

K. Georges Bank/Gulf of Maine White Hake by K.A. Sosebee

1.0 Background

A VPA was last conducted for this stock in 1998 and reviewed at SAW 28 (NEFSC 1999). In 1999, projections were done to estimate mean biomass in 2000. Reported landings in 1998 were used to derive fishing mortality in 1998. Fully recruited fishing mortality (ages 4-8) in 1998 was estimated to be 1.09, a decrease from 1.15 in 1997. Spawning stock biomass was estimated to have declined to 2,700 mt in 1998, a decline from a recent high of 9,600 mt in 1992. NEFSC spring and autumn research vessel bottom trawl survey indices had declined to near record low levels in 1998 and 1999.

2.0 2000 Assessment

Fishery

United States commercial landings of white hake increased to 2,624 metric tons (mt) in 1999, an 11% increase from 1998 (Table K1; Figure K1). Canadian landings declined to 175 mt (23% decline). No discard estimates were derived for 1999.

Input Data and Analyses

The present assessment represents a one-year update to the previous assessment (Northern Demersal Working Group 2000). Forecast software was used to estimate fishing mortality and biomass in 1999. Survivors from 1000 bootstrapped VPA outcomes from the 1997 assessment (NEFSC 1999) were used to start the projections. Reported landings were used to generate fishing mortality in 1998 and 1999. Survey data from the fall of 1998 and 1999 and the spring of 1999 and 2000 was aged using seasonal pooled age-length keys from 1982-1999. The age estimates for fall age-1 and spring age-2 were then used to derive an estimate of recruitment for the 1997 and 1998 year classes using RCT3. The estimate and the standard error were used to generate 1000 recruitment estimates for age 1 in the projections for 1997. The estimate for 1998 was used in the first year of the projection.

3.0 Assessment Results

NEFSC research vessel bottom trawl survey abundance and biomass indices for white hake remained relatively low through autumn 1999 and spring 2000 (Table K2, Figure K2). The autumn 1999 indices declined slightly from the 1998 levels, while the spring 2000 indices increased from the 1998 levels because of an apparently strong 1998 year class (Figure K3). Recruitment of the 1997 year class was estimated to be 1.9 million fish, the second lowest value in the time series while the 1998 year class is estimated to be 9.0 million fish, the third highest value (Figure K5).

Fully recruited fishing mortality (ages 4-8) in 1999 is now estimated to be 0.90 (Figure K4), a slight decline from 1.09 in 1998, as reported in the previous assessment. Spawning stock biomass is estimated at 3,297 mt in 1999, an increase from 2,717 mt in 1998 (Figure K5). The most recent high level of SSB (9,563 mt) occurred in 1992. Mean biomass increased to 6,887 in 1999 due to both the 1996 and 1998 year classes (Figure K5). Biomass weighted fishing mortality (ages 1+) has declined from 0.8 in 1996 to 0.40 in 1999 (Figure K4). Accounting for precision in the current assessment, there is a 90% probability that fully recruited F in 1999 was greater than 0.6, SSB in 1999 was less than 4,500 mt, and mean biomass was less than 9,000 mt.

4.0 Consistency of 1999 Projection Forecast with 2000 Assessment Results

Projections conducted during the 1999 assessment were performed assuming that $F_{1999} = F_{1998} = 1.09$ and estimated that mean biomass would be 5498 mt in 1999. The 2000 assessment using actual landings estimated an F of 0.9 with 80% probability that F was between 0.6 and 1.7 which includes the former value of 1.09. With a lower value of fishing mortality and a higher level of recruitment in 1999, the mean biomass from the new projection was 6,887 mt as compared to 5,498 mt. With 80% confidence limits of 3847 and 8964, the values are still similar.

5.0 Control rule.

According to the SARC 28 overfishing control rule, when mean biomass is at B_{msy} (22,300 mt) or greater, the target fishing mortality is 0.12 and the threshold is 0.24 (Figure K6). When biomass is between 6,900 mt and 22,300 the fishing mortality rate should allow recovery to B_{msy} in 5 years. At biomass levels below 6,900 mt, fishing mortality should be as close to zero as possible.

6.0 Sources of Uncertainty

- 1999 fishing mortality may be uncertain if landings are not complete and if the PR has changed.
- 1997 and 1998 year classes based on pooled age-length keys.
- The control rule is based on a rescaled estimate of F_{msy} . The scaling may not show the actual rate of recovery.

From SARC 28:

- Discards are not incorporated into the VPA catch at age.
- Red hake may be mis-identified as white hake and vice versa.
- Missing ages in the survey age/length keys were interpolated.
- White hake may move seasonally into and out of the defined stock area.

7.0 References

NEFSC. 1999. 28th Northeast Regional Stock Assessment Workshop (28th SAW). Stock Assessment Review Committee (SARC) Consensus Summary of Assessments. NMFS/NEFSC, Woods Hole Laboratory Ref. Doc. 99-08.

NDWG (Northern Demersal Working Group, Northeast Regional Stock Assessment Workshop). 2000. Assessment of 11 Northeast Groundfish Stocks through 1999: a report to the New England Fishery Management Council's Multi-Species Monitoring Committee. NMFS/NEFSC, Woods Hole Laboratory Ref. Doc. 00-05, 175 p.

Table K1. Total Landings (mt, live) of white hake by country from the Gulf of Maine to Cape Hatteras (NAFO Subareas 5 and 6), 1964-1999.

	Canada	USA	Other	Grand Total
1964	29	3016	0	3045
1965	0	2617	0	2617
1966	0	1563	0	1563
1967	16	1126	0	1142
1968	85	1210	0	1295
1969	34	1343	6	1383
1970	46	1807	280	2133
1971	100	2583	214	2897
1972	40	2946	159	3145
1973	117	3279	5	3401
1974	232	3773	0	4005
1975	146	3672	0	3818
1976	195	4104	0	4299
1977	170	4976	338	5484
1978	155	4869	29	5053
1979	251	4044	4	4299
1980	305	4746	2	5053
1981	454	5969	0	6423
1982	764	6179	2	6945
1983	810	6408	0	7218
1984	1013	6757	0	7770
1985	953	7353	0	8306
1986	956	6109	0	7065
1987	555	5818	0	6373
1988	534	4783	0	5317
1989	583	4548	0	5131
1990	547	4927	0	5474
1991	552	5607	0	6159
1992	1138	8444	0	9582
1993	1681	7466	0	9147
1994	955	4737	0	5692
1995	481	4333	0	4814
1996	372	3287	0	3659
1997	290	2225	0	2515
1998	228	2364	0	2592
1999	175	2624	0	2799

Table K2 Stratified mean catch per tow in numbers and weight (kg) for white hake from NEFSC offshore spring and autumn research vessel bottom trawl surveys (strata 21-30,33-40), 1963-2000.

Year	Spring			Autumn		
	No/Tow	Wt/Tow	Length	No/Tow	Wt/Tow	Length
1963				5.00	6.31	46.2
1964				1.77	4.14	56.3
1965				4.39	6.86	50.4
1966				6.79	7.67	45.1
1967				3.92	3.64	42.6
1968	1.60	1.74	44.1	4.24	4.54	44.9
1969	3.76	5.09	46.3	9.24	13.09	46.8
1970	5.84	11.86	52.9	8.05	12.82	51.3
1971	3.31	5.14	51.3	10.38	12.10	43.6
1972	10.18	12.66	47.3	12.52	13.10	45.2
1973	9.24	12.22	49.9	9.05	13.46	51.7
1974	8.08	13.99	55.0	5.35	11.00	54.5
1975	9.32	11.22	44.7	5.28	7.23	48.5
1976	9.98	17.01	52.7	6.04	10.56	54.7
1977	6.13	11.01	55.5	9.78	13.74	47.8
1978	3.22	6.14	51.8	7.87	12.54	50.2
1979	5.26	4.97	43.0	5.62	10.31	53.1
1980	10.38	13.96	49.7	10.86	16.66	48.8
1981	17.09	19.92	45.9	8.70	12.16	49.9
1982	6.06	8.91	51.0	1.96	2.11	46.7
1983	3.23	3.12	43.7	8.22	10.79	48.8
1984	2.75	4.17	51.4	5.32	8.23	51.9
1985	4.33	5.38	48.5	9.37	9.74	42.9
1986	8.24	5.61	40.0	14.42	11.56	41.9
1987	7.15	6.44	45.3	7.59	9.62	49.2
1988	4.52	3.69	41.9	8.12	9.88	46.1
1989	3.65	3.22	43.0	11.76	9.23	40.5
1990	11.11	18.37	53.3	13.09	10.58	41.5
1991	8.42	6.14	41.6	13.22	12.20	44.6
1992	7.59	7.11	45.1	10.16	11.24	47.7
1993	7.93	6.84	45.1	11.35	11.66	45.2
1994	4.59	3.17	40.1	8.44	7.02	42.3
1995	4.38	4.02	44.1	9.54	8.20	40.8
1996	2.87	3.07	45.9	4.52	6.35	51.2
1997	1.88	0.89	38.4	4.69	4.55	41.5
1998	2.25	1.09	37.7	4.41	4.27	44.5
1999	3.32	2.97	44.6	5.68	3.44	36.3
2000	5.19	3.33	40.4			

Table K3. Input data for projections.

Age	Fish Mort Pattern	Nat Mort Pattern	Proportion Mature	Average Weights	
				Catch	Stock
1	0.0000	1.0000	0.0400	0.199	0.124
2	0.0399	1.0000	0.2600	0.544	0.340
3	0.5191	1.0000	0.7000	1.066	0.756
4	1.0000	1.0000	0.8900	1.910	1.437
5	1.0000	1.0000	0.9800	3.069	2.416
6	1.0000	1.0000	0.9800	4.393	3.681
7	1.0000	1.0000	1.0000	6.040	5.175
8	1.0000	1.0000	1.0000	7.886	6.910
9+	1.0000	1.0000	1.0000	13.200	13.200

Table K4. PROJECTION RUN: white hake projection

INPUT FILE: whake993.in
 OUTPUT FILE: whakenew.out
 RECRUITMENT MODEL: 9
 NUMBER OF SIMULATIONS: 100

MIXTURE OF F AND QUOTA BASED CATCHES

YEAR	F	QUOTA (THOUSAND MT)
1998		2.592
1999		2.799

SPAWNING STOCK BIOMASS (THOUSAND MT)

YEAR	AVG SSB (000 MT)	STD
1998	2.756	0.556
1999	3.335	1.276

PERCENTILES OF SPAWNING STOCK BIOMASS (000 MT)

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1998	1.234	1.868	2.051	2.403	2.717	3.091	3.456	3.738	4.070
1999	0.608	1.517	2.001	2.382	3.307	3.988	4.526	5.039	7.078

ANNUAL PROBABILITY THAT SSB EXCEEDS THRESHOLD: 10.000 THOUSAND MT

YEAR	Pr(SSB > Threshold Value)
1998	0.000
1999	0.000

MEAN BIOMASS (THOUSAND MT) FOR AGES:1 TO 9

YEAR	AVG MEAN B (000 MT)	STD
1998	5.573	1.411
1999	7.001	2.195

PERCENTILES OF MEAN STOCK BIOMASS (000 MT)

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1998	2.723	3.673	3.987	4.551	5.471	6.228	6.803	7.444	9.623
1999	2.722	3.847	4.672	5.517	6.887	7.895	8.964	9.900	13.016

ANNUAL PROBABILITY THAT MEAN BIOMASS EXCEEDS THRESHOLD: 22.300 THOUSAND MT

YEAR	Pr(MEAN B > Threshold Value)
1998	0.000
1999	0.000

F WEIGHTED BY MEAN BIOMASS FOR AGES:1 TO 9

YEAR	AVG F_WT_B	STD
1998	0.492	0.119
1999	0.438	0.141

PERCENTILES OF F WEIGHTED BY MEAN BIOMASS FOR AGES:1 TO 9

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1998	0.199	0.312	0.374	0.414	0.470	0.569	0.630	0.691	0.875
1999	0.151	0.248	0.309	0.354	0.402	0.495	0.587	0.664	0.991

ANNUAL PROBABILITY THAT F WEIGHTED BY MEAN BIOMASS EXCEEDS THRESHOLD: 0.240

YEAR	Pr(F_WT_B > Threshold Value)
1998	0.990
1999	0.970

RECRUITMENT UNITS ARE:1000. FISH

BIRTH	AVG	STD
YEAR	RECRUITMENT	
1998	9046.000	0.000
1999	2857.256	1666.965

PERCENTILES OF RECRUITMENT UNITS ARE:1000. FISH

BIRTH	1%	5%	10%	25%	50%	75%	90%	95%	99%
YEAR									
1998	9046.000	9046.000	9046.000	9046.000	9046.000	9046.000	9046.000	9046.000	9046.000
1999	1471.000	1471.000	1471.000	1911.000	1911.000	5692.000	5692.000	5692.000	5692.000

LANDINGS FOR F-BASED PROJECTIONS

YEAR	AVG LANDINGS (000 MT)	STD
1998	2.592	0.000
1999	2.799	0.000

PERCENTILES OF LANDINGS (000 MT)

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1998	2.592	2.592	2.592	2.592	2.592	2.592	2.592	2.592	2.592
1999	2.799	2.799	2.799	2.799	2.799	2.799	2.799	2.799	2.799

REALIZED F SERIES FOR QUOTA-BASED PROJECTIONS

YEAR	AVG F	STD
1998	1.145	0.333
1999	1.153	0.901

PERCENTILES OF REALIZED F SERIES

YEAR	1%	5%	10%	25%	50%	75%	90%	95%	99%
1998	0.703	0.737	0.791	0.931	1.093	1.237	1.507	1.710	2.059
1999	0.282	0.510	0.605	0.712	0.901	1.310	1.663	2.104	5.441

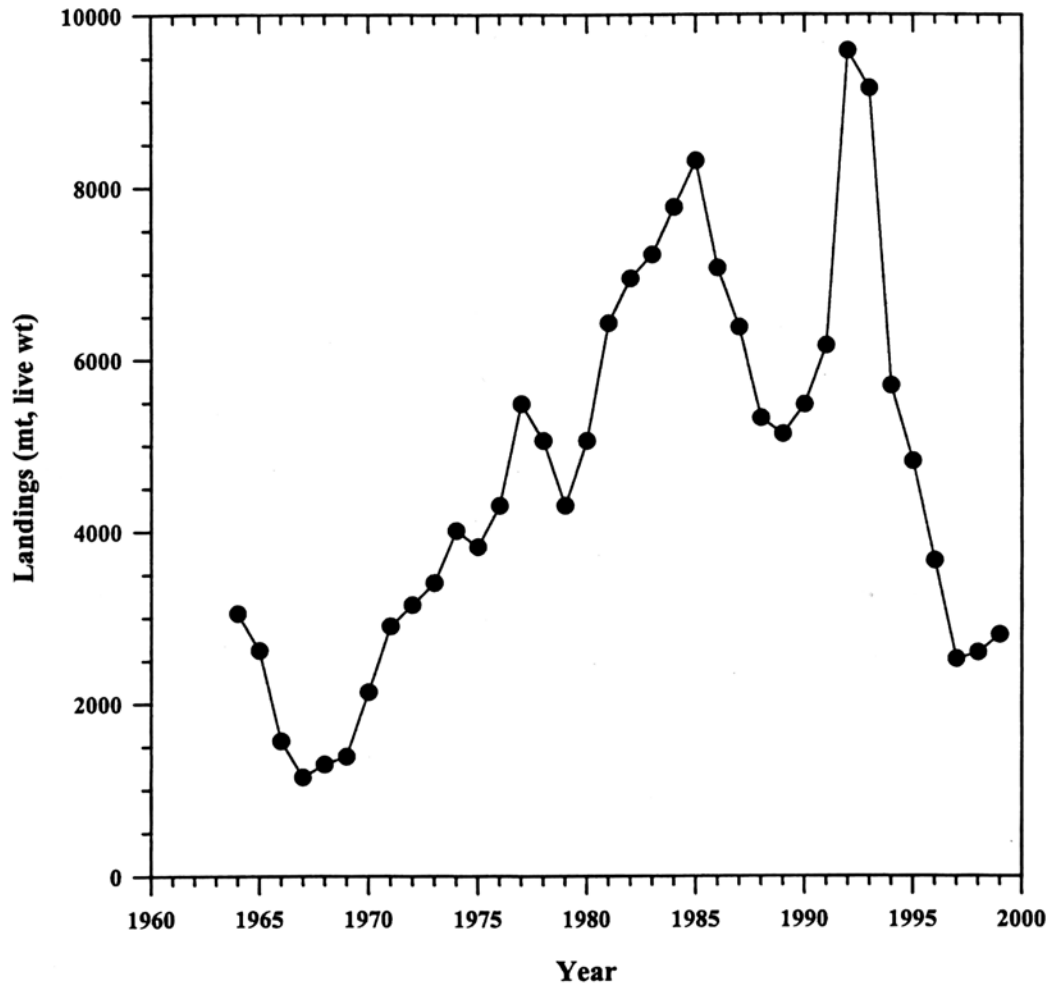


Figure K1. Total landings of white hake from the Gulf of Maine to Mid-Atlantic region, 1964-1999.

White Hake *Long-term Biomass Indices*

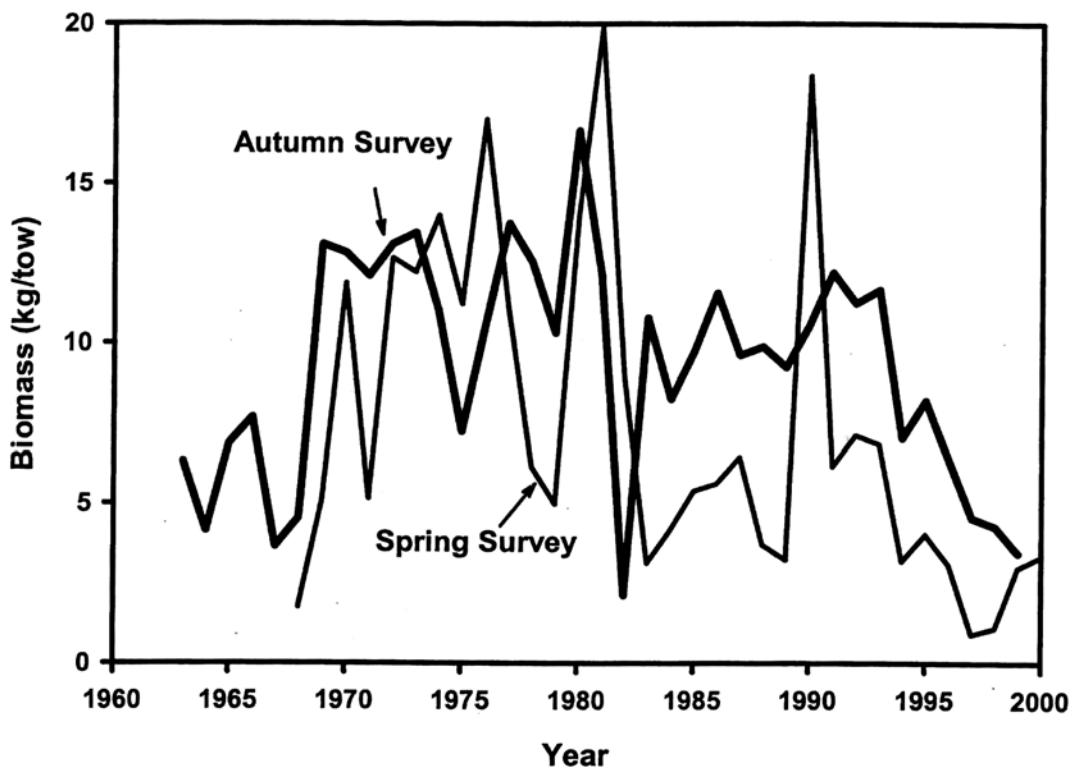


Figure K2. Spring and autumn bottom trawl indices from 1963-2000 for Gulf of Maine-Northern Georges Bank White Hake.

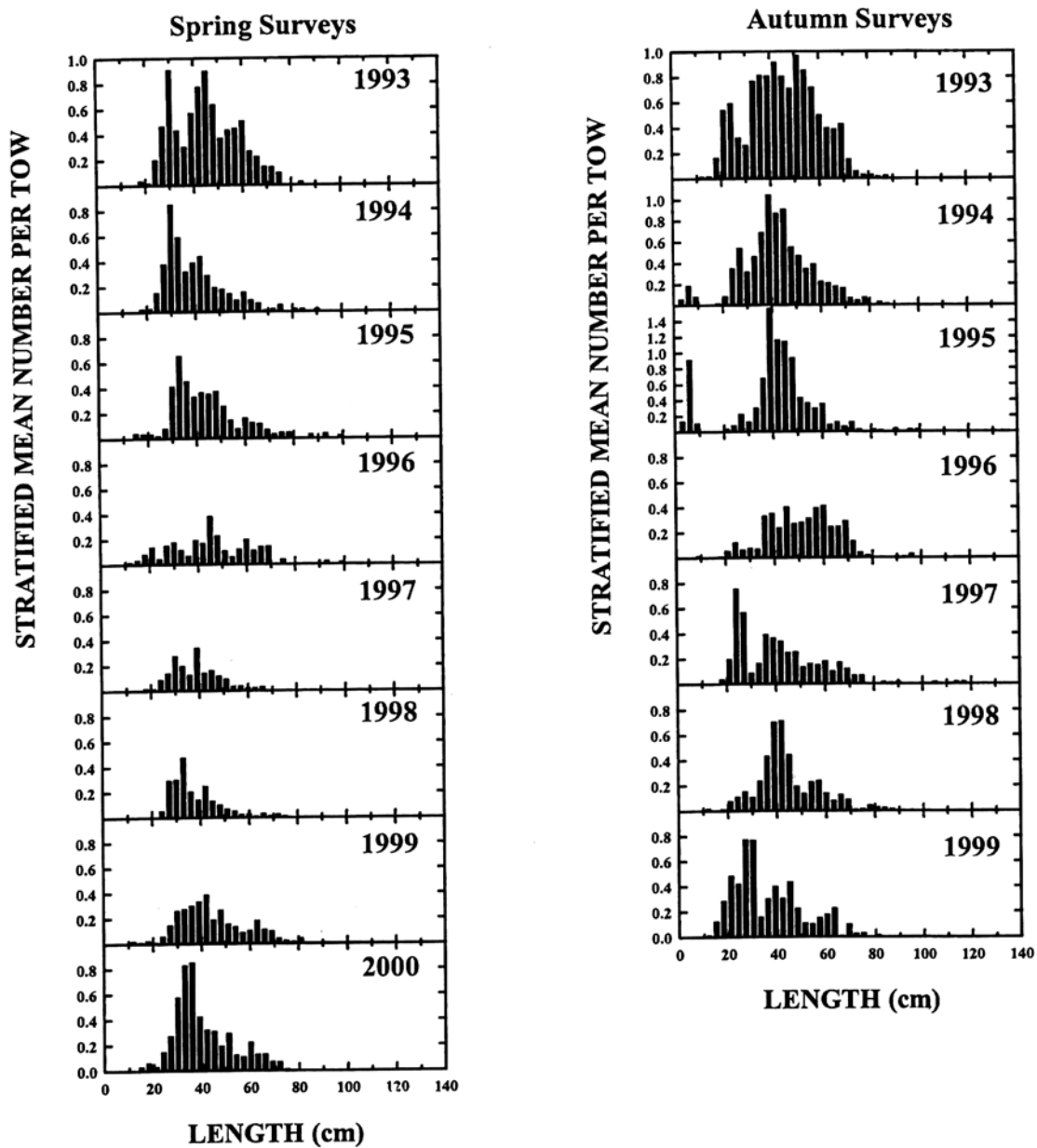


Figure K3. Length composition of white hake from the NEFSC bottom trawl surveys in the Gulf of Maine to northern Georges Bank region, 1993-2000.

White Hake

Trends in Landings and Fishing Mortality

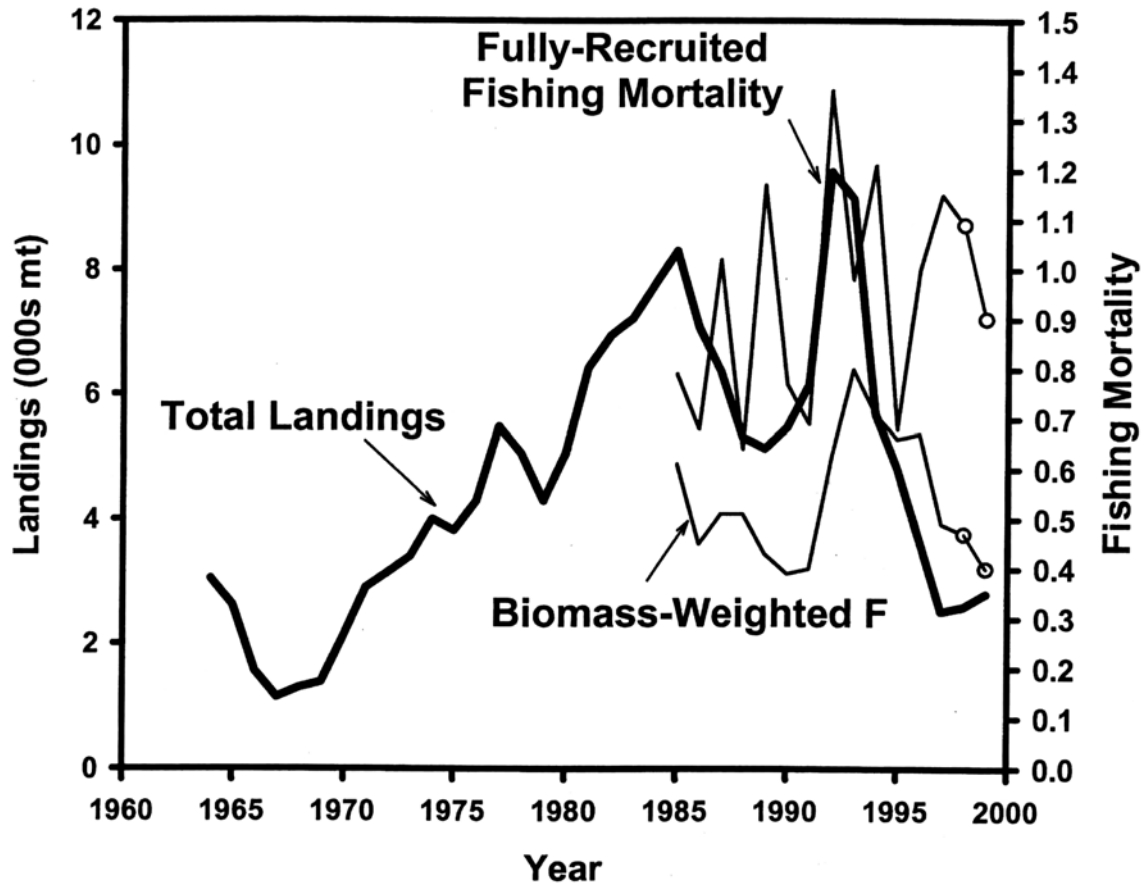


Figure K4. Total commercial landings and fishing mortality from the VPA calibration (solid thick lines) and the projection (open circle).

White Hake

Trends in Spawning Stock Biomass and Recruitment

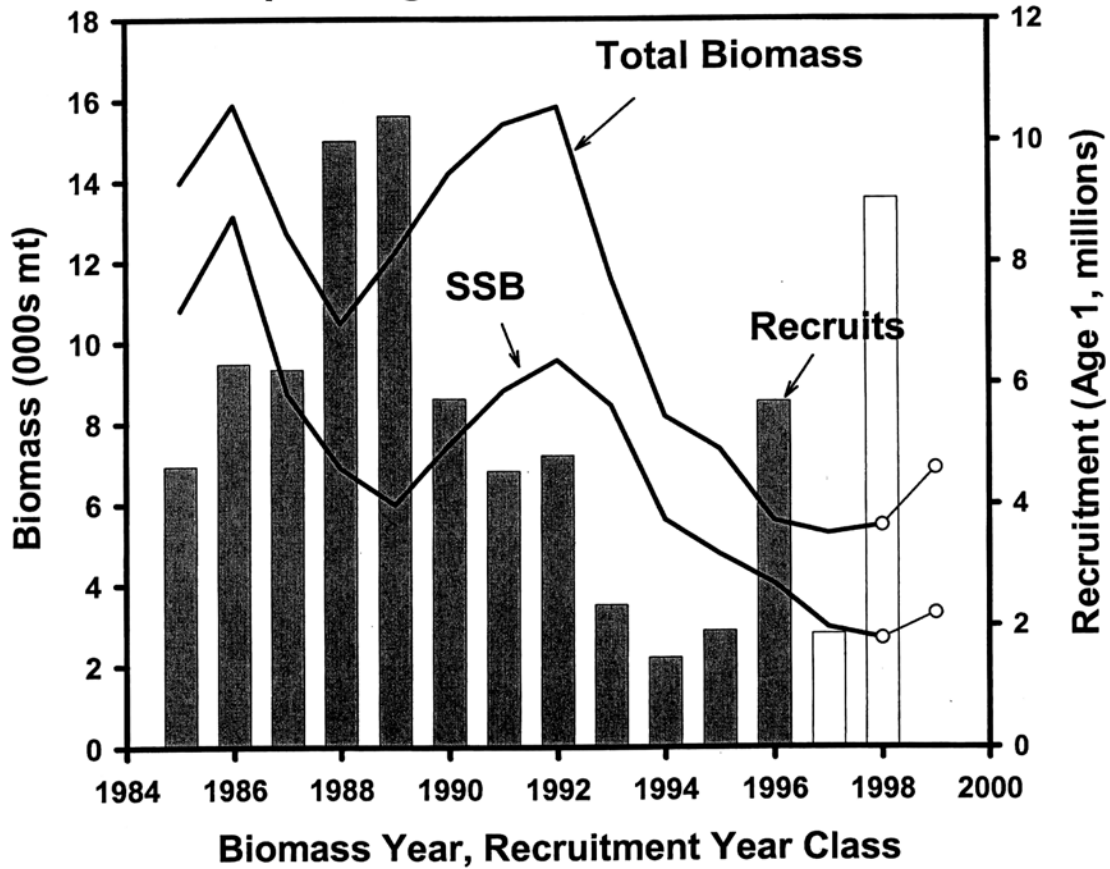


Figure K5. Total (mean) biomass, spawning stock biomass and recruitment from the VPA calibration (solid thick lines) and the projection (dotted line).

White Hake
Harvest Control Rule and Recent Stock Status

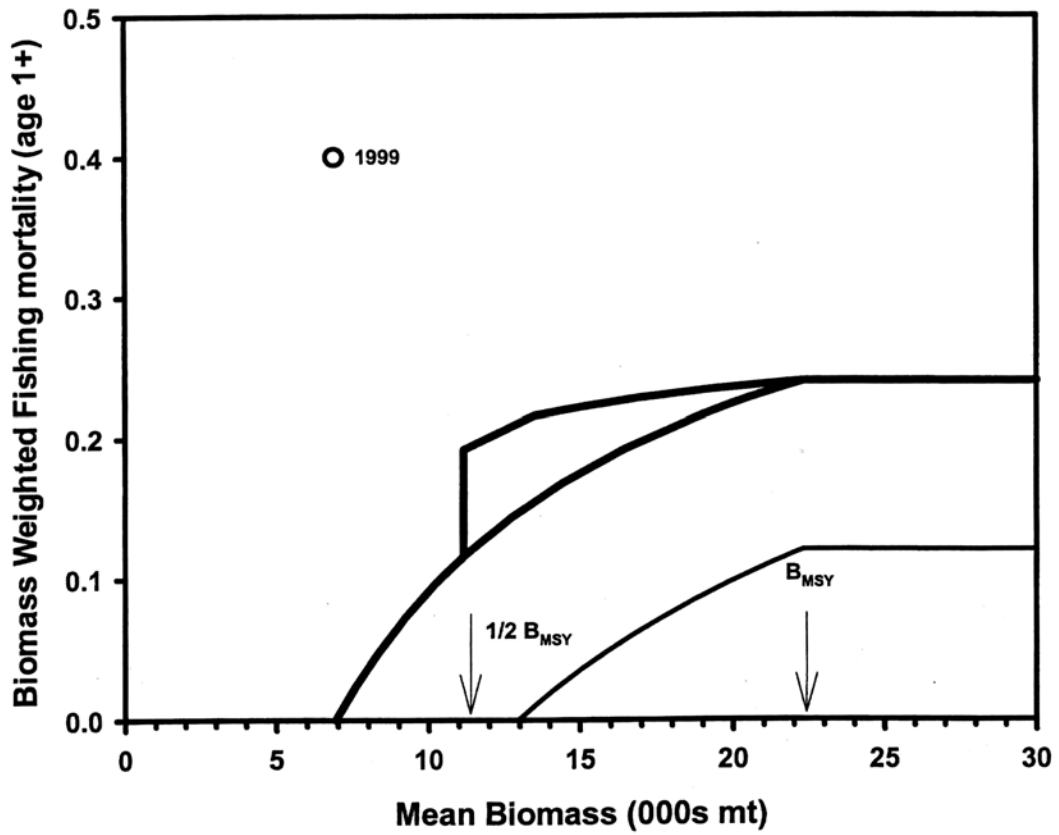


Figure K6. Harvest control rule for white hake.