# Overview of data issues for stock assessments: Timing, QA/QC etc.

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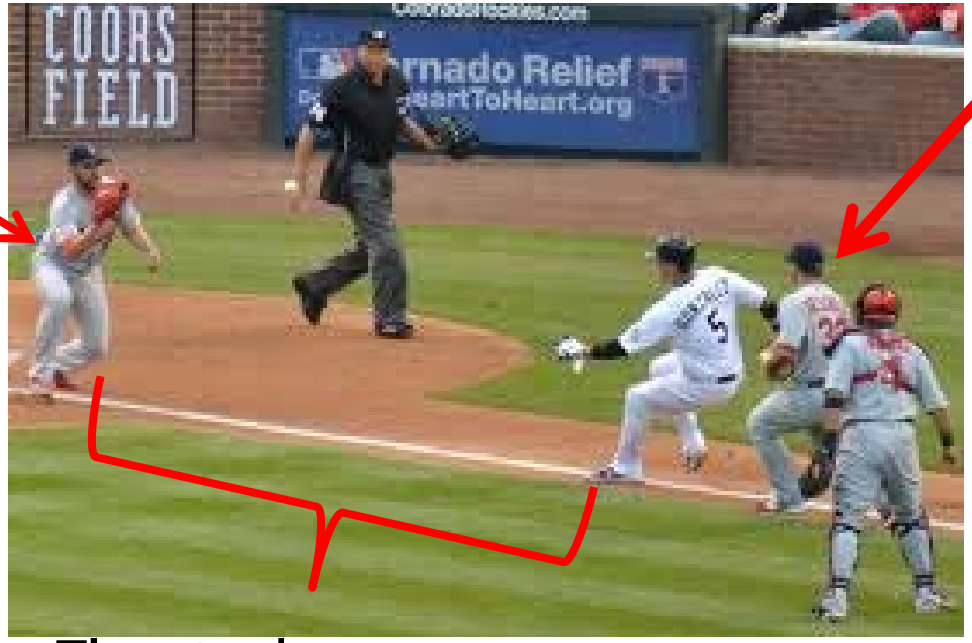
*NEFSC Stock Assessment Data Collection Program Review*
*August 5-9*
*Woods Hole. MA*
*Version 1 (last update July 20, 2013)*

# Assessment Timing

Data Availability

Management Process




Time to do Assessment

# Presentation overview

- Relationship between data and models—and the interface with management
- Chronology of data for assessments
- Need for robust integrated system
- Strengths, challenges, proposed solutions

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# Duality of Data vs Models

Einstein-Theory of Relativity—Space and Time Continuum

Eddington— one of the few who understood what Einstein was saying

MacArthur/Hutchinson--Ecology

# Sir Arthur Eddington—Selective Subjectivism (1)

## Finding in nature what the mind put into nature

“LET us suppose that an ichthyologist is exploring the life of the ocean. He casts a net into the water and brings up a fishy assortment. Surveying his catch, he proceeds in the usual manner of a scientist to systematise what it reveals. He arrives at two generalisations:(1) No sea-creature is less than two inches long.(2) All sea-creatures have gills.These are both true of his catch, and he assumes tentatively that they will remain true however often he repeats it.”

“An onlooker may object that the first generalisation is wrong. "There are plenty of sea-creatures under two inches long, only your net is not adapted to catch them." The ichthyologist dismisses this objection contemptuously. "Anything uncatchable by my net is *ipso facto* outside the scope of ichthyological knowledge, and is not part of the kingdom of fishes which has been defined as the theme of ichthyological knowledge. In short, what my net can't catch isn't fish.””

The Philosophy of Physical Science, 1938, Published 1978 U. Mich Press

# Sir Arthur Eddington—Selective Subjectivism (2)

- "In applying this analogy, the catch stands for the body of knowledge which constitutes physical science, and the net for the sensory and intellectual equipment which we use in obtaining it. The casting of the net corresponds to observation; for knowledge which has not been or could not be obtained by observation is not admitted into physical science."

- "Metaphysical contamination" To guess that there are fish under 2 inches would add unwelcome "metaphysical contamination" to the fish scientist's work.

The Philosophy of Physical Science, 1938, Published 1978 U. Mich Press

# Duality of data vs models

- MacArthur/Hutchinson--Ecology

**"Scientists are perennially aware that is it best not to trust theory until it is confirmed by evidence. It is equally true...that it is best not to put too much faith in facts until they are confirmed by theory"**

**Robert H. MacArthur, 1972**

# Historic vs Future Data

Need to improve future data collections

But how do we mesh high quality contemporary data with less than perfect historical data?

Time Machine is broken, so we are left with interpreting the historical record.

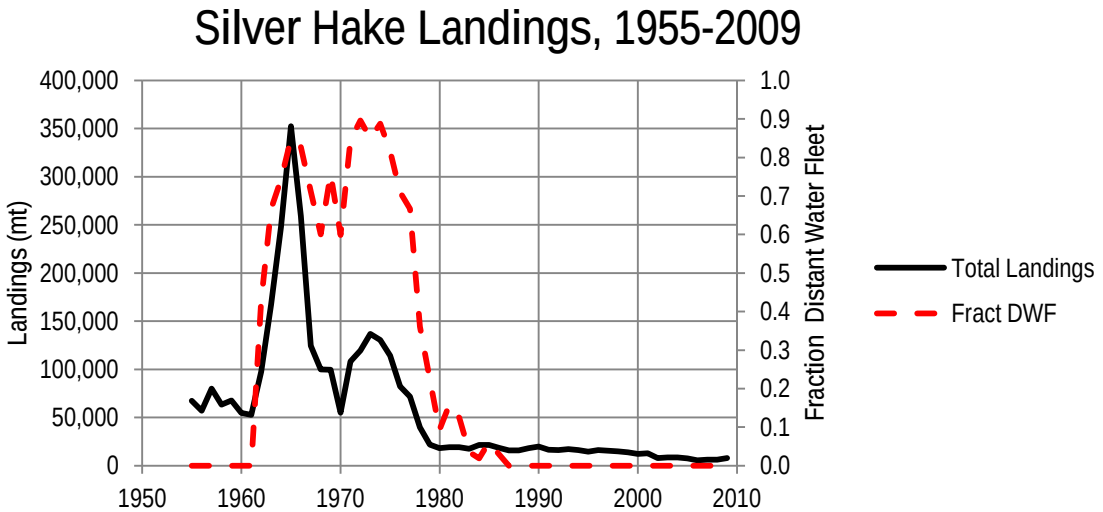
Methods to reconstruct the past have profound influence on measures of scale, and ultimately biological reference points

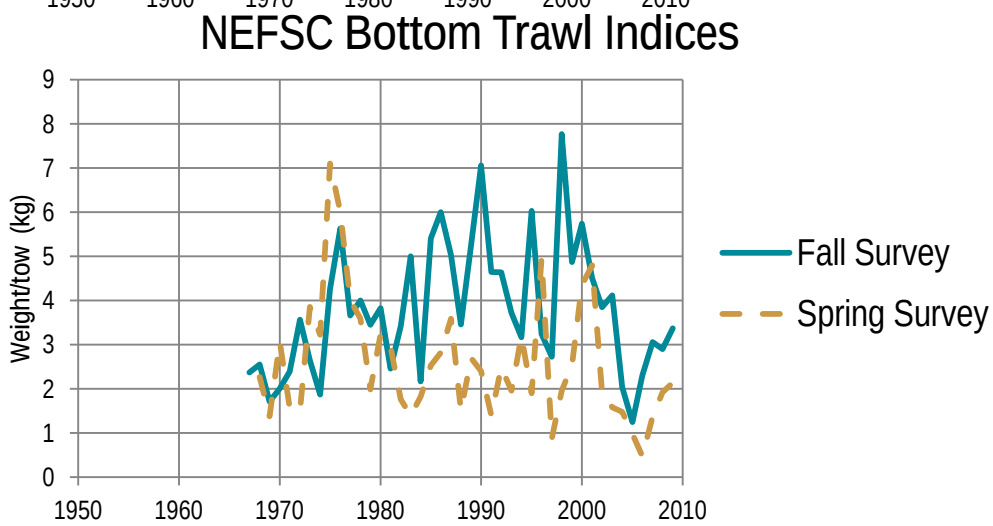
Often left with untenable alternatives

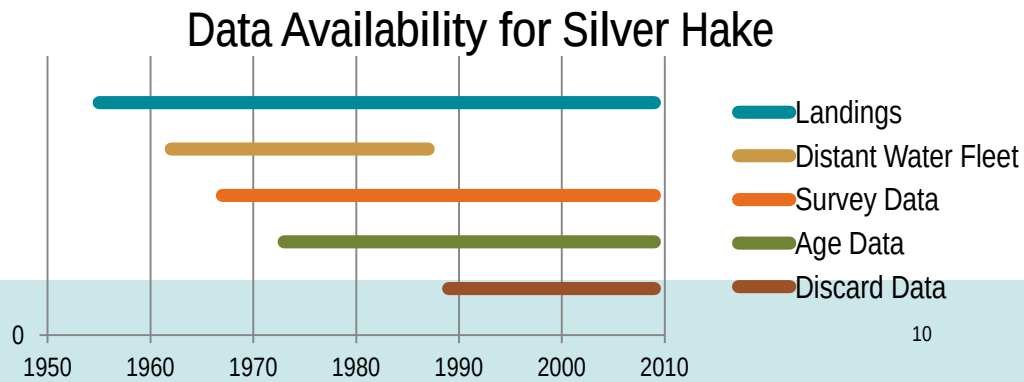
- Ignore historical record
- Incorporate historical record but make no adjustment
- Incorporate historical record with heroic adjustment, e.g., hindcasting

# Silver Hake Data History

- Distant water fleet arrived in 1962.
- Removed 850 kt by 1966
- Survey data ~1968
- Age data ~1973
- Discard data ~1989
- Recent catches about 7kt over last decade
- Other species with similar histories—eg spiny dogfish, mackerel



# Monitoring fish landed as parts or species complex

## Head off fisheries

- Monkfish
- White hake

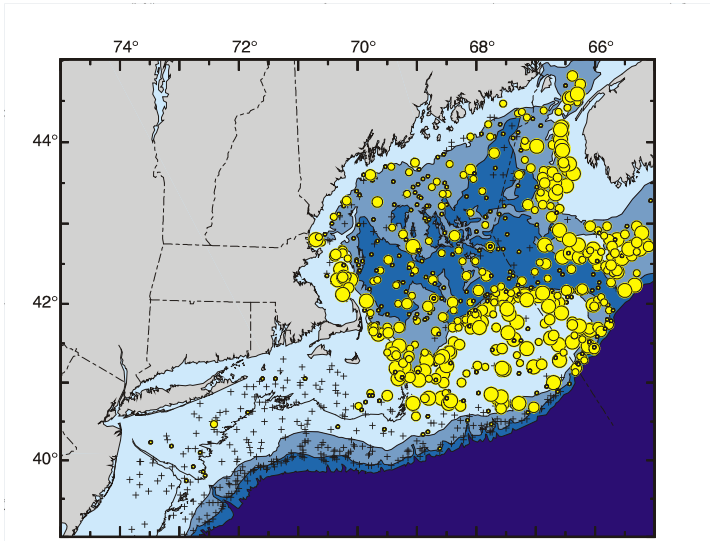
## Parts fisheries

- Monkfish livers
- Scallop meats
- Skate wings

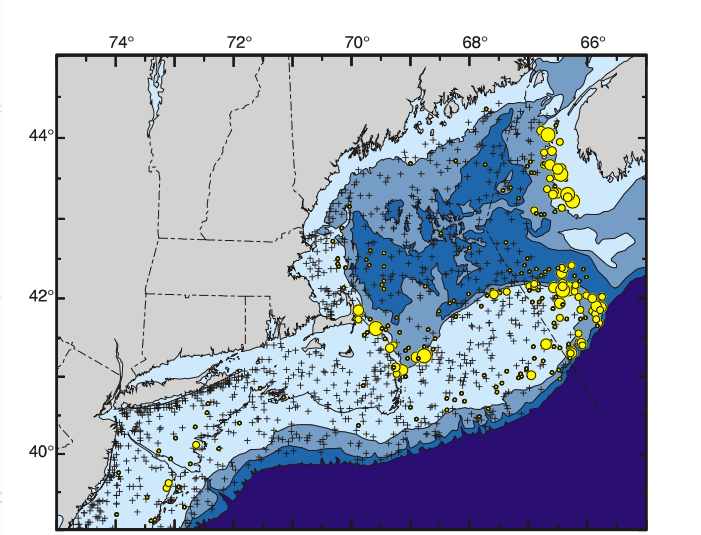
## Mixed Species fisheries (poorly separated)

- Skate Complex (7)
- White vs Red hake
- Silver vs Offshore hake

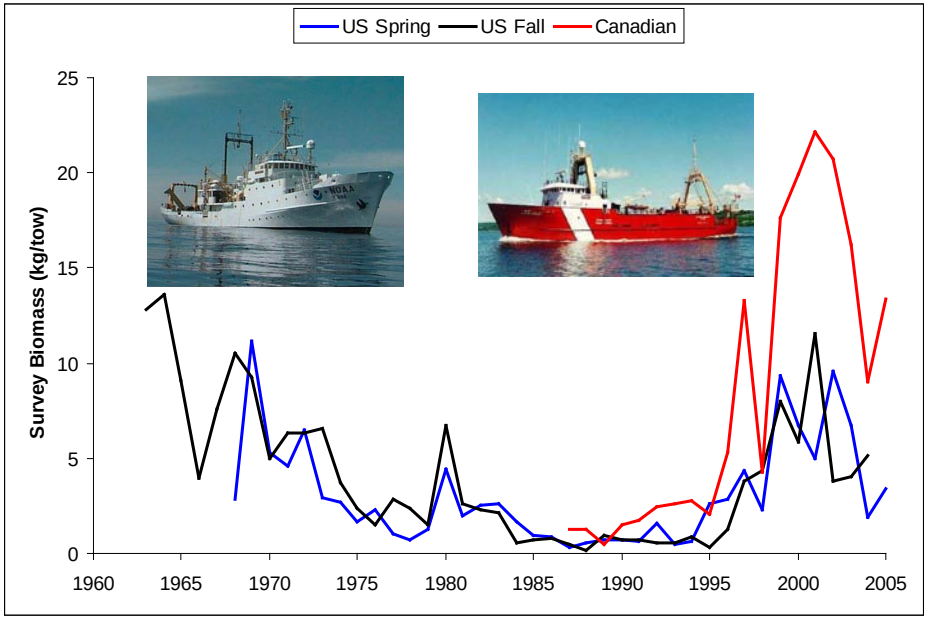
# Sometimes the picture is very clear…



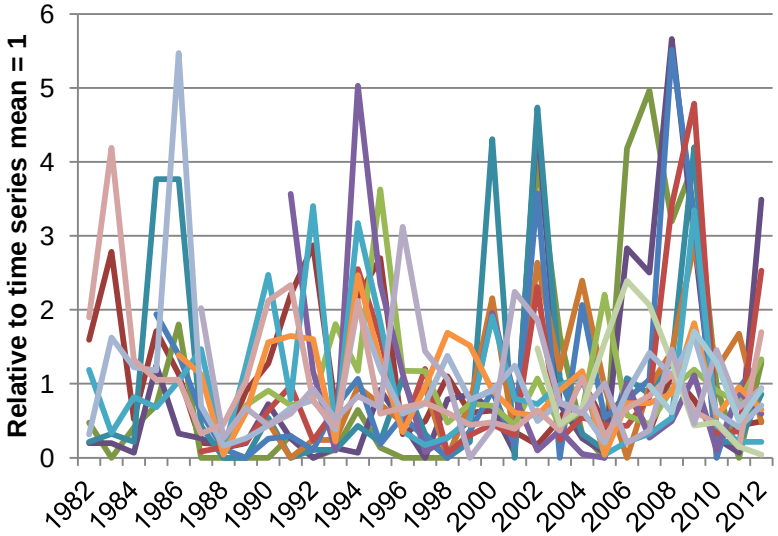

Autumn 1963-1967

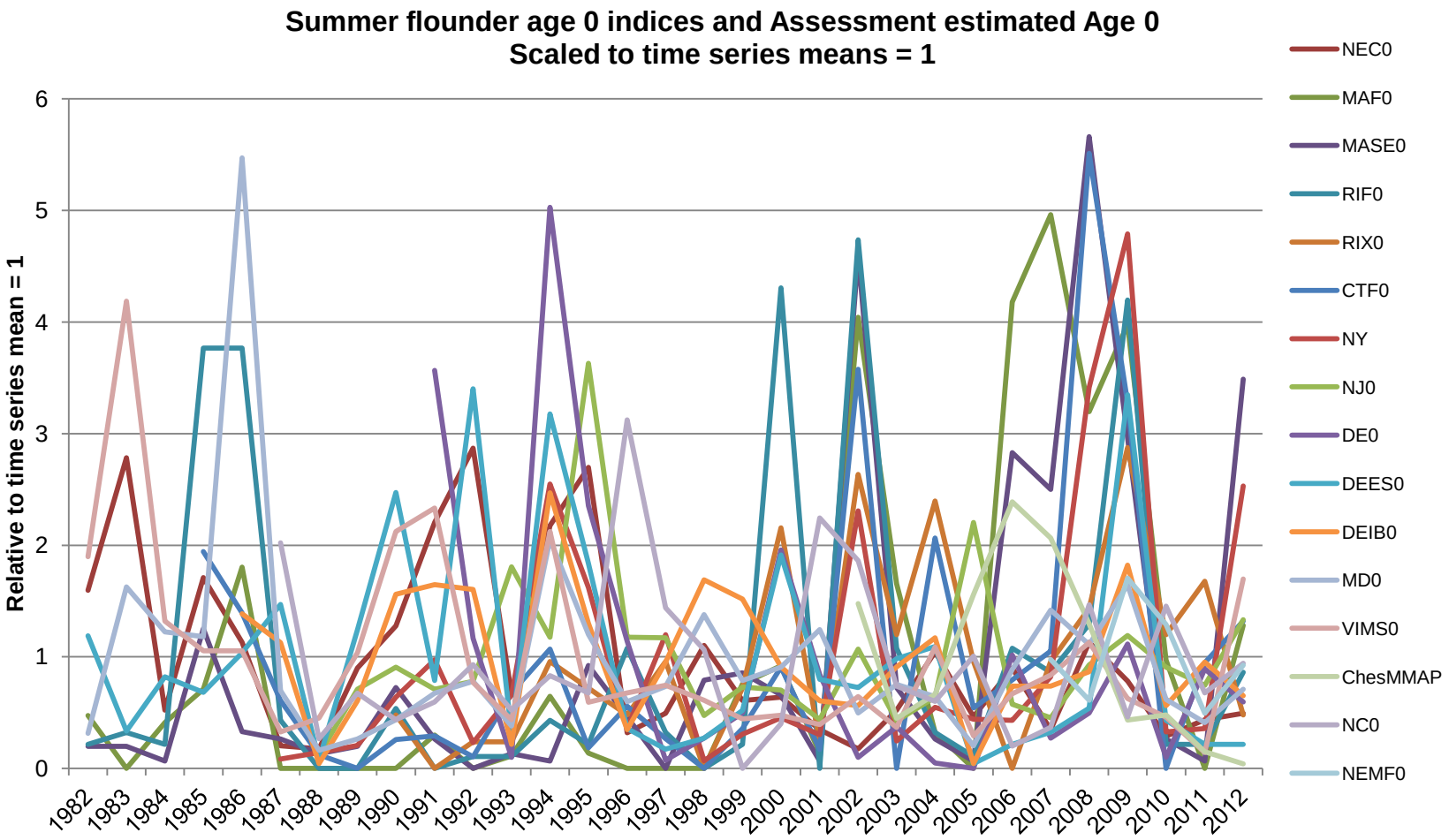



Autumn 1988-1992




# Sometimes you'll need a model to help sort things out…




Summer flounder age 0 indices and Assessment estimated Age 0
Scaled to time series means = 1
Relative to time series mean = 1
0
1
2
3
4
5
6
1982
1983
1984
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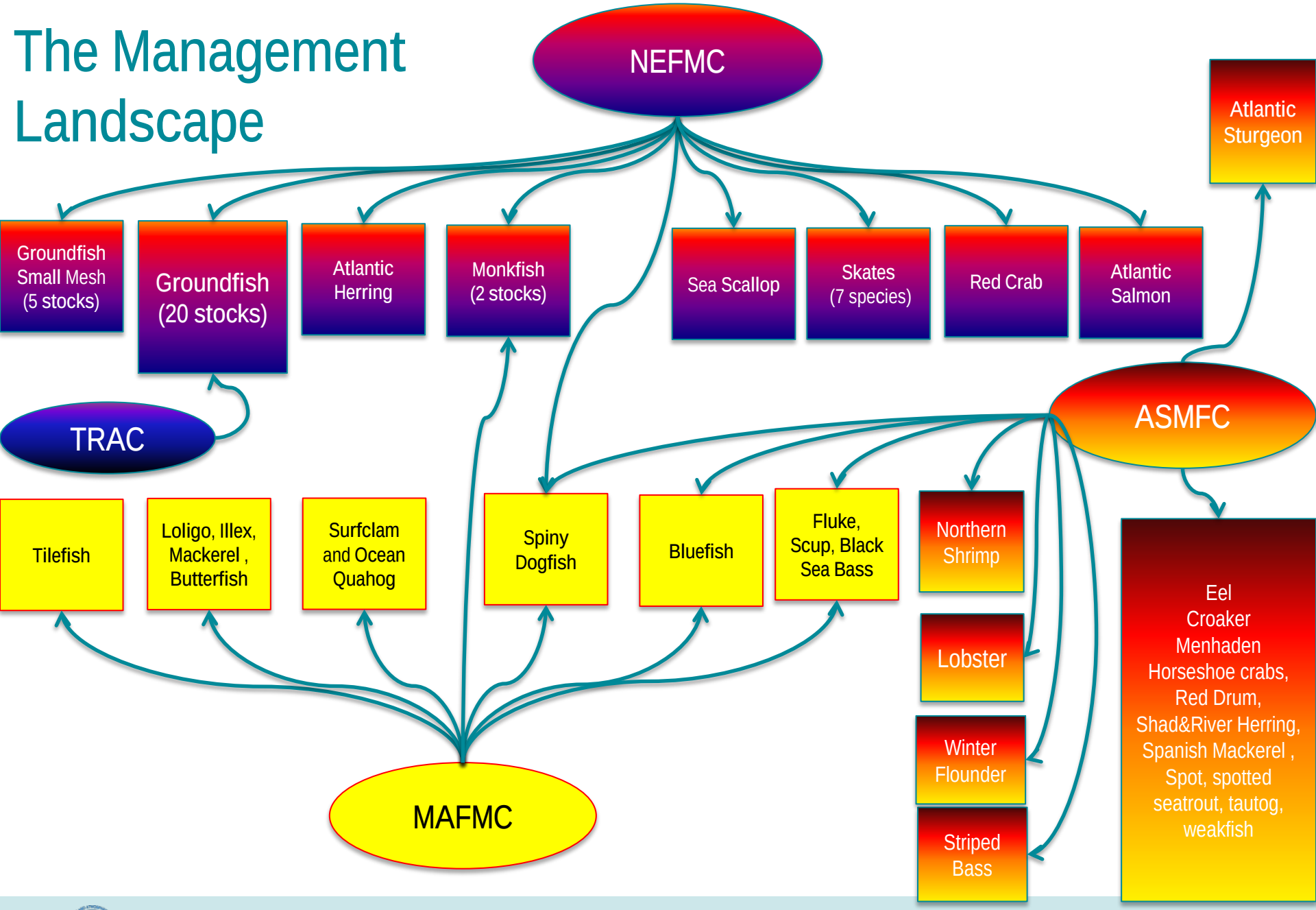
DEES0
DEIB0
MD0
VIMS0
ChesMMAP
NC0
NEMF0

# The Management Landscape



# Presentation overview

Relationship between data and models—and the interface with management

Chronology of data for assessments

Need for robust integrated system

Strengths, weaknesses, potential solutions

# Portfolio of Assessment Products—2013—a typical year (30 products)

**Data Updates—survey, landings, catch & application of simple statistical models:**

- Mackerel, squid (2 sp), skates (7 sp), tilefish, butterfish, black sea bass, scup

**Updates—Run existing model with updated data, SSC review**

- TRAC—E. Georges Bank Cod, E. GB haddock, GB yellowtail
- MAFMC—Bluefish, Spiny Dogfish, Ocean quahogs

**Operational Assessments—Run existing model with external review + SSC**

- Monkfish (2 stocks)

**Benchmarks: Complete Review—data, model, Ref Pts; Independent External Review + SSC**

- E. Georges Bank cod (via TRAC)
- White Hake
- Surfclam
- Striped bass
- Summer flounder
- Tilefish
- Northern shrimp
- Butterfish

# Data Richness Spectrum: Properties

## Data Poor (Model Resistant stocks)

- Few or No indices of relative abundance
- Inadequate Catch (heads off, mixed species)
- Imprecise estimates of discards
- Unknown availability to survey
- Uncertainty about historical record

## Data Moderate

- Missing critical life history information
- Low catchability
- Uncertainty about historical record (requires heroic imputation)

## Data Rich

- Multiple survey indices (often coherent and have ability to detect change)
- Well sampled  catch data for biological sampling
- Discard estimation relatively precise
- Long-term, reliable catch records
- Ancillary information on predator prey relationships, environmental data, etc.

# Data Richness Spectrum: Examples

## Data Poor (Model Resistant stocks)

- Tilefish ( Comm. CPUE only)
- Skates (7 sp)
- Deep Sea Red Crab (2 surveys)
- Ocean pout, windowpane flounder etc
- Mackerel, squid, butterfish (Availability to survey area)

## Data Moderate

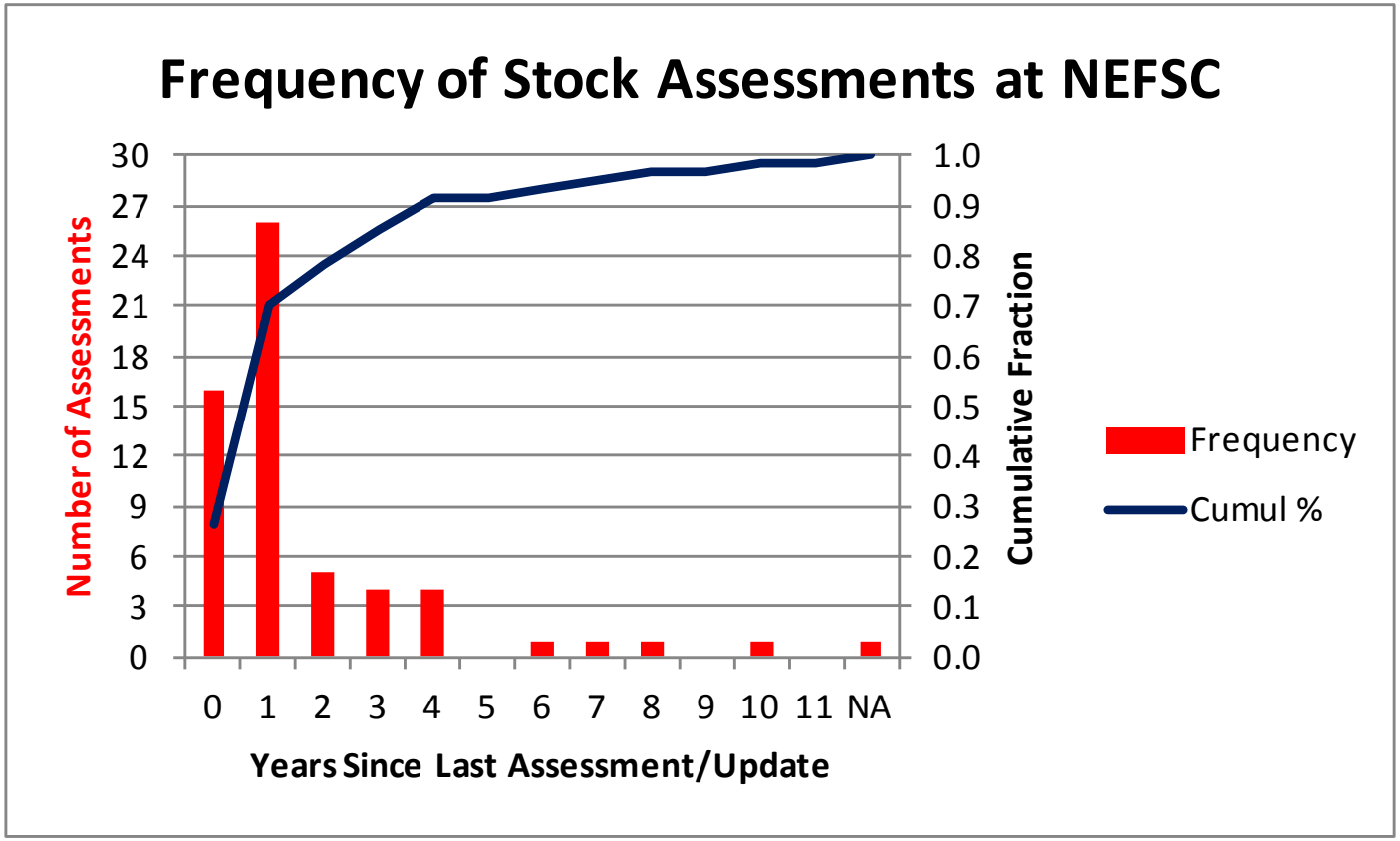
- Monkfish: Growth rate?
- Dorso-ventrallly compressed species: low catchabilty until Bigelow.
- White Hake—heads off fishery
- Skate discards (requires heroic imputation)

## Data Rich

- Summer flounder (multiple state indices+ well sampled catch)
- Sea scallops—multiple coherent surveys, growth well known, amenable to spatial management.
- Gulf of Maine Cod—multiple indices, spatial information on landings,
- Atlantic herring—useful estimates of predation mortality (M2)

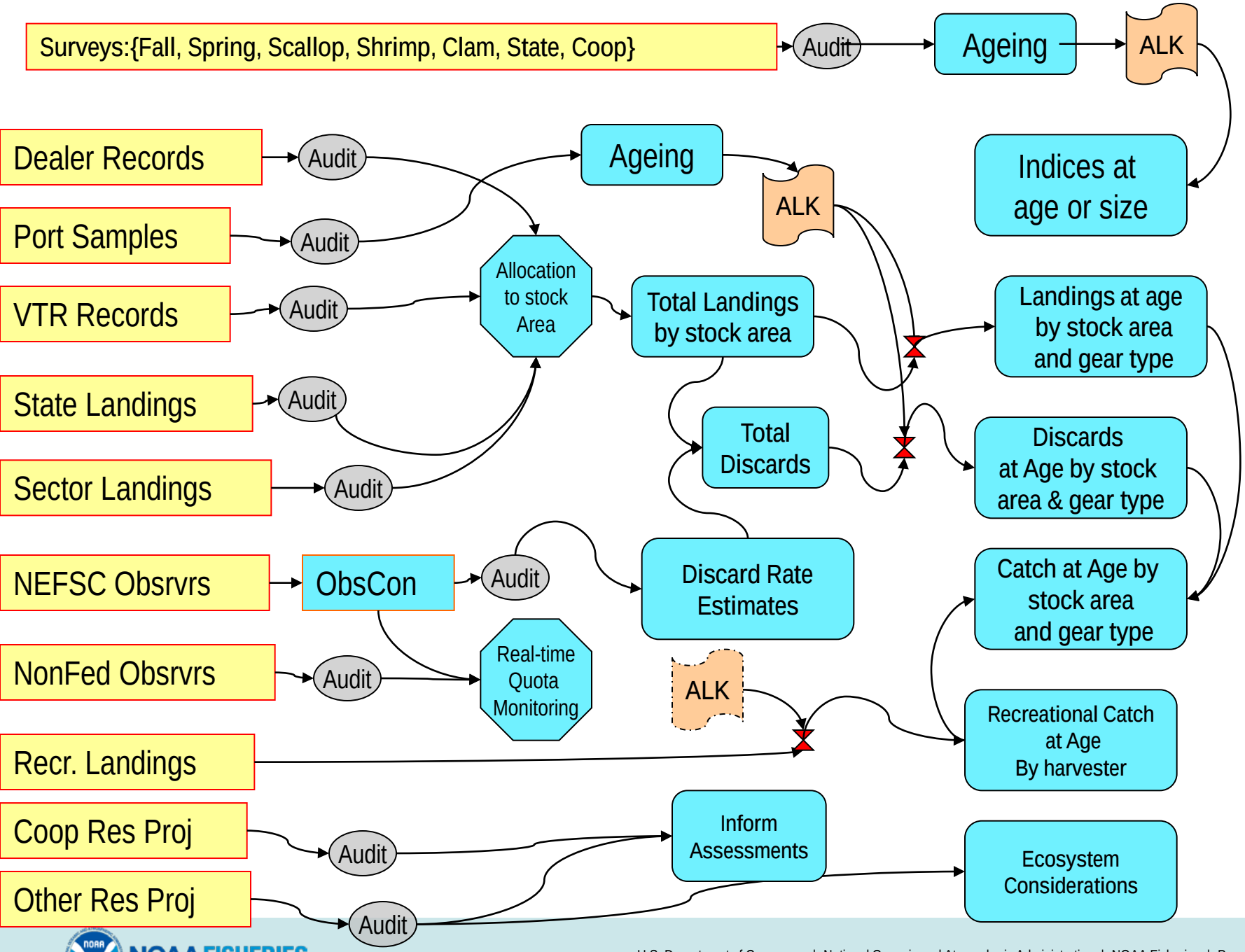
| | FMP | Species | Stock |
|---|---|---|---|
| 1 | Northeast Multispecies | Cod | GB |
| 2 | | Cod | GOM |
| 3 | | Haddock | GB |
| 4 | | Haddock | GOM |
| 5 | | Yellowtail Flounder | GB |
| 6 | | Yellowtail Flounder | SNE/MA |
| 7 | | Yellowtail Flounder | CC/GOM |
| 8 | | American Plaice | GB/GOM |
| 9 | | Witch Flounder | |
| 10 | | Winter Flounder | GB |
| 11 | | Winter Flounder | GOM |
| 12 | | Winter Flounder | SNE/MA |
| 13 | | Redfish | |
| 14 | | White Hake | GB/GOM |
| 15 | | Pollock | GB/GOM |
| 16 | | Windowpane Flounder | GB/GOM |
| 17 | | Windowpane Flounder | SNE/MA |
| 18 | | Ocean Pout | |
| 19 | | Atlantic Halibut | |
| 20 | | Atlantic Wolffish | |
| 21 | Northeast Multispecies (small mesh) | Silver Hake | North |
| 22 | | Silver Hake | South |
| 23 | | Red Hake | North |
| 24 | | Red Hake | South |
| 25 | | Offshore Hake | |
| 26 | NEFMC (potential) | Cusk | |
| 27 | Northeast Skate Complex | Little Skate | |
| 28 | | Winter Skate | |
| 29 | | Barndoor Skate | |
| 30 | | Thorny Skate | |
| 31 | | Clearnose Skate | |
| 32 | | Rosette Skate | |
| 33 | | Smooth Skate | |
| 34 | Atlantic Herring | Atlantic Herring | |
| 35 | Deep-Sea Red Crab | Deep-Sea Red Crab | |
| 36 | Atlantic Sea Scallop | Atlantic Sea Scallop | |
| 37 | Monkfish | Monkfish | North |
| 38 | | Monkfish | South |
| 39 | Spiny Dogfish | Spiny Dogfish | |
| 40 | Summer flounder, scup and black sea bass | Summer Flounder | |
| 41 | | Scup | |
| 42 | | Black Sea Bass | |
| 43 | Squid, Mackerel, Butterfish | Atlantic Mackerel | |
| 44 | | *Loligo* Squid | |
| 45 | | *Illex* Squid | |
| 46 | | Atlantic Butterfish | |
| 47 | Atlantic surfclam and ocean quahog | Atlantic Surfclam | |
| 48 | | Ocean Quahog | |
| 49 | Bluefish | Bluefish | |
| 50 | Tilefish | Golden Tilefish | |
| 51 | American Lobster | American Lobster | GB |
| | | American Lobster | GOM |
| | | American Lobster | SNE |
| 52 | Northern Shrimp | Northern Shrimp | |
| 53 | Striped Bass | Striped Bass | |
| 54 | NEFMC (potential) | Atlantic Hagfish | |
| 55 | Atlantic Salmon | Atlantic Salmon | |
| 56 | American Eel | American Eel | |
| 57 | Atlantic Sturgeon | Atlantic Sturgeon | |
| 59 | Shad and River Herring | River Herring | |
| 60 | | American Shad | |

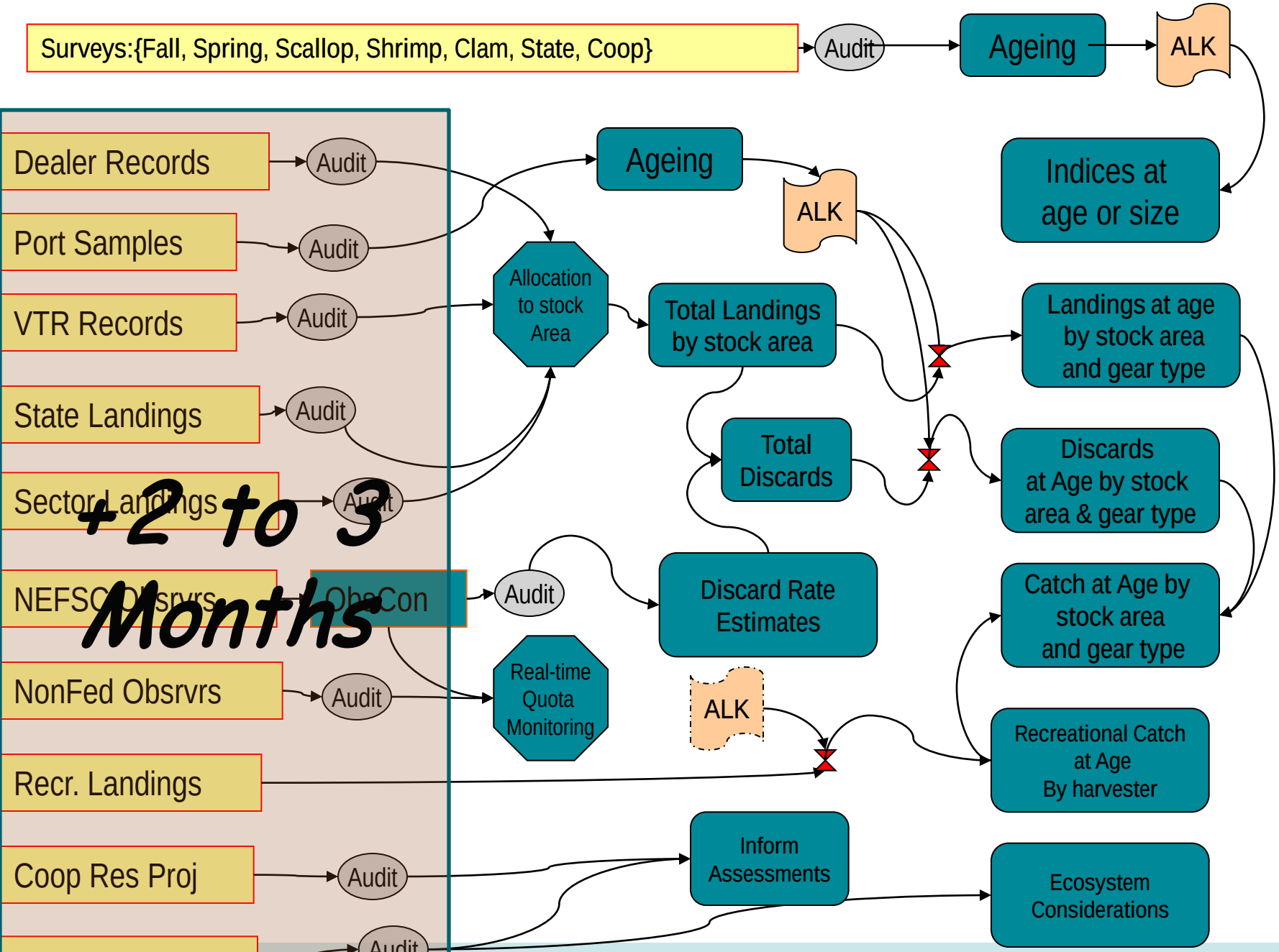
# Years Since Last Assessment/Update
# 70% of assessments in 2012 or 2013



# Timing of Assessments
# What if firemen did assessments?

http://www.youtube.com/watch?v=6WaUPTHJsrM


Surveys:{Fall, Spring, Scallop, Shrimp, Clam, State, Coop}
Audit
Ageing
ALK
Dealer Records
Audit
Port Samples
Audit
VTR Records
Audit
State Landings
Audit
Sector Landings
Audit
Ageing
ALK
Indices at age or size
Allocation to stock Area
Total Landings by stock area
Landings at age by stock area and gear type
Total Discards
Discards at Age by stock area & gear type
NEFSC Obsrvrs
ObsCon
Audit
Discard Rate Estimates
Catch at Age by stock area and gear type
NonFed Obsrvrs
Audit
Real-time Quota Monitoring
ALK
Recreational Catch at Age By harvester
Recr. Landings
Coop Res Proj
Audit
Inform Assessments
Ecosystem Considerations
Other Res Proj
Audit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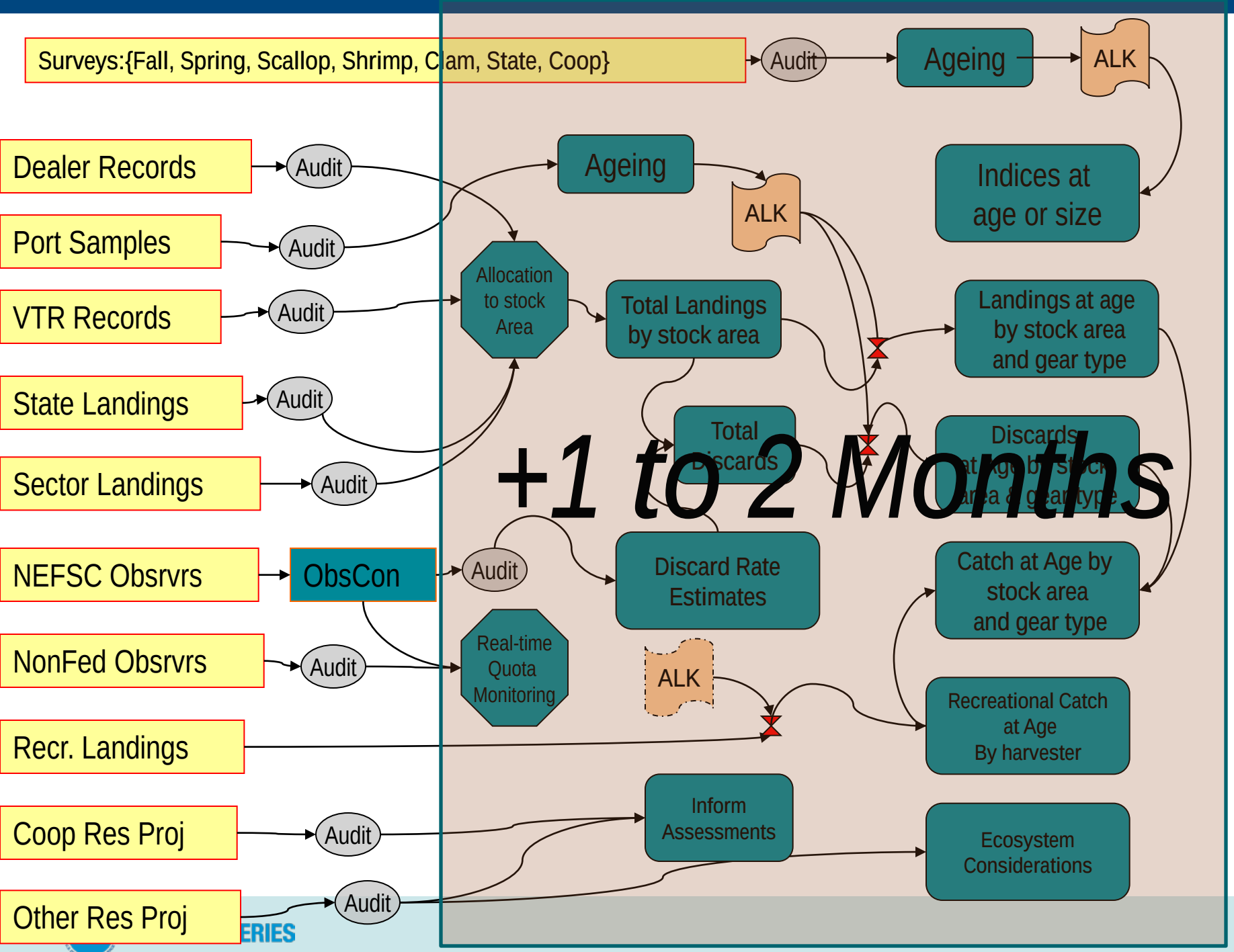
NonFed Obsrvrs
Recr. Landings
Coop Res Proj
Other Res Proj
Audit
ObsCon
Ageing
ALK
Indices at age or size
Allocation to stock Area
Total Landings by stock area
Landings at age by stock area and gear type
Total Discards
Discards at Age by stock area & gear type
Discard Rate Estimates
Catch at Age by stock area and gear type
Real-time Quota Monitoring
ALK
Recreational Catch at Age By harvester
Inform Assessments
Ecosystem Considerations
+2 to 3 Months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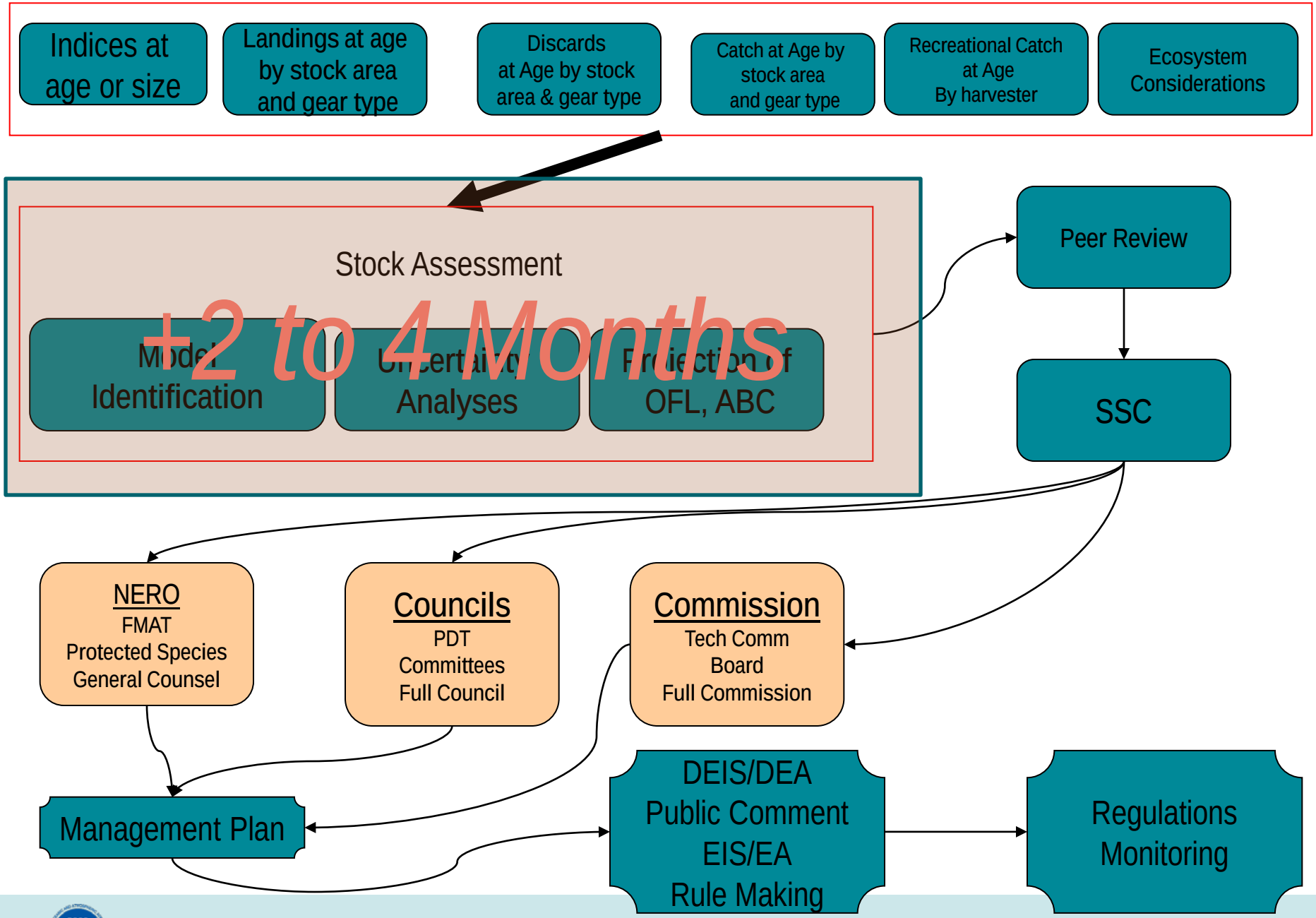
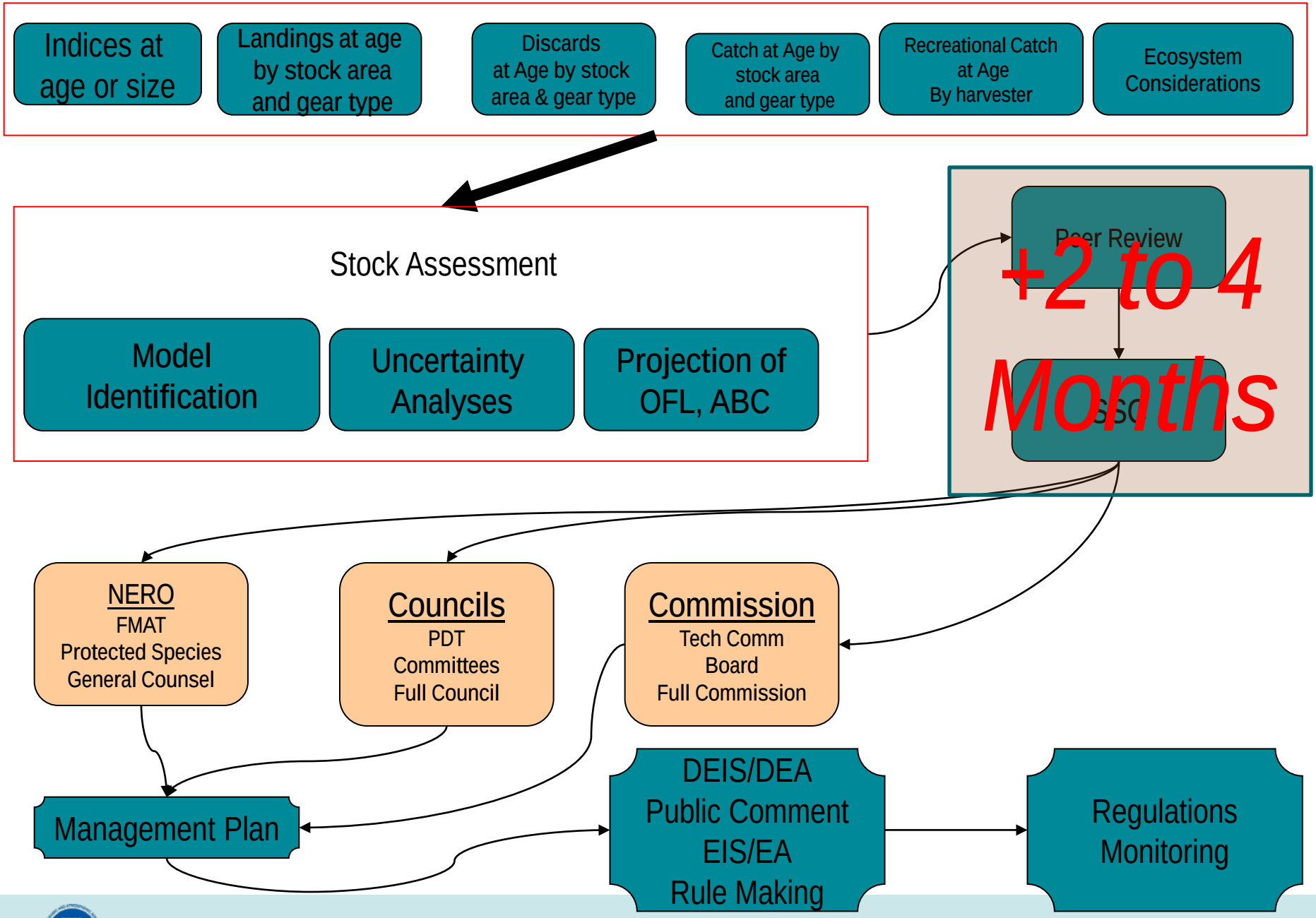
Allocation to stock Area
Total Landings by stock area
Indices at age or size
Landings at age by stock area and gear type
Total Discards
Discard Rate Estimates
Real-time Quota Monitoring
Catch at Age by stock area and gear type
Recreational Catch at Age By harvester
Inform Assessments
Ecosystem Considerations
+1 to 2 Months


Indices at age or size
Landings at age by stock area and gear type
Discards at Age by stock area & gear type
Catch at Age by stock area and gear type
Recreational Catch at Age By harvester
Ecosystem Considerations
Stock Assessment
+2 to 4 Months
Model Identification
Uncertainty Analyses
Projection of OFL, ABC
Peer Review
SSC
NERO
FMAT
Protected Species
General Counsel
Councils
PDT
Committees
Full Council
Commission
Tech Comm
Board
Full Commission
Management Plan
DEIS/DEA
Public Comment
EIS/EA
Rule Making
Regulations
Monitoring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Landings at age by stock area and gear type
Discards at Age by stock area & gear type
Catch at Age by stock area and gear type
Recreational Catch at Age By harvester
Ecosystem Considerations
Stock Assessment
Model Identification
Uncertainty Analyses
Projection of OFL, ABC
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SSC
+2 to 4 Months
NERO
FMAT
Protected Species
General Counsel
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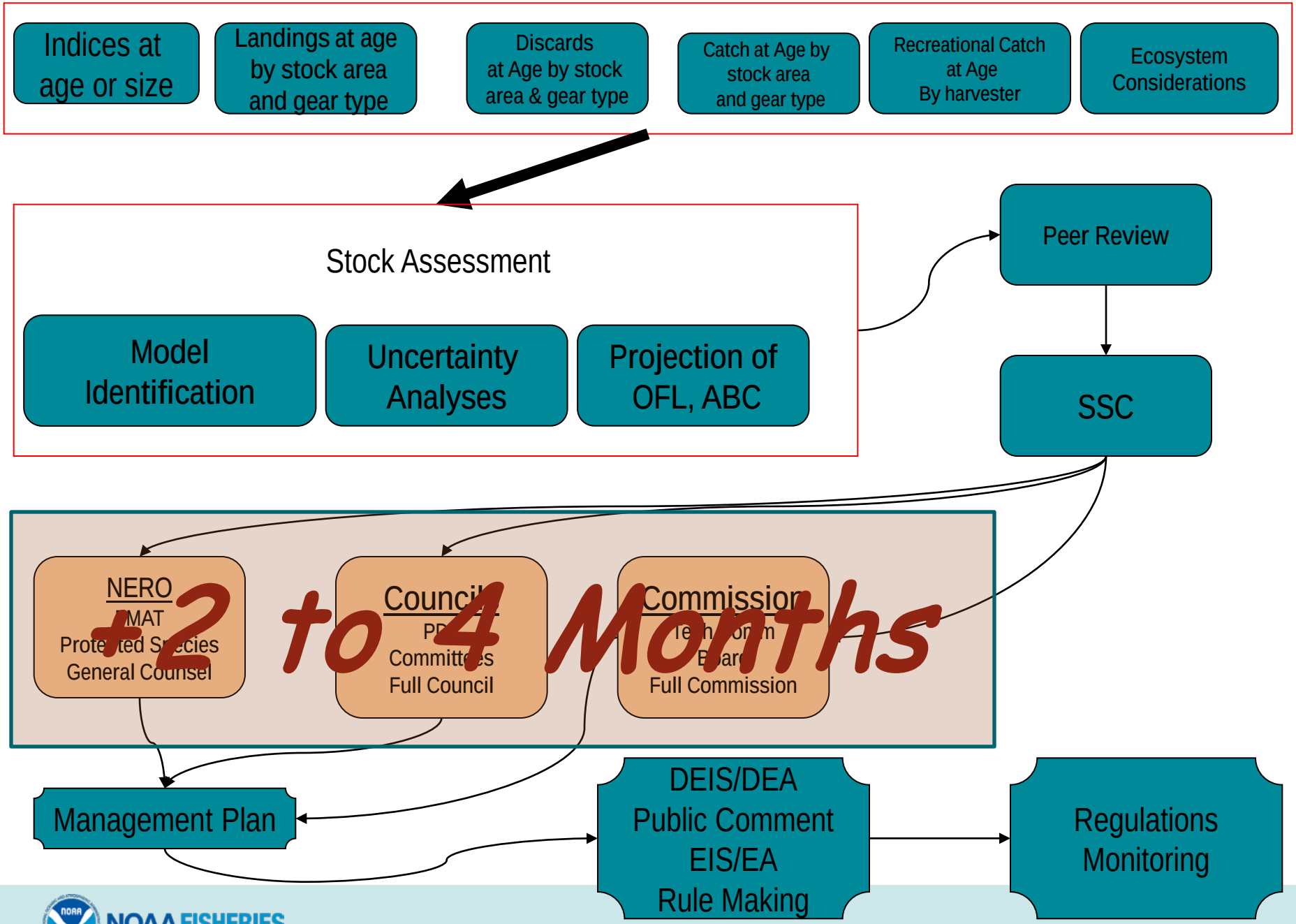
Monitoring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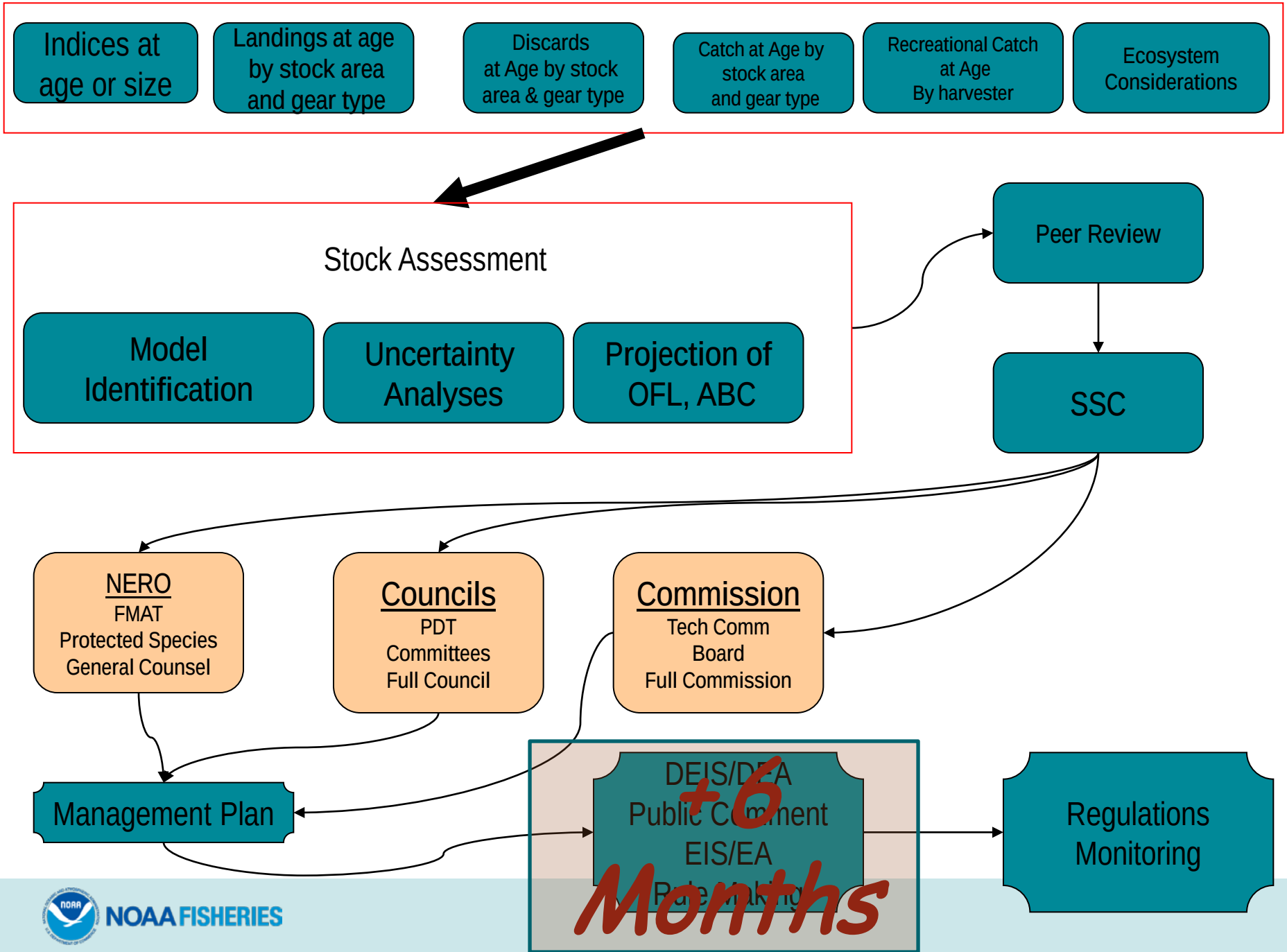



NOAA FISHERIES

*Appendix VII, Table 1. Draft time line for preparation of scientific advice for management. Annual cycle assumes data though March of year t.*

| Class | Event | Subevent | 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 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Week of Year t | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | January | | | | February | | | | March | | | | | April | | | | May | | | | | June | | | | July | | | | | August | | | | September | | | | October | | | | November | | | | December | | | |
| Fishery Independent Data | Spring Survey | Survey | | | | | | | | | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Audit | | | | | | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Ageing | | | | | | | | | | | | | | | | | | | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Fall Survey | Survey | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | X | X | | | | | | | |
| | | Audit | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X | X | X | X | X |
| | | Ageing | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X | X | | | |
| | Scallop Survey | Survey | | | | | | | | | | | | | | | | | | | | | X | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Audit | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | | | | | | | | | | | | | | | | | |
| | Shrimp Survey | Survey | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X | X | | | | | | | | | | | | | | | | | | | |
| | | Audit | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X | X | | | | | | | | | | | | | | | | |
| | Clam Survey | Survey | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X | X | X | | | | | | | | | | | | | | | | | |
| | | Audit | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | | | | | | | | | |
| | | Analyses | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | X |
| | Coop Surveys | Survey (eg monkfish) | | | | | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Audit | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | |
| | | Analyses | | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| | | | Week of Year t | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | January | | | | February | | | | March | | | | | April | | | | May | | | | | June | | | | July | | | | | August | | | | September | | | | October | | | | November | | | | December | | | |
| Class | Event | Subevent | 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 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 |
| | Dealer Landings | Landing Event | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fishery Dependent Data | | Electronic Reports Rc'd | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Audit | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Port Sampling | Collection | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Length and Ageing | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | State Landings | Landing Event | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Reports | | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (ASSUME | | Audit | | | | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Sectors | Landing Event | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| QTRLY | | Sector Reporting | | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TIME STEP) | | Sector Discard Rates | | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Reconsile with VTR/ Dealer | | | | | | | | | | | | | | | | | | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | VTR data | Landing Event | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | VTR Received | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Data Entry | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Audit | | | | | | | | | | | | | | | | | | | | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Area Allocation | Data Prep/Accommodations | | | | | | | | | | | | | | | | | | | | | | | | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | (depends on | Run programs | | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Observer | Collection | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Obscon | | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Data Entry + Final Audit | | | | | | | | | | | | | | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Recreational | by Wave | X | X | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Data Entry + Final Audit | | | | | | | | | X | X | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Analyses and Assess-ment | NEFSC | Assess Subcom Tasks | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | LAA, DAA, CAA | | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | |
| | | State Data | | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | |
| | | Coop Res Data | | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | |
| | | Special Studies | | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | |
| | | Survey Indices | | | | | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Model Selection | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X | X | X | | | | | | | | | | | | | | | | | | |
| | | Uncertainty/Risk | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | | | | | | | | | | | | | | | | | |
| | | Assess Subcomm. Mtg | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | O | O | | | | | | | | | | | | | | | | | |
| | | Report Review Period | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | | | | | | | | | | | | | | | | |
| | | SARC--Benchmark | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | | | | | | | | | | |
| | | SARC Update | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | | | | | | | | | | |
| | | SARC Signpost | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | | | | | | | | | | | | | | | | |
| | | CIE report Review | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X | | | | | | | | | | | | | |
| | | Final Report | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | | | | | | | | | | | |
| | TRAC (C, H, Y) | Analyses | | | | | | | | | | | | | | | | | | | | | | | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Meeting | | | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Reports | | | | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | MAFMC updates | Analyses | | | | | | | | | | | | | | | | | | | | | | | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Meeting | | | | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | SBRM | Analyses (year t-1) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X | X | X | X |
| | | Initial Report | X | X | X | X | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Feedback | | | | | | | | | | X | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Manage-ment and Review | Councils | PDT (~5/yr) | | | X | | | | | | | | X | | | | | | | | | X | | | | | | | | | | | | | | | | | | | | | X | | | | X | | | | | | | |
| | and | Committee (~5/yr) | | | | X | | | | | | | | X | | | | | | | | | X | | | | | | | | | | | | | | | | | | | | | | X | | | | X | | | | | |
| | Commission | Council (~6/yr) | | | | | | X | | | | | | | | | X | | | | | | | | | | X | | | | | | | | | | | | | X | | | | | | X | | | | X | | | | |
| | NERO | DEIS/ DEA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Public Comment | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | EIS/ EA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Public Comment | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | SSC | Review Reports | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | | | | | | | | | | |
| | | Meeting | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | | | | |
| | | Advice to Councils | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | | | |

# A Condensed Timeline for Data Availability (using Groundfish as an example

## Commercial Landings and Discards

- VTR in ~March
- Discard monitoring by March
- Aging data by April
- State landings by April/May
- AA in April/May
- Discard estimation by April/May
- Stock assessment data meeting in April
- Stock assessment model meeting in April/May
- Stock assessment peer review in June/July

## Surveys

- NEFSC spring by June 1

## Example: 2013—Summer flounder benchmark: data mtg June 3-7, model mtg June 17-20

# An Accelerated Assessment Timeline: Pollock

- Management concern identified (summer 2009)
- Issue prioritized and assessment scheduled (fall 2009)
- Meeting with fishermen (Jan 2010)
- Data meeting (Feb 2010)
- Model meeting (Mar 2010)
- Peer review meeting (Jun 2010)
- Catch recommendations for 2011 (Aug 2010)
- Council action on 2011 (Sep 2010)
- Development of 2011 regulations (Fall-Winter 2010)
- 2011 Fishing year (May 2011)

# The GARM Process: 2008, (19 stocks)

| Meeting | # Working Papers | # Authors | # Pages | # Partici-pants | # Reviewers |
|---|---|---|---|---|---|
| Data Methods | 34 | 94 | 1,022 | 52 | 3 SSC<br>4 External |
| Models | 21 | 42 | 84 | 45 | 3 CIE<br>3 External |
| Biological Reference Points | 42 | 76 | 1,534 | 45 | 3 CIE<br>2 External |
| Assessment | 43 | 68 | 1,773 | 49 | 1 SSC<br>3 External |
| Total | 140 | 280 (72 unique) | 5,177 | 191 | 22 |

| Data Source | Ave # Records per year (2002-2007) |
|---|---|
| VTR | **148,187** |
| Dealer Transactions (Federal) | **170,197** |
| Observer Trips | **2,677** |
| Observer Days | **4,577** |
| Port Samples | **1,309** |
| Comm. Lengths | **88,201** |
| # Fish Aged | **21,173** |
| Tagging Databases | **2** |
| NEFSC Survey Stations | **811** |

+ State Surveys, Industry based surveys

# Species vs use of data matrix

- See poster

# Presentation overview

Relationship between data and models—and the interface with management

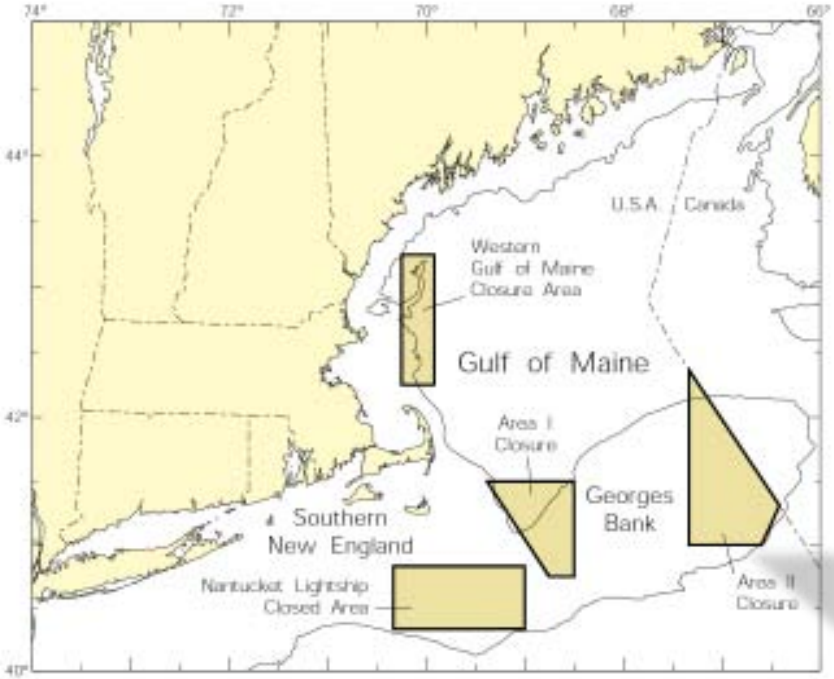
Chronology of data for assessments

Need for robust integrated system

Strengths, challenges, proposed solutions

# Large Scale Experiments

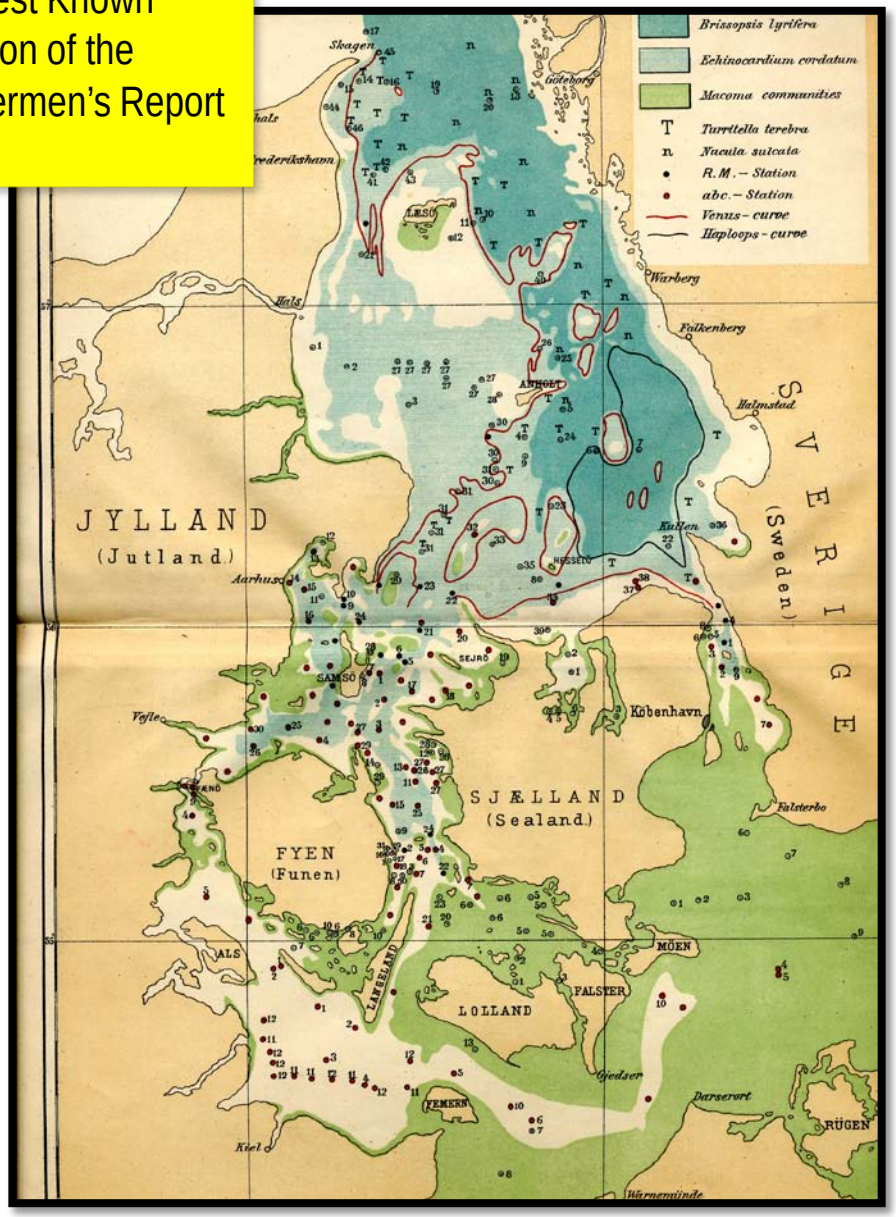
- Foreign Fleets
- EEZ and Increase in Domestic Fleet
- Closed Areas
- OFL/ABC/ACL
- Sectors



# Scientific Surveys have Met Unanticipated Demands

- Advances in population estimation methods.
- Allocation of resources among jurisdictions
- Management demands
  - Season and area closures
  - Effects of gear changes
- Ecosystem monitoring
- Habitat identification

Earliest Known Version of the Fishermen's Report




Peterson, C.D.J. 1918. The Sea Bottom and its Production of Fish-Food. Rep. Danish Biological Station. 25. Activities from 1883-1917

# Important Transitions for Data Systems

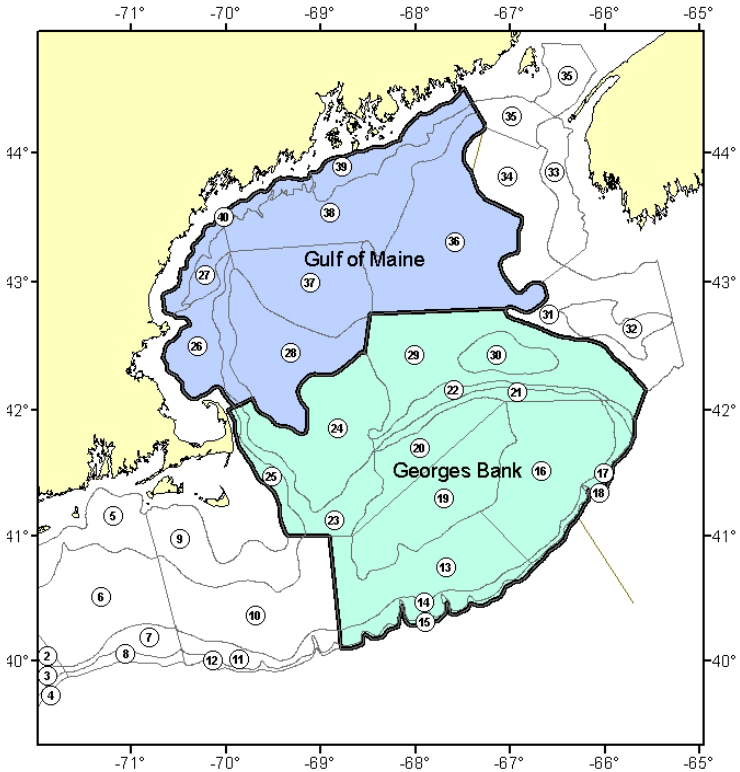
- Fisherman interviews by port agents to VTR
- *Albatross* to *Bigelow*
- MRFSS to MRIP
- Seasonal Closures to long-term, year-round closures and back again
- Input controls to output controls for harvests

# Increasing demand for surveys and catch information

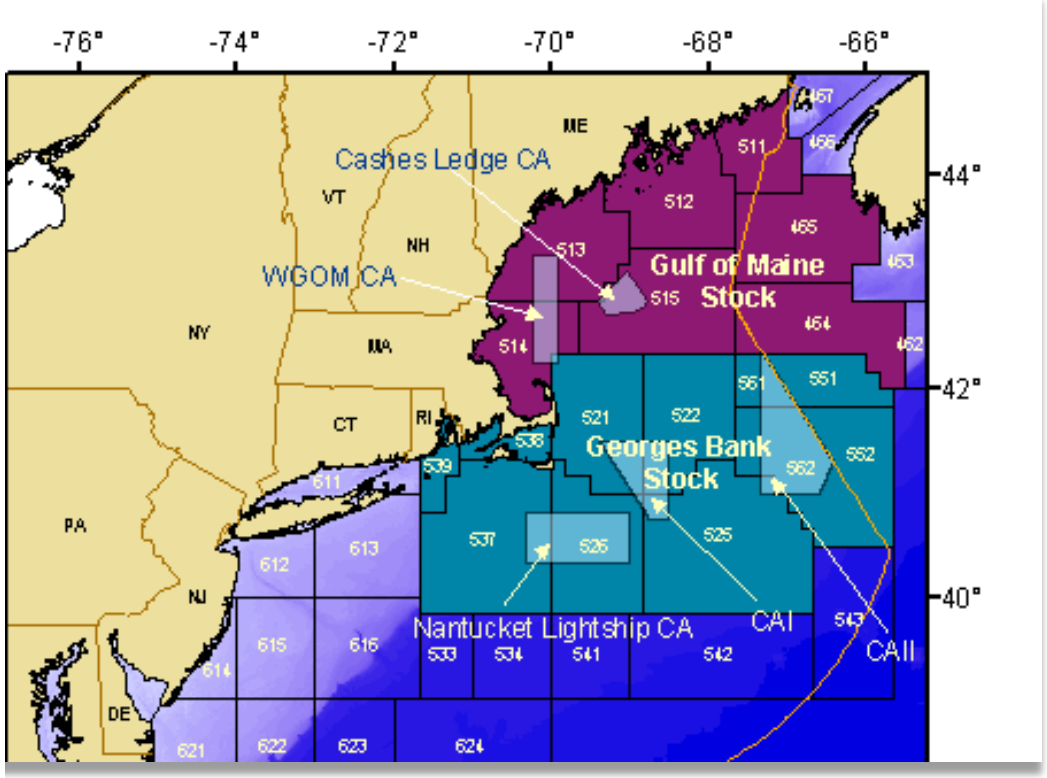
## Finer scale management with respect to

- Timing of information, feedback loop for managers
- Example—effects of reductions in size limits, using real-time dats requires real-time estimation of landings AND discards
- Need to prepare for the unexpected (in real time)
  - Can we avoid discards, --reduce technical interactions among fisheries?
  - Can we implement ACLs in real time for all species?
  - Can we improve the bases for observer deployment in real time?
  - Can we improve the bases for discard estimation?

# Stock Area Definitions: Matching Survey Strata to Statistical Area




Measures of Trend from Surveys




Measures of Scale from Catches by Stat Area

# Meeting Unanticipated Demands

## Closure areas—displacement of effort

## Magnuson Stevens Act : OFL/ABC/ACL

## Sectors

- Influence of changing economic incentives

## Fine-scale management changes

- Targeted discard monitoring
- Changes in size limits
- Mandatory use of gear
  - Turtle chains on scallop dredges
  - Break away gear to protect marine mammals
  - Do these measures work?
- Exemption fisheries to allow access to under utilized stocks

## Revised stock structure

- Stretching the limits of data granularity

# Incorporating Environmental data into stock assessments: Interpretation of Observations

## Interpretive Role

- Using environmental covariates to understand limitations of observations.
- Example—adjusting relative abundance indices for temperature, light intensity, salinity etc.
- What integral of space and time is appropriate for measuring impact of environmental data?

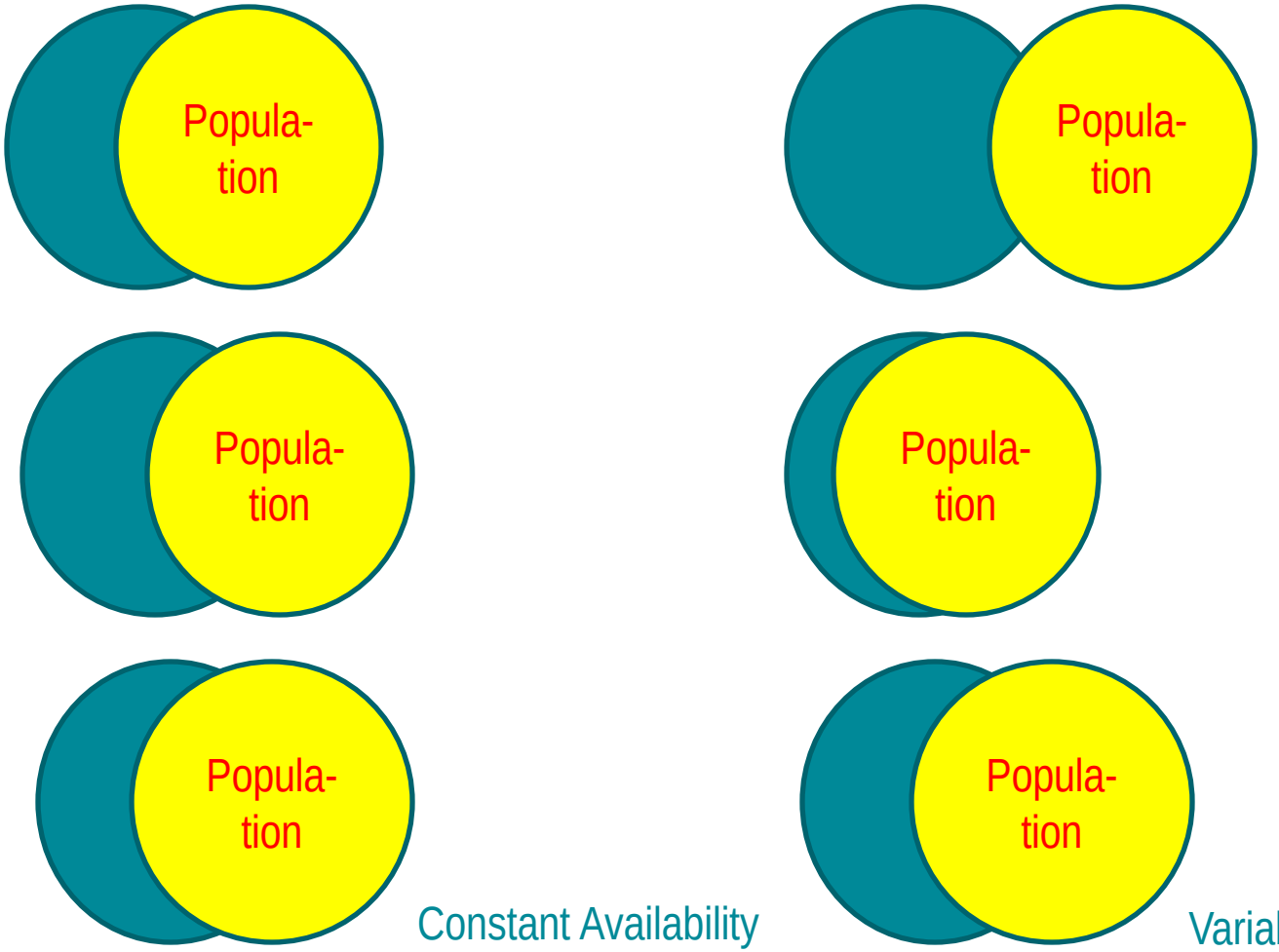
## Predictive Forecasting future conditions

- Can we forecast the environmental data in the future?
- If not, can we use decision theory to temper decisions on basis of expected outcomes (Markov methods for state change).

# Implications of Changes in Availability

Survey Area (t)

Survey Area (t+Δt)




Overestimate
Rate of Change

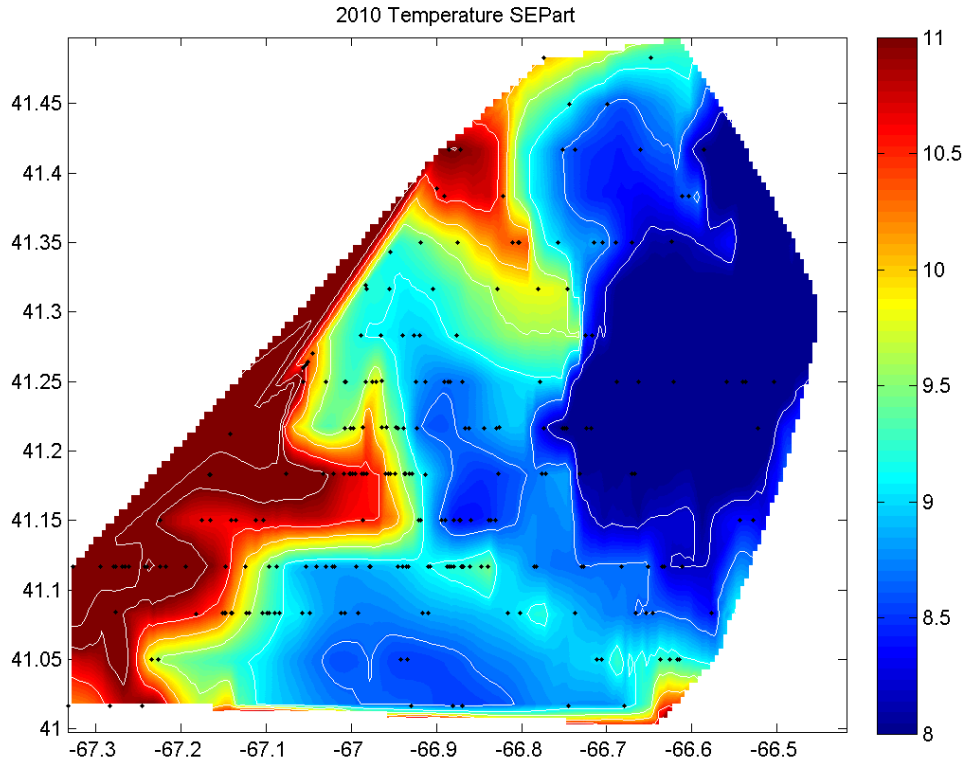
Underestimate
Rate of Change

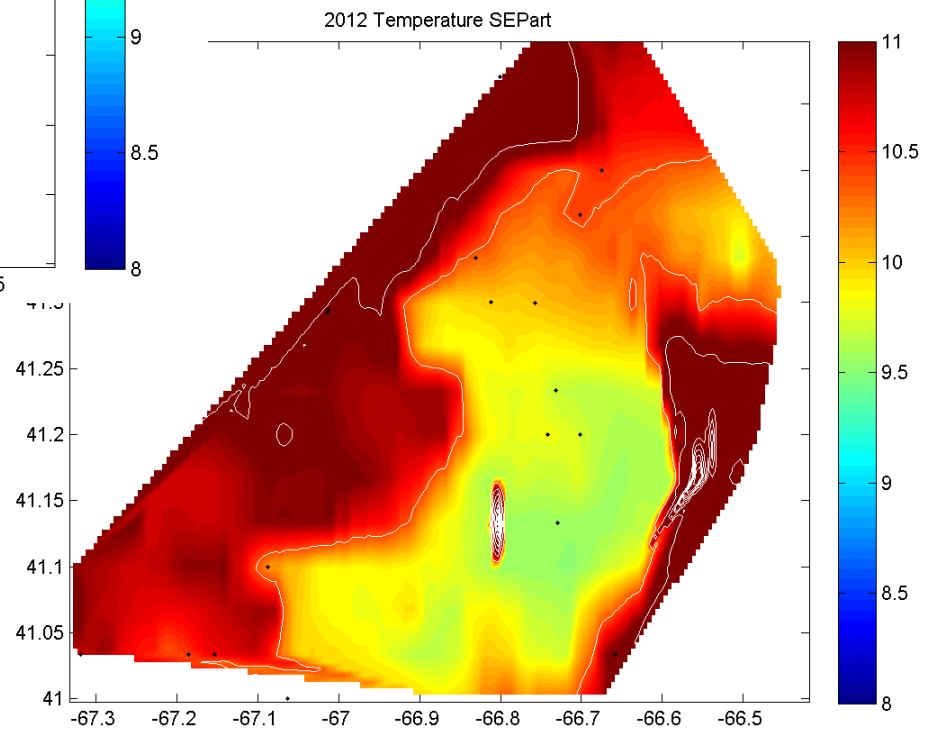
Goldilocks--
Rate of Change
just right!

Constant Availability

Variable Availability

# HabCam observations on Georges Bank




Changes in distribution of Yellowtail flounder on Closed Area II in 2010 an 2012—Potential effects of temperatu

# Incorporating Environmental data into stock assessments: Informing model processes

## Use of models to improve understanding of population dynamics

- Relationship between spawning stocks and recruitment
- Effects on growth, natural mortality, maturation etc.

## Developing a predictive or informative model

- As before, what integral of space and time is appropriate for measuring impact of environmental data?
- Do we ever know that we have found the right kernel?

## Forecasting future conditions

- Can we forecast the environmental data in the future?
- If not, can we use decision theory to temper decisions on basis of expected outcomes (Markov methods for state change).

# Changes in Average Weight at Age

## Reductions in average weight at age are evident for a number of stocks

- Georges Bank Cod and Haddock
- Gulf of Maine Winter flounder, Plaice, and Witch flounder

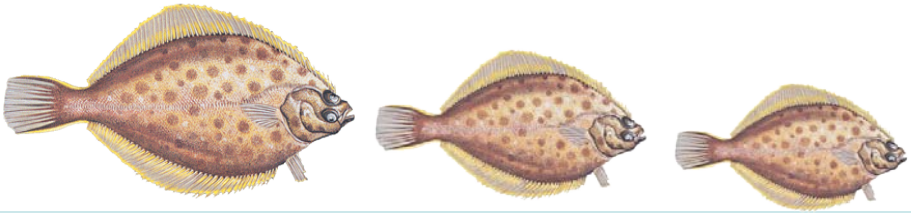
## Appear for stocks at both high and low abundance levels

## Causal mechanisms unknown but could include

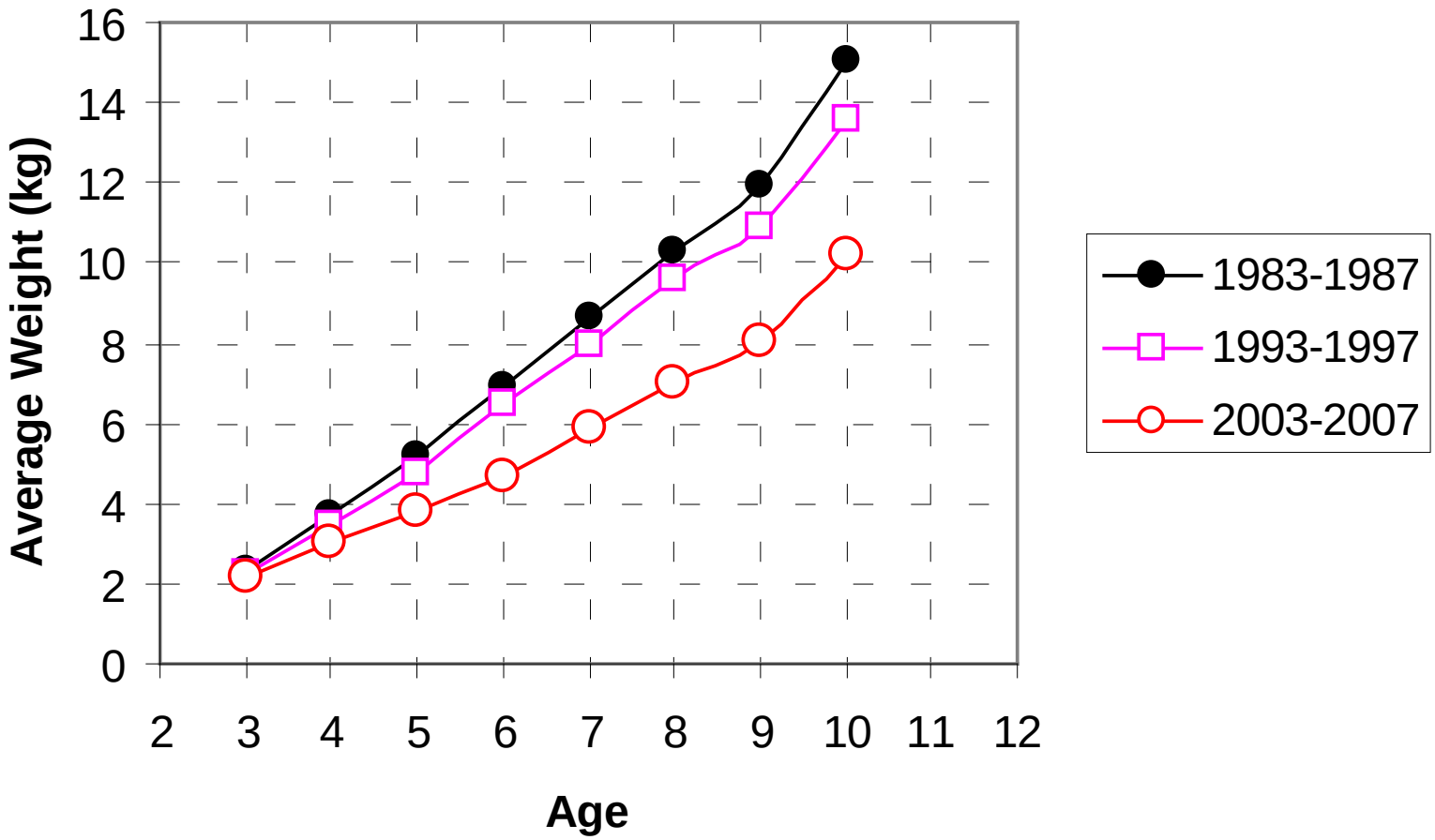
- Environmental change
- Density dependence
- Earlier maturation/genetic selection
- All of the above and more

## Implications if patterns persist

- *Lower yields*
- *Slower rebuilding*
- *Possible changes in rebuilding targets*



# Average Weight at age of Georges Bank Cod in Commercial Catch (Landings +Discards)

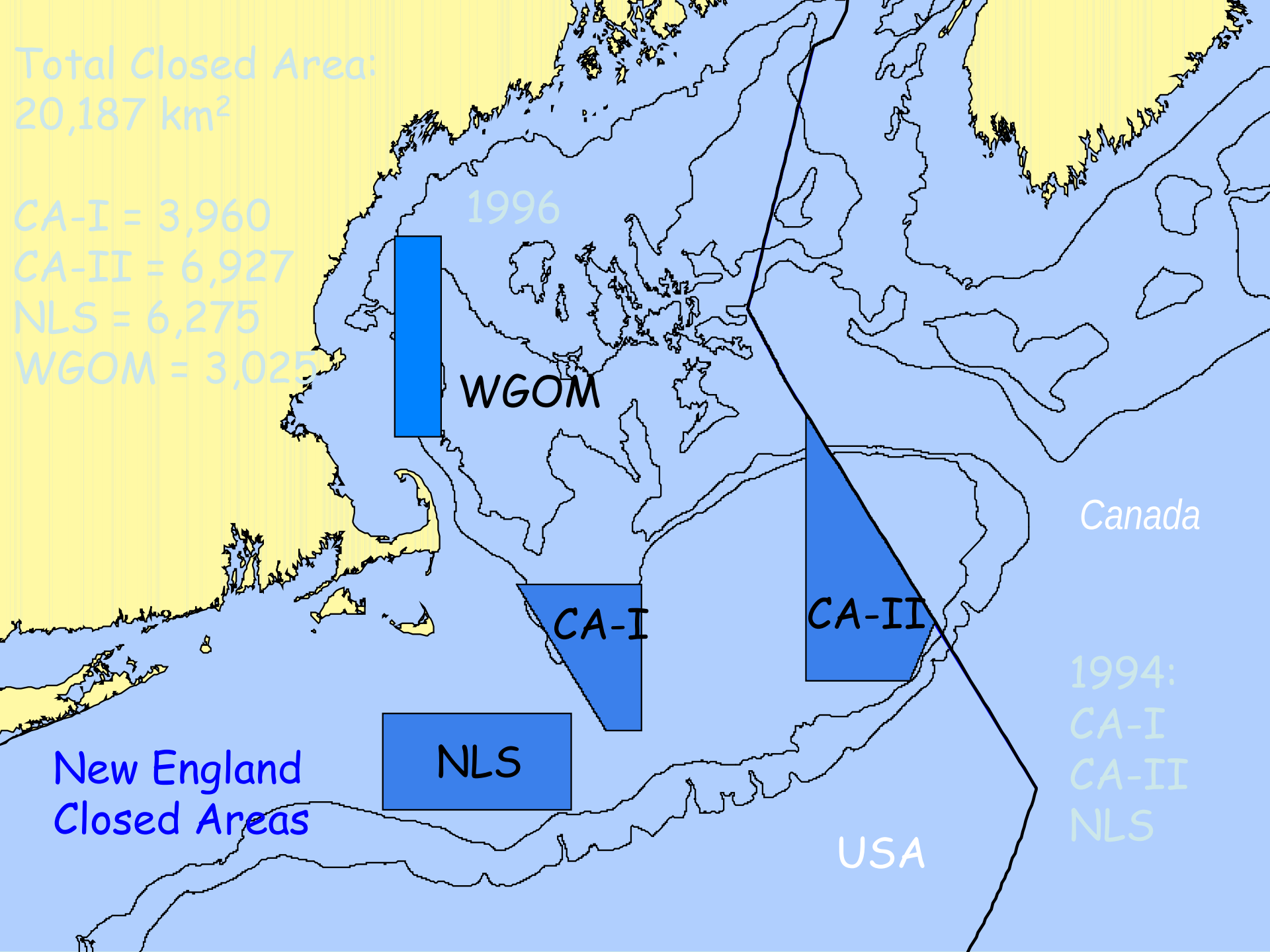


# Effects of Closure Areas on Fish and Fisheries

Catch rates of haddock in the vicinity of Closed Area I

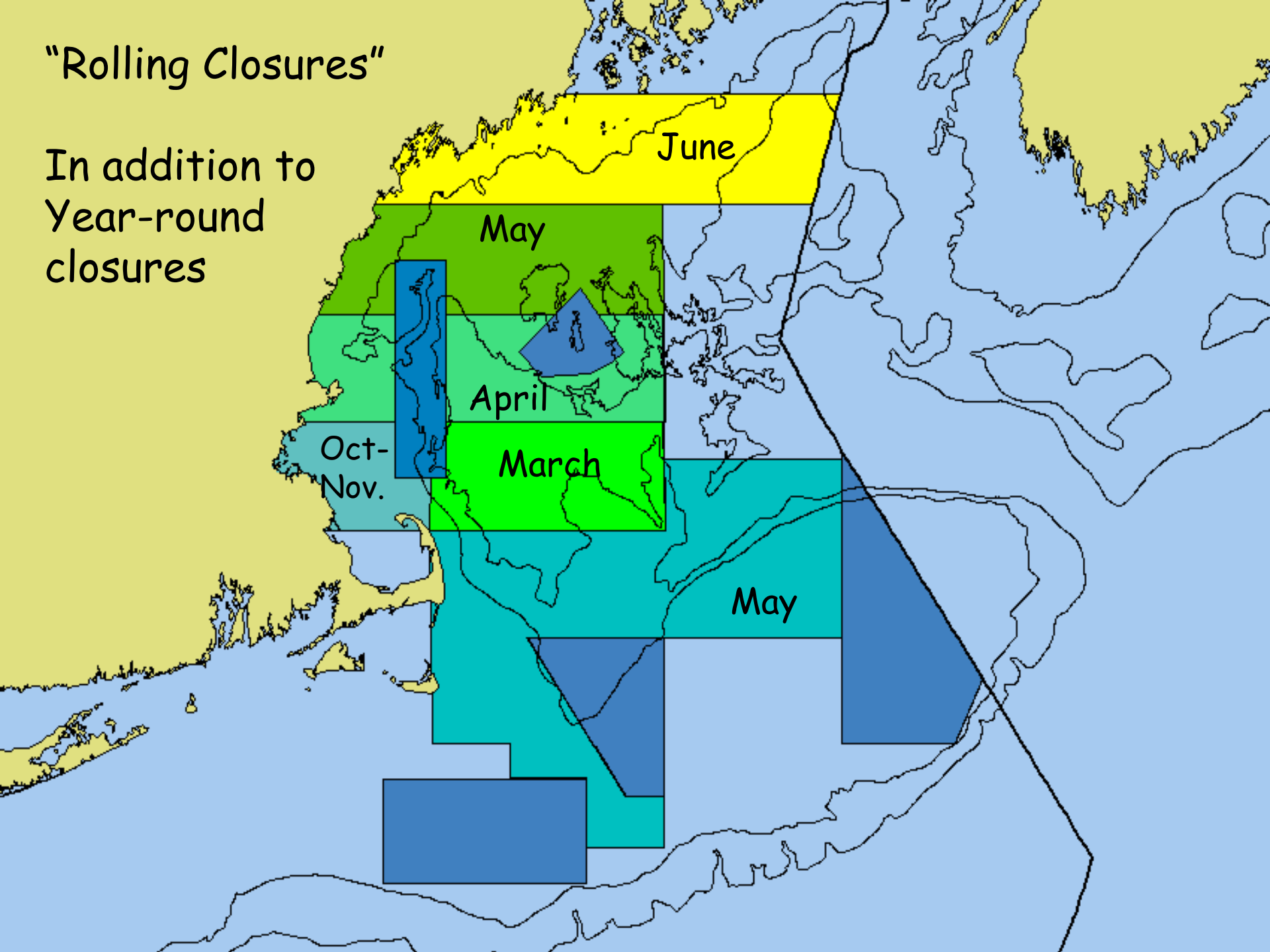
Concentration of  yellowtail flounder in Closed Area II

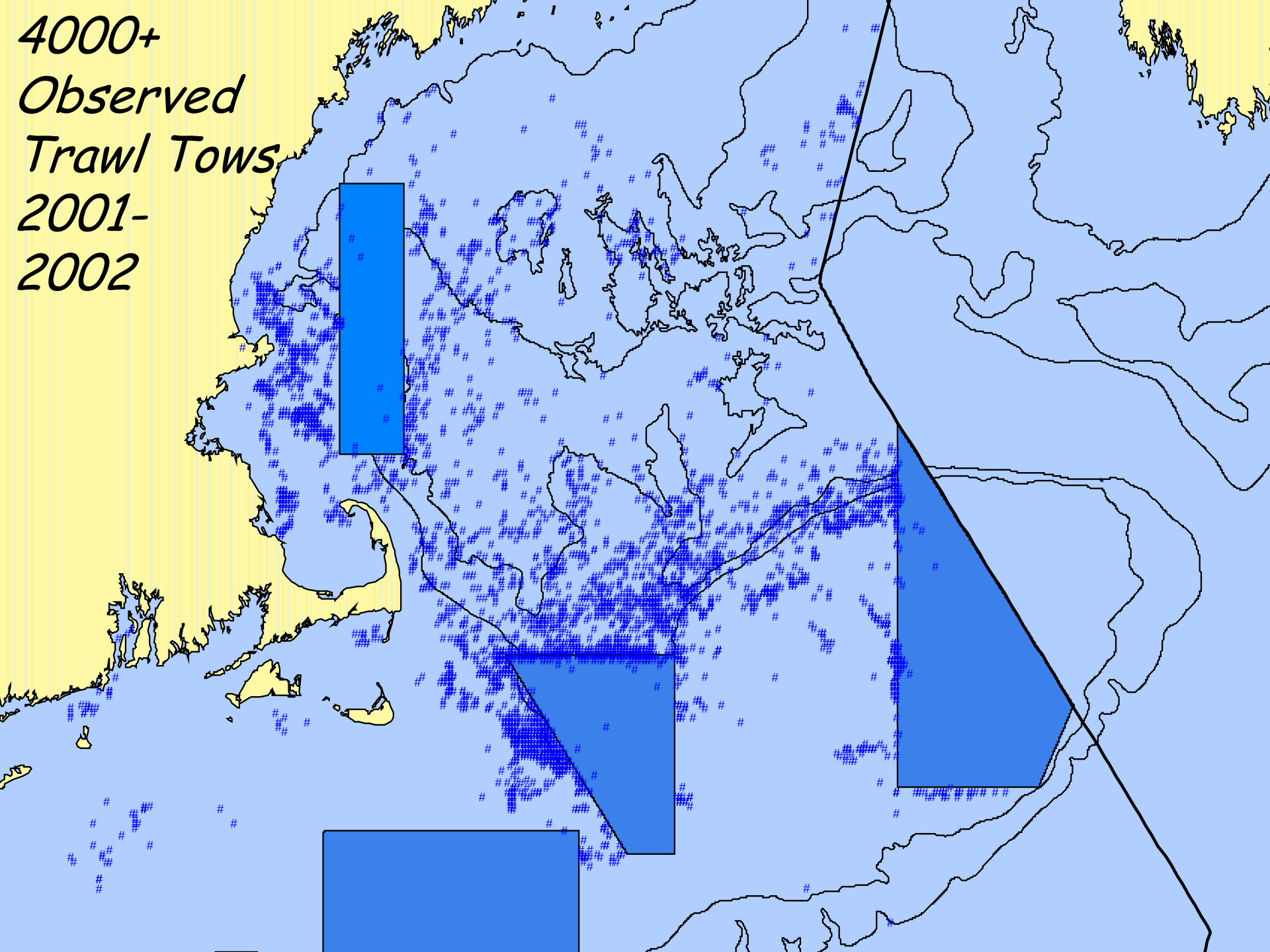
Response of Scallop populations Closed Areas

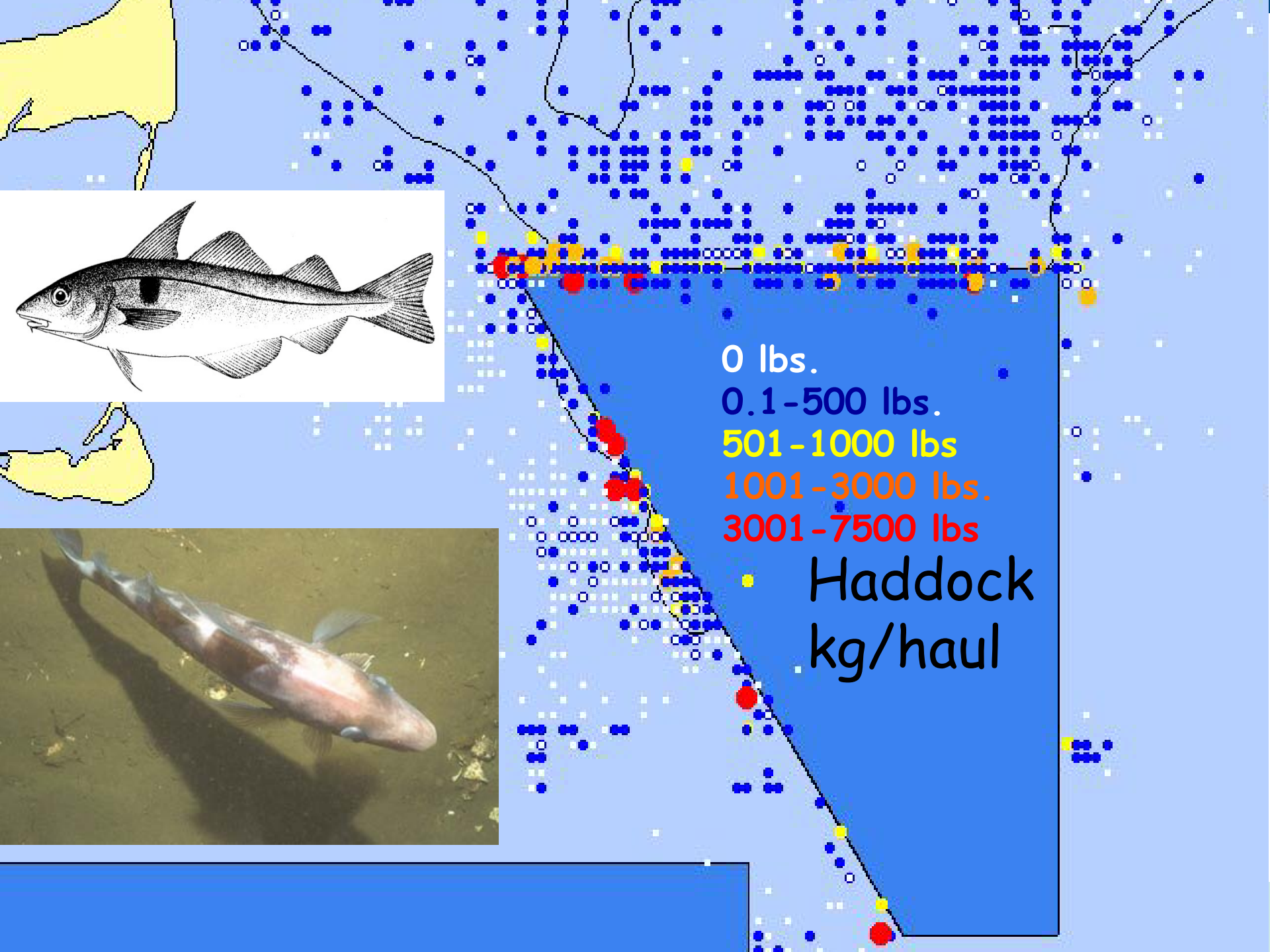

Total Closed Area:
20,187 km²
CA-I = 3,960
CA-II = 6,927
NLS = 6,275
WGOM = 3,025
1996
WGOM
CA-I
CA-II
NLS
Canada
USA
1994:
CA-I
CA-II
NLS
New England
Closed Areas

"Rolling Closures"

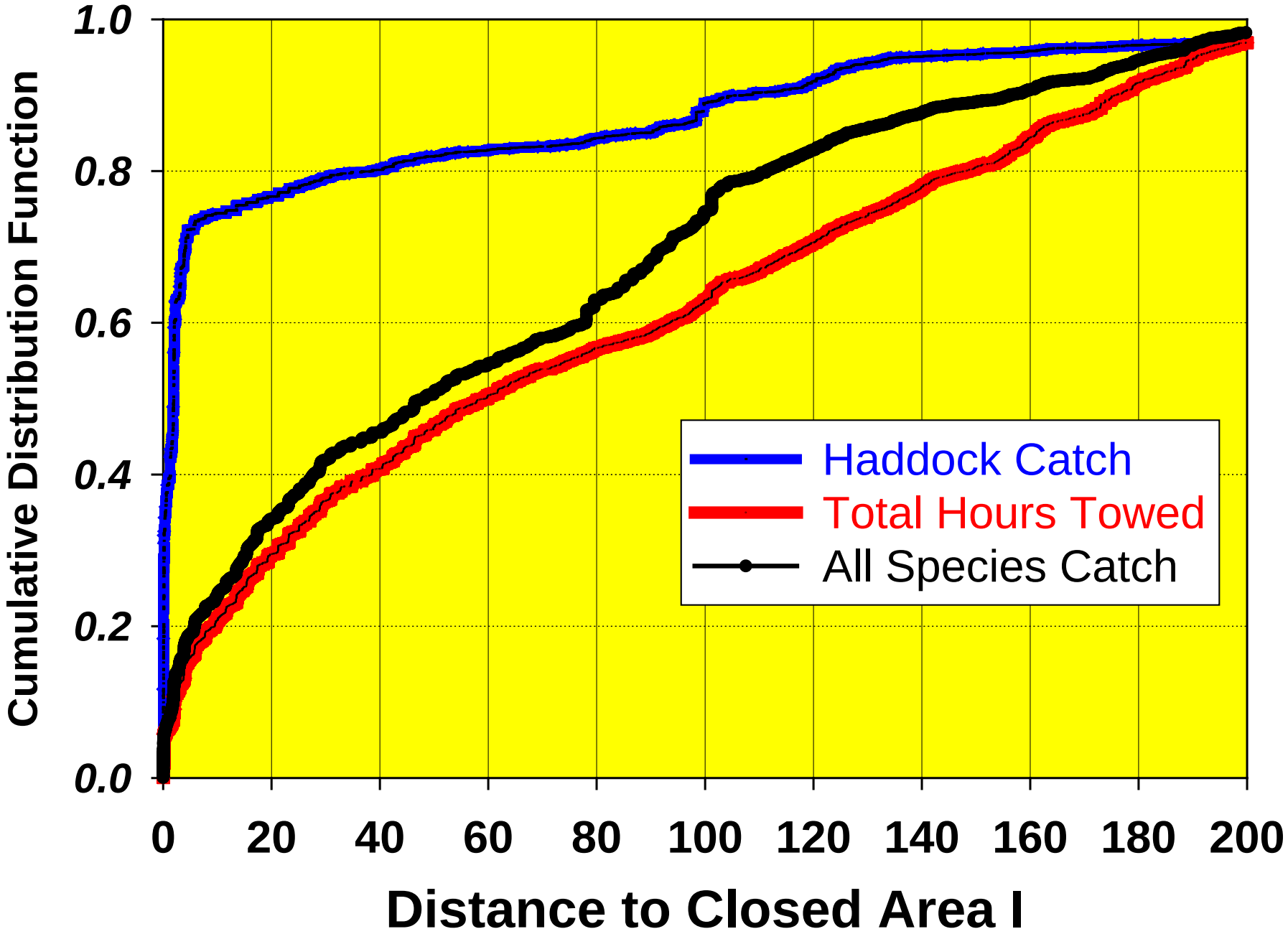
In addition to Year-round closures



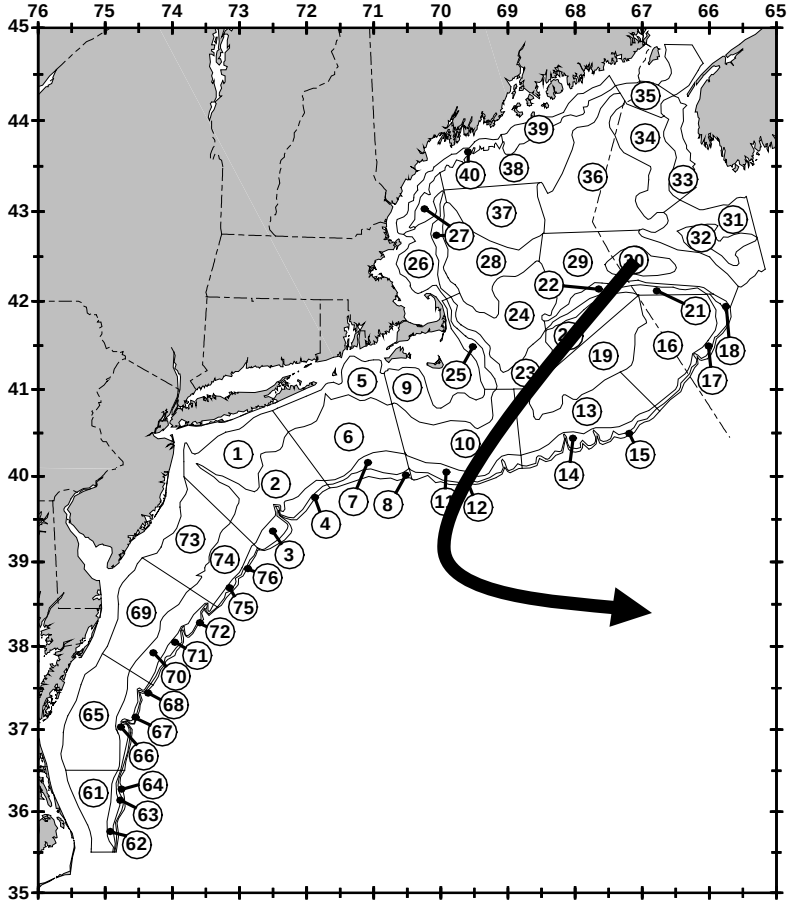

4000+
Observed
Trawl Tows
2001-
2002


0 lbs.
0.1-500 lbs.
501-1000 lbs
1001-3000 lbs.
3001-7500 lbs
Haddock
kg/haul

# How Much Catch & Effort is Proximate to CA-I?

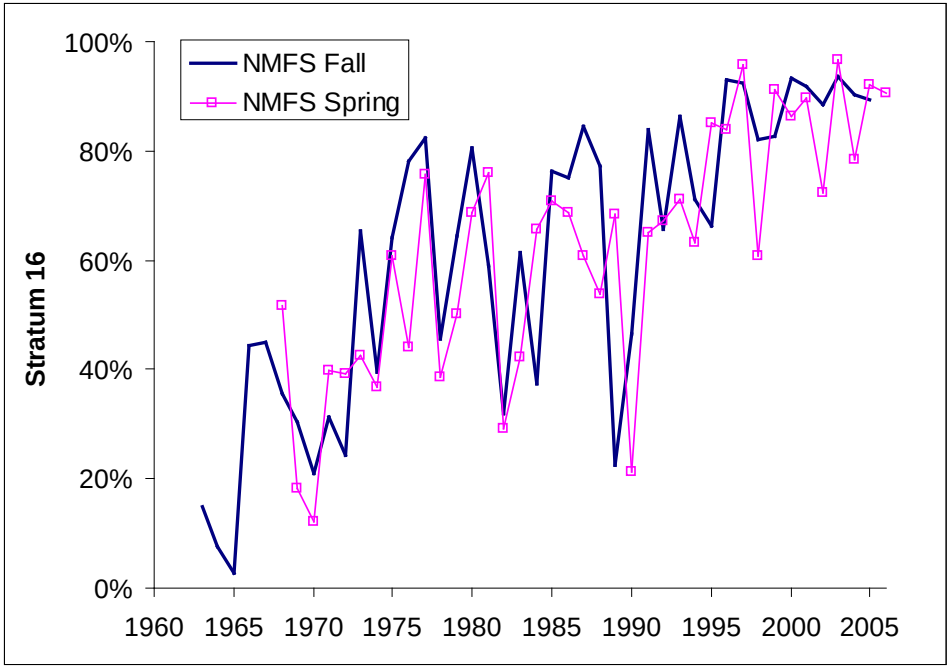


*NEFSC offshore bottom trawl survey strata*

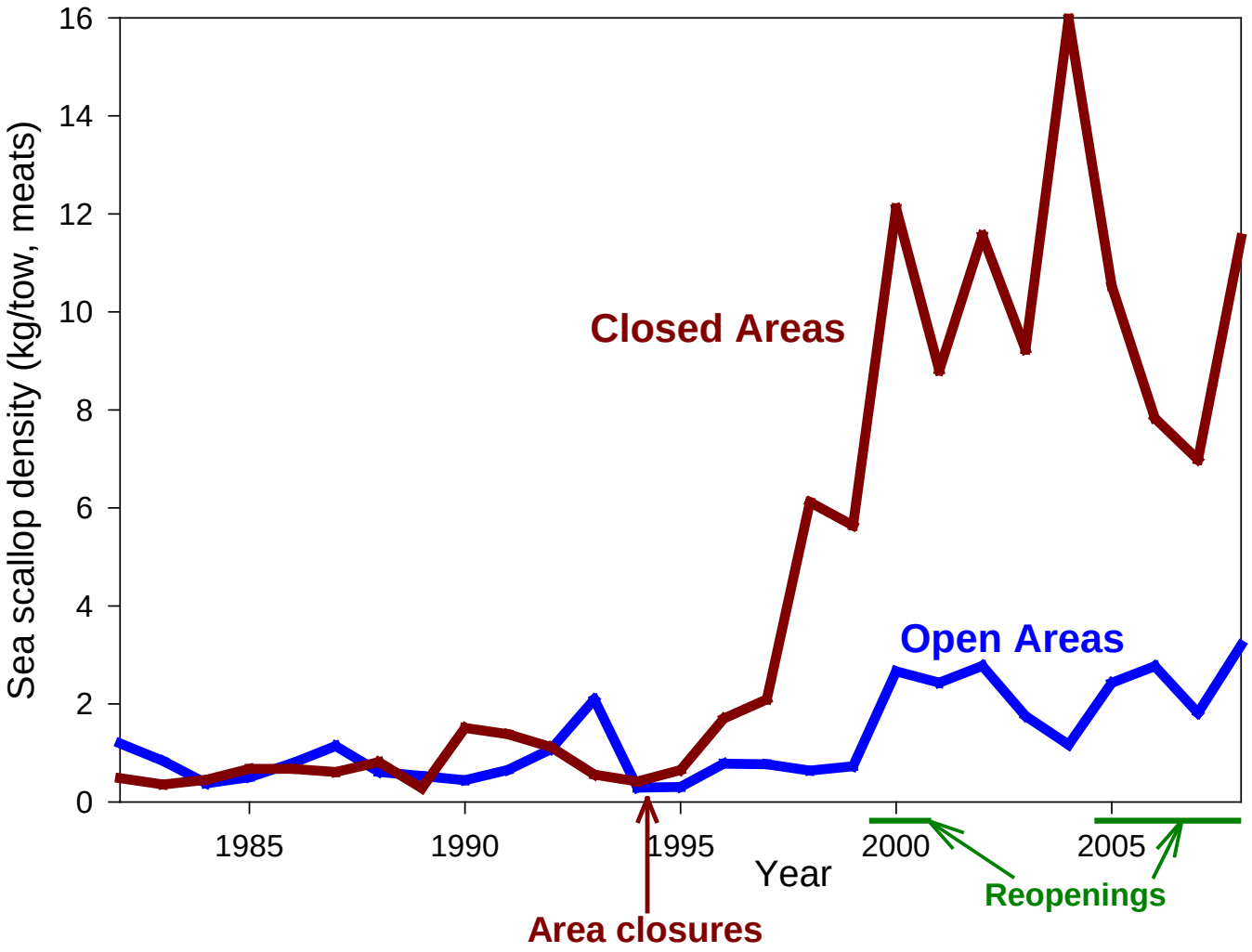



# Spatial Concentration of Population Density

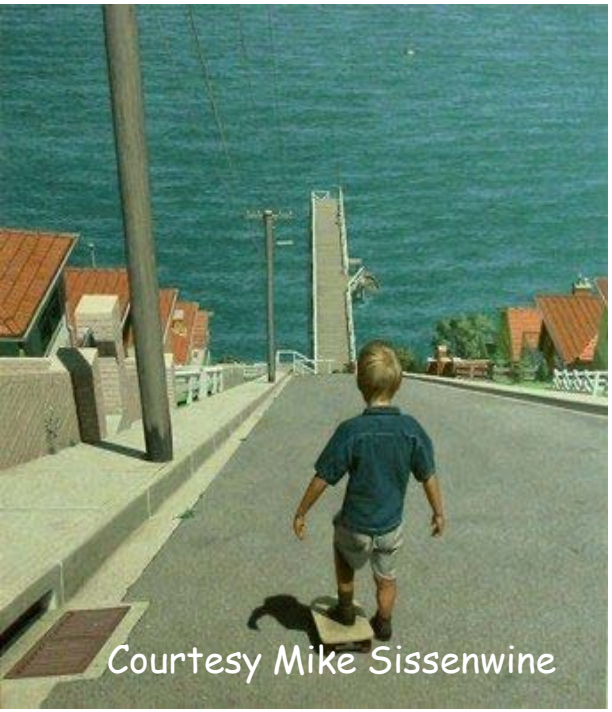
Increases in Georges Bank Yellowtail Flounder have been dominated by increases in stratum 16, an area largely closed to fishing since 1994.



# U.S. Georges Bank scallop indices inside and outside groundfish closed areas



# A Robust Integrated System increases the likelihood of:




"life does not stand still while specialists put their minds in order."
Michael Graham, 1950, Address to the United Nations

Meeting the demand for stock assessments and related products

Improving the science underlying stock assessments

The ability to meet these challenges relies on the timely production of fishery-dependent data that are fully integrated and sufficient to meet needs for both management and science.

# Presentation overview

- Relationship between data and models—and the interface with management
- Chronology of data for assessments
- Need for robust integrated system
- Strengths, challenges, proposed solutions

# Strengths

- Luxury of data—long time series of catch
- Multiple fishery independent surveys over entire resource
- Multiple State surveys
- Multiple systems for collection
- Calibrations of transitions in technology
- Communication among groups
- Center machinery is geared for production of scientific advice to management, with a special acknowledgement to Data Management Services (DMS).

# Challenges

Linking databases

Coordination of the moving parts

Timing of heterogeneous data bases

- VTR-Dealer
- State Landings
- Recreational data

Addressing finer scale questions for management

Meeting the need for increased frequency of assessments

More data creates more questions→stock assessments get more complicated

Increasing demands of peer-review process

# Proposed Solutions

Define a <u>unique</u> key associated with each trip

The key links all aspects of data collections associated with trip

- VTR
- Dealer
- Port Sample
- Observer Coverage
- VMS

Increase QA/QC at point of data collection

Develop better linkages with “special conditions for trip” such as access to closed areas, exempted fisheries, sectors, etc.

Invest efforts to create greater buy-in from fishermen on utility of fishermen collected data.

# END—Questions?

"An investigator who gives serious attention to the numerous types of systematic error which may enter into his procedures for sampling fish populations may at times tend to forget that even his best efforts will not make the result anything better than a good *sample*, subject to sampling error."

*Ricker, W. E. (1945). Some applications of statistical methods to fishery problems. Biometrics Bulletin 1, 73-79.*