MARINE MAMMAL COMMISSION

19 October 2012

Glenn Merrill
Assistant Regional Administrator
Sustainable Fisheries Division
Alaska Region NMFS
P.O. Box 21668
Juneau, AK 99802-1668
Attn: Ellen Sebastian

Dear Mr. Merrill:

The Marine Mammal Commission, in consultation with its Committee of Scientific Advisors on Marine Mammals, has reviewed the National Marine Fisheries Service 30 August 2012 notice seeking comments on an environmental impact statement that will evaluate Steller sea lion protection measures imposed on the Alaska groundfish fisheries. The Commission provides the following recommendation and rationale for the Service's consideration.

RECOMMENDATION

The Marine Mammal Commission recommends that the National Marine Fisheries Service focus its required environmental impact statement on a full analysis of fisheries effects on Steller sea lions, especially the effects of intentionally reducing target stock biomass by 60 percent or more; such a focus and analysis is necessary if the Service is to identify clearly the potential ecological effects of its fishing strategy based on the maximum sustainable yield (MSY) and develop the type of adaptive management approach that is needed to characterize and manage those effects.

RATIONALE

Indirect effects of fishing on Steller sea lions

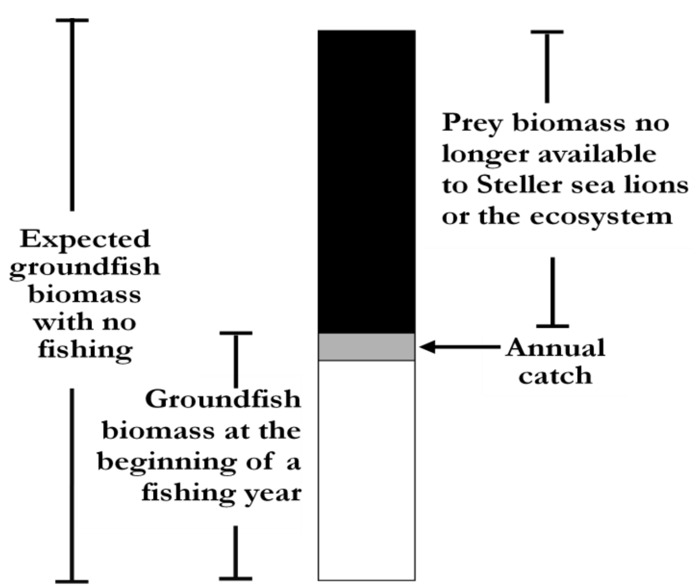
The central questions regarding the effects of the Alaska groundfish fisheries on Steller sea lions have been whether and, if so, to what extent the fisheries have caused or contributed to the sea lion decline by reducing the prey available to them (e.g., pollock, Atka mackerel, Pacific cod). The Service has yet to address these fundamental questions by describing, or attempting to describe, the full ecological consequences of a fishery management strategy based on the concept of MSY. National Standard 1 of the Magnuson-Stevens Fishery Conservation and Management Act requires that the Service manage fisheries to achieve the optimum yield, and the Act defines "optimum" to be based on MSY, as reduced by any relevant economic, social, or ecological factor. Although determining the fish stock size (biomass) that will produce MSY is itself a challenge, describing the indirect or ecological consequences of fishing under an MSY-based strategy is far more difficult.[1]

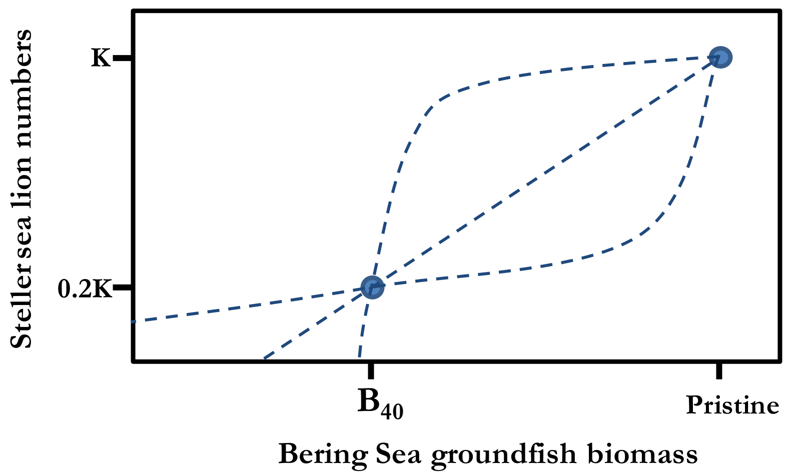
[1] In the1960s and through the 1980s the fisheries also caused substantial direct effects on the sea lion populations. The fisheries killed thousands of sea lions that were caught in trawl nets and drowned. Fishing practices have changed since then and, at present, the groundfish fisheries take on the order of only two dozen sea lions per year.

The term "indirect" is an accurate a descriptor of fishery effects in this case. The primary effects of the fisheries are not on the Steller sea lions per se, but on the fish stocks that the sea lions depend on as prey. The central question, which the Service has yet to examine in depth, is how fishing has changed the prey field for sea lions. Describing annual fishery removals is important, but the effects on the prey field go beyond a simple tally of biomass removed annually. How does the prey field in the current, fished ecosystem compare to that if no fishing were to occur. Fishing under an MSY-based strategy has at least four main types of effect on a target stock, including its (a) biomass, (b) age/size structure, (c) temporal/spatial distribution, and (d) ecological role.

Fishing rates and target stock biomass

Each year the Alaska groundfish fisheries remove about 10 percent (plus or minus a few percent) of the biomass of their main target stocks. That would seem to suggest that fishing leaves about 90 percent of their biomass in the ecosystem. But that observation only accounts for yearly changes in the biomass of the fished stocks. Instead, fisheries managers seek to reduce each target stock's biomass by 60 percent relative to its predicted pristine (unfished) level. They can achieve that reduction through annual fishing rates of about 10 percent because the target stocks are all age-structured. Each age/size class of a target stock is reduced each year by the annual fishing rate from the time that it recruits into the fishery (i.e., its members are large enough to be caught) until it disappears from a combination of natural and fishery-related mortality. In the Bering Sea, fishery managers generally target such reductions for a whole suite of groundfish, including pollock, Pacific cod, Atka mackerel, various flatfish, and so on. So the first major effect of a fishery management strategy based on MSY is an intentional, massive reduction of the groundfish biomass in the affected ecosystems (in this case, the Bering Sea/Aleutian Islands region and the Gulf of Alaska). In an ecological sense, fished ecosystems are driven to a fundamentally new state with potentially profound changes in the biomass, age/size structure, distribution, and ecological significance of the target stocks. This major alteration of the fished ecosystems has been largely overlooked in the analyses of fishery effects conducted over the past decade but, as illustrated in the figure below, it dwarfs the changes in biomass that occur on an annual basis. That is, previous analyses have focused largely on the effects of removing 10 percent of the biomass left in a fished system, which likely are far smaller than the effects of reducing the overall biomass of the system by as much as 60 percent.



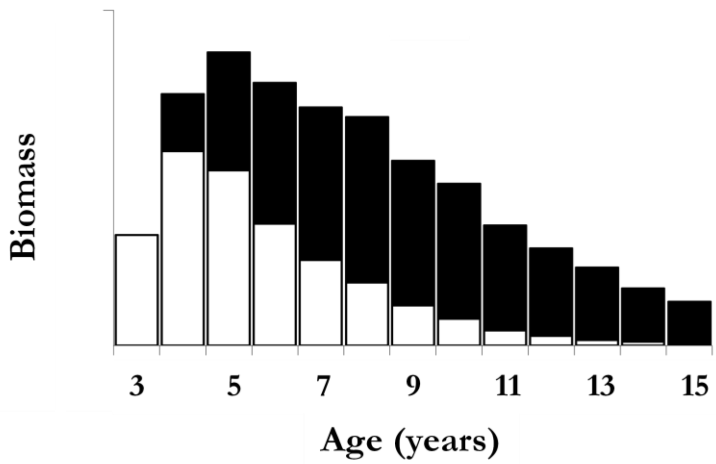


How does such a reduction in biomass affect the remainder of the ecosystem, including sea lions? The above figure illustrates this question graphically—what is the relationship between groundfish biomass and Steller sea lion numbers? In the absence of fishing, and with all groundfish stocks at their pristine levels, the collective biomass of those stocks would be expected to support some number (i.e., carrying capacity (K)) of Steller sea lions. Large-scale commercial fishing started in these ecosystems in the late 1960s and early 1970s, and the sea lion population followed with a collapse that reflected some direct bycatch of sea lions, but likely resulted primarily from indirect effects leading to reduced pup production and poor juvenile survival. The fishing strategy followed now is to reduce the biomass of target stocks to 40 percent of the expected biomass if there were no fishing (i.e., B_{40}). Although the correlation illustrated in the above figure does not prove causation, the existing data indicate that Steller sea lions numbered in the hundreds of thousands before the fishery and then declined by about 80 percent after the fishery began. One also could argue that the sea lion population would decline further if the groundfish stocks, which they depend on, were depleted to an even greater degree. This graph raises the basic question that must be considered if we are to manage any resource extraction industry on an ecosystem basis—that is, how much of a major ecosystem component (in this case, groundfish) can be removed before that removal has fundamentally changed the character of the affected ecosystem? Despite decades of fishing under an MSY-based strategy, the Service has yet to address this question in a systematic and comprehensive manner.

Age/size structure of the target stocks

Fishing does not simply affect the amount of biomass left in the ecosystem. It also affects the age/size structure of the targeted stocks. Pollock recruit to the fishery at about age 3 and live to about age 12 to 15, so any given cohort is diminished by 10-12 percent at age 3, again at age 4, again at age 5, and so on until the cohort no longer exists. Such annual reductions change the age/size structure of the target stock, shifting the mean age/size of the remaining fish downward. The average Bering Sea pollock is about 30 percent smaller (in mass) than it would be if the stock were not fished. The following figure illustrates this shift in the age/size distribution of a hypothetical fished pollock stock. The white portion of each bar indicates the age-specific biomass remaining after fishing, and the black portion represents fishery-caused losses from each cohort as it ages. Such changes in the age/size structure of the fished stock have effects on the stock itself (e.g., reproduction) as well as the remaining ecosystem (e.g., predators). Both the reduction in overall

**Biomass by age for a hypothetical pollock population,
fished (white bars) and not fished (white and black bars combined)**



biomass and the reduction in average fish size likely affect the foraging efficiency and success of Steller sea lions and those differences, in turn, may influence the survival of immature females and the productivity of mature females—females being more critical to the population's growth and recovery because Steller sea lions are polygynous.

Temporal/spatial distribution of the target stocks

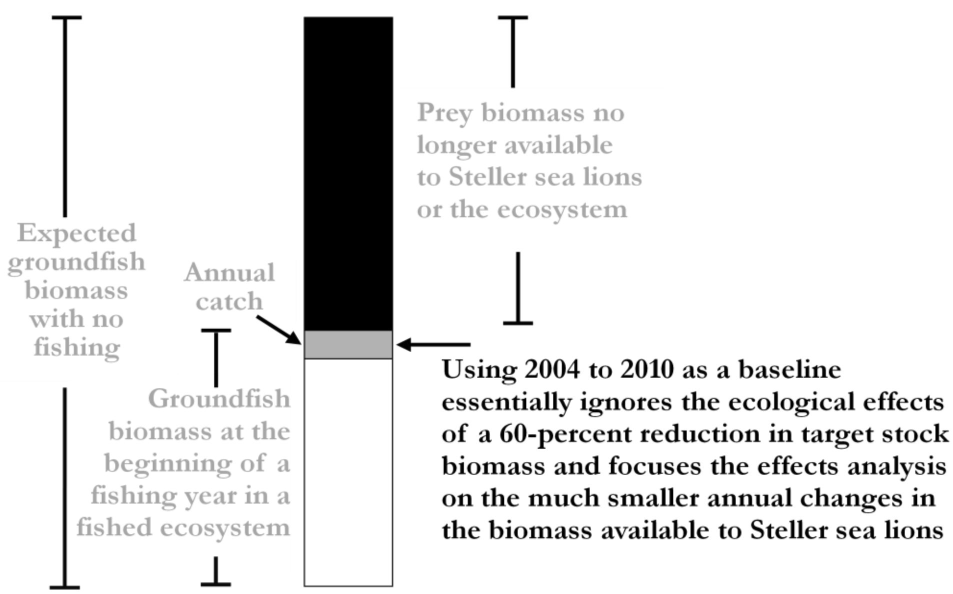
Fishing also can change the temporal/spatial distribution of the target stocks in at least three ways. First, it may result in localized depletion of prey. This has been a substantial concern with regard to the Alaska groundfish fisheries because they tend to concentrate in time and space, taking their catches from relatively small areas when catch targets have been set based on estimates of fish biomass over much larger areas. In the Bering Sea pollock fishery, a disproportionate amount of the catch still occurs in areas that have been designated as critical habitat for Steller sea lions because of their importance for sea lion foraging.

Second, fishing may alter the distribution of the target stock if the fishery is size-selective and the stock's distribution varies by size. The distribution of Bering Sea pollock, for example, is known to vary by size with younger, smaller fish tending to disperse over the eastern shelf and northern reaches of the Bering Sea and adults tending to be concentrated more in the southeastern Bering Sea. The fishery concentrates in areas where it removes the largest individuals, leaving the stock dispersed over broad areas consistent with the distribution of younger fish.

The third mechanism by which a fishery may affect the stock's distribution may be particularly important to sea lions in the western Aleutian Islands. Pollock can reasonably be expected to follow an "ideal-free" spatial distribution (Fretwell 1972). That is, they tend to occupy the best habitat first, and, when their increasing density reduces the suitability of those prime areas, they begin to occupy more marginal habitat. The central-western Bering Sea used to support a considerable density of pollock that was overfished in the early period of the fishery and has never recovered. It may not have recovered for a number of reasons, but one of them could be that fishing has held the Bering Sea population at such a low level that the remaining fish have never reoccupied marginal habitat such as the central and western Bering Sea. If that is the case, then the large-scale reduction of pollock biomass in the southeastern Bering Sea may mean that the remaining stock is not compelled to re-occupy marginal habitat in areas around the central and especially western Aleutian Islands. Here, too, the general assumption has been that the fished stock is distributed in the same manner as the pristine (unfished) stock. That is likely not the case, particularly in the western Aleutian Islands region. These kinds of considerations have never been examined in detail in the Service's analyses because the Service has always used a fished ecosystem as its baseline and focused on the effects of annual fishing without considering the large-scale changes that occur over time as a result of the MSY-based fishing strategy on age-structured groundfish stocks.

Using a baseline that will reflect the full ecological effects of fishing under MSY

The *Federal Register* notice indicates that the Service may use conditions in the period from 2004 to 2010 as a baseline for its required environmental impact statement. The fact that the Service plans to use a fished ecosystem as its baseline means that, once again, it is focusing its analysis of effects upon changes that occur from annual fishing patterns, but ignoring the large-scale, long-term effects of fishing the ecosystem under the MSY-based strategy (see the figure below). If the Service is committed, as it claims to be, to an ecosystem-based approach to fishery management, and if it intends to authorize MSY-scale fishing but also maintain healthy ecosystems, then it has to consider the full ecological consequences of its current management strategy. Otherwise, huge amounts of time and energy will continue to be spent debating the annual effects of fishing without any attempt at a meaningful, comprehensive analysis of the broader-scale, longer-term effects of fishing. The recent reviews by the Center for Independent Experts illustrate the futility of arguing over the annual changes that occur from fishing while ignoring the system-scale effects of the fisheries. Arguably, the groundfish fisheries have altered substantially the Bering Sea/Aleutian Islands and Gulf of Alaska ecosystems' carrying capacity for Steller sea lions. At this time, well after the collapse of the sea lion population, researchers should expect to see a population that behaves like it is in a new state at a new carrying capacity, albeit an artificial one set largely by human activities rather than one set by natural forces alone.



Moving forward

The debate over the potential effects of the Alaska groundfish fisheries on the western stock of Steller sea lions has been long and tortuous. It has been so in part because of the difficulty of studying such interactions in the Bering Sea/Aleutian Islands region and the Gulf of Alaska. But it also has been difficult, and unnecessarily so, because the focus of the debate has been kept on the annual effects of fishing rather than their cumulative effects over time on the stocks that are targeted by the fisheries and also are vital prey for Steller sea lions. As the action agency, the Service has an affirmative responsibility to ensure that its actions are not causing or contributing to the endangered status of the western stock of Steller sea lions.

The Commission does not see a way forward on this issue unless the Service is willing to consider its MSY-based fishing management strategy. Doing so will require a willingness and ability to manipulate the fisheries in ways that will inform fishery managers regarding the long-term ecological effects of fishing under this strategy. That means adjusting fisheries management efforts and the fisheries themselves to the appropriate scale to determine the full ecological consequences of fishing. Such an adaptive, experimental approach is one of the three major recommendations of the Revised Steller Sea Lion Recovery Plan. Therefore, the Marine Mammal Commission recommends that the National Marine Fisheries Service focus its required environmental impact statement on a full analysis of fisheries effects on Steller sea lions, especially the effects of intentionally reducing target stock biomass by 60 percent or more. Such a focus and analysis is necessary if the Service is to identify clearly the potential ecological effects of its MSY-based fishing strategy and develop the type of adaptive management approach that is needed to characterize and manage those effects.

Please contact me if you have questions regarding our recommendation or rationale.

Sincerely,

Timothy J. Ragen

Timothy J. Ragen, Ph.D.
Executive Director

Reference

Fretwell, S. D. 1972. Populations in a Seasonal Environment. Princeton University Press, Princeton, NJ.