

Estimate of the 2005 Harvest and 2006 Quota
for Spring Coastal Migrant Striped Bass in Chesapeake Bay

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Introduction

The Maryland Department of Natural Resources (DNR) re-opened its spring recreational and charter fisheries for coastal migrant striped bass in 1992 after a six-year closure. From 1996 to 2003 the baywide harvest quota was set at 30,000 fish. Since 2004, the spring quota has been calculated based on the VPA estimate of absolute abundance of coastwide population of age eight and older striped bass (Barker and Sharov, 2004). The spring quota for 2005 was estimated at 31,434 fish based on the 2004 striped bass stock assessment results. The Technical Committee approved a lower value of 26,754 after adjustment for exceeding the cap in the previous year. However, the Striped Bass Management Board set the final quota for 2005 at the level of the previous year (40,624 fish) as a part of the "status quo" management decision for the 2005 coastwide fishing season.

This report presents an updated calculation of the 2005 harvest quota, based on the updated F from the VPA, calculation of the 2005 Maryland spring harvest of coastal migrant striped bass in Chesapeake Bay and estimation of the conservation equivalence for the 2005 harvest excess.

I. Calculation of the 2005 Maryland Chesapeake Bay Spring Harvest of Coastal Migrant Striped Bass

The method used to estimate the spring trophy season harvest in Maryland was presented in detail in Jones (2003). Results of the 2005 calculations are summarized in Table 1. The specific steps used in the calculation are as follows:

Estimation of Harvest.

- Maryland charter boat logbook reports provided the census values of daily charter boat harvest (Table 2).
- NOAA MRFSS survey provided estimates of harvest for private/rental boats for Waves 2 and 3 (Table 2).

Harvest apportioned by time.

- The migrant harvest season overlaps parts of both Wave 2 and 3 of the MRFSS Survey. Length distribution of the harvest is known to change over this time period, so total harvest was apportioned into length categories for 2-week intervals between April 16 and June 15.
- All Wave 2 harvest occurred during the spring season.
- Maryland charter boat logbook reports were used to develop the Wave 3 distribution of charter harvest by 2-week intervals between May 1 and June 15 (Table 1).
- The MRFSS estimate of Wave 3 private/rental harvest was distributed among the 2-week intervals by the charter harvest distribution.
- Total striped bass harvest per interval was calculated as charter boat harvest + private/rental harvest (Table 1).

Harvest apportioned by length.

- Data from the Maryland DNR charter boat creel survey were used to develop the length frequency distribution of the harvest for each 2-week interval (Table 3).
- Each interval's harvest was distributed by the appropriate length frequency distribution.
- Length-specific migration probabilities were applied to the length-distributed harvest for each interval. (Tables 4a-d). These probabilities were derived from the estimate of the number of striped bass tagged on the spawning grounds in Maryland that migrate to the Atlantic coast before December of the first year at large (Dorazio et al., 1994).
- The result was the migrant harvest for each 2-week interval, distributed among interval-specific length groups.

Total 2005 Maryland spring harvest of coastal migrant striped bass in Chesapeake Bay was calculated as the sum over all length groups and 2-week intervals.

Differences from the 2003-2004 calculations.

The calculations for 2005 differ from the 2003-2004 calculations to estimate migrant harvest in that:

- There were insufficient length data from the Maryland Volunteer Angler Survey to develop length frequencies for all 2-week intervals, so only data from the Maryland DNR charter boat creel survey were used to develop length frequency distributions.
- The Maryland charter boat logbook reports were used to develop the estimate of charter harvest.

For the past three years, MRFSS web-based survey harvest estimates were used for both charter boat and private/rental boat harvest. However, the MRFSS 2005 estimate of harvest was abnormally high. Maryland DNR has no data to verify the accuracy of the private/rental boat harvest. However, the Maryland charter boat logbook reports were a source of alternative values to verify estimates of the charter harvest. Examination of the 6-year time series of charter harvest revealed that Wave 2 & 3 harvests reported by Maryland charter boats were not significantly different from MRFSS estimates of charter boat harvest for 2000-2004 (2-tail paired t-test, $P [T \leq t] = 0.51$). In contrast, the 2005 MRFSS estimate of charter harvest was significantly higher than that reported by Maryland charter boats ($\alpha = 0.05$) (Figure 1). In addition, the number of 2005 trips and anglers reported by Maryland charter boats were not significantly different from previous years ($\alpha = 0.05$) (Figure 2). The number of boats in the charter fleet has been capped since the striped bass fishery reopened in 1990 and the season length for the trophy season has been constant in recent years. Therefore it is reasonable that effort, as measured by number of trips and anglers, has remained relatively constant.

The final estimate of Maryland coastal migrant harvest was 64,345 fish (Table 1). The preliminary estimated coastal migrant harvest in Virginia in the spring of 2004 is estimated to be between 150 and 1,319. Therefore, the overall estimate of the spring 2005 trophy striped bass season harvest in Chesapeake Bay is less than or equal to 65,664 fish.

II. Updated Estimate of 2005 Quota

The most recent stock assessment for the striped bass population (August 2005) estimated the striped bass population fishing mortality for the 2004 season to be substantially lower and the population size to be substantially higher than was estimated in the 2004 stock assessment. Since VPA terminal year estimates are the least reliable and population estimates improve retrospectively (because of the convergence property of VPA), we believe that the numbers from the updated 2005 assessment should be used in quota estimation. Using updated VPA estimates of population size, the recalculated striped bass quota for the 2005 spring trophy fishery is 55,565 fish (Table 5).

III. Estimate of the 2006 Chesapeake Bay Spring Coastal Migrant Striped Bass Harvest Quota

The 2005 spring coastal migrant striped bass fishery harvest quota in Chesapeake Bay was estimated using the methodology approved by the ASMFC Technical Committee. As proposed by the three Chesapeake Bay management entities, the quota on the annual spring coastal migrant striped bass harvest is adjusted each year according to changes in the size of the population. Specifically, the spring season quota changes in proportion to the number of age 8 and older striped bass in the population, as determined annually by the ADAPT VPA.

The estimate of striped bass abundance of a given age for ages 8 and older (8±) in 2005 was calculated from the equation:

$$N_{2006,i+1} = N_{2005,i} * \exp(-(F * PR_{2004} + M)) \quad \text{Eqn. 1}$$

where:

$N_{2006,i+1}$ = number of striped bass of age $i+1$ in the population on January 1, 2006,

$N_{2005,i}$ = number of striped bass of age i in the population on January 1, 2005, taken from the 2004 striped bass ADAPT VPA,

$F = 0.30$ (target),

$M = 0.15$,

PR = the age specific PR vector from the most recent VPA run.

The harvest quota (HC) for 2006 was estimated using the following equation:

$$HC_{2006} = (N_{2006} / N_{1996} * 30,000) \quad \text{Eqn. 2}$$

where:

N_{2006} = projected number of striped bass age 8± in the population in 2005,

N_{1996} = estimated number of striped age 8+ striped bass in the population in 1996 (the first year that the population was declared to have recovered and a spring harvest quota for Chesapeake Bay was established at 30,000 fish).

The population of 8± striped bass in 2006 is estimated to be 5.237 million fish, 1.8 times greater than the population size of 2.895 million fish in 1996. Consequently, the baywide harvest quota for 2006 should be $30,000 * 1.809 = 54,266$ fish (Tables 6 and 7).

IV. Estimation of Conservation Equivalence for the 2005 Harvest Excess

Amendment II to the Striped Bass Fisheries Management Plan established target fishing mortalities (F) of 0.3 on the coast and 0.27 for Chesapeake Bay. Fishing mortality in Chesapeake Bay has been estimated using summer-fall tagging data since 1993. Estimated values of F presented in Table 8 indicate that fishing mortality for the last four years has been well below the target level. Consequently, the actual harvest was substantially below that which could have been achieved under the target F, resulting in savings between 230,878 and 974,121 fish over this time period.

This section of the report demonstrates conservation equivalency between the portion of the allowable 2004 Maryland Chesapeake Bay summer-fall recreational harvest that was not caught and the 2005 spring fishery overage. The 2005 Maryland striped bass migrant harvest was 64,345 fish. The 2005 spring migrant quota, based on the updated fishing mortality (F), was 55,565 fish. Therefore, Maryland's 2005 spring striped bass harvest included an overage of 8,780 fish. We demonstrate here that the biomass of saved fish that will become spring migrants the following year will be greater than the biomass of the excess 2005 spring harvest.

Calculation of 2005 overage biomass.

The calculations to estimate the migrant harvest provided a matrix of migrant harvest by 2-week interval and length group. Summation of the interval vectors produced a vector of total landings by length group. Landings were multiplied by the ratio of overage / total landings (0.136) to produce the overage per length group. Finally, the overage was distributed among length groups (Table 9).

Overage landings-at-length were multiplied by weight-at-length to produce biomass-at-length. A length-weight regression was used to develop weight-at-length parameters using length, weight and harvest data from the 2004 Maryland charter boat creel survey. Summation of biomass-at-length produced the total biomass of the overage (69,999 kg).

Calculation of uncaught allowable 2004 harvest.

The ratio of calculated catch for target fishing mortality (F = 0.27) vs. catch for actual Chesapeake Bay F (0.16) was used to calculate the proportion of 2004 allowable recreational harvest that was not caught in Waves 4, 5 and 6. Catch was calculated as:

$$C = N_0 * F/Z (1 - e^{-Z}) \quad \text{Eqn. 3}$$

where:

$$Z = F + M \quad \text{Eqn. 4}$$

The ratio of allowable to actual catch was therefore:

$$\frac{C_{\text{Target}}}{C_{\text{Actual}}} = \frac{N_0 * 0.27/0.42 (1 - e^{-0.42})}{N_0 * 0.16/0.31 (1 - e^{-0.31})} = 1.59 \quad \text{Eqn. 5}$$

where:

$$F_{\text{target}} = 0.27,$$

$$F_{\text{actual}} = 0.16 \text{ (F values were taken from 2004 striped bass VPA results).}$$

$$M = 0.15.$$

Calculation of uncaught allowable 2004 harvest biomass.

The calculations to estimate the 2004 catch-at-age provided vectors of recreational harvest by length group for each MRFSS Wave. Landings-at-length were multiplied by 0.59 to produce vectors of uncaught allowable harvest per length group (Table 10a-c).

Uncaught allowable harvest-at-length was multiplied by weight-at-length to produce biomass-at-length. Because the length-weight relationship has been shown to change throughout the year, a regression was developed for each MRFSS Wave. Weight-at-length parameters for the standard linear log-log length-weight regression were developed as part of the 2004 catch-at-age (Table 11). Summation of the biomass-at-length values produced the total biomass of the excess allowable 2004 harvest for each wave (Table 10a-c).

Calculation of 2005 biomass of uncaught allowable 2004 harvest.

Growth and population loss were applied to the 2004 uncaught allowable fish to calculate parameters for these fish in 2005.

The 2005 length of each 2004 length group was calculated by applying a growth regression developed from coastwide growth data provided by Gary Sheppard of NOAA. The annual increase in length was calculated as:

$$\text{Log Length}_{T+1} = (0.9158 * \text{log length}_T) + 123.65 \quad \text{Eqn. 6}$$

where:

$$T = \text{year},$$

Length is measured as total length in mm.

These calculations produced a vector of 2005 lengths for each 2004 length group (Table 10a-c).

The number of fish in each 2005 length group was calculated by applying the population growth relationship:

$$N_{T+1} = N_T e^{(-Z)} \quad \text{Eqn. 7}$$

where:

$$Z = 0.30 + 0.15 = 0.45 \quad \text{Eqn. 8}$$

The 2005 population per length group was therefore:

$$N_{2005} = N_{2004} e^{(-0.45)} \quad \text{Eqn. 9}$$

Use of a conservative F value produced minimal 2005 population estimates.

The 2005 biomass per length group was calculated by multiplying the 2005 population-at-length by weight-at-length to produce biomass-at-length. 2004 Wave-specific length-weight parameters were used (Table 11).

The total biomass of all 2005 length groups greater than 28 inches (711mm) was greater than the overage of the 2005 spring striped bass migrant harvest (Table 12). The projection was carried forward for several years under the assumption that annual total mortality Z would be equivalent to target fishing mortality (F = 0.3) plus natural mortality (M = 0.15). Results indicated that even higher biomass can be achieved by the saved fish - their total cumulative biomass in five years (2009) would be 546,236 kg (Table 13). Thus the savings achieved by harvesting striped bass below target fishing mortality in Chesapeake Bay has provided a significant addition to reproductive potential as well as additional harvest along the coast. These savings provide more than adequate compensation for the excess 2005 spring harvest.

V. Proposal to Eliminate the Chesapeake Bay Spring Trophy Fishery Quota

The total number of fish harvested during the spring trophy season is subject to significant variation due to factors such as spawning population size, fishing effort, and residence time for spawners (as influenced by weather conditions). The spring 2005 weather conditions (extended period of cool weather) are historically associated with long spawning seasons in the Bay and increased vulnerability of coastal migrants to recreational fishery in the Bay.

The VPA-based estimates of striped bass spawning stock are at record high levels. These estimates are supported by data from the Maryland DNR spring spawning survey. As discussed in Section I, fishing effort of the charter boat fleet is maximized. The number of private boat anglers is likely to be close to the maximum level as well.

Based on the expected trends in spawning stock abundance and fishing effort, we anticipate the spring trophy harvest in the next few years at or below the 2005 level. Some decline in the number of spawners is expected in the future, once the dominant 1993 and 1996 year-classes decline in numbers due to natural and fishing mortality. Fishing effort in the Chesapeake Bay trophy fishery is not expected to increase. In addition, average and warm weather conditions during the spring season will substantially reduce the residence time of spring migrants and harvest compared to the 2005 season.

With fishing effort being relatively stable, the spring trophy harvest seems to fluctuate with spawning population size, similar to the recently accepted method of harvest cap calculation. Consequently, the harvest is expected to be close to the estimated quota with some variation. Given the modest harvest of spring migrants in Chesapeake Bay compared to coastwide harvest of the migrant striped bass, any overages of spring cap in the Bay would cause a very small increase in the total fishing mortality rate of the striped bass stock 28 inches and larger. Attempts to regulate recreational fishery by the means of a hard cap have shown to be impractical in many fisheries, resulting in a series of under and over harvesting, primarily due to estimation of actual harvest 'post factum'.

Continuous annual adjustments of fishing season, minimum size and bag limit do not seem to improve management success. As an alternative to ad hoc management, we propose to eliminate the Chesapeake Bay spring trophy season quota. Bay jurisdictions will continue to control the spring migrant harvest by a combination of strict regulations - fixed season (one month duration from mid April to mid May), one fish creel limit and 28" minimum size. The states of Maryland and Virginia will continue to estimate and report total spring trophy harvest. Given the continuation of the current management strategy for striped bass in Chesapeake Bay the annual fishing mortality is expected to be below the target F, thus providing substantial overcompensation for the harvest of spring migrants.

References

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Jones P. 2003. Estimates of the harvest of coastal migrant striped bass in Chesapeake Bay in the spring of 2003. Report to the ASMFC Striped Bass Technical Committee, November 2003.

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Table 1. Total 2005 Maryland striped bass spring harvest, reported charter harvest, apportioned Maryland spring harvest, and estimate of the Maryland 2005 striped bass coastal migrant harvest.

	Interval	Charter Harvest (number of fish)	Charter Harvest (% by interval)	MRFSS Private Harvest	MD Spring Harvest Portioned into Approximately 2-week Intervals	Migrant Harvest
Wave 2	Apr 1-15	0	0	0	0	0
	Apr 16-30	9,534	100	22,336	31,870	23,911
Wave 3	May 1-15	9,960	0.25	29,820	39,780	30,720
	May 16-31	7,253	0.18	21,715	28,968	8,111
	June 1-15	9,361	0.24	28,026	37,387	1,603
	June 16-30	12,938	0.33	38,786		
Wave 3 total		39,512		118,297		
Season Total		36,108		101,897	138,005	64,345

Table 2. Maryland spring striped bass harvest for charter and private/rental boats for waves 2 and 3. Charter boat harvest derived from Maryland charter boat log reports. Private/rental boat harvest estimates from MRFSS.

	MD DNR Charter Logs	MRFSS Private
Wave 2	9,534	22,336
Wave 3	39,512	118,297

Table 3. Length distribution of the Maryland striped bass spring season harvest by 2-week intervals, based on length data collected by the Maryland DNR charter boat creel survey (Apr 16 – June 15).

LGp	Apr 16-30	May 1-16	May 17-31	June 1-15
18			12	8
19			39	16
20			17	15
21			12	15
22			4	14
23			5	10
24			1	11
25			2	7
26			5	5
27			2	4
28	1		2	8
29	1	1	1	4
30	4	2	1	1
31	5	4	1	0
32	14	13	5	0
33	18	17	3	0
34	29	16	9	2
35	19	23	11	1
36	12	17	5	1
37	13	10	3	0
38	8	11	7	0
39	7	6	2	0
40	5	4	5	0
41	6	2	0	0
42	1	3	1	0
43	0	1	0	0
44	0	0	0	0
45	1	0	0	0
46	0	1	1	0
n	144	131	156	122

Table 4a.

Development of April 16-30, 2005 Maryland striped bass coastal migrant harvest, distributed among length groups, based on length data from Maryland DNR charter boat creel survey, charter boat harvest from Maryland charter boat log reports, and private/rental boat harvest from MRFSS angler intercept survey.

LGrp (TL, in)	Probability of Mmigration	Frequency	Proportion	Number	Migrants	Residents
28	0.1283	1	0.01	221	28	193
29	0.193	1	0.01	221	43	179
30	0.2797	4	0.03	885	248	638
31	0.3868	5	0.03	1,107	428	679
32	0.5061	14	0.10	3,098	1,568	1,530
33	0.6247	18	0.13	3,984	2,489	1,495
34	0.73	29	0.20	6,418	4,685	1,733
35	0.8146	19	0.13	4,205	3,425	780
36	0.8771	12	0.08	2,656	2,329	326
37	0.9206	13	0.09	2,877	2,649	228
38	0.9496	8	0.06	1,771	1,681	89
39	0.9683	7	0.05	1,549	1,500	49
40	0.9803	5	0.03	1,107	1,085	22
41	0.9878	6	0.04	1,328	1,312	16
42	0.9924	1	0.01	221	220	2
43	0.9953	0	0.00	0	0	0
44	0.9971	0	0.00	0	0	0
45	1	1	0.01	221	221	0
46	1	0	0.00	0	0	0
47	1	0	0.00	0	0	0
48	1	0	0.00	0	0	0
total		144	1.00	31,870	23,911	7,959

Table 4b.

Development of May 1-16, 2005 Maryland striped bass coastal migrant harvest, distributed among length groups, based on length data from Maryland DNR charter boat creel survey, charter boat harvest from Maryland charter boat log reports, and private/rental boat harvest from MRFSS angler intercept survey.

LGp (TL, in)	Probability of Mmigration	Frequency	Proportion	Number	Migrants	Residents
28	0.1283	0	0.00	0	0	0
29	0.193	1	0.01	304	59	245
30	0.2797	2	0.02	607	170	437
31	0.3868	4	0.03	1,215	470	745
32	0.5061	13	0.10	3,948	1,998	1,950
33	0.6247	17	0.13	5,163	3,225	1,938
34	0.73	16	0.12	4,859	3,547	1,312
35	0.8146	23	0.18	6,985	5,690	1,295
36	0.8771	17	0.13	5,163	4,528	635
37	0.9206	10	0.08	3,037	2,796	241
38	0.9496	11	0.08	3,341	3,172	168
39	0.9683	6	0.05	1,822	1,764	58
40	0.9803	4	0.03	1,215	1,191	24
41	0.9878	2	0.02	607	600	7
42	0.9924	3	0.02	911	904	7
43	0.9953	1	0.01	304	302	1
44	0.9971	0	0.00	0	0	0
45	1	0	0.00	0	0	0
46	1	1	0.01	304	304	0
47	1	0	0.00	0	0	0
48	1	0	0.00	0	0	0
total		131	1.00	39,784	30,720	9,063

Table 4c. Development of May 17-31, 2005 Maryland striped bass coastal migrant harvest, distributed among length groups, based on length data from Maryland DNR charter boat creel survey, charter boat harvest from Maryland charter boat log reports, and private/rental boat harvest from MRFSS angler intercept survey.

LGrp (TL, in)	Probability of Mmigration	Frequency	Proportion	Number	Migrants	Residents
18		12	0.08	2,229	0	2,229
19		39	0.25	7,243	0	7,243
20		17	0.11	3,157	0	3,157
21		12	0.08	2,229	0	2,229
22		4	0.03	743	0	743
23		5	0.03	929	0	929
24		1	0.01	186	0	186
25		2	0.01	371	0	371
26		5	0.03	929	0	929
27		2	0.01	371	0	371
28	0.1283	2	0.01	371	48	324
29	0.193	1	0.01	186	36	150
30	0.2797	1	0.01	186	52	134
31	0.3868	1	0.01	186	72	114
32	0.5061	5	0.03	929	470	459
33	0.6247	3	0.02	557	348	209
34	0.73	9	0.06	1,671	1,220	451
35	0.8146	11	0.07	2,043	1,664	379
36	0.8771	5	0.03	929	814	114
37	0.9206	3	0.02	557	513	44
38	0.9496	7	0.04	1,300	1,234	66
39	0.9683	2	0.01	371	360	12
40	0.9803	5	0.03	929	910	18
41	0.9878	0	0.00	0	0	0
42	0.9924	1	0.01	186	184	1
43	0.9953	0	0.00	0	0	0
44	0.9971	0	0.00	0	0	0
45	1	0	0.00	0	0	0
46	1	1	0.01	186	186	0
47	1	0	0.00	0	0	0
48	1	0	0.00	0	0	0
n		156	1.00	28,971	8,111	20,860

Table 4d. Development of June 1-15, 2005 Maryland striped bass coastal migrant harvest, distributed among length groups, based on length data from Maryland DNR charter boat creel survey, charter boat harvest from Maryland charter boat log reports, and private/rental boat harvest from MRFSS angler intercept survey.

LGrp (TL, in)	Probability of Mmigration	Frequency	Proportion	Number	Migrants	Residents
18		8	0.07	2,452	0	2,452
19		16	0.13	4,903	0	4,903
20		15	0.12	4,597	0	4,597
21		15	0.12	4,597	0	4,597
22		14	0.11	4,290	0	4,290
23		10	0.08	3,065	0	3,065
24		11	0.09	3,371	0	3,371
25		7	0.06	2,145	0	2,145
26		5	0.04	1,582	0	1,582
27		4	0.03	1,226	0	1,226
28	0.1283	8	0.07	2,452	315	2,137
29	0.193	4	0.03	1,226	237	989
30	0.2797	1	0.01	306	86	221
31	0.3868	0	0.00	0	0	0
32	0.5061	0	0.00	0	0	0
33	0.6247	0	0.00	0	0	0
34	0.73	2	0.02	613	447	165
35	0.8146	1	0.01	306	250	57
36	0.8771	1	0.01	306	269	38
37	0.9206	0	0.00	0	0	0
38	0.9496	0	0.00	0	0	0
39	0.9683	0	0.00	0	0	0
40	0.9803	0	0.00	0	0	0
41	0.9878	0	0.00	0	0	0
42	0.9924	0	0.00	0	0	0
43	0.9953	0	0.00	0	0	0
44	0.9971	0	0.00	0	0	0
45	1	0	0.00	0	0	0
46	1	0	0.00	0	0	0
47	1	0	0.00	0	0	0
48	1	0	0.00	0	0	0
n		122	1.00	37,387	1,603	35,784

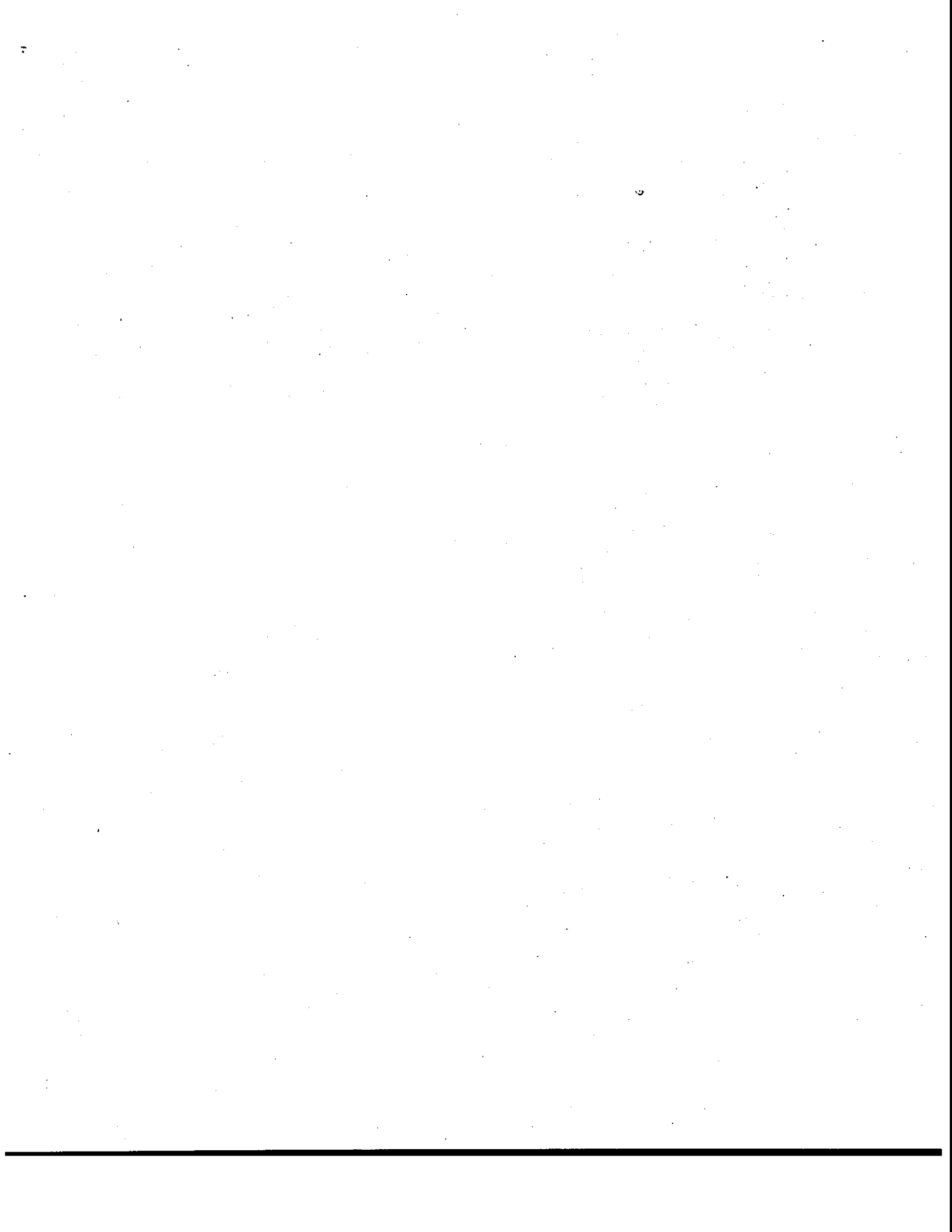


Table 5. Updated estimates of striped bass population size at age and corresponding spring trophy quota estimates for Chesapeake Bay.

Age (years)	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1	12,286	15,021	10,337	10,696	8,006	14,847	17,330	5,734	21,380	12,177
2	10,896	10,574	12,927	8,873	9,197	6,855	12,746	14,893	4,909	18,359
3	11,351	9,292	8,836	10,956	7,529	7,616	5,750	10,773	12,585	4,061
4	5,861	9,177	7,547	7,156	9,029	6,091	6,156	4,666	8,836	10,096
5	3,831	4,457	7,112	5,842	5,552	6,856	4,683	4,870	3,469	6,926
6	2,973	2,804	3,266	5,081	4,425	3,834	5,132	3,503	3,553	2,520
7	2,162	2,135	1,865	2,339	3,713	3,087	2,656	3,731	2,475	2,568
8	1,093	1,458	1,463	1,346	1,702	2,513	2,124	1,811	2,581	1,663
9	811	748	911	1,014	948	1,176	1,719	1,500	1,119	1,655
10	438	569	459	585	694	668	822	1,224	958	568
11	185	314	378	290	376	467	464	609	800	527
12	252	120	215	238	160	268	307	318	411	451
13	116	100	312	241	168	260	394	367	433	498
8+ numbers	2,895	3,309	3,738	3,714	4,048	5,352	5,830	5,829	6,302	5,362
quota =>	30,000	34,290	38,736	38,487	41,948	55,461	60,415	60,404	65,306	55,565

Table 6. Projected population size and harvest quota for the Chesapeake Bay spring coastal migrant striped bass fishery in 2006.

Age	Partial Recruitment in 2004	Estimated 1/1/2005 Abundance (thousands)	Projected 1/1/2006 Abundance (thousands)
1	0.01	12177	
2	0.07	18339	10,460
3	0.13	4061	15,434
4	0.18	10096	3,359
5	0.32	6926	8,241
6	0.33	2520	5,415
7	0.47	2568	1,964
8	0.56	1663	1,921
9	1.00	1655	1,211
10	0.84	568	1,055
11	0.80	527	379
12	0.71	451	357
13	0.71	498	313
8+		5,362	5,237
Spring Quota			54,266

Table 7. Summary of the spring coastal migrant striped bass harvest in Chesapeake Bay and spring harvest quota by year since 1991. (Note that the PRFC harvest is included in data presented for Maryland and Virginia).

Year	MD	VA	Total	TC Approved Harvest Cap	Over Quota	Adjusted for Overage
1991	336			3,000		
1992	1,013			3,000		
1993	2,719			3,000		
1994	3,672			5,000		
1995	42,368	266	42,634	25,000		
1996	11,480	133	11,613	30,000		
1997	21,001	221	21,222	30,000		
1998	9,898	123	10,021	30,000		
1999	16,758	293	17,051	30,000		
2000	26,669	79	26,748	30,000		
2001	25,714	14	25,728	30,000		
2002	14,814	25	14,839	30,000		
2003	43,248	242	43,900	30,000	-13,900	
2004	31,218	186	31,404	40,624	-4,680	26,724
2005	64,345		64,345	40,624	-23,721	40,624*
2006				54,266		30,545

* no adjustment has been made by the Management Board.

Table 8. Observed fishing mortality and harvest of striped bass in Chesapeake Bay, estimated harvest at target fishing mortality $F=0.27$ and achieved savings.

Year	Observed F	Observed Harvest	Harvest at Target F (0.27)	Savings (# fish)
1993	0.19	521,993	714,497	192,504
1994	0.2	587,191	767,160	179,969
1995	0.25	1,017,726	1,088,949	71,223
1996	0.33	1,071,505	901,361	-170,144
1997	0.25	1,559,862	1,669,025	109,163
1998	0.21	1,699,544	2,124,676	425,132
1999	0.31	1,498,877	1,329,900	-168,977
2000	0.28	1,716,129	1,662,546	-53,583
2001	0.23	1,516,948	1,747,826	230,878
2002	0.22	1,280,177	1,534,853	254,676
2003	0.2	1,547,869	2,022,277	474,408
2004	0.16	1,616,707	2,590,828	974,121

Table 9. Development of overage biomass of Maryland 2005 coastal migrant striped bass harvest, based on overage of 8,780 migrants.

LGrp (IN)	LGrp (MM)	April 16-30	May 1-15	May 16-31	June 1-15	Landings By LGrp	Overage By LGrp	Proportion By LGrp	Weight at Length (kg/mm)	Overage Biomass By LGrp
28	711	28	0	48	315	391	53	0.01	3.64	194
29	737	43	59	36	237	375	51	0.01	4.05	207
30	762	248	170	52	86	556	76	0.01	4.50	341
31	787	428	470	72	0	970	132	0.02	4.98	659
32	813	1,568	1,998	470	0	4,036	551	0.06	5.50	3,028
33	838	2,489	3,225	348	0	6,062	827	0.09	6.05	5,002
34	864	4,685	3,547	1,220	447	9,899	1,351	0.15	6.63	8,959
35	889	3,425	5,690	1,664	250	11,029	1,505	0.17	7.26	10,920
36	914	2,329	4,528	814	269	7,940	1,083	0.12	7.92	8,578
37	940	2,649	2,796	513	0	5,958	813	0.09	8.62	7,006
38	965	1,681	3,172	1,234	0	6,087	831	0.09	9.36	7,775
39	991	1,500	1,764	360	0	3,624	494	0.06	10.15	5,017
40	1,016	1,085	1,191	910	0	3,186	435	0.05	10.97	4,770
41	1,041	1,312	600	0	0	1,912	261	0.03	11.85	3,090
42	1,067	220	904	184	0	1,308	178	0.02	12.76	2,277
43	1,092	0	302	0	0	302	41	0.00	13.73	566
44	1,118	0	0	0	0	0	0	0.00	14.74	0
45	1,143	221	0	0	0	221	30	0.00	15.80	477
46	1,168	0	304	186	0	490	67	0.01	16.92	1,131
47	1,194	0	0	0	0	0	0	0.00	18.08	0
48	1,219	0	0	0	0	0	0	0.00	19.30	0
		23,911	30,720	8,111	1,604	64,346	8,780	1.00	TOTAL	69,999 KG

Table 10a. Development of 2005 biomass (kg) of uncaught allowable 2004 Wave 4 recreational harvest. Shaded areas are fish ≥ 28 inches.

2004	2004	2004	2004	2005	2005	2005	2005
LGrp (mm)	Wave 4 Uncaught	Wt/LGrp (kg/mm)	Biomass By LGrp (kg)	LGrp New Length	LGrp New Numbers	Wt/LGrp (kg/mm)	Biomass/LGrp (kg)
300	0	0.2	0	398	0	0.6	0
320	0	0.3	0	417	0	0.6	0
340	0	0.3	0	435	0	0.7	0
360	0	0.4	0	453	0	0.8	0
380	0	0.5	0	472	0	0.9	0
400	0	0.6	0	490	0	1.1	0
420	1,032	0.7	674	508	658	1.2	782
440	1,032	0.8	780	527	658	1.3	873
460	8,255	0.9	7,169	545	5,264	1.5	7,777
480	6,191	1.0	6,145	563	3,948	1.6	6,470
500	7,223	1.1	8,148	582	4,606	1.8	8,346
520	4,127	1.3	5,266	600	2,632	2.0	5,256
540	4,127	1.4	5,928	618	2,632	2.2	5,776
560	4,643	1.6	7,474	636	2,961	2.4	7,122
580	2,064	1.8	3,708	655	1,316	2.6	3,460
600	2,064	2.0	4,125	673	1,316	2.9	3,772
620	3,611	2.2	8,000	691	2,303	3.1	7,182
640	4,643	2.4	11,363	710	2,961	3.4	10,023
660	3,096	2.7	8,343	728	11,974	3.7	7,238
680	516	3.0	1,527	746	329	4.0	1,304
700	516	3.2	1,672	765	329	4.5	1,407
720	0	3.5	0	783	0	4.6	0
740	0	3.9	0	801	0	5.0	0
760	0	4.2	0	820	0	5.3	0
780	0	4.6	0	838	0	5.7	0
800	0	4.9	0	856	0	6.1	0
820	0	5.3	0	875	0	6.5	0
840	0	5.7	0	893	0	7.0	0
860	516	6.2	3,190	911	329	7.4	2,439
880	0	6.6	0	930	0	7.9	0
900	0	7.1	0	948	0	8.4	0
920	0	7.6	0	966	0	8.9	0
940	0	8.2	0	985	0	9.4	0
960	0	8.7	0	1003	0	10.0	0
980	0	9.3	0	1021	0	10.6	0
1000	0	9.9	0	1039	0	11.2	0
1020	0	10.6	0	1058	0	11.8	0
1040	0	11.2	0	1076	0	12.5	0
1060	0	11.9	0	1094	0	13.2	0
1080	0	12.6	0	1113	0	13.9	0
1100	0	13.4	0	1131	0	14.6	0
1120	0	14.2	0	1149	0	15.4	0
1140	0	15.0	0	1168	0	16.1	0
1160	0	15.8	0	1186	0	16.9	0
1180	0	16.7	0	1204	0	17.8	0
1200	0	17.6	0	1223	0	18.6	0
1220	0	18.5	0	1241	0	19.5	0
For TL ≥ 28 in	0		3,190		5,921		22,410

Table 10b. Development of 2005 biomass (kg) of uncaught allowable 2004 Wave 5 recreational harvest. Shaded areas are fish ≥ 28 inches.

2004	2004	2004	2004	2005	2005	2005	2005
LGrp (mm)	Wave 4 Uncaught	Wt/LGrp (kg/mm)	Biomass By LGrp (kg)	LGrp New Length	LGrp New Numbers	Wt/LGrp (kg/mm)	Biomass/LGrp (kg)
300	214	0.2	67	124	136	0.5	75
320	214	0.3	87	124	136	0.6	86
340	0	0.3	113	124	0	0.7	0
360	0	0.4	143	124	0	0.8	0
380	0	0.5	179	124	0	0.9	0
400	214	0.6	222	124	136	1.1	144
420	428	0.6	272	839	273	1.2	324
440	2,994	0.8	331	923	1,909	1.3	2,540
460	8,341	0.9	398	7246	5,319	1.5	7,889
480	6,202	1.0	476	6049	3,955	1.6	6,516
500	5,347	1.1	564	7767	3,409	1.8	6,218
520	7,486	1.3	665	4937	4,773	2.0	9,607
540	8,555	1.4	778	5414	5,455	2.2	12,081
560	2,994	1.6	906	6646	1,909	2.4	4,639
580	2,780	1.8	1,049	3292	1,773	2.7	4,715
600	1,925	2.0	1,209	3578	1,227	2.9	3,563
620	1,925	2.2	1,386	6701	1,227	3.2	3,880
640	1,283	2.5	1,583	9303	3818	3.4	2,811
660	642	2.7	1,800	6752	409	3.7	1,524
680	428	3.0	2,039	1318	273	4.0	1,099
700	0	3.3	2,301	1412	0	4.4	0
720	0	3.6	2,589	124	0	4.7	0
740	0	3.9	2,903	124	0	5.1	0
760	0	4.3	3,245	124	0	5.4	0
780	0	4.6	3,617	124	0	5.8	0
800	0	5.0	4,020	124	0	6.2	0
820	0	5.4	4,457	124	0	6.7	0
840	0	5.9	4,929	124	0	7.1	0
860	0	6.3	5,438	2357	0	7.6	0
880	0	6.8	5,986	124	0	8.1	0
900	0	7.3	6,575	124	0	8.6	0
920	0	7.8	7,208	124	0	9.2	0
940	0	8.4	7,885	124	0	9.7	0
960	0	9.0	8,610	124	0	10.3	0
980	0	9.6	9,385	124	0	10.9	0
1000	0	10.2	10,211	124	0	11.5	0
1020	0	10.9	11,092	124	0	12.2	0
1040	0	11.6	12,029	124	0	12.9	0
1060	0	12.3	13,026	124	0	13.6	0
1080	0	13.0	14,084	124	0	14.3	0
1100	0	13.8	15,206	124	0	15.1	0
1120	0	14.6	16,395	124	0	15.9	0
1140	0	15.5	17,653	124	0	16.7	0
1160	0	16.4	18,983	124	0	17.6	0
1180	0	17.3	20,388	124	0	18.4	0
1200	0	18.2	21,871	124	0	19.3	0
1220	0	19.2	23,435	124	0	20.3	0
For TL ≥ 28 in	0		271,218		1,500	TOTAL	5,434

Table 10c. Development of 2005 biomass (kg) of uncaught allowable 2004 Wave 6 recreational harvest. Shaded areas are fish ≥ 28 inches.

2004	2004	2004	2004	2005	2005	2005	2005
LGrp (mm)	Wave 4 Uncaught	Wt/LGrp (kg/mm)	Biomass By LGrp (kg)	LGrp New Length	LGrp New Numbers	Wt/LGrp (kg/mm)	Biomass/LGrp (kg)
300	0	0.2	0	398	0	0.5	0
320	0	0.2	0	417	0	0.6	0
340	0	0.3	0	435	0	0.7	0
360	0	0.4	0	453	0	0.8	0
380	0	0.5	0	472	0	1.0	0
400	0	0.5	0	490	0	1.1	0
420	0	0.6	0	508	0	1.2	0
440	369	0.8	278	527	235	1.4	330
460	1,353	0.9	1,187	545	863	1.6	1,362
480	3,813	1.0	3,878	563	2,432	1.8	4,306
500	2,952	1.2	3,459	582	1,882	2.0	3,725
520	2,337	1.3	3,138	600	1,490	2.2	3,283
540	1,353	1.5	2,070	618	863	2.4	2,110
560	984	1.7	1,708	636	627	2.7	1,698
580	246	2.0	482	655	157	3.0	468
600	492	2.2	1,085	673	314	3.3	1,031
620	369	2.5	912	691	235	3.6	849
640	369	2.8	1,018	710	235	3.9	929
660	246	3.1	755	728	157	4.3	677
680	0	3.4	0	746	0	4.7	0
700	0	3.8	0	765	0	5.1	0
720	0	4.1	0	783	0	5.6	0
740	0	4.6	0	801	0	6.0	0
760	246	5.0	1,231	820	157	6.5	1,020
780	0	5.5	0	838	0	7.0	0
800	369	6.0	2,206	856	235	7.6	1,781
820	492	6.5	3,205	875	314	8.1	2,556
840	369	7.1	2,613	893	235	8.8	2,059
860	492	7.7	3,731	911	314	9.4	2,926
880	861	8.3	7,165	930	549	10.1	5,524
900	246	9.0	2,213	948	157	10.8	1,689
920	492	9.7	4,777	966	314	11.5	3,610
940	492	10.5	5,146	985	314	12.3	3,852
960	1,107	11.3	12,456	1,003	706	13.1	9,240
980	123	12.1	1,437	1,021	78	13.9	1,093
1000	615	13.0	7,973	1,039	392	14.8	5,813
1020	123	13.9	1,708	1,058	78	15.7	1,235
1040	369	14.9	5,480	1,076	235	16.7	3,933
1060	123	15.9	1,952	1,094	78	17.7	1,390
1080	246	16.9	4,164	1,113	157	18.8	2,945
1100	123	18.0	2,219	1,131	78	19.9	1,553
1120	0	19.2	0	1,149	0	21.0	0
1140	0	20.4	0	1,168	0	22.2	0
1160	0	21.7	0	1,186	0	23.4	0
1180	0	23.0	0	1,204	0	24.7	0
1200	0	24.4	0	1,223	0	26.0	0
1220	123	25.8	3,178	1,241	78	27.4	2,149
For TL ≥ 28 in	7,012		72,954		4,863	TOTAL	56,001

Table 11. Parameters for the standard linear log-log length-weight regression for Maryland recreational harvest for MRFSS Waves 4, 5 and 6 of 2004.

Parameter	Wave 4	Wave 5	Wave 6
a	-19.373	-19.627	-21.392
b	3.137	3.178	3.468

Table 12. Biomass of uncaught allowable 2004 summer-fall striped bass that would be greater than or equal to 28 inches total length by the end of 2005.

Wave	Biomass (kg)
Wave 4	22,410
Wave 5	5,434
Wave 6	56,001
Total	83,845

Table 13. Projected biomass of uncaught fish greater than 28 inches from allowable harvest in the 2004 Chesapeake Bay summer and fall fishery that will survive through the 2005-2009 under the assumption of total mortality $Z = 0.45$.

Year	2005	2006	2007	2008	2009
Biomass (kg)	83,845	100,964	138,299	125,729	97,399
Cumulative Biomass	83,845	184,809	323,109	448,837	546,236

Figure 1. Time series of Waves 2 & 3 Maryland charter boat harvest of striped bass. The 2002 MRFSS estimate is not presented because 2002 data were not available, and the estimate was the average of 1999-2001 values.

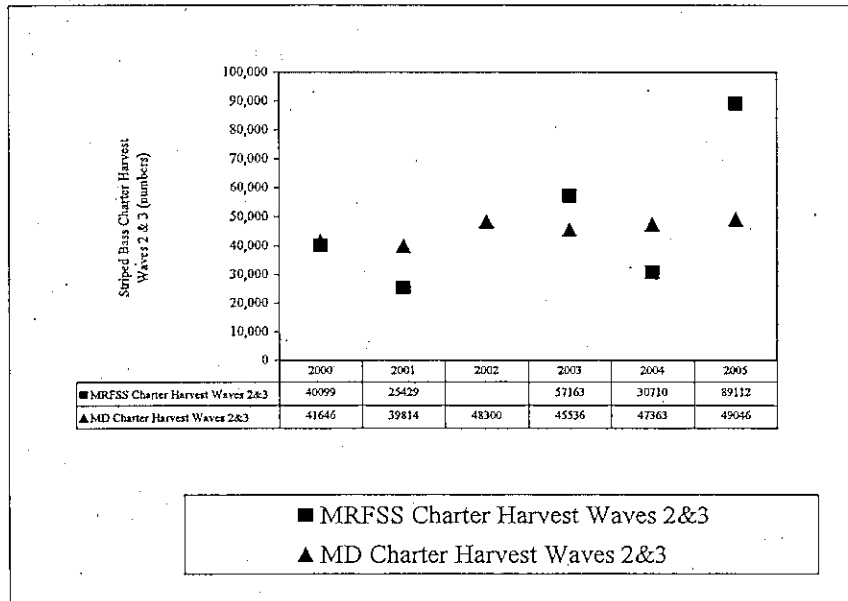


Figure 2. Time series of Waves 2 & 3 charter boat harvest, number of trips and number of anglers, based on Maryland charter boat log reports.

