

**The Abundance and Biomass of Fish and
Invertebrates in Narragansett Bay, 1990-2006.**

By Brooke Longval, a PhD Graduate student working under Dr. Candace Oviatt at the University of Rhode Island, Graduate School of Oceanography.
April 2008

The aim of this article is to provide a summary of trends in fish abundance and biomass in Narragansett Bay over the last 17 years. Data for this summary was obtained from the Rhode Island Department of Environmental Management's (RI DEM) monthly fish trawl survey. This survey has sampled approximately 15 stations in Narragansett Bay and Rhode Island sound monthly from 1990-2006. A standard otter trawl with a 13.7 meter headrope, 18.3 meter footrope and 0.95 cm stretched mesh cod end is towed for 20 minutes at 2.5 knots (4.63 km/hour) at each station (Lynch 2000). An average trawl covers 21,139 square meters. In this time period, 2090 trawls were conducted and approximately 2.3 million fish and invertebrates from 101 species were observed. While the term "fish" will be used to describe the organisms captured, two invertebrate species (American lobster and longfin squid) are included in this dataset. From this trawl survey, information on the species caught, their abundances (numbers of fish of each species) and biomass (total weight of fish of each species) were compiled.

Abundance:

The following table (Table 1) shows the top 15 species ranked by abundance (or number of fish caught) over the period from 1990-2006. Bay anchovy was the most abundant fish in the bay over the time period, with over 472,000 fish caught, or 20.5% of the total fish caught. The cumulative percent value is a running tally of the percent of total of each species, and shows that 98% of the fish in the bay belong to the 15 most abundant species. Bay anchovy, butterfish, Atlantic herring, Atlantic silverside, alewife and blueback herring are small, schooling fish that live in the water column and primarily eat small floating plants and animals (phytoplankton and zooplankton). Scup are generalized carnivores that eat a variety of prey, and both juvenile and adult scup are found in the bay. Longfin squid, weakfish and bluefish are predators that eat other fish. American lobster, winter flounder and skates are benthic (bottom) dwellers that eat polychaete worms, mollusks, fish and invertebrates. Atlantic moonfish is a subtropical species that arrives in the bay in the summer months. Feeding preferences are taken from Collette and Klein-MacPhee (2002).

Table 1: Fish Species Ranked by Abundance, 1990-2006 DEM Fish Trawl Survey

Rank	Species	Number Caught	Percent of Total	Cumulative Percent
1	Bay Anchovy	472055	20.5	20.5
2	Scup	433408	18.8	39.4
3	Butterfish	376879	16.4	55.8
4	Longfin Squid	316307	13.8	69.5
5	Atlantic Herring	290760	12.6	82.2
6	Atlantic Menhaden	89259	3.9	86.0

7	Atlantic Silverside	82845	3.6	89.6
8	Alewife	53006	2.3	92.0
9	Weakfish	30056	1.3	93.3
10	American Lobster	29109	1.3	94.5
11	Winter Flounder	22948	1.0	95.5
12	Atlantic Moonfish	17187	0.7	96.3
13	Skates	15997	0.7	97.0
14	Blueback Herring	14813	0.6	97.6
15	Bluefish	10035	0.4	98.0

Biomass:

Biomass is the weight of each species caught, and is calculated by multiplying the number of fish by the average weight per fish for each species. Here, the top 15 species by biomass are listed along with the total and cumulative percent of biomass calculated in the same way as for abundance (Table 2). Again, a few species comprise most of the biomass in the bay, with 90% of the total biomass contained in 15% of the species. A few species are “new” to this list compared to the abundance list. Most of these new species such as summer flounder, spiny dogfish, tautog and fourspot flounder are relatively large fish. Species that were in the top 15 on the abundance list that are not on the biomass list are smaller species such as Atlantic menhaden, Atlantic silverside, Atlantic moonfish and Blueback herring.

Table 2: Fish Species Ranked by Biomass, 1990-2006 DEM Fish Trawl Survey

Rank	Species	Total Biomass (kg)	Percent of Total	Cumulative Percent
1	Skates	8557	16.6	16.6
2	Scup	8048	15.6	32.1
3	American Lobster	7864	15.2	47.3
4	Butterfish	4956	9.6	56.9
5	Longfin Squid	3370	6.5	63.4
6	Winter Flounder	2870	5.6	69.0
7	Atlantic Herring	2656	5.1	74.1
8	Summer Flounder	2058	4.0	78.1
9	Spiny Dogfish	1572	3.0	81.1
10	Tautog	1470	2.8	84.0
11	Alewife	984	1.9	85.9
12	Fourspot Flounder	685	1.3	87.2
13	Bay Anchovy	619	1.2	88.4
14	Weakfish	582	1.1	89.5
15	Bluefish	552	1.1	90.6

Yearly trends:

With 17 years of data, it can be informative to look at trends in species abundance and biomass over time. The following tables show the top five species by abundance and biomass for each year from 1990-2006. Each species has its own color code to aid in visualizing the trends. These tables can be compared to the previous tables to get a more detailed picture of the trends in fish abundance and biomass in the bay.

Table 3: Yearly Ranked Abundance of Fish Species, 1990-2006

Year	1	2	3	4	5
1990	Bay Anchovy	Butterfish	Scup	Longfin Squid	Atlantic Herring
1991	Bay Anchovy	Scup	Longfin Squid	Butterfish	Amer. Lobster
1992	Bay Anchovy	Butterfish	Atlantic Herring	Longfin Squid	Scup
1993	Butterfish	Scup	Longfin Squid	Bay Anchovy	Atlantic Herring
1994	Butterfish	Longfin Squid	Bay Anchovy	Atlantic Herring	Atl. Silverside
1995	Bay Anchovy	Butterfish	Longfin Squid	Scup	At.I Silverside
1996	Bay Anchovy	Atlantic Herring	Longfin Squid	Atl. Menhaden	Scup
1997	Atlantic Herring	Bay Anchovy	Butterfish	Scup	Longfin Squid
1998	Atlantic Herring	Bay Anchovy	Butterfish	Longfin Squid	Alewife
1999	Longfin Squid	Butterfish	At.I Menhaden	Scup	Bay Anchovy
2000	Scup	Atl. Silverside	Longfin Squid	Atlantic Herring	Butterfish
2001	Bay Anchovy	Scup	Butterfish	Atlantic Herring	Longfin Squid
2002	Bay Anchovy	Atl. Menhaden	Longfin Squid	Scup	Butterfish
2003	Scup	Weakfish	Atlantic Herring	Butterfish	Alewife
2004	Bay Anchovy	Longfin Squid	Scup	Butterfish	Atlantic Herring
2005	Scup	Atlantic Herring	Longfin Squid	Butterfish	Bay Anchovy
2006	Butterfish	Scup	Longfin Squid	Atlantic Herring	Bay Anchovy

Bay anchovy was the most abundant fish overall during the trawl survey, and was most abundant in 8 of the 17 years. The other species that occupied the top spot for abundance (butterfish, Atlantic herring, longfin squid and scup) were also highly ranked overall. This indicates that the same group of species tends to dominate the fish community by abundance year to year. In some years, species that were further down on the overall list appeared in the yearly lists, such as American lobster, Atlantic menhaden or weakfish. In general, the species that were ranked high by abundance were small, schooling species. Some trends can be seen, such as the increase in rank of scup through the time series.

Table 4: Yearly Ranked Biomass of Fish Species, 1990-2006

Year	1	2	3	4	5
1990	Amer. Lobster	Scup	Winter Flounder	Skates	Atlantic Herring
1991	Scup	Amer. Lobster	Winter Flounder	Longfin Squid	Skates
1992	Amer. Lobster	Skates	Scup	Butterfish	Atlantic Herring
1993	Amer. Lobster	Skates	Butterfish	Longfin Squid	Scup
1994	Amer. Lobster	Butterfish	Skates	Longfin Squid	Scup
1995	Skates	Amer. Lobster	Winter Flounder	Scup	Butterfish
1996	Amer. Lobster	Scup	Skates	Atlantic Herring	Winter Flounder
1997	Amer. Lobster	Skates	Atlantic Herring	Butterfish	Scup
1998	Amer. Lobster	Atlantic Herring	Skates	Butterfish	Spiny Dogfish
1999	Amer. Lobster	Longfin Squid	Scup	Skates	Butterfish
2000	Scup	Skates	Amer. Lobster	Sum. Flounder	Butterfish
2001	Scup	Skates	Butterfish	Amer. Lobster	Longfin Squid
2002	Scup	Skates	Butterfish	Sum. Flounder	Longfin Squid
2003	Scup	Skates	Sum. Flounder	Amer. Lobster	Butterfish
2004	Skates	Scup	Amer. Lobster	Butterfish	Longfin Squid

2005	Skates	Scup	Amer. Lobster	Butterfish	Sum. Flounder
2006	Butterfish	Scup	Spiny Dogfish	Skates	Amer. Lobster

Unlike the trends for abundance, the highest ranked species for biomass (skates) only occupied the top spot by year in three years. However, skates ranked second in biomass for 7 out of 17 years. For all years except 2006, biomass was dominated by three species: American Lobster, scup and skates. In 2006, butterfish took the top spot in both biomass and abundance. Similar to the pattern seen with abundance, most of the top spots were occupied by a few species, with a variety of other species appearing occasionally, such as winter and summer flounder, spiny dogfish and Atlantic herring. The decline in lobster biomass through the time series can easily be seen, as well as the increase in skate biomass. Winter flounder fall out of the top five in 1996 and do not reappear on the list.

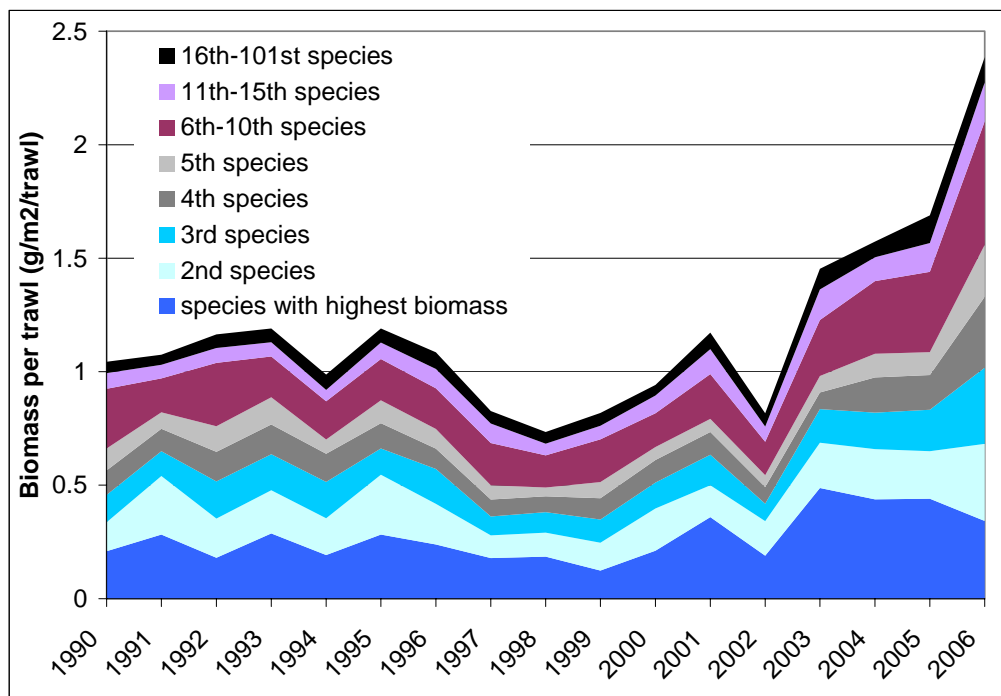


Figure 1: Cumulative Fish Biomass, 1990-2006. Biomass units are grams wet weight per meter squared.

The uppermost (black) line in Figure 1 plots the total biomass of fish caught (standardized to the average area trawled in square meters) in each year. Total fish biomass ranged from a low of 0.73 grams of fish per square meter in 1998 to 2.39 grams/m² in 2006, nearly a three-fold increase. Fish biomass has shown a steady increase from 1998 to 2006 except for 2002 when fish biomass declined to 0.82 grams/m². The individual colors represent the species holding a particular rank per year. The lowermost (blue) section represents the species with the highest rank biomass in that year (i.e. the first column in Table 4), followed by the species with the 2nd highest biomass, 3rd highest biomass, etc. The last three groups are the species ranked 6th-10th, 11th-15th and 16th-101st. This figure confirms that a few species make up the majority of the biomass in the fish community of the bay.

References:

- Collette, B.B. and G. Klein-MacPhee. 2002. *Bigelow and Schroeder's Fishes of the Gulf of Maine*. Third Edition, Smithsonian Institution Press, Washington DC. 748 pp.
- Lynch, T. 2000. *Assessment of Recreationally Important Finfish Stocks in Rhode Island Waters*. Coastal Fishery Resource Assessment Trawl Survey. RIDEM Division of Fish and Wildlife, Government Center, Wakefield, RI.