

E. ATLANTIC HAGFISH ADVISORY REPORT

In New England, a growing fishery for Atlantic hagfish (*Myxine glutinosa*) has initiated science and policy discussions about the development of the fishery, its potential for future expansion, and its effect on the resource. The hagfish fishery in New England was developed in the early 1990s, with the first reported landings of around 1 million pounds in 1993. Korean buyers quickly recognized that a fishery in the New England area could provide the high quality hagfish skins used in making leather as well as hagfish meat for human consumption.

The Fishery

Reported hagfish landings in New England quadrupled during the first four years of the fishery (1993-1996), exceeding the highest reported landings in other North American hagfish fisheries (including British Columbia, Oregon, Washington, California and Nova Scotia) by 1994. Landings increased six-fold from 1993 to 2000, with a reported 6.8 million pounds of hagfish landed in 2000 yielding over \$1.8 million in revenues. Landings in 2001 and 2002 are estimated to be 3-6 million pounds in each year (Figure E1). There is no management program for this fishery, and consequently no permitting or reporting requirements. Thus, there is considerable uncertainty regarding the actual level of hagfish landings, as the data provided by fishers and processors may be incomplete. Moreover, the level of discards and discard mortality of hagfish culled at sea or rejected by the dealer in port is unknown. Landings are highest during the summer and fall months.

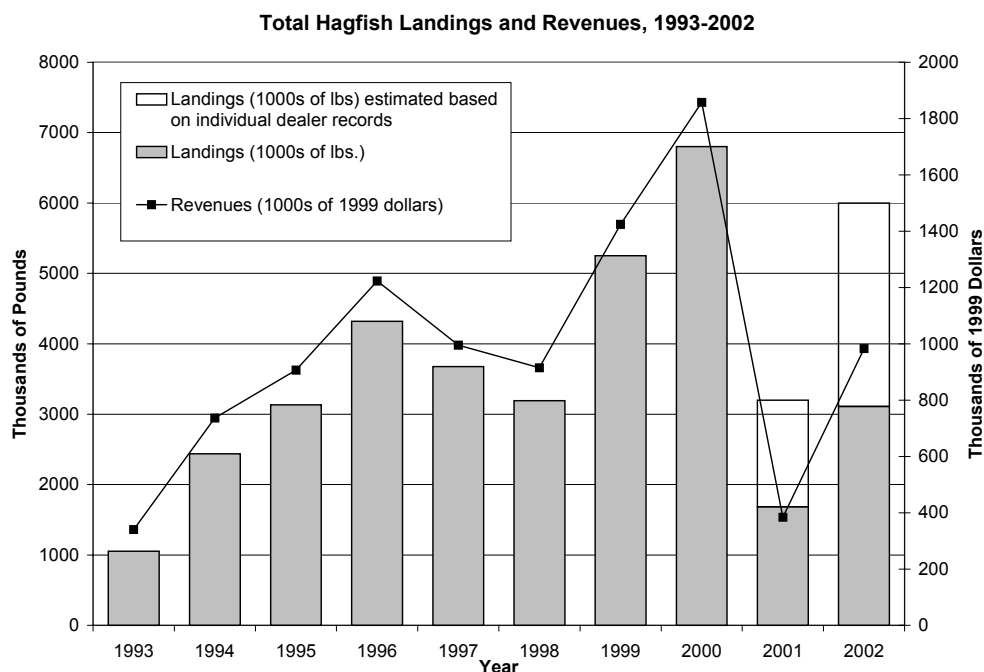


Figure E1 - Total hagfish landings and revenues, 1993-2002
Data Source: NMFS Dealer Database (WODETS/CFDETS)
Note: 2001 and 2002 landings adjusted based on individual dealer reports

The number of active vessels in the fishery has fluctuated between 1993 and the present, ranging from 5 to more than 30 vessels reporting landings per year (Figure E2). These vessels use specialized hagfish traps and land their catch primarily in Gloucester, Massachusetts. Hagfish are no longer landed in Maine (Figure E3). The average size of active vessels in the fishery has increased since 1993 (Figure E4), with new entrants as large as 165 feet. The fishing capabilities and efficiency of these larger vessels has increased even over the past year, as fishermen have developed more effective means of sorting and storage of hagfish at sea, an enhanced awareness of localized aggregations of hagfish, and improved product quality control.

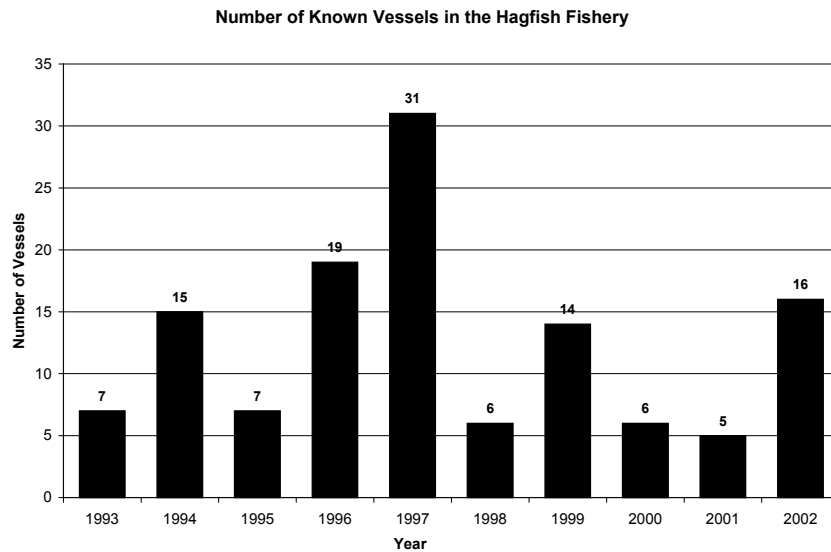


Figure E2 – Active hagfish vessels reported by dealer records, 1993-2002
Data Source: NMFS Dealer Database (WODETS/CFDETS)

Note: 2002 data may be incomplete

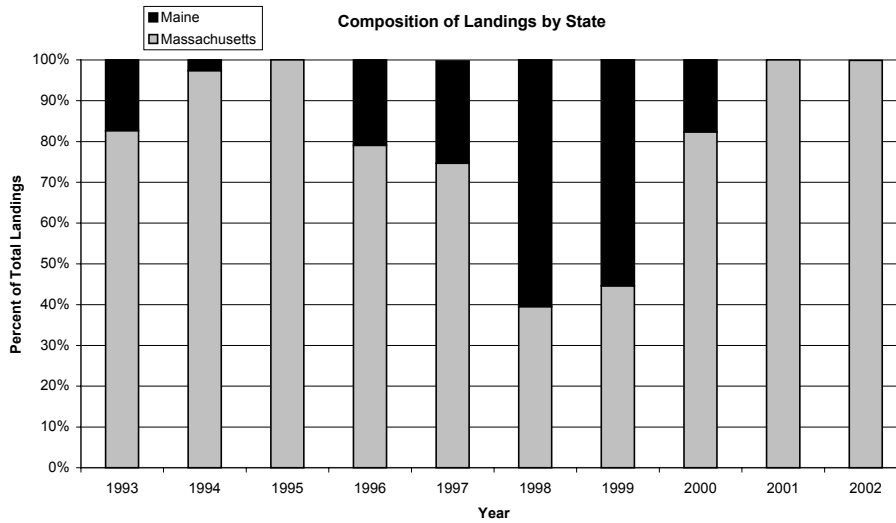


Figure E3 - Composition of hagfish landings by state
Data Source: NMFS Dealer Database (WODETS/CFDETS)
Note: 2002 data may be incomplete
States with less than 0.1% of total landings are not included.

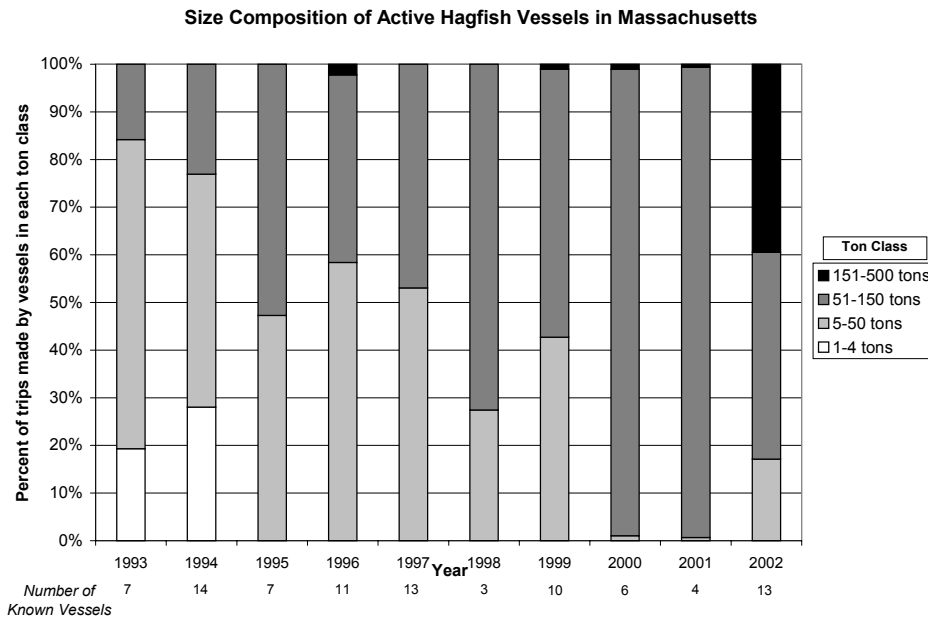


Figure E4 - Size composition of active hagfish vessels in Massachusetts, 1993-2002
Data Source: NMFS Dealer Database (WODETS/CFDETS)
Note: 2002 data may be incomplete

The fishery is prosecuted throughout the Gulf of Maine, from Nantucket to eastern Maine and east to the Hague line, with the majority of landings from trips in the inshore Gulf of Maine between Gloucester and Portland. The vast majority of hagfish trips occur in the deeper waters (greater than 40 fathoms) of the Gulf of Maine, within a 60 nautical mile range of Gloucester, MA. The geographic range of the fishery and spatial distribution of hagfish trips have expanded since 1994, with vessels moving further offshore and trips more broadly distributed across the range of the fishery (Figure E5 and Map 1). Average trip duration, as reported via vessel trip reports, has generally increased since 1994. Nominal and standardized estimates of landings per unit of effort (LPUE) fluctuated from 1994 to 2002, with distinctions among LPUE trends for different seasons and statistical areas across the time period.

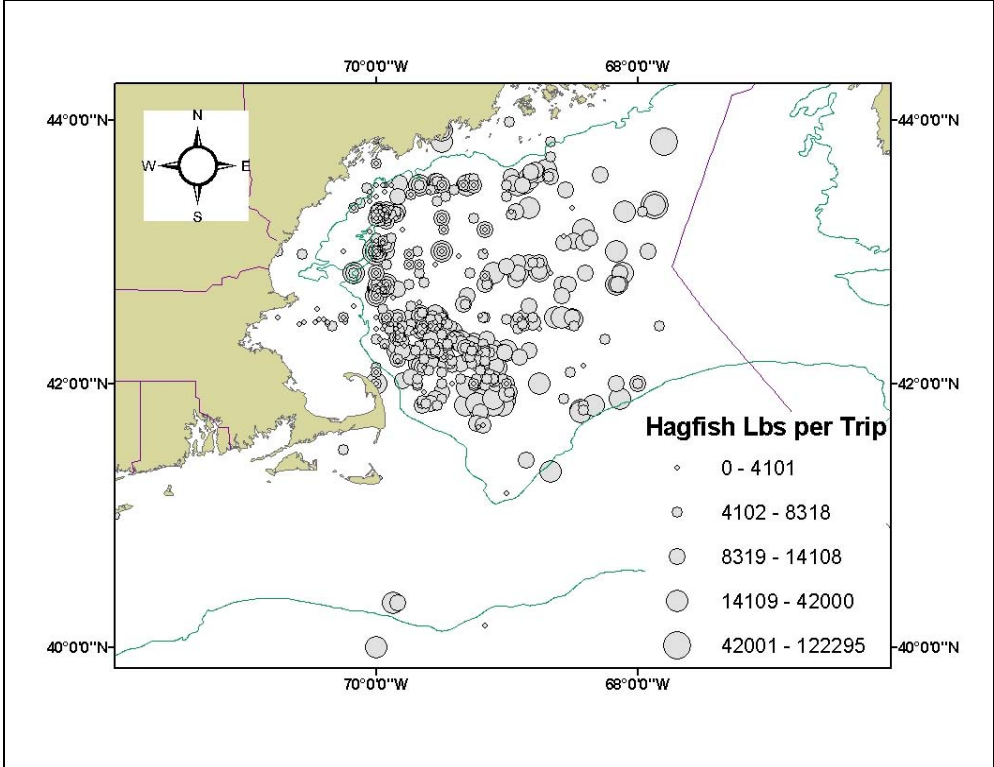
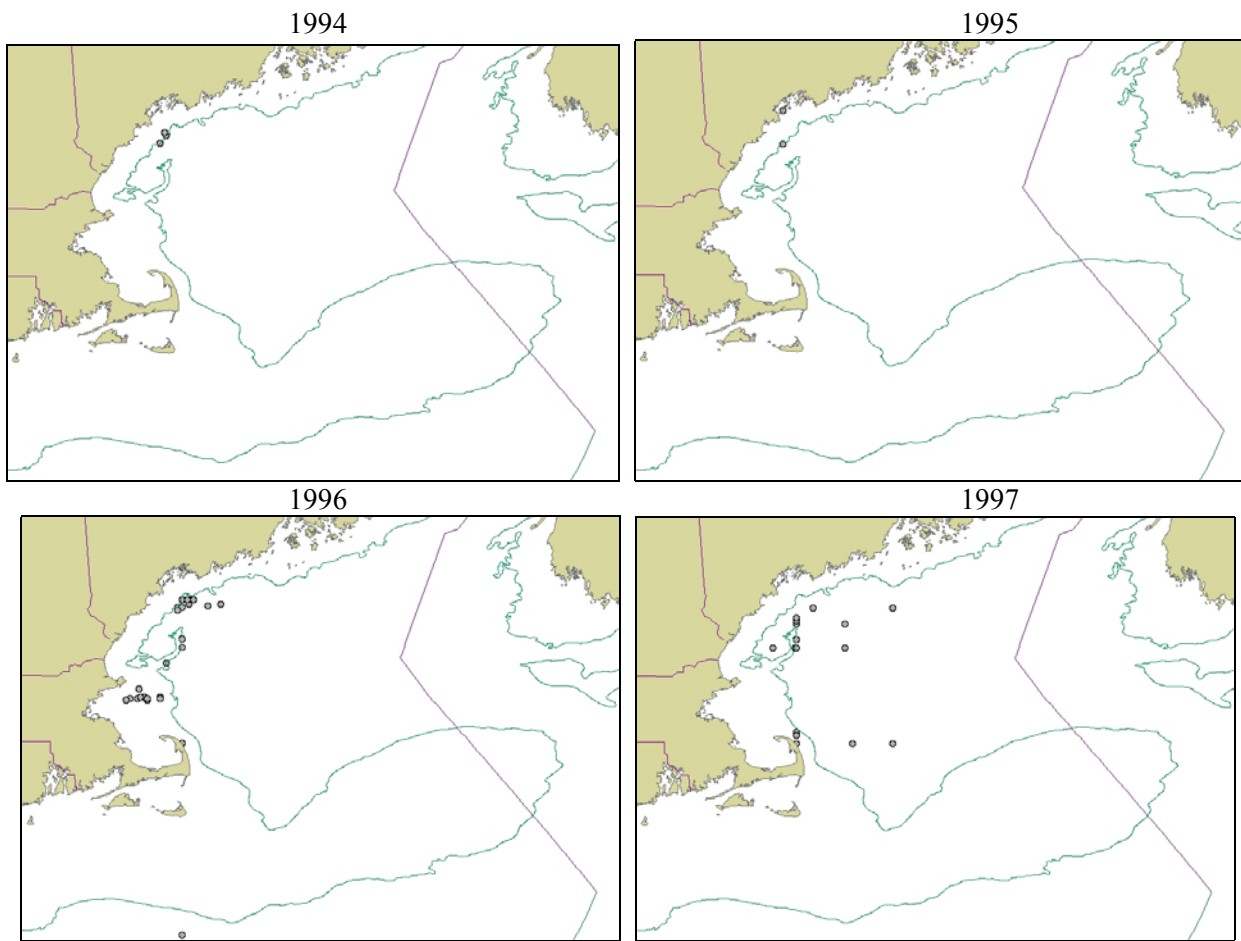
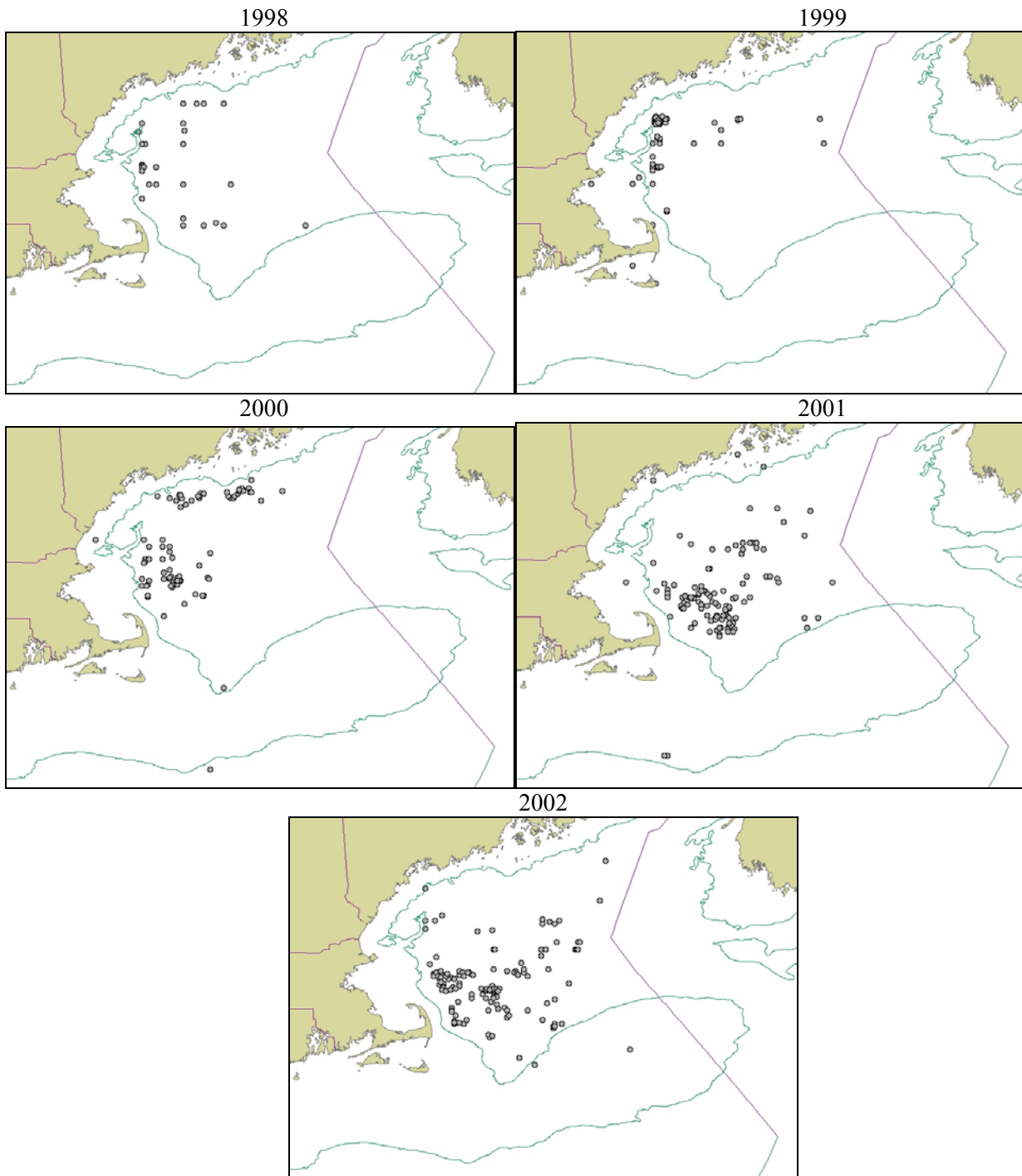


Figure E5 - Point estimates for hagfish landings based on reported trip lat/long (1994-2002 VTR data, n=1,571).



Map 1 - All trips reporting via VTR, 1994 - 2002.



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(continued)

Survey Information

Hagfish have been captured in low numbers in the Northeast Fisheries Science Center groundfish bottom trawl surveys since 1963 from the Gulf of Maine to Cape Hatteras. Based on these trawl survey data and Gulf of Maine shrimp survey data, it appears that hagfish abundance in the Gulf of Maine decreased from the mid-1970s through the mid-1980s and remained at a fairly consistent low level until the early to mid-1990s, with an increase during the late 1990s (Figure E6). The factors that contributed to the apparent decline in the 1970s are unknown. Hagfish captured in the Gulf of Maine groundfish trawl survey are generally larger than those captured in the deeper offshore survey strata south of Cape Cod. Mean lengths of hagfish from the spring and fall groundfish surveys were 40.5 cm and 42.6 cm, respectively. In the offshore survey area, hagfish averaged 34.7 cm in the spring and 34.6 cm in the fall. Hagfish are most commonly captured in the survey at depths of 150-250 meters and at temperatures of 5-10°C, but can be found across a broader range of depths and temperatures.

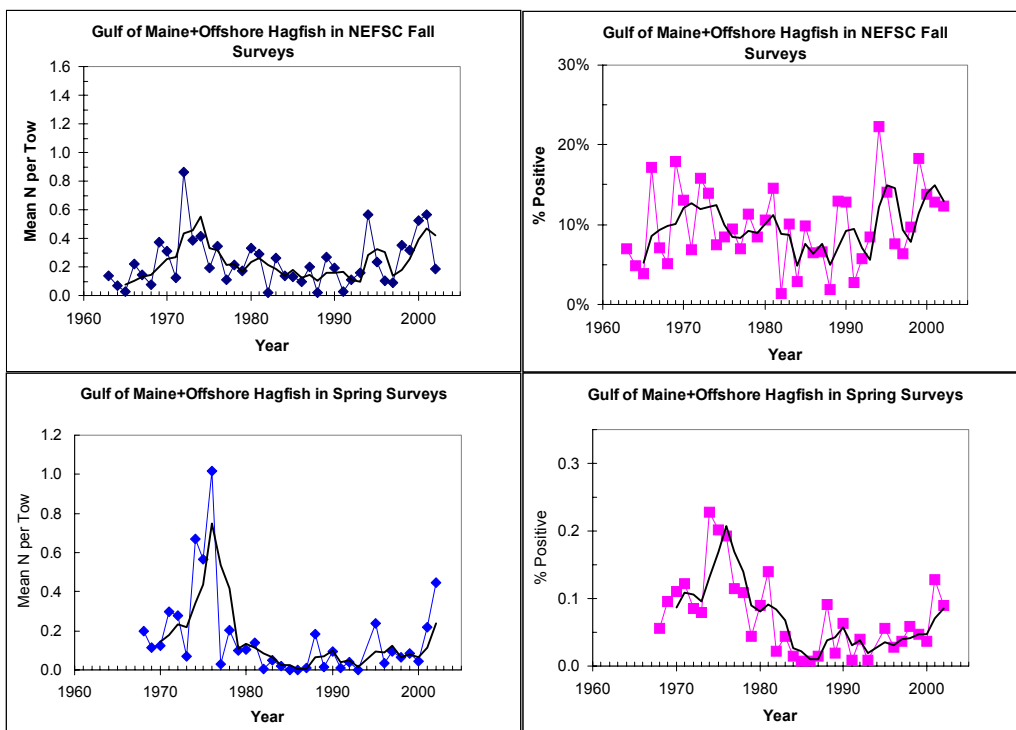


Figure E6 - Hagfish abundance in Gulf of Maine and offshore survey areas, fall (1963-2002) and spring (1968-2002). A 3 year moving average is also plotted.

Source: Northeast Fisheries Science Center

Life History

Little is known about the life history of hagfish. The age at maturity and lifespan of *Myxine* (in the Gulf of Maine and elsewhere), as well as timing, conditions and location of reproduction are not known. Hagfish have a limited reproductive potential, as suggested by the small number (20-30) of large, yolky eggs carried by the females. Hagfish serve an important ecological role, contributing to nutrient cycling, substratum turnover and removal of dead or dying organisms on the sea floor.

Developing a comprehensive understanding of the hagfish fishery and resource will require new scientific and fishery-dependent research and data collection efforts. A one-day working group that met to discuss hagfish

science and management identified important information gaps and discussed a number of potential approaches to acquiring the data and information needed to fill them. Among these are the initiation of an at-sea observer program and port sampling for estimating discard levels and collecting length/weight data, tagging studies to estimate growth rates and examine movement of localized populations of hagfish, age and growth studies conducted in the laboratory, specialized broad-scale surveys of hagfish, investigation of spatial movement of the fishery through interviews with fishermen.

Several potential approaches for stock assessment modeling were also described. However, it is unlikely that conventional stock assessment approaches will provide significant information in the near future due to lack of data. There are many opportunities for development of industry-based research projects and further collaborative efforts among scientists, fishermen, administrators and policy analysts. Implementation of some of these recommendations may require adoption of a formal fishery management plan.

Discussion

Despite the rapid growth of the Atlantic hagfish fishery over the span of the last decade, there remain substantial gaps in basic information on fishery performance, as well as many fundamental unanswered questions on the biology and life history of the animal. The paucity of crucial data makes assessing the hagfish resource extremely problematic.

- Hagfish fisheries around the world have not been sustained and some have a history of overexploitation followed by fishery collapse. The level of a potentially sustainable fishery on Atlantic hagfish is uncertain.
- The working group has developed a set of data requirements necessary for stock assessment to determine the level of a sustainable fishery. A number of these are endorsed by the SARC and listed in the Research Recommendations section below.
- Based on the life history information that is currently available, there is a strong argument for a management system that, at a minimum, would cap effort and protect juveniles (smaller than 40-45 cm).

Research Recommendations

- Consider appropriate measures of “effective” fishing effort, including but not limited to soak time, number of traps, size of traps, number of hauls per trip, and fishing power differences between large and small vessels, that are directly related to fishing mortality;
- Look at LPUE in conjunction with survey data and use density measures from the surveys to estimate CPUE.
- Establish biological sampling in ports (length and weight, by sex to the extent possible).
- Collect commercial length frequency data for size composition of catch; seek additional information on the Nova Scotia hagfish fishery (landings, biological sampling data).
- Examine US export data for information on hagfish exports.
- Develop a study fleet with electronic reporting.
- Consider conservation engineering studies to minimize the catch of juveniles and the potential for ghost fishing.
- Conduct a directed population dynamics study, examining food web dynamics (stomach sampling data from survey), age and growth, maturation, fecundity and stock identification.
- Evaluate gillnet sea sampling data for evidence of hagfish eating gilled fish. (There may be spatial and temporal overlaps between discards in gillnet fisheries and hagfish that predate on the discarded fish.)