The preliminary data presented in the following PDF is not to be used without the author's consent.

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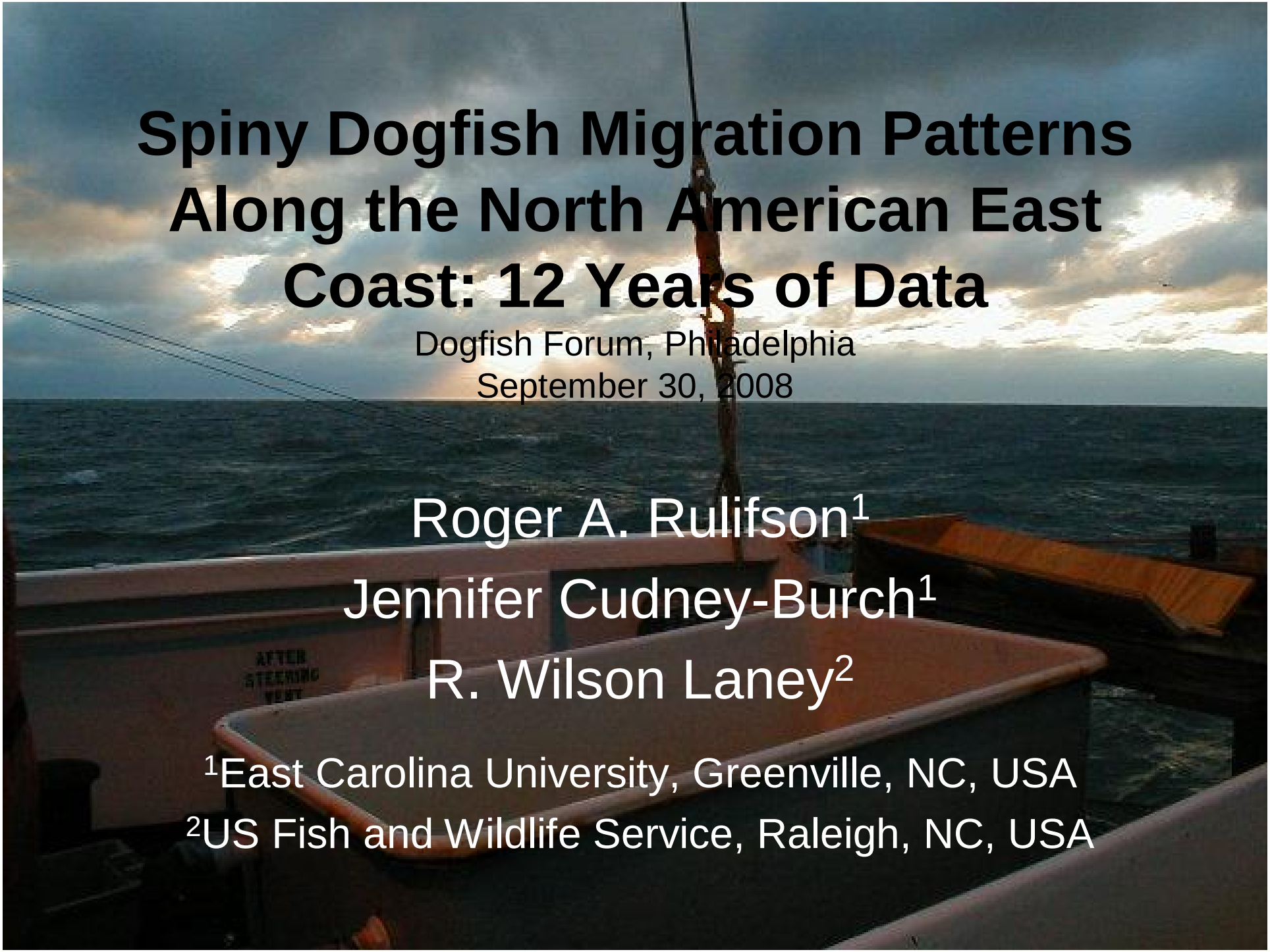

Spiny Dogfish Migration Patterns Along the North American East Coast: 12 Years of Data

Dogfish Forum, Philadelphia
September 30, 2008

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Jennifer Cudney-Burch[1]

R. Wilson Laney[2]

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Language	Names
English	SPINY DOGFISH
	DOGFISH
	SHARK
	GREYFISH
	NORTHERN SHARK
French	AIGUILLAT COMMUN
	AIGUILLAT
	REQUIN ÉPINEUX
	REQUIN
Spanish	GALLUDO
	MIELGA
Scientific names	***SQUALIDAE***
	Squalus acanthias

Outline

- Background of the spiny dogfish problem
- Objective of the studies
- Databases available
- Results
- Where do we go from here?

Background of the Problem

- Increased regulation of high-profile/desired species
- Encourage use of underutilized species
- Concern about level of sustained use by commercial fishermen
- Too late!
- Rebuilding faster than anticipated but no recruits
- Little known about life history patterns on East Coast.

Spiny Dogfish Research at East Carolina University

- 1996 – 2008
- Variety of Research Projects
  - Fishermen – Academic collaborations
  - U.S. Fish & Wildlife Service Cooperative Winter Tagging Cruise
- 38,000+ fish tagged since 1996

East Coast Migration Patterns of the Spiny Dogfish

Methods

Single barb dart tags

- Address
- Reward Information
- Website
- ***www.spinydogfish.org***

Research Website: www.spinydogfish.org

Tag Return Form

DOGFISH MIGRATION AND POPULATION ESTIMATE

Institute for Interdisciplinary Coastal Science and Policy
EAST CAROLINA UNIVERSITY

We are studying the migration patterns of the spiny dogfish along the coast of North America. Any information you provide about a recaptured fish is valuable in helping us understand the dogfish movements, migration patterns and population size. We will happily provide a reward for providing as much of the following information as possible.

TAG NUMBER:_____ **DATE OF CAPTURE:_____**

LOCATION:

Description:_____

_____

_____

WAS THE FISH RERELEASED? _____Yes _____No

Coordinates: Latitude and Longitude:_____

OR Loran TD-X: _____ Loran TD-Y:_____ Chain:_____

Tag Return Form

CAPTURE METHOD:_____

(gear type, mesh size, etc.)

CONDITIONS:

Depth:_____ Water Temp:_____ Air Temp:_____

Weather Conditions:_____

(cloud cover, precipitation etc.)

OTHER:

Sex:_____ Total Length:_____ Fork Length:_____

Comments:_____

_____

PLEASE ATTACH TAG HERE:

NAME:_____

ADDRESS:_____

_____

Telephone_____**Email**_____

GIS Spatial Analysis

- Incremental (15 & 30 day) Time Series Analysis
- Mean directional movement
- Zonal Statistical Analysis
- Variables of interest
  - Bathymetry
  - Exclusive Economic Zone (EEZ)

Major Questions

- Where are the high intensity recapture areas for the fishery?
- What is the migration extent of dogfish tagged in North Carolina waters?
  - South of Cape Hatteras?
  - Movement into Canadian waters?
  - 100 fathom contour and move onto the continental slope?

Major Questions (continued)

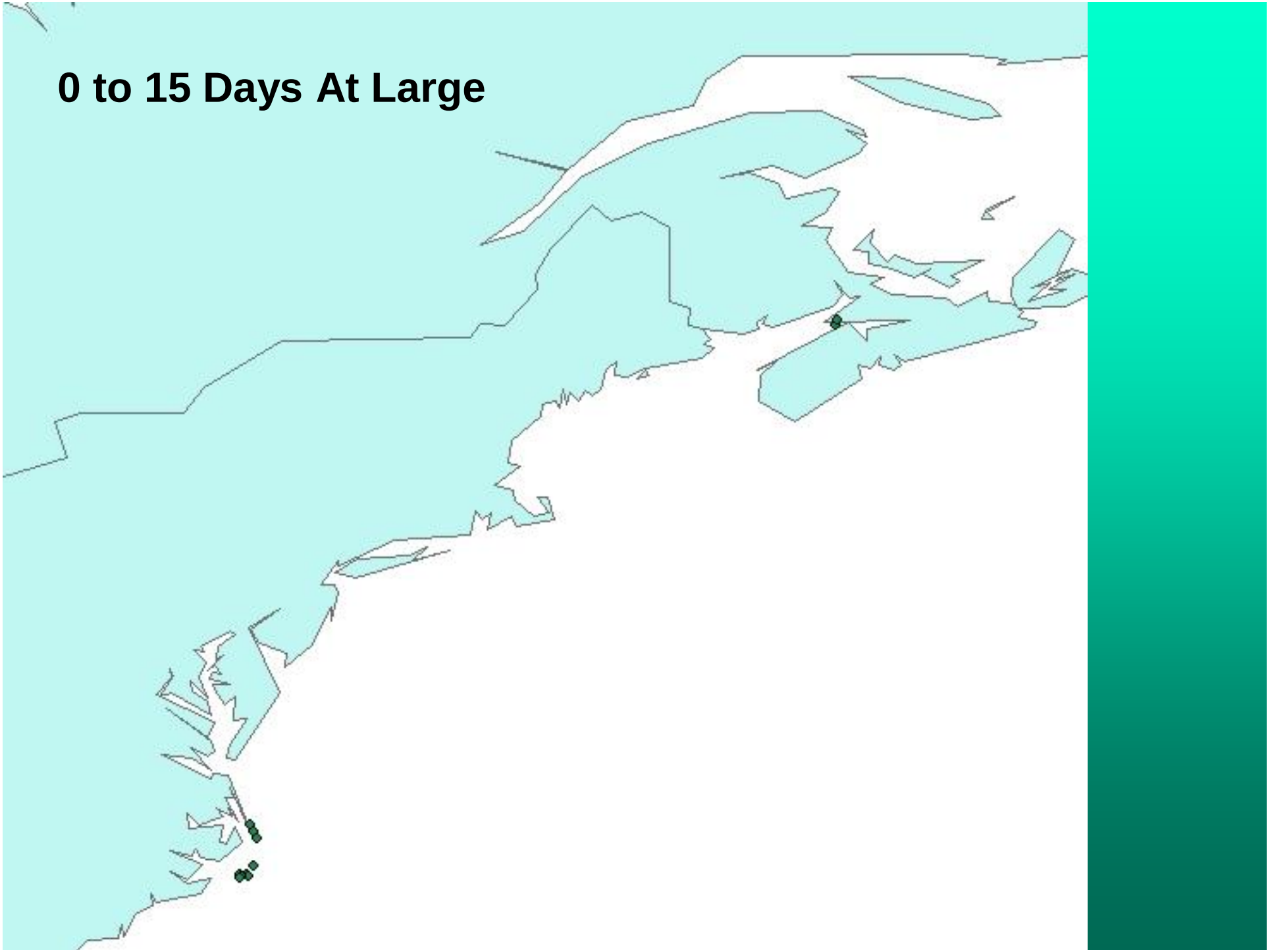
- How long do dogfish stay in the overwinter habitats?

Mark Recapture Study

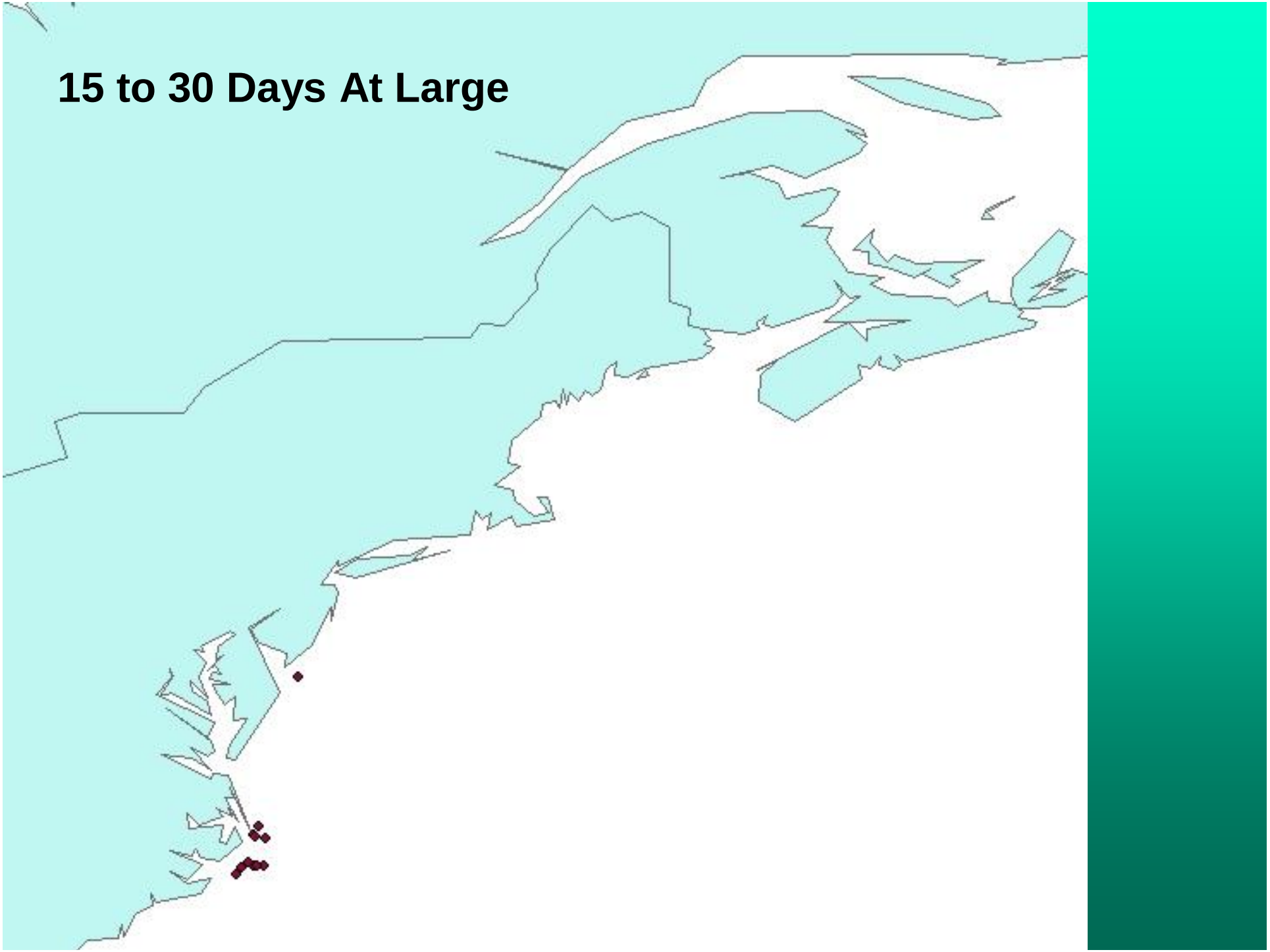
- 38,000+ tagged
- 340 returned (~0.9%)
- Data issues still need to be resolved
  - Some recaptures are on land
- Fishermen may capture and land in different states

Land Location	Release Location		Total
	Canada	USA	
"Canada"	6	1	7
New Brunswick	1	2	3
Prince Edward Island		1	1
Nova Scotia	8	12	20
"New England"		1	1
Maine	1	9	10
New Hampshire		11	11
Massachusetts	3	81	84
Rhode Island		29	29
New York		7	7
New Jersey		33	33
Delaware		1	1
Maryland		3	3
Virginia		21	21
North Carolina		84	84
Not Listed	17	8	25
Total	36	304	340

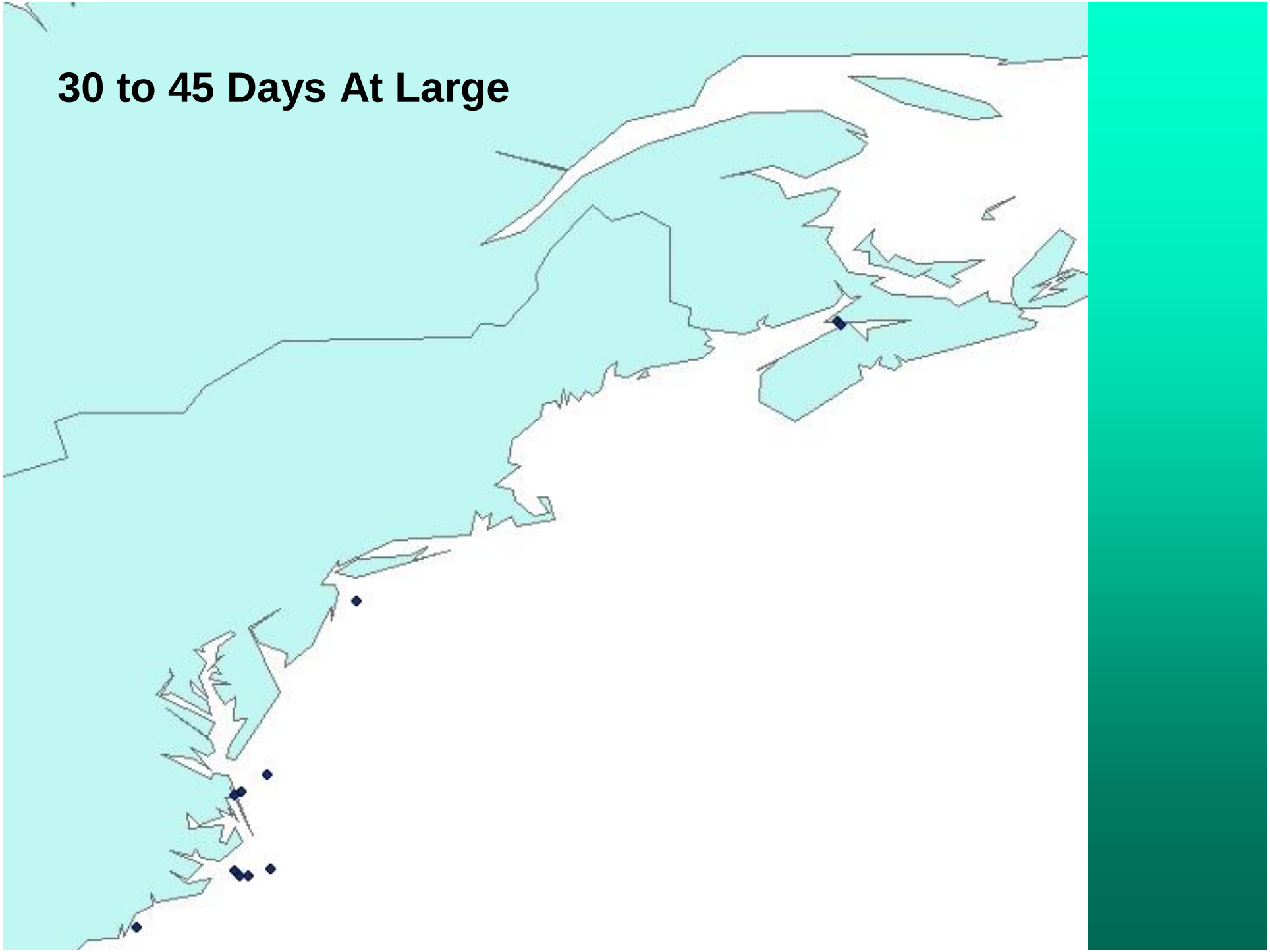
0 to 15 Days At Large



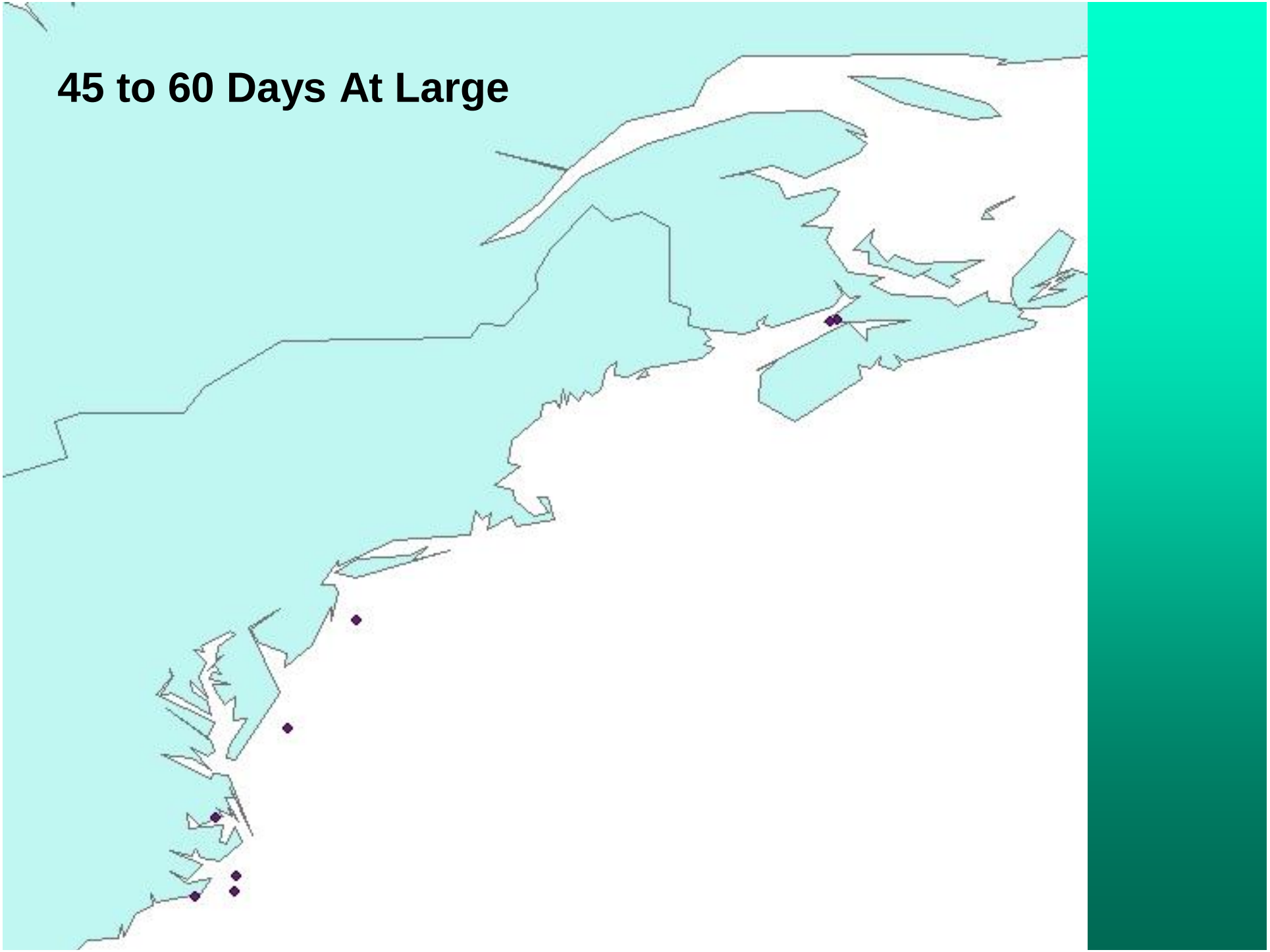
15 to 30 Days At Large



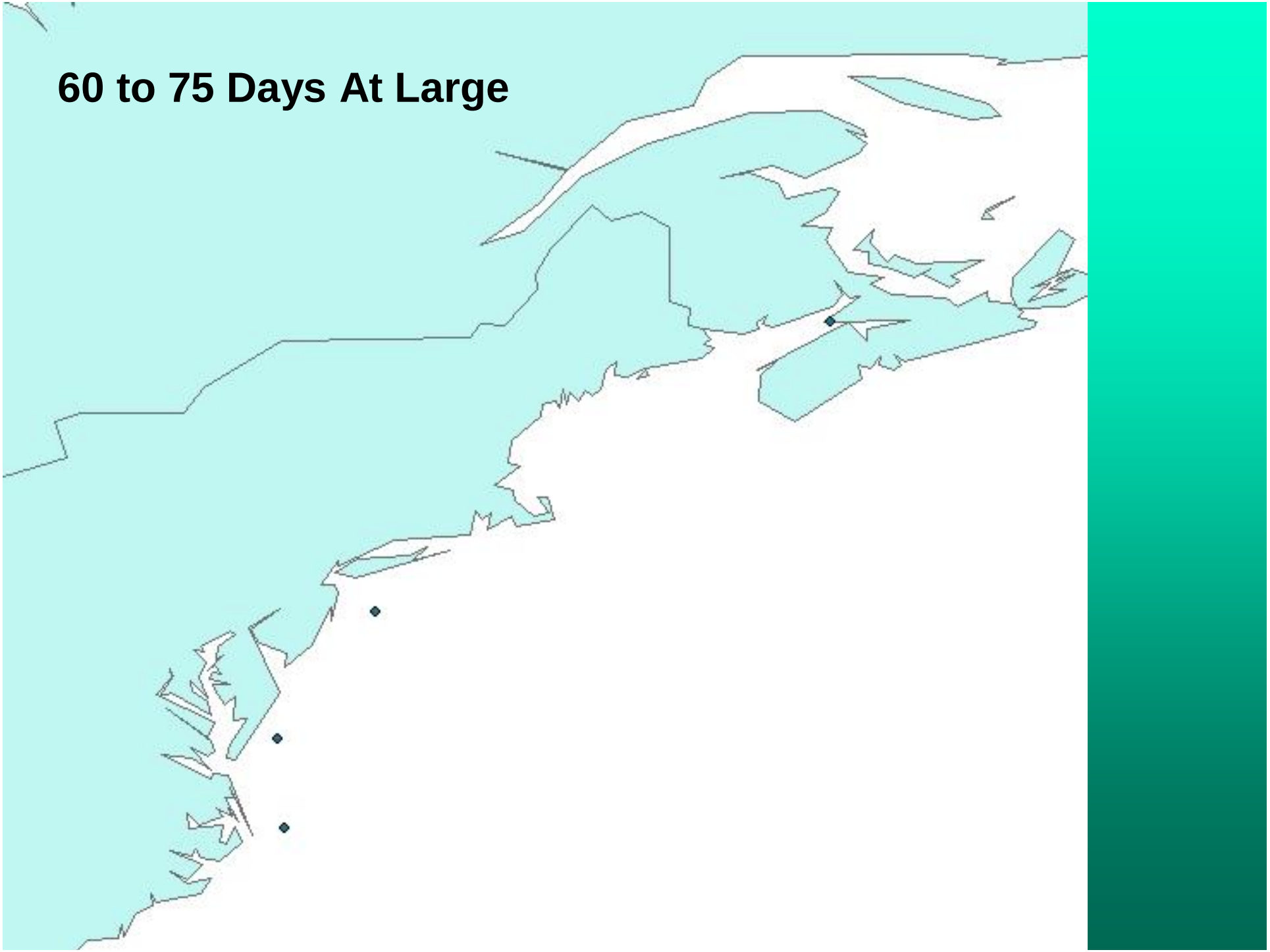
30 to 45 Days At Large



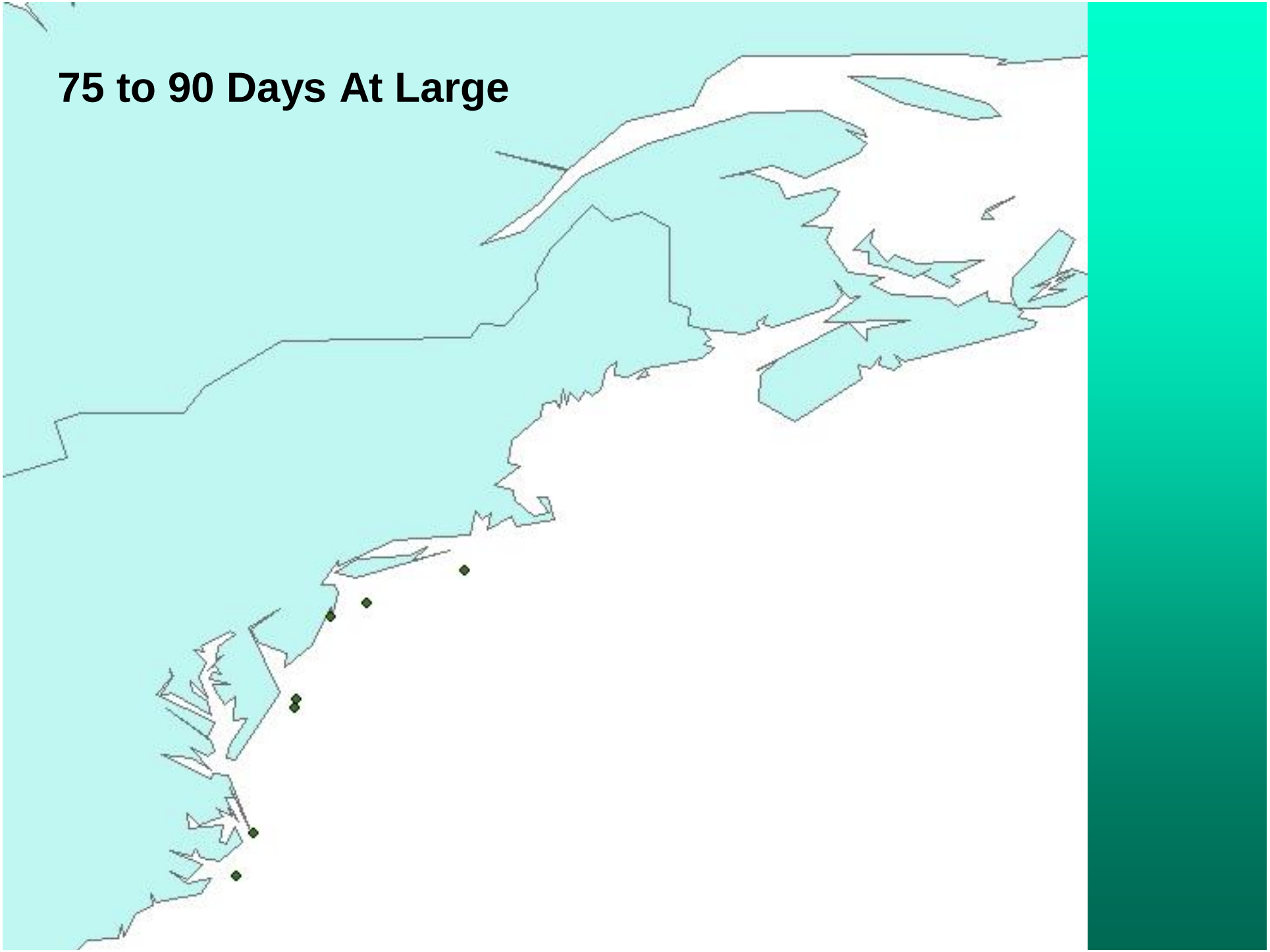
45 to 60 Days At Large



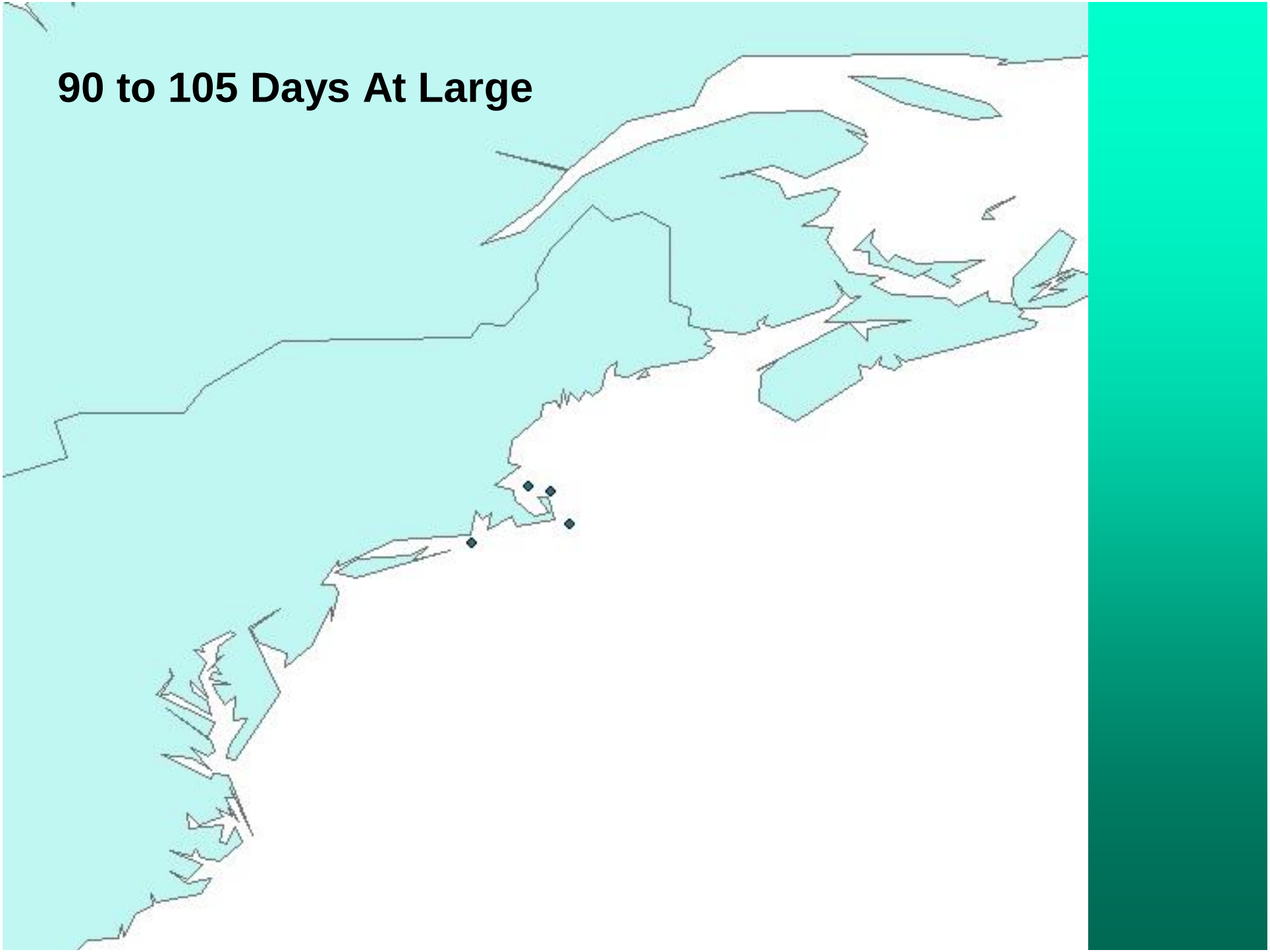
60 to 75 Days At Large



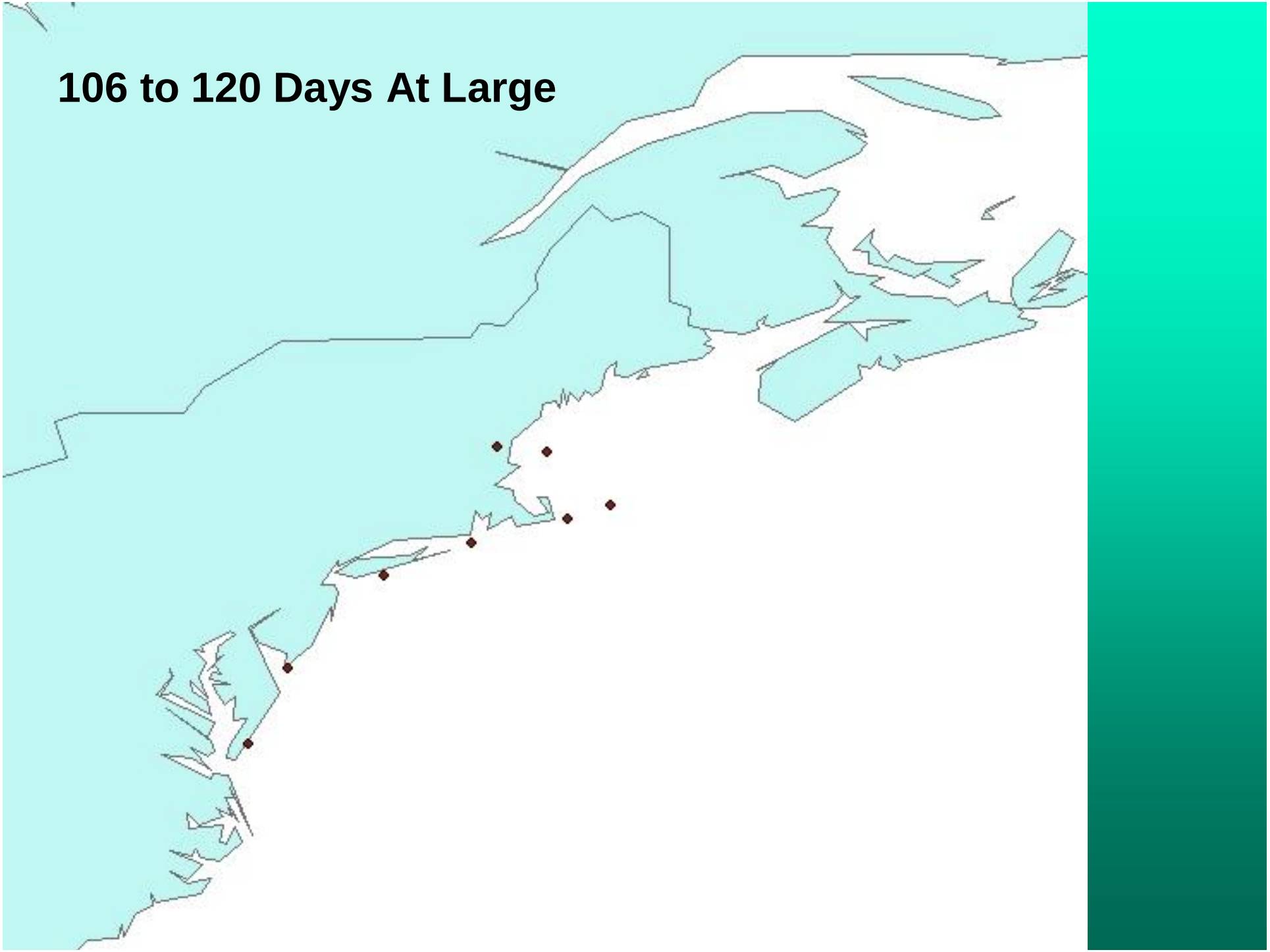
75 to 90 Days At Large



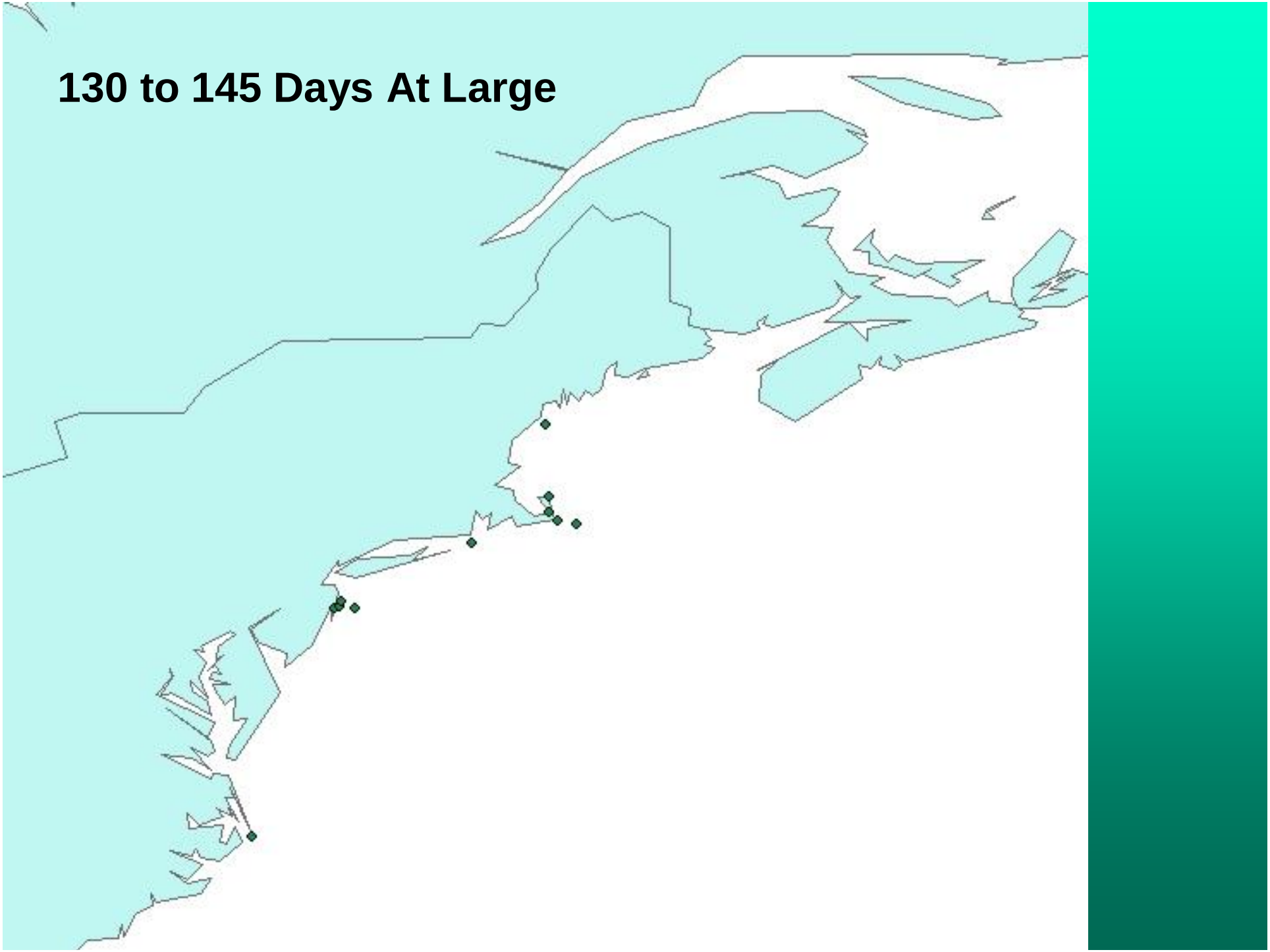
90 to 105 Days At Large



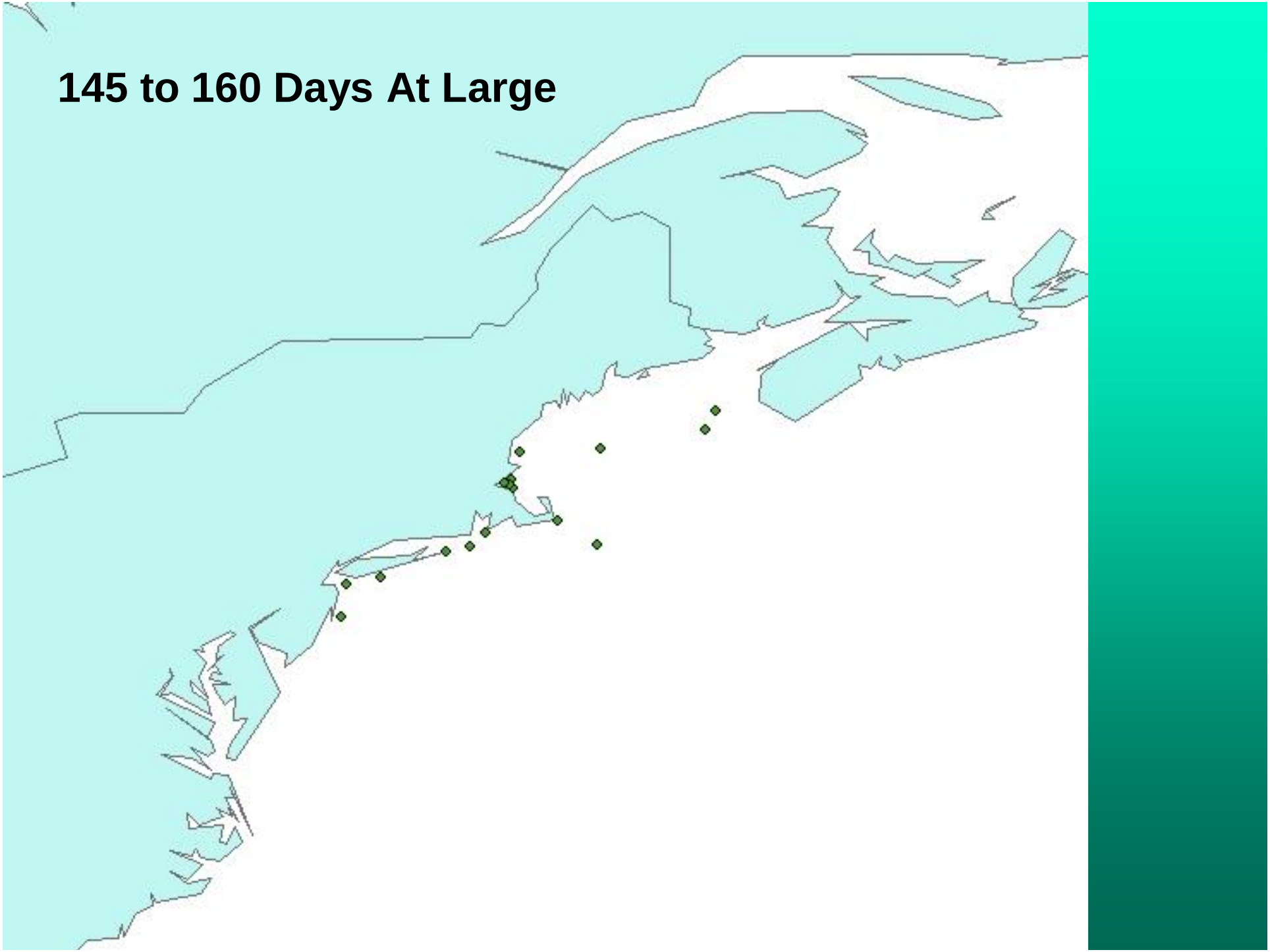
106 to 120 Days At Large



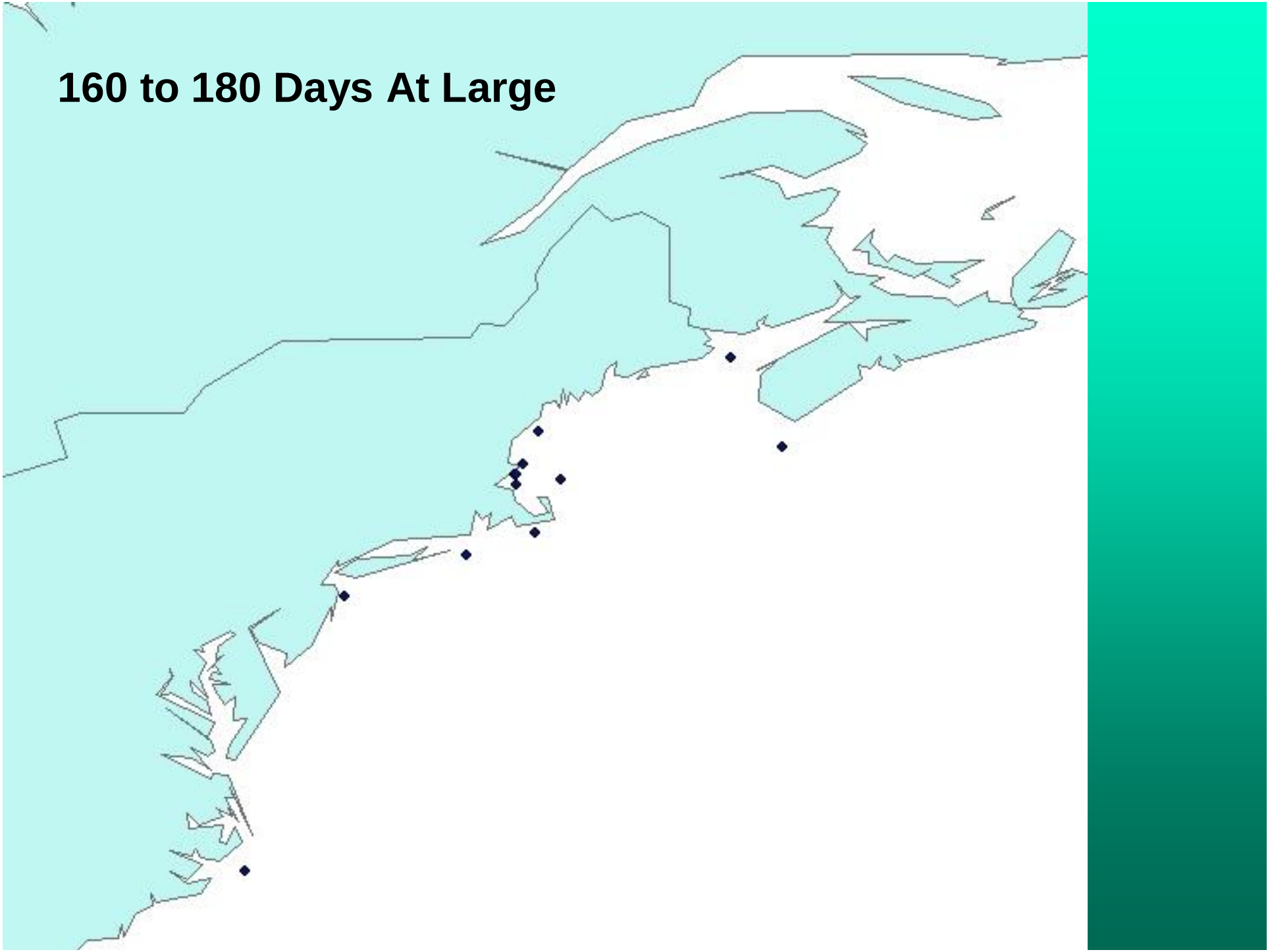
130 to 145 Days At Large



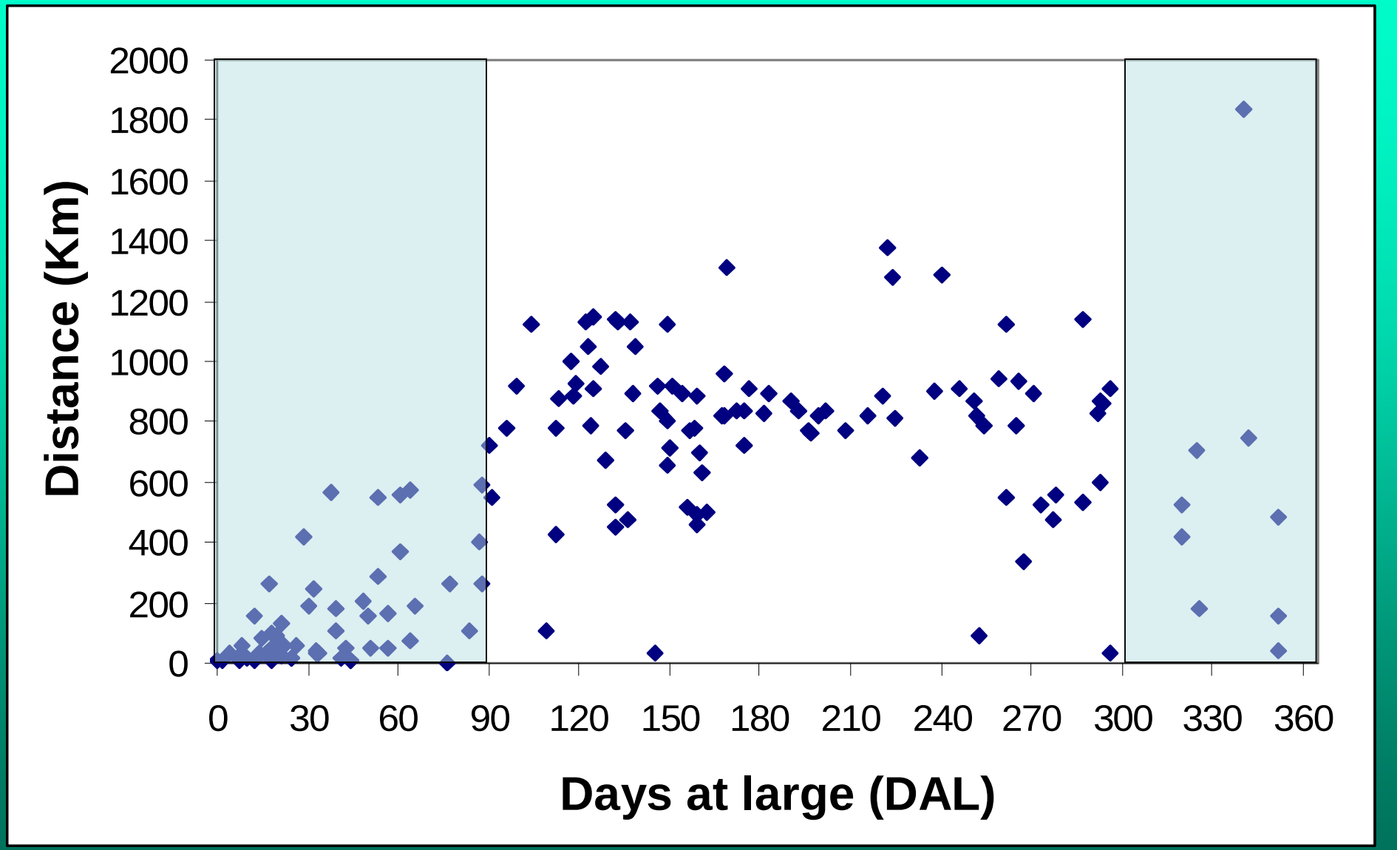
145 to 160 Days At Large



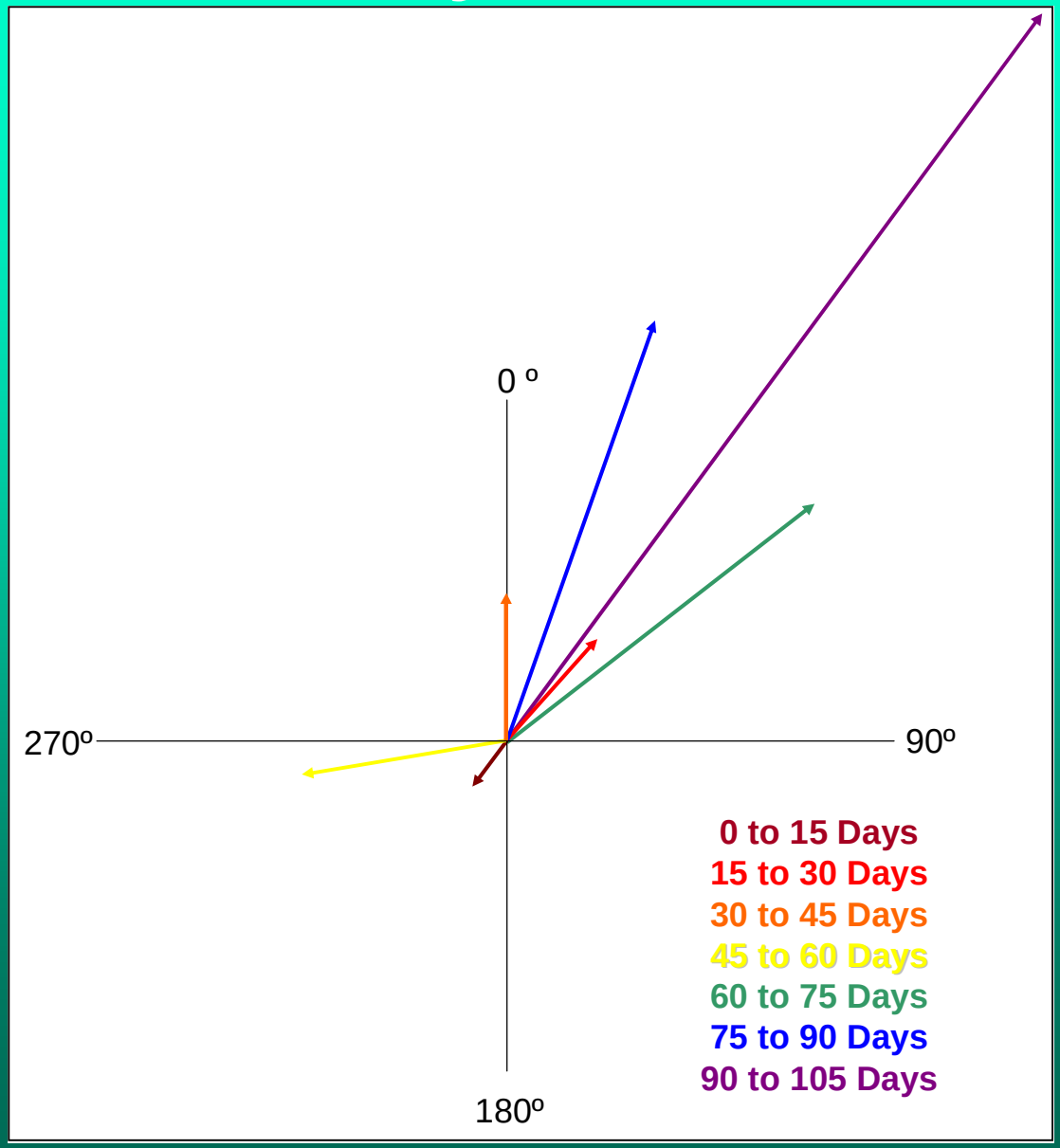
160 to 180 Days At Large



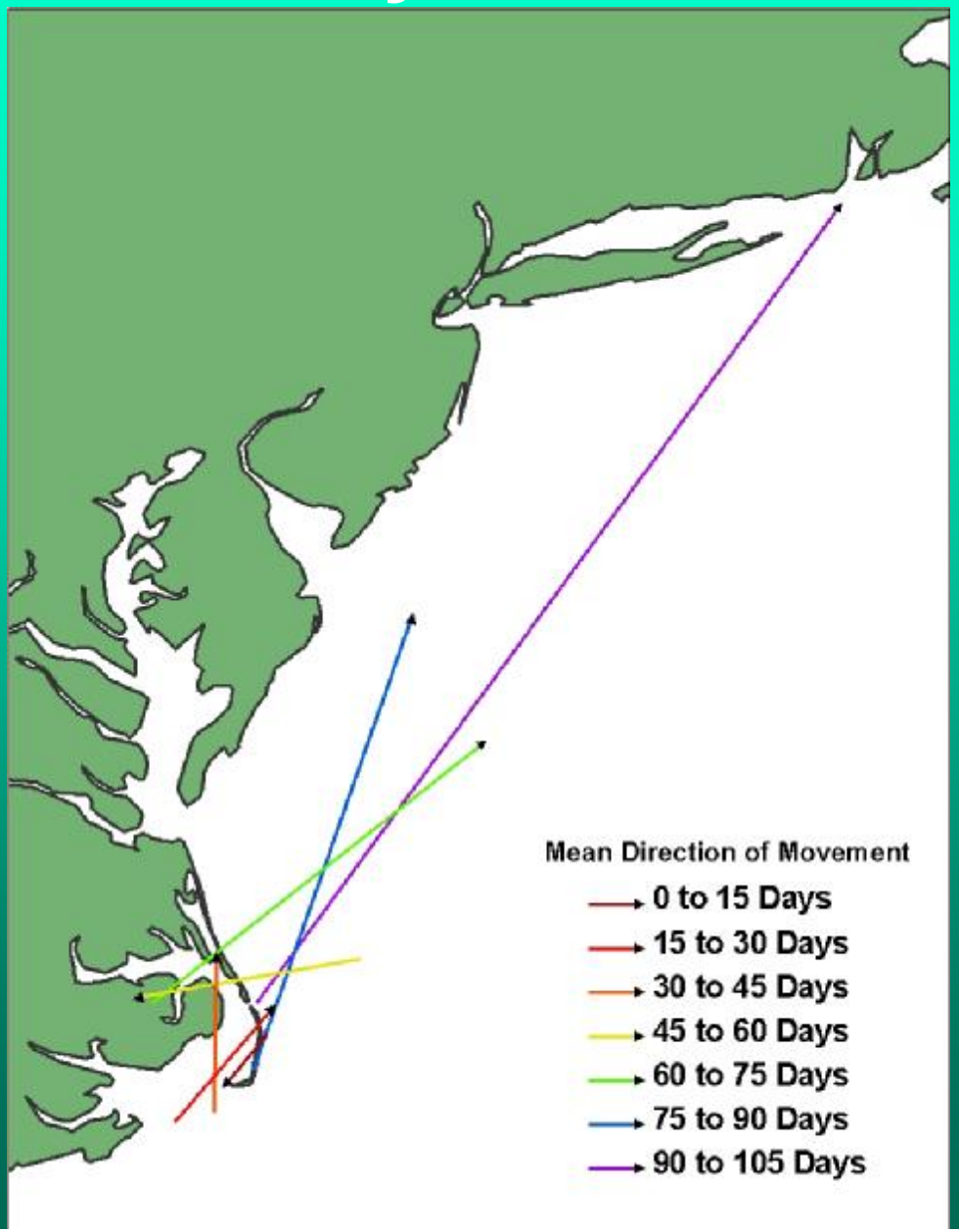
Recaptures 1996 – 2008

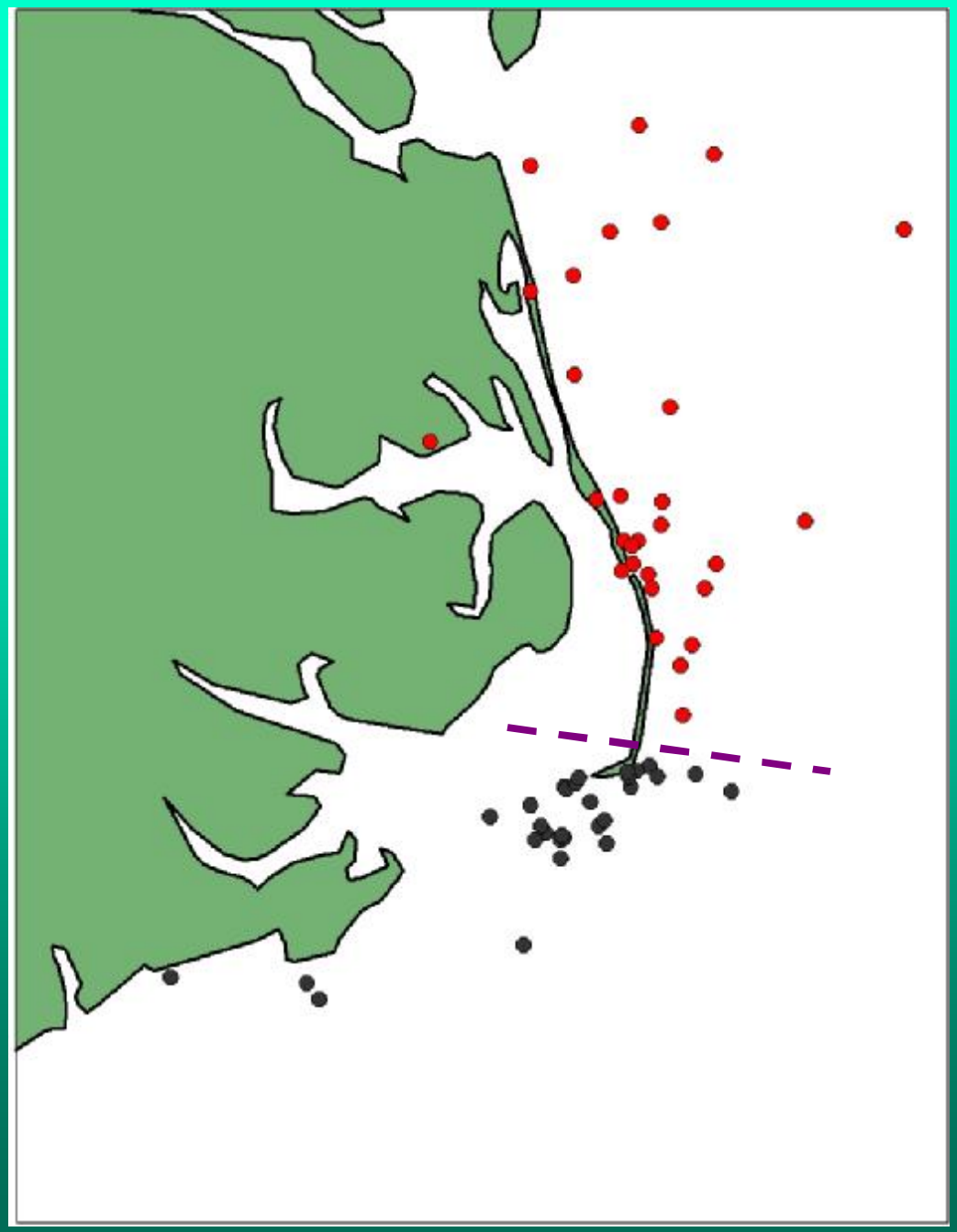


Directionality of Movement



Directionality of Movement

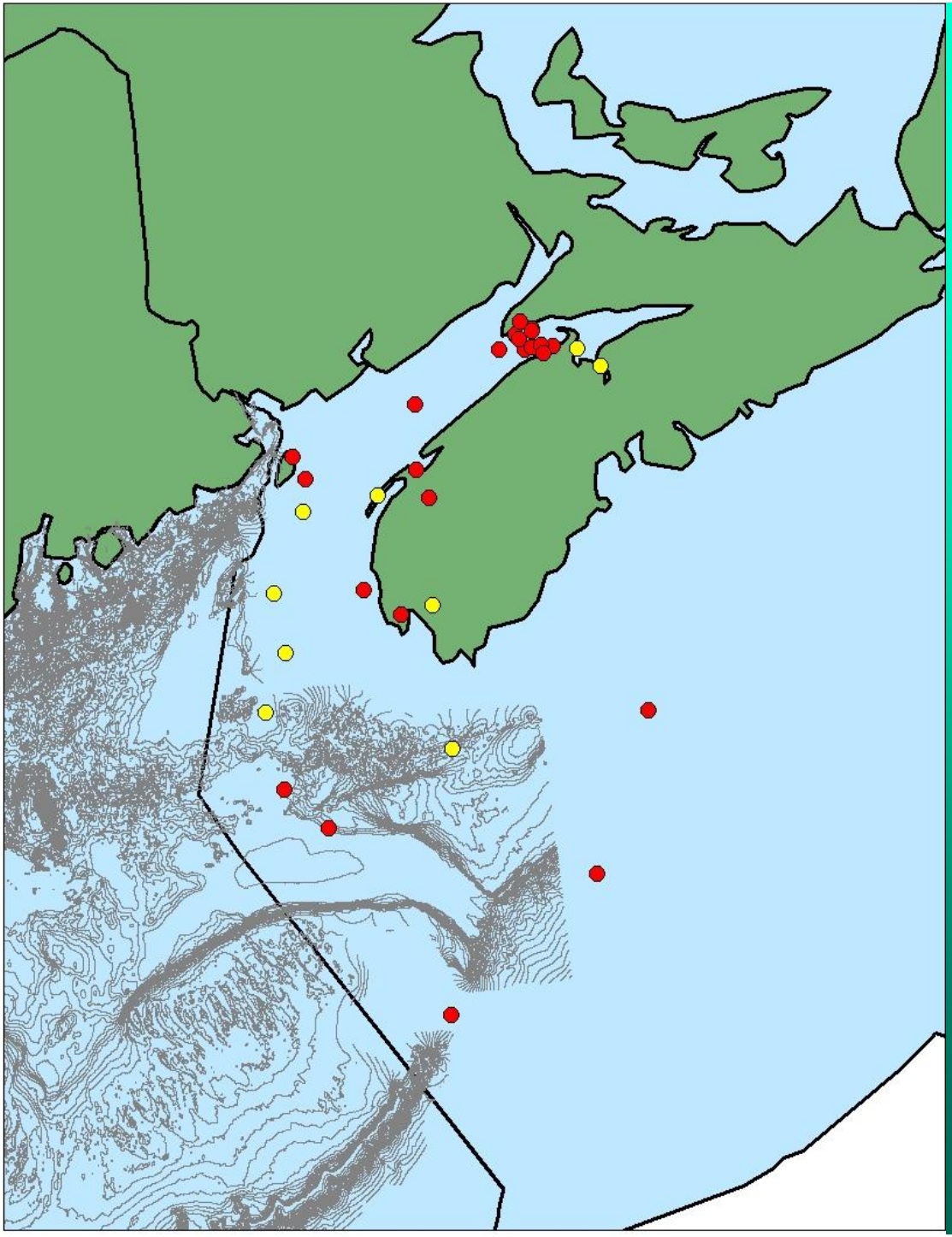




How many move south of Cape Hatteras?

45 of 305 sampled

~13% of all returns

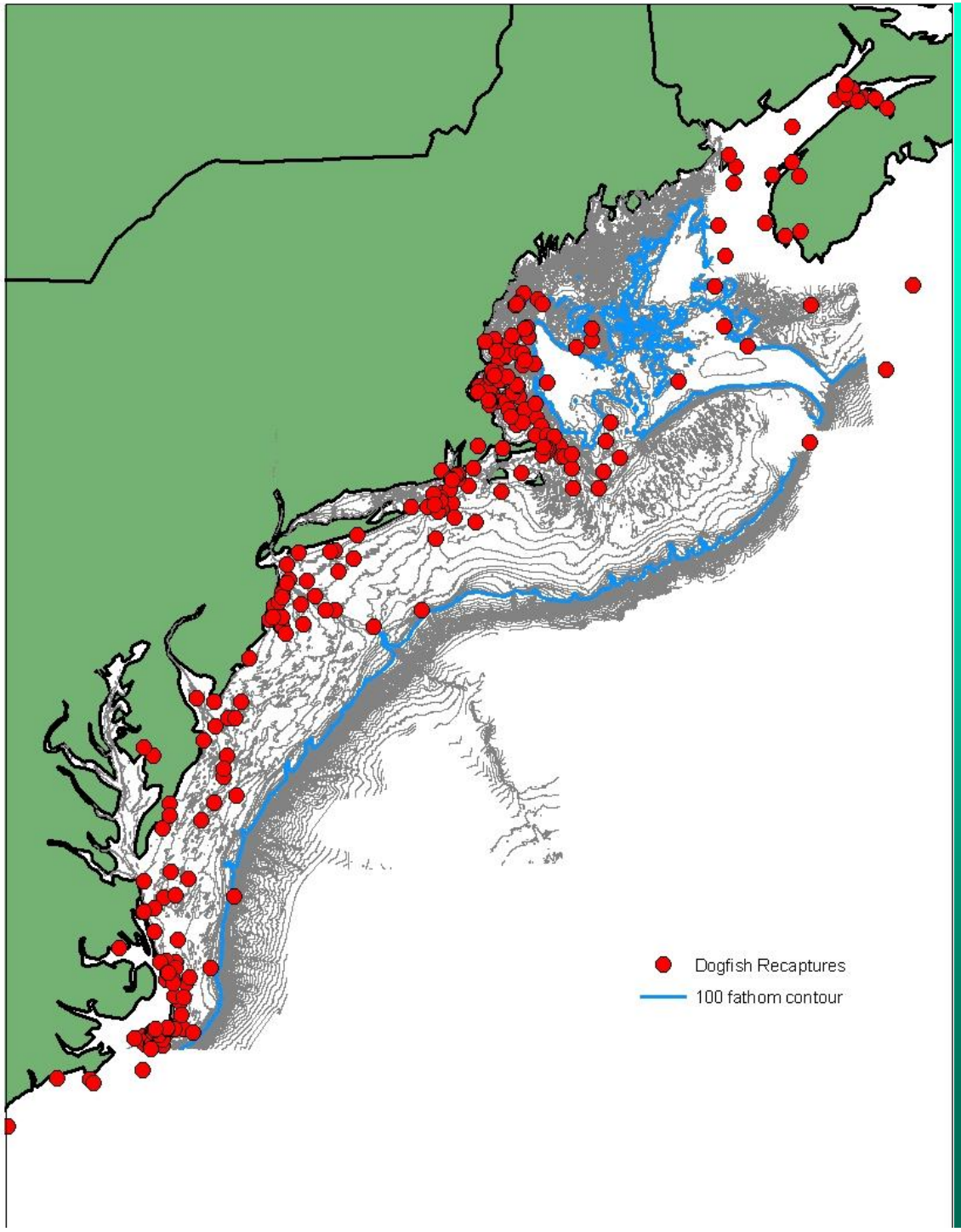


How many move into Canadian Waters?

U.S. Fish Captured in Canada

Canadian Fish Captured in Canada

25 U.S. Fish
(7% of All Recaptures)

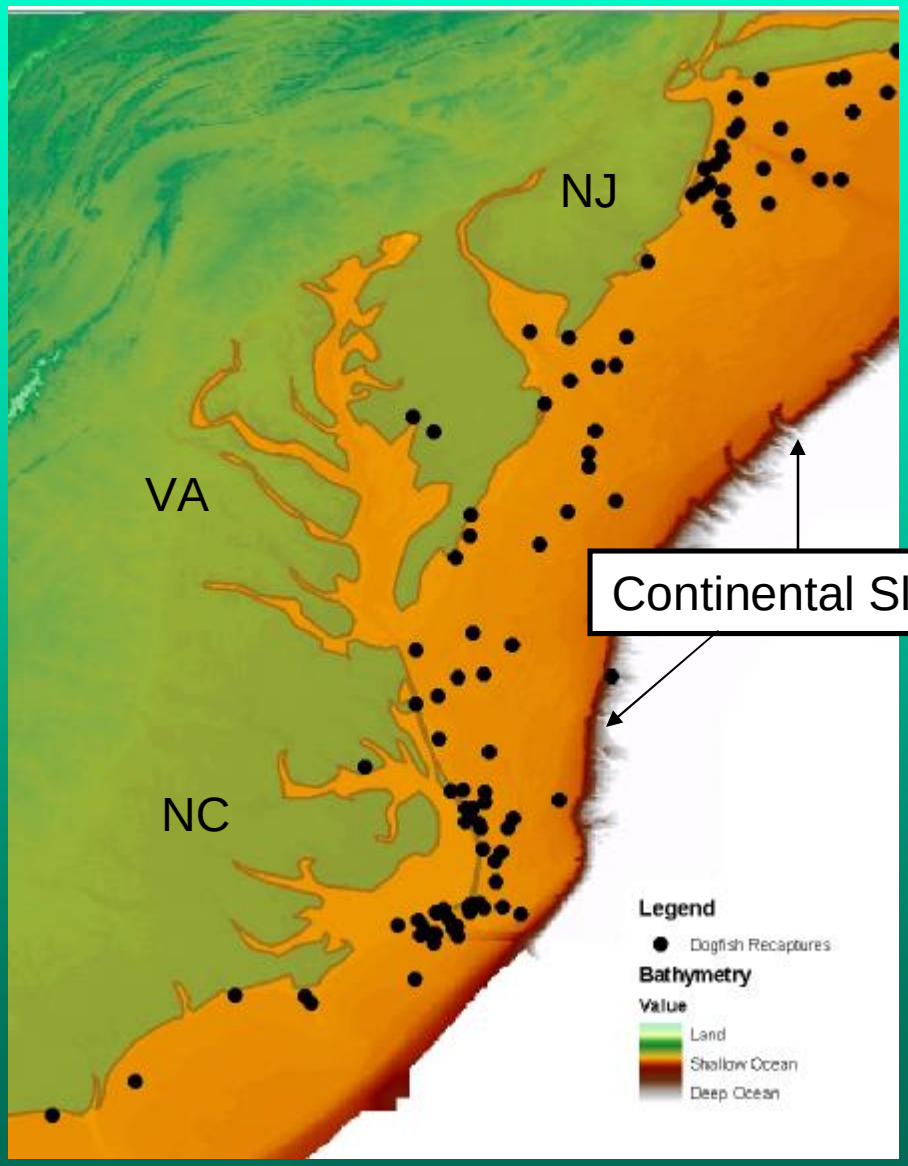


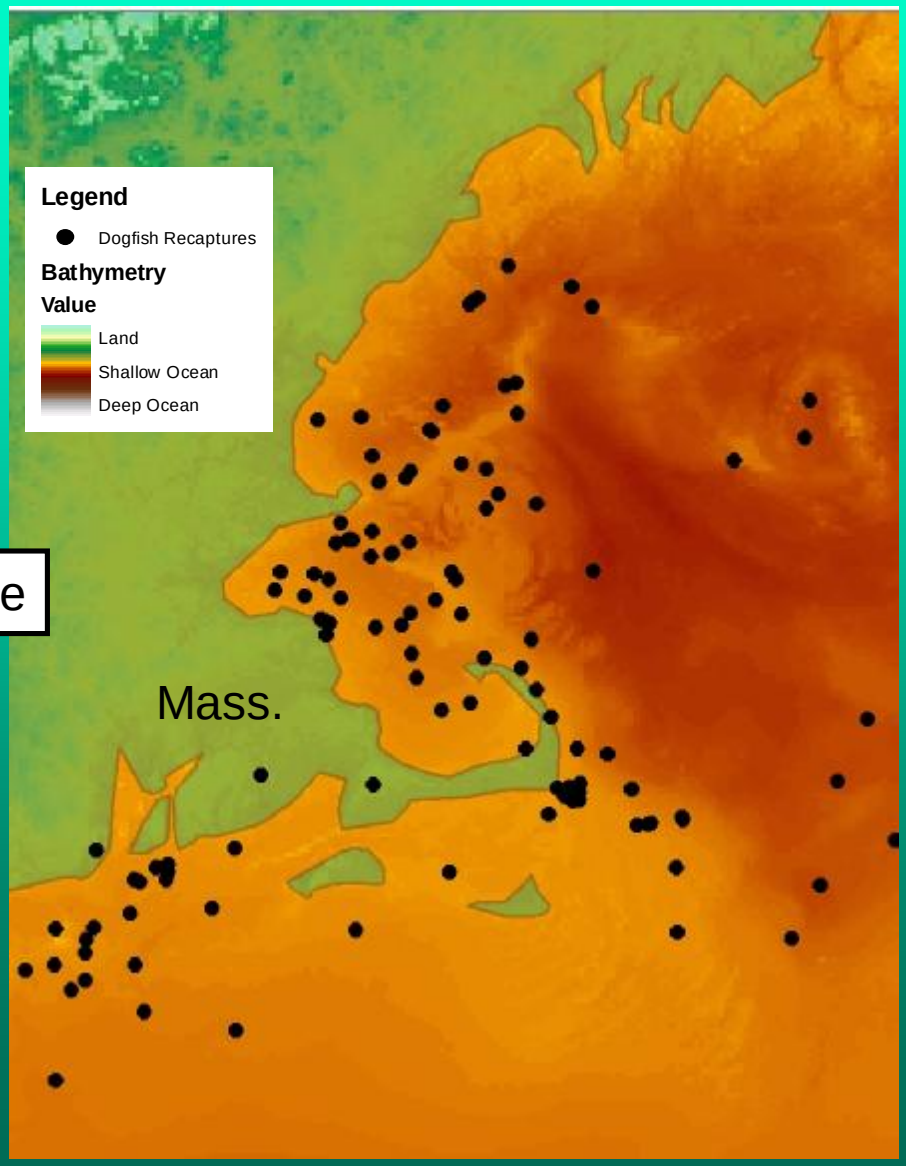
Dogfish cross the 100 fa contour?

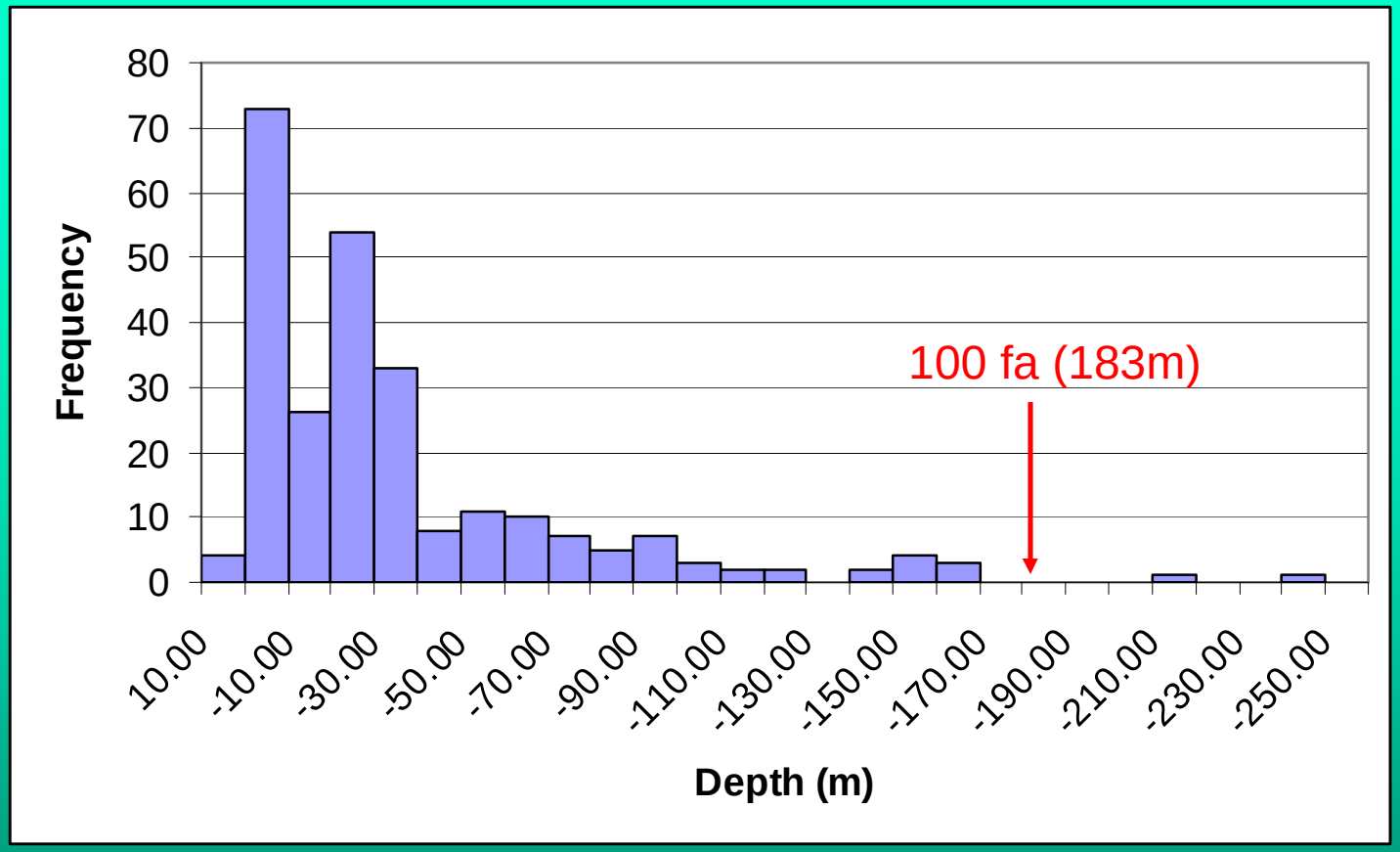
- 3 Tag Returns > 100 fa (183m)

- Biased by where fishermen can go

Zonal Statistics Analysis







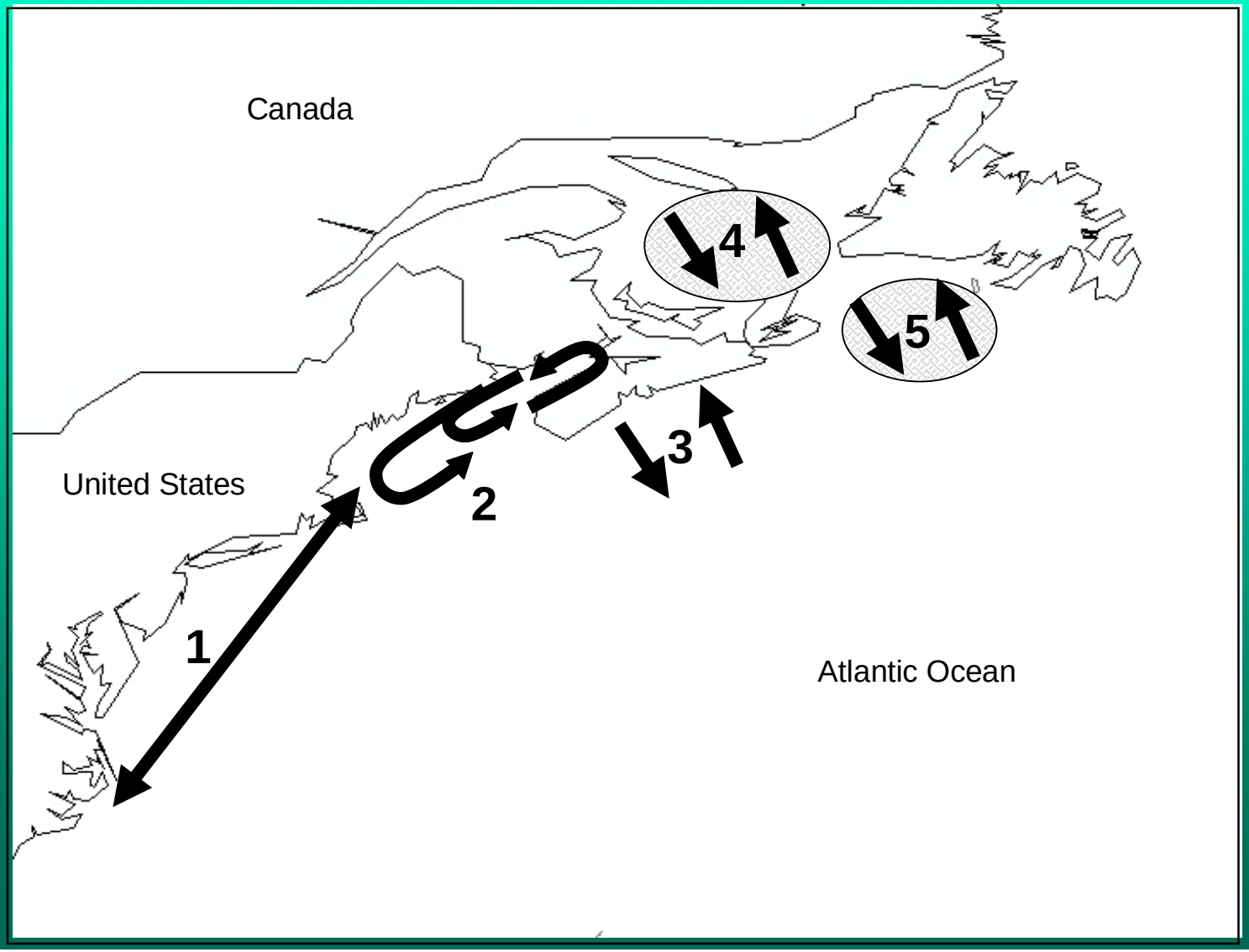
Max Depth of Recapture:	860m
Average Depth of Recapture:	36.9m
28% captured:	10m
53% captured:	25m

Mark Recapture Study

- Limitations:
  - Start and end point only
  - Faulty information
  - Tag holders reluctant to return tags
  - Fishermen are limited in areas they can fish

- U.S. East Coast (Rulifson, unpublished)
  - 38,000 tags
  - 340 returns
- Nova Scotia (Moore, Dadswell, Rulifson 1990s)
  - 1,100 tags
  - 17 returns (1.5%)
- Canadian Maritimes (S. Campana / RAP working paper 2007)
  - Templeman (1950s) – 2,657
  - Jensen (1960s) – 999
  - Shafer (1970) -
  - Myklevoll (1993) - 500
  - Kelly (2005-06) – 743

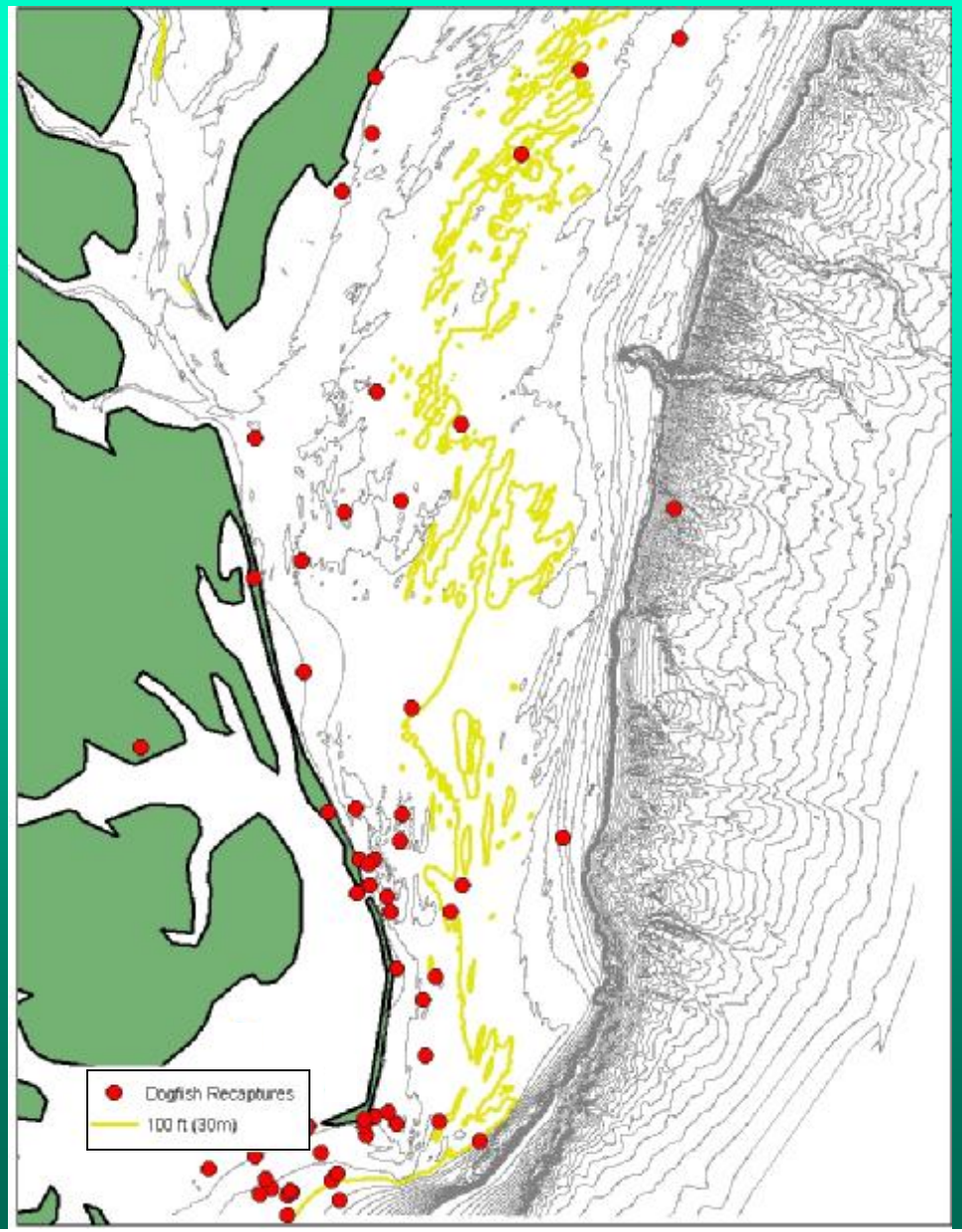
New Hypothesized Paradigm of East Coast Spiny Dogfish Migration



Conclusion

- Tagging data supports some of the mid-Atlantic movement paradigm.
- Mark-recapture data can be used to challenge current sampling efforts in the southern extent of the range.

Are dogfish effectively sampled?



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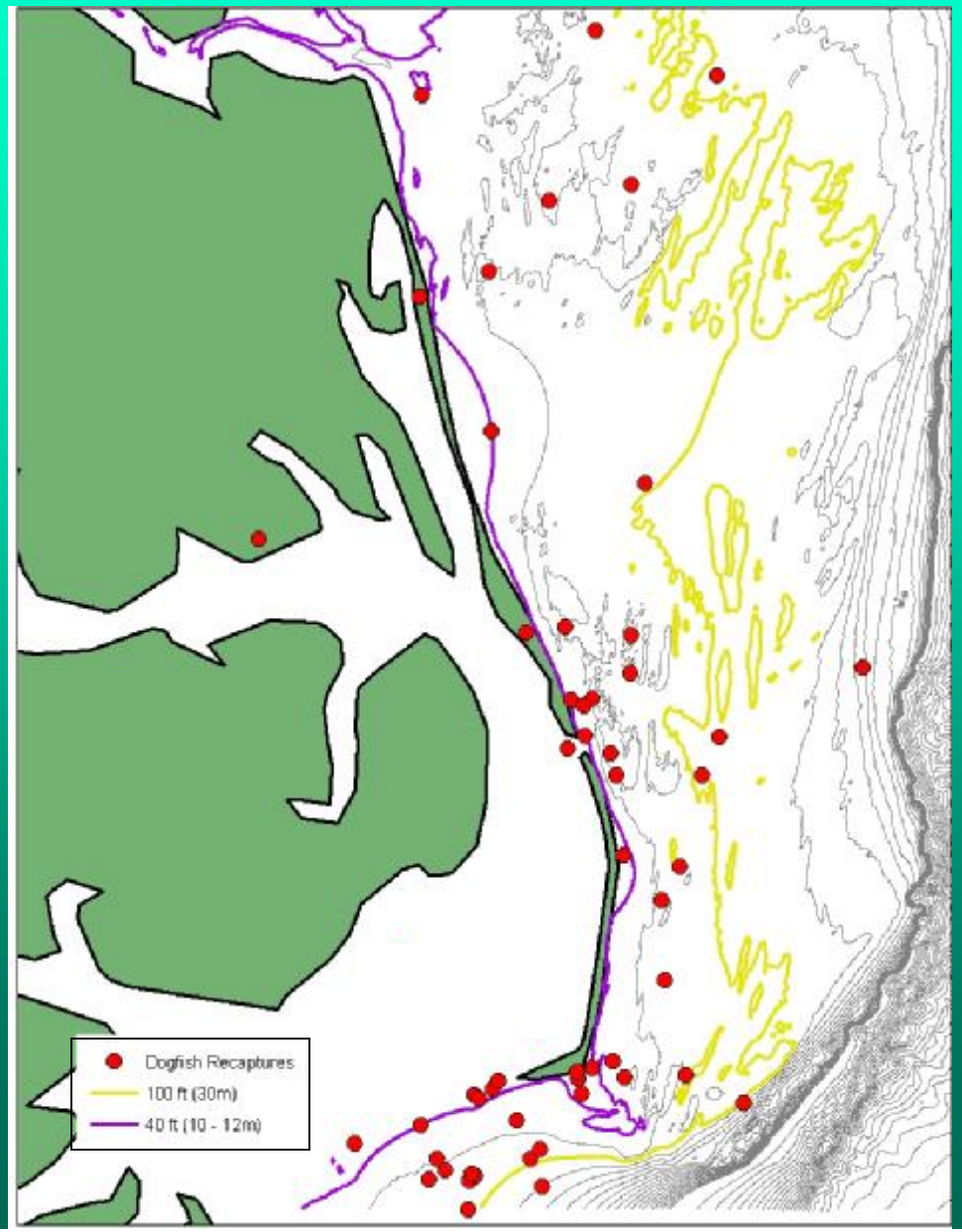
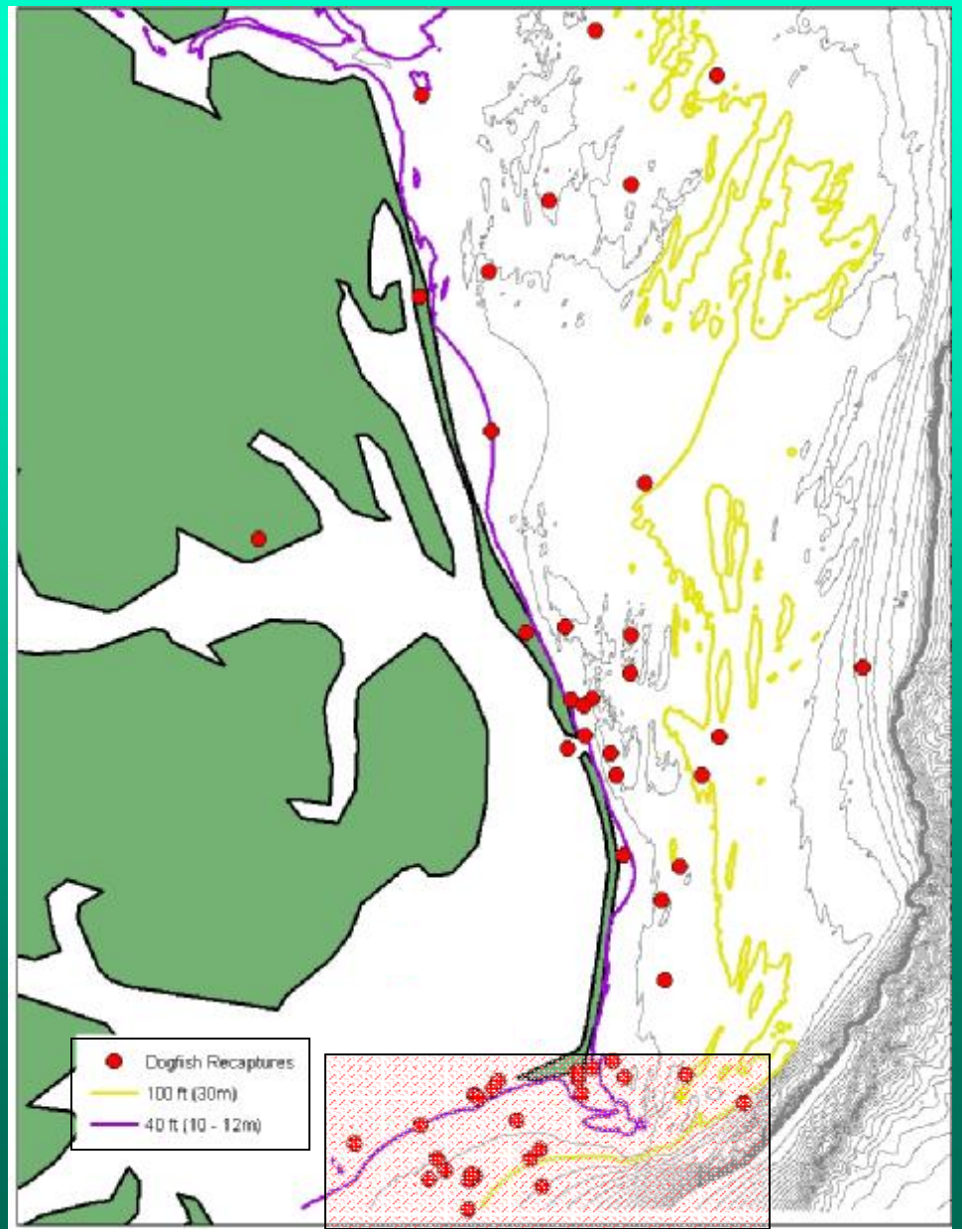


Are dogfish effectively sampled?



Overwintering of Spiny Dogfish in North Carolina: Is Abundance Affecting Other Species?

Questions

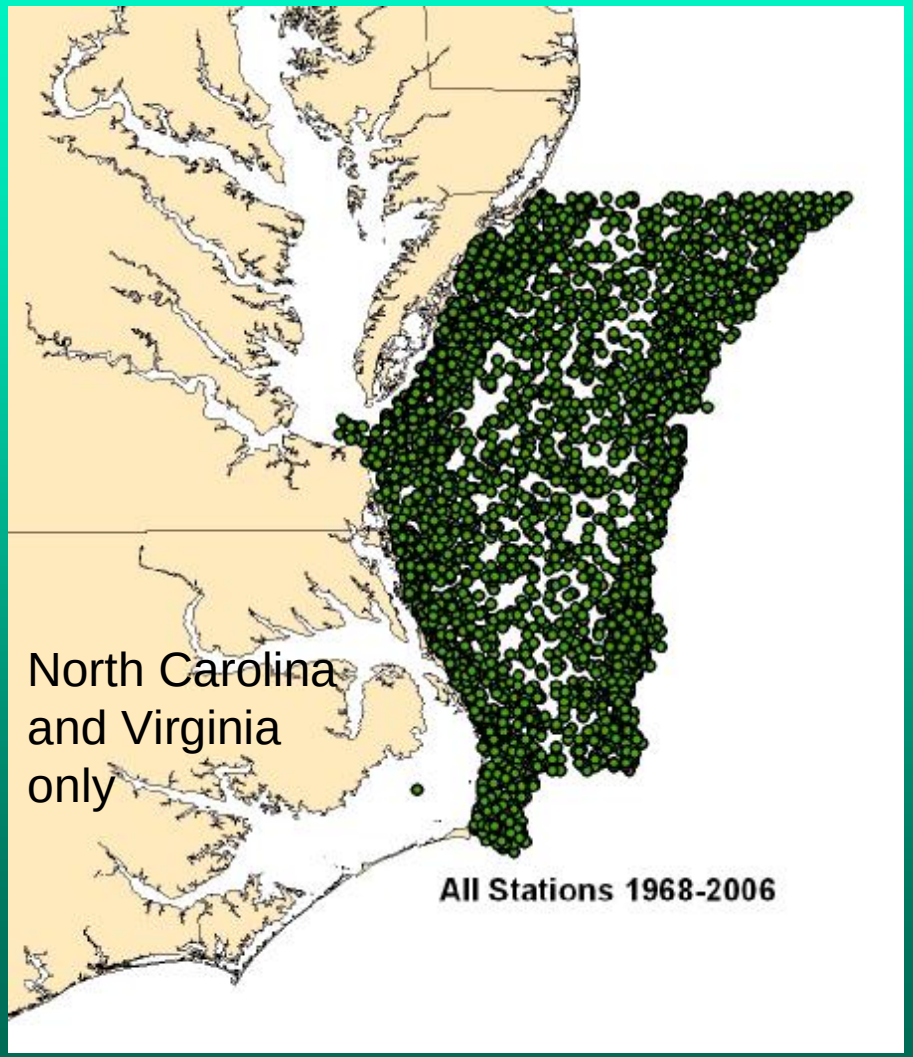
- Are increasing spiny dogfish catches reflected in a corresponding decline in striped bass catches?
- If so, are spiny dogfish driving out the overwintering striped bass from preferred habitats (e.g., shift from preferred environmental variables)?

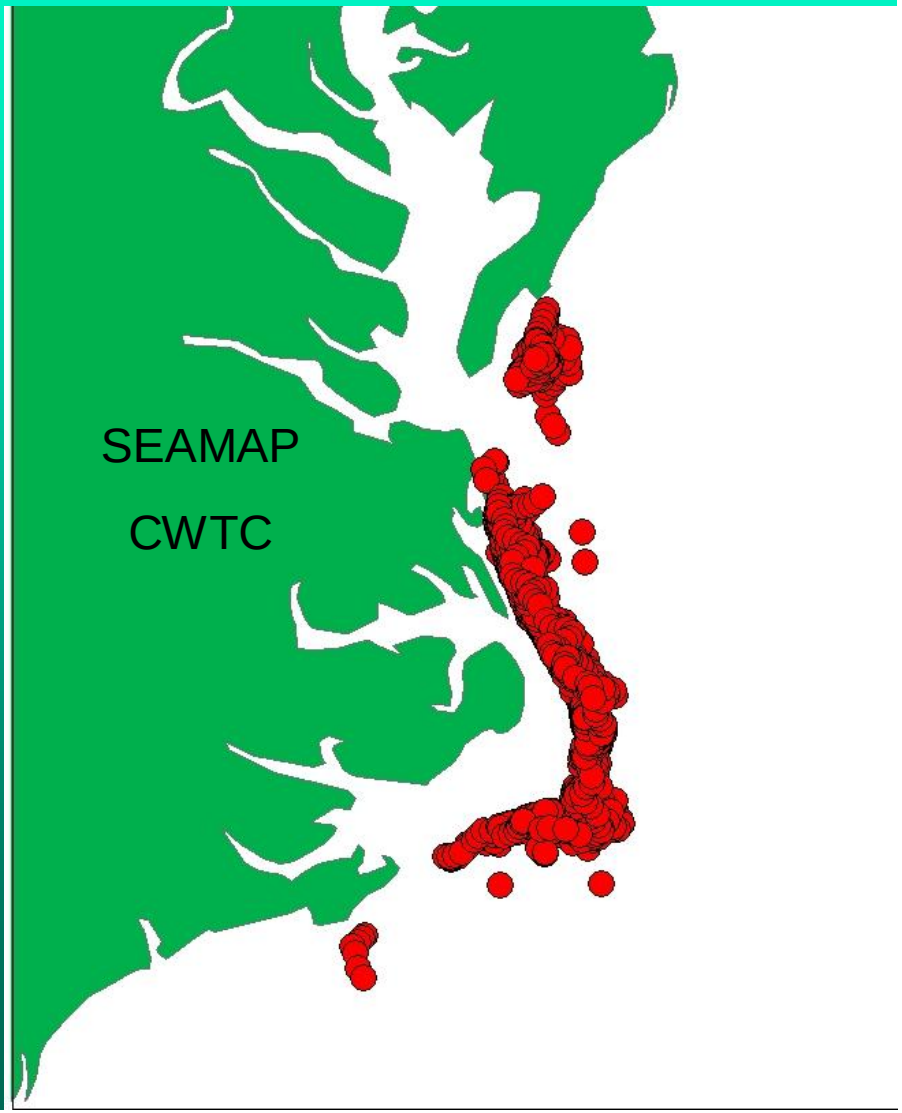
Caveats

- Early years until recent – survey specific to tagging striped bass (not stratified random but more “lookie-here”
- Not all data available for all years (work in progress)
- Monday night – discovered corrupted dataset for environmental variables

Datasets Available

NEFSC Fall and Spring Stations, 1968-2006
SEAMAP Cooperative Winter Tagging Cruises 1996-2008

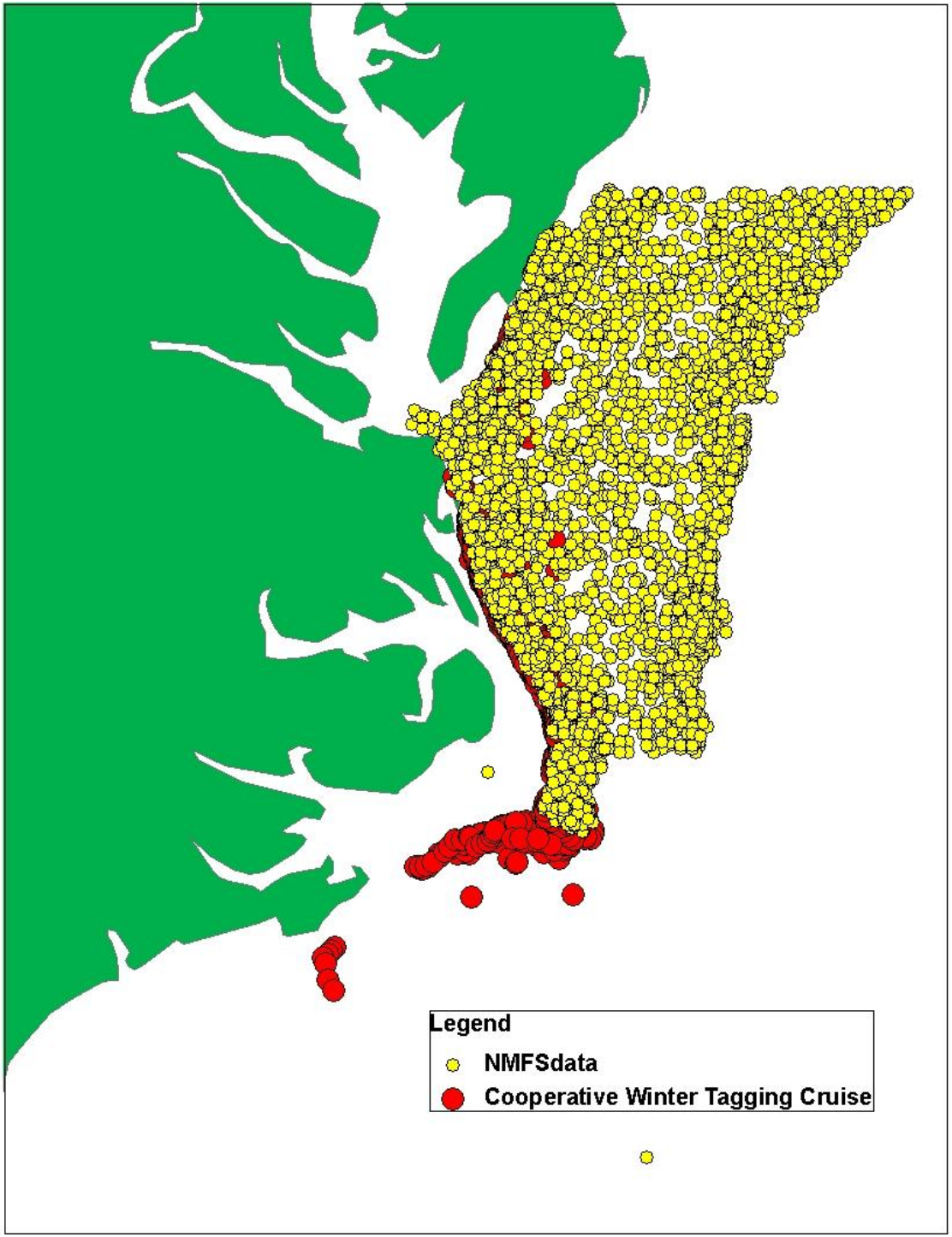




NMFS
1968-2006

CWTC
1996-2008

Period 1 =1997-99
Period 2 = 2006-08



Sampling Platforms

NOAA R/V Oregon II
(Pascagoula, Mississippi)

NOAA R/V Albatross
(NEFSC, Woods Hole,
Massachusetts)

SEAMAP CWTC typically
in later January each year

Trawl

Tailbag

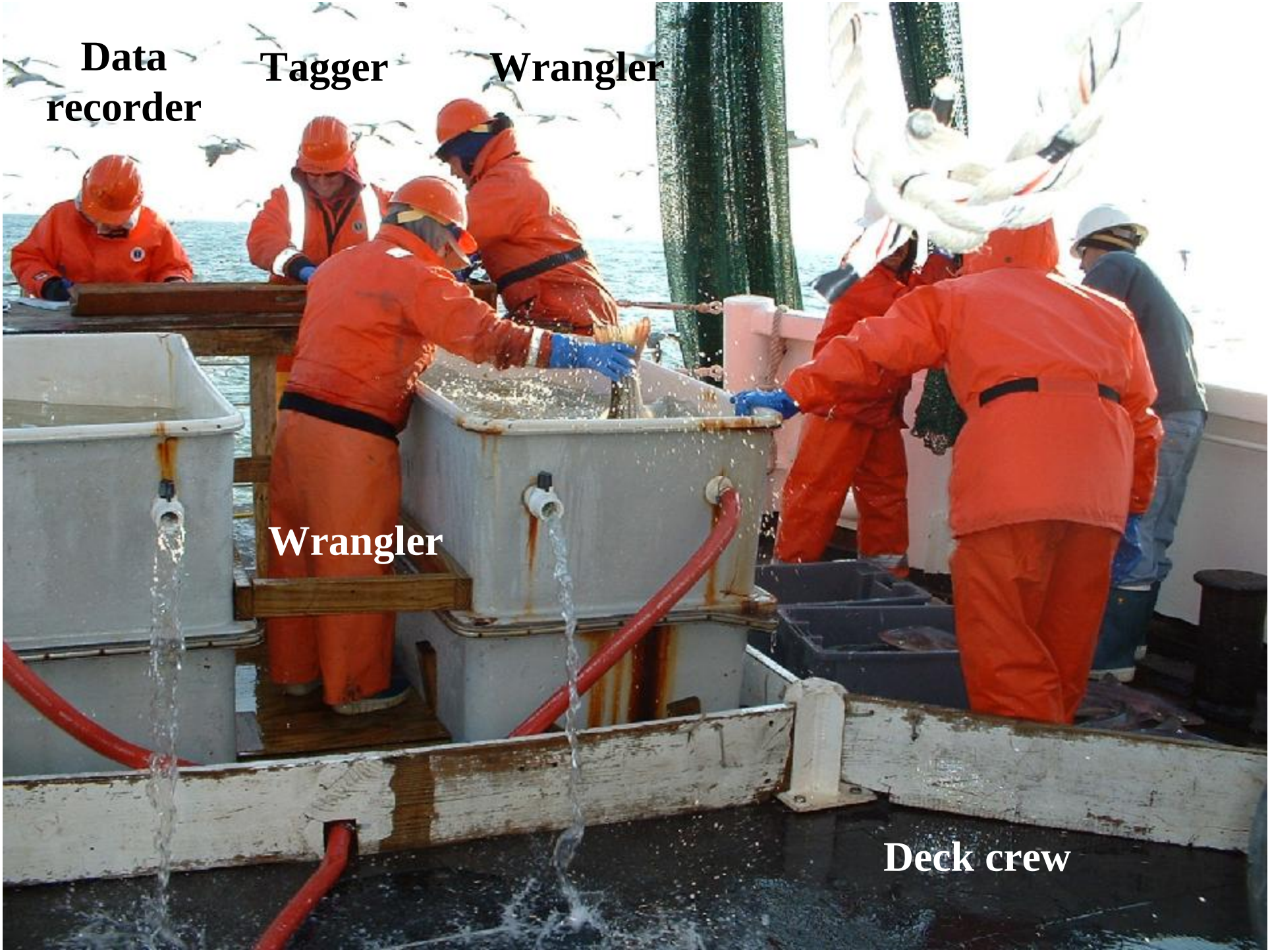
Totes

Thingies to tie the boat up to the dock with

Seagulls

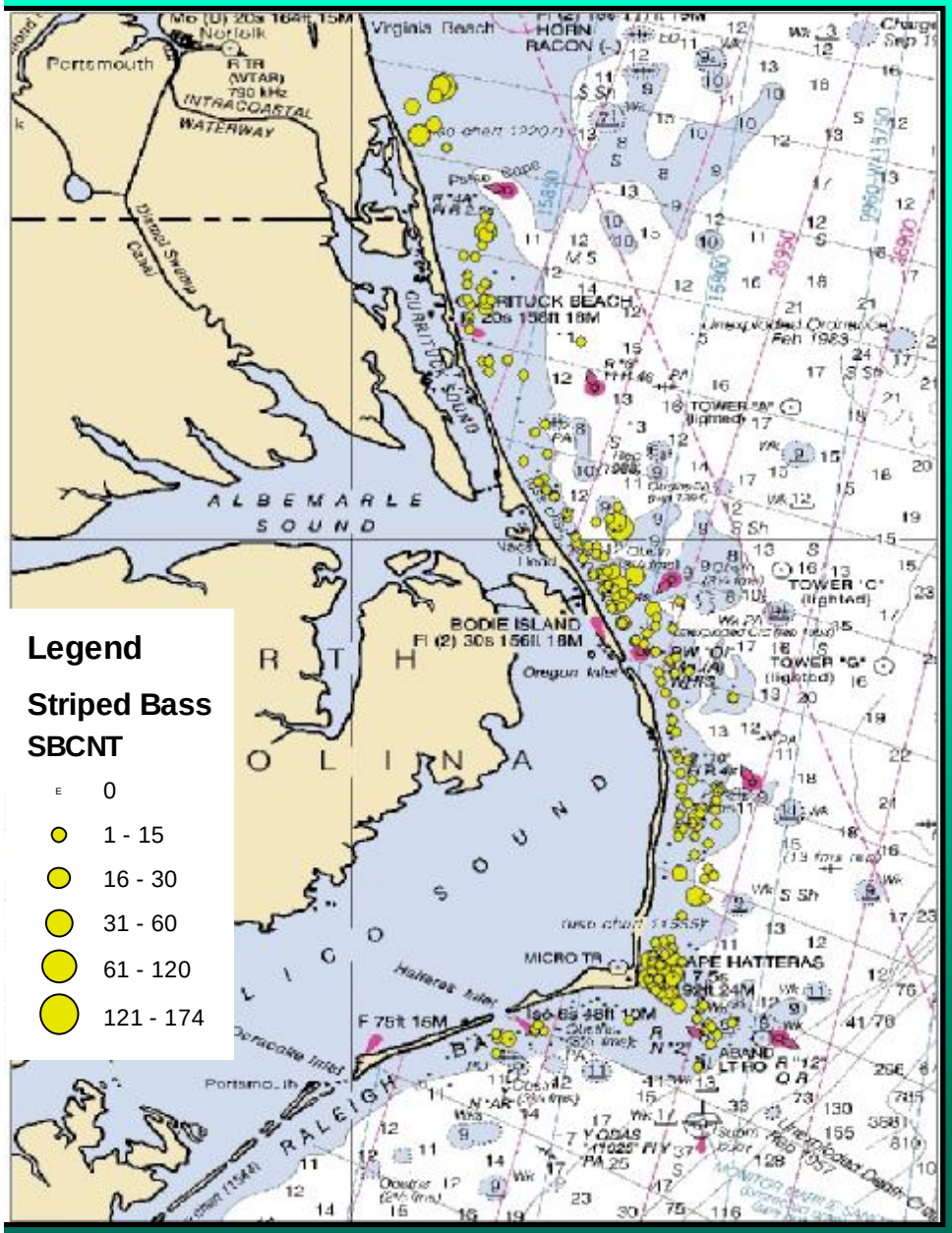
Dogfish tags

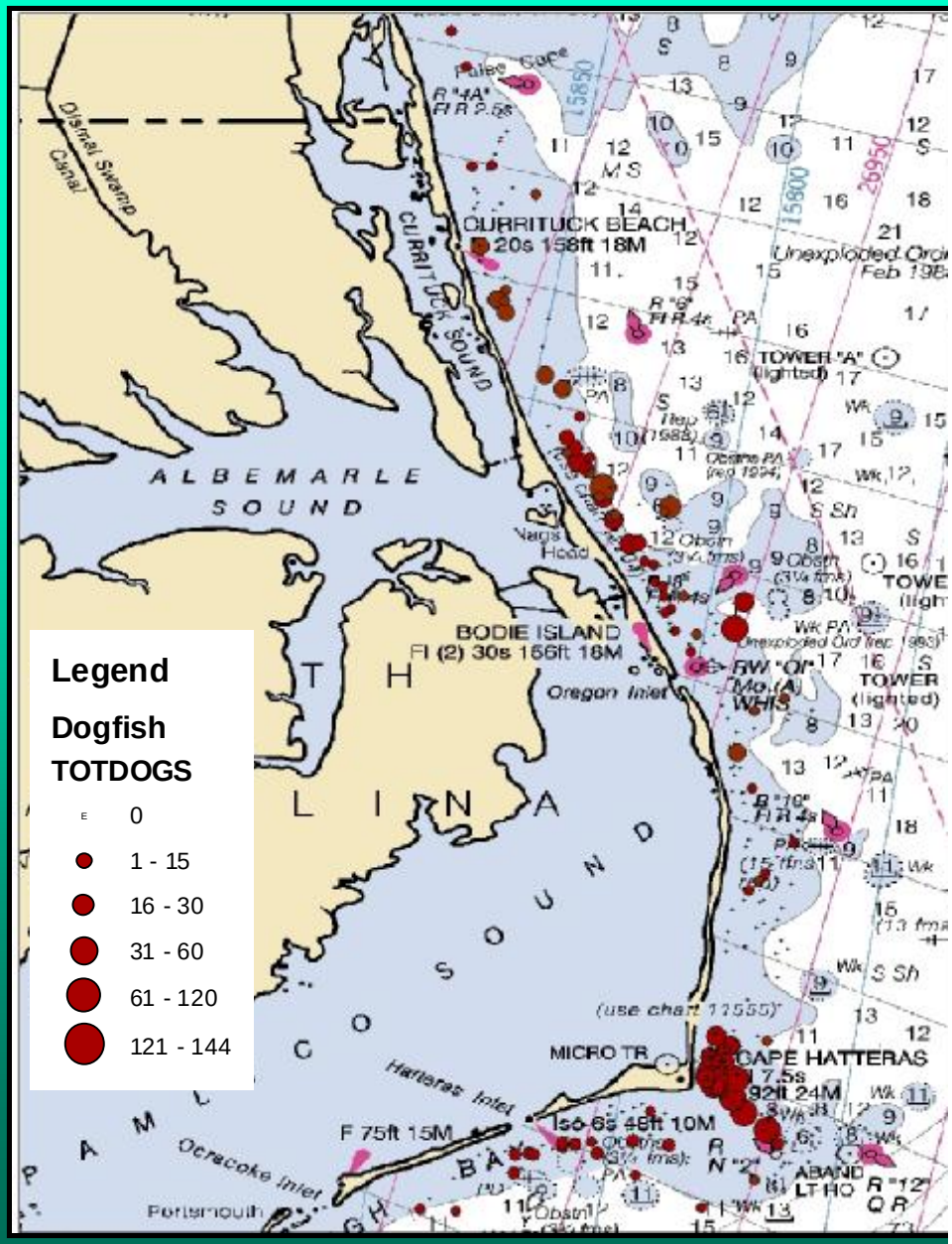
Running seawater holding tanks


Data recorder
Tagger
Wrangler
Wrangler
Deck crew

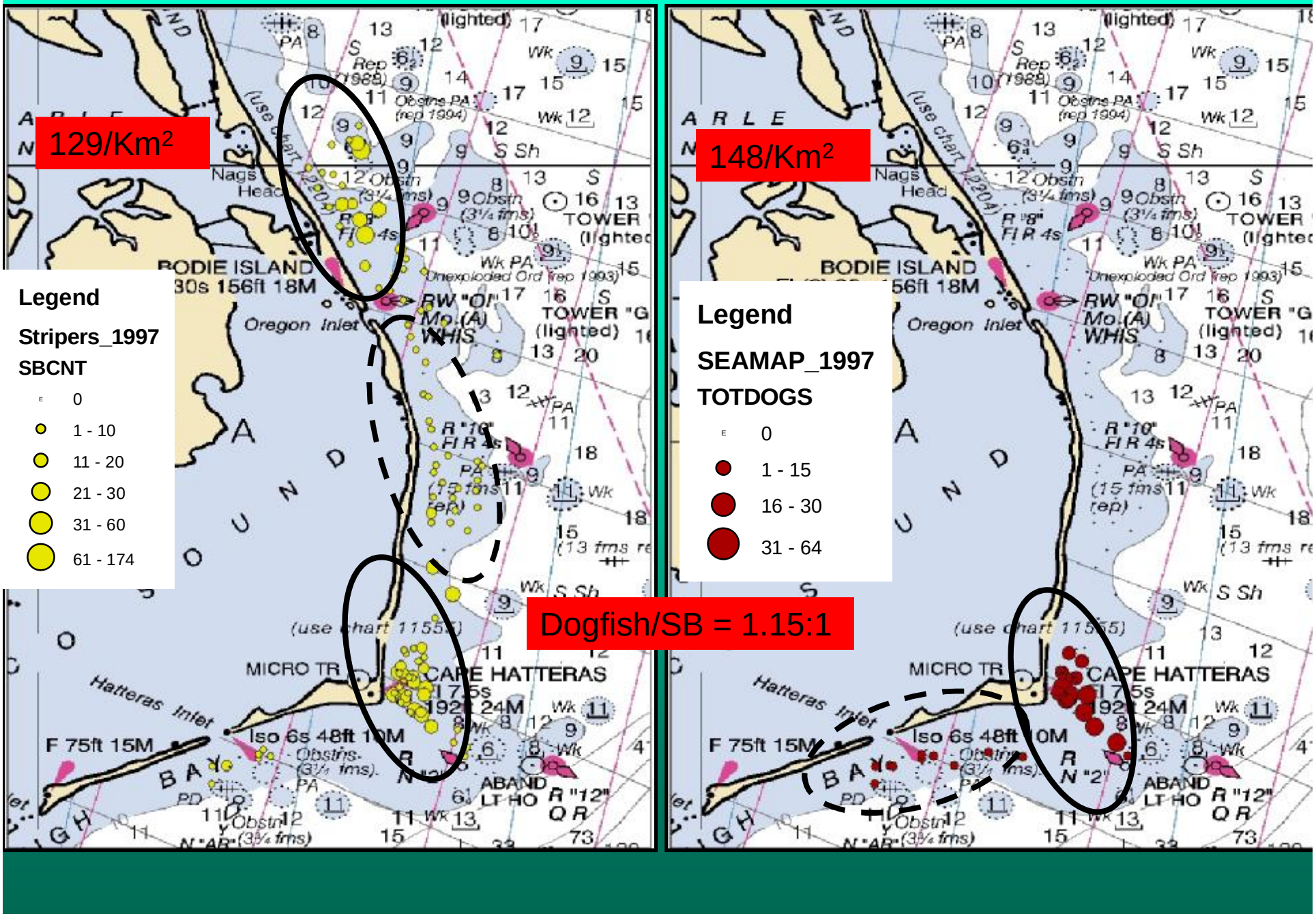

EMERGENCY
EXIT
WWII bomb from airplane, still live
Captured in 2002 but no ordinance since – Hooray!

Striped Bass 1997-1999 Dogfish





Striped Bass 1997 Dogfish



1997

Legend

11.4ºC

6.9ºC

Depth 30-81 ft

Wtemp 6.9-11.7º C

Salinity N/A

Atemp 5.8-19.1º C

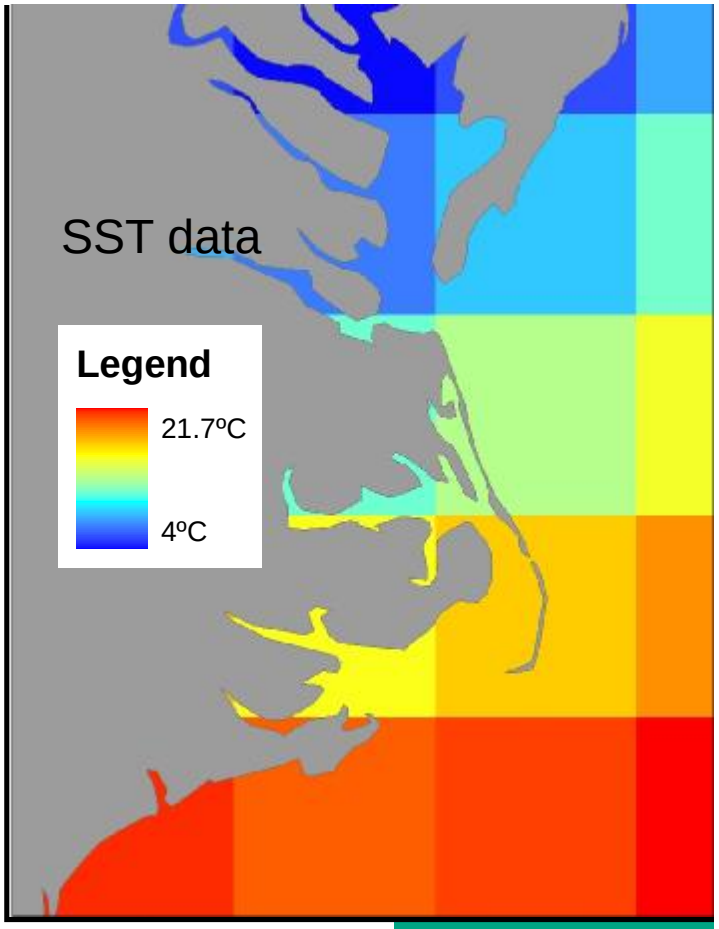
Trawl area = 11.7 km²

Red circles are striped bass

Black circles = dogfish

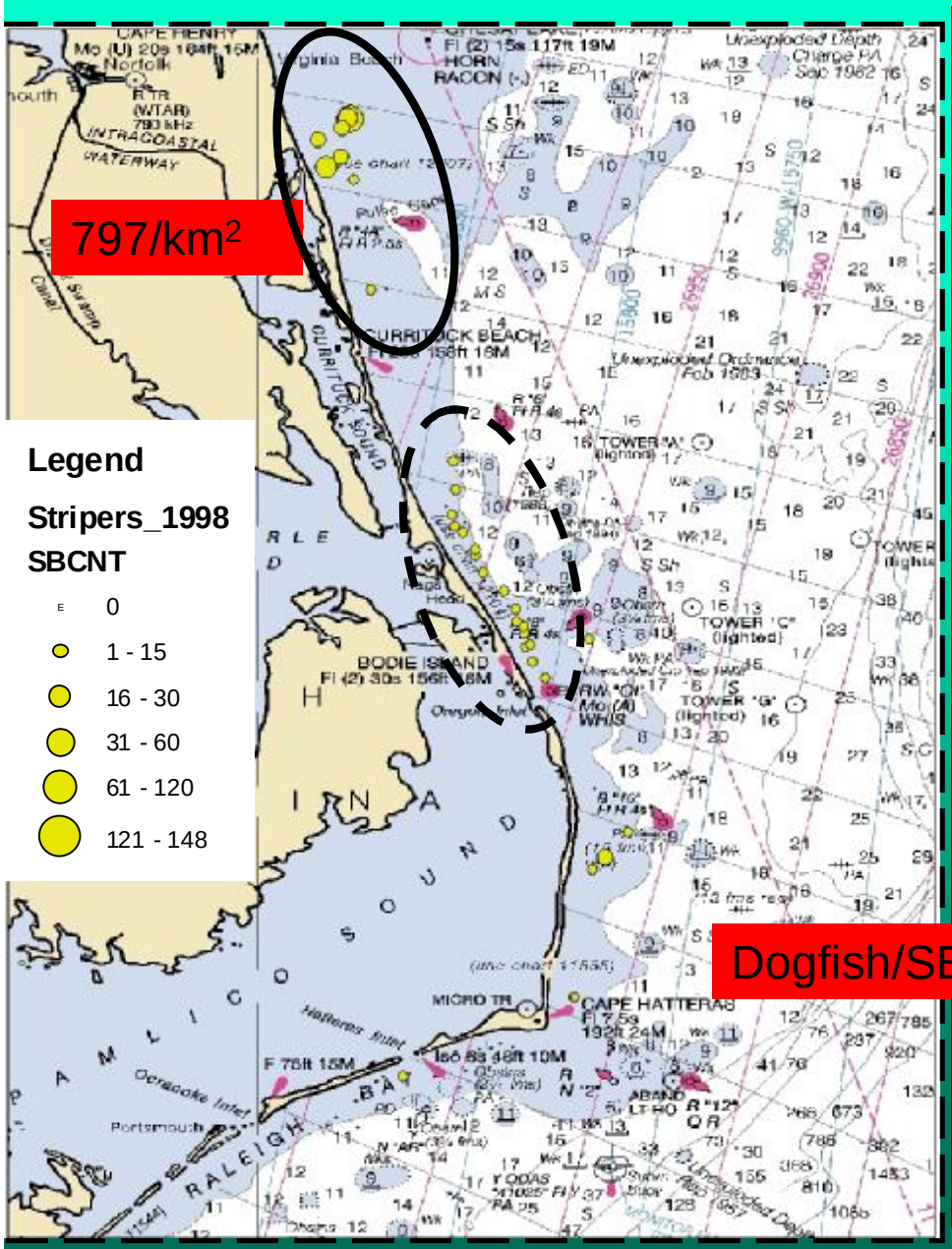
Solid ring = major aggregation

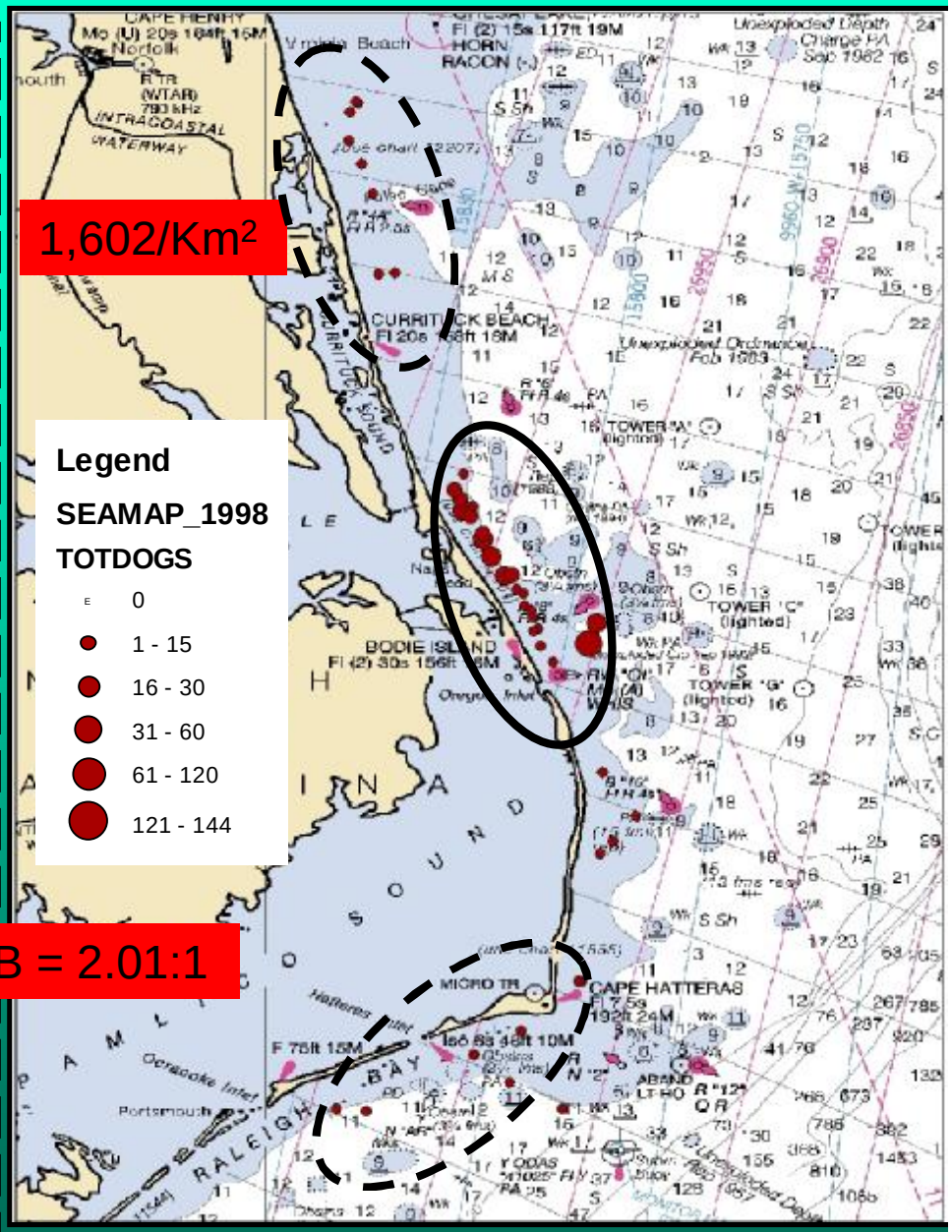
Dashed ring = minor aggregation

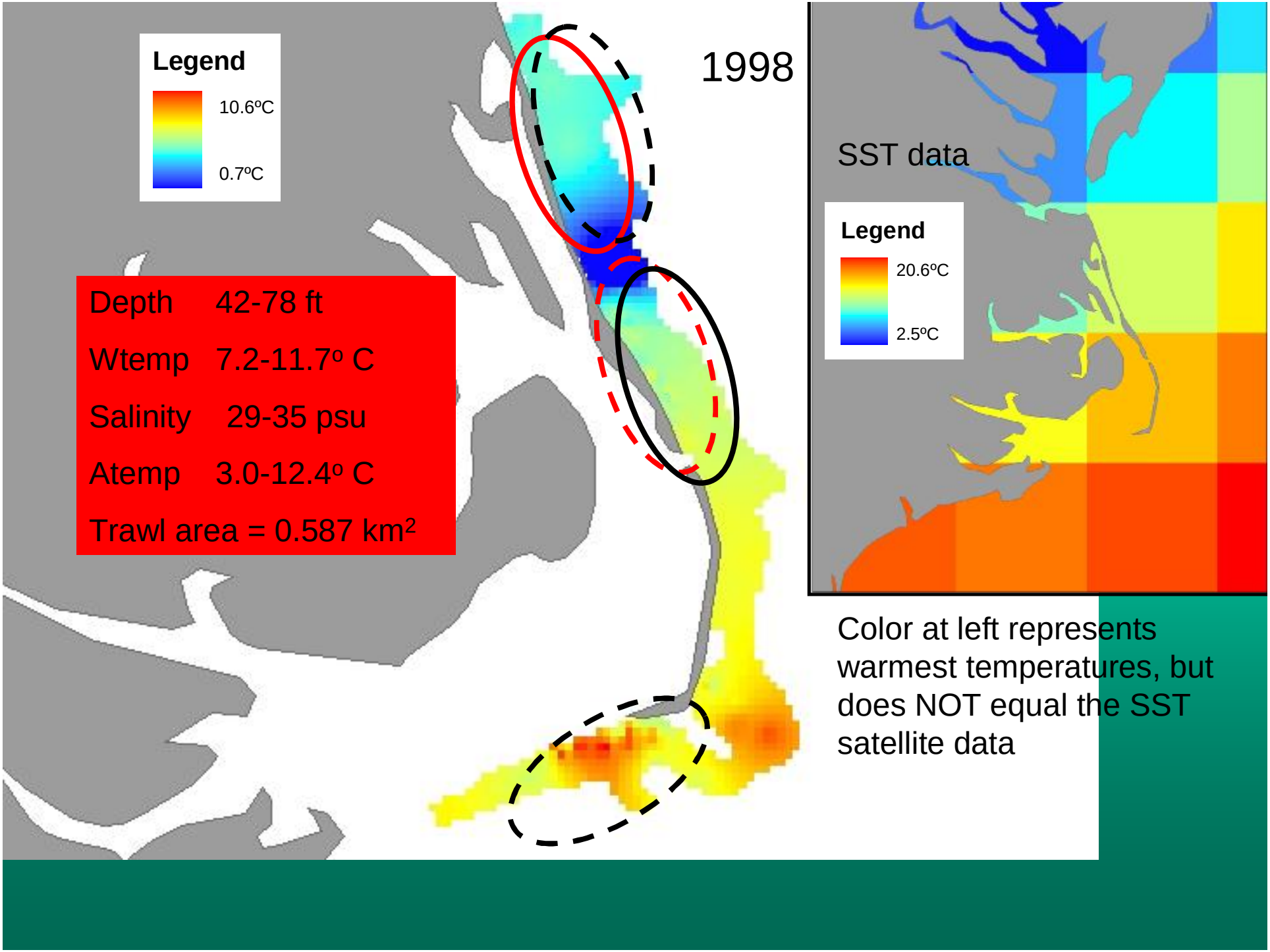


Color at left represents warmest temperatures, but does NOT equal the SST satellite data

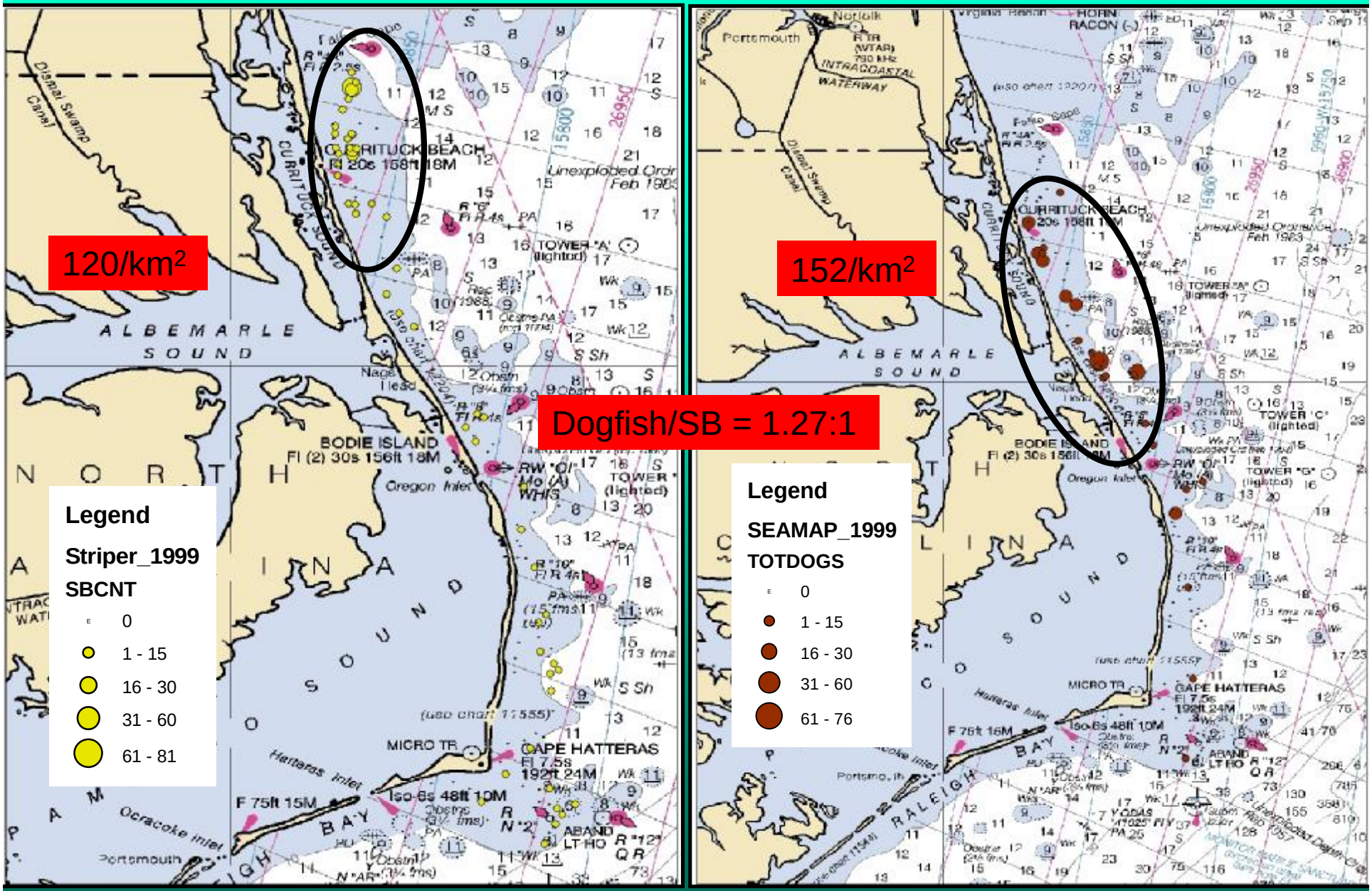
Striped Bass 1998 Dogfish

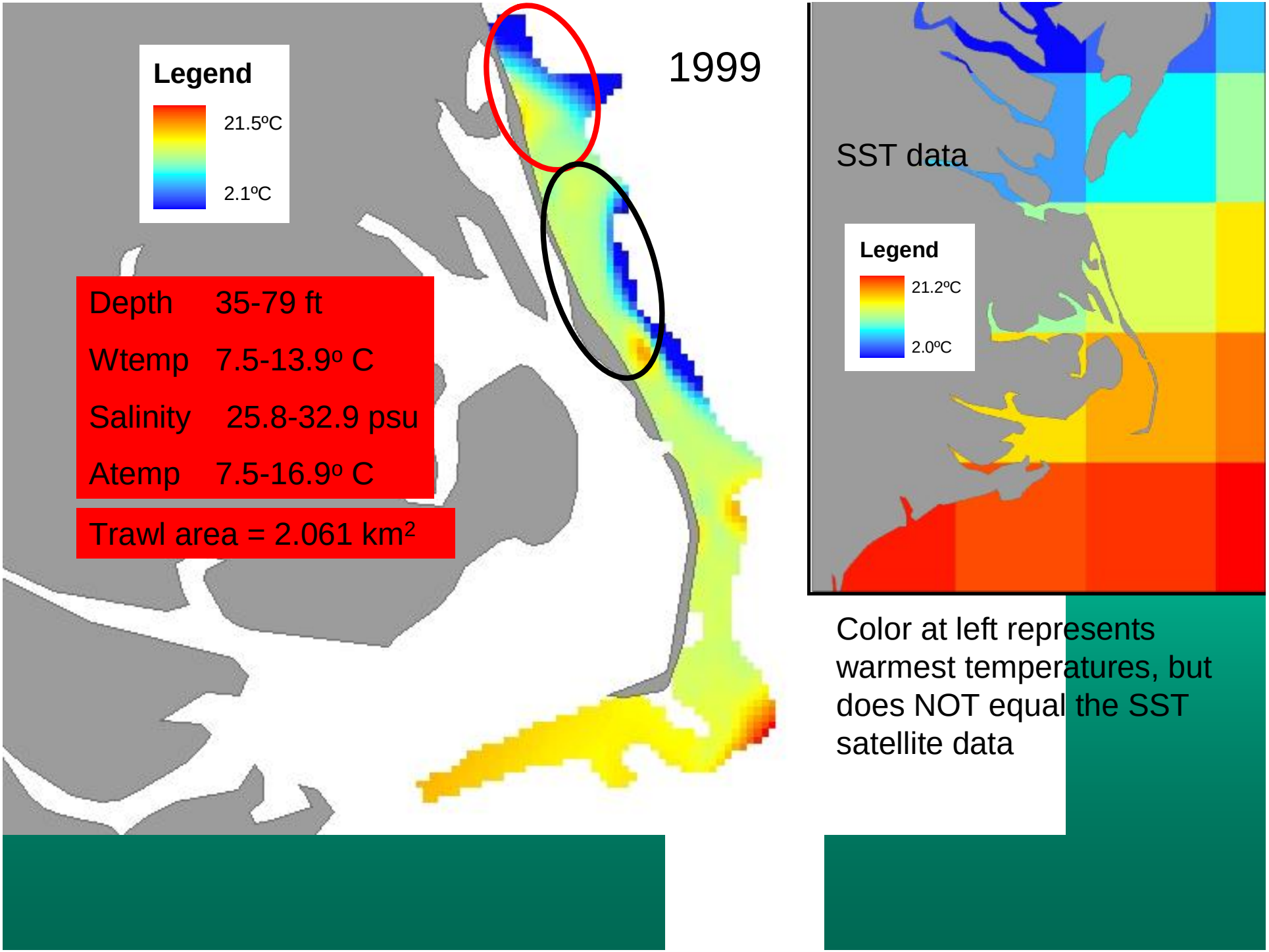





Legend
10.6ºC
0.7ºC
1998
Depth 42-78 ft
Wtemp 7.2-11.7º C
Salinity 29-35 psu
Atemp 3.0-12.4º C
Trawl area = 0.587 km²
SST data
Legend
20.6ºC
2.5ºC
Color at left represents warmest temperatures, but does NOT equal the SST satellite data

Striped Bass 1999 Dogfish

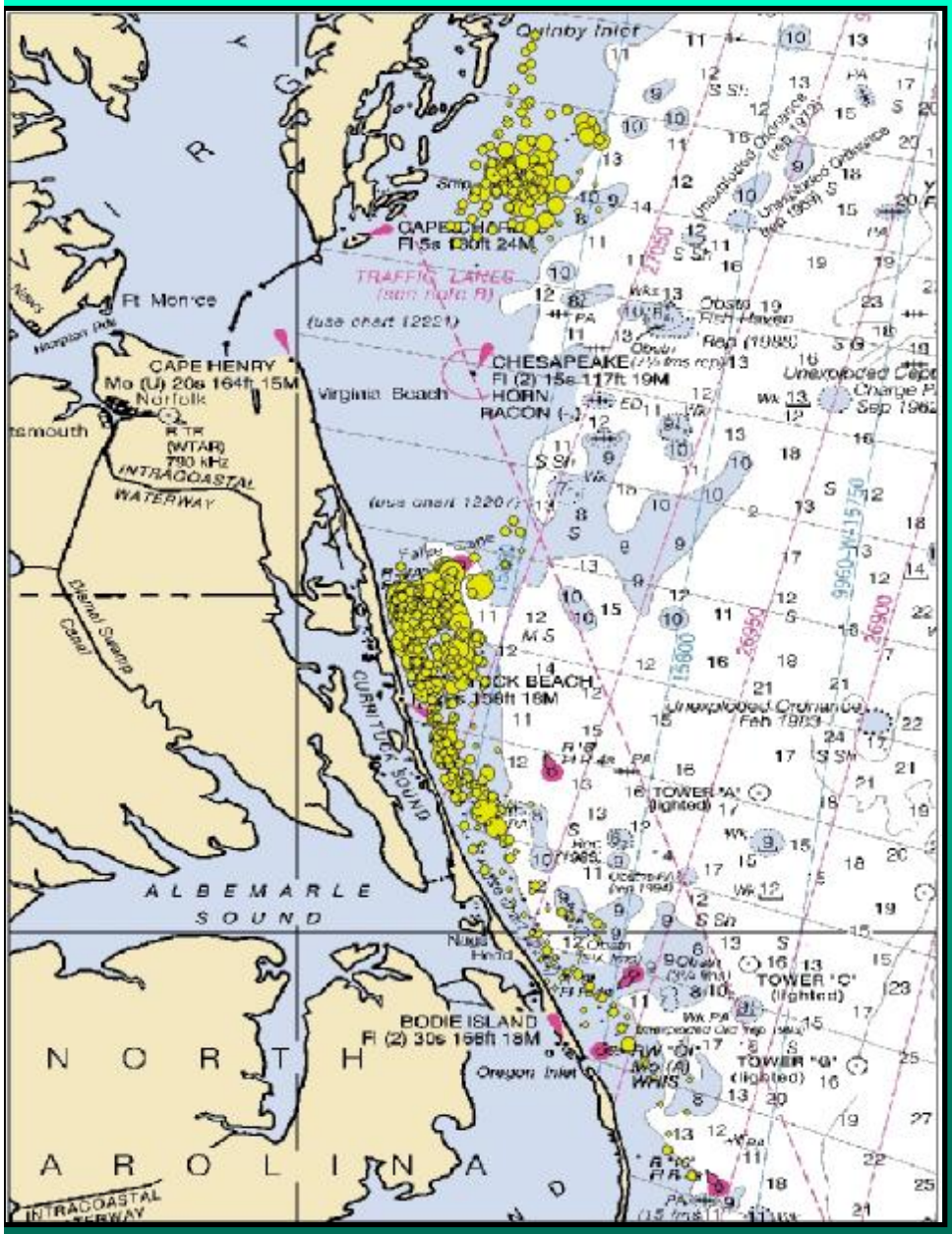


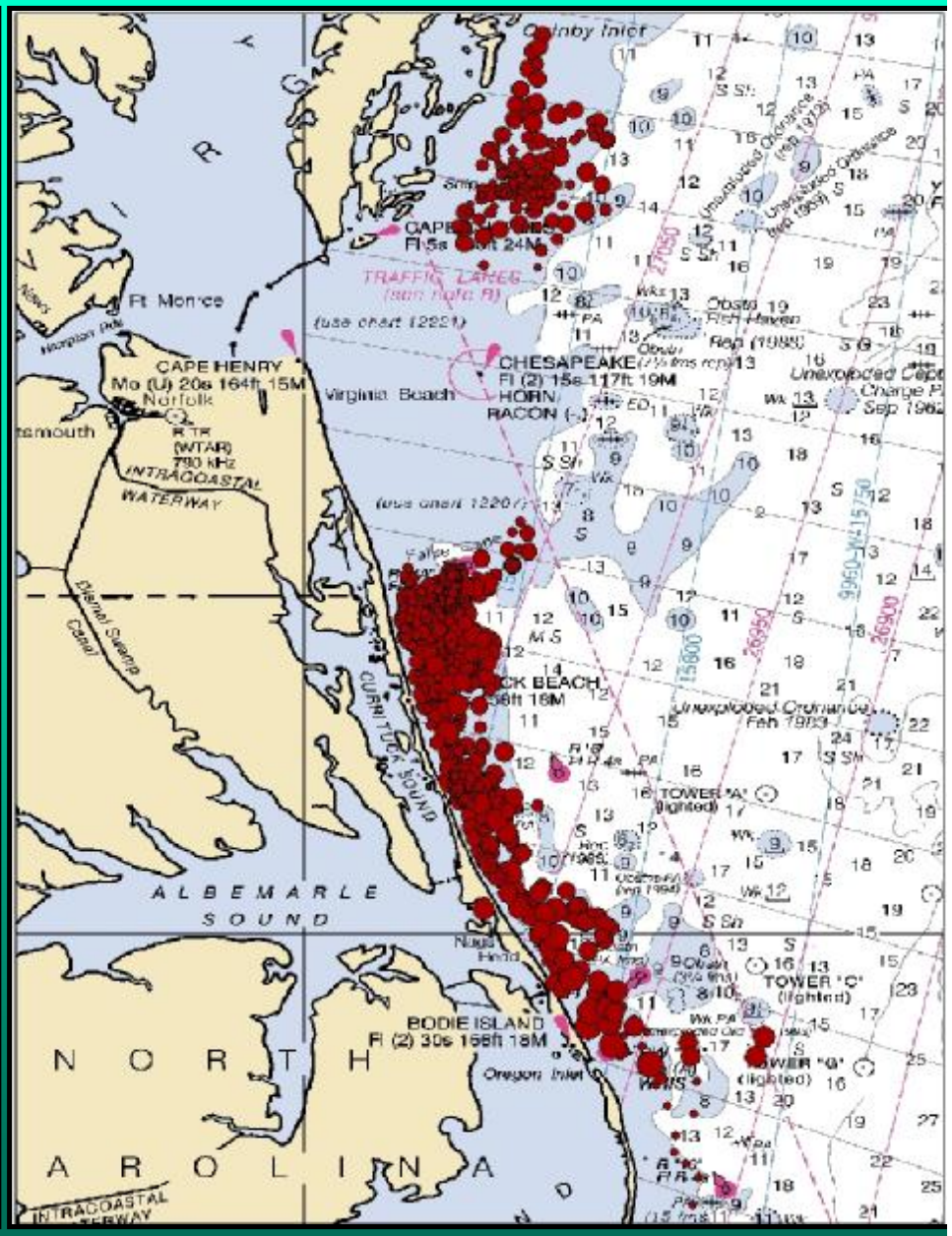

Legend
21.5ºC
2.1ºC
1999
Depth 35-79 ft
Wtemp 7.5-13.9º C
Salinity 25.8-32.9 psu
Atemp 7.5-16.9º C
Trawl area = 2.061 km²
SST data
Legend
21.2ºC
2.0ºC
Color at left represents warmest temperatures, but does NOT equal the SST satellite data

Striped Bass

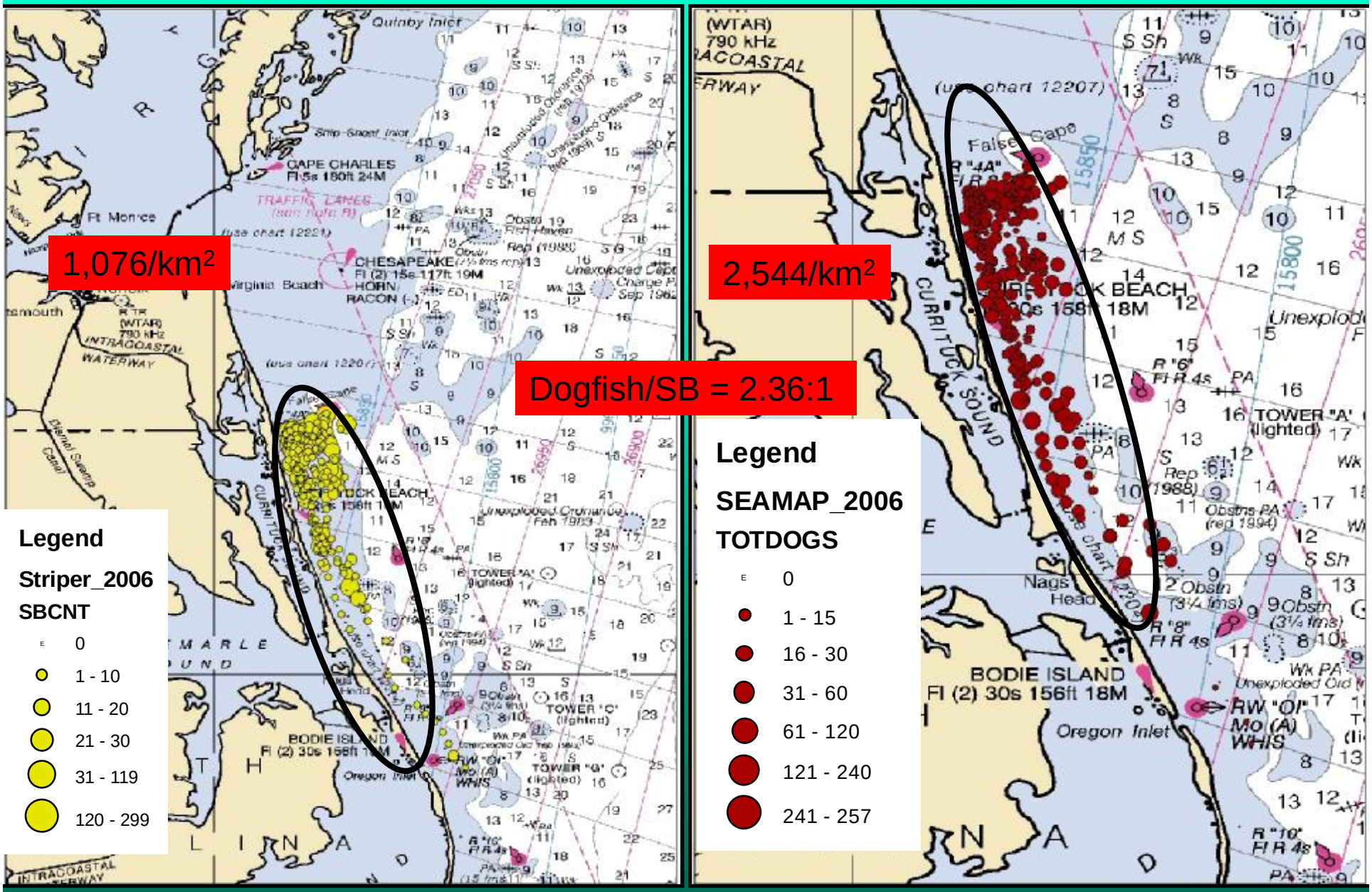
2006-2008

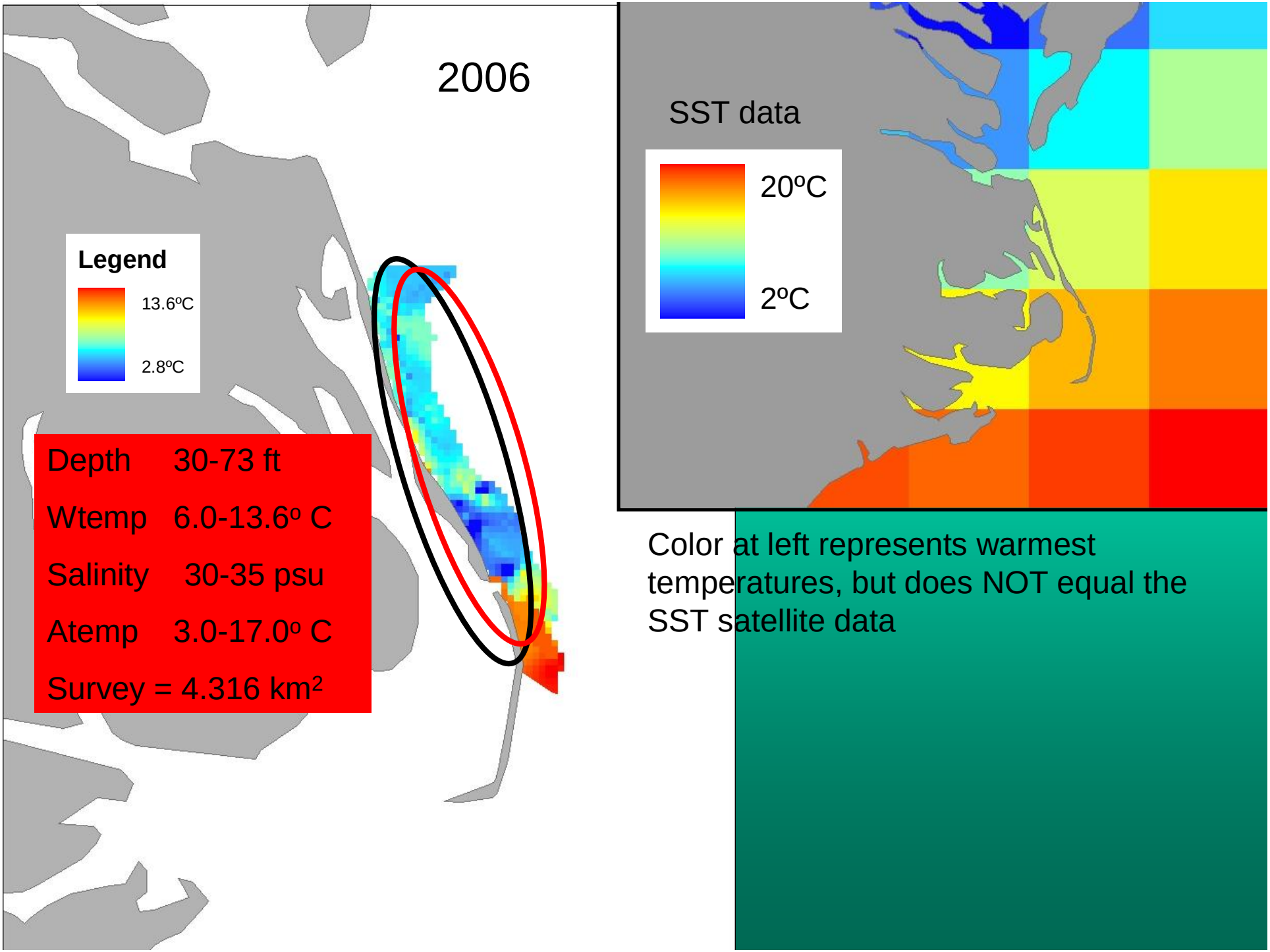
Dogfish



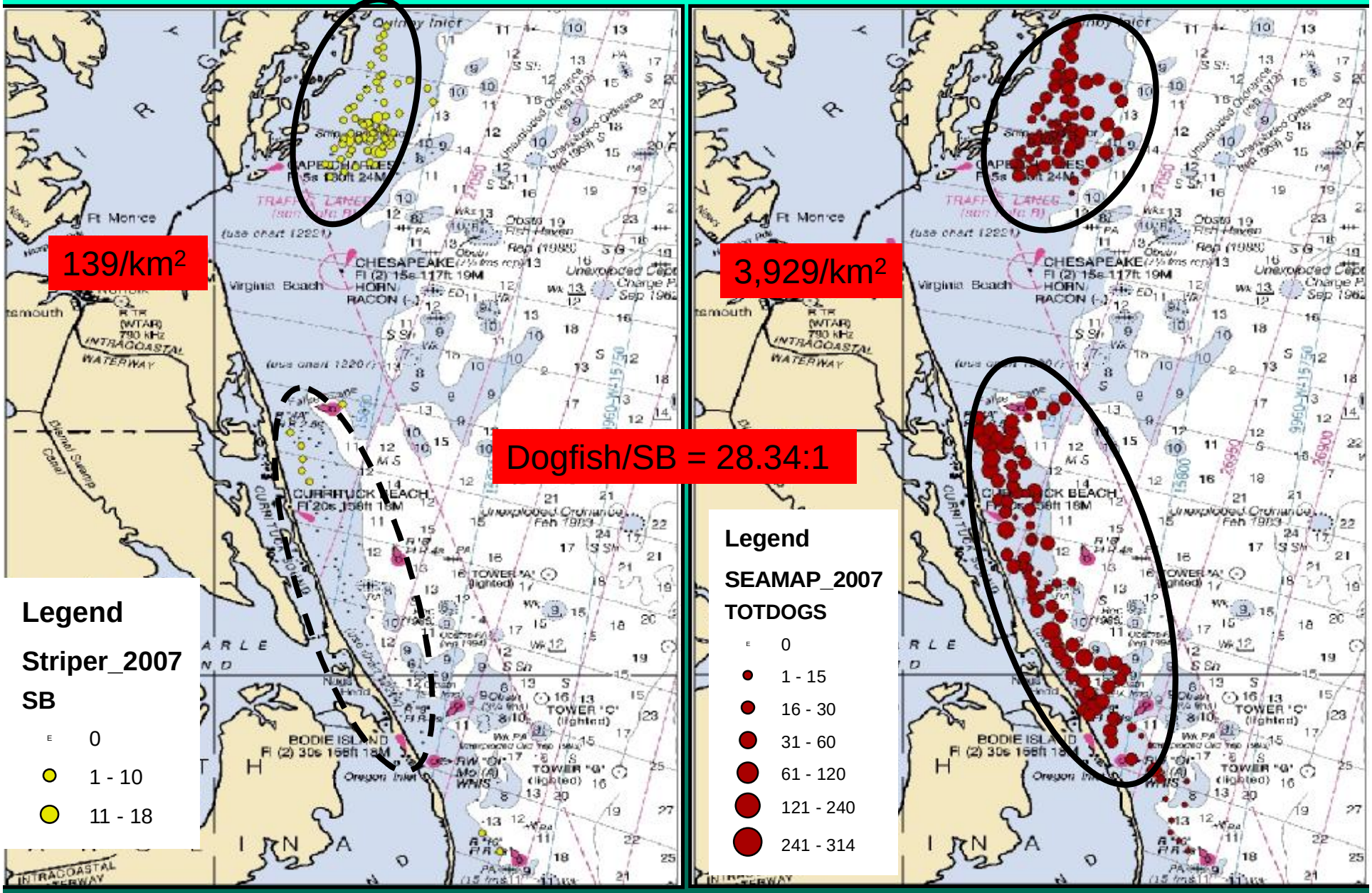


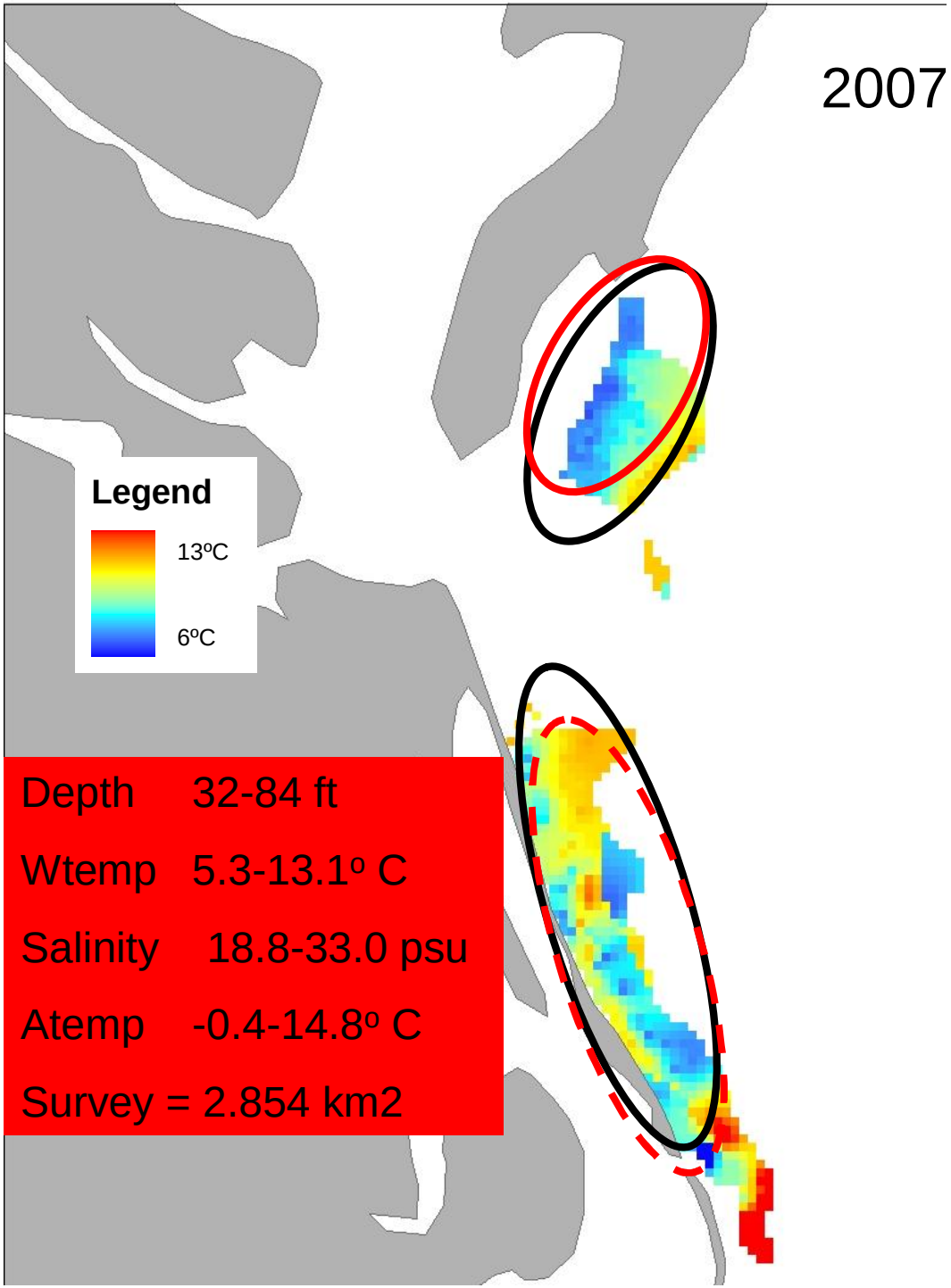
Striped Bass 2006 Dogfish

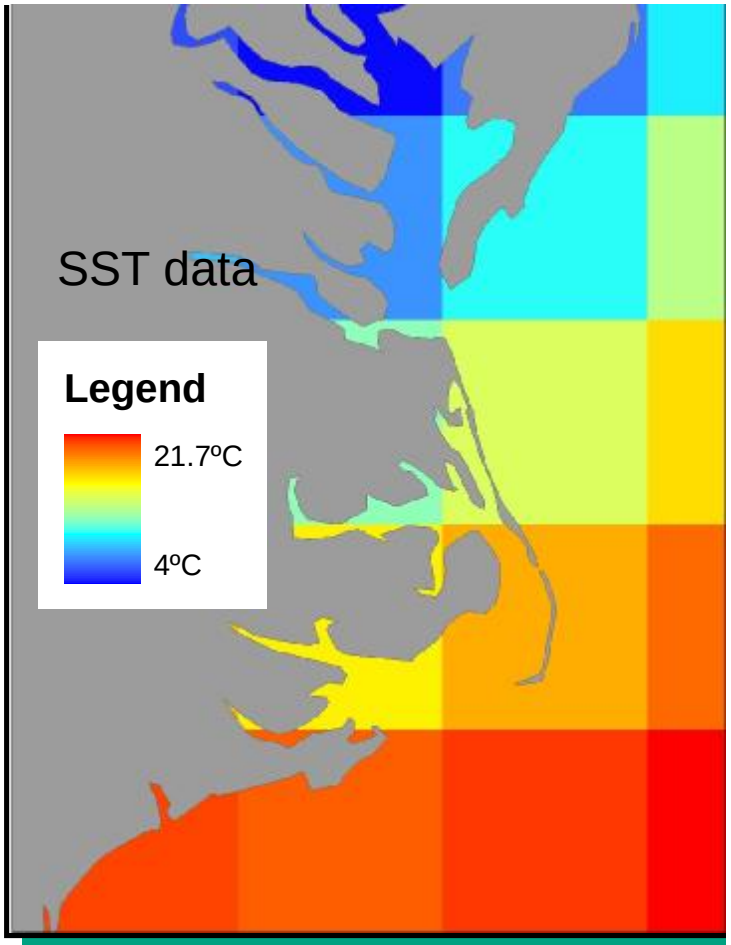



2006
Legend
13.6ºC
2.8ºC
Depth 30-73 ft
Wtemp 6.0-13.6º C
Salinity 30-35 psu
Atemp 3.0-17.0º C
Survey = 4.316 km²
SST data
20ºC
2ºC
Color at left represents warmest temperatures, but does NOT equal the SST satellite data

Striped Bass 2007 Dogfish

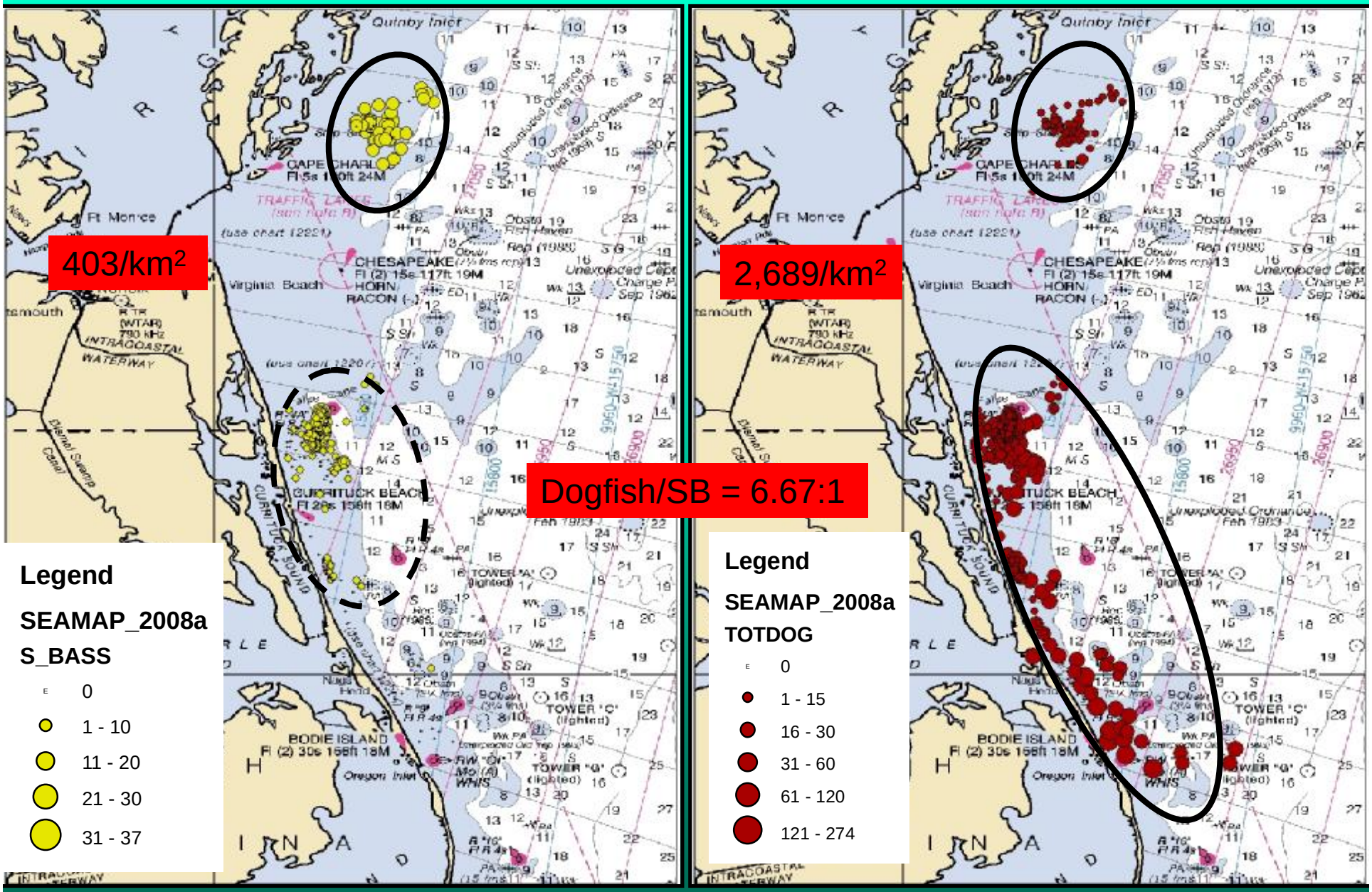


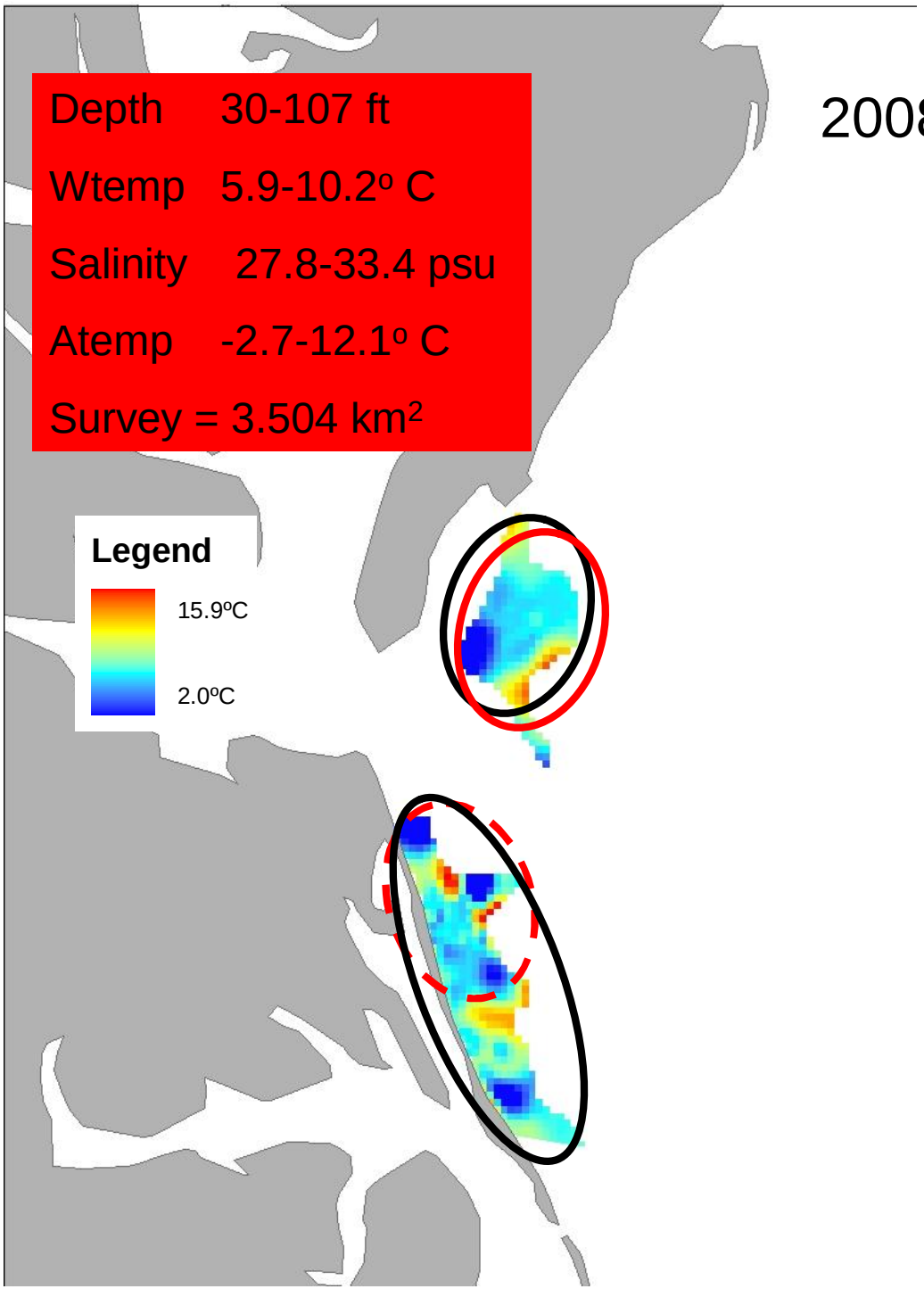




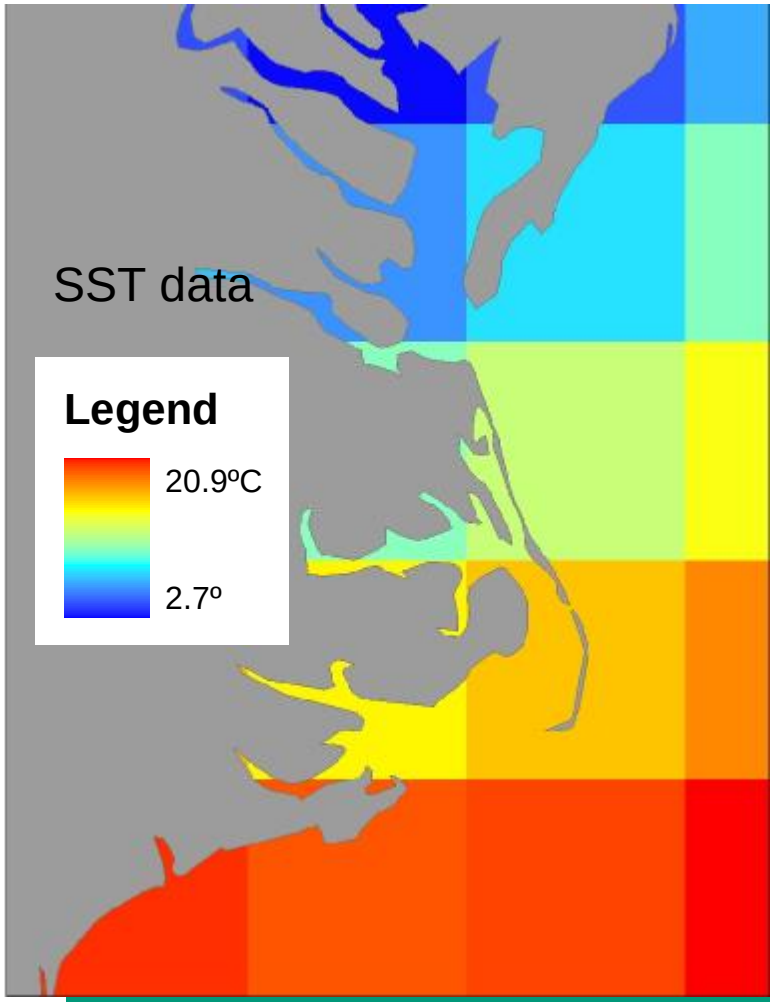
Color at left represents warmest temperatures, but does NOT equal the SST satellite data

Striped Bass 2008 Dogfish





2008



Color at left represents warmest temperatures, but does NOT equal the SST satellite data

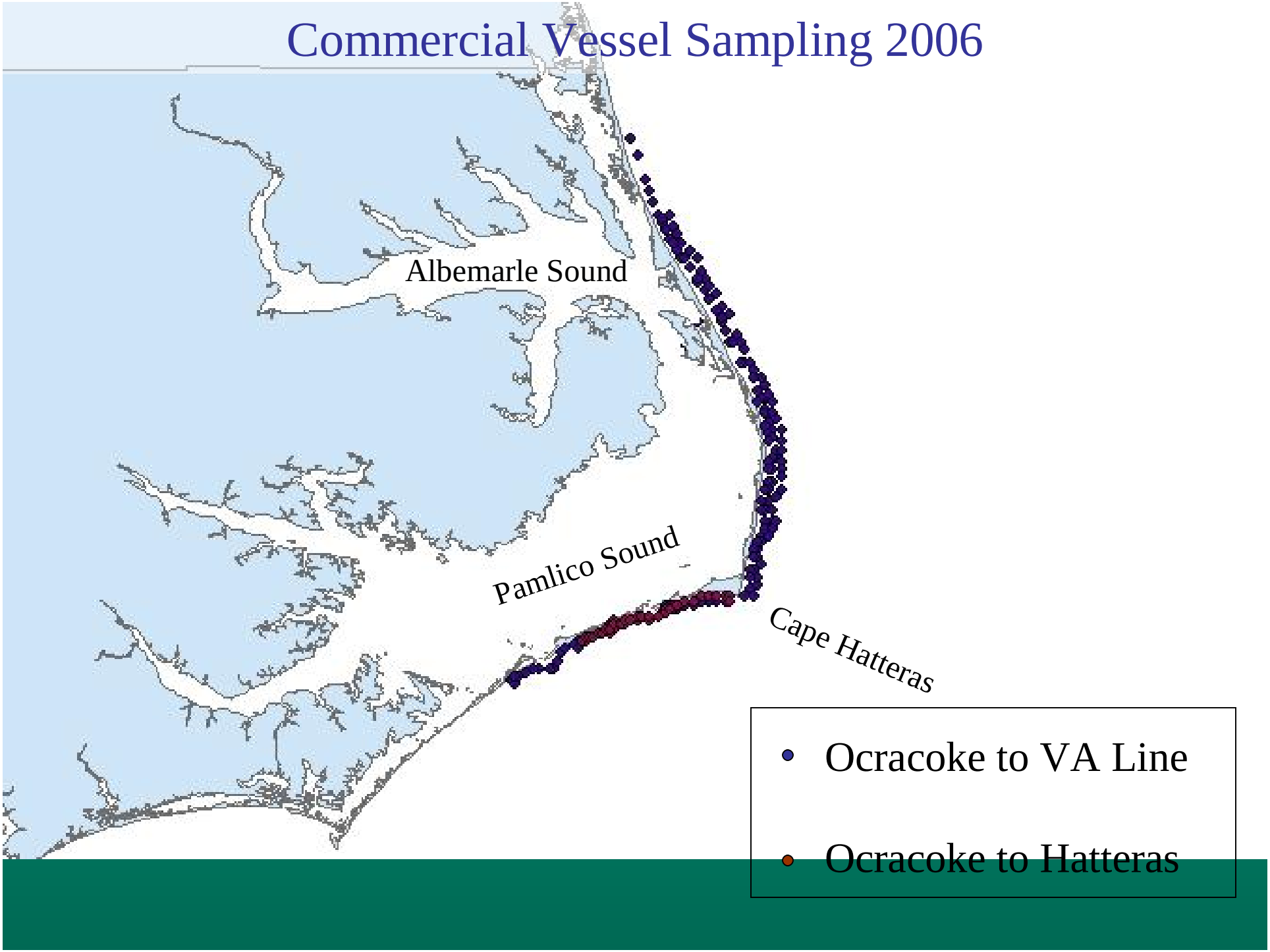
Discussion

Are these density estimates realistic?

How do spiny dogfish aggregations interact with other species?

Did we demonstrate that the magnitude of spiny dogfish has an impact on preferred habitats of other species?

Commercial Vessel Sampling 2006



Results – Ocracoke to Virginia

(Inshore waters only)

Population estimate of all spiny dogfish on the continental shelf overwintering between Ocracoke Inlet and the Virginia State Line in Feb-Mar 2006 using the area-density method.

	Linear distance of influence from the sink gill net (meters)			
Survey aspect	9.14	22.86	45.72	91.44
Total dogfish catch	1,692	1,692	1,692	1,692
Total survey area (km2)	1,410,558	1,410,558	1,410,558	1,410,558
Number of units in survey area	514,802.13	205,620.67	102,810.34	20,568.06
Total population size (individuals)	871,045,200	347,910,182	173,955,091	34,801,164
Total population size (lbs)	5,226,271,200.79	2,087,461,091.86	1,043,730,545.93	208,806,985.86
Total population size (kg)	2,369,242,944.36	946,315,694.98	473,157,847.49	94,659,166.92
Total population size (mt)	2,369,242.94	946,315.69	473,157.85	94,659.17

Schnabel M/R biomass of mature females (>80 cm) = 85,848 mt or 63.83% of NMFS 2006 estimate

Bycatch in Scientific Sink Gillnets, Cape Hatteras to SC

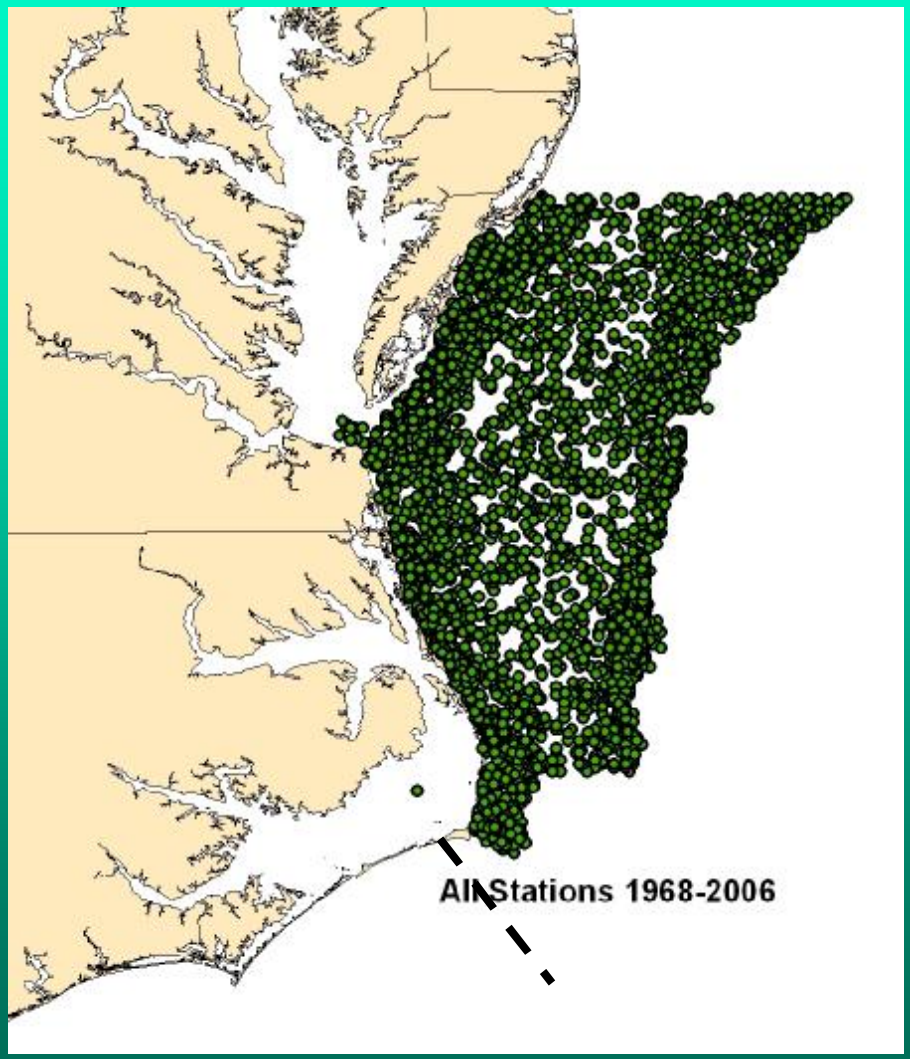
Moore, Rulifson, and Newman (2000)

Table 1. Number of spiny dogfish and bycatch fish species collected in scientific sink gill nets south of Cape Lookout to the North Carolina-South Carolina state line during the winter of 1999 onboard the Captain Dell.

Common name	Scientific name	Number captured	Percent of total
Spiny dogfish	*Squalus acanthias*	1,444	87.2
Atlantic menhaden	*Brevoortia tyrannus*	83	5.0
Smooth dogfish	*Mustelus canis*	60	3.6
American shad	*Alosa sapidissima*	12	0.7
Atlantic croaker	*Micropogon undulatus*	11	0.7
Sandbar shark	*Carcharhinus milberti*	11	0.7
Summer flounder	*Paralichthys dentatus*	9	0.5
Weakfish	*Cynoscion regalis*	9	0.5
Butterfish	*Peprilus triacanthus*	4	0.2
White mullet	*Mugil curema*	4	0.2
Searobin	Family – Triglidae	3	0.2
Pinfish	*Lagodon rhomboides*	2	0.1
Clearnose skate	*Raja eglanteria*	1	<0.1
Black sea bass	*Centropristis striata*	1	<0.1
Mullet	*Mugil sp.*	1	<0.1
Bluefish	*Pomatomus saltatrix*	1	<0.1
Total fish captured		1,656	100

What's Next?

- Tagging in New England (hopefully this fall)
- Acoustic tagging next 2 winters off the Outer Banks
- Additional studies on demographics of overwintering population



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- John Boreman