PUBLIC REVIEW DRAFT

Environmental Assessment/ Regulatory Impact Review/ Initial Regulatory Flexibility Analysis

For

Amendment 100 to the Fishery Management Plan for Groundfish of the Bering Sea and Aleutian Islands, and Amendment 91 to the Fishery Management Plan for Groundfish of the Gulf of Alaska:

Management of Grenadiers (Family Macrouridae)

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Abstract: This Environmental Assessment/Regulatory Impact Review/Initial Regulatory Flexibility Analysis analyzes alternatives to manage three species of grenadiers (giant, Pacific, and popeye grenadiers). This action would amend the fishery management plans (FMPs) for groundfish of the Bering Sea and Aleutian Islands and the Gulf of Alaska to include grenadiers in the FMPs as either "in the fishery" or an "ecosystem component." The purpose of this action is to improve the reporting and catch accounting of grenadiers in order to provide additional protection for grenadiers from the potential adverse effects of groundfish fisheries off Alaska. This action is necessary to adopt management measures to improve the protection, conservation, and catch accounting of grenadiers.

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Executive Summary

This document analyzes alternatives for managing three species of grenadiers (giant, Pacific, and popeye grenadiers) in the Fishery Management Plan for Groundfish of the Bering Sea and Aleutian Islands Management Area (BSAI FMP) and the Fishery Management Plan for Groundfish of the Gulf of Alaska (GOA FMP).

Currently, grenadier are not managed in the Exclusive Economic Zone (3 to 200 nautical miles from shore) off Alaska, meaning that there are no catch limits and no required monitoring of catch. Because of their great abundance, there have been several attempts to develop a fishery for giant grenadier, however, because of their low flesh quality, there has been little success. A NOAA Fisheries (NMFS) sensory analysis panel has categorized giant grenadier as "unpalatable" because of its soft texture and high moisture content. It also rates low in protein content. There have also been endeavors to develop treatment processes to make the fish palatable, but so far these efforts have not proven successful. While they are not marketable at present, giant grenadier have an important ecological role in their environment as an apex predator. Apex predators have few to no predators of their own, residing at the top of their food chain.

In bottom trawl surveys conducted by NMFS in the Bering Sea and the Gulf of Alaska, this species is the most abundant fish, in terms of weight, in depths from 600 to 3,000 feet (200-1,000 meters). Giant grenadier extend much deeper than 3,000 feet (1,000 meters). There are reports that they have been caught deeper than 6,000 feet (2,000 meters), but little is known about their abundance in waters deeper than 3,000 feet because neither the NOAA surveys nor fishing effort presently extend below this depth.

The NMFS tracks grenadier abundance and estimates catch via observer records as well as works on research to better understand the biology of this species. In a recent maturity and aging study conducted by the NOAA Auke Bay Laboratories and the NOAA Age and Growth Laboratory in Seattle, scientists discovered that female giant grenadier do not start to reproduce until they are 20 years old. The maximum age found in the study was 58 years, which is older than the vast majority of fish species. Most giant grenadier caught in surveys and incidentally in other fisheries are female. NOAA scientists think most males reside in even deeper depths.

Grenadiers are caught incidentally in the deep water trawl and hook-and-line groundfish fisheries off Alaska. The purpose of this action is to improve the reporting and catch accounting of grenadiers in order to provide additional protection for grenadiers from the potential adverse effects of groundfish fisheries. This action is necessary to amend the FMPs to include grenadiers, thereby allowing the adoption of management measures and catch accounting requirements. These management measures would be achieved by including grenadiers in the fishery management plans (FMPs) as either "in the fishery" or an "ecosystem component" and adopting management measures designed to improve the protection, conservation, and catch accounting of grenadiers.

Council[1] Purpose and Need Statement

The Council adopted the following purpose and need statement in December 2013.

> *Grenadiers are not included in the BSAI or GOA groundfish FMPs. There are no limits on their catch or retention, and no reporting requirements. However, grenadiers are taken as bycatch, especially in longline fisheries; no other Alaskan groundfish has similar levels of catches that is not included in the FMPs. Inclusion in the groundfish FMPs would provide for their precautionary management by, at a minimum, recording their harvest and/or placing limits on their harvest.*

Alternatives

The action alternatives evaluated in this analysis were adopted by the Council in December of 2013. The alternatives apply separately at the FMP level: an alternative will be selected for the BSAI FMP and for the GOA FMP. Under both the action alternatives, grenadier species are aggregated due to a lack of data necessary to manage the species separately. This section outlines management measures that need to be adopted for grenadiers when considered for inclusion as "in the fishery" or an "ecosystem component," as well as additional management measures that could be, but need not be, adopted.

Alternative 1: No action (Status Quo)

Under this alternative, grenadiers are not federally managed and are not included in the groundfish FMPs. Directed fishing is not prohibited and there are no catch or retention limits for grenadiers, and unlimited amounts may be taken and sold. There are no reporting or recordkeeping requirements for grenadiers, and currently the best estimate of catch comes from observer data. Vessels which have a Federal Fisheries Permit may use their retention of grenadiers as basis species for the retention of other groundfish up to the maximum retainable amounts listed in Tables 10 and 11 to 50 CFR 679, for the GOA and BSAI.

Alternative 2, Preliminary Preferred Alternative[2]: Include grenadiers in the FMP as an Ecosystem Component species.

This alternative would manage grenadiers in ecosystem component category under the FMP. The term "ecosystem component" is defined in the National Standard 1 guidelines (50 CFR 600.310). According to the National Standard 1 guidelines, in order to be designated as an "ecosystem component" (EC), the species or species group should be:

- a non-targeted species or species group;
- not subject to overfishing, overfished, or approaching an overfished condition;
- not likely to become subject to overfishing or overfished in the absence of conservation and management measures; and
- not generally retained (a small amount could be retained) for sale or personal use.

According to the National Standard 1 guidelines, it is important to consider whether use of the EC species classification in a given instance is consistent with Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) conservation and management requirements. Species may be included in the FMP as an EC for any of the following reasons: for data collection and catch monitoring purposes; for ecosystem considerations related to specification of optimum yield (OY) for the associated

[1] Council denotes the North Pacific Fisheries Management Council which is also referred to as NPFMC.
[2] The Council chose Alternative 2 as the Preliminary Preferred Alternative for the BSAI and GOA in December of 2013.

fishery; as considerations in the development of conservation and management measures for the associated fishery; or to address other ecosystem concerns.

As an EC species, the catch of grenadiers would be required to be reported for monitoring purposes and directed fishing for grenadiers would be prohibited. Further, Maximum Retainable Amounts (MRAs) of grenadiers as an incidental catch species would be established and limit grenadier retained catch. The Council is considering an MRA range of 2 percent to 20 percent.

Under the ecosystem component, targeting grenadiers would not be possible without moving them to "in the fishery" and establishing status determination criteria. While grenadiers are currently not targeted commercially, moving them to the ecosystem component would be intended to discourage uncontrolled fishing on these species without applicable management measures in place should they become economically viable in the future.

Alternative 3: Include grenadiers in the FMP as "in the fishery."

This alternative would include grenadiers "in the fishery" as incidental catch species.

The term "in the fishery" is defined in the National Standard 1 guidelines (50 CFR 600.310). Stocks of fish that are "in the fishery" are:

- stocks that are targeted, and retained for sale or personal use;
- stocks that are not directly targeted but are taken incidentally in other directed fisheries and are retained for sale or personal use; and
- stocks not targeted or retained but are taken as incidental catch and for which overfishing or overfished status may be a concern.

For each stock "in the fishery", all Magnuson-Stevens Act requirements under section 303(a) must be met. Therefore, the Council and NMFS would establish Overfishing Limits (OFLs), Allowable Biological Catches (ABCs), and Total Allowable Catches (TACs) each year in the annual harvest specifications process. Recordkeeping and reporting of grenadier catch would be required and other management measures discussed in Chapter 2 would need to be adopted. Additionally, the Council would need to describe and identify Essential Fish Habitat for grenadiers.

Impacts of the Alternatives

The proposed action is limited in scope and will likely not affect most environmental components of the BSAI and GOA. The environmental effects discussion is limited to impacts on grenadiers, impacts on groundfish target species, ecosystem impacts, and cumulative effects.

Alternative 1: No Action

Potential Effects on Grenadiers

Under the no action alternative, NMFS does not manage grenadiers and there is no prohibition on "unmanaged targeted fishing" of grenadiers. Present and past harvests of grenadiers taken incidentally are well below the current estimate of an OFL calculated for grenadiers, there are no significant effects (either adverse or beneficial) on the stock biomass, fishing mortality, spatial or temporal distribution, or changes in prey availability for grenadier and groundfish target species in either the BSAI or GOA.

Under Alternative 1, NMFS does not have the ability to protect grenadiers from the risk of overfishing should a market for grenadier products develop and catch increase substantially above current levels. Grenadier species have low fecundity and low growth rates, which would lead to slow recoveries if stocks were fished down. Historically, nearly all incidental catch of grenadiers has been discarded; however, the status quo allows retention of grenadier as a basis species in the retention of other, valuable, groundfish. Once delivered as a basis species these grenadier are either turned to meal or, more frequently, discarded leading to wasting of the catch.

Potential Effects on Groundfish

Under Alternative 1, the status quo, grenadiers would continue as non-FMP species without any harvest limitations or recordkeeping and reporting requirements. Since there is no limit on grenadier catch or retention, and grenadiers are not assessed in the calculation of optimum yield in the groundfish fishery, there would be no short term effects (either adverse or beneficial) on the stock biomass, fishing mortality, spatial or temporal distribution, or changes in prey availability for other groundfish target species in either the BSAI or GOA.

Alternative 1; however, retains the possibility for "unmanaged targeted fishing "of grenadiers to occur. Were a market to develop, grenadier could be targeted and there would be no required recordkeeping and reporting of catch and disposition of catch. Given the ecological importance of grenadiers, increased removals of grenadiers in an unmanaged and unreported fishery could have adverse effects on prey availability for other groundfish target species. However, little information is available on food web and habitat interactions between grenadiers and other groundfish The information that is available indicates that in the Aleutian Islands, the diet of grenadiers is comprised mostly squid and bathypelagic fish (myctophids) (Yang 2003), whereas in the Gulf of Alaska, squid and pasiphaeid shrimp predominated as prey (Yang et al. 2006). Thus, other groundfish do not appear to compose the prey field of grenadiers. However, sablefish do appear to prey on grenadiers. However, the extent of grenadier in the diet of sablefish is unknown. Alternative 1 does not provide for improvements in that level of scientific knowledge through, at a minimum, accurate recording of their harvest and/or placing limits on their harvests.

Alternative 1 also allows the retention of grenadiers for use as a basis species in retaining other groundfish; however, the additional harvest of groundfish would not have a significant impact on groundfish stocks, because the harvest is conducted within the MRA limits and is subtracted from the annual TAC specified for each groundfish species group. It is still possible, under Alternative 1 for grenadier to be used as a basis species and then be discarded at the shoreside plant level as there is no market for grenadier at present.

Potential Effects on the Ecosystem

Under Alternative 1, grenadiers would continue as non-FMP species without any harvest limitations or recordkeeping and reporting requirements. The Council and NMFS are considering federal conservation and management for grenadiers. Bottom trawl surveys have shown giant grenadier is the most abundant species at depths 200 m to 1,000 m on the continental slope of the GOA, eastern Bering Sea, and Aleutian Islands. Alternative 1 provides no management structure for either tracking or limiting harvest of this ecologically important species. Under Alternative 1, the overall risk to grenadier stocks and their ecological role would appear to be limited based on known biomass, harvests, and reasonably foreseeable harvest trends. However, under Alternative 1, NMFS would not have management tools to accurately track catch or limit harvests should a directed fishery develop quickly. The likelihood of such a fishery developing in the foreseeable future is uncertain but unlikely

based on past attempts to develop a market and the lack of any indication that such a market is under development.

Potential Cumulative Effects

While it is not known what the exact effect climate change may have on grenadier stocks, it is possible that changing ocean conditions, such as salinity, temperature, and acidity, may affect grenadiers in several life stages and as they move through the water column to feed. This is partly due to the lack of comprehensive harvest information collection on grenadiers that is perpetuated under the status quo.

Alternative 2, Preliminary Preferred Alternative: Grenadiers in the FMP as "Ecosystem Component" species.

Potential Effects on Grenadiers

Under Alternative 2 grenadier would be included in the FMP as an "ecosystem component" species. Grenadiers meet the National Standard guidelines definition for an ecosystem component. Grenadiers are not a target species and generally not retained for sale or personal use. Grenadiers are not subject to overfishing, overfished, or approaching an overfished condition[3]. The Alaska Fisheries Science Center estimates the grenadier OFL in the annual Tier 5 grenadier stock assessment. In the BSAI, the grenadier OFL is 135,236 (Table 3-3) and the estimated catch is 5,294 (mean for 2003-2013, Table 3-4). In the GOA, grenadier OFL is 46,635 (Table 3-2) and the estimated catch is 8,707 (mean for 2003-2013, Table 3-4). At the current level of catch, grenadiers are not likely to become subject to overfishing or overfished in the absence of conservation and management measures. However, the Council and NMFS are concerned with the potential vulnerability to overfishing if catch increases dramatically in the absence of conservation and management measures.

Under Alternative 2, NMFS would establish recordkeeping and reporting requirements established for grenadiers, and grenadiers would be closed to "directed fishing." A closure to "directed fishing" means that targeting grenadiers would no longer be allowed. Further, MRAs of grenadiers as an incidental catch species would be established and limit grenadier retained catch. These measures are all in sharp contrast to the status quo conditions and would improve catch estimation, thereby helping to reduce scientific uncertainty, as well as preventing "unmanaged target fishing" of grenadiers. Thus, Alternative 2 provides management measures necessary to ameliorate the vulnerability of grenadiers to overfishing as an incidental catch species.

In contrast to Alternative 1, Alternative 2 prevents "unmanaged target fishing" of grenadiers and prohibits a "directed fishery" from being developed as well. Were a market for grenadiers to be developed, Alternative 2 would allow a "small amount" of grenadier to be retained and marketed; however, establishing a formal directed fishery would require an FMP amendment. Due to the prohibition of a directed fishery, Alternative 2 would also prevent use of grenadier incidental catch as a basis species for retention of other groundfish, thereby eliminating the potential discard waste of grenadiers post-delivery.

Potential Effects on Groundfish

[3] Due to a lack of necessary information, NMFS cannot establish a minimum stock size threshold from which to determine whether grenadiers (a Tier 5 stock) are overfished or approaching an overfished condition; however, However, on annual basis, NMFS can determine whether overfishing is occurring for tiers 4 and 5 stocks. Grenadiers catch is well below OFL and ABC and thus not subject to overfishing and there is no indication that grenadier are overfished or approaching an overfished condition.

Alternative 2 would place grenadiers in the FMPs as "ecosystem component" species. As has been discussed above, directed fishing for grenadiers would not be allowed, recordkeeping and reporting would be required, and conservation and management measures to reduce incidental catch of grenadiers would be applied. Given limited interaction information, it is difficult to discern any direct effects of this alternative on other groundfish species; however, the enhanced recordkeeping and reporting requirements may lead to improvements in interaction information over time. Further, Alternative 2 formalizes management of grenadiers and provides for conservation and management of grenadiers should concerns about effects of grenadier removals on other groundfish species arise in the future.

While little is presently known about the interactions of grenadiers with other groundfish species, Alternative 2 may improve the level of scientific knowledge through, at a minimum, recording of their harvest and/or placing limits on their harvests. Thus, Alternative 2 does provide the precautionary management structure needed to sustainably manage the grenadier stock to potentially promote its sustainability and the sustainability of other groundfish species with which grenadier may have important ecological interactions.

Potential Effects on the Ecosystem

Under Alternative 2 grenadier would be included in the FMP as an "ecosystem component," species. NMFS established the ecosystem component category to encourage ecosystem approaches to management and to incorporate ecosystem considerations (74 FR 3179, January 16, 2009). Alternative 2 provides management measures necessary for precautionary management of this ecologically important species, as an "ecosystem component" with limited incidental catch. These measures are all in sharp contrast to the status quo conditions and would provide for ecosystem approaches to management via improving grenadier catch estimation, thereby helping to reduce scientific uncertainty, as well as limiting grenadier harvest in recognition of their important ecological role.

Potential Cumulative Effects

Under Alternative 2, increased TAC in target fisheries where grenadiers are caught incidentally and the resulting increase in grenadier incidental catch would be monitored via recordkeeping and reporting requirements. Thus, Alternative 2 provides management structure necessary to monitor grenadier removals under changing future conditions. Similarly, Alternative 2 offers a management structure under which information can be collected to improve understanding of stock structure thereby improving understanding of the potential effects of future climate change on stock structure.

Alternative 3: Grenadiers in the FMP as "in the Fishery"

Potential Effects on Grenadiers

Alternative 3 would place grenadiers in the FMP as "in the fishery," with all of the associated, recordkeeping and reporting, stock assessment, harvest specifications, and conservation and management measures afforded to all other groundfish species in the BSAI and GOA. A directed fishery could develop if the Council recommended a TAC above the amount needed for incidental catch in other fisheries. In addition, The Council would need to describe and identify grenadier Essential Fish Habitat (EFH) in the FMP.

Alternative 3 would expand the record keeping and reporting requirements of Alternative 2 by incorporating grenadiers into the annual harvest specifications process. Alternative 3 also provides a formal structure under which a "directed fishery" for grenadiers could be allowed with all the associated management structure required under the Magnuson-Stevens Act to prevent overfishing. Further, Alternative 3 addresses the recommendation of stock assessment authors who have recommended that management measures appropriate for target species (such as Annual Catch Limits (ACLs) and Accountability Measures (AMs)) should also be applied to grenadiers because of the similarities in vulnerability scores between target stocks and giant grenadier (Ormseth and Spencer 2009, 2011). Thus, Alternative 3 provides management measures necessary to ameliorate the vulnerability of grenadiers to overfishing as either incidental catch or in a "directed fishery." However, because a directed fishery could be opened for grenadiers under Alternative 3, this alternative would be less conservative that Alternative 2 relative to susceptibility to fishing.

Under Alternative 3, no directed fishery would be allowed and the grenadier basis species MRA would be zero, with a 35 percent MRA as an incidental catch species. Alternative 3 does allow a directed fishery to be opened through the specifications process with amendment of the MRAs in regulations. The additional harvest of groundfish that could occur under MRAs in a grenadier "directed fishery" would not have a significant impact on groundfish stocks, because the harvest is conducted within the MRA limits and is subtracted from the annual TAC specified for each groundfish species group. A separate MRA for grenadiers would allow "topping off" with other groundfish species up to the MRA; however, the Council could choose to have a separate TAC for grenadier, but not have a separate MRA for them. Any grenadiers caught in excess of the MRA would have to be discarded. This policy decision is discussed under chapter 2.

In contrast to Alternatives 1 and 2, Alternative 3 provides the management structure needed to potentially promote sustainable harvest of grenadiers in a future "directed fishery." However, the implications for other groundfish stocks of establishing a grenadier "directed fishery" differ between the GOA and the BSAI.

Potential Effects on Groundfish

At present, the OY cap established in the GOA FMP is substantially greater than the total of all GOA TACs. Thus, placing grenadier "in the fishery" in the GOA does not require "funding" of grenadier TAC via reductions in TACs of any other groundfish species. Further, since the present and past harvests of grenadiers taken incidentally are well below the current ABCs calculated for grenadiers, there would be no effects (either adverse or beneficial) on the stock biomass, fishing mortality, spatial or temporal distribution, or changes in prey availability for groundfish target species in the GOA.

In contrast to the potential effects of Alternative 3 in the GOA, the BSAI FMP specifies a total OY cap of 2 million mt. The total of all BSAI groundfish TACs may not exceed this 2 million mt cap. Thus, placing BSAI grenadiers "in the fishery" means that grenadier incidental catch would have to be "funded" from reduced TAC of other BSAI groundfish species. The actual reduction in TAC that may occur in other BSAI groundfish target fisheries to "fund" grenadiers is unknown. However, the Regulatory Impact Review (RIR) has analyzed hypothetical examples and the results of those analyses are provided in the summary of the RIR, below. Alternative 3 also provides a formal structure under which a "directed fishery" for grenadiers could be allowed with all the associated management structure required under the MSA to prevent overfishing. Thus, Alternative 3 provides management measures necessary for precautionary management of this ecologically important species, either with limited incidental catch, or if a "directed fishery" is eventually developed.

Potential Effects on Ecosystem

Alternative 3 would expand on information available on grenadiers from Alternative 2 by incorporating grenadiers into the annual harvest specifications process. Alternative 3 also provides a formal structure under which a "directed fishery" for grenadiers could be allowed with all the associated management structure required under the MSA to prevent overfishing. Thus, Alternative 3 provides management measures necessary to precautionary management of this ecologically important species, either with limited incidental catch, or if a "directed fishery" is eventually developed.

Potential Cumulative Effects

Under Alternative 3, increased TAC in target fisheries where grenadiers are caught incidentally and the resulting increase in grenadier incidental catch would be monitored via recordkeeping and reporting requirements. Thus, Alternative 3 provides management structure necessary to monitor grenadier removals under changing future conditions. Similarly, Alternative 3 offers a management structure under which information can be collected to improve understanding of stock structure thereby improving understanding of the potential effects of future climate change on stock structure.

Regulatory Impact Review and Initial Regulatory Flexibility Analysis

Alternative 1: The status quo

Since the present and past harvests of grenadiers taken incidentally are well below the current ABCs calculated for grenadiers, and there is presently no market value for Alaska grenadiers, there would be no significant short term effects (either adverse or beneficial), under Alternative 1, on the stock biomass, fishing mortality, spatial or temporal distribution, or changes in prey availability for grenadier and groundfish target species in either the BSAI or GOA. Thus, there would be no significant short term changes in groundfish harvesting operations and no significant short term changes in the socioeconomic conditions in the commercial groundfish fisheries in the two areas. However, were conditions to change, grenadier could be targeted and there would be no required recordkeeping and reporting. Alternative 1 also allows the retention of grenadiers for use as a basis species in retaining other groundfish; however, grenadier can then be discarded at the shoreside plant level, as there is no market for grenadier at present.

Alternative 1 would allow future revenue increases via unmanaged targeted fishing of grenadiers. However, Alternative 1 provides none of the management structure needed to ameliorate the risk of overfishing nor to manage the grenadier stock to promote its sustainability and the sustainability of other species with which grenadier may have important ecological interactions.

Alternative 2, Preliminary Preferred Alternative: Grenadiers in the Groundfish FMPs as "Ecosystem Component" species.

Under Alternative 2, the present and past harvests of grenadiers taken incidentally are well below the current ABCs calculated for grenadiers. Thus, there would be no significant effects (either adverse or beneficial) on the stock biomass, fishing mortality, spatial or temporal distribution, or changes in prey availability for grenadier and groundfish target species in either the BSAI or GOA. There would be no significant (either beneficial or adverse) socioeconomic effects on those who harvest grenadiers or other groundfish targets in either the BSAI or GOA.

Alternatives 2 will impose new recordkeeping and reporting requirements on the groundfish fishing industry, as well as additional fisheries management processes; however, given the small relative amount

of grenadier incidental catch these requirements will have *de-minimus* effects on fishery participants and NMFS.

In contrast to Alternative 1, Alternative 2 prevents targeting of grenadiers and prevents a "directed fishery" from being developed as well. Alternative 2 would allow management structure needed to ameliorate the risk of overfishing and to sustainably manage the grenadier stock. Were a market for grenadiers to be developed, Alternative 2 would allow a "small amount" of grenadier to be retained and marketed; however, establishing a formal directed fishery would require further regulatory action. Alternative 2 would also prevent use of grenadier incidental catch as a basis species for retention of other groundfish. Thus, while Alternative 2 does not allow unlimited grenadier harvests and associated revenue, it does provide the management structure needed to ameliorate the risk of overfishing and to sustainably manage the grenadier stock to potentially promote its sustainability and the sustainability of other species with which grenadier may have important ecological interactions.

Alternative 3: Grenadiers in the Groundfish FMPs as "in the Fishery"

Alternative 3 could allow retention, subject to potential MRA restrictions (see Section 2), and marketing of incidentally caught grenadier. In contrast to Alternative 2, were a market to develop, a "directed fishery" could be allowed as part of the annual TAC specifications process without further FMP amendment. Thus, Alternative 3 provides the management structure needed to ameliorate the risk of overfishing and to sustainably manage the grenadier stock to potentially promote its sustainable harvest in a future "directed fishery" as well as promoting the sustainability of other species with which grenadier may have important ecological interactions.

At present, the OY cap established in the GOA FMP is substantially greater than the total of all GOA TACs. Thus, placing grenadier "in the fishery" in the GOA does not require "funding" of grenadier TAC via reductions in TACs of any other groundfish species. There would be no significant (either beneficial or adverse) socioeconomic effects on those who harvest grenadiers or other groundfish targets in the GOA.

In contrast to the potential effects of Alternative 3 in the GOA, placing grenadiers "in the fishery" in the BSAI FMP may have adverse effects on fishery total revenue in the short term. The BSAI FMP specifies a total OY cap of 2 million mt. The total of all BSAI groundfish TACs may not exceed this 2 million mt cap. Thus, placing BSAI grenadiers "in the fishery" means that grenadier incidental catch would have to be "funded" from reduced TAC of other, presently valuable, BSAI groundfish species.

The actual amount of reduction in TAC that may occur in other BSAI groundfish target fisheries with grenadiers "in the fishery" in the BSAI are unknown and would be determined in the annual harvest specifications process. However, to put the potential impacts in perspective, consider that if the grenadier TAC in the BSAI were set at, for example, the estimated mean 2003 through 2013 incidental catch level of 5,294 mt, the cumulative TACs for other groundfish species would be reduced by as little as 0.26 percent.

The RIR analyzes funding of grenadier TAC from target species/species groups having the highest incidental catch proportions. The highest proportions of incidental catch occur in the Greenland turbot, sablefish, other flatfish, and halibut target species/species groups. Note; however, that the halibut target fishery would not be subject to TAC reductions via the annual specifications process. Thus, the proportion of incidental BSAI grenadier catch that occurs in the halibut fishery would have to be made up elsewhere. This analysis shows that a substantial amount of revenue could be lost with proportional "funding" of BSAI grenadier TAC via BSAI sablefish TAC reductions. These impacts range from $7.3 million (19.9% of target total) to $17.1 million (46.9% of target total), while the potential impacts to the

Greenland turbot target fishery range from $800,000 (11% of target total) to $2.0 million (25.9% of target total).

The hypothetical revenue impacts in the other flatfish target fishery range from $500,000 (2.5% of target total) to $1.1 million (5.9% of target total) with the remaining fisheries having lesser impacts especially when considered as a percent of fishery total revenue. Note that with substantially larger TACs in the Pacific cod, rockfish, and other species target species/species groups the percentage of total fishery revenue potentially lost is less than one percent in each example. Another consideration is that "funding" of BSAI grenadier TAC via reductions in the TACs of target fisheries that have the highest proportions of BSAI grenadier incidental catch will likely reduce BSAI grenadier incidental catch as well. However, due to incomplete reporting of BSAI grenadier catch, at present, it is not possible to estimate the potential magnitude of the effect.

A further consideration is the fact that the 2 million mt TAC cap in the BSAI is not always reached. For example, in the period from 2008 through 2010, BSAI pollock TACs decreased considerably and the average annual grenadier catch of approximately 5,300 mt would have been easily "funded" within the OY cap. Thus, in three of the past ten years, grenadier catch in the BSAI could have been "funded" with either no reduction in the TACs of other BSAI groundfish species, or with less than two tenths of a percent reduction in other TACs. The period of lower than normal BSAI groundfish TACs between 2008 and 2010 appears to be somewhat anomalous. Total BSAI TAC has fallen below 2 million mt in only two other years (1992 and 1993; by 145 and 3380 tons, respectively)[4], since implementation in the early 1980's. Nonetheless, were future variability in groundfish stocks to result in total BSAI TACs significantly lower than 2 million mt tons then, were a market for grenadier products to develop, retention of incidental catch and/or directed fishing of grenadier in the BSAI could improve optimal yield from the BSAI fishery in times of decreased stock abundance of other groundfish species, all else equal. Thus, placing grenadiers "in the fishery" in the BSAI may offer the potential for improved future benefits to the nation.

It is important to recognize that these hypothetical impacts would be spread across all Federal groundfish participants, including BSAI Community Development Quota (CDQ) entities, via the allocations made to sectors in the TAC specifications process. Thus, the impacts of funding a grenadier TAC, if any, would be borne by all harvesting platforms in an affected sector and gear type, further ameliorating potential impacts. These hypothetical examples show that the likely potential economic impacts of having grenadiers "in the fishery" in the BSAI are not significant in comparison to the overall value of the BSAI groundfish fishery.

As with Alternatives 2, Alternative 3 will impose new recordkeeping and reporting requirements on the groundfish fishing industry, as well as additional fisheries management processes; however, given the small relative amount of grenadier incidental catch these reporting requirements will have *de-minimus* effects on fishery participants. Similarly, grenadier stock assessments are presently being conducted and the additional burden on NMFS of new grenadier management measures will have *de-minimus* impacts.

Effects on Net Benefits to the Nation

Under Alternative 1, the no action alternative, grenadiers would continue as non-FMP species without any harvest limitations or recordkeeping and reporting requirements. Since the present and past harvests of grenadiers taken incidentally are well below the current ABCs calculated for grenadiers, there would be no significant effects (either adverse or beneficial) on the stock biomass, fishing mortality, spatial or

[4] Data Available at: http://alaskafisheries.noaa.gov/sustainablefisheries

temporal distribution, or changes in prey availability for grenadier and groundfish target species in either the BSAI or GOA. Thus, there would be no significant short term change in groundfish harvesting operations and no significant short term changes in the socioeconomic conditions in the commercial groundfish fisheries in the two areas.

Alternative 1 would allow unlimited targeting of grenadier without any formal management structure in place to prevent overfishing. Thus, while Alternative 1 provides the possibility of allowing future revenue increases via unmanaged targeted fishing of grenadiers it provides none of the management structure needed to ameliorate the risk of overfishing nor to sustainably manage the grenadier stock to promote its sustainability and the sustainability of other species with which grenadier may have important ecological interactions. Thus while Alternative 1 appears to have no short term adverse effects on net national benefits it does nothing to mitigate risks of non-management of grenadier stocks.

Net benefits are not expected to decrease, in the near term, under Alternative 2. Alternative 2 does not affect current fishery revenue, as grenadiers are not currently marketable. However, Alternative 2 does not allow a directed fishery to develop without further regulatory action, thus potentially constraining future revenue potential should a market develop for grenadiers. Alternative 2 does provide enhancements to species monitoring and management that, while not quantifiable, are considered to be beneficial. Alternative 2 also ameliorates the risks of non-management of grenadiers that would continue under the status quo.

Under Alternative 3, grenadiers are defined as "in the fishery," with all of the associated management structure required under the MSA. Grenadier would be assessed under the calculation of OY. Both the BSAI FMP and statute constrains TAC at 2 million metric tons (mt) in the BSAI. The GOA OY cap far exceeds the sum of all GOA TACs and is nonbinding. However, in order to establish a grenadier TAC in the BSAI annual harvest specifications, in most years it would require the Council and NMFS to reduce TAC of some other BSAI groundfish species (or group of groundfish species) to ensure the 2 million mt TAC is not exceeded. Given that grenadier is currently valueless, this will decrease groundfish revenue in the short run unless a market for grenadier can be established. However, given the large biomass of grenadier it is possible that, if a market is developed, grenadier catch could be taken in years when the BSAI TAC for all other non-grenadier species is less than 2 million mt, thus contributing to additional harvest opportunities under those conditions. Similar to Alternative 2, Alternative 3 also ameliorates the risks of non-management of grenadiers that would continue under the status quo, and extends management to include the potential for a "directed fishery" to develop.

Initial Regulatory Flexibility Analysis:

The Initial Regulatory Flexibility Analysis (IRFA) addresses the statutory requirement of the Regulatory Flexibility Act of 1980, as amended by the Small Business Fairness Act of 1996, and by the final rule implementing new size standards for finfish fishing effective July 22, 2013. These acts require an analysis of the numbers of small entities directly regulated by regulatory actions subject to the notice and comment provisions of the Administrative Procedures Act.

Earnings from all fisheries in and off Alaska for 2012 were estimated for trawl catcher/processors and catcher vessels, and non-trawl catcher/processors and catcher vessels that participated in the BSAI and GOA groundfish fisheries. Table 6.1, of the IRFA provides the numbers of BSAI and GOA small entities that would be directly regulated by this action. These small entities had total gross revenue from all fisheries off Alaska of less than $19 million in 2011 and were not cooperative affiliated, to the best of our knowledge. In the GOA, there were a total of 688 small catcher vessels and 5 small catcher/processors, for a combined total of 693 small GOA entities in 2012. The majority of these (561) are Catcher Vessels in the hook-and-line (HAL) gear type sector. In the BSAI, there were 76 small catcher vessels and 5 small catcher/processors, for a total of 81 small BSAI entities in 2012. The combined total for all of the

EEZ groundfish fisheries is 725 small catcher vessels and 10 small catcher/processors, or 735 small groundfish vessels, directly regulated by this action, in 2012. In addition, the six CDQ groups qualify as directly regulated small entities under this action, as do 73 shoreside processing plants in the BSAI and GOA combined.

The action alternatives would impose additional recordkeeping and reporting requirements on fishery participants. These requirements include recording grenadier catch using a new species code and require no additional skills. Given the small amount of grenadier incidental catch, relative to groundfish catch, these recordkeeping and reporting requirements are found to have *de-minimus* impacts on fishery participants.

Organization of the Document

This document is an Environmental Assessment/Regulatory Impact Review/Initial Regulatory Flexibility Analysis (EA/RIR/IRFA). The EA/RIR/IRFA provides assessments of the environmental impacts of an action and its reasonable alternatives (the EA), the economic benefits and costs of the action alternatives, as well as their distribution (the RIR), and the impacts of the action on directly regulated small entities (the IRFA). The purpose and need for the proposed action and the problem statement adopted by the Council are presented in Section 1, along with the history of the action. A description of the alternatives and options considered are presented in Section 2. Background information on grenadier biology, stocks, and catch history are presented in Sections 3.1, 3.2, and 3.3, respectively. The environmental impacts of the proposed action alternatives and options are presented in Sections 3.4 through 3.7. The Regulatory Impact Review (Section 4) discusses the socioeconomic impacts of the action, and the Initial Regulatory Flexibility Analysis (Section 5) evaluates the impact of the action on small entities. Section 6 reviews the proposed action with respect to the BSAI and GOA groundfish FMPs, the Magnuson-Stevens Act requirements. Section 7 lists the preparers and agencies and persons consulted, and Section 8 provides references for the literature cited. Section 9 provides an appendix containing stock assessment tables and detailed vulnerability analysis.

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List of Acronyms and Abbreviations

ABC	acceptable biological catch
ACL	annual catch limit
ADF&G	Alaska Department of Fish and Game
AFSC	Alaska Fisheries Science Center
AM	accountability measure
B	biomass
BSAI	Bering Sea and Aleutian Islands
BSAI groundfish FMP	Fishery Management Plan for Groundfish of the Bering Sea and Aleutian Islands Management Area
CDQ	community development quota
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
Council	North Pacific Fishery Management Council
E.O.	Executive Order
EA	environmental assessment
EC	ecosystem component
EEZ	exclusive economic zone
EFH	essential fish habitat
EIS	environmental impact statement
F	Fishing mortality rate
FMP	fishery management plan
FR	*Federal Register*
GOA	Gulf of Alaska
GOA groundfish FMP	Fishery Management Plan for Groundfish of the Gulf of Alaska
Hook-and-line	Regulatory abbreviation for common gear term longline.[5]
HAL	hook-and-line
IFQ	Individual fishing quota
IRFA	Initial regulatory flexibility analysis
M	natural mortality rate
Magnuson-Stevens Act (MSA)	Magnuson-Stevens Fishery Conservation and Management Act
MRA	maximum retainable amount
mt	metric ton
NEPA	National Environmental Policy Act
NMFS	National Marine Fishery Service
NOAA	National Oceanographic and Atmospheric Administration
NOAA Fisheries	National Marine Fisheries Service
NPFMC	North Pacific Fishery Management Council
NS	National Standard
Observer Program	North Pacific Groundfish Observer Program
OFL	Overfishing Level[6]
OY	optimum yield
PAFL	pre-anal fin length
POT	pot gear
PRR	product recovery rates
PSA	productivity and susceptibility analysis
PSC	prohibited species catch
PSEIS	programmatic supplemental environmental impact statement
RFA	Regulatory Flexibility Act
RFFA	reasonably foreseeable future action
RIR	regulatory impact review
RPW	relative population weight
SAFE	Stock Assessment and Fishery Evaluation
SBA	Small Business Act
SSC	Scientific and Statistical Committee
TAC	total allowable catch
U.S.	United States
U.S. DOC	United States Department of Commerce
VEWG	Vulnerability Evaluation Working Group

[5] NMFS regulations use hook-and-line to define longline gear using hooks, as longline gear is also used with pots. Hook-and-line is used throughout this document except where "longline" is from a quote or an external source, title, or proper name.

[6] The BSAI Groundfish FMP defines OFL as overfishing level, while the GOA Groundfish FMP defines it as overfishing limit. Overfishing level is the term used in this document, as it is consistent with the MSA definition of overfishing.

1 Introduction

This document analyzes three alternatives to manage several species of grenadiers (giant, Pacific, and popeye grenadiers) in the Fishery Management Plan for Groundfish of the Bering Sea and Aleutian Islands Management Area (BSAI FMP) and the Fishery Management Plan for Groundfish of the Gulf of Alaska (GOA FMP). The alternatives under consideration include managing these species of grenadier either as ecosystem component species or "in the fishery" in the BSAI and/or GOA.

This document is an Environmental Assessment/Regulatory Impact Review/Initial Regulatory Flexibility Analysis (EA/RIR/IRFA). An EA/RIR/IRFA provides assessments of the environmental impacts of an action and its reasonable alternatives (the EA), the economic benefits and costs of the action alternatives, as well as their distribution (the RIR), and the impacts of the action on directly regulated small entities (the IRFA). This EA/RIR/IRFA addresses the statutory requirements of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), the National Environmental Policy Act, Presidential Executive Order 12866, and the Regulatory Flexibility Act. An EA/RIR/IRFA is a standard document produced by the North Pacific Fishery Management Council (Council) and the National Marine Fisheries Service (NMFS) Alaska Region to provide the analytical background for decision-making.

1.1 Purpose and Need

The Council formulated the following purpose and need statement in December 2013.

> *Grenadiers are not included in the BSAI or GOA groundfish FMPs. There are no limits on their catch or retention, and no reporting requirements. However, grenadiers are taken as bycatch, especially in longline[7] fisheries; no other Alaskan groundfish has similar levels of catches that is not included in the FMPs. Inclusion in the groundfish FMPs would provide for their precautionary management by, at a minimum, recording their harvest and/or placing limits on their harvest.*

Grenadier stock assessment authors, the Council's BSAI and GOA Groundfish Plan Teams, and the Council's Scientific and Statistical Committee (SSC) have recommended in recent years that grenadiers should be subject to federal conservation and management. Bottom trawl surveys have shown giant grenadier is the most abundant species at depths 200 m to 1,000 m on the continental slope of the GOA, eastern Bering Sea, and Aleutian Islands. Because of their abundance on the continental slope, scientists conclude grenadiers have great ecological importance in this habitat (Rodgveller et.al. 2012). Grenadiers are taken as bycatch, especially in hook-and-line fisheries, and nearly all are discarded, and discard mortality is 100 percent (Rodgveller et.al. 2012). If giant grenadier were included in the FMPs, reporting of catches would be mandatory resulting in more accurate catch estimates than the present estimates that are based exclusively on observer data.

[7] The term "longline" is used herein as a quote, or when part of a title (e.g. "longline" Survey). The regulatory term for what is commonly referred to as a "longline" fishery is "hook-and-line," and "hook-and-line" will be used whenever possible in this document. This usage allows differentiation between "hook-and-line" gear and "pot" gear, the latter of which may, in some circumstances, also be attached to a "longline."

1.2 History of this Action

Prior to the implementation of Amendment 8 to the GOA groundfish FMP on November 1, 1980, grenadiers were managed as an FMP species. Amendment 8 established four species categories: unallocated, target, other, and non-specified. Amendment 8 placed grenadiers in the non-specified category. Non-specified species were defined as a residual category of species and species groups of no current or foreseeable economic value or ecological importance, which are taken in the groundfish fishery as incidental catch and are in no apparent danger of depletion, and for which virtually no data exists that would allow population assessments. As non-specified species, no stock assessments are required and OFLs, ABCs, and TACs were not established as part of the annual harvest specifications in either the BSAI or GOA. There are no limits on their catch or retention, no reporting requirements, and no official record of their catch and disposition.

The Council formed its Non-Target Species Committee in 2003, initially tasking it to 1) identify efficient methods for monitoring non-target catch, 2) improve abundance estimates of non-target catch, and 3) develop harvest recommendations that build sustainable populations of non-target species. At that time, grenadiers were listed in the BSAI and GOA as non-specified species. The committee initially focused its attention on the species in the "other species" category (consisting of sharks, skates, sculpins, and octopus in the BSAI, and sharks, squids, sculpins, and octopus in the GOA) and Tier 6 species. The Council initiated action in June 2008 to move grenadiers from the non-specified category to the target category based on recommendations from the Groundfish Plan Teams, SSC, and Non-Target Species Committee. Due to time constraints in implementing provisions of the reauthorized Magnuson-Stevens Act of 2006 and the revision of National Standard 1(NS1) guidelines in 2009, the Council deferred action on grenadiers in 2011.

The reauthorized MSA strengthened provisions to prevent and end overfishing and rebuild depleted fisheries. NMFS proposed revisions to NS1 guidelines at 50 CFR 600.310, to integrate these new requirements intended to reduce overfishing with existing provisions related to overfishing, rebuilding overfished stocks, and achieving optimum yield. On January 16, 2009, NMFS issued final guidelines for NS1 (74 FR 3178).

The Magnuson-Stevens Act requires that each regional fishery management council develop annual catch limits (ACLs) and accountability measures (AMs) for each of its managed fisheries designated as being in the fishery, such that each FMP under its jurisdiction has a mechanism for specifying ACLs at a level that overfishing does not occur in the fishery. In order to comply with the provisions of the MSA, NMFS issued a final rule to implement Amendments 95 and 96 to the BSAI groundfish FMP, and Amendment 87 to the GOA groundfish FMP (75 FR 61639, October 6, 2010). These amendments revised the FMPs to meet NS1 guidelines for ACLs and AMs and removed the "other species" and the "non-specified species" categories from the FMPs. The major taxonomic groups with similar life histories from the "other species" category (sharks, skates, octopus, and sculpins in the BSAI and sharks, squid, octopus, and sculpins in the GOA) were moved as species groups to the "in the fishery" category. The amendments originally included alternatives that would have moved grenadiers to either "in the fishery" or "ecosystem component" categories, but these alternatives were not carried forward when the final amendments were approved. Prohibited species (which include salmon, steelhead trout, crab, halibut, and herring) and forage fish (as defined in Table 2c to part 679 and section 679.20(i)) in both the BSAI and GOA were designated as "ecosystem components" in the FMPs. Existing management measures to conserve these stocks (such as no retention of prohibited species and the maximum retainable amount of 2 percent for forage fish) were retained for these stocks as "ecosystem components."

2 Description of Alternatives

The National Environmental Policy Act (NEPA) requires that an EA analyze a reasonable range of alternatives consistent with the purpose and need for the proposed action. The primary focus of this chapter is to (1) describe the alternatives, (2) compare the alternatives, and (3) discuss the alternative considered and eliminated from detailed study. The alternatives in this chapter were designed to accomplish the stated purpose and need for the action. The two action alternatives were designed to federally manage grenadiers.

The alternatives evaluated in this analysis modify the set of alternatives adopted by the Council in June of 2012. These alternatives retain the critical elements of the June 2012 set; however, they have been reorganized to reflect a logical progression of management complexity. The action alternatives considered would include grenadiers in the FMPs either as "ecosystem component" species or as "in the fishery" as a potential target species group. The alternatives also now apply separately at the FMP level: an alternative will need to be selected for the BSAI FMP and for the GOA FMP. This analysis incorporates reorganizations to the alternatives to clarify the specific alternative management measures. This reorganization does not alter the substance of the alternatives proposed by the Council in June 2012. The reorganized alternative set greatly enhances differentiation between the potential effects of the alternatives within each region. In addition, separating the actions by FMP allows the Council to adopt different approaches in each region while maintaining analytical clarity. Via its December 2012 grenadier management motion, the Council clarifies that it supports this reorganized suite of alternatives and provided further direction on this analysis.

Under both the action alternatives, grenadier species are aggregated due to a lack of data necessary to manage the species separately. Giant grenadier are by far the most common grenadier caught in the fisheries and surveys off Alaska and are used as a proxy for the entire grenadier complex in the grenadier stock assessment. Popeye and Pacific grenadiers do not commonly occur in the surveys and are seldom caught in the commercial fisheries because they inhabit depths greater than where the commercial fisheries occur and at depths infrequently sampled by the surveys. Thus, under Alternative 3, a grenadier OFL and ABC would continue to be based on biomass and maturity estimates for giant grenadiers, only, as a proxy for the grenadier complex. The immediate advantage of grouping all grenadier species together in the alternatives is the added improvement of catch accounting and disposition estimates of popeye and Pacific grenadier.

This chapter discusses the management measures needed to implement each of the alternatives. The management measures are also summarized in Table 2-1 below. These measures are of great importance to understanding the potential effects of the alternatives.

One complicated aspect of groundfish management applicable to the decision between managing grenadiers "in the fishery" or as an ecosystem component is the application of maximum retainable amounts (MRAs). MRAs are a management tool used to slow catch of a species so that catch can be managed up to but not over the TAC by the end of the year. MRAs apply at the vessel level when a groundfish species is closed for directed fishing. The MRA is the percentage of the retained catch of a species closed for directed fishing (incidental catch species) to the retained catch of a species open for directed fishing (basis species). A directed fishery closure limits the allowable retention of the incidental catch species. However, MRAs do not require a vessel to retain a species or lower discard rates. For MRA calculations, groundfish and non-groundfish species may be basis species, but only groundfish species may be incidental catch species.

Beyond management of a TAC to obtain optimum yield, MRA calculations perform additional functions. The MRAs can be set at a percentage that limits retention to species' expected or accepted incidental catch rate. Also, the MRA can be set at a higher percentage that allows for limited targeting of a species up to the MRA ("topping off"). For several incidental/basis species combinations, the use of low MRA rates may reduce the incentive for topping off that would occur in the absence of this tool. In these cases, the MRAs represent the expected catch of an incidental species absent deliberate action by the vessel operator to maximize that incidental catch. The requirement to not exceed MRA proportions at any time during a trip limits the vessel operators' ability to maximize catch. This restriction is used to limit total catch of species with low TACs (relative to the species caught in the open directed fisheries), at greater risk of being caught in excess of the overfishing level, and of high value. For other species where restricting catch to an incidental rate is not a consideration, regulations establish a default MRA rate of 20 percent. Current regulations establish in many groundfish fisheries a relatively high MRA for particular species. For example, the highest MRA is 35 percent for arrowtooth flounder as an incidental species is applied to species open for directed fishing as a basis species. A higher MRA would allow for increased indirect targeting on a species.

2.1 Alternative 1: No Action (Status Quo)

Under this alternative, grenadiers are not federally managed and are not included in the groundfish FMPs. Directed fishing is not prohibited and there are no catch or retention limits for grenadiers, and unlimited amounts may be taken and sold. There are no reporting or recordkeeping requirements for grenadiers, and currently the best estimate of catch comes from observer data. Vessels which have a Federal Fisheries Permit may use their retention of grenadiers as basis species for the retention of other groundfish up to the maximum retainable amounts listed in Tables 10 and 11 to 50 CFR 679, for the GOA and BSAI.

Alternative 1 Management Measures:

Under Alternative 1, NMFS has no catch limitations or any recordkeeping or mandatory reporting requirements for grenadiers. Grenadier species are listed as non-FMP species in 50 CFR part 679 Table 2d, and harvest recording (e.g. logbooks, e-landings) of such species is optional. Observer program data collection would continue to be used to estimate incidental catch of grenadiers. Under Alternative 1, nothing prevents "unmanaged targeted fishing" for grenadiers should such a fishery develop, and such fishing would not be subject to federal management; however, observer data collection and estimation of incidental catch of grenadiers would continue.

Grenadiers as a basis species for MRAs

In past years there has been minimal effort to directed fish for and retain grenadiers as a basis species to retain more valuable groundfish species closed for directed fishing. Without a directed fishery, the incidental catch of groundfish species in a directed fishery for grenadiers (basis species) is not known. However, it is expected that directed fisheries for species with high incidental catch of grenadiers also would have high incidental catch in a grenadier directed fishery. The status quo MRAs would allow continued use of grenadiers as a basis species. The current MRAs for grenadiers as a basis species are found in 50 CFR part 679 Tables 10 and 11 under the basis species category for "aggregated amount of non-groundfish species". The definition of "aggregated amount of non-groundfish species" is found in the footnotes in Tables 10 and 11 as all legally retained species of fish and shellfish, including CDQ halibut and IFQ halibut that are not listed as FMP groundfish in Tables 2a and 2c to this part. The MRAs in Tables 10 and 11, for grenadiers as the basis species and for most groundfish species as incidental catch species are 20 percent. Some groundfish species as incidental catch species have lower MRAs. In both areas, the MRAs for Greenland turbot and sablefish are 1 percent, aggregated rockfish are 5 percent, and arrowtooth and Kamchatka (BSAI only) flounder are 35 percent. Some groundfish species as incidental catch species have different MRAs by area. The BSAI has a separate MRA for shortraker and

rougheye rockfish combined as 2 percent and the GOA Southeast Outside District has a separate MRA for demersal shelf rockfish for catcher/processors as 10 percent.

Grenadiers as an incidental catch species for MRAs.
Since grenadiers currently are not in the FMPs there are no MRAs for grenadiers as an incidental catch species.

2.2 Alternative 2, Preliminary Preferred Alternative: Include grenadiers in the FMP as an Ecosystem Component species.

This alternative would manage grenadiers in ecosystem component category under the FMP. According to the National Standard 1 guidelines, in order to be designated as an "ecosystem component" (EC), the species or species group should be

- a non-targeted species or species group;
- not subject to overfishing, overfished, or approaching an overfished condition;
- not likely[8] to become subject to overfishing or overfished in the absence of conservation and management measures; and
- not generally retained (a small amount could be retained) for sale or personal use.

According to the National Standard 1 guidelines, it is important to consider whether use of the EC species classification in a given instance is consistent with Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) conservation and management requirements. Species may be included in the FMP as an EC for any of the following reasons: for data collection and catch monitoring purposes; for ecosystem considerations related to specification of optimum yield (OY) for the associated fishery; as considerations in the development of conservation and management measures for the associated fishery; or to address other ecosystem concerns. While EC species are not considered to be "in the fishery," the Council should consider measures for the fishery to minimize incidental catch and mortality of EC species consistent with National Standard 9, and to protect their role in the ecosystem. EC species do not require specification of reference, but should be monitored as new, pertinent scientific information becomes available to determine changes in their status or their vulnerability to the fishery.

The catch of EC species is required to be reported for monitoring purposes and directed fishing for EC species is prohibited. Under the ecosystem component, targeting grenadiers would not be possible without moving them to "in the fishery" and establishing status determination criteria for these stocks. While grenadiers are currently not targeted commercially, moving them to the ecosystem component would be intended to discourage uncontrolled fishing on these species without applicable management measures in place should they become economically viable in the future. Moving a species from the EC to "in the fishery" would need to be investigated under various situations including when the industry expresses an interest in targeting grenadiers or when retention of grenadiers increases.

Based on the available information presented in Sections 2 and 3, grenadiers would meet all four of the criteria described above to qualify for inclusion as an EC species.

[8] In December of 2013, the SSC requested that the term "likely" be further defined. The context is with respect to the potential for an EC species to be found subject to overfishing or overfished. This analysis has determined that grenadiers are not presently subject to overfishing in either the BSAI or GOA (see section 3.4). This is due to the large biomass relative to fishery removals at present and that removals are far below the informal OFL. Future analysis of the likelihood of grenadiers being subject to overfishing would compare the trend of grenadier catch with trends in biomass estimates to determine whether fishery removals are increasing relative to biomass in a way that suggests that future removals may result in overfishing. If overfishing (exceeding the informal OFL estimate) appeared "likely" based on these trends then this criteria for listing a species in the ecosystem component of the FMP may no longer be met.

Alternative 2 Management Measures:

Under Alternative 2 several management measures would need to be adopted while other management measures could be, but need not be, adopted. Currently, the BSAI and GOA FMPs (in section 3.2.1 and Table 3-1) divide the EC category into two subcategories: prohibited species and forage fish species. This alternative would establish a new separate subcategory for grenadier species in section 3.2.1 and Table 3-1. FMP text that would encompass ecosystem component for grenadiers is proposed to read as follows:

> 2. Ecosystem Component:
>
> * * * * *
>
> c) Grenadiers – are those species listed in Table 3-1, which are abundant on the continental slope and have ecological importance to this habitat. The grenadier species category is established to allow for the management of these species in a manner that prevents the development of a commercial directed fishery for grenadiers. Management measures for this species category will be specified in regulations and may include such measures as prohibitions on directed fishing, limitations on allowable bycatch retention amounts, or limitations on the sale, barter, trade, or any other commercial exchange, as well as the processing of grenadier in a commercial processing facility.

Recordkeeping and Reporting Requirements.
Catch reporting (e.g. logbooks, e-landings) would be required at 679.5(a)(3) and grenadier species codes would be added to Table 2c (50 CFR part 679) Species Code: FMP Forage Fish Species (all species of the following families) *and Grenadier Species*. Table 3 to part 679 would be amended to include PRRs for grenadiers of 100 percent for whole fish, 50 percent for headed and gutted fish, and 24.3 percent for fillets (see Matsui et.al, 1990). These rates are from one of the only known food science studies of grenadiers that estimates product recovery rates. This study also indicates that fillet recovery may be as high as 28 percent; however, the more conservative estimate of 24.3 percent is included here.

Annual Harvest Specifications and Directed Fishery. OFLs, ABCs, and TACs for grenadiers would **NOT** be established; however, stock assessments may continue and are optional. Grenadiers would be closed to directed fishing year round by amending the regulations to include grenadiers in 679.20(i). Catches of grenadiers would not accrue towards the OY caps in the BSAI and GOA. While EC species do not require specification of reference points, grenadiers would be monitored as new, pertinent scientific information becomes available to determine changes in their status or their vulnerability to the fishery. An FMP amendment would be required to move grenadiers to "in the fishery," where annual harvest specifications would be required and directed fishing could be allowed.

Bycatch Management
Under Alternative 2, Table 10, GOA Retainable Percentages, and Table 11, BSAI Retainable Percentages, to 50 CFR 679 would be amended to include MRAs for grenadiers as an incidental catch species. This would allow vessels fishing for groundfish to retain a quantity of grenadiers equal to but no more than a certain percent of the round weight or round weight equivalent of groundfish species open to directed fishing that are retained on board the vessel during a fishing trip.

At final action, the Council will specify the MRA for grenadier. The Council is considering an MRA range of 2 percent to 20 percent. As the MRA increases, there is less likelihood of regulatory discards of grenadiers, and greater potential for retention if markets can be developed. A 2 percent MRA likely limits development of markets; however, the EC classification does allow retention of "a small amount"

for sale. The lower range MRA has been used in the forage fish classification, for example, with the rationale being to ban targeted fishing of these ecologically important species.

Higher MRAs would allow retention and potential utilization of grenadiers that are incidentally caught. However, evaluating vessel level effects of these MRA ranges is problematic given that current catch estimation is done using observer data and highly specialized queries of catch accounting data would be necessary to attempt to assess effects. However, an analysis of the small amount of fish ticket and production report data for 2013 shows that there was almost no reported retention of grenadiers in the BSAI (only 1 mt), no reported retention by catcher/processors in the GOA, and 55 mt of giant grenadiers were retained by catcher vessels in the GOA. This represents a GOA fishery wide retention rate of one half of one percent. Of this retention of grenadiers, 35 mt was made into fish meal, 17 mt was discarded at the dock, 3 mt was retained for bait, and less than 1 mt was sold[9]. Thus, there is no evidence that grenadiers are presently being targeted or purposely retained. It is much more likely that grenadiers are being retained only when mixed in with other catch.

Transition from "ecosystem component" species to "in the fishery."
If grenadiers are placed into the "ecosystem component" of the FMPs, formal catch monitoring (see above) would begin, which would expand on the existing catch estimates obtained through observer data. At present, an unofficial stock assessment is being conducted and this process provides an estimated OFL, which is periodically reported to the SSC and the Council via the groundfish SAFEs. Provided that the informal stock assessment continues, enhanced catch monitoring will allow continued and improved evaluation of catch relative to biomass and OFL.

As indicated in the NS1 Guidelines, species classification in the FMPs may be reviewed by the Council to determine whether changing conditions have changed the applicability of the classification criteria for a species. For example, if viable markets for grenadiers can be developed and retention and marketing, within applicable MRA limits, begins to occur then the "not generally retained for sale or personal use" and possibly the "a non-targeted species or species group" criteria leading to classification in the "ecosystem component" may no longer be valid and may imply that grenadiers would be more appropriately re-classified as "in the fishery." If such a change in criteria becomes a concern the Council could initiate an analysis of whether grenadiers can be successfully marketed and whether they meet the criteria to be classified as "in the fishery."

The Council could also consider re-classification of grenadiers to "in the fishery" if the criteria that grenadiers are "not subject to overfishing, overfished, or approaching an overfished condition" and "not likely to become subject to overfishing or overfished in the absence of conservation and management measures" are no longer met. Improved recordkeeping and reporting of catch will allow monitoring of catch that will identify changes in removals over time. If dramatically increased catch were to occur in the future, the Council could initiate analysis to determine the likelihood that grenadiers catch is creating an overfishing and/or overfished condition. If the Council determined that these criteria are no longer being met, grenadiers could be re-classified as "in the fishery."

[9] Personal communication via e-mail (November 13, 2013) with Josh Keaton, In-Season Management Staff, Sustainable Fisheries Division, NOAA Fisheries, Alaska Region.

2.3 Alternative 3: Include grenadiers in the FMP as "in the fishery."

This alternative would include grenadiers "in the fishery" as incidental catch species.

The term "in the fishery" is defined in the National Standard 1 guidelines (50 CFR 600.310). Stocks of fish that are "in the fishery" are

- stocks that are targeted, and retained for sale or personal use;
- stocks that are not directly targeted but are taken incidentally in other directed fisheries and are retained for sale or personal use; and
- stocks not targeted or retained but are taken as incidental catch and for which overfishing or overfished status may be a concern.

For each stock "in the fishery", whether a single species or species group, OFLs, ABCs, and TACs must be established each year in the annual harvest specifications process. In order for separate species to be aggregated and managed as a species group, the species should have a similar geographic distribution, life history, and vulnerability. Recordkeeping and reporting of grenadier catch would be required and other management measures discussed below would need to be adopted.

Alternative 3 Management Measures:

Under Alternative 3 several management measures would be adopted.

Record and Reporting Requirements: Grenadier species codes would be added to Table 2a, Species Codes: FMP Groundfish. Catch reporting of all grenadiers would be required, and Table 3 to part 679 would be amended to include PRRs for grenadiers of 100 percent for whole fish, 50 percent for headed and gutted fish, and 24.3 percent for fillets (rates are from published study: see Matsui et.al, 1990).

Annual Harvest Specifications and Directed Fishery.
Grenadiers would be incorporated into the annual harvest specifications process with the stock assessment reviewed by the Council's Groundfish Plan Teams and Scientific and Statistical Committee (SSC). The SSC and Council would set annual OFL, ABC, and TAC for grenadiers with the grenadier TAC being assessed in the optimum yield. TACs would be set less than or equal to the ABC, as for all groundfish. Existing accountability measures that apply to all groundfish would also apply to grenadiers. The stock assessment authors have recommended that the management areas should be the BSAI and the GOA separately without further subdivision. The harvest specifications could be subdivided between the eastern Bering Sea subarea and Aleutian Islands subarea, but this is not recommended due to the variability of biomass estimates in the Aleutian Islands subarea. Combining the Aleutian Islands biomass estimates with the eastern Bering Sea biomass estimates reduces the variability of the overall biomass estimate.

The Council would have considerable flexibility in setting the TACs. TACs could be set minimally at a level anticipated to meet incidental catch needs in other directed fisheries. At this TAC level grenadiers would be closed to directed fishing (bycatch status only). Also, grenadier would have the least impact on other groundfish TACs in the BSAI which has an optimum yield (OY) cap of 2 million mt. TACs could be set at higher levels than incidental catch needs, which would allow for a directed fishery targeting grenadiers. At present, incidental catch meets the industry need for experimental processing, and marketing of grenadiers and is well below ABC recommendations (Section 3.3). Additionally, in the BSAI only, NMFS would have to determine, as part of the harvest specifications process, if a directed fishery exits for the purposes of the CDQ allocation under 679.20(b)(ii)(D)(2).

NMFS could open a directed fishery provided the Council recommends and the Secretary approves a TAC above incidental catch needs. A directed fishery would also require amending the MRA regulations to set a new MRA that provides for directed fishing.

Bycatch Management
Grenadiers as a basis species for MRAs
Table 10, GOA Retainable Percentages, and Table 11, BSAI Retainable Percentages, to 50 CFR part 679 would be amended to include an MRA for grenadiers as a basis species and as an incidental catch species. As a basis species, a grenadier MRA at zero would prevent vessels from using grenadiers (a species currently for which no market exists) as a basis species for retention of more readily marketable, valuable species. Currently, grenadiers are not pursued as a target fishery. However, if a market for grenadier develops in the future then the economic incentive for vessels to target grenadiers will likely increase. Under a zero MRA, this potentially could result in higher regulatory discards of valuable incidental catch species. If grenadiers become marketable and a directed fishery develops then the Council would need to increase MRAs for grenadiers as the basis species. This would require rulemaking.

In the BSAI, the Amendment 80 fleet would be required to meet Improved Retention and Improved Utilization rules at 50 CFR 679.27(b) and (c). These regulations require an owner or operator of an Amendment 80 trawl catcher/processor in the BSAI to retain on board until lawful transfer a primary product from grenadiers brought on board the vessel, if directed fishing for grenadiers is open. If directed fishing for grenadiers is prohibited then it requires a primary product from all grenadiers brought on board the vessel up to the point that the round-weight equivalent of primary products on board equals the MRA for grenadiers.

Grenadiers as incidental catch species for MRAs
Table 10, GOA Retainable Percentages, and Table 11, BSAI Retainable Percentages, to 50 CFR part 679 would also be amended to include MRAs for grenadiers as an incidental catch species when closed to directed fishing but retention is not prohibited. Several directed fisheries incur high grenadier incidental catch rates: IFQ halibut, sablefish, Greenland turbot, and flatfish. A low MRA may result in regulatory discards. However, currently grenadiers are not marketable and 100 percent are discarded. Therefore, the Council may want to set a higher MRA for grenadiers of 35 percent in these directed fisheries to allow for increased retention if a market develops for grenadiers.

Prohibited Species Catch (PSC) limits. Grenadiers would be included in an existing PSC limit fishery category. In the BSAI grenadiers would be included in the trawl Greenland turbot/arrowtooth flounder/Kamchatka flounder/sablefish fishery category and for other gear types in the non-trawl fisheries. In the GOA grenadiers would be included in the trawl deep-water species fishery and for the hook-and-line fishery the "other hook-and-line fishery" category.

Essential Fish Habitat.

As an "in the fishery" species, the Council would need to amend the FMP to identify and describe Essential Fish Habitat (EFH) for grenadiers. Grenadier EFH could be described and identified as part of the five year EFH update cycle undertaken by the Council.

2.4 Comparison of Alternatives

The NS1 guidelines include suggested classifications of ''stocks in the fishery'' and ''ecosystem component (EC) species.'' See Figure 2-1 for diagram of classifications. The classifications in the NS1 guidelines are intended to reflect how FMPs have described ''fisheries,'' and to provide a helpful framework for thinking about how FMPs have incorporated and may continue to incorporate ecosystem

considerations. To that end, the NS1 guidelines describe the fact that FMPs typically include certain target species, and sometimes certain non-target species, that the Councils and/or the Secretary believed required conservation and management. In some FMPs, Councils have taken a broader approach and included hundreds of species, many of which may or may not require conservation and management but could be relevant in trying to further ecosystem management in the fishery.

NMFS wants to encourage ecosystem approaches to management, thus it proposed the EC species as a possible classification a Council or the Secretary could—but is not required to—consider. The final NS1 guidelines do not require a Council or the Secretary to include all target and non-target species as ''stocks in the fishery,'' do not mandate use of the EC species category, and do not require inclusion of particular species in an FMP. The decision of whether conservation and management is needed for a fishery and how that fishery should be defined remains within the authority and discretion of the relevant Council or the Secretary, as appropriate. NMFS presumes that stocks or stock complexes currently listed in an FMP are ''stocks in the fishery,'' unless the FMP is amended to explicitly indicate that the EC species category is being used. ''Stocks in the fishery'' need status determination criteria, other reference points, ACL mechanisms and AMs; EC species would not need them.

Figure 2-1: General Framework for "Stocks in the Fishery" versus "Ecosystem Component Species." This figure describes the kind of stocks or stock complexes that might fall into the two classifications, but should not be viewed as requiring FMPs to include specific species or stock complexes in their category (source: Overview of Major Aspects of the Final Action implementing National Standard 1 Guidelines revisions (74 FR 3179)

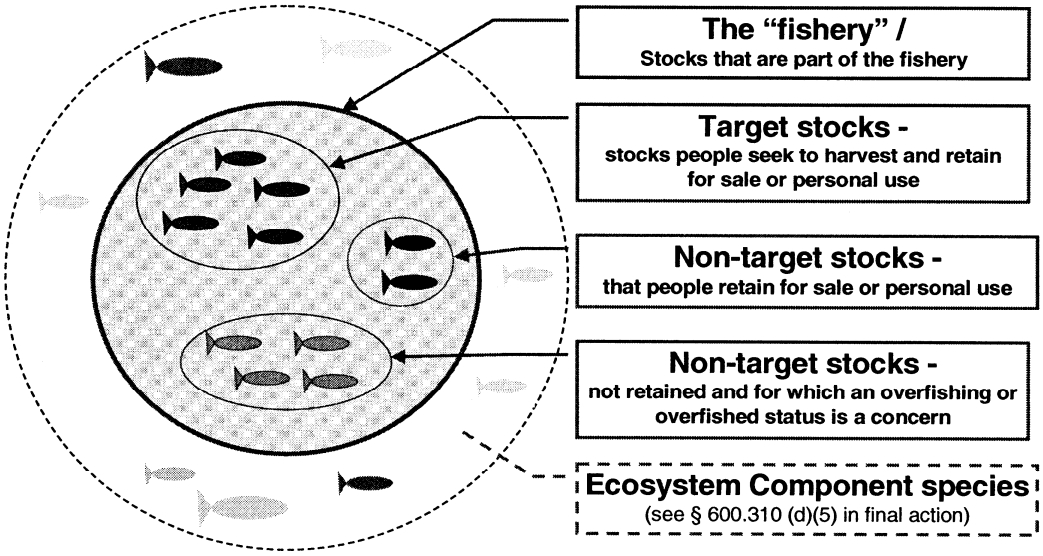
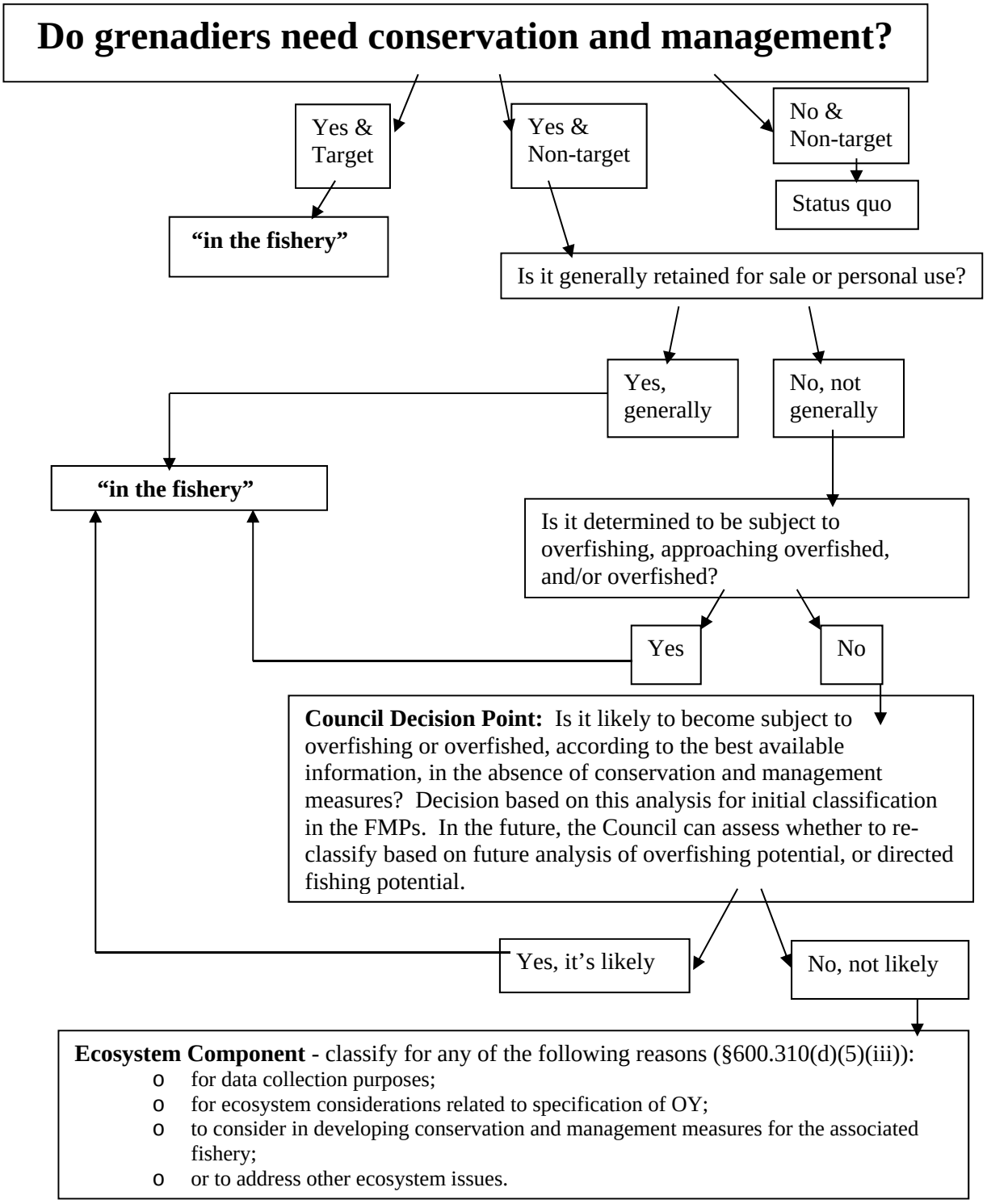


Table 2-1: Summary of Management Measures in Alternative 2 and 3

Management Measure	Alt 2 - Ecosystem Component	Alt. 3 - "In the Fishery"
Recordkeeping and Reporting	**Yes** - require catch reporting - add grenadiers to Table 2c Species Code: FMP Forage Fish *and Grenadiers*.	**Yes** - require catch reporting - add grenadiers to Table 2a, Species Codes: FMP Groundfish
Product Recovery Rates (PRR)	**Yes** - add PRRs (whole 100%, headed and gutted 50% and fillet 24.35%) for grenadiers to Table 3. (Matsui et.al, 1990)	**Yes** - add PRRs (whole 100%, headed and gutted 50% and fillet 24.35%) for grenadiers to Table 3. (Matsui et.al, 1990)
Annual Harvest Specifications	**No** - stock assessment optional - catch not assessed in optimum yield	**Yes** - incorporate grenadiers into the annual harvest specifications - stock assessment reviewed by plan team and SSC - SSC/ Council set annual OFL, ABC, and TAC - assess grenadier TAC/catch in optimum yield - apply existing accountability measures to grenadiers - *BSAI* - CDQ allocation, if directed fishery exits, 679.20(b)(ii)(D)(2)
Bycatch Management	**Yes** - MRA as incidental catch species = 2% (same as forage fish) to 20% (many other groundfish) - grenadiers cannot be used as a basis species - add grenadiers to Table 10 GOA Retainable Percentages, Table 11 BSAI Retainable Percentages as incidental catch species - Council could recommend any additional management measures to minimize grenadier bycatch in the groundfish, halibut, or sablefish fisheries	**Yes** - MRA as basis species = 0 - MRA as incidental catch species = 35% - add grenadiers as a basis species and as an incidental catch species in Table 10 GOA Retainable Percentages, Table 11 BSAI Retainable Percentages - include grenadier in an existing PSC category - *BSAI* - IR/IU for Amendment 80 C/Ps
Prohibit A Directed Fishery	**Yes** - prohibit directed fishing in regulations at 679.20(i) Forage Fish *and Grenadiers*	**Yes** - prohibit directed fishery through 679.20(d) Fishery Closures
Open A Directed Fishery	**No** - requires an FMP amendment to move grenadiers to "in the fishery"	**Yes** - open a directed fishery if TAC is set to support over incidental catch needs - amend MRAs in regulations
Essential Fish Habitat (EFH)	**No**	**Yes** - describe and identify EFH for grenadiers

Figure 2-2: Decision-tree: "In the Fishery" vs. "Ecosystem Component" classification



In December of 2013, the SSC made the following comment regarding the version of this decision tree that appeared in the Initial Review Draft of this document:

> *The SSC notes that the decision tree in Figure 2-1 does not accurately portray potential actions by the Council. In some cases decisions are clearly binary but in most cases the decisions faced by the Council are probabilistic in nature where the analysts are weighing the costs and benefits of the action. The decision tree should be modified to reflect this reality; in particular the SSC is referring to the decision point about the likelihood of a stock becoming subject to overfishing or overfished according to the best available information, in the absence of conservation and management measures.*

As the SSC notes, some decisions are binary. These would include whether the species is in a target fishery and may include whether it is generally retained for sale or personal use. If only a small amount is retained, as is the case with grenadiers at present, then grenadiers are not "generally" retained for sale or personal use. The analysis of whether grenadiers are presently subject to overfishing, approaching overfished, and/or overfished is contained herein and largely based on the results of the informal stock assessment presently being conducted. This analysis has determined that grenadiers are not presently subject to overfishing or overfished in either the BSAI or GOA (see section 3.4), and not likely to become subject to overfishing, approaching overfished, and/or overfished in the foreseeable future. This is due to the large grenadier biomass relative to fishery removals at present and that removals are far below the informal OFL. Further, past attempts to develop markets for grenadier products have been unsuccessful and there is no indication from industry that any attempts are being made at present. Future analysis of the likelihood of grenadiers being subject to overfishing and/or overfished would compare the trend of grenadier catch with trends in biomass estimates to determine whether fishery removals are increasing relative to biomass in a way that suggests that future removals may result in overfishing. If overfishing (exceeding the informal OFL estimate) appeared "likely" based on these trends then this criteria for listing a species in the ecosystem component of the FMP may no longer be met and reclassification may be in order.

2.5 Alternatives Considered but not Analyzed Further

The Council is not considering an alternative that would explicitly require that NMFS open a directed fishery for grenadiers. Under Alternative 3, the Council can recommend that NMFS open a directed fishery in the future, but only after taking action to change the grenadier basis species MRA and set a TAC. These actions would be based on best available information gathered under the improved reporting requirements under Alternative 3.

No additional reasonable alternative have been identified that meet the proposed action's purpose and need.

3 Environmental Assessment

This section evaluates the impacts of the alternatives on grenadiers, target groundfish, and the ecosystem. Information with which to understand the affected environment for grenadiers is summarized in the following subsections. If significant impacts are likely to occur, preparation of an environmental impact statement (EIS) is required. Although an EIS should evaluate economic and socioeconomic impacts that are interrelated with natural and physical environmental effects, economic and social impacts by themselves are not sufficient to require the preparation of an EIS (see 40 CFR 1508.14).

Analysis of the potential cumulative effects of a proposed action and its alternatives is a requirement of the National Environmental Protection Act (NEPA). An environmental assessment or environmental impact statement must consider cumulative effects when determining whether an action significantly affects environmental quality. The Council on Environmental Quality (CEQ) regulations for implementing NEPA define cumulative effects as:

> *"the impact on the environment, which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR 1508.7*).

The discussion of past and present cumulative effects is addressed with the analysis of direct and indirect impacts below. The cumulative impact of reasonably foreseeable future actions is addressed in Section 3.7.

Because of the limited potential for impacts from the proposed action, the effects analysis is limited to grenadiers, target groundfish, and the ecosystem. The proposed action is focused on how best to apply federal conservation and management to grenadiers. However, none of the alternatives would change the fact that there is no fishery for grenadiers. None of the alternative would change how the groundfish fisheries are managed. No changes in overall amount, timing, or location of harvest of groundfish are expected under the alternatives being considered. Table 3.1 shows the components of the human environment and whether the proposed action or its alternative may have an impact on the component and require further analysis. Extensive environmental analysis on all environmental components is not needed in this document because the proposed action is not anticipated to have environmental impacts on any other environmental components. Analysis is included only for grenadiers, groundfish, and the ecosystem, the only environmental components which the proposed action is predicted to impact.

Table 3-1: Resources potentially affected by the proposed action and alternatives.

Habitat	Ecosystem	Grenadiers	Marine Mammals	Seabirds	Groundfish	Ecosystem Component Species
N	Y	Y	N	N	Y	N

N = no impact anticipated by each alternative on the component.
Y = an impact is possible if each alternative is implemented.

The Action Area

The action area includes the entire BSAI and GOA management areas. The documents listed below contain extensive information about the fishery management areas, fisheries, marine resources,

ecosystem, social, and economic elements of the BSAI and GOA groundfish fisheries. Rather than duplicate an affected environment description here, readers are referred to these documents. This is a partial listing of NEPA documents that have been prepared for BSAI and GOA fishery management measures. Internet links to these documents, as well as a comprehensive list of NEPA documents that have been prepared by NMFS Alaska Region and the Council are at http://www.alaskafisheries.noaa.gov/cm/analyses/default.aspx.

***Alaska Groundfish Harvest Specifications Final Environmental Impact Statement* (NMFS 2007)**. This EIS provides decision makers and the public with an evaluation of the environmental, social, and economic effects of alternative harvest strategies for the federally managed groundfish fisheries in the GOA and BSAI management areas. The EIS examines alternative harvest strategies that comply with Federal regulations, the BSAI groundfish FMP, and the Magnuson-Stevens Act. These strategies are applied to the best available scientific information to derive the TAC estimates for the groundfish fisheries. For more information, see the Final Harvest Specifications EIS and related documents at http://alaskafisheries.noaa.gov/analyses/specs/eis/default.htm.

***Stock Assessment and Fishery Evaluation (SAFE) Reports for the Groundfish Resources of the Bering Sea and Aleutian Islands, and Gulf of Alaska* (NPFMC 2010a and b, 2011a and b, 2012a and b, 2013 a and b).** Annual SAFE reports contain a review of the latest scientific analyses and estimates of each BSAI and GOA species' biomass, and other biological parameters. This includes the acceptable biological catch specifications used by NMFS in the annual harvest specifications. The SAFE reports also include summaries of the available information on the BSAI and GOA ecosystem and the economic condition of the groundfish fisheries off Alaska. These documents are available from the Alaska Fisheries Science Center (AFSC) website at: http://www.afsc.noaa.gov/RFA /stocks/assessments.htm.

***Alaska Groundfish Fisheries Final Programmatic Supplemental Environmental Impact Statement* (Final PSEIS; NMFS 2004)**. This Final PSEIS was prepared to evaluate the fishery management policies embedded in the BSAI and GOA groundfish FMPs, against policy-level alternatives. NMFS issued a Record of Decision for the Final PSEIS on August 26, 2004, effectively implementing a new management policy that is ecosystem-based, and more precautionary when faced with scientific uncertainty. The Final PSEIS serves as the primary environmental document for subsequent analyses of environmental impacts on the groundfish fisheries. Chapter 3 of the Final PSEIS provides a detailed description of the affected environment, including extensive information on fishery management areas, marine resources, and marine habitat in the North Pacific Ocean. For more information, see the Final PSEIS and related documents at http://www.alaskafisheries.noaa.gov/sustainablefisheries/seis/default.htm.

3.1 Grenadier Biology and Life History

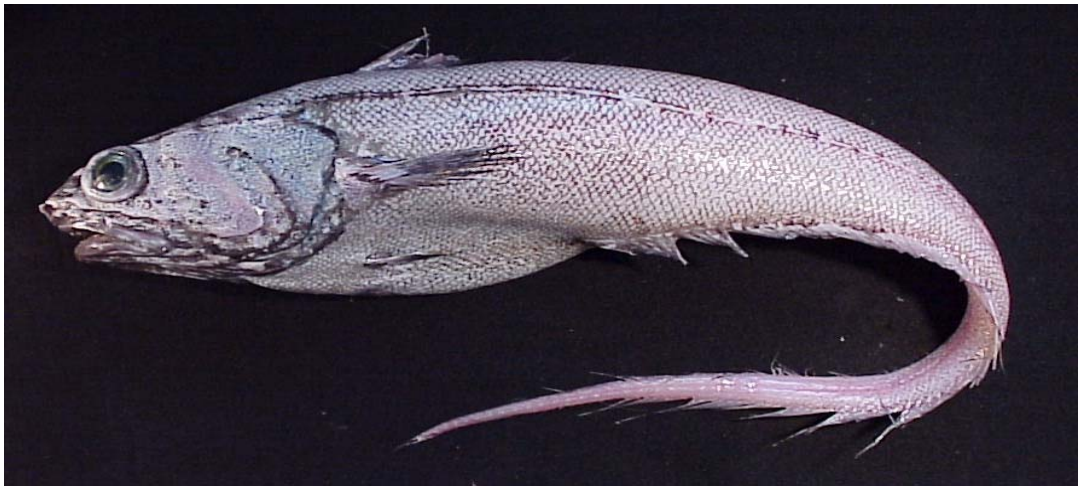


Figure 3-1 Giant grenadier

Giant Grenadier

Distribution, abundance, and ecology: Giant grenadier range from Baja California, Mexico, around the arc of the north Pacific Ocean to Japan, including the Bering Sea and the Sea of Okhotsk (Mecklenburg et al. 2002), and are also found on seamounts in the Gulf of Alaska, and on the Emperor Seamount chain in the North Pacific (Clausen 2008). Giant grenadier have the shallowest depth distribution of all grenadiers caught in the EEZ off Alaska, the largest apparent biomass, and the largest body size (see Figure 3-1) of all grenadiers. They are the most abundant species, overall, on the continental slope in the eastern Bering Sea and the GOA from 200 m to 1,000 m (von Szalay et al. 2008; Hoff and Britt 2011). In Alaska, they are especially abundant on the continental slope, in waters greater than 400 m depth. Bottom trawl and hook-and-line surveys, as well as fishery samples indicate that females and males have different depth distributions, with females comprising the great majority of the catch at depths less than 800 m.

Small, juvenile and larval fish less than approximately 15 cm to 20 cm pre-anal fin length (PAFL) are absent from bottom trawl catches, so juveniles may be pelagic in their distribution. Since they are not caught, there is no information on their early life history. PAFL is defined as the distance between the tip of the snout and the insertion of the first anal fin ray, since grenadiers have long, fragile tails that are frequently broken off when caught. Measurements of bomb radiocarbon were used in an attempt to validate aging techniques, but there was no evidence of radiocarbon in otoliths, indicating that grenadier spend little or no time near the surface, even as larvae or juveniles.

Adults are often found in close association with the bottom, as evidenced by their large catches in bottom trawls and bottom hook-and-line gear. However, studies on the food habits of giant grenadier have found that they feed primarily on species found in the water column (Drazen et al. 2001; Yang 2003; Yang et al. 2006). Sablefish hook-and-line fishermen report that their highest catches of giant grenadier often occur when the line has been inadvertently "clothes-lined" between two pinnacles, rather than set directly on the bottom. If giant grenadier do move off-bottom, some of the population may be unavailable to the bottom trawl, so biomass may be even greater than estimates from trawl surveys.

Predators: Pacific sleeper sharks (*Somniosus pacificus)* and Baird's beaked whales (*Berardius bairdii*) are predators of giant grenadier (Orlov and Moiseev 1999; Walker et al. 2002). Sperm whales (*Physeter macrocephalus*) are also likely predators of giant grenadier, since there is evidence of them depredating on hook-and-line catches of grenadier on the Alaska Fisheries Science Center's (AFSC's) annual Alaska Longline Survey.

Maturity and age*:* Grenadiers are long-lived and late to mature. In a recent age-at-maturity study of females, the oldest fish was 58 years and the age and length at which 50 percent of the females were mature was 23 years and 26 cm PAFL, much older than most other groundfish (Rodgveller et al. 2010). Length frequency distributions for giant grenadier in the commercial fishery, and size composition data for the AFSC Longline Surveys, show that only fish greater than 20 cm PAFL are taken by hook-and-line gear and pots, and relatively few fish less than 25 cm PAFL are caught; therefore, mature fish likely comprise the majority of the giant grenadier catch (see Figure 3-8 for an example of the relative size of giant grenadier).

Spent, resting, maturing, and immature fish were all found during the summer months in the Gulf of Alaska. Thus, the spawning period is thought to be protracted and may even extend throughout the year (Rodgveller et al. 2010).

Speciation: In a recent study of age-at-maturity of giant grenadier (Rodgveller et al. 2010) different otoliths shapes were observed among fish. There are no other known cases of otolith shape varying to this degree within a species. In 2013, tissue and otolith samples will be collected on the AFSC Longline Survey for an analysis of speciation, stock structure, and otoliths morphometrics. Fish will be sampled from the Bering Sea, western GOA, and the eastern GOA.

Popeye and Pacific Grenadier

Figure 3-2 Giant (top) and Pacific (bottom) grenadier

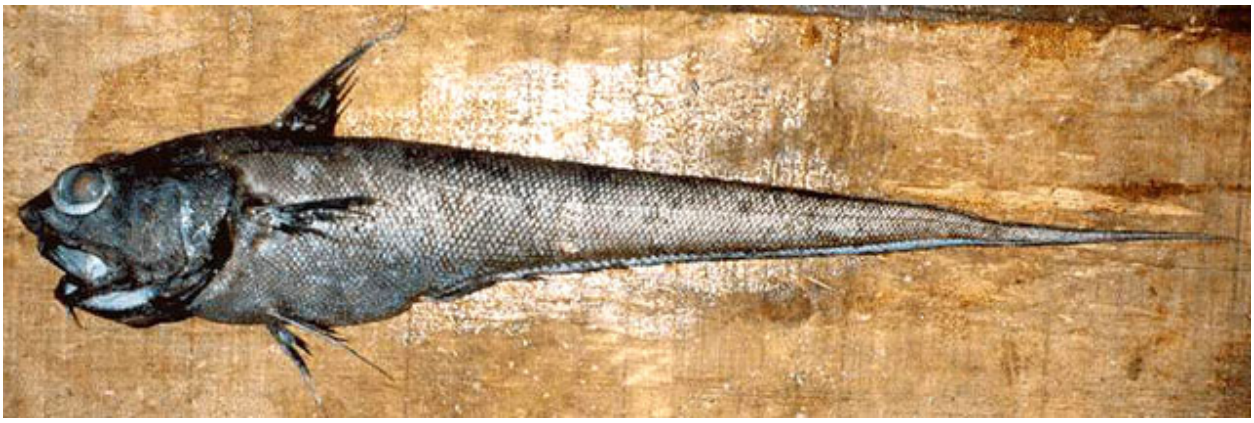


Figure 3-3 Popeye grenadier

Figure 3-4 Popeye grenadier (photo by Jerry Hoff, AFSC trawl survey)

Distribution, abundance, and ecology: Pacific grenadier (shown in Figure 3-2) have a geographic range nearly identical to that of giant grenadier, i.e., Baja California, Mexico, to Japan. Popeye grenadier (see Figure 3-3 and Figure 3-4) range from Oregon to Japan. Generally, Pacific grenadier and popeye grenadier are found in deeper water than giant grenadier; they appear to be most abundant in waters greater than 1,000 m, which is deeper than virtually all commercial fishing operations and fish surveys in Alaska. Popeye grenadier are caught in greater numbers than Pacific grenadier, however, giant grenadier comprise approximately 90 percent to 96 percent of the aggregate grenadier biomass. Pacific grenadier may be more prevalent at deeper depths. For example, in a recent experimental hook-and-line haul in the western Gulf of Alaska at a depth of 1,400 m to 1,500 m, 56 percent of the hooks caught Pacific grenadier. This indicates that, at least in some locations in deep water, abundance of Pacific grenadier in Alaska can be extremely high. Few popeye grenadier are caught on hook-and-line gear, apparently because of the relatively small size of these fish; most of the information on this species comes from trawling. Food studies off the U.S. West Coast indicate that Pacific grenadier are more benthic in their habitat than are giant grenadier.

Maturity and age: The maximum age of Pacific grenadier has been estimated at 56 years to 73 years from reading otoliths (Matsui et al. 1990; Andrews et al. 1999). Ripe, female Pacific grenadier have been documented off Oregon in the spring and fall, so like many other grenadiers and deep-sea fishes, they likely have a protracted spawning season.

3.2 Stock Assessment for Grenadiers

3.2.1 Tier 5 Calculations

Full assessment reports were prepared in even years starting in 2006 (Clausen 2006; Clausen and Rodgveller 2008; 2010; Clausen and Rodgveller 2011, Rodgveller and Clausen 2012). Because grenadiers are non-FMP species, these reports are considered unofficial and have been included as appendices in the standard Stock Assessment and Fishery Evaluation (SAFE) reports.

At present, stock assessment information for giant grenadier is relatively good compared to many other non-target species off Alaska. Since 2010, ABC and OFL recommendations have been based on Tier 5 computations, since reliable estimates of biomass are available, as well as an estimate of natural mortality (*M*). These computations have been based on giant grenadier only, and have excluded the other grenadier species because virtually none of the other species are caught in the commercial fishery, and relatively few are taken in fish surveys. Therefore, in the Tier 5 determinations, as previously noted, giant grenadiers have served as a proxy for the entire grenadier group. To estimate acceptable biological catch (ABC) for Tier 5, *M* is multiplied by the biomass in each region. Overfishing levels (OFL) are computed by multiplying the ABC by 0.75.

3.2.2 Survey and Fishery Data Reported in the Assessment

Biomass estimates are obtained from trawl surveys on the slope in the Aleutian Islands, Bering Sea, and GOA. The biomass estimates indicate that sizeable populations of giant grenadier are found in each of the three regions surveyed, but the survey time series of depths down to 1,000 m are too intermittent to show any trends in abundance. Estimates of biomass are relatively precise for giant grenadier (approximately 10 percent coefficient of variation) compared with those of many other groundfish species. This demonstrates that giant grenadier have a uniform distribution within each sampled strata. The Aleutian Islands trawl survey has not sampled deeper than 500 m since 1986, so an indirect method is used to estimate abundance. Biomass estimates are in the same order of magnitude in the Aleutian Islands, eastern Bering Sea, and GOA. The average biomass from the last three surveys is 553,557 mt in the eastern Bering Sea, 598,727 in the Aleutian Islands, and 597,884 in the GOA. Highest trawl survey catches in the GOA occur between 500 m and 700 m. In the eastern Bering Sea, they are typically more common from 400 m to 1,000 m. There are more large fish in the eastern Bering Sea than in the GOA. Length data is sparse in the Aleutian Islands, since the trawl survey only samples to 500 m.

One factor that could have a significant effect on the biomass estimates is the extent that giant grenadier move off the bottom into the water column. There is indirect evidence from feeding studies that giant grenadier may be semi-pelagic when searching for prey. If so, some of the population may be unavailable to the bottom trawl, which would result in an underestimate of biomass of indeterminate size.

The annual AFSC Longline Survey samples depths from 200 m to 1,000 m along the continental shelf in the Gulf of Alaska, Bering Sea, and Aleutian Islands. These data are used in calculations of biomass from 500 m to 1,000 m in the Aleutian Islands, because the trawl survey does not sample these depths. Otherwise, the survey estimates of relative abundance in weight are tracked but not used for calculations of ABC and OFL. Absolute estimates of biomass cannot be calculated because the area of attraction by the baited gear is unknown (catch per area cannot be calculated); therefore, an index of abundance in numbers and weight is used for following trends. The hook-and-line survey provides an extensive time series of lengths and relative abundance. Relative abundance of giant grenadier is highest in the Aleutian Islands, with an average of approximately 2.9 million mt; it is second highest in the Gulf of Alaska (approximately 0.9 million mt) and lowest in the eastern Bering Sea (approximately 0.6 million mt). Like

lengths taken on the trawl survey, fish caught on the hook-and-line survey in the eastern Bering Sea are larger than those in other areas.

All areas have a relatively high abundance of giant grenadier from 800 m to 1,000 m, which implies the possibility that a considerable biomass may inhabit depths greater than 1,000 m. To determine if grenadiers reside in waters deeper than 1,000 m, an experimental hook-and-line survey was conducted in the Shumagin Area. The results showed that catch rates of giant grenadier were considerably less at greater than 1,000 m than at shallower depths. Female giant grenadier were much larger in size at the deep-water stations. Also, males were much more abundant in deep water comprising as much as 42 percent of the giant grenadier catch at one station (instead of the usual 5 percent). Additional survey work needs to be done in depths greater than 1,000 m to better determine the abundance and biological characteristics of giant grenadier in these deep waters.

Beginning in 2007, data on length and sex for giant grenadier in the sablefish fishery has been collected by fishery observers. Results indicate that fish in the BSAI are larger than in the GOA, which agrees with fishery-independent surveys. There is no difference between the sizes of fish caught in pot or hook-and-line gear in the BSAI.

3.2.3 2013 Assessment Results and Recommendations for 2014 and 2015

To estimate ABC for Tier 5, the natural mortality (*M*) is multiplied by the biomass in each region. OFLs are computed by multiplying the ABC by 0.75. Catches are not approaching OFLs or ABCs. Giant grenadier serve as a proxy for the entire grenadier species group. The 2013 and 2014 grenadier assessment recommendations for the GOA and BSAI are shown in Table 3-3 and Table 3-3, respectively.

Table 3-2: 2013–2014 Gulf of Alaska grenadier stock assessment

	As specified last year for[a]:		**Recommended this year for:**	
Quantity/Status	2013	2014	**2014**	2015
M (natural mortality)	0.078	0.078	**0.078**	0.078
Specified/recommended Tier	5	5	**5**	5
Biomass	597,884	597,884	**597,884**	597,884
F_{OFL} (F=M)	0.078	0.078	**0.078**	0.078
$maxF_{ABC}$ (maximum allowable = 0.75x F_{OFL})	0.0585	0.0585	**0.0585**	0.0585
Specified/recommended F_{ABC}	0.0585	0.0585	**0.0585**	0.0585
Specified/recommended OFL (t)	46,635	46,635	**46,635**	46,635
Specified/recommended ABC (t)	34,976	34,976	**34,976**	34,976
Incidental Catch Estimate	11,218			
Is the stock being subjected to overfishing?	n/a	n/a	n/a	n/a

[a]The values for biomass, OFL, and ABC in these two columns are based on Rodgveller et al. 2012. No new biomass estimates were available in 2013 so values of OFL and ABC remain constant

Table 3-3: 2013–2014 Bering Sea and Aleutian Islands grenadier stock assessment

	As specified last year for[a]:		Recommended this year for:	
Quantity/Status	2013	2014	**2014**	2015
M (natural mortality)	0.078	0.078	**0.078**	0.078
Specified/recommended Tier	5	5	**5**	5
Biomass	1,152,284	1,152,284	**1,152,284**	1,152,284
F_{OFL} (F=M)	0.078	0.078	**0.078**	0.078
$maxF_{ABC}$ (maximum allowable = 0.75x F_{OFL})	0.0585	0.0585	**0.0585**	0.0585
Specified/recommended F_{ABC}	0.0585	0.0585	**0.0585**	0.0585
Specified/recommended OFL (t)	135,236	135,236	**89,878**	89,878
Specified/recommended ABC (t)	101,427	101,427	**67,409**	67,409
Incidental Catch Estimate	4,135			
Is the stock being subjected to overfishing?	n/a	n/a	n/a	n/a

[a] The values for biomass, OFL, and ABC in these two columns are based on Rodgveller et al. 2012.

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3.2.4 Response to December 2013, Scientific and Statistical Committee Comments.

The SSC commented that it would be useful to develop a food web for the slope regions as part of the ecosystem concerns chapter of the groundfish SAFEs. While it would be useful to develop a slope regions food web, doing so in practice would be very difficult. Diet information is available for grenadiers and sablefish; however, there is very limited data on all of the other deep slope species that grenadier and sablefish are ecologically connected to (e.g. squid, sleeper sharks, sperm whales, myctophids and bathylagids). Thus, developing a slope regions food web would require field work and not just grenadier and sablefish diet data analysis. In the absence of the necessary data, the Alaska Fisheries Science Center staff will review available data during the next groundfish stock assessment cycle[10].

The 2012 stock assessment revealed strong spatial partitioning of the sexes by depth. The SSC requests the author to estimate the sex ratio for survey biomass estimates in the assessment. The SSC requests that, if possible, the document should provide trawl and longline survey biomass estimates by sex and depth. With respect to depth, the SSC requests that the document includes a short discussion of the potential uncertainty associated with the expansion method used to estimate grenadier biomass at deeper depths in the AI.

Catch and survey abundance estimates by sex and depth are provided in the 2012 stock assessment. The primary problem with using the AI trawl survey biomass estimates for giant grenadier is that the survey does not sample deeper than 500 m; where the majority of the giant grenadier population can be found. To account for the missing biomass from the trawl survey an expansion method is needed, for which NMFS uses the AFSC longline survey data, the only survey that samples deeper than 500 m in the AI.

The primary uncertainty associated with this method centers on the use of a ratio estimator between trawl survey biomass and longline survey relative population weight (RPW). The ratio between trawl survey biomass and longline survey RPWs is assumed to be the same in shallow depths (1-500 m, for which

[10] Personal Communication, via e-mail, January 9, 2014: Kerim Aydin, Alaska Fisheries Science Center.

NMFS has trawl survey data) and deep depths (500-1000 m, for which NMFS does not have trawl survey data), an assumption that must be made due to the available data. There may be uncertainty associated with extrapolating trawl survey biomass in this manner. NMFS continues to consider other options for estimating deep-water biomass in the AI. However, it is important to present estimates of deep-water biomass so that a better reflection of the potential grenadier biomass in the AI can be presented.

In an attempt to validate this approach, future work will examine the ratios of "shallow" and "deep" trawl and longline survey data in the GOA (where trawl surveys sometimes sample to 1,000 m) to determine if the assumptions we are making with the AI expansion method are justified.

For the same reason as noted above, the SSC requests that the author estimates the sex ratio for the catch estimates in the assessment where possible. As a default, the SSC requests that the document contains an analysis of grenadier bycatch by depth. In making this and the previous comment, the SSC is striving toward a clearer understanding of the portion of the stock that is represented in the catch and the portion of the stock biomass that is assessed.

Giant Grenadier Depth Distribution by Sex

Method and Results:

Catch
Observed grenadier catch, not estimated total catch, was split by sex using sex ratios from observer specimen data, i.e., fish that had their lengths taken from 2003-2013 (Appendix Table 9-1, Figure 9-1Figure 9-1: Summed observed grenadier catch from 2003-2013, not total estimated catch, split by sex and depth strata.). This timeframe was chosen because catch estimates are available for grenadier since 2003. Length frequencies by sex, stratum, and FMP area were converted to weights using area (BS, AI, and GOA) and sex specific growth curves from AFSC trawl surveys. The percent males by weight were used to split the observed catch for the Bering Sea (BS), Aleutian Islands (AI), and the Gulf of Alaska (GOA) by stratum (Appendix Table 9-2). The same percentages were used for splitting BS and AI observed catch (Appendix Table 9-4).

Total estimated grenadier catch from the Catch Accounting System (CAS) was split by sex using sex ratios of weight from observer specimen data (Appendix Table 9-3), as described above, except a single proportion was used for all depth strata combined because catch is not available by depth from CAS. The percent male was 13% in the BSAI and 15% in the GOA.

AFSC Longline Survey
The AFSC longline survey stations are spaced systematically (~20-30 km apart) along the slope from the eastern Gulf of Alaska west to the Aleutian Islands and north into the eastern Bering Sea. At each station, depths from ~150-1000 m are sampled. Giant grenadier are caught in great numbers throughout the survey range, primarily in depths from 400-1,000 m. The Aleutian Islands are sampled in even years, the Bering Sea in odd years, and the Gulf of Alaska is sampled annually. Because the area that is sampled by the longline cannot be defined, an index of abundance in weight is calculated, called relative populating weight (RPW), but is not a measure of absolute biomass. The index is used for tracking trends in abundance.

Giant grenadier length frequencies are available since 2006. Length frequencies by sex, stratum, and area (AI, BS, GOA) were converted to weights using area and sex specific growth curves from AFSC trawl surveys. The percent males, by weight, for each depth strata and area were calculated (Appendix Table 9-4) and used to split the RPWs by sex and stratum (Appendix Table 9-5, Figure 9-2 Figure 9-1).

AFSC Gulf of Alaska Trawl Survey
The AFSC GOA trawl survey samples the continental shelf and slope where stations are randomly chosen within depth strata. Only surveys that sampled down to 1,000 m were included in this analysis (1999, 2005, 2007, and 2009); surveys in 1984 and 1987 were not included because survey methodology changed in 1996. In other years, surveys sampled down to only 500 or 700 m and are not reflective of the extent of grenadier distribution by sex.

Giant grenadier population length frequencies are available split by sex for each depth stratum. We converted these population length frequencies to weight (biomass) using sex specific growth curves from GOA trawl survey data (Appendix Table 9-6). The biomass split by sex, year, and strata, as well as the percent of giant grenadier biomass that is male, is presented in Appendix Table 9-6. For comparison to the longline survey and observed catch, the average biomass by sex and strata are shown in Appendix Figure 9-3 Bering Sea trawl survey biomass estimates spilt by sex are not currently available and will be examined in the future.

Discussion
The observed catch is primarily between depths of 201-400 m; however, this is not where the bulk of giant grenadier biomass is found (e.g., see Appendix Figure 9-2, and Appendix Figure 9-3) for AFSC longline and trawl survey data). Observer length data shows that the percent of the catch that is male, by weight, increases with depth in the GOA, but there is the opposite trend in the BSAI. Although, the decreasing trend in male abundance is not dramatic in the BSAI and sample sizes for several depths strata are small. Due to small sampled sizes, the apparent trend in the BSAI may not be representative of the true distribution of giant grenadier.

There is a much greater proportion of male grenadier in the catch data compared to the longline survey. This could be partially explained by the diverse gear types in the fisheries that incidentally catch grenadier; however, a large proportion of the observed grenadier catch is from longline fisheries. The difference between the proportion of males in longline survey and fishery could also be attributed to seasonal variation in depth distribution. The longline survey takes place only in the summer, whereas fisheries take place nearly year round. More time is required to explore distribution differences in the fishery by season and we plan to examine this in the future.

The trawl survey had a greater proportion of males than the longline survey and the proportion of males increased with depth in all surveys. The sex proportions in the trawl survey were more similar to the fishery than the longline survey when all depths are considered; however, in the 1-500 depth stratum the trawl survey had a very low percentage of males (2-5%), whereas the majority of the fishery data was from 201-400 m and the percentage male was larger than 5% (12-16%).

In all data sources, including surveys and fisheries, the large majority of catch is females. Also, overall the proportion of male grenadier, by weight, increases with deeper depths. Taken together, this information indicates that our surveys and fisheries may not completely cover the range of grenadier distribution. However, it also indicates that a disproportionate harvest of females is occurring, and should continue to be monitored.

Although a portion of the male population may reside in depths deeper than surveys and fisheries, it is possible that there is not a 1:1 ratio of males to females. NMFS has not aged males and, therefore, it is not known if the natural mortality rate is different between sexes for grenadiers. Given the sexual dimorphism in growth and differences in distribution by sex, it could be postulated that other life-history parameters, like natural mortality, may also vary by sex. For example, in some flatfish species there is sexual dimorphism in natural mortality, where males have a much higher rate than females (e.g., arrowtooth

flounder, 0.2 for females and 0.35 for males). If this is true for grenadier, the sex ratio may not be 1:1. The number of females could be larger than the number of males. Even in a deep-water AFSC longline survey (down to 1,600 m in the WGOA), on average 24% were male by number. Also, because females were much larger at depths >1,000 m than depths <1,000 m, the weight ratio would likely be much less than 24%.

3.3 Targeting, Catch, and Retention of Grenadiers

Grenadiers are incidentally caught in deep water trawl and hook-and-line fisheries. Grenadiers are not presently being actively targeted, nor are they being purposely retained. In 2013, for example, there was almost no reported retention of grenadiers in the BSAI (only 1 mt), no reported retention by catcher/processors in the GOA, and just 55 mt of giant grenadiers were retained by catcher vessels in the GOA. This represents a GOA fishery wide retention rate of one half of one percent. Of this retention of grenadiers, 35 mt was made into fish meal, 17 mt was discarded at the dock, 3 mt was retained for bait, and less than 1 mt was sold. Thus, there is no evidence that grenadiers are presently being targeted or purposely retained. It is much more likely that grenadiers are being retained only when mixed in with other catch.

3.3.1 Catch Estimation Methods

Fishermen that do not deliver grenadier to shore in Alaska are not required, by Federal regulation, to report catch statistics for grenadiers, because grenadiers are non-FMP species. However, catches since 1997 have been estimated for the eastern Bering Sea, Aleutian Islands, and GOA, based largely on data from the Alaska Fishery Science Center's (AFSC) Fishery Monitoring and Analysis program (Observer Program). The estimates for 1997 through 2002 were determined using what was formerly called their "blend catch estimation system" (Gaichas 2002 and 2003). However, these pre-2003 estimates may not be as accurate as the official catch estimates determined for managed groundfish species. Therefore, data prior to 2003 are not included here for analysis. The estimates for 2003 through 2013 were computed by the NMFS Alaska Regional Office, based on their Catch Accounting System, which replaced the AFSC "blend" system. All the data are presented as "grenadiers, all species combined," because observers were not instructed to identify giant grenadiers until 2005. From 2005 to 2007 many observers did not identify grenadiers to species and stock assessment authors began to request that the observer program identify grenadiers to species[11]. From 2008 to 2012, more observers identified grenadier by species, but the remainder were categorized as unidentified. Most of these were likely also giant grenadier since bottom trawl and hook-and-line surveys all show that very few Pacific and popeye grenadier are found shallower than 800 m deep, whereas giant grenadier are abundant in shallower depths. The restructured observer program implemented in 2013 presently utilizes only giant grenadier and unidentified grenadier species codes.

3.3.2 Catch History of Grenadiers in the BSAI

Catch estimates for the BSAI may be more accurate than those for the GOA. In the catch estimation process, it is assumed that grenadier catch aboard observed vessels is representative of grenadier catch aboard unobserved vessels. However, observer coverage in the BSAI fisheries is considerably higher than that in the GOA. Because grenadiers are caught primarily in hook-and-line fisheries, and most hook-and-line fisheries in the BSAI were conducted by larger vessels subject to some level of observer coverage (typically in the 30 percent category[12]) from 2003-2011, estimates in the BSAI are derived from greater observer coverage than in the GOA. Since 2012, NMFS has deployed 100 percent observer coverage on hook-and-line catcher/processors. These vessels are used in the BSAI to harvest the greatest proportion of sablefish, Greenland turbot, and Pacific cod fisheries in the BSAI where incidental catch of grenadiers is known to occur. In general, smaller vessels fish in the GOA, especially in the hook-and-line fisheries, Hook-and-line catcher/processors in the GOA were subject to limited observer coverage prior to 2012

[11] Pers. Comm. Dave Clausen, AFSC retired; Cara Rodgeveller, AFSC, Auke Bay Laboratories: November 26, 2013, via e-mail.
[12] A description of observer coverage requirements prior to 2013 is provided in the final rule implementing the restructured observer program (**77 FR 70062, November 21, 2012).**

based on vessel size (again, most of these vessels were subject to the "30 percent category" coverage requirements). Since 2012, 100 percent observer coverage on GOA hook-and-line catcher/processors is required. However, many of the catcher vessels that harvest most of the sablefish, and most of the incidental harvest of grenadiers, have not been required to have observers before 2013. This limited coverage could introduce a bias into the historical GOA estimates. This potential bias should be reduced in 2013, when for the first time the restructured observer program will deploy observers on these vessels. Total catch estimates and catch by target fishery estimates are presented in tables 3-3 and 3-4. below.

From 2003 through 2013, catches in the eastern Bering Sea have ranged from 1,629 mt (2007) to 4,240 mt (2011), averaging 2,612 mt annually. Similarly, catches in the Aleutian Islands have ranged from 1,545 mt (2007) to 4,570 mt (2012) averaging 2,707 mt annually. Catches in the eastern Bering Sea and Aleutian Islands combined have averaged 5,320 mt annually from 2003 through 2013.

Catches in the BSAI are consistently lower than catches in the GOA. Catches in the GOA have ranged from 5,765 (2010) to 11,341 (2008) and have averaged 8,769 mt annually. The geographical distribution of BSAI grenadier catch, since identification in observer records began, is shown in Figure 3-6 and is closely associated with the shelf break bathymetry. Nearly all the grenadier catch is discarded, and the discard mortality rate is assumed to be 100 percent, because the pressure difference experienced by the fish when they are brought to the surface invariably causes death.

Table 3-4: Estimated total catch (mt) of grenadiers (all species combined) in the eastern Bering Sea, Aleutian Islands, and Gulf of Alaska, 2003 through 2013.

	Eastern Bering Sea	Aleutian Islands	BSAI Total	Gulf of Alaska	Total
2003	2,869	3,558	6,427	11,073	17,500
2004	2,223	1,251	3,474	10,527	14,001
2005	2,633	1,795	4,428	6,606	11,034
2006	2,067	2,194	4,260	8,427	12,687
2007	1,629	1,545	3,174	9,118	12,292
2008	2,820	2,521	5,341	11,341	16,682
2009	2,890	3,717	6,607	6,605	13,212
2010	2,798	3,553	6,350	5,756	12,107
2011	4,240	2,598	6,838	7,862	14,701
2012	2,914	4,570	7,484	7,931	15,415
2013	1,654	2,480	4,135	11,218	15,353
mean	2,612	2,707	5,320	8,769	14,089

Data is from a Catch Accounting System data query accessed through the Alaska Fisheries Information Network in January, 2014.

Most of the grenadier catch in the Aleutian Islands has been taken in the sablefish fishery, whereas in the Bering Sea the majority came from the Greenland turbot fishery. Historically, both the sablefish and Greenland turbot fisheries have been predominantly hook-and-line, and a previous analysis of grenadier catch showed most grenadiers in the BSAI and GOA were caught on hook-and-line gear (Clausen and Gaichas 2005). In recent years, however, many sablefish and Greenland turbot fishermen in the BSAI have switched to using pots to protect their catches from whale depredation. In 2011, 60 percent of the fixed-gear eastern Bering Sea catch of sablefish was taken in pots (Hanselman et al. 2011), and it is

uncertain how this change has affected grenadier catches in this area. However, analysis of sablefish pot catches in the BSAI indicates that giant grenadier is the fourth most abundant bycatch species (Hanselman et al. 2009).

Grenadiers may also be taken incidentally in the Pacific halibut fishery. However, at this time NMFS is not able to reliably estimate the total incidental catch of grenadiers in that fishery given the limited observer coverage prior to the implementation of the restructured observer program in 2013.

There were relatively larger catches of grenadiers in some flatfish fisheries in the Aleutian Islands since 2009. The most common target fisheries that caught grenadiers were the arrowtooth and Kamchatka flounder trawl fisheries. Catches of grenadiers in the GOA were less substantial and were found in the arrowtooth flounder and rex sole trawl fisheries (Rodgveller and Clausen 2012). In 2013, estimated catch decreased in the EBS by 43 percent, decreased in the AI by 46 percent, and decreased in the Bering Sea by 45 percent This variation is typical and is in part due to a decrease in grenadier catch in the Greenland turbot and Kamchatka flounder fisheries. Grenadier bycatch has only appeared in the Kamchatka fishery since 2011 because Kamchatka flounder was included in the arrowtooth flounder fishery.

Figure 3-5 Incidental catch of giant grenadier

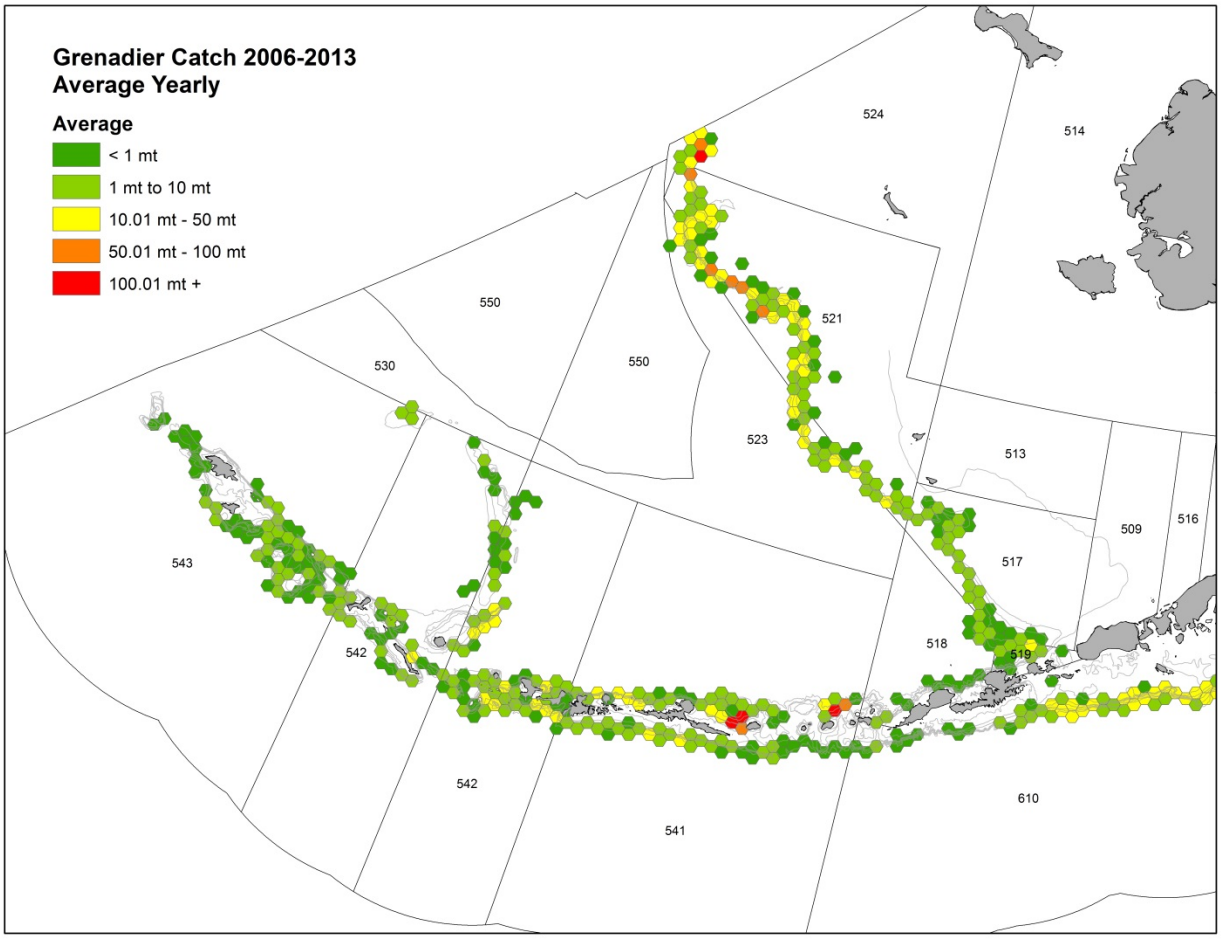

Figure 3-6 Average yearly BSAI grenadier catch, 2006–2013

Table 3-5: Estimated catch (mt) of grenadiers (all species combined) in the eastern Bering Sea, Aleutian Islands, and Gulf of Alaska by target species/species group, 2003–2013.

Year	Sablefish	G. turbot	Halibut*	Other flat	P. cod	Rockfish	Other sp.
			Eastern Bering Sea				
2003	598	1,452	n/a	150	240	9	65
2004	287	1,315	n/a	79	240	22	29
2005	108	1,975	n/a	24	334	32	18
2006	419	1,192	n/a	125	130	12	16
2007	199	1,070	n/a	7	179	17	68
2008	113	687	n/a	82	148	3	204
2009	539	1,807	n/a	240	203	6	7
2010	128	1,853	n/a	166	415	126	8
2011	263	1,759	n/a	1,052	1,096	17	4
2012	170	1,469	n/a	705	510	4	3
2013	164	542	347	285	273	40	1
			Aleutian Islands				
2003	2,016	113	n/a	0	46	6	0
2004	748	14	n/a	0	13	60	1
2005	979	161	n/a	0	2	21	16
2006	1,083	328	n/a	341	120	154	0
2007	893	342	n/a	108	40	21	76
2008	656	67	n/a	397	26	59	276
2009	1,397	414	n/a	1,377	11	200	84
2010	902	175	n/a	1,693	222	168	206
2011	1,226	84	n/a	774	18	292	105
2012	1,124	0	n/a	2,824	54	38	428
2013	1,093	44	222	685	3	221	211
			Gulf of Alaska				
2003	8,482	0	n/a	1,208	5	613	54
2004	7,703	0	n/a	420	0	2,240	8
2005	5,743	0	n/a	109		212	54
2006	7,184	0	n/a	69	22	336	77
2007	8,198	0	n/a	114	79	198	5
2008	8,213	0	n/a	93	97	165	244
2009	4,382	0	n/a	118	58	688	26
2010	4,259	0	n/a	292	149	574	11
2011	6,045	0	n/a	343	69	529	116
2012	7,035	0	n/a	188	169	438	85
2013	8,237	0	311	1,433	165	1,006	68

G. turbot = Greenland turbot; halibut = Pacific halibut; other flat = flatfish species other than Greenland turbot or Pacific halibut; P. cod = Pacific cod; and other sp. = other species, n/a = not available. Source: Regional Office Catch Accounting System accessed through the Alaska Fisheries Information Network, January 17, 2014**. NOTE: at this time NMFS is not able to reliably estimate the total incidental catch of grenadiers in the halibut fishery, prior to 2013, due to limited observer coverage prior to the implementation of the restructured observer program in 2013.**

3.3.3 Catch History of Grenadiers in the GOA

Highest catches of grenadiers have consistently been in the GOA. Catches in the GOA have ranged from 5,765 mt (2010) to 11,341 mt (2008), averaging 8,769 mt annually (Table 3-4). Most of the grenadier catch in the GOA has been taken in the sablefish fishery and occurs in deep water off the shelf break (Figure 3-9). Substantial catches of grenadiers are sometimes estimated to be taken in the Pacific halibut fishery. However, these data should be viewed with great caution, because before 2013 there was no observer coverage in the halibut fishery. A large portion of the sablefish and Pacific halibut IFQ fleet is under 60 ft and previous to 2013 did not have any observer coverage. Additionally, before 2013 there was no observer coverage on any trips that were carrying Pacific halibut IFQ but not fishing for other

groundfish. Therefore, the only coverage of the Pacific halibut fishery was on sets where there was groundfish fishing (usually sablefish IFQ). Pacific halibut was determined to be the target by the catch accounting system when it was the most abundant retained species in a haul. Before 2013 the reported catch of grenadier was sometimes large in the Pacific halibut fishery, but was variable. From 2013 forward more observer data will be obtained from the Pacific halibut fishery. Increased coverage may have the effect of decreasing the annual variation in catch estimates due to higher sample sizes.

In 2013, estimated catch increased by 42 percent in the GOA. In the GOA, catch of grenadier increased dramatically in the deep-water flatfish fishery (up 1,246 mt from 0 mt). Catch of grenadiers in this fishery has been limited since 2003. It is unknown whether this increased catch is due to changes in fishing practices, or due to catch estimation in these fisheries with the implementation of the restructured observer program in 2013; future analyses will aim to investigate shifts in observer coverage and the effects on grenadier catch estimation.

Figure 3-7 Grenadier and sablefish on AFSC longline survey

Figure 3-8 Giant grenadier on AFSC longline survey

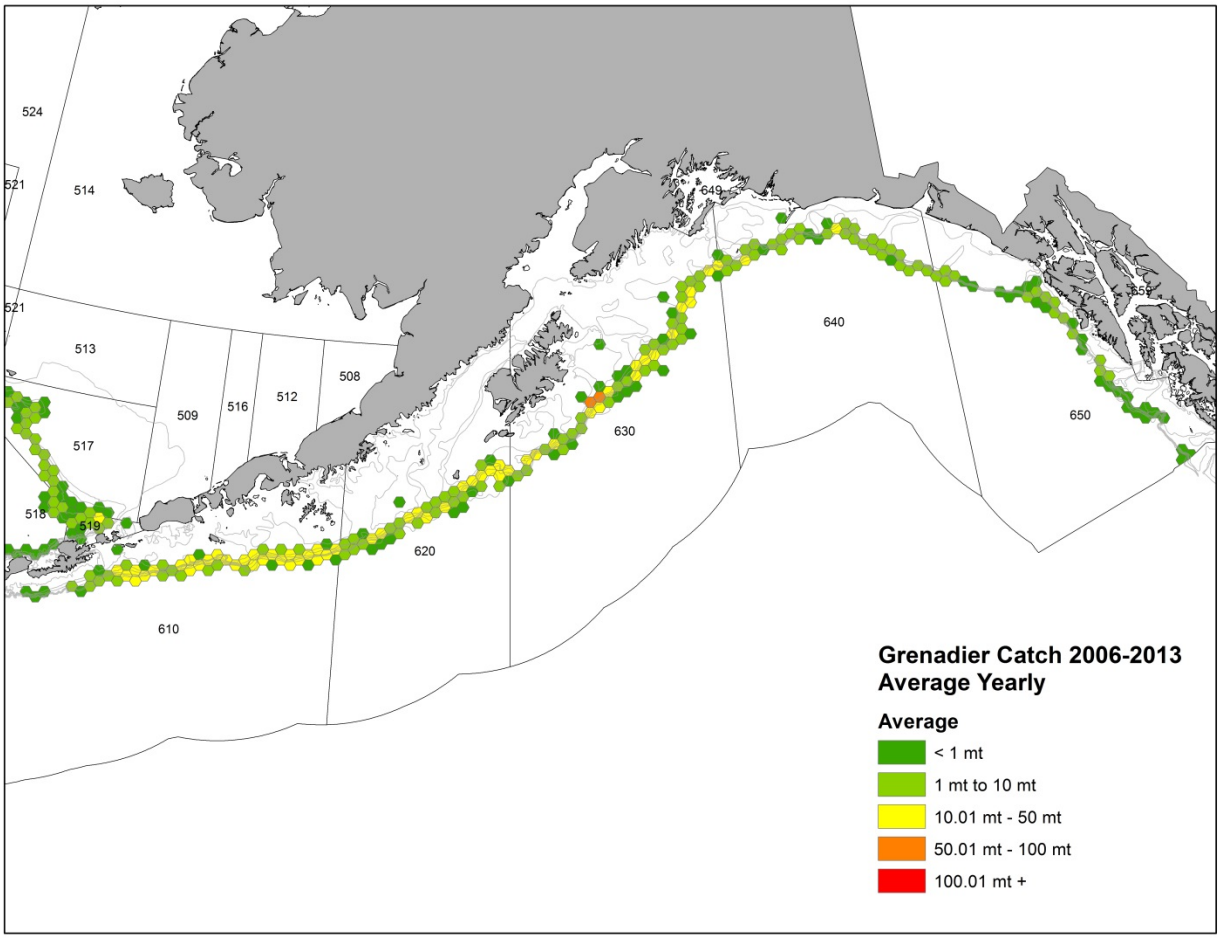

Figure 3-9 Average yearly GOA grenadier catch, 2006–2013

3.3.4 Attempts to Develop a Market

Because of the large biomass of giant grenadier on the continental slope, research has been done to develop marketable products from this species (Crapo et al. 1999a and 1999b). However, grenadiers have very low protein content of 7 percent to 16 percent and can have moisture content of between 88 percent and 91 percent (Matsui et.al. 1990, Crapo et. al. 1999a). Findings of a sensory analysis panel at the NMFS Northwest Fishery Science Center indicate that giant grenadier flesh was unpalatable, primarily because of its soft texture. The panel gave giant grenadier flesh scores, on a scale of 0 (none) to 7 (high), that were low (3.36 and below) for flakiness, hardness, chewiness, and fibrousness, and high scores for moistness (as reported in Matsui et.al. 1990). Similarly, panelists in the Crapo study rated giant grenadier at half, and a third, of the texture and firmness of Dover sole and Alaska pollock, respectively.

Table 3-6: Protein and moisture content of giant grenadier, Alaska pollock, and Dover sole.

Species	Protein (%)	Moisture (%)	Water/protein ratio
Giant Grenadier	6.8	91.4	13.4
Alaska Pollock	17.3	81.5	4.7
Dover Sole	14.2	83.7	5.9

Source: Crapo et al., 1999a.

There have been several known attempts to develop a fishery in Alaska. The first, at the Port of Kodiak in 1998,[13] was an endeavor to process hook-and-line-caught giant grenadier for surimi. This small effort was apparently unsuccessful, as it ended in 1999. The second, also from the Port of Kodiak, was an exploratory effort, in 2005, using trawls to target giant grenadier and develop a fillet and roe market.[14] This venture was not continued in 2006. From 2009 to 2011 a total of approximately 1,400 mt were retained for processing.[15] Anecdotal evidence from industry indicate that at least some of this catch was sold as headed and gutted and tail cut off (see Figure 3-10 through Figure 3-12.)

Figure 3-10 Frozen block of giant grenadier

[13] J. Ferdinand, National Marine Fisheries Service, Alaska Fisheries Science Center, REFM Division, 7600 Sand Point Way NE, Seattle WA 98115-0070. Personal communication, September 2004.

[14] T. Pearson, Kodiak Fisheries Research Center, National Marine Fisheries Service, Sustainable Fisheries, 302 Trident Way, Room 212, Kodiak AK 99615. Personal communication, October 2005.

[15] J. Keaton, National Marine Fisheries Service, Regional Office, P.O. Box 21668, 709 W. 9th St., Juneau, AK, 99802-1668, Personal communication, October 2012.

Figure 3-11 Giant grenadier, headed, gutted, collar and tail removed

Figure 3-12 Giant grenadier fillets

3.4 Impacts of the Alternatives on Grenadiers

At present there is no directed fishing for grenadiers. Grenadiers are taken as incidental catch in the directed commercial groundfish and Pacific halibut fisheries, most commonly in the sablefish and Greenland turbot fisheries.

As detailed in section 3.2, abundance of giant grenadier in both the BSAI and GOA is relatively high and estimated catch is low relative to abundance (see Table 3-4). In the BSAI, the grenadier OFL is 135,236 (Table 3 3) and the estimated catch is 5,294 (mean for 2003-2013, Table 3 4). In the GOA, grenadier OFL is 46,635 (Table 3 2) and the estimated catch is 8,707 (mean for 2003-2013, Table 3 4). At the current level of catch, grenadiers are not likely to become subject to overfishing or overfished in the absence of conservation and management measures. However, the Council and NMFS are concerned with the potential vulnerability to overfishing if catch increases dramatically in the absence of conservation and management measures. Potential vulnerability to overfishing and scientific uncertainty are the primary reasons grenadiers are being considered for conservation and management under the FMPs. Alternatives 2 and 3 both contain conservation measures and reporting requirements to directly address these two issues.

This section presents results of an analysis of Alaska grenadiers' vulnerability to overfishing as well as their importance in the ecology of the ocean. These findings suggest that grenadiers, as a long lived, and deep dwelling, species comprising a large proportion of total biomass at ocean depths they inhabit, are both ecologically important and somewhat vulnerable to overfishing.

3.4.1 Vulnerability to Overfishing

The vulnerability of a stock or stock complex to overfishing is an important consideration in the designation as an ecosystem component or as "in the fishery." NS1 guidelines define vulnerability for a stock as a combination of its productivity, which depends upon its life history characteristics, and its susceptibility to the fishery. Productivity refers to the capacity of the stock to produce maximum sustainable yield and to recover if the population is depleted. Susceptibility is the potential for the stock to be impacted by the fishery, which includes direct captures, as well as indirect impacts to the fishery (e.g., loss of habitat quality). NS1 guidelines advise regional fishery management Councils to, in consultation with their SSCs, analyze the vulnerability of stocks in stock complexes where possible.

To date, vulnerability analysis has been used in several other NMFS regions. The South Atlantic and Gulf of Mexico Councils used vulnerability analysis in adopting ACLs. The Pacific Council has developed several briefing documents related to stock complex restructuring using vulnerability analysis, and the Caribbean Council is using vulnerability analysis within their Only Reliable Catch Stocks (ORCS) data poor methodology to set ABCs for stocks. (Pers. Comm. via e-mail, Dr. Wesley Patrick, NMFS, Nov. 5 2013).[16]

Recent studies in other parts of the world have shown that deep-sea fisheries have rapidly depleted a number of species, including grenadiers, and these species have not recovered. Deep-sea species share many biological features that make them slow to rebound to overfishing, such as slow growth and low metabolic rate, late maturity, and, in the case of all grenadiers, 100% discard mortality (Devine et al. 2012). Although giant grenadiers have not yet been commercially exploited, there are other deep-water species that have been targeted in other areas. For example, when the roundnose grenadier fishery was initiated in the northwest Atlantic in the late 60's and early 70's, landings increased to 84,000 mt and then quickly declined and never recovered (Atkinson 1995). In 2008, roundnose grenadier was listed as endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Haedrich et al. (2001) suggests there is a common pattern in many deep-water fisheries that results in overfishing: 1) preliminary exploratory surveys discover large stocks, 2) a high volume but probably low value fishery develops, and 3) very high yields are realized for a few years, but then drop off rather steeply. Often, a fishery may develop before catch accounting, fishery management, and research can be initiated. To avoid large declines in grenadier stocks worldwide, fishing effort and fishing mortality should remain very low (with fishing mortality being much lower than natural mortality) and bycatch and discard amounts and composition should be monitored by observers (Devine et al 2012).

To aid in the classification of stocks, as well as to provide advice on the formation of stock complexes and other management actions, NOAA Fisheries convened a Vulnerability Evaluation Working Group (VEWG), in 2008. This group was tasked with developing an analytical tool for assessing the vulnerability of stocks in an FMP (the word "vulnerability" appears frequently in the National Standard guidelines). Stock assessment scientists from the Alaska Fisheries Science Center prepared a vulnerability analysis for a number of Alaska stocks and stock complexes, including giant grenadier, and presented the results in Appendix 3 to the 2009 SAFE report (Ormseth and Spencer 2009, also provided

[16] Documentation may be found at the following locations:
http://sero.nmfs.noaa.gov/sf/pdfs/Comp%20ACL%20Am%20101411%20FINAL.pdf
http://sero.nmfs.noaa.gov/sf/SAACLAmend.htm
http://sero.nmfs.noaa.gov/sf/pdfs/Final_Generic_ACL_AM_Amendment_September_9_2011.pdf
http://sero.nmfs.noaa.gov/sf/GulfACL.htm
http://www.pcouncil.org/resources/archives/briefing-books/november-2013-briefing-book/#groundfishNov2013
http://sero.nmfs.noaa.gov/sustainable_fisheries/caribbean/2010_acl/documents/pdfs/2010_caribb_acl_amend_feis.pdf

in the appendix) as well as in a journal article in Fisheries Research (Ormseth and Spencer, 2011). The procedure used was a "productivity-susceptibility analysis," (PSA) and follows a method developed by the NMFS national level working group (Patrick, et.al. 2009).

The PSA analysis compares two main features of a fish stock that together influence its vulnerability to fishing: productivity, which determines a population's natural capacity for growth and its resilience to fishery impacts; and susceptibility, which indicates how severe those fishery impacts are likely to be for the population. Productivity and susceptibility are evaluated by scoring a number of related attributes. For productivity, these are mainly life-history traits such as natural mortality rate and age at maturity; susceptibility attributes include spatial overlap between the stock and the fishery, stock status, etc. Grenadiers are not listed in the current FMPs but were included in the analysis due to potential conservation concerns. The authors conclude that the PSA results suggest that grenadiers should be included as stocks "in the fishery" in the FMPs for both regions. In the GOA, the vulnerability score for giant grenadier is between Pacific cod and Pacific ocean perch. In the BSAI, giant grenadier is between Pacific cod and pollock. Thus, the authors concluded that management measures (ACLs) appropriate for these target species should also be applied to grenadiers. However, it should also be noted that placing grenadiers species in the FMP as an "ecosystem component" also provides management measures that will affect vulnerability, as discussed below.

3.4.2 Impacts of the Alternatives Relative to the Vulnerability of Overfishing

Due to the abundance of giant grenadier in both the BSAI and GOA and low estimated catch, overfishing does not appear to be a problem at present. In the BSAI, the grenadier OFL is 135,236 (Table 3-3) and the estimated catch is 5,294 (mean for 2003-2013, Table 3-4). In the GOA, grenadier OFL is 46,635 (Table 3-2) and the estimated catch is 8,707 (mean for 2003-2013, Table 3-4). The annual estimates of fishery removals are used in the annual Tier 5 grenadier stock assessment voluntarily conducted by the Alaska Fisheries Science Center. Improved recordkeeping and reporting requirements could reduce uncertainty in the biomass estimates and would decrease the risk of overfishing since the trend in removals could be compared to trends in population size. However, Alternative 1 does nothing to improve data collection and reduce scientific uncertainty.

If future catches increase due to increased quotas of sablefish or Greenland turbot or due to the development of a fishery, grenadier may be vulnerable to overfishing because: 1) the vast majority of the giant grenadier catch is discarded, and the discard mortality rate is 100 percent; 2) female giant grenadier greatly outnumber males at the depths where the sablefish and Greenland turbot fisheries operate, which means there is a disproportionate removal of females; 3) like many deep-sea fish, giant grenadier are long-lived, slow growing, and late maturing, which are traits that do not support high rates of fishing. Under Alternative 1, grenadiers would be susceptible to fishing because there is a potential for an unmanaged target fishery. Alternative 1 does not provide any management measures that ameliorate the vulnerability of the grenadier stock to the potential for overfishing if a market can be developed and unlimited "unmanaged targeted fishing" for grenadiers begins to occur.

A grenadier market could be developed for the large biomass of grenadiers in the EEZ off Alaska. Under Alternative 1, this presently untapped resource could come under rapidly developing fishing pressure. Examples of rapidly developing fisheries for FMP species include arrowtooth and Kamchatka flounder in the BSAI and GOA. Fifteen years ago these flounders did not have directed fisheries and were often discarded. These species were once used as a basis species for the retention of other more valuable groundfish like sablefish, rockfish, and Pacific cod; discarded at sea; or used for the production of fishmeal. After food technology research developed marketable products from arrowtooth and Kamchatka flounder, retention of flounders rose from 21 percent in 2004 to 88 percent

in 2012, and total catch rose from 18,151 mt in 2004 to 32,370 mt in 2012. Were a market for grenadier to be developed, similar rapid increases in grenadier catch could occur

Potential vulnerability to overfishing and scientific uncertainty are the primary reasons grenadiers are being considered for conservation and management under the FMPs. Alternatives 2 and 3 both directly address these two issues. Under Alternative 2 grenadier would be included in the FMP as an "ecosystem component," species. The recordkeeping and reporting requirements, the prohibition on directed fishing, and MRAs of grenadiers as an incidental catch species would limit grenadier catch. These measures are all in sharp contrast to the status quo conditions and would improve catch estimation, thereby helping to reduce scientific uncertainty, as well as preventing "unmanaged target fishing" of grenadiers. Under Alternative 2, grenadiers would be less susceptible to fishing because incidental catch would be restricted and directed catch would be prohibited. Thus, Alternative 2 provides management measures necessary to ameliorate the vulnerability of grenadiers to overfishing as an incidental catch species.

Alternative 3 would include grenadier in either the BSAI or GOA groundfish FMPs as target species "in the fishery." In addition to the recordkeeping and reporting requirements that would be adopted similar to Alternative 2, under Alternative 3, grenadiers would be part of the annual harvest specifications process and status determination criteria would be established annually. Therefore, the Council would annually assess catch relative to the OFL. This is the prescribed method to prevent overfishing in the National Standard 1 guidelines.

Alternative 3 also provides a formal structure under which a "directed fishery" for grenadiers could be allowed with all the associated management structure required under the MSA to prevent overfishing. Further, Alternative 3 addresses the recommendation of stock assessment authors who have recommended that management measures appropriate for target species (such as ACLs and AMs) should also be applied to grenadiers because of the similarities in vulnerability scores between target stocks and giant grenadier (Ormseth and Spencer 2009, 2011). Thus, Alternative 3 provides management measures necessary to ameliorate the vulnerability of grenadiers to overfishing as either incidental catch or in a "directed fishery." However, because a directed fishery could be opened for grenadiers under Alternative 3, this alternative would be less conservative that Alternative 2 relative to susceptibility to fishing.

3.5 Impacts of the Alternatives on Groundfish Species

Analyses are prepared for each target stock, species or species group in the BSAI and GOA and are contained in the annual BSAI and GOA SAFE reports, which are incorporated by reference here. (Available at: http://www.afsc.noaa.gov/REFM/stocks/assessments.htm)

Presently, twenty-two stock target categories are specified in the BSAI SAFEs and twenty-four target categories are specified in the GOA SAFEs. In the BSAI, grenadier incidental catch is concentrated in the hook-and-line sablefish, Greenland turbot, halibut, flatfish, Pacific cod, rockfish, and other species target fisheries with sablefish and Greenland turbot having the highest rates of BSAI grenadier incidental catch during 2003 through 2013 (Table 3-4) . In the GOA grenadier incidental catch is concentrated in the hook-and-line sablefish, halibut, flatfish, Pacific cod, rockfish, and other species target fisheries with sablefish having the highest rates of GOA grenadier incidental catch during 2003 through 2013

Under Alternative 1, the status quo, grenadiers would continue as non-FMP species without any harvest limitations or recordkeeping and reporting requirements. Since there is no limit on grenadier catch or retention, and grenadiers are not assessed in the calculation of optimum yield in the groundfish fishery, there would be no significant short term effects (either adverse or beneficial) on the stock biomass, fishing mortality, spatial or temporal distribution, or changes in prey availability for other groundfish target species in either the BSAI or GOA.

Alternative 1; however, retains the possibility for "unmanaged targeted fishing "of grenadiers to occur. Were a market to develop, grenadier could be targeted and there would be no required recordkeeping and reporting of catch and disposition of catch. Given the ecological importance of grenadiers, increased removals of grenadiers in an unmanaged and unreported fishery could have adverse effects on prey availability for other groundfish target species. However, little information is available on food web and habitat interactions between grenadiers and other groundfish; however, the information that is available indicates that in the Aleutian Islands, the diet comprised mostly squid and bathypelagic fish (myctophids) (Yang 2003), whereas in the Gulf of Alaska, squid and pasiphaeid shrimp predominated as prey (Yang et al. 2006). Thus, other groundfish do not appear to compose the prey field of grenadiers. However, sablefish do appear to prey on grenadiers. The extent of grenadier in the diet of sablefish is unknown. Thus it is not possible to determine whether incidental catches of grenadiers under the status quo remove a substantial amount of sablefish prey, nor what might happen if incidental catches were to increase under the status quo. Alternative 1 does not provide for improvements in that level of scientific knowledge through, at a minimum, accurate recording of their harvest and/or placing limits on their harvests.

Alternative 1 also allows the retention of grenadiers for use as a basis species in retaining other groundfish; however, the additional harvest of groundfish would not have a significant impact on groundfish stocks, because the harvest is conducted within the MRA limits and is subtracted from the annual TAC specified for each groundfish species group. It is still possible, under Alternative 1 for grenadier to be used as a basis species and then be discarded at the shoreside plant level as there is no market for grenadier at present. Thus, Alternative 1 does nothing, in any formalized way, to address the problem of grenadier incidental catch potentially resulting in discard waste, either on the fishing grounds or post-delivery when used as a basis species.

Alternative 2 would place grenadiers in the FMPs as "ecosystem component" species. As has been discussed above, directed fishing for grenadiers would not be allowed, recordkeeping and reporting would be required, and conservation and management measures to reduce incidental catch of grenadiers would be applied. Given limited interaction information, it is difficult to discern any direct effects of this alternative on other groundfish species; however, the enhanced recordkeeping and reporting requirements may lead to improvements in interaction information over time. Further, Alternative 2 formalizes management of grenadiers and provides for conservation and management of grenadiers should concerns about effects of grenadier removals on other groundfish species arise in the future.

In contrast to Alternative 1, Alternative 2 prevents "unmanaged target fishing" of grenadiers and prevents a "directed fishery" from being developed as well. Were a market for grenadiers to be developed, Alternative 2 would allow a "small amount" of grenadier to be retained and marketed; however, establishing a formal directed fishery would require further regulatory action. Alternative 2 would also prevent use of grenadier incidental catch as a basis species for retention of other groundfish, thereby eliminating the potential discard waste of grenadiers post-delivery.

While little is presently known about the interactions of grenadiers with other groundfish species, Alternative 2 may improve the level of scientific knowledge through, at a minimum, accurate recording of their harvest and/or placing limits on their harvests. Thus, Alternative 2 does provide the precautionary management structure needed to sustainably manage the grenadier stock to potentially promote its sustainability and the sustainability of other groundfish species with which grenadier may have important ecological interactions.

Alternative 3 would place grenadiers in the FMP as "in the fishery," with all of the associated stock assessment, harvest specifications, and conservation and management measures afforded to all other groundfish species in the BSAI and GOA. Under Alternative 3, no directed fishery is allowed and the grenadier basis species MRA would be zero, with a 35 percent MRA as an incidental catch species.

Alternative 3 does allow a directed fishery to be opened through the specifications process with amendment of the MRAs in regulations. The additional harvest of groundfish that could occur under MRAs in a grenadier "directed fishery" would not have a significant impact on groundfish stocks, because the harvest is conducted within the MRA limits and is subtracted from the annual TAC specified for each groundfish species group. A separate MRA for grenadiers would allow "topping off" with other groundfish species up to the MRA; however, the Council could choose to have a separate TAC for grenadier, but not have a separate MRA for them. Any grenadiers caught in excess of the MRA would have to be discarded. This policy decision is discussed under chapter 2.

In contrast to Alternatives 1 and 2, Alternative 3 provides the management structure needed to potentially promote sustainable harvest of grenadiers in a future "directed fishery." However, the implications for other groundfish stocks of establishing a grenadier "directed fishery" differ between the GOA and the BSAI.

At present, the OY cap established in the GOA FMP is substantially greater than the total of all GOA TACs. Thus, placing grenadier "in the fishery" in the GOA does not require "funding" of grenadier TAC via reductions in TACs of any other groundfish species. Further, since the present and past harvests of grenadiers taken incidentally are well below the current ABCs calculated for grenadiers, there would be no significant effects (either adverse or beneficial) on the stock biomass, fishing mortality, spatial or temporal distribution, or changes in prey availability for groundfish target species in the GOA.

In contrast to the potential effects of Alternative 3 in the GOA, the BSAI FMP specifies a total OY limit of 2 million mt. This limit on OY is mandated by statute.[17] NMFS ensures that the provisions of the statute and FMP are met by limiting the TAC in the BSAI to 2 million mt., Placing BSAI grenadiers "in the fishery" means that grenadier incidental catch would have to be "funded" from reduced TAC of other BSAI groundfish species in the combined TAC in the BSAI is set at 2 million mt. The actual reduction in TAC would depend on the TAC established for grenadiers. The specific reallocation of TAC within this 2 million mt OY limit from one, or more, groundfish species in the BSAI to "fund" grenadiers is unknown at this time, but would be established through the annual harvest specification process.

Each year, the annual stock assessments are prepared and revised over the course of two Groundfish Plan Team meetings and then presented, along with TAC range recommendations, to the Council in December. It is in that TAC setting process that changes in TAC levels are proposed and revisions to the TAC specifications are made in order not to exceed the overall maximum of 2.0 million mt in the BSAI. Thus, it is not possible to estimate what proportion of grenadier TAC would be specified from each of the other target fisheries in the BSAI.

A grenadier TAC in the BSAI would not affect the TAC established for other groundfish species if the combined TAC is set at some amount less than 2 million mt, For example, in the period from 2008 through 2010, BSAI pollock TACs decreased considerably. Reduced BSAI pollock TAC resulted in adoption of BSAI groundfish TACs totaling 1,838,354 mt, 1,681,586 mt, and 1,677,154 mt, in 2008, 2009, and 2010, respectively (see groundfish harvest specification tables at http://alaskafisheries.noaa.gov/sustainablefisheries/). Assuming that grenadier TAC were set at the average annual grenadier catch of approximately 5,300 mt, there would have been considerably more groundfish available under the 2 million mt cap to fund this level of a grenadier TAC in these years without affecting TACs for any other BSAI groundfish species. Thus, in three of the past ten years,

[17] See section 803(c) of Pub. L. No. 108-199 "The optimum yield for groundfish in the Bering Sea and Aleutian Islands Management Area shall not exceed 2 million metric tons."

grenadier catch in the BSAI could have been "funded" with either no reduction in the TACs of other BSAI groundfish species, or with less than two tenths of a percent reduction in other TACs.

However, the period of lower than normal BSAI groundfish TACs between 2008 and 2010 appears to be somewhat anomalous. Total BSAI TAC has fallen below 2 million mt in only two other years (1992 and 1993; by 145 and 3380 tons, respectively)[18], since implementation in the early 1980's. Nonetheless, were future variability in groundfish stocks to result in total BSAI TACs significantly lower than 2 million mt tons then, were a market for grenadier products to develop, retention of incidental catch and/or directed fishing of grenadier in the BSAI could improve optimal yield from the BSAI fishery in times of decreased stock abundance of other groundfish species, all else equal. Thus, placing grenadiers "in the fishery" in the BSAI may offer the potential for improved future benefits to the nation.

3.6 Impacts of the Alternatives on the Ecosystem

Ecosystems consist of communities of organisms interacting with their physical environment. Within marine ecosystems, competition, predation, and environmental disturbance cause natural variation in recruitment, survival, and growth of fish stocks. Human activities, including commercial fishing, can also influence the structure and function of marine ecosystems. Fishing may change predator-prey relationships and community structure, introduce foreign species, affect trophic diversity, alter genetic diversity, alter habitat, and damage benthic habitats.

Nearly all the grenadier catch is discarded at sea, and the discard mortality rate is 100 percent because the pressure difference experienced by the fish when they are brought to the surface causes death. Because almost all grenadiers presently caught in the sablefish and Greenland turbot fisheries are discarded and do not survive, this constitutes a major input of dead organic material to the ecosystem that would not otherwise be there.

Fishing has the potential to influence ecosystems in several ways. Certain forage species, such as walleye pollock and Atka mackerel, are at a central position in the food web and their abundance is an indicator of prey availability for many species. Removal of top level predators is another potential effect of fishing, contributing to a "fishing-down the food web" effect. Introduction of non-native species may occur through emptying of ballast water in ships from other regions. These species introductions have the potential to cause large changes in community dynamics. Fishing may alter the amount and flow of energy in an ecosystem by removing energy and altering energetic pathways though the return of discards and fish processing offal back into the sea. The recipients, locations, and forms of this returned biomass may differ from those in an unfished system. Selective removal of species and/or sizes of organisms has the potential to change predator/prey relationships and community structure. Fishing can alter different measures of diversity. Species level diversity, or the number of species, can be altered if fishing essentially removes a species from the system. Fishing can alter functional or trophic diversity if it selectively removes a structural living habitat group or trophic guild member and changes the evenness with which biomass is distributed among a functional or trophic guild. Fishing can alter genetic level diversity by selectively removing faster growing fish or removing spawning aggregations that might have different genetic characteristics than other spawning aggregations. Fishing gear may alter bottom habitat and damage benthic organisms and communities.

[18] Data Available at: http://alaskafisheries.noaa.gov/sustainablefisheries

3.6.1 Role of Grenadiers in the Ecosystem

A determination of ecosystem considerations for grenadiers in Alaska is hampered by the lack of biological and habitat information for these species and by limited knowledge in general on the deep slope environment inhabited by these fish.

Prey availability/abundance trends: The only food studies on grenadiers in the northeast Pacific have been on adults. One study of giant grenadier off the U.S. west coast concluded that the fish fed primarily off-bottom on bathy- and mesopelagic food items that included gonatid squids, viperfish, deep-sea smelts, and myctophids (Drazen et al. 2001). Smaller studies of giant grenadier food habits in Alaska showed generally similar results. In the Aleutian Islands, the diet comprised mostly squid and myctophids (Yang 2003), whereas in the Gulf of Alaska, squid and pasiphaeid shrimp predominated as prey (Yang et al. 2006). Research on these deep-sea prey organisms in Alaska has been virtually non-existent, so information on prey availability or possible variations in abundance of prey are unknown. Very few juvenile giant grenadier have ever been caught, so nothing is known about their food preferences.

In contrast to giant grenadier, a study of Pacific grenadier food habits off the U.S. west coast found a much higher consumption of benthic food items such as polychaetes, cumaceans, mysids, and juvenile Tanner crabs (*Chionoecetes* sp.), especially in smaller individuals (Drazen et al. 2001). Carrion also contributed to its diet, and larger individuals consumed some pelagic prey including squids, fish, and bathypelagic mysids.

Predator population trends: The only documented predators of giant grenadier are Pacific sleeper sharks (Orlov and Moiseev 1999) and Baird's beaked whales (Walker et al. 2002). According to Orlov's and Moiseev's study, giant grenadier was ranked third in relative importance as a food item in the diet of these sharks. Sperm whales are another potential predator, as they are known to dive to depths inhabited by giant grenadier on the slope and have been observed depredating on longline catches of giant grenadier[19]. Giant grenadier is a relatively large animal that is considered an apex predator in its environment on the deep slope (Drazen et al. 2001), so it may have relatively few predators as an adult. Predation on larval and juvenile giant grenadiers would likely have a much greater influence on the ultimate size of the adult population size, but information on predators of these earlier life stages is nil.

Changes in habitat quality: Little or no environmental information has been collected in Alaska for the deep slope habitat in which grenadiers live. This habitat is likely more stable oceanographically than shallower waters of the upper slope or continental shelf. Regime shifts on the continental shelf and slope in Alaska in recent decades have been well documented, but it is unknown if these shifts also extend to the deep slope. Regime shifts could have a pronounced effect on giant grenadier if their larvae or post-larvae inhabited upper portions of the water column. However, no larvae or post-larvae for this species have ever been collected in Alaska. The absence of larvae or post-larvae giant grenadier in larval surveys in Alaska, which have nearly all been conducted in upper parts of the water column, implies that larval giant grenadier may reside in deeper water, where they may be less affected by regime shifts since water temperatures in deep water tend to be more stable.

Bottom trawl surveys have shown giant grenadier is the most abundant species at depths 200 m to 1,000 m on the continental slope of the GOA, eastern Bering Sea, and Aleutian Islands. Hence, it is of great ecological importance in this habitat. Adults are often found in close association with the bottom, as

[19] C. Lunsford, National Marine Fisheries Service, Alaska Fisheries Science Center, Auke Bay Laboratories, 17109 Point Lena Loop Rd., Juneau, AK 99801. Pers. comm. Oct 2006.

evidenced by their large catches in bottom trawls and on hook-and-line sets on the bottom. However, based on a study of the food habits of giant grenadier, it appears that they feed primarily in the water column. In the Aleutian Islands, the diet was comprised mostly of squid and bathypelagic fish (myctophids), whereas in the Gulf of Alaska, squid and pasiphaeid shrimp predominated as prey. Pacific sleeper sharks (Somniosus pacificus) and Baird's beaked whales (Berardius bairdii) have been documented as predators on giant grenadier. Sperm whales (Physeter macrocephalus) are another likely predator, as they are known to dive to depths inhabited by giant grenadier on the continental slope and have been observed in Alaska depredating on longline catches of giant grenadier. On a GOA research survey in 2011 on a commercial trawl vessel, there was evidence of partially digested grenadier in the stomachs of sablefish. The extent of grenadier in the diet of sablefish is unknown.

Results of the trawl surveys emphasize the important ecological role of giant grenadier in Alaskan waters. In a ranking of all species caught in the 1999 GOA trawl survey, giant grenadier was the fifth most abundant species in terms of CPUE, after arrowtooth flounder, Pacific ocean perch, walleye pollock, and Pacific halibut. It should be noted that this survey covered both the continental shelf and slope; if we consider just the slope deeper than 400 m, giant grenadier had the highest overall CPUE. Similarly, the 2007 GOA trawl survey indicated giant grenadier was third most abundant species in terms of CPUE, and was exceeded only by arrowtooth flounder and Pacific ocean perch (von Szalay et al. 2008). In the EBS slope surveys, giant grenadier is even more important. Among all species caught in the surveys in this area, giant grenadier was by far the most abundant in terms of both CPUE and biomass.

3.6.2 Impacts of the Alternatives on Ecological Importance

Under Alternative 1, grenadiers would continue as non-FMP species without any harvest limitations or recordkeeping and reporting requirements. The Council and NMFS are considering federal conservation and management for grenadiers because, although grenadiers have not been managed as an FMP species since 1980, there is no longer a valid scientific reason to exclude them. Bottom trawl surveys have shown giant grenadier is the most abundant species at depths 200 m to 1,000 m on the continental slope of the GOA, eastern Bering Sea, and Aleutian Islands. Alternative 1 provides no management structure for either tracking or limiting harvest of this ecologically important species. Under Alternative 1, the overall risk to grenadier stocks and their ecological role would appear to be limited based on known biomass, harvests, and reasonably foreseeable harvest trends. However, under Alternative 1, NMFS would not have management tools to accurately track catch or limit harvests should a directed fishery develop quickly. The likelihood of such a fishery developing in the foreseeable future is unknown.

Under Alternative 2 grenadier would be included in the FMP as an "ecosystem component," species. NMFS established the ecosystem component category to encourage ecosystem approaches to management and to incorporate ecosystem considerations (74 FR 3179, January 16, 2009). Alternative 2 provides management measures necessary for precautionary management of this ecologically important species, as an "ecosystem component" with limited incidental catch. These measures are all in sharp contrast to the status quo conditions and would provide for ecosystem approaches to management via improving grenadier catch estimation, thereby helping to reduce scientific uncertainty, as well as limiting grenadier harvest in recognition of their important ecological role.

Alternative 3 would expand the information available on grenadiers from Alternative 2 by incorporating grenadiers into the annual stock assessment and harvest specifications process. Alternative 3 also provides a formal structure under which a "directed fishery" for grenadiers could be allowed with all the associated management structure required under the MSA to prevent overfishing.

Thus, alternative 3 provides management measures necessary to precautionary management of this ecologically important species, either with limited incidental catch, or if a "directed fishery" is eventually developed.

Because both Alternatives 2 and 3 would provide methods for tracking catch, and provide management measures to limit the overall harvests they would be expected to provide a more precautionary management, and likely reduced impacts on the ecological role of grenadiers relative to Alternative 1. Alternative 2 is likely to result in greater limits on the harvest relative to Alternatives 1 or 3 because it would not allow a directed fishery, and total retention would be limited to incidental harvest. Alternative 3 could provide additional harvest opportunities relative to Alternative 2, but would still be more precautionary than Alternative 2. Under Alternative 3, the specific amount of TAC for grenadiers would be established through the annual harvest specifications process. Although the specific TAC is not known at this time, it may be reasonable to assume that the mean harvest rage (see Table 3-4 for additional detail) could be used for purposes of analysis. With these assumptions, the total potential harvests of grenadiers under Alternative 3 would represent a small proportion of the known biomass of grenadiers, and would be likely to have a limited overall impact on the ecological role of grenadiers. However, this impact would be anticipated to be slightly greater than the impacts under Alternative 2 because no directed fishery would be permitted.

3.7 Cumulative Effects

Analysis of the potential cumulative effects of a proposed federal action and its alternatives is a requirement of NEPA. Cumulative effects are those combined effects on the quality of the human environment that result from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions, regardless of which federal or non-federal agency or person undertakes such other actions (40 CFR 1508.7, 1508.25(a) and 1508.25(c)). Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time. The concept behind cumulative effects analysis is to capture the total effects of many actions over time that would be missed if evaluating each action individually. Concurrently, the Council on Environmental Quality (CEQ) guidelines recognize that it is most practical to focus cumulative effects analysis on only those effects that are truly meaningful. Based on the preceding analysis, the effects that are meaningful are potential effects on grenadiers. The cumulative effects on the other resources have been analyzed in numerous documents and the impacts of this proposed action on those resources is minimal; therefore there is no need to conduct an additional cumulative impacts analysis.

This EA analyzes the cumulative effects of each alternative and the effects of past, present, and reasonably foreseeable future actions (RFFA). The past and present related actions are described in sections 3.1-3.4.

This section provides a review of the RFFA that may result in cumulative effects on grenadiers, the resource most impacted by the proposed action and its alternatives. Actions are understood to be human actions (e.g., a proposed rule to designate northern right whale critical habitat in the Pacific Ocean), as distinguished from natural events (e.g., an ecological regime shift). CEQ regulations require consideration of actions, whether taken by a government or by private persons that are reasonably foreseeable. This requirement is interpreted to indicate actions that are more than merely possible or speculative. In addition to these actions, this cumulative effects analysis includes climate change.

Actions are considered reasonably foreseeable if some concrete step has been taken toward implementation, such as a Council recommendation or NMFS's publication of a proposed rule. Actions only "under consideration" have not generally been included because they may change substantially or may not be adopted, and so cannot be reasonably described, predicted, or foreseen. Identification of actions likely to impact a resource component within this action's area and time frame will allow the public and Council to make a reasoned choice among alternatives.

The following RFFAs are identified as likely to have an impact on a resource component within the action area and timeframe:

- Directed fishery for grenadiers
- Increased TACs in fisheries where grenadiers are taken incidentally.
- Climate change.

Directed Fishery

At present there are no directed fisheries for grenadiers in the BSAI or GOA; grenadiers are taken as incidental catch in other directed commercial groundfish and Pacific halibut fisheries. Under Alternative 3, a directed fishery for grenadiers could develop. Thus far a couple of test trips by vessels using trawl gear out of Kodiak to target giant grenadiers have taken place. While the fishing effort was considered successful (the total catch comprised approximately 80 percent grenadiers), there was no market for the product so directed fishing ceased (Wayne Tippler, fishing participant and vessel captain, personal communication, October 2005). In recent years up to 200 mt of giant grenadier, taken as incidental catch in other directed groundfish fisheries were retained for processing. Although giant grenadier are generally considered poor for human consumption due to the high water content of their flesh, there has been some food technology research to develop marketable products from giant grenadiers (Crapo, 1999 a and b).

A good case study for the development of a directed fishery would be arrowtooth and Kamchatka flounder in the BSAI and GOA. Fifteen years ago these flounders did not have directed fisheries and were often discarded. These species were once used as a basis species for the retention of other more valuable groundfish like sablefish, rockfish, and Pacific cod; discarded at sea; or used for the production of fishmeal. After food technology research developed marketable products from arrowtooth and Kamchatka flounder, retention of flounders rose from 21 percent in 2004 to 88 percent in 2012, and total catch rose from 18,151 mt in 2004 to 32,370 mt in 2012.

Under Alternative 1, the no action alternative (status quo), grenadiers would continue as non-FMP species without any harvest limitations or recordkeeping and reporting requirements, and a directed fishery could develop with unknown, but potentially adverse impacts on grenadiers and the ecosystem.

Under Alternative 2, which would include grenadier in the FMP as an "ecosystem component," recordkeeping and reporting requirements would be established for grenadiers. Present and past harvests of grenadiers have been taken incidentally in other directed fisheries. As an "ecosystem component" grenadiers would be closed to directed fishing and there would be no directed fishing targeting grenadiers. MRAs of grenadiers as an incidental catch species would be established limiting the development of a grenadier fishery.

Under Alternative 3, which would include grenadier in either the BSAI or GOA groundfish FMPs as target species "in the fishery," OFLs, ABCs, TACs, other management measures, and recordkeeping and reporting requirements would be established for grenadiers. A directed fishery could develop if the Council recommended a TAC above the amount needed for incidental catch in other fisheries.

Increased TAC in Targeted Fisheries

In the BSAI, grenadier incidental catch is concentrated in the hook-and-line sablefish, Greenland turbot, halibut, flatfish, Pacific cod, rockfish, and other species target fisheries with sablefish and Greenland turbot having the highest rates of BSAI grenadier incidental catch during 2003 through 2013 (RIR Table 4-1). In the GOA grenadier incidental catch is concentrated in the hook-and-line sablefish, halibut, flatfish, Pacific cod, rockfish, and other species target fisheries with sablefish having the highest rates (see Table 3-5)of GOA grenadier incidental catch during 2003 through

Under Alternative 1, the Status Quo, grenadiers are taken incidentally in the fisheries identified above and may be retained and used as a basis species allowing retention, up to the groundfish species' MRA, of valuable groundfish species. If the TACs for any of these valuable groundfish species increase via the annual stock assessment and TAC setting process, then it is reasonable to expect the incidental catch of grenadier to increase due to increased effort to harvest the larger TACs. This would also be true under Alternatives 2 and 3, unless a directed fishery occurs under Alternative 3 and/or the Council and NMFS choose to restrict incidental catch via management measures. However, given that grenadier incidental catch is small in comparison to the OFL, TACs in fisheries where grenadier are taken incidentally would have to increase dramatically before it would be likely that grenadier incidental catch would rise to a level of conservation concern. It is also likely that some additional retention of grenadiers, as a basis species, may occur under the Status quo; however, Alternatives 2 would prohibit the use of grenadiers as a basis species, while Alternative 3 would set an MRA as a basis species to zero.

Climate Change

Compelling evidence from studies of changes in Bering Sea and Arctic climate, ocean conditions, sea ice cover, permafrost, and vegetation indicate that the area is experiencing warming trends in ocean temperatures and major declines in seasonal sea ice. While climate warming trends are being studied and increasingly understood on a global scale, the ability for fishery managers to forecast biological responses to changing climate continues to be difficult. The North Pacific Ocean is subject to periodic climatic and ecological "regime shifts." These shifts change the values of key parameters of ecosystem relationships, and can lead to changes in the relative success of different species.

Many efforts are underway to assess the relationship between oceanographic conditions and groundfish species. Diversity among groundfish species means that the uncertainty in predicting biological responses to climate change remains large, and the specific impacts of changing climate on salmon cannot be assessed.

The Council and NMFS have taken actions that indicate a willingness to adapt fishery management to be proactive in the face of changing climate conditions. The Council currently receives an annual update on the status and trends of indicators of climate change in the GOA through the presentation of the "Ecosystem Considerations" chapter of the annual SAFE reports[20]). Much of the impetus for Council and NMFS actions in the northern Bering Sea, where bottom trawling is prohibited in the Northern Bering Sea Research Area, and in the Alaskan Arctic, where the Council and NMFS have prohibited all fishing until further scientific study of the impacts of fishing can be conducted, derives from the understanding that changing climate conditions may impact the spatial distribution of fish, and consequently, of fisheries. In order to be proactive, the Council has chosen to close any potential loopholes to unregulated fishing in areas that have not previously been fished.

[20]Available at http://www.afsc.noaa.gov/REFM/Docs/2012/ecosystem.pdf

Consequently, it is likely that as other impacts of climate change become apparent, fishery management will also adapt in response. Because of the large uncertainties as to what these impacts might be, however, and our current inability to predict such change, it is not possible to estimate what form these adaptations may take.

No additional reasonably foreseeable future actions have been identified. Considering the direct and indirect impacts of the proposed action when added to the impacts of past and present actions previously analyzed in other documents that are incorporated by reference and the impacts of the reasonably foreseeable future actions listed above, the cumulative impacts of the proposed action are determined to be not significant.

4 Regulatory Impact Review and Probable Economic and Socioeconomic Impacts

4.1 Introduction

This Regulatory Impact Review (RIR) evaluates the costs and benefits of four alternatives for the inclusion of several species of grenadiers (giant, Pacific, and popeye grenadier) in the Fishery Management Plan for Groundfish of the Bering Sea and Aleutian Islands Management Area (BSAI groundfish FMP) and the Fishery Management Plan for Groundfish of the Gulf of Alaska (GOA groundfish FMP). This would be achieved by including grenadiers in the FMPs as being either "in the fishery" or as an "ecosystem component" and adopting management measures designed to improve the protection, conservation, and catch and disposition accounting of grenadiers. There are also two options which would specify the grenadier species to be included in any of the action alternatives.

4.2 What is a Regulatory Impact Review

This RIR is required under Presidential Executive Order 12866 (58 FR 51735, September 30, 1993). The requirements for all regulatory actions specified in E.O. 12866 are summarized in the following statement from the order:

> *In deciding whether and how to regulate, agencies should assess all costs and benefits of available regulatory alternatives, including the alternative of not regulating. Costs and benefits shall be understood to include both quantifiable measures (to the fullest extent that these can be usefully estimated) and qualitative measures of costs and benefits that are difficult to quantify, but nonetheless essential to consider. Further, in choosing among alternative regulatory approaches agencies should select those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity), unless a statute requires another regulatory approach.*

E.O. 12866 further requires that the Office of Management and Budget review proposed regulatory programs that are considered to be "significant." A significant regulatory action is one that is likely to—

- Have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, local or tribal governments or communities;
- Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency;
- Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or
- Raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in this Executive Order.

4.3 Statutory Authority

Under the Magnuson-Stevens Act, the United States has exclusive fishery management authority over all marine fishery resources found within the exclusive economic zone (EEZ). The management of these marine resources is vested in the Secretary of Commerce and in the regional fishery management councils. The potentially affected groundfish fisheries in the Bering Sea and Aleutian Islands EEZ and

the GOA EEZ are managed under the BSAI groundfish FMP and the GOA groundfish FMP. The Council prepared the FMPs, and the Secretary of Commerce approved them, under the authority of the Magnuson-Stevens Act (16 U.S.C. 1801, *et seq.*). Regulations implementing the FMPs are contained in the Code of Federal Regulations (CFR) at 50 CFR part 679. General regulations that also pertain to U.S. fisheries appear at subpart H of 50 CFR part 600.

4.4 Purpose and Need for Action

The purpose of this action is to determine whether grenadiers need federal conservation and management and, if so, determine the appropriate way to manage grenadiers in the BSAI and GOA. Management will provide additional protection for grenadiers in the BSAI and GOA from the potential adverse effects of groundfish fisheries and improve the reporting and catch accounting of grenadiers. As FMP species, the Council and NMFS can adopt management measures designed to improve the protection, conservation, and catch and disposition accounting of grenadiers.

The Council and NMFS are considering federal conservation and management for grenadiers because, although grenadiers have not been managed as an FMP species since 1980, there is no longer a valid scientific reason to exclude them. Bottom trawl surveys have shown giant grenadier is the most abundant species at depths 200 m to 1,000 m on the continental slope of the GOA, eastern Bering Sea, and Aleutian Islands. Hence, it is of great ecological importance in this habitat. Based on this ecological importance alone, giant grenadier should be managed under the FMPs. This is especially true given the current emphasis on ecosystem management by NMFS and the recommendations in the Magnuson-Stevens Act to implement ecosystem management. Moreover, giant grenadier is taken in relatively large amounts as bycatch, especially in hook-and-line fisheries for sablefish, halibut, and Greenland turbot. The giant grenadier catch is nearly all (more than 99 percent) discarded, and discard mortality is 100 percent. If giant grenadier were included in the FMPs, reporting of catches would be mandatory and this would result in more accurate catch estimates than the present estimates that are based exclusively on observer data. Inclusion in the FMPs would also serve to more accurately document giant grenadier bycatch and discard waste in a formal manner.

4.5 Background

4.5.1 Grenadiers

At present, there is no directed fishery for grenadiers in the waters off Alaska. However, grenadiers are taken incidentally in several fisheries. Historically, grenadier catch in the federally managed fishery off Alaska has occurred in groundfish hook-and-line sector (Clausen and Gaichas 2005). In the Aleutian Islands, most grenadier catch has historically been taken in the sablefish hook-and-line fishery, while in the Bering Sea the majority came from the Greenland turbot hook-and-line fishery. In recent years, however, many sablefish and Greenland turbot fishermen in the BSAI have switched to using pots to protect their catches from whale depredation. In 2011, 60 percent of the fixed-gear eastern Bering Sea catch of sablefish was taken in pots (Hanselman et al. 2011), and it is uncertain how this change has affected grenadier catches in this area. However, analysis of sablefish pot catches in the BSAI indicates that giant grenadier is the fourth most abundant incidental catch species (Hanselman et al. 2009).

From 2003 through 2013, catches in the eastern Bering Sea have ranged from 1,482 mt (2013) to 4,240 mt (2011), and have averaged 2,597 mt annually (see Table 3.5). Similarly, catches in the Aleutian Islands have ranged from 1,545 mt (2007) to 4,570 mt (2012) and have averaged 2,697 mt annually. Catches in the eastern Bering Sea and Aleutian Islands combined have averaged 5,294 mt annually from 2003 through 2013.

Catches in the BSAI are consistently lower than catches in the GOA. Catches in the GOA have ranged from 5,765 mt (2010) to 11,341mt (2008) and have averaged 8,707 mt annually. The geographical distribution of BSAI grenadier catch, since identification in observer records began, is shown in Figure 3-6 and is closely associated with the shelf break bathymetry. Nearly all the grenadier catch is discarded, and the discard mortality rate is 100 percent because the pressure difference experienced by the fish when they are brought to the surface invariably causes death.

Because of the large biomass of giant grenadier on the continental slope, research has been done to develop marketable products from this species (Crapo et al. 1999a and 1999b). There have been several known attempts to develop a fishery off Alaska. The first, at the Port of Kodiak in 1998[21], was an endeavor to process hook-and-line-caught giant grenadier for surimi. This small effort was apparently unsuccessful, as it ended in 1999. The second, also from the Port of Kodiak, was an exploratory effort in 2005 using trawls to target giant grenadier and develop a fillet and roe market.[22] This second venture was not continued in 2006. From 2009 to 2011 approximately 1,400 mt of incidentally caught grenadier were retained for processing.[23] Anecdotal evidence from industry indicates that at least some of this catch was sold as headed and gutted and tail off; however, giant grenadiers have little or no value at present.

The SSC commented, in December of 2013, that this analysis should consider more information on fisheries for grenadiers world-wide. In particular information on Russian and Japanese grenadier fisheries would be a useful addition. The SSC also requested a treatment of the feasibility of processing grenadiers as alternative product forms, such as meal. For instance, the SSC understands that the Japanese may use grenadiers to produce a gelatin product and public testimony suggested that the Russians may produce other forms, such as fish cakes.

NOAA fisheries stock assessment authors are familiar with the Russian grenadier harvests and provided a report from colleagues in Russia. However, the Russian data is not officially published and does not differentiate by grenadier species and Russian scientists cannot determine whether any of the Russian grenadier catch that was marketed was giant grenadier[24]. It is possible that other grenadier species, such as Pacific grenadier are marketed in Russia; however, this action, while including Pacific grenadiers, seeks to address the giant grenadier species, which comprises nearly all of the catch of grenadiers off of Alaska.

It is true that some grenadier species were used in the past to make a surimi product. However, the low protein and low lipid content of giant grenadiers limits their use in surimi and fish meal production. In recent times, giant grenadiers have not been produced into meal or surimi, as production of surimi primarily uses Alaska Pollock[25] and meal production uses waste from the groundfish fishery. The high moisture content of giant grenadiers (in excess of 90 percent) severely limits their potential use in meal production because of the energy requirement to dry the product. There are simply other inputs available for meal production that are more cost effective[26].

[21] J. Ferdinand, National Marine Fisheries Service, Alaska Fisheries Science Center, REFM Division, 7600 Sand Point Way NE, Seattle WA 98115-0070. Personal communication, September 2004.
[22] T. Pearson, Kodiak Fisheries Research Center, National Marine Fisheries Service, Sustainable Fisheries, 302 Trident Way, Room 212, Kodiak AK 99615. Personal communication, October 2005.
[23] J. Keaton, National Marine Fisheries Service, Regional Office, P.O. Box 21668, 709 W. 9th St., Juneau, AK, 99802-1668, Personal communication, October 2012.
[24] Personal Communication via e-mail (December 13, 2013), Cara Rodgveller, NOAA Fisheries, Alaska Fisheries Science Center. Personal Communication via e-mail (December 13, 2013), Alexie Orlov, Russian Federal Research Institute of Fisheries and Oceanography, Moscow, Russia.
[25] Public Testimony at the December 2013 Council meeting: Merrick Burden, Marine Conservation Alliance.
[26] Personal Communication via interview, at December 2013 Council meeting: Chad See, Freezer Longline Coalition.

4.5.2 Groundfish Management

The proposed action alternatives being considered would apply to all BSAI and GOA Federal groundfish fisheries inclusive of all gear types used to harvest groundfish. As has been mentioned above, grenadier incidental catch has historically occurred primarily in the hook-and-line gear class; however, the pot gear and trawl gear sectors also contribute to the incidental catch of grenadiers. Each of these fishing sectors is thoroughly described in "Fishing Fleet Profiles," prepared by Council staff in April of 2012 (NPFMC 2012c), which is incorporated by reference here.

The potential impacts of the proposed actions will depend largely on decisions made by the Council in future annual catch specifications processes. In the BSAI, the sum of all total allowable catch (TAC) cannot exceed 2.0 million mt annually; however, there is no similar constraint in the GOA. Thus, any alternative that requires the Council to set a grenadier TAC in the BSAI will require reduction in the TAC of some other species so as to "fund" the grenadier TAC such that the cumulative total TAC remains under 2.0 million mt. In contrast, a grenadier TAC in the GOA can be set without impact on other TAC specifications.

The annual TAC specifications process is quite complex. This process involves assessment authors developing and presenting stock models to the Council's Groundfish Plan Teams in September. The assessments and models are also reviewed by the Council's SSC and there are further Groundfish Plan Team reviews in November. The Council's SSC provides a final review in December, including recommendation of TAC ranges by species. Ultimately, the Council reviews the SSC recommendations, along with recommendations from the Council's Advisory Panel and chooses TAC levels for each species based on this input as well as input from the public. Clearly, it is not possible to predict future outcomes of this process, as they depend on biologic and socioeconomic conditions as well as a thorough public process. Thus, it is not possible to quantify the potential impacts that setting a grenadier TAC in the BSAI may have as those impacts will be determined in future annual TAC setting processes.

4.6 Alternatives

The alternatives evaluated in this analysis were adopted by the Council in December of 2013. The action alternatives considered would include grenadiers in the FMPs either as "ecosystem component" species or as "in the fishery" as a potential target species group. The alternatives also now apply separately at the FMP level: an alternative will need to be selected for the BSAI FMP and for the GOA FMP.

Under both the action alternatives, grenadier species are aggregated due to a lack of data necessary to evaluate potential effects of breaking the species out separately. Giant grenadier are by far the most common grenadier caught in the fisheries and surveys off Alaska and are used as a proxy for the entire grenadier complex in the grenadier stock assessment. Popeye and Pacific grenadiers do not commonly occur in the surveys and are seldom caught in the commercial fisheries because they inhabit depths greater than where the commercial fisheries occur and at depths infrequently sampled by the surveys.

A comprehensive discussion of the alternatives, including the management and enforcement actions needed to implement each of the alternatives is contained in Section 2. A brief summary of each alternative is provided here.

Alternative 1: **No action (Status Quo).**

Under this alternative, grenadiers are not federally managed and are not included in the groundfish FMPs. Unmanaged targeted fishing is not prohibited and there are no catch or retention limits for grenadiers, thus unlimited amounts may be taken and sold. There are no reporting or recordkeeping requirements for grenadiers, and currently the best estimate of catch comes from observer data. Vessels which have a Federal Fisheries Permit may use retained grenadiers as a basis species for the retention of other groundfish up to the maximum retainable amounts listed in Tables 10 and 11 to part 679, for the GOA and BSAI.

Under Alternative 1, NMFS has no catch limitations or any recordkeeping or mandatory reporting requirements for grenadiers. Observer program data collection would continue to provide some catch data. Importantly, under Alternative 1, nothing prevents directed fishing for grenadiers and any directed fishery would not be subject to federal management.

Alternative 2 , Preliminary Preferred Alternative: **Include grenadiers in the FMP as an Ecosystem Component species.**

This alternative would manage grenadiers in ecosystem component category under the FMP. The term "ecosystem component" is defined in the final rule to amend National Standard 1 guidelines (74 FR 3178, January 16, 2009). According to the National Standard 1 guidelines, in order to be designated as an "ecosystem component" (EC), the species or species group should be

- a non-targeted species or species group;
- not subject to overfishing, overfished, or approaching an overfished condition;
- not likely to become subject to overfishing or overfished in the absence of conservation and management measures; and
- not generally retained (a small amount could be retained) for sale or personal use.

Species may be included in the FMP as an EC for any of the following reasons: for data collection and catch monitoring purposes; for ecosystem considerations related to specification of optimum yield (OY) for the associated fishery; as considerations in the development of conservation and management measures for the associated fishery; or to address other ecosystem concerns. While EC species are not considered to be "in the fishery," the Council should consider measures for the fishery to minimize incidental catch and mortality of EC species consistent with National Standard 9, and to protect their role in the ecosystem. EC species do not require specification of reference points, but should be monitored as new pertinent scientific information becomes available to determine changes in their status or their vulnerability to the fishery.

The catch of EC species is required to be reported for monitoring purposes, and directed fishing for EC species is prohibited. Under the ecosystem component, targeting of these species would not be possible without moving them to "in the fishery" and establishing status determination criteria for these stocks. While grenadiers are currently not targeted commercially, moving them to the ecosystem component would be intended to discourage uncontrolled fishing on these species without applicable management measures in place should they become economically viable in the future. Moving a species from the EC to "in the fishery" would need to be investigated under various situations including when the industry expresses an interest in targeting grenadiers or when retention of grenadiers increases. Based on the available information presented in Sections 2 and 3, grenadiers would meet all four of the criteria described above to qualify for inclusion as an EC species.

Alternative 3: **Include grenadiers in the FMP as "in the fishery."**

This alternative would include grenadiers "in the fishery" as incidental catch species.

The term "in the fishery" is defined in the final rule to amend National Standard 1 guidelines (74 FR 3178, January 16, 2009). Stocks of fish that are "in the fishery" are

- stocks that are targeted, and retained for sale or personal use;
- stocks that are not directly targeted but are taken incidentally in other directed fisheries and are retained for sale or personal use; and
- stocks not targeted or retained but are taken as incidental catch and for which overfishing or overfished status may be a concern.

For each stock "in the fishery", whether a single species or species group, OFLs, ABCs, and TACs must be established each year in the annual harvest specifications process. In order for separate species to be aggregated together and managed as a species group, the species should have a similar geographic distribution, life history, and vulnerability. Recordkeeping and reporting of grenadier catch would be required and other management measures discussed below would need to be adopted. Based on the available information, grenadiers may qualify for inclusion in the fishery. However, it should be noted that the retention of grenadiers for sale or personal use is not known to commonly occur for these species (see Section 3.3.4 and Section 4.5.1 for additional detail on fishery markets). Additionally, information available on current harvest rates does not indicate that there is a concern that grenadiers are subject to overfishing or are currently in an overfished status (see Tables 3-2, 3-3, and 3-4).

4.7 Potential Effects of the Alternatives

Alternative 1: The status quo

Under Alternative 1, the status quo, grenadiers would continue as non-FMP species without any harvest limitations or recordkeeping and reporting requirements. Since the present and past harvests of grenadiers taken incidentally are well below the current ABCs calculated for grenadiers, and there is presently no market value for Alaska grenadiers, there would be no significant short term effects (either adverse or beneficial) on the stock biomass, fishing mortality, spatial or temporal distribution, or changes in prey availability for grenadier and groundfish target species in either the BSAI or GOA. Thus, there would be no significant short term changes in groundfish harvesting operations and no significant short term changes in the socioeconomic conditions in the commercial groundfish fisheries in the two areas.

Alternative 1; however, retains the possibility for unmanaged targeted fishing of grenadiers to occur. There are presently no restrictions on targeting, retaining, and marketing grenadiers nor are there any recordkeeping and reporting requirements. Thus, were conditions to change, grenadier could be targeted and there would be no required recordkeeping and reporting; however, presumably observer data and landings reports would provide data on retention of grenadiers, albeit with potentially considerable delay (e.g. the Alaska Department of Fish and Game (ADF&G) Commercial Operators Annual Report). Alternative 1 also allows the retention of grenadiers for use as a basis species in retaining other groundfish; however, grenadier can then be discarded at the shoreside plant level as there is no market for grenadier at present.

The accompanying EA presents results of an analysis of Alaska grenadiers' vulnerability to overfishing as well as their importance in the ecology of the ocean. These findings suggest that grenadiers, as a long lived, and deep dwelling, species comprising a large proportion of total biomass at ocean depths they inhabit, are both ecologically important and somewhat vulnerable to overfishing. Alternative 1 provides

no management structure with which to ameliorate the vulnerability of the grenadier stock to the potential for overfishing if a market can be developed and targeted fishing for grenadiers begins to occur.

The Cumulative Effects Section of the accompanying EA identifies several Reasonably Foreseeable Future Actions, or RFFAs. Among these are targeting of grenadiers, development of a directed fishery for grenadiers, increased TACs in target fisheries that catch grenadiers incidentally, and climate change. As these actions have been identified as reasonable expectations in the foreseeable future one must consider what effect these actions might have on fishery socioeconomics, and whether the alternatives address foreseeable effects of these RFFAs.

Present and past harvests of grenadiers, taken incidentally, are well below the current ABCs calculated for grenadiers, and there is presently no market value for Alaska grenadier. Were a market to develop; however, Alternative 1 would allow unlimited targeting of grenadier without any formal management structure in place to prevent overfishing. It is true that, via observer records, dramatically increased harvest and retention of grenadiers would become obvious fairly quickly; however, development and implementation of management measures to monitor and control the fishery could take many years (the reader is referred to EA section 1.2: The history of this Action). Thus, while Alternative 1 provides the possibility of allowing future revenue increases via unmanaged targeted fishing of grenadiers it provides none of the management structure needed to ameliorate the risk of overfishing nor to sustainably manage the grenadier stock to promote its sustainability and the sustainability of other species with which grenadier may have important ecological interactions.

Increased TAC in target fisheries where grenadiers are caught incidentally is also identified as an RFFA. In such cases, the additional fishing effort (gear deployed) would increase in order to harvest the larger TAC amount. As a result, interactions with grenadiers would be expected to increase thereby increasing grenadier incidental catch. Were this to occur, under the status quo, removals of grenadiers could increase without any required recordkeeping or reporting and, under present market conditions, most, if not all, of that increased grenadier incidental catch would be discarded. While the potential risk of increased removals of grenadiers due to increased TACs in other groundfish targets is smaller than the risk of overfishing if targeting of grenadiers were to occur, it still represents unmitigated risk in a changing future.

The last RFFA identified in the accompanying EA is climate change. While it is not known what the exact effect climate change may have on grenadier stocks, it is possible that changing ocean conditions, such as salinity, temperature, and acidity, may affect grenadiers in several life stages and as they move through the water column to feed. This is partly due to the lack of comprehensive harvest information collection on grenadiers that is perpetuated under the status quo.

Alternative 2, Preliminary Preferred Alternative: Grenadiers in the Groundfish FMPs as "Ecosystem Component" species.

Under Alternative 2, which would include grenadier in the groundfish FMPs as "ecosystem component" species, OFLs, ABCs, and TACs, would **NOT** need to be established. However, other management measures could be, and recordkeeping and reporting requirements would need to be established for grenadiers. Since the present and past harvests of grenadiers taken incidentally are well below the current ABCs calculated for grenadiers, there would be no significant effects (either adverse or beneficial) on the stock biomass, fishing mortality, spatial or temporal distribution, or changes in prey availability for grenadier and groundfish target species in either the BSAI or GOA. There would be no significant (either beneficial or adverse) socioeconomic effects on those who harvest grenadiers or other groundfish targets in either the BSAI or GOA.

It is true that Alternatives 2 will impose new recordkeeping and reporting requirements on the groundfish fishing industry, as well as additional fisheries management processes; however, given the small relative amount of grenadier incidental catch these reporting requirements will have *de-minimus* effects on fishery participants. Similarly, grenadier stock assessments are presently being conducted and the additional burden on NMFS of new grenadier management measures will have *de-minimus* impacts.

In contrast to Alternative 1, Alternative 2 prevents targeting of grenadiers and prevents a "directed fishery" from being developed as well. Alternative 2 would allow management structure needed to ameliorate the risk of overfishing and to sustainably manage the grenadier stock. Were a market for grenadiers to be developed, Alternative 2 would allow a "small amount" of grenadier to be retained and marketed; however, establishing a formal directed fishery would require further regulatory action. Alternative 2 would also prevent use of grenadier incidental catch as a basis species for retention of other groundfish. Thus, while Alternative 2 does not allow unlimited grenadier harvests and associated revenue, it does provide the management structure needed to ameliorate the risk of overfishing and to sustainably manage the grenadier stock to potentially promote its sustainability.

Under Alternative 2, increased TAC in target fisheries where grenadiers are caught incidentally and the resulting increase in grenadier incidental catch would be monitored via recordkeeping and reporting requirements. Thus, Alternative 2 provides management structure necessary to monitor grenadier removals under changing future conditions. Similarly, Alternative 2 offers a management structure under which information can be collected to improve understanding of stock structure thereby improving understanding of the potential effects of future climate change on stock structure.

Alternative 3: Grenadiers in the Groundfish FMPs as "in the Fishery"

Under Alternative 3, which would include grenadiers in the groundfish FMPs as "in the fishery," OFLs, ABCs, TACs, other management measures, and recordkeeping and reporting requirements would need to be established for grenadiers in both the BSAI and the GOA. Alternative 3 could allow retention, subject to potential MRA restrictions (see Section 2), and marketing of incidentally caught grenadier. In contrast to Alternative 2, were a market to develop, a "directed fishery" could be allowed as part of the annual TAC specifications process without further regulatory action. Thus, Alternative 3 provides the management structure needed to ameliorate the risk of overfishing and to sustainably manage the grenadier stock to potentially promote its sustainable harvest in a future "directed fishery".

Under Alternative 3, increased TAC in target fisheries where grenadiers are caught incidentally and the resulting increase in grenadier incidental catch would be monitored via recordkeeping and reporting requirements. Thus, Alternative 3 provides management structure necessary to monitor grenadier removals under changing future conditions. Similarly, Alternative 3 offers a management structure under which information can be collected to improve understanding of stock structure thereby improving understanding of the potential effects of future climate change on stock structure.

At present, the OY cap established in the Groundfish FMP for the GOA is substantially greater than the total of all GOA TACs. Thus, placing grenadier "in the fishery" in the GOA does not require "funding" of grenadier TAC via reductions in TACs of any other groundfish species. Further, since the present and past harvests of grenadiers taken incidentally are well below the current ABCs calculated for grenadiers, there would be no significant effects (either adverse or beneficial) on the stock biomass, fishing mortality, spatial or temporal distribution, or changes in prey availability for grenadier and groundfish target species in the GOA. There would be no significant (either beneficial or adverse) socioeconomic effects on those who harvest grenadiers or other groundfish targets in the GOA.

In contrast to the potential effects of Alternative 3 in the GOA, placing grenadiers "in the fishery" in the BSAI FMP may have adverse effects on fishery total revenue in the short term. The BSAI Groundfish FMP specifies a total OY cap of 2 million mt. The total of all BSAI groundfish TACs may not exceed this 2 million mt cap. Thus, placing BSAI grenadiers "in the fishery" means that grenadier incidental catch would have to be "funded" from reduced TAC of other, presently valuable, BSAI groundfish species.

The actual amount of reduction in TAC that may occur in other BSAI groundfish target fisheries with grenadiers "in the fishery" in the BSAI are unknown. Each year, the annual stock assessments are prepared and revised over the course of two Groundfish Plan Team meetings and then presented, along with TAC range recommendations, to the Council in December. It is in that TAC setting process that changes in TAC levels are proposed and revisions to the TAC specifications are made in order not to exceed the overall maximum of 2.0 million mt in the BSAI. Thus, it is not possible to estimate what proportion of grenadier TAC would be specified from each of the other target fisheries in the BSAI. However, to put the potential impacts in perspective, consider that if the grenadier TAC in the BSAI were set at, for example, the estimated mean 2003 through 2013 incidental catch level of 5,294 mt, the cumulative TACs for other groundfish species would be reduced by as little as 0.26 percent.

In September of 2013, the BSAI and GOA groundfish plan teams reviewed a preliminary draft of this analysis and provided the following comments in their meeting minutes:

"The description of lost revenue could be presented in different ways, such as, proportional reduction of other groundfish TACs (based on current rates of harvest in each fishery) to accommodate added grenadier TACs. Consider adding analysis of bycatch rates of grenadiers in different groundfish fisheries."[27]

Proportion, in percent, of Grenadier catch in the BSAI, by target species / species group is presented in Table 4-1, below. The highest proportions of BSAI grenadier catch tend to occur in the sablefish, Greenland turbot, and flatfish targets. However, in some years the halibut target fishery takes a substantial portion of the BSAI grenadier catch. Similarly, the Pacific cod fishery has taken as much as 16 percent (2011) of the BSAI grenadier catch total. On average, the Greenland turbot fishery takes the largest proportion of BSAI grenadier incidental catch (30%) with sablefish taking a close second (24%). The next largest catch proportion occurs, on average, in the flatfish fishery (15%). The halibut target fishery accounts for 13 percent of the BSAI grenadier catch, on average, while the Pacific cod target fishery accounts for 7 percent. Finally, the rockfish fishery accounts for 2 percent and the other species group accounts for 3 percent, on average, of the incidental catch of BSAI grenadier.

[27] see joint Groundfish Plan Team meeting minutes available at: http://www.alaskafisheries.noaa.gov/npfmc/PDFdocuments/membership/PlanTeam/Groundfish/JOINT913minutes.pdf

Table 4-1: Proportional BSAI grenadier catch (% of total), TAC reduction (mt), and hypothetical revenue Impacts ($ millions and % of total) by target species/species group, 2003–2013

	Target species/species group						
Year	Sablefish	G. turbot	Halibut	Other flat	P. cod	Rockfish	Other sp.
Proportion of BSAI Grenadier Catch							
2003	41%	24%	27%	2%	4%	0%	1%
2004	30%	38%	19%	2%	7%	2%	1%
2005	25%	48%	17%	1%	8%	1%	1%
2006	35%	36%	8%	11%	6%	4%	0%
2007	34%	45%	5%	4%	7%	1%	5%
2008	14%	14%	49%	9%	3%	1%	9%
2009	29%	34%	5%	24%	3%	3%	1%
2010	16%	32%	5%	29%	10%	5%	3%
2011	22%	27%	2%	27%	16%	5%	2%
2012	17%	20%	2%	47%	8%	1%	6%
2013	31%	12%	13%	25%	7%	6%	5%
Average	24%	30%	13%	15%	7%	2%	3%
Average Proportional TAC Reduction/deficit to Fund Grenadier Incidental Catch at Historic Levels							
High: 7,484	1,823	2,254	1,006	1,114	541	162	195
Av: 5,294	1,289	1,595	712	788	383	115	138
Low: 3,174	773	956	427	472	230	69	83
Hypothetical Revenue Impacts ($ millions) in 2012 Total Product Value ($ per round mt)							
High: 7,484	$15.6	$2.0	n/a	$1.0	$0.7	$0.3	$0.2
Av: 5,294	$11.0	$1.4	n/a	$0.7	$0.5	$0.2	$0.1
Low: 3,174	$6.6	$0.8	n/a	$0.4	$0.3	$0.1	$0.1
BSAI TAC by Target Species/Species Group							
2012	4,280	8,660	n/a	20,900	261,000	31,338	31,000
Hypothetical Revenue Impacts as a percent of Target species/species group 2012 Total Product Value							
High: 7,484	42.6%	26.0%	n/a	5.3%	0.2%	0.5%	0.6%
Av: 5,294	30.1%	18.4%	n/a	3.8%	0.1%	0.4%	0.4%
Low: 3,174	18.1%	11.0%	n/a	2.3%	0.1%	0.2%	0.3%

Also presented in Table 4-1 are average proportional TAC reductions that would be necessary to "fund" BSAI grenadier incidental catch at historical high, low, and average levels. This is simply the target species/species group grenadier incidental catch average multiplied by the historic incidental catch amount. As expected from the distribution of averages, the highest values are in the Greenland turbot, sablefish, flatfish, and halibut target species/species groups. Note; however, that the halibut target fishery would not be subject to TAC reductions via the annual specifications process. Thus, the proportion of incidental BSAI grenadier catch that occurs in the halibut fishery would have to be made up elsewhere and are, thus, represented here as a "funding" deficit. It is not known what target species/species group TAC might be reduced to address this deficit.

The next panels in Table 4-1 converts the TAC reduction tonnages to hypothetical revenue reductions using the total product value per round metric ton reported in table 27 of the 2012 Economic Safe report[28] and then provide that value as a percent of target fishery total revenue in 2012. Immediately obvious is the substantial amount of revenue that could be lost with proportional "funding" of BSAI grenadier TAC via BSAI sablefish TAC reductions. These impacts range from $6.6 million (18.1%) to $15.6 million (42.6%), while the potential impacts to the Greenland turbot target fishery range from $800,000 (11%) to $2.0 million (26 %). The hypothetical revenue impacts in the other flatfish target fishery range from $400,000 (2.3%) to $1 million (5.3%) with the remaining fisheries having lesser impacts especially when considered as a percent of fishery total revenue. Note that with substantially larger TACs in the Pacific cod, rockfish, and other species target species/species groups the percentage of total fishery revenue potentially lost is less than one percent in each example. Another consideration is that "funding" of BSAI grenadier TAC via reductions in the TACs of target fisheries that have the highest proportions of BSAI grenadier incidental catch will likely reduce BSAI grenadier incidental catch as well. However, due to incomplete reporting of BSAI grenadier catch, at present, it is not possible to estimate the potential magnitude of the effect.

A further consideration is the fact that the 2 million mt TAC cap in the BSAI is not always reached. For example, in the period from 2008 through 2010, BSAI pollock TACs decreased considerably. Reduced BSAI pollock TAC resulted in adoption of BSAI groundfish TACs totaling 1,838,354 mt, 1,681,586 mt, and 1,677,154 mt, in 2008, 2009, and 2010, respectively (see groundfish harvest specification tables at http://alaskafisheries.noaa.gov/sustainablefisheries/). With average annual grenadier catch of approximately 5,320 mt, there would have been considerably more groundfish tonnages available under the 2 million mt cap to fund this level of grenadier catch in these years without affecting TACs for any other BSAI groundfish species. Thus, in three of the past ten years, grenadier catch in the BSAI could have been "funded" with either no reduction in the TACs of other BSAI groundfish species, or with less than two tenths of a percent reduction in other TACs.

The period of lower than normal BSAI groundfish TACs between 2008 and 2010 appears to be somewhat anomalous. Total BSAI TAC has fallen below 2 million mt in only two other years (1992 and 1993; by 145 and 3,380 tons, respectively)[29], since implementation in the early 1980's. Nonetheless, were future variability in groundfish stocks to result in total BSAI TACs significantly lower than 2 million mt tons then, were a market for grenadier products to develop, retention of incidental catch and/or directed fishing of grenadier in the BSAI could improve optimal yield from the BSAI fishery in times of decreased stock abundance of other groundfish species, all else equal. Thus, placing grenadiers "in the fishery" in the BSAI may offer the potential for improved future benefits to the nation.

It is important to recognize that these hypothetical impacts would be spread across all Federal groundfish participants, including BSAI Community Development Quota (CDQ) entities, via the allocations made to sectors in the TAC specifications process. Thus, the impacts of funding a grenadier TAC, if any, would be borne by all harvesting platforms in an affected sector and gear type, further ameliorating potential impacts. These hypothetical examples show that the likely potential economic impacts of having grenadiers "in the fishery" in the BSAI are not significant in comparison to the overall value of the BSAI groundfish fishery; however, the impacts may be significant to individual operators and/or target fishery sectors depending on how the grenadier TAC would be funded.

As with Alternatives 2, Alternative 3 will impose new recordkeeping and reporting requirements on the groundfish fishing industry, as well as additional fisheries management processes; however, given the small relative amount of grenadier incidental catch these reporting requirements will have *de-minimus*

[28] Available at: http://www.afsc.noaa.gov/refm/stocks/plan_team/economic.pdf
[29] Data Available at: http://alaskafisheries.noaa.gov/sustainablefisheries

effects on fishery participants. Similarly, grenadier stock assessments are presently being conducted and the additional burden on NMFS of new grenadier management measures will have *de-minimus* impacts.

4.8 Effects on Net Benefits to the Nation

Under Alternative 1, the no action alternative, grenadiers would continue as non-FMP species without any harvest limitations or recordkeeping and reporting requirements. Since the present and past harvests of grenadiers taken incidentally are well below the current ABCs calculated for grenadiers, there would be no significant effects (either adverse or beneficial) on the stock biomass, fishing mortality, spatial or temporal distribution, or changes in prey availability for grenadier and groundfish target species in either the BSAI or GOA. Thus, there would be no significant short term change in groundfish harvesting operations and no significant short term changes in the socioeconomic conditions in the commercial groundfish fisheries in the two areas.

Alternative 1 would allow unlimited targeting of grenadier without any formal management structure in place to prevent overfishing. Thus, while Alternative 1 provides the possibility of allowing future revenue increases via unchecked targeted fishing of grenadiers it provides none of the management structure needed to ameliorate the risk of overfishing nor to sustainably manage the grenadier stock to promote its sustainability and the sustainability of other species with which grenadier may have important ecological interactions. Thus while Alternative 1 appears to have no short term adverse effects on net national benefits it does nothing to mitigate risks of non-management of grenadier stocks.

Net benefits are not expected to decrease, in the near term, under Alternative 2. Alternative 2 does not affect current fishery revenue, as grenadiers are not currently marketable. However, Alternative 2 does not allow a directed fishery to develop without further regulatory action, thus potentially constraining future revenue potential should a market develop for grenadiers. Alternative 2 does provide enhancements to species monitoring and management that, while not quantifiable, are considered to be beneficial. Alternative 2 also ameliorates the risks of non-management of grenadiers that would continue under the status quo.

Under Alternative 3, grenadiers are defined as "in the fishery," with all of the associated management structure required under the MSA. Grenadier would be assessed under the calculation of OY, which is constrained at 2 million mt of TAC in the BSAI. The GOA OY cap far exceeds the sum of all GOA TACs and is nonbinding. This creates an immediate need to reduce TAC of some other BSAI groundfish species (or group of groundfish species) in order to add grenadier TAC to the annual specifications. Given that grenadier is currently valueless, this will decrease groundfish revenue in the short run unless a market for grenadier can be established. However, as a result of protecting the biomass, it is hoped that establishing grenadier TAC in the BSAI and GOA may lead to greater gross revenues from a sustainable fishery in the longer term. Further, given the large biomass of grenadier it is possible that, if a market is developed, grenadier catch could be taken in years when the BSAI TAC total is less than 2 million mt, thus contributing to enhancing OY in such years, rare as they may be. Similar to Alternative 2, Alternative 3 also ameliorates the risks of non-management of grenadiers that would continue under the status quo, and extends management to include the potential for a "directed fishery" to develop.

5 Initial Regulatory Flexibility Analysis

5.1 Introduction: The Purpose of an IRFA

This initial regulatory flexibility analysis (IRFA) evaluates the impacts on directly regulated small entities of the proposed action to include grenadiers in the Fishery Management Plan for Groundfish of the Bering Sea and Aleutian Islands Management Area (BSAI groundfish FMP) and the Fishery Management Plan for Groundfish of the Gulf of Alaska (GOA groundfish FMP). This IRFA addresses the statutory requirements of the Regulatory Flexibility Act (RFA) of 1980, as amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (5 U.S.C. 601-612).

The RFA, first enacted in 1980, was designed to place the burden on the government to review all regulations to ensure that, while accomplishing their intended purposes, they do not unduly inhibit the ability of small entities to compete. The RFA recognizes that the size of a business, unit of government, or nonprofit organization frequently has a bearing on its ability to comply with a Federal regulation. Major goals of the RFA are 1) to increase agency awareness and understanding of the impact of their regulations on small business, 2) to require that agencies communicate and explain their findings to the public, and 3) to encourage agencies to use flexibility and to provide regulatory relief to small entities.

The RFA emphasizes predicting significant adverse economic impacts on small entities as a group distinct from other entities, and on the consideration of alternatives that may minimize adverse economic impacts, while still achieving the stated objective of the action. When an agency publishes a proposed rule, it must either "certify" that the action will not have a significant adverse economic impact on a substantial number of small entities, and support that certification with the "factual basis" upon which the decision is based; or it must prepare and make available for public review an IRFA. When an agency publishes a final rule, it must prepare a Final Regulatory Flexibility Analysis.

In determining the scope, or "universe," of the entities to be considered in an IRFA, NMFS generally includes only those entities that are directly regulated by the proposed action. If the effects of the rule fall primarily on a distinct segment, or portion thereof, of the industry (e.g., user group, gear type, geographic area), that segment would be considered the universe for the purpose of this analysis. NMFS interprets the intent of the RFA to address adverse economic impacts, not beneficial impacts, and thus such a focus exists in analyses that are designed to address RFA compliance.

Data on cost structure, affiliation, and operational procedures and strategies in the fishing sectors subject to the proposed regulatory action are insufficient, at present, to permit preparation of a "factual basis" upon which to certify that the alternatives considered do not have the potential to result in "significant economic impacts on a substantial number of small entities" (as those terms are defined under the RFA). Based on all available information, it is not possible to "certify" this outcome, should one of the action alternatives be adopted.

5.2 What is Required in an IRFA

Until the North Pacific Fishery Management Council (Council) makes a final decision on a preferred alternative, a definitive assessment of the proposed management alternatives cannot be conducted. In order to allow the agency to make a certification decision, or to satisfy the requirements of an IRFA of the preferred alternative, this section addresses the requirements for an IRFA. Under 5 U.S.C. section 603(b) of the RFA, each IRFA is required to contain:

- A description of the reasons why action by the agency is being considered;
- A succinct statement of the objectives of, and the legal basis for, the proposed rule;
- A description of and, where feasible, an estimate of the number of small entities to which the proposed rule will apply (including a profile of the industry divided into industry segments, if appropriate);
- A description of the projected reporting, record keeping, and other compliance requirements of the proposed rule, including an estimate of the classes of small entities that will be subject to the requirement and the type of professional skills necessary for preparation of the report or record;
- An identification, to the extent practicable, of all relevant Federal rules that may duplicate, overlap, or conflict with the proposed rule;
- A description of any significant alternatives to the proposed rule that accomplish the stated objectives of the proposed action, consistent with applicable statutes, and that would minimize any significant economic impact of the proposed rule on small entities. Consistent with the stated objectives of applicable statutes, the analysis shall discuss significant alternatives, such as:
    1. The establishment of differing compliance or reporting requirements or timetables that take into account the resources available to small entities;
    2. The clarification, consolidation, or simplification of compliance and reporting requirements under the rule for such small entities;
    3. The use of performance rather than design standards;
    4. An exemption from coverage of the rule, or any part thereof, for such small entities.

In preparing an IRFA, an agency may provide either a quantifiable or numerical description of the effects of a proposed action (and alternatives to the proposed action), or more general descriptive statements, if quantification is not practicable or reliable.

5.3 Definition of a Small Entity

The RFA recognizes and defines three kinds of small entities: 1) small businesses, 2) small non-profit organizations, and 3) small government jurisdictions.

Small businesses. Section 601(3) of the RFA defines a "small business" as having the same meaning as "small business concern," which is defined under Section 3 of the Small Business Act (SBA). "Small business" or "small business concern" includes any firm that is independently owned and operated and not dominant in its field of operation. The SBA has further defined a "small business concern" as one "organized for profit, with a place of business located in the United States, and which operates primarily within the United States or which makes a significant contribution to the U.S. economy through payment of taxes or use of American products, materials or labor… . A small business concern may be in the legal form of an individual proprietorship, partnership, limited liability company, corporation, joint venture, association, trust or cooperative, except that where the firm is a joint venture there can be no more than 49 percent participation by foreign business entities in the joint venture."

The SBA has established size criteria for all major industry sectors in the United States, including fish harvesting and fish processing businesses. Effective July 22nd, 2013, a business involved in fin-fish harvesting is a small business if it is independently owned and operated, not dominant in its field of operation (including its affiliates), and if it has combined annual gross receipts not in excess of $19.0 million from all economic activities , including operations worldwide.[30] A seafood processor is a small

[30] SBA updated the Gross Annual Receipts thresholds (78 FR 37398, June 20, 2013, effective July 22, 2013) for determining "small entity" status in finfish harvesting under the RFA. This is a periodic action to account for the impact of economic inflation. The revised threshold for "commercial finfish-fishing" operations (which, at present, has been determined by NMFS to include catcher/processors, as well as catcher vessels) changed from $4.0

business if it is independently owned and operated, not dominant in its field of operation, and employs 500 or fewer persons on a full-time, part-time, temporary, or other basis, at all its affiliated operations worldwide. A business involved in both the harvesting and processing of finfish products is a small business if it meets the $19.0 million criterion for fin fish harvesting operations. Finally, a wholesale business servicing the fishing industry is a small business if it employs 100 or fewer persons on a full-time, part-time, temporary, or other basis, at all its affiliated operations worldwide.

The SBA has established "principles of affiliation" to determine whether a business concern is "independently owned and operated." In general, business concerns are affiliates of each other when one concern controls or has the power to control the other or a third party controls or has the power to control both. The SBA considers factors such as ownership, management, previous relationships with or ties to another concern, and contractual relationships, in determining whether affiliation exists. Individuals or firms that have identical or substantially identical business or economic interests, such as family members, persons with common investments, or firms that are economically dependent through contractual or other relationships, are treated as one party with such interests aggregated when measuring the size of the concern in question. The SBA counts the receipts or employees of the concern whose size is at issue and those of all its domestic and foreign affiliates, regardless of whether the affiliates are organized for profit, in determining the concern's size. However, business concerns owned and controlled by Indian Tribes, Alaska Regional or Village Corporations organized pursuant to the Alaska Native Claims Settlement Act (43 U.S.C. 1601), Native Hawaiian Organizations, or Community Development Corporations authorized by 42 U.S.C. 9805 are not considered affiliates of such entities, or with other concerns owned by these entities solely because of their common ownership.

Affiliation may be based on stock ownership when 1) a person is an affiliate of a concern if the person owns or controls, or has the power to control 50 percent or more of its voting stock, or a block of stock which affords control because it is large compared to other outstanding blocks of stock, or 2) if two or more persons each owns, controls or has the power to control less than 50 percent of the voting stock of a concern, with minority holdings that are equal or approximately equal in size, but the aggregate of these minority holdings is large as compared with any other stock holding, each such person is presumed to be an affiliate of the concern.

Affiliation may be based on common management or joint venture arrangements. Affiliation arises where one or more officers, directors, or general partners, controls the board of directors and/or the management of another concern. Parties to a joint venture also may be affiliates. A contractor and subcontractor are treated as joint venturers if the ostensible subcontractor will perform primary and vital requirements of a contract or if the prime contractor is unusually reliant upon the ostensible subcontractor. All requirements of the contract are considered in reviewing such relationship, including contract management, technical responsibilities, and the percentage of subcontracted work.

Small organizations. The RFA defines "small organizations" as any not-for-profit enterprise that is independently owned and operated, and is not dominant in its field.

Small governmental jurisdictions. The RFA defines "small governmental jurisdictions" as governments of cities, counties, towns, townships, villages, school districts, or special districts with populations of fewer than 50,000.

million to $19.0 million in annual gross receipts, from all its economic activities and affiliated operations, worldwide.

5.4 Reason for Considering the Proposed Action

The Council formulated the following purpose and need statement in December, 2013, to initiate this analysis.

> *Grenadiers are not included in the BSAI or GOA groundfish FMPs. There are no limits on their catch or retention, and no reporting requirements. However, grenadiers are taken as bycatch, especially in longline fisheries; no other Alaskan groundfish has similar levels of catches that is not included in the FMPs. Inclusion in the groundfish FMPs would provide for their precautionary management by, at a minimum, recording their harvest and/or placing limits on their harvest.*

Bottom trawl surveys have shown grenadiers are is the most abundant species at depths 200 m to 1,000 m on the continental slope of the GOA, eastern Bering Sea, and Aleutian Islands. Hence, they are of great ecological importance in this habitat. Based on their ecological importance alone, it appears that grenadier species should be included in the FMPs. This is especially true given the current emphasis on ecosystem management by NMFS, and the recommendations in the Magnuson-Stevens Act to implement ecosystem management. Moreover, giant grenadier are taken in relatively large amounts as bycatch, especially in hook-and-line fisheries for sablefish and Greenland turbot. The giant grenadier are nearly all (more than 99 percent) discarded, and discard mortality is 100 percent. If giant grenadier were included in the FMPs, reporting of catches would be mandatory, and this would result in more accurate catch estimates than the present estimates that are based exclusively on observer data. Inclusion in the FMPs would also serve to address the problem of giant grenadier bycatch and discard waste in a formalized manner.

Based on these reasons, grenadier assessment authors, the BSAI and GOA Groundfish Plan Teams, and the SSC have, in recent years, all recommended that grenadiers be included in the FMPs, where they would be subject to management purview.

5.5 Objectives of Proposed Action and its Legal Basis

Objectives

The objectives of this action are provided in the purpose and need statement contained in the Regulatory Impact Review and are as follows.

- To provide formalized structure for grenadier management in the BSAI and GOA EEZ.
- To include grenadiers in the groundfish FMPs for the BSAI and GOA,
- To provide for precautionary management by, at a minimum, recording grenadier harvest and/or placing limits on their harvest.
- To address the problem of grenadier bycatch and discard waste in a formalized manner.

Legal Basis

NMFS manages the U.S. groundfish fisheries of the BSAI and GOA under the BSAI groundfish FMP and the GOA groundfish FMP. The Council prepared the FMPs, and the Secretary of Commerce approved them, under the authority of the Magnuson-Stevens Act (16 U.S.C. 1801, *et seq.*). Regulations implementing the FMPs are contained in 50 CFR part 679. General regulations that also pertain to U.S. fisheries appear at subpart H of 50 CFR part 600.

5.6 Number and Description of Directly Regulated Small Entities

This action would directly regulate the harvest activities of all catcher vessels and catcher/processors conducting directed fishing for groundfish in the BSAI and GOA management areas. The action would also directly regulate motherships and shoreside processors via requirement that they report grenadier landings, processing on daily production reports, and sale of grenadier products on transfer reports. Under Alternative 2 and 3, all directly regulated harvesting entities would be subject to the grenadier MRA established with the proposed rule and required to report all grenadier catch by species code.

Small business firms, non-profit entities, and small government entities are the appropriate focus of consideration in a regulatory flexibility analysis. This analysis uses fishing vessels as a proxy for business firms. This is a practical response to the relative lack of information currently available on the potentially complex co- or joint-ownership, and various contractual relationships that are believed to exist among multiple vessels operated by individual firms. This approach can lead to overestimates of the numbers of entities, since several vessels may be owned by a single firm; and to an overestimate of the relative proportion of small entities, since more of the smaller vessels might have been treated as large entities, had multiple ownership and/or affiliation structures been identified. No large entities would have been moved to the small entity category as a result of the adoption of this approach.

Many of the vessels active in these fisheries operate in formally established fishing cooperatives. These constitute affiliations within the meaning of the RFA. In this analysis, affiliations among entities participating in cooperatives formed pursuant to Secretarial regulation, including the American Fisheries Act (AFA), Amendment 80 trawl cooperative, GOA Rockfish cooperative[31], and BSAI Crab Rationalization cooperatives, as well as the private voluntary cooperative recently formed among the BSAI Freezer-Longline vessel operators, are expressly taken into account.

Earnings from all fisheries in and off Alaska for 2012 were estimated for trawl catcher/processors and catcher vessels, and non-trawl catcher/processors and catcher vessels that participated in the BSAI and GOA groundfish fisheries. Table 6.1 provides the numbers of BSAI and GOA small entities that would be directly regulated by this action. These small entities had total gross revenue from all fisheries off Alaska of less than $19 million in 2011 and were not affiliated with any of the aforementioned cooperatives, to the best of our knowledge. In the GOA, there were a total of 688 small catcher vessels and 5 small catcher/processors, for a combined total of 693 small GOA entities in 2012. The majority of these (561) are Catcher Vessels in the hook-and-line (HAL) gear type sector. In the BSAI, there were 76 small catcher vessels and 5 small catcher/processors, for a total of 81 small BSAI entities in 2012. The

[31] The Central GOA Rockfish Pilot Program expired on December 31, 2011. The Council's Amendment 88 to the GOA FMP replaced the Pilot Program with a new Rockfish Program that carried forward key elements of the older Pilot Program, while making changes to fix problems that had been identified. In 2011, NMFS published the Notice of Availability for the FMP amendment and the final rule (76 FR 45217, July 28, 2011; 76 FR 81248, December 27, 2011). The effective date for this action was December 27, 2011. Because of the similarities between the programs, the experience during the Pilot Program in 2011 is used to evaluate the small entity status of vessels that are members of Rockfish Program cooperatives.

combined total for all of the EEZ groundfish fisheries is 725 small catcher vessels and 10 small catcher/processors, or 735 small groundfish vessels, directly regulated by this action, in 2012.

Through the CDQ program, the Council and NMFS allocate a portion of the BSAI groundfish TACs, and apportion prohibited species halibut and crab PSC limits, to 65 eligible Western Alaska communities. These communities work through six non-profit CDQ groups, and are required to use the proceeds from the CDQ allocations to start or support activities that will result in ongoing, regionally based, commercial fishery or related businesses. The CDQ groups receive allocations through the specifications process, and are directly regulated by this action, but the 65 communities are not directly regulated. Because they are explicitly defined as small nonprofit entities within the MSA, the CDQ groups are small entities for purposes of this analysis.

Table 5-1: Number of non-affiliated groundfish vessels that caught or caught and processed less than $19.0 million ex-vessel value or first wholesale product value of groundfish and other species by area, vessel type, and gear, 2012

		Gulf of Alaska			Bering Sea and Aleutians			All Alaska		
		Catcher Vessels	Catcher/ Processors	All Vessels	Catcher Vessels	Catcher/ Processors	All Vessels	Catcher Vessels	Catcher/ Processors	All Vessels
2012	HAL	561	4	565	31	3	34	576	7	583
	POT	119		119	26	3	29	135	3	138
	TRAWL	47	1	48	24		24	59	1	60
	ALL GEAR	688	5	693	76	5	81	725	10	735

NOTE: Includes only vessels that fished part of Federal groundfish TACs.
Source: CFEC Fish Tickets, weekly processing reports, NMFS Permits, Commercial Operators Annual Report, ADF&G intent to operate listing as tabulated in Table 37 of the draft 2012 Economic Status of Alaska Groundfish Fisheries. National Marine Fisheries Service, P.O. Box 15700, Seattle, WA 98115-0070.

A seafood processor is a small business if it is independently owned and operated, not dominant in its field of operation, and employs 500 or fewer persons on a full-time, part-time, temporary, or other basis, at all its affiliated operations worldwide. The proposed actions would require that shoreside seafood processors report grenadier landings, processing of grenadiers on production reports, and sale of grenadier products on transfer reports. Thus, shoreside processors that receive and process groundfish from either the BSAI or GOA would be directly regulated by the proposed action. An analysis[32] of State of Alaska employment records of all shoreside processors with Federal Fishery Permits in Alaska reveals that there are 72 small shoreside processors that would be directly regulated by this action. This number is inclusive of entities located in both the BSAI and GOA, as some groundfish may be caught in one area and delivered to the other. This number also takes into consideration known processor affiliations of AFA entities, and AFA cooperatives; however, this number may overstate the number of small entities to the extent that not all affiliations are known.

[32] Analysis conducted by Ben Muse, Economist, Sustainable Fisheries Division, NOAA Fisheries Alaska Region, September 2012.

5.7 Recordkeeping and Reporting Requirements

The IRFA should include "a description of the projected reporting, recordkeeping, and other compliance requirements of the proposed rule, including an estimate of the classes of small entities that will be subject to the requirement and the type of professional skills necessary for preparation of the report or record..."

Implementation of Alternative 1, the no action alternative, would not change the overall reporting structure and record keeping requirements of the vessels and processors participating in the BSAI and GOA groundfish fisheries.

Alternatives 2, and 3 would change the recordkeeping and reporting requirements of the vessels and processors participating in the BSAI and GOA groundfish fisheries. Presently, all FMP species must be recorded in logbooks, and e-landings. Recording is optional for non-FMP species, such as grenadiers. Alternatives 2 and 3 would move grenadiers into the FMP. To implement this, NMFS would amend regulations to include FMP species codes for grenadiers and thereby requiring that catcher vessel operators, catcher processor operators, and shoreside processing plant operators record catch and/or landings of all grenadier species in logbooks, via the e-landings reporting system. If retention and landing is allowed (e.g. "small amount" under EC, or an MRA under "in the fishery"), then landings and disposition would be reported on fish tickets and production reports. These changes will require that those responsible for recordkeeping and reporting learn new species codes for grenadiers, as well as any other management measures requiring compliance (e.g. MRAs). Given the small amount of grenadier taken as incidental catch, relative to other groundfish, these reporting requirements would have *de-minimus* impact on fishery participants and processors.

At the agency level, the recordkeeping and recording system is designed such that grenadiers can be moved from the non-FMP to the FMP category and, once the regulations assign species codes, associated species codes would be changed in the eLandings system. Once the coding is completed, the system is already established and can begin to receive eLandings data on grenadiers. Similarly, after amending the regulations, given the minimal coding work and the pre-existence of eLandings, these reporting requirements would have *de-minimus* impact on management costs.

5.8 Federal Rules that may Duplicate, Overlap, or Conflict with Proposed Action

There are not any Federal rules that duplicate, overlap, or conflict with the Alternative 1, the no action alternative. Under Alternatives 2, 3, and 4, the action alternatives, there do not appear to be any Federal rules that duplicate, overlap, or conflict with the proposed action. Some current Federal regulations will need modification to implement the Council's preferred alternative (when identified).

5.9 Description of Significant Alternatives to the Proposed Action

An IRFA should include "A description of any significant alternatives to the proposed rule that accomplish the stated objectives of the Magnuson-Stevens Act and any other applicable statutes and that would minimize any significant (implicitly adverse) economic impact of the proposed rule on small entities." In December of 2013, the Council chose Alternative 2, "ecosystem component," as the Preliminary Preferred Alternative (PPA) for this action.

The only aspects of this proposed action that directly regulates small entities are the grenadier MRAs and the requirement to report grenadier catch under federal regulations at 679.5(a)(3). These requirements would have a *de minimus* economic impact on small entities, as explained in the RIR. There are no significant alternatives that would accomplish the MRA objectives or account for grenadier catch and minimize adverse economic impacts on small entities.

6 Magnuson-Stevens Act and FMP Considerations

6.1 Magnuson-Stevens Act National Standards

Below are the 10 National Standards as contained in the Magnuson-Stevens Fishery and Conservation Act (Magnuson-Stevens Act), and a brief discussion of the consistency of the proposed alternatives with those National Standards, where applicable.

National Standard 1 — Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry.

Under Alternative 1, the status quo, grenadiers are not managed under the groundfish FMPs. There are no catch limits, no recordkeeping and reporting requirements, and no directed fishery targeting grenadiers. Based on recent stock assessments, grenadiers have a large biomass relative to incidental catch. Recent stock assessments estimate a 2013 GOA OFL of 46,635 with incidental catch 10,535, and a 2013 BSAI OFL of 89,878 with incidental catch of 3,848. Thus, grenadiers are not presently subject to overfishing, overfished, or approaching an overfished condition. However, grenadiers are a deep dwelling and long lived species that are slow to mature to fecundity.

The potential vulnerability of Alaska grenadiers to overfishing has been evaluated via productivity and susceptibility analysis (PSA) (Ormseth and Spencer, 2008, 2001). The PSA scores for grenadiers are similar to scores for other managed groundfish species such as Pacific cod and pollock which led the PSA study authors to conclude that grenadiers should be managed similarly to other similarly vulnerable managed groundfish species. Further, there is at least one example of the potential for overfishing to severely deplete, and potentially endanger, a grenadier species. For example, when the roundnose grenadier fishery was initiated in the northwest Atlantic in the late 60's and early 70's, landings increased to 84,000 mt and then quickly declined and never recovered (Atkinson 1995). In 2008, roundnose grenadier was listed as endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Haedrich et al. (2001) suggests there is a common pattern in many deep-water fisheries that results in overfishing: 1) preliminary exploratory surveys discover large stocks, 2) a high volume but probably low value fishery develops, and 3) very high yields are realized for a few years, but then drop off rather steeply.

While there is not presently an overfishing concern, the absence of conservation and management measures applying to grenadiers means that there is no mechanism under Alternative 1 to prevent overfishing should conditions change in the future. Increased grenadier catch could occur if a market can be developed, if the TAC specifications in target fisheries (e.g. halibut, sablefish, Greenland turbot) where grenadiers are taken incidentally increase, or if changes in climate and ocean regimes alter the distribution of grenadiers relative to other target fisheries. Alternative 1 provides no mechanism to control the removal of grenadiers under changing conditions and, thereby, may expose the population to the risk of overfishing.

As an "ecosystem component" species, under Alternative 2, there would be no directed fishery for grenadiers; however, a small amount may be retained and used to attempt to develop a market. There would not be a TAC specified for grenadiers and thus no impact on other targeted groundfish fisheries. Conservation and management measures could be employed, either presently or in the future, to prevent overfishing should the risk of overfishing arise. Thus, Alternative 2 may enhance OY by taking into account marine ecosystems while continuing to provide the greatest overall benefit to the nation in terms

of food production and is consistent with management for maximum sustainable yield from the fishery while considering the ecological factors associated with the grenadier species.

With grenadiers as an "in the fishery" species, under Alternative 3, the potential effects on OY differ for the BSAI versus the GOA. In the GOA, the current OY cap level is considerably above the sum of the TACs for all species. Thus, there is no constraint on retention of harvest of other groundfish if grenadiers were "in the fishery," as either incidental catch or if TAC is sufficient to support a grenadier directed fishery, provided a market can be found. Thus Alternative 3 in the GOA may enhance optimum yield similarly to Alternative 2 and, further, provides a structure upon which a directed fishery can be initiated without additional FMP amendments, although regulatory amendments may be necessary to adopt conservation and management measures. However, there is some cost associated with recordkeeping and reporting, as well as in-season management, although our ability to quantify those effects is quite limited. Overall, In the GOA, Alternative 3 is expected enhance OY, even at incidental catch levels, and provides the potential to further enhance OY if grenadiers can be utilized in the future.

In the BSAI, managing grenadiers as "in the fishery" may presently reduce optimum yield from the BSAI fishery. The BSAI is subject to an OY cap of 2 million mt annually. The 2 million mt cap is a binding constraint on fishery removals in most years and this means that placing grenadiers "in the fishery" would require that a TAC be set for grenadiers either for incidental catch or for a directed fishery. The grenadier TAC would now count in the calculation of total TAC under the OY cap and this would require that the grenadier TAC be "funded" from reduced TAC in one or more species groups presently having market value, while grenadier are valueless at present. Thus, establishing a grenadier TAC, even at incidental catch levels, will, under present market conditions, lower fishery total revenue in the BSAI thereby reducing net national benefit.

National Standard 2 — Conservation and management measures shall be based upon the best scientific information available.

Information in this analysis represents the most current and comprehensive information available to the Council, recognizing that some information (such as operational costs) is unavailable. Information previously developed on the BSAI and GOA groundfish fisheries, as well as the most recent information available, has been incorporated into this analysis. It represents the best scientific information available. It is worthwhile noting that grenadiers are the only non-FMP species group in Alaska (and perhaps the nation) for which stock assessments, based on Tier 5 calculations, have been prepared.

National Standard 3 — To the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination.

Based on the most recent stock assessments prepared by NMFS for grenadiers, the assessment authors have recommended separate OFLs and ABCs for grenadiers in the BSAI and GOA management areas without further subdivision into smaller geographic areas. The annual TACs under Alternative 3 would be set for grenadiers according to the Council and NMFS harvest specification process. The Council would recommend the TACs for grenadiers based on the most recent stock assessment and survey information, public testimony, and other socioeconomic considerations.

National Standard 4 — Conservation and management measures shall not discriminate between residents of different states. If it becomes necessary to allocate or assign fishing privileges among various U.S. fishermen, such allocation shall be (A) fair and equitable to all such fishermen, (B) reasonably calculated to promote conservation, and (C) carried out in such a manner that no particular individual, corporation, or other entity acquires an excessive share of such privileges.

Nothing in the alternatives considers residency as a criterion for the Council's decision. Residents of various states, including Alaska and states of the Pacific Northwest, participate in the major sectors affected by these allocations. No discriminations are made among fishermen based on residency or any other criteria.

National Standard 5 — Conservation and management measures shall, where practicable, consider efficiency in the utilization of fishery resources, except that no such measure shall have economic allocation as its sole purpose.

The wording of this standard was changed in the recent Magnuson-Stevens Act authorization, to consider rather than promote efficiency. Efficiency in the context of this change refers to economic efficiency, and the reason for the change, essentially, is to de-emphasize to some degree the importance of economics relative to other considerations (United States Senate, 1996). The analysis presents information relative to these perspectives and provides information on the economic risks associated with the harvest specifications for grenadiers.

National Standard 6 — Conservation and management measures shall take into account and allow for variations among, and contingencies in, fisheries, fishery resources, and catches.

All of the action alternatives under consideration in the proposed action appear to be consistent with this standard.

National Standard 7 — Conservation and management measures shall, where practicable, minimize costs and avoid unnecessary duplication.

Grenadiers are presently not managed under the groundfish FMPs for the BSAI and GOA, nor are there any other state/Federal, or international commissions for their regulation in the waters of the EEZ off Alaska. Grenadiers are, however, an ecologically important species comprising a large proportion of deep ocean biomass. Grenadiers are also long lived, slow to mature, and considered an apex predator in the deep ocean, and have been assessed with a moderate vulnerability to overfishing, similar to other presently managed target species in the BSAI and GOA. Absent any management structure, grenadiers could be taken in unlimited quantities in "unmanaged targeted fishing" and there would be no required recordkeeping or reporting of such removals.

Under Alternative 2, the present and past harvests of grenadiers taken incidentally are well below the current ABCs calculated for grenadiers. Thus, there would be no significant effects (either adverse or beneficial) on the stock biomass, fishing mortality, spatial or temporal distribution, or changes in prey availability for grenadier and groundfish target species in either the BSAI or GOA. There would be no significant (either beneficial or adverse) socioeconomic effects on those who harvest grenadiers or other groundfish targets in either the BSAI or GOA.

Under Alternative 3, grenadiers are defined as "in the fishery," with all of the associated management structure required under the MSA. Grenadier would be assessed under the calculation of OY, which is constrained at 2 million mt of TAC in the BSAI. The GOA OY cap far exceeds the sum of all GOA TACs and is nonbinding. This creates an immediate need to reduce TAC of some other BSAI groundfish species (or group of groundfish species) in order to add grenadier TAC to the annual specifications. Given that grenadier is currently valueless, this will decrease groundfish revenue in the short run unless a market for grenadier can be established. However, as a result of protecting the biomass, it is hoped that establishing grenadier TAC in the BSAI and GOA may lead to greater gross revenues from a sustainable fishery in the longer term. Further, given the large biomass of grenadier it is possible that, if a market is developed, grenadier catch could be taken in years when the BSAI TAC total is less than 2 million mt,

thus contributing to enhancing OY in such years, rare as they may be. Similar to Alternative 2, Alternative 3 also ameliorates the risks of non-management of grenadiers that would continue under the status quo, and extends management to include the potential for a "directed fishery" to develop.

It is true that Alternatives 2 and 3 will impose new recordkeeping and reporting requirements on the groundfish fishing industry, as well as additional fisheries management processes; however, given the small relative amount of grenadier incidental catch these reporting requirements will have *de-minimus* effects on fishery participants. Similarly, grenadier stock assessments are presently being conducted and the additional burden on NMFS of new grenadier management measures will have *de-minimus* impacts. Thus, all of the action alternatives under consideration appear to be consistent with this NS7.

National Standard 8 — Conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities.

An analysis of the alternatives suggests that the additional record keeping and reporting requirements under the action alternatives will have *de-minimus* impacts on operators and similarly *de-minimus* impacts on management at the agency level. Potential impacts to revenue in the fisheries would only occur in the BSAI. Such impacts will occur only under Alterative 3 and would be determined in the annual harvest specifications process and are unknown at this time. This analysis suggests; however, that impacts at the community level for any of the involved fishing communities would be well under the level of significance. The sustained participation of these fishing communities is not put at risk by any of the alternatives being considered. Economic impacts to participating communities would not likely be noticeable at the community level, so consideration of efforts directed at a further minimization of adverse economic impacts to any given community is not relevant.

National Standard 9 — Conservation and management measures shall, to the extent practicable, (A) minimize bycatch, and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch.

All of the action alternatives (Alternatives 2, and 3) under consideration in the proposed action appear to be consistent with this standard. Alternative 1, the status quo, provides no measures to minimize bycatch of grenadiers and mortality of grenadiers brought to the surface is 100 percent and cannot be further minimized due to the extreme depth from which they are taken. The Council is considering MRAs under Alternative 2 in a range of from 2 percent to 20 percent. A 2 percent MRA likely limits development of markets; however, the EC classification does allow retention of "a small amount" for sale. The lower range MRA has been used in the forage fish classification with the rationale being to ban targeted fishing of these ecologically important species. Alternative 3 contains MRAs of zero percent as a basis species, and 35 percent as an incidental catch species. Higher MRAs would allow retention and potential utilization of grenadiers that are incidentally caught.

National Standard 10 — Conservation and management measures shall, to the extent practicable, promote the safety of human life at sea.

The alternatives under consideration appear to be consistent with NS10. None of the alternatives or options proposed would change safety requirements for fishing vessels.

6.2 Section 303(a)(9) Fisheries Impact Statement

Section 303(a)(9) of the Magnuson-Stevens Act requires that a fishery impact statement be prepared for each FMP amendment. A fishery impact statement is required to assess, specify, and analyze the likely effects, if any, including the cumulative conservation, economic, and social impacts, of the conservation and management measures on, and possible mitigation measures for a) participants in the fisheries and fishing communities affected by the plan amendment; b) participants in the fisheries conducted in adjacent areas under the authority of another Council; and c) the safety of human life at sea, including whether and to what extent such measures may affect the safety of participants in the fishery.

The EA/RIR/IRFA prepared for this plan amendment constitutes the fishery impact statement. The likely effects of the proposed action are analyzed and described throughout the EA/RIR/IRFA. The effects on participants in the fisheries and fishing communities are analyzed in the RIR/IRFA sections of the analysis (Sections 5 and 5). The effects of the proposed action on safety of human life at sea are evaluated above under National Standard 10, in Section 6.1

The proposed action affects the groundfish fisheries in the EEZ off Alaska, which are under the jurisdiction of the North Pacific Fishery Management Council. Impacts on participants in fisheries conducted in adjacent areas under the jurisdiction of other regional fishery management councils are not anticipated as a result of this action.

6.3 Groundfish Management Policy Priorities

The alternatives discussed in this action accord with the management policy of in the Fishery Management Plan for Groundfish of the Bering Sea and Aleutian Islands Management Area and the Fishery Management Plan for Groundfish of the Gulf of Alaska. The Council's management policy includes the following objectives:

- Control the removal of prohibited species through PSC limits or other appropriate measures.
- Continue and improve current incidental catch, prohibited species catch, and bycatch management program.
- Continue to manage incidental catch, prohibited species catch, and bycatch through seasonal distribution of total allowable catch and geographical gear restrictions.
- Continue program to reduce discards by developing management measures that encourage the use of gear and fishing techniques that reduce groundfish bycatch, which includes economic discards.

By proposing to place incidentally caught grenadier species either into the ecosystem component or "in the fishery" as a targeted species in the BSAI and/or GOA groundfish fisheries, this action is consistent with the Council's longstanding management policy.

7 Preparers and Persons Consulted

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9 Appendix

SSC Comment Response Tables

Table 9-1: Sum of observed giant grenadier catch in mt for males (M) and females (F) from 2003-2013.

	Aleutian Islands			Bering Sea			Gulf of Alaska		
Depth strata (m)	AI	AI F	AI M	BS	BS F	BS M	GOA	GOA F	GOA M
1-100	31	27	5	441	383	58	69	59	10
101-200	802	701	106	1,280	1,113	166	1,891	1,607	284
201-300	10,183	8,855	1,328	5,300	4,610	692	8,849	7,522	1,327
301-400	6,338	5,512	828	8,457	7,355	1,104	8,726	7,415	1,309
401-500	265	230	34	788	684	104	671	570	101
501-600	4	4	0	8	6	0	20	16	1
601-700	0	0	0	2	2	0	4	4	0
701-800	0	0	0	0	0	0	3	3	0
801-900	0	0	0	0	0	0	1	1	0

Table 9-2: Percent of male giant grenadier in observed catch from 2003-2013 in numbers and weight. Weights were calculated from length frequencies by depth, sex, and area using sex specific growth curves from the AFSC trawl survey. The total sample size (n) for length frequencies is presented for each sex.

	BSAI		GOA	
Depth (m)	% male (numbers, weight)	n	% male (numbers, weight)	n
1-100		0	17%, 15%	6
101-200	25%, 22%	296	9%, 7%	690
201-300	19%, 16%	4,535	14%, 12%	6,623
301-400	17%, 14%	8,013	20%, 16%	11,986
401-500	23%, 17%	719	28%, 21%	1,603
501-600	20%, 13%	155	37%, 24%	123
601-700	11%, 6%	22	56%, 54%	18
701-800		0	20%, 12%	5

Table 9-3: Total estimated grenadier catch from 2003-2013 split by sex (mt). Observed lengths were converted to weights using area and sex specific growth curves and the percent male was calculated using these weights. The average proportion of males and females by weight in the catch was used to split catch.

Year	BS total	BS male	BS female	AI total	AI Male	AI Female	GOA total	GOA male	GOA female
2003	2,869	373	2,439	3,558	463	3,024	12,253	1,838	10,415
2004	2,223	289	1,890	1,251	163	1,063	11,989	1,798	10,191
2005	2,633	342	2,238	1,795	233	1,526	7,251	1,088	6,163
2006	2,067	269	1,757	2,195	285	1,866	8,429	1,264	7,165
2007	1,631	212	1,386	1,544	201	1,312	9,119	1,368	7,751
2008	2,820	367	2,397	2,525	328	2,146	11,333	1,700	9,633
2009	2,902	377	2,467	3,739	486	3,178	6,326	949	5,377
2010	2,799	364	2,379	3,553	462	3,020	5,419	813	4,606
2011	4,221	549	3,588	2,596	337	2,207	8,216	1,232	6,984
2012	2,276	296	1,935	4,383	570	3,726	7,206	1,081	6,125
2013	1,482	193	1,260	2,367	308	2,012	10,525	1,579	8,946
average	2,538	330	2,158	2,682	349	2,280	8,915	1,337	7,578

Table 9-4: Percent of fish that were male caught during the AFSC longline survey 2006-2013 in numbers and weight. Weights were calculated from length frequencies by depth, sex, and area using sex specific growth curves from the AFSC trawl survey. The total sample size (n) for length frequencies is presented for each sex.

	Aleutian Islands		Bering Sea		Gulf of Alaska	
Depth (m)	% male (numbers, weight)	n	% male (numbers, weight)	n	% male (numbers, weight)	n
101-200	0%, 0%	20	0%, 0%	9	0%, 0%	11
201-300	0%, 0%	312	0%, 0%	582	0.5%, 0.8%	2,098
301-400	0%, 0%	1,280	0%, 0%	1,559	1%, 0.5%	9,947
401-600	2%, 2%	2,912	0%, 0%	2,949	2%, 1%	19,527
601-800	6%, 5%	2,533	2%, 1%	3,038	5%, 3%	17,378
801-1000	20%, 15%	777	6%, 4%	1,015	9%, 6%	8,603
Total	5%, 4%	7,834	2%, 1%	9,255	4%, 3%	58,828

Table 9-5: Average AFCS longline survey Relative Population Weights split by sex and strata from 2006-2013.

	Aleutian Islands		Bering Sea		Gulf of Alaska	
Strata (m)	AI M	AI F	BS M	BS F	GOA M	GOA F
201-300	0	16,322	7	9,263	152	17,772
301-400	189	93,257	0	39,385	477	95,590
401-600	6,707	299,368	285	121,839	3,613	279,659
601-800	17,890	348,645	2,854	232,902	10,020	283,846
801-1000	37,164	218,898	6,692	148,634	17,131	271,927

Table 9-6: AFCS Gulf of Alaska trawl survey biomass estimates from recent years when the survey sampled down to 1,000 m (1999, 2005, 2007, 2009).

Depth strata (m)	Year	GOA M	GOA F	% male
1-500	1999	2,183	126,234	2%
1-500	2005	10,698	226,337	5%
1-500	2007	3,163	103,382	3%
1-500	2009	1,510	89,961	2%
501-700	1999	15,336	136,471	10%
501-700	2005	25,470	221,437	10%
501-700	2007	16,467	218,538	7%
501-700	2009	29,116	142,184	17%
701-1000	1999	28,466	81,219	26%
701-1000	2005	28,522	74,882	28%
701-1000	2007	46,574	99,862	32%
701-1000	2009	83,034	372,514	18%

Figure 9-1: Summed observed grenadier catch from 2003-2013, not total estimated catch, split by sex and depth strata.

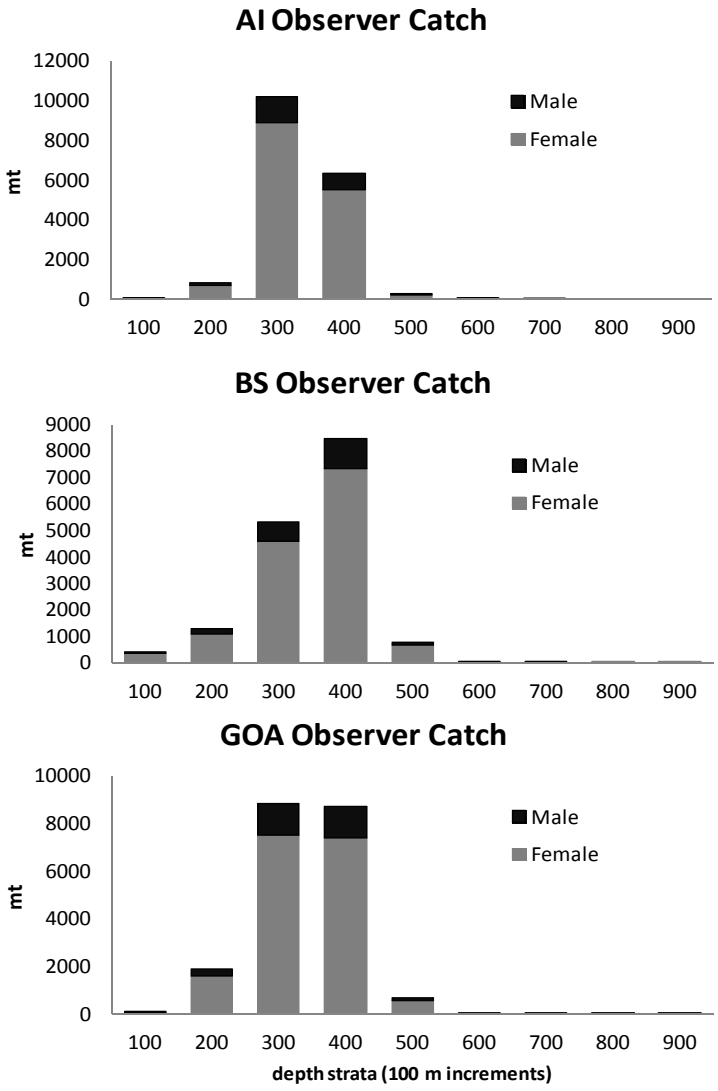


Figure 9-2: Average AFCS longline survey giant grenadier Relative Population Weights from 2006-2013 split by sex and depth stratum

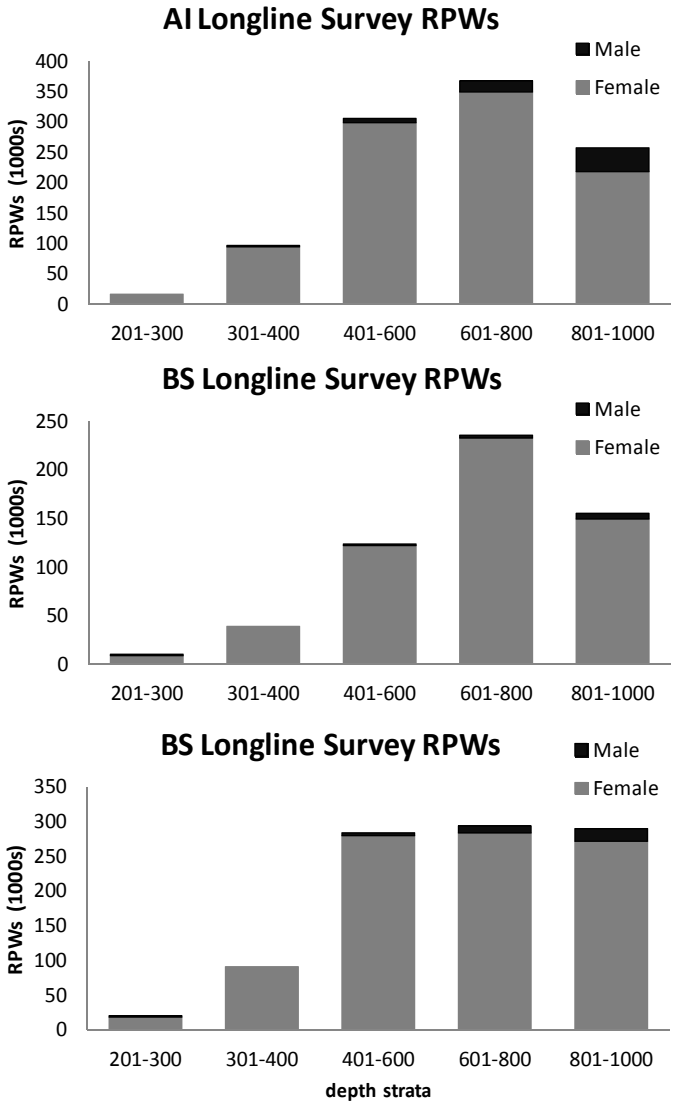
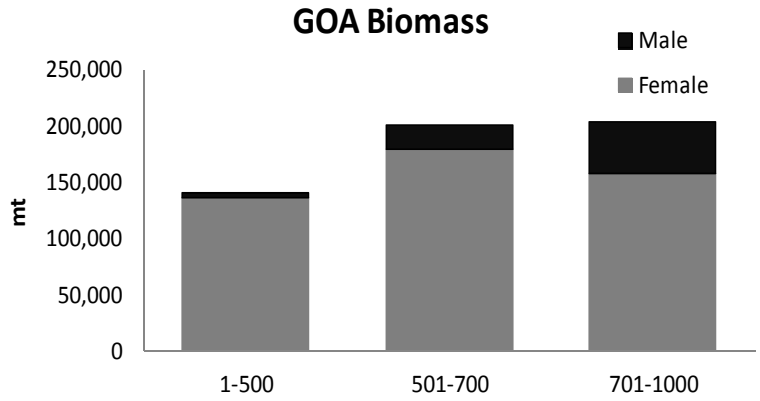


Figure 9-3: Figure 3. Average of AFCS trawl survey giant grenadier biomass estimates in 1999, 2005, 2007, and 2009 split by sex and strata (recent years when the survey sampled down to 1,000 m).



Vulnerability Analysis

To aid in the classification of stocks, as well as to provide advice on the formation of stock complexes and other management actions, NOAA Fisheries convened a Vulnerability Evaluation Working Group, in 2008. This group was tasked with developing an analytical tool for assessing the vulnerability of stocks in an FMP (the word "vulnerability" appears frequently in the National Standard guidelines). Stock assessment scientists from the Alaska Fisheries Science Center prepared a vulnerability analysis for a number of Alaska stocks and stock complexes, including giant grenadier, and presented the results in Appendix 3 to the 2009 SAFE report (Ormseth and Spencer 2009) as well as in a journal article in Fisheries Research (Ormseth and Spencer, 2011). The procedure used was a "productivity-susceptibility analysis," (PSA) and follows a method developed by the NMFS national level working group (Patrick, et.al. 2009). Much of the discussion of this vulnerably analysis, presented here, is reprinted from Ormseth and Spencer, 2009.

The PSA analysis compares two main features of a fish stock that together influence its vulnerability to fishing: productivity, which determines a population's natural capacity for growth and its resilience to fishery impacts; and susceptibility, which indicates how severe those fishery impacts are likely to be for the population. Productivity and susceptibility are evaluated by scoring a number of related attributes. For productivity, these are mainly life-history traits such as natural mortality rate and age at maturity; susceptibility attributes include spatial overlap between the stock and the fishery, stock status, etc. The table below (Table 9-7) lists all attributes evaluated in the productivity-susceptibility analysis (PSA):

Table 9-7: Productivity and Susceptibility Attributes

productivity attributes	**susceptibility attributes**
population growth	management strategy
maximum age	areal overlap
maximum size	geographic concentration
growth rate (*k*)	vertical overlap
natural mortality	fishing rate relative to M
measured fecundity	biomass of spawners (SSB) or other proxies
breeding strategy	seasonal migrations
recruitment pattern	schooling/aggregation and other behaviors
age at maturity	gear selectivity
mean trophic level	survival after capture and release
	desirability/value of the fishery
	fishery impact to habitat

Each attribute is scored with a 1, 2, or 3, indicating low, medium, and high values, respectively. Each attribute score is then weighted according to the analyst's interpretation of the relevance of each attribute. In the Alaska groundfish PSA, all attributes were weighted equally with the exception of recruitment pattern, which was deemed to have an inconsistent relationship to productivity and received a weight half that of the other attributes. The weighted attribute scores are used to calculate mean scores for productivity and susceptibility that are used in two separate ways:

1) The scores are depicted graphically in a scatter plot, with productivity on the x-axis and susceptibility on the y-axis. This provides a strong visual appreciation of differences among stocks. In addition, the x-axis is reversed (i.e. it starts at 3 and ends at 1), so that the area of the plot close to the origin (which is at 3,1) corresponds to high-productivity, low-

susceptibility stocks. Such stocks are considered to have low vulnerability. The further a stock is from the origin, the more vulnerable to fishing it is likely to be.

2) Following on (1), the Euclidean, or straight-line, distance from the origin to the stock's datapoint is calculated and used as a measure of the stock's overall vulnerability. The distance is calculated as:

$$\sqrt{(P-3)^2 + (S-1)^2}$$

where P = productivity and S = susceptibility.

Each attribute score is also evaluated for the quality of the data used to determine the score. Data quality scores range from 1 to 5 as follows:

1: (Best data) Information is based on established and substantial data
2: (Adequate Data) Information with limited coverage and corroboration
3: (Limited Data) Limited confidence; may be based on similar taxa
4: (Very Limited Data) Expert opinion or based on general literature review
5: (No Data) No information to base score on

The results of the GOA analysis are presented in Figure 9-4, and the results of the BSAI analysis are presented in Figure 9-5.

The results indicate the following:

1) Productivity varies widely among stocks in both regions, but susceptibility is constrained to moderate values. This is especially true for the BSAI. This is probably due in large part to the fact that all stocks evaluated in each PSA are included in that region's FMP (with the exception of giant grenadier; see below). Thus, a common level of susceptibility among the stocks makes sense.

2) The main target stocks (e.g. pollock and Pacific cod) in each region have the highest susceptibility scores.

3) Data quality is highest for target stocks and lowest for non-target stocks. There is no relationship between data quality and vulnerability.

4) Vulnerability does not appear to depend on whether a stock is targeted or not. In Table 9-8 & Table 9-9, stocks are listed in order of increasing vulnerability. The target stocks are distributed among the intermediate vulnerability scores in each region, with non-target stocks displaying the lowest and highest scores. This is likely because, although target stocks tend to have higher susceptibility they also have higher productivity.

5) There are no clear divisions among stocks in the PSA, i.e. there appears to be a continuum of vulnerability rather than distinct levels of vulnerability.

6) High vulnerability scores can be a result of low productivity, high susceptibility, or both. For example, in the GOA, pollock and Dover sole have similar vulnerability scores (1.44 and 1.34, respectively) despite the lower productivity of Dover sole.

Implications for stock classification and nontarget management

Ecosystem components

There are no clear divisions among the stocks in their vulnerability scores, and the working group that developed the methodology did not provide any guidance regarding how the vulnerability score of a stock corresponds to the appropriate management measures for that stock (this was done on purpose due to the difficulty of making divisions that would be broadly applicable in different regions). However, considering the vulnerability scores relative to each other and particularly to the scores of target stocks provides some insight into how stocks should be classified.

In the BSAI (Figure 9-5), squid have the lowest vulnerability (0.84) and they have the most distinct vulnerability score. In addition, vulnerability scores for target stocks begin at 1.39 (yellowfin sole). The analyses conducted by the VEWG also suggested that target stocks and nontarget stocks commonly believed to be conservation concerns (e.g. BSAI skates) tended to have vulnerability scores greater than 1. Thus, the PSA for this region suggests that squid may be a candidate for EC classification.

This conclusion is supported by the results for the GOA (Figure 9-4), where squid, capelin, and eulachon form a somewhat distinct, high-productivity group. Eulachon have the highest susceptibility score of this group, as they are the only member of the forage fish category that is regularly caught in the groundfish fisheries. The PSA results suggest that the current management measures used for capelin and eulachon as part of the forage fish classification (i.e. no ACLs) may also be appropriate for squid. Octopus have a vulnerability score almost equivalent to eulachon and so may be considered for EC classification. However, their lower productivity separates them from the squid/forage fish group. This separation is even more pronounced in the BSAI.

In summary, the PSA results demonstrate that squid and forage fishes have relatively low vulnerability to commercial fishing and may be candidates for an EC classification. Octopus also have low vulnerability scores. While some sculpin species have relatively low scores (though still greater than 1), other members of that group have high scores. As a result, sculpins should remain “in the fishery”. Skates and sharks have high vulnerability scores and require ACLs.

Giant grenadier

Grenadiers are not listed in the current FMPs but were included in the analysis due to potential conservation concerns. The PSA results suggest that grenadiers should be included as stocks “in the fishery” in the FMPs for both regions. In the GOA, the vulnerability score for giant grenadier is between Pacific cod and Pacific ocean perch (Table 9-8). In the BSAI, giant grenadier is between Pacific cod and pollock (Table 9-9). Thus, management measures (ACLs) appropriate for these target species should also be applied to grenadiers.

Table 9-8: Results of the productivity/ susceptibility analysis for the Gulf of Alaska region. Fish stocks are organized in order of increasing vulnerability score. Bold italics indicate target species.

ID #	Stock Name	Productivity	Susceptibility	Vulnerability	Data quality		
					P	S	Av.
1	capelin	2.75	1.50	0.56	2.58	3.27	2.93
2	squid	2.63	1.71	0.81	2.79	3.55	3.17
3	eulachon	2.69	2.00	1.05	2.68	2.36	2.52
4	octopus	2.14	1.63	1.06	2.89	3.82	3.36
5	great sculpin	1.88	1.71	1.33	3.11	3.18	3.14
6	plain sculpin	1.88	1.71	1.33	3.11	3.18	3.14
7	***Dover sole***	***1.71***	***1.36***	***1.34***	***1.63***	***1.64***	***1.63***
8	***rex sole***	***1.87***	***1.73***	***1.35***	***1.32***	***1.64***	***1.48***
9	***pollock***	***2.29***	***2.25***	***1.44***	***1.63***	***2.36***	***2.00***
10	yellow Irish lord	1.75	1.86	1.52	3.11	3.18	3.14
11	***sablefish***	***1.76***	***2.08***	***1.64***	***1.11***	***1.27***	***1.19***
12	bigmouth sculpin	1.50	1.71	1.66	3.11	3.18	3.14
13	***Pacific cod***	***2.00***	***2.42***	***1.73***	***1.53***	***1.45***	***1.49***
14	giant grenadier	1.44	1.79	1.75	2.05	2.00	2.03
15	***Pacific ocean perch***	***1.74***	***2.29***	***1.81***	***1.47***	***1.41***	***1.44***
16	***rougheye rockfish***	***1.30***	***1.68***	***1.83***	***1.95***	***1.68***	***1.81***
17	big skate	1.33	1.90	1.89	1.63	3.00	2.32
18	salmon shark	1.19	1.75	1.96	1.95	3.73	2.84
19	longnose skate	1.22	1.90	1.99	1.53	3.27	2.40
20	spiny dogfish	1.11	1.91	2.10	1.84	3.00	2.42
21	sleeper shark	1.00	2.00	2.24	3.63	3.73	3.68

Source: Ormseth and Spencer 2009.

Figure 9-4: Results of the PSA analysis for the Gulf of Alaska region. Colors and symbol shapes indicate data quality scores. Numbers indicate stocks listed in Table 9-8. For clarity, not all stocks are labeled.

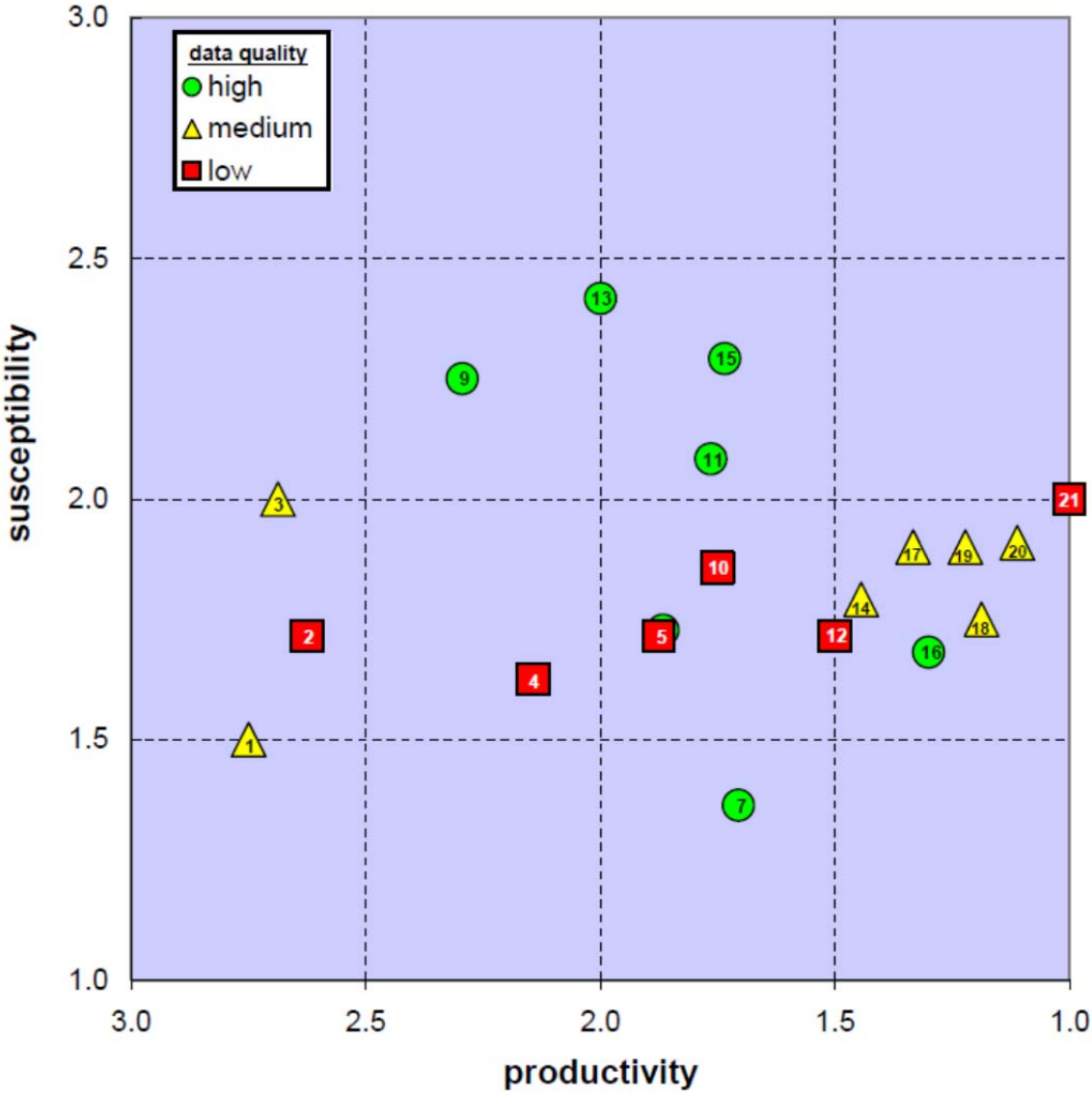
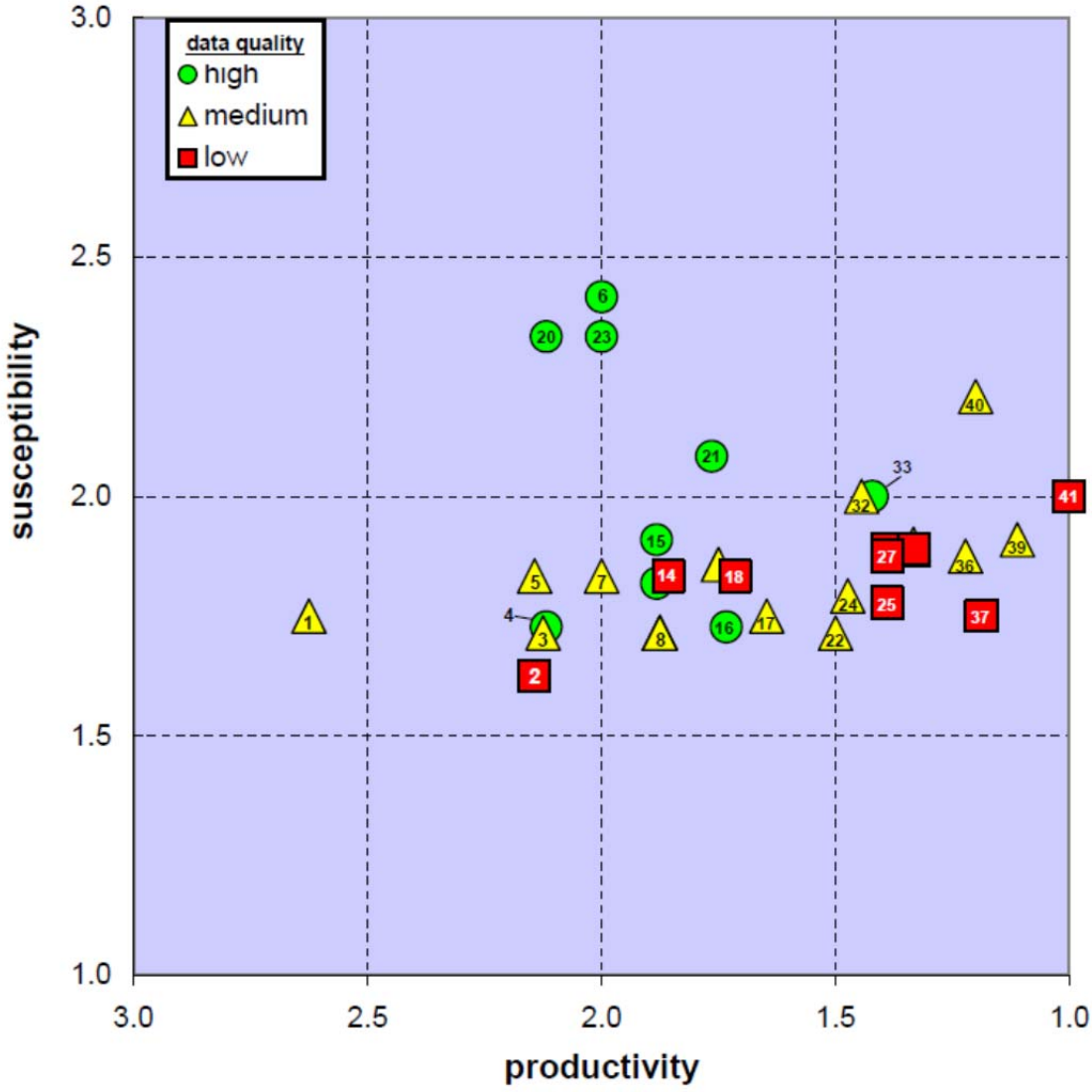


Table 9-9: Results of the productivity/ susceptibility analysis for the Bering Sea and Aleutian Islands region. Fish stocks are organized in order of increasing vulnerability score. Bold italics indicate target species.

ID #	Stock Name	Productivity	Susceptibility	Vulnerability	Data quality		
					P	S	Av.
1	squid	2.63	1.75	0.84	2.37	3.55	2.96
2	octopus	2.14	1.63	1.06	2.89	3.82	3.36
3	red Irish lord	2.13	1.71	1.13	2.47	2.91	2.69
4	Alaska plaice	2.12	1.73	1.14	1.74	1.73	1.73
5	threaded sculpin	2.14	1.83	1.20	2.37	3.36	2.87
7	longfin Irish lord	2.00	1.83	1.30	2.37	3.55	2.96
8	great sculpin	1.88	1.71	1.33	1.95	2.91	2.43
9	plain sculpin	1.88	1.71	1.33	1.95	2.91	2.43
10	great sculpin	1.88	1.71	1.33	1.95	2.91	2.43
11	warty sculpin	1.88	1.71	1.33	2.26	2.82	2.54
12	***yellowfin sole***	***1.88***	***1.82***	***1.39***	***1.74***	***1.73***	***1.73***
13	spinyhead sculpin	1.86	1.83	1.41	2.79	3.55	3.17
14	thorny sculpin	1.86	1.83	1.41	3.00	3.55	3.27
15	northern rock sole	1.88	1.91	1.44	1.74	1.73	1.73
16	arrowtooth flounder	1.73	1.73	1.46	2.05	1.73	1.89
17	yellow Irish lord	1.75	1.86	1.52	1.63	2.82	2.22
18	armorhead sculpin	1.71	1.83	1.53	2.68	3.55	3.11
19	***Greenland turbot***	***1.65***	***1.75***	***1.55***	***2.42***	***2.55***	***2.48***
20	***Atka mackerel***	***2.12***	***2.33***	***1.60***	***1.95***	***2.00***	***1.97***
21	***sablefish***	***1.76***	***2.08***	***1.64***	***1.63***	***1.27***	***1.45***
22	bigmouth sculpin	1.50	1.71	1.66	1.95	2.91	2.43
23	***pollock (EBS)***	***2.00***	***2.33***	***1.67***	***1.53***	***1.27***	***1.40***
24	giant grenadier	1.47	1.79	1.72	2.00	2.00	2.00
6	***Pacific cod***	***2.00***	***2.42***	***1.73***	***1.53***	***1.45***	***1.49***
25	whitebrow skate	1.39	1.78	1.79	2.89	3.36	3.13
26	butterfly skate	1.39	1.78	1.79	2.89	3.64	3.27
27	roughshoulder skate	1.39	1.88	1.83	3.00	3.64	3.32
28	roughtail skate	1.39	1.89	1.84	2.68	3.36	3.02
29	whiteblotched skate	1.39	1.89	1.84	2.79	3.36	3.08
30	mud skate	1.39	1.89	1.84	2.79	3.36	3.08
31	commander skate	1.39	1.89	1.84	2.89	3.36	3.13
32	Bering skate	1.44	2.00	1.85	1.63	3.00	2.32
33	Alaska skate	1.42	2.00	1.87	1.26	2.18	1.72
34	big skate	1.33	1.89	1.89	1.63	3.55	2.59
35	deepsea skate	1.33	1.89	1.89	2.89	3.55	3.22
36	Aleutian skate	1.33	1.90	1.89	1.53	3.09	2.31
37	salmon shark	1.19	1.75	1.96	3.21	3.73	3.47
38	longnose skate	1.22	1.88	1.98	1.53	3.82	2.67
39	spiny dogfish	1.11	1.91	2.10	1.84	3.00	2.42
40	***rougheye rockfish (AI)***	***1.20***	***2.21***	***2.17***	***2.68***	***2.09***	***2.39***
41	sleeper shark	1.00	2.00	2.24	3.63	3.73	3.68

` Source: Ormseth and Spencer 2009.

Figure 9-5: Results of the PSA analysis for the Bering Sea and Aleutian Islands region. Colors and symbol shapes indicate data quality scores. Numbers indicate stocks listed in Table 9-9. For clarity, not all stocks are labeled.



The PSA indicates that giant grenadiers had similar vulnerability to several major target species, such as Pacific cod and walleye pollock. Because of the similarities in vulnerability scores between target stocks and giant grenadier, the authors conclude that management measures appropriate for target species (such as ACLs and AMs) should also be applied to grenadiers (Ormseth and Spencer 2009, 2011).