Fleet Dynamics of the Atlantic Sea Scallop Fishery

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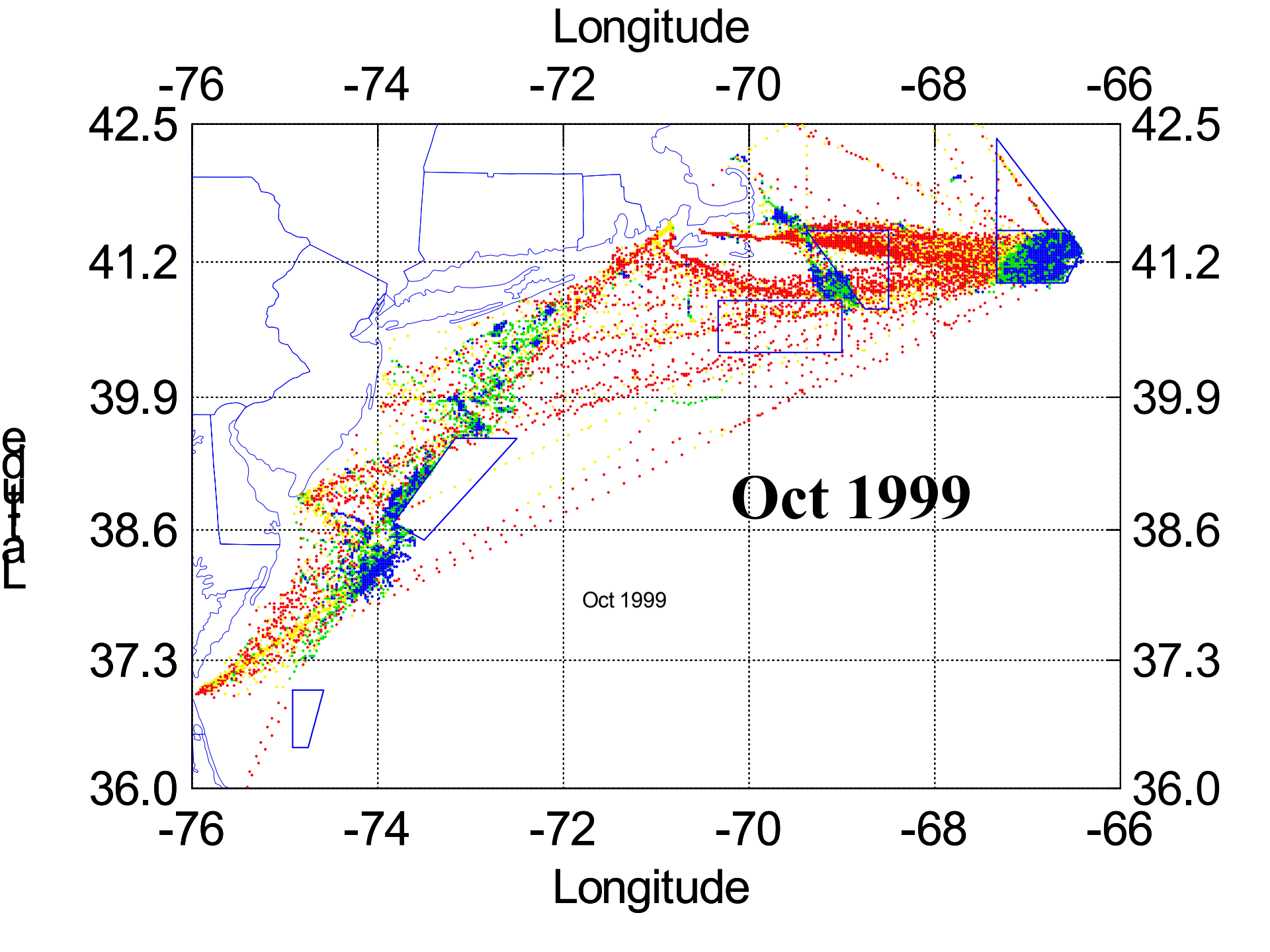
Objectives of Presentation

- Describe offshore Scallop Fishery
- Factors Influencing spatial and seasonal distribution of fishing effort
- Implications for harvest and management
- Interactions with habitat and bycatch


Longitude
-76
-74
-72
-70
-68
-66
42.5
41.2
39.9
38.6
37.3
36.0
Oct 1999
Oct 1999
Longitude

Scallop Fishery (1)

- **Georges Bank to Virginia: 40-100 m depth**
- **2nd most valuable in Northeast: 2000 $150M**
- **Historic range well below potential 40-60 M lb**
- **~250 vessels, 90% dredge**
- **120 Days at Sea ~ 25000 vessel days, down from 60,000 in early 1990s**
- **Effort Controls: Crew, Rings, Twine top**
- **Vessel Tracking and Monitoring System 1998 Mandatory**

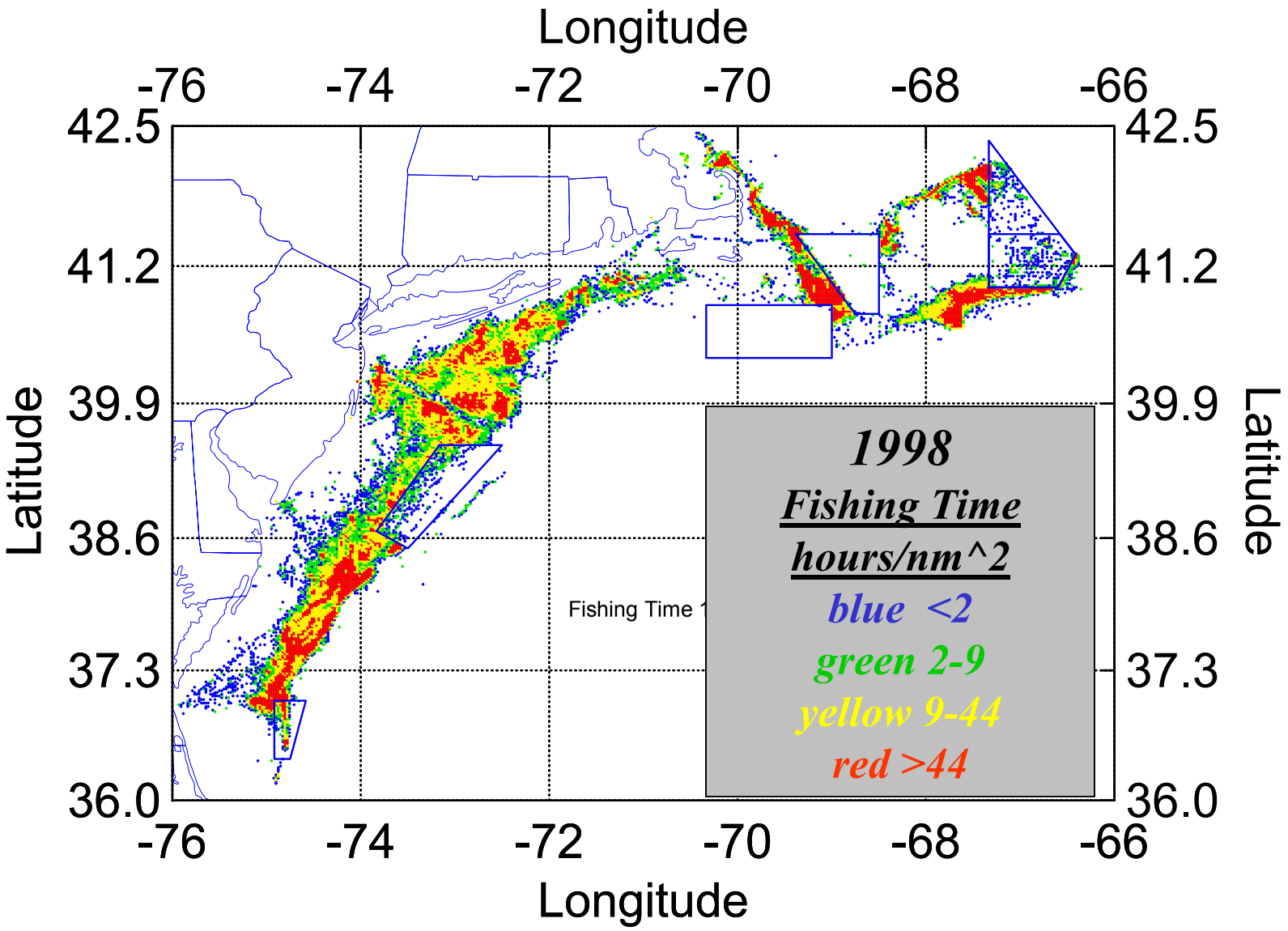
Vessel Tracking System

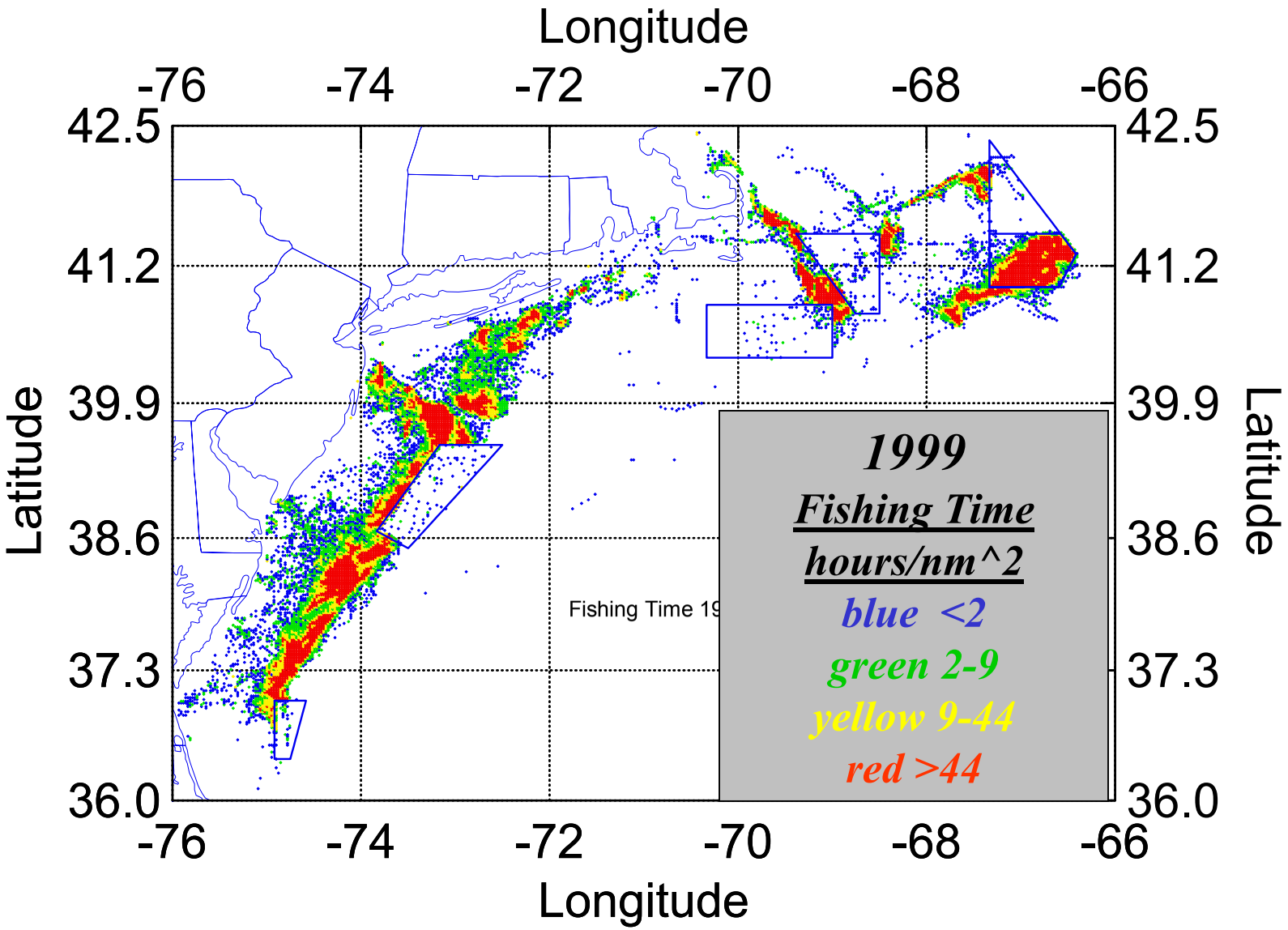
- Hourly position and velocity measures by geosynchronous satellite
- Pooled by 1 nm sqr quadrats
- Computed ave speed, duration, duration at speeds <5 knots
- Ship velocity < 5 knots ==> fishing activity
- Travel time=total time- fishing Activity
- Area Swept ~4.5 knots*30 ft*6076 ft/nm * Fishing Activity

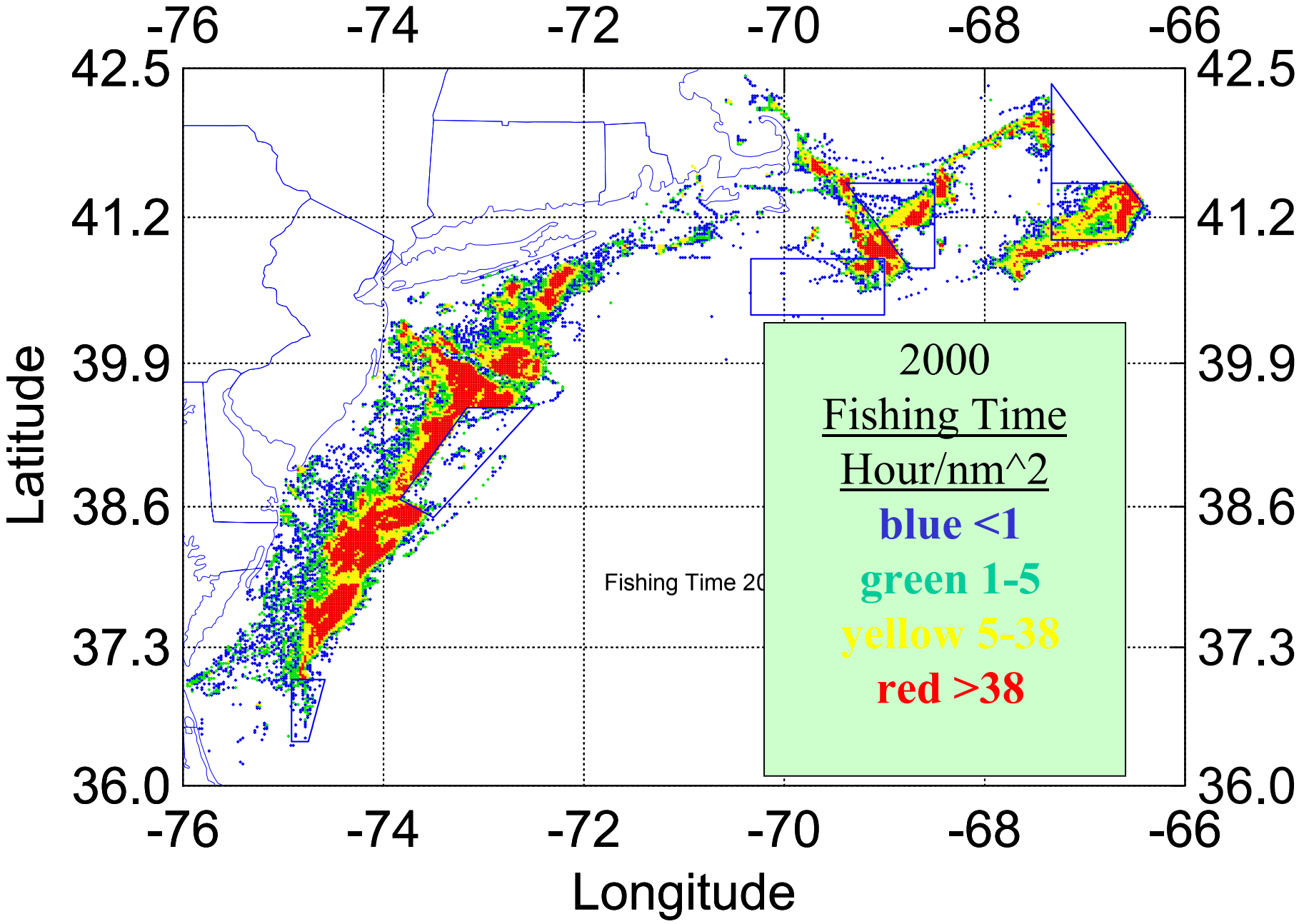
Scallop Fishery (2)

- **Closed Areas:**
  - **3 Georges Bank since Dec. 1994**
  - **2 Mid Atlantic since April 1998**
- **Reopenings--steps toward rotational management**
  - **Area II 1999, 2000;**
  - **Area I 2000-2001**
  - **Nantucket Lightship 2000**
  - **Hudson Canyon & Virginia Beach 2001**

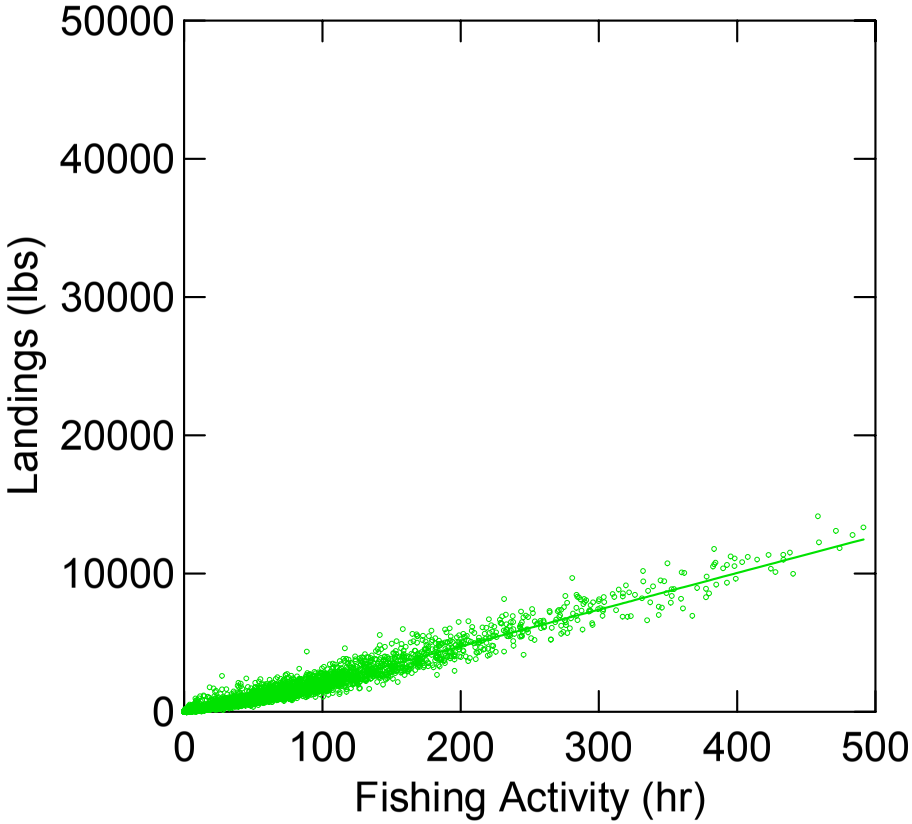
Effects of Density and Size on Exploitation Patterns


Longitude
-76
-74
-72
-70
-68
-66
42.5
41.2
39.9
38.6
37.3
36.0
Latitude
1998
Fishing Time
hours/nm^2
blue <2
green 2-9
yellow 9-44
red >44
Fishing Time

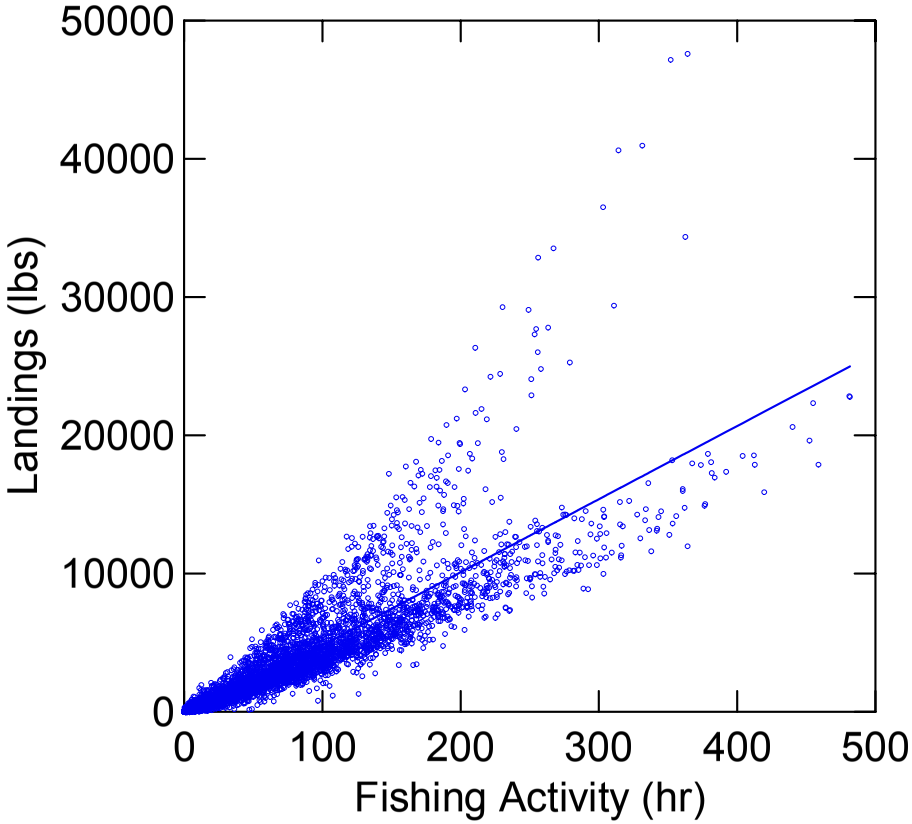

Longitude
-76
-74
-72
-70
-68
-66
42.5
41.2
39.9
38.6
37.3
36.0
Latitude
Fishing Time 19
1999
Fishing Time
hours/nm^2
blue <2
green 2-9
yellow 9-44
red >44


-76
-74
-72
-70
-68
-66
42.5
41.2
39.9
38.6
37.3
36.0
Latitude
Longitude
2000
Fishing Time
Hour/nm^2
blue <1
green 1-5
yellow 5-38
red >38
Fishing Time 20

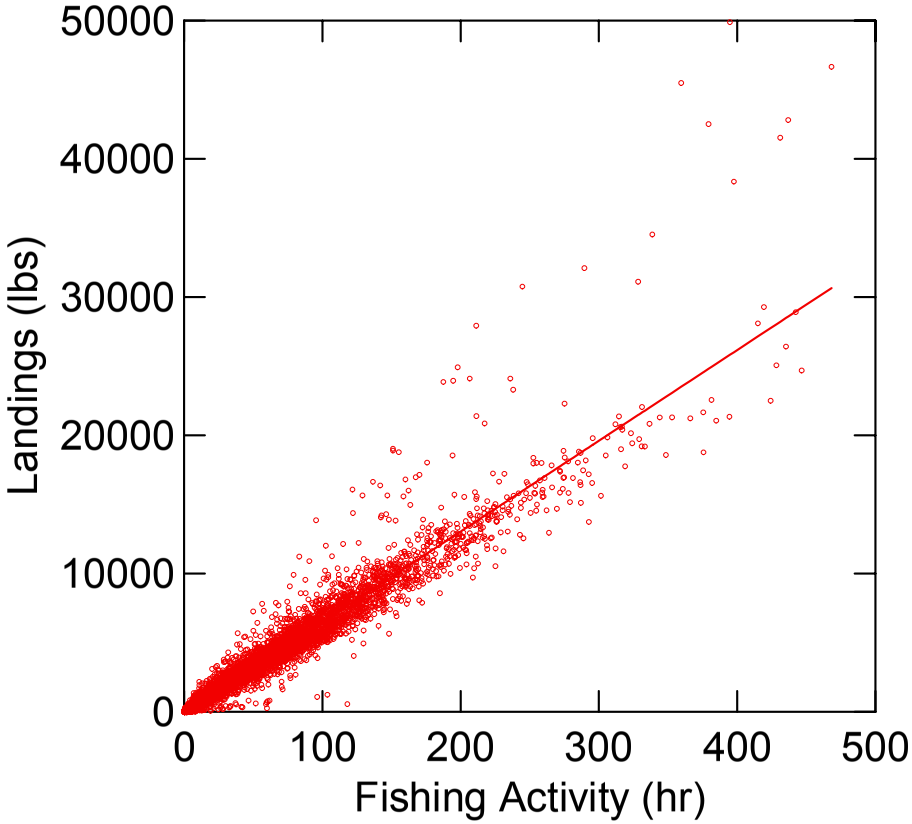
1998


50000
40000
30000
20000
10000
0
Landings (lbs)
0
100
200
300
400
500
Fishing Activity (hr)

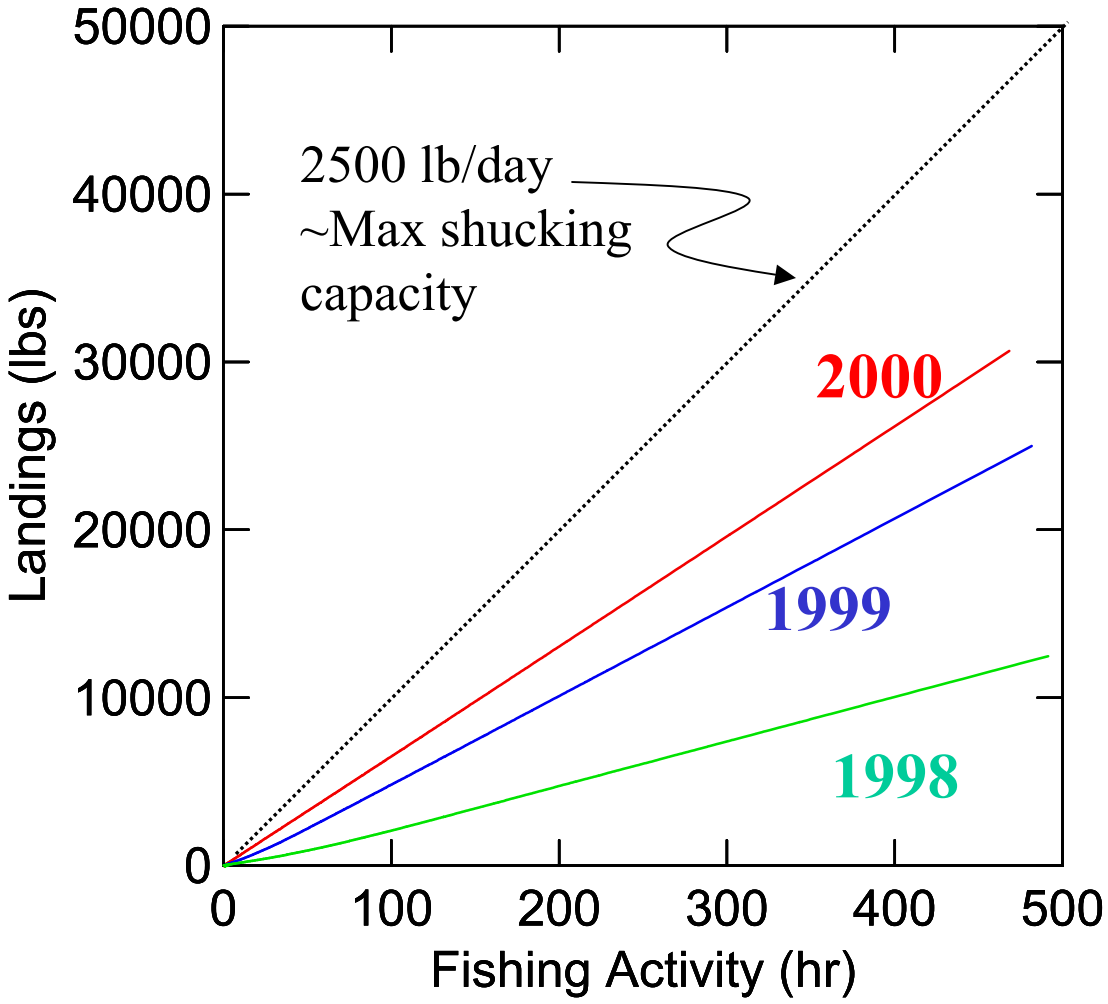
1999


50000
40000
30000
20000
10000
0
Landings (lbs)
0
100
200
300
400
500
Fishing Activity (hr)

2000

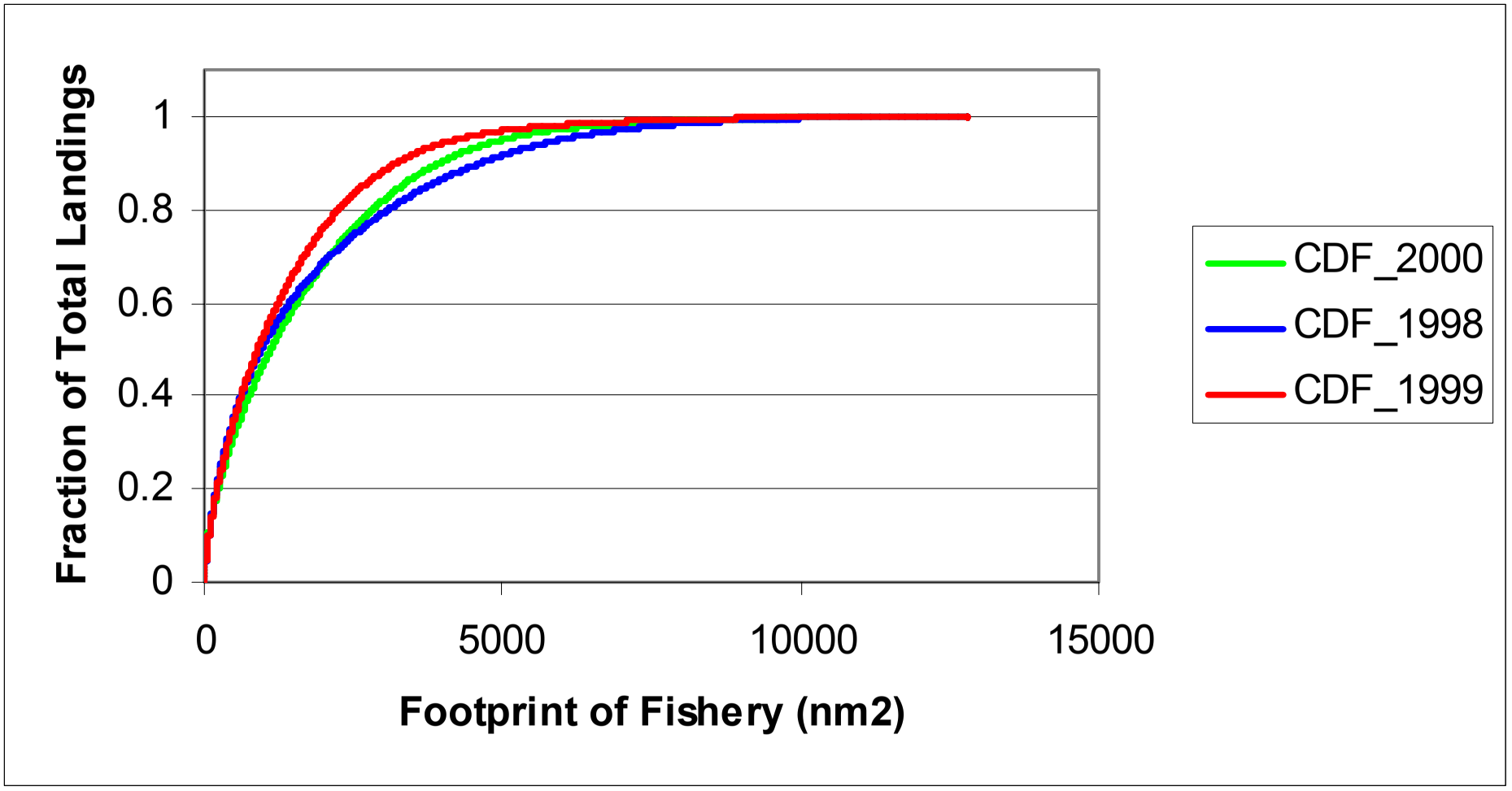

50000
40000
30000
20000
10000
0
Landings (lbs)
0
100
200
300
400
500
Fishing Activity (hr)

Landings per sqr. Mile vs Fishing Activity (hr)

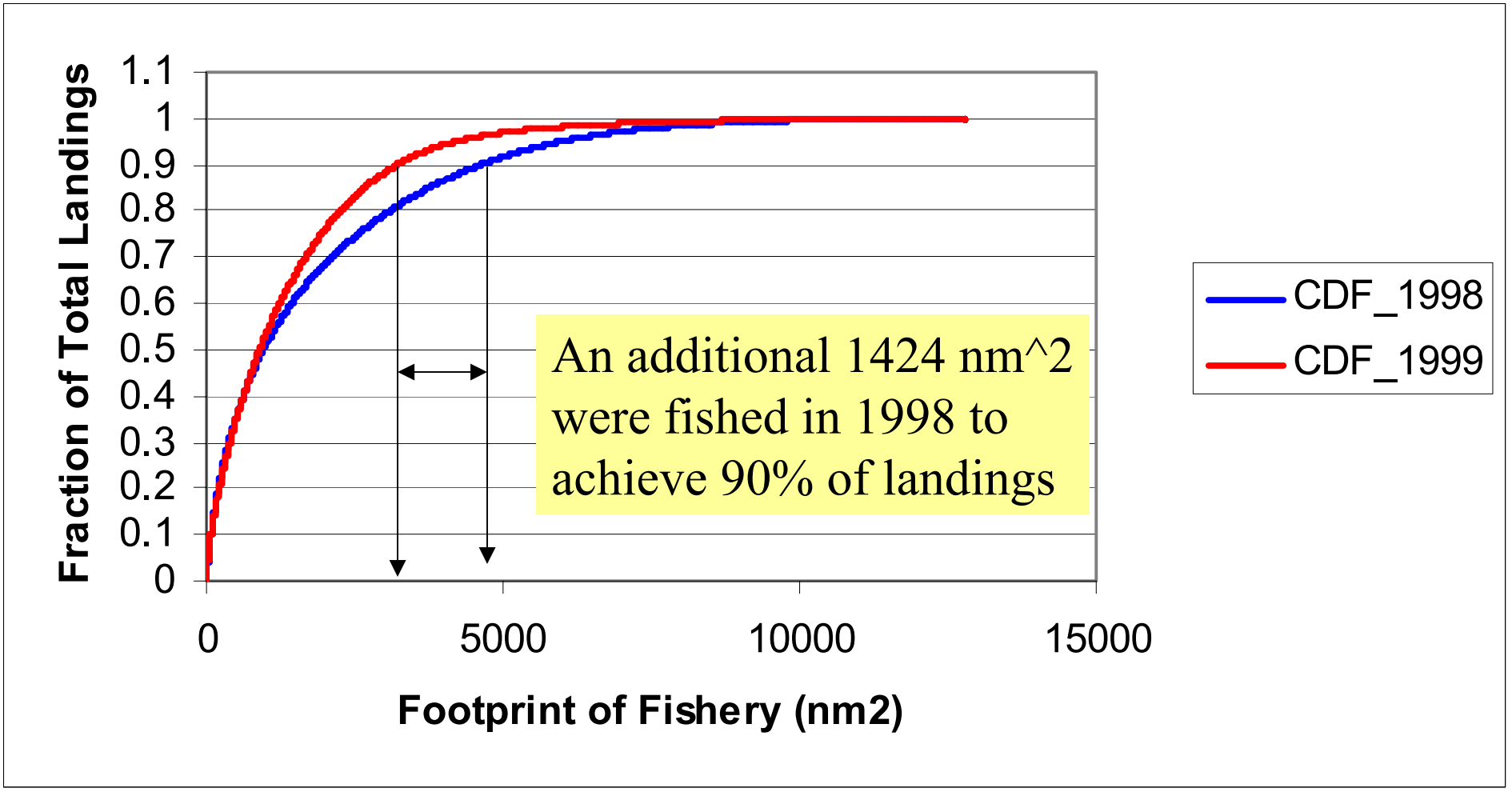


Footprint of the Fleet

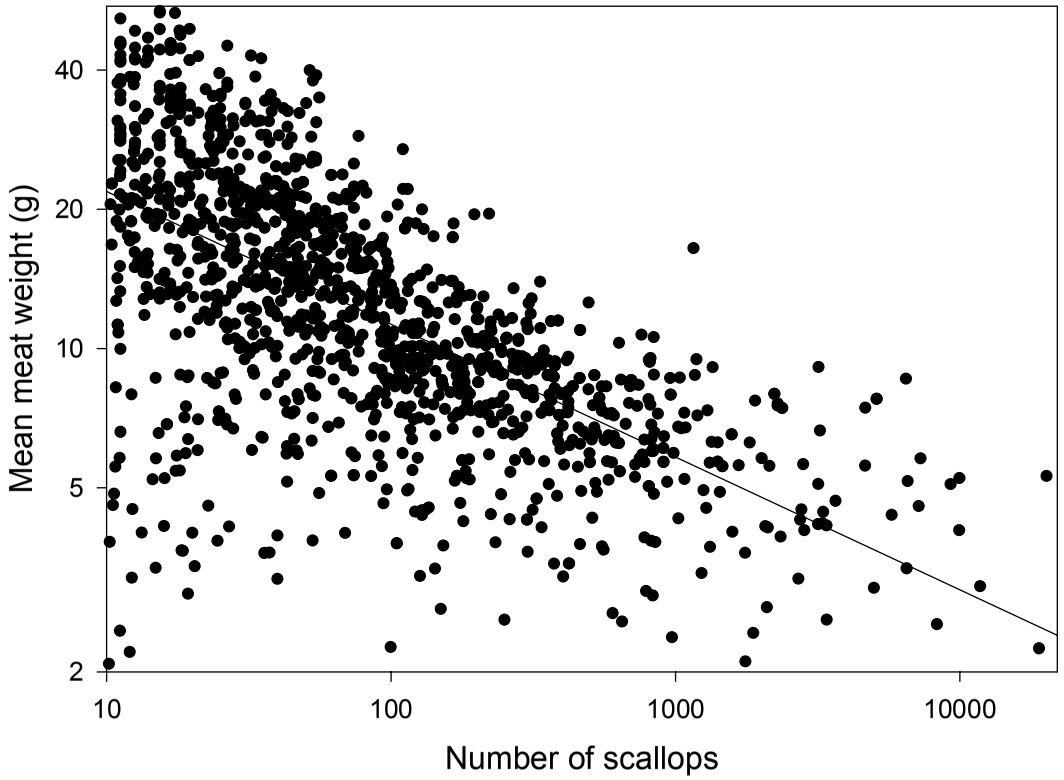
Concentration of Landings Profiles for Scallop fishery in 1998,1999, and 2000



Comparison of Concentration Curves for Landings in a low density year 1998 and 1999, a year in which landings were augmented by access to the Closed Area II.

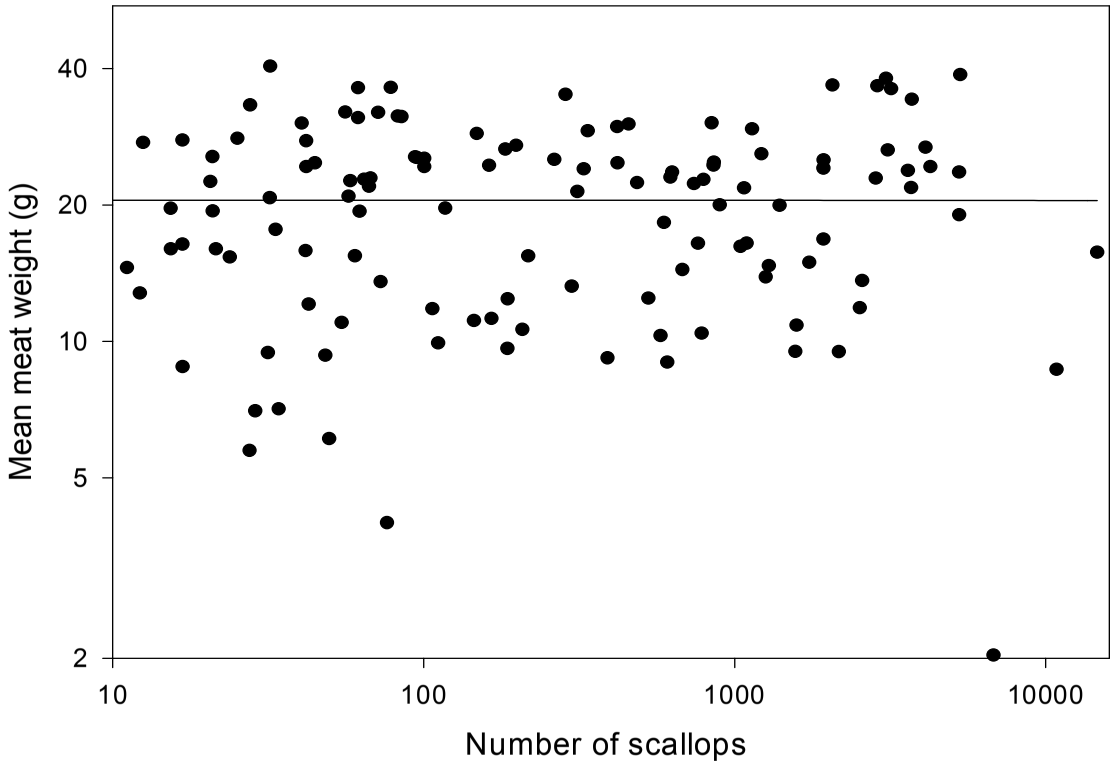


Density-dependent fishing mortality is strong...



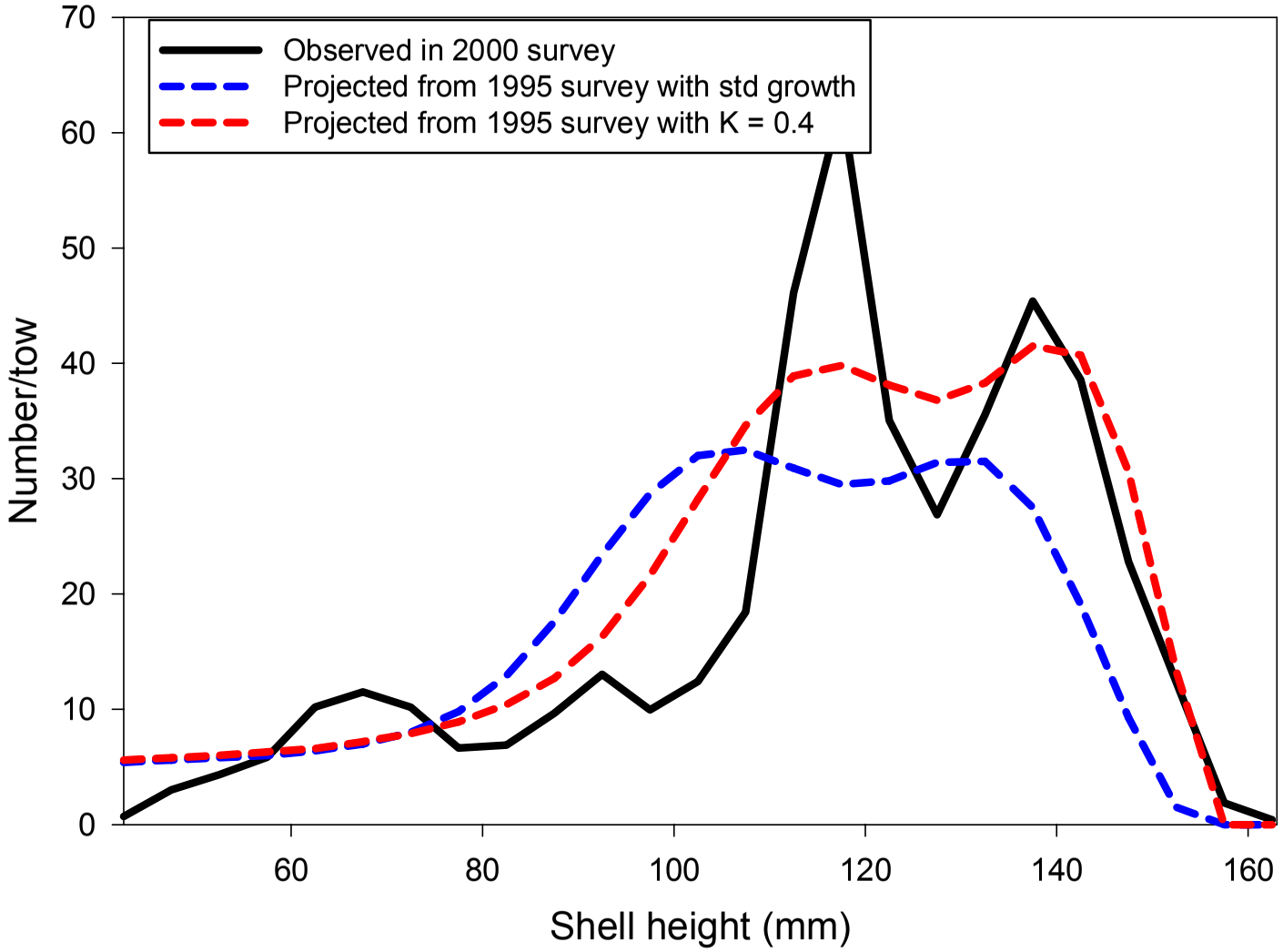
Georges Bank, 1982-1994 (Hart. 2001. CJFAS 58:2351-2358)

...but there is no evidence of density-dependent natural mortality.



Georges Bank closed areas (excluding CA2-S), 1999-2000

Georges Bank 2000 closed area size-frequencies (excluding CA2-S), together with projected size-frequencies assuming standard and fast (K=0.4) growth (from SARC-32).



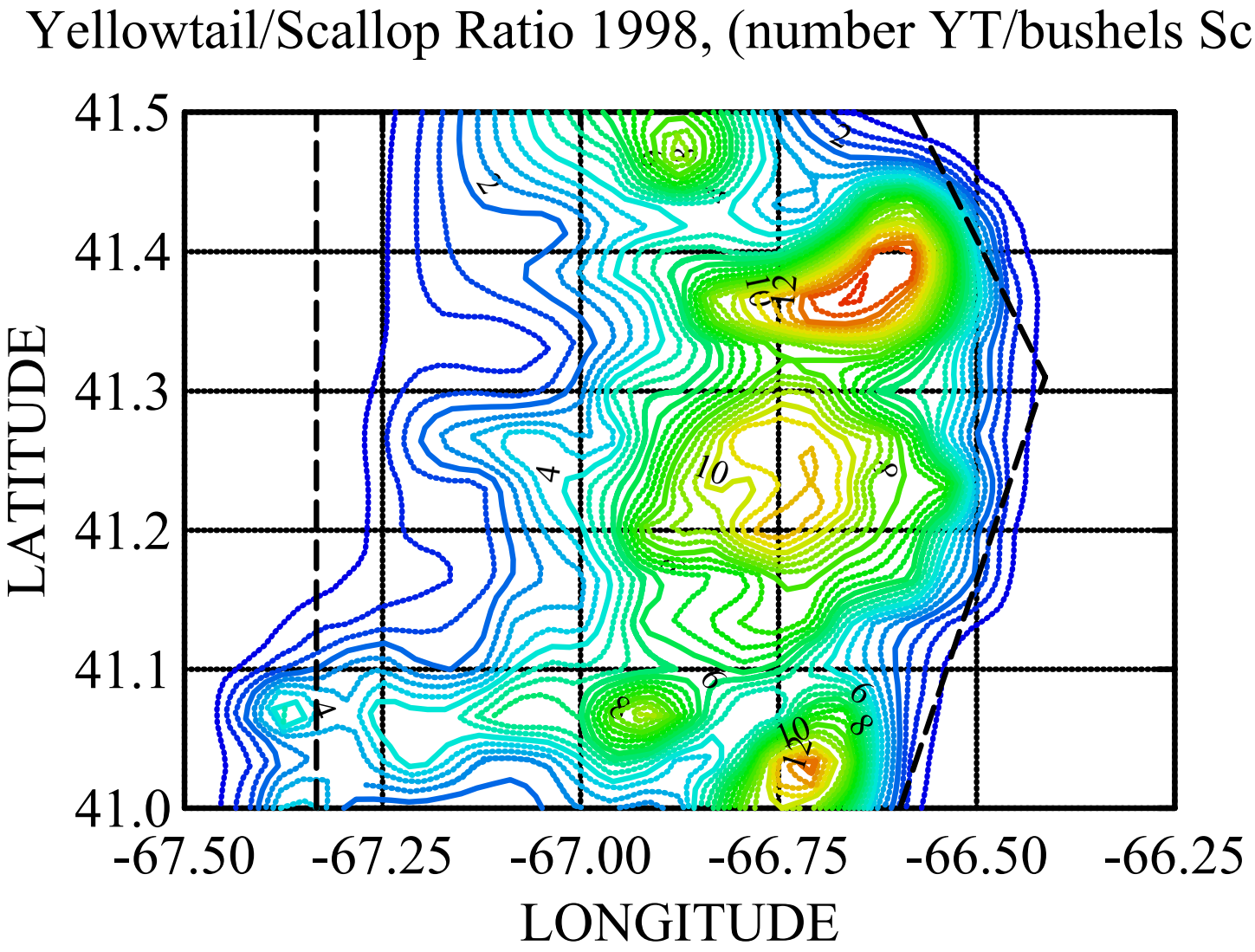
1999 --Area II Fishery Reopens

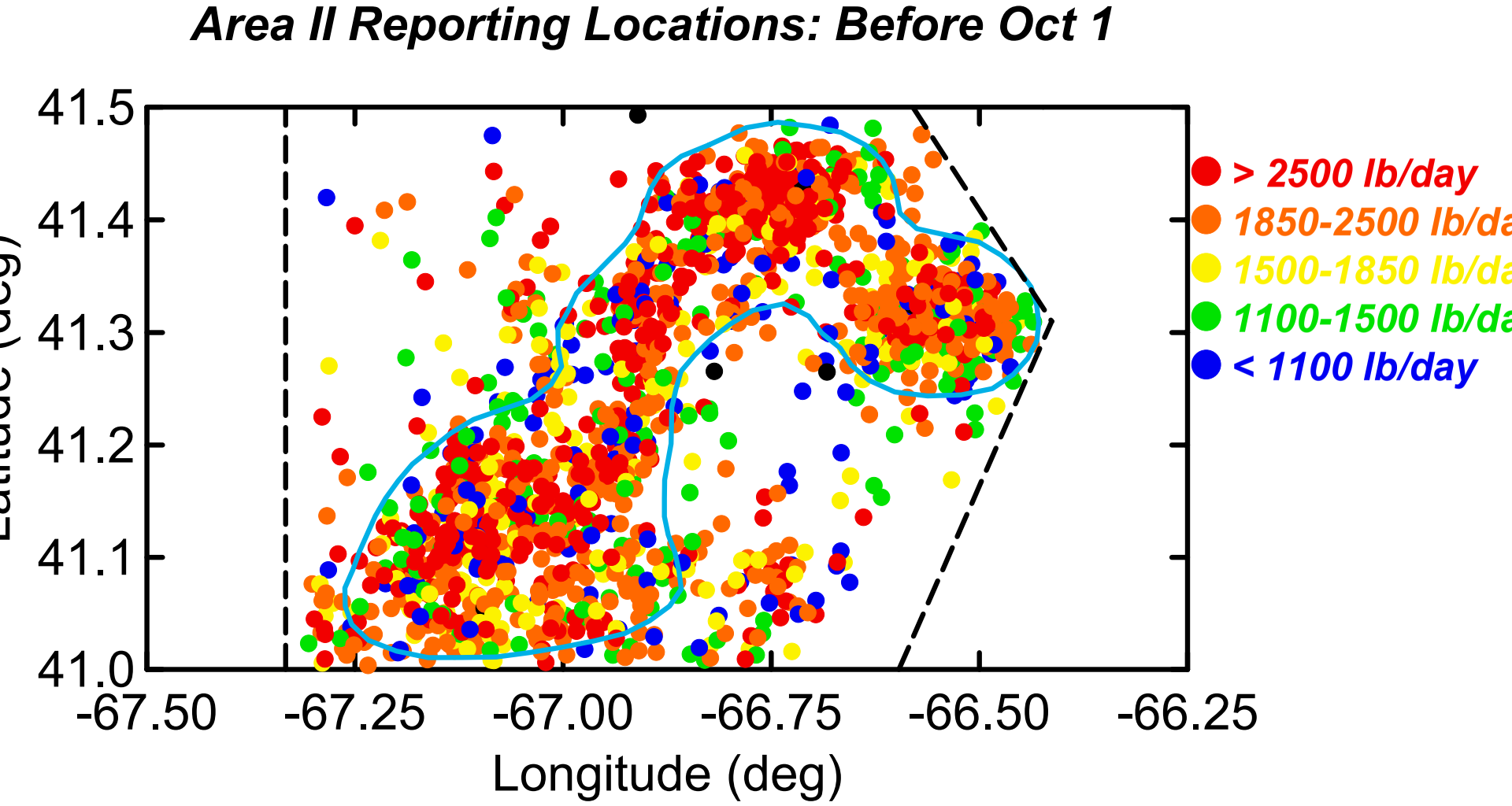
life does not stand still while specialists put their minds in order”

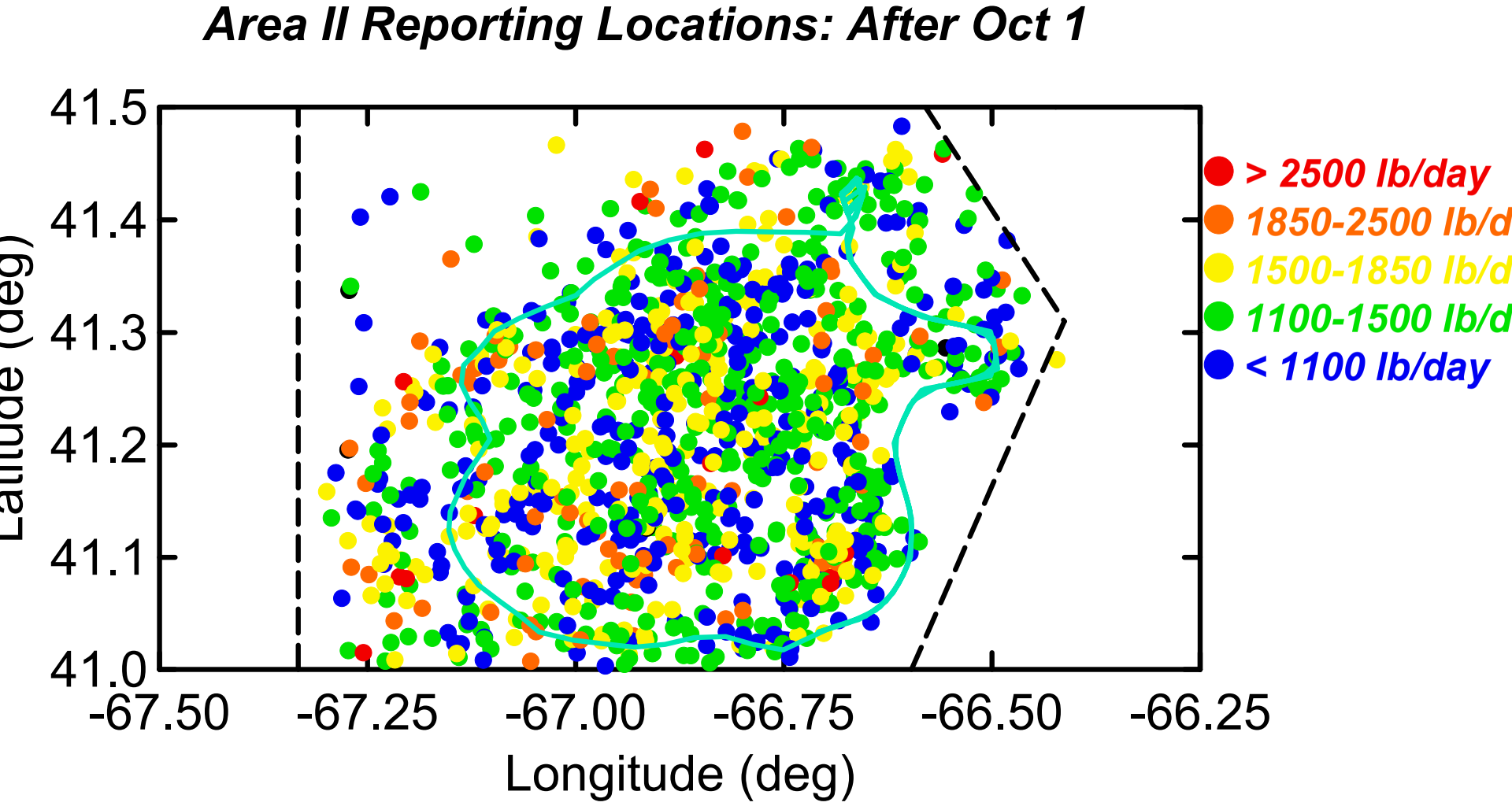
Michael Graham, 1950

Address to United Nations

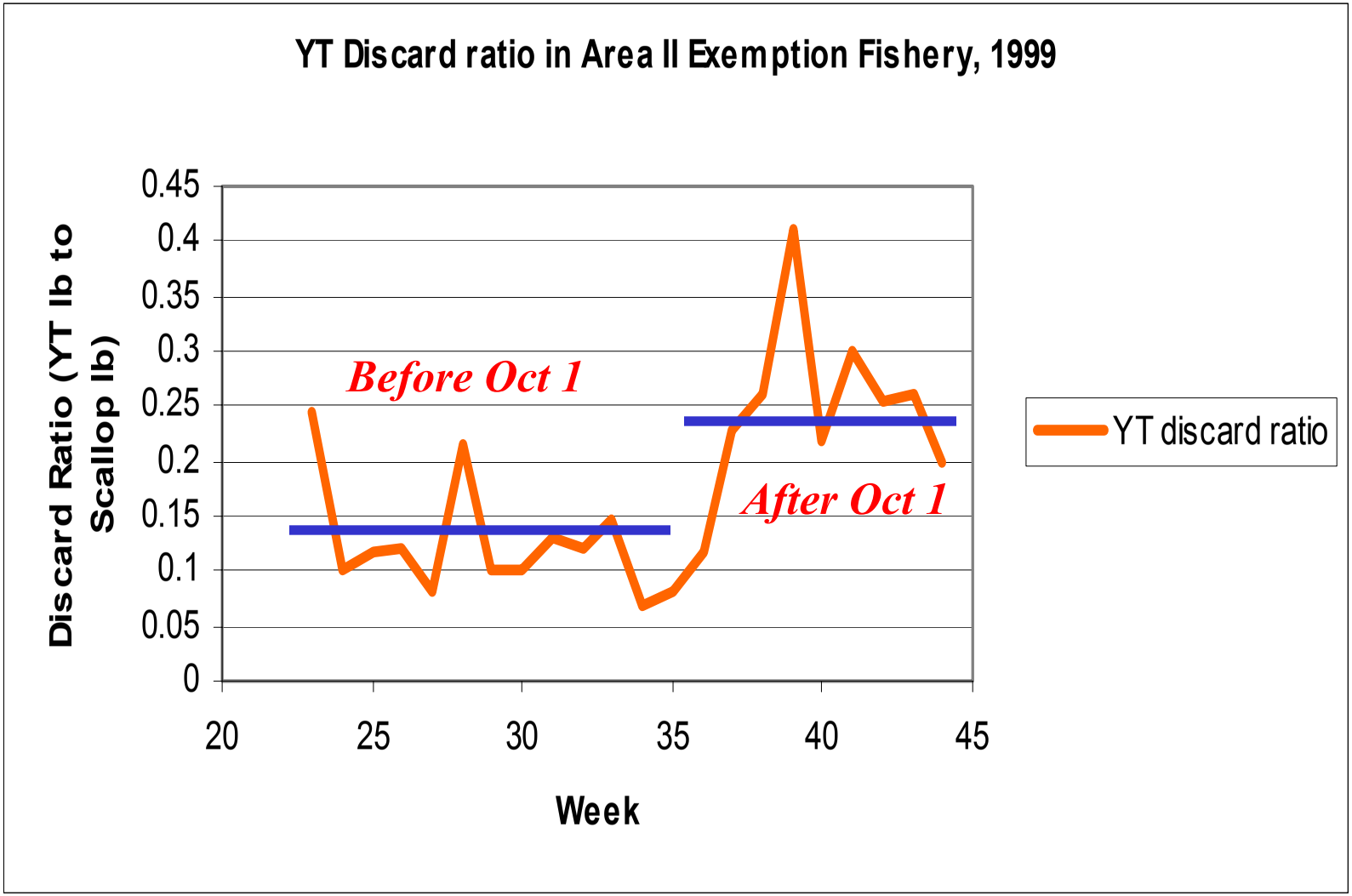
Spatial Distribution of Bycatch



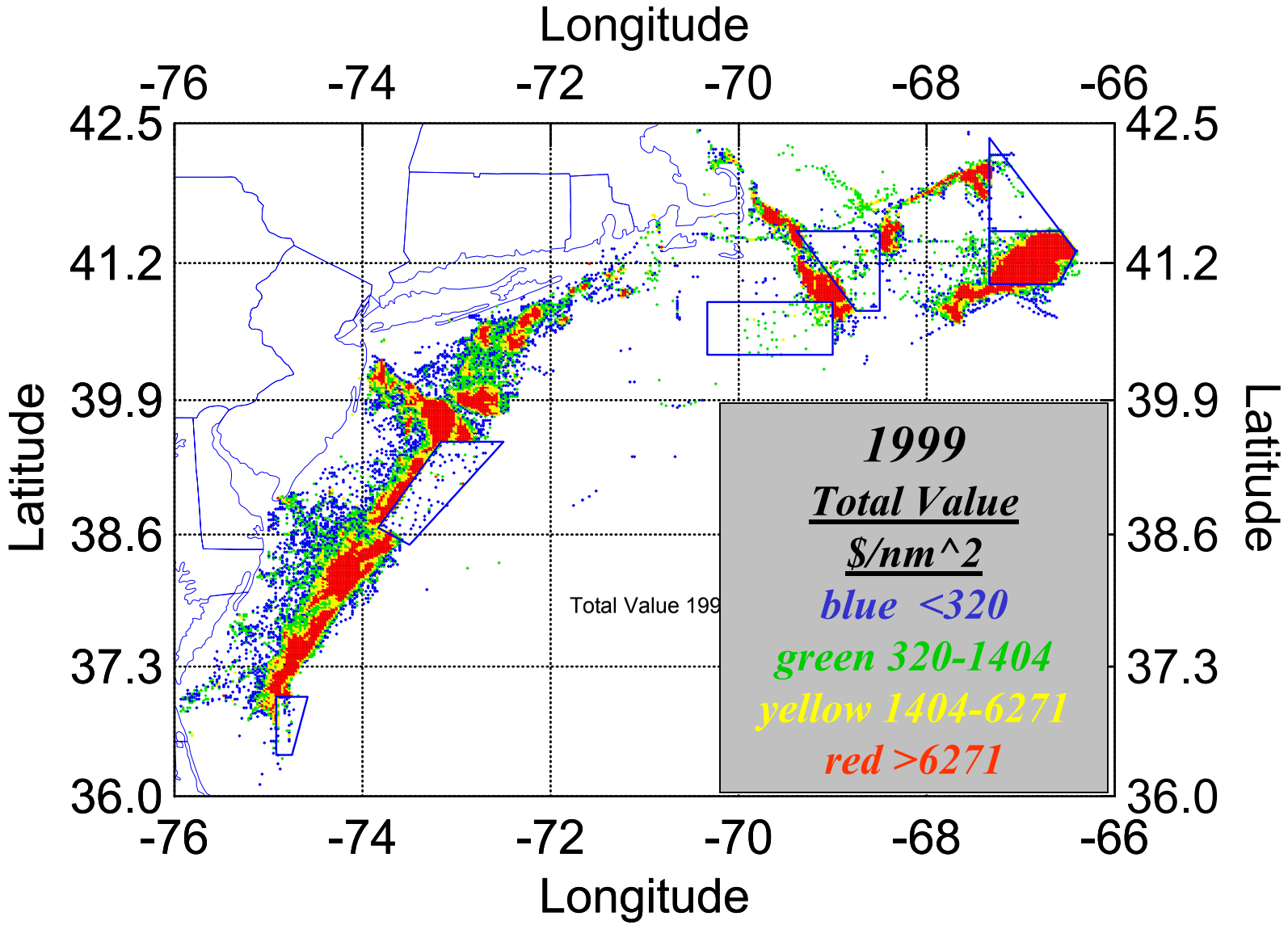

Area II Reporting Locations: Before Oct 1
41.5
41.4
41.3
41.2
41.1
41.0
-67.50
-67.25
-67.00
-66.75
-66.50
-66.25
Longitude (deg)
> 2500 lb/day
1850-2500 lb/da
1500-1850 lb/da
1100-1500 lb/da
< 1100 lb/day


Area II Reporting Locations: After Oct 1
41.5
41.4
41.3
41.2
41.1
41.0
Latitude (deg)
-67.50
-67.25
-67.00
-66.75
-66.50
-66.25
Longitude (deg)
> 2500 lb/day
1850-2500 lb/d
1500-1850 lb/d
1100-1500 lb/d
< 1100 lb/day

BYCATCH AND DISCARD CONSIDERATIONS

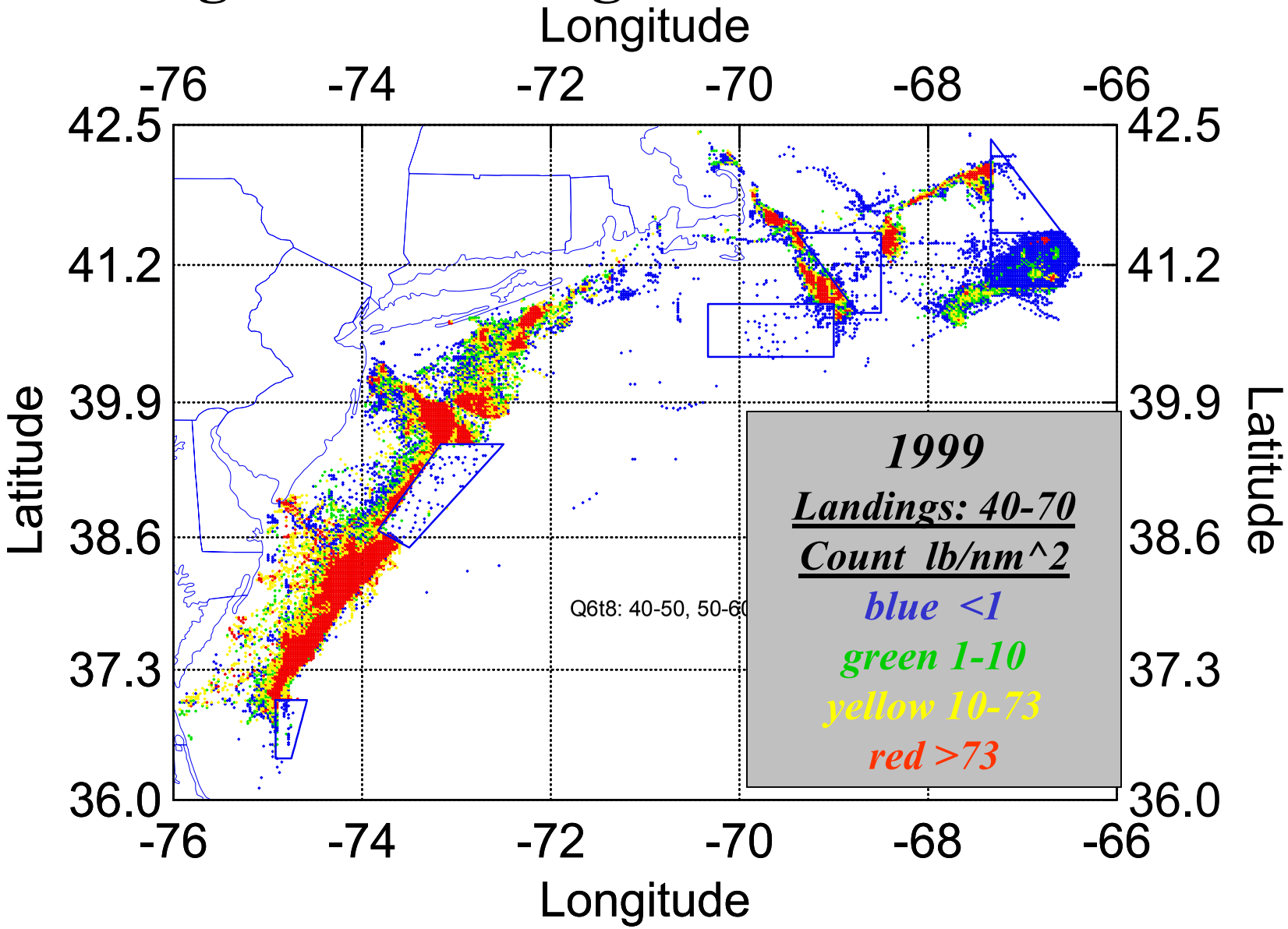


Spatial Economics: Revenue per square nautical mile



Meat Count Distribution:

Where might overfishing occur?



Some Basic Conclusions from VMS Data

- Fishing activity occurs over about 12,000 sqr nm, BUT 75% of total effort occurs in less than 3,000 sqr nm.
- Primary scallop areas experience about 110 hours of fishing activity per year
- In 1999, primary scallop areas generated 88% of landings and revenue
- Primary scallop areas generated about $33,000 of landings per sqr nm in 1999

Advantages of VMS

- *Common Language—integration of survey, at-sea observers, landings, enforcement and management*
- *Timely and Detailed*
- *Enables Adaptive Management*
- *Improved Surveys*
- *Design of Area Rotation*
- *Habitat and Bycatch Tradeoffs*
- *Improved Theory/Models*

Where do we go from here?

- Rotational Area Mgt
- Biological Reserves for spawning stock
- Hydrodynamic models to develop reproductive footprint
- Experiments within SFA
- Explicit consideration of tradeoffs: habitat and bycatch
- Stewardship/ownership

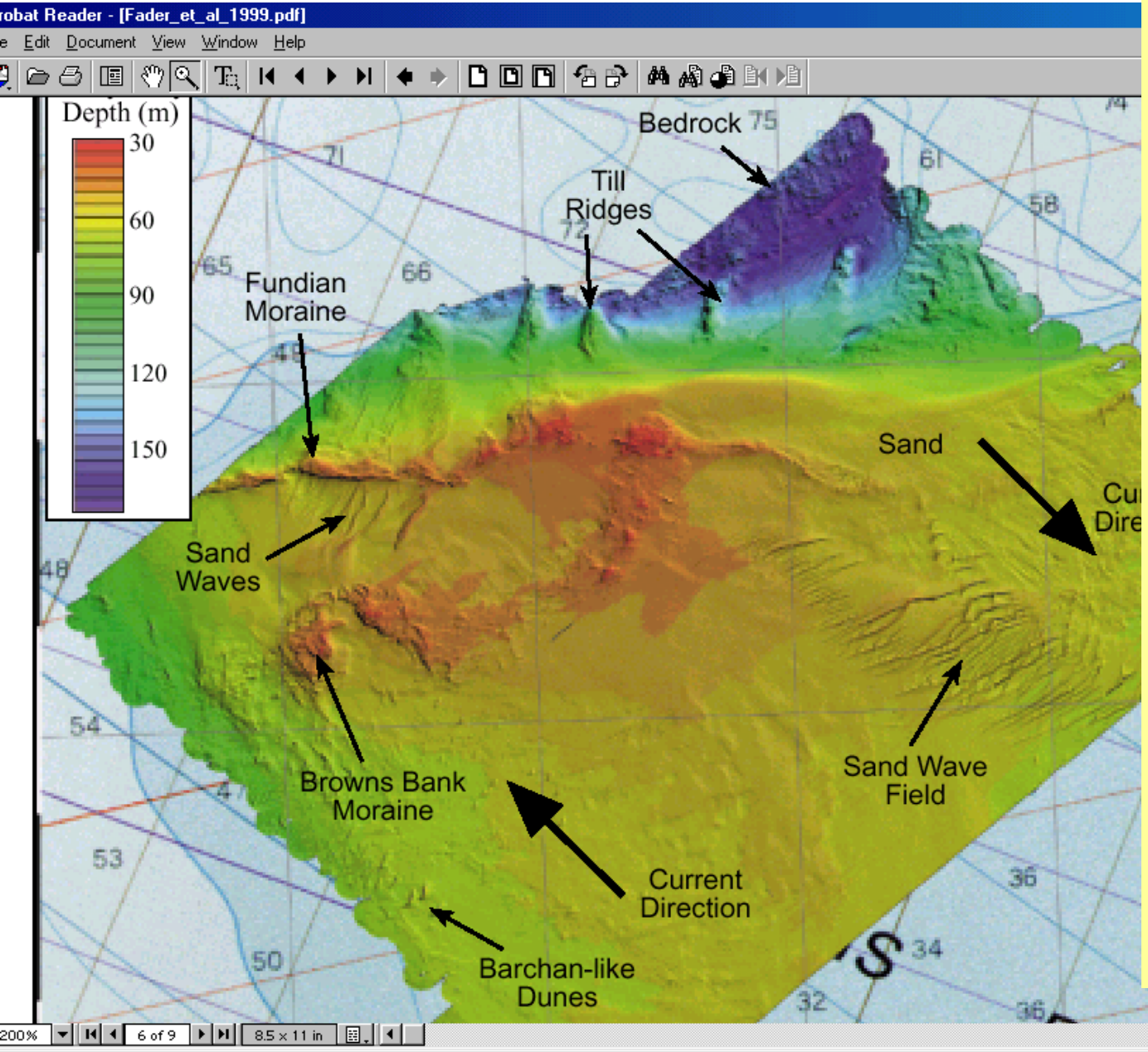
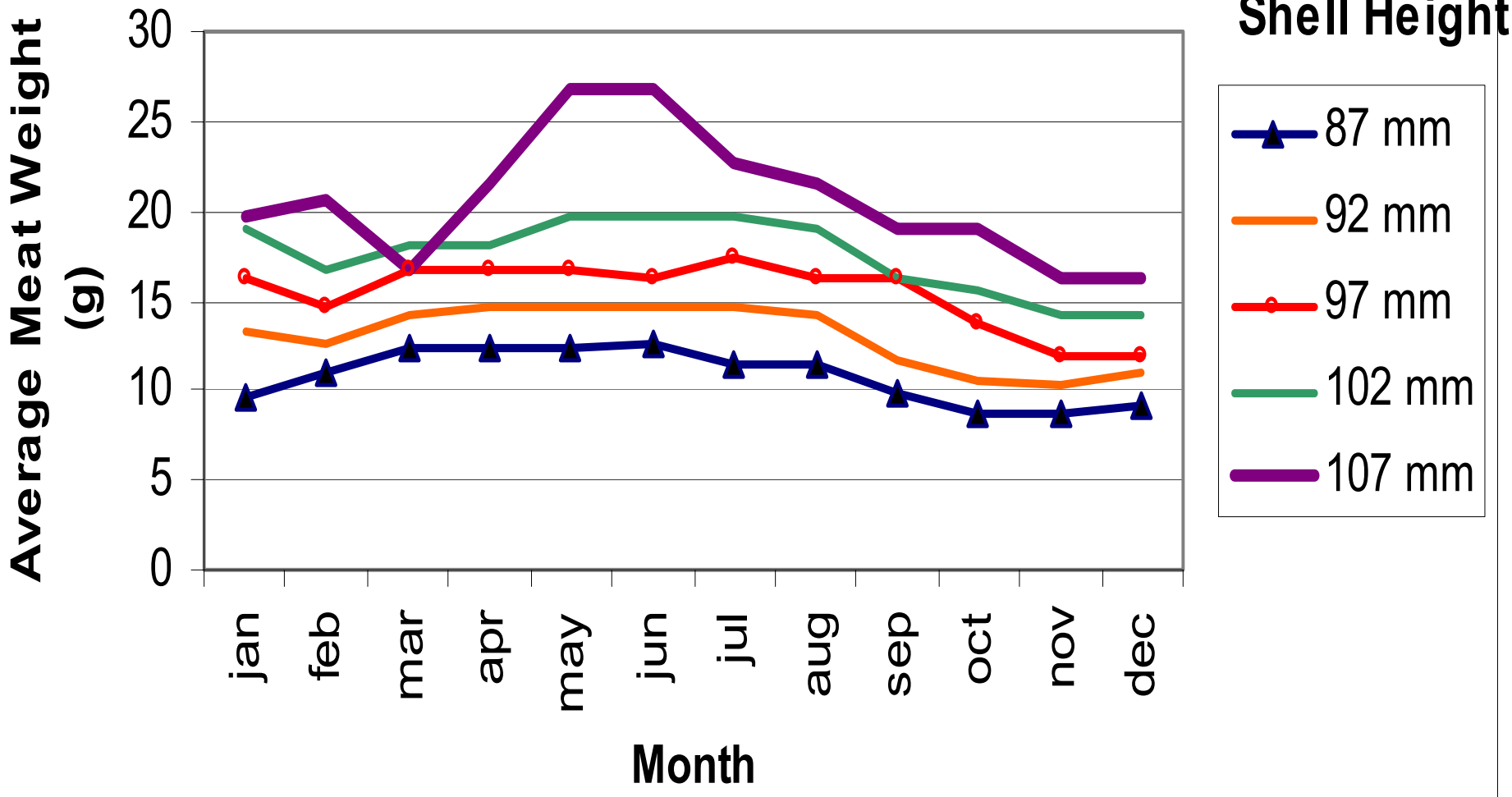
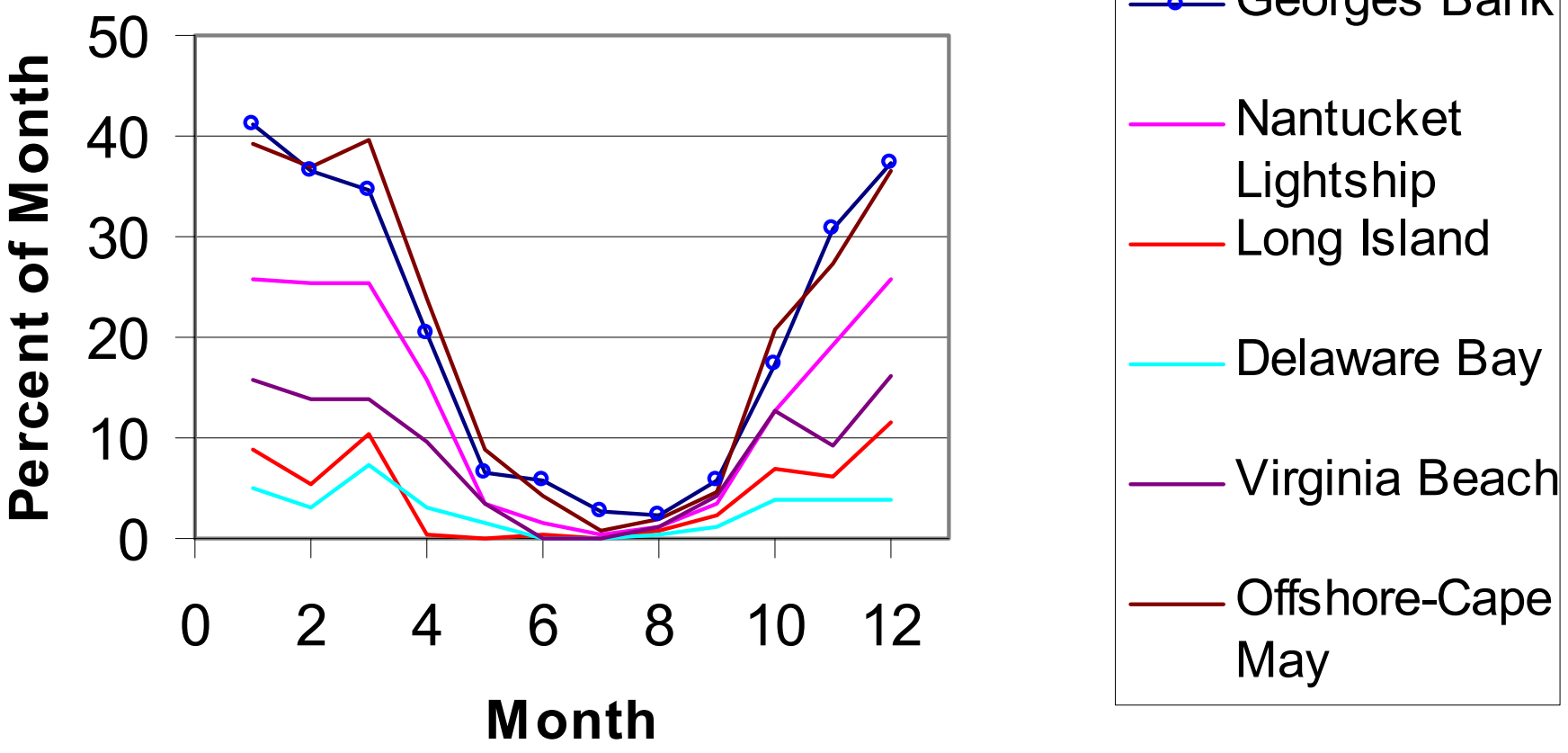


Figure 4.Multibeam bathymetric image of western Browns Bank,western Scotian Shelf.The image shows colour-coded depths and is artificially-shaded from the northwest to enhance the portrayal of morphology.Prominent features include bouldery ridged moraines,fields of sandy bedforms,shelf-edge low stand deltas,and a variety of other subtle terrain types.The bank is largely formed of glacial materials,reworked and modified by a transgressing sea in post glacial time.Both glacial (relict)and modern (present day)seabed features occur adjacent to one another.

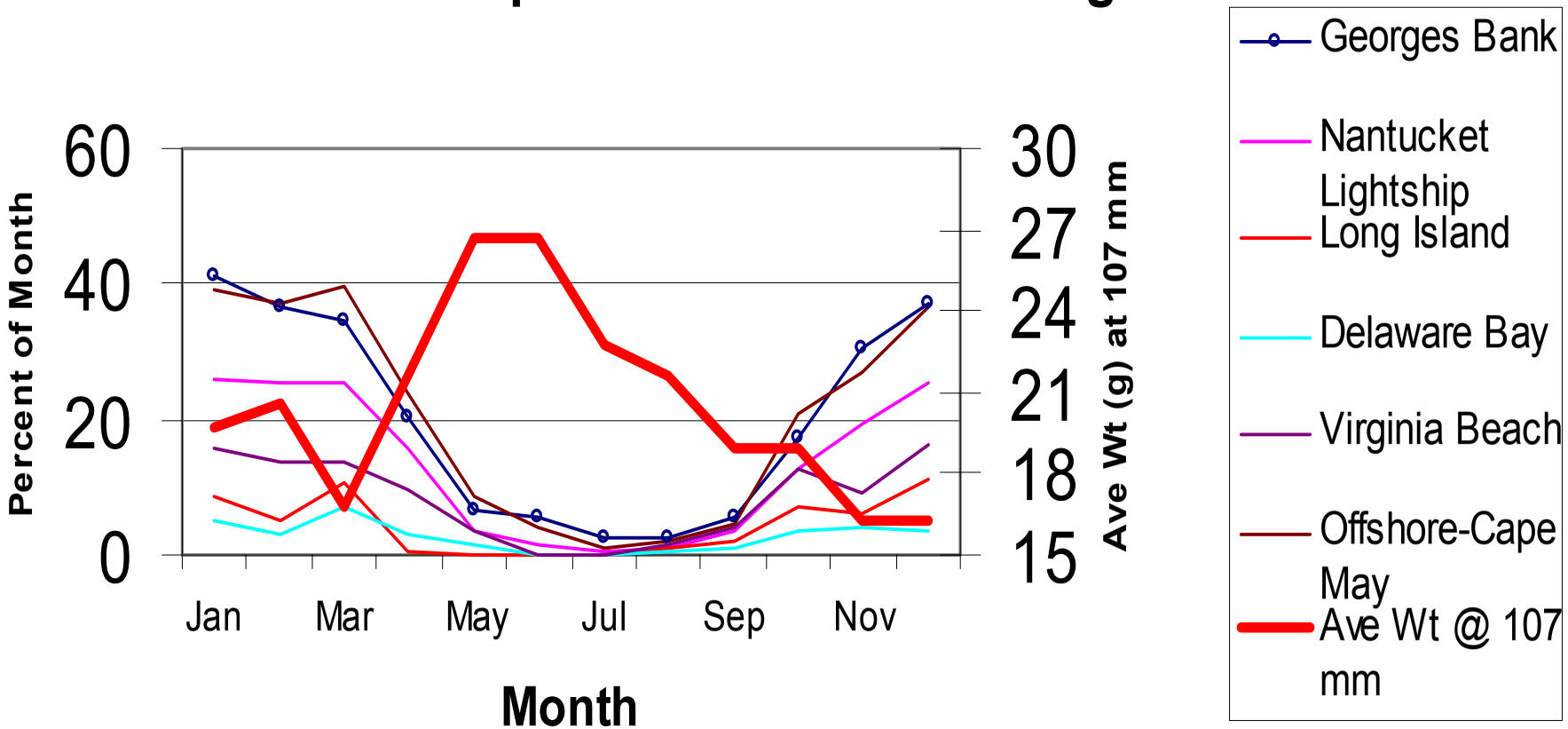
Seasonal Average Weights for Scallops (1987-1988)
Serchuk and Smolowitz (1988)



Fraction of time that Wave Height exceeds 2.5 meters By Station



Comparison of Seasonal Patterns in Wave Height (percent observations >2.5 m) and Ave Wt (g) of Scallops at 107 mm Shell Height



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