Changes in the Fish and Macroinvertebrate Assemblage Near Millstone Point, CT Over the Past 32 Years

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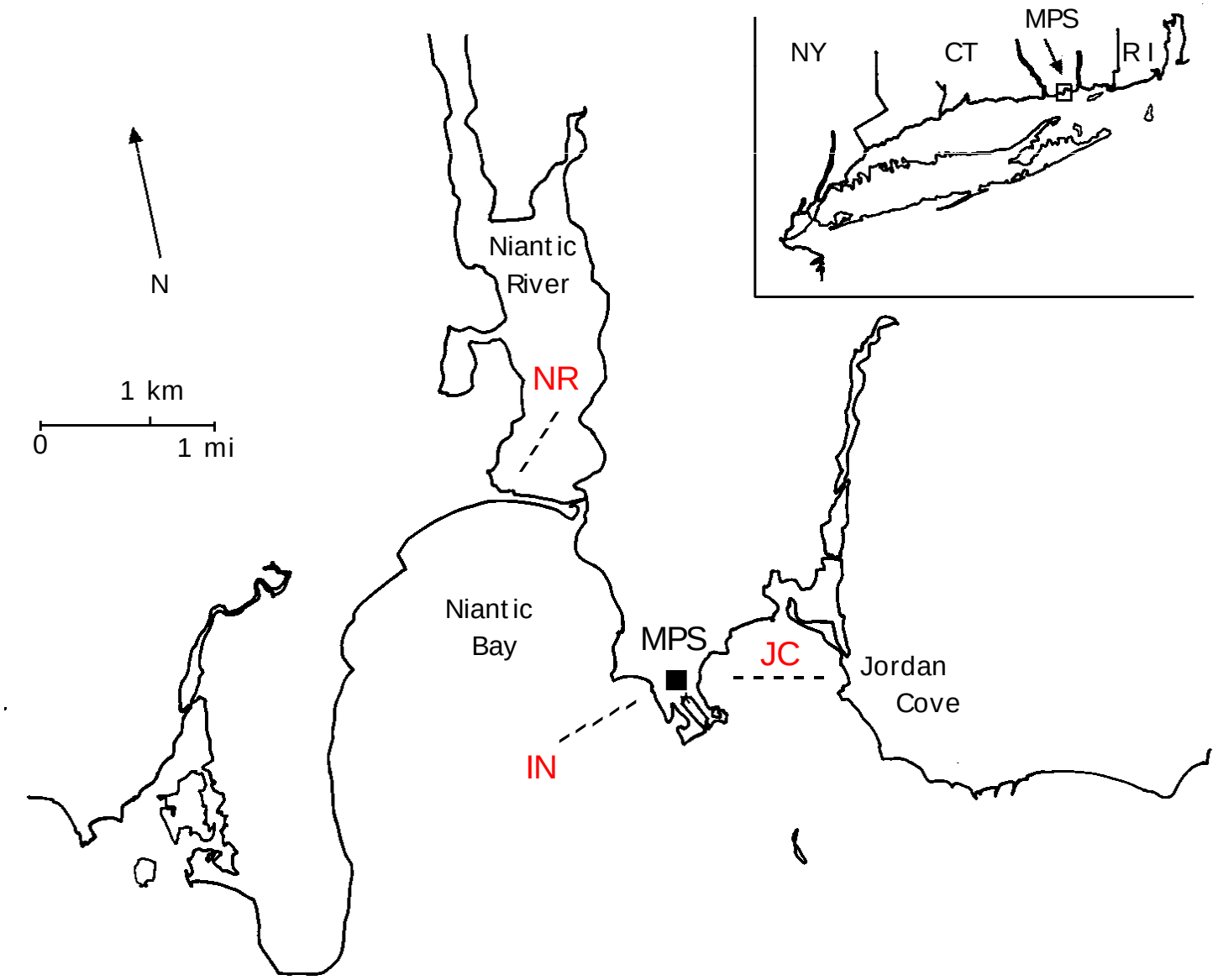
WATERFORD CT.

Source of Data

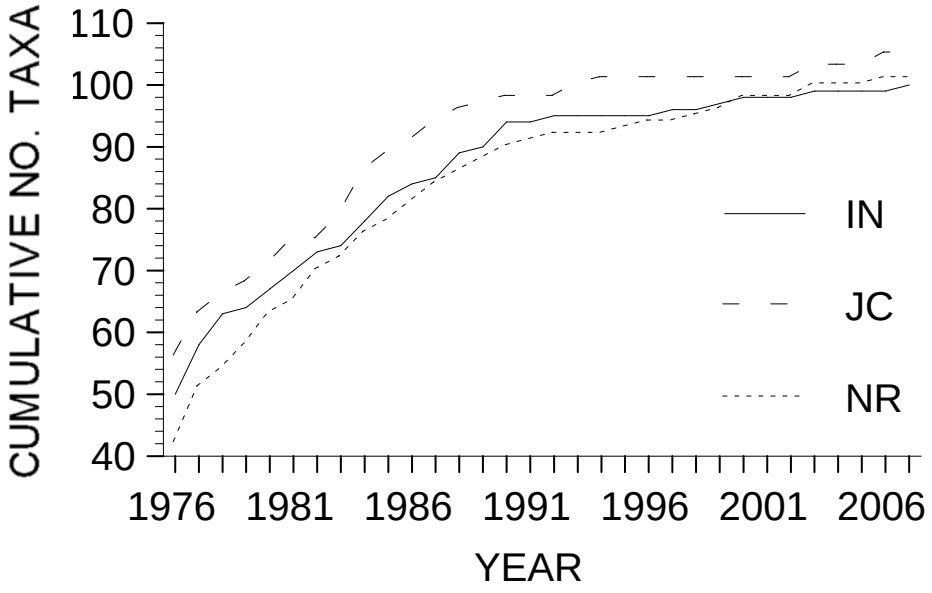
- Long-term trawl survey completed at three stations in vicinity of Millstone Point, CT
- Three stations sampled (three replicates) every other week
- Tows standardized by distance
- For this analysis, effort-adjusted catch of each taxon summed over a June-May year from June 1976 through May 2008 (32 years)


MPS
NY
CT
R I
N
Niantic
River
NR
1 km
0
1 mi
Niantic
Bay
MPS
JC
Jordan
Cove
IN

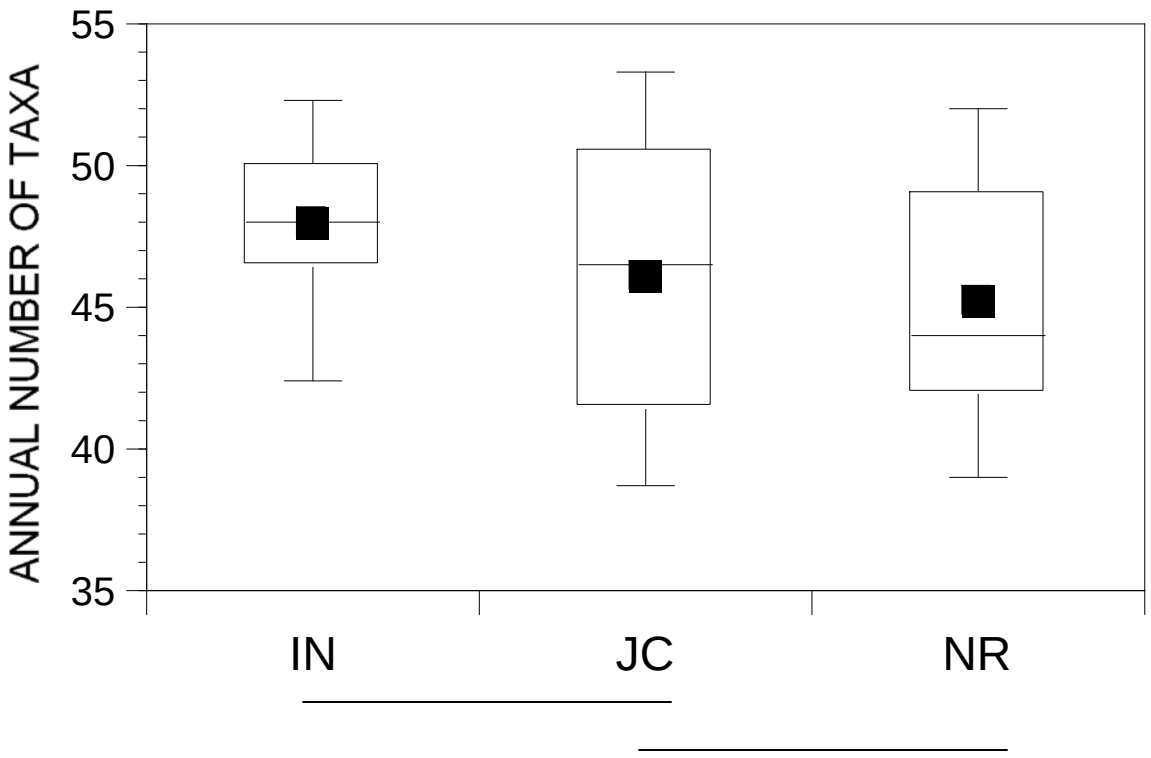
Abundance Totals

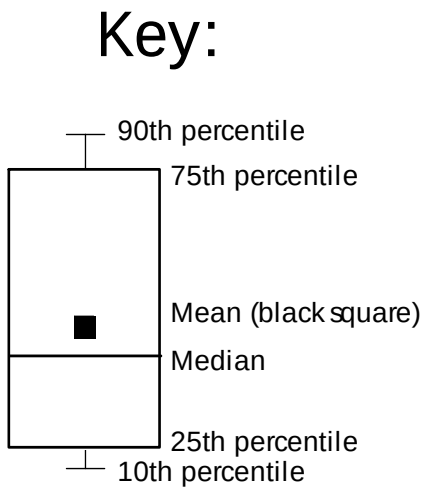
- 115 taxa considered (some higher level):
- Intake (Niantic Bay):
  - 229,181 fish + 53,940 macroinvertebrates
- Jordan Cove:
  - 120,015 fish + 33,644 macroinvertebrates
- Niantic River:
  - 136,975 fish + 276,046 macroinvertebrates

Cumulative Catch of Taxa

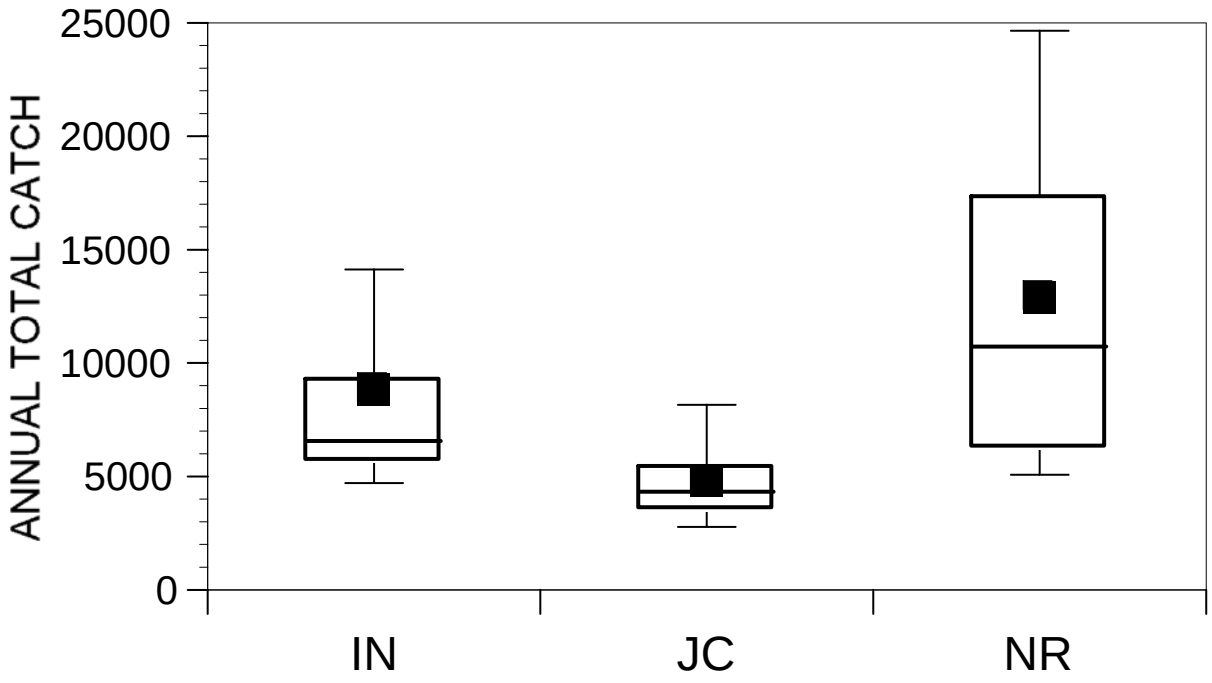


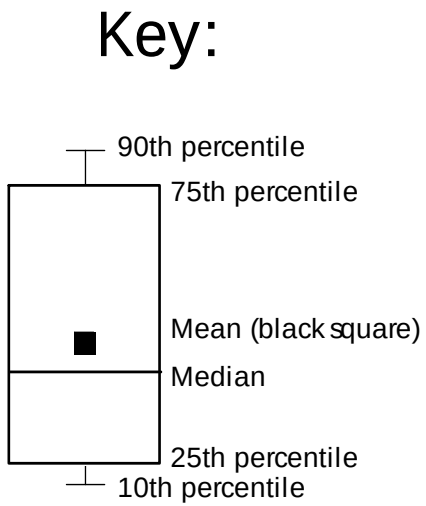
Number of Taxa by Station





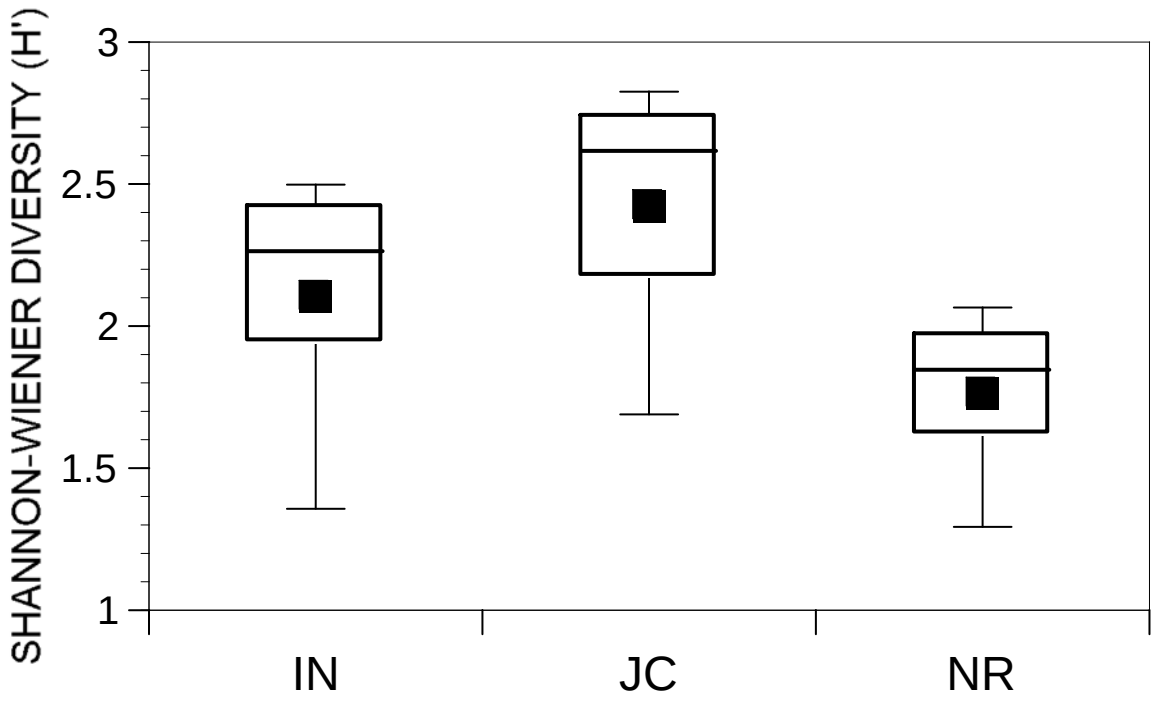
Total Annual Catch





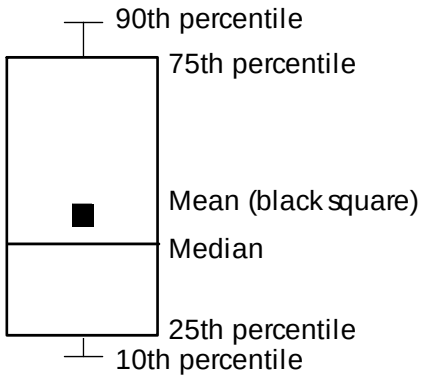
NR > IN > JC

Shannon-Wiener Diversity

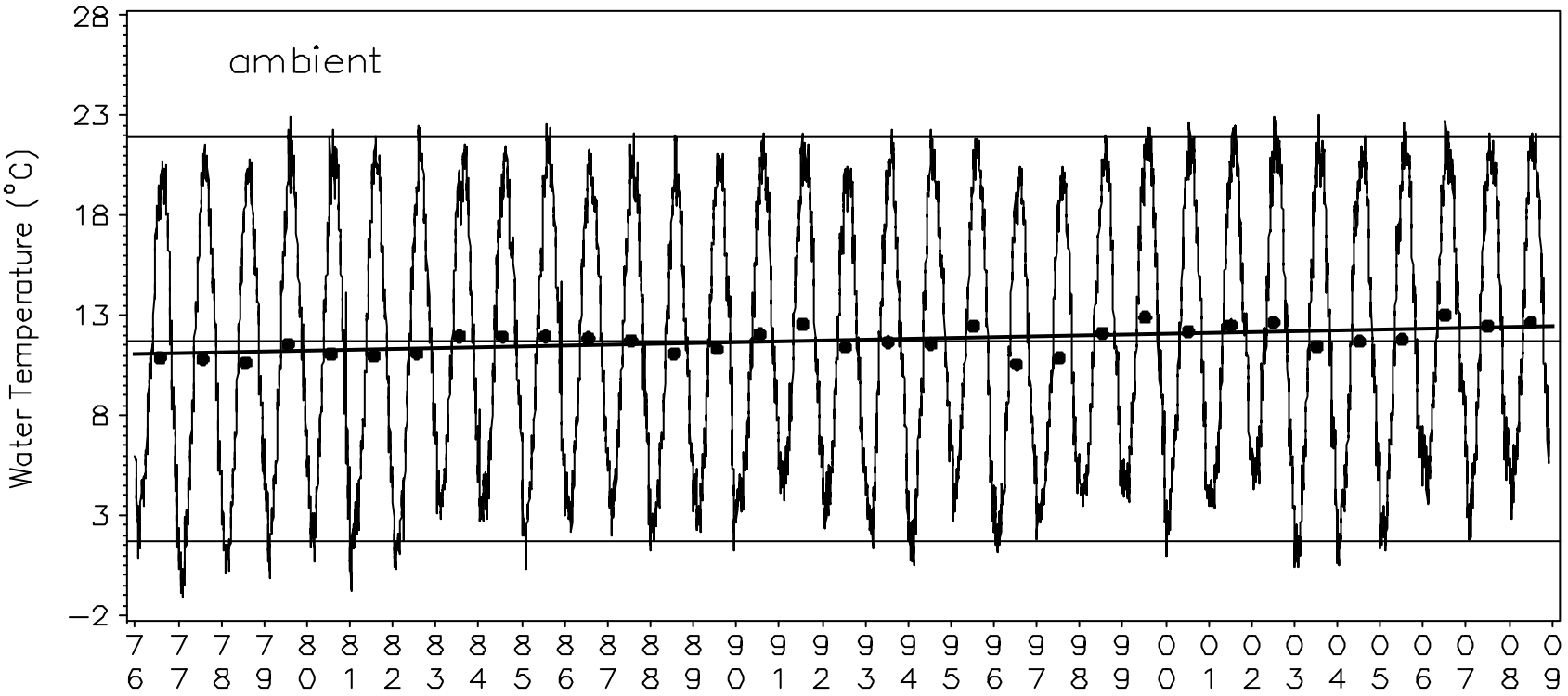


JC > IN > NR

Key:



Daily Mean Seawater Temperature – MPS Intakes



Slope = 0.042°C/year; p=0.0002**; 1.4°C increase over 33 years

Multivariate Analyses

- Hierarchical clustering and nonmetric multidimensional scaling (MDS) ordination techniques used
- PRIMER (v. 6) software package
- Bray-Curtis similarity index an important component of this analysis
- SIMPROF and SIMPER routines helped elucidate differences

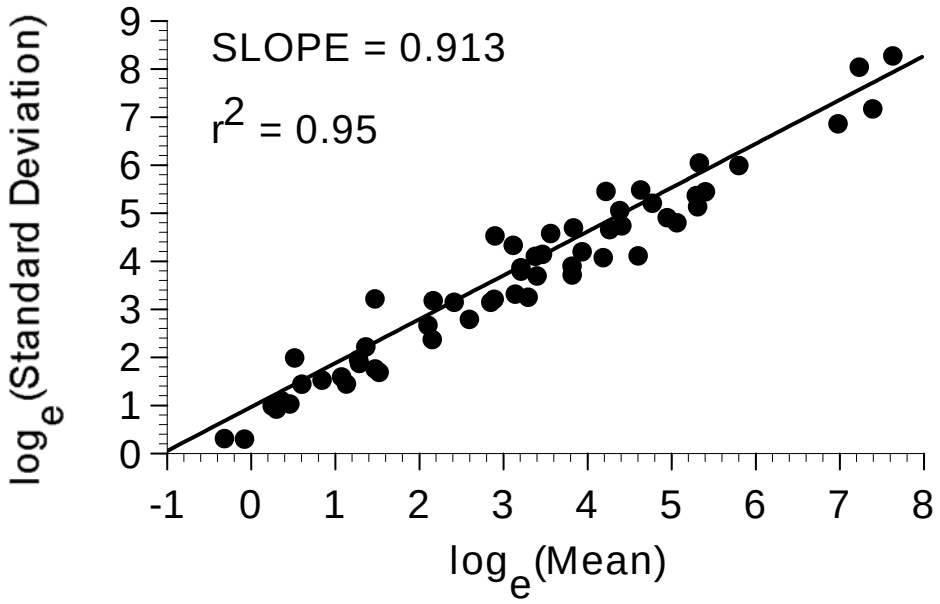
Data Subsetting

- Catch data screened to remove taxa with high proportions of zero catches
- Criteria for inclusion:
  - $\geq$0.2% of total catch at a station and taken in at least 7 of the 32 years
- Analyses used 56 of 115 taxa (49%), but 99.9% of total catch:
  - 44/98 fishes and 12/17 macroinvertebrates

Data Transformation

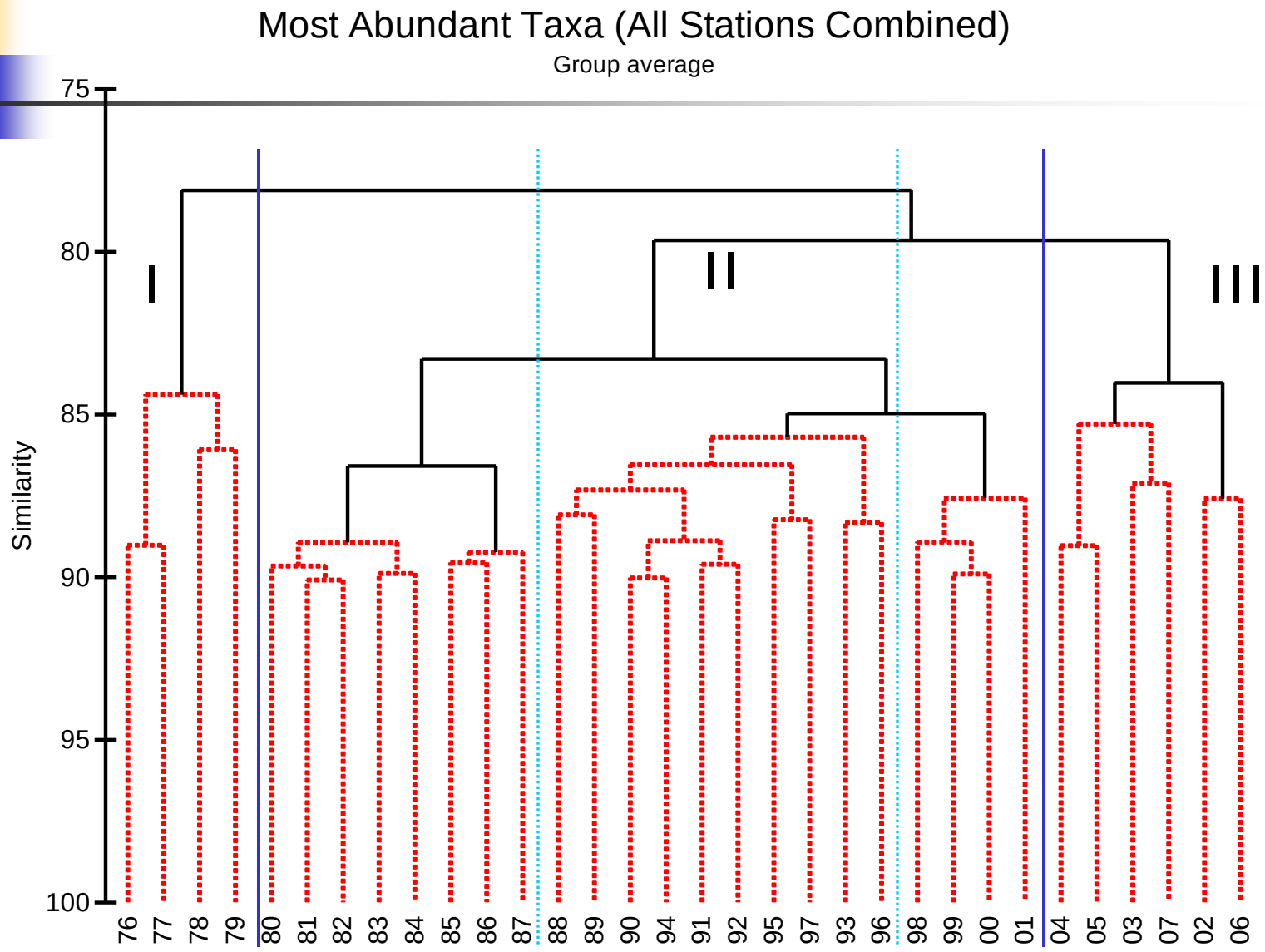
- Data were transformed to help balance differing contributions of both abundant and less common taxa
- Graphical technique suggested:
  - slope of log mean abundance vs. log standard deviation indicates appropriate data transformation

Data Transformation



$Log_e(X + 1)$ data transformation indicated

Clustering Dendrogram - by Year



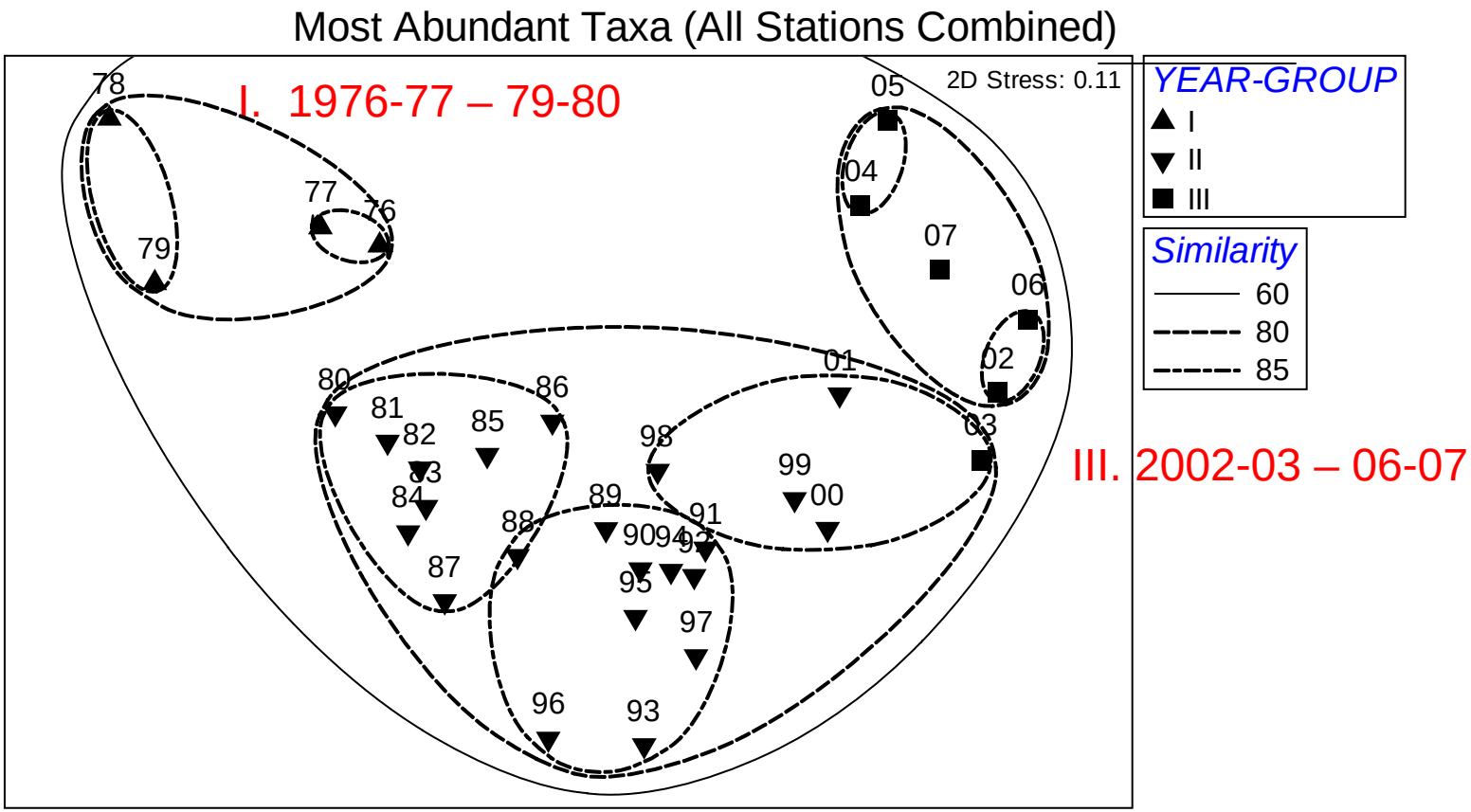
Annual Groupings - Similarities

- 14 to 16 taxa accounted for ~50% of average similarity within major clusters
- 6-7 taxa made up ~25%

Annual Groupings - Similarities

- Group I (1976-1979):
  - Winter flounder, silversides, scup, cunner, spider crabs, windowpane
- Group II (1980-2001):
  - Winter flounder, green crab, spider crabs, scup, windowpane, Atlantic rock crab, grubby
- Group III (2002-2007):
  - Scup, green crab, spider crabs, winter flounder, black sea bass, silversides

2D MDS Plot – by Year



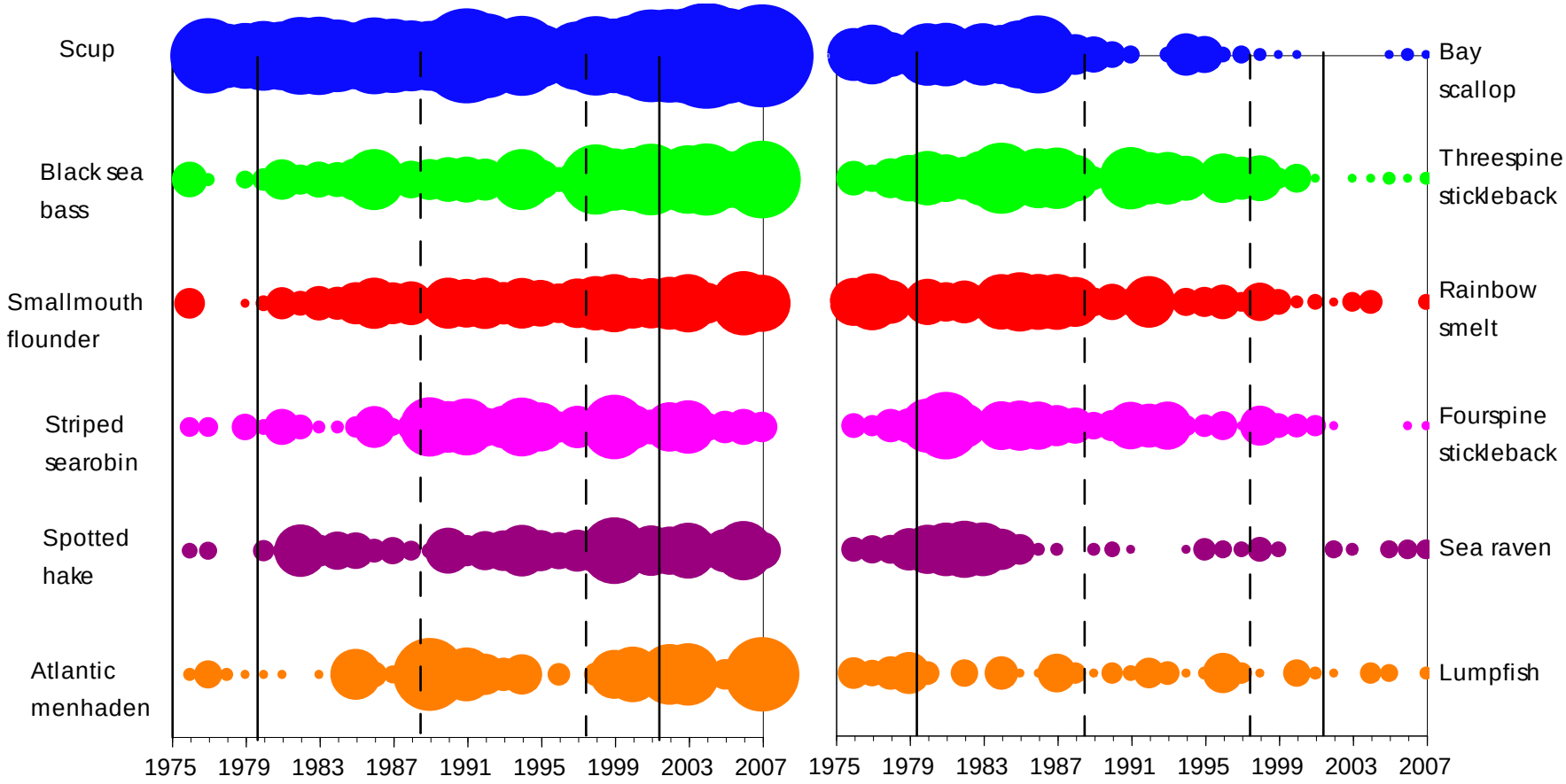
Annual Groupings - Dissimilarities

- 15 to 20 taxa accounted for ~50% of inter-group differences
- Of note, some of more abundant taxa (winter flounder, scup, spider crabs, and silversides) were not informative
- Exception was green crab, which was in low abundance during late 1970s (Group I vs. II-III differences)

Annual Groupings - Dissimilarities

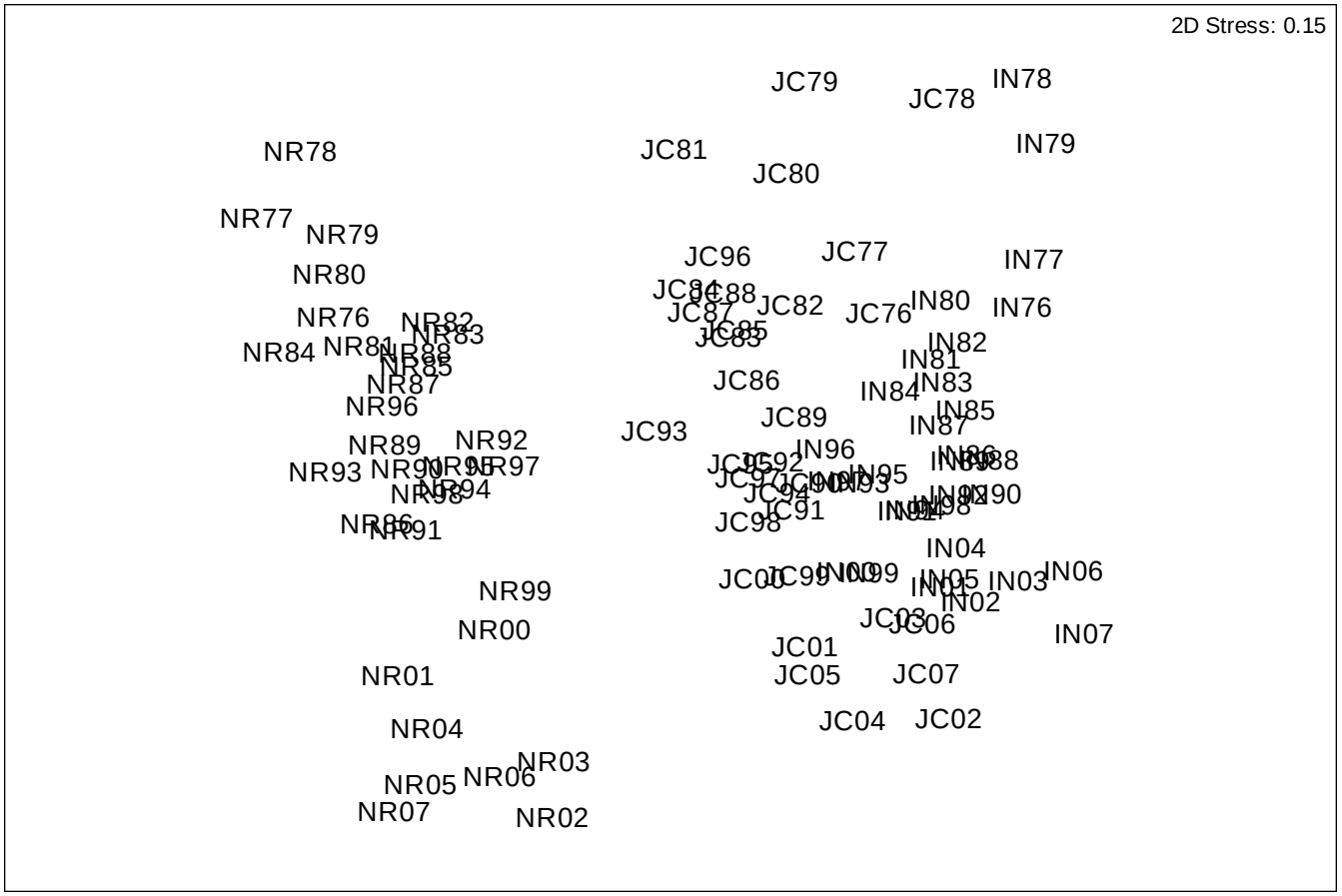
- Over the 32 years, we saw near complete loss of bay scallop, three- and fourspine sticklebacks, rainbow smelt, and sea raven, and decreases in lady crab, lumpfish, and American sand lance
- Had increases in black sea bass, Atlantic menhaden, spotted hake, smallmouth flounder, striped searobin, clearnose skate, and scup

ANNUAL log(X + 1) ABUNDANCES



INCREASING DECREASING

Station Differences



Station Differences

- Intra-station similarities were 75-78%
- Stations represent distinctly different habitats, with JC and IN showing more inter-station similarity (73%) than either had with NR (62-66%)
- 17-20 taxa accounted for half of the dissimilarities between stations

Informative or Distinctive Taxa

- IN:
  - Longfin squid, whelks, flatclaw hermit crab, skates, scup, smallmouth flounder, Atlantic cod, silver hake, northern searobin
- JC:
  - Green crab, rock gunnel, Atlantic tomcod, skates
- NR:
  - Green crab, lady crab, horseshoe crab, oyster toadfish, sticklebacks

Conclusions - Analytical Technique

- Clustering and MDS are complementary techniques useful in explaining variability found in species assemblages over time and space
- Can differentiate sets of years, stations, and taxa
- Moderately abundant species are often the best discriminators

Conclusions - Millstone Study

- No negative trends found in taxa or abundance indicating community stress
- Differences in assemblages appear related to species preferences and long-term changes in habitat or abundances
- Some changes probably reflect a long-term increase in average ambient water temperature or localized habitat changes

Conclusions - Millstone Study

- Scup-black sea bass-spotted hake-smallmouth flounder assemblage is currently dominant and cool-water fishes are in decline
- Above species similar to groupings of others - commonly characterized as “southern, warm”
- An ichthyofaunal change has occurred, probably associated with warming ambient water temperatures


Questions?