Effects of predation on Canadian Atlantic crustacean resources: A comparison between the Newfoundland-Labrador Shelf and the Gulf of St. Lawrence

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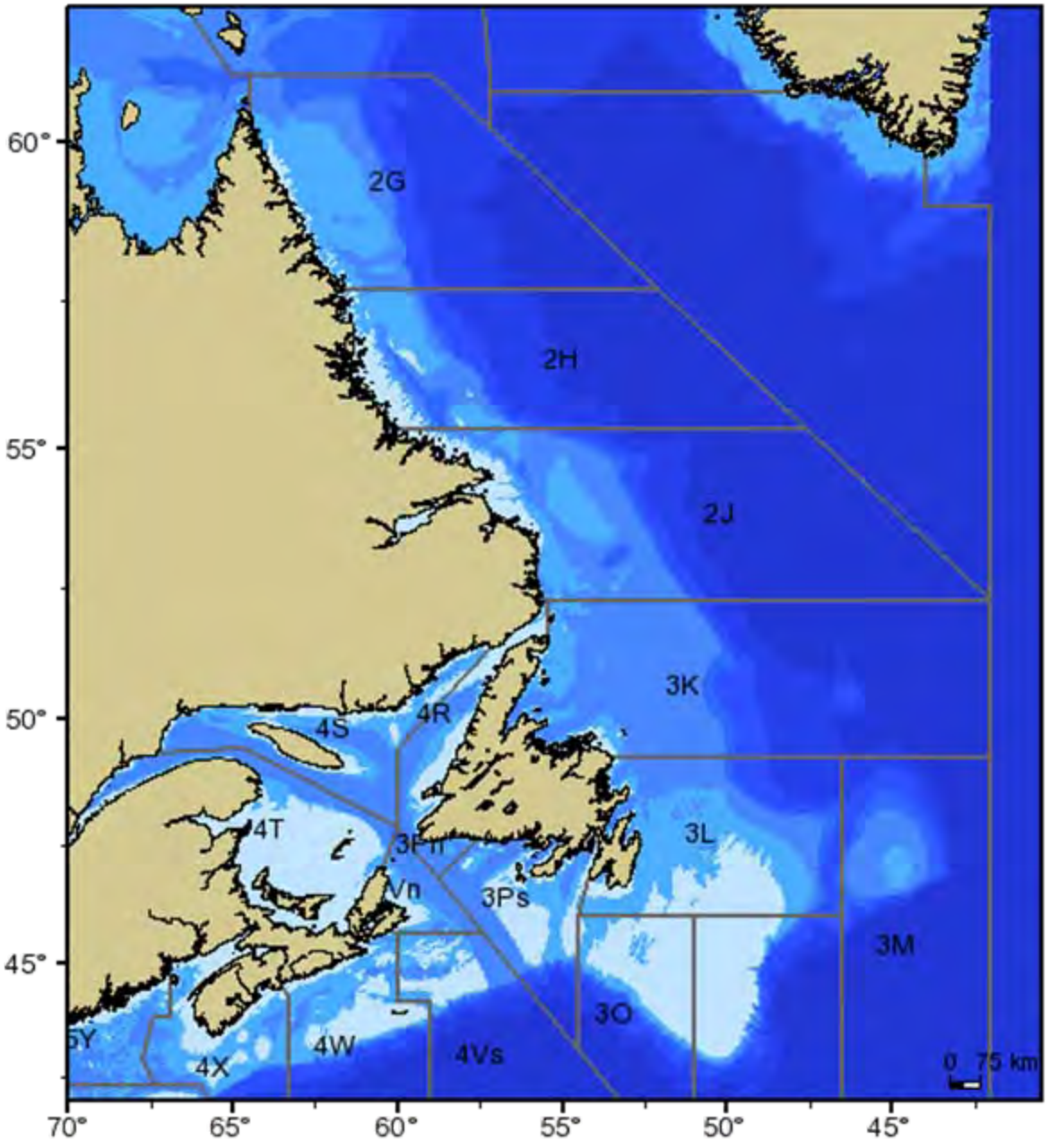
Outline

- Trends in abundance of fish predators and crustacean prey
- Diets of predatory fishes (cod and turbot)
- Spatial interaction between predators (cod and turbot) and prey (crab and shrimp)
- Conclusions:

  -Importance of predation in controlling populations of snow crab and northern shrimp

  -Implications to predators



Campelen Trawl surveys

nGSL August

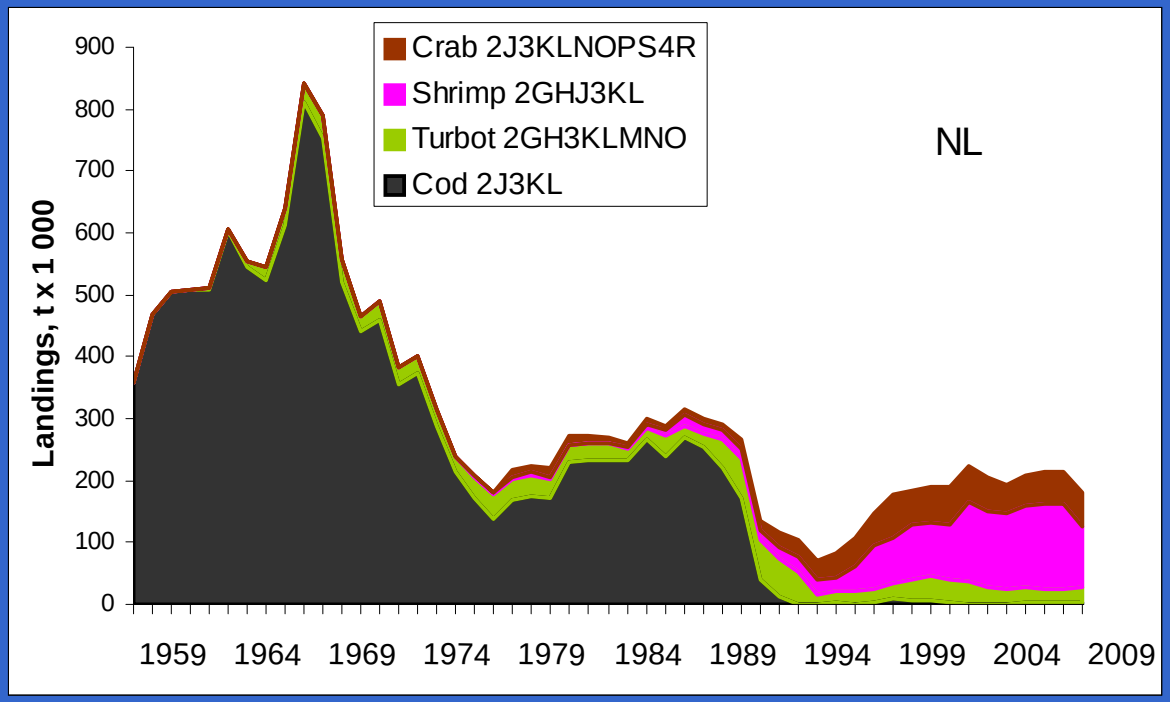
Div. 4RS, deep 4T

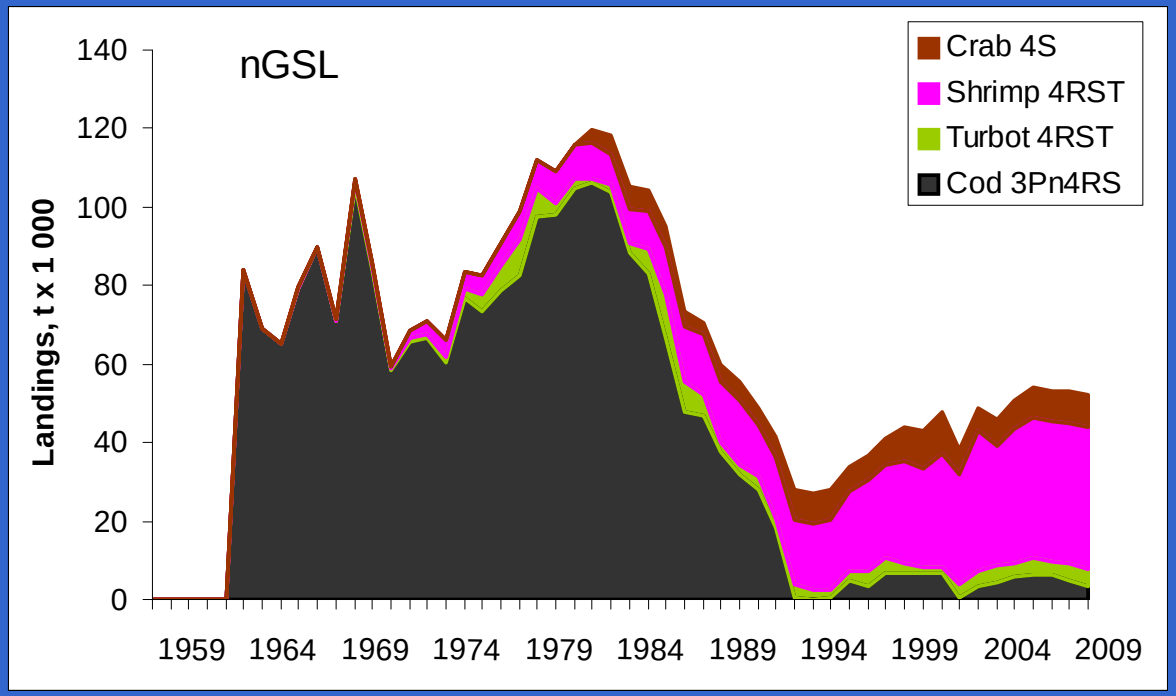
NL

Fall (Sep-Dec)

2J3KLNO

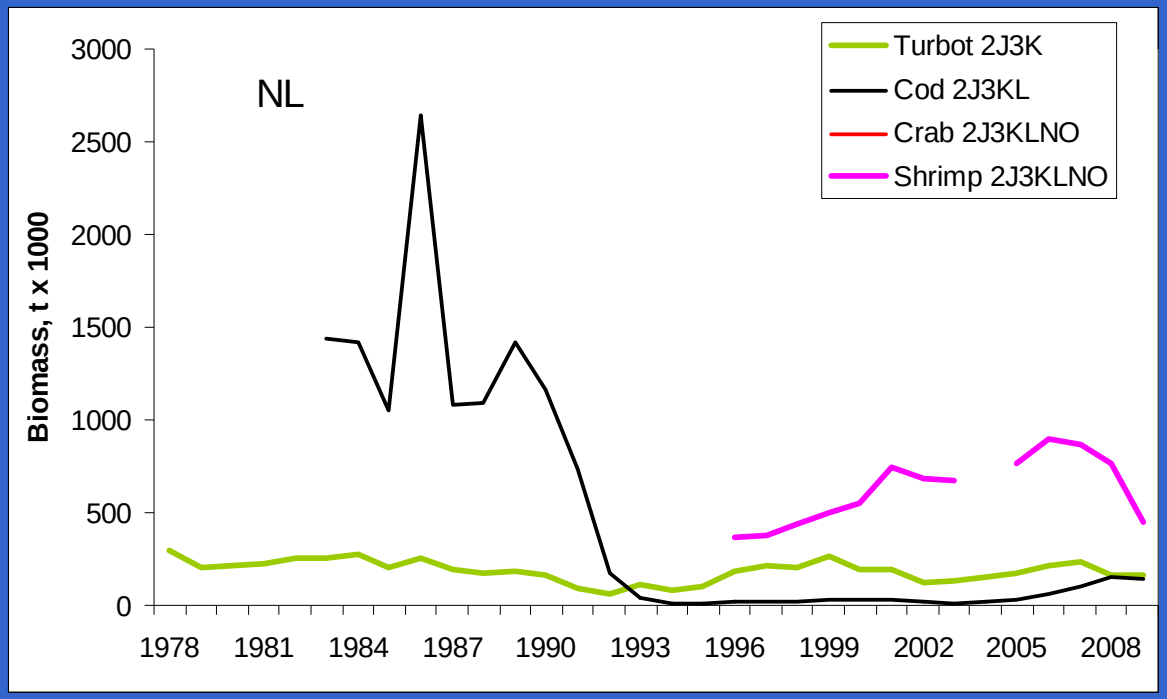
DFO Science Virtual Data Centre Aug 17 2010

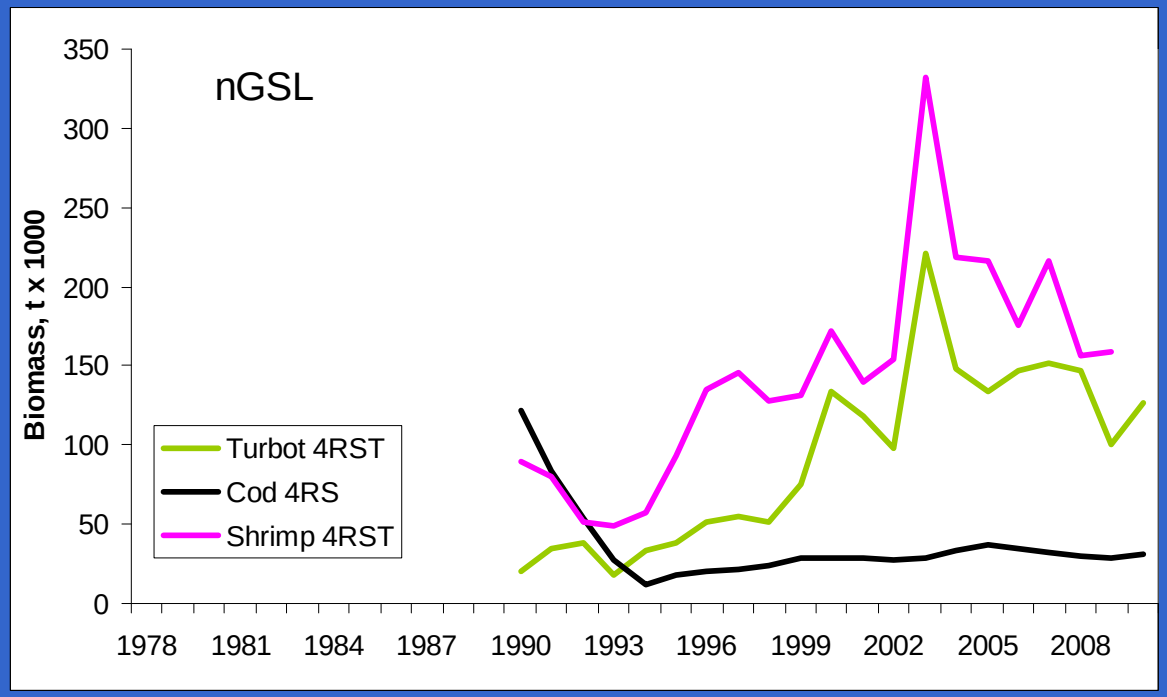




Landings

- Regime shift in fisheries
- Prolonged cold period
- Changes in abundance or vs. re-direction of fishing effort

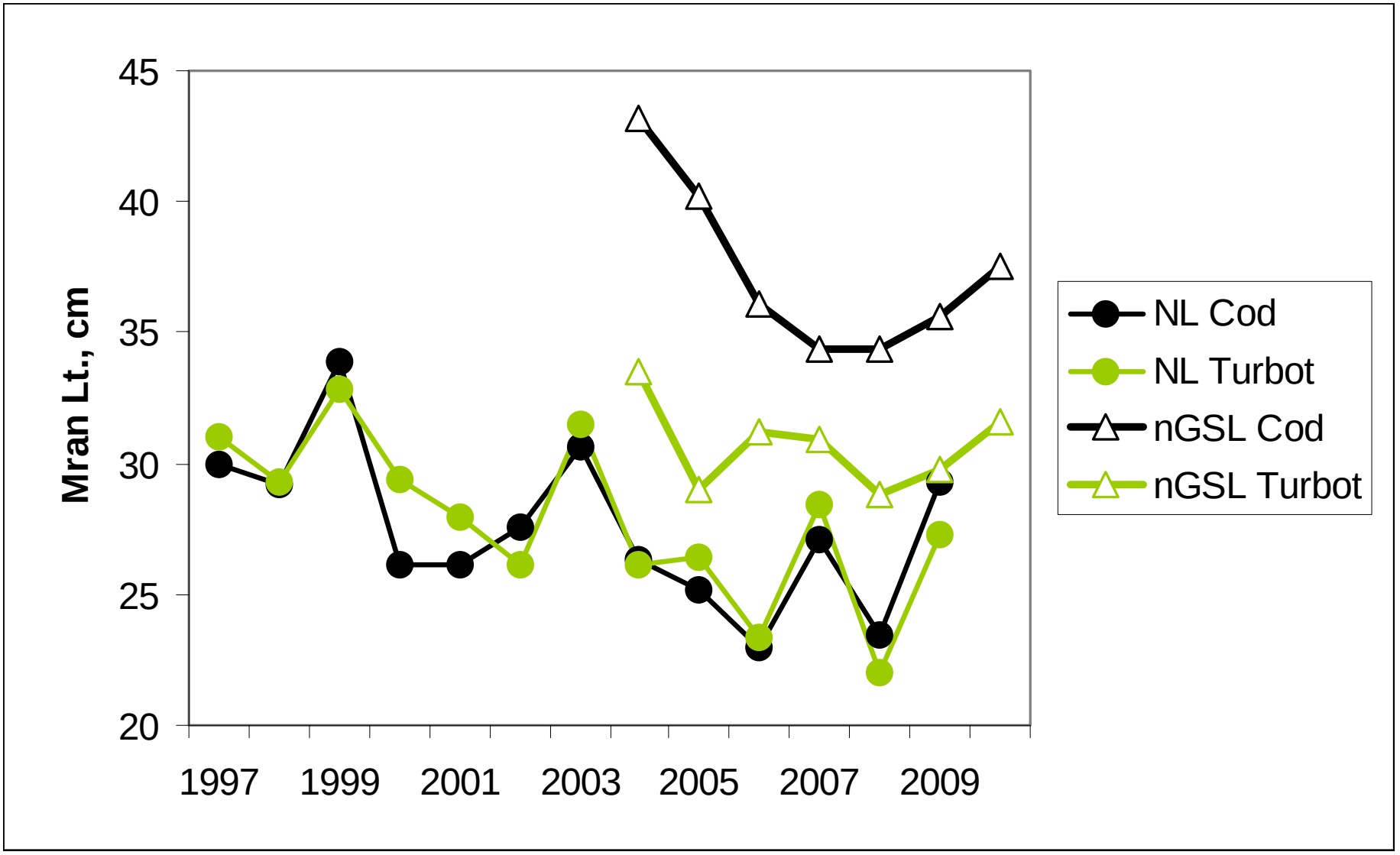




Survey biomass trends

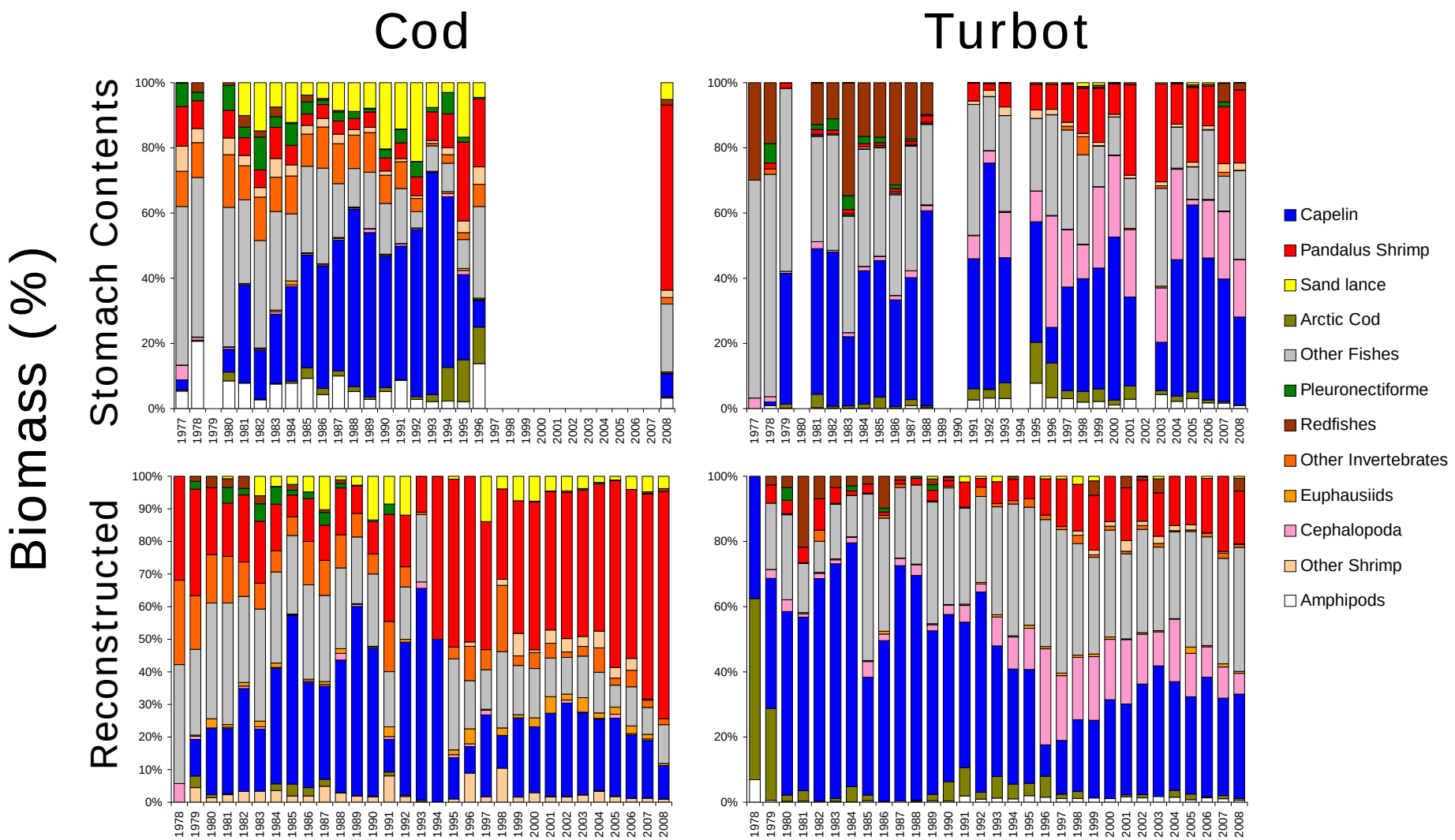
- Survey biomass time series are too short
- Snow crab CPUE has maintained regular oscillations
- NL recent decline in shrimp & increase in cod
- nGSL shrimp & turbot co-vary

Trends in Predator sizes

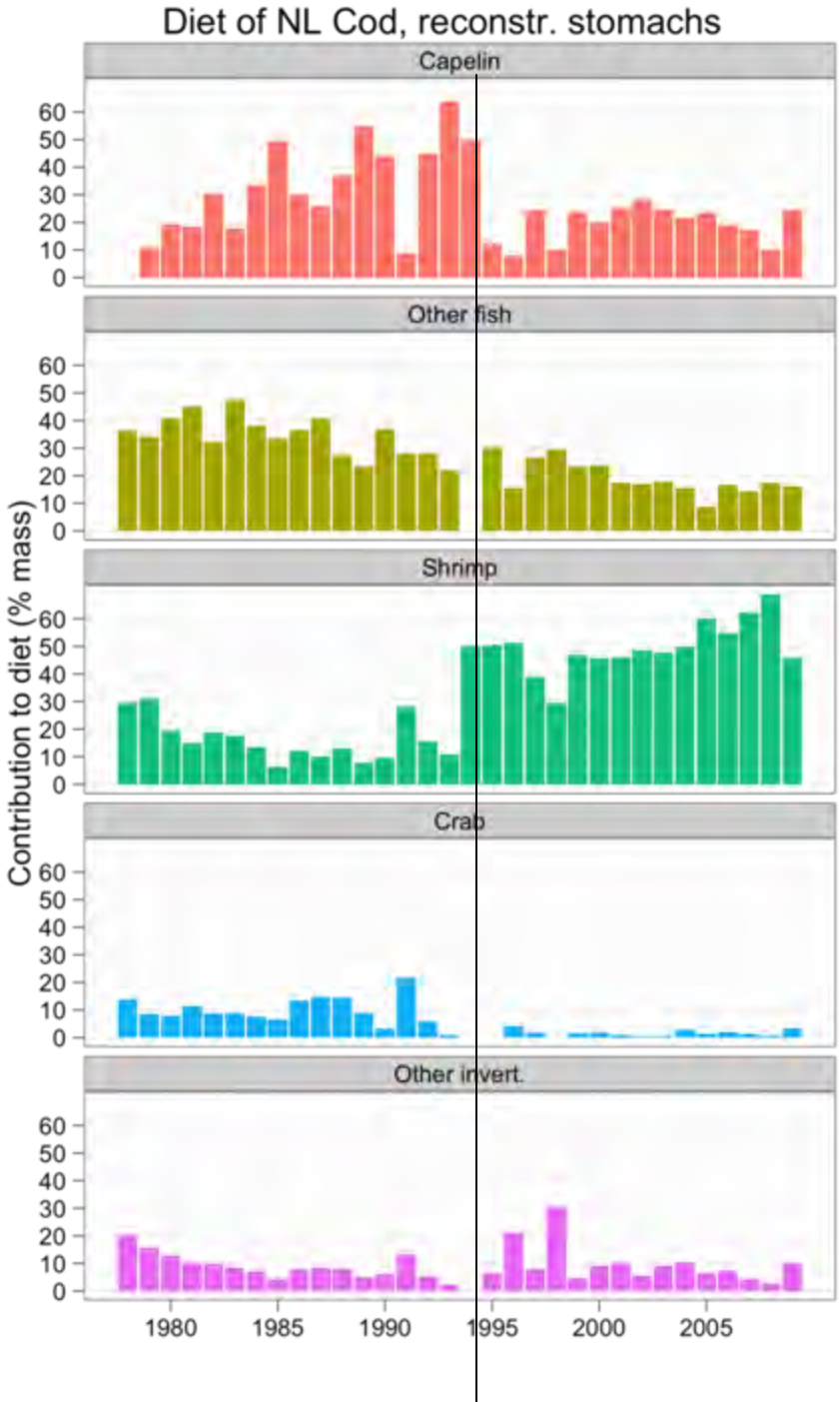


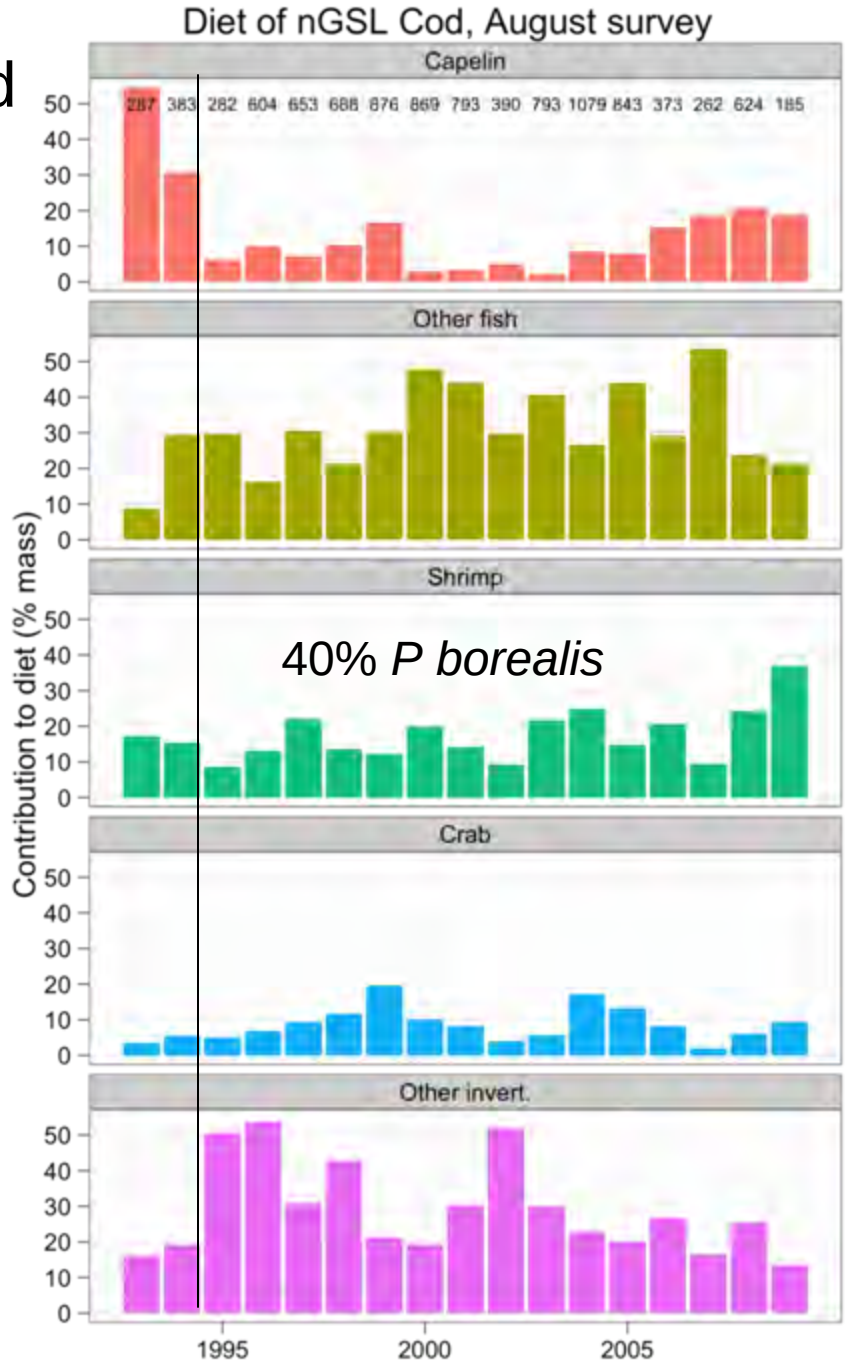
Diet of Key Fish Predators: NAFO Divs. 2J3KL

Reconstructing NL diets

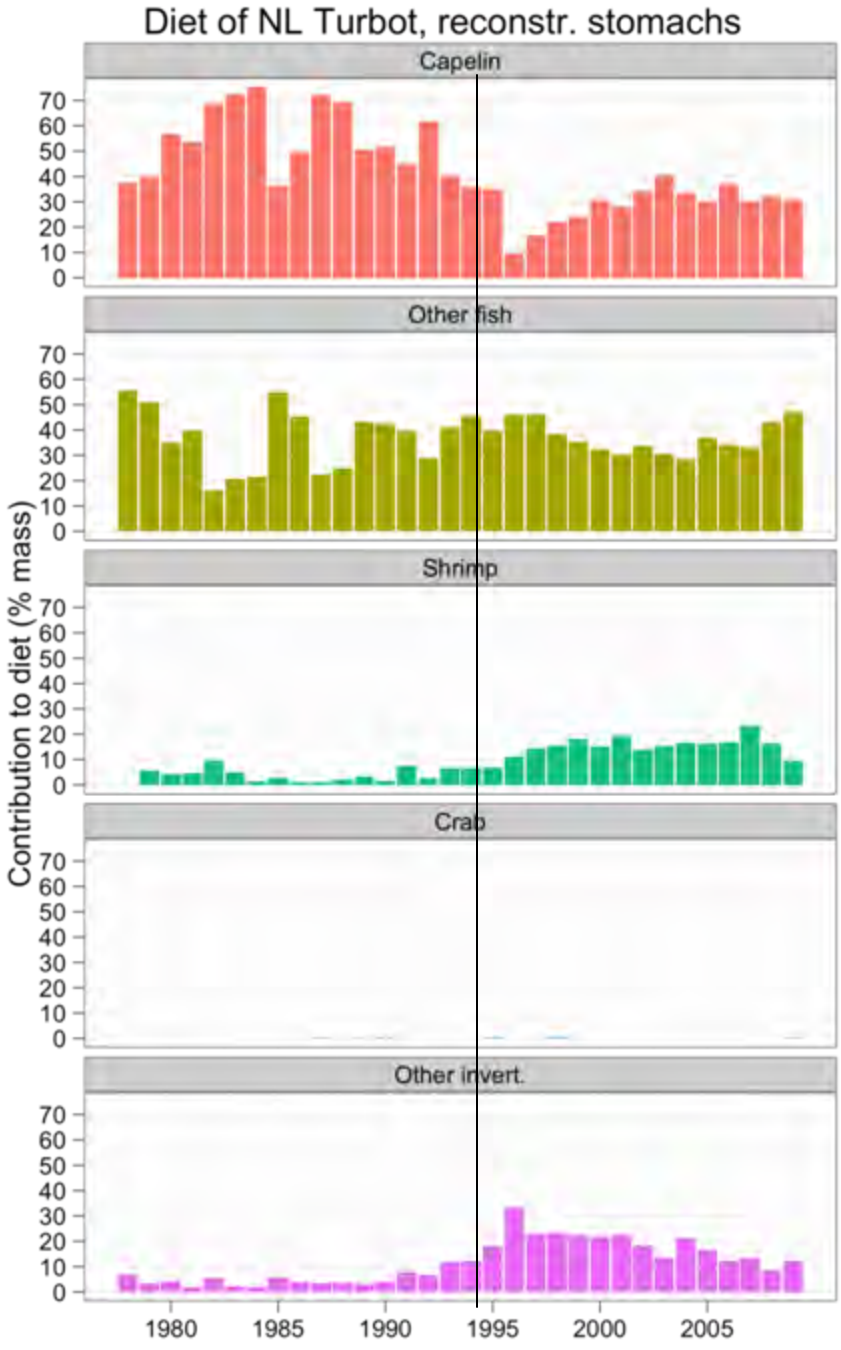


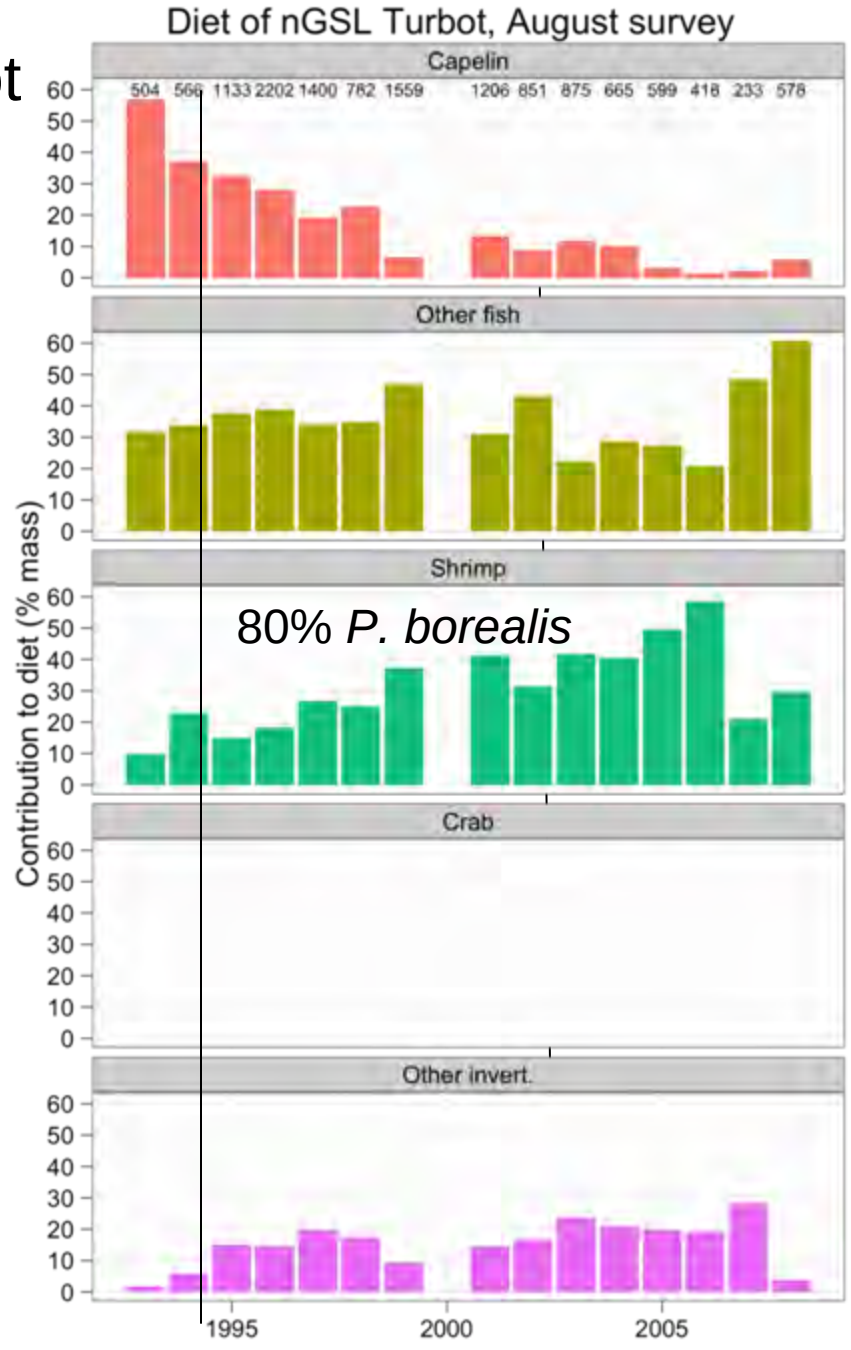
Cod


Diet of NL Cod, reconstr. stomachs
Capelin
Other fish
Shrimp
Crab
Other invert.
Contribution to diet (% mass)
0
10
20
30
40
50
60
1980
1985
1990
1995
2000
2005


Diet of nGSL Cod, August survey
Capelin
287 383 282 604 653 688 876 869 793 390 793 1079 843 373 262 624 185
Other fish
Shrimp
40% P borealis
Crab
Other invert.
Contribution to diet (% mass)
0
10
20
30
40
50
1995
2000
2005

Turbot


Diet of NL Turbot, reconstr. stomachs
Capelin
Other fish
Shrimp
Crab
Other invert.
Contribution to diet (% mass)
0 10 20 30 40 50 60 70
1980 1985 1990 1995 2000 2005


Diet of nGSL Turbot, August survey
Capelin
504 566 1133 2202 1400 782 1559 1206 851 875 665 599 418 233 578
Other fish
Shrimp
80% P. borealis
Crab
Other invert.
Contribution to diet (% mass)
0 10 20 30 40 50 60
1995 2000 2005

Summary of diet results

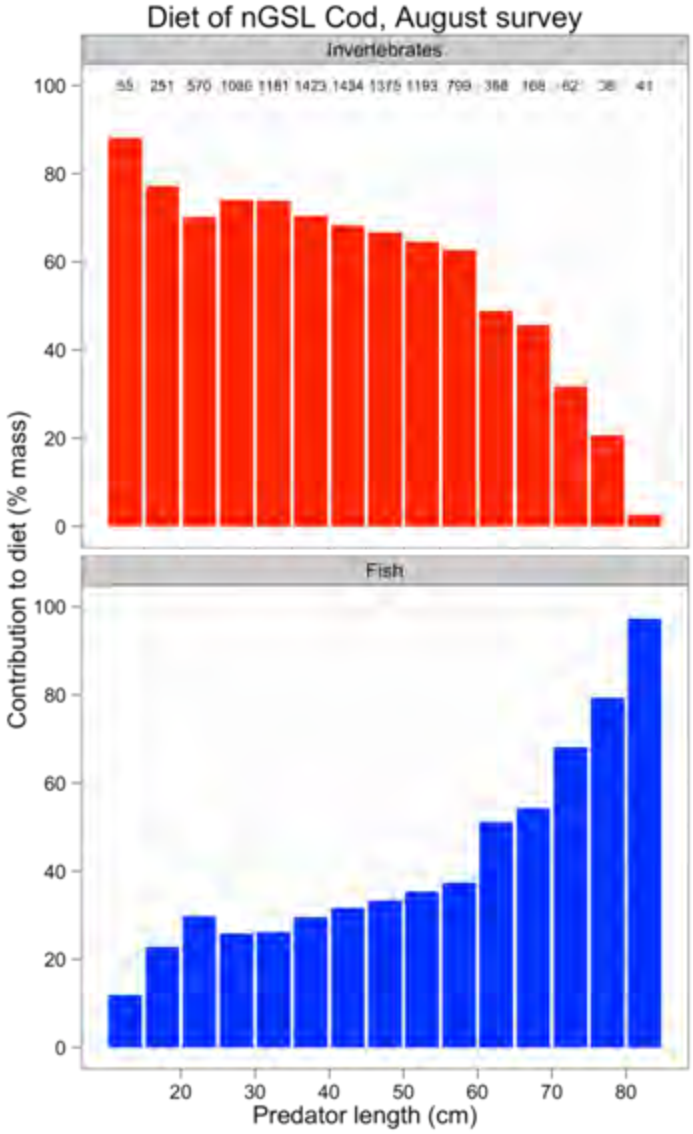
- **Snow crab is usually not prominent in the cod diets. It is virtually absent from turbot diets.**
- **The main forage species (capelin) has declined in diets since the mid-1990s collapse of the entire fish community.**
- **Shrimp has increased in diets in recent (post-collapse) years, in replacement of preferred capelin: especially in (very small) NL cod and (larger) nGSL turbot**
- **Suggest that predation mortality should have increased since the mid 1990s, given the increasing shrimp contribution to diets and the positive trend in overall fish biomass.**
- **However overall biomass of fish is still well below pre-collapse levels.**
- **This effect is expected to be distributed across many predators, and not necessarily linked to a single predator species (e.g. cod or turbot).**

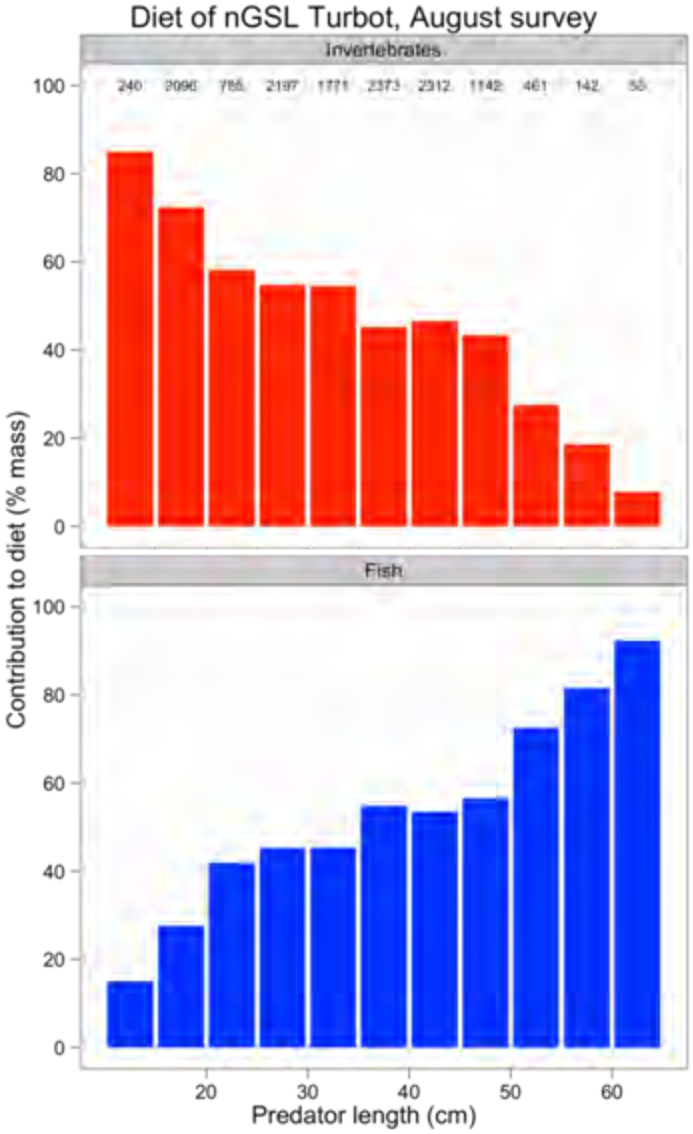
Spatial interaction between populations of predators and prey

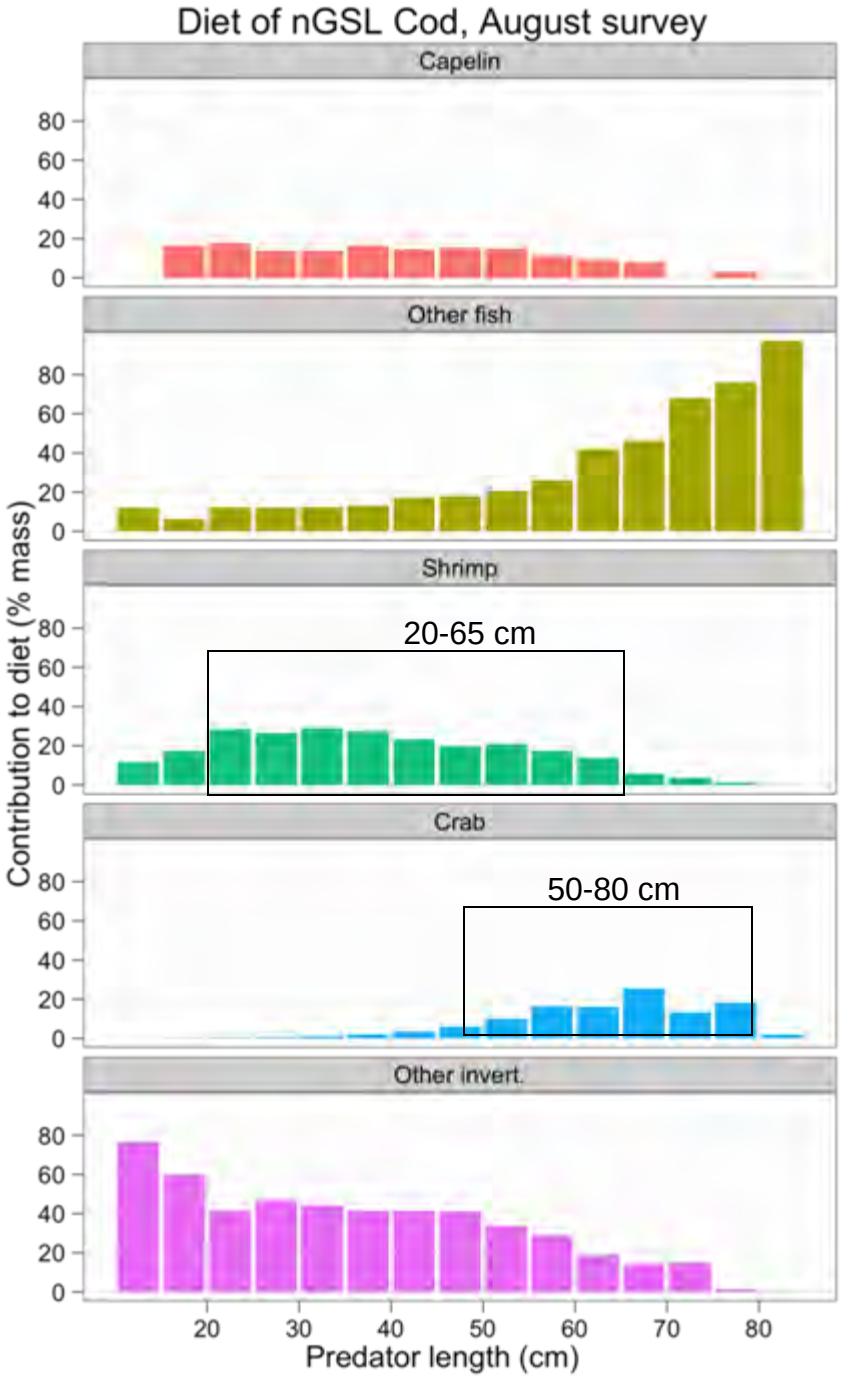
Global Index of Colocation (GIC)

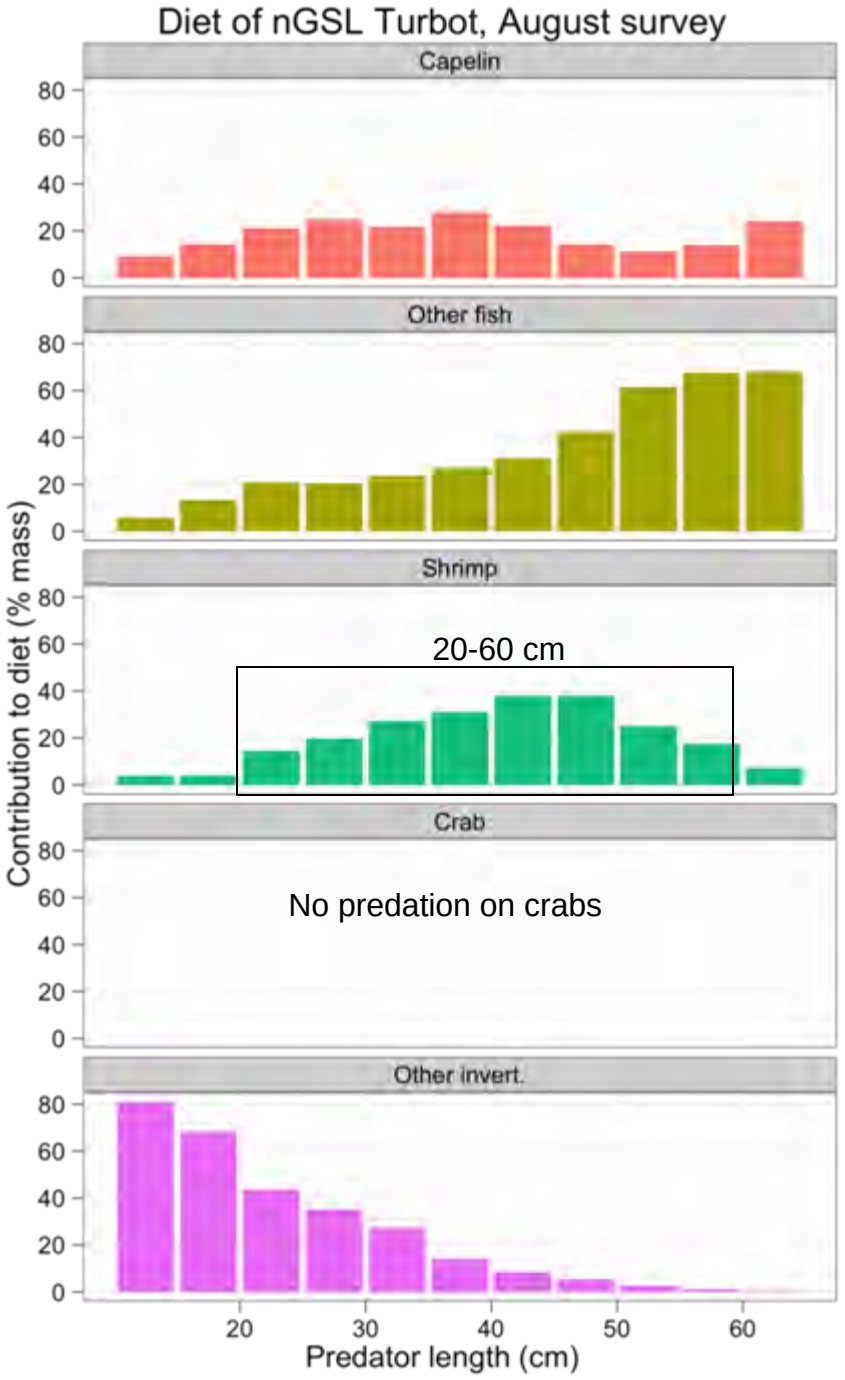
Bez and Rivoirard (2000), Wieland et al. (2007)

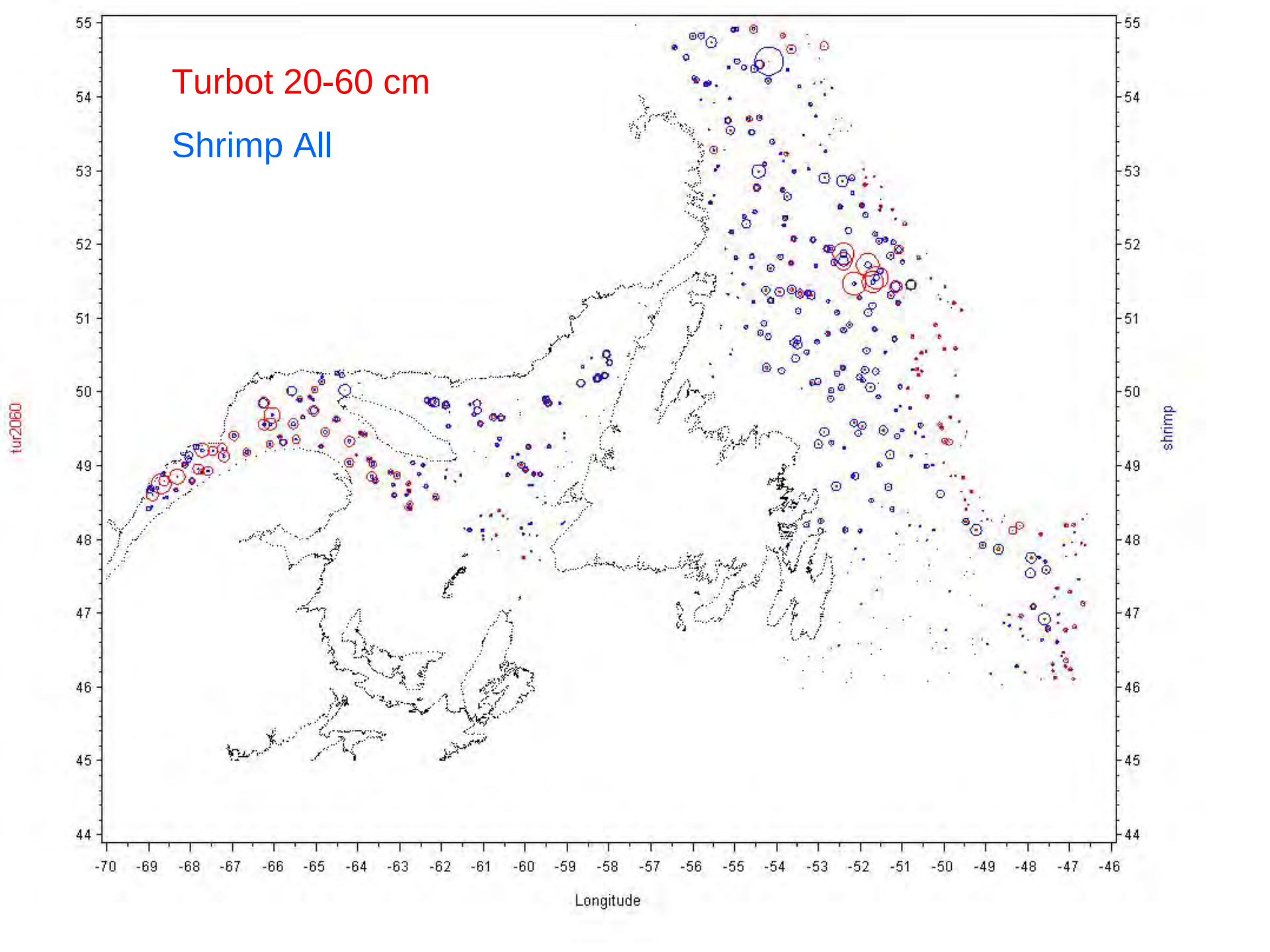
- GIC is based on differences in centers of gravity (GC, ‘mean location’) between populations and Inertia (horizontal dispersion) of each population.
- GIC ranges from 0 (distinctly different GC) to 1 (two GCs are coincident)


Diet of nGSL Cod, August survey
Invertebrates
55 251 570 1086 1161 1423 1434 1375 1193 799 388 168 62 38 41
Fish
Contribution to diet (% mass)
0
20
40
60
80
100
20
30
40
50
60
70
80
Predator length (cm)

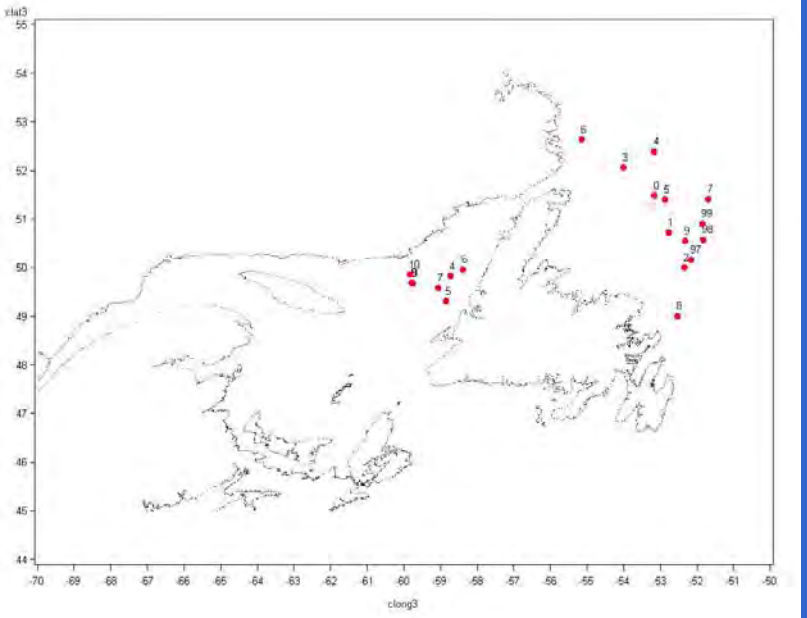

Diet of nGSL Turbot, August survey
Invertebrates
240 2096 785 2197 1771 2373 2312 1142 461 142 55
Fish
Contribution to diet (% mass)
0
20
40
60
80
100
20
30
40
50
60
Predator length (cm)


Diet of nGSL Cod, August survey
Capelin
Other fish
Shrimp
20-65 cm
Crab
50-80 cm
Other invert.
Contribution to diet (% mass)
Predator length (cm)

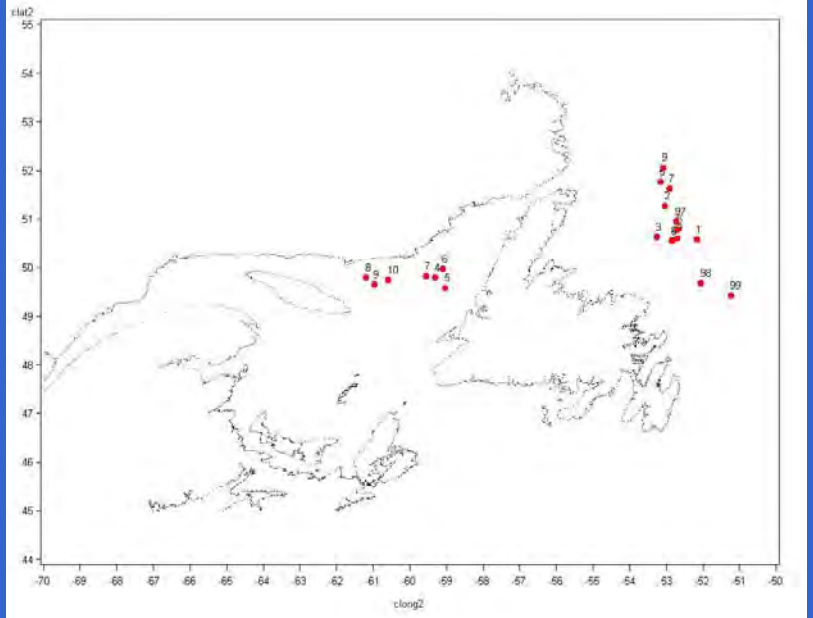

Diet of nGSL Turbot, August survey
Capelin
Other fish
Shrimp
20-60 cm
Crab
No predation on crabs
Other invert.
Contribution to diet (% mass)
Predator length (cm)


Turbot 20-60 cm
Shrimp All
tur2060
shrimp
55
54
53
52
51
50
49
48
47
46
45
44
-70 -69 -68 -67 -66 -65 -64 -63 -62 -61 -60 -59 -58 -57 -56 -55 -54 -53 -52 -51 -50 -49 -48 -47 -46
Longitude

Cod 50-80 cm

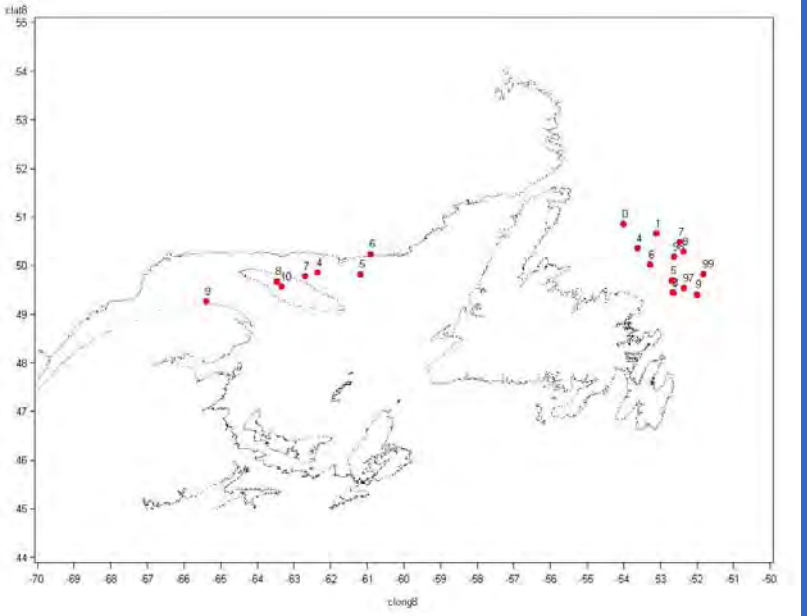


Cod 20-65 cm

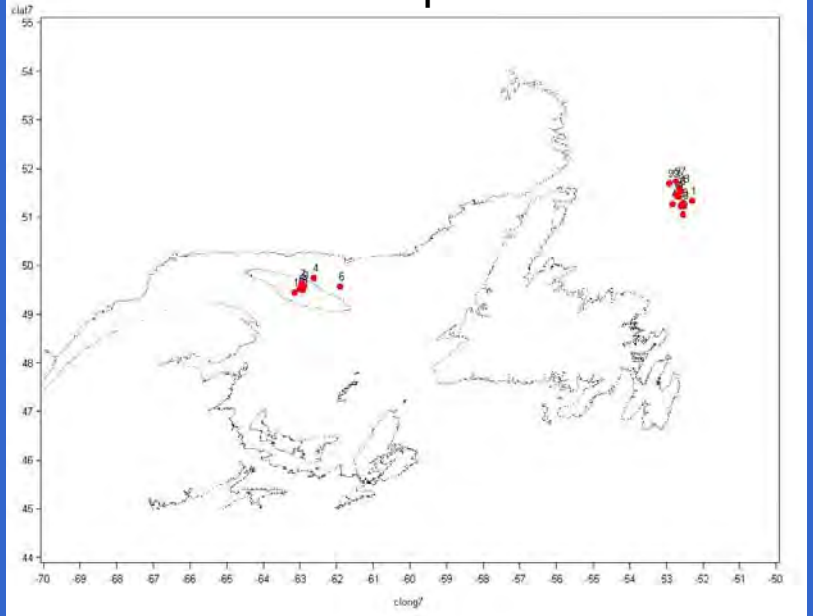


CG by Year

Crab <50 mm

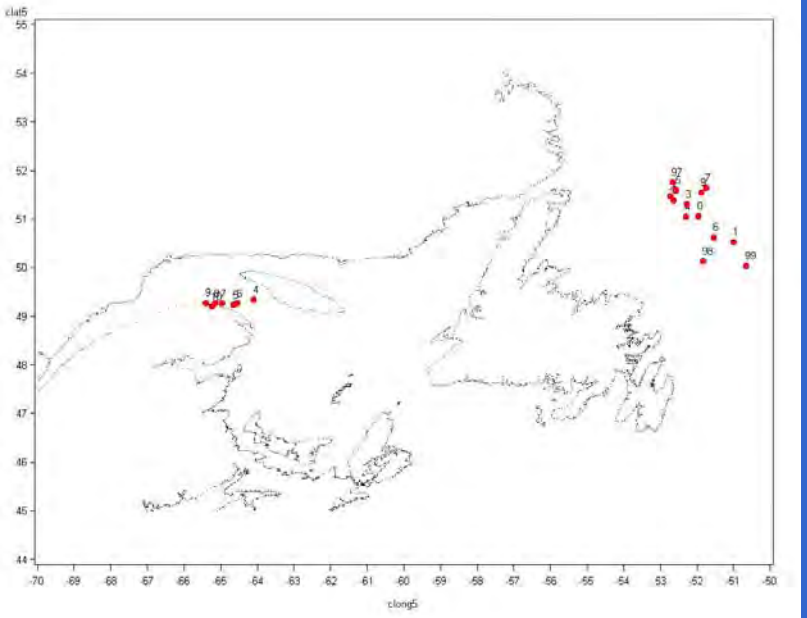


Shrimp All

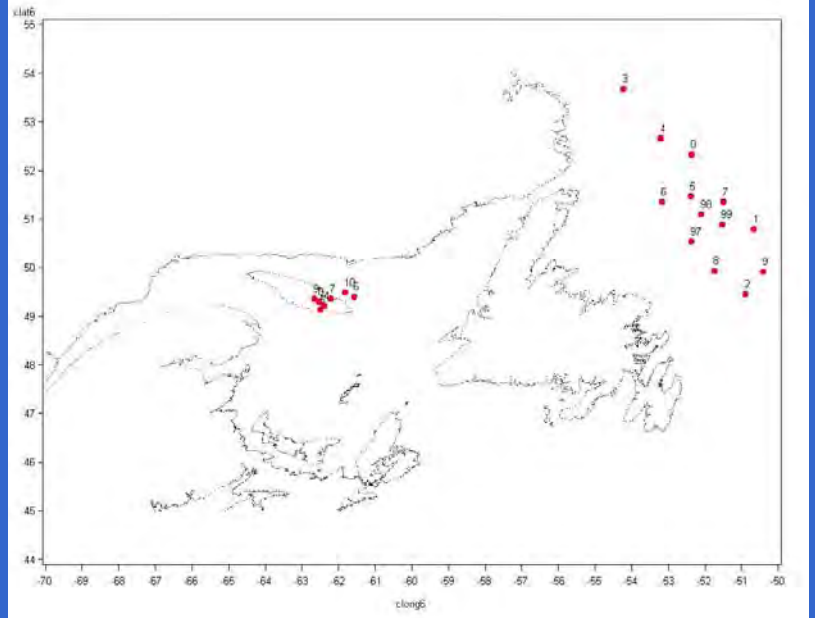


Cod vs. Prey

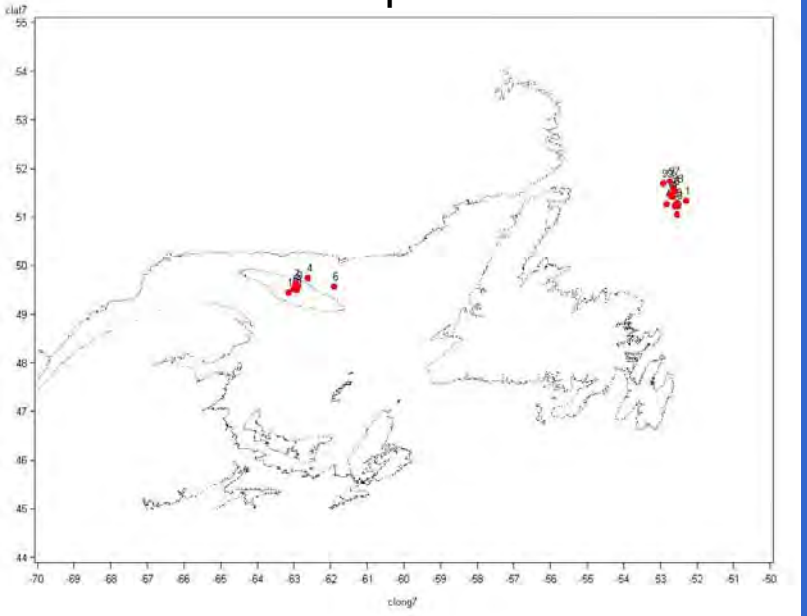
Turbot 20-60 cm



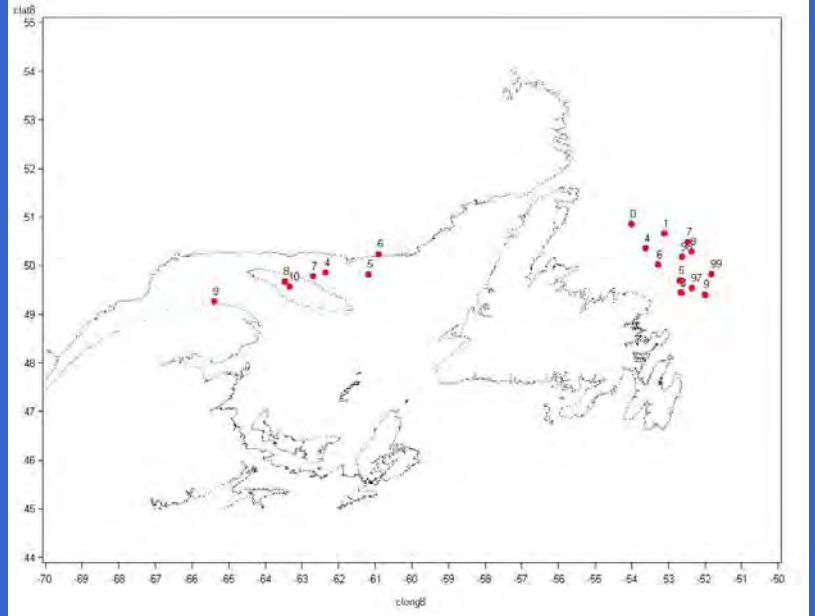
Turbot 50-80 cm



Shrimp All



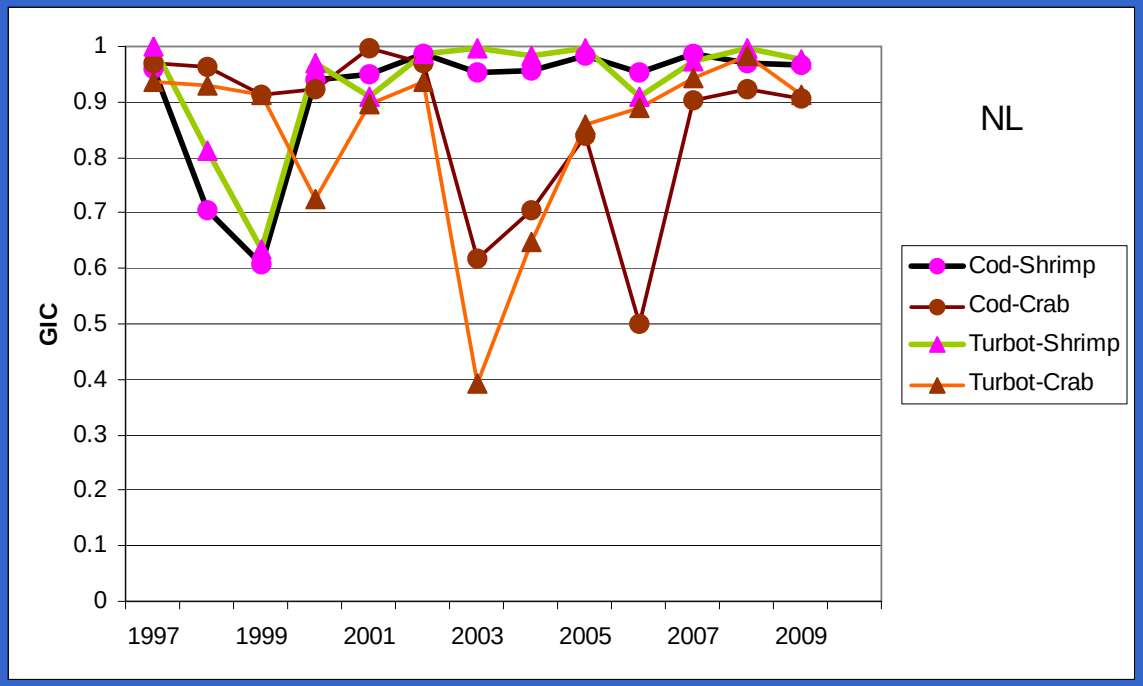
Crab <50 mm

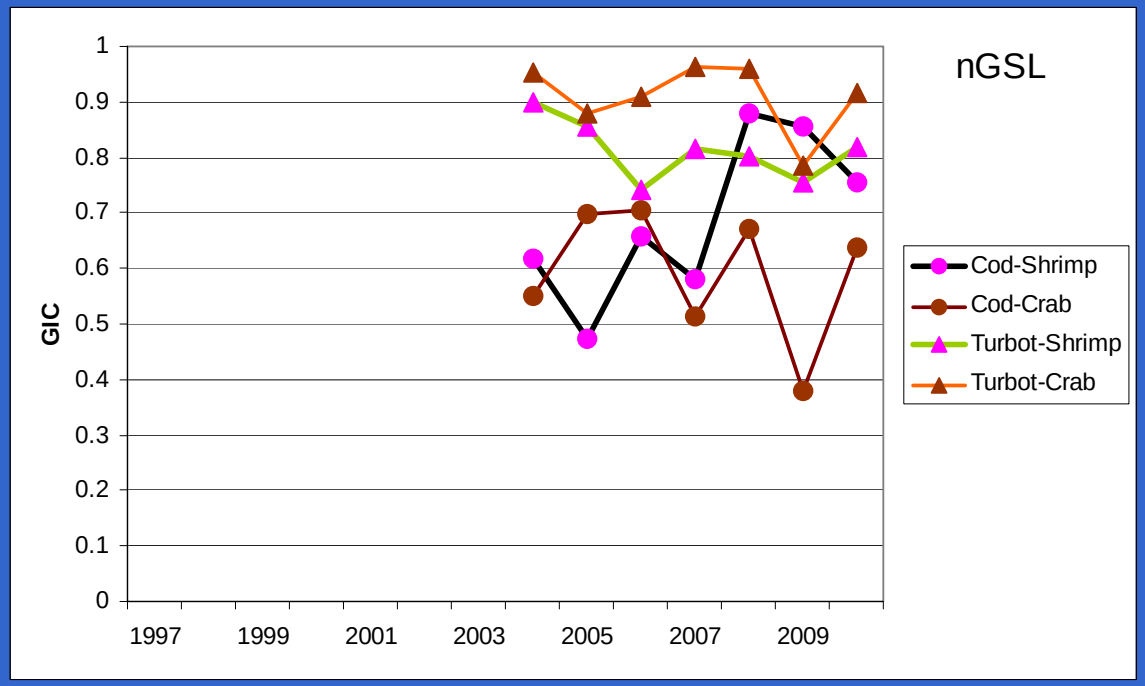


CG by Year

Turbot vs. Prey

(and Crab)





Global Index of Colocation (GIC) Div. 2J3KLNO

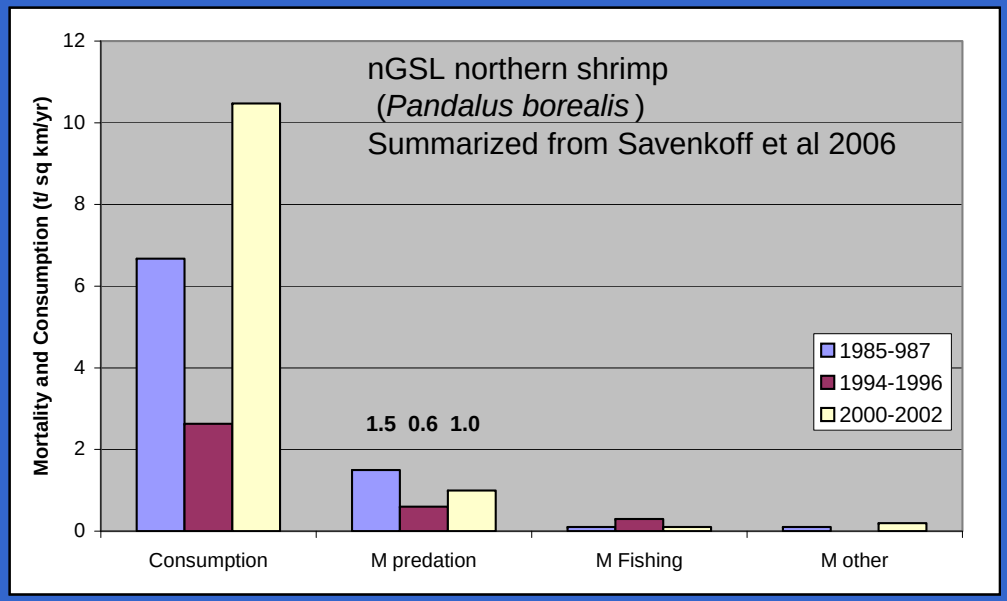
- NL looks like we'd expect:
- closest interactions with shrimp.

- nGSL results not what we would expect:
- closest interaction is turbot-crab,
- Predator-shrimp interactions are weaker than at NL
- nGSLcod-shrimp interaction has become closer recently

Summary and Conclusions

regarding crustacean prey

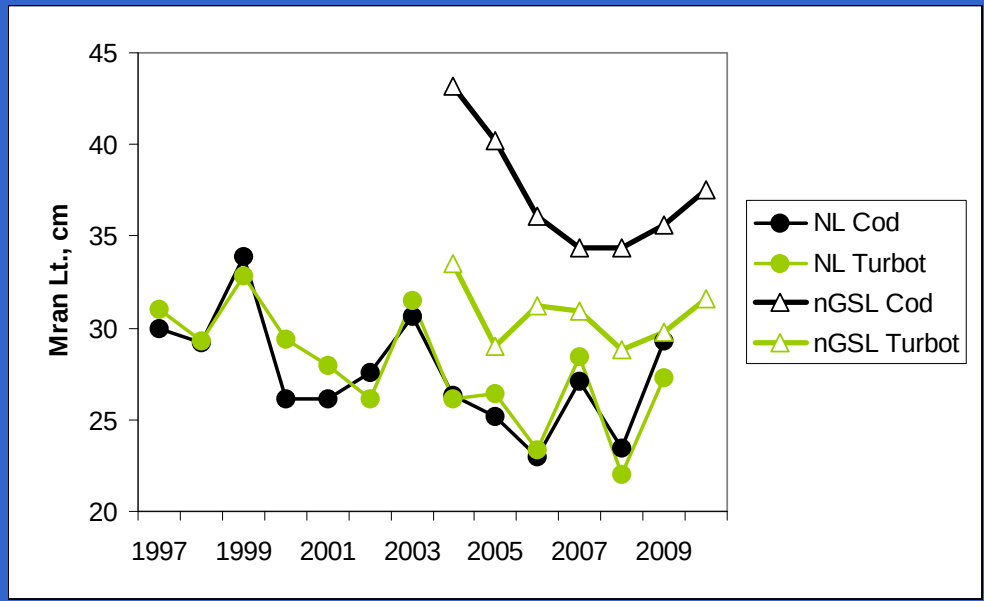
- There is no evidence that predation is controlling snow crab.
- In the case of shrimp, predation may be a factor, based on importance of shrimp in diets BUT the amount of shrimp consumed is more relevant to shrimp mortality rate.
- mortality rate may remain low, relative to the pre-collapse period, due to recent high shrimp biomass and low predator biomass (eg. n GSL)



Concerns (hypotheses)

regarding ecosystems and fish predators

- Are these ecosystems changing from an energy pathway through pelagic fish species to one where more energy goes directly to the demersal-benthic community?
- Can predator populations recover on a shrimp diet (small prey, low fat, low evacuation rate)?




Thank You
SHAMOOK
2003 9 6

Thanks for providing data and advice

nGSL

- Philippe Schwab
- Brigitte Bernier
- Hugo Bourdages
- Denis Bernier
- Louise Savard

NL

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- Alejandro Buren
- Denise Holloway
- Brad Vaters