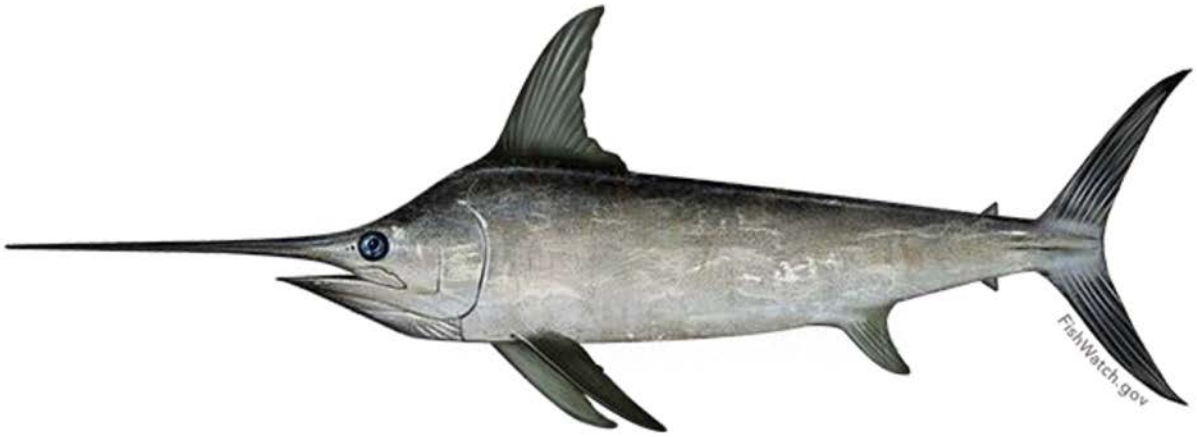
Providing Domestically Caught U.S. West Coast Swordfish:

How to Achieve Environmental Sustainability and Economic Profitability



Geoff Shester, Ph.D., Oceana California Campaign Director and Senior Scientist
Erin Kincaid, Oceana Pacific Marine Scientist
Carlito Turner, Oceana Research Associate
Ben Enticknap, Oceana Pacific Campaign Manager and Senior Scientist
August 2018

OCEANA Protecting the World's Oceans

Table of Contents

Cover image: NOAA

Introduction

The California Current Large Marine Ecosystem off the U.S. West Coast is one of the richest temperate marine ecosystems in the world. Fueled by life-giving swarms of krill and forage fish like sardine and anchovy, these productive waters support a wide diversity of marine life including large and diverse populations of whales, dolphins, sea turtles and sea birds, as well as top ocean predators like white sharks, bluefin tuna and swordfish that travel here to feed. The California Current ecosystem also supports many recreational and commercial fisheries. One of those fisheries, the U.S. West Coast drift gillnet swordfish fishery, is at a major crossroad.

Drift gillnets targeting swordfish stretch up to one mile in length and are deployed at night amid this epicenter of ocean wildlife off California. This fishery is one of the dirtiest fisheries in the Nation in terms of its overall bycatch rate and impact to protected marine life. On average, the fishery throws overboard more animals than those kept. It also kills more dolphins than all other observed West Coast fisheries combined. Despite gear modifications to reduce marine mammal interactions and area closures to protect endangered sea turtles, major ecological concerns remain with the unacceptably high levels of bycatch associated with this fishing method. In addition, many fishermen have left the fishery and landings in California have decreased by 57 percent from 2008 to 2018.[1] Fortunately, however, there are other ways to catch swordfish that are cleaner and profitable.

The National Marine Fisheries Service (NMFS) and federal Pacific Fishery Management Council (Council) are considering alternative swordfish fishing gears like shallow-set longlines, deep-set longlines, and deep-set buoy gear.[2] If these fishing gears can maximize catch efficiency and minimize bycatch, they have the potential to replace drift gillnets and revitalize West Coast commercial swordfish fishing. In 2015, the Council and NMFS proposed regulations to implement strict limits—called hard caps—to limit the take of the nine most at-risk species of whales, dolphins, and sea turtles in the drift gillnet swordfish fishery. However, in 2017, NMFS withdrew its proposed rule claiming detrimental economic impacts, without providing the Council the opportunity to correct or address the issue. The Council also approved new monitoring requirements, including 100% observer coverage or electronic monitoring, to be phased in by 2018, and a suite of performance metrics to measure bycatch of other marine mammals and finfish. However, NMFS decided not to adopt these requirements and observer coverage in the fishery has remained below 20 percent on average.

The decline in U.S. West Coast swordfish landings raises concerns about the bycatch impacts of foreign-caught swordfish imports. While the extent of such a transfer effect is likely small (U.S. drift gillnet landings represent roughly 1% of U.S. swordfish consumption)[3], such concerns can be directly addressed by promoting clean domestic fisheries and banning imports from countries that do not meet U.S. standards. As fishery managers on the U.S. West Coast search

---

[1] PFMC. Swordfish Landings by fishery, 2008-2017. 2018. Agenda Item G.7 Attachment 2 https://www.pcouncil.org/wp-content/uploads/2018/05/G7_Att2_Landings_of_swordfish_2008-2017_Jun2018BB.pdf

[2] NMFS. Status of Exempted Fishing Permits. Available: http://www.westcoast.fisheries.noaa.gov/fisheries/migratory_species/status_exempted_permits.html

[3] California State Senate Appropriations Analysis, April 30, 2018. In 2015 DGN swordfish landings totaled 72.5 metric tons, while nearly 11,000 metric tons of swordfish were imported into the U.S. http://leginfo.legislature.ca.gov/faces/billAnalysisClient.xhtml?bill_id=201720180SB1017#

for ways to boost waning regional swordfish catches, understanding the benefits and drawbacks of different gear types is essential. To that end, this report contains a comparative analysis of the gear types utilized in North American swordfish fisheries, with recommendations for how alternative gear types can best replace destructive drift gillnets. This analysis concludes with a transition plan for the drift gillnet fleet to deep-set buoy gear and harpoon gear that could lead to a clean and productive West Coast swordfish fishery.

Bycatch

"Bycatch" refers to the incidental catch, discarding, and resultant injury or mortality of non-target fish, protected marine species and seabirds in fisheries.[4] Under the Magnuson-Stevens Fishery Conservation and Management Act, Regional Fishery Management Councils and NMFS have an ongoing responsibility to minimize and avoid bycatch.[5] As stated in the National Oceanic Atmospheric Administration (NOAA) National Bycatch Report:

> *Ensuring the sustainability of marine resources for future generations is the primary mission of the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS). Reducing the unintentional capture, or bycatch, of fish, marine mammals, sea turtles, and seabirds is an essential part of this goal and is required under NMFS' guiding legislation.*[6]

Under the law, conservation and management measures are required to minimize and avoid bycatch. Bycatch should be avoided, but where it cannot be avoided, managers must work to minimize the mortality of bycatch. In some fisheries, like the U.S. West Coast swordfish fishery, different gear types can be used that are more selective than drift gillnets, thus target species can be selectively caught, avoiding the take of non-target marine life in the first place.

The Drift Gillnet Fishery

Drift gillnets are an unselective fishing gear used off the California coast to catch swordfish and thresher sharks. The enormous nets, which can measure over a mile in length and two hundred feet in height, drift near the surface at night in the open ocean and indiscriminately entangle many forms of marine life. Due to this, drift gillnets have been internationally recognized as harmful. The practice is banned in many places around the globe including the Mediterranean Sea and on the international High Seas. In the United States, domestic concerns over swordfish drift gillnet gear have led to prohibitions in all coastal states except California. [7,8,9]

---

[4] NOAA: Policy Directive (2.7.2006).
[5] Magnuson Stevens Fishery Conservation and Management Act, 16 U.S.C. § 1853(a)(11).
[6] National Marine Fisheries Service. 2011. U.S. National Bycatch Report [W. A. Karp, L. L. Desfosse, S. G. Brooke, Editors]. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-F/SPO-117E, 508 p.
[7] PFMC. 2013, Status of the U.S. West Coast Highly Migratory Species Fisheries through 2013. Stock Assessment and Fishery Evaluation Report (SAFE).
[8] PFMC. 2011. Fishery Management Plan for U.S. West Coast Fisheries for Highly Migratory Species: As Amended Through Amendment 2.
[9] NMFS. 2013. Amendment 8 to the 2006 Consolidated Atlantic Highly Migratory Species Fishery Management Plan: Commercial Swordfish Management Measures. 2013.

The California-based drift gillnet fishery discards more animals than it retains. According to data from the NOAA Drift Gillnet Fishery Observer Program, from 2008 to 2018, the drift gillnet fishery discarded approximately 52 percent of all animals caught.[10] A few examples of the frequently discarded species include ocean sunfish (*Mola mola*), blue sharks, pelagic stingrays, and shortfin mako sharks.

NMFS estimates of marine mammals, seabirds, and sea turtles caught in the DGN fishery from 2001-2015.

753 Dolphins
507 Seals and Sea Lions
112 Seabirds
53 Whales
35 Sea Turtles

Source: Carretta JV, Moore JE, Forney KA (2017) Regression tree and ratio estimates of marine mammal, sea turtle, and seabird bycatch in the California drift gillnet fi shery: 1990-2015. NOAA Technical Memorandum, NOAA-TM-NMFS-SWFSC-568. 83 p. Tables 4-39.

© NOAA, 1997. Short beaked common dolphin killed in a California swordfish drift gillnet. Its tail fin is cut off.

From 2001-2015, NMFS estimates that the California drift gillnet fishery caught over 1,400 marine mammals, seabirds and sea turtles.[11] All dolphins were killed, and only a handful of the large whales, turtles and sea lions escaped without serious injury or death. In addition, more than 140,000 fish, including tens of thousands of sharks were thrown overboard.[12] In response to the take of marine mammals in the 1990s, bycatch reduction measures including buoy line extenders and acoustic pingers — devices that emit noise to keep marine mammals away from nets — were made mandatory in 1997. However, there have only been modest improvements in protected species interaction rates in the fishery; from 1990 to 2000, a combined 13.7 marine mammals, sea turtles, and sea birds were caught per 100 drift gillnet sets. From 2004 to 2014, this number fell only marginally to 10.8 per 100 sets.[13] A few of the protected species caught by the drift gillnet fleet include humpback, gray, and minke whales, bottlenose dolphins, Pacific white-sided dolphins, leatherback sea turtles, California sea lions, and Northern elephant seals.

[10] NOAA. 2017. West Coast Region Observer Program. http://www.westcoast.fisheries.noaa.gov/fisheries/wc_observer_programs/sw_observer_program_info/data_summ_report_sw_observer_fish.html
[11] Carretta JV, Moore JE, Forney KA (2017) Regression tree and ratio estimates of marine mammal, sea turtle, and seabird bycatch in the California drift gillnet fishery: 1990-2015. NOAA Technical Memorandum, NOAA-TM-NMFS-SWFSC-568. 83 p. Tables 4-39.
[12] NOAA. 2017. West Coast Region Observer Program. http://www.westcoast.fisheries.noaa.gov/fisheries/wc_observer_programs/sw_observer_program_info/data_summ_report_sw_observer_fish.html
[13] *Id.*

Drift gillnets also threaten endangered sperm whales living in the California Current ecosystem. In 2010, two sperm whales were observed caught by the California drift gillnet fleet. One of the whales was confirmed dead and the other whale sustained serious injuries that were likely fatal.[14] These mortalities exceeded the potential biological removal (1.5 animals)—the maximum number of deaths that the population can sustain and still recover — set at the time for the endangered whales under the Marine Mammal Protection Act.[15] The two sperm whale mortalities occurred in a set where an onboard observer noted that the acoustic pingers were functioning, both before and after the whales were killed.[16] NMFS originally estimated 16 sperm whales were injured or killed by the drift gillnet fleet in 2010 and issued emergency regulations in 2013 requiring hard caps on sperm whale bycatch and 100 percent observer coverage.[17] However, these protections were removed following NMFS's recalculation of potential biological removal and mortality estimates. Since 2010, the observer program has documented the fishery killing gray whales, northern right whale dolphins, shortfin pilot whales, Risso's dolphins, sea lions, elephant seals and porpoises. Furthermore, the fishery continues to catch critically endangered Pacific leatherback sea turtles, including an observed interaction in 2012.[18] NMFS estimates the fishery killed or seriously injured six leatherback sea turtles from 2001-2015.[19] Despite the efforts of fishery managers, bycatch reduction measures have failed to end the indiscriminate killing of marine life.

[14] Carretta, James V., and L. Enriquez. 2012. Marine Mammal and seabird bycatch in California gillnet fisheries in 2010. NOAA Fisheries. Administrative Report LJ-12-01. https://swfsc.noaa.gov/uploadedFiles/Divisions/PRD/Programs/Coastal_Marine_Mammal/2010_Bycatch_Estimates_Carretta_Enriquez%20LJ-12-01.pdf

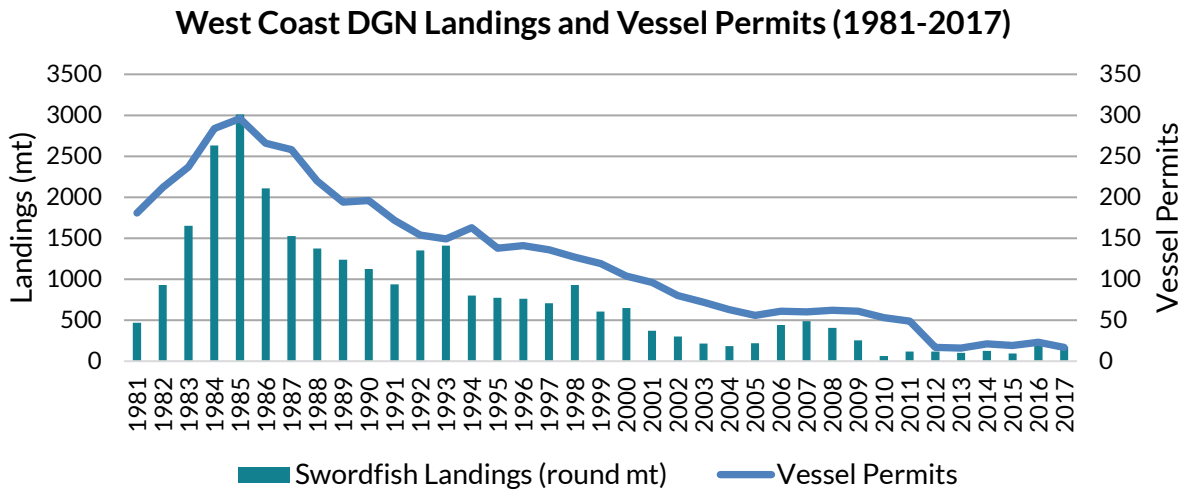
[15] NMFS. 2014. Recommendations from the Pacific Offshore Cetacean Take Reduction Team to Minimize Sperm Whale Interactions in the West Coast Swordfish Drift Gillnet Fishery. 2014. Agenda Item K.5.b. http://www.pcouncil.org/wp-content/uploads/K5b_NMFS_RPT_POCTRT_MAR2014BB.pdf

[16] Carretta, James V., and L. Enriquez. 2012. Marine Mammal and seabird bycatch in California gillnet fisheries in 2010. NOAA Fisheries. Administrative Report LJ-12-01.

[17]http://www.westcoast.fisheries.noaa.gov/publications/fishery_management/swr_observer_program/dgn_observer_fleet_notice_2013.pdf

[18] NOAA. 2017. West Coast Region Observer Program. http://www.westcoast.fisheries.noaa.gov/fisheries/wc_observer_programs/sw_observer_program_info/data_summ_report_sw_observer_fish.html

[19] Carretta JV, Moore JE, Forney KA (2017) Regression tree and ratio estimates of marine mammal, sea turtle, and seabird bycatch in the California drift gillnet fi shery: 1990-2015. NOAA Technical Memorandum, NOAA-TM-NMFS-SWFSC-568. 83 p. Tables 4-39.



West Coast DGN landings and vessel permits. Source: PFMC HMS SAFE 2012, Swordfish Landings by fishery, 2008-2017.

In addition to high levels of bycatch, participation and landings in the drift gillnet fishery are also declining. In California, annual landings by the drift gillnet fleet have declined since peaking at 2,198 metric tons (mt) in the mid-1980s.[20] In 2017, the California drift gillnet fleet landed approximately 176 mt of swordfish.[21] Participation has also dropped precipitously; from 2000 to 2017 the number of drift gillnet permits that have been actively fishing declined by 86 percent, from 119 to just 17.[22]

Exploring North American Swordfish Fisheries and Alternative Gears Used to Catch Swordfish

Alarmingly high levels of bycatch, frequent interactions with endangered and protected species, decreasing swordfish landings, and declining participation by fishermen, all signal that a transition from drift gillnets to clean gear types is needed. There are a number of other gear types that can be used to catch swordfish. Some of these gear types could help reestablish a productive U.S. West Coast swordfish fishery, while others would only exacerbate current problems. Exploring the methods used by other North American swordfish fisheries demonstrates which alternative gears could help revitalize the U.S. West Coast swordfish fishery.

[20] PFMC. 2012, Status of the U.S. West Coast Highly Migratory Species Fisheries through 2011. Stock Assessment and Fishery Evaluation Report (SAFE).
[21] PFMC. Swordfish Landings by fishery, 2008-2017. 2018. Agenda Item G.7 Attachment 2 https://www.pcouncil.org/wp-content/uploads/2018/05/G7_Att2_Landings_of_swordfish_2008-2017_Jun2018BB.pdf
[22] PFMC. 2014 HMSMT Report: Drift Gillnet Management. 2014. Agenda Item K.5.b. http://www.pcouncil.org/wp-content/uploads/K5b_HMSMT_DGN_MAR2014BB.pdf

Harpoon Gear

In **California**, archeological records show that harpoon fishing for swordfish has been practiced for nearly 3,000 years.[23] While technologies have certainly changed, the fundamentals remain the same. To catch swordfish, fishermen spot the swordfish finning, jumping, or basking near the surface, and strike the fish with a harpoon that is attached to a buoy.

California's modern day swordfish harpoon fishery first developed in the early 1900s. Logbook records from 1974 to 1993 indicate that 74 percent of pursued swordfish were harpooned and 91 percent of the harpooned swordfish were landed.[24] Harpoon gear was once a major contributor to the West Coast swordfish fishery and in 1978 over 300 vessels made nearly 1,700 mt in landings.[25] However, after drift gillnets were authorized by the California legislature as a legal gear type, many harpoon vessels converted to drift gillnets and harpoon participation and landings quickly declined. In 2017, only 24.5 mt of swordfish were landed on the West Coast with harpoon gear.[26] The harpoon fishery is considered highly selective and there is near zero bycatch associated with the fishery.[27] The California harpoon fishery has no documented incidents of marine mammal bycatch.[28]

There is also a **Canadian** harpoon fishery operating in the Atlantic that is allotted just 10 percent of the Canadian national swordfish quota. Holders of type "A" harpoon licenses, which receive the vast majority of the quota, were able to catch their full quota in seven of the eight years from 2002 to 2009.[29] From 2000 to 2013, an average of over 172 mt was landed by harpoon gear in Canada.[30] Like the California harpoon fishery, the Canadian harpoon fishery is clean; there is no bycatch associated with the fishery and there are no expected interactions with endangered or protected species.[31] The Canadian harpoon fishery's steady production for over a decade shows that modern harpoon fisheries can be financially and ecologically viable.

---

[23] Kronman, M. 1988. Harpooning: slow but steady improvements in the technology of a timeless skill. Natl. Fisherman, August, p. 5357, as in, Coan Jr, A.L., Vojkovich, M., Prescott, D. 1998. The California Harpoon Fishery for Swordfish, *Xiphias gladius.*
[24] Coan Jr, A.L., Vojkovich, M., Prescott, D. 1998. The California Harpoon Fishery for Swordfish, *Xiphias gladius.*
[25] *Id.*
[26] PFMC. Swordfish Landings by fishery, 2008-2017. 2018. Agenda Item G.7 Attachment 2 https://www.pcouncil.org/wp-content/uploads/2018/05/G7_Att2_Landings_of_swordfish_2008-2017_Jun2018BB.pdf
[27] California Ocean Science Trust. 2013. Rapid Assessments for Selected California Fisheries. http://opc.ca.gov/webmaster/ftp/project_pages/Rapid%20Assessments/CA%20Rapid%20Assessments.pdf
[28] NMFS. 2014. List of Fisheries, 2014. Web. Last Accessed: October 19, 2015.
[29] Intertek Moody Marine (IMM). 2010. North Atlantic Swordfish Canadian Harpoon Fishery Public Certification Report.
[30] ICCAT. 2015. ICCAT Database. Web. Last Accessed: October 20, 2015.
[31] Intertek Moody Marine (IMM). 2010. North Atlantic Swordfish Canadian Harpoon Fishery Public Certification Report.

Shallow-set Longline

© NOAA, 2013. An endangered Pacific leatherback sea turtle ensnared by a Hawaii-based shallow-set longline.

A shallow-set longline (SSLL) consists of a mainline that can measure up to 60 miles long, attached to hundreds or thousands of baited hooks. Shallow-set gear is set from dusk until dawn when targeting swordfish. The **Hawaii-based** shallow-set longline fleet is required to use circle hooks and mackerel-type bait, which have reduced sea turtle interactions. However, this fishery remains problematic; since reopening in 2004, the fishery has been forced to close twice due to excessive interactions with endangered loggerhead and leatherback sea turtles and was shut down in May of 2018 following settlement of a 2012 lawsuit challenging NMFS action to increase caps for sea turtle takes. From 2007 to 2017, the fleet also caught 755 seabirds, 92 marine mammals, and 193 sea turtles.[32] From 2007 to 2017, on board observers noted that 46 percent of the animals caught by this fishery were discarded, often dead or dying (31 percent).[33]

The **U.S. Atlantic** shallow-set longline fishery targets primarily swordfish and tunas. Swordfish caught in the Atlantic Ocean are subject to minimum size requirements and undersized fish must be released.[34] These size regulations are intended to protect juvenile fish, allowing them to grow and reproduce. However, as a result of being caught underwater for hours, hooked juvenile swordfish have little chance at survival. In the Atlantic shallow-set longline fishery, between 2005 and 2011, 71 percent of the swordfish discards were released dead.[35] In 2012, NMFS estimated that U.S. Atlantic SSLL the fishery caught 413 marine mammals, 1,006 leatherback sea turtles, and 681 loggerhead sea turtles.[36] From 2005 to 2011, the U.S. Atlantic SSLL fishery's catch (not including the Gulf of Mexico and Caribbean) had a 49 percent discard rate and only 17 percent of the total catch was comprised of retained swordfish.[37]

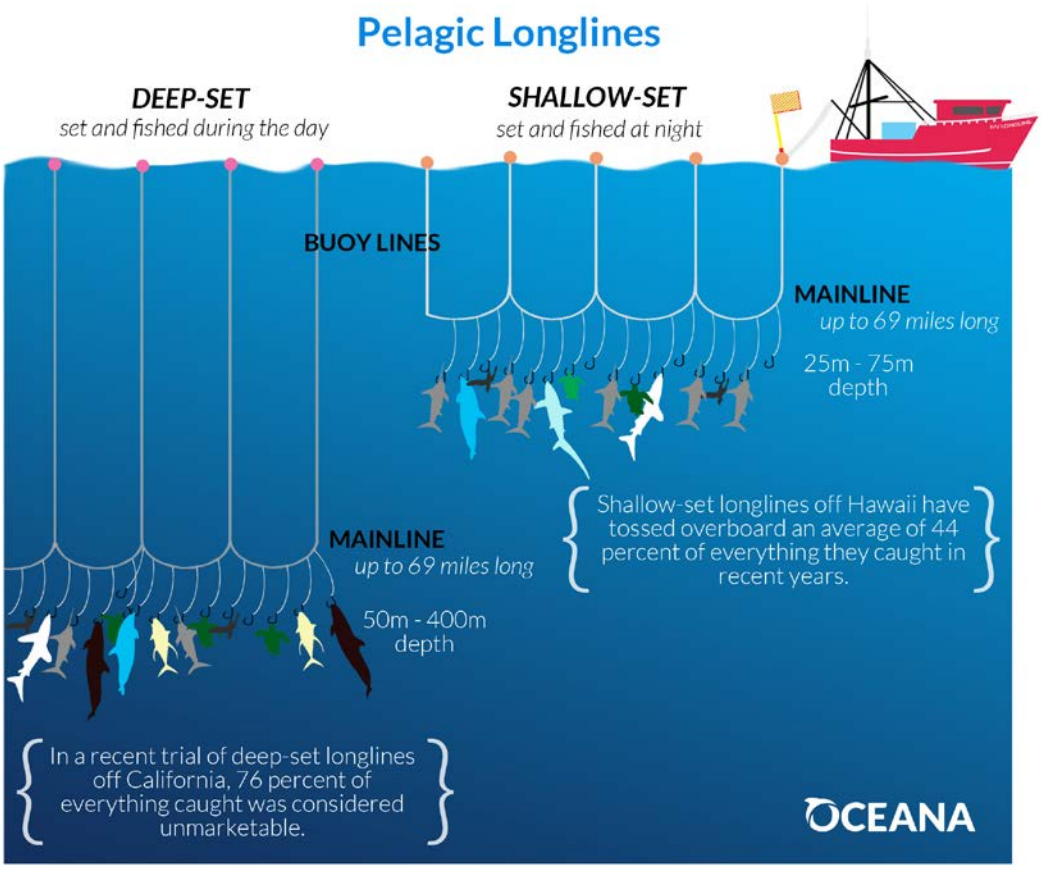
Canada's swordfish fisheries are exclusive to the Atlantic coast and 100 percent of Canadian swordfish catch is exported to the United States.[38] This fishery catches an estimated 1,200 loggerhead sea turtles and 100,000 sharks per year.[39] The fishery also has over eight protected

[32] NOAA. 2014. Pacific Islands Regional Office Observer Program. Hawaii Longline Shallow-set Quarterly and Annual Status Reports. http://www.fpir.noaa.gov/OBS/obs_hi_ll_ds_rprts.html
[33] NMFS. 2017. Hawaii Shallow-set Longline Data (2007-2017). Unpublished data.
[34] NOAA. 2014. NOAA Highly Migratory Species Commercial Compliance Guide. http://www.nmfs.noaa.gov/sfa/hms/compliance/guides/documents/hms_commercial_compliance_guide_april_2014__print_.pdf
[35] MRAG. 2013. MSC Public Certification Report for U.S. North Atlantic Swordfish Pelagic Longline and Handgear Buoy Line Fishery.
[36] NMFS. 2014. Stock Assessment and Fishery Evaluation (SAFE) Report for Atlantic Highly Migratory Species.
[37] MRAG. 2013. MSC Public Certification Report for U.S. North Atlantic Swordfish Pelagic Longline and Handgear Buoy Line Fishery.
[38] Department of Fisheries and Oceans, Canada. 2014. "Swordfish: Species at a glance" Last Accessed October 19, 2015. http://www.dfo-mpo.gc.ca/fm-gp/sustainable-durable/fisheries-peches/swordfish-espadon-eng.htm
[39] Christian, Claire, et al. 2013. "A review of formal objections to Marine Stewardship Council fisheries certifications." *Biological Conservation* 161: 10-17.

species (marine mammals, sea turtles, and sea birds) interactions for every 100 retained swordfish it lands; this is a higher rate than any of the other fisheries assessed in this report. Observer data shows that 51 percent of the catch was discarded between 2002 and 2009.[40] Despite the high levels of bycatch in the Canadian SSLL fishery, the fleet is allotted 90 percent of Canada's national swordfish quota.

Deep-set longline

This report focuses on the shallow-set longline fishery because deep-set longlines primary targets include tunas. However, an alternative experiment using deep-set longline gear was recently conducted off **California**. The results are discouraging. Just 24 percent of the catch was marketable species and less than two percent of the total catch was swordfish.[41] In these experimental trials, over 40 unmarketable blue sharks were caught for every swordfish. Deep-set longline gear is similar to shallow-set longline gear, however deep-set longlines are deployed at greater depths and fished during the day. The low percentage of target catch along with high bycatch rates make deep-set longline gear a poor alternative for the West Coast swordfish fishery.



Both shallow-and deep-set longlines off Hawaii discard important and iconic marine life accidentally caught during fishing, including sea turtles, sharks, whales, albatrosses, and dolphins.

[40] Intertek Moody Marine (IMM). 2011. North Atlantic Swordfish Canadian Pelagic Longline Fishery. Volume 1: Final Report and Determination.
[41] Dewar, H., Kohin, S. 2014. Deep-Set Longline Study. Agenda Item K.5.b. NMFS SWFSC Report. http://www.pcouncil.org/wp-content/uploads/K5b_NMFS_SWFSC_ALTERNATIVE_GEAR_MAR2014BB.pdf

Deep-Set Buoy Gear

In 2006, a deep-set buoy gear fishery was established on the **U.S. Atlantic Coast**. There, fishing takes place at night, with one to two hooks attached to each buoy. Buoys are deployed and retrieved by hand and a vessel will normally deploy 11 to 14 buoys per trip. Between 2007 and 2012, the number of vessels participating in the fishery increased from 42 to 55.[42] Landings from logbook records show that the catch composition during that time period was over 90 percent swordfish.[43] Atlantic buoy gear is also subject to minimum size requirements for swordfish, but because buoy gear is constantly monitored, hooked bycatch is quickly landed and released; subsequently the fishery has very low rates of bycatch mortality. According to logbook records, between 2007 and 2012, 92 percent of the swordfish discarded were released alive.[44] This means that high numbers of released juvenile swordfish may grow large enough to reproduce. The Atlantic buoy gear fishery has low bycatch interaction rates and NMFS has determined that the likelihood of buoy gear injuring marine mammals and protected species is remote.[45]

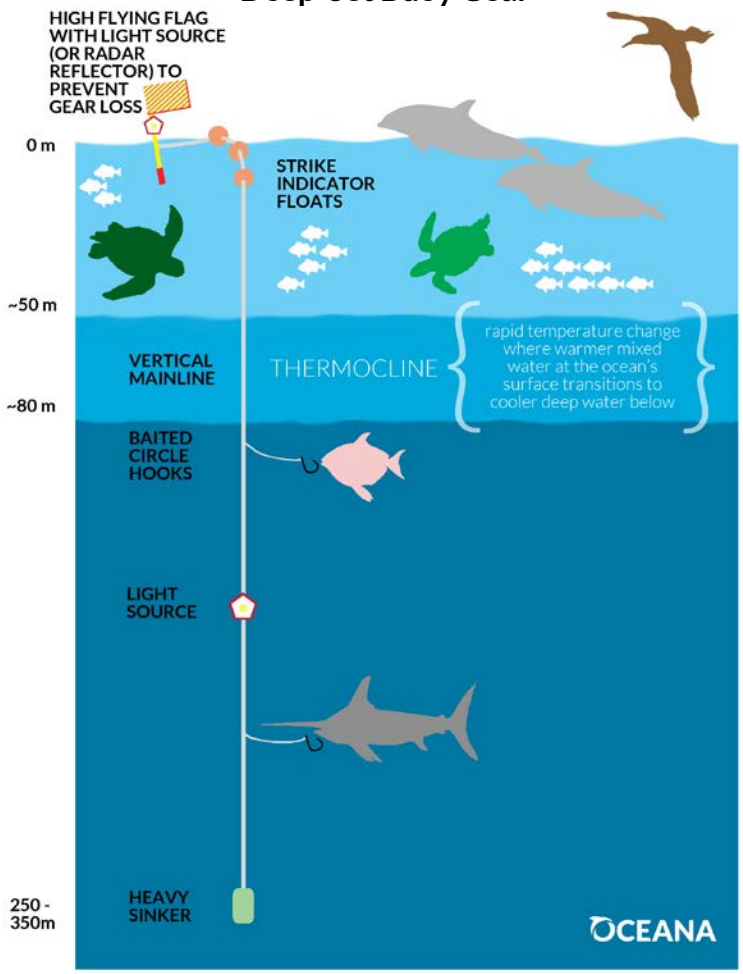
In 2011, researchers and fishermen began testing the use of deep-set buoy gear to target swordfish off **California,** modeled on the commercially successful swordfish fishery in the Atlantic Ocean. Each buoy is connected to a single vertical line with two to three branch lines and baited hooks. The gear is deployed at depths between 250 meters and 350 meters (820 feet to 1148 feet) during the daytime, far below the surface depths where species like sea turtles frequently swim. Commercial fishing trials began in 2015, after four years of successful research trials demonstrated the gear could be profitable and had minimal bycatch. The commercial fishing trials, authorized under exempted fishing permits issued by NMFS, have further confirmed these successful results. Results from the deep-set buoy gear commercial trials in California are demonstrate profitability and minimal bycatch, and the Pacific Fishery Management Council has scheduled authorization of the gear for March 2019.

From 2011 to 2017, more than 98 percent of fish caught in deep-set buoy gear off California were marketable species. There were no sea turtle takes, and only two marine mammal interactions (Northern elephant seals) where the animals were quickly released alive. The catch was primarily swordfish (approximately 83 percent), followed by bigeye thresher shark (approximately 12 percent), and the remainder was various shark species, escolar, and opah.[46] Unlike many other gear types, deep-set buoy gear is actively tended by fishermen, and when a bite is detected the gear is immediately hauled in; this means that if bycatch is captured, it can be released quickly with a high probability of post-release survival. In fact, all non-marketable species captured in experimental and commercial trials to date were released alive.[47] Swordfish caught by deep-set buoy gear are a higher value product pound for pound than drift gillnet or

[42] NMFS. 2014. Stock Assessment and Fishery Evaluation (SAFE) Report for Atlantic Highly Migratory Species.
[43] *Id.*
[44] *Id.*
[45] NMFS. 2013. Amendment 8 to the 2006 Consolidated Atlantic Highly Migratory Species Fishery Management Plan: Commercial Swordfish Management Measures. 2013.
[46] Exempt Fishery Proposal Application for Deep-Set Buoy Gear. Pfleger Institute of Environmental Research. February 2015. http://www.pcouncil.org/wp-content/uploads/H3a_Att2_PIER_MAR2015BB.pdf; PFMC. 2015-2017 PIER Deep-set Buoy Gear EFP. June 2018. Agenda Item G.4 https://www.pcouncil.org/wp-content/uploads/2018/05/G4_Att1_PFMC_2017-2018.BB_.PIER-DSBG.EFP_.Update_Jun2018BB.pdf
[47] *Id.*

pelagic longline caught swordfish (imported and domestic), due to greater freshness, quality, and market demand for sustainable seafood. From 2015-2017, the average market price for swordfish caught with deep-set buoy gear (2015-2017) was $6.53 per pound, versus $3.92 per pound for drift gillnet caught swordfish.[48] A higher market price for selective gear increases its profitability and economic viability. Switching to deep-set buoy gear may involve initial transition costs, with more time required to set and retrieve the gear relative to deploying a drift gillnet. Deep-set buoys, however, may provide fishermen with additional opportunities to fish in locations that are off limits to drift gillnets per existing regulations and where pelagic longlines are banned due to bycatch interactions.[49] High levels of targeted catch and low levels of discard mortality make deep-set buoy gear a profitable, low-bycatch alternative to drift gillnets, with potential to increase domestic landings of swordfish on the U.S. West Coast.

Deep-Set Buoy Gear



Deep-set buoy gear targets swordfish and secondary species like opah, thresher sharks, and mako sharks below the thermocline during the daytime, depths that greatly reduce interactions with marine mammals and sea turtles.

[48] PFMC. Swordfish Landings by fishery, 2008-2017. June 2018. Agenda Item G.7 Attachment 2 https://www.pcouncil.org/wp-content/uploads/2018/05/G7_Att2_Landings_of_swordfish_2008-2017_Jun2018BB.pdf

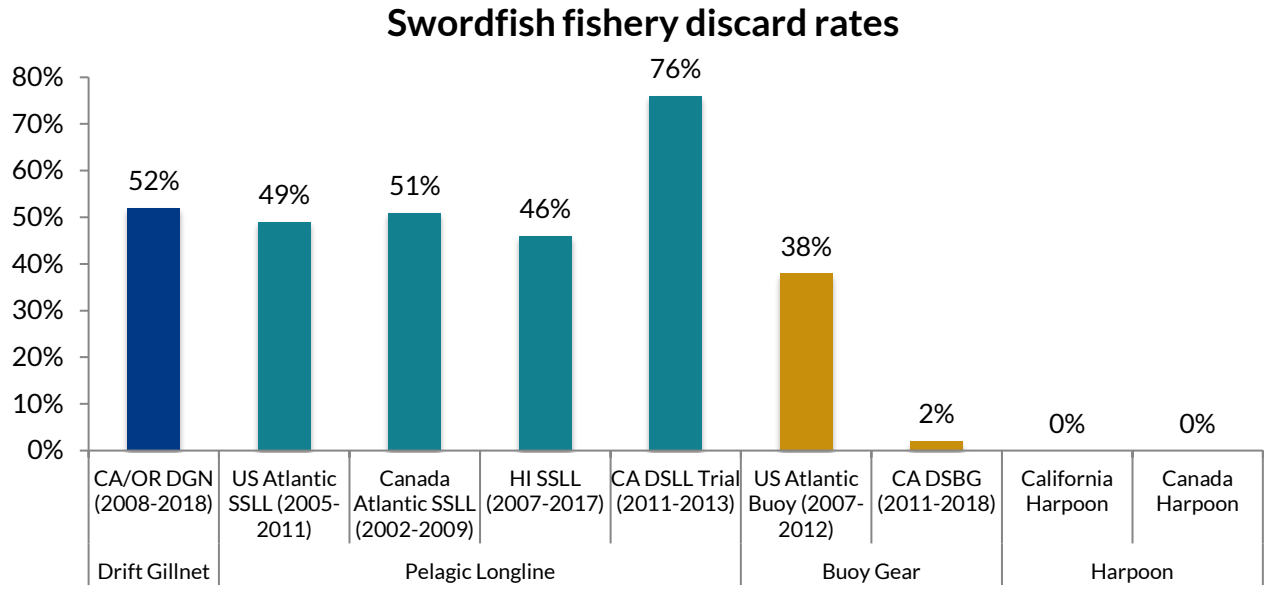
[49] Sepulveda et. al. Testing Modified Deep-Set Buoy Gear to Minimize Bycatch and Increase Swordfish Selectivity. 2014.

Comparison of Swordfish Fisheries

A side-by-side comparison across swordfish fisheries can show us which gear types may be best suited to transition the West Coast swordfish fishery to clean and sustainable methods. For this analysis we compared discard rates, discard mortality, percentage of total catch that is swordfish, and sensitive species caught per retained swordfish across North American swordfish fisheries. These metrics were selected because they help address current concerns in the fishery regarding total catch and selectivity. When compared, these data help elucidate the best options for a clean and productive swordfish fishery on the West Coast.[50]

Discard Rate

The discard rate measures the percentage of the total catch that is discarded. Discards can be alive or dead and include undersized target catch, non-target species, or even protected species—like whales and sea turtles. The drift gillnet fishery has the highest discard rate of any of the commercial fisheries assessed. During a ten-year period from 2008 to 2018, the drift gillnet fishery discarded 52 percent of its catch. Data revealed that commercial longline fisheries also have high discard rates, ranging from 46 percent to 51 percent. For the experimental fisheries (deep-set longlines and deep-set buoy gear) non-marketable species have been used as a proxy for discards because non-marketable species have no economic value and are likely to be discarded. The experimental California deep-set longline catch was comprised of an astounding 76 percent non-marketable species. While Atlantic deep-set buoy gear is highly selective for swordfish, size-limit regulations prevent the retention of undersize fish, so most of the discards are juvenile swordfish. The California deep-set buoy gear trials revealed that less than two percent of the catch was non-marketable species and the harpoon fisheries are estimated to have a discard rate of zero.

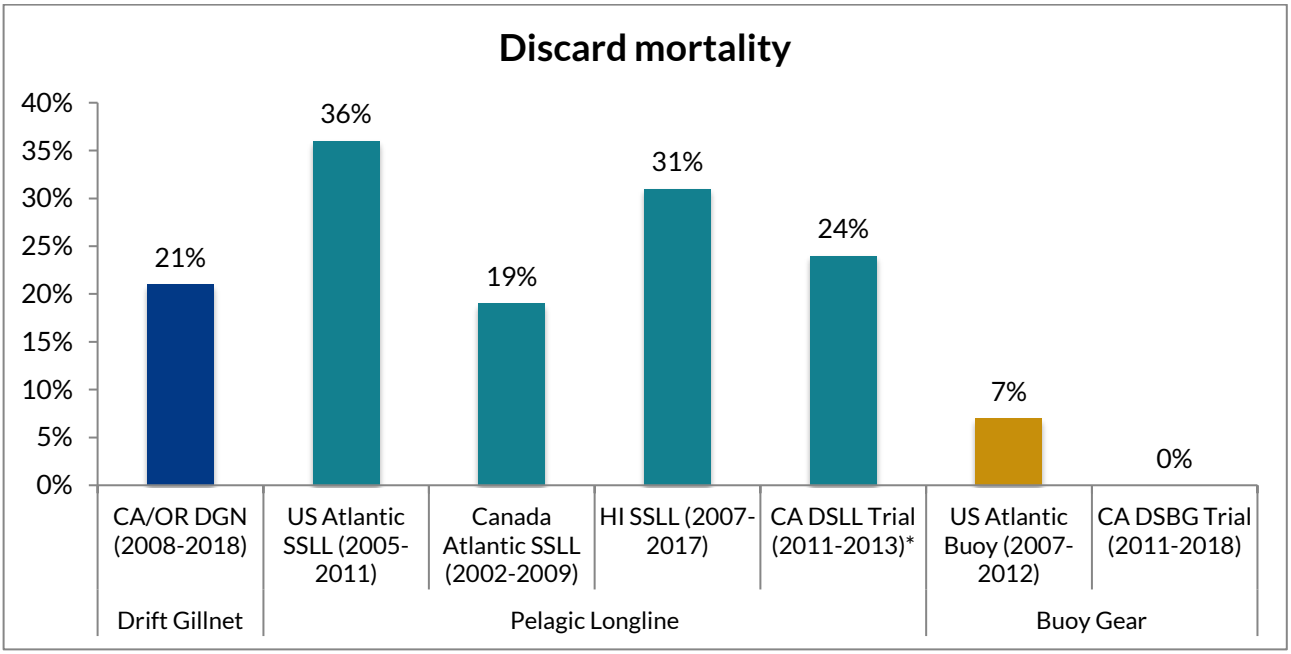


[50] Note: The sources for all data used in these comparisons can be found in the references section. Data that was collected by onboard observers has been used (to the extent available) for the purposes of this analysis.

Discard Mortality

Not all discards are released dead. Discard mortality measures the percentage of discards that are discarded dead, injured, or in an unknown state. However, it does not include potential post-release mortality, which can be high for some species but is not currently assessed. The process of being caught in nets or on hooks can be traumatic. Some animals that are released may live for several hours or days before succumbing to injuries. Due to insufficient species-specific scientific studies, these post-release mortalities are difficult to calculate and are not counted in discard mortality estimates, thus the figures for discard mortality likely underrepresents total mortality.

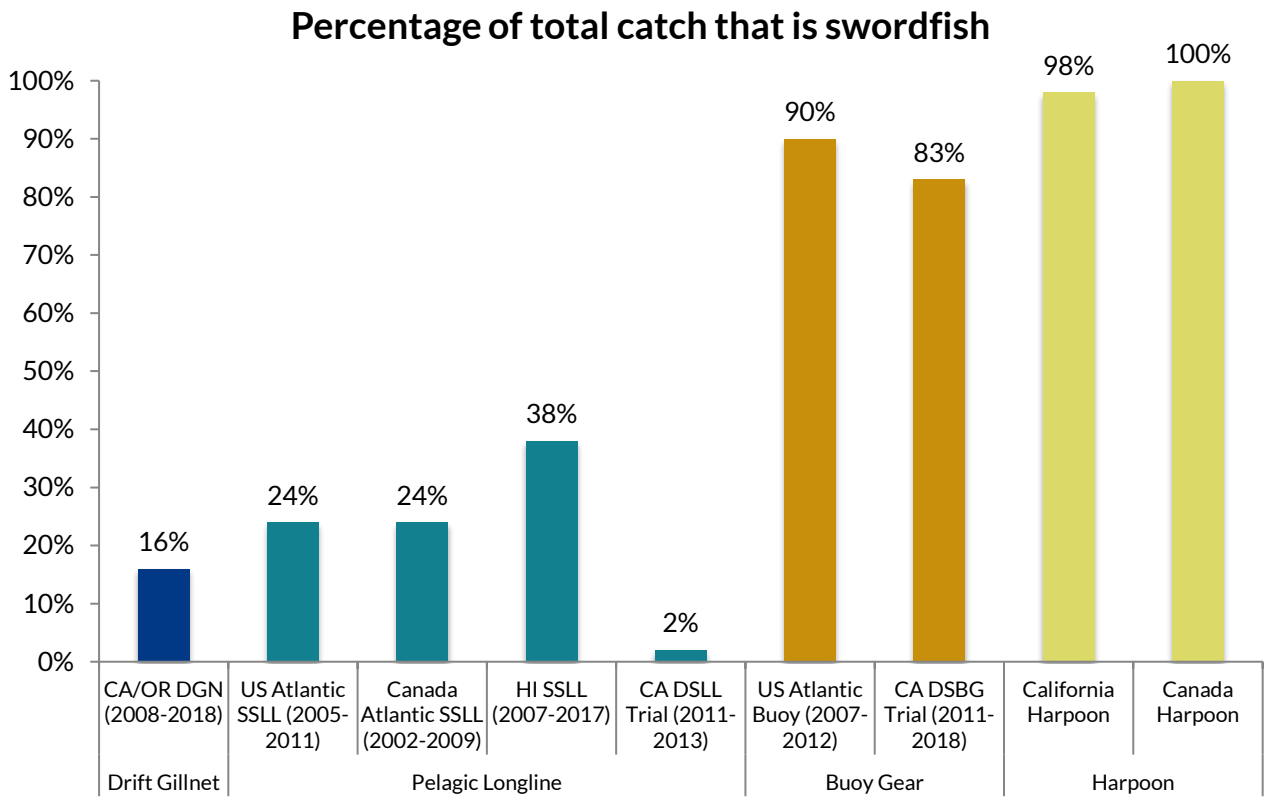
Data shows that of the swordfish fisheries analyzed, those utilizing shallow-set longline gear, deep-set longline gear, and drift gillnets had higher discard mortality than deep-set buoy gear. These gears are normally passively fished for many hours at a time; as a result, animals that are caught in the nets or longlines are often trapped beneath the surface for hours. Marine mammals are unable to surface for air and sharks are unable to pass water over gills, and drown. In contrast, buoy gear is actively monitored, meaning that bycatch can be quickly released, greatly improving the chance of survival.



Note: Discards with a status of "unknown" or "injured" are counted as mortalities.

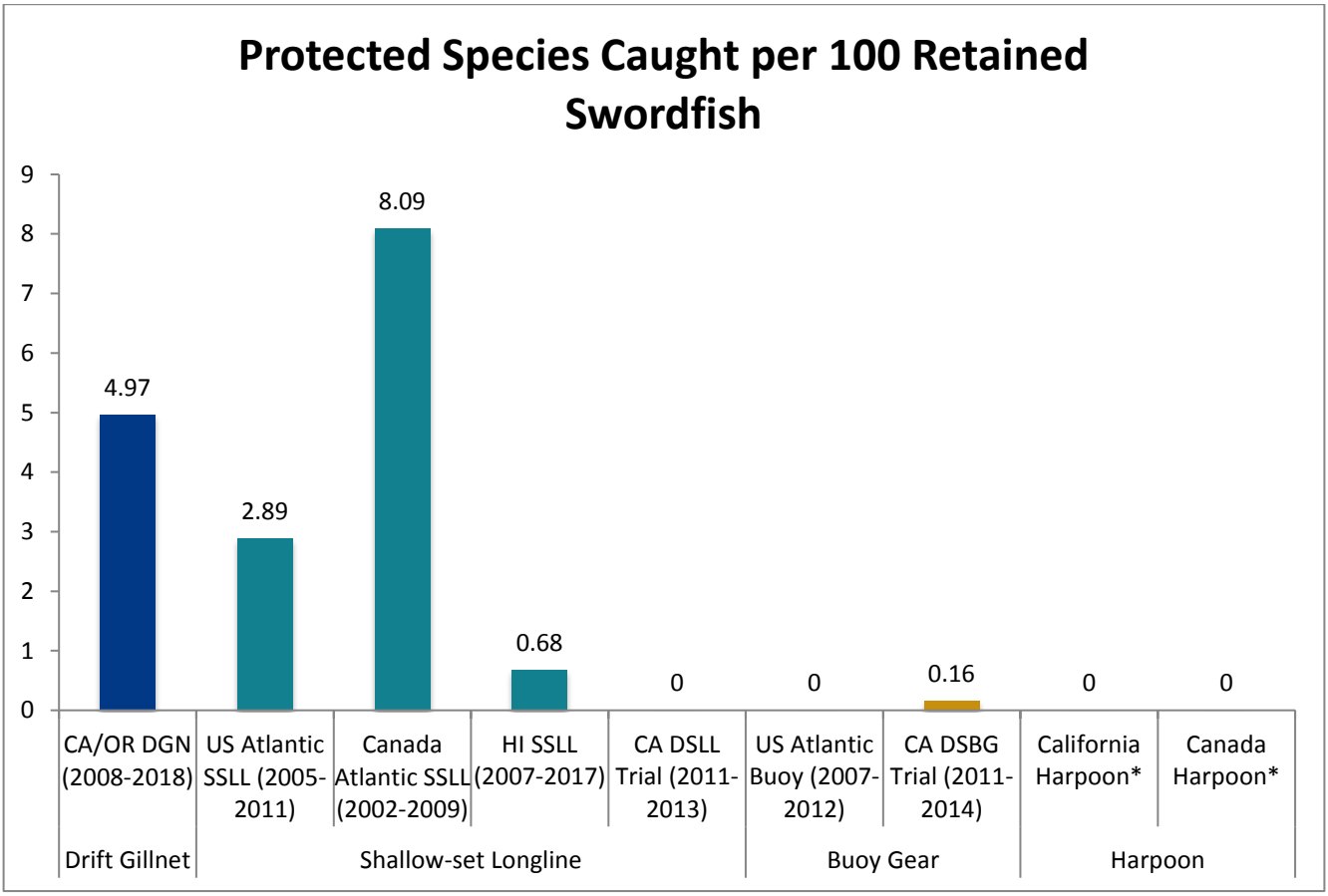
Percentage of the Total Catch that is Swordfish

Maximizing the catch of the target species is critical to the productivity and profitability of a fishery. The ability to catch the target species — in this case swordfish — is also a strong indicator of a gear's efficiency and selectivity. In the drift gillnet fishery only 16 percent of the animals caught were swordfish — the lowest number of any commercial fishery analyzed. Commercial longline gears performed better, with swordfish comprising between 24 percent and 38 percent of the total catch. The California deep-set buoy gear trials and Experimental Fishing Permits (EFP) resulted in a catch composition of 83 percent swordfish, and the commercially successful Atlantic buoy gear fishery is comprised of 90 percent swordfish. Notably, 98 to 100 percent of the harpoon catch is swordfish.



Comparing the Bycatch of Protected Marine Life to Retained Swordfish

Comparing the bycatch of protected marine life (marine mammals, sea turtles, and seabirds) with the amount of retained swordfish is a measure of the overall impact of a swordfish fishery on sensitive and important species adjusted for the amount of swordfish landed. The figure below answers the question: for every 100 swordfish kept, how many interactions did the fishery have with protected species? The highest proportion of protected species per 100 retained swordfish was recorded by the Canadian SSLL fishery, which caught over eight marine mammals, seabird or sea turtles per 100 retained swordfish.



* Based on data from Fisheries Logbook System in NMFS, 2014 and observer data from Kerstetter, 2009.

Transitioning the West Coast Swordfish Fishery to Deep-set Buoy Gear and Supplementing with Increased Harpoon Gear

The bycatch comparisons in this report show that drift gillnet gear is one of the most destructive methods for catching swordfish among North America's swordfish fisheries. Concerns over high discard rates, frequent interactions with protected species, and waning landings and participation demonstrate a need to transition from drift gillnets to selective fishing methods.

Shallow-set longlines, a gear type that is currently banned off the West Coast, are not a solution as they would only create a new suite of bycatch problems including additional takes of several endangered species. Data from SSLL fisheries in Hawaii, the U.S. Atlantic, and Canada, clearly show that the introduction of pelagic longlines would only exacerbate the bycatch issues that are pervasive in the California swordfish drift gillnet fishery.

Deep-set longlines are also an unacceptable alternative. The DSLL trials in California have shown that less than 2 percent of the total catch is actually comprised of swordfish and over three quarters of the catch are unmarketable species, primarily blue sharks. Like SSLL, a commercial DSLL fishery on the West Coast would only exacerbate current bycatch issues. Although drift gillnets and longlines are poor choices for targeting swordfish, the West Coast swordfish fishery has two excellent options: deep-set buoy gear and harpoon gear.

Deep-set Buoy Gear

Why deep-set buoy gear should replace drift gillnets: Buoy gear is an efficient and highly selective method to catch West Coast swordfish. In the deep-set buoy gear trials conducted off California to date, 83 percent of the catch was swordfish, compared to only 16 percent in the California drift gillnet fishery. In the Atlantic buoy gear fishery, 90 percent of the total catch is swordfish. Both in the California trials and the Atlantic fishery, no marine mammals, birds, or sea turtles have been killed or seriously injured to date. One of the major advantages of buoy gear is that it is actively tended. Once a bite is detected, the gear is hauled in, meaning that retained fish are higher quality and any bycatch is expected to be primarily released alive. In the Atlantic buoy gear fishery between 2007 and 2012, 92 percent of the swordfish discards were discarded alive. Since its inception, participation and landings in the Atlantic buoy gear fishery have remained steady or increased, while maintaining low levels of bycatch, proving that buoy gear is commercially sustainable. Based on 100 percent live discards thus far, an expanded commercial California deep-set buoy gear fishery should expect the same positive results.

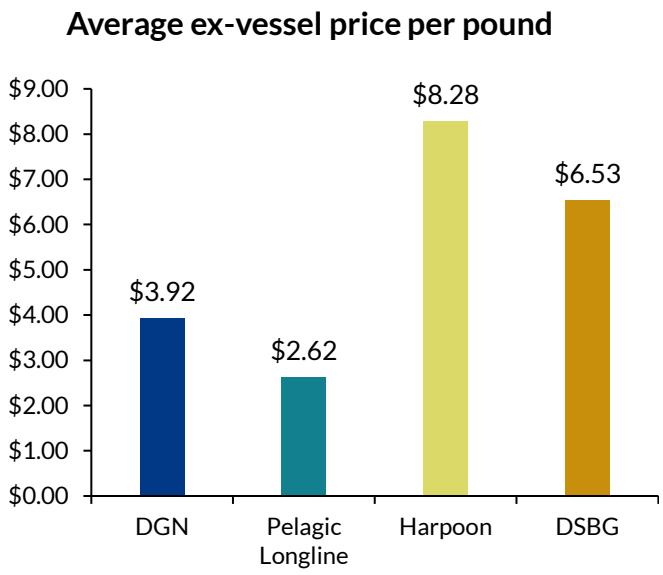
The prospects for economic success in a commercial deep-set buoy gear fishery in California are already demonstrated. Thus far, swordfish landed with deep-set buoy gear has attained high ex-vessel prices, similar to harpoon gear, due to freshness and quality of the landed catch. From 2015-2017 deep-set buoy gear swordfish fetched an average ex-vessel price of $6.53 per pound compared to $3.92 per pound for drift gillnet caught swordfish.[51] This premium price-point means that even if deep-set buoy gear swordfish landings per fishing day are lower than

[51] PFMC. Swordfish Landings by fishery, 2008-2017. June 2018. Agenda Item G.7 Attachment 2 https://www.pcouncil.org/wp-content/uploads/2018/05/G7_Att2_Landings_of_swordfish_2008-2017_Jun2018BB.pdf

drift gillnet landings, fishermen can earn equal or greater profits due to markedly higher prices per pound. From 2015-2017, the average annual swordfish landings revenue per deep-set buoy gear vessel was $57,498 versus $46,181 per drift gillnet vessel.[52]

These ecological and economic indicators suggest that deep-set buoy gear has the potential to reinvigorate the West Coast commercial swordfish fishery, while enabling a full transition away from drift gillnets while maintaining and even increasing domestic swordfish landings and fishing jobs. Along with proven commercial success in the Atlantic, the experience to date off California shows that buoy gear is a viable commercial alternative to drift gillnet swordfish gear.

Harpoon Gear



Source: PFMC. Swordfish Landings by fishery, 2008-2017. June 2018. Agenda Item G.7 Attachment 2

Why harpoon gear can further increase sustainable West Coast swordfish landings: Harpoon fishing is an extremely selective method that produces little to no bycatch. Skilled harpoon fishermen can target and land swordfish with precision, making it one of the cleanest gear types available. In addition, consumer demand for harpoon caught swordfish is high and customers are willing to pay for sustainably caught, high quality swordfish. In 2017, California harpooned dressed (gutted with head and tail removed) swordfish held an average ex-vessel price of $7.78 per pound — over double the price of swordfish caught in drift gillnets ($3.37) and triple that of longline-caught swordfish ($2.59).[53] There are also opportunities for significant cost savings over other gear types such as drift gillnets and shallow-set longlines, which often require onboard observers to monitor fishing due to high levels of bycatch. Harpoon vessels do not require observers, saving the fleet considerable expense including the management costs associated with the observer program.

Why harpoon gear can complement the deep-set buoy gear fishery: Harpoon landings reached a historic high in 1978, when 1,699 mt were landed in California, over ten times greater than the drift gillnet fishery has landed in recent years.[54] However, since the

[52] *Id.*
[53] PFMC. Swordfish Landings by fishery, 2008-2017. June 2018. Agenda Item G.7 Attachment 2 https://www.pcouncil.org/wp-content/uploads/2018/05/G7_Att2_Landings_of_swordfish_2008-2017_Jun2018BB.pdf
[54] Ito, R., Coan, I. 2007. U.S. Swordfish Fisheries in the North Pacific Ocean. ISC Billfish Working Group Workshop.

introduction of drift gillnets, the harpoon fishery has seen declining participation and production. The harpoon fishery landed 24 mt in 2011 and just 4.2 mt in 2013.[55,56]

In recent years, however, it is not just harpoon caught swordfish that has been low. In 2013, California's swordfish drift gillnet fishery landed only 61 mt.[57] Because swordfish fishing with harpoon gear does not incur bycatch, harpoon gear isn't subject to time and area closures or other management safeguards like those needed to limit bycatch in the drift gillnet fishery. In other words, acting responsibly by fishing with clean gear types comes with the benefit of fewer management measures and more flexibility. Further, phasing out drift gillnet gear all together could help shift fishing effort to other legal gear types like harpoon, and encourage a rise in harpoon landings.

The main economic concern with the harpoon swordfish fishery is that it is only possible during certain ocean conditions where swordfish are basking at the surface, which makes it a less dependable fishing technique if fished on its own. However, during certain periods, it can be extremely productive and could therefore be a supplement to increase swordfish landings if opportunistically fished in tandem with deep-set buoy gear.

It is unknown whether harpoon landings may once again peak to historic levels seen in the 1970s, but if California can encourage the resurgence of the once robust harpoon fishery, harpoon gear could provide a valuable complement to deep-set buoy gear landings.

The Next Step: A Drift Gillnet Transition Plan

Oceana recommends a *transition plan for the West Coast swordfish fishery that phases out and prohibits drift gillnets within a time-certain period, while authorizing and incentivizing deep-set buoy gear and additional harpoon effort.* We envision a comprehensive transition plan that includes the following elements:

1) *Phase out and prohibit drift gillnets over a time-certain period.*

   Establishing a timeline for the complete phase out would allow the remaining swordfish drift gillnet fleet to plan its transition to clean gear types.

2) *Provide financial compensation to drift gillnet fishermen who retire their drift gillnet permits and surrender their drift gillnets.*

   Providing financial compensation from government and non-government sources would help provide the capital necessary for fishermen to transition to cleaner methods, including the purchase of deep-set buoy gear and modifications to fishing vessels to

[55] *Id.*
[56] PFMC. 2012, Status of the U.S. West Coast Highly Migratory Species Fisheries through 2011. Stock Assessment and Fishery Evaluation Report (SAFE).
[57] California Department of Fish and Wildlife (CDFW). 2014. Annual Marine Fisheries Report 2014.

allow fishing with other gears. Fishermen who participate in such a program should qualify for a federal deep-set buoy gear permit.

3) *Oppose attempts to replace drift gillnets with gear types that are similarly destructive.*

   Proposals to re-establish damaging fishing gears such as a California-based shallow-set or deep-set longline fishery should be rejected.

4) *Expand and promote the use of deep-set buoy gear and harpoon gear*.

   Results from California testing and the experience in the Atlantic demonstrate that deep-set buoy gear has the potential to develop into a clean and viable fishery off the West Coast that can increase total landings above current levels. The continued research and commercial trials of deep-set buoy gear will allow for authorization as an allowable gear type in the federal U.S. West Coast Highly Migratory Species Fishery Management Plan and inform any necessary management measures. A successful transition to deep-set buoy gear and harpoon gear will require cooperation among fishermen, fisheries managers, seafood markets and other stakeholders. Marketing efforts, traceability, and partnerships can help grow demand and new markets for deep-set buoy gear caught swordfish to help maintain higher prices.

5) *Ban swordfish imports from countries that do not meet U.S. bycatch standards*.

   The U.S. currently imports two times more swordfish than it catches domestically, including a majority of Mexican and Canadian swordfish catch. By requiring swordfish exporters to demonstrate that they are using clean methods to catch swordfish, the U.S. can influence responsible fishing abroad and hold foreign imports to the same standards as domestically caught swordfish. Under section 101(a)(2) of the Marine Mammal Protection Act (MMPA): *"the Secretary of the Treasury shall ban the importation of commercial fish or products from fish which have been caught with commercial fishing technology which results in the incidental kill or incidental serious injury of ocean mammals in excess of United States standards."*

   NMFS finalized the import provisions of the MMPA in August 2016. Fish and fish products can only be imported into the United States if the harvesting nation has received a comparability finding from NMFS. To receive a comparability finding, the harvesting nation must demonstrate it has prohibited the intentional mortality or serious injury of marine mammals in the course of commercial fishing operations in the fishery. The harvesting nation must demonstrate that it has adopted and implemented, with respect to an export fishery, a regulatory program governing the incidental mortality and serious injury of marine mammals in the course of commercial fishing operations in its export fishery that is comparable in effectiveness to the U.S. regulatory program.[58]

[58] 81 Fed. Reg. 54,390, 54,390-54,391 (Aug. 15, 2016).

Conclusion

Drift gillnets and pelagic longlines targeting swordfish both have high levels of bycatch. Conversely, harpoon and deep-set buoy gear can selectively target swordfish with minimal bycatch. A plan should be developed to transition the current drift gillnet fishery off California from unselective drift gillnets to deep-set buoy gear and harpoon gear. Such a plan should provide drift gillnet fishermen with opportunities to continue fishing swordfish with clean gears and financial incentives so that they can continue to profitably catch swordfish as they learn to effectively use new, clean fishing methods. Concerns over impacts of imported swordfish can be directly addressed by imposing bans on imported swordfish that do not meet U.S. standards, while authorizing and promoting the use of clean methods for targeting swordfish off the U.S. West Coast. Financial compensation cushions the learning curve and capital costs of a gear switch. By assisting fishermen with this transition and focusing efforts toward known sustainable fishing methods, we can achieve a clean, sustainable U.S. West Coast swordfish fishery.

Swordfish Catch and Discard Data References

CA/OR DGN: NOAA. 2018. West Coast Region Observer Program: Summaries & Reports.
US Atlantic SSLL: MRAG. 2013. MSC Public Certification Report for US North Atlantic Swordfish Pelagic Longline and Handgear Buoy Line Fishery.
Canada Atlantic SSLL: Intertek Moody Marine (IMM). 2011. North Atlantic Swordfish Canadian Pelagic Longline Fishery. Volume 1: Final Report and Determination.
HI SSLL: NMFS. 2017. Hawaii Shallow-set Longline Data (2007-2017). Unpublished.
CA DSLL Trial: Dewar, H., Kohin, S. 2014. Deep-Set Longline Study. http://www.pcouncil.org/wp-content/uploads/K5b_SUP_SWFSC_PPT1_MAR2014BB.pdf
US Atlantic Buoy: NMFS. 2014. Stock Assessment and Fishery Evaluation Report (SAFE) for Atlantic Highly Migratory Species; Kerstetter. 2009. Characterization of the Catch by Swordfish Buoy Gear in Southeast Florida.
CA DSBG Trial: Sepulveda, C. 2015. Exempt Fishery Proposal Application for Deep-set Buoy Gear. http://www.pcouncil.org/wp-content/uploads/H3a_Att2_PIER_MAR2015BB.pdf; PFMC. June 2018. 2015-2017 PIER Deep-Set Buoy Gear EFP Preliminary Summary. https://www.pcouncil.org/wp-content/uploads/2018/05/G4_Att1_PFMC_2017-2018.BB_.PIER-DSBG.EFP_.Update_Jun2018BB.pdf
California Harpoon: Coan Jr, A.L., Vojkovich, M., Prescott, D. 1998. The California Harpoon Fishery for Swordfish, *Xiphias gladius* and PFMC 2015. Highly Migratory Species Stock Assessment and Fishery Evaluation Reports Current HMS SAFE Report. http://www.pcouncil.org/highly-migratory-species/stock-assessment-and-fishery-evaluation-safe-documents/current-hms-safe-document/ (accessed October 2015),
Canada Harpoon: Coan Jr, A.L., Vojkovich, M., Prescott, D. 1998. The California Harpoon Fishery for Swordfish, *Xiphias gladius*.