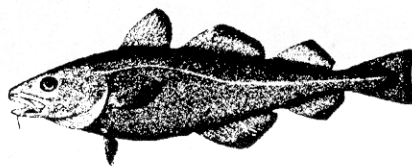


Atlantic Cod



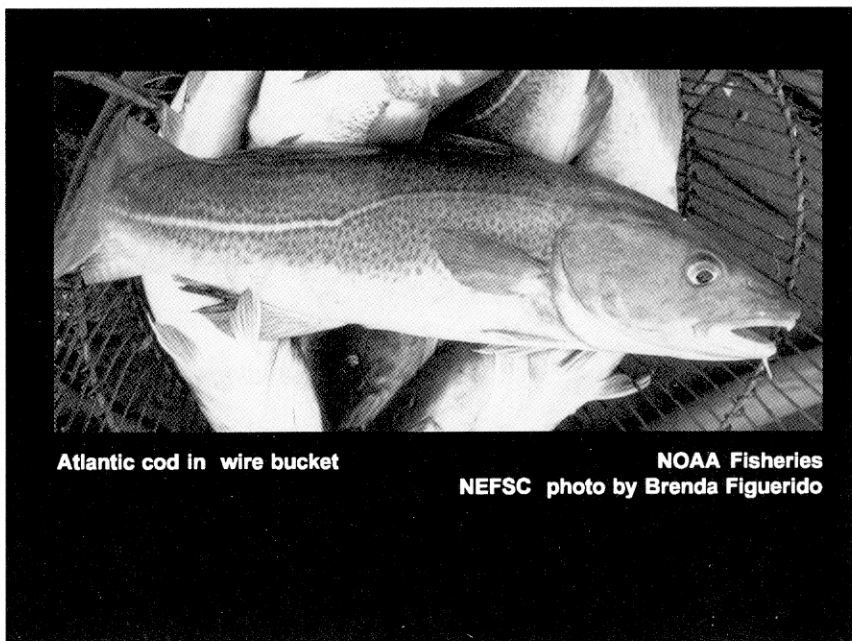
by R.K. Mayo
L. O'Brien

The Atlantic cod, *Gadus morhua*, is a demersal gadoid species found on both sides of the North Atlantic. In the Northwest Atlantic it occurs from Greenland to North Carolina. Cod may attain lengths of up to 130 cm (51 in.) and weights of 25 to 35 kg (55 to 77 lb). Maximum age is in excess of 20 years, although young fish (ages 2 to 5) generally constitute the bulk of the catch. Sexual maturity is attained between ages 2 to 4; spawning occurs during winter and early spring. Cod are omnivorous, feeding on a variety of invertebrates and fish species.

In U.S. waters, cod are assessed and managed as two stocks: Gulf of Maine, and Georges Bank and Southward. Both stocks support important commercial and recreational fisheries. Commercial fisheries are conducted year round, primarily with otter trawls and gill nets. Recreational fishing also occurs year round; peak activity occurs during the late summer in the lower Gulf of Maine, and during late autumn to early spring from Massachusetts southward.

Growth rates differ between the two stocks, although each is exploited by the same gear types with similar selection characteristics. Growth of cod has traditionally been slower in the Gulf of Maine than on Georges Bank but appears to have increased in recent years. Differences in growth rate by sex have also become less pronounced in both stocks.

United States commercial and recreational fisheries for cod are managed under the New England Fishery Management Council's Multispecies Fishery Management Plan (FMP). Under this FMP cod are included in a complex of 10 groundfish species which have been managed by time/area closures, gear restrictions, mini-



Atlantic cod in wire bucket

NOAA Fisheries
NEFSC photo by Brenda Figuerido

mum size limits, and, since 1994, direct effort controls including a moratorium on permits and days-at-sea restrictions under Amendments 5 and 7. Trip limits are also in effect for Gulf of Maine cod. The ultimate goal of the management program is to reduce fishing mortality to levels which will allow stocks within the complex to rebuild to above minimum spawning biomass thresholds. The Canadian fishery on Georges Bank is managed under an individual quota system.

Total commercial cod landings from the Georges Bank and Gulf of Maine stocks in 1996 were 16,100 mt, a slight increase from 14,700 mt in 1995, but 30% less than in 1994. United States commercial landings in 1996 equalled 14,200 mt, 4% higher than in 1995, but 20% less than in 1994 (17,800 mt). The total recreational cod catch in 1996 equalled 2,900 mt, about 35% lower than the 1993-1995 average.

Gulf of Maine

Total commercial landings (exclusively U.S.) in 1996 were 7,200 mt, a 6% increase over 1995, but a 60% decrease from the record-high 1991 total of 17,800 mt. The 1996 U.S. landings were among the lowest since 1973 and were well below the 1977-1986 average of 12,100 mt. Discards of cod were relatively high in 1989 and 1990, (1,500 and 3,600 mt, respectively), but have since declined to lower levels. Since 1993, discards of Gulf of Maine cod have ranged between 200 and 400 mt annually. The U.S. recreational catch in 1996 totalled 2,100 mt, approximately equal to the 1993-1995 average (2,300 mt).

Northeast Fisheries Science Center (NEFSC) bottom trawl survey abundance and biomass indices declined to record low levels in both the autumn 1993 and spring 1994 surveys and have since remained relatively

Gulf of Maine Atlantic Cod

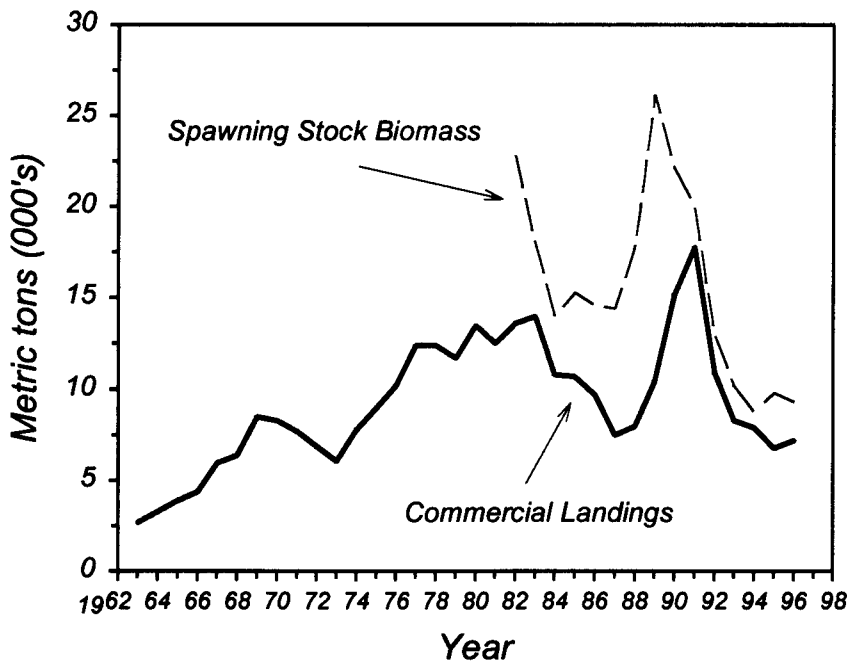


Table 1.1 Recreational catches¹ and commercial landings (thousand metric tons)

Category	Year										
	1977-86 Average	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
U.S. recreational	3.1 ²	2.3	2.1	2.7	3.9	3.6	1.2	2.4	2.6	1.8	2.1
Commercial											
United States	12.1	7.5	8.0	10.4	15.2	17.8	10.9	8.3	7.9	6.8	7.2
Canada	<0.1	-	-	-	-	-	-	-	-	-	-
Other	<0.1	-	-	-	-	-	-	-	-	-	-
Total nominal catch	15.2	9.8	10.1	13.1	19.1	21.4	12.1	10.7	10.5	8.6	9.3

¹Excludes cod caught and released

²1979-1986

Summary Status

Long-term potential catch	=	10,000 mt
SSB for long-term potential catch	=	30,000 mt
Importance of recreational fishery	=	Major
Management	=	Multispecies FMP
Status of exploitation	=	Overexploited
Age at 50% maturity	=	2.5 years, males 2.2 years, females
Size at 50% maturity	=	38 cm (15.0 in.), males 33 cm (13.0 in.), females
Assessment level	=	Age structured
Overfishing definition	=	20% MSP
Fishing mortality rate corresponding to overfishing definition	=	$F_{20\%} = 0.37$

$M = 0.20$ $F_{0.1} = 0.16$ $F_{max} = 0.29$ $F_{1996} = 1.04$

“...SSB will not increase appreciably in the near future even if fishing mortality is reduced substantially.”

low through autumn of 1997. Survey catch-at-age data indicate that the strong 1987 year class is no longer predominant, having been replaced by a series of average to below-average year classes from 1993 through 1996.

Fishing mortality has remained above 1.0 (58% exploitation rate) during 1994, 1995 and 1996. Since 1983, fishing mortality has been 2-3 times the level needed to attain 20% maximum spawning potential ($F_{20\%} = 0.37$, 28% exploitation rate), the overfishing definition established for this stock, and well above F_{max} (0.29, 23% exploitation rate), the management target selected to allow the stock to rebuild.

The 1987 year class (17.7 million fish at age 2) was the highest in the 1982-1996 series and about twice the size of the above-average 1980 and 1986 year classes. Recent recruitment, however, has been poor, and the 1994 and 1995 year classes (each less than 1 million fish) are especially weak.

Spawning stock biomass (SSB) peaked in 1989 at 26,200 mt, following recruitment of the strong 1987 year class to the spawning stock. However, SSB declined to 8,800 mt in 1994, remained at less than 10,000 mt through 1996, and dropped to 6,900 mt in 1997. Given the size of the incoming weak 1994 and 1995 year classes, SSB will not increase appreciably in the near future even if fishing mortality is reduced substantially. With continued high levels of fishing mortality, SSB will decline further, increasing the probability of total stock collapse.

The Gulf of Maine cod stock is overexploited and remains at an extremely low biomass level. Fishing mortality must be substantially reduced to prevent further declines in SSB.

Georges Bank and Areas to the South

Total commercial landings (U.S. and Canada) in 1996 were 8,900 mt, 13% more than in 1995, but 41% less than in 1994. The 1996 U.S. total (7,000 mt) is the fourth lowest in the time series, which dates back to 1893, and is well below the 1977-1991 annual average of 28,700 mt. Canadian 1996 landings totalled 1,900 mt, 71% higher than in 1995, yet 64% lower than in 1994. Total commercial landings in 1997 were 10,400 mt, a 17% increase from 1996. The U.S. ac-

“Recovery of the stock will depend on continued low fishing mortality as well as improved recruitment.”

counted for 72% (7,500 mt) of the total landings and Canada landed the remaining 28% (2,900 mt). The 1996 U.S. recreational catch (800 mt) was 63% less than the 1993-1995 average and remained well below the 1979-1986 average (3,700 mt). The 1997 U.S. recreational catch was 1,200 mt.

The NEFSC bottom trawl survey indices for spring and autumn declined from 1995 to 1996. The 1993 and 1992 year classes contributed to the higher autumn index in 1995 as above average two and three old fish, respectively; however, abundance was not sustained in 1996. Indices remain well below the long term average and continue to indicate that the stock is at a low level. In 1997 survey indices continued to

Georges Bank Atlantic Cod

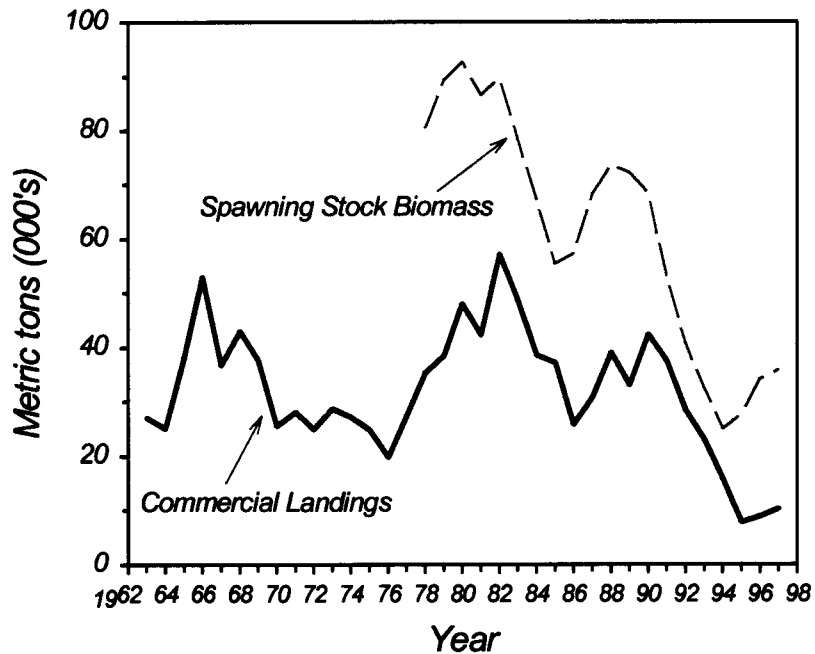


Table 1.2 Recreational catches¹ and commercial landings (thousand metric tons)

Category	Year											
	1977-86 Average	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1996
U.S. recreational	3.7 ²	0.8	4.4	2.0	1.0	1.9	0.6	2.9	1.5	2.1	0.8	
Commercial												
United States	30.8	19.0	26.3	25.1	28.2	24.2	16.9	14.6	9.9	6.8	7.0	
Canada	9.2	11.9	12.9	8.0	14.3	13.4	11.7	8.5	5.3	1.1	1.9	
Other	0.1	-	-	-	-	-	-	-	-	-	-	
Total nominal catch	43.8	31.7	43.6	35.1	43.5	39.5	29.2	26.0	16.7	10.0	9.7	

¹Excludes cod caught and released

²1979-1986

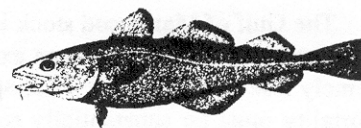
Summary Status

- Long-term potential catch = 35,000 mt
- SSB for long-term potential catch = 105,000 mt
- Importance of recreational fishery = Major
- Management = Multispecies FMP
- Status of exploitation = Overexploited
- Age at 50% maturity = 2.1 years (both sexes)
- Size at 50% maturity = 41 cm (16.1 in.), both sexes
- Assessment level = Age structured
- Overfishing definition = 20% MSP
- Fishing mortality rate corresponding to overfishing definition = $F_{20\%} = 0.41$

$M = 0.20$ $F_{0.1} = 0.18$ $F_{max} = 0.34$ $F_{1997} = 0.26$



Man with Atlantic cod

NOAA Fisheries
NEFSC photo by Gareth W. Coffin

mass in 1997 was estimated to be 35,900 mt.

The Georges Bank cod stock remains at a low biomass level and is in an overexploited state. Recovery of the stock will depend on continued low fishing mortality as well as improved recruitment.

For further information

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decline and the autumn abundance index is the lowest in the time series.

Fishing mortality in 1997 was estimated at $F=0.26$ (21% exploitation rate), above the 1996 level of $F=0.20$ and the current management target selected to allow the stock to rebuild above the minimum spawning stock biomass threshold ($F_{0.1}=0.18$, 15% exploitation rate). However, it was below the level needed to attain 20% maximum spawning potential ($F_{20\%}=0.41$, 31% exploitation rate), the overfishing definition established for this stock.

Spawning stock biomass increased from 55,000 to 72,000 mt between 1985 and 1989 due to recruitment of the strong 1983, 1985, and 1987 year classes. However, SSB has since declined and in 1994 dropped to a record low 25,000 mt. Spawning stock biomass increased in 1995 and 1996 (28,000 and 34,000 mt, respectively) as the 1992 and 1993 cohorts recruited to the spawning stock. The 1996 spawning stock biomass represents 49% of the minimum SSB threshold of 70,000 mt. Spawning stock bio-