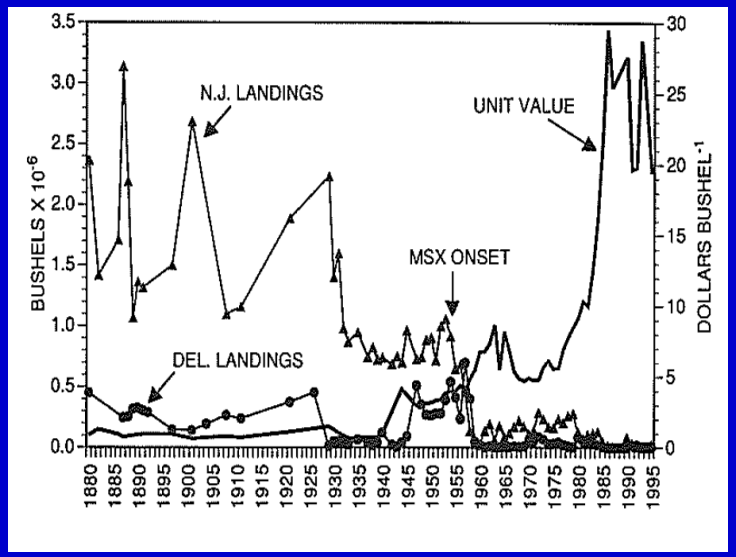

Shifting Baselines
in Mid-Atlantic Estuaries

Historical perceptions affect restoration goals



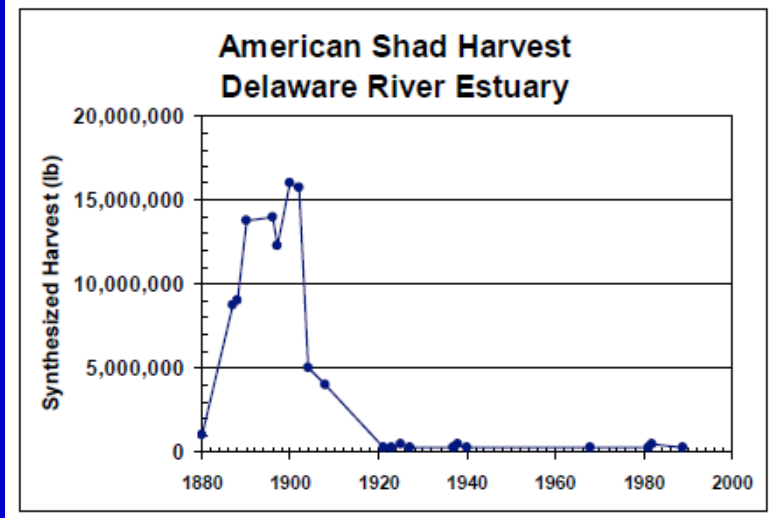
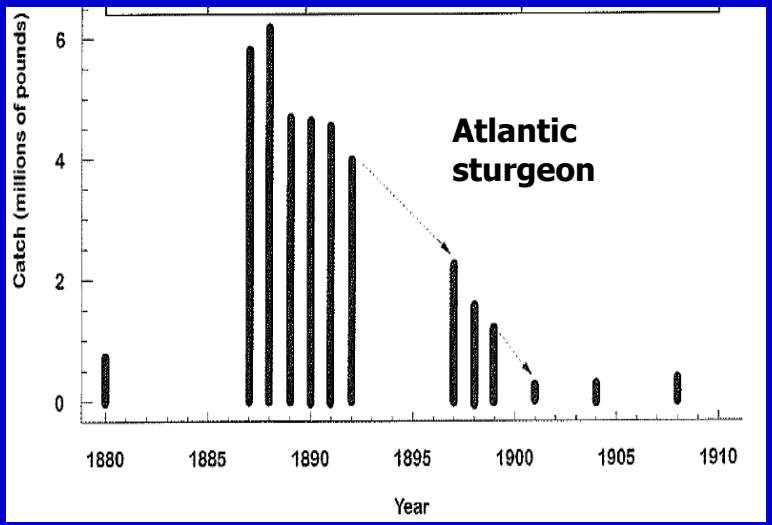
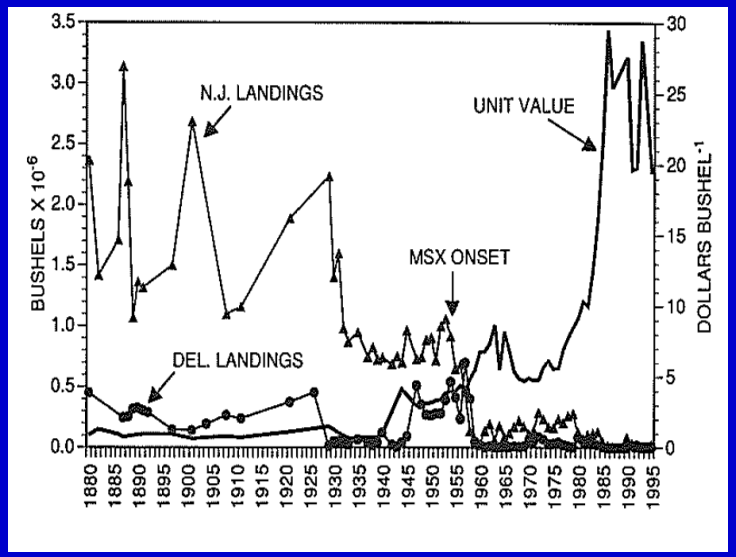
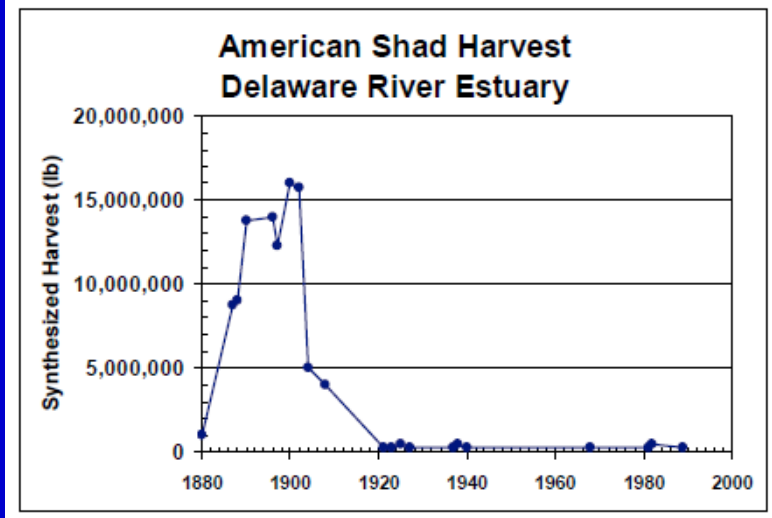


Figure 2.4. Synthesized American shad harvest in the Delaware Estuary. (Delaware Estuary Program 1996)



However, shifting baselines affect our historical perceptions





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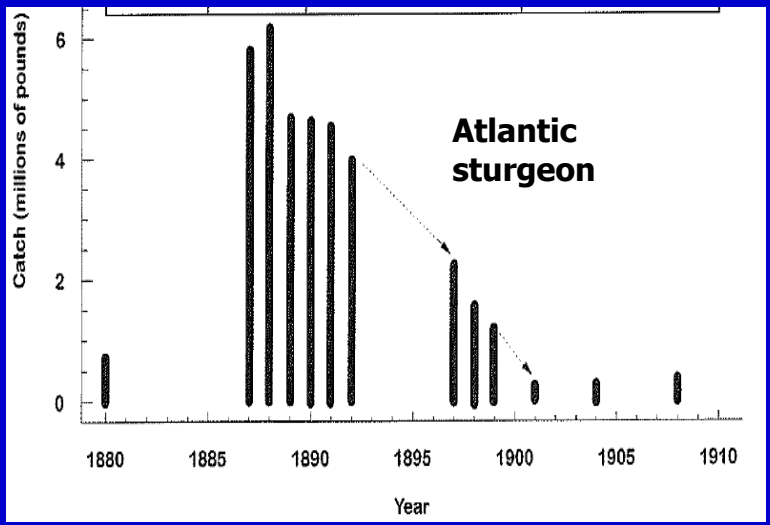


What is a shifting baseline?

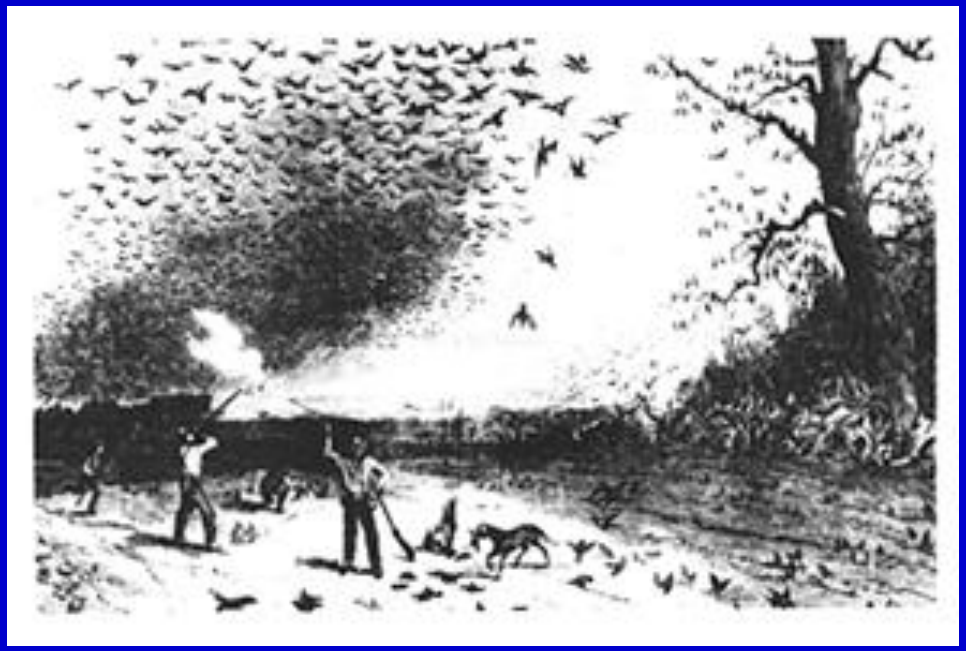
- A baseline is a point of reference against which other points can be compared.

- A shift occurs when the point of reference at time A is different from a point of reference at a later time B because of a change of conditions.

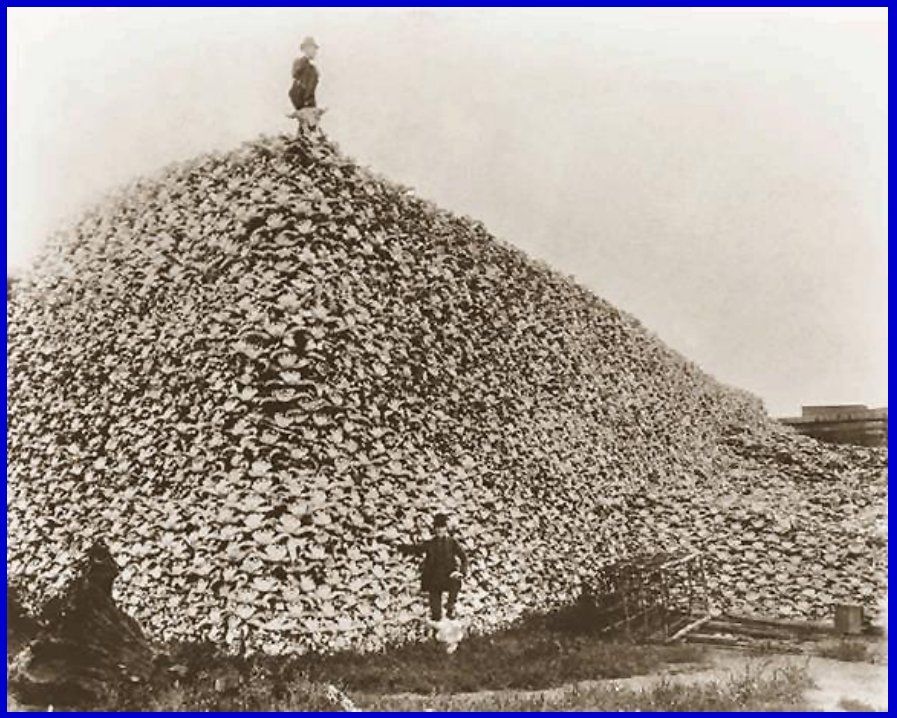
So, shifting baselines can affect ecosystem restoration goals

- Ecosystems have a long history of human intervention, but a short history of biological study
- People adjust to continuous degradation of a resource and eventually reduce expectations
- The reference point changes, restricting understanding of the extent of degradation
- This affects our restoration objectives
- To understand the changes, scientists, managers, politicians, and the public need to develop historical frameworks

You know about shifting terrestrial baselines

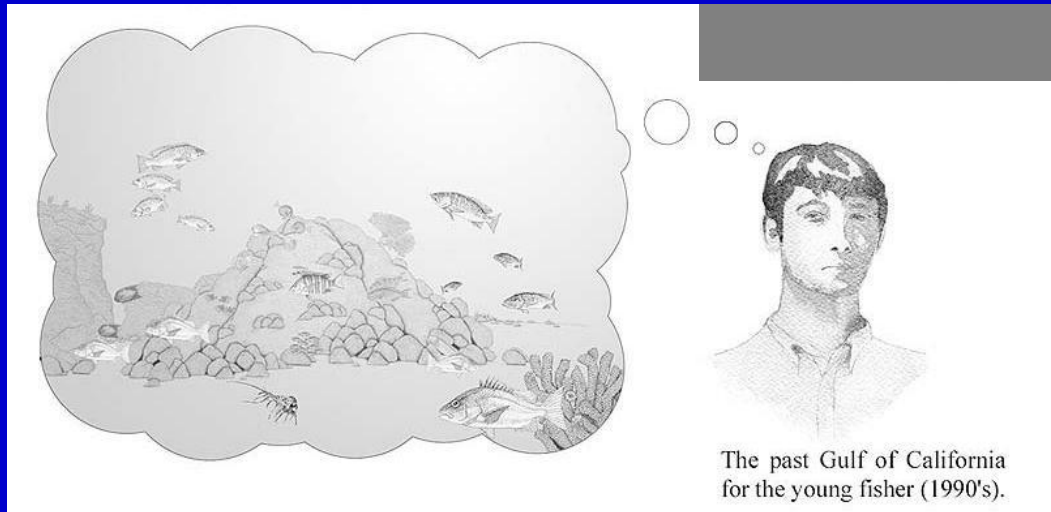


Old magazine illustration of hunters shooting passenger pigeons.
(From copy in Schorger, 1955.)



Pile of bison skulls.
http://upload.wikimedia.org/wikipedia/commons

An example of shifting aquatic baselines in the Gulf of California



The past Gulf of California for the young fisher (1990's).

cobi.org.mx/index.php?pag=fp01_3&sp=&idioma=eng

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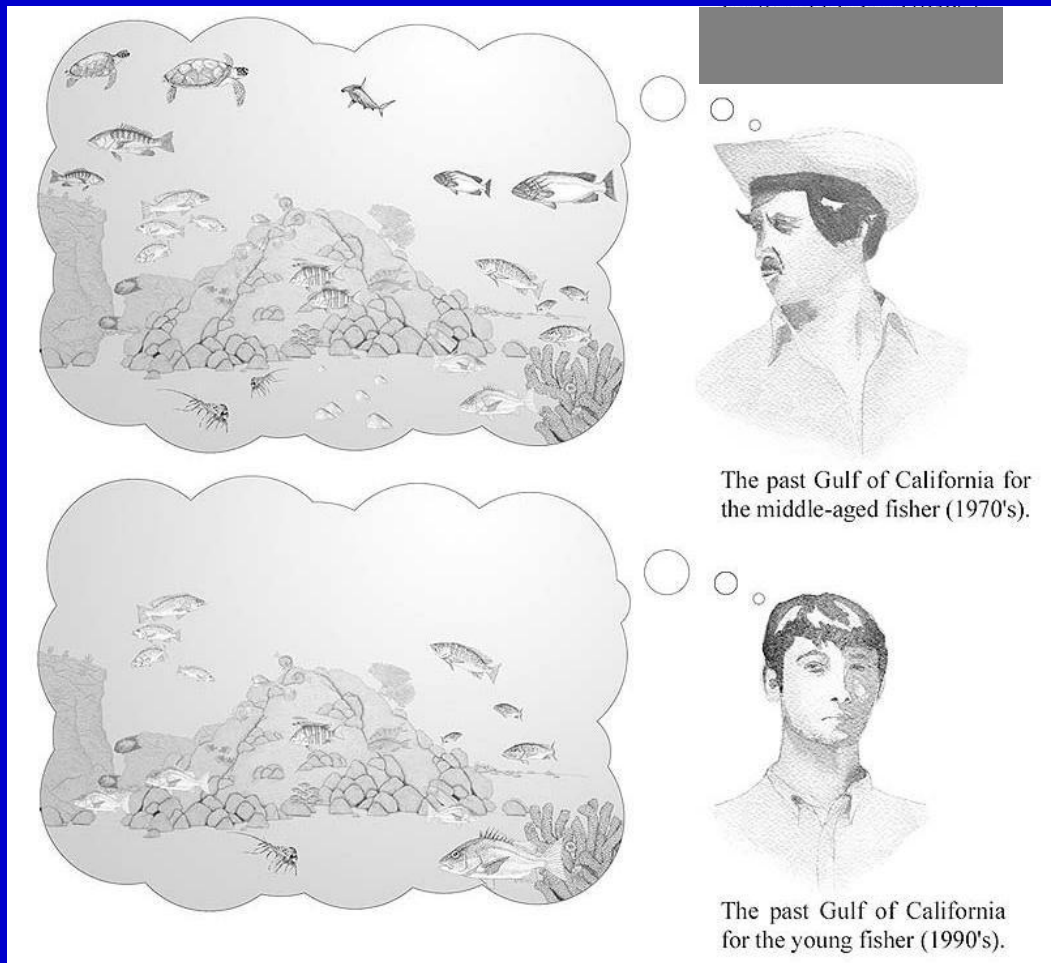

The past Gulf of California for the middle-aged fisher (1970's).

The past Gulf of California for the young fisher (1990's).

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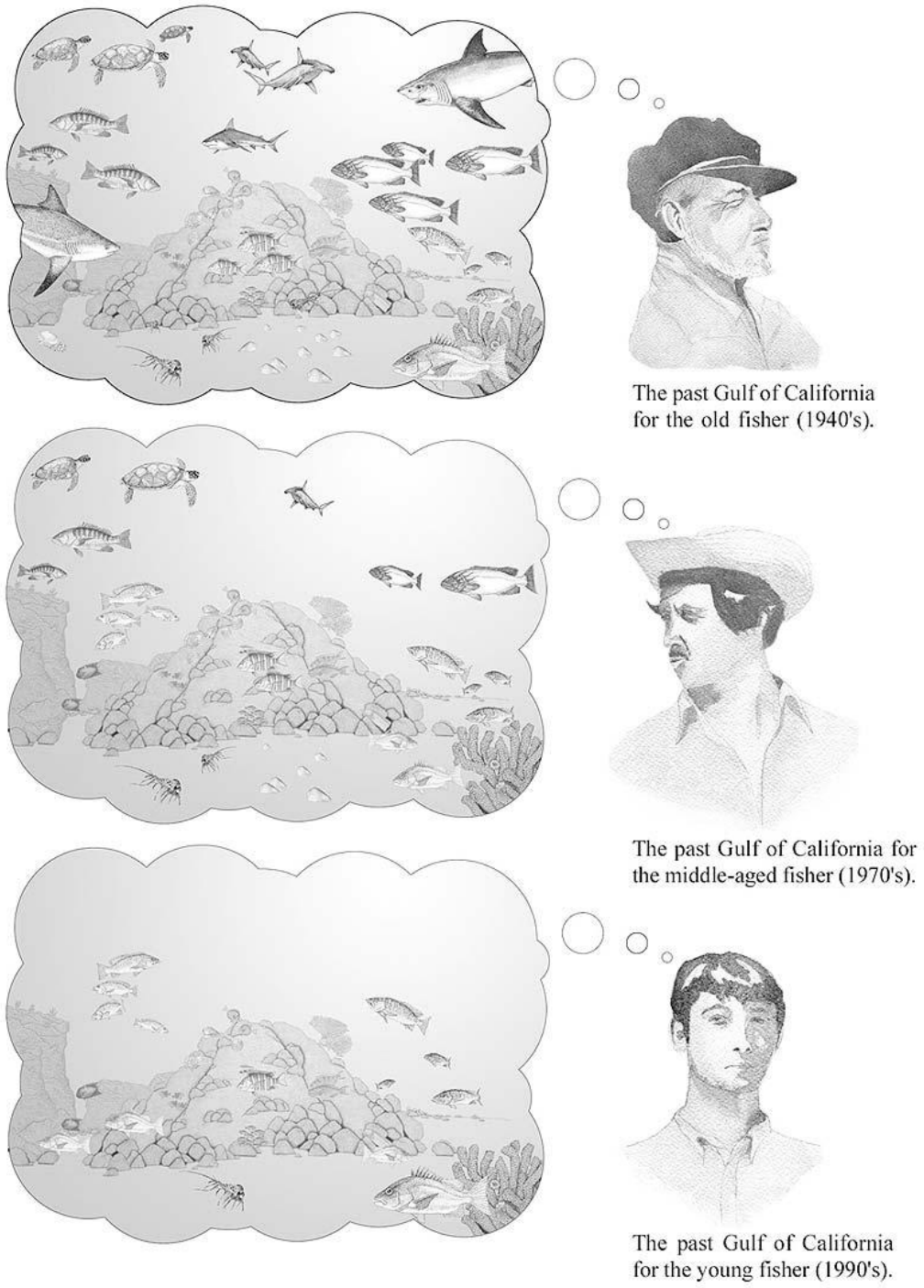


cobi.org.mx/index.php?pag=fp01_3&sp=&idioma=eng

Scope of the talk

- Accounts of early explorers in New World
- Oyster baselines
- Shad & river herring baselines
- Sturgeon baselines
- Blue crab & Waterfowl baselines
- Ecological & restoration implications

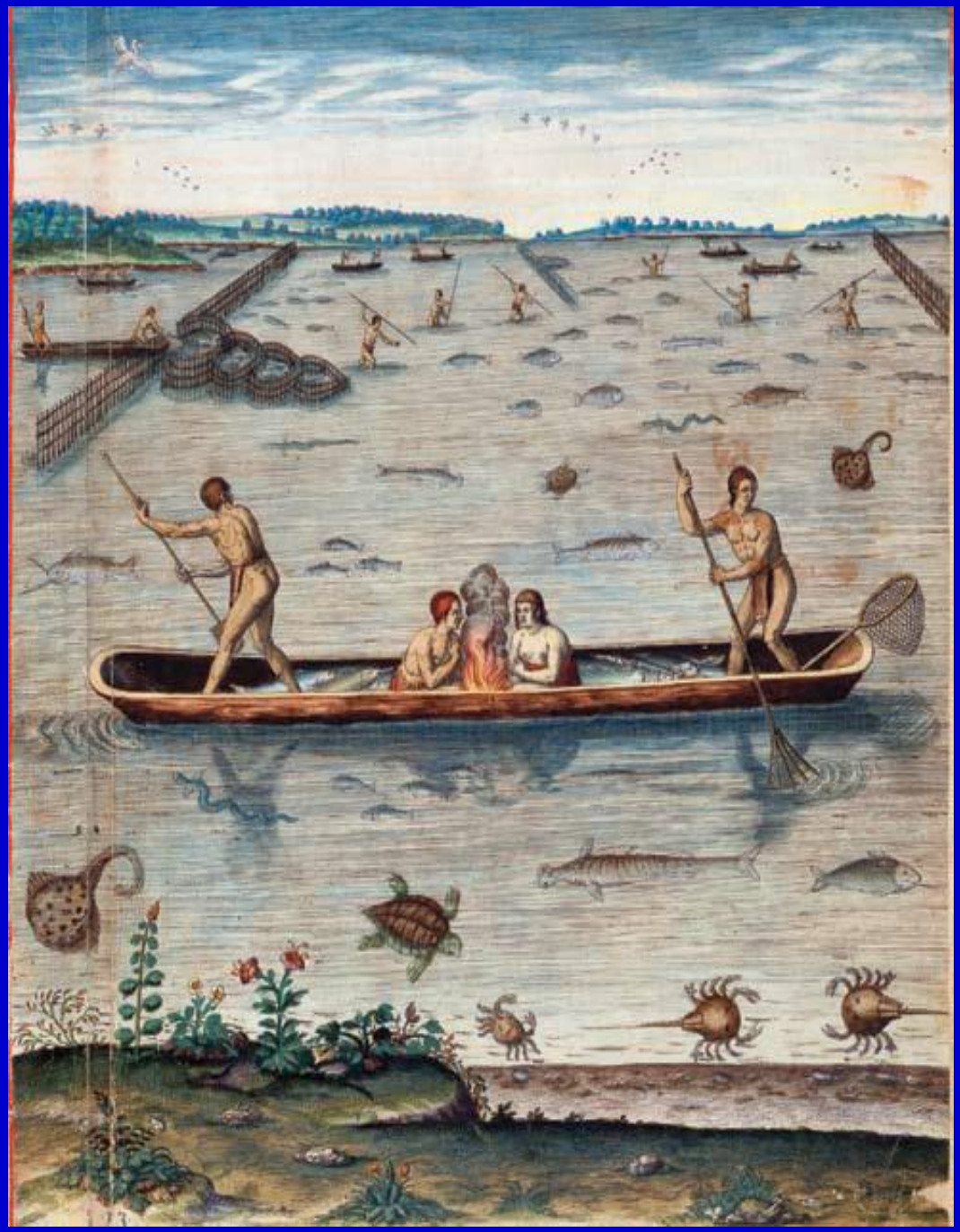
Fish and shellfish used to be abundant worldwide

Human population numbers were lower & gear more primitive

Giuseppe Arcimboldo 1566 Water

Indian fishing techniques

- Used multiple fishing techniques
- Colonists wrote reports of large and abundant fish
- Water was reported to be clear with abundant seagrasses



Engraving by Theodor DeBry based on drawings by John White, ~1585

Early explorers describe natural resources

"…. and they affirm that the sea is covered with fish which are caught not merely with nets but with baskets, a stone being attached to make the baskets sink with the water …."

Capt. Giovanni Caboto off Newfoundland

" an abundance of fish lying so thick with their heads above the water …as for want of nets we attempted to catch them with a frying pan… neither better fish, more plenty nor more variety had any of us ever seen…but they are not to be caught with frying pans."

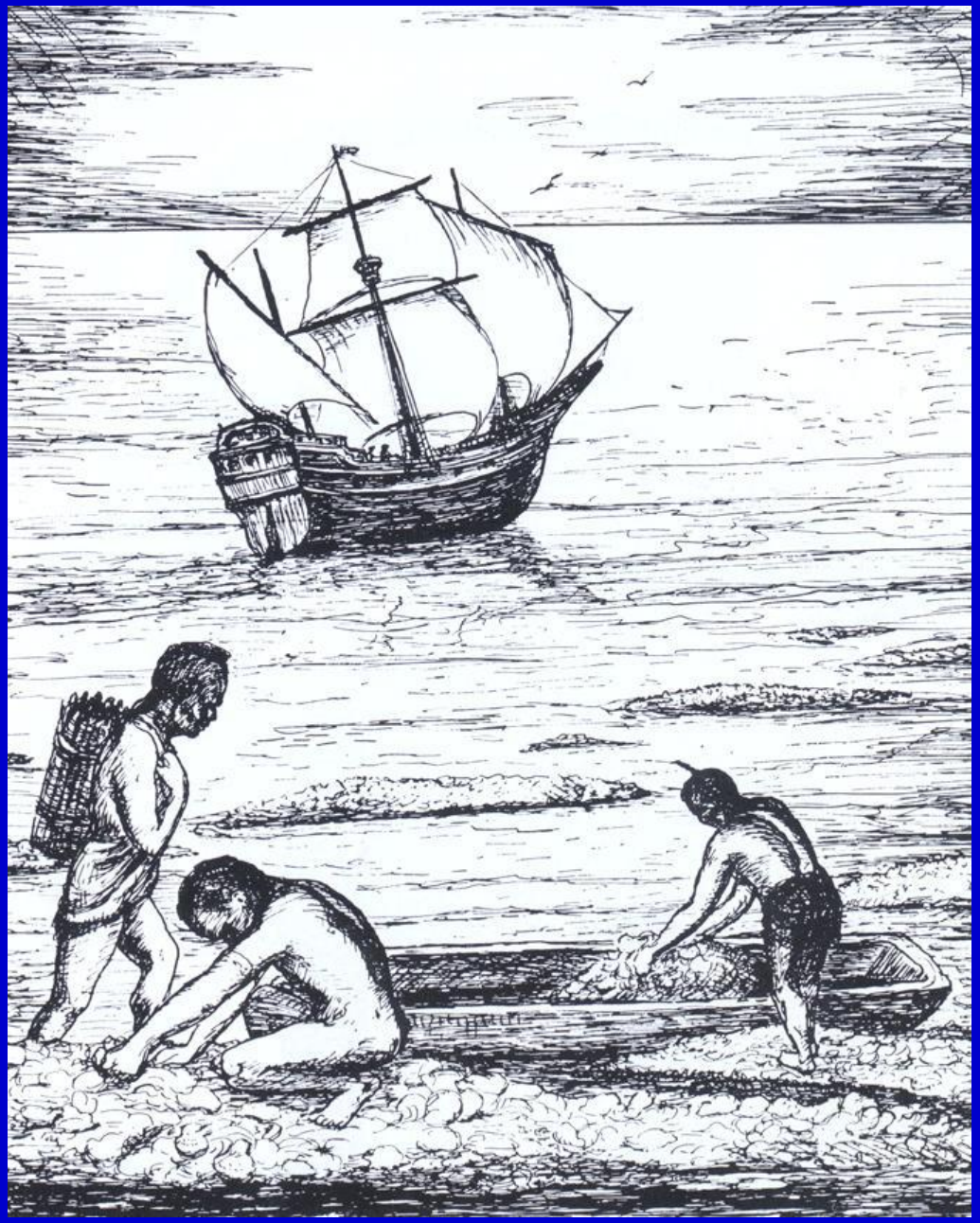
Capt. John Smith in Chesapeake Bay

Chesapeake Bay oysters

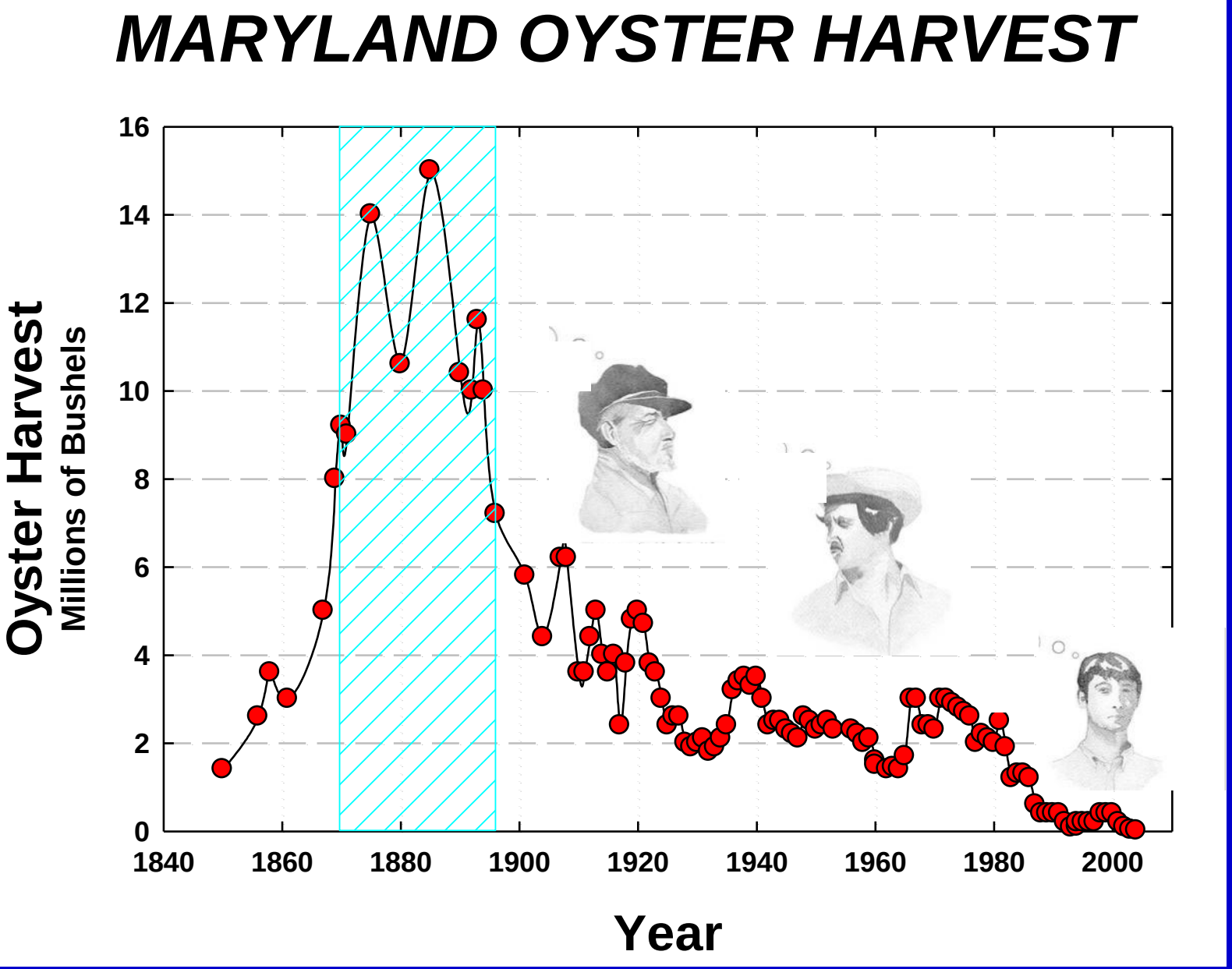
"The abundance of oysters is incredible. There are whole banks of them so that ships must avoid them."

"They surpass those in England by far in size. I often cut them in two before I could put them in my mouth."

Swiss visitor Francis Louis Michel after a visit to Virginia in 1701



Shifting baselines for Maryland oysters



Shifting baselines for Delaware & New Jersey oysters

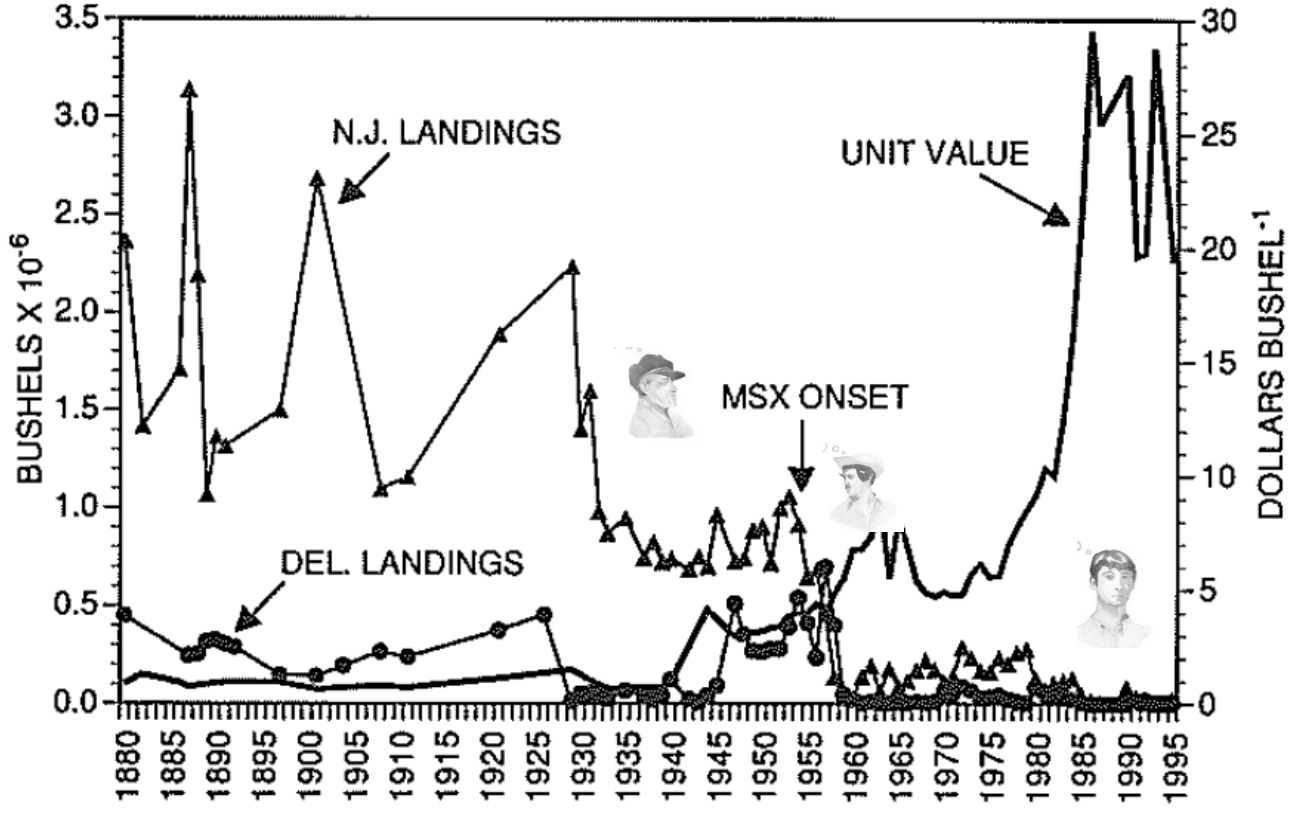


Figure 9

Reported landings of eastern oysters in New Jersey and Delaware. Most Delaware landings are from Delaware Bay. Of the New Jersey landings, about half came from Delaware Bay through 1901, but by 1930, the proportion was 90%, and it has been nearly 100% in many years since 1974.

Susan Ford 1997. History & present status of molluscan shellfisheries from Barnegat Bay to Delaware Bay

Oyster boats, Baltimore
1905 postcard
New York Public Library

Baltimore Harbor, circa 1900

http://amhistory.si.edu/onthewater/exhibition/3_5.html

Oyster fleet in Bivalve NJ, early 1900s

Maurice River Recollections Project
http://www.cumauriceriver.org/reaches/pg/narratives.cfm?sku=45

Oyster fleet in Bivalve NJ in 1928

Figure 6

The towns of Bivalve and Maurice River, N.J., on the left and right sides, respectively, of the Maurice River in 1928. Note railroad cars adjacent to large building at center left that housed shipping companies, and sailing vessels up to six deep tied along the docks. Photograph courtesy of the Urban Archives, Temple University, Philadelphia, Pa.

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THE OYSTER INDUSTRY.

Opening or shucking oysters in a Baltimore packing-house. (Sect. v, vol. ii, p. 560.)

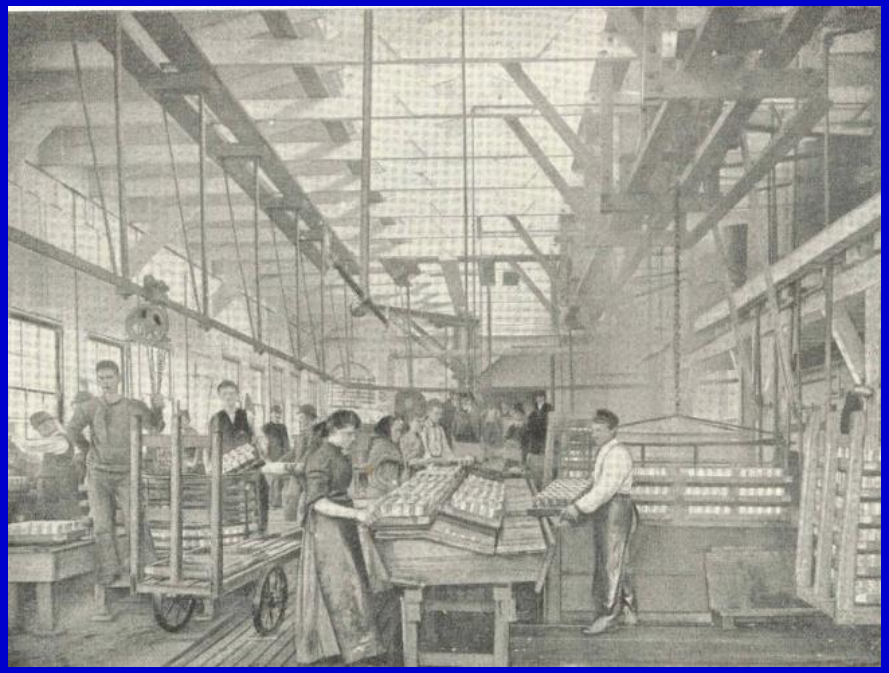
From a photograph.

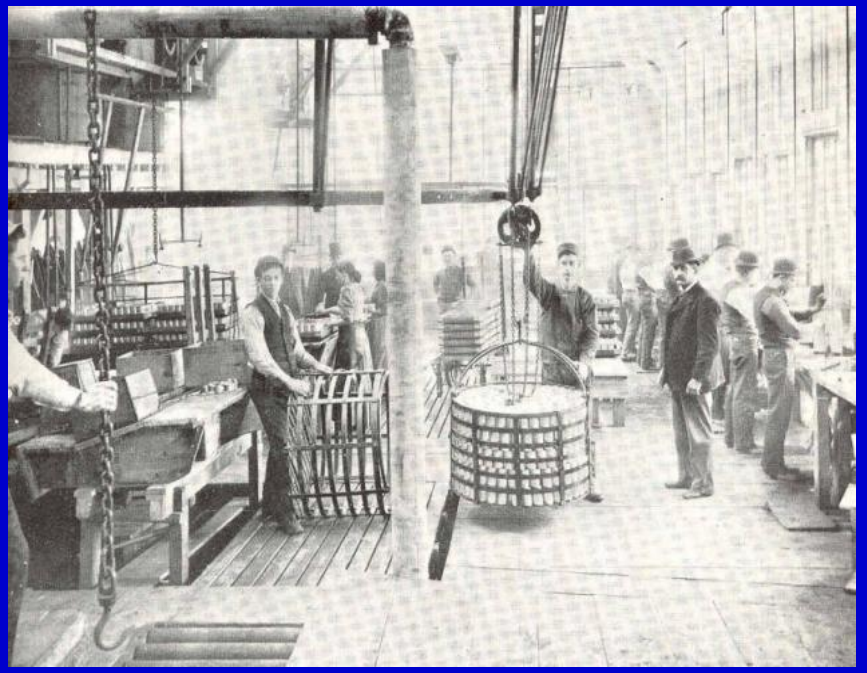
THE "SHUCKING" ROOM OF AN OYSTER PACKING ESTABLISHMENT.

The Chesapeake Bay's oyster industry was huge in the late 1800s

Chesapeake oyster industry in 1880s

- ~29 million bushels harvested in 1885
- 26,000 fishermen and processors; 4200 boats





Processing Rooms of Baltimore Oyster Canneries 1894 and 1899

- 414 million lbs estimated as oyster stock in 1880s
- 4 million lbs estimated as oyster stock 2007

SACKING OYSTERS FOR SHIPMENT, BIVALVE

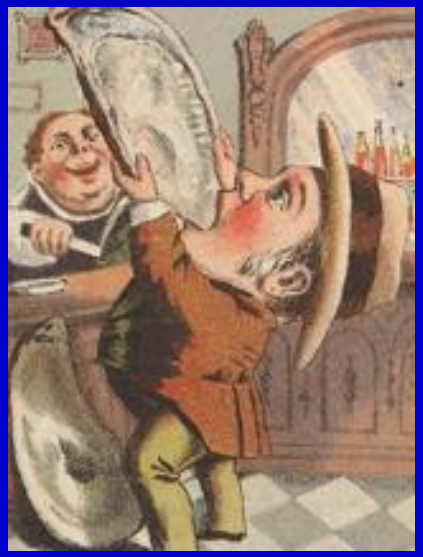
LAYING OUT OYSTERS AT BIVALVE

TAKING UP OYSTERS AT BIVALVE

CANNING RAW OYSTERS AT PORT NORRIS

Early 20th Century: >300 dredge boats & 3000 men oystering in Delaware Bay Parsons, F. W. 1928. New Jersey Life, Industries and Resources.

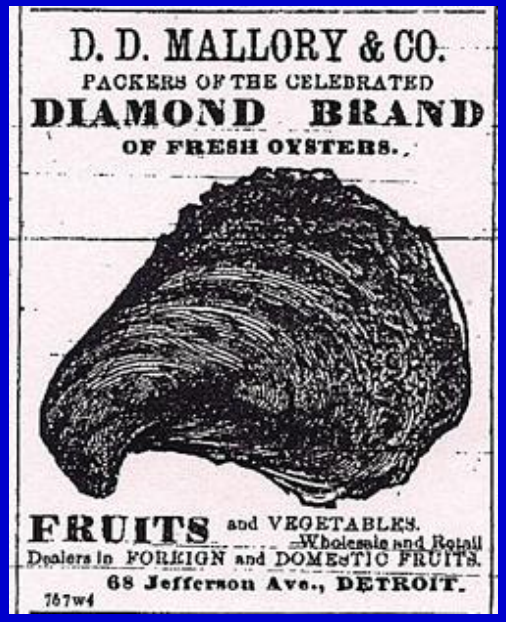
Oyster packers used trade cards to advertise their oysters



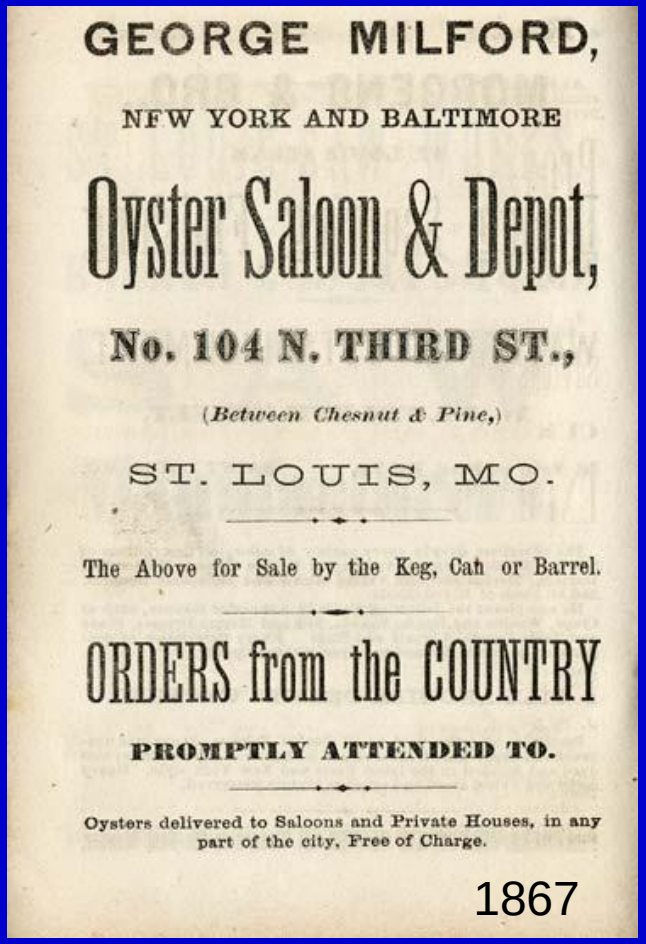
Oyster tongs

From *On the Water: Stories from Maritime America*

Oysters were shipped inland and were available whole or in "oyster saloons"



Mankato Minnesota 1881
From *On the Water: Stories from Maritime America*



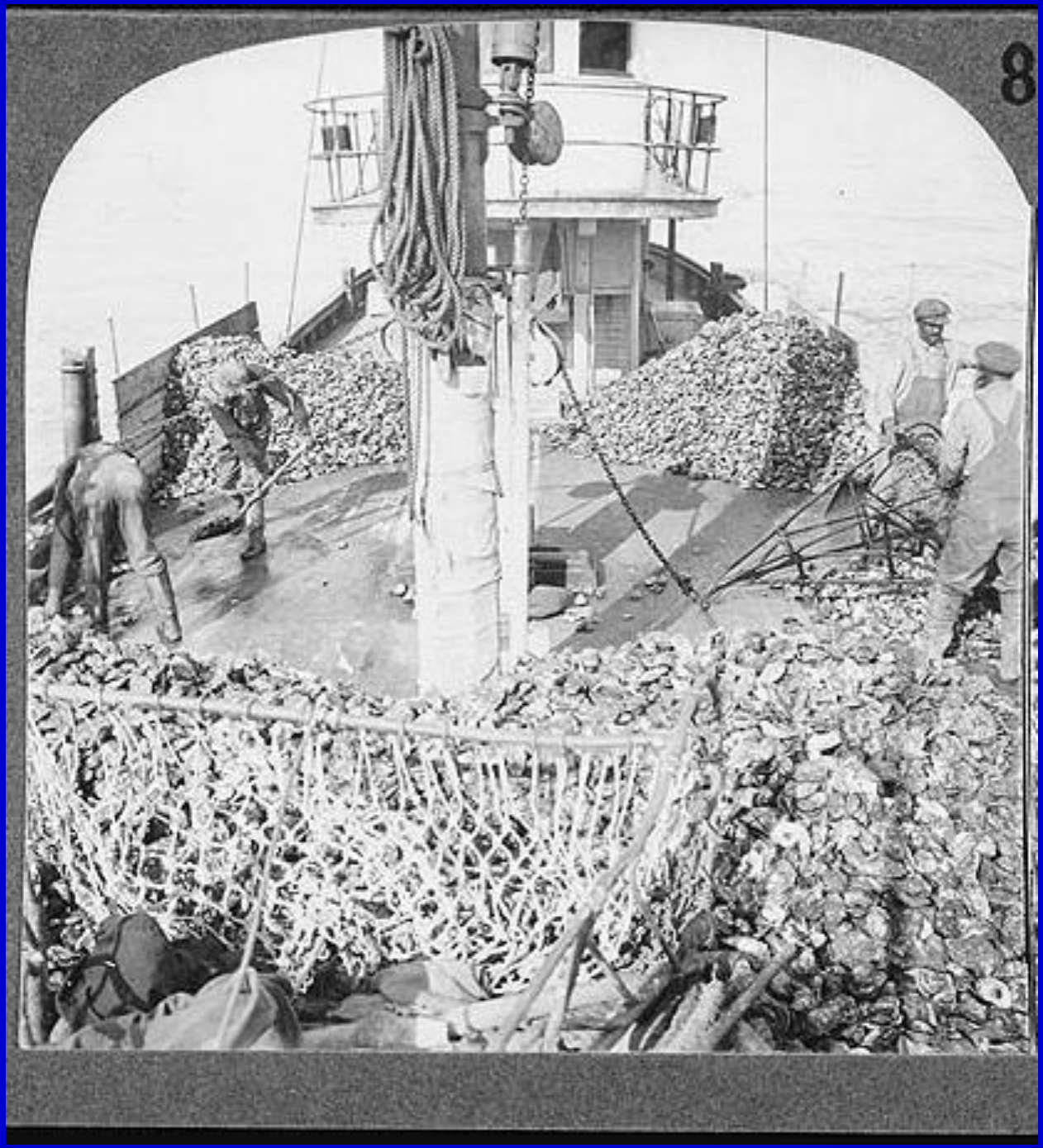
Cooked or raw oysters were sold in many places

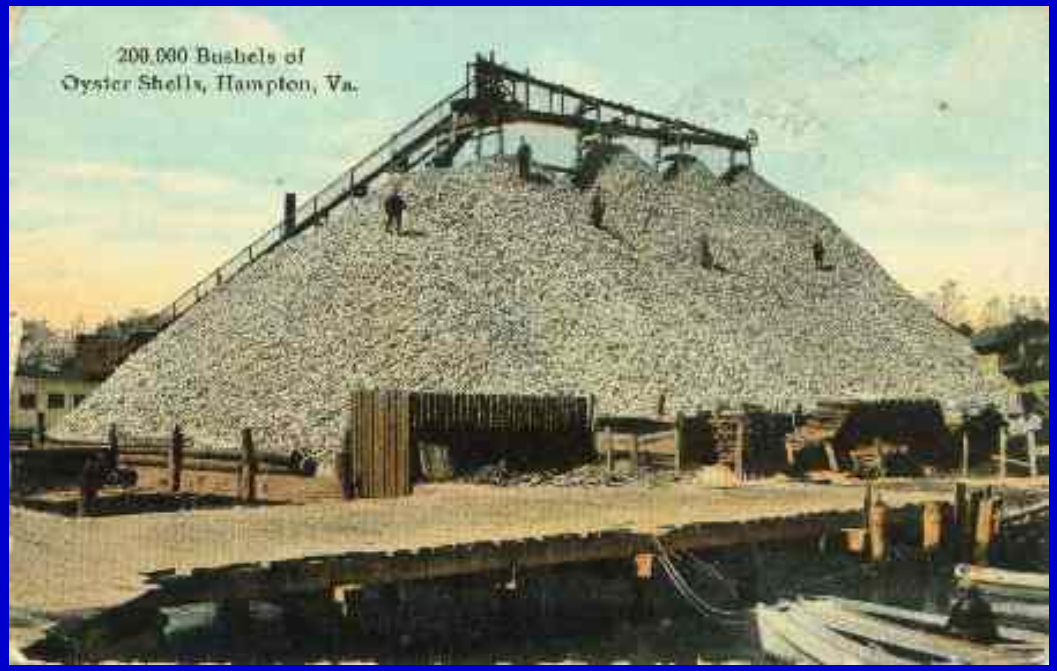
Oyster stands in Fulton Market 1870

Nicholino Calyo, Oyster Stand, 1840.
(New-York Historical Society)

Increased demand led to increased harvest

The catch on a Maryland skipjack 1912

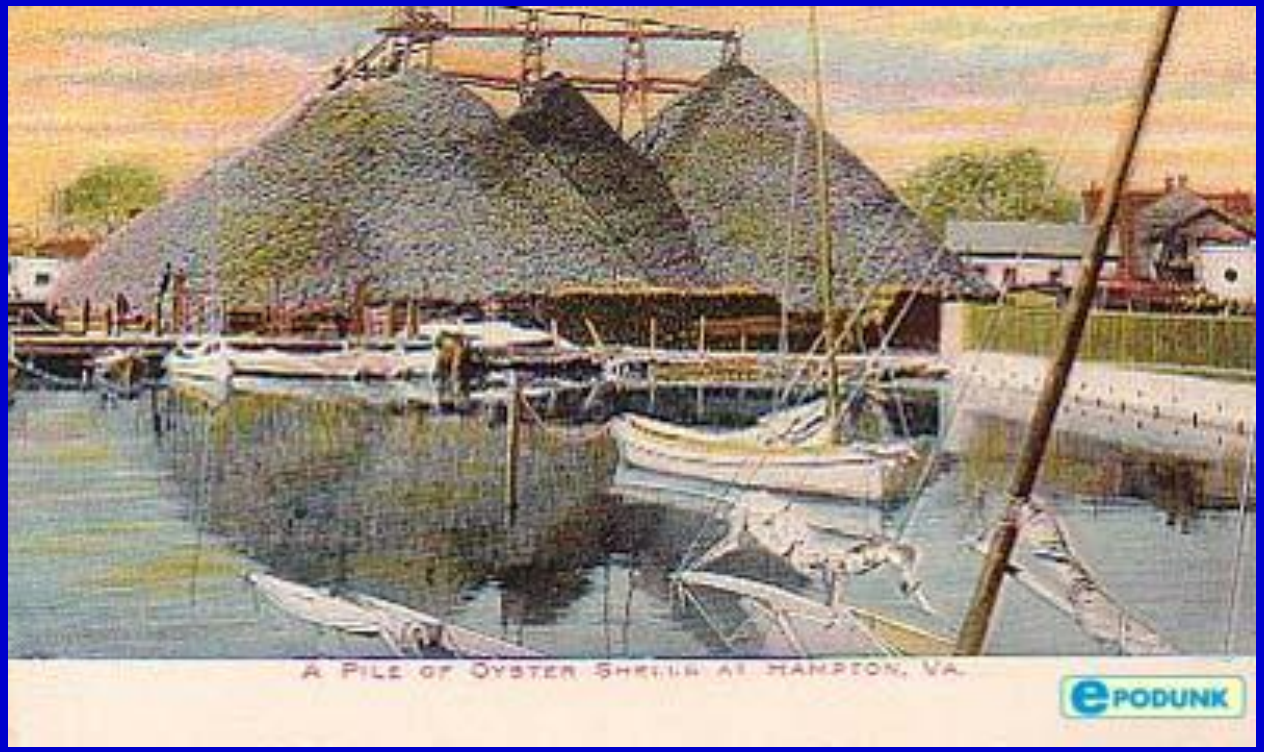




Oyster shell piles, Hampton, VA

Circa 1900

~ 200,000 bushels of shell



Causes of declining oyster populations

1. Overfishing

The Walrus and the Carpenter
Walked on a mile or so,
And then they rested on a rock
Conveniently low:
And all the little Oysters stood
And waited in a row.

"O Oysters," said the Carpenter,
"You've had a pleasant run!
Shall we be trotting home again?'
But answer came there none--
And this was scarcely odd, because
They'd eaten every one.

Lewis Carroll

Cause 2. Habitat destruction resulted from loss of settlement material

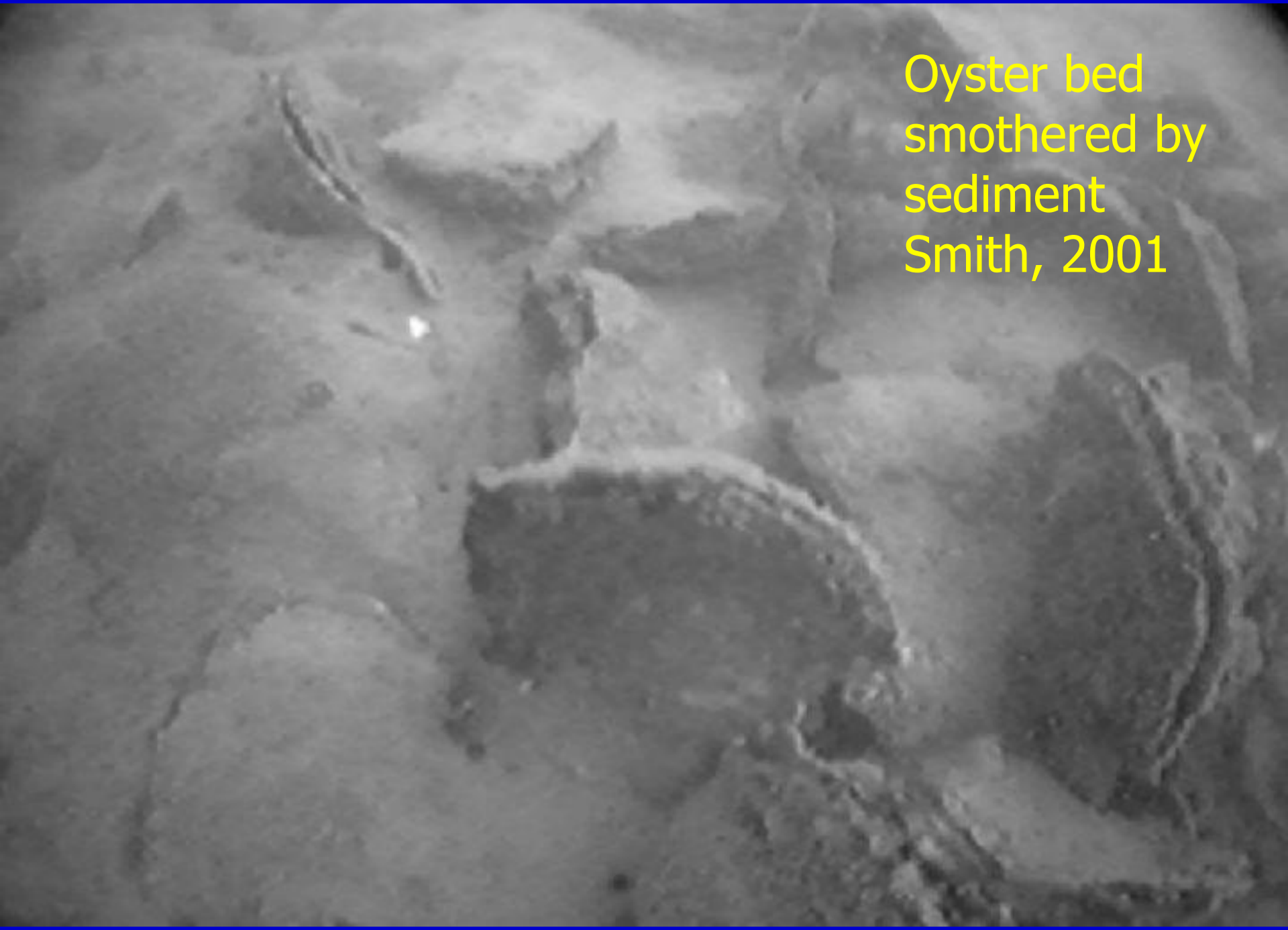
One year's shell from a single Chesapeake Bay shucking house

Cause 2. Habitat destruction resulted from loss of settlement material

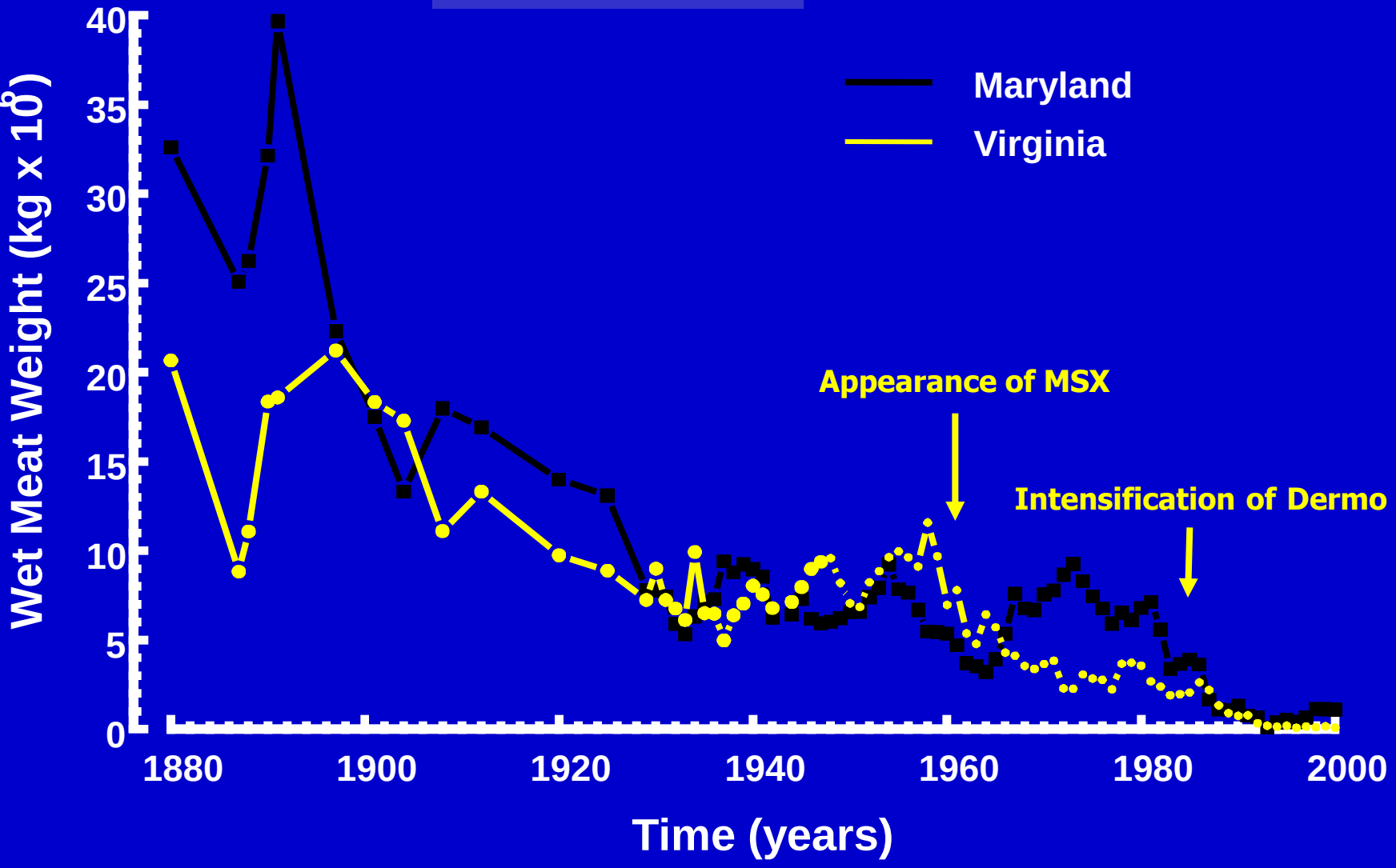
A Shell Pile. Which will it be, Roads, Chick Grit or Material for Oyster Restoration?

Truitt 1931

A NATURAL OYSTER BED IN THE CHESAPEAKE SHOWING CULTCH, SPAT AND MATURE OYSTERS.


Oyster bed
smothered by
sediment
Smith, 2001

Cause 3. Disease



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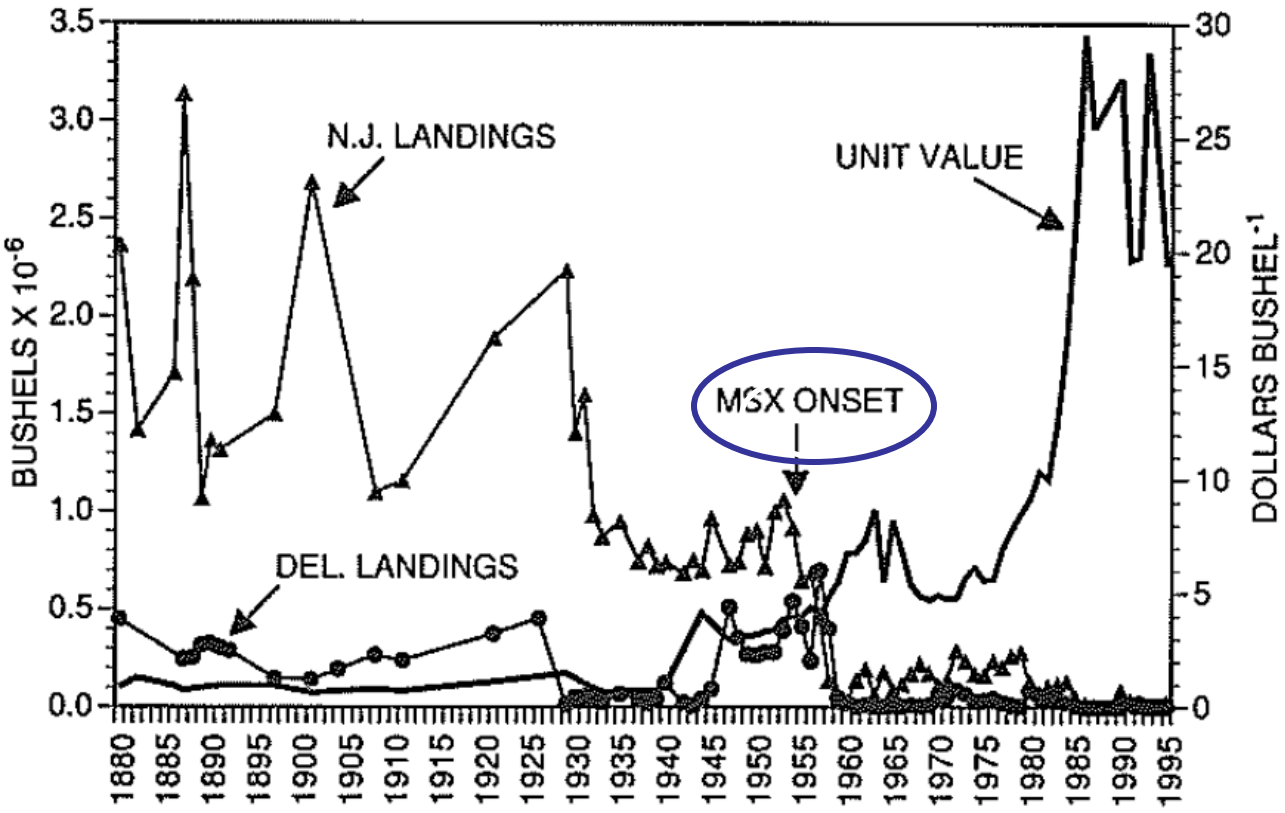

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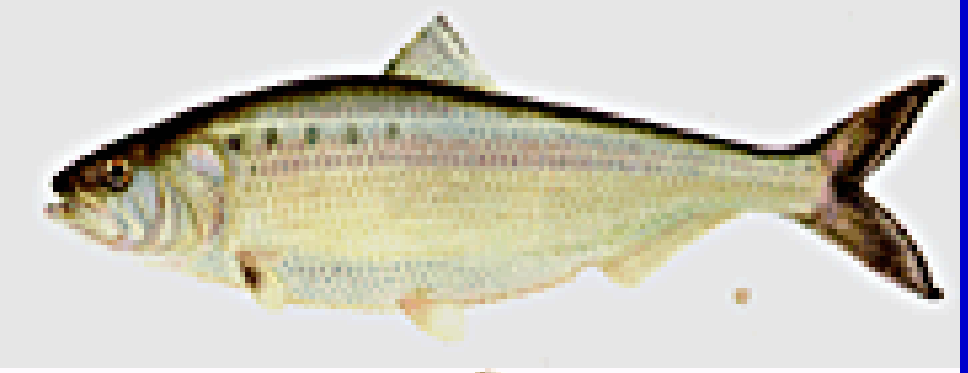


American shad

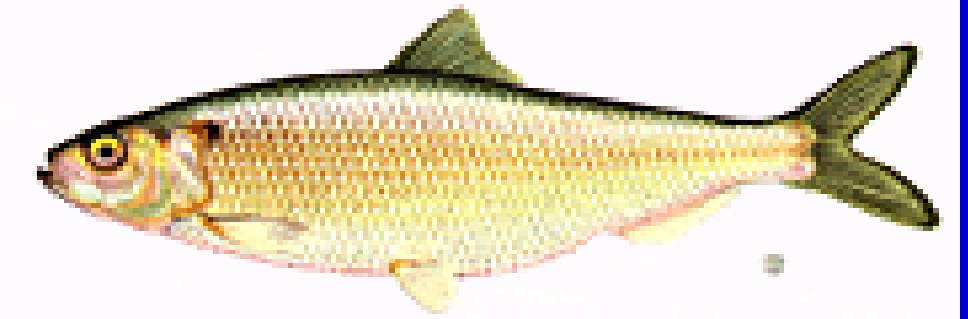
Alosa sapidissima

Alewife *Alosa pseudoharengus*

March Branch herring

Hickory shad

Alosa mediocris



Blueback herring *Alosa aestivalis*

April Glut herring

American shad were once hugely abundant

"From the banks of the river at this fishery could be seen great schools of shad coming up the river when they were a quarter mile distant.

They came in such numbers and so compact as to cause or produce a wave or rising of the water in the middle of the river extending from shore to shore."

Letter from Gilbert Fowler about the Webb Fishery in the Susquehanna River near Bloomsburg PA in the early 1800s (Bull. U.S. Fish Commission for 1881).

American Shad in Delaware Bay

"Far up the [Delaware] river it is no uncommon sight to see hundreds of shad making their way upward with their backs frequently showing above the surface."

William E. Meehan. 1893. Fish, Fishing and Fisheries of Pennsylvania. State Printer, Harrisburg,

Decline in Delaware River shad harvest

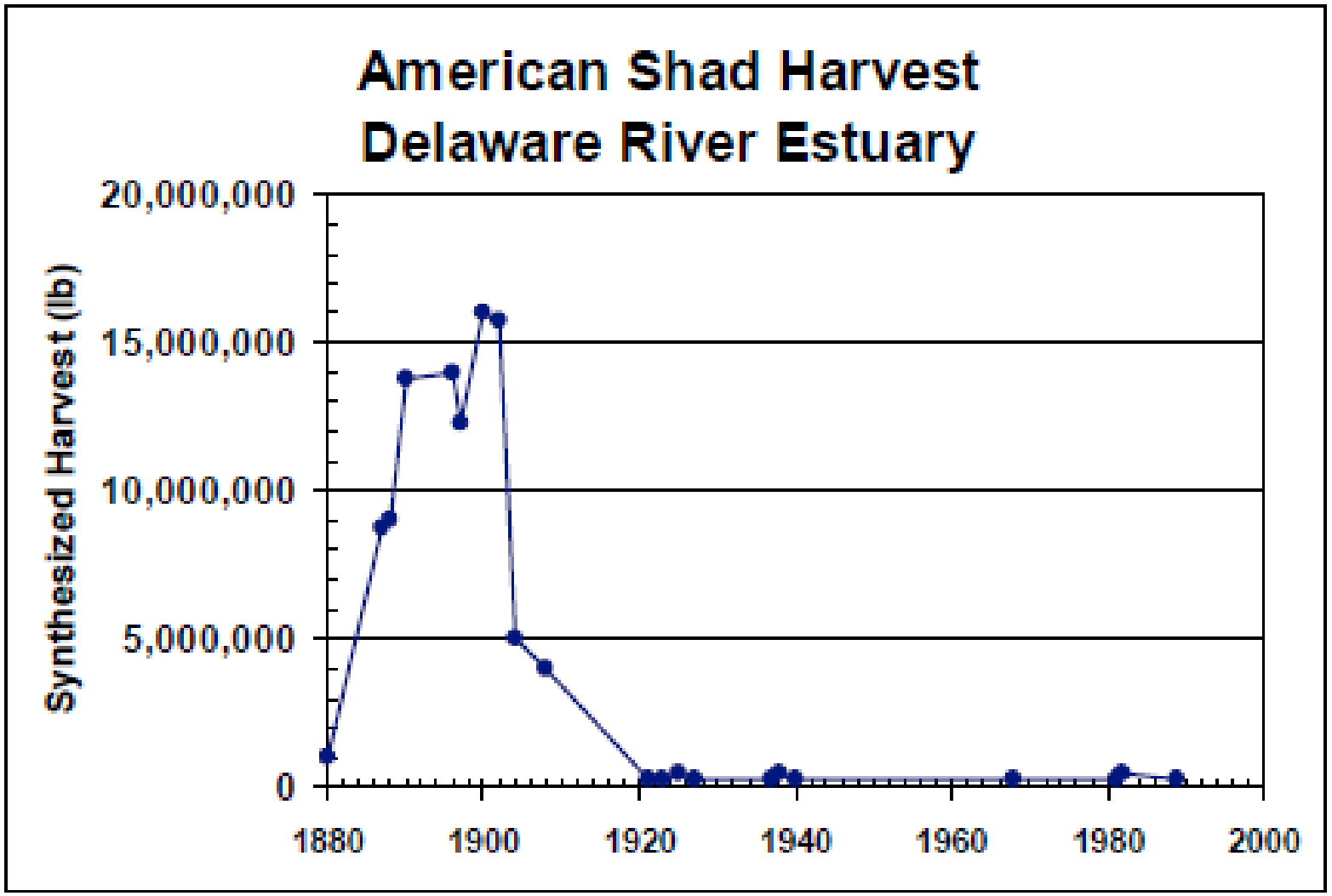


Figure 2.4. Synthesized American shad harvest in the Delaware Estuary. (Delaware Estuary Program 1996)

Shad-fishing gear: Haul seines

Between 1735 and 1928, up to 453 seine fisheries operated in the Susquehanna River and its tributaries. These could be very profitable.

Seine size depended on location. In 1883, a Havre de Grace seine was 5,580’ long and 30’ deep. Mesh: 4.5” to 5.5”

Record single hauls – 9,000 to 12,000 shad; usually 10,000 to 20,000 per season per net

Potomac River catches in 1832

A seine haul could capture 4,000+ shad and 100,000 to 300,000 river herrings

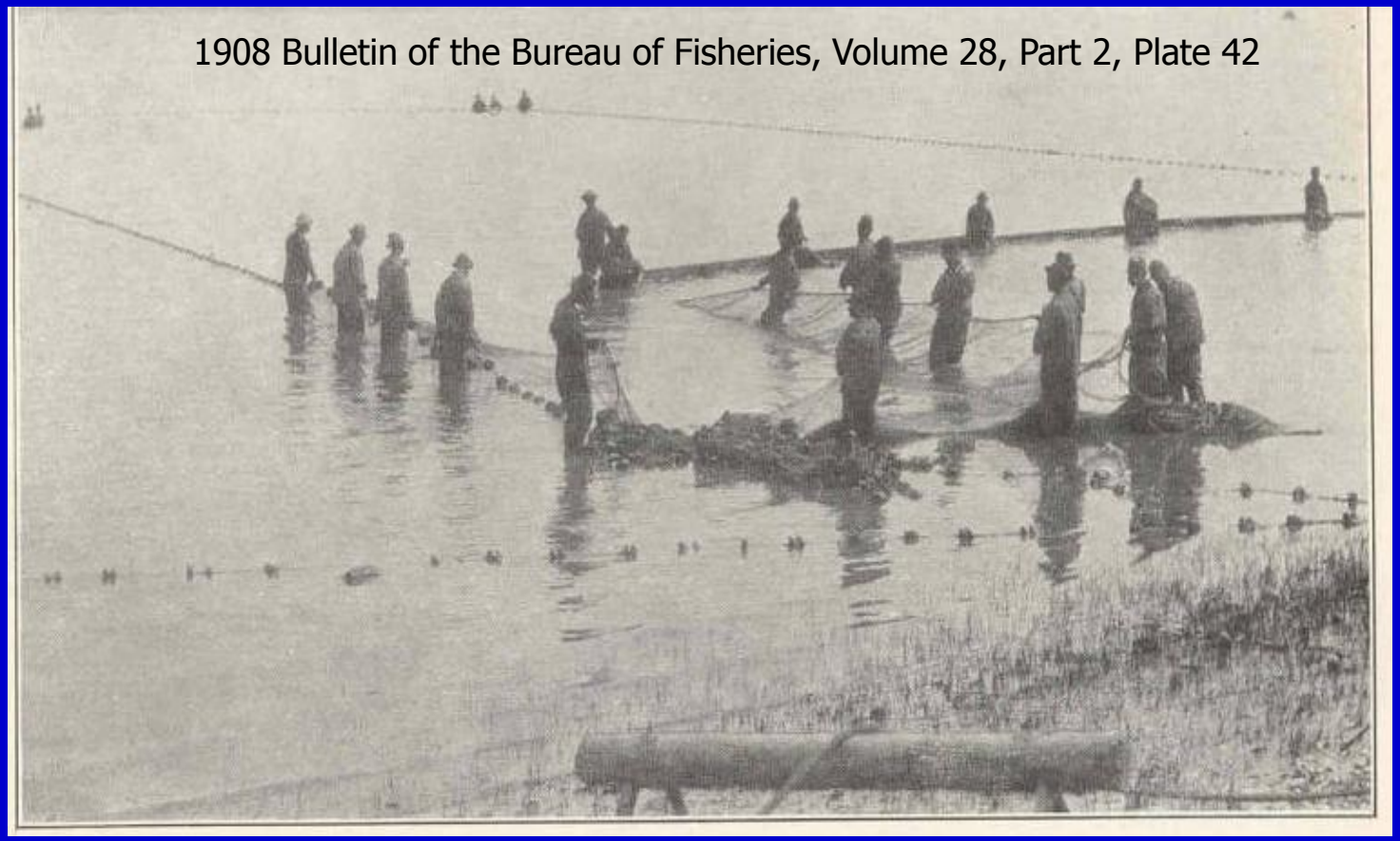
Six-week shad season could yield 22,500,000 shad and 750,000,000 river herring.

These catches required 995,000 bushels of salt and 995,000 barrels

Thousands of people were employed as seiners, processors, barrel makers, etc.

Joseph Martin. 1835. A New and Comprehensive Gazetteer of Virginia and the District of Columbia, quoted by US Commissioner of Fishes S.F. Baird in 1889.

Largest seine in the world



- Stony Point in Potomac River
- 9600’ net + 22,400’ ropes = 32,000’ sweep
- Hauled by steam engine and 80 men
- Up to 3600 shad & 250,000 alewives caught in a sweep
- By 1905, only 3000 shad caught in a season so fishery ended

Shad fishing facilities: floats

These were wooden floating structures anchored in a river. Some were 75’ to 100’ wide and 200’ to 300’ long.

They might contain a bunkhouse for up to 100 men, a kitchen, mess area, fish cleaning and washing rooms, barrel rooms, and a stable (!!!).

Two shad floats used 4,800’ seines.

Shad fishing facilities: floats

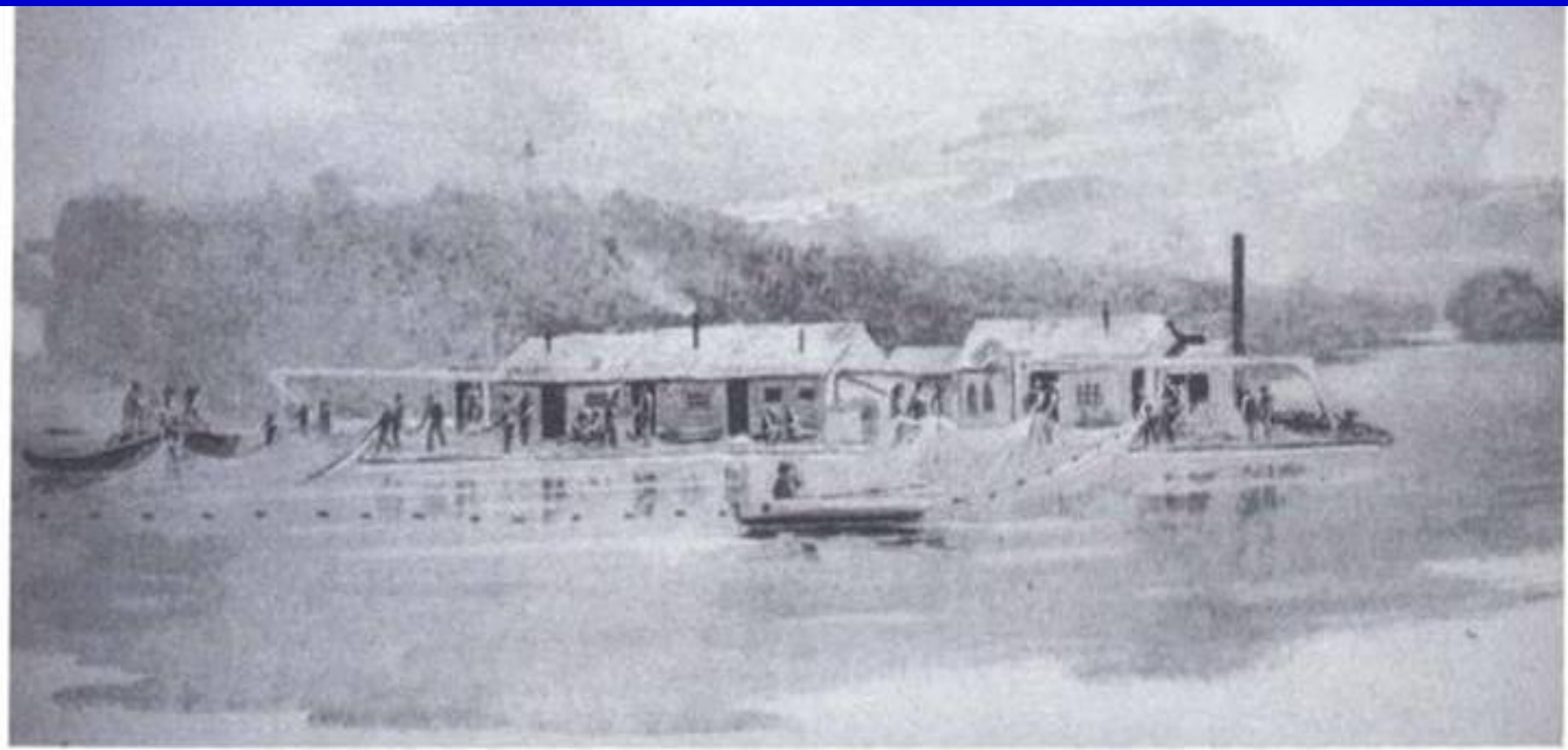


Fig. 6. A Susquehanna River Shad Float. This late nineteenth-century photograph shows a large float anchored in the river with a full crew aboard. The men both lived and worked on the float for about three weeks each spring. (Courtesy, *Harper's Weekly*)

Gerstell 1998

Fig. 7. A Seine Boat En Route to a Shad Float. Along the Lower Susquehanna, local fishing companies used large seine boats to take crew members, supplies, and fish back and forth between headquarters, floats, and fishing grounds. For a few individuals, their assigned duties annually lasted for more than a month during the spring of each year. (Courtesy, Cecil County Historical Society)

Gerstell 1998

Haul seine on a shad float

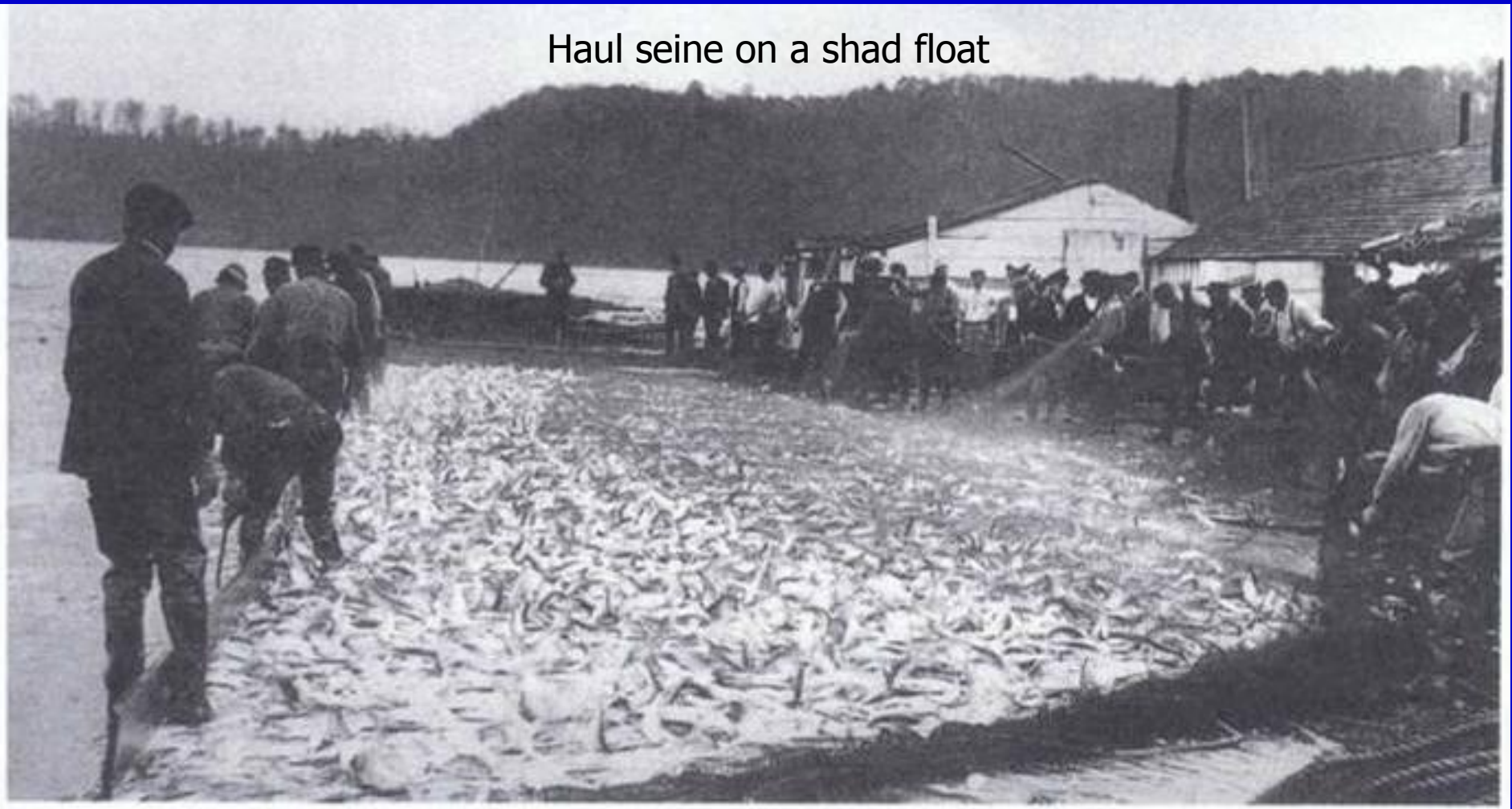


Fig. 9. The Haul Is In. With a good catch of wet fish flopping around on the float deck, the crew in rubber boots is ready to move in, sort out the desirable ones, and carry them into the cleaning room. The remainder will be tossed back into the river. (Courtesy, Cecil County Historical Society)

Gerstell 1998

Here's why a float had a stable

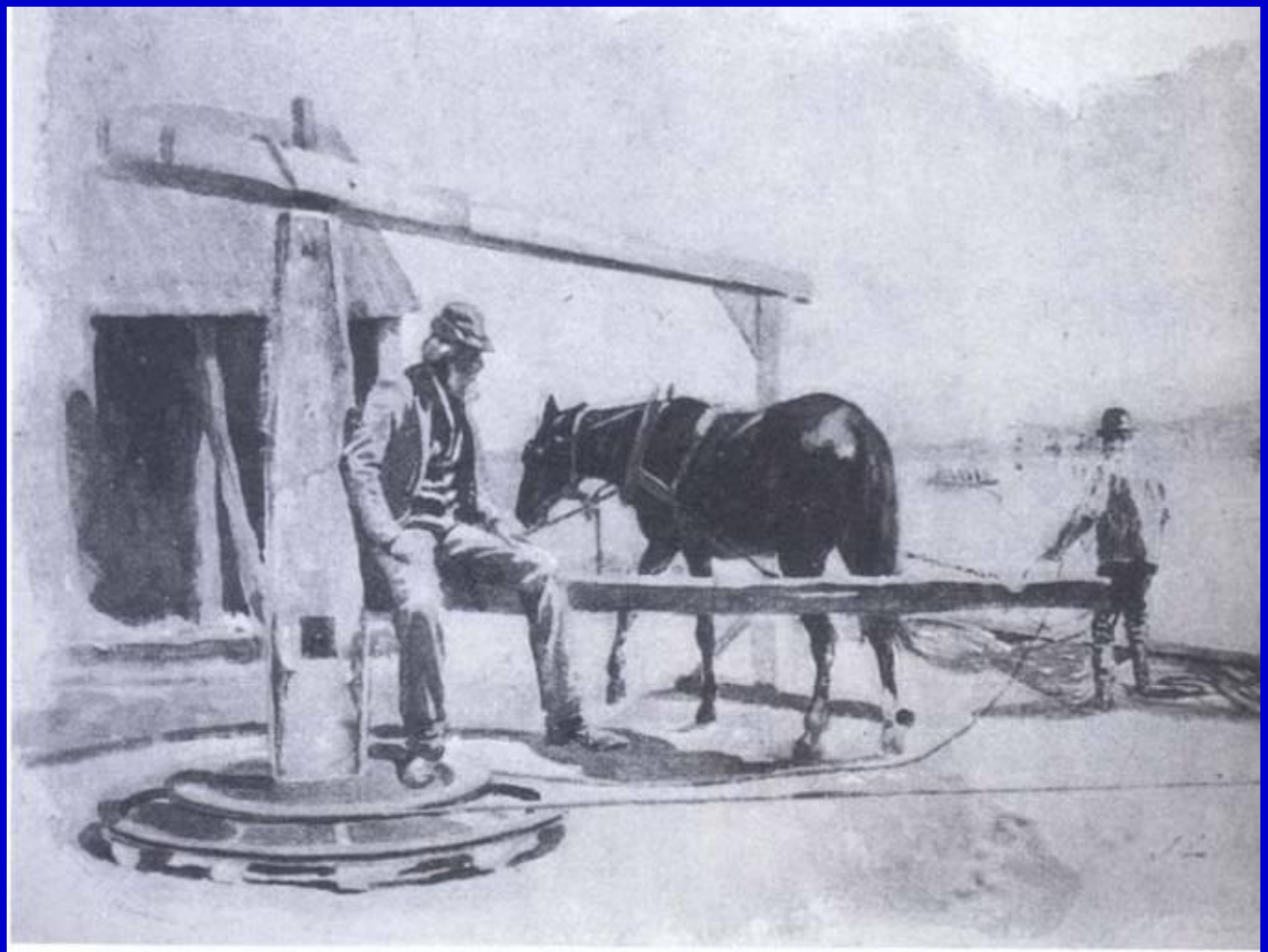


Fig. 10. A Horse-Drawn Windlass for Shad-Fishing. This 1892 illustration shows a horse-drawn windlass installed on a shad float. Its purpose was to help pull in the huge seines used by float fishermen. Earlier, the nets had been hauled in entirely by hand. Later, units driven by steam and gasoline were mounted on the haul deck for use in the work. (Courtesy, *Harper's Weekly*)

Gerstell 1998

Shad-fishing gear: Drift or stake gill nets

The fishery in Chesapeake Bay extended 25 miles from the Susquehanna River mouth to Pooles Island.

In 1896, drift nets at Havre de Grace were about 125’ long, with 5.5” mesh.

Fishermen rowed back and forth along the net to remove captured shad before they were eaten by hordes of eels.

Drift gill nets on the Delaware River

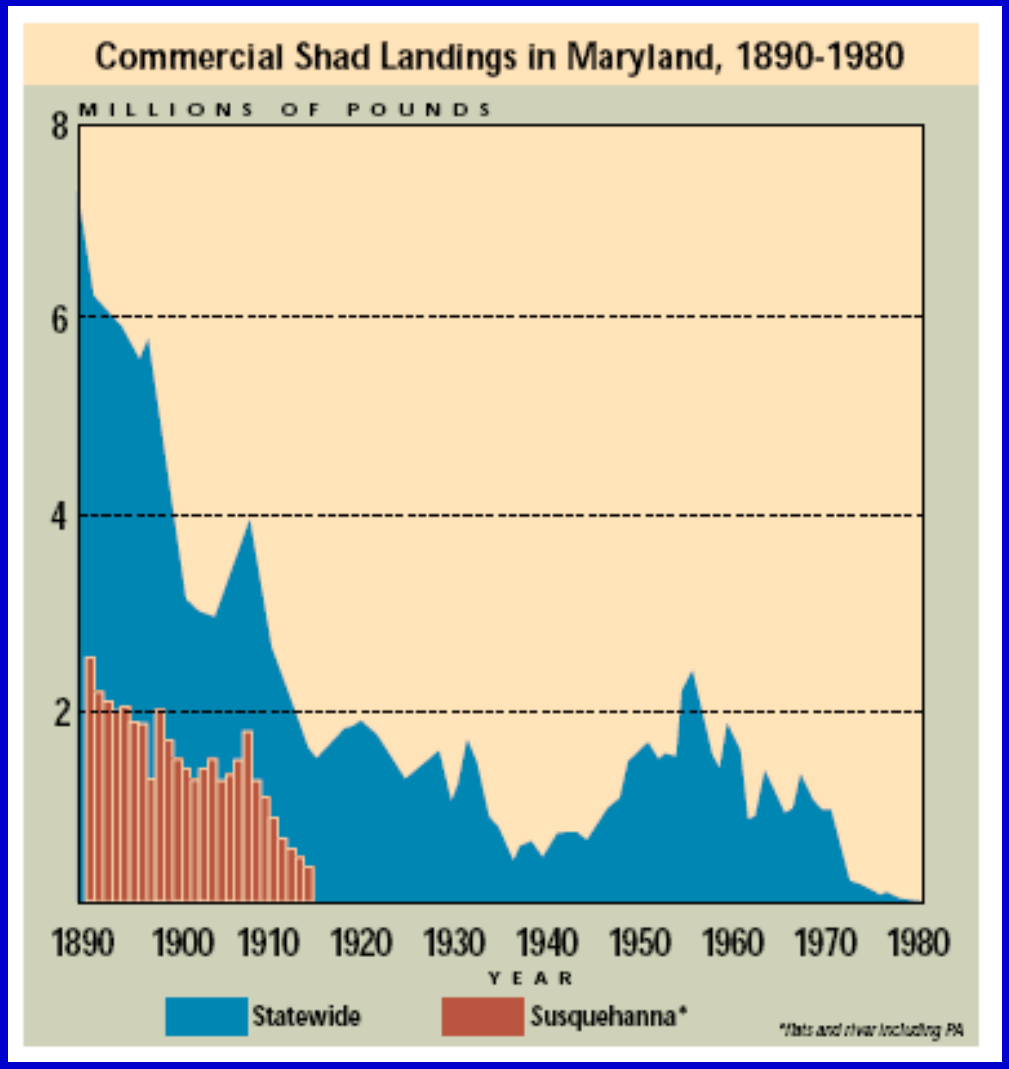
(Report of the State Commissioners of Fisheries for the Years 1892-93-94. 1895).

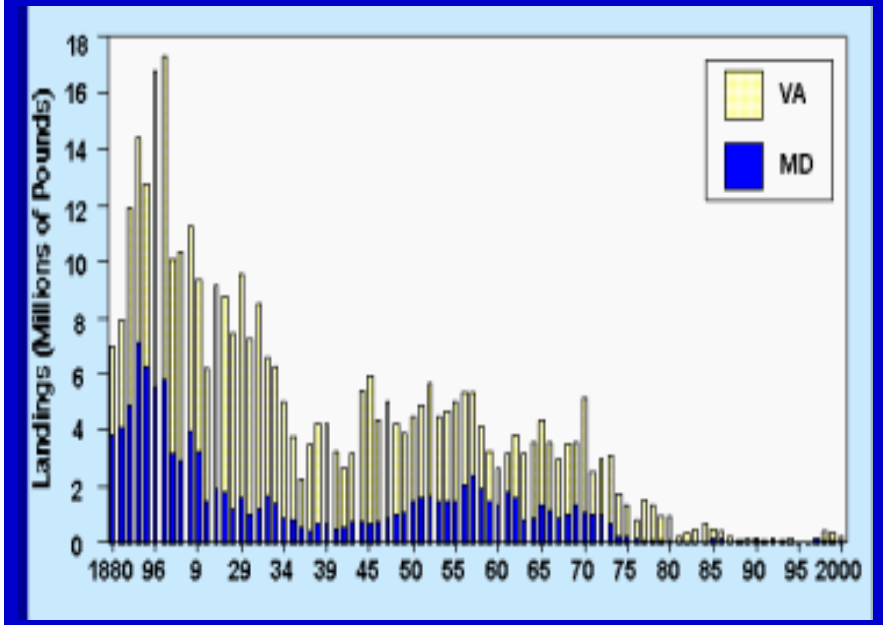
SHAD GILL NETS AT NIGHT ON THE DELAWARE.

Fig. 20. Farmers Waiting to Buy Shad. This 1892 illustration depicts Pennsylvania farmers encamped near the mouth of the Susquehanna River. They are awaiting the availability of newly caught shad taken at nearby fisheries. (Courtesy, *Harper's Weekly*)

Gerstell 1998

Commercial shad landings in Chesapeake Bay





Shifting baselines for shad

Limburg, K.E., and J.R. Waldman. 2009. Dramatic declines in North Atlantic diadromous fishes. BioScience 59:955-965.

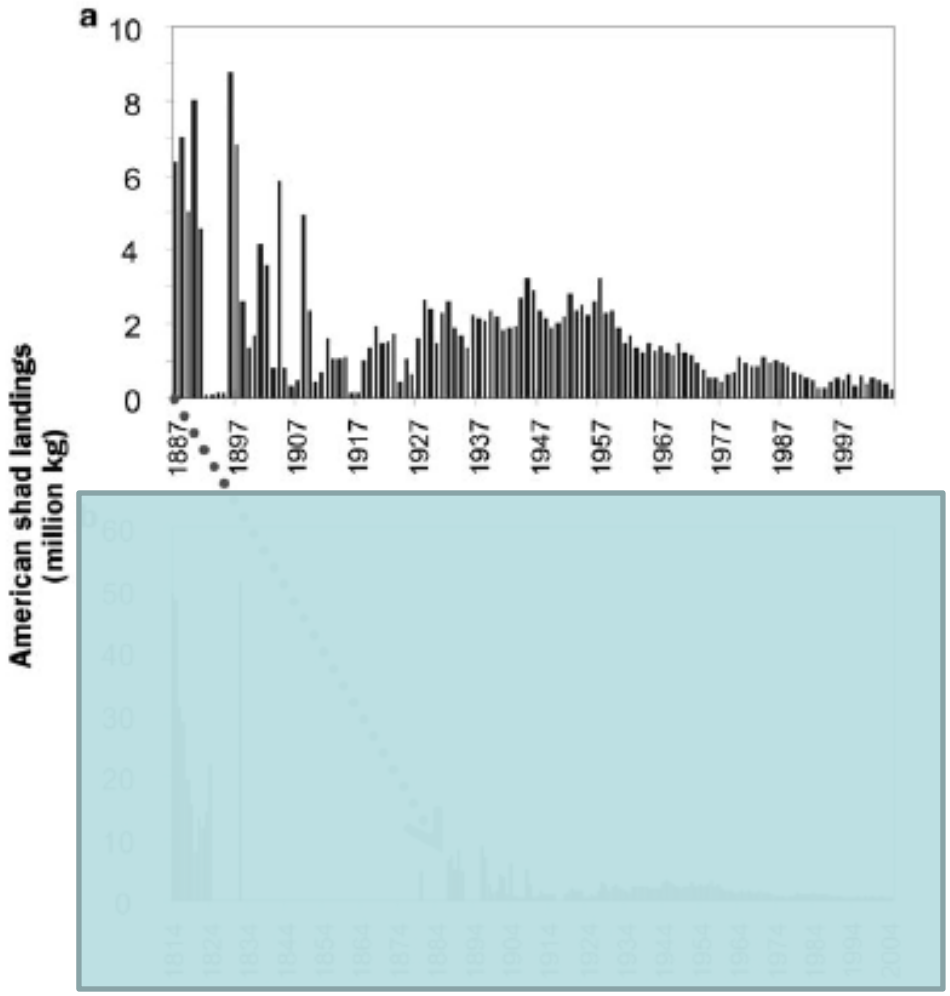


Figure 2. Example of how baselines shift. (a) Baseline for American shad restoration is typically referenced to 1887, when the US Fishery Commission began to collect statistics. (b) Earlier data show that levels for the 1887 baseline are considerably lower than they were in the past. Source: ASMFC (2007).

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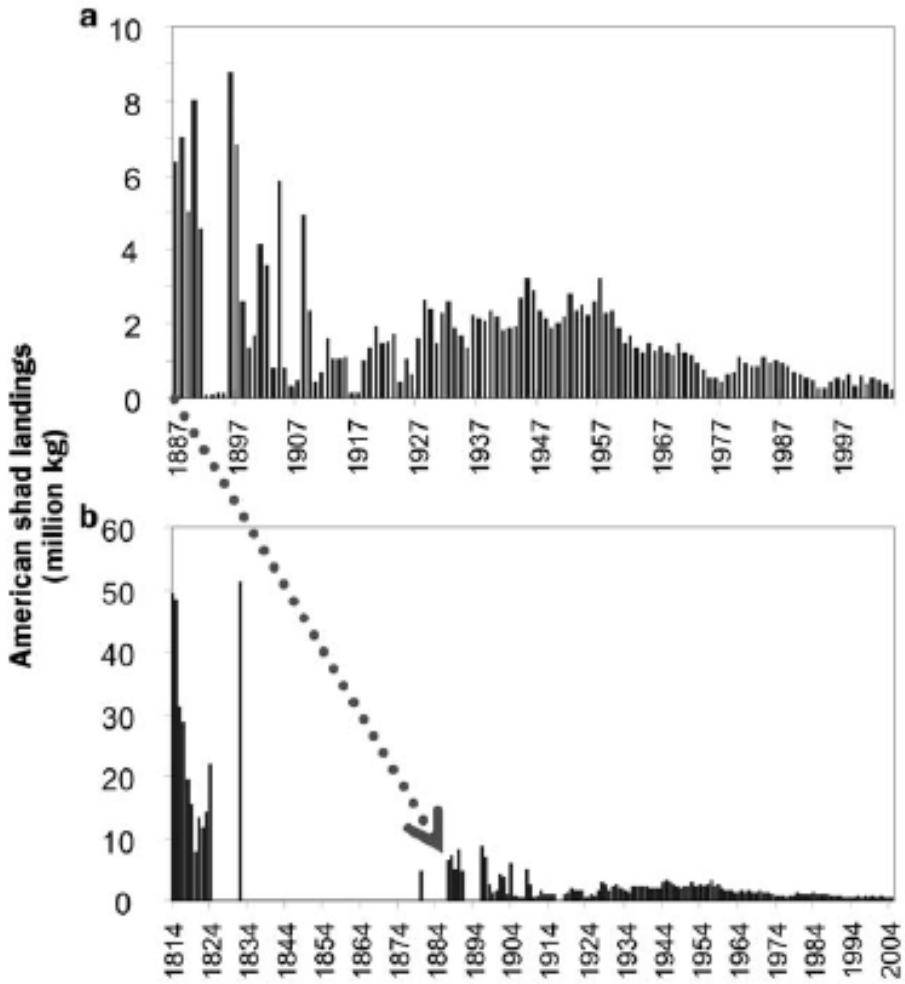

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Reasons for declines in the shad fisheries

- Overfishing by seines, gill nets, and pound nets
- Dams: 18th C – mostly mills in tributaries;
  19th C - canal feeders; 20th C - hydroelectric
- Pollution (sawdust, chemicals, oils, etc.) that degraded spawning habitat
- Dredging of spawning habitat for sand and gravel, etc.

Sturgeon: "The fish that saved Jamestown"

"In summer, no place affords more plenty of sturgeon…. There was once taken 52 sturgeon at a draught, at another draught, 68. "

"And in four or five hours with one net were ordinarily taken seven or eight; often more, seldom less."

By 1609, the colonists "had more sturgeon than could be devoured by dog or man, of which the industrious by drying and pounding, mingled with caviar, sorrel, and other wholesome herbs, would make bread and good meat."

John Smith, "A Map of Virginia, etc.," (1612) in J. C. Pearson (1942). "The Fish and Fisheries of Colonial Virginia" *William and Mary College Quarterly Historical Magazine, 2nd Ser. 22(3): 213–220.*

American Indians and sturgeon fishing

Engraving by Theodor DeBry based on drawings by John White, ~1585

"[T]he Indian way of catching sturgeon, when they came into the narrow part of the rivers, was by a man's clapping a noose over their tails and by keeping fast his hold.

Thus a fish, finding itself entangled would flounce and often pull him under water.

Then that man was counted a cockarouse, or brave fellow, that would not let go till with swimming, wading and diving, he had tired the sturgeon and brought it ashore."

Robert Beverley, 1705

Atlantic sturgeon in Delaware Bay

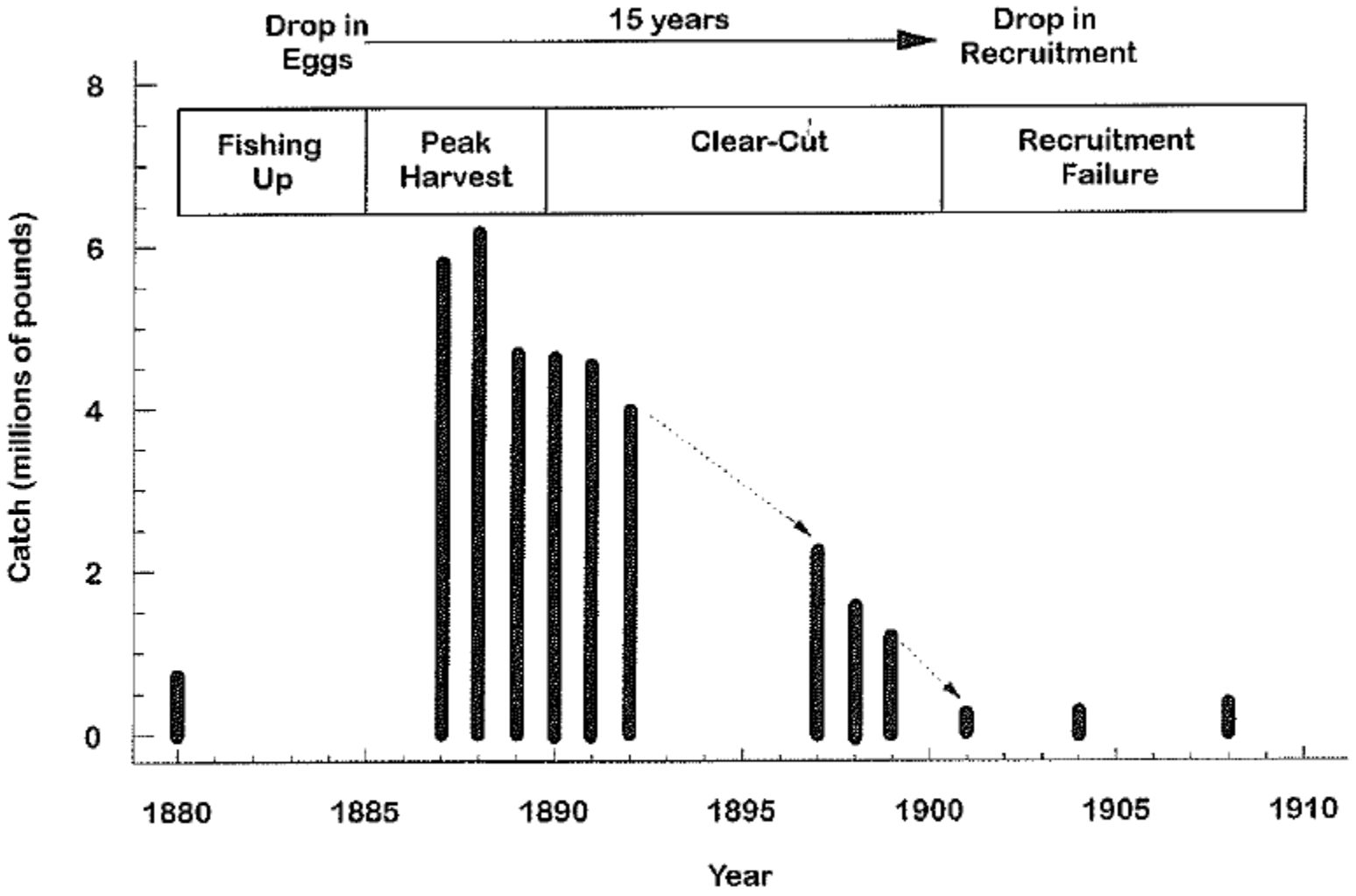


FIGURE 1.—Landings of Atlantic sturgeon in Delaware Bay, 1880–1910. Data from U.S. Fish Commission Reports.

Secor & Waldman 1999 AFS Symposium 23:203-216

Fishing effort for Atlantic sturgeon in Delaware Bay 1890

Camps, processing centers & gill nets

Secor & Waldman 1999
AFS Symposium 23:203-216

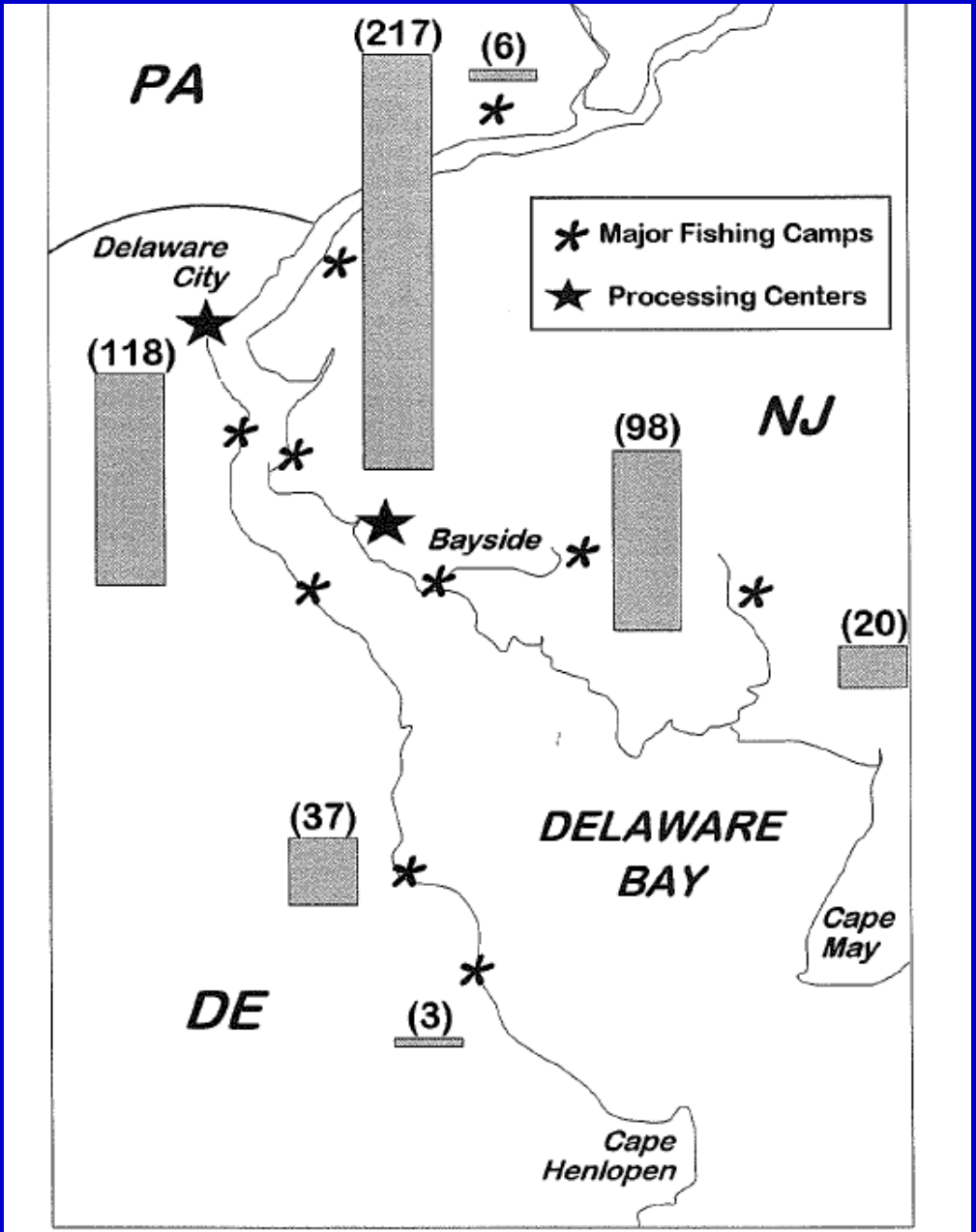
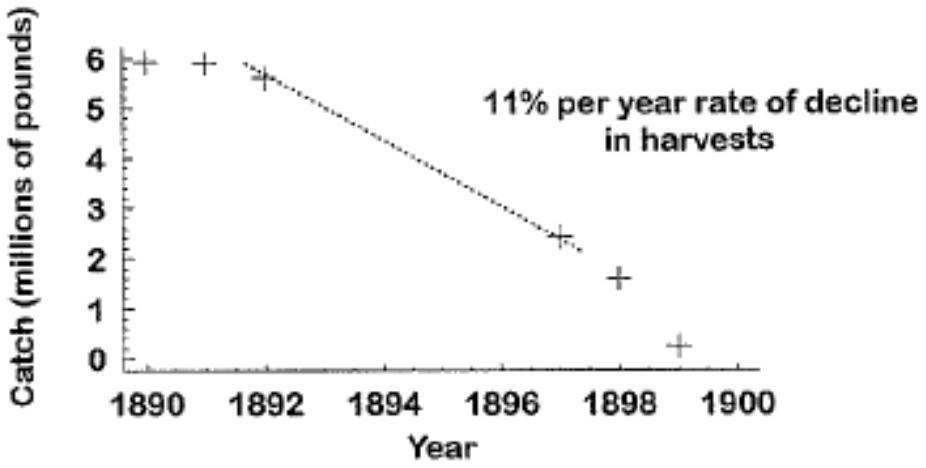


FIGURE 2.—Fishing effort for Atlantic sturgeon in Delaware Bay, by county, 1890. Bars represent number of gill nets (given above each bar) used by county in Pennsylvania, Delaware, and New Jersey. Data from Cobb (1900).

Atlantic sturgeon in Delaware Bay



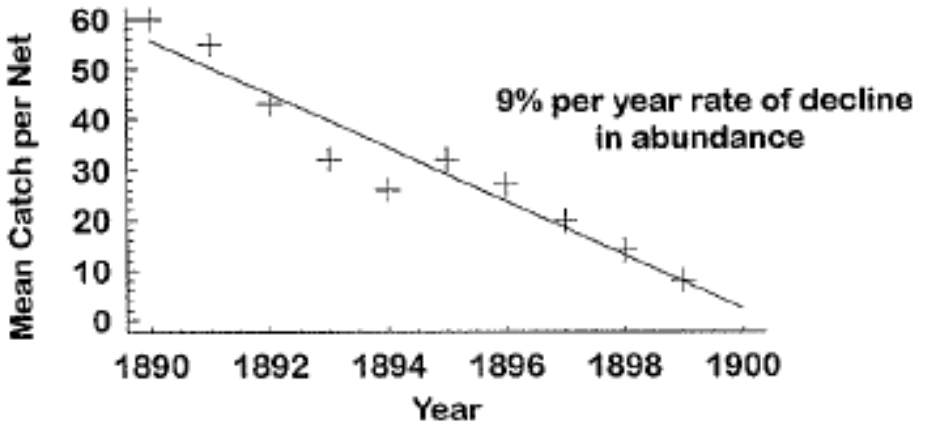
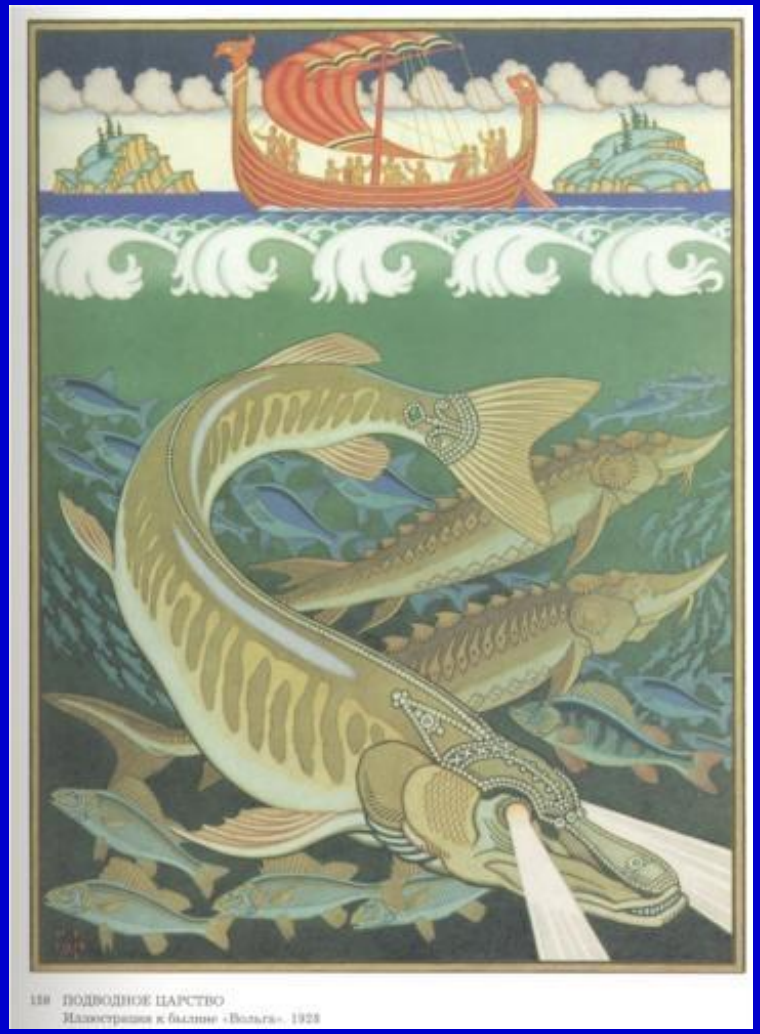


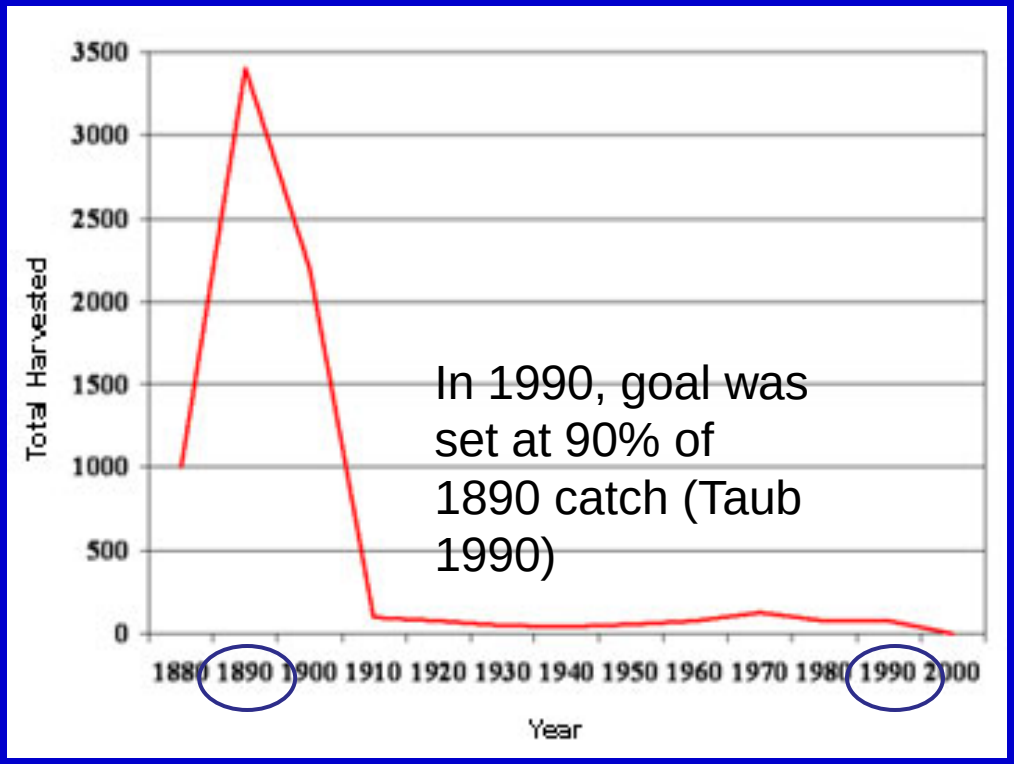
FIGURE 3.—Plot of decline in harvests and abundance (catch per unit effort) of Delaware Bay Atlantic sturgeon during the period 1890 to 1899. 1899 harvest data estimated from number of caviar kegs. Data from Cobb (1900).

Secor & Waldman 1999 AFS Symposium 23:203-216

Sturgeon restoration goals are ambitious



Ivan Bilibin 1927 Underwater.



Sturgeon restoration is a lengthy process

Hindrances to restoration

- Overfishing
- Degradation of spawning habitat
- Sturgeon grow very slowly and take years to mature

Chesapeake Bay crab harvests 1884

"The abundance of the crabs in our waters is well illustrated by the fact that we were told, in 1884, by fishermen in the lower part of the Chesapeake Bay, that they were earning from $1.50 to $2.00 a day catching crabs to sell at one cent a dozen or ten cents a bushel…

[= 1800-2400 crabs or 15-20 bushels; now averaging 10-11 bushels in a day]

…and these men seldom went to their work before sunrise or fished longer than till noon. In fact, most of them were home for the day at ten in the morning."

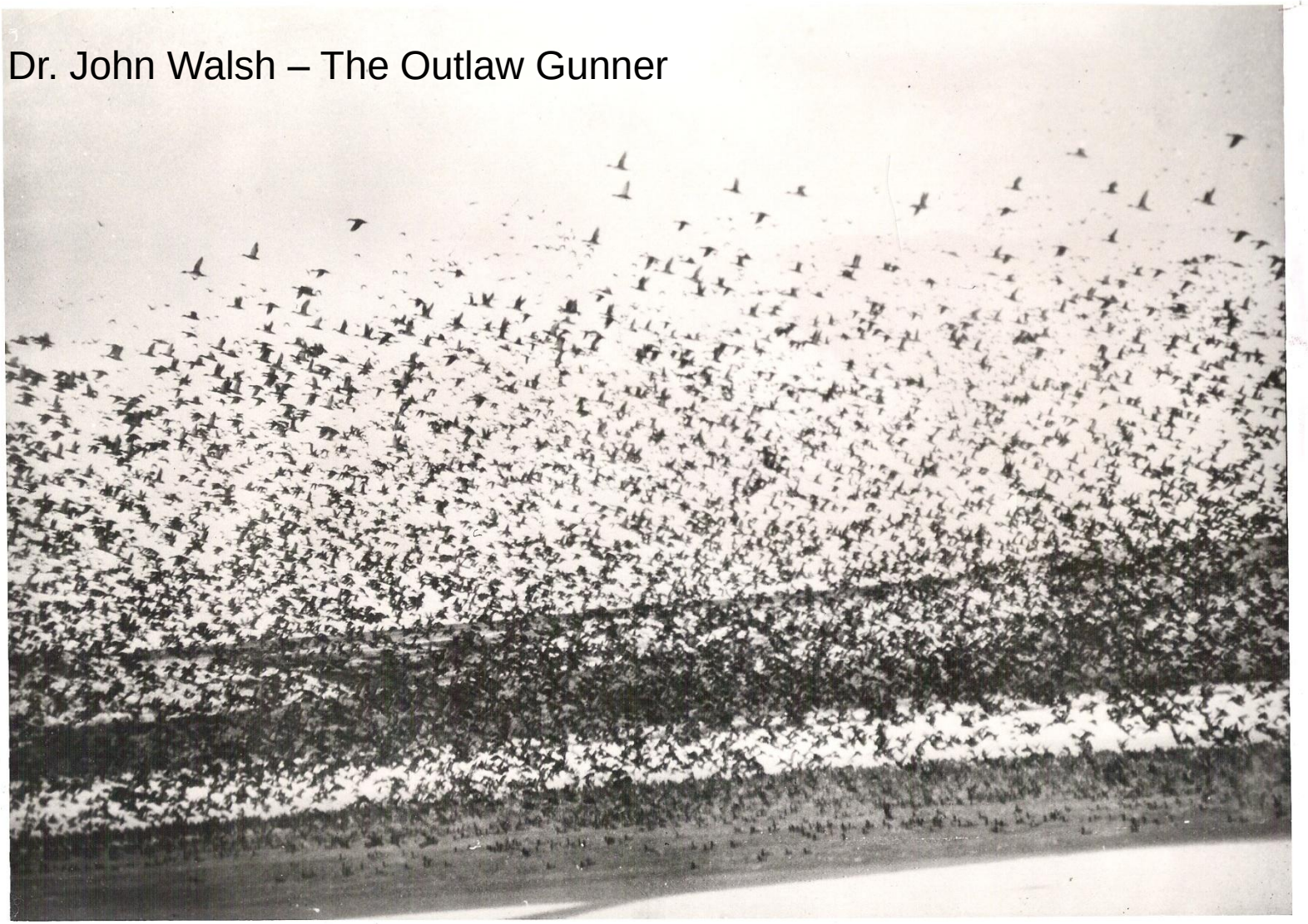
Professor W.K. Brooks, 1893, Johns Hopkins

Wintering waterfowl used to form enormous flocks

"…the water was so black that it seemed a mass of filth or turf, and when they flew up there was a rushing and vibration of the air like a great storm coming through the trees while the sky over the whole creek filled with them like a cloud."

1669-1670 journal note by Dutch itinerant ministers Dankers and Sluyter about waterfowl in the Bohemia River near the Delaware border

Pintails at Barren Island, Chesapeake Bay 1930

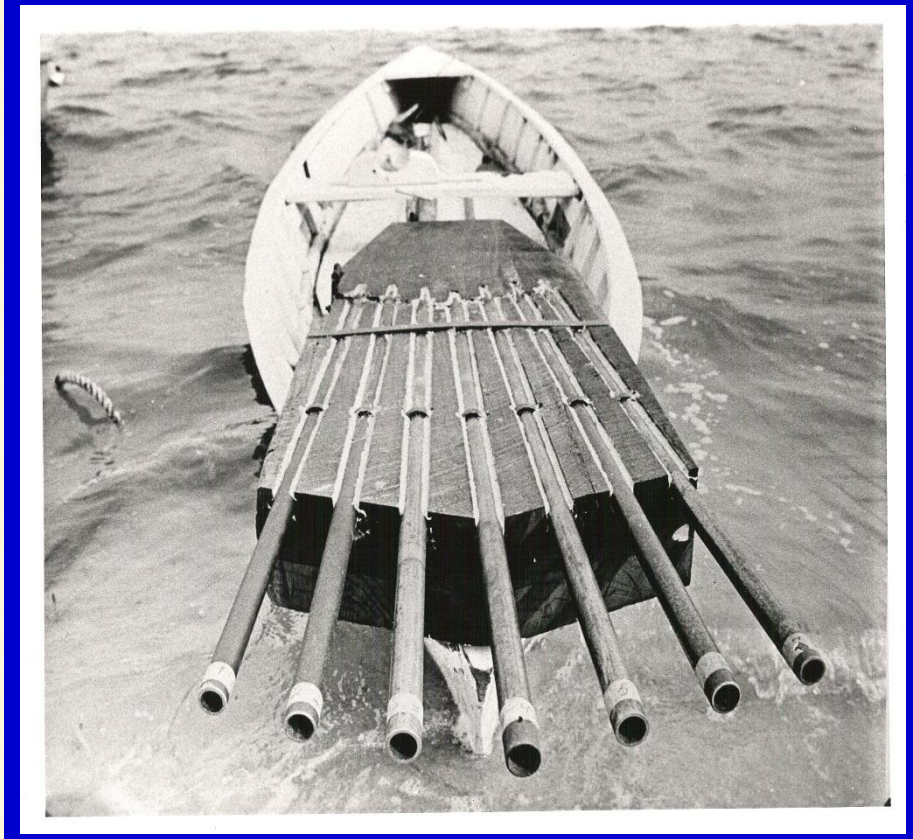


One-day kill, Havre de Grace MD ~1920

Dr. John Walsh – The Outlaw Gunner

Punt guns (left) & battery guns (below) Chesapeake Bay

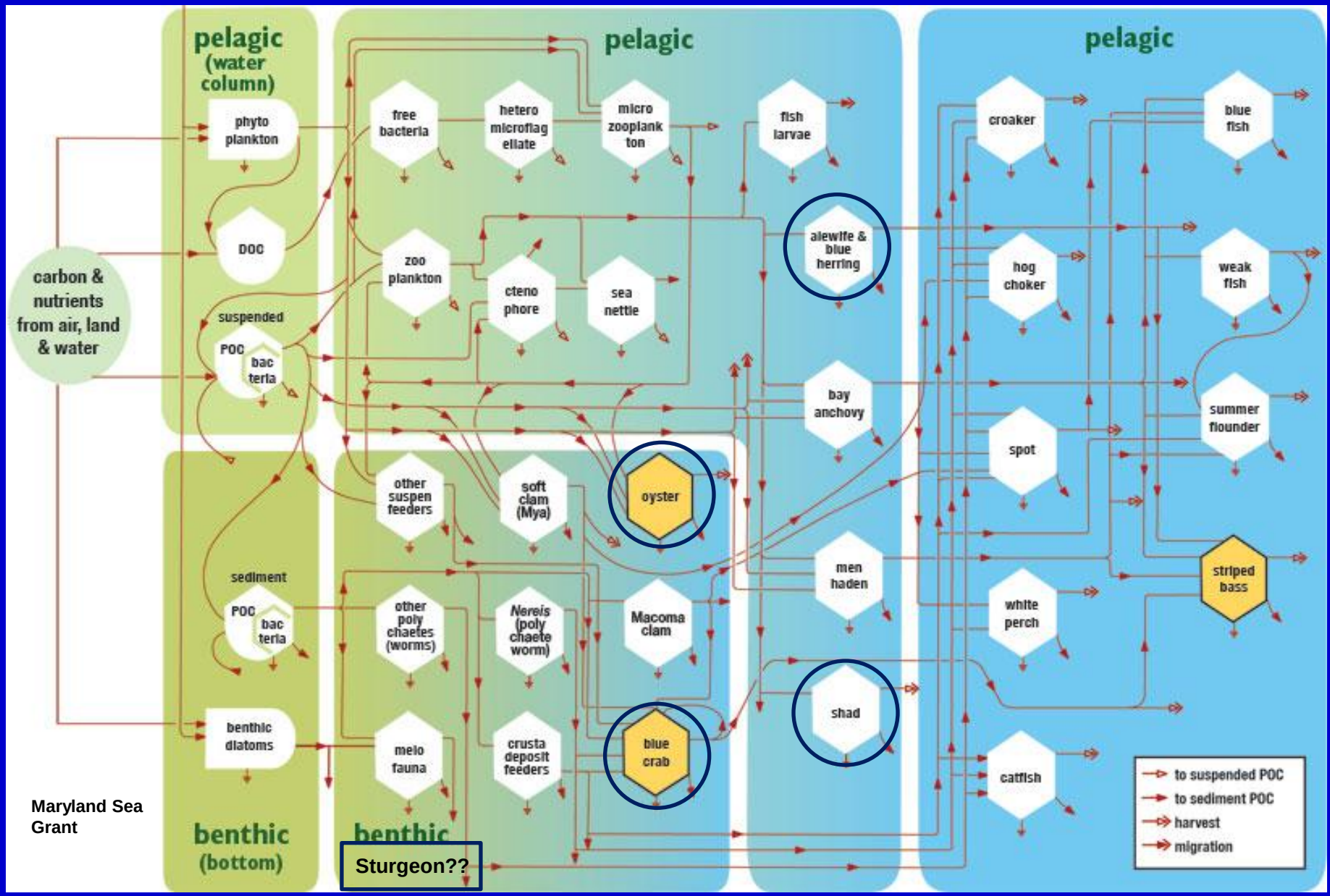
Dr. John Walsh – The Outlaw Gunner



Food webs involve big fish eating little fish (and other stuff)

Pieter van der Heyden from a design by Pieter Bruegel (1557) The Metropolitan Museum of Art

What did a colonial food web look like?



Maryland Sea Grant

How do we deal with the breakdown of expectations of what species should be present in healthy populations, plus societal loss of interest?

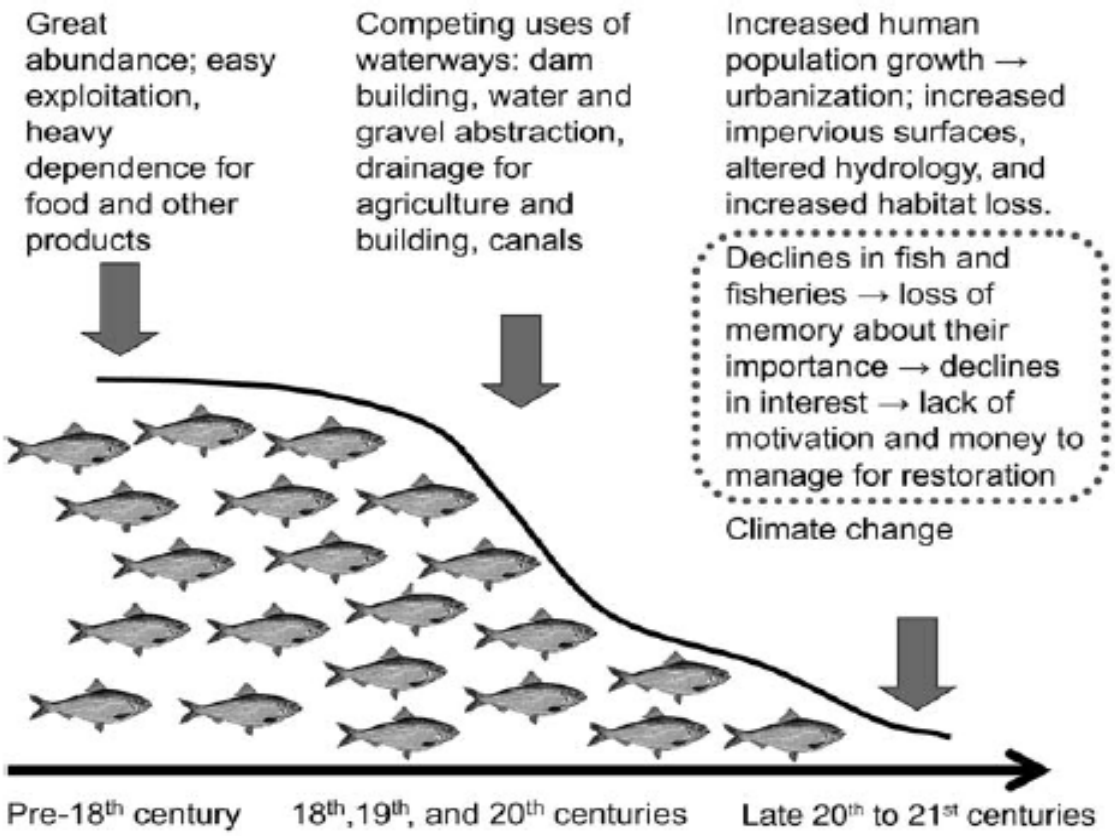


Figure 3. Conceptual diagram of the general history and factors leading to declines in North Atlantic diadromous species. Most species were heavily exploited before industrialization and physical alteration of waterways; further watershed alterations due to human population expansion and climate change increased habitat loss. Gradually, the declines also led to the loss of institutional and societal memory about past abundance and importance (outlined for emphasis).

Limburg, K.E., and J.R. Waldman. 2009. Dramatic declines in North Atlantic diadromous fishes. BioScience 59:955-965.

How do we set a baseline?

- A pristine environment does not exist; humans have always affected aquatic resources
- If we are not aiming towards a pristine environment, what are our aims?
- Do our data go back far enough for us to construct reasonable baselines?
- In a fishery, should a baseline be set according to the *start* of a commercial fishery or the *peak* or *later*?
- How do we account for natural species fluctuations?