely modify critical habitat of species on the List of Endangered and Threatened Wildlife. Neither jeopardy nor adverse modification is defined in the ESA, but regulations promulgated by NMFS define the terms as:

AJeopardize the continued existence means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species.@

ADestruction or adverse modificaition means a direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and recovery of a listed species. Such alterations include, but are not limited to, alterations adversely modifying any of those physical or biological feautres that were the basis for determining the habitat to be critical.@

A formal consultation with itself is required if NMFS cannot determine that a proposed action (e.g., authorization of groundfish fisheries based on the existing Fishery Management Plans) is not likely to jeopardize the continued existence or adversely modify the critical habitat of a listed species. In this case, NMFS specifically initiated a formal consultation with itself regarding the potential impact of the groundfish fishery in the Bering Sea and Gulf of Alaska on ESA listed species.

NMFS made a determination in the 30 November 2000 Biological Opinion that the groundfish fishery in Alaska would jeopardize the continued existence and would adversely modify the critical habitat of the western stock of Steller sea lion. As required under the ESA, NMFS developed additional conservation measures that, if implemented, would remove jeopardy and adverse modification of critical habitat. The set of conservation measures described in the 30 November Biological Opinion is referred to as the Reasonable and Prudent Alternative (RPA).

To evaluate whether the fishery, as managed under the RPA, would jeopardize the continued existence of the western stock of Steller sea lion, NMFS developed a metric designed to index the area-specific effect of the RPA relative to the effect of fishing on the likelihood of extinction of the western population of Steller sea lion. A separate approach was used to evaluate the effects of the groundfish fisheries in the BS/AI and GOA on the value of critical habitat for the western population of sea lions. The objective of this paper is to describe the method used by NMFS in the 30 November 2000 Biological Opinion in detail and to apply this same methodology to the set of conservation measures proposed by the NPFMC=s RPA committee (Witherell 2001. Minutes of the 21-24 May 2000 RPA Committee Meeting) for the purpose of making a determination as to whether the fishery, as it would be prosecuted under the guidelines recommended by the RPA committee, would jeopardize the continued existence of the western population of Steller sea lion.

METHODS AND ASSUMPTIONS

To mitigate the effects of the groundfish fisheries in Alaska on the western stock of Steller sea lion, NMFS established 13 distinct management areas from Prince William Sound west to the end of the Aleutian Chain (Fig. XX, NMFS 2000) to which area-specific conservation measures were to be applied. Because the ESA mandates the implementation of programs designed to allow for the evaluation of conservation measures imposed as part of a formal Section 7 consultation, NMFS included in the RPA described in the 30 November 2000 Biological Opinion an Aadaptive management@-type experiment, where a subset of the areas were open to directed fishing for pollock, Pacific cod, and Atka mackerel (e.g., areas 1, 3, 5, 7, and 12) and a subset of the areas were closed to directed fishing for these three species (e.g., areas 2, 4, 6, 8, 9, 10, 11, and 13).

To evaluate whether the RPA described in the 30 November 2000 Biological Opinion (hereafter referred to as BiOp 3) removed jeopardy, NMFS developed a population trajectory model that was used to predict how the sea lion population would respond to the implementation of the RPA. NMFS recognized that the approach adopted in BiOp 3 was a Aworst case@ approximation, as it was necessary to assume that all of the current decline in the abundance of western Steller sea lions was due to competition with the groundfish fishery (**NMFS 2000; p. xx- check**).

The following methodology was adopted and reported in BiOp 3:

1. The initial non-pup subpopulation in each of the 13 subareas was set equal to the estimates reported in BiOp 3 (Table 1). The total non-pup population was therefore equal to 25,187 animals (see 30 Nov BiOp Table 9.7, p. 299-300).
2. The predicted rate of population change in each of the 13 subareas was set equal to the sum of the following: 1) the reported average trend in abundance for non-pups using data from surveys conducted from 1991 through 2000 (note: the average trend was set equal to the slope of the regression line, where year was regressed against the natural log of the non-pup count in that year), and 2a) 0.04 in areas 2, 4, 6, 8, 9, 10, 11, and 13 (areas closed to directed fishing for pollock, Pacific cod, and Atka mackerel) and 2b) 0.00 in the remaining areas (Table 1).
4. The subpopulation in a given area in year two was equal to the subpopulation in the same area in year 1 multiplied by the exponential rate of increase for a given subarea from step 2. This process was repeated seven more times to represent population change over an eight year period.
5. The total number of animals in the western population was determined for each of the next eight years by summing the number of animals in each of the 13 subareas.
6. The average trend in the population size over the eight year period was calculated as the slope of the regression line, where year was regressed against the natural log of the non-pup abundance estimate.

* Note: 8 years was chosen as a reasonable time frame for comparison because a trend of 1% or greater would be expected to be detectable statistically, given the reported level of precision in the non-pup count data.

The following assumptions were made:

1. The sea lion subpopulation in areas closed to directed fishing for pollock, Pacific cod, and

Atka mackerel would benefit by an amount equal to the average rate of decline in the western Steller sea lion population between 1991 and 2000 (e.g., 4% per year).

2. The positive effect of a specific management action in a given area on the sea lion population would remain constant for the period over which the population dynamics were simulated (i.e., 8 years).
3. The area-specific trend in abundance, as determined from census data from 1991 to 2000, would remain constant for the period over which the population dynamics were simulated.
4. The maximum benefit of management actions in a given area would not exceed 0.04.
5. The underlying population rate of change following the implementation of a given management regime in a given area would equal the sum of the observed trend between 1991 and 2000 and the benefit assumed for that particular area (based on the conservation measures implemented in that area).

In addition, NMFS in BiOp 3 noted that the action under consideration (i.e., the development of Fishery Management Plans for the Federally managed portion of groundfish fisheries in Alaska) did not directly involve State-management fisheries in waters within 3 nm of the shore for herring, salmon, pollock and Pacific cod. NMFS recognized in BiOp 3 that it was possible these fisheries were adversely affecting the western stock of Steller sea lion, but recommended that separate negotiations between the Federal government and the State of Alaska be held to address this concern. Therefore, conservation measures directed at State-managed fisheries were not considered further.

In May 2001, the NPFMC=s RPA committee (hereafter referred to as the RPA committee) proposed an alternative set of conservation measures to remove the potential for jeopardy to sea lions caused by groundfish fisheries in Alaska. The approach used the same 13 management areas described in BiOp 3. However, rather than using a series of areas either closed altogether to fishing for pollock, Pacific cod, and Atka mackerel and areas where no additional restrictions were implemented (note: these areas are referred to as Aopen@ in BiOp 3 and referred to as Arestricted@ by the RPA committee), the approach proposed by the RPA committee allowed fishery specific management measures to be implemented in a given area.

Therefore, unlike the population trajectory described in BiOp 3, where the predicted effect of management was to increase the underlying rate of population change by 0.04 in areas closed to fishing, the expected population trajectory under the management regime proposed by the RPA committee was area-specific (Table 1). The rationale for the area-specific effect of management was based on the premise that sea lions appear to spend approximately 75% of their time at sea within 10 nm of rookeries and haulouts and 25% of their time at sea outside of 10 nm of rookeries and haulouts. This conclusion was based on the preliminary results of telemetry data presented to the RPA committee (R. Small, pers. comm., Alaska Department of Fish and Game, Anchorage, AK and J. Tagart, pers. comm., Washington Department of Fisheries, Seattle, WA – **check, Small et al. 2001**). To account for this behavior, it was further assumed that closing directed fishing for pollock, Pacific cod and Atka mackerel within 10 nm of rookeries and haulouts in a given area would result in an increase in the underlying population trend in that area of 75% of the maximum increase allowed (i.e., 0.03). It was further assumed in this approach that the most of the spatial and temporal restrictions included in the RPA described in BiOp 3 were unnecessary in areas where year-round closures to at least trawl fisheries for Pollock, Pacific cod, and Atka mackerel were imposed to a distance of 10nm from major haulouts and rookeries.

PREDICTED EFFECTS OF AREA-SPECIFIC MANAGEMENT UNDER THE RPA COMMITTEE PROPOSAL (see Witherell 2000 for details of RPA committee proposal):

Area 1- Closed to cod and pollock trawling out to 20 nm, except for Middleton Island where trawling would not be allowed inside 10 nm. Fixed gear fishing for cod would be allowed outside of 3 nm.

Effect: 0.03

Rationale: An area closed to all gear types for pollock, cod and Atka mackerel out to 10 nm would be expected to have a positive effect on the expected population change of 0.03 (hereafter referred to as the base case). Here, pollock trawling is prohibited inside of 20 nm (with one exception to 10 nm), while pot and longline gear are allowed outside of 3 nm. The effect on this subpopulation of sea lions of fishing was therefore considered similar to the base case.

Area 2- Closed to cod and pollock trawling out to 10 nm around haulouts. The Pye Island and Sugarloaf rookeries are closed out to 20 nm for trawling and 10 nm for fixed gear. For Marmot Island - in the first half of the year the trawl fishery is open from 15 nm, which extends to 20 nm in the second half of the year. The Marmot closure for fixed gear is 10 nm year-round.

Effect: 0.02

Rationale: One point (0.01) was subtracted from the base case effect due to the allowance of fixed gear fisheries outside of 3 nm.

Area 3- Closed to cod and pollock trawling out to 10 nm around haulouts. Cape Barnabus and Cape Ikolik are open to all cod and pollock gear from 3 nm out. Gull Point and Ugak Island are open to trawl (outside 3 nm) in C+D season pollock and B season trawl cod.

Effect: 0.02

Rationale: Same as area 2.

Area 4- Closed to pollock, cod, and mackerel fishing out to 20 nm (all gears except jig).

Effect: 0.04

Rationale: Same as reported in BiOp 3.

Area 5- Closed to trawling out to 20 nm, except Mitrofania/Spitz where trawling, longlining, and pot fishing are allowed from 3 nm out.

Effect: 0.03

Rationale: Same as area 1.

Area 6- Closed to fishing **[check with Dave W. - is this right? In your notes you have trawling]** out to 0 nm except that trawling, longlining, and pot fishing are allowed from 3 nm at the Whale back,

Sea Lion Rocks, Mountain Point, Caton, Castle Rock, the Pinnacles.

Effect: 0.0.0275

Rationale: The allowance of trawling, longline, and pot gear outside of 3 nm in 6 areas make this management regime less conservative than the base case. One-quarter point (0.0025) was subtracted from the base case.

Area 7-Establish a 10 nm ›Leitzell line= for the pollock fishery A season; 0-3 nm of all rookeries would be closed to all groundfish fishing, 0-3 nm of major haulouts would be closed to pollock, cod, and mackerel fishing, except with jig gear, 3-10 nm of rookeries and major haulouts would be closed to pollock, cod, and mackerel fishing except with jig, longline, and pot gear. All trawling for pollock, cod, and mackerel within 0-10 nm of all rookeries and major haulouts would be prohibited; 0-20 nm closure of the 5 northern haulouts to all groundfish fishing; close CVOA to trawl c/ps fishing for pollock (June 10 - Dec 31) as per current regulations; the Pribilof haulouts would be closed only to 3 nm; prohibit fishing with longline and pot gear inside of 7 nm of Amak rookery.

Effect: 0.015

Rationale: Fishery management in this area is approximately 50% less conservative than the base case as trawling for cod is authorized outside of 3 nm. In addition, the seasonal restrictions on cod trawling and longlining are less severe than in the base case. One and one-half points (0.015) were subtracted from the base case.

Area 8- Same as area 7.

Effect: 0.015

Rationale: Same as area 7.

Area 9-Closed to pollock, cod, and mackerel fishing out to 20 nm (all gears except jig).

Effect: 0.04

Rationale: Same as reported in BiOp 3

Area 10- Closed to pollock, cod, and mackerel fishing with trawls or pots out to 20 nm (all gears except jig). Longlining closed out to 10 nm.

Effect: 0.0325

Rationale: Fishery management in this area is more conservative than the base case as trawling and pot gear for pollock, Pacific cod and Atka mackerel are prohibited out to 20 nm. One-quarter point (0.0025) was added to the base case.

Area 11- Same as area 10.

Effect: 0.0325

Rationale: Same as area 10.

Area 12- Conservation measures in areas 12 and 13 are complicated (see Witherell 2000 for additional details).

Atka Mackerel:

Temporal Measures: A&B Seasons (January 20 and September 1).

Season TAC allocations: 50/50 per A&B seasons

Measures to reduce catch rates on localized basis: Platoon management in Areas 542 and 543. Vessels wishing top participate would register with NMFS to fish scheduled A or B seasons and would be randomly assigned to one of two teams. The teams would start in either 542 or 543.

Area Restrictions: No CH fishing in Seguam foraging area and Area 518 (Bogoslof).

No CH fishing for mackerel east of 178 West longitude.

Rookeries west of 178 West longitude closed out to 10 nm except 15 miles at Balder.

Haulouts: closed 0-3 nm.

CH Apportionment: 70% inside and 30% outside.

Pacific cod:

Seasons:

trawl:	January 20 - June 10 (80%), June 11 - October 31 (20%)
longline, jig:	January 1 - June 10 (60%), June 11 - December 31 (40%)
pot:	January 1 - June 10 (60%), September 1 - December 31 (40%)
pot CDQ	January 1 - December 31

Note: the harvest of cod by the <60' pot vessels should account towards the 1.4% quota when the 18.3% season is closed.

Area Restrictions: Longline and Pot: no CH fishing east of 173 degrees West to western

boundary of Area 9, Balder closed inside 10 nm, Agligadak closed to 20 nm.
Trawl: East of 178 west: rookeries closed at 10 miles except 20 nm Agligadak, haulouts open from 3 miles and out; west of 178 west: no fishing within 10 miles at haulouts and rookeries until the Atka mackerel fishery inside CH A or B season, respectively, is completed, at which time trawling for cod can occur 3 nm outside of haulouts and 10 nm of rookeries.
Seguam foraging area closed to all gear types.

Pollock:
One season with January 20 opening.
No fishing for pollock in CH.
Other applicable allocation splits (AFA)

Effect: 0.025
Rationale: Fishery management in this area is less conservative than the base case as trawling and longlining for Pacific cod is authorized outside of 3 nm from rookeries and haulouts (with some exceptions), although Pollock and Atka mackerel fishing in CH is prohibited. Further, seasonal restrictions on trawling for cod is less severe than the base case. One-half point (0.005) was subtracted from the base case.

Area 13- Same as area 12.
Effect: 0.0275
Rationale: Fishery management in this area is less conservative than the base case. The platoon approach for the Atka mackerel fishery should reduce daily catch rates by roughly 50% relative to the 1999 fishery. In addition, the cod fishery is prohibited while the Atka mackerel fishery is being prosecuted. One-quarter point (0.0025) was subtracted from the base case.

Table 1. Summary of area-specific management effects for two RPAs: 1) RPA described in the 30 November 2000 Biological Opinion, and 2) RPA recommended by the NPFMC=s RPA Committee. The effect of management is scaled in units based on an exponential population model. In all cases, the management effects were greater than or equal to zero.

Area	*Abundance (2000)*	*Management Effect (30 Nov BiOp)*	*Management Effect (RPA Comm.)*
1	2134	0.00	0.03
2	2935	0.04	0.02
3	779	0.00	0.02
4	1262	0.04	0.04
5	2033	0.00	0.03
6	2398	0.04	0.0275
7	1204	0	0.015
8	624	0.04	0.015
9	884	0.04	0.04
10	1105	0.04	0.0325
11	1316	0.04	0.0325
12	4925	0.00	0.025
13	3588	0.04	0.0275
Total	25187		

RESULTS AND DISCUSSION

The results of the population trajectories for all 13 areas are presented in Figure 1 for the RPA reported in BiOp 3 and the RPA proposed by the RPA committee. The average trend in abundance under the two management scenarios were both negative (i.e., -0.77% per year and -0.41% per year, respectively).

A comparison of use of management tools under the RPA from BiOp3 and the RPA recommended by the RPA committee (hereafter referred to as the RRPAC) is summarized in Table 2 (from review by L. Fritz – insert). The key differences are as follows: 1) 100% of pups occurred in areas restricted to fishing out to 10nm in the RRPAC, while 72% of pups occurred in areas restricted to fishing in the RPA from BiOp3; 2) 56% (check) of CH was closed to fishing for cod, Pollock, and Atka mackerel in the RRPAC, while 64% (check) was closed in the RPA from BiOp3; 3) additional spatial and temporal restrictions were for the most part not included in the RRPAC, while they were included in the RPA from BiOp3; and 4) the Global Control Rule in the RRPAC was more restrictive than the GCR in the existing FMP, while less restrictive than the GRC in BiOp3.

It should be noted that the population trajectories calculated for the RRPAC were not intended to accurately predict population trends over the next eight years. Rather, given the assumptions listed above, the trajectory calculated for the fishery that would result were the RPA of the RPA committee adopted was intended for use as an index of the effectiveness of the RRPAC relative to the RPA in BiOp3 for the purpose of making a jeopardy determination. As no uncertainty was assigned to any of the predicted increases in the underlying area-specific trends in abundance, the results of the analysis were used to conclude that the RPA proposed by the RPA committee was at least as conservative as the RPA described in BiOp3 in terms of avoiding a jeopardy determination.

After a preliminary review of this analysis by the SSC of the NPFMC and an independent panel of experts contracted by the NPFMC to review BiOp3 and the RPA of the RPA committee, the following additional analyses were performed to investigate the robustness of the conclusions to one or more of the assumptions listed above.

1) Would the same conclusion be reached if the time period for which the population was simulated was changed from eight years to one year? An analysis was done that projected the population forward one time step and then compared the overall trend in abundance for the 13 areas. The same conclusion was reached (i.e, the RPA of the RPA committee was at least as conservative as the RPA in BiOp3) in terms of avoiding jeopardy.
2) Would the same conclusion be reached if the underlying trend in each of the 13 areas was assumed to be independent and to be directly related to commercial fisheries. That is, what would be the results of a trajectory analysis be, where the increase in the area-specific trend in abundance related to fishery restrictions were not limited to 0.04, but was set equal to the product of the area-specific trend in abundance and the percentage of the area-specific increase in the trend in abundance of the maximum increase allowed (i.e., 0.04) in the RRPAC. An analysis was done that assumed the area-specific increase in abundance was proportional to the percent increase in the trend relative to the maximum increase allowed. For example, in area 1, the assumed increase in the trend in abundance was 75% of the maximum allowed increase. Because the underlying trend in area 1 was –0.096, the resulting increase in the trend in abundance was 0.072. Therefore, the new trend in abundance under this scenario was –0.024 (-0.096+0.072). A similar calculation was made for each of the other 12 areas, except that in the two areas that were increasing, no increase in the population trend was assumed. The same conclusion was reached as the base case.
3) Would the same conclusion be reached if the importance of the inner 10nm was equal to the importance of the outer 10nm (note: in the RRPAC, the assumption was made that the inner 10nm was three times as important as the outer 10nm)? An analysis was done that recalculated the assumed increases in the underlying trend in abundance, where the relative importance of the inner 10nm was set equal to the outer 10nm. In this case, the conclusion reached was that the RPA recommended by the RPA committee was not as conservative as the RPA in BiOp3.

These additional analyses indicate that the conclusion reached regarding the relative conservatism of the RPA recommended by the RPA committee and that described in BiOp3 is robust to conclusions about the independence of the 13 areas or the time period over which the trajectories are simulated. However, it appears that the results are sensitive to assumptions

regarding the relative importance of the inner 10nm of CH relative to the outer 10nm. At this point, while the telemetry data indicate that the inner 10nm are more important to lactating adult females in the summer and to young-of-the-year in the first winter and spring, additional data are needed to evaluate the relative merits of the inner 10nm of CH to one and two year old animals and to adult females during the winter.