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Skates

by

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Distribution, Biology and Management

Skates, Family Rajidae, are distributed throughout the Northwest Atlantic from near the tide line to depths exceeding 700 m (383 fathoms; Bigelow and Schroeder 1953; McEachran 2002). Members of this family lay eggs that are enclosed in a hard, leathery case commonly called a mermaid's purse. Incubation time is at least 6 to 12 months, with the young having the adult form at the time of hatching. There are seven species of skates occurring along the North Atlantic coast of the United States (McEachran and Musick 1975): barndoor skate (*Dipturus laevis*), clearnose skate (*Raja eglanteria*), little skate (*Leucoraja erinacea*), rosette skate (*L. garmani*), smooth skate (*Malacoraja senta*), thorny skate (*Amblyraja radiata*), and winter skate (*L. ocellata*).

The center of distribution for barndoor skates is Georges Bank and Southern New England (Figure 27.1), with some animals occasionally found in the Gulf of Maine and on the Scotian Shelf. Clearnose skates are a southern species, occurring primarily in the inshore Middle Atlantic and inshore Southern New England (Figure 27.2). Little skate are found in all areas but primarily Georges Bank and Southern New England (Figure 27.3). Rosette skates are a southern species, occurring primarily in deep waters in the Middle Atlantic, Southern New England, and occasionally off Georges Bank (Figure 27.4). Smooth and thorny skates are most commonly found in the Gulf of Maine (Figure 27.5, Figure 27.6). The center of distribution for winter skate is Georges Bank and Southern New England (Figure 27.7), with some animals occasionally found in the Gulf of Maine, on the Scotian Shelf, and in the Mid-Atlantic. Skates are not known to undertake large-scale migrations, but move seasonally in response to changes in water temperature, generally offshore in summer and early autumn and vice-versa during winter and spring.

Barndoor skate is a large-bodied species reaching sizes of 150 cm (Bigelow and Schroeder 1953) and ages of more than 10 (Gedamke et al. 2005). Males reach sexual maturity at age 6 at a size of 108 cm, while females attain maturity at age 6.5 and 116 cm. Clearnose skate are smaller

reaching sizes of 90 cm and live to be around 8 years old (Gelsleichter 1998). Size at first maturity is 56 cm for males and 66-73 cm for females (Sosebee 2005). Little skate is the second smallest skate species reaching sizes around 54 cm (McEachran 2002) and maximum ages between 8 and 12 (Waring 1984; Frisk 2004; Frisk and Miller 2006). Size at first maturity is reached at 39 cm for males and 40-42 cm for females (Sosebee 2005). Rosette skate is the smallest of the seven species and reaches a maximum size of 45-50 cm (McEachran 2002). Sexual maturity occurs at 33 cm for males and 33-35 cm for females (Sosebee 2005). Smooth skate reach a slightly larger size of around 58 cm (McEachran 2002) and size at first maturity occurs at 50 cm for males and 33-48 cm for females (Sosebee 2005). Thorny skate is a large-bodied species with a maximum size of 102 (McEachran 2002) and can live to be age 16 and older (Sulikowski et al. 2005a). Sexual maturity appears to occur over a broad size range (Sosebee 2005) with most mature animals over 80 cm (Sulikowski et al. 2005b). Winter skate are large-bodied as well potentially reaching sizes of 150 cm (McEachran 2002) and ages of about 20 years (Sulikowski et al. 2003; Frisk 2004). Sexual maturity is reached at a large size of around 74 cm at about age 12 (Sulikowski et al. 2004; Frisk 2004; Frisk and Miller 2006).

The principal commercial fishing method used to catch skates is otter trawling (NEFSC 2000). Skates are frequently taken as bycatch during groundfishing operations and discarded. Recreational and foreign landings are insignificant. Skates are currently managed under the New England Fishery Management Council's Skate Fishery Management Plan implemented in 2003. This plan includes mandatory reporting by species, possession prohibitions on barndoor, thorny, and smooth skates, trip limits for winter skate, and a suite of measures in other fisheries management plans to aid in the recovery of the overfished skate species. The information provided herein reflects the results of the most recent peer-reviewed assessments for the skate complex (NEFSC 2007).

The Fishery

Skates have been reported in New England fishery landings since the late 1800s. However, landings (primarily from off Rhode Island) never exceeded more than a few hundred metric tons until the advent of industrial fishery in Southern New England in the 1950s followed by the distant-water fleets during the 1960s. Commercial landings peaked in 1969 at 9,500 mt and again in 1972 at 8,800 mt, declined quickly during the early and mid-1970s, and fell to a low of 500 mt in 1981 (Table 27.1; Figure 27.8). Reported landings have since increased substantially, partially in response to increased demand for lobster bait and to increased export markets for skate wings, but also due to improved statistical data collection. Wings are taken from winter and thorny skates, the two species currently known to be used for human consumption. Bait landings appear to be primarily from little skate, based on areas fished and known species distribution patterns. Landings increased to 12,900 mt in 1993, declined somewhat to 7,200 mt in 1995, and subsequently rose sharply to average 13,000 mt during 1996-1998. Landings have since continued to increase and are now averaging around 15,000 mt.

Research Vessel Survey Indices

NEFSC spring survey biomass indices for these seven skate species as a group indicate that the skate complex is presently at a medium level of biomass (Figure 27.9). NEFSC spring survey

biomass indices were relatively stable from 1968 to 1980, increased to peak levels in the 1980s, and then declined steadily until 1994. Subsequently, the indices increased through 1999 and have since slightly decreased. The large increase in biomass in the early to mid-1980s was dominated by winter and little skate. Biomass indices of the large-sized skates (barndoor, winter, and thorny) declined from the mid-1980s to the mid-1990s (Figure 27.10), and have since been stable. Biomass indices of the smaller skates (little, clearnose, rosette, and smooth, mainly little skate) increased from 1980 through the mid-1990s (Figure 27.10) but have declined from 1999 onwards.

Biological Reference Points

Biomass reference points are based entirely on NEFSC survey data since reliable landings and discard information are not available by species. For all species but barndoor, the B_{msy} proxy is defined as the 75th percentile of the appropriate survey biomass index time series for that species (Table 27.2). For barndoor skate, the B_{msy} proxy is the average of 1963-1966 autumn survey biomass indices since the survey did not catch barndoor for a protracted period.

The fishing mortality reference points are based on changes in survey biomass indices. If the three-year moving average of the survey biomass index for a skate species declines by more than the average CV of the survey time series, then fishing mortality is assumed to be greater than F_{msy} and overfishing is occurring for that skate species. The average CVs of the indices are given by species in Table 27.2.

Barndoor Skate

NEFSC autumn survey biomass indices of barndoor skate declined continuously through the 1960s, and reached historic lows during the early 1980s (Figure 27.11). Since 1990, the biomass index increased on Georges Bank, the western Scotian Shelf, and off Southern New England. However, the 2005 index is still less than 50% of the peak observed in 1963. The 2003-2005 average survey biomass index of 0.96 kg/tow is above 50% of the B_{msy} proxy ($1/2 B_{msy} = 0.81$ kg/tow), which is the biomass threshold reference point. Thus, barndoor skate is not overfished, but is not yet rebuilt to B_{msy} . Since the 2003-2005 average index is higher than the previous 3-year average index (2002-2004) of 0.88, overfishing is not occurring.

Clearnose Skate

NEFSC autumn survey biomass indices increased from the mid 1980s to 2000 (Figure 27.12), but have since declined. The 2003-2005 average biomass index of 0.63 kg/tow is above both the biomass threshold reference point (0.28 kg/tow) and the B_{msy} proxy (0.56 kg/tow), and hence the species is not overfished. The 2003-2005 index is lower than the 2002-2004 index of 0.75 by 16% but not by 30% (the average CV), and therefore overfishing is not occurring.

Little Skate

NEFSC spring survey indices of little skate biomass increased in the early 1980s to 1999 but have since decreased (Figure 27.13). The 2004-2006 average biomass index of 4.59 kg/tow is

above the biomass threshold reference point (3.27 kg/tow), and thus the species is not overfished. The 2004-2006 index is lower than the 2003-2005 index of 5.65 by 19%, but overfishing is not occurring as this decline is slightly less than 20%.

Rosette Skate

NEFSC autumn survey biomass indices of rosette skate have been increasing since 1986 (Figure 27.14). The 2003-2005 average biomass index of 0.049 kg/tow is above both the biomass threshold reference point (0.015 kg/tow) and the B_{msy} proxy (0.029 kg/tow), and thus the species is not overfished. The 2003-2005 index is above the 2002-2004 index of 0.045, and therefore overfishing is not occurring.

Smooth Skate

NEFSC autumn survey biomass indices of smooth skate were highest during the early 1960s and late 1970s (Figure 27.15), but have been stable at a lower level since the mid-1980s. The 2003-2005 average biomass index of 0.178 kg/tow is slightly above the biomass threshold reference point (0.16 kg/tow) and thus the species is not overfished. The 2003-2005 index is above the 2002-2004 index of 0.172, and therefore overfishing is not occurring.

Thorny Skate

NEFSC autumn survey biomass indices of thorny skate have declined since the 1960s and are now at historic lows (Figure 27.16). The biomass is about 10% of the peaks observed in the late 1960s. The 2003-2005 average biomass index of 0.56 kg/tow is well below the biomass threshold reference point (2.20 kg/tow), indicating that the species is in an overfished condition. The 2003-2005 index is lower than the 2002-2004 index by 11%, but overfishing is not occurring as this is less than the reference decline of 20%.

Winter Skate

NEFSC autumn survey biomass indices of winter skate peaked in the mid-1980s, declined through the early 1990s, and have since stabilized at a moderately higher levels (Figure 27.17). The 2003-2005 average biomass index of 3.34 kg/tow is slightly above biomass threshold reference point (3.23 kg/tow), and thus the species is not overfished. The 2003-2005 index is below the 2002-2004 index by 23%, and therefore overfishing is occurring as this change exceeds the 20% reference decline level.

Summary

Of the seven species of skate that occur off the Northeastern United States, one species, thorny skate, remains in an overfished condition, four species (barndoor, winter, smooth, and little) are at biomass levels between the biomass threshold and the B_{msy} proxy, and two species (clearnose and rosette) are at biomass levels that exceed the B_{msy} proxy. For one species, winter skate, overfishing is occurring.

Table 27.1 Recreational catches and commercial landings for skate (thousand metric tons).

Category	1986-95 Average	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
U. S. Recreational	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Commercial											
United States	8.7	14.2	10.9	13.8	11.7	13.4	13.1	13.0	15.0	16.1	13.9
Canada	<0.1	<0.1	<0.1	-	-	-	-	-	-	-	-
Other	<0.1	-	-	-	-	-	-	-	-	-	-
Total Nominal Catch	8.7	14.2	10.9	13.8	11.7	13.4	13.1	13.0	15.0	16.1	13.9

Table 27.2 Summary of MSY-based reference points for skates.

	Barndoor	Clearnose	Little	Rosette	Smooth	Thorney	Winter	
MSY	=			undetermined for all				
B _{MSY} proxy	=	1.62	0.56	6.54	0.029	0.31	4.41	6.46
Biomass Threshold (50% of B _{msy} proxy)	=	0.81	0.28	3.27	0.015	0.16	2.20	3.23
F _{MSY} proxy (average CV of survey)	=	30	30	20	60	30	20	20

For further information

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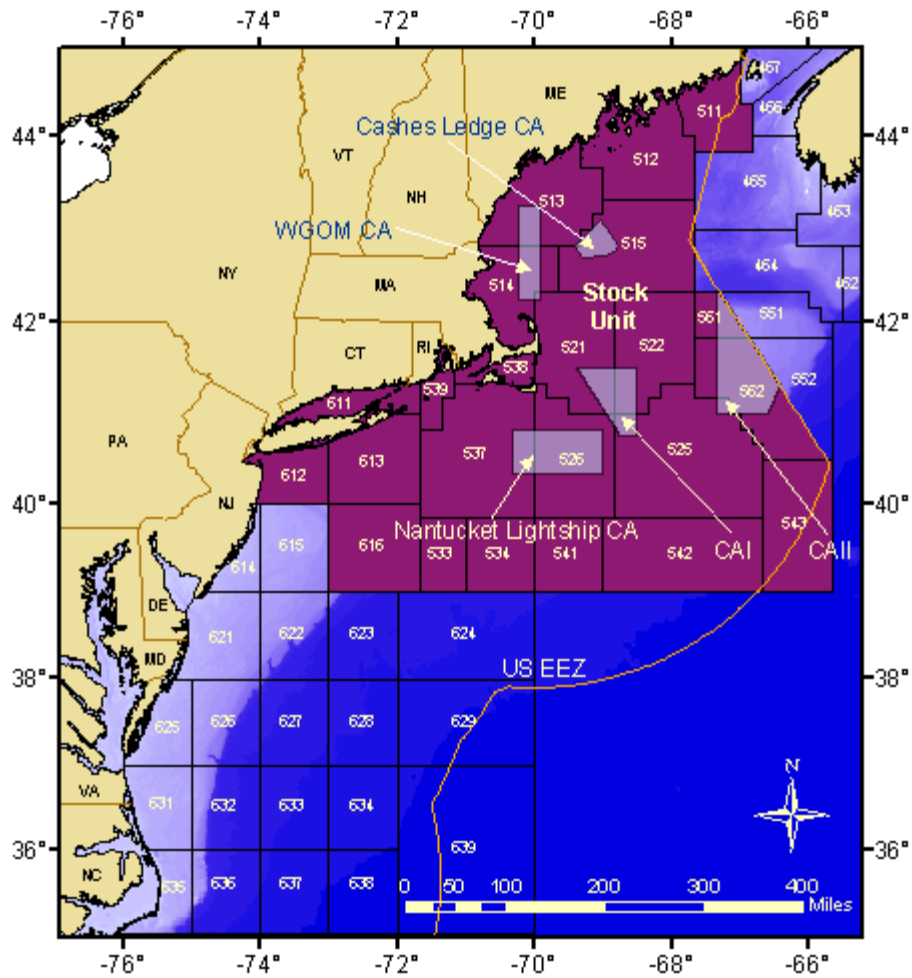


Figure 27.1. Statistical areas used to define the barndoor skate stock.

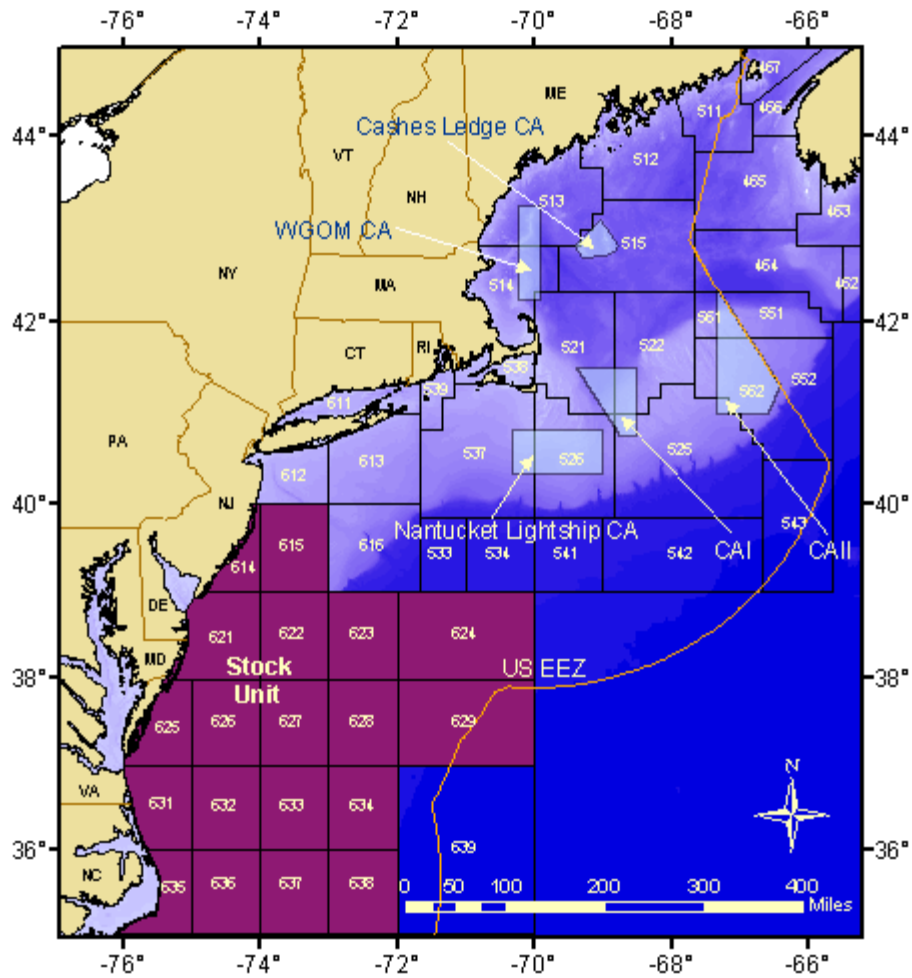


Figure 27.2. Statistical areas used to define the clearnose skate stock.

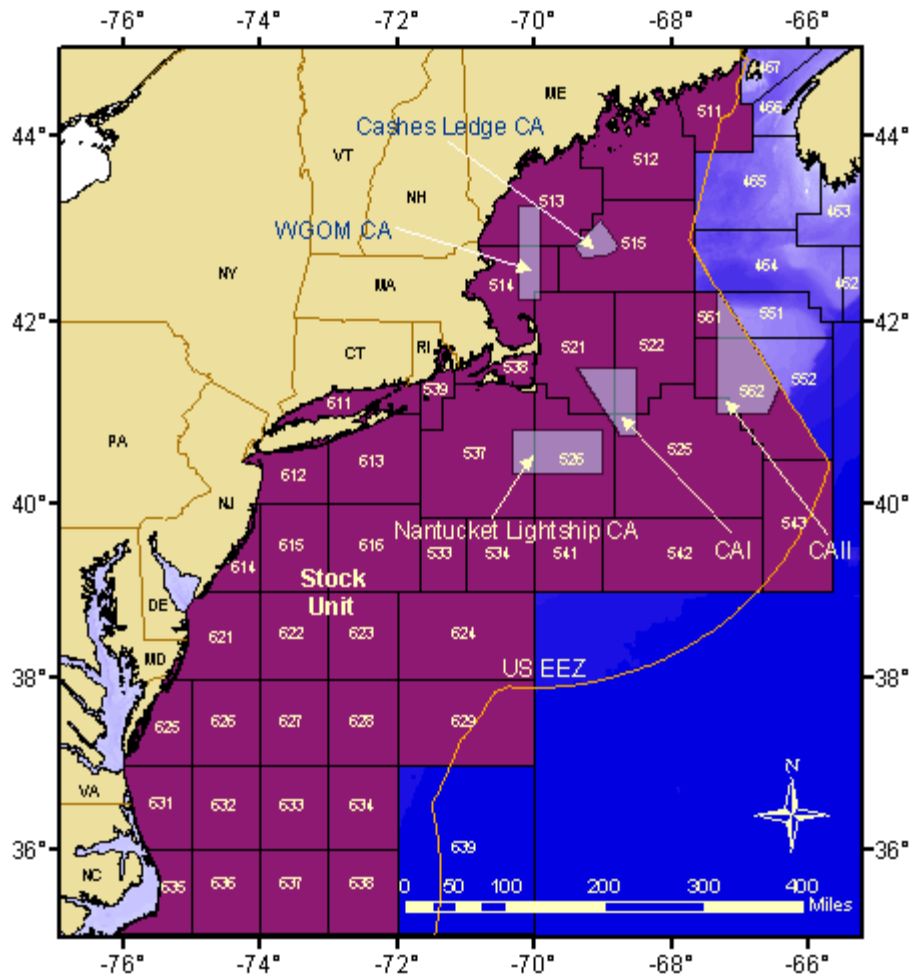


Figure 27.3. Statistical areas used to define the little skate stock.

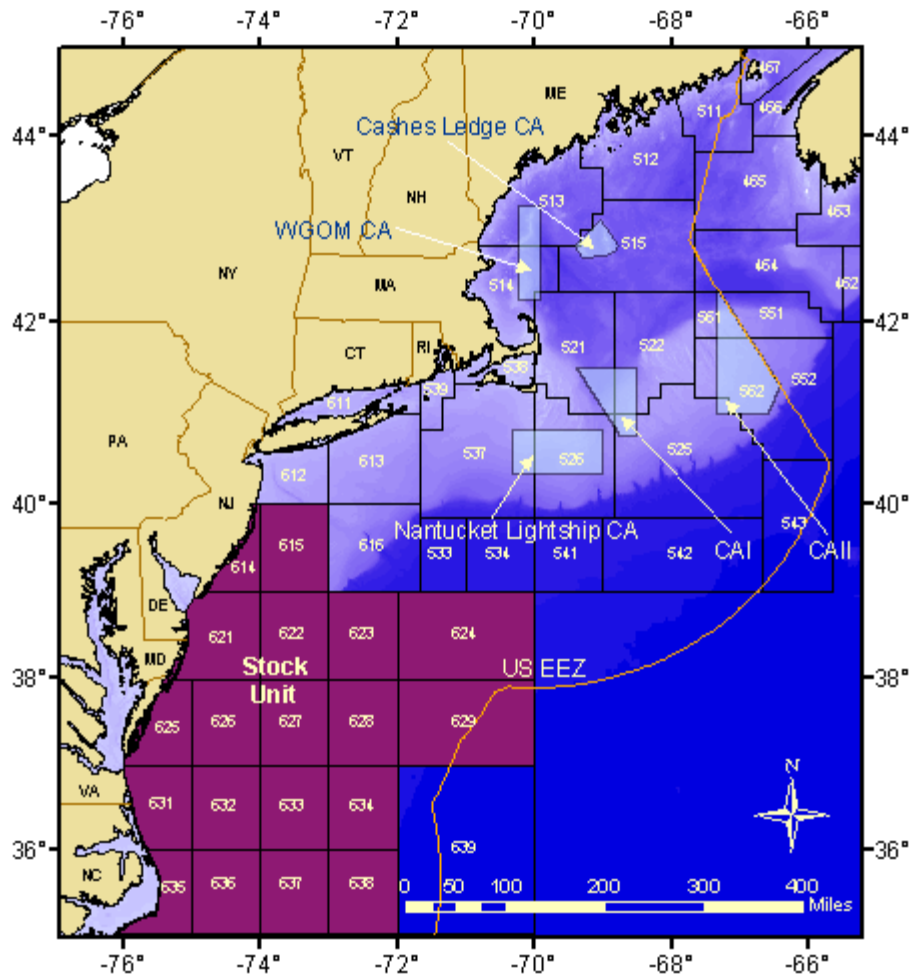


Figure 27.4. Statistical areas used to define the rosette skate stock.

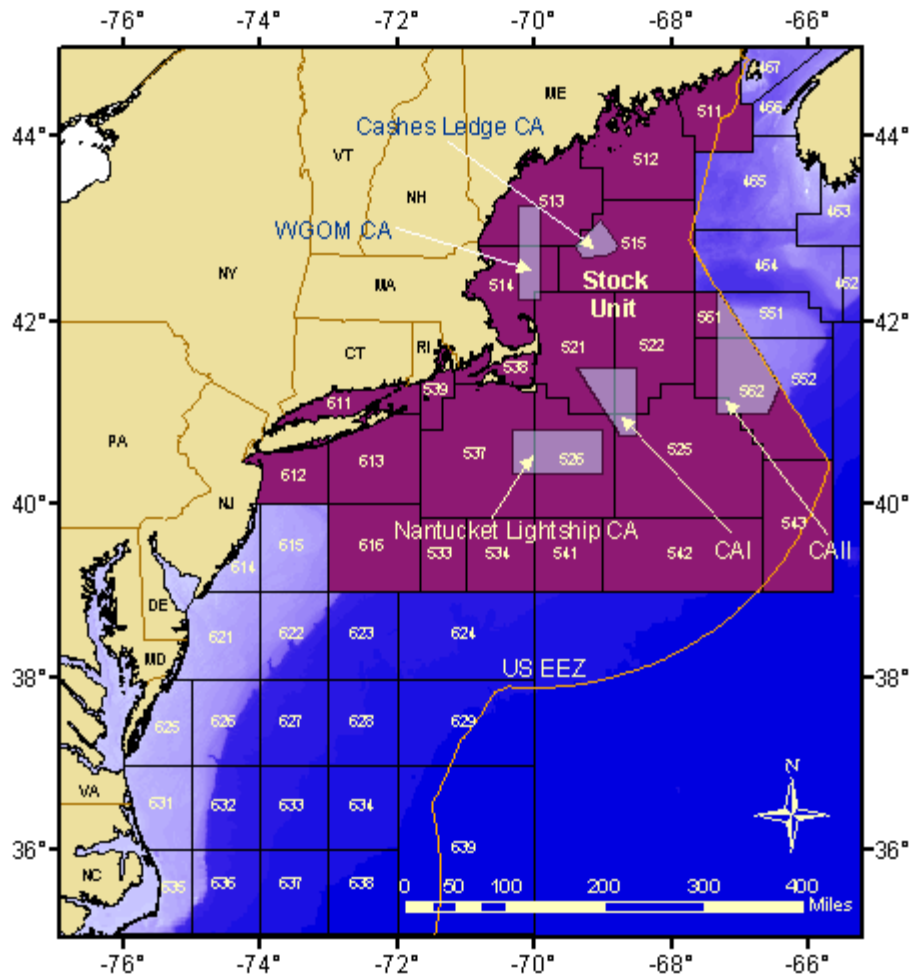


Figure 27.5. Statistical areas used to define the smooth skate stock.

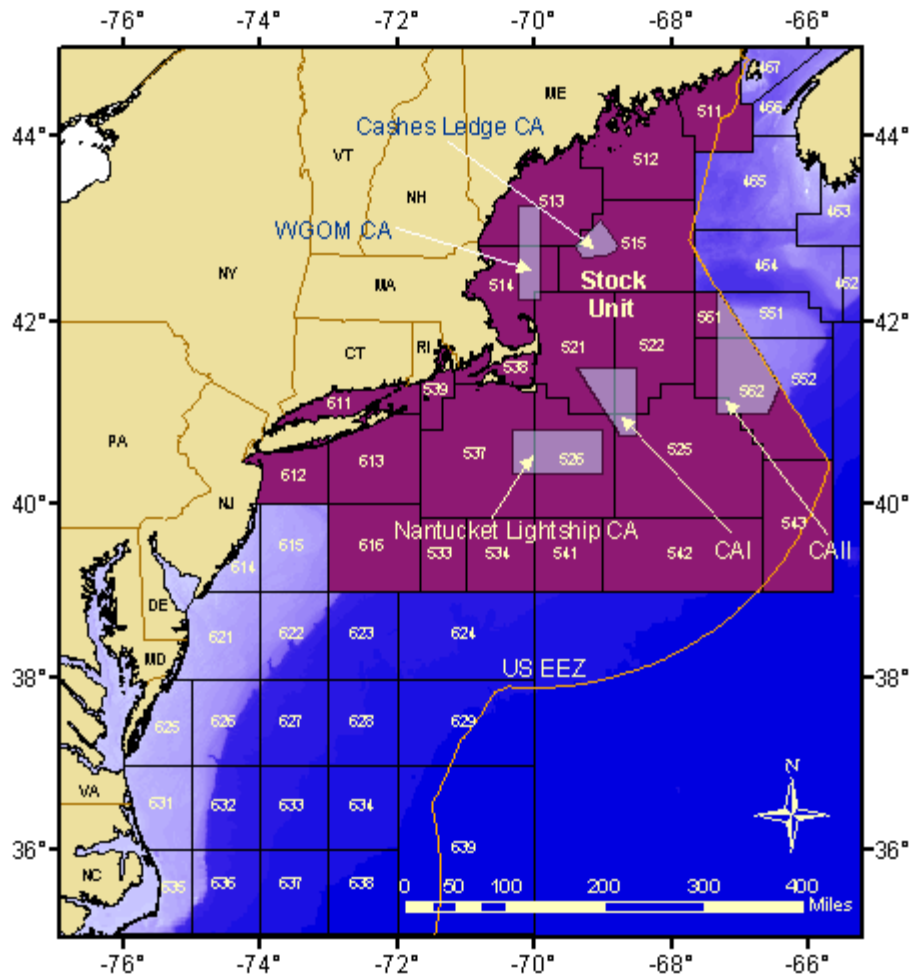


Figure 27.6. Statistical areas used to define the thorny skate stock.

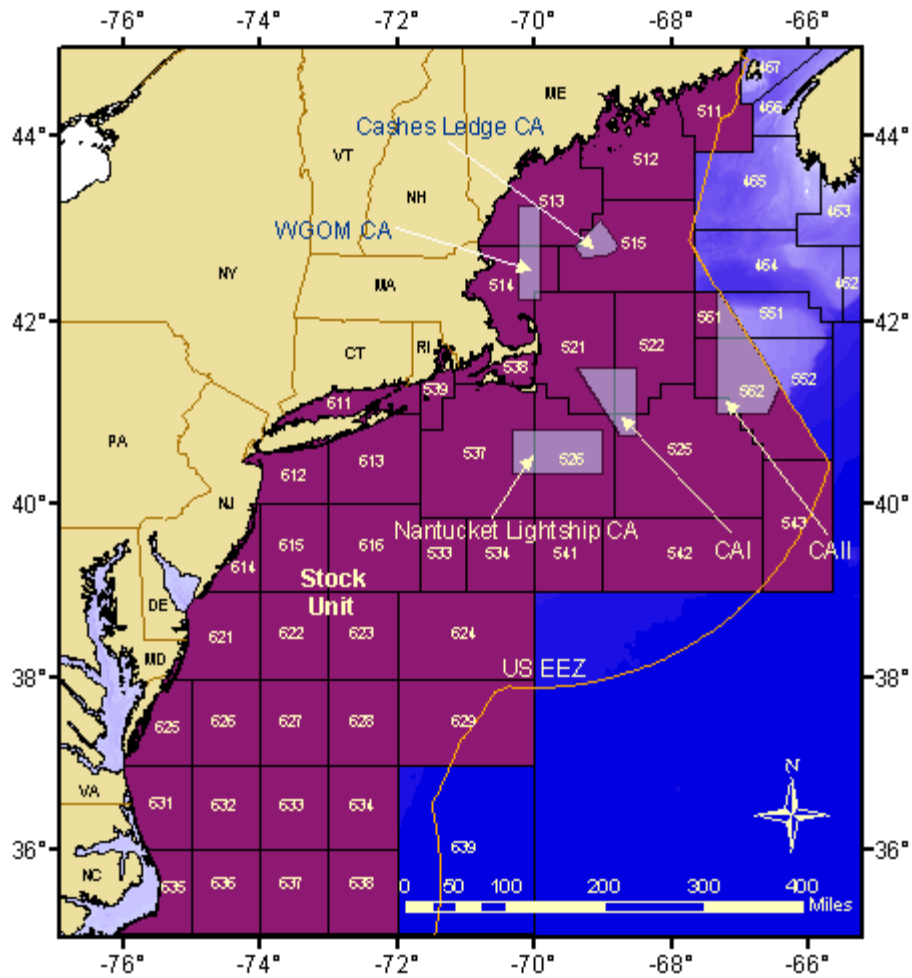


Figure 27.7. Statistical areas used to define the winter skate stock.

Skates Commercial Landings

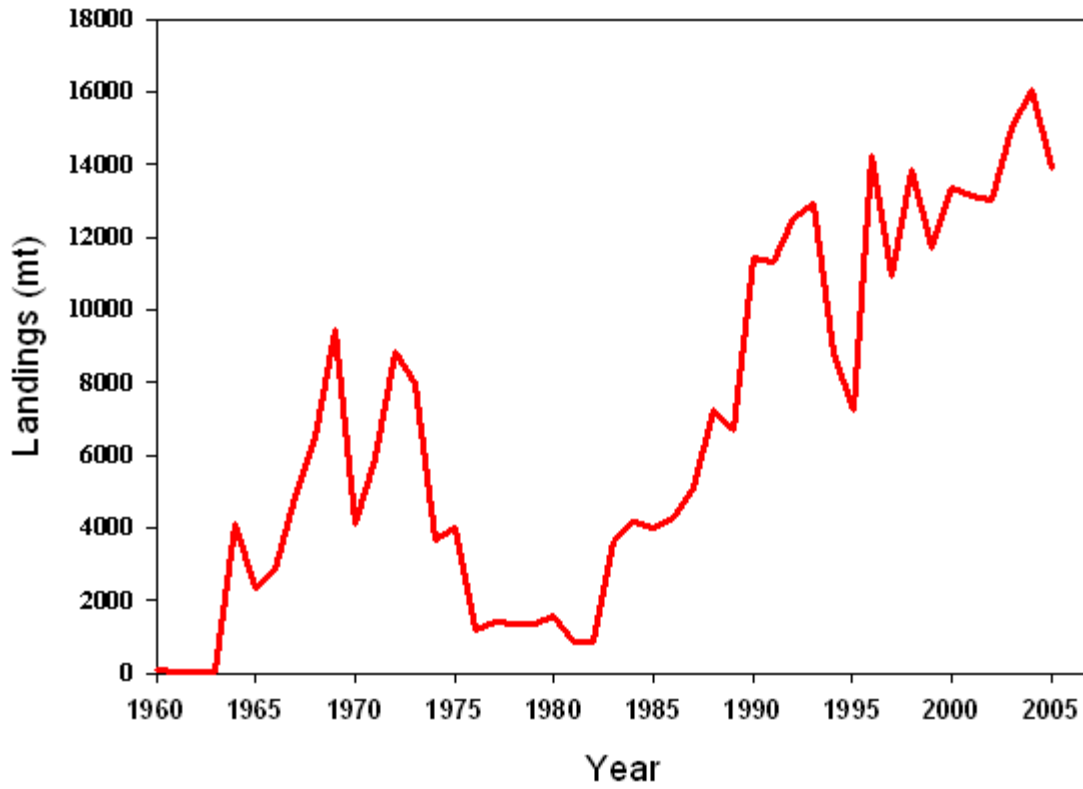


Figure 27.8. Total reported landings of skates in Subareas 5 and 6.

Skates Spring Survey Species Composition

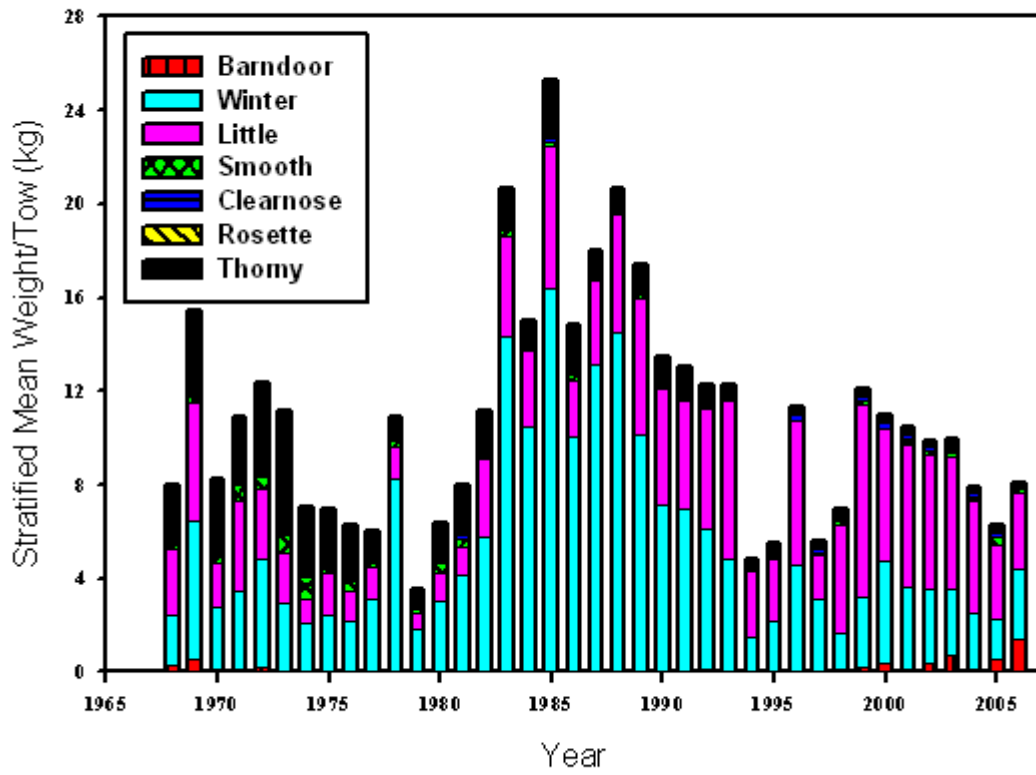


Figure 27.9. Species composition of skates from the spring survey.

Skates Spring Survey Species Composition

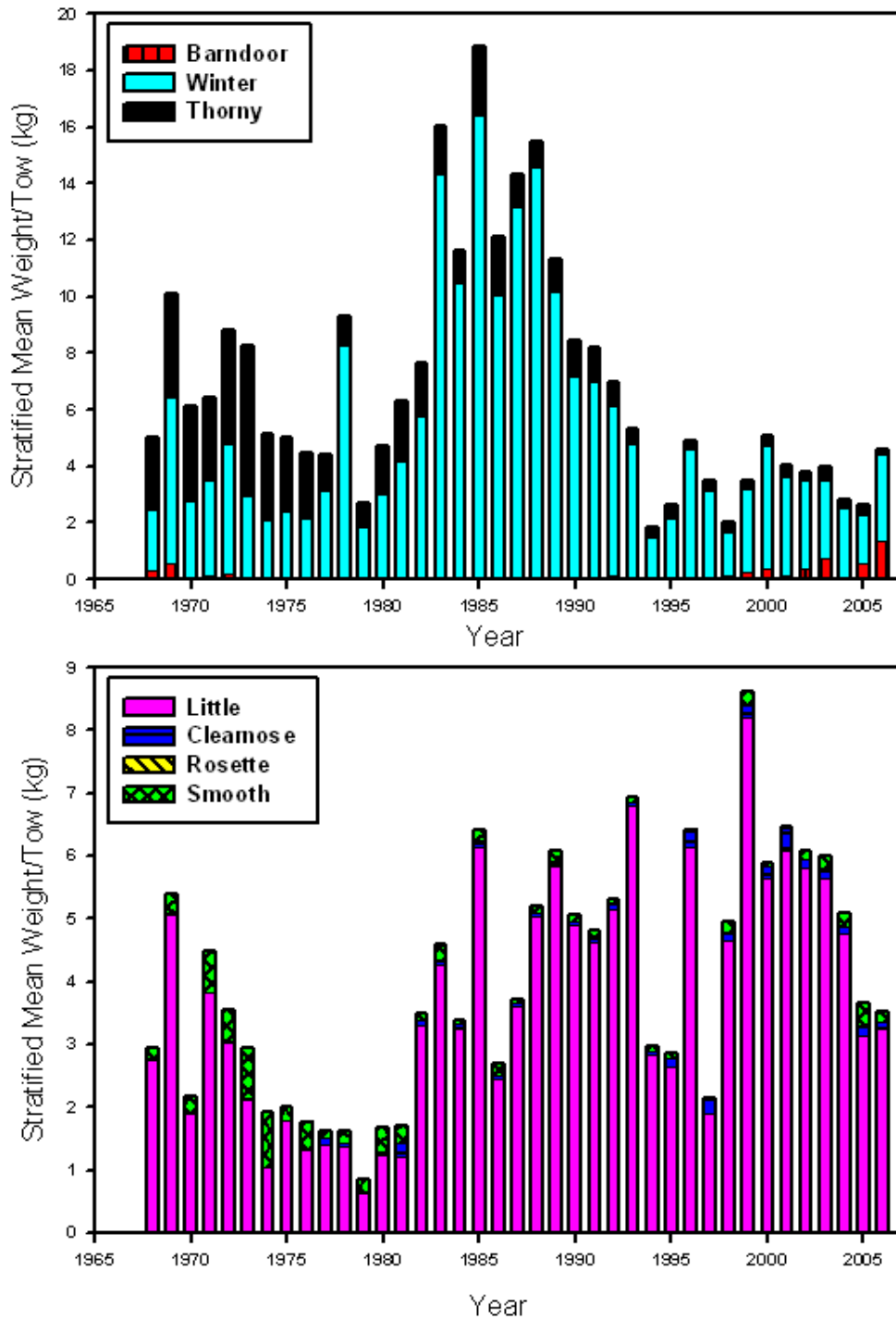


Figure 27.10. Species composition of skates from the spring survey. The top panel shows the composition of large species (>100 cm maximum length) while the bottom panel shows the composition of the small species (maximum length < 100cm).

Barndoor Skate Biomass Indices

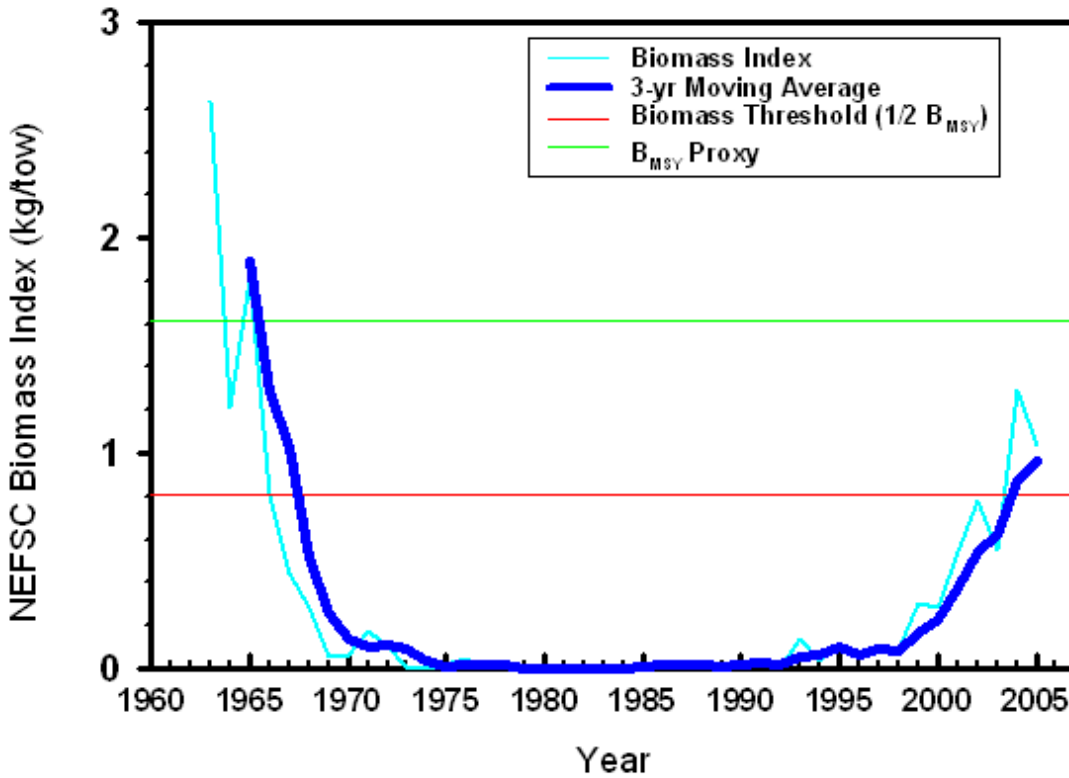


Figure 27.11. NEFSC survey biomass indices (kg/tow) for barndoor skate. Thin blue lines are annual indices, thick lines are 3-year moving averages, the red horizontal line is the biomass threshold, and the green horizontal line is the B_{MSY} proxy.

Clearnose Skate Biomass Indices

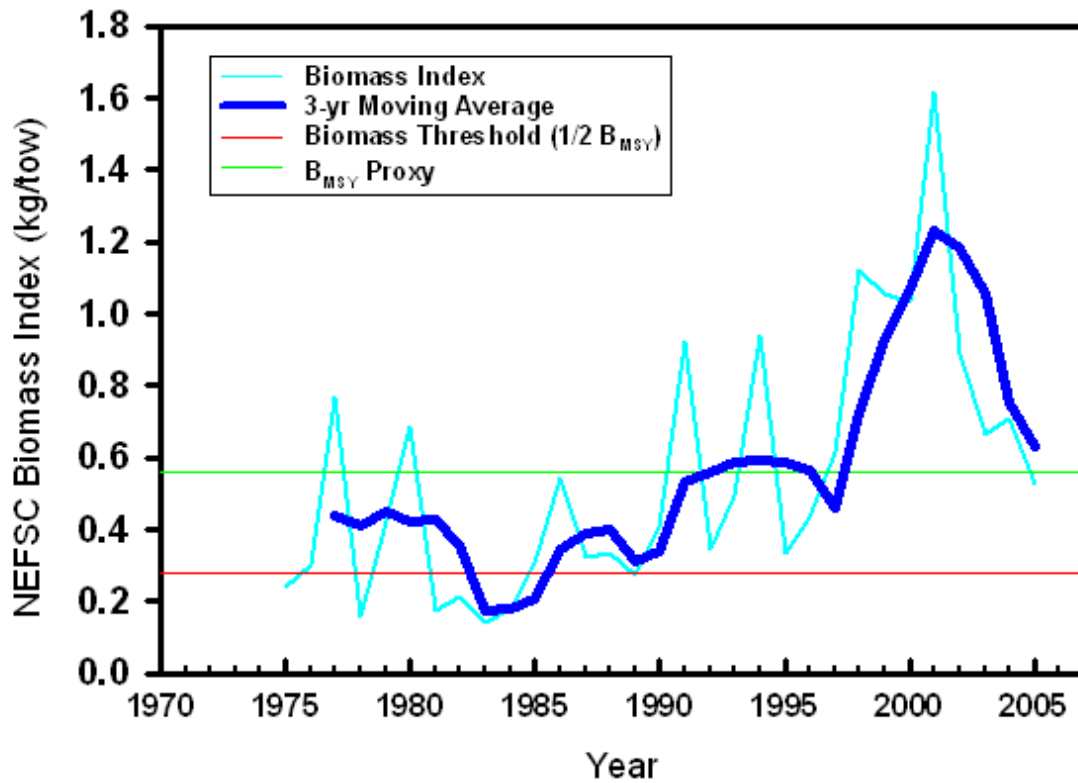


Figure 27.12. NEFSC survey biomass indices (kg/tow) for clearnose skate. Thin blue lines are annual indices, thick lines are 3-year moving averages, the red horizontal line is the biomass threshold and the green horizontal line is the B_{MSY} proxy.

Little Skate Biomass Indices

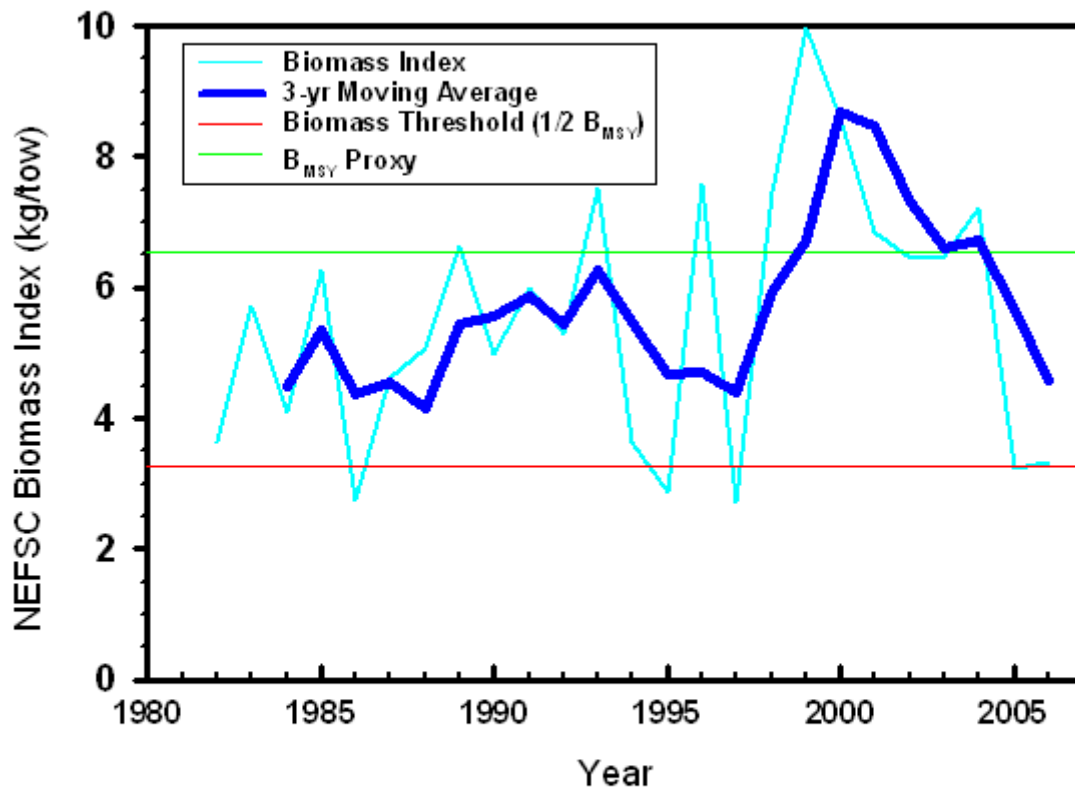


Figure 27.13. NEFSC survey biomass indices (kg/tow) for little skate. Thin blue lines are annual indices, thick lines are 3-year moving averages, the red horizontal line is the biomass threshold, and the green line is the B_{MSY} proxy.

Rosette Skate Biomass Indices

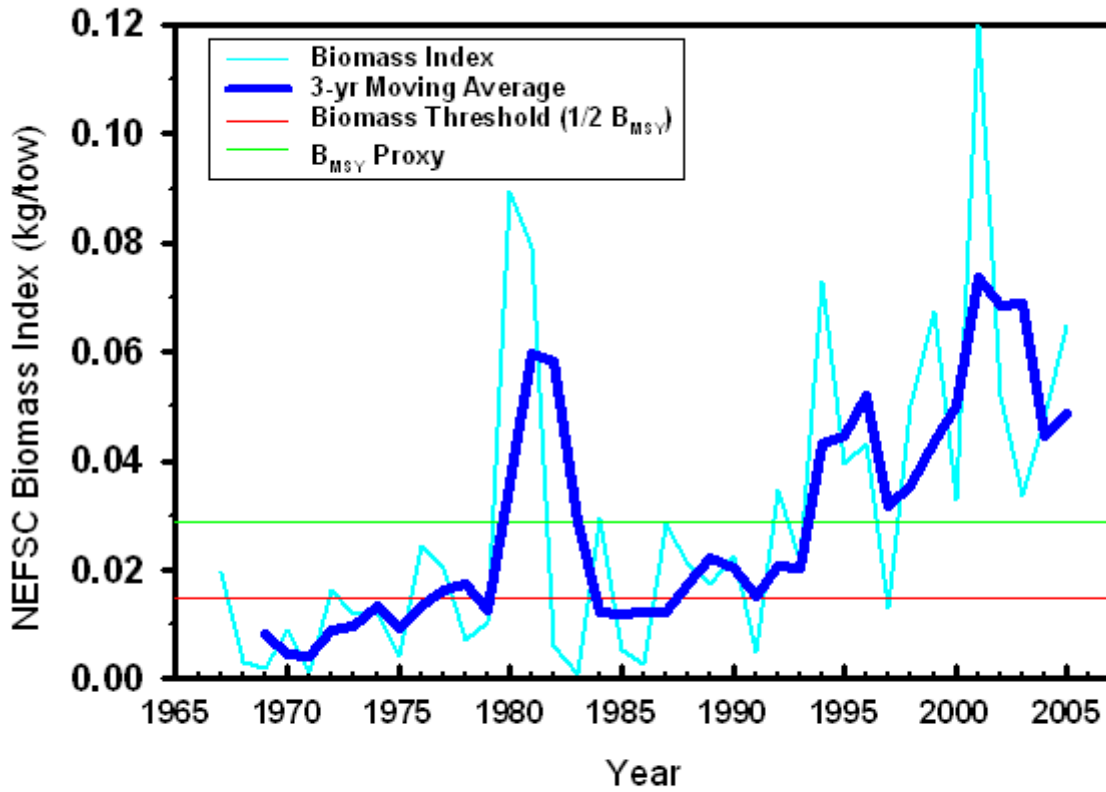


Figure 27.14. NEFSC survey biomass indices (kg/tow) for rosette skate. Thin blue lines are annual indices, thick lines are 3-year moving averages, the red horizontal line is the biomass threshold and the green line is the B_{MSY} proxy.

Smooth Skate Biomass Indices

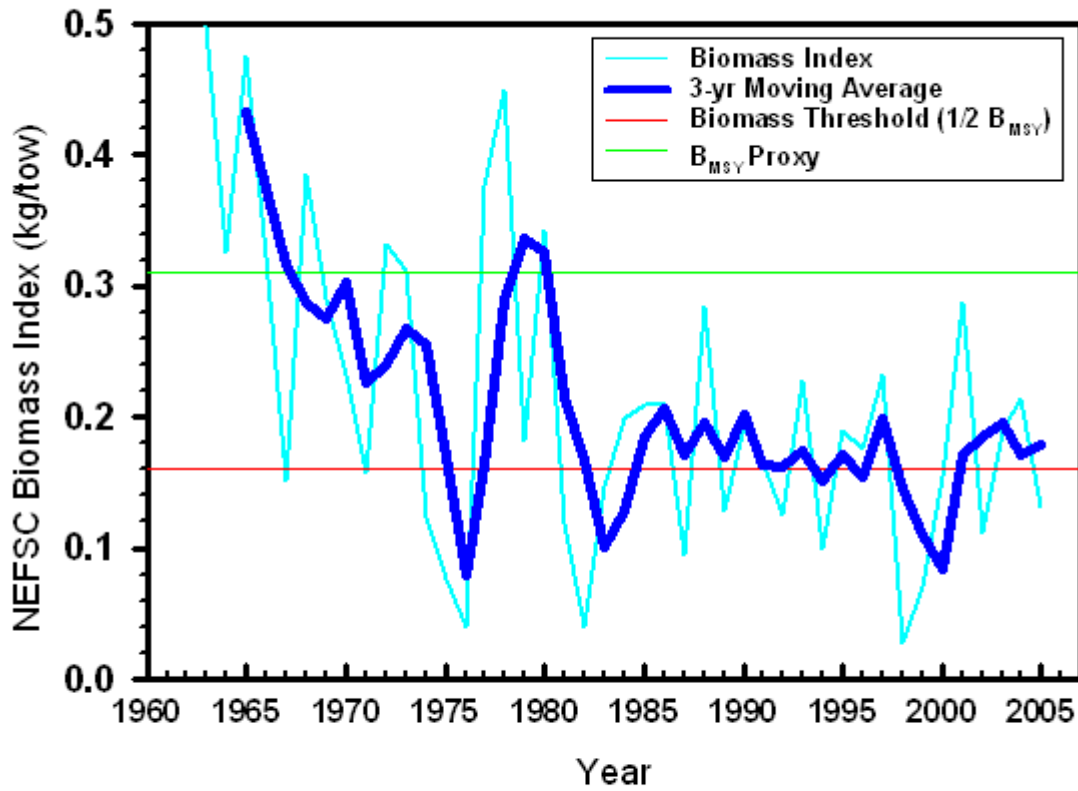


Figure 27.15. NEFSC survey biomass indices (kg/tow) for smooth skate. Thin lines with symbols are annual indices, thick lines are 3-year moving averages, the thin red horizontal line is the biomass threshold and the thin green line is the B_{MSY} proxy.

Thorny Skate Biomass Indices

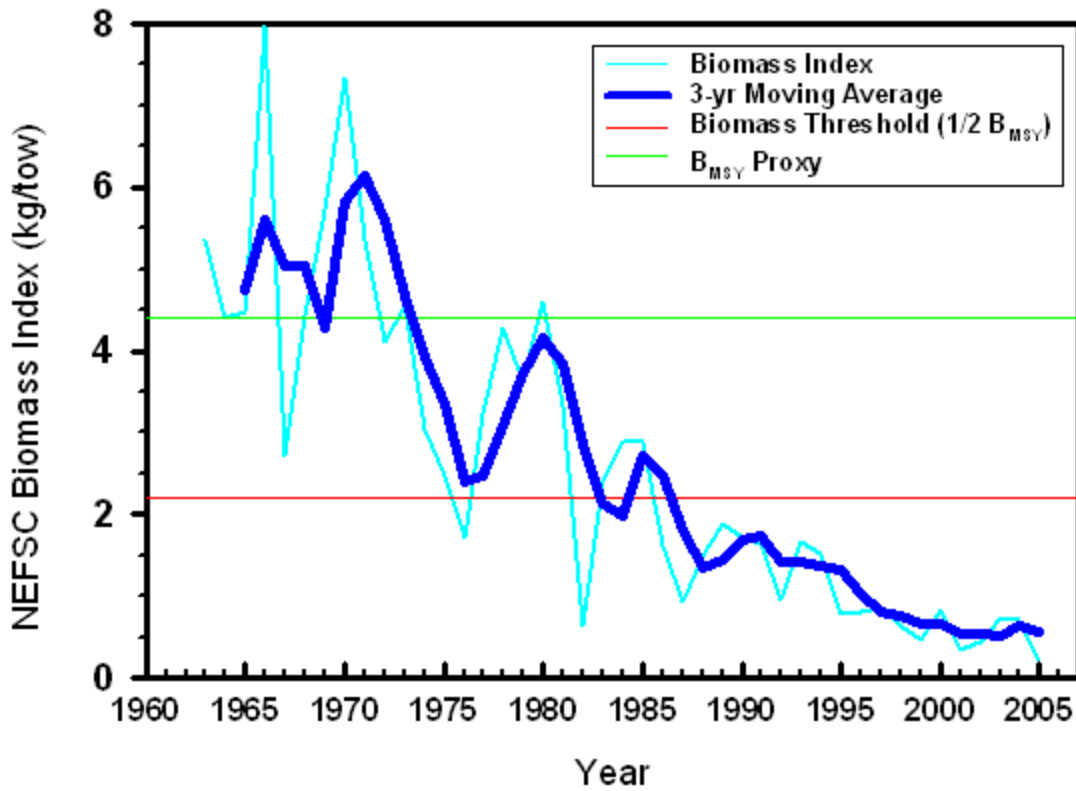


Figure 27.16. NEFSC survey biomass indices (kg/tow) for thorny skate. Thin lines with symbols are annual indices, thick lines are 3-year moving averages, the thin red horizontal line is the biomass threshold and the thin green line is the B_{MSY} proxy.

Winter Skate Biomass Indices

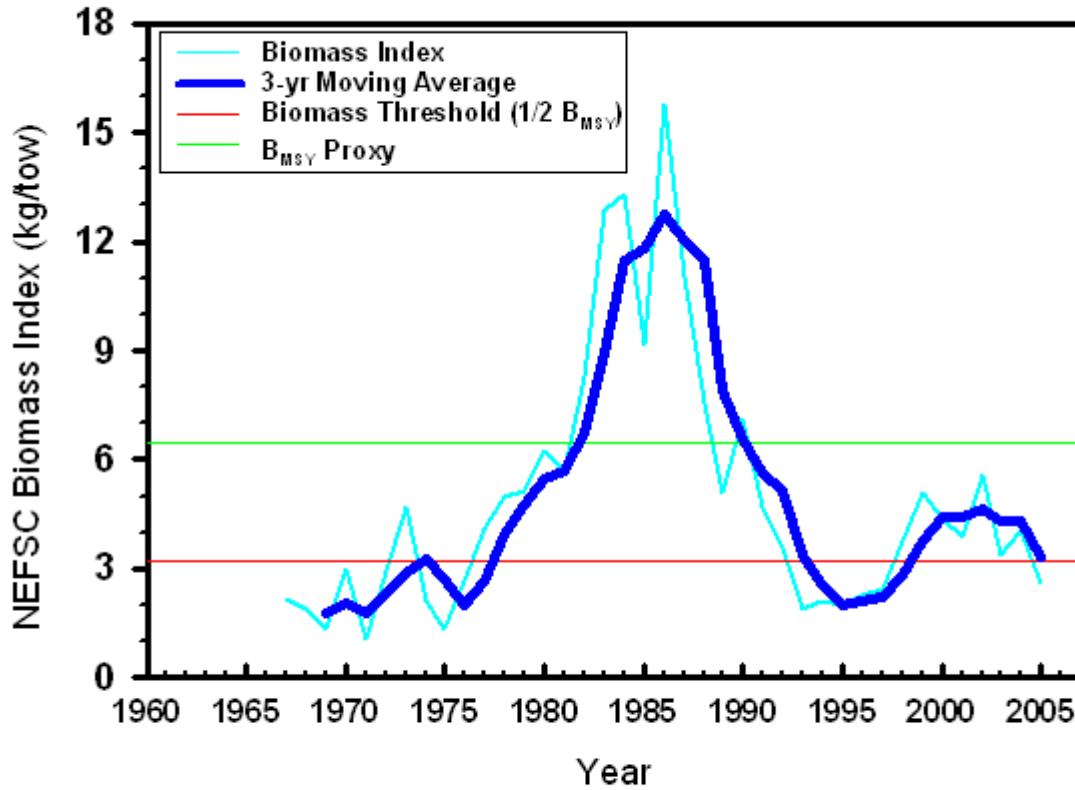


Figure 27.17. NEFSC survey biomass indices (kg/tow) for winter skate. Thin lines with symbols are annual indices, thick lines are 3-year moving averages, the thin red horizontal line is the biomass threshold and the thin green line is the B_{MSY} proxy.