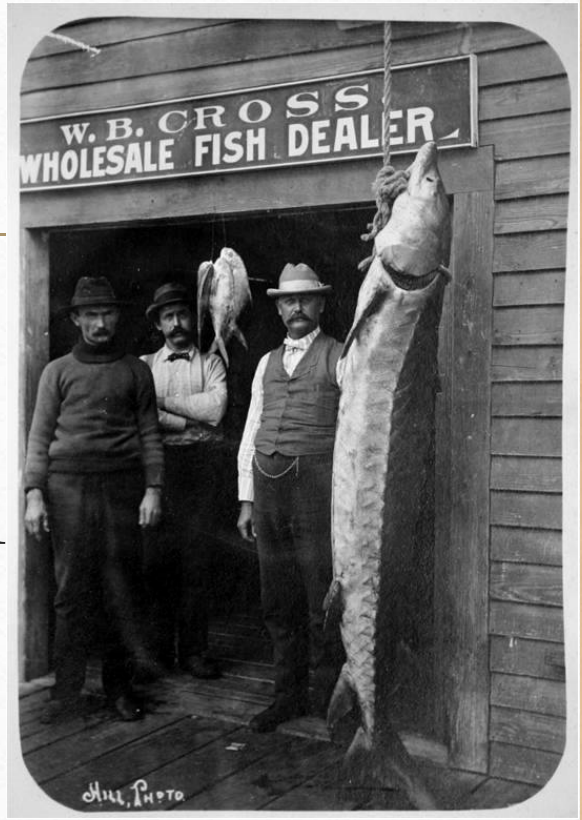
Honoring the Past

1941-1991

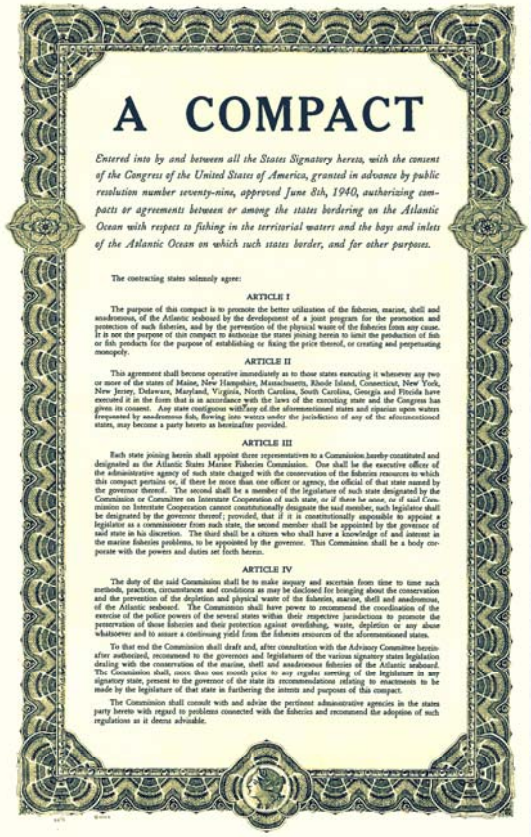
The Beginning

- 1937 Eastern States Conservation Conference
- Concern Over Declining Stocks
  - Lobster, shad, striped bass, sturgeon
  - RI lobster catch decreased by half between 1931 & 1935
  - Flounder catch fell from 6 to 2 millions pounds over the same time period
- Idea of interstate compact proposed to encourage cooperation in fisheries conservation



Interstate Compact

- Argued, amended and ultimately approved during several Eastern States Conservation Conferences
- Establish Interstate Commission with recommendatory, rather than regulatory, authority



A COMPACT

Entered into by and between all the States Signatory hereto, with the consent of the Congress of the United States of America, granted in advance by public resolution number seventy-nine, approved June 8th, 1940, authorizing compacts or agreements between or among the states bordering on the Atlantic Ocean with respect to fishing in the territorial waters and the bays and inlets of the Atlantic Ocean on which such states border, and for other purposes.

The contracting states solemnly agree:

ARTICLE I

The purpose of this compact is to promote the better utilization of the fisheries, marine, shell and anadromous, of the Atlantic seaboard by the development of a joint program for the promotion and protection of such fisheries, and by the prevention of the physical waste of the fisheries from any cause. It is not the purpose of this compact to authorize the states joining herein to limit the production of fish or fish products for the purpose of establishing or fixing the price thereof, or creating and perpetuating monopoly.

ARTICLE II

This agreement shall become operative immediately as to those states executing it whenever any two or more of the states of Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia and Florida have executed it in the form that is in accordance with the laws of the executing state and the Congress has given its consent. Any state contiguous with any of the aforementioned states and riparian upon waters frequented by anadromous fish, flowing into waters under the jurisdiction of any of the aforementioned states, may become a party hereto as hereinafter provided.

ARTICLE III

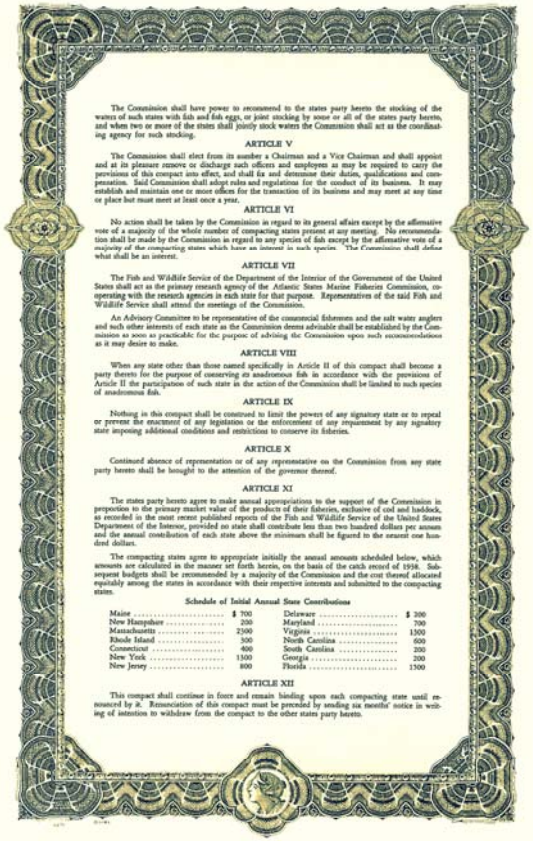
Each state joining herein shall appoint three representatives to a Commission hereby constituted and designated as the Atlantic States Marine Fisheries Commission. One shall be the executive officer of the administrative agency of such state charged with the conservation of the fisheries resources to which this compact pertains or, if there be more than one officer or agency, the official of that state named by the governor thereof. The second shall be a member of the legislature of such state designated by the Commission or Committee on Interstate Cooperation of such state, or if there be none, or if said Commission on Interstate Cooperation cannot constitutionally designate the said member, such legislator shall be designated by the governor thereof; provided, that if it is constitutionally impossible to appoint a legislator as a commissioner from such state, the second member shall be appointed by the governor of said state in his discretion. The third shall be a citizen who shall have a knowledge of and interest in the marine fisheries problems, to be appointed by the governor. This Commission shall be a body corporate with the powers and duties set forth herein.

ARTICLE IV

The duty of the said Commission shall be to make inquiry and ascertain from time to time such methods, practices, circumstances and conditions as may be disclosed for bringing about the conservation and the prevention of the depletion and physical waste of the fisheries, marine, shell and anadromous, of the Atlantic seaboard. The Commission shall have power to recommend the coordination of the exercise of the police powers of the several states within their respective jurisdictions to promote the preservation of those fisheries and their protection against overfishing, waste, depletion or any abuse whatsoever and to assure a continuing yield from the fisheries resources of the aforementioned states.

To that end the Commission shall draft and, after consultation with the Advisory Committee hereinafter authorized, recommend to the governors and legislatures of the various signatory states legislation dealing with the conservation of the marine, shell and anadromous fisheries of the Atlantic seaboard. The Commission shall, once then one month prior to any regular meeting of the legislature in any signatory state, present to the governor of the state its recommendations relating to enactments to be made by the legislature of that state in furthering the interests and purposes of this compact.

The Commission shall consult with and advise the pertinent administrative agencies in the states party hereto with regard to problems connected with the fisheries and recommend the adoption of such regulations as it deems advisable.



The Commission shall have power to recommend to the states party hereto the stocking of the waters of such states with fish and fish eggs, or joint stocking by some or all of the states party hereto, and when two or more of the states shall jointly stock waters the Commission shall act as the coordinating agency for such stocking.

ARTICLE V

The Commission shall elect from its number a Chairman and a Vice Chairman and shall appoint and at its pleasure remove or discharge such officers and employees as may be required to carry the provisions of this compact into effect, and shall fix and determine their duties, qualifications and compensation. Said Commission shall adopt rules and regulations for the conduct of its business. It may establish and maintain one or more offices for the transaction of its business and may meet at any time or place but must meet at least once a year.

ARTICLE VI

No action shall be taken by the Commission in regard to its general affairs except by the affirmative vote of a majority of the whole number of compacting states present at any meeting. No recommendation shall be made by the Commission in regard to any species of fish except by the affirmative vote of a majority of the compacting states which have an interest in such species. The Commission shall define what shall be an interest.

ARTICLE VII

The Fish and Wildlife Service of the Department of the Interior of the Government of the United States shall act as the primary research agency of the Atlantic States Marine Fisheries Commission, cooperating with the research agencies in each state for that purpose. Representatives of the said Fish and Wildlife Service shall attend the meetings of the Commission.

An Advisory Committee to be representative of the commercial fishermen and the salt water anglers and such other interests of each state as the Commission deems advisable shall be established by the Commission as soon as practicable for the purpose of advising the Commission upon such recommendations as it may desire to make.

ARTICLE VIII

When any state other than those named specifically in Article II of this compact shall become a party thereto for the purpose of conserving its anadromous fish in accordance with the provisions of Article II the participation of such state in the action of the Commission shall be limited to such species of anadromous fish.

ARTICLE IX

Nothing in this compact shall be construed to limit the powers of any signatory state or to repeal or prevent the enactment of any legislation or the enforcement of any requirement by any signatory state imposing additional conditions and restrictions to conserve its fisheries.

ARTICLE X

Continued absence of representation or of any representative on the Commission from any state party hereto shall be brought to the attention of the governor thereof.

ARTICLE XI

The states party hereto agree to make annual appropriations to the support of the Commission in proportion to the primary market value of the products of their fisheries, exclusive of cod and haddock, as recorded in the most recent published reports of the Fish and Wildlife Service of the United States Department of the Interior, provided no state shall contribute less than two hundred dollars per annum and the annual contribution of each state above the minimum shall be figured to the nearest one hundred dollars.

The compacting states agree to appropriate initially the annual amounts scheduled below, which amounts are calculated in the manner set forth herein, on the basis of the catch record of 1938. Subsequent budgets shall be recommended by a majority of the Commission and the cost thereof allocated equitably among the states in accordance with their respective interests and submitted to the compacting states.

Schedule of Initial Annual State Contributions

Maine	$ 700	Delaware	$ 300
New Hampshire	200	Maryland	700
Massachusetts	2500	Virginia	1300
Rhode Island	300	North Carolina	600
Connecticut	800	South Carolina	200
New York	1300	Georgia	200
New Jersey	800	Florida	1300

ARTICLE XII

This compact shall continue in force and remain binding upon each compacting state until renounced by it. Renunciation of this compact must be preceded by sending six months' notice in writing of intention to withdraw from the compact to the other states party hereto.

Compact, Rules and Regulations

- 1940 – ME, NH, MA, RI, NY, NJ, DE, MD, VA accepted Compact with the following provisions:
  - Compact would have 15-year life
  - ASMFC would report to both the states and Congress
- Approved by Congress as P.L. 77-539
- Signed into law by President Roosevelt on May 4, 1942

Responsibilities

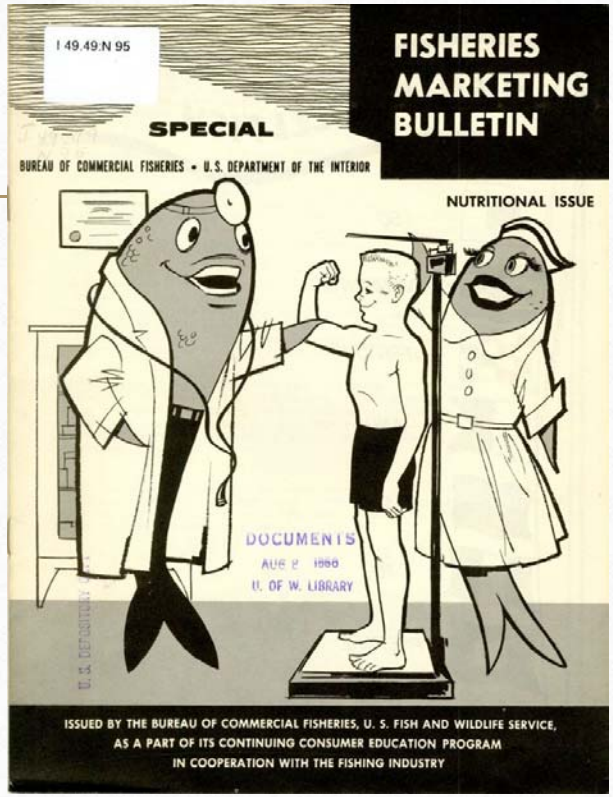
- Recommend **coastwide management measures**
- Be a **fact finding and deliberative body** with the power to make recommendations to state legislatures, federal agencies and Congress
- Establish Commission's **position on national legislation**
- Nominate and assign duties to an **Executive Director**
- Develop & administer **fishery management plans**

The War Years
1941-1949

- Food will win the war
- President Roosevelt establishes Office of Coordinator for Fisheries
- Goal to ensure greatest production possible
- Commissioners focused on maximizing seafood production

Areas of Focus

- Education
  - Conservation best achieved through education
  - Bring fisheries education on par with agriculture
  - Courses and curricula on fisheries biology & management levels
    - Elementary schools through college
    - General public and fishermen



Jurisdictional Challenges

- A big issue on the international front was conservation zones
- Potential to undermine states' sovereign rights
- Working closely with State Dept, ASMFC was able to ensure state interests were safeguarded and adequately represented
- Outcome: International Commission for the Northwest Atlantic Fisheries (ICNAF)
  - ASMFC member of US delegation until ICNAF's dissolution 25 years later

Amendment One to the Compact

- States recognized limited impact as a conservation agency given recommendatory authority
- Approved in 1950, Amendment One became one of the most important ASMFC tools to encourage uniform state regulations
- Applied to only those states which choose to ratify it
- Designed to permit neighboring states to establish joint regulation of common fisheries in adjacent waters
- Atlantic herring and northern shrimp managed via Amendment One

ASMFC Early Leaders
Wayne Heydecker and Ernie Mitts

Top row far left: Heydecker with Commissioners in 1946

Far right: Mitts with David Hart & Edmund Dunn, 1st ASMFC Chair

Wayne Heydecker

- Council of State Governments played seminal role in forming ASMFC
- Heydecker - NY Regional Rep. for the Council
- Appointed ASMFC Secretary-Treasurer in 1942
- Extensive administrative and governmental experience

- Tireless and effective advocate
  - Traveled up and down coast, meeting with fishing agency and industry leaders
  - Extensive correspondence with Presidents, Congress, international leaders, federal agencies, promoting Commission mission and advocating for state rights

- Interpreted original Compact
- Clarified Commission's abilities and limits
- Instrumental in Commission's establishment and organization
- Almost single-handedly ran Commission for two decades

Ernie Mitts

- 2nd Executive Director
- Former Director of Conservation from Tallahassee, FL
- Long-time Commissioner, Chair of South Atlantic Section, Executive Committee member
- Served from 1961-1971
- Facilitated passage of critically important legislation
  - Anadromous Fish Conservation Act and Commercial Fisheries Research and Development Act

1950-1959

- Investment in expanding catch statistics and research to meet fisheries management needs
- Creation of Cooperative Offshore Research Program
  - Uniform system for collecting catch records and generating statistics through Southeast
- MD/VA/NC Joint Research Program
  - Collaborative effort of fishery labs in all three states

- Continued focus on pollution control
  - Industrial pollution found to affect coastal fisheries, though extent unknown
  - Focused on improving shellfish sanitation
- Fisheries and social legislation
  - Intensifying conflicts among user groups compromised conservation measures
  - Sought ways to balance user group needs
  - Condemned any legislation that sought “to protect one particular fishery at the expense of another”

15-Year Review of Accomplishments

- Growth and influence evidenced by expanding number of sections, committees and subcommittees, revealing scope of issues addressed
  - Mid-Atlantic Section's study of weakfish and shad
  - South Atlantic Section's discussion of wrecks and obstructions on fishing grounds
- Throughout the period, ASMFC debated, advised, and/or requested studies for any and all timely matters relating to fisheries

According to Chair Charles Lankford (VA)

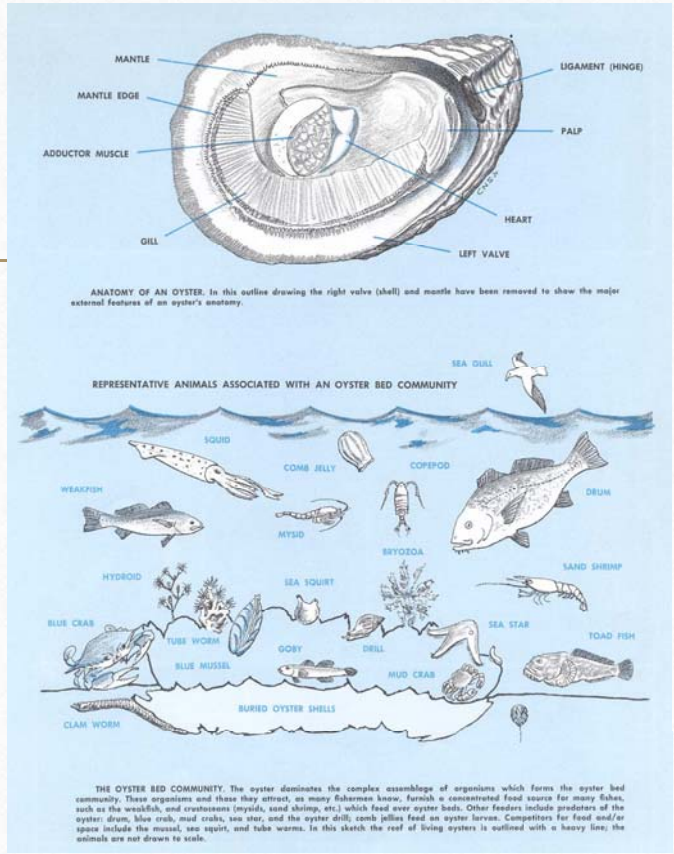
"The Commission's greatest accomplishment so far has been its success as a referee. By providing a neutral arena for the states, the Commission has been able to facilitate improved relations up and down the coast. "

1960-1969

- Emerging concern for the environment
- Recognized link between habitat & fisheries; loss of habitat to pollution and pesticides
- Policy statement and management plan on "Developing and Managing Estuaries"
  - Called for increased research, inventory of estuaries, and establishment of controls
- Concern about impacts of pesticides on shellfish and mullet
  - Resolution to expand research into safer chemicals and sterilization techniques for pest control

Advancements in Research & Education

- Regionally-divided technical committees to advance fishing industry and improve production
- Advanced research on freezing and refrigeration techniques, extending fish quality by months
- Exploring forecasting as a critical first step in species conservation
- Leaflet Series: educating the public while promoting value of fisheries



Captain David H. Hart

- Commercial fisherman, industry leader, statesman, conservationist
- Served for over 40 years, initially as NJ's Administrative Commissioner and later as Governor Appointee
- Only Governor Appointee to serve as ASMFC Chair and only Commissioner to be conferred title of Honorary Chair
- Longtime Chair of the Mid-Atlantic Council
- Shepherded passage of Commercial Fisheries Research and Development Act

State/Federal Fisheries Management Program 1970-1979

- Established in 1972 in cooperation with NMFS
- True state/federal partnership
  - Majority of funding provided by NMFS; ASMFC coordinated meetings and communication
- Goal: Improve coordination and cooperation among states, NMFS, and commercial and recreational fishing industries
- Develop FMPs for important interjurisdictional species
  - Earliest plans – surf clams, lobster, northern and South Atlantic shrimp, menhaden, striped bass, summer flounder

Fishery Conservation and Management Act

- Passed in 1976, forever altering the course of US fisheries management
- Established 200-mile EEZ
- 7 national standards
- 8 regional fishery management councils
- ASMFC ensured final Act preserved states' authority within their boundaries and strictly limited circumstances where federal government could preempt

Interstate Fisheries Management Program 1980-1991

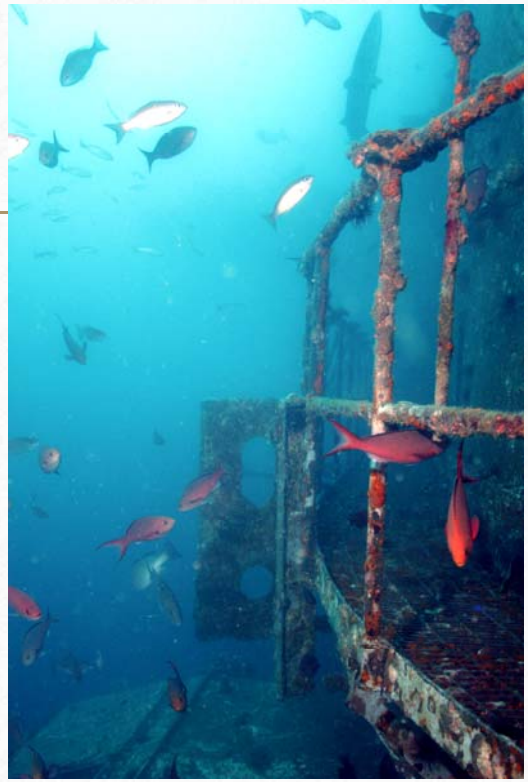
- 1980 - State/Federal Fisheries Management Program becomes ISFMP
  - State/federal consensus Program could better meet its potential under ASMFC's authority as a cooperative interstate body
  - States believed assuming full responsibility much needed step to improve interjurisdictional cooperation

5 Goals of the ISFMP

- Determine priorities for territorial sea fisheries management
- Develop, monitor and review plans for high priority fisheries
- Recommend to the states, regional management councils, and federal government measures to benefit such fisheries
- Provide means of conducting short-term research essential to preparation or revision of FMPs
- Provide organizational structure for efficient and timely administration

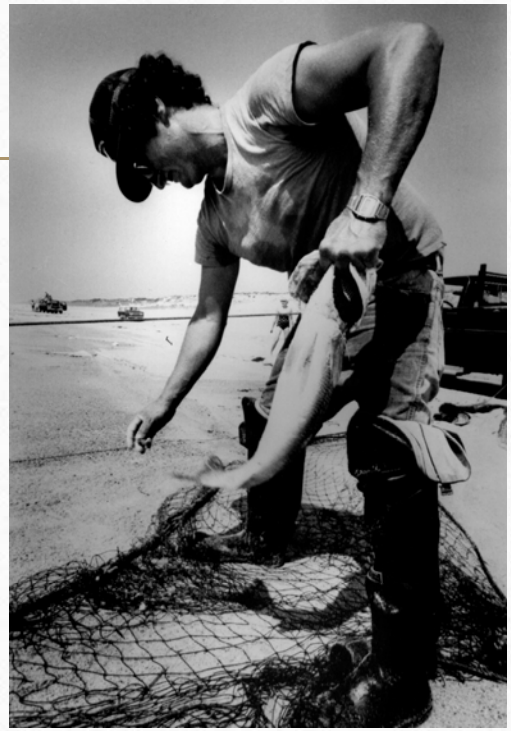
1980 – 1991 (cont'd)

- Extensive short-term projects and workshops to address key research needs
- Formation of programs on artificial reefs, marine recreational fishing, and conservation engineering to serve as forums of issue and information exchange
- Funding support from Wallop-Breaux, Sport Fish Restoration Program
- Reorganization and streamlining of ISFMP



Atlantic Striped Bass

- Striped bass has dominated ASMFC activities and priorities for extended periods throughout its history
- Species decline in 1930s one of the principal reasons for the states coming together
- Increased fishing pressure in 1970s combined with degradation and loss of habitat led to species collapse



Resource in Decline

- 1979 – Chafee Amendment authorizes Emergency Striped Bass Studies
- Determine stock status and factors responsible for decline
- 3- year study by US Fish and Wildlife Service and NMFS
- Findings led to development and implementation of FMP in 1981

Atlantic Striped Bass Conservation Act

- Amendments 1 & 2 call for strict management measures and significant reduction in harvest
- Voluntary management program results in continued decline of resource
- Rep. Studds sponsors Act to ensure state compliance with FMP through Secretarial preemption
- Following Act passage in 1984, several states impose moratoria on striped bass fishing
- Management program sets stage for rebuilding
- Resource declared rebuilt in 1995
- Precursor to the Atlantic Coastal Fisheries Cooperative Management Act

Irwin Alperin
1971-1990

- 3rd Executive Director
- Involvement with ASMFC began in 1951 as NY state biologist and continued through his selection as Executive Director
- Commission flourished under his leadership
- Expanded Commission staff and with that its efforts and influence
- Greatly increased conservation programs
- Executive Directorship evolved from a lobby-intensive to administrative

- Developed and administered the ISFMP, which he considered his single greatest accomplishment
  - 15 FMPs approved during his tenure
- Established Council Liaison Program
  - Enabled greater state/federal cooperation
- Tripled Commission Budget
  - Not only did he develop program but found funding to support them

In Summary

The first 50 years was a time of –

- Formalizing state responsibilities and coordination
- Defining state and federal partnerships and coordination
- Evolution, shifting from a forum for discussion to a vital management entity
- Congressional recognition and support of the states' role in managing fishery resources

1992 - 2016

Celebrating the Present

1992 - 2002

Working Together to Achieve Common Goals That Exceed Needs of Individual States

The Early 1990s: Political/Management Landscape

- 15 years of federal management under Magnuson-Stevens Act
- Atlantic striped bass population rebounded
- Other stocks in worrisome decline
- New generation of ASMFC and state leadership
- 6th decade one of expansion and effective collaboration for common good

Atlantic Coastal Fisheries Cooperative Management Act

- Seeds for new Act began at 50th Annual Meeting
- Adopted by Congress in December 1993
- Broadened success of Striped Bass Act to all ASMFC managed species

Atlantic Coastal Fisheries Cooperative Management Act

- Funding for ASMFC and state fisheries management and science activities
- State compliance tied to conservation requirements
  - Secretarial preemption
- ISFMP Charter – standards and procedures

Mid-1990s: Growth & Expansion

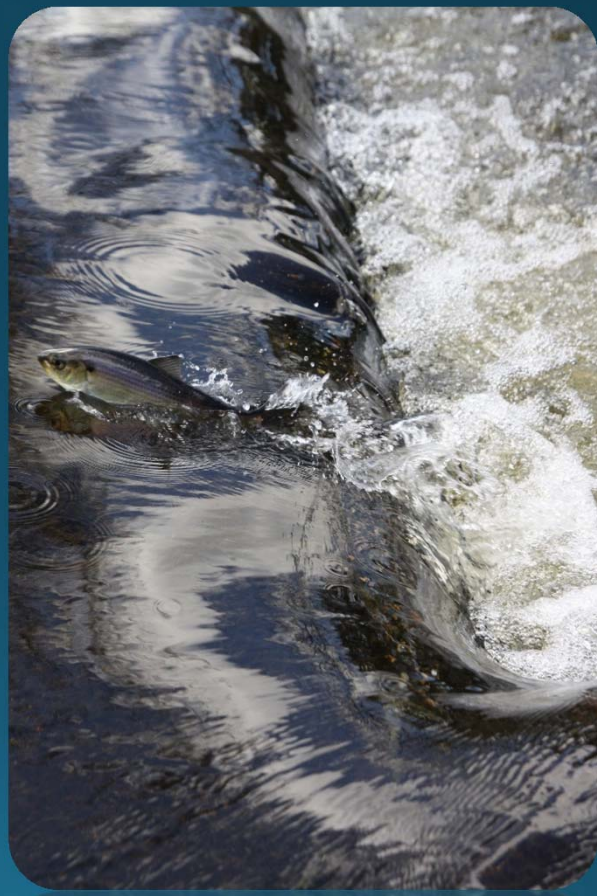
- Tremendous Growth for the ISFMP
- New FMPs for tautog, horseshoe crab and American eel
- Plan Amendments for Atlantic Sturgeon & Shad/River Herring
  - Sturgeon Plan implements 40-year moratorium

Mid-1990s: Growth & Expansion

- Creation of New Programs
  - Habitat
  - Research & Statistics
  - Outreach
- Refined Administrative Rules & Operational Practices

Habitat Program

- Education
  - *Habitat Hotline Atlantic*
  - Incorporation of habitat considerations in Interstate FMPs
- Advocacy
  - Input on federal legislation and environmental policies
- Stakeholder Engagement
  - Fishermen Involved in Saving Habitat (F.I.S.H.)



Research & Statistics Program

- Focused Research Initiatives
  - Tagging
  - Ageing
- Enhanced Stock Assessment Training
- Strengthened Fishery-independent Data
  - SEAMAP-SA
  - NEAMAP
- Improved Fishery-dependent Data
  - Harmonizing federal and state collection efforts
  - Creation of Atlantic Coastal Cooperative Statistics Program

Changing Dynamics

- Increased Role of Legislators & Governors' Appointees
- Growing Staff to Meet Expanding Needs
  - 1991 – 6 staff; 2002 – 26 staff
- Visionary Leadership Among Elected Officers
- Strengthened State/Federal Cooperation
- Strategic Planning
- Transition in Executive Leadership

2003 - 2016

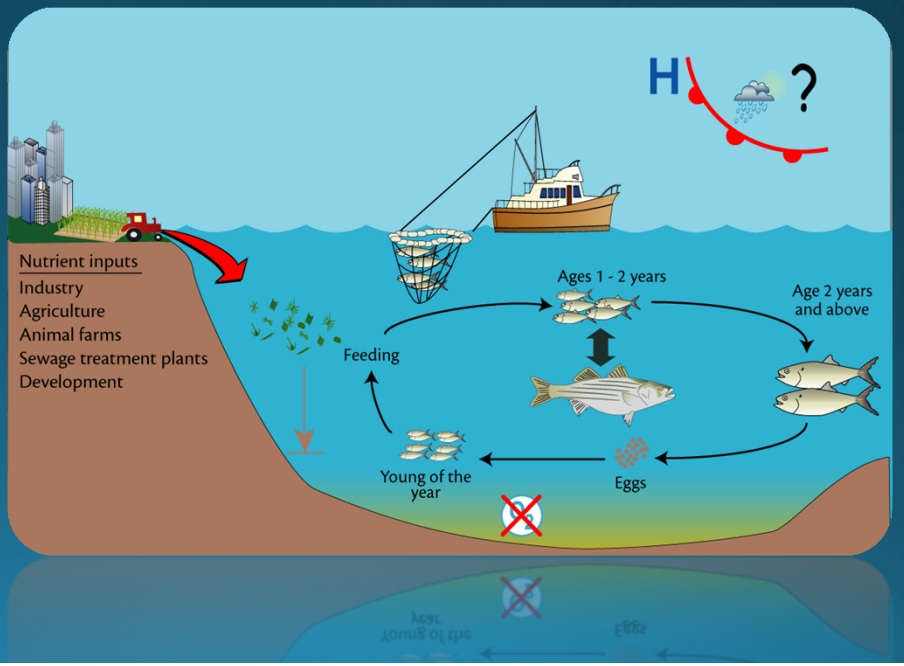
Seeking Efficiencies, Investing in People, Advancing Data Collection & Use, Working Cooperatively

New Challenges, New Opportunities

- By 2016, 10 Species Added under ASMFC Management, Bringing Total to 26
- Atlantic Coastal Act Successfully Upheld through Litigation and Noncompliance Findings
- Increased Protected Species Mandates
- Empowered Constituency
- Diminished State and Federal Resources
- Rapidly Changing Marine Environment

Overarching Issues

- Ecosystem-based Fisheries Management
- Advancing Science Capabilities and Fisheries-independent Data
- Promoting Habitat Conservation Partnerships
- Adapting to the Changing Face of Fisheries



Ecosystem-based Fisheries Management

- Multispecies Assessments Developed for Single Species Management
  - Key species: menhaden, weakfish, bluefish and striped bass
- Horseshoe Crab and Atlantic Menhaden
  - 1st time management action taken for a species due to concerns about another species

Horseshoe Crab

- Area-specific management tailored to address forage needs of migratory shorebirds
- Adaptive Resource Framework
  - Incorporates shorebird and horseshoe crab abundances to set annual specifications

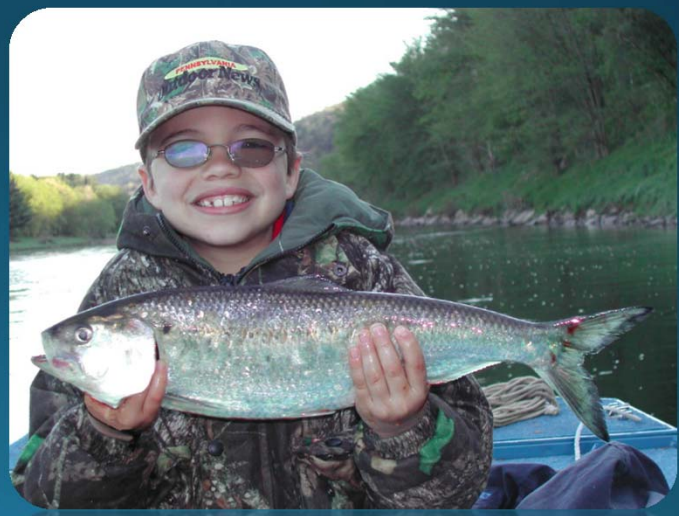


Atlantic Menhaden

- 2006 – 2013
  - Cap on Chesapeake Bay reduction fishery to address concerns about localized depletion and impacts to predator species
- 2013 – Present
  - New plan amendment underway to establish ecological-based reference points, reflecting menhaden's role as a forage species

Advancing Science Capabilities and Fisheries-independent Data

- Increased Stock Assessment Capabilities
  - In-house & Training Workshops for State Biologists
- Revised Peer Review Process
- Informed Management through Sound Science
  - Benchmark assessments led to changes in management
    - Shad, river herring, American lobster, weakfish
- Expanding Coverage of Fishery-independent Data Collection
  - NEAMAP



Habitat Conservation through Outreach and Partnerships

- Habitat Management Series
  - Advancing understanding of habitat needs and considerations
- Fish Passage Workshop and Policy
  - Guidance on effective approaches for efficient upstream and downstream passage

Habitat Conservation through Outreach and Partnerships

- Atlantic Coastal Fish Habitat Partnership
  - ASMFC Habitat Committee catalyst in development of
  - partnership
  - Mission: Conserve habitat for Atlantic coast diadromous, estuarine-dependent and coastal fish species

Changing Face of Fisheries

- Climate Change
  - Warming water temperatures
  - Species decline – northern shrimp and American lobster
  - Shifting species distribution
- New Species Plans
  - Black drum, Jonah crab and cobia

Changing Face of Fisheries

- Diadromous Species and the ESA
  - Atlantic sturgeon listed under the ESA; compromising state monitoring programs
  - ASMFC river herring and American eel management affirmed; ESA listing not warranted

2002 – 2016: Executive Directors

- Jack Dunnigan
  - Visionary; ACFCMA Architect
  - Statesman: Forging alliances among a broad range of jurisdictions
- Vince O'Shea
  - Process-driven
  - Accountability and transparency
- Bob Beal
  - Committed to States' needs driving Commission priorities
  - Building relationships and cultivating Congressional champions

Maine's dynamic fisheries: Multiple drivers and accelerating changes

Bob Steneck
Professor
University of Maine
School of Marine Sciences

1. Big picture: What *was* natural?

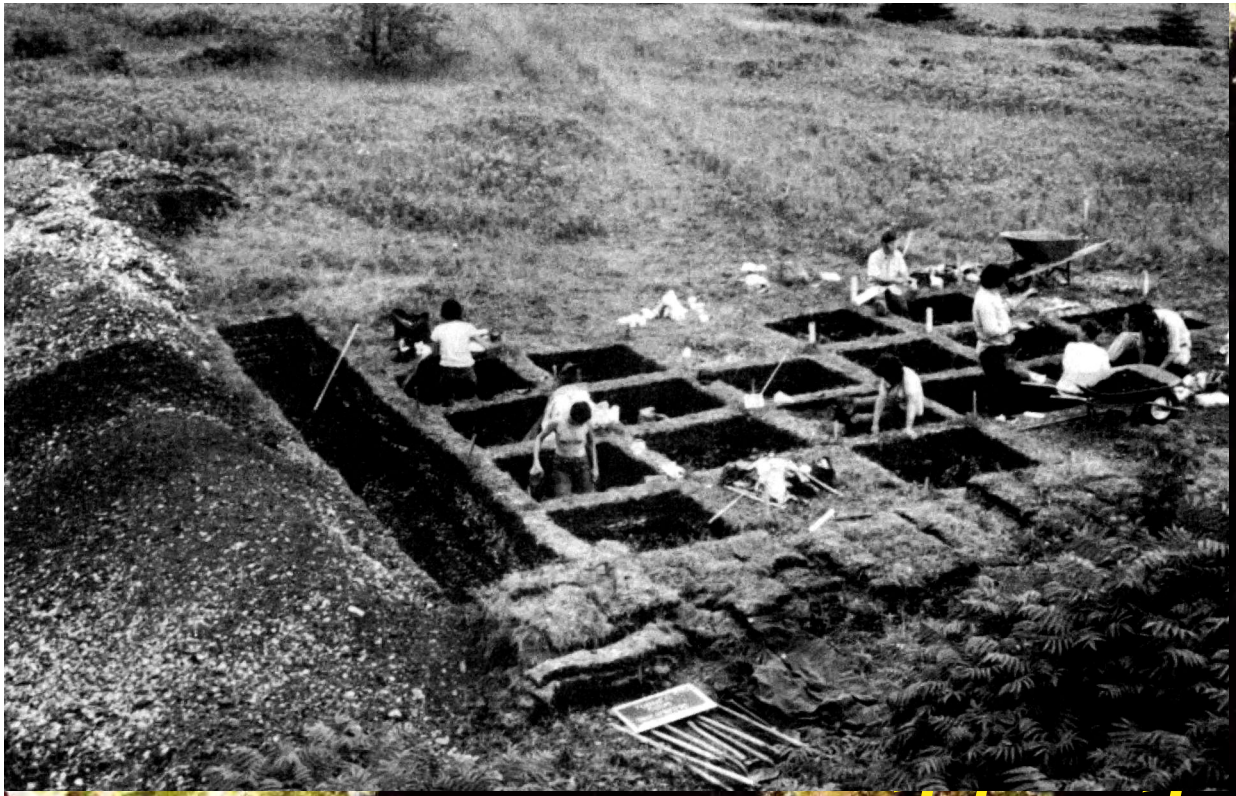
2. Evolution and impacts of fishing technology and practices to today

3. Some coastal ecosystem dynamics stories

5. Climate challenges and opportunities now and for tomorrow.

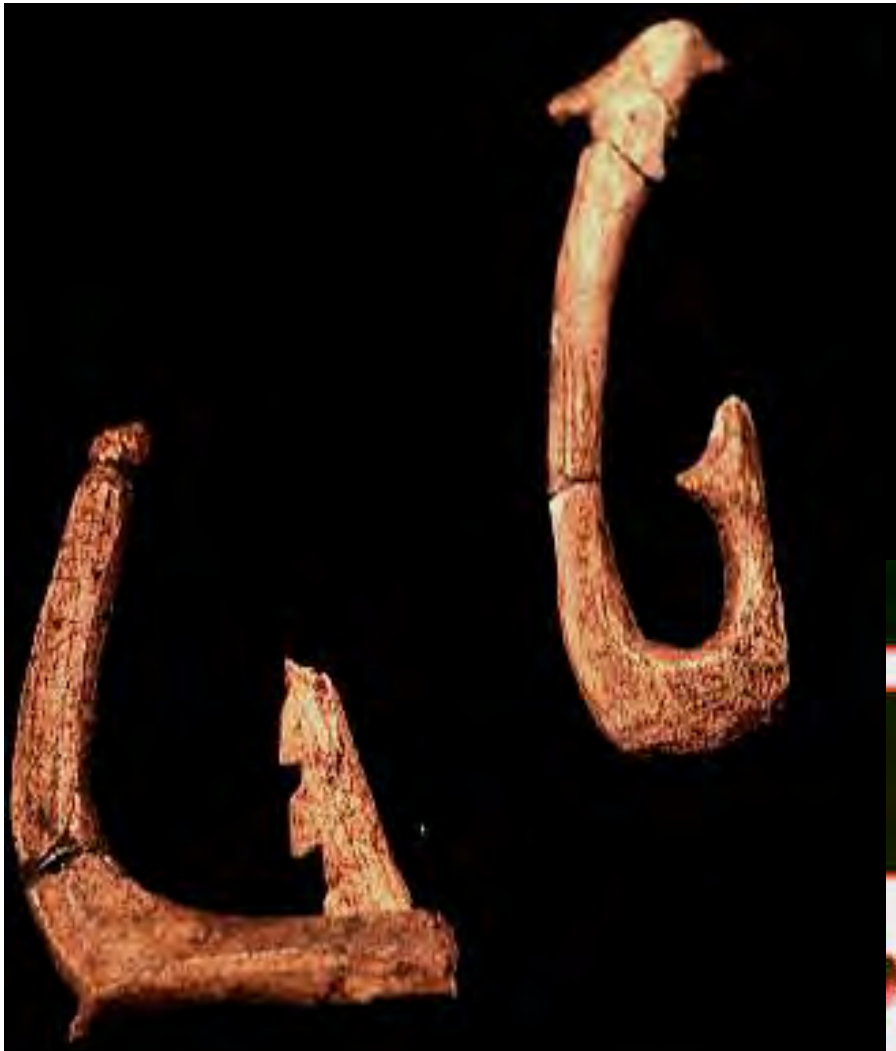
North Atlantic Ocean

- World's youngest ocean
- Incompletely inoculated by North Pacific biota
- Then there are those pesky glaciers (ca 120 k years)-- more extinctions.
- Leaving us with remarkably low species diversity
- But extremely high productivity
- Prone to "*Booms and Busts*"



The Turner Farm

Coast of Maine



Fish hooks: 5,000 y bp

Cod vertebra: 4,100 y bp

Average percent fragments from all strata

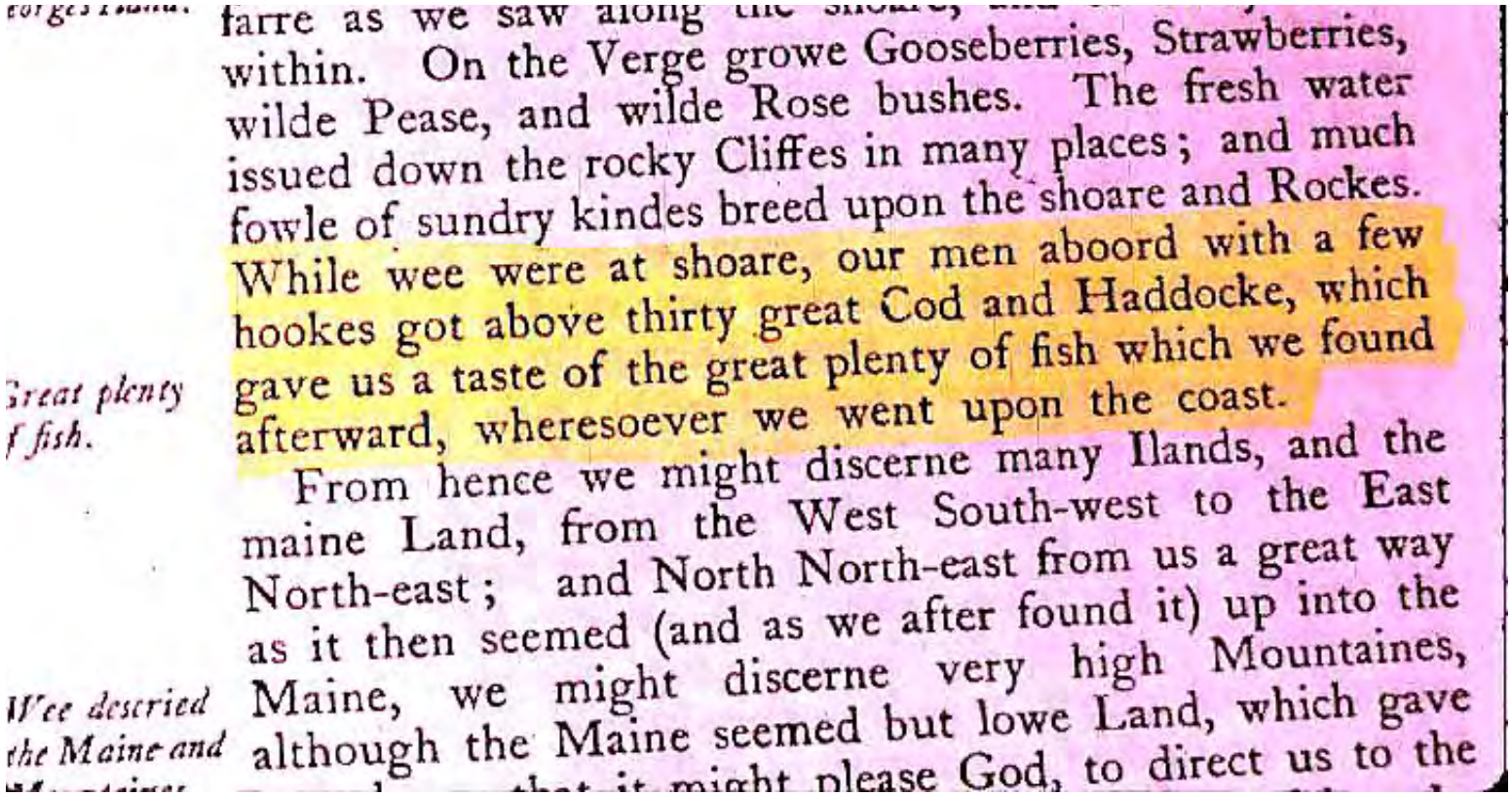
400 to 4500 years ago

Those folks loved seafood!

But note: NO LOBSTERS!

Steneck & Wahle 2013

Writings about the Maine coast in 1600s (Rosier 1605)



farre as we saw along the shoare, and ... within. On the Verge growe Gooseberries, Strawberries, wilde Pease, and wilde Rose bushes. The fresh water issued down the rocky Cliffes in many places; and much fowle of sundry kindes breed upon the shoare and Rockes. While wee were at shoare, our men aboord with a few hookes got above thirty great Cod and Haddocke, which gave us a taste of the great plenty of fish which we found afterward, wheresoever we went upon the coast.

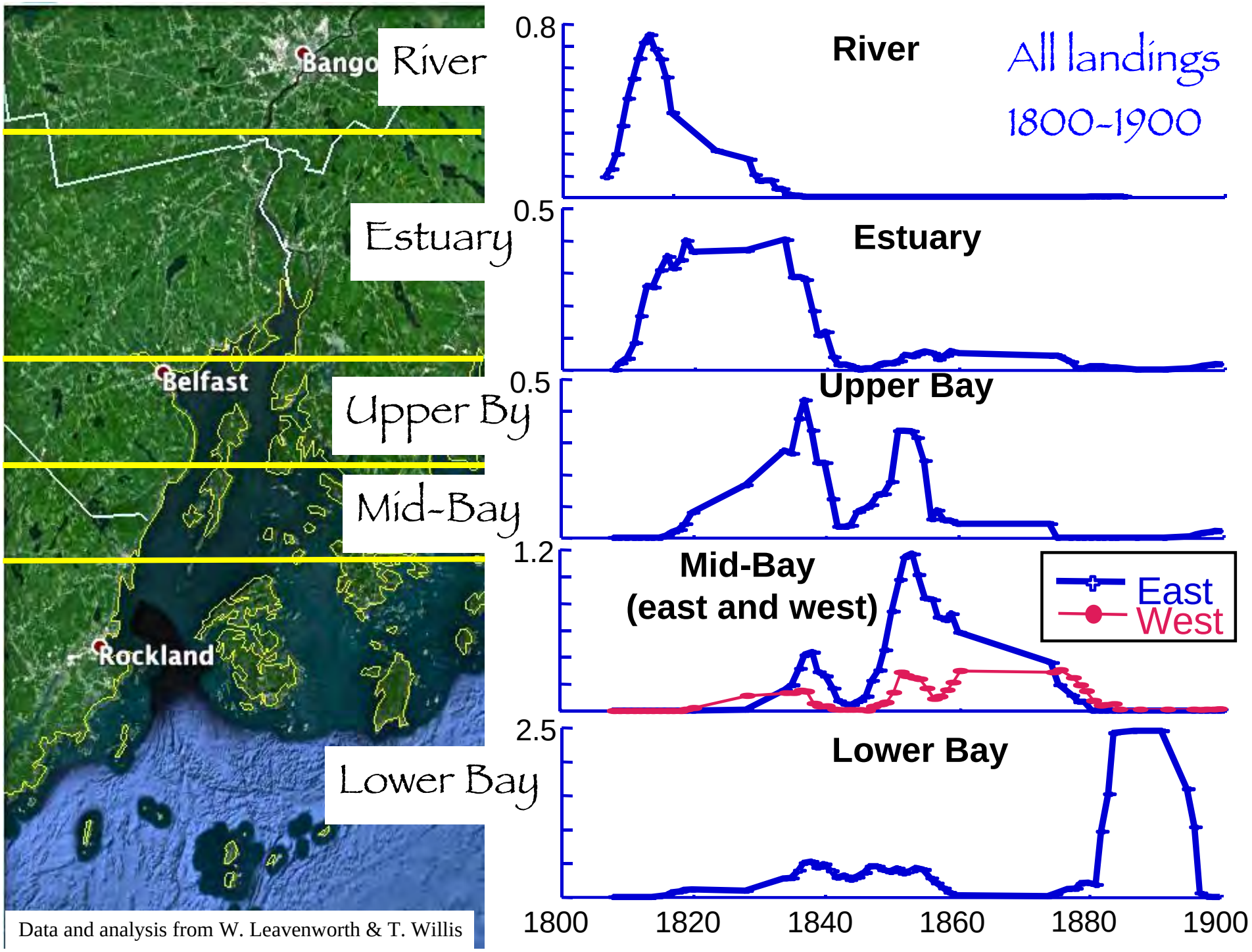
Great plenty of fish.

From hence we might discerne many Ilands, and the maine Land, from the West South-west to the East North-east; and North North-east from us a great way as it then seemed (and as we after found it) up into the Maine, we might discerne very high Mountaines, although the Maine seemed but lowe Land, which gave

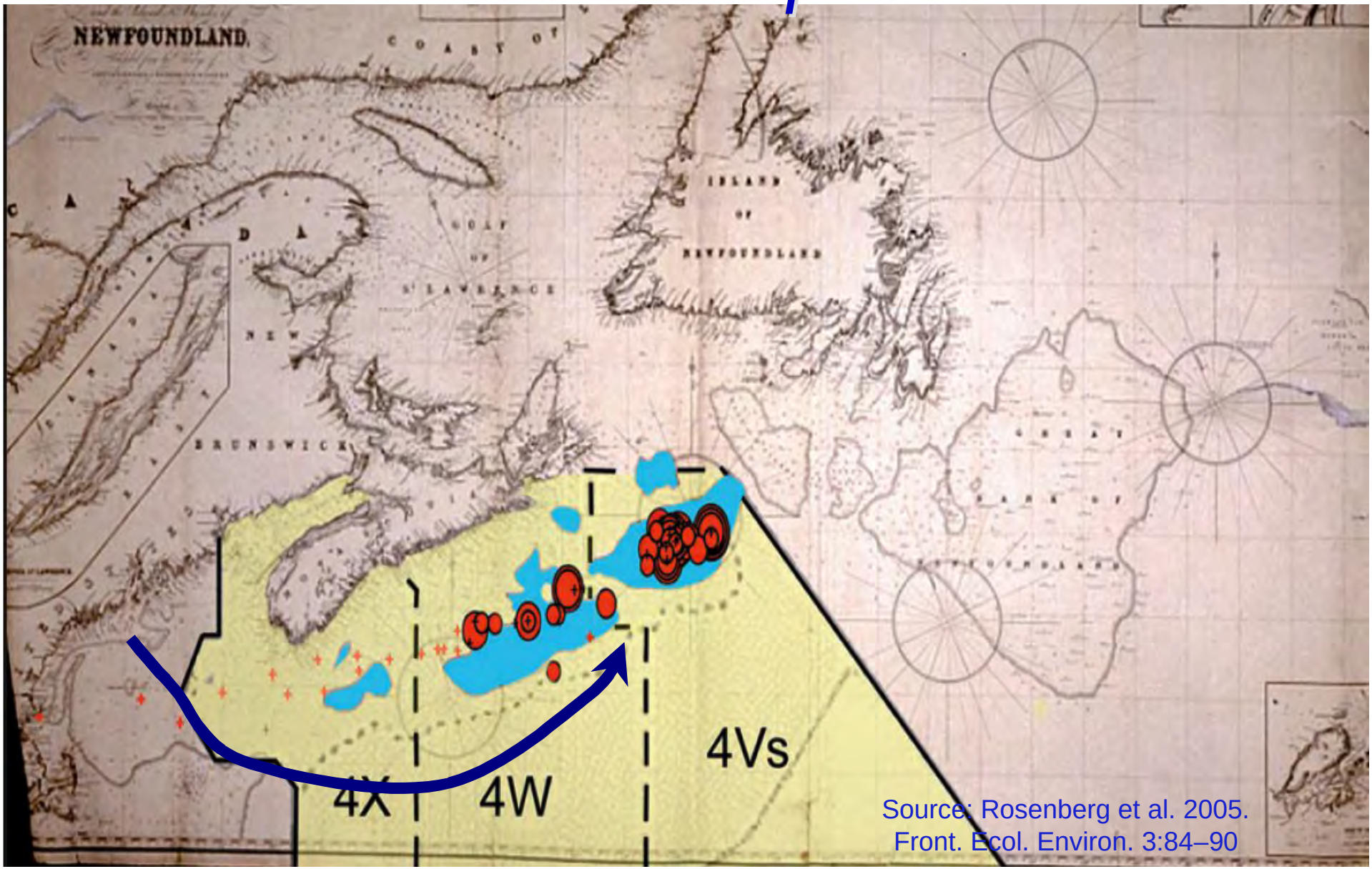
Wee descried the Maine and

... that it might please God, to direct us to the

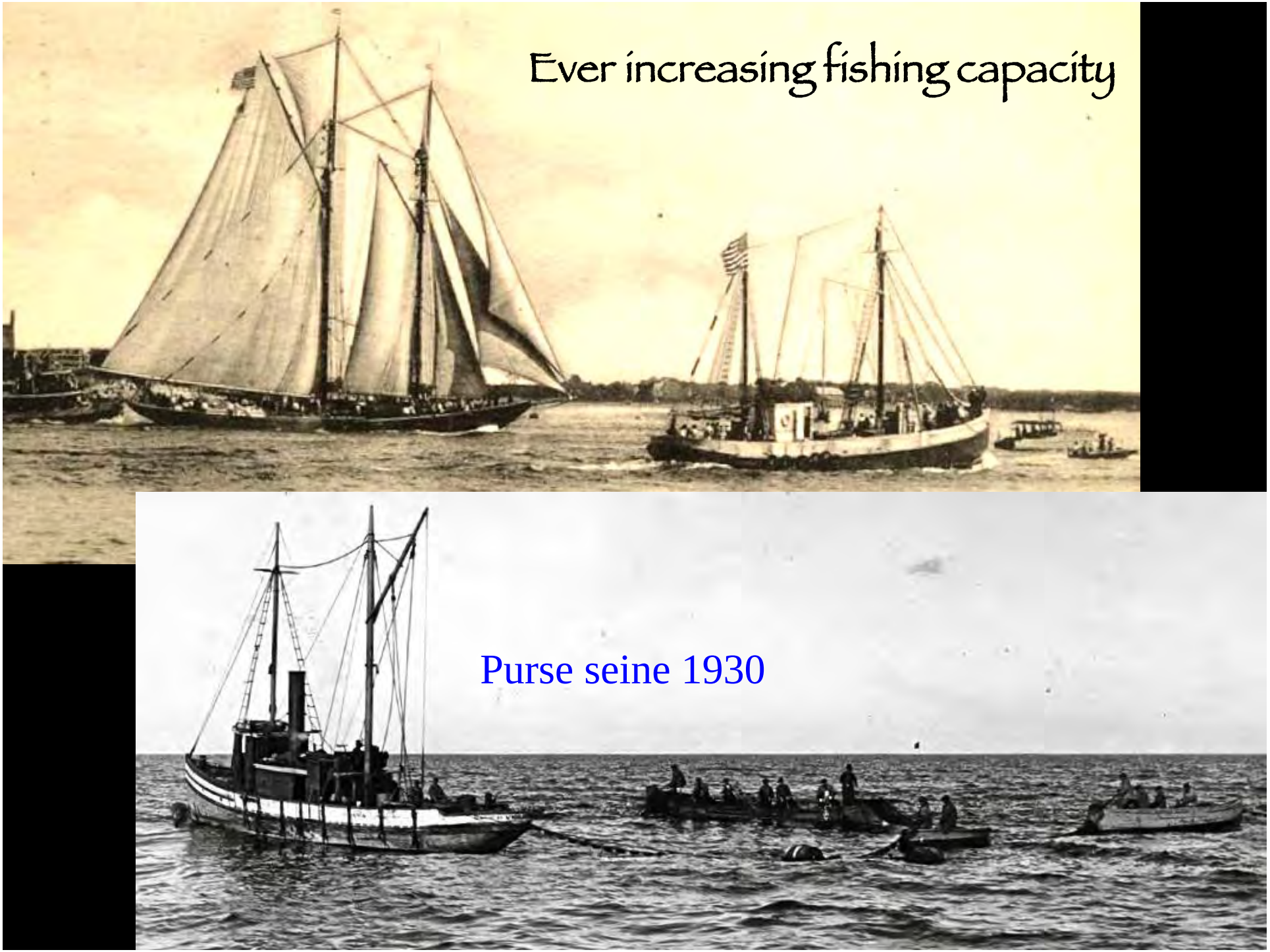
Large cod and haddock everywhere!


Bango
River
Estuary
Belfast
Upper By
Mid-Bay
Rockland
Lower Bay
Data and analysis from W. Leavenworth & T. Willis
0.8
River
All landings
1800-1900
0.5
Estuary
0.5
Upper Bay
1.2
Mid-Bay
(east and west)
East
West
2.5
Lower Bay
1800
1820
1840
1860
1880
1900

Penobscot Bay fishermen on the Scotian Shelf 1850



Source: Rosenberg et al. 2005.
Front. Ecol. Environ. 3:84–90

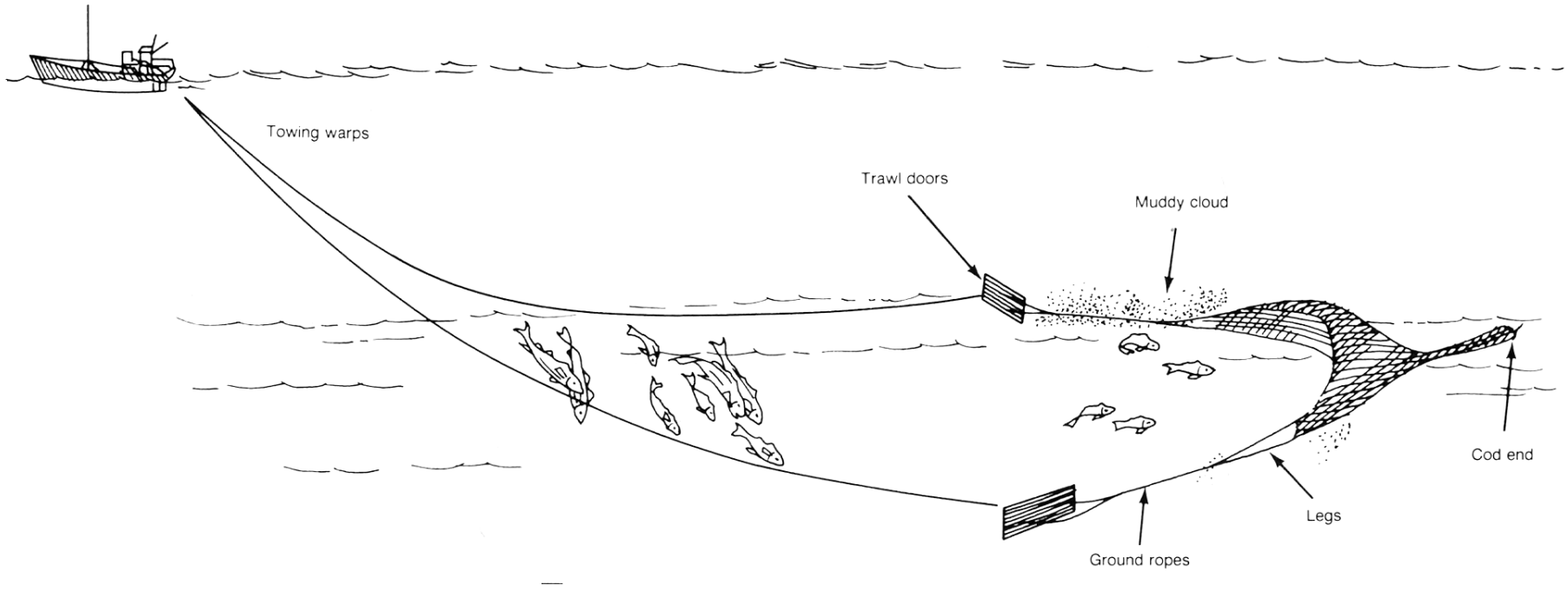

Ever increasing fishing capacity
Purse seine 1930

Technology since 1930s:

to target spawning aggregations

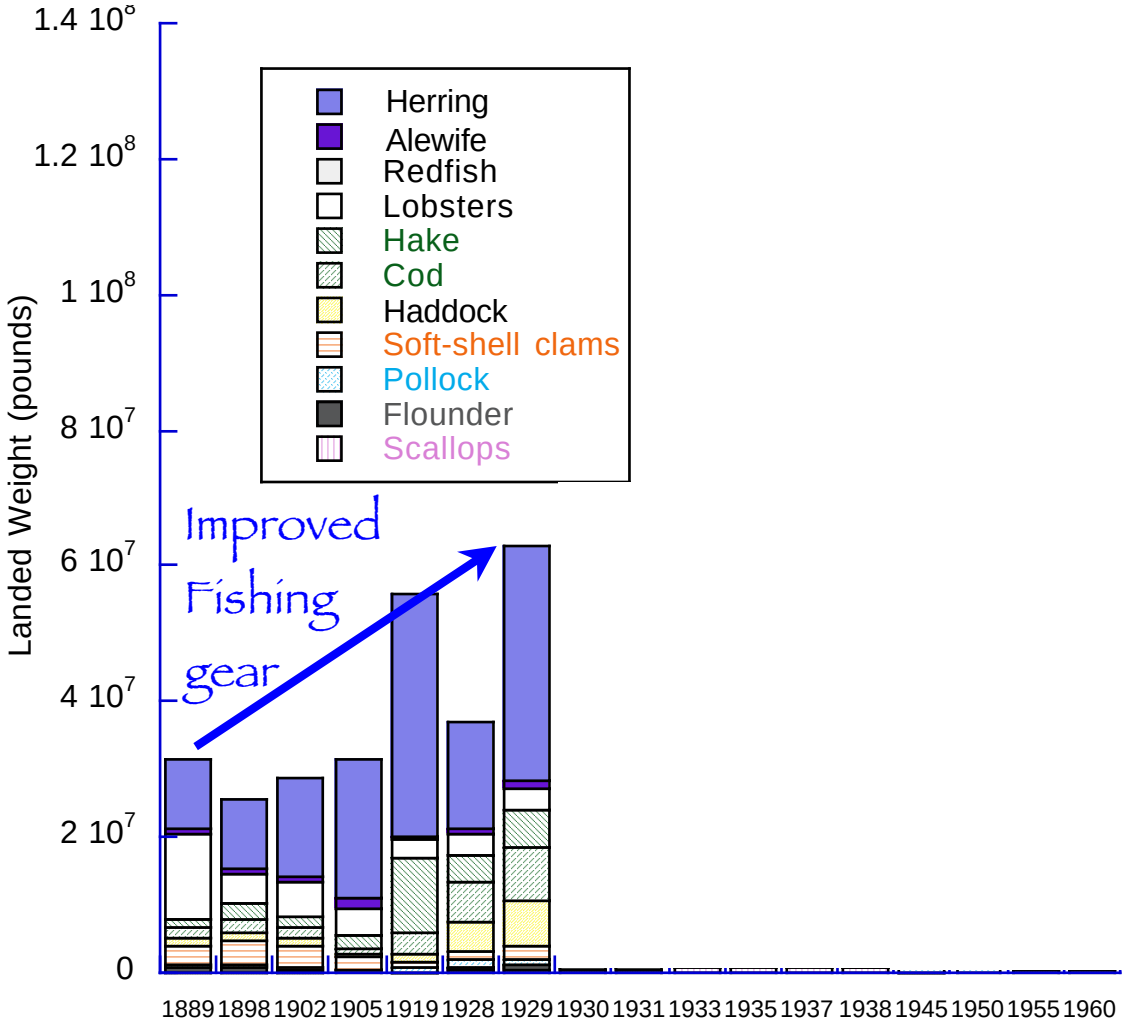
to refrigerate ‘spawn’ cod

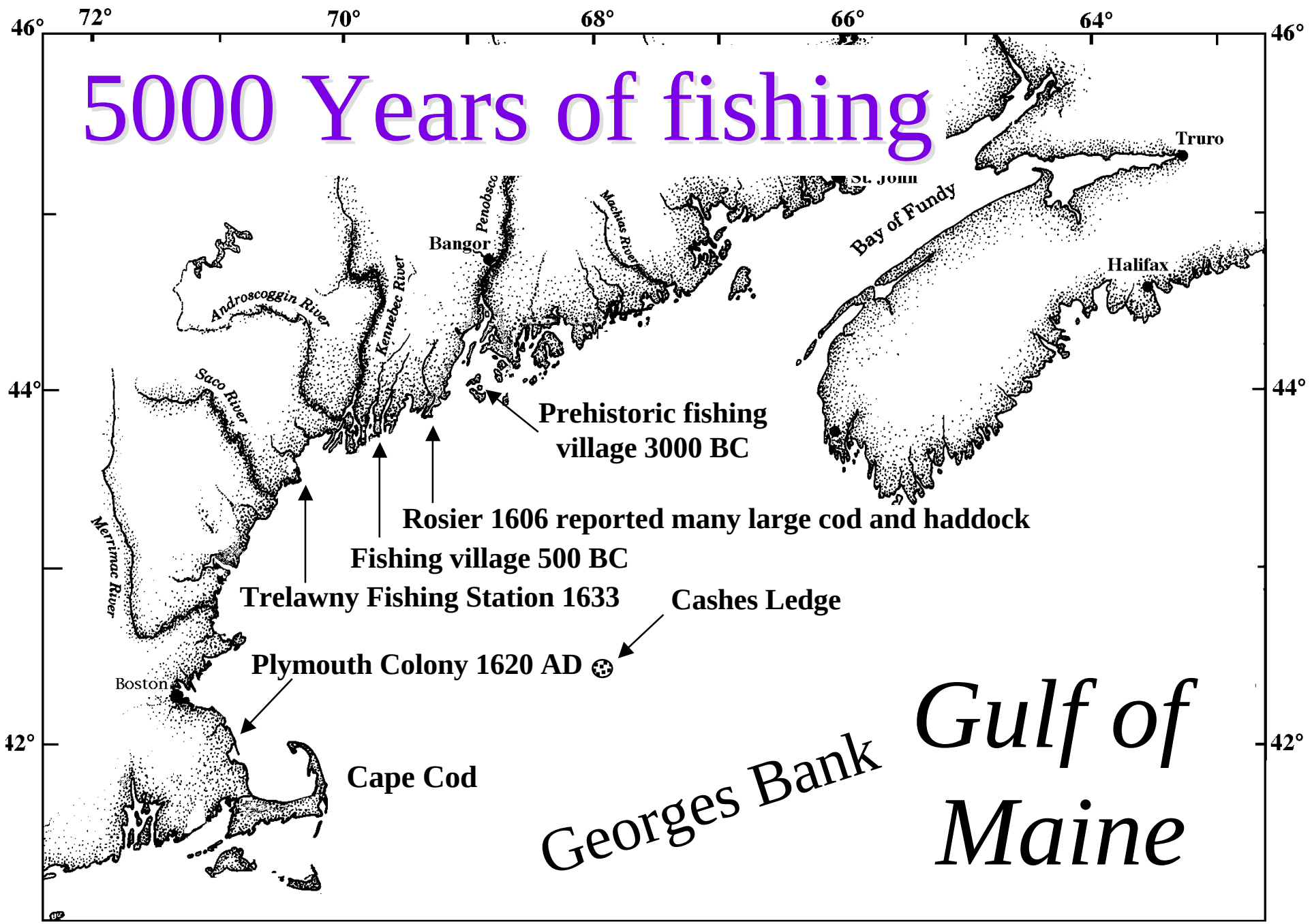
improved transportation of seafood



Bigger boats and better gear had an impact.

All landings in Penobscot Bay 1889 - 1960



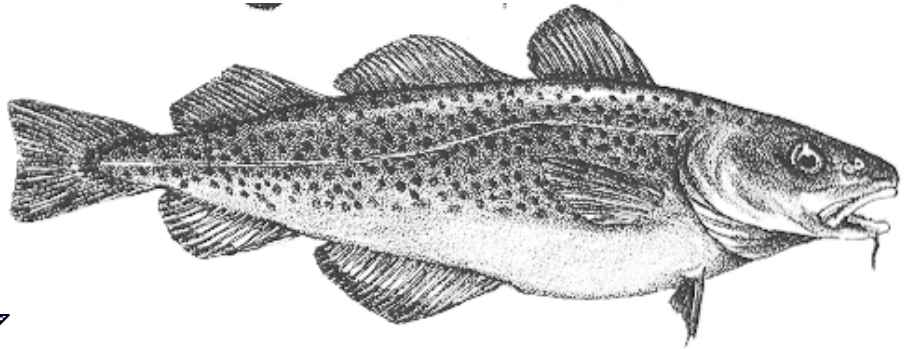


Steneck & Carlton 2001

Trophic cascade .....

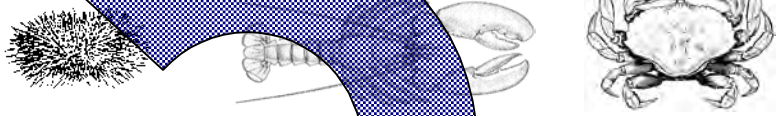
Apex Predators

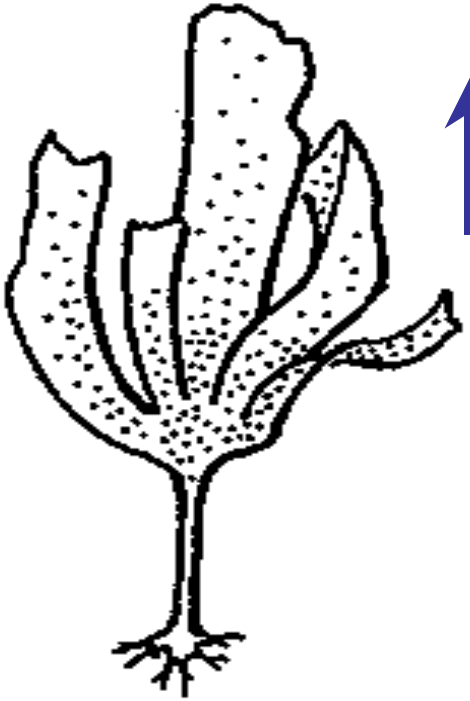
Carnivores



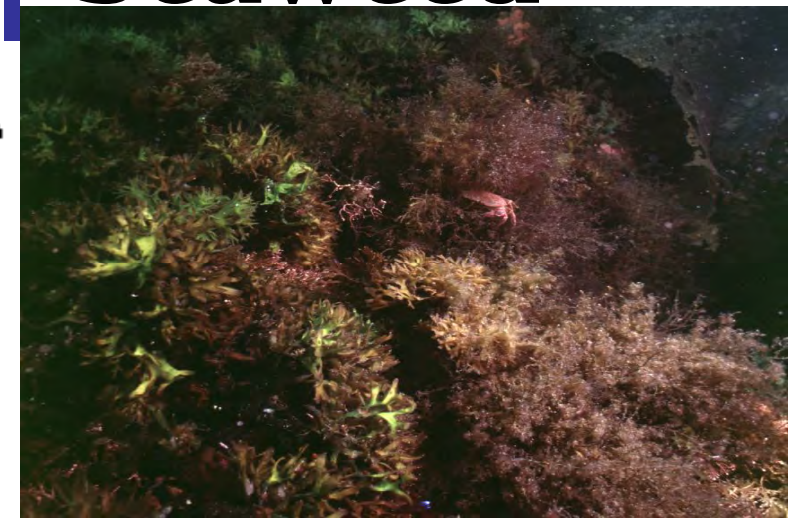
Herbivore

Prey





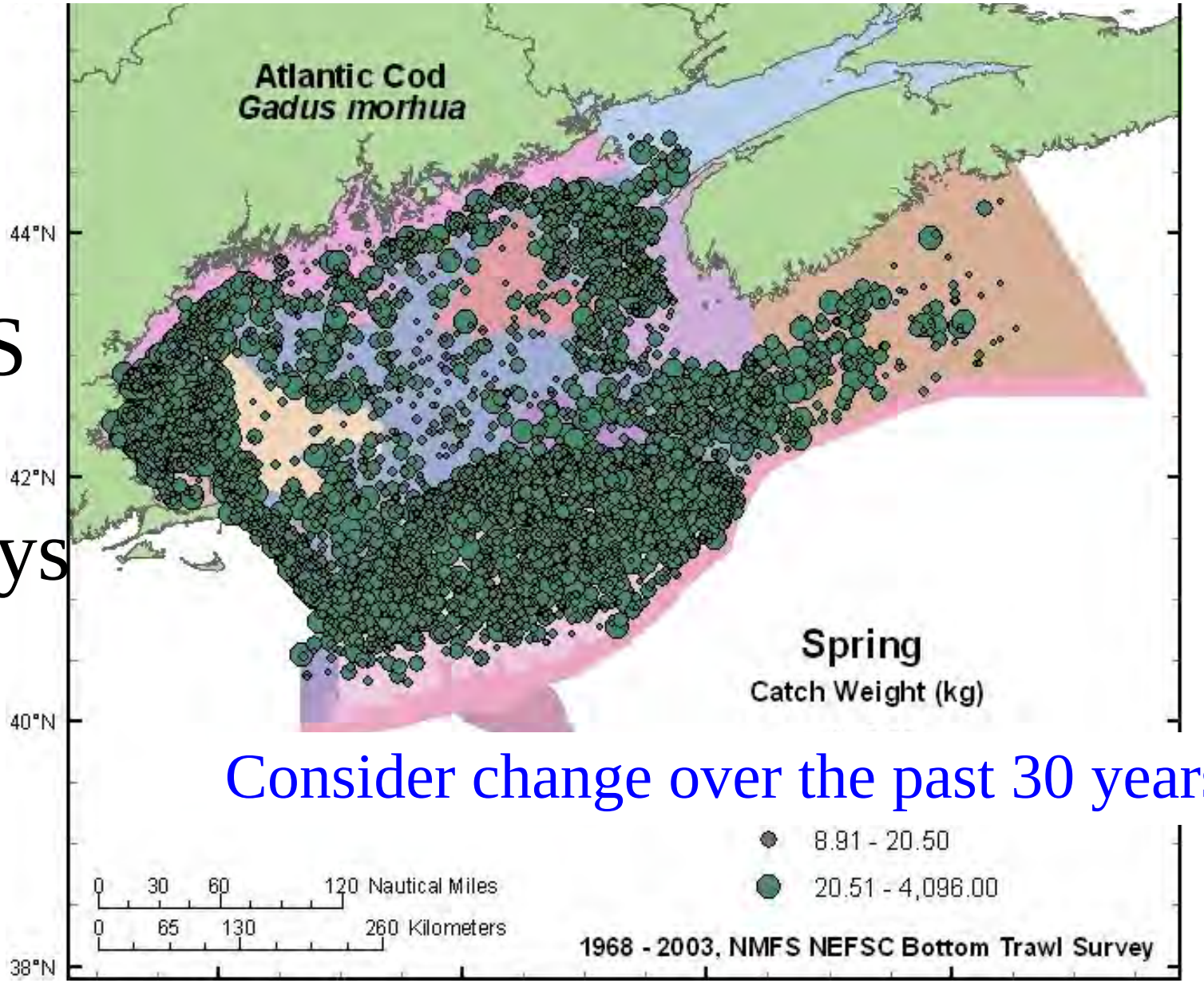
Seaweed



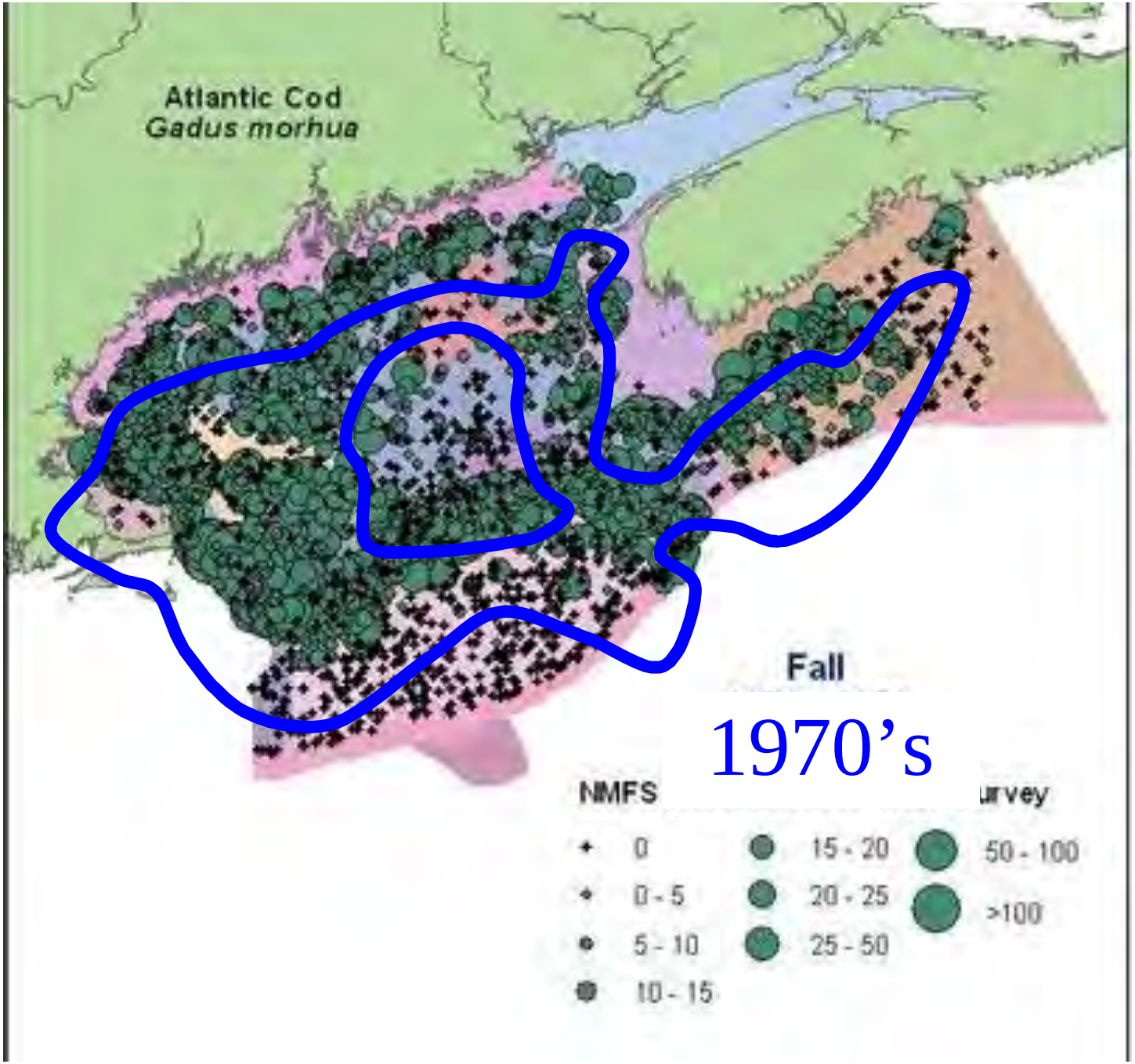
The Abundance of Cod 1968 - 2003

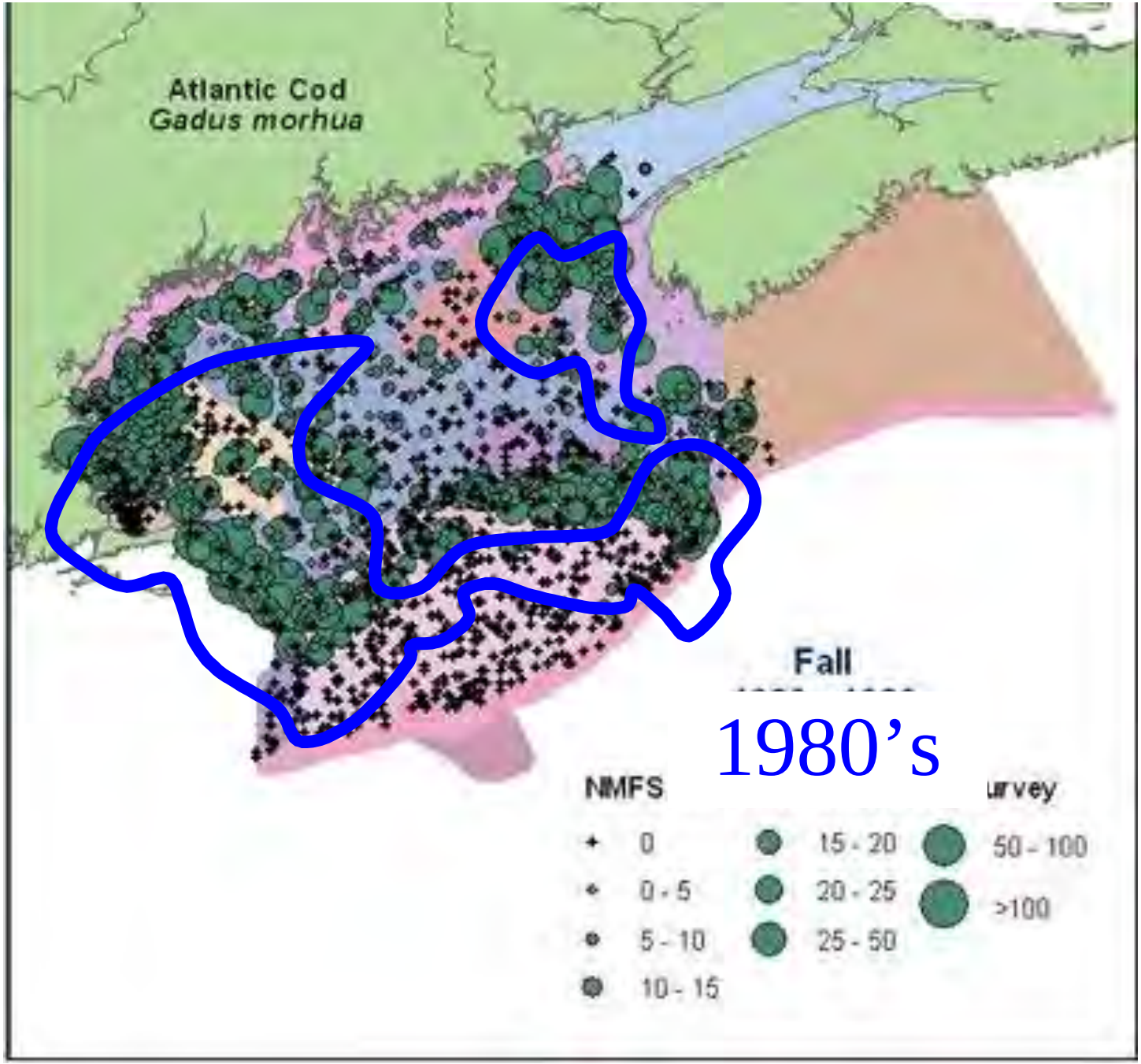
Some mid-coast cod stocks persisted into the 1970s

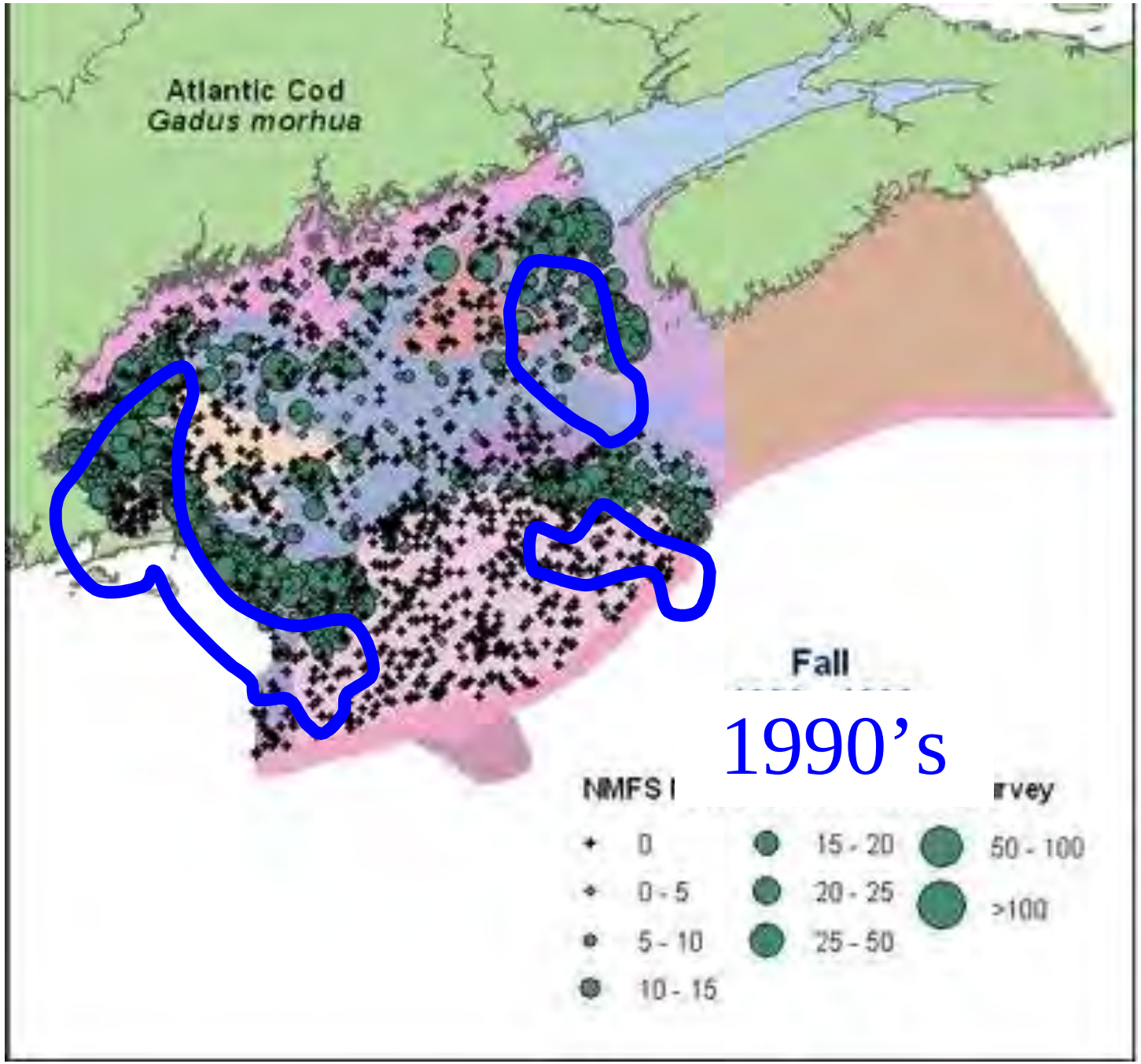
NMFS Trawl Surveys



Consider change over the past 30 years….


Atlantic Cod
Gadus morhua
Fall
1970's
NMFS
urvey
0
0 - 5
5 - 10
10 - 15
15 - 20
20 - 25
25 - 50
50 - 100
>100


Atlantic Cod
Gadus morhua
Fall
1980's
NMFS
0
0 - 5
5 - 10
10 - 15
15 - 20
20 - 25
25 - 50
50 - 100
>100


Atlantic Cod
Gadus morhua
Fall
1990's
NMFS I
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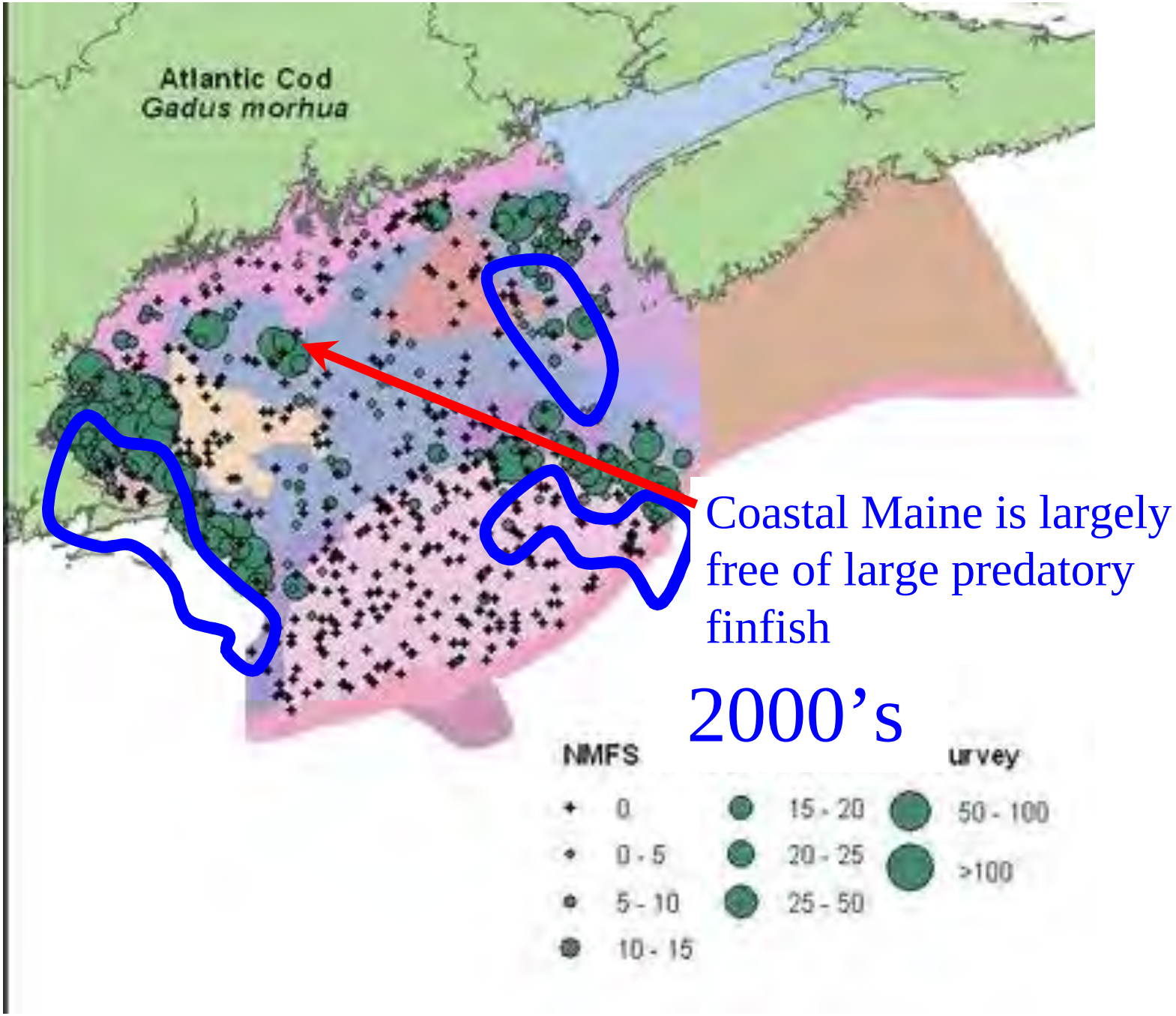
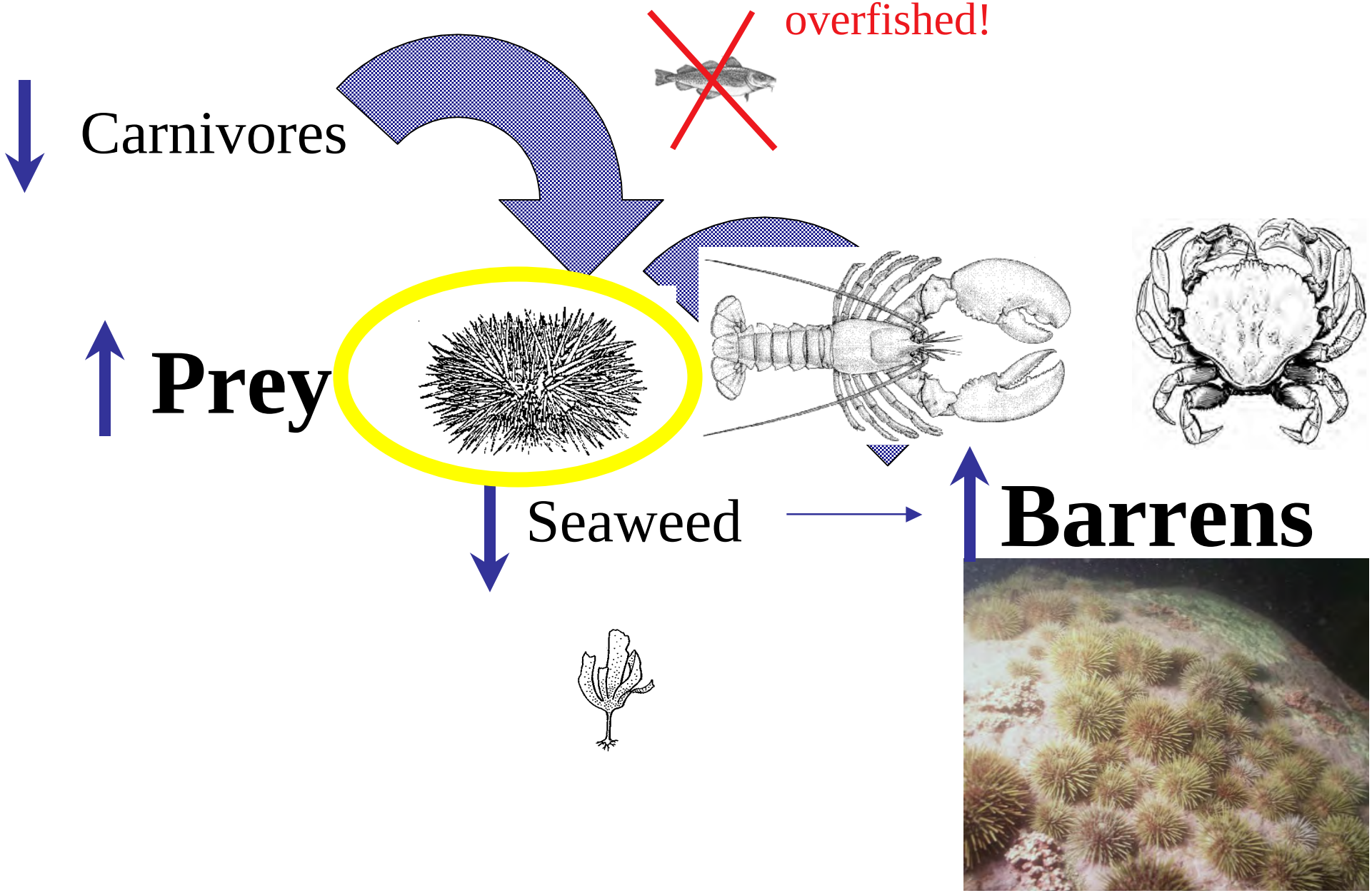
20 - 25
25 - 50
50 - 100
>100

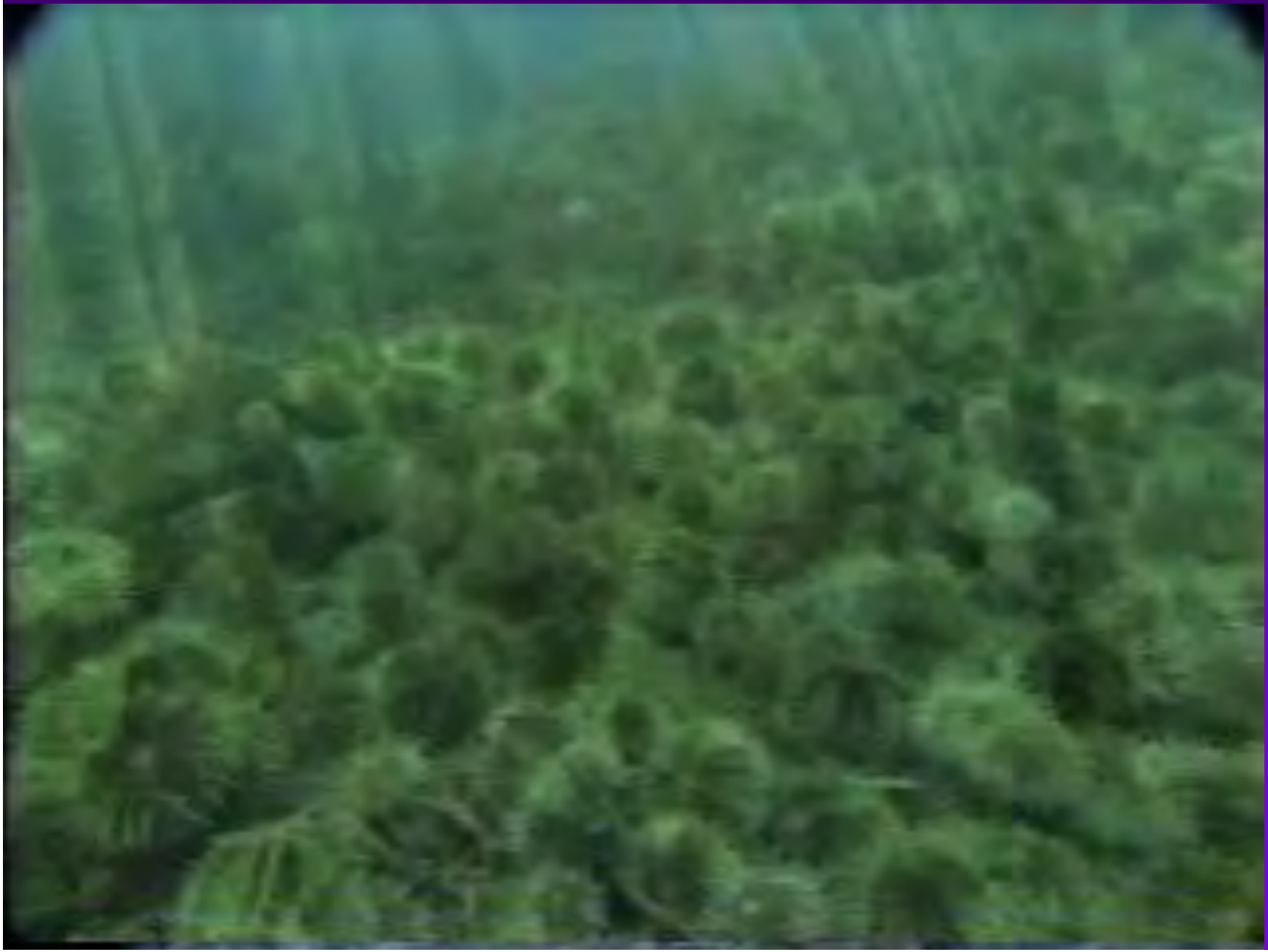

Atlantic Cod
Gadus morhua
Coastal Maine is largely free of large predatory finfish
2000's
NMFS
urvey
0
0 - 5
5 - 10
10 - 15
15 - 20
20 - 25
25 - 50
50 - 100
>100

Trophic level dysfunction .....




Sea urchin domination…
Coastal Maine 1970s

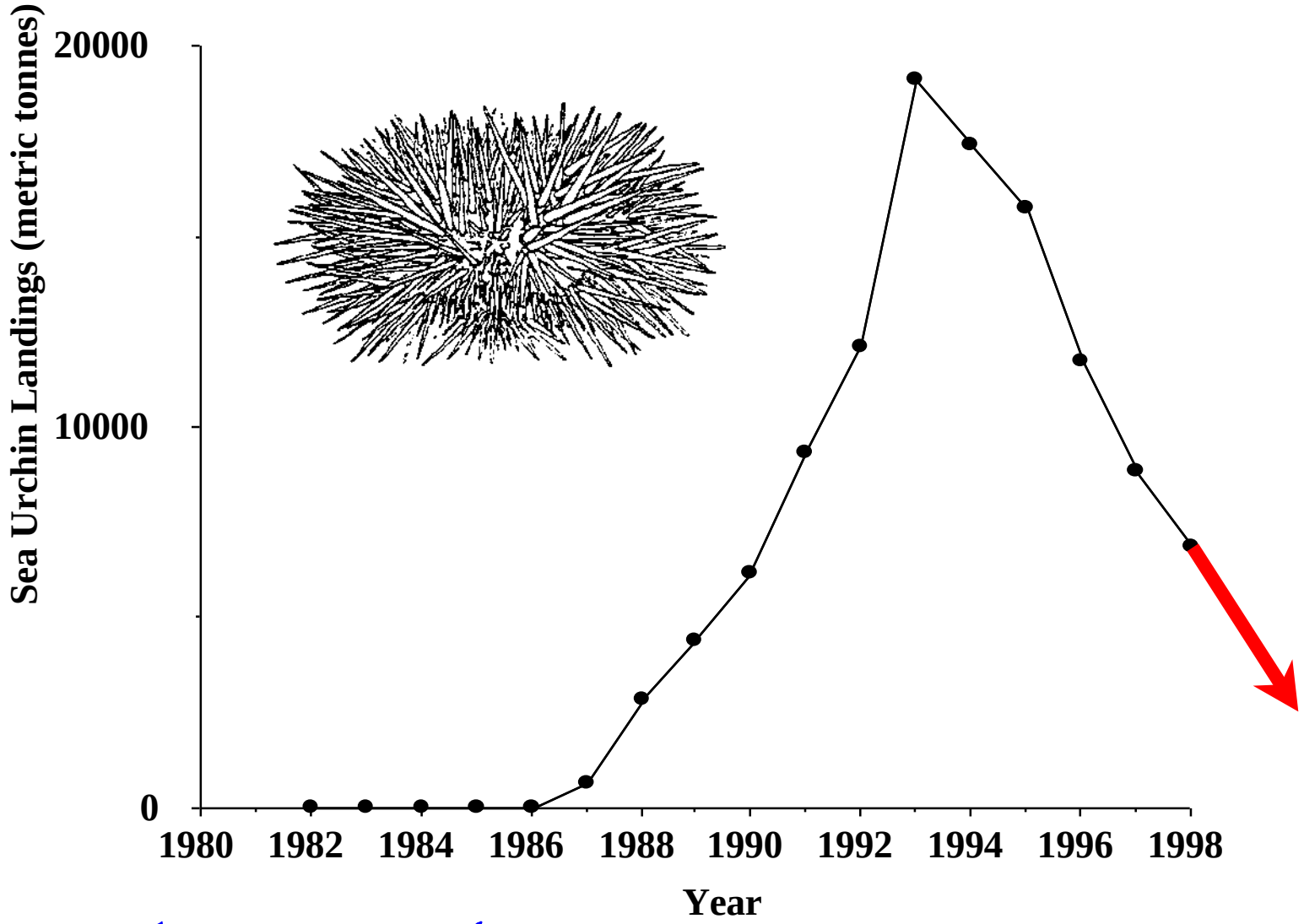
Carpets of sea urchins



Maine's Sea Urchin Fishery
Began 1987

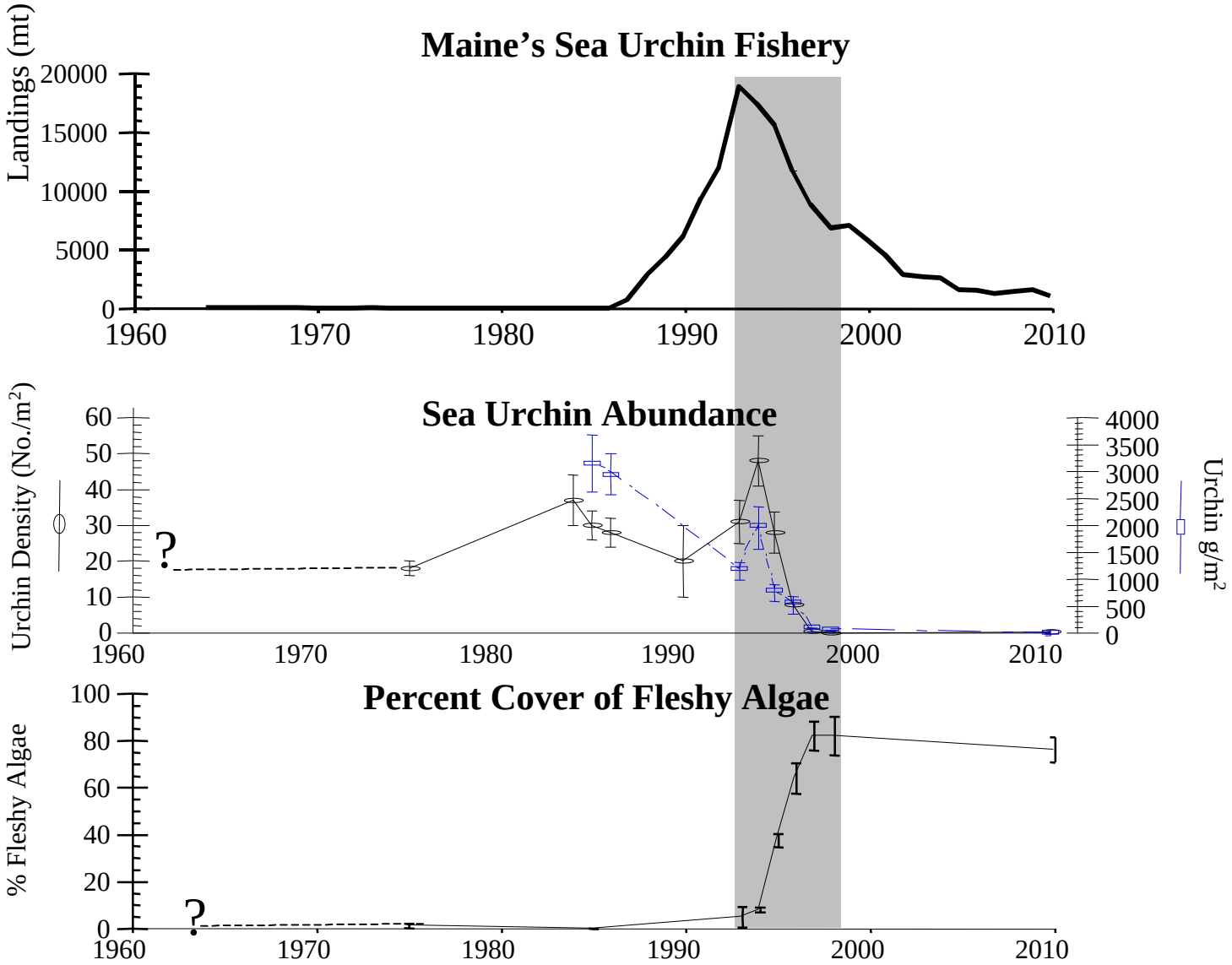
By 1993
Second in Value
to Lobster Fishery

Sea Urchin Landings in Maine



Is this "pulse" perturbation a tipping point "trigger"?

Urchin/Coralline vs. Algal Dominated Stable States



Rapid Kelp forest "flip": Pemaquid Point Maine 1993 - 1995

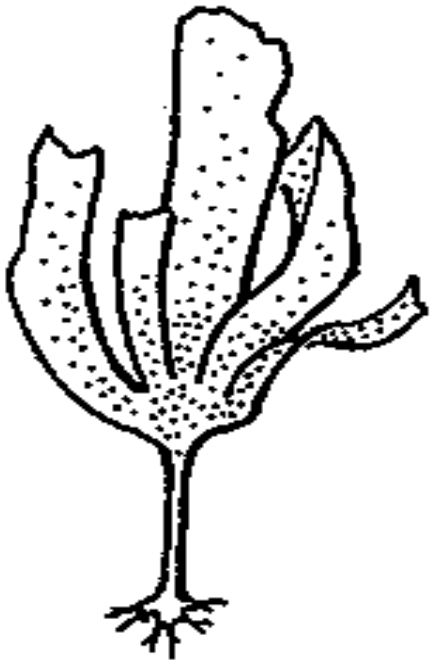
Trophic level dysfunction continues

overfished!

↓Carnivores

overfished!

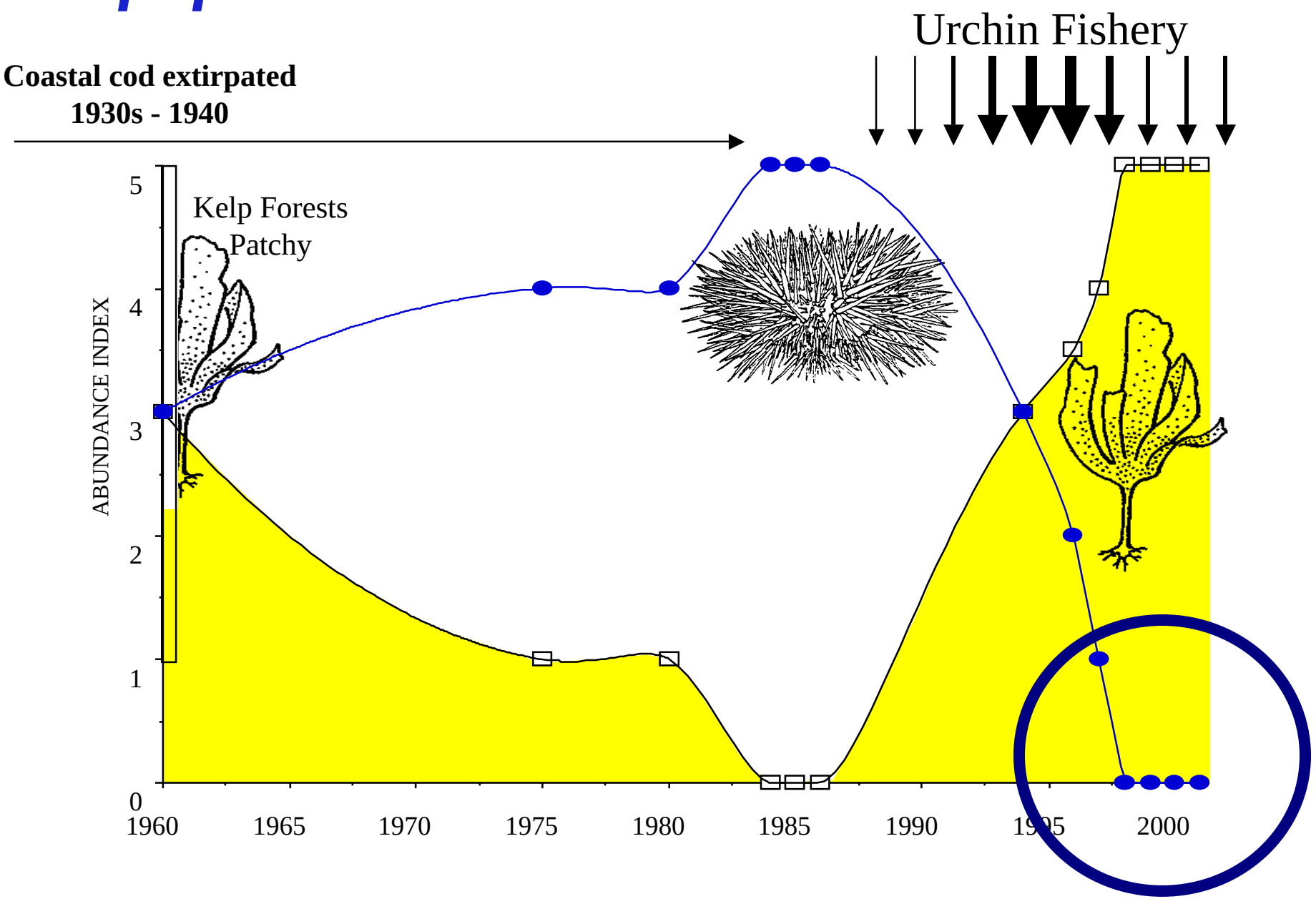
↓Herbivores



↑**Macroalgae** → ↓Corallines

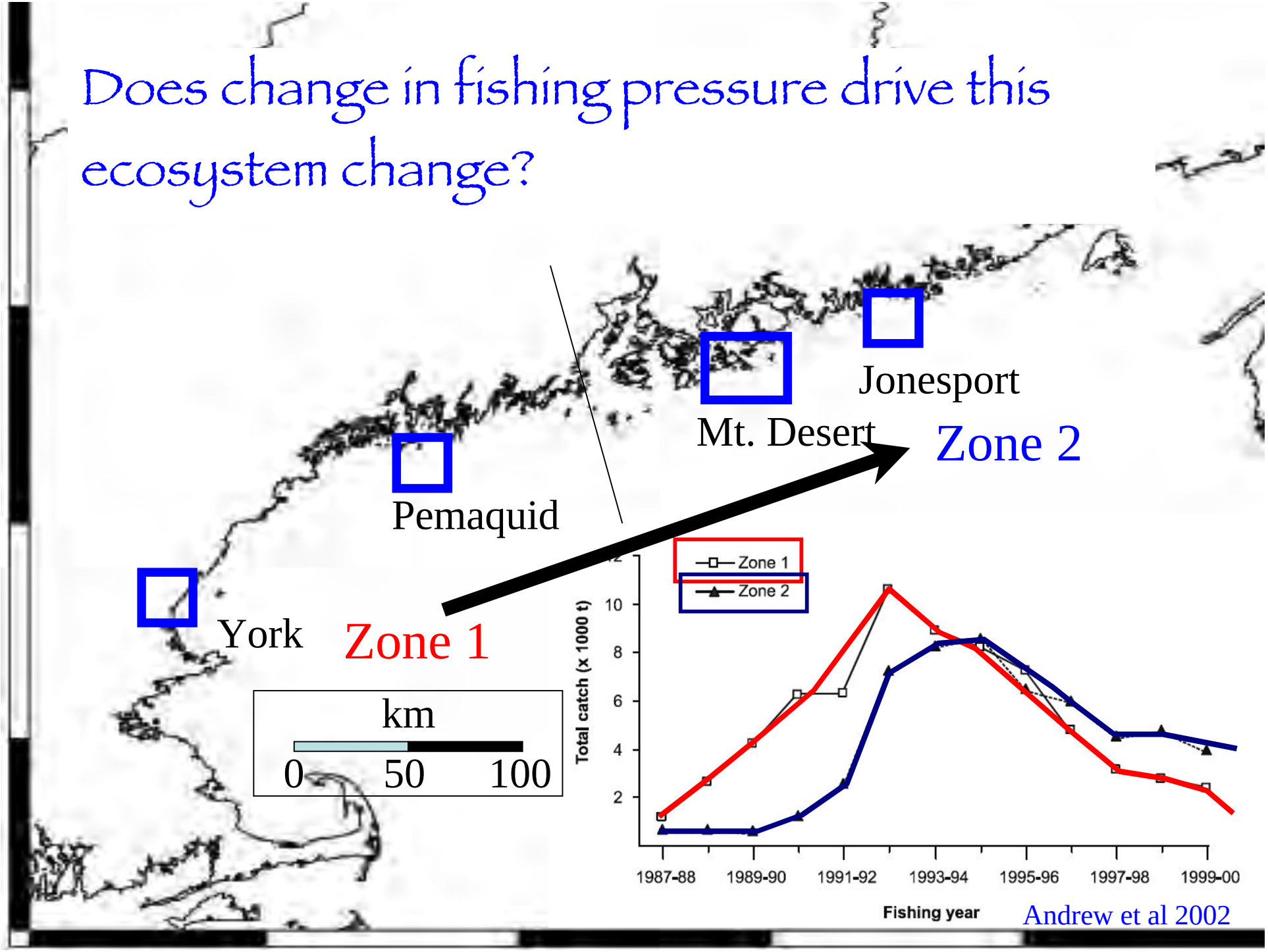
Cross-linkage

Gulf of Maine



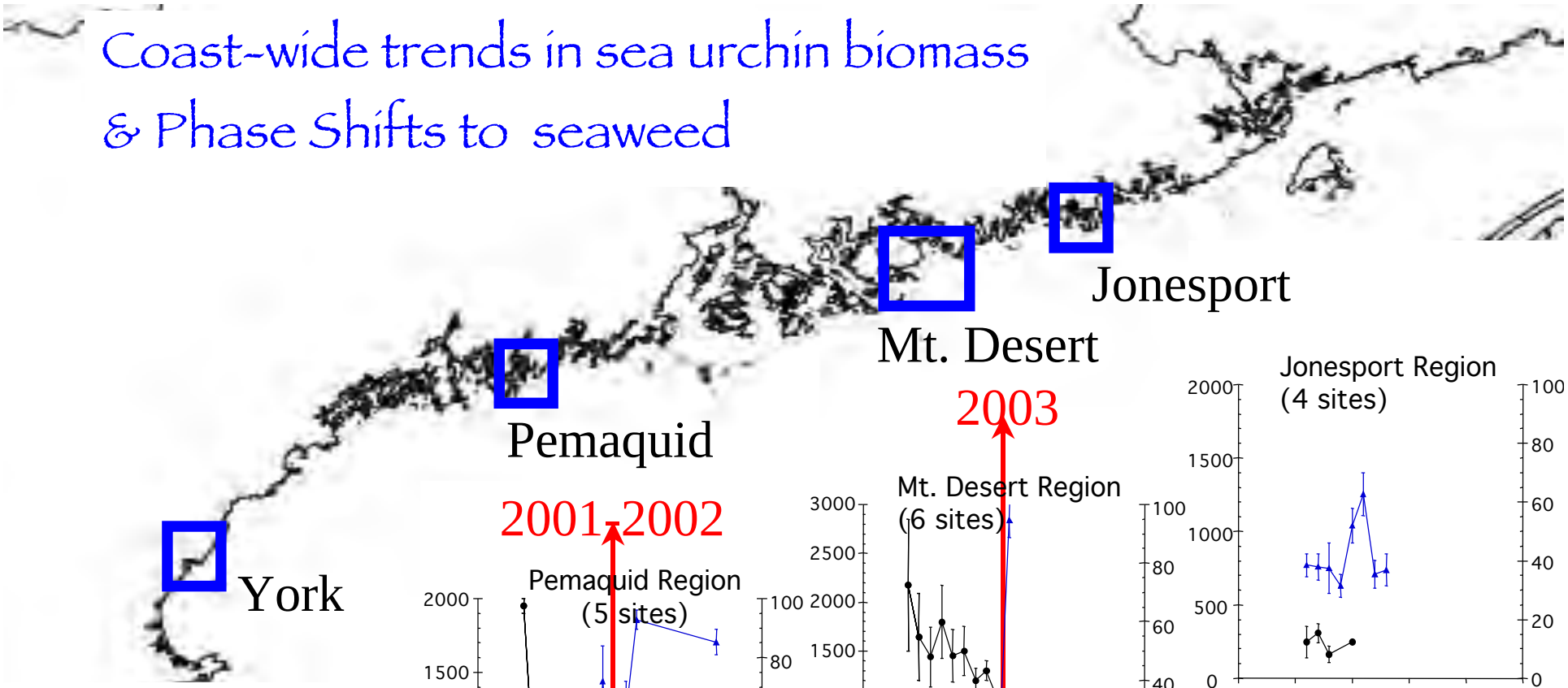
Steneck et al 2002

Does change in fishing pressure drive this ecosystem change?

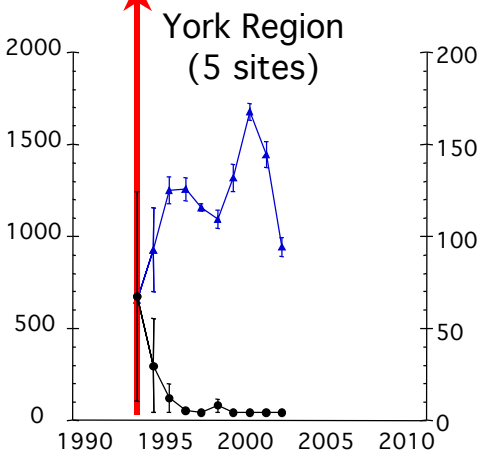


Andrew et al 2002

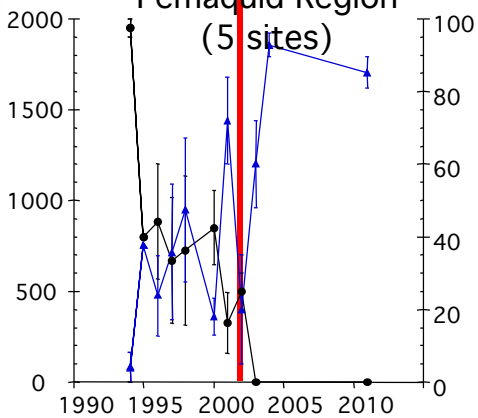
Coast-wide trends in sea urchin biomass & Phase Shifts to seaweed



1994

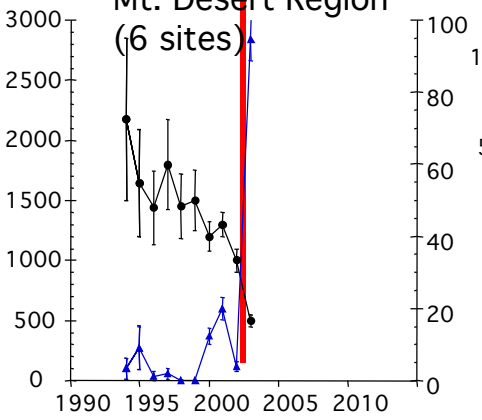


2001, 2002



Urchin Biomass (g/m^2) ▲ % algal cover

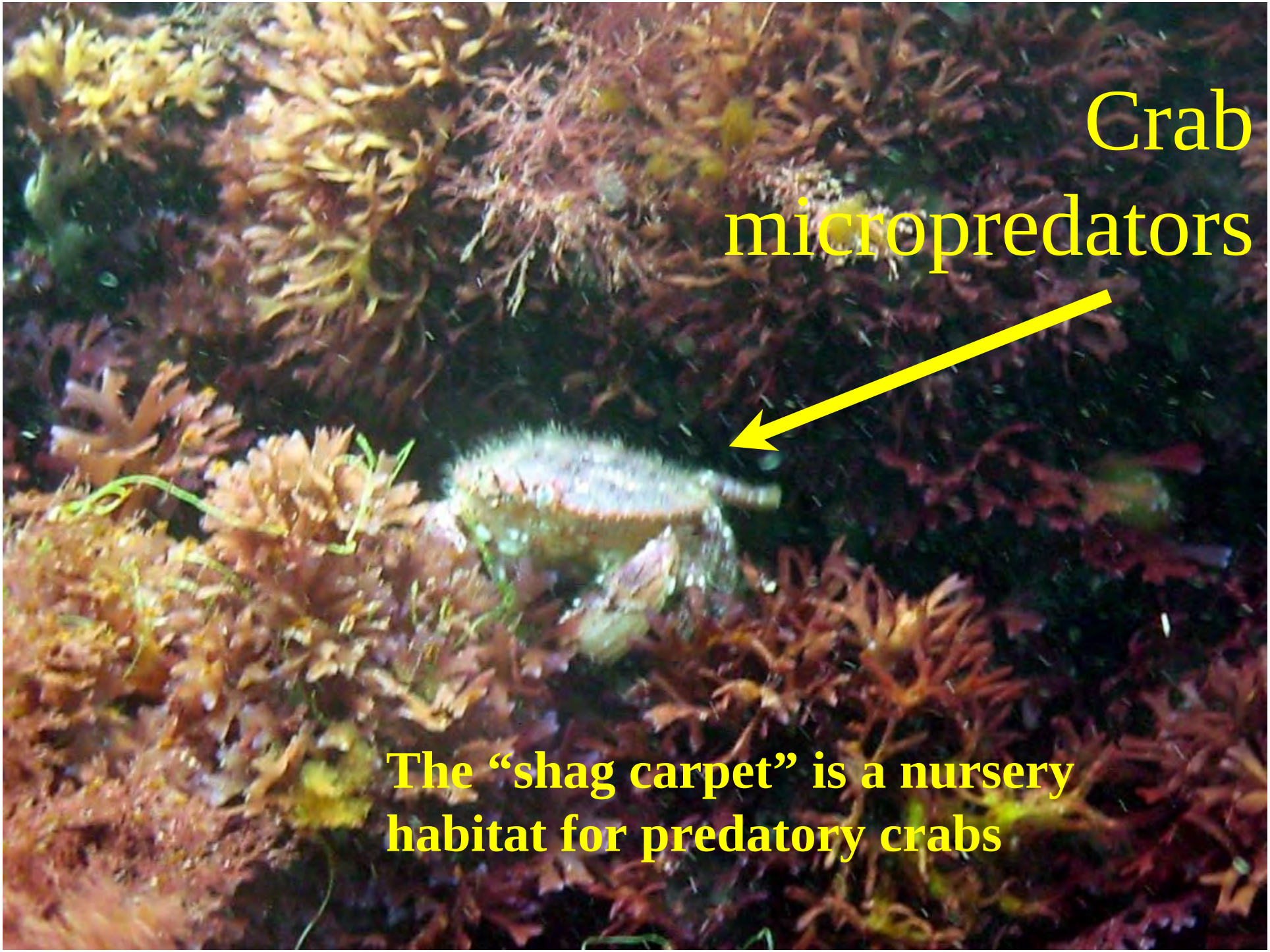
2003



Phase Shifts Widespread

Why no recovery?

Steneck et al 2013


Crab
micropredators
The “shag carpet” is a nursery
habitat for predatory crabs

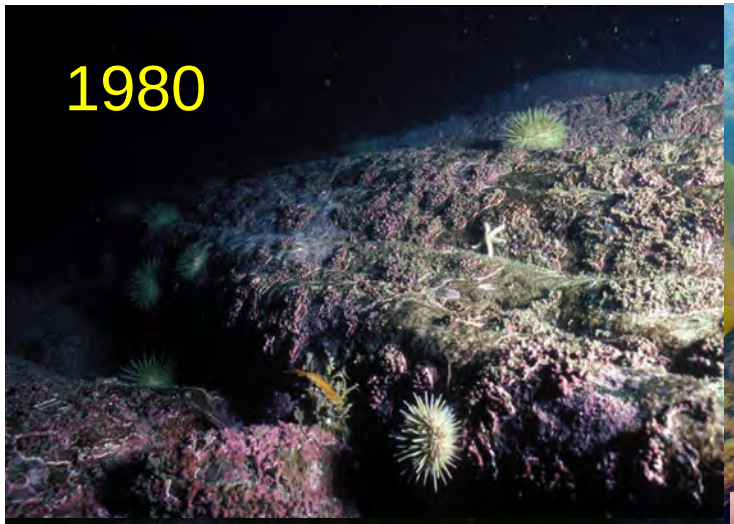
What happens to small crustaceans on barren substrates?

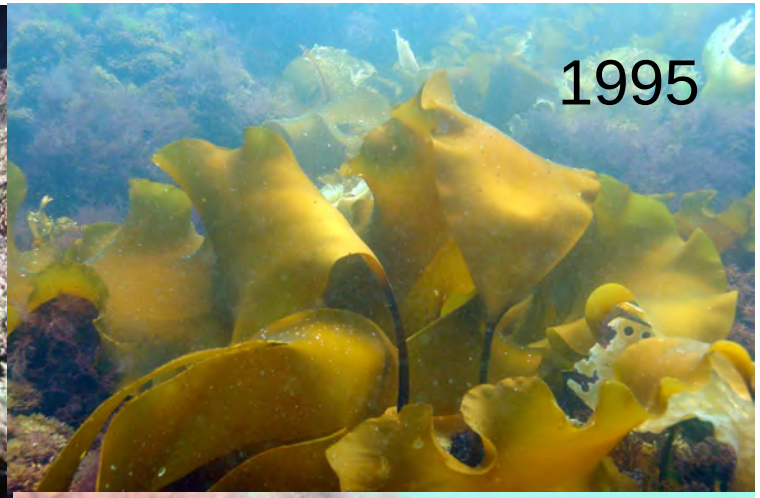
Before and after tipping point

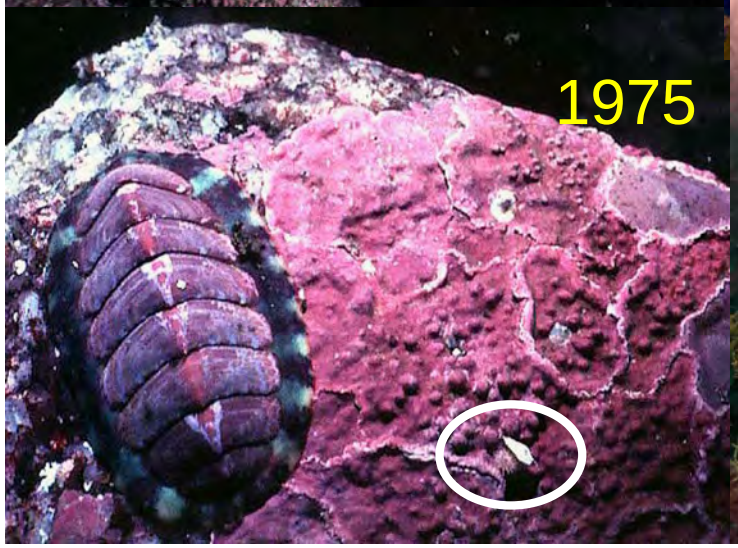
(all photos from same area at Pemaquid Point)

1975–1990

1995–2011

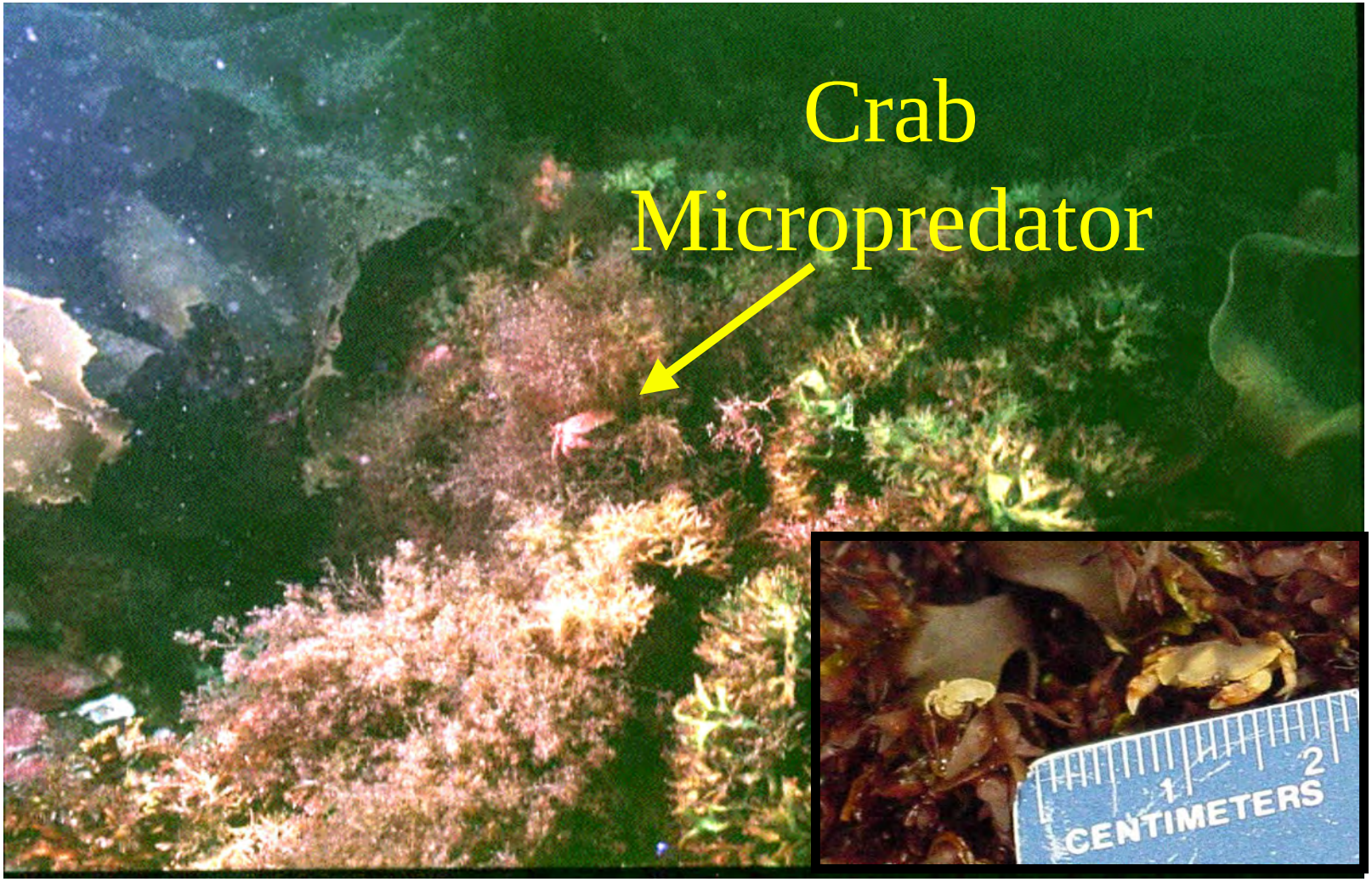






Hostile for settling crabs
Good for settling urchins

Good for settling crabs
Hostile for settling urchins



August 2000 Maine

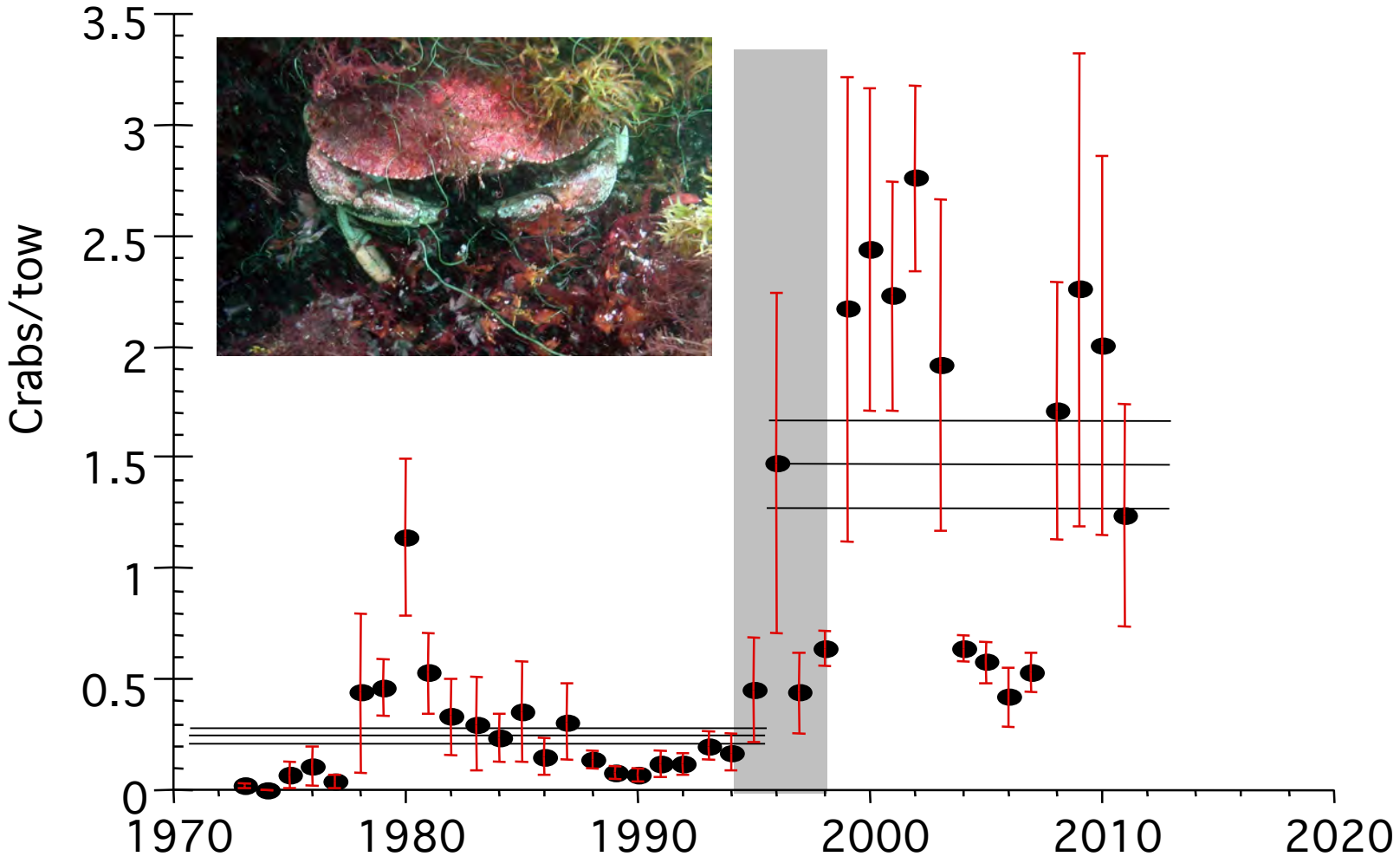
Phase-shift increased nursery habitat for crabs with micropredatory crabs exceeding 200 / m^2

Steneck et al 2013


So what?
Is this demographically important for crabs?
Juvenile *Cancer* spp
Pemaquid
2013

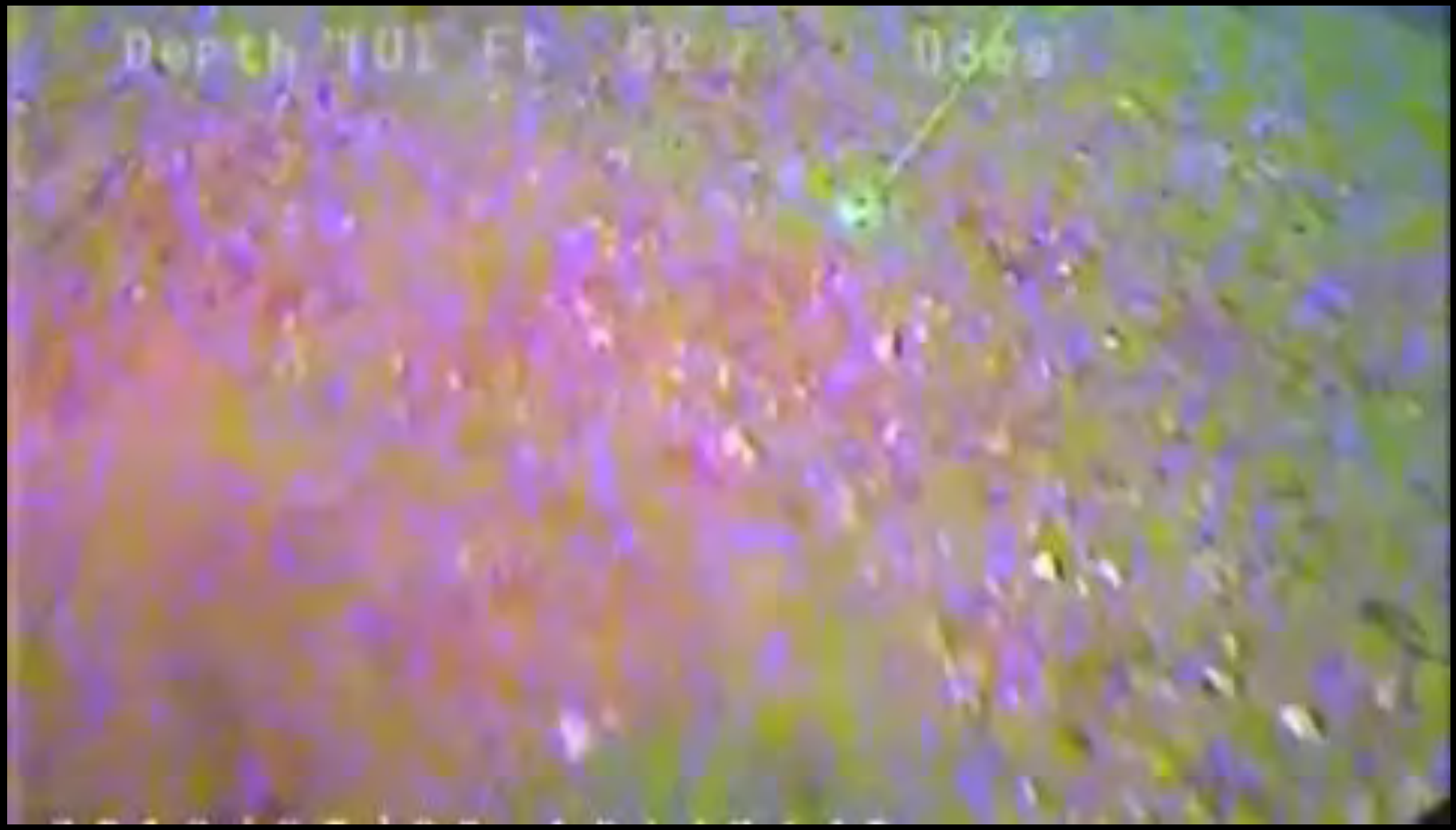
Cancer borealis coastal Gulf of Maine

(National Marine Fisheries Service Trawl data 1975-2010)



Steneck *et al.* 2013

July 2012 ROV survey of a rocky ledge
off Isle au Haute, Maine



9 Jonah crabs and 1 lobster in 23 seconds!

BUSINESS Posted June 21 2015 at 11:32 am lated at 6:08 AM INCREASE FONT SIZE

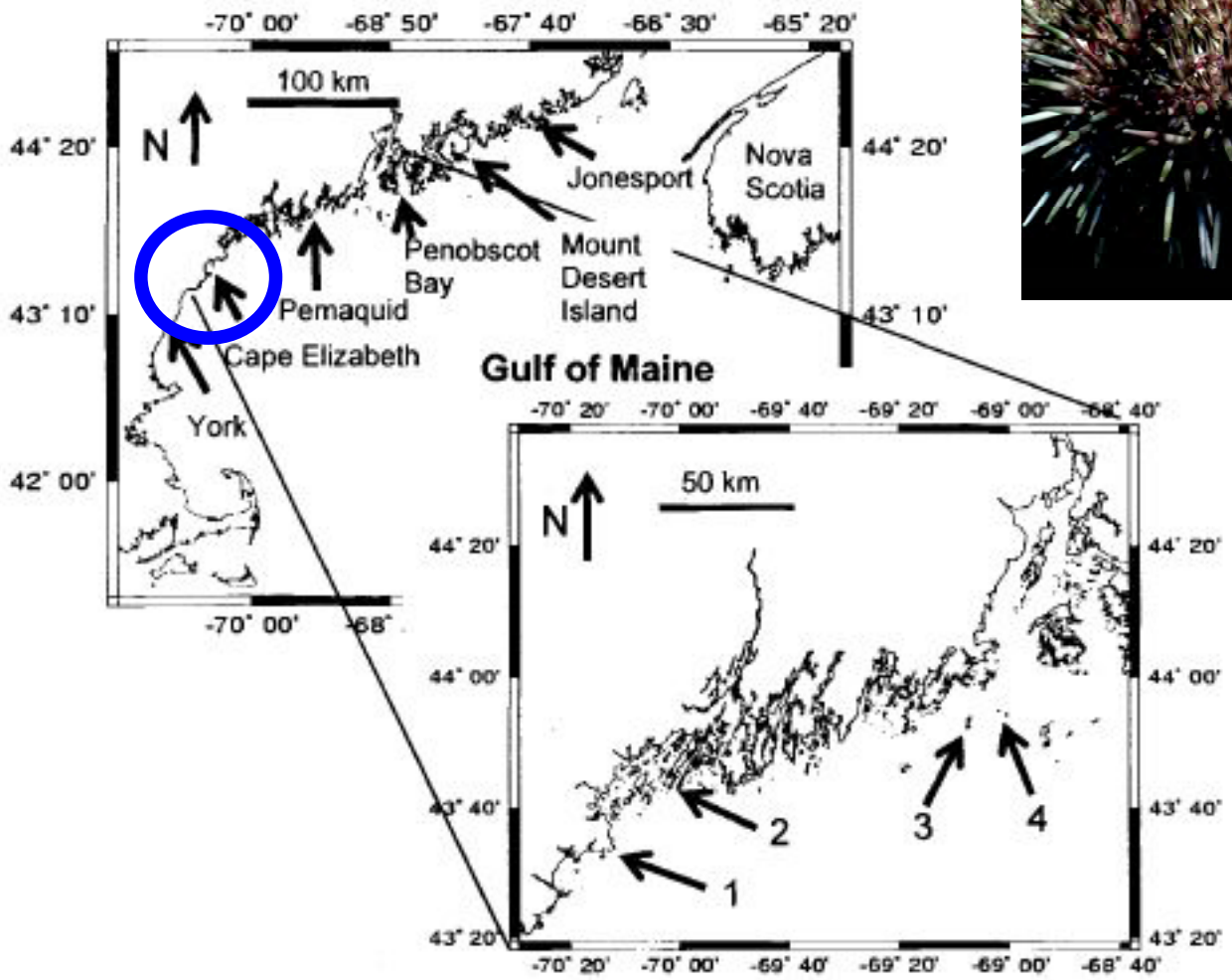
Jonah crabs booming in value as managers seek fishery plan

They're popular with diners and cooks for their meaty claws and as a low-cost source of processed crabmeat.

BY **PATRICK WHITTLE** THE ASSOCIATED PRESS

New England lobstermen are catching and selling more of a long-overlooked crab species, leading regulators to try to craft a management plan for the fishery before it becomes overexploited.

Urchin Relocation experiment (to break the phase shift)



Sea urchin collection locations

2000 and 2001

3000 Sea urchins

8-9 Release sites

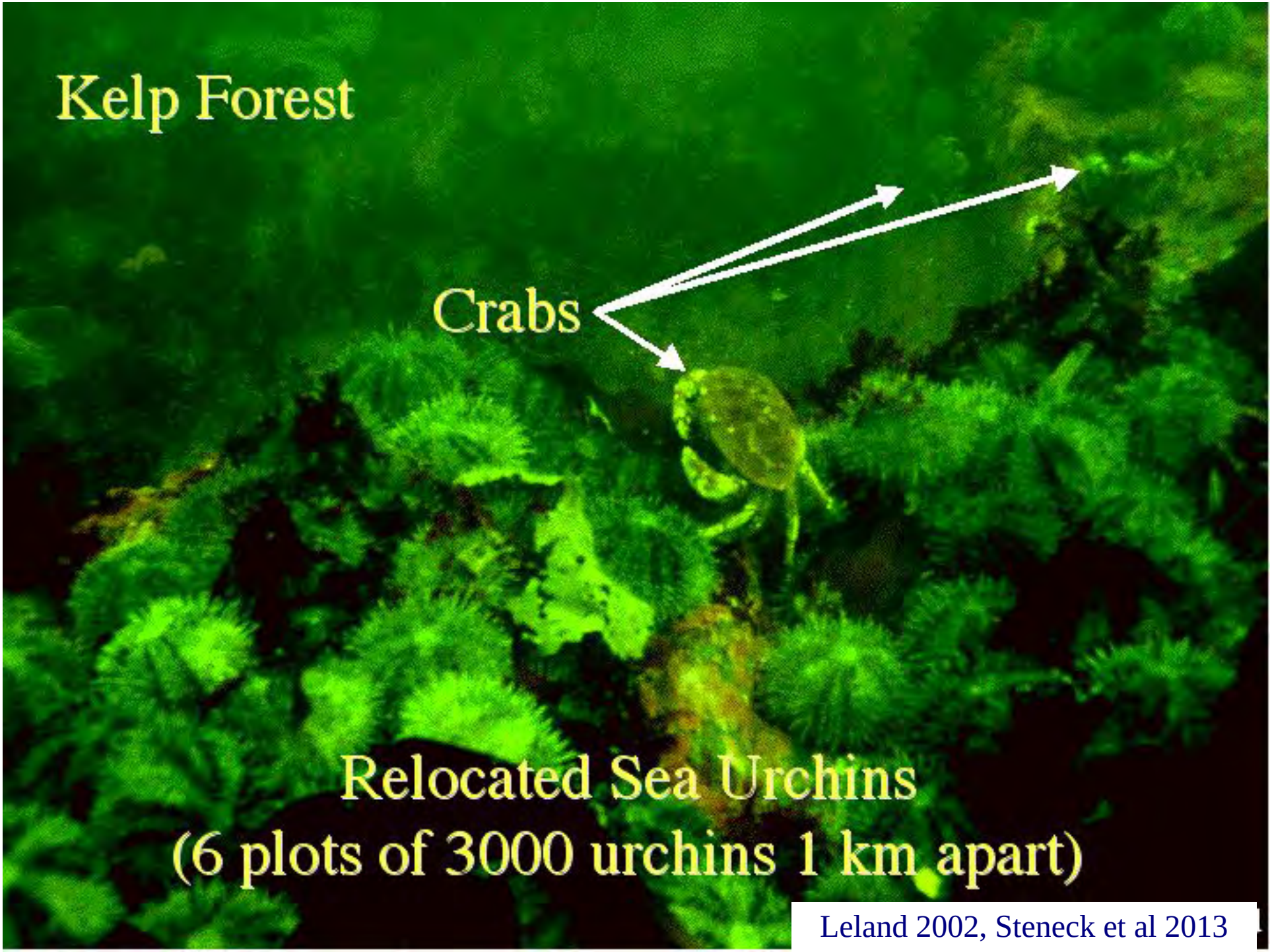
Repeated twice

A total of 51,000

sea urchins

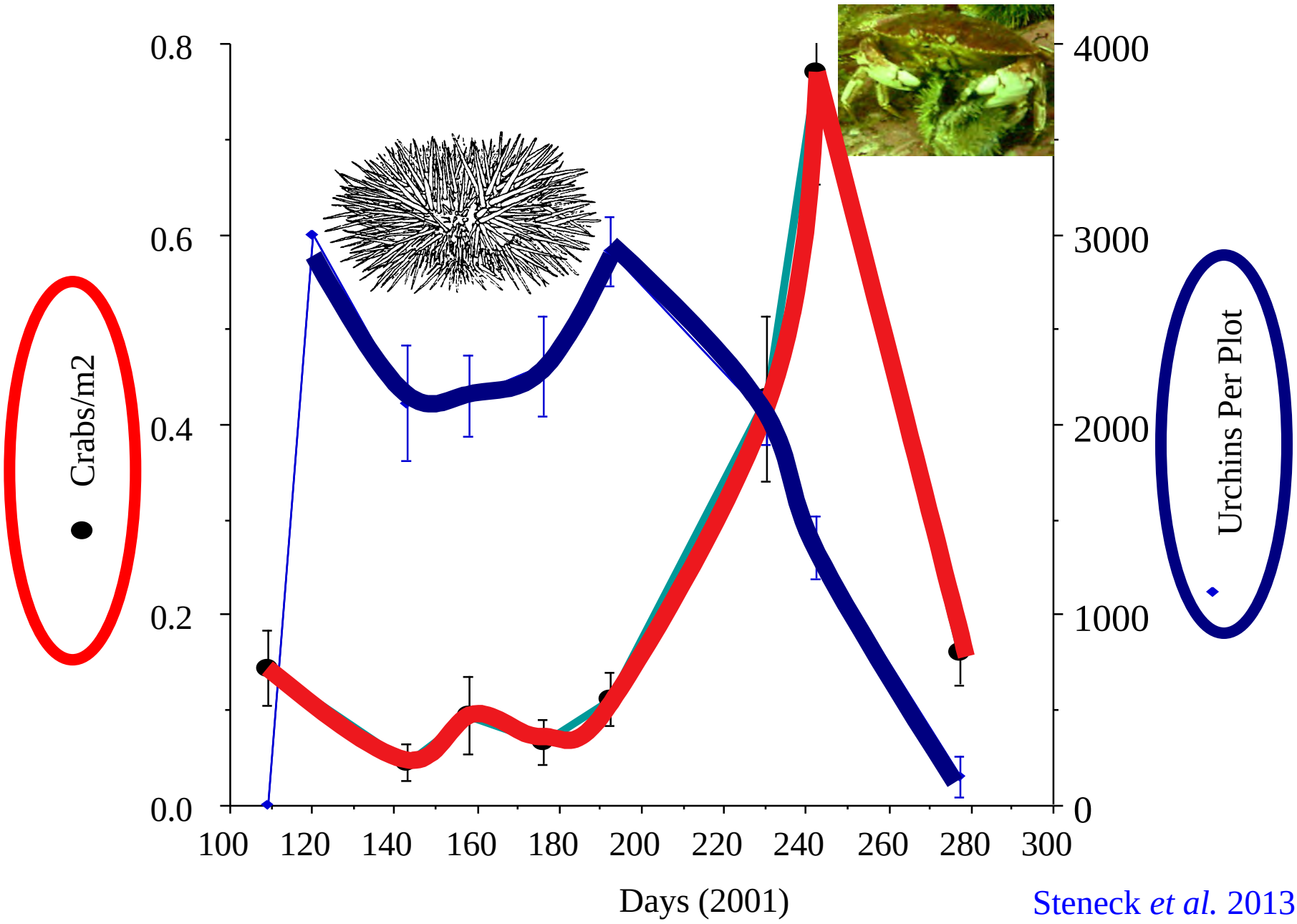
relocated

Steneck et al 2013



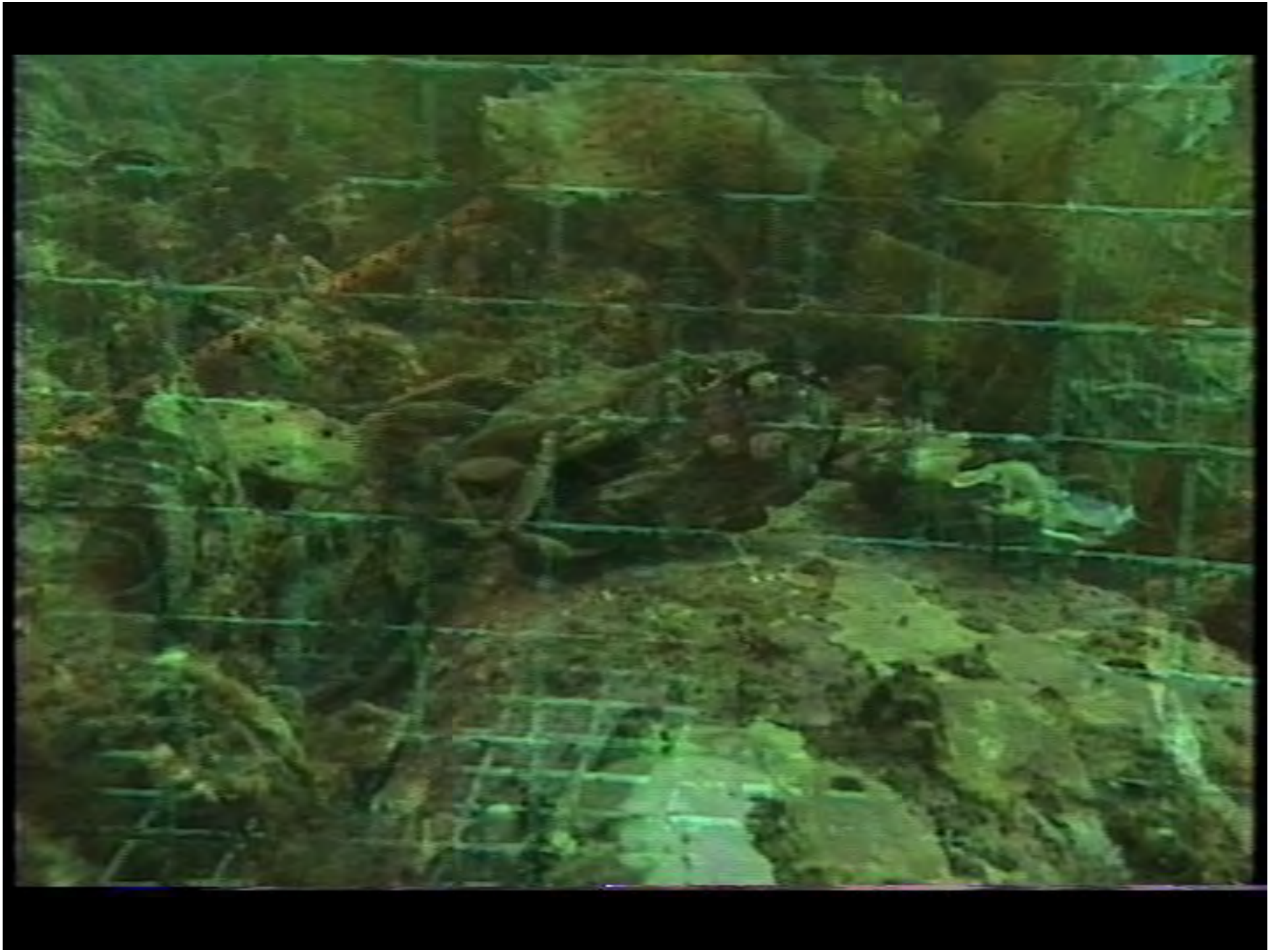
Leland 2002, Steneck et al 2013

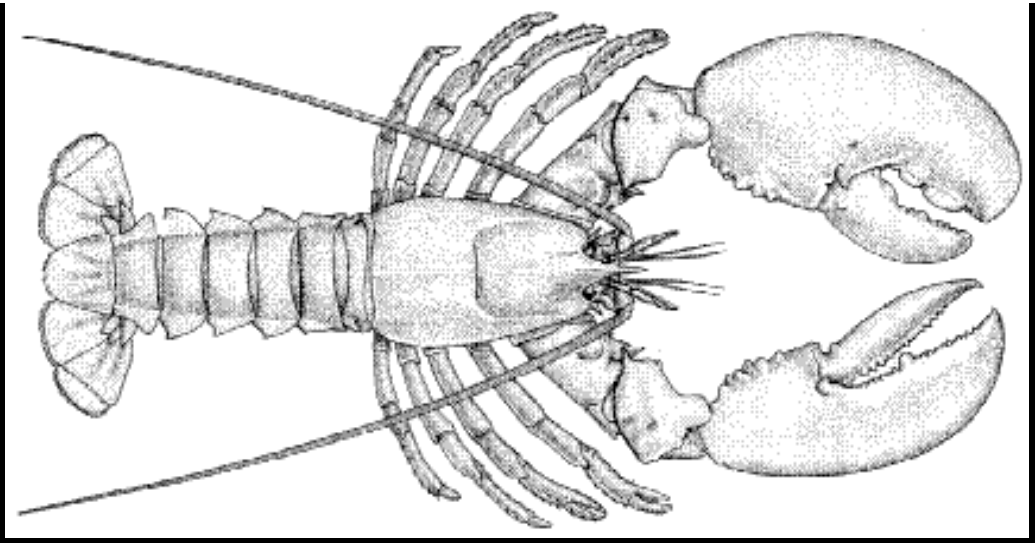
Crabs as the New ‘Apex’ Predator



Steneck *et al.* 2013

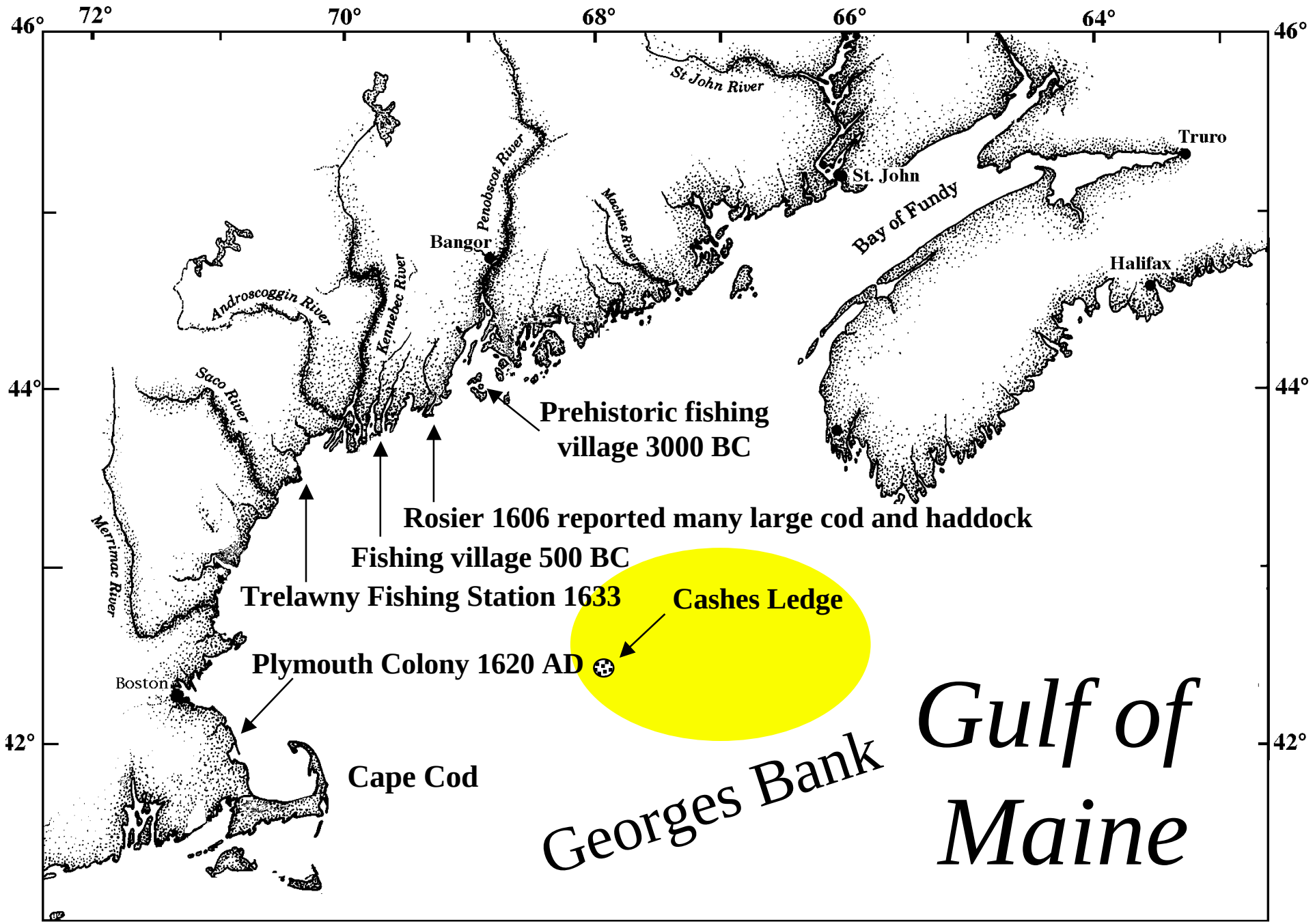

Apex predator regime shift!
"I'll be back"
LD'S LARGEST
STER ROLL $19.95
TRIPLE LOBS





"Next to man with his traps, the codfish is probably the most destructive enemy of the lobster …"

Francis Hobart Herrick 1909
Natural history of the American Lobster

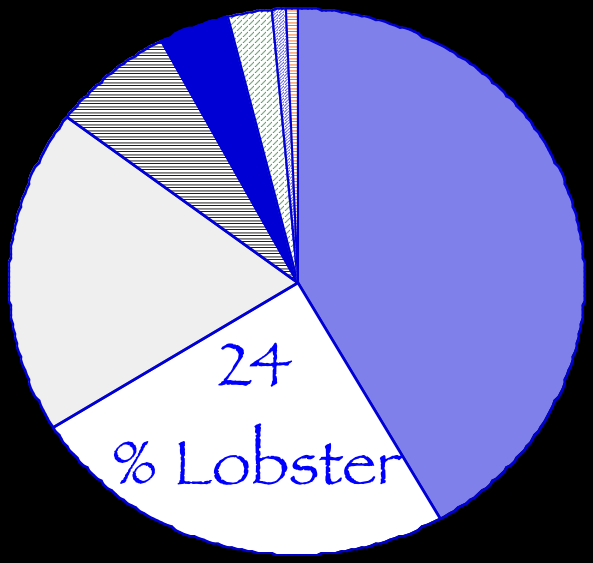

46°
72°
70°
68°
66°
64°
46°
44°
42°
St John River
Truro
St. John
Bay of Fundy
Halifax
Penobscot River
Machias River
Bangor
Androscoggin River
Kennebec River
Saco River
Merrimac River
Boston
Prehistoric fishing village 3000 BC
Rosier 1606 reported many large cod and haddock
Fishing village 500 BC
Trelawny Fishing Station 1633
Cashes Ledge
Plymouth Colony 1620 AD
Cape Cod
Georges Bank
Gulf of Maine

Relict populations of Large Predatory Fishes Persist

The ecosystem has changed in favor of the lobster

Value of Marine Resources in Penobscot Bay

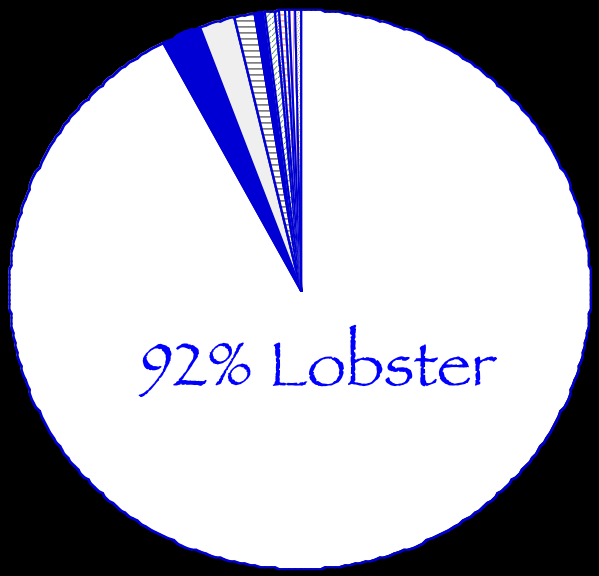
1880



Mackerel
Lobster
Cod
Hake
Herring
Haddock
Pollock
Cusk

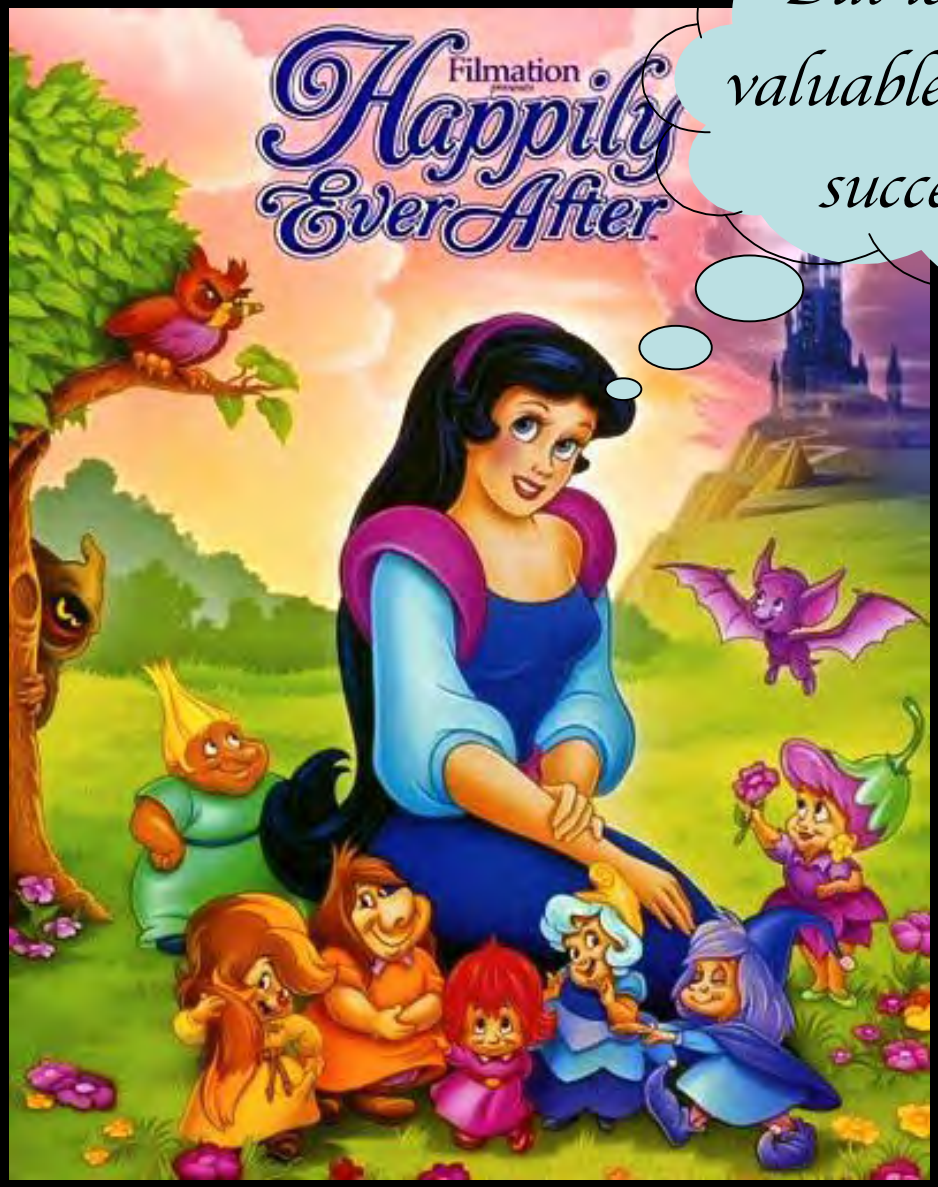
Value $ 19.3 Million
(2015 $)

2014 - 2015



Lobster
Atlantic herring
soft clam
elver
worms
blue mussel
scallop
urchins
crab
other species
groundfish
oysters
tuna
Seaweed
periwinkle
hard clam

Value $ 323 Million
(2015 $)



But lobsters are valuable so this IS a success story!

Let's consider the bigger socio-economic picture

Is the success of Maine's lobster industry masking bigger problems?

"The Gilded Trap"

While lobstering technology has improved - obviously stocks have NOT declined

The New York Times

Late
New York Toda
breezy, high 68 T
Tomorrow, sunr
clouds, high 72.
low 54. Weather

NEW YORK, THURSDAY, MAY 31, 2001

Ting-Li Wang/The New York Times

With Maine lobster catches at a record, lobster boats abound in the harbor in the town of Vinalhaven.

Down East, the Lobster Hauls Are Up Big

By CAREY GOLDBERG

VINALHAVEN, Me., May 24 — Never before in Maine's long memory has there been a lobster boom like this one.

Year after year lately, the state's lobster landings have risen to record heights, even as the levels of many fish stocks remain miserably low. The latest figures, issued this spring, put last year's catch at an unheard-of 56.7 million pounds, about 20 million pounds above the 100-year average and nearly triple the take of 15 years ago.

"We keep saying, 'It can't go any higher than this,' and the next year, darned if it doesn't go up another million pounds," said Pat White, executive director of the Maine Lobstermen's Association.

Something is going very right, and nobody claims to know for sure what it is.

What is clear, though, is that these are exceptionally flush times for the Maine lobsterman, that crusty old rubber-booted, oilskin-suited icon of the state. More than ever, Maine's brooding, pine-pointed, rock-rounded coast is dotted by the bright confetti of orange and yellow and chartreuse lobster buoys, more than two million in all.

Here on Vinalhaven Island, home to 1,200 year-round souls in the heart of lobster country, many a shiny new pickup truck plies the roads, and many a bright new workhorse boat plies the harbor. Island schoolchildren are likelier these days to sport the latest L. L. Bean fashions. And they can know that their lobstering parents are not only better-to-do but even a little hip: a new "Bachelor Lobstermen of Maine" calendar sold out within days last year.

Virtually everyone, from biologists to old-time fishermen, expects the catches to drop again. But for now, Maine lobstermen are enjoying that rarest of modern maritime tales: a fisheries success story.

"The lobster is perhaps one of the only species that's been intensively fished for 150 years and is doing better today than ever," said one lobster expert, Bob Steneck, a professor of marine sciences at the University of Maine.

Which raises an urgent question: How to keep it

Continued on Page A22

New York Times

May 31 2001

Front Page:

Declare lobster landings

in Maine are booming !

New York Times July 28 2012

July 28, 2012

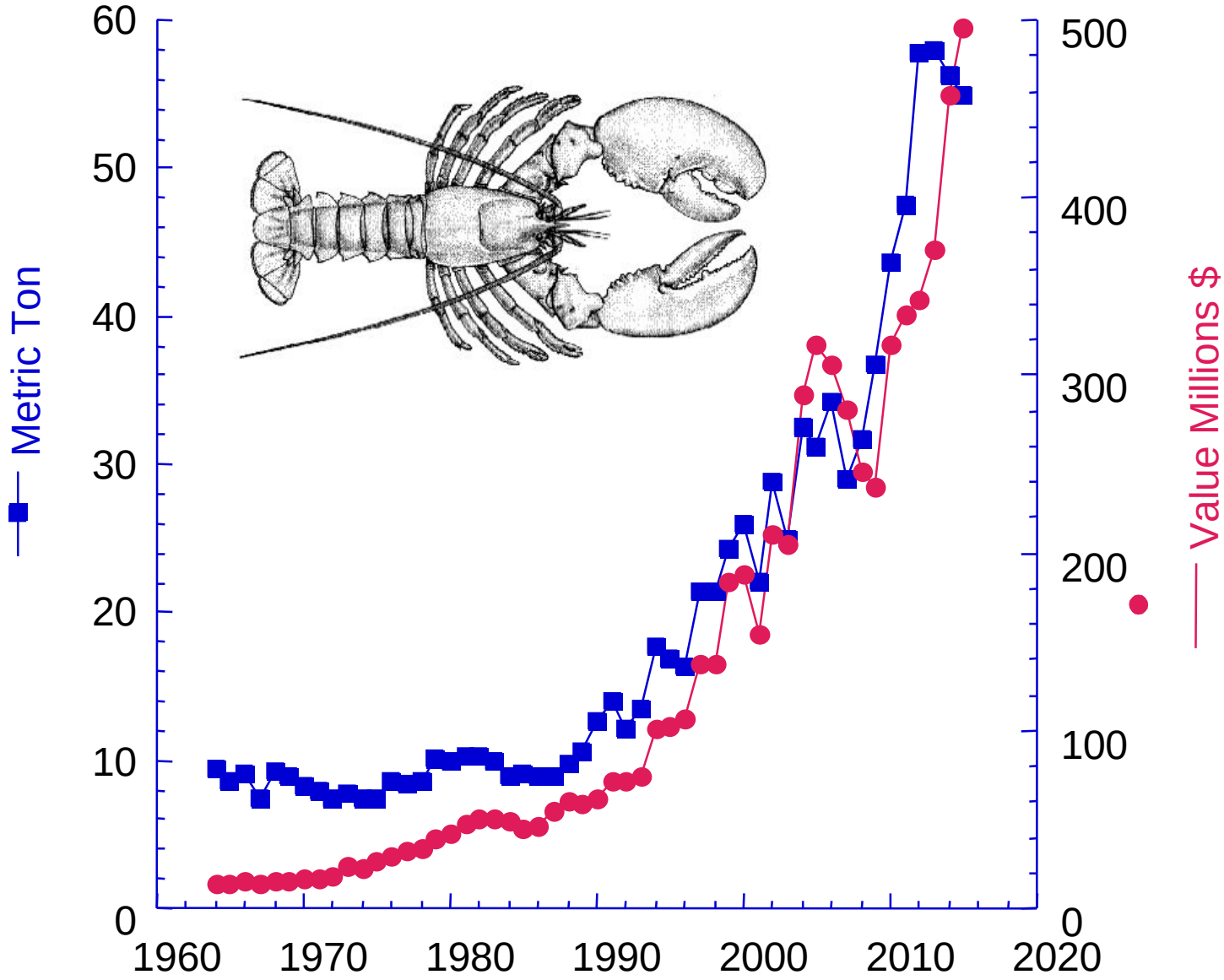
In Maine, More Lobsters Than They Know What to Do With

By KATHARINE Q. SEELYE

STONINGTON, Me. — Lobsters are flooding the market here.

A combination of warm weather and good conservation techniques has led to what could end up being a record lobster harvest across Maine waters. The glut is particularly noticeable here in Stonington, a fishing village on an archipelago by the Atlantic Ocean that has more lobster "landings," or catches, than anywhere in the state.

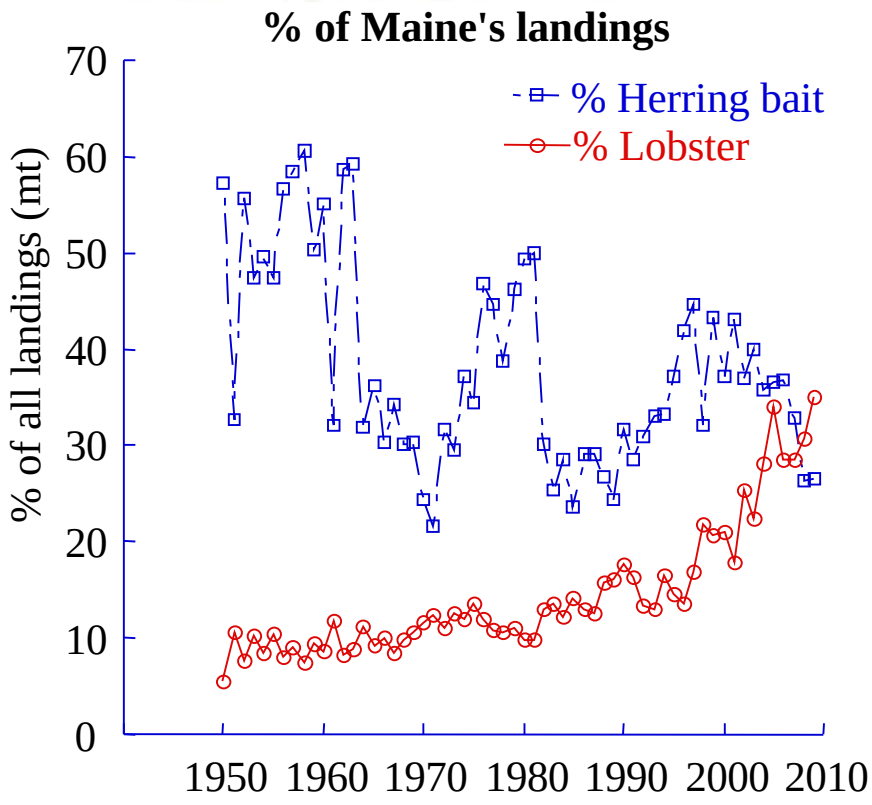
Maine Lobster Landings and Value

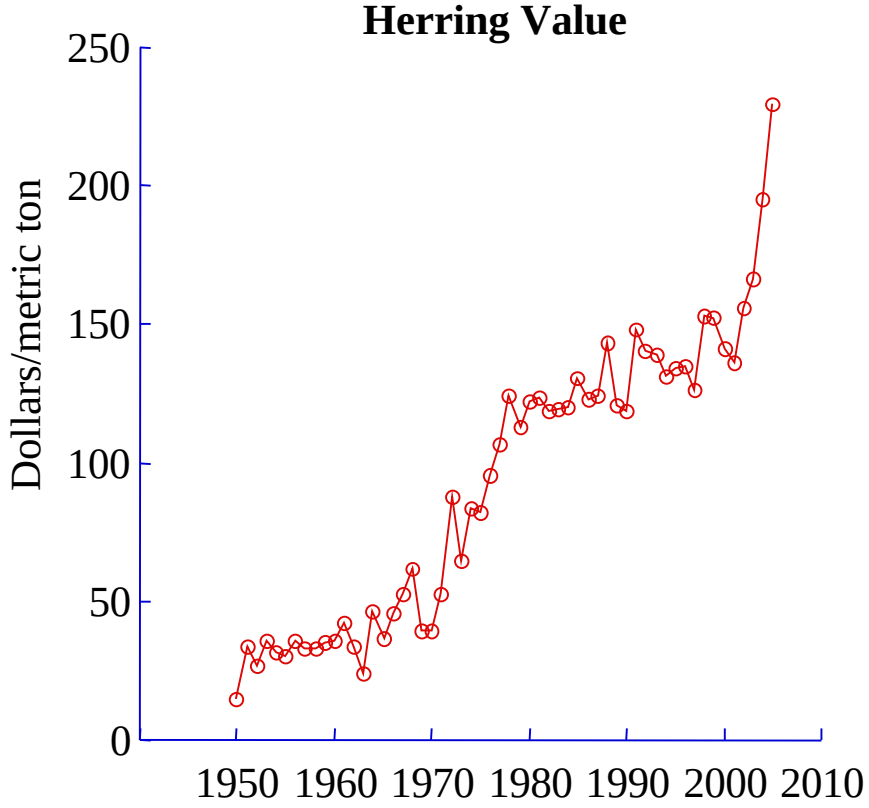


Is it a good idea to be so dependent on one species?

The dependence is more than one species

Feeding this lucrative monoculture: The role of herring as bait



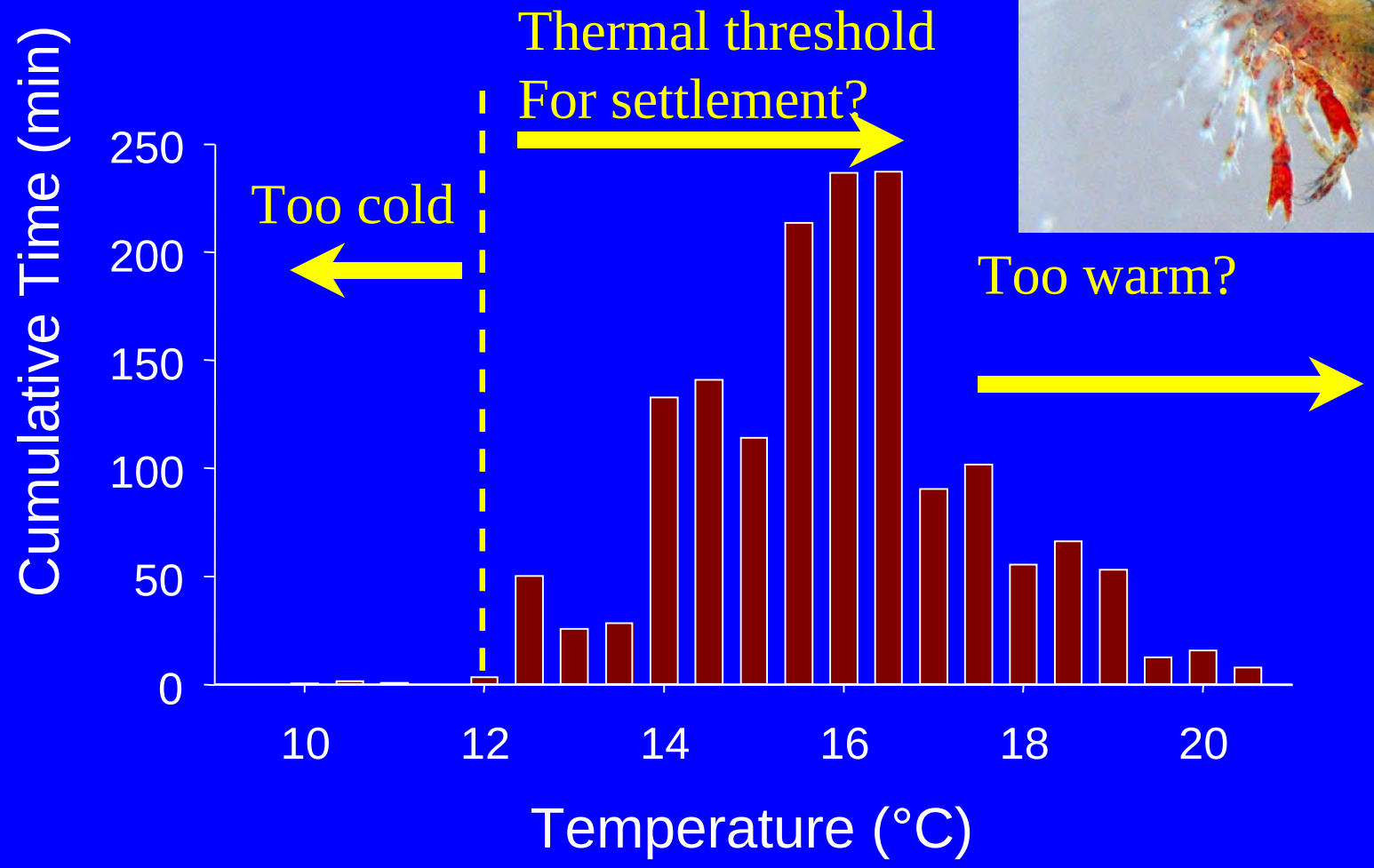


Increase dependency on lobster bait at ever increasing cost

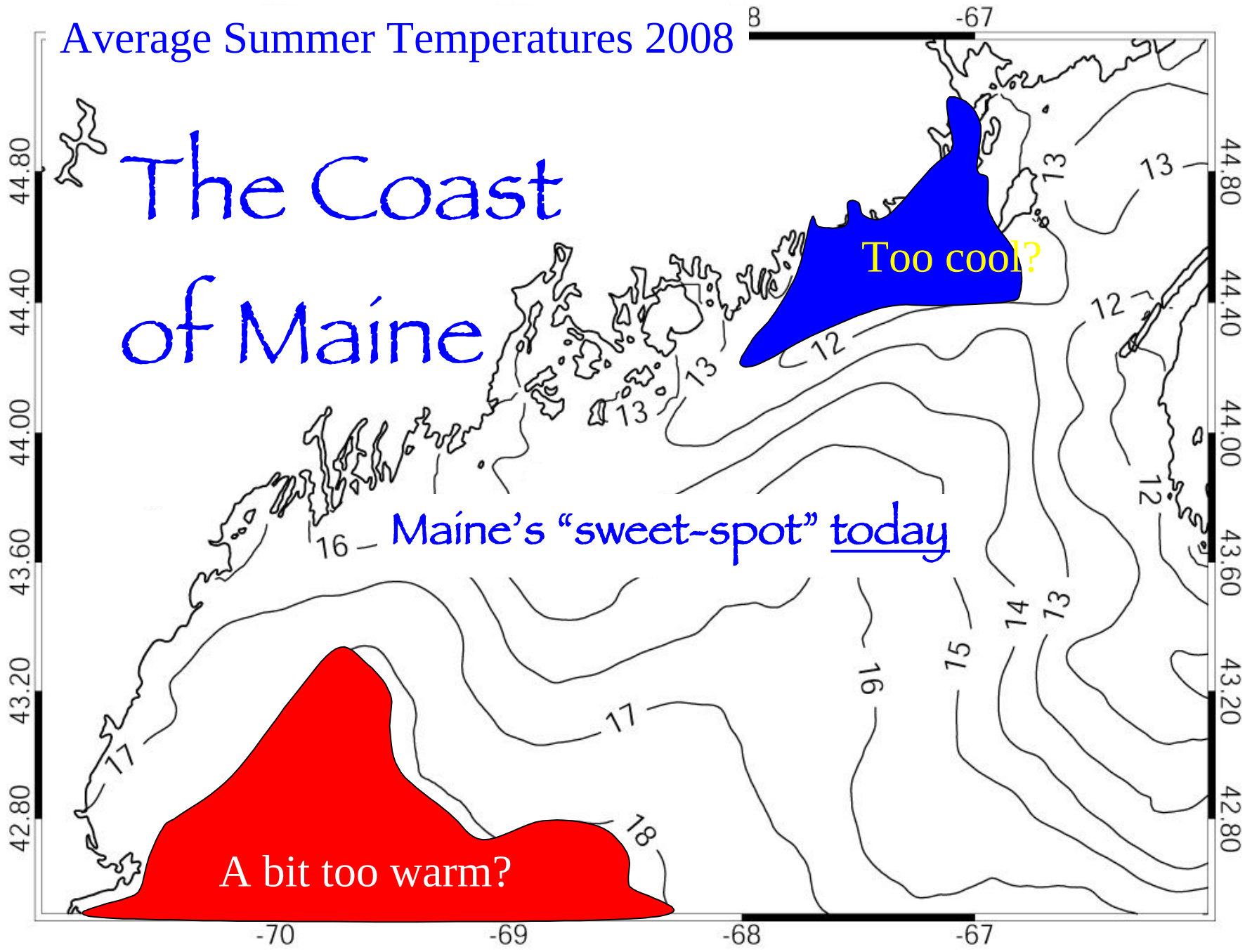
More bait for the *gilded trap*… A domesticated ecosystem?

Challenges from our changing climate

Settling Postlarvae prefer warmer water (and more larvae survive in water > 12°C)



Annis 2005, *Limnol. Oceanogr.*, 50: 1972-1982

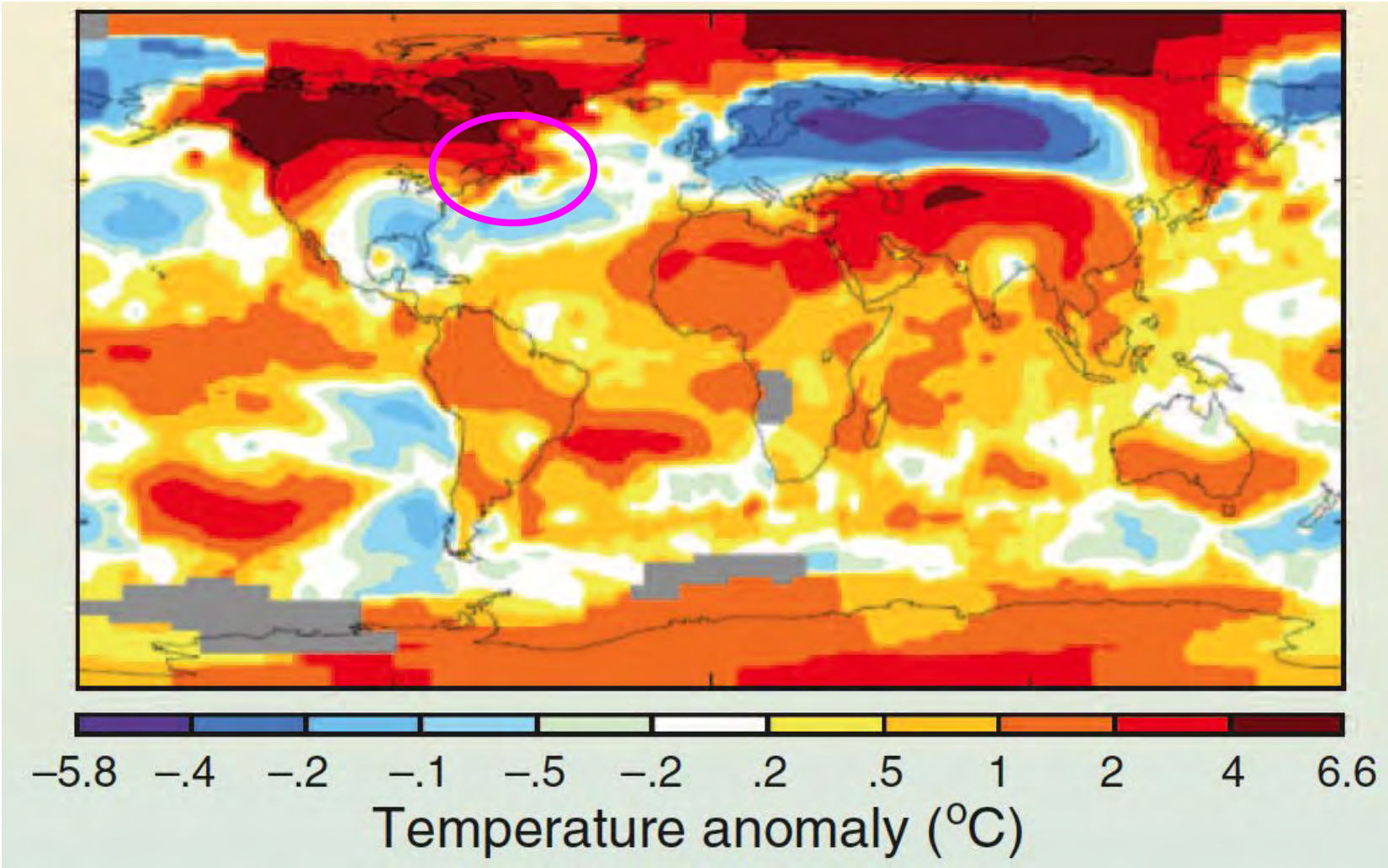


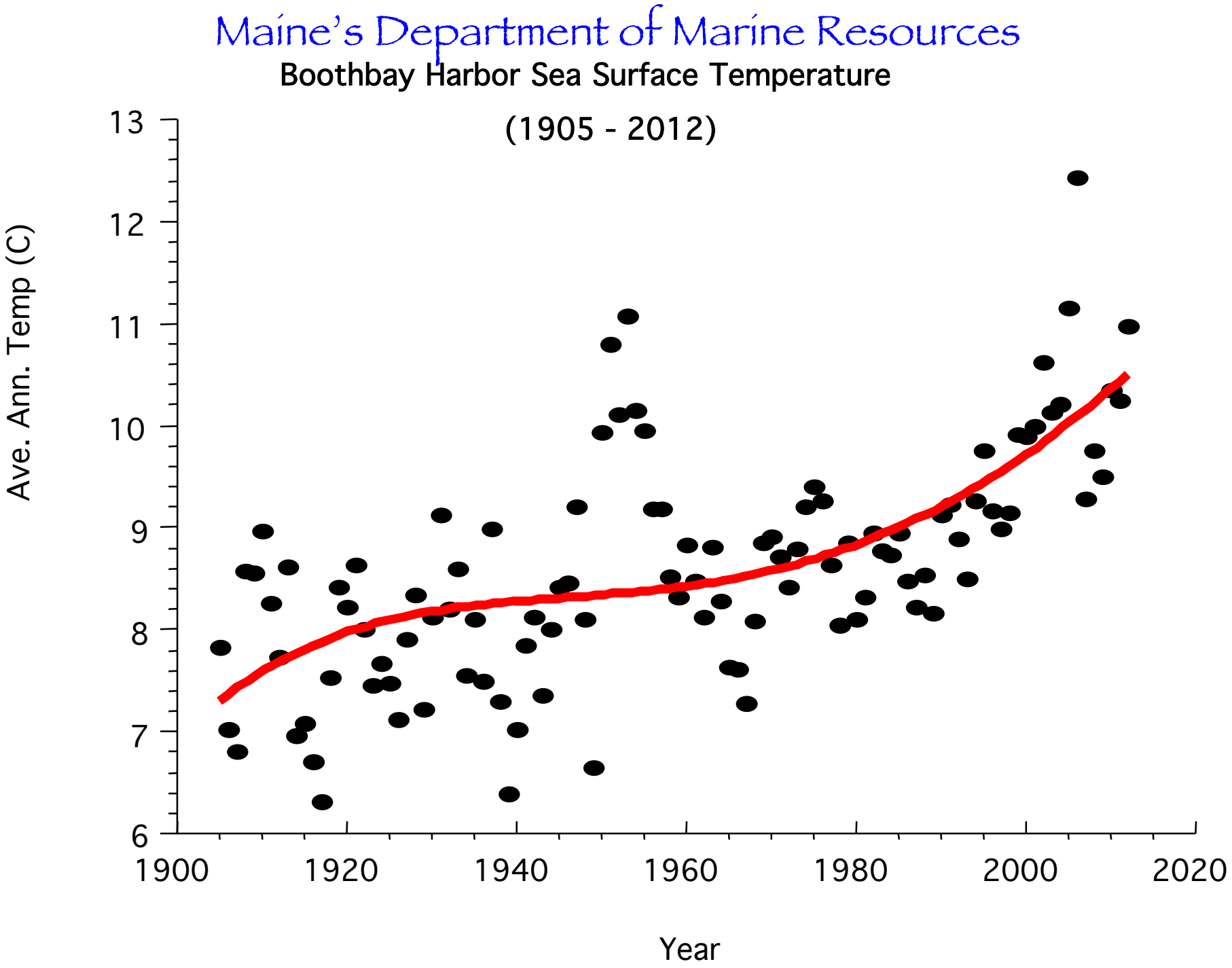
Steneck and Wahle 2013

The Impact of Climate Change on the World's Marine Ecosystems

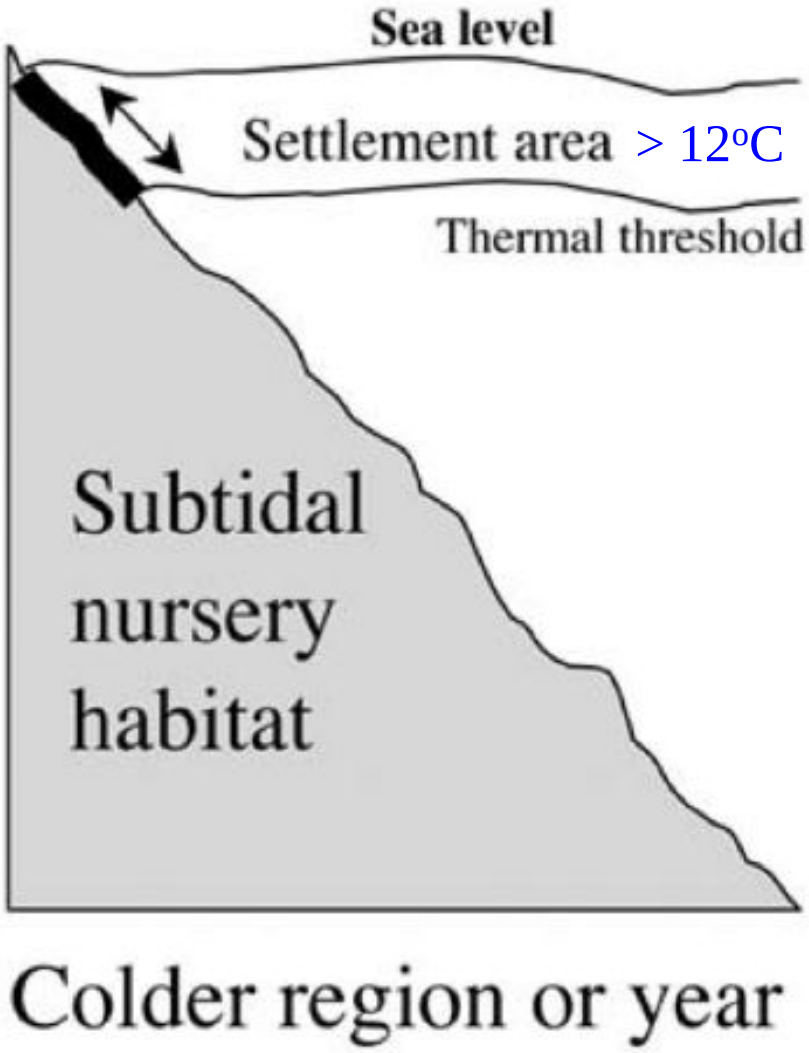
Ove Hoegh-Guldberg[1]* and John F. Bruno[1,2]

SCIENCE VOL 328 18 JUNE 2010

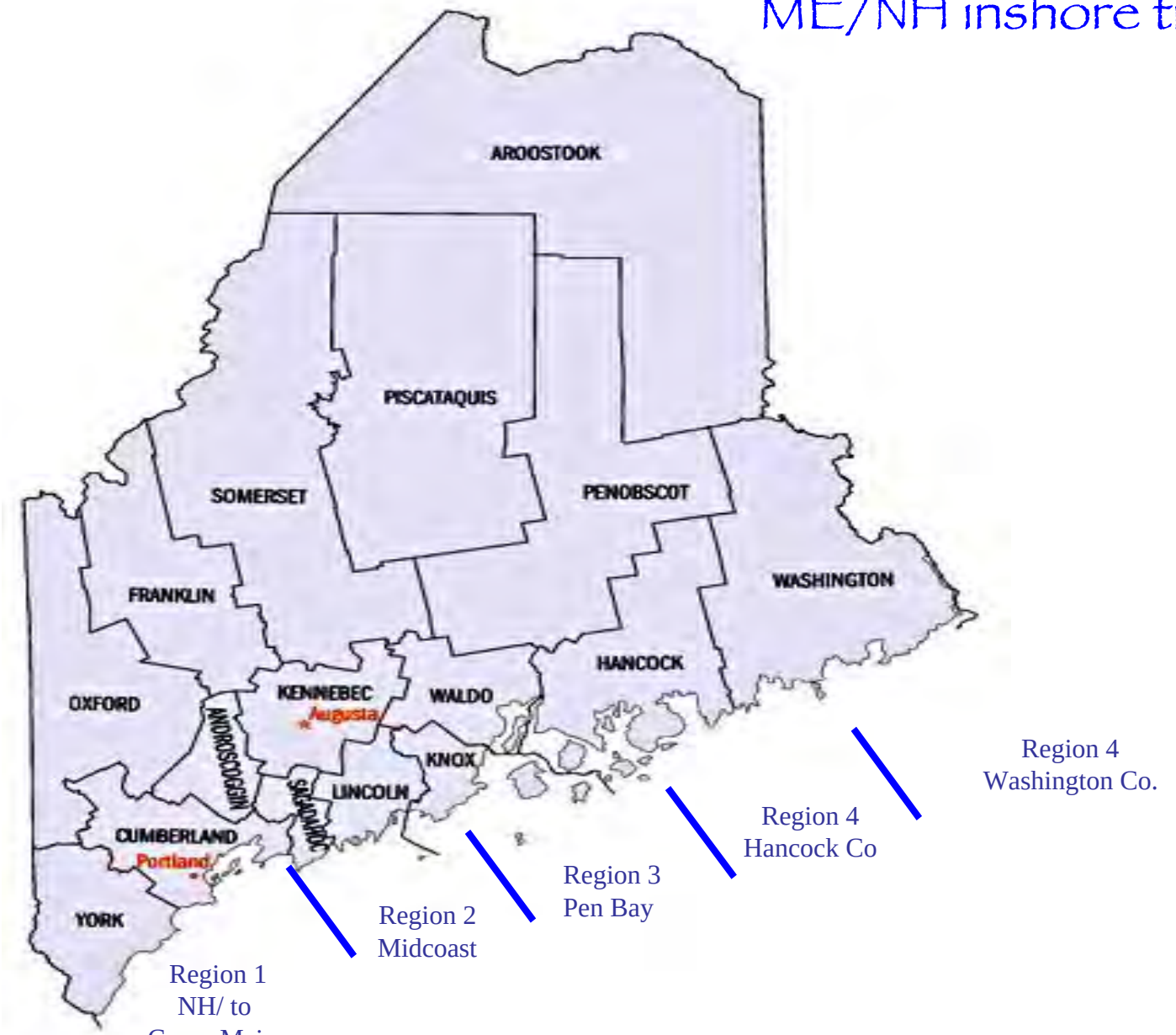



Maine's Department of Marine Resources
Boothbay Harbor Sea Surface Temperature
(1905 - 2012)
Ave. Ann. Temp (C)
13
12
11
10
9
8
7
6
1900
1920
1940
1960
1980
2000
2020
Year

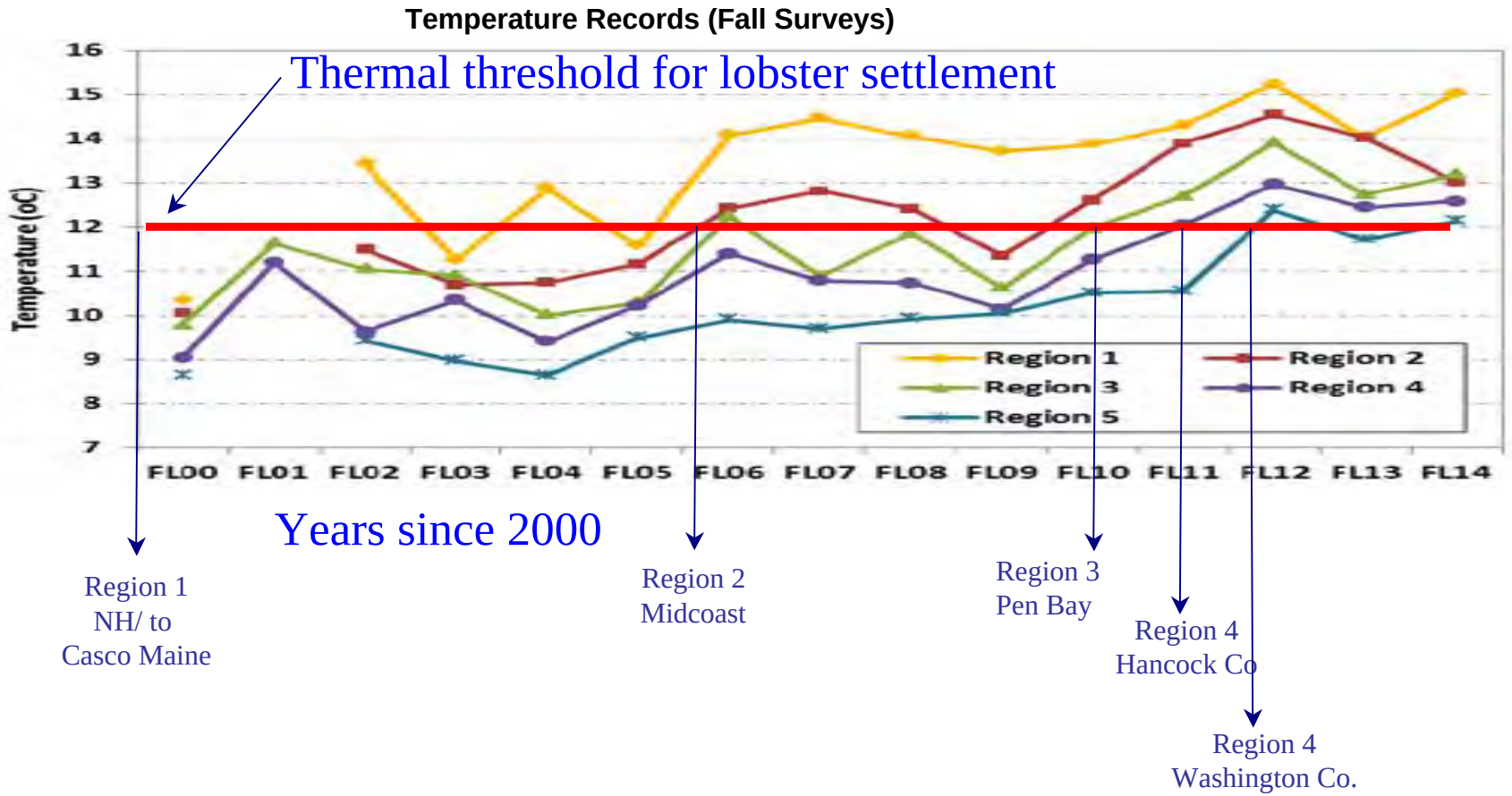
Warmer Sea Temperature Allows for Deeper Settlement

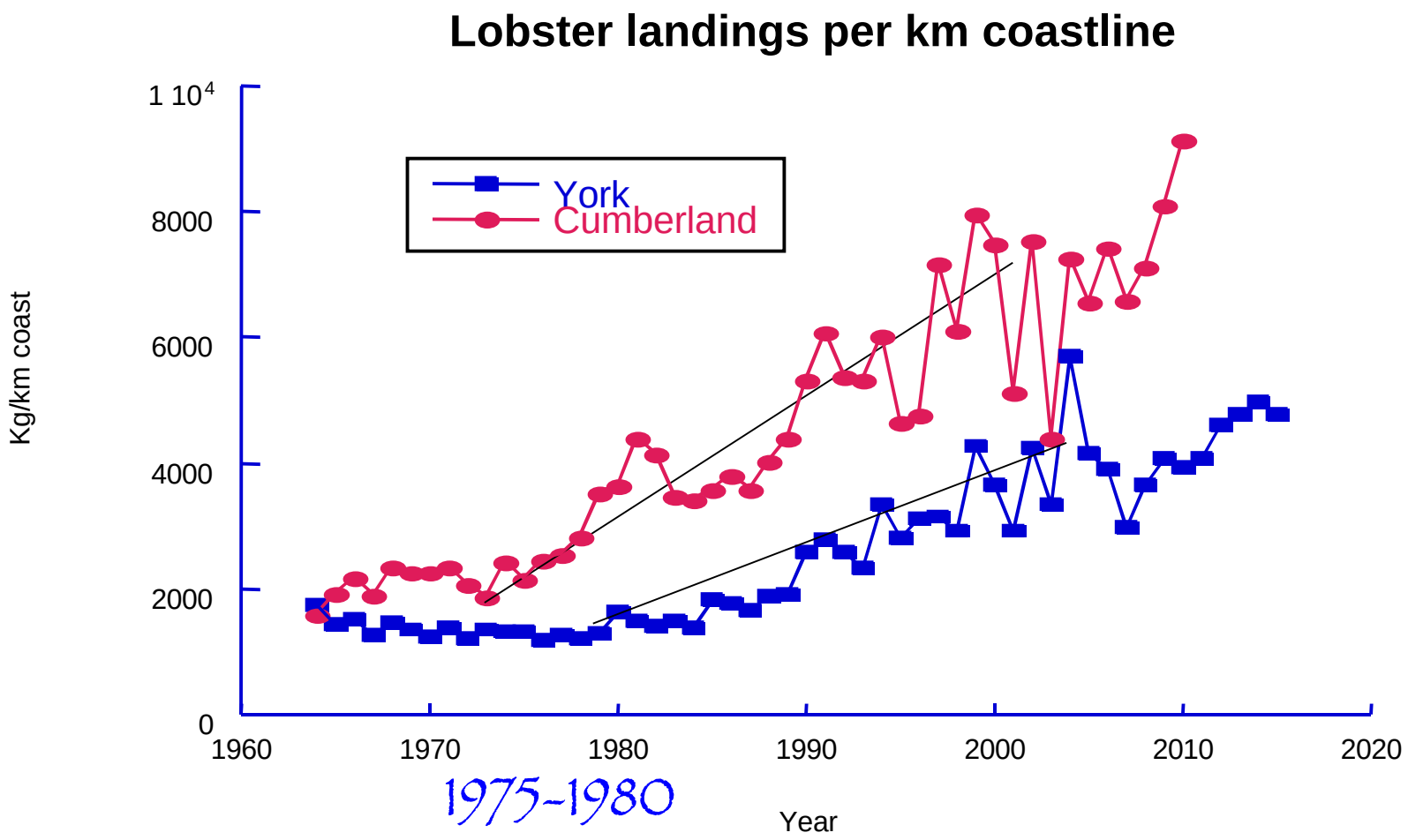


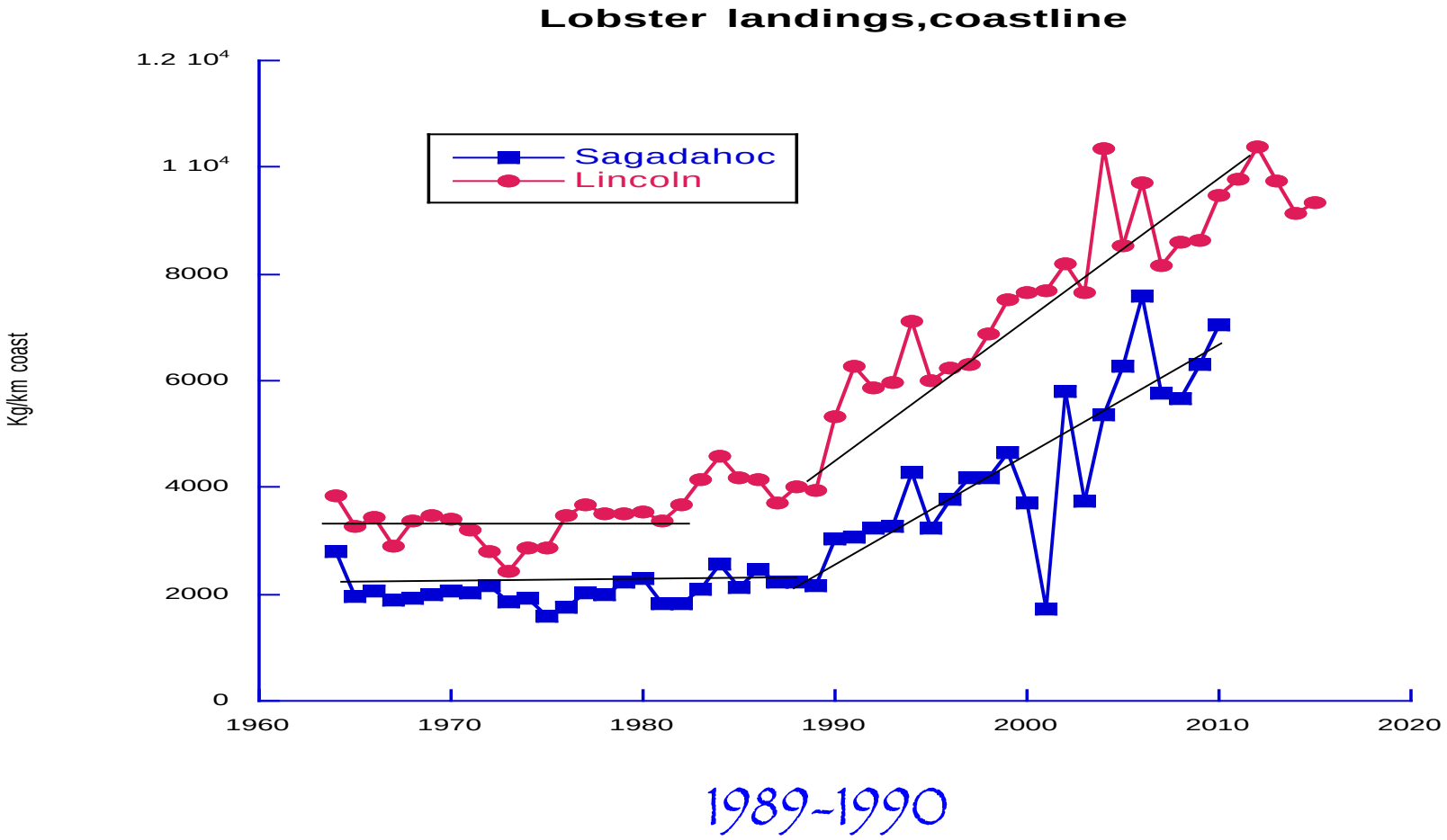
ME/NH inshore trawl surveys

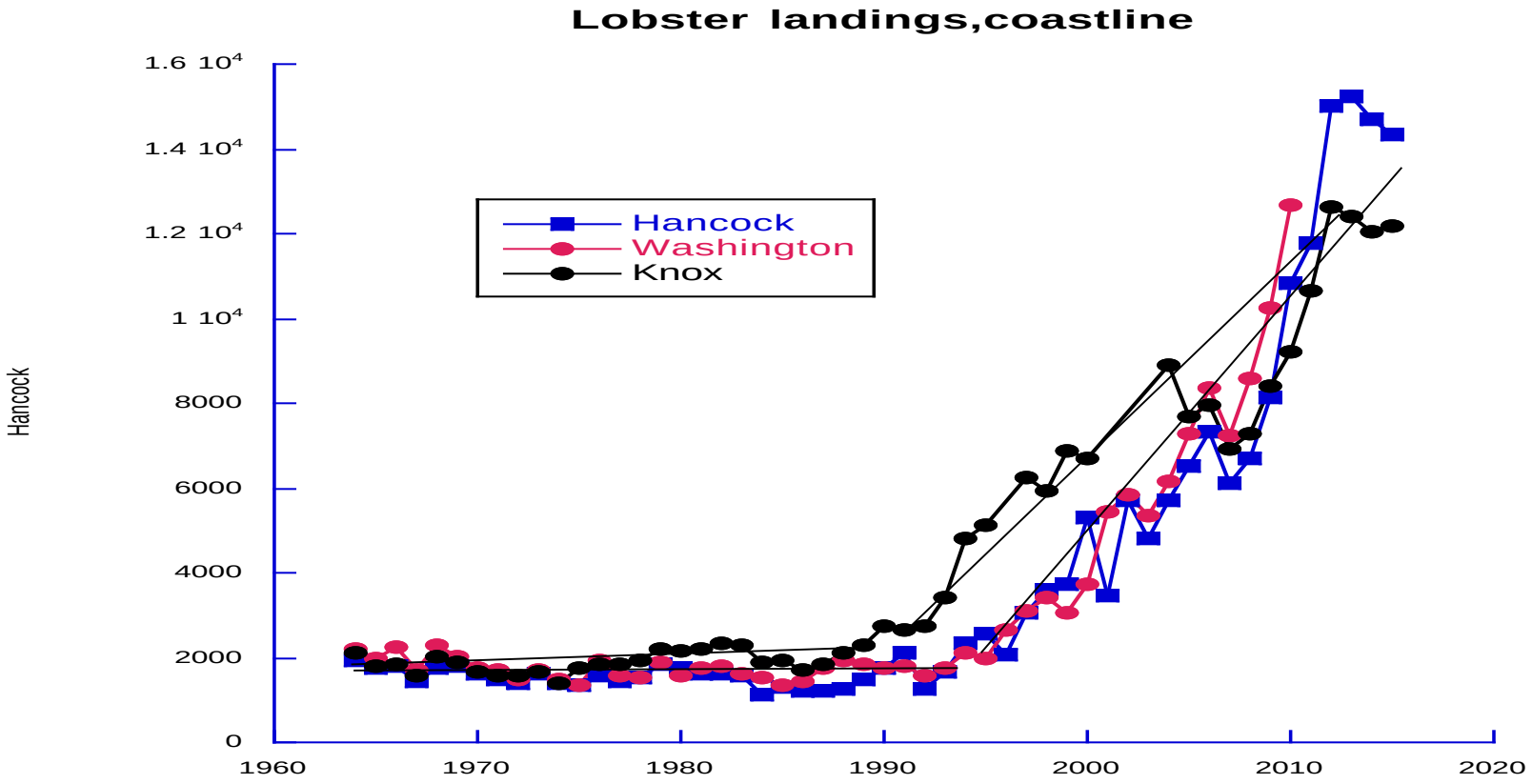


ME/NH inshore trawl surveys

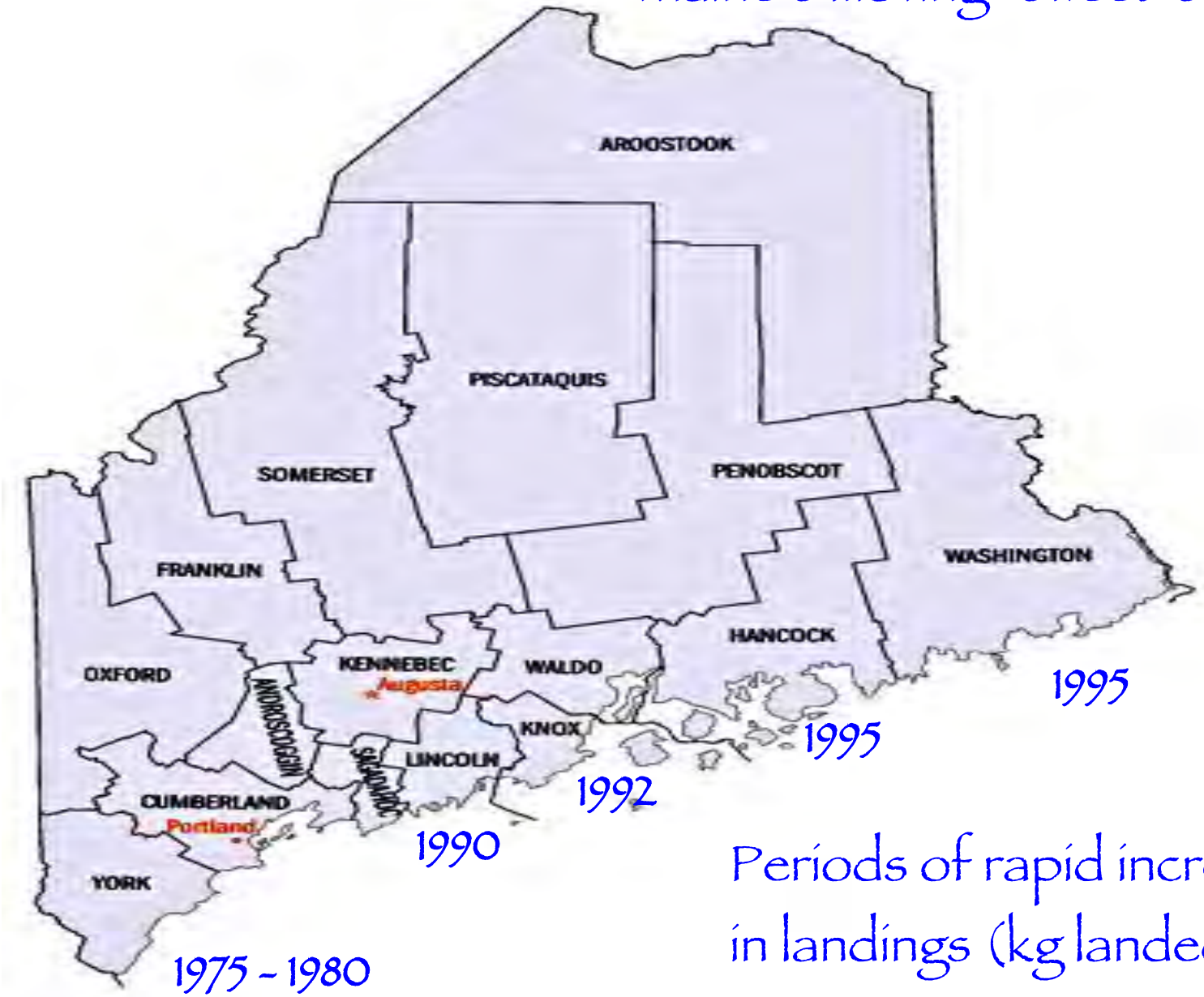



Lobster landings per km coastline
1 10^4
8000
6000
4000
2000
0
Kg/km coast
York
Cumberland
1960
1970
1980
1990
2000
2010
2020
1975-1980
Year


Lobster landings,coastline
Kg/km coast
1.2 10⁴
1 10⁴
8000
6000
4000
2000
0
1960
1970
1980
1990
2000
2010
2020
Sagadahoc
Lincoln
1989-1990

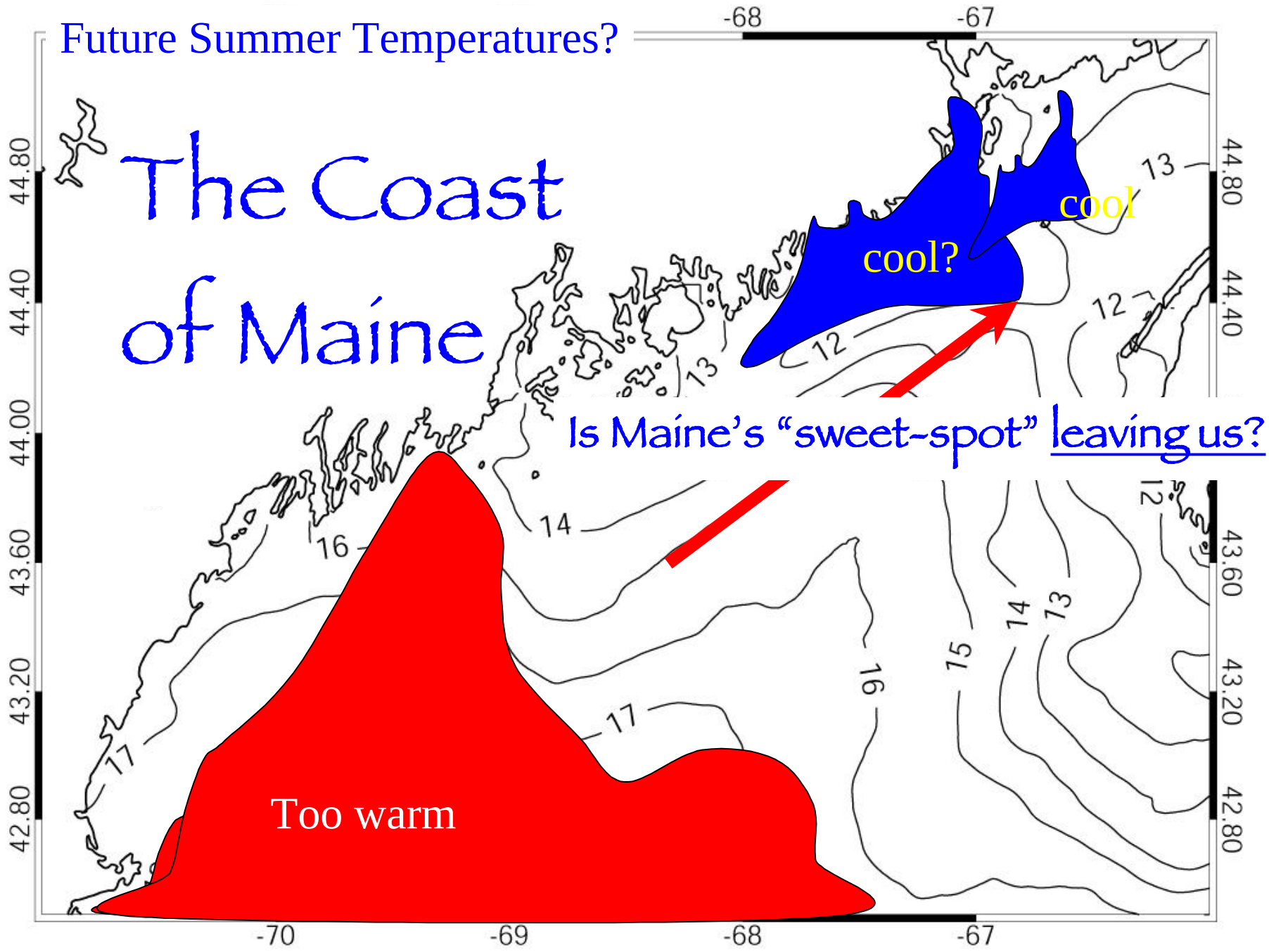

Lobster landings,coastline
Hancock
Washington
Knox
1.6 10⁴
1.4 10⁴
1.2 10⁴
1 10⁴
8000
6000
4000
2000
0
1960
1970
1980
1990
2000
2010
2020
Hancock
1990-1995

Maine's moving "sweet-spot"



Periods of rapid increases in landings (kg landed/kg coast)

Future Summer Temperatures?

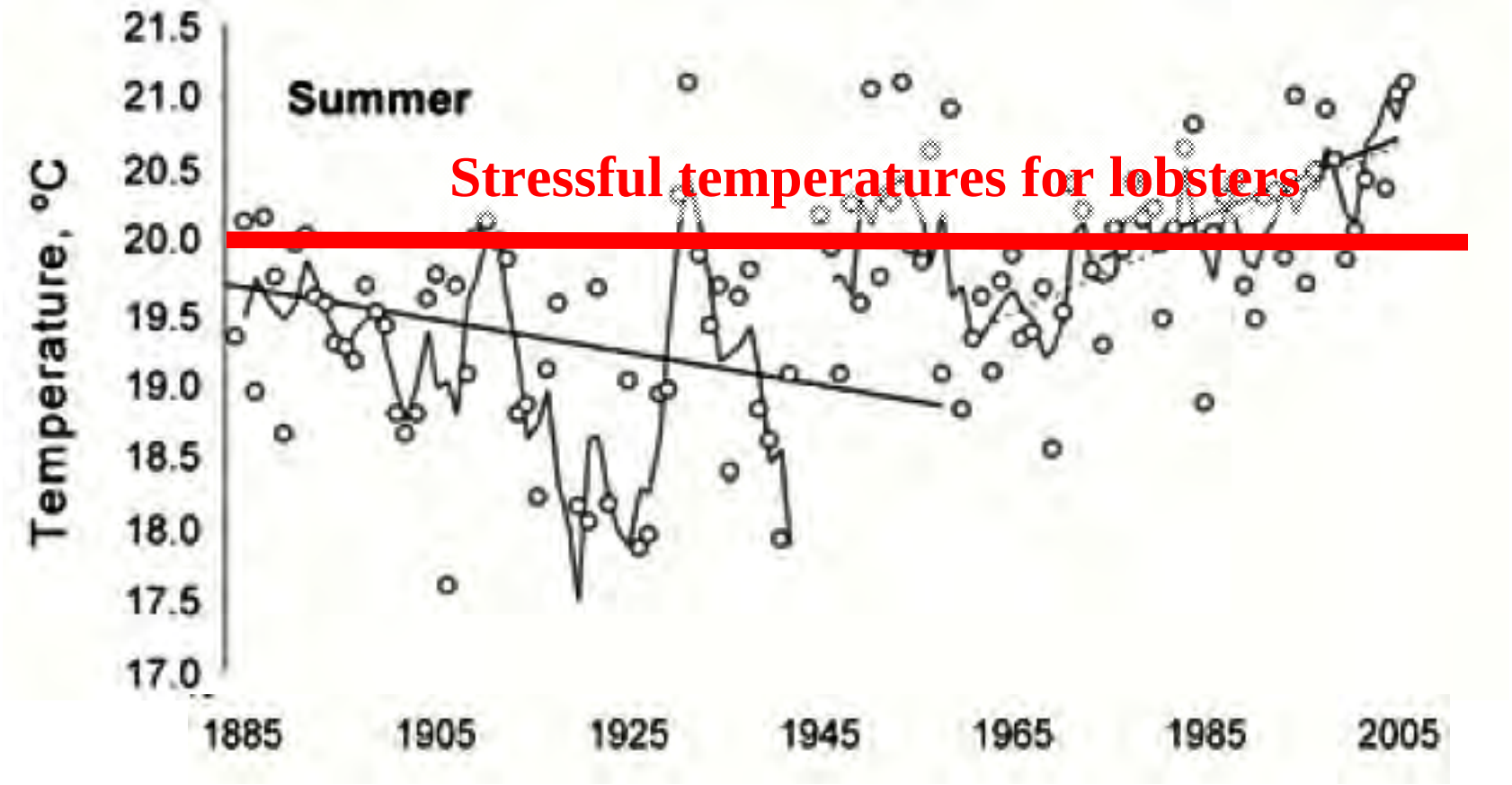


Steneck and Wahle 2013

A ONE HUNDRED AND SEVENTEEN YEAR COASTAL WATER TEMPERATURE RECORD FROM WOODS HOLE, MASSACHUSETTS

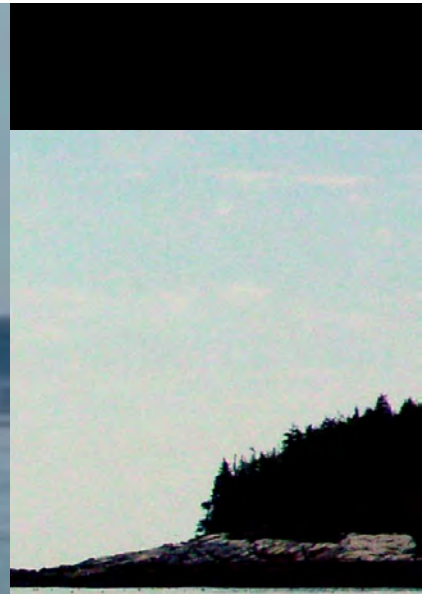
Scott W. Nixon et al

Are Southern New England's coastal waters getting too warm for lobsters?



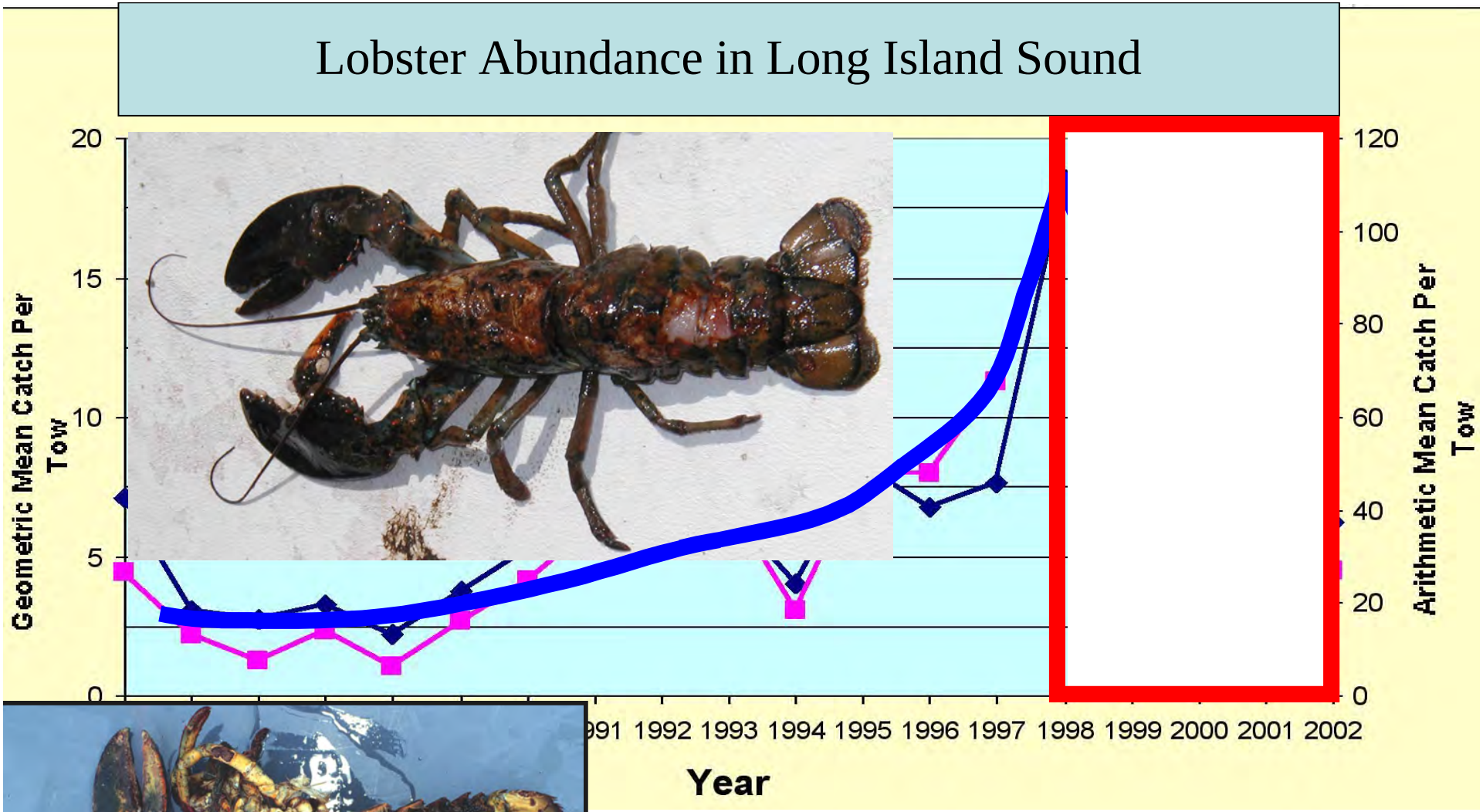
6000 lobstermen depend on this one species

A domesticated ecosystem?
A socio-economic Time Bomb?



In Maine,
only lobster traps as far as the eye can see….

Lobster Abundance in Long Island Sound



Shell Disease!

This surprised everyone

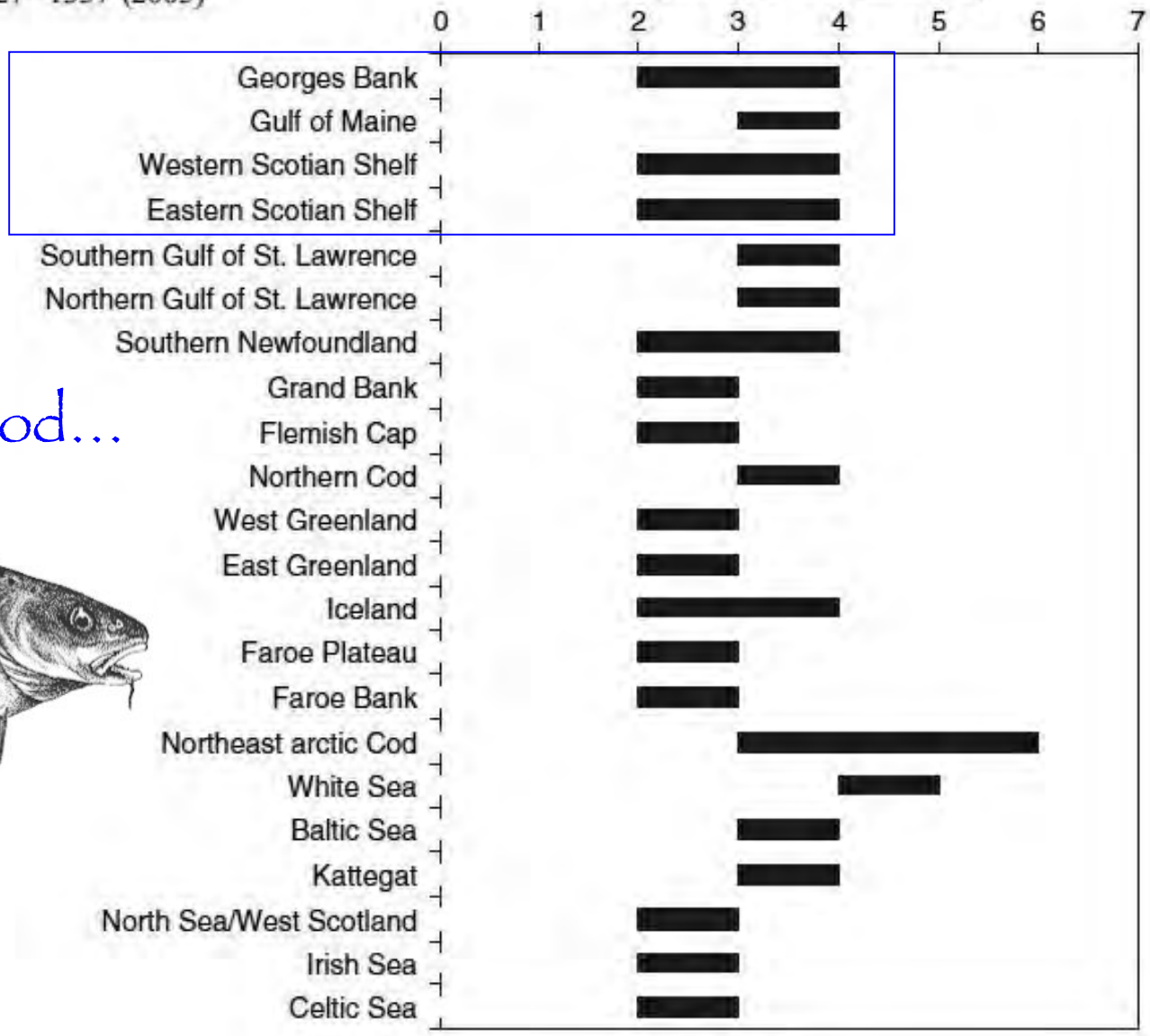
From K. Castro (Univ. Rhode Island)

The response of Atlantic cod (*Gadus morhua*) to future climate change

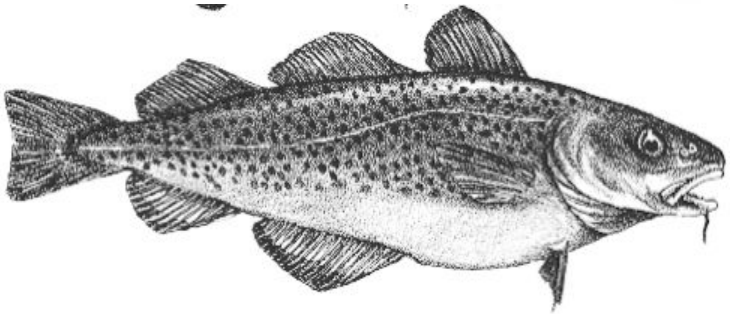
Kenneth F. Drinkwater

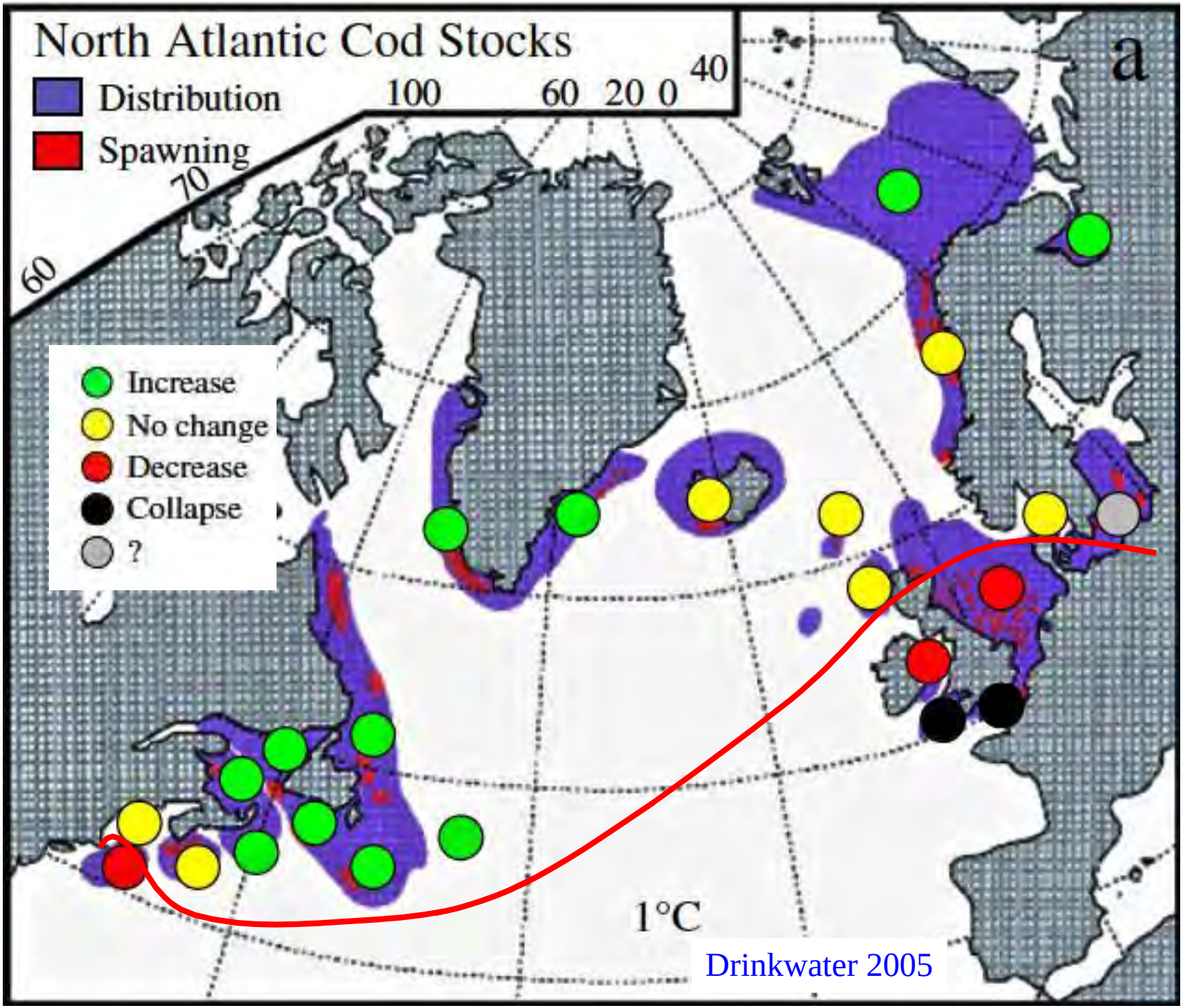
ICES Journal of Marine Science, 62: 1327–1337 (2005)
doi:10.1016/j.icesjms.2005.05.015

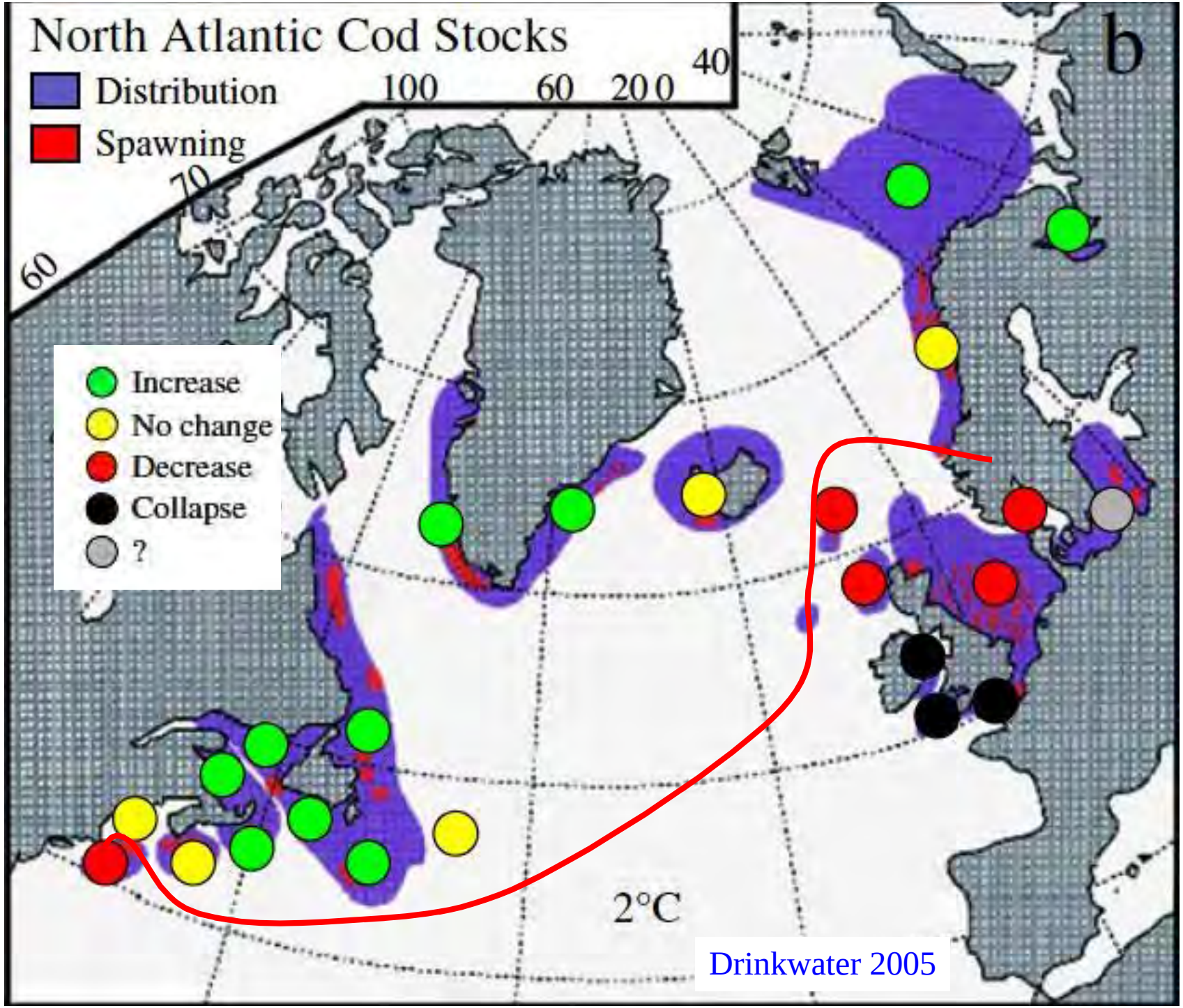
Anticipated

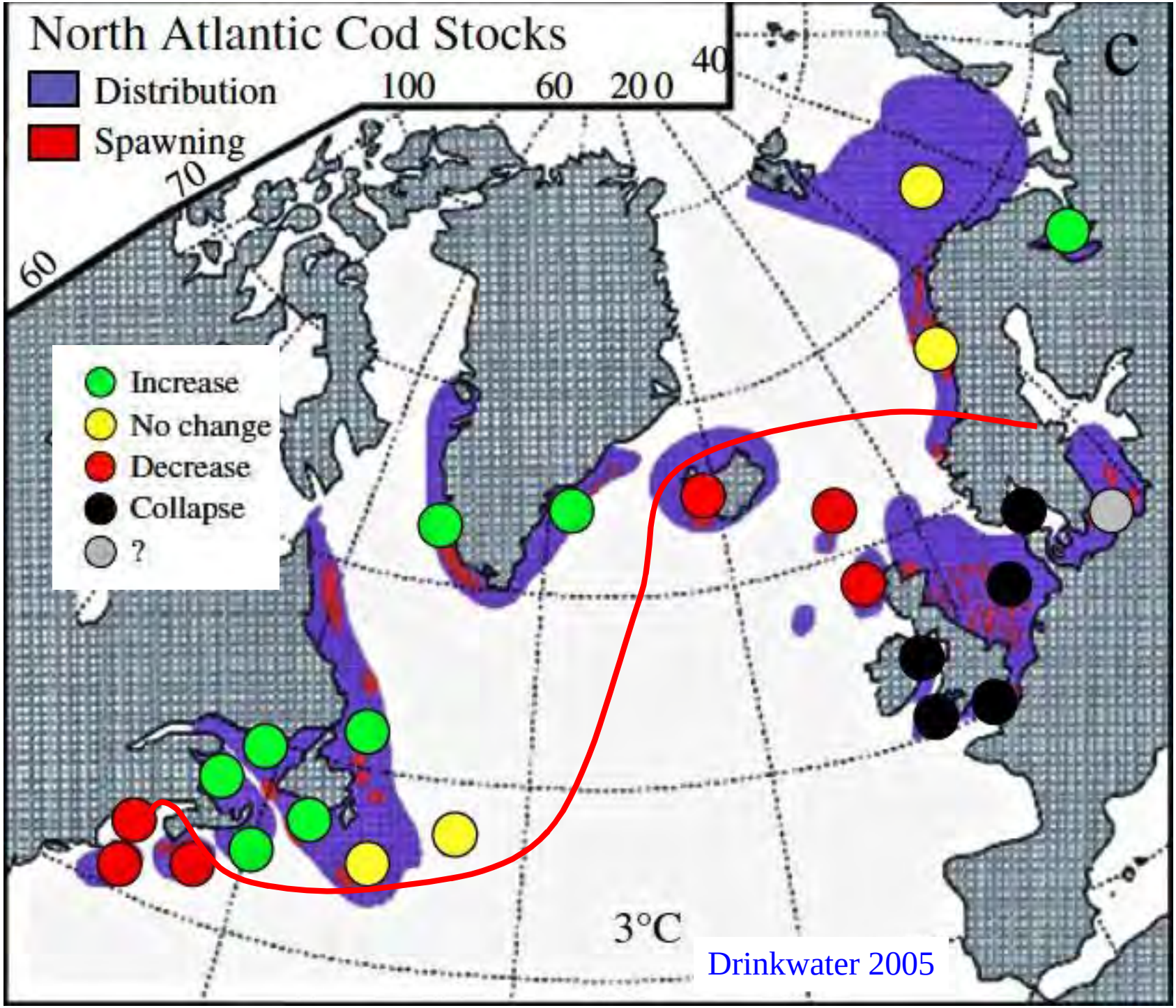


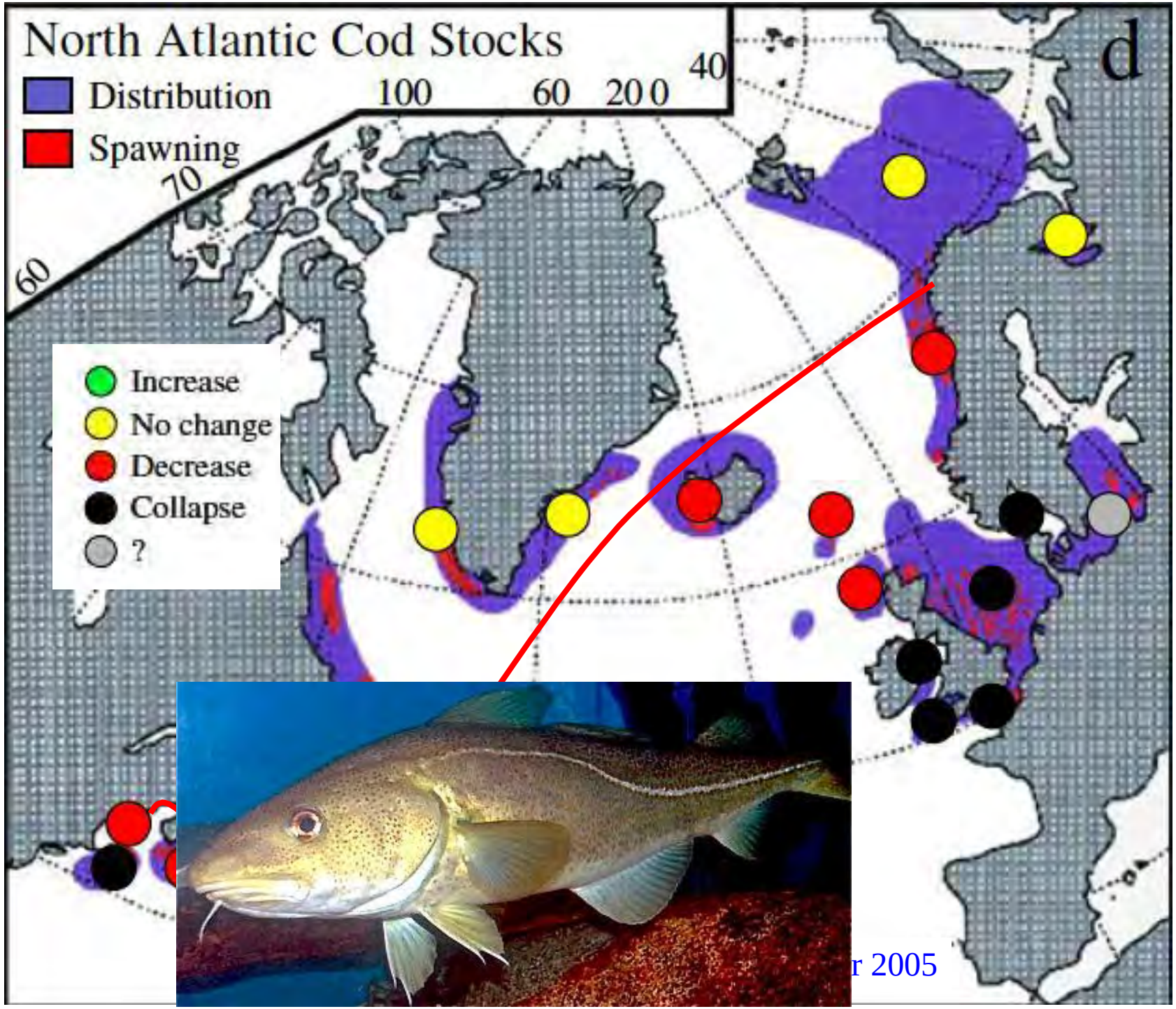
Warming seas and cod…




North Atlantic Cod Stocks
Distribution
Spawning
100
60
20
0
40
70
60
a
Increase
No change
Decrease
Collapse
?
1°C
Drinkwater 2005


North Atlantic Cod Stocks
Distribution
Spawning
100
60
20 0
40
70
60
b
Increase
No change
Decrease
Collapse
?
2°C
Drinkwater 2005

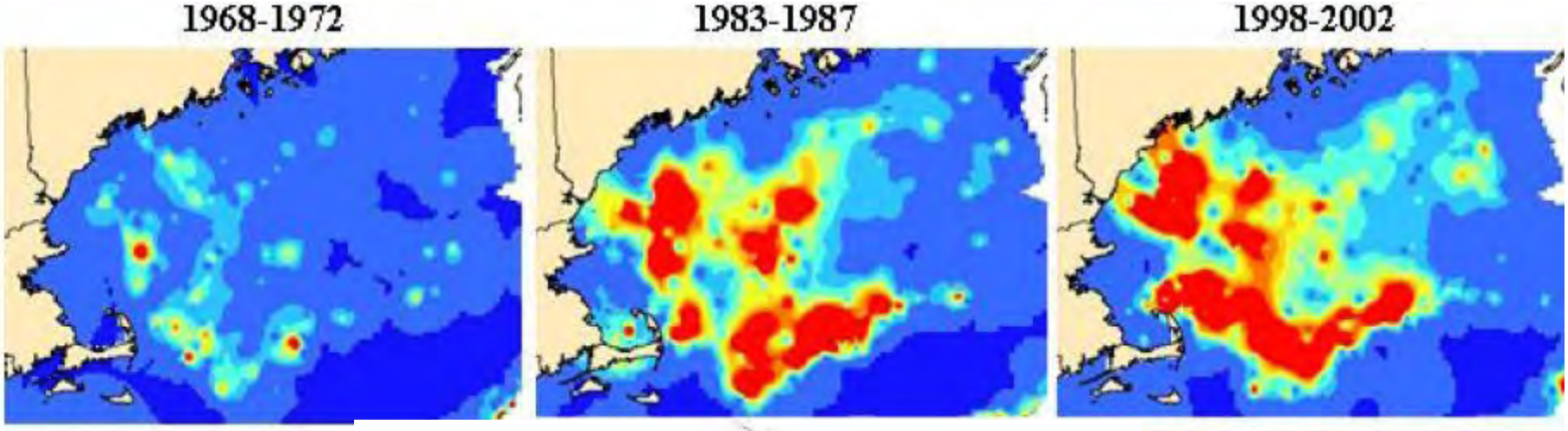

North Atlantic Cod Stocks
Distribution
Spawning
100
60
20 0
40
70
60
C
Increase
No change
Decrease
Collapse
?
3°C
Drinkwater 2005

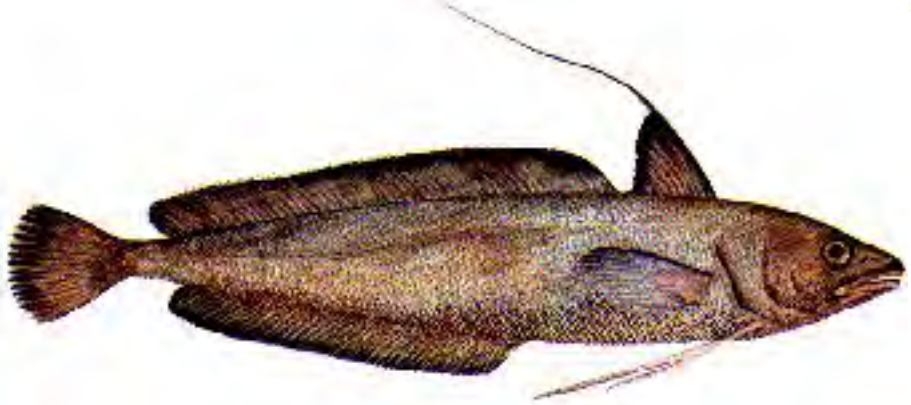

North Atlantic Cod Stocks
Distribution
Spawning
100
60
20 0
40
70
60
d
Increase
No change
Decrease
Collapse
?

r 2005

Northern shifts expected for new species increasing into the Gulf of Maine

Evidence from the distribution of Red Hake





Nye et al. 2009
Image: NOAA

Other northern shifts

Increasing black sea bass in the Gulf of Maine?

Lobstermen reported seeing many black sea bass along the coast of Maine

East Coast of North America Strategic Assessment Project

Distribution of Black sea bass (*Centropristis striata*)

And more species are coming!

1001 - 10000 2

> 10000 0

0 - 200 meters

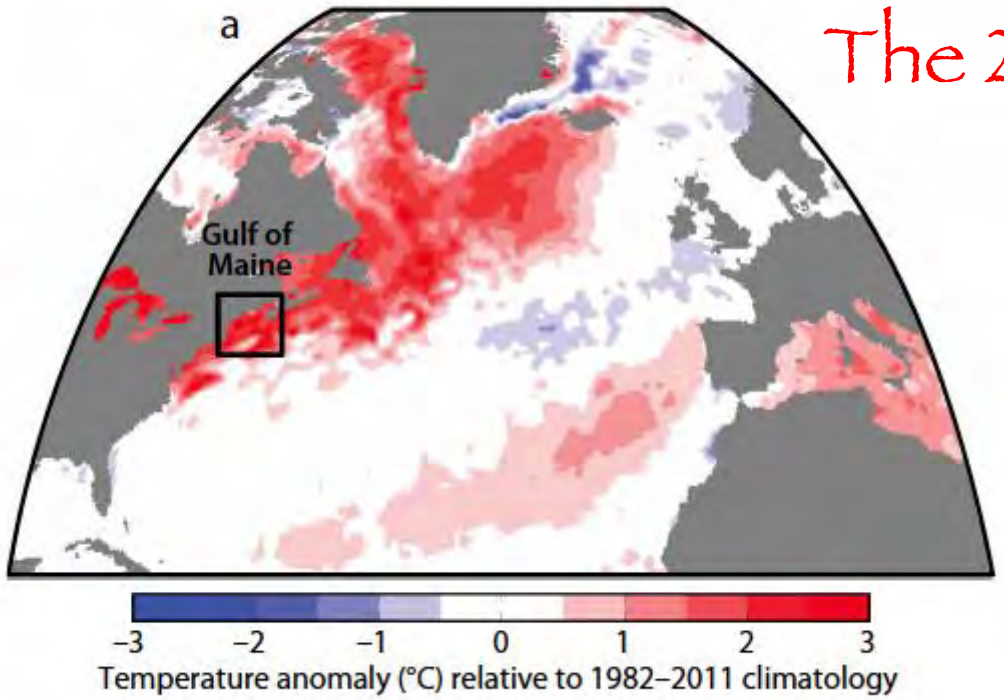
>200 meters

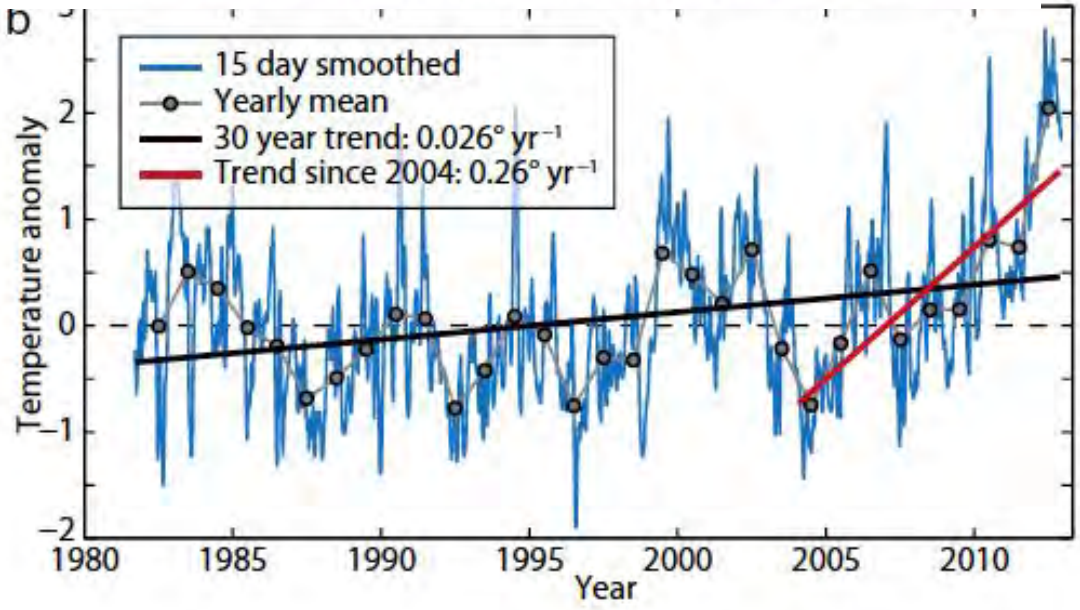
Total Tows

% Tows with species

Mean Catch/Tow

The 2012 Ocean Heatwave





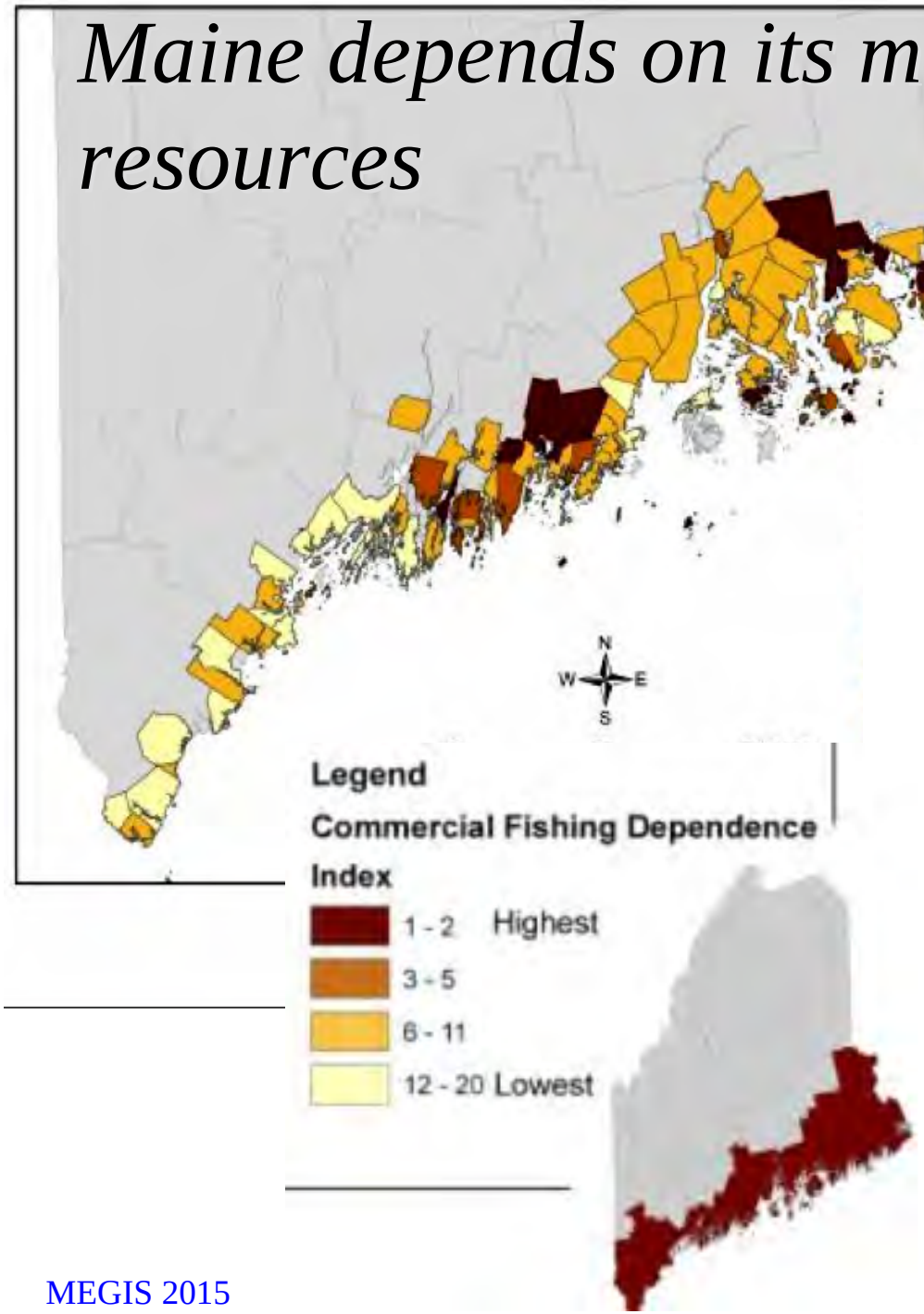
Fishermen were the first to know about it

Fishermen were the first to adapt to it

We must reinvent fisheries management so fishermen can become better stewards of their fishing grounds

Mills et al 2013

Maine depends on its marine resources



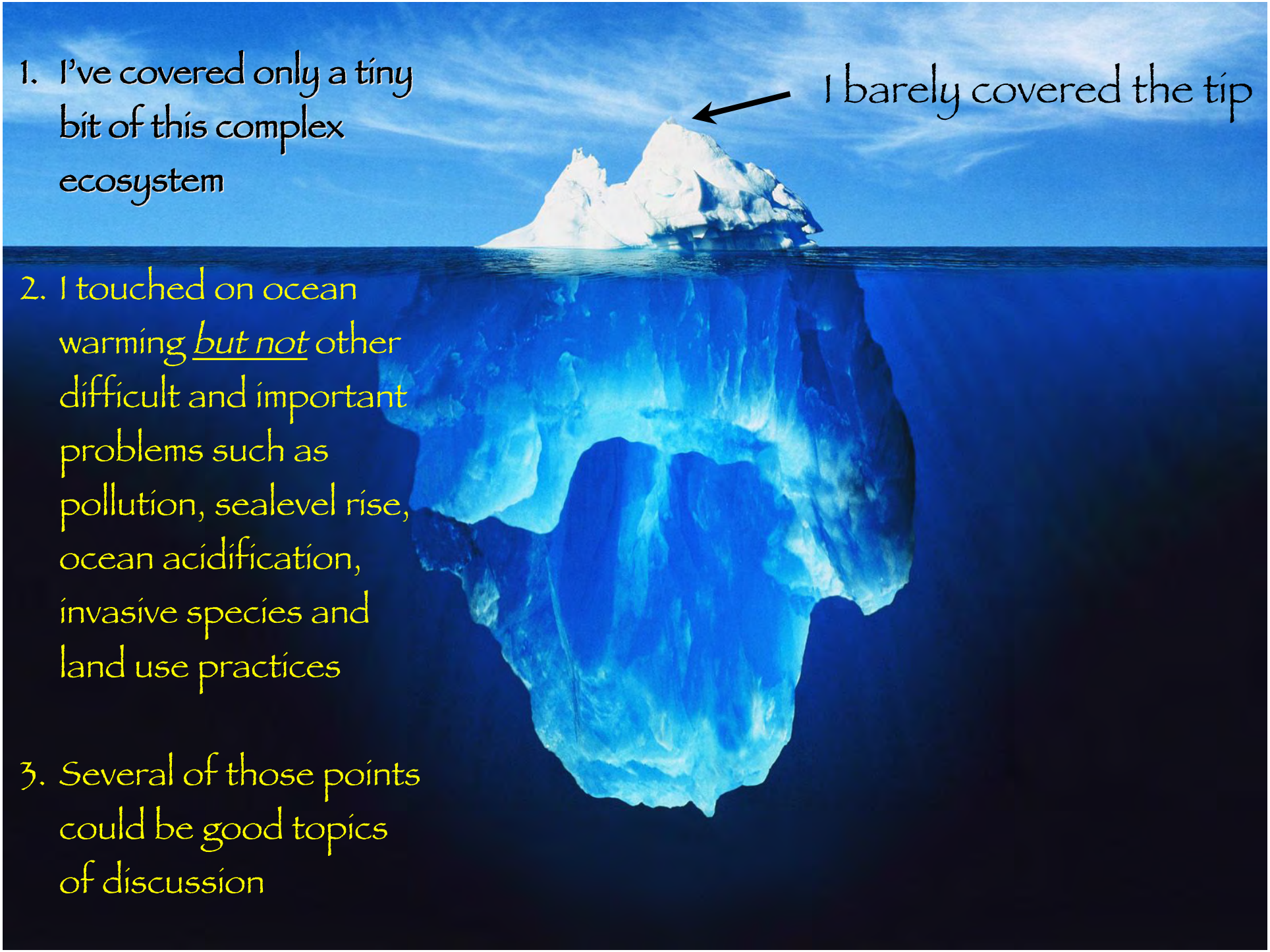
Some Conclusions:

1. Maine's maritime heritage depends on the sustainability of its marine resources

2. Natural resources are rapidly changing in dynamic ways.

3. These changes are first observed by the local fishers in the communities.

4. The challenges will be to find ways of locally managing this dynamic ecosystem sustainably.


1. I've covered only a tiny bit of this complex ecosystem
I barely covered the tip
2. I touched on ocean warming but not other difficult and important problems such as pollution, sealevel rise, ocean acidification, invasive species and land use practices
3. Several of those points could be good topics of discussion

Past and Present Graduate Students & Interns

Special thanks to: *Field Teams lead by:* Carl Wilson, Rick Wahle, Doug McNaught, Amanda Leland, Eric Annis, John Vavrinec, Greg Welsh, Jessica Stevens, Alvaro Palma, Thew Suskiewicz and countless other summer interns .

Funding from: Maine Sea Grant, Sea Urchin Zone Council, National Undersea Research Program, NSF, Pew Fellows Program for Marine Conservation, Canada's DFO, Maine's DMR, and UpEast Foundation