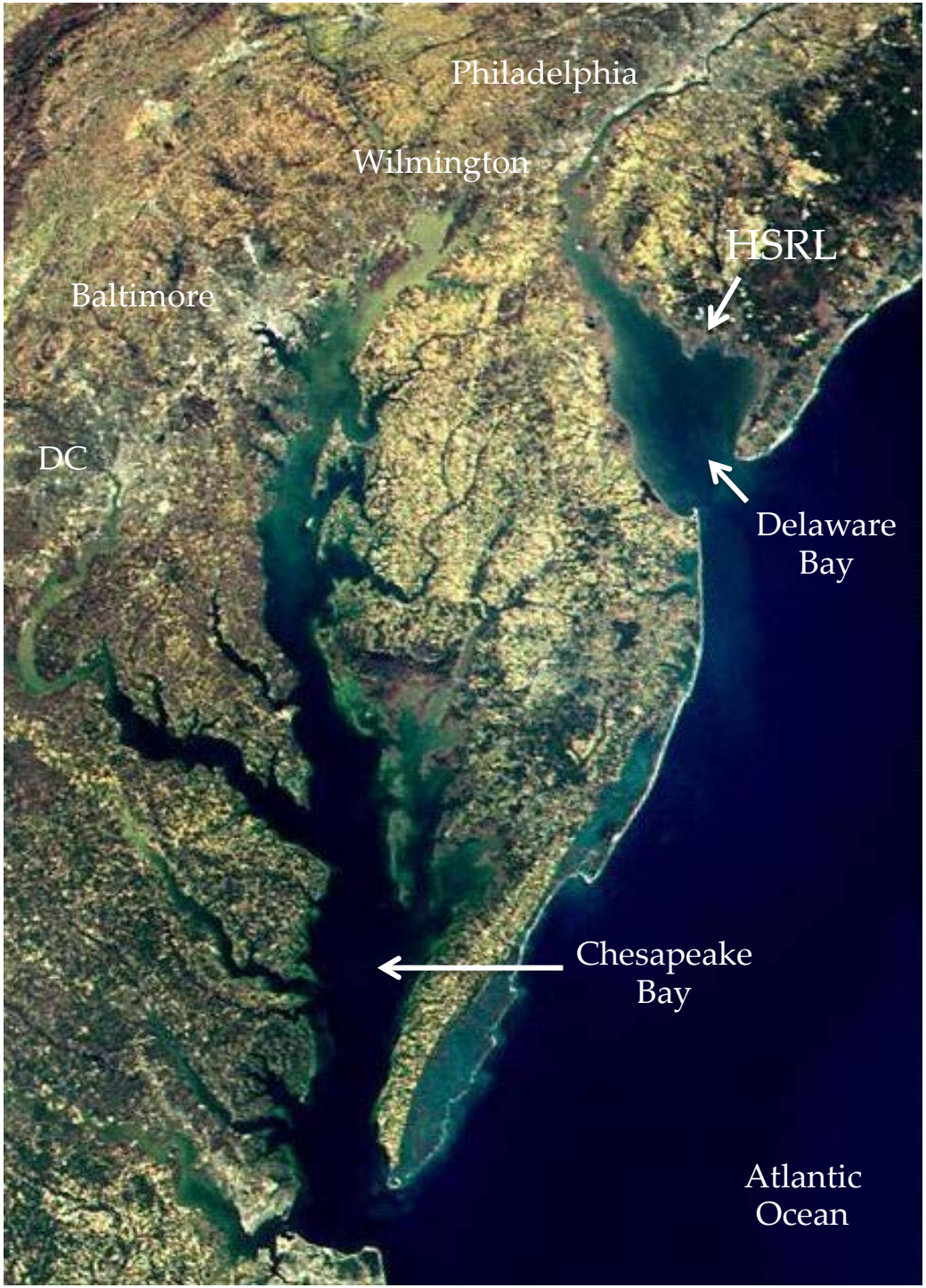
Sustainable Fishery – Sustainable Habitat
Managing Oysters in Delaware Bay

David Bushek, Kathy Alcox & Lisa Calvo

RUTGERS
New Jersey Agricultural
Experiment Station
Haskin Shellfish
Research Laboratory



Delaware Bay is (geographically) superior to Chesapeake Bay

project PORTS
Promoting Oyster Restoration Through Schools

Celebrating 10 years

- Provides students with **authentic** research and restoration experience in the Delaware Bay
  - *Community-based oyster restoration*
  - *In-school enrichment*
  - *Field trips*
  - *Curriculum Guides*
  - *Teacher workshops*
  - *Stewardship opportunities for all ages*

Intensive Oyster Aquaculture

Photo: B Hollinger

Small, but large potential, many challenges:
- Regulatory
- User conflicts
- Endangered species

Report: hsrl.rutgers.edu

Journal of Shellfish Research, Vol. 19, No. 1, 371–377, 2000.

OYSTER REEF RESTORATION: CONVERGENCE OF HARVEST AND CONSERVATION STRATEGIES

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AND JAMES A. WESSON[6]

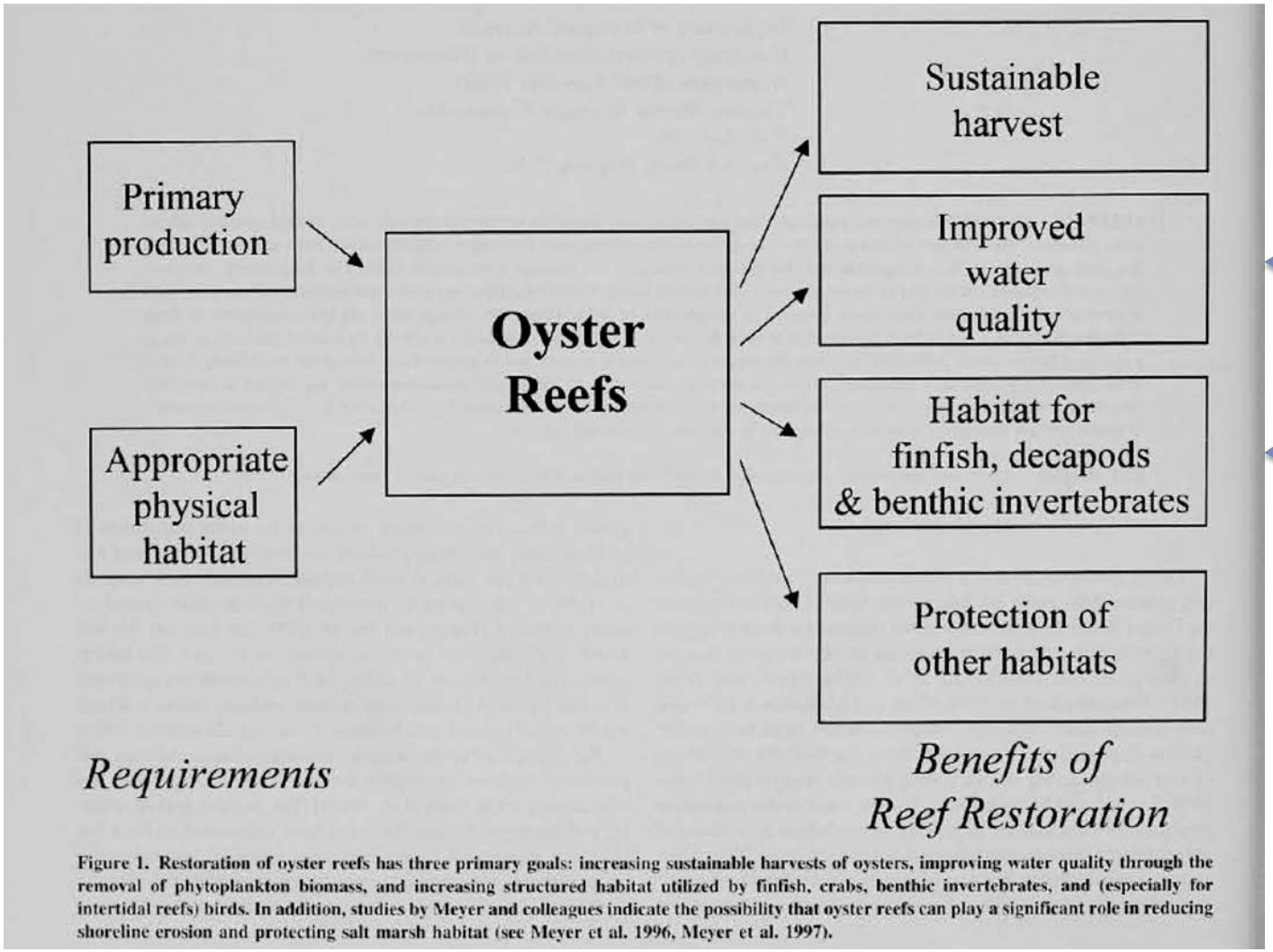


Figure 1. Restoration of oyster reefs has three primary goals: increasing sustainable harvests of oysters, improving water quality through the removal of phytoplankton biomass, and increasing structured habitat utilized by finfish, crabs, benthic invertebrates, and (especially for intertidal reefs) birds. In addition, studies by Meyer and colleagues indicate the possibility that oyster reefs can play a significant role in reducing shoreline erosion and protecting salt marsh habitat (see Meyer et al. 1996, Meyer et al. 1997).

Benefits of a sustainable harvest:

Restoration does not create a sustainable harvest, but creating a sustainable harvest provides ecological restoration

Fishing vs Farming

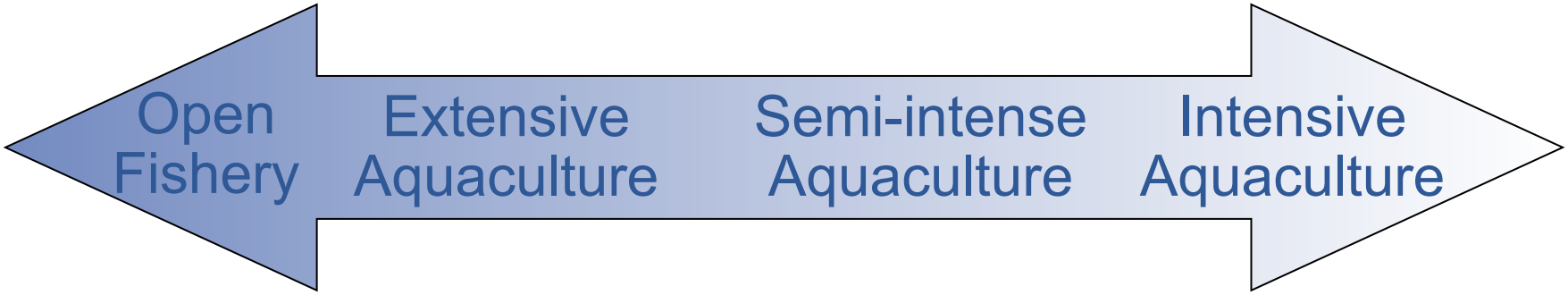
- According to FAO/USDA/NOAA/NJ DEP:

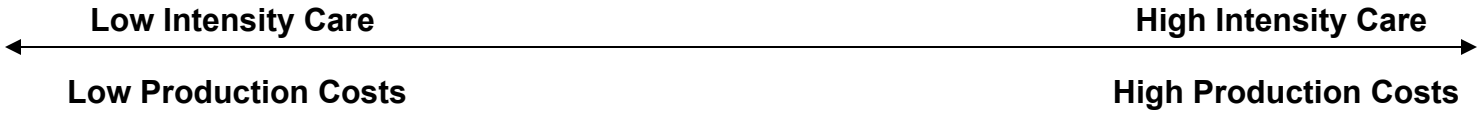
Aquaculture *is understood to mean the* ***farming of aquatic organisms*** *including fish, molluscs, crustaceans and aquatic plants.*

Farming implies *some form of* ***intervention*** *in the rearing process* ***to enhance production****, such as regular stocking, feeding, protection from predators, etc.*

Farming also implies *individual or corporate* ***ownership*** *of the stock being cultivated.*

The Fishery – Aquaculture gradient

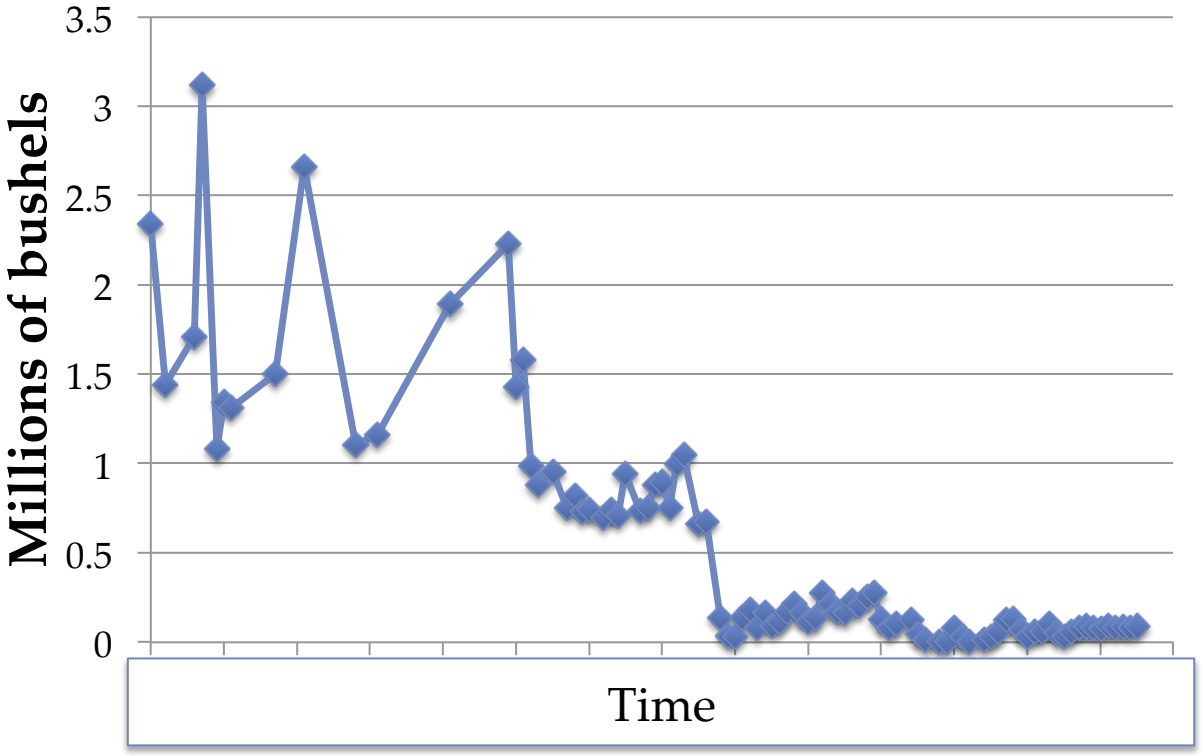




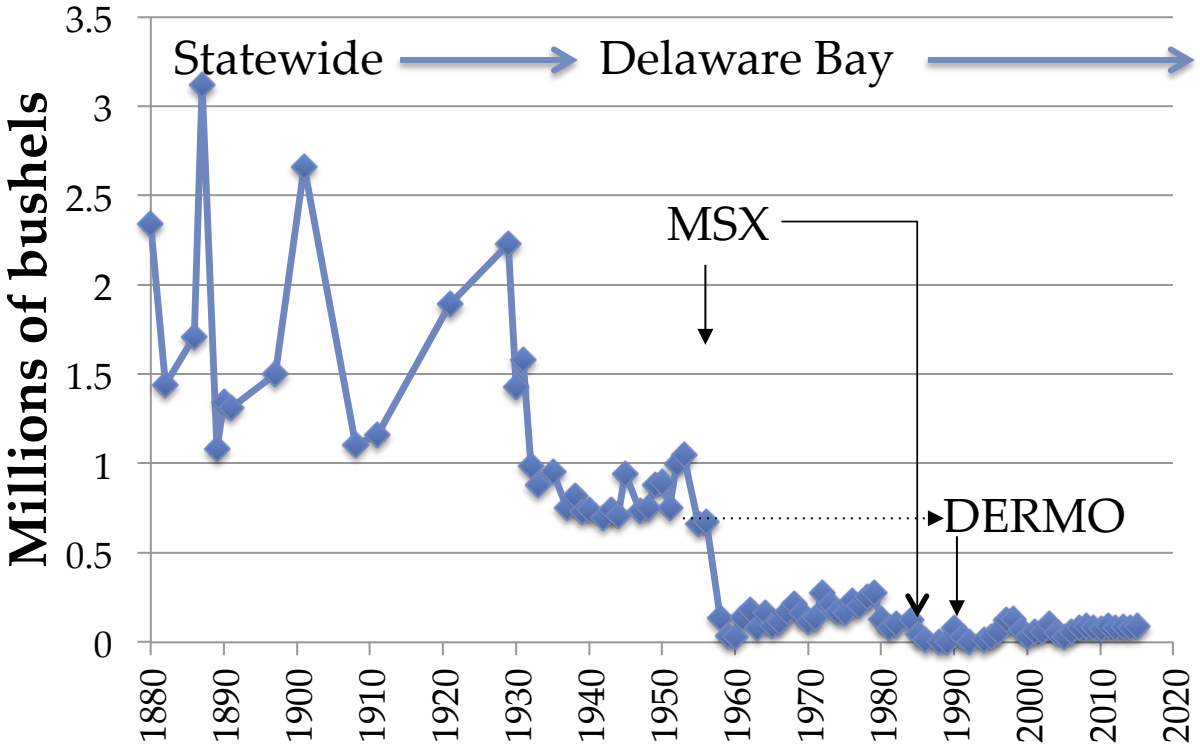
Examples:

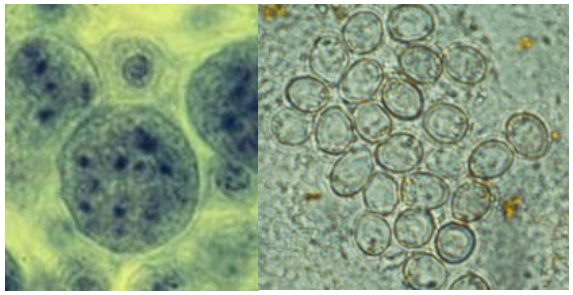
• Salmon fishing	–	salmon ranching	–	salmon pens
• Catfishing	–	stocking lake/river	–	catfish ponds
• Shrimping	–	capturing PL's	–	spawn & rear
• Oystering	–	plant shell/seed	–	rack & bag culture
• Collect seaweed	–	removing grazers	–	catch spores for raceways

Delaware Bay Oyster Landings

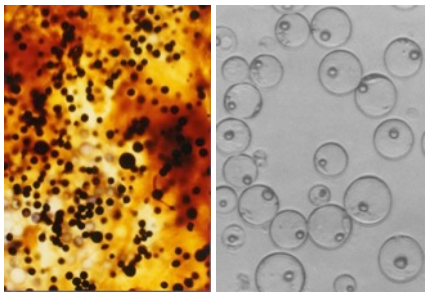


Delaware Bay Oyster Landings





MSX = *Haplosporidium nelsoni*



Dermo = *Perkinsus marinus*

Disease major factor in limiting harvest

Landings at 1% historic harvest

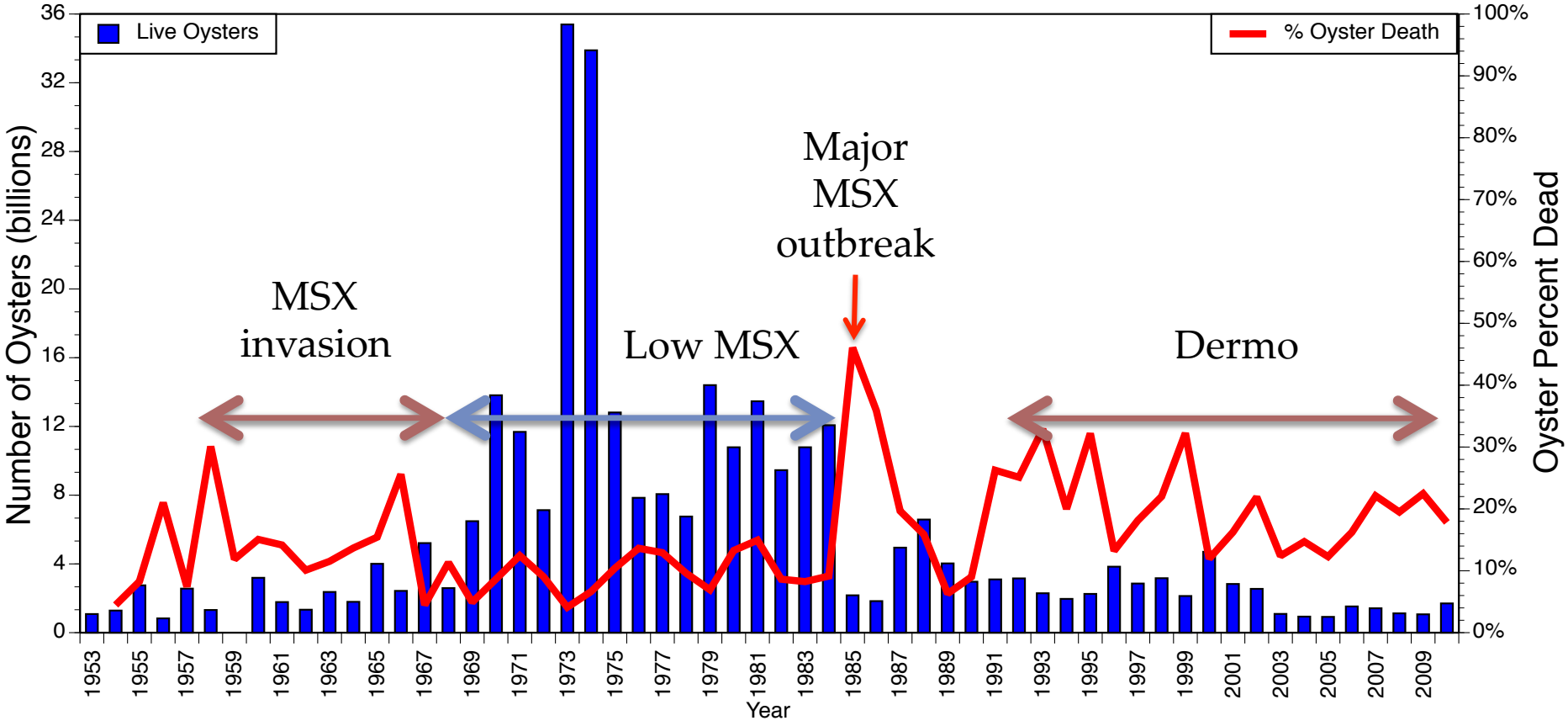
Landings ≠ Population
Not all bushels are equal

Population roughly ~15% of maximum levels we can confidently estimate, which we believe are close to carrying capacity

Fishery has adapted and evolved to remain sustainable

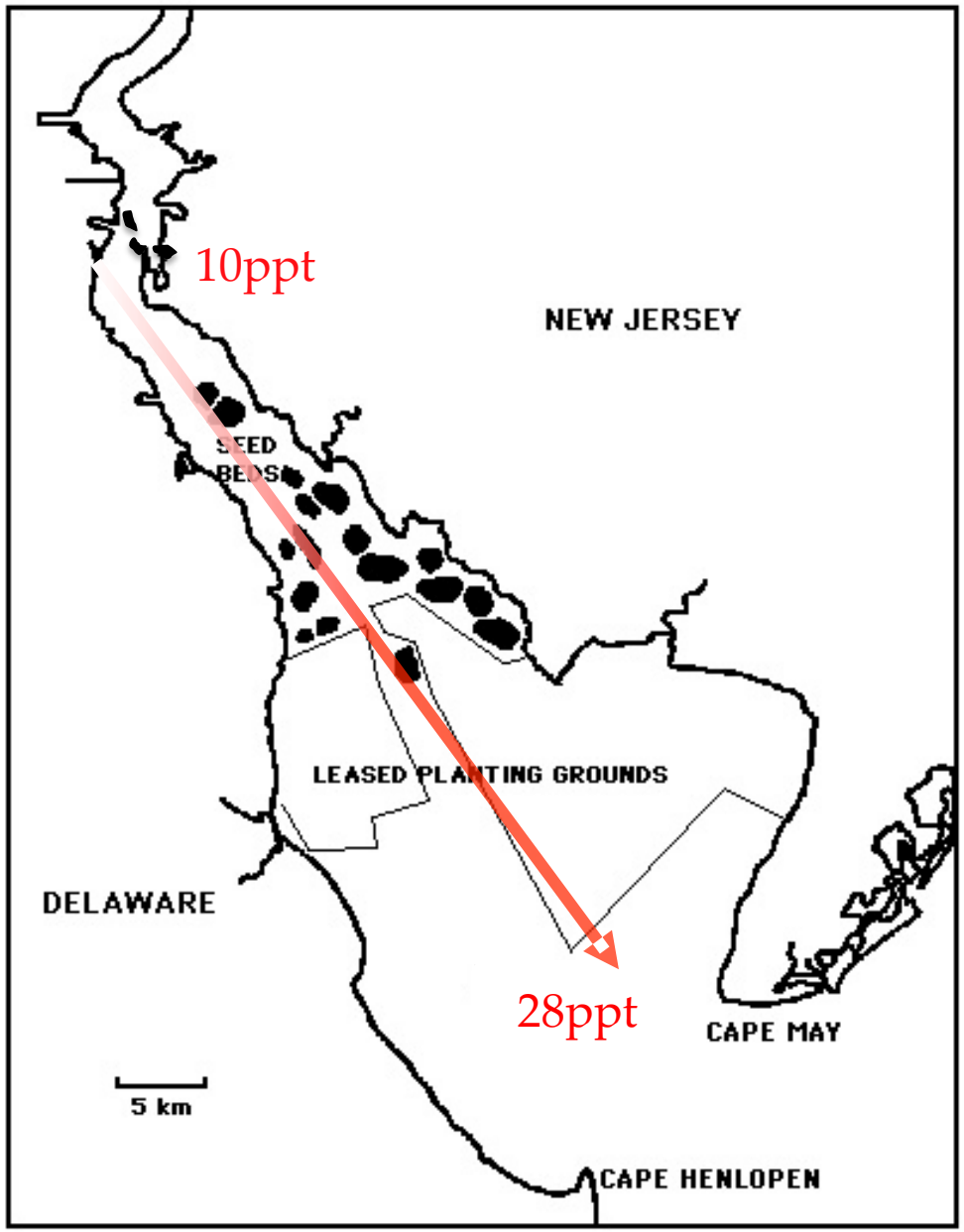
Population controlled by survival/disease

Fishing controlled by us



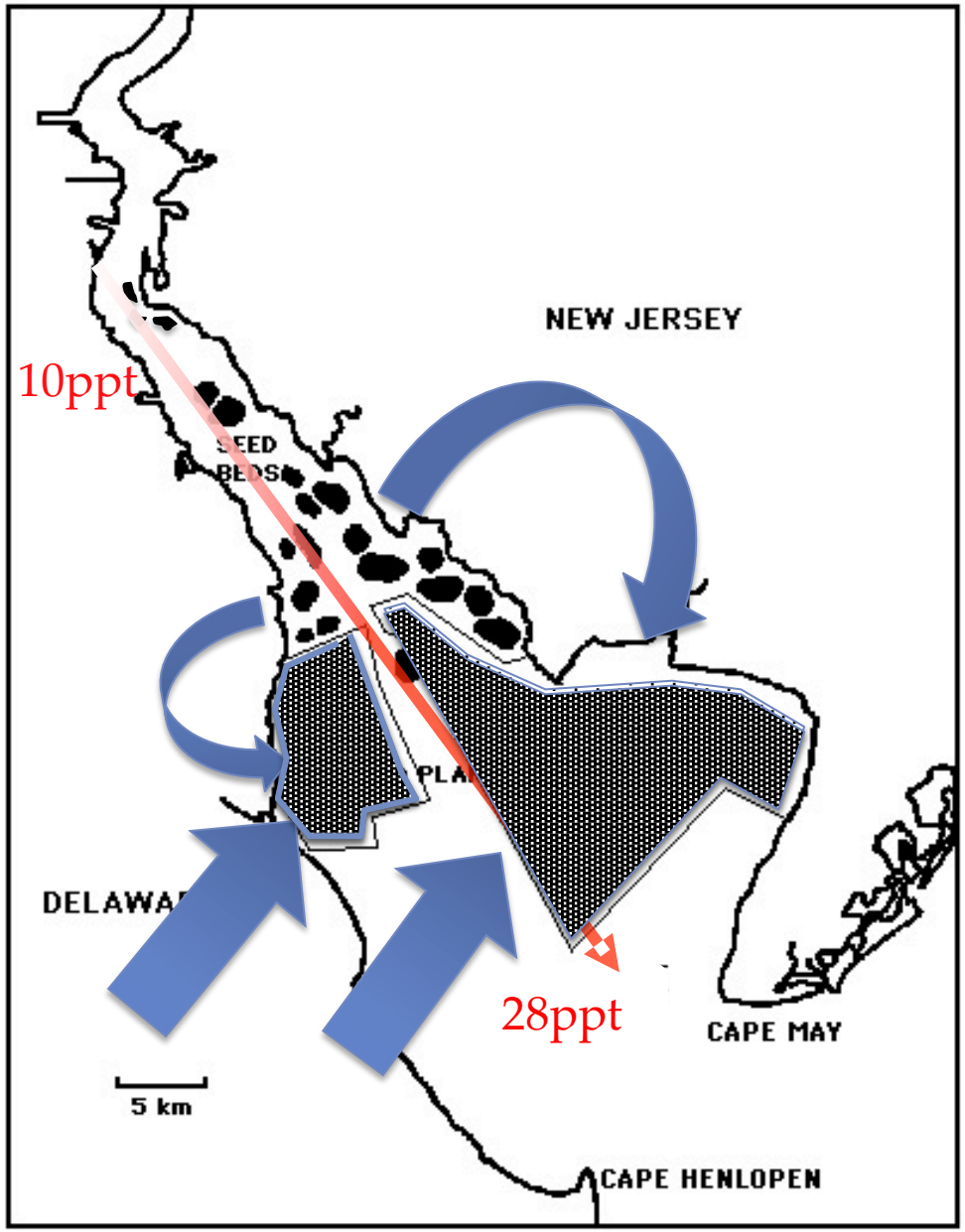
Throughout this period, Delaware Bay oyster fishery has been sustainably managed

Delaware Bay Oyster Population



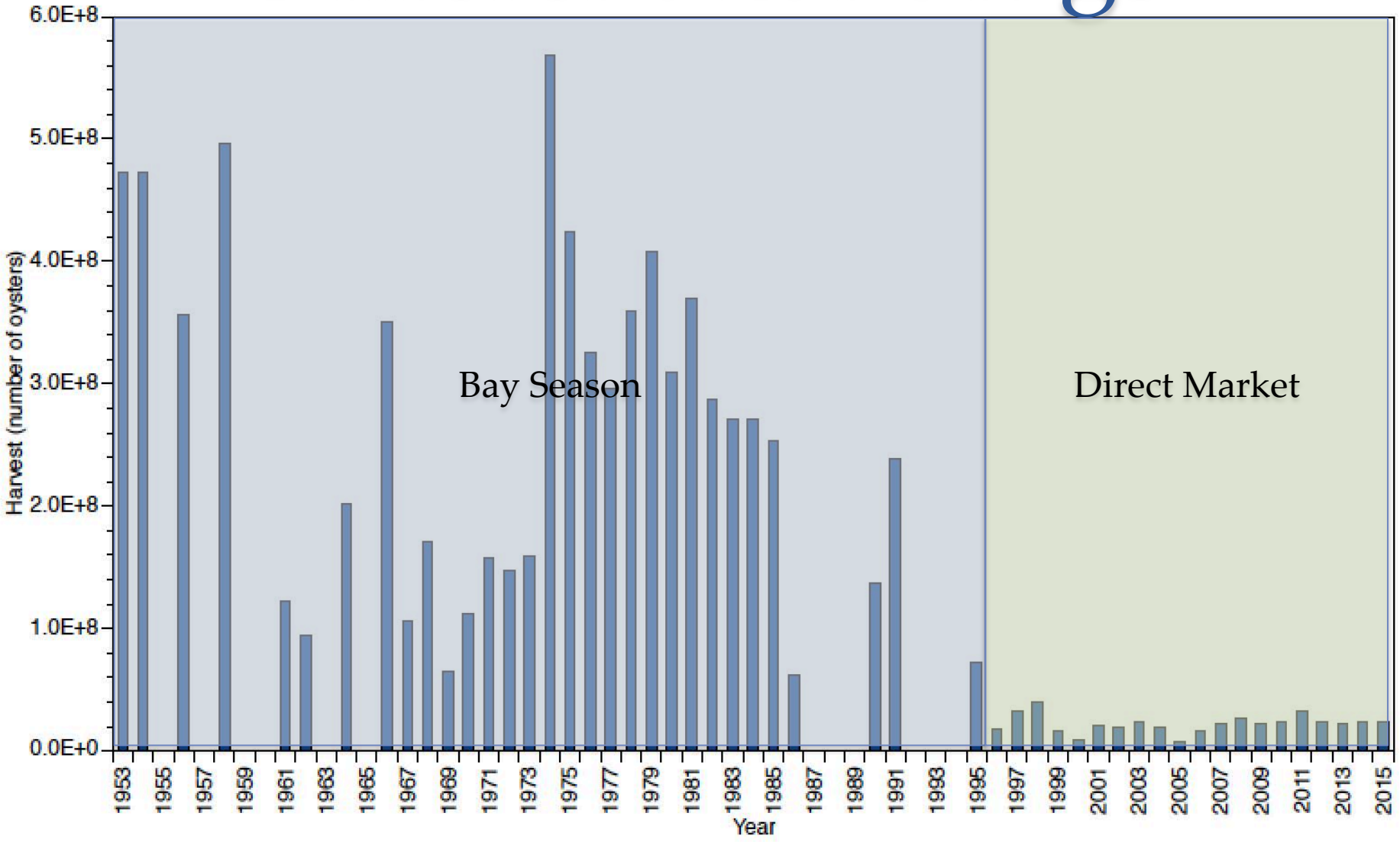
- Oysters exist throughout Bay with highest abundance in upper bay
  - 'natural' or 'seed' beds
- Additional oysters exist in tributaries and marshes
  - Closed waters = natural sanctuaries
- Oyster recruitment, growth, condition and quality all increase with salinity
- Oyster predation & mortality increase with salinity

Traditional 'Bay Season' Fishery

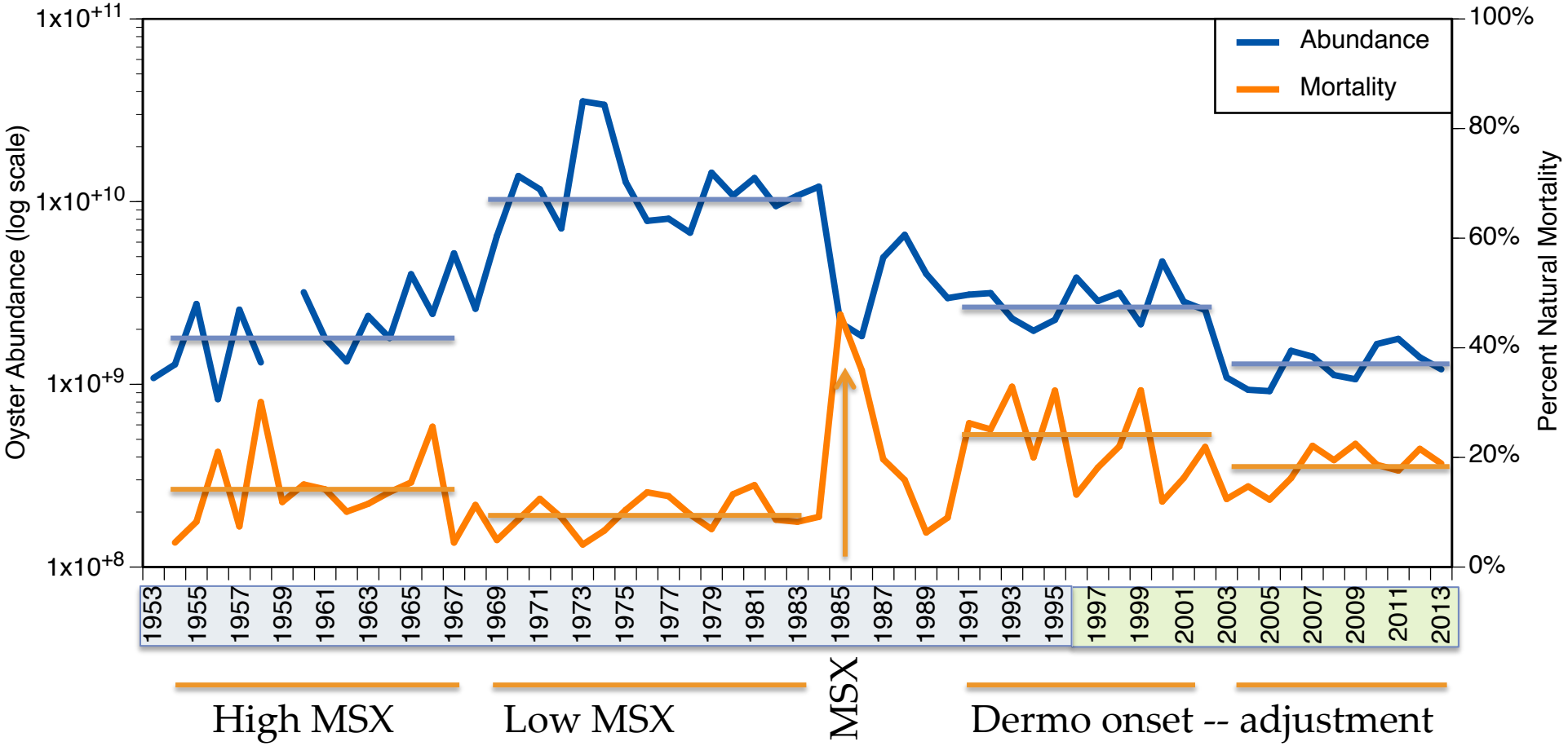


- Oyster recruitment, growth, condition and quality all increase with salinity
- Bay divided into natural beds and planted grounds
- Oysters transplanted during "bay season" for cultivation on leased grounds
- Additional oysters imported from out of state to increase production

Different Management Different Landings

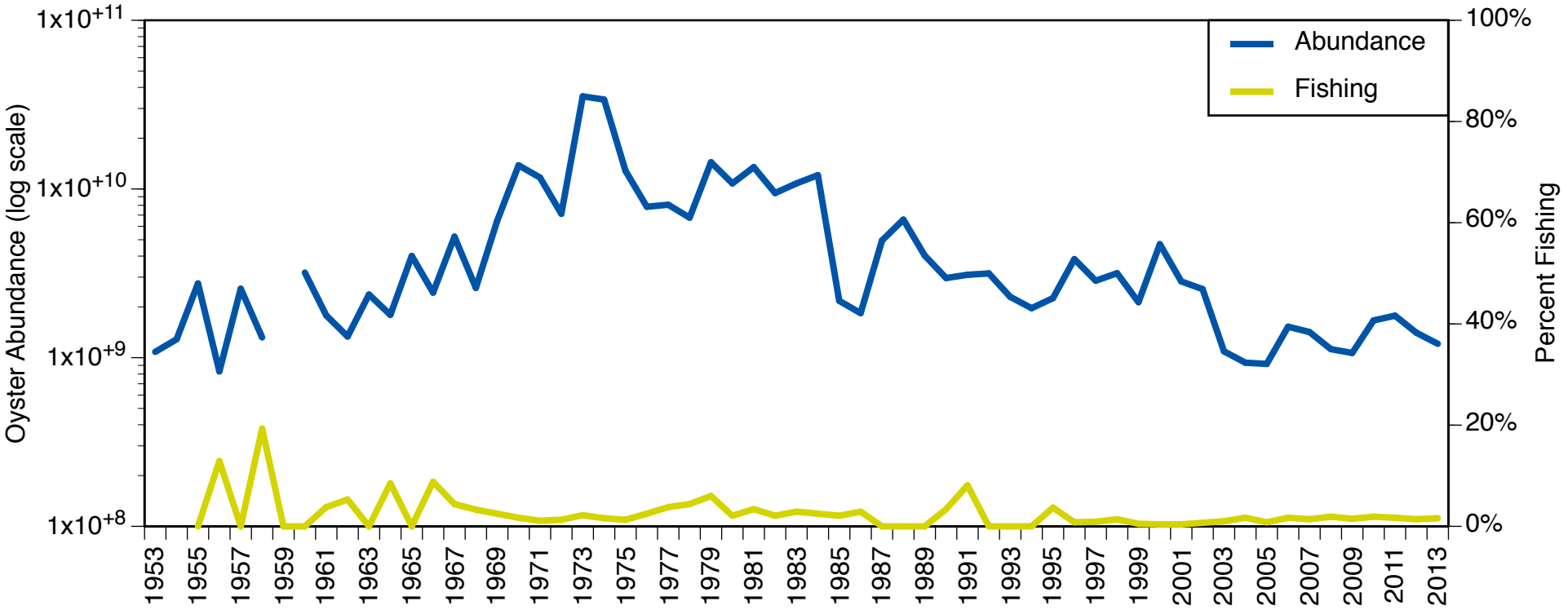


Long-term data highlight role of disease

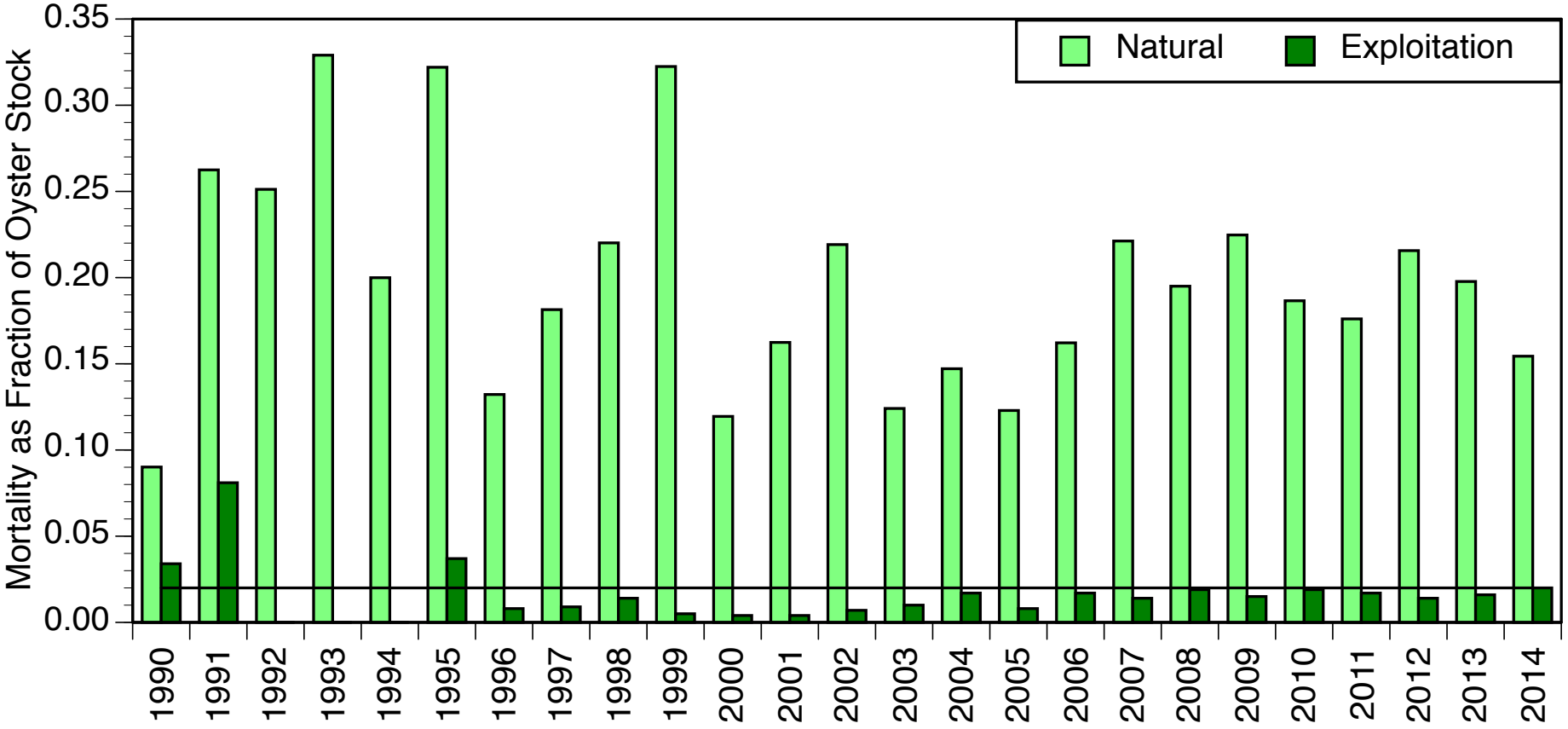


Oyster abundance in Delaware Bay is inversely related to mortality, which is largely controlled by disease.

Long-term data indicate population change in not linked to fishing

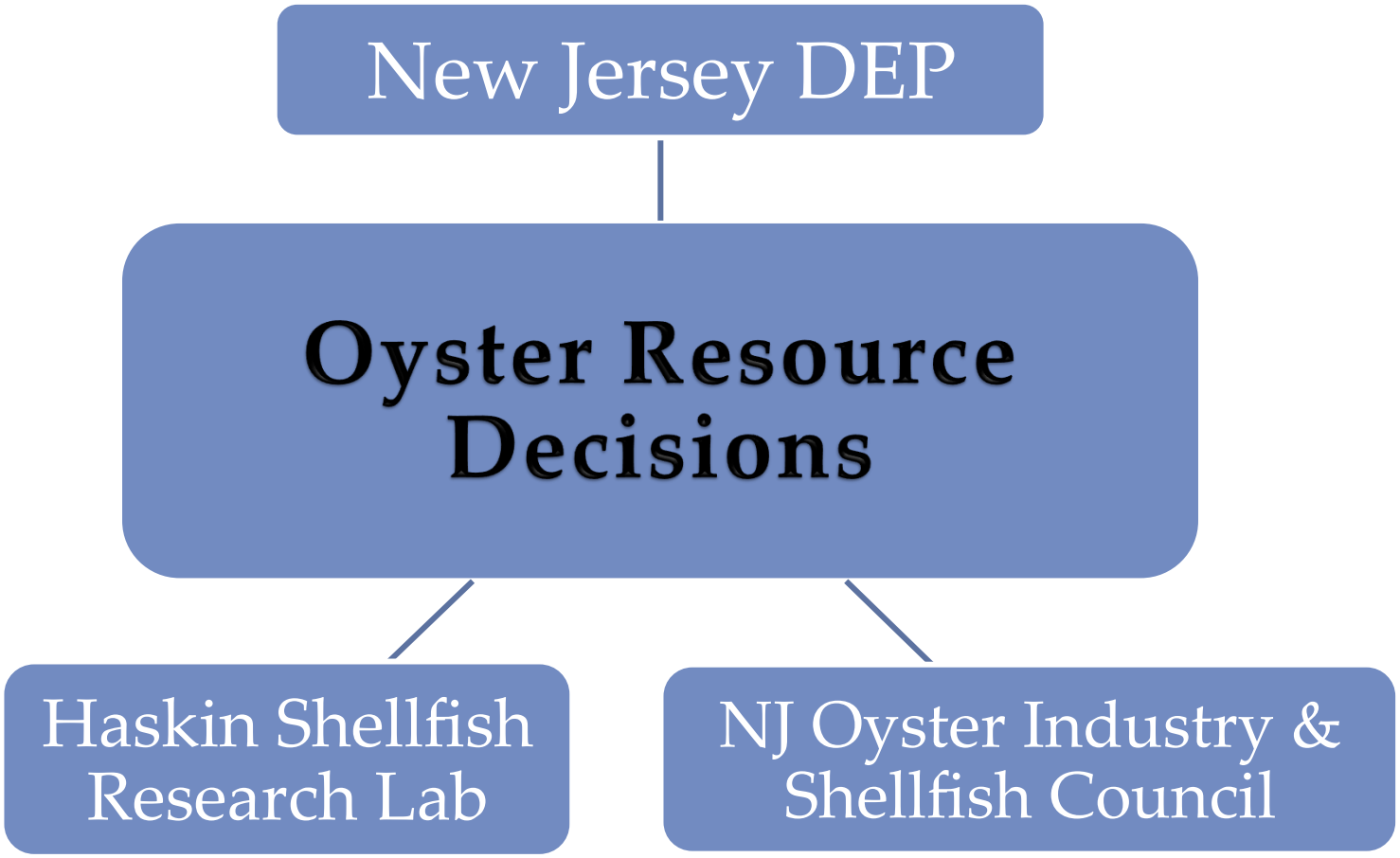


Fishing mortality (aka exploitation) has been a small fraction of total annual mortality. Less than 2%



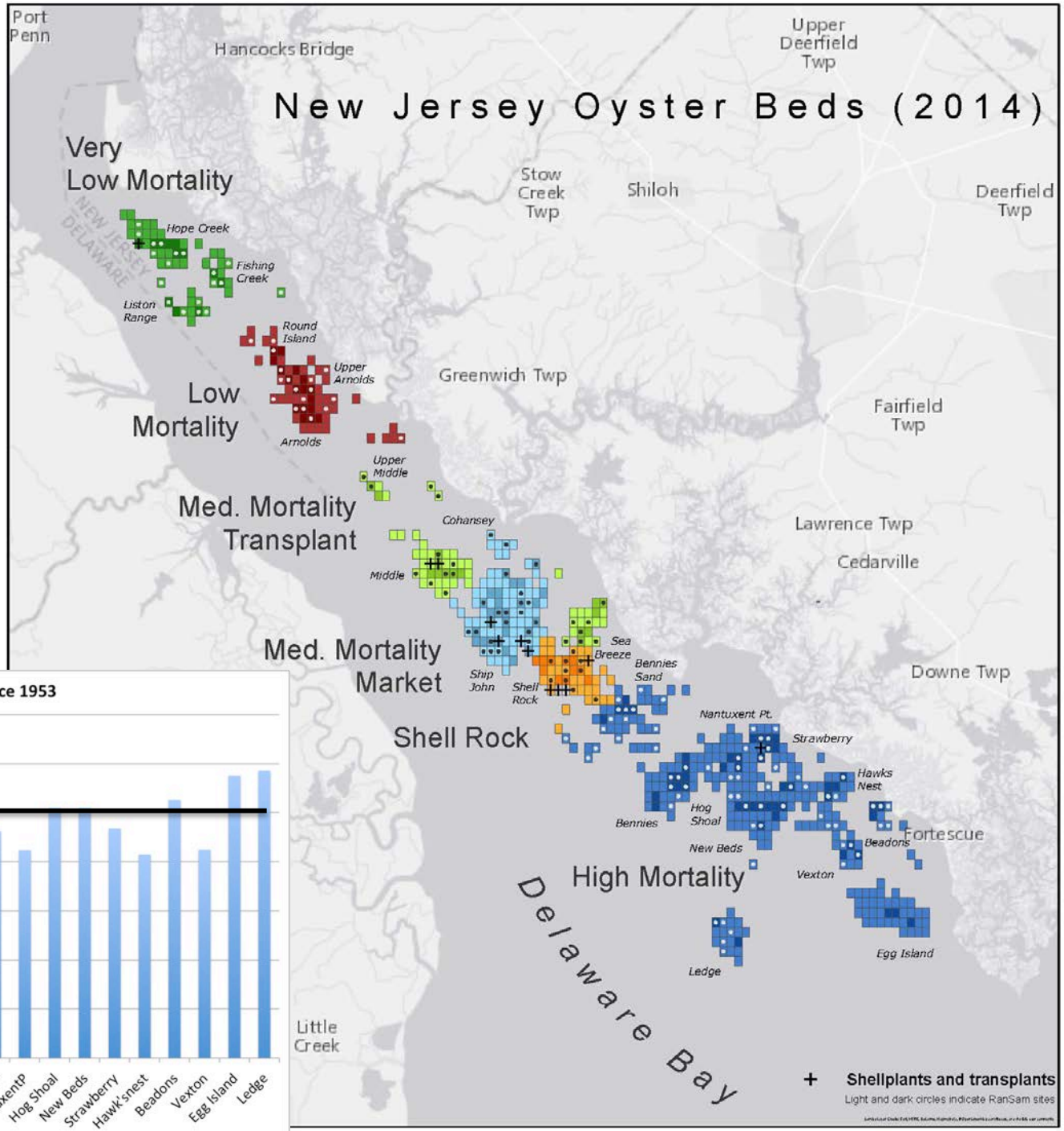
High mortality rates, driven up by persistent disease pressure requires precautionary fishing rates – other fisheries often operate at 10, 15 or 20%.

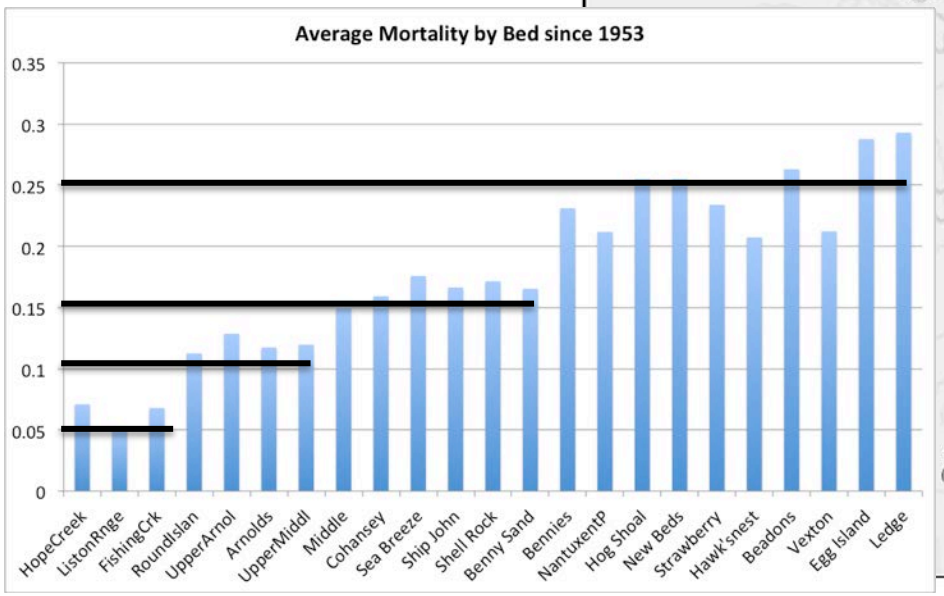
Delaware Bay Oyster Resource Management



Key Management Strategies:

- 40% Rule – harvest control point (biological reference pt)
- Area Management – spreads harvest
- Quantitative Survey – key component
- Abundance Based Quota – closely controls harvest
- Direct Marketing – avoids lower bay losses to predation disease and fouling





18th Annual New Jersey Delaware Bay Oyster Stock Assessment

Haskin Shellfish Research Laboratory
February 9-11, 2016

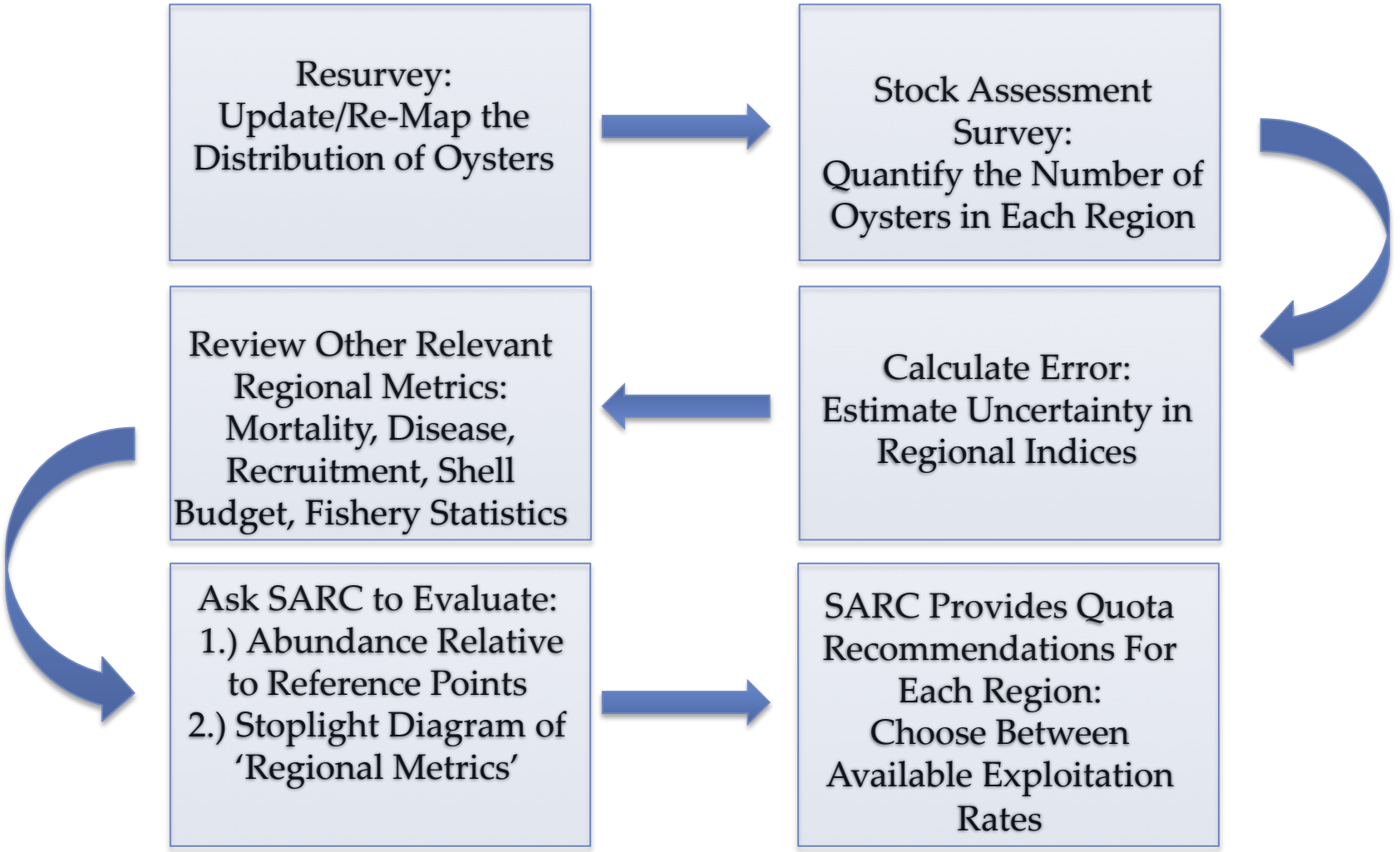
RUTGERS
New Jersey Agricultural Experiment Station

New Jersey's annual oyster stock assessment is a formal, peer-reviewed, cooperatively managed process.

- The Haskin Shellfish Research Lab monitors oysters throughout the year culminating in a spatially explicit population assessment each fall.
- Survey and other program results are presented at a Stock Assessment Workshop (SAW) and are evaluated by a Stock Assessment Review Committee (SARC)
- The SARC has 9 rotating positions that include academicians, resource managers, and industry members from New Jersey and elsewhere.

Group	Members	Duties
NJDEP	Biologists Managers Statisticians Enforcement Administrators	Approves all decisions impacting public oyster resource. Lead/coordinate management activities. Monitor harvest/enforce regulations. Collect, maintain & disperse industry imposed harvest taxes.
Rutgers Haskin Shellfish Research Laboratory (HSRL)	HSRL faculty and staff	Design & analyze stock assessment. Execute surveys with industry and NJDEP assistance. Address science needs. Host and facilitate SAW. Prepare SAW report.
Shellfish Council	Industry	Select harvest rate & area mgmt. activities from SARC recommendations. Plan and approve disbursement of industry imposed harvest taxes.
Oyster Industry Science Steering Committee	HSRL Shellfish Council NJDEP	Prioritize science agenda and management strategies. Nominate SARC membership
Stock Assessment Review Committee (SARC)	**Academics: 1 RU + 2 external. Managers: 2 NJ + 2 external. Industry: 1 Council + 1**	**Peer review of assessment. Recommend harvest rates & area management by region. Provide science advice**

Stock Assessment Design



Resurvey → Stock Assessment Survey → Estimate Uncertainty → Review Metrics → BRPs / Stoplight → Quota Recommendations

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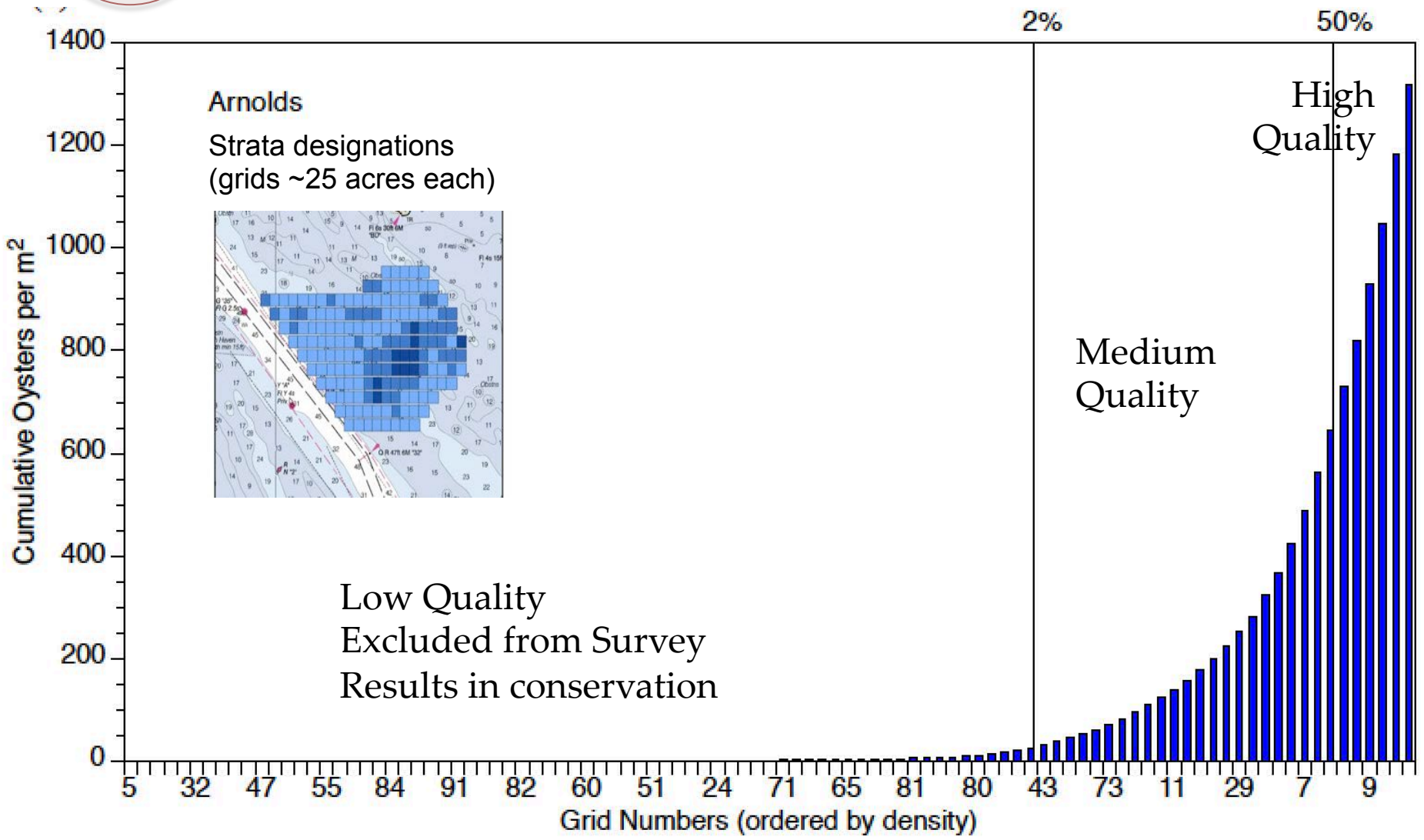

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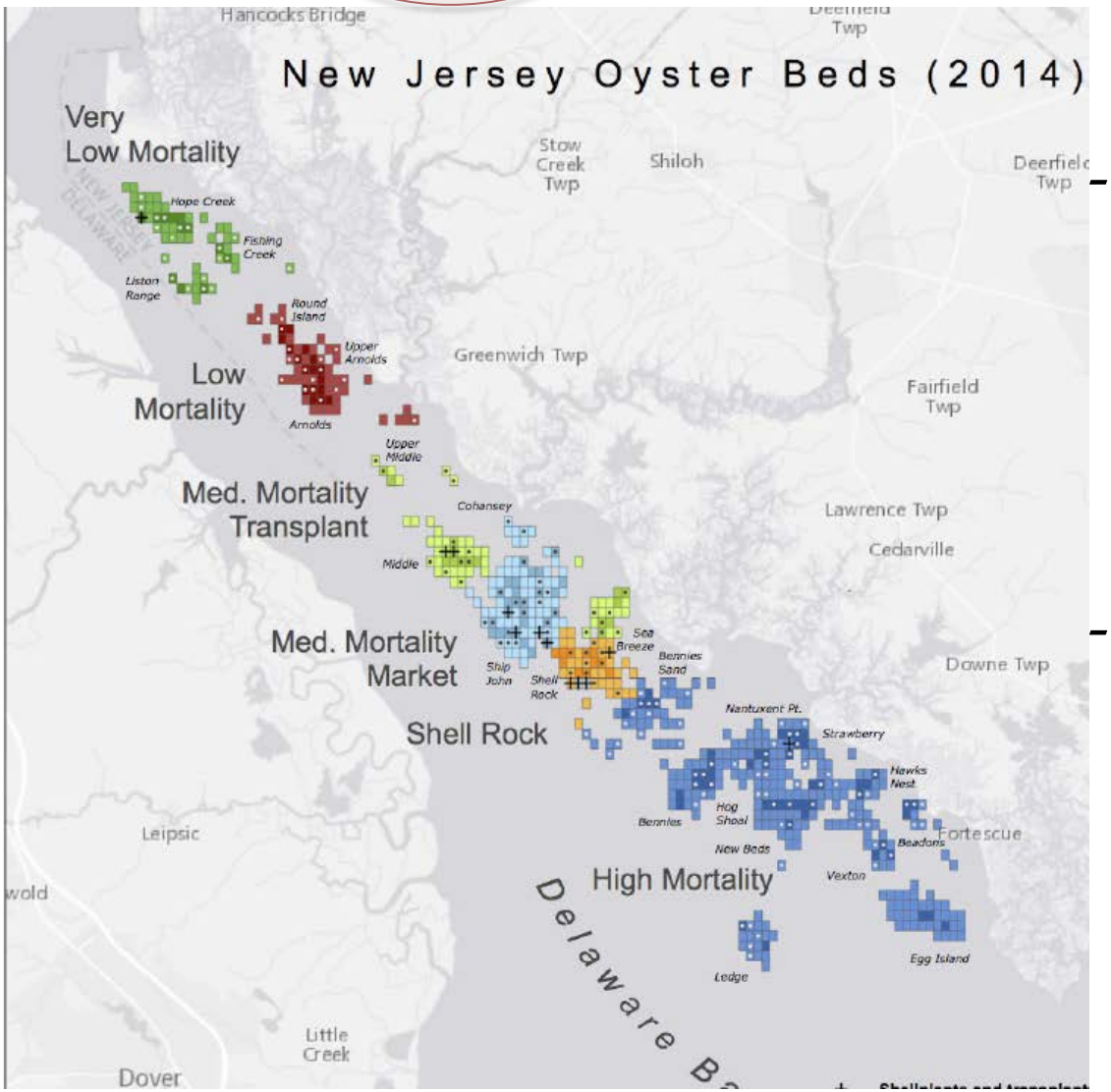
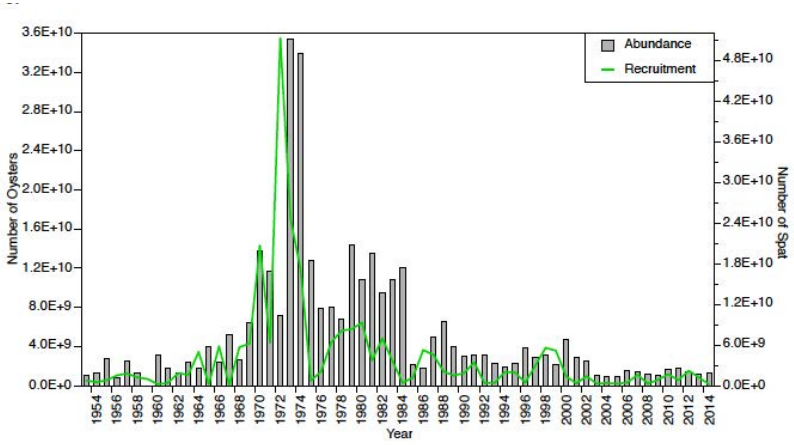


- High and medium strata-specific abundance estimates are summed for each bed.
- The abundance estimates on each bed are summed within a each management region.

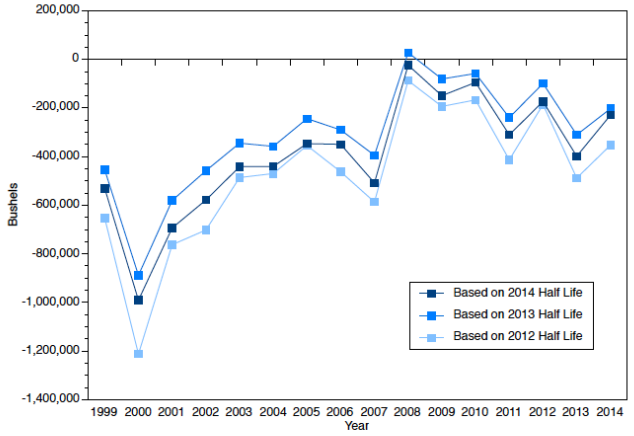
Stock Assessment Design

Resurvey → Stock Assessment Survey → Estimate Uncertainty → **Review Metrics** → BRPs / Stoplight → Quota Recommendations

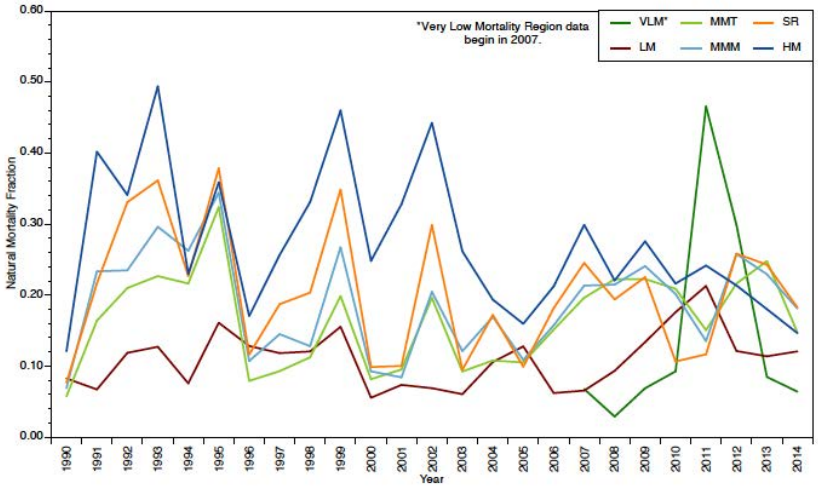
Recruitment



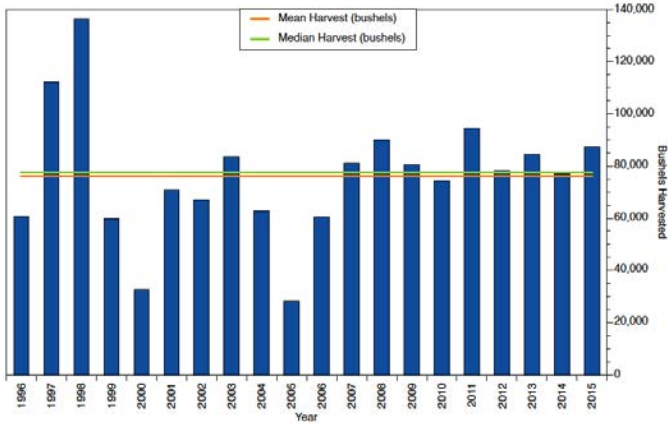
Shell Budget



Disease and Natural Mortality



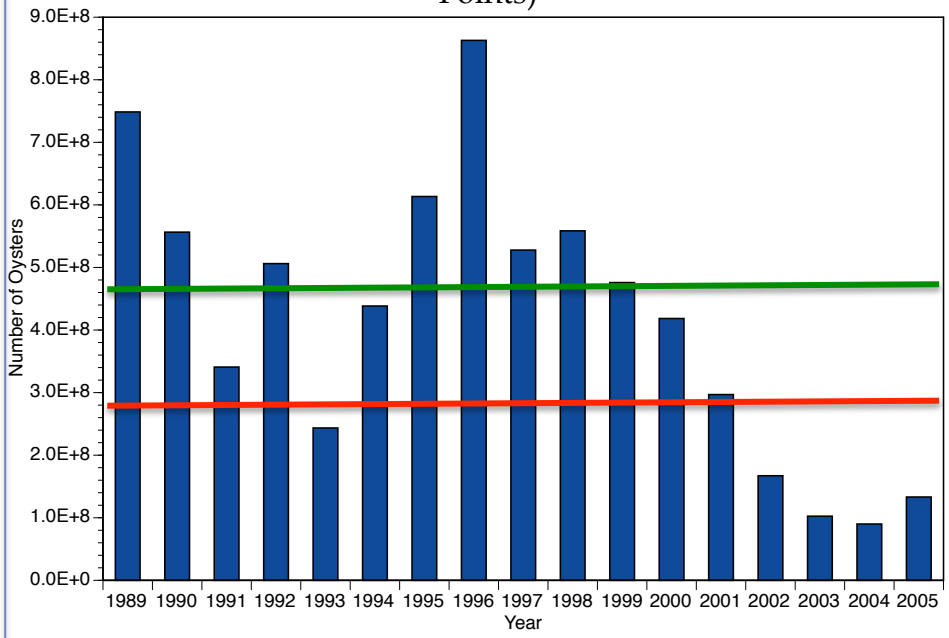
Fishery Statistics



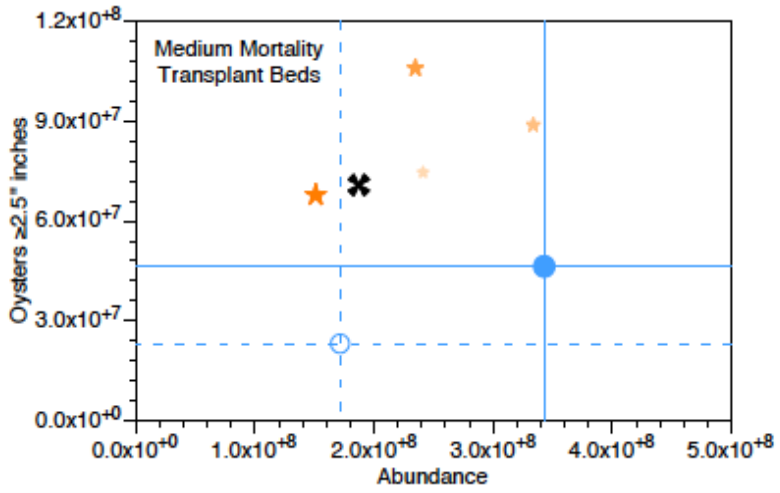
Stock Assessment Design

Resurvey → Stock Assessment Survey → Estimate Uncertainty → Review Metrics → BRPs / Stoplight → Quota Recommendations

Region-Specific Targets and Thresholds (Biological Reference Points)



- Baseline time period used to calculate Target/Threshold is 1989 – 2005.
- Target is the median (green).
- Threshold is ½ of the median (red).



Stoplight Table: Abundance-Based Metrics, Disease and Mortality, and Recruitment

2014 Metrics	Transplant Very Low Mortality	Transplant Low Mortality	Transplant Medium Mortality	Market Medium Mortality	Market Shell Rock	Market High Mortality
Total Abundance						
Percentile	--	0.22	0.14	0.42	0.54	0.42
vs 09-13 Median	Above	Below	Below	Below	Above	Above
vs Target-Thresh	Between	Between	Between	Between	Above	Between
SSB						
Percentile	--	0.06	0.30	0.42	0.78	0.58
vs 09-13 Median	Below	Below	Below	Above	Above	Above
vs Target-Thresh	Below	Below	Between	Between	Above	Between
Mkt. Abundance						
Percentile	--	0.38	0.63	0.54	0.88	0.71
vs 09-13 Median	Above	Below	Below	Below	Above	Above
vs Target-Thresh	Above	Above	Above	Above	Above	Above
Recruitment						
Percentile	--	0.18	0	0.06	0	0.06
vs 09-13 Median	Below	Below	Below	Below	Below	Below
Mortality						
Percentile	--	0.62	0.38	0.46	0.42	0.06
vs 09-13 Median	Below	Below	Below	Below	Below	Below
Rate	0.06	0.12	0.15	0.18	0.18	0.15
Dermo						
Percentile	0.285	0.291	0.41	0.65	0.25	0.08
vs 09-13 Median	Below	Below	Below	Above	Below	Below
Wtd. Prevalence	0.01	0.22	1.58	2.18	1.58	1.64

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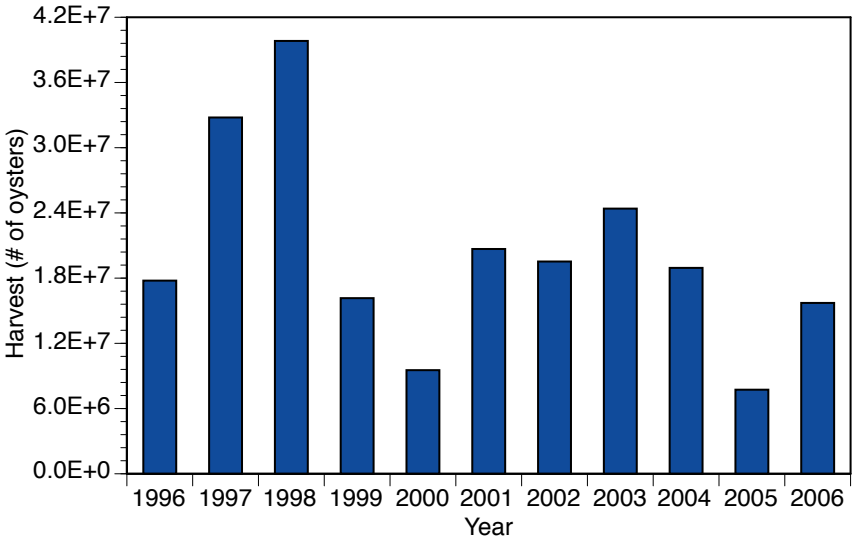


Fishing rates based 1996-2006 harvests, a period of conservative fishing during Dermo era, that did not impact abundance

Calculate the percent of the population harvested = exploitation rate

These rates available to calculate quota

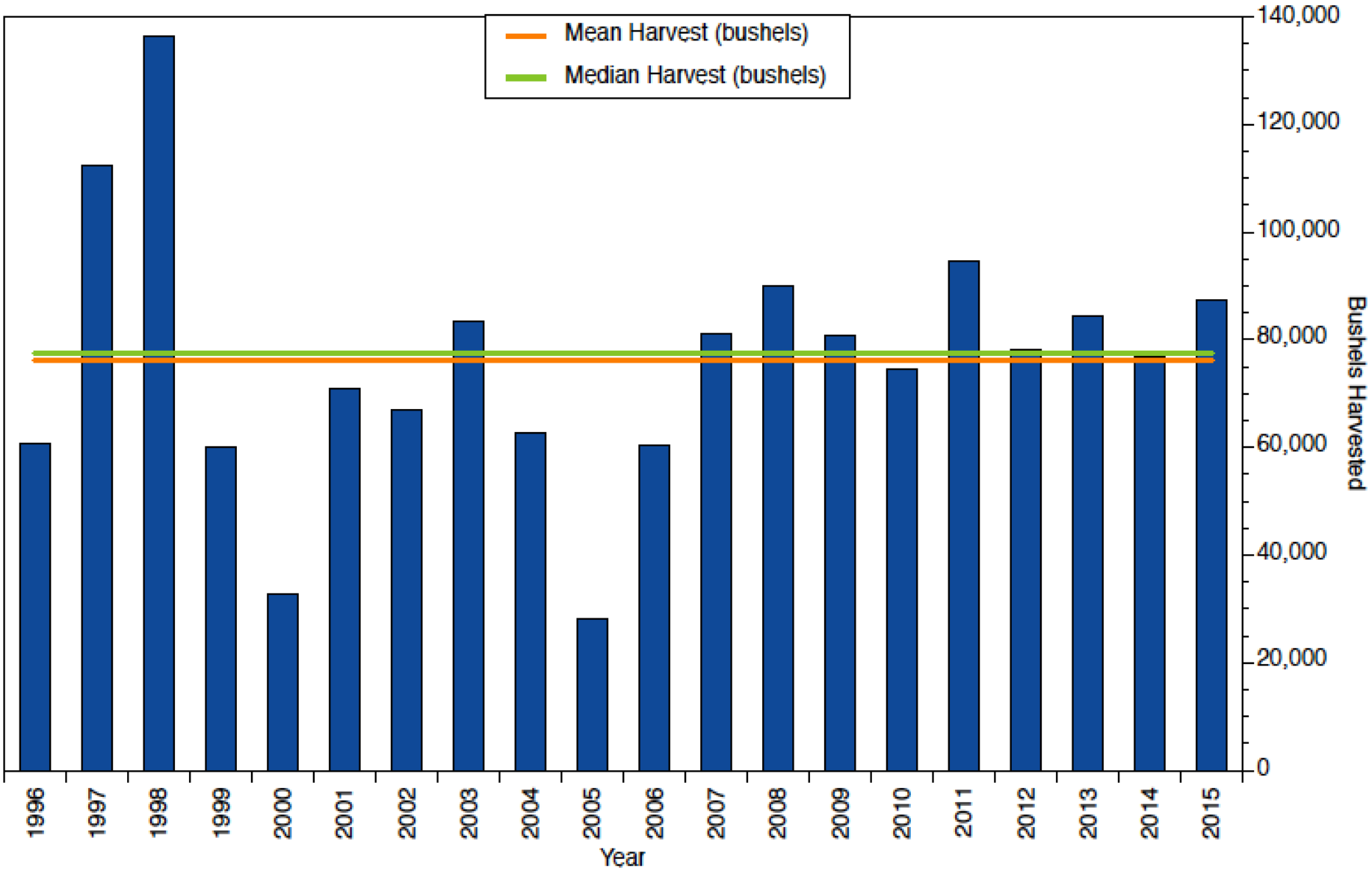
2013 Quota Table

Bay Region	Percentile	Exploitation Rate	Number of Oysters Removed	Direct-market Bushels
High Mortality	→ 40th	.0122	730,049	2,745
	→ 50th	.0652	3,901,574	14,668
	→ 60th	.0782	4,679,494	17,592
Shell Rock	→ 25th	.0531	1,603,191	6,027
	→ 40th	.0870	2,626,696	9,875
	50th	.0880	2,656,888	9,988
	60th	.1140	3,441,878	12,939
Medium Mortality Market	→ 40th	.0178	4,113,325	15,464
	→ 50th	.0214	4,945,234	18,591
	→ 60th	.0267	6,169,988	23,195
	→100th	.0398	9,197,210	34,576

Quota divided equally among licenses

= catch share management

Adding a license decreases every catch share



Delaware Bay direct market fishery has stabilized at an average of ~76,000 bushels.

Oysters build habitat

Fishery harvests habitat

Ecosystem health depends upon healthy reefs
Local economy depends on healthy oyster fishery
Managers must balance these needs

Shell planting is primary restoration tool.

Presently, entirely industry funded by self-imposed bushel tax

Plant ~150,000 bu/yr

Shell planting increases:
oyster abundance
oyster habitat
oyster harvest

Fall 2005

Spring 2005

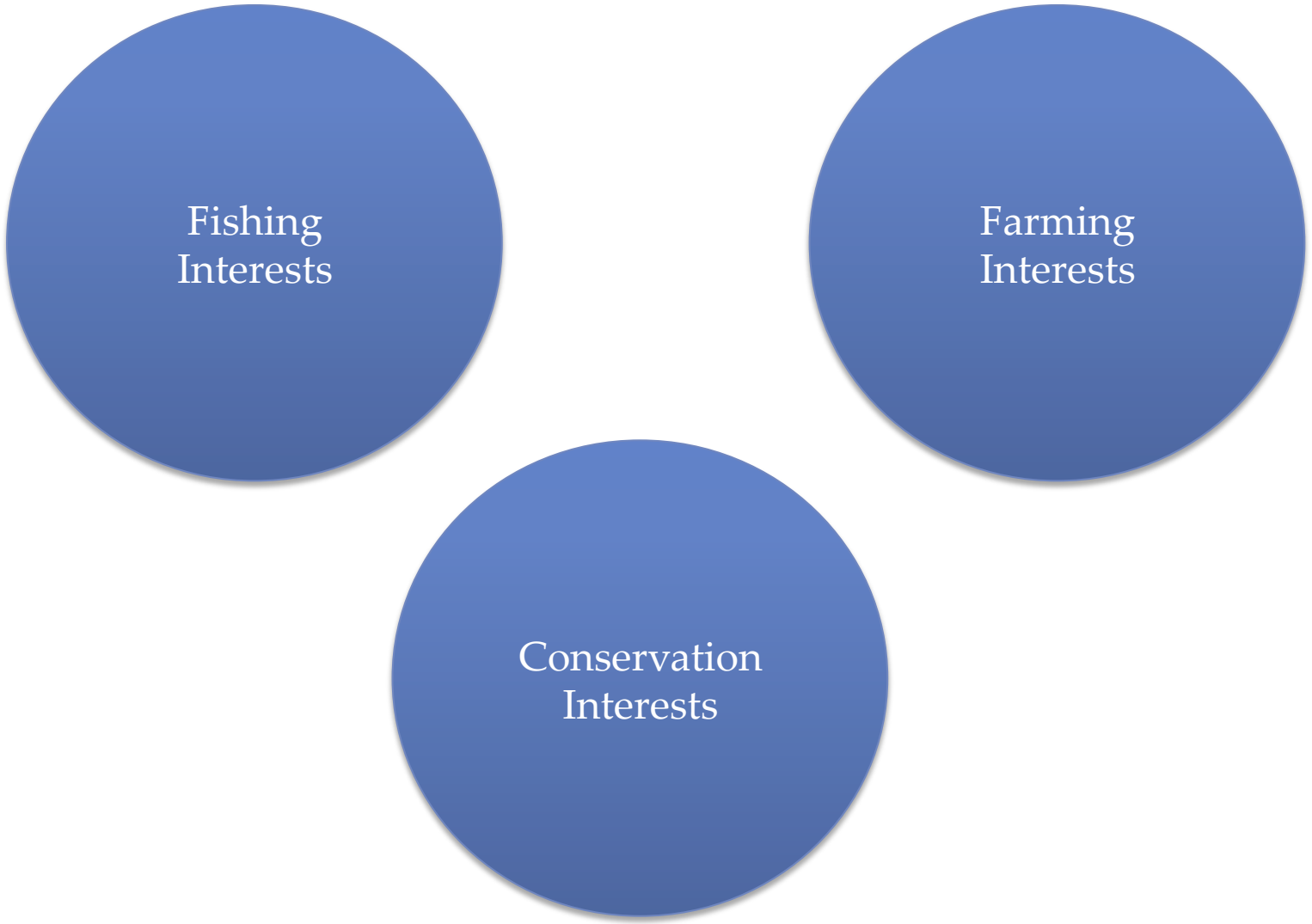
Summer 2004

Fall 2003

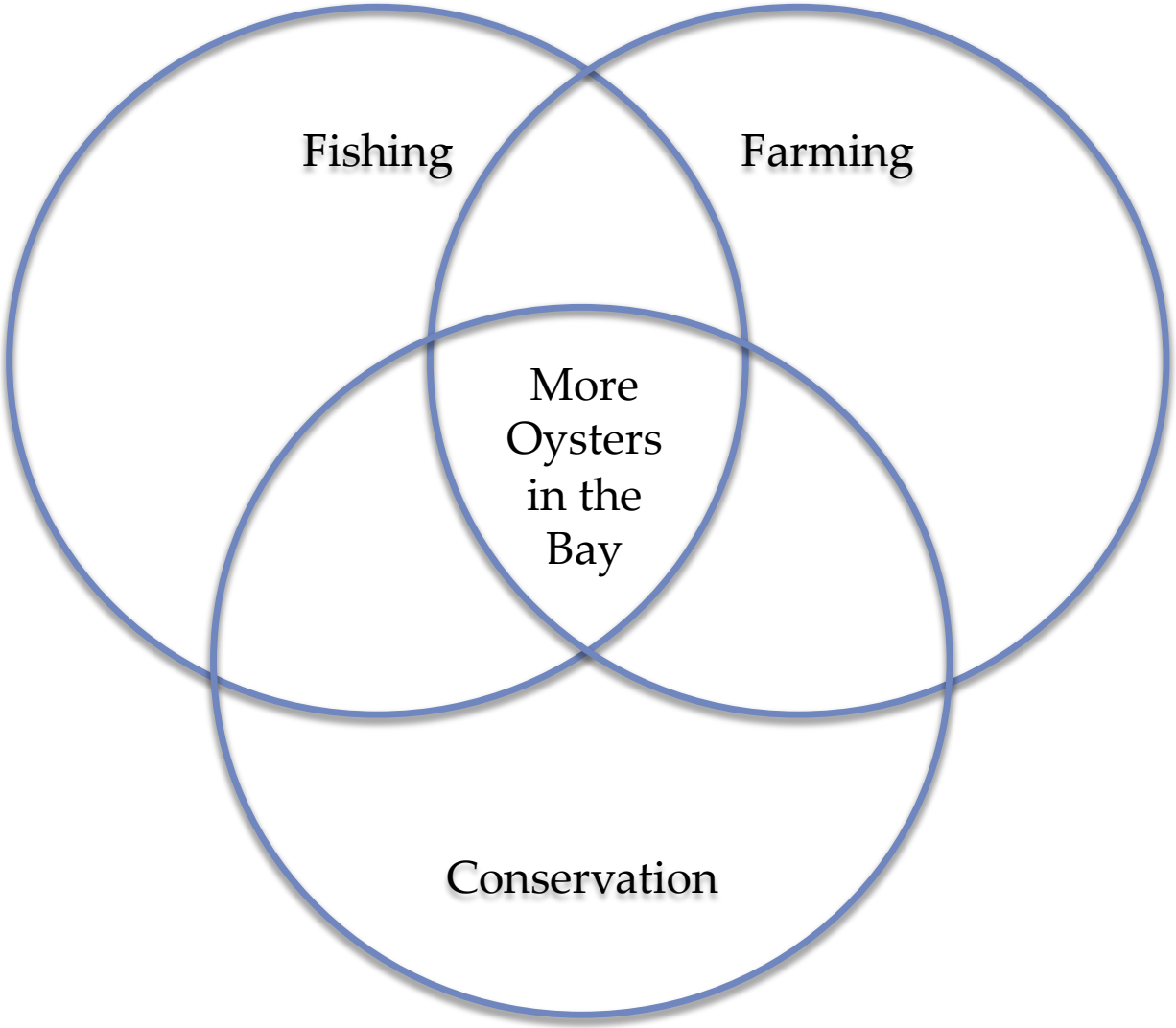
Estimated economic impact is 25:1 on average

Limitations: Funding, shell, regulations, labor

Observation



Oysters beget oysters



INTERNATIONAL CONFERENCE ON SHELLFISH RESTORATION
ICSR/2016

NOVEMBER 16-19, 2016

SAVE THE DATE

18TH INTERNATIONAL CONFERENCE ON SHELLFISH RESTORATION
HYATT PLACE IN CHARLESTON, SOUTH CAROLINA, U.S.A.

Please plan on joining shellfish restoration experts, resource managers, farmers, community groups, NGOs, and others in historic Charleston, South Carolina for the **18th International Conference on Shellfish Restoration (ICSR)**.

For more information, visit www.scseagrant.org/icsr

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Photo: Elizabeth Ashton, Ph.D., Queen's University Belfast

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Thanks

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Questions?