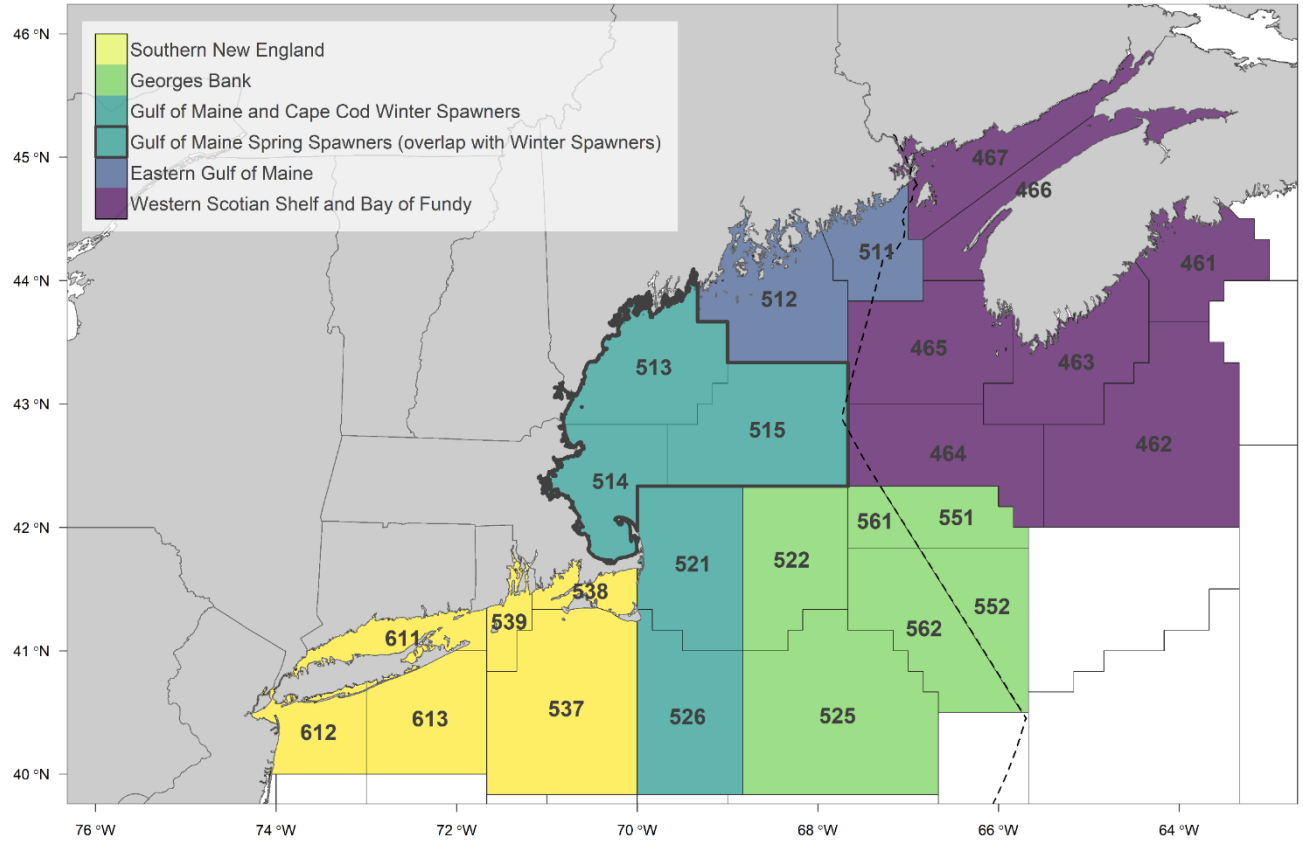
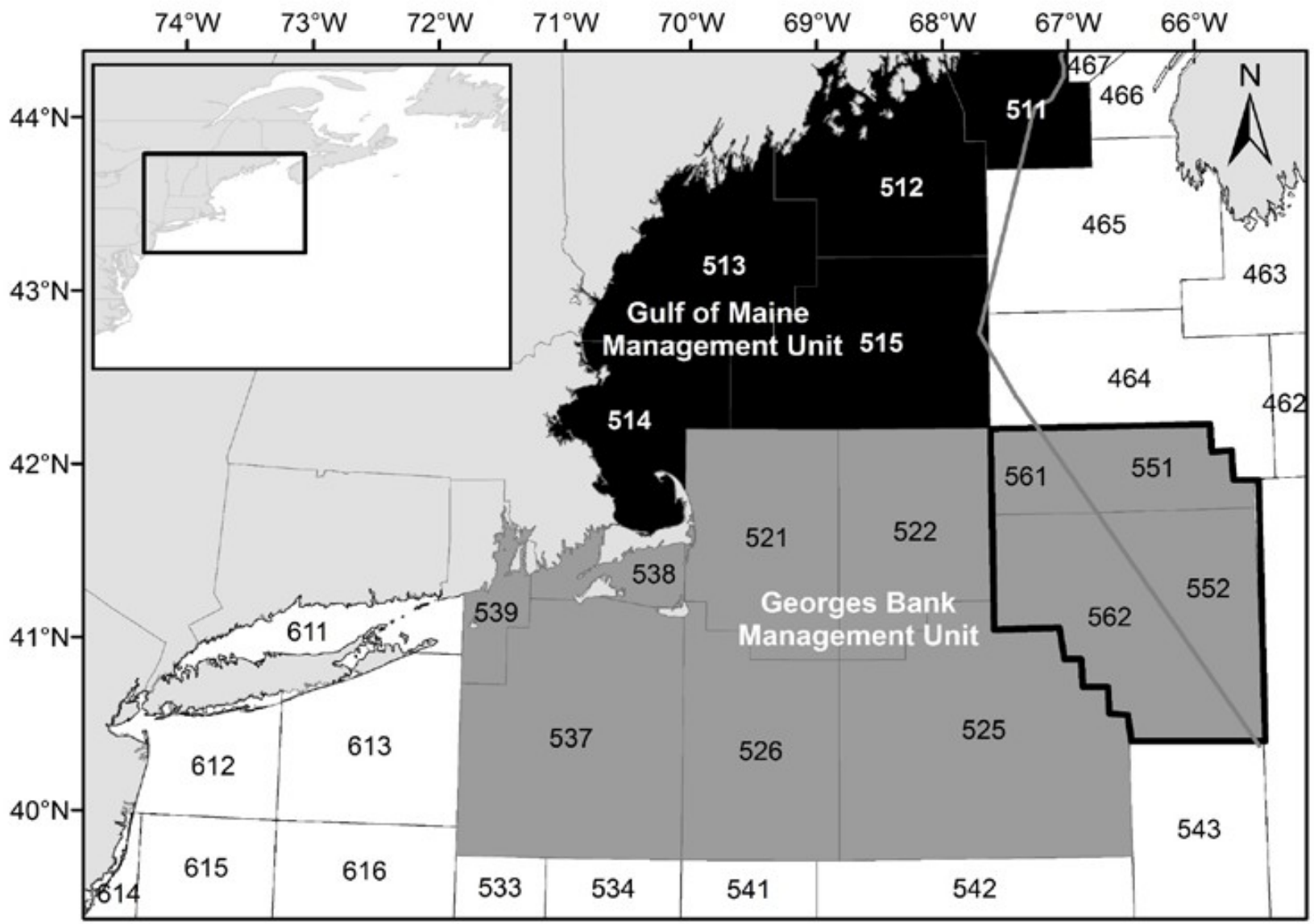
Atlantic Cod Science & Assessment Workshops Data Availability



Data Presentation on Behalf of:

- Loretta O'Brien (retired), Chris Legault, Alicia Miller, Andrew Jones, Anna Mercer, Richard McBride (Northeast Fisheries Science Center)
- Chris Bonzek and Jim Gartland (VIMS, NEAMAP)
- Alex Hansell and Matt Camisa (MA Division of Marine Fisheries)
- Rhode Island Department of Environmental Management
- Irene Andrushchenko (Department of Fisheries and Oceans Canada)
- Atlantic Cod Stock Structure Working Group

Current Management Areas for Atlantic Cod



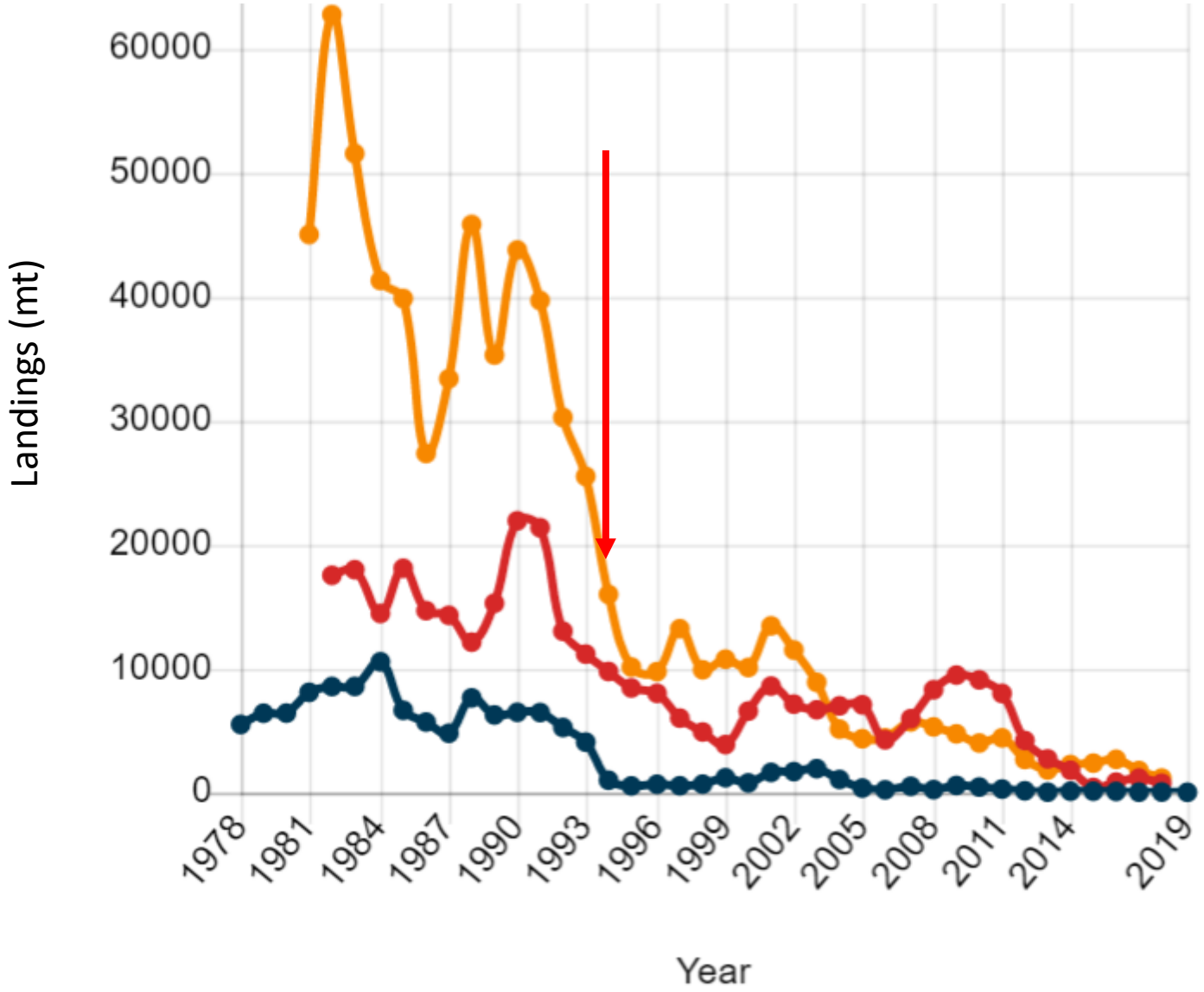
Current Atlantic Cod Stock Assessment Framework

- **Gulf of Maine Management Area** (Stat Areas 511-515, 464, 465)
  - Last assessment 2019, Operational Assessment
  - ASAP Model, two formulations (M = 0.2, M-Ramp model)

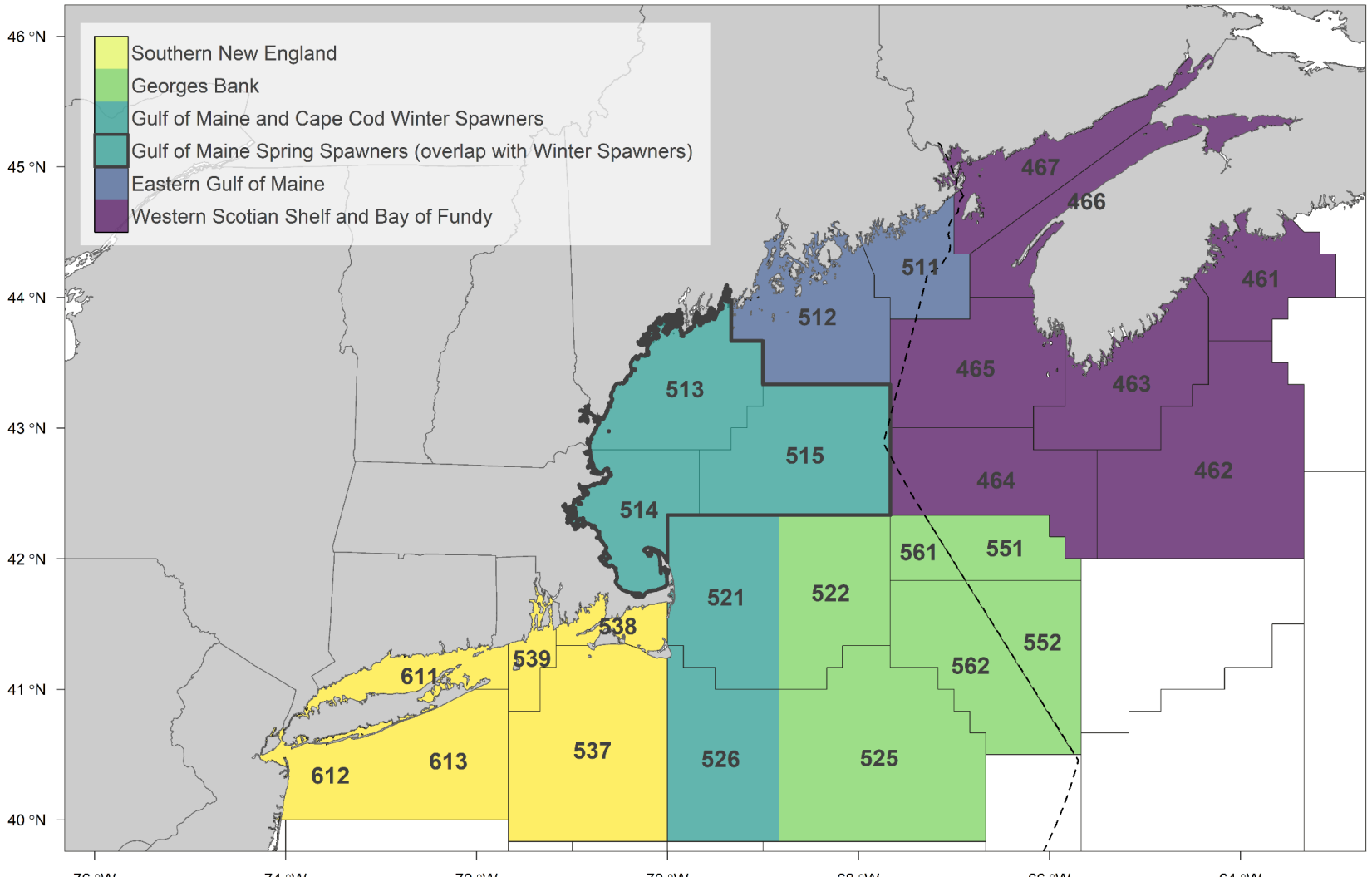
- **Georges Bank and South Management** Area (Stat Areas 521, east and south)
  - Last assessed 2019, Operational Assessment
  - Plan B Smooth approach

- **Eastern Georges Bank Management Area (5Zj&m)**
  - Transboundary with Canada, Subset of the GB and South Management Area
  - Last assessed 2020, TRAC Assessment
  - Migrating to a Data Limited Model approach

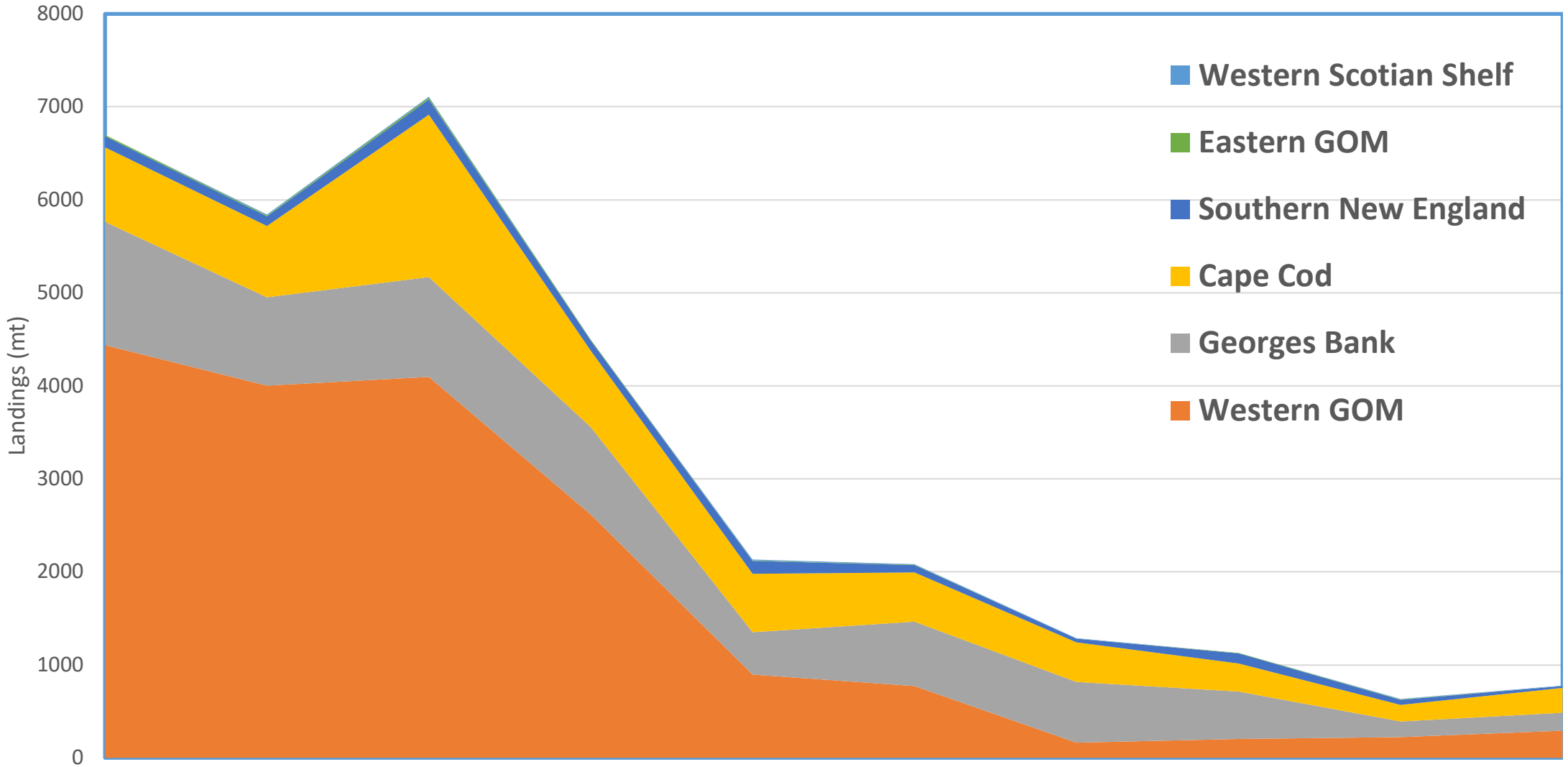
Cod Landings by Current Management Areas (1978-2019)



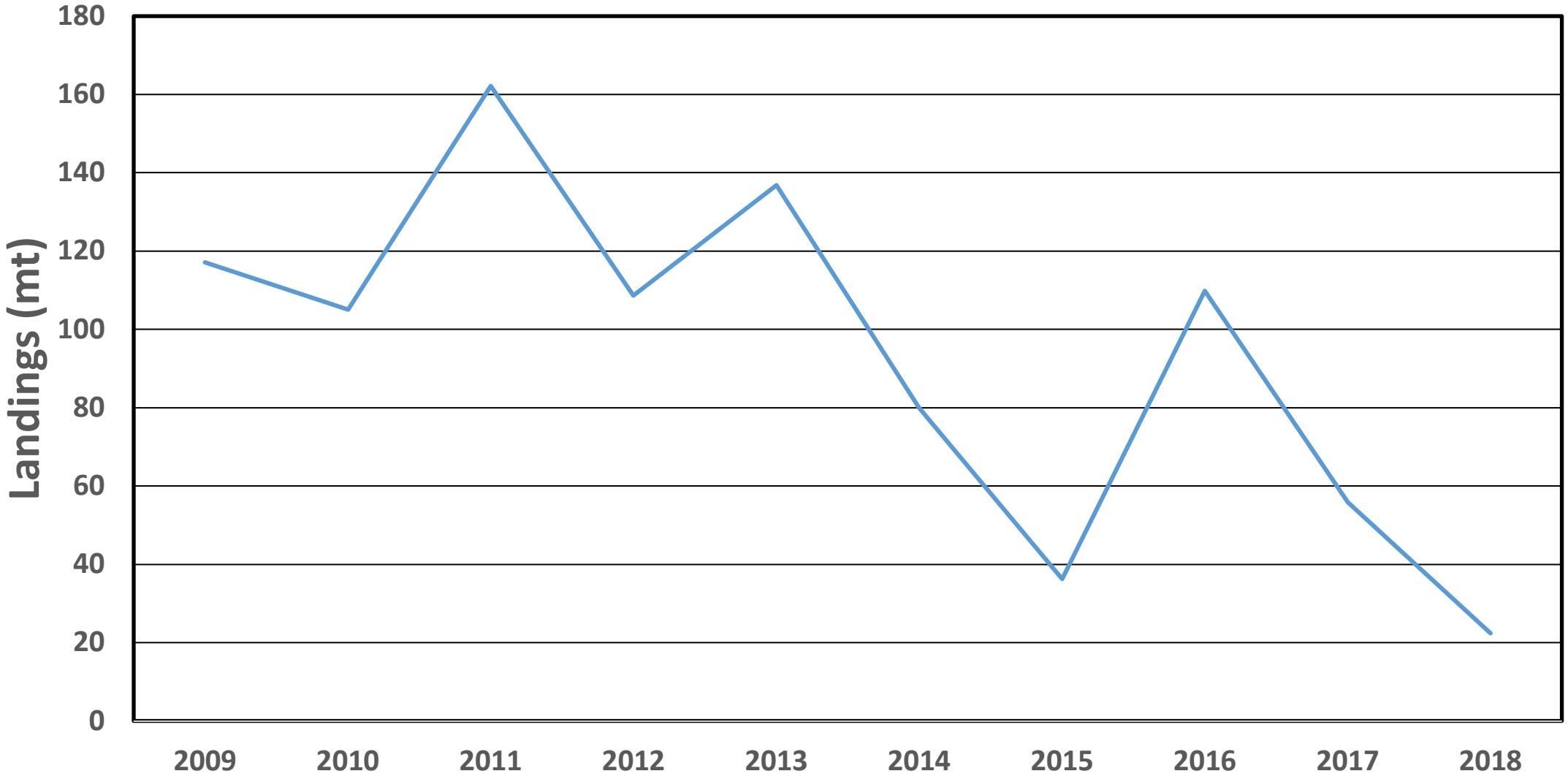
Southern New England Proposed Stock Area



U.S. Atlantic Cod Commercial Landings
Southern New England 2010-2019



Southern New England
Recent Commercial Landings



Port Sampling Program

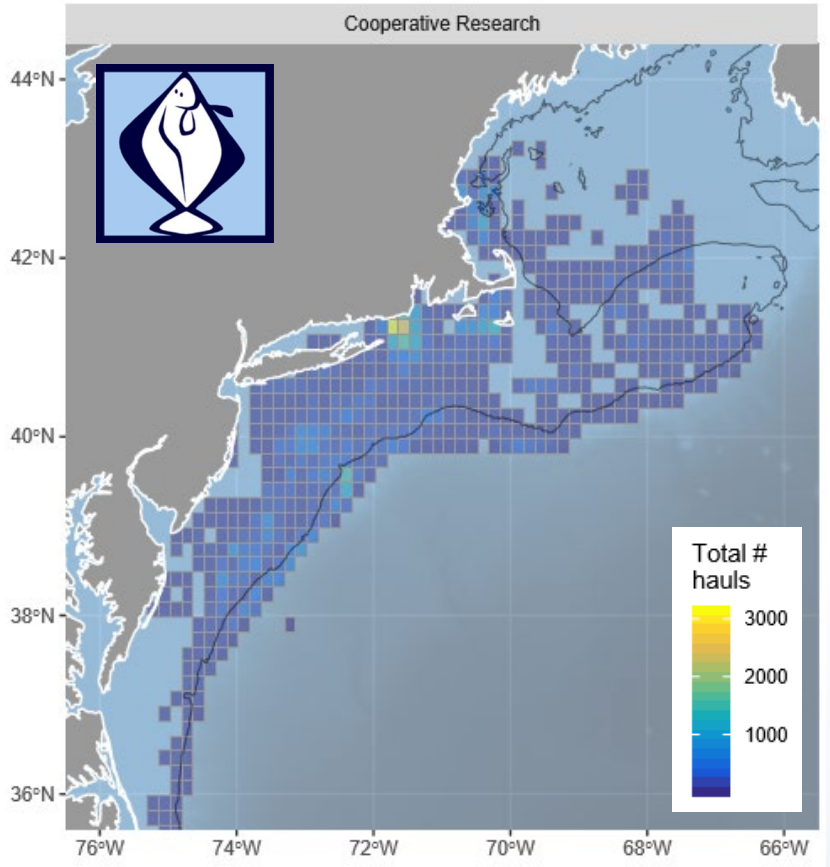
- Intercepts landed fish to collect biological data
- Collects length and age samples stratified by date, statistical area, gear, port, market category
- Two Primary Market Categories for Cod:
  - Large
  - Scrod
- Sampling is designed to be representative of anticipated patterns in landings by date, gear, port, and market category
- Why stratify?
  - Date: fish grow during the year and size frequency changes
  - Gear: different gears (e.g. trawls, gillnet, hook) have different selectivity patterns
  - Port: market categories often have different length cutoffs among ports

Little Usable Sampling Data to Characterize Commercial Catch

- Historical sampling was allocated to be representative of catch
- Southern New England catch was a very small proportion of the overall Georges Bank stock area
- Little or no sampling effort was expended or samples collected in the Southern New England stock area
- Sampling is insufficient to characterize either commercial landings or discards by length or age

NEFSC's Study Fleet Program

- Engages fishermen in collecting high resolution fishery dependent data to address science and management needs
- Program of ~40 contracted vessels
- Uses an electronic data collection system (FLDRS) that is effective and efficient
- Data set has been collected since 2006 but most consistent from 2010 - present



NOAA FISHERIES

Study Fleet Vessel, Trip, and Effort Tallies

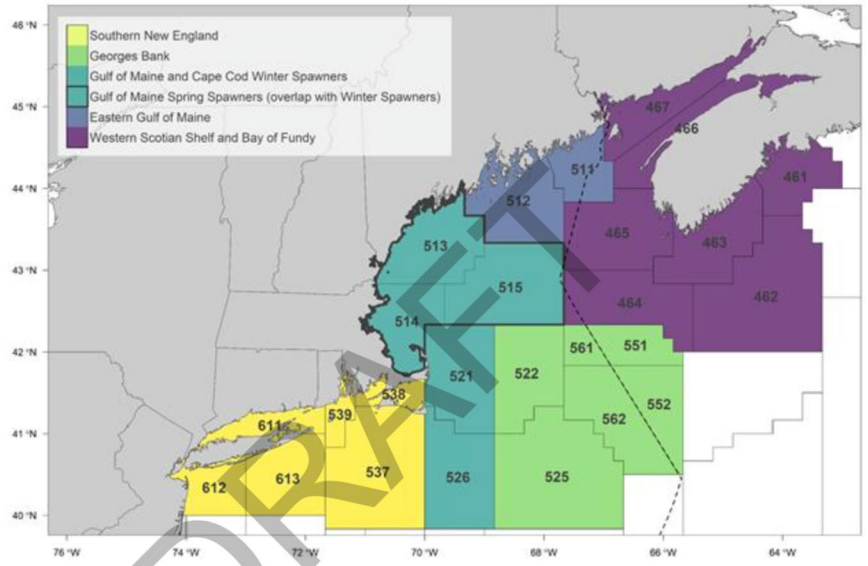


Figure 9.8. Proposed biological stock structure of Atlantic cod (*Gadus morhua*) in NAFO division 5 and adjacent division 4X.

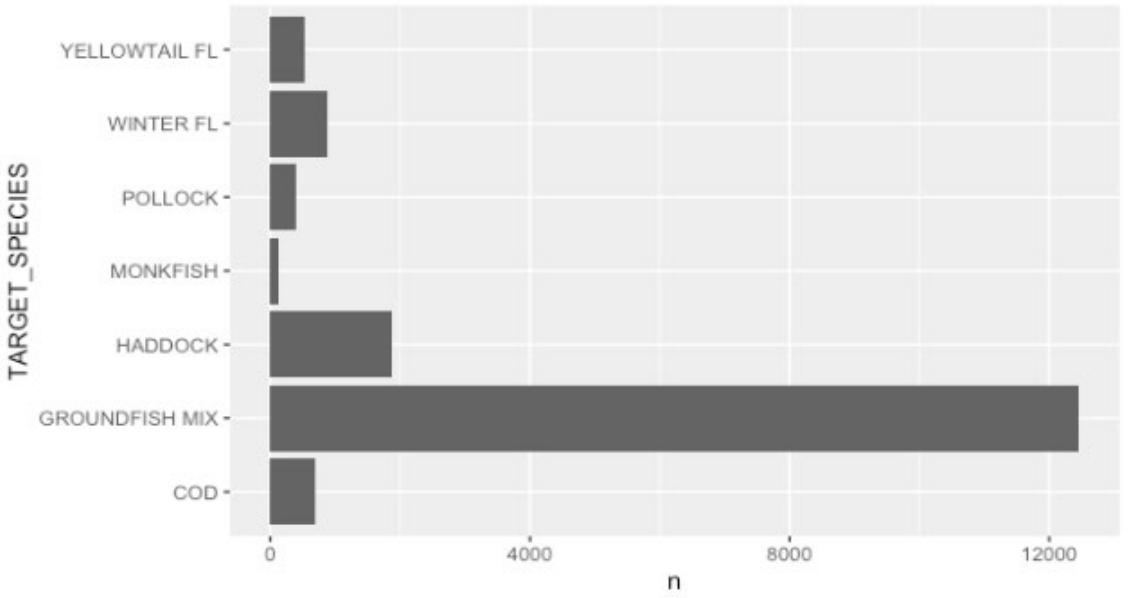
DRAFT

Stock Area	Number of vessels	Number of trips	Number of efforts
GB	10	365	4082
SNE	23	804	2378
WGOMSS_WGOMWS	15	3227	8751
WGOMWS	9	247	1734

- Study Fleet data from 2010-2020, with groundfish as target species AND >1 cod caught
- Data binned using the statistical areas within each proposed stock
- WGoM binned as either definitely spring spawning or from the overlapping area of spring and winter spawners

Study Fleet Data Break Down

Stock Area	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Number of vessels											
GB	6	5	3	5	4	5	3	4	3	3	4
SNE	3	9	7	11	10	14	9	9	7	7	5
WGOMSS_WGOMWS	9	10	10	9	9	6	7	7	7	5	7
WGOMWS	5	4	4	4	4	3	4	2	2	2	1
Number of trips											
GB	42	52	33	32	40	25	24	31	35	19	29
SNE	27	105	70	145	86	116	65	80	52	32	24
WGOMSS_WGOMWS	204	479	472	320	244	169	135	239	347	249	350
WGOMWS	23	37	17	36	24	16	23	19	21	15	13
Number of efforts											
GB	606	578	286	410	573	276	256	286	352	195	219
SNE	65	378	288	460	311	296	182	189	123	50	32
WGOMSS_WGOMWS	544	1418	1424	1016	684	428	316	632	855	618	766
WGOMWS	132	267	128	210	174	143	178	139	143	94	111



Notes:

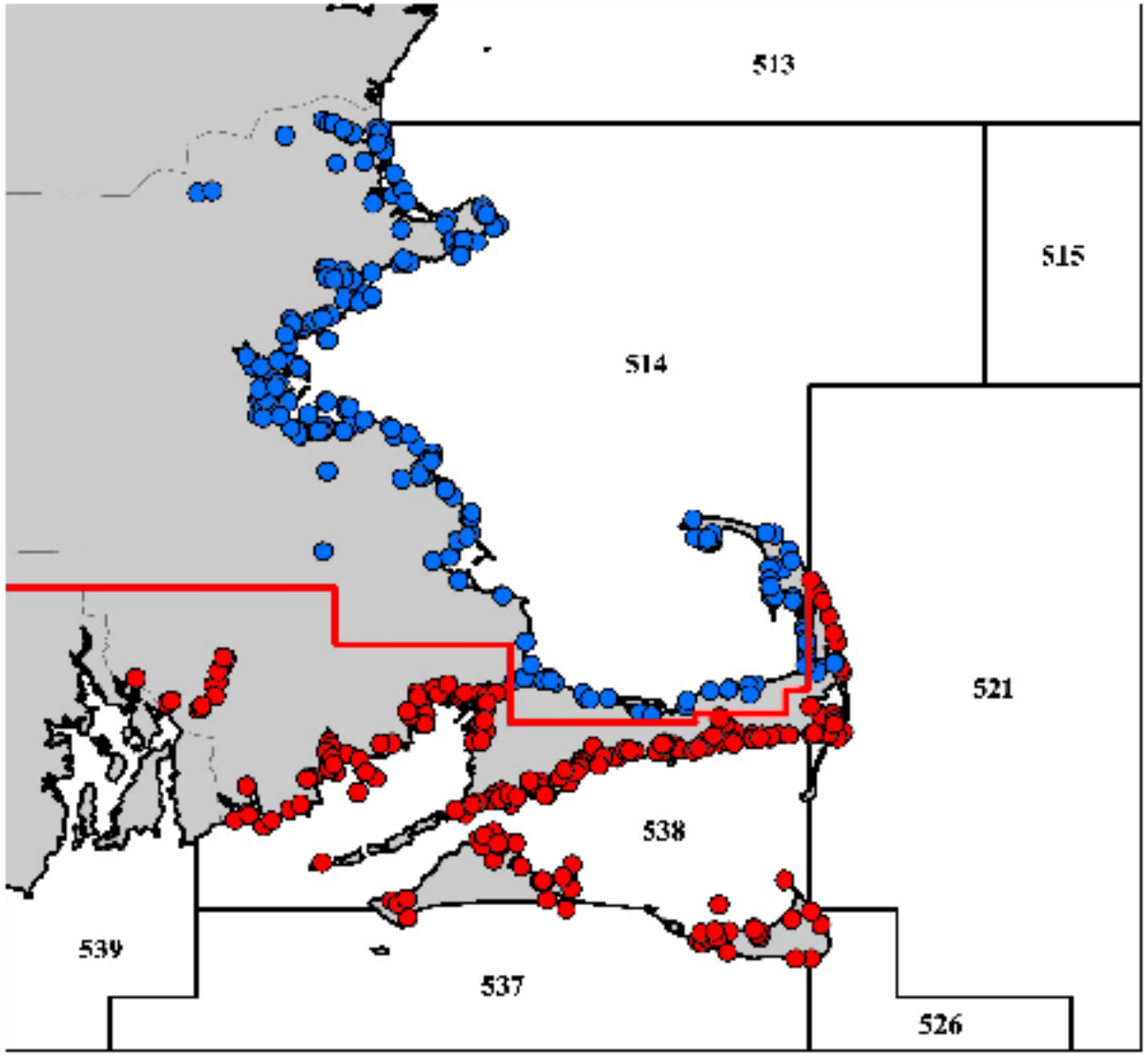
- Study Fleet data from trips targeting groundfish, with at least one caught between 2010-2020
- These data represent ~87% of all cod records (23,300/26,700 cod) in Study Fleet database

VTR_GEAR_CODE										
DSC	GNS	GNT	HND	OHS	OTF	OTM	OTO	OTR	OTS	PTL
46	14997	12	3168	8222	320456	51	7044	1270	28	43

NOAA FISHERIES

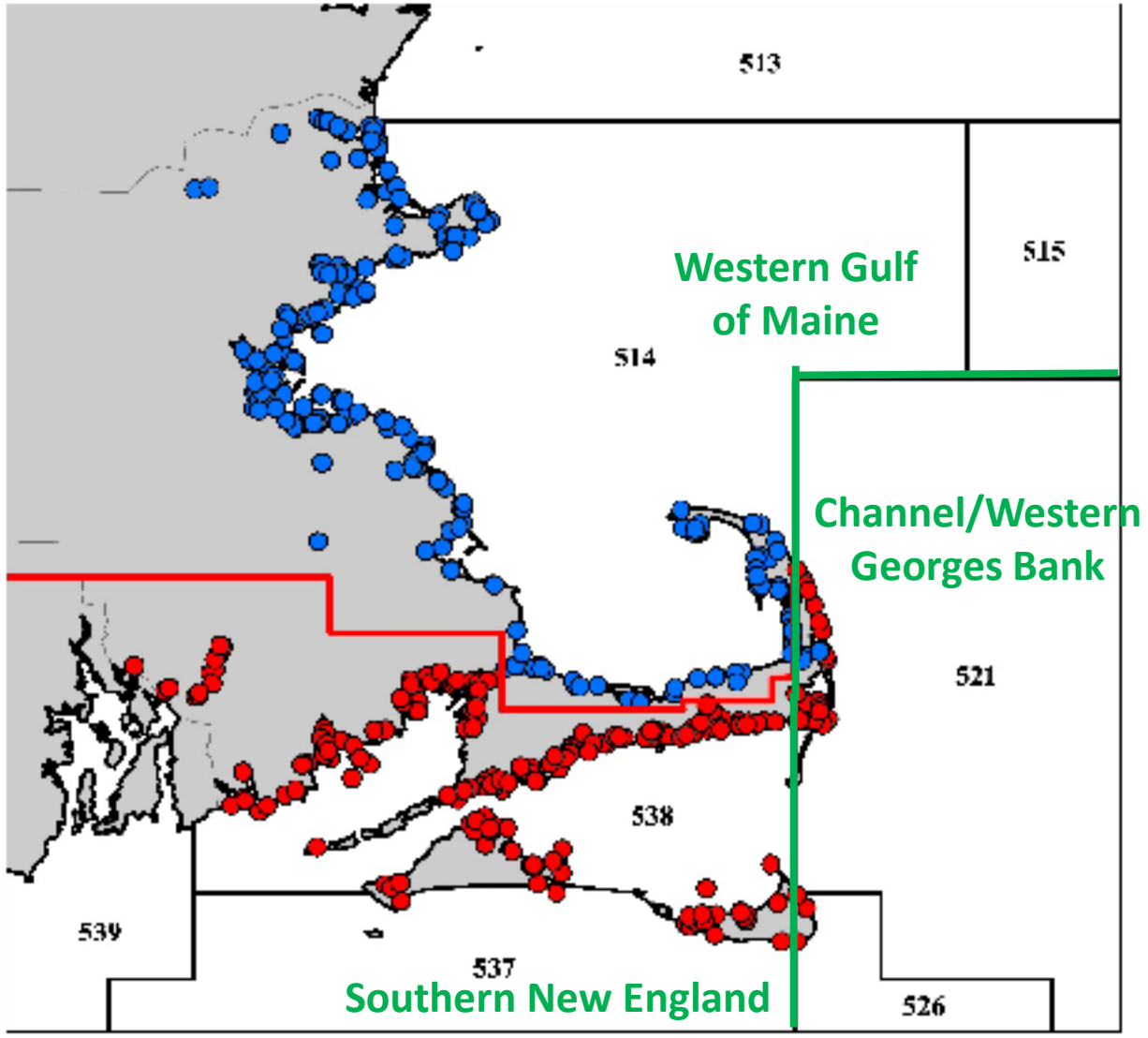
Recreational Catch Data

- Survey design to generate coast-wide estimates of landings and discards
- Catch estimates are generated by state
- Currently, Massachusetts has recreational catch from two stock areas (Gulf of Maine and Georges Bank & South)
  - Catches are assigned to stock area by landing or intercept location

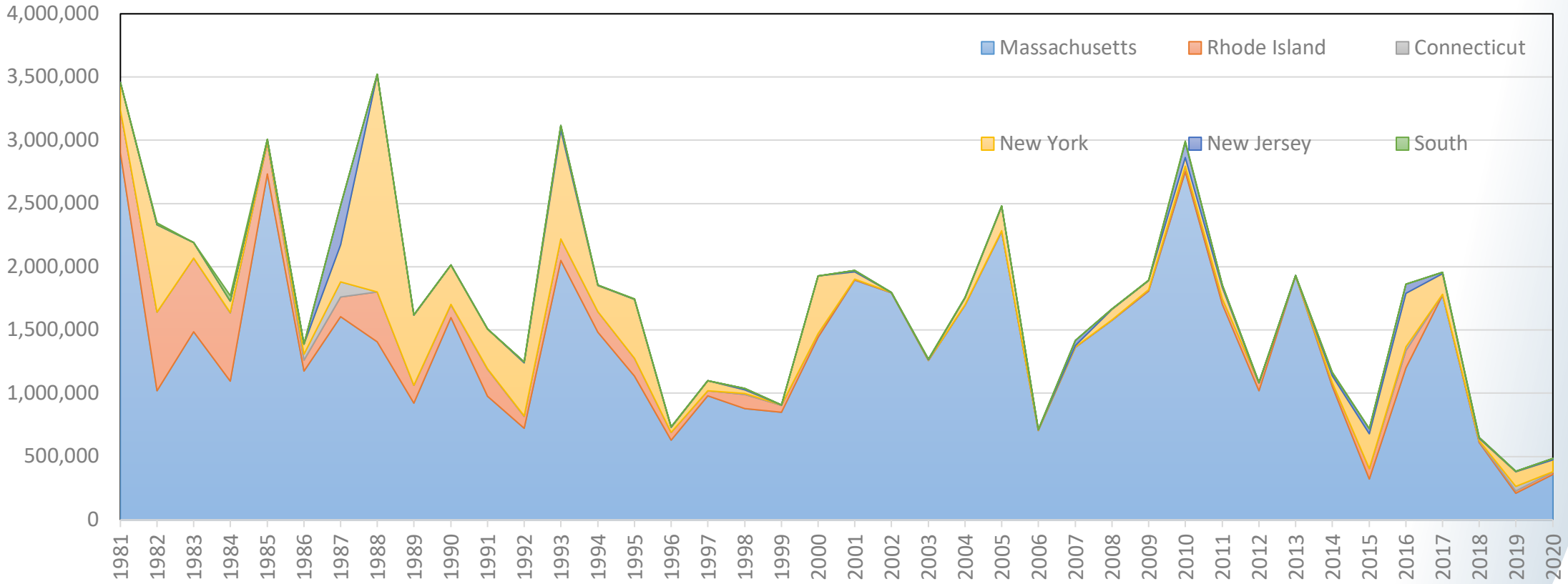


Recreational Catch Data

- Under a Five Stock Management Model
  - Massachusetts recreational catch would need to be assigned to three different stock areas (SNE, Channel/Western GB, and Georges Bank)
  - Maine recreational catch would need tobe assigned to two different stock areas (Western and Eastern GOM)



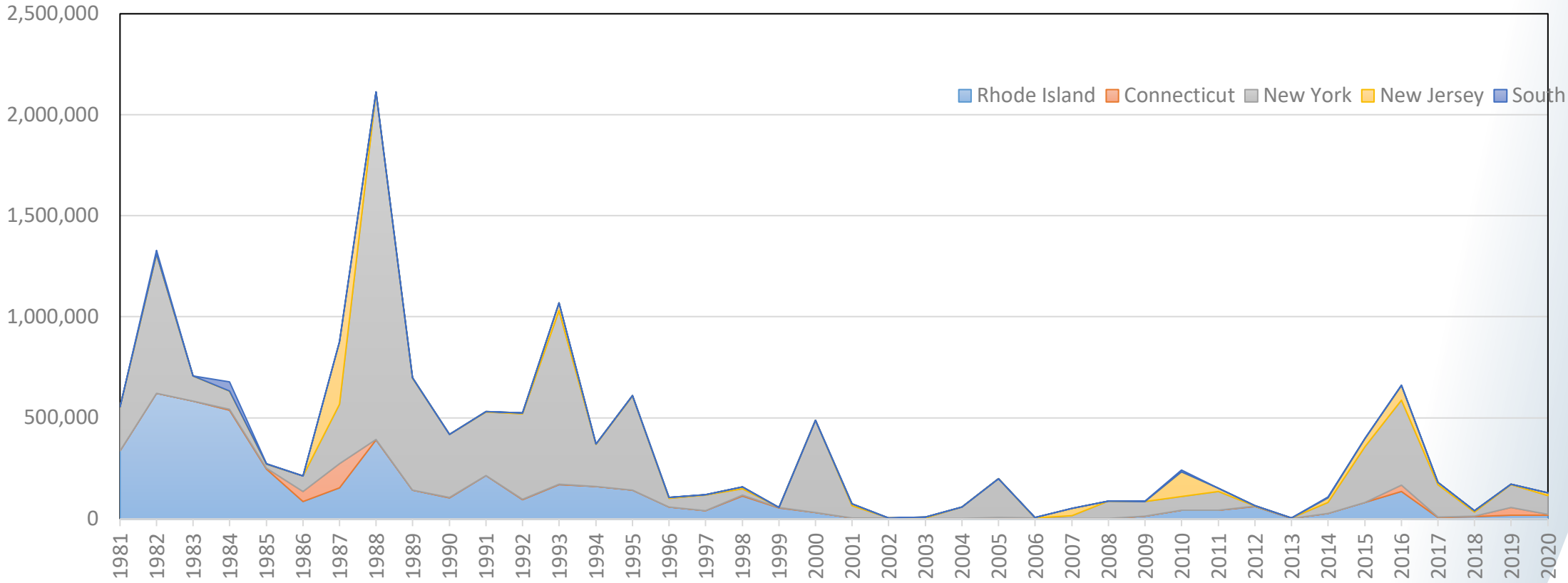
Southern New England Stock Area Recreational Catch Numbers (A+B1+B2)



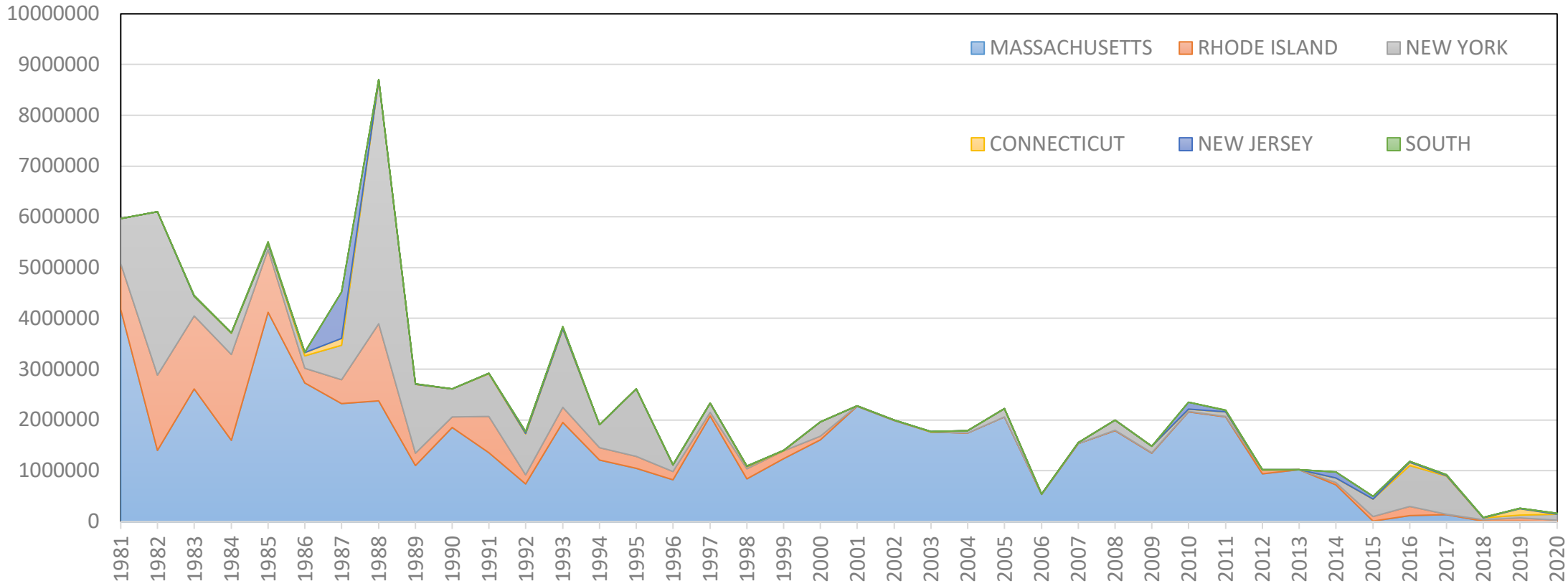
NOAA FISHERIES

Southern New England Stock Area Recreational Catch Numbers (A+B1+B2)

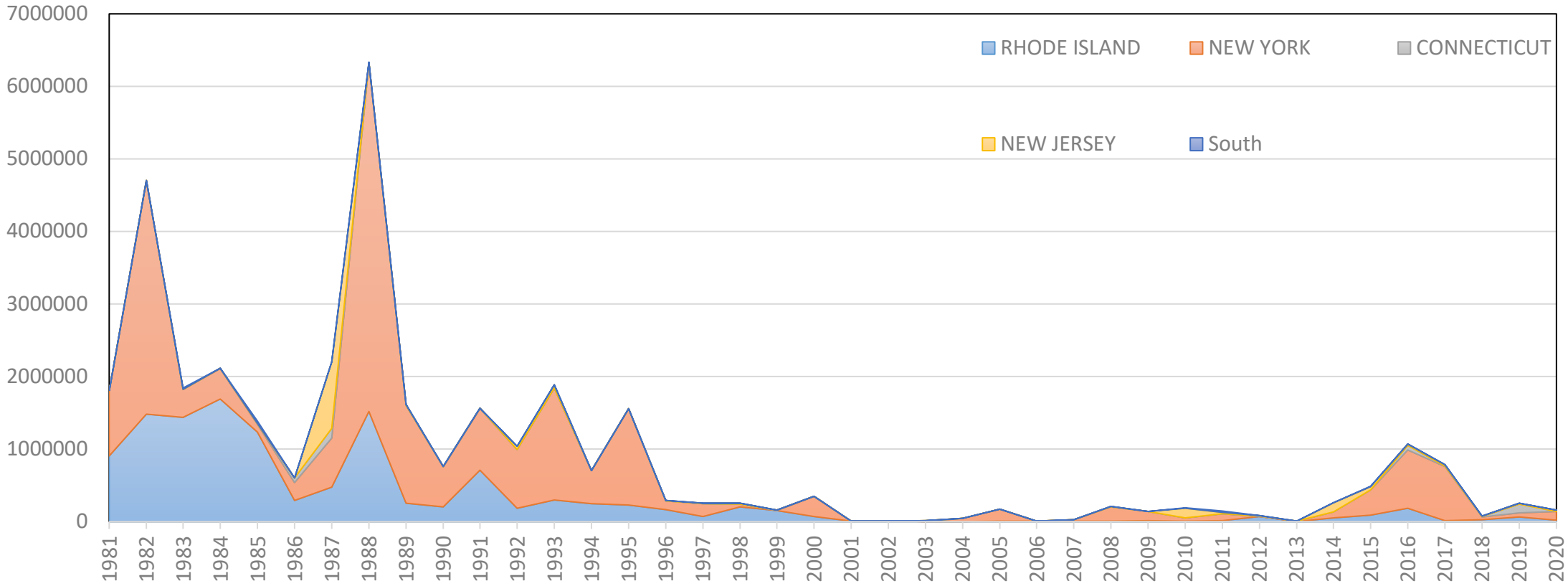
Excluding Massachusetts



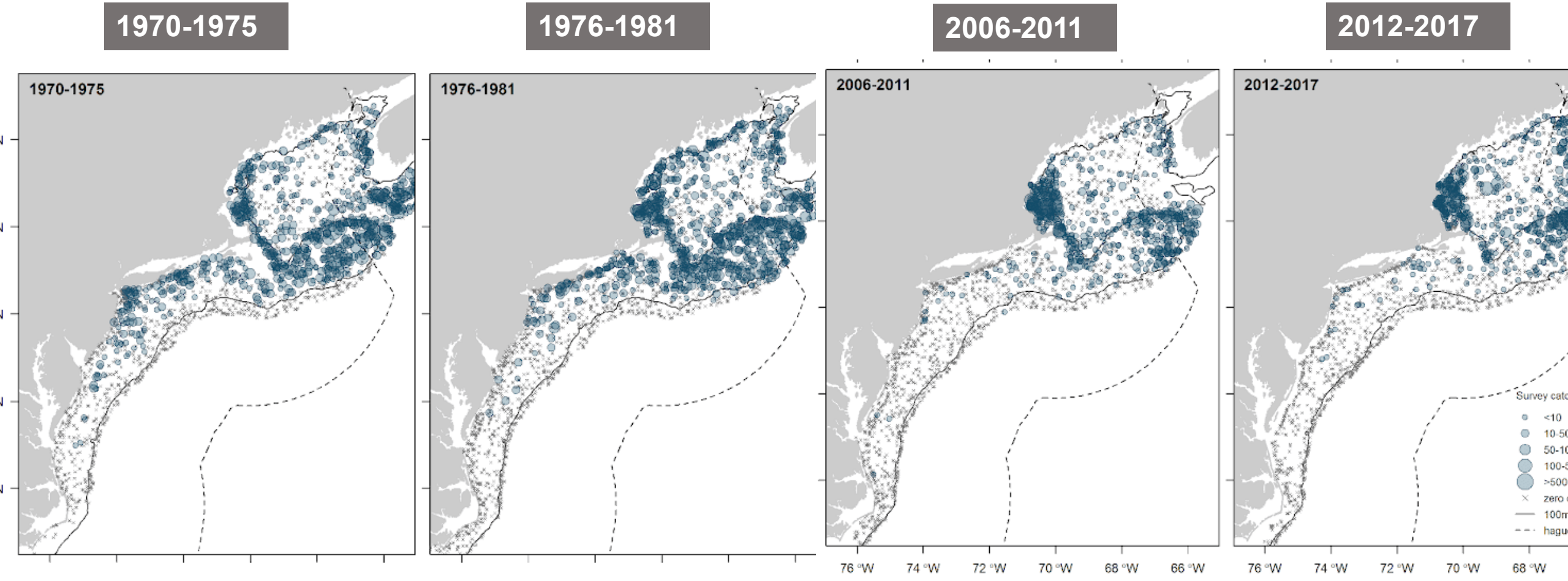
Southern New England Stock Area Recreational Catch Weight (A+B1)



Southern New England Stock Area Recreational Catch Weight (A+B1)
(excluding Massachusetts)

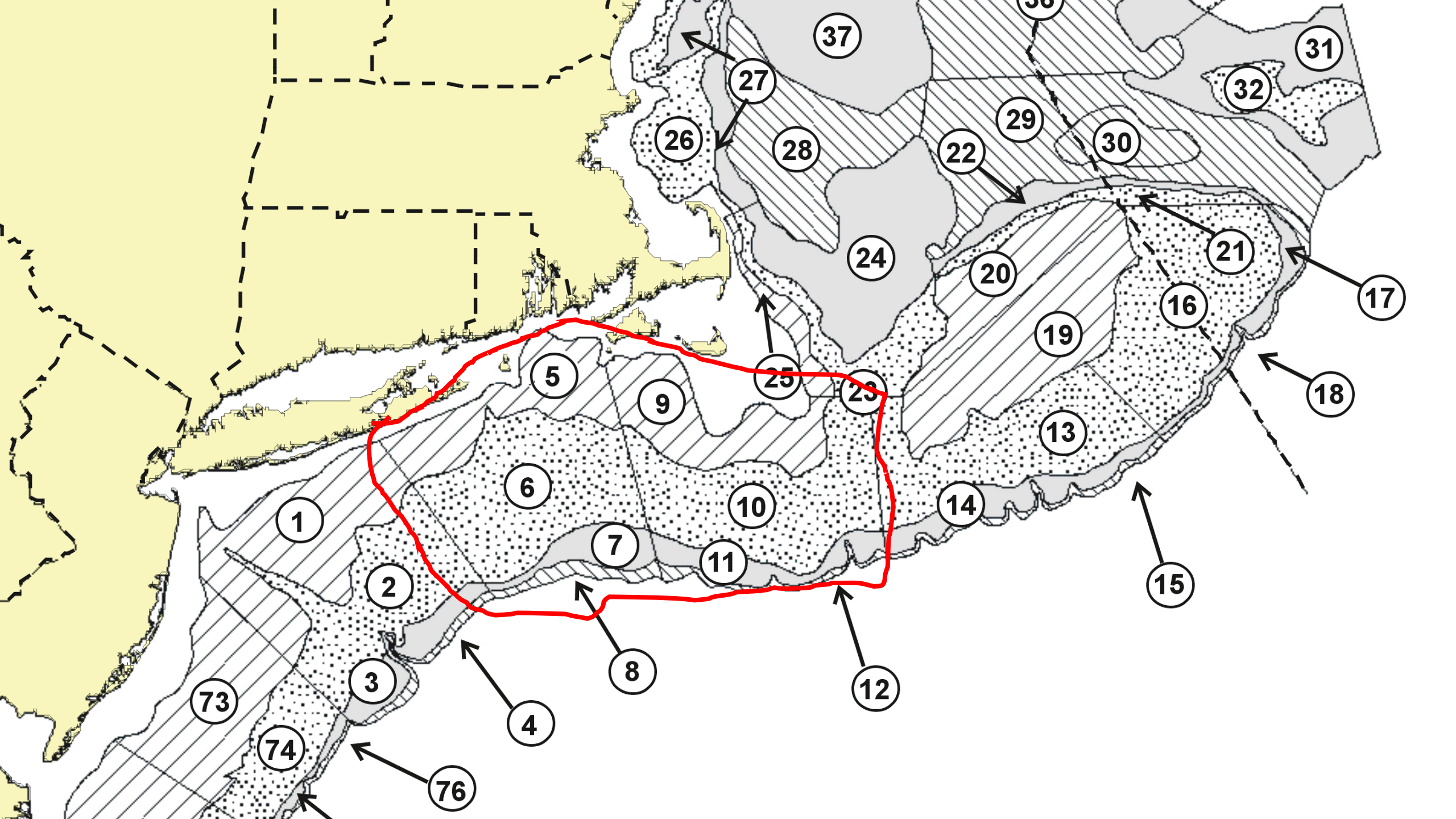


Abundance (cod biomass/tow [spring])



Analysis of NEFSC Bottom Trawl Survey Data

- For this workshop, only FSV Bigelow survey data (2009-2019) were analyzed
  - Full data set including Albatross years will be analyzed during the Research Track Assessment
- Strata set includes offshore strata 01050-01120, which is roughly representative of the Southern New England stock area
- No attempts were made to post-stratify the survey, but this could be attempted during the Research Track assessment



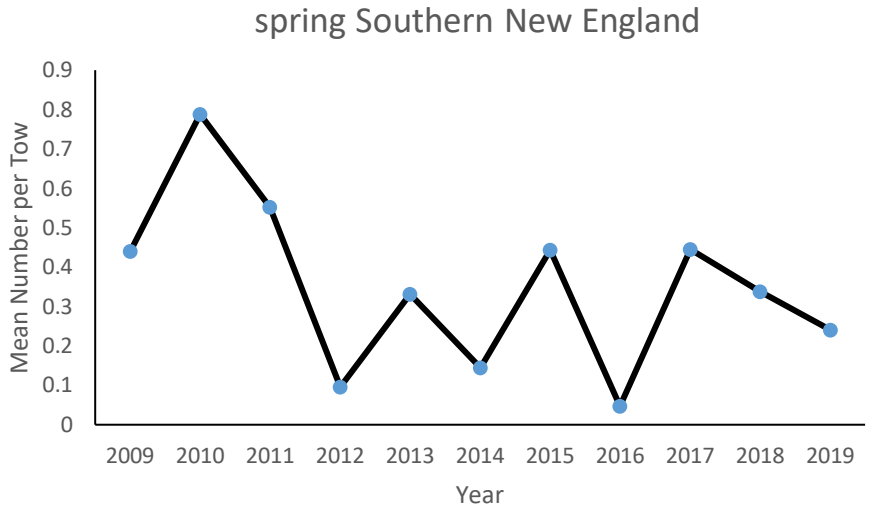
37
31
32
27
26
28
29
22
30
24
21
20
17
16
19
18
5
25
23
9
13
6
10
14
1
7
11
15
2
8
12
3
73
4
74
76

Southern New England Stock

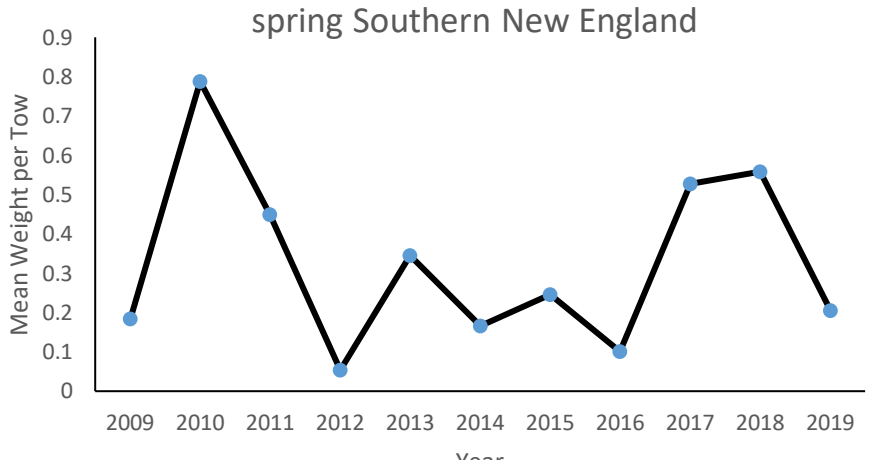
NOAA NEFSC Spring Bottom Trawl Survey

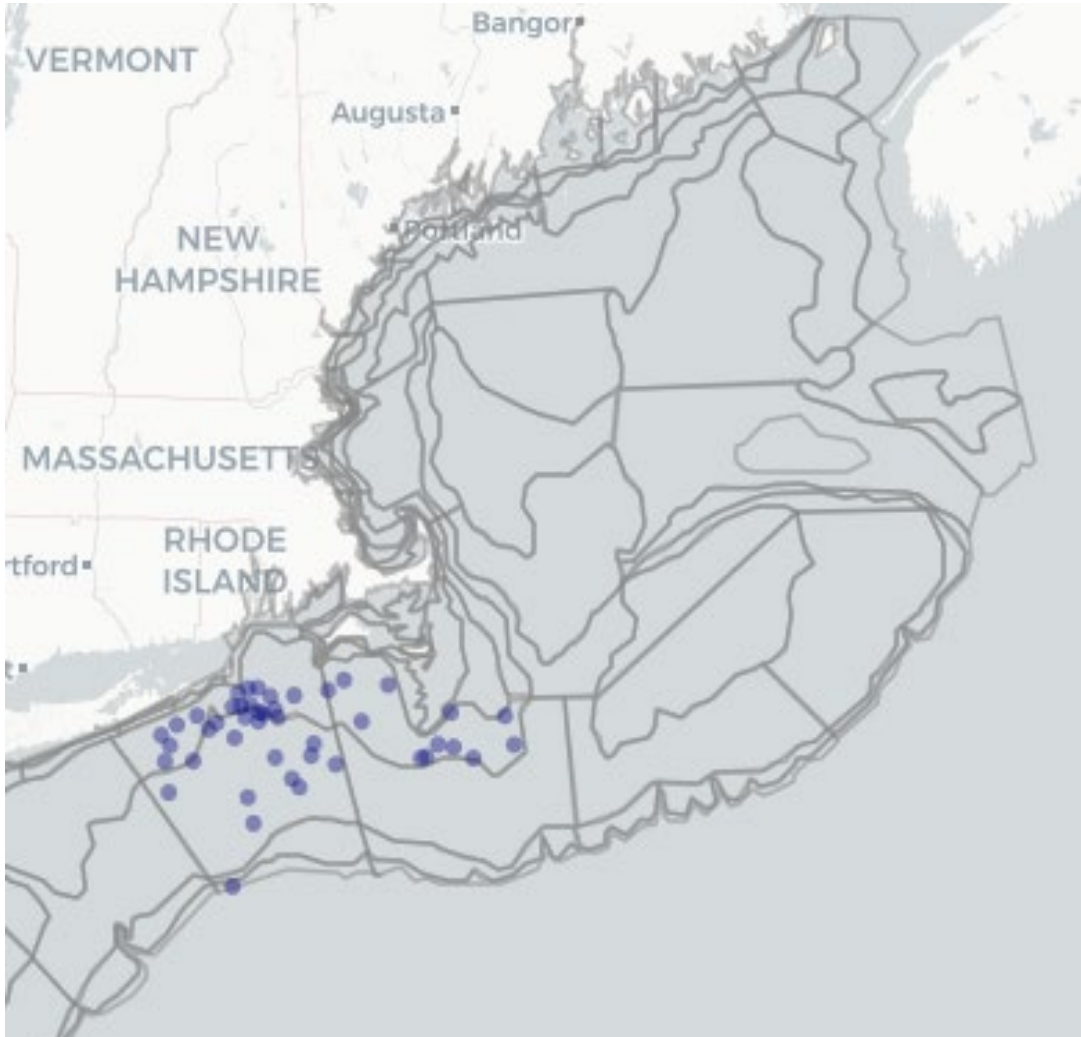
NOAA FISHERIES
National Oceanic and Atmospheric Administration

Abundance



Biomass



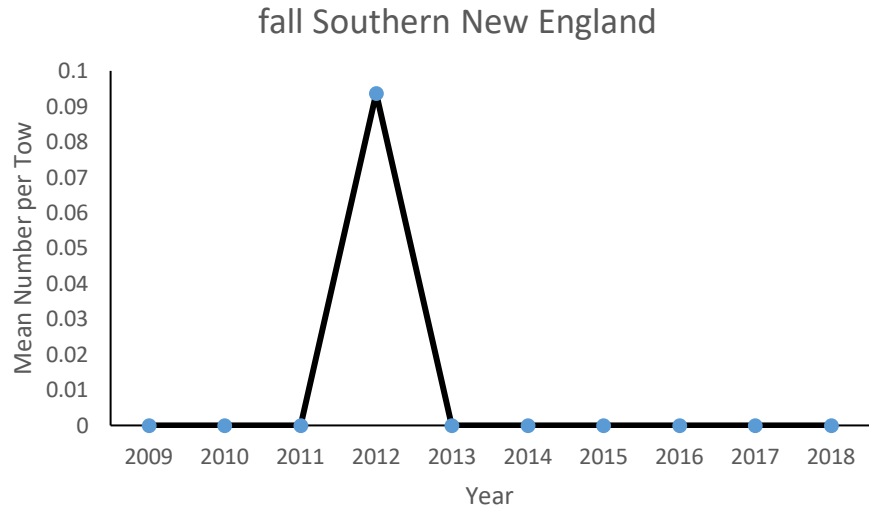


Southern New England Stock

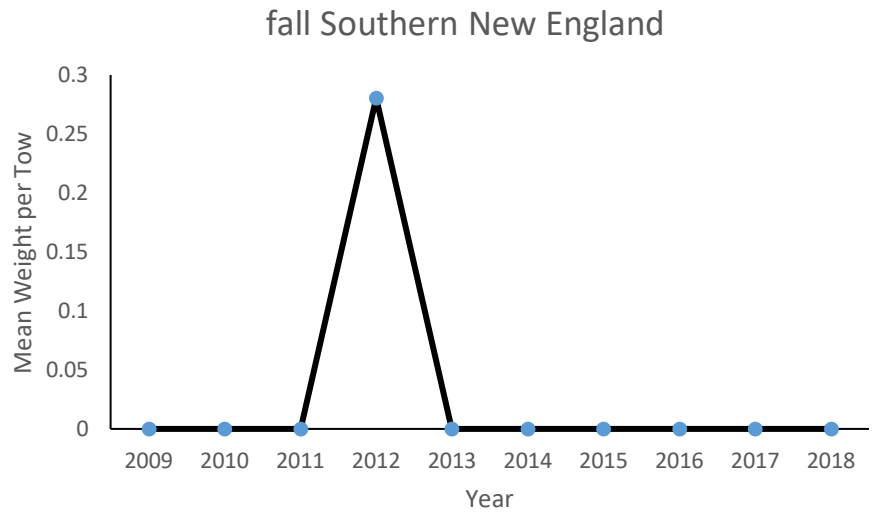
NOAA NEFSC Spring Bottom Trawl Survey

NOAA FISHERIES
National Oceanic and Atmospheric Administration

Abundance



Biomass



Age Structure Information

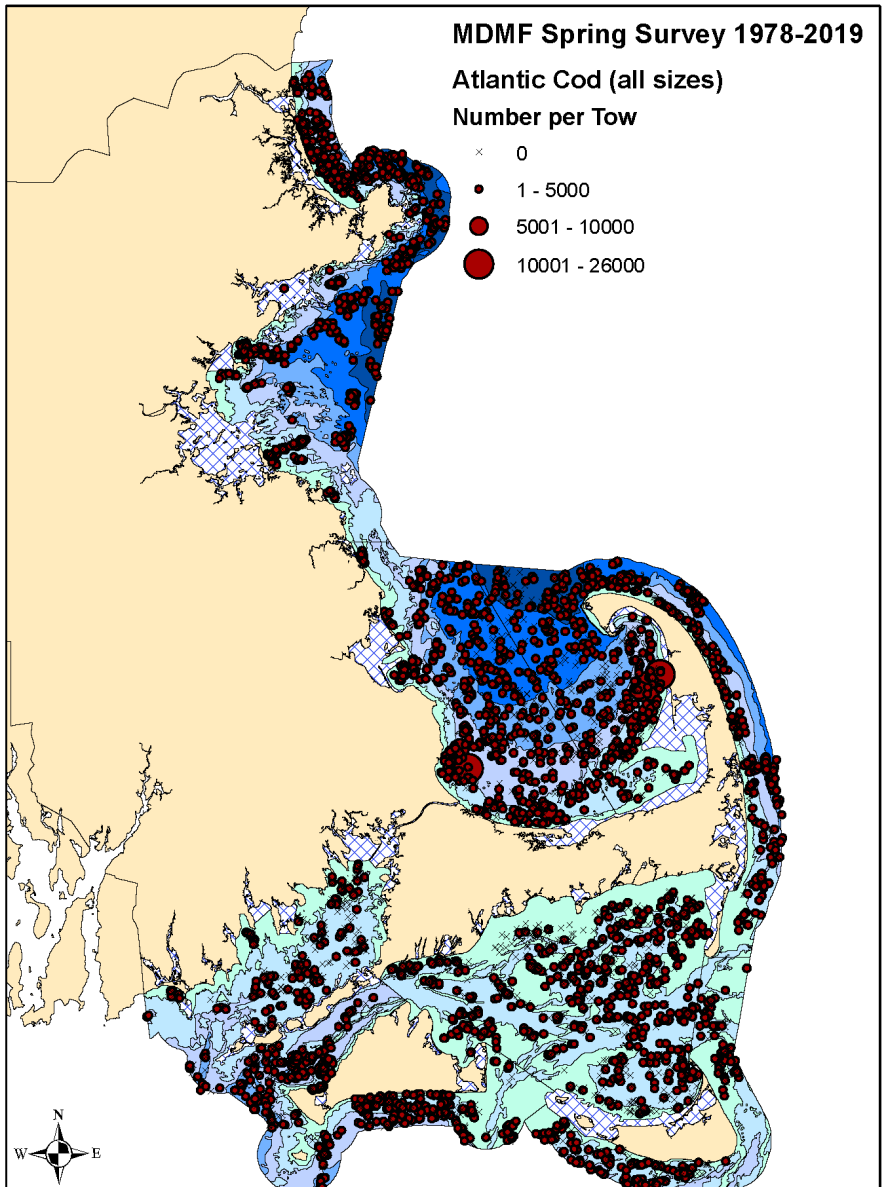
NEFSC Spring Survey

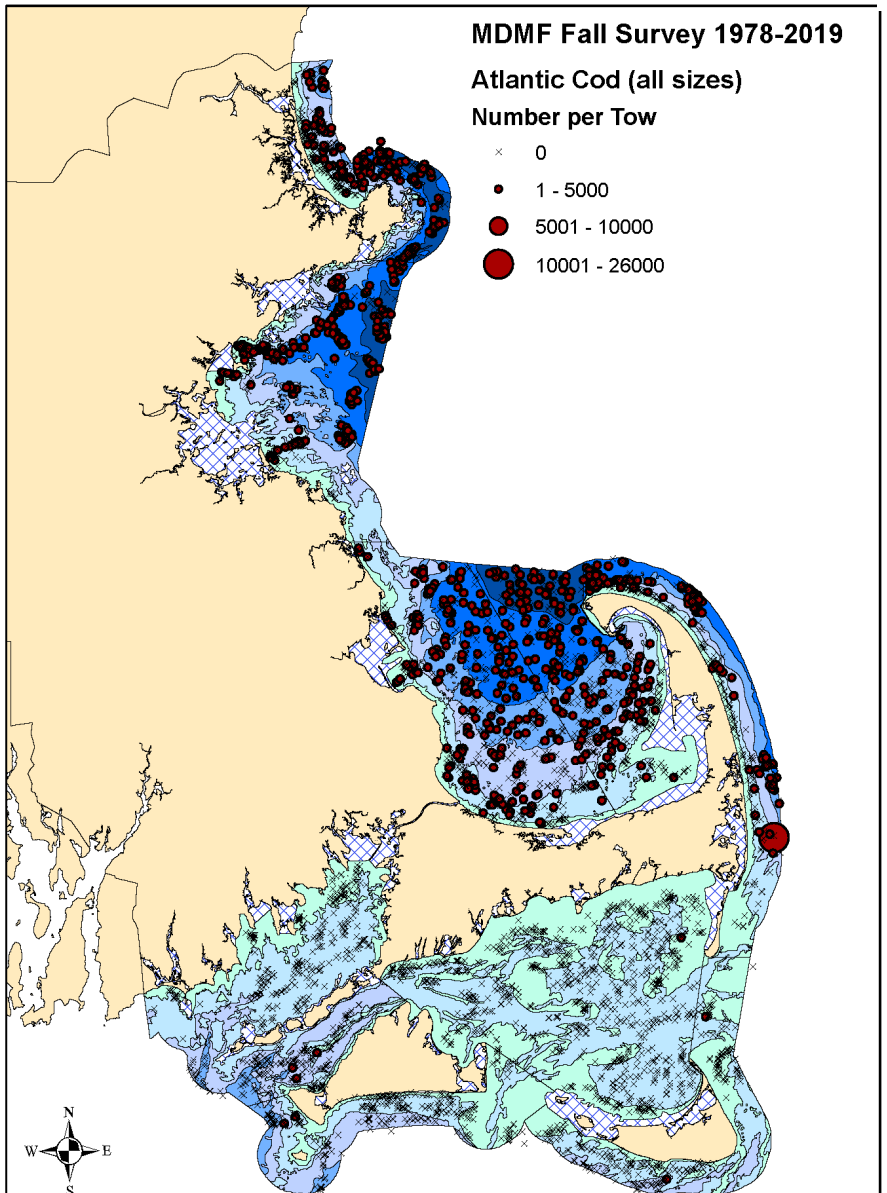
- Age 0 Fish: 3 of 11 surveys
- Age 1 Fish: 5 of 11 surveys
- Age 2 Fish: 8 of 11 surveys
- Age 3 Cod: 10 of 11 surveys
- Age 4 Cod: 4 of 11 surveys
- No Cod older than age 4 detected

NEFSC Fall Survey

- 1 Age 3 Fish detected in 2012 survey

Massachusetts DMF Inshore Trawl Survey
Cod Spatial Distribution 1978-2019





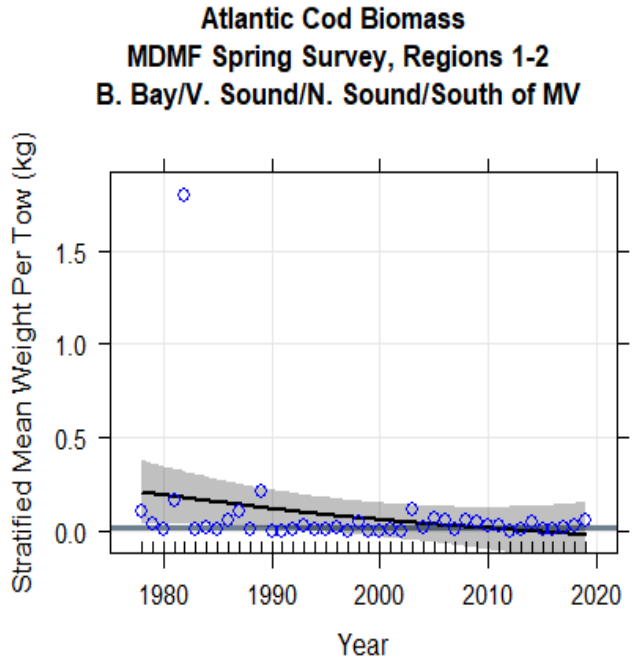
Analysis of MADMF Bottom Trawl Survey Data

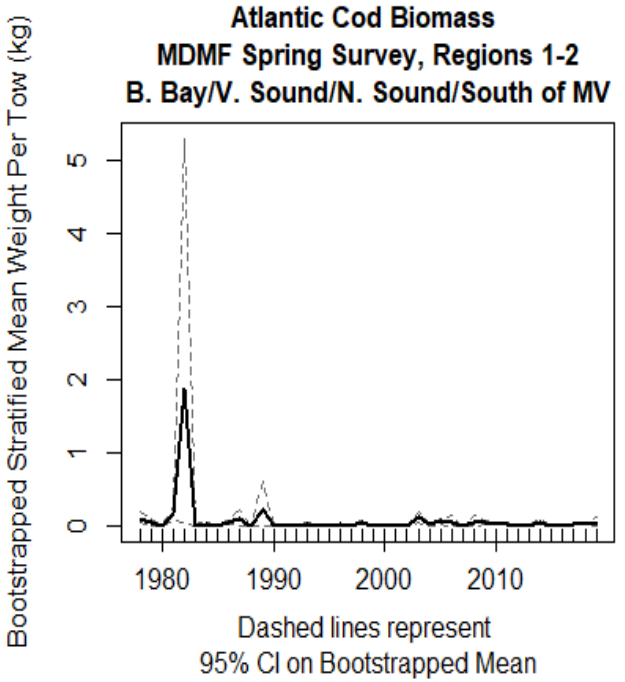
- Strata set includes 11-16, which is roughly representative of the Southern New England stock area
- No attempts were made to post-stratify the survey, but this could be attempted during the Research Track assessment

Massachusetts Inshore Bottom Trawl Survey 1978-2019

Spring Survey

Stratified Mean Number Per Tow

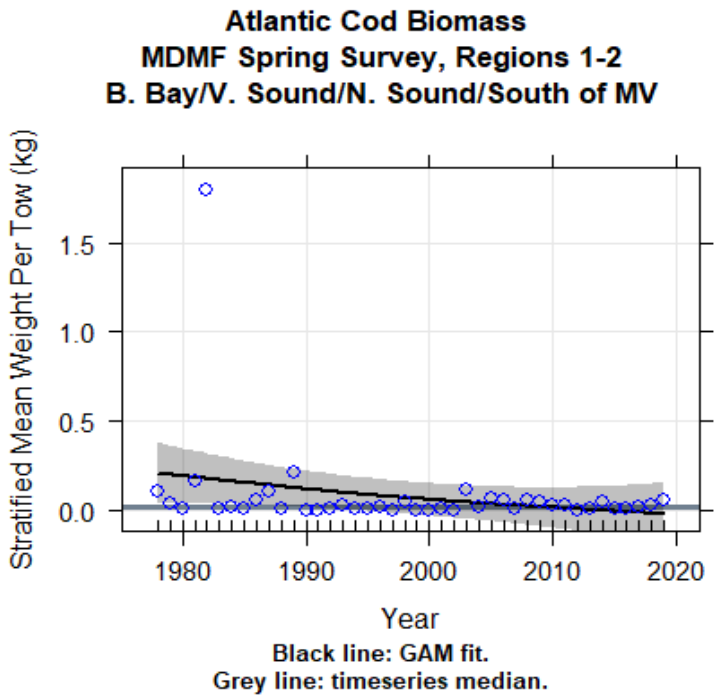


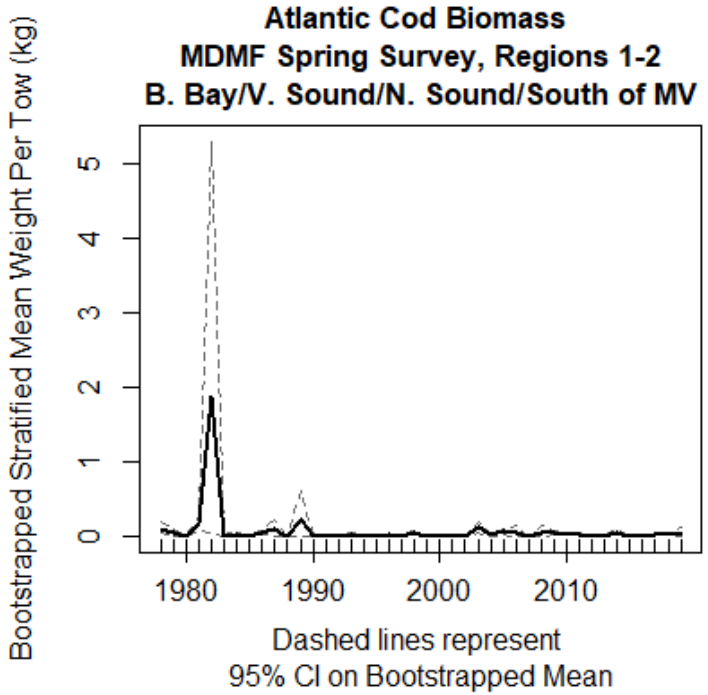


Massachusetts Inshore Bottom Trawl Survey 1978-2019

Fall Survey

Stratified Mean Weight Per Tow

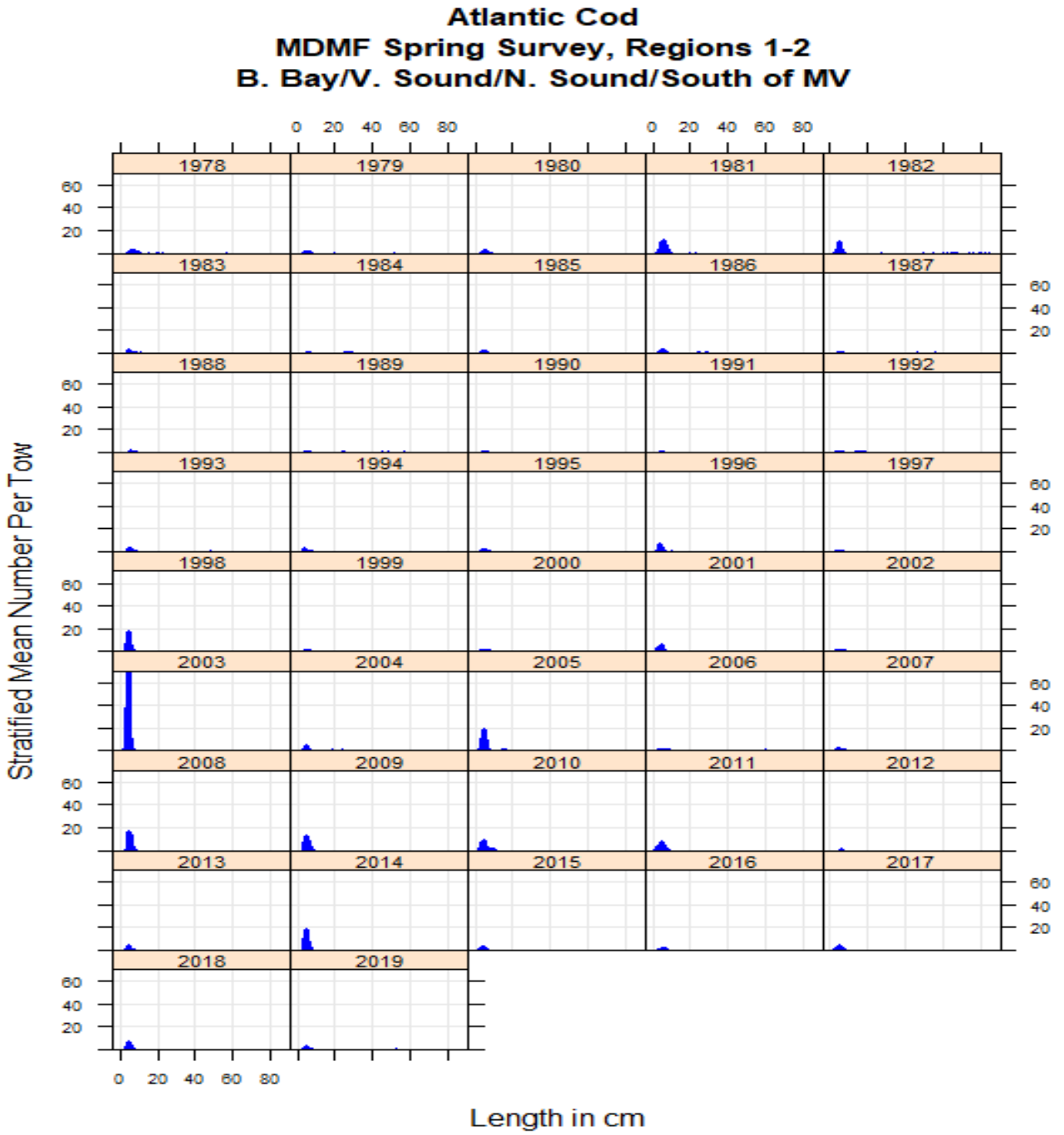




Massachusetts Inshore Bottom Trawl Survey 1978-2019

Spring Survey

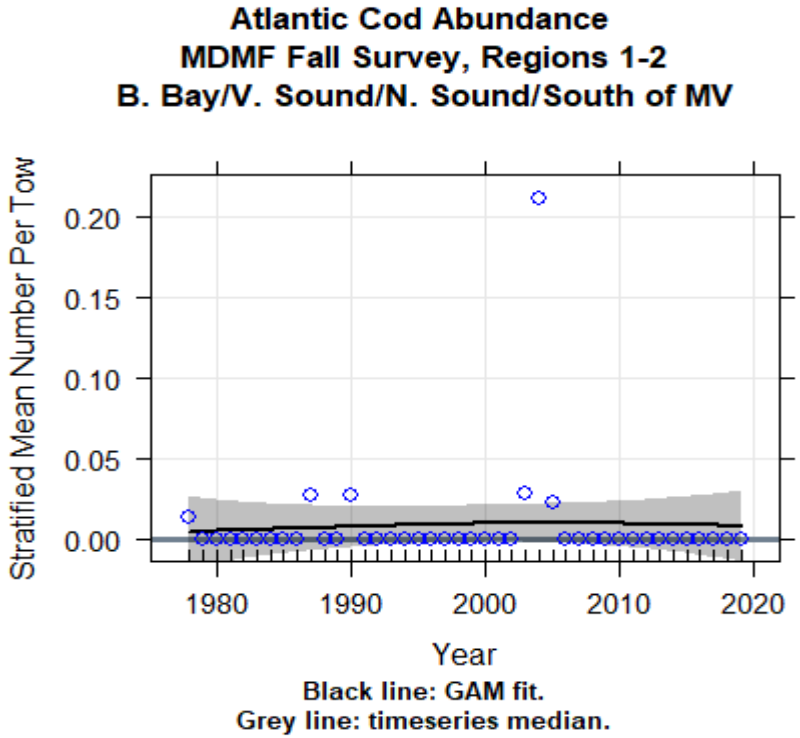
Length Frequency

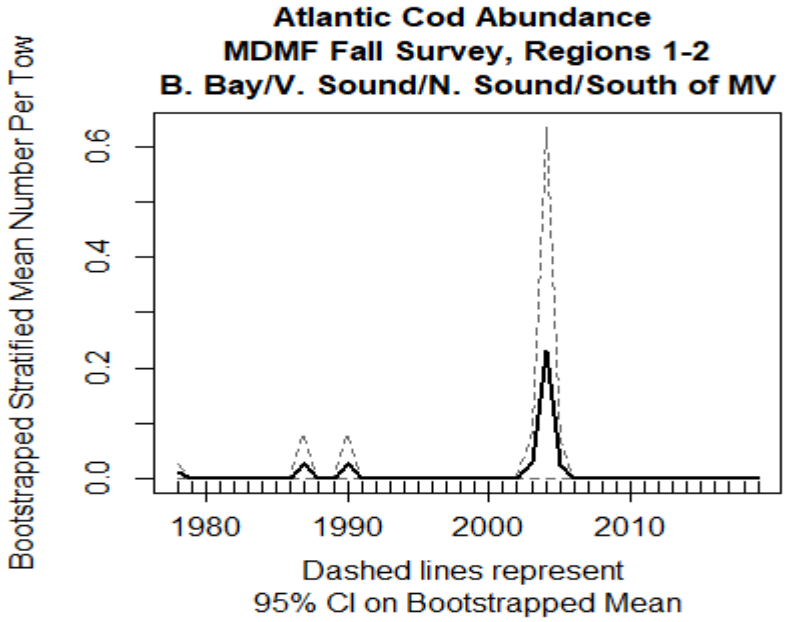


Massachusetts Inshore Bottom Trawl Survey 1978-2019

Fall Survey

Stratified Mean Number Per Tow

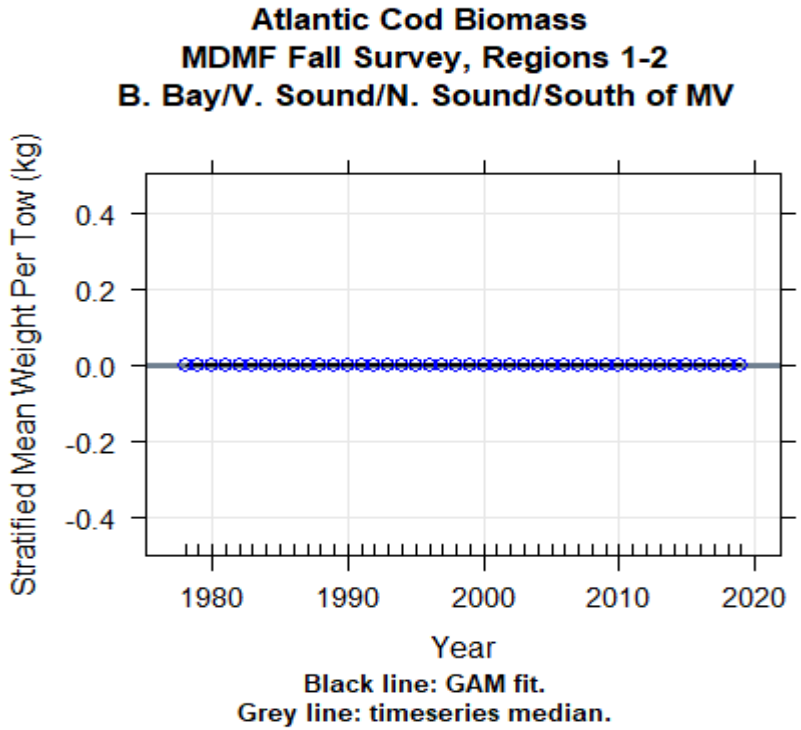


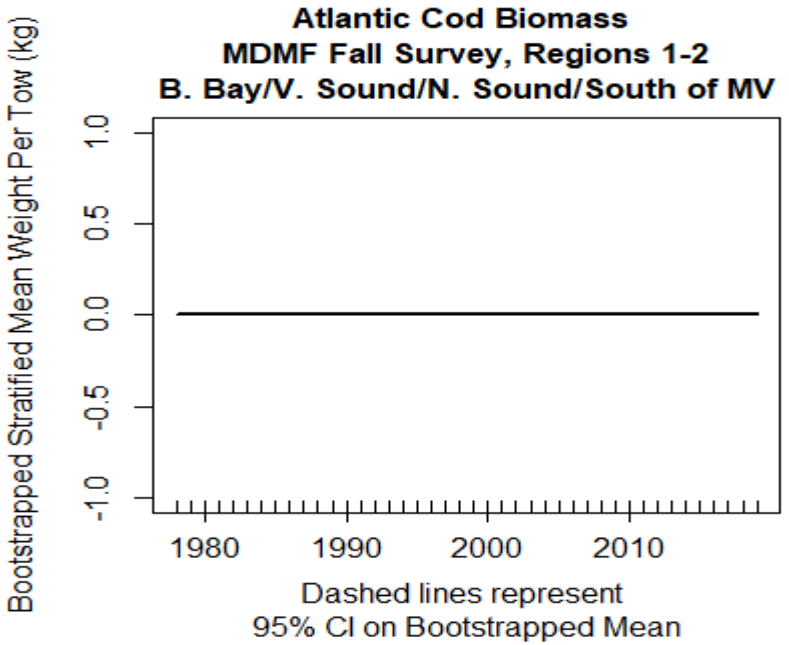


Massachusetts Inshore Bottom Trawl Survey 1978-2019

Fall Survey

Stratified Mean Weight Per Tow

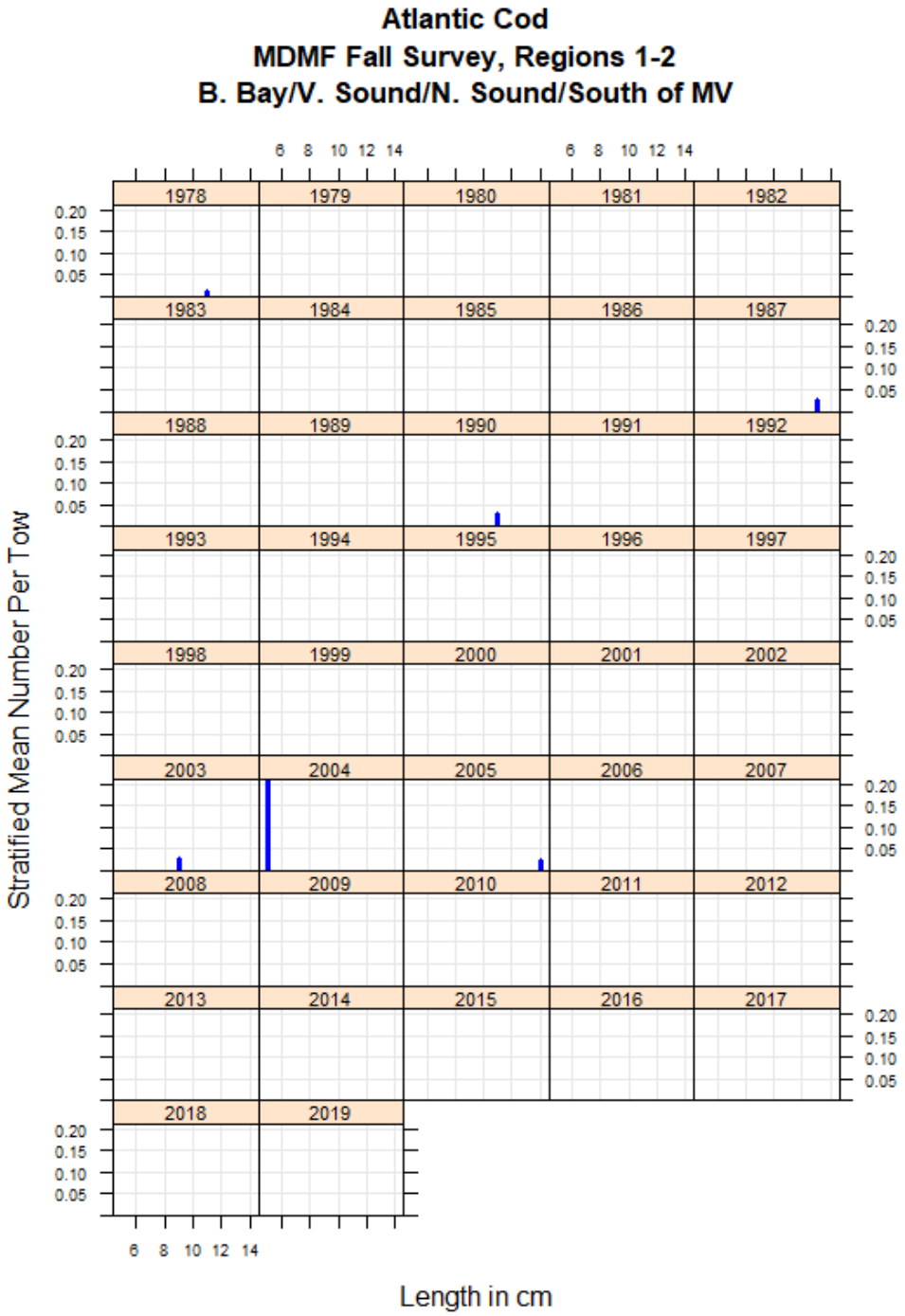




Massachusetts Inshore Bottom Trawl Survey 1978-2019

Fall Survey

Length Frequency



Northeast Area Monitoring and Assessment Program (NEAMAP) Inshore Bottom Trawl Survey

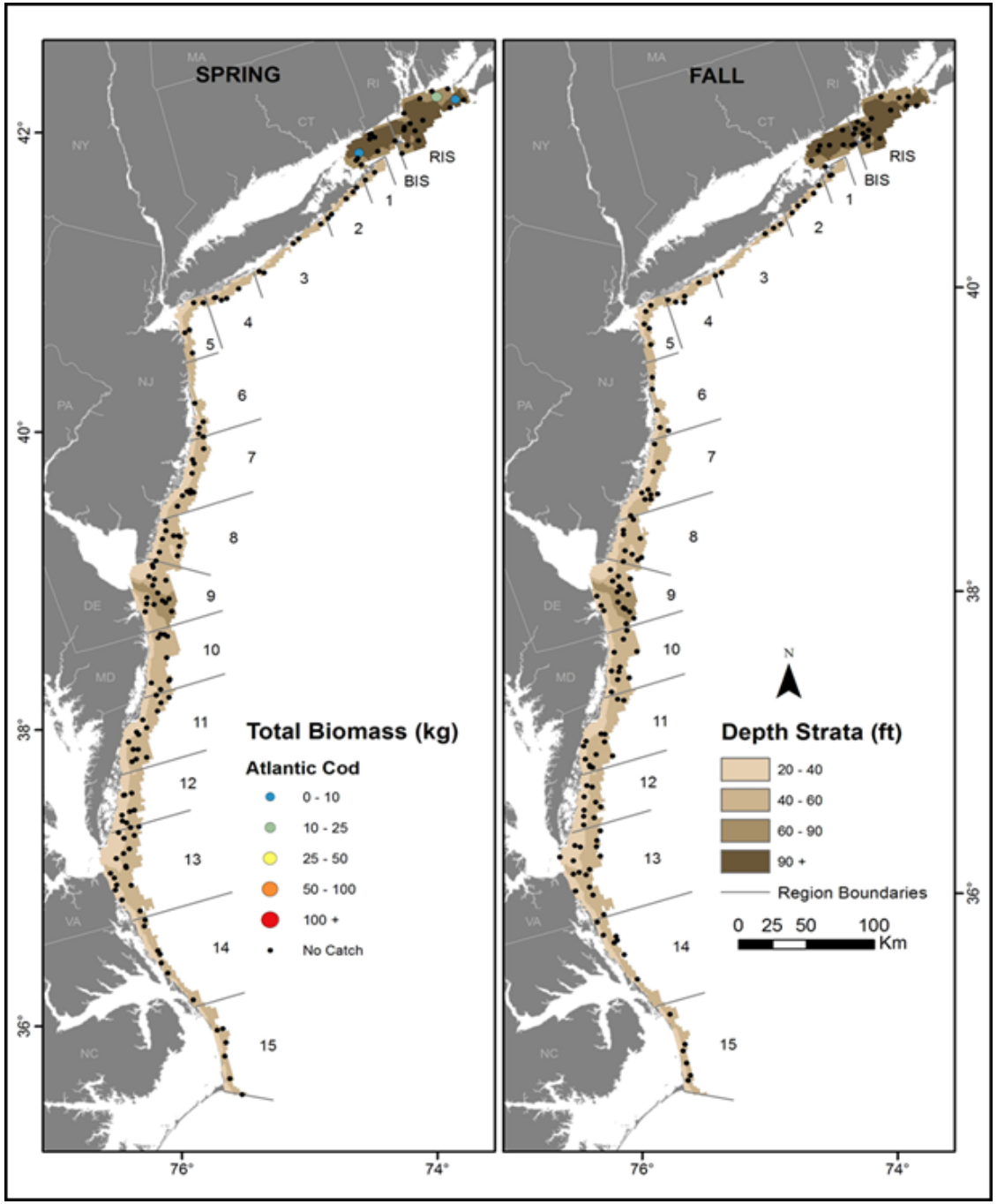
Spring Survey 2008 – 2019

- 0-15 Atlantic Cod captured annually
- > 4 Atlantic Cod captured in 10 of 12 years
- Encounters primarily in Rhode Island, Block Island and Long Island Sounds

Fall Survey 2007-2019

- No Atlantic Cod captured

"These numbers are so small that calculation of abundance indices would not yield meaningful results"



DEM
RHODE ISLAND

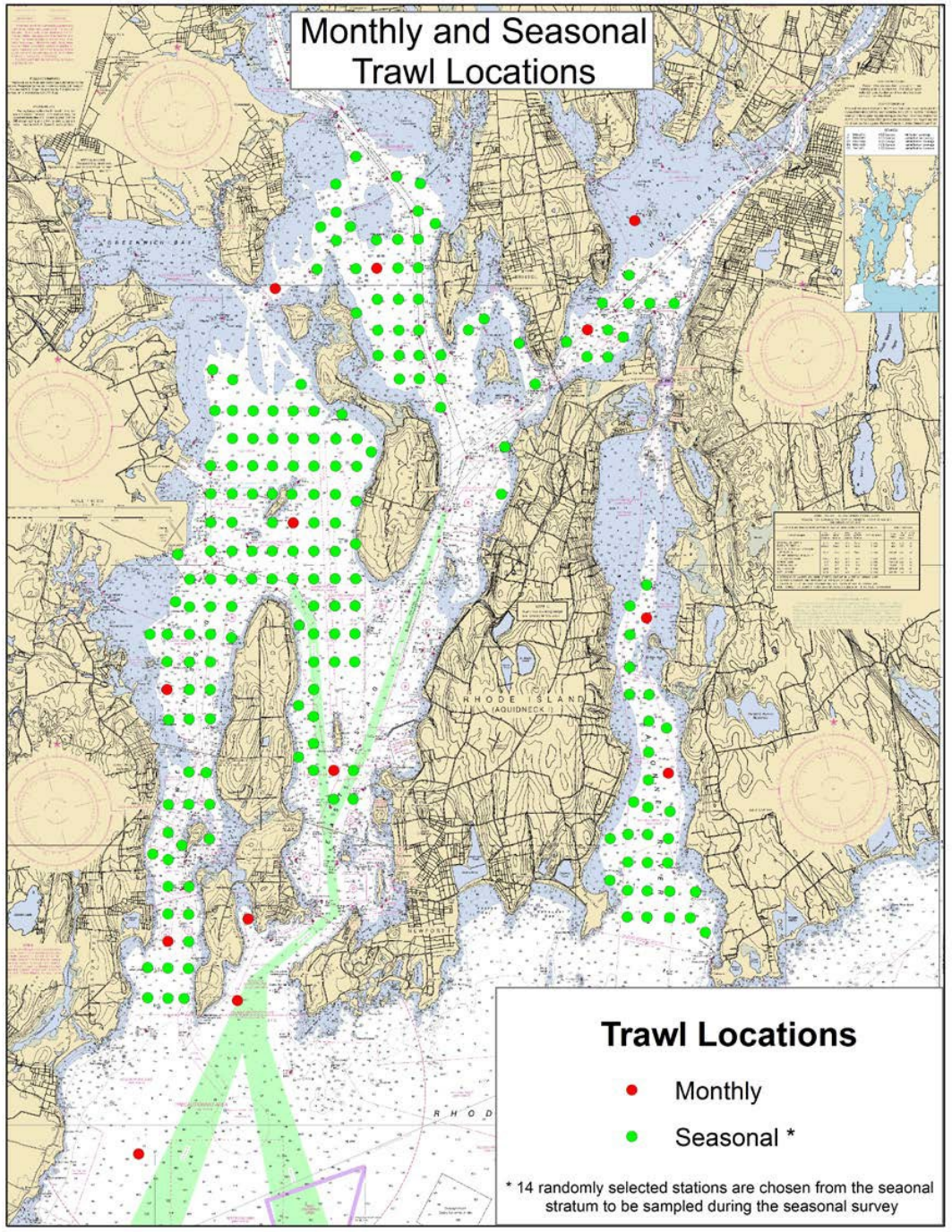
Rhode Island Monthly and Seasonal Trawl Surveys

2019 Monthly Coastal Survey

- 67 Atlantic Cod
- 2.615 kg

2019 Seasonal Coastal Survey

- 343 Atlantic Cod
- 0.142 kg

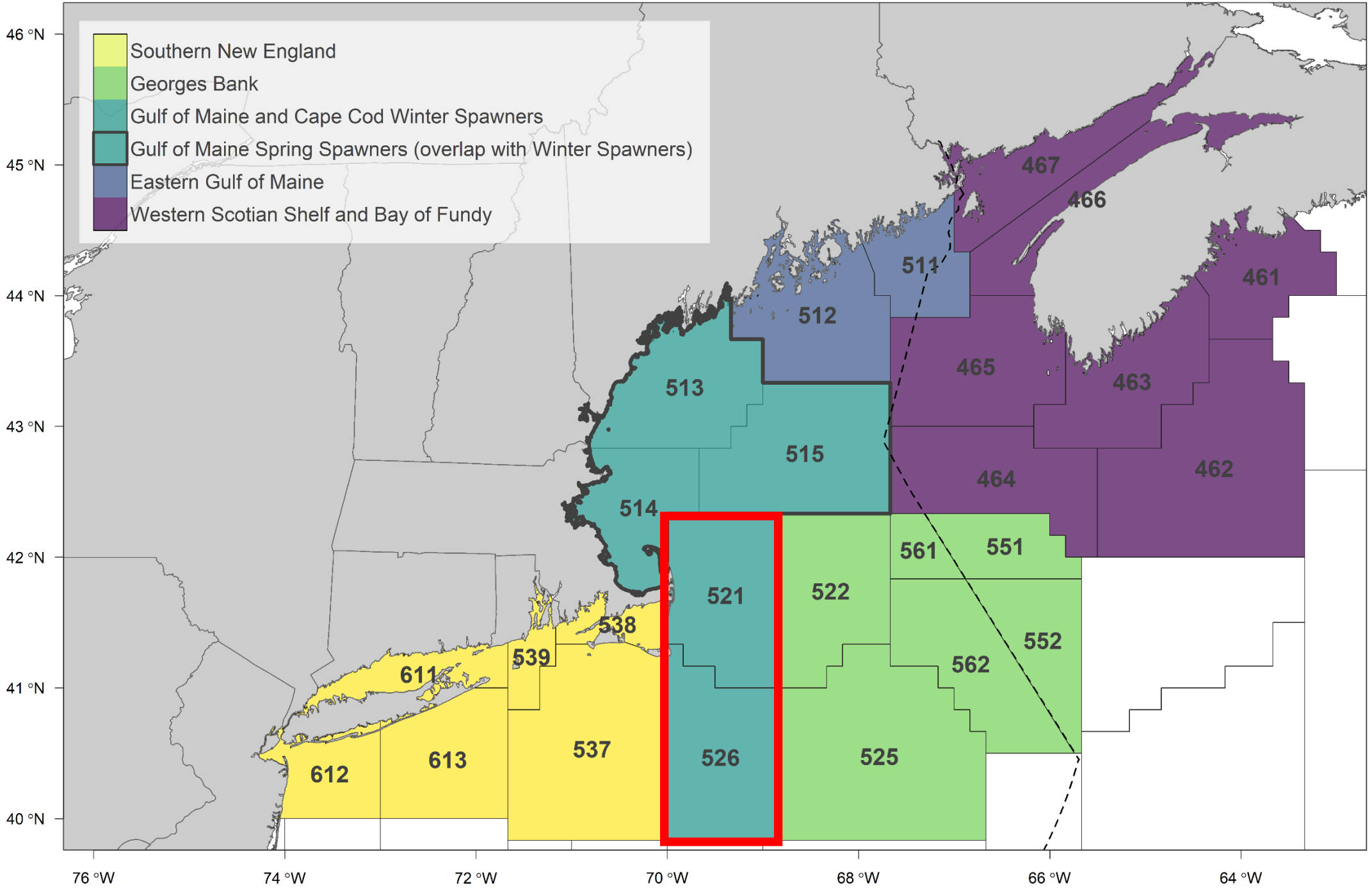


Southern New England Stock Area Preliminary Data Availability Summary

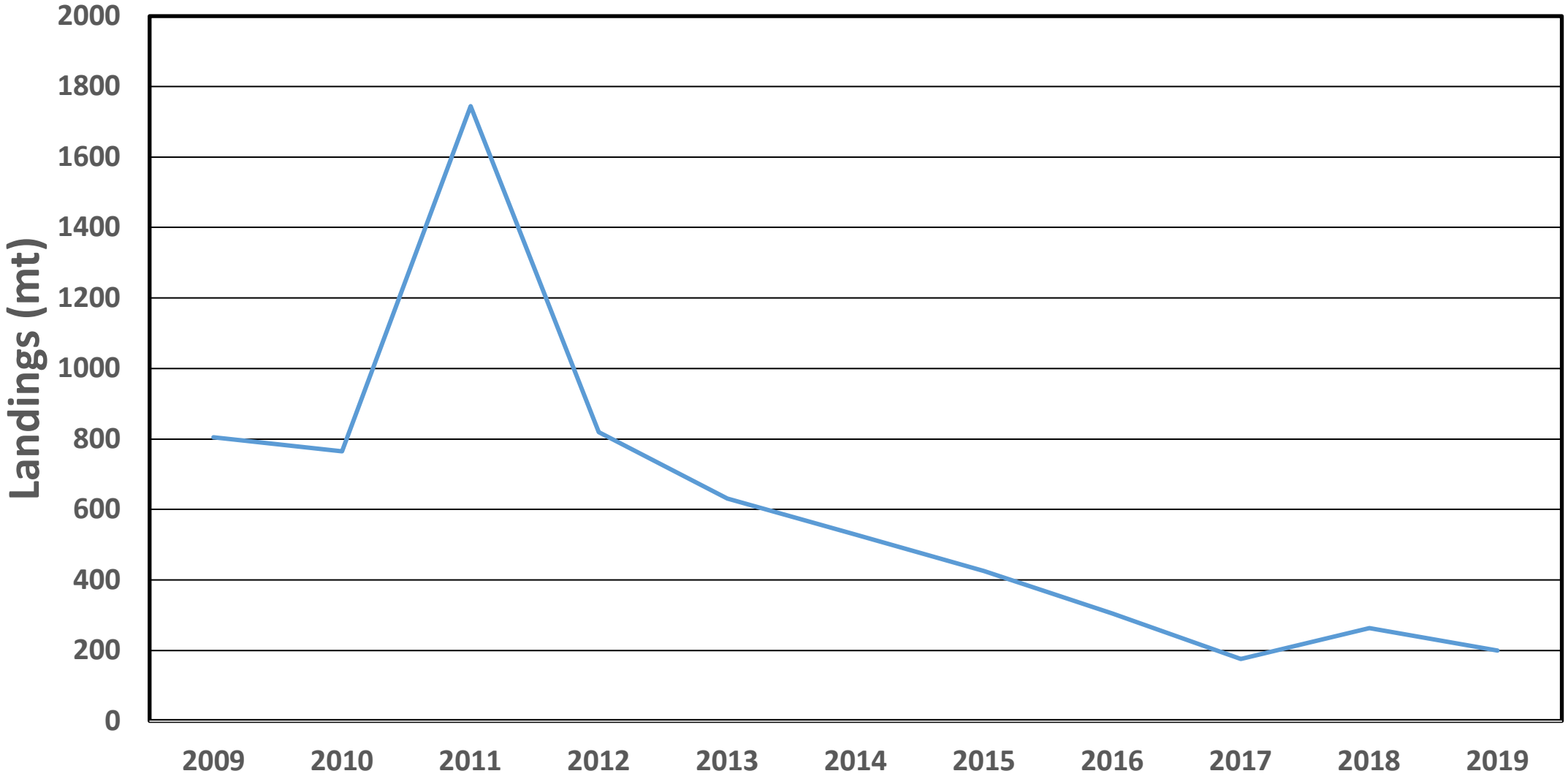
- Fishery catch is minor relative to other stock areas
- Little or no information is available to characterize the size and age composition of the catch
  - Unlikely to be able to reliably estimate a catch at age for this stock area
- Eight fishery independent bottom trawl surveys sample in this area but none appear to have consistent representation of the size and age composition of cod in this stock area
  - Further exploration of the MADMF, RIDEM and URI-GSO surveys may yield reliable indices for young cod
- Additional data exploration warranted with CPUE and LPUE indices for both commercial and recreational fisheries

Questions and Discussion

Cape Cod – Great South Channel Proposed Stock Area


Southern New England
Georges Bank
Gulf of Maine and Cape Cod Winter Spawners
Gulf of Maine Spring Spawners (overlap with Winter Spawners)
Eastern Gulf of Maine
Western Scotian Shelf and Bay of Fundy
46 °N
45 °N
44 °N
43 °N
42 °N
41 °N
40 °N
76 °W
74 °W
72 °W
70 °W
68 °W
66 °W
64 °W
467
466
461
511
512
465
463
513
515
464
462
514
561
551
521
522
538
552
539
562
611
537
613
526
525
612

Cape Cod / Great South Channel
Recent Commercial Landings



Sampling Data to Characterize Commercial Catch

- Historical sampling was allocated to be representative of catch and catch has been and continues to be significant in this area
- In most years, there is sufficient biological sampling of the commercial catch to generate reliably characterize the length and age composition of the landings
- Given that catch and associated sampling from Stat areas 522, 525, 561 and 562 would be assigned to the Georges Bank stock, we expect a degradation in our ability to reliably characterize length and size composition

Study Fleet Vessel, Trip, and Effort Tallies

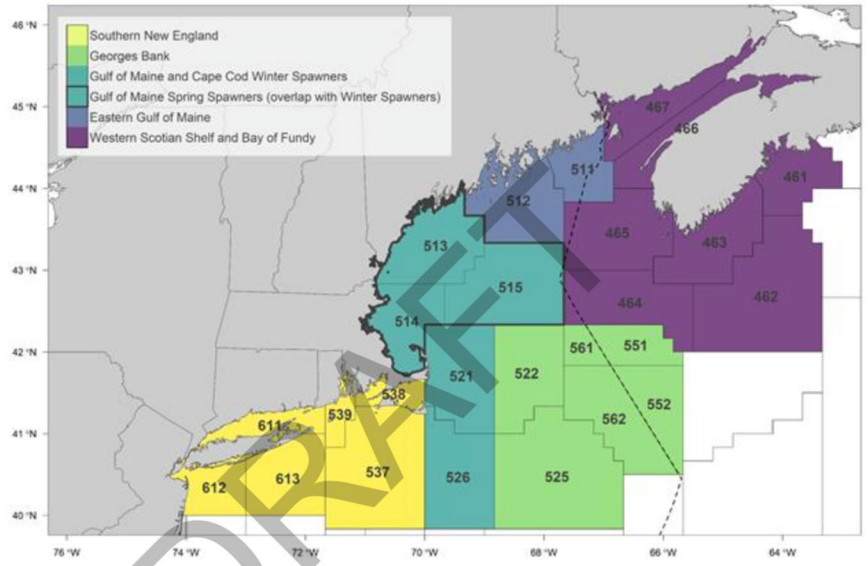


Figure 9.8. Proposed biological stock structure of Atlantic cod (*Gadus morhua*) in NAFO division 5 and adjacent division 4X.

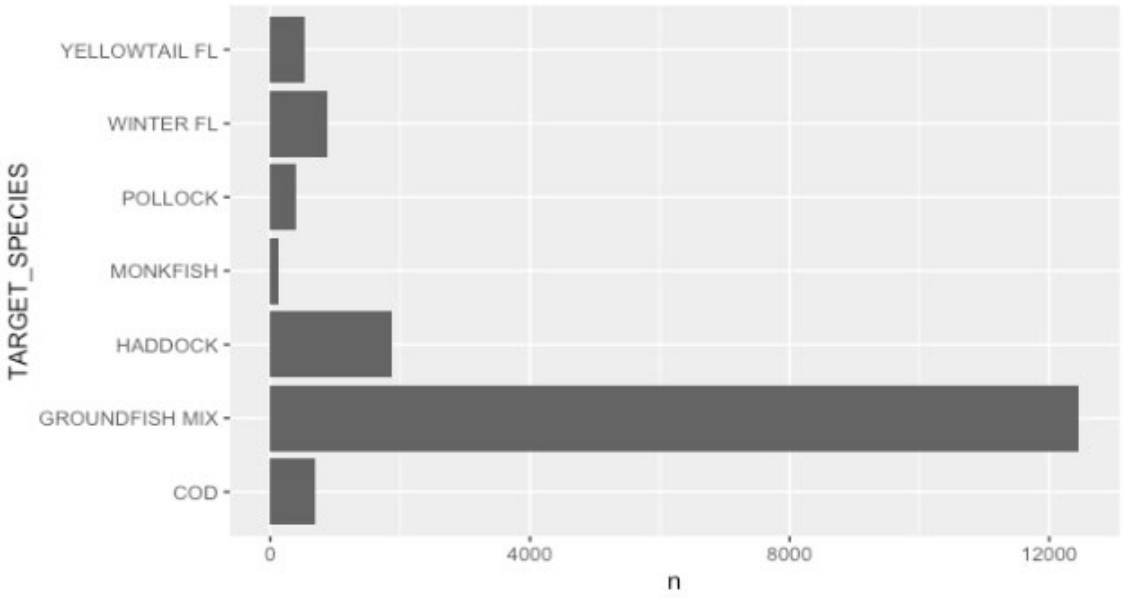
DRAFT

Stock Area	Number of vessels	Number of trips	Number of efforts
GB	10	365	4082
SNE	23	804	2378
WGOMSS_WGOMWS	15	3227	8751
WGOMWS	9	247	1734

- Study Fleet data from 2010-2020, with groundfish as target species AND >1 cod caught
- Data binned using the statistical areas within each proposed stock
- WGoM binned as either definitely spring spawning or from the overlapping area of spring and winter spawners

Study Fleet Data Break Down

Stock Area	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Number of vessels											
GB	6	5	3	5	4	5	3	4	3	3	4
SNE	3	9	7	11	10	14	9	9	7	7	5
WGOMSS_WGOMWS	9	10	10	9	9	6	7	7	7	5	7
WGOMWS	5	4	4	4	4	3	4	2	2	2	1
Number of trips											
GB	42	52	33	32	40	25	24	31	35	19	29
SNE	27	105	70	145	86	116	65	80	52	32	24
WGOMSS_WGOMWS	204	479	472	320	244	169	135	239	347	249	350
WGOMWS	23	37	17	36	24	16	23	19	21	15	13
Number of efforts											
GB	606	578	286	410	573	276	256	286	352	195	219
SNE	65	378	288	460	311	296	182	189	123	50	32
WGOMSS_WGOMWS	544	1418	1424	1016	684	428	316	632	855	618	766
WGOMWS	132	267	128	210	174	143	178	139	143	94	111



Notes:

- Study Fleet data from trips targeting groundfish, with at least one caught between 2010-2020
- These data represent ~87% of all cod records (23,300/26,700 cod) in Study Fleet database

VTR_GEAR_CODE										
DSC	GNS	GNT	HND	OHS	OTF	OTM	OTO	OTR	OTS	PTL
46	14997	12	3168	8222	320456	51	7044	1270	28	43

NOAA FISHERIES

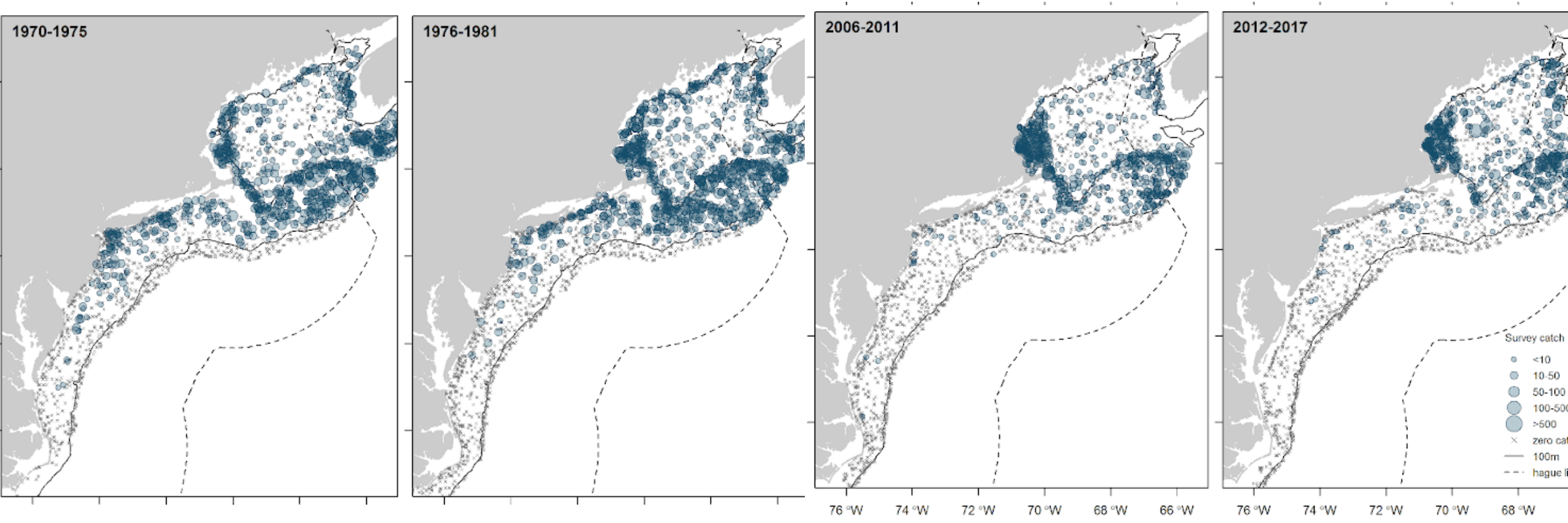
Abundance (cod biomass/tow [spring])

1970-1975

1976-1981

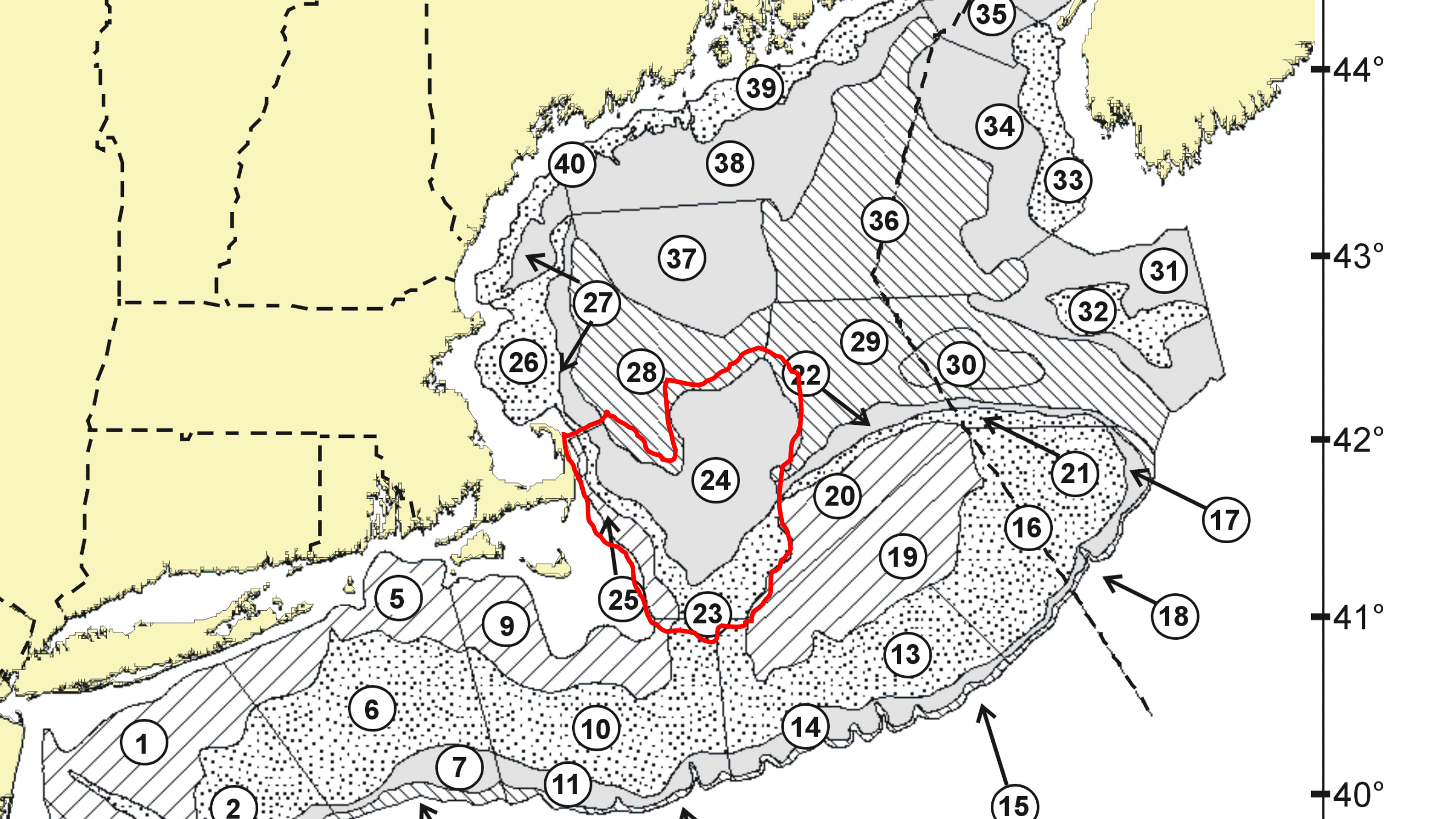
2006-2011

2012-2017



Analysis of NEFSC Bottom Trawl Survey Data

- For this workshop, only FSV Bigelow survey data (2009-2019) were analyzed
  - Full data set including Albatross years will be analyzed during the Research Track Assessment
- Strata set includes offshore strata 01100 – 01120 & 01230 - 01250, which is roughly representative of the Channel / Western Georges Bank stock area
- No attempts were made to post-stratify the survey, but this could be attempted during the Research Track assessment

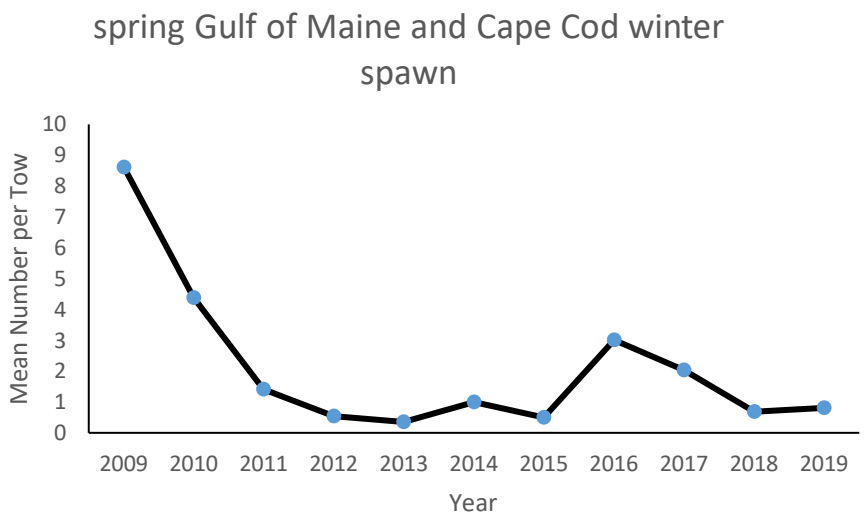

44°
43°
42°
41°
40°
1
2
5
6
7
9
10
11
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40

Channel / Western GB Stock

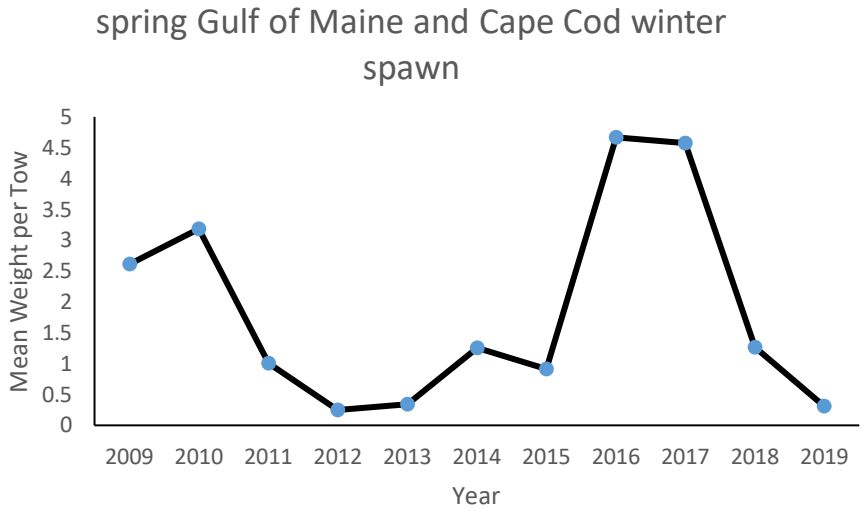
NOAA NEFSC Spring Bottom Trawl Survey

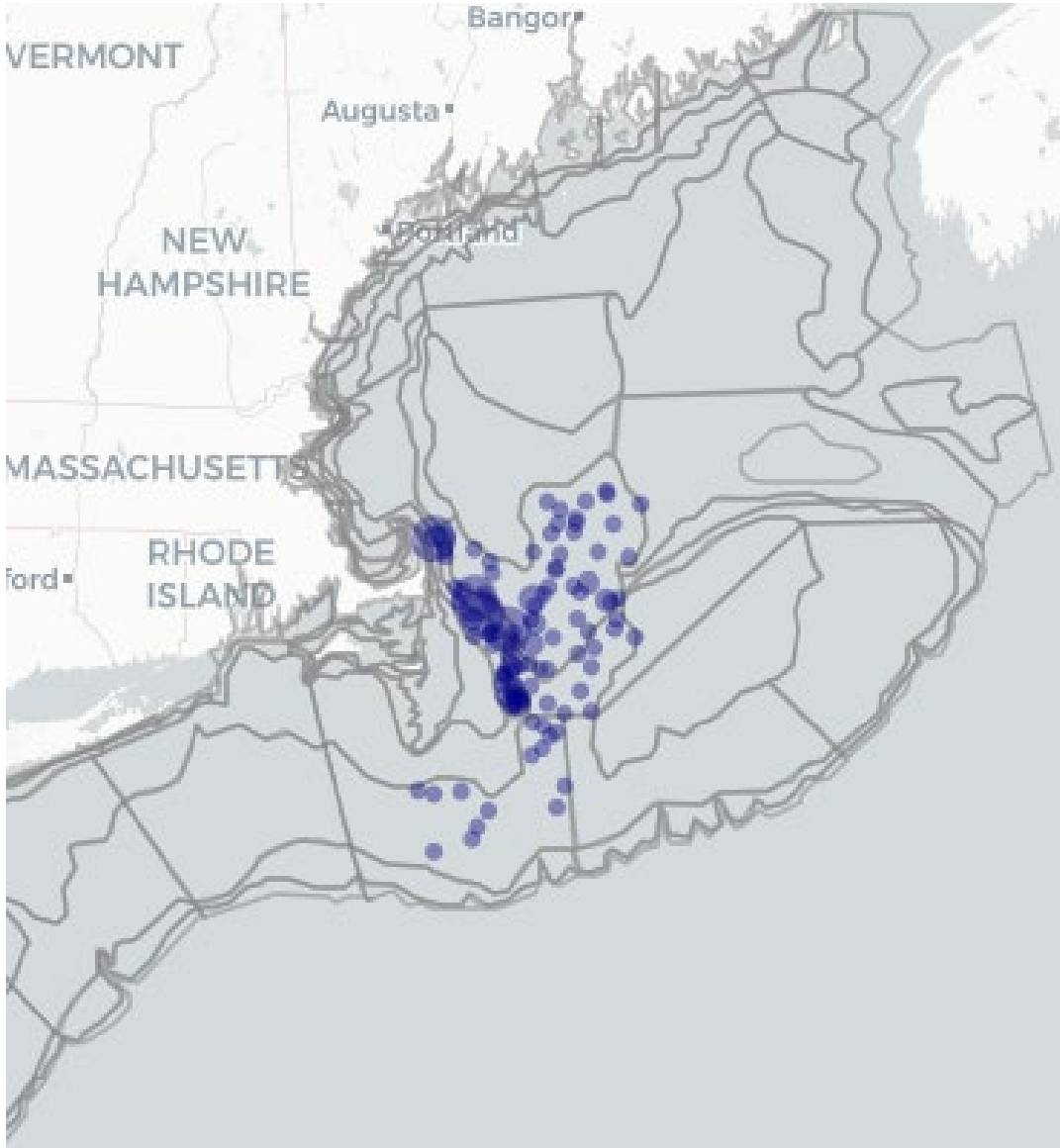
NOAA FISHERIES
National Oceanic and Atmospheric Administration

Abundance



Biomass



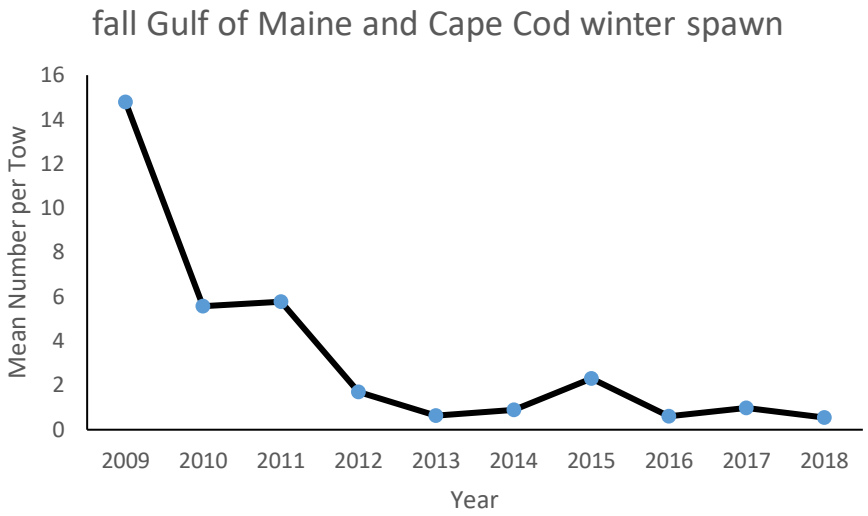


Channel / Western GB Stock

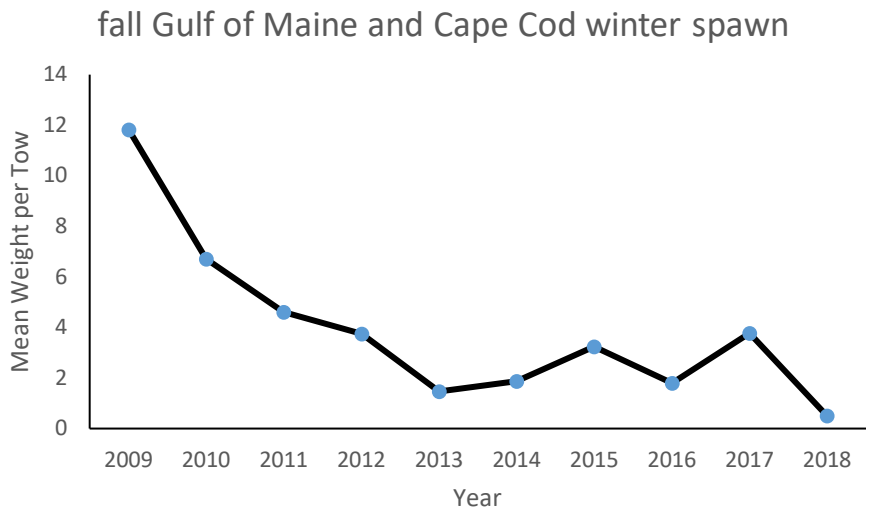
NOAA NEFSC Fall Bottom Trawl Survey

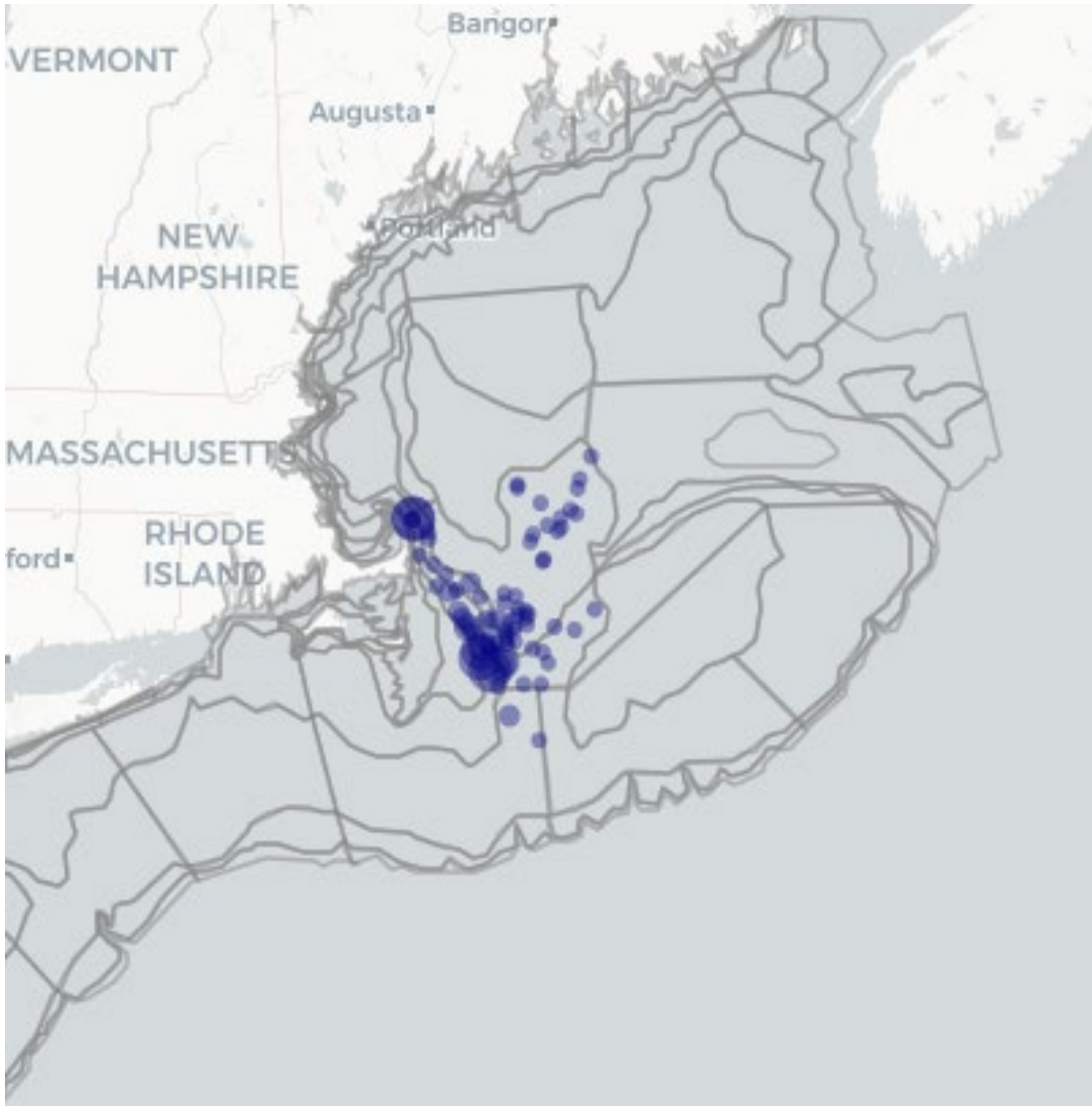
NOAA FISHERIES
National Oceanic and Atmospheric Administration

Abundance

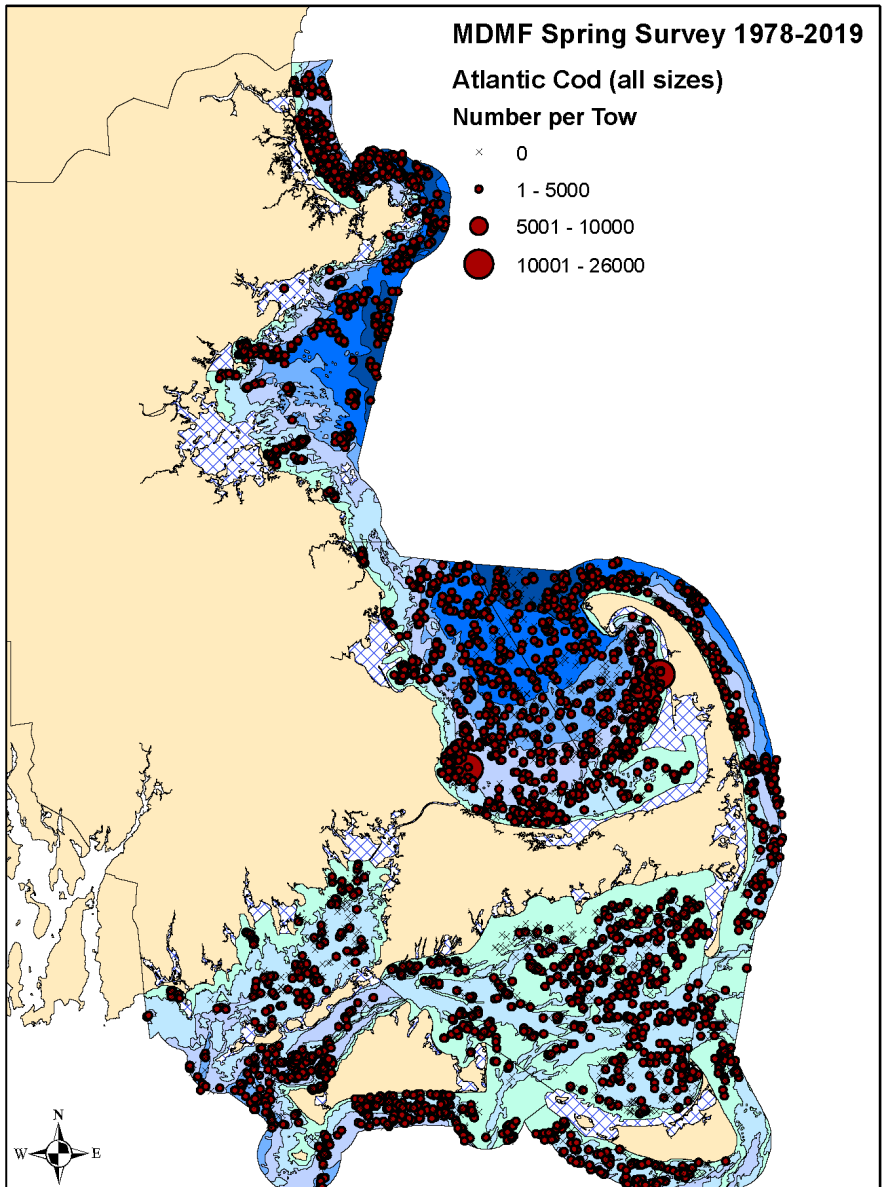


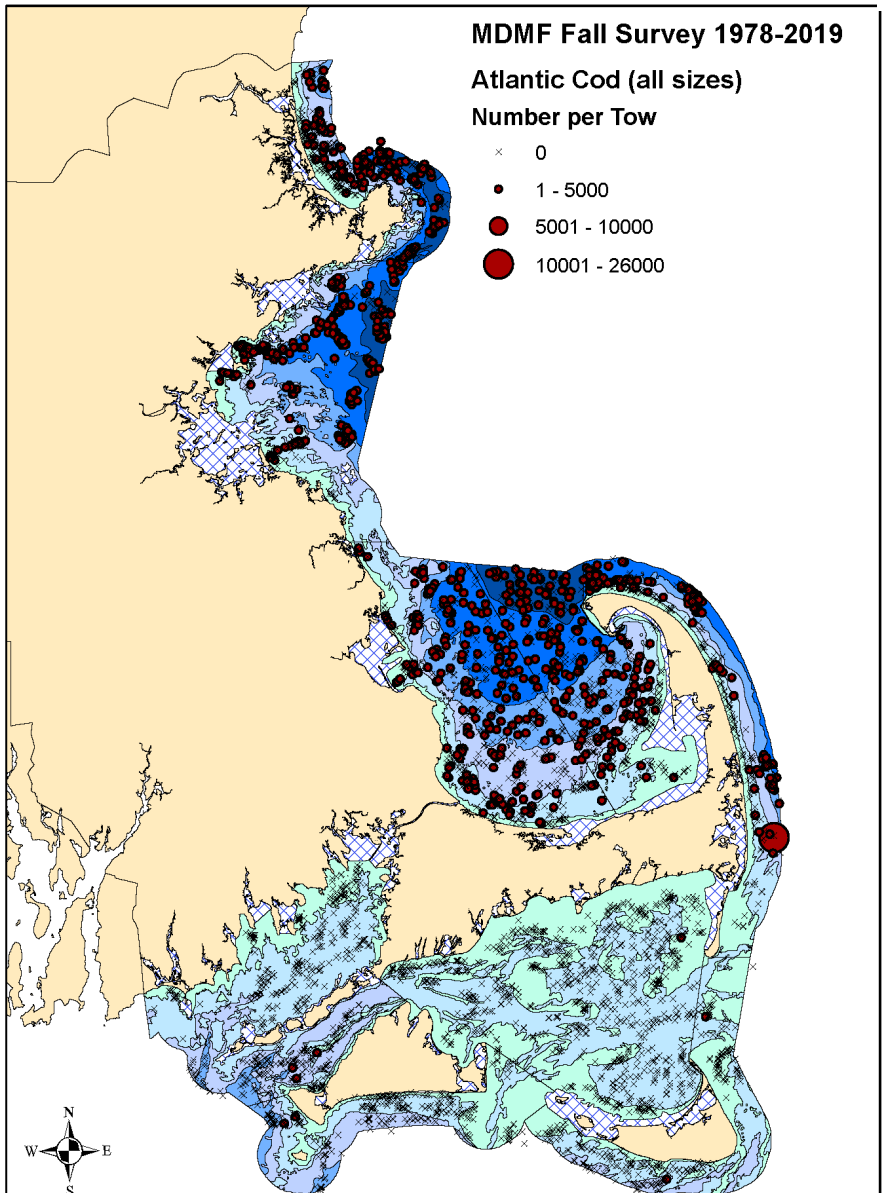
Biomass





Massachusetts DMF Inshore Trawl Survey
Cod Spatial Distribution 1978-2019





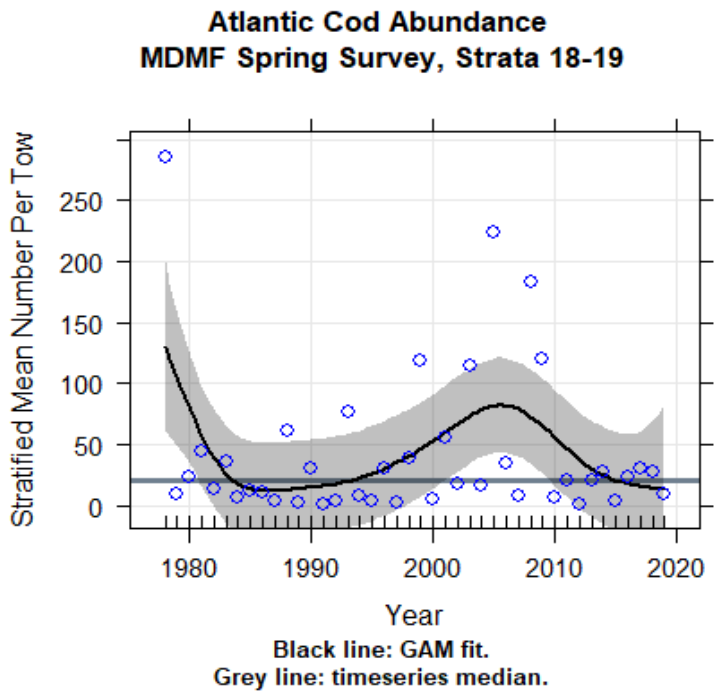
Analysis of MADMF Bottom Trawl Survey Data

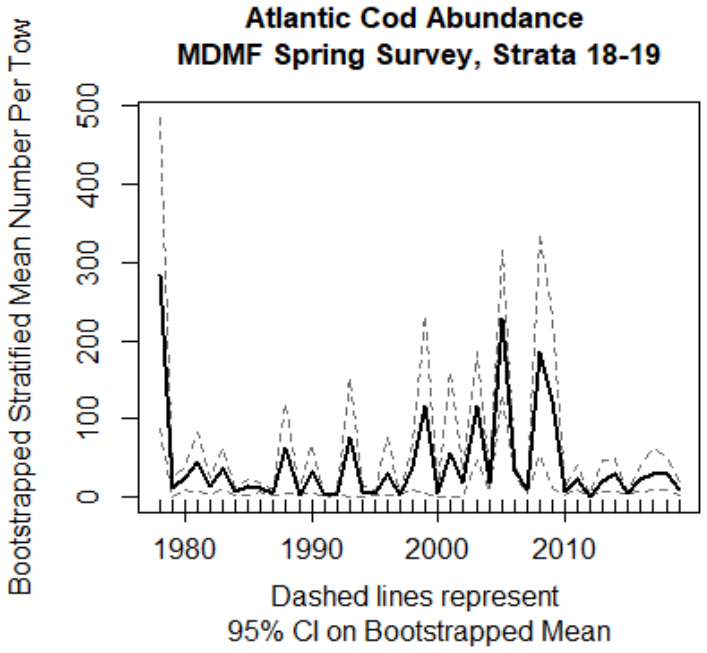
- Strata set includes 17-18, which is roughly representative of the Channel/Western Georges Bank stock area
- No attempts were made to post-stratify the survey, but this could be attempted during the Research Track assessment

Massachusetts Inshore Bottom Trawl Survey 1978-2019

Spring Survey

Stratified Mean Number Per Tow

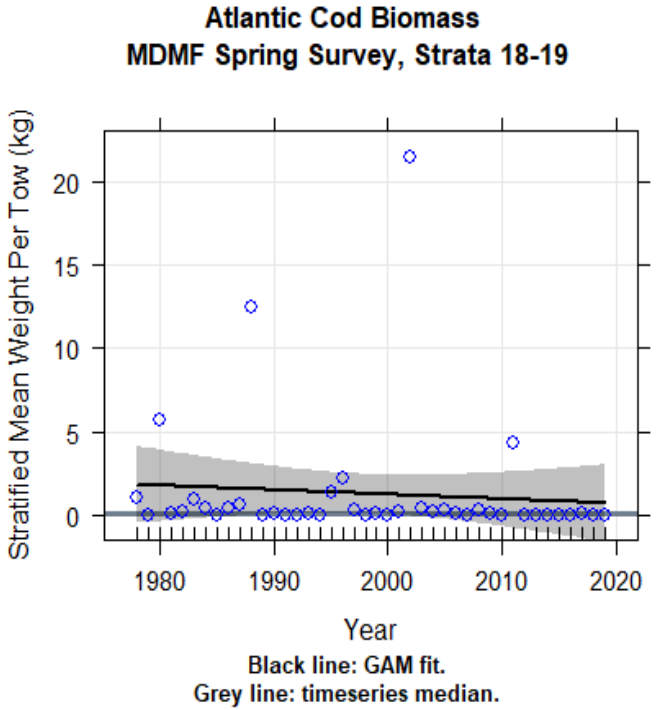


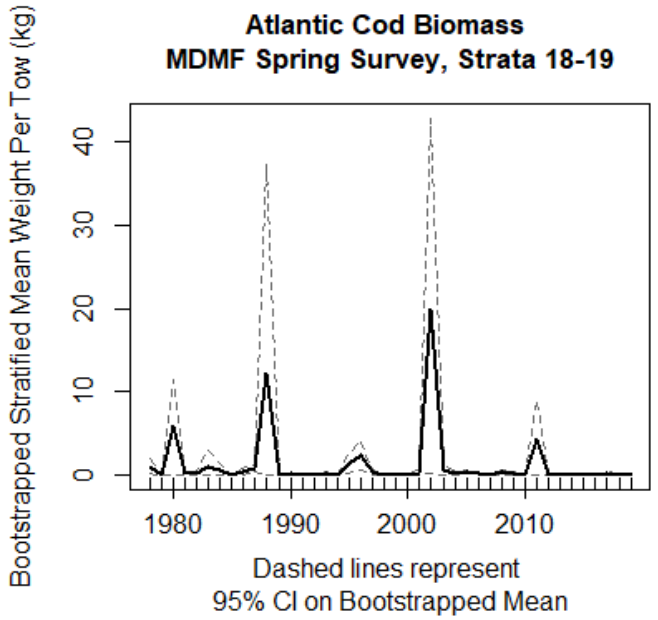


Massachusetts Inshore Bottom Trawl Survey 1978-2019

Spring Survey

Stratified Mean Weight Per Tow

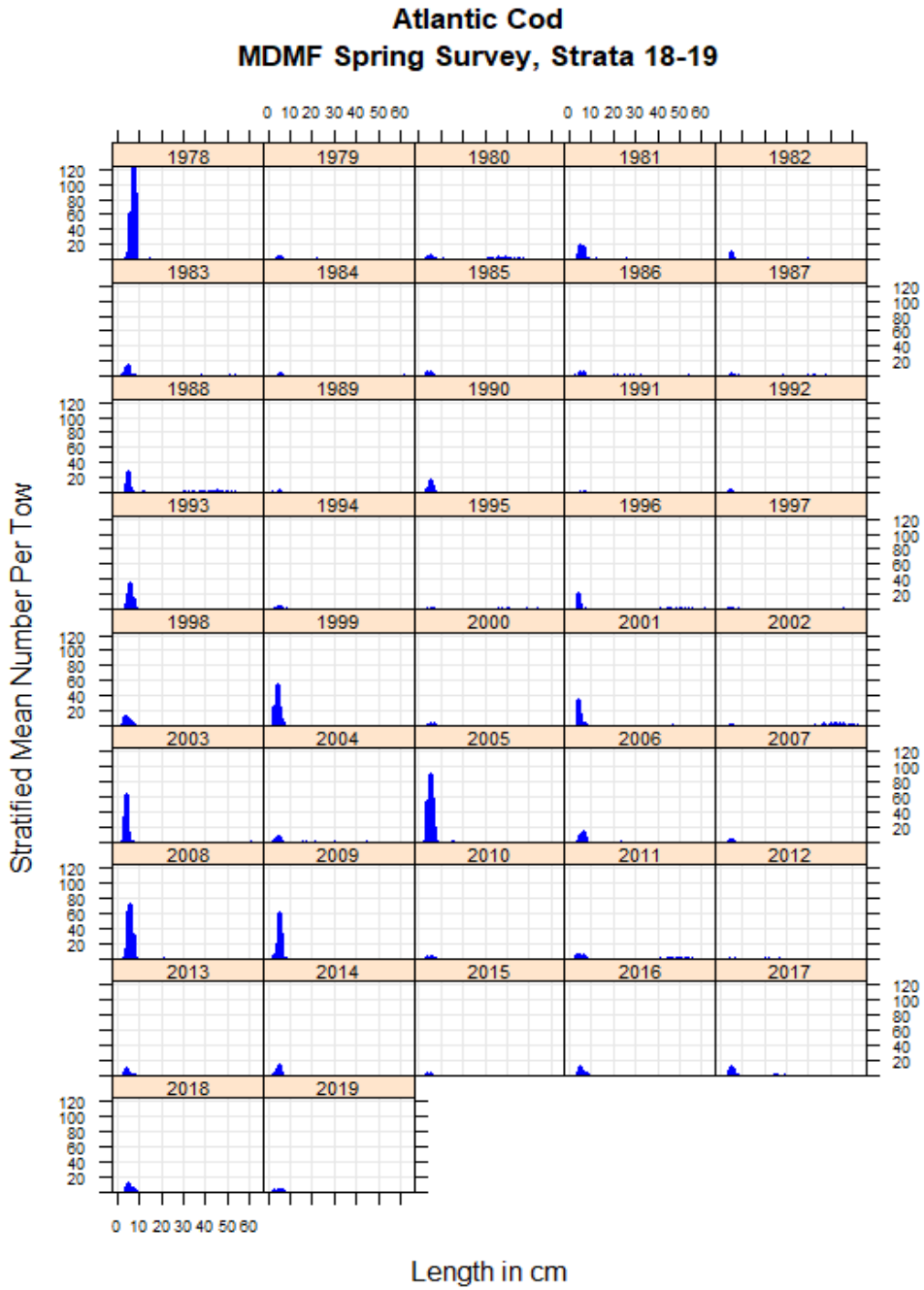




Massachusetts Inshore Bottom Trawl Survey 1978-2019

Spring Survey

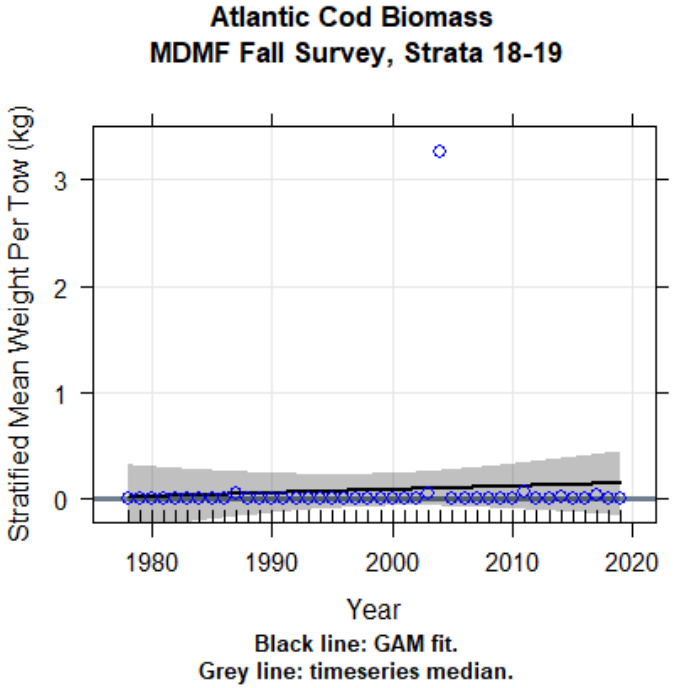
Length Frequency

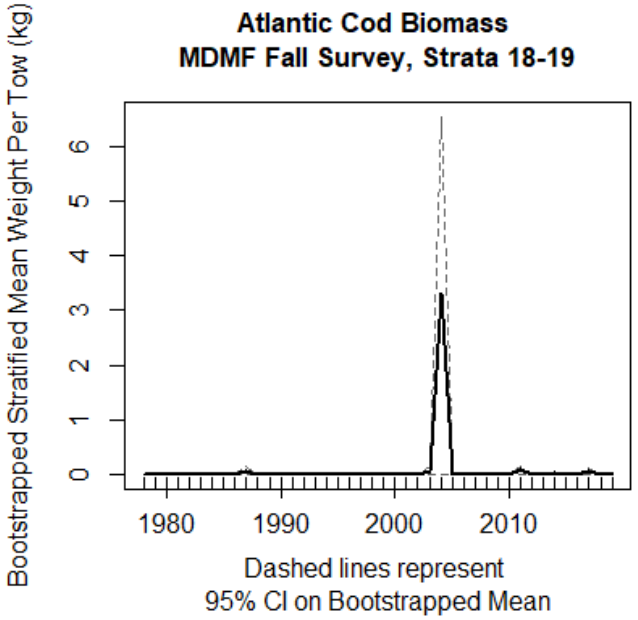


Massachusetts Inshore Bottom Trawl Survey 1978-2019

Fall Survey

Stratified Mean Number Per Tow

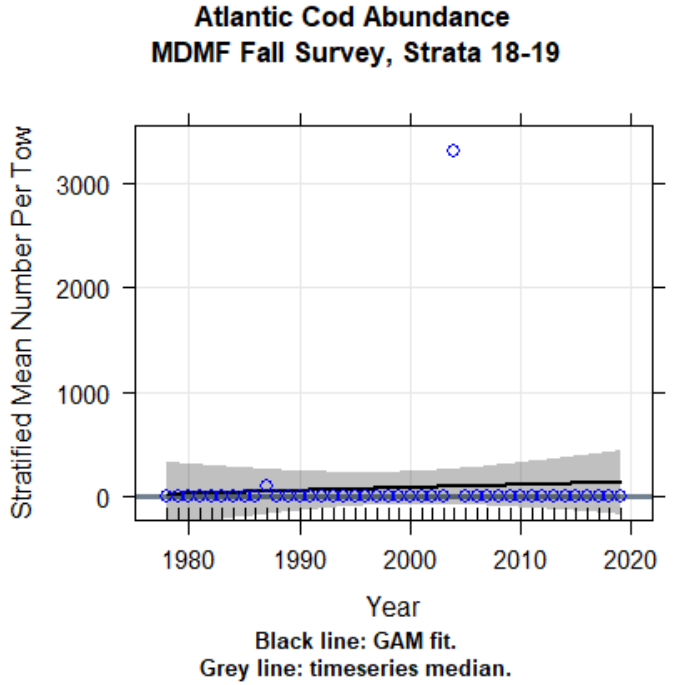


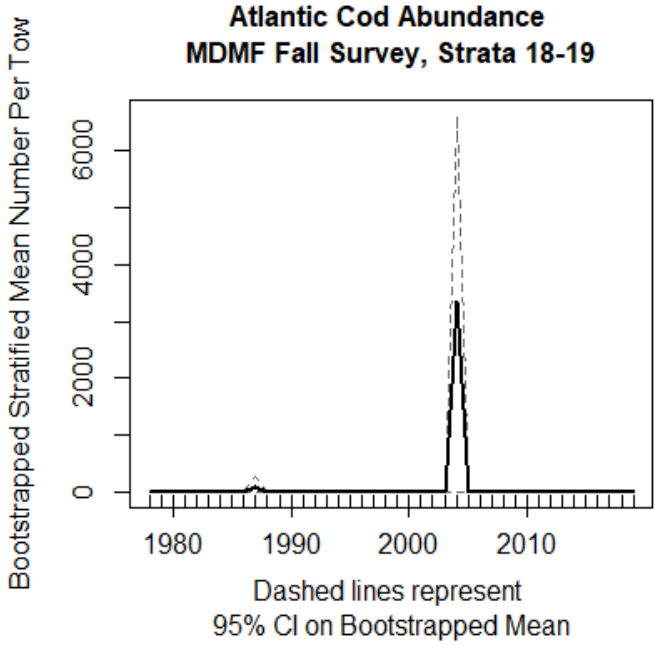


Massachusetts Inshore Bottom Trawl Survey 1978-2019

Fall Survey

Stratified Mean Weight Per Tow

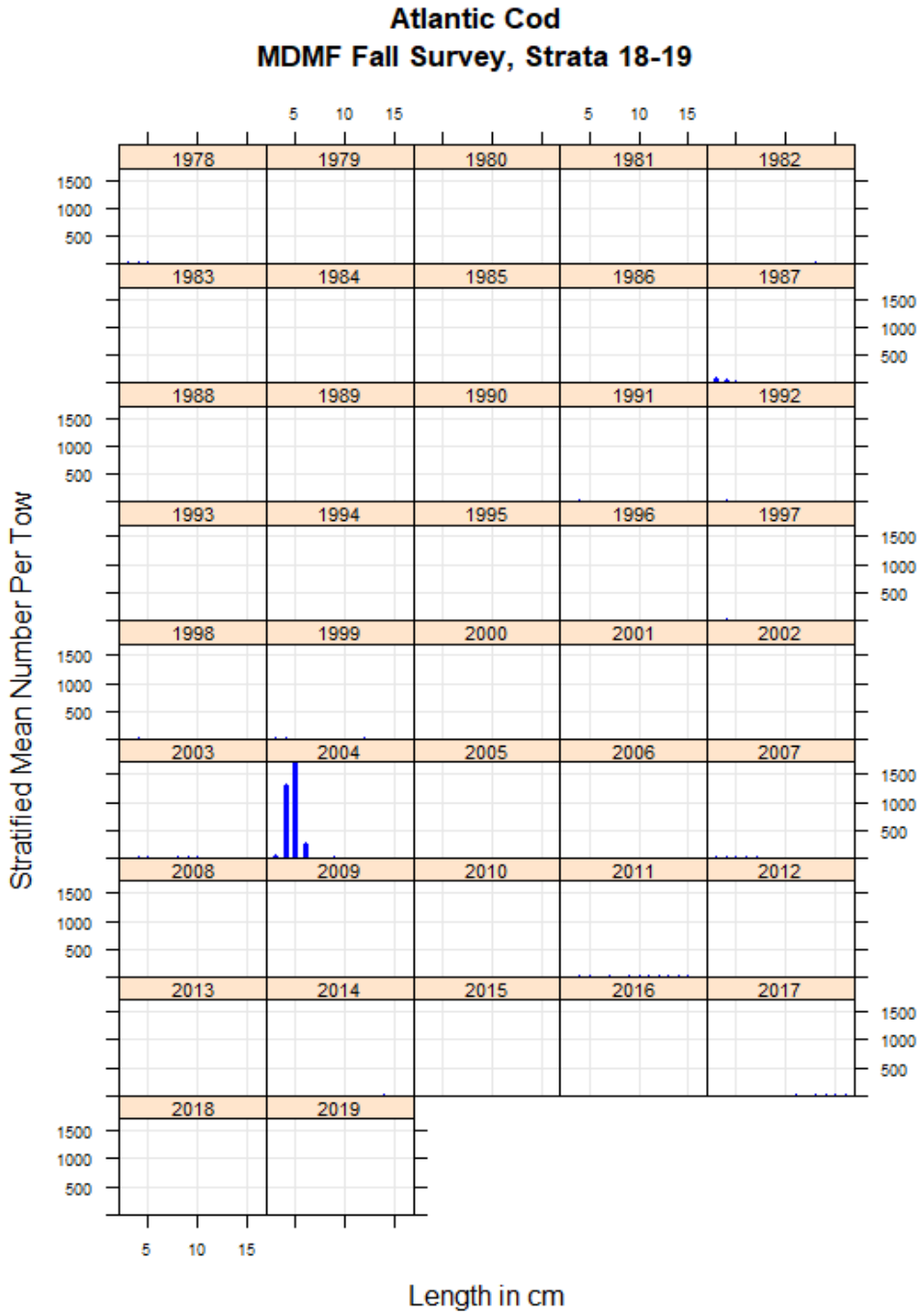




Massachusetts Inshore Bottom Trawl Survey 1978-2019

Fall Survey

Length Frequency

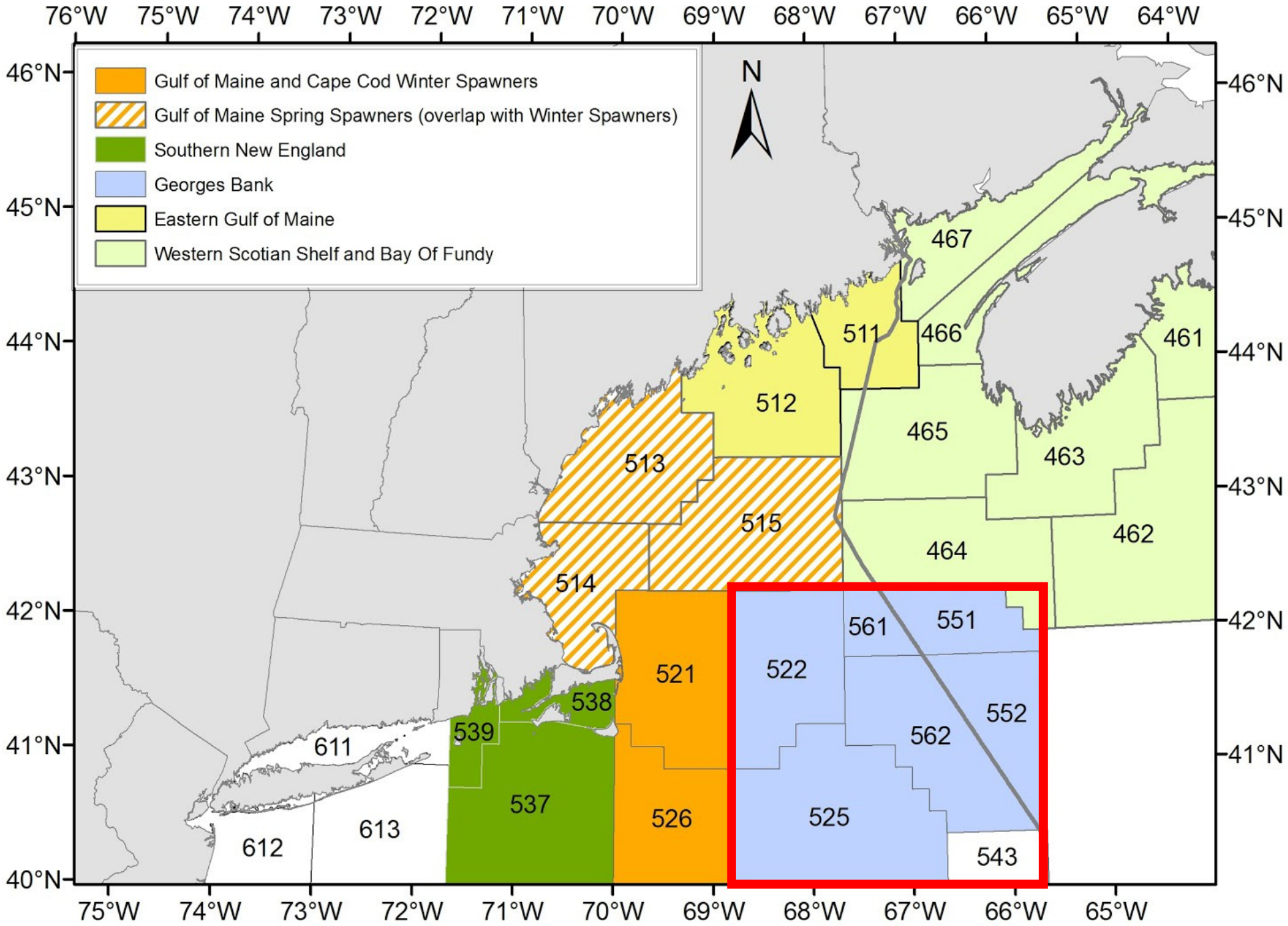


Channel/Western Georges Bank Preliminary Data Availability Summary

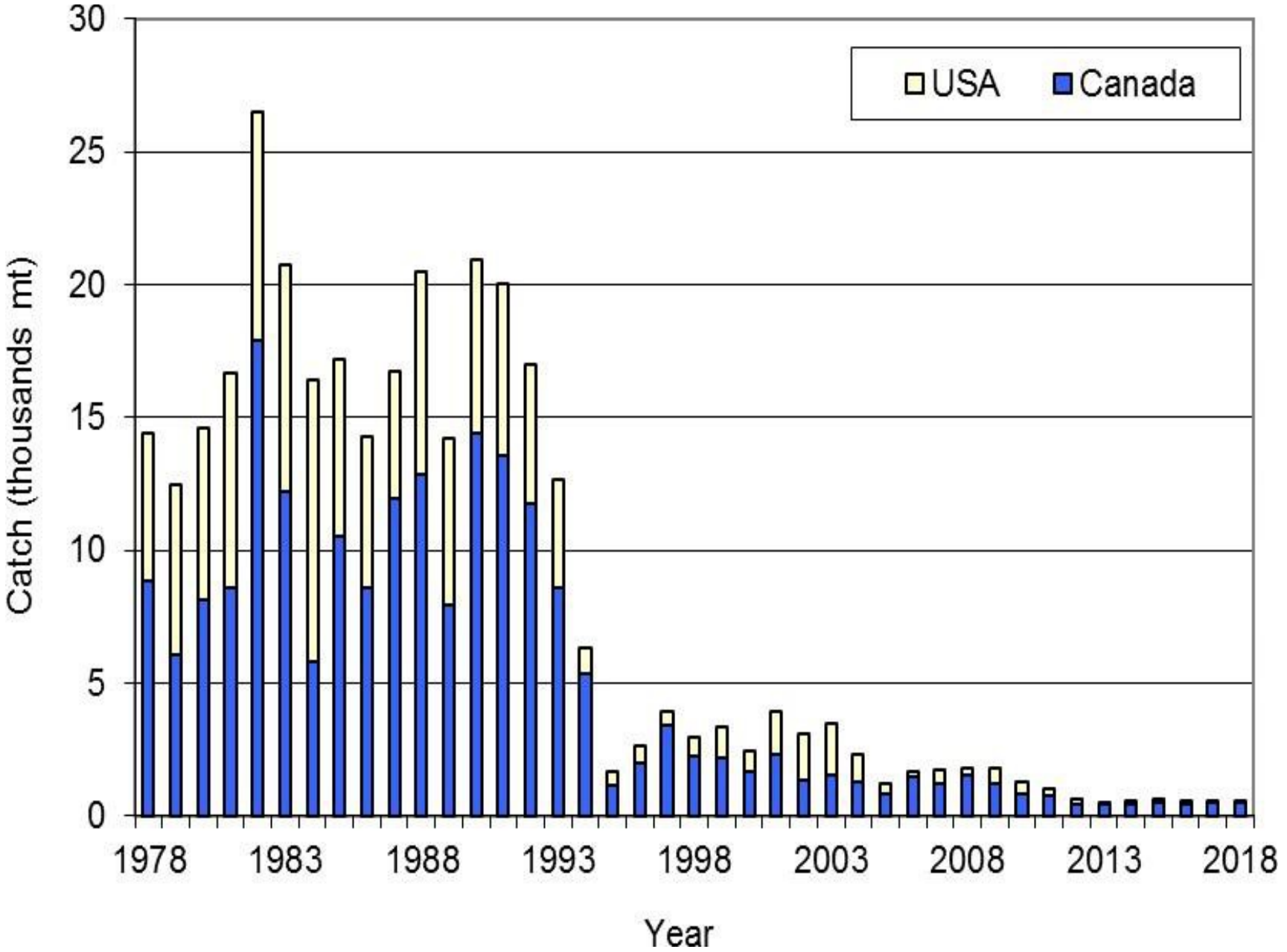
- Commercial catch and associated sampling would only include Stat Areas 521 and 526.
  - Compared with the current Georges Bank assessment, this means removal of data from Stat Areas 522, 525, 561, 562, 551, 525, and the entire Southern New England stock area
- There are significant recreational fisheries landings or discards, but Channel/Western Georges Bank catch will be difficult to isolate from the Southern New England and Western Gulf of Maine catch in the Massachusetts data
- Four fishery independent surveys, the NEFSC Spring and Fall Bottom Trawl Surveys and the Massachusetts DMF Spring and Fall Bottom Trawl Surveys are available for this stock area
  - The MA DMF survey only includes two survey strata in the stock area.
- The current (full) Georges Bank stock assessment is utilizing a Plan B Smooth approach because low fishery and survey catch currently make the data model resistant to statistical catch at age modeling approaches.

Questions and Discussion

Georges Bank
Proposed Stock Area

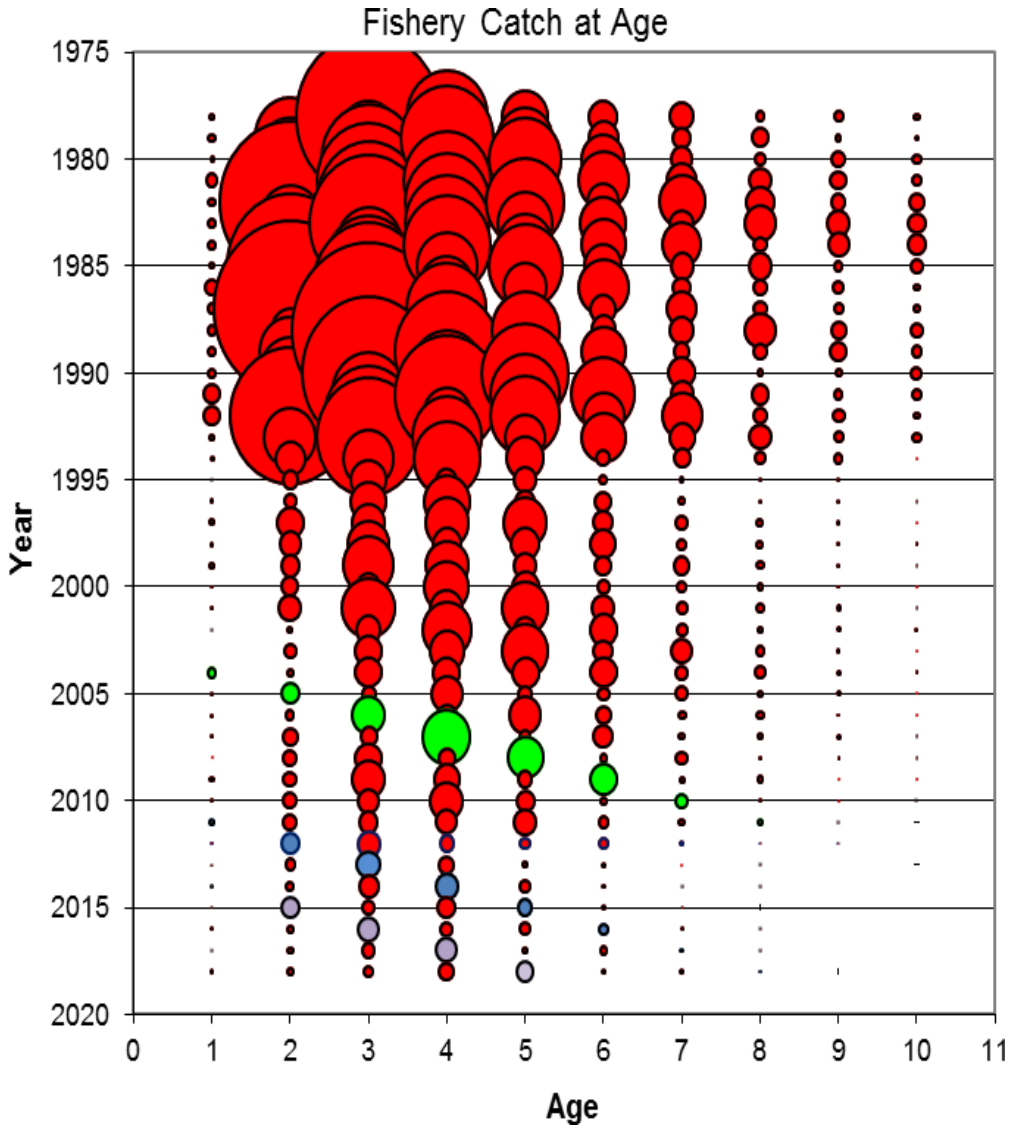

Gulf of Maine and Cape Cod Winter Spawners
Gulf of Maine Spring Spawners (overlap with Winter Spawners)
Southern New England
Georges Bank
Eastern Gulf of Maine
Western Scotian Shelf and Bay Of Fundy
N
76°W
75°W
74°W
73°W
72°W
71°W
70°W
69°W
68°W
67°W
66°W
65°W
64°W
46°N
45°N
44°N
43°N
42°N
41°N
40°N
467
511
466
461
512
465
463
513
515
462
464
514
561
551
522
521
538
552
562
539
611
537
526
525
613
612
543

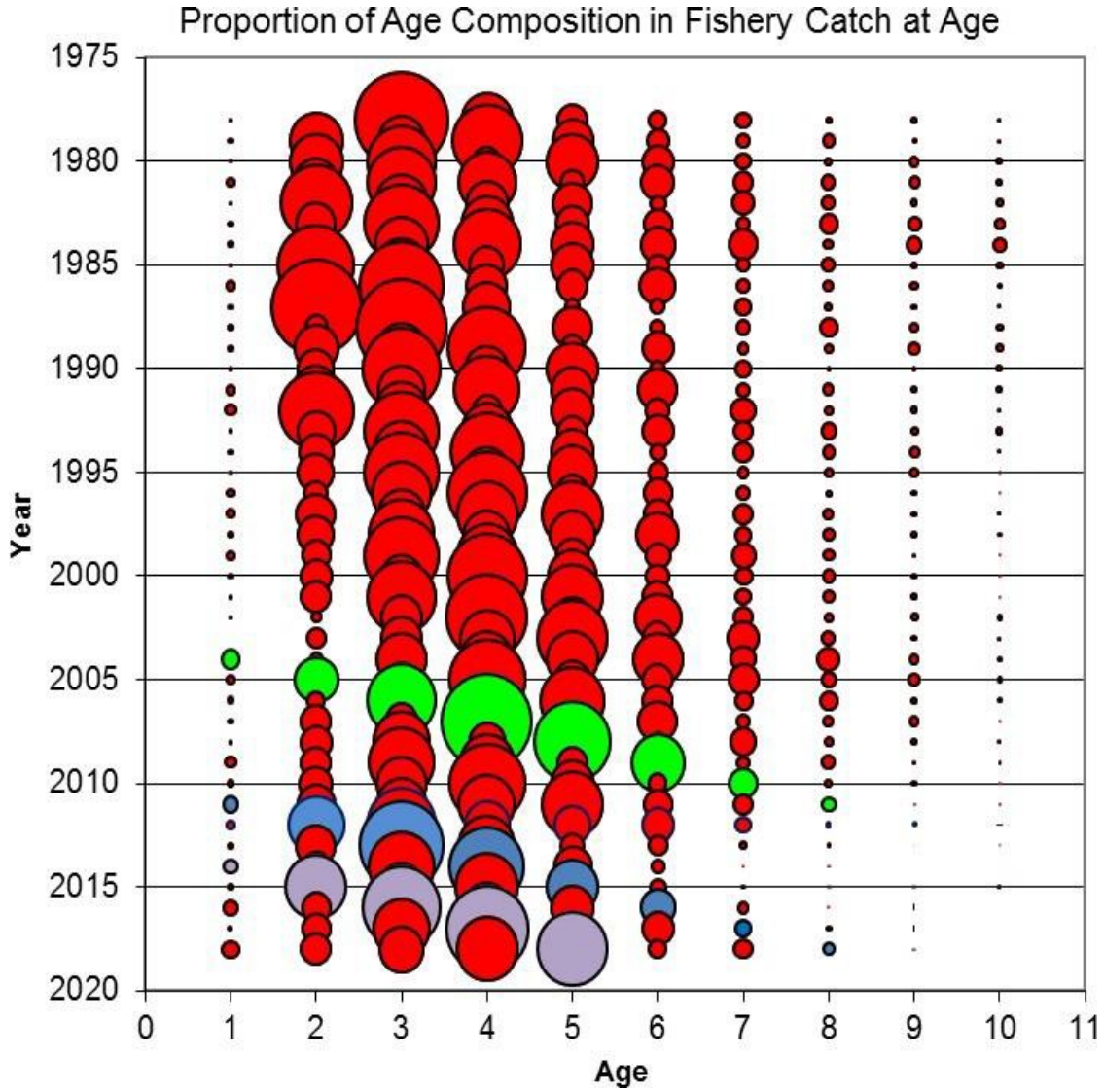
Georges Bank Catch 1978-2018



Year	USA		Canada	
	Lengths	Ages	Lengths	Ages
1978	2,294	384	7,684	1,364
1979	2,384	402	3,103	796(205)
1980	2,080	286	2,784	728(192)
1981	1,498	455	4,147	897
1982	4,466	778	4,705	1,126(268)
1983	3,906	903	3,822	754(150)
1984	3,891	1,130	1,889	1,243(858)
1985	2,076	597	7,031	1,309(351)
1986	2,145	643	5,890	991(103)
1987	1,865	524	9,133	1,429(193)
1988	3,229	797	11,350	2,437(510)
1989	1,572	347	8,726	1,561
1990	2,395	552	31,974	2,825(1,153)
1991	1,969	442	27,869	1,782
1992	2,048	489	29,082	2,215(359)
1993	2,215	569	31,588	2,146
1994	898	180	27,972	1,268
1995	2645	14	6,660	548
1996	4,895	1,163	26,069	828
1997	1,761	82	31,617	1,216
1998	1,301	338	26,180	1,643
1999	726	228	26,232	1,290(410)
2000	500	121	20,582	1,374
2001	1,434	397	19,055	1,505
2002	1,424	429	16,119	1,252
2003	1,367	416	19,757	1,070
2004	1,547		18,392	1,357
2005	297		23,937	1,483(697)
2006	446		44,708	1,460(648)
2007	589		141,607	1,647(456)
2008	972		64,387	1,709(495)
2009	1,286		48,335	1,725(246)
2010	1,446		30,594	1,455(433)
2011	1,203		40,936	1,655(536)
2012	598		49,447	1,115(216)
2013	2,951		75,275	1,334(319)
2014	547		50,501	1,141(184)
2015	4,677		74,028	970 (202)
2016	715		76,869	990 (282)
2017	4,120		50,902	1,039 (334)[3]
2018	1,695		54,609	1,254(309) [3]

Georges Bank Catch at Age





Study Fleet Vessel, Trip, and Effort Tallies

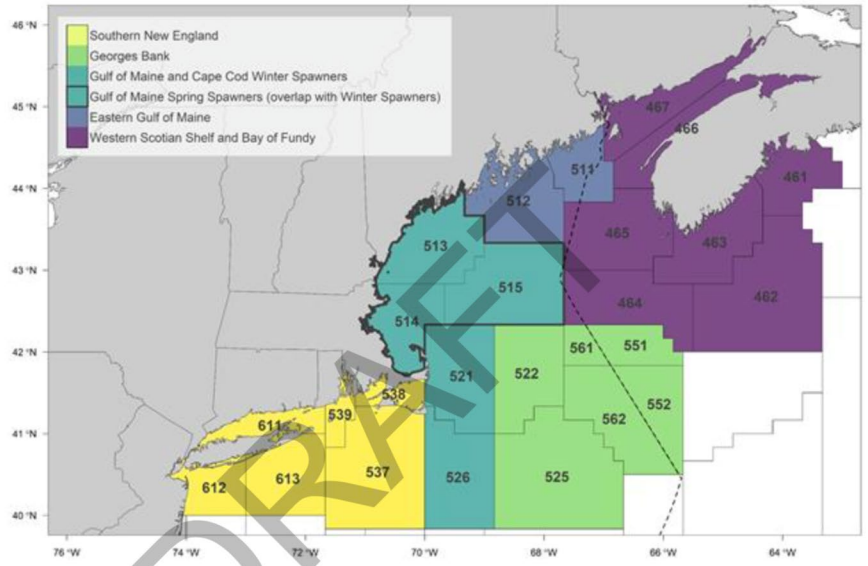


Figure 9.8. Proposed biological stock structure of Atlantic cod (*Gadus morhua*) in NAFO division 5 and adjacent division 4X.

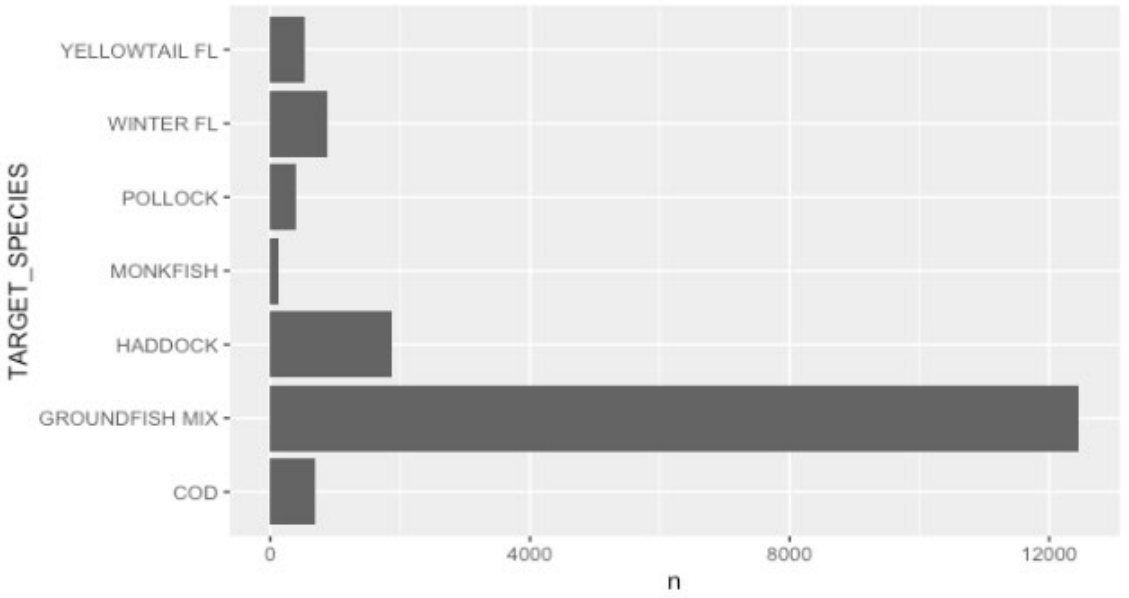
DRAFT

Stock Area	Number of vessels	Number of trips	Number of efforts
GB	10	365	4082
SNE	23	804	2378
WGOMSS_WGOMWS	15	3227	8751
WGOMWS	9	247	1734

- Study Fleet data from 2010-2020, with groundfish as target species AND >1 cod caught
- Data binned using the statistical areas within each proposed stock
- WGoM binned as either definitely spring spawning or from the overlapping area of spring and winter spawners

Study Fleet Data Break Down

Stock Area	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Number of vessels											
GB	6	5	3	5	4	5	3	4	3	3	4
SNE	3	9	7	11	10	14	9	9	7	7	5
WGOMSS_WGOMWS	9	10	10	9	9	6	7	7	7	5	7
WGOMWS	5	4	4	4	4	3	4	2	2	2	1
Number of trips											
GB	42	52	33	32	40	25	24	31	35	19	29
SNE	27	105	70	145	86	116	65	80	52	32	24
WGOMSS_WGOMWS	204	479	472	320	244	169	135	239	347	249	350
WGOMWS	23	37	17	36	24	16	23	19	21	15	13
Number of efforts											
GB	606	578	286	410	573	276	256	286	352	195	219
SNE	65	378	288	460	311	296	182	189	123	50	32
WGOMSS_WGOMWS	544	1418	1424	1016	684	428	316	632	855	618	766
WGOMWS	132	267	128	210	174	143	178	139	143	94	111



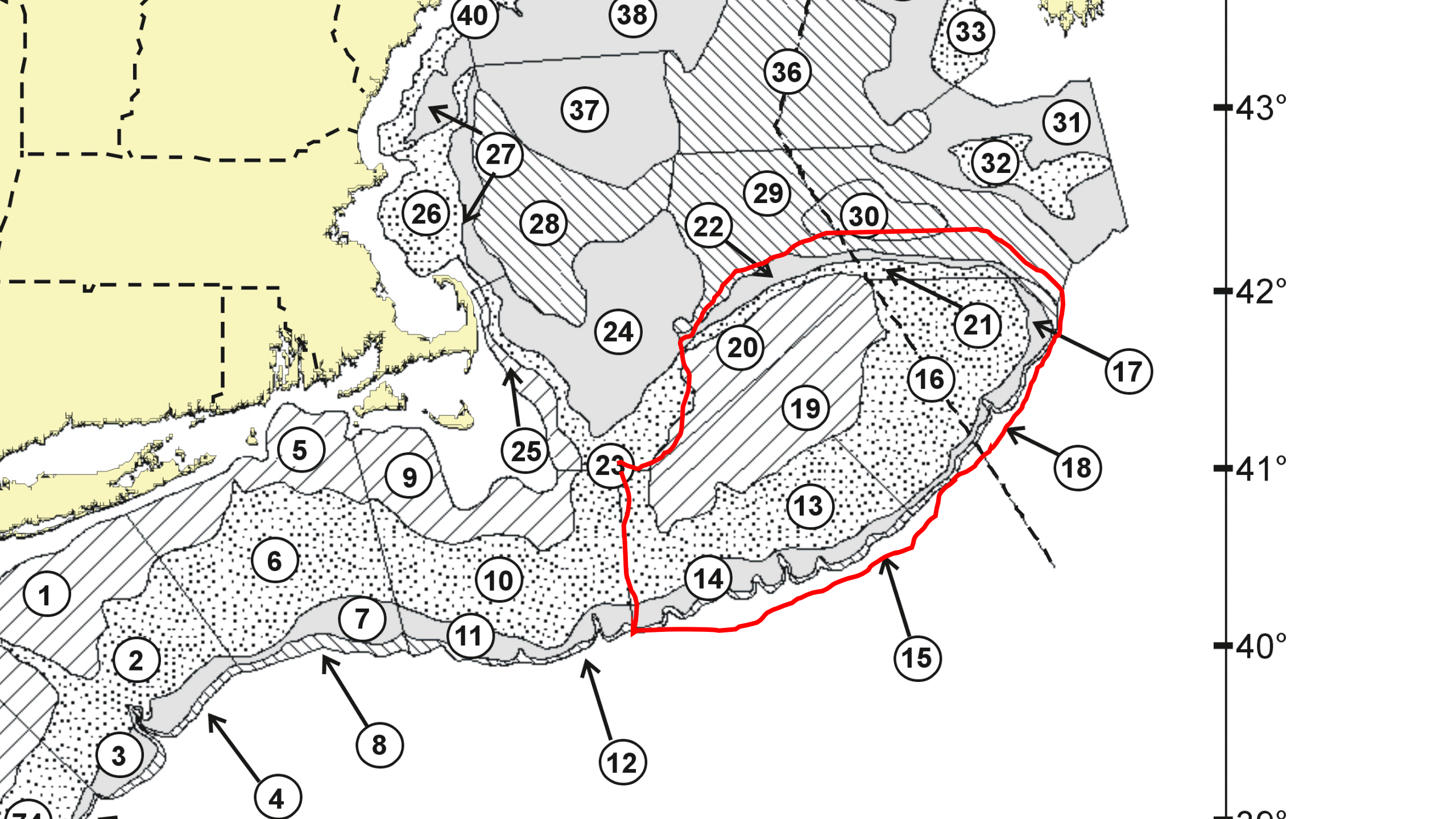
Notes:

- Study Fleet data from trips targeting groundfish, with at least one caught between 2010-2020
- These data represent ~87% of all cod records (23,300/26,700 cod) in Study Fleet database

VTR_GEAR_CODE										
DSC	GNS	GNT	HND	OHS	OTF	OTM	OTO	OTR	OTS	PTL
46	14997	12	3168	8222	320456	51	7044	1270	28	43

Analysis of NEFSC Bottom Trawl Survey Data

- For this workshop, only FSV Bigelow survey data (2009-2019) were analyzed
  - Full data set including Albatross years will be analyzed during the Research Track Assessment
- Strata set includes offshore strata 01130-01220, which is roughly representative of the Southern New England stock area
- No attempts were made to post-stratify the survey, but this could be attempted during the Research Track assessment

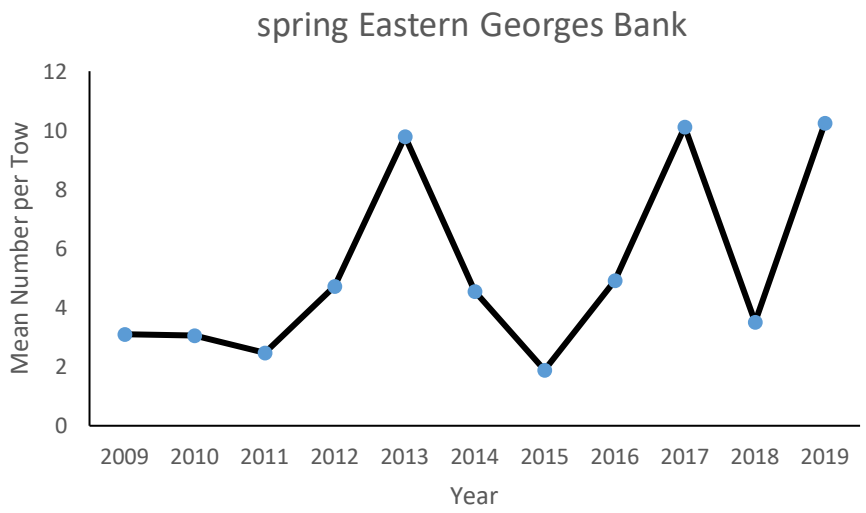

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
36
37
38
40
43°
42°
41°
40°

Georges Bank Stock

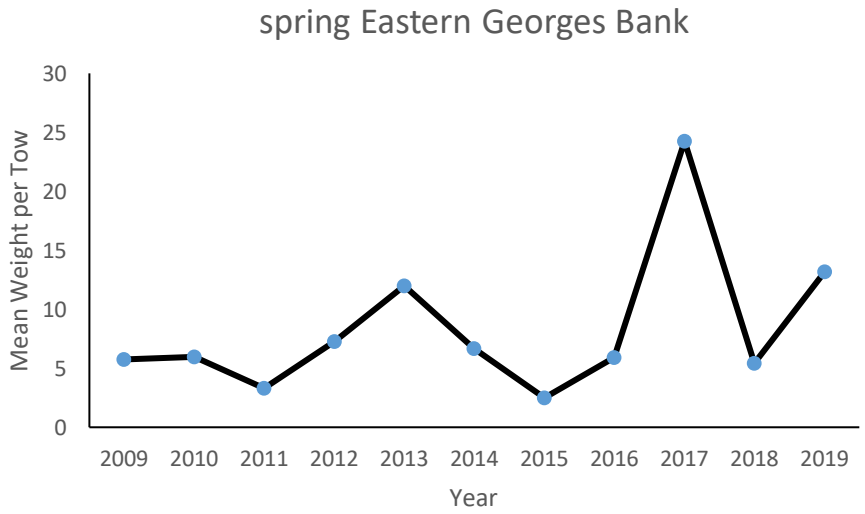
NOAA NEFSC Spring Bottom Trawl Survey

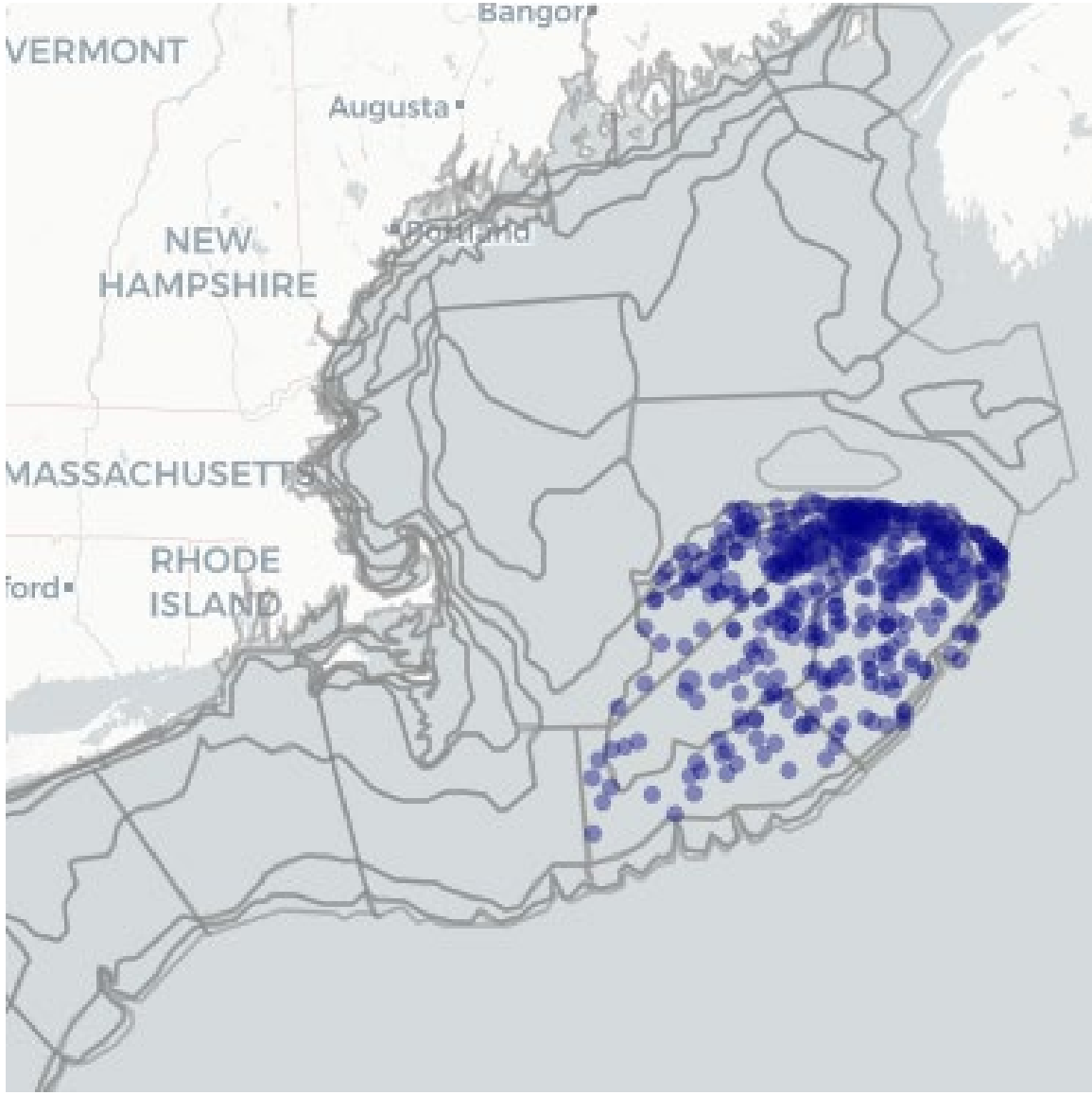
NOAA FISHERIES
National Oceanic and Atmospheric Administration

Abundance



Biomass



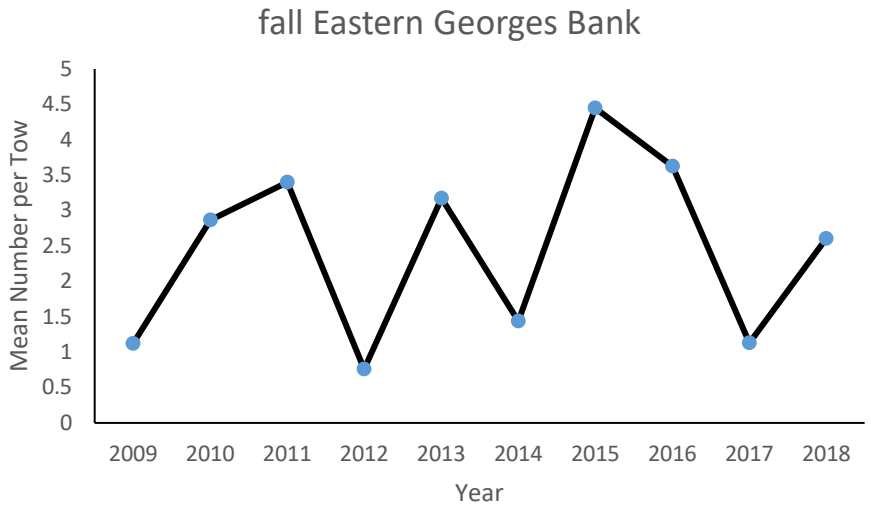


Southern New England Stock

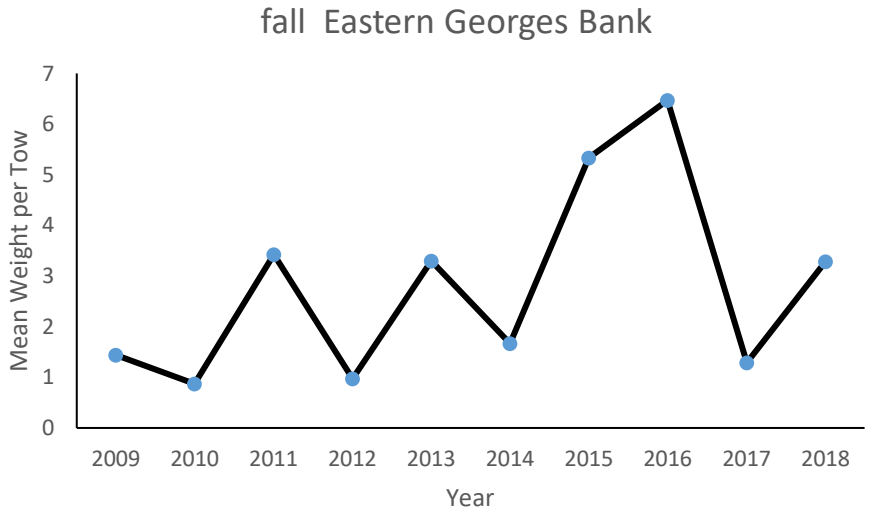
NOAA NEFSC Spring Bottom Trawl Survey

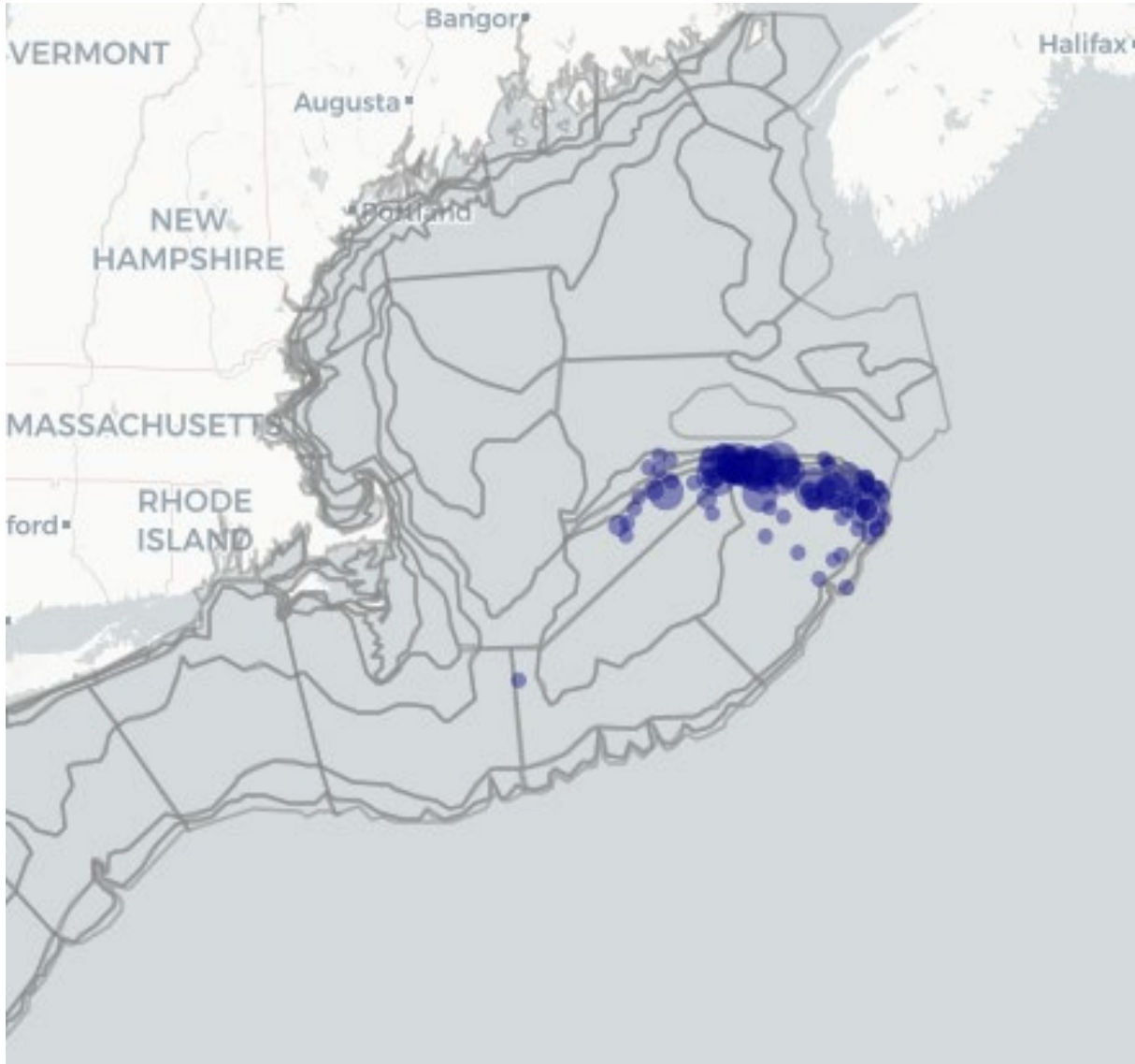
NOAA FISHERIES
National Oceanic and Atmospheric Administration

Abundance



Biomass





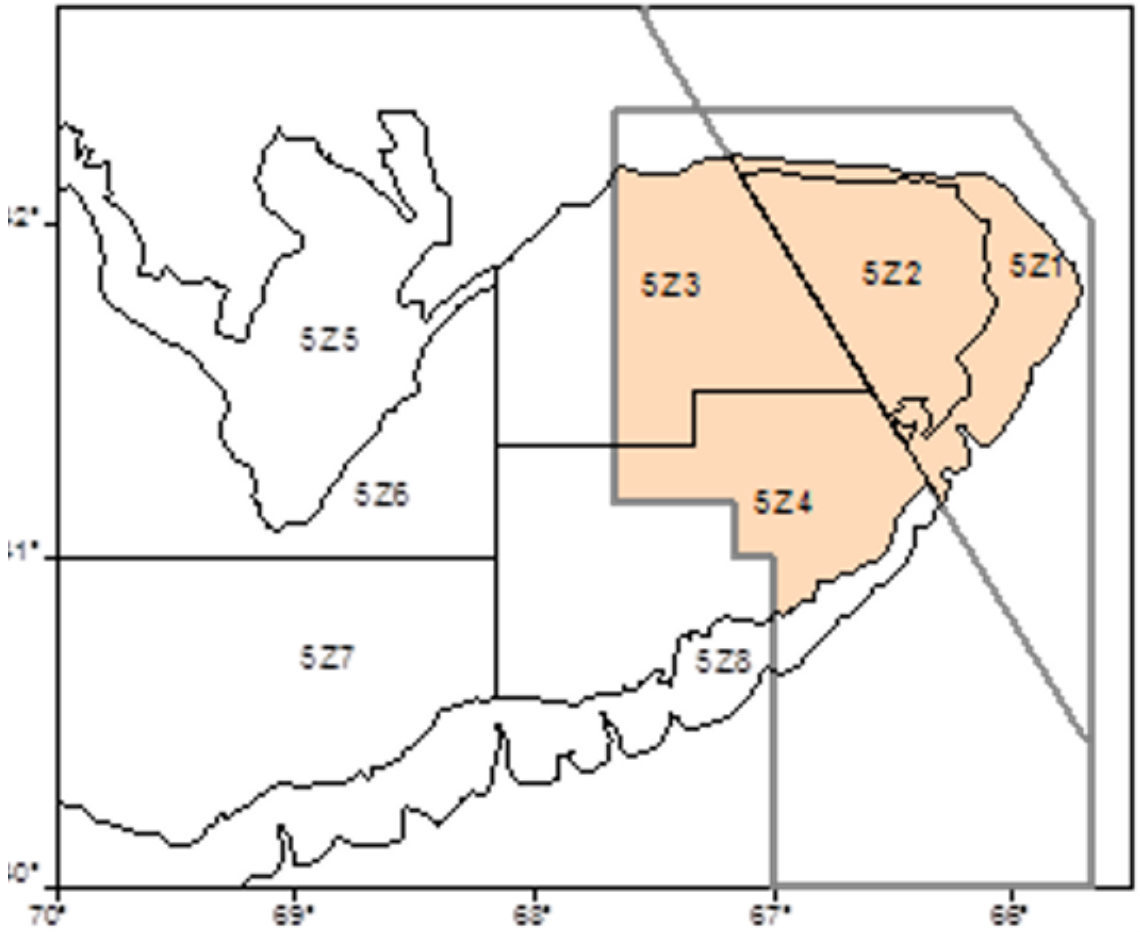
Fisheries and Oceans Canada

Pêches et Océans Canada

Canada Department of Fisheries & Oceans Spring Bottom Trawl Survey

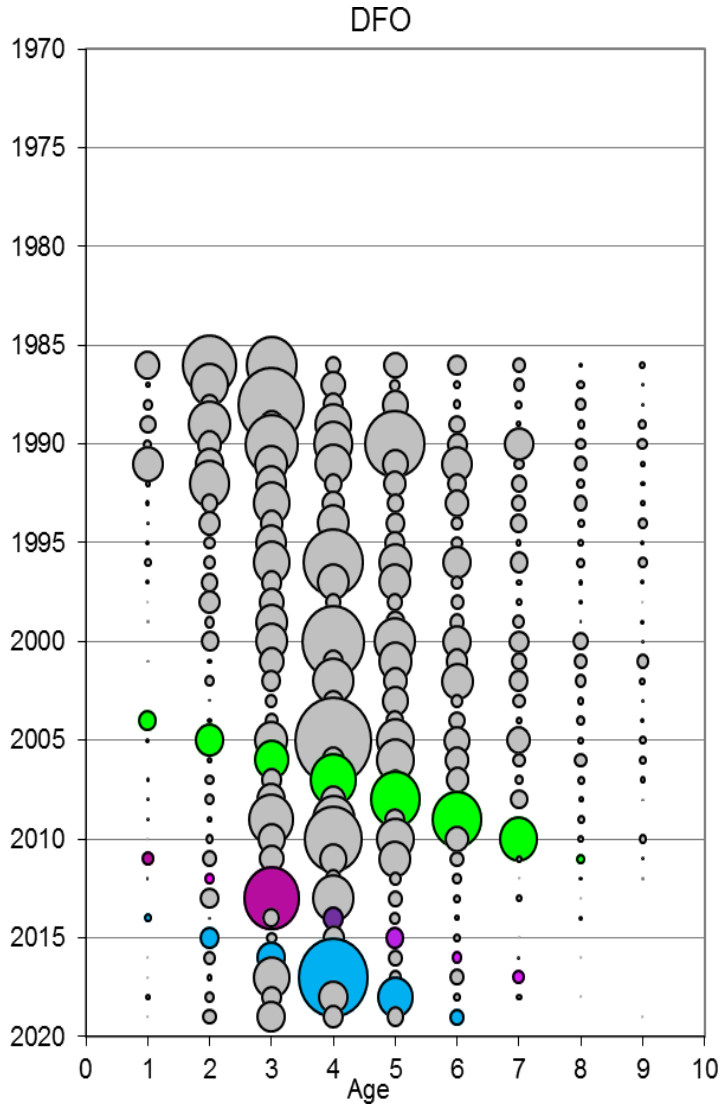
Stratification Design

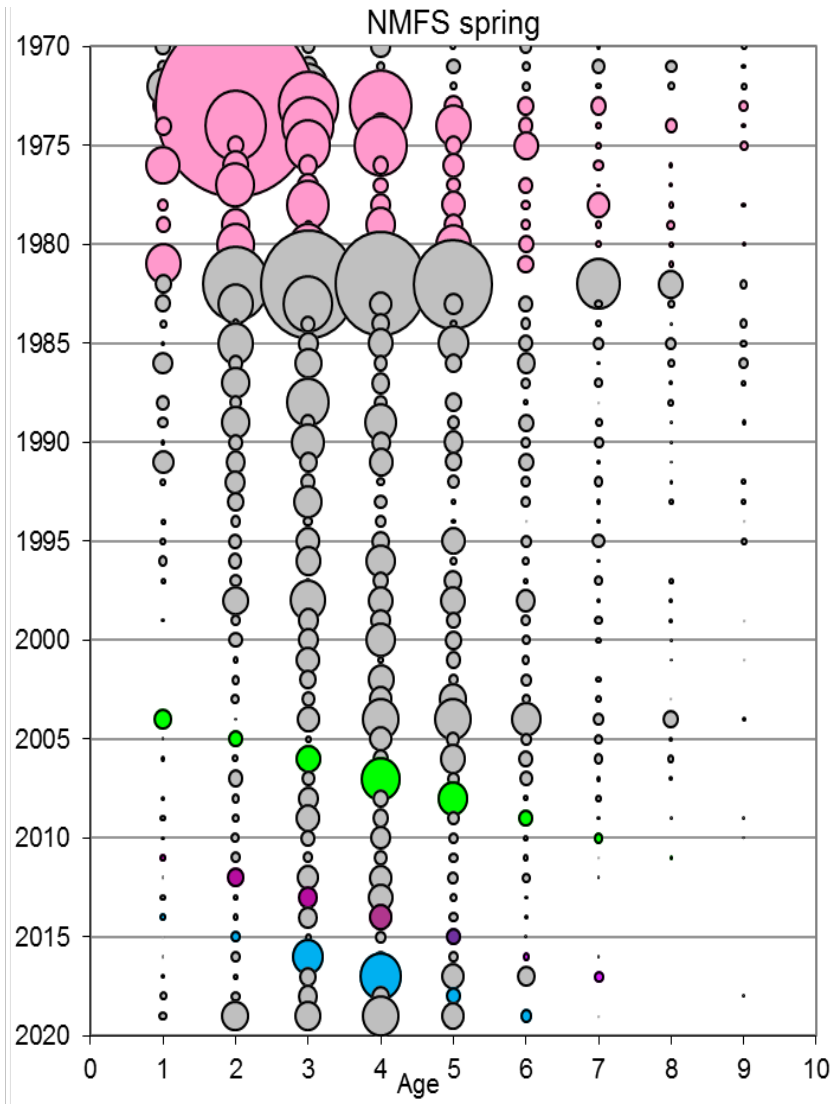
- Strata 5Z1, 5Z2, and portions of 5Z3 & 5Z4 currently used for the Eastern Georges Bank (5Z j&m) TRAC assessment
- Need to reanalyze this using all of 5Z1 – 5Z4
- 5Z5 – 5Z8 have been inconsistently sampled and are unlikely a usable time series
- 5Z8 generally has low catches of cod

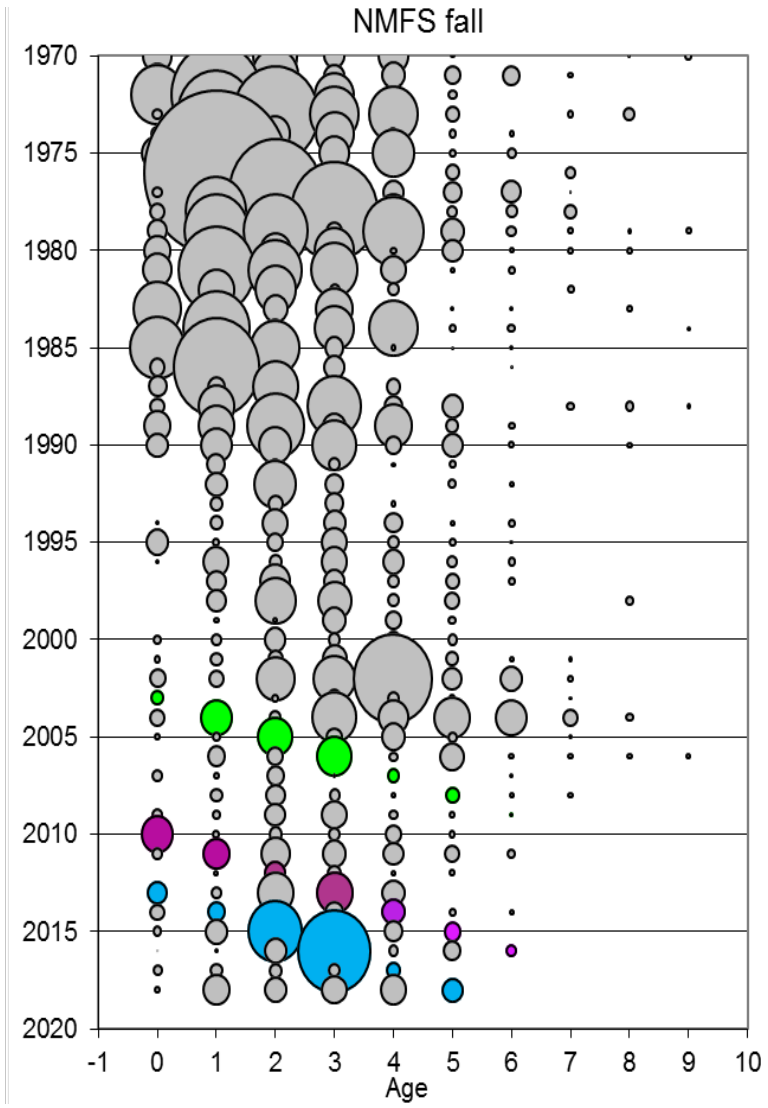


Georges Bank Survey Catch at Age

(*excludes some portions of Stat Areas 522 & 526*)







Georges Bank Stock Area
Preliminary Data Availability Summary

- A complete data inventory should include additional catch and sampling data from tatistical areas 522 and 525, and associated survey data for this same area.
- There are no significant recreational fisheries landings or discards
- The three primary fishery independent surveys are the NEFSC Spring & Fall bottom trawl surveys and the DFO Canada Spring bottom trawl survey
- Although robust catch and survey data exist for this area, recent low fishery and survey catches have made this stock model resistant
  - Recent efforts have focused on Data Limited Modeling approaches, which will be tabled at this year's TRAC meeting

Questions and Discussion