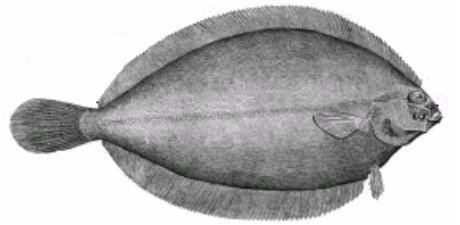

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Witch Flounder

by

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Distribution, Biology and Management

The witch flounder, *Glyptocephalus cynoglossus*, is a demersal flatfish distributed on both sides of the North Atlantic. In the Northwest Atlantic, the species ranges from Labrador southward to Virginia, and is closely associated with mud or sand-mud bottom. In US waters, witch flounder are common throughout the Gulf of Maine and in deeper areas on and adjacent to Georges Bank and along the shelf edge as far south as Cape Hatteras. Witch flounder are assessed as a unit stock (Figure 10.1).

Witch flounder appear to be sedentary, preferring moderately deep areas; few fish are taken shallower than 27 m (15 fathoms) and most are caught between 110 and 275 m (60 and 150 fathoms). Witch flounder diet consists mostly of polychaete worms. Witch flounder attain lengths up to 78 cm (31 in.) and weights of approximately 2 kg (4.5 lb) (Bigelow and Schroeder 1953), but are slow-growing, late-maturing and can live as old as 30 years. Female witch flounder reach maturity between ages 5 and 6; spawning occurs in late spring and summer. The larval period is relatively long, between 6 to 12 months (Cargnellis et al. 1999).

The U.S. commercial fishery for witch flounder is managed under the New England Fishery Management Council's Northeast Multispecies Fishery Management Plan (FMP). Under this FMP witch flounder are included in a complex of 15 groundfish species managed by time/area closures, gear restrictions, minimum size limits, and, since 1994, by direct effort controls including a moratorium on permits and days-at-sea restrictions. Amendment 9 established initial biomass rebuilding targets (NEFMC 1998) and defined control rules which specify target fishing mortality rates and corresponding rebuilding time horizons. Amendment 13 implemented formal rebuilding plans within specified time frames based on revised biomass and fishing mortality targets derived by the Working Group on Re-Evaluation Biological Reference Points for New England Groundfish (NEFSC 2002). The goal of the management program is to reduce fishing mortality to allow stocks to rebuild above minimum biomass thresholds, and, to attain and

remain at or near target biomass levels. The information provided herein reflects the results of the most recent peer-reviewed assessment for witch flounder (Wigley and Col, 2005).

The Fishery

Total commercial landings in 2005 were 2,652 mt, near the long-term average of 2,800 mt and slightly below those from 2001-2004 (Table 10.1, Figure 10.2). Commercial fishing is conducted year round, primarily with otter trawls. Recreational catches are insignificant.

Historically, significant proportions of the U.S. catch have been taken both on Georges Bank and in the Gulf of Maine. Canadian landings have been minor (never more than 68 mt annually). Distant-water fleet catches averaged 2,700 mt in the early 1970s, but subsequently declined sharply and have been negligible since 1976. Total landings peaked at more than 6,000 mt in 1971, declined to an annual average of 2,800 mt during 1973-1981, and then increased sharply to 6,700 mt in 1984. Landings subsequently declined to only 1,500 mt in 1990, the lowest value since 1964. Landings increased during the 1990s and are presently near the long term average. Prior to the 1980s, witch flounder was primarily a bycatch species.

Discards of witch flounder occurs primarily in the otter trawl fishery and, to a lesser extent, in the northern shrimp fishery. Since 1993, discards from the large mesh otter trawl fishery and the northern shrimp fishery have averaged about 10% of the total catch.

Witch flounder catch (in numbers) have generally been dominated by ages 5-8 (Figure 10.3). The proportion of older fish (ages 9+) in the catch has increased since the early 2000s.

Research Vessel Survey Indices

NEFSC spring and autumn biomass indices for witch flounder have generally exhibited similar trends throughout the survey time series (Figure 10.4). Biomass indices generally declined from the early 1960s to the early 1990s when they reached record lows. Survey biomass indices increased during the late 1990s, but have exhibited a declining trend since 2000. As the stock declined in the late 1980s, the age structure of the population became truncated, with a low proportion of fish at age 9 and older (Figure 10.5). Since the late 1990s, the age structure has started to expand.

Assessment Results

Average fishing mortality (ages 8-9, unweighted) fluctuated between 0.26 and 1.12 between 1982 and 1996, but afterward declined to a record-low of 0.20 in 2004 (Figure 10.6). Spawning stock biomass declined steadily from nearly 17,000 mt in 1982 to 3,900 mt in 1996, but has since increased to over 21,000 mt in 2004 (Figure 10.7). Since 1982, recruitment of age 3 witch flounder has ranged from approximately 3 million fish (1984 year class) to 45 million fish (the 1997 year class), with arithmetic mean recruitment of 15.5 million fish (Figure 10.7). The above year classes in the late 1990s have been followed by below-average year classes in early 2000s.

Biological Reference Points

Yield and spawning stock biomass biological reference points (Figure 10.8) were last calculated in the 2003 assessment (Wigley et al. 2003) and reported in the 2005 GARM assessment (NEFSC 2005; Wigley and Col, 2005). These are given in Table 10.2.

The relationship between spawning stock biomass and recruitment for witch flounder over the period covering the 1982-2002 year classes is illustrated in Figure 10.9. The stock-recruitment trajectory indicates the position of the most recent levels of SSB and recruitment on the far-right side of the plot, and illustrates the level of the 2002 year class that was produced from the 1999 spawning stock biomass. The solid horizontal line indicates arithmetic mean recruitment over the same period. Witch flounder exhibit a negative stock-recruitment relationship where low recruitment is associated with high stock biomass. This atypical relationship is seen in other flatfish stocks. Survival ratios, recruits per unit of spawning biomass (Figure 10.10) illustrate the relatively low survival of recent year classes.

MSY-based reference points were updated in the 2003 assessment (Wigley et al. 2003), using the same method as the Working Group on Re-Evaluation Biological Reference Points for New England Groundfish (NEFSC 2002) which utilized yield and spawning stock biomass per recruit analyses and the arithmetic mean of age 3 recruitment. These updated reference points are given in Table 10.2.

Summary

Witch flounder spawning stock biomass has increased since the mid 1990s from 3,901 mt in 1996 to 21,175 mt in 2004; the stock is currently slightly below SSB_{MSY} (25,248 mt). Fully recruited fishing mortality declined from 1.1 in 1996 to 0.20 in 2004, indicating that F is at or just below all the F reference points ($F_{0.1}$ = 0.196; F_{msy} = 0.23; F_{max} = 0.545). Thus, the stock is not in an overfished condition and overfishing did not occur in 2004.

Table 10.1 Recreational and commercial catch of witch flounder (thousand metric tons).

Category	1986-95 Average	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
U. S. Recreational	-	-	-	-	-	-	-	-	-	-	-
Commercial											
U.S. Landings	2.6	2.1	1.8	1.8	2.1	2.4	3.0	3.2	3.1	2.9	2.6
U.S. Discards	0.2	0.2	0.3	0.3	0.2	0.1	0.2	0.3	0.4	0.2	n/a
Canada	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-
Other	-	-	-	-	-	-	-	-	-	-	-
Total Nominal Catch	2.8	2.3	2.1	2.1	2.3	2.5	3.2	3.5	3.5	3.1	2.6

Table 10.2 Yield and SSB per Recruit and MSY based reference points for witch flounder.

Yield and SSB per Recruit-based Reference Points

$F_{0.1}$ = 0.196
F_{max} = 0.545
$F_{40\%}$ = 0.23

MSY-based Reference Points

MSY = 4,375 mt
SSB_{msy} = 25,248 mt
F_{MSY} = 0.23

For further information

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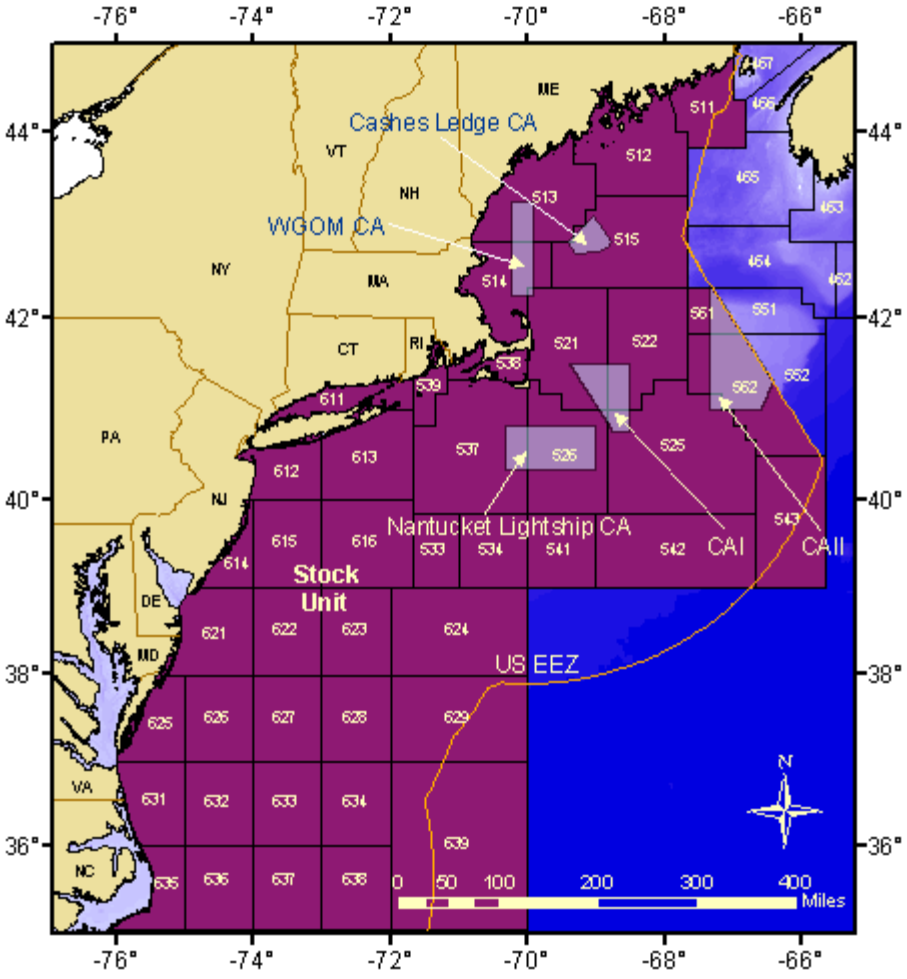

Figure 10.1. Statistical areas used to define the witch flounder stock.

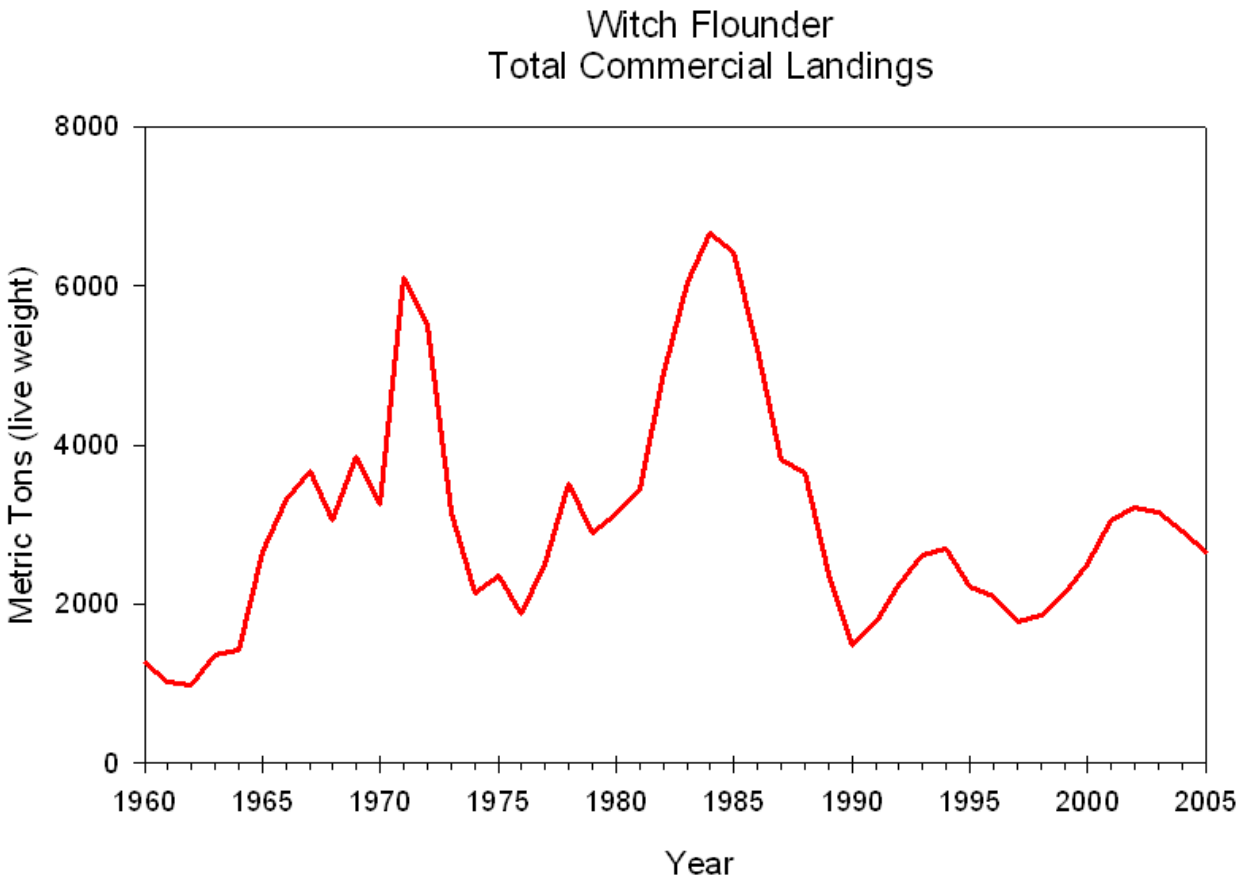

Figure 10.2. Total commercial landings of witch flounder, 1960 - 2005.

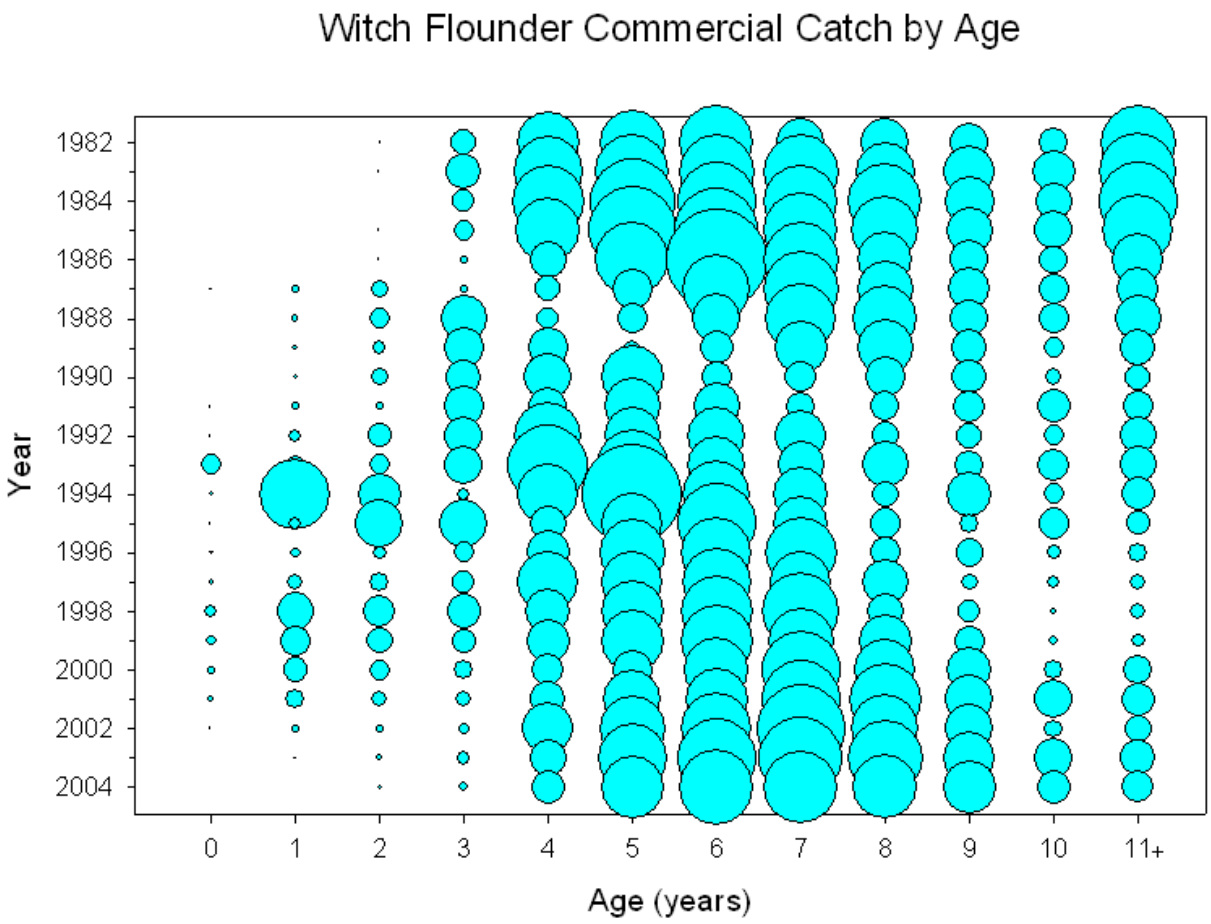

Figure 10.3. Age structure of the commercial witch flounder catch, 1982-2004.

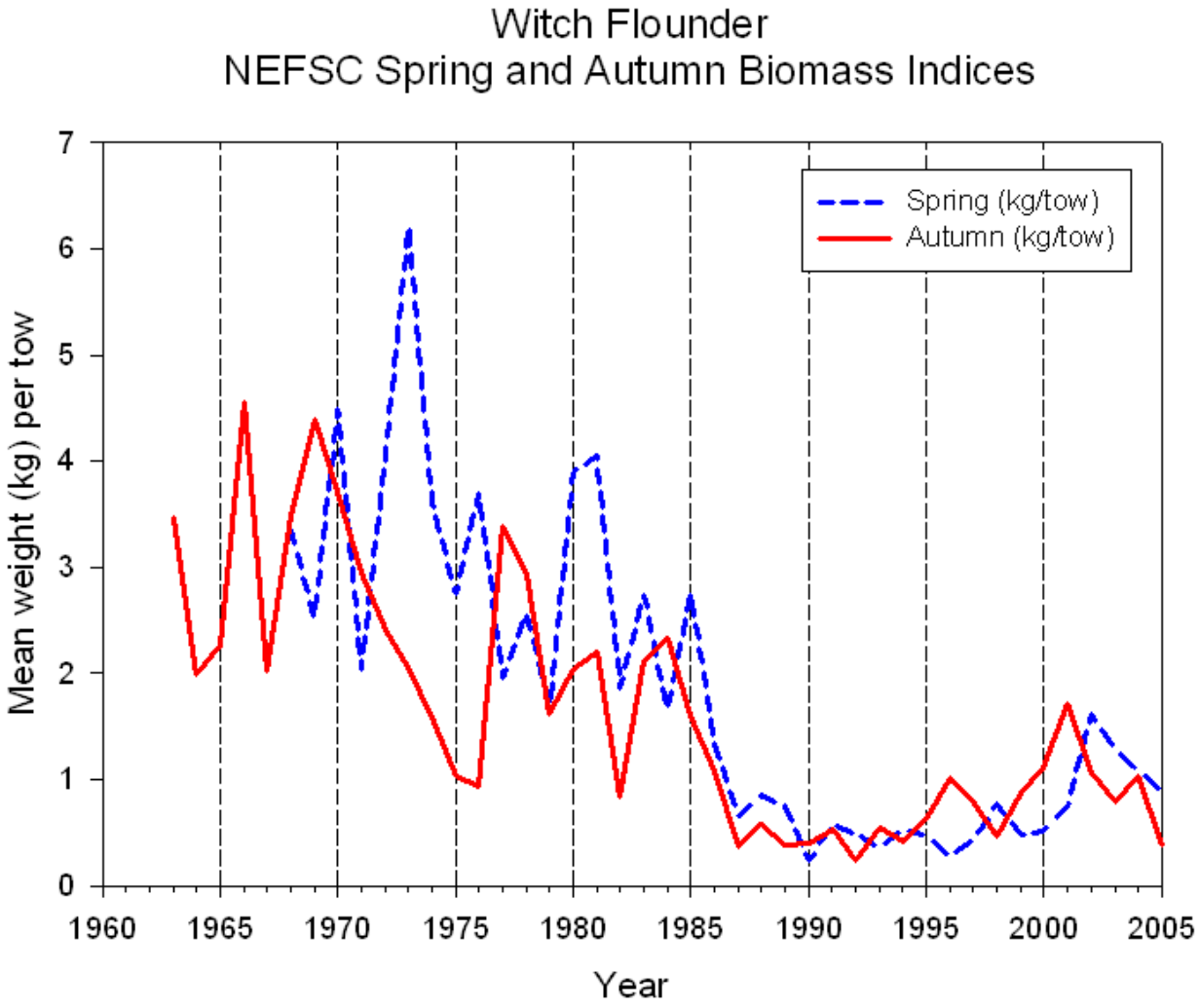

Figure 10.4. Biomass indices (stratified mean weight per tow) of witch flounder from NEFSC research vessel surveys.

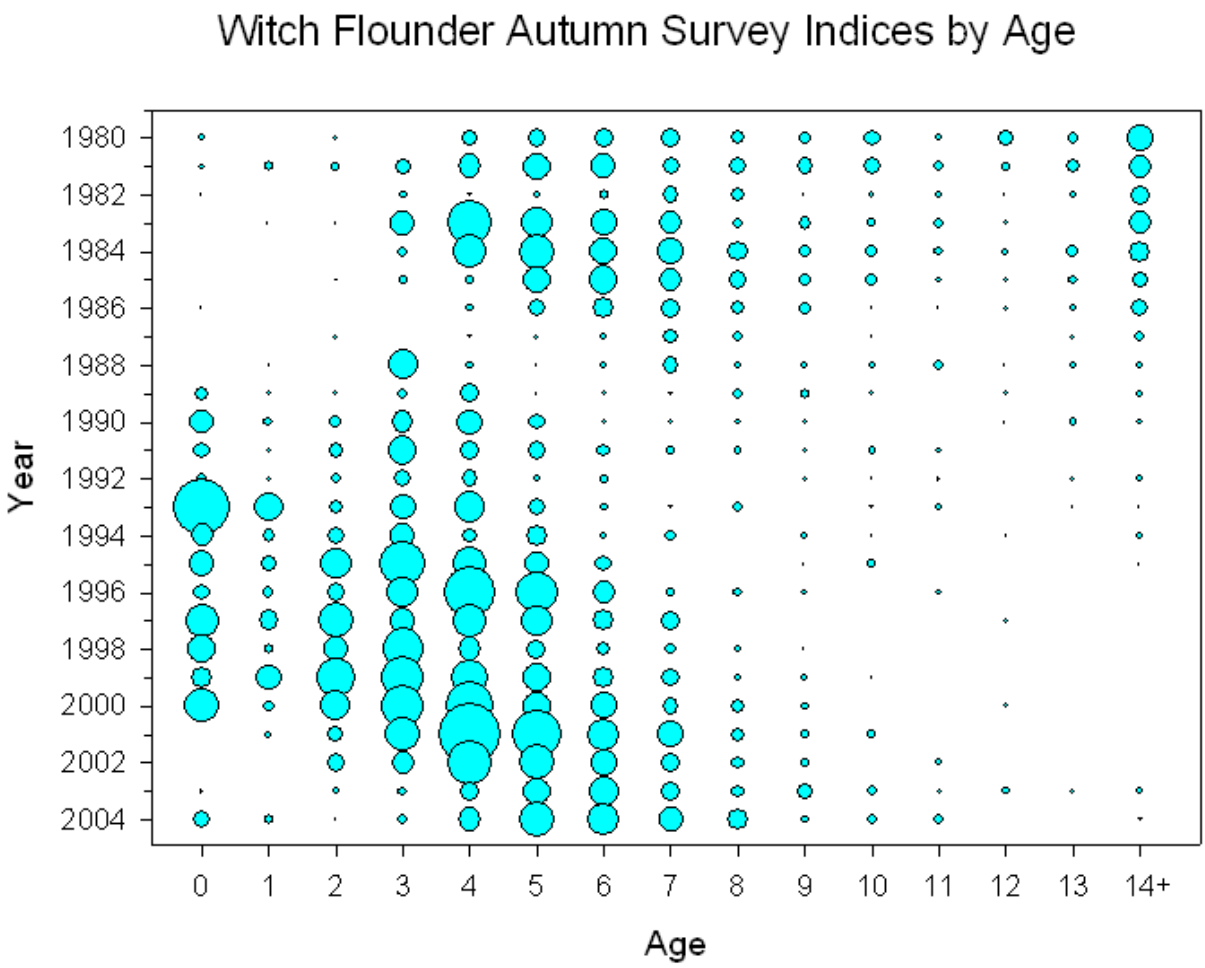

Figure 10.5. Age structure of the witch flounder population, 1980-2004.

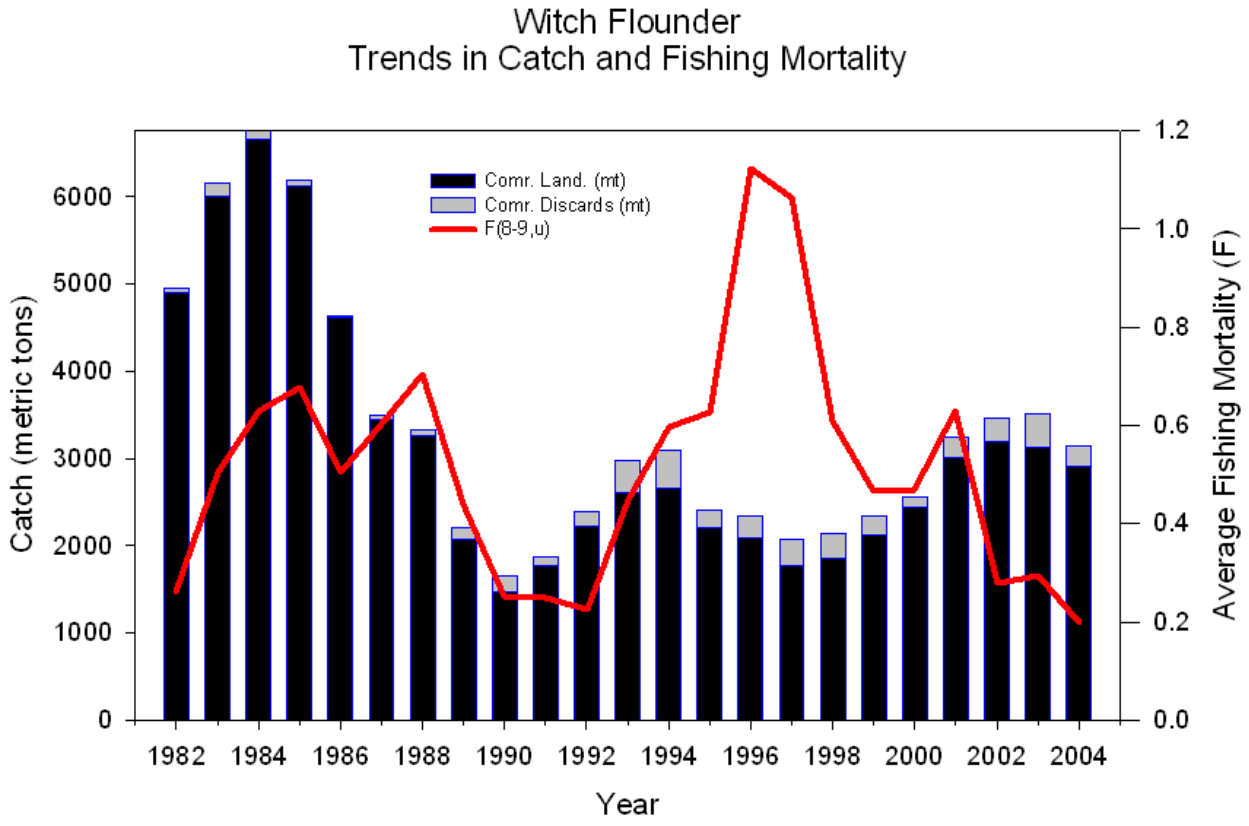

Figure 10.6. Trends in catch and fishing mortality for witch flounder, 1982 - 2004.

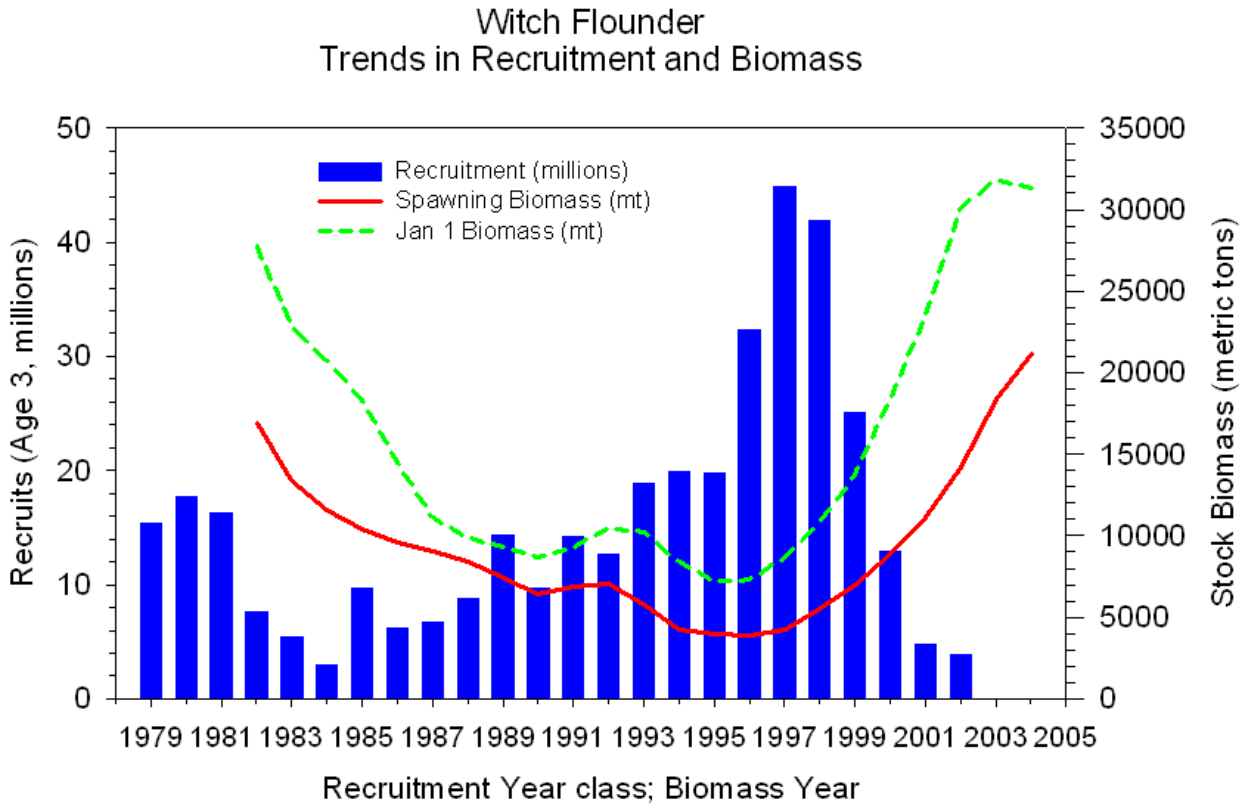

Figure 10.7. Trends in recruitment (age 3) and biomass for witch flounder.

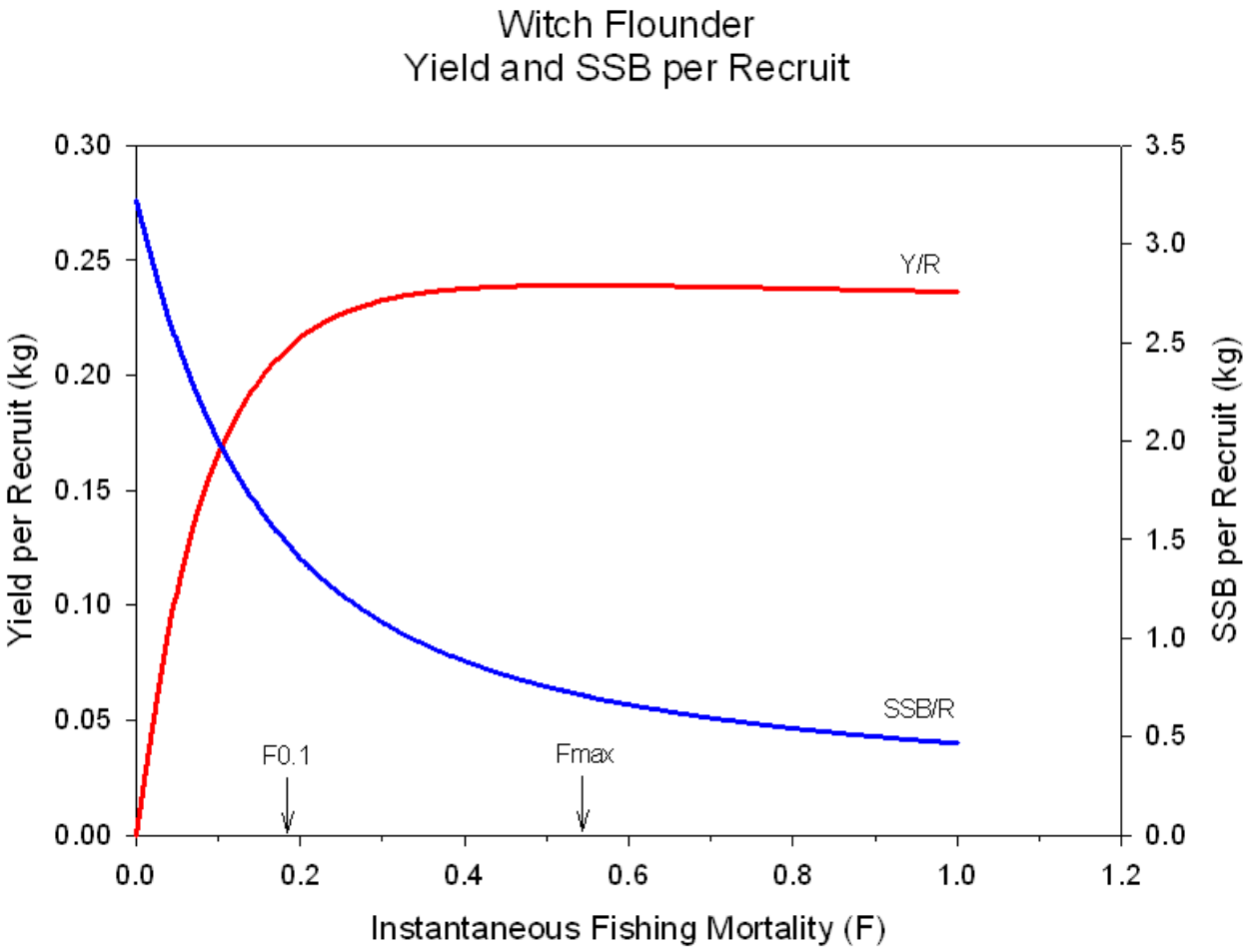

Figure 10.8. Yield and SSB per recruit results for witch flounder.

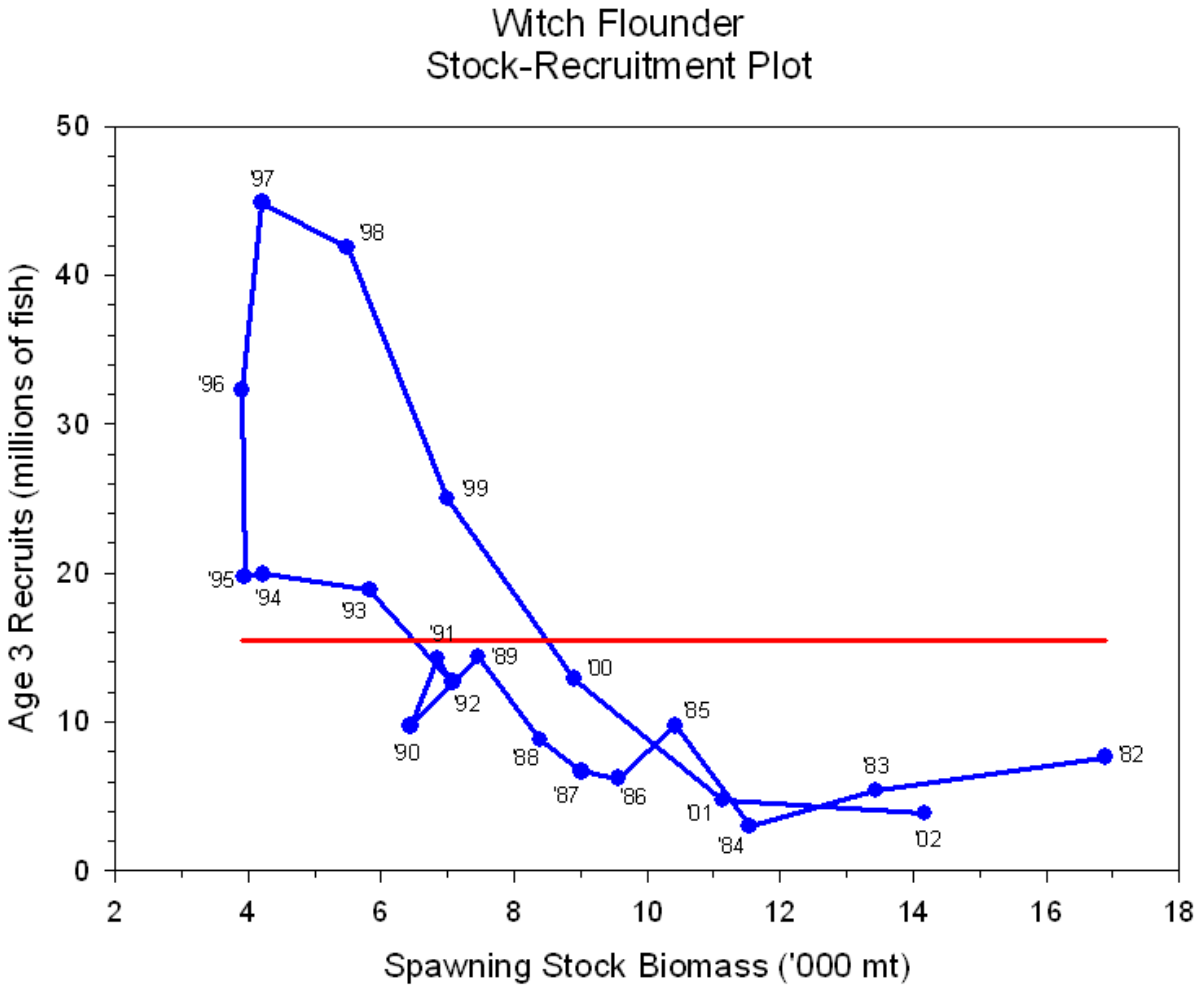

Figure 10.9. Spawning stock-recruitment scatterplot for witch flounder. The horizontal line represents the arithmetic mean recruitment.

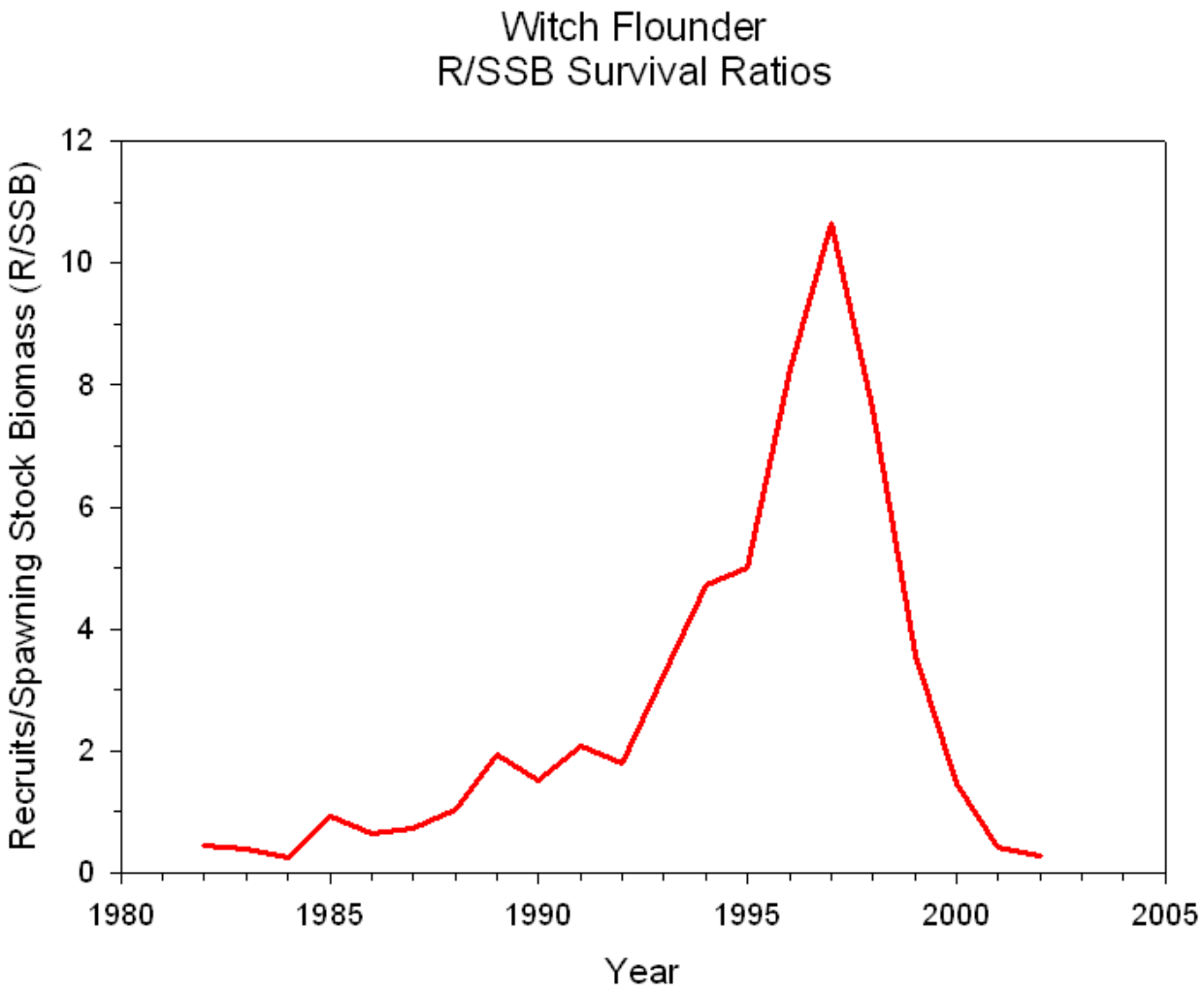

Figure 10.10. Trends in survival ratios (R/SSB) for witch flounder.