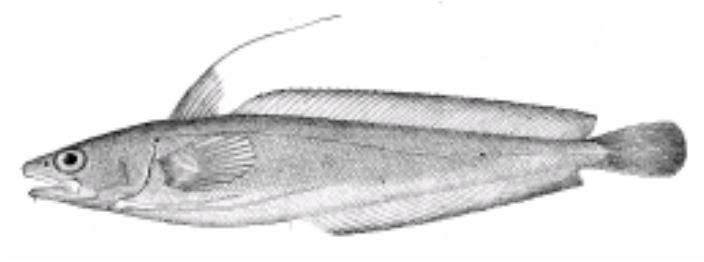

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Red Hake

by

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Distribution, Biology and Management

Red hake, *Urophycis chuss,* is a demersal gadoid species distributed from the Gulf of St. Lawrence to North Carolina, and is most abundant from the western Gulf of Maine through Southern New England waters. Red hake are separated into northern and southern stocks for management purposes. The northern stock is defined as the Gulf of Maine to Northern Georges Bank region, while the southern stock is defined as the Southern Georges Bank to Mid-Atlantic Bight region (Figure 5.1). Both red hake stocks were last assessed in the fall of 1990.

Red hake migrate seasonally, preferring temperatures between 5 and 12^{o} C (41-54^{o} F) (Grosslein and Azarovitz 1982). During the spring and summer months, red hake move into shallower waters to spawn, and during the winter months move offshore to deep waters in the Gulf of Maine and the edge of the continental shelf along Southern New England and Georges Bank. Spawning occurs from May through November, with primary spawning grounds on the southwest part of Georges Bank and in the Southern New England area off Montauk Point, Long Island (Colton and Temple 1961).

Red hake do not grow as large as white hake, and normally reach a maximum size of 50 cm (20 in.) and 2 kg (4.4 lbs.) (Musick 1967). However, females are generally larger than males of the same age, and reach a maximum length of 63 cm (25 in.) and a weight of 3.6 kg (7.9 lbs.) (Collette and Klein-MacPhee eds. 2002). Although they generally do not live longer than 8 years, red hake have been recorded up to 14 years old. In the northern stock, the age at 50% maturity is 1.4 years for males and 1.8 years for females, and the size at 50% maturity is 22 cm (8.7 in.) for males and 27 cm (10.6 in.) for females (O'Brien et al. 1993). In the southern red hake stock, the age at 50% maturity is 1.8 years for males and 1.7 years for females, and the size at 50% maturity is 24 cm (9.5 in.) for males and 25 cm (9.8 in.) for females (O'Brien et al. 1993).

Red hake prefer soft sand or muddy bottom, and feed primarily on crustaceans such as euphausiids, decapods, and rock crabs as well as fish such as haddock, silver hake, sea robins, sand lance, mackerel and small red hake (Bowman et al. 2000). Primary predators of red hake include spiny dogfish, cod, goosefish, and silver hake (Rountree 1999). As juveniles, red hake seek shelter from predators in scallop beds, and are commonly found in the mantle cavities of (or underneath) sea scallops. In the fall, red hake likely leave the safety of the scallop beds due to their increasing size and to seek warmer temperatures in offshore waters (Steiner et al. 1982).

Following the arrival of distant-water fleets in the early 1960s, total landings from both stocks combined peaked at 113,600 mt in 1966 (Figure 5.2). Annual landings then declined sharply to 12,900 mt in 1970, increased to 76,400 mt in 1972, and then declined steadily with increased restrictions on distant-water fishing effort. Prior to implementation of the Magnuson Fisheries Conservation and Management Act (MFCMA) in 1977, distant-water fleets accounted for approximately 80-90% of the total landings from both stocks. Between 1977 and 1986, landings generally declined due to restrictions placed on distant water fleets, and foreign landings ceased in 1987 (Brodziak 2001). Red hake landings continued to decline afterwards, and averaged only 1,100 mt per year during 1996-2005. In 2005, total red hake landings were a historic low of 300 **mt (Figure 5.2).**

The primary fishing gear used to catch red hake is the otter trawl. Recreational catches, taken almost exclusively from the southern stock, have been of minor importance and have been negligible in recent years. In 2000, the New England Fisheries Management Council implemented Amendment 12 to the Northeast Multispecies Fishery Management Plan (FMP), and placed red hake into the "small mesh multispecies" management unit, along with silver hake and offshore hake. This amendment set retention limits based on net mesh size, adopted overfishing definitions for the northern and southern red hake stocks, identified essential fish habitat for all life stages, and set requirements for fishing gear (NEFMC 2000). The survey indices used in this document differ from previous assessments in that vessel and door conversion coefficients have been incorporated (NEFSC 1991).

NORTHERN STOCK RED HAKE

The Fishery

The northern red hake stock had significantly lower commercial landings than the southern stock through the mid-1970s (Figure 5.2). In 1973, total commercial landings peaked at 15,281 mt but have since declined progressively. After 1976, landings declined considerably due to the withdrawal of the distant water fleet. Commercial landings attained a historical low of 130 mt in 2005 (Figure 5.3, Table 5.1).

Research Vessel Survey Indices

The NEFSC autumn bottom trawl survey biomass index exhibits considerable inter-annual variability. Despite this, the index suggests a gradual increase in biomass from the 1970s

through 2002. Subsequently, the biomass index has steadily declined (Figure 5.4), and in 2005 was 1.274 kg/tow, the lowest value since 1974, and less than ½ B_{MSY} (Figure 5.5).

Biological Reference Points

The overfishing definition uses a relative exploitation index (total landings/NEFSC autumn survey biomass index) as a proxy when fishing mortality is unknown (NEFMC 2003). The northern stock is considered overfished when the 3-year moving average biomass is less than the ½ B_{MSY} proxy (1.6 kg/tow). Overfishing occurs when the exploitation ratio exceeds the F_{MSY} proxy (0.61). The 3-year average biomass has remained above the ½ B_{MSY} proxy since the mid-1970s (Figure 5.5). Exploitation indices have been below the F_{MSY} proxy since 1977, as well as below the F_{proxy} target level of 0.37 since 1988 (Figure 5.6).

Summary

Northern red hake landings and NEFSC autumn survey biomass indices were relatively high until the mid-1970s when the distant water fishery was at its maximum. Landings have since declined to a historical low in 2005. In 2005, the exploitation index was well below the F_{MSY} proxy of 0.65 and the 3-year average biomass index remained above the ½ B_{MSY} proxy, indicating that the stock is not overfished and overfishing is not occurring.

Table 5.1. Recreational and commercial landings of Northern red hake (thousand metric tons).

Category	1986-95 Average	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
U. S. Recreational	-	-	-	-	-	-	-	-	-	-	-
Commercial											
United States	0.8	0.4	0.5	0.5	0.6	0.6	0.7	0.3	0.3	0.2	0.1
Canada	-	-	-	-	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-	-	-	-	-
Total Nominal Catch	0.8	0.4	0.5	0.5	0.6	0.6	0.7	0.3	0.3	0.2	0.1

Table 5.2. MSY- based reference points for the Northern red hake stock.

F_{TARGET} Proxy	=	0.37
$F_{0.1}$	=	0.50
F_{MSY} Proxy	=	0.61
MSY	=	2,000 mt
B_{MSY} Proxy	=	3.3 kg/tow
1/2 B_{MSY}	=	1.6 kg/tow

SOUTHERN STOCK RED HAKE

The Fishery

During 1962 to 1976, landings from the southern red hake stock were much higher than those from the northern stock (Figure 5.2). However, southern red hake landings decreased sharply after 1966 and also after 1976 (Figure 5.7) due to restrictions on distant water fleets. The southern stock landings have continued to decrease, and reached a record low of 200 mt in 2005 (Table 5.3).

Research Vessel Survey Indices

The NEFSC autumn survey biomass index for the southern red hake stock markedly declined during 1963-1967 (Figure 5.8), corresponding to the increase in landings by distant water fleets. During 1967 to 1983, the survey index fluctuated without trend, and has since declined despite very low landings since the early 1980s. In 2005, the stock biomass index for southern red hake was 0.78 kg per tow (Figure 5.8).

An exploitation index was calculated as the ratio of commercial landings to the 3-year average biomass index from the NEFSC autumn survey (Figure 5.9). Before 1975, the exploitation indices were generally high but subsequently declined to a very low level and has remained relatively stable over the past 30 years. The 2005 exploitation index (0.3) is the lowest since 1985 (Figure 5.9).

Biological Reference Points

In 1998 the Overfishing Definition Review Panel (Applegate et al. 1998) concluded that MSY and F reference points could not be determined for southern red hake because the time series of landings and survey biomass indices did not include a period of stable landings at high biomass levels. The Panel noted that discarding could be significant, especially in the scallop and trawl fisheries. Habitat destruction was also thought to be prohibiting stock recovery since juveniles rely on intact scallop beds for shelter. However, in recent years the scallop stock has been recovering, but red hake biomass indices have not increased.

The southern red hake stock is considered to be in an overfished condition when the three-year moving average weight per individual fish in the NMFS autumn survey falls below the 25^{th} percentile of the 1963-1997 average of 0.12 kg and when the three-year moving average of the abundance of immature fish less than 25 cm in the fall survey is below the 1963-1997 median value of 4.07 immature fish per tow (Table 5.4).

Summary

The 2003-2005 average fish weight of 0.068 kg was about half of the individual fish weight reference point; however, the 2003-2005 recruitment index of 5.68 red hake less than 25 cm length per tow was above 4.07, the median value (Figure 5.10). Based on this, the southern red hake stock is not in an overfished condition.

Table 5.3. Recreational and commercial landings of Southern red hake (thousand metric tons).

Category	1986-95 Average	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
U. S. Recreational	0.4	<0.1	0.2	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Commercial											
United States	1.0	0.7	0.9	0.8	0.9	1.0	1.0	0.6	0.6	0.5	0.2
Canada	-	-	-	-	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-	-	-	-	-
Total Nominal Catch	1.4	0.7	1.1	0.9	0.9	1.0	1.0	0.6	0.6	0.5	0.2

Table 5.4. Reference points for the Southern red hake stock.

$F_{0.1}$	=	0.50
Overfishing definition	=	Average fish weight <0.12 and recruitment index <4.07

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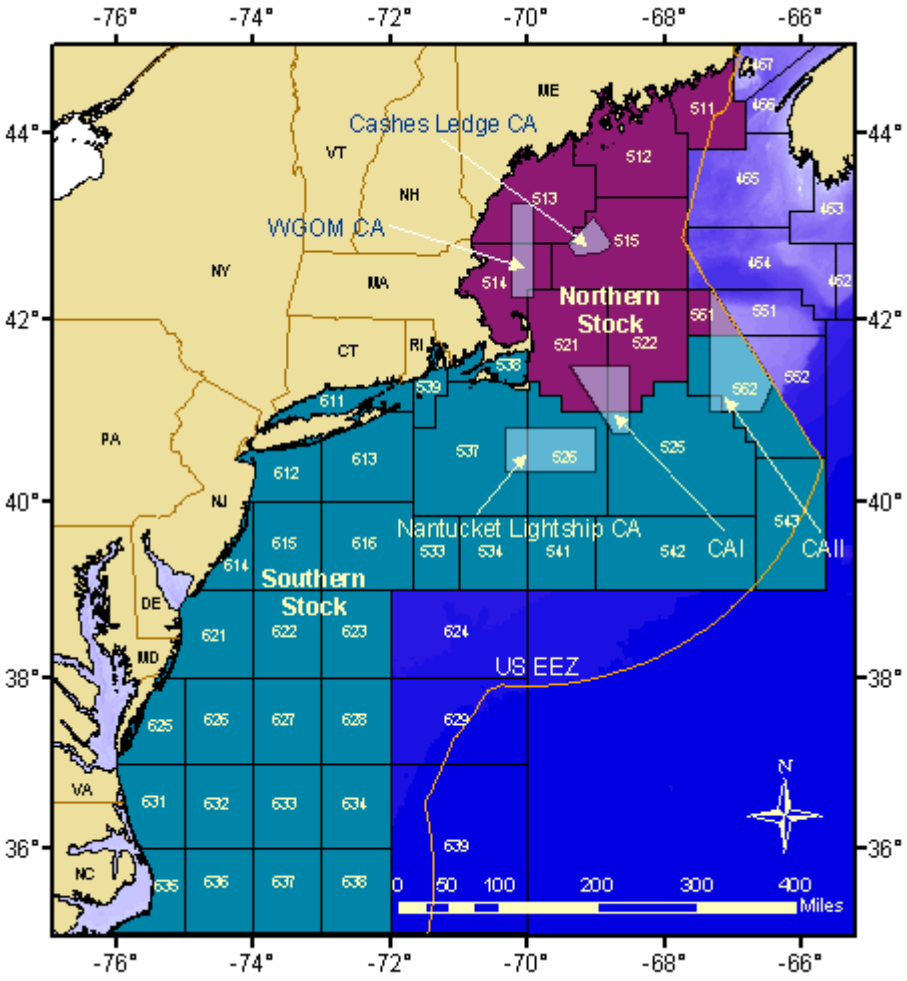

Figure 5.1. Statistical areas used to define the northern and southern red hake stocks.

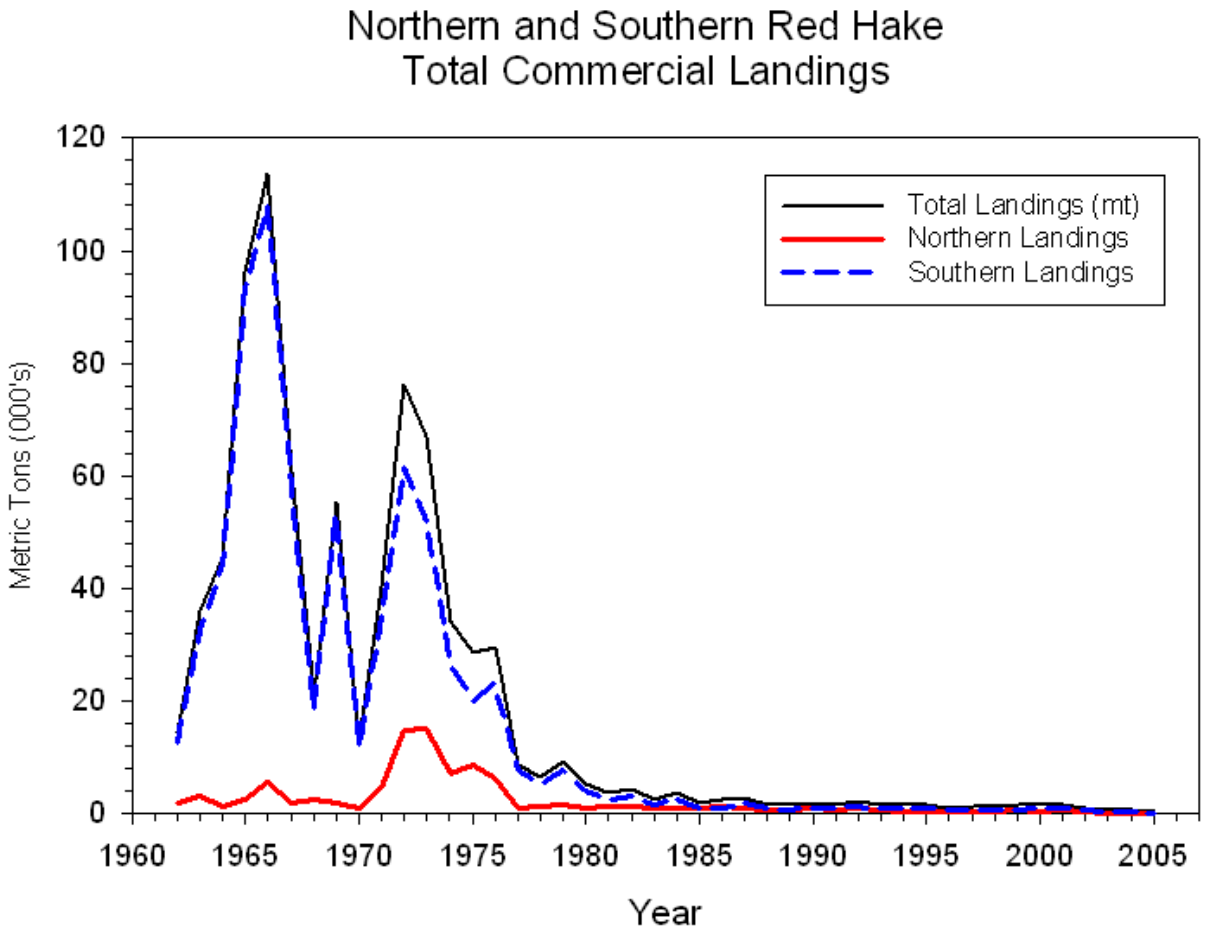

Figure 5.2. Total commercial landings of northern and southern red hake, 1962-2005.

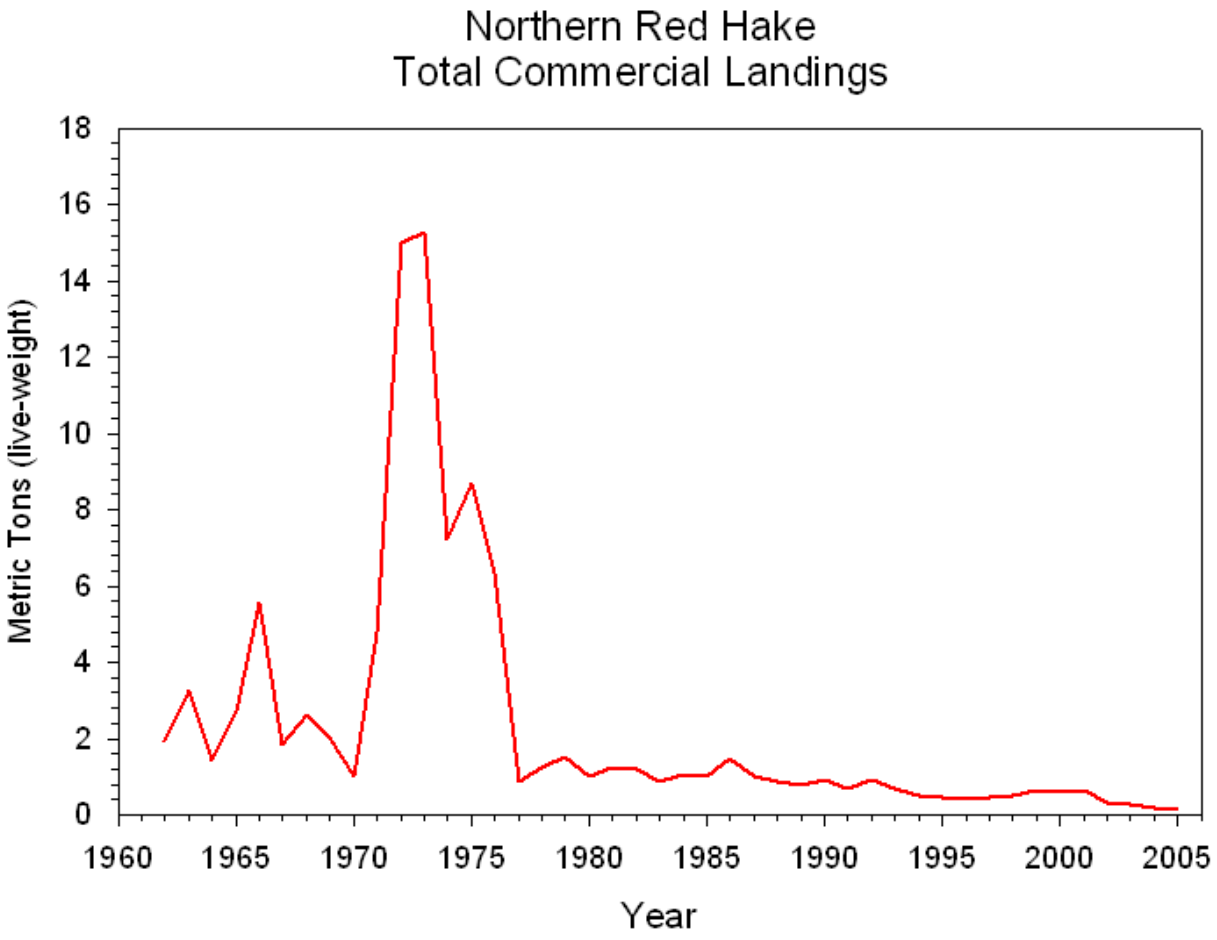

Figure 5.3. Total commercial landings of Northern red hake from the Gulf of Maine-Georges Bank region, 1962-2005.

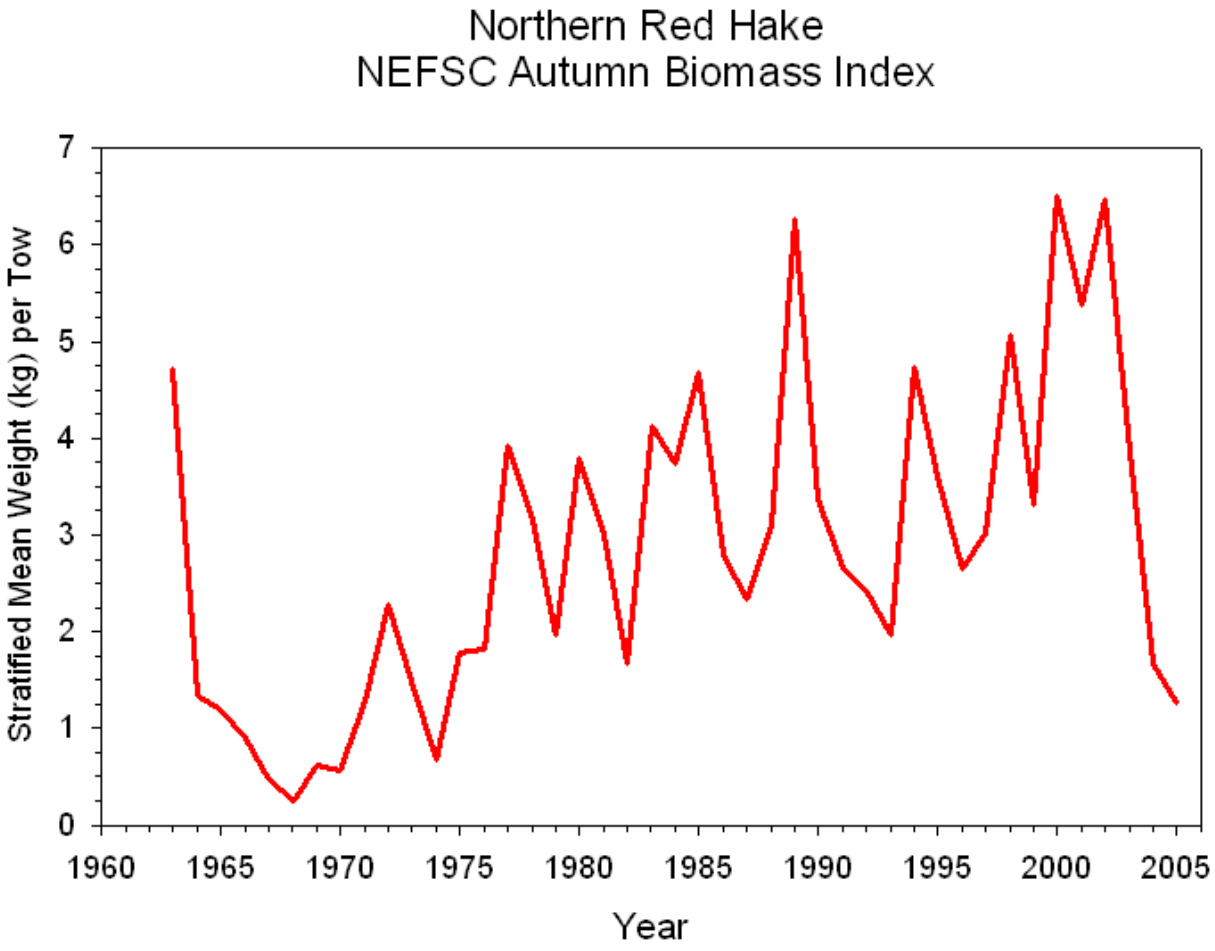

Figure 5.4. Biomass index (stratified mean weight per tow) for Northern red hake from the NEFSC autumn research vessel survey.

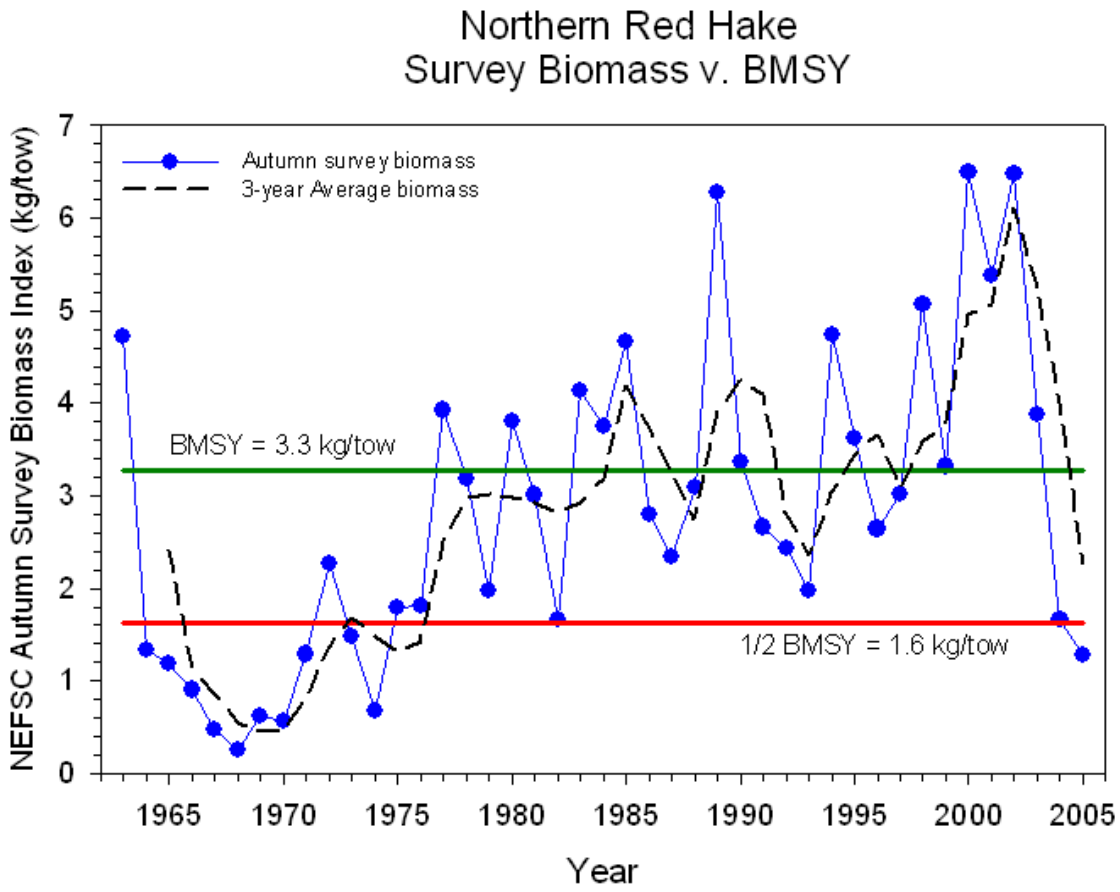

Figure 5.5. Trends in biomass indices (mt) of Northern red hake from NEFSC autumn bottom trawl surveys in relation to the B_{MSY} proxy (3.1 kg/tow) and 1/2 B_{MSY} (1.6 kg/tow.

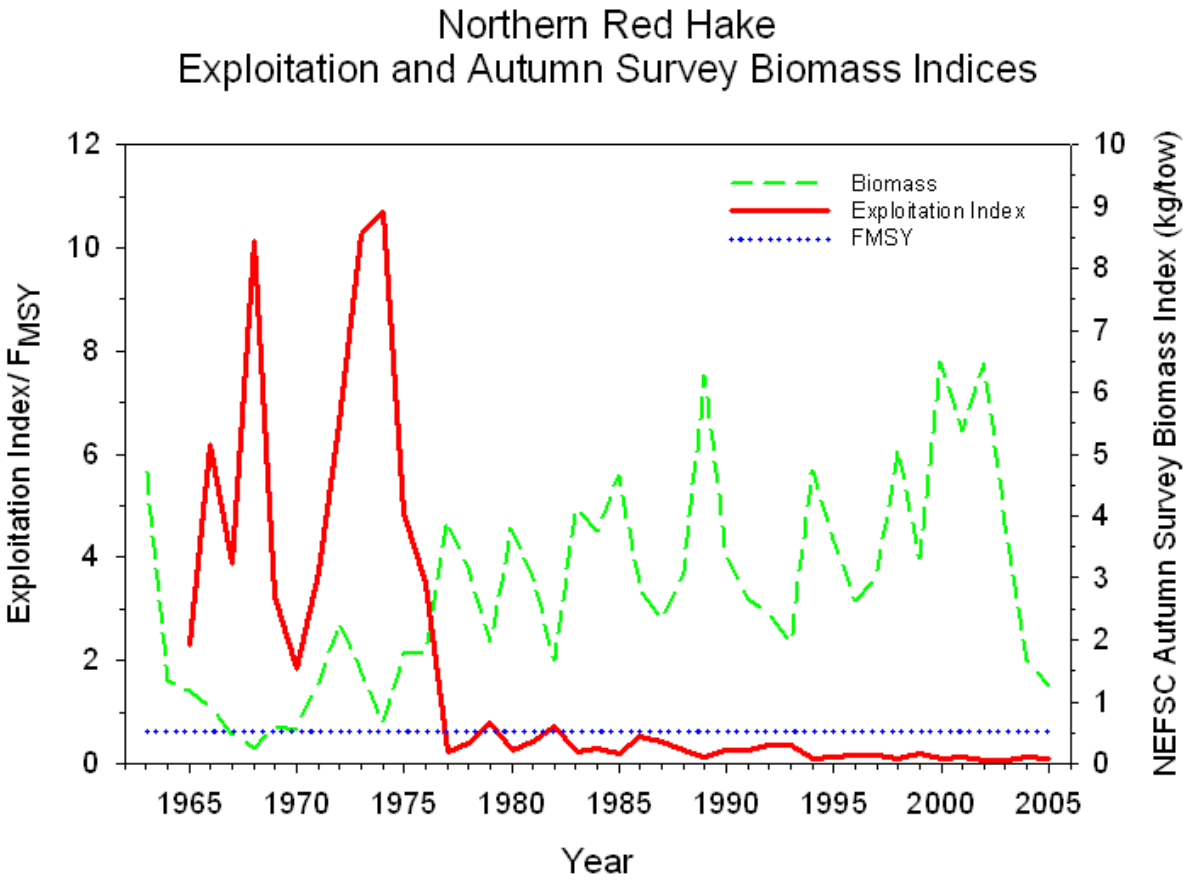

Figure 5.6. Trends in Northern red hake autumn survey biomass and exploitation indices (calculated as annual landings divided by the autumn survey biomass index). The dashed line represents the F_{MSY} proxy (0.61).

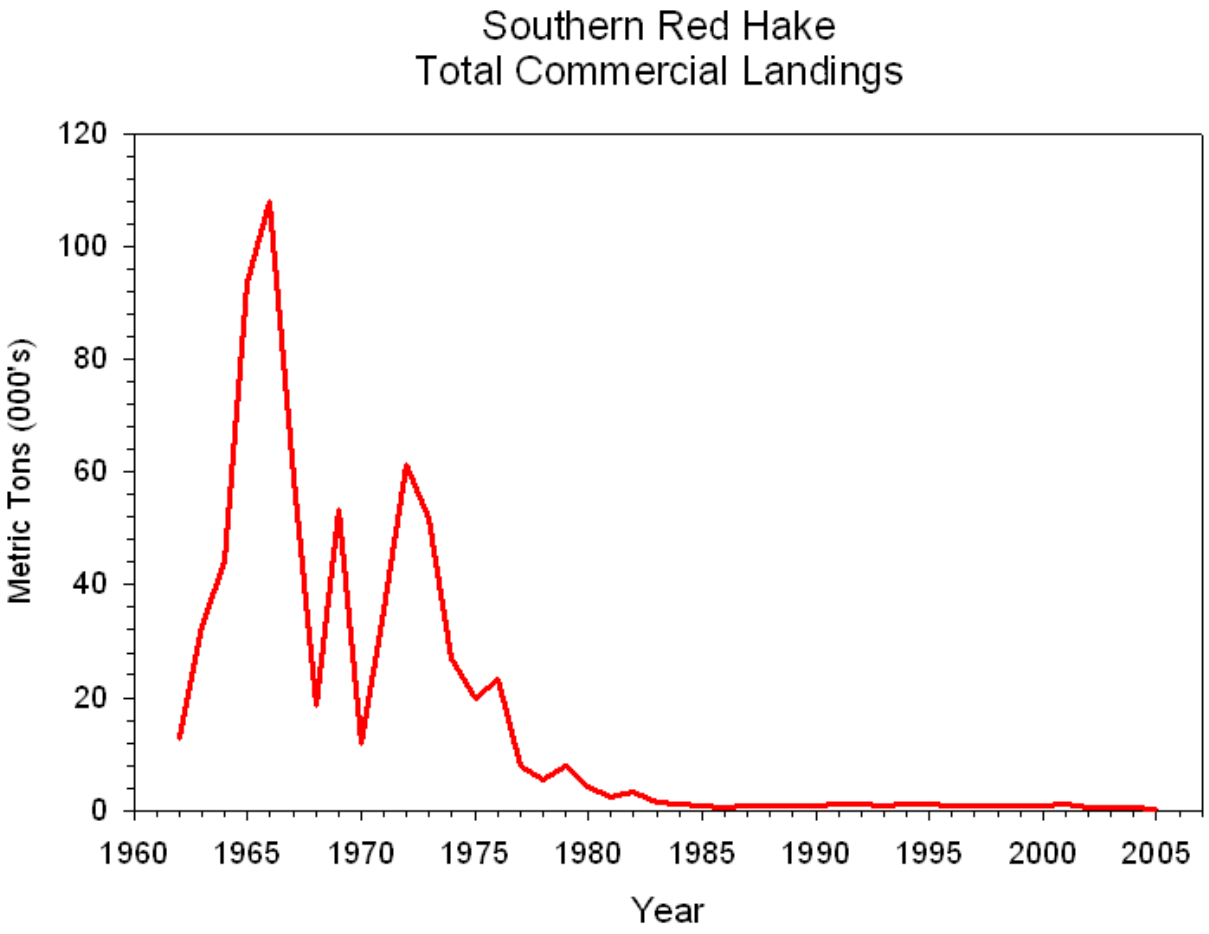

Figure 5.7. Total commercial landings of southern red hake, 1962-2005.

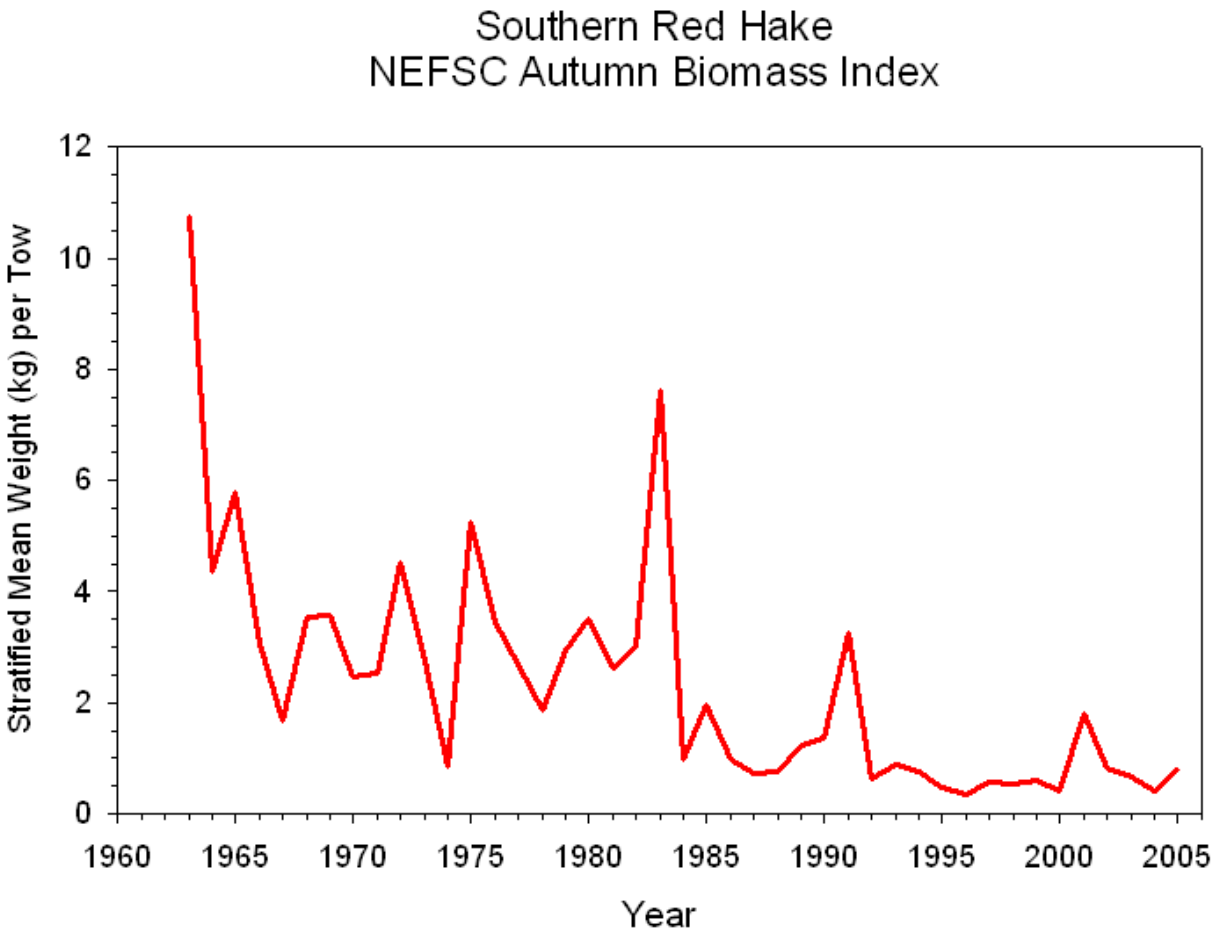

Figure 5.8. Biomass index (stratified mean weight per tow) for southern red hake from the NEFSC autumn research vessel survey.

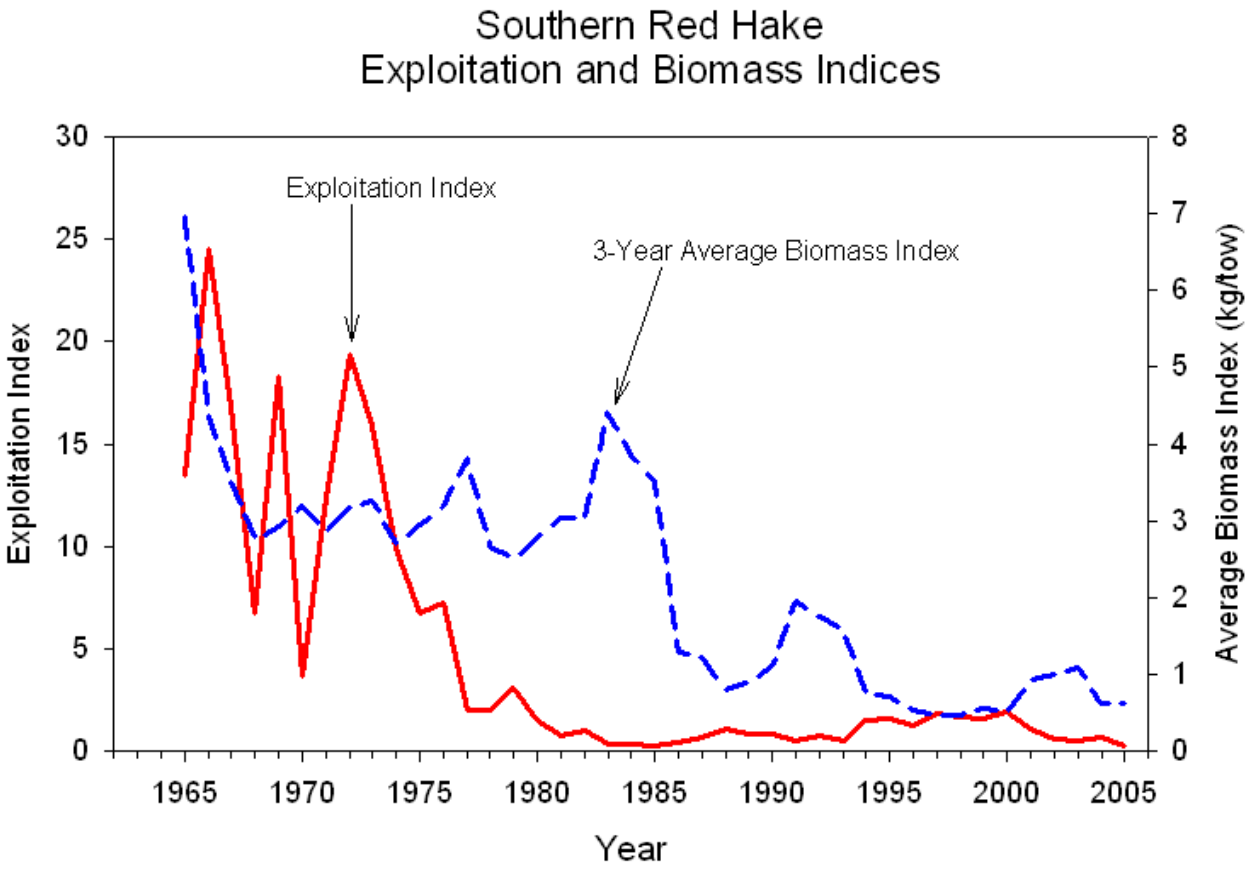

Figure 5.9. Trends in southern red hake fall survey biomass index and exploitation index, calculated as annual landings divided by the 3-year moving average of the biomass index.

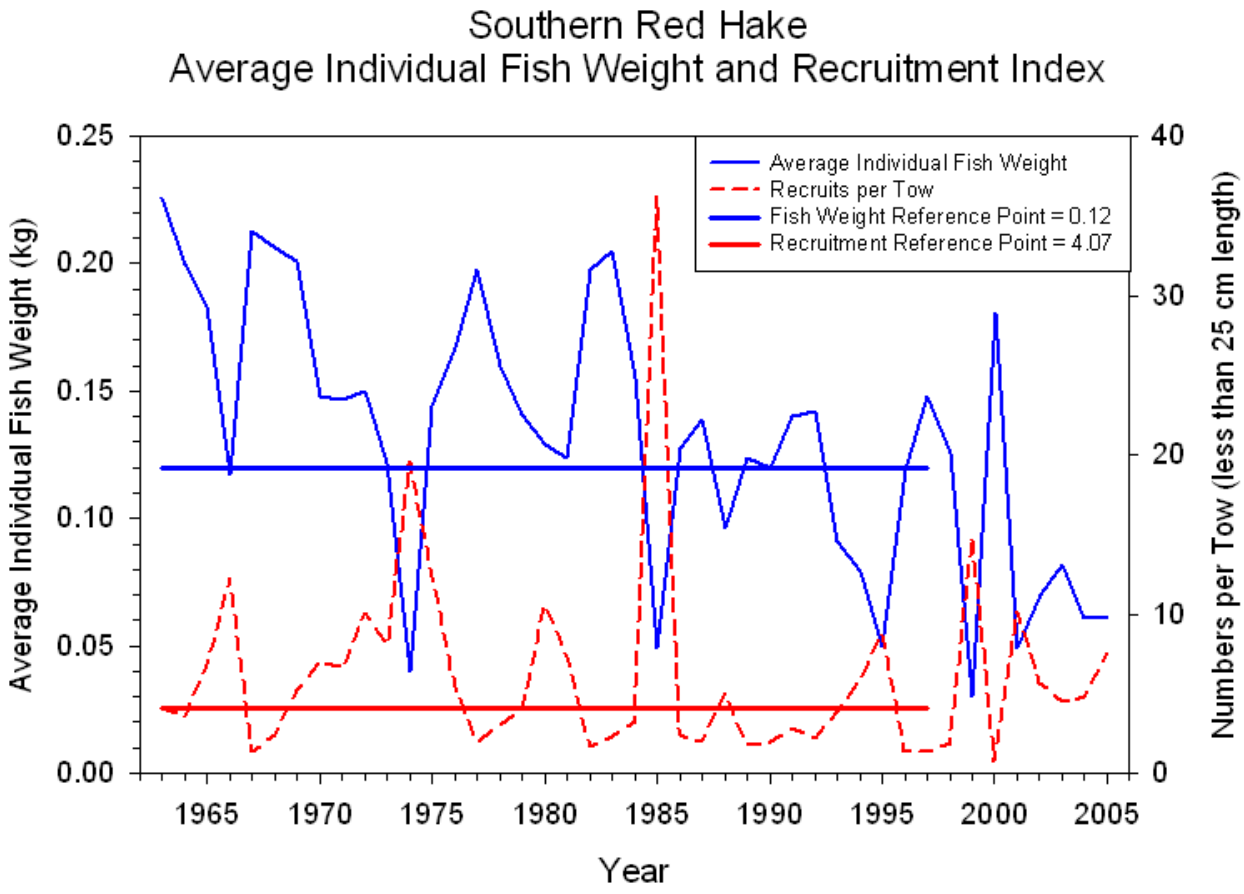

Figure 5.10. Average individual fish weight and recruitment index of southern red hake from the NEFSC autumn bottom trawl survey.