Fishery Management Report No. 35
of the

Atlantic States Marine Fisheries Commission

Amendment 1 to the Interstate Fishery Management Plan for Shad & River Herring

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Approved by the
Atlantic States Marine Fisheries Commission
October 1998

This document was prepared in cooperation with the Atlantic States Marine Fisheries Commission=s Shad & River Herring Management Board, Shad & River Herring Technical Committee, Shad & River Herring Plan Development Team, Shad & River Herring Stock Assessment Subcommittee and the Shad & River Herring Advisory Panel.

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Section 1. INTRODUCTION

1.1 Background Information

Historically, American shad *(Alosa sapidissima),* hickory shad *(Alosa mediocris), alewife (Alosa pseudoharengus),* and blueback herring *(Alosa aestivalis)* (collectively termed alosines) were extremely important resource species and supported very large commercial fisheries along the east coast of both the United States and Canada. Coastwide landings of American shad at the turn of the century were approximately 50 million pounds. However, by 1980, they decreased dramatically to 3.8 million pounds, and by 1993, only 1.5 million pounds were landed. Total landings of river herring varied from 40-65 million pounds from 1950-1970; however, they declined steadily thereafter to less than 12 million pounds by 1980, and by 1996, only 1.4 million pounds were landed. These large declines in commercial landings were perceived as an indication that management action would be required to restore alosine stocks to their former levels of abundance. Therefore, the members of the Atlantic States Marine Fisheries Commission (Commission) recommended the preparation of a cooperative Interstate Fishery Management Plan (Plan) for American Shad and River Herrings. This recommendation was adopted by the Commission in 1981 and the Plan was completed in 1985. A supplement to this American Shad and River Herrings Plan was approved by the Commission in 1988. The document included reports prepared by the Shad and River Herring Stock Assessment Subcommittee, and summaries of material presented at an 1987 Anadromous Alosine Research Workshop. The 1988 supplement also documented changes to management recommendations and research priorities based on new research findings. The 1985 Plan specified recommended management measures, focused primarily on regulating exploitation and enhancing stock restoration efforts. At the time of the 1985 Plan, implementation of its recommendation was at the discretion of the individual states and the Commission did not have direct regulatory authority over individual state fisheries.

The decline in stocks continued, and in 1994, the Plan Review Team and the Management Board determined that the original 1985 Plan was no longer adequate for protecting or restoring the remaining shad and river herring stocks. These declines are possibly due to overharvest by inriver and ocean-intercept fisheries, excessive striped bass predation (Savoy and Crecco 1995), biotic and abiotic environmental changes, and loss of essential spawning and nursery habitat due to water quality degradation and blockages of spawning reaches by dams and other impediments. Although improvement has been seen in a few stocks, alosine populations remain severely depressed.

Depressed stock conditions are unlikely to change under current management because the 1985 Plan does not require any specific management approach or monitoring programs within the management unit, asking only that states provide annual summaries of restoration efforts and ocean fishery activity. Moreover, the Plan does not provide for adaptive management in light of stock growth or declines. In addition, to address the problem of voluntary Plan implementation, the 1993 Atlantic Coastal Fisheries Cooperative Management Act (ACFCMA) requires states to adopt management guidelines in approved Commission Plans. In the event that a state does not implement a Commission fishery management plan, the law provides that the U.S. Secretary of Commerce may impose a moratorium in that state=s particular fishery. Under this law, all Commission Plans must include specific measurable standards to improve the status of the stocks and to determine if states comply with these standards. Amendment 1 to the 1985 Plan will provide management guidance, ad required by ACFCMA, by setting specific standards to be met by the states.

Because of the scarcity of reliable data on river herring and hickory shad populations, the ASMFC member states decided to focus Amendment I on American shad regulations and monitoring programs. However, the amendment requires states to initiate fishery-dependent monitoring programs for river herring and hickory shad while recommending continuance of current fishery-independent programs for these species. As data become available for river herring and hickory shad fisheries, states will develop a better understanding of stock status and may take regulatory action at a future date.

1.1.1 Benefits and Implementation

1.1.1.1 Social and Economic Benefits

Restoring populations of American shad would be beneficial because such management action would generally increase the total use and non-use (existence) values of this species in the ASMFC member states and the nation. Increases in consumptive use values could include future allowances for commercial and recreational fishing harvest, while improvements in non-consumptive use values might include increases in ecotourism activities related to the restored American shad stocks (e.g. bird and fish watching at fish passage facilities). Population restoration of American shad might also stabilize harvesting and related commercial markets.

1.1.1.2 Ecological Benefits

American shad play an important ecological role in freshwater, estuarine and marine food chains by preying on some species and serving as prey for others, at all life stages (Facey et al. 1986, MacKenzie et al. 1985, Weiss-Glanz et al.1986). They also historically played a significant role, especially in South Atlantic coastal river systems where the percentage of spawning is low and many of the shad die after spawning, in transferring nutrients from the marine system into the freshwater interior rivers. Durbin et al. (1979) conducted a study of the effects of postpawing alewife on freshwater ecosystems. It was suggested that the potential influence of alosine migrations on the energetics and nutrient dynamics of Atlantic coastal ecosystems is equivalent to effects documented for similar systems in the Pacific Northwest. In additional, Garman (1992) studied the fate and potential significance of postpawning anadromous fish carcasses in the James River, Virginia. He hypothesized that, before recent declines in abundance, the annual input of marine-derived biomass via alosine migrations was an important episodic sources of energy and nutrients for the non-tidal James River.

As predators, American shad consume a variety of invertebrate organism at each life stage and may consume small fishes as adults. As larvae in the Holyoke pool of the Connecticut River, shad consume copepods, midge larvae, midge pupae and small crustaceans (Facey and Van Den Avyle 1986). In the same location, juveniles consumed crustacean zooplankton, midge larvae and pupae, caddis fly larvae and adult insects. Juvenile shad appear to be opportunistic feeders that consume most of their food from the water column, rather than from the bottom or surface. In some areas, however, juvenile shad were clearly selective choosing water fleas (Daphnia) and bosmids over other available prey (MacKenzie et al. 1985). Juveniles in Virginia consumed amphipods, aquatic insects and terrestrial insects. Studies of juveniles from Florida, Georgia and North Carolina also documented insects and crustaceans as primary food items in the diet of juveniles. Once they leave coastal rivers and estuaries and move to the nearshore Atlantic Ocean, the diet of juvenile American shad shifts to include small fishes. Juveniles off the North Carolina coast consumed striped anchovy (Anchoa hepsetus). In the St. Johns River, Florida, juveniles ate bay anchovy (Anchoa mitchelli) and mosquitofish (Gambusia affinis). As adults offshore, shad are believed to be primarily planktivorous, consuming mainly copepods, mysid shrimp, and other zooplanktors. The stomachs of 41 adults caught off the North Carolina coast all contained zooplankton, including amphipods, copepods, isopods, crustaceans and larval decapods. There were fish remains in 39 of the stomachs, however, which indicates that shad are not exclusively planktivorous. Adult shad in the Bay of Fundy consumed copepods and mysid shrimp. It is still unclear whether adult shad eat during the spawning migration. Chittenden (1976) found that the stomachs of most shad captured in freshwater were empty, but a few did contain mayflies. This finding of little or no food is similar to the reports of Hildebrand and Schroeder (1928) and Moss (1946) that adult shad take little or no food while ascending rivers. Chittenden=s (1976) observations suggest, however, that adult shad would opportunistically feed in freshwater if suitably large planktonic forms were readily available.

As prey, American shad are important for other species that are themselves important commercially, recreationally and ecologically. American eels prey on American shad eggs, larvae, and juveniles in freshwater, and striped bass consume juveniles (Facey et al. 1986, Mansueti and Kolb 1953, Walburg and Nichols 1967). Savoy and Crecco (1995) also suggest a direct linkage between increased striped bass predation and the recent dramatic drop in American shad and blueback herring abundance in the Connecticut River. Predation on juvenile American shad by bluefish and other large predators (e.g. weakfish, striped bass) is also perhaps a minor factor that could be delaying the recovery of American shad stocks in the Chesapeake Bay (Klauda et al. 199 1). Once in the ocean, as a schooling species with no dorsal or opercular spines, American shad are undoubtedly preyed upon by many species including sharks, tunas, king mackerel (Scomberomorus regales) and seals and porpoises (Melvin et. al. 1985, Weiss-Glanz et al. 1986).

1.2 Description of the Resource

A comprehensive description of the Atlantic coast stocks of American shad, hickory shad, alewife, and blueback herring can be found in the 1985 Interstate Fishery Management Plan (Plan) for American Shad and River Herrings. This provides the basic information necessary to understand how anadromous alosines relate to their essential habitats, and the significance of the commercial and recreational alosine fisheries to the economy and culture of the Atlantic coast.

1.2.1 American Shad and Hickory Shad Life Histories

American shad and hickory shad are anadromous fish that spend the majority of their life at sea and only enter freshwater in the spring to spawn. Shad are river-specific; that is, each major river along the Atlantic coast appears to have a discrete spawning stock. Shad spawning can occur as early as November in southern states and as late as July in New England and Canada. Depending on geographical location, shad may spawn once and die, or they may survive to make several spawning runs per lifetime. Repeat spawning in hickory shad runs varies among river systems. In American shad, differences occur as shad move north. Most American shad native to rivers south of Cape Fear, North Carolina, die after spawning (Carscadden and Leggett 1975), however, in rivers to the north, the incidence of repeat spawning increases with latitude.

Spawning American shad broadcast a large quantity of eggs into the water column. Fertilized eggs are carried by river currents and hatch within 2-17 days depending on water temperatures (Jones, et. al. 1978). Larvae drift with the current until they mature into juveniles. Juveniles remain in nursery areas, feeding on copepods, other crustaceans, zooplanktors, chironomid larvae, and aquatic and terrestrial insects (Levesque and Reed 1972, Marcy and Jacobson 1976). By late fall, most juvenile shad migrate to nearshore coastal wintering areas. Immature shad will remain in the ocean for three to six years before returning to spawn. Little information is available on the life history of subadult and adult American shad and hickory shad after they emigrate to the sea.

Both American shad and hickory shad are schooling species and highly migratory. After spawning, iteroparous adult American shad return to the sea and migrate northward to their summer feeding grounds in the Gulf of Maine/Bay of Fundy (Dadswell et. al. 1987). Here, they primarily feed on zooplankton and small fishes. Overwintering (winter habitat) occurs along the mid-Atlantic coast, particularly from Maryland to North Carolina. Hickory shad historically spawned in rivers and tributaries along the Atlantic coast from the Bay of Fundy, Canada to the Tomoka River, Florida. Current presence in waters north of Chesapeake Bay is uncertain; however, recent spawning has been documented as far north as the Connecticut River. Studies suggest that hickory shad migrate in a pattern similar to the coastal migrations of American shad, feeding on small fish, squid, fish eggs, small crabs, and pelagic crustaceans.

1.2.2 Alewife and Blueback Herring Life Histories

Alewife and blueback herring (collectively termed river herring because fishermen do not distinguish between them) are relatively small anadromous fish, spending their adult lives at sea, returning only to freshwater areas to spawn in the spring. Alewife spawn in rivers and tributaries from northeastern Newfoundland to South Carolina, but are most abundant in the mid-Atlantic and northeastern states. Blueback herring spawn from Nova Scotia to northern Florida, but are most numerous in warmer waters from Chesapeake Bay south. The onset of spring spawning is related to temperature and thus, varies with latitude. Alewife spawn in a diversity of habitats that includes large rivers, small streams, ponds, and large takes over a range of substrates such as gravel, sand, detritus, and submerged vegetation. Blueback herring prefer to spawn in swift flowing sections of freshwater tributaries, channel sections of fresh and brackish tidal rivers, and Atlantic coastal ponds over gravel and clean sand substrates, especially in northeastern rivers where alewife and blueback herring co-exist. In southeastern rivers where alewife are few, blueback herring exhibit more of a variety in their spawning sites including shallow areas covered with vegetation, in rice fields, in swampy areas, and in small tributaries upstream from the tidal zone. Mature river herring broadcast their eggs and sperm simultaneously into the water column and over the substrate. Immediately after spawning, adults migrate rapidly downstream. Larvae begin to feed externally three to five days after hatching, and transform gradually into the juvenile stage. Juveniles remain in freshwater nursery areas in spring and early summer, feeding mainly on zooplankton. As water temperatures decline in the fall, juvenile move downstream to more saline waters, eventually to the sea. Little information is available on the life history of subadult and adult river herring after they emigrate to the sea as young-of-year or yearlings, and before they mature and return to spawn.

1.2.3 American Shad Stock Assessment Summary

Given the pronounced drop in coastwide shad landings and stock abundance from several Atlantic coast rivers after 1990, a revised stock assessment was clearly warranted to determine the root cause(s) of the recent shad declines along the Atlantic coast. A coast-wide assessment was prepared by Vic Crecco, chair of the Shad Stock Assessment Subcommittee (SAS). This report chose an overfishing definition (F_{30}), reviewed stock trends, and estimated current and historic coastal (Fc) and inriver (F_R) fishing mortality rates on American shad from seven river systems located from Maine rivers in the north to the Altamaha River, Georgia to the south. Trends in total mortality (Z), which include fishing and natural mortalities, were examined for the Pawcatuck River, Rhode Island, upper Chesapeake Bay, Maryland, and tributaries of Albemarle Sound, North Carolina.. Crecco also examined trends in commercial landings for Maine rivers, as well as for North Carolina rivers (Albemarle Sound, Neuse, Panilico, and Cape Fear Rivers) and South Carolina rivers (Waccamaw-Pee Dee, Savannah, Edisto, and Santee Rivers). Crecco examined trends in relative adult stock abundance in the Merrimack River Massachusetts-New Hampshire based on fishway counts and for Virginia rivers based on commercial catch-per-effort (CPUE). A Thompson-Bell yield-per-recruit (YPR) was used to determine the overfishing definition (F_{30}) for each shad stock.

Based on historic trends in commercial CPUE, fishway counts and population estimates, there is evidence of recent and persistent stock declines in three of 12 rivers or systems [Hudson, New York (1992-1996), York and Rappahannock, Virginia (1980-1993)]. Stock declines were evident in the Pawcatuck River, Rhode Island from 1992 to 1994, but stock abundance has risen sharply in the Pawcatuck during 1995 and 1996. Similarly, although shad stock abundance in the Connecticut River has declined to low levels from 1992 to 1995, stock size has risen steadily in 1996 and 1997 to levels approaching the long-term average (800,000 fish). Inriver commercial landings in the Edisto River, South Carolina have declined since 1990, but shad stock abundance in the Edisto exhibited no apparent decline from 1989 to 1996. This strongly suggests that the drop in commercial landings in the Edisto River was largely due to a reduction in fishing effort and not stock abundance. There was no evidence of recent stock declines for seven additional stocks including the Merrimack River, Massachusetts-New Hampshire, the Delaware River, Delaware-New Jersey, Upper Bay tributaries, Maryland, James River, Virginia, Santee River, South Carolina, and the Altamaha River, Georgia. Presumed stock declines inferred solely from declining trends in inriver commercial landings were evident for seven additional stocks including the Neuse, Pamlico, and Cape Fear Rivers, North Carolina, Waccamaw-Pee Dee and Savannah Rivers, South Carolina, for tributaries of Albemarle Sound, North Carolina, as well as for rivers in the state of Maine.

Recent (1992-96) coastal fishing mortality rates (FC) on seven shad stocks (Connecticut, Hudson, Delaware, Upper Bay, Edisto, Santee, and Altamaha Rivers) were relatively low (FC range: 0.02 to 0.24) and well below our overfishing definitions (F_{30} range: 0.39 - 0.48). Average (1992-1996) total fishing mortality rates (FT), which include inriver and coastal fishing mortalities, were below overfishing definitions (F_{30}) for all seven shad stocks for which inriver (FR) and coastal (FC) fishing rates could be estimated. The recent (1994-1997) average FT level (FT=0.45) on Edisto River shad was only slightly below the overfishing definition ($F_{30} = 0.48$) for southern stocks, indicating that fishing mortality rates on Edisto River shad should be monitored closely over the next few years. Based on the analysis, there is no evidence thus far that the coastal intercept fishery has had an adverse impact on these seven shad stocks. In the absence of population data, it is impossible to quantify the impact the ocean-intercept fisheries have on other shad stocks. Like all mixed stock fisheries, small stocks can be at risk under these conditions.

There are no direct fishing mortality estimates on the Pawcatuck River stock. However, total mortality rates declined by about 50% in the Pawcatuck River between 1989 and 1992. Since total mortality estimates have not risen recently and fishing mortality rates on the Pawcatuck shad stock have not increased, the recent (1992-1994) stock decline in the Pawcatuck may not be due to overfishing. The ability to rule out overfishing for the Pawcatuck River stock is tempered somewhat by the fact that no stock origin studies have ever been conducted on the coastal Rhode Island shad landings which, in theory, could easily have overharvested the small (stock size: 1000-2000 fish) Pawcatuck stock. Moreover, total mortality estimates are not available for the Pawcatuck stock after 1992. In order to address potential overfishing in the Pawcatuck, it would be beneficial to estimate fishing mortality directly and to conduct a tagging study on the Rhode Island coastal fishery to determine stock origin.

Relative exploitation rates from the coastal intercept fishery on the York, Rappahannock and James Rivers, Virginia exhibited no apparent trends from 1980 to 1993. This suggests that the coastal intercept harvest was not related to the shad declines in the York and Rappahannock Rivers. The ability to directly link the coastal intercept fishery to stock declines for these rivers is somewhat limited by the lack of CPUE data in 1994, 1995 and 1996, and by the fact that relative exploitation rates cannot be directly compared to our overfishing definition (F_{30}). In addition, it is difficult to assess recent trends in relative exploitation on the Rappahannock or James Rivers origin shad because shad fishing effort declined markedly in these rivers by 1986 as compared to the 1980-85 period. There are no direct estimates of current fishing mortality for seven rivers that have exhibited a recent decline in shad landings. These include shad stocks from Maine rivers, Albemarle Sound, Neuse, Pamlico, and Cape Fear Rivers (North Carolina), and the Waccamaw-Pee Dee and Savannah River (South Carolina). Given the limitations in using landings trends to infer stock trends, there is no way to adequately link inriver and coastal fisheries with presumed stock declines in these rivers. Total mortality estimates have been estimated for shad tributaries of Albemarle Sound between 1980 and 1995. Since these total mortality estimates have varied without trend, there is no indication here that a rise in fishing mortality was related to the decline in commercial shad landings in Albemarle Sound. Shad stock sizes in the Hudson River have declined rather steadily from 1988 to 1996, although current average fishing mortality (mean $F = 0.33$) was still below the estimated overfishing definition($F_{30} = 0.39$). As a result, the Hudson River stock is considered to be fully exploited. Shad stock abundance in the Merrimack River (Massachusetts-New Hampshire), Santee River (South Carolina), Altamaha River (Georgia), Delaware River (Delaware-New Jersey) and upper Bay Rivers (Maryland) have either recently risen to high levels (i.e., Santee, Altamaha and upper Bay stocks) or have remained stable (i.e., Delaware and Merrimack stocks). Current (mean 1992-96) fishing mortality rates (FT) on these stocks have either approached our overfishing definition (F_{30} level) (i.e., as in the case of the Altamaha and Edisto stocks), or were far below the estimated F_{30} level (i.e., as in the case of the upper Bay, Delaware River and Santee River stocks). No fishing mortality estimates are available for the Merrimack River stock.

There is no evidence of recent (1990-96) recruitment failure for any of the eight shad stocks (Maine Rivers, Pawcatuck, Connecticut, Hudson, Delaware, Upper Bay tributaries, Altamaha, and Virginia Rivers) for which a continuous time series of juvenile indices could be examined. This assessment estimated fishing mortality rates for nine shad stocks and general trends in abundance for 13 American shad stocks. The total range of extant American shad populations includes additional populations in small river systems, as well as depleted populations in larger river systems that are actively being restored. Also, much historical habitat is currently void of American shad and may be targeted for restoration in the future. For these stocks, individual states have targeted minimal fishing mortality to protect small stocks and rebuild others. This assessment cannot quantitatively address these systems because of limited biological data, as well as associated uncertainties in stock composition of small populations in fisheries.

1.3 Habitat Considerations

1.3.1 Description of Habitat

Habitats used by all Atlantic anadromous alosine species include spawning sites in coastal rivers and nursery areas, which include primarily freshwater portions of the rivers and their associated bays and estuaries. In addition to the spawning and nursery areas, adult habitats also consist of the nearshore ocean. Adult American shad have also been found to migrate up to 60 miles off the coast (Neves and Depres 1979). These habitats are distributed along the East Coast from the Bay of Fundy, Canada to Florida. Use of these habitats by migratory alosines may increase or diminish as the size of the population changes.

1.3.1.1 Spawning Habitat

A. American Shad

American shad spawn in rivers throughout the species' range. Historically, the species probably spawned in virtually every accessible river and tributary along the Atlantic coast. However, blockage of spawning rivers by dams and other impediments and degradation of water quality and physical habitat in spawning reaches have severely depleted suitable American shad spawning habitat. American shad migrate from the sea to coastal rivers in the spring and begin spawning when water temperatures range from about 16-19^{0}C. Water temperature is the primary factor that triggers spawning, but photoperiod, current velocity, and turbidity also exert some influence (Leggett and Whitney 1972). American shad can spawn as early as mid-November in Florida to as late as July in some Canadian rivers (MacKensie et al.1985). If possible, adults migrate far upstream and typically spawn in freshwater areas dominated by extensive flats and over sandy or rocky shallows, including the mouths of larger tributary streams (Davis et al. 1970). However, substrate type should be relatively unimportant to successful American shad spawning since the eggs are broadcast into the water column over a range of substrates and most are carried downstream (Mansueti and Kolb 1953; MacKenzie et al. 1985). Only in areas where the eggs settled to the bottom, were covered by silt or sand and then smothered would substrate become a critical habitat problem.

2. Hickory Shad

Historically, hickory shad spawned in rivers and tributaries along the Atlantic coast from the Bay of Fundy, Canada to the Tomoka River, Florida, but now the species= range is uncertain. The most detailed information available on spawning habitat comes from Maryland, Virginia, North Carolina, and Georgia. Hickory shad are anadromous and begin to ascend freshwater streams for spawning in early spring. Spawning can occur between March and early June, depending on latitude, over a water temperature range of 12 to 22^{o}C (Rulifson et. al. 1982). Adult hickory shad appear to spawn in a diversity of physical habitats ranging from backwaters and sloughs, to tributaries, to mainstem portions of large rivers in tidal and non-tidal freshwater areas. Major hickory shad spawning sites in Maryland and Virginia occur in mainstem rivers at the fall line, but some appear to spawn further downstream and also in tributaries. In North Carolina, the freshwater reaches of coastal rivers are the major spawning sites for hickory shad. However, shad have been found in the Neuse River in flooded swamps and sloughs off the channels of tributary creeks and not in the mainstem river. In Georgia, hickory shad apparently spawn in flooded areas off the channel of the Altamaha River, and not in the mainstem of the upper reaches.

3. Alewife and Blueback Herring

Alewife spawn in rivers and tributaries from northeastern Newfoundland to South Carolina, but are most abundant in the mid-Atlantic and northeastern states. At the extreme southern end of their range, alewife begin spawning in late February, but they may not commence spawning until late April or early June at the northern end of their range (Loesch 1987). Blueback herring spawn in rivers and tributaries from Nova Scotia to northern Florida, but are most numerous in warmer waters from Chesapeake Bay south (Scott and Scott 1988). At the extreme southern end of their range, spawning can begin in December or January, but may not commence until June near the northern end of their range and can continue through August (Marcy 1976). Alewife spawn in a diversity of physical habitats that includes large rivers, small streams, ponds, and large lakes over a range of substrates such as gravel, sand detritus, and submerged vegetation. Blueback herring spawning sites include swift flowing sections of freshwater tributaries, channel sections of fresh and brackish tidal rivers, and Atlantic coastal ponds over gravel and clean sand substrates, especially in northeastern rivers where alewife and blueback herring coexist. In southeastern rivers where alewife are few, blueback herring exhibit more of a variety in their spawning sites including: shallow areas covered with vegetation, rice fields, swampy areas, and in small tributaries upstream from the tidal zone. Upstream distribution of adults is a function of habitat suitability and hydrologic conditions permitting access to these sites (Loesch and Lund 1977). Immediately after spawning, surviving adult river herring migrate rapidly downstream.

1.3.1.2 Nursery Habitat

1. American Shad

Nursery habitats for American shad are downstream of spawning grounds because juveniles begin to disperse downstream upon transformation from the larval stage (Chittenden 1969). These nursery habitats usually occur in deep pools away from the shoreline in non-tidal areas, although juveniles occasionally move into shallow water areas (Chittenden 1969). In the Chesapeake Bay system, juveniles are usually found in tidal freshwater reaches of the spawning rivers. Juvenile American shad leave the nursery areas by late fall and may remain in the estuaries and nearshore ocean until they reach one year of age. As young-of-year, they presumably join other schools of young shad in the ocean, where they grow and develop for three to six years before returning to their natal streams to spawn. Subadults appear to migrate farther offshore than sexually mature adults (Neves and Depres 1979).

2. Hickory Shad

Documentation of hickory shad nursery area is difficult because capture of juveniles is rare. Studies suggest that most juveniles leave freshwater and brackish areas in early summer and migrate to estuarine nursery areas (Mansueti 1962). Other studies completed in North Carolina suggest that juveniles migrate directly to saline areas; they do not use the oligohaline portion of the estuary as a nursery area (Pate 1972).

3. Alewife and Blueback Herring

Nursery habitats for alewife and blueback herring occur in non-tidal and tidal freshwater and semi-brackish areas during spring and early summer, moving upstream during periods of decreased flows and encroachment of saline waters. Juvenile alewife and blueback herring begin migrating from their nursery areas as water temperatures decline in the fall. However, in some instances, it appears that a high abundance of juveniles may trigger very early (e.g., summer) emigration of large numbers of small juveniles from the nursery area (Richkus 1975).

1.3.1.3 Adult Resident Habitat and Migratory Routes

1. American Shad

American shad are currently distributed from the Bay of Fundy, Canada southward to the St. Johns River in Florida, and move along the Atlantic coast between summer feeding grounds in the Gulf of Maine and coastal wintering areas mainly off the mid-Atlantic states (Leggett and Whitney 1972). Adult shad migrate to spawning grounds beginning as early as mid-November for southern stocks (Florida) and as late as July in some Canadian rivers (MacKenzie et al. 1985). Those fish return to rivers north of Cape Hatteras usually begin migration later in the spring and follow a route farther seaward into the Mid-Atlantic Bight where water temperatures have risen sufficiently. After spawning is complete, adult and immature shad migrate out of tributaries and rivers and proceed northward along the Atlantic coast to their summer feeding grounds in the Gulf of Maine, Bay of Fundy, the St Lawrence estuary and along the Labrador coast (Dadswell et al. 1987), and remain in that vicinity throughout the summer into fall. In mid-fall**,** a southward migration begins, with overwintering occurring off Florida, in the mid-Atlantic area, and in the Scotian Shelf-Gulf of Maine (Leggett and Whitney 1972; Dadswell et al. 1987).

B. Hickory Shad

Hickory shad are currently distributed from the Connecticut River to the Tomoka River, Florida. The distribution and movements of adult hickory shad at sea are essentially unknown. Adults have been captured along the southern New England coast during summer and fall. These observations suggest that hickory shad may migrate northward from the mid-Atlantic and southeast Atlantic spawning rivers in a pattern that is similar to the coastal migrations of American shad (Dadswell et al. 1987).

3. Alewife and Blueback Herring

Alewife are currently distributed from northeastern Newfoundland to South Carolina, but are most numerous in the mid-Atlantic and northeastern states. Blueback herring are distributed from Nova Scotia to northern Florida, and are most abundant from the Chesapeake Bay south. However, little information is available concerning the distribution and movements of adult and subadult alewife and blueback herring once they emigrate to the sea. Various studies have determined that alewife and blueback herring are capable of migrating long distances (over 2000 km) in ocean waters of the Atlantic seaboard, and that patterns of river herring migration may be similar to those of American shad (ASMFC 1988).

1.3.2 Present Status of Habitats and Impacts on Fisheries

Fisheries management measures cannot successfully sustain anadromous alosine stocks if the quantity and quality of habitat required by all the species are not available. Harvest of fisheries resources is a major factor impacting population status and dynamics, and is subject to control and manipulation. However, without adequate habitat quantity and quality, the population cannot exist.

Concerns that the declines in anadromous alosine populations are related to habitat degradation has been alluded to in past evaluation of these stocks (Mansueti and Kolb 1953; Walburg and Nichols 1967). However, it has never been possible to rigorously quantify the magnitude of this contribution.

1.3.2.1 Quantity

Little information exists which quantifies the area of existing or historical anadromous alosine habitat. No attempt has been made to quantify the existing area of alosine habitat coastwide.

Nursery areas for anadromous alosines consist of areas in which the larvae, postlarvae, and juveniles grow and mature. These areas include the spawning grounds and areas through which the larvae and postlarvae drift after hatching, as well as the portions of rivers and adjacent estuaries in which they feed, grow, and mature. Juvenile alosines which leave the coastal bays and estuaries prior to reaching adulthood also use the nearshore Atlantic Ocean as a nursery area.

Sub-adult and adult alosine habitat consists of the nearshore Atlantic Ocean from Bay of Fundy, Canada to Florida, inlets which provide access to coastal bays and estuaries, and riverine habitat upstream to the spawning grounds. American shad generally tend to move north to the Gulf of Maine during the summer, and southward and inshore off the Mid-Atlantic states in the winter. Hickory shad are believed to follow a similar migratory pattern to that of American shad. Adult alewife and blueback herring may be capable of migrating along the Atlantic coast, but little information exists on their movements and distribution after they migrate to the ocean. Coastal habitats for adult American shad are depicted in Figures 1-3.

1.3.2.2 Quality

The quality of alosine habitat has been compromised largely by impacts resulting from human activities. Impacts that may have contributed to declines in alosine populations include blockage of spawning rivers by dams and other impediments, pollution of spawning rivers resulting in reduced oxygen levels, elevated levels of heavy metals and toxic contaminants, low pH from acidic deposition, siltation of spawning areas, turbidity, changes in temperature and flow from hydropower or flood control discharge regimes, thermal pollution, and power plant entrainment and impingement. Specific examples of the effects of these impacts on alosine populations can be found in Walburg and Nichols (1967), Mansueti and Kolb (1953), DBFWMC (1981), Johnson (1982), Dadswell et al. (1983), and Gordon and Longhurst (1979).

Recently, stock displacement or enhanced mortality among alosine stocks due to colder than normal ocean water temperatures has also been suggested to explain the recent declines of these stocks. A decline in ocean temperature since 1990 along the Atlantic coast during winter and spring months could have caused a disruption of normal spring migration patterns, resulting in a direct mortality of alosines, or a displacement and/or poor food availability (Jesien et al. 1992).

1.3.2.3 Loss and Degradation

It is generally assumed that anadromous alosine habitat has undergone some degree of loss or degradation; however, few studies exist which quantify impacts in terms of the area of habitat lost or degraded.

1. Water Quality

Loss due to water quality degradation is evident in the northeast Atlantic coast estuaries. In most alosine spawning and nursery areas, water quality declines have been gradual and poorly defined, and it has not been possible to link those declines to changes in alosine stock size. In cases where there have been drastic declines in alosine stocks, such as in the Chesapeake Bay in Maryland, water quality problems have been implicated, but not conclusively demonstrated to have been the single or major causative factor.

Toxic materials such as heavy metals and various organic chemicals (e.g., insecticides, solvents, herbicides) occur in anadromous alosine spawning and nursery areas and are believed to be potentially harmful to aquatic life, but have been poorly monitored. Similarly, pollution or nearly all estuarine waters along the east coast has certainly increased over the last 30 years, due to industrial, residential, and agricultural development on the watersheds. The general degradation of water quality is a coast-wide problem, although the levels of sewage nutrients discharge into coastal waters during the past 30 years have decreased. This decrease in organic enrichment would benefit water quality conditions; however, it probably would not result in a reduction of other types of pollutant discharges into these waters such as heavy metals and organic compounds.

American shad eggs and larvae have been found to be sensitive to various levels of acid and aluminum (Klauda 1994). American shad stocks that spawn in poorly buffered Eastern Shore Maryland rivers, like the Nanticoke and Choptank, were found to be vulnerable to storm-induced, toxic pulses of low pH and elevated aluminum, and may therefore recover at a much slower rate than well-buffered Western Shore stocks, even if all other anthropogenic stressors are removed. (Klauda 1994) hypothesized that whenever the abundance of an acid-sensitive fish species like American shad is as low as most Maryland stocks are today and annual climatic conditions are less than favorable for good reproduction, even infrequent and temporary episodes of critical or lethal pH and aluminum exposures in the spawning and nursery areas could contribute to significant reductions in egg or larval survival and thereby slow stock recovery.

Riverine areas serve as routes for migration and as spawning and nursery habitats for most alosine stocks. However, alterations of flow caused by human water use activities in these areas can have serious effects on alosine populations. Facilities using water for cooling purposes (e.g., power plants) or large volume water withdrawals (e.g., drinking water, pumped storage hydroelectric projects, irrigation, snow-making) may deny access to spawning and nursery areas and alter habitat characteristics such as flow (due to peaking operation and imposition of low flows) and water quality (due to impoundment effects such as decreases in dissolved oxygen and changes in temperature).

2. Water Use

Impacts of impingement, expressed as reductions in year-class abundance, were calculated for Hudson River American shad in 1974 and 1975. The maximum estimated reductions in year-class abundance were 0.04 in 1974 and 0.06 in 1975. These extremely low impingement impacts on American shad are related to the brief period that this species was concentrated in the vicinity of major power plants during their emigration from the estuary in autumn. It was determined that impingement is probably not a biologically important source of mortality except, perhaps, when added to other, more serious stresses (Barnthouse and Van Winkle 1988).

A large tidal hydroelectric project is currently in use at the mouth of the Annapolis river in portions in the Bay of Fundy, Canada. Dadswell et al. (1983) have found that this particular basin and other surrounding waters are used extensively by American shad from all runs along the east coast of the United States as foraging areas during summer months. Since these are tidal hydroelectric projects, fish may move into and out our the impacted areas with each tidal cycle. Thus, although these turbines cause a relatively small percentage mortality with one passage, the cumulative mortality resulting from repeated tidal passage into and out of these impacted areas would result in substantial mortalities (Scarratt and Dadswell 1983).

In addition, hydroelectric darns exist in several states that only allow one-way passage or no passage of spawning adult American shad. Dams with no passage of fish have substantially reduced the amount of spawning habitat available to spawning American shad and have likely contributed to long-term stock declines. It is also assumed that with darns that allow only one-way passage that most, if not all, adult fish transported above dams are unsuccessful at passing through the hydroelectric stations during outmigration and hence, are lost as returning adults.

1.3.2.4 Current Threats

Potentially serious threats stem from the continued alteration of freshwater flows and discharge patterns to spawning and nursery habitats in rivers and estuaries. Other threats in the form of increased mortality resulting from the placement of additional intakes in spawning and nursery areas will occur, although the impacts may be mitigated to some degree through the use of the best available intake screen technology. Placement of jetties, which disrupt current flow patterns into and out of coastal estuaries and lagoons, may also affect migration patterns or habitat use.

1.3.2.5 Effect on the Ability to Harvest and Market

Impacts which result in mortality over and above that which would occur naturally at any life stage will reduce the size of the population and thereby ultimately reduce the size of the allowable harvest. Such impacts include pollution of spawning rivers, siltation of spawning areas, blockages or other changes in spawning grounds, and overharvesting which could reduce or eliminate reproductive success. Impacts that may not increase mortality, but reduce or eliminate marketability include non-lethal limits of contaminants that may render fish unfit for human consumption, or changes in water quality that may reduce fish condition or appearance to a point where they are unmarketable.

1.3.3 Identification and Distribution of Essential Habitats

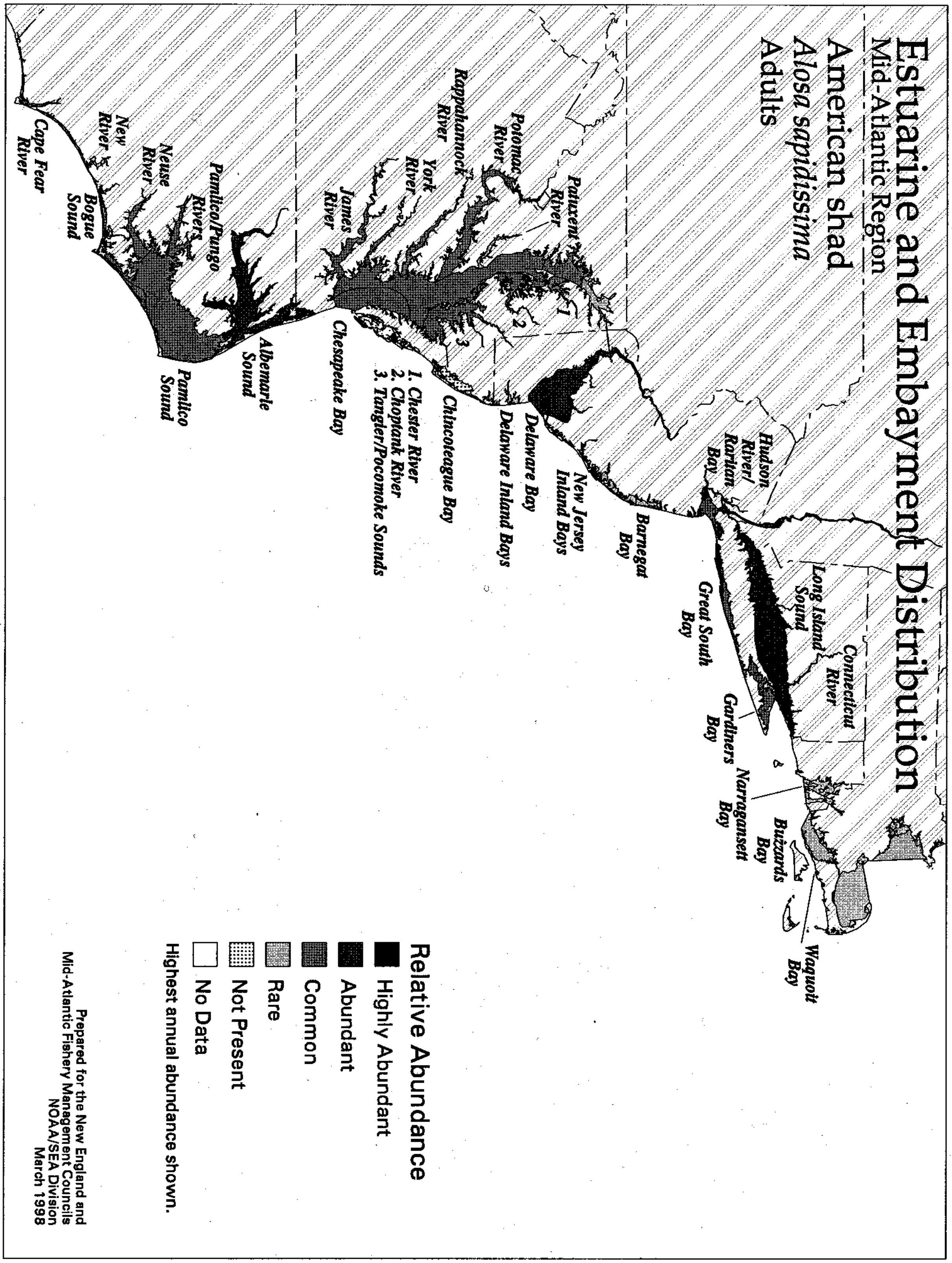
All habitats described above are deemed essential to the sustainability of the four anadromous alosine stocks as they presently exist. These habitats are depicted in Figures 1-3. Due to decreasing stock sizes of all alosine species along the Atlantic coast, it is difficult to determine if adequate spawning, nursery, and adult habitat presently exist to sustain the stocks at recovered levels.

Without a specific goal for restoration of historic or potential alosine habitat, it is difficult to describe all "essential habitat" along the Atlantic coast. States may wish to identify areas targeted for restoration as essential habitat. These additional areas may be necessary for achieving historic alosine production levels in those jurisdictions.

Figure 1. New England Estuarine and Embayment Distribution of Adult American shad.

Figure 2. Mid-Atlantic Estuarine and Embayment Distribution of Adult American shad.

Figure 3. South Atlantic Estuarine and Embayment Distribution of Adult American



shad.

1.4 Description of the Fisheries

American shad, hickory shad, and river herring formerly supported important commercial and recreational fisheries along the entire Atlantic coast. However, all of these fisheries have declined dramatically. Two types of fisheries exploit spring spawning migrations of anadromous alosines: inriver and coastal ocean. Inriver fisheries have been traditionally accepted because they only exploit their stock of origin, whereas ocean fisheries begin earlier in the winter and exploit mixed stocks of different river origins. Although inriver fisheries have traditionally dominated the catch, coastal ocean fisheries have increased in recent years.

Catch statistics for both ocean and inriver alosine fisheries on the Atlantic Coast are compiled by the National Marine Fisheries Service (NMFS) and state agencies for both commercial and recreational fisheries. Information provided below is based on the state reports which are on file with the Commission.

1.4.1 Commercial Fishery

A. American Shad

Historically, American shad supported very large commercial fisheries along the East Coast of both the United States and Canada. Even though total commercial landings (coastal ocean and inriver) of American shad have shown long-term declines, coastal ocean landings of American shad have increased more than four-fold since 1978. In 1980, coastal ocean landings equaled approximately 623,000 pounds; however, by 1989, this number had peaked to 2.1 million pounds and, in 1996, landings were 1.1 million pounds. Ocean harvest contributed about 11 % of total East Coast landings in 1978; however, this contribution increased yearly to approximately 67% by 1996.

The commercial coastal ocean fishery for American shad is primarily gillnet, with exceptions occurring in Rhode Island (floating trap), Connecticut (bottom otter trawl), and New York (pound net and trawl).

Even though only a few states dominate ocean harvest of American shad, the ocean fishery for the species is an important component of the fishery for most East Coast states. From 1980-1996, the majority of commercial coastal harvest was taken in Virginia (24 percent), Delaware (19 percent), New Jersey (18 percent), South Carolina (14 percent) and Maryland (nine percent). All other fisheries were below five percent of the total ocean landings. American shad ocean harvest for states north of New Jersey is from a bycatch fishery, and from New Jersey south, the fishery is directed for American shad. Florida, Georgia, Potomac River Fisheries Commission (PRFC) - District of Columbia, Pennsylvania, and Connecticut do not have coastal ocean fisheries.

American shad landings from commercial inriver fisheries have been steadily decreasing, based on individual state landings records. In 1980, three million pounds of American shad were landed; however, by 1996, this figure had dropped to approximately 594,000 pounds. From 1980-1996, the majority of commercial American shad harvest from inriver fisheries was taken in New York (33 percent), North Carolina (17 percent), Connecticut (15 percent) and Virginia (14 percent). Recently, dramatic declines in landings have occurred even in some of these river systems. In the Connecticut River, 1.6 million American shad were estimated to have returned to the river in 1992. However, as of 1995, this number had dropped dramatically to 304,500. Maine and New Hampshire runs continue to remain at low levels of abundance, and Delaware personnel reported the 1996 adult population estimate of 792,000 fish was well below the 1992 high. American shad inriver fisheries are not allowed in Maine, New Hampshire, Massachusetts, and Rhode Island, and a moratorium on the capture and sale of American shad has existed in Maryland since 1980, and in Virginia, since 1994.

However, some river systems appear to show signs of improvement. Maryland's stocks still remain at historic lows, although the upper Chesapeake Bay 1995 shad run of 336,000 fish represented a 159% increase from the 1994 estimate of 129,500. In addition, Virginia reported excellent runs in the Pamunkey River. Personnel in South Carolina reported the 1995 run of shad up the Santee-Cooper system had greatly improved over the last few years. In general, shad stocks remain depressed with some improvement occurring in rivers such as the Altamaha in Georgia and the Savannah River between South Carolina and Georgia.

B. Hickory shad

Atlantic coast (Maryland to Florida) hickory shad commercial landings (reported by state) are poorly monitored. This is primarily because of mixing with American shad upon landing, poorly understood geographic ranges, and a lack of monitored recreational fishing areas. Report ed commercial hickory shad landings have ranged from a high of 349,980 pounds in 1961 to 95,282 in 1980 to a recent low of 24,114 in 1991. The most recent and complete hickory shad data are for North Carolina, which has historically dominated the commercial fishery. From 1980-1996, North Carolina has accounted for the majority (88%) of the total hickory shad landed from New Jersey to Florida. Hickory shad landings of 125,871 pounds in 1996 were up dramatically from the 11,389 pounds landed in 1990. Hickory shad numbers have been increasing in the last three to four years in the upper Chesapeake Bay and its tributaries, and increases have been evident in both North Carolina and Georgia commercial landings data. However, the lack of accurate commercial harvest data makes it difficult to ascertain the actual status of the stocks.

C. Alewife and Blueback Herring

Total commercial landings of river herring from the Gulf of Maine to Florida were approximately 11 million pounds in 1980. However, total landings decreased to 5.7 million pounds in 1988, and in 1996, they only equaled 1.4 million pounds. Overall, river herring landings data may not accurately represent stock abundance. The many factors influencing river herring-reported commercial landings may explain the large degree of variability observed in data on a state-by-state basis.

River herring commercial inriver landings have been steadily decreasing from a high of 14.1 million pounds in 1985 to 1.4 million pounds in 1996. During the past decade, North Carolina, Virginia, and Maine have accounted for approximately 81 percent of coastwide landings. Inriver herring fisheries are nonexistent in New Hampshire, Rhode Island, New Jersey, and Georgia.

Reliable data on river herring fisheries in the Mid-Atlantic region and Southeast are scarce. Even so, it has been reported that river herring landings from North Carolina increased from approximately 6.2 million pounds in 1980 to 11.6 million pounds in 1985. However, commercial landings have been rapidly decreasing since then, and by 1996 only 529,474 pounds were harvested. A similar situation was seen in Virginia where landings increased to a high of 18.4 million pounds in 1983 and continued to decrease to 141,008 pounds in 1996. Since 1976, Maine has been the major contributor to New England river herring landings. However, these numbers have shown a major downward trend since the early 1970's, and in the past four years, Maine landings have declined dramatically in those rivers which traditionally contributed the majority of the catch.

The river herring fishery was exclusively an U.S. inshore fishery until the late 1960s when distant-water fleets began fishing for river herring off the Mid-Atlantic coast. Commercial ocean harvest of river herring occurs as bycatch in other fisheries of various gear types: gillnet, bottom otter trawl, and menhaden purse seine. From 1980-1996, the majority of the river herring harvest (inriver and ocean) was taken in North Carolina (65 percent), Maine (14 percent), and Virginia (12 percent). Four Atlantic coast states do not have river herring fisheries in ocean waters: Delaware, South Carolina, Georgia, and Florida. Apparently, Georgia is the only state that has no river herring fishery, either inriver or ocean.

1.4.2 Recreational Fishery

It is not known if recreational fisheries exist in the coastal ocean for any of the four alosine species in any state along the Atlantic coast.

A. American Shad

Recreational fisheries for all alosines are poorly documented. It is widely known that American shad do support fairly intensive recreational fisheries in many East Coast rivers; however, very little harvest and catch/effort data exists.

Fisheries occur in the Delaware River (New Jersey, New York and Pennsylvania) and in the Connecticut River, where recreational harvest accounts for approximately more than 10% of total American shad landings. The magnitude of recreational harvest in these two rivers is probably suggestive of the impact of fairly intensive recreational fisheries on American shad stocks. Recreational fishing is growing in popularity in many other river systems along the coast.
A June 1995 angler utilization and economic survey of the American shad fishery in the Delaware River found that anglers caught 83,141 shad and harvested an estimated 16,387 shad

during the 10-week survey period (Miller and Lupine 1996). Although angler effort was apparently reduced during the 1995 season, and the American shad population estimate, determined by the New Jersey Division of Fish, Game, and Wildlife, indicated fewer shad in the river, the catch rate was slightly greater than during the 1986 season. Catch rates varied substantially from lows of 0.04 fish per hour to a high of 0.45 fish per hour.

B. Hickory Shad

Although good recreational catch/effort data does not exist, it is widely known that hickory shad do support substantial recreational fisheries in some East Coast rivers.

C. Alewife and Blueback Herring

There are extensive recreational fisheries for river herring in many rivers along the East Coast. While some are hook and line fisheries (i.e., Delaware River), many states permit various types of dip nets and seines. The total quantity of fish landed by these recreational netters for personal use (i.e., bait and consumption) may be quite large. All of these landings are unreported and thus, represent a large potential error in recorded recreational river herring harvests.

1.4.3 Subsistence Fishing

There are known subsistence fisheries for all alosine species, but the extent of effort and harvest is undocumented.

1.4.4 Non-consumptive Factors

People interested in conservation and wildlife have been known to observe alosine migrations through natural corridors and fish passage facilities. In some regions, this non-consumptive use of the alosine resources is an important part of public education, local heritage and outdoor recreation.

1.4.5 Interactions with other fisheries, species, and other users

Catch of anadromous alosines that occurs in fisheries directed at other species is referred to as bycatch. Bycatch also refers to illegal or unmarketable alosines caught in directed fisheries. Estimates of bycatch are difficult to obtain since few studies have focused specifically on that issue. Bycatch losses contribute to the overall mortality of alosines and are important to consider in the current and future management of these fisheries.

Few data exist on a state-by-state basis for bycatch of any anadromous alosine in other commercial and recreational fisheries. Bycatch in commercial fisheries has occurred in those states with Atlantic mackerel fisheries. Alosines captured in pound nets and gillnets experience high mortality unless the nets are checked often.

The State of Maine, in cooperation with the NMFS, collects landings data from various commercial fisheries in state territorial and the U.S. Exclusive Economic Zone (EEZ) waters. Offshore American shad landings from southwestern Maine (Jeffery=s Ledge) occur as a bycatch to the groundfish gillnet fishery. From 1978-1995, 420,616 pounds of American shad were captured; however, these landings have been declining since 1988.

River herring bycatch does occur in the Atlantic mackerel commercial fishery. This offshore commercial venture involves either a directed U.S. fishery, or a joint venture between U.S. and foreign vessels operating under a quota restriction. For Joint Venture mackerel fisheries operating south of lat. 37^{0}30=N, r. herring by catch may not exceed 0.25% of the over-the-side transfers of Atlantic mackerel. However, these fisheries do focus on small, immature fish and a low percentage in terms of total poundage can represent a larger percentage in terms of numbers of individuals. Although the potential for problems with offshore fisheries exists, the problem appears minimal at present.

In addition, bycatch of river herring in Atlantic herring *(Clupea harengus)* fisheries is a potential concern, especially for the recovery of depressed alosine stocks of the Chesapeake Bay and waters further south. A report was completed summarizing the results from 36 sea sampling trips aboard commercial small-mesh trawlers during July through November 1995 in an area that had been previously closed by the NMFS to this type of fishing. This area was opened to small-mesh trawling by the NMFS after extensive analyses that predicted bycatch of regulated species would fall below a five percent threshold, a standard approved by the New England Fishery Management Council to address groundfish conservation. A total of 77 shad (<0.1%), 177 alewife (0.1%), and 3511 blueback herring (1.9%) were captured during the entire sampling.

Recreational bycatch of alosines has not been documented in many states. A hickory shad catch and release experiment was conducted in 1996 by the Maryland Department of Natural Resources (MDNR) in Deer Creek, a tributary to the Susquehanna River. This study showed that no short-term mortality (within 48 hours) was observed from catch and release fly fishing (Lukacovic and Pieper 1996). In addition, a catch and release mortality study of American shad was also completed in the Susquehanna River by MDNR in 1997. Results of this study showed that short-term mortality (within 48 hours) experienced by American shad was less than 1.0%, with all deaths occurring in less than 24 hours. Deaths occurred in fish that bled heavily from hook wounds or suffered damage to the gills (Lukacovic, personal communication).

<u>Protected Species Considerations:</u>

A. Marine Mammals

In October 1995, Commission member states, NMFS and USFWS began discussing ways to improve implementation of the Marine Mammal Protection Act (MMPA) and the Endangered Species Act (ESA) in state waters. Historically, these policies have been only minimally implemented and enforced in state waters (0-3 miles). It was agreed that the Commissions Plans describe impacts of state fisheries on certain marine mammals and endangered species (collectively termed "protected species", and recommend ways to minimize these impacts. Section 117 of the MMPA requires that NMFS complete stock assessment reports for all marine mammal stocks within U.S. waters. Each stock assessment report is required to estimate the annual human-caused mortality and serious injury of the stock by source, and for a strategic stock other factors that may be causing a decline or impeding recovery of the stock, including effects on marine mammal habitat and prey and commercial fisheries that interact with the stock.

A strategic stock is defined as a stock: (1) for which the level of direct human-caused mortality exceeds the potential biological removal (PBR) level; (2) which is declining and is likely to be listed under the Endangered Species Act (ESA) within the foreseeable future; or (3) which is listed as a threatened or endangered species under the ESA or as a depleted species under the MMPA.

Section 3(20) of the MMPA defines the term "potential biological removal (PBR) as:

"the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population."

For a strategic stock, Section 118(f) of the MMPA requires NMFS to appoint a Take Reduction Team and this TRT must develop a Take Reduction Plan (TRP) designed to assist in the recovery or to prevent the depletion of the strategic stock which interacts with a commercial fishery.

As a result of draft stock assessment reviews developed under Section 117 of the MMPA, NMFS recognized the need to establish a Team(s) that would focus on reducing the bycatch of coastal bottlenose dolphin, harbor porpoise and humpback whales in several coastal gillnet fisheries of the mid-Atlantic and southeastern United States.

Section 118 (f)(2) of the MMPA states that the immediate goal of a TRP for a strategic stock shall be to reduce, within six months of its implementation, the incidental mortality or serious injury of marine mammals incidentally taken in the course of commercial fishing operations to levels less than the PBR level established for that stock under Section 117.

There are strategic stocks of marine mammals that are taken by gillnets in coastal state waters at the time the American shad fishery occurs. NMFS proposed that the geographic definition for the mid-Atlantic coastal gillnet fishery to be bounded on the east by the 72'30'W. longitudinal line, running south from the southern Long Island shoreline, and on the south by a line drawn from the North Carolina-South Carolina border east to the 72'30' line (61 FR 37035, July 16, 1996). The following are the strategic stocks of marine mammals that are taken by gillnets in coastal state waters at the time mixed stock American shad fisheries occur. There are three strategic stocks that interact with coastal fisheries in state waters on an annual basis: the harbor porpoise, humpback whale, and the coastal migratory stock of bottlenose dolphin.

1. Harbor Porpoise

Harbor porpoise that are found along the eastern United States are considered to be one stock or population. This population was proposed as threatened under the Endangered Species Act (ESA) on January 7, 1993, and the bycatch of the Gulf of Maine population of harbor porpoise (approximately 1300 per year in 1992 and 1993) is significantly greater than the calculated PBR (approximately 400). The distribution of this population extends through at least North Carolina in the winter and early-spring, and then moves northward to the Bay of Fundy/Gulf of Maine in summer.

A total of 124 stranded porpoises have been examined from the Mid-Atlantic states since 1993. Most of the animals taken in state waters are taken in the months of March, April and May, from North Carolina to New Jersey. Fifty percent of those porpoise which stranded in Virginia and North Carolina, and for which a cause of death could be determined, had net marks indicative of gillnet entanglement. Nine porpoise that stranded in Virginia had further indications of mutilation. The timing and location of these stranding data follow the timing and location(s) of the intercept shad fishery as it moves north along the coastline.

2. Humpback Whale

During the past several years there has been a fourfold increase in the number of strandings of humpback whales in the mid-Atlantic region, many with indications of fishing gear entanglement. Between 1989 and 1992, 31 humpback whales stranded from New Jersey through Virginia (Wiley et. al. 1994). Significantly more strandings occurred between Chesapeake Bay and Cape Hatteras, North Carolina. Strandings increased from February through April and 25 percent had scars consistent with net entanglement. Between 1990 and 1996, 10 humpbacks stranded in Virginia. Three of the animals showed evidence of rope abrasion consistent with entanglement.

3. Bottlenose Dolphin

There are at least two stocks of bottlenose dolphin along the eastern coast of the United States: a coastal migratory stock that occurs in coastal waters of the eastern United States; and an offshore stock which is larger and occurs farther offshore than the coastal stock. The coastal bottlenose dolphin stock is designated as depleted under the MMPA as a result of a significant die-off in 1987-1988 that reduced the size of this stock by an estimated 50 percent. At least part of the coastal migratory stock moves north of Cape Hatteras in approximately mid-April and returns south of Cape Hatteras in late October-early November.

Coastal bottlenose dolphin strandings in North Carolina follow the pattern of gillnet fishing effort. Strandings from Cape Hatteras to New Jersey follow the seasonal occurrence of the stock in local waters. Strandings in North Carolina generally occur January through May (peaking in March-May), then again from October through December. This stranding pattern also follows increased fishing effort from Virginia to New Jersey and the seasonal occurrence of bottlenose dolphins in these waters (i.e., late spring through fall from Virginia north). The only known fishery mortalities of this stock occur in state waters. Many of these occur when the shad fishery is in operation in many of these states, as well as other coastal gillnet fisheries. The PBR for this stock (based on stranding data and estimated percentage of these animals taken in gillnet fisheries in state waters) is exceeded by gillnet mortalities each year in North Carolina and northward. Therefore, the estimated bycatch of the coastal stock of bottlenose dolphin in state waters needs to be reduced by greater than 50 percent in order to get below PBR for this stock.

B. Sea Turtles

Sea turtles that occur in U.S. waters are listed as either endangered or threatened under the ESA. Five species occur along the Atlantic coast of the United States; the loggerhead *(Caretta caretta),* Kemp's ridley *(Lepidochelys kempii), green (Chelonia mydas), leatherback (Dermochelys coriacea),* and hawksbill *(Eretmochelys imbricate).*

Shad are harvested primarily with anchored, staked and drift gillnets; however there is also a pound net, trawl, and hook and line component. All of these gear types are documented to impact sea turtles. Because the fishery occurs inshore and in nearshore waters, it is likely to interact with sea turtles depending on the location and season.

<u>Gillnets</u>

Stranded loggerhead and Kemp's ridley sea turtles have been partially or completely entangled in

gilinet material, and are most likely to come in contact with the gear in shallow coastal waters. Green sea turtles are present in small numbers in these areas and could also be taken in this fishery. Leatherbacks are also present especially when warmer waters bring jellyfish, their preferred prey, into coastal areas. Hawksbill sea turtles are only rare visitors to the areas where fishing effort occurs, preferring coral reefs with sponges for forage, so interaction would be limited. However, entanglement in gillnets has been identified as a serious problem for hawksbills in the Caribbean (NMFS and USFWS 1993).

Spring and fall gillnet operations have been strongly implicated in coincident sea turtle stranding events from North Carolina through New Jersey. On average, the highest numbers of interactions occurred in spring, followed by summer and fall. The southern states appear to have had more spring interactions, while the northern states had more summer interactions, probably due to the northern migration of sea turtles in the warmer months.

Netting gear found on stranded turtles varied widely, from 2 - 11.5" (5-29 cm) stretch mesh, and ranged from small, cut pieces of net, to lengths (up to 1200'(365m)) of abandoned net. Net gear was of various materials including nylon, cotton, and propylene, and in various colors including blue, black, and green. Gear type included flounder, sturgeon, and mullet nets, monofilament, twine, gillnets, pound nets, trammel nets, seines, sink nets, and nets attached to anchors, cork floats, and buoys.

<u>Pound Nets</u>

Most of pound net fishery interactions result in live releases and are documented primarily from North Carolina, Virginia, Long Island and Rhode Island. In Chesapeake Bay, Virginia, turtles become entangled in pound nets starting in mid-May with increasing numbers of entanglements until late June. The construction of leaders in pound nets was found to be a significant factor in these entanglements (Musick et. al. 1987). Entanglement was found to be insignificant for small mesh (8-12-inch mesh = small; >12-16-inch mesh = large). Large mesh nets and nets with stringers spaced 16-18 inches apart entangled a large number of turtles. Therefore, the potential to entangle sea turtles in pound nets could be alleviated by decreasing the mesh size in the leaders (Musick et. al. 1987). The pound net component of the shad and river herring fishery for North Carolina occurs in Albemarle Sound that is not frequented by turtles due to the relatively low salinities found there.

Hook and Line

From 1991 through 1995, a total of 112 turtles stranded with fishing hooks associated with some part of its body. Thus, hook and line fishing does impact sea turtles.

Recommendations for Sea Turtle Protection:

1. A conservation plan and application for a section ten ESA incidental take permit should be developed for those states where the fishery occurs when sea turtles are present.

2. Research into gear development/deployment for gillnets should be conducted to minimize the impact on sea turtles.

3. Pound net leaders should be no larger than 12-inch mesh.

4. Public outreach material should be developed to improve awareness of sea turtle entanglement with hooks and monofilament line.

C. Migratory Coastal Birds

An unknown, but possibly significant, number of migratory birds are drowned each year in anchored gillnets in the nearshore marine waters of the mid-Atlantic region during the American shad coastal intercept fishery. Preliminary estimates, based on a study underway by the U.S. Fish and Wildlife Service (USFWS) and incidental mortality data from the Service=s Madison Wildlife Health Laboratory, indicate that many thousands of loons and sea ducks are killed each year. Most of these shad/bird interactions occur during January through March from North Carolina to New Jersey. South Carolina banned anchored gillnets in their coastal fishery because of excessive bird mortalities.

All of the species listed are diving birds which pursue fish underwater or feed on benthic invertebrates. Fish eating birds are especially vulnerable to drowning in gillnets because they pursue prey underwater. Additionally, fish eating birds may be attracted to the vicinity of nets that are anchored for days at a time to feed on forage fish feeding near the nets. All of the birds listed are present along the Atlantic coast from October through April, depending on weather and timing of migration. Double-crested cormorants are present throughout the year but are most abundant in the middle and northern Atlantic states during the summer.

The actual populations of most migratory coastal birds are largely unknown. Except for some diving ducks *(Aythya),* current surveys sample only a small portion of the populations of sea ducks and do not survey for non-game birds such as loons and grebes. The U.S. Migratory Bird Treaty Act prohibits the take and possession of protected migratory birds, except as may be permitted by regulations. Take means to pursue, hunt, shoot, wound, kill, trap, capture or collect. Possession means to detain and control.

A list of protected bird species most likely to interact with American shad fisheries along the Atlantic coast are listed below:

I. Protected birds in nearshore marine coastal waters most likely to interact with American shad gillnets:

Common Loon *(Gavia immer)*
Red-throated Loon *(Gavia stellata)*
Homed Grebe *(Podiceps auritus)*
Red-necked Grebe *(Podiceps grisegena)*
Double-crested Cormorant *(Phalacrocorax auritus)*
Northern Gannet *(Sula bassanus)*
Oldsquaw *(Clangula byemalis)*
Black Scoter *(Melanitta nigra)*
Surf Scoter *(Melanitta perspicillata)*
Red-breasted Merganser *(Mergus serrator)*

II. Protected birds in coastal bays most likely to interact with American shad gillnets and East Coast population status.

Species:	Status:
Common Loon *(Gavia immer)*	Unknown
Red-throated Loon *(Gavia stellata)*	Unknown, 50,000+ winter S. of NJ
Homed Grebe (Podiceps auritus)	Unknown
Red-necked Grebe *(Podiceps grisegena)*	Unknown
Double-crested Cormorant *(Phalacrocorax auritus)*	Abundant and increasing
Redhead *(Aythya americans)*	Depressed but increasing slightly
Canvasback *(Aythya valisineria)*	Slightly increasing
Greater Scaup *(Aythya marila)*	Decreasing
Lesser Scaup *(Aythya affinis)*	Stable
Ring-necked Duck *(Aythya collaris)*	Unknown
Red-breasted Merganser *(Mergus serrator)*	Stable
Common Goldeneye *(Bucephala clangula)*	Stable
Bufflehead *(Bucephala albcola)*	Increasing

Oldsquaw *(Clangula hyemalis)*	Stable
Black Scoter *(Melanitta nigra)*	Probably declining
White-winged Scoter *(Melanittafusca*	Probably declining
Surf Scoter *(Melanitta perspicillata)*	Probably declining
Ruddy Duck *(Oxyurajamaiccasis)*	Stable

C. Shortnose Sturgeon

The shad gillnet fishery has long been know to capture large numbers of sturgeons (Leland 1968), including adult shortnose sturgeon (Collins and Smith 1995). In the southeast, the shad fishery is likely the primary source of injury and direct mortality of shortnose sturgeon (Collins et a1. 1996). Existing data indicate that in the southeastern U.S., this species occurs in the shad gillnet bycatch in every river system that supports both a shad gillnet fishery and a shortnose sturgeon population. In addition to consistent records from the riverine and estuarine segments of the fishery, bycatch of this species has been recorded from the coastal ocean segment of the shad fishery in certain areas (e.g., off Winyah Bay, South Carolina, unpublished data).

The riverine shad gillnet season and the shortnose sturgeon spawning migration normally coincide in the southeastern U.S., resulting in capture of individuals intending to spawn (females apparently spawn only once every 2-3 years). Preliminary data suggest that non-lethal encounters of migrating sturgeon with gillnets may result in fallback (i.e., individuals abort the migration, move back downriver, and presumably resorb their gametes) (unpublished data; personal communication, M. Moser, UNC Wilmington). Thus, in addition to causing injury and direct mortality of spawners, the non-lethal capture of sturgeon in the shad gillnet fishery may cause reduced spawning success and low year class strength.

Recommendation for Shortnose Sturgeon Protection:

A conservation plan and application for a section ten ESA incidental take permit should be developed for those states where the fishery occurs when shortnose sturgeons are present.

1.5 Technical Documentation For New Amendment

In order to reduce the length of Amendment I and restrict its content to major revisions and a minimum of explanatory text, supporting documentation can be found in the 1985 Interstate Fishery Management Plan (Plan) for American Shad and River Herrings. This Plan, along with the 1998 American Shad Stock Assessment Peer Review Report, contain extensive materials that depict essential habitats and provide detailed explanations of the science behind the American shad and river herring management process.

Other supporting documents such as socioeconomic and law enforcement studies may be prepared as needed.

Section 2. AMENDMENT 1 GOAL AND OBJECTIVES

2.1 Amendment 1 Goal and Objectives

Goal: Protect, enhance, and restore east coast migratory spawning stocks of American shad, hickory shad, and river herrings in order to achieve stock restoration and maintain sustainable levels of spawning stock biomass.

Objectives:

1. Prevent overfishing of American shad stocks by constraining fishing mortality below $F_{30.}$

2. Develop definitions of stock restoration, determine appropriate target mortality rates and specify rebuilding schedules for American shad populations within the management unit.

3 . Maintain existing or more conservative regulations for hickory shad and river herring fisheries until new stock assessments suggest changes are necessary. This should keep fishing mortality sufficiently low to ensure survival and enhancement of depressed stocks and the maintenance of stabilized stocks.

4. Promote improvements in degraded or historic alosine habitat throughout the species= range. State and federal managers should consider the following methods to achieve this objective:

   A. Improve or install passage facilities at dams and other obstacles to provide upstream passage to historic spawning areas, or remove these obstacles entirely.

   B. Improve water quality in areas where water quality degradation may have affected alosine stocks.

   C. Evaluate current fish passage facilities for efficiency.

   D. Ensure that decisions on river flow allocation (e.g., irrigation, evaporative loss, out of basin water transport, hydroelectric operations) take into account flow needs for alosine migration, spawning, and nursery usage.

   E. Ensure that water withdrawal (e.g., cooling flow, drinking water) effects (e.g., impingement and entrainment mortalities, turbine mortalities) do not affect alosine stocks to the extent that they result in stock declines.

   F. Evaluate and improve downstream passage for adults and juveniles.

   G. Promote and coordinate alosine stocking programs for:

a) reintroduction to historic spawning area
b) expansion of existing stock restoration programs
c) initiation of new strategies to enhance depressed stocks.

H. Promote cooperative interstate research monitoring and law enforcement.

Establish criteria, standards, and procedures for plan implementation as well as determination of states= compliance with management plan provisions.

2.2 Management Unit

All migratory American shad, hickory shad, and river herring stocks of the east coast of the United States.

Recommendations on management for migratory alosines in the EEZ (3-200 nautical miles offshore) can be found in Section 4.9.

2.3 Definition of Overfishing

For the purposes of this Amendment, a stock of American shad is considered overfished if it exhibits a fishing mortality rate at or above F_{30}. A fishing mortality rate of F_{30} will result in 30% of the maximum spawning potential (biomass per recruit) in the female component of an unfished population.

A conservative overfishing definition of F_{30} was calculated for each of seven studied river systems (Table 1). The overfishing definition mentioned above is not a target for commercial or recreational fisheries to achieve, nor is it suitable for rebuilding depleted stocks. For the purposes of this Amendment, the overfishing definition of F_{30} will serve as a reference point that should not be exceeded in any given year. Target fishing mortality rates for rebuilding or protecting individual stocks shall be developed and monitored by the Technical Committee as data become available and restoration goals are established.

Table 1. Estimates of F_{30} (overfishing mortality rate) for selected stocks of American shad

Connecticut River	[illegible]
Hudson River	0.39
Delaware River	0.43
Upper Chesapeake Bay	0.43
Edisto River	0.48
Santee River	0.48
Altamaha River	0.48

Section 3. ENHANCEMENT AND MONITORING PROGRAM SPECIFICATIONS

This section describes the operational (as opposed to regulatory) procedures for states to follow in implementing Amendment 1. The requirements described below concern both fishery-independent and fishery-dependent monitoring programs as well as stocking and hatchery operations.

In both regulatory and operational considerations, Amendment 1 makes a distinction between producer areas and coastal areas. Producer areas are typically estuaries or river systems in which a discreet population of American shad, hickory shad and/or river herring spawn each spring. Each state shall delineate areas in their jurisdictions where single-stock or inriver fisheries are believed to occur, while differentiating these areas from coastal areas where mixed-stock fisheries occur. States shall report these descriptions when implementing this Amendment under Section 5.1.2.

Newly restored or recolonized producer areas can be designated at the discretion of the Management Board. The term "coastal areas" refers to all other regions within the Management Unit.

3.1 Assessing Annual Recruitment

Annual juvenile recruitment (appearance of juveniles in the ecosystem) of American shad, hickory shad, and river herring is measured in order to assess juvenile production to predict future year-class strength, provide a signal for recruitment failure or major habitat changes, and assessment of hatchery-released larvae. Recruitment is measured by sampling current year juvenile fish abundance in producer areas.

3.1.1 Calculation of Juvenile Abundance Indices

While much data on juvenile alosine abundance in the various river systems exists and CPUE indices are regularly calculated, most of the time series of indices have not been validated against relative abundance of adults in subsequent spawning runs and none have been validated to the same extent as have been striped bass indices. Nonetheless, these indices are still important indicators of juvenile production throughout the management unit.

All juvenile abundance indices, or JAIs, shall be reported as a geometric mean. The method for calculating the geometric mean is described in ASWC (1992) and Crecco (1992). Use of the geometric mean will reduce the probability of a single value unduly influencing management action.

3.1.2 Elements for Measurement and Use of Juvenile Indices

The sampling protocol (stations, sampling intensity and gear type) should be consistent through time for the period for which the index is to be used. For new sampling programs, the following information will be required: details of the sampling design, a description of the analyses performed, and a presentation of the results of those analyses. The Technical Committee shall review any such submittal and either accept or reject it. If rejected, the Committee will provide a written explanation to the sponsor explaining the reasons for the rejection.

Validation is not required for any particular JAI survey. Validation of American shad juvenile indices has been proven difficult and will not be a criteria for accepting or rejecting any given JAI survey.

Indices can be used to guide the management of individual stocks in individual producer areas. The Management Board may require juvenile abundance surveys in new producer areas, or for any other alosine species not currently monitored for juvenile production.

The Technical Committee shall annually examine trends in all required JAI surveys. If any JAI shows recruitment failure (i.e., JAI is lower than 90% of all other values in the dataset) for three consecutive years, then appropriate action should be recommended to the Management Board. The Management Board shall be the final arbiter in all management decisions.

3.1.3 Juvenile Abundance Index Surveys Required

The states that will be required to report an annual juvenile abundance index for American shad are listed in Table 2. When possible, states should report JAIs for other alosine species obtained from the required surveys listed in Table 2. Results of all JAI surveys shall be reported as per Section 5.1.2.2.

3.2 Assessing Adult Population Size and Distribution

Indices of adult spawning stocks are important when determining the efficacy of a particular management approach. Coupled with juvenile abundance indices and fishing mortality estimates, they clarify population dynamics and progress toward restoration goals. Adult stock indices can include mark/recapture studies, enumeration at fish passage facilities, catch-per-unit effort, and measurement of mortality and survival rates.

In addition to examining the adult stock abundance, scientists and managers must also understand how those populations are distributed in mixed-stock fisheries. In the case of American shad, this is particularly important for determining the effects of ocean-intercept fisheries on small, hatchery-supplemented stocks.

3.2.1 Adult Stock Restoration Goals for American Shad

This Amendment is intended to prevent overfishing of alosine populations (including American shad) within the management unit. Although some stocks of American shad are not currently overfished, almost all of them are believed to be at or near historically low levels and far from complete restoration. Nonetheless, definitions of individual stock restoration (e.g. minimum acceptable spawning run size) have not been established by the Technical Committee and approved by the Management Board. This situation has been perpetuated by a poor understanding of actual landings, stock/recruitment relationships and habitat carrying capacity. Therefore, the Technical Committee shall annually review new information obtained by the mandatory monitoring programs in Section 5, and use these data to recommend stock-specific restoration goals and suitable fishing mortality targets to the Management Board. The Management Board shall be the final arbiter in deciding these goals and targets, and may change the regulatory requirements of this Amendment under Section 4.5.

3.2.2 Adult Spawning Stock Surveys Required

States are required to implement the surveys shown in Table 2. Each year, the Technical Committee shall review the results of these surveys and analyze progress made toward any individual stock restoration goals. If restoration milestones for a particular stock are not achieved within five years after they have been established under Section 3.2.1, then the PRT shall recommend to the Management Board appropriate regulatory changes to be implemented under Section 4.5.

States may employ a variety of survey techniques in adult spawning stock surveys in river systems within their jurisdiction. These include gillnet surveys, mark-recapture studies, hydroacoustic surveys, and fish passage CPUES. As part of spawning stock surveys, states are required to take representative samples of adults to determine sex and age composition, repeat spawning (for states north of South Carolina), and size distribution of each stock within their jurisdiction. States must submit proposals to initiate these programs under Section 5.1.2 and changes to required monitoring programs as per Section 4.4.

3.2.3 Mixed Stock Contribution Surveys Required

Each year (beginning in the year 2000), states will be required to take part in a coastwide analysis of mixed stock contribution to ocean landings. The best available technique has been a cooperative coastwide tagging program to determine the origin of fish landed in ocean-intercept fisheries. If states allow a bycatch fishery, they will be required to subsample for tags and/or otoliths (see Section 4. 1). The Technical Committee will recommend the proper methodology or any changes in methodology to the Management Board on an annual basis. The Management Board may institute these changes under Section 4.5.

3.3 Annual Fishing Mortality Target and Measurement

3.3.1 Definition

Total mortality of alosines has essentially two components: natural mortality and fishing mortality. Fishing mortality is the rate at which fish are removed from the population by human activities. These activities include both intentional legal harvest (F_{dir}, or directed fishing mortality) and background or non-harvest activities which include poaching, bycatch, and hook-and-release mortality. Fishing mortality arises from both inriver and ocean fisheries. Non-directed mortality and directed mortality constitute total fishing mortality. Fishing mortality rates are estimated using a variety of fishery-dependent and fishery-independent data. These include catch curve analyses from commercial fisheries and tag/recapture studies. Unfortunately, the linkage between most harvest regulations and F rates is difficult to predict: the success of regulations in attaining target fishing mortality rates is usually determined through retrospective analysis (i.e., examining the previous years results).

It is critical that intensive fishery monitoring be initiated through this Amendment. If fishing mortality rates are too high (i.e., overshooting the target rate), the Management Board can consider imposing more strict regulations coastwide. It should be noted that bycatch of American shad and other alosines in oceanic fisheries, as well as undocumented ocean harvest, could severely bias estimates of total fishing mortality**.**

3.3.2 Biological reference points

Biological reference points (overfishing definitions) were estimated for American shad in seven Atlantic coast rivers including the Connecticut, Hudson, Delaware, upper Chesapeake Bay, Edisto, Santee, and Altamaha systems (Crecco 1998). Although American shad stocks exist in more than 30 river systems within the management unit, only these seven systems generated sufficient data to permit current F estimates.

A conservative overfishing definition of F_{30} was calculated for each of the seven studied river systems (Table 1). F_{30} is t le fishing mortality rate that will result in 30% of the maximum spawning potential (biomz ss per recruit) of an unfished population. The overfishing definition mentioned above is not a target for commercial or recreational fisheries to achieve, nor is it suitable for rebuilding depleted stocks. For the purposes of this Amendment, the overfishing definition of F_{30} will serve as a reference point that shall not be exceeded in any given year. Target fishing mortality rates for rebuilding or protecting individual stocks shall be developed by the states and monitored by the Technical Committee as data become available and restoration goals are established by the states (Section 4).

3.3.3 Requirements for Fishing Mortality Rate Calculation

States that re-open or establish new inriver or ocean bycatch fisheries will have to implement these requirements.

1) Catch composition data will be gathered by those states with inriver commercial fisheries for American shad. Samples shall be representative of location and seasonal distribution of catch, and appropriate biological data shall be collected including size, sex and age composition of landings. Catch composition data will be gathered by those states with coastal commercial fisheries (directed and non-directed) for American shad. Samples shall be representative of

location and seasonal distribution of catch, and appropriate biological data shall be collected including size and sex and age composition of landings.

2) Representative catch and effort data will be gathered by those states with inriver commercial fisheries. Programs should include an evaluation of harvest under-reporting. This reporting element will apply to fisheries for American shad, hickory shad, and river herring.

Representative catch and effort data will be gathered by those states with ocean-intercept commercial fisheries. Programs should include an evaluation of harvest under-reporting.

States are encouraged to gather catch and effort data from inriver subsistence fisheries, including personal consumption and bait harvest.

3) Existing monitoring programs for American shad recreational catch and effort shall be continued every 5 years (see Table 3). New programs to monitor recreational catch and effort in areas not covered by the Marine Recreational Fisheries Statistics Survey (MRFSS) should be developed for anadromous alosines, and NMFS should work to develop ways to differentiate between anadromous alosines in current and future management programs.

States should report any hickory shad incidentally intercepted in creel surveys for American shad.

4) For those river systems listed in Table 2, states must also provide annual estimates of survivorship and/or fishing mortality on American shad using a variety of techniques including catch curve analysis and tagging.

5) The Technical Committee may recommend additional monitoring programs for newly restored or colonized American shad populations as stock status or habitat improvements warrant.

6) Existing programs to monitor catch, effort, mortality, fish passage, migration, and/or stock composition in hickory shad and river herring fisheries shall be continued, and expanded as noted above. Any change to a state's monitoring program for these species must first be reviewed by the Technical Committee and approved the Management Board (see Sections 4.4 and 5)

3.4 Summary of Monitoring Programs

3.4.1 Biological Information

States are mandated to implement the fishery-dependent and independent monitoring programs outlined in Tables 2 and 3. In addition, states are encouraged to continue or augment the monitoring programs for river herring and hickory shad listed in Tables 4-6.

Whenever practical, state harvest and effort reporting requirements will coincide with current and future mandates of the Atlantic Coastal Cooperative Statistics Survey (ACCSP). Data needs not covered by the ACCSP will still be covered by annual reports submitted in conjunction with this FMP.

3.4.2 Social Information

Consumptive use (e.g. commercial fishing activities before closures) and non-consumptive use (e.g. ecotourism activities) surveys focusing on social data should be conducted periodically in a manner consistent with the intent of the Atlantic Coastal Fisheries Cooperative Management Act (ACFCMA) and the ACCSP Implementation Plan.

3.4.3 Economic Information

Consumptive use (e.g. commercial fishing activities before closures) and non-consumptive use (e.g. ecotourism activities) surveys focusing on economic data should be conducted periodically in a manner consistent with the intent of the ACFCMA and the ACCSP implementation Plan.

3.5 Stocking/Restoration

Most ASMFC jurisdictions are actively involved in alosine habitat surveys, identification of stream blockages and fish passage development, management planning, permit review, and stock assessment related to recovery efforts. Although potential exists in many rivers for stock supplementation and re-introductions using adult transplants and cultured fish, few jurisdictions not already involved in these techniques have plans to use them.

Ongoing stocking efforts include:

New England States
Maine conducts active shad restoration programs in many of their river systems. Prespawning adult American shad are stocked in the Androscoggin and Kennebec Rivers, and cultured American shad fry are being stocked in the Kennebec, Medomak, and Saco Rivers. A shad restoration plan is being prepared for the Penobscot River. New Hampshire participates in cooperative American shad passage assessment at major facilities on the Connecticut and Merrimack Rivers. New Hampshire has also been stocking adult American shad from the Connecticut River into various coastal rivers since the 1980s. Massachusetts has been stocking American shad in the Charles, Agawam, and Nemasket Rivers, and the Connecticut River above Vernon Dam. Rhode Island has stocked adult American shad taken from the Holyoke Dam to the Pawcatuck River. Connecticut has long been active in the state-federal cooperative program to restore anadromous fishes to the Connecticut River; however, no stocking of shad currently occurs in Connecticut waters.

Mid-Atlantic States
New York conducts a very limited alosine stocking program; however, further restoration activity in the Hudson River and Long Island tributaries may be planned pending results of ongoing habitat surveys. New Jersey has been stocking adult shad into the Raritan River for several

years; however, a new fish ladder with a viewing window has been in operation at the first darn on this river since 1996. Pennsylvania is not only actively involved in the Susquehanna River shad and herring restoration program, but they have also stocked up to one million cultured Delaware River source shad larvae above the Easton and Glendon dams on the lower Lehigh, and several hundred thousand cultured shad larvae in the Schuylkill River above dams. The most extensive shad stock rebuilding programs occur in the Chesapeake Bay watershed. On the Susquehanna River, New York, Pennsylvania, Maryland, USFWS, and NMFS have worked closely with private utility companies since 1969 to restore alosine populations returning to Conowingo Dam in Maryland. Following several years of shad egg stocking with limited results, Pennsylvania has been able to stock over 145 million larvae and fingerling shad from Delaware, Hudson, and Connecticut stocks into the river. Maryland also has an active culture and stocking program which includes American shad for the upper Bay and the Patuxent, Choptank, and Nanticoke rivers, and hickory shad for the Patuxent and Choptank rivers. Virginia has stocked American shad to the Pamunkey River and James River above Richmond. In addition, for several decades, the Pamunkey Indians had released a total of 22 million larvae into adjacent waters in Virginia. The Potomac River Fisheries Commission stocked 3.2 million shad larvae into the upper Potomac above Little Falls Dam in 1995-1996.

South Atlantic States

North Carolina currently stocks American shad in the Roanoke River. None of the remaining South Atlantic states (South Carolina through Florida) have active alosine restoration programs that involve fish stocking.

3.5.1 Stocking Techniques

Three basic elements of ongoing restoration efforts for anadromous alosines along the Atlantic coast include: (1) control of harvest to allow sufficient spawning escapement; (2) removal of barriers to migration or development of fish passage facilities at dams; and (3) active stock rebuilding, which typically involves fish juvenile or larval) introductions into waters above blockages. Harvest controls may be comprehensive as in state-wide or river-specific fishery closures, or they may be localized as in seasonal or gear restrictions, angler creel limits, or area closures near fishway entrances. Depending on the nature and size of the barrier to migration, the amount of available upstream habitat, and the target population size to be restored, eliminating in-stream obstructions may involve darn removal or breaching, barrier reconfiguration, or construction of fish ladders, lifts, or locks. Although each barrier to migration warrants individual attention from fishery managers and engineers, techniques for providing fish passage are now well established and readily available. Population rebuilding techniques most frequently used include culture and stocking of larvae or juveniles or stocking of pre-spawned adults which have been netted or trapped from nearby or distant waters.

3.5. 1.1 Culture and Marking

Modem American shad culture techniques have been largely developed and refined since the mid-1970s by the Pennsylvania Fish and Boat Commission (PFBC) for the Susquehanna River restoration program. Using eggs stripped and fertilized from spawning adult shad on many east coast rivers (and the Columbia River), PFBC researchers developed or improved incubation and hatching techniques, first feeds and artificial diets, larval rearing densities, flow and water quality requirements, mass-marking using oxytetracycline, and handling and stocking procedures sufficient to produce 10-20 million shad larvae each year. Pennsylvania and Maryland have also refined techniques for rearing and marking fingerling shad in ponds using artificial and natural diets. One of the high costs associated with culture and stocking programs relates to collection and delivery of eggs. Large-scale programs such as those on the Susquehanna and James rivers may require 15-20 million shad eggs to produce ten million fry. Since spawners are not yet sufficiently abundant in rivers undergoing restoration, these eggs are taken and delivered nightly during spawning seasons from neighboring rivers such as the Delaware, Hudson, and Pamunkey. Strip spawning produces 10,000-30,000 eggs per female and viability averages 60-75%. Of those shad that hatch, 90% or more typically survive to stocking.

In the past few years, the Maryland Department of Natural Resources (MDNR) has successfully used tank spawning techniques for shad which were initially developed for striped bass in cooperation with the University of Maryland's Center for Marine Biotechnology. This method involves use of timed-release hormone implants in gravid fish and free-spawning in tanks over a several day period. An air-lift system delivers eggs to collection boxes for incubation on-site or delivery to distant hatcheries. With individual females providing 50,000- 100,000 eggs, high fertilization rates, and very little labor requirement, fewer adult fish are needed and costs are greatly reduced. This technique has also proven effective for hickory shad - but has thus far been unsuccessful with river herring because of the adhesive nature of their eggs.

Cultured shad larvae are typically stocked at seven to 22 days of age and carry one to several fluorescent tags on their otoliths. Marking involves a two-four hour immersion in 200 ppm oxytetracycline antibiotic and can be repeated at three-four day intervals. In addition to allowing discrimination between wild and hatchery fish, use of distinct marks allows for analysis of relative survival or abundance based on egg source, stocking location, time of release or other parameters. Tetracycline marking is 100% effective and the tags appear to stay with the fish throughout their lives. Fish being analyzed for marks must be sacrificed for otolith removal and processing. MDNR has also had success placing binary coded wire tags in fingerling shad.

3.5.1.2 Trap and Transport

Trapping and live transfer of adult shad and river herring has been used by many jurisdictions since the 1960s. These activities may occur within a specific river system, such as taking fish from lifts at downstream hydroelectric projects for stocking above blockages as in the Connecticut and Susquehanna rivers, or they may involve collecting fish with nets or traps in one river for transport and release in another. Examples include shad transfers from Holyoke Dam on the Connecticut to spawning rivers in Maine, New Hampshire, Rhode Island, and eastern Massachusetts, and herring transfers from Conowingo Dam on the Susquehanna to the Patapsco and Patuxent rivers in Maryland. Shad and river herring have also been netted and hauled to upstream or distant spawning waters undergoing restoration (e.g., Hudson River shad to the Susquehanna River; Delaware River shad to the Raritan River). Hauling techniques are well-developed using insulated circular tanks with oxygenation. A properly equipped 1,200 gallon tank can handle 150 adult shad or 1,000 river herring for two-four hour trips with minimal mortality.

3.5.1.3 Evaluation

States with active hatchery programs for American shad or other alosines shall report annually on hatchery contributions (% wild vs. hatchery). States in this category shall submit proposals for these evaluations under Section 5.1.2. 1, and provide annual reports as per Table 10 and Section 5.1.2.2. States should work in cooperation with appropriate federal or regional programs to ensure unique marking in their operations.

3.6 Bycatch Monitoring and Reduction

States and federal agencies shall make every effort to assess the magnitude of alosine bycatch discard mortality (including hook and release mortality) occurring in waters under their jurisdiction. In cases where excessive alosine bycatch is documented, the involved jurisdiction(s) shall make such documentation available immediately to the Technical Committee, Advisory Panel, and Management Board. Any documentation shall include, at a minimum, the following information:

1) location, target species, and season of fishery or fisheries involved;

2) gear and gear specifications used in the fishery (e.g., gillnets, 4.5" mesh size);

3) an estimate of pounds or numbers and size or age of American shad taken per unit of effort in the fishery (e.g., lb. per trip), as well as an estimate of total American shad bycatch in the fishery;

4) an estimate of how long (e.g., years, months, weeks) American shad bycatch has occurred in the fishery.

Where appropriate, NWS and/or USFWS shall assist states with preparing the required report. The Technical Committee and Advisory Panel shall review such information, and prepare reports for the Management Board. After reviewing these reports, the Management Board may recommend remedial steps to be taken by the involved jurisdictions) (i.e., gear restrictions, seasonal/geographic closures, etc.), and may ask the jurisdictions) to continue documenting the problem until it is resolved to the Management Board=s satisfaction.

In general, states shall undertake every effort to reduce or eliminate the loss of American shad from the population due to bycatch discard mortality. When data are available, the Technical Committee shall examine trends in estimated bycatch annually. The Technical Committee will cooperate with the ACCSP to develop a system to collect bycatch data for American shad and other alosine species.

Atlantic Sturgeon Bycatch in Shad and River Herring Fisheries

Atlantic sturgeon have been documented as bycatch in coastal gillnet fisheries for American shad, and Amendment I to the 1990 Interstate Fishery Management Plan for Atlantic Sturgeon (ASMFC, 1998) stipulates that states will annually report on Atlantic sturgeon bycatch to the ASMFC Sturgeon Management Board (Sturgeon Board).

Jurisdictions within this Amendment's management unit shall report any estimates of Atlantic sturgeon bycatch in their shad or river herring fisheries to the Sturgeon Board, regardless of the fishery location. If the Sturgeon Board determines that unacceptable levels of sturgeon bycatch occur in these fisheries, it will stipulate corrective measures for the jurisdictions involved (e.g., area/season closures, gear modification, etc.). If the named jurisdictions do not comply with the conservation measures recommended by the Sturgeon Board, the Sturgeon Board may intervene to close the given shad or river herring fishery under the Atlantic Coastal Fisheries Cooperative Management Act (ACFCMA) until the bycatch reduction measures are implemented. Please refer to Amendment I to the ASMFC Fisheries Management Plan for Atlantic Sturgeon for more detail.

Table 2. Summary of mandatory fishery independent monitoring programs for American shad.

STATE	SYSTEM	SAMPLING PROGRAM (annual unless otherwise noted)
Maine	Androscoggin & Saco Rivers	Annual spawning stock survey and representative sampling for biological data Calculation of mortality and/or survival estimates Recovery of any visibly marked animals
New Hampshire	Lamprey and Exeter Rivers	Annual spawning stock survey and representative sampling for biological data Calculation of mortality and/or survival estimates Recovery of any visibly marked animals
Massachusetts	Merrimack River	Annual spawning stock survey and representative sampling for biological data Calculation of mortality and/or survival estimates Recovery of any visibly marked animals
Rhode Island	Pawcatuck River	Annual spawning stock survey and representative sampling for biological data Calculation of mortality and/or survival estimates Recovery of any visibly marked animals
Connecticut	Connecticut River	Annual spawning stock survey and representative sampling for biological data Calculation of mortality and/or survival estimates JAI: Juvenile abundance survey (GM)
New York	Hudson River	Annual spawning stock survey and representative sampling for biological data Calculation of mortality and survival estimates JAI: Juvenile abundance index (GM)
	Delaware River	Annual spawning stock survey and representative sampling for biological data Calculation of mortality and/or survival estimates JAI: Juvenile abundance index (GM)
New Jersey	Delaware River	Annual spawning stock survey and representative sampling for biological data Calculation of mortality and/or survival estimates JAI: Juvenile abundance index (GM)
Pennsylvania	Susquehanna River	Annual spawning stock survey and representative sampling for biological data Calculation of mortality and/or survival estimates Recovery of any visibly marked animals JAI: Juvenile abundance index (GM) Hatcherv evaluation
	Lehigh River	Annual spawning stock survey and representative sampling for biological data Calculation of mortality and/or survival estimates Hatcherv evaluation

Table 2 (cont=d). Summary of mandatory fishery independent monitoring programs for American shad.

Pennsylvania	Delaware River	Annual spawning stock survey and representative sampling for biological data Calculation of mortality and/or survival estimates JAI: Juvenile abundance_index (GM)
Delaware	Delaware River	Annual spawning stock survey and representative sampling for biological data Calculation of mortality and/or survival estimates
Maryland	Upper Ches. Bay	Annual spawning stock survey and representative sampling for biological data Calculation of mortality and/or survival estimates JAI: Juvenile abundance index (GM) Hatchery evaluation
	Potomac River	JAI: Juvenile abundance index (GM)
D.C.	Potomac River	Annual spawning stock survey and representative sampling for biological data Calculation of mortality and/or survival estimates
Virginia	James, York, and Rappahannock Rivers	Annual spawning stock survey and representative sampling for biological data Calculation of mortality and/or survival estimates JAI: Juvenile abundance index (GM) Hatchery evaluation
North Carolina	Albemarle Sound and its tributaries, Tar-Pamlico, Neuse, and Cape Fear Rivers	Annual spawning stock survey and representative sampling for biological data Calculation of mortality and/or survival estimates
South Carolina	Santee-Cooper system, Edisto River, Winyah Bay and tributaries (Waccwnaw and Pee Dee Rivers), Combahee, Ashepoo, Coosawhatchie, and Savannah Rivers	Annual spawning stock survey and representative sampling for biological data Calculation of mortality and/or survival estimates *State may elect to sample these systems on a rotational basis (i.e., one system evaluated per year)
Georgia	Altamaha River	Annual spawning stock survey and representative sampling for biological data Calculation of mortality and/or survival estimates
Florida	St. Johns River	Annual spawning stock survey and representative sampling for biological data Calculation of mortality and/or survival estimates

Table 3. Mandatory fishery-dependent monitoring programs for American shad.

STATE	SYSTEM	SAMPLING PROGRAM
Maine	Inriver	Recreational catch and effort using MRFSS
	Atlantic Ocean	Mandatory reporting of catch (numbers and weight) and effort from commercial fisheries; subsamples shall indicate size, age, and sex composition of catch. Participate in ocean landings stock composition study.
New Hampshire	Inriver/coastal-	Recreational catch and effort using MRFSS
Connecticut	Connecticut River	Mandatory reporting of catch (numbers and weight) and effort from commercial fisheries; subsamples shall indicate size, age, and sex composition of catch. Biannually monitor recreational landings in CT and MA - age, sex ratio, and fishing effort (hours fished) until annual catch > 1,000 fish
Rhode Island	Pawcatuck River	Mandatory reporting of catch (numbers and weight) and effort from commercial fisheries; subsamples shall indicate size, age, and sex composition of catch. Monitor recreational catch and effort every 5 years.
	Atlantic Ocean	Mandatory reporting of catch (numbers and weight) and effort from commercial fisheries; subsamples shall indicate size, age, and sex composition of catch. Participate in Ocean landings stock composition study.
New York	Hudson River	Mandatory reporting of catch (numbers and weight) and effort from commercial fisheries; subsamples shall indicate size, age, and sex composition of catch. Monitor recreational landings, catch, and effort every 5 years.
	Delaware River	Monitor recreational landings, catch, and effort every 5 years. (Cooperative effort between New Jersey, New York, Pennsylvania, and Delaware)
New Jersey	Delaware River and Bay	Mandatory reporting of catch (numbers and weight) and effort from commercial fisheries; subsamples shall indicate size, age, and sex composition of catch. Monitor recreational landings, catch, and effort every 5 years. (Cooperative effort between New Jersey, New York, Pennsylvania, and Delaware)
	Atlantic Ocean	Mandatory reporting of catch (numbers and weight) and effort from commercial fisheries; subsamples shall indicate size, age, and sex composition of catch. Participate in Ocean landings stock composition study.
Delaware	Delaware River and Bay (RM 0-75)	Mandatory reporting of catch (numbers and weight) and effort from commercial fisheries; subsamples shall indicate size, age, and sex composition of catch. Monitor recreational landings, catch, and effort every 5 years. (Cooperative effort between New Jersey, New York, Pennsylvania, and Delaware)

Table 3 (cont=d). Mandatory fishery-dependent monitoring programs for American shad.

Delaware	Nanticoke River Ches. Bay tributatry, upstream portion)	Mandatory reporting of catch (numbers and weight) and effort from commercial fisheries; subsamples shall indicate size, age, and sex composition of catch. Monitor recreational landings, catch, and effort every 5 years.
	Atlantic Ocean	Mandatory reporting of catch (numbers and weight) and effort from commercial fisheries; subsamples shall indicate size, age, and sex composition of catch. Participate in Ocean landings stock composition study.
Pennsylvania	Delaware River	Monitor recreational landings, catch, and effort every 5 years. (Cooperative effort between New Jersey, New York, Pennsylvania, and Delaware)
Maryland	Inriver	Monitor recreational landings, catch, and effort every 5 years.
	Atlantic Ocean	Mandatory reporting of catch (numbers and weight) and effort from commercial fisheries; subsamples shall indicate size, age, and sex composition of catch. Participate in Ocean landings stock composition study.
Virginia	Inriver	Monitor recreational landings, catch, and effort every 5 years.
	Atlantic Ocean	Mandatory reporting of catch (numbers and weight) and effort from commercial fisheries; subsamples shall indicate size, age, and sex composition of catch. Participate in Ocean landings stock composition study.
North Carolina	Albemarle Sound and its tributaries, Tar-Pan-dico, Neuse, and Cape Fear Rivers	Mandatory reporting of catch (numbers and weight) and effort from commercial fisheries; subsamples shall indicate size, age, and sex composition of catch. Monitor recreational landings, catch, and effort every 5 years.
	Atlantic Ocean	Mandatory reporting of catch (numbers and weight) and effort from commercial fisheries; subsamples shall indicate size, age, and sex composition of catch. Participate in Ocean landings stock composition study.
South Carolina	Santee-Cooper system, Charleston Harbor and its tributaries (Ashley and Cooper Rivers), Edisto River, Santee River, Winyah Bay and its tributaries (Waccwnaw and Pee Dee Rivers)	Mandatory reporting of catch (numbers and weight) and effort from commercial fisheries; subsamples shall indicate size, age, and sex composition of catch. Monitor recreational landings, catch, and effort every 5 years. *State may elect to sample these systems on a rotational basis (i.e., one system evaluated per year
	Atlantic Ocean	Mandatory reporting of catch (numbers and weight) and effort from commercial fisheries; subsamples shall indicate size, age, and sex composition of catch. Participate in Ocean landings stock composition study.
Georgia	Ogeechee	Mandatory reporting of catch (numbers and weight) and effort from commercial fisheries; subsamples shall indicate size, age, and sex composition of catch. Monitor recreational landings, catch, and effort every 5 years.
Florida	St. Johns River	Mandatory reporting of catch (numbers and weight) and effort from commercial fisheries; subsamples shall indicate size, age, and sex composition of catch.

		Monitor recreational landings, catch, and effort every 5 years.

Table 4. Summary of recommended fishery-dependent monitoring programs for adult river herring and hickory shad .

State	System	Species	Sampling Program
Maine	All rivers	River herring	Towns must submit an annual harvesting plan and landings to the Department of Marine Resources
New Hampshire	Lamprey, Oyster, Cocheco, Taylor, Exeter Rivers, and Great Bay Estuary	River herring	Mandatory reporting by all Coastal Netters Permittees of catch and effort information. Coastal Netters Permits are required by all fishermen using nets, traps, or weirs in New Hampshire=s open ocean and coastal estuaries
Massachusetts	Over 125 active natal river herring runs	River herring	Some periodic sampling of runs harvested under Local control
Delaware	Delaware River (RM 0-75) Nanticoke River (Ches Bay tributary, upstream portion)	River herring	Mandatory catch reports of the commercial fisheries for landings and effort
Maryland	Nanticoke River	River herring	Monitor annually the commercial pound and fyke net river herring bycatch for catch, effort, sex ratio, length/weight
Virginia	James River, York River system (includes Pamunkey and Mattaponi Rivers), and Rappahannock River	River herring	Monitor the commercial pound net and haul seine fisheries
North Carolina	Albermarle Sound area	River herring	Annually monitor the commercial herring fishery for catch composition age, length, and sex, Annually monitor the catch effort of the Chowan River pound net fishery. Annually monitor Annually monitor the size, age and sex composition of hickory shad
South Carolina	Santee-Cooper system	River herring	Annually monitor the commercial herring fishery for age, length, weight, sex ratio and effort
	Santee River	River herring	A hoop, drop and cast net fishery targeting herring has developed in the Re-diversion canal below St. Stephen Dam since completion of the Re-diversion Project. Landings from this fishery collected by the Freshwater Division.

Table 5. Summary of recommended fishery-independent monitoring programs for adult river herring and hickory shad .

State	System	Species	Sampling Program
Maine	Saco Androscoggin, and St. Croix Rivers	River herring	Estimated number of spawning adults returning to the fishway are made and samples of length, age, and sex are collected
	Kennebec, Anndroscoggin, and Union Rovers	Alewife	Numbers of adults stocked in each lake/impoundment are recorded. Samples are collected for length, age, and sex in the Kennebec and Androscoggin Rivers.
New Hampshire	Lamprey River	River herring	Estimated number of spawning adults returning to fish ladders are made via absolute counts, timed counts, or electronic counting tubes. Samples of 150 lengths by sex are taken three times during the spawning runs (beginning, middle, end). Fifty of the fish from each of the three samples are aged.
	Oyster River	River herring	Estimated number of spawning adults returning to fish ladders are made via absolute counts, timed counts, or electronic counting tubes. Samples of 150 lengths by sex are taken three times during the spawning runs (beginning, middle, end). Fifty of the fish from each of the three samples are aged.
	Cocheco River	River herring	Number of spawning adults returning to fish ladder is counted by hand. Samples of 150 lengths by sex are taken three times during the spawning runs (beginning, middle, end). Fifty of the fish from each of the three samples are aged.
	Exeter River	River herring	Number of spawning adults returning to fish ladder is made via timed counts or absolute counts. Length measurements by sex, and scales for aging are taken in some years on an opportunistic basis.
	Taylor River	River herring	Estimated number of spawning adults returning to fish ladders are made via absolute counts, timed counts, or electronic counting tubes. Length measurement by sex and scales for aging have been taken in some years on an opportunistic basis
Massachusetts	Over 125 active natal river herring runs	River herring	Connecticut River - see Connecticut River Restoration Program annual progress report Merrimack River - See USFWS Anadromous Fish Restoration Program progress report Monument River - Bourne Local Control MR Spring spawning stock survey electronic counters, dip netting, haul seines Programs run annually, expected to continue

Table 5 (cont=d). Summary of recommended fishery-independent monitoring programs for adult river herring and hickory shad .

Connecticut	Connecticut River	Blueback herring	Stock abundance derived from Holyoke fish lift
Rhode Island	Pawcatuck River	Various Alosines	Fishway trap and count at first dam on system since 1979.
Virginia	James River, York River system (includes Pamunkey and Mattaponi Rivers), and Rappahannock River	River herring	Spring spawning stock survey from pound nets
North Carolina	Albemarle Sound and tributaries	River herring and hickory shad	Spawning area assessment work - gillnets of various mesh sizes (not continuous) were set in certain systems for a season (March to May) to capture adults participating in spawning migration. Species, number, length and age data are available for some years.

Table 6. Summary of recommended monitoring programs for juvenile river herring and hickory shad .

State	System	Species	Sampling Program
Maine	Kennebec and Anddroscoggin Rivers	*Alosa* spp.	Annual juvenile Alosine survey
Connecticut	Connecticut River	Blueback herring	Annual geometric mean (catch/seine haul)
Rhode Island	Pawcatuck River	*Alosa* spp.	Juvenile index at 5 stations in estuary, Sept-Oct weekly
New York	Hudson River	*Alosa* spp.	Annual juvenile Alosine survey
Delaware	Delaware River (RM 0-75) Nanticoke River (Ches Bay tributary, upstream portion)	*Alosa* spp.	Annual juvenile fish trawl survey - Delaware River and Bay, April through November Data used to determine year class strength of primarily demersal fishes CPUE, length frequency
New Jersey	Delaware River and Bay	*Alosa* spp.	Striped bass annual JAI seine survey
Pennsylvania	Susquehanna River	*Alosa* spp.	Weekly seining July-Oct (300' x 6' x 3/8") Twice weekly lift net at Holtwood (8' x 8' x 1/2")
Maryland	Chesapeake Bay tributaries	*Alosa* spp.	Striped bass annual JAI seine survey
North Carolina	Albemarle Sound and tributaries	*Alosa* spp.	Annual trawl surveys conducted at set stations, at times year round or seasonal June-October. Three different types of trawls were employed. Trawl sampling dropped due to reduction in force and funds. Annual seine surveys June-October. Number of stations varies, but core station of 11. Data used as relative abundance index of age zero. Arithmetic mean calculated monthly and annually. Mean size data determined monthly and annually.
South Carolina	Santee-Cooper system	River herring and shad	Annual beach seine survey, July-September - number caught per seine haul in Lake Marion Cast netting data from forbay in front of St. Stephen Dam - number caught, length, weight for shad and herring
	Charleston harbor and tributaries (Ashley and Cooper Rivers)	Alosa spp.	Limited Alosine data is available for the lower portions of the Charleston Harbor system from catches made during the conduct of annual shrimp sampling programs. This data is primarily related to time of occurrence, with some size by date information available.

Section 4. MANAGEMENT PROGRAM IMPLEMENTATION

4.1 Commercial fisheries Management Measures

Mandatory reporting on catch and effort in active commercial fisheries for all alosines (American shad, hickory shad, and river herring) will be required as per Section 3.

Whenever practical, state harvest and effort reporting requirements will coincide with current and future mandates of the Atlantic Coastal Cooperative Statistics Survey (ACCSP). Data needs not covered by the ACCSP will still be covered by annual reports submitted in conjunction with the FMP.

A. Ocean-intercept commercial fisheries

Begin a phase-out reduction plan for the commercial ocean-intercept fishery for American shad (outside state-defined producer areas - see beginning of Section 3.1) over a five-year period. States must achieve at least a 40% reduction in effort in the first three years, beginning January 1, 2000. States with directed ocean-intercept fisheries will determine how to achieve this effort reduction and submit proposals as per Sections 5.1.2.1 and 5.1.2.2.

States with non-directed harvest of American shad in ocean fisheries (outside state-defined producer areas - see beginning of Section 3.0) can permit the landing of this shad bycatch, provided that American shad do not constitute more than 5% of the total landings (in pounds) per trip. States permitting the landing of American shad ocean bycatch must annually document that the 5% trip limit is not exceeded, report the extent and nature of the non-directed fisheries, and the total landings of American shad bycatch. In addition, these jurisdictions must subsample all American shad bycatch for size, age, sex distribution as per Section 3.3.3, except as exempted under *de minimis* provisions of Section 4.8.

All jurisdictions shall maintain existing or more conservative regulations for commercial river herring and hickory shad fisheries in ocean waters.

Jurisdictions currently managing under a moratorium in producer areas may shift effort from ocean-intercept fisheries to inriver fisheries, provided that the total mortality for a given exploited stock does not exceed the target mortality (F_{30} or restoration target rate) for that stock**.**

2. Inriver commercial fisheries

States may conduct inriver fisheries for American shad at levels not to exceed F_{30} for the following systems: Connecticut, Hudson, Delaware, Upper Chesapeake Bay, Santee, Edisto, and Altamaha. States with jurisdiction over these systems must submit proposals on how to maintain F at or below F_{30} as per Section 5.1.2. 1. For all other stocks, or any stock of American shad identified for restoration, states must develop and adopt recovery plans as per Section 5.1.2.1 below. States shall not exceed any specified target F suitable for attaining adopted restoration goals.

All jurisdictions shall maintain existing or more conservative regulations for commercial river

herring and hickory shad fisheries, except for expanded monitoring programs outlined in Section 3.3.3.

4.2 Recreational Fisheries Management Measures

All jurisdictions shall not exceed an aggregate 10 fish daily creel limit in recreational fisheries for American shad or hickory shad. For American shad or hickory shad stocks under restoration, states must adopt recreational creel limits consistent with restoration targets. Creel limits should be described in state recovery/fishing plans as per Section 5.1.2. 1.

4.3 Habitat Conservation and Restoration

Shad and river herring stocks along the Atlantic coast are greatly diminished compared to historic levels. Much of this reduction is related to spawning and nursery habitat degradation brought on by effects of human population increase (sewage and stormwater runoff, industrialization), increased erosion, sedimentation and nutrient enrichment associated with agricultural practices, and losses of riparian forests and wetland buffers. All Atlantic coast jurisdictions and several federal agencies routinely review and comment on water development project permits and licenses for activities which adversely affect alosine habitat or interfere with upstream or downstream migrations. Legislation, such as the Clean Water and Clean Air Acts, address these concerns and both water and air quality has shown substantial improvements since the 1960s.

Thousands of kilometers of historic anadromous alosine habitat were lost due to development of dams and other obstructions to migration. These impediments take many forms including large hydroelectric darns on mainstems of rivers, water storage and flood protection projects, small dams erected in tributaries to supply water to historic mills or to meet local water supply or industrial needs, culverts at highway crossings, gauging station weirs, and others. Passage success at these barriers often depends on individual stream flow characteristics during the fish migration season. Shad and river herring may be blocked by a structure only 20-30 centimeters in height above water.

Many state and federal fishery agencies are involved in habitat improvement programs aimed specifically or indirectly at rebuilding stocks of shad and river herring. In most cases, these involve characterizing habitat suitability, defining historic spawning and nursery areas, inventory of blockages to migration, and provision of fish passage facilities. Frequently, these efforts are accompanied by re-stocking above dams to imprint alosines to return and recolonize these waters. Depending on the quality and size of the habitat being restored and the nearness and migratory patterns of suitable source stocks, restoration can occur quickly and at relatively small cost (e.g., adult alewife introduction to a coastal pond), or it can take decades and cost tens of millions of dollars (e.g., large rivers with multiple mainstem dams).

Table 7. Commercial regulations for American shad - Inriver fisheries (as of Jan. 97)

STATE	SYSTEM	SEASON	GEAR LIMITS	Mandatory reporting	Other Restrictions
Maine	All rivers		Hook/Line Only		2 fish per day
New Hampshire	All rivers		Hook/Line Only		2 fish per day
Massachusetts	All rivers		Closed		
Rhode Island	All rivers		Closed		
Connecticut	All rivers	Apr 1 - Jun 15	Multifilament and monofilament gillnets only; monofilament net - nights only	Yes	48hr. escapement period/week
New York	Hudson	Mar 15-Jun 15	Net length: 1200 ft. max Mesh: 3.5 in to 5 in. Not allowed Gear restrictions in defined areas	yes	36hr. escapement period/week - closed area in spawning reach
New Jersey	Delaware River	None	None	None	
	Delaware Bay	Feb 1-Dec 15	Mesh: 5" from Feb 1-Feb 29 Net length 2400 ft.- Feb 1-May 15 1200 ft.-May 16-Dec 15	None	
	Raritan/ Sandy Hooks Bays	Feb 1-Dec 15	Mesh: 5" from Feb 1-Feb 29 Net length 2400 ft.- Feb 1-May 15 1200 ft.-May 16-Dec 15	None	Pound net season: open all year round
New Jersey	Hudson River	Mar 15-Jun 15	Net length: 1200 ft. Mesh 5 in.Gear restrictions in defined areas	yes	36hr. escapement period/week - closed area in spawning reach
Delaware	Delaware River	None	No fixed gillnets (Jan 1-May 31) No Drift gillnet Sat., 1600 hrs Sun. (May 10-Sep 30)	yes	Limited entry on licenses

Table 7 (cont=d). Commercial regulations for American shad - Inriver fisheries (as of Jan. 97).

	Delaware Bay	None	No anchor gillnet-May 10-Sep 30 No drift gillnet Sat., 1600 hrs Sun. May 10-Sep 30	Yes	Limited entry on Licenses
Pennsylvania			Closed		
Maryland			Closed (since 1980)		
PRFC			Closed (Since 1982)		
Virginia			Closed (since 1994)		
North Carolina		Jan 1-Apr 14	Varies by system Mesh Size and net length/yardage restricts Closed areas to gillnetting	Yes; Trip ticket	None
South Carolina		Jan or Feb-Apr (varies by system)	Varies by system Mesh Size: 4.5-5.5 in. Net length limits Closed areas	Yes, from dealers Volunteer from others	Weekly escapement varies by river (72-108hr)
Georgia		Jan 1-Mar 31	Net length limit by gear type Mesh 4.5 in. Minimum restricted area for nets by system		Weekly escapement varies by river (48-120hr)
Florida			Closed		

Table 8. Commercial regulations on American shad - ocean fisheries (as of Jan. 97).

STATE	SEASON	GEAR LIMITS	Mandatory reporting	Other Restrictions
Maine		Hook and Line only		2 fish per day
New Hampshire		NONE		
Massachusetts		Closed		
Rhode Island		NONE		
Connecticut		NONE		
New York		NONE		
New Jersey	Feb 1-Dec15	Mesh: 5" from Feb 1 -Feb 29 Net length: 2400 ft. - Feb 1 -May 15 1200 ft. May 16-Dec 15	NONE	
Pennsylvania		N/A		
Delaware	NONE	Same as inriver No gillnets<0.5 mi offshore form May 10-Nov 30	Yes	Limited entry on licenses
Maryland	Feb 2-Apr 30	NONE	Yes	Limited entry on licenses
PRFC		N/A		
Virginia	NONE	NONE		NONE
North Carolina	Jan 1-Apr 14	NONE	Yes, Trip ticket	Area restrictions
South Carolina	Feb 1-Sat. before Easter or Mar 25	Mesh Size4. Minimum Drift net only Some restricted & closed areas		Weekly escapement: 48 hr
Georgia		Closed		
Florida		Closed		

Table 9. Recreational fishing regulations for American shad - Inriver (as of Jan. 97).

STATE	SEASON	DAILY LIMIT	GEAR LIMIT	Other Restrictions
Maine	NONE	2 fish/day	H&L only	
New Hampshire	NONE	2 fish/day	H&L only	
Massachusetts	NONE	NONE	H&L only, marine waters	
Rhode Island		Catch and release only		
Connecticut	Apr 1-Jun 30	6 fish/day - includes MA water of CT River	H&L only	
New York - Hudson River	Mar 15 - Jun 15	NONE	H&L only	No License required
- Delaware River	NONE	6 fish/day	NONE	
New Jersey - Delaware River	NONE	NONE	NONE	
Pennsylvania - Delaware River	NONE	6 fish/day	H&L only	
- Other systems	NONE	Lehigh: 1 fish/day; Susquehanna: C&R Schuykill: 6 fish/day	H&L only	
Delaware - Delaware River	NONE	NONE	H&L only	
- Other systems	NONE	NONE	H&L only	≤2 lures/line and 1 hook/lure
Maryland		Closed		
PRFC		Closed		
Virginia		Closed		
North Carolina - Inland - Coastal	NONE Jan 1 - Apr 14	10 fish/day (Aggregate Am. and hickory shad) 10 fish/day (Aggregate Am. and hickory shad)	H&L, License required H&L	License required
South Carolina	NONE	NONE	H&L in most rivers, small nets in others with restrictions	
Georgia	NONE	8 fish/day	H&L only	
Florida	NONE	10 fish aggregate (hickory/American /day	H&L only	License required

4.3.1 Recommendations for Fish Habitat Conservation/Restoration

1. State marine fisheries agencies should identify state permitting and planning agencies that regulate those activities identified in Section 1.3.2 as likely to adversely affect habitat areas of particular concern (H.A.P.Cs) and habitats, either by destruction of habitat or degradation of quality. The marine fisheries agency should work with the relevant permitting or planning agency in each state to develop permit conditions and planning considerations to avoid or mitigate adverse impacts on H.A.P.C.s or other habitats necessary to sustain the species. Standard permit conditions and model policies that contain mitigation techniques should be developed. The development of Memoranda of Understanding (MOUS) with other state agencies are recommended for joint review of projects and planning activities to ensure that habitat protections are adequately incorporated. For example, dredging windows should be established to avoid impacts to susceptible life stages. Dredging windows should be coordinated to ensure practical opportunities for permitted dredging to take place.

2. When it is expected that impacts will occur from an activity described in Section 1.3.2, but probably not above some *de minimum* level, prohibition of the activity may not be warranted, but the marine fisheries agency should request that the appropriate agency consider requiring application of Best Management Practices for the activity.

3. State marine fisheries agencies should coordinate with state water quality agencies and state coastal zone management agencies to ensure that Clean Water Act Section 319 non-point source control plans and Coastal Zone Act Re-authorization Amendment Section 6217 coastal non-point source control plans are developed and implemented so as to minimize adverse impacts of non-point source pollution on the species. In particular, marine fisheries agencies should consider whether areas merit designation as critical coastal areas under state 6217 programs (non-point source pollution control under the Coastal Zone Management Act amendments of 1990) due to water quality impacts to fish habitat, and should provide input to the 6217 lead agencies..

4. State marine fisheries agencies should coordinate with appropriate state agencies to strengthen compliance with National Pollutant Discharge Elimination System (NPDES) or State Pollutant Discharge Elimination System (SPDES) permits.

5. State marine fisheries agencies should work with state coastal zone management agencies to determine whether: 1) additional state policies for habitat protection should be adopted under the state coastal management program; 2) additional federal activities should be added to the state coastal management programs list of activities subject to state consistency review; and 3) the state is fully utilizing the Coastal Zone Management Act federal consistency process for protection of fish habitats.

6. When states have identified habitat restoration as a need, state marine fisheries agencies should coordinate with other agencies to ensure that habitat restoration plans are developed, and funding is actively sought for plan implementation and monitoring.

7. State marine fisheries agencies should coordinate with and provide input to the state water quality agency in development and updating of the Clean Water Act section 303(d) list (priority list of water not meeting state water quality standards). In addition, state marine fisheries agencies should review the adequacy of water quality standards to protect the species of concern and should participate in the triennial review of the state water quality standards.

8. State marine fisheries agencies should review oil spill prevention and response plans for preventing accidental release and recommending prioritized response in H.A.P.C.s.

9. State marine fisheries agencies should work closely with the appropriate Coast Guard District Office in the development, amendment, and implementation of areawide oil spill contingency plans.

10. State marine fisheries agencies should work closely with water quality agencies in the development or revision of river basin plans to identify degraded or threatened resources and recommend preventative, remedial or mitigation measures.

11. State marine fisheries agencies should work with the appropriate agencies to develop contaminated sediment re-mediation plans or active sediment pollution prevention programs for areas with or susceptible to sediment contamination.

12. State marine fisheries agencies should coordinate with appropriate National Estuary Program (NEP) committees to ensure that NEP Comprehensive Coastal Management Plans (CCMPS) identify and implement habitat protection and restoration needs.

Other information regarding habitat restoration and conservation goals, and water quality requirements for American shad can be found in the 1985 Fishery Management Plan for American Shad and River Herrings (ASMFC 1985).

4.4 Alternative State Management Regimes

A state may, with the approval of the Management Board, vary their regulatory specifications contained in Sections 4.2 and 4.3, so long as that state can show to the Boards satisfaction that the target fishing mortality rate or the overfishing definition (see Section 3.3) will not be exceeded.

4.4.1 Management Program Equivalency

Alternative management regimes may also include other indices of their equivalency (e.g., eggs-per-recruit, yield-per-recruit, etc.), in addition to fishing mortality protection.

States shall submit proposals for altering their regulatory program for American shad, hickory shad, or river herring to the Technical Committee and Advisory Panel for review prior to implementing any changes. The Technical Committee and Advisory Panel shall prepare reports on the proposal for the Management Boards. The Management Board shall then accept or reject the changes and establish implementation schedules for any approved changes.

4.5 Adaptive Management

The term "adaptive management" means that fishery managers evaluate the response of a population to the regulatory measures employed and react to resulting changes to ensure that the goal and objectives of a FMP are met. Adaptive management requires that the fishery and population is monitored to an extent sufficient to allow an assessment of how well the plan is performing. Necessary corrections must be made to the management regime if indications are that the population is declining, or that target fishing rates exceed levels desired. If target F is too high or the population is not stable or growing, additional restrictions on harvest must be imposed. If, on the other hand, landings are low and population growth is high, harvests may be increased. Amendment 1 will use this adaptive management approach.

4.5.1 General Procedures

The Management Board may vary the requirements specified in this Amendment as a part of adaptive management in order to achieve the goals and objectives specified in Section 2. Specifically, the Management Board may change target fishing mortality rates, creel limits, seasonal restrictions, commercial fishery quotas and the restoration status of producer areas. Such changes will be instituted to be effective on January 1 or on the first fishing day of the following year, but may be put in place at an alternative time when deemed necessary by the Management Board.

4.5.1.1 Procedural Steps

1. The Plan Review Team (PRT) will continually monitor the status of the fishery and the resource and report on the status to the Management Board on or about May 1. The PRT will consult with the Technical Committee, the Stock Assessment Subcommittee (SAS) and the relevant Advisory Panel, if any, in making such review and report. The report will contain recommendations concerning proposed adaptive management revisions to the management program.

2. The Management Board will review the report of the PRT, and may consult further with the Technical Committee, the SAS or the Advisory Panel. The Management Board may direct the

PRT to prepare an addendum to effectuate any changes it deems necessary. The addendum shall contain a schedule for the states to implement its provisions,

3. The PRT will prepare a draft addendum as directed by the Management Board, and shall distribute it to all states for review and comment. A public hearing will be held in any state that requests one. The PRT will also request comments from federal agencies and the public at large. After a 30-day review period, the PRT will summarize the comments and prepare a final version of the addendum for the Management Board.

D. The Management Board shall review the final version of the addendum prepared by the PRT, and shall also consider the public comments received and the recommendations of the Technical Committee, the SAS and the Advisory Panel; and shall then decide whether to adopt or revise and adopt the addendum.

E. Upon adoption of an addendum implementing adaptive management, states shall prepare plans to carry out the addendum, and submit them to the Management Board for approval, according to the schedule contained in the addendum.

4.5.2 Measures Subject To Change

Management measures that may be modified under this adaptive management framework include changes in regulatory measures such as size limits, possession limits, seasonal closures, and area closures; alteration of EEZ recommendations; creation of Special Management Zones; and modification of individual state commercial and recreational management program requirements.

The Management Board may make changes to the state implementation schedule in accordance with adaptive management provisions. Each jurisdictions= shad and river herring regulations and management program must be approved by the Management Board. States may not implement any regulatory changes concerning shad and river herring, or any management program changes that affect their responsibilities under this Amendment, without first having those changes reviewed by the Technical Committee, Advisory Panel and approved by the Management Board. Also, any jurisdiction using a fishery model is required to submit any changes to its input parameters, including tuning procedures and model formulation, to the Technical Committee for its review and the Technical Committee will report its findings to the Management Board. See Section 4.4, Alternative State Management Regimes, for reporting procedures.

4.6 Emergency Procedures

The Shad and River Herring Management Board may authorize or require emergency action that is not covered by, or is an exception or change to, any provision in Amendment 1. These actions are based on unanticipated changes in the ecosystem, alosine stocks or alosine fisheries that result in significant risks to public health, alosine conservation, or attainment of alosine fishery management objectives. Procedures for implementation are addressed in the ASMFC Interstate Fisheries Management Charter, Section 6(c)(10) (ASMFC 1998).

4.7 Management Institutions

4.7.1 Atlantic States Marine Fisheries Commission and ISFMP Policy Board

The Atlantic States Marine Fisheries Commission (ASMFC) and the Interstate Fisheries Management Program (ISFMP) Policy Board are generally responsible for the oversight and management of the Commission's fisheries management activities. The Commission must approve all fishery management plans and amendments thereto, including this Amendment 1; and must also make all final determinations concerning state compliance or noncompliance. The ISFMP Policy Board reviews recommendations of the various Management Boards and, if it concurs, forwards them on to the Commission for action.

4.7.2 Shad and River Herring Management Board

The Shad and River Herring Management Board is established by the Commission's ISFMP Policy Board and is generally responsible for carrying out all activities under this Amendment. It establishes and oversees the activities of the PRT, the Technical Committee and the SAS; and requests the establishment of the Commissions Shad and River Herring Advisory Panel. Among other things, the Management Board makes changes to the management program under adaptive management, and approves state programs implementing the amendment and alternative state programs under Section 4.4. The Management Board reviews the status of state compliance with the FMP at least annually, and if it determines that a state is out of compliance, reports that determination to the ISFMP Policy Board under the terms of the ISFMP Charter.

4.7.3 Plan Review Team

The Plan Review Team is a small group whose responsibility is to provide all necessary staff support to carry out and document the decisions of the Management Board. This team will be chaired by an ASMFC Shad and River Herring Coordinator. The PRT is directly responsible to the Management Board for providing all of the information and documentation necessary to carry out the Boards decisions.

4.7.4 Technical Committee

The Shad and River Herring Technical Committee will consist of representatives from each jurisdiction and federal agency with an interest in shad and river herring fisheries. Its role is to act as a liaison to the individual state agencies, providing information to the management process and reviewing and making recommendations concerning the management program. The Technical Committee will report to the Management Board, normally through the PRT.

4.7.5 Stock Assessment Subcommittee

The Stock Assessment Subcommittee (SAS) will consist of those scientists with expertise in the assessment of shad and river herring populations. Its role is to assess shad and river herring populations and provide scientific advice concerning the implications of proposed or potential management alternatives, or to respond to other scientific questions of the Management Board.

The SAS will report to the Management Board as well as the Technical Committee.

4.7.6 Advisory Panel

The Shad and River Herring Advisory Panel is established according to the Commission's Advisory Committee Charter. Members of the Advisory Panel are citizens who represent a cross-section of commercial and recreational fishing interests and others who are concerned about shad and river herring conservation and management. The Advisory Panel provides the Management Board with advice directly concerning the Commissions shad and river herring management program. Normally, the Advisory Panels meetings will be held at and in conjunction with selected Management Board meetings.

4.7.7 Secretaries of Commerce and the Interior

Under ACFCMA, if the Commission determines that a state is out of compliance with the FMP it reports that finding to the Secretary of Commerce. The Secretary of Commerce must determine that the measures not taken by the state are necessary for conservation and if such a finding is determined, he/she is then required by the federal law to impose a moratorium on fishing for shad and/or river herring in that states= waters until the state comes back into compliance. In addition, the Commission has accorded NMFS and USFWS voting status on the ISFMP Policy Board and the Shad and River Herring Management Board; and the federal agencies participate on the PRT, the Technical Committee and the SAS.

4.8 *De minimis* status

States that report recreational or commercial landings of American shad that are less than 1% of the coastwide recreational or commercial total are exempted from sub-sampling this catch for biological data, as outlined in Section 3.3.3, paragraph 1.

4.9 Recommendations to Secretaries

Secretary of Interior
ASMFC requests that the Secretary of Interior provide necessary funding to expand the state/federal cooperative tagging program for migratory and mixed stocks of American shad. An enhanced program would greatly improve the current understanding of stock contributions to mixed stock fisheries, annual survivorship, migration, growth rates, and the efficacy of state restoration plans.

In addition, ASMFC recommends that the Secretary of Commerce direct the National Marine Fisheries Service (NMFS) to examine existing databases for information on distribution and habitat use of offshore areas by alosines. In addition, the NMFS should expand at-sea observer programs to further quantify the extent of alosine bycatch in oceanic fisheries. Finally, ASMFC recommends that NMFS expand MRFSS coverage to include riverine or estuarine areas used by anglers to intercept alosines.

Section 5. COMPLIANCE

Under the provisions of ACFCMA, all states (including Washington, D.C. and Potomac River Fisheries Commission (PRFC)) are required to implement the provisions of this Amendment. This section sets forth the specific requirements with which states must comply under the law, and the procedures that will govern the evaluation of compliance.

5.1 Mandatory Compliance Items For States

5.1.1 Regulatory Requirements

A state will be found out of compliance if it's regulatory and management programs for shad and river herring have not been approved by the Management Board.

All state programs must include a regime of restrictions on commercial and recreational fisheries consistent with the requirements of Sections 4.1 and 4.2. Except, a state may propose an alternative management program under Section 4.4, which if approved by the Management Board, may be implemented as an alternative regulatory requirement for compliance under the law.

5.1.1.2 Monitoring Requirements

All state programs must include the mandatory monitoring requirements contained in Section 3.4. 1. States must submit proposals for all intended changes to required monitoring programs that may affect the quality of the data, or the ability of the program to fulfill the needs of the Plan. State proposals for making changes to required monitoring programs will be submitted to the Technical Committee at least two weeks prior to its spring or fall meeting. Proposals must be on a calendar year basis. The Technical Committee will make recommendations to the Management Board concerning whether the proposals are consistent with Amendment 1.

5.1.2 Compliance Schedule

5.1.2.1 Transition to Amendment 1

States must implement this Amendment according to the following schedule:

July 1, 1999: States must submit state recovery/fishing plans (see Table 1) to implement Amendment 1 for approval by the Management Board. Plans, including monitoring programs, must be implemented according to schedule approved by the Management Board.

January 1, 2000: All states must have an approved recovery/fishing plan to implement Amendment 1 in place.

5.1.2.2 Reports On Compliance Submitted to PRT Annually

Each state must submit an annual report concerning its shad and river herring fisheries and management program on or before July I each year, beginning July 1, 1999. The report shall cover: the previous calendar years fishery and management program including activity and results of monitoring, regulations which were in effect and harvest, including estimates of non-harvest losses, following the outline contained in Table 10.

All state programs must include the mandatory monitoring requirements contained in Section 3.4 and Tables 2-3. States must submit proposals for all intended changes to required monitoring programs which may affect the quality of the data, or the ability of the program to fulfill the needs of the fishery management plan. State proposals for making changes to required monitoring programs will be submitted to the Technical Committee at least two weeks prior to its spring or fall meeting. Proposals must be on a calendar year basis. The Technical Committee will make recommendations to the Management Board concerning whether the proposals are consistent with Amendment 1.

In the event that a state realizes it will not be able to fulfill its fishery independent monitoring requirements, it should immediately notify the Commission in writing. The Commission must be notified by the planned commencement date of the monitoring program. The Commission will work with the state to develop a plan to secure funding or plan an alternative program that will satisfy the needs outlined in Amendment 1. If the plan is not implemented 90 days after it has been adopted, the state will be found out of compliance with Amendment 1.

5.2 Procedures for Determining Compliance

Detailed procedures regarding compliance determinations are contained in the ISFMP Charter, Section 7 (ASMFC 1998).

1. The PRT will continually review the status of state implementation, and advise the Management Board at any time that a question arises concerning state compliance. The PRT will review state reports submitted under Section 5.1.2 and prepare a report by October 1 for the Management Board summarizing the status of the resource and the fishery (see Section 4.5. la) and the status of state compliance on a state-by-state basis.

2. Upon review of a report from the PRT, or any time by request from a member of the Management Board, the Management Board will review the status of an individual state=s compliance. If the Management Board finds that a state's approved regulatory and management program fails to meet the requirements of this section, it may recommend that the state be found out of compliance. The recommendation must include a specific list of the state=s deficiencies in implementing and enforcing the Amendment and the actions that the state must take in order to come back into compliance.

3. If the Management Board recommends that a state be found out of compliance as referred to in the preceding paragraph, it shall report that recommendation to the ISFMP Policy Board for further review according to the Commissions Charter for the Interstate Fisheries Management Program.

D. The state that is out of compliance or subject to a recommendation by the Management Board under the preceding subsection may request at any time that the Management Board reevaluate its program. The state shall provide a written statement concerning its actions that justify a reevaluation. The Management Board shall promptly conduct such reevaluation, and if it agrees with the state, shall recommend to the ISFMP Policy Board that the determination of noncompliance be withdrawn. The ISFMP Policy Board and the Commission shall deal with the Management Board's recommendation according to the Commission's Charter for the Interstate Fisheries Management Program..

Table 10. Format required for Annual State Report.

1. Harvest and losses
   A. Commercial fishery
      1. Characterization of fishery (seasons, cap, gears, regulations)

      2. Characterization of directed harvest for all alosines
         a. Landings and method of estimation
         b. Catch composition
            1. Age frequency
            ii Length frequency
            ii Sex ratio
            iv Degree of repeat spawning (estimated from scale data)
         c. Estimation of effort

      3. Characterization of other losses (poaching, bycatch, etc.)
         a. Estimate and method of estimation
         b. Estimate of composition (length and/or age)

   B. Recreational fishery
      1. Characterization of fishery (seasons, cap, regulations)
      2. Characterization of directed harvest
         a. Landings and method of estimation
         b. Catch composition
            i. Age frequency
            ii. Length frequency (legal and sub-legal catch)
         c. Estimation of effort

      3. Characterization of other losses (poaching, hook/release mortality, etc:.)
         a. Estimate and method of estimation
         b. Estimate of composition (length and/or age)

   C. Other losses (fish passage mortality, discarded males, brood stock capture, research losses, etc.)

   D. Table 1. Harvest and losses - including all above estimates in numbers and weight (pounds) of fish and mean weight per fish for each gear type

   E. Protected species I Atlantic sturgeon bycatch estimates

11. Required fishery independent monitoring
   A. Description of requirement as outlined in Amendment 1, Table 2
   B. Brief description of work performed

Table 10 (cont=d). Format required for Annual State Report.

C. Results

1. Juvenile indices
    a. Index of abundance
    b. Variance

2. Spawning stock assessment
    a. Length frequency
    b. Age frequency
    c. Sex
    d. Degree of repeat spawning

3. Annual mortality rate calculation

4. Hatchery evaluation (%wild vs. hatchery juveniles)

Table 11. Format for state fishing/recovery plans

I.. Inriver or estuarine fisheries

- A. Description of inriver management areas (including geographic boundaries)
- B. Restoration targets for stocks (e.g., spawning run size, population targets, etc.)
- C. Restoration target mortality rate for individual stocks
- D. Timeline for restoration of individual stocks
- E. Management measures to achieve restoration
    1. Commercial quotas, seasons, gear restrictions
    2. Recreational possession limits, seasons
    3. Hatchery programs
    4. Other programs (habitat improvement, fish passage, etc.)

II .Ocean-intercept fisheries

- A. Description of fisheries (season, location, regulations, etc.)
- B. Phase-out plan (five year timeline for effort reduction)
- C. Mixed stock evaluation (i.e., programmatic details for evaluating stock contribution to state ocean landings of American shad).

Section 6. MANAGEMENT RESEARCH NEEDS

States are strongly encouraged to implement the management measures contained in Section 3.4 (stocking/restoration), Section 4.1 (habitat requirements), and Section 6 (research).

6.1 Stock Assessment and Population Dynamics

1) Initiate studies to document fishing mortality rates and to establish if density dependent catchability exists.

2) Improve records of catch and effort, particularly on inland recreational fisheries of American shad, and establish the amount of harvest reported as American shad and/or river herring that is actually hickory shad.

3) Develop standard procedures for developing and validating juvenile abundance indices.

4) Design and implement a coordinated interstate coastal tagging research program.

5) Conduct studies on energetics of feeding and spawning migrations of shad on the Atlantic coast.

6) Analyze American shad growth.

7) Determine and partition annual mortality rates for A major exploited stocks,

8) Ensure that domestic Atlantic mackerel, squid, butterfish fisheries, and joint venture fisheries for Atlantic herring, Atlantic mackerel, and Atlantic menhaden are closely monitored for river herring and immature American shad bycatch and discard.

9) Encourage research on hickory shad.

10) Additional bycatch research and the effects of the shad gillnet fishery on protected species.

6.2 Habitat Information Needs/Recommendations for Future Research

1) Identify and quantify potential American shad spawning and nursery habitat not presently utilized and analyze the cost of recovery within those areas.

2) Define restrictions necessary for implementation of projects in spawning and overwintering areas and develop policies on limiting development projects seasonally or spatially.

3) Conduct historical characterization of socioeconomic development (potential pollutant sources and habitat modification) of selected shad rivers along the East Coast.

4) Document the impact of power plants and other water intakes on larval, postlarval, and juvenile mortality in spawning and nursery areas, and calculate the resultant impact to adult population size.

5) Review studies dealing with the effects of acid deposition on anadromous alosines.

6) Evaluate state water quality standards and criteria to ensure accountability for the special needs of anadromous alosines.

7) Analyze optimum habitat utilization of American shad.

8) Determine the effects of pollution, passage impediments, and other anthropogenic impacts on all life history stages of shad and river herring.

9) Determine utilization/effectiveness of constructed passage devices to evaluate continued use and/or further construction.

10) Determine biotic effects of alosine passage into previously restricted habitats (i.e., lakes, ponds, strearns).

6.3 Stocking

1) Conduct studies of egg and larval survival and development.

2) Determine biotic and abiotic mechanisms affecting the stock/recruitment relationship.

3) Examine early juvenile stages of anadomous alosines.

4) Develop a long-term mark or tag for juvenile American shad.

5) Develop stock ID procedures to permit identification of specific river stocks in mixed-stock intercept fisheries.

6) Conduct research to identify effective methods for restoration stocking programs.

7) Determine biotic effects of alosine stocking on other native species into previously restricted habitats.

6.4 Social and Economic Research Needs

Social data needs might include the following for consumptive and non-consumptive users: demographic information (e.g. age, gender, ethnicity/race, etc.), social structure information (e.g. historical participation, affiliation with NGOS, perceived conflicts, etc.), emic culture information (e.g. occupational motivation, cultural traditions related to resources use), and community information.

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