# Long-term Marine Research and the Grand Challenges in Ecology


Organizers:
Hugh Ducklow
Dan Reed
Chuck Hopkinson

# Long-Term Ecological Research

**Roll on, thou deep and dark blue Ocean -- roll!**
**Ten thousand fleets sweep over thee in vain;**
**Man marks the earth with ruin -- his control**
**Stops with the shore;**

**Byron, Childe Harold's Pilgrimage**

**The very deep did rot : O Christ !**
**That ever this should be !**
**Yea, slimy things did crawl with legs**
**Upon the slimy sea.**

**Coleridge, Rime of the Ancient Mariner**

LTER

Mini-Symposium at the NSF
03 March, 2005
Long-term Marine Research
and the Grand Challenges in Ecology"

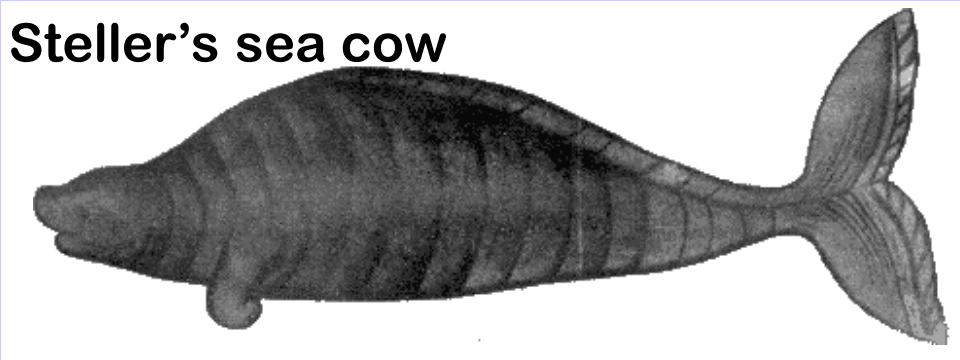
## The economic value of marine ecosystem goods and services

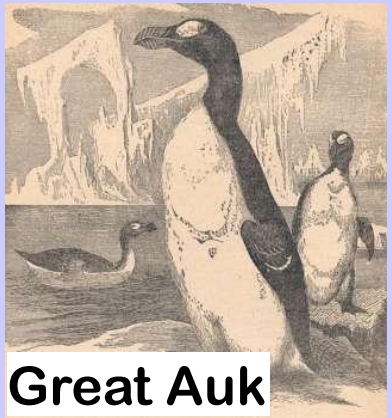
| | Open Sea | Coastal |
|---|---|---|
| Area (ha) | 3.32E+10 | 3.10E+09 |
| | | |
| Services ($/yr/ha) | | |
| Gas Reg | 38 | |
| Disturbance | | 88 |
| Nutrient cycling | 118 | 3677 |
| Biol Control | 5 | 38 |
| Habitat/refugia | | 8 |
| Food production | 15 | 93 |
| Raw materials | | 4 |
| Recreation | | 82 |
| Cultural | 76 | 62 |
| | | |
| Total ($/ha/yr) | 252 | 4052 |
| Total (trillion $/yr) | 8.4 | 12.6 |
| | | |
| Total Marine value | | $21 trillion/year |
| Global GNP | | $18 trillion/year |

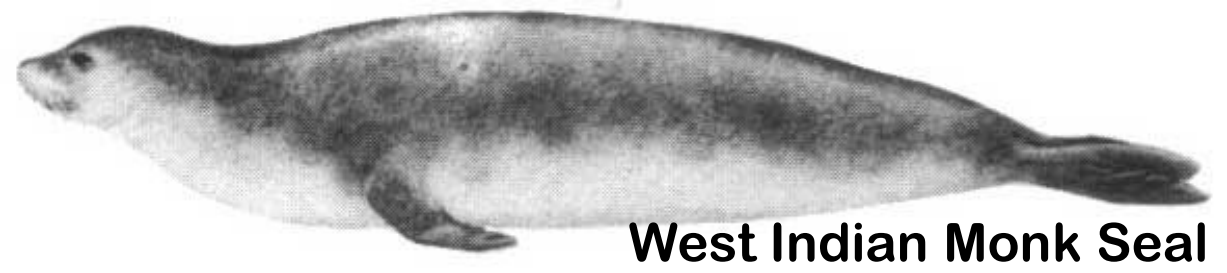
**Table after Costanza et al. Nature 387:253 (1997)**


Trash bag: 4000 meters
Courtesy: MBARI

# Exxon Valdez oil spill



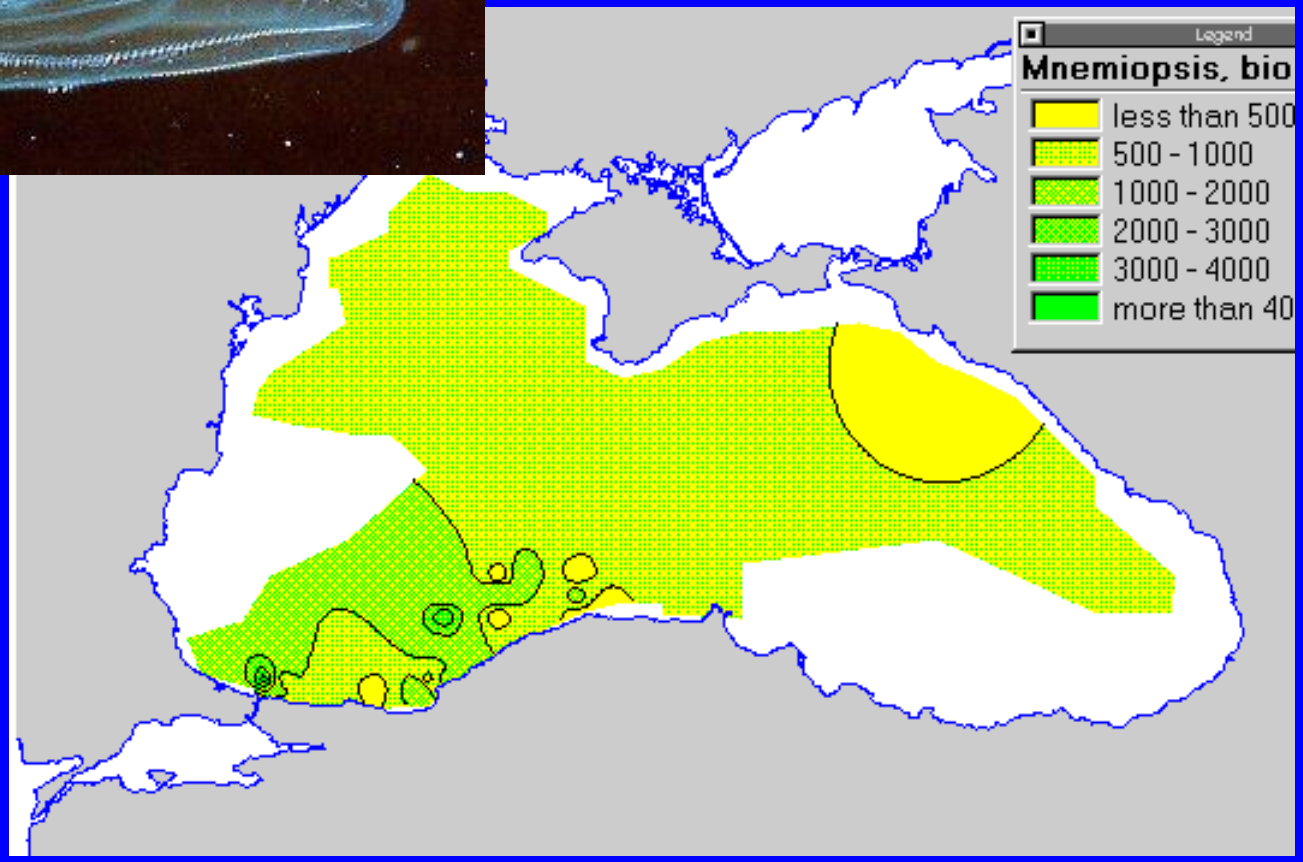





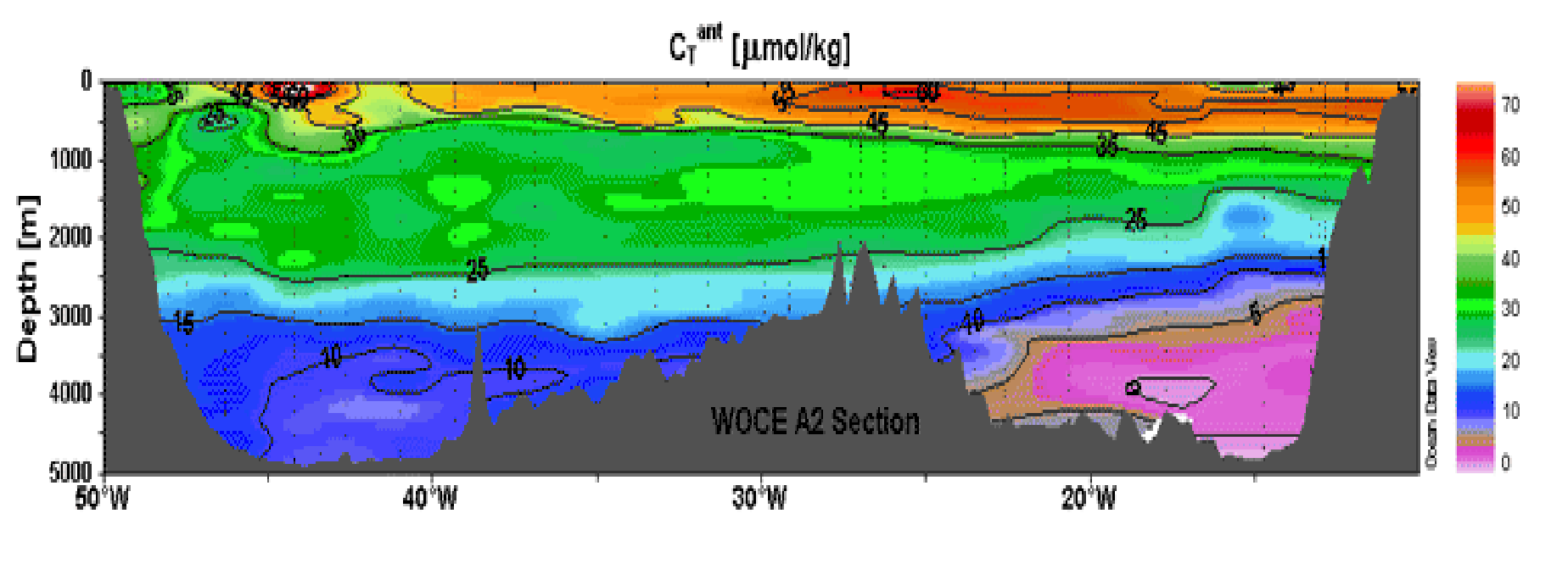

# Marine Species Extinctions

# Species invasions
# *Mnemiopsis* – Black Sea




Sea Ice: pollutant laden
29 January, 2005
PAL LTER 400.040

# Anthropogenic carbon dioxide accumulation in the North Atlantic ocean, 1997




Courtesy: D. Wallace, A Kortzinger, University of Kiel

# Acidification of the global ocean

BBC NEWS WORLD EDITION

LATEST NEWS IN VIDEO AND AUDIO

News Front Page

Africa
Americas
Asia-Pacific
Europe
Middle East
South Asia
UK
Business
Health
Science/Nature
Technology
Entertainment

Have Your Say
In Pictures
Week at a Glance
Country Profiles
In Depth
Programmes

BBC SPORT
BBC WEATHER
BBC ON THIS DAY

Last Updated: Tuesday, 17 August, 2004, 08:49 GMT 09:49 UK

E-mail this to a friend  Printable version

WATCH/LISTEN

## Probe into rising ocean acidity

**The UK's Royal Society has launched an investigation into the rising acidity of the world's oceans due to pollution from the greenhouse gas carbon dioxide.**

Ocean acidity is gradually on the rise

The change could have catastrophic consequences for marine life.

Oceans mop up carbon dioxide from the atmosphere, lowering the water's pH value - an effect that may be exacerbated by burning of fossil fuels.

Scientists on the working group are due to publish an initial report into the phenomenon by early next year.

The investigation by the Royal Society, the UK national academy of science, will probe the potential impact of this rising ocean acidity on marine life - which at present is largely unknown.

> **"The same pollution that we believe is heating the world's oceans...is also altering their chemical balance"**
>
> Professor John Raven

**SEE ALSO:**

- Oceans becoming more acidic
  24 Sep 03 | Science/Nature
- Ocean medicines could be lost
  13 May 04 | Science/Nature
- Sea 'dead zones' threaten fish
  29 Mar 04 | Science/Nature

**RELATED INTERNET LINKS:**

- Royal Society, Policy

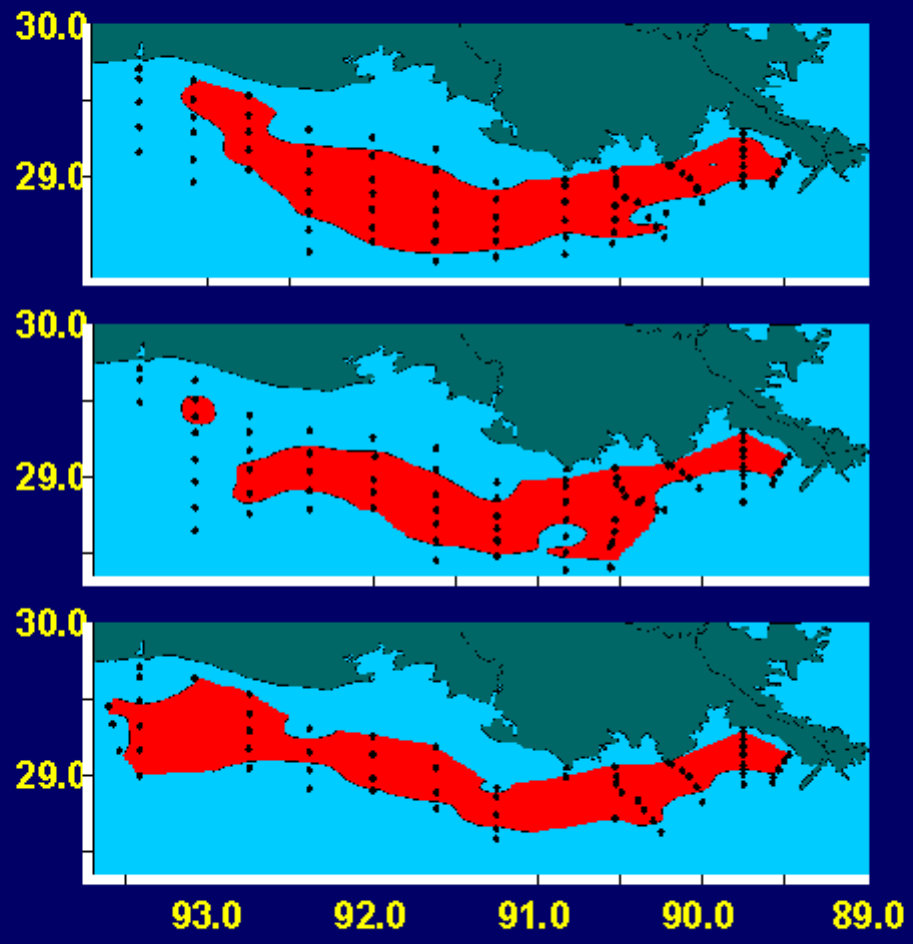
The BBC is not responsible for the content of external internet sites

**TOP SCIENCE/NATURE STORIES NOW**

- Kyoto Protocol set to take effect
- Key to intelligence questioned
- Europe's super-rocket rides high
- UK rail chiefs eye sat-navigation

# Area of Hypoxia

## Shelfwide Mid-summer Cruises




**1993**
**17,600 sq km**
**6,800 sq mi**

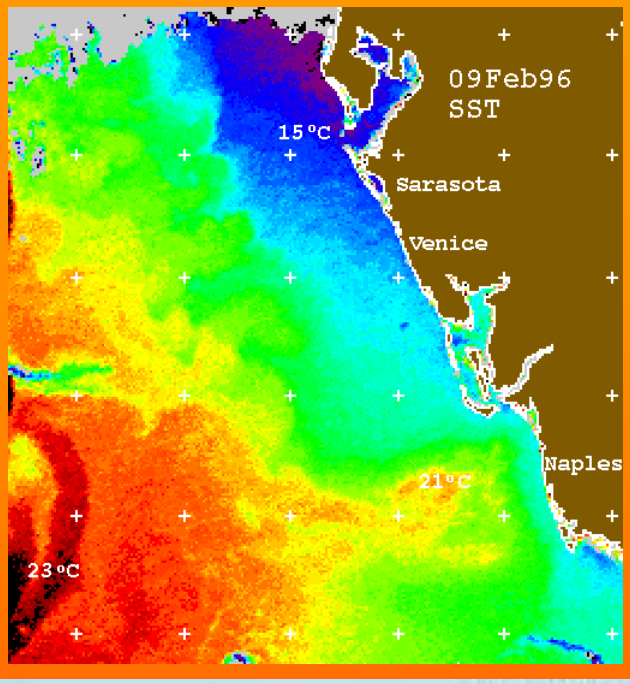
**1994**
**16,600 sq km**
**6,414 sq mi**

**1995**
**18,200 sq km**
**7,032 sq mi**

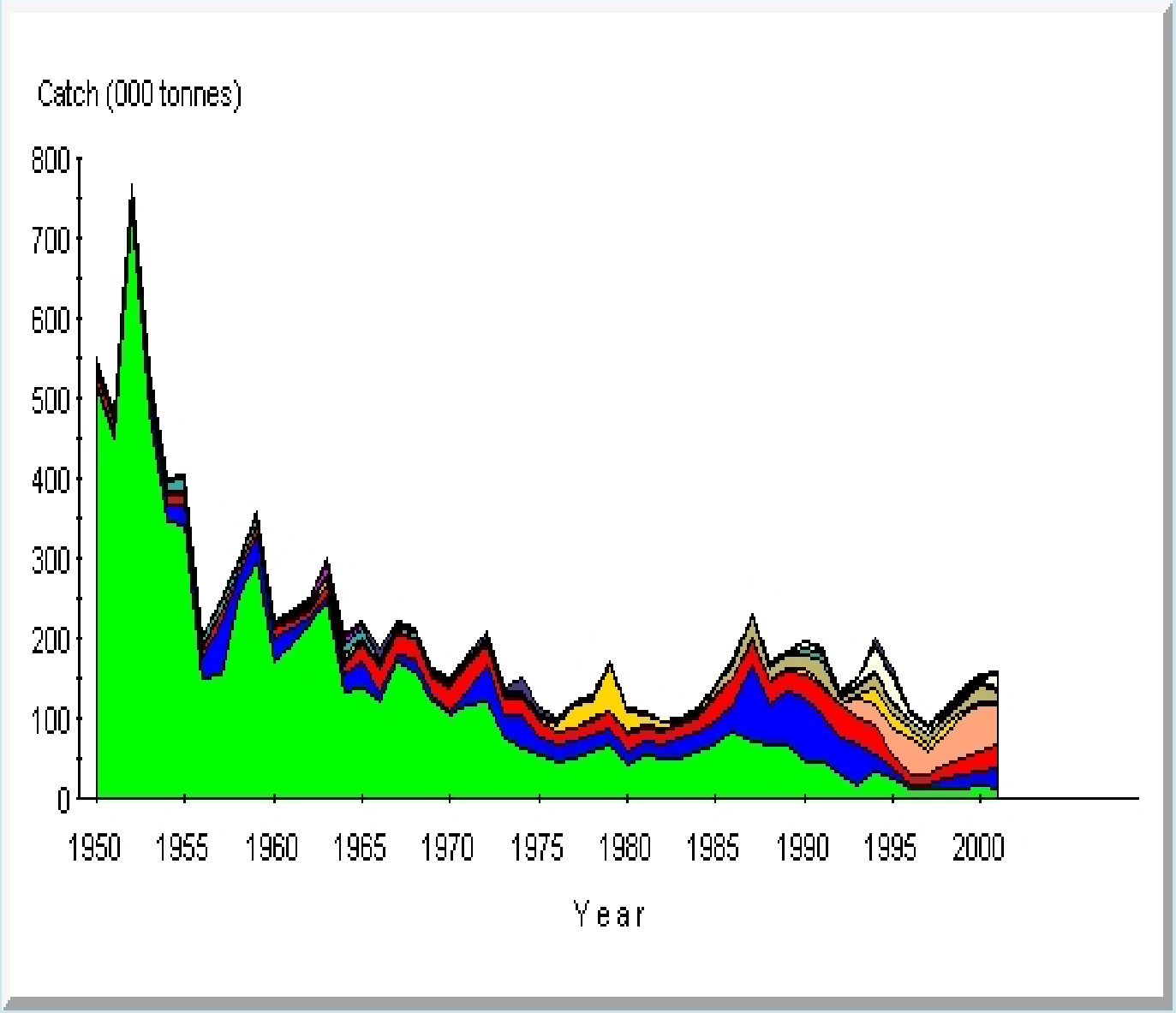
*(Rabalais, Turner & Wiseman)*

Eutrophication: Growing hypoxia

# Harmful algal blooms


# Devastation of fisheries




20 January, 2005
At the Antarctic Circle

# Tools:
# The LTER Network  The Grand Challenges



neon

National Ecological Observatory Network

**Strategically-chosen marine coastal and oceanic LTER Sites can be a vital part of the global ocean and climate observing systems.**

The Global Ocean Observing System

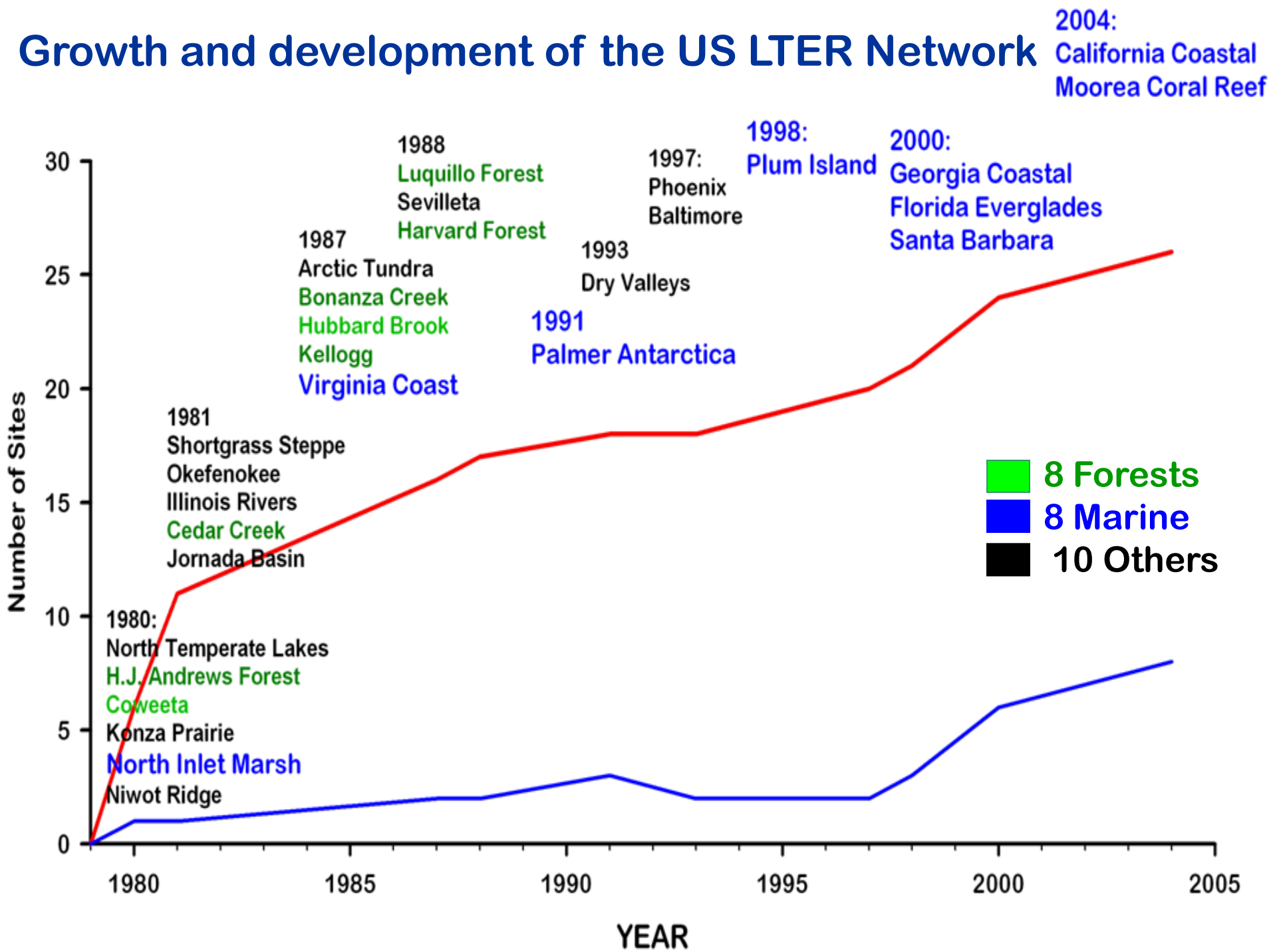
GOOS

Ocean.US

# LTER Network 1980


ARC
BNZ
PAL
MCM
AND
CDR
NTL
HBR
HFR
Plum Island
SGS
KBS
BES
NWT
CAP
LND
KNZ
VCR
SEV
CWT
JRN
SB Coastal
CA Current
GA Coastal
Moorea Coral
FL Everglades
LUQ
LTER

# Growth and development of the US LTER Network




- **2001: NRC Report, Grand Challenges in Environmental Sciences**

"...written in response to a request from the National Science Foundation (NSF) that the National Research Council (NRC), drawing on expertise from across the environmental sciences, offer a judgment regarding the most important environmental research challenges of the next generation—the areas most likely to yield results of major scientific and practical importance if pursued vigorously now."

- **2004: NRC list of grand challenges adapted to guide LTER Synthesis Initiative.**

## The LTER Grand Challenges for research at the Network level:

- Alterations in biodiversity
- Coupled human-natural ecosystems
- Climate change and climate variability
- Altered biogeochemical cycles
- Integrating education through all 4 challenges and across the LTER Network
- Today: how LTER is addressing these challenges in the marine biosphere

# LTER Grand Challenges and Program Today:

**Alterations in biodiversity**
Presentation by Sally Holbrook and Dan Reed (UCSB; Moorea and SB Coastal )

**Coupled human-natural ecosystems**
Presentation by Wil Wollheim (UNH and Plum Island)

**Education**
Presentation: Ali Whitmer (UCSB, SB-Coastal and Moorea Coral Reef)

**Climate change and climatic variability**
Presentation: Mark Ohman (CA Current and Scripps)
Sharon Stammerjohn (Palmer and Lamont-Doherty)

**Altered biogeochemical cycles**
Presentation: Karen McGlathery (UVA and VA Coast Reserve)

**Discussion & Conclusions:**
Chuck Hopkinson (Ecosystems Center and Plum Island)