Winter Flounder and Waquoit Bay: A History of *MarineFisheries* Research in the Reserve and Beyond

Waquoit Bay NERR
Research at the Reserve
Coffee House Series
April 16, 2015
Falmouth, MA

Why did I get into this field?

The natural world amazes me!

I love fieldwork…

And… I can't wait to see what's in the bag!

Arne Howe – Former MarineFisheries Senior Biologist

He worked over 35 years for the DMF and began the seine and trawl surveys we still conduct today.

Arne is also responsible for a large body of work used to manage winter flounder and understand the needs of this species.

Winter Flounder Life History Understanding Pre-1970

- Most authors focused on early life history and the fisheries.

- Seasonal migrations understood.

- Wide-scale tagging work not yet published.

- Unit stock not defined for resource in US waters.

CATCH BY STATE (SEVERAL RECENT YEARS) x 10^3 lbs

YEAR		MAINE	MASS.	R.I.	CONN.	N.Y.	N.J.	TOTAL
1955	lbs	935	9,324	1,475	878	536	40	13,188
	%	7.1	70.7	11.2	6.6	4.1	0.3	
1959	lbs	342	12,041	2,264	857	1,310	74	16,917
	%	2.0	71.2	13.4	5.1	7.7	0.4	
1961	lbs	158	14,342	2,036	980	1,695	153	19,384
	%	0.8	74.0	10.5	5.1	8.8	0.8	
1963	lbs	456	13,744	2,925	984	1,843	185	20,174
	%	2.3	68.1	14.5	4.9	9.1	0.9	
1966	lbs	96	23,099	4,309	831	3,259	438	32,032
	%	0.3	72.1	13.4	2.6	10.2	1.4	

Winter Flounder Life History

- Important Species to Commercial and Recreational Fisheries

- Medium-sized (31-38 cm) “right-eyed” flatfish inhabiting coastal waters

- Most abundant from the Gulf of St. Lawrence to New Jersey

- Spawn adhesive demersal eggs near and inside coastal embayments and on offshore banks.

- Larval period is short, average of 2 months

- Age-0 fish depart estuaries after first summer for deeper shelf waters

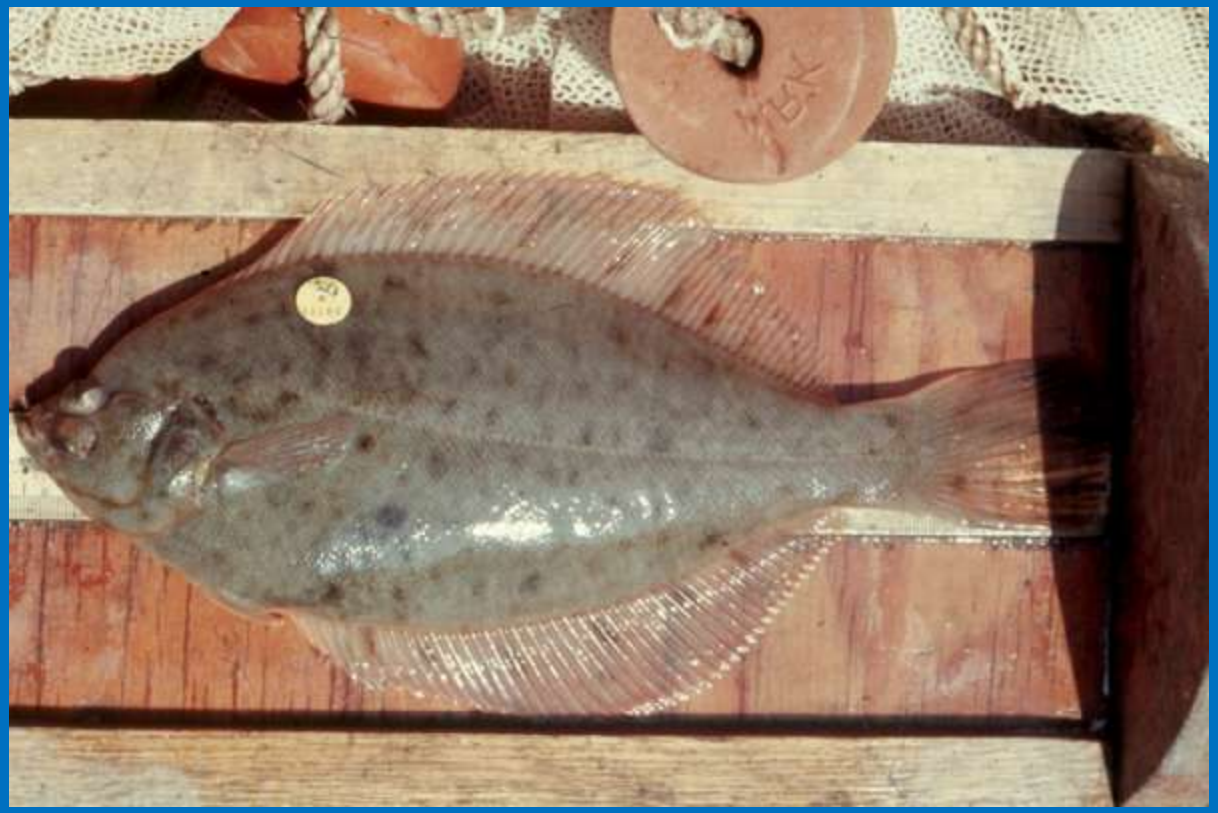
MarineFisheries Winter Flounder Research

Population Structure: 1960 - 1967

DMF biologists Arne Howe and Phil Coates organized a tagging study.

Goal to document migration, growth and mortality of winter flounder off MA.

12,151 winter flounder were tagged in the program with 4,400 returns through 1971.



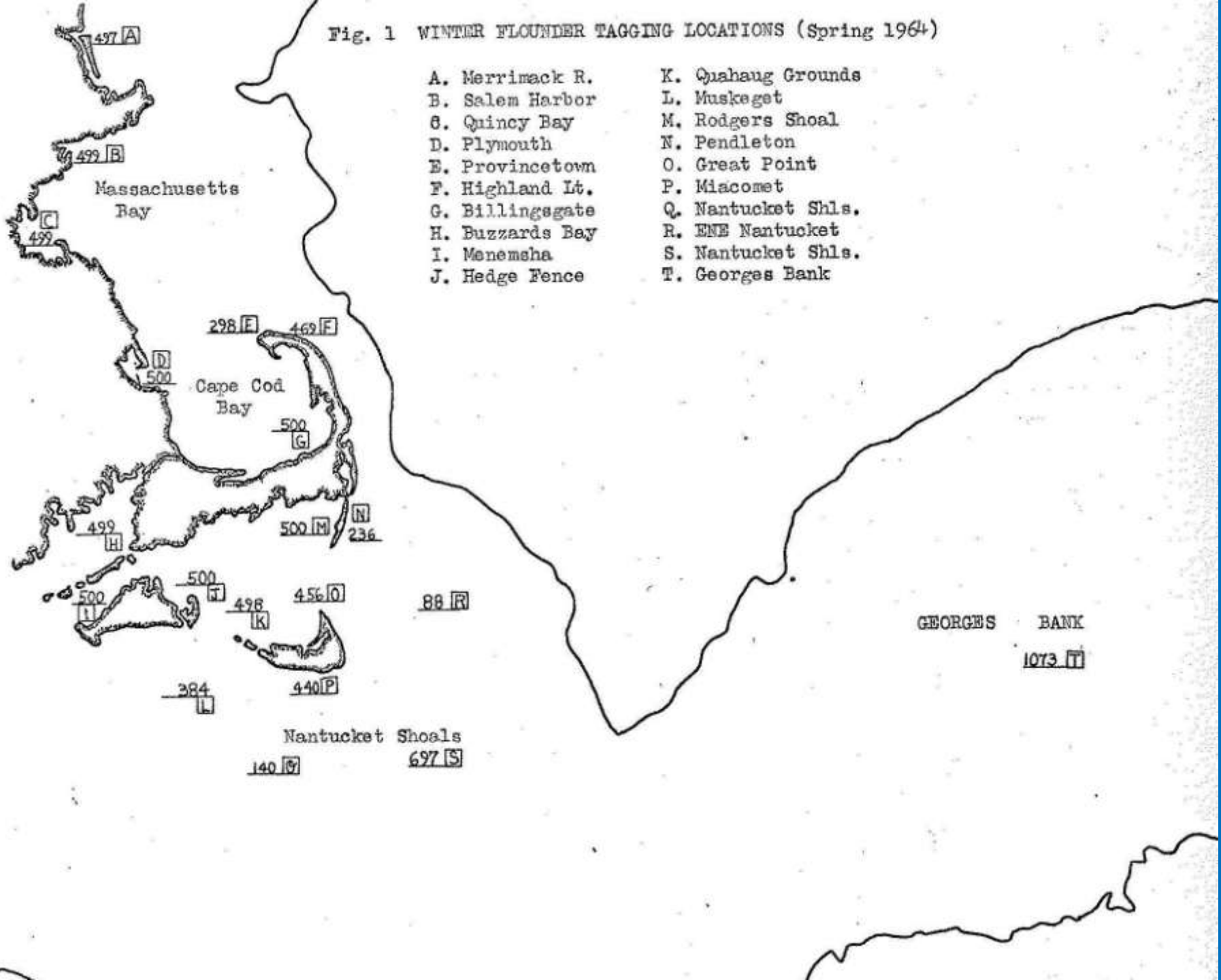


Fig. 1 WINTER FLOUNDER TAGGING LOCATIONS (Spring 1964)
A. Merrimack R.
B. Salem Harbor
C. Quincy Bay
D. Plymouth
E. Provincetown
F. Highland Lt.
G. Billingsgate
H. Buzzards Bay
I. Menemsha
J. Hedge Fence
K. Quahaug Grounds
L. Muskeget
M. Rodgers Shoal
N. Pendleton
O. Great Point
P. Miacomet
Q. Nantucket Shls.
R. ENE Nantucket
S. Nantucket Shls.
T. Georges Bank
497 A
499 B
Massachusetts Bay
499 C
298 E
469 F
500 D
Cape Cod Bay
500 G
499 H
500 M
N 236
500 I
500 J
498 K
456 O
88 R
440 P
384 L
Nantucket Shoals
140 Q
697 S
GEORGES BANK
1073 T

Tagging results delineated three distinct population units:

1. Gulf of Maine

2. Southern New England / Mid Atlantic

3. Georges Bank

- with limited immigration and emigration between groups.

A STUDY OF THE MARINE RESOURCES of the WAQUOIT BAY – EEL POND ESTUARY

John R. Curley, Robert P. Lawton
John M. Hickey and John D. Fiske

1967 – 1968 Waquoit Bay was studied under the Estuarine Research Program

Monograph Series
Number 9

Division of Marine Fisheries
Department of Natural Resources
The Commonwealth of Massachusetts

1960's 1970's DMF Estuarine Monograph Series

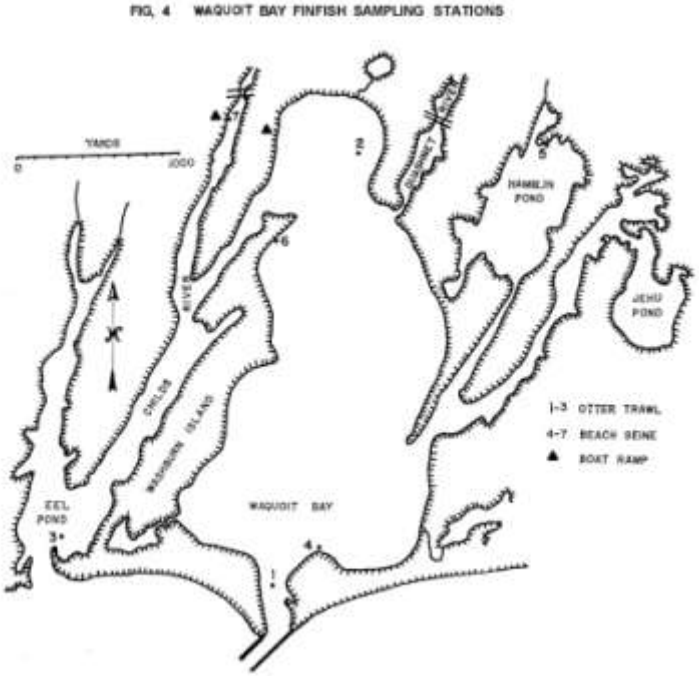
- Waquoit Bay was 1 of 17 estuaries surveyed.

- Monthly water quality, contaminate, and finfish and sampling.

- Additional shellfish and saltmarsh resource mapping and fisheries statistics gathered and reported.

PLATE 1.

The Waquoit Bay — Eel Pond Estuary (Ben Harrison).



Estuarine studies reinforced the

importance of these systems

to spawning and juvenile recruitment.

Nantucket Sound Studies: 1969 - 1974

- Four projects conducted from DMF research vessel F.C. Wilbour as well as estuarine work via skiff trawls and beach seining.

1. Investigation of Offshore Winter Flounder Spawning.
2. Assessment of Recruitment of Estuarine Winter Flounder to the Offshore Fishery
3. Meristic Stock Identification
4. Development of a Sampling Method for Estimating Winter Flounder Year Class Abundance

Nantucket Sound Studies: 1969 - 1974

1. Investigation of Offshore Winter Flounder Spawning.

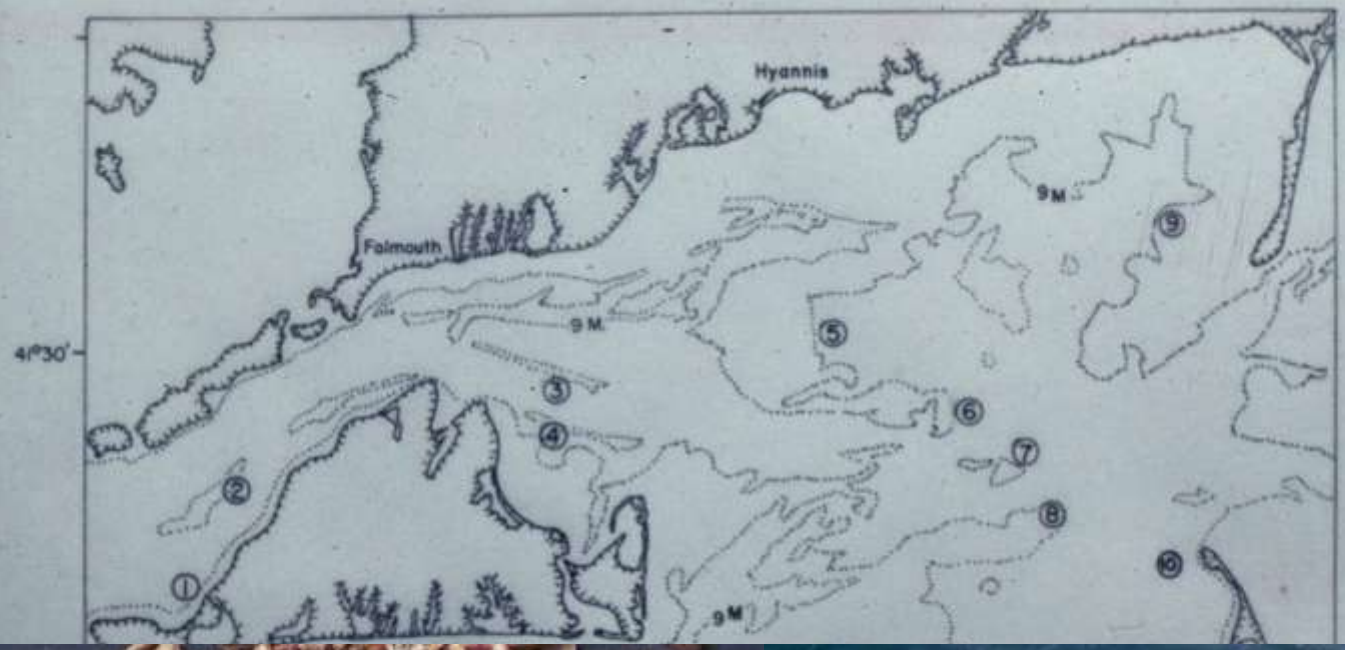
- Benthic egg / ichthyoplankton sled tows – low incidence of eggs / larvae in sound.

- Surface and oblique ichthyoplankton tows - decreasing abundance of larvae seaward of estuary inlets.

- Concurrent sampling for adults with a bottom trawl lacked spawning fish in season.

- 2 M beam trawl hauls found YOY in only 9 of 102 tows made in the sound.

Figure 1. Vineyard and Nantucket Sounds, showing sampling stations and shoals.



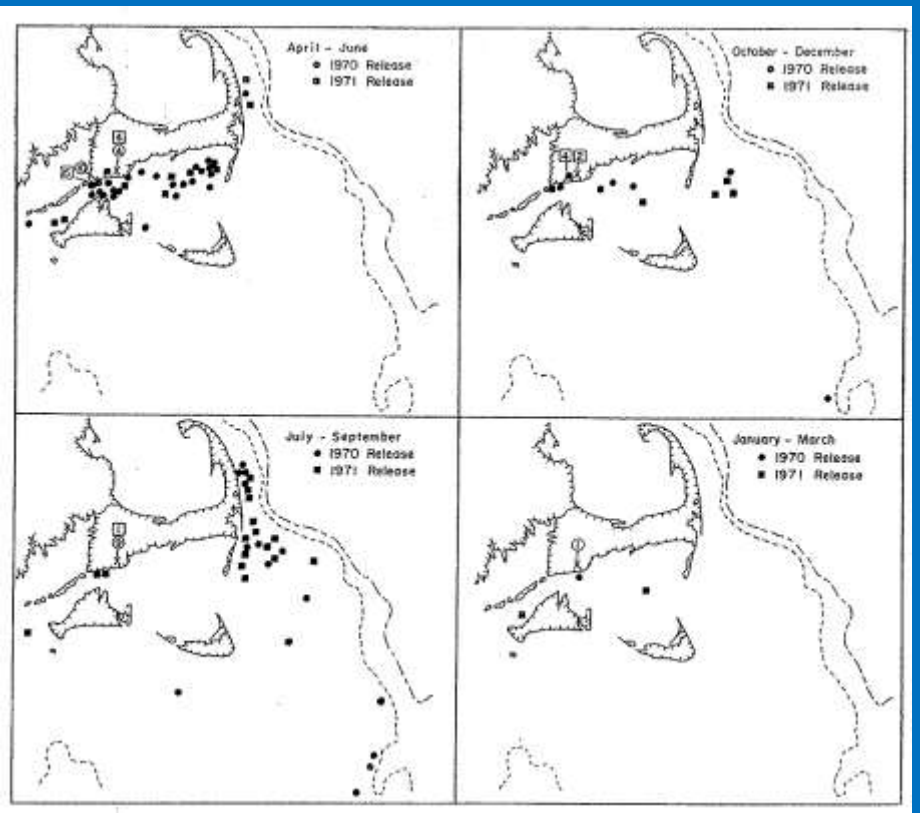
Nantucket Sound Studies: 1969 - 1974

2. Assessment of Recruitment of Estuarine Winter Flounder to the Offshore Fishery

- Waquoit Bay served as the primary study site for this project.

- A skiff trawl was used to collect fish for tagging during March and early April 1970-71.

- Flounder 25-35 cm were tagged and returns from sportfishermen and commercial draggers were collected with a reward for returns of 1$ for a tag and $2 for a fish with tag attached. 1,288 fish were tagged with Petersen Discs.



Results of analysis predicted that recruits from Waquoit Bay provide less than 1% of the total number of fish required to maintain equilibrium catch for this fishery.

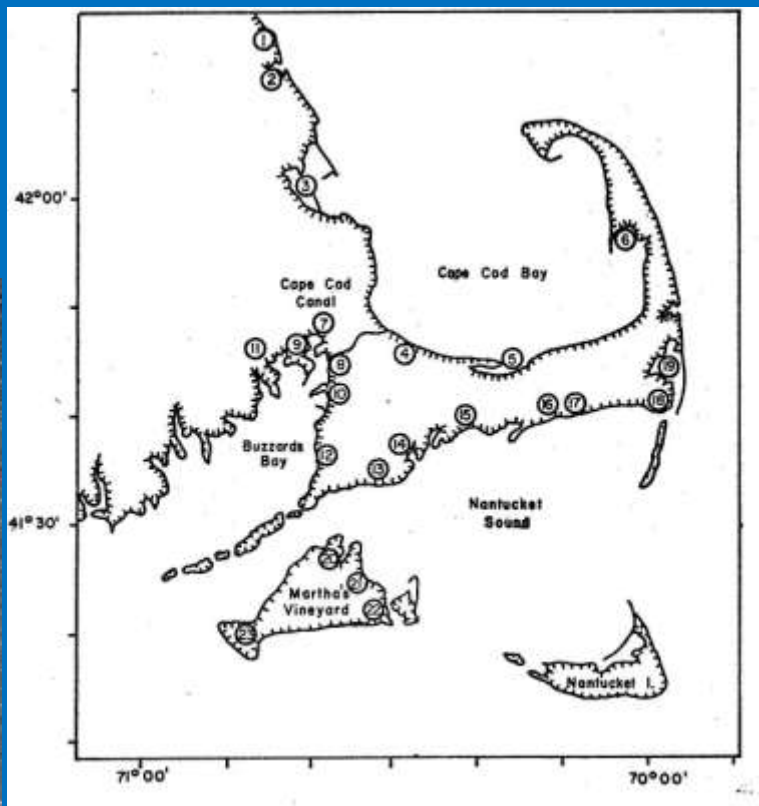
Nantucket Sound Studies: 1969 - 1974

3. Meristic Stock Identification

Nineteen estuaries were sampled via seine and ~100 YOY from each locale were gathered and dorsal and anal fin rays were counted. (5,322 fish!)

Fin ray differences delineated three distinct groups within the study area.

Idea of individual estuary spawning groups begins to gain acceptance.



Nantucket Sound Studies: 1969 - 1974

4. Development of a Sampling Method for Estimating Winter Flounder Year Class Abundance

Waquoit Bay served as a primary study site where trials were conducted to determine the correct time of year and design for a winter flounder recruitment survey.

Nantucket Sound Studies Reinforced:

1. Stock delineations (through tagging).

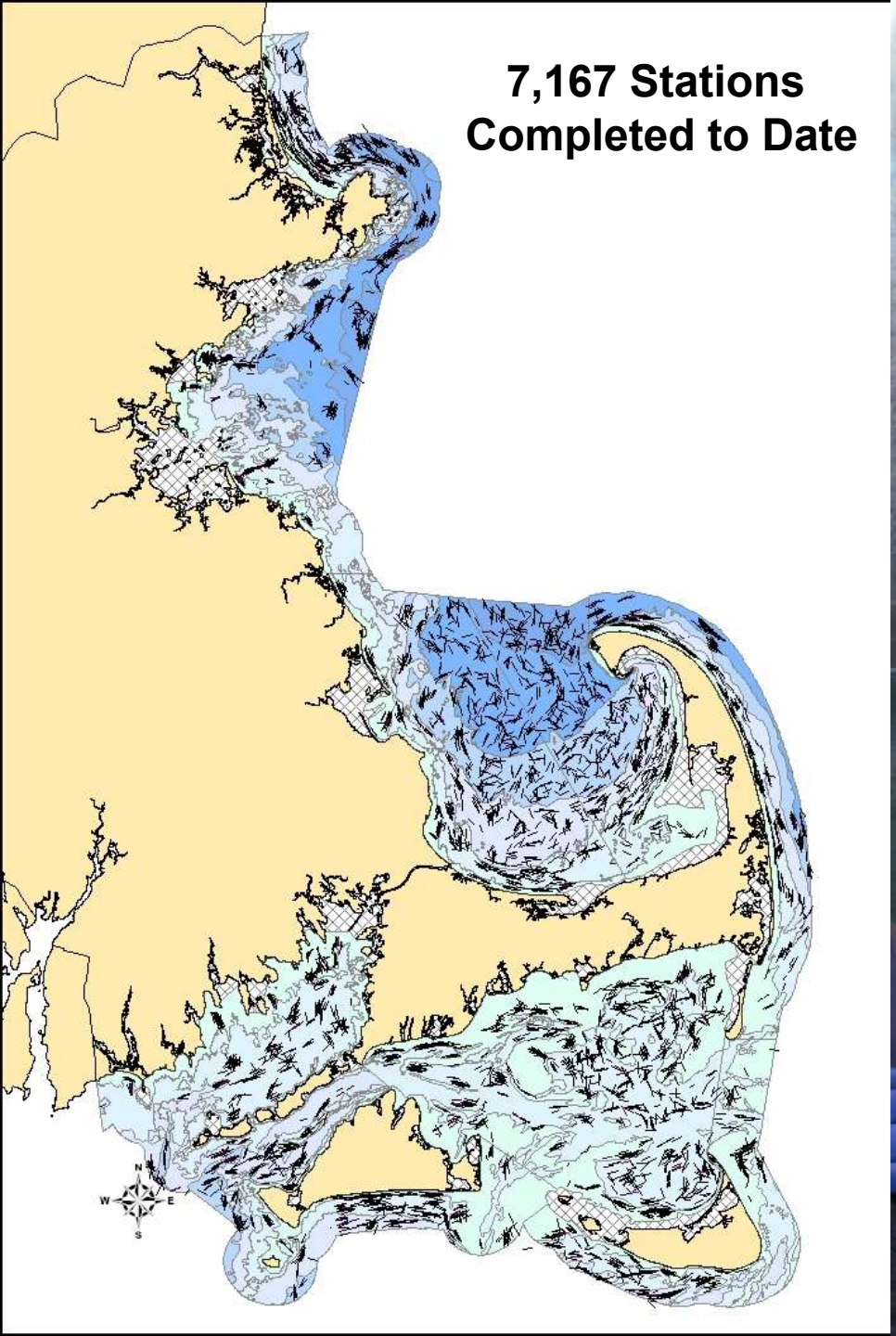
2. Understanding of spawning habitat.

3. Fine scale understanding of juvenile habitat use in estuaries.

***THEN*… a need for population monitoring of winter flounder and other marine species could wait no longer…**

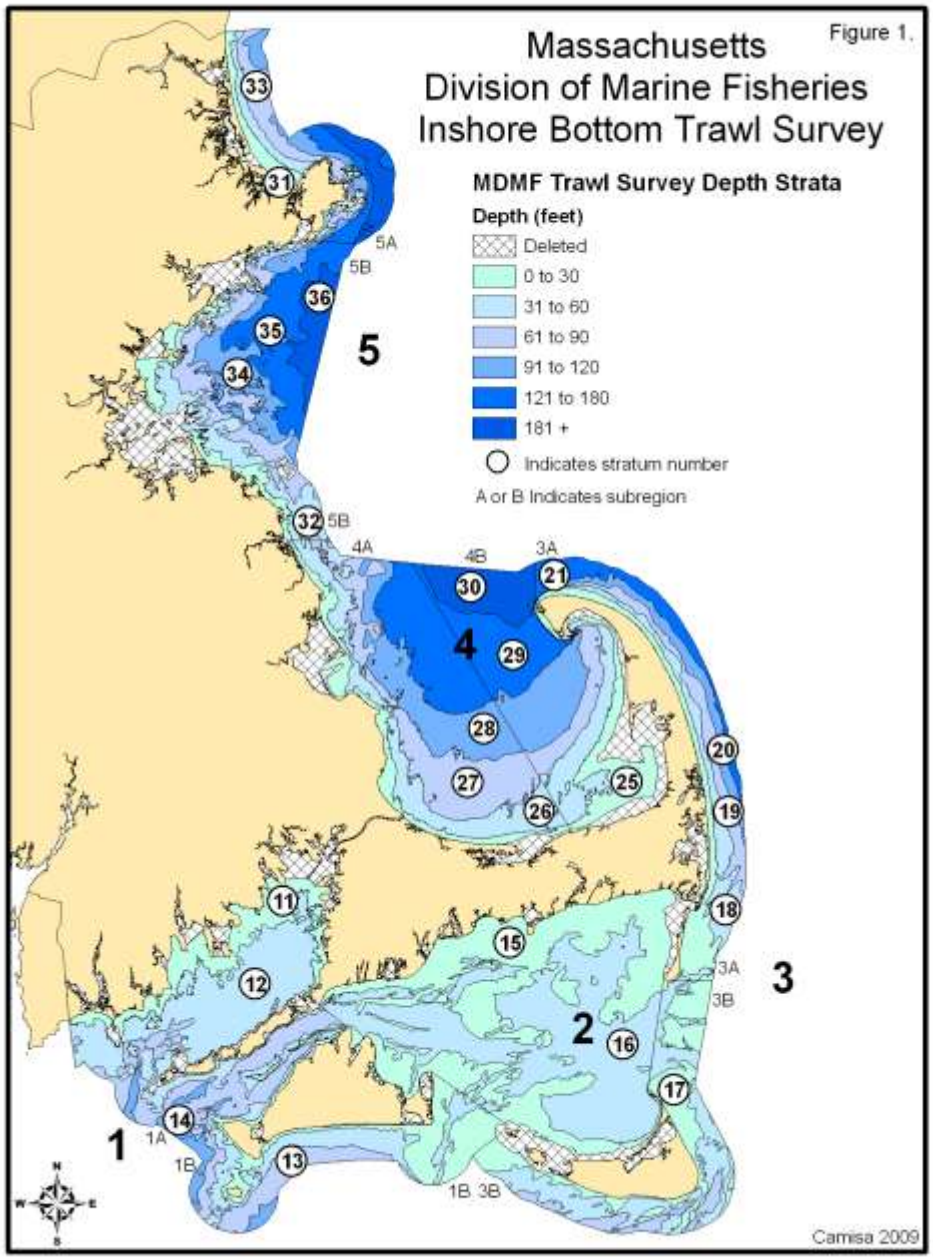
Trawl Survey

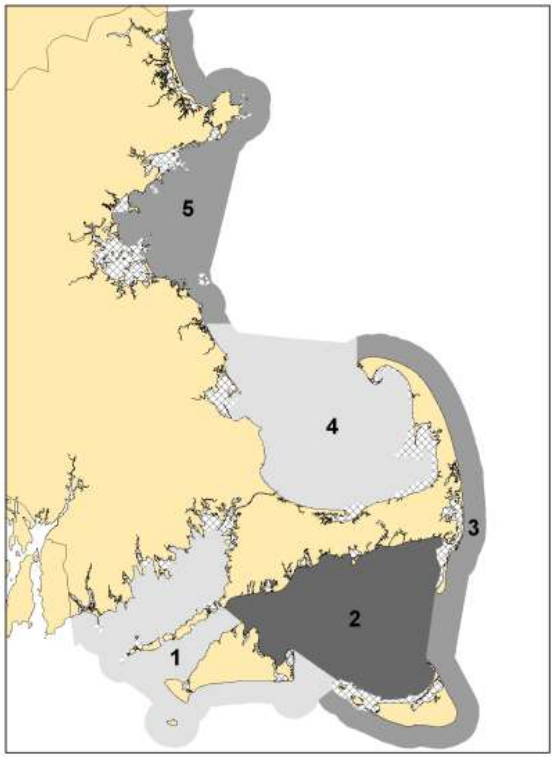
7,167 Stations Completed to Date



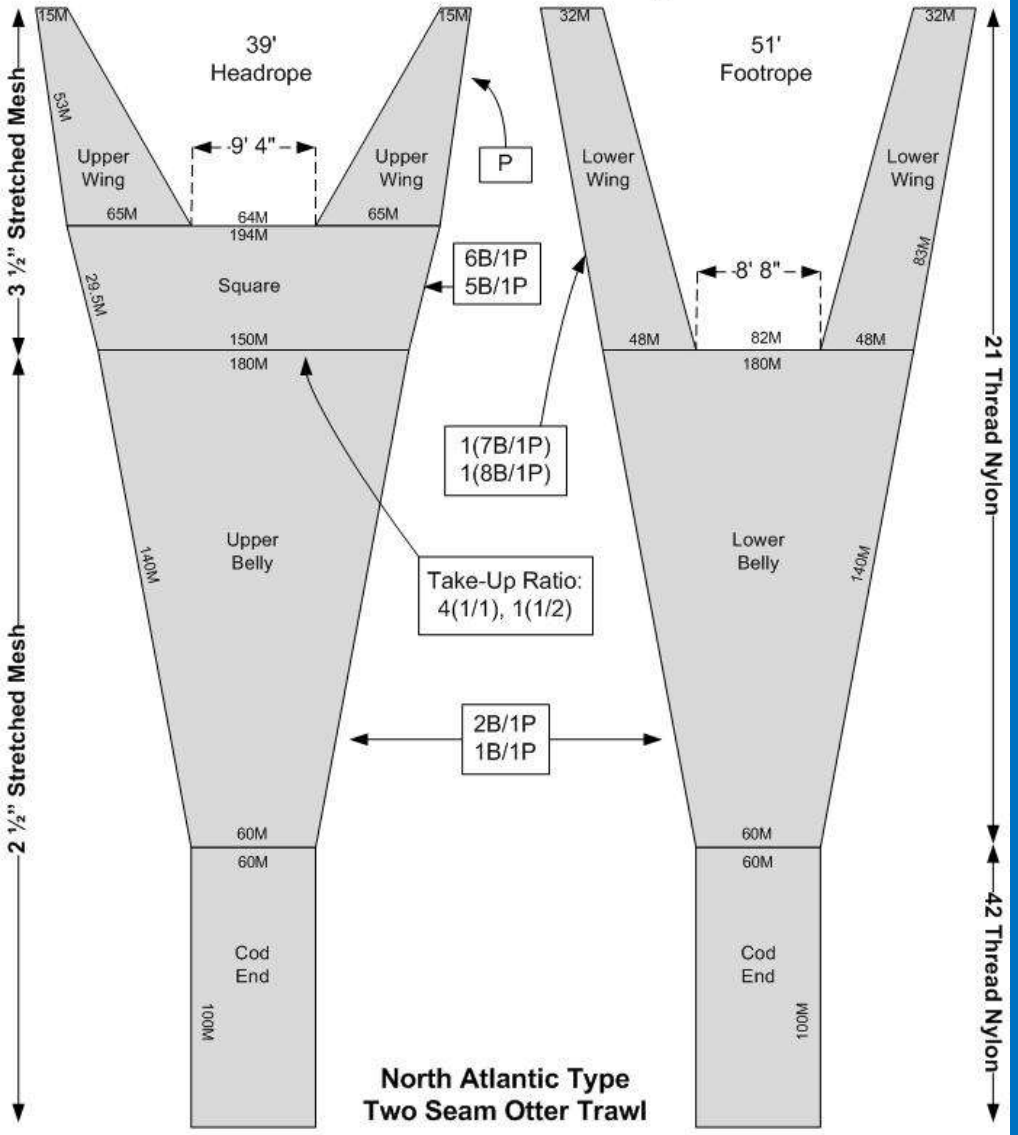
Survey Area

- 5 Geographic Regions
- 6 Depth Zones
- 23 Strata





Massachusetts Division of Marine Fisheries
Inshore Bottom Trawl Survey Net Plan



North Atlantic Type
Two Seam Otter Trawl

Headrope:	39ft, ½" SS combination rope.
Footrope:	51ft, ½" SS combination rope.
Sweep:	51ft, 3/8" Trawlex chain with 3½" rubber discs. Seized to FR at 18" intervals with 3/8" shackles and 2" ID, 5/16" steel rings.
Floats:	7, 8" diameter double-becket aluminum trawl floats.
Bridles:	Top legs – 60ft, 3/8" wire; Bottom legs – 63ft, 3/8" Trawlex chain.
Doors:	Tomkiewicz flat trawl doors, 40" x 72", double shoed, 325 lbs each.
Cod End:	Liner - ¼" knotless nylon; Rings – ¼" SS 2" ID; Chaffer - 1/2 of a cod end, running gore to gore, extending 1 mesh beyond the rings.

CAMISA 2009

The sampling gear design has remained unchanged since 1978.

Data Collected

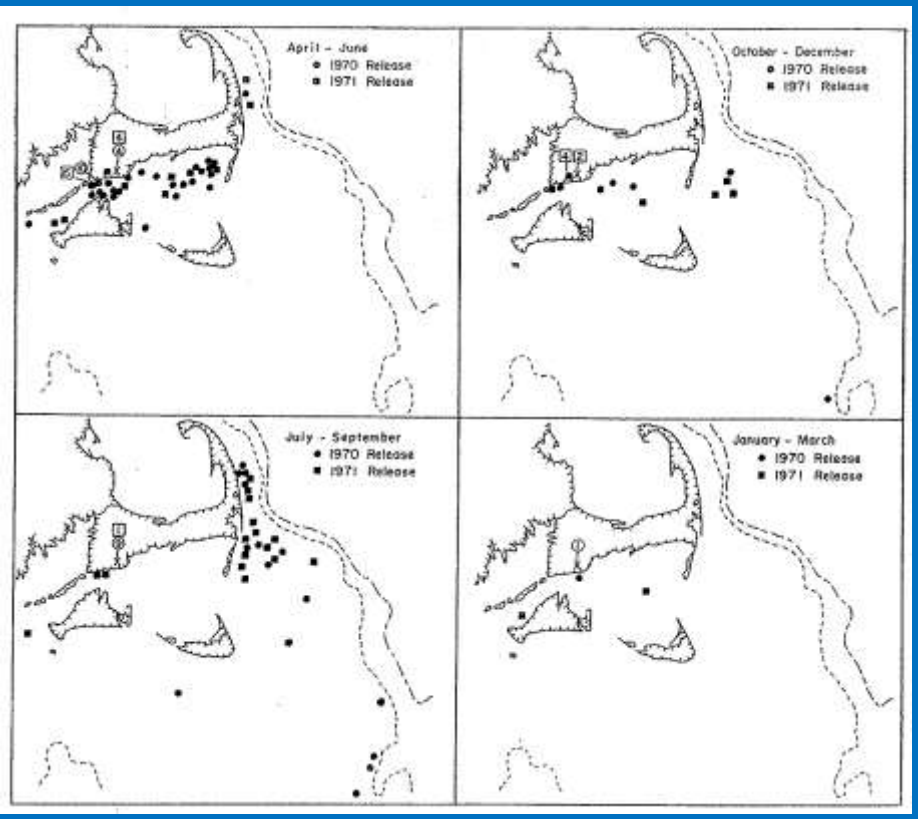
- All fishes separated by species.

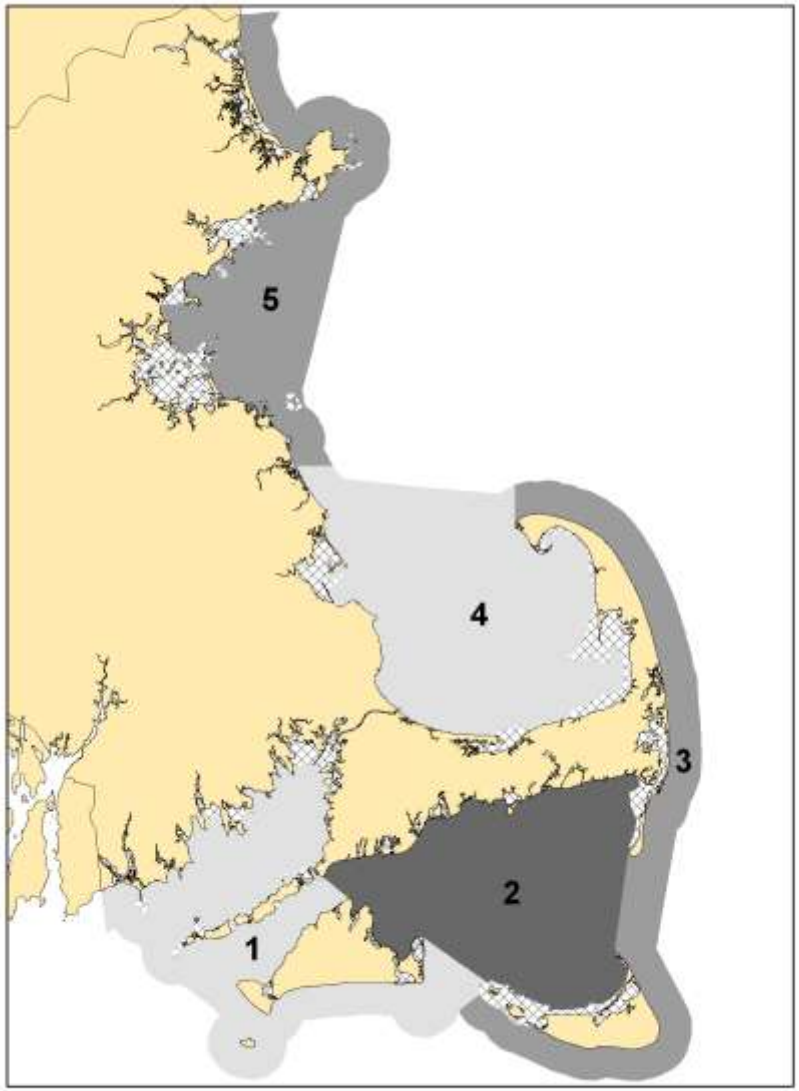
- A subset of crustaceans and finfish species separated by sex.

- All catch components are weighed.

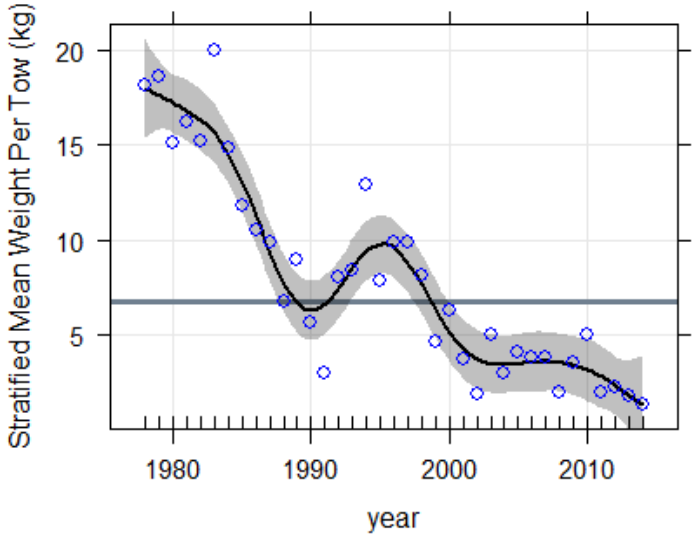
- A representative sample of each finfish species and select invertebrates are measured for a length frequency.

- Priority species are sampled for age structures, as well as sex and maturity observations.


April - June
1970 Release
1971 Release
October - December
1970 Release
1971 Release
July - September
1970 Release
1971 Release
January - March
1970 Release
1971 Release

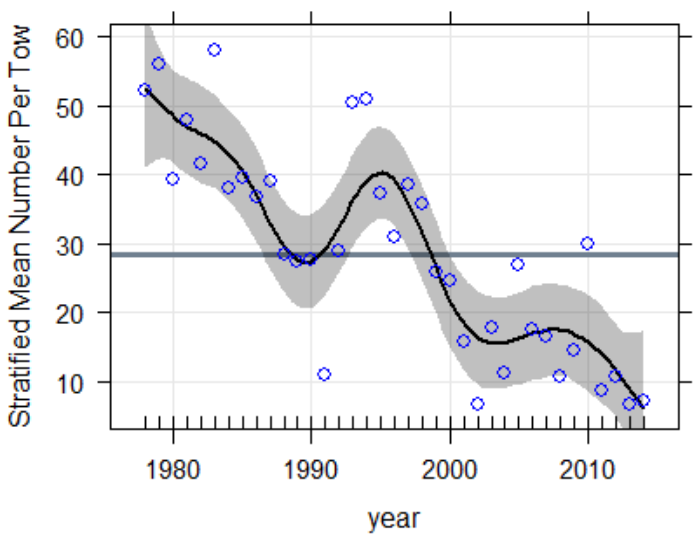

5
4
3
2
1

Winter Flounder Biomass
MDMF Spring Survey, Regions 1-3



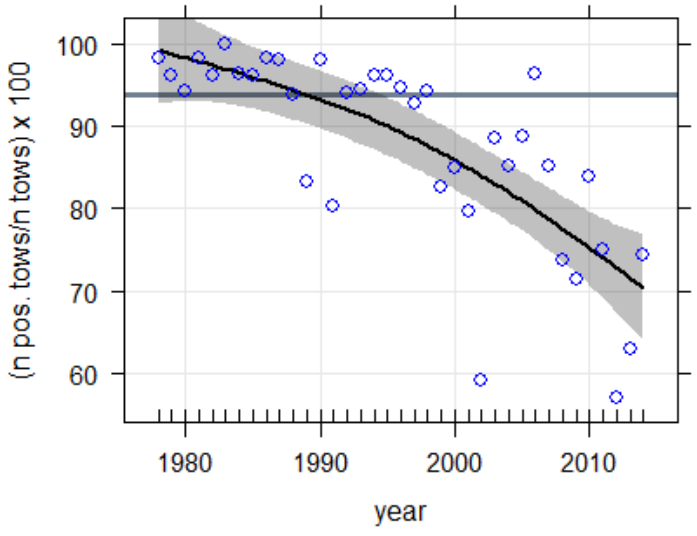
Black line: GAM fit.
Grey line: timeseries median.

Winter Flounder Abundance
MDMF Spring Survey, Regions 1-3



Black line: GAM fit.
Grey line: timeseries median.

Winter Flounder Occurrence in Survey Stations
MDMF Spring Survey, Regions 1-3



Black line: GAM fit.
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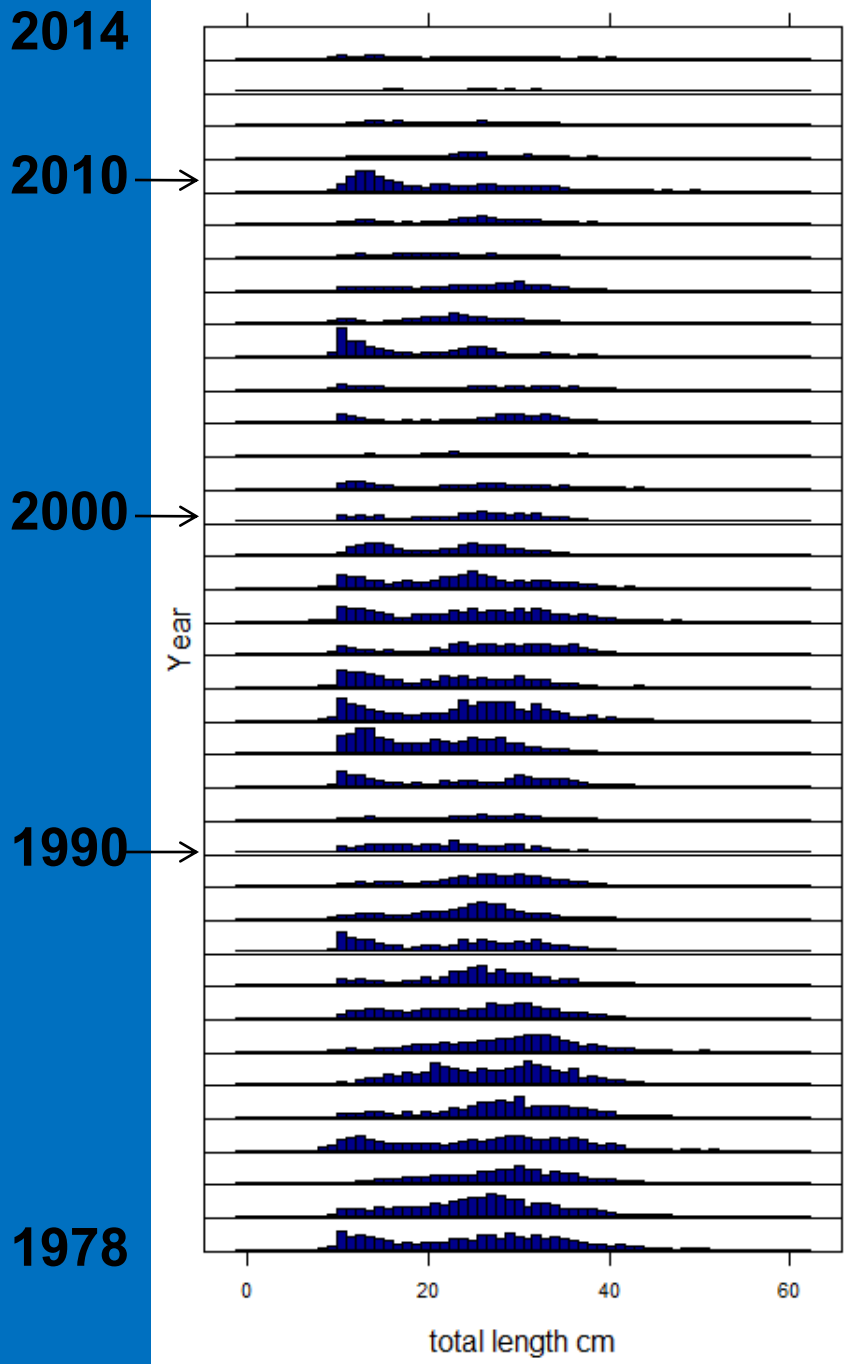
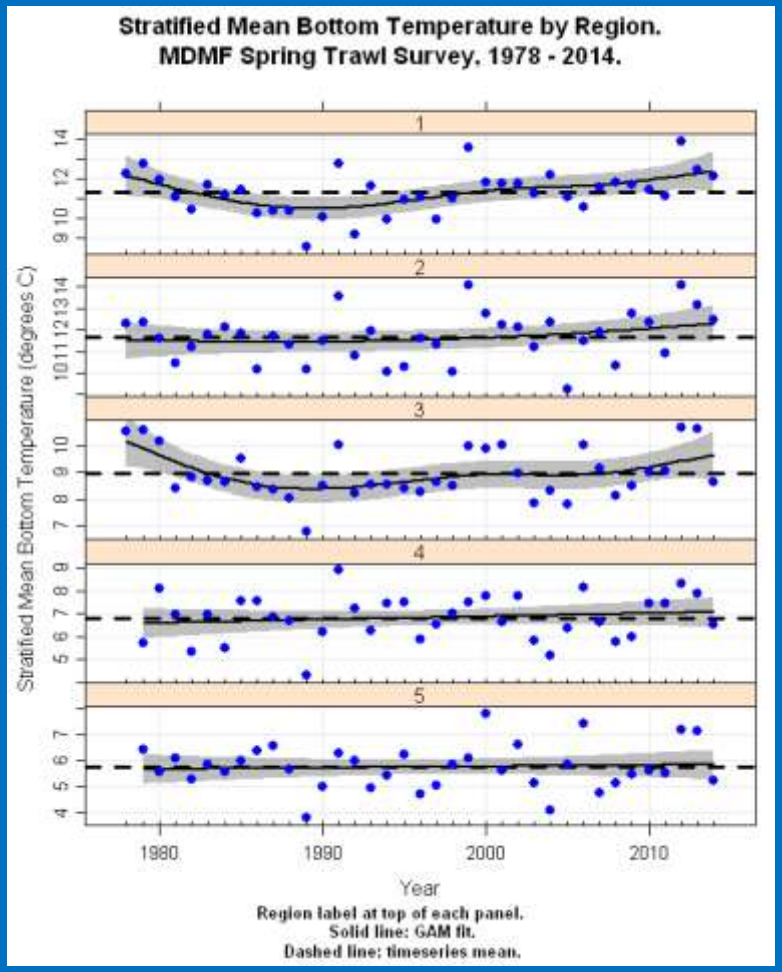
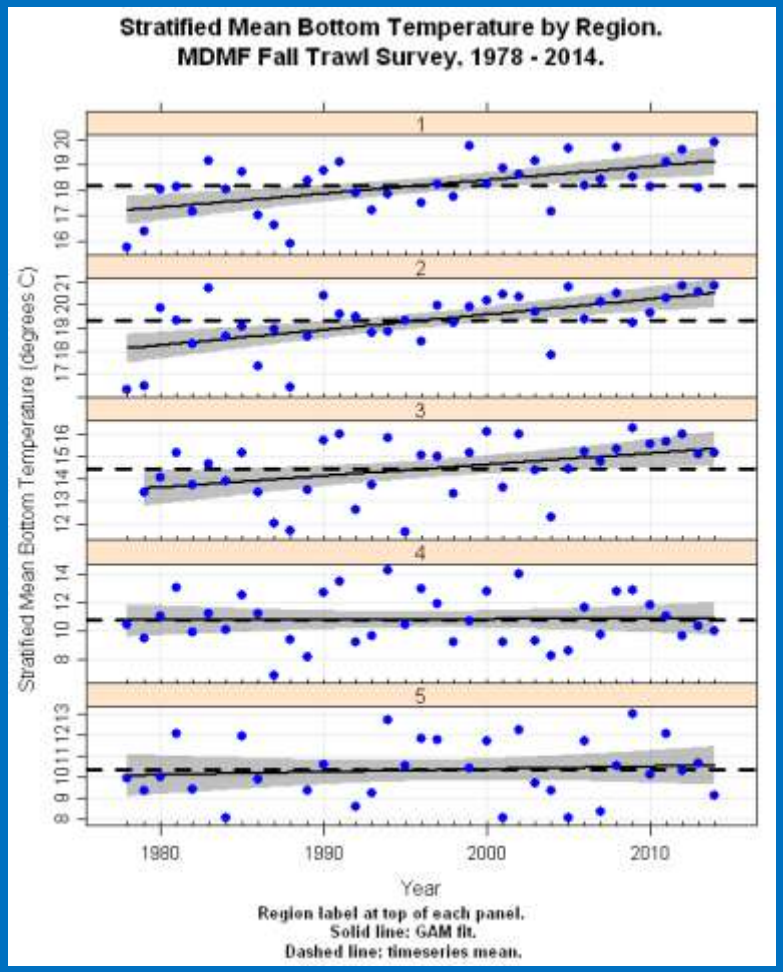

2014
2010
2000
1990
1978
Year
0
20
40
60
total length cm



Trawl Survey Mean Bottom Temperatures,

Spring and Fall



Seine Survey

Seine Survey Design/Protocols

- 49 stations in 6 estuaries (Waquoit / Eel Pond is 1 of the 6).

- Mid-June through Mid-July.

- Fixed stations from survey inception with minor changes.

- Sampling from +/- 2 hrs around high tide.

- 6.4 M (21') distance is measured to yield area swept.

- All commercially and recreationally important species are counted. Other species noted for presence.

- Temperature monitors deployed year-round in five estuaries since December 2006.

Station Locations
MDMF Seine Survey.

Bass River

Stage Harbor

Lewis Bay

Cotuit Bay

Great Pond

μ

MADMF Resource Assessment Project
Vincent M. Manfredi

Temperature Monitor Locations
MDMF Seine Survey.

Great Pond

Cotuit Bay

Lewis Bay

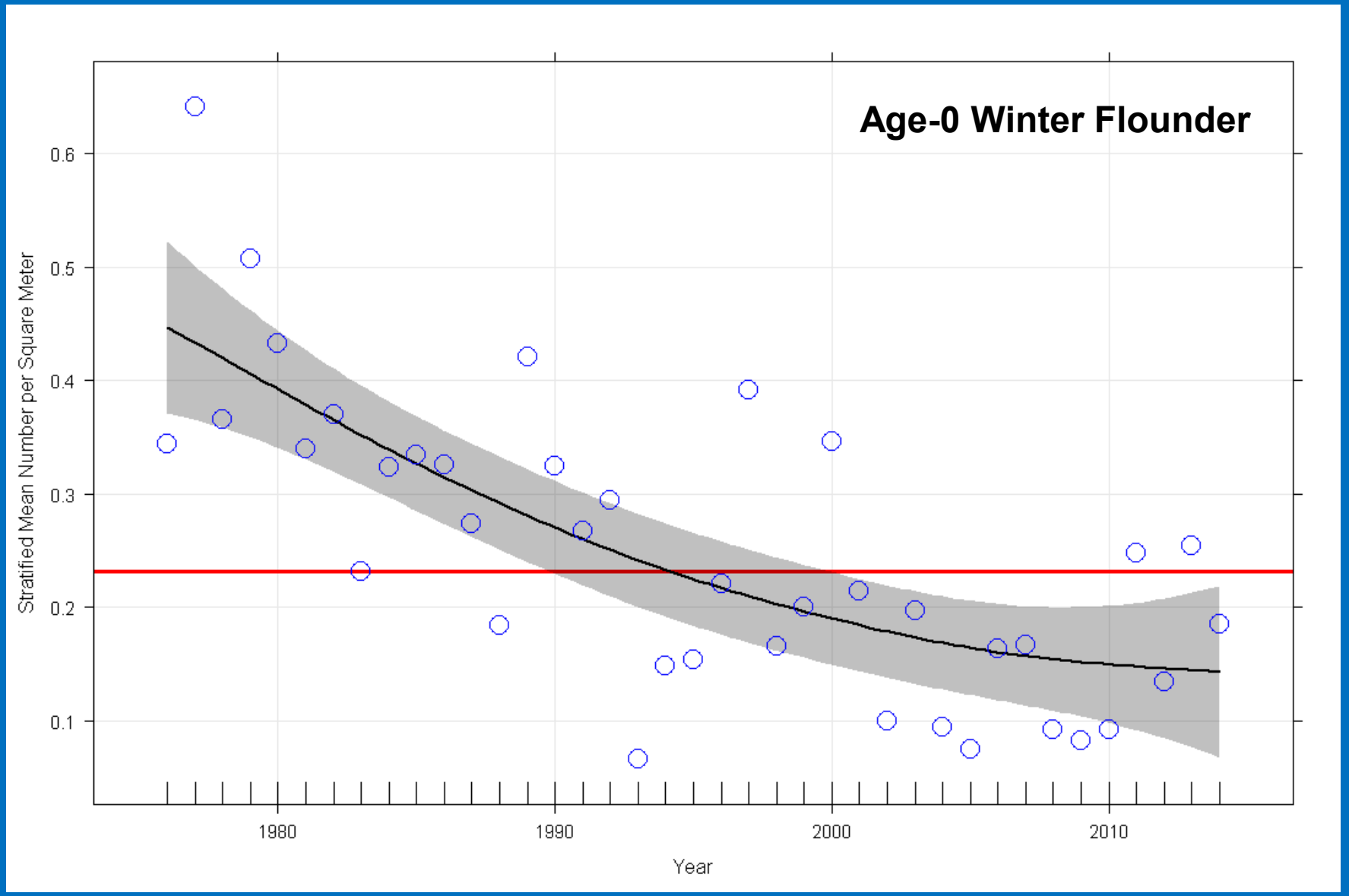
Bass River

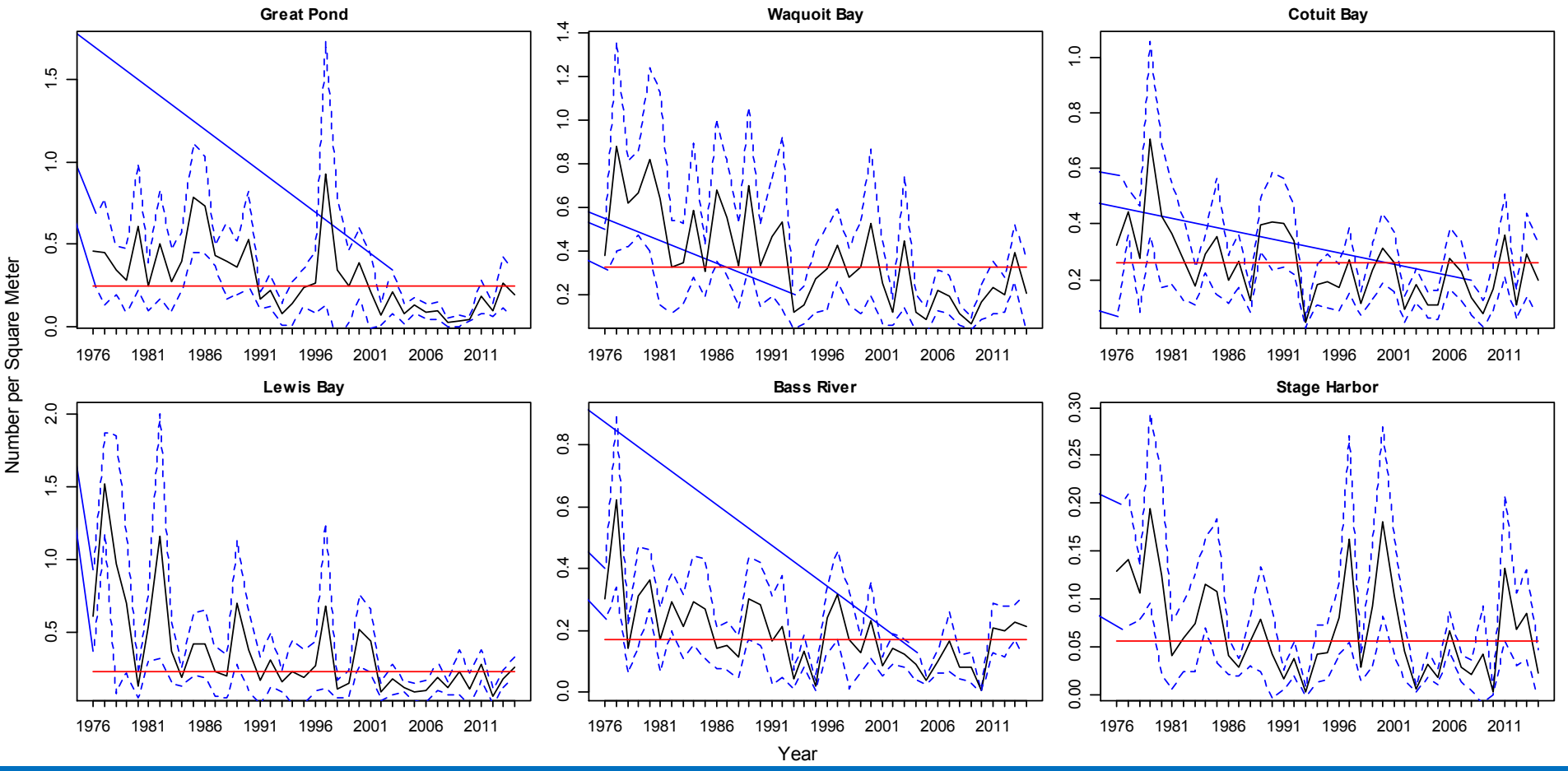
Stage Harbor

μ

Produced by: MADMF Resource Assessment Project
Vincent M. Manfredi

Seine Survey Results, 1976 – 2014.




Great Pond
Waquoit Bay
Cotuit Bay
Lewis Bay
Bass River
Stage Harbor
Number per Square Meter
Year
1976
1981
1986
1991
1996
2001
2006
2011

End Products / Goals

In 1988, MA DMF scientists contributed to the first fishery management plan for winter flounder.

DMF has an active role in most stock assessments and management for this and other species.

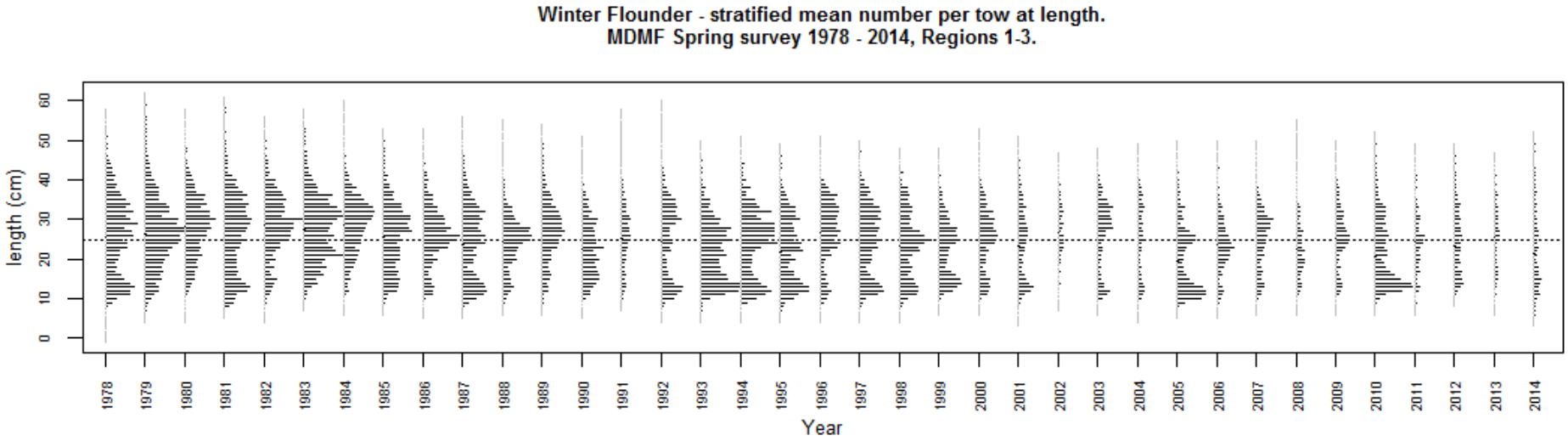
Massachusetts' waters support the largest biomass of this species in the US.

Fisheries science work in MA is critical to the proper management of this species.

MANY Thanks to:
Former and Present Supporters of Fisheries Field Research at the MA Division of Marine Fisheries.

This is a very long list but particular thanks is due to these present and former co-workers.

Arnold Howe, Phil Coates, Tom Currier,
David Pierce, Michael Armstrong, Steven Correia, Jeremy King and Matthew Camisa and Mark Szymanski.


Winter Flounder - stratified mean number per tow at length.
MDMF Spring survey 1978 - 2014, Regions 1-3.
length (cm)
0
10
20
30
40
50
60
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
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Year