E.6.4.4 Social and Cultural Aspects

Aguirre (1996) analyzed the fishing communities of the northeast and described the characteristics of the communities that depend on this industry. While focused on the impacts of increasing regulation and declining catches in the northeast multispecies fishery, this analysis includes brief discussions on the herring fishery in Gloucester and Pt. Judith/Galilee, RI. For the most part, the same communities described in this report are important to the herring fishery. Through impacts on the community, support business, and infrastructure, reductions in the multispecies fishery will impact herring fishermen. Many of the concerns held by groundfish participants are the same as ones held by herring fishermen. At present, however, the herring resource is in a healthy condition—in fact, the resource is estimated to be at its largest size in the past twenty years. Those who have participated in the fishery during periods of reduced abundance are interested in maintaining it in a healthy state so they can benefit from the increased abundance. Some fishermen in fisheries that are rebuilding view the herring fishery as an alternative that can supplement their income until they can rely on these fisheries in the future. If herring landings and ex-vessel revenues were to double, the value of landings would rival those for Atlantic cod and would exceed the value of many other groundfish species.

Dyer and Poggie (1998) (Appendix I) build upon the concept of natural resource communities in their analysis of the social and cultural aspects of the herring industry. They provide information specific to herring harvesters and processors, as well discuss the impacts of the management measures under consideration. The directed herring fishery for Atlantic herring is a relatively small subset of the east coast fishing industry. Currently, less than 20 boats land the majority of the herring caught, as compared to well over 2,800 vessels in the northeast multispecies fishery, or over 3,000 federal lobster permit holders. Communities dependent on fishing are experiencing severe social and economic uncertainty caused by declines in fish stocks, and increasing regulation (Dyer and Poggie 1998). Appendix I contains a description of the major participants in the herring industry and a discussion of the potential impacts of various management alternatives. This appendix provides the basis for the discussion in this section and an analysis of the social impacts of the various management measures in section 3.0.

With the collapse of the Georges Bank herring fishery in the late 1970's, the U. S. herring industry was concentrated in the Gulf of Maine. With the exception of a brief period in the early 1980's, the major market for herring was the Maine sardine canneries until the development of an expanded bait market in the early 1990's. This continued the historic importance of the herring resource to the small communities of eastern Maine that began in the 1800's.

In spite of its relatively small size compared to other northeast fisheries, the herring fishery is critical to some small communities that have developed a dependence on a steady supply of herring for economic survival. The sardine canning industry, located entirely in Maine, is a key employer in several small towns that have limited alternatives for manufacturing employment. According to the Bureau of the Census economic profile of Maine, in 1995 there were twelve canned and cured fish and seafood processors (six were sardine canneries) employing 910 workers with a payroll of $9,578,000. In 1996, the five remaining sardine canneries employed nearly 850 people full and part-time and have a payroll of $8.5 million. Three of the remaining Maine packing plants are owned by one company. Four plants account for 90% of the total payroll. The plants that are still open are located in Prospect Harbor (Hancock County), Milbridge and Lubec (Washington County), Belfast (Waldo County), and Bath (Sagadahoc County). Table E.50 provides a summary of employment statistics for these areas (including one cannery that was open in 1990 and has since closed).

Location	Persons	Employed	Agriculture /Forestry/ Fishing	Non-durable Goods Manufacturing	Durable Goods Manufacturing	Median Household Income, 1989
Hancock County	46,948	21,000	1,108	1,406	1,254	$25,247
Sagadahoc County	33,535	15,810	303	580	3,911	31,948
Bath	9,825	4,402	28	117	1,365	29,892
Waldo County	33,018	14,172	663	1,722	1,042	23,148
Belfast	6,355	2,653	82	345	164	19,884
Washington County	35,308	13,271	1,009	1,446	806	19,993

Table E.50 – Selected demographic characteristics of Maine communities with sardine canneries (Source: U. S. Census, 1990)

The canneries are important to the economy of their communities and provide steady employment in an area with few other options. In 1997, for example, the unemployment rate in Washington County (location of canneries in Lubec and Milbridge, ME) was 13 percent. The heavy reliance of Washington County on cannery employment can be seen by the limited number of other manufacturing jobs available in the county. A similar reliance can be seen in Belfast, ME, where manufacturing jobs account for nearly 20 percent of employment—non-durable goods manufacturing employment (which includes the sardine cannery) accounts for 13 percent of employment.

The importance of the canneries to the their employees is illustrated by their reliance on cannery earnings. In February 1998, a survey of 123 workers at two sardine plants was conducted to develop a socio-cultural profile of the industry (Dyer and Poggie 1998). 71 percent of those surveyed were born in the state of Maine, while a total of 88 percent were born in Maine or other New England states. 66 percent were full time workers. The estimated factory earnings for 1998 ranged from $2,500 to $34,000, with a mean of just over $11,000. 61 percent replied that their total income was earned in the cannery, with an average of 2.2 persons per household dependent on the factory income.

Reiling and Bennett (1998) estimated the overall economic impacts of the sardine industry.

The output produced by the three firms totaled $40 million in 1996. Using the IMPLAN input-output model, the sardine canneries were estimated to have direct effects on the Maine economy of $50.8 million. Induced effects of the industry increase the total impact to $62.8 million. If the industry did not exist, overall employment in the state would decline by 1,378 to 1,800 (1995 state employment was approximately 432,000).

Another important fisheries sector that is linked to the herring fishery is the lobster fishery. In 1996, 71.6 million pounds of lobster worth $241.8 million were landed on the east coast. This fishery is heavily dependent on a ready supply of fresh bait, which comprises a significant share of the fisherman's variable costs. While a variety of species can be used, with each locality having a preferred species based on availability and price (NEFMC 1983), herring is the major lobster bait used in many areas. In 1981, only 1,460 mt of herring were used for bait (Maine Department of Marine Resources, 1997, quoted in Reiling and Bennett 1998). With the decline of redfish landings over the next ten years, the industry increasingly relied on herring. Alternatives to fresh herring are more expensive and not as readily available. Frozen herring is not only more costly, but is not preferred because it is difficult to handle (White, pers. comm). Any lengthy interruption to the supply of herring for bait would adversely impact this key industry. Not only is the value of lobster landings high, but lobster is a key part of the tourism culture important to the New England states (Dyer and Poggie).

The herring fishery has been suggested as an alternative to vessels in other fisheries that are under severe restrictions to do poor condition of the resource. Aguirre (1996) describes the pressures experienced by the groundfish industry in New England due to a declining resource and increasing regulation. This has caused significant changes in the fishing community as many fishermen have been forced to seek other employment. Herring, on the other hand, is an under-utilized resource that could absorb increased fishing effort. To the extent the management scheme allows entry of participants from other fisheries, it may provide a way to preserve the fishing community until groundfish stocks recover. It is not clear, however, that fishermen in stressed fisheries will be able to make the investment necessary to convert to fishing for a pelagic species that sells for pennies a pound.

The possibility of a large number of new entrants into the herring fishery causes concern in some long term participants. These fishermen have carefully developed markets in a high volume, low value fishery. In some instances, they have focused completely on herring and have limited opportunities to move into other fisheries because of limited entry provisions. The influx of new entrants is viewed as a threat to what has been a small industry niche that they have developed.

The size of the available resource attracted one company to consider using a large factory trawler in the herring fishery. This vessel obtained the letter of authorization necessary to use a small mesh mid-water trawl in the Gulf of Maine and Georges Bank, but never actually fished for herring. Intense opposition to the introduction of a large factory trawler led to a number of initiatives to prevent it from entering the fishery, including legislative action by Congress to rescind this authorization letter (section 2.1). During development of the FMP, this issue attracted considerable public comment (see Appendices VII and VIII). Many of the comments in opposition focused on the perceived disruption to communities that would result from the introduction of at-sea processing vessels. These comments expressed concern that a large at-sea processor would prevent the development of shoreside processing capacity that would benefit their communities. They also argued that large factory trawlers would eventually control the herring resource and force out smaller, traditional owner/operators from the fishery. Counter-arguments focused on the ability of a large factory trawler to freeze herring at sea, using the underutilized offshore resource and selling the product into international markets. The possibility that a large factory trawler could be used in a "joint venture" with other U.S. catcher vessels, providing them a relatively easy way to enter the herring fishery, was also noted. Because of the lack of experience with similar large scale fishing vessels in the northeast, it is difficult to evaluate their impacts. Dyer and Poggie (1998) noted community interest in increased development of shoreside processing, as well as in using the herring fishery as an alternative for the stressed groundfish fishery. The difficulty will lie in balancing these interests which, to many, are in conflict.

E.6.5 Impacts of Human Activity (Fishing) on the Environment

The impact of fishing for herring is described primarily as fishing mortality. Particularly with respect to forage species, however, the impact may extend to other species through complex predator-prey relationships. Weinrich (1997), for example, has identified changes in the distribution of whales apparently caused by shifts in the abundance of prey species. Fishing for herring at levels that result in a change in species abundance in certain areas may result in changes in marine mammal distributions. Payne et al. (1990) speculated that the recovery of the northern right whale may be inhibited by competition with herring and sand lance for its prey species. These examples show the complexity of this issue; it is difficult to predict how herring fishing will impact other species, but the impacts are not expected to be major as long as the herring biomass is maintained in a healthy state.

Because herring are a pelagic species, the gears used are not expected to have significant impact on the sea floor. These issues will be explored in detail through the Council's review of essential fish habitat.

E.6.5.1 Impacts of Human Activity Other Than Fishing on the Environment

The Council will identify impacts of non-fishing activity on the environment through its review of essential fish habitat.

E.7.0 Environmental Consequences of the Proposed Action

E.7.1 Summary of Consequences

In general, the proposed management actions should have a positive impact on the biological, economic, and social components of the herring fishery. Spawning stock biomass is projected to continue to increase at the same time that landings of herring could double. In the long-term, the establishment of a total allowable catch and effort controls should develop a sustainable herring fishery.

The social impacts of the proposed actions are not expected to be large in scale, long-term, or far reaching. Fishermen in the Gulf of Maine may be the most affected by the proposed actions, primarily by forcing a redistribution of fishing effort from the inshore area. Some fishermen in other fisheries will have the opportunity to enter the herring fishery, which may alleviate problems caused by increasing restrictions in those fisheries.

E.7.2 Biological Impacts of the Alternatives

The following sections describe the expected biological impacts for the proposed management actions listed in section 3.0. Most of the analysis is focused on the primary management measures that will control fishing mortality: establishment of an overfishing definition (section E.7.2.1), a TAC (section E.7.2.5.1), the TAC distribution system (section E.7.2.5.2), mandatory days out of the fishery (section E.7.2.5.3), and vessel size limits (section E.1.1.1.1). The impact of spawning area closures (section E.7.2.4) is also addressed. In many instances, the Council considered variations of the proposed measure. These variations are discussed in the same section as the adopted measure. Section E.7.2.10 addresses the expected biological impacts of those measures that were not adopted in any form – primarily the limited entry/controlled access system.

The herring resource is currently underutilized and overall fishing mortality is at an extremely low level (NEFSC, 1998a). For this reason, the management measures are not designed to reduce fishing mortality, but to establish controls so that as fishing effort increases, the mortality is held to levels consistent with the overfishing definition. Prior to adoption of this plan, there are no limits on the harvest of herring by domestic vessels. While herring is not currently overfished, as noted in section, there is increased interest in the fishery. The history of the management of this stock (section 2.1) clearly demonstrates that absent appropriate controls, fishing mortality can exceed acceptable levels and can damage the resource. Another impact of the proposed measures is that they will distribute fishing effort across fishing areas. This will help protect the different spawning components as effort will not be concentrated on any one segment.

E.7.2.1 Overfishing Definition

The establishment of an overfishing definition is required by the Magnuson-Stevens Act. The term "overfishing" or "overfished" means a level or rate of fishing mortality that jeopardizes the capacity of a fishery to produce the maximum sustainable yield on a continuing basis. Absent a statement that defines the appropriate level of fishing mortality, it is problematic to determine whether a fishery is overfished and a rebuilding effort is necessary. The overfishing definition reference points are described in section 2.6.

The target fishing mortality should prevent the overfishing of the herring coastal stock complex. When combined with estimates of natural mortality, the target fishing mortality (at B_{MSY}) will result in the annual removal of 38 per cent of the stock on an annual basis. This will preserve sufficient resource for successful spawning in the future. This definition is more conservative than the overfishing definition in the Commission's 1994 management plan for herring.

One weakness in this definition is that the fishing mortality target applies to the entire coastal stock complex. It may be possible to stay within the mortality target for the entire coastal stock complex while overfishing a particular spawning component. For this reason, attempts are being made to develop a separate assessment for the Gulf of Maine spawning component. This will facilitate a separate definition for this component, reducing the likelihood of overfishing. Until this assessment is developed, the plan addresses this concern by incorporating other measures (primarily through distribution of the TAC by area) that are intended to limit the effort on any individual spawning component.

Implicit in the determination of the overfishing definition is consideration of the needs of other species in the ecosystem. The definition insures that fishing mortality will not adversely impact the needs of other species. As noted in section E.6.3.1.6, herring play a key role as a forage species. For example, Gannon et al. (1998) estimated that herring are 44% of the total mass in the diet of non-calf harbor porpoise in the Gulf of Maine during the fall. Overholtz et al. (1991) estimated that from 1988 through 1992, five species of whales, three species of dolphins, harbor porpoise and harbor seals consumed, on average, 19,300 mt of herring annually. The development of the MSY estimate and the target fishing mortality take into account the natural mortality from all causes, including the needs of predator species. Because the entire management program hinges on the target fishing mortality specified in the overfishing definition, the concerns of forage species are addressed.

E.7.2.2 Specifications

The plan bases all specifications (OY, DAH, DAP, JVPt, JVPs, IWP, BT, USAP and the Reserve) on the overfishing definition—specifically, the target fishing mortality. Allowable biological catch (ABC), which is F_{Target} times the estimated biomass, must be determined before any other specification can be defined. When the stock size is larger than B_{MSY}, ABC could be significantly larger than MSY. However, in the early years of the plan, the ABC is artificially limited to no more than MSY. For example, the stock biomass in 1997 is estimated to have been 2.5 times the biomass necessary to support MSY. Applying the target fishing mortality (F=0.28) to this stock size would give an ABC of well over 500,000 mt. There is concern this biomass is overestimated, based in part on the low level of fishing mortality and on a pronounced positive bias observed in estimation of recent year biomass and a negative bias in fishing mortality (NEFSC, 1998). Rather than allow rapid buildup to a large harvest in the initial years of the plan based on uncertain stock estimates, the plan takes a precautionary approach and artificially limits the ABC to a level consistent with ABC at B_{MSY}. This will allow the development of the fishery at a slower pace, reducing the likelihood that high levels of harvest in the early years of the plan will result in a rapidly declining biomass. This conservative approach should reduce the possibility of overfishing in the early plan years while allowing fishing mortality to gradually increase, improving the precision of assessments. This is consistent with the recommendation of the SARC that the catch should be increased in an incremental fashion (NEFSC 1998a and b).

A surplus production model was used to estimate the impact on the biomass of different harvest scenarios. These models show that an immediate high catch could result in a rapid decline in the biomass level. This rapid decline could be problematic if there are errors in the assessment or reporting, or a sudden change in environmental conditions. While any increase in the catch will be in response to market conditions, the simulation shows that current high biomass levels can be rapidly depleted if catches are allowed to increase rapidly. The plan chooses, instead, to cap the catches at a level well below the theoretical ABC at B_{MSY} until catch reporting, spawning restrictions, permit requirements, and other management measures have a chance to be evaluated. These measures should lead to improved assessment precision.

Optimum yield (OY) is specified in this fishery consistent with the overfishing definitions. As a result, the specification of OY should have little biological impact. The key is that OY does not exceed the ABC. A second reason that OY should have little impact is that it cannot exceed MSY. This means the long term ability of the fishery to produce MSY should be maintained. The remainder of the specifications distribute the OY to various industry sectors and should have little biological impact.

Because the preferred alternative does not provide the opportunity for TALFF, the OY definition may have a positive impact on other marine resources in the area. Directed foreign mid-water fisheries have a well-documented impact on marine mammals (Waring 1990). The reasons for these impacts are not clearly understood, but preventing foreign vessels from participating in this fishery removes any impact these vessels may have. Given the lack of understanding about the causes of the marine mammal takes this approach is consistent with the precautionary principle.

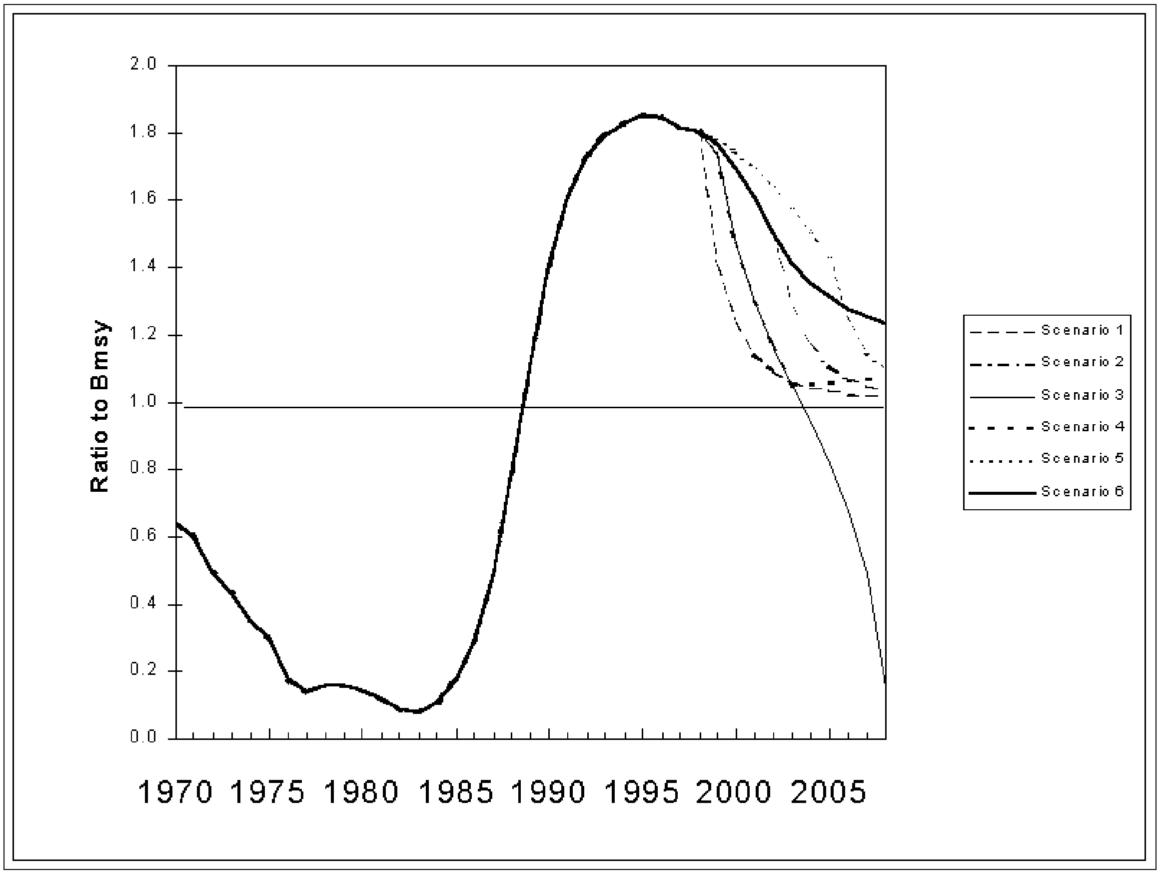

Figure E.17 - Biomass predictions based on different annual harvests

Scenario 1: Harvest at F_{MSY} in all years

Scenario 2 Catch increase by 50K mt each year, followed by F_{MSY}

Scenario 3: Catch of 400K mt in 1999, held constant

Scenario 4: Catch of 400K mt in 1999, then MSY in 2003 and beyond

Scenario 5: Catch increase by 30K mt each year, followed by F_{MSY}

Scenario 6: Catch increase of 50K mt each year, up to MSY level

E.7.2.3 Management Areas

The management areas adopted by the plan are based on knowledge of the various spawning components. This allows the development of management measures that specifically target a particular spawning component. It also provides some flexibility, as specific measures can be adopted in an area of concern.

The subdivision of Management Area 1 refines the areas that were initially adopted by the Commission in its 1994 management plan. This identifies areas of concern for herring from the Gulf of Maine spawning component. During the winter and early spring, most of the fish in Management Area 1A are believed to be from the Gulf of Maine spawning component. In the early summer, some fish from the Georges Bank/Nantucket Shoals spawning component are also in this area. Defining this area facilitates development of TACs for these areas that will account, in part, for stock mixing. This provides a measure of protection to individual spawning components - particularly the Gulf of Maine spawning component.

To some extent, the proposed areas are a compromise that do not precisely represent the geographic areas occupied by the various components during spawning season. A presentation of fall trawl survey data by Melvin et al. (1996) shows that there is a continuum of herring from Cape Ann, Stellwagen Bank, Great South Channel, Nantucket Shoals and out across Georges Bank. As noted by Tupper et al. (1998), the line dividing Management Area 1 and Management Area 2 cuts through this continuum. They suggest that this dividing line should be moved to the north and closer inshore so that catch statistics from Area 1 more closely represent removals from the Gulf of Maine spawning component, rather than a mix of herring. This approach was not adopted by the Council, which preferred to use the same area boundaries that were adopted by the Commission in 1994. As a result, the TAC assigned to Management Area 1 must consider the mixing of herring from different components. The location of the area boundaries is a measure that can be adjusted through framework action as more information is developed on the structure of the coastal stock complex.

E.7.2.4 Spawning Area Closures

One of the goals of the FMP is to protect individual spawning populations consistent with the National Standards. The desirability of establishing closed areas to protect spawning aggregations of herring was recognized and articulated by the Council in the original FMP (43 FR 60533). The Council prepared a recommendation for spawning closures while drafting Amendment 4 to the original FMP; this amendment was never adopted because approval of the FMP was withdrawn by the NMFS. The concept of a spawning closure was adopted by the Commission in its FMP for Atlantic herring in 1994, and has been implemented through state landing regulations and closure areas.

There is considerable support for the concept that successful management of herring requires protection of individual spawning stocks to insure successful recruitment in the face of wide stock size fluctuations common to pelagic species (Sinclair 1985; Stevenson 1997 pers. comm.). Because the recovery of a collapsed spawning population may take a long period of time (Sinclair 1985), it is important that the individual populations be protected and monitored. For such an approach to be successful, the individual populations should be monitored so that evidence of overfishing can be readily detected (Pope 1980).

Spawning closures reduce the impact of fishing on aggregations of spawning fish, when the fish are most susceptible to capture. They afford the resource the opportunity to aggregate and spawn with minimum disturbance. Anthony and Waring (1980) theorized that sequential fishing on spawning herring contributed to the collapse of the Georges Bank fishery not only due to excessive mortality but because intense fishing effort reduced the ability of the remaining fish to spawn. The implementation of spawning area restrictions will reduce this danger. At the same time, the removal of fishing pressure will help the assessment of individual spawning populations. It will be easier to accurately evaluate the extent and size of spawning populations if they are not disturbed by fishing activity. Annual variations in spawning populations can be monitored and adjustments to the management system can be made to protect individual populations. This will help achieve the FMP's goal to protect individual spawning closures.

The proposed spawning closures are based on the existing Commission spawning closures, locations of known egg beds, knowledge on larvae distribution, and the locations of ICNAF gonadal stage 5 and 6 herring from commercial catch samples. The locations of egg beds and larval distribution are summarized in Reid et al. (1998). This information was used to determine the essential fish habitat for these life stages in the Council's Essential Fish Habitat (EFH) amendment, reproduced in Figure E.18 and Figure E.19 (NEFMC 1998a). In addition, Maine Department of Marine Resources scientists plotted data from commercial catch samples obtained from 1964 through 1997 to show the observed locations of stage 5 and 6 herring (Figure E.20 and Figure E.21). The closures were chosen to include most of the areas identified by examining this data.

The original (pre-amendment) Commission spawning closures allowed some herring fishing to continue during the closures, in both state and federal waters. Vessels were allowed to fish for herring during the closures as long as no more than s25 percent of the catch contained spawn fish (spawn or milt). It was up to the individual states to choose whether to enforce this provision – in some areas, states instead closed the directed fishery and allowed only a bycatch of herring. Maine allowed fishing subject to a tolerance in the waters north of Portland, reducing the percentage of spawned fish to 20% in 1998. For the area south of Portland, state closures (Maine, New Hampshire, and Massachusetts) did not include a tolerance, limiting vessels to a bycatch of herring. The Commission has altered its closure scheme to apply this tolerance provision in all state waters of the Gulf of Maine for the period August 1 through October 31. Once again, it will be up to individual states to choose whether to enforce the tolerance provision or adopt an equivalent conservation measure.

Considerable herring spawning occurs in the EEZ, an area not included in the Commission's draft amendment. The Council closures are intended to augment the state waters closures at the time of peak spawning. The closures adopted by the Council do not include the "tolerance" provision. Any catch that would have been taken under the tolerance provision will not be harvested during the Council's closures. Fishermen can be expected to change their behavior to compensate for the loss of landings from the Central and Western Maine areas. The easiest way to compensate would be to fish in a different area. During the Council's closures off the coast of Maine, fishermen will be able to fish either in state waters (subject to the tolerance provision enforced through state regulations), or in the area off the coast of New Hampshire and Massachusetts that remains open. Maine fishermen are likely to fish in state waters as they will be closer and transit time will be lower. This may result in increased fishing pressure in these areas during these periods, with a negative impact on pre-spawning aggregations. The overall impact of this redistribution of effort is unclear.

An alternative approach to protect individual spawning components of herring suggested by Sinclair et al. (1985) is to reduce fishing mortality during the periods that spawning populations are mixed together. Since there is currently no way to identify individual populations when they are mixed together outside of spawning seasons, the concern is that an entire spawning population may be caught even though overall TACs have not been reached. The best time to identify the size of individual populations is when they are aggregated for spawning; a "survey, assess, fish" protocol (as used by Canada) could then insure that the individual populations are protected. This method limits the harvest in the spawning period. Another issue is that the extent to which populations remain aggregated during the mixed phases of the fishery is unclear. If, during a mixed phase, individual populations remain in discrete groups, the chances of a small population being overfished rapidly may be high. On the other hand, if the mixing of herring populations during these phases is complete, there may be a greater hazard to individual populations if they are targeted while aggregated on the spawning grounds and survey information is incomplete.

Herring eggs are typically laid on the bottom in large masses. These egg beds attract feeding schools of fishes and invertebrates (Caddy and Iles 1973), which can, in turn, attract mobile gear fishermen. There is a possibility that bottom tending mobile gear may damage or dislodge herring eggs. The extent of damage to egg beds, and the effect this has on survival of the eggs, is uncertain. In addition, there is limited information on the precise location of herring egg beds on an annual basis. Ultimately, it may prove desirable to identify small, discrete egg beds and prohibit all fishing activity in these areas until the eggs hatch. Information is not currently available to support such an approach, and this approach may not provide sufficient protection to pre-spawning aggregations of herring.

A number of variations were considered for the timing and location of spawning areas. One alternative included starting the closures on dates determined by biological sampling, in order to be certain the closures protected peak spawning activity. The logic behind this approach is that spawning periods could change from year to year, depending on stock and oceanic conditions. Fixed dates do not respond to these annual changes, so the closures may miss the time of peak spawning. This proposal was rejected because of the necessity for accurate sampling programs to estimate the correct dates. By using four week closures (eight weeks on Cashes Ledge), it is likely the closures will cover at least part of the peak spawning period. If the closures consistently miss the time of spawning, the dates can be revised through a framework adjustment.

The Council also considered different boundaries for the spawning closures in Management Area 1A. The draft measures included three areas off the Maine coast, one large area that covered all of coastal Massachusetts, New Hampshire, and southern Maine, and a different closure area on Cashes Ledge. Because two of the proposed areas off Maine had the same closure dates, they were combined for the proposed alternative to make one area. The Maine areas were also slightly modified to make use of existing regulatory areas, with no expected impact on their effect. The Massachusetts/New Hampshire closure area was significantly reduced in size. The adopted areas make use of existing regulatory areas, but also focus on the primary spawning areas within the original proposed area. The Cashes Ledge closure was increased to include several offshore banks that have some spawning activity. The net result of these changes is that while the reduced size of the Massachusetts/New Hampshire closure can be expected to provide less spawning protection than the original proposal, the benefit is that it allows fishing effort to be spread over more area during this closure.

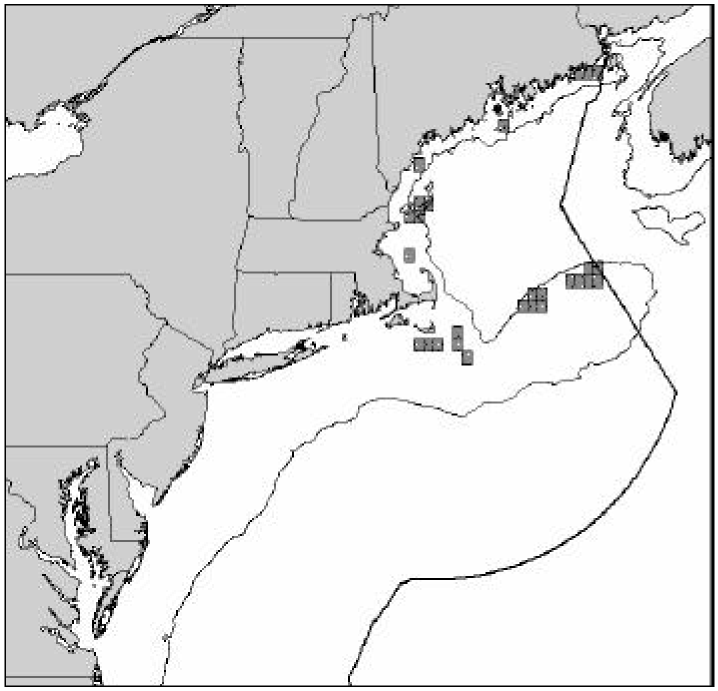

Figure E.18 – Essential fish habitat designations for Atlantic herring eggs (NEFMC 1998a)

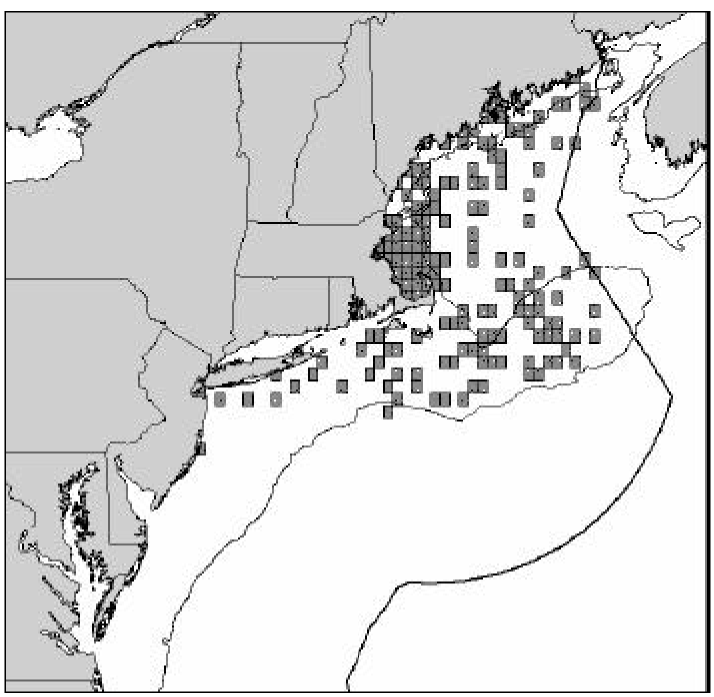

Figure E.19 – Essential fish habitat designations for Atlantic herring larvae (NEFMC 1998a)

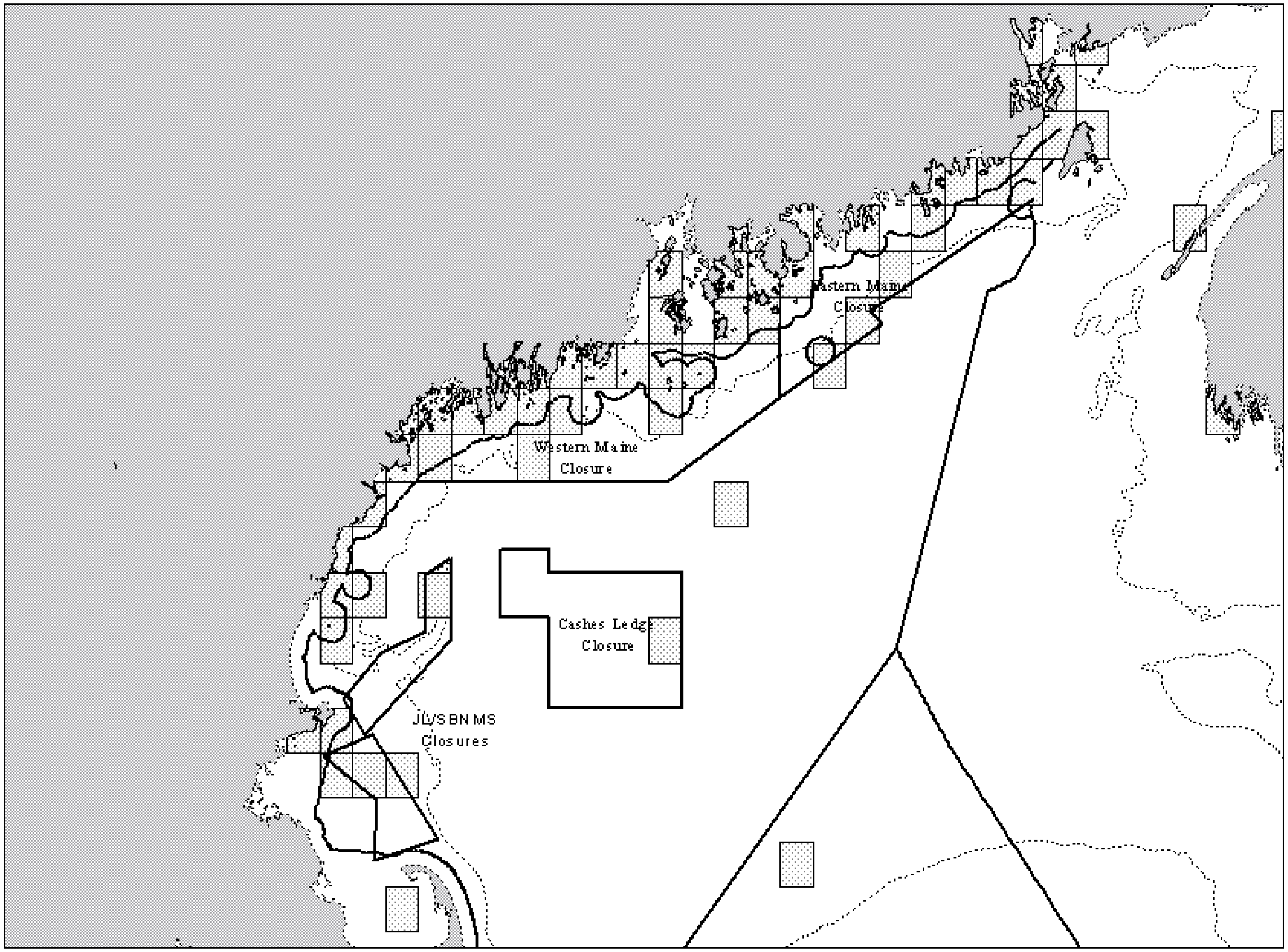

Figure E.20 – Distribution of ICNAF gonadal stage 5 herring from commercial catch samples, 1964-1997 (Source: Maine DMR)

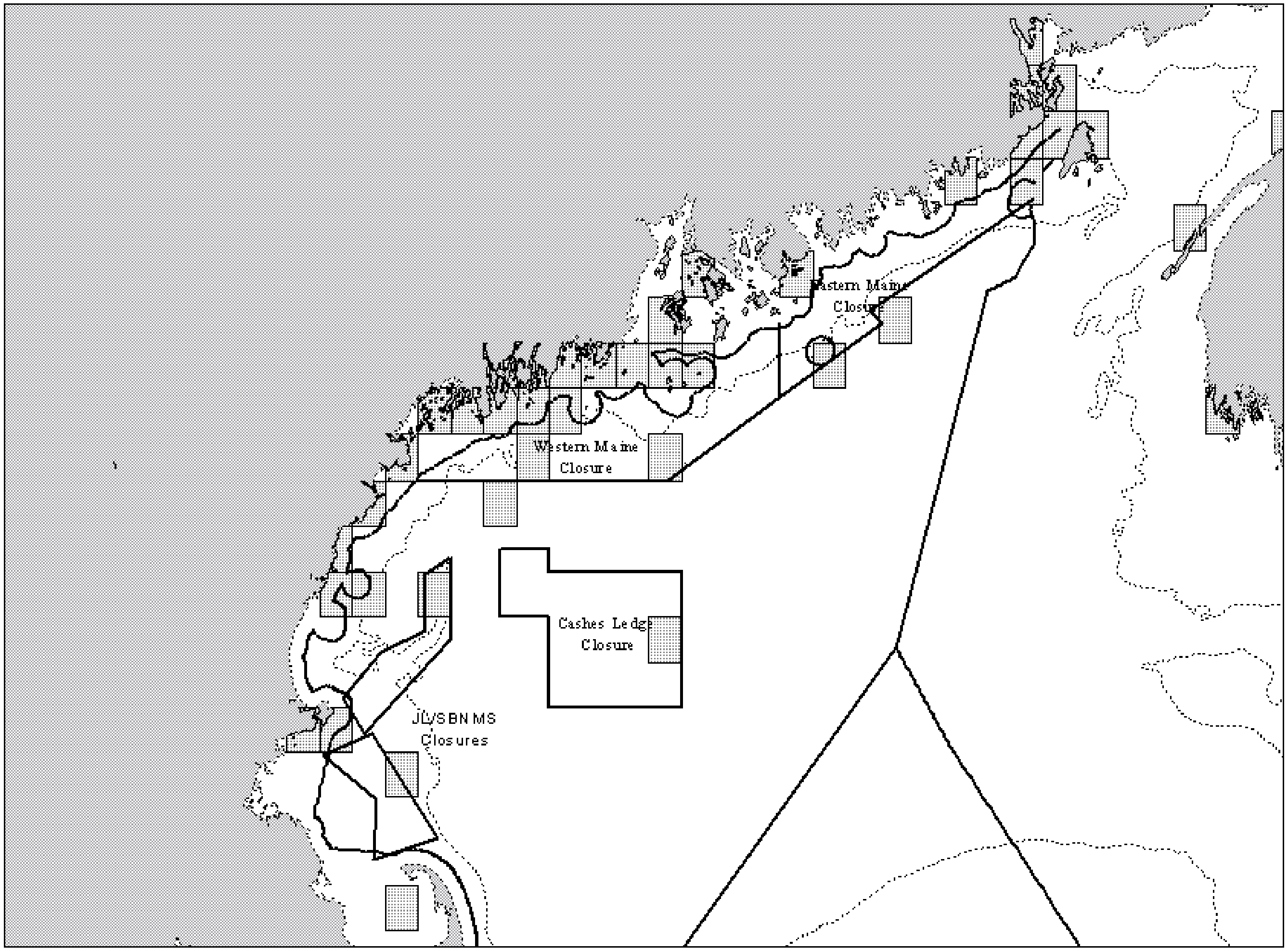

Figure E.21 – Distribution of ICNAF gonadal stage 6 herring from commercial catch samples, 1964-1997 (Source: Maine DMR)

E.7.2.5 Catch Controls

The primary management measure adopted by this plan is a system designed to control fishing mortality through specification of a total allowable catch (TAC). This system includes a requirement to close the directed herring fishery when the TAC is approach, the distribution of the overall TAC to different management areas, and the imposition of mandatory days out of the fishery to slow catch rates. The system is designed to not only control overall fishing mortality for the coastal stock complex, but to spread fishing effort throughout the range.

E.7.2.5.1 Total Allowable Catch

Based on the optimum yield in the fishery, the plan establishes a total allowable catch (TAC) to limit the catch of herring to levels consistent with the overfishing definition. The establishment of a "hard" TAC provides a firm limit on fishing mortality. The management plan proposes to prohibit large-scale directed fishing for herring when 95 percent of the TAC is reached in an area during a time period. As the TAC is approached, effort controls are imposed which will slow catch rates, extending the fishing season and making it easier to determine when the TAC will be attained. This insures that regardless of fishing effort, the fishing mortality of herring will be tightly controlled. Some herring, limited to 2,000 pounds per trip (with a one trip per day limit), may be taken in other fisheries after an area was closed (or subject to effort controls) when the TAC is reached.

At various levels of the TAC, effort controls are imposed. Possible high catch rates make it important to accurately identify when these catch controls should be implemented. Rather than wait until the landings are reported that equal the trigger points, the TAC system relies on projections of the catch. The requirement that vessels report landings on a weekly basis through an IVR system is also intended to help determine the appropriate time to implement effort controls. Recent changes to the NMFS dealer reporting system will also require weekly telephonic reports. For the first time, there will be both dealer and vessel statistics available on a weekly basis to use in projecting when the TAC will be reached.

According to a Food and Agriculture Organization (FAO) report, the use of a TAC where the quota "…is not individually assigned to operators in the fisheries has not had an impressive track record in either resource conservation or in economic optimization of fisheries" (Morgan, 1997). This report cites an Organization for Economic Cooperation and Development study of 22 fisheries managed with catch quotas, showing that only 6 were maintained at steady catch levels. Some of the conclusions of this report, however, are not directly applicable to the proposed measures. This same report noted that typically (24 of 37 stocks examined) the TAC is set too high. At least for the initial year of this plan, however, the herring TAC is being set at a very conservative level - 75% of the MSY for a stock that is believed to have a biomass far in excess of B_{MSY}. Some of the other problems noted in this report are also addressed in this management plan. Many of the fisheries studied used quotas to monitor multispecies complexes, rather than an individual species as in this plan. In addition, very few (only 2) of the fisheries included a system for an annual adjustment of the TAC based on stock status. A key element of this herring proposal is that the TAC will be determined on an annual basis after a review of the status of the coastal stock complex. Finally, the plan does not rely solely on a TAC, but uses effort controls to slow the catch of herring.

In establishing the TAC system, the Council carefully considered the impact of the TAC on other fisheries. While in 1997 over 97 percent of reported herring landings were caught by 16 vessels, over 185 additional vessels reported some landings of herring. These vessels primarily participate in the groundfish, shrimp, and mackerel fisheries, using mid-water and bottom trawls. The Council considered prohibiting the landing of herring in these fisheries after the TAC in an area is reached, or closing any fishery that has an incidental catch of herring. If the first approach was chosen, the effect will be to increase regulatory discards of incidentally caught herring. The second approach, while very effective in protecting herring, would impose severe hardships on other fisheries with little additional protection provided to the herring resource. As a result, it is not considered to be cost effective. Another difficulty in this approach is the reliance of the lobster and tuna fisheries on bait herring. A prohibition on the possession of herring after the TAC is reached would cripple these industries with no benefit to the herring resource.

The proposed action is a compromise. After 95% of the TAC is reached in an area, vessels will be limited to a small incidental catch of herring. While directed fishing for herring will cease, exceeding this 5% set aside will not result in a prohibition on the landing of herring or closure of these other fisheries. This could result in exceeding the TAC in a given area. A rough analysis, however, indicates this is unlikely.

Most herring landings are from purse seine, mid-water trawl, or fixed gear (stop seine and weir) fisheries. Bottom trawl, sink gillnet, and shrimp trawl fisheries, however, do catch some herring. Observer/sea sampler observations on the ratio of herring catch to total landings (from the dealer weighout database) were used to determine rough approximations of the catch of herring in bottom trawl, shrimp trawl, and sink gillnet fisheries. The range of estimates for annual catches (landings and discards) from these gear types in all areas is 2,294 mt to 7,342 mt. Catch ratios could not be determined for mid-water trawls due to a lack of observer/sea sampler reports. As a comparison to the predicted estimates, the reported herring landings for bottom trawl and sink gillnet gears (from the dealer weighout database) are also listed in Table E.51 and Table E.52. Upon implementation of the management plan, the management area most likely to have catches approach the TAC is Area 1. Management Area 1 vessel trip report data was examined to estimate the magnitude of incidental reported landings by all gear types.

These estimates should be used with caution. The incidental catch ratios have not been examined to determine whether sampling was adequate to characterize each fishery. Some monthly ratios do not accurately represent catches of the gear in use, illustrated by actual landings of herring exceeding the estimate predicted by the ratio. The lack of estimates from the mackerel fishery, whose vessels have occasional large landings of herring, may result in an underestimate of actual incidental catches. Summing the observations over the range of the fishery may gloss over local variations. There are also differences between landings attributed to bottom trawl gear in the dealer and vessel trip report databases. The dealer weighout database attributes more landings to bottom trawls than the vessel trip report database. A cursory review indicates some landings in the dealer database may have been mis-assigned to bottom trawls. To the extent the dealer weighout database overestimates bottom trawl landings of herring, this analysis may actually overestimate the incidental catch of herring by bottom trawl vessels. Finally, some large herring landings from bottom trawls indicate some bottom trawl trips may be directed on herring and may not be incidental catches. To the extent these trips are included in the various "incidental catch" definitions, they will overestimate the true incidental catches during a closure.

The Northeast Fisheries Science Center (NEFSC) examined the observer and sea sampler databases for information on the catch of herring by gears that do not normally target herring (see Appendix II). Four gears were identified to be of interest: bottom trawls (gear code 50), shrimp bottom trawls (gear code 58), sink gillnets (gear code 100), and mid-water trawls (gear code 370). Estimated ratios of herring catches to total landings were determined for the first three gear types. These ratios were determined for the entire time period (1989-1997) by statistical area, month, and an overall ratio for the time period. Annual trends in the ratio were also computed. Ratios could not be estimated for mid-water trawls because of the limited number of observations.

The monthly, annual, and overall ratios were applied to total landings (all species) obtained from the dealer weighout database to estimate herring catches for bottom trawls and sink gillnets from all areas. The estimates were not broken down by statistical area because the dealer weighout database does not include location of catch. The results are shown in tables Table E.51 and Table E.52. The actual reported herring landings for the various gear types were obtained from the same database for comparison. Incidental catches of herring in shrimp trawls are estimated by applying the annual landing ratios to landings of northern shrimp.

The estimated catches of herring in bottom trawls range from 2,205 mt to 6,794 mt, depending on year and which catch ratio is used. Shrimp fishery incidental catch estimates range from 80 to 588 mt for the period 1989 – 1996. In the sink gillnet fishery, the estimates range from 9 mt to 278 mt. These estimates include all catches, regardless of disposition.

By using bycatch ratios computed on an annual basis, this approach may gloss over differences in bycatch ratios in different areas. To get a sense of the magnitude of this potential problem, incidental catches in Management Area 1 were examined. The vessel trip report database was examined to estimate the amount of herring reported landed from Management Area 1 as an "incidental catch." "Incidental catches" were identified in three ways: herring landings from vessels that landed no more than 50 mt of herring from all areas, herring landings from vessels that landed no more than 20,000 mt of herring from all areas, and herring landings from vessels that landed less than 2,000 pounds of herring per trip that landed herring from Management Area 1. Under any of these definitions, "incidental catches" does not include vessels that may land more than 50 mt of herring in the course of the year while targeting herring for a small number of trips

– a practice that some whiting vessels pursue in the late summer. In 1996 and 1997, the average herring incidental catch landings per trip for vessels identified in these three ways was less than 800 pounds. A trip-by-trip analysis was not performed to determine herring landings as percentage of the value of each trip or the distribution of landings.

The conclusion from this analysis is that in recent years, the estimated incidental catch (landings and discards) of herring over all areas in the bottom trawl, shrimp, and gillnet fisheries ranged from 2.5% to 6.6% of reported herring landings. In Management Area 1, the estimated incidental landings of herring were less than 200 mt in 1996 and 1997. It should be noted these percentages are for the entire year, not just the period after an area closure or imposition of effort controls. Consequently, the proposed action should prevent the TAC from being exceeded. It is possible that in the future, the percentage set-aside may need to be adjusted. While these estimates do not include incidental catches in the mackerel fishery, the character of that fishery will minimize its impact on the overall TAC. The overwhelming majority of mackerel landings occur at the start of the herring fishing year, from January through May. It is unlikely that any area will be closed or subject to effort controls during this period. Any herring landed in connection with this fishery will be counted against the TAC, not the 5 percent set-aside. These landings will be caught before the imposition of the trip limit. Because the mackerel fishery will be essentially over, the trip limit should not encourage regulatory discards by mackerel vessels.

Two other factors should be considered when evaluating the impact of this approach. First, many of the fisheries that report incidental catches of herring are under increasing regulatory restrictions. Reductions in fishing effort should result in a reduced level of incidental catches of herring. Second, the plan has adopted a conservative approach to harvest levels in the initial year. OY is established well below the MSY level. Given current conditions, in most management areas there is some flexibility to monitor the incidental catch estimates and adjust as necessary (through framework action) in later fishing years. One area of possible concern is Management Area 1A, where the resource may be fully utilized. The proposed 45,000 mt TAC will result in an incidental catch set-aside of 2,250 mt. This is nearly three times the estimate of incidental catches of herring from all of Management Area 1 in 1999. It is nearly equal to reported landings of herring by bottom trawl vessels from all areas in 1997. Given increasing effort restrictions on other fisheries, it's unlikely that this amount underestimates the incidental catches that can be expected after the directed fishery is closed.

The Council originally considered closing the directed herring fishery only when the projected landings reached 100% of the TAC, without providing any allowance for incidental catches in other fisheries. Under that scenario, the TAC would always be exceeded by any incidental catches taken after closure of the directed fishery. The adopted approach makes it more likely that catches of herring will be within the TAC limits, while allowing some flexibility for other fisheries to continue.

Bottom trawls, fish																
Year	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**Sep.**	**Oct.**	**Nov.**	**Dec.**	**Sum**	**Overall**	**Year**	**Est.**
Catch/Landings Ratio	0.044	0.086	0.035	0.039	0.043	0.020	0.010	0.008	0.022	0.021	0.014	0.115		0.033		
1997 - Est. Herring Catch	443	859	334	437	337	146	112	85	228	217	98	799	4,097	3,668	0.0196	2,205
1997 - Reported Landings	*402*	*474*	*229*	*410*	*74*	*109*	*186*	*68*	*119*	*51*	*145*	*102*	*2,368*			
1996 - Est. Herring Catch	491	488	547	428	431	537	489	445	475	546	450	324	5,651	4,171	0.0531	6,794
1996 - Reported Landings	*281*	*505*	*217*	*150*	*143*	*25*	*6*	*10*	*433*	*159*	*597*	*442*	*2,969*			
1995 - Est. Herring Catch	372	375	506	471	383	535	607	413	371	480	401	292	5,205	3,840	0.0318	3,746
1995 - Reported Landings	*202*	*357*	*322*	*156*	*514*	*0.3*	*82*	*42*	*54*	*0.4*	*245*	*466*	*2,440*			

Table E.51 - Estimated herring catch from bottom trawls, gear code 50. (Shaded areas highlight months that actual reported landings exceeded estimated catch.) (Source: Herring catch to landings ratio from NEFSC letter date February 20, 1998; total landings from the NMFS dealer weighout database.)

Sink gillnet																
Year	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**Sep.**	**Oct.**	**Nov.**	**Dec.**	**Sum**	**Overall**	**Year**	**Amount**
Catch/Landings Ratio	0.0002	0.0003	0.0007	0.0008	0.0021	0.0065	0.0129	0.0217	0.0055	0.0022	0.0016	0.0002		0.0084		
1997 - Est. herring Catch	1	1	2	2	6	21	48	69	16	5	3	0	173	278	0.0007	23
1997 - Reported Landings	*0*	*0*	*0*	*0*	*0*	*0*	*3*	*28*	*0*	*3*	*0*	*0*	*35*	*35*		
1996 - Est. Herring Catch	0	0	1	1	6	27	62	77	15	5	3	0	197	249	0.0073	216
1996 - Reported Landings	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*2*	*0*	*0*	*0*	*0*	*2*	*2*		
1995 - Est. Herring Catch	0	0	1	1	7	32	70	65	14	5	3	0	200	251	0.0003	9
1995 - Reported Landings	*0.1*	*0.0*	*0.0*	*0.1*	*0.1*	*0.2*	*0.0*	*15.7*	*21.7*	*1.7*	*15.3*	*0.0*	*55*	*55*		

Table E.52 - Estimated herring catch from sink gillnets, gear code 100. (Shaded areas highlight months that actual reported landings exceeded estimated catch.) (Source: Herring catch to landings ratio from NEFSC letter date February 20, 1998; total landings from the NMFS dealer weighout database.)

Year	Shrimp Landed (MT)	Herring Bycatch Ratio	Estimated Herring Bycatch (Bycatch Ratio X Shrimp Landings)
1989	3,610	.1629	588
1990	4,385	.0254	111
1991	3,377	.0593	200
1992	3,382	.0363	123
1993	2,270	.0094	21
1994	3,718	.0091	34
1995	6,829	.0117	80
1996	9,524	.0221	210
Total	40,176	.0327	1313

Table E.53 - Estimated herring catches in the northern shrimp fishery 1989-1996. Bycatch ratios based on 856 hauls sampled between 1989 and 1996. (Source: Herring catch to total landings ratios from NEFSC letter dated February 20, 1998; shrimp landings from NMFS Fisheries Statistics and Economics Division, pers. comm.)

Criteria for identifying "incidental catches"	Number of trips landing herring from Area 1		Herring landed from Area 1 (mt)		Number of Vessels		Herring lbs/trip (Area 1)	
	1996	1997	1996	1997	1996	1997	1996	1997
Total herring landed by each vessel less than 50 mt from all areas	706	432	192	155	99	64	599	789
Total herring landed by each vessel less than 20,000 lbs from all	532	368	71	45	94	60	292	267
Average Area 1 herring trip less than 2,000 pounds	659	408	103	74	93	58	248	399

Table E.54 - 1996/1997 Reported landings of "incidental catch" herring, Management Area 1 (Source: NMFS VTR database, unpublished data)

E.7.2.5.2 TAC Distribution

The distribution of this TAC to different management areas and seasons provides a measure of protection to individual spawning components. The range of options considered by the Council provided different levels of protection. The proposed action specifies an annual TAC for each of the management areas and sub-areas (1, 1A, 2 and 3, Figure 4). The distribution of the overall TAC is based on existing knowledge of stock structure, mixing, and current fishing patterns. The proposal acknowledges that over time the information on stock structure may change, and allows the PDT/TC to revise the distribution pattern to take into account new information.

The TACs in this option are based on current fishing patterns and estimates of stock mixing. The TACs established in Area 1A, 1B and 2 take into account the mixing of Gulf of Maine herring with those from other components in the summer and winter. By controlling the catch in Area 2, some control is exercised over the amount of Gulf of Maine fish caught during the winter months. If the catch in this area during this time period were unlimited, it is possible that the Gulf of Maine spawning component could be rapidly depleted without notice. The assignment of part of the Area 2 TAC to a TAC reserve provides some control over this winter fishery.

Mistakes in estimating the relative size of the various spawning components, or in estimating migration of herring during the course of the year, could result in establishing a TAC that does not provide protection to specific spawning components. The cautious approach taken in establishing OY helps to reduce the likelihood that any such mistake will result in severe damage to the resource.

A number of different options were considered for the TAC system. The options are described below (identified as in the draft management measures).

Option 1 proposed assigning a TAC to Management Areas 1A, 1B, 2A, and 2B/3. (the proposed Management Area 2A – the northern part of management Area 2 – is not adopted by this plan). The seasonal (winter) TAC assigned to area 2A would have explicitly considered the mixing of Gulf of Maine and GB/NS fish in this area. By limiting the catch in this area, some control is exercised over the amount of Gulf of Maine fish caught during the winter months. If the catch in this area during this time period were unlimited, it is possible that the Gulf of Maine spawning component could be rapidly depleted without notice. Similarly, the TAC in Area 1A protects the Gulf of Maine fish in this area during the remainder of the year. TACs for the other areas insure that the overall catch does not exceed the OY. This option was rejected because of uncertainty over the migration of Gulf of Maine fish into the proposed Management Area 2. While the migration patterns can be estimated based on the location of herring in this area during the winter months when the Georges bank stock had collapsed, the exact location of fish in this area is unknown.

Option 3 proposed assigning TACs to all four areas for each of three seasons. It makes explicit use of knowledge on stock structure and relative stock sizes to control catch in each area and time period so that individual spawning components are not damaged. In theory, this option provided the greatest protection to individual spawning components of herring. In practice, however, this option relied on a level of detail on stock structure that is lacking. The complexity of the scheme also made it less likely that it could be accurately monitored and implemented, reducing it is effectiveness.

Option 4 proposed assigning TACs to the three major management area based on an estimate of the amount of fish that is present in these areas on an annual basis. It does not have as close a relationship to current knowledge on stock structure. It does provide some measure of protection to the individual spawning components, primarily through the use of conservative TACs. Because this method puts less emphasis on seasonal migrations of herring, any amount of herring assigned to Management Area 1B reduces the amount of herring available for Management Area 1A. TACs must be set at a conservative level to prevent overfishing on specific spawning components. This option was rejected because of its reliance on historic fishing patterns that may change.

Option 5 proposed assigning one overall TAC to the entire CSC based on the ABC and OY. This option ignores any information on stock structure, and assumed that the entire coastal stock complex is one homogenous stock. For this reason, it provides no protection whatsoever to individual spawning components. In theory, the entire OY could be taken from the Gulf of Maine in the summer months. Harvests at this level far exceed historical catches from this area and could not be supported. This approach could decimate herring stocks if all fishing effort is concentrated in one management area.

E.7.2.5.2.1 Initial TAC Distribution

The specific TAC distribution for the first year of the plan can be examined to gain a qualitative sense of the likelihood it will meet the objectives described in the previous section. For the initial year of the plan, the recommended TACs for the individual areas are as follows (from 3.6.3.1):

Area	TAC
Area 1A	45,000 mt
Area 1B	25,000 mt
Area 2	50,000 mt
Area 3	50,000 mt
Area 2 TAC Reserve	54,000 mt
Total TAC	224,000 mt

Table E.55 – Initial TAC distribution

In the last twenty years, the herring fishery has concentrated in the inshore Gulf of Maine area, Area 1A. Landings in Management Area 2 the southern New England area) were less than 20,000 mt until 1997 and 1997, and landings on Georges Bank have been negligible until 1997 (1998 landings from this area are expected to approach 20,000 mt). Landings exceeded 70,000 mt in 1996 and 1997 from the inshore Gulf of Maine area. The SARC noted in its advisory report that "It is currently unknown whether the fishing mortality rates in Management Area 1 are sustainable" (NEFSC 1998a). Further, the SARC cautioned that any increases in catch should not come from the Gulf of Maine stock component. The proposed initial TACs consider this advice. In particular, the proposed 45,000 mt TAC for Area 1A is lower than the reported catch from this area for any year since 1989.

Fishing effort has concentrated on the inshore area of Management Area 1A due to convenience (lower operating costs) and the ready availability of herring. In 1996, approximately 8,700 mt were caught in statistical area 515, which roughly corresponds to Area 1B. The proposed TAC of 25,000 mt from this area is a substantial increase, based on the belief that during some periods of the year, there are considerable herring in this area from several spawning components that are available. The restrictive TAC in Area 1A, which will move fishing effort out of this area, will force vessels into Area 1B to catch these fish. The result should be additional protection for the Gulf of Maine spawning component as effort is moved onto other components of herring.

For the other two management areas, the TACs represent the estimate of SAW 27 that 65% of the stock complex occupies Nantucket Shoals and about 10% (increasing in recent years) occupies Georges Bank during the spawning season. While all three spawning components mix during the year, these herring are most susceptible to harvest in the winter months or during the spawning season. The assigned TACs, while a substantial increase over recent catches from these areas, take into account mixing throughout the year. Only 66% of the overall TAC (including the TAC reserve) is assigned to Management Areas 2 and 3, taking into account the fact some of these herring are caught in the other management areas due to mixing.

E.7.2.5.3 Mandatory Days Out of the Fishery

Fishing effort will be reduced as the TAC is approached by requiring vessels to take mandatory days out of the fishery. The number of days taken out of the fishery is determined by how close the catch is to approaching the TAC. This regulation should reduce catch rates as the TAC is approached. This will facilitate a more accurate prediction of when the TAC will be reached, helping to prevent the TAC from being exceeded before the fishery can be closed. The greater the accuracy that attainment of the TAC can be projected, the more likely that mortality targets will not be exceeded.

This measure also redistributes fishing effort to other areas, further reducing effort in a particular area. As the number of days out of the fishery increases, some vessels may choose to relocate to areas that remain open. This is likely to be an option for the larger vessels that fish in Management Area 1A, who can easily move into Management Area 1B and continue to fish on the mandatory days out of the fishery. Whether they will choose to fish in both areas, or shift operations into areas where they can fish without interruption, is uncertain and will be based in large measure on market conditions caused by the imposition of effort controls.

Most herring trips for both mid-water trawl and seine vessels are one day or less in length. The number of consecutive days taken out of the fishery is based on an analysis of the number of trips that would have been effected in 1996 if these measures were in place. This analysis demonstrated that taking a certain number of consecutive days out of the fishery would have affected a percentage of the total trips taken. If two consecutive days are taken out of the fishery, 12.8% of the fishing days were removed; if three consecutive days were taken out of the fishery, 26.5% of the days were removed. The relationship between landings and number of trips is not clear. If, in 1996, all trips examined landed the maximum amount of herring possible, then a reduction in the number of trips should have a proportional reduction in the amount of landings, but an examination of trips that landed in Maine in 1996 shows that many trips land only a fraction of the documented hold size. If a vessel can increase its landings on an open day, replacing the landings that would have been caught on a closed day, it will reduce the impact of days out of the fishery. This means the exact impact of the consecutive days out of the fishery cannot be accurately predicted. Should this effort control be ineffective the TAC will still limit the overall harvest.

In analyzing the economic impacts of the alternatives, the impact of this measure was modeled on the catches from Management Area 1 in 1996 and 1997. The results of the model indicate that this measure may slow the rate of landings. Once again, this model should be viewed with caution as it does not predict any compensatory action by fishermen to make up reduced revenues caused by the days out of the fishery. The actual reduction in landings will be less than predicted by the model by some unknown amount.

When directed herring vessels cannot fish in an area because of mandatory days out of the fishery, some herring will continue to be taken by vessels in other fisheries. These vessels will be subject to a 2,000 pound limit per trip. It is unlikely any vessel will target herring at this low level, equal to about $120 in ex-vessel revenue. This limit will allow the landing of incidental catches of herring, minimizing discards. As shown in Table E.54, the average landings of herring for incidental catches in 1996 and 1997 were less than 800 pounds per trip.

E.7.2.5.4 Vessel Size Limits

Domestic vessels catching, taking, or harvesting herring are limited to less than 165 feet in length and 750 GRT. No vessel catching herring can have more than 3,000 shaft horsepower. While this measure is primarily designed to limit the entry of excessive fishing capacity into the fishery, it may also have beneficial biological impacts.

SAW-27 (NEFSC 1998a) expressed concern about the precision of current estimates of fishing mortality and spawning stock biomass for the coastal stock complex. The SARC's management advice further stated that any increase in landings should occur incrementally so that the precision of these estimates can be improved. The large estimates of biomass are, in part, a result of very high recruitment in the 1990's. The SARC believed that a rapid increase in catches could have a detrimental impact on the stock.

Large harvesting vessels entering the fishery could have exactly the impact that the SARC cautioned against. According to public testimony, some vessels in the 300-foot range are estimated to be capable of harvesting 200 to 300 mt of herring each day, limited by processing capacity. Based on this daily harvest, one such vessel could be capable of catching as much as 40,000 to 60,000 mt of herring if fishing for 200 days in a year. This would be an immediate increase in catch of nearly 40% over the 1996 and 1997 reported landings. While vessels of this size may choose to fish only part of the year for herring, even a harvest of 20,000 mt – possible with only 100 days of fishing by one vessel - is an immediate increase of 20% over recent landings. While there could be a similar impact if a large number of smaller vessels simultaneously enter the fishery, because of economic limitations on converting vessels and market limitations it is less likely that the increase will occur in as rapid a fashion. Generally, smaller vessels are also more likely to be limited in the number of days they can fish due to weather, carrying capacity, and the endurance of the vessels. This also tends to reduce the overall catch of these vessels. No single vessel fishing for herring in 1996 harvested more than 20,000 mt even though some vessels fished for over 190 days in the year. The average daily landings of the twenty vessels that landed the most herring in 1997 were only 77 mt, far less than the possible 200 mt average catch of a large fishing vessel (see Table E.14). This illustrates that both catch rates and overall landings for existing vessels are likely to be significantly less than for a vessel that exceeds the size limitation.

With respect to overall fishing mortality, the size of vessel (and resultant catch rates and overall harvesting capacity) becomes less important with the establishment of a "hard" TAC. As long as effective catch control measures are in place, from a biological standpoint, the size of the vessel should make little difference to the management of the herring resource. Large vessels may, however, reduce the effectiveness of those catch controls. If a number of large vessels enter the fishery, it is possible that the resultant high catch rates may make it difficult to accurately assess the industry's progress towards reaching the TAC. This may result in overshooting the TAC, with resultant damage to the resource. As noted above, existing vessels in the fishery have lower catch rates than the estimated catch rates for vessels over the size limit. By limiting the size of vessel in the fishery, it may be easier to accurately determine when effort controls should be imposed. Because of the lower catch rates of the smaller vessels, the magnitude of error caused by missing reports from any one vessel is likely to be less. The opposing view is that it may actually prove easier to monitor a small group of large vessels than a large group of smaller vessels.

The current OY is based on estimates of existing DAH and DAP in the New England area. It is a conservative figure, less than the estimated MSY for the resource. Part of the reason for choosing this MSY is because of the uncertainties highlighted in the SARC report. If a an immediate increase in DAH and DAP is allowed into the fishery through the entry of large domestic fishing vessels, the increase in DAH and DAP could result in a corresponding increase in OY. This would not be consistent with the SARC's recommendation to increase landings in an incremental fashion.

Another possible impact of not allowing large vessels to enter the fishery is that overall fishing effort may be distributed over a wider area and longer time period, helping to protect individual spawning components. The reduced catch rates of smaller vessels may result in spreading the effort over longer time periods. This may occur, in particular, on the offshore areas, where the limited capacity, seakeeping ability, and endurance of smaller vessels will reduce the number of days spent actually fishing. If a large number of small vessels enter the fishery, however, their total effort could approach the average catch rates of several vessels over the size limit.

The plan proposes to limit at-sea processing by U.S. vessels that exceed 165 feet or 750 GRT to a specific allocation. Catch rates by vessels supporting at-sea processors can be expected to be similar to the catch rates for a large harvesting vessel, as the processors have similar processing capacity and can be expected to hire enough catcher vessels to support that capacity. Restricting those vessels to a specific allocation will insure that a high catch rate by vessels support large processors does not result in exceeding the TAC, resulting in some limited biological benefits to the measure.

E.7.2.6 Use Restrictions

The plan allows the harvest of roe from herring as long as the carcass is not discarded. The requirement that the carcass be retained is intended to reduce waste in the herring fishery. During initial development of the pollock roe fishery in the North Pacific, harvesters discarded male pollock and the carcasses of female pollock; this practice is now prohibited (Witherell 1997). This practice complicates the enforcement of the overall TAC, as it is difficult to accurately estimate the quantity of male fish discarded. It also makes it difficult to estimate the overall harvest of herring in such an operation, as there is no accurate way to compare the roe on board a vessel with the operator's reported total catch. There isn't any way to estimate how many herring were discarded without removing the roe. By requiring the retention of all carcasses, it is possible to develop a relationship between the weight of the roe product and the weight of the carcass, creating a more accurate estimate of the actual harvest. This will help insure that the catches remain within the established TAC.

One potential biological impact of allowing the harvest of roe is a direct result of the high economic value of this product. Because of spawning closures and state spawning restrictions in the Gulf of Maine, it is unlikely that a significant roe fishery will develop in this area. The high value of the product may encourage vessels to conduct a roe fishery on Georges Bank or Nantucket Shoals. This could have the beneficial effect of moving fishing effort into other areas, reducing mortality in Management Area 1.

The amount of herring harvested for roe, if excessive, could have an adverse impact on spawning. This fishery will be monitored and, if necessary, further controls implemented through framework action. The simplest way to control the roe fishery is to limit the amount of herring that can be harvested for this purpose.

E.7.2.6.1 Other Roe Fishery Alternatives

The Council considered several options for managing the development of the roe fishery, including a complete prohibition on harvesting herring for roe. A prohibition would reduce the incentive to fish on spawning fish (outside of the spawning closures) and would provide the most protection to the resource. The Council also considered establishing a limitation for the amount of herring that could be harvested for roe. There is little information available to determine an a appropriate level for this activity, however, so the Council instead chose to allow this activity and to monitor its development. The Council also considered establishing regulations for a roe-on-kelp fishery. In these activities, herring are confined in some manner, allowed to spawn on artificial or real kelp, then released. This provides an opportunity to profit from herring roe while minimizing the mortality of herring. The Council decided not to regulate this activity, however, since it is more likely to occur in state waters and should therefore be regulated by the states.

E.7.2.7 General Administrative Provisions

While the administrative provisions of the plan do not have a direct impact on the resource, they should improve management of the resource and help prevent overfishing.

The establishment of vessel, dealer and operator permit requirements will identify participants in the herring fishery. It also enables managers to identify participants in the fishery who should be reporting landings or purchases of herring. These requirements are necessary if management of the resource will be based on an accurate knowledge of landings and effort.

There is no current comprehensive reporting requirement for vessels fishing for herring in the EEZ. Many herring vessels possesses a federal permit of some sort and must report all herring landings through the vessel trip report system. There are some vessels that may not report all herring landings in a timely fashion, or do not report because they do not possess a federal permit. The requirement for vessels and dealers to report catches and purchases will indirectly have a positive biologic impact. Developing a comprehensive reporting system is needed to monitor catches. This, in turn, will lead to better estimates of fishing mortality and assessments of the status of the herring resource. The requirement that dealers or vessels report herring landings on a weekly basis will help managers track progress towards achieving the TAC. By making this requirement more frequent than standard monthly report, the likelihood that the TAC will be exceeded is reduced. As a result, managers will be better able to tailor measures to insure the target fishing mortality is not exceeded.

The establishment of an annual review of the plan reduces the likelihood that any negative impacts of the fishery on the herring or other resources will be undetected for any length of time. The periodic adjustments to the specifications, in a similar fashion, will make it easier to achieve the targeted fishing mortality. The framework management measures will make it easier and quicker to implement and adjustments to the management measures. A more rapid response to problems or changes in the fishery is the result.

E.7.2.8 Vessel Monitoring System (VMS)

The adoption of a VMS requirement is needed to enforce the area specific TACs. While a VMS position does not prove fishing activity, the ability to track vessel locations when underway provides NMFS a limited capability to confirm that vessels are operating in the same areas that they are reporting their catches. This will encourage accurate reporting of catch locations, a key element of the TAC distribution scheme. Accurate catch reports will insure that the area specific TACs are not exceeded, with the result that fishing mortality on specific spawning components will be limited to acceptable levels.

E.7.2.9 Measures to Reduce/Monitor Bycatch

Because of the limited information available on bycatch in the herring fishery (summarized in section E.6.4.2.6), there are no management measures proposed specifically to reduce bycatch. There are several measures, however, that will encourage reduction in bycatch and help to identify the extent of the problem. Bycatch and incidental catch will be considered when developing herring TACs. Vessels are required to report all herring caught (including discards) on the vessel trip report. In this manner, there will be an incentive for the industry to reduce the amount of herring discards as all amounts of herring caught will be applied to the TAC; it will be to the advantage of the industry to develop fishing practices and methods that maximize the economic value of the herring caught. The plan also encourages the development of an observer program to collect additional information on discards and incidental catch, and acknowledge that such programs may be developed through industry initiatives.

Provision also is made in this plan to allow the landing of herring in other fisheries. If an open access management system is selected for the herring fishery, there will not be any limits on the amounts of incidentally caught herring that can be landed, as long as vessels possess a permit and report all herring catches. During periods when the directed fishery is closed, vessels in other fisheries will be allowed to land up to 2,000 pounds of herring per trip. Similarly, if a controlled access system is implemented for the herring fishery, vessels in other fisheries will be allowed to land the same 2,000 pound incidental catch limit per trip.

One possible adverse result of the use of TACs may be the mis-reporting of catch. If vessel operators know that discarded herring will count against the TAC if it reported, they may choose not to report these catches, particularly in those areas that may be subject to closure or effort controls as the TAC is reached. Ultimately, this practice will reduce the estimates of catch included in the assessment. The impact this mis-reporting will have on estimates of stock size and mortality depends on many factors and cannot be predicted. The possibility this will occur makes it essential that accurate information on discards be obtained from objective observers of the fishery.

E.7.2.10 Biological Impacts of Alternatives Not Selected