

Appendix A5a: Analysis and Discussion of the 1998-2002 Striped Bass Coastwide Weight-at-Age

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Introduction

A crucial element of the yearly catch-age based virtual population analyses (VPA) of Atlantic striped bass is the calculation of biomass of the mixed coastal stock. This calculation requires coastwide weight-at-age (WAA). The coastwide WAA has consistently been calculated as a weighted mean:

$$\text{State WAA} = \Sigma (\text{state WAA} * \% \text{ state CAA by numbers}) \quad \text{Eqn. 1}$$

$$\text{Coastwide WAA} = \Sigma (\text{State WAA} * \text{state \% coastwide CAA}) \quad \text{Eqn. 2}$$

The current VPA analysis uses a time series dating back to 1982. The yearly values were not calculated on a yearly basis, however. In 1997, the values for 1982-1997 were developed. These values were developed using data from all states, subdividing each year into quarterly time periods to account for growth, and weighting by numbers of fish. (Details of developing weights at age for 1982 to 1996 can be found in NEFSC Lab Ref. 98-03.) Coastwide WAA was not re-calculated in 1998 or 1999. Instead, the 1997 values were used as these years' values. The 2000, 2001 and 2002 coastwide WAA were developed at the Stock Assessment Subcommittee Workshops, weighted by total weight of fish, using readily available data sets. Therefore, the methodology and data sets used for these calculations were not consistent, either with the methodology used for the 1982-1997 WAA or with each other. The 2000-2002 values showed an apparent decline in WAA, but it was impossible to determine if this apparent trend was due to the change in method or a true change in WAA.

In 2004, a standardized report format was developed that calculated WAA as part of the CAA calculations. The 2003 coastwide WAA was developed using all states' data:

- Maine and New Hampshire recreational harvest and discards,
- Massachusetts recreational and commercial catch,
- Rhode Island recreational and commercial catch,
- Connecticut recreational catch,
- New York recreational catch and commercial landings,
- New Jersey recreational catch,
- Delaware recreational and commercial catch,
- Maryland recreational and commercial catch,
- Virginia recreational and commercial catch, and
- North Carolina recreational and commercial catch.

An apparent decline was observed between the 2001 and 2002 coastwide WAA – only 2 of 13 age-classes of harvested fish did not show a reduction in WAA (Table 1). Due to concerns about this apparent decrease in coastwide WAA and the inability to compare 1998-2002 with the rest of the time series, the subcommittee decided to re-calculate these coastwide WAA values.

Methods: Recalculation of the 1998-2002 values.

All states were requested to provide the 1998-2002 time series of WAA, landings and discards. Because information was not received from all states, it was decided to develop the coastwide WAA from information for states with greatest catch. For 1998-2001, the coastwide WAA was calculated using the 5 major harvester states (MA, NY, NJ, MD, VA), NH and CT (Table 2). For 2002, data were available to include RI and DE (Table 3). WAA was calculated as the weighted mean, weighted by numbers for commercial harvest, recreational harvest, and recreational discard. Annual state removals were taken from the time series tables for commercial harvest, recreational harvest and recreational discard numbers in the 2004 coastwide compliance report summary prepared by Gary Sheppard if not provided by state. WAA for the nearest neighboring state was used if that state's WAA was not available. The oldest age group was designated "13+", and 1982-1997 "13+" values were recalculated as the arithmetic averages of 13- to 15-year-old age class values. A constraint imposed by the 1998-2002 data was that an annual time frame was used for all calculations, as opposed to the finer time frame used in the 1982-1997 and 2003 calculations. The time series matrix of WAA including re-calculated values is presented in Table 4.

Discussion

The apparent decrease in WAA from 2000 - 2002 within the "old" WAA time series. Most age classes showed a decrease between 2000 and 2002 (14 of 15 age-classes) (Table 2). However, examination of the development of the WAA revealed that this decrease was due to differences in the development of the values. Because average WAA is greater for coastal than Chesapeake Bay states for all harvested age classes, calculations are skewed if the harvest proportion is not used in the WAA calculations.

Evaluation of the apparent decline between 2001-2002 values

The 1982-1997 coastwide WAA time series was developed using all states' data. In contrast, the 2001 coastwide WAA was developed without data from RI, CT, MD and NC. Due to comparatively low harvest, RI, CT and NC do not contribute strongly to the coastwide WAA. However, the exclusion of MD data from the 2001 calculation had a major influence on the coastwide value. Without the MD numbers factoring in to the average, the coastwide WAA was disproportionately weighted by MA (Figure 1, Table 5). This is significant because MD is a Chesapeake Bay harvest state and MA is a coastal harvest state. Based on data from 1982-1997, the majority of fish harvested in Chesapeake Bay (ages 3–11) were, on average, 2.6 kg (5.7 lb) smaller than coastal fish (Table 6). The unnaturally strong contribution of MA in the 2001 WAA, followed by the strong contribution of MD fish in the 2002 WAA, certainly contributed to the observed decline in the coastwide WAA.

Patterns in WAA from 2000–2003 within the recalculated WAA time series

Coastwide WAA values for 2000 to 2002 were recalculated using a consistent method that was considered functionally equivalent to the method used for earlier calculations. Although a subset of states was used, these states constitute the majority of the harvest and therefore maintained the overall harvest proportion throughout the WAA calculations. In contrast to the earlier values, these values showed a consistent increase across the 2000–2003 time frame (Table 4). Between 2000 and 2001, 11 of the 13 age classes showed an increase in WAA, between 2002 and 2003, 12 of the 13 age classes showed an increase in WAA. The 2003 WAA was developed from information provided by all states for the 2003 stock assessment. Comparison of the 2003 WAA against the mean values for 2000-2002 showed an increase in 11 of 13 age classes.

Comparison of "old" vs. recalculated WAA values from 2000 – 2002. Although the recalculated WAA values showed an increase across the 2000-2003 time frame, these values were lower than the mean of the 1982-1996 time series (Table 7).

Future Work

Future years' WAA will be calculated from information provided in stock assessment "Compliance Report Template", and will therefore include all states' data. No recommendations are suggested to improve calculation methodology for future years.

It would be useful to determine if there truly was a decrease between the 1982-96 WAA and the 1998-2003 WAA. However, data are not available to recalculate 1982-2002 WAA using the current method, nor are data available to recalculate 2000-03 using the earlier method.

Appendix A5a Figures

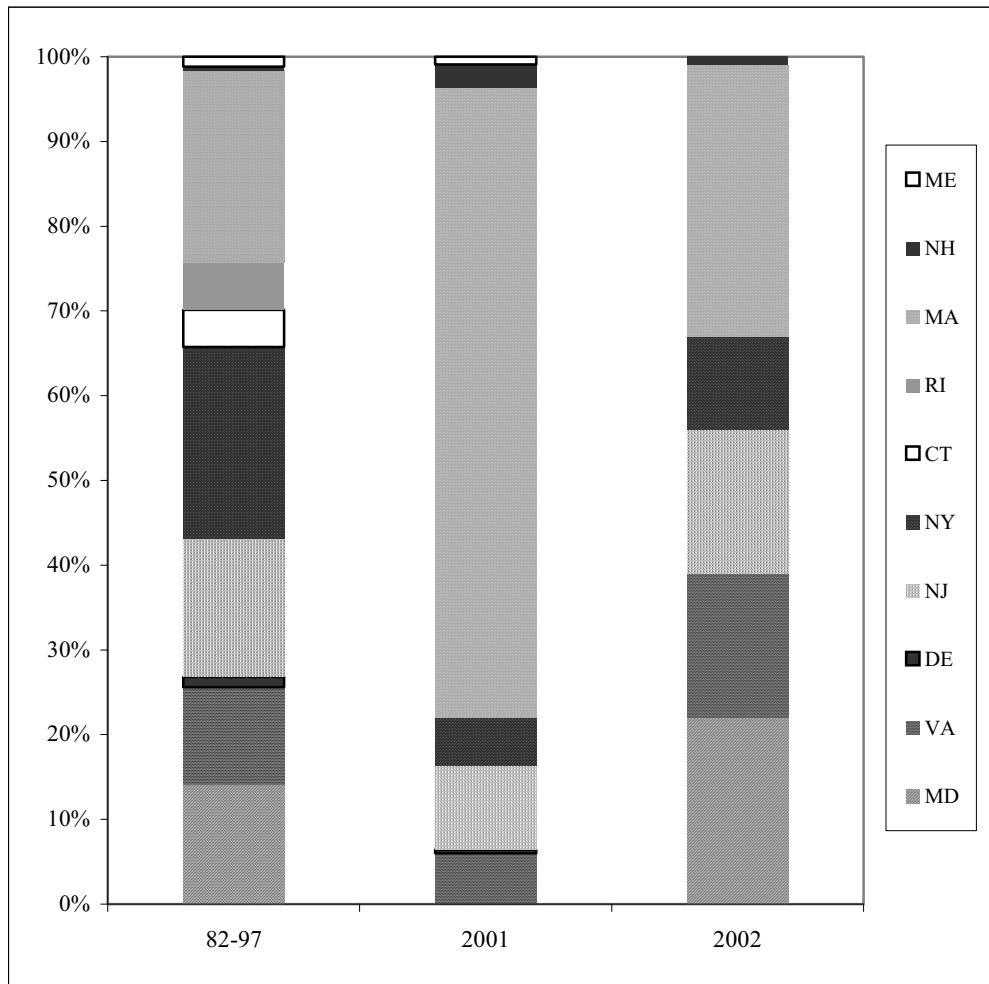


Figure 1. Composition of Striped Bass Coastwide WAA by State. 1982-1997 coastwide WAA shows a fairly even distribution from the 5 major harvest (by numbers) states (MA, NY, NJ, MD, VA). 2001 WAA is dominated by MA. 2002 WAA shows a strong contribution from MD and VA (Chesapeake Bay harvest states).

Appendix A5a Tables

Table 1. Striped Bass Coastwide WAA (kg) Time Series Used for the 2002 Stock Assessment. 1997-1999 values are identical. Note the apparent decline in WAA between 2001-2002.

Year	1	2	3	4	5	6	7	Age	8	9	10	11	12	13	14	15
1982	0.13	0.64	1.09	1.54	2.42	3.75	4.83	5.79	6.20	8.68	10.80	11.20	12.97	13.26	15.91	
1983	0.20	0.55	0.94	1.37	2.37	3.29	3.77	5.36	6.01	8.10	9.57	10.39	11.11	11.10	11.12	
1984	0.24	0.60	1.69	1.62	2.67	3.39	5.07	5.65	6.76	7.76	8.41	12.65	10.65	11.75	14.75	
1985	0.06	0.61	1.07	1.66	2.19	3.59	4.91	5.46	6.77	7.45	9.00	10.69	11.42	14.34	15.98	
1986	0.14	0.57	1.27	2.40	2.44	3.12	3.95	5.05	5.44	6.09	7.75	9.16	10.97	11.55	15.83	
1987	0.20	0.77	1.41	2.11	2.50	2.91	3.61	4.74	5.52	6.49	7.77	9.78	11.38	11.62	16.46	
1988	0.31	0.91	1.10	1.98	3.12	4.02	4.38	4.70	5.24	5.62	8.58	10.40	11.50	11.31	17.00	
1989	0.16	0.83	1.22	2.23	3.06	4.53	5.37	6.23	6.04	8.68	8.94	9.74	13.04	9.93	17.11	
1990	0.08	0.89	1.14	2.05	2.35	3.83	4.91	5.96	5.70	5.97	7.44	9.08	9.36	10.80	17.65	
1991	0.21	0.92	1.29	2.17	2.62	3.17	4.81	5.64	6.46	6.24	9.46	8.30	9.62	15.96	17.09	
1992	0.10	0.69	1.31	1.93	2.81	3.67	4.90	5.79	6.96	8.15	9.77	12.44	13.10	11.15	17.65	
1993	0.07	0.76	1.31	1.99	2.77	3.58	4.80	6.11	7.03	8.01	9.53	10.76	14.45	13.85	15.36	
1994	0.24	1.05	1.69	2.21	2.85	3.50	4.94	6.20	6.80	7.53	9.73	10.69	11.38	9.06	17.75	
1995	0.28	0.70	1.35	2.18	2.77	3.65	5.38	6.16	7.27	8.86	7.57	9.73	13.97	15.65	20.37	
1996	0.14	1.05	1.47	2.32	3.23	4.52	6.39	7.11	7.81	9.20	9.31	10.10	11.36	12.45	17.30	
1997	0.13	0.62	1.18	2.46	2.81	3.64	4.51	5.07	6.73	9.17	9.94	10.24	11.94	14.49	17.92	
1998	0.13	0.62	1.18	2.46	2.81	3.64	4.51	5.07	6.73	9.17	9.94	10.24	11.94	14.49	17.92	
1999	0.13	0.62	1.18	2.46	2.81	3.64	4.51	5.07	6.73	9.17	9.94	10.24	11.94	14.49	17.92	
2000	0.14	1.05	1.47	2.32	3.23	4.52	6.39	7.11	7.81	9.20	9.31	10.10	11.36	12.45	17.30	
2001	0.13	0.62	1.17	2.46	2.81	3.63	4.51	5.07	6.73	9.17	9.94	10.24	11.94	14.49	17.92	
2002	0.82	0.81	1.25	1.75	2.47	3.30	4.16	5.48	6.36	7.45	8.75	8.89	9.99	11.03	13.95	

Table 2. Revised Time Series of Striped Bass Coastwide WAA (kg).

Year	Age												
	1	2	3	4	5	6	7	8	9	10	11	12	13+
1982	0.1	0.6	1.1	1.5	2.4	3.7	4.8	5.8	6.2	8.7	10.8	11.2	14.0
1983	0.2	0.6	0.9	1.4	2.4	3.3	3.8	5.4	6.0	8.1	9.6	10.4	11.1
1984	0.2	0.6	1.7	1.6	2.7	3.4	5.1	5.7	6.8	7.8	8.4	12.7	12.4
1985	0.1	0.6	1.1	1.7	2.2	3.6	4.9	5.5	6.8	7.4	9.0	10.7	13.9
1986	0.1	0.6	1.3	2.4	2.4	3.1	4.0	5.0	5.4	6.1	7.8	9.2	12.8
1987	0.2	0.8	1.4	2.1	2.5	2.9	3.6	4.7	5.5	6.5	7.8	9.8	13.2
1988	0.3	0.9	1.1	2.0	3.1	4.0	4.4	4.7	5.2	5.6	8.6	10.4	13.3
1989	0.2	0.8	1.2	2.2	3.1	4.5	5.4	6.2	6.0	8.7	8.9	9.7	13.4
1990	0.1	0.9	1.1	2.1	2.4	3.8	4.9	6.0	5.7	6.0	7.4	9.1	12.6
1991	0.2	0.9	1.3	2.2	2.6	3.2	4.8	5.6	6.5	6.2	9.5	8.3	14.2
1992	0.1	0.7	1.3	1.9	2.8	3.7	4.9	5.8	7.0	8.2	9.8	12.4	14.0
1993	0.1	0.8	1.3	2.0	2.8	3.6	4.8	6.1	7.0	8.0	9.5	10.8	14.6
1994	0.2	1.1	1.7	2.2	2.9	3.5	4.9	6.2	6.8	7.5	9.7	10.7	12.7
1995	0.3	0.7	1.3	2.2	2.8	3.7	5.4	6.2	7.3	8.9	7.6	9.7	16.7
1996	0.1	1.0	1.5	2.3	3.2	4.5	6.4	7.1	7.8	9.2	9.3	10.1	13.7
1997	0.1	0.6	1.2	2.5	2.8	3.6	4.5	5.1	6.7	9.2	9.9	10.2	14.8
1998	0.4	0.8	1.2	1.6	2.2	2.9	4.7	5.7	6.8	7.0	7.8	9.9	11.9
1999	0.6	0.9	1.1	1.4	1.9	2.5	3.4	5.0	6.6	7.8	8.7	9.8	12.0
2000	0.4	0.6	1.1	1.5	2.0	2.8	3.9	5.1	7.1	7.4	9.7	10.7	13.6
2001	0.2	0.4	1.1	1.8	2.2	3.2	4.1	5.0	6.4	7.8	8.6	8.3	10.9
2002	0.1	0.3	1.1	1.5	2.2	3.2	4.2	5.5	6.0	7.6	9.1	9.7	11.5

Table 3. Comparison of 2001& 2002 Data Used to Develop Striped Bass Coastwide WAA.

STATE	2001			2002		
	SURVEYS	% WAA	% HARVEST	SURVEYS	% WAA	% HARVEST
ME	COMM (harv, discards)	1	1	X	0	2
NH	COMM (harv, discards)	3	1	REC	1	1
MA	COMBINED	74	16	COMBINED	32	20
RI	X	0	5	X	0	5
CT	X	0	3	X	0	3
NY	COMM & REC	6	13	COMM & REC	11	13
NJ	REC	10	23	REC	17	19
DE	COMM	<1	2	X	0	1
MD	X	0	17	COMM (C.BAY)	22	15
VA	COMM & REC	6	17	COMM & REC	17	19
NC	X	0	3	X	0	3

Table 4. Comparison of Average Striped Bass WAA (lb) for "Coastal" (MA, NY, NJ) and "Chesapeake Bay" (MD and VA) States, based 1982-1997 Values.

Age	Coastal	CBay	Δ
1	1.8		
2	1.9	2.3	-0.4
3	3.3	2.4	0.9
4	4.7	2.7	2.0
5	6.7	3.5	3.2
6	8.3	5.5	2.8
7	10.1	7.4	2.8
8	12.9	10.4	2.5
9	14.9	12.3	2.6
10	17.4	14.1	3.4
11	20.4	17.3	3.0
12	22.8	14.9	7.8
13	24.9	17.7	7.2
14	27.9	19.4	8.5
15	35.1	15.8	19.4

Table 5. Information Used to Calculate 1998-2002 Striped Bass Coastwide WAA.

REMOVAL	YEARS	HARVEST-AT-AGE	Pre-calculated WAA
NH Rec landings	98-02	supplied	used MA
NH Rec discards	98-02	supplied	used MA
MA Rec landings	98-02	supplied	supplied
MA Rec discards	98-02	supplied	supplied
MA Com landings	98-02	supplied	supplied
MA Com discards	98-02	supplied	supplied
RI Com landings	2002	supplied	used MA
RI Rec landings	2002	supplied	used MA
RI Rec discards	2002	supplied	used MA
CT Rec landings	98-02	GaryN CAA ³	used MA
CT Rec discards	98-00,02	GaryN CAA ³	used MA
NY all	98-00		
NY Com landings	01-02	01,02 Ann. Rpts.	01,02 Ann. Rpts.
NY Rec landings	01-02	01,02 Ann. Rpts.	01,02 Ann. Rpts.
NY Rec discards	01-02	01,02 Ann. Rpts.	01,02 Ann. Rpts.
NJ Rec landings	98-01		
NJ Rec discards	98-01	% of harvest #s ¹	% of harvest WAA ²
NJ ALL	2002	supplied	supplied
Del Com landings	2002	GaryN CAA ³	used NY
Del Rec landings	2002	GaryN CAA ³	used NJ
MD Com landings	98-02	supplied	supplied
MD Rec landings	98-02		
MD Rec discards	98-02		
VA Com landings	98-00,02	GaryN CAA ³	used MD
VA Rec landings	98-00,02	GaryN CAA ³	used MD
VA Rec discards	98-00,02	GaryN CAA ³	used MD
VA ALL	2001	GaryN CAA ³	used MD

¹ (rec harvest-at-age)*(rec discard-at-age)/(total harvest)

² Ages 2-5: discard WAA = 0.8*harvest WAA, Ages 6+: discard WAA = 0.9*harvest WAA

³ Coastwide summary CAA document supplied by Gary Nelson

Table 6. Removals Used to Calculate 1998-2002 Striped Bass Coastwide WAA.

1998	1999	2000	2001	2002
NH Rec landings NH Rec discards	NH Rec landings NH Rec discards	NH Rec landings NH Rec discards	NH Rec landings NH Rec discards	NH Rec landings NH Rec discards
MA Rec landings MA Rec discards MA Com landings MA Com discards	MA Rec landings MA Rec discards MA Com landings MA Com discards	MA Rec landings MA Rec discards MA Com landings MA Com discards	MA Rec landings MA Rec discards MA Com landings MA Com discards	MA Rec landings MA Rec discards MA Com landings MA Com discards
				RI Com landings RI Rec landings RI Rec discards
CT Rec landings CT Rec discards	CT Rec landings CT Rec discards	CT Rec landings CT Rec discards	CT Rec landings	CT Rec landings CT Rec discards
NY all	NY all	NY ALL	NY Com landings NY Rec landings NY Rec discards	NY Com landings NY Rec landings NY Rec discards
NJ Rec landings NJ Rec discards	NJ Rec landings NJ Rec discards	NJ Rec landings NJ Rec discards	NJ Rec landings NJ Rec discards	NJ ALL
				Del Com landings Del Rec landings
MD Com landings MD Rec landings MD Rec discards	MD Com landings MD Rec landings MD Rec discards	MD Com landings MD Rec landings MD Rec discards	MD Com landings MD Rec landings MD Rec discards	MD Com landings MD Rec landings MD Rec discards
VA Com landings VA Rec landings VA Rec discards	VA Com landings VA Rec landings VA Rec discards	VA Com landings VA Rec landings VA Rec discards	VA ALL	VA Com landings VA Rec landings VA Rec discards

¹ (rec harvest-at-age)*(rec discard-at-age)/(total harvest)

² Ages 2-5: discard WAA = 0.8*harvest WAA, Ages 6+: discard WAA = 0.9*harvest WAA

³ Coastwide summary CAA document supplied by Gary Nelson

Table 7. Comparison of "Old" and "New", or Recalculated Striped Bass Coastwide WAA (kg) for 2000-2003.

	YEAR	AGE	1	2	3	4	5	6	7	8	9	10	11	12	13/13+	14	15
OLD	2000		0.14	1.05	1.47	2.32	3.23	4.52	6.39	7.11	7.81	9.2	9.31	10.1	11.36	12.45	17.3
	2001		0.13	0.62	1.17	2.46	2.81	3.63	4.51	5.07	6.73	9.17	9.94	10.24	11.94	14.49	17.92
	2002		0.82	0.81	1.25	1.75	2.47	3.3	4.16	5.48	6.36	7.45	8.75	8.89	9.99	11.03	13.95
	MEAN 00-02		0.36	0.83	1.30	2.18	2.84	3.82	5.02	5.89	6.97	8.61	9.33	9.74	11.10	12.66	16.39
	Δ 2002 - 2001		0.69	0.19	0.08	-0.71	-0.34	-0.33	-0.35	0.41	-0.37	-1.72	-1.19	-1.35	-1.95	-3.46	-3.97
	Δ 2002 - 2000		0.68	-0.24	-0.22	-0.57	-0.76	-1.22	-2.23	-1.63	-1.45	-1.75	-0.56	-1.21	-1.37	-1.42	-3.35
NEW	2000		0.2	0.6	0.9	1.4	1.9	2.8	4	4.9	6.1	6	8.8	9.8	12.8		
	2001		0.1	0.4	0.8	1.7	2.2	3.2	4	5	5.9	7.2	8.1	7.4	10.6		
	2002		0.1	0.3	1.1	1.5	2.2	3.2	4.2	5.5	6.0	7.6	9.1	9.7	11.5		
	2003		0.1	0.6	1.0	1.4	2.2	3.2	4.1	5.2	6.1	7.2	8.5	9.4	11		
	Δ 2000(N) - 2000(O)		0.06	-0.45	-0.57	-0.92	-1.33	-1.72	-2.39	-2.21	-1.71	-3.2	-0.51	-0.3	1.44		
	Δ 2001(N) - 2001(O)		-0.03	-0.22	-0.37	-0.76	-0.61	-0.43	-0.51	-0.07	-0.83	-1.97	-1.84	-2.84	-1.34		
	Δ 2002(N) - 2002(O)		-0.72	-0.51	-0.15	-0.25	-0.27	-0.10	0.04	0.02	-0.36	0.15	0.35	0.81	-0.16		
	MEAN 82-96		0.2	0.8	1.3	2.0	2.7	3.6	4.8	5.7	6.4	7.5	8.9	10.3	13.5		
	Δ 2003 - MEAN 82-96		-0.07	-0.17	-0.29	-0.58	-0.48	-0.43	-0.7	-0.53	-0.3	-0.32	-0.41	-0.94	-2.5		

Negative values emphasized by italics.