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APPLICATION OF SEASONAL CLOSURES TO REDUCE FLATFISH BYCATCH IN THE U.S. ATLANTIC SEA SCALLOP FISHERY

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ABSTRACT The U.S. Atlantic sea scallop fishery has a bycatch allocation of Georges Bank yellowtail flounder that has in some cases limited the ability of the scallop fleet to fully optimize harvest of the scallop allocation. One strategy used to mitigate bycatch in the Georges Bank sea scallop fishery is time/area closures of scallop access areas. The original access area closure period, established in 1999, ran from February 1 through June 15, and it was primarily based on historical yellowtail spawning data at a broad spatial resolution. Beginning in 2011, data on yellowtail bycatch rates in the scallop fishery were collected during a dedicated seasonal bycatch survey in and around the scallop access areas of Closed Area I and Closed Area II on Georges Bank. Examination of seasonal trends in this data resulted in managers eliminating seasonal closures starting in 2013 in the Nantucket Lightship and Closed Area I access areas, and changing the dates for the seasonal closure in the Closed Area II access area to August 15 through November 15. This cooperative, fishery-independent seasonal bycatch survey has been an effective tool for monitoring seasonal variability in bycatch and informing time/area closures.

KEY WORDS: yellowtail flounder, closed areas, time/area closures, Georges Bank, Fishery Management Plan

INTRODUCTION

The Atlantic sea scallop *Placopecten magellanicus* (Gmelin, 1791) fishery is one of the most valuable fisheries in the United States, with 2014 landings worth over $424 million (National Marine Fisheries Service 2015). The stock has been rebuilt from its overfished status in 1997, and no overfishing is occurring (Northeast Fisheries Science Center 2014). The limited access (LA) scallop fishery consists of 347 vessels; primarily fishing two dredges per vessel. In the fishing years (FY) 2005 to 2012, the landings from the northeastern U.S. sea scallop fishery exceeded 50 million pounds annually (National Marine Fisheries Service 2015). Total fleet revenues more than quadrupled in the 2011 FY from levels in 1995 (from $137 to $585 million, in inflation adjusted to 2011 dollars) (National Marine Fisheries Service 1996, 2015).

The harvest of this important resource can be restricted due to bycatch of yellowtail flounder *Limanda ferruginea* (Storer, 1839) on Georges Bank (GB) and in southern New England (SNE). Yellowtail flounder is a demersal flatfish distributed from Labrador to Chesapeake Bay, and on GB it is common in depths of 37–73 m (Bigelow et al. 2002). Three stocks are recognized for management purposes in the northeastern United States: Cape Cod/Gulf of Maine, GB, and SNE/Mid-Atlantic (MA). Landings in the United States totaled 1,777 metric tons (mt) in 2014, a 75% decline from the 7,208 mt landed in 2004 (National Marine Fisheries Service 2005, 2015).

In 2012, the GB yellowtail flounder allocation to the scallop fishery was approximately 308 mt, and the allocation to the groundfish industry was roughly 218 mt. These quotas were constraining to both the scallop fleet and groundfish vessels targeting other species on GB. The overall U.S. allocation of the GB yellowtail stock was reduced by 61% in the 2013 FY. A number of factors indicate that the GB yellowtail stock is in poor shape, including recent declines in weights at age, truncated age structure, and poor recruitment, including the lowest on record (Legault et al. 2014). The stock is considered overfished and continues to decline.

The U.S. fisheries for yellowtail flounder are managed by the New England Fishery Management Council (NEFMC) under the Northeast Multispecies Fishery Management Plan (FMP) (NEFMC 2010). Under this FMP, yellowtail flounder are included in a complex of 15 groundfish species managed by time/area closures, gear restrictions, minimum size limits, and output controls involving individual vessel allocations that are based on annual catch entitlements. Vessels can form voluntary sectors allowing annual catch entitlements to be transferred within and among sectors. The goal of the management program is to reduce fishing mortality to allow stocks to rebuild and remain at or near target biomass levels. In addition, a formal quota sharing agreement was implemented in 2004 between Canada and the United States to share the harvest of yellowtail in the Transboundary GB management unit (Fig. 1). The agreement includes total allowable catch quotas for each country as well as in-season monitoring of the U.S. catch of yellowtail on GB.

In 2004, Amendment 10 to the scallop FMP formally introduced rotational area management, establishing three scallop access areas on or near GB including Closed Area I (CAI), Closed Area II (CAII), and the Nantucket Lightship Closed Area (NLCA) (Fig. 1) (Murawski et al. 2000, NEFMC 2003). These areas are portions of closures implemented in 1994 to reduce impacts on groundfish mortality from all mobile bottom-tending fishing gears, including scallop dredges. With this amendment, fishing effort controls for LA scallop vessels became spatially specific. Instead of effort being regulated by an annual days-at-sea allocation that could be fished anywhere, vessels had to use a portion of their total days-at-sea allocation, converted into a weight-defined possession limit, in the scallop access areas. Access area trips could be exchanged between vessels.

Amendment 10 includes a detailed set of guidelines that would be applied for closing and reopening scallop access areas. Framework (FW) adjustments, developed with cooperation

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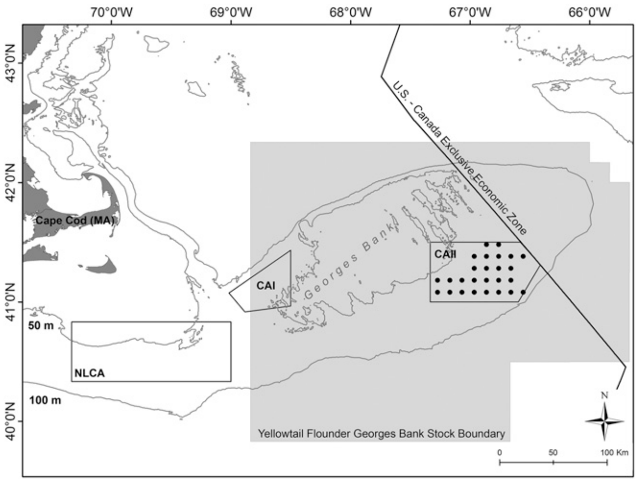

Figure 1. The boundaries of current scallop access areas on GB, including CAI, CAII, and the NLCA. The shaded portion is the Transboundary GB yellowtail stock area. The black dots inside CAII are the station locations used for determining yellowtail flounder bycatch rates in the scallop dredge fishery for the CAII seasonal bycatch analysis.

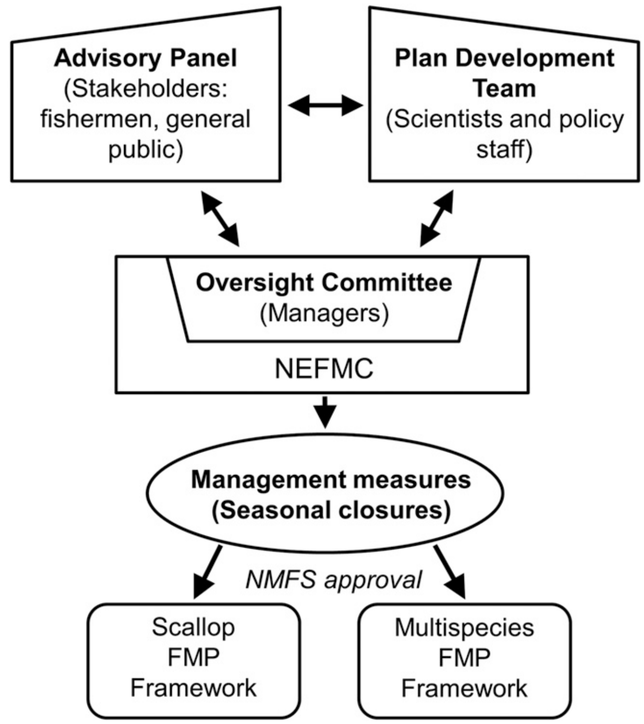

Figure 2. The NEFMC framework process. Framework adjustments are developed in cooperation with the Advisory Panel, the Plan Development Team, and the Oversight Committee. The Advisory Panel includes fishermen and the general public (environmental advocates, shore-side community members), whereas the Plan Development Team comprises scientists and policy staff. Management measures, including seasonal closures, are proposed by NEFMC. After approval by the NMFS, measures are included in FMP Framework adjustments.

between policy staff, scientists, fishermen, and the general public, are used to design and evaluate the closures and openings of access areas, which are later recommended by the Council and ultimately implemented by the National Marine Fisheries Service (NMFS) (Fig. 2). In general, an area closes when the expected increase in exploitable scallop biomass in the absence of fishing exceeds 30% per year, and reopens to fishing when the annual increase in the absence of fishing is less than 15% per year. This adaptive scheme takes advantage of the fact that smaller scallops, needed to maintain the population, grow more quickly than larger scallops targeted by the fishery. The status of the scallop resource is determined based on biomass and mortality estimates for the GB and MA stocks combined. Area rotation allows for different rates of fishing mortality by area if optimum yield is achieved for the resource as a whole, and overfishing does not occur in an area unless the averaged mortality over all areas exceeds the resource-wide threshold.

Overall, any alternative that closes areas during the fall and winter would most likely have positive impacts on the scallop resource, because that is when scallop meat weights are poorest, and therefore, harvesting an equivalent weight of scallop meats requires harvesting a larger number of animals. In the most extreme case, there is a 20% difference in scallop meat weights per animal, with meat weight at its lowest from September to April on GB (Sarro & Stokesbury 2009). In general, the overall impacts of seasonal closures are difficult to assess because vessels shift effort in response to a seasonal closure. While a seasonal closure could benefit the scallop resource in one area, it could cause seasonal changes in fishing effort in other areas, impacting overall scallop mortality in unexpected ways.

Assessing the spatial and temporal influences on bycatch of groundfish species has been challenging. At times, there are large aggregations of commercial-sized scallops in the three scallop access areas of GB that also contain populations of yellowtail flounder, and restrictions on the timing of scallop harvest in these areas may result in high bycatch ratios of yellowtail flounder if scallop fishing is permitted when yellowtail are also present in high numbers. Further complicating the matter, there are different restrictions on different stocks of yellowtail flounder in these closed areas. The yellowtail flounder in the NLCA are considered part of the SNE/MA stock, whereas CAI and CAII yellowtail flounder are considered part of the GB stock (Murawski et al. 2000).

When the scallop fishery was first granted access in portions of the groundfish closed areas in 1999 by a Joint Framework (Scallop FW11/Multispecies FW29), there were seasonal restrictions from February 1 to June 14, the months when groundfish spawning aggregations were predicted to be highest (Colton et al. 1979, NEFMC 1999). Yellowtail bycatch was estimated based on the results of an experimental scallop fishery conducted in CAII from August to October 1998 (NEFMC 1999, 2003). A 2004 Joint Framework (Scallop FW 16/Multispecies FW39) of the scallop and groundfish FMPs defined the scallop access season to coincide with the rest of the year, a decision based on potential risks to spawning groundfish and possible high bycatch rates during the spring when bycatch could not be predicted from the existing August–October data (NEFMC 2004).

The reauthorized Magnuson–Stevens Act (National Marine Fisheries Service 2007) established new additional requirements to end and prevent overfishing through the implementation of annual catch limits (ACL) and accountability measures (AM) if ACL are exceeded. For the U.S. sea scallop fishery, these requirements apply to Atlantic sea scallops and nontarget species, including yellowtail. To comply with the new requirements, catches of yellowtail founder by the scallop fishery are limited on GB and in SNE fishing areas by sub-ACL (percentages of the stock ACL allocated to the scallop fishery) determined by the NEFMC beginning in FY 2010 through Amendment 16 to the Multispecies FMP (NEFMC 2009). By 2011, Amendment 15 to the Scallop FMP established a specific AM for the yellowtail sub-ACL for both GB and SNE/MA stocks. If a sub-ACL is exceeded, a preidentified area closes to all LA scallop vessels during the upcoming FY based on the overage.

The NEFMC has made several modifications to the yellowtail sub-ACL structure to improve effectiveness and better optimize yield. Scallop FW 23 includes measures to improve the effectiveness of the yellowtail AM by refining the closure schedules to better reflect bycatch rates. The areas now close during months with the highest bycatch rates. In addition to the measures in the Scallop FMP, there have also been modifications under the Multispecies FMP to improve the effectiveness and management of the yellowtail ACL. Multispecies FW 47 includes several modifications to improve the administration of the yellowtail sub-ACL. The cap that limited the catches of yellowtail flounder in the GB access areas to 10% of the ACL was eliminated because it was viewed as redundant. Scallop fishery AM are implemented only if the overall ACL for either GB or SNE/MA are exceeded, or if the total ACL for a given broad stock area is not exceeded but the scallop fishery exceeds its sub-ACL for that area by 50% or more. Finally, in-season data can be used to recalculate the amount of yellowtail flounder allocated to the scallop fishery GB sub-ACL, enabling a transfer to the groundfish fishery if necessary. These measures are expected to still prevent overfishing of yellowtail flounder by keeping total catch under the overall ACL, but provide flexibility to help optimize yield of both scallops and yellowtail flounder.

During the development of these management measures, there was limited information pertaining to groundfish bycatch and scallop meat yield in the GB closed areas from February through mid-June because of the absence of fishing in these areas during these months. Furthermore, limited information existed on the optimization of scallop catch and yellowtail bycatch reduction in open areas. Spatially and temporally specific data on meat yield and bycatch rates were required to minimize yellowtail flounder bycatch in this fishery because spatial and temporal variation in scallop meat yield had been observed on GB (Sarro & Stokesbury 2009), and variation in GB yellowtail flounder bycatch rates had been noted through observer data (Bachman 2009). The seasonal bycatch survey provided the data that were needed to develop effective access area closures.

MATERIALS AND METHODS

Seasonal Bycatch Survey

The seasonal bycatch survey included 30 research trips utilizing commercial scallop vessels. A grid-survey design was used in and around GB scallop access areas, including CAII where yellowtail bycatch is typically high (Fig. 1). Each trip sampled approximately 75 stations of which 26 stations were consistently sampled on every trip in CAII.

On each trip, the vessel was outfitted with one standardized 4.57-m wide Turtle Deflector Dredge (TDD) and one 4.57-m wide New Bedford style dredge. Both dredges were outfitted with 4-inch rings and met all management restrictions. The design of the New Bedford style dredge was not consistent; therefore only catch data from the TDD are analyzed in this article. The TDD had an 8-by-40 ring apron, a 10-by-40 ring belly, 6-by-18 ring sides, and a two-ring skirt. The twine top had a stretched mesh length of 10.5 inches, and a 2:1 hanging ratio. The TDD was also equipped with turtle mats made from 3/8-inch grade 70 chain, with 9 rows of ticklers and 13 rows of ups and downs. The dredges were towed at a target speed of 4.8 knots using 3:1 wire scope; tows were 30 min in duration. All tow parameters were recorded, including start and end positions, depth, and sea conditions.

For each paired tow, the bycatch from each dredge was separated and counted by species. The entire scallop catch was quantified in bushels (bu = 35.2 L). A one-bushel subsample of scallops was picked at random from each dredge and scallops were measured in 5-mm shell-height increments. Size frequency of the subsample was later extrapolated to the whole catch. The commercially important finfish species were measured to the nearest centimeter. Composition and estimated quantity of "trash" (including rocks, sand dollars, crabs, sea stars, clams, and shell debris) were also recorded.

A subset of roughly 13 stations within CAII was randomly selected for scallop sampling on each trip. At each of these stations, 12 scallops representing a range of observed shell sizes were selected. The top shell of each animal was measured to the nearest millimeter, and the scallop was then carefully dissected. The meat was blotted dry, placed in a plastic bag, and individually frozen. Station number, meat quality, shell height, sex, and reproductive stage were recorded for each meat sample. Upon return to port, each sample was weighed to the nearest 0.1 g. Depth, location, and date of collection were also recorded for each sample.

Bycatch rate was calculated for each trip by dividing the weight of fish bycatch (lbs) by the meat weight of the scallop catch (lbs). Because tow duration and speed were standardized for each trip from March 2011 through March 2014, catch was quantified by the same swept area throughout the study. Fish weight was calculated based on the lengths of fish caught in each survey tow using published length-to-weight conversions (Wigley et al. 2003). Scallop meat weight was predicted using a generalized linear mixed model (gamma distribution, log link) using PROC GLIMMIX on the SAS v. 9.2 system. Scallop shell height, depth, sampling area (CAI, CAII, or open areas), and month were used as variables to predict meat weight, with a random effect incorporated to account for temporal and fine-scale spatial variability (Northeast Fisheries Science Center 2014).

Fleet Catch Monitoring and Reporting

Catch data collected by the National Oceanic and Atmospheric Administration Atlantic sea scallop monitoring program were extracted from their website (http://www.greateratlantic.fisheries.noaa.gov/ro/fso/scal.htm). Methodology for monitoring the scallop fishery yellowtail flounder sub-ACL became effective on July 21, 2011. To monitor the yellowtail sub-ACL, the Analysis and Program Support Division (APSD) for the Northeast Region relies on a number of sources of data.

The Northeast Fishery Observer Program collects and processes data and biological samples obtained during commercial fishing trips. Preliminary (partially audited) observer data, including yellowtail bycatch, are available to APSD for monitoring purposes within 24 h of the end of observed fishing trips in CAI, CAII, and NLCA. Fully audited data from open areas and all other access areas are usually available within 90 days of the end of an observed trip.

Federally permitted dealers are required to submit reports that document the weight of each species purchased from vessels during a given reporting week. Reports are submitted through the Standard Atlantic Fisheries Information System; these reports are available to APSD upon submission. Federally permitted vessels are required to submit vessel trip reports detailing the weights of each species kept, as well as the statistical area where they were caught. A daily vessel monitoring system catch report is also required for all scallop trips for LA scallop vessels. Each of these vessels must report yellowtail caught (kept and discarded) and all other species kept.

The yellowtail discard rate (lbs) for the LA fleet is calculated as the ratio of yellowtail discards (lbs) to the kept catch of all species (lbs) on observed scallop trips. The cumulative yellowtail catch and the yellowtail discard rate are calculated by multiplying the LA discard rate by the dealer year-to-date total kept of all species (lb), and then adding the dealer year-to-date yellowtail kept (no longer allowed).

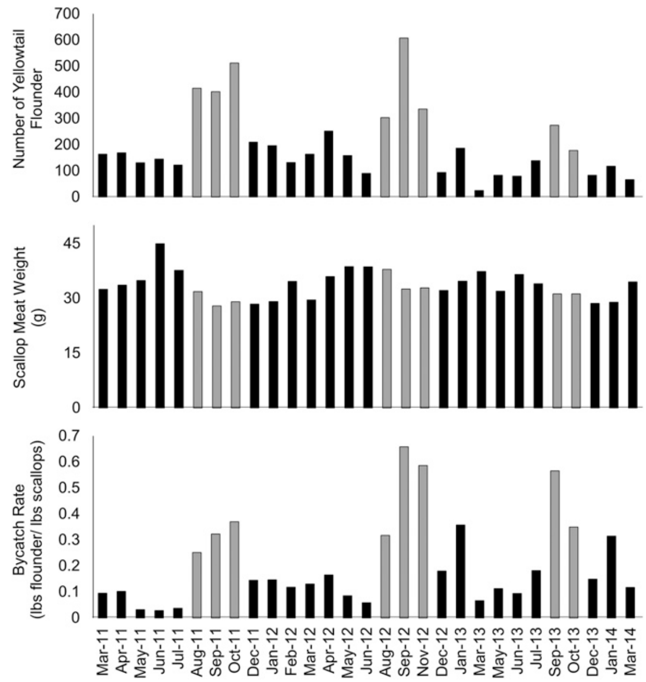

Figure 3. Yellowtail flounder catch (numbers) in the standardized TDD (top panel), predicted weight (grams) of a 132-mm scallop from CAII (middle panel), and bycatch rate (pounds of yellowtail flounder/pounds of scallop meat) for the TDD (bottom panel) for each bycatch survey trip from March 2011 until March 2014 at 26 continuously sampled stations in CAII. The gray sections represent months included in the seasonal closure.

RESULTS

Seasonal Bycatch Survey: GB Yellowtail Catch by Month in CAII

Yellowtail flounder catch (numbers) in the standardized TDD for each bycatch survey trip from March 2011 until December 2013 is shown in Figure 3 (top panel). Peak yellowtail abundance in CAII occurred in the months of August through November. This period also coincides with a decrease in scallop meat yields because of spawning (Fig. 3, middle panel). The increase in yellowtail catch coupled with the decrease in scallop meat yields leads to the highest bycatch rates during this period (Fig. 3, bottom panel).

Scallop and Yellowtail Catch for CAII from Vessel Reporting

Data from the NMFS for 3 y were examined on a monthly basis (Table 1). The old CAII seasonal closure, from February 1 to June 15, was in effect in FY 2012 and through April 2013. The new August 15 to November 15 closure went into effect in 2013. August and November catches were made before August 15 and after November 15 for FY 2013 and 2014. As predicted by the seasonal bycatch survey, the newly opened months of February through June show a much lower bycatch rate than what existed in the fall when August through November were open to fishing (February 2013 to June 2014: average D:K = 0.016, range 0–0.034; August 2012 to November 2012: average D:K = 0.053, range 0.047–0.061). In FY 2012, the scallop catch during the prime months for good scallop meats, March through August, was 59.5% of the landings. Scallop catch during this period was 85.5% of the landings in FY 2013 and 78.4% of the landings in FY 2014.

DISCUSSION

The seasonal bycatch survey was critically important for determining how seasonal closures of the scallop fishery should be constrained in time and space to best mitigate yellowtail bycatch. Our analysis of the seasonal changes in yellowtail bycatch revealed a peak in bycatch numbers for the months of August through October, months not previously covered by other surveys. Because scallop meat weight is at a low during these months, the potential impact of shifting the seasonal closure from February–June to August–November was clear. Yellowtail flounder bycatch mitigation would be best achieved by closing areas when scallop meat weight was also low.

Reducing bycatch and discards is complicated in multispecies fisheries. Bycatch mitigation in the scallop industry has been accomplished with a mix of gear modifications, time/area closures, and the higher scallop catch per unit effort achieved by rotational management (Walsh 2008). Time-area closures are effective if (1) the spatial distribution of bycatch constitutes a small subset of the fishery, (2) bycatch patterns are spatially and temporally predictable, (3) displaced effort does not result in higher bycatch rates, (4) fishermen are supportive of the approach, and (5) adequate data exist to design the closure and season (Murray et al. 2000).

A high level of research and monitoring under NMFS scallop management makes the implementation of effective time/area closures possible. Comprehensive dredge and video surveys are carried out annually through funding generated by the resource as part of a Research Set-Aside program. Catch is controlled by allocating a known number of trips to specific access areas with possession limits, and gear requirements allow most small scallops and fish to escape. Uniformity in harvest gear, vessel size, and operational strategies reduces variability in the industry, so adequate industry-funded observer coverage can be provided at relatively low levels (<10%) to estimate discards and other major catch parameters. Finally, it is

TABLE 1.

CAII vessel reports of scallop and yellowtail (YT) catches from FY 2012 to 2014 and the resulting bycatch ratio of discarded YT to kept scallop meats (D:K).

	Month	Scallop meats (lbs)	YT catch (lbs)	D:K
FY 2012	**March**	**0**	**0**	**0.00**
	April	**0**	**0**	**0.00**
	May	**0**	**0**	**0.00**
	June	**1,023,831**	**49,518**	**0.05**
	July	**1,349,106**	**65,370**	**0.05**
	August	**904,681**	**43,292**	**0.05**
	September	768,062	46,718	0.06
	October	630,566	31,831	0.05
	November	333,961	17,684	0.05
	December	355,128	24,352	0.07
	January	142,397	19,102	0.13
	February	0	0	0.00
	TOTAL	5,507,732	297,867	0.05
	March–August	3,277,618	158,180	0.05
FY 2013	**March**	**0**	**0**	**0.00**
	April	**0**	**0**	**0.00**
	May	**65,327**	**935**	**0.01**
	June	**789,589**	**10,076**	**0.01**
	July	**855,666**	**12,001**	**0.01**
	August	**346,977**	**4,402**	**0.01**
	September	0	0	0.00
	October	0	0	0.00
	November	179,917	3,352	0.02
	December	82,895	1,218	0.01
	January	38,460	2,677	0.07
	February	47,231	560	0.01
	TOTAL	2,406,062	35,221	0.01
	March–August	2,057,559	27,414	0.01
FY 2014	**March**	**0**	**0**	**0.00**
	April	**16,335**	**1,118**	**0.03**
	May	**16,728**		
	June	**389,558**	**13,242**	**0.03**
	July	**756,305**	**25,215**	**0.03**
	August	**660,927**	**23,122**	**0.03**
	September	0	0	0.00
	October	0	0	0.00
	November	194,052	6,750	0.03
	December	264,004	9,345	0.04
	January	41,462	1,422	0.03
	February	7,024	237	0.03
	TOTAL	2,346,395	80,451	0.03
	March–August	1,839,853	62,697	0.03

Months highlighted in gray were closed to scallop fishing for the entire month. Months highlighted in light gray were closed to scallop fishing for half of the month. The prime months for good scallop meats (March through August) are in bold.

mandatory for vessels and dealers to report catch by area, and each vessel is tracked electronically.

A seasonal closure addresses the yellowtail bycatch issue in the sea scallop fishery because of differences in the behaviors of the target and bycatch species. Scallops are mostly sedentary, and the location of a bed of scallops can be mapped, and catch from that bed can be projected several years in advance (Smith & Rago 2004). By contrast, yellowtail seem to seasonally migrate, at least over limited distances (Stone & Nelson 2003). Yellowtail geographical range may also expand or contract as a function of population size, changing the relative proportions of yellowtail in open and closed fishing areas (Pereira et al. 2012). Although yellowtail are widely distributed over scallop beds, bycatch rates in scallop dredges exhibit seasonality. This is probably due to shifts in the yellowtail population, but changes in the vulnerability of yellowtail to capture in dredges cannot be ruled out. There is evidence that yellowtail spend time off bottom (Walsh & Morgan 2004), and water temperature and fish condition during spawning season may affect catchability (Langton 1983, Department of Fisheries and Oceans 2007).

The dynamics of the situation seem to call out for near real-time reporting of bycatch. In 2007, Scottish fishermen piloted a project for real-time closures in the North Sea to reduce cod discard (Catchpole & Gray 2010). Fishermen were responsible for voluntarily reporting catch of cod above a minimum size, and catches above a threshold value in one area triggered closures for 3 wk. It was estimated that 300,000 juvenile cod were not caught as a result of the pilot closures. The scallop industry set up such a system with the help of the University of Massachusetts Dartmouth School for Marine Science and Technology to have scallop vessels voluntarily report their bycatch (O'Keefe & DeCelles 2013). This type of system could work if vessels have an alternative area to fish and maintain target catch rates, since it is naive to think an unobserved vessel will shift fishing areas when it is economically disadvantageous (Alverson et al. 1994, Hall et al. 2000).

Yellowtail caught as bycatch in the scallop dredge fishery can be landed for economic value or discarded. Historically, yellowtail and other flounders were important economic elements of the catch, especially when scallop catches were low (Alverson et al. 1994). In recent years, because of the high value of the scallop catch and the low value of yellowtail flounder, most scallop vessels choose to discard the yellowtail. Captains say it is not worth the cost of handling or the risk of an enforcement violation that can put the scallop catch at jeopardy. Even in 2012, when there was a regulatory requirement to land all legal size fish, the scallop fleet landed 25 mt of GB yellowtail and discarded 139 mt (http://www.nero.noaa.gov/ro/fso/scal.htm). In 2013, the NEFMC reversed course and made it illegal for a scallop vessel to retain GB yellowtail to eliminate any incentive to target the stock.

Clearly, the discard of yellowtail bycatch is wasteful, yet because GB yellowtail is so depleted, it cannot be directly targeted and can only be considered a bycatch species.

Consequently, GB yellowtail has become a choke species—a species that limits the capture of other more abundant targets. Managers use bycatch allocations to encourage the fishermen to reduce their bycatch of yellowtail, and the various fleets compete for quota allocation so they can maximize their landings of the more abundant target species.

The Magnuson–Stevens Fishery Conservation and Management Act requires management measures to minimize bycatch and the mortality of bycatch that cannot be avoided. Today, there is a belief that output controls, such as hard quotas, are needed, and these measures are required as part of management programs. In the case of the scallop fishery, there is a sub-ACL for yellowtail flounder, and when it is exceeded, AM are triggered. Yet, setting reference points, such as allowable biological catch and ACL, is difficult when bycatch is not accurately assessed. Input controls, such as seasonal closures and gear regulations, may be more pragmatic options. The seasonal bycatch survey has allowed NEFMC to develop scientifically based seasonal closures in the scallop fishery from spatially and temporally specific data sets collected for both the target and the bycatch species, thereby achieving effective bycatch reduction objectives for yellowtail flounder.

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