



Long Island Sound Study

LONG ISLAND SOUND STUDY FACT SHEET



[Home](#)
[General Info](#)
[Calendar](#)
[Committees](#)
[Plan](#)
[Implementation](#)
[Research](#)
[Publications](#)
[News Releases](#)
[Kids/Teachers](#)
[Links](#)
[Small Grants](#)
[Glossary](#)
[Feedback](#)

How Low Dissolved Oxygen Conditions Affect Marine Life In Long Island Sound

[View this in PDF Format](#) | [Return to Publications](#)

The information presented here is based on results of laboratory research conducted by the United States Environmental Protection Agency's Environmental Research Laboratory at Narragansett, Rhode Island and trawl surveys conducted by the Connecticut Department of Environmental Protection Marine Fisheries Division. Examples are provided for dissolved oxygen conditions. The timing, duration, and areal extent of low dissolved oxygen conditions are very important in determining the overall affect on marine organisms.

The Long Island Sound Study is using these data to identify dissolved oxygen conditions of Long Island Sound aquatic resources and to guide management efforts. For more information, please contact Mark Tedesco in the Long Island Sound Office at (203) 434-2494.

Dissolved Oxygen Levels	Consequences
5.0 mg/L or greater	<ul style="list-style-type: none"> Few adverse effects expected
4.0 mg/L	<ul style="list-style-type: none"> May reduce survival (30%) of very sensitive planktonic crab larvae of <u>some</u> crabs
3.0 mg/L	<ul style="list-style-type: none"> Greater lethality (~75%) among the most sensitive planktonic crab larvae. Growth reduced (25%) in other, less sensitive planktonic crab larvae. Growth reduced in juvenile American lobsters by 25%. Bottom-living fishes begin to show low dissolved oxygen avoidance
2.5 mg/L	<ul style="list-style-type: none"> Lethality threshold (15%) for the less sensitive planktonic larvae of crustaceans. Growth reduced (25%) in juvenile summer flounder; 50% in American lobsters. Most species of bottom-living fishes show dissolved oxygen avoidance.
2.0 mg/L	<ul style="list-style-type: none"> Reduce growth (~ 50%) in juvenile summer flounder and juvenile grass shrimp. Lowest safe dissolved oxygen for survival of several fish and crustaceans.
1.5 mg/L	<ul style="list-style-type: none"> Lethality in some juvenile fishes: pipe fish, 100%; winter flounder, 35%; summer flounder, 50%; Atlantic menhaden, 20%. Lethal threshold for some juvenile crustaceans: American lobster, sand shrimp, grass shrimp, 100%.

	<ul style="list-style-type: none">• At least 50% reduction in abundance of bottom-living fishes.
1.0 mg/L	<ul style="list-style-type: none">• High Lethality (75-90%) in above mentioned fishes.• Lethality (~ 25%) in three additional fishes: windowpane flounder, tautog, fourspine sculpin.• Increased lethality (50%) in above mentioned juvenile crustaceans.• Total avoidance by bottom-living fishes.

Layout and design by Kimberly Zimmer, New York Sea Grant Extension Program for the Long Island Sound Study.

Funded by the Long Island Sound Study, Cooperating agencies: United States Environmental Protection Agency; Connecticut Department of Environmental Protection; New York State Department of Environmental Conservation.

Long Island Sound Study

EPA Long Island Sound Office

888 Washington Boulevard

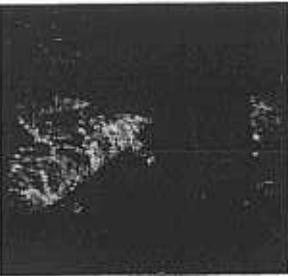
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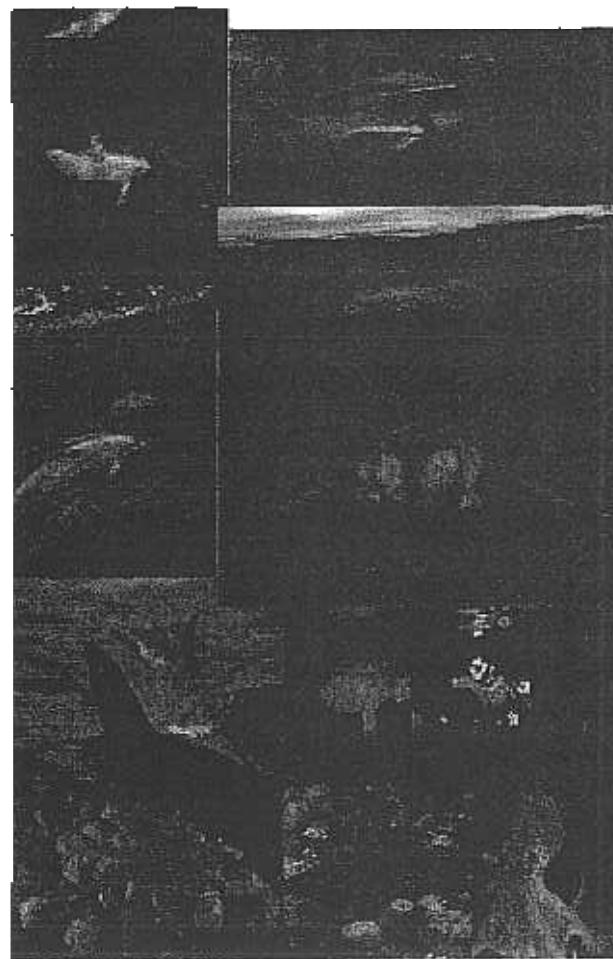


FINFISH

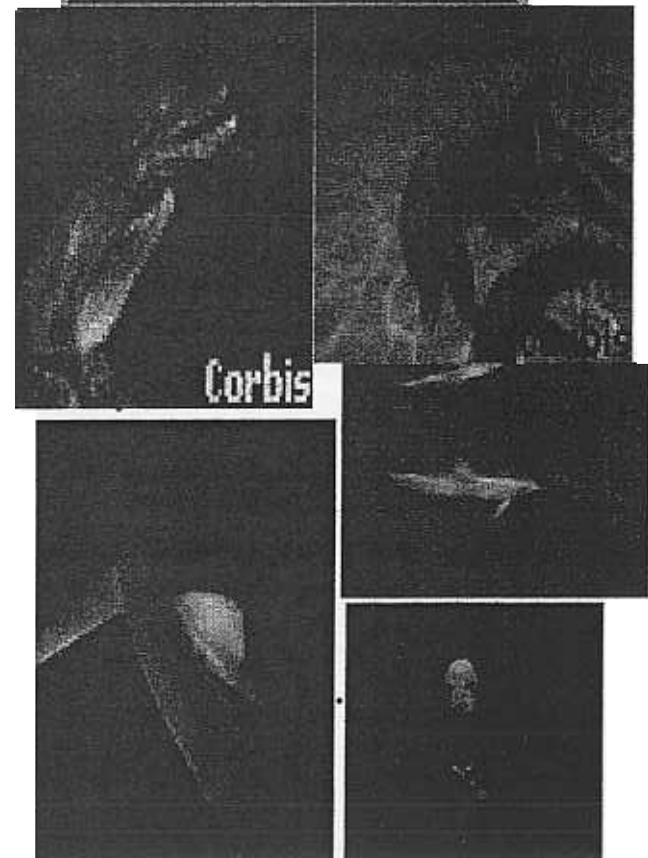
In the late 1980s and early 1990s, marine fish stocks in Long Island Sound dropped greatly. All of the main fish were taken out of the Sound in great numbers. This is called over-fishing. These included bluefish, striped bass, winter flounder, fluke, scup, tautog, and weakfish. Over fishing will mess up the food chain and eventually cause the species extinction. This will happen when there are no female fish to repopulate the species when they give birth.

Winter Flounder, and Tautog

Tautog can also be called blackfish. Rocks and boulders can be an ideal habitat for tautog. Less tautog in the Sound now than in the past. Winter Flounder are a very important species in the Sound. Winter Flounder were heavily taken out of the Sound.



Animal Life in Long Island Sound



Corbis

Plankton and more

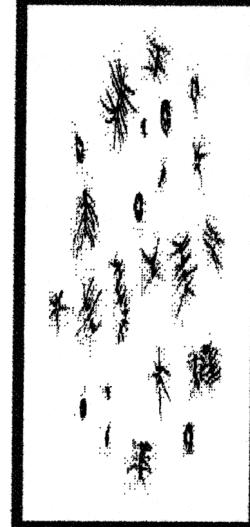
Zooplankton are animals, whose swimming arms are too small to enable them to swim effectively against the currents. They are typically microscopic, ranging in size up to a few centimeters long. Many can dart for short distances in short bursts of energy, however these bursts are mainly reserved for flight from danger, or pursuit of prey.



Shellfish



Long Island Sound produces some of the finest shellfish in the country. More than 60,000 acres of shellfish grounds are cultivated in Connecticut's costal water by aquaculture industry with additional acres cultivated in New York. Although oysters are the dominant commercial shellfish resource in the Sound, commercial ands recreational shellfishers also harvest hard clams, soft shell clams, bay scallops, blue mussels, surf clams, and razor clams.



Phytoplankton are sometimes called the grass of the sea because they are plants eaten by animals. Their size is 1 millionth of an inch to 1 hundredth of an inch. In the winter there may be as many as 110 million of them in one cubic meter of the Long Island Sound . Phytoplankton are at the bottom of the food chain because of their size.

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Environmental Indicators

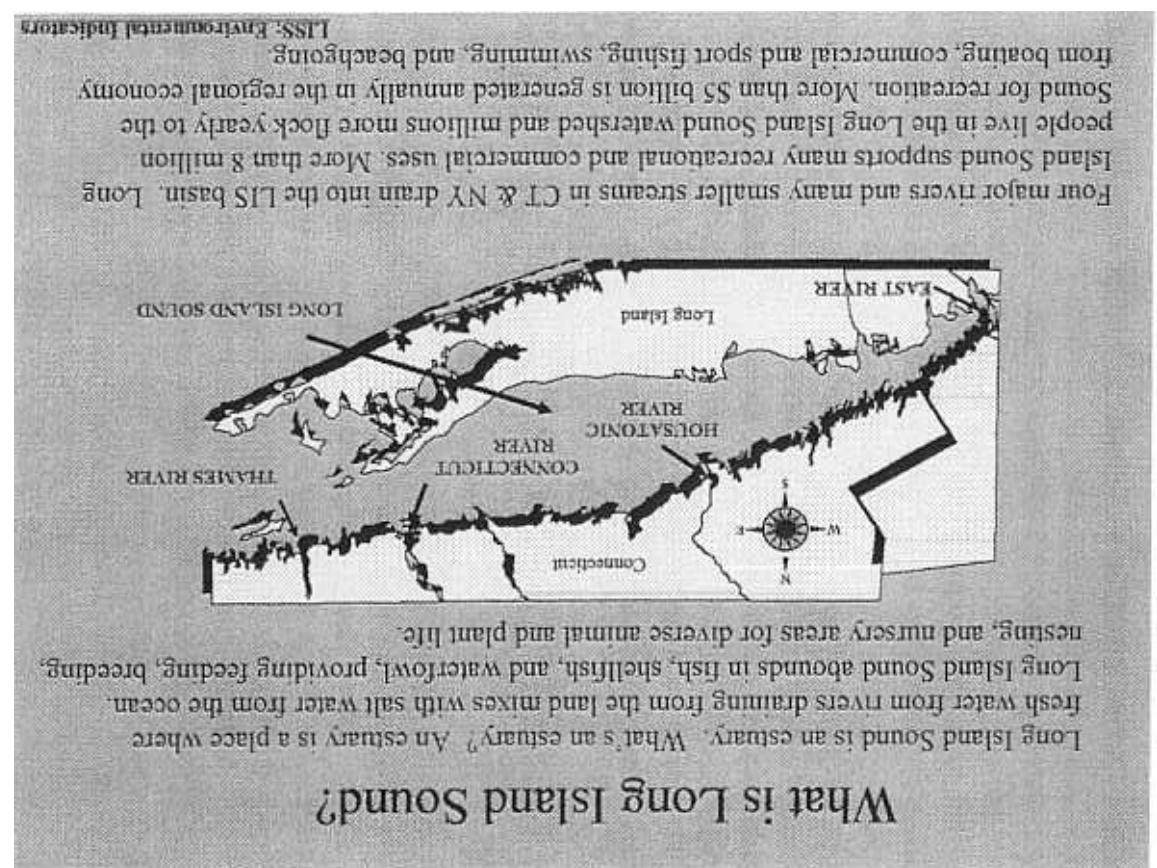
STATUS AND
TRENDS
IN THE HEALTH OF
LONG ISLAND
SOUND



LISS: Environmental Indicators



What is Long Island Sound?



Long Island Sound

An Estuary of National Significance

1985 - The federal government and the states of Connecticut and New York initiated the Long Island Sound Study, a cooperative endeavor to analyze and correct the Sound's most pressing environmental problems.

1987 - Congress recognized the significance of preserving and enhancing coastal environments and established the National Estuary Program (NEP). Under this program, the Long Island Sound was designated an estuary of National Significance. Since its establishment, the NEP has expanded to include 28 estuaries throughout the United States, including the Long Island Sound.

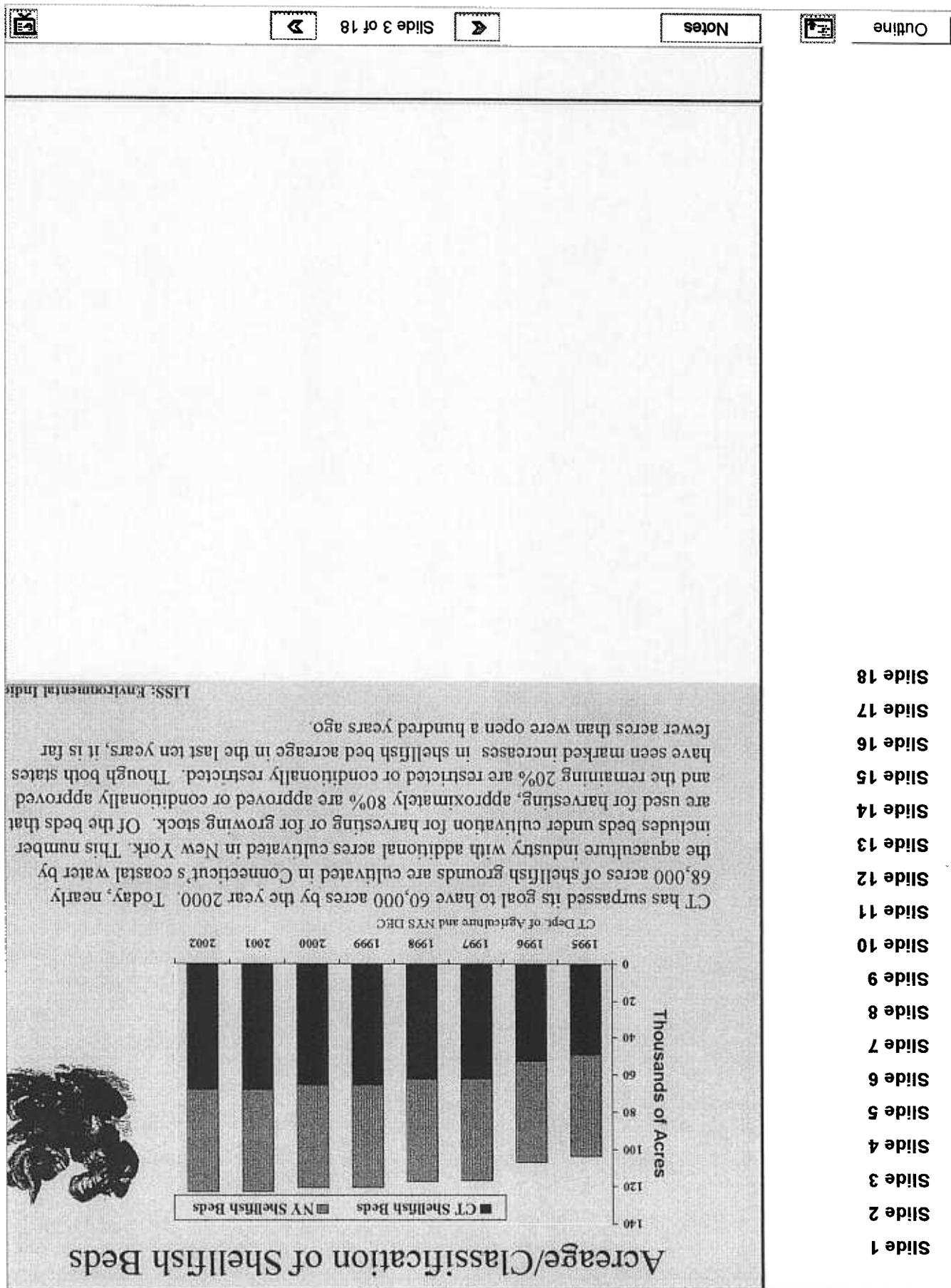
1994 - The LISS Management Conference issued and began implementation of a Comprehensive Conservation and Management Plan to protect and preserve Long Island Sound.

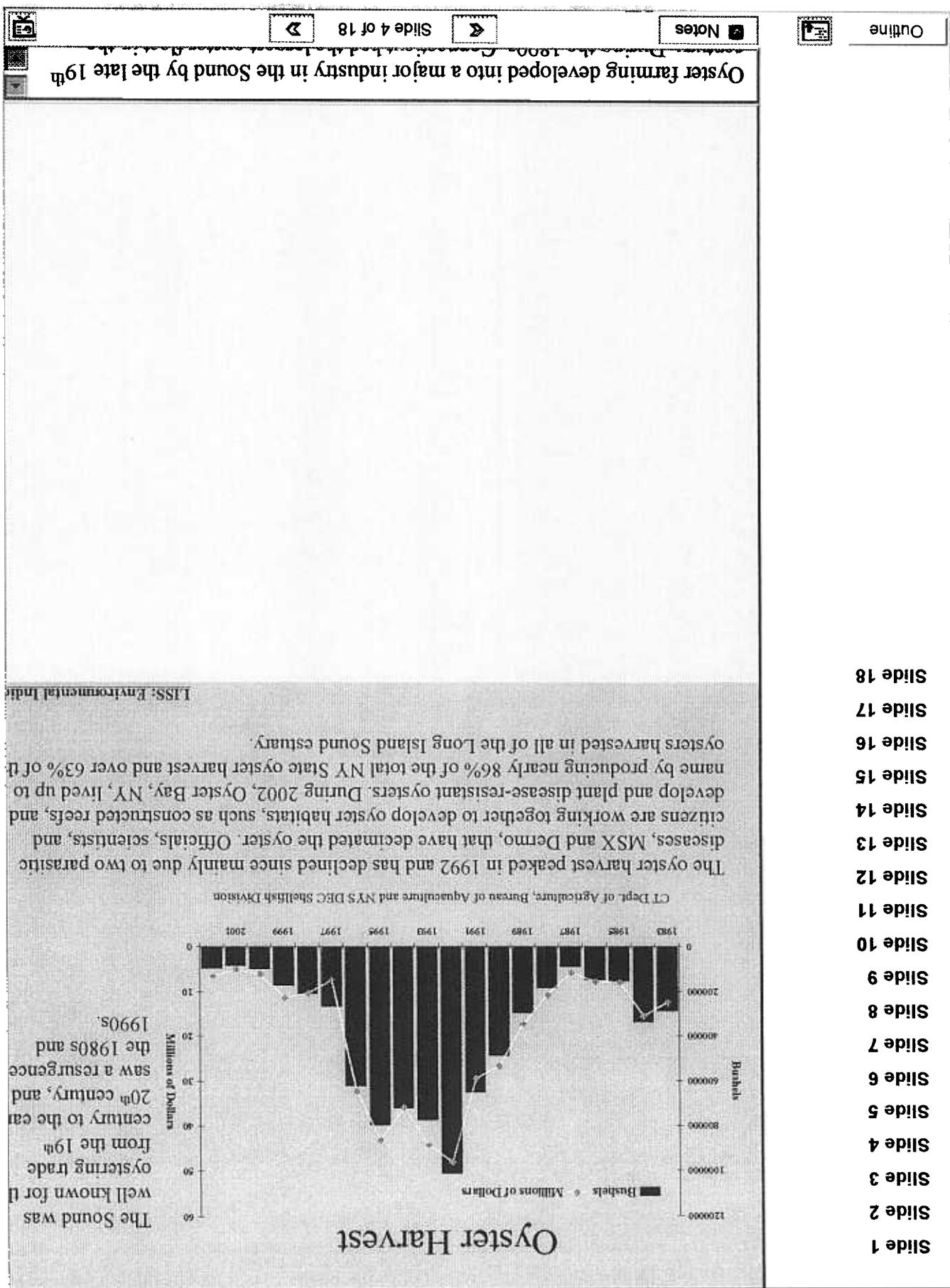
LISS: Environmental Indicators

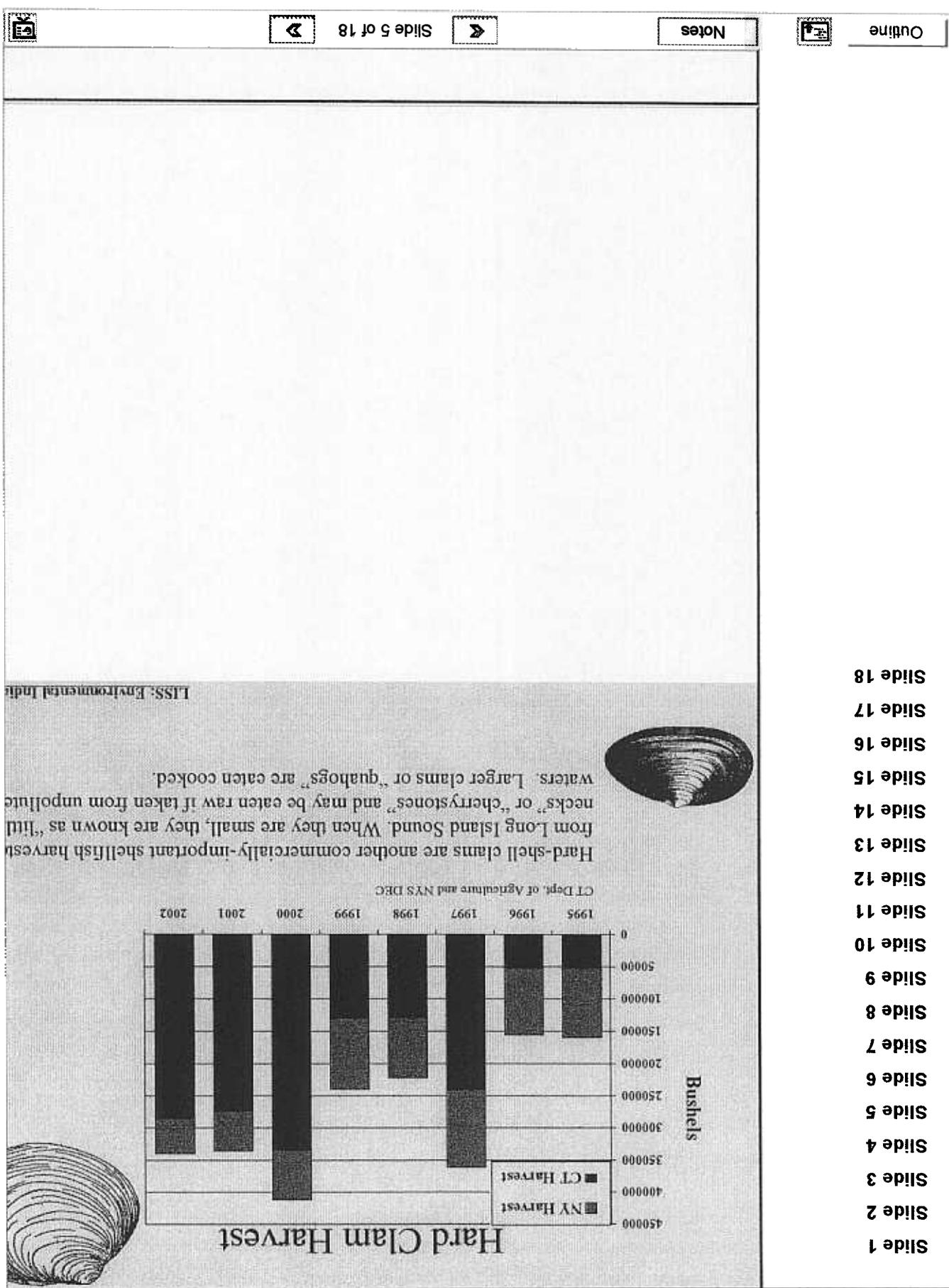
Slide 1
Slide 2
Slide 3
Slide 4
Slide 5
Slide 6
Slide 7
Slide 8
Slide 9
Slide 10
Slide 11
Slide 12

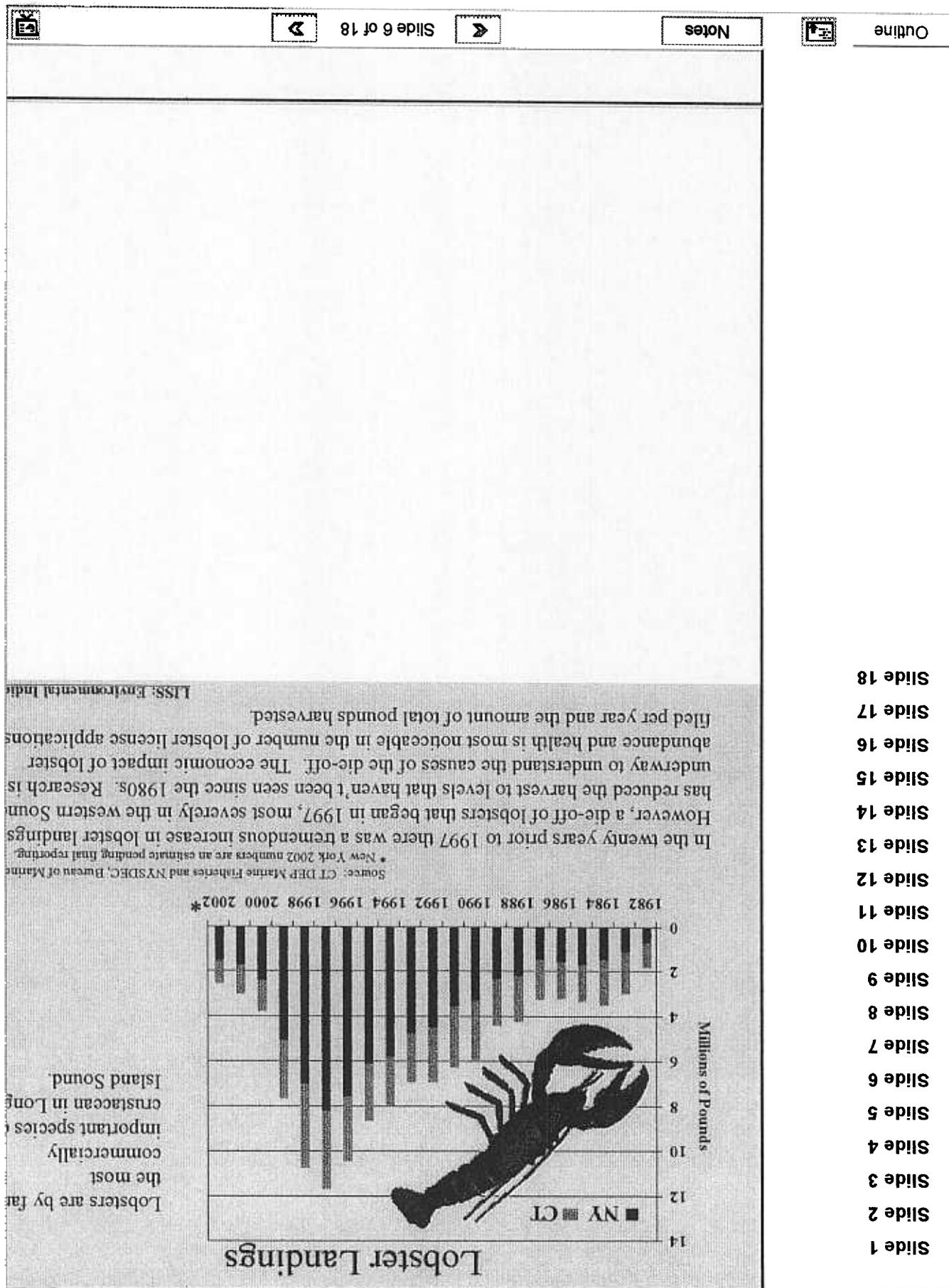
Outline

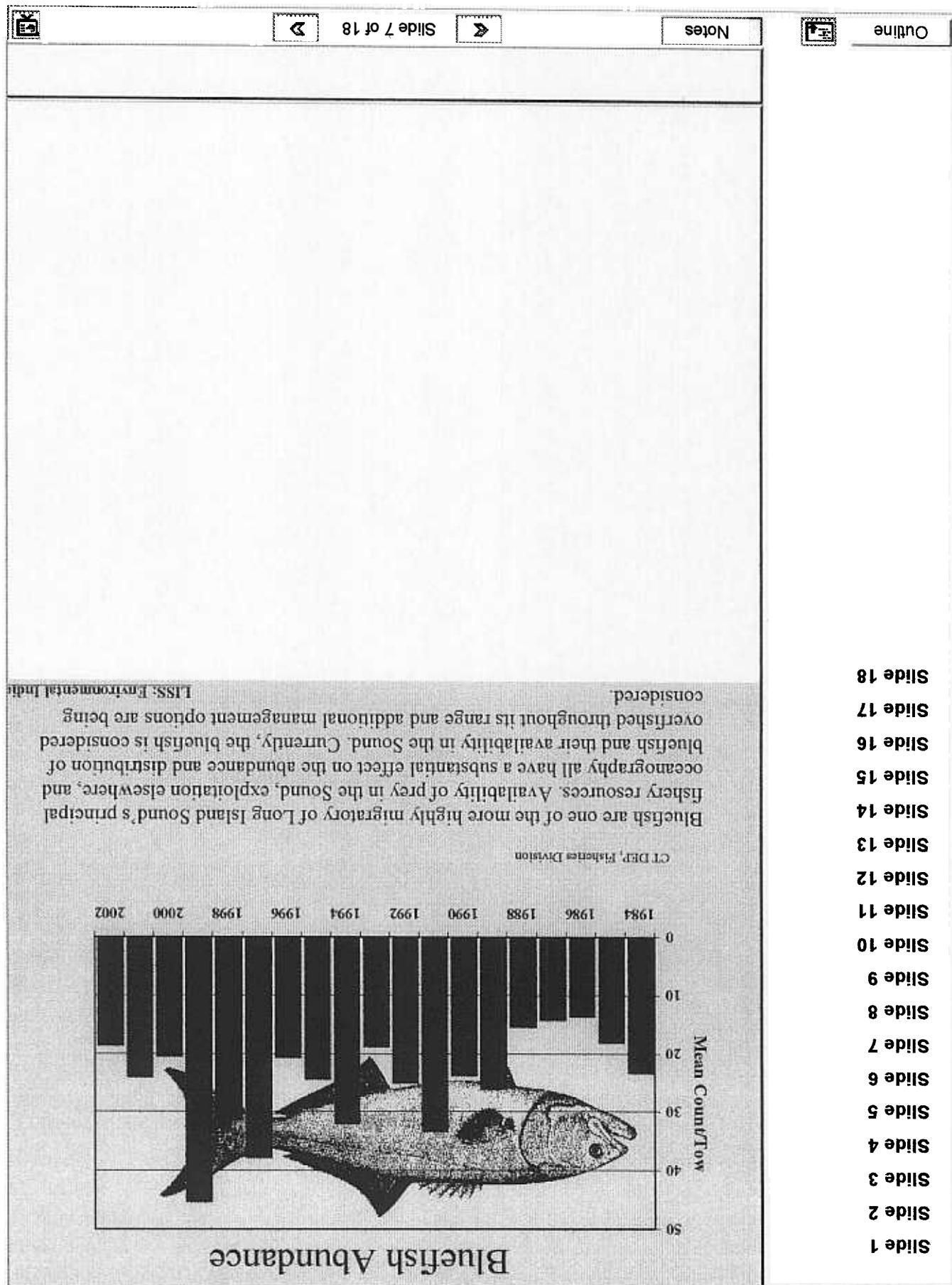
Slide 1	Sound Health: Status and Trends in the Health of Long Island Sound Indicators & Trends: Status and Trends in the Health of the Sound	Section 1: Introduction to Long Island Sound and the Long Island Sound Study	Section 2: Are the Waters and Sediments Getting Cleaner?	Section 3: Are Fish and Wildlife Populations Abundant?	Section 4: Are Fish and Wildlife Habitats Being Protected and Restored?	Section 5: How is the Landscape Changing Due to Human Activities?	Section 6: How is the Public Involved in Restoring and Protecting Long Island Sound?	Section 7: Are Fish and Wildlife Populations Abundant?	Section 8: Are Fish and Wildlife Habitats Being Protected and Restored?	Section 9: Are Fish and Wildlife Habitats Being Protected and Restored?	Section 10: How is the Landscape Changing Due to Human Activities?	Section 11: How is the Landscape Changing Due to Human Activities?	Section 12: How is the Public Involved in Restoring and Protecting Long Island Sound?	Section 13: Are Fish and Wildlife Populations Abundant?	Section 14: Are Fish and Wildlife Habitats Being Protected and Restored?	Section 15: Are Fish and Wildlife Habitats Being Protected and Restored?	Section 16: Are Fish and Wildlife Habitats Being Protected and Restored?	Section 17: Are Fish and Wildlife Habitats Being Protected and Restored?	Section 18: Environmental Impacts
Slide 1	Indicators & Trends: Status and Trends in the Health of the Sound	Section 1: Introduction to Long Island Sound and the Long Island Sound Study	Section 2: Are the Waters and Sediments Getting Cleaner?	Section 3: Are Fish and Wildlife Populations Abundant?	Section 4: Are Fish and Wildlife Habitats Being Protected and Restored?	Section 5: How is the Landscape Changing Due to Human Activities?	Section 6: How is the Public Involved in Restoring and Protecting Long Island Sound?	Section 7: Are Fish and Wildlife Populations Abundant?	Section 8: Are Fish and Wildlife Habitats Being Protected and Restored?	Section 9: Are Fish and Wildlife Habitats Being Protected and Restored?	Section 10: How is the Landscape Changing Due to Human Activities?	Section 11: How is the Landscape Changing Due to Human Activities?	Section 12: How is the Public Involved in Restoring and Protecting Long Island Sound?	Section 13: Are Fish and Wildlife Populations Abundant?	Section 14: Are Fish and Wildlife Habitats Being Protected and Restored?	Section 15: Are Fish and Wildlife Habitats Being Protected and Restored?	Section 16: Are Fish and Wildlife Habitats Being Protected and Restored?	Section 17: Are Fish and Wildlife Habitats Being Protected and Restored?	Section 18: Environmental Impacts

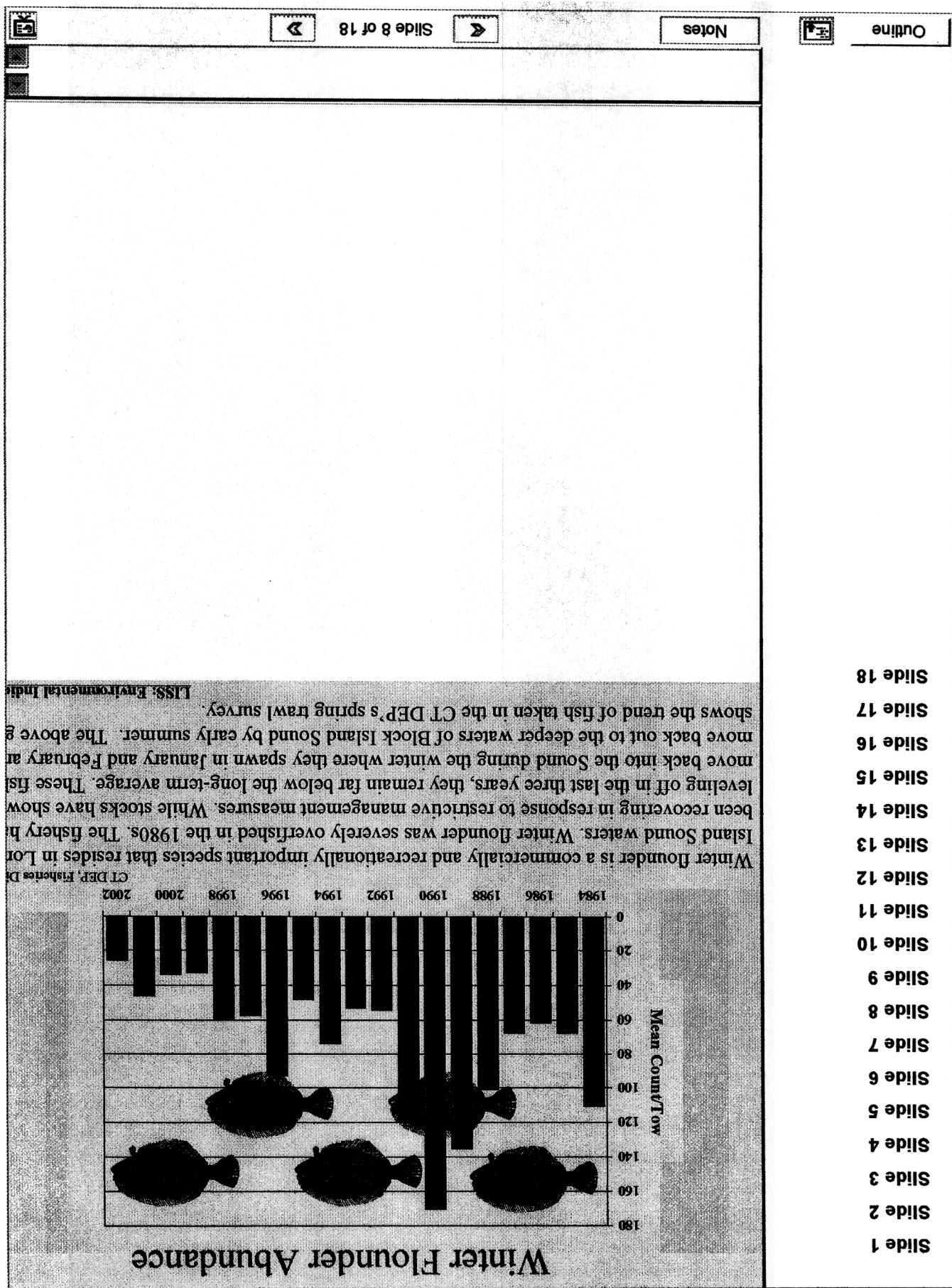


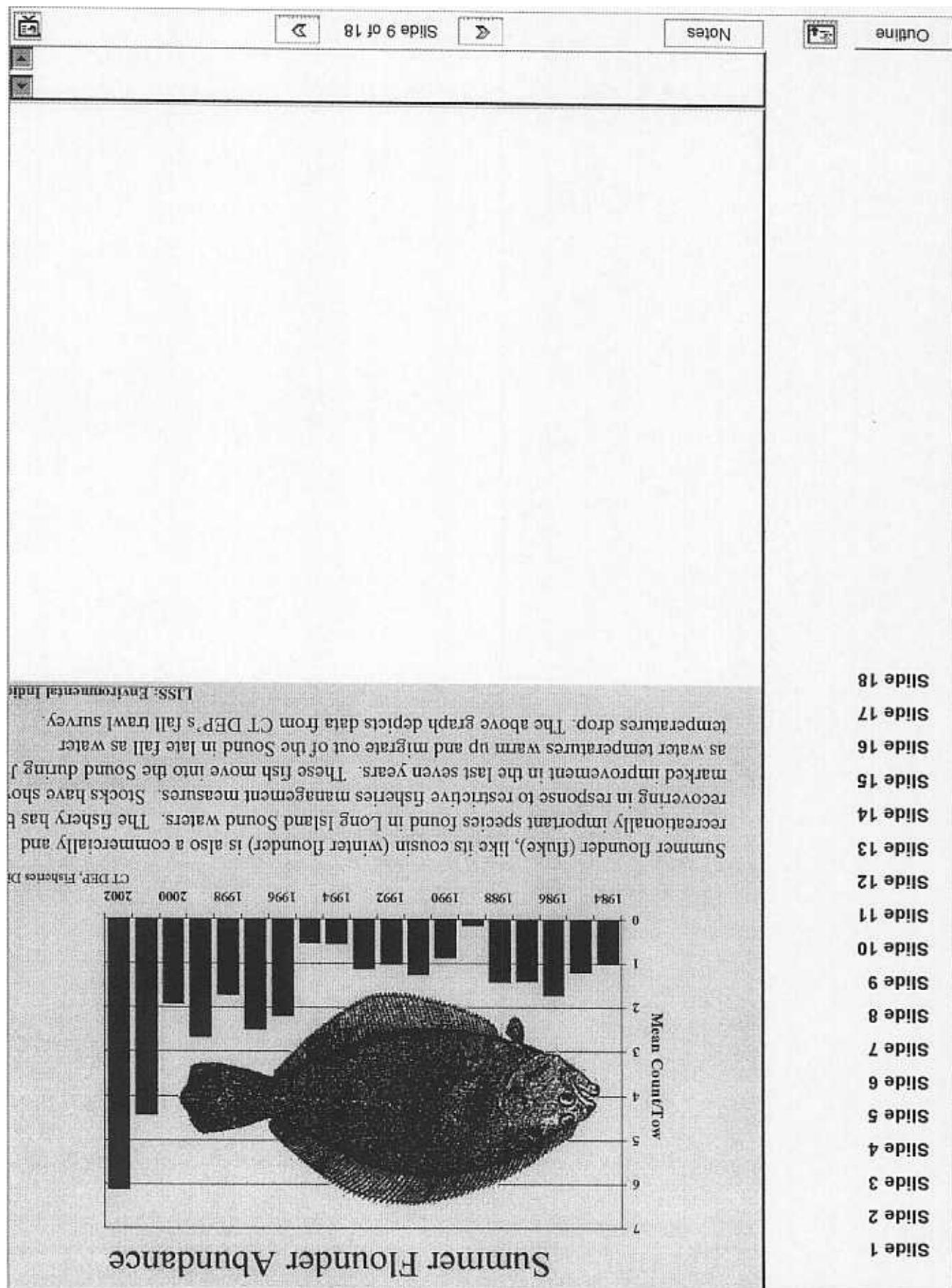


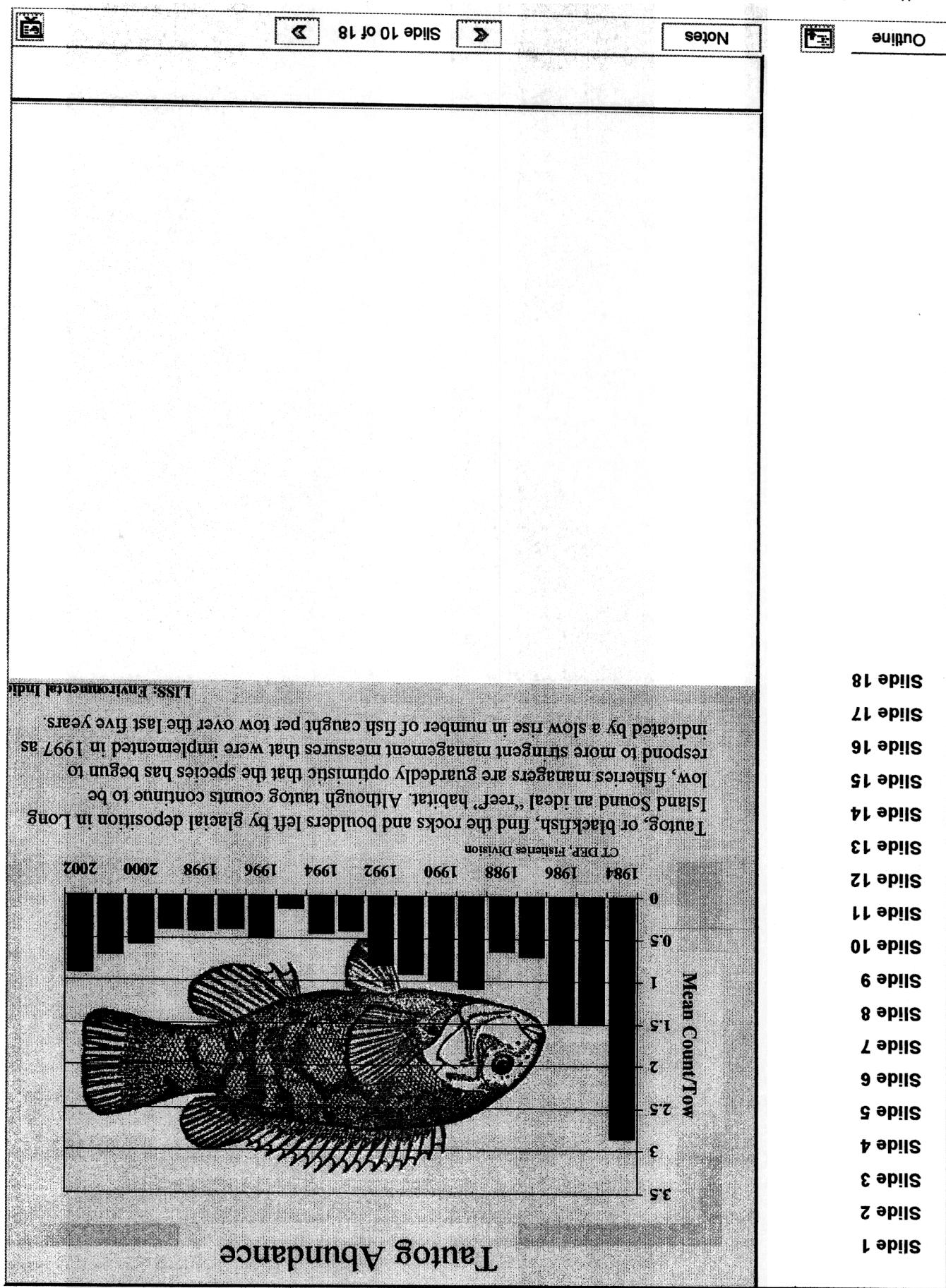








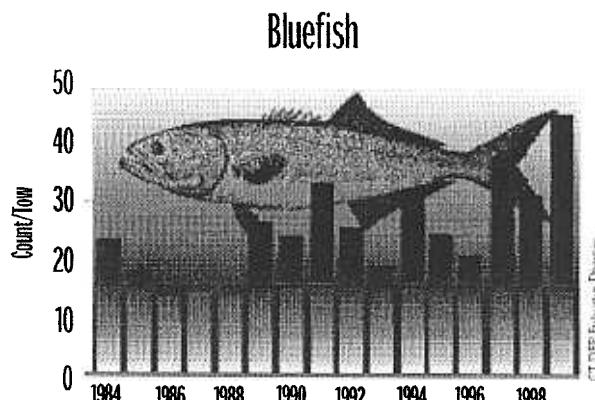




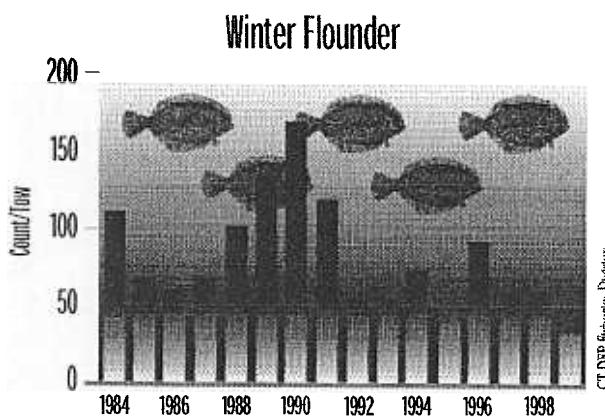
In the late 1980s and early 1990s, marine fish stocks plummeted in Long Island Sound. All of the principal species supporting the recreational and commercial fisheries of the Sound were considered overfished. These included bluefish, striped bass, winter flounder, fluke, scup, tautog, and weakfish. These fish comprise 95 percent of the species sought by anglers and commercially-licensed seafood producers. All of the species listed are now

managed by the Atlantic States Marine Fisheries Commission. A combination of environmental conditions leading to improved recruitment (the number of young produced per year) for some species and fishery management measures to limit exploitation and rebuild stock for others has helped "turn the corner" for Long Island Sound fishery productivity. However, there still remains a great deal of work to be done to improve fish stocks.

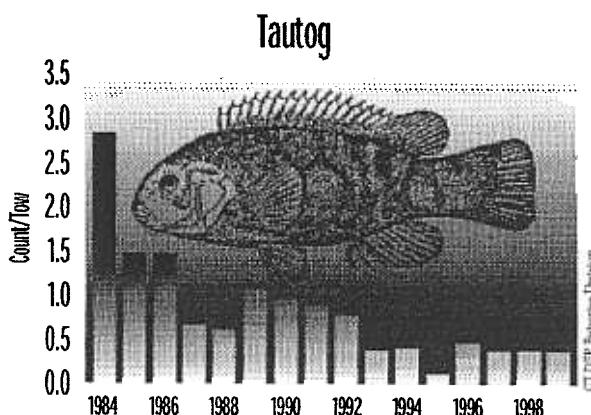
Bluefish, Winter Flounder, and Tautog Abundance



Bluefish are one of the more highly migratory of Long Island Sound's principal fishery resources. Availability of prey in the Sound, exploitation elsewhere, and oceanography all have a substantial effect on the abundance and distribution of bluefish and their availability in the Sound. Currently, the bluefish is considered overfished throughout its range and additional management options are being considered.



Winter flounder is a commercially and recreationally important species that resides in Long Island Sound waters. Winter flounder was severely overfished in the 1980s. The fishery has been recovering in response to restrictive management measures. While stocks have shown modest improvement in the last three years, they remain far below the long-term average.



Tautog, or blackfish, find the rocks and boulders left by glacial deposition in Long Island Sound an ideal "reef" habitat. Continuing low tautog counts indicate that the species has not yet responded to more stringent management measures that were implemented in 1997.

FISH CONSUMPTION ADVISORY

This advisory refers to sport fish that people catch. It does not apply to fish bought in stores. Due to the possibility that ingested fish will have elevated concentrations of contaminants, the following marine organisms have consumption advisories issued by the NYS Department of Health and CT Department of Public Health:

Marine Bluefish and Eels—

NY: Eat no more than one meal per week of bluefish or eels. (PCB contamination) CT: Bluefish 13-25" - Eat no more than one meal per month. Bluefish over 25" - Eat no more than one meal per 2 months; high risk group (women of childbearing age, pregnant women, and children under 6) should not eat bluefish over 25". Eels: Do not eat eels.

Marine Striped Bass—

NY: Women of childbearing age and children under 15 should not eat striped bass taken from Long Island Sound west of Wading River. Others should eat no more than one meal per month from the above-mentioned area. Everyone should eat no more than one meal per week of striped bass taken from Long Island Sound east of Wading River. (PCB contamination) CT: High risk group should not eat striped bass. All others should eat one meal per 2 months.

Crabs and Lobsters—

CT/NY: Hepatopancreas (green meat or mustard) should not be eaten (PCB, cadmium, and dioxin contamination). For more information, visit www.health.state.ny.us/nysdoh/environ/fish www.state.ct.us/dph/BCH/eefch/webfsh

Outline

Slide 1

Slide 2

Slide 3

Slide 4

Slide 5

Slide 6

Slide 7

Slide 8

Slide 9

Slide 10

Slide 11

Slide 12

Slide 13

Slide 14

Slide 15

Slide 16

Slide 17

Slide 18

Slide 19

Slide 20

Slide 21

Slide 22

Slide 23

Slide 24

Slide 25

Slide 26

Indicators & Trends: Status and Trends in the Health of the Sound

Section 1: Introduction to Long Island Sound and the Long Island Sound Study

Section 2: Are the Waters and Sediments Getting Cleaner?

Section 3: Are Fish and Wildlife Populations More Abundant?

Section 4: Are Fish and Wildlife Habitats Being Protected and Restored?

Section 5: How is the Landscape Changing Due to Human Activities?

Section 6: How is the Public Involved in Restoring and Protecting Long Island Sound?

LISS: Environmental Indicators

Outline Notes ← Slide 1 of 28 →

- [Slide 1](#)
- [Slide 2](#)
- [Slide 3](#)
- [Slide 4](#)
- [Slide 5](#)
- [Slide 6](#)
- [Slide 7](#)
- [Slide 8](#)
- [Slide 9](#)
- [Slide 10](#)
- [Slide 11](#)
- [Slide 12](#)
- [Slide 13](#)
- [Slide 14](#)
- [Slide 15](#)
- [Slide 16](#)
- [Slide 17](#)
- [Slide 18](#)
- [Slide 19](#)
- [Slide 20](#)
- [Slide 21](#)
- [Slide 22](#)
- [Slide 23](#)
- [Slide 24](#)
- [Slide 25](#)
- [Slide 26](#)

Are the Waters and Sediments Getting Cleaner?

Table of Contents

Hypoxia

- [Introduction to Hypoxia](#)
- [Dissolved Oxygen in Bottom Waters](#)
- [DO Area and Duration](#)
- [Biological Nutrient Removal \(BNR\)](#)
- [Sewage Treatment Plant Effluent With and Without BNR](#)
- [Point Source Nitrogen Load](#)
- [Tributary Trends](#)
- [River and Coastal Nonpoint Source Pollution](#)
- [Total Nitrogen: Point and Nonpoint Sources](#)
- [Chlorophyll-a Levels](#)

Toxic Contaminants

- [Introduction to Toxic Contaminants](#)
- [End-of-Pipe Toxicity](#)
- [Connecticut Industrial Chemical Discharges](#)
- [New York Industrial Chemical Discharges](#)
- [Contaminant Trends in Mussels](#)
- [Lead in Surface Sediments](#)
- [Mercury Concentrations in Sediment](#)

Pathogens

- [Introduction to Pathogens](#)
- [Beach Closure Days](#)
- [Vessel Pumpout Stations](#)
- [Floatable Debris](#)
- [Introduction to Floatable Debris](#)
- [International Coastal Cleanup](#)
- [Composition of Debris Collected in CT](#)
- [Pounds of Debris and Miles of Beach Cleaned Around Long Island Sound](#)



Photo by CDEC

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[Outline](#)[Notes](#)

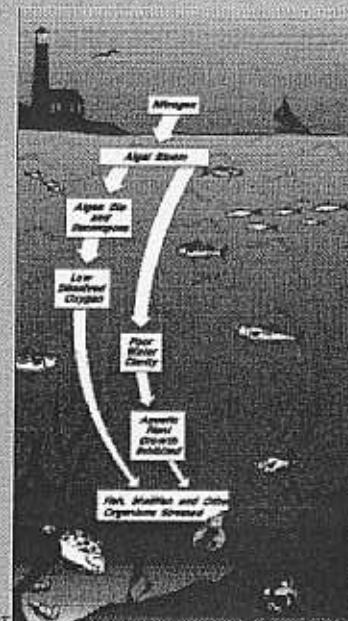
Slide 2 of 28



[Slide 1](#)[Slide 2](#)[Slide 3](#)[Slide 4](#)[Slide 5](#)[Slide 6](#)[Slide 7](#)[Slide 8](#)[Slide 9](#)[Slide 10](#)[Slide 11](#)[Slide 12](#)[Slide 13](#)[Slide 14](#)[Slide 15](#)[Slide 16](#)[Slide 17](#)[Slide 18](#)[Slide 19](#)[Slide 20](#)[Slide 21](#)[Slide 22](#)[Slide 23](#)[Slide 24](#)[Slide 25](#)[Slide 26](#)

Hypoxia

- Dissolved oxygen (DO) levels gauge the overall health of the aquatic environment
- When DO levels in the bottom waters of the Sound are low (a condition called hypoxia) to non-existent (anoxia), then the survival, reproduction, or use of an area by marine life is impaired.
- Food sources for commercially-valuable marine species are depleted.
- Marine species life cycle development may be impaired due to stress caused by hypoxia.
- The larger problem is over-fertilization of the Sound with nutrients, primarily nitrogen.
- Nitrogen fuels excessive algae growth. When the algae die and settle to the bottom of the Sound, the decay process uses up the available oxygen.
- In 1998, LISS adopted a 58.5 percent reduction target for nitrogen loads from human sources to the Sound over 15 years, with five and ten-year interim targets to assure steady progress.
- In 2001, the EPA approved Connecticut's and New York's strategy, called a Total Maximum Daily Load (TMDL), for achieving the reductions and allocating responsibility among nitrogen sources.



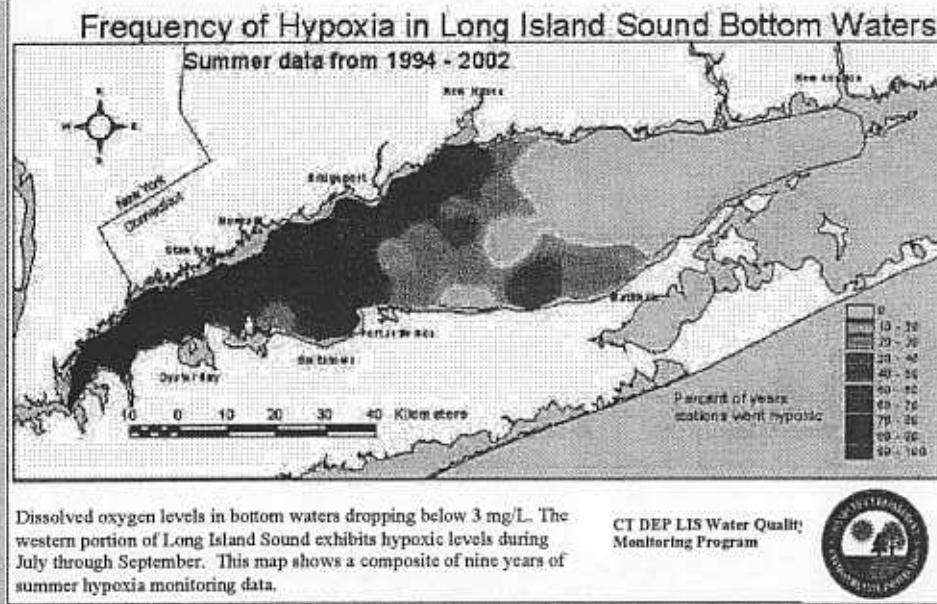
LISS: Environmental Indicators

[Outline](#)[Notes](#)

Slide 3 of 28



- [Slide 1](#)
- [Slide 2](#)
- [Slide 3](#)
- [Slide 4](#)
- [Slide 5](#)
- [Slide 6](#)
- [Slide 7](#)
- [Slide 8](#)
- [Slide 9](#)
- [Slide 10](#)
- [Slide 11](#)
- [Slide 12](#)
- [Slide 13](#)
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- [Slide 19](#)
- [Slide 20](#)
- [Slide 21](#)
- [Slide 22](#)
- [Slide 23](#)
- [Slide 24](#)
- [Slide 25](#)
- [Slide 26](#)



From mid-July through September, portions of Long Island Sound, particularly the bottom waters at the western end, experience low dissolved oxygen conditions known as hypoxia. The low levels of oxygen impair the feeding, growth, and reproduction of aquatic life. In extreme conditions, some organisms may suffocate and die, while others flee the hypoxic zones.

LISS: Environmental Indicators

- Dissolved oxygen levels in water are often used to gauge the overall health of the aquatic environment.

Outline



Notes



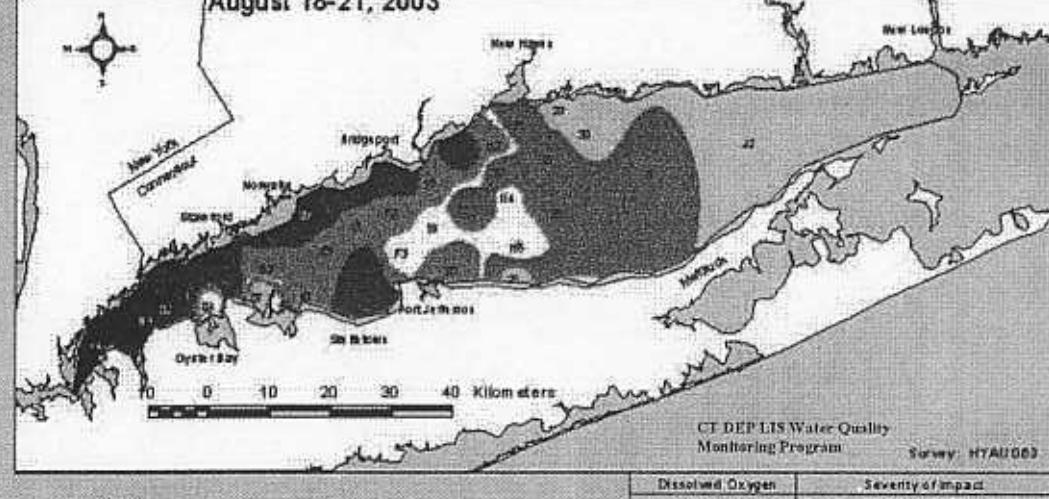
Slide 4 of 28



[Slide 1](#)[Slide 2](#)[Slide 3](#)[Slide 4](#)[Slide 5](#)[Slide 6](#)[Slide 7](#)[Slide 8](#)[Slide 9](#)[Slide 10](#)[Slide 11](#)[Slide 12](#)[Slide 13](#)[Slide 14](#)[Slide 15](#)[Slide 16](#)[Slide 17](#)[Slide 18](#)[Slide 19](#)[Slide 20](#)[Slide 21](#)[Slide 22](#)[Slide 23](#)[Slide 24](#)[Slide 25](#)[Slide 26](#)

Dissolved Oxygen in Long Island Sound Bottom Waters

August 18-21, 2003



Summer of 2003 experienced the height of the annual hypoxic event in late August with dissolved oxygen in the bottom waters dropping below 1.0 ppm in the areas historically experiencing hypoxia 80 to 90% of the time over the last 10 years.

Dissolved Oxygen	Severity of Impact
0.0 - 0.90 mg/L	Severe
1.0 - 1.99 mg/L	Moderately severe
2.0 - 2.99 mg/L	Moderate
3.0 - 3.49 mg/L	Marginal
3.5 - 4.76 mg/L	Interim management goal
4.8 + mg/L	Excellent - Supportive of marine life

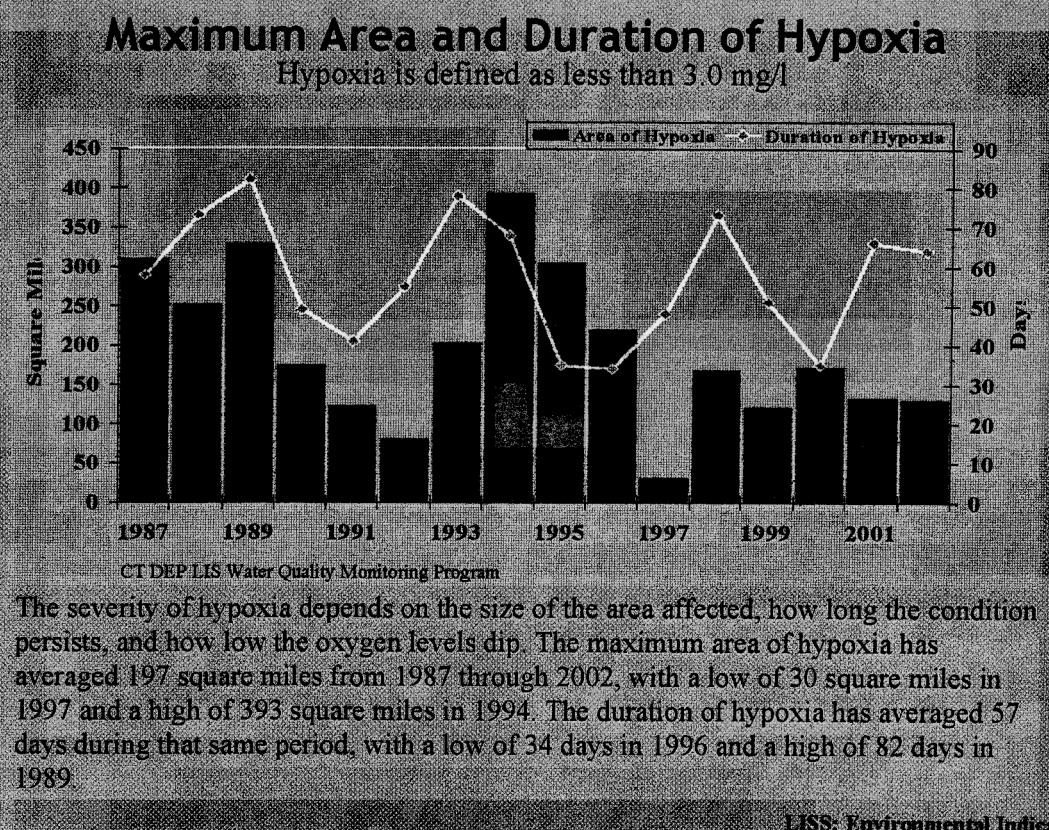
LISS: Environmental Indicators

[Outline](#)[Notes](#)

Slide 5 of 28



- Slide 1
- Slide 2
- Slide 3
- Slide 4
- Slide 5
- Slide 6
- Slide 7
- Slide 8
- Slide 9
- Slide 10
- Slide 11
- Slide 12
- Slide 13
- Slide 14
- Slide 15
- Slide 16
- Slide 17
- Slide 18
- Slide 19
- Slide 20
- Slide 21
- Slide 22
- Slide 23
- Slide 24
- Slide 25
- Slide 26

[Outline](#)[Notes](#)

Slide 6 of 28



- [Slide 1](#)
- [Slide 2](#)
- [Slide 3](#)
- [Slide 4](#)
- [Slide 5](#)
- [Slide 6](#)
- [Slide 7](#)
- [Slide 8](#)
- [Slide 9](#)
- [Slide 10](#)
- [Slide 11](#)
- [Slide 12](#)
- [Slide 13](#)
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- [Slide 15](#)
- [Slide 16](#)
- [Slide 17](#)
- [Slide 18](#)
- [Slide 19](#)
- [Slide 20](#)
- [Slide 21](#)
- [Slide 22](#)
- [Slide 23](#)
- [Slide 24](#)
- [Slide 25](#)
- [Slide 26](#)

Biological Nutrient Removal (BNR)

There are 105 sewage treatment plants (STPs) in CT and NY that discharge into the Sound or its tributaries. BNR systems to remove nitrogen are being phased in at selected STPs.

Both states have actively implemented actions and incentives to upgrade plants. Since 1990, 25 percent of the STPs have been upgraded to include BNR.



CT DEP

LISS: Environmental Indicators

Outline



Notes

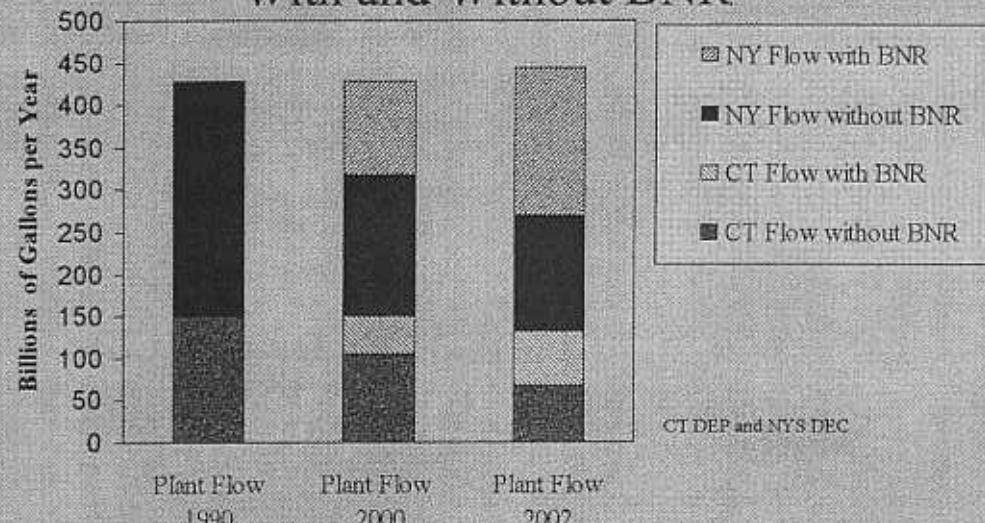


Slide 7 of 28



[Slide 1](#)[Slide 2](#)[Slide 3](#)[Slide 4](#)[Slide 5](#)[Slide 6](#)[Slide 7](#)[Slide 8](#)[Slide 9](#)[Slide 10](#)[Slide 11](#)[Slide 12](#)[Slide 13](#)[Slide 14](#)[Slide 15](#)[Slide 16](#)[Slide 17](#)[Slide 18](#)[Slide 19](#)[Slide 20](#)[Slide 21](#)[Slide 22](#)[Slide 23](#)[Slide 24](#)[Slide 25](#)[Slide 26](#)

Sewage Treatment Plant Effluent With and Without BNR



CT DEP and NYS DEC

In 1990, there were no STPs in Connecticut or New York using BNR to remove nitrogen from wastewater. In 2000, STPs in the two states treated more than 157 billion gallons of effluent with BNR to remove nitrogen from the waste stream and in 2002 over 240 billion gallons of effluent had gone through BNR processes. Of the 445 billion gallons per year of effluent discharged from CT & NY plants, over 54% is treated using BNR technology.

LISS: Environmental Indicators

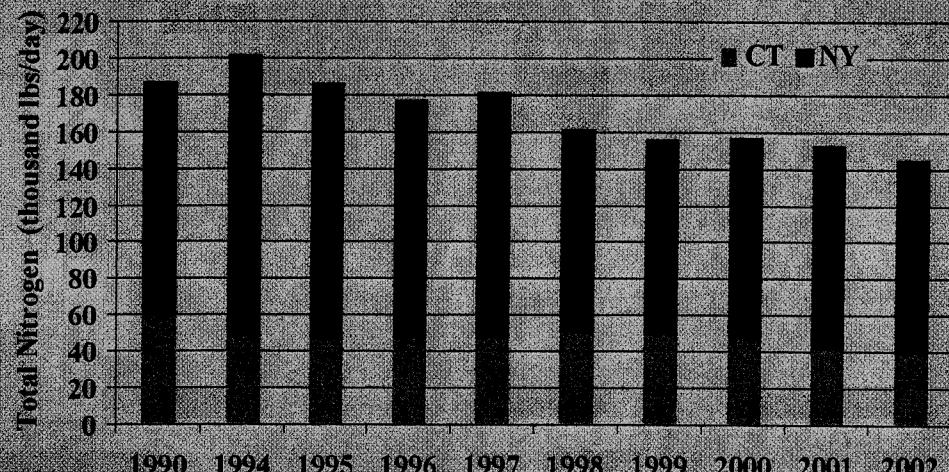
[Outline](#)[Notes](#)

Slide 8 of 28



- Slide 1
- Slide 2
- Slide 3
- Slide 4
- Slide 5
- Slide 6
- Slide 7
- Slide 8
- Slide 9
- Slide 10
- Slide 11
- Slide 12
- Slide 13
- Slide 14
- Slide 15
- Slide 16
- Slide 17
- Slide 18
- Slide 19
- Slide 20
- Slide 21
- Slide 22
- Slide 23
- Slide 24
- Slide 25
- Slide 26

Point Source Nitrogen Load



CT DEP and NYSEEC

As a result of BNR upgrades to STPs, there has been a reduction of 18.3 percent in nitrogen loading to Long Island Sound from STPs over the past ten years.

LISS, Environmental Indicators

- Since 1990, the LISS has been implementing a phased plan to improve oxygen levels in the Sound by reducing nitrogen loads

Outline



Notes



Slide 9 of 28



Slide 1**Slide 2****Slide 3****Slide 4****Slide 5****Slide 6****Slide 7****Slide 8****Slide 9****Slide 10****Slide 11****Slide 12****Slide 13****Slide 14****Slide 15****Slide 16****Slide 17****Slide 18****Slide 19****Slide 20****Slide 21****Slide 22****Slide 23****Slide 24****Slide 25****Slide 26****Outline****Notes**

Slide 19 of 28



Contaminant Trends in Mussels

(Since 1986)

NOAA National Status and Trends Program

Contaminant Trends in Mussels

Site	As	Cd	Cu	Hg	Ni	Pb	Se	Zn	Cdane	DDT	Dield	PCB	PAH	BT
Connicutt River	→	→	→	→	→	→	→	→	→	→	→	→	→	→
New Haven	→	→	→	→	→	→	→	→	→	→	→	↓	→	→
Housatonic River	→	↑	→	→	↑	→	→	→	↑	→	→	↑	→	→
Shefield Island	→	↑	→	→	→	→	→	→	↑	↑	→	→	→	→
Mamaroneck	→	↑	→	→	→	→	→	→	↑	↑	→	→	→	→
Throgs Neck	→	↑	↑	→	→	→	→	→	↑	↑	→	→	→	→
Hempstead Harbor	→	↑	↑	↑	↑	→	→	→	↑	↑	→	→	→	→
Huntington Harbor	→	↑	→	→	→	→	→	→	↑	→	→	→	→	→
Port Jefferson Harbor	↑	→	↑	→	→	→	→	→	↑	→	→	→	→	→

As=Arsenic, Cd=Cadmium, Cu=Copper, Hg=Mercury, Ni=Nickel, Pb=Lead, Se=Selenium, Zn=Zinc, Cdane=Total Chlordane, DDT=Total DDT, Dield=Total Dieldrin, PCB=Total Polychlorinated Biphenyls, PAH=Total Polycyclic Aromatic Hydrocarbons, BT=Total Butyl Tin

→ No Trend

↓ Decreasing Trend

↑ Increasing Trend

LISS: Environmental Indicators

On the whole, levels of metals (copper, nickel, lead and zinc) and organics in mussels have declined. Contamination is decreasing at many sites for chemicals whose use has been banned (chlordane, DDT)

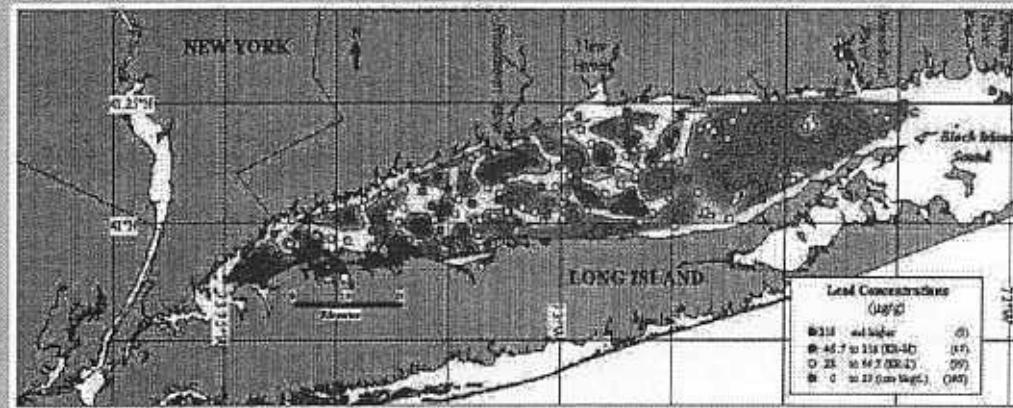


[Slide 1](#)[Slide 2](#)[Slide 3](#)[Slide 4](#)[Slide 5](#)[Slide 6](#)[Slide 7](#)[Slide 8](#)[Slide 9](#)[Slide 10](#)[Slide 11](#)[Slide 12](#)[Slide 13](#)[Slide 14](#)[Slide 15](#)[Slide 16](#)[Slide 17](#)[Slide 18](#)[Slide 19](#)[Slide 20](#)[Slide 21](#)[Slide 22](#)[Slide 23](#)[Slide 24](#)[Slide 25](#)[Slide 26](#)[Outline](#) Notes

Slide 20 of 28



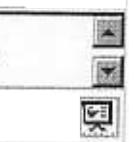
Lead in Surface Sediments



Source: Murray, E.L., and M.R. Buchholz ten Brink, 2000. "Contaminant Distribution and Accumulation in the Surface Sediments of Long Island Sound". Journal of Coastal Research, v. 16, no. 3, p. 575-590

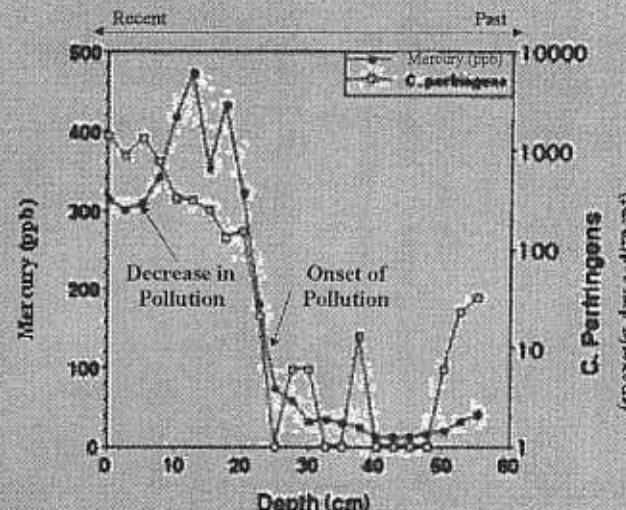
LISS: Environmental Indicators

- Humans have used Long Island Sound as a resource and a disposal site since industrialization began.



[Slide 1](#)[Slide 2](#)[Slide 3](#)[Slide 4](#)[Slide 5](#)[Slide 6](#)[Slide 7](#)[Slide 8](#)[Slide 9](#)[Slide 10](#)[Slide 11](#)[Slide 12](#)[Slide 13](#)[Slide 14](#)[Slide 15](#)[Slide 16](#)[Slide 17](#)[Slide 18](#)[Slide 19](#)[Slide 20](#)[Slide 21](#)[Slide 22](#)[Slide 23](#)[Slide 24](#)[Slide 25](#)[Slide 26](#)

Mercury Concentrations in Sediment



Varekamp, J.C., M.R. Buchholz ten Brink, E.L. Meers, and B. Kreulen, 2000,
"Mercury in Long Island Sound Sediments", Journal of Coastal Research, v. 16, no. 3, p. 613-626

Mercury concentrations in the upper 10-15 cm of sediment have decreased, reflecting reductions in mercury sources in recent decades. *Clostridium perfringens*, an indicator of sewage-derived pollution, mirrors the continued increases in population around the Sound.

LISS: Environmental Indicators

- Human activities over the last 400 years have affected the water and sediment quality of Long Island Sound

[Outline](#)[Notes](#)

Slide 21 of 28

