GROUNDFISH MANAGEMENT TEAM REPORT ON ECOSYSTEM COMPONENT SPECIES AND THEIR FISHERY MORTALITY

Contents

Executive Summary

The Groundfish Management Team (GMT) provides information on current Ecosystem Component (EC) groundfish species to inform the Pacific Fishery Management Council's (Council) consideration of these species within the Stock Definitions Phase 2 process. EC species, as described at §600.305(d)(13), have been designated as not in need of conservation and management and are considered non-target species, which are generally not retained for sale or personal use. The Council monitors these species for new information, including catch trends and vulnerability. This document provides a description of current EC species, including taxonomy, distribution, conservation status, and mortality trends, with a focus on mortality before and after being declared an EC species. It covers 23 species and families (22 species for the quantitative analysis, plus an "unidentified" category), including those listed under "all other skates" and "all other grenadiers" in Table 3-3 of the Pacific Coast Groundfish Fishery Management Plan (FMP), noting diverse International Union for Conservation of Nature (IUCN) statuses ranging from Least Concern to Critically Endangered (one species - soupfin shark). Seventeen of the 23 species have known distributions that span the entire West Coast, five species have distributions that only partially cover the West Coast, and one species (Bering skate) has a distribution that does not include any waters off of the West Coast, with the southernmost extent of its known distribution off British Columbia, Canada.

Analyzing 2002-2023 mortality data from the Groundfish Expanded Mortality Multiyear (GEMM) report, the GMT found that only shortbelly rockfish and soupfin shark showed notable changes in mortality and discard trends in recent years. Shortbelly rockfish, designated EC in 2021, saw a substantial increase in average annual mortality post-designation compared to all years prior to designation (2021-2023 vs. pre-2021) but a decrease compared to the immediate preceding period (2021-2023 vs. 2017-2020). Soupfin shark, caught across the widest variety of sectors, had an overall slight decrease (2 percent) in average annual mortality across all groundfish and non-groundfish fisheries since its 2015 EC designation. However, when looking at directed groundfish sectors only, soupfin shark saw a substantial increase in average annual mortality before and after

EC designation, as well as a steady increase in discarding practices. For most EC species, the Individual Fishing Quota (IFQ) bottom trawl sector contributed the majority of their mortality, although this contribution shifted for some species over the time series as bottom trawl effort declined. The majority of mortality of EC species is attributed to discards, though some retention occurs. Changes in mortality trends may be due to a number of factors, including changes in species abundance, species distribution, and/or changes in fishery activity.

Background

At the March 2025 meeting, the Council made progress on defining all stocks in the FMP. The Council discussion at that meeting identified the need to consider how current EC species in the FMP will be considered as part of the Stock Definitions Phase 2 process and whether they should also be evaluated with the 10-factor analysis outlined in National Standard Guidance §600.305(c) to determine if they are in need of conservation and management. In March, the Council chose to include, "groundfish species designated as Ecosystem Component species as identified in the groundfish fishery management plan table 3-3 analysis and consideration under the range of alternatives" (Agenda Item H.6, Council Motion, March 2025).

To help inform the Council's consideration of groundfish EC species under each of the Stock Definitions alternatives, the GMT provides the following report describing each of the current groundfish EC species in more detail and their respective mortality trends. As described in Section 4.4.4 of the FMP, "EC species do not require specification of reference points (i.e., OFLs, ABCs, and ACLs) but are monitored to the extent that any new pertinent scientific information becomes available (e.g., catch trends, vulnerability, etc.) to determine changes in their status or their vulnerability to the fishery." The FMP also specifies that EC species, "should:

1. Be a non-target species or stock;
2. Not be determined to be subject to overfishing, approaching overfished, or overfished;
3. Not be likely to become subject to overfishing or overfished, according to the best available information, in the absence of conservation and management measures; and
4. Not generally be retained for sale or personal use."

There are also several species, and families of species, categorized as shared EC species, which means they are shared across all FMPs the Council manages (Table 3-4 of the FMP). Shared EC species require further consideration of their importance to the greater marine ecosystem, along with other relevant information, before they can be the subject of directed commercial fisheries.

Table 3-3 of the FMP lists the groundfish species, and families of species, which are EC species for only the Groundfish FMP (Table 1). Note that this list includes two families of species described as "all other skates" and "all other grenadiers," which encompasses "all endemic species" in the Arhynchobatidae and Macrouridae families, respectively. The GMT notes that the biological definition of an endemic species is one found exclusively in a specific geographic region or location and nowhere else on Earth (Krebs, 1972; Sottosanti, 2025). Because the term "endemic" does not fit within the context of the FMP, the Council could consider simply listing the scientific names of all species that are intended to be included as EC species in the FMP, or alternatively, using more accurate language such as, "species in the family […] occurring within the Exclusive Economic Zone off the continental U.S. West Coast."

Table 1. Groundfish species designated as Ecosystem Component Species in the FMP (Table 3-3 of Section 3.3).

Common Name	Scientific Name
Shortbelly rockfish	*Sebastes jordani*
Aleutian skate	*Bathyraja aleutica*
Bering/sandpaper skate	*B. interrupta*
California skate	*R. inornata*
Roughtail/black skate	*Bathyraja trachura*
All other skates	Endemic species in the family *Arhynchobatidae*
Pacific grenadier	*Coryphaenoides acrolepis*
Giant grenadier	*Albatrossia pectoralis*
All other grenadiers	Endemic species in the family *Macrouridae*
Finescale codling (aka Pacific flatnose)	*Antimora microlepis*
Ratfish	*Hydrolagus colliei*
Soupfin shark	*Galeorhinus zyopterus*

Shortbelly rockfish is the only rockfish species designated as an EC species in Table 3-3, and when it was given this designation, the Council specified a threshold of 2,000 metric tons (mt) to which catch would be monitored at each inseason groundfish meeting. If the threshold is exceeded or is projected to be exceeded, the Council, "shall review and investigate all relevant information, including but not limited to, survey abundance trends and other stock status information, changes in fishing behavior, and changes in the market interest for shortbelly rockfish" (FMP Section 4.4.4). Based on this review of information, the Council will consider voluntary measures and other management measures to reduce shortbelly rockfish mortality.

Taxonomy & Distribution

Table 2 below lists each species covered in Table 3-3 of the FMP, including those species that fall under the categories of "all other skates" and "all other grenadiers". Species in Table 2 are grouped based on whether they are explicitly listed at the species level or, if not, whether they fall under the "all other skates" (family Arhynchobatidae) or the "all other grenadiers" (family Macrouridae). Each species' scientific name, IUCN status, spatial distribution, and depth are provided, along with any notes about the taxonomic classification of the species that was identified during this analysis. For scientific names, taxonomic classification, distribution, and depth information, the GMT consulted the National Oceanic and Atmospheric Administration's 2017 Technical Memorandum (NOAA Tech. Memo.) on the list of fishes captured in West Coast surveys, which is intended to be a field reference for species identification. The GMT also referenced FishBase as a supplementary source and to fill any information gaps.

Table 3-3 of the FMP groups Bering skate and sandpaper skate under the same scientific name *Bathyraja interrupta*. The NOAA Tech. Memo. states that, "in some texts, *B. kincaidii* is a junior synonym to *B. interrupta*, the sandpaper or Bering skate. However, Ebert (2003) suggests two distinct species, and that *B. kincaidii* may have one or more morphological variants throughout its range." The geographic range of B. interrupta (as listed in Table 3-3) does not extend into any waters off of the West Coast, with British Columbia, Canada defined as the southernmost extent of its range (Knuckey & Ebert, 2022). *B. kincaidii* on the other hand, which is not listed in Table

3-3, ranges from British Columbia, Canada south to Baja California, Mexico. For the purposes of this analysis and to be consistent with the NOAA Tech. Memo., we have broken out "Bering/sandpaper skate" into two distinct species: Bering skate (*B. interrupta*) and sandpaper skate (*B. kincaidii*).

The GMT also discovered that there are two types of abyssal grenadier within the same genus, smooth abyssal grenadier (*Coryphaenoides armatus*) and rough abyssal grenadier (*C. yaquinae*). The former is commonly referred to as just "abyssal grenadier," as it is in Table 3-3, and the latter is described in Table 3-3 as "Yaquina grenadier" but is more commonly referred to as rough abyssal grenadier in other sources.

Out of the total 23 species listed in Table 2, 12 are listed as Least Concern by the IUCN, one is listed as Data Deficient (finescale codling, a.k.a., "Pacific flatnose"), one is Critically Endangered (soupfin shark, a.k.a., "tope shark"), and the remaining 9 have not been evaluated. Finescale codling was listed as Data Deficient in 2010, because "as this is a deep-water species with biological characteristics that make it more vulnerable to exploitation, further research is suggested to determine the impact of harvesting before a more accurate assessment can be made" (Iwamoto, 2010). In 2022, NMFS responded to a petition under the Endangered Species Act to list soupfin shark as a threatened or endangered species that had substantial scientific or commercial information indicating action may be warranted.[1] NMFS has commenced a review of the status of the soupfin [tope] shark to determine whether listing under the ESA is warranted

Given that vulnerability is identified as a source of information with which EC species should be monitored, the GMT explored whether vulnerability scores (through a Productivity and Susceptibility Assessment, i.e., Cope et al 2011) have been calculated for any of the groundfish EC species in Table 2. We did not identify any such analyses for West Coast populations, but four of the species were given vulnerability scores associated with their stocks off of Alaska: Aleutian skate, Bering sea skate, roughtail/black skate, and deepsea skate (Patrick et al., 2009), all of which were between 1.5 and 2 (i.e., low to moderate concern).

Seventeen of the 23 species in Table 2 have a known distribution that spans the entire West Coast, although two of those 17 species are rare north of California (California grenadier and smooth grenadier). Five of the 23 species have distributions that include only portions of the West Coast, such as white skate (*B. spinosissima*), which does not occur north of central Oregon. The remaining one species (Bering skate) does not have a range that extends into any waters off the West Coast, as described above. Many of the EC species are deep-dwelling fishes, particularly the grenadiers, with one species (Yaquina grenadier) reaching up to 6,450 meters (m). However, some species are found as shallow as inshore bays (e.g., soupfin shark) or the intertidal zone (e.g., spotted ratfish).

[1] 87 FR 25209 Endangered and Threatened Wildlife; 90-Day Finding on a Petition To List the Tope Shark as Threatened or Endangered Under the Endangered Species Act:

Table 2. Scientific name, IUCN status, and spatial information of the groundfish EC species in Table 3-3, including species that fall under the categories "all other skates" and "all other grenadiers" but not explicitly listed in Table 3-3. "Off the West Coast…" indicates that the species is also found elsewhere, such as in Pacific waters off of Japan, but those areas are not relevant to Council management of this species. The distribution in this table is limited to Pacific Ocean waters off of the Americas. Sources: NOAA Technical Memorandum and FishBase.org. If there was a record of the species in the NOAA Tech. Memo., we deferred to that source, but if not, we referenced FishBase.

Species	Scientific Name	IUCN Status (date assessed)	Notes on Taxonomy	Distribution & Depth
Species explicitly listed in Table 3-3				
Aleutian skate	*Bathyraja aleutica*	Least Concern (September 2023)		Off the West Coast, they range from BC, Canada to Cape Mendocino, CA; 15-1,602 m but most common 100-800 m[a/]
Bering skate	*Bathyraja interrupta*	Least Concern (September 2023)	Table 3-3 groups this with sandpaper skate but the NOAA Tech. Memo. identifies these as two separate species that can be confused.	Bering Sea, Alaska south to BC, Canada; 23-1,500 m but most common 200-500 m[b/]
California skate	*Raja inornata*	Least Concern (September 2014)		Juan de Fuca Strait in Canada and the U.S. to central Baja California, Mexico; 5-641 m[a/]
Finescale codling	*Antimora microlepis*	Data deficient (February 2009)	Also referred to as "Pacific flatnose" or "finescale mora"	Off the West Coast, the Bering Sea, Alaska to the Gulf of California; 175-3,408m but usually 500-950 m[a/]
Giant grenadier	*Albatrossia pectoralis*	Not evaluated		Off the West Coast, they range from the Bering Sea, Alaska to northern Baja California, Mexico; 140-3,500 m[a/]
Pacific grenadier	*Coryphaenoides acrolepis*	Not evaluated		Off the West Coast, they range from the Bering Sea, Alaska to Baja California, Mexico; 900-1,300 m[a/]
Roughtail/black skate	*Bathyraja trachura*	Least Concern (September 2023)		Western Bering Sea to northern Baja California, Mexico; 400-2,550 m[a/]
Shortbelly rockfish	*Sebastes jordani*	Not evaluated		BC, Canada to northern Baja California, Mexico; 50-350 m (usually less than 250 m)[a/]

Species	Scientific Name	IUCN Status (date assessed)	Notes on Taxonomy	Distribution & Depth
Spotted ratfish	*Hydrolagus colliei*	Least Concern (May 2024)		Eastern Gulf of Alaska to the northern Gulf of California, Mexico; from the intertidal zone to depths of 971 m[a/]
Soupfin shark	*Galeorhinus galeus*	Critically Endangered (February 2020)	Also referred to as "tope shark"	Off the West Coast, they range from BC, Canada to the Gulf of California, Mexico; from close inshore to depths of 471 m[a/]
Species in the family Arhynchobatidae (soft nose skates) but not explicitly listed in Table 3-3				
Deepsea skate	*Bathyraja abyssicola*	Least Concern (September 2023)		Off the West Coast, they range from the Western Bering Sea, Alaska to northern Baja California, Mexico; 362-2,904 m[a/]
Fine-spined skate[c/]	*Bathyraja microtrachys*	Least Concern (January 2015)		Washington to northern Baja California, Mexico; 1,995-2,900 m (rarely shallower)[a/]
Sandpaper skate	*Bathyraja kincaidii*	Least Concern (February 2019)	According to Table 3-3 and ASHOP, this is *B. interrupta* (Bering skate) but there is a separate species with a West Coast distribution. The NOAA Tech Memo lists sandpaper skate as *B. kincaidii*.	BC, Canada to Baja California, Mexico; 32-500 m[a/]
White skate	*Bathyraja spinosissima*	Least Concern (November 2014)	Also referred to as "spiny skate" or "Pacific white skate"	Central Oregon to the Galapagos Islands, with some reports from the Sea of Okhotsk off Russia; 800-2,938 m[a/]
Species in the family Macrouridae (grenadiers) but not explicitly listed in Table 3-3				
Abyssal grenadier	*Coryphaenoides armatus*	Least Concern (July 2012)	Also referred to as "smooth abyssal grenadier"	Off the West Coast, they range from the southeastern Bering Sea to Mexico and down to South America; 2,000-4,300 m[a/]
California grenadier	*Nezumia stelgidolepis*	Not evaluated		Although rare north of California, they range

Species	Scientific Name	IUCN Status (date assessed)	Notes on Taxonomy	Distribution & Depth
				from BC, Canada to Peru; 277-909 m[a/]
Filamented grenadier	*Coryphaenoides filifer*	Not evaluated	Also referred to by the At-Sea Hake Observer Program as "filamented rattail"	Off the West Coast, they range from the southeastern Bering Sea, Alaska to southern California; 1,829-2,904 m[a/]
Ghostly grenadier	*Coryphaenoides leptolepis*	Least Concern (July 2012)		Off the West Coast, they range from the Gulf of Alaska to Baja California, Mexico; 640-4,100 m[a/]
Popeye grenadier	*Coryphaenoides cinereus*	Not evaluated		Off the West Coast, they range from the Bering Sea, Alaska to Oregon; 225-2,832 m[a/]
Shoulderspot grenadier	*Coelorinchus scaphopsis*	Not evaluated		Southern California south to northern Gulf of California; 180-300 m; 165-274 m[a/]
Smooth grenadier	*Nezumia liolepis*	Not evaluated		Although rare north of central California, they range from Washington to Baja California, Mexico; 768-1,660 m[a/]
Softhead grenadier	*Malacocephalus laevis*	Least Concern (July 2012)		Off the West Coast, they range from central California south to Baja California, Mexico; 200-1,000 m but usually 300-750 m[a/]
Yaquina grenadier	*Coryphaenoides yaquinae*	Not evaluated	Also referred to as "rough abyssal grenadier," a separate species in the same genus as "abyssal grenadier"	Off the West Coast, they range from Oregon south to the equator; 3,400-6,450 m[a/]

a/ Kamikawa, 2017
b/ Knuckey & Ebert, 2022
c/ Fine-spined skate has never been recorded in the GEMM. Since its depth range is no shallower than 1,995 m (~1,000 fathoms), it is most likely that none of the observed fisheries have encountered it.

Mortality Analysis Methods

The GMT used mortality data from the GEMM report, which can be downloaded at https://connect.fisheries.noaa.gov/gemm_csv/ (Somers et al., 2024). The GEMM was filtered for the grouping "Ecosystem component species," and then the total landings and discard data with mortality rates applied were summarized by EC species across all GEMM sectors (including non-groundfish-targeting fisheries and research) for an annual total mortality (Table A-1, Appendix A). The EC species grouping includes "Grenadier Unidentified (Unid.)" with an average mortality of 145 mt each year since 2002. After consultation with staff in the Fisheries Observation Science (FOS) program, the GMT chose to keep "Grenadier Unidentified" in a separate bin rather than explore ways to apportion it into the various grenadier species.

In Table A-2 (Appendix A), the GMT further summarized the trends in total mortality for each species to look at changes in mortality across the time series (2002-2023). These calculations included the total mortality across the entire times series (2002-2023), the average annual mortality across the entire time series, the average annual mortality during the period before (2002-2014) and after (2015-2023) the majority of EC species were designated in the FMP[2], and the absolute (in mt) and percentage of change between these two periods.

Finally, the GMT evaluated the sector-level contributions to annual total mortality as well as sector-level discard proportions for only those EC species where total mortality across the entire time series was >1 mt. For the sector-level analysis, the team chose to only include directed groundfish sectors, as those sectors make up the "fishery" to which the 10-factor analysis would be applied. Sectors were grouped into the following categories: at-sea hake Catcher Processor (CP), at-sea hake Mothership/Catcher Vessel (MSCV), IFQ bottom trawl, IFQ midwater hake, IFQ midwater rockfish, IFQ fixed gear, limited entry fixed gear (LEFG), open access (OA) fixed gear, nearshore, recreational (Washington, Oregon, and California combined), and Tribal[3]. Figure 1 shows sector-specific contributions to annual mortality for each species with >1 mt of mortality across the entire time series, and Figures A-1 through A-15 (Appendix A) display individual species from Figure 1. Figure 2 shows the variation in sector-level discard proportions of total mortality as well as the mean discard proportion across all sectors. Sector-specific contributions since 2015 were examined by calculating the average annual total mortality and average annual proportion of mortality from discards by sector for each EC species (Tables A-3 and A-4).

Results & Conclusions

Of the 22 current EC species evaluated[4], 14 species (plus the unidentified grenadier category) had a total mortality of >1 mt across the time series. These species are Aleutian skate, California grenadier, California skate, deepsea skate, finescale codling/Pacific flatnose, giant grenadier,

[2] Shortbelly rockfish is the only EC species that was not designated as an EC species in 2015. Shortbelly rockfish was designated as an EC species in 2021.

[3] Note that the GEMM Tribal shoreside category includes landings from all Tribal fish tickets and may include non-groundfish-targeting trips.

[4] While there are 23 species in Table 2, one species (fine-spined skate) has zero mortality recorded in the GEMM throughout the entire time series; therefore, fine-spined skate is not included in the quantitative analysis portion of this report.

Pacific grenadier, popeye grenadier, roughtail/black skate, sandpaper skate, shortbelly rockfish, soupfin shark, spotted ratfish, and white skate (Table A-2, Appendix A). Of these 14 species, only shortbelly rockfish showed an increase in mortality between the periods before (2002-2014) and after (2015-2023) the majority of EC species were designated in the FMP. However, shortbelly rockfish was designated as an EC species in 2021, so this increase in mortality occurred before shortbelly rockfish was given EC designation. The spike in shortbelly rockfish mortality starting in 2017 was likely the result of an environmentally driven increase in abundance and spurred discussions amongst the Council about whether management changes were needed to address this increase (Free et al., 2023). However, given that shortbelly rockfish is not targeted by any fisheries and serves as an important forage species in the California Current Ecosystem, the Council opted to designate it as an EC species with a threshold by which it is to be monitored. Shortbelly rockfish average annual mortality was 121 mt prior to 2021 and increased to 326 mt for the time period of 2021-2023, or a 169 percent increase. However, comparing the more recent three-year period of 2017-2020 with 2021-2023, shortbelly rockfish average annual mortality decreased from 519 mt to 232 mt, or a 55 percent decrease. Seven of the 14 species experienced a decrease in total mortality >50 percent between the periods before and after 2015 (Table A-2, Appendix A). These species are California grenadier, giant grenadier, finescale codling/Pacific flatnose, Pacific grenadier, popeye grenadier, roughtail/black skate, and spotted ratfish. The remaining five species did not have a change >50 percent in total mortality between these time periods.

For species analyzed at the sector level, the majority of the mortality was tied to the IFQ bottom trawl sector (Figures 1 & A-1 through A-15, Appendix A). Exceptions to this were California grenadier (with mortality distributed among the LEFG, OA, and IFQ bottom trawl sectors), shortbelly rockfish (with mortality distributed among the at-sea hake CP, at-sea hake MSCV, IFQ midwater hake, and IFQ midwater rockfish sectors), and soupfin shark (which exhibited morality across all sectors; Figures 1, A-2, A-12, and A-13, Appendix A, respectively). The primary source of mortality shifted away from the IFQ bottom trawl sector for several species within the last 15 years. These species are deepsea skate (shift started in 2014), finescale codling (shift started in 2011), unidentified grenadier (i.e., a combination of grenadier species; shift started in 2013), Pacific grenadier (shift started in 2011), roughtail/black skate (shift started in 2019), and white skate (shift started in 2016; Figures 1, A-4, A-5, A-7, A-8, A-10, and A-15, Appendix A, respectively). Changes in mortality trends may be due to a number of factors, including changes in species abundance, species distribution, and/or changes in fishery activity.

Examining the average annual mean discard proportions across sectors revealed the majority of EC species mortality is due to discarding. For six of the species analyzed, the discard proportion across all sectors was less than 75 percent (i.e., some retention) in at least one year across the time series. These species are Aleutian skate, California skate, grenadier unidentified, Pacific grenadier, shortbelly rockfish, and soupfin shark (Figure 2). Although the annual discard proportion across sectors did not drop below 75 percent for roughtail/black skate, sandpaper skate, and spotted ratfish, there was at least one sector where all of the mortality was retained (i.e., zero percent discard proportion) for multiple years throughout the time series, so there is some retention of these species (Figure 2). The sectors in which these three species are occasionally fully retained are predominantly the at-sea hake CP, IFQ midwater hake, and IFQ midwater rockfish sectors. While there is some retention of these nine species, this is not an indication that they are targeted.

Overall, for most of the species analyzed, the proportion of discard mortality did not change notably after they were designated as an EC species (Figure 2). The exception to this is Aleutian skate. However, the overall annual average total mortality for this species is low (2.2 mt) and changed minimally (-13 percent) since the EC species designation (Tables A-1 and A-2, Appendix A). The discard proportion of soupfin shark across all sectors appears to have steadily increased since the beginning of the time series; however, there is wide annual variation in sector-specific discard proportions due to the range of sectors that commonly encounter this species. This increase in discard proportions in recent years could be due to increasing catches in the groundfish trawl sectors beginning in 2014 (Figure A-13, Appendix A), as the trawl sectors generally exhibit high discarding of EC species, including soupfin shark (Table A-4).

Tables A-3 and A-4 (Appendix A) further demonstrate that the IFQ bottom trawl sector tends to encounter the widest diversity of EC species, followed by the LEFG sector. Both sectors generally have high rates of discarding for all species in recent years, with lower rates (average discard proportion <80 percent) for Aleutian skate (bottom trawl only), California skate (LEFG only), undidentified grenadier, shortbelly rockfish, and soupfin shark. Within the at-sea hake fishery, the CP sector generally tends to discard at a lower proportion by species compared to the MS sector, but most species caught in that fishery are caught in very low amounts. The difference between the two sectors is likely due to operational differences and the feasibility of discarding while fishing. The discard proportions for the IFQ midwater rockfish, OA, nearshore, and recreational sectors varied widely depending on the species. However, the overall mortality associated with these sectors was very low. The IFQ midwater hake sector is a maximized retention sector, which is reflected in the very low discard proportions seen in these tables. Similarly, the Tribal shoreside whiting sector requires full retention, so discard proportions in that sector would be expected to be low; however, note that the shoreside Tribal GEMM sector comprises all shoreside Tribal landings, including non-groundfish-targeting fisheries (e.g., Dungeness crab, salmon, etc). As Tribal discards are not available for all Tribal fisheries, Tribal discard values are not included in the GEMM, except for the Tribal at-sea hake sector. While Table A-4 shows zero percent discard proportions for the Tribal sector, this is in part due to a lack of Tribal discard information in the GEMM. While this may not necessarily reflect actual discard proportions, the combined Tribal sectors had very low mortality across all of the EC species. This would suggest that total mortality of EC species in Tribal groundfish fisheries is minimal.

Ultimately, these results showed that the only EC species which saw notable changes in mortality and discard trends in recent years were shortbelly rockfish and soupfin shark. Shortbelly rockfish mortality started increasing in 2017, but it was designated as an EC species in 2021, so the large increase in average annual mortality (from 14 mt to 344 mt) between time periods in Table A-2 (Appendix A) occurred prior to EC designation, and was the primary reason for, EC designation. The one IUCN critically endangered EC species, soupfin shark, was caught in the greatest variety of sectors (Figures 1 and A-13, Appendix A), showed a slight decrease (2 percent) in average total mortality across all sectors between periods before and after EC designation (Table A-2, Appendix A), and was increasingly discarded in various groundfish sectors (Figure 2). While total mortality of soupfin shark across all GEMM sectors decreased by 2 percent before and after 2015, total mortality saw a substantial increase between these time periods when looking at directed groundfish sectors alone, as shown in Figure 2. This is due to large amounts of incidental mortality in other non-groundfish sectors in the early 2000s that is not included in Figure 2. Overall, these changes in mortality and discard trends for shortbelly rockfish and soupfin shark do not necessarily

warrant further consideration of the current EC designation; the GMT is simply highlighting deviations discovered during the analysis.

1.1.1 Figures

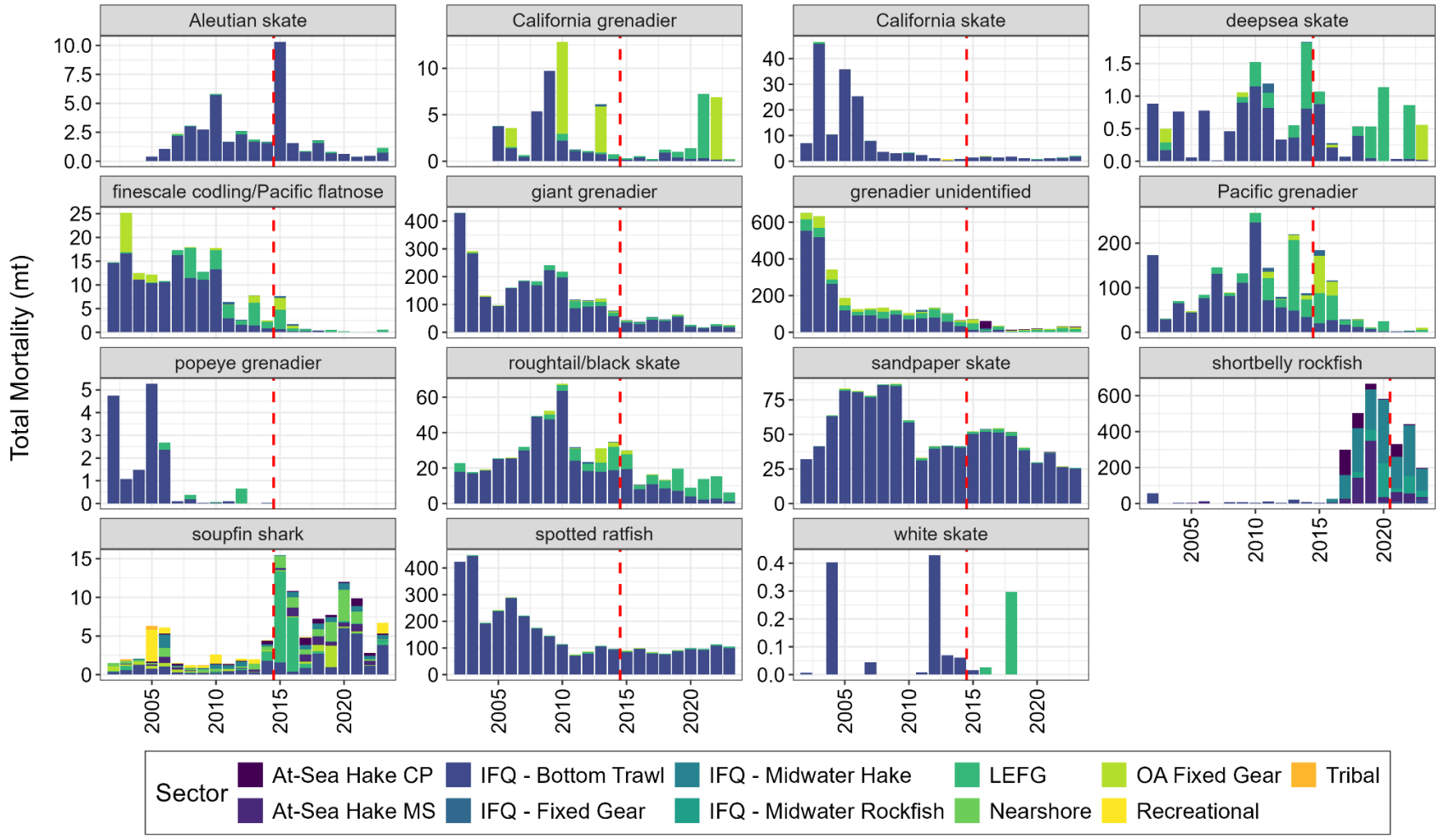

Figure 1. Total annual mortality by sector of each EC species with a total mortality >1 mt across the time series (2002-2023). Sectors are color coded, and a red dashed line denotes when the species was designated as an EC species. Note the total mortality scales vary by species for better visualization.

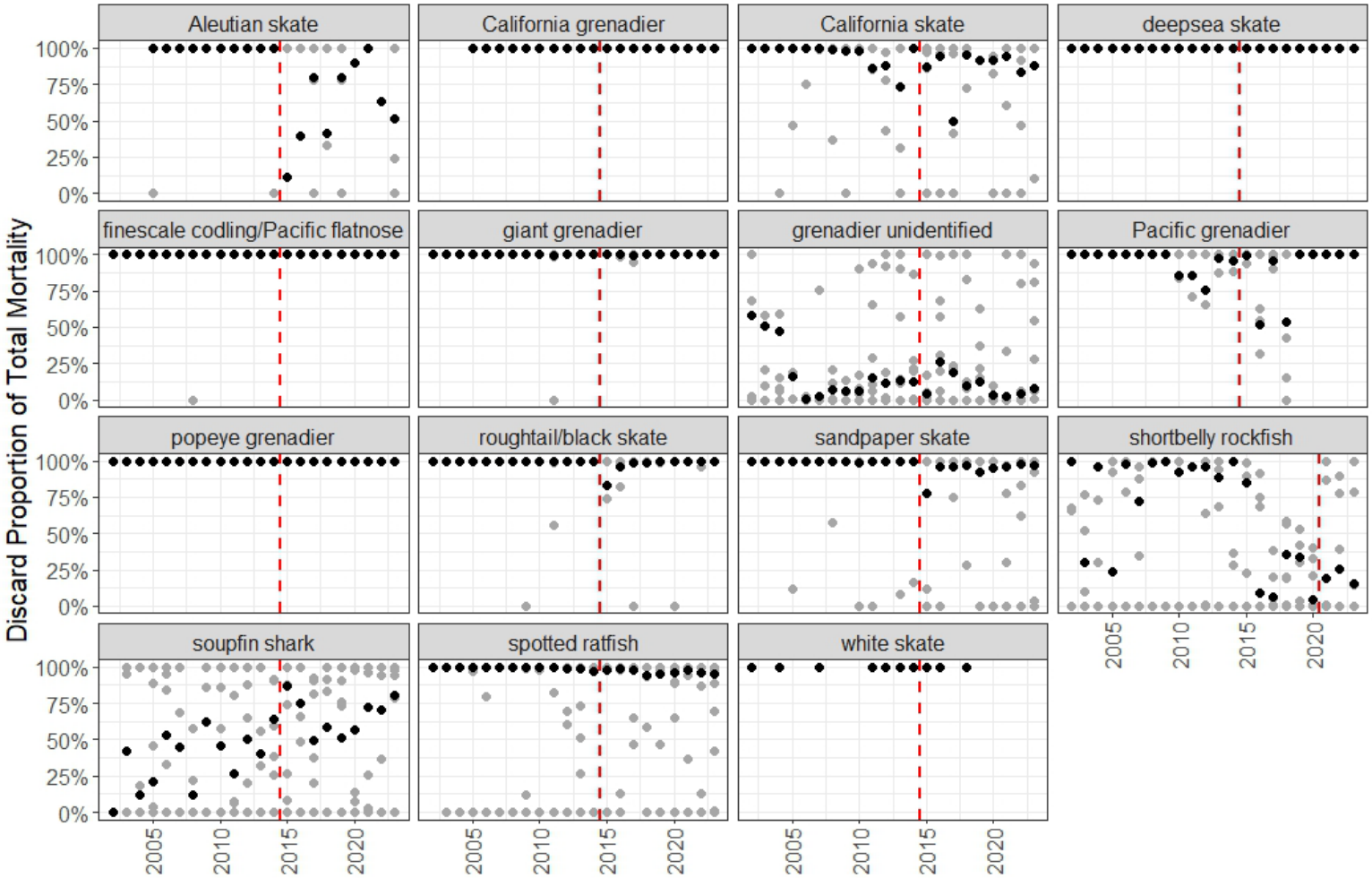

Figure 2. Annual discard mortality as a proportion of total mortality for species where total mortality across the entire time series is >1 mt. Gray dots represent sector-level discard proportions within each year, and black dots represent annual discard proportions across all sectors. A red dashed line denotes when the species was designated as an EC species. Sectors are grouped into: at-sea hake CP, at-sea hake MSCV, IFQ bottom trawl, IFQ midwater hake, IFQ midwater rockfish, IFQ fixed gear, limited entry fixed gear, open access fixed gear, nearshore, recreational, and Tribal. Note that as Tribal discards are not available for all Tribal fisheries, Tribal discard values are not included in the GEMM, except for the Tribal at-sea hake sector.

1.1.2 **References**

Ebert, D. (2003). *Sharks, rays, and chimaeras of California* (No. 71). Univ of California Press.

Free, C. M., Anderson, S. C., Hellmers, E. A., Muhling, B. A., Navarro, M. O., Richerson, K., Rogers, L. A., Satterthwaite, W. H., Thompson, A. R., Burt, J. M., Gaines, S. D., Marshall, K. N., White, J. W., & Bellquist, L. F. (2023). Impact of the 2014–2016 marine heatwave on US and Canada West Coast fisheries: Surprises and lessons from key case studies. *Fish and Fisheries*, 24, 652–674. https://doi.org/10.1111/faf.12753

Iwamoto, T. 2010. *Antimora microlepis*. The IUCN Red List of Threatened Species 2010: e.T155287A4766841. http://dx.doi.org/10.2305/IUCN.UK.2010-4.RLTS.T155287A4766841.en

Kamikawa, D. J. 2017. Survey Fishes: An illustrated list of the fishes captured during the Northwest Fisheries Science Center's Fishery Resource Analysis and Monitoring Division's West Coast surveys. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-138. https://doi.org/10.7289/V5/TM-NWFSC-138

Knuckey, J.D.S. and D.A. Ebert, 2022. A taxonomic revision of Northeast Pacific softnose skates (Rajiformes: Arhynchobatidae: *Bathyraja Ishiyama*). Zootaxa 5142(1):1-89. (Ref. 126515) (sourced from FishBase)

Krebs, C. J. (1972). *Ecology. The experimental analysis of distribution and abundance.*

Patrick, W. S., P. Spencer, O. Ormseth, J. Cope, J. Field, D. Kobayashi, T. Gedamke, E. Cortés, K. Bigelow, W. Overholtz, J. Link, and P. Lawson. 2009. Use of productivity and susceptibility indices to determine stock vulnerability, with example applications to six U.S. fisheries. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-F/SPO-101, 90 p.

Somers, K.A., K. Richerson, V. Tuttle, and J. McVeigh. 2024. Estimated discard and catch of groundfish species in the 2023 U.S. west coast fisheries. NOAA Fisheries, NWFSC Observer Program, 2725 Montlake Blvd E., Seattle, WA 98112.

Sottosanti, K. (2025, March 13). *endemic species*. *Encyclopedia Britannica*. https://www.britannica.com/science/endemic-species

Appendix A. Mortality Tables and Species-Specific Figures

Table A-1. Total annual mortality of groundfish EC species in mt, 2002-2023, across all directed groundfish and non-groundfish fisheries. Blank cells indicate that there was no mortality recorded in the GEMM for that sector in any of the years 2015-2023. Cells with "0" indicate that some mortality was recorded but the value is less than 1 mt.

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Abyssal grenadier							0			0	0	0	0									
Aleutian skate				0	1	2	3	3	6	2	3	2	2	10	2	1	2	1	1	1	0	1
Bering skate									0		0			0								
Roughtail/black skate	23	18	19	26	26	32	50	52	68	32	24	31	35	31	11	17	14	20	9	14	16	7
California grenadier				4	4	1	5	10	13	1	1	6	1	0	1	0	1	1	1	7	7	0
California skate	8	70	49	90	50	15	16	11	16	10	2	7	2	16	16	25	18	36	31	14	32	39
Deepsea skate	1	1	1	0	1	0	0	1	2	1	0	1	2	1	0	0	1	1	1	0	1	1
Filamented grenadier								0		0	0	0		0								
Ghostly grenadier										0		0					0					
Giant grenadier	430	294	132	97	161	186	184	242	219	118	117	121	77	47	40	56	49	65	28	20	32	28
Grenadier unidentified	652	639	342	191	125	133	134	123	105	126	137	105	66	72	62	36	14	16	21	19	34	32
Finescale codling/ Pacific flatnose	15	25	13	12	11	17	18	13	18	7	3	8	3	8	2	1	1	1	0	0	0	1
Pacific grenadier	174	31	71	47	84	145	89	132	268	145	80	223	93	191	122	33	35	13	25	6	6	13
Popeye grenadier	5	1	1	5	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Sandpaper skate	33	46	65	84	81	78	86	87	61	33	42	42	42	53	55	56	53	41	30	38	28	27
Shortbelly rockfish	57	1	12	14	14	1	8	9	6	12	7	25	18	9	30	320	508	667	583	334	442	201
Shoulderspot grenadier						0	0			0	0		0	0	0	0	0	0		0		
Smooth grenadier							0	0	0	0	0		0	0	0	0	0	0	0	0	0	0
Softhead grenadier							0			0	0	0		0	0		0	0				

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Soupfin shark	33	38	28	34	38	18	9	8	5	9	5	4	5	20	15	12	15	16	23	25	17	14
Spotted ratfish	436	504	206	242	292	223	176	150	115	75	94	110	96	95	104	89	84	96	101	99	117	108
White skate	0		0			0		0		0	0	0	0	0	0		0					
Yaquina/rough abyssal grenadier										0												

Table A-2. Summarized mortality trends for all EC species across all directed groundfish and non-groundfish sectors, including trends in average annual mortality before and after 2015. Bolded species indicate that average mortality increased after 2015 and the absolute (mt) change before and after 2015 is >0.1 mt.

	Total Mortality (mt), 2002-2023	Average Annual Mortality (mt)	Average Annual Mortality (mt), 2002-2014	Average Annual Mortality (mt), 2015-2023	Change from 2002-2014 to 2015-2023 (mt)	% Change
Abyssal grenadier	0.3	0.1	0.1	0.0	-0.1	-100%
Aleutian skate	41.7	2.2	2.3	2.0	-0.3	-13%
Bering skate	0.1	0.0	0.0	0.0	0.0	-47%
Roughtail/black skate	573.6	26.1	33.4	15.5	-18.0	-54%
California grenadier	64.9	3.4	4.5	2.2	-2.3	-52%
California skate	571.1	26.0	26.5	25.1	-1.4	-5%
Deepsea skate	15.4	0.7	0.8	0.6	-0.2	-22%
Filamented grenadier	0.0	0.0	0.0	0.0	0.0	196%
Ghostly grenadier	0.1	0.0	0.0	0.0	0.0	-94%
Giant grenadier	2,742.3	124.6	182.9	40.5	-142.4	-78%
Finescale codling/Pacific flatnose	175.3	8.0	12.5	1.5	-11.0	-88%
Pacific grenadier	2,027.2	92.1	121.7	49.4	-72.3	-59%
Popeye grenadier	16.7	0.8	1.3	0.0	-1.3	-100%
Sandpaper skate	1,160.3	52.7	59.9	42.3	-17.6	-29%
Shortbelly rockfish[a/]	**3,277.1**	**149.0**	**14.1**	**343.7**	**329.6**	**2,331%**

	Total Mortality (mt), 2002-2023	Average Annual Mortality (mt)	Average Annual Mortality (mt), 2002-2014	Average Annual Mortality (mt), 2015-2023	Change from 2002-2014 to 2015-2023 (mt)	% Change
Shoulderspot grenadier	0.2	0.0	0.0	0.0	0.0	-97%
Smooth grenadier	0.6	0.0	0.0	0.0	0.0	20%
Softhead grenadier	0.0	0.0	0.0	0.0	0.0	64%
Soupfin shark	389.3	17.7	17.8	17.5	-0.3	-2%
Spotted ratfish	3,612.6	164.2	209.3	99.1	-110.1	-53%
White skate	1.4	0.1	0.1	0.1	0.0	-12%
Yaquina/rough abyssal grenadier	0.0	0.0	0.0	0.0	0.0	-100%

a/ Shortbelly rockfish was designated as an EC species in 2021, whereas all other species in this table were designated as EC species in 2015.

Table A-3. Average annual sector-specific total mortality by EC species in directed groundfish sectors only, 2015-2023. Blank cells indicate that there was no mortality recorded in the GEMM for that sector in any of the years 2015-2023. Cells with "0.0" indicate that some mortality was recorded but the annual average is less than 0.1 mt.

	At-Sea CP	**At-Sea MS**	**IFQ Bottom Trawl**	**IFQ Midwater Hake**	**IFQ Midwater Rockfish**	**IFQ Fixed Gear**	**LEFG**	**OA**	**Nearshore**	**Rec.**	**Tribal[a/]**
Abyssal grenadier											
Aleutian skate	0.0	0.0	1.9		0.0	0.0	0.1				
Bering skate			0.0								
California grenadier			0.3				1.2	2.3	0.1		
California skate	0.0	0.0	1.3				0.2	0.0	0.1		
Deepsea skate	0.0		0.2			0.0	0.6	0.3			
Filamented grenadier			0.0								
Ghostly grenadier			0.0								
Giant grenadier			31.8		0.1	0.8	5.7	0.7			
Grenadier unidentified	6.5	0.0	4.1	0.0		0.9	15.8	6.8	0.1		
Finescale codling	0.0		0.2			0.2	0.7	1.0			
Pacific grenadier			10.2		0.0	2.5	20.0	17.7	0.0		

	At-Sea CP	At-Sea MS	IFQ Bottom Trawl	IFQ Midwater Hake	IFQ Midwater Rockfish	IFQ Fixed Gear	LEFG	OA	Nearshore	Rec.	Tribal[a/]
Popeye grenadier			0.0				0.0				
Roughtail/black skate			7.1		0.0	0.2	7.4	0.8			
Sandpaper skate	0.0	0.0	39.8	0.0	0.0	0.2	1.3	0.2	0.1		
Shortbelly rockfish[b/]	37.8	73.2	6.6	172.2	49.0		0.0	0.0	0.0		0.0
Shoulderspot grenadier			0.0								
Smooth grenadier			0.0				0.0				
Softhead grenadier			0.0				0.0				
Soupfin shark	0.5	0.7	2.5	0.6	0.1	0.1	2.5	0.6	1.6	0.9	0.0
Spotted ratfish	0.0	0.0	91.1	0.0	0.7	0.0	3.0	0.6	0.1	0.0	0.0
White skate			0.0				0.2				
Yaquina grenadier											

a/ Note that as Tribal discards are not available for all Tribal fisheries, Tribal discard values are not included in the GEMM, except for Tribal at-sea hake.
b/ Shortbelly rockfish was designated as an EC species in 2021, whereas all other species in this table were designated as EC species in 2015.

Table A-4. Average annual sector-specific discard mortality as a proportion of total mortality in directed groundfish sectors only, 2015-2023. Blank cells indicate that there was no mortality recorded in the GEMM for that sector in any of the years 2015-2023. Cells with "0.0" indicate that some mortality was recorded but the annual average is less than 0.1 mt.

	At-Sea CP	At-Sea MS	IFQ Bottom Trawl	IFQ Midwater Hake	IFQ Midwater Rockfish	IFQ Fixed Gear	LEFG	OA	Nearshore	Rec.	Tribal[a/]
Abyssal grenadier											
Aleutian skate	0%	100%	57%		0%	100%	100%				
Bering skate			100%								
California grenadier			100%				100%	100%	100%		
California skate	50%	100%	89%				58%	33%	66%		
Deepsea skate	100%		100%			100%	100%	100%			
Filamented grenadier			100%								
Ghostly grenadier			100%								

	At-Sea CP	At-Sea MS	IFQ Bottom Trawl	IFQ Midwater Hake	IFQ Midwater Rockfish	IFQ Fixed Gear	LEFG	OA	Nearshore	Rec.	Tribal[a/]
Giant grenadier			100%		100%	100%	99%	100%			
Grenadier unidentified	20%	72%	29%	0%		70%	9%	8%	0%		
Finescale codling	100%		100%			100%	100%	100%			
Pacific grenadier			92%		100%	100%	84%	87%	0%		
Popeye grenadier			100%				100%				
Roughtail/black skate			96%		0%	100%	98%	100%			
Sandpaper skate	23%	97%	94%	0%	42%	100%	100%	97%	100%		
Shortbelly rockfish[b/]	25%	67%	58%	3%	15%		0%	0%	0%		0%
Shoulderspot grenadier			100%								
Smooth grenadier			100%				100%				
Softhead grenadier			100%				100%				
Soupfin shark	88%	91%	78%	0%	3%	100%	74%	11%	11%	36%	0%
Spotted ratfish	50%	67%	97%	2%	58%	95%	100%	100%	53%	98%	0%
White skate			100%				100%				
Yaquina grenadier											

a/ Note that as Tribal discards are not available for all Tribal fisheries, Tribal discard values are not included in the GEMM, except for Tribal at-sea hake.
b/ Shortbelly rockfish was designated as an EC species in 2021, whereas all other species in this table were designated as EC species in 2015.

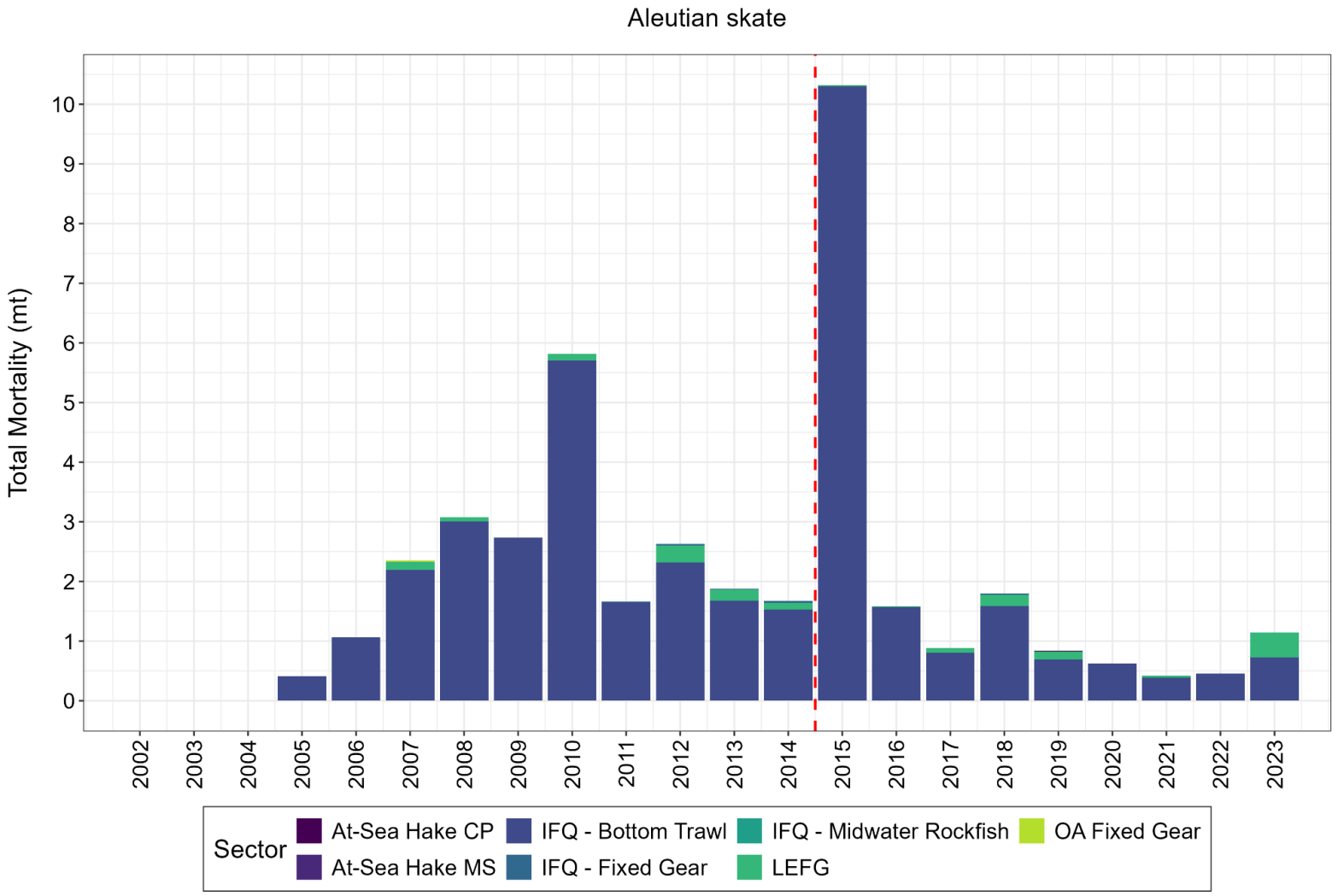

Figure A-1. Total annual mortality of Aleutian skate by directed groundfish sector (2002-2023). Sectors with recorded observations are color coded, and a red dashed line denotes that Aleutian skate was designated as an EC species in 2015.

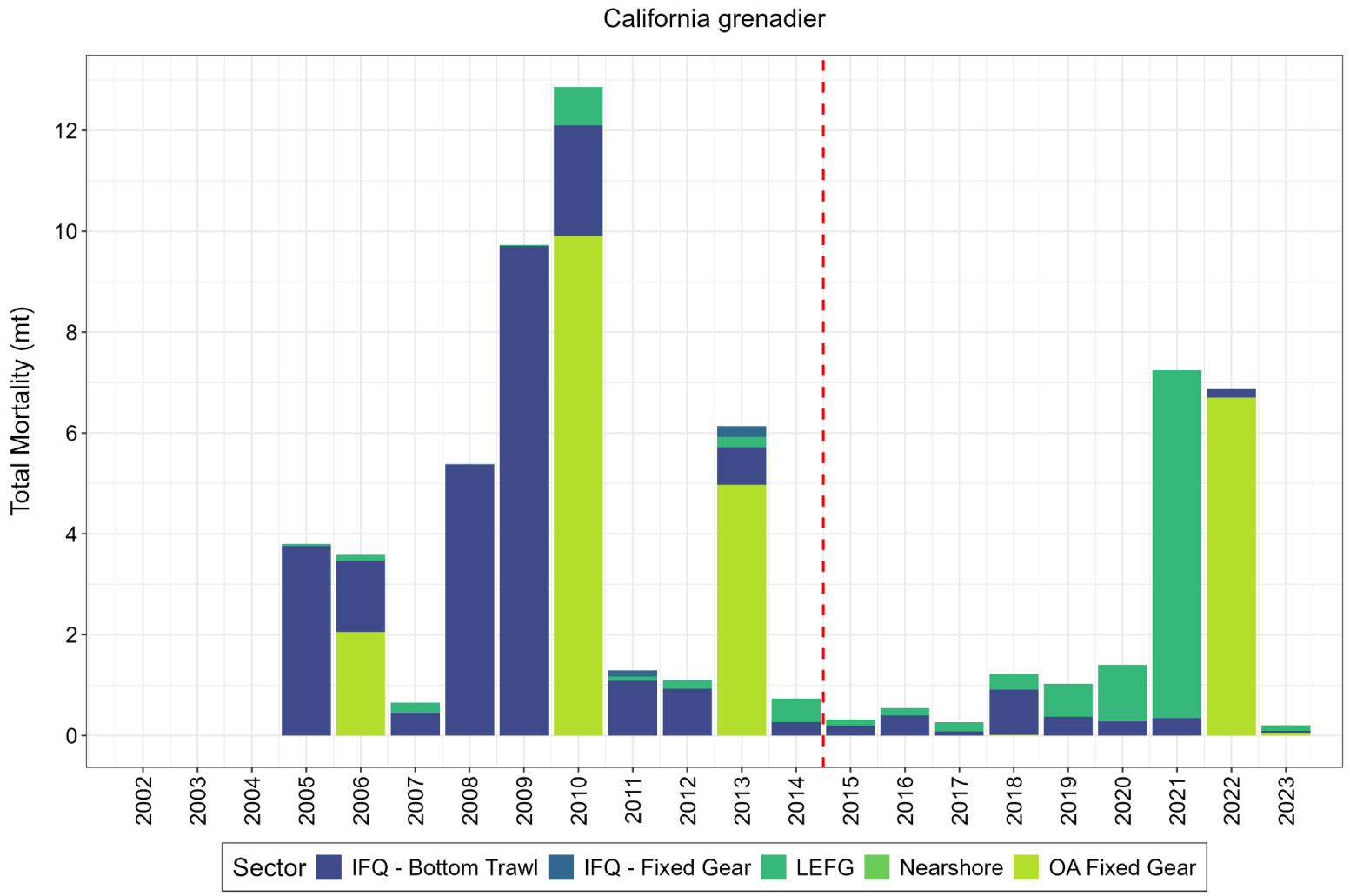

Figure A-2. Total annual mortality of California grenadier by directed groundfish sector (2002-2023). Sectors with recorded observations are color coded, and a red dashed line denotes that California grenadier was designated as an EC species in 2015.

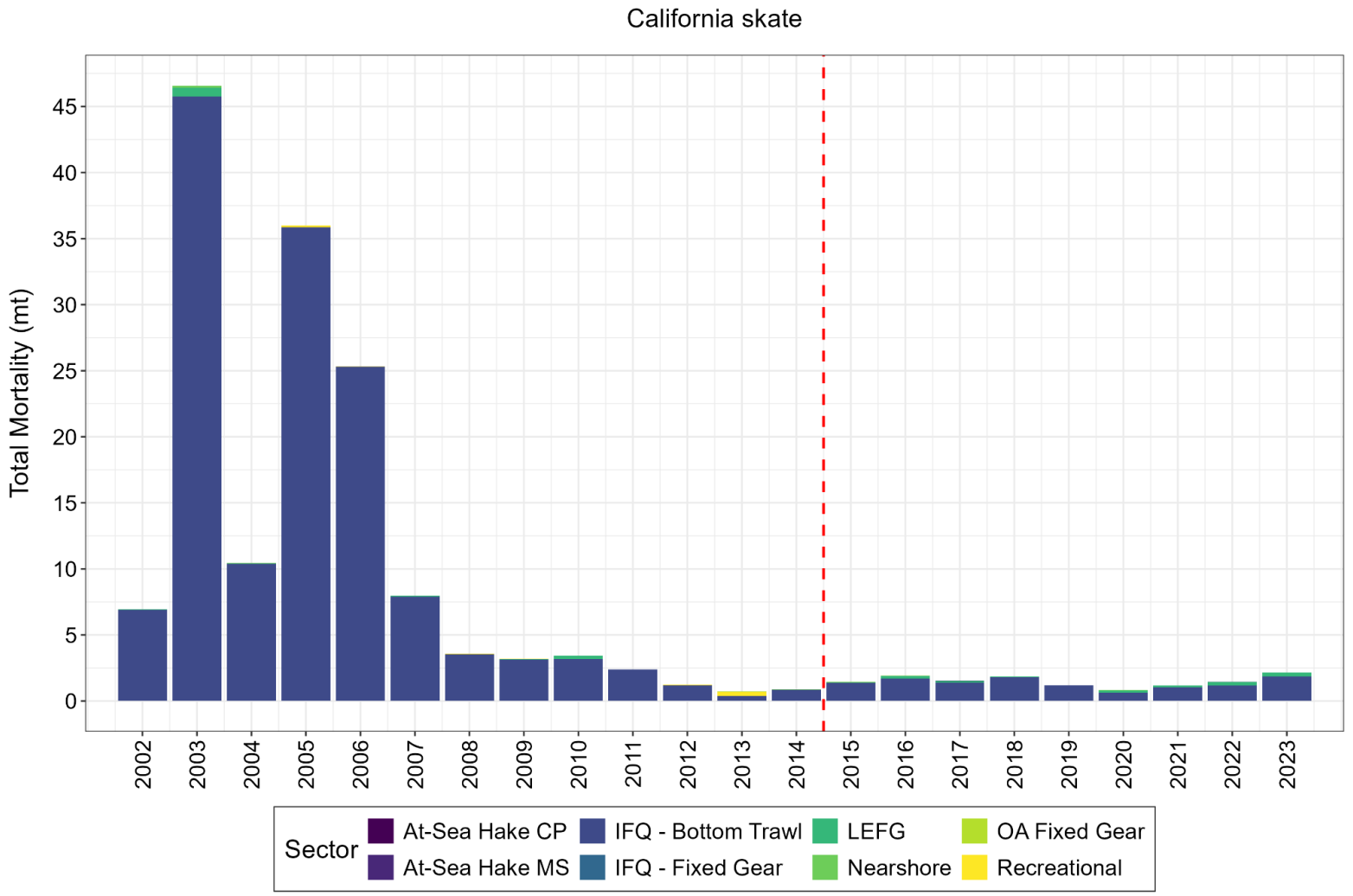

Figure A-3. Total annual mortality of California skate by directed groundfish sector (2002-2023). Sectors with recorded observations are color coded, and a red dashed line denotes that California skate was designated as an EC species in 2015.

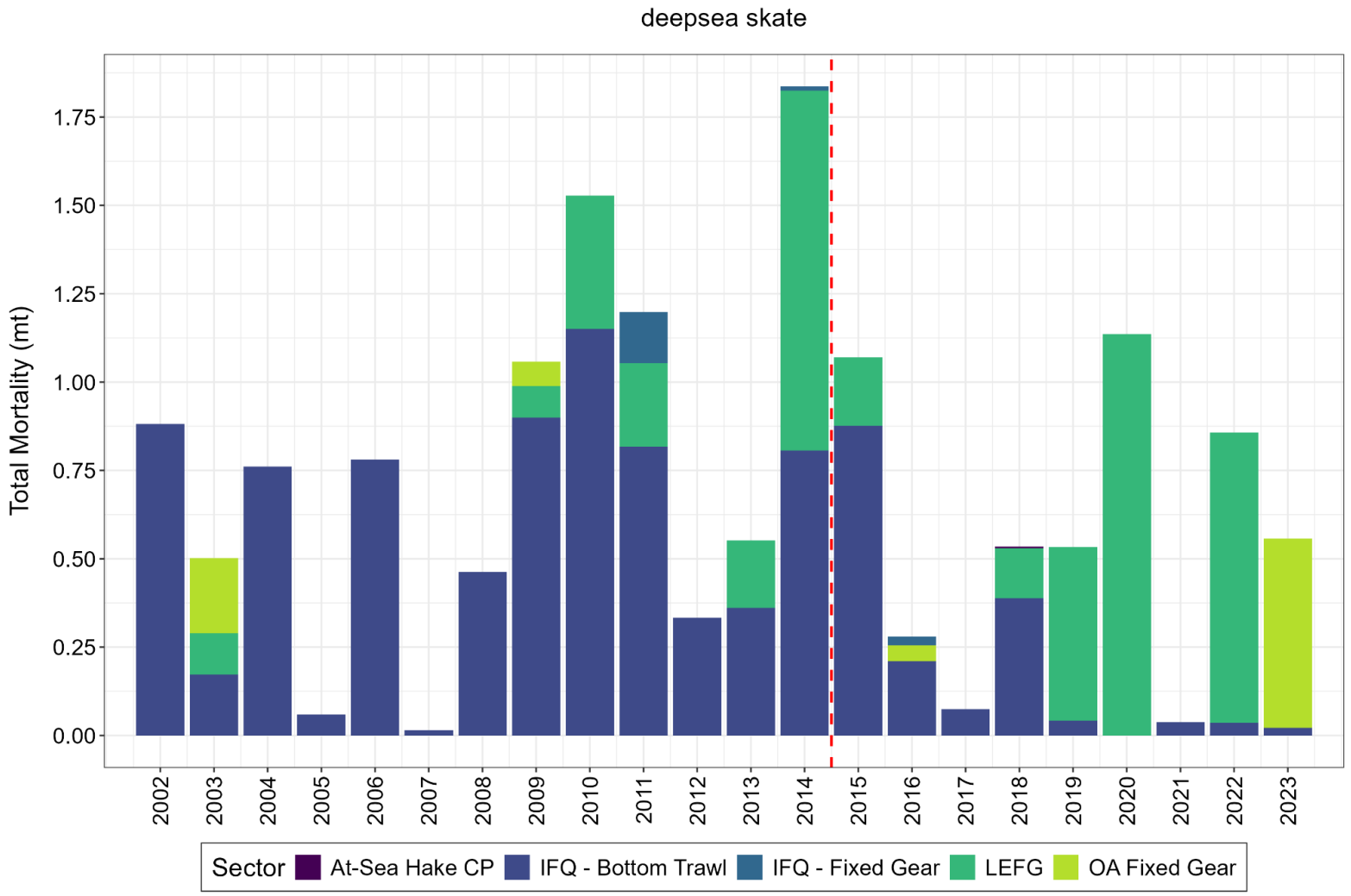

Figure A-4. Total annual mortality of deepsea skate by directed groundfish sector (2002-2023). Sectors with recorded observations are color coded, and a red dashed line denotes that deepsea skate was designated as an EC species in 2015.

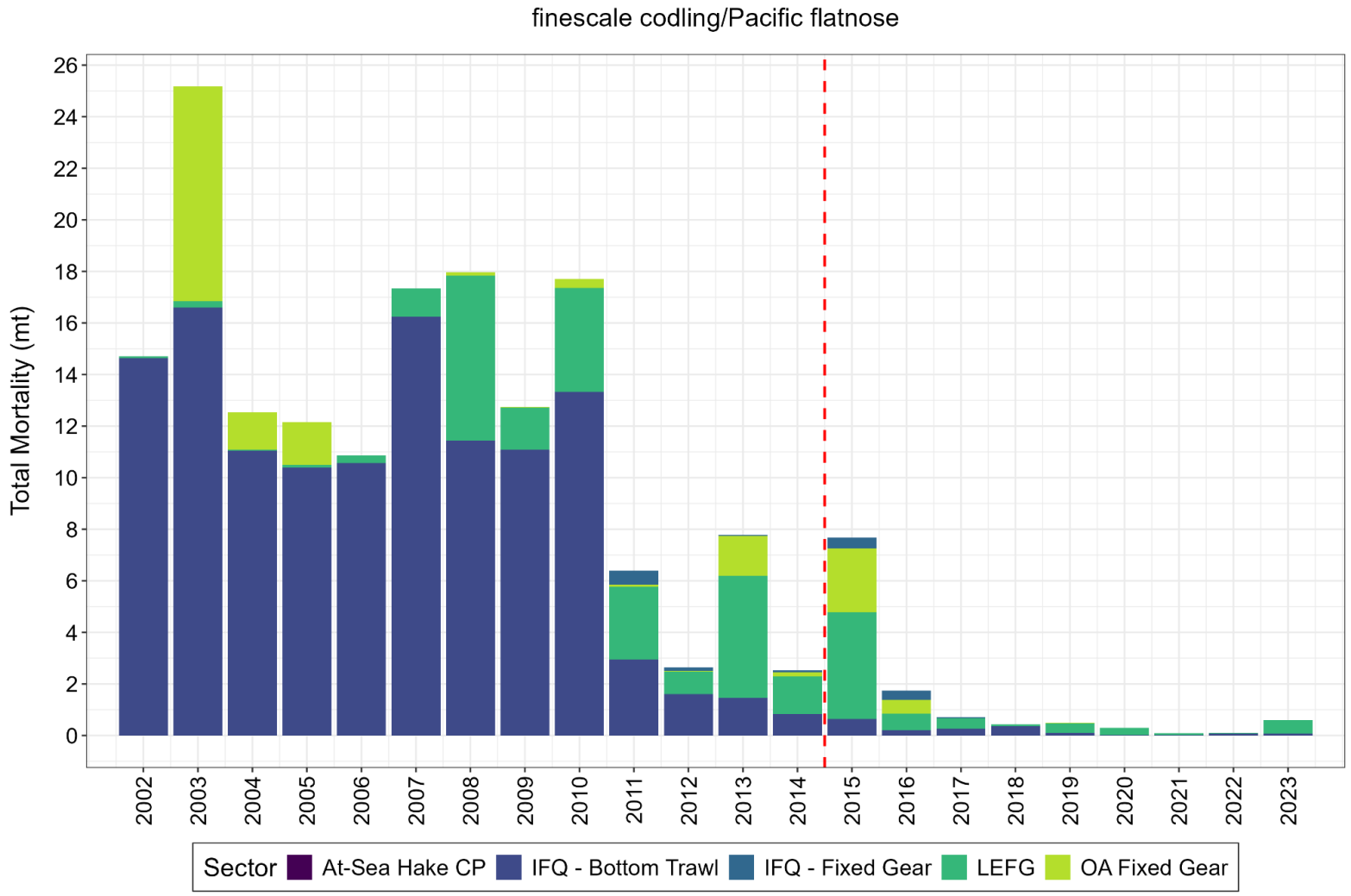

Figure A-5. Total annual mortality of finescale codling/Pacific flatnose by directed groundfish sector (2002-2023). Sectors with recorded observations are color coded, and a red dashed line denotes that finescale codling/Pacific flatnose was designated as an EC species in 2015.

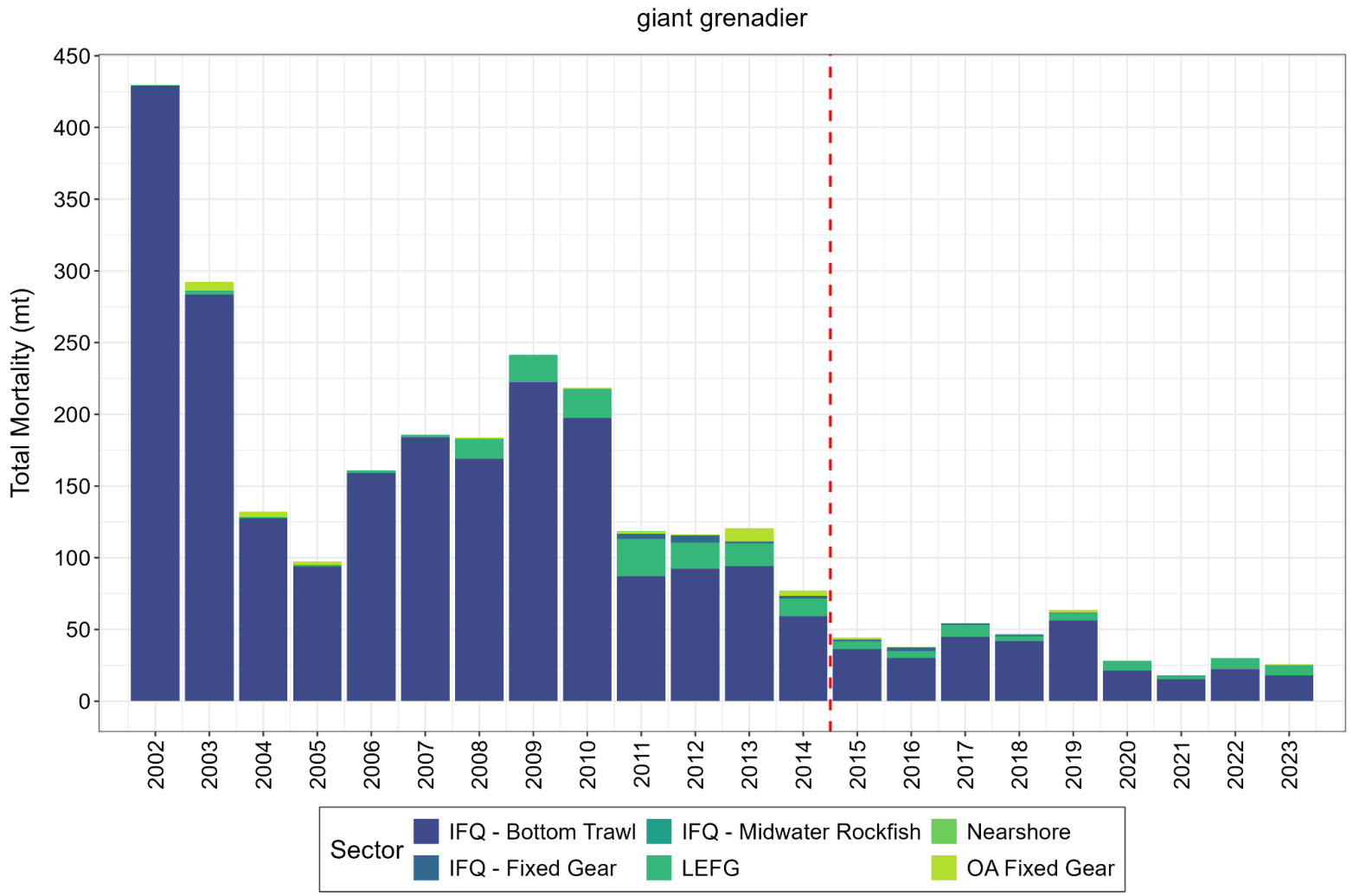

Figure A-6. Total annual mortality of giant grenadier by directed groundfish sector (2002-2023). Sectors with recorded observations are color coded, and a red dashed line denotes that giant grenadier was designated as an EC species in 2015.

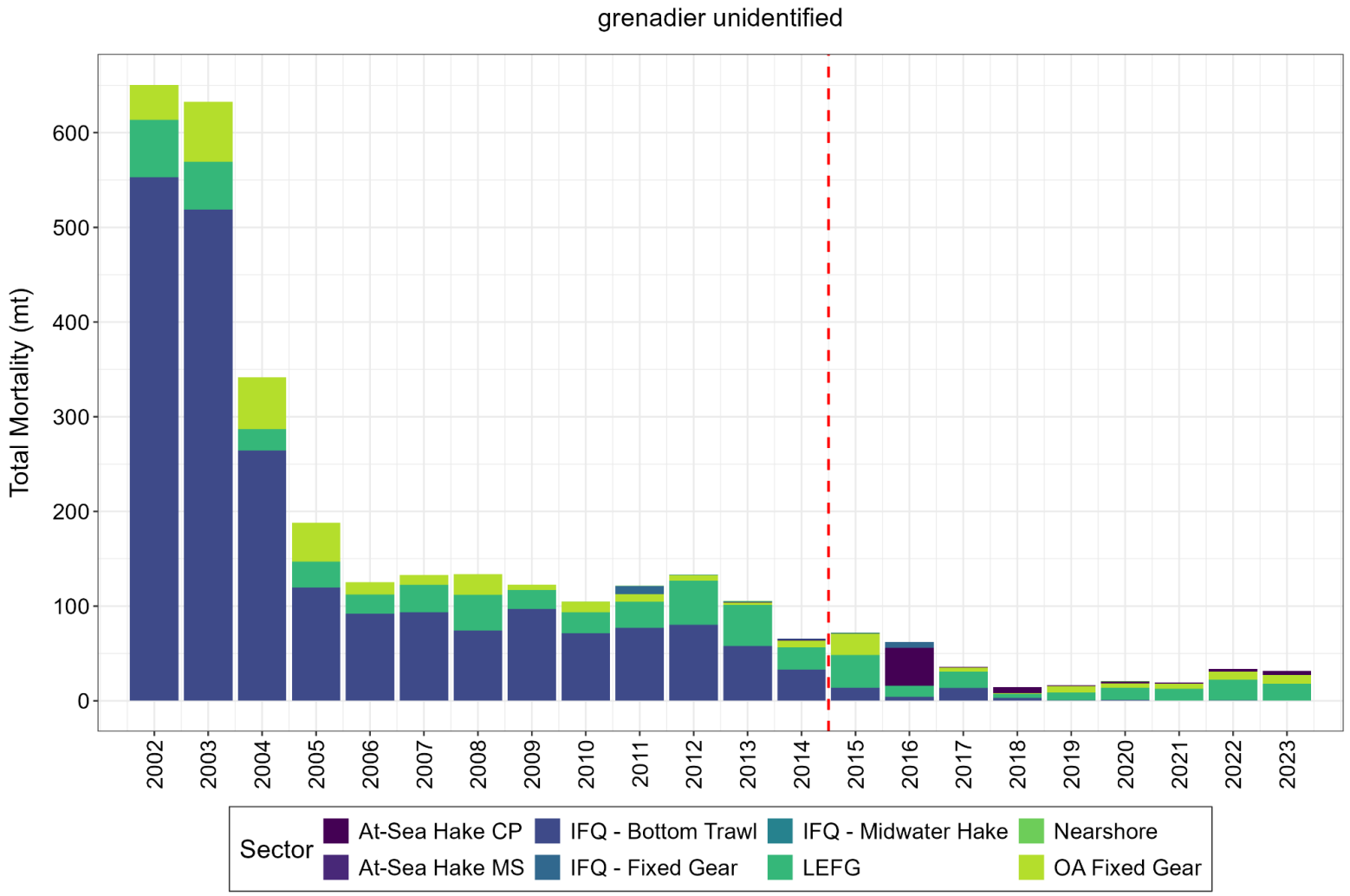

Figure A-7. Total annual mortality of grenadier unidentified by directed groundfish sector (2002-2023). Sectors with recorded observations are color coded, and a red dashed line denotes that endemic grenadier species within the family Macrouridae were designated as EC species in 2015.

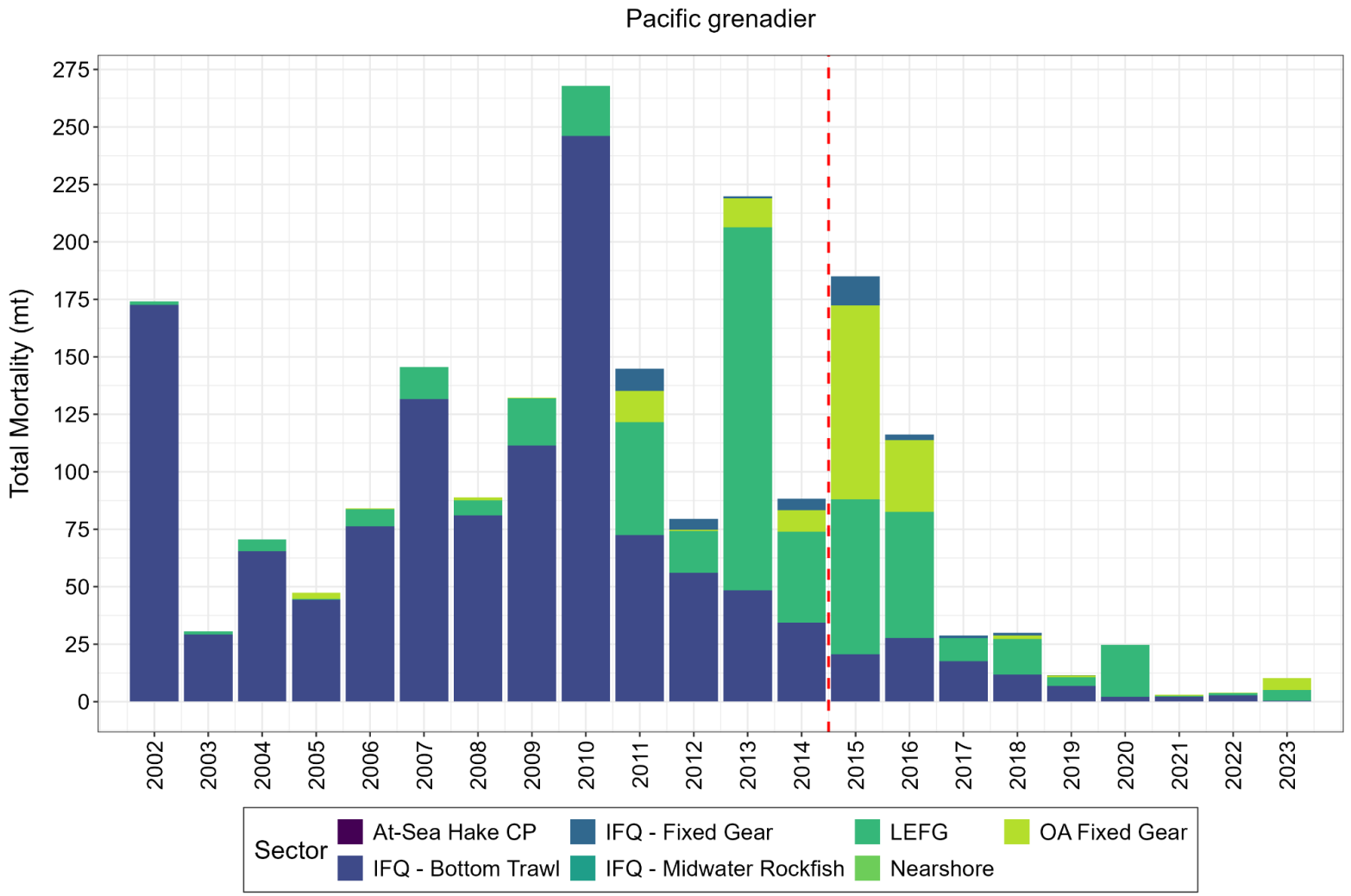

Figure A-8. Total annual mortality of Pacific grenadier by directed groundfish sector (2002-2023). Sectors with recorded observations are color coded, and a red dashed line denotes that Pacific grenadier was designated as an EC species in 2015.

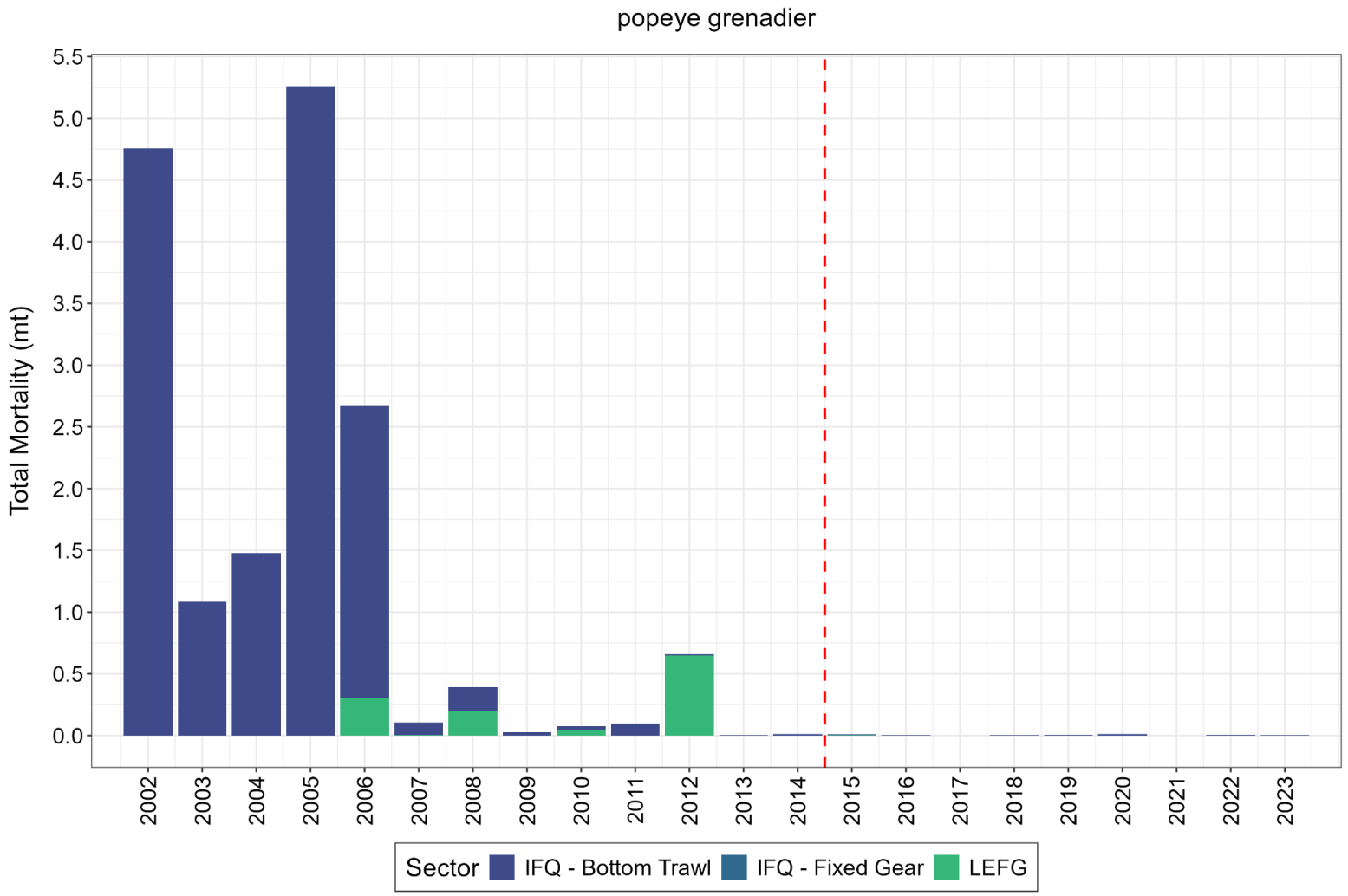

Figure A-9. Total annual mortality of popeye grenadier by directed groundfish sector (2002-2023). Sectors with recorded observations are color coded, and a red dashed line denotes that popeye grenadier was designated as an EC species in 2015.

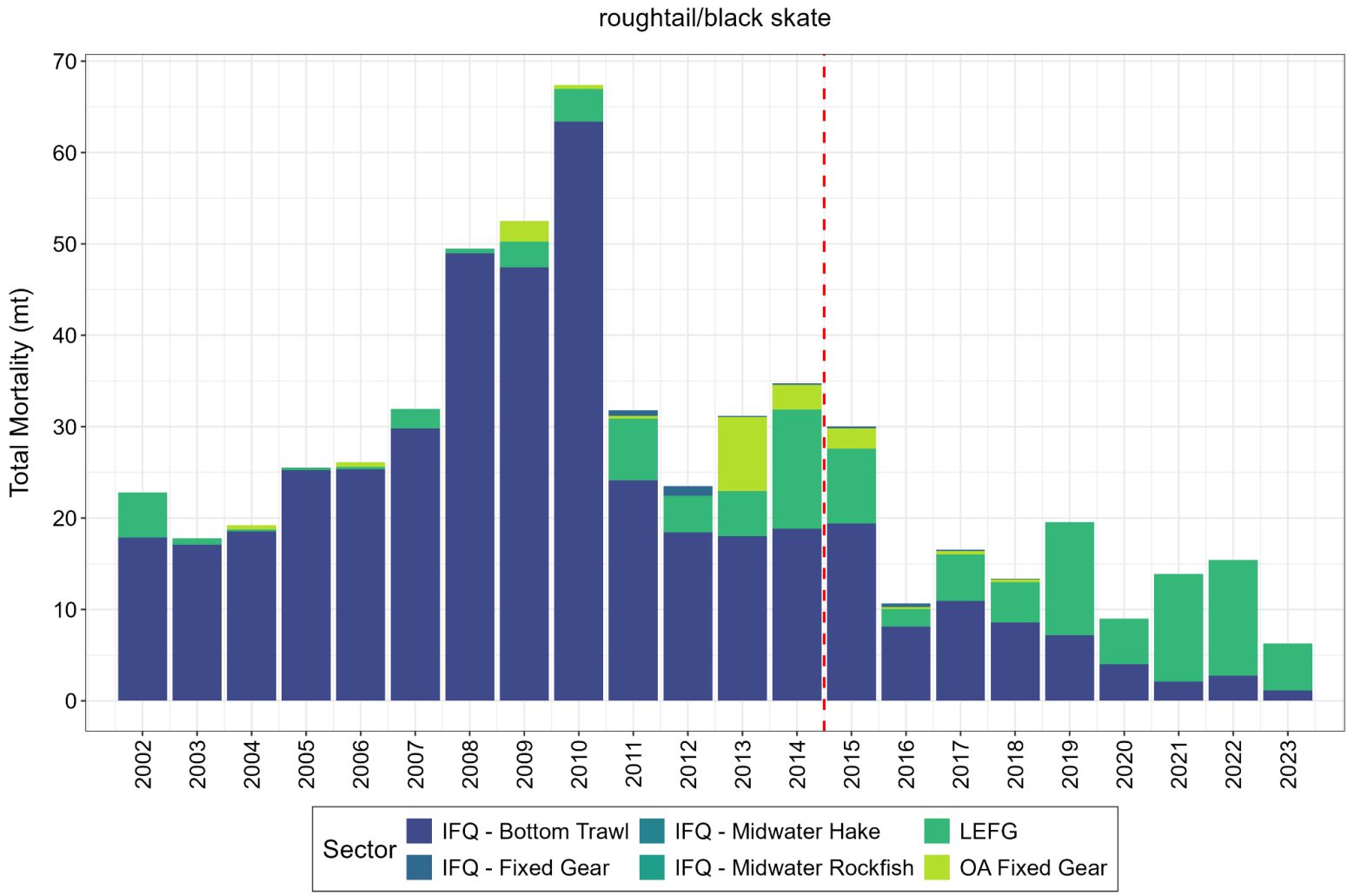

Figure A-10. Total annual mortality of roughtail/black skate by directed groundfish sector (2002-2023). Sectors with recorded observations are color coded, and a red dashed line denotes that roughtail/black skate was designated as an EC species in 2015.

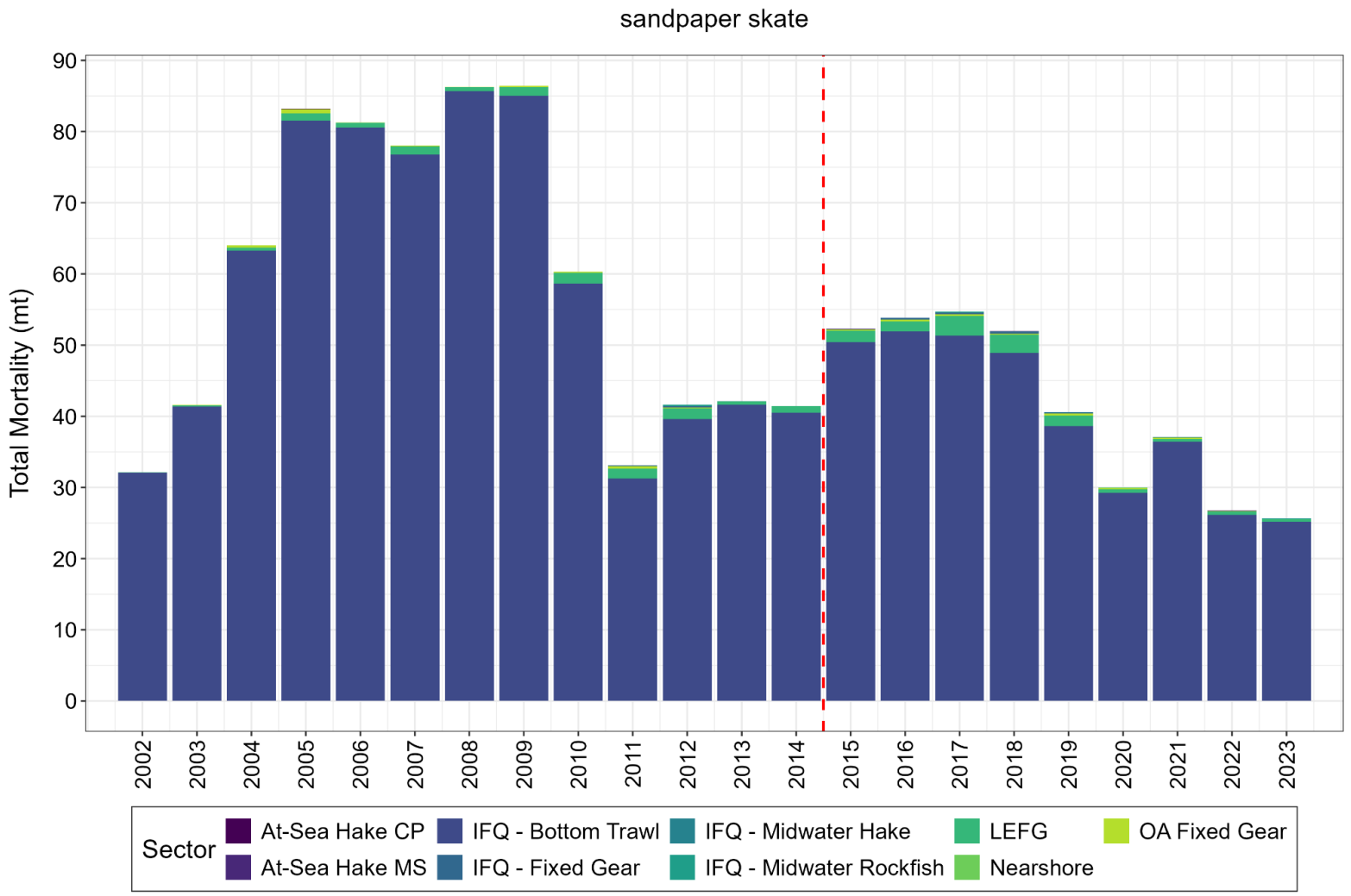

Figure A-11. Total annual mortality of sandpaper skate by directed groundfish sector (2002-2023). Sectors with recorded observations are color coded, and a red dashed line denotes that sandpaper skate was designated as an EC species in 2015.

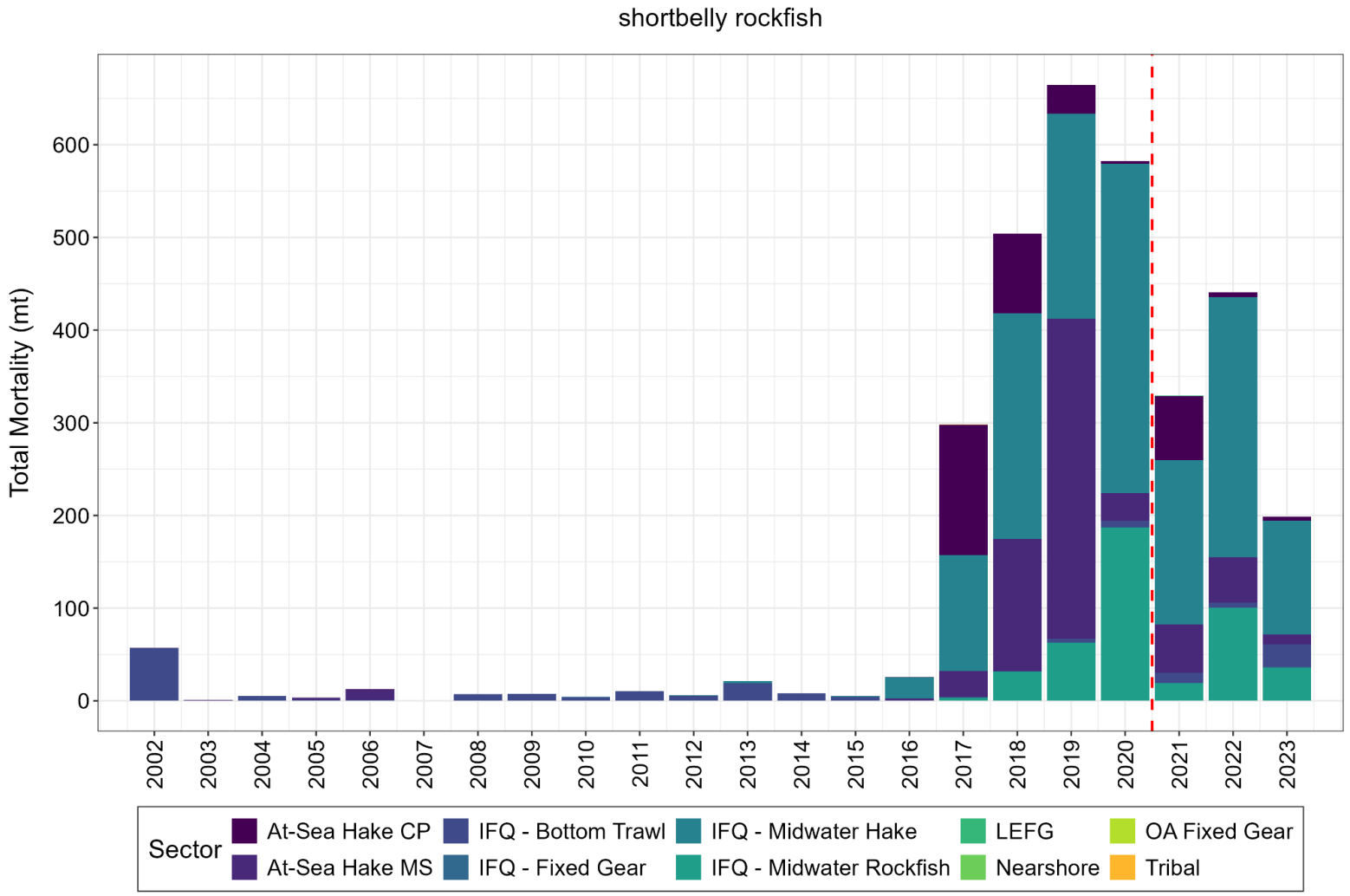

Figure A-12. Total annual mortality of shortbelly rockfish by directed groundfish sector (2002-2023). Sectors with recorded observations are color coded, and a red dashed line denotes that shortbelly rockfish was designated as an EC species in 2021.

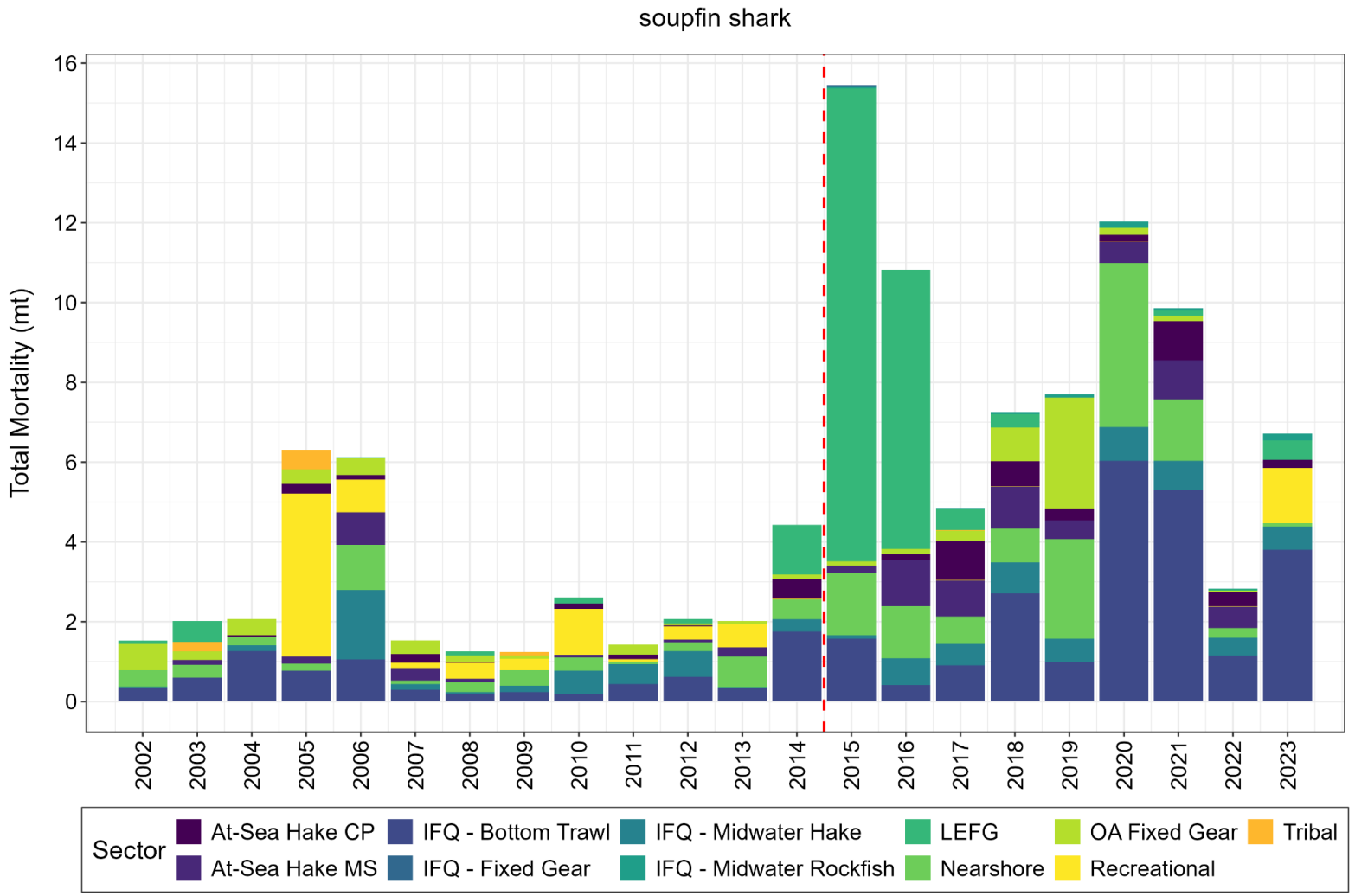

Figure A-13. Total annual mortality of soupfin shark by directed groundfish sector (2002-2023). Sectors with recorded observations are color coded, and a red dashed line denotes that soupfin shark was designated as an EC species in 2015.

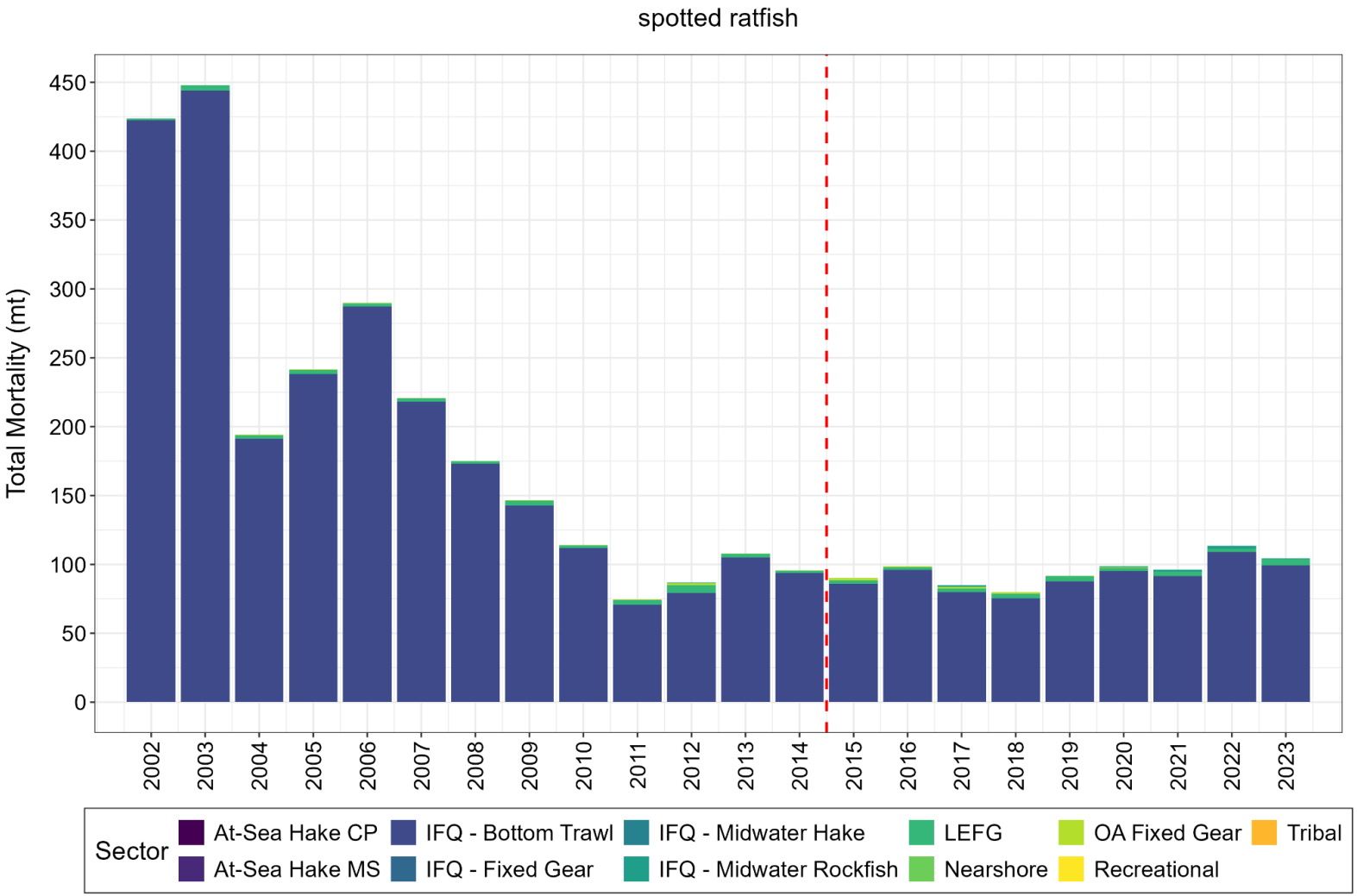

Figure A-14. Total annual mortality of spotted ratfish by directed groundfish sector (2002-2023). Sectors with recorded observations are color coded, and a red dashed line denotes that spotted ratfish was designated as an EC species in 2015.

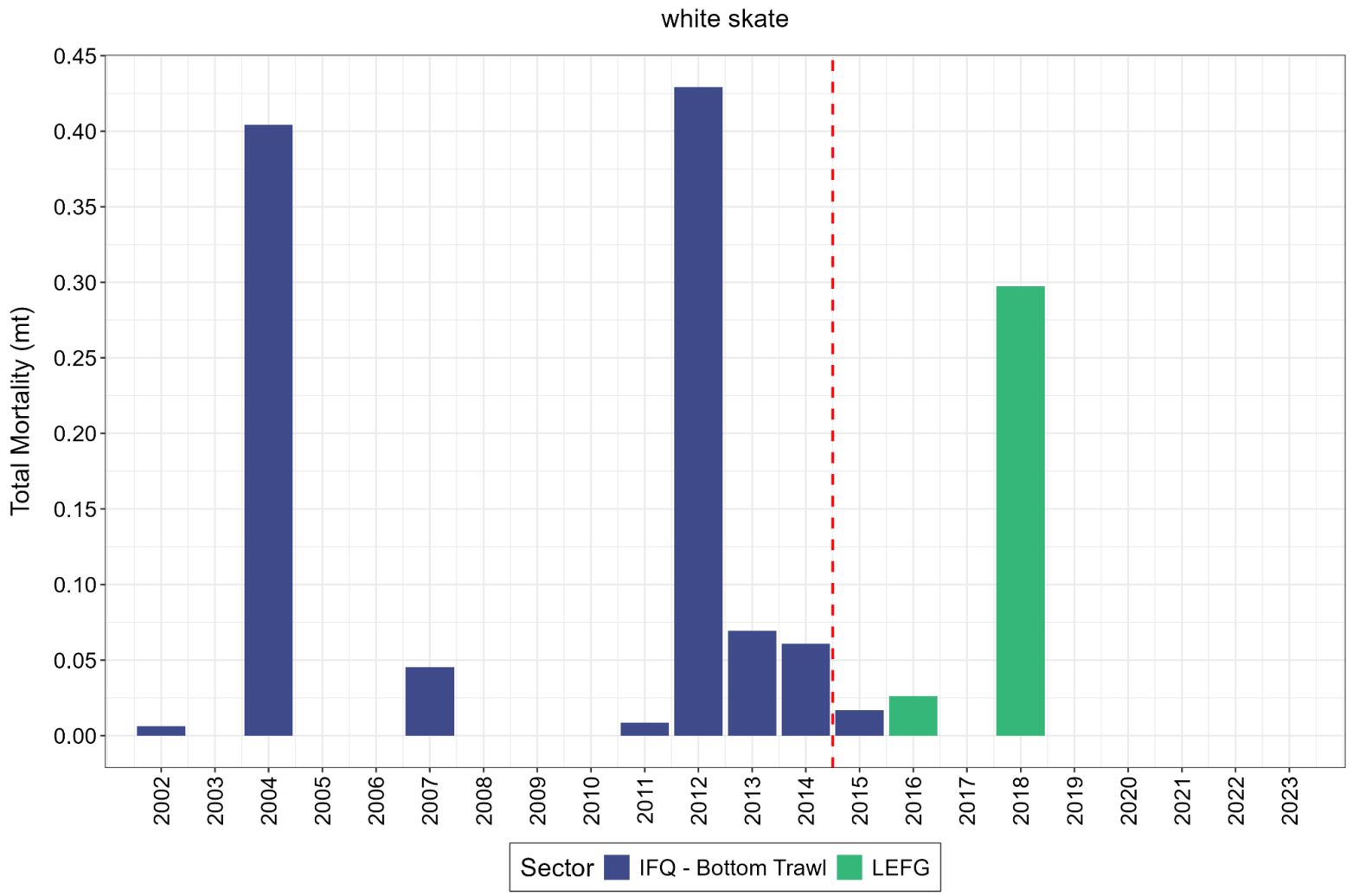

Figure A-15. Total annual mortality of white skate by directed groundfish sector (2002-2023). Sectors with recorded observations are color coded, and a red dashed line denotes that white skate was designated as an EC species in 2015.

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