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Aggregate Resource and Landings Trends

by

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The fishery resources off the northeastern United States are harvested by a variety of fishing gears, including trawls, gillnets, handlines, traps, pots, longlines, and dredges. While each type of gear captures a different mix of species, few fishing operations target just one species. The number of species caught varies by gear type and area fished. In addition, predator-prey and competitive relationships occur in almost all species.

These relationships result in significant interactions among gear types (termed technical interactions) and among species (termed biological interactions). Management of fishing activity in the northeast region is complex, in part owing to these types of interactions. This complexity is reflected, for example, in the structure of some of the fishery management plans (FMPs). The groundfish fisheries off New England, comprising 15 species, are managed under the Northeast Multispecies FMP (of the New England Fishery Management Council), while several pelagic stocks are managed under the Atlantic Mackerel, Squid, and Butterfish FMP of the Mid-Atlantic Fishery Management Council. The Atlantic States Marine Fisheries Commission is responsible for stocks which occur primarily in state waters such as lobsters, striped bass, and bluefish.

While much of the stock assessment advice used in managing these fisheries requires knowledge of the dynamics of individual populations, there is an increasing need to consider information in a more aggregated way as fisheries management takes account of ecosystem impacts. In this section, biomass and landings trends are presented for several aggregated species groups to illustrate overall changes in some of the fisheries resources off the northeastern United States.

FISHERY INDEPENDENT DATA

The Northeast Fisheries Science Center (NEFSC) has conducted an intensive bottom trawl survey program off the northeastern United States for more than 40 years. An autumn survey has been conducted annually since 1963 and a spring survey was initiated in 1968. The NEFSC surveys employ standard gear and sampling procedures following a stratified random sampling design, and thus provide a valuable time series of data for monitoring resource trends. Although standard gear and vessels were used for most of the time series, a different net, type of doors and a second vessel were used when necessary (Sosebee and Cadrin 2006). Conversion factors to the standard gear have been estimated for some species (Sissenwine and Bowman 1982; NEFSC 1991). Since bottom-tending gear is used, the data are most appropriate for demersal species, although reliable indices of abundance have also been developed for several pelagic species.

AGGREGATE RESOURCE TRENDS

Biomass trends for seven species assemblages are reviewed in this section. These are as follows:

Principal groundfish, which are mostly demersal species includes Atlantic cod, haddock, pollock, Acadian redfish, silver hake, and red hake that historically supported important offshore trawl fisheries.

Flounders, which includes all the major flatfish species including yellowtail flounder, winter flounder, witch flounder, American plaice, windowpane flounder, Atlantic halibut, and summer flounder.

Other groundfish, which includes a variety of demersal species including goosefish, black sea bass, white hake, tilefish, ocean pout, cusk, scup, and Atlantic wolffish.

Principal pelagics, comprising Atlantic herring and Atlantic mackerel.

Other pelagics, which includes such species as bluefish, butterfish, blueback herring, alewife, and American shad.

Squids, comprising two species of squid, *Loligo pealeii* and *Illex illecebrosus*.

Small elasmobranchs, which includes spiny dogfish, barndoor skate, clearnose skate, little skate, rosette skate, smooth skate, thorny skate and winter skate.

For each of these groups, an aggregate index of biomass was developed to monitor resource trends. Autumn survey data (stratified mean catch per tow, kg) were used for principal groundfish, flounders, other groundfish, other pelagics and squids while spring survey data were used for principal pelagics and for small elasmobranches. Since the autumn survey did not begin sampling in the Mid-Atlantic area until 1967, only data from 1967 to present are presented. For each group, an aggregate biomass index was computed as the sum of the individual species' stratified mean catch-per-tow values, smoothed (LOESS smoother using 20 percent of the data) to account for inter-annual variability. When a conversion factor for a species/gear was significant, it was used to adjust the index to the standard gear. No adjustments have been made for differences in vulnerability to the trawl gear by species.

Principal Groundfish

The annual index for this group declined between 1967 and 1974, reflecting increases in exploitation associated with the arrival of distant-water fishing fleets (Figure 6). Declines in abundance occurred for many stocks in this group, notably Georges Bank haddock and Acadian redfish. Partial resource recovery occurred during the mid-to-late 1970s, due in part to reduced fishing effort associated with increasingly restrictive management measures enacted by the International Commission for the Northwest Atlantic Fisheries (ICNAF) during the early 1970s. Cod and haddock abundance markedly increased, pollock biomass sharply increased, silver and red hake were stable, and Acadian redfish continued to decline. The smoothed aggregate index

peaked in 1977, but subsequently declined reaching low values in 1987 and 1988. During 1989-1990, the aggregate index increased slightly in response to improved recruitment (primarily for cod, redfish, silver hake, and red hake), but afterwards reached record-low levels during 1992-1994. Since the mid-1990s the index has been increasing due to higher biomass levels of Georges Bank haddock and redfish. In 2005, the index for the group was similar in magnitude to that observed in the mid-1970s.

Flounders

The combined index for this group increased in the late 1960s, declined in the early 1970s, but recovered and peaked in the late 1970s-early 1980s (Figure 7) due to reduced fishing effort associated with increasingly restrictive management measures enacted by the International Commission for the Northwest Atlantic Fisheries (ICNAF) during the early 1970s. Most of the northern flatfish species (yellowtail flounder, American plaice, witch flounder and winter flounder) increased during this time. Since the early 1980s, the index has trended downward and was at near-record lows in 2005.

Other Groundfish

The aggregate index for this group increased through 1970, remained relatively stable through 1980, (Figure 8) and then declined through 1994. The index increased in the late 1990s and early 2000s due to a high biomass of scup, black sea bass and modest increases in white hake biomass. However, the index declined in 2003 and 2004 and in 2005 was near the time series low. Overall, the other groundfish index declined by 70 to 80 percent during the past 30 years reflecting increased exploitation of the individual species within this group.

Principal Pelagics

Biomass of Atlantic herring and Atlantic mackerel has been monitored in NEFSC spring surveys since both species occur almost completely within the survey area in March and April. In general, survey catch-per-tow data for these two species are more variable than for principal groundfish and flounders, although the aggregate index adequately depicts overall trends (Figure 9). The index dropped to extremely low levels in the mid-1970s, reflecting pronounced declines in the abundance of both species, including the collapse of the Georges Bank herring stock. Between 1983 and 2000, the index generally increased, peaking in 1998 and 2000 at near record high values. Subsequently, the index has slightly declined.

Other Pelagics

The aggregate index for other pelagics mainly reflects the biomass of butterfish (Figure 10). The index was relatively low in the late 1960s through the early 1970s, increased in the late 1970s and remained relatively stable for a decade, but has since declined with the 2005 value the lowest in the time series.

Squids

The index for this group of species is dominated by the biomass of the longfin inshore squid, *Loligo pealeii* (Figure 11). The aggregate index has progressively declined from its 1975 peak with some very brief increases occurring about every decade.

Small Elasmobranchs

The small elasmobranch biomass index includes data for two important resource components, spiny dogfish and seven species of skates, which are monitored using spring survey data (Figure 12). This index increased from the late 1960s through 1990, reflecting large increases in spiny dogfish biomass, as well as increases in abundance of winter skate and little skate. From 1990 through 2003, the index gradually declined, reflecting reductions in biomass due to harvesting of winter skate and spiny dogfish. The aggregate index has increased since 2003 as restrictions on the exploitation of spiny dogfish have allowed for some recovery of this stock.

COMMERCIAL LANDINGS TRENDS

Prior to 1994, fishery statistics in the Northeast Region were collected using a voluntary reporting system. Landings and price data were obtained by NMFS port agents and state personnel at the point of first sale through dealer reports or "weighout receipts". This information was complemented by dockside interviews of vessel captains by NMFS port agents in which detailed information was acquired on fishing effort, gear used, and areas fished; and also by a monthly canvas to collect landings data at secondary ports. In June 1994, a mandatory reporting system was enacted in which dockside interviews were replaced by a logbook reporting system. This system is now used in all Northeast fisheries subject to federal fishery management plans (except for the American lobster and Atlantic herring fisheries). However, many vessels that fish for lobster and herring possess permits under one or more of the other federal plans, and are therefore subject to mandatory reporting.

In this section, landings trends are presented for eight species groups which closely correspond to those used in the previous section on Aggregate Resource Trends. Slight changes were imposed in order to make the groupings the same as those found in the Species Synopses section. Landings data for these groups were obtained from records of U.S. domestic fishing activity and from the database of reports of distant-water fleet catches maintained by the Northwest Atlantic Fisheries Organization (NAFO). These data cover the period from the early 1960s through 2005. Landings of most species are given in terms of nominal catches, defined as live weight equivalent of landings. Conversion factors for roundfish usually range from 1.1 to 1.2 but for bivalves (sea scallops, ocean quahogs and surfclams), the conversion factors are 8.33, 8.25 and 5.24, respectively. Therefore, the nominal catches of these 3 species are expressed in their meat weight equivalents so the weights do not overshadow the finfish categories.

The eight groups are as follows:

Principal groundfish: Atlantic cod, haddock, pollock, Acadian redfish, silver hake and red hake.

Flounders: yellowtail flounder, winter flounder, witch flounder, American plaice, windowpane

flounder, Atlantic halibut and summer flounder.

Other groundfish: goosefish, black sea bass, white hake, tilefish, ocean pout, cusk, scup, and Atlantic wolffish.

Principal pelagics: Atlantic herring and Atlantic mackerel.

Other pelagics: bluefish, butterfish.

Invertebrates: sea scallops, ocean quahogs, surfclams, *Loligo* squid, *Illex* squid, Northern shrimp and American lobster.

Small elasmobranchs: spiny dogfish, barndoor skate, clearnose skate, little skate, rosette skate, smooth skate, thorny skate and winter skate.

Anadromous species: river herring (alewife and blueback herring), American shad, striped bass, Atlantic salmon.

For all eight groups combined, U.S. commercial landings in 2005 totaled 363,223 mt, 11% lower than in 2004 (Figure 13). U.S. commercial landings in each of the eight categories have declined since the early 1960s. Total aggregate landings were dominated by distant-water fleets during the 1960s through the mid 1970s. Following implementation of extended jurisdiction in 1977, landings have been primarily taken by the U.S. domestic fleet.

Principal groundfish annual landings decreased from a peak of over 650,000 mt in 1965 to about 200,000 mt through the mid-1970s, declined to about 100,000 mt through the mid-1980s, and have averaged about 40,000 mt since the mid-1990s. During the 1960s and early 1970s, landings were dominated by red hake and silver hake taken primarily by distant water fleets. During subsequent decades, principal groundfish landings were dominated by cod, pollock and silver hake. Landings of haddock averaged between 50,000 and 100,000 mt annually during the mid-1960s, especially in 1965 and 1966 when distant-water fleets caught between 70,000 and 98,000 mt. USA haddock landings declined from over 50,000 mt per year during the mid-1960s to 3,000 to 5,000 mt during the mid-1970s, increased briefly during the late 1970s, but have remained below 5,000 mt since the mid-1980s.

Flounder landings remained relatively stable, varying annually between 60,000 and 70,000 mt during the early 1960s through the mid-1980s. During this period, yellowtail flounder dominated USA landings, but during the late 1980s were replaced by summer flounder and winter flounder. In recent years, these two species, along with American plaice, have accounted for the majority of the flounder landings.

Landings of **other groundfish** have remained relatively stable since the early 1960s, generally averaging between 20,000 and 30,000 mt annually. USA landings generally fluctuated between 15,000 mt and 25,000 mt during the early 1960s through the late 1980s. Scup, and to a lesser extent, ocean pout dominated the USA landings during the 1960s and 1970s, but were replaced by goosefish and white hake during the late 1980s. USA landings of other groundfish increased

substantially during the 1990s largely due to increasing landings of goosefish which, since 1993, have accounted for 50% or more of USA landings of other groundfish. Landings by distant-water fleets were relatively minor compared to USA landings, generally accounting for less than 2,000 mt annually except for a few years during the 1960s when large catches of ocean pout increased the total distant water fleet landings of other groundfish to between 10,000 mt and 25,000 mt.

During the 1960s and 1970s, the fisheries for **principal pelagics** were prosecuted primarily by distant-water fleets. Annual landings increased throughout the 1960s as these fleets directed fishing effort initially on Atlantic herring and later during the 1970s on Atlantic mackerel. The international fishery for Atlantic mackerel persisted through the mid-1980s via domestic joint ventures with several countries, while the domestic fishery focused on Atlantic herring. Total landings of principal pelagics have increased steadily since 1998 due, in large part, to increased USA landings of Atlantic herring.

Landings of **other pelagics** have remained relatively stable since the early 1960s, generally averaging between 5,000 and 10,000 mt annually, with occasional annual landings as high as 15,000 mt and 20,000 mt. Butterfish dominated USA landings during the 1960s, but since 1970 commercial landings of other pelagics, have been almost equally divided between butterfish and bluefish. Landings by distant water fleets were relatively minor except for a few years during the 1960s and early 1970s when butterfish landings were between 10,000 mt and 20,000 mt.

Landings of **invertebrates** have generally varied between 100,000 mt and 150,000 mt since 1970. Landings for this group peaked once during the mid-1970s at over 133,000 mt and again beginning in 1989 at over 150,000 mt. Annual USA landings ranged from 50,000 to 70,000 mt during the 1960s and 1980s, and increased to over 100,000 mt annually beginning in 1986. Total USA landings remained relatively constant throughout the 1990s and early 2000s, generally between 120,000 mt and 130,000 mt annually. USA landings were dominated by surfclams and ocean quahogs throughout most of the period, with surfclam landings consistently in the range of 20,000 to 30,000 mt of meats from 1963 onwards. Ocean quahog landings became significant in 1978 as landings increased to 10,000 mt of meats and since 1985 have fluctuated around 20,000 mt. Landings of sea scallops have been variable, but generally ranged between 5,000 and 10,000 mt of meats during the 1960s through the mid-1970s, and between 10,000 mt and 20,000 mt of meats since 1977. Longfin and shortfin squids and American lobster also contributed between 10,000 and 20,000 mt during the 1980s and between 20,000 and 30,000 mt since the 1990s. Distant-water fleet landings consisted primarily of almost equal amounts of longfin and shortfin squid with combined landings of the two species averaging over 20,000 mt during the 1970s and early 1980s, peaking at almost 45,000 mt in 1973 and 1974. The remaining non-USA landings consist primarily of Canadian harvests of sea scallops, with landings generally between 4,000 and 10,000 mt of meats annually, primarily from the Canadian fishery on the Northeast peak of Georges Bank.

Small elasmobranch landings exhibit two peaks in the range of 20,000 mt to 30,000 mt, one in the mid-1970s due to distant water fleet landings of spiny dogfish, and one during the 1990s due to USA landings of spiny dogfish and several species of skates. During the intervening years, total landings from the small elasmobranch group generally were below 10,000 mt per year.

Reported landings of **anadromous species** generally ranged from 20,000 mt to 60,000 mt during the 1960s through the mid-1970s. During this period alewives dominated both USA and distant-water fleet landings. USA alewife landings have subsequently declined and have averaged less than 500 mt annually since 1993. Striped bass have also accounted for a substantial share of USA anadromous species landings, contributing up to about 5,000 mt during the 1960s and 1970s. Landings of this species declined rapidly during the 1980s to 100 mt by 1989. Striped bass commercial landings subsequently increased during the 1990s, and since 1998 have averaged between 2,500 mt and 4,000 mt annually.

CONCLUSIONS ABOUT RESOURCE ABUNDANCE

Both fishery-independent and fishery-dependent data suggest major changes in the abundance of resources in the Northwest Atlantic, especially since implementation of the MFCMA in 1977. Increases in abundance of groundfish and flounders associated with the reduction of distant-water fleet fishing activity during the mid-1970s were followed by increased domestic fishing effort and landings. Biomass of both principal groundfish and flounders began to decline after 1978, reached record low levels in the early 1990s, and has since improved for some species. Biomass of other groundfish slowly declined after 1977, with more rapid declines occurring in recent years. Biomass of principal pelagic species declined rapidly after the period of extensive fishing in the 1960s and 1970s but has sharply increased in recent years. Extensive changes in the species composition of the catches have also occurred over the past four decades, with shifts to previously less desirable species. During this same time, increases in the abundance of historically non-targeted species such as spiny dogfish and skates occurred, followed by the development of directed fisheries for these species and subsequent declines in the resource.

Most of the changes in abundance are directly attributable to changes in fishing mortality. For example, increases in biomass of groundfish and flounder occurred during 1975 to 1978 when fishing effort was being reduced by international and domestic management actions. Decreases in abundance began in the early 1980s when fishing effort from domestic fleets substantially increased. The record high levels of fishing effort in the late 1980s and early 1990s resulted in rapid reduction of year classes before they were able to achieve full growth and maturity. Reductions in fishing effort, beginning in the mid-1990s in the New England area, were followed by increases in biomass of several groundfish and flounder stocks, including haddock on Georges Bank and witch flounder in the Gulf of Maine.

SUMMARY OF STOCK STATUS

Each of the individual species synopsis sections contains a determination where possible of current stock status with respect to a biomass threshold as well as a fishing mortality threshold. The section below provides an overview of all of the individual species/stock status determinations. A stock is considered to be overfished when the current estimate of biomass is below the threshold of ½ Bmsy. Likewise, overfishing is occurring on a stock if the current estimate of fishing mortality is above the threshold of Fmsy. Using this categorization scheme, 19 stocks are considered to be overfished and 10 stocks are currently experiencing overfishing. For 14 stocks, neither their status with respect to not-overfished or being overfished can presently be determined and hence these stocks are classified as ‘Status Unknown’.

Figure 14 provides a qualitative picture of all of the stocks in one view. To obtain the specific details on each stock, the following tables contain the most current estimates of fishing mortality and biomass or their proxies, and the corresponding reference points used for status determination.

Links

Status determination details for Principal groundfish
Status determination details for Flounders
Status determination details for Other groundfish
Status determination details for Principal pelagics
Status determination details for Other pelagics
Status determination details for Invertebrates
Status determination details for Small elasmobranchs
Status determination details for Anadromous species

Management Actions

Improvements noted for some resource components in recent years reflect recent management actions by the New England and Mid-Atlantic Fishery Management Councils and the Atlantic States Marine Fisheries Commission. Amendment 5 to the Northeast Multispecies Fishery Management Plan was implemented in 1994 with a planned reduction in fishing effort by 50% over 5-7 years. Amendment 7 (implemented in 1996) permanently closed large areas of fishery habitat and accelerated days-at-sea effort reductions. Amendment 13, implemented in 2004, instituted additional restrictions on fishing effort and imposed formal rebuilding plans for those stocks considered to be overfished at that time. These measures have resulted in reductions in fishing mortality rates for four of the main New England groundfish stocks (Georges Bank cod, Georges Bank haddock, Gulf of Maine cod and witch flounder). Currently, Framework 42 to the FMP is aimed at further reductions in fishing mortality to achieve stock rebuilding by restricting effort in the areas where critical stocks are most vulnerable. Other overfished components of the groundfish resource are benefiting as well. Monkfish and spiny dogfish are now regulated under Fishery Management Plans implemented in 1999 and 2000, respectively.

Amendments 4, 5, and 6 to the Sea Scallop FMP were implemented beginning in 1994 to replace meat count regulations with direct controls on fishing effort (e.g., days at sea) and gear selectivity. Also in 1994, three large areas, two on Georges Bank and one on Nantucket Shoals, were closed to scallop fishing under the groundfish plan. Scallop biomass in these areas rapidly increased between 1994 and 2000, and limited re-openings of portions of these areas in 1999-2001 and 2004-2006 have produced considerable landings. In the Mid-Atlantic, three areas have been closed rotationally to scallop fishing (with each area closed for about three years) since 1998 in order to improve yield, and a fourth area is scheduled for closure in 2007. Other major management measures include Amendment 7, implemented in 1999, that established reference points and implemented a rebuilding plan for the sea scallop resource. Amendment 10, implemented in 2004, formally adopted area management and rotational closures and further increased dredge ring and twine top size to shift gear selectivity toward larger scallops and to reduce finfish bycatch.

Management programs for summer flounder have been successful in reducing exploitation levels, although fishing mortality still exceeds the threshold reference point. The quota-based system of management has resulted in a series of trip limits, and state-by-state closures as the quota is approached. The time schedule adopted by the Mid-Atlantic Fishery Management Council calls for additional reductions in mortality to broaden the age distribution within the stock, to reduce fishery dependence on ages 0-2 fish, and reach the target spawning stock biomass by 2010.

A joint management plan for bluefish between the Mid-Atlantic Fishery Management Council (MAFMC) and the Atlantic States Marine Fisheries Commission (ASMFC) was implemented in 1990. The basis for management is an annual quota subdivided between recreational and commercial fisheries. Management actions have resulted in a decrease in fishing mortality and an improvement in bluefish biomass, although biomass levels require further improvement to reach the target level.

Other fishery management programs are currently being developed to address overfishing of inshore stocks (winter flounder, weakfish, scup and others) primarily under the jurisdiction of the ASMFC and individual states. A summary of fishery management plans currently in place is given in Table 1.

For further information

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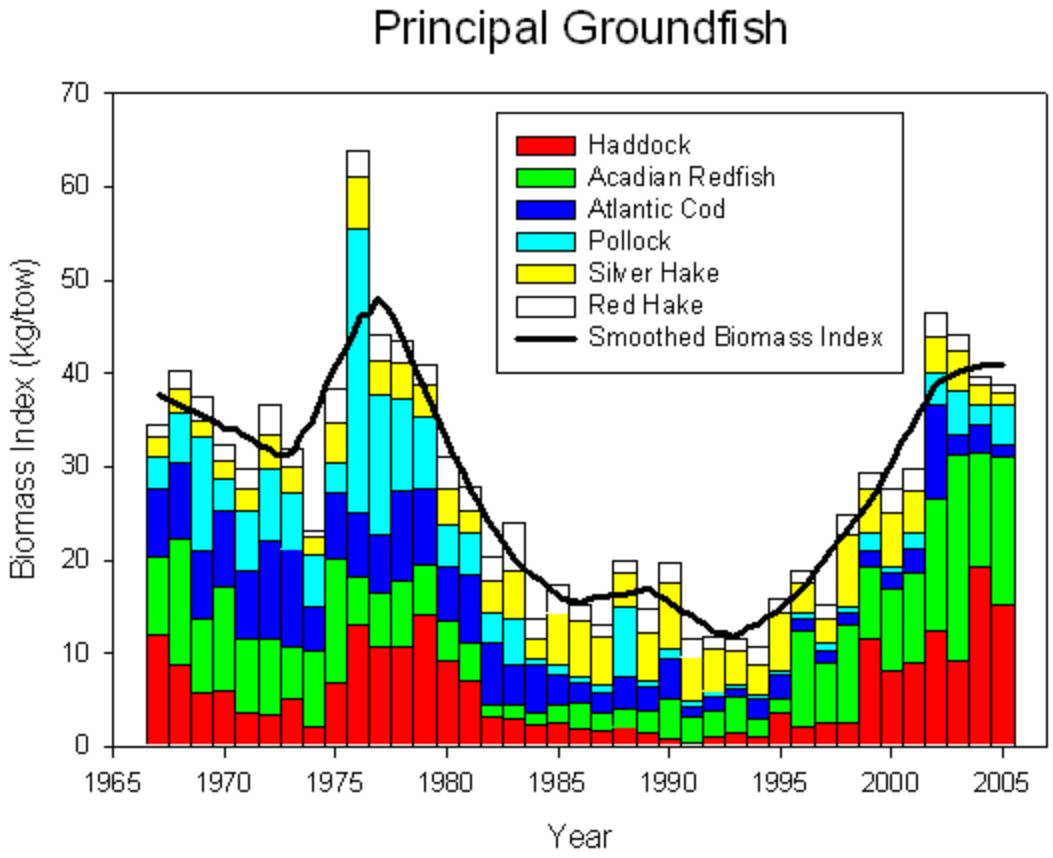


Figure 6. Relative biomass index of principal groundfish (Atlantic cod, haddock, pollock, silver hake, red hake, and Acadian redfish) in the NEFSC autumn survey, 1967-2005. The solid line represents a smoothed index.

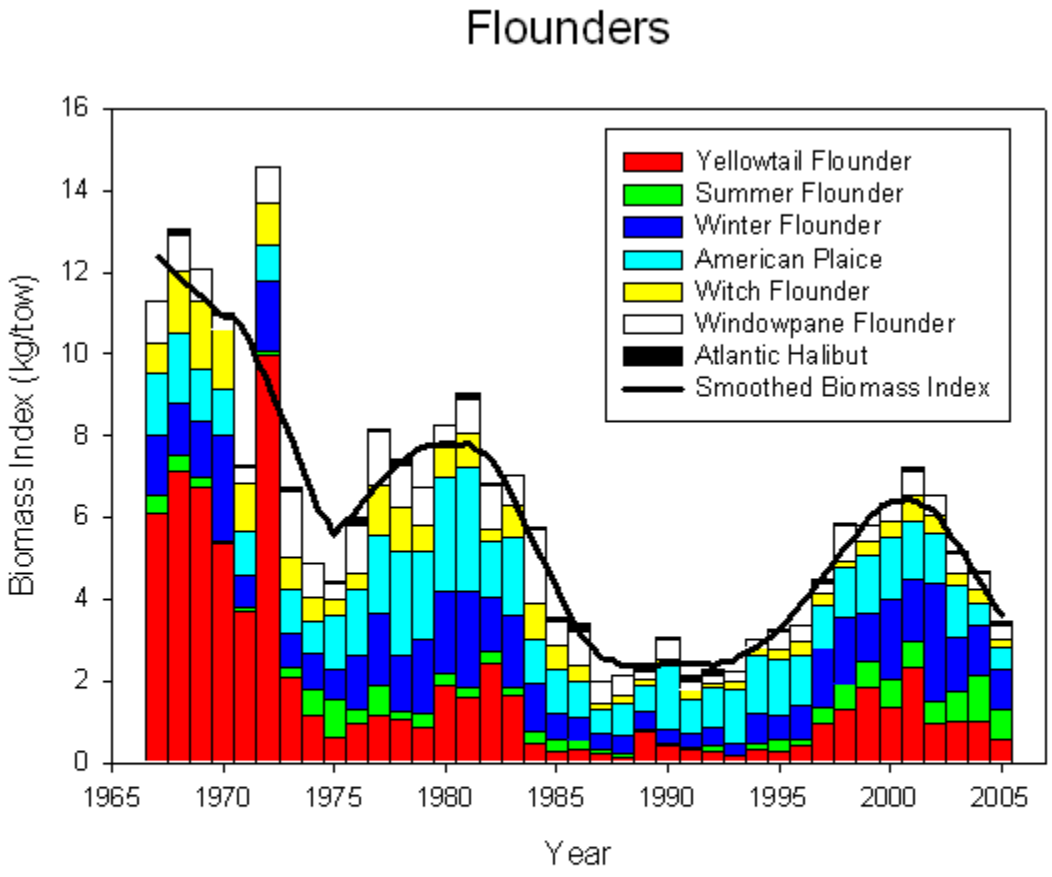


Figure 7. Relative biomass index of flounders (yellowtail flounder, summer flounder, winter flounder, American plaice, witch flounder, windowpane flounder, and Atlantic halibut) in the NEFSC autumn survey, 1967-2005. The solid line represents a smoothed index.

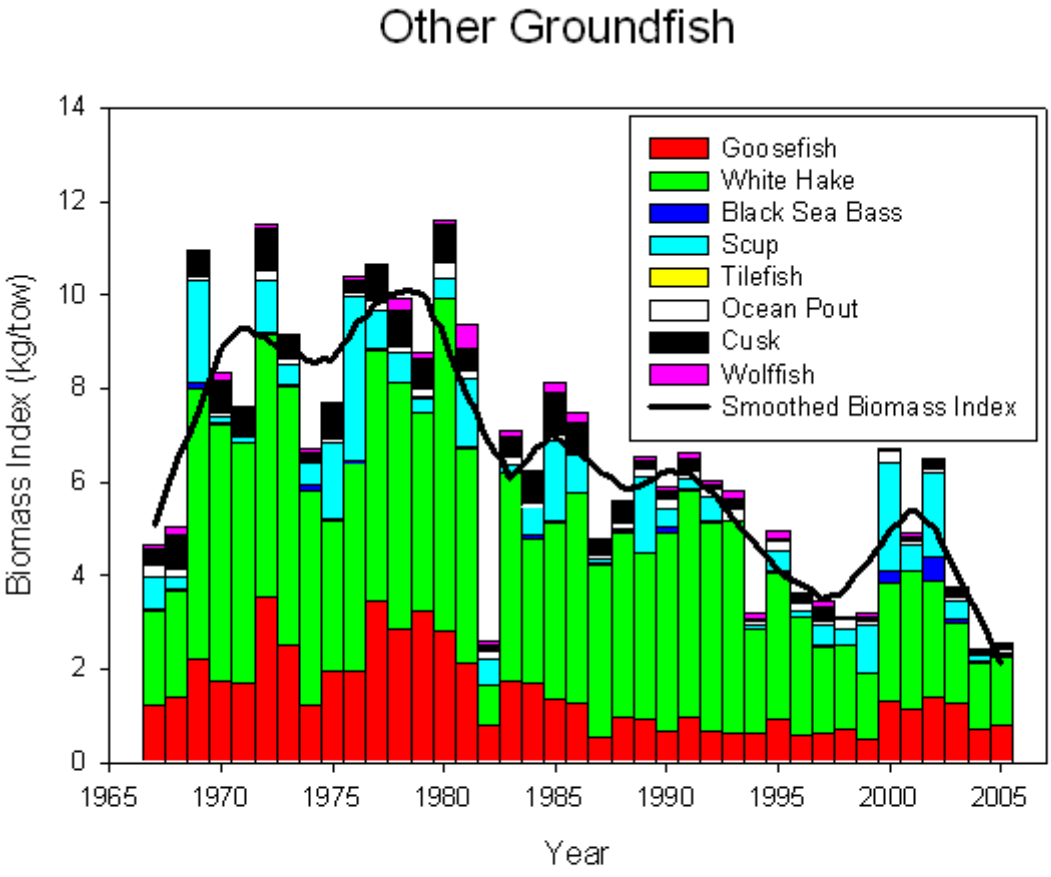


Figure 8. Relative biomass index of other groundfish (goosefish, white hake, black sea bass, scup, tilefish, ocean pout, cusk and Atlantic wolffish) in the NEFSC autumn survey, 1967-2005. The solid line represents a smoothed index.

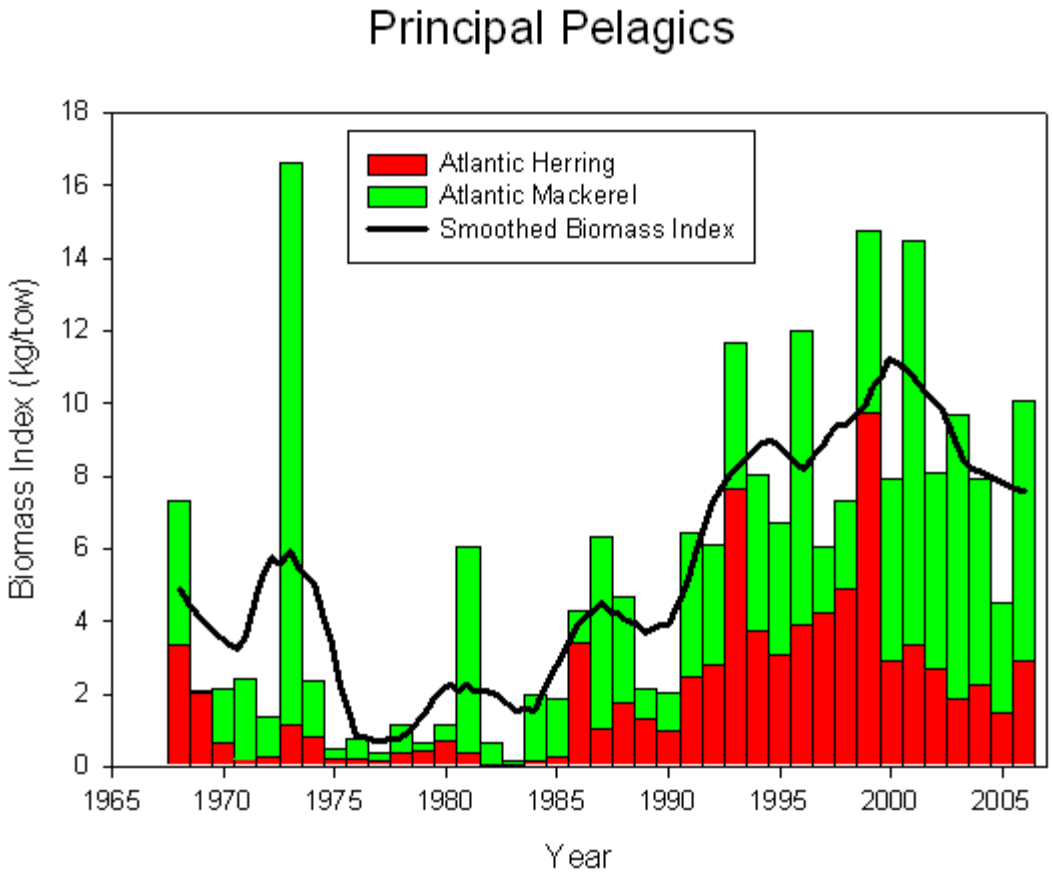


Figure 9. Relative biomass index of principal pelagics (Atlantic herring and Atlantic mackerel) in the NEFSC spring survey, 1968-2006. The solid line represents a smoothed index.

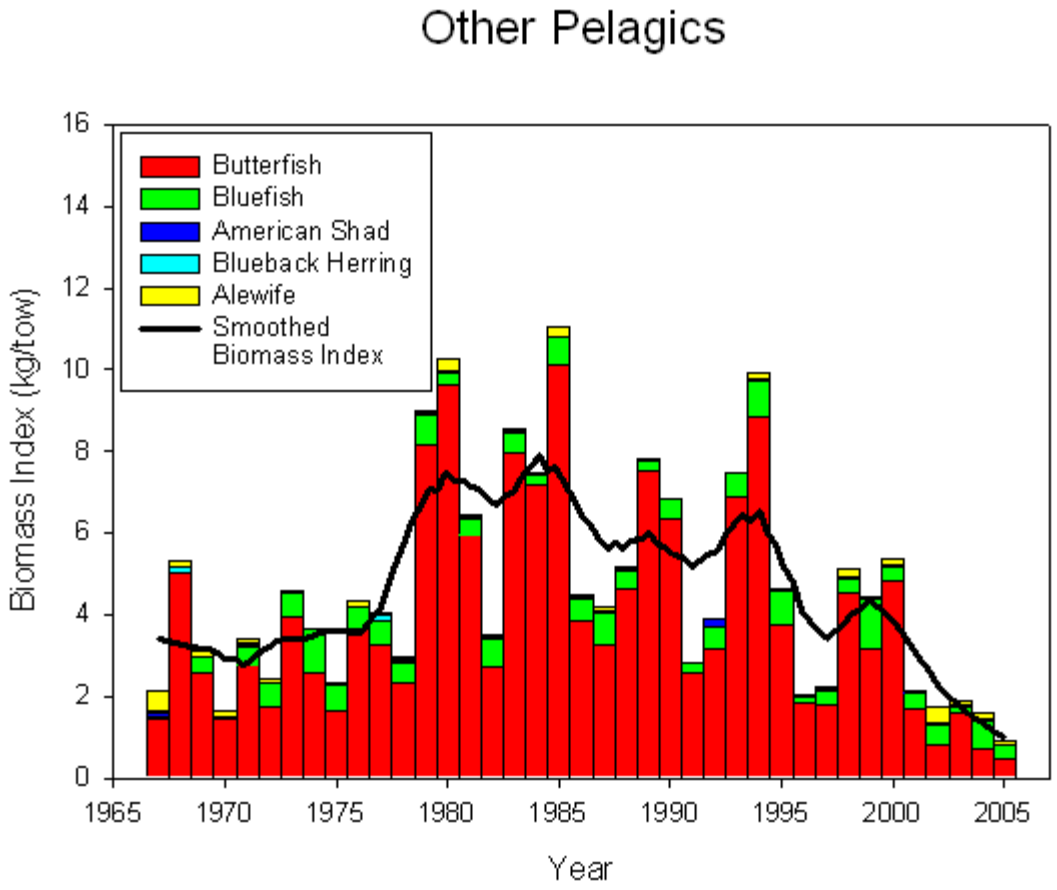


Figure 10. Relative biomass index of other pelagics (butterfish, bluefish, American shad, blueback herring, and alewife) in the NEFSC autumn survey, 1967-2005. The solid line represents a smoothed index.

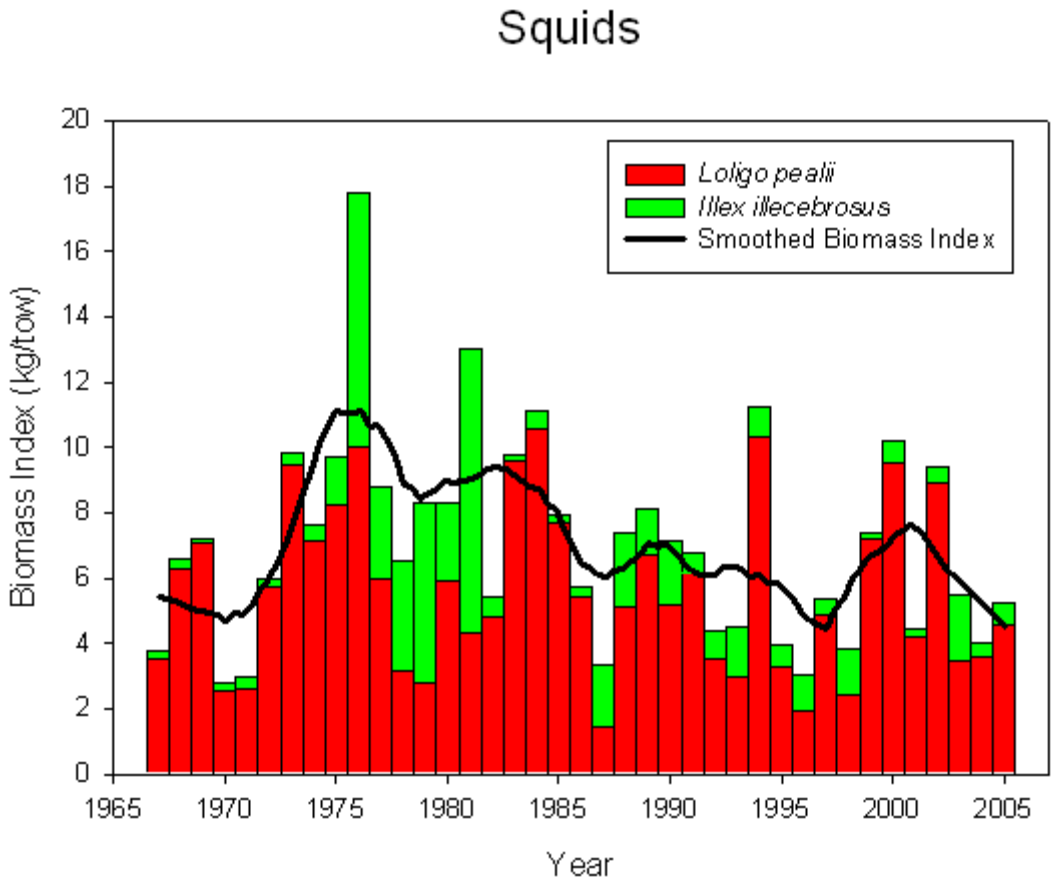


Figure 11. Relative biomass index of squids (*Loligo pealii and Illex illecebrosus*) in the NEFSC autumn survey, 1967-2005. The solid line represents a smoothed index.

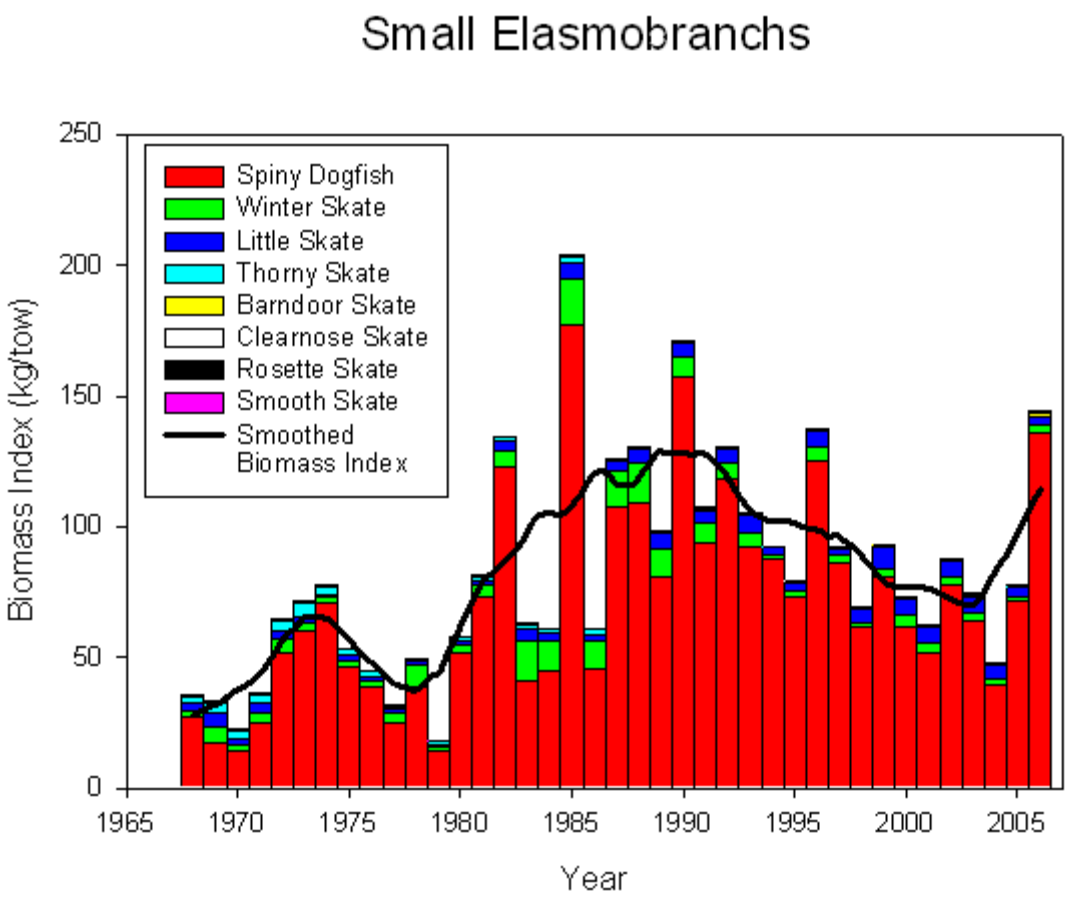


Figure 12. Relative biomass index of small elasmobranchs (spiny dogfish, winter skate, little skate, thorny skate, barndoor skate, clearnose skate, rosette skate, and smooth skate) in the NEFSC spring survey, 1968-2006. The solid line represents a smoothed index.

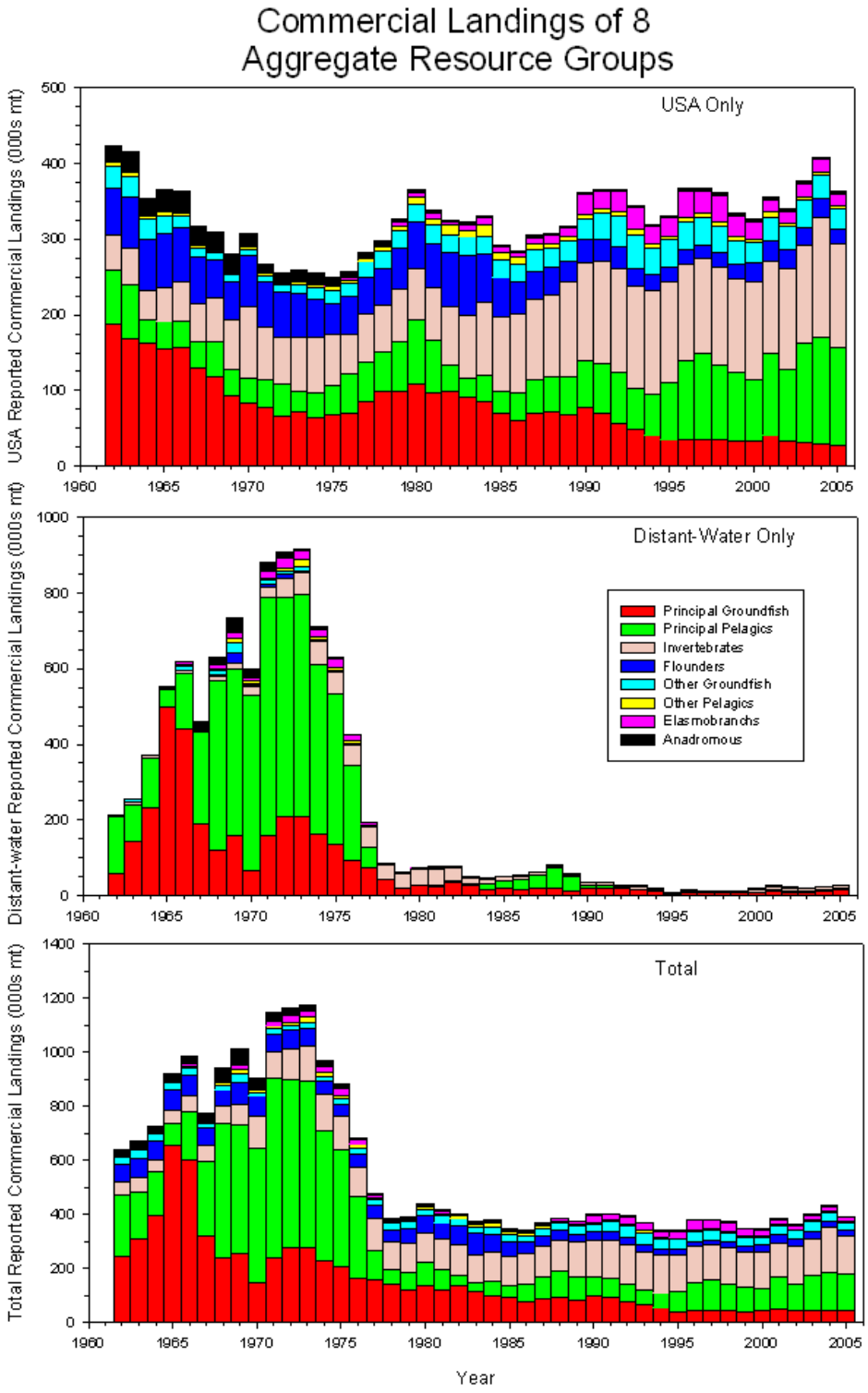
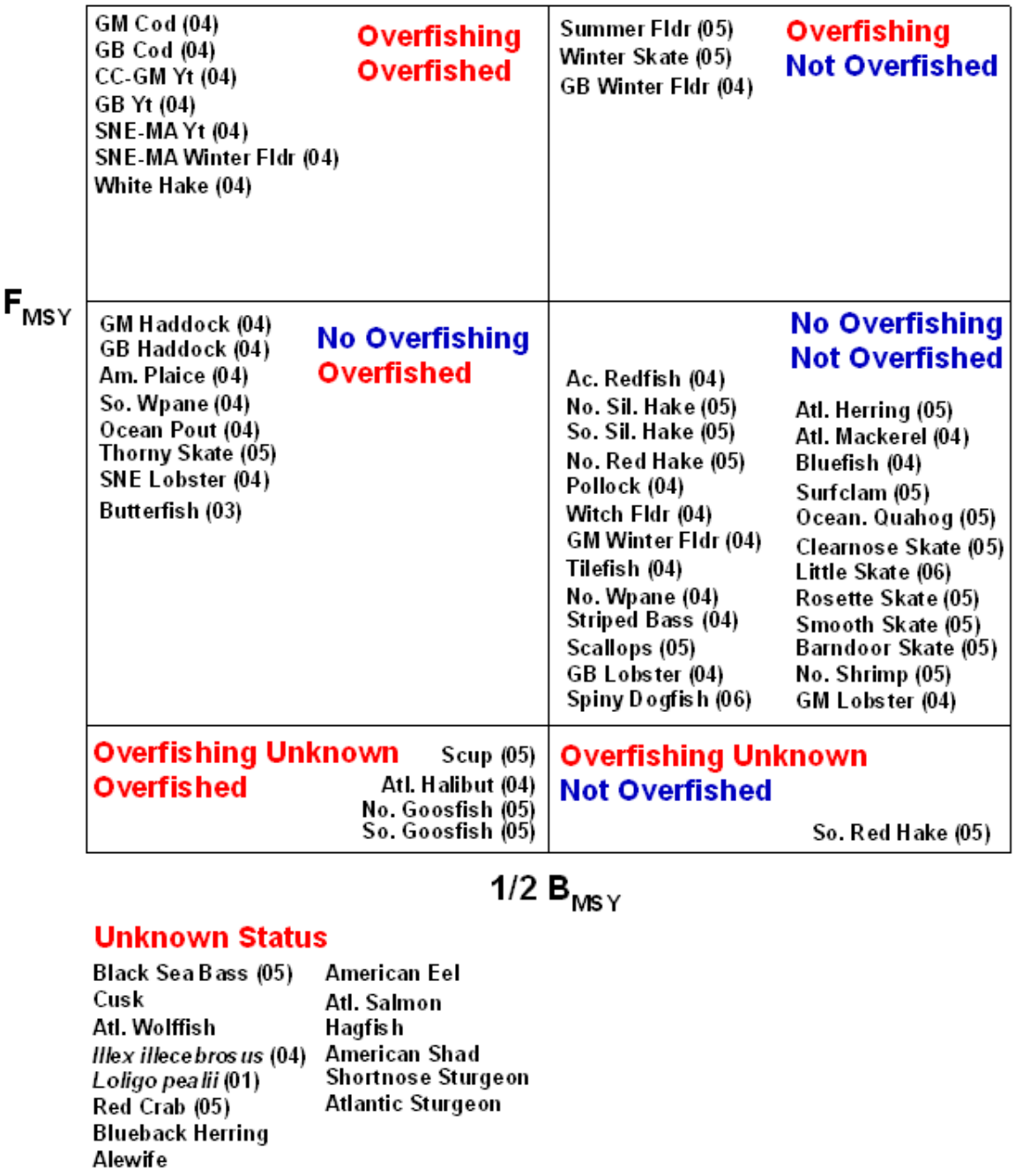


Figure 13. Commercial landings of 8 aggregate resource groups for USA, distant-water fleets, and total fleets combined, 1962-2005. Landings are given as nominal catches, defined as live weight equvalent of landings, except for sea scallops, ocean quahogs and surfclams where the nominal catches were adjusted to meat weights.



Unknown Status

Black Sea Bass (05)
Cusk
Atl. Wolffish
Illex illecebrosus (04)
Loligo pealii (01)
Red Crab (05)
Blueback Herring
Alewife
American Eel
Atl. Salmon
Hagfish
American Shad
Shortnose Sturgeon
Atlantic Sturgeon

Figure 14. Summary of the status of 62 finfish and invertebrate stocks reviewed in this report. Stocks are classified by their relationship to biomass threshold (1/2 Bmsy) and fishing mortality threshold (Fmsy). The numbers in parentheses refer to the last year of data used for status determination.