

Discussion Paper

Inclusion of Grenadiers in the Fishery Management Plans For the Bering Sea and Aleutian Islands and/or the Gulf of Alaska

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Objectives

This paper discusses the inclusion of grenadiers (family Macouridae) into the fishery management plans (FMPs) for groundfish of the BSAI (Bering Sea and Aleutian Islands) and GOA (Gulf of Alaska) either as individual species or as a species complex “in the fishery”, or as an “ecosystem component”. This paper also discusses the management measures which would be needed for the inclusion of grenadiers in the FMPs and other management options which could be considered for grenadiers.

Problem Statement

Grenadiers are not included in the groundfish FMPs for either the BSAI or GOA. There are no limits on their catch or retention, no reporting requirements, and no official record of their catch. Prior to the ACL (annual catch limits) amendments, grenadiers were considered non-specified species, which 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 accidental bycatch and are in no apparent danger of depletion” and for which “virtually no data exists (that) would allow population assessments (DiCosimo 2001, Witherell 1997)”. Based on this definition, Groundfish Plan Teams recommended in 2008 that grenadiers be moved into the groundfish FMPs. Because of their abundance on the continental slope, giant grenadiers are of great ecological importance in this habitat, they are important bycatch species in slope fisheries, and they could hold future economic potential. In addition, considerable information on giant grenadier exists that can be used for stock assessment (tier 5 status). In 2010, the Groundfish Plan Teams reiterated their previous recommendations that the Council (NPFMC) prioritize this for action. The SSC (Scientific and Statistical Committee) also has recommended that the Council consider revising management of grenadiers.

In order to move grenadiers into the FMPs the NPFMC would need to adopt a purpose and need statement that would include the NPFMC’s objective for this action and also initiate an analysis of alternatives and management alternatives to be considered. An

EA/RIR/IRFA would need to be prepared for FMP amendments to move grenadiers into the FMPs and to implement regulatory amendments for the management of grenadiers.

Introduction

Prior to the implementation of Amendment 8 to the GOA FMP on November 1, 1980, grenadiers were included in the FMP. 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 are 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 NPFMC 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 NPFMC 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 (MSRA) and the revision of National Standard 1(NS1) in 2009 in 2011 it was decided to defer action on grenadiers.

The MSRA strengthened provisions to prevent and end overfishing and rebuild depleted fisheries. The National Marine Fisheries Service (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, as amended by the MSRA, requires that each Regional Council develop Annual Catch Limits (ACLs) and Accountability Measures (AMs) for each of its managed fisheries designated as being in the fishery designated as being in the fishery such that each FMP under its jurisdiction have 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 MSRA NMFS issued a final rule to implement Amendments 95 and 96 to the BSAI FMP and Amendment 87 to the GOA FMP (October 6, 2010, 75 FR 61639).

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 due to time constraints. 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”.

What does it mean for a species or species group to be designated as being “in the fishery” or as an “ecosystem component”?

The terms “in the fishery” and “ecosystem component” are defined in the final rule to amend NS1 guidelines (74 FR 3178, January 16, 2009). Stocks of fish that are “in the fishery” are those 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 nor retained but are taken as incidental catch and for which overfishing or overfished status may be a concern. For each of those stocks, whether a single species or species group, ACLs, AMs, 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 (sometimes called a species complex) the species should have a similar geographic distribution, life history, and vulnerability. The species groups may be managed as an indicator stock or stocks with separate Significance Determination Criteria (SDC) consisting of a maximum fishing mortality threshold and minimum stock size threshold and ACL; managed with a single SDC and ACL for the entire species group; or as indicator stock or stocks with separate SDCs with a single ACL for the species group (provided that the indicator stock or stocks are representative of the species group as described above).

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 based on the best available information in the absence of conservation and management measures; and not generally retained (a small amount could be retained) for sale or commercial use. The catch of EC species would be required to be reported for monitoring purposes and directed fishing (open status) for EC species would be prohibited. However, maximum retainable amounts of incidental catch and other management measures could be adopted for EC species. 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 NPFMC 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. Should it become necessary, they should be reclassified as “in the fishery.”

Assessment and Catch History of Grenadiers

An assessment for grenadiers was first prepared in 2006 and was presented as Appendix F to the 2006 SAFE (Stock Assessment and Fishery Evaluation) reports for the BSAI and GOA (Clausen D., 2006). The last full assessment of grenadiers was prepared for the 2010 SAFE reports with an update in the 2011 SAFE reports (Clausen D. and C. Rodgveller, 2010 and 2011). The assessments include information on new data used in the assessment and assessment methodology, including estimates of grenadier biomass and natural mortality; recommended OFL and ABC levels; catch and fishery history; geographic range, life history and ecosystem considerations; data gaps and research priorities.

There are seven species of grenadiers known to occur off Alaska. The giant grenadier (*Albatrossia pectoralis*) appears to be the most abundant and also has the shallowest depth distribution on the continental slope. It is by far the most common grenadier caught in the commercial fishery and fish surveys. Two other species, the Pacific grenadier and the popeye grenadier, are occasionally taken in the commercial fisheries and in the fish surveys. The other four species of grenadier off Alaska occur at depths too great to be encountered in the commercial fisheries and fish surveys. The assessment is based on using giant grenadier as a proxy species for grenadier stocks, and uses a tier 5 approach for determining OFL and ABC. For the remaining species of grenadiers there are no reliable estimates of biomass or reliable reports of historical catch on which to base either a tier 5 or tier 6 assessment. The assessment authors have recommended that giant grenadiers be managed with a single OFL and ABC in the BSAI and a single OFL and ABC in the GOA without further spatial division of the OFLs and ABCs.

The stock assessment authors and the NMFS Alaska Region staff have made the following observations pertinent to giant grenadiers:

- Estimated annual catches of giant grenadier off Alaska for the years 1997-2011 have ranged from 12,000 to 21,000 mt, with an average of about 16,000 mt.
- Average catch in the GOA has been about 10,000 mt, and about 3,000 mt each in the Aleutian Islands (AI) and the Bering Sea (BS).

- In the GOA and AI for all years since 2003, the catch of giant grenadier has been much higher than any other non-target species in the NPFMC's "other species" or "non-specified" categories.
- Virtually all the giant grenadier catch has been taken as incidental catch, mostly in longline or pot fisheries on the BSAI and GOA continental slope for sablefish and Greenland turbot.
- The vast majority of the giant grenadier catch is discarded, and the discard mortality rate is 100% because the fish do not survive the pressure difference when brought to the surface and suffer great scale loss.
- 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.
- Bottom trawl surveys of the BS and GOA indicate that giant grenadier is by far the most abundant species in terms of biomass for continental slope waters deeper than 400 meters. Therefore, giant grenadier is of great ecological importance in this habitat.
- There may be potential for the future development of a targeted fishery for giant grenadier. Although giant grenadier are generally considered poor for human consumption due to the high water content of their flesh, there have been experimental attempts to market the fish, and there has been food technology research to develop marketable products from this species. Although retained catch information is confidential, in recent years up to 200 mt have been retained for processing (up to 1 % of the total catch), either as fish meal or headed and gutted. It is not known if this retained catch is the result of directed fishing effort on grenadiers or retention of incidentally caught grenadiers in other groundfish fisheries.
- The life history traits and deep-sea habitat of giant grenadier indicate they may be especially susceptible to overfishing. In common with 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. 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.
- Because of the large abundance of giant grenadier in both the BSAI and GOA, overharvest does not appear to be a problem at present. However, if future catches of giant grenadier were to increase due to the development of a target fishery or increased quotas for sablefish, overfishing concerns could arise, especially in the GOA.
- At present, stock assessment information for giant grenadier is relatively good compared to many other non-target species off Alaska. Trawl survey biomass estimates appear reasonable with low coefficients of variation, and extensive data are also available from longline surveys. A female size of maturity and fecundity study was recently completed, and ageing methods have developed, although the ages have not been validated. Giant grenadier can be presently assessed at the tier 5 level of the NPFMC's overfishing definitions, and potentially could be assessed at tier 4 or even tier 3 if the ages are verified.

In Appendix 1 to the 2011 SAFE reports the stock assessment authors made the following OFL and ABC recommendations for the giant grenadier: F refers to fishing mortality, M refers to natural mortality rate, amount are in metric tons (t).

Year	BSAI		GOA	
	2012	2013	2012	2013
M (natural mortality rate)	0.03	0.03	0.03	0.03
Tier	5	5	5	5
Biomass (t)	1,733,797	1,733,797	597,884	597,884
F_{OFL}	$F=M=0.078$	$F=M=0.078$	$F=M=0.078$	$F=M=0.078$
$maxF_{ABC}$	$0.75M=0.0585$	$0.75M=0.0585$	$0.75M=0.0585$	$0.75M=0.0585$
F_{ABC}	$0.75M=0.0585$	$0.75M=0.0585$	$0.75M=0.0585$	$0.75M=0.0585$
OFL (t)	135,236	135,236	46,635	46,635
maxABC (t)	101,427	101,427	34,976	34,976
ABC (t)	101,427	101,427	34,976	34,976
Overfishing Status (Year)	2010	2011	2010	2011
Overfishing	No	n/a	No	n/a

In the 2010 and 2011 SAFE reports the assessment authors estimated the total catch (mt) for all species of grenadier combined. Nearly all the catch is believed to be giant grenadier.

Year	Eastern Bering Sea	Aleutian Islands	BSAI Total	Gulf of Alaska
1997	2,964	2,887	5,851	12,029
1998	5,011	1,578	6,589	14,683
1999	4,505	2,883	7,388	11,388
2000	4,067	3,254	7,321	11,610
2001	2,294	1,460	3,754	9,685
2002	1,891	2,807	4,698	10,479
2003	2,869	3,558	6,427	12,253
2004	2,223	1,251	3,474	11,989
2005	2,633	1,795	4,428	7,251
2006	2,070	2,195	4,265	8,738
2007	1,628	1,547	3,175	9,261
2008	2,670	2,490	5,160	11,508
2009	2,902	3,743	6,645	6,427
2010	2,795	3,553	6,348	5,419
2011	n.a	n.a	6,390	8,191
Mean	2,893	2,498	5,495	10,061

n.a. = data not available

Using observer data from 2006 through 2010 the spatial distribution of average catch of grenadiers in the BSAI and GOA is illustrated in the following two figures.

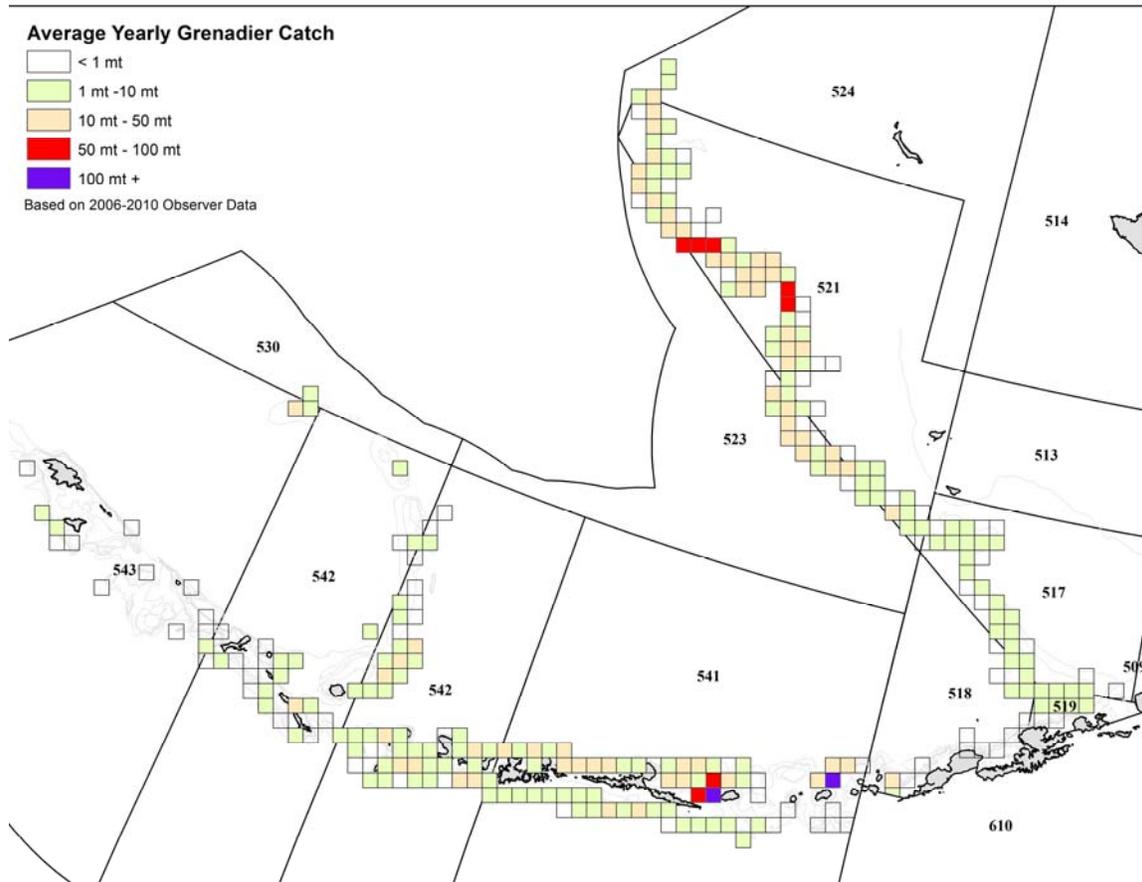


Figure 1. Average Yearly Grenadier Catch (2006 – 2010) in the BSAI.

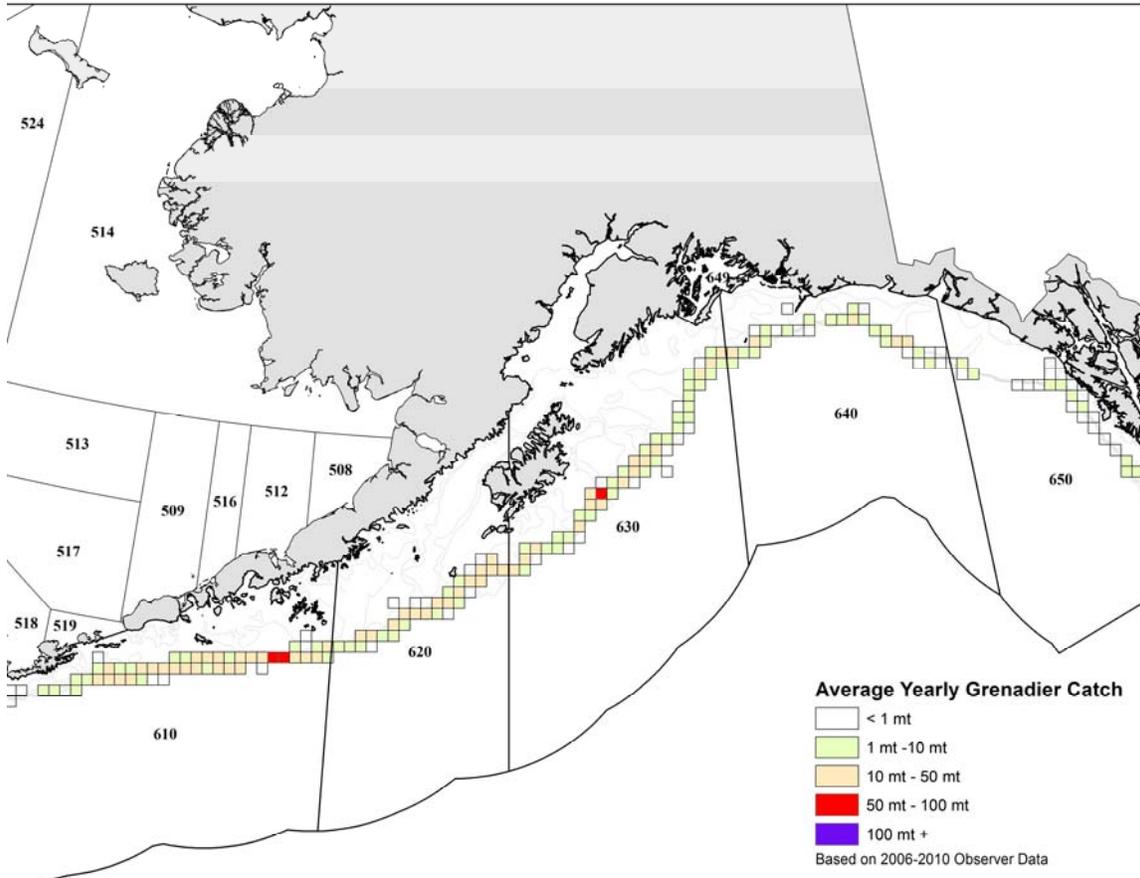


Figure 2. Average Yearly Grenadier Catch (2006 – 2010) in the GOA.

Vulnerability of Grenadiers and Complexes

The vulnerability of a stock or stock complex is an important consideration in the designation of a stock or stock complex as an “ecosystem component” (EC) and in the formation of a stock complex itself as either in the fishery or as an EC. National Standard 1 (NS1) defines vulnerability for a stock as a combination of its productivity, which depends on its life history characteristics, and its susceptibility to the fishery. Productivity refers to the capacity of the stock to produce maximum sustainable yield (MSY) 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, in consultation with their Scientific and Statistical Committees, to analyze the vulnerability of stocks in stock complexes whenever possible.

In 2008 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) with assessment authors from the regional science centers. 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). The work of the VEWG is complete and will be published soon as a NOAA Technical Memorandum and in a peer-reviewed journal. A preliminary report and other supporting materials that explain the group’s work in detail can be found at www.nmfs.noaa.gov/msa2007/vulnerability.htm. Here, a brief review of the analysis is provided to aid interpretation of the results for Alaska groundfish.

The analysis developed by the VEWG is based on previous work in Australia and elsewhere. It 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 lists all attributes evaluated in the productivity-susceptibility analysis (PSA):

productivity attributes

- reproductive strategy
- maximum age
- maximum size
- growth rate (*k*)
- natural mortality
- measured fecundity
- breeding strategy
- recruitment pattern
- age at maturity
- mean trophic level

susceptibility attributes

- management strategy
- areal overlap
- geographic concentration
- vertical overlap
- fishing mortality rate relative to natural mortality rate
- biomass of spawners (SSB) or other proxies
- seasonal migrations
- schooling/aggregation and other behaviors
- gear selectivity
- survival after capture and release
- desirability/value of the fishery
- fishery impact to habitat

Stock assessment scientists from the Alaska Fisheries Science Center prepared a draft vulnerability analysis for a number of Alaskan stocks and stock complexes, including grenadier, and presented the results in Appendix 3 to the 2009 SAFE report (Ormseth and Spencer 2009). Each attribute was scored with a 1, 2, or 3, indicating low, medium, and high values, respectively. Each attribute score was 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 were used in two separate ways:

- 1) The scores were 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 data point 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 data quality scores are reported in tables and the average data quality scores are depicted graphically (green = data quality <2; yellow = data quality >2 but <3; red = data quality >3).

A separate PSA was conducted for each region, Gulf of Alaska (GOA) and Bering Sea and Aleutian Islands (BSAI). Stock assessment authors were asked to provide attribute scores for the stocks they are responsible for, and the analyst (Ormseth) used those scores to produce the PSA. One of the difficulties of producing a PSA is that the susceptibility of a stock depends on the gear type under consideration (e.g. a skate is more susceptible to a bottom longline than a midwater trawl). In this analysis, the attributes were scored according to the fishery and gear type that would have the most impact on the stock. (e.g. Squids were evaluated relative to midwater trawl gear, where most of the incidental catch occurs.) While it may seem that this biases the analysis towards overestimating impacts (because you may have a fishery with a lot of overlap with a stock where the catch of that stock is fairly low) in practice this type of situation is "corrected" within the susceptibility analysis. If the incidental catch is low in a particular fishery and gear type, there will be some reason for it (e.g. low selectivity) that will be captured in the analysis. Similarly, if catch is high in that particular fishery and gear type, but the fishery itself is small, this will be captured in such attributes as the fishing rate relative to *M*.

The results of the GOA analysis are presented in Table 1 and Figure 3. The results of the BSAI analysis are presented in Table 2 and Figure 4. 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 Tables 1 and 2, 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.

Table 1. 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 giant grenadier.

ID #	stock name	productivity	susceptibility	vulnerability	data quality		
					prod	susc	average
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 (BS)	2.00	2.33	1.67	1.53	1.27	1.40
24	<i>giant grenadier</i>	<i>1.47</i>	<i>1.79</i>	<i>1.72</i>	<i>2.00</i>	<i>2.00</i>	<i>2.00</i>
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	rougtail 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	rougeye 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

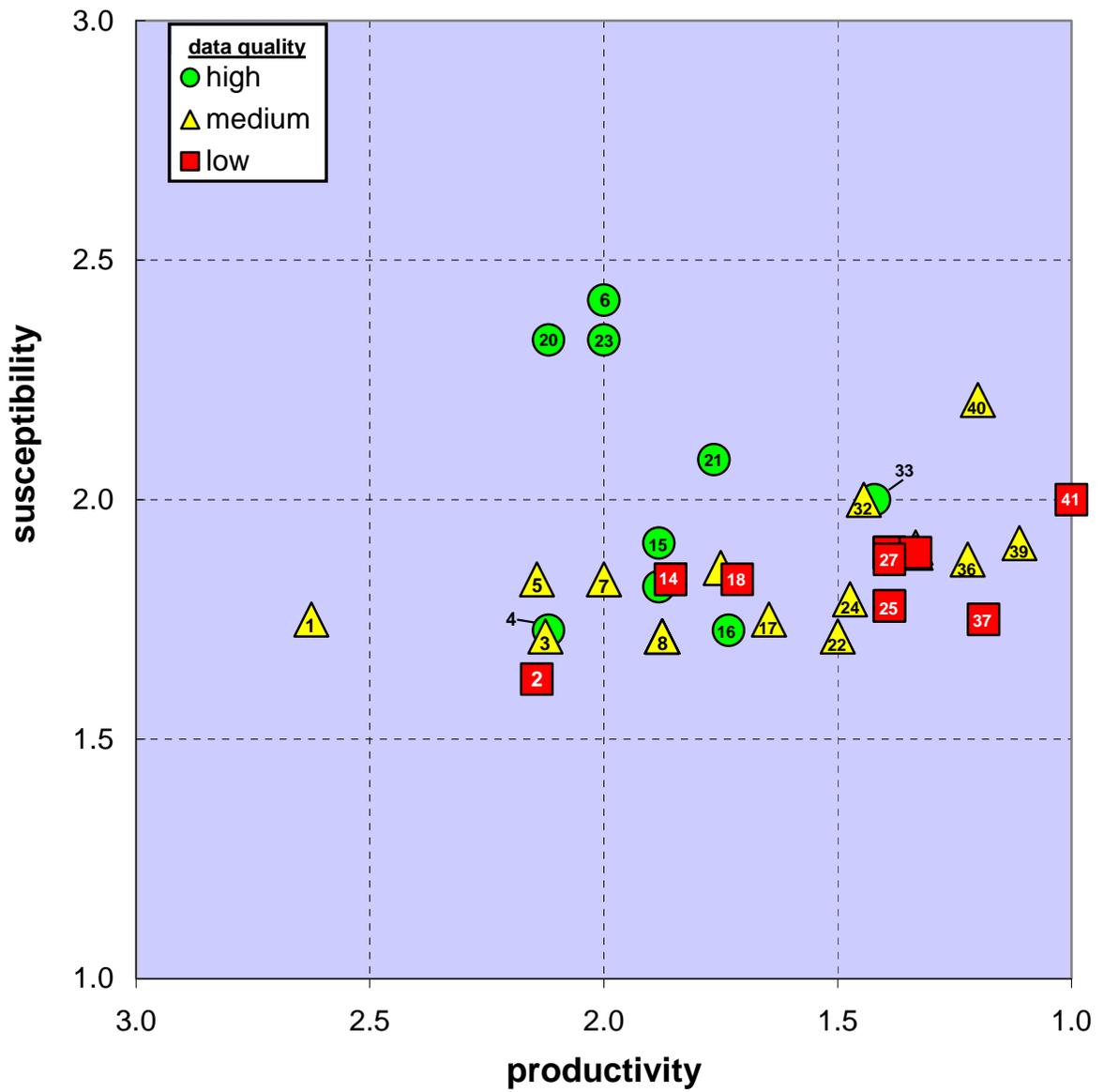


Figure 3. Results of the PSA analysis for the Bering Sea and Aleutian Islands region. Colors and symbol shapes indicate data quality scores. Numbers indicate stocks listed in Table 1. For clarity, not all stocks in Table 1 are labeled. Giant grenadiers are the yellow colored triangle # 24.

Table 2. 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 giant grenadier.

ID #	stock name	productivity	susceptibility	vulnerability	data quality		
					P	S	average
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	<i>giant grenadier</i>	<i>1.44</i>	<i>1.79</i>	<i>1.75</i>	<i>2.05</i>	<i>2.00</i>	<i>2.03</i>
15	Pacific ocean perch	1.74	2.29	1.81	1.47	1.41	1.44
16	rougeye 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

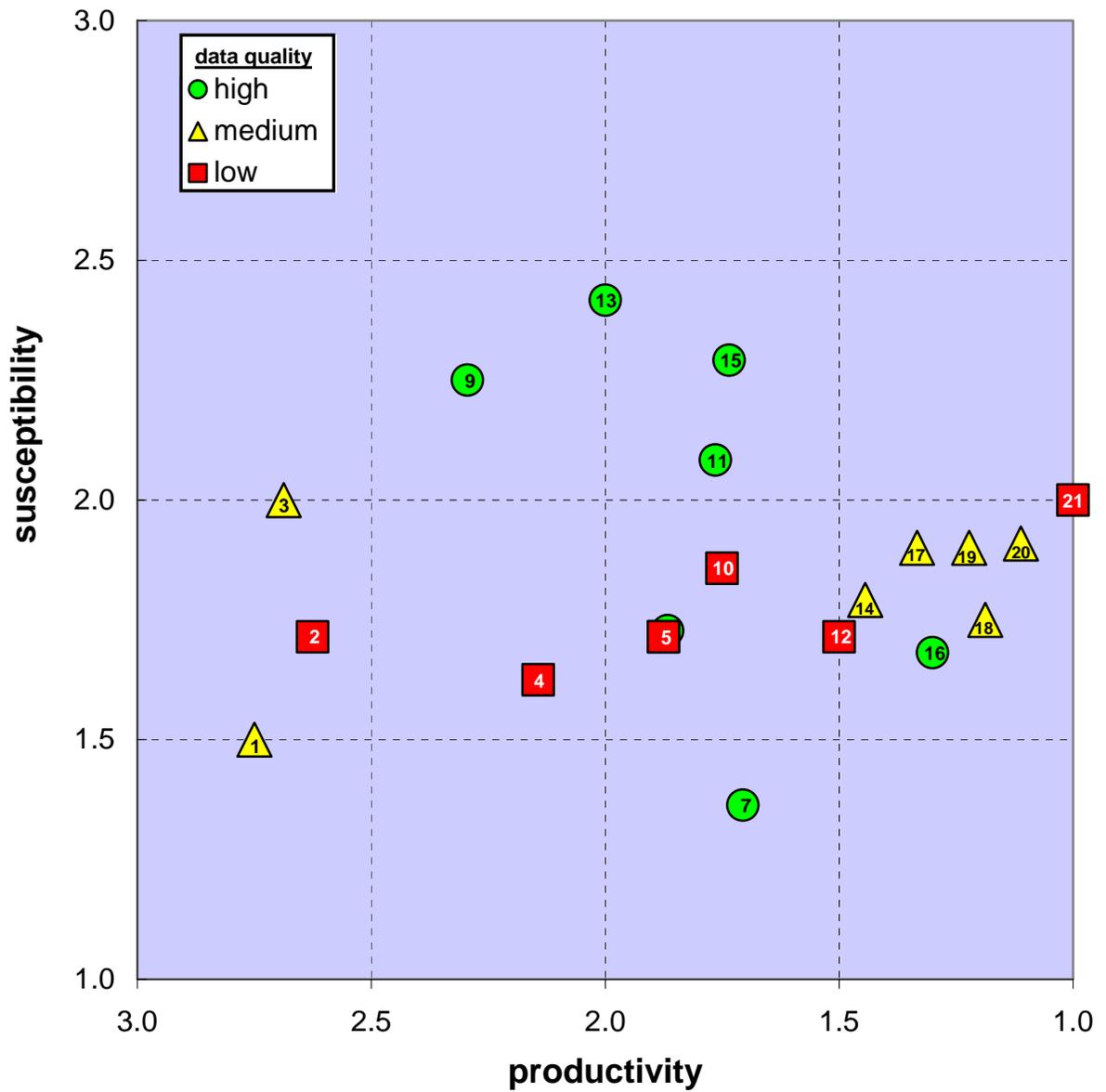


Figure 4. Results of the PSA analysis for the Gulf of Alaska region. Colors and symbol shapes indicate data quality scores. Numbers indicate stocks listed in Table 2. For clarity, not all stocks in Table 2 are labeled. Giant grenadiers are the yellow colored triangle #14.

In their discussion of the results the authors noted that:

- 1) Productivity varies widely among stocks in the fishery but that susceptibility is moderate probably due to the fact that all of the stocks, except grenadiers are in that region's FMP.
- 2) The principal target stocks (e.g., pollock and Pacific cod) have the highest susceptibility scores.
- 3) Data quality scores are highest for target stocks and lowest for non-target stocks, but there is no relationship between data quality and vulnerability.
- 4) Vulnerability does not appear to depend on whether a stock is targeted or not.
- 5) There are no clear divisions among stocks in this PSA. 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.

With respect to grenadiers the authors noted that:

- 1) Grenadiers are not presently included in the FMPs but were included in the PSA due to conservation concerns.
- 2) In the BSAI, the vulnerability score for giant grenadier is between that of Pacific cod and pollock (Table 1).
- 3) In the GOA, the vulnerability score for giant grenadier is between that of Pacific cod and Pacific ocean perch (Table 2).

Because of these similarities in vulnerability scores the authors state that “the PSA results suggest that grenadiers should be included as stocks “in the fishery” in the FMPs”. Thus, management measures appropriate for target species (such as ACLs and AMs) should also be applied to grenadiers.

In its discussion of the management of ecosystem species the authors noted that:

- 1) National Standard guidelines do not recommend specific management measures that should be applied to EC stocks but neither do they prohibit them.
- 2) The NPFMC has wide latitude to apply conservation measures to EC stocks but in view of National Standard 9 to reduce bycatch the NPFMC should consider management measures intended to reduce incidental catch.

Specific recommendations by the authors for EC stocks included:

- 1) Establish recordkeeping and reporting requirements for all EC stocks.
- 2) Prohibit directed fishing for EC stocks
- 3) Establish maximum retainable amounts (MRAs) for EC stocks, but these MRAs could vary among EC stocks.
- 4) EC stocks do not have annual catch limits and the potential exists for incidental catches of EC stocks (in fact for all non-FMP species) to become excessively high. The NPFMC should establish an allowable incidental catch (AIC) threshold for EC stocks based on current methods to determine OFLs.

- 5) Should the AIC for an EC stock be exceeded more than once in a four year period there would be a mandatory review of the stock's status by the Plan Teams and SSC, with the possibility of reclassification of that stock as in the fishery if warranted. The authors believe this approach would ensure that the EC classification does not result in uncontrolled incidental catches of EC stocks.
- 6) The AIC could also be time, area, and gear specific (e.g. areas could be established in order to prevent impacts to critical foragers).
- 7) The authors also suggested that, due to their low vulnerability scores similar to those of forage fish, the NPFMC could also consider designating the octopus and squid complexes as EC components. Directed fishing for octopus and squid is prohibited in the BSAI and GOA. However for a stock to be considered as an EC it should not be generally retained for sale or personal use (although a small amount of retention could be considered). Octopus are generally retained for sale or personal use. Most of this catch comes from pot gear used to target Pacific cod. Because octopus are generally retained they should not be considered as an EC. Squid is not generally retained except in infrequent instances. Squid have been retained as incidental catch (its difficult to sort out from the target catch) in the spring pollock fisheries in the Central GOA and retained for processing when the volume of squid delivered is sufficient to justify the cost of processing. However squid are not generally retained for sale or personal use except in the special instance noted above.

Implications for stock complexes

The authors also note that the PSAs presented in this draft report are also useful for considering how and whether stocks are formed into stock complexes. The National Standard guidelines suggest, among other requirements, that stocks in a complex should have similar vulnerability scores.

Management Alternatives

Alternative 1 The Status Quo. At present grenadiers are not part of the FMPs. There are no catch limits or retention limits for grenadiers and unlimited amounts may be taken. There are no recordkeeping or reporting requirements for grenadiers and currently the best estimate of catch comes from observer data. However vessels which have a Federal Fisheries Permit may use retained grenadiers as basis species for other groundfish. The maximum retainable amounts (MRAs) of groundfish using aggregated non-groundfish species (which include such species as Pacific halibut and grenadiers) as basis species ranges from 1 to 35 percent of incidental catch. At present the MRAs for groundfish using grenadiers as a basis species in the GOA is 20 percent for pollock, Pacific cod, deep-water flatfish, rex sole, flathead sole, shallow-water flatfish, Atka mackerel, skates, and other species; 35 percent for arrowtooth flounder; 5 percent for aggregated rockfish; 2 percent for aggregated forage fish; and 1 percent for sablefish (see Table 10 to part 679). At present the MRAs for groundfish using grenadiers as a basis species in the BSAI is 20 percent for pollock, Pacific cod, Atka mackerel, Alaska plaice, yellowfin sole,

other flatfish, rock sole, flathead sole, squid, and other species; 35 percent for arrowtooth and Kamchatka flounder combined; 5 percent for aggregated rockfish; 2 percent for shortraker and roughey rockfish combined and aggregated forage fish; and 1 percent for sablefish and Greenland turbot (see Table 11 to part 679).

Although grenadiers have not been in the target species category in the FMPs since 1980, there is no longer a valid scientific reason for them not to be included. According to bottom trawl surveys, giant grenadier is the most abundant species at depths 200-1,000 m on the continental slope of the GOA, BS, and AI. Based on their abundance, grenadiers play a dominant role in the food chain at this depth and hence, are of great ecological importance in this habitat (Kerim Aydin, AFSC, personal communication, May 18, 2012). Based on this ecological importance alone, giant grenadier deserves to 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 is taken in relatively large amounts as bycatch, especially in longline fisheries for sablefish and Greenland turbot. The giant grenadier are all discarded, and discard mortality is 100% because none of the fish survive when brought to the surface.

The reporting of grenadier catch is not required at this time. If giant grenadier were included in the FMPs, reporting of catches would be mandatory, and this would result in better, 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 Plan Teams, and the SSC have all recommended in recent years that grenadiers should be included in the FMPs, where they would be subject to management purview. Therefore, continued exclusion of grenadiers from the FMPs does not appear to meet the goals of ecosystem management.

What grenadier species should be considered for inclusion in the FMPs?

Three options could be considered concerning which grenadier species should be moved into the FMPs:

- 1) All seven species of grenadier that have been reported to occur in Alaskan waters;
- 2) Only giant grenadier, which is by far the most abundant species in the fishery; or
- 3) Giant grenadier and two other species that are occasionally taken in the fishery, Pacific and popeye grenadier.

Option 1 (move all species) does not appear necessary. Four of the grenadier species in Alaska only occur in very deep water and are never encountered in the fishery or in any of our standard surveys. There is no reason to include these abyssal species in the FMPs, and this option probably can be rejected.

Option 2 (move only giant grenadier) is viable and should be considered. Giant grenadier is by far the most abundant grenadier species in the depths where most fishing operations occur in Alaska (less than 800 m depth), and giant grenadier comprises the overwhelming majority of the commercial catch of grenadiers. Giant grenadier is the only grenadier species in Alaska that has adequate information available for stock assessment; and in the previous assessments for grenadiers, has served as a proxy for the entire group.

Option 3 (move giant, Pacific, and popeye grenadier) also deserves consideration. Pacific and popeye grenadier reside primarily in waters deeper than 1,000 m and are therefore infrequently caught in the fishery. However, these two fish can be quite abundant in these deep waters, and Pacific grenadier has a history of commercial exploitation off the U.S. West Coast. Including Pacific and popeye grenadier in the FMPs could be useful if fishing effort in Alaska ever expands into depths where these two species are more common. If Pacific and popeye grenadier are included in the FMPs along with giant grenadier as a “grenadier complex”, it is likely that giant grenadier would continue to be a proxy species for the whole group in the stock assessments.

Currently both NMFS and the State of Alaska (State) have two species codes for grenadiers, giant grenadiers (which is species specific) and grenadiers, rattail (which is not species specific and means only generic grenadiers unidentified). In the Federal regulations NMFS could move the two species codes from Table 2d to part 679 non-FMP species to Table 2a FMP species. NMFS would also propose the re-definition of grenadier, rattail to grenadier, other than giant. Since it is not necessary to specify a separate quota for other grenadiers the addition of two new species codes could be considered; one for Pacific grenadier and one for popeye grenadier. The greatest immediate benefit of including grenadiers in the FMPs as either in the fishery or as an ecosystem component would be the enhanced reporting, recordkeeping, and monitoring of catch that could result.

If grenadiers were to be designated as “in the fishery” in the FMP what other changes to the fishery regulations would need to be implemented?

This is Alternative 2. Giant grenadiers are caught in large amounts as bycatch in fisheries directed at other species. Total estimated catch of grenadiers (nearly all of which is believed to be giant grenadier) in Alaska has averaged about 16,000 mt since 1997, which is similar to the amount taken in some important target fisheries in Alaska, such as sablefish. In the GOA in 2010, the estimated catch of giant grenadier (5,419 mt) was exceeded by only 5 species: walleye pollock, Pacific cod, arrowtooth flounder, Pacific ocean perch, and sablefish. Giant grenadier does not rank as high in the BSAI groundfish catch, but substantial amounts are also taken in this area. No other groundfish that is not classified as “in the fishery” is caught in such large amounts in the BSAI or GOA.

Stocks of fish that are “in the fishery” are those stocks that are targeted, harvested, 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 nor retained but are taken as bycatch and for which overfishing or

overfished status may be a concern. For each of those stocks, whether a single species or species group, OFLs, ABCs, and total allowable catches (TACs) must be established each year in the annual harvest specifications process, as well as ACLs and AMs. In order for separate species to be aggregated together and managed as a species group (sometimes called a species complex) the species should have a similar geographic distribution, life history, and vulnerability.

Some giant grenadier has been retained for sale in the GOA since at least 1999, but the amounts have been small. However, given the relatively large catches of giant grenadier, it is not unreasonable to expect fishermen in the future to increase their efforts at developing markets for these fish, which would substantially increase the retained catch. The Magnuson-Stevens Act has a goal of decreasing the economic discards of fish and promoting their increased retention and utilization, which may also cause more retention of giant grenadier in the future. If the TACs for grenadiers were set at a level above the incidental catch of grenadiers in other fisheries then a directed fishery for grenadiers could be permitted. If markets are developed for giant grenadier then it is possible that some targeted fishing could occur. Due to their life history characteristics of slow growth, longevity, and late maturity, and also their deep-sea habitat, giant grenadier are especially vulnerable to overfishing. The fact that female giant grenadier are disproportionately caught in the fishery (over 90% of the catch is female) is another factor that could lead to overfishing concerns.

The current stock assessment for grenadiers does not indicate that overfishing is presently occurring. However, if abundance estimates for giant grenadier were to decrease, and/or catches increase due to factors such as increased quotas for the sablefish fishery (where much of the giant grenadier bycatch is taken), overfishing concerns could arise. This could be especially a problem in the GOA, where abundance (and resultant OFLs) of giant grenadier is lower and catches higher than in the BSAI.

The vulnerability analysis by Ormseth and Spencer (2009) that was discussed previously also supports that giant grenadier would be most appropriately categorized as “in the fishery”. The two criteria that were used in the study, productivity and susceptibility, yielded a relatively high vulnerability score for giant grenadier that was similar to species that were “in the fishery” and therefore have the potential for experiencing overfishing. In contrast, “ecosystem component” species such as capelin and eulachon had very low vulnerability scores.

Moving grenadiers to “in the fishery” would require that they become part of the NPFMC’s harvest specification process and that official values of ABC, OFL, and TAC be determined. “Unofficial” stock assessments for grenadiers have been done since 2006, and relatively good biological and population data are available for giant grenadier to determine the harvest specification values. However, incorporating grenadiers into the harvest specification process would mean that their values of TAC would contribute to the overall OY for groundfish in the GOA and the BSAI.

If TACs were established for grenadiers and the area-wide OY was already fully utilized by existing fisheries then TACs for the existing fisheries would have to be lowered proportionately to accommodate the new TAC for grenadiers. In the GOA, the OY for the groundfish fishery has been established as between 116,000 and 800,000 mt. Annual TACs in the GOA have always totaled much less than these OYs; for example, in 2012 the sum of TACs for groundfish totaled 438,159 mt in the GOA, far below the upper OY limit of 800,000 mt. Therefore, it appears that the OYs in the GOA could easily accommodate the addition of a TAC for grenadiers, with no constraint on existing fisheries.

In the BSAI, however, the situation is different. OYs in the BSAI have been established as between 1.4 and 2.0 million mt, with the latter value being a “hard cap” (absolute legal maximum). Frequently in past years, the NPFMC has recommended, and NMFS has approved, TACs totaling the “hard cap” of 2.0 million mt in the BSAI groundfish fisheries. In such years, to accommodate the addition of a new TAC for grenadiers, TACs for other groundfish would have to be lowered. As an example, a reasonable TAC for grenadiers in the BSAI might be 8,000 mt, which is an amount greater than any of the estimated annual catches for grenadier in this area. This level of TAC would presumably allow the current level of grenadier bycatch to continue and not impact fisheries such as sablefish and Greenland turbot where most grenadier are caught. For those years when the 2.0 million mt “hard cap” was fully utilized, the TACs for other groundfish species would have to be reduced by 0.4% to accommodate the 8,000 mt TAC for grenadiers. Although this is a very small percentage, it would probably cause some loss of income for fishermen because the other species are higher valued than grenadier.

If grenadiers were to be included “in the fishery” then product recovery rates (PRRs) would need to be established for grenadiers in Table 3 to part 679. If grenadiers were included in the FMPs as an ecosystem component and retention is allowed then it may also be advisable to establish PRRs. Possibilities include adopting the existing PRRs for a species with a similar external morphology (e.g. Pacific cod; both are roundfish with large heads) or establishing PRRs unique for grenadiers. The options for establishing a PRR would need further development and analysis with any alternative that allows retention.

There has been some discussion of reviewing discard mortality rates (DMRs) for several species of groundfish, sablefish, skates, and octopus. With the exception of halibut DMRs for groundfish are currently assumed to be 100 percent. There is good data to support a DMR of 100 percent for grenadiers. Grenadiers experience extreme barotrauma when brought up from the depths they inhabit and easily lose scales when handled and are therefore not likely to survive being caught and discarded.

Other management measures that would need to be established for grenadiers if moved to “in the fishery” include prohibited species bycatch management. Grenadiers could be included with the trawl deep-water species fisheries in the GOA, the trawl Greenland turbot/arrowtooth flounder/sablefish fisheries in the BSAI, and the other hook-and-line fisheries in the GOA and BSAI in §679.21.

Seasons for the grenadier fishery could be established in § 679.23. They could follow the general season opening dates of January 1 for hook-and-line gear and January 20 for trawl gear, or for the Individual Fishing Quota sablefish fisheries in the GOA and BSAI (§ 679.23(g)), or for the Greenland turbot and arrowtooth flounder fisheries on May 1 in the BSAI (§ 679.23(e)(1)).

For observer coverage grenadiers would need to be added to the groundfish fishing categories found at § 679.50(c)(2), either as a new category or combined with another category such as the sablefish fishery or the “other species” fishery.

If grenadiers were to be designated as “an ecosystem component” what other changes to the fishery regulations may need to be implemented?

This is Alternative 3. To be designated as an “ecosystem component” (EC), the species or species group should be non-targeted (taken as bycatch only); not subject to overfishing, overfished, or approaching an overfished condition based on the best available information, in the absence of conservation and management measures; and not generally retained for sale or commercial use. The EC definitions allow for the retention of a “small” amount of catch, but give no guidelines on what is meant by “small”. Moving grenadiers into the FMPs as “ecosystem components” would allow for development of management measure specific to meeting conservation goals.

EC species may be included in the FMPs 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”, a Council should consider measures for the fishery to minimize bycatch 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 biological reference points or determinations of acceptable biological catch (ABC) and overfishing levels (OFLs). Catches of EC species do not count toward optimum yield (OY), such as the upper OY cap of 2.0 million mt for BSAI groundfish. However, EC species should be monitored to the extent that any new pertinent scientific information becomes available to determine changes in their status or their vulnerability to the fishery. If new information indicates that they no longer meet the criteria for an ecosystem component and there is potential for overfishing or retention, they should be reclassified as “in the fishery”.

Due to their importance in the ecosystem, giant grenadier may be categorized in the FMPs as an “ecosystem component.” Moving grenadiers into the “ecosystem component” category would be beneficial because it can result in mandatory and more accurate catch accounting for giant grenadier than exists at present. Given the relatively high bycatch of giant grenadier, improved catch records are needed. Giant grenadier also meets the “ecosystem components” requirement that the species should be non-targeted, although it is possible that a very small amount of targeted fishing has occurred.

Although OFLs, ABCs, and TACs would not need to be set annually for grenadiers as an “ecosystem component,” an annual incidental catch (AIC) limit could be set for grenadiers which if reached could result in prohibiting all retention. Assigning grenadiers to the ecosystem component species should be re-evaluated if the AIC limit is exceeded more than once in a time period recommended by the NPFMC. If a species in the ecosystem component is believed to have become subject to overfishing, approaching overfishing, or overfished it must be moved to in the fishery and a rebuilding plan may need to be developed. Additional management measures to conserve and minimize incidental catch of grenadiers “ecosystem component” could be considered such as recordkeeping and reporting requirements and MRAs for grenadiers as an incidental catch species.

Move Grenadiers into the FMPs as “In the Fishery” in the GOA and as “Ecosystem Component” Species in the BSAI:

This is Alternative 4. This alternative recognizes the difference between catch and abundance of grenadiers in the BSAI compared to the GOA and the different potential vulnerabilities to overfishing in each area. Classifying grenadiers as “in the fishery” in the BSAI may pose difficulties for setting TACs in the harvest specifications process because TACs for other, more valuable groundfish would have to be slightly lowered in those years when the OY of 2.0 million mt has been fully allocated among the target species. A possible solution to this problem would be to categorize grenadiers as an “ecosystem component” in the BSAI. Placing grenadiers in the “ecosystem component” category in the BSAI would mean that their catches would not count toward the OY of 2.0 million mt and would not affect the TACs of other groundfish in this area. An “ecosystem component” classification for grenadiers in the BSAI may be acceptable from a biological and management standpoint because giant grenadiers are very abundant in this area, whereas catches have been relatively small. Thus, overfishing of grenadiers in the BSAI is unlikely in the foreseeable future.

In contrast, there is more of a need to categorize grenadiers in the GOA as “in the fishery” because giant grenadiers in this area are not as abundant and their catches have been consistently larger than in the BSAI. Categorizing grenadiers in the GOA as “in the fishery” would help ensure that overfishing of giant grenadier in this area would not occur.

Under what other circumstances would it also be prudent to consider moving a species from the ecosystem component to in the fishery?

Moving a species from the ecosystem component to in the fishery may need to be investigated under various situations including:

- When the industry expresses an interest in targeting the ecosystem component species.
- When retention of the ecosystem component increases.

- When an adequate assessment of the ecosystem component is approved by the Science and Statistical Committee.
- When there is evidence that discards required by regulation is occurring.

Parties interested in targeting the ecosystem component could apply for an exempted fishing permit so that issues such as the incidental catch of other groundfish and prohibited species could be evaluated before management measures could be considered for the new, potential directed fishery.

Summary of Potential Alternatives and Management Options

Table 3. Summary of Alternatives

Alternative	Action Required
1. Status Quo. No Action	<p>None.</p> <ol style="list-style-type: none"> 1. No recordkeeping, reporting, and monitoring requirements. 2. No annual harvest specifications would be required. 3. No PRRs or DMRs would be required. 4. Existing MRAs for groundfish using grenadiers as a basis species would continue. 5. No PSC limits would apply. 6. No closed season to directed fishing. 7. No observer coverage requirements.
2. Include Grenadiers in the BSAI and GOA FMPs as “in the fishery”	<p>FMP amendments and regulatory additions to establish management measures</p> <ol style="list-style-type: none"> 1. Recordkeeping and reporting would be required and NMFS would monitor the catch and disposition of catch. 2. Annual harvest specifications would be specified (OFLs, ABCs, TACs along with ACLs and AMs) 3. PRRs would need to be established in regulation. DMR would be assumed to be 100 %. 4. MRAs using grenadiers as a basis species and the MRA of grenadiers as an incidental catch species would need to be established in regulation. 5. PSC limits for the grenadier fishery would need to be established in regulation. 6. Open seasons for directed fishing would need to be established in regulation. 7. Grenadiers would need to be assigned to a target fishery for observer coverage requirements in regulation.

<p>3. Include Grenadiers in the BSAI and GOA FMPs as an “ecosystem component”</p>	<p>FMP amendments and regulatory additions to establish management measures</p> <ol style="list-style-type: none"> 1. Recordkeeping and reporting would be required and NMFS would monitor the catch and disposition of catch. 2. Annual harvest specifications would not be specified (OFLs, ABCs, TACs along with ACLs and AMs). However, an AIC limit could be established which if approached reached could trigger PSC status. 3. PRRs would need to be established in regulation. DMR would be assumed to be 100 %. 4. MRAs using grenadiers as a basis species would not be established. An MRA of grenadiers as an incidental catch species would need to be established in regulation. 5. PSC limits for the grenadier fishery would not need to be established in regulation. 6. Open seasons for directed fishing would not need to be established in regulation. Grenadiers would be closed to directed fishing year round. 7. Grenadiers would not need to be assigned to a target fishery for observer coverage requirements in regulation.
<p>4. Include Grenadiers in the BSAI FMP as an ‘ecosystem component’ and in GOA FMP as “in the fishery”</p>	<p>FMP amendments and regulatory additions to establish management measures</p> <p>In the BSAI those actions listed under Alternative 3 would need to be undertaken while in the GOA those actions listed under Alternative 2 would need to be undertaken.</p>

Table 4. Summary of Management Options under Alternative 2 in the Fishery.

Action Required	Management Options
1. Recordkeeping and reporting would be required and NMFS would monitor the catch and disposition of catch.	Which species should be included in the reporting. A) giant grenadier only. B) giant grenadier and other grenadiers. C) giant, popeye, and Pacific grenadiers. D) giant, popeye, Pacific, and other grenadiers.
2. Annual harvest specifications would be specified (OFLs, ABCs, TACs along with ACLs and AMs).	Management Area A) BSAI and GOA without further subdivision. B) BS, AI, and GOA without further subdivision. Annual harvest specifications A) giant grenadiers. B) all grenadiers with giant grenadiers as a proxy for the group.
3. PRRs would need to be established in regulation.	A) Use Pacific cod PRRs. B) Establish a species specific PRR for grenadiers.
4. MRAs using grenadiers as a basis species and the MRA of grenadiers as an incidental catch species would need to be established in regulation.	As a Basis Species A) Status quo. Same as aggregated amount of non-groundfish species. B) Include with other species. C) Establish grenadier specific MRAs As an Incidental Catch Species A) Include grenadiers with the other species. B) Establish specific MRAs for grenadiers.
5. PSC limits for the grenadier fishery would need to be established in regulation.	Trawl Fisheries A) Establish grenadier specific PSC limits in the BSAI and GOA. B) Include grenadiers with Greenland turbot/arrowtooth/sablefish fisheries in the BSAI and the deep-water species in the GOA. Hook-and-Line and Non-Trawl Fisheries A) Establish grenadier specific PSC limits in the BSAI and GOA. B) Include grenadiers with other hook-and-line fisheries in the GOA and the non-trawl fisheries in the BSAI.

<p>6. Open seasons for directed fishing would need to be established in regulation.</p>	<p>A) Include grenadiers with general opening for hook-and-line (January 1) and trawl (January 20). B) Concurrent with the IFQ season. Suboption for the BSAI C) Concurrent with the Greenland turbot and arrowtooth fisheries (May 1).</p>
<p>7. Grenadiers would need to be assigned to a target fishery for observer coverage requirements in regulation.</p>	<p>Include grenadiers with A) A new specific grenadier only target. B) Sablefish. C) Other species.</p>

Table 5. Summary of Management Options under Alternative 3 Ecosystem Component.

Action Required	Management Options
1. Recordkeeping and reporting would be required and NMFS would monitor the catch and disposition of catch.	Which species should be included in the reporting. A) giant grenadier only B) giant grenadier and other grenadiers C) giant, popeye, and Pacific grenadiers D) giant, popeye, Pacific, and other grenadiers
2. Annual harvest specifications would be specified (OFLs, ABCs, TACs along with ACLs and AMs)	Not required. However an AIC could be established and monitored which if reached could trigger PSC status based on A) Estimated incidental catch need of 5,000 mt in the BS 3,000 mt in the AI Or 8,000 mt in the BSAI 15,000 mt in the GOA. B) 50% of recommended ABC. C) 75% of recommended ABC.
3. PRRs would need to be established in regulation.	Not required.
4. MRAs using grenadiers as a basis species and the MRA of grenadiers as an incidental catch species would need to be established in regulation.	As a Basis Species Not required, as an ecosystem component grenadiers would be closed to directed fishing year round. As an Incidental Catch Species A) Include grenadiers with the other species. B) Establish specific MRAs for grenadiers.
5. PSC limits for the grenadier fishery would need to be established in regulation.	Not required, as an ecosystem component grenadiers would be closed to directed fishing year round.
6. Open seasons for directed fishing would need to be established in regulation.	Not required, as an ecosystem component grenadiers would be closed to directed fishing year round.
7. Grenadiers would need to be assigned to a target fishery for observer coverage requirements in regulation.	Not required, as an ecosystem component grenadiers would be closed to directed fishing year round.

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