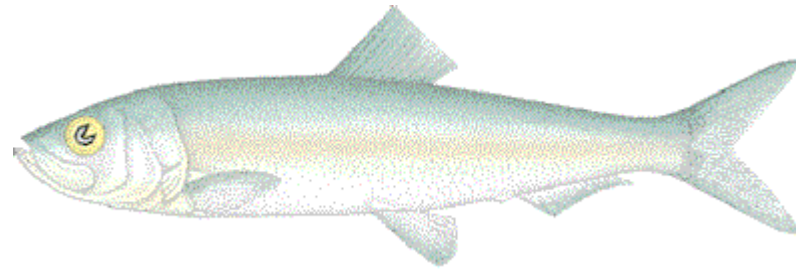




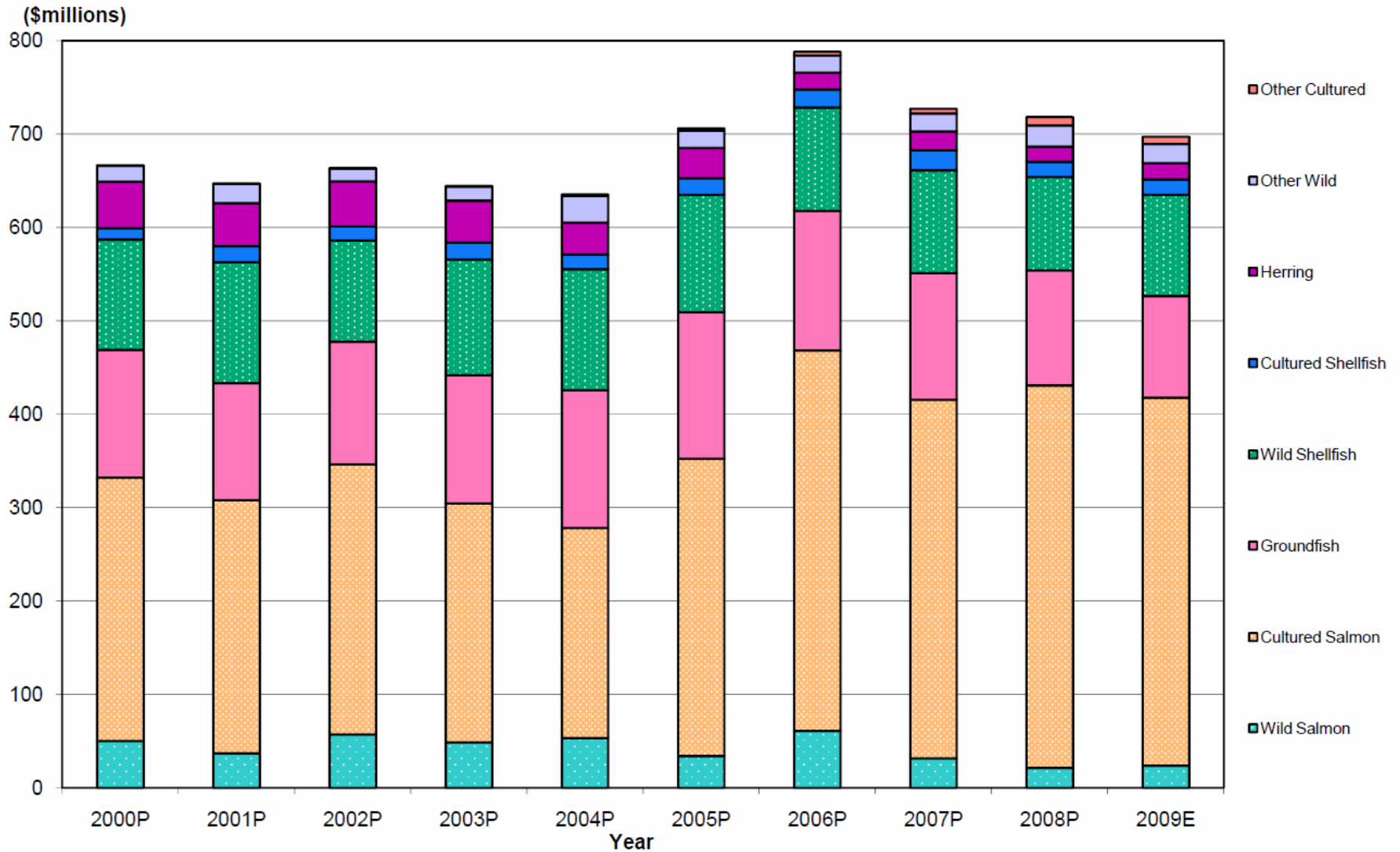
Nearshore fish community dynamics in the Strait of Georgia: information from juvenile herring surveys



Jennifer L. Boldt, Thomas W. Therriault, Douglas E. Hay, Jacob Schweigert, & Matthew Thompson
Fisheries and Oceans Canada, Science Branch, Pacific Biological Station,
Nanaimo, BC, Canada

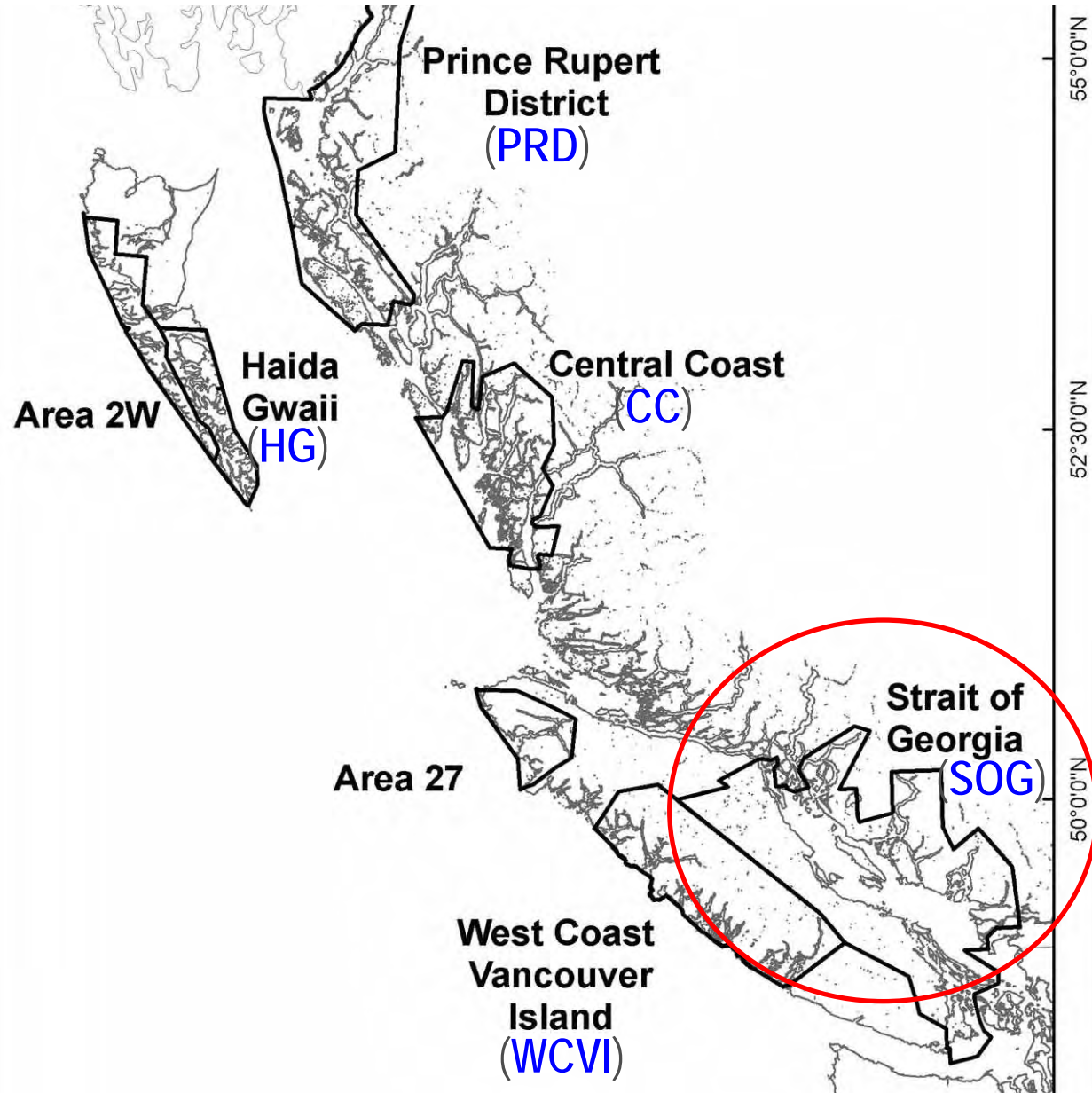
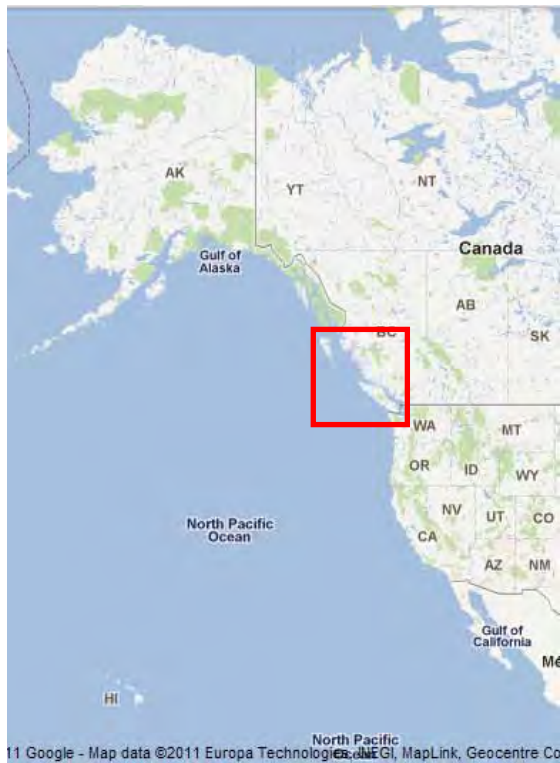


B.C. Seafood Landed Value



British Columbia Pacific Herring

5 major & 2 minor fishing stocks



Map courtesy of Kristen Daniel, DFO

DFO 2010



- SOG herring are migratory
- Migrate between SOG and WCVI
- Spawning occurs in late Feb-early March
- Juveniles are found nearshore for about the first 1.5 years of life
- Mature and recruit at age-3



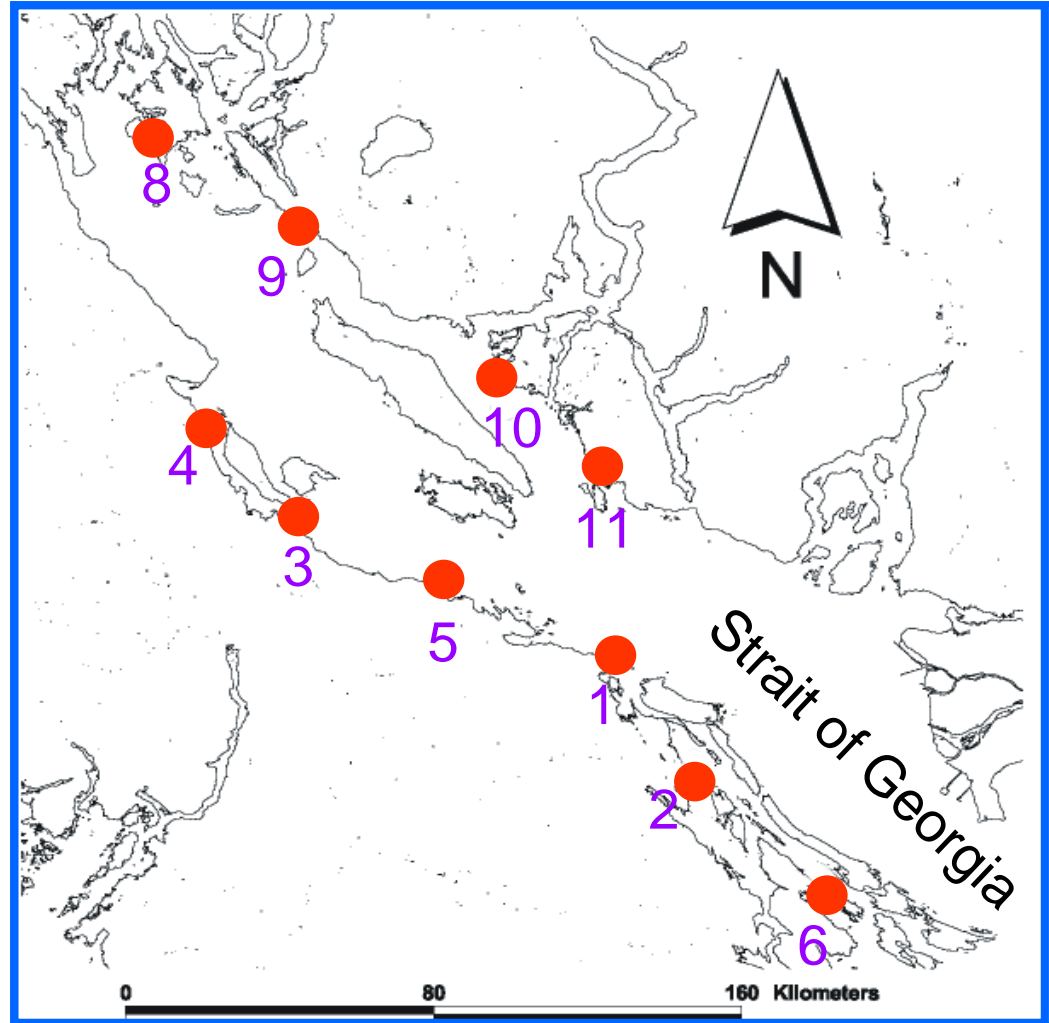


- Recruitment in Pacific herring is highly variable
- Juvenile herring surveys were designed to forecast recruitment based on the density of juvenile herring in the SOG during their first year of life
- Thus, the forecast would be made 2½ years prior to the fishery and provide advanced “information” for fisheries management



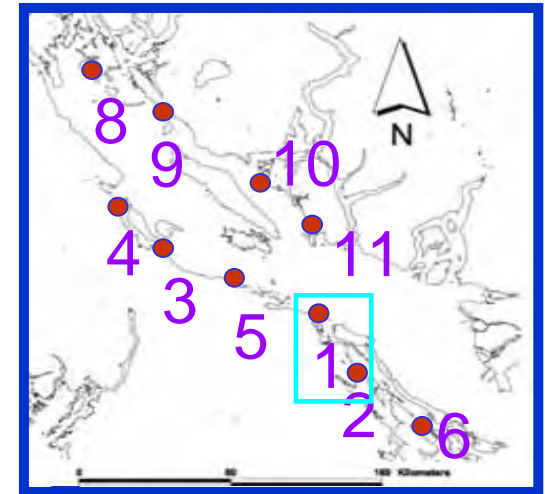
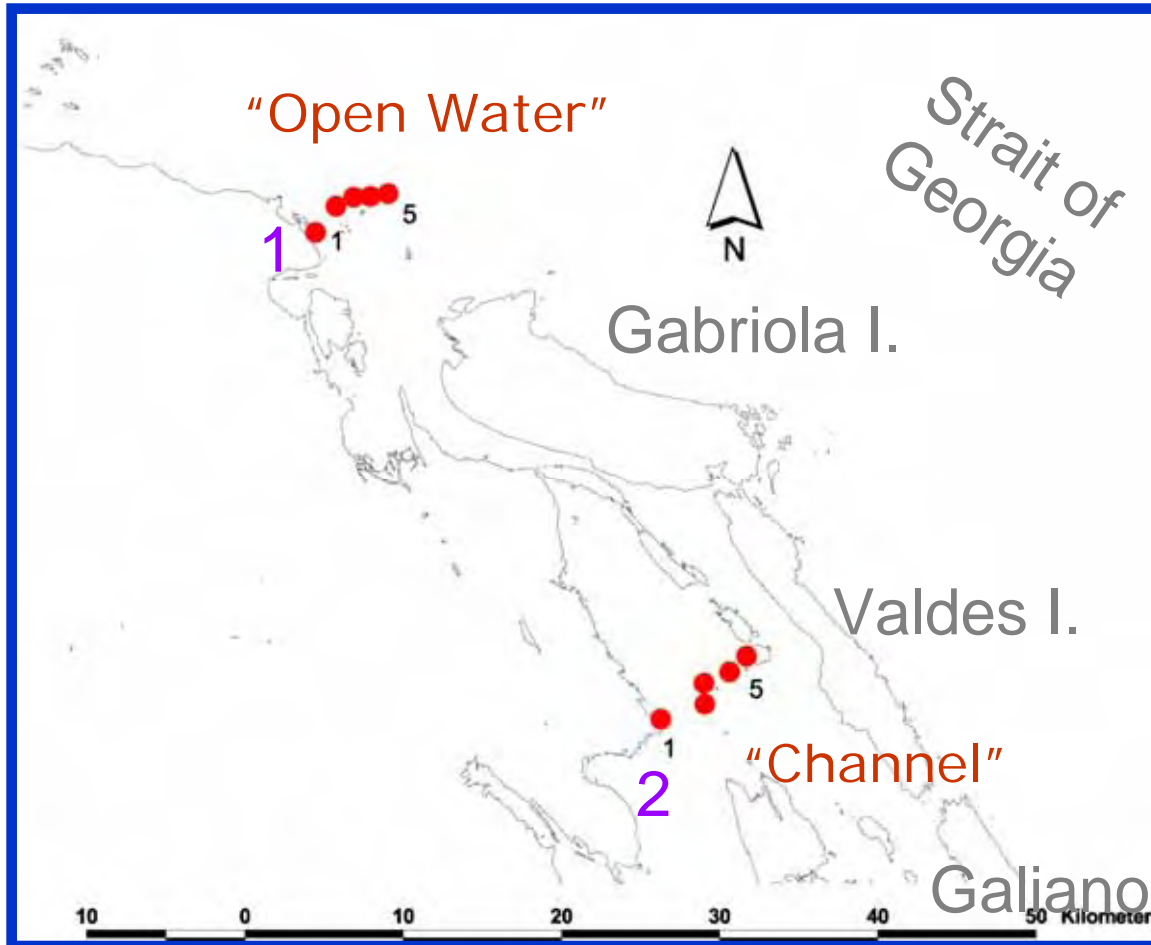
"Core" SOG Transects

- 10 "Core" Transects
- Both open water and channel type habitats
- Annual sampling between 1992 and 2011 (except 1995)
- September-October



Stations at Transects

Generally one transect sampled per night



5 stations per transect

Transects perpendicular to shore

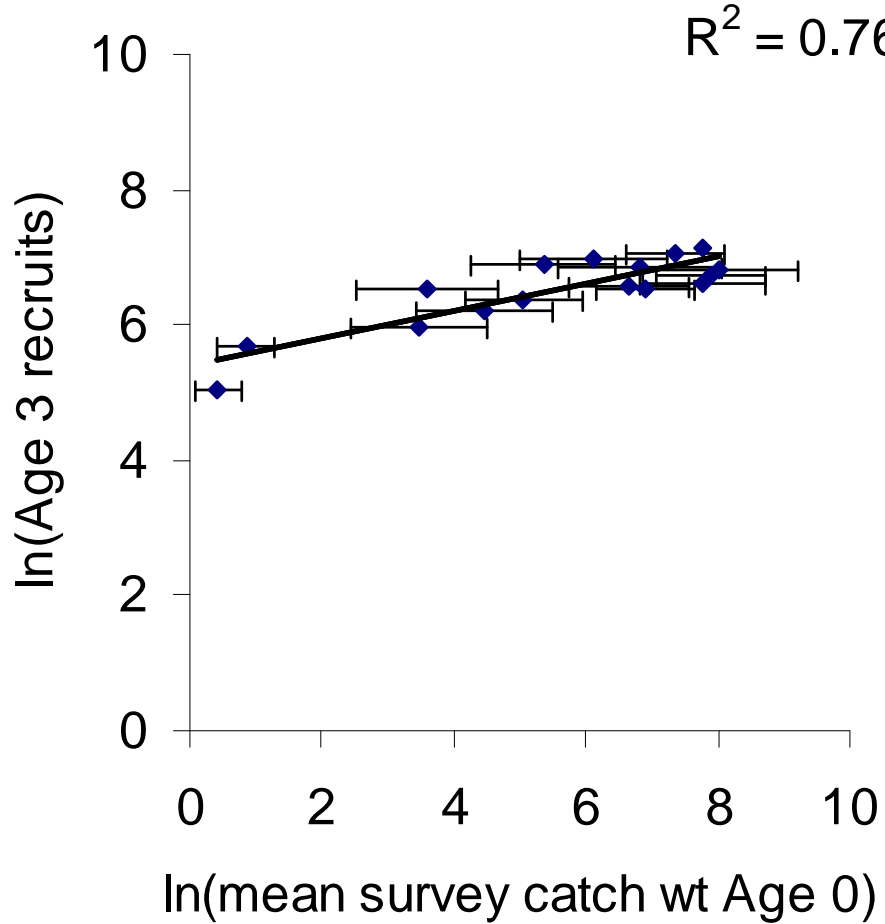
Sampling



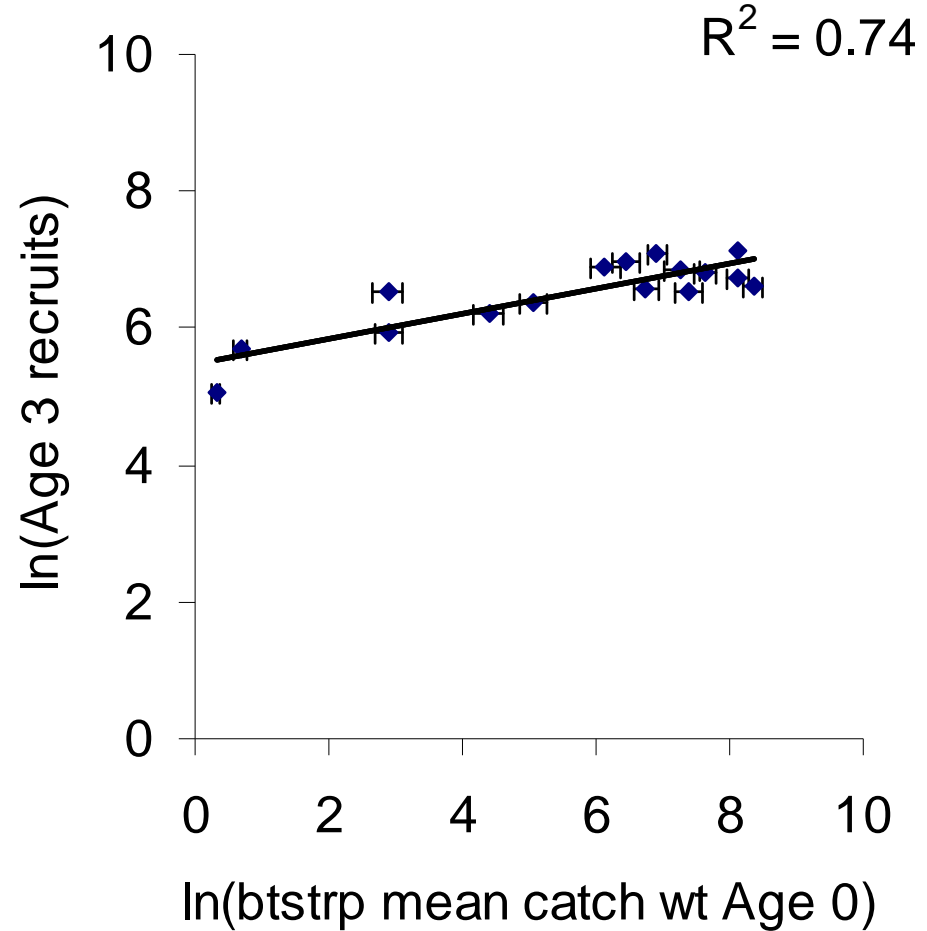
- "Blind" purse seine sets made after dusk
- Fish sorted, identified and enumerated

- Determine age classes of herring by length frequencies
- Include all successful purse seine sets (even zero catches)
- Transformed catch weights, $\ln(\text{wt}+1)$
- Estimate annual average catch weight for age-0 herring
 - Mean across samples
 - Bootstrapped mean and variance (1000 times)
- Correlate survey catch with age-3 recruits (3 years later)

Survey catch age-0 correlated with age 3 recruits



Mean catch wt



Bootstrap mean catch wt



Recruit year	Predicted age 3 recruits *10 ⁶ (non-bootstrap method)	Recruit category
2012	753 (698)	Good (Average)
2013	679 (670)	Average (Average)

Recruit category
based on 33% & 66% of ranked recruitment time series (1952-2011):

Poor/Average cutoff = 414

Average/Good cutoff = 714



Additional Benefits?

- Given the amount and type of data collected and the cost of these surveys, are there any other benefits to be derived from this survey data?
- For example, can we detect community-level change?

Are there differences over time, between open water and channel sites, across depths?



- Removed rare species not sampled well by gear (<10 occurrences in the 19 year time series).

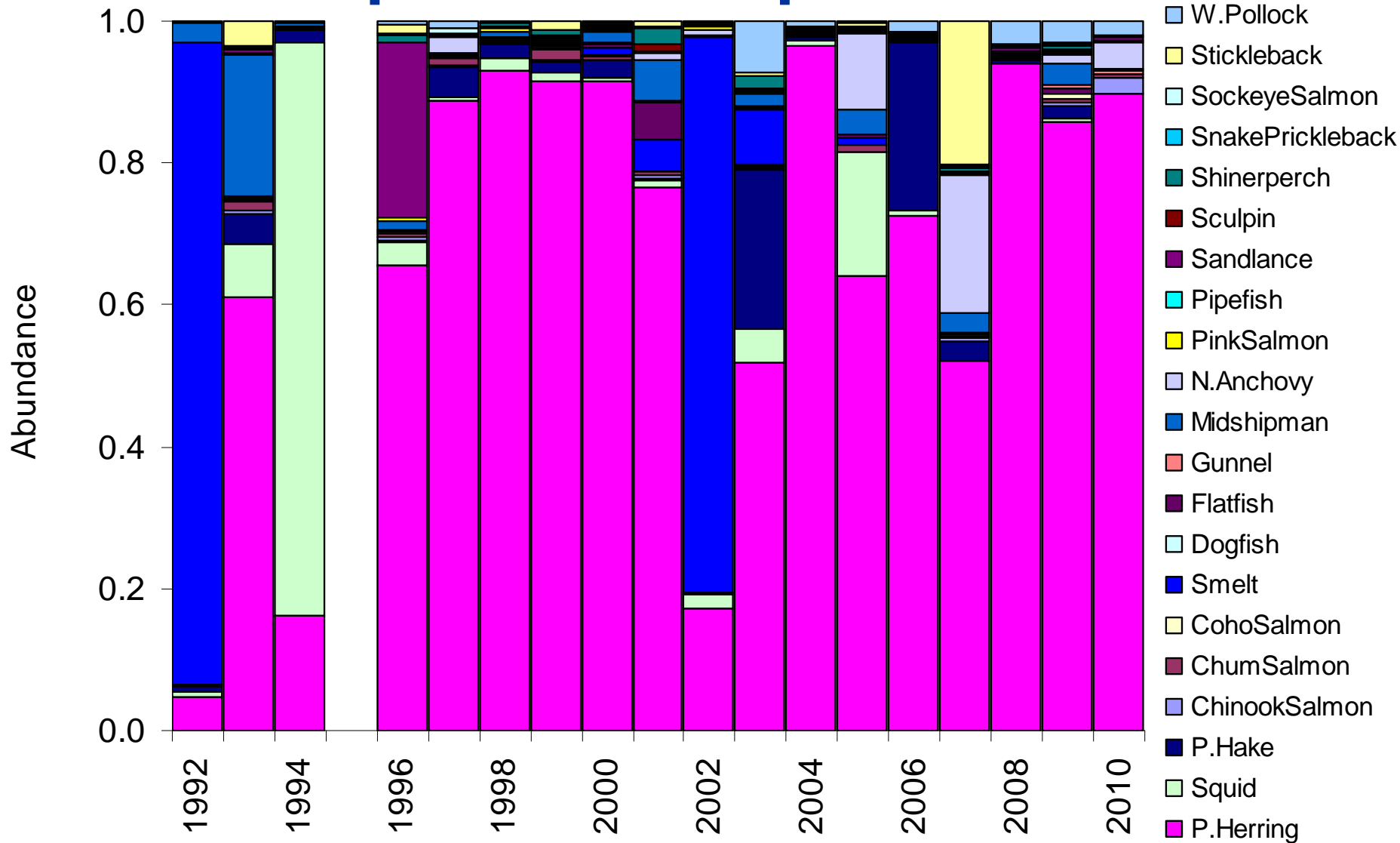
Chub Mackerel, Eelpout, Goby, Greenling, Invertebrate (non-squid), Kelp Perch, Lingcod, P. Cod, P. Lamprey, P. Sardine, P. Tomcod, Pile Perch, Poacher, Ratfish, Rockfish, Skate, Snailfish, Surfperch

- Species included = fish and squid

P. Herring, N. Anchovy, Chinook Salmon, Chum Salmon, Coho Salmon, Sockeye Salmon, Pink Salmon, Dogfish, Flatfish, Gunnel, Midshipman, Pipefish, Sandlance, Sculpin, Shiner Perch, Smelt, Stickleback, P. Hake, W. Pollock, Snake Prickleback, Squid

- Include all successful purse seine sets (even zero catches)
- Estimate counts for species samples where weight, but not numbers were recorded (using avg. indiv. wt)

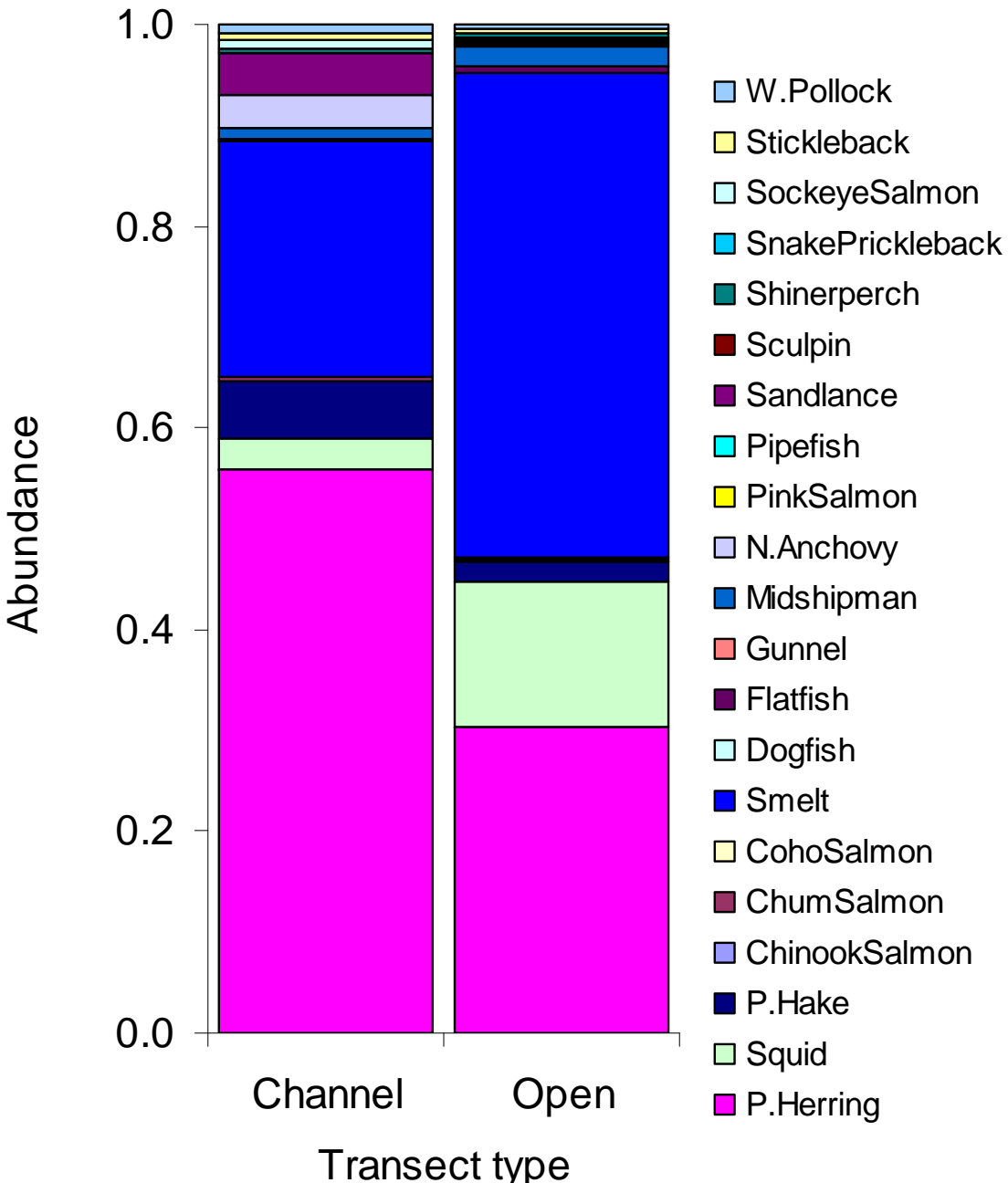
Species Composition



ANOSIM
 $R=0.142$
 $p < 0.1$

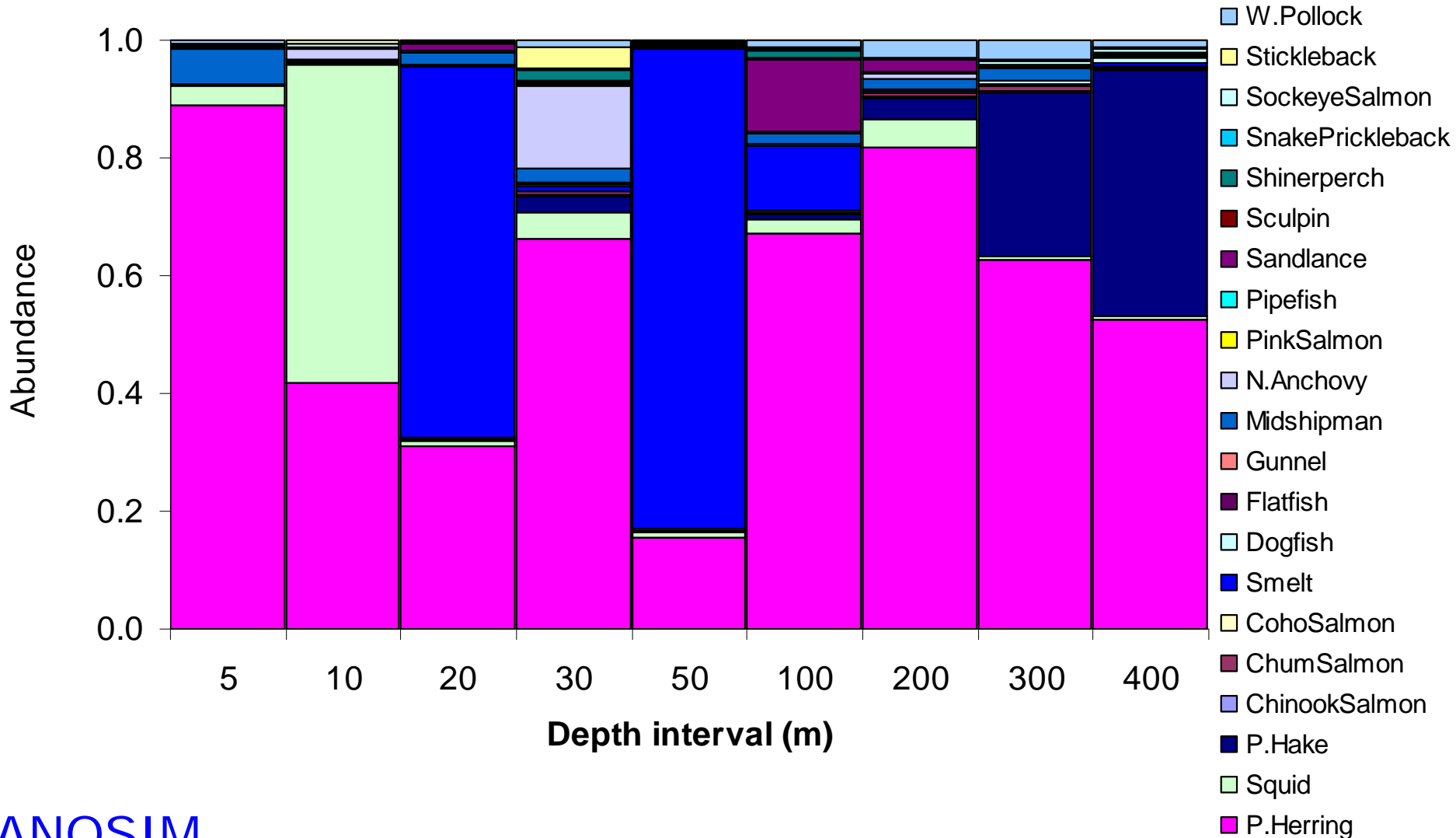
1992: due to 1 sample with a large catch of juvenile smelt
 1994: due to 2 samples with large catches of squid
 2002: due to 1 sample with a large catch of juvenile smelt

Species Composition By Transect Type



ANOSIM
 R=0.053
 p < 0.1

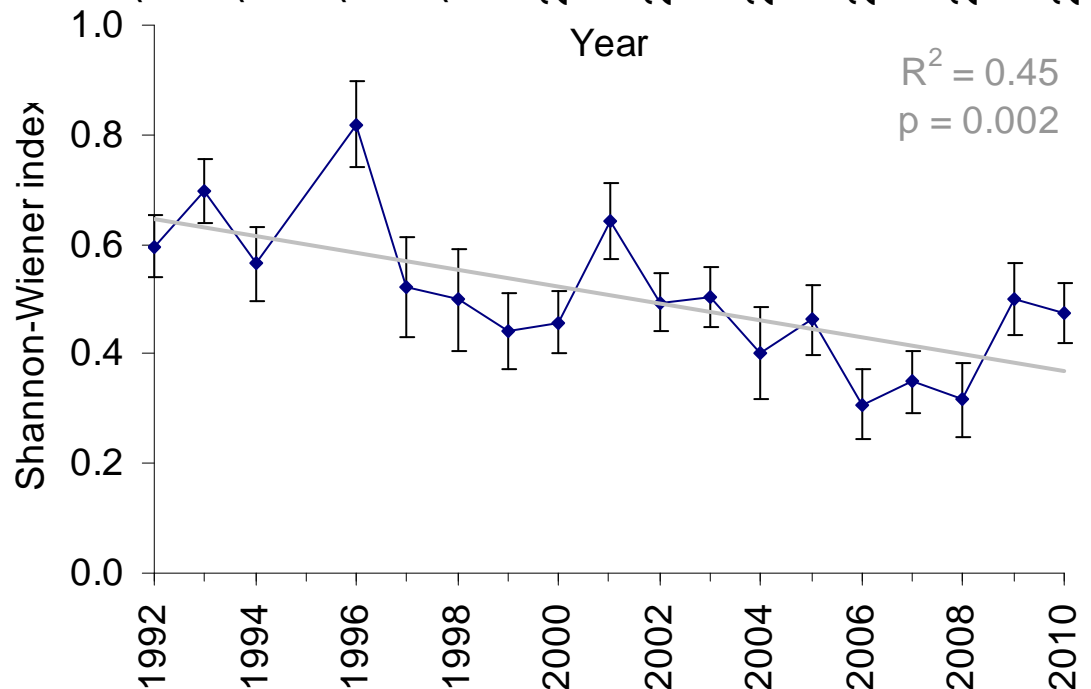
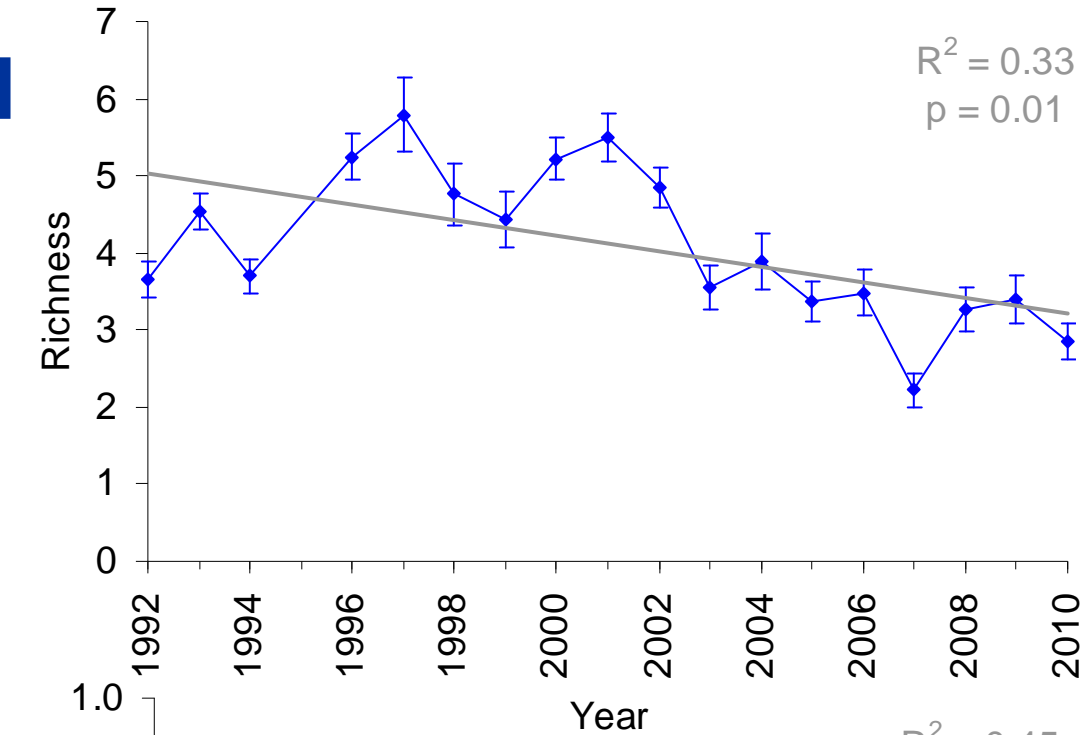
Species Composition By Depth



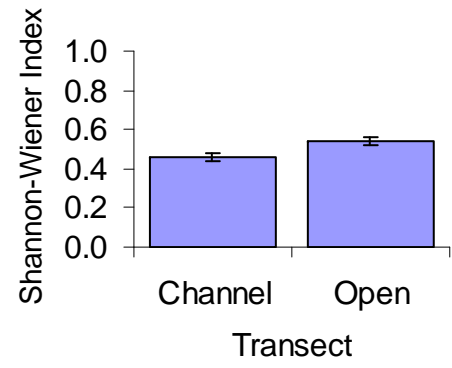
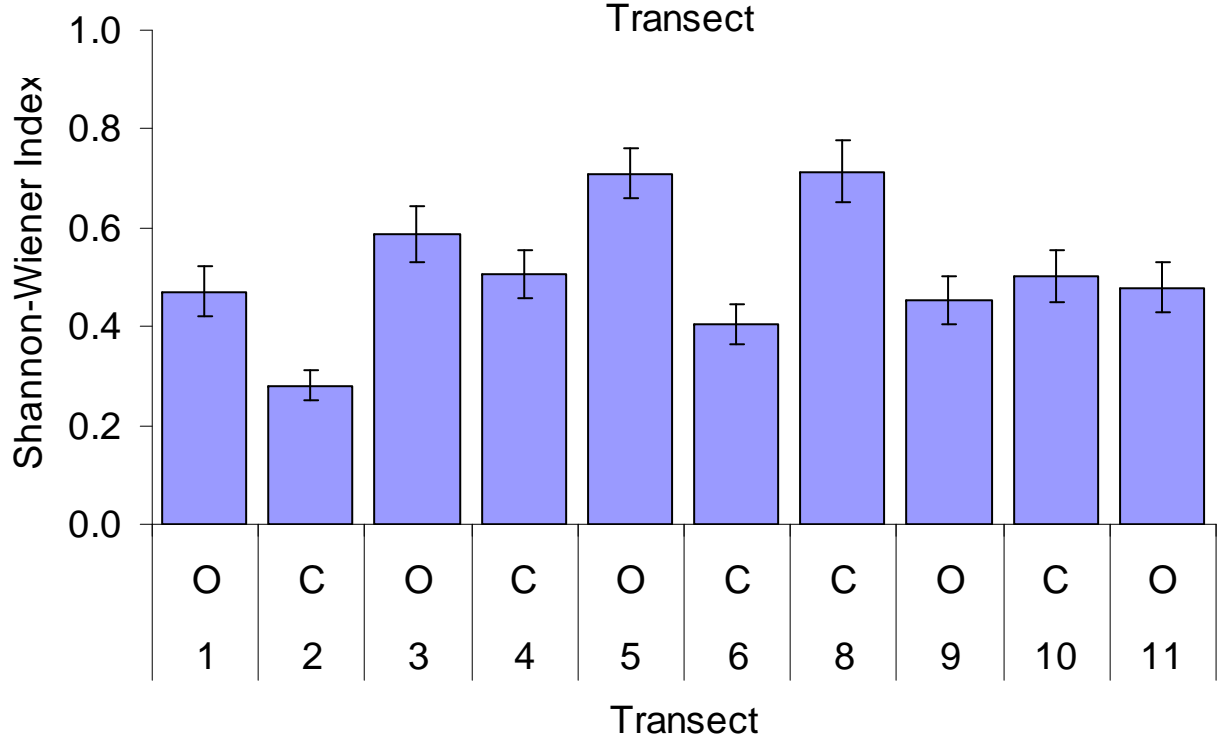
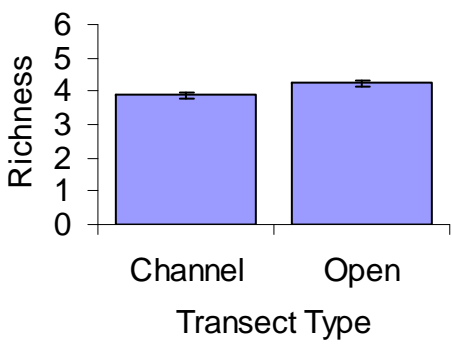
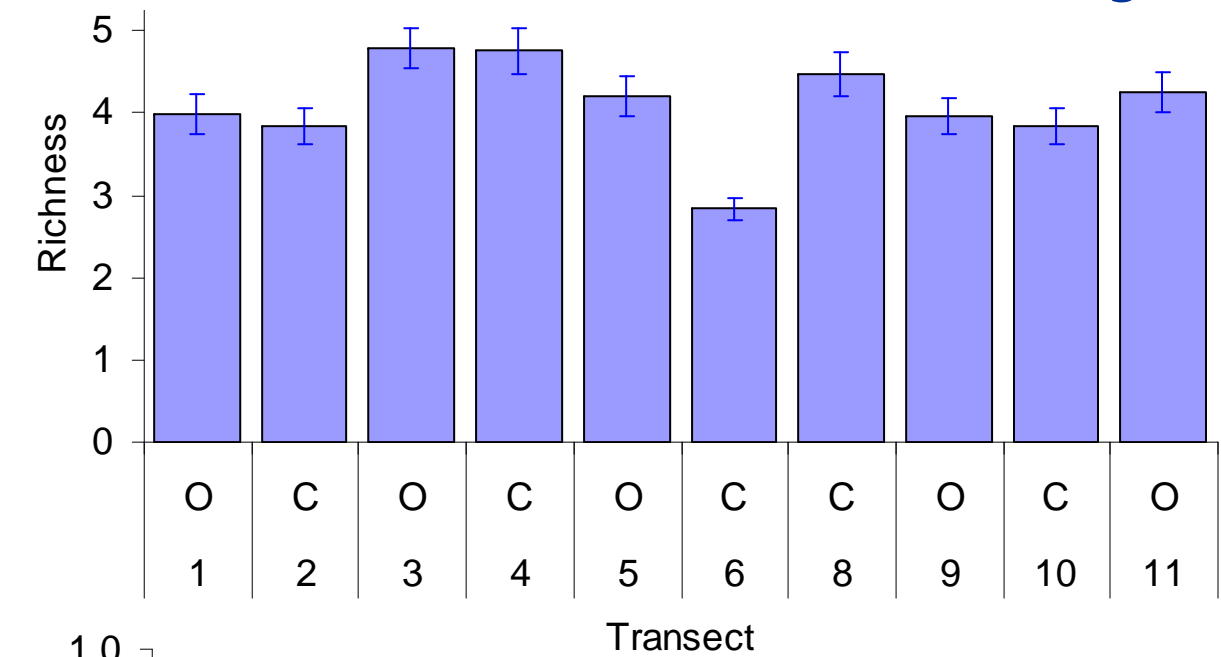
ANOSIM
R=0.102
p<0.1

Species Richness and Diversity

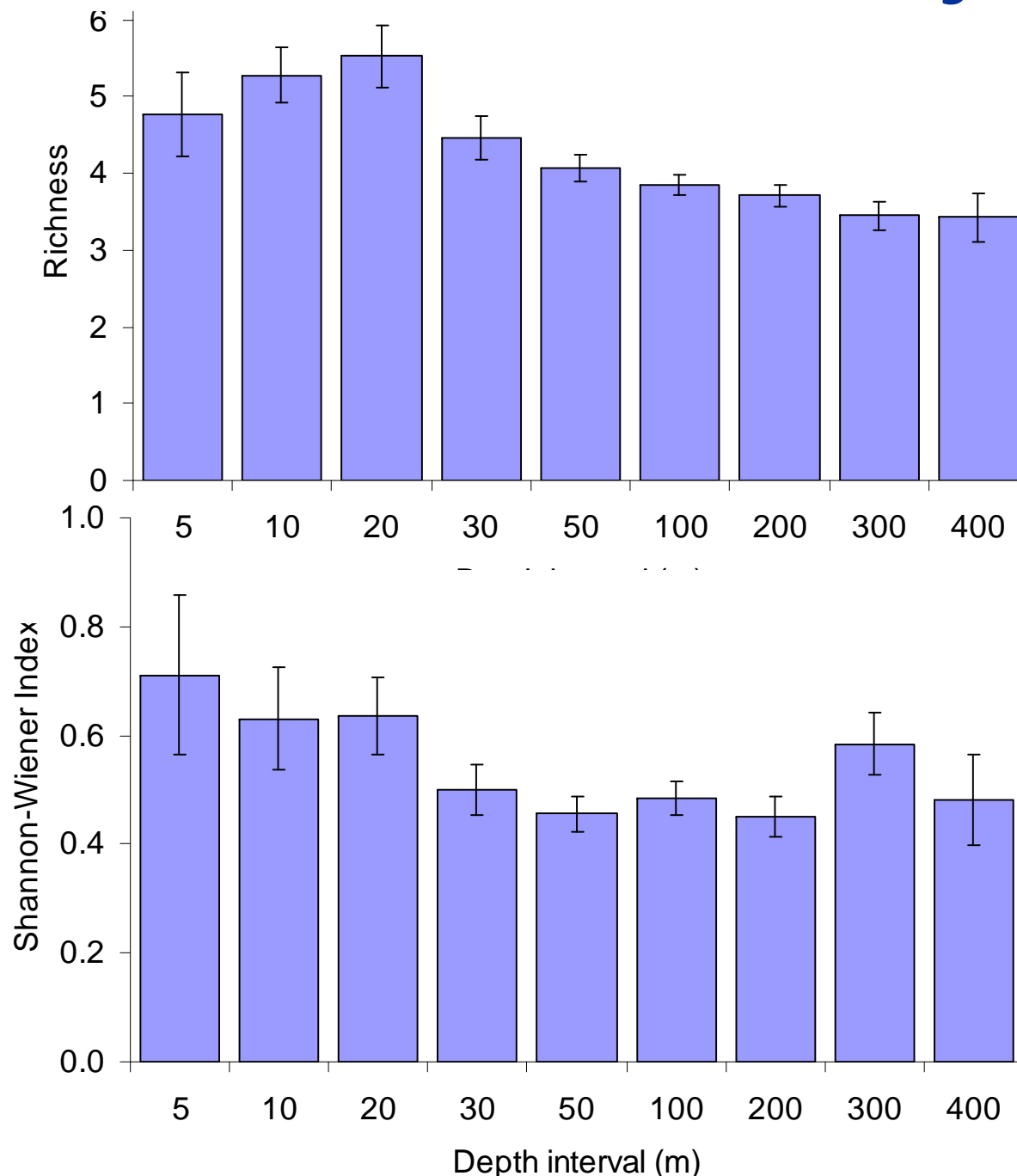
Decreased since 1997



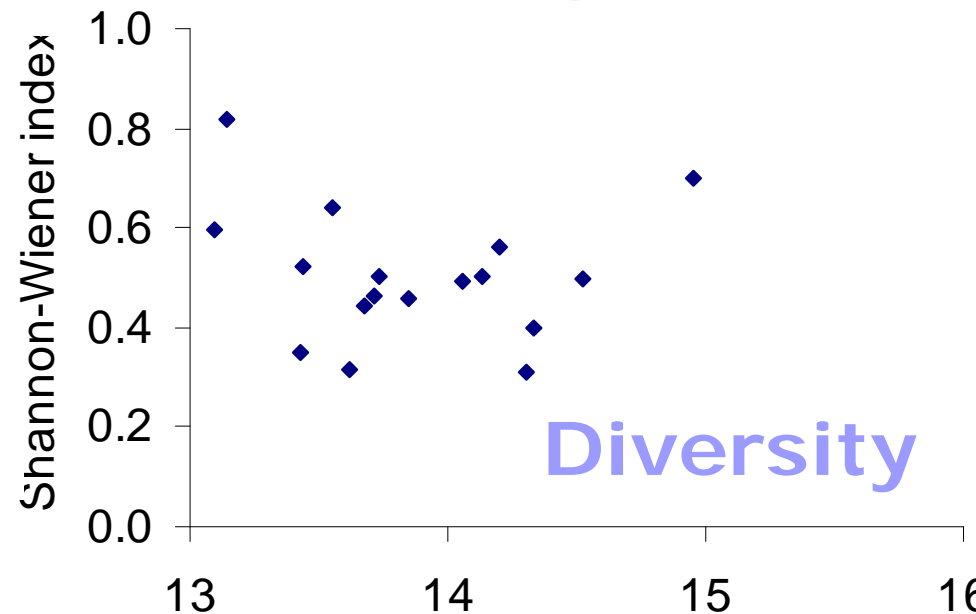
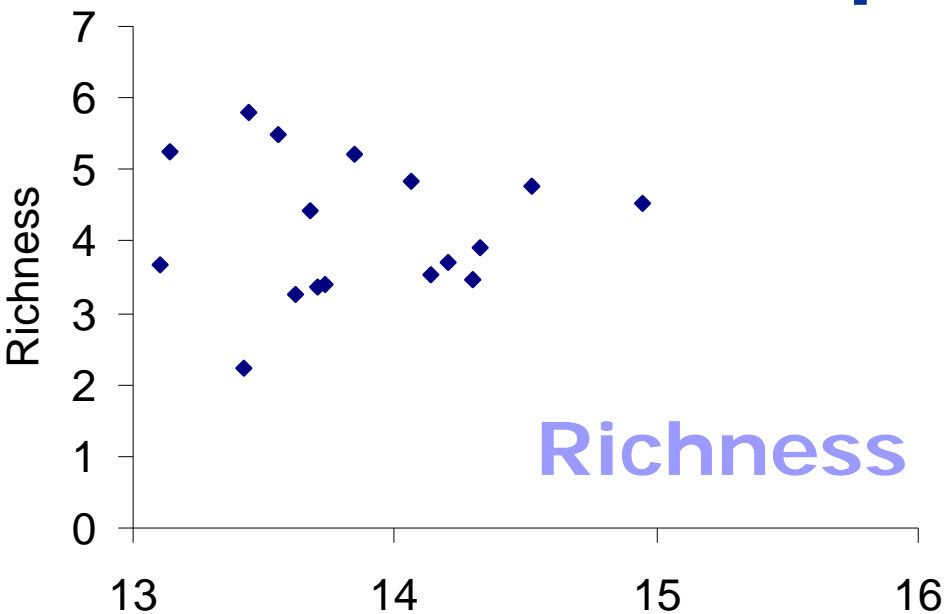
Species Richness and Diversity By Transect



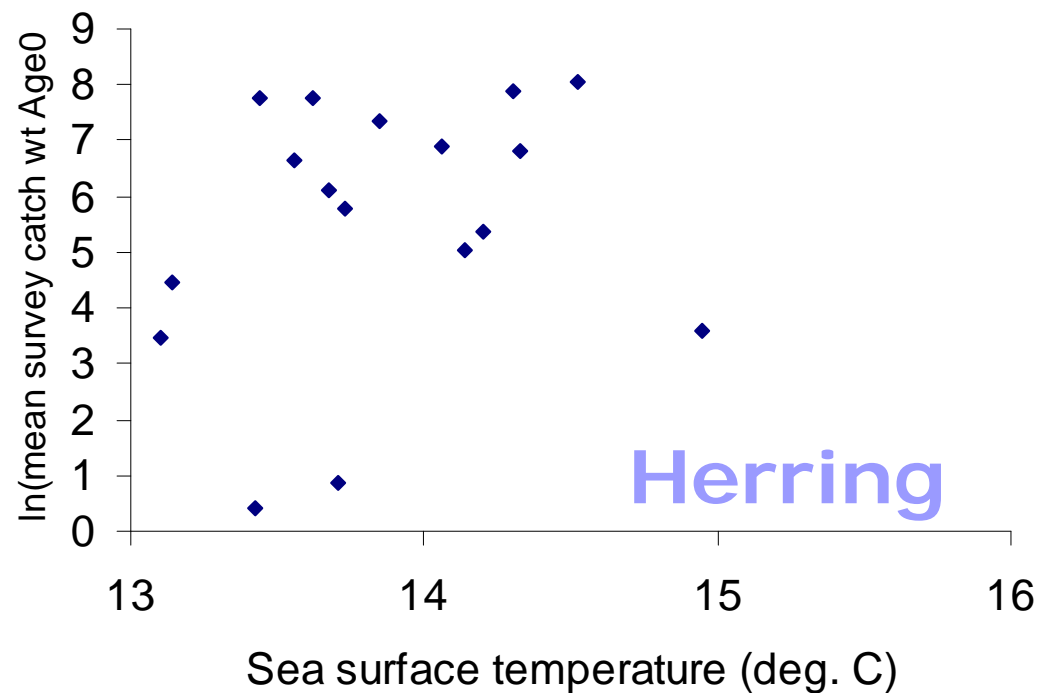
Species Richness and Diversity By Depth



No Relationship with SST (Sept-Oct)



Entrance Is. lighthouse





Summary

- Catch weight of age-0 herring is a good predictor of age-3 recruits
- Species composition varies a little over time, location, and depth
- Decreased richness & diversity over time
- Higher diversity & richness in open areas than in channel areas
- Higher diversity and richness at 10-20 m depth
- Diversity, richness, age-0 herring abundance not related to SST





- Examine other indicators of this data set
 - e.g., mean trophic level of the community?, etc.
- Relate community indicators & herring abundance to
 - biological drivers (e.g., zooplankton prey, predators)
 - environmental drivers (e.g., more site-specific SST)