

7.1.5.1.1.6.3 Biological effects

There are three reasons to manage fisheries with minimum size limits:

1. They cause changes in fishing behavior to reduce fishing mortality on small fish, e.g. by causing fishermen to fish in other areas where small fish are less abundant or by reducing the incentive to circumvent mesh regulations.
2. They inhibit the development of markets for small fish, especially when there is a difference in price by size.
3. They cause increases in yield and spawning activity through growth of fish that survive discarding.

Changes in fishing behavior

The most likely fishing sector to avoid small fish and discarding are fishermen that target monkfish. Following implementation of the Monkfish FMP, this group will include any limited access vessel using 10-inch square or 12-inch diamond mesh with trawls, beam trawls, or gillnets. Since up to 70 percent of monkfish landings will come from limited access vessels in the Southern Fishery Management Area (Table 95), a minimum size limit could help to reduce mortality on a large proportion of small monkfish.

During scoping hearings, fishermen that targeted monkfish warned about landings and markets for small fish. They urged the management include a size limit to reduce mortality on small monkfish. Fishermen could not identify specific areas where small monkfish concentrated, but they believed that they could avoid small fish on the fishing grounds by responding to fishing conditions.

A minimum size would also be effective in preventing the development of a day-fishery that targets monkfish and lands them in amounts below the trip limit. A short trip-length fishery may become feasible by small boats in inshore areas. A size limit could make this change less likely if the inshore vessels cannot make enough money on large monkfish.

Fishermen that target other species and land their monkfish bycatch are unlikely to change their fishing behavior unless monkfish revenue is a significant fraction of the trip's value. Fisheries in this category include those targeting roundfish (cod and haddock), flatfish (American plaice, winter flounder, and yellowtail flounder), sea scallops, and summer flounder. Monkfish that are caught by sea scallop dredges are unlikely to survive because of the heavy gear as well as the rocks and shell frequently captured by the gear. Monkfish are also unlikely to survive fisheries that tow for long periods, such as the flatfish fishery in the Gulf of Maine.

Markets for small fish

Prohibiting the landings and possession of small monkfish would prevent price increases for small fish in response to reduced landings of large fish. Monkfish prices vary by size. Increasing prices for small monkfish would reduce the incentive to target larger fish and also would be an incentive for fishermen to circumvent other management measures that could reduce the mortality on small fish. If quotas control catches (non-preferred alternative 1), landings of small rather than large fish would substantially increase overall fishing mortality, because many more small fish are needed to fill a quota.

Discard survival and growth

During development of the proposed management measures, the industry advisors felt that the PDT had used an excessively high discard mortality rate, especially for monkfish catches in the southern management area. The advisors recommended using a 70 percent rate in the northern area and 40 percent rate in the southern area. The advisors pointed out that the only study on monkfish discard mortality was limited and it was conducted only on muddy bottom.

If the industry advice is accurate, the mortality reduction from implementation of a size limit would produce greater mortality benefits. In year 1, the preferred alternative would produce a five percent reduction in mortality (Table 104), rather than four percent that the Councils estimate (Table 99). There are no differences in the north, but the mortality reduction would double in the Southern Fishery Management Area. Similarly, the year 2 mortality reduction would also increase to 12 percent (Table 105), rather than the seven percent Council estimate. In the Southern Fishery Management Area, the mortality reduction could be as much as 27 percent, if the industry advice is a better estimate of discard mortality.

The PDT contacted three scientific experts, familiar with monkfish caught in mobile gear, to get their advice about discard mortality. The PDT contacted Dr. William DuPaul of the Virginia Institute of Marine Science, Dr. Joseph DeAlteris of the University of Rhode Island, and Mr. Arnie Carr of the Massachusetts Division of Marine Fisheries. All three advised that the 40% mortality rate, recommended by the advisors for the Southern Fishery Management Area, was too low. They also saw no reason to suspect that discard mortality would be any different on sandy bottom, characteristic of the southern area, than on muddy bottom, characteristic of the northern area. At a minimum, they felt that the 70 percent rate for mobile gear was appropriate, and that discard mortality could be higher, depending on the type of gear used, the length of tow, and the season. Dr. DuPaul had furthermore submitted a letter to the Councils about his extensive observations aboard boats using scallop dredges and trawls.

The PDT recommended that a 70-80 percent discard mortality rate for mobile gear is the most appropriate level to use for estimating impacts, but also included the expert advice of the industry advisors in the PDT evaluation of size limits. Both industry and scientific advisors agreed that a 70 percent discard mortality rate for trawls is appropriate in the northern area.

The preferred alternative includes a 14-inch minimum tail length in the Southern Fishery Management Area because the majority of monkfish will be able to spawn at least once prior to capture. About 75 percent of monkfish are mature at 18.5 to 21.4 inches total length (Table 103). Monkfish at this size yield a tail that is 12.3 to 14.3 inches long. Higher minimum sizes to allow more spawning would not have the same amount of benefits as the proposed increase from 11 to 14 inches. A greater size increase would be necessary to allow for 100 percent of monkfish to mature before becoming vulnerable to fishing.

Table 103. Monkfish maturity ogive, derived from NEFSC (1992).

	Proportion of Females Mature								
	50 percent			75 percent			99 percent		
	Total	Tail	Age	Total	Tail	Age	Total	Tail	Age
Northern area	18.0	12.0	3-3½	21.4	14.3	4	28.8	19.4	6
Southern area	16.0	10.6	3½-4	18.5	12.3	4½-5	24.5	16.4	6½-7

Monkfish grow from the current minimum size (11-inch tail length) to the proposed size limit (14-inch tail length) in about 13 months (Table 106). Monkfish at this size grow rapidly and would be vulnerable to discarding

over a short period. While these fish gain about 90 percent in tail weight, about 20 percent would be lost through natural mortality and some will die from discarding. Even if fishermen discarded all the undersized fish that they currently catch (i.e. the size limit and other management measures cause no changes in fishing behavior), the net gain in yield per recruit would be positive whenever discard mortality rate was below 30 percent (Figure 34).

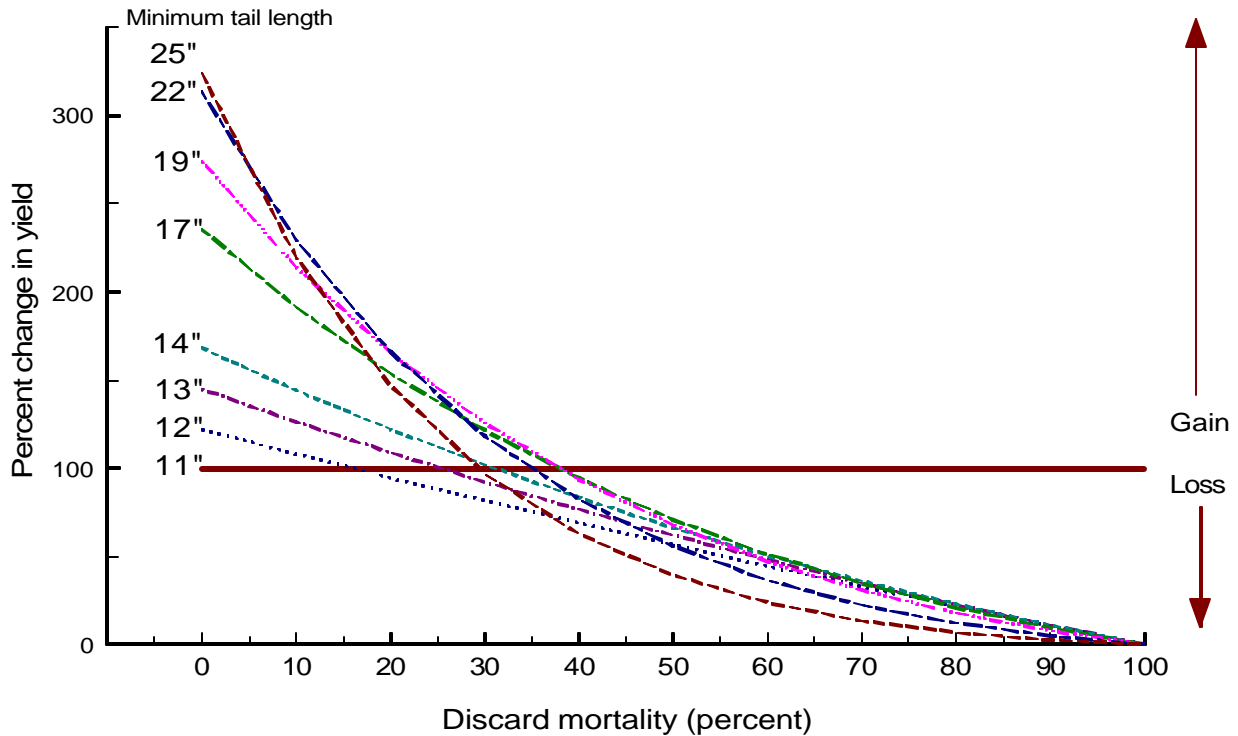


Figure 34. Gain or loss in yield-per-recruit (tail-weight) caused by growth and discard mortality at minimum size options, expressed as tail-length. The increase in landings is highest when discard mortality is low. Losses in yield occur in all cases when discard mortality is more than 40 percent. The lowest size limit that produces gains at the highest mortality rate is a 17-inch minimum tail-length

A higher minimum size would produce different marginal gains in yield (Figure 34) or spawning because monkfish would undergo more natural mortality and discarding while growing larger. A 19-inch minimum tail length would be required to ensure maturity of 100 percent of monkfish prior to becoming vulnerable to fishing. Another 25 percent of immature monkfish would be able to spawn if they were allowed to grow to this larger size. Because growth slows with age, monkfish in this size range would take another two years to reach the higher, alternative limit. Monkfish would grow from the current minimum size to 28 inches total length (19-inch tail) in about 38 months (Table 106). During this time, monkfish would gain about 380 percent in tail weight but 50 percent would die from natural causes and others would die from discarding. Discard mortality would have to be less than 38 percent to realize a net gain in yield per recruit. Coincidentally, the delayed harvest of existing small monkfish would delay the economic benefits, reducing the net present value of those future gains.

Table 104. Estimated mortality reduction from the survivors of discarded monkfish due to an 11-inch minimum size limit in all areas. The Industry Advisory Committee recommended the discard mortality rates in December 1997.

Gear	Total Landings (mt)		Percent of Total		Percent of landed number below size limit		Discard mortality rate		Fraction of catch surviving		
	North	South	North	South	North - 11"	South - 11"	North	South	North	South	
Fish Trawl	10,672	4,290	63%	48%	16%	12%	70%	40%	5%	7%	
Scallop Dredge	3,768	1,356	22%	15%	14%	29%	70%	40%	4%	17%	
Gillnet	2,537	3,138	15%	35%	2%	1%	70%	40%	1%	1%	
Other	48	144	0%	2%	0%	0%	70%	40%	0%	0%	
Total	17,026	8,928						Mortality reduction:		4%	6%
									All areas:		5%

Table 105. Estimated mortality reduction from the survivors of discarded monkfish due to an 11-inch minimum tail length in the Northern Fishery Management Area and a 14-inch minimum tail length in the Southern Fishery Management Area. The Industry Advisory Committee recommended the discard mortality rates in December 1997

Gear	Total Landings (mt)		Percent of Total		Percent of landed number below size limit		Discard mortality rate		Fraction of catch surviving		
	North	South	North	South	North - 11"	South - 14"	North	South	North	South	
Fish Trawl	10,672	4,290	63%	48%	16%	61%	70%	40%	5%	36%	
Scallop Dredge	3,768	1,356	22%	15%	14%	65%	70%	40%	4%	39%	
Gillnet	2,537	3,138	15%	35%	2%	15%	70%	40%	1%	9%	
Other	48	144	0%	2%	0%	0%	70%	40%	0%	0%	
Total	17,026	8,928						Mortality reduction:		4%	27%
									All areas:		12%

7.1.5.1.1.6.4 Data source

The size distribution of current monkfish catches was estimated from sea sampling data collected during 1992 and 1993. A second estimate of the monkfish catch size-frequency was made using 1995-1996 data to reflect the potential effects of recent management. The 1992-1993 time period was before states began enforcing an 11-inch tail-length size limit. Discarding small monkfish during this time period was, therefore, the result of poor markets for small fish or other fishing conditions. During 1995-1996, 11-inch minimum size landings limits were in effect in NH, MA, RI, CT, NY, and NJ. Changes due to implementation of Multispecies Amendment 5 and Scallop Amendment 4 are also reflected in the more recent data.

For the 1992-1993 period, it was possible to stratify the sea sampling data by gear, area, and monkfish targeting to expand observations and estimate total monkfish landings and discards. The stratification included two areas, northern and southern. Trips that targeted monkfish included those where monkfish landings were more than 50 percent of the total from all species. Sea sampling from other years was not used because sampling intensity was low or data were unavailable. The sea sampling observer program began in 1988, but few trips with monkfish catches were observed until 1992, especially for directed trips. Sea sampling data for 1995-1996 were stratified only by monkfish management area and gear, because sea sampling intensity declined.

7.1.5.1.1.6.5 Distributional impacts

The present catch and discard patterns differ by gear, area, and targeting. Fishermen using certain gears tend to catch larger fish. Part of this size difference by gear type may be explained by segregated fishing by area and bottom type. On the other hand, there is anecdotal evidence that certain gears catch larger monkfish (or at least do not catch smaller monkfish) than others working in the same area. The current monkfish size-frequency distribution for catch and landings are summarized below by gear type (Section 7.1.5.1.1.6.6). As a result of these differences, there will be different impacts on fisheries using each gear. In some cases, fishermen that target monkfish may use different gear, avoiding discards and improving their efficiency to catch larger fish. A more in-depth explanation of these possible effects is given above in Section 7.1.5.1.1.6.1.

Fish size differences in the catch may also be caused by differential size distribution by area. During recent years, there has been a notable increase of small fish captured by research surveys in the northern area. This observation point to above average recruitment and the sea sampling observations would be affected by this condition. These differences by area are not very meaningful in terms of management impact, because conditions may change. Recruitment may worsen in the northern area and improve in the southern area, making an assessment of geographic impacts of the size limit meaningless. On the other hand, the estimator was stratified by area so that the proper expansion coefficients were used to estimate the size-frequency distributions of total landings.

Table 106. Time in months to grow from a tail-length equivalent to another larger size. Monkfish at the present minimum size (11-inches in most states) will require 13 months to grow to the proposed 14-inch minimum size. The table show the number of months that would be required for monkfish to grow between various minimum size alternatives. To determine the length of time required for a monkfish having a tail measuring nine inches (34.8 cm total length) to grow to a tail length of twelve inches (45.9 cm total length), choose the cell at the seventh column (9 inches tail, current landed size) and the eleventh row (12 inches tail, target minimum size).

Target Minimum Size		Current Landed Size																			
Total Length (cm)		20.0	23.7	27.4	31.1	34.8	38.5	42.2	45.9	49.6	53.4	57.1	60.8	64.5	68.2	71.9	75.6	79.3	83.0	86.7	90.4
Total Length (cm)	Tail Length (in)	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
20.0	5	0																			
23.7	6	3	0																		
27.4	7	7	4	0																	
31.1	8	11	7	4	0																
34.8	9	14	11	7	4	0															
38.5	10	18	15	11	8	4	0														
42.2	11	22	19	15	12	8	4	0													
45.9	12	26	23	19	16	12	8	4	0												
49.6	13	31	27	24	20	16	12	8	4	0											
53.4	14	35	32	28	24	21	17	13	9	4	0										
57.1	15	40	36	33	29	25	21	17	13	9	5	0									
60.8	16	44	41	37	34	30	26	22	18	14	9	5	0								
64.5	17	49	46	42	39	35	31	27	23	19	14	10	5	0							
68.2	18	54	51	47	44	40	36	32	28	24	19	15	10	5	0						
71.9	19	60	56	53	49	45	42	38	33	29	25	20	15	10	5	0					
75.6	20	65	62	58	55	51	47	43	39	35	30	26	21	16	11	6	0				
79.3	21	71	68	64	61	57	53	49	45	41	36	32	27	22	17	11	6	0			
83.0	22	77	74	70	67	63	59	55	51	47	42	38	33	28	23	18	12	6	0		
86.7	23	84	80	77	73	69	66	62	57	53	49	44	39	34	29	24	18	13	6	0	
90.4	24	91	87	84	80	76	72	68	64	60	56	51	46	41	36	31	25	19	13	7	0
94.1	25	98	94	91	87	83	80	76	71	67	63	58	53	48	43	38	32	27	20	14	7

Fishermen that target monkfish may also be able to avoid areas with small monkfish. Some fishermen that commented about the possible management of monkfish indicated that small fish could be avoided, but specific areas with concentrations of small fish could not be defined in advance (possibly making area closures effective). To some extent, the evidence from sea sampling data bears this out. The current monkfish size-frequency distribution for catch and landings are summarized below (Section 7.1.5.1.1.6.7) for trips with monkfish bycatch and for trips targeting monkfish.

Fisheries that catch monkfish as a bycatch will be less likely to try to avoid small fish. On the other hand, fishermen targeting monkfish will not be able to land small fish and will, if conditions are right, seek areas where larger fish are more abundant and smaller fish are less abundant. SAW 14 (NEFSC 1992) attempted to address this issue through a thorough examination of the research survey data. With the exception of areas too deep for the survey gear, the research survey randomly samples locations throughout the range of monkfish. The SAW noted some differences in seasonal distribution of fish. With regard to immature and mature fish, the research survey showed few areas where the distribution of these size groups was different. On a finer resolution and during unsampled seasons, however, fishermen may be able to identify pockets of larger fish and avoid discarding smaller ones.

7.1.5.1.1.6.6 Size frequency distribution by gear

Gillnets

Gillnets generally catch larger monkfish and would have the lowest impact from a 14-inch minimum size. The mean length of monkfish caught on sea sampled trips in 1992-1993 was 67 cm total length, or nearly an 18-inch tail (Figure 35). Twenty-seven percent of gillnet-caught monkfish are less than the proposed minimum size, and ten percent of these sub-legal fish are currently discarded. The sublegal component of gillnet catch would total about 10 percent, by weight.

The size-frequency distribution of gillnet-caught monkfish did not appear to change in 1995-1996. Only two percent of the landed fish are less than the proposed 11-inch size limit in the Northern Fishery Management Area (Figure 37, lower panel). In the Southern Fishery Management Area (Figure 38, lower panel), only one percent of landed monkfish is below the 11-inch size limit, but about 15 percent is below the proposed 14-inch size limit for year 2. Very little change in the lengths of discarded and landed catches appear to have occurred between 1992 and 1995.

It is unknown how well that fishermen that target monkfish with gillnets in the Southern Fishery Management Area will be able to avoid catching the smaller fish. Some gillnet fishermen have advised that gillnet mesh is effective in selecting larger monkfish, but the mechanism of how this would occur is unclear. Monkfish gillnets are tied-down and capture the fish by wrapping them in the net, rather than by gilling. Most gillnet fishermen in the southern area already use 12-inch mesh, rather than 10-inch mesh that will be allowed under the FMP.

The survival rate for small monkfish in gillnets is unknown. It may vary by season and frequency of net hauling. The larger fish size in gillnets can be partially attributed to when and where fishermen use gillnets. Gillnet fishermen often target monkfish when they are making short, seasonal migrations, often to spawn. Larger fish are more likely to be spawning and they may as a result be moving further than their smaller counterparts. There are no migration studies to validate or refute this hypothesis.

On the other hand, fishermen have reported that gillnets catch larger monkfish than trawls or scallop dredges operating in the same areas. This apparent difference in selectivity may be due more to the ability of large fish to respond and escape from mobile gear than do smaller fish. No estimates of monkfish selectivity by gillnets are available.

Trawls

The majority of trawl sea sampling data during 1992-1993 come from vessels using regulated mesh, then 5 inches square or diamond. Most of trawl catches would be smaller than the proposed 14-inch size limit, but 59 percent of those fish are currently discarded (Figure 35, upper panel). The size limit, therefore, would cause fishermen to discard 46 percent of monkfish that are currently landed or 40 percent by weight.

During 1995-1996, most vessels catching monkfish with trawls were either targeting other species with 6-inch mesh trawls, or targeting monkfish with trawl mesh that was at least 8 inches. During late 1996, a framework to the Multispecies FMP required vessels that target monkfish along the continental shelf edge of Southern New England to use 8-inch mesh to reduce groundfish bycatch.

The size-frequency estimates for trawl-caught monkfish in both areas show signs of good recruitment. In the Northern Fishery Management Area (Figure 37, upper panel), the bulk of the catch occurs at 25 to 40 cm total length, reflecting the high recruitment that has been observed for several recent years in the research survey data (NEFSC 1997). In the Southern Fishery Management Area (Figure 38, upper panel), there appears to be a strong year-class that was about 24 to 28 cm total length. In both cases, nearly all of the newly recruited fish were discarded. The 1992-1993 period was sparsely sampled for trawl-caught monkfish, so it is difficult to say if the size-frequency of landings or discards has recently changed.

In the Northern Fishery Management Area (Figure 37, upper panel), nearly all the discarded fish are less than the proposed size limit and only 16 percent of the landings (by number of fish) would be discarded under the size limit. It was possible to land undersized fish caught in the northern area, because ME has no monkfish size limit. The proposed 11-inch size limit, therefore, is very consistent with the current culling practice caused by market conditions and liver yield.

On the Southern Fishery Management Area (Figure 38, upper panel), nearly all of the catch below the proposed 11-inch minimum size is discarded by vessels using trawls. Only 12 percent (by number of fish) of the landings would be discarded with the 11-inch minimum size. Either due to the 11-inch size limit that is effective in most bordering states or due to market conditions and liver yield, the 11-inch minimum size limit approximates the status quo. After May 1, 2000, the proposed 14-inch minimum size will cause trawl vessels to discard considerably more monkfish. In fact 61 percent of current landings (by number of fish) would be discarded. A significant fraction of monkfish caught by trawls in the southern area are targeted, so the vessels may be able to avoid catching small monkfish or it might be uneconomic to target monkfish until they re-recruit to the new minimum size.

About 20 percent of the trawl landings occur from a fishery that targets exclusively monkfish, so the above fractions overestimate the amount of discards that would occur in the trawl sector. Another large fraction of the trawl-caught monkfish landings occurs from fisheries that target monkfish and a mix of other species. The entire former group and some of the latter group are expected to seek other fishing areas where large monkfish are more prevalent. The remaining proportion of trawl-caught landings occurs from fisheries where monkfish is a bycatch. Some of these fish are currently discarded because the fishermen are targeting other species. Monkfish landings of fish less than the proposed size limit would, however, be discarded. When small monkfish account for a small fraction of the total landings, it is unlikely that fishermen will move to other areas to avoid discarding small monkfish.

If monkfish survival is reasonably high, then trawlers would be able to retain more larger monkfish when the survivors grow beyond the minimum size. On the other hand, discards caused by the size limit will initially be an appreciable proportion of monkfish catches taken by trawls, especially when monkfish are caught as a bycatch to

other species. The anticipated benefits from surviving fish will, of course, vary with discard mortality. This effect is explained in the section above.

Scallop dredges

Scallop dredges appear to catch more small monkfish than other gears. The mean size of monkfish in dredges is 29.7 cm, or 11.7 inches tail length during 1992-1993. In 1995-1996, the mean size of landings was 13 to 13½ inches tail-length. Discards averaged 9 to 9 ½ inches in tail-length equivalent. Even though no size limits were in place prior to 1994, scallopers discarded 39 percent of their monkfish, presumably due to the likely price they would receive for monkfish compared to what they could make using their time to process scallops. Of the monkfish that are presently landed, scallop dredges would discard 31 percent of their monkfish (Figure 35, middle panel), or 27 percent by weight.

During 1995-1996, scallop dredges had nearly the same size-frequency of discards and landed monkfish as they had during 1992-1993, before state size limits. With an 11-inch minimum tail-length limit, scallopers the fish in the Southern Fishery Management Area would be forced to discard 29 percent (by number of fish) of the monkfish that are currently landed (Figure 38, middle panel). This fraction is very uncertain because the landing of monkfish tails less than 11-inches appears to be sporadic and poorly sampled. After May 1, 2000, scallopers would be forced to discard 65 percent (by number) of monkfish that are currently landed. Discard survival of these fish are believed to be low, because the monkfish epidermis is often nicked, abraded, and cut in the heavy scallop dredges.

The size selectivity of small fish by dredges may be no worse than for trawls, but large fish may be more successful in avoiding a noisy, narrower dredge (compared to a trawl). Dredges may, therefore, appear to catch smaller monkfish than other gears, when they may be just simply catching fewer large fish.

7.1.5.1.1.6.7 Size frequency of bycatch versus targeted catch

Trips that target monkfish (aka "Directed") tend to catch larger monkfish than trips where monkfish is a bycatch (Figure 36). Conversely, trips that target monkfish appear to keep a greater proportion of small fish (between 8 and 13 inches tail length). On directed trips, about 76 percent of monkfish would be less than the 14-inch size limit. The weight of fish between the current minimum size (11") and the proposed minimum size (14") is 29 percent of current landings. A greater proportion of the estimated future discards are already discarded in the present bycatch fishery, 12 percent (Figure 36, lower panel) versus 3 percent in the directed fishery (Figure 36, upper panel). Of the monkfish that vessels currently land, the size limit would make fishermen discard 37 percent of the fish currently landed in the directed fishery, or 29 percent by weight. The percent of current landings in this fishery sector that would be discarded is 38 percent, or 32 percent by weight. The total number of fish captured as bycatch, however, is nearly seven times the number of fish caught on trips targeting monkfish, however. Since 1993, the proportions of fish caught as a bycatch have declined compared to the targeted catch because of effort reductions in other fisheries and improving markets for monkfish.

When expressed as a proportion of the catch, the proposed size limit would have a larger impact on the directed fisheries. Without changes in fishing patterns, the fisheries that target monkfish would discard about 50 percent of their catch by weight. The intent of the size limit, however, is to induce fishermen to seek larger fish in areas where small monkfish are less abundant. The directed fishery is the most likely group to shift effort away from small fish due to a size limit.

Conversely, the fisheries that capture monkfish as a bycatch are targeting other species and would be less likely to fish elsewhere to avoid discarding monkfish. This outcome is indicated by existing data that shows the majority of fish smaller than the proposed minimum size are already discarded. The benefits of the minimum size that would be derived from this fishery rely mainly on the survival rate from discarding. No formal studies of

discarding survival are available, but anecdotal evidence suggests that the survival rate varies by season, gear of capture, and handling on deck.

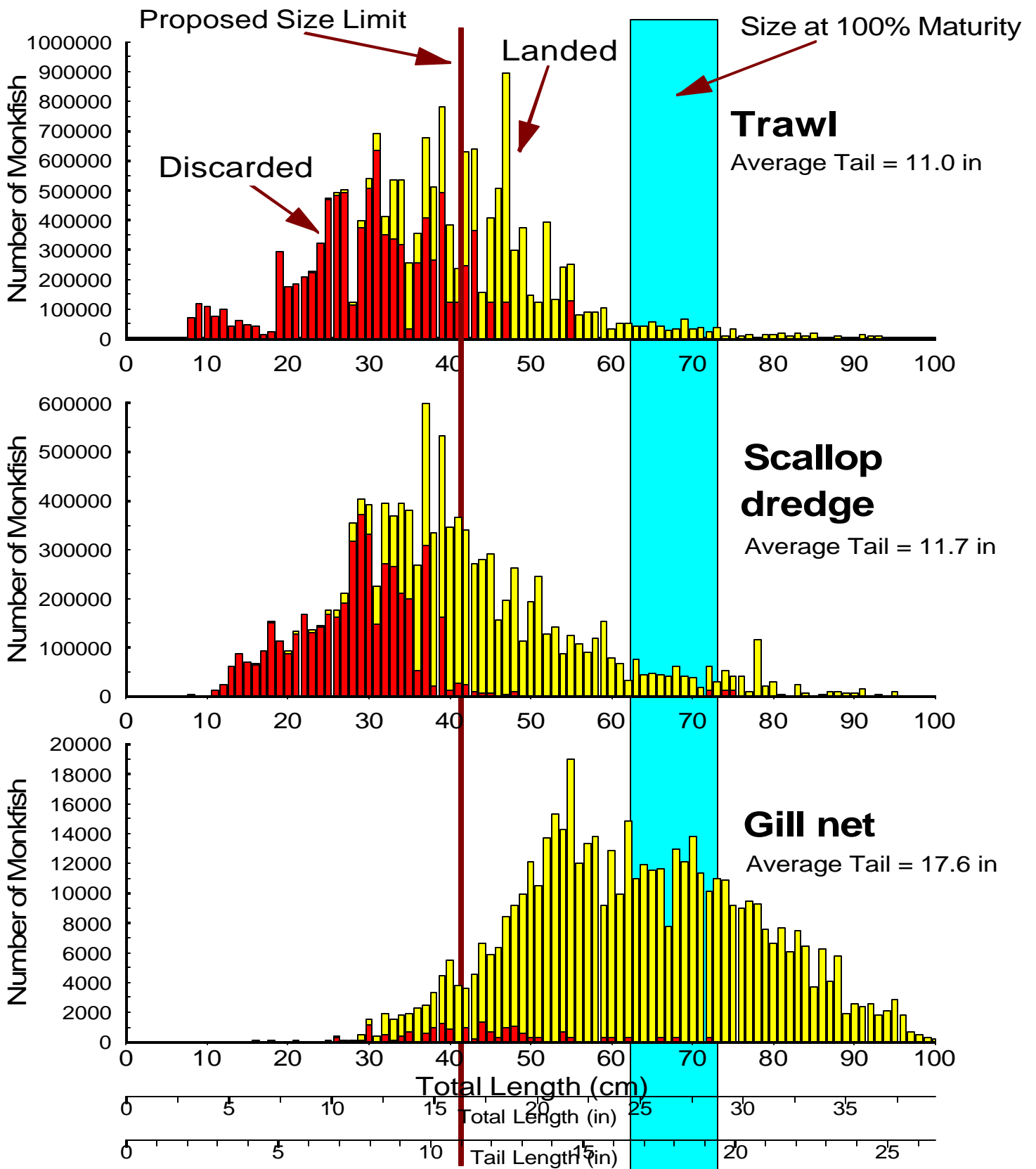


Figure 35. Northern and Southern Fishery Management Areas combined: Total length size-frequency of monkfish catch by gear of capture compared to tail length and size at maturity. Size frequency estimates were extrapolated to total landings from 1992-1993 via post-stratification of sea sampling data by gear, area, and directivity.

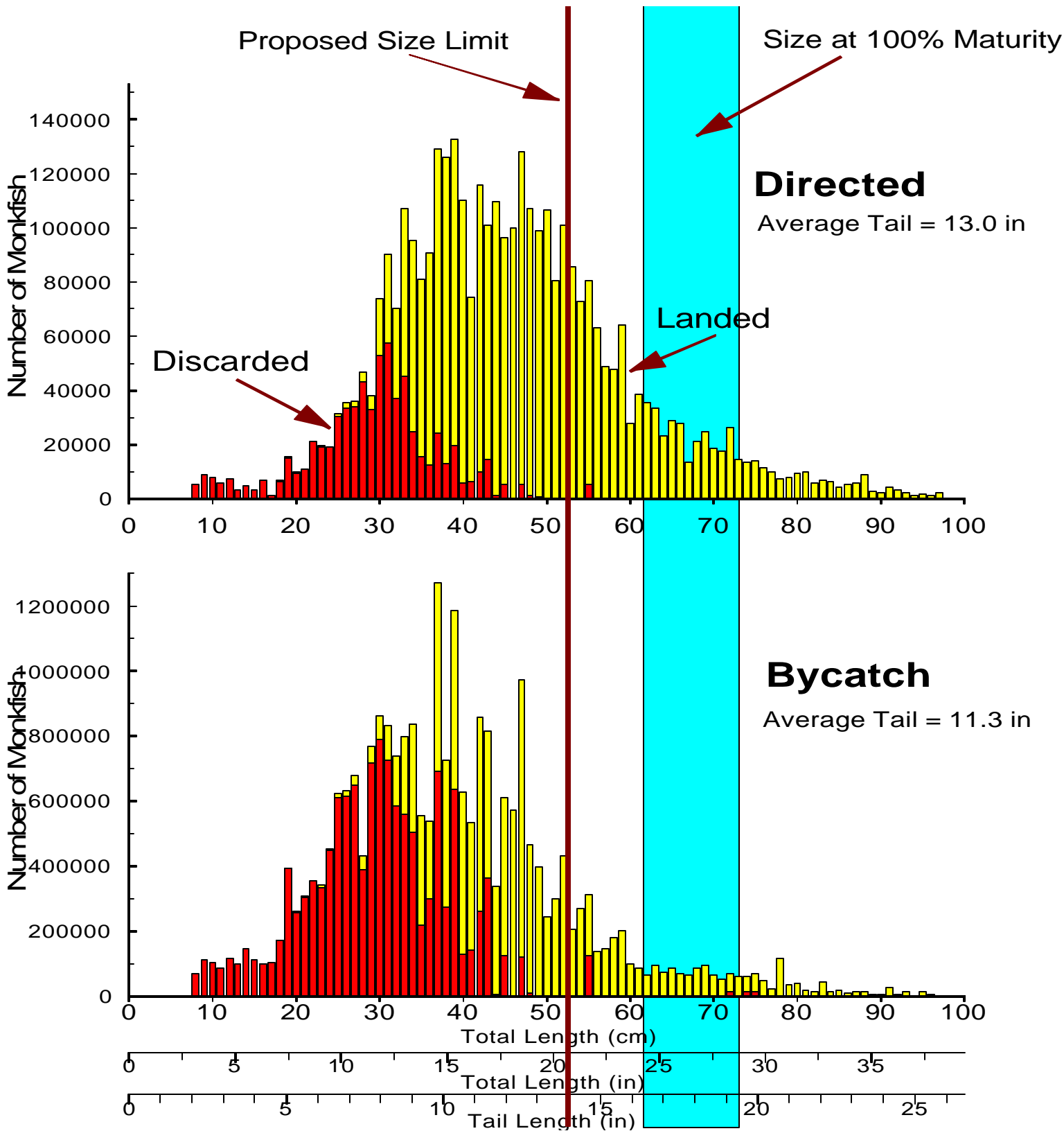


Figure 36. Northern and Southern Fishery Management Areas combined: Size-frequency of monkfish catch by directivity for monkfish compared to tail-length and size-at-maturity. Size-frequency estimates were extrapolated from 1992-1993 sea sampling data via post-stratification by gear, area, and directivity. 'Directed' trips were those that had greater than 50 percent of total revenue from the landings of monkfish.

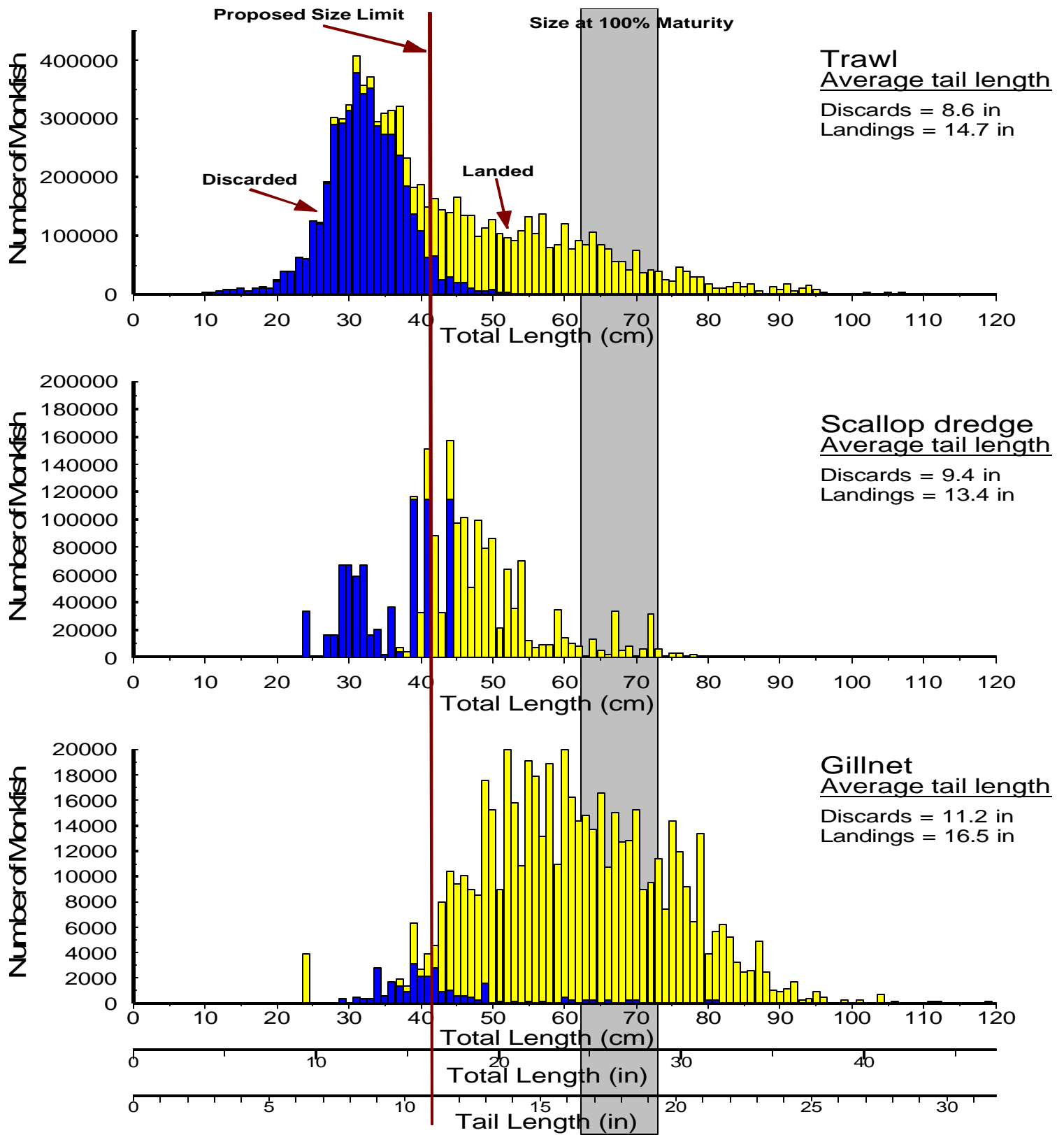


Figure 37. Northern Fishery Management Area: Total length size frequency of monkfish catch by gear of capture compared to tail length and size at maturity for fishing effort. Size frequency estimates were extrapolated to total landings from 1995-1996 via post stratification of sea sampling data by gear and monkfish management area.

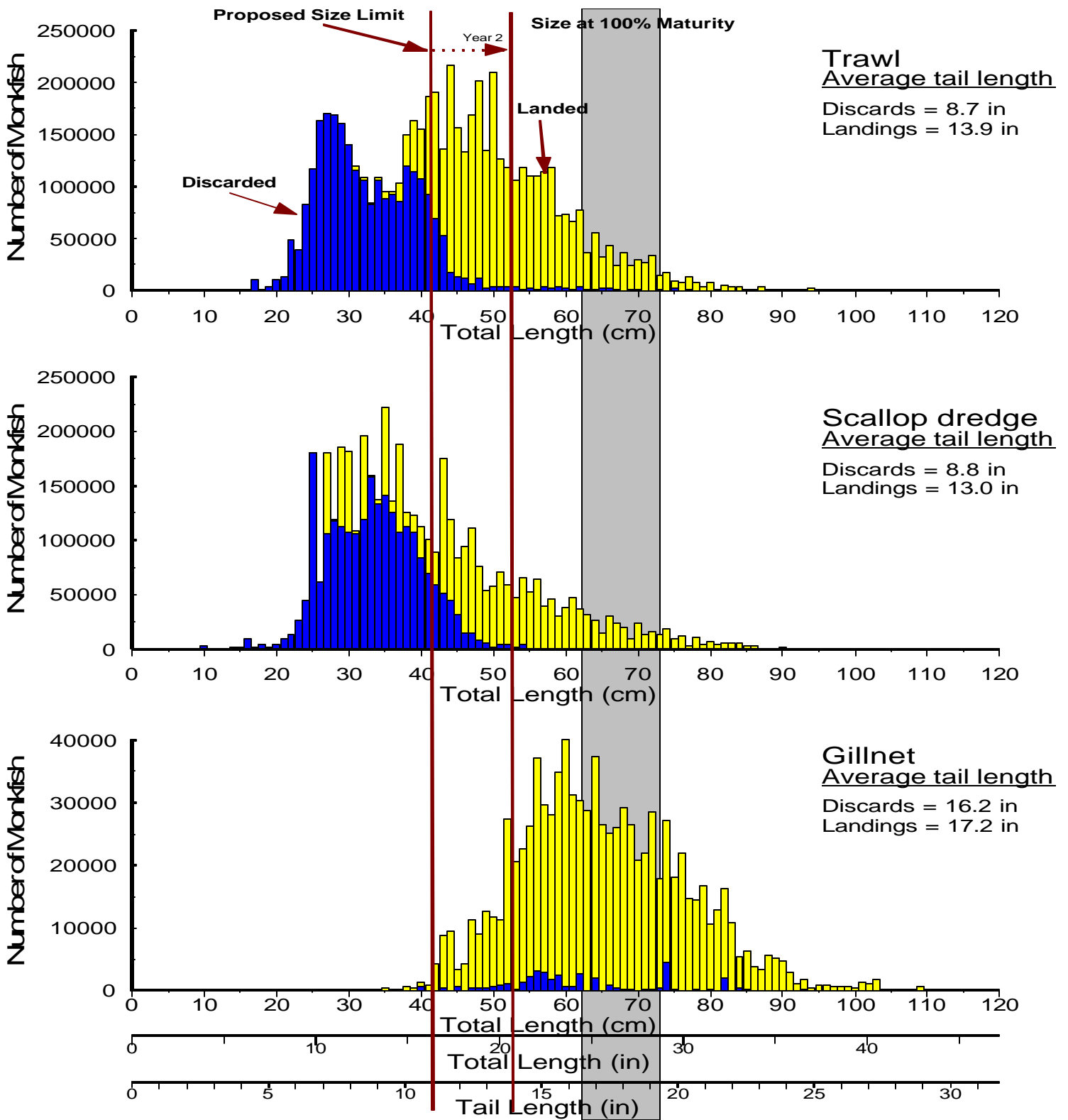


Figure 38. Southern Fishery Management Area: Total length size frequency of monkfish catch by gear of capture compared to tail length and size at maturity for fishing effort. Size frequency estimates were extrapolated to total landings from 1995-1996 via post stratification of sea sampling data by gear and monkfish management area.

7.1.5.1.1.7 *Limits on landings of livers*

The demand for monkfish livers has been very high, creating a significant incentive to increase fishing effort. The average 1995 price for monkfish livers was \$5.00 per pound with liver landings in excess of 1,100,000 pounds (

Figure 19). Although fishermen often had difficulty selling small monkfish tails associated with liver landings, a management induced incentive to discard valueless fish did not exist. Under a size limit, however, fishermen forced to discard small, undersized fish could cut and land livers from discarded fish. Such a response would eliminate the benefit of a minimum size.

Rationale for the 25% liver to tail landings ratio

The purpose of a limit on liver landings is to allow normal liver landings from legal size fish while not creating an incentive to cut livers from undersized fish. An analysis of 1992 landings shows that the majority of trips had liver to tail landings ratios below 25%. The median liver to tail ratios are approximately 14% for all states, except New Jersey and Maryland. The median ratio in New Jersey is about 18%. Notable exceptions to these trips occur in New Hampshire, Massachusetts, New Jersey, and Maryland. The data indicating high liver ratio trips occur for two possible reasons. Certain vessels may have retained only monkfish livers and had no market for monkfish tails. Alternatively, the monkfish tails might have been sold through dealers that did not participate in the weighout system. There were, however, trips with recorded monkfish tail landings and liver ratios in excess of 50%. A 25% liver to tail landings ratio limit would, in all but a few cases, allow the normal landings of livers from legal sized fish. Higher limits would allow a larger proportion of trips to cut and land the livers from discarded monkfish.

If fishermen are currently landing livers and discarding monkfish, the liver ratio limit could reduce liver landings. If monkfish livers were landed during 1992 without the associated tails (Case A, Table 107), then the potential impact on ex-vessel revenue is \$72,758 or 2.8%. Massachusetts and New Jersey would suffer the greatest adverse impact. If vessels having trips with only liver landings in the weighout data base actually landed their monkfish tails where they were not recorded (Case B, Table 107), then the potential impact is estimated to be \$41,436 or 1.6%. New Jersey, Rhode Island, Massachusetts, and Maine would be the most severely impacted, respectively.

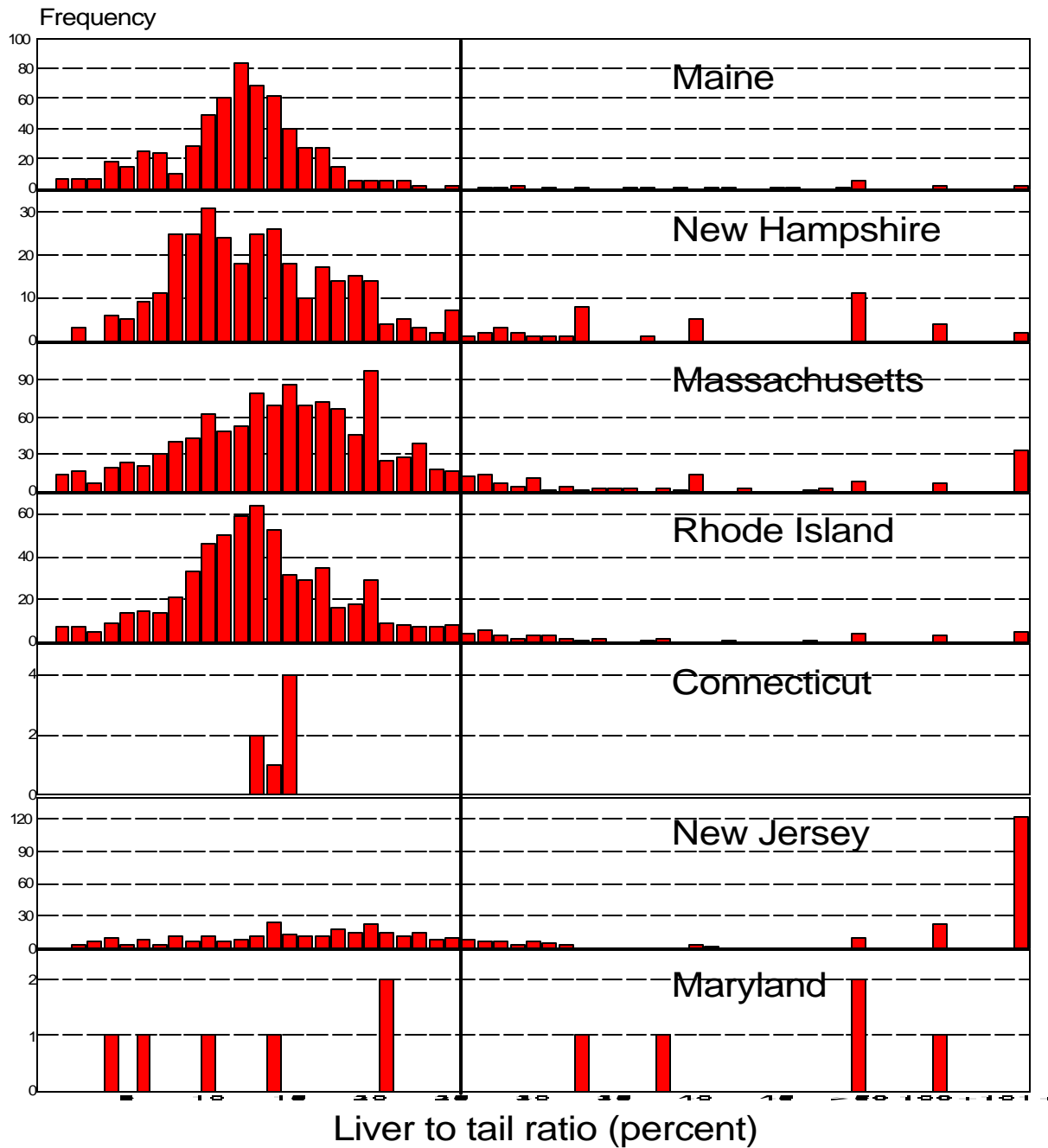
The proposed liver landing ratios--25 percent of tail landings and 10 percent of whole or round fish (live-weight equivalent)--could change landings and onboard processing practices in several ways increase landings in order to maintain monkfish revenues and to compensate for scheduled cutbacks in other fisheries, particularly groundfish and sea scallops. During 1994 and 1995, approximately 10 to 50 percent of all fishing trips reporting monkfish landings exceeded the 25 percent livers-to-tails ratio, the highest incidence being by sink gillnet fishermen. In addition, about 30 to 100 percent of the trips reporting liver landings exceeded the 10 percent livers-to-round fish ratio. To comply with the liver landings regulations, fewer livers would have been landed or tail or round fish landings would have been higher, depending also on possession limits (Section 3.6.1). Similarly, trips falling under the ratio limits could have increased liver landings. Finally, the high percentages associated with the 10 percent liver-to-round fish ratio are largely due to relatively few trips landing whole or round fish; therefore, the ratios also provide an incentive to increase landings of whole or round fish until the 10 percent liver-to-live weight limit is reached.

Table 107. Potential impact on ex-vessel revenues from a 25% liver to tail landing limit based on 1992 weighout data. Case A imposes the liver limit on all trips that had liver landings exceeding 25 percent of the landed tail weights. Case B excluded trips where only livers were landed according to the NMFS weighout data.

	Case A 25% Liver Landings Limit on All Trips		Case B 25% Liver Landings Limit on All Trips Landing Monkfish Tails	
	Ex-vessel Revenue	Percent	Ex-vessel Revenue	Percent
Maine	\$6,943	1.8	\$6,827	1.8
New Hampshire	794	5.8	734	5.3
Massachusetts	22,669	3.0	7,587	1.0
Rhode Island	8,468	1.6	8,024	1.5
Connecticut	0	0	0	0
New York	0	0	0	0
New Jersey	24,368	8.0	15,830	5.2
Delaware	0	0	0	0
Maryland	53	19.8	53	19.8
Virginia	9,463	12.7	2,381	3.2

Monkfish Liver Landings

Proportion of Landings of Tails and Whole Fish



100+ - Liver landings greater than fish landings

101+ - Only livers landed

Source: 1992 NMFS Weighout Data

Figure 39. Ratio of liver landings to landings of monkfish tails and whole fish by trip, 1992.

7.1.5.1.1.8 *Gear limits*

7.1.5.1.1.8.1 Minimum mesh size for trawls operating in monkfish limited access fisheries

Although vessels in the limited access fishery would be required to use 10-inch square or 12-inch diamond mesh or larger to target monkfish, they would have to participate in an exempted fishery. The main reason to require very large mesh for targeting monkfish is to reduce the groundfish bycatch below the five percent tolerance. The FMP does not call for any initial changes to the exempted fishery, because the groundfish bycatch for vessels using 10-inch square mesh in the Gulf of Maine or on Georges Bank is unknown.

Monkfish mesh selectivity with these large mesh nets is unknown, but they could have a beneficial effect on monkfish size selection. The body shape of monkfish is, however, prevents even large changes in minimum mesh size from substantially improving monkfish selectivity. The preferred alternative, therefore, relies more on ceilings for total landings, days-at-sea restrictions, trip limits, and size limits to reduce fishing mortality.

7.1.5.1.1.8.2 Gillnet limits

Gillnet minimum mesh

The 10-inch minimum mesh requirements will not be restrictive for many vessels targeting monkfish. Most vessels, especially in the Mid-Atlantic use 12-inch mesh in the monkfish fishery and are unlikely to change to a smaller mesh because they catch more unwanted bycatch. Vessels targeting monkfish in the Gulf of Maine tend to use smaller mesh, possibly because they use mesh with thinner twine. Although the Monkfish FMP allows for 10-inch mesh in all areas, the Councils anticipate new regulations to protect harbor porpoise in the Mid-Atlantic area. These regulations will require a larger minimum mesh and a minimum twine thickness, at least during critical seasons and in critical areas. These harbor porpoise regulations are unlikely to change the fishery for monkfish, except to prevent gillnets that are customarily used in New England to be used in the Mid-Atlantic where they have had a higher marine mammal encounter rate.

The other non-groundfish fishery that fishermen use gillnets in offshore waters is for spiny dogfish. The minimum mesh regulations in the Monkfish FMP are unlikely to affect the spiny dogfish fishery, because that fishery is segregated from the monkfish fishery has very little monkfish bycatch. The 50-pound per trip small mesh bycatch allowance will be sufficient to land the small amount of monkfish bycatch in the spiny dogfish fishery. Other inshore gillnet fisheries do not appear to catch many monkfish although some fishermen use different nets to target monkfish and other species during a single trip. This limited practice will not be allowed under the Monkfish FMP because it would raise enforcement costs to unacceptable levels.

Sea sampling data for 1995 and 1996 indicate that vessels targeting monkfish used gillnet mesh averaging 9.9 inches in the Gulf of Maine, 11.6 inches in Southern New England, and 11.5 inches in the Mid-Atlantic (

Table 108). Vessels targeting spiny dogfish used gillnet mesh averaging 6.6 inches in the Gulf of Maine, 7.2 inches in Southern New England, and 6.8 inches in the Mid-Atlantic. These data show that the spiny dogfish gillnet fishery is prosecuted with smaller mesh, on average, than the mesh fishermen use to target monkfish.

Table 108. Average gillnet mesh size for vessels targeting monkfish or spiny dogfish. Targeting, in this case, was defined as trips with landings above 50 percent of the total landings by weight. Source: NEFSC sea sampling program, 1995- 1996.

<i>Area</i>	<i>Target species</i>	
	<i>Monkfish (> 50% of total landings)</i>	<i>Spiny dogfish (> 50 percent of total landings)</i>
<i>Gulf of Maine</i>	9.9	6.6
<i>Southern New England</i>	11.6	7.2
<i>Mid-Atlantic</i>	11.5	6.9

Rationale for a net cap

Net controls have been considered by the New England Council as a way to control the proliferation of fishing gear in response to other restrictive multispecies management measures. Without controls on the number of nets, days-at-sea limits and closed areas would be only partially successful in controlling fishing mortality generated by gillnet vessels. Many of the proposals for managing groundfish are based on controlling the total fishing power of mobile gear, without recognizing that gillnet gear could fish harder without the vessel being at sea for equally longer periods.

Many of the issues that the Council examined for multispecies management are apropos to the monkfish gillnet fleet. Due partly to technical difficulties in designing a net reduction program, the Council is has amended the multispecies plan to establish a system of net caps combined with days-at-sea reductions. Since the preferred alternative includes days-at-sea limits, the New England and Mid-Atlantic Councils are proposing a similar system for the monkfish gillnet fishery. The Councils' intent on capping the number of nets is to:

- Prevent uncontrolled increases in the number of nets used by vessels in response to limitation on days-at-sea, and

- Establish, over time, standardization in numbers of nets in use that could be used in the future as a measurable adjustable component of an effort reduction program in addition to days-at-sea limits.

The Councils recognize that a net cap may result in a reduction for some segments of the fleet and may allow for an increase in nets used by other segments of the fleet. The Councils are proposing a limit of 160 monkfish nets in the water at one time. Although this limit was selected based on advice of monkfish gillnet advisors in the Mid-Atlantic region, industry practice in other areas is to fish more nets less frequently. The Councils recognize that fishermen use different methods to fish monkfish gillnets and the amount of nets that fishermen use vary widely. As a result of public comment, the Council raised the preferred net cap taken to public hearing to 160 nets. The intent is to establish a limit that will be effective in limiting the size of the potential increase in nets as a response to other restrictive limits on fishing activity. Having different net caps for the New England and Mid-Atlantic areas was determined to be too expensive to administer and too difficult to enforce. Although the different mesh limits were proposed for a pre-existing mesh area boundary (between the multispecies and Mid-Atlantic regulated mesh areas), the boundary for the harbor porpoise mesh regulations will be different. This difference between regulations could reduce compliance and pose problems for law enforcement.

Analysis of the net cap proposal

Analysis of the net cap is hampered by a lack of data on the numbers of nets used, and by the diversity of gillnet fishing operations. Public comment at Council meetings suggests that in some areas, nearly all vessels fish fewer than 80 nets. In other areas, vessels fish more like they do for flatfish and set between 150 and 200 nets. Since the purpose of the cap is to limit uncontrolled increases in the numbers of nets fished, a reasonable upper limit that would be restrictive on a minority of fishermen will fulfill the intent of this measure.

7.1.5.1.1.9 Mandatory Reporting

NMFS has developed a mandatory landing reporting system that covers all regulated species managed by FMPs. The Councils have stated their strong support of a mandatory system as an integral part of proposed management systems. The specific process and data items that fishermen would use to report their landings has not been specified, and the Council has deferred the decisions for the details of the landings reporting system to NMFS.

The Council is proposing that the mandatory data collection program established for other species include monkfish in order to correct for problems caused by non-reporting. Because of the low value of monkfish tails compared to the livers, significant landings of monkfish tails are marketed through non-traditional channels and are therefore not reported. It represents a significant data gap when trying to estimate the importance of the fishery and when estimating fishing mortality rates. At-sea processing of monkfish presents another problem to obtaining size frequency data to assess the resource. The FMP for monkfish, therefore, calls for significant increases in sea sampling to collect the necessary data.

The costs of adding monkfish to the existing mandatory landings reporting system are negligible (Section 7.7). The net benefits of this measure cannot be quantified, but are thought to be considerable. The only added burden of adding monkfish reporting to the system is the additional reporting burden of fishermen who fish exclusively for monkfish or other unregulated species. Since most monkfish fishermen participate in the groundfish, scallop, or summer flounder fisheries, the increase in reporting requirements will be small. More detailed discussion of this measure is presented in the Paperwork Reduction Act analysis (Section 7.7).

7.1.5.1.1.10 Permits

Permits for the various entities in the monkfish fishery are needed for multiple reasons. In order to make sure that the only vessels directing fishing effort on monkfish are qualifiers under the limited access program, all vessels in the fishery need to be permitted. These vessel permits make enforcement easier at sea. The U.S. Coast Guard can quickly ascertain whether a fishing vessel should be fishing for monkfish. In addition, a vessel permit makes tracking the participants possible when vessels are sold or transferred.

The primary benefit of an operator's permit is to provide for accountability. Upon application for the permit, individuals would be notified that if the permit holder violates the regulations and is issued a "Notice of Permit Sanction", he/she will forfeit the right to work in any capacity on any commercial vessel fishing for federally regulated species during the period of sanction. There are approximately 600 vessels that will be eligible for monkfish limited access permits. The total number of operators requiring this permit would be equal to or slightly more than this number of vessels. More details are given in the Paperwork Reduction Act analysis (Section 7.7) on the number of vessels and operator permits.

Industry has expressed the view that permit sanctions are more effective than monetary penalties in deterring violations. Sanctions are no longer a "cost of doing business" when supply can be interrupted or employees laid off. The permit sanction would be viewed as a severe penalty to be applied only in the case of serious violations.

The primary purpose of a dealer permit is to improve enforcement of the regulations through dealer accountability. A second purpose is to improve the administration of the FMP by identifying the participants in the fishery and principle business locations. Once identified, the Council and NMFS can provide notices and other information to processors/dealers on changing regulations that might have an impact on how they conduct their business. Regulations that concern dealers include recording time landed (for days-at-sea) and amount of landings, minimum shell sizes, trip limits or possession limits (by-catch), and offloading windows that might interrupt the supply of product in the short term. Dealer identification also provides a secondary avenue for information dissemination to fishing vessels.

While the costs of administrating these permits is high (Section 7.7), they are certainly less than the costs of trying to collect comprehensive data and enforcing limited entry without a mechanism to determine participation in the fishery.

Permits are required to establish who is eligible to fish for monkfish and must report their landings. Operator permits will be useful in establishing culpability and in assessing meaningful sanctions for egregious violations. The costs of the permits will be established by the Regional Administrator to cover administrative expenses, but since most fishermen and dealers already require permits in other fisheries very few additional businesses will be required to apply for permits (Section 7.7). During public hearings, many fishermen and processors voiced strong support for mandatory reporting and sanctions for severe violations. Additional permitting requirements will have a low cost while offering the most efficient means of establishing who must report and offers a way to place sanctions against future fishing by violators.

11.6.12 Framework adjustments to management measures

The proposed regulatory measures in the Monkfish FMP are designed to reduce the catch, and therefore fishing mortality, on small monkfish and collect data necessary to achieve the FMP's goals. These short-term objectives will be achieved through the following management measures: a prohibition on landing monkfish measuring less than 11 inches tail length (or 17 inches total length for whole fish), a maximum liver to tail landings per trip ratio, and provisions for permitting of vessels, operators, and dealers as well as mandatory data reporting.

The Council recommends applying the frameworks and their procedures to the Monkfish FMP, as provided in 50 CFR 660.61. Like the Pacific Coast Groundfish FMP, the proposed measures will need adjustments to accurately reach the FMP's objectives. Achieving these adjustments through the proposed frame works will reduce administrative costs and increase responsiveness and flexibility. The administrative cost reductions are unknown. They will depend on the frequency of adjustments and the framework processes employed to submit recommendations. A framework adjustment mechanism will, however, reduce costs by diminishing the need to publish a proposed rule or submit a full FMP amendment. Because the public is substantially involved in the Council process, the Council believes that publishing a proposed rule for proposed adjustments and allowing further public comment would be duplicative.

The abbreviated process for recommending and implementing changes to the management measures will be possible because of the high degree of public involvement in the Council process. The North Pacific and the New England Fishery Management Councils' review of management proposals is substantially similar. The New England Council has seventeen voting members and four non-voting members. Voting members are the state fishery directors of Maine, New Hampshire, Massachusetts, Rhode Island, and Connecticut, the Northeast Regional Administrator of the NMFS, and eleven individuals who are knowledgeable about the New England fisheries and who are appointed by the Secretary of Commerce from lists submitted by the governors of the constituent states. Non-voting members are the Regional Administrator of the U.S. Fish and Wildlife Service, the Commander of the Coast Guard District, the Executive Director of the Atlantic States Marine Fisheries Commission, and a representative from the U.S. Department of State.

The Councils also utilizes several committees to seek expert advice and provide review of proposed measures. These committees are convened several times during the development of a new management proposal. The Council maintains a standing committee of industry advisors who represent the following interests: six fishermen who use otter trawls, three fishermen who use gillnets, and one dealer.. The fishermen represent diverse

groups from both large and small ports within the Councils' constituent states. One industry advisor is from Massachusetts, two are from Rhode Island, one each from Connecticut and New York, and two are from New Jersey. The Monkfish Oversight Committee, composed of New England and Mid-Atlantic Council members, and includes representation from Maine, Massachusetts, Rhode Island, New York and New Jersey.

The Council considers monkfish management issues at a series of Monkfish Oversight Committee meetings and at regularly scheduled Council meetings. All meetings of the Councils and its committees are open to the public. Council meeting notices, including a list of issues to be considered, are published in the *Federal Register*. Notices, agendas, and newsletters are distributed through a mailing list of approximately 1,600 names of individuals and organizations that includes vessel owners, processors, fishermen, fishermen's organizations, and fisheries service industries such as fishery consultants, joint venture companies and port managers. These persons may also receive draft and final FMPs, amendments and proposed regulations. The Council also maintains an interested-parties list of approximately 210 names of individuals and organizations that receive notices, agendas, and relevant information on Monkfish Oversight committee meetings.

Interested persons regularly attend Council meetings and obtain descriptions and analyses of the proposals being considered. Portions of the Council and Monkfish Oversight committee meetings are specifically set aside to receive public comment. The public is invited and regularly avails itself of the opportunity to make both oral and written comments, and to discuss any management issue with Council members and Council advisors.

7.1.5.1.2 Non-preferred alternatives

A summary of the biological implications of the three non-preferred alternatives is presented in the following sections. After that, a more detailed description is given in Sections 7.1.5.1.2.4 to 7.1.5.1.2.9 on the biological impacts of management options that were not included in the preferred alternative.

Non-preferred alternatives 1, 2, and 4 were developed with mortality objectives that would stop overfishing by year seven of the FMP. The intent of these proposals was to stop overfishing in seven years and rebuild the stock in eight, unlike the preferred alternative which proposes to stop overfishing in four years and rebuild stock biomass in ten through additional fishing mortality reductions and management adjustments. At that time, the Sustainable Fisheries Act had just passed and there were no guidelines on how the Councils should comply with the revised National Standards. One of the main criticisms of these non-preferred alternatives was that they would take too long to stop overfishing and had unrealistic expectations for rebuilding. In part, that is why the Councils rejected these alternatives and looked to more aggressive strategies to manage monkfish.

The intent of all three non-preferred alternatives is approximately the same: to reduce mortality on a gradual schedule until it falls below the overfishing threshold and biomass exceeds the biomass threshold. The proposed actions would achieve this objective by gradually reducing landings, and associated catch, until the thresholds are achieved no later than the fishing year beginning on July 1, 2005. An initial 45 percent reduction from current landings is intended to take place during the fishing year ending June 30, 1999. A second 20 percent reduction in landings would be scheduled for the second fishing year, beginning July 1, 1999. Following the second year, the proposed action would hold the limited access fishery allocations at the 1999-2000 levels for the third through the sixth fishing years. Some reductions in landings and catch are expected due to presently scheduled limits in other fisheries that have a monkfish bycatch (multispecies, sea scallops, and summer flounder). If additional reductions in the TAC are necessary to achieve the thresholds in the fishing year beginning July 1, 2005, the additional reductions would be taken from the limited access fishery.

The benefits of a minimum size rely mainly on changes in fishing behavior to reduce mortality on small fish. Although specific areas with concentrations of only small fish cannot be a priori identified, fishermen that target monkfish say they can make ad hoc changes in where they fish to avoid small fish. There is not enough price difference over size to induce fishermen to target large monkfish, but the size limit will act as a disincentive to

continue fishing where small monkfish are prevalent. It is impossible to estimate how frequently this change in fishing practices will occur.

All the alternatives include a 14-inch tail length and a 21-inch whole length minimum size. Section 7.1.5.1.1.6.3 shows that any selection of a size limit above an 11-inch tail would not increase yield per recruit unless discard mortality is less than 38 percent. A 17-inch minimum tail size is the optimum size that gives a marginal gain in yield at the highest discard mortality rate. Limited studies in coastal waters indicate that monkfish mortality ranges from 43 to 92 percent. Due to increased chance of predation, larger surface-to-bottom temperature changes, and longer tow times with heavier gear, monkfish discard mortality is likely to be higher than these estimates.

The non-preferred alternatives also include a minimum mesh limit for vessels targeting monkfish in a limited access fishery. The main benefit of using large mesh to target monkfish is to reduce the bycatch of regulated groundfish, species that are overfished and at low levels of abundance. The Councils anticipate that many areas will have acceptably low levels of groundfish bycatch when vessels target monkfish with 10-inch square or 12-inch diamond mesh.

Size selectivity for monkfish is not likely to be significantly improved by using 10-inch square or 12-inch diamond mesh, especially in trawls. Most monkfish that are slightly below the proposed minimum size would be captured by trawls using this mesh. It will, however, prevent scallopers using dredges to target monkfish from intensifying their effort with gear that captures mainly small fish. Limited gear selectivity studies exist, but their practicality in the U.S. monkfish fishery has not been demonstrated, making it premature to introduce requirements to use separator gear in the monkfish fishery. One such study (Appendix III) uses separator gear in a limited mixed fishery that targets monkfish. Although it might be practical in the limited access fishery to use gear that allows small monkfish to escape, the gear will not work in a mixed fishery that includes smaller groundfish.

The non-preferred alternatives differ in how the TAL targets are allocated between the various fisheries, how much discarding would mitigate the effects of reducing landings, and how much current fishing behavior will change (either by avoiding areas with monkfish that cannot be landed or by intensifying fishing effort for monkfish within the proposed limits). It is difficult to quantify changes in fishing behavior under the proposed actions, because they depend on a variety of factors that cannot be anticipated. Where possible, a qualitative assessment of the potential changes is given.

7.1.5.1.2.1 Non-preferred alternative 1

Biologically, non-preferred alternative 1 has the greatest likelihood of achieving the biological objectives without future framework adjustments. The quotas are fixed and effectively close the directed fishery when landings exceed the allocations. Bycatch may increase some under the proposed trip limits, but the increases are limited by the effort reductions in other fisheries and by the proposed monkfish limits. These limits are a compromise between a landing cap at reasonable bycatch levels and lower levels that would cause unacceptably high discarding.

The management strategy for non-preferred alternative 1 is to determine a reasonable amount of monkfish bycatch in fisheries that target other species and what the landings would be if these vessels continued their current practices but had limits on monkfish landings. These estimates include the anticipated reduction of effort for fisheries that are currently managed by FMPs. These estimated landings from bycatch were deducted from the annual TAL to determine the amount of quota for the limited access fishery.

The trip limits for non-preferred alternative 1 were chosen so that few trips that previously landed monkfish would be affected by the proposed limit, unless it was targeting monkfish. In nearly all cases, the percent of trips targeting other species that would be affected by the proposed limits is less than 10 percent. When total revenue from monkfish landings was less than 15 percent, only one percent of the trips would be affected. In the other cases when monkfish revenue accounted for a significant fraction of the total, some changes in fishing behavior will be necessary to keep monkfish discarding below an acceptable level. Some vessels making trips with high monkfish

revenue will qualify for limited access and fish when quota is available. Others may seek other fishing locations if a large fraction of their catch cannot be landed.

On the other hand, many trips that target other species land much lower amounts of monkfish. Some vessels may begin landing more monkfish as they spend more time targeting monkfish. If many vessels 'fish-up' to the limit, the bycatch target allocations would be exceeded and additional action would be necessary if the limited access fishery also takes its quota.

7.1.5.1.2.2 Non-preferred alternative 2

It is less likely that the biological objectives would be met by non-preferred alternative 2, because many vessels would be able to increase effort on monkfish without exceeding the trip limits. These trip limits are substantially higher than those for non-preferred alternative 1, since the intent of non-preferred alternative 2 is to allow the prosecution of a mixed fishery (including monkfish) under the trip limits. No changes in fishing behavior to target monkfish were assumed to estimate monkfish allocations, but the higher trip limits left little biomass to be allocated to a limited access monkfish fishery. The Councils considered, but rejected this alternative for these two reasons.

7.1.5.1.2.3 *Non-preferred alternative 4*

It is more likely that non-preferred alternative 4 would initially achieve the biological targets, because the days-at-sea allocations are based on the monkfish history of vessels that qualify for limited access and the lower trip limits would prevent increased landings from bycatch in other fisheries. This deficiency in the preferred alternative, however, is addressed by the proposed directed fishery trip limits.

Unlike the preferred alternative, the days-at-sea allocations are proposed based on the number of vessels that qualify and their history of landing monkfish. The more liberal qualification procedure allows more vessels in the limited access fishery. The allocation of monkfish-only days is correspondingly lower to achieve a fixed TAC allocation. Alternatively, a more conservative qualification procedure allows fewer vessels in the fishery and the days-at-sea allocations can be higher. The total number of days-at-sea per vessel is lower than non-preferred alternative 3, but some multispecies vessels could qualify for monkfish limited access and receive monkfish-only days to tack onto their multispecies days.

The trip limits for multispecies trawl and scallop dredge vessels are also lower, reducing the opportunity for fishermen to increase their monkfish bycatch. The proposed trip limits are lower than those proposed for non-preferred alternative 1 and preferred alternative. Non-preferred alternative 4 proposes a 200-pound (tail weight) per day-at-sea limit for multispecies and scallop fisheries. The expected landings from bycatch are lower, leaving a larger TAC allocation (and a greater number of days) for the limited access fishery. The lower limit, however, may cause increased discarding that would reduce the effectiveness of the proposed action to control monkfish fishing mortality.

7.1.5.1.2.4 *Other mortality reduction and rebuilding schedules through adjustments to Total Allowable Catch (TAC)*

Purpose

The TAC limits will be used in two ways to manage the monkfish fisheries. On one hand, the TACs would not be strict limits, but would act as a guideline to indicate whether the management measures are effective. The other use is for a baseline, to set concrete fishing limits, like quotas. In all alternatives, trip limits set an upper limit to landings from certain fisheries, mainly as bycatch. The three non-preferred alternatives allocate landings, in the form of quotas or targets, by subtracting the expected amount of non-limited access landings (mostly as bycatch) from the TALs. The non-preferred alternatives proposed to use TALs (total allowable landings) as interim targets because not enough was known about how much regulatory discards would occur. In the preferred alternative, regulatory discards were estimated in the biological analysis, based on the assumptions within a model that applied the proposed rules to fishing trips during 1995 and 1996.

Annual limits on total allowable landings of monkfish will act as intermediate biological objectives to limit landings below a level estimated to achieve a certain fishing mortality rate. Landings, rather than catch (TAC), would be used as the controlling factor, because the amount of discarding is not well known and catch is difficult to monitor. Moreover, discarding is likely to change in unpredictable ways, making the amount of catch difficult to estimate.

Uncontrollable factors

Without accounting for changes in discarding or the effects of a longer size limit and closed areas, the TAL objectives will nominally achieve mortality reductions in proportion to the reductions in landings. Two biological factors can also affect the realized fishing mortality rate: changes in exploitable biomass and changes in stock age-structure.

Under an invariant TAL established by reducing recent landings by a pre-determined percentage, decreases in exploitable biomass (the total biomass of fish that are vulnerable to fishing), will cause increases in fishing mortality. The increased fishing mortality occurs because a greater fraction of the exploitable fish is removed from the stock by fishing. In contrast, a fixed level of landings will remove a smaller proportion of the stock if biomass increases.

Similarly, changes in stock age-structure can also affect the realized fishing mortality rate. Landings from a stock of older fish will have a lower fishing mortality rate, because fewer, heavier fish fill the TAL limit. Removal of fewer fish, as a proportion by number, translates into lower fishing mortality.

TAL schedule

In the non-preferred alternatives taken at the first round of public hearings, the Councils proposed to reduce the TALs in three major steps over a seven-year period. The first reduction would occur in the year beginning July 1, 1996³¹. The second landings reduction would occur in the next year, beginning July 1, 1997. The last reduction is scheduled at the start of the seventh year of management, if other management measures do not first stop overfishing.

³¹ Dates for the original analyses have not been changed, so they remain consistent with the figures prepared for the DEIS. To compare these proposals with the analyses of the preferred alternative, advanced the year indicated within this section's text by two years, consistent with a May 1, 1999 implementation date.

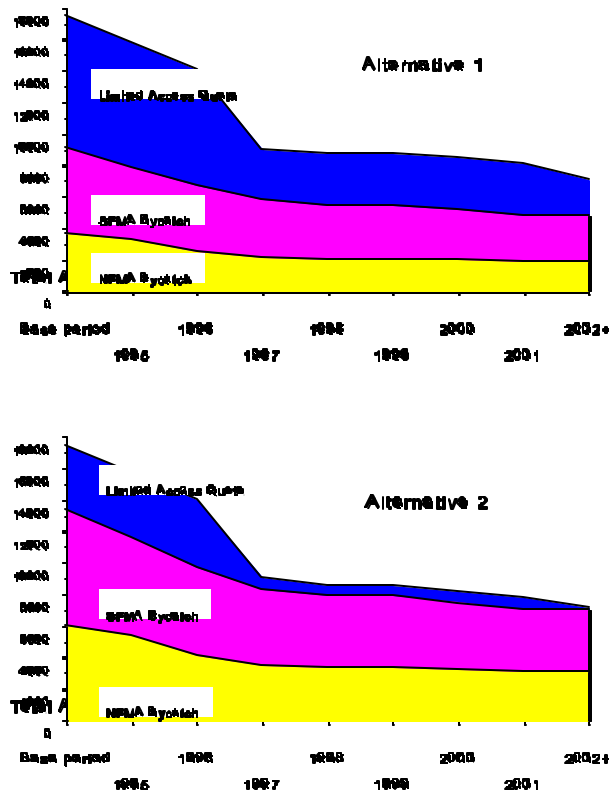


Figure 40. Estimated TAL specifications and allocations between fishery sectors for non-preferred alternative 1 and 2 for a seven-year schedule to meet the overfishing mortality objectives.

Between the second and seventh years, slight reductions in the TAL (and associated mortality) would accrue from the effort and quota reductions already scheduled in other regulated fisheries. The TAL schedules, therefore vary slightly between the three alternatives, because the monkfish trip limits differ. These schedules are given in Table 74 (non-preferred alternative 1), and Section 7.1.4.4.3.3.2 (non-preferred alternative 4) in Section 7.1.5.1.2.3. The TAL schedules are also shown graphically in Figure 40 and Figure 41.

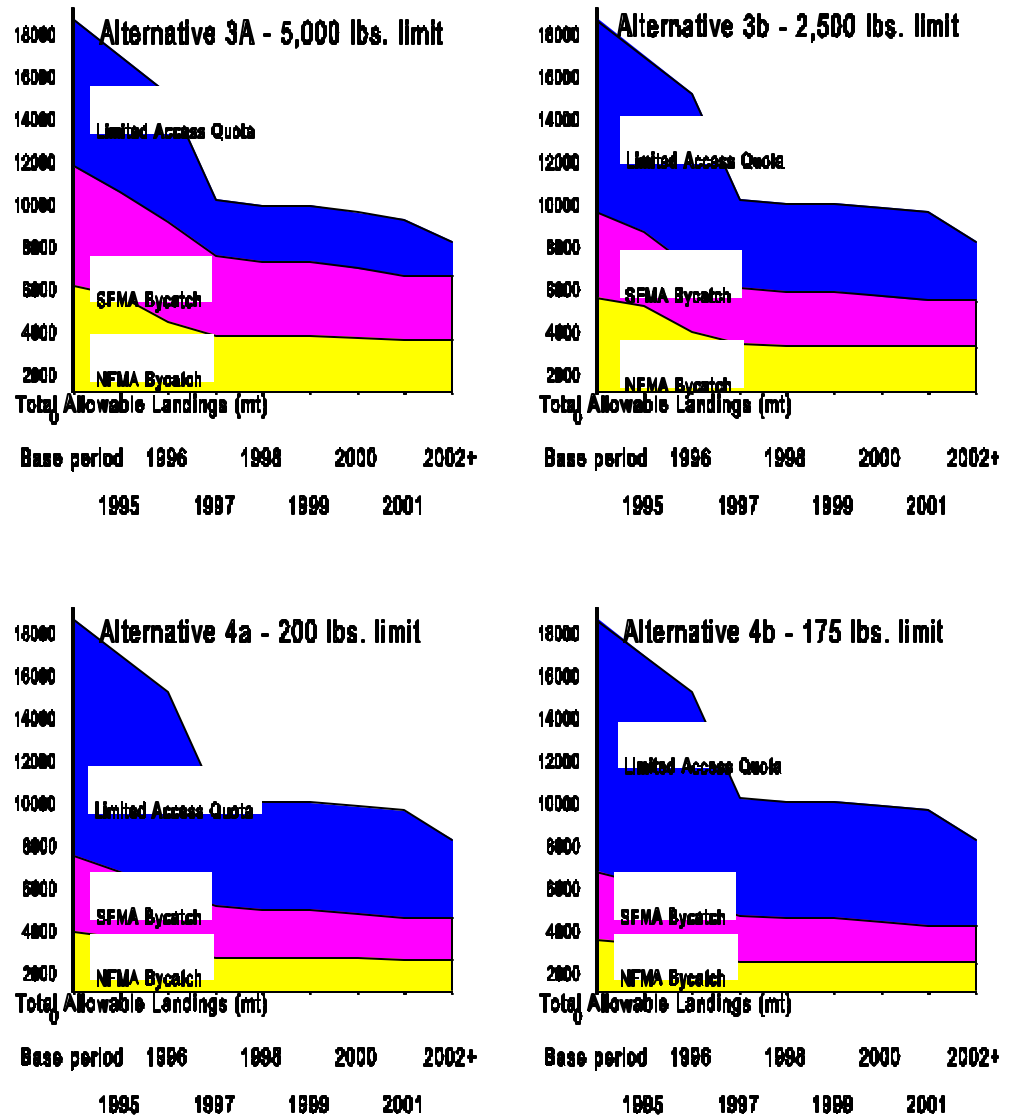


Figure 41. Other TAL reduction schedules and allocations that the Council included as options for the first rounds of public hearings in February 1997. These TAL reductions were based on a seven-year schedule to reduce mortality below the maximum fishing mortality threshold, specified in the overfishing definition.

Overfishing stops by year seven

The fishing mortality rate that would be achieved by the various management measures in year six is uncertain. Unless the Councils adjust other management measures (size limits, closed areas, and trip limits) to prevent overfishing within the seven-year schedule, a further reduction in the annual TAL and the limited access allocation will take place on July 1, 2002, the seventh year of the planned mortality reduction.

Compared to the threshold mortality rates that define overfishing (0.051 in the NFMA, 0.217 in the SFMA³²), current levels of fishing mortality need to be reduced by 70 and 52 percent, respectively. Without taking into account the effect of other management measures, the landings would have to be reduced to 2,148 and 4,927 mt, respectively, to reduce mortality below the overfishing threshold.

Overfishing may be relieved or exacerbated by other management measures or by external biological events. The potential effects of possession limits and size limits are described in Sections 7.1.5.1.1.5 and 7.1.5.1.1.6, respectively. Increased discarding will cause increases in fishing mortality above those nominally expected by the reductions in TACs. The possible implications are described in Section 7.1.5.1.1.6.

7.1.5.1.2.5 *Limited entry qualification criteria*

The characteristics of vessels that potentially qualify for monkfish limited access is given in Section 5.4.5.5. Based on 1991 - 1995 weighout data, 1,871 vessels³³ landed at least one pound of monkfish on one or more trips. Fifty-seven percent had multispecies limited access (days-at-sea) permits, sixteen percent had a sea scallop limited access permit, and eleven percent had no permit. Most vessels are home-ported in Massachusetts. Most are between 61 and 100 feet in length and between 5 and 150 gross registered tons, but there seems to be a secondary cluster of vessels between 31 and 45 feet. Many of the latter are probably gillnet vessels.

Qualification criteria 1- One pound on one trip

Option 1 would qualify the most vessels (1,871 minus those removed by the vessel capacity reduction program). Seven-hundred and seventy-six (776) vessels do not have multispecies permits³⁴, while 1,095 have multispecies days-at-sea permits. An additional 310 vessels (68% of limited access scallop permits) have a history of landing monkfish and would therefore qualify for the monkfish-only days-at-sea fishery under this option. Of the 1,871 qualifiers, seven percent are less than 5 gross registered tons (grt). Forty-two percent are between 5 and 50 grt, 36% are between 51 and 150 grt, and 15% are larger than 151 grt. The majority (59%) had multispecies days-at-sea permits and a greater proportion (75%) participated in a fishery managed by days-at-sea. Vessels with scallop permits contributed to an increasing number of qualifiers for vessels greater than 50 grt. The proportion that had days-at-sea permits increased with vessel size, 69% for vessels less than 5 grt, 67% for vessels between 5 and 50 grt, 79% for vessels between 51 and 150 grt, and 91% for vessels greater than 150 grt.

Over the four years, the 1,871 qualifying vessels averaged 48 days-at-sea for trips that had monkfish landings. Some of these vessels fished seasonally in fisheries that typically have monkfish bycatch. Other vessels may only have a partial history of monkfish landings. The mean number of days-at-sea is affected by these conditions and it is therefore an underestimate of the average days-at-sea for vessels that continually landed monkfish. The maximum number of days-at-sea was 283. Many of the 1,871 vessels landed monkfish as a bycatch in other fisheries. Only 255 vessels out of the potential qualifiers for option (a) had landings of monkfish that contributed to 20% or more of its total revenue and they averaged only 5 days-at-sea annually. One possible reason

³² These fishing mortality targets were estimated by NEFSC 1992. More recent biological reference points have been estimated by NEFSC 1997. While the reference point in the Northern Fishery Management Area did not change, the threshold fishing mortality rate in the Southern Fishery Management Area was revised to 0.14.

³³ Eight of the vessels that potentially qualify for monkfish limited access have been removed by the groundfish vessel capacity reduction program.

³⁴ As of June 1995.

for this low average is that a few of the 255 vessels appeared in the weighout data for one or two trips where monkfish was a high proportion of landings.

Table 109. Qualification criteria option 1: Distribution by ton class and permit holdings of vessels that would qualify for monkfish limited access under qualification option 1.

Ton Class (grt)	Multispecies permit?		Days-at-sea permit?	
	No	Yes	No	Yes
< 5	42	88	40	90
5 - 50	297	505	261	541
51 - 150	286	379	141	524
151 - 500	151	123	24	250
Sum	776	1095	466	1405

Qualification option 2 - 50,000 pounds (tail weight)

Under this option, 316 vessels qualify based on NMFS weighout data from 1991 to 1994, inclusive. Sixty percent (191) have multispecies days-at-sea permits. An additional 114 scallop vessels (25% of all scallop permits) with days-at-sea permits would also qualify for the monkfish-only fishery. The distribution of qualifying vessels by size is considerably different than under option (a), favoring large vessels. No vessels less than 5 grt would automatically qualify. Only 10% of qualifying vessels are between 5 and 50 grt, while 42% are between 51 and 150 grt and 48 percent are over 150 grt.

Table 110. Qualification criteria option 2: Distribution by ton class and permit holdings for any vessel that landed one or more pounds of monkfish during the qualification period.

	Ton Class (grt)	Multispecies permit?		Days-at-sea permit?	
		No	Yes	No	Yes
Qualifier	< 5	0	0	0	0
	5 - 50	5	27	4	28
	51 - 150	36	97	4	129
	151 - 500	84	67	3	148
	Sum	125	191	11	305
Non-qualifier	< 5	42	88	40	90
	5 - 50	292	478	257	513
	51 - 150	250	282	137	395
	151 - 500	67	56	21	102
	Sum	651	904	455	1100

Qualification option 3- 10,000 pounds tail weight per trip on five or more trips, etc.

Under this qualification option, 114 vessels would automatically qualify based on the 1991-1994 NMFS weighout data. Over two-thirds (77) of these qualifying vessels have multispecies days-at-sea permits. An additional 29 scallop vessels (6 percent of the scallop fleet) would also qualify. Compared to qualification option (b), a greater proportion of smaller vessels would qualify. Thirty-two percent of the vessels are between 5 and 50 grt, while 23% are between 51 and 150 grt and 46% are over 151 grt. This option appears to qualify fewer scallop vessels for the monkfish-only fishery.

Table 111. Qualification criteria option 3: Distribution by ton class and permit holdings for any vessel that landed one or more pounds of monkfish during the qualification period.

	Ton Class (grt)	Multispecies permit?		Days-at-sea permit?	
		No	Yes	No	Yes
Qualifier	< 5	0	0	0	0
	5 - 50	7	29	6	30
	51 - 150	3	23	1	25
	151 - 500	27	25	1	51
	Sum	37	77	8	106
Non-qualifier	< 5	42	88	40	90
	5 - 50	290	476	255	511
	51 - 150	283	356	140	499
	151 - 500	124	98	23	199
	Sum	739	904	458	1299

7.1.5.1.2.6 Quotas (Non-preferred alternatives 1 and 2)

Quotas can be a very effective limit on fishing mortality, and therefore, are often a favored method to manage fisheries. If fishing power increases, for example, the catches can be controlled simply by closing the season earlier. It is also clear when vessels should not be fishing, making enforcement easier. On the other hand, management by quotas can also have some undesirable effects. Quotas may give vessels an incentive to high-grade or to avoid reporting their landings. They also force vessels to fish in restricted seasons, not when the price or weather is favorable. Quotas do not allow fishermen to decide when they should fish and they tend to make fishermen overcapitalize their business to catch more fish while the season is open. Short seasons can also depress prices as the market responds to concentrated supply.

Alternative 1 is the only non-rejected management strategy to use quotas. The quotas begin at 7,329 mt in 1996-1997 and fall to 3,290 mt in 1997-1998 (Table 74). The non-preferred alternative 1 quota would remain constant at 3,290 mt through year six (2001). Due to the insufficient quotas for the limited access fishery and the high trip limits, the Councils have considered and rejected non-preferred alternative 2. Non-preferred alternative 2 quotas would be 730 mt, instead of 3,290 mt under non-preferred alternative 1.

Impact on qualifying vessels

The average allocation of monkfish quota to qualifying vessels depends on the number of vessels that would be allowed to fish in the limited access fishery. The Councils propose three potential methods that qualify different vessels. The number of qualifying vessels presented here is a minimum estimate, because additional vessels will qualify based on their own sources of data. This underestimate is especially relevant for small vessels that often land at dealers that did not participate in the voluntary weighout system. More qualifying vessels would cause the averages given below to be overestimated.

The most liberal of these alternatives would qualify 1,871 vessels that have an average annual history of landing 19,110 mt of monkfish. The 3,290 mt quota, therefore, represents an 83 percent reduction in monkfish for these vessels (Table 112). Each vessel would, on average, be allowed to land 1.76 mt, or 1,168 pounds tail-weight. At 1995 prices, this allocation would allow the average vessel to derive \$2,326 in annual revenue from monkfish.

Option 2 (50,000 pounds of monkfish tails over four years) would qualify at least 316 vessels. They have an average annual history of landing 14,346 mt of monkfish. Even though this qualification option would allow 83 percent fewer vessels than the option discussed above, these 316 vessels landed 75 percent of the amount landed by the 1,871 vessels during 1991-1994. The 3,290 mt quota represents a 77 percent reduction in landings for these vessels (Table 112). Each vessel would, on average, be able to land 10.41 mt, or 6,914 pounds tail-weight. At 1995 prices, this allocation would allow the average vessel to derive \$13,773 in annual revenue from monkfish.

Option 3 qualifies the fewest vessels, but would allow qualifying vessels to derive the most income from targeting monkfish. This qualification option would allow at least 114 vessels to fish in the limited access fishery. Historically, these vessels had an average annual total landings of 7,418 mt. The 3,290 mt quota would, therefore, correspond to a 56 percent reduction (Table 74). The average vessel would land 28.86 mt, or 19,164 pounds tail-weight. At \$1.99 per pound (average 1995 prices including livers), the average vessel would derive \$38,175 in annual revenue from monkfish

Table 112. Comparison of annual monkfish landings during 1991-1994 with the a quota needed to meet the mortality reduction objectives and stop overfishing.

	<i>Number of qualifying vessels</i>	<i>Average annual landings (mt)</i>	<i>Quota (mt)</i>	<i>Average allowable landngs per vessel (mt)</i>	<i>Average revenue per vessel (mt)</i>
<i>Option 1 - One pound of monkfish on one or more trips</i>	1,871	19,110	3,290	1.76	\$2,326
<i>Option 2 - Monkfish landings exceeding 50,000 pounds tail weight</i>	316	14,346	3,290	10.41	\$13,773
<i>Option 3 - 10,000 pounds tail weight on five or more trips, etc.</i>	114	7,418	3,290	28.86	\$38,175

Biologic impacts

Two factors affect the biological results of quotas for a limited access fishery: the size selectivity of the fishery and the amount of discards. Allocations that favor more size selective fisheries would reduce discarding of small fish and fishing mortality. Lower fishing mortality would result because fewer fish would be required to fill a quota defined by weight. High discards, on the other hand, would make the management measures less effective and would require greater reductions in landings or adjustments to other measures to stop overfishing.

Although mesh selectivity is believed to be marginal owing to the morphology of monkfish, vessels that target monkfish will be more likely to search for and target monkfish that are larger than the size limit to avoid discarding valuable fish. Vessels that catch monkfish as a bycatch are targeting other species and the target species may be concentrated in areas where there are many small monkfish. Allocations that favor the limited access fishery may, therefore, have fewer discards and more effectively control fishing mortality at a constant TAL amount.

On the other hand, greater restrictions on landings (and hopefully catch) are required to reserve the monkfish TALs for the limited access quota. Since fisheries with monkfish bycatch are targeting other species by definition, there are few management measures to reduce monkfish bycatch without affecting a vessel's efficiency to target other species. Trip limits are sometimes used to control the amount of bycatch in mixed fisheries. If the trip limits are too high, they do not effectively limit bycatch. In fact, some vessels may increase their catches of monkfish with high trip limits. If the limits are too low, vessels targeting other species may not be able to avoid monkfish and would have to discard the excess. The proposed possession limits and their effects are discussed in Section 7.1.5.1.1.5.

Economic impacts

Seasonal quotas could create a "race" for monkfish because limited access monkfish fishermen will compete for quota before seasons close. This behavior has implications for dockside prices and revenues, fishing costs, and product flow. The dockside prices of monkfish products do not appear to be affected by landings, but prices change seasonally because of seasonality in overseas demand, particularly for livers (Section 5.4.5.2.1). For example, during 1995 liver landings peaked during December when prices were also highest--an average of \$8.64 per pound. If fishing effort increases in response to the management system, it could end a limited access fishery earlier than if fishing practices had not changed in response to quota management. In a race to land fish while the limited access fishery is open, quotas could, however, end the season early during October or November when prices are lower--\$5.71 and \$7.43, respectively, during 1995.

In addition to reducing revenues from livers landings, the "race" for fish in quota fisheries typically increase fishing costs as fishermen invest more heavily in gear and change fishing practices to catch fish before the fishery closes. Furthermore, changing fishing practices in response to single-species regulations implies lost revenues from the harvest of other species.

Finally, "races" for fish typically interfere with the steady flow of fish products from the dock to consumers and export markets, including during future years when likely overages are subtracted from future quotas through the framework process. Processors and exporters need to assure buyers of a steady, reliable supply of products in order to keep market channels open.

The wide range of landings criteria and the potential for appeals using non-official records makes it difficult to predict which vessels might qualify for a limited access fishery or, therefore, which qualified vessels might select this option. Based on monkfish revenues as a percentage of gross vessel earnings (Section 5.4.5.3), though, it seems likely that sink gillnet fishermen would be in a limited access category under each alternative, particularly gillnetters lacking either Multispecies or Sea Scallop permits. In addition, trawlers and dredge operations in the Multispecies and Sea Scallop fisheries might qualify and choose to participate in a limited access fishery under non-preferred alternative 1.

Total monkfish revenues from 1994 and 1995 are reported by proposed fishing season and gear in Table 113. During these years, the seasonal distribution of revenues earned by scallop operations most closely matched the proposed quarterly limited access quotas. In contrast, the proposed closed season was the most important season for sink gillnetters as a group; during these months alone, gillnetters received 35 to 40 percent of their total annual monkfish revenues.

Table 113. Monkfish revenue (million dollars) by season and gear.

Gear	Year	Season			
		January 16 to March 31 (25 percent of annual quota)	April 1 to June 30 (closed)	July 1 to October 14 (25 percent of annual quota)	October 15 to January 15 (50 percent of annual quota)
Fish Trawl	1994	23.3	18.2	24.8	33.7
	1995	24.6	19.9	22.1	33.3
Sea Scallop Dredge	1994	18.8	9.7	20.1	51.4
	1995	19.6	12.6	25.3	42.4
Sink Gillnet	1994	6.2	34.7	23.2	35.9
	1995	8.1	39.9	19.3	32.7
Other	1994	11.1	8.4	29.9	50.7
	1995	22.5	15.1	4.8	57.7

7.1.5.1.2.7 Days-at-sea limits (Non-preferred alternative 4)

The analyses presented below take a different approach to evaluating days-at-sea and trip limit allocations between a potential targeted and bycatch monkfish fishery. The analysis shows that qualification criteria 1 (50,000 pounds of monkfish landings) would qualify too many vessels to allow a 50 day-at-sea annual allocation and still meet the accepted TAL targets. An annual allocation of 50 days-at-sea is possible when qualification criteria 2 applies (qualifying 114 vessels) if the 'bycatch' trip limit is reduced to about 175 pounds tail weight per day-at-sea. A schematic diagram showing the potential consequences is shown in Figure 43.

A different approach for the allocation of monkfish total allowable landings (TAL) between 'bycatch' and a limited access fishery is to first decide on the management objective for the limited access fishery, then determine the 'bycatch' trip limit that would be permissible and meet the overall TAL objective. Other alternatives take a different approach, first establishing a reasonable 'bycatch' or 'mixed' catch trip limit, then allocating the remainder of the TAL to the limited access fishery. The approach used for non-preferred alternative 4 initially ignores the potential amount of discard mortality, leaving the method for minimizing bycatch to other management solutions, once the severity of potential discarding is established.

The Council objective for non-preferred alternative 4 was to allocate 50 days-at-sea for each qualifying vessel to target monkfish. The initial proposal was made without information on whether this allocation would meet or exceed the target TAL. The proposal was also made without regard for the number and type of vessels that would qualify for limited access. The following discussion contains an analysis of the potential trip limits to meet the 50 days-at-sea objective for limited access vessels. The effect of these lower trip limits is discussed above and in Section 7.1.4.4.1.1.

Three qualifying options have been proposed for the monkfish fishery, outlined in the summary of management alternatives. The least restrictive (one pound, one trip) would automatically qualify 1,871 fishing vessels, based on NMFS weighout data. The most restrictive criterion would automatically qualify 114 vessels.

Since the original intention for non-preferred alternative 4 was to qualify vessels that targeted monkfish before the control date, the least restrictive criterion does not apply and was not further analyzed.

The potential allocations of monkfish-only days-at-sea, given a plausible range in the 'bycatch' trip limit for multispecies trawls and scallop dredge vessels is given in 7.1.4.4.1.1. The expected landings of qualifying vessels were estimated by examining the most productive trips of qualifiers in terms of monkfish landings would be expected during their participation in a limited access fishery.

Even when the potential bycatch trip limit is severely reduced, the landings of the 316 qualifiers with option 1 would exceed the total TAL within 50 days-at-sea for each vessel. Roughly, three days-at-sea are gained for these qualifiers for every 20-pound tail weight (PTW) reduction in the bycatch limit.

On the other hand, the more restrictive qualification criterion would allow fewer vessels in the limited access fishery. Although there is likely to be some unanticipated increases in fishing effort for monkfish during a monkfish day-at-sea, the aggregate landings of these vessels is lower, which in turn, allows for more days-at-sea per vessel. Based only on information from the landing history of the potential qualifiers, their projected landings reach an asymptote and they are not capable of taking the entire TAL without intensifying their monkfish fishing effort.

Yet another way of looking at this problem is to ask how many qualifying vessels can be permitted, and still allow allocations of 50 days-at-sea to limited access vessels and 200 pounds per day-at-sea in the 'bycatch' fisheries. The information in Figure 42 indicates that slightly more restrictive qualification criteria would be necessary.

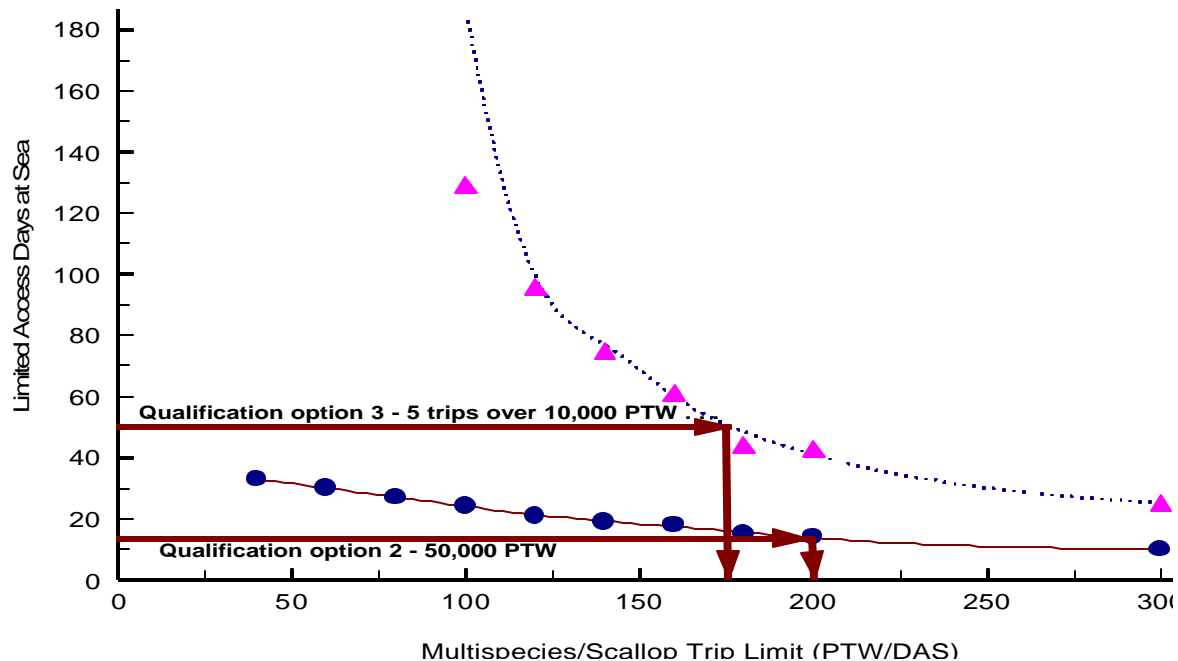


Figure 42. Limited access monkfish-only days-at-sea allocations over a range of potential monkfish bycatch trip limits for multispecies trawl and scallop dredge vessels. The potential trip limits are expressed in units of monkfish pounds tail-weight per day-at-sea (PTW/DAS). All other fisheries and vessels, unless qualified for monkfish limited access, would be limited to 1,000 pounds tail-weight per trip or 10 percent of total weight of fish onboard, whichever is less. Qualification criteria 1 would allow for pre-qualification, based on existing weigh-out landings records of 316 vessels. Qualification criteria 2 would allow for pre-qualification of 114 vessels. The proportion of landings excluded by the trip limit would be equivalent to discards if there is no re-direction of fishing effort and no vessels qualify to target monkfish in the limited access fishery.

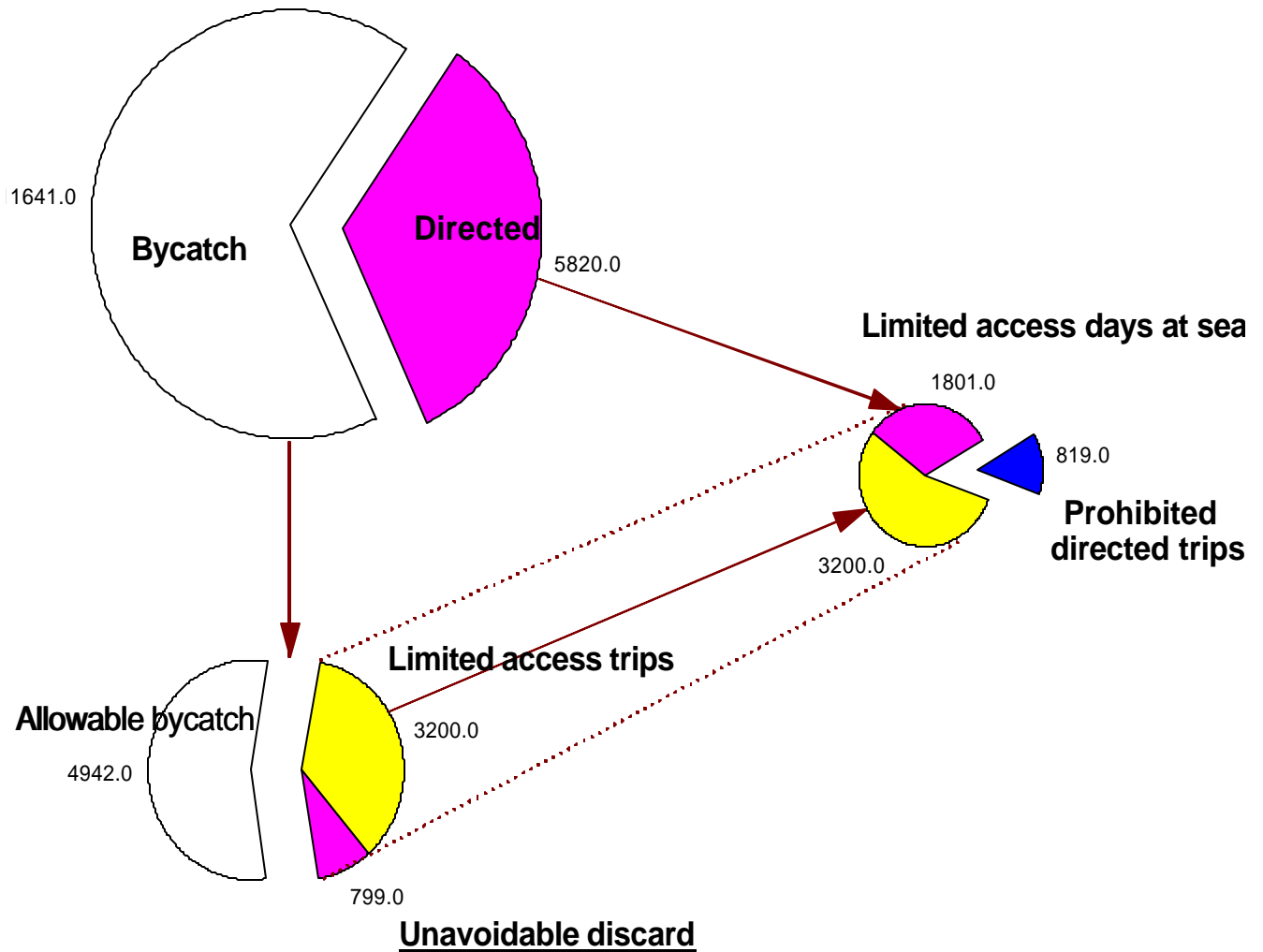


Figure 43. Schematic of monkfish bycatch and limited access fisheries. Total bycatch is reduced by effort reductions in associated fisheries. Additional trip limits apply to trips catching monkfish (lower left). Some trips with catches that exceed the proposed trip limits will be able to land monkfish under the limited access days-at-sea program for monkfish. Some directed trips for monkfish will be prohibited because those vessels did not meet the qualification criteria.

7.1.5.1.2.8 Trip limits

The non-preferred alternatives incorporate a wide-range of trip limits that would have varying effects on the fisheries and have different implications for discards, depending on what vessels these rules would apply. The Councils examined all trips made by vessels that would not qualify for limited access under each qualification option. The impact of various trip limit options for the preferred alternative are described more thoroughly in Section 7.1.5.1.1.3.

In general, the proposed trip limits for non-preferred alternative 1 were based on the 95th percentile of monkfish landings for individual trips during 1994 and 1995. These trip limits would have been effective to limit true monkfish bycatch, but could have caused problems in mixed species fisheries. If qualification option 1 had

been selected, the program with these trip limits would not have met the mortality objectives and the monkfish quotas would have been zero. On the other hand, if the qualification criteria were too restrictive, vessels in mixed-species fisheries (including monkfish) would be required to discard a portion of their valuable catch under the proposed non-preferred alternative 1 trip limits.

The trip limits for non-preferred alternative 2 were chosen at much higher levels to accommodate the mixed-species catch, if the qualification criteria are more restrictive. The Councils no longer support non-preferred alternative 2, mainly because the more liberal trip limits would become the primary management measure to control fishing mortality. Other plans that have relied on trip limits have been unsuccessful.

The bycatch trip limit for non-preferred alternative 4 was intentionally set low at 200 pounds per day-at-sea to reduce bycatch as much as possible. While this strategy theoretically reduced bycatch and allowed higher day-at-sea allocations, the additional discarding would have caused the management program to exceed the mortality targets. For this reason, the Councils designated alternative 4 as “non-preferred” during public hearings and did not subsequently develop it further.

7.1.5.1.2.9 Seasonal closures

A fishery closure should not have an excessive impact on one sector of the fishery, but not other sectors. Area or seasonal closures can be controversial because it is difficult to avoid placing an unequal burden of the management measure on a particular fishing sector. In order for closures to be equitable, they should occur over a period having equal impact for all fishing sectors or at least occur so that all sectors have a reasonable opportunity to fish at other times of the year.

7.1.5.1.2.9.1 Spring Spawning Closure

The main effect of a spawning closure is meant to reduce directed fishing activity when the fish are spawning and shift it to seasons that monkfish return a higher value. On one hand, the attractive feature of a spawning closure is to reduce the catches of fish when they are most vulnerable to the fishing gear, usually when they form spawning aggregations. Monkfish spawning occurs during May and June. Fishermen have reported that monkfish often extrude their egg veils on deck during this time of year. Armstrong (1992) reported that the weight of reproductive tissue as a percent of total weight peaks in May and June for females and March through June for males.

One of the benefits of closures is to delay harvest to periods when monkfish value is higher, either due to seasonal variations in demand or due to growth. Some growth will occur for monkfish that survive between spawning and the fall fishery, but the major benefit will be from seasonal price changes. Prices for monkfish tails show little seasonal variation, but prices for livers varies by a factor of nine over the year (Section 5.4.5.2.1). Since livers average 18 percent of the tail weight, the total value of monkfish parts increases in November and December to \$2.22 per pound of tails, versus \$1.18 per pound of tails in the spring. Without accounting for growth and natural mortality, the delayed harvest would cause an increase of revenue of 188 percent for every pound of monkfish landed in the spring directed fishery.

Most of the landings by trawl and dredge vessels in a directed monkfish fishery now occur in October through January (Figure 10 and Figure 11). This seasonality coincides nicely with the Councils' objective for proposing a spring spawning closure. Since the closure only applies to vessels targeting monkfish in the limited access fishery, the impact of spring spawning closures on these vessels will be tolerable. It is clear that any effort for monkfish in the springtime could be shifted to the fall and winter when monkfish are more valuable.

The majority of landings by gillnet vessels, on the other hand, occurs in May and June, precisely when monkfish appear to spawn in the Mid-Atlantic (Armstrong 1992). May and June landings by vessels using gillnets to target monkfish account for 52 percent of the annual landings by this fishing sector. The proposed spring spawning closure also includes the month of April, bringing the proportion of monkfish landings by gillnets to 58 percent for the three month period. Except for some landings in New Jersey, there appears to be little evidence that

gillnet fishermen could materially shift their monkfish fishing effort to other seasons. If the spring spawning closure applies to gillnet fishermen, the most likely outcome is that they will intensify their fishing effort in July to catch the last portion of the spawning activity when the monkfish are moving.

Shifting fishing effort from gillnets in the spring to trawls and dredges in the fall and winter may mitigate the gains in revenue caused by harvesting the fish when they are most valuable. Gillnet fishermen catch larger monkfish than do trawl and dredge fishermen (Section 7.1.5.1.1.6.6). This generalization may not be true in all cases, particularly for the directed fishery, but significant differences occur between gear types if bycatch and directed fisheries are considered together. Because of the differences in size landed by these fishing sectors, the monetary value per recruit could be significantly reduced by shifting fishing effort from gears that catch larger fish to those that catch smaller fish. The net result of these two factors (higher prices in the fall and winter; lower tail weights in the trawl and dredge fisheries) is difficult to estimate because of the confounding effects of inter-annual growth, mortality, and geographical distribution of the catch.

7.1.5.1.2.9.2 Gear-specific area closures

Area closures that apply to a specific fishing gear can also be effective in increasing the economic value from a fishery. Since the size of monkfish caught by the three major gear types differs (Figure 35, Figure 37, and Figure 38), closing an area to the least size-selective gear (in this case scallop dredges) when it is used to target monkfish could enhance yield by delaying harvest until the fish are larger. This type of closure does not depend on seasonal growth or price differences to enhance value, but instead delays harvest on some fish until they grow and become vulnerable to other portions of the fishery.

There are two issues that can be addressed by closing areas (prohibiting possession of monkfish) when vessels use certain gears or are permitted for certain fisheries. One issue is whether vessels using certain gears can be prevented from fishing for monkfish when and where another target species is not present. Can vessels using scallop dredges, for example, be prevented from targeting monkfish in areas where scallops are less abundant? The second issue is whether closed seasons (possibly area-specific) can be used to delay harvesting monkfish until seasonal prices are more favorable.

The first issue can be analyzed by examining the research vessel survey data and commercial landings. Both data sets have strengths and weaknesses. The survey is conducted with standardized methods and the geographical resolution of the data is high. Samples are taken only once annually for scallops and twice annually for monkfish. These survey data give little information about seasonal patterns. Commercial data, on the other hand, have a coarse geographical resolution because it depends on the reported fishing area, usually a three digit statistical box. Better seasonal information can be obtained from this data set, and it also reflects the seasonality of the fishery in response to prices, weather, other fishing opportunities, and custom.

The distribution of monkfish (officially known as goosefish) is shown in **Error! Reference source not found.** and **Error! Reference source not found.**. One aggregation occurs in the Gulf of Maine, the other in Southern New England and the Mid-Atlantic Bight. There is some southerly and inshore migration of monkfish notably in the southern aggregation. Monkfish in the autumn survey are found further north and along the shelf edge in the Mid-Atlantic.

Scallops, on the other hand, exhibit limited migration, but there are geographic concentrations of spat that vary over time. Thus, the densities of scallops shown in **Error! Reference source not found.** are not representative of the general condition. The general locations where the 1995 survey catches scallops, however, are representative of the general distribution of scallops in any year. There are, for example, few scallops found directly south of Block Island and New Bedford and scallops are generally concentrated near the Delmarva region, Hudson Canyon, and the Great South Channel.

The research survey data indicates that monkfish coincide with the distribution of scallops from directly south of Long Island to nearly Cape Hatteras, N.C. in both spring and autumn. There appear to be more scallops and fewer monkfish in the South Channel area, west of Georges Bank. Scallops and monkfish also have coincidental distributions on the margins of Georges Bank. Few monkfish or scallops are observed in survey tows in the center of Georges Bank. Scallop surveys were not conducted in the Gulf of Maine during 1995, and therefore no inferences can be made about co-distribution of the two species.

<\\AJA1\work\goosefish\FMP\Distribution plots.doc>

Another approach to defining closed areas for scallopers targeting monkfish is to examine the relative catch per unit effort within commercial fisheries data. We don't have sufficient samples to characterize the catch for each statistical area, but we do have reported landings according to three-digit statistical area (**Error! Reference source not found.**). Areas could be closed that have a high ratio of monkfish landings to scallop landings. For an initial evaluation, this ratio was determined for 25 statistical areas for each month during 1991 to 1993. The average ratio for all areas ranged from 0.38 in April to 1.86 in November. The following areas were found to have a high monkfish landing per day fished compared to scallops:

Table 114. Ratio of monkfish landings (pounds whole-weight) to sea scallop landings (meat weight) by statistical area (**Error! Reference source not found.**) and season for vessels using scallop dredges during 1991-1995. Shaded blocks represent areas and seasons that might be closed to vessels using scallop dredges to discourage targeting monkfish and reducing monkfish bycatch.

Statistical Area		August	September	October	November	December	January
Gulf of Maine	513				5:1	5:1	
	514				2:1	2:1	
	515			3:1			
Georges Bank	522	2:1	2:1	2:1	2:1	2:1	
	525	2:1	2:1	2:1			
Southern New England	537	3:1		2:1	2:1	5:1	2:1
	538			5:1			
	539	3:1		2:1	5:1	5:1	3:1
	613			2:1	3:1	2:1	2:1

Grouping these seasons into manageable blocks of times and areas, and including seasons and areas where there was no scallop landings reported by scallop vessels, suggests the following time/area closures for scallopers would be effective in reducing the monkfish catch without substantially decreasing the opportunity for scallop vessels to target scallops.

Areas 513 and 514:	November and December
Area 515:	October, November, and December
Areas 537, 538, 539, and 613:	October through January, inclusive

If these areas were closed to fishing with scallop dredges, the allocations for the limited access fishery could be increased by about 220 metric tons. The actual amount will vary depending on the final monkfish possession limit for scallopers.

Closed areas or seasons could also be used to preserve quota for more valuable seasons. Monkfish (especially liver) prices are known to vary seasonally and are high in the late fall and around Christmas. Prices for tails and whole fish have less seasonal variation and may be partially out of sync with seasonal liver prices. Part of the seasonal variation in price is due to quality of product and part due to market demand, somewhat driven by the holiday season in the orient.

Table 115. Total landings of monkfish (mt, whole) vs. scallop meats (mt) by month and three-digit statistical area (**Error! Reference source not found.**) for vessels using scallop dredges, 1991-1993. Shaded cells represent seasons and areas where the ratio of monkfish to scallop landings is high. Landings for all areas include three-digit statistical areas where landings of monkfish and scallops were negligible. Source: NMFS Weighout data.

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
521	Monkfish (mt)	12	25	12	13	33	102	170	151	147	157	135	44	1,001
	Scallop meats (mt)	41	75	66	80	105	101	150	113	121	90	98	50	1,090
	Ratio	0.3	0.3	0.2	0.2	0.3	1.0	1.1	1.3	1.2	1.7	1.4	0.9	0.9
522	Monkfish (mt)	9	10	10	26	60	79	176	210	173	202	147	91	1,193
	Scallop meats (mt)	29	37	47	107	135	86	100	86	62	67	47	41	844
	Ratio	0.3	0.3	0.2	0.2	0.4	0.9	1.8	2.4	2.8	3.0	3.1	2.2	1.4
525	Monkfish (mt)	10	19	25	38	93	43	125	199	158	128	47	20	905
	Scallop meats (mt)	22	63	97	94	91	43	87	70	69	56	33	12	737
	Ratio	0.5	0.3	0.3	0.4	1.0	1.0	1.4	2.8	2.3	2.3	1.4	1.7	1.2
526	Monkfish (mt)	97	43	38	57	65	194	180	230	203	165	153	126	1,551
	Scallop meats (mt)	210	128	184	227	137	231	163	125	124	118	85	101	1,833
	Ratio	0.5	0.3	0.2	0.3	0.5	0.8	1.1	1.8	1.6	1.4	1.8	1.2	0.8
537	Monkfish (mt)	10	2	2	4	3	5	1	3	4	5	10	34	83
	Scallop meats (mt)	6	2	2	3	3	4	2	1	3	3	3	6	38
	Ratio	1.7	1.0	1.0	1.3	1.0	1.3	0.5	3.0	1.3	1.7	3.3	5.7	2.2
539	Monkfish (mt)	10	4	0	1		1	3	6	2	9	35	33	104
	Scallop meats (mt)	3	2	1	3		2	2	2	2	4	6	7	34
	Ratio	3.3	2.0	0.0	0.3		0.5	1.5	3.0	1.0	2.3	5.8	4.7	3.1
561	Monkfish (mt)	10	4	6	3	23	28	55	58	43	55	93	50	428
	Scallop meats (mt)	43	20	41	20	65	54	79	66	22	27	59	63	559
	Ratio	0.2	0.2	0.1	0.2	0.4	0.5	0.7	0.9	2.0	2.0	1.6	0.8	0.8
562	Monkfish (mt)	23	16	20	18	56	111	130	140	105	64	21	14	718
	Scallop meats (mt)	87	133	141	100	154	175	163	113	57	28	10	14	1,175
	Ratio	0.3	0.1	0.1	0.2	0.4	0.6	0.8	1.2	1.8	2.3	2.1	1.0	0.6
612	Monkfish (mt)	14	11	3		5	4	3	6	2	3	4	16	71
	Scallop meats (mt)	13	11	7		8	6	7	11	4	7	6	9	89
	Ratio	1.1	1.0	0.4		0.6	0.7	0.4	0.5	0.5	0.4	0.7	1.8	0.8
613	Monkfish (mt)	54	65	21	37	38	37	31	27	34	52	60	68	524
	Scallop meats (mt)	24	38	23	38	42	32	47	31	33	29	22	31	390
	Ratio	2.3	1.7	0.9	1.0	0.9	1.2	0.7	0.9	1.0	1.8	2.7	2.2	1.3
615	Monkfish (mt)	75	96	70	55	47	65	48	38	25	19	40	63	641
	Scallop meats (mt)	73	126	147	121	102	125	113	70	43	36	46	40	1,042
	Ratio	1.0	0.8	0.5	0.5	0.5	0.5	0.4	0.5	0.6	0.5	0.9	1.6	0.6
616	Monkfish (mt)	21	30	46	53	55	64	65	61	16	11	4	17	443
	Scallop meats (mt)	28	61	107	201	191	145	168	67	34	14	6	9	1,031
	Ratio	0.8	0.5	0.4	0.3	0.3	0.4	0.4	0.9	0.5	0.8	0.7	1.9	0.4
621	Monkfish (mt)	31	30	14	7	10	16	5	3	4	7	9	16	152
	Scallop meats (mt)	31	28	20	19	22	33	8	8	8	22	23	15	237
	Ratio	1.0	1.1	0.7	0.4	0.5	0.5	0.6	0.4	0.5	0.3	0.4	1.1	0.6
622	Monkfish (mt)	18	22	10	23	25	26	18	19	20	13	15	17	226
	Scallop meats (mt)	27	24	25	56	84	83	53	57	47	29	29	19	533
	Ratio	0.7	0.9	0.4	0.4	0.3	0.3	0.3	0.3	0.4	0.4	0.5	0.9	0.4
All areas	Monkfish (mt)	415	418	325	400	563	799	1,021	1,161	949	905	814	661	8,431
	Scallop meats (mt)	655	788	969	1,175	1,264	1,167	1,168	847	662	556	500	451	10,202
	Ratio	0.6	0.5	0.3	0.3	0.4	0.7	0.9	1.4	1.4	1.6	1.6	1.5	0.8

Table 116. Average landings per day absent of monkfish (lbs, whole) vs. scallop meats (lbs) by month and three-digit statistical area (**Error! Reference source not found.**) for vessels using scallop dredges, 1991-1993. Shaded cells represent seasons and areas where the ratio of monkfish to scallop landings is high. Average landings per day absent for all areas include three-digit statistical areas where landings of monkfish and scallops were negligible. Source: NMFS Weighout data.

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
521	Monkfish (lbs)	246	104	181	182	299	760	907	938	744	928	835	547	663
	Scallop meats (lbs)	714	825	906	941	902	759	901	682	601	569	618	564	719
	Ratio	0.3	0.1	0.2	0.2	0.3	1.0	1.0	1.4	1.2	1.6	1.4	1.0	0.9
522	Monkfish (lbs)	263	723	201	254	419	807	1,191	1,541	1,411	1,291	1,303	981	962
	Scallop meats (lbs)	851	965	825	912	925	808	683	657	535	465	451	448	678
	Ratio	0.3	0.7	0.2	0.3	0.5	1.0	1.7	2.3	2.6	2.8	2.9	2.2	1.4
525	Monkfish (lbs)	302	285	241	341	774	828	1,072	1,483	1,123	1,063	839	767	827
	Scallop meats (lbs)	712	923	912	842	812	830	707	552	479	496	547	466	684
	Ratio	0.4	0.3	0.3	0.4	1.0	1.0	1.5	2.7	2.3	2.1	1.5	1.6	1.2
526	Monkfish (lbs)	392	302	209	277	443	816	981	1,167	1,029	790	953	715	664
	Scallop meats (lbs)	793	836	947	1,035	879	941	863	675	600	585	579	567	777
	Ratio	0.5	0.4	0.2	0.3	0.5	0.9	1.1	1.7	1.7	1.4	1.6	1.3	0.9
537	Monkfish (lbs)	1,626	433	521	610	637	754	317	1,616	931	858	1,003	1,734	1,216
	Scallop meats (lbs)	731	560	517	976	745	670	660	434	554	407	356	267	490
	Ratio	2.2	0.8	1.0	0.6	0.9	1.1	0.5	3.7	1.7	2.1	2.8	6.5	2.5
539	Monkfish (lbs)	2,887	1,240	96	417		903	1,559	2,232	447	1,331	1,717	1,849	1,724
	Scallop meats (lbs)	736	600	927	1,091		894	688	612	455	197	263	397	496
	Ratio	3.9	2.1	0.1	0.4		1.0	2.3	3.6	1.0	6.8	6.5	4.7	3.5
561	Monkfish (lbs)	223	145	125	103	314	459	661	802	957	1,204	874	520	582
	Scallop meats (lbs)	899	1,012	737	645	957	863	917	852	479	731	585	629	758
	Ratio	0.2	0.1	0.2	0.2	0.3	0.5	0.7	0.9	2.0	1.6	1.5	0.8	0.8
562	Monkfish (lbs)	247	135	151	221	179	511	741	967	1,066	970	948	624	533
	Scallop meats (lbs)	881	1,082	989	1,113	1,381	861	896	775	570	442	462	530	877
	Ratio	0.3	0.1	0.2	0.2	0.1	0.6	0.8	1.2	1.9	2.2	2.1	1.2	0.6
612	Monkfish (lbs)	1,117	667	320		580	891	250	642	217	194	356	864	628
	Scallop meats (lbs)	1,070	586	973		836	1,761	853	562	515	553	571	353	698
	Ratio	1.0	1.1	0.3		0.7	0.5	0.3	1.1	0.4	0.4	0.6	2.4	0.9
613	Monkfish (lbs)	1,197	990	731	552	575	710	497	683	524	783	1,179	1,253	830
	Scallop meats (lbs)	524	591	779	621	592	615	657	604	465	404	380	434	542
	Ratio	2.3	1.7	0.9	0.9	1.0	1.2	0.8	1.1	1.1	1.9	3.1	2.9	1.5
615	Monkfish (lbs)	598	452	349	308	332	356	247	260	281	190	277	669	368
	Scallop meats (lbs)	533	574	604	604	614	668	589	440	461	326	315	383	527
	Ratio	1.1	0.8	0.6	0.5	0.5	0.5	0.4	0.6	0.6	0.6	0.9	1.7	0.7
616	Monkfish (lbs)	438	394	429	320	288	430	285	373	419	335	295	850	368
	Scallop meats (lbs)	553	655	750	844	930	882	696	588	485	394	388	284	734
	Ratio	0.8	0.6	0.6	0.4	0.3	0.5	0.4	0.6	0.9	0.9	0.8	3.0	0.5
621	Monkfish (lbs)	507	475	522	211	259	326	286	294	230	134	139	470	335
	Scallop meats (lbs)	462	451	551	498	609	602	169	448	398	363	361	315	447
	Ratio	1.1	1.1	0.9	0.4	0.4	0.5	1.7	0.7	0.6	0.4	0.4	1.5	0.7
622	Monkfish (lbs)	121	410	328	308	262	262	195	194	215	216	173	343	258
	Scallop meats (lbs)	447	416	564	635	680	713	638	552	480	440	312	123	543
	Ratio	0.3	1.0	0.6	0.5	0.4	0.4	0.3	0.4	0.4	0.5	0.6	2.8	0.5
All areas	Monkfish (mt)	505	410	299	304	379	545	671	862	810	783	910	768	602
	Scallop meats (mt)	684	730	770	807	815	787	741	620	529	489	488	455	666
	Ratio	0.7	0.6	0.4	0.4	0.5	0.7	0.9	1.4	1.5	1.6	1.9	1.7	0.9

7.1.5.1.2.9.3 Groundfish area closures

Monkfish occur in areas now closed to fishing for groundfish, but these closures do not appear to have reduced monkfish fishing mortality because landings have not declined since the closures and directed effort for monkfish has increased. A model used by the Northeast Fisheries Science Center to predict the effect of area closures indicates that the landings of monkfish could be reduced as much as 17 percent (9 of 52 million lbs.) by the Georges Bank area closures (J. Walden, pers. comm.). These area closures, coupled with reductions in days-at-sea, appear to have intensified fishing effort on monkfish in Southern New England and possibly in the Gulf of Maine as well. Monkfish landings have remained high despite these closures and fishermen report increased monkfish effort during 1995 and 1996³⁵.

Recent management changes, however, may have reduced monkfish mortality more so than did the Georges Bank area closures. Amendment 7 to the Multispecies FMP prohibits fishermen from targeting non-groundfish species unless the bycatch of groundfish is below acceptable levels. This management change prohibits vessels from targeting monkfish east of 72° 30' W longitude, unless they are participating in an exempted fishery³⁶. Two monkfish gillnet fisheries were exempted from the multispecies days-at-sea requirements during fall 1996, but are now closed because acceptably low groundfish bycatch has not yet been demonstrated. As of November 1996, a fishery for monkfish has been exempted from the multispecies regulations if they use trawls with 8-inch or larger mesh, south of 40° 10' N latitude.

Although some monkfish effort has shifted south, outside the multispecies regulated mesh area, the multispecies prohibition on non-exempt monkfish effort, coupled with the multispecies and sea scallop days-at-sea reductions³⁷, could have reduced monkfish mortality, especially in the northern area and on Georges Bank. Most of this reduction comes from landings that would otherwise have occurred in a directed monkfish fishery.

³⁵ Data is not yet available to estimate changes in landings by statistical area during 1995 and 1996. Landings have not declined from 1994 levels, even though significant area closures on Georges Bank were implemented during 1995 and fewer multispecies and sea scallop days-at-sea were available. Fishermen reported increases in fishing activity during 1995 and 1996, especially by trawlers working in deep water of Southern New England and for gillnet fishermen in the Mid-Atlantic and Southern New England.

³⁶ Fisheries that target species other than regulated groundfish cannot occur under Amendment 7 rules unless their bycatch of groundfish is less than five percent of the total weight of fish onboard.

³⁷ The effect of the days-at-sea reductions on monkfish landings have been included in the TAL allocations (Section 8.3.1).