**Subject: RE: SSLMC proposal ranking tool report**
**Date:** Tue, 8 Aug 2006 14:00:32 -0800
**From:** "Steve MacLean" <smaclean@tnc.org>
**To:** "Sam Cotten" <resourceanalyst@aleutianseast.org>,
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"Bill Wilson" <Bill.Wilson@noaa.gov>, "Dan Hennen" <danielhennen@alaskasealife.org>,
"John Henderschedt" <johnh@prempac.com>
**CC:** "Peggy Merritt" <pmerritt@ak.net>

First, I apologize for the delay in my comments, I hope there is still time for them to be useful.

I, too, agree with most of the comments so far raised. I think Sue hit the nail on the head when she stated " the whole logical construction is based on the primary assumption that fishing affects SSL negatively, which may or may not be true." I think that needs to be stated at the beginning, regardless of whether we all agree with the assumption or not. We are unlikely to come to consensus on that assumption, but that is the reason we're all here.

Regarding John's comment re: Scenario #1, I wonder at what level of change (1%, 10%, 90%) would anyone be able to differentiate potential impacts. The model, as Dan pointed out, serves to compare proposals to current situations, rather than comparing proposals to each other. We would, presumably, have to rely on our best judgment when comparing two proposals. The model would, in my mind, only serve as one of the criteria by which proposals were considered, not the answer. With this in mind, I agree strongly with Dan's suggestion that any sort of qualitative comparison between potential impacts between proposals and status quo (the *not much* on p 18) should be removed, and not included in future drafts.

In all, I consider this a reasonable first draft that will be much improved in future iterations.

Best regards,
Steve

-----Original Message-----
**From:** John Henderschedt [mailto:johnh@prempac.com]
**Sent:** Tuesday, August 08, 2006 9:16 AM
**To:** Daniel Hennen; Bill Wilson; Jerry Bongen; Julie Bonney; Sam Cotten; Larry Cotter; Ed Dersham; Earl Krygier; Kevin Duffy; John Gauvin; Sue Hills; Frank Kelty; Terry Leitzell; Dave Little; Steve MacLean; Max Malavansky, Jr.; Art Nelson; Kristin R. Mabry; Douglas Demaster; Lowell Fritz
**Cc:** Peggy Merritt
**Subject:** RE: SSLMC proposal ranking tool report

I agree with the comments presented thus far and would like to expand on Dan's comments in regard to the model and the results of the three scenarios-

In looking at Scenario #1, it seem that the results are not very instructive unless there were a variable that captures the exact percentage to be moved. A transfer of seasonal apportionment from the CD to the AB season appears to result in a lower impact on sea lions, but I don't think that the model can distinguish between a movement of 1% and a movement of all of the CD quota to AB season. This

Steve Maclean

# Multi-Criteria Decision Tool to Evaluate Proposals for Change in Steller Sea Lion Protection Measures in the Gulf of Alaska and Bering Sea/Aleutian Islands Groundfish Fisheries, 2006

**Developed by the**

**Steller Sea Lion Mitigation Committee**

**North Pacific Fishery Management Council**

**August 2006**

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# INTRODUCTION

The North Pacific Fishery Management Council (NPFMC) reinstituted the Steller Sea Lion Mitigation Committee (SSLMC) for the purpose of tracking the recent Section 7 Consultation, and to accept proposals for possible changes to existing Steller sea lion (SSL) mitigation measures for the Pacific cod, pollock and Atka mackerel fisheries in the Gulf of Alaska and the Bering sea/Aleutian Islands. The SSLMC began work to prepare and develop a tool for evaluating proposals, which was presented to the NPFMC and the SSC in June 2006. The SSLMC were advised to institute a more rigorous approach to identifying potential impacts to the SSL resulting from fishing activity, and how changes in fishery regulations could be gauged to minimize impacts to the SSL. In July 25-27, 2006 SSLMC members and scientific advisors with the National Marine Fisheries Service Alaska Fisheries Science Center (NMFS-AFSC) met in Seattle to begin development of an evaluation tool using a facilitated systems approach to planning and evaluation – the Analytic Hierarchy Process (AHP).

The AHP has been used extensively for decades to address planning, conflict resolution, and prioritization in such areas as policy development, economics, engineering, medical and military science, and has more recently been applied to fisheries research and management (Leung et al. 1998; Merritt and Criddle 1993; Merritt 1995, 2000 and 2001; Merritt and Skilbred 2002; Merritt and Quinn 2000; Ridgley et al. 1997; USFWS 2005, 2006). The AHP is a tool for facilitating decision-making by structuring the problem into levels comprising a hierarchy. Breaking a complex problem into levels permits decision makers to focus on smaller sets of decisions, improving their ability to make accurate judgments. Structuring also allows decision makers to think through a problem in a systematic and thorough manner. The AHP encourages people to explicitly state their judgments of preference or importance. Decision support software, Expert Choice,[1] was used interactively to structure the problem, depict the influence of weights, and derive the priority of elements.

The evaluation tool will undergo several phases of development and review:

1. July 25-27, 2006 the SSLMC develops a prototype evaluation tool, in collaboration with the NMFS-AFSC staff in Seattle;

2. August 4-9, 2006 the SSLMC reviews and comments on a draft report of the prototype evaluation tool;

3. August 15-16, 2006 the SSC reviews and comments on the prototype evaluation tool in Juneau; and,

4. The SSLMC incorporates comments from the SSC in the development of the evaluation tool.

[1] Forman, E., T. Saaty, M. Selly, and R. Waldron. Expert Choice, Decision Support Software, McLean VA. 1983.

importance than another, in relation to its mother node?" A specific example follows: "Are all SSL site types (rookery, haulout, or other) of equal importance (sensitivity) to impact from fishing activity, or is one of more or less importance than another, in relation to a given season (winter or summer)?" In-depth discussion, with supporting data from NMFS-AFSC staff, followed each such question, so that the rationale for judging importance was clearly established.

Using criteria as guidelines, the SSLMC was asked to use supporting data (when possible) and/or their expert judgment in individually assigning ratings of importance to elements in each level of the hierarchy. The relative importance of the dimensions was evaluated, then that of the variables within each dimension, then that of the sub-units within each variable. Participants were given time to think and write their ratings of importance down before sharing and discussing their judgments. A positive ratio scale with associated verbal equivalents was used to rate importance, where numbers between those listed (e.g., 2, or 2.5, etc.) were used to interpolate meanings as a compromise:

| Scale of Importance | Definition |
|---|---|
| 9 | Extreme importance |
| 7 | Very strong importance |
| 5 | Strong importance |
| 3 | Moderate importance |
| 1 | Slight importance |

Elements judged to be of equal importance were given equal scores. Consensus within a range of two to three points on the rating of elements was usually achieved among participants. When disparity in judging importance occurred, it meant there was disagreement, and discussion and debate was encouraged. Debates advanced the understanding of important concepts and often resulted in a clearer definition of the dimension or variable. By seeking consensus not only was dialogue and learning encouraged, but also the formation of a group solution, rather than individual solutions, was promoted.

Expert Choice was used interactively to depict the influence of weights and derive the priority of variables. Priorities approximate the strength of importance for each variable, adjusted to reflect the importance assigned to the dimension addressed by that variable. Mathematically, relative ratings of importance are entered into a vector and normalized. The values from the vector are then multiplied by the weight in the next highest level, and the result is the weight of importance for variables. The total score for each variable is then calculated by adding the weighted proportions over all variables within a dimension:

Comment [SM3]: Wow, this seems important, and I wish I could follow along.

$$T_m = \sum_{k=1}^{d} W_k p_{k,m}$$

where

$T_m$ = the total weighted score for variable *m*,
$W_k$ = the weight for dimension k,
$p_{k,m}$ = the weighted proportion of the total score for variable m addressing dimension k
$d$ = the number of variables.

### STRUCTURAL ADJUST

Structural imbalance in the hierarchy can lead to dilution of the weight of many variables under a single dimension, so an adjustment feature in Expert Choice can be used to restore priorities to their respective proportion of weight. While approximate balance is sought and desired, complex problems do not always lend themselves to balance – thus the advantage of the structural adjust feature.

**Comment [SM4]:** Is this the case in this model, particularly for the "How fisheries affect the SSL" side of the model?

In a conceptual example, consider that if a dimension (A) has four variables, and another dimension (B) has two variables, then there are six variables in all and structural adjusting multiplies A's priority by 4/6 and B's by 2/6. Thus, the overall priorities for A's variables are not diluted simply because there are many of them.

## RESULTS AND DISCUSSION

### MISSION

The mission of the SSLMC is to build upon previous efforts in developing a rational approach to evaluating proposed changes in regulations (relativeto existing mitigation measures) that encompasses relevant and measurable dimensions of the SSL and their prey.

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**Comment [SM5]:** This phrase should be defined. What makes something relevant *and* measurable, relevant *but not* measurable, etc.?

Work proceeded with the assumption that there is a relationship between prey and the nutritional balance of the SSL. [suggest "predicated on the assumption that fishing has some relationship with SSL" or very similar language from earlier in report]

**Comment [SM6]:** This is true for all animals.

**Comment [SM7]:** I think it's important that this is stated early.

### DIMENSIONS ALONG WHICH IMPACTS OF PROPOSED CHANGES ARE EVALUATED

The SSLMC identified two dimensions of the problem:

- how fisheries affect the prey of the SSL; and,
- how fisheries affect the SSL.

The SSLMC's perception of the problem mirrors primary concerns of the Endangered Species Act, which are the potential for jeopardy or adverse modification through fishing effects on the SSLs and their habitat with changes in the prey field or the ability of the SSLs to acquire food.

## The Prey of the SSL

The SSLMC engaged in lengthy discussions about concepts relating fishing to the prey field, including concerns about the availability of prey as affected by dispersal from fishing activities. Response of the prey field to fishing can include changes in fish schooling behavior, which may impact the SSL's ability to capture and consume prey. Dispersal of the prey field through fishing activities may also induce "prey switching". The question that arises is, "Will prey availability be altered?" The assumption is that more aggregated prey are easier for the SSL to capture. A second concern is the likelihood of depletion of prey by removal. Removal of fish can result in a reduced number of fish or fish aggregations. The question that arises is, "Will prey be measurably depleted?" The assumption is that fewer fish diminishes the value of the prey field.

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Comment [SM8]: Another question is "can we measure changes that might be meaningful to SSLs?"

Both of the above concerns were ultimately combined by the SSLMC into one dimension because it was thought that realistically there could be little measurable distinction between the two.

## The SSL

Much discussion focused on SSL foraging ecology, reproductive behavior and energy balance needs, and potential disruptions from fishing activity to the general well-being of the SSL. Degree of impacts was related to adult females and weanlings, as these categories of individuals have more restrictive energy balance needs, as compared with adult males. Non-territorial males are able to forage further and longer because they do not care for young, and do not need to expend energy on lactation. There can be degrees of impact to adult females through competition. The assumption is that females have dual roles of maintenance and reproduction. Fishing competition with juvenile SSLs that have not yet weaned and are still partly reliant on maternal care is a primary concern. The assumption is that weanlings have smaller body size, lesser diving capability and must balance energy over a shorter period of time than adults. In addition to the concept of competition, the concept of disturbance to the SSL by fishing activity was discussed. The SSLMC intended the term "disturbance" to include behavioral and physical aspects.

Deleted: varying

Deleted: over time

Deleted: M

Deleted: more independently

Deleted: converting food into maternal milk

Deleted: disruption

Deleted: disruption

All concerns were ultimately combined into one dimension because adult females and weanlings largely overlap in time and space, thus making these components of the problem nearly indistinguishable from an impact point of view; and, disturbance is an overarching concern, related to several variables, including proximity.

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Judgments of importance between the prey field and the SSL dimensions was based on the degree to which change may cause an impact, resulting in an adverse effect on the energy balance of an individual SSL. The geometric mean of all scores resulted in ratings of importance for the dimensions (Figure 1). The spread of scores was between 3-4, on a scale of 1-9, which can be characterized as mild disagreement, occurring within a minority of the SSLMC.

Comment [SM9]: How does the spread indicate what proportion of the committee disagreed? A spread of 3 with 50% choosing 4 and 50% choosing 7 would look the same as 95% choosing 4 and 5% choosing 7.

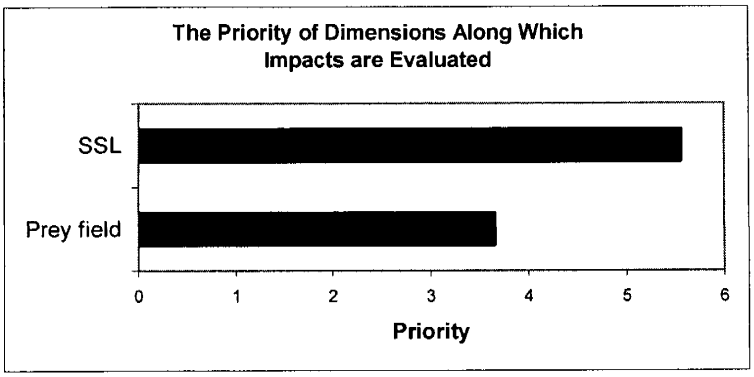


**Figure 1. The priority of SSL and their prey.**

## VARIABLES

Prior to the meeting, a scoping survey was distributed to a sub-group, to identify variables. The question asked was, "What's on the table for change?" And, "Given the set of variables, what sub-set will be used in the evaluation tool?" At the meeting, the entire SSLMC modified the list. Table 1 lists the variable field identified as useful to the evaluation tool.

**Table 1. The potential set of variables from proposed fishing regulation changes that are included in the model to evaluate impacts to the SSL and their prey.**

| Variable | Sub-units |
|---|---|
| 1. Fish Species of Interest | a. Pacific cod b. Pollock c. Atka mackerel |
| 2. TAC | The TAC is calculated for each fish species of interest, for each region. |
| 3. Fish Biomass | The biomass is estimated for each fish species of interest, for each region |
| 4. Fishing duration | a. Pulse (TAC is taken in 3-10 days)<br>b. Prolonged (TAC is spread out across time) |
| 5. Geographic regions | a. Eastern Gulf of Alaska (EGOA)<br>b. Central Gulf of Alaska (CGOA)<br>c. Western Gulf of Alaska (WGOA)<br>d. Eastern Aleutian Islands (EAI; includes the Bering Sea)<br>e. Central Aleutian Islands (CAI)<br>f. Western Aleutian Islands (WAI)<br>g. Pribilof Islands |
| 6. Seasons | a. Summer (the SSL breeding season, defined as May-September)<br>b. Winter (non-breeding season, October-April) |
| 7. SSL site types | a. Rookery b. Haulout c. other |
| 8. Proximity zones to a SSL site | a. 0-3 nm b. 3-10 nm c. 10-20 nm d. 20+ nm e. not critical habitat |
| 9. The percentage of SSL sites affected | a. 1-10% b. 11-25% c. 26-50% d. 51-75% e. 76-100% |

**Comment [SM10]:** Note, these are all critical habitat.

**Comment [SM11]:** This denotes the foraging area, still critical habitat. I don't think this was clear when the scoring took place, and I believe that scoring would be different were this done again.

Explanations of variables used in the hierarchy follow for each dimension.

### Variables Applicable to the Prey Dimension

Variables that can potentially impact the prey field dimension are:

- the TAC for a given fish species in a given region,
- estimates of fish biomass in a given region, and
- fishing duration.

The ideal way to evaluate impacts of proposed changes on the prey field would be to know fish biomass at the site in question, understand SSL prey needs at the site, and be able to predict with accuracy the amount and rate of harvest relative to biomass associated with the proposed change. However, this is a data-poor environment in which to make decisions, so judgments must be made on the best available information. While the rationale for a hierarchy of fishing power by gear type was provided in the June 2003 Supplement to the BiOp (page 36), and explained to the SSLMC by NMFS-AFSC staff, the SSLMC concluded that gear type and vessel size are dissatisfactory proxies for removal rate. Concerns for using gear type and vessel size as proxies for removal rate include the lack of consideration for the number of vessels fishing, fisheries occurring on large schools of fish, and agreement between sectors to avoid fishing conflicts.

**Comment [SM12]:** This should probably be explained in detail, if it's going to pass muster with the SSC.

The SSLMC launched into a lengthy debate on how best to account for fish removal relative to available biomass, and raised the possibility of assigning a rating to a fishery based on the percentage of the TAC taken. Staff from the NMFS-AFSC were asked if exploitation rates could be estimated in areas smaller than a given region. Unfortunately, fish biomass data are not collected on a scale suitable to provide estimates at each site, rather fish biomass is estimated on a regional scale. Therefore, the group decided that the best characterization of removal rate, given limited knowledge, is a qualitative assessment of the ratio of the TAC to biomass ratio, per species, on a regional basis. For example, a proposal for a high harvest in an area of low target species abundance would be rated high (more adverse to the SSL). The NMFS-AFSC agreed to provide to the SSLMC a qualitative statement of biomass in each region. Catch to biomass comparisons could be provided by developing a ratio between TAC for a region with the estimated biomass in that region, projected for 2008, from the next stock assessments and SAFE reports. The NMFS-AFSC would use their best judgment to estimate regional biomass for Pacific cod, pollock and Atka mackerel.

**Deleted:** ?

**Deleted:** surveys do not

**Deleted:** on a per-site basis

**Deleted:** ;

**Deleted:** per species

Prey removal rate may be complicated by seasonal behavior of fish; for example, pollock aggregate for spawning in winter and a fishery targeting these fish would have an exploitation rate that is high, in part because of the schooling behavior of the fish. Fish migratory behavior could also affect exploitation rate.

The TAC/biomass ratio can be scaled by degrees of impact to the prey field according to Saaty's 1-9 ratio scale in the following manner:

- A high TAC/low biomass ratio is interpreted as having an extreme impact on the prey field, and is given a value of "9".
- A low TAC/high biomass ratio is interpreted as having a slight impact on the prey field, and is given a score of "1".

Between the values of "9" and "1", are gradations (scores of 2-8) that can be used to depict the degree of impact to the prey field. For each proposal, the SSLMC must judge the expected proportion of removal, and score it according to the following guide:

| **TAC/Biomass per species, per region** | **Weight of impact (score)** |
|---|---|
| High TAC/Low Biomass | 9 |
| | 8 |
| | 7 |
| | 6 |
| | 5 |
| | 4 |
| | 3 |
| | 2 |
| Low TAC/High Biomass | 1 |

The data supplied by the NMFS-AFSC for this piece of the evaluation tool is found in Appendix B.

Characterization of removal rate must be discussed in relation to the duration of removal – so, the SSLMC engaged in an extended debate about the impacts of "pulsed" (defined as approximately 3-10 days) versus "prolonged" fishing on the prey field (small amounts of fish harvested incrementally over long periods of time). The SSLMC turned to the NMFS-AFSC for data in this regard. There is some research that suggests SSL are most vulnerable to prey field disruptions that are characterized by a high removal rate in a pulsed time frame in a given area (June 2003 Supplement to the BiOp). That is, SSL can probably deal with low food abundance for a few days, but going without food for 3-10 days would be detrimental to the health of the SSL. The concern with pulsed fishing is localized removals of large quantities of available biomass. Ultimately, the majority (90%) of the SSLMC decided that at high removal rates, pulsed fishing has the highest impact; however, at low removal rates the duration of fishing is of slight consequence (Table 2). The spread of scores shows that general agreement (defined as a spread of 0-3) is lacking about the impacts of fishing duration in relation to fishing removal rate on the prey field. The SSLMC intends to continue discussion on this topic upon receipt of better information.

Removal rate and duration was considered in the context of region; however, all regions were assigned equal weight because recovery of the SSL is required in all. The SSLMC

also considered removal rate and duration in the context of fish species, but again assigned equal weight to all three species of interest, because all are important in the diet of SSL.

**Table 2. Judgments on the degree of impact (group geometric mean) that scenarios of removal rate and duration of fishing have on the SSL prey. A high geometric mean score reflects a highly adverse impact.**

| TAC/Biomass Score[a] | Duration of Fishery | Geometric Mean Group Score | Spread of Scores |
|---|---|---|---|
| 9 | Pulsed | 8.74 | 1 |
| | Prolonged | 1.43 | 8 |
| 8 | Pulsed | 8.00 | 0 |
| | Prolonged | 1.41 | 7 |
| 7 | Pulsed | 6.90 | 2 |
| | Prolonged | 1.40 | 6 |
| 6 | Pulsed | 6.15 | 0 |
| | Prolonged | 1.38 | 5 |
| 5 | Pulsed | 5.36 | 3 |
| | Prolonged | 1.16 | 2 |
| 4 | Pulsed | 4.04 | 4 |
| | Prolonged | 1.12 | 1 |
| 3 | Pulsed | 3.15 | 6 |
| | Prolonged | 1.06 | 1 |
| 2 | Pulsed | 2.00 | 7 |
| | Prolonged | 1.06 | 1 |
| 1 | Pulsed | 1.19 | 7 |
| | Prolonged | 1.06 | 1 |

[a] A high TAC/low biomass ratio reflects a high rate of removal, which is deemed as having an adverse effect on the SSL prey field.

**Variables Applicable to the SSL Dimension**

Variables that can potentially impact the SSL dimension are:

- fishing near a type of SSL site,
- fishing within zones of proximity to the site, in a given season,
- the percentage of SSL sites in a region affected by the proposed change,
- fish species targeted for harvest, and
- fishing within a geographic region, in a given season.

***SSL Site Type by Season and Proximity, and the Percentage Affected***

The ideal way to evaluate the impacts of proposed changes to fishing regulations on the degree of disturbance to SSL would be to examine the impacts related to the number of SSL per site on a seasonal basis, and the trend in SSL abundance. However, survey counts of SSL are not conducted at every site, occur primarily in summer, and movement of SSL between sites is known to occur; thus, the effects of fishing in winter at a particular site would have little relation to SSL abundance counts that were conducted in summer. Lack of complete knowledge of SSL abundance per site on a seasonal basis and the extent of movement between sites also hampers incorporation of SSL trend information into the evaluation tool. Trends per area are subject to error due to variability in SSL movement between sites, and thus trends are not meaningful on a per-site basis. The NMFS-AFSC staff suggested that incorporation of the concept of the sensitivity of site type and proximity per season into the evaluation tool would serve as the best available proxy to SSL abundance and trend, because data on sites is the better data source.

**Comment [SM13]:** Site trends are the only way that NMFS has to assess population trends. This makes little sense to me.

The SSLMC discussed the best way in which to incorporate time, and concluded that seasons based on the energy needs of the SSL would be the best characterization. Summer is defined as the breeding season (May-September) and is roughly equivalent to the BC fishing seasons. It is assumed that energy needs are greater for lactating females and other nutritional stresses associated with breeding; thus, summer would be a more important (sensitive) time than winter. Winter is defined as the non-breeding season (October-April) and is roughly equivalent to the DA fishing season.

The NMFS-AFSC staff distributed a table characterizing SSL site types as rookery, haulout or "other", according to usage (Appendix C). The new telemetry information included SSL diet composition by region and season (Appendix C). The "other" designation is given to sites that are listed under the Endangered Species Act, but do not meet the seasonal criteria for rookery or haulout; SSL can still be present at these sites. The new telemetry data show that both rookeries and haulouts are used for a longer period of time by a more diverse group of SSL than previously observed. Following testimony from the NMFS-AFSC staff regarding site type and importance based on seasonal use, votes were taken on the degree of sensitivity, where a high score represents a site that has great importance in the overall recovery of the SSL and is sensitive to change (Figure 2).

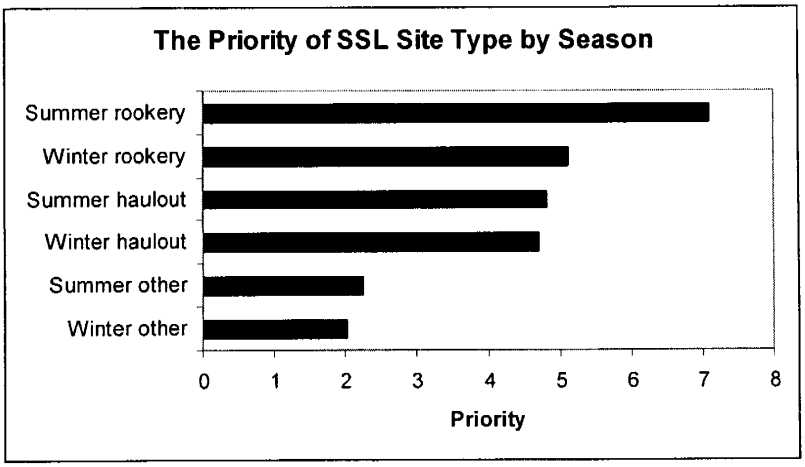


**Figure 2. The priority of SSL site types, by season**

Thus, a summer rookery is more important and is more sensitive to impact than a winter "other" site because of SSL breeding activity. The majority of the group voted similarly, with a 4 -5 spread in scores due to only a disagreement from one or two members, depending upon the site/season in question.

The impact of fishing to a site/season combination depends on how close fishing takes place. The assumption is that fishing in increasing proximity to a SSL site increases deleterious effects on the SSL. Much work and discussion has previously gone into the "zonal approach" presented in Tables II 1-9, on pg 94 of the June 2003 Supplement to the BiOp. New juvenile telemetry data (Lowell Fritz, personal communication) supports high sensitivity for the 0-3 nm and 3-10 nm zones. The assumption is that increasing distance of activity from the SSL site reduces disturbance to the SSL. The SSLMC wished to incorporate the concept of the zonal approach into the evaluation tool, and prior ratings of importance were adjusted to reflect the 1-9 rating scales used in the AHP. The SSLMC expanded on the zonal approach by considering sensitivity to proximity in relation to site type and season (Figure 3).

There was agreement (a spread of 0-3) among the group on the sensitivity of the zones per site/season combination. The most important zone is 0-3 nm for all site types by season; the least important zones are the 20+ nm and that area designated as "not critical habitat (CH)". The priority scores assigned by the SSLMC are consistent with those recommended by the NMFS-AFSC. The most critical habitat surrounds rookeries, in the 0-3nm and 3-10 nm zones.

**Comment [SM14]:** It was not clear during the discussion that the 20+ nm zone was the Foraging Area, as was discussed at the end of the day on Thursday. It was agreed to visit this again later since the scoring was done erroneously.

Members of the SSLMC wanted to account for the percentage of SSL sites in a region affected by a proposal, combined with proximity to a site. Consensus was reached to include five categories of site percentages affected, within three proximity zones (Figure 4). The greatest adverse impacts (scored as "9") would occur if the proposal sought to affect from 11-100% of SSL sites in a given region, operating within the 0-3 nm zone.

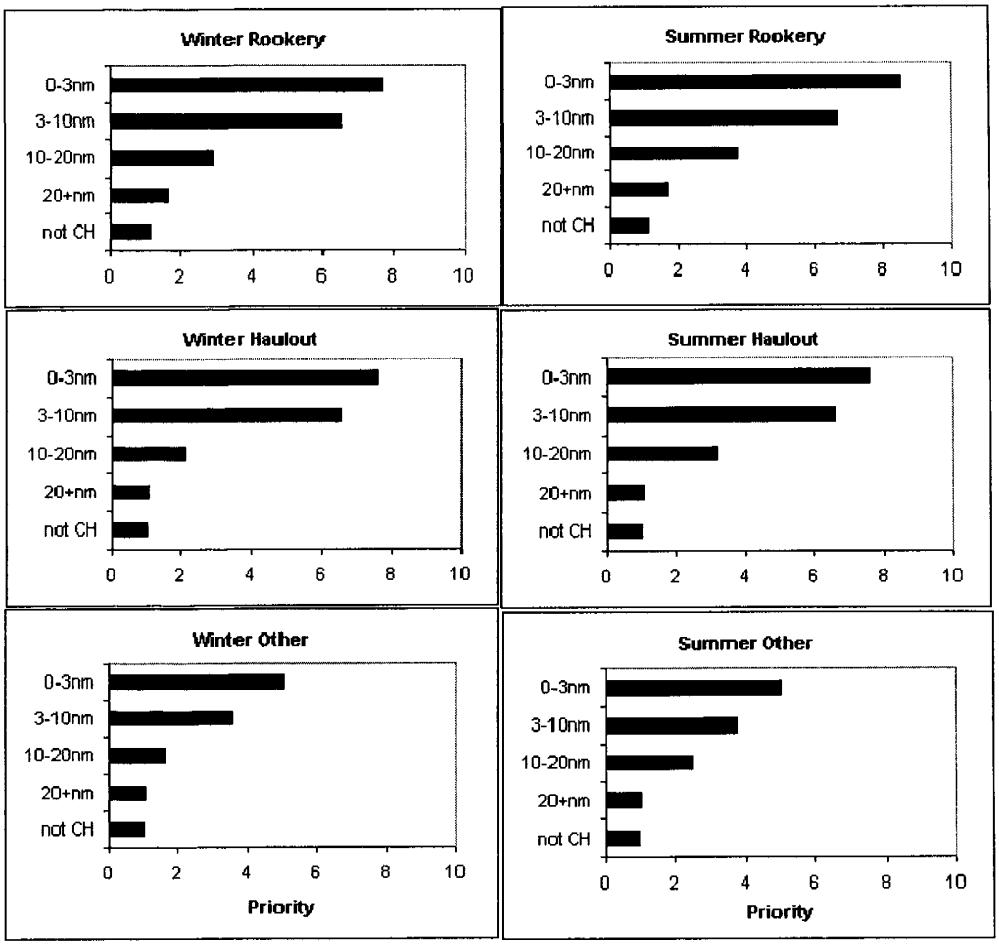


**Figure 3. The sensitivity (priority) of a SSL site type to proximity of fishing, by season.**

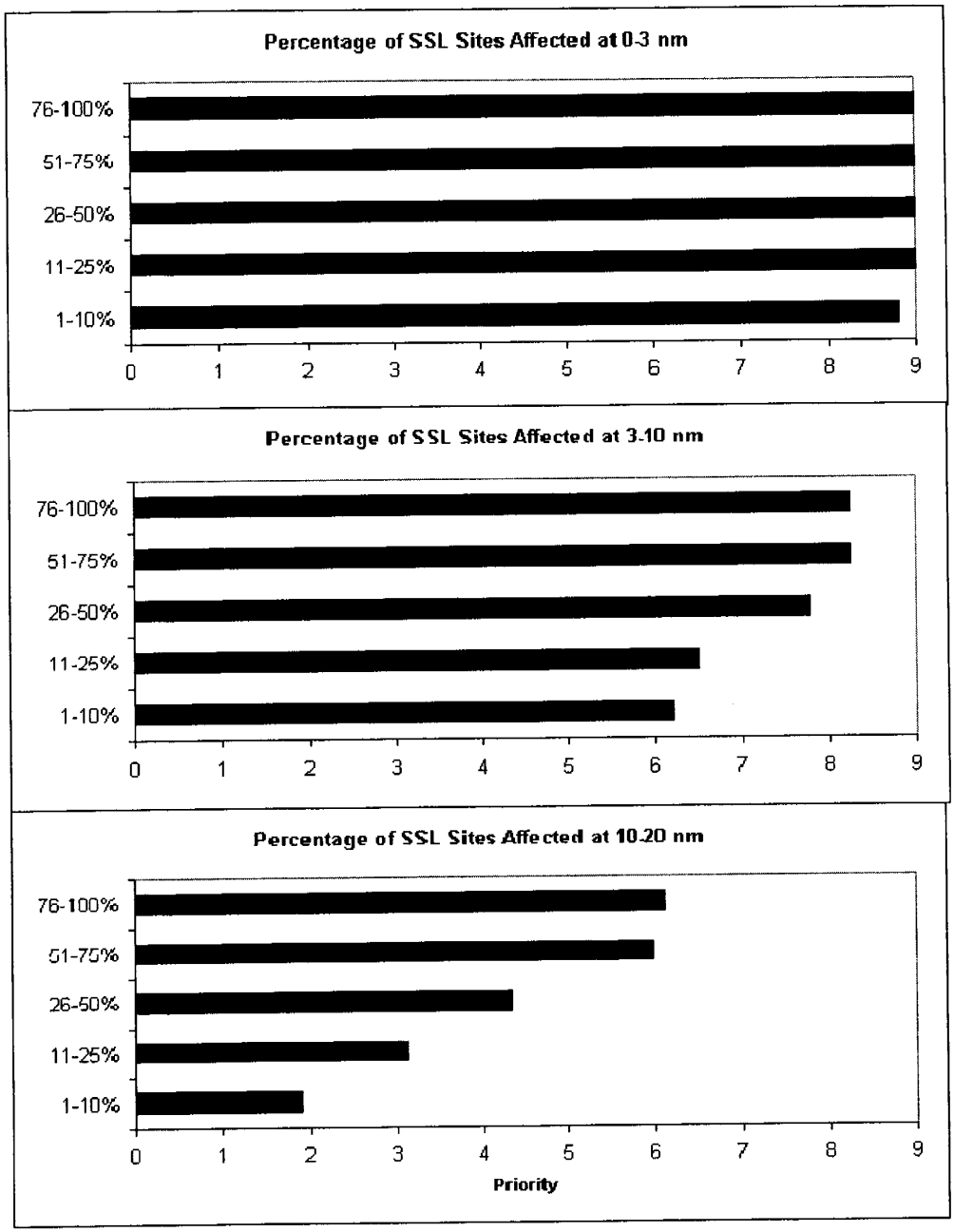


**Figure 4. The potential of adverse impact (priority) of a change in fishing, considering percentages of SSL sites affected in a region, and fishing in proximity to the sites.**

*Fish Species Harvested, by Region and Season*

The combination of variables - fish species harvested, in a given geographic region, on a seasonal basis - is a proxy for nutritional needs of the SSL. Fish species of interest are Pacific cod, pollock and Atka mackerel, based on scat research that has defined these species as occurring frequently in the diet (Sinclair and Zeppelin *in review*). Data presented to develop ratings of importance included the most recent SSL food habits data (including Sinclair and Zeppelin 2002). Members of the SSLMC did not assign any species/region combination a score of "9" because the SSL diet is diverse and not wholly comprised of Pacific cod, pollock or Atka mackerel, but rather a combination of prey items. Other species observed in high diet proportions include Irish lords, salmon, and cephalopods. Thus, a fishery that harvested Pacific cod, pollock or Atka mackerel would still leave unharvested many other SSL prey items.

The seven geographic regions are defined in relation to the SSL draft revised recovery plan and include three in the Gulf of Alaska (western, central, eastern), three in the Aleutian Islands (western, central, eastern which includes the Bering Sea), and the Pribilof Islands region. The group unanimously assigned equal weights of importance (score = 5) to the Gulf of Alaska and Aleutian Islands regions because the draft recovery plan requires an increasing trend in all regions, so all are considered of equal importance to recovery. (If the criteria in the draft recovery plan change regarding the importance of regions, then the evaluation tool would need to be adjusted to reflect those criteria changes). The Pibilofs were assigned a slightly lesser rating of importance (score = 3.56) because the haulouts are not identified in the recovery plan.

The SSLMC scored the importance of the combination of fish species by region and season (Figure 5). A concern was raised about the relatively high ratings of importance for Pacific cod and pollock removals in the EGOA given the increasing trend in SSL in this region and the general lack of large Pacific cod or pollock fisheries in the region.

**Comment [SM15]:** The increasing trend, if true, needs to be cited. Fritz and Stinchcomb (2005) state that while non-pup counts increased in the eastern AI & E and W GOA, "the annual rate of change was not significantly different from zero." Not significant = no trend. I sure hope that the increase continues and an increasing trend is what is happening.

## OVERALL MODEL

The hierarchy consists of 215 total elements: two dimensions, 11 variables in the third level, 26 variables in the fourth level, 44 variables in the fifth level, and 132 variables in the sixth level (Appendix D). Variables are repeated, so in reality, the hierarchy consists of only 31 unique elements. Variables were repeated in order to provide multiple scenarios, thus allowing flexibility in the scoring process. For example, one scenario could be that a proposal seeks to harvest P. cod in an area with a moderate TAC/biomass ratio of cod over a prolonged time period, in the summer, in the Eastern Gulf of Alaska, in the 10-20nm zone, and affect 1-10% of rookeries in the region.

**Comment [SM16]:** So variables are what we decided to include in the model, rather than proposals...

To facilitate the evaluation of proposals, the lowest levels of the hierarchy were transferred to the Data Grid format (see example in Appendix E). The Data Grid is a recommended format for evaluating large numbers of alternatives (proposals) with respect to each variable in the next highest level in the hierarchy.

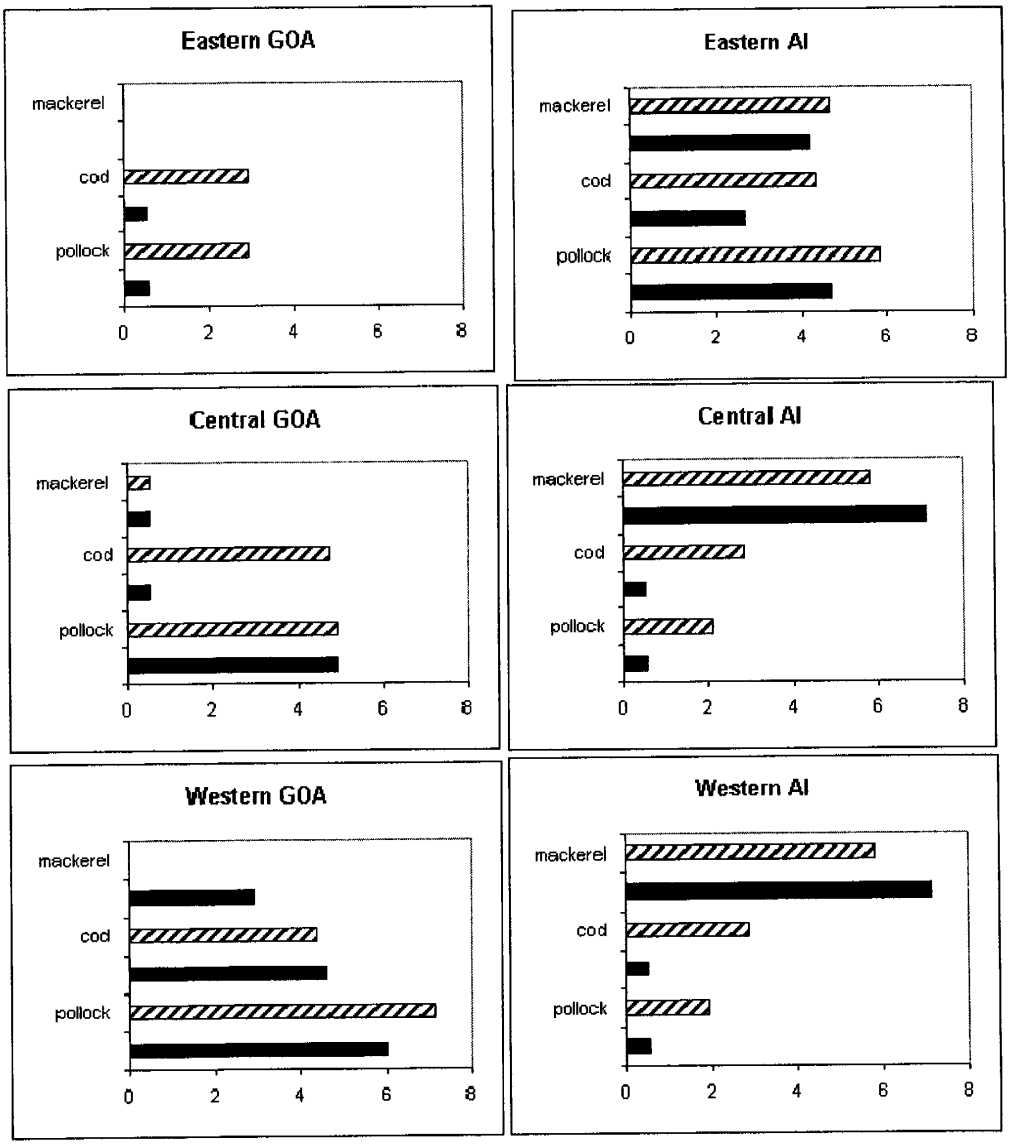


**Figure 5. Ratings of importance of Atka mackerel, Pacific cod and pollock to the SSL, by region and season; the striped bar is winter and the solid black bar is summer. The absence of a bar indicates the lack of a fishery for the species in that region. A high score indicates a high impact to the SSL.**

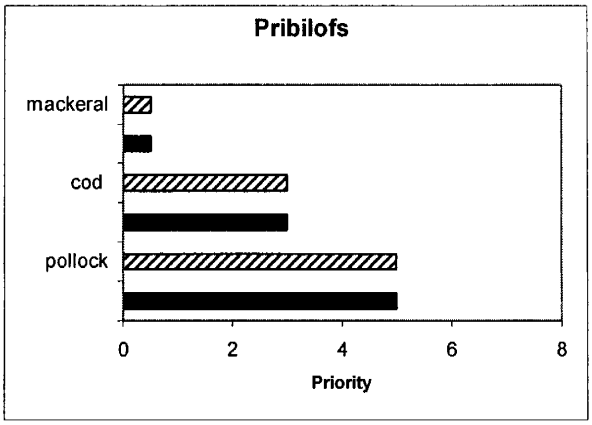


**Figure 5 continued.**

### OTHER VARIABLES

The SSLMC considered possible variables that do not apply to evaluating impacts; that is, those variables that may offer a benefit, or a "credit". One such variable discussed was whether a fishery was rationalized. A rationalized fishery has some capacity to reduce practices that could adversely affect SSL, however the capacity might not always be exercised. The consensus of the SSLMC was not to include the variable, "rationalized fishery", in the model.

Other variables mentioned that do not apply to the impacts model are proposals that seek to increase safety or economic benefits, and proposals to improve administrative or management efficiency. These benefits can be listed during the proposal screening process and examined after the impact evaluation is completed.

## IMPLEMENTATION OF THE EVALUATION TOOL

The metric against which rated proposals will be held up to was debated by the SSLMC. Questions such as these arose: "How will proposals compare to the jeopardy bar?", and "Can we compare proposals to the status quo?" One approach suggested was to run a proposal through the model and obtain its score; then run its status quo through the model to see the net effect of the proposed change for that specific proposal.

As an example, the following three scenarios were run through the model and scores were obtained for the proposed change, and its status quo. Each scenario's scores add to 1, because the proposed change is being compared to its own status quo. A lower score is better. So, for example, if the proposed change scored 0.4 and the status quo scored 0.6, that means that the proposed change would have less of an impact on the SSL than the current situation.

| Scenario # 1 | Score |
|---|---|
| **Proposed change:** "Change the seasonal apportionments for the longline catcher/processor Pacific cod fishery in the BSAI from 60/40 A/B season to 80/20 in the A/B season. The amount of harvest from the increase in A season fishing would be restricted to areas outside SSL critical habitat (outside 20nm and outside foraging areas)."<br><br>**Interpretation:** The region mostly affected is the EAI (because this area contains the eastern Bering Sea). The change will mostly entail shifting fishing from summer to winter, and additional A season fishing will be outside the 20+nm zone, around "other" sites. The TAC/biomass ratio is about "5" and will not likely change. Fishing is prolonged.<br><br>**Variables :** TAC/biomass of 5, prolonged, winter, EAI, Pacific cod, other site, 20+nm. | .369 |
| **Status Quo:** Fishing occurs at about a TAC/biomass ratio of 5, is prolonged, occurs mostly in summer, in the EAI, in the 10-20nm zone, and affects about 26-50% of rookeries in the region.<br><br>**Variables:** TAC/biomass of 6, prolonged, summer, EAI, Pacific cod, rookery site, 10-20nm, 26-50% of sites affected. | .661 |
| **Scenario # 2** | **Score** |
| **Proposed change:** "Relax pollock trawl fishing closures around rookeries and haulouts in the western GOA area 620 between 155 degrees and 150 degrees 30 minutes. Allow pollock trawl fishing between 10 and 20 nm around those sites during the A and B seasons only."<br><br>**Interpretation:** The region affected is the WGOA. The TAC/ biomass ratio is about "7" and fishing is prolonged. There are 4 haulouts & 2 rookeries affected & the proposal affects 26-50% of all sites in Area 620. The proposal seeks to allow fishing in the 10-20nm zone, in both winter and summer.<br><br>**Variables :** TAC/biomass of 7, prolonged, WGOA, pollock, 26-50% of sites affected in the region, at 10-20nm, both winter and summer, for both haulouts and rookeries. | .553 |
| **Status Quo:** Fishing for pollock occurs in the WGOA at about a TAC/biomass ratio of 7, is prolonged, occurs year round, but is only allowed at 20+nm.<br><br>**Variables:** TAC/biomass of 7, prolonged, WGOA, pollock, 20+nm, both winter and summer, for both haulouts and rookeries. | .447 |

| Scenario # 3 | Score |
|---|---|
| **Proposed change:** "New science shows that pollock are important in the SSL diets and therefore some of the haulouts where SSL occur should have protection by shifting pollock trawling further offshore. Therefore, close to pollock trawl fishing all haulouts on the Pribilofs from 0-10nm year round."<br><br>**Interpretation:** The TAC/biomass is about 3, and fishing is prolonged. This change would affect 100% of haulouts. It would affect both summer & winter.<br><br>**Variables:** TAC/biomass of 3, prolonged, Pribilofs, winter and summer, pollock, 10-20nm, 100% of haulouts. | .347 |
| **Status Quo:** Currently there are pollock trawl closures at Pribilof haulouts only from 0-3 nm.<br><br>**Variables:** TAC/biomass of 3, prolonged, Pribilofs, winter and summer, pollock, 3-10nm, 100% of haulouts. | .653 |

Of the three scenarios, it is predicted that only #2 could result in greater impact to the SSL. Scenarios #1 and 3 could actually remove some level of existing impact to the SSL.

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The SSLMC agreed that additional discussion will be required to develop a process for using the model to rate proposals. That work will commence following review and advice from the SSC.

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**Appendix A. Participants involved in the development of the evaluation tool, Seattle, July 25-27, 2006.**

| SSLMC | | | |
|---|---|---|---|
| **Name** | **Organization** | **Phone** | **E-mail** |
| Jerry Bongen | Fisherman | 907 486-6245 | jbongen@mac.com |
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| Facilitator | Peggy Merritt | 907 457-5911 | pmerritt@ak.net |
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| Note taker | Bill Wilson | 907 271-2809 | bill.Wilson@noaa.gov |

**Subject: RE: SSLMC proposal ranking tool report**
**Date:** Mon, 7 Aug 2006 15:06:10 -0800
**From:** "Sue Hills" <shills@ims.uaf.edu>
**To:** "'Terry Leitzell'" <TerryL@IcicleSeafoods.com>, "'Bill Wilson'" <bill.wilson@noaa.gov>, "'Jerry Bongen'" <jbongen@mac.com>, "'Julie Bonney'" <jbonney@gci.net>, "'Sam Cotten'" <samc.er@gci.net>, "'Larry Cotter'" <LCotter371@aol.com>, "'Ed Dersham'" <outlook@ptialaska.net>, "'Earl Krygier'" <Earl_Krygier@fishgame.state.ak.us>, "'Kevin Duffy'" <kduffy@atsea.org>, "'John Gauvin'" <gauvin@seanet.com>, "'John Henderschedt'" <johnh@prempac.com>, "'Dan Hennen'" <danielhennen@alaskasealife.org>, "'Frank Kelty'" <fvkelty@arctic.net>, "'Dave Little'" <dlittle@clipperseafoods.com>, "'Steve MacLean'" <smaclean@tnc.org>, "'Max Malavansky, Jr.'" <max_malavan@hotmail.com>, "'Art Nelson'" <artnelson49@yahoo.com>, "'Kristin R. Mabry'" <Kristin.Mabry@noaa.gov>, "'Douglas Demaster'" <Douglas.Demaster@noaa.gov>, "'Lowell Fritz'" <lowell.fritz@noaa.gov>
**CC:** "'Peggy Merritt'" <pmerritt@ak.net>

I believe I was the one at the meeting who requested that we note the assumptions behind many of our weightings. I did not mean that to imply that the SSL MC agreed with those assumptions I meant that we should be clear that the weights were done GIVEN those conditions. Sort of like saying "if we assume that smoking Camel cigarettes makes one more attractive, and one wants to be attractive, then one should smoke Camels." That 's all true even if one disagrees with the assumption. Ditto here. The ESA deal is all about the possibility that fisheries affect SSL in some negative way. We may or may not agree with that, but that is the shape of the problem now. If one assumes that fisheries affect SSL, then one of the ways could be through prey depletion. If it is true that fisheries negatively affect SSL through prey depletion, then one might want to restrict fishing near where SSL are when they are most vulnerable etc etc. But the whole logical construction is based on the primary assumption that fishing affects SSL negatively, which may or may not be true. Earl's comments on changing the language were helpful but perhaps we need to be even more direct, saying that by the development of this tool, the committee does not mean to imply that it agrees wtih the original assumption or not, that the various statements of the assumptions throughout the document are strictly to clarify the logic and do not imply agreement or belief in those assumptions.

More detailed comments to follow.

Sue

---

**From:** Terry Leitzell [mailto:TerryL@IcicleSeafoods.com]
**Sent:** Monday, August 07, 2006 2:23 PM
**To:** Bill Wilson; Jerry Bongen; Julie Bonney; Sam Cotten; Larry Cotter; Ed Dersham; Earl Krygier; Kevin Duffy; John Gauvin; John Henderschedt; Dan Hennen; Sue Hills; Frank Kelty; Dave Little; Steve MacLean; Max Malavansky, Jr.; Art Nelson; Kristin R. Mabry; Douglas Demaster; Lowell Fritz
**Cc:** Peggy Merritt; Terry Leitzell
**Subject:** RE: SSLMC proposal ranking tool report

Bill, et al,

I have attached a mark-up of the draft report. My more generic comments follow.

Sue Hills

# Multi-Criteria Decision Tool to Evaluate Proposals for Change in Steller Sea Lion Protection Measures in the Gulf of Alaska and Bering Sea/Aleutian Islands Groundfish Fisheries, 2006

**Developed by the**

**Steller Sea Lion Mitigation Committee**

**North Pacific Fishery Management Council**

**August 2006**

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# INTRODUCTION

The North Pacific Fishery Management Council (NPFMC) reinstituted the Steller Sea Lion Mitigation Committee (SSLMC) for the purpose of tracking the recent Section 7 Consultation, and to accept proposals for possible changes to existing Steller sea lion (SSL) mitigation measures for the Pacific cod, pollock and Atka mackerel fisheries in the Gulf of Alaska and the Bering Sea/Aleutian Islands. The SSLMC began work to prepare and develop a tool for evaluating proposals, which was presented to the NPFMC and the SSC in June 2006. The SSLMC were advised to institute a more rigorous approach to identifying potential impacts to the SSL resulting from fishing activity, and how changes in fishery regulations could be gauged to minimize impacts to the SSL. July 25-27, 2006 SSLMC members and scientific advisors with the National Marine Fisheries Service Alaska Fisheries Science Center (NMFS-AFSC) met in Seattle to begin development of an evaluation tool using a facilitated systems approach to planning and evaluation – the Analytic Hierarchy Process (AHP).

**Comment [SH1]:** I'd insert more info here on all the "getting smart" work we did early on. As it stands now, it could be thought that we're just a bunch of uninformed folks with a couple of experts around to make up a tool. We had lots more preparation and background than that. May not be needed at this stage in the report but certainly for the final to be sure the process is not misunderstood.

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The AHP has been used extensively for decades to address planning, conflict resolution, and prioritization in such areas as policy development, economics, engineering, medical and military science, and has more recently been applied to fisheries research and management (Leung et al. 1998; Merritt and Criddle 1993; Merritt 1995, 2000 and 2001; Merritt and Skilbred 2002; Merritt and Quinn 2000; Ridgley et al. 1997; USFWS 2005, 2006). The AHP is a tool for facilitating decision-making by structuring the problem into levels comprising a hierarchy. Breaking a complex problem into levels permits decision makers to focus on smaller sets of decisions, improving their ability to make accurate judgments. Structuring also allows decision makers to think through a problem in a systematic and thorough manner. The AHP encourages people to explicitly state their judgments of preference or importance. Decision support software, Expert Choice,[1] was used interactively to structure the problem, depict the influence of weights, and derive the priority of elements.

The evaluation tool will undergo several phases of development and review:

1. July 25-27, 2006 the SSLMC develops a prototype evaluation tool, in collaboration with the NMFS-AFSC staff in Seattle;

2. August 4-9, 2006 the SSLMC reviews and comments on a draft report of the prototype evaluation tool;

3. August 15-16, 2006 the SSC reviews and comments on the prototype evaluation tool in Juneau; and,

4. The SSLMC incorporates comments from the SSC in the development of the evaluation tool.

**Comment [SH2]:** Maybe put in the additional steps it looks like will be needed now.

[1] Forman, E., T. Saaty, M. Selly, and R. Waldron. Expert Choice, Decision Support Software, McLean VA. 1983.

The purpose of this report is to describe and present the evaluation tool developed by the SSLMC, in concert with the NMFS-AFSC and public in Seattle, July 25-27, 2006. This report constitutes the first phase in the development of the evaluation tool. After review by the SSLMC and subsequent modifications it will provide a basis for review and comment from the SSC at their August 15-16, 2006 meeting in Juneau.

Work on the evaluation tool by the SSLMC does not imply that a clear linkage between fish harvest and abundance of SSL is known to exist or that the committee believes that it does. Rather, the evaluation tool is predicated on the assumption that fishing has some relationship with SSL. The July 25-27 meeting in Seattle was solely concerned with developing a tool to evaluate impacts; insufficient time and information have been available to the SSLMC to fully develop a tool to evaluate benefits or "credit" in a proposal except as noted below.

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Comment [SH3]: Some of Terry L's wording may be useful here.

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Comment [SH4]: I'm thinking here about the rating proposals relative to their own status quo – that does recognize additional protection. Rather the aspects that are not being measured are the economic, social, safety, enforcement etc costs and benefits. When we'd talked earlier we'd assumed those would be benefits but they aren't necessarily.

# METHODS

## PARTICIPANTS

A total of 13 SSLMC members participated in developing the evaluation tool (see Appendix A). Advice and scientific information was provided by NMFS AFSC staff as well as members of the public. The meeting was facilitated by Dr. Margaret Merritt (Resource Decision Support).

## APPROACH

The AHP was used to structure the problem and derive the interactions of its parts using data (when available) in combination with expert judgment (Saaty 1999). Expert judgment is defined as "previous relevant experience, supported by rational thought and knowledge" (Saaty and Kearns 1985).

## STRUCTURING AND ESTABLISHING PRIORITIES

A top-down structuring approach was used, whereby the mission forms the top of the hierarchy and dimensions form the second level of the hierarchy. The mission is a responsibility to fulfill. A dimension is a path along which an impact can be measured. Variables and their sub-units are the set of proposed changes to fishing regulations, and form the starting point for discussing the lower levels of the hierarchy. The group was tasked with discerning how variables associated with fishing would be likely to impact the dimensions of the SSL and their prey.

Development of the hierarchy was completed first, and then priorities were assigned to the elements of the hierarchy, with discussion about criteria for judging importance. Judgments on the degree of importance (or degree of sensitivity to impact) of a group of elements was always made in relation to their "mother" node - this linked the elements in the lower levels to the upper levels of the hierarchy. In discussing criteria, a question such as the following was asked for each group of judgments, "Are all elements of this

group of equal importance in assessing impacts, or is one element of more or less importance than another, in relation to its mother node?" A specific example follows: "Are all SSL site types (rookery, haulout, or other) of equal importance (sensitivity) to impact from fishing activity, or is one of more or less importance than another, in relation to a given season (winter or summer)?" In-depth discussion, with supporting data from NMFS-AFSC staff, followed each such question, so that the rationale to be used by committee members for judging importance was clearly established.

Comment [SH5]: From subsequent comments this seems to be an area of concern. Don't know how you want to handle it here but might say something like "upon review of the draft report from the July meeting, it was clear that additional understanding of ranking scale and rationales was desired and will be developed at the next meetings" or some such. Applies to the scale of importance too. Why did we not use 1/9, 1/7 etc?

Using criteria as guidelines, the SSLMC was asked to use supporting data (when possible) and/or their expert judgment in individually assigning ratings of importance to elements in each level of the hierarchy. The relative importance of the dimensions was evaluated, then that of the variables within each dimension, then that of the sub-units within each variable. Participants were given time to think and write their ratings of importance down before sharing and discussing their judgments. A positive ratio scale with associated verbal equivalents was used to rate importance, where numbers between those listed (e.g., 2, or 2.5, etc.) were used to interpolate meanings as a compromise:

Comment [SH6]: Unclear what this means. What criteria? The above paragraph mentions rationale, is that what you mean?

| Scale of Importance | Definition |
|---|---|
| 9 | Extreme importance |
| 7 | Very strong importance |
| 5 | Strong importance |
| 3 | Moderate importance |
| 1 | Slight importance |

Elements judged to be of equal importance were given equal scores. Consensus within a range of two to three points on the rating of elements was usually achieved among participants. When disparity in judging importance occurred, it meant there was disagreement a difference in understanding, or a different application of the rating criteria, and discussion and debate was encouraged. Debates advanced the understanding of important concepts and often resulted in a clearer definition of the dimension or variable. By seeking consensus not only were dialogue and learning encouraged, but also the formation of a group solution, rather than individual solutions, was promoted.

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Expert Choice was used interactively to depict the influence of weights and derive the priority of variables. Priorities approximate the strength of importance for each variable, adjusted to reflect the importance assigned to the dimension addressed by that variable. Mathematically, relative ratings of importance are entered into a vector and normalized. The values from the vector are then multiplied by the weight in the next highest level, and the result is the weight of importance for variables. The total score for each variable is then calculated by adding the weighted proportions over all variables within a dimension:

Comment [SH7]: So where do the eigenvectors come in? No reference to them here, I'm confused. The comic book sequence I sen in email is how I understood it worked and that doesn't seem exactly like this.....what's up? I'm just lost again, right?

$$T_m = \sum_{k=1}^{d} W_k p_{k,m}$$

where

$T_m$ = the total weighted score for variable *m*,
$W_k$ = the weight for dimension k,
$p_{k,m}$ = the weighted proportion of the total score for variable m addressing dimension k
$d$ = the number of variables.

## STRUCTURAL ADJUST

Structural imbalance in the hierarchy can lead to dilution of the weight of many variables under a single dimension, so an adjustment feature in Expert Choice can be used to restore priorities to their respective proportion of weight. While approximate balance is sought and desired, complex problems do not always lend themselves to balance – thus the advantage of the structural adjust feature.

In a conceptual example, consider that if a dimension (A) has four variables, and another dimension (B) has two variables, then there are six variables in all and structural adjusting multiplies A's priority by 4/6 and B's by 2/6. Thus, the overall priorities for A's variables are not diluted simply because there are many of them.

**Comment [SH8]:** So? Was this used for us? It was certainly not presented at the meeting. Please clarify the relevance of this section.

# RESULTS AND DISCUSSION

## MISSION

The SSLMC's mission statement for the AHP model, to which all dimensions and variables related, is to build upon previous efforts that were made to develop a rational approach to evaluating proposed changes in fishing regulations for Atka mackerel, pollock and Pacific cod in the Bering Sea, Aleutian Islands and Gulf of Alaska that had been put in place previously to protect SSL and their prey.

In the most recent biological opinion on the impact of federal fisheries for Atka mackerel, pollock and Pacific cod in the Bering Sea, Aleutian Islands and Gulf of Alaska, Protected Resources division of NOAA Fisheries, one of the hypotheses for the decline in the number of SSL in the Western DPS is that fisheries have somehow contributed to their decline, probably indirectly by reducing the prey available to SSL. Although SSLMC's work on this tool proceeded with the assumption that there is a relationship between prey and the nutritional balance of the SSL, that does not imply concurrence with that assumption by the SSLMC.

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Deleted: mitigation measures) that encompasses relevant and measurable dimensions of the SSL

Comment [SH9]: Is it a division? Or an office or a bureau or what?

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## DIMENSIONS ALONG WHICH IMPACTS OF PROPOSED CHANGES ARE EVALUATED

The SSLMC identified two dimensions of the problem:

- the needs of the SSL, that is when and where they are "sensitive" to reduced prey; and,
- how fisheries affect the prey of SSL.

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Comment [SH10]: I didn't mean to switch the order of the dimensions, it's just the way I typed it.

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### The Prey of the SSL

The SSLMC engaged in lengthy discussions about concepts relating fishing to the prey field, including concerns about the availability of prey from dispersal caused by fishing activities. Response of the prey field to fishing can include changes in fish schooling behavior, which may impact the SSL's ability to capture and consume prey. Dispersal of the prey field through fishing activities may also induce "prey switching". The question that arises is, "Will prey availability be altered?" The assumption is that more aggregated prey are easier for the SSL to capture. A second concern is the likelihood of depletion of prey by removal. Removal of fish can result in a reduced number of fish or fish aggregations. The question that arises is, "Will prey be measurably depleted?" The assumption is that fewer fish diminishes the value of the prey field.

Deleted: The SSLMC's perception of the problem mirrors primary concerns of the Endangered Species Act, which are the potential for jeopardy or adverse modification through fishing effects on the SSLs and their habitat with changes in the prey field or the ability of the SSLs to acquire food. ¶

¶

Both of the above concerns were ultimately combined by the SSLMC into one dimension because it was thought that realistically there could be little measurable distinction between the two.

Comment [SH11]: This all seems perfectly clear to me

## The SSL

Much discussion focused on SSL foraging ecology, reproductive behavior and energy balance needs, and potential disruptions from fishing activity to the general well-being of the SSL. Degree of impacts was related to adult females and weanlings, as these categories of individuals have varying energy balance needs over time, as compared with adult males. Males are able to forage further and more independently because they do not care for young, and do not need to expend energy converting food into maternal milk. There can be degrees of impact to adult females through competition. The assumption is that females have dual roles of maintenance and reproduction. Fishing competition with juvenile SSLs that have not yet weaned and are still partly reliant on maternal care is a primary concern. The assumption is that weanlings have lesser diving capability and must balance energy over a shorter period of time than adults because of a smaller body size. In addition to the concept of competition, the concept of other effects of fishing activity on SSL through disturbance was discussed. The SSLMC intended the term "disturbance" to include behavioral and physical aspects.

Deleted: smaller body size

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All concerns were ultimately combined into one dimension because adult females and weanlings overlap in time and space, thus making these components of the problem nearly indistinguishable from an impact point of view; and, disturbance is an overarching concern, related to several variables, including proximity.

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Judgments of importance between the prey field and the SSL dimensions were based on the degree to which change may result in an adverse effect on the energy balance of an individual SSL. The geometric mean of all scores resulted in ratings of importance for the dimensions (Figure 1). The spread of scores was between 3-4, on a scale of 1-9, which can be characterized as mild disagreement, occurring within a minority of the SSLMC.

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Comment [SH12]: Maybe a reference here for interpreting that range of disagreement? Or else drop the mild?

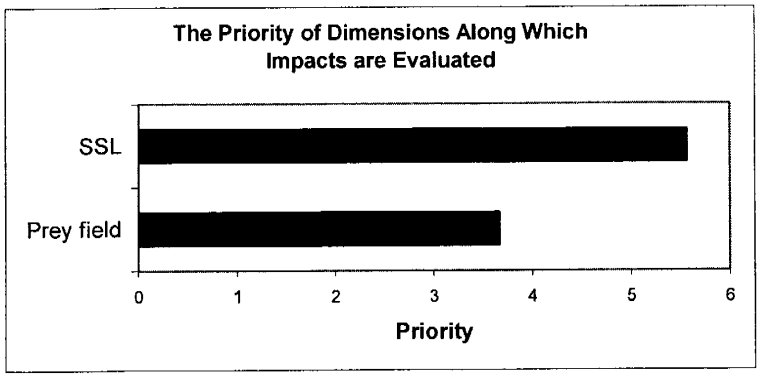


**Figure 1. The relative priorities of SSL needs versus fishery effects on SSL prey.**

Comment [SH13]: If we had more clear rationale for this , might be good to put it here too. Or at least more text discussing why they are not 50:50.

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## VARIABLES

Prior to the meeting, a scoping survey was distributed to a sub-group, to identify variables that might be encountered in proposals. The question asked was, "What's on the table for change?" And, "Given the set of variables, what sub-set will be used in the evaluation tool?" At the meeting, the entire SSLMC modified the list. Table 1 lists the variable field identified as useful to the evaluation tool.

**Table 1. The potential set of variables from proposed fishing regulation changes that are included in the model to evaluate impacts to the SSL and their prey.**

| Variable | Sub-units |
|---|---|
| 1. Fish Species of Interest | a. Pacific cod b. Pollock c. Atka mackerel |
| 2. TAC | The TAC is calculated for each fish species of interest, for each region for a year (ie not by seasons). |
| 3. Fish Biomass | The biomass is estimated for each fish species of interest, for each region for a year (ie not by seasons) |
| 4. Fishing duration | a. Pulse (TAC is taken in 3-10 days)<br>b. Prolonged (TAC is spread out across time) |
| 5. Geographic regions | a. Eastern Gulf of Alaska (EGOA)<br>b. Central Gulf of Alaska (CGOA)<br>c. Western Gulf of Alaska (WGOA)<br>d. Eastern Aleutian Islands (EAI; includes the Bering Sea)<br>e. Central Aleutian Islands (CAI)<br>f. Western Aleutian Islands (WAI)<br>g. Pribilof Islands |
| 6. Seasons | a. Summer (the SSL breeding season, defined as May-September)<br>b. Winter (non-breeding season, October-April) |
| 7. SSL site types | a. Rookery b. Haulout c. other |
| 8. Proximity zones to a SSL site | a. 0-3 nm b. 3-10 nm c. 10-20 nm d. 20+ nm e. not critical habitat |
| 9. The percentage of SSL sites affected in a region | a. 1-10% b. 11-25% c. 26-50% d. 51-75% e. 76-100% |

Explanations of variables used in the hierarchy follow for each dimension.

### Variables Applicable to the Prey Dimension

Variables that can potentially impact the prey field dimension are:

- the TAC for a given fish species in a given region,
- estimates of fish biomass in a given region, and
- fishing duration.

The ideal way to evaluate impacts of proposed changes on the prey field would be to know fish biomass at the site and time in question, understand SSL prey needs at the site

and time, and be able to predict with accuracy the amount and rate of harvest relative to biomass associated with the proposed change. However, this is a data-poor environment in which to make decisions, so judgments must be made on the best available information. While the rationale for a hierarchy of fishing power by gear type was provided in the June 2003 Supplement to the BiOp (page 36), and explained to the SSLMC by NMFS-AFSC staff, the SSLMC concluded that gear type and vessel size are not satisfactory proxies for removal rate. Concerns for using gear type and vessel size as proxies for removal rate include the lack of consideration for the number of vessels fishing, fisheries occurring on large schools of fish, agreement between sectors to avoid fishing conflicts, and the expectation that some proposals may be presented that would control removal rate directly.

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The SSLMC launched into a lengthy debate on how best to account for fish removal relative to available biomass, and raised the possibility of assigning a rating to a fishery based on the percentage of the TAC taken. Staff from the NMFS-AFSC were asked if exploitation rates could be estimated in areas smaller than a given region? Unfortunately, fish biomass surveys do not provide estimates on a per-site basis; fish biomass per species is estimated on a regional scale. Therefore, the group decided that the best characterization of removal rate, given limited knowledge, is a qualitative assessment of the ratio of the TAC to biomass ratio, per species, on a regional basis. For example, a proposal for a high harvest in an area of low target species abundance would be rated high (more adverse to the SSL). The NMFS-AFSC agreed to provide to the SSLMC a qualitative statement of biomass in each region. Catch to biomass comparisons could be provided by developing a ratio between TAC for a region with the estimated biomass in that region, projected for 2008, from the next stock assessments and SAFE reports. The NMFS-AFSC would use their best judgment to estimate regional biomass for Pacific cod, pollock and Atka mackerel. Need some discussion here about these being estimates for a year, not by seasons. Surveys done in summer, fishing takes place at different times of year when biomass may be different.

Prey removal rate may be complicated by seasonal behavior of fish; for example, pollock aggregate for spawning in winter and a fishery targeting these fish would have an exploitation rate that is high, in part because of the schooling behavior of the fish. Fish migratory behavior could also affect exploitation rate.

The TAC/biomass ratio can be scaled by degrees of impact to the prey field according to Saaty's 1-9 ratio scale in the following manner:

- A high TAC/low biomass ratio is interpreted as having an extreme impact on the prey field, and is given a value of "9".
- A low TAC/high biomass ratio is interpreted as having a slight impact on the prey field, and is given a score of "1".

Between the values of "9" and "1", are gradations (scores of 2-8) that can be used to depict the degree of impact to the prey field. For each proposal, the SSLMC must judge the expected proportion of removal, and score it according to the following guide:

| TAC/Biomass per species, per region | Weight of impact (score) |
|---|---|
| High TAC/Low Biomass | 9 |
| | 8 |
| | 7 |
| | 6 |
| | 5 |
| | 4 |
| | 3 |
| | 2 |
| Low TAC/High Biomass | 1 |

The data supplied by the NMFS-AFSC for this piece of the evaluation tool is found in Appendix B. These data were not seen by the Committee at the July meeting.

Characterization of removal rate must be discussed in relation to the duration of removal – so, the SSLMC engaged in an extended debate about the impacts of "pulsed" (defined as approximately 3-10 days) versus "prolonged" fishing on the prey field (small amounts of fish harvested incrementally over long periods of time). The SSLMC turned to the NMFS-AFSC for data in this regard. There is some research that suggests SSL are most vulnerable to prey field disruptions that are characterized by a high removal rate in a pulsed time frame in a given area (June 2003 Supplement to the BiOp). That is, an individual SSL can probably deal with low food abundance for a few days, but going without food for 3-10 days would be detrimental to the health of the SSL. The concern with pulsed fishing is localized removals of large quantities of available biomass. Ultimately, the majority (90%) of the SSLMC decided that at high removal rates, pulsed fishing has the highest impact; however, at low removal rates the duration of fishing is of slight consequence (Table 2). The spread of scores shows that general agreement (defined as a spread of 0-3) is lacking about the impacts of fishing duration in relation to fishing removal rate on the prey field. The SSLMC intends to continue discussion on this topic upon receipt of additional information.

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Removal rate and duration was considered in the context of region; however, all regions were assigned equal weight because recovery of the SSL is required in all for delisting the SSL from endangered status. The SSLMC also considered removal rate and duration in the context of fish species, but again assigned equal weight to all three species of interest, because all are important in the diet of SSL and relative importance by region is captured in the SSL dimension.

**Table 2. Judgments on the degree of impact (group geometric mean) that scenarios of removal rate and duration of fishing have on the SSL prey. A high geometric mean score reflects a highly adverse impact.**

| TAC/Biomass Score[a] | Duration of Fishery | Geometric Mean Group Score | Spread of Scores |
|---|---|---|---|
| 9 | Pulsed | 8.74 | 1 |
| | Prolonged | 1.43 | 8 |
| 8 | Pulsed | 8.00 | 0 |
| | Prolonged | 1.41 | 7 |
| 7 | Pulsed | 6.90 | 2 |
| | Prolonged | 1.40 | 6 |
| 6 | Pulsed | 6.15 | 0 |
| | Prolonged | 1.38 | 5 |
| 5 | Pulsed | 5.36 | 3 |
| | Prolonged | 1.16 | 2 |
| 4 | Pulsed | 4.04 | 4 |
| | Prolonged | 1.12 | 1 |
| 3 | Pulsed | 3.15 | 6 |
| | Prolonged | 1.06 | 1 |
| 2 | Pulsed | 2.00 | 7 |
| | Prolonged | 1.06 | 1 |
| 1 | Pulsed | 1.19 | 7 |
| | Prolonged | 1.06 | 1 |

[a] A high TAC/low biomass ratio reflects a high rate of removal, which is deemed as having an adverse effect on the SSL prey field.

### Variables Applicable to the SSL Dimension

Variables that can potentially impact the SSL dimension are:

- fishing near a type of SSL site,
- fishing within zones of proximity to the site, in a given season,
- the percentage of SSL sites in a region affected by the proposed change,
- fish species targeted for harvest, and
- fishing within a geographic region, in a given season.

***SSL Site Type by Season and Proximity, and the Percentage Affected***

The ideal way to evaluate the impacts of proposed changes to fishing regulations on the degree of disturbance to SSL would be to examine the impacts related to the number of SSL per site on a seasonal basis, and the trend in SSL abundance. However, survey counts of SSL are not conducted at every site, occur primarily in summer, and movement of SSL between sites is known to occur; thus, the effects of fishing in winter at a

particular site would have little relation to SSL abundance counts that were conducted in summer. Lack of complete knowledge of SSL abundance per site on a seasonal basis and the extent of movement between sites also hampers incorporation of SSL trend information into the evaluation tool. Trends per area are subject to error due to variability in SSL movement between sites, and thus trends are not meaningful on a per-site basis. The NMFS-AFSC staff suggested that incorporation of the concept of the sensitivity of site type and proximity of fishing activities to the site in a given season into the evaluation tool would serve as the best available proxy to SSL abundance and trend, because data on sites are more reliable.

The SSLMC discussed the best way in which to incorporate time, and concluded that seasons based on the energy needs of the SSL would be the most useful since we are discussing the availability of energy (food) to SSL. Summer is defined as the breeding season (May-September) and is roughly equivalent to the B and C fishing seasons. It is assumed that energy needs are greater for lactating females and other nutritional stresses associated with breeding; thus, summer would be a more important (sensitive) time than winter. Winter is defined as the non-breeding season (October-April) and is roughly equivalent to the D and A fishing seasons.

The NMFS-AFSC staff distributed a table characterizing SSL site types as rookery, haulout or "other", based on the occurrence of breeding activity at the site and the numbers of animals counted there (Appendix C). The "other" designation is given to sites that are listed in the Biological Opinion, but do not meet the seasonal criteria for rookery or haulout; SSL can still be present at these sites. The new telemetry data show that both rookeries and haulouts are used for a longer period of time by a more diverse group of SSL than previously observed. Following testimony from the NMFS-AFSC staff regarding site type and importance based on seasonal use, votes were taken on the degree of sensitivity, where a high score represents a site that has great importance in the overall recovery of the SSL and is sensitive to change (Figure 2).

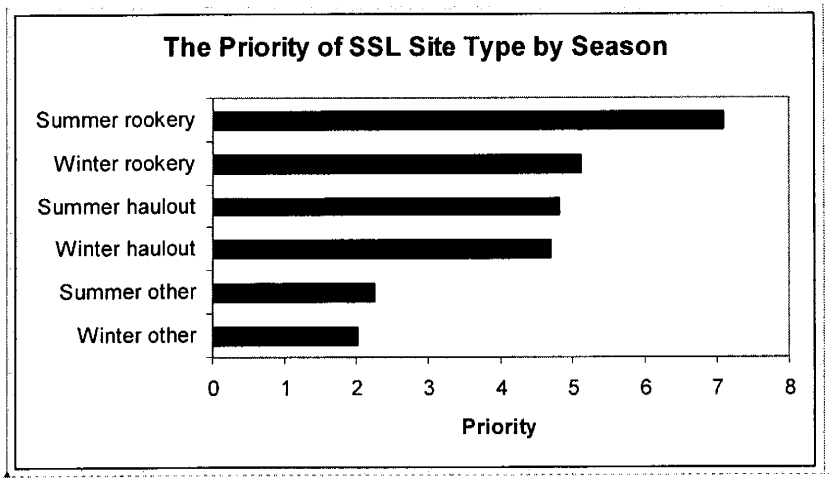


**Figure 2. The priority of SSL site types, by season**

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**Comment [SH14]:** Nope. Telemetry info just give where they have been. No diet info there.

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**Deleted:** The new telemetry information included SSL diet composition by region and season (Appendix C).

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**Comment [SH15]:** Is that true? They're still tagging young animals so that couldn't show more diverse use.....maybe it was the remore cameras?

**Comment [SH16]:** Why not show to 9 since that is the whole scale?

**Field Code Changed**

Thus, a summer rookery is more important and is more sensitive to impact than a winter "other" site because of SSL breeding activity. The majority of the group voted similarly, with a 4 -5 spread in scores due to a disagreement from one or two members, depending upon the site/season in question.

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The impact of fishing to a site/season combination depends on how close fishing takes place to the site. The assumption is that fishing in increasing proximity to a SSL site increases deleterious effects on the SSL. Much work and discussion has previously gone into the "zonal approach" presented in Tables II 1-9, on pg 94 of the June 2003 Supplement to the BiOp. New juvenile telemetry data (Lowell Fritz, personal communication) supports high sensitivity for the 0-3 nm and 3-10 nm zones. The assumption is that increasing distance of activity from the SSL site reduces disturbance to the SSL. The SSLMC wished to incorporate the concept of the zonal approach into the evaluation tool, and prior ratings of importance were adjusted to reflect the 1-9 rating scales used in the AHP. The SSLMC expanded on the zonal approach by considering sensitivity to proximity in relation to site type and season (Figure 3).

**Comment [SH17]:** I know he mentioned it but I recall the committee asking if we'd seen it. Bill – did we? If so, remind everyone of that fact. If not, then say that.

There was agreement (a spread of 0-3) among the group on the sensitivity of the zones per site/season combination. The most important zone is 0-3 nm for all site types by season; the least important zones are the 20+ nm and that area designated as "not critical habitat (CH)". The priority scores assigned by the SSLMC are consistent with those recommended by the NMFS-AFSC. The most critical habitat surrounds rookeries, in the 0-3nm and 3-10 nm zones.

Members of the SSLMC wanted to account for the percentage of SSL sites in a region affected by a proposal, combined with proximity to a site. Consensus was reached to include five categories of site percentages affected, within three proximity zones (Figure 4). The greatest adverse impacts (scored as "9") would occur if the proposal sought to affect from 11-100% of SSL sites in a given region, operating within the 0-3 nm zone.

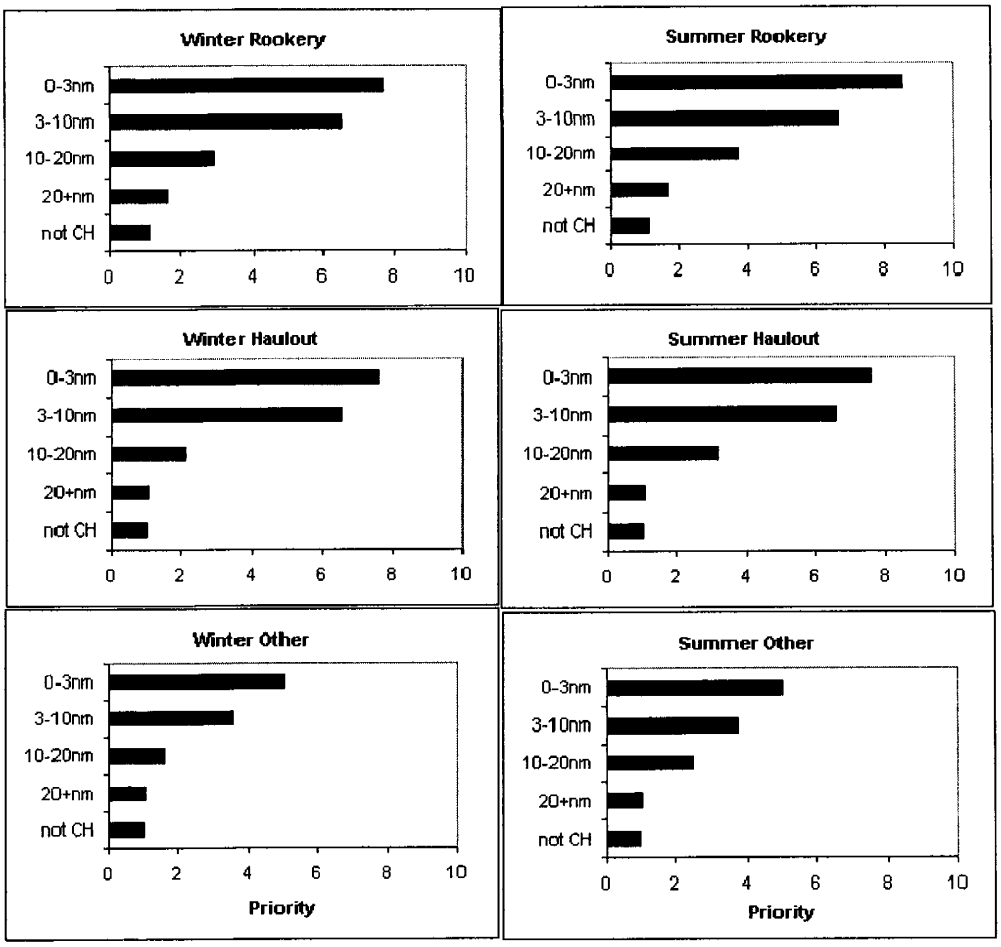


**Figure 3. The sensitivity (priority) of a SSL site type to proximity of fishing, by season.**

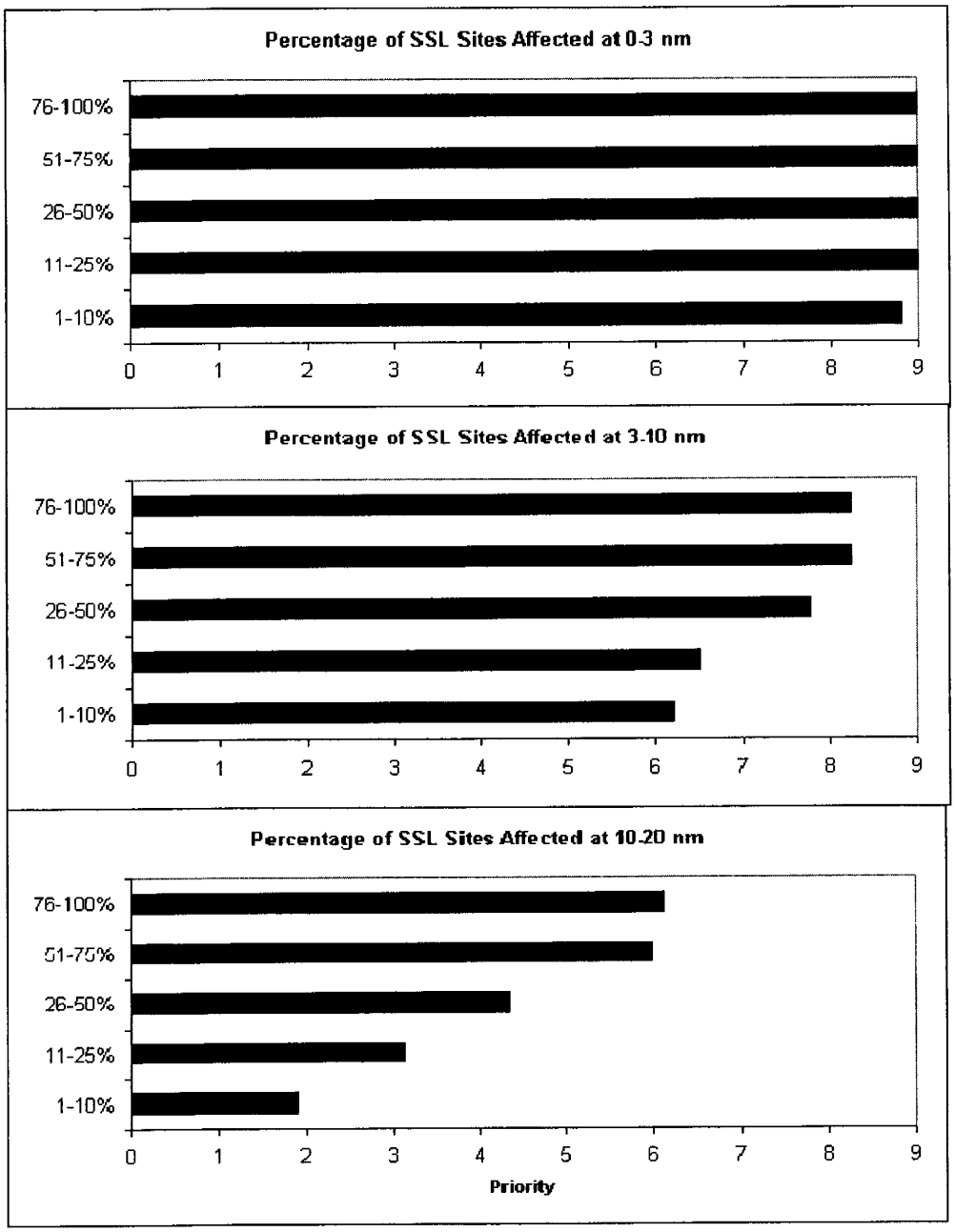


**Figure 4. The potential of adverse impact (priority) of a change in fishing, considering percentages of SSL sites affected in a region, and fishing in proximity to the sites.**

*Fish Species Harvested, by Region and Season*

The combination of variables - fish species harvested, in a given geographic region, on a seasonal basis - is a proxy for nutritional needs of the SSL. Fish species of interest are Pacific cod, pollock and Atka mackerel, based on scat research that has defined these species as occurring frequently in the diet (Sinclair and Zeppelin *in review*). Data presented to develop ratings of importance included the most recent SSL food habits data (including Sinclair and Zeppelin 2002). Members of the SSLMC did not assign any species/region combination a score of "9" because the SSL diet is diverse and not wholly comprised of Pacific cod, pollock or Atka mackerel, but rather a combination of prey items. Other species observed in high diet proportions include Irish lords, salmon, and cephalopods. Thus, a fishery that harvested Pacific cod, pollock or Atka mackerel would still leave unharvested many other SSL prey items.

The seven geographic regions are defined in relation to the SSL draft revised recovery plan and areas for which proposals are expected and include three in the Gulf of Alaska (western, central, eastern), three in the Aleutian Islands (western, central, eastern which includes the Bering Sea), and the Pribilof Islands region. The group unanimously assigned equal weights of importance (score = 5) to the Gulf of Alaska and Aleutian Islands regions because the draft recovery plan requires an increasing trend in all regions for delisting, so all are considered of equal importance to recovery. (If the criteria in the draft recovery plan change regarding the importance of regions, then the evaluation tool would need to be adjusted to reflect those criteria changes). The Pibilofs were assigned a slightly lesser rating of importance (score = 3.56) because those haulouts are not identified in the recovery plan, but at least one proposal is likely to address that area.

The importance of the combination of fish species by region and season (Figure 5) was assigned based on diet data. A concern was raised about the relatively high ratings of importance for Pacific cod and pollock removals in the EGOA given the increasing trend in SSL in this region and the general lack of large Pacific cod or pollock fisheries in the region.

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**Comment [SH18]:** Put in the part about what % of the diet = what score etc from that page by Lowell. The SSLMC didn't decide anything – hence the concern but it wasn't about the lack of big fisheries , it was how could they be so important in the diet since no one thought there were many there as evidenced by the lack of fisheries.

## OVERALL MODEL

The hierarchy consists of 215 total elements: two dimensions, 11 variables in the third level, 26 variables in the fourth level, 44 variables in the fifth level, and 132 variables in the sixth level (Appendix D). Variable names are repeated, so the hierarchy consists of 31 unique elements. Variable names were repeated to capture different aspects in relation to other variables and to provide multiple scenarios, thus allowing flexibility in the scoring process. The repetition of variable does not result in inappropriate weights for these elements because different aspects of the variables are considered. For example the variable name "season" is found in several places but in one place it refers to the seasonal occupation of sites, in another the relative importance of a diet element, and in another the timing of a fishery. For example, one scenario could be that a proposal seeks to harvest P. cod in an area with a moderate TAC/biomass ratio of cod over a prolonged time period, in the summer, in the Eastern Gulf of Alaska, in the 10-20nm zone, and affect 1-10% of rookeries in the region.

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**Comment [SH19]:** I'm sure you ca find a better way to say this – my brain isn't very eloquent right now.

To facilitate the evaluation of proposals, the lowest levels of the hierarchy were transferred to the Data Grid format (see example in Appendix E). The Data Grid is a recommended format for evaluating large numbers of alternatives (proposals) with respect to each variable in the next highest level in the hierarchy.

**Comment [SH20]:** By whom? Al the way through more references would be helpful so someone can go find the source for recommendations such as this. You probably planned on doing that anyway but the SSC will like it.....

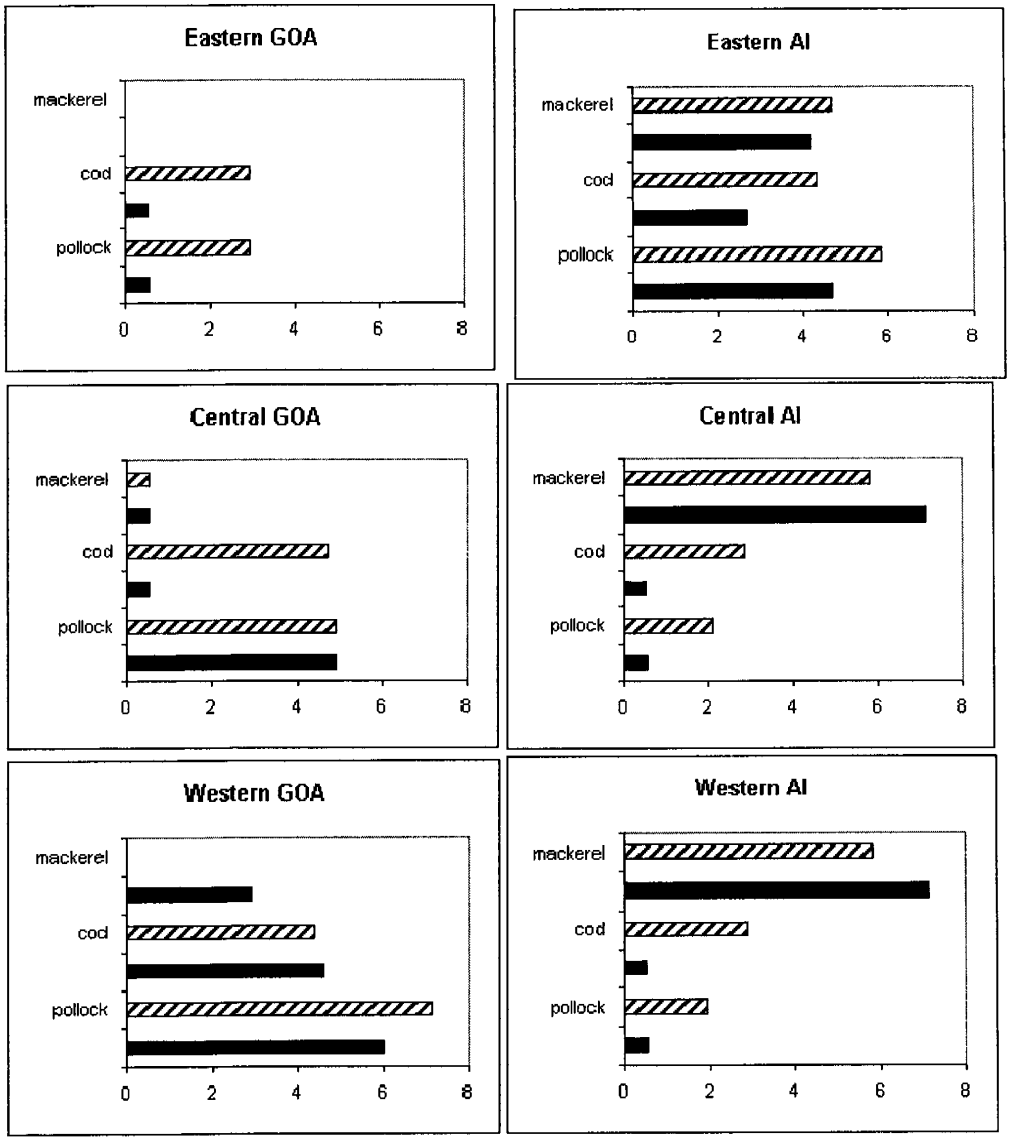


**Figure 5. Ratings of importance of Atka mackerel, Pacific cod and pollock to the SSL, by region and season; the striped bar is winter and the solid black bar is summer. The absence of a bar indicates the lack of a fishery for the species in that region. A high score indicates high relative importance of that species in the SSL diet in that region at that season.**

**Comment [SH21]:** Naw...this was based on diet data I'm pretty sure. Lack of a bar means it didn't occur in the diet in that region. This is the SSL part and has nothing to do with the fishery. Someplace, perhaps in the appendix with all this info should be the criteria for assigning importance weights.

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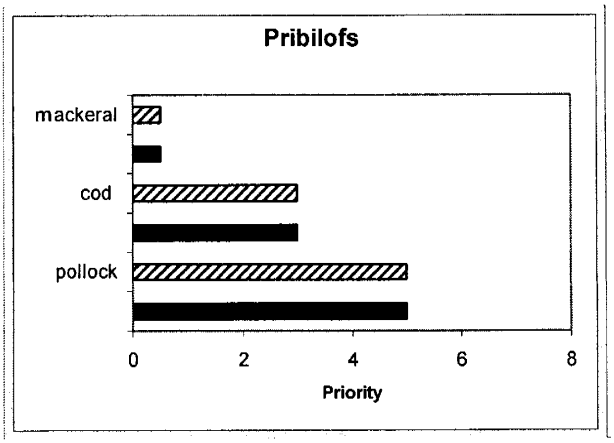


Comment [SH22]: Where did these number come from since ther is no diet data available from the Pribs? If I recall it was seat of the pants numbers from Doug. Then be sure to say pers com DD and that it is not based on the same data as the others.

**Figure 5 continued.**

### OTHER VARIABLES

The SSLMC considered possible variables that do not apply to evaluating impacts; that is, those variables that may offer a benefit, or a "credit". One such variable discussed was whether a fishery was rationalized. A rationalized fishery has some capacity to reduce practices that could adversely affect SSL, however the capacity might not always be exercised. The consensus of the SSLMC was not to include the variable, "rationalized fishery", in the model.

Other variables mentioned that do not apply to the impacts model are proposals that seek to increase safety or economic benefits, and proposals to improve administrative or management efficiency. These benefits can be listed during the proposal screening process and examined after the impact evaluation is completed.

## IMPLEMENTATION OF THE EVALUATION TOOL

The metric against which rated proposals will be measured was debated by the SSLMC. Questions such as these arose: "How will proposals compare to the jeopardy bar?", and "Can we compare proposals to the status quo?" One approach suggested was to run a proposal through the model and obtain its score; then run the aspects of status quo that it seeks to change (the "proposal's status quo") through the model to see the net effect of the proposed change for that specific proposal.

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As an example, the following three scenarios were run through the model and scores were obtained for the proposed change, and its status quo. Each scenario's scores add to 1, because the proposed change is being compared to its own status quo. A lower score is better. So, for example, if the proposed change scored 0.4 and the status quo scored 0.6, that means that the proposed change would have less of an impact on the SSL than the current situation.

Comment [SH23]: I don't get this. I thought each one just got what ever total it got based on what boxes it hits . why would the one it's compared against matter? You mean the scores change depending on how many are compared? Clearly we all need more info here.....

| Scenario # 1 | Score |
|---|---|
| **Proposed change:** "Change the seasonal apportionments for the longline catcher/processor Pacific cod fishery in the BSAI from 60/40 A/B season to 80/20 in the A/B season. The amount of harvest from the increase in A season fishing would be restricted to areas outside SSL critical habitat (outside 20nm and outside foraging areas)."<br><br>**Interpretation:** The region mostly affected is the EAI (because this area contains the eastern Bering Sea). The change will mostly entail shifting fishing from summer to winter, and additional A season fishing will be outside the 20+nm zone, around "other" sites. The TAC/biomass ratio is about "5" and will not likely change. Fishing is prolonged.<br><br>**Variables :** TAC/biomass of 5, prolonged, winter, EAI, Pacific cod, other site, 20+nm. | .369 |
| **Status Quo:** Fishing occurs at about a TAC/biomass ratio of 5, is prolonged, occurs mostly in summer, in the EAI, in the 10-20nm zone, and affects about 26-50% of rookeries in the region.<br><br>**Variables:** TAC/biomass of 6, prolonged, summer, EAI, Pacific cod, rookery site, 10-20nm, 26-50% of sites affected. | .661 |
| **Scenario # 2** | **Score** |
| **Proposed change:** "Relax pollock trawl fishing closures around rookeries and haulouts in the western GOA area 620 between 155 degrees and 150 degrees 30 minutes. Allow pollock trawl fishing between 10 and 20 nm around those sites during the A and B seasons only."<br><br>**Interpretation:** The region affected is the WGOA. The TAC/ biomass ratio is about "7" and fishing is prolonged. There are 4 haulouts & 2 rookeries affected & the proposal affects 26-50% of all sites in Area 620. The proposal seeks to allow fishing in the 10-20nm zone, in both winter and summer.<br><br>**Variables :** TAC/biomass of 7, prolonged, WGOA, pollock, 26-50% of sites affected in the region, at 10-20nm, both winter and summer, for both haulouts and rookeries. | .553 |
| **Status Quo:** Fishing for pollock occurs in the WGOA at about a TAC/biomass ratio of 7, is prolonged, occurs year round, but is only allowed at 20+nm.<br><br>**Variables:** TAC/biomass of 7, prolonged, WGOA, pollock, 20+nm, both winter and summer, for both haulouts and rookeries. | .447 |

**Comment [SH24]:** I did not try to reproduce these scores from the info available but am concerned thatJohn H was unable to do so. Should he have been able to do it with what he had? Does he just need a new calculator? But see my confusion in the previous note...

| Scenario # 3 | Score |
|---|---|
| **Proposed change:** "New science shows that pollock are important in the SSL diets and therefore some of the haulouts where SSL occur should have protection by shifting pollock trawling further offshore. Therefore, close to pollock trawl fishing all haulouts on the Pribilofs from 0-10nm year round."<br><br>**Interpretation:** The TAC/biomass is about 3, and fishing is prolonged. This change would affect 100% of haulouts. It would affect both summer & winter.<br><br>**Variables:** TAC/biomass of 3, prolonged, Pribilofs, winter and summer, pollock, 10-20nm, 100% of haulouts. | .347 |
| **Status Quo:** Currently there are pollock trawl closures at Pribilof haulouts only from 0-3 nm.<br><br>**Variables:** TAC/biomass of 3, prolonged, Pribilofs, winter and summer, pollock, 3-10nm, 100% of haulouts. | .653 |

Of the three scenarios, only #2 would result in greater impact to the SSL, Scenarios #1 and 3 would remove some level of existing impact to the SSL.

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The SSLMC agreed that additional discussion will be required to develop a process for using the model to rate proposals. That work will commence following review and advice from the SSC.

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**Appendix A. Participants involved in the development of the evaluation tool, Seattle, July 25-27, 2006.**

| SSLMC | | | |
|---|---|---|---|
| **Name** | **Organization** | **Phone** | **E-mail** |
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| Kevin Duffy | At-Sea Processors Assoc. | 206 285-5139 | kduffy@atsea.com |
| John Gauvin | Fishery Consultant | 206 660-0359 | gauvin@seanet.com |
| John Henderschedt | Premier Pacific Seafoods | 206 286-8584 | john@prempac.com |
| Daniel Hennen | Alaska Sea Life Center | 907 224-6894 | danielhennen@alaskasealife.org |
| Sue Hills | Univ. of Alaska Fairbanks | 907 474-5106 | shills@ims.alaska.edu |
| Terry Leitzell | Icicle Seafoods | 206 281-5372 | TerryL@icicleseafoods.com |
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| Steve MacLean | The Nature Conservancy | 907 276-3133 | smaclean@tnc.org |
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**Appendix B. The TAC/biomass tables to be supplied by Doug**

**Appendix C. Handouts given at the July meeting**

**Appendix D. The word documents, Treeview of prey & Treeview of SSL**

**Appendix E. The word document, Data Grid.**

**Subject: RE: SSLMC proposal ranking tool report**
**Date:** Mon, 7 Aug 2006 11:39:07 -0800
**From:** "Daniel Hennen" <danielhennen@alaskasealife.org>
**To:** "Bill Wilson" <bill.wilson@noaa.gov>, "Jerry Bongen" <jbongen@mac.com>, "Julie Bonney" <jbonney@gci.net>, "Sam Cotten" <samc.er@gci.net>, "Larry Cotter" <LCotter371@aol.com>, "Ed Dersham" <outlook@ptialaska.net>, "Earl Krygier" <Earl_Krygier@fishgame.state.ak.us>, "Kevin Duffy" <kduffy@atsea.org>, "John Gauvin" <gauvin@seanet.com>, "John Henderschedt" <johnh@prempac.com>, "Sue Hills" <shills@ims.uaf.edu>, "Frank Kelty" <fvkelty@arctic.net>, "Terry Leitzell" <TerryL@icicleseafoods.com>, "Dave Little" <dlittle@clipperseafoods.com>, "Steve MacLean" <smaclean@tnc.org>, "Max Malavansky, Jr." <max_malavan@hotmail.com>, "Art Nelson" <artnelson49@yahoo.com>, "Kristin R. Mabry" <Kristin.Mabry@noaa.gov>, "Douglas Demaster" <Douglas.Demaster@noaa.gov>, "Lowell Fritz" <lowell.fritz@noaa.gov>
**CC:** "Peggy Merritt" <pmerritt@ak.net>

I have attached a version of the report with my comments and edits embedded.

I have particular concerns about a few aspects of this report and a few minor wording suggestions. I'll briefly outline the parts I consider important and leave the minor pieces in the 'track changes' format within the attached document.

Specific Concerns

1. How does this model deal with repeated variables? What are the effects of interactions between variables? Some illustrative examples would be useful. It seems that we have made season an extremely important variable as it recurs several times in the "how fisheries affect the SSL" branch of the model. How does this play out in real applications of the model and does that reflect what we were trying to do? It appears (from my limited understanding) that the season in which you propose to fish is 7-500 times more important than the region and species you propose to fish. Is this really what we want?
2. There is some very confusing language in this report which I think we should clean up. Specifically, what is meant by dimension and variable? Page 2 implies that the variables are the proposals, "Variables and their sub-units are the set of proposed changes to fishing regulations". Page 2 also states that a dimension is "a path along which an impact can be measured", which makes sense until one gets to the last paragraph on page 3 in which variables can be "within a dimension", implying that variables are actually children within a dimension. Which is it? We need some distinguishing terms and some examples specific to our model, not general AHP jargon.
3. I cannot generate the same scores that the report gives for the example proposals. I find this a little disturbing because the model seems very straight forward and we should have all the pieces we need to work through the examples ourselves. If the "structural adjustment" discussed on page 4 is being used, that could explain the discrepancy, but no mention of that is made in the example

section. I would appreciate a step-by-step walk through on the scoring of at least one of the example proposals and it's "status quo" (Incidentally we need different language for this – a proposal can't have a status quo – status quo exists by itself, not as an aspect of a proposed change to it…).

4. There is a brief statement on page 18 "Of the three scenarios, only #2 would result in greater impact to the SSL, *although not much*. [emphasis added]" I think we need to remove the 'although not much' piece. This model is designed to compare between proposed changes to existing regulations regarding SSL, not to judge the level of impact these proposals actually have! We can't say that a proposal that scores .635 has 1.2% less impact on SSL than a proposal that scores .647. The model doesn't have meaningful units except in terms of judging one proposal relative to others.
5. Finally, I have a problem with the way this report measures agreement between committee members. It made no difference in the calculation of weights for siblings (the geometric mean and proportion calculations) if a committee member scored one a 1 and another a 2, or if they were scored 4 and 8. In either case the final weightings would be identical. This to me represents agreement - one sibling was judged to be twice as important as another. This report would score that scenario as one in which there was disagreement. This isn't terribly important, but I think that the committee had a higher level of agreement regarding scores for this model than the report indicates.

There are other comments in the attached document, but they are mostly editorial in nature.

-DH.

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**From:** Bill Wilson [mailto:bill.wilson@noaa.gov]
**Sent:** Thursday, August 03, 2006 1:05 PM
**To:** Jerry Bongen; Julie Bonney; Sam Cotten; Larry Cotter; Ed Dersham; Earl Krygier; Kevin Duffy; John Gauvin; John Henderschedt; Daniel Hennen; Sue Hills; Frank Kelty; Terry Leitzell; Dave Little; Steve MacLean; Max Malavansky, Jr.; Art Nelson; Bill Wilson; Kristin R. Mabry; Douglas Demaster; Lowell Fritz
**Cc:** Peggy Merritt
**Subject:** SSLMC proposal ranking tool report

Greetings:

Attached is a preliminary draft of the report on the development of the proposal ranking tool the Committee completed about a week ago. This report will go to the SSC for their review and comments at their August 15-16 meeting in Juneau.

Dan Hennen

# Multi-Criteria Decision Tool to Evaluate Proposals for Change in Steller Sea Lion Protection Measures in the Gulf of Alaska and Bering Sea/Aleutian Islands Groundfish Fisheries, 2006

**Developed by the**

**Steller Sea Lion Mitigation Committee**

**North Pacific Fishery Management Council**

**August 2006**

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# INTRODUCTION

The North Pacific Fishery Management Council (NPFMC) reinstituted the Steller Sea Lion Mitigation Committee (SSLMC) for the purpose of tracking the recent Section 7 Consultation, and to accept proposals for possible changes to existing Steller sea lion (SSL) mitigation measures for the Pacific cod, pollock and Atka mackerel fisheries in the Gulf of Alaska and the Bering sea/Aleutian Islands. The SSLMC began work to prepare and develop a tool for evaluating proposals, which was presented to the NPFMC and the SSC in June 2006. The SSLMC were advised to institute a more rigorous approach to identifying potential impacts to the SSL resulting from fishing activity, and how changes in fishery regulations could be gauged to minimize impacts to the SSL. In July 25-27, 2006 SSLMC members and scientific advisors with the National Marine Fisheries Service Alaska Fisheries Science Center (NMFS-AFSC) met in Seattle to begin development of an evaluation tool using a facilitated systems approach to planning and evaluation – the Analytic Hierarchy Process (AHP).

The AHP has been used extensively for decades to address planning, conflict resolution, and prioritization in such areas as policy development, economics, engineering, medical and military science, and has more recently been applied to fisheries research and management (Leung et al. 1998; Merritt and Criddle 1993; Merritt 1995, 2000 and 2001; Merritt and Skilbred 2002; Merritt and Quinn 2000; Ridgley et al. 1997; USFWS 2005, 2006). The AHP is a tool for facilitating decision-making by structuring the problem into levels comprising a hierarchy. Breaking a complex problem into levels permits decision makers to focus on smaller sets of decisions, improving their ability to make accurate judgments. Structuring also allows decision makers to think through a problem in a systematic and thorough manner. The AHP encourages people to explicitly state their judgments of preference or importance. Decision support software, Expert Choice,[1] was used interactively to structure the problem, depict the influence of weights, and derive the priority of elements.

The evaluation tool will undergo several phases of development and review:

1. July 25-27, 2006 the SSLMC develops a prototype evaluation tool, in collaboration with the NMFS-AFSC staff in Seattle;

2. August 4-9, 2006 the SSLMC reviews and comments on a draft report of the prototype evaluation tool;

3. August 15-16, 2006 the SSC reviews and comments on the prototype evaluation tool in Juneau; and,

4. The SSLMC incorporates comments from the SSC in the development of the evaluation tool.

[1] Forman, E., T. Saaty, M. Selly, and R. Waldron. Expert Choice, Decision Support Software, McLean VA. 1983.

The purpose of this report is to describe and present the evaluation tool developed by the SSLMC, in concert with the NMFS-AFSC and public in Seattle, July 25-27, 2006. This report constitutes the first phase in the development of the evaluation tool, and is intended to provide a basis for review and comment from the SSC at their August 15-16, 2006 meeting in Juneau.

Work on the evaluation tool by the SSLMC does not imply that a clear linkage between fish harvest and abundance of SSL is known to exist. Rather, the evaluation tool is predicated on the assumption that fishing has some relationship with SSL. The July 25-27 meeting in Seattle was solely concerned with developing a tool to evaluate impacts; insufficient time and information has been available to the SSLMC to fully develop a tool to evaluate benefits or "credit" in a proposal.

# METHODS

## PARTICIPANTS

A total of 13 SSLMC members participated in developing the evaluation tool (see Appendix A). Advice and scientific information was provided by NMFS AFSC staff as well as members of the public. The meeting was facilitated by Dr. Margaret Merritt (Resource Decision Support).

## APPROACH

The AHP was used to structure the problem and derive the interactions of its parts using data (when available) in combination with expert judgment (Saaty 1999). Expert judgment is defined as "previous relevant experience, supported by rational thought and knowledge" (Saaty and Kearns 1985).

## STRUCTURING AND ESTABLISHING PRIORITIES

A top-down structuring approach was used, whereby the mission forms the top of the hierarchy and dimensions form the second level of the hierarchy. The mission is a responsibility to fulfill. A dimension is a path along which an impact can be measured. Variables and their sub-units are the set of proposed changes to fishing regulations, and form the starting point for discussing the lower levels of the hierarchy. The group was tasked with discerning how variables associated with fishing would be likely to impact the dimensions of the SSL and their prey.

**Comment [d1]:** This is confusing. Is this saying that variables are the proposals?

**Comment [d2]:** I thought variables were "the set of proposed changes to fishing regulations" – how could variables NOT be associated with fishing?

Development of the hierarchy was completed first, and then priorities were assigned to the elements of the hierarchy, with discussion about criteria for judging importance. Judgments on the degree of importance (or degree of sensitivity to impact) of a group of elements was always made in relation to their "mother" node - this linked the elements in the lower levels to the upper levels of the hierarchy. In discussing criteria, a question such as the following was asked for each group of judgments, "Are all elements of this group of equal importance in assessing impacts, or is one element of more or less

where

$T_m$ = the total weighted score for variable $m$,
$W_k$ = the weight for dimension k,
$p_{k,m}$ = the weighted proportion of the total score for variable m addressing dimension k
$d$ = the number of variables.

Comment [d4]: This makes sense to me if, by variable you mean proposal (as on page 2). But then the paragraph above is confusing ...

Comment [d5]: I'd like an example of what this value actually is. Does this formula propagate through the whole model? ie do variables become dimensions in the calculations of weighted scores down the hierarchy?

Comment [d6]: Shouldn't this be the number of dimensions? m refers to variables in this equation.

### STRUCTURAL ADJUST

Structural imbalance in the hierarchy can lead to dilution of the weight of many variables under a single dimension, so an adjustment feature in Expert Choice can be used to restore priorities to their respective proportion of weight. While approximate balance is sought and desired, complex problems do not always lend themselves to balance – thus the advantage of the structural adjust feature.

In a conceptual example, consider that if a dimension (A) has four variables, and another dimension (B) has two variables, then there are six variables in all and structural adjusting multiplies A's priority by 4/6 and B's by 2/6. Thus, the overall priorities for A's variables are not diluted simply because there are many of them.

Comment [d7]: Are the examples in this report structurally adjusted? That might explain why I can't reproduce the scores...

## RESULTS AND DISCUSSION

### MISSION

The mission of the SSLMC is to build upon previous efforts in developing a rational approach to evaluating proposed changes in regulations (relative to existing mitigation measures) that encompasses relevant and measurable dimensions of the SSL and their prey.

Deleted: relevant

Work proceeded with the assumption that there is a relationship between prey and the nutritional balance of the SSL.

Comment [d8]: Perhaps this should be removed? This isn't an assumption it is a fact. Energy balance is related to food intake – for any animal.

### DIMENSIONS ALONG WHICH IMPACTS OF PROPOSED CHANGES ARE EVALUATED

The SSLMC identified two dimensions of the problem:

- how fisheries affect the prey of the SSL; and,
- how fisheries affect the SSL.

The SSLMC's perception of the problem mirrors primary concerns of the Endangered Species Act, which are the potential for jeopardy or adverse modification through fishing effects on the SSLs and their habitat with changes in the prey field or the ability of the SSLs to acquire food.

## The Prey of the SSL

The SSLMC engaged in lengthy discussions about concepts relating fishing to the prey field, including concerns about the availability of prey from dispersal caused by fishing activities. Response of the prey field to fishing can include changes in fish schooling behavior, which may impact the SSL's ability to capture and consume prey. Dispersal of the prey field through fishing activities may also induce "prey switching". The question that arises is, "Will prey availability be altered?" The assumption is that more aggregated prey are easier for the SSL to capture. A second concern is the likelihood of localized depletion of prey by removal. Removal of fish can result in a reduced number of fish or fish aggregations. The question that arises is, "Will prey be measurably depleted?" The assumption is that fewer fish diminishes the value of the prey field.

Both of the above concerns were ultimately combined by the SSLMC into one dimension because it was thought that realistically there could be little measurable distinction between the two.

## The SSL

Much discussion focused on SSL foraging ecology, reproductive behavior, energy balance needs, and potential disruptions from fishing activity to the general well-being of the SSL. Degree of impacts was related to adult females and weanlings, as these categories of individuals have more acute energy balance needs over time, as compared with adult males. Males are able to forage further and with less time restriction, because they do not care for young, and do not need to expend energy on lactation. Females have dual roles of maintenance and reproduction. Fishing competition with juvenile SSLs that have not yet weaned and are still partly reliant on maternal care is a primary concern. Weanlings have smaller body size, lesser diving capability and fewer reserves for energy balance over time than adults. In addition to the concept of competition, the concept of disruption to the SSL by fishing activity was discussed. The SSLMC intended the term "disruption" to include behavioral and physical aspects.

All concerns were ultimately combined into one dimension because adult females and weanlings overlap in time and space, thus making these components of the problem nearly indistinguishable from an impact point of view; disruption is an overarching concern related to several variables, including proximity.

Judgments of importance between the prey field and the SSL dimensions were based on the degree to which change may cause an impact, resulting in an adverse effect on the energy balance of an individual SSL. The geometric mean of all scores resulted in ratings of importance for the dimensions (Figure 1). The spread of scores was between 3-4, on a scale of 1-9, which can be characterized as mild disagreement, occurring within a minority of the SSLMC.

**Deleted:** and

**Deleted:** varying

**Deleted:** more independently

**Deleted:** converting food into maternal milk

**Deleted:** There can be degrees of impact to adult females through competition. The assumption is that f

**Deleted:** The assumption is that w

**Deleted:** must

**Deleted:** balance

**Deleted:** a shorter period of

**Comment [d9]:** The phrase 'disruption to' recurs in this document. Shouldn't it be 'disruption of'?

**Deleted:** and,

**Deleted:** ,

**Deleted:** was

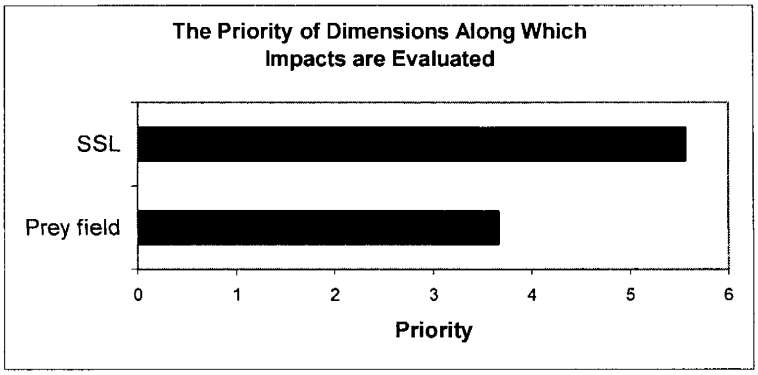


**Figure 1. The priority of SSL and their prey.**

## VARIABLES

Prior to the meeting, a scoping survey was distributed to a sub-group, to identify variables. The question asked was, "What's on the table for change?" And, "Given the set of variables, what sub-set will be used in the evaluation tool?" At the meeting, the entire SSLMC modified the list. Table 1 lists the variable field identified as useful to the evaluation tool.

**Table 1. The potential set of variables from proposed fishing regulation changes that are included in the model to evaluate impacts to the SSL and their prey.**

| Variable | Sub-units |
|---|---|
| 1. Fish Species of Interest | a. Pacific cod b. Pollock c. Atka mackerel |
| 2. TAC | The TAC is calculated for each fish species of interest, for each region. |
| 3. Fish Biomass | The biomass is estimated for each fish species of interest, for each region |
| 4. Fishing duration | a. Pulse (TAC is taken in 3-10 days)<br>b. Prolonged (TAC is spread out across time) |
| 5. Geographic regions | a. Eastern Gulf of Alaska (EGOA)<br>b. Central Gulf of Alaska (CGOA)<br>c. Western Gulf of Alaska (WGOA)<br>d. Eastern Aleutian Islands (EAI; includes the Bering Sea)<br>e. Central Aleutian Islands (CAI)<br>f. Western Aleutian Islands (WAI)<br>g. Pribilof Islands |
| 6. Seasons | a. Summer (the SSL breeding season, defined as May-September)<br>b. Winter (non-breeding season, October-April) |
| 7. SSL site types | a. Rookery b. Haulout c. other |
| 8. Proximity zones to a SSL site | a. 0-3 nm b. 3-10 nm c. 10-20 nm d. 20+ nm e. not critical habitat |
| 9. The percentage of SSL sites affected | a. 1-10% b. 11-25% c. 26-50% d. 51-75% e. 76-100% |

Explanations of variables used in the hierarchy follow for each dimension.

### Variables Applicable to the Prey Dimension

Variables that can potentially impact the prey field dimension are:

- the TAC for a given fish species in a given region,
- estimates of fish biomass in a given region, and
- fishing duration.

The ideal way to evaluate impacts of proposed changes on the prey field would be to know fish biomass at the site in question, understand SSL prey needs at the site, and be able to predict with accuracy the amount and rate of harvest relative to biomass associated with the proposed change. However, this is a data-poor environment in which to make decisions, so judgments must be made on the best available information. While the rationale for a hierarchy of fishing power by gear type was provided in the June 2003 Supplement to the BiOp (page 36), and explained to the SSLMC by NMFS-AFSC staff, the SSLMC concluded that gear type and vessel size are dissatisfactory proxies for removal rate. Concerns for using gear type and vessel size as proxies for removal rate include the lack of consideration for the number of vessels fishing, fisheries occurring on large schools of fish, and agreement between sectors to avoid fishing conflicts.

The SSLMC launched into a lengthy debate on how best to account for fish removal relative to available biomass, and raised the possibility of assigning a rating to a fishery based on the percentage of the TAC taken. Staff from the NMFS-AFSC were asked if exploitation rates could be estimated in areas smaller than a given region. Unfortunately, fish biomass surveys do not provide estimates on a per-site basis; fish biomass per species is estimated on a regional scale. Therefore, the group decided that the best characterization of removal rate, given limited knowledge, is a qualitative assessment of the ratio of the TAC to biomass ratio, per species, on a regional basis. For example, a proposal for a high harvest in an area of low target species abundance would be rated high (more adverse to the SSL). The NMFS-AFSC agreed to provide to the SSLMC a qualitative statement of biomass in each region. Catch to biomass comparisons could be provided by developing a ratio between TAC for a region with the estimated biomass in that region, projected for 2008, from the next stock assessments and SAFE reports. The NMFS-AFSC would use their best judgment to estimate regional biomass for Pacific cod, pollock and Atka mackerel.

Deleted: ?

Prey removal rate may be complicated by seasonal behavior of fish; for example, pollock aggregate for spawning in winter and a fishery targeting these fish would have an exploitation rate that is high, in part because of the schooling behavior of the fish. Fish migratory behavior could also affect exploitation rate.

The TAC/biomass ratio can be scaled by degrees of impact to the prey field according to Saaty's 1-9 ratio scale in the following manner:

- A high TAC/low biomass ratio is interpreted as having an extreme impact on the prey field, and is given a value of "9".
- A low TAC/high biomass ratio is interpreted as having a slight impact on the prey field, and is given a score of "1".

Between the values of "9" and "1", are gradations (scores of 2-8) that can be used to depict the degree of impact to the prey field. For each proposal, the SSLMC must judge the expected proportion of removal, and score it according to the following guide:

| TAC/Biomass per species, per region | Weight of impact (score) |
|---|---|
| High TAC/Low Biomass | 9 |
| | 8 |
| | 7 |
| | 6 |
| | 5 |
| | 4 |
| | 3 |
| | 2 |
| Low TAC/High Biomass | 1 |

The data supplied by the NMFS-AFSC for this piece of the evaluation tool is found in Appendix B.

Characterization of removal rate must be discussed in relation to the duration of removal – so, the SSLMC engaged in an extended debate about the impacts of "pulsed" (defined as approximately 3-10 days) versus "prolonged" fishing on the prey field (small amounts of fish harvested incrementally over long periods of time). The SSLMC turned to the NMFS-AFSC for data in this regard. There is some research that suggests SSL are most vulnerable to prey field disruptions that are characterized by a high removal rate in a pulsed time frame in a given area (June 2003 Supplement to the BiOp). That is, SSL can probably deal with low food abundance for a few days, but going without food for 3-10 days would be detrimental to the health of the SSL. The concern with pulsed fishing is localized removals of large quantities of available biomass. Ultimately, the majority (90%) of the SSLMC decided that at high removal rates, pulsed fishing has the highest impact; however, at low removal rates the duration of fishing is of slight consequence (Table 2). The spread of scores shows that general agreement (defined as a spread of 0-3) is lacking about the impacts of fishing duration in relation to fishing removal rate on the prey field. The SSLMC intends to continue discussion on this topic upon receipt of better information.

Removal rate and duration was considered in the context of region; however, all regions were assigned equal weight because recovery of the SSL is required in all. The SSLMC

also considered removal rate and duration in the context of fish species, but again assigned equal weight to all three species of interest, because all are important in the diet of SSL.

**Table 2. Judgments on the degree of impact (group geometric mean) that scenarios of removal rate and duration of fishing have on the SSL prey. A high geometric mean score reflects a highly adverse impact.**

| TAC/Biomass Score[a] | Duration of Fishery | Geometric Mean Group Score | Spread of Scores |
|---|---|---|---|
| 9 | Pulsed | 8.74 | 1 |
| | Prolonged | 1.43 | 8 |
| 8 | Pulsed | 8.00 | 0 |
| | Prolonged | 1.41 | 7 |
| 7 | Pulsed | 6.90 | 2 |
| | Prolonged | 1.40 | 6 |
| 6 | Pulsed | 6.15 | 0 |
| | Prolonged | 1.38 | 5 |
| 5 | Pulsed | 5.36 | 3 |
| | Prolonged | 1.16 | 2 |
| 4 | Pulsed | 4.04 | 4 |
| | Prolonged | 1.12 | 1 |
| 3 | Pulsed | 3.15 | 6 |
| | Prolonged | 1.06 | 1 |
| 2 | Pulsed | 2.00 | 7 |
| | Prolonged | 1.06 | 1 |
| 1 | Pulsed | 1.19 | 7 |
| | Prolonged | 1.06 | 1 |

[a] A high TAC/low biomass ratio reflects a high rate of removal, which is deemed as having an adverse effect on the SSL prey field.

**Variables Applicable to the SSL Dimension**

Variables that can potentially impact the SSL dimension are:

- fishing near a type of SSL site,
- fishing within zones of proximity to the site, in a given season,
- the percentage of SSL sites in a region affected by the proposed change,
- fish species targeted for harvest, and
- fishing within a geographic region, in a given season.

***SSL Site Type by Season and Proximity, and the Percentage Affected***

The ideal way to evaluate the impacts of proposed changes to fishing regulations on the degree of disturbance to SSL would be to examine the impacts related to the number of SSL per site on a seasonal basis, and the trend in SSL abundance. However, survey counts of SSL are not conducted at every site, occur primarily in summer, and movement of SSL between sites is known to occur; thus, the effects of fishing in winter at a particular site would have little relation to SSL abundance counts that were conducted in summer. Lack of complete knowledge of SSL abundance per site on a seasonal basis and the extent of movement between sites also hampers incorporation of SSL trend information into the evaluation tool. Trends per area are subject to error due to variability in SSL movement between sites, and thus trends are not meaningful on a per-site basis. The NMFS-AFSC staff suggested that incorporation of the concept of the sensitivity of site type and proximity per season into the evaluation tool would serve as the best available proxy to SSL abundance and trend, because data on sites is the better data source.

**Comment [d10]:** I think this would be news to NMML...

The SSLMC discussed the best way in which to incorporate time, and concluded that seasons based on the energy needs of the SSL would be the best characterization. Summer is defined as the breeding season (May-September) and is roughly equivalent to the BC fishing seasons. It is assumed that energy needs are greater for lactating females and other nutritional stresses associated with breeding; thus, summer would be a more important (sensitive) time than winter. Winter is defined as the non-breeding season (October-April) and is roughly equivalent to the DA fishing season.

The NMFS-AFSC staff distributed a table characterizing SSL site types as rookery, haulout or "other", according to usage (Appendix C). The new telemetry information included SSL diet composition by region and season (Appendix C). The "other" designation is given to sites that are listed under the Endangered Species Act, but do not meet the seasonal criteria for rookery or haulout; SSL can still be present at these sites. The new telemetry data show that both rookeries and haulouts are used for a longer period of time by a more diverse group of SSL than previously observed. Following testimony from the NMFS-AFSC staff regarding site type and importance based on seasonal use, votes were taken on the degree of sensitivity, where a high score represents a site that has great importance in the overall recovery of the SSL and is sensitive to change (Figure 2).

**Comment [d11]:** huh? Telemetry has nothing to do with diet...

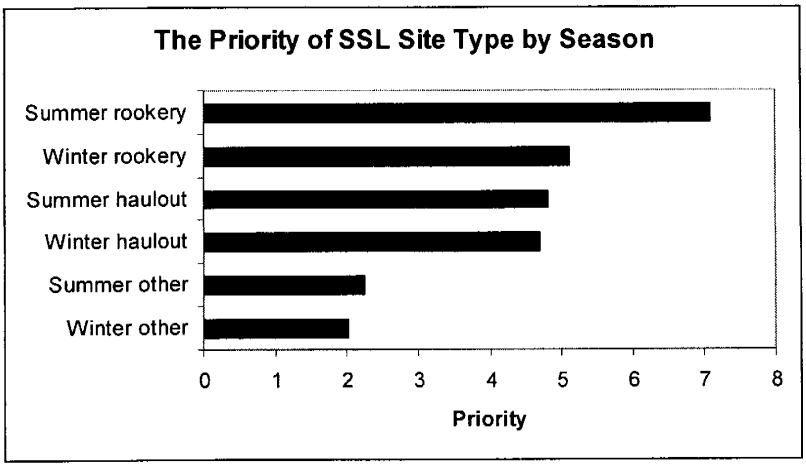


**Figure 2. The priority of SSL site types, by season**

Thus, a summer rookery is more important and is more sensitive to impact than a winter "other" site because of SSL breeding activity. The majority of the group voted similarly, with a 4 -5 spread in scores due to only a disagreement from one or two members, depending upon the site/season in question.

The impact of fishing to a site/season combination depends on how close fishing takes place. The assumption is that fishing in increasing proximity to a SSL site increases deleterious effects on the SSL. Much work and discussion has previously gone into the "zonal approach" presented in Tables II 1-9, on pg 94 of the June 2003 Supplement to the BiOp. New juvenile telemetry data (Lowell Fritz, personal communication) supports high sensitivity for the 0-3 nm and 3-10 nm zones. The assumption is that increasing distance of activity from the SSL site reduces disturbance to the SSL. The SSLMC wished to incorporate the concept of the zonal approach into the evaluation tool, and prior ratings of importance were adjusted to reflect the 1-9 rating scales used in the AHP. The SSLMC expanded on the zonal approach by considering sensitivity to proximity in relation to site type and season (Figure 3).

There was agreement (a spread of 0-3) among the group on the sensitivity of the zones per site/season combination. The most important zone is 0-3 nm for all site types by season; the least important zones are the 20+ nm and that area designated as "not critical habitat (CH)". The priority scores assigned by the SSLMC are consistent with those recommended by the NMFS-AFSC. The most critical habitat surrounds rookeries, in the 0-3nm and 3-10 nm zones.

**Comment [d12]:** This concept is continually brought up, but probably doesn't accurately reflect the degree of "agreement" of the committee. Some members maintained internal but not absolute relative scoring schemes. That is, a score of 1 vs. 2 is equivalent mathematically in the model to a score of 4 vs. 8 and represents "agreement" about the relative importance of the two items being weighted. This degree of absolute difference however would register as "disagreement" in Dr. Merritt's definition. "Agreement" could be better defined as the difference in the ratio of the scores for opposing items between committee members' scores.

Members of the SSLMC wanted to account for the percentage of SSL sites in a region affected by a proposal, combined with proximity to a site. Consensus was reached to include five categories of site percentages affected, within three proximity zones (Figure 4). The greatest adverse impacts (scored as "9") would occur if the proposal sought to affect from 11-100% of SSL sites in a given region, operating within the 0-3 nm zone.

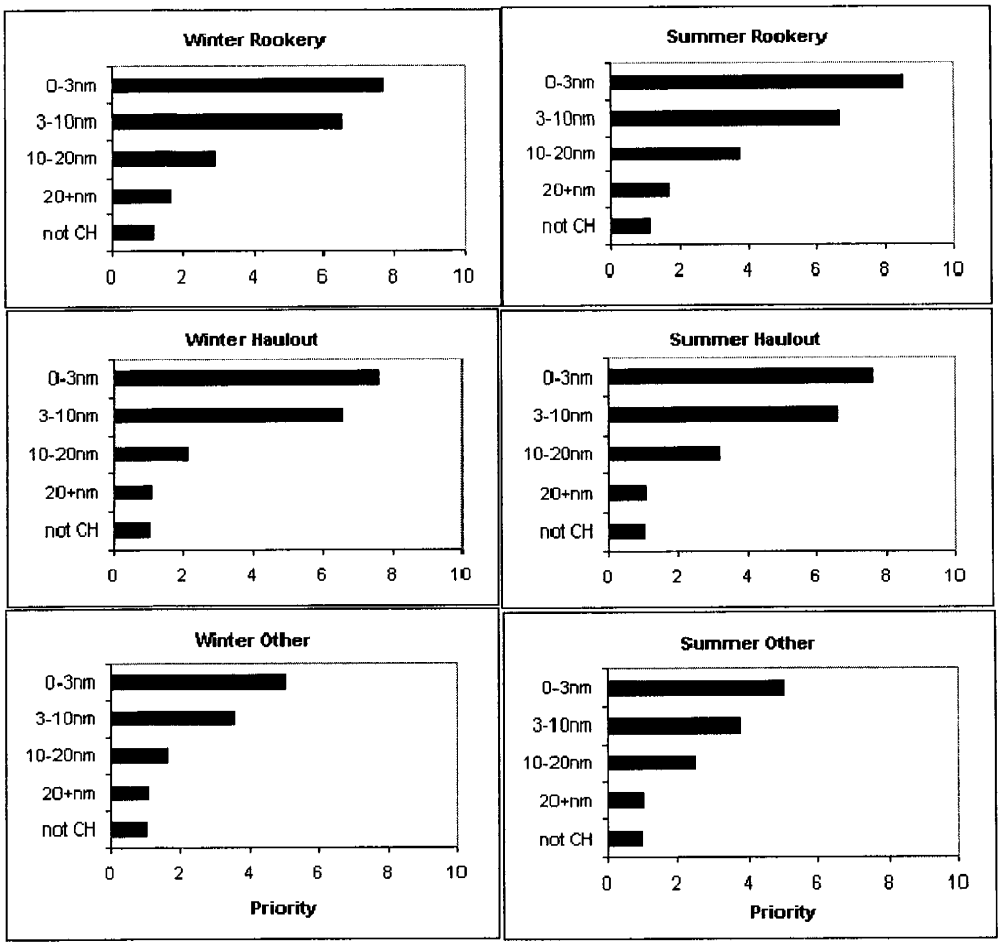


**Figure 3. The sensitivity (priority) of a SSL site type to proximity of fishing, by season.**

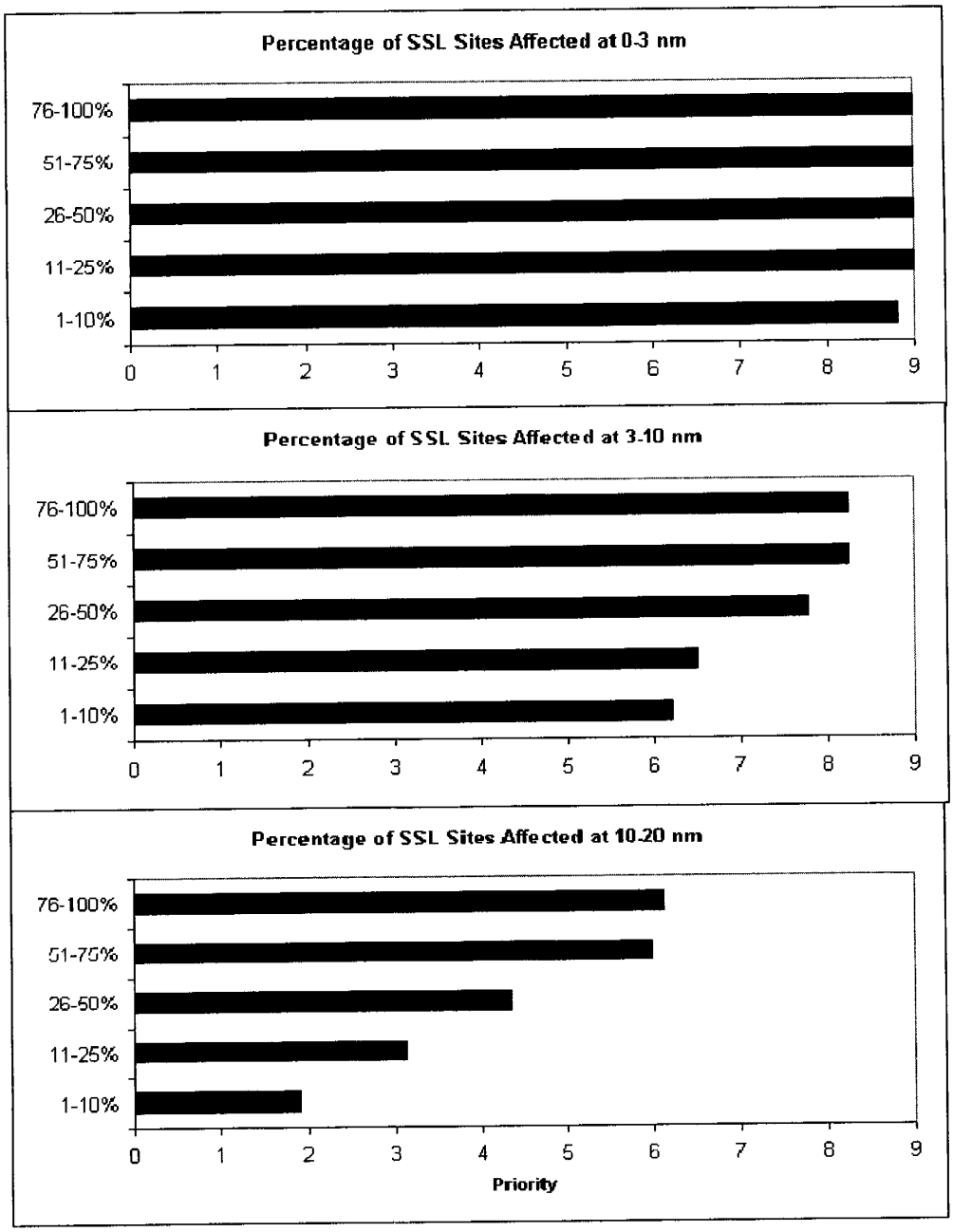


**Figure 4. The potential of adverse impact (priority) of a change in fishing, considering percentages of SSL sites affected in a region, and fishing in proximity to the sites.**

*Fish Species Harvested, by Region and Season*

The combination of variables - fish species harvested, in a given geographic region, on a seasonal basis - is a proxy for nutritional needs of the SSL. Fish species of interest are Pacific cod, pollock and Atka mackerel, based on scat research that has defined these species as occurring frequently in the diet (Sinclair and Zeppelin *in review*). Data presented to develop ratings of importance included the most recent SSL food habits data (including Sinclair and Zeppelin 2002). Members of the SSLMC did not assign any species/region combination a score of "9" because the SSL diet is diverse and not wholly comprised of Pacific cod, pollock or Atka mackerel, but rather a combination of prey items. Other species observed in high diet proportions include Irish lords, salmon, and cephalopods. Thus, a fishery that harvested Pacific cod, pollock or Atka mackerel would still leave unharvested many other SSL prey items.

**Comment [d13]:** I don't understand this sentence. How can fishing harvest specifics be a proxy for SSL nutritional needs? I suppose this could be a proxy for what is left for the SSL...

The seven geographic regions are defined in relation to the SSL draft revised recovery plan and include three in the Gulf of Alaska (western, central, eastern), three in the Aleutian Islands (western, central, eastern which includes the Bering Sea), and the Pribilof Islands region. The group unanimously assigned equal weights of importance (score = 5) to the Gulf of Alaska and Aleutian Islands regions because the draft recovery plan requires an increasing trend in all regions, so all are considered of equal importance to recovery. (If the criteria in the draft recovery plan change regarding the importance of regions, then the evaluation tool would need to be adjusted to reflect those criteria changes). The Pibilofs were assigned a slightly lesser rating of importance (score = 3.56) because the haulouts are not identified in the recovery plan.

The SSLMC scored the importance of the combination of fish species by region and season (Figure 5). A concern was raised about the relatively high ratings of importance for Pacific cod and pollock removals in the EGOA given the increasing trend in SSL in this region and the general lack of large Pacific cod or pollock fisheries in the region.

## OVERALL MODEL

The hierarchy consists of 215 total elements: two dimensions, 11 variables in the third level, 26 variables in the fourth level, 44 variables in the fifth level, and 132 variables in the sixth level (Appendix D). Variables are repeated, so in reality, the hierarchy consists of only 31 unique elements. Variables were repeated in order to provide multiple scenarios, thus allowing flexibility in the scoring process. For example, one scenario could be that a proposal seeks to harvest P. cod in an area with a moderate TAC/biomass ratio of cod over a prolonged time period, in the summer, in the Eastern Gulf of Alaska, in the 10-20nm zone, and affect 1-10% of rookeries in the region.

**Comment [d14]:** I can't figure out how this example helps us understand the repeated variable issue – something I am concerned about.

To facilitate the evaluation of proposals, the lowest levels of the hierarchy were transferred to the Data Grid format (see example in Appendix E). The Data Grid is a recommended format for evaluating large numbers of alternatives (proposals) with respect to each variable in the next highest level in the hierarchy.

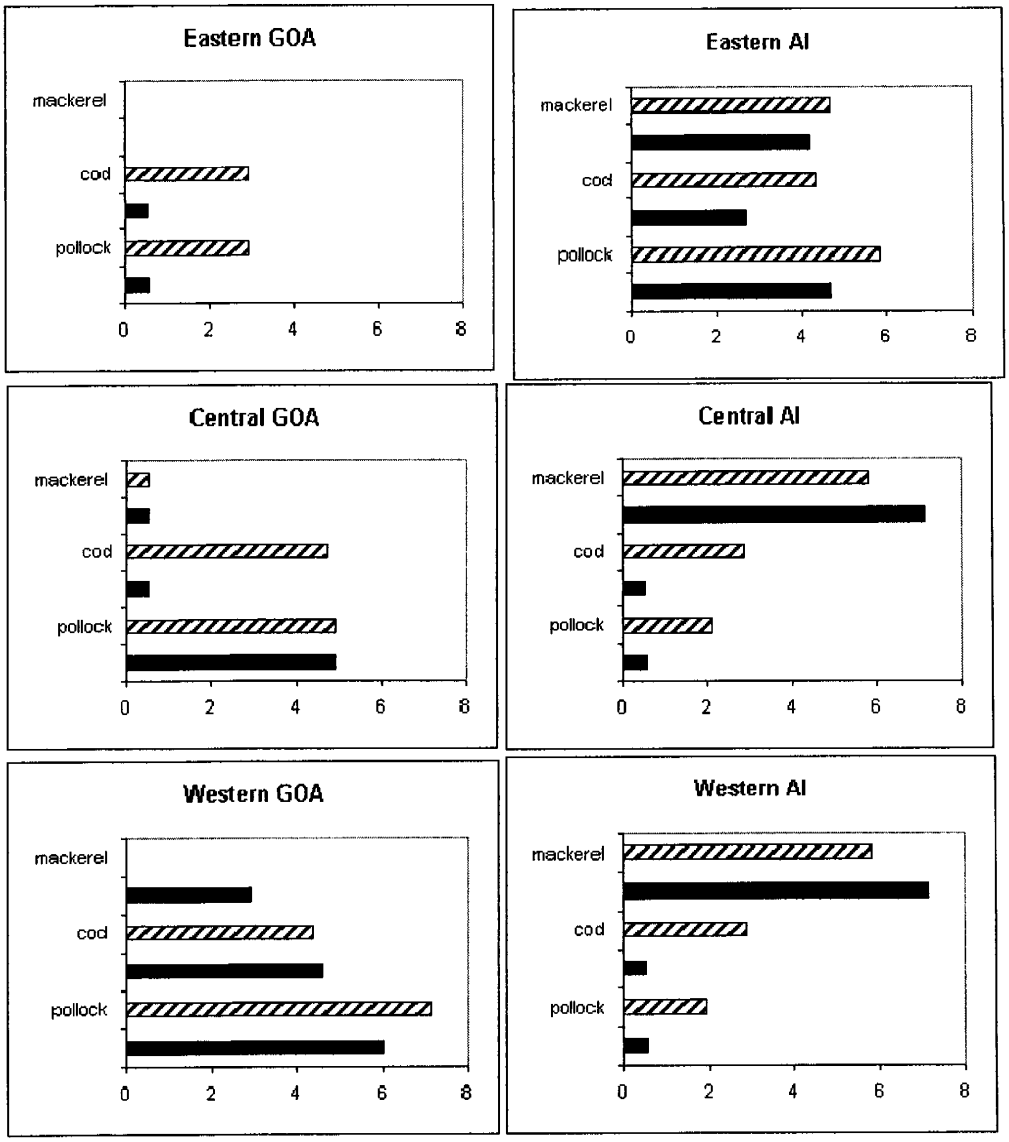


**Figure 5. Ratings of importance of Atka mackerel, Pacific cod and pollock to the SSL, by region and season; the striped bar is winter and the solid black bar is summer. The absence of a bar indicates the lack of a fishery for the species in that region. A high score indicates a high impact to the SSL.**

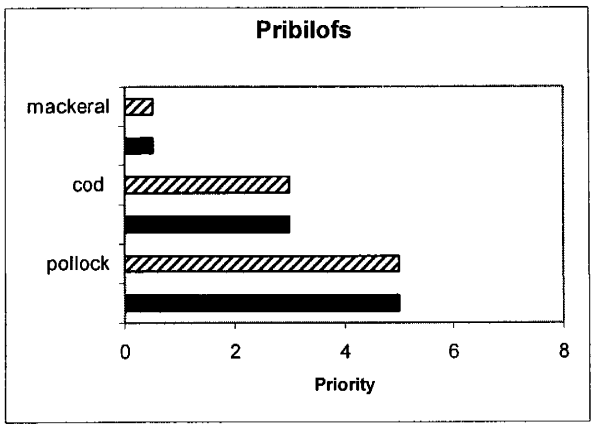


**Figure 5 continued.**

### OTHER VARIABLES

The SSLMC considered possible variables that do not apply to evaluating impacts; that is, those variables that may offer a benefit, or a "credit". One such variable discussed was whether a fishery was rationalized. A rationalized fishery has some capacity to reduce practices that could adversely affect SSL, however the capacity might not always be exercised. The consensus of the SSLMC was not to include the variable, "rationalized fishery", in the model.

Other variables mentioned that do not apply to the impacts model are proposals that seek to increase safety or economic benefits, and proposals to improve administrative or management efficiency. These benefits can be listed during the proposal screening process and examined after the impact evaluation is completed.

**Comment [d15]:** It seems like we could structure benefits directly into this model. Its additive, we could just subtract benefits scores from the total for a proposal.

## IMPLEMENTATION OF THE EVALUATION TOOL

The metric against which rated proposals will be held up to was debated by the SSLMC. Questions such as these arose: "How will proposals compare to the jeopardy bar?", and "Can we compare proposals to the status quo?" One approach suggested was to run a proposal through the model and obtain its score; then run its status quo through the model to see the net effect of the proposed change for that specific proposal.

**Comment [d16]:** This doesn't make sense. How can each proposal have a status quo? There is only one status quo.

As an example, the following three scenarios were run through the model and scores were obtained for the proposed change, and its status quo. Each scenario's scores add to 1, because the proposed change is being compared to its own status quo. A lower score is better. So, for example, if the proposed change scored 0.4 and the status quo scored 0.6, that means that the proposed change would have less of an impact on the SSL than the current situation.

| Scenario # 1 | Score |
|---|---|
| **Proposed change:** "Change the seasonal apportionments for the longline catcher/processor Pacific cod fishery in the BSAI from 60/40 A/B season to 80/20 in the A/B season. The amount of harvest from the increase in A season fishing would be restricted to areas outside SSL critical habitat (outside 20nm and outside foraging areas)."<br><br>**Interpretation:** The region mostly affected is the EAI (because this area contains the eastern Bering Sea). The change will mostly entail shifting fishing from summer to winter, and additional A season fishing will be outside the 20+nm zone, around "other" sites. The TAC/biomass ratio is about "5" and will not likely change. Fishing is prolonged.<br><br>**Variables :** TAC/biomass of 5, prolonged, winter, EAI, Pacific cod, other site, 20+nm. | .369 |
| **Status Quo:** Fishing occurs at about a TAC/biomass ratio of 5, is prolonged, occurs mostly in summer, in the EAI, in the 10-20nm zone, and affects about 26-50% of rookeries in the region.<br><br>**Variables:** TAC/biomass of 6, prolonged, summer, EAI, Pacific cod, rookery site, 10-20nm, 26-50% of sites affected. | .661 |
| **Scenario # 2** | **Score** |
| **Proposed change:** "Relax pollock trawl fishing closures around rookeries and haulouts in the western GOA area 620 between 155 degrees and 150 degrees 30 minutes. Allow pollock trawl fishing between 10 and 20 nm around those sites during the A and B seasons only."<br><br>**Interpretation:** The region affected is the WGOA. The TAC/ biomass ratio is about "7" and fishing is prolonged. There are 4 haulouts & 2 rookeries affected & the proposal affects 26-50% of all sites in Area 620. The proposal seeks to allow fishing in the 10-20nm zone, in both winter and summer.<br><br>**Variables :** TAC/biomass of 7, prolonged, WGOA, pollock, 26-50% of sites affected in the region, at 10-20nm, both winter and summer, for both haulouts and rookeries. | .553 |
| **Status Quo:** Fishing for pollock occurs in the WGOA at about a TAC/biomass ratio of 7, is prolonged, occurs year round, but is only allowed at 20+nm.<br><br>**Variables:** TAC/biomass of 7, prolonged, WGOA, pollock, 20+nm, both winter and summer, for both haulouts and rookeries. | .447 |

**Comment [d17]:** Isn't it a 5?

**Comment [d18]:** Does this translate to the whole WGOA area?

**Comment [d19]:** What proportion of sites are affected?

| Scenario # 3 | Score |
|---|---|
| **Proposed change:** "New science shows that pollock are important in the SSL diets and therefore some of the haulouts where SSL occur should have protection by shifting pollock trawling further offshore. Therefore, close to pollock trawl fishing all haulouts on the Pribilofs from 0-10nm year round."<br><br>**Interpretation:** The TAC/biomass is about 3, and fishing is prolonged. This change would affect 100% of haulouts. It would affect both summer & winter.<br><br>**Variables:** TAC/biomass of 3, prolonged, Pribilofs, winter and summer, pollock, 10-20nm, 100% of haulouts. | .347 |
| **Status Quo:** Currently there are pollock trawl closures at Pribilof haulouts only from 0-3 nm.<br><br>**Variables:** TAC/biomass of 3, prolonged, Pribilofs, winter and summer, pollock, 3-10nm, 100% of haulouts. | .653 |

Of the three scenarios, only #2 would result in greater impact to the SSL, although not much. Scenarios #1 and 3 would actually remove some level of existing impact to the SSL.

**Comment [d20]:** Does the model really give us the power to say how strong these effects would be? If so I would like to see how that is determined!!

The SSLMC agreed that additional discussion will be required to develop a process for using the model to rate proposals. That work will commence following review and advice from the SSC.

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**Appendix A. Participants involved in the development of the evaluation tool, Seattle, July 25-27, 2006.**

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|---|---|---|---|
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**Appendix B. The TAC/biomass tables to be supplied by Doug**

**Appendix C. Handouts given at the July meeting**

**Appendix D. The word documents, Treeview of prey & Treeview of SSL**

**Appendix E. The word document, Data Grid.**