FIGURES

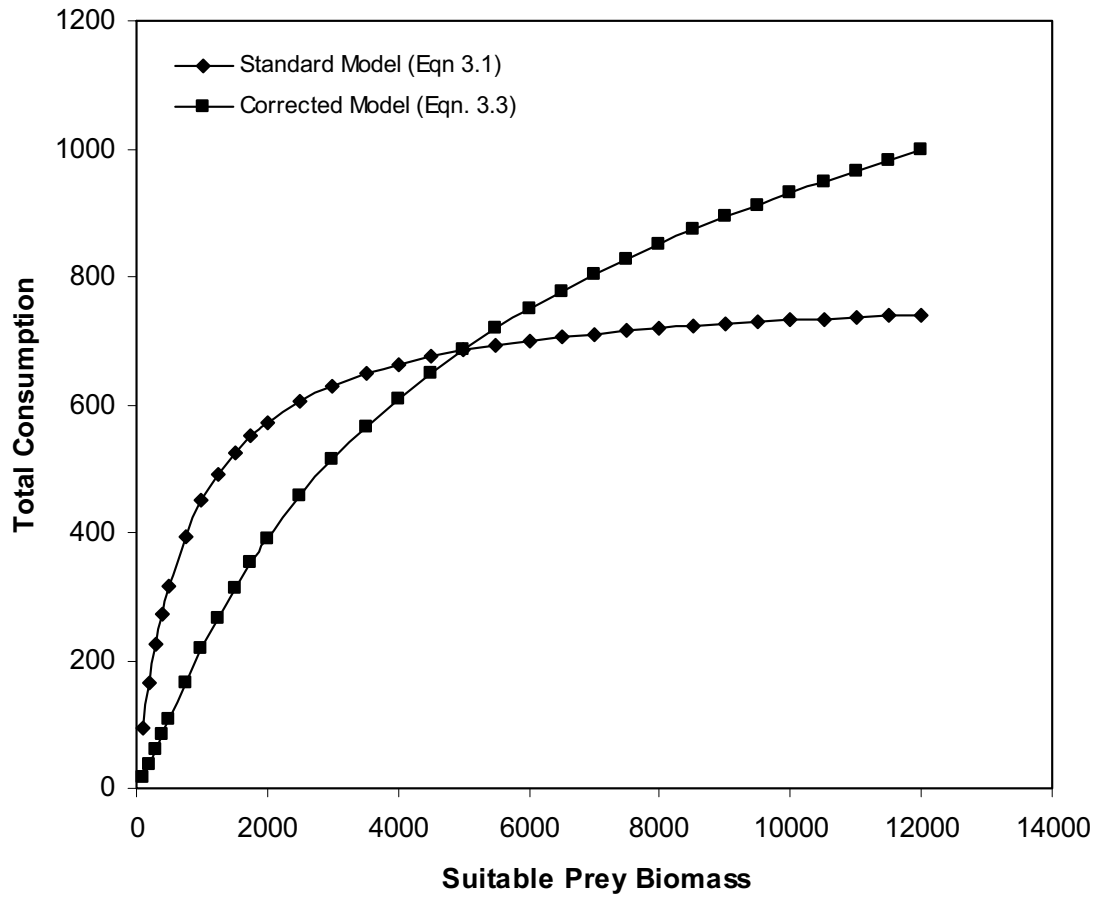Figure D.1. Predator consumption related to food availability.

Figure D.2. Predator mortality rate related to food availability.
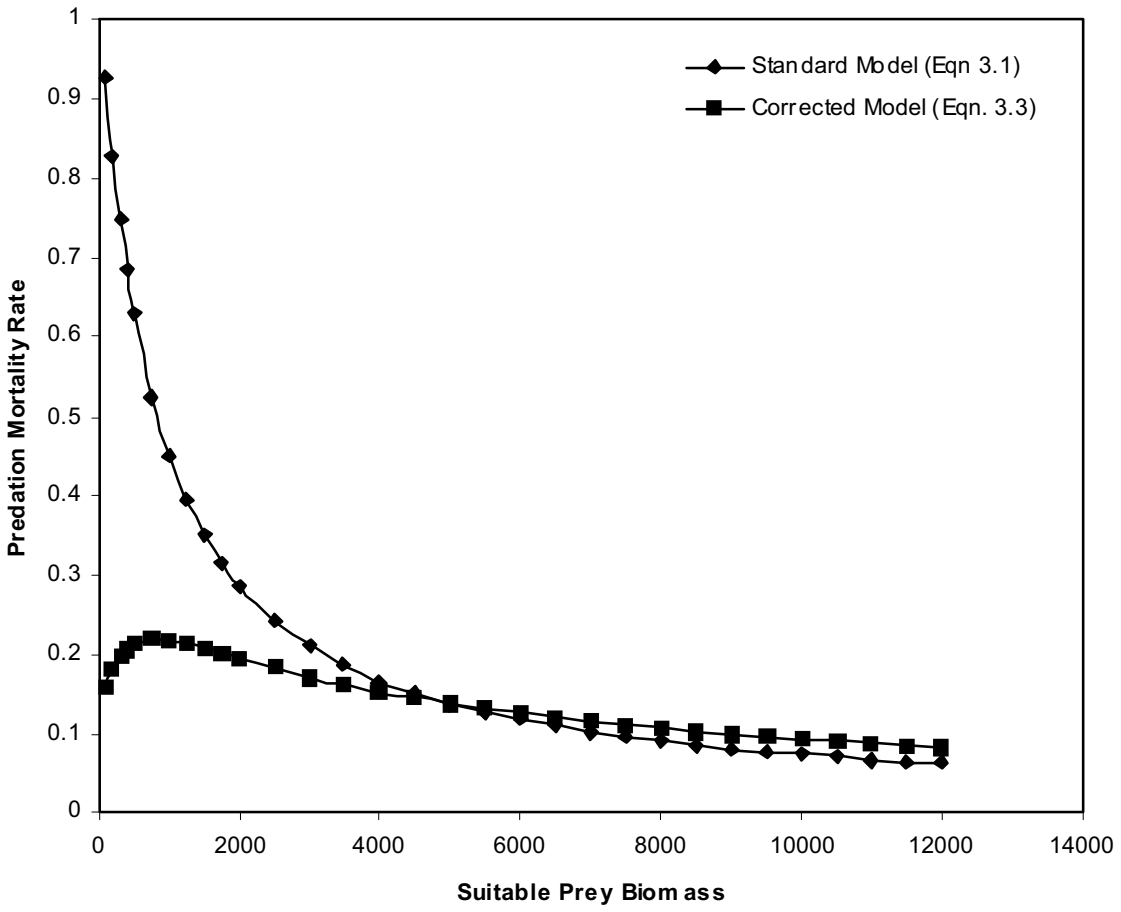
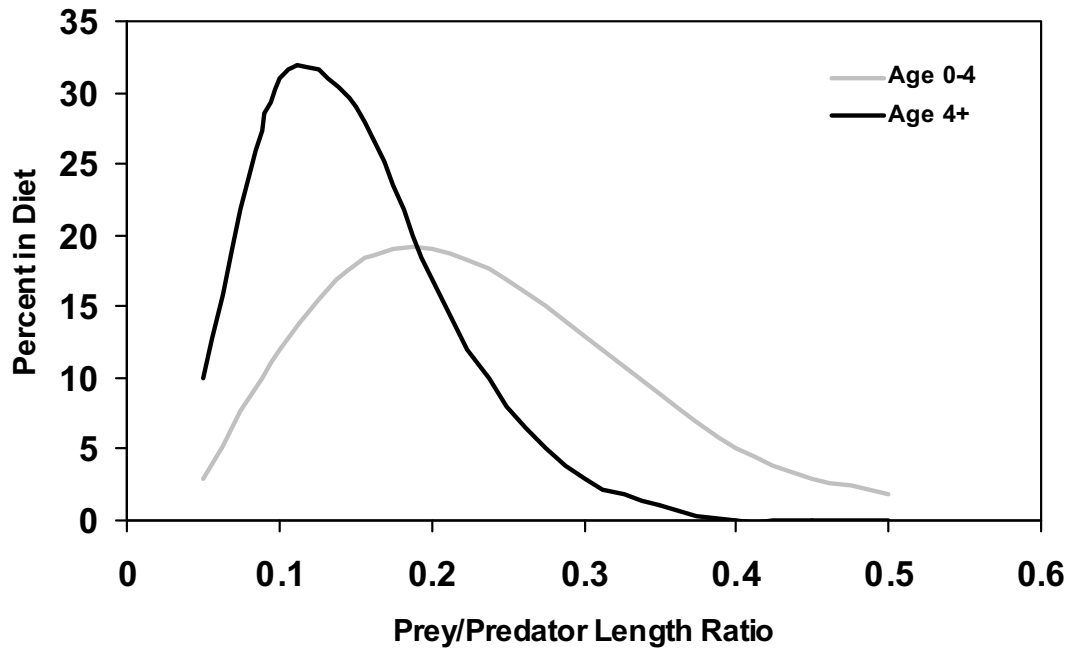Figure D.3. Prey size selection curves.
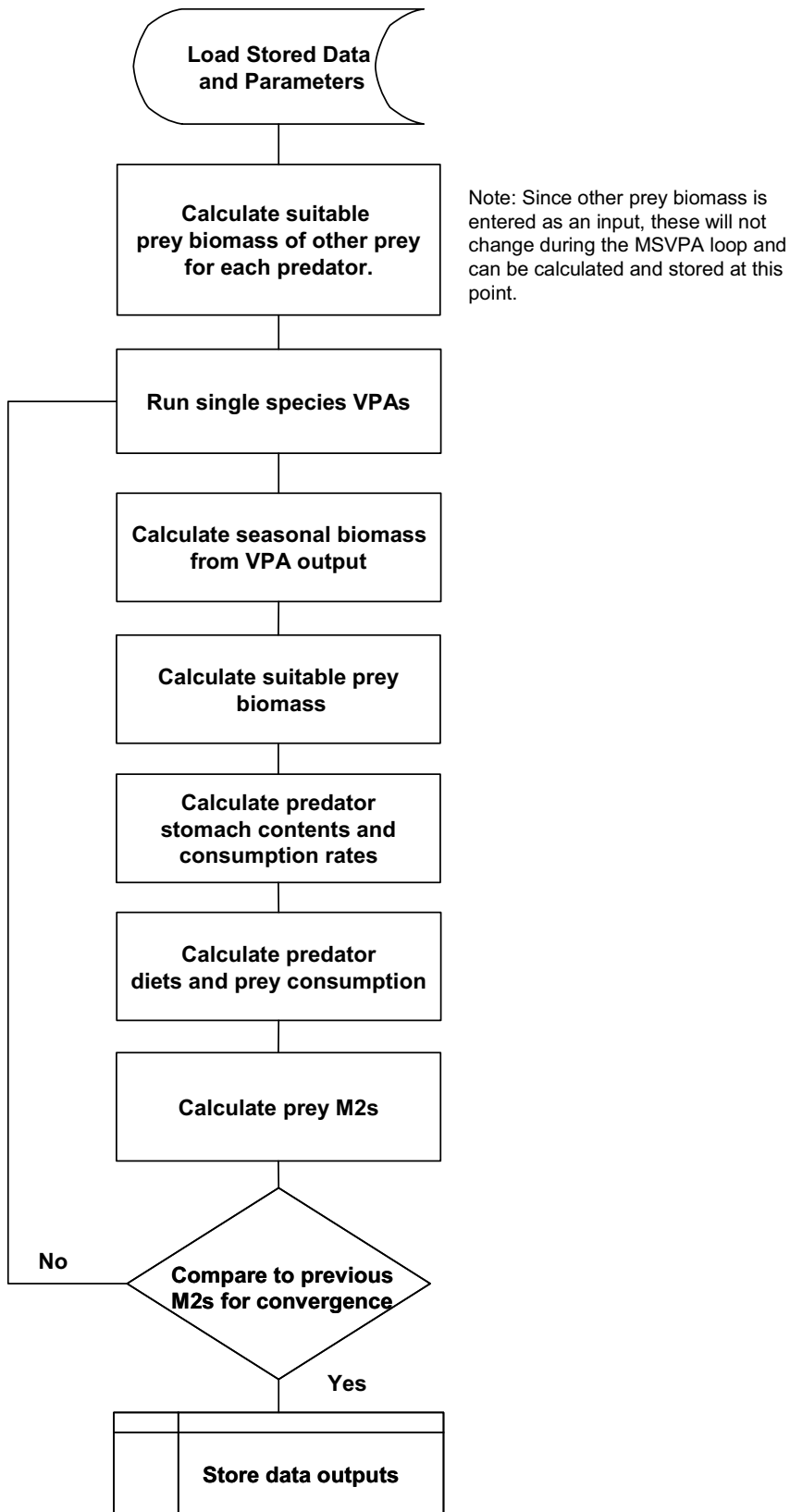
Figure D.4. MSVPA-X Implementation flow chart.

```
        ╭─────────────────────╮
        │  Load Stored Data    │
        │   and Parameters     │
        ╰─────────────────────╯
                 │
        ┌─────────────────────┐        Note: Since other prey biomass is
        │   Calculate suitable │        entered as an input, these will not
        │ prey biomass of other prey    change during the MSVPA loop and
        │    for each predator. │        can be calculated and stored at this
        └─────────────────────┘        point.
                 │
        ┌─────────────────────┐
        │ Run single species VPAs │
        └─────────────────────┘
                 │
        ┌─────────────────────┐
        │ Calculate seasonal biomass │
        │    from VPA output   │
        └─────────────────────┘
                 │
        ┌─────────────────────┐
        │  Calculate suitable prey │
        │       biomass        │
        └─────────────────────┘
                 │
        ┌─────────────────────┐
        │   Calculate predator │
        │  stomach contents and │
        │   consumption rates  │
        └─────────────────────┘
                 │
        ┌─────────────────────┐
        │   Calculate predator │
        │ diets and prey consumption │
        └─────────────────────┘
                 │
        ┌─────────────────────┐
        │   Calculate prey M2s │
        └─────────────────────┘
                 │
 No    ◇─────────────────────◇
◄──────┤  Compare to previous │
        │  M2s for convergence │
        ◇─────────────────────◇
                 │ Yes
        ┌─────────────────────┐
        │   Store data outputs │
        └─────────────────────┘
```

Figure D.5. Forecast model implementation flow chart.

Load Stored Data, Parameters, and Scenario Inputs

Calculate suitable prey biomass of other prey for biomass predators

Note: Since other prey biomass is entered as an input, these will not change during the simulation and can be calculated and stored at this point.

Model Iteration Loop

Calculate Suitable Prey Biomass

Calculate predator stomach contents and consumption rates

Calculate predator diets and prey consumption

Calculate F and M2

Daily Time Step

Project Populations Forward

Calculate Seasonal Mortality Rates and Populations

Seasonal Time Step

Store data outputs

Annual Time Step

Initialize Recruits from SR Relationships

Figure D.6. Estimated average fishing mortality rate at age during 2000-2002 for Atlantic menhaden in evaluation runs assessing sensitivity to the number of age classes used to calculate shrinkage means.
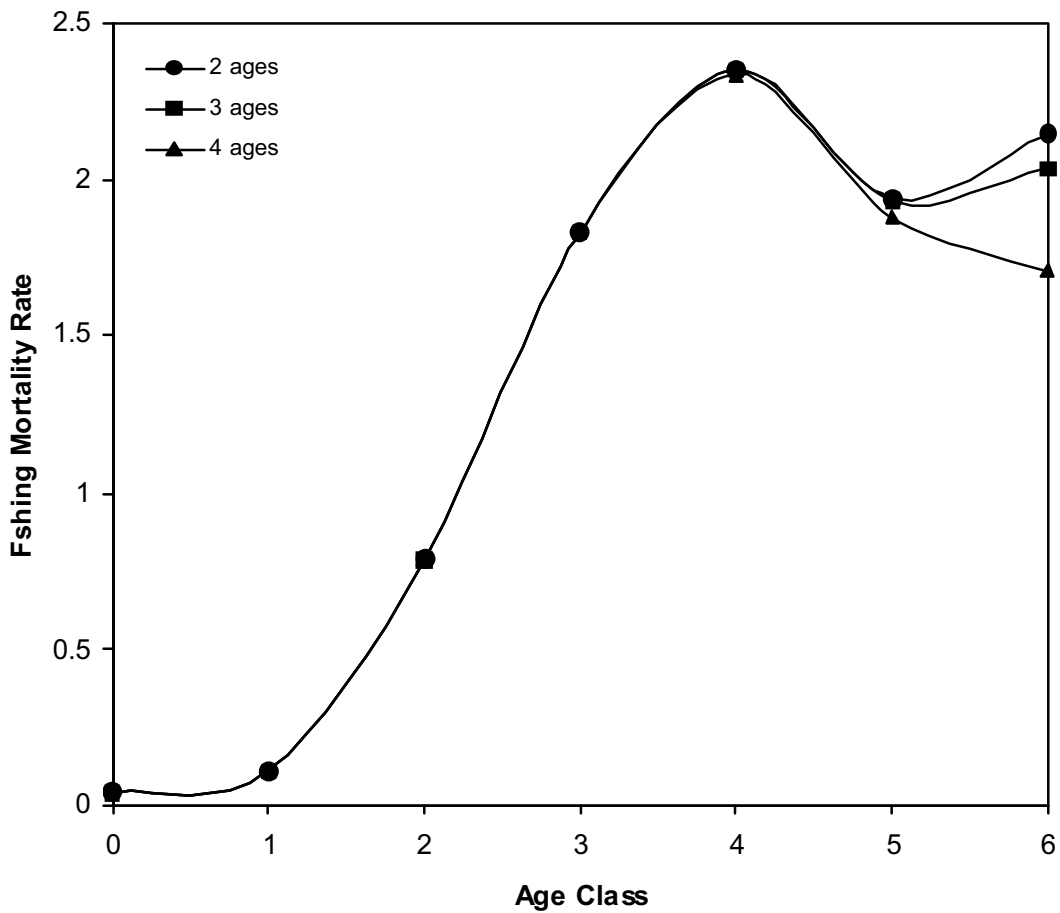
Figure D.7. Average fishery mortality rate on age classes 2+ menhaden estimated by the forward projection model and evaluation runs using Extended Survivors Analysis (XSA).
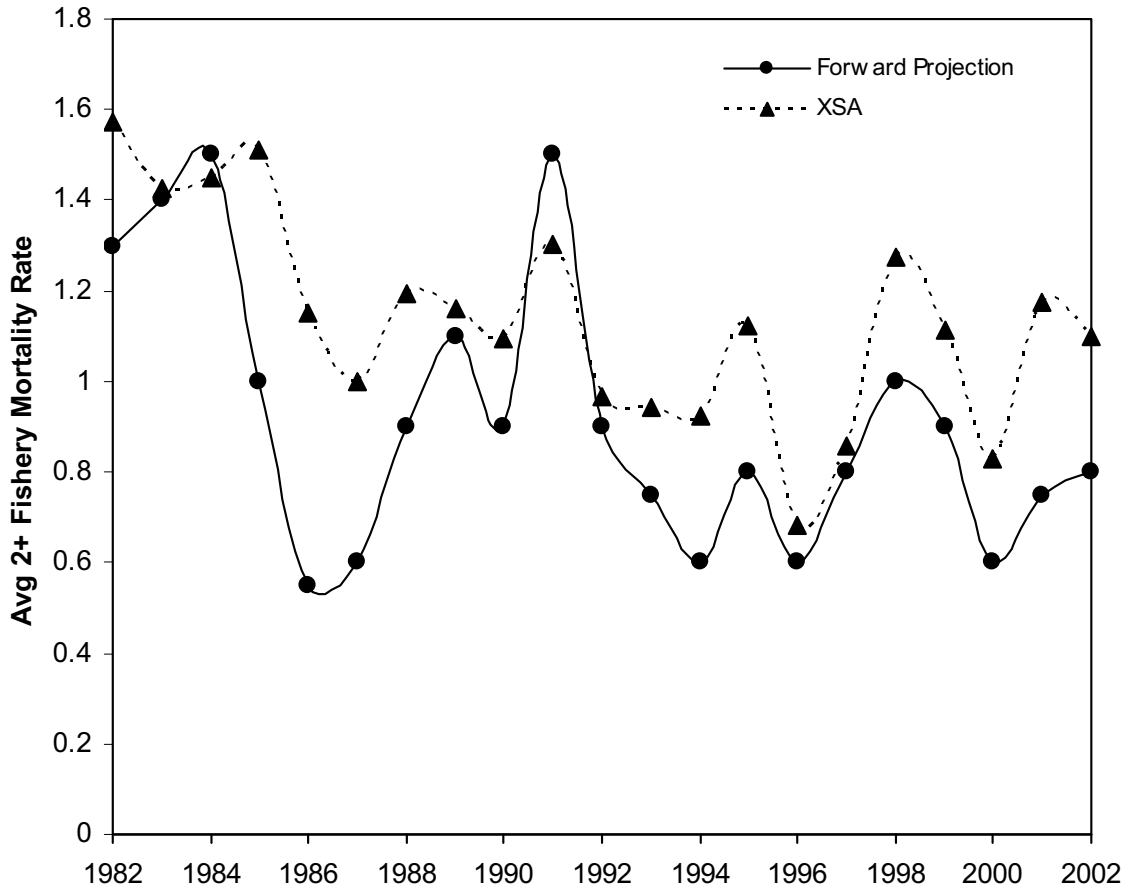
Figure D.8. Estimated abundance of (a) age-0, (b) age-1, and (c) age-3+ Atlantic menhaden in evaluation runs of the forward projection model and XSA.
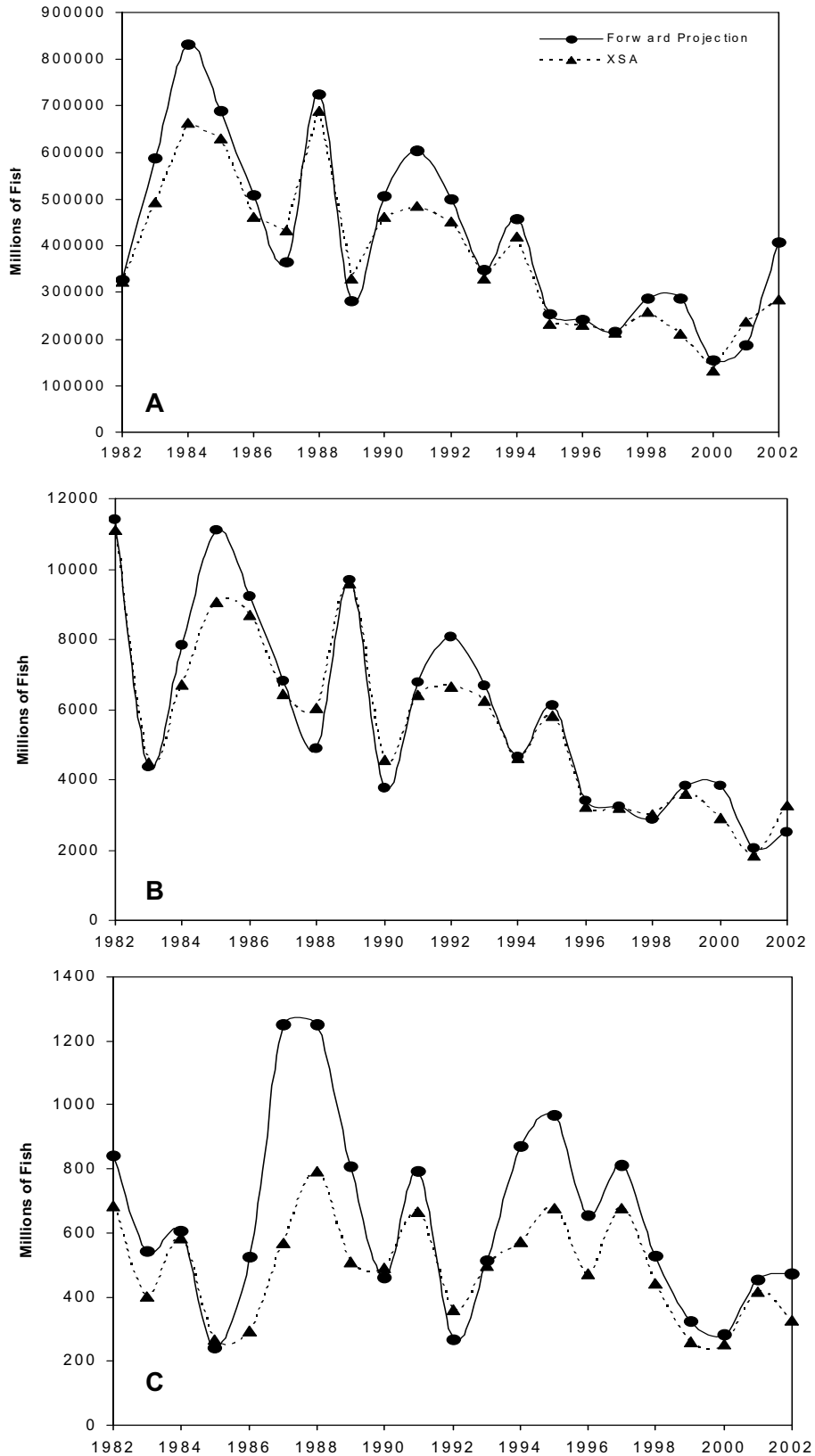
Figure D.9. Average fishery mortality rates for ages (A) 8-11 and (B) 3-8 for striped bass estimated from XSA evaluation runs. The ADAPT time series represents average F from the striped bass stock assessment (ASMFC, 2003).
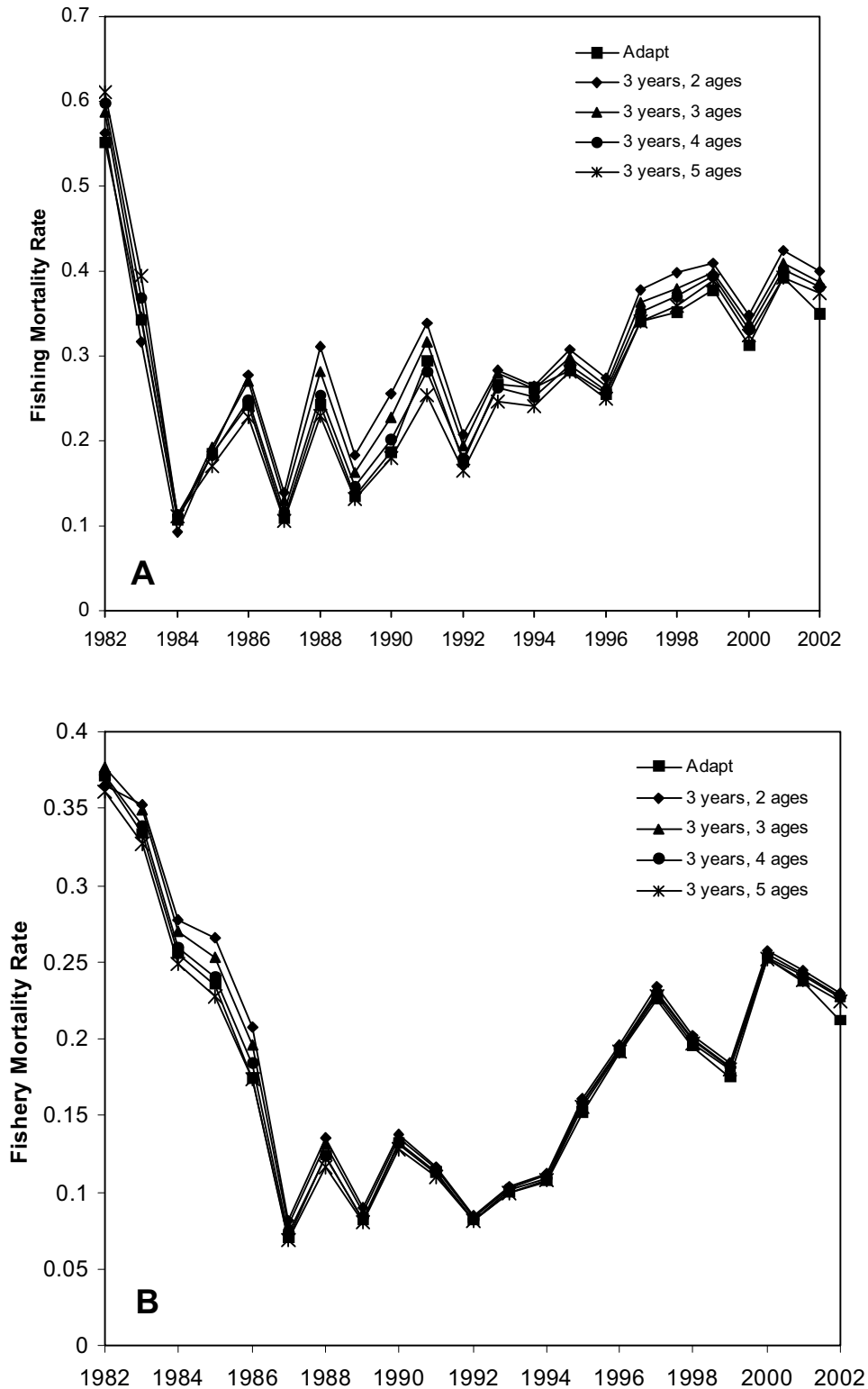
Figure D.10. Average fishery mortality rates during 2000-2002 by age class for the XSA evaluation run. The ADAPT time series represents output from the striped bass stock assessment (ASMFC, 2003).
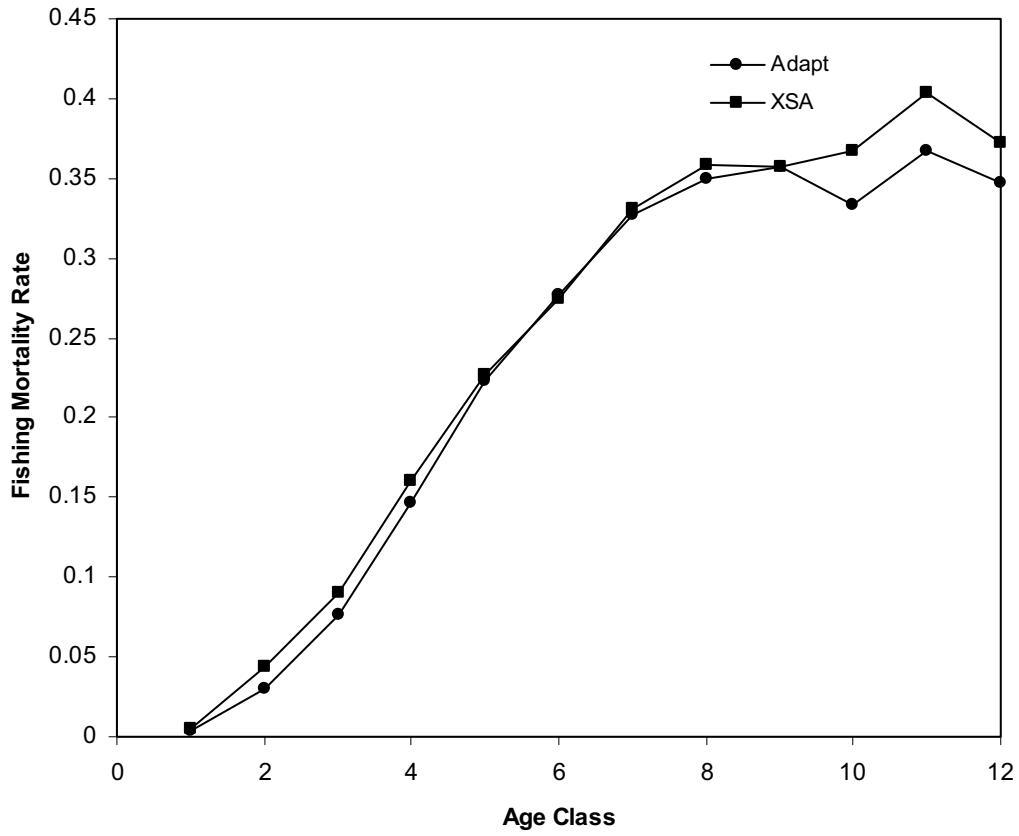
Figure D.11. Total abundance of striped bass age class 1 (A), ages 3-8 (B), and ages 8-11 (C) estimates from XSA evaluation runs. The ADAPT time series represents output from the striped bass stock assessment (ASMFC, 2003).
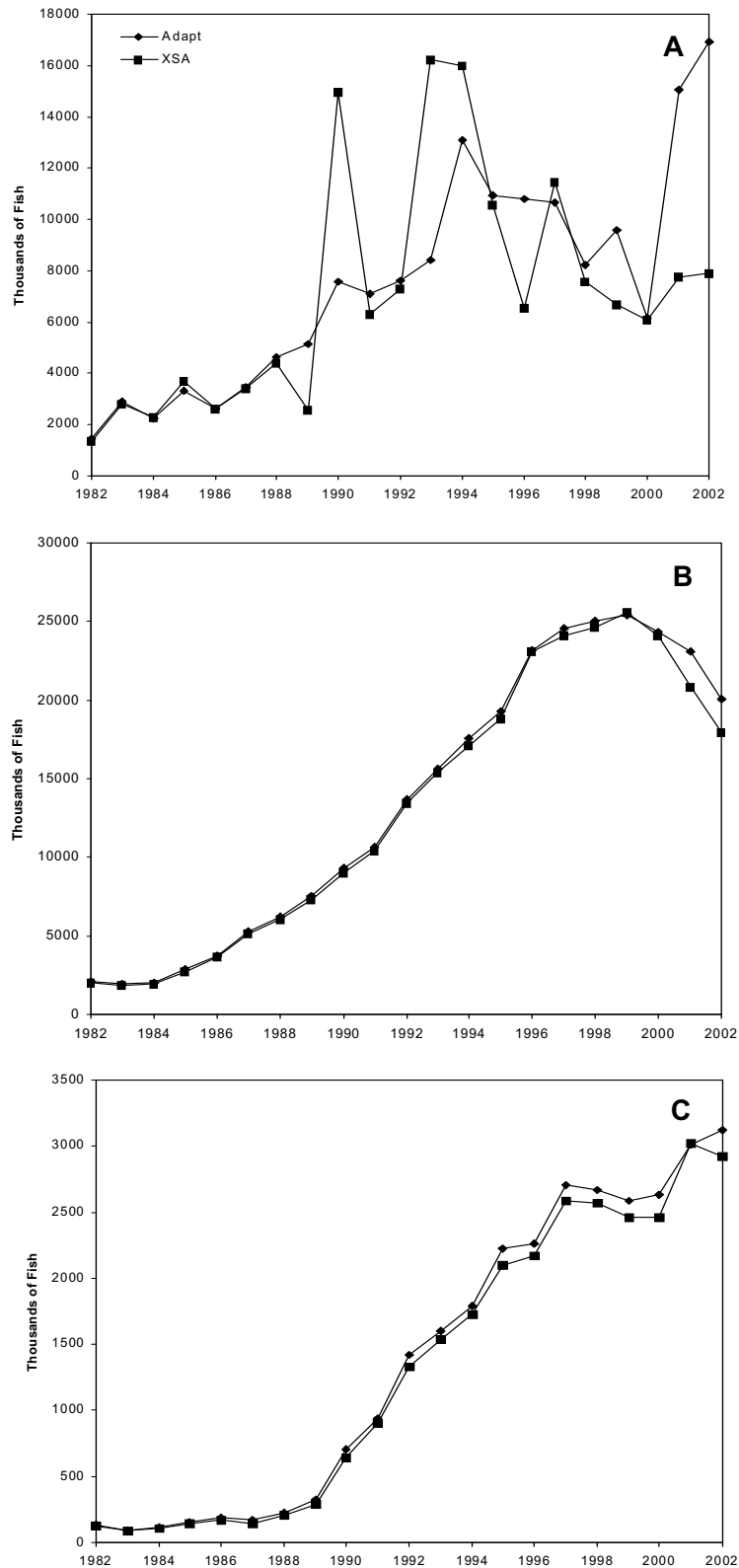
Figure D.12. Average age 4 and 5 fishing mortality rates for weakfish estimated by evaluation runs of the extended survivors analysis. Results from the ADAPT VPA assessment for weakfish (Kahn, 2002a) and an integrated catch at age (ICA) analysis are shown.
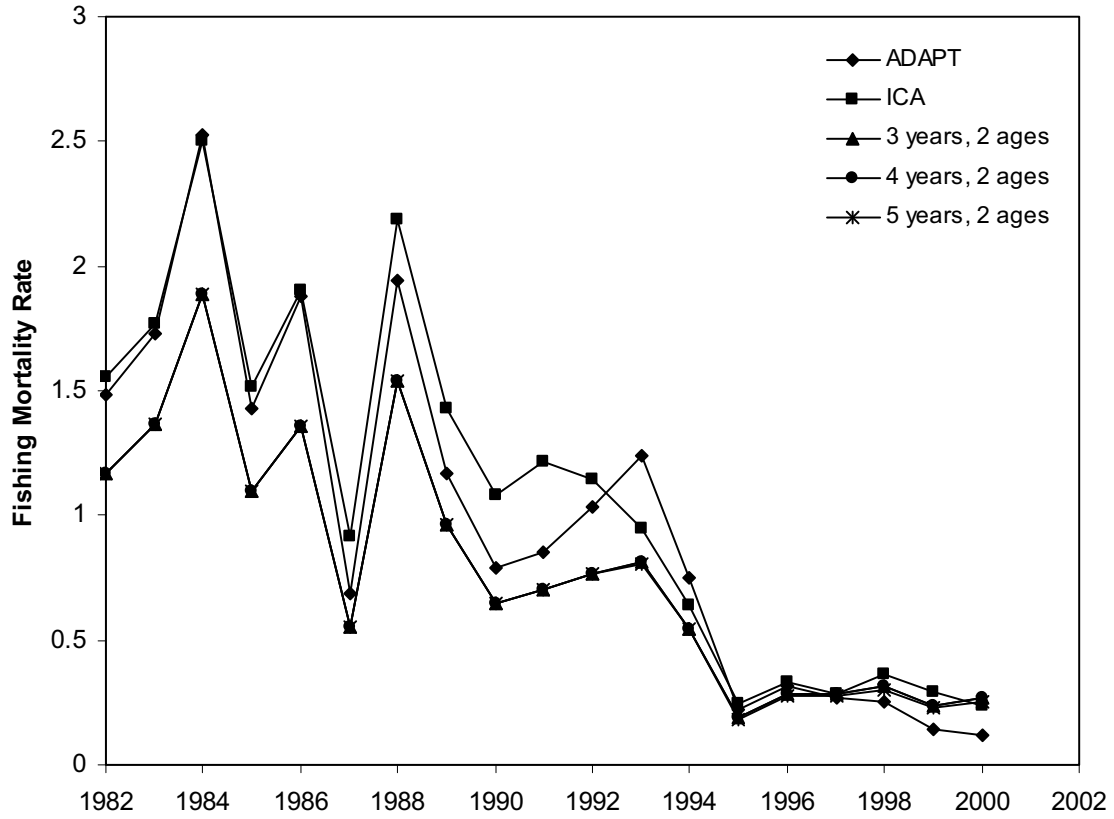
Figure D.13. Average fishing mortality rates by age class during 1998-2000 for weakfish estimated by evaluation runs of the extended survivors analysis. Results from the ADAPT VPA assessment for weakfish (Kahn, 2002a) and an integrated catch-at-age (ICA) analysis are shown.
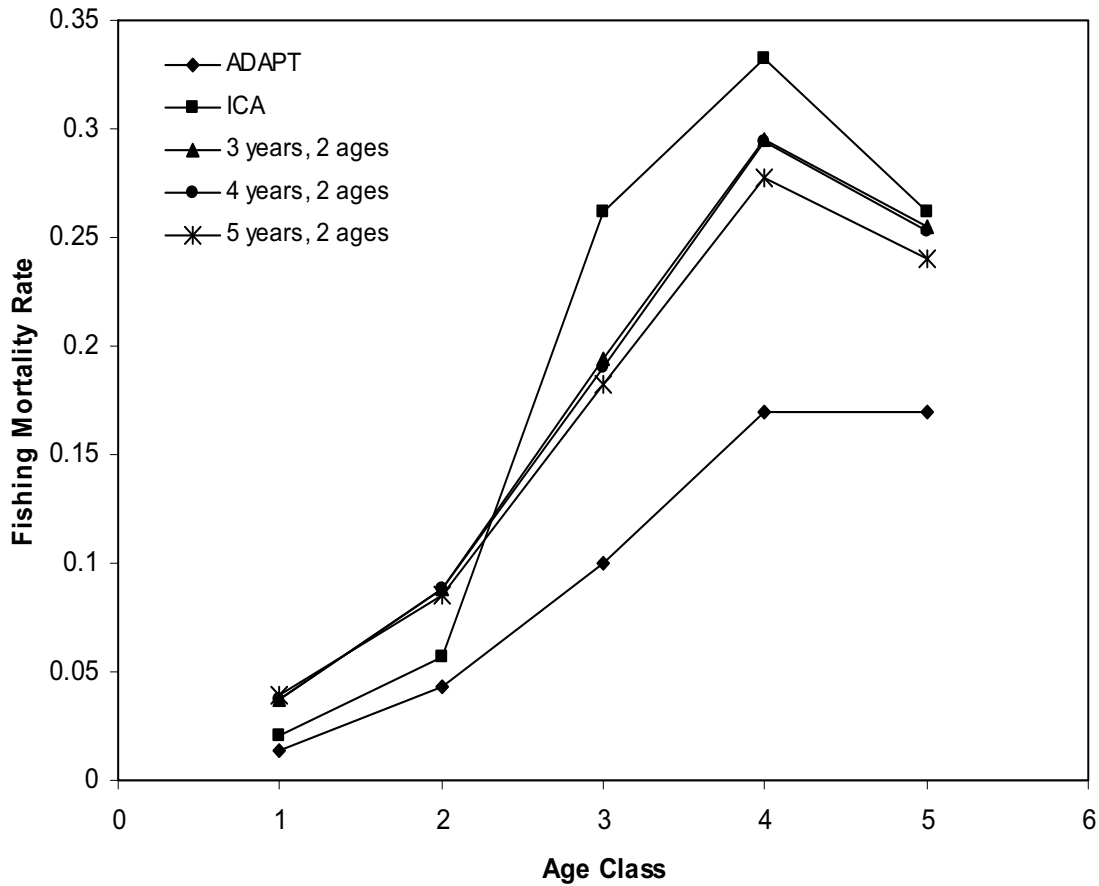
Figure D.14. Abundance of (A) ages 4-6+ and (B) ages 1-3 weakfish as estimated by XSA, ADAPT and ICA.
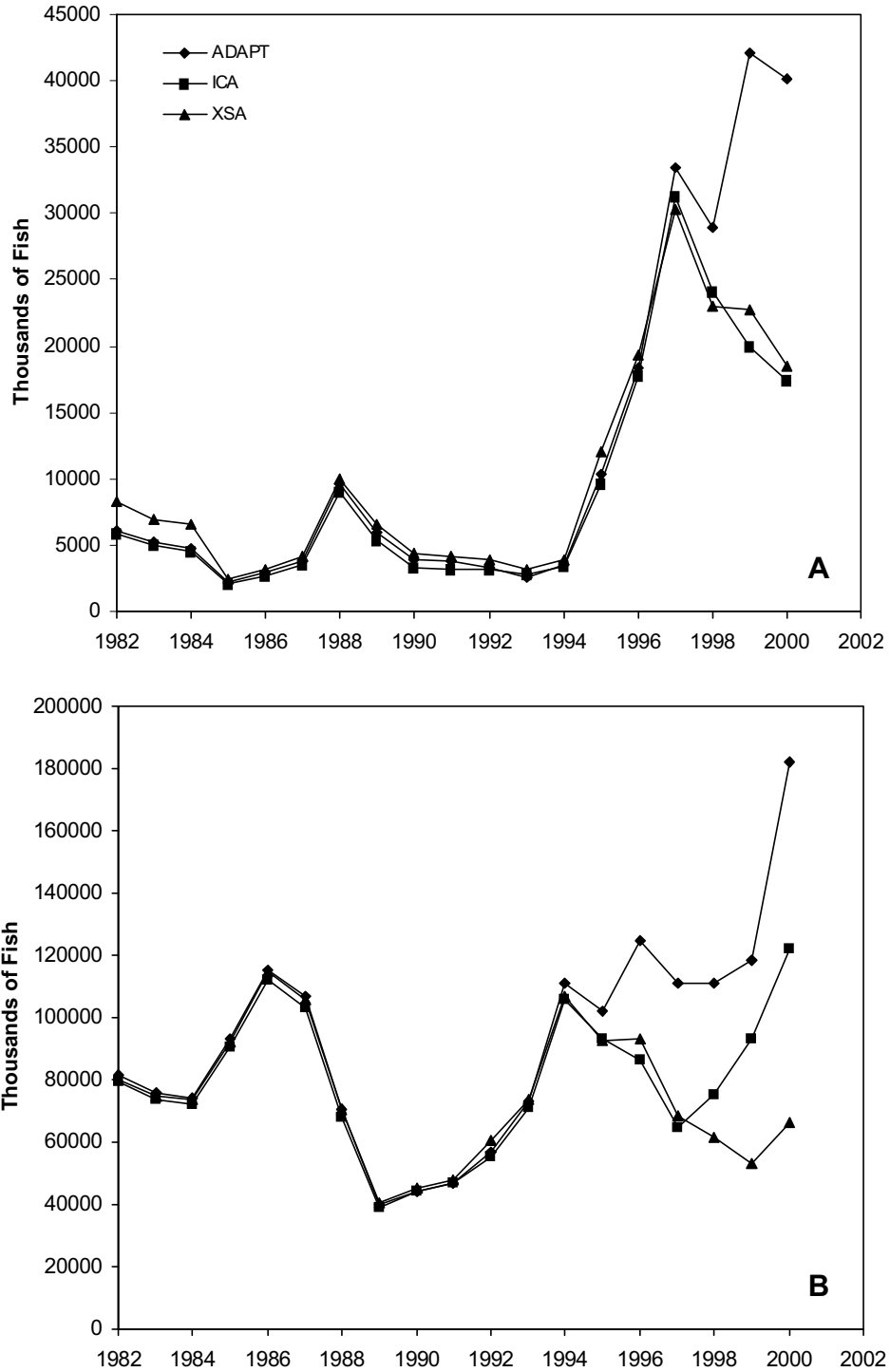
Figure D.15. Total biomass (000 mt) of the bluefish stock from 1982-2002 estimated by the ASPIC biomass-dynamic model (Lee, 2003).
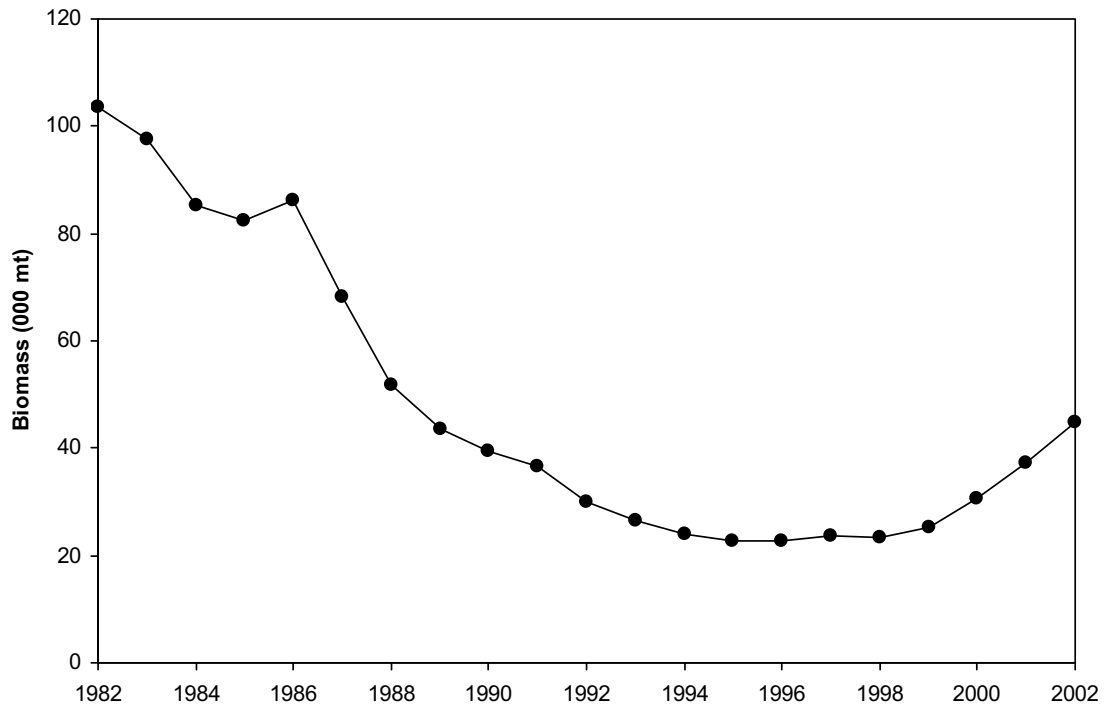
Figure D.16. Assumed biomass size distribution of the benthic invertebrate prey category.
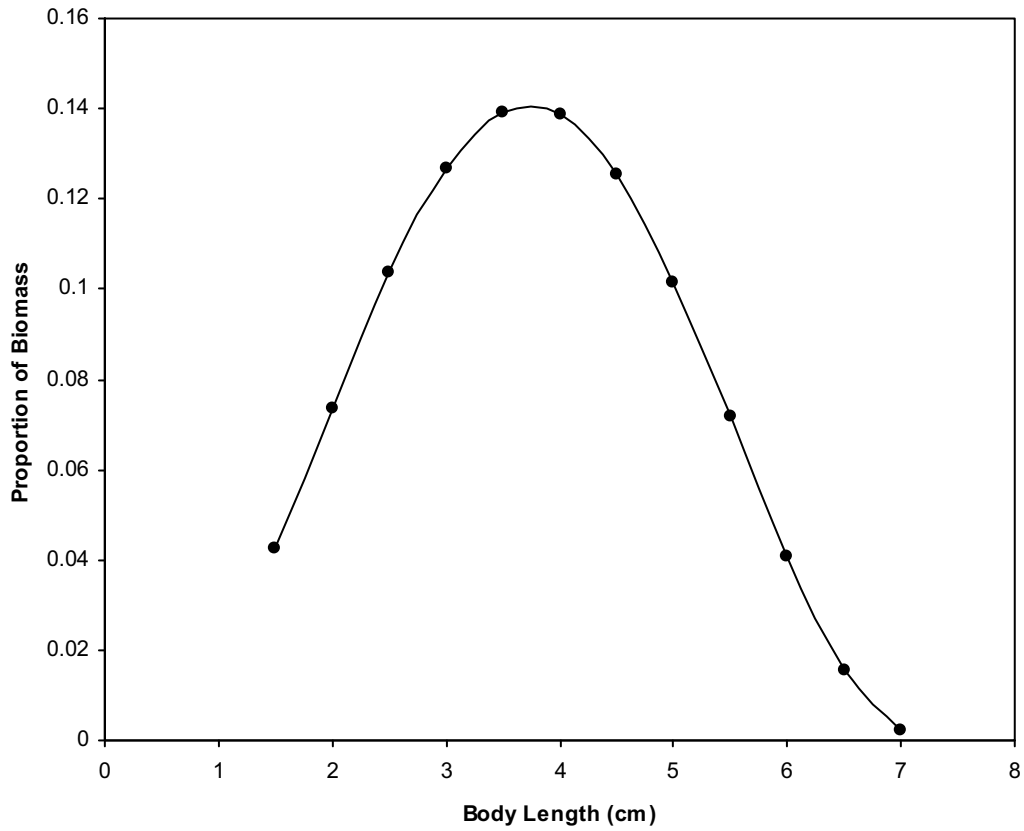
Figure D.17. Assumed biomass size distribution of the macrozooplankton prey category.
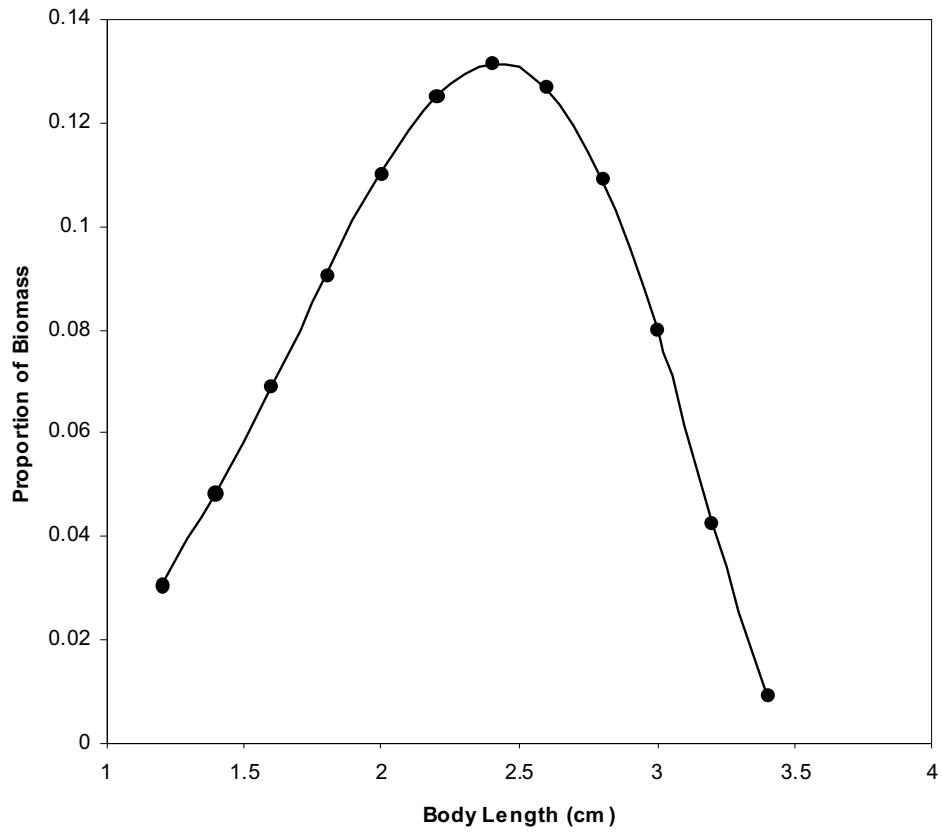
Figure D.18. Biomass size distribution of the benthic crustacean prey category.
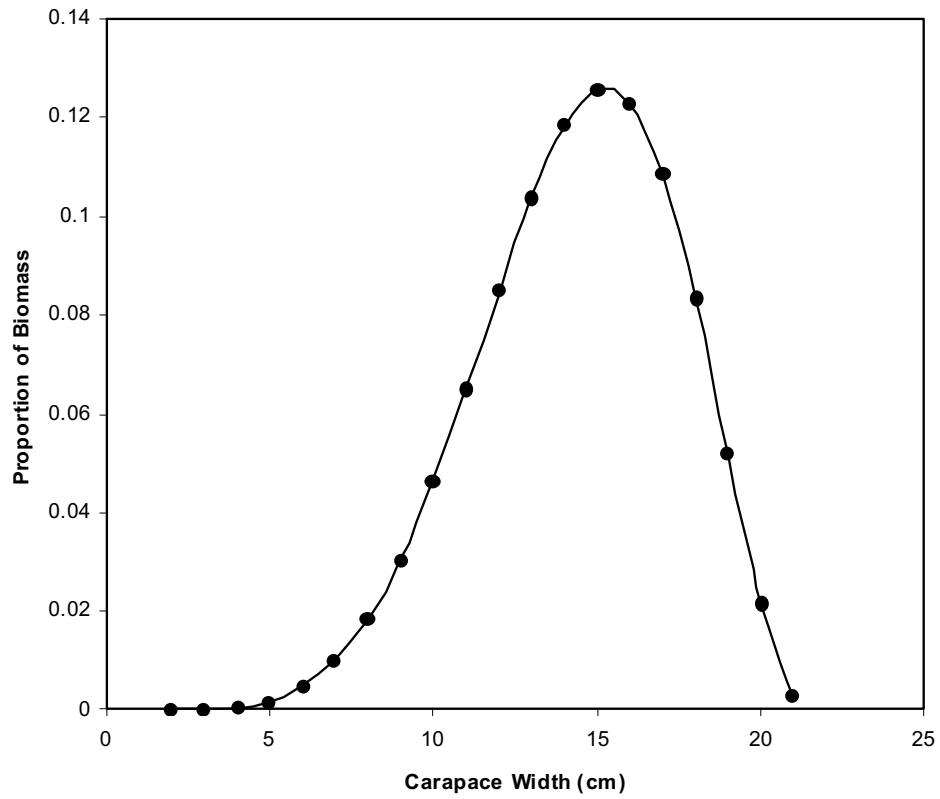
Figure D.19. Seasonal bay anchovy biomass (mt) estimates for the Chesapeake Bay (Rilling and Houde, 1999) and the New Jersey coast.

	Season 1	Season 2	Season 3	Season 4
■ Ches. Bay	23,000	23,000	100,000	60,000
□ NJ	92	24,536	99,540	599,516
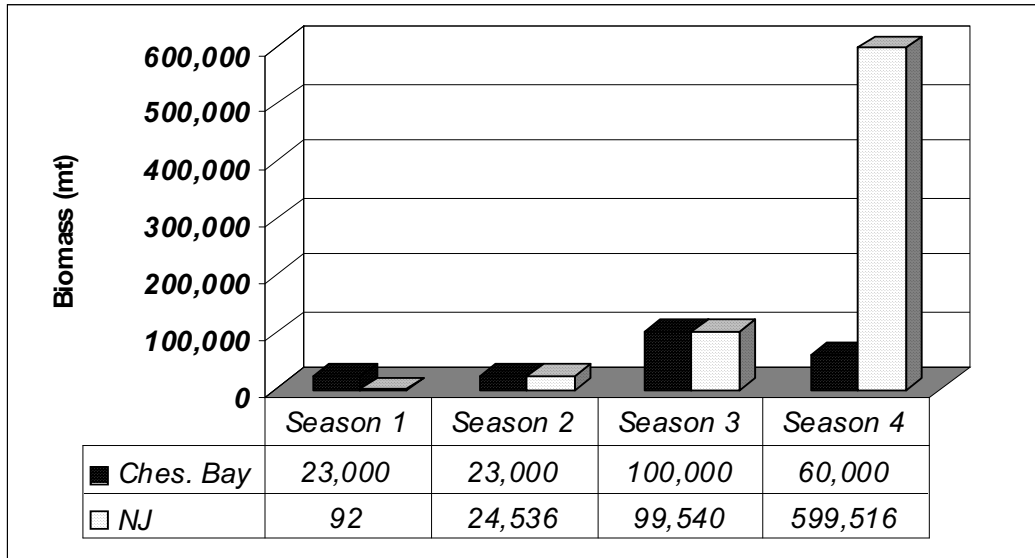
Figure D.20. Annual z-transformed (+2) CPUE indices for the Chesapeake Bay region.
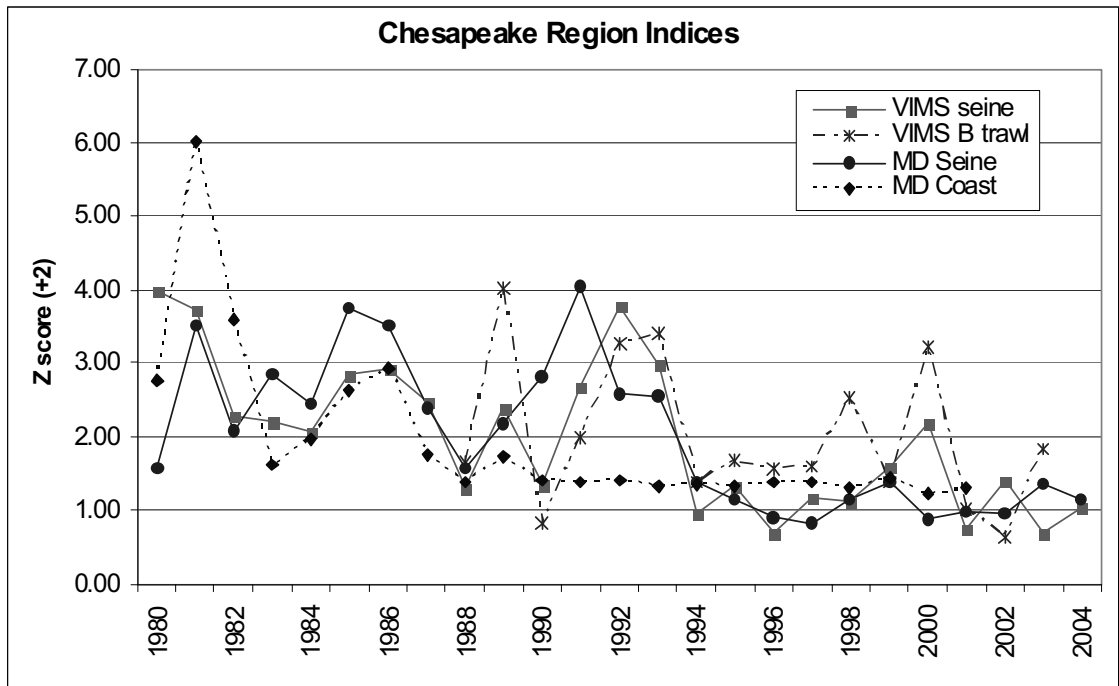
Figure D.21. Annual z-transformed (+2) CPUE indices for the Delaware Bay region.
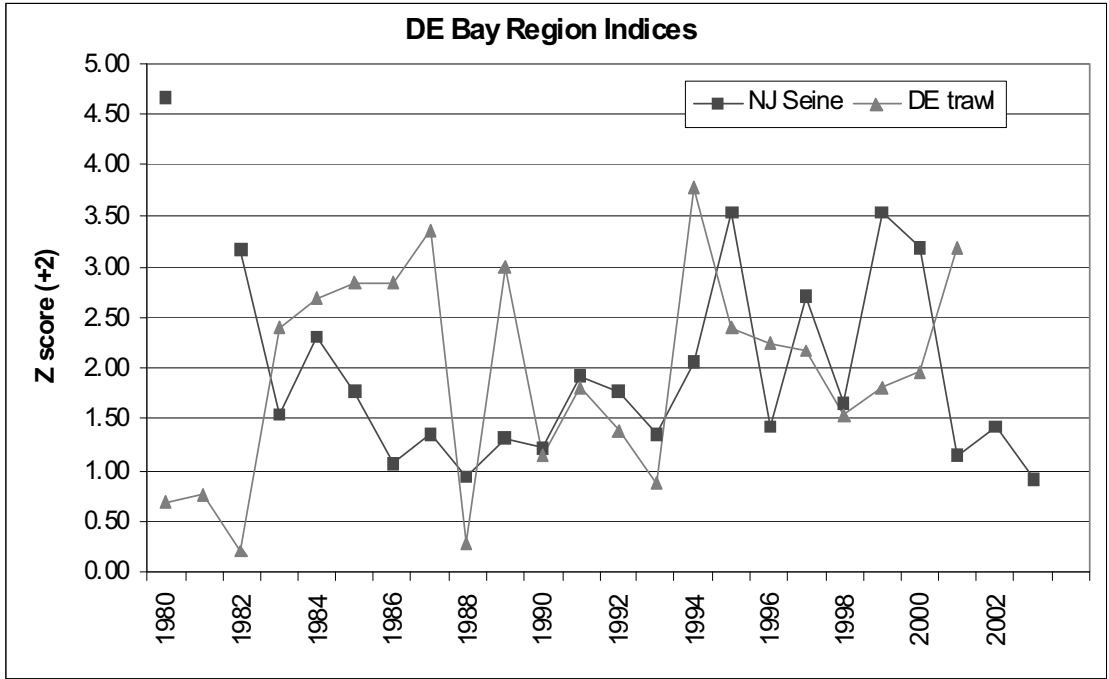
Figure D.22. Combined weighted Chesapeake Bay index, Delaware Bay index and a combined (Chesapeake and Delaware) *Estuary* index.
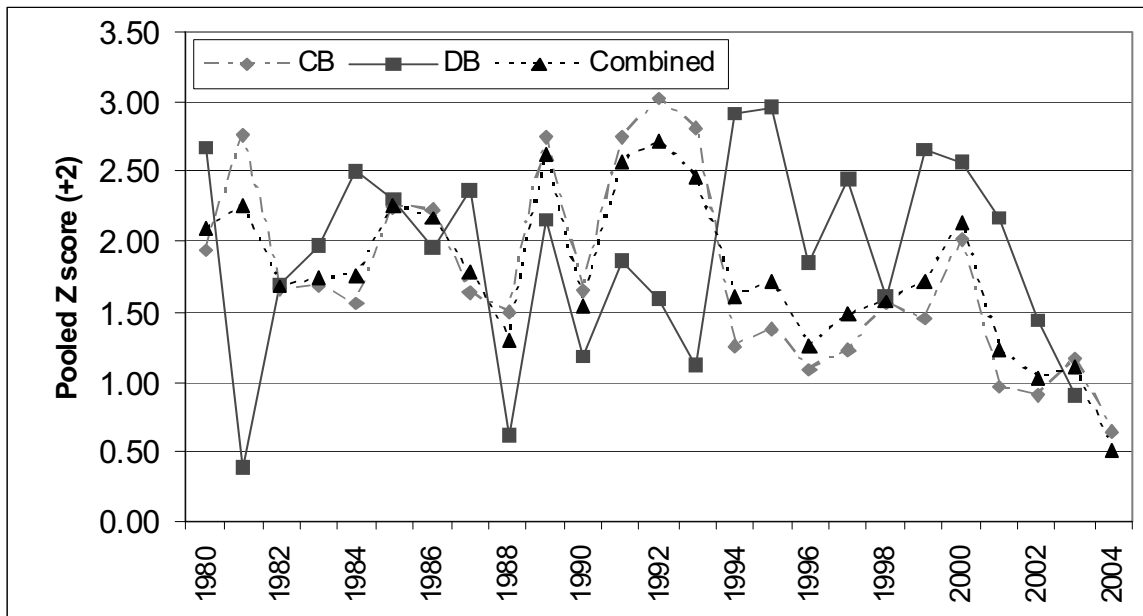
Figure D.23. Annual z-transformed (+3) CPUE indices for the NJ Ocean Trawl, SEAMAP survey, and a combined *Coastal* index.
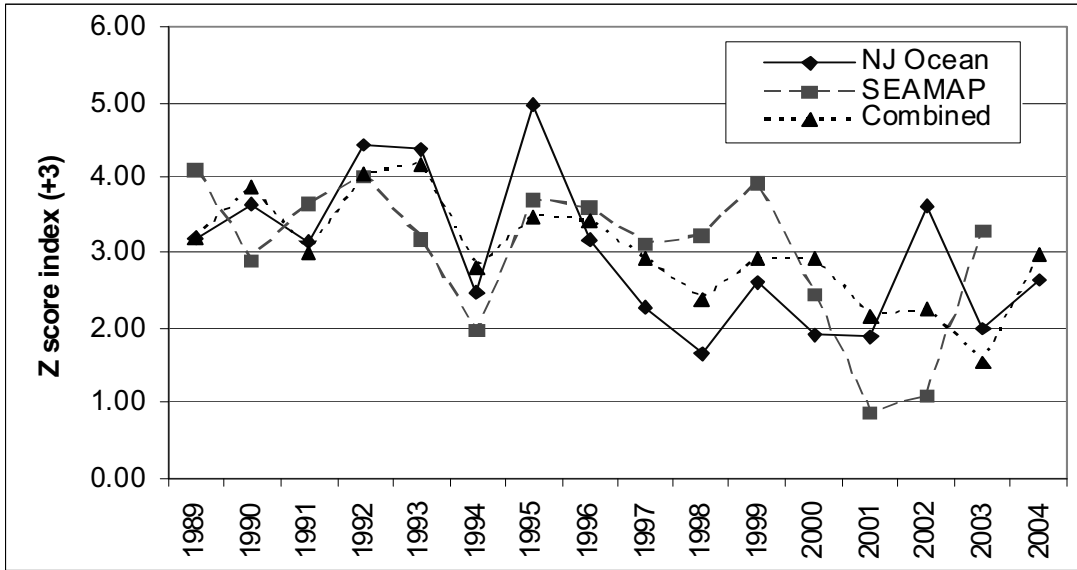
Figure D.24. Diet composition of (A) age-0, (B) age 1-2, and (C) age 3-5 striped bass in the Chesapeake Bay from Hartman & Brandt, 1995a.
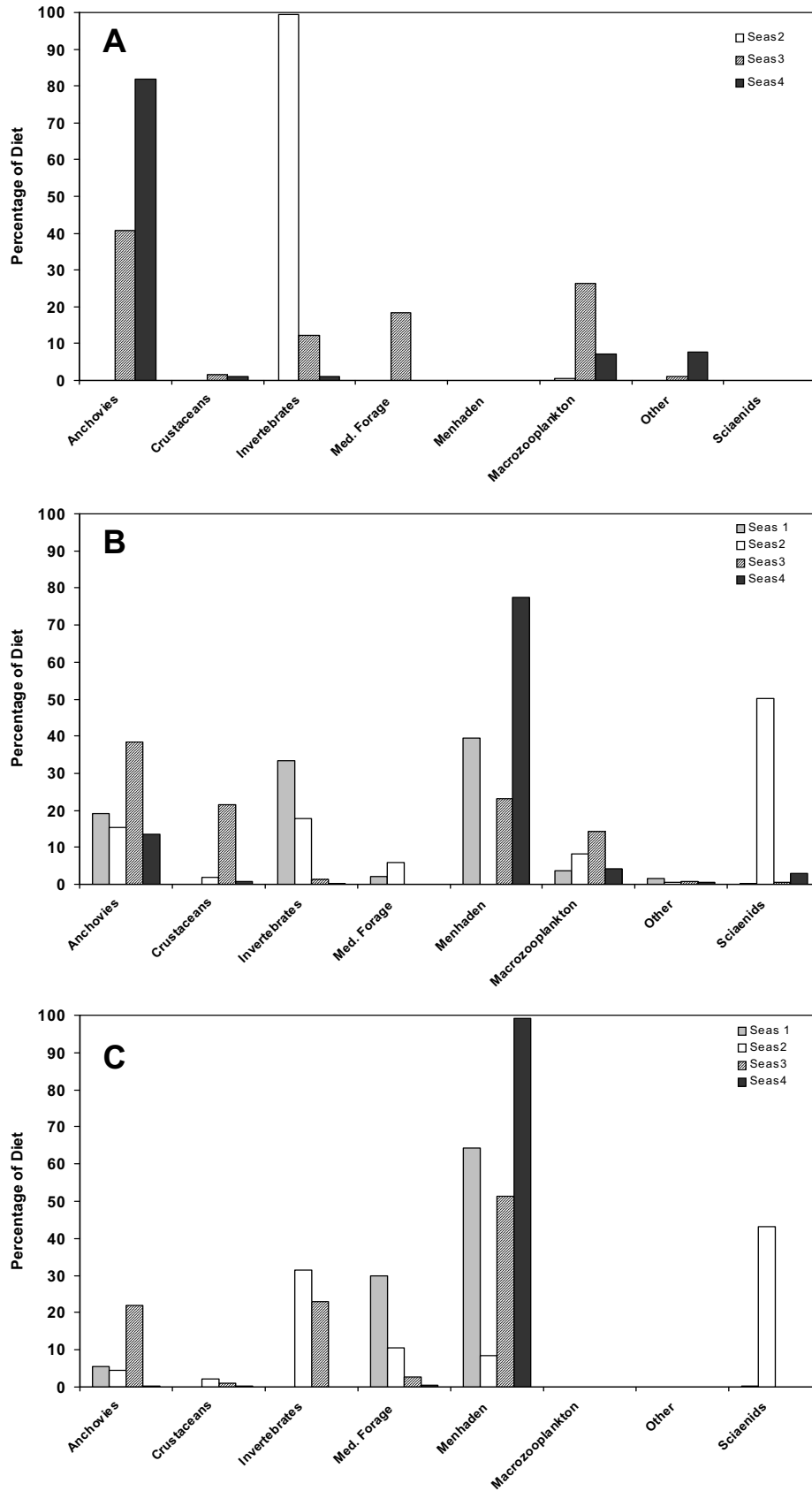
Figure D.25. Diet composition of (A) ages 5-6 and (B) ages 8+ striped bass in the Chesapeake Bay (Walter and Austin 2003).
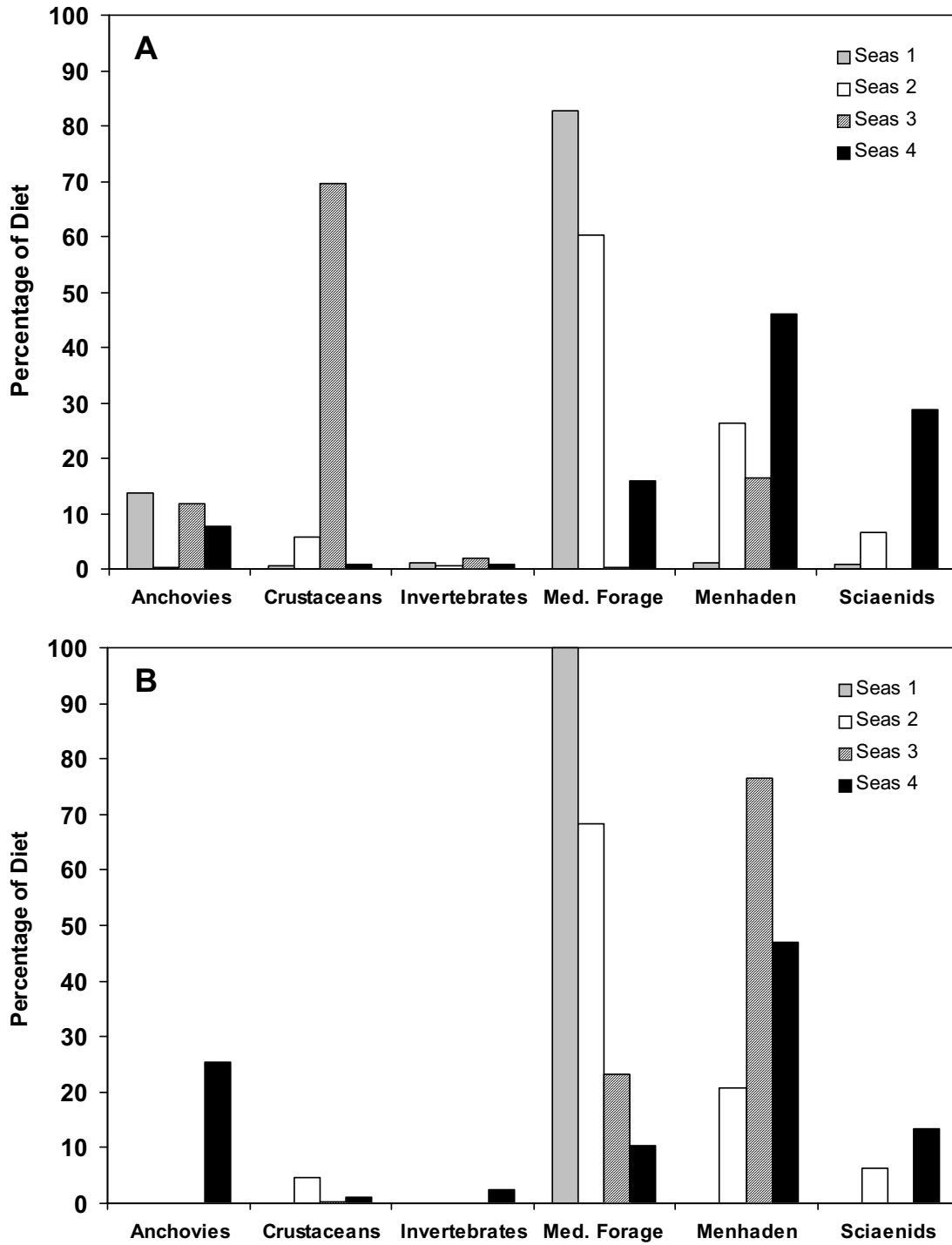
Figure D.26. Seasonal proportion of biomass in each prey category in the Chesapeake Bay region.
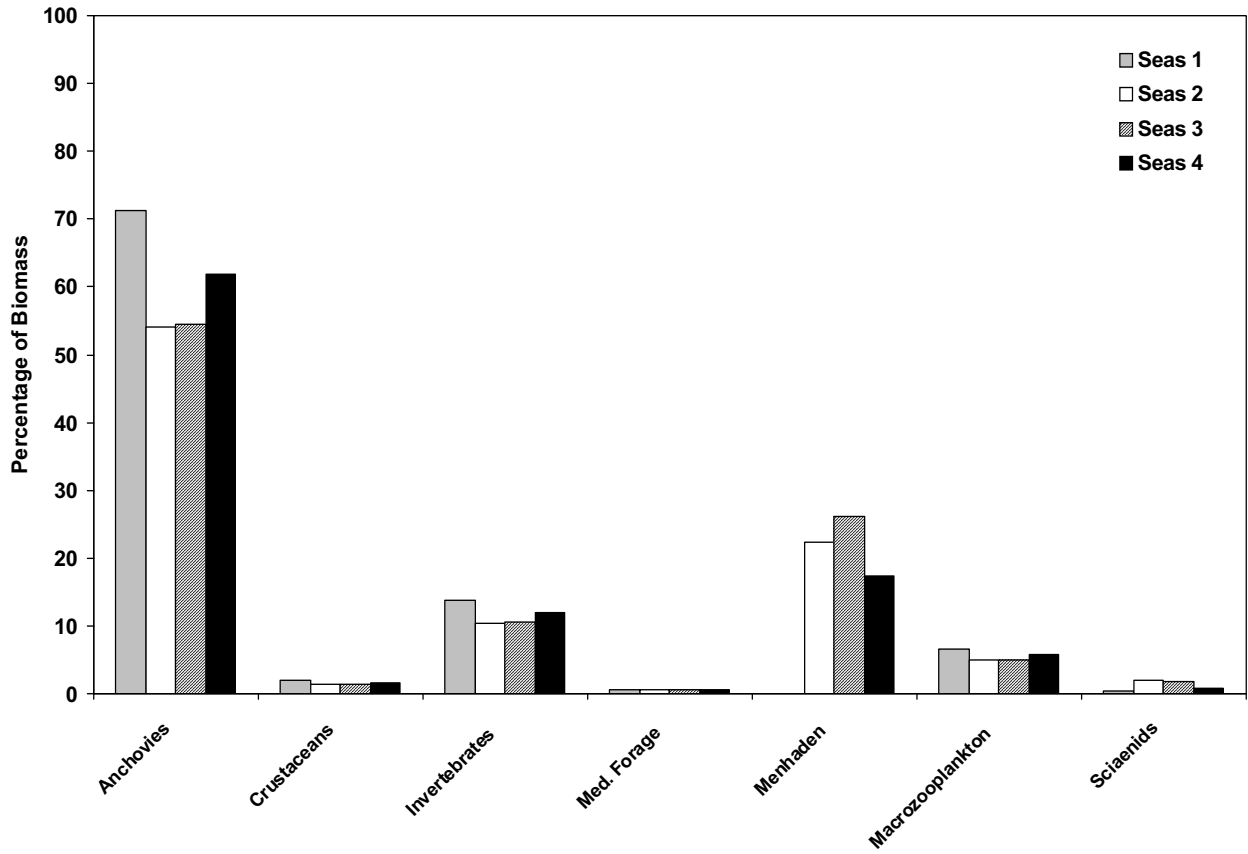
Figure D.27. Five regional strata were defined from North Carolina to the Gulf of Maine.
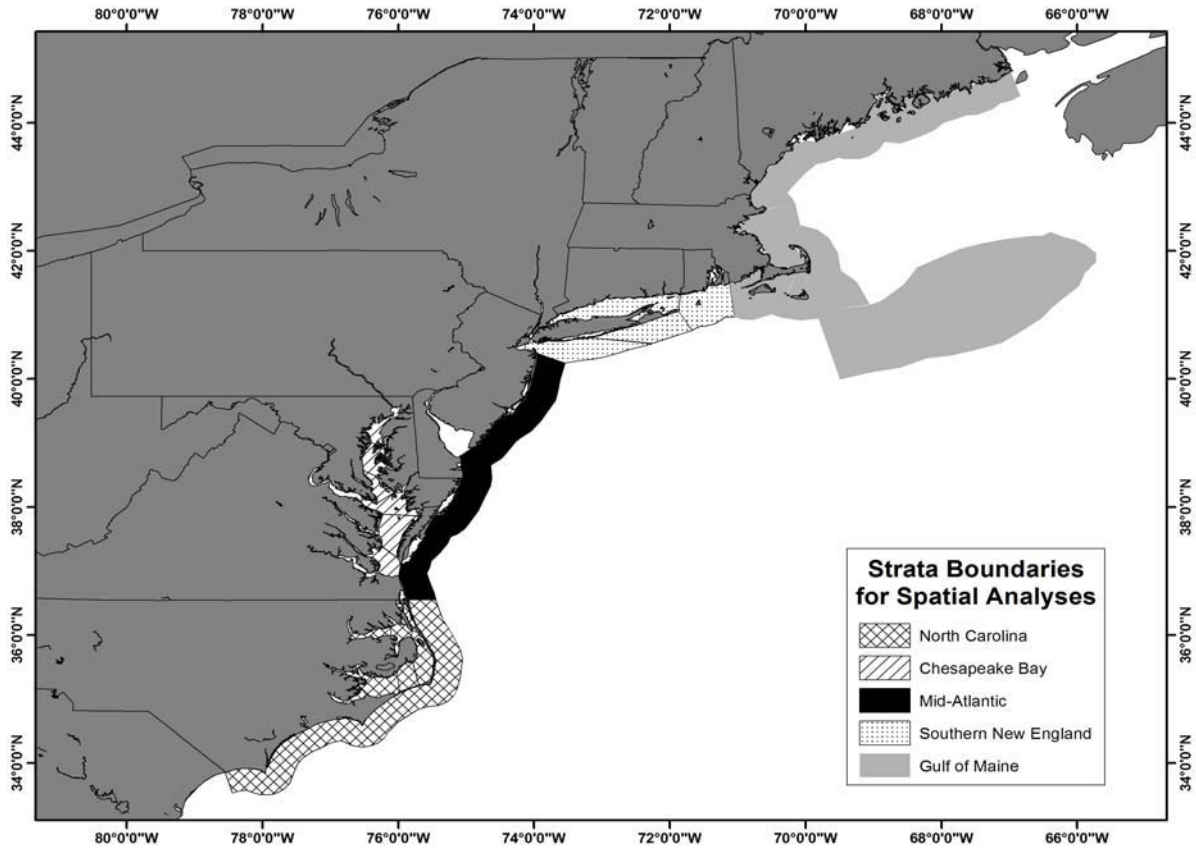
Figure D.28. Seasonal spatial distribution of striped bass based on landings data: a. Season 1; b. Season 2; c. Season 3; and d. Season 4.
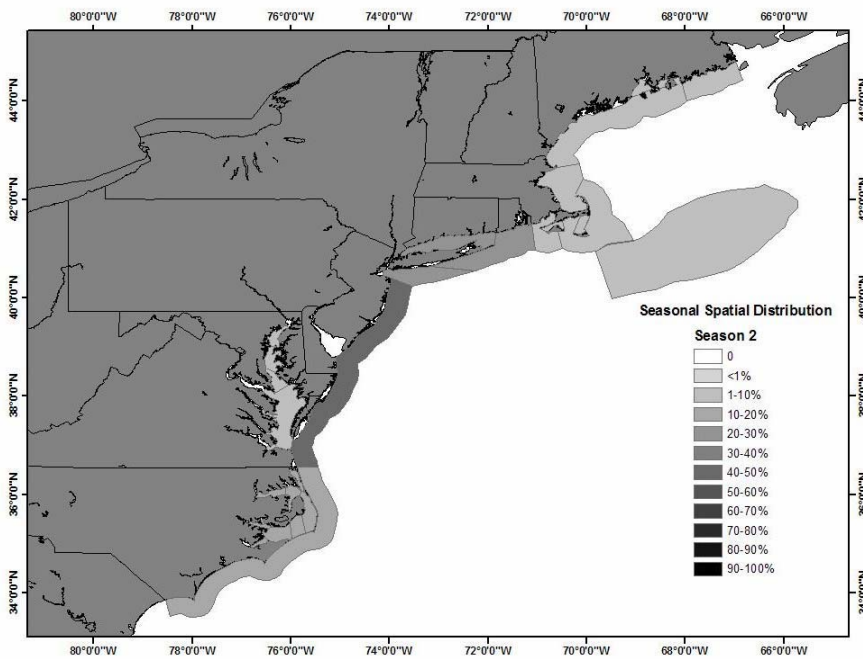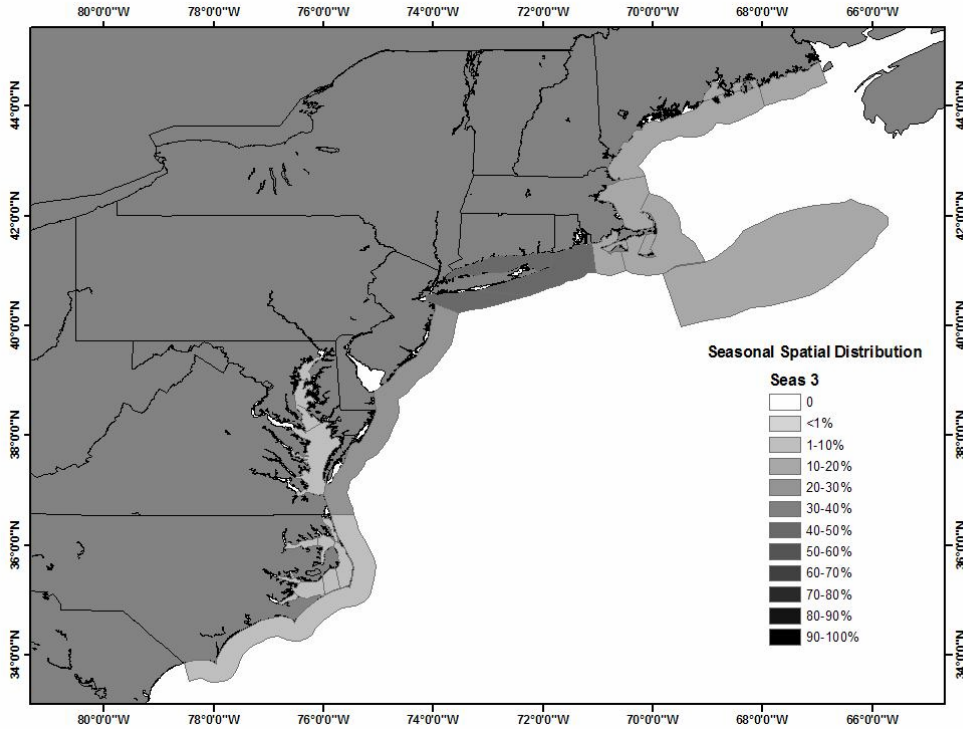
a)
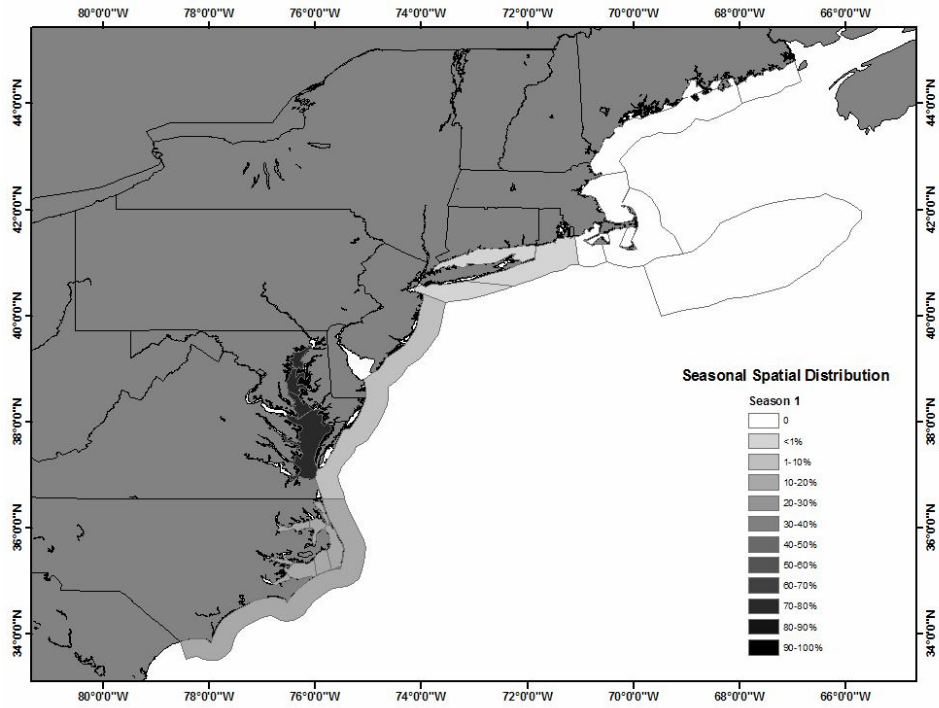
b)
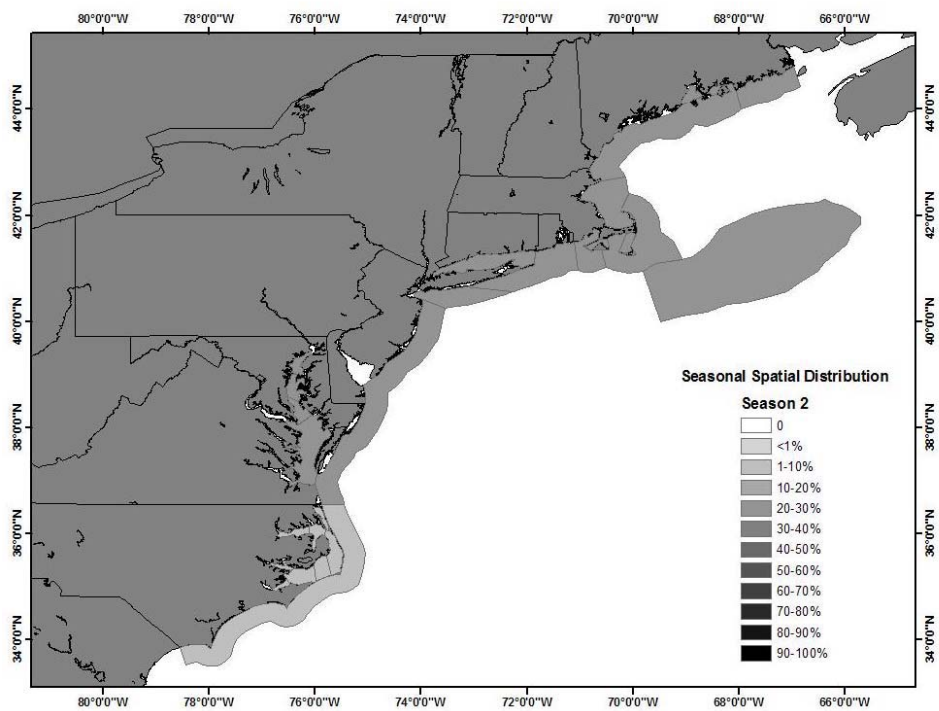
Figure D.28 (cont'd). Seasonal spatial distribution of striped bass based on landings data: a. Season 1; b. Season 2; c. Season 3; and d. Season 4.

c)
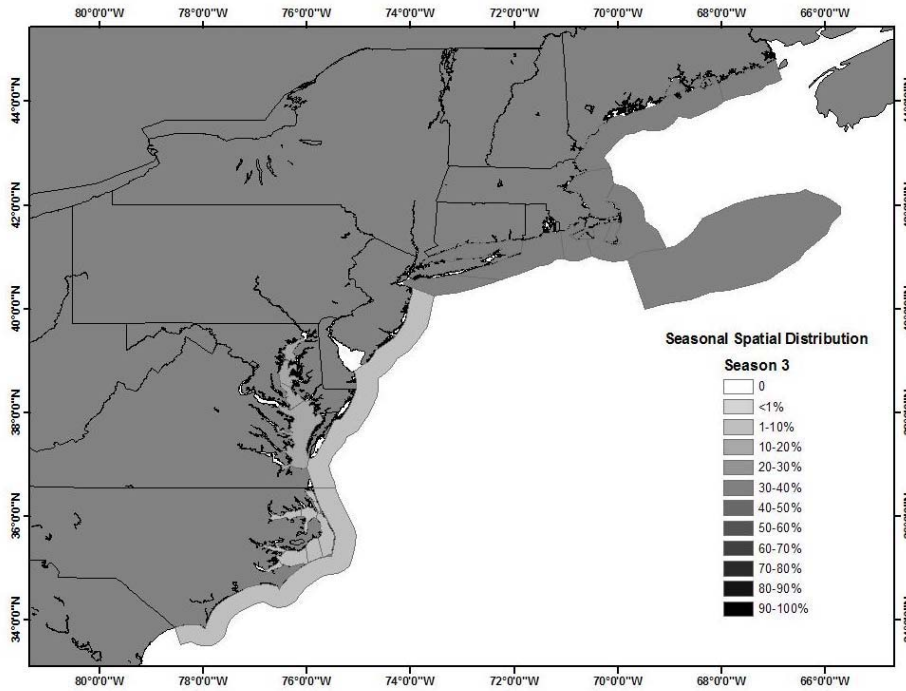
d)
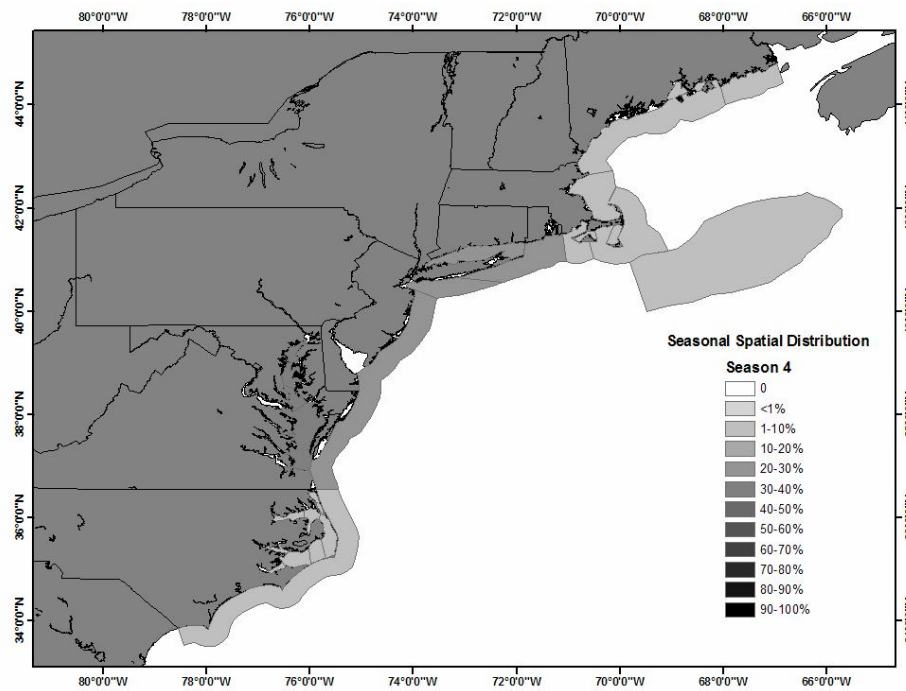
Figure D.29. Observed age-structure of striped bass catch within each region.
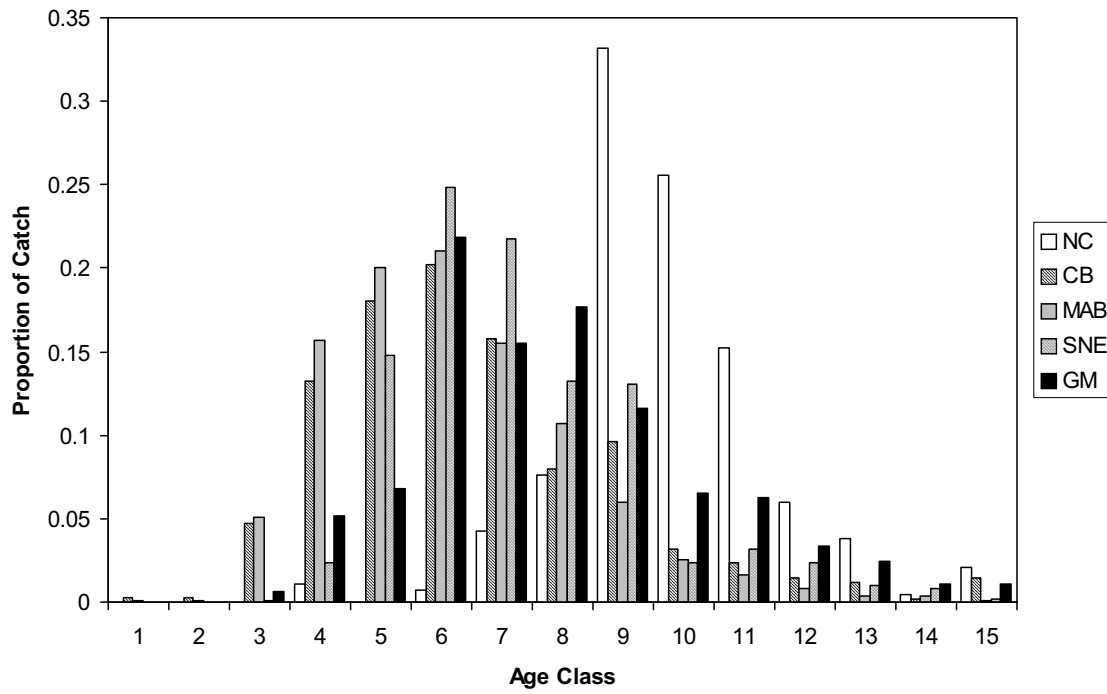
Figure D.30. Seasonal spatial distribution of weakfish based on landings data: a. Season 1; b.
Season 2; c. Season 3; and d. Season 4.

a)
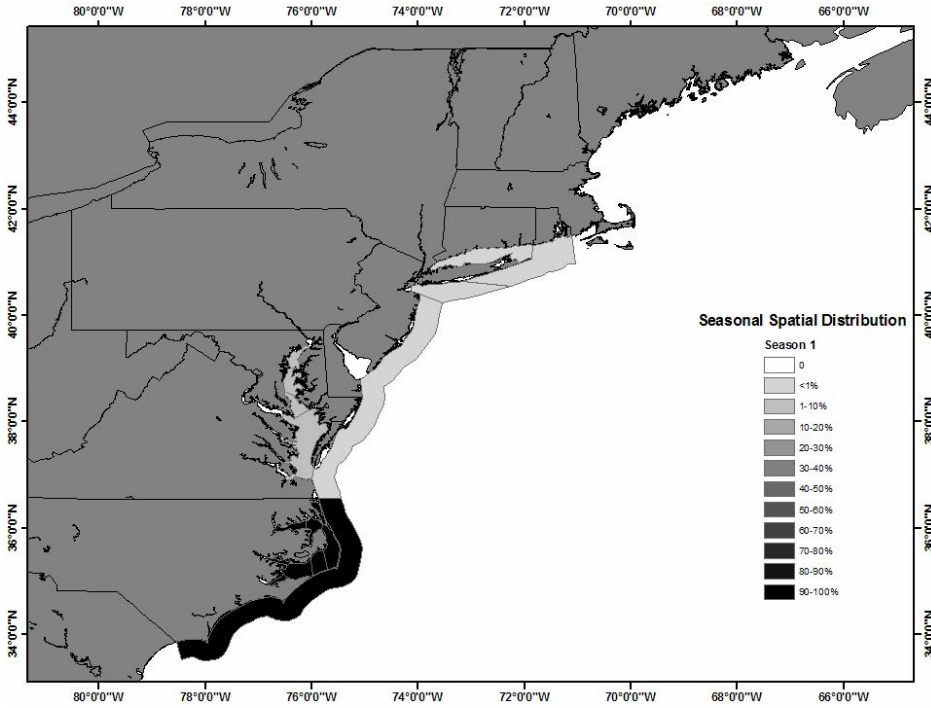
b)
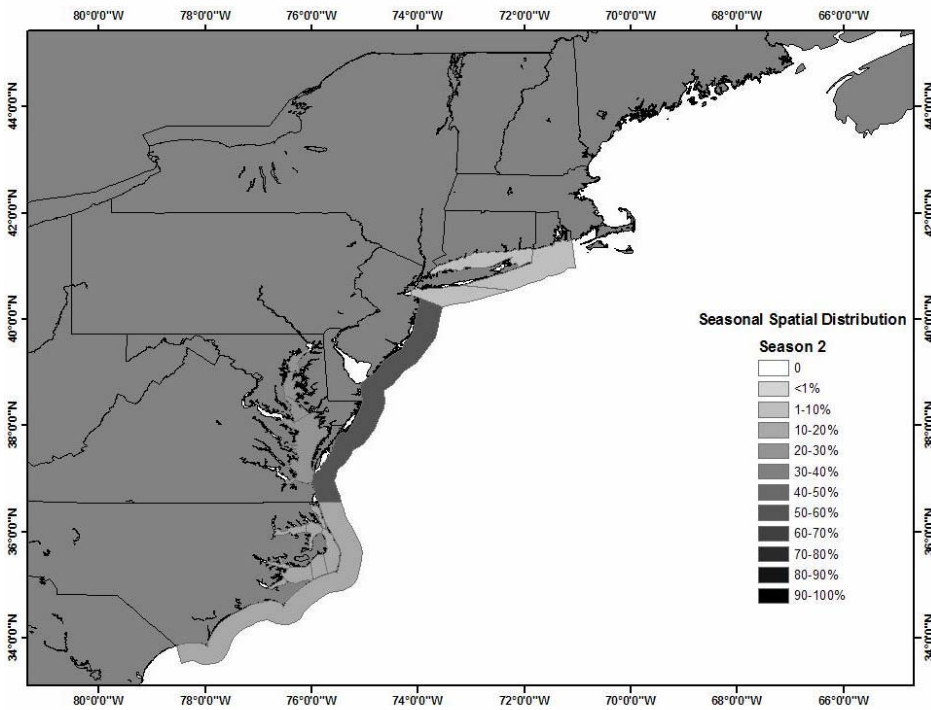
Figure D.30 (cont'd). Seasonal spatial distribution of weakfish based on landings data: a. Season 1; b. Season 2; c. Season 3; and d. Season 4.
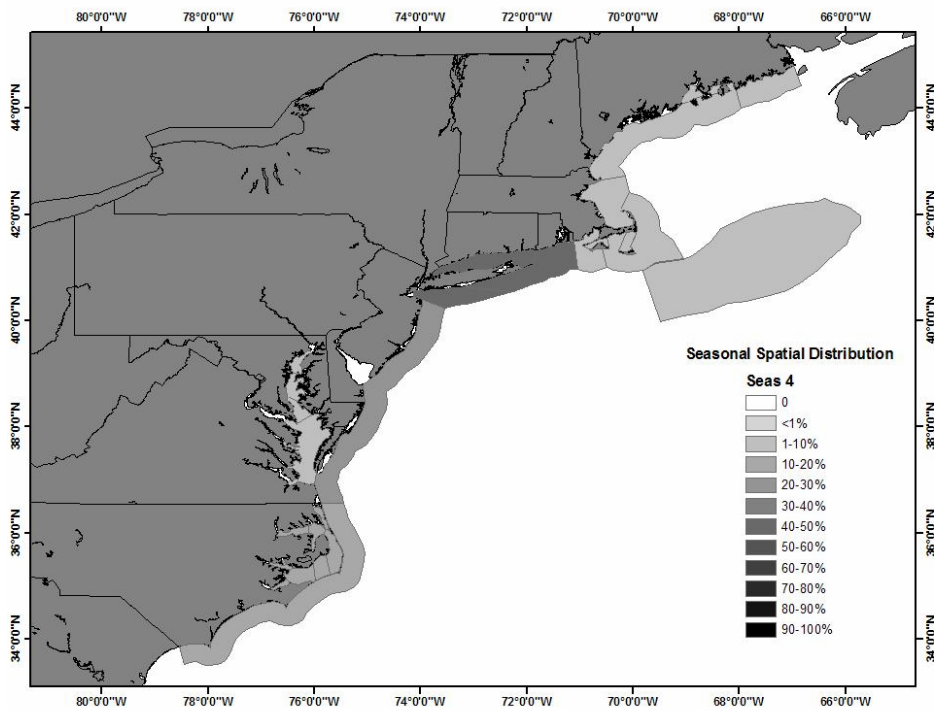
c)
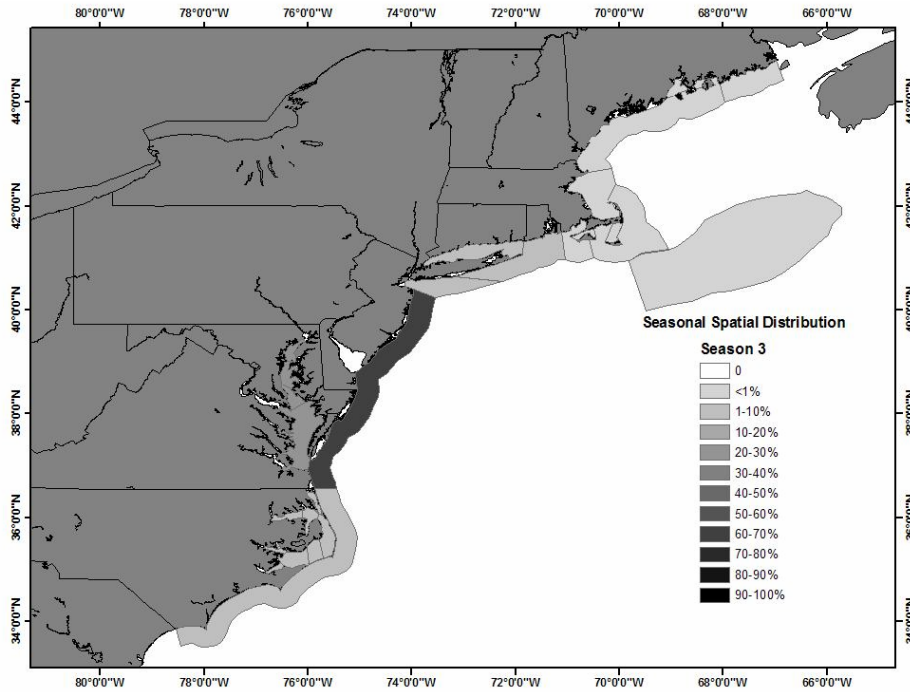
d)
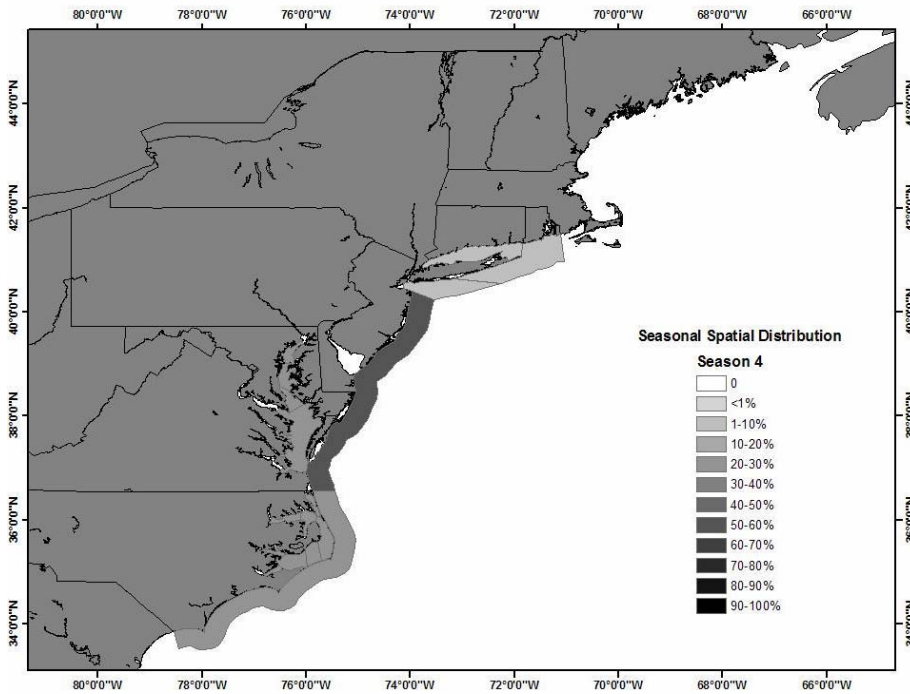
Figure D.31. Observed age-structure of weakfish catch within each region.
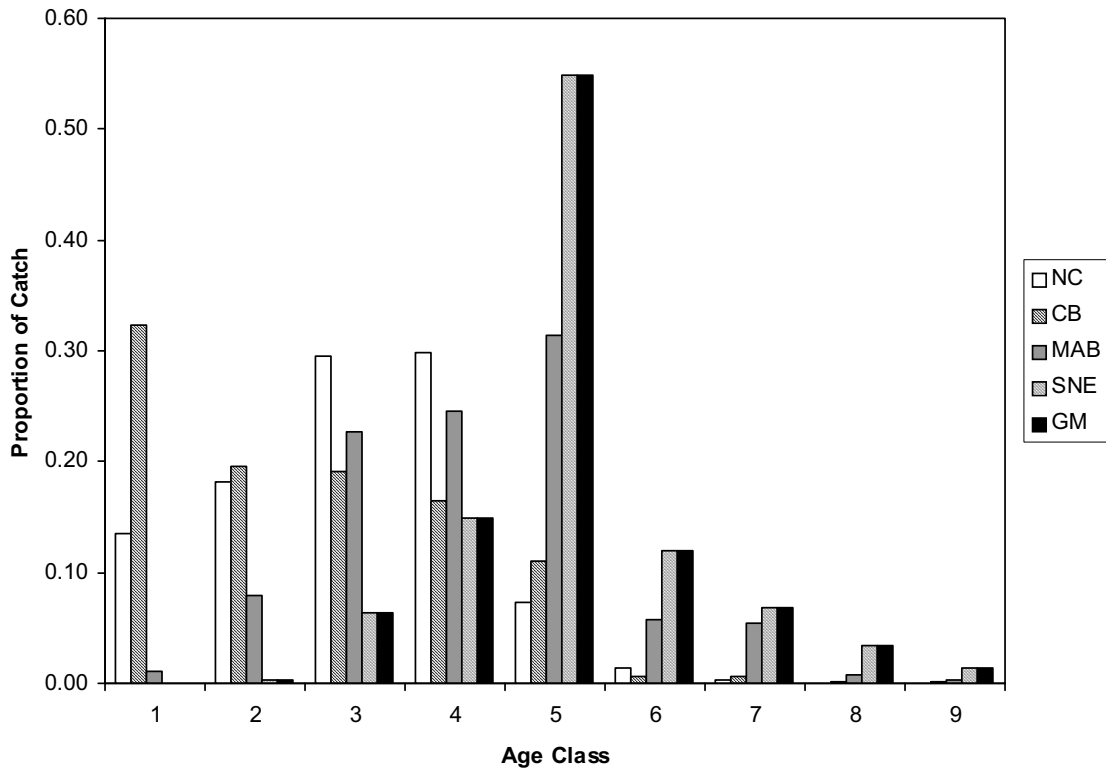
Figure D.32. Seasonal spatial distribution of bluefish based on landings data: a. Season 1; b. Season 2; c. Season 3; and d. Season 4.

a)
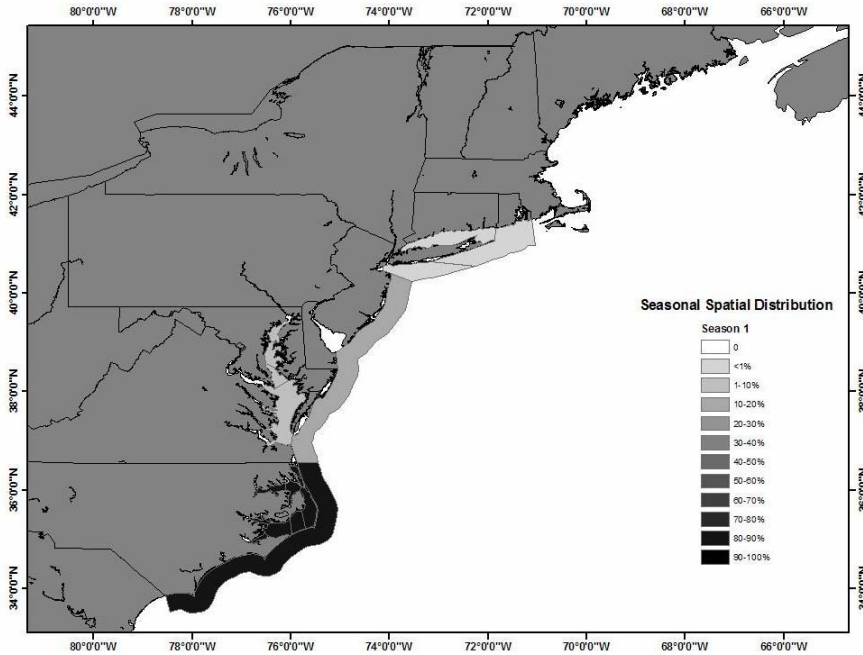
b)

Figure D.32 (cont'd). Seasonal spatial distribution of weakfish based on landings data: a. Season 1; b. Season 2; c. Season 3; and d. Season 4.

c)

d)

Figure D.33. Relative mean catch per tow of bluefish in each region for each season by the NMFS bottom trawl survey.
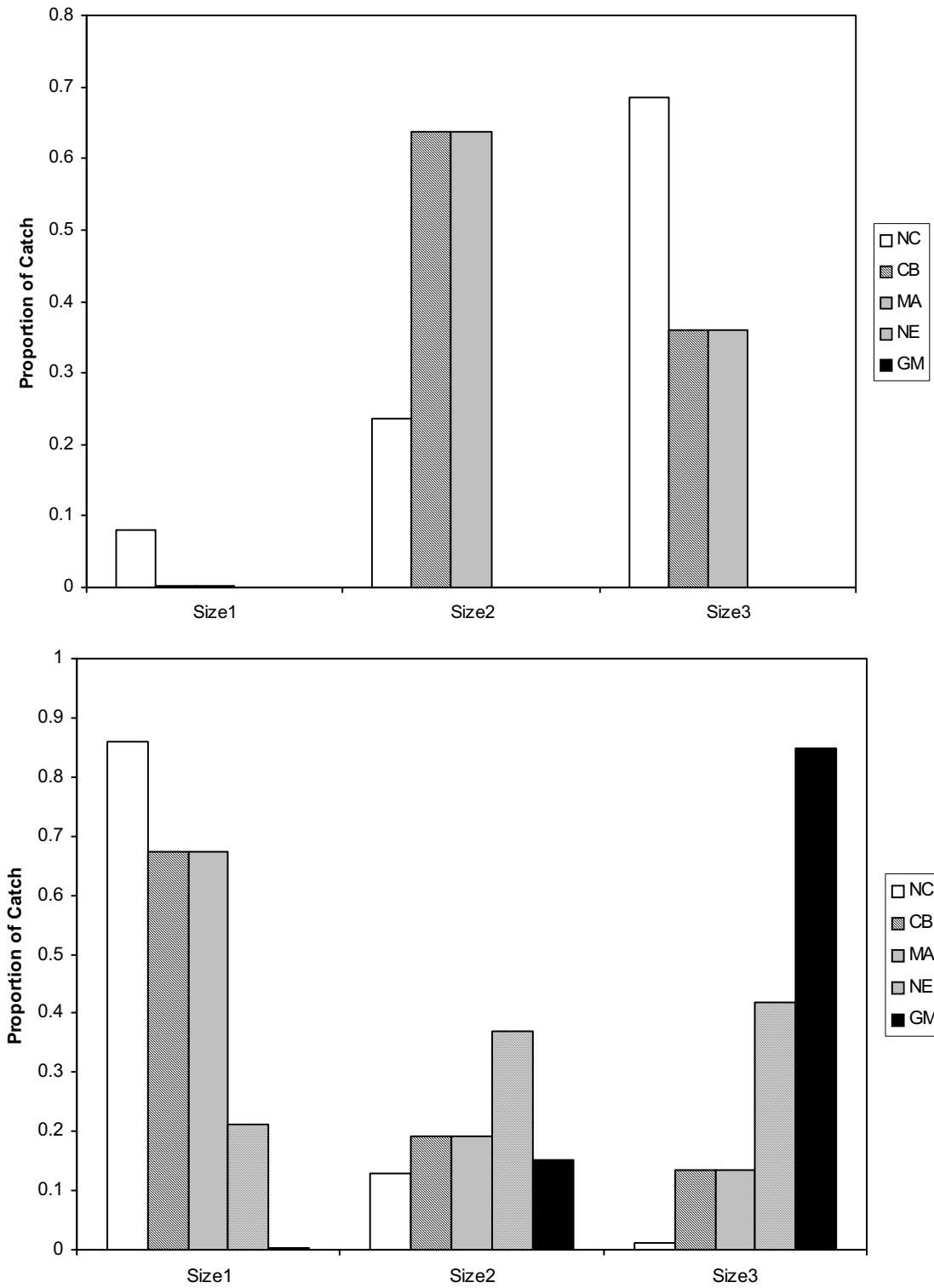
Figure D.34. Seasonal spatial distribution of menhaden based on landings data: a. Season 1; b. Season 2; c. Season 3; and d. Season 4.

a)
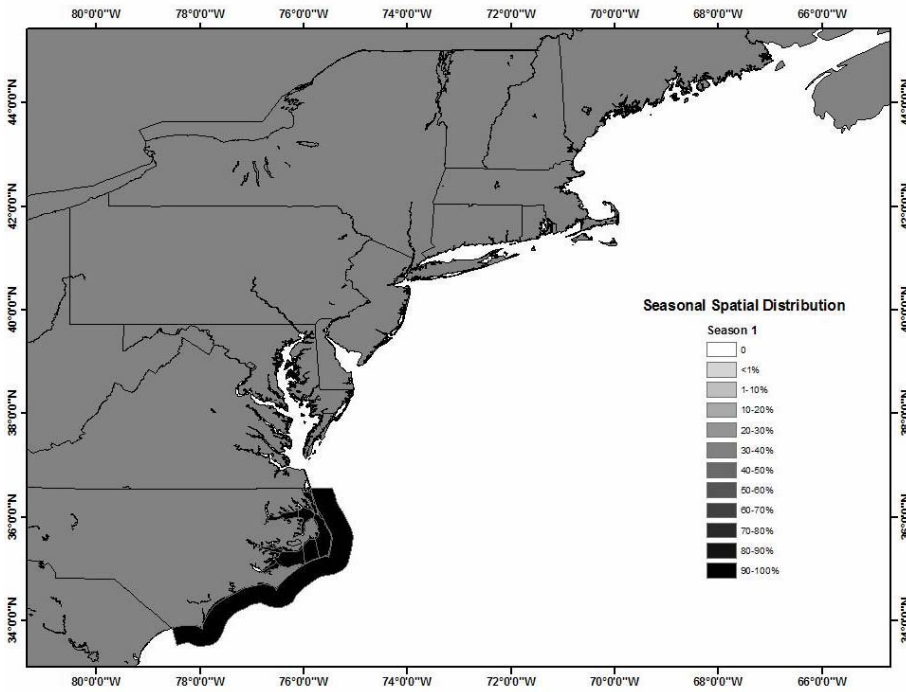
b)
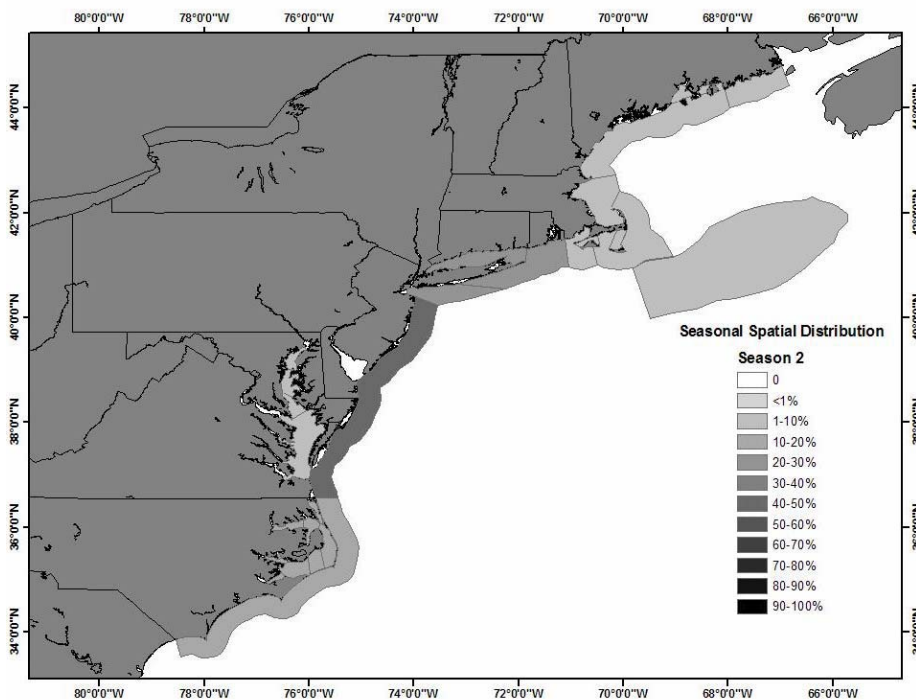
Figure D.34 (cont'd). Seasonal spatial distribution of menhaden based on landings data: a.
Season 1; b. Season 2; c. Season 3; and d. Season 4.

c)
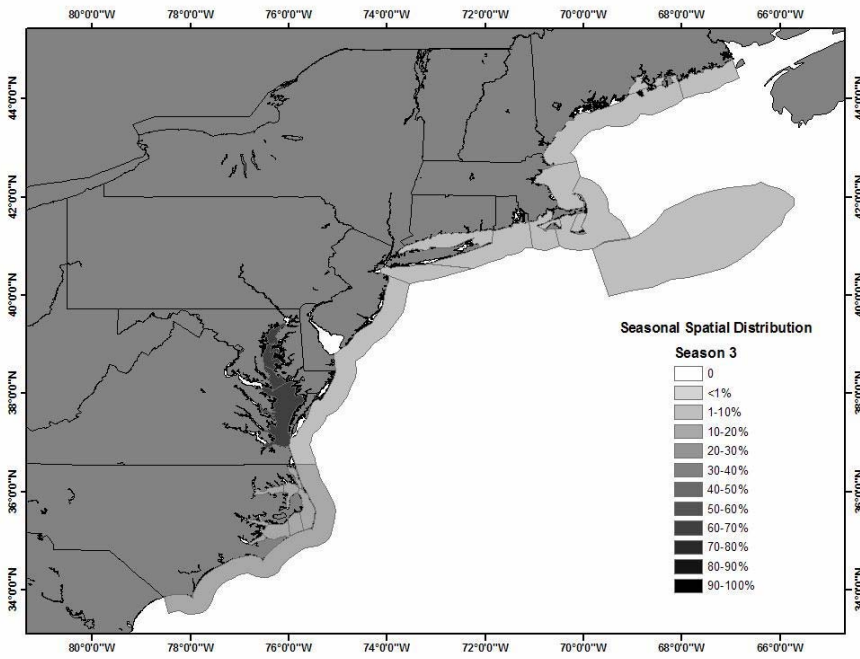
d)
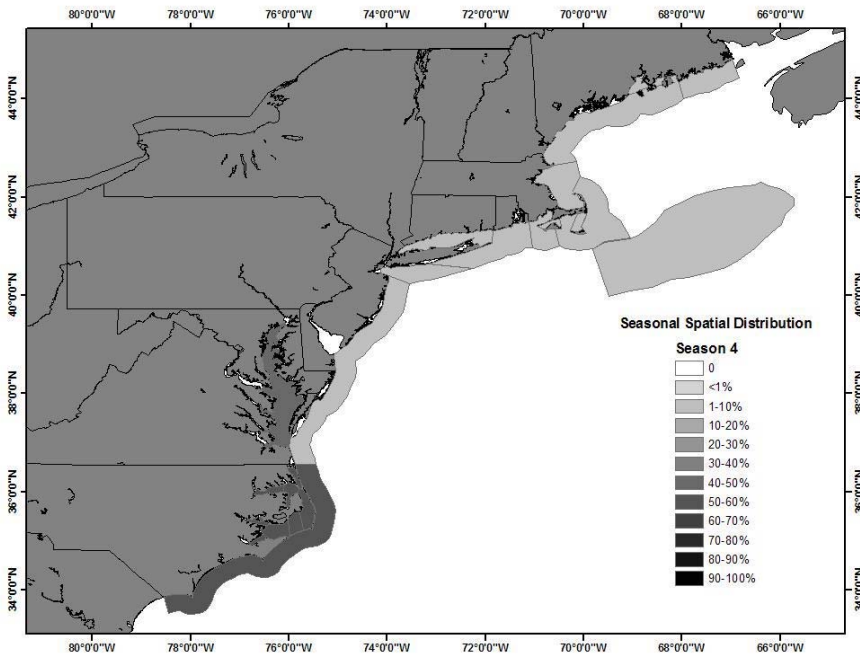
Figure D.35 (A.-C.). Seasonal spatial distribution of A) medium forage fish (primarily squid and butterfish),B) herrings (clupeids), and C) sciaenids (spot and croaker) from the mean catch per tow in each region from NMFS bottom trawl survey data.
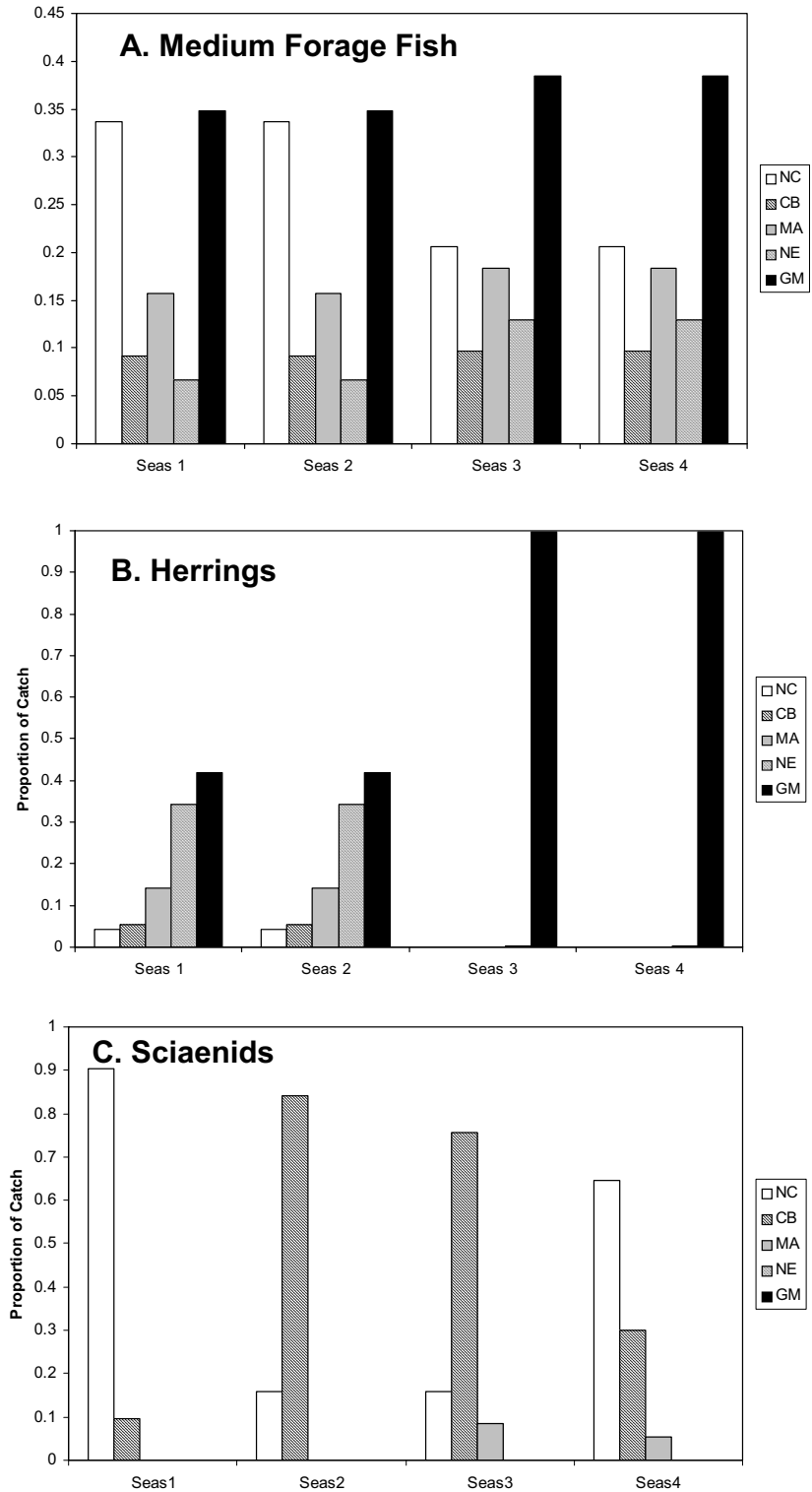
Figure D.36. Spatial distribution of anchovies, benthic invertebrates, benthic crustaceans and macrozooplankton.
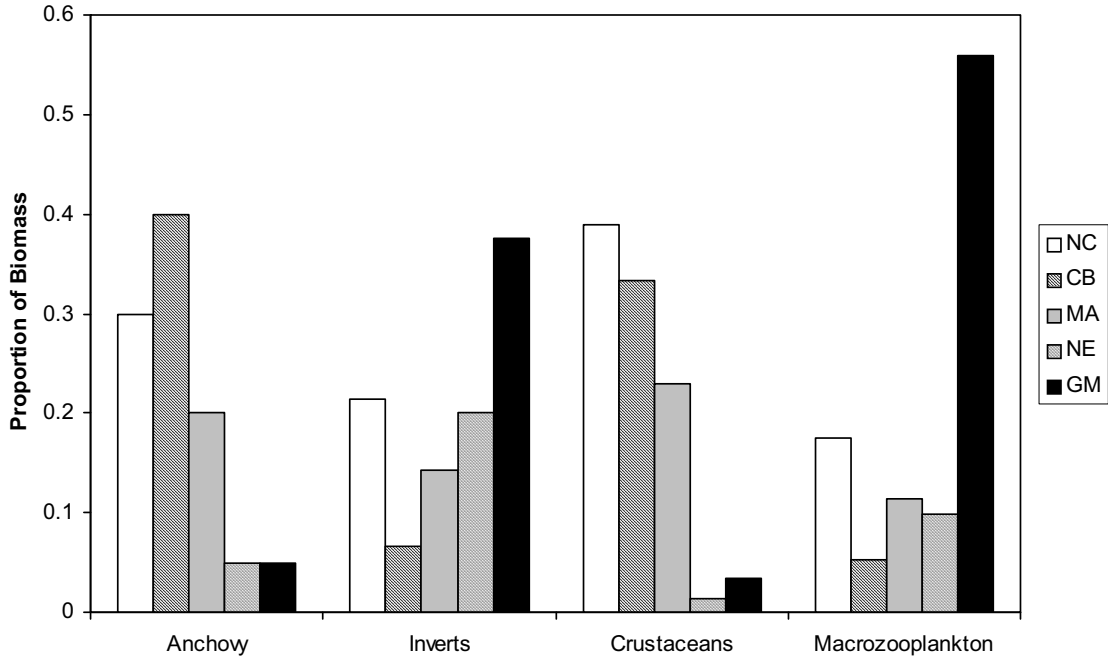
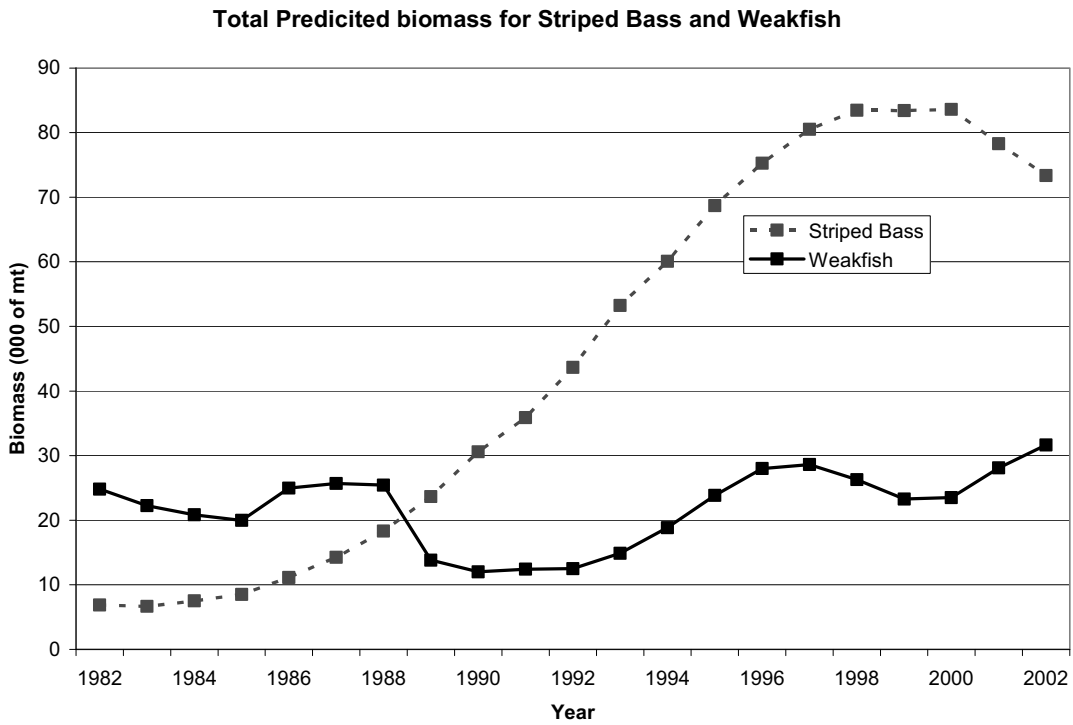Figure D.37. Total population biomass (000 mt) for weakfish and striped bass.

Total Predicited biomass for Striped Bass and Weakfish

Figure D.38. Annual SSB (000 mt) for weakfish and striped bass.

SSB for Striped Bass and Weakfish
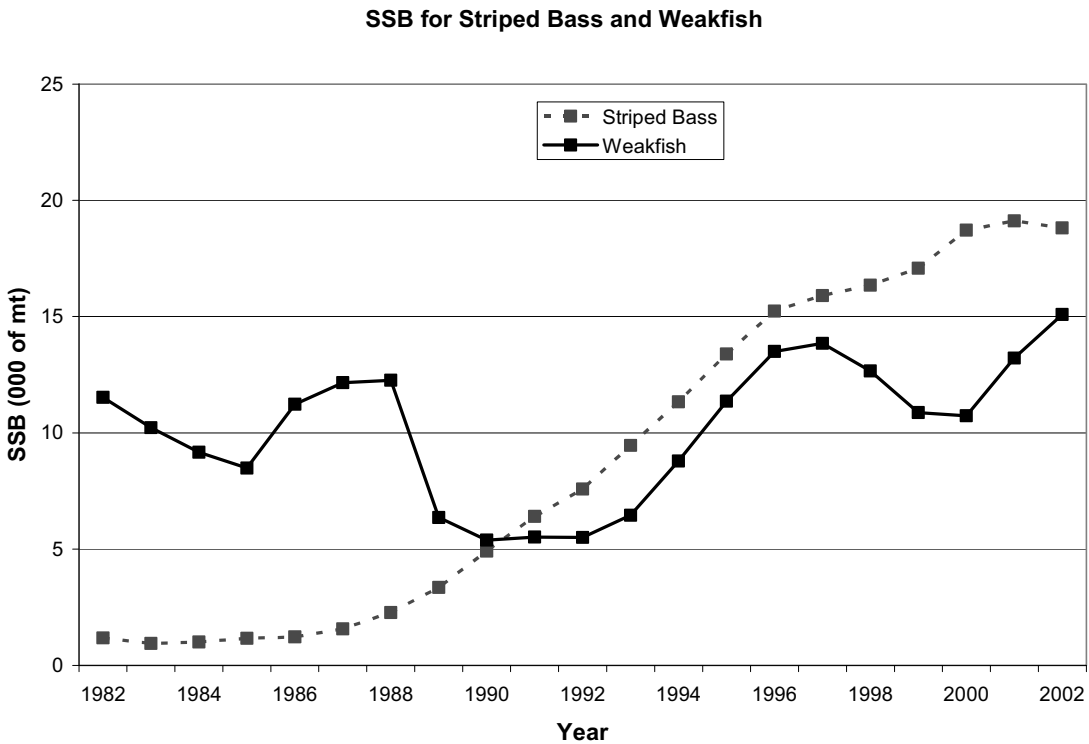
Figure D.39. Annual bluefish population biomass (000mt) by size class.
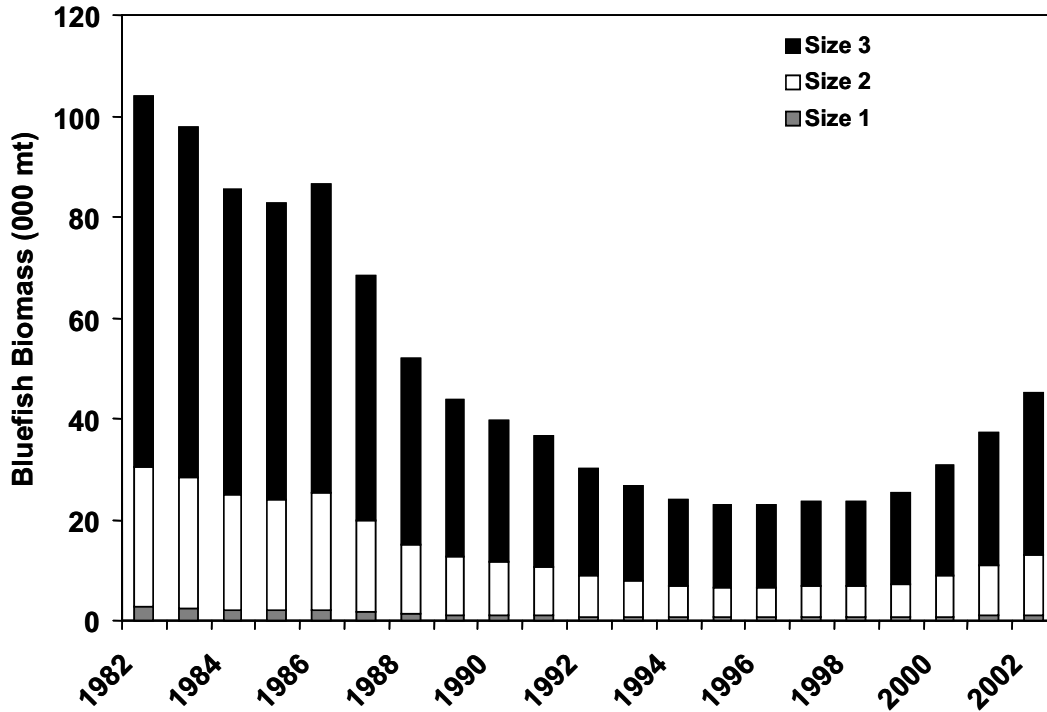
Figure D.40. Menhaden abundance at maturity (Age 2+, primary y-axis) and total menhaden abundance (secondary y-axis). Note the scale change on the secondary y-axis.
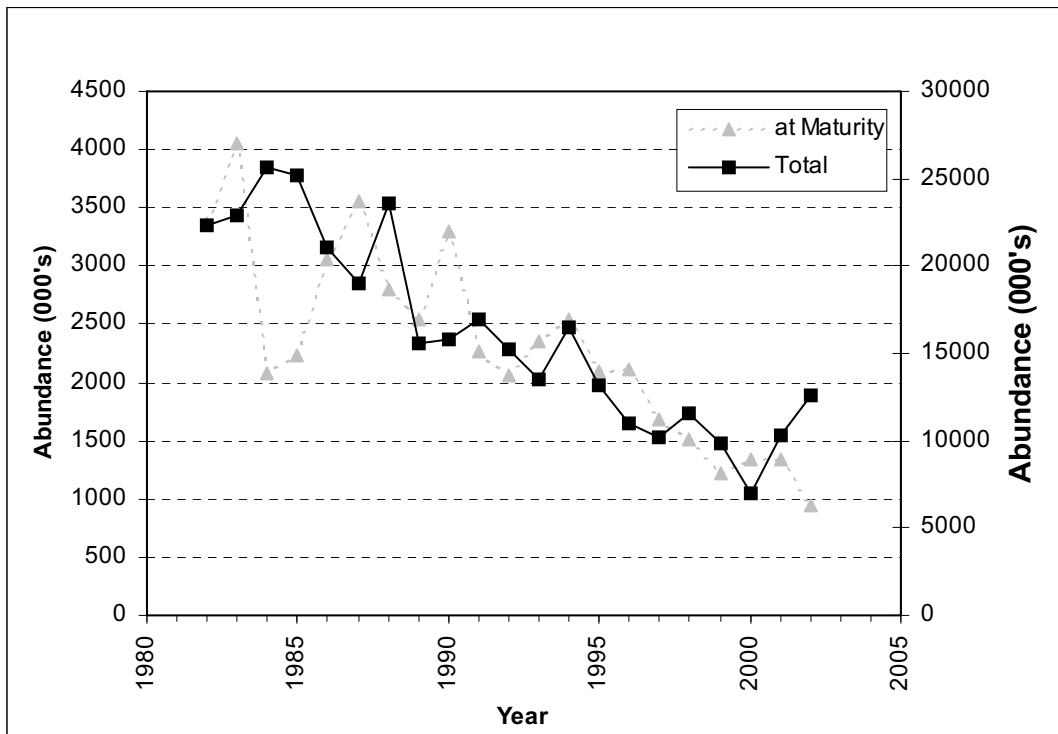
Figure D.41. Total menhaden SSB (primary y-axis) and population biomass (secondary y-axis) (000 mt). Note the scale change on the secondary y-axis.
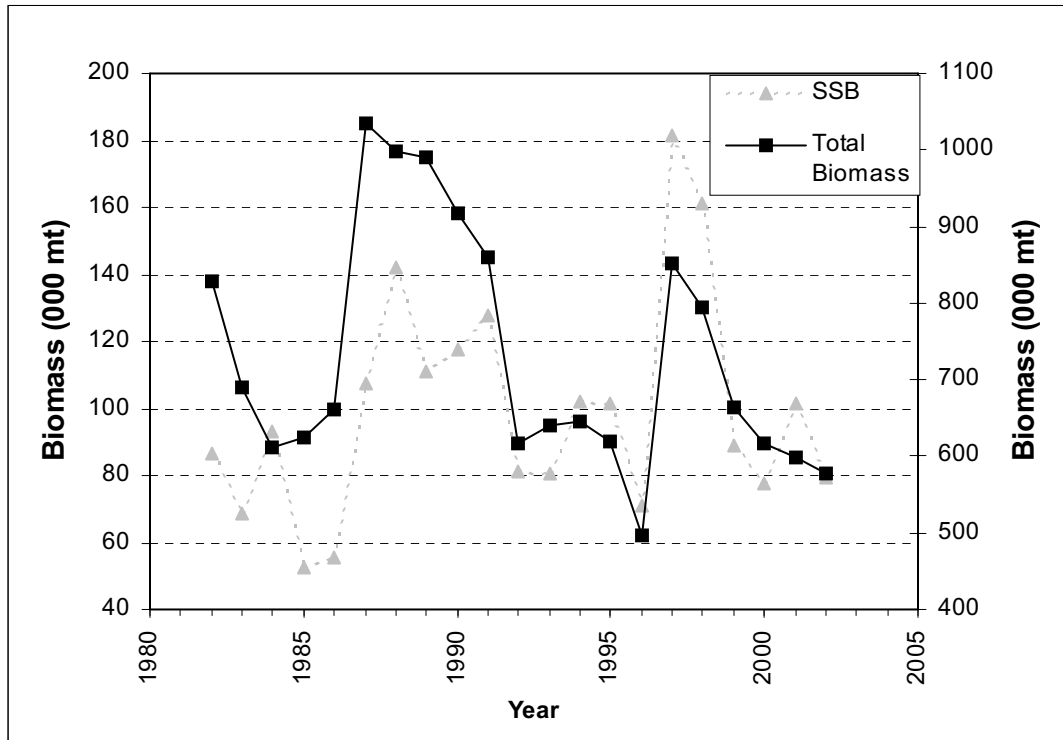

Figure D.42. Annual population biomass (000 mt) trends in MSVPA-X forage species.
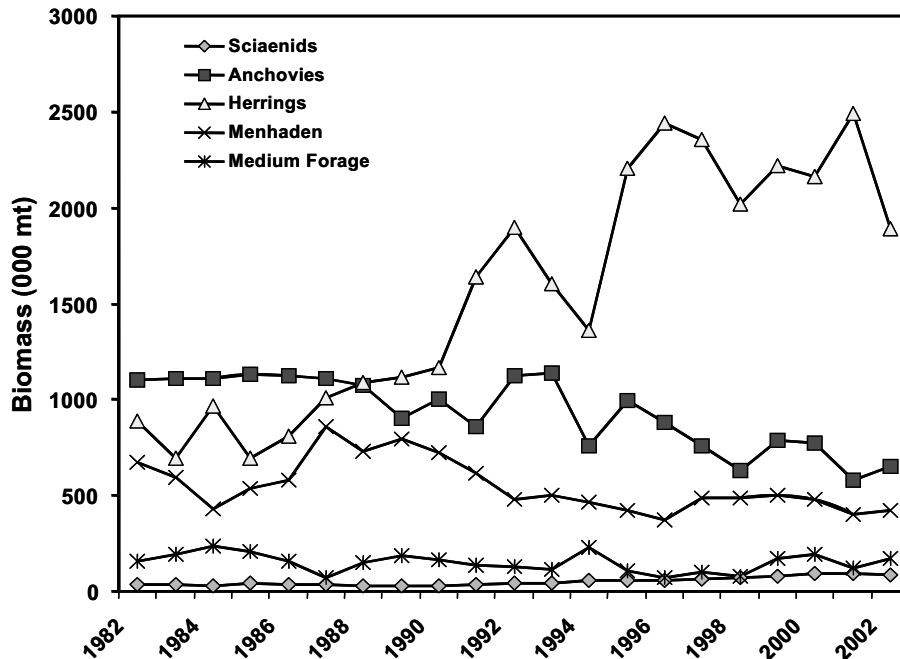
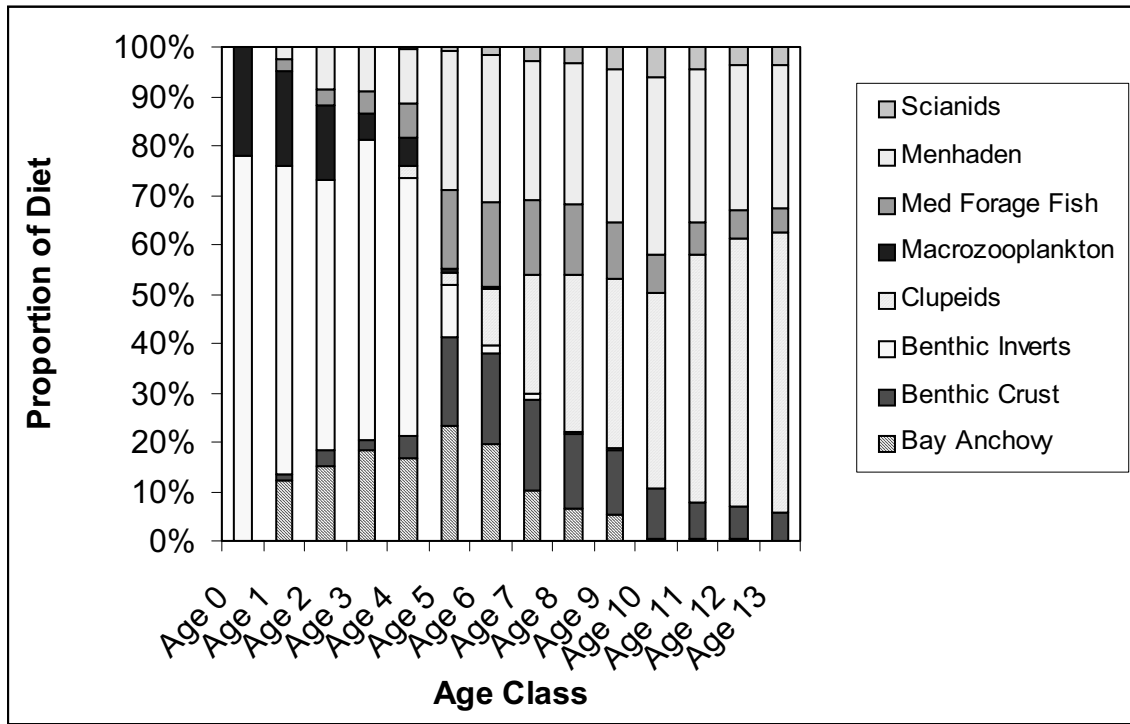Figure D.43. Predicted average proportion of prey in striped bass diets.

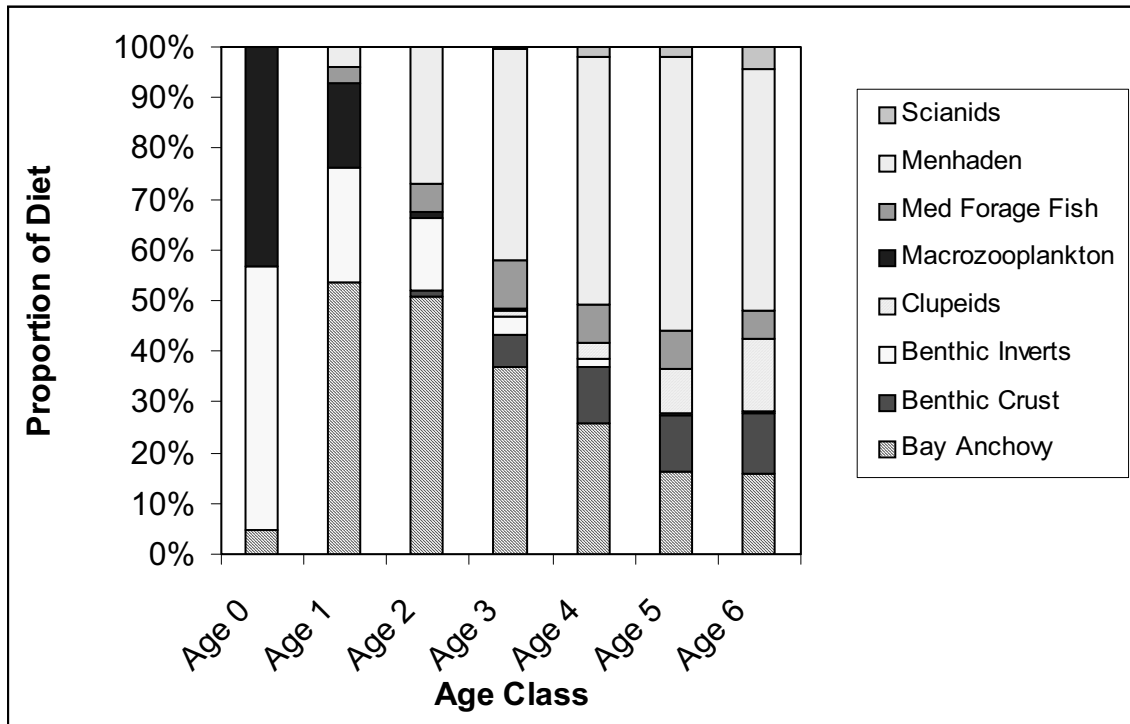Figure D.44. Predicted average proportion of prey in weakfish diets.

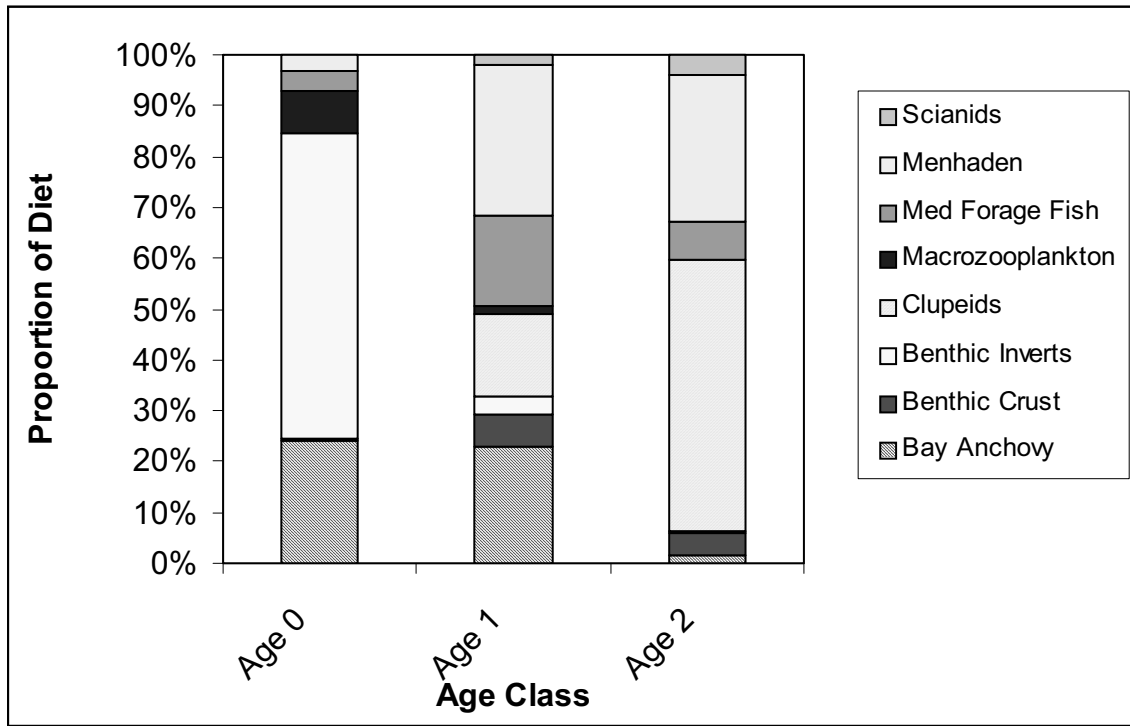Figure D.45. Predicted average proportion of prey in bluefish diets.

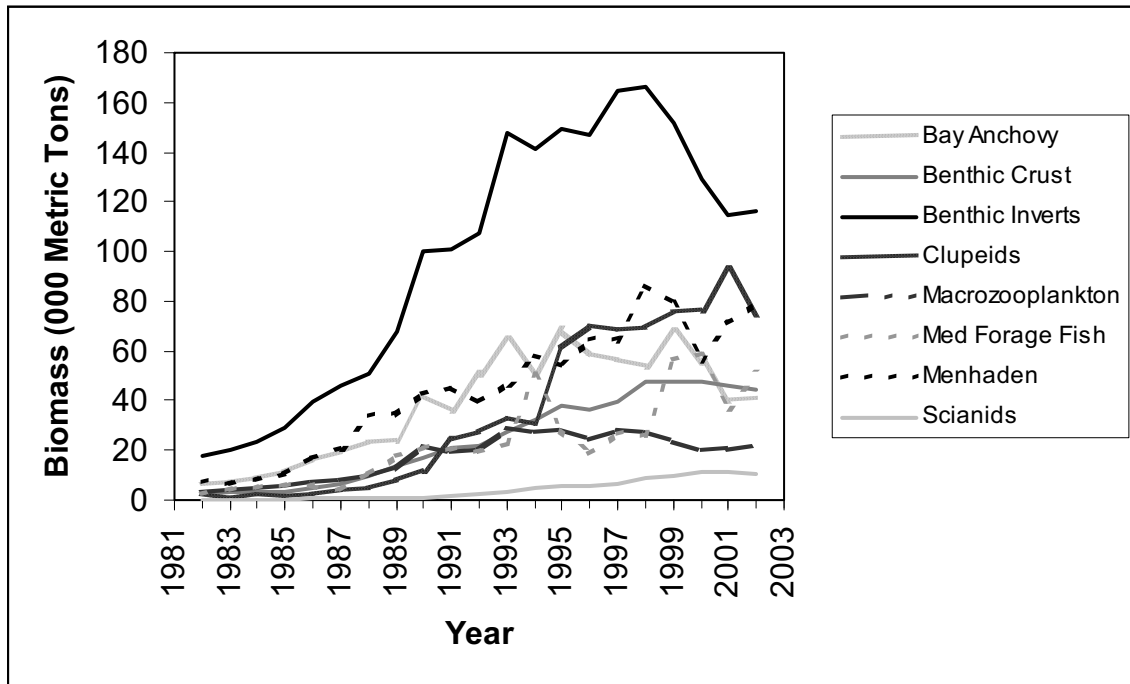Figure D.46. Predicted total prey biomass consumed annually by all ages of striped bass.

Figure D.47. Predicted total prey biomass consumed annually by all ages of weakfish.
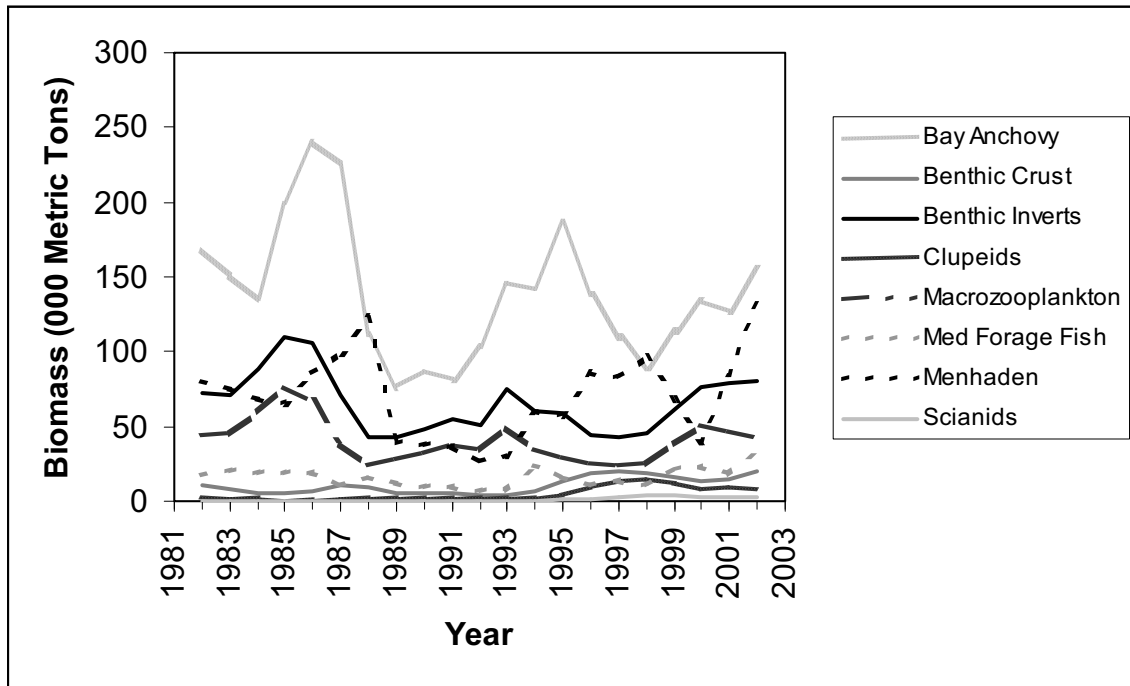
Figure D.48. Predicted total prey biomass consumed annually by all size classes of bluefish.
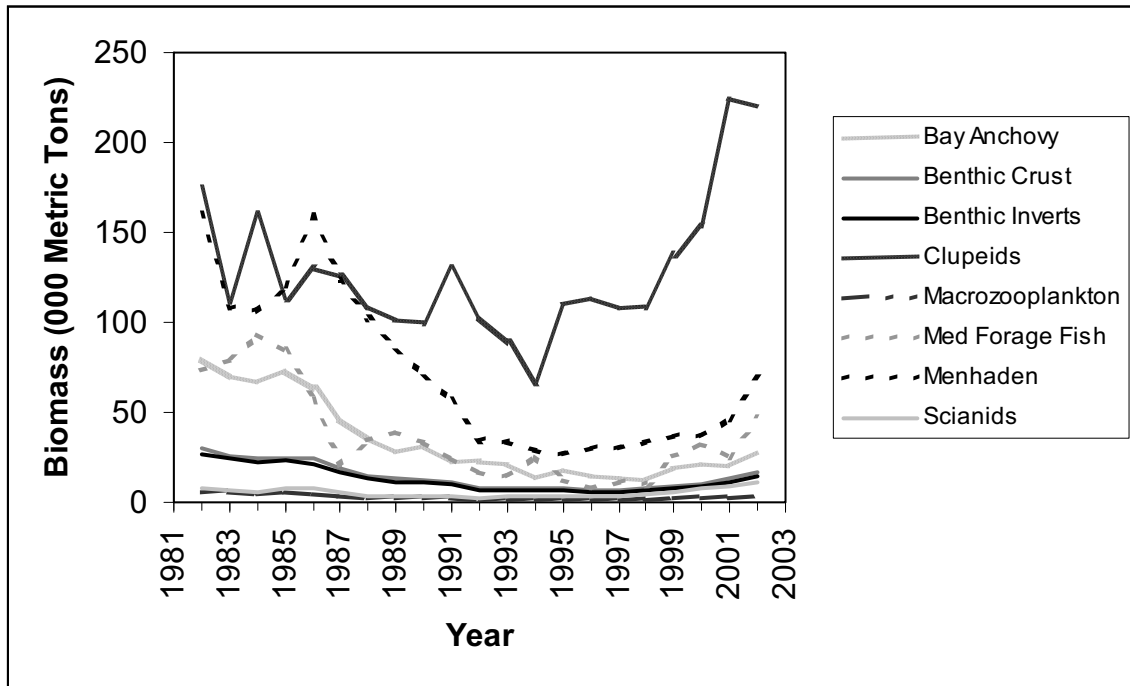
Figure D.49. Prey availability by species for Age 7 striped bass. Relative availability based on time series average.
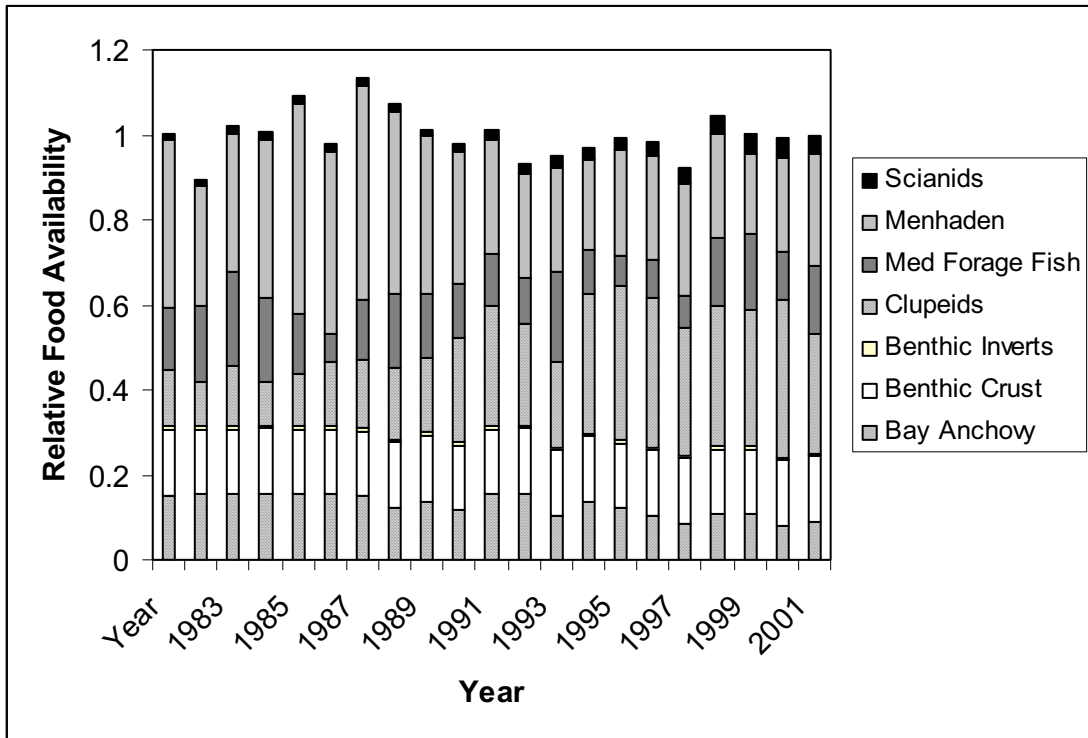
Figure D.50. Prey availability by species for age 4 weakfish. Relative availability is based on time series average.
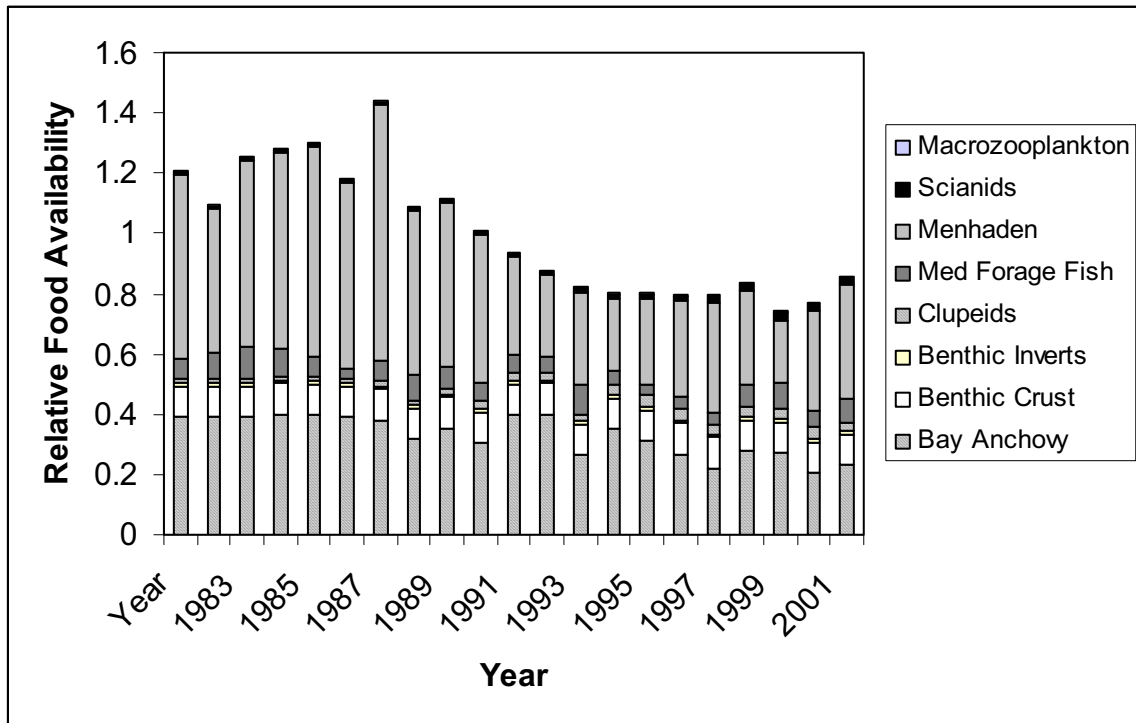
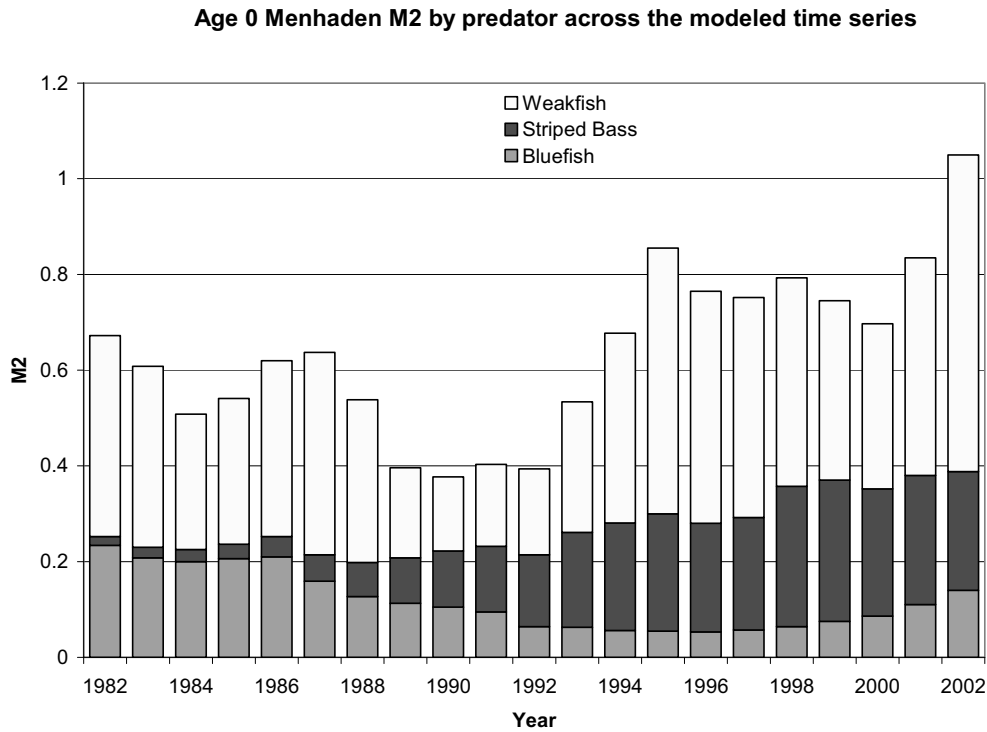Figure D.51. Annual age-0 menhaden predation mortality (M2) by predator.

Age 0 Menhaden M2 by predator across the modeled time series

Figure D.52. Annual age-1 menhaden predation mortality (M2) by predator.

Age 1 Menhaden M2 by predator across the modeled time series
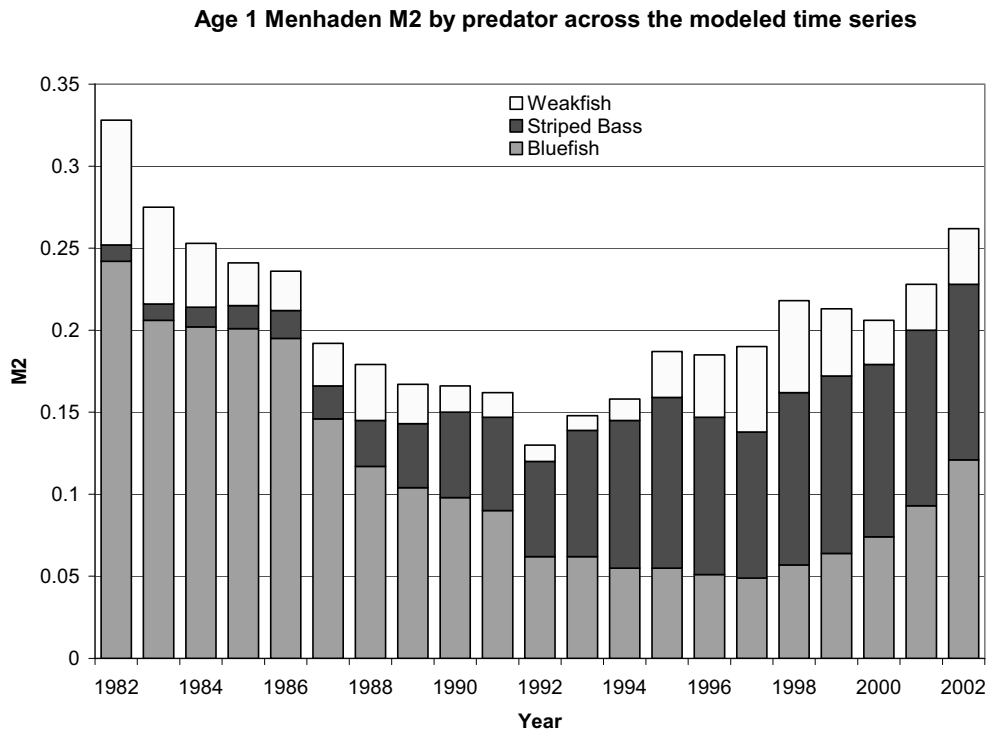
Figure D.53. Annual age-2 menhaden predation mortality (M2) by predator.

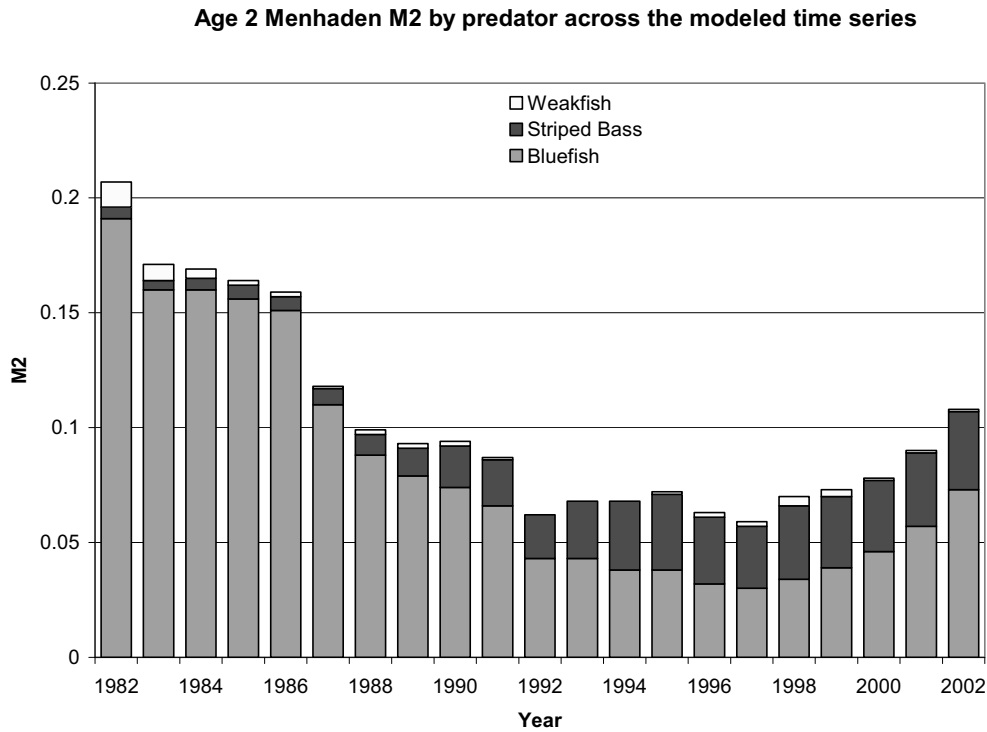**Age 2 Menhaden M2 by predator across the modeled time series**

Figure D.54. Annual age-3 menhaden predation mortality (M2) by predator.

Age 3 Menhaden M2 by predator across the modeled time series