

Global decline of large predatory fishes: causes, consequences, and solutions



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Our ocean planet

- 90% of the biosphere
- 50% of global net primary production
- 80% of fisheries
- Less 0.1% protected



Questions

- I. What has changed in the ocean?
- II. What are the consequences?
- III. What can we do?



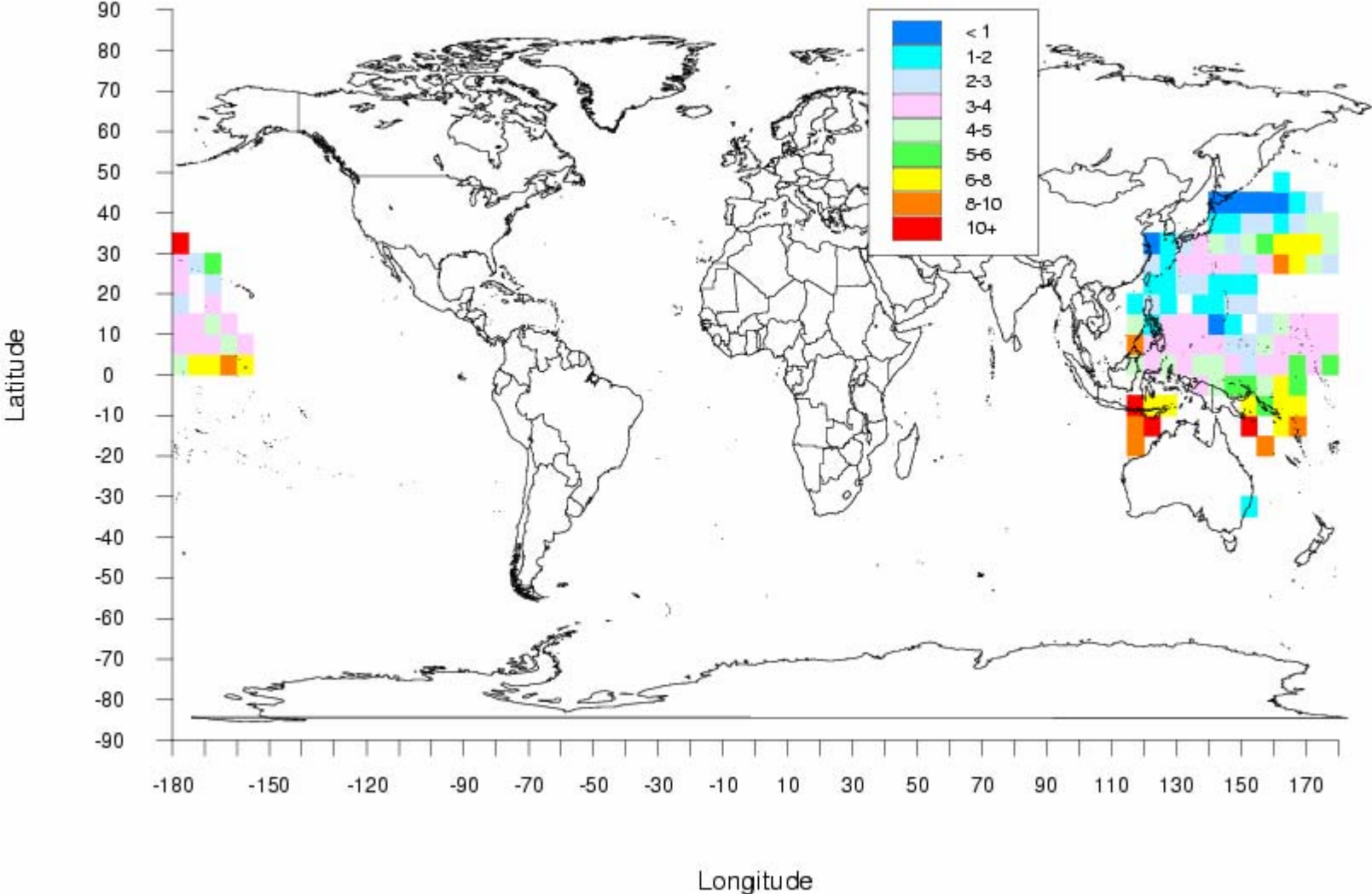
Tuna: Atlantic Bluefin



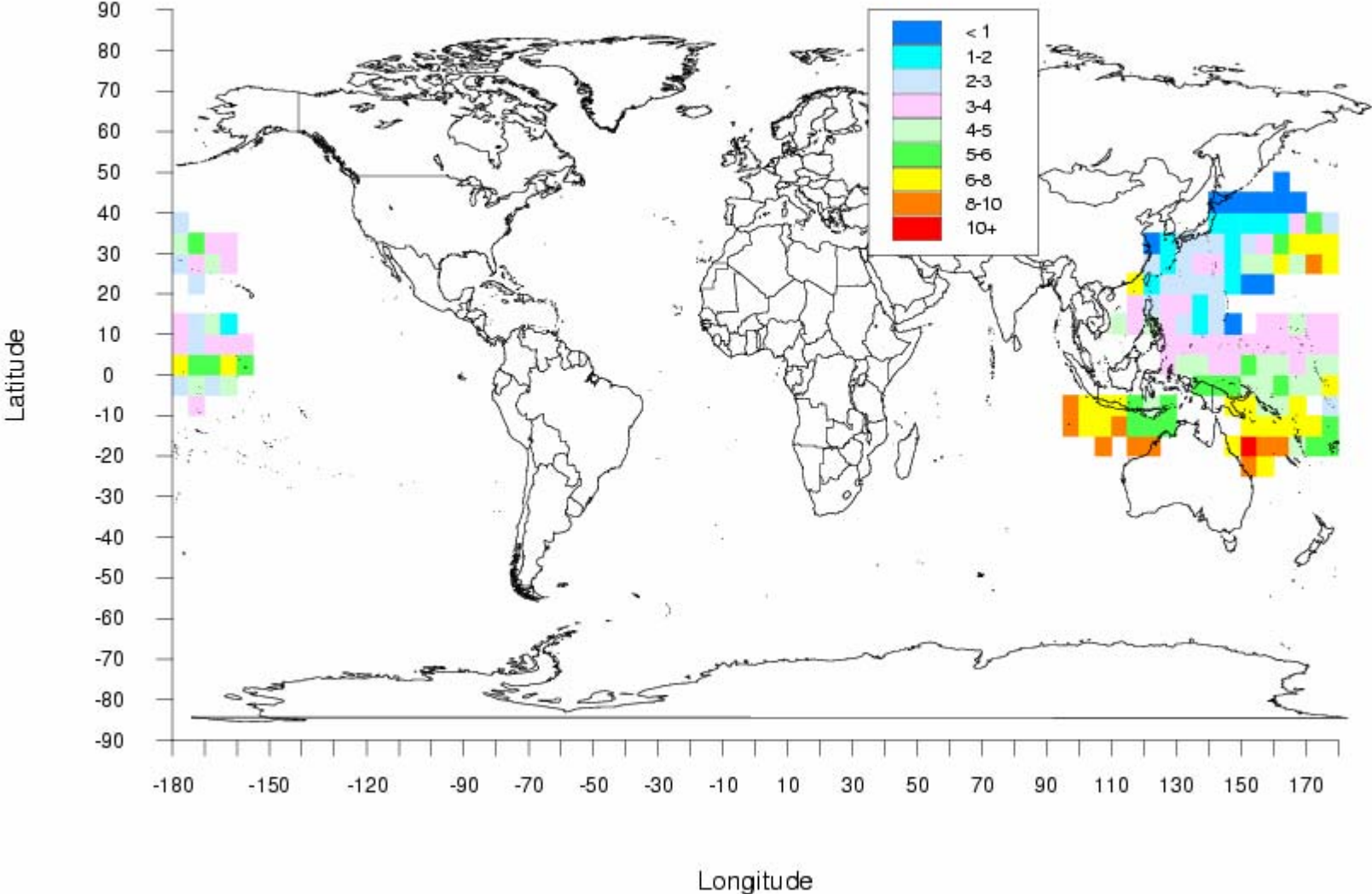
Billfish: swordfish and marlins



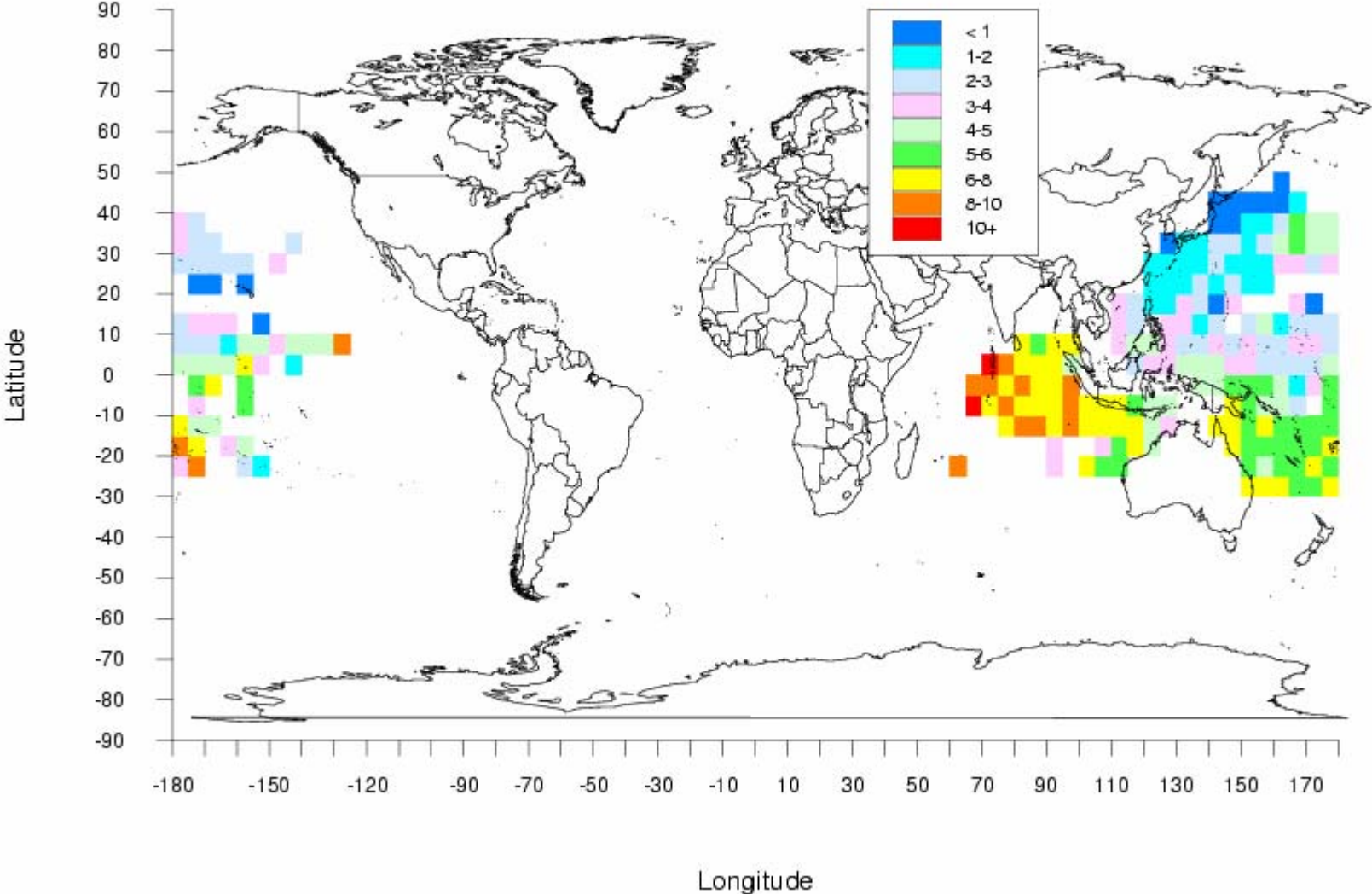
Catch Per Hundred Hooks, Year = 1952



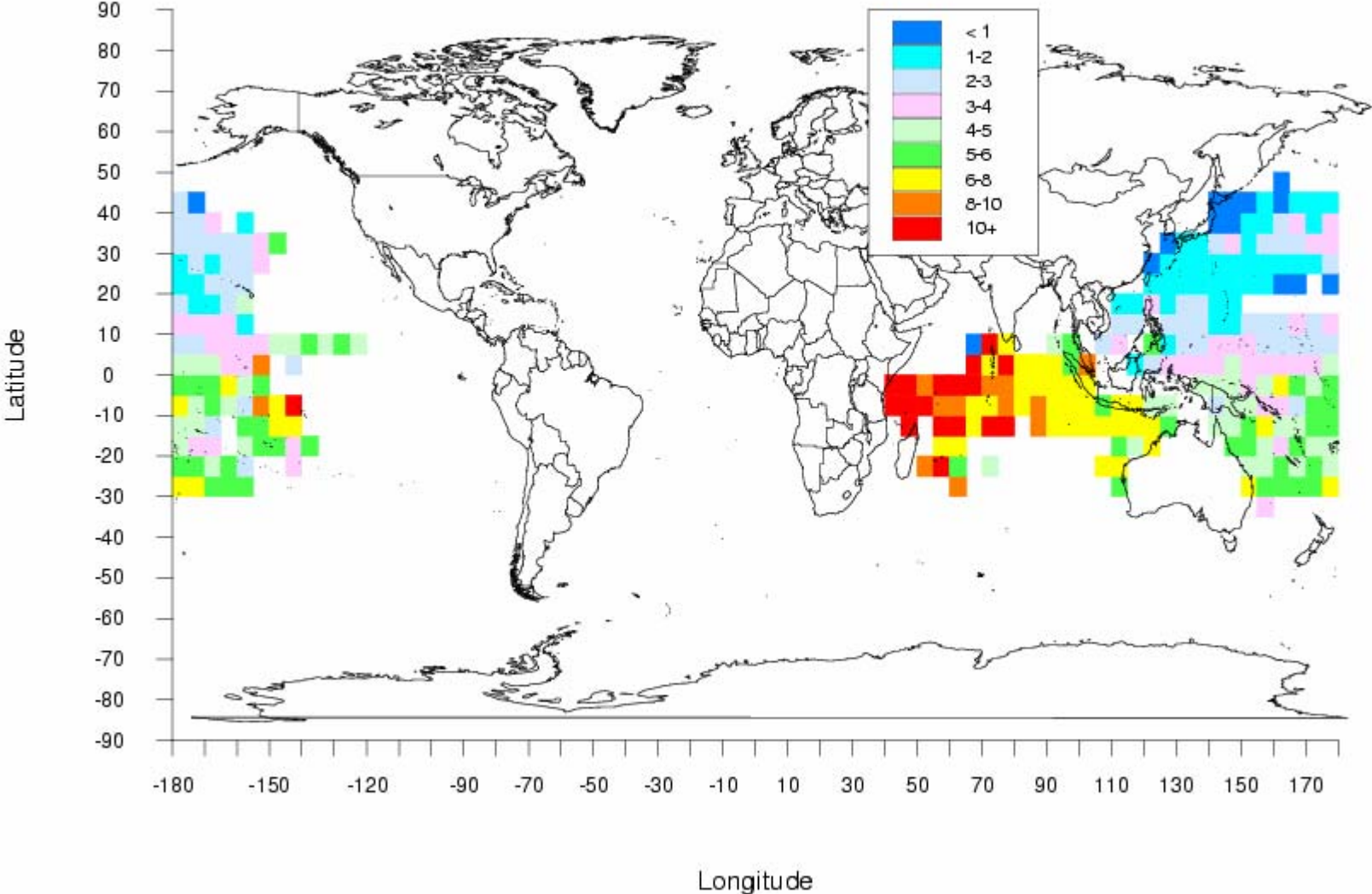
Catch Per Hundred Hooks, Year = 1953



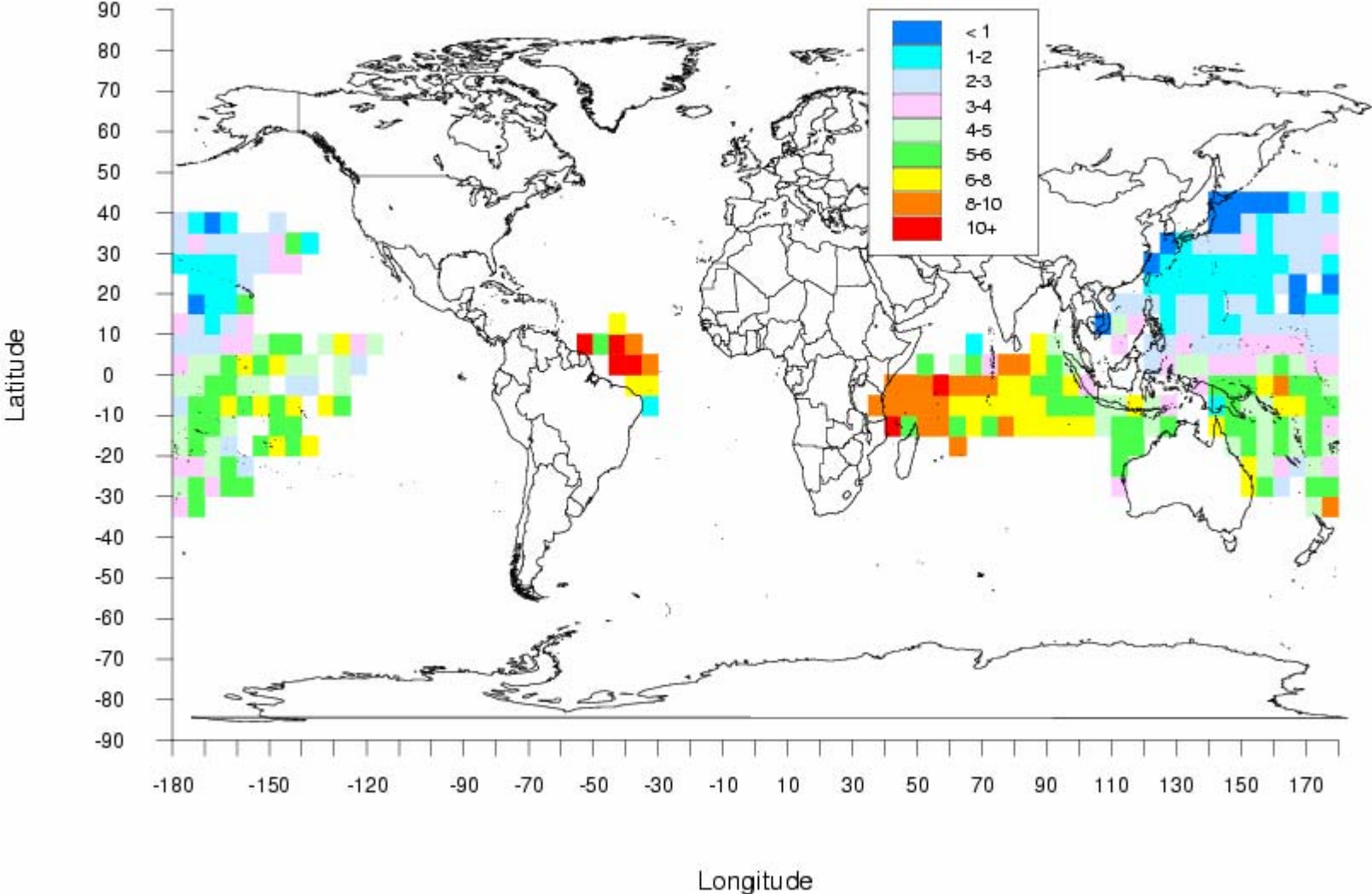
Catch Per Hundred Hooks, Year = 1954



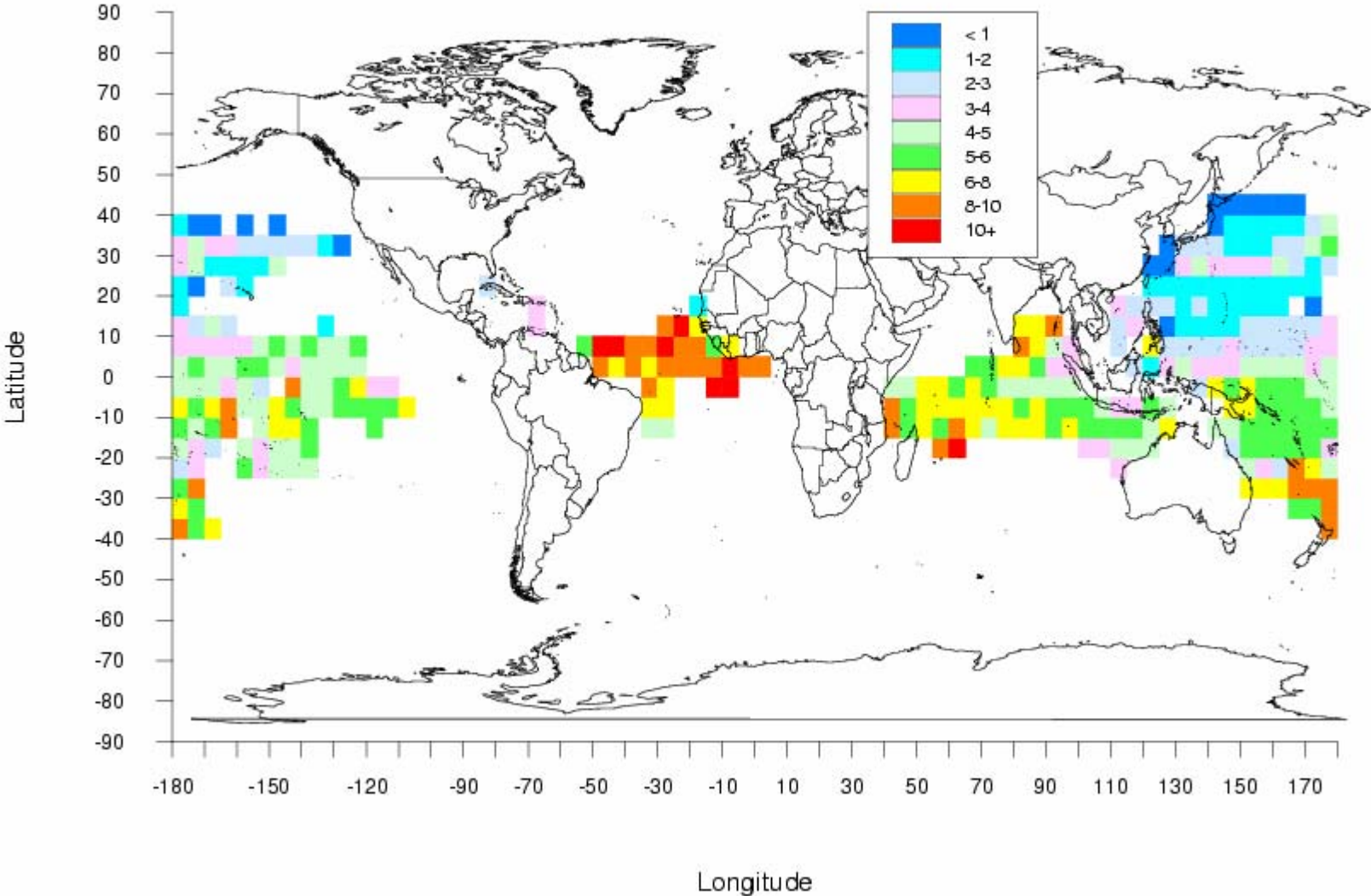
Catch Per Hundred Hooks, Year = 1955



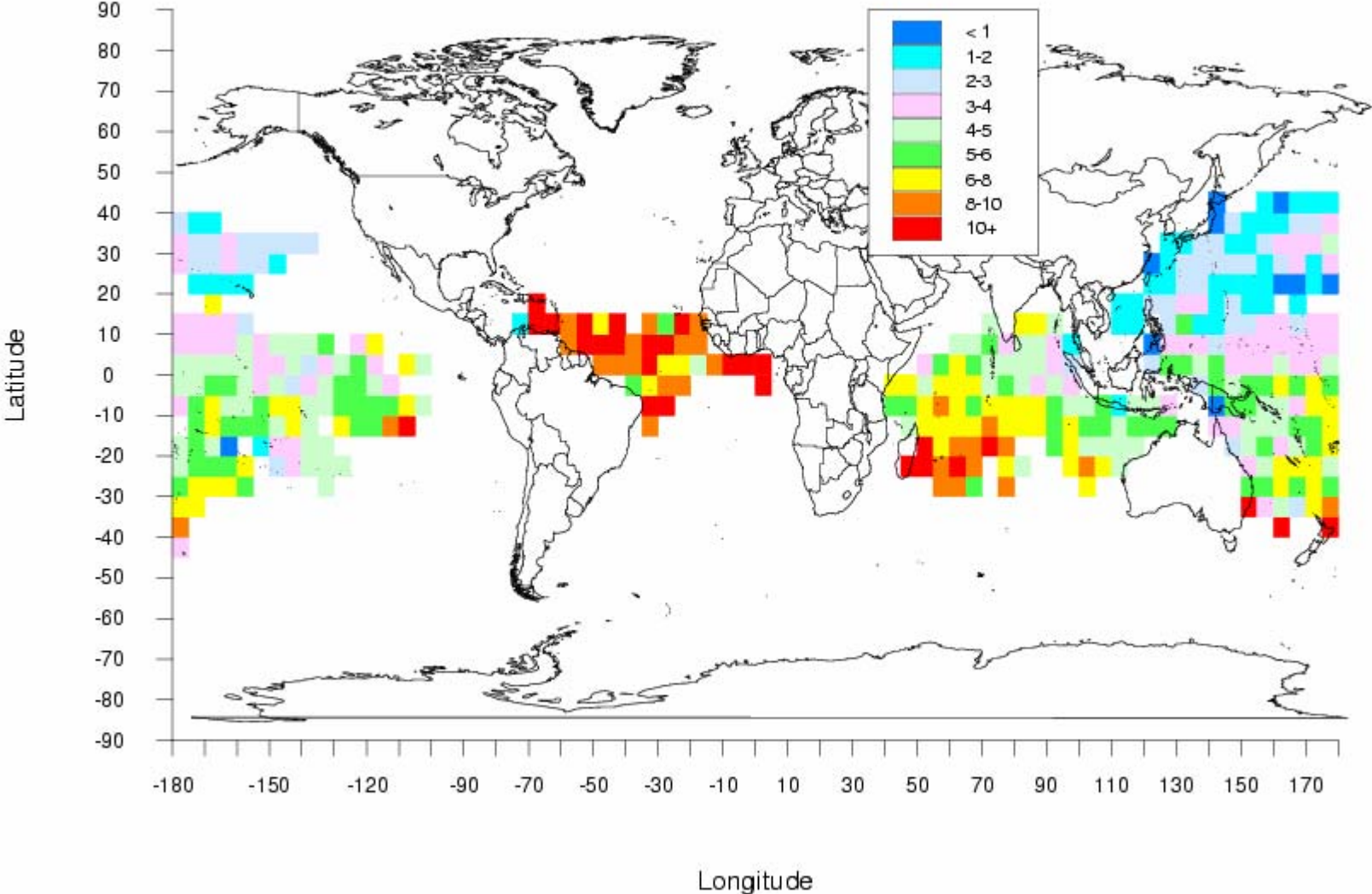
Catch Per Hundred Hooks, Year = 1956



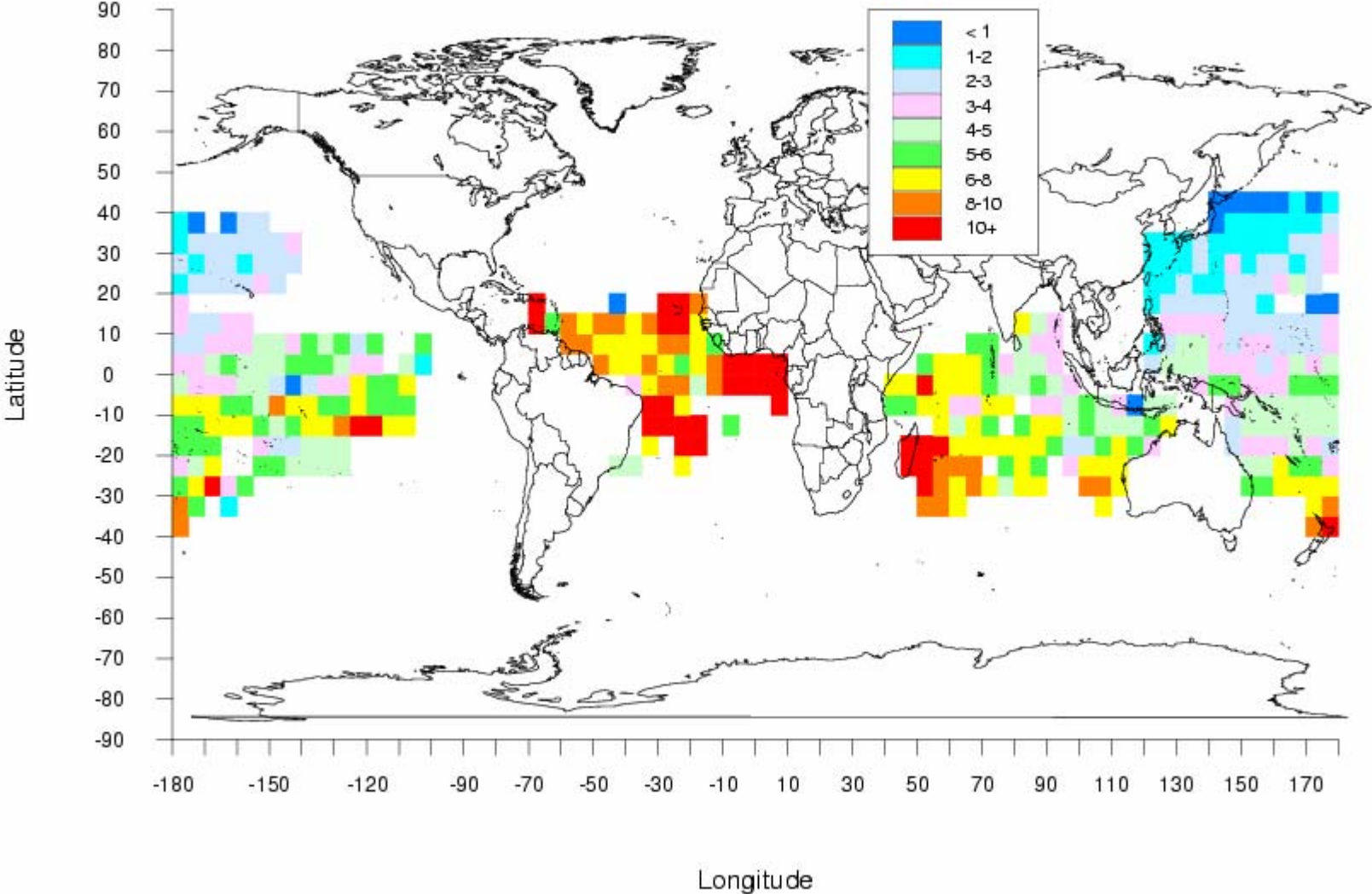
Catch Per Hundred Hooks, Year = 1957



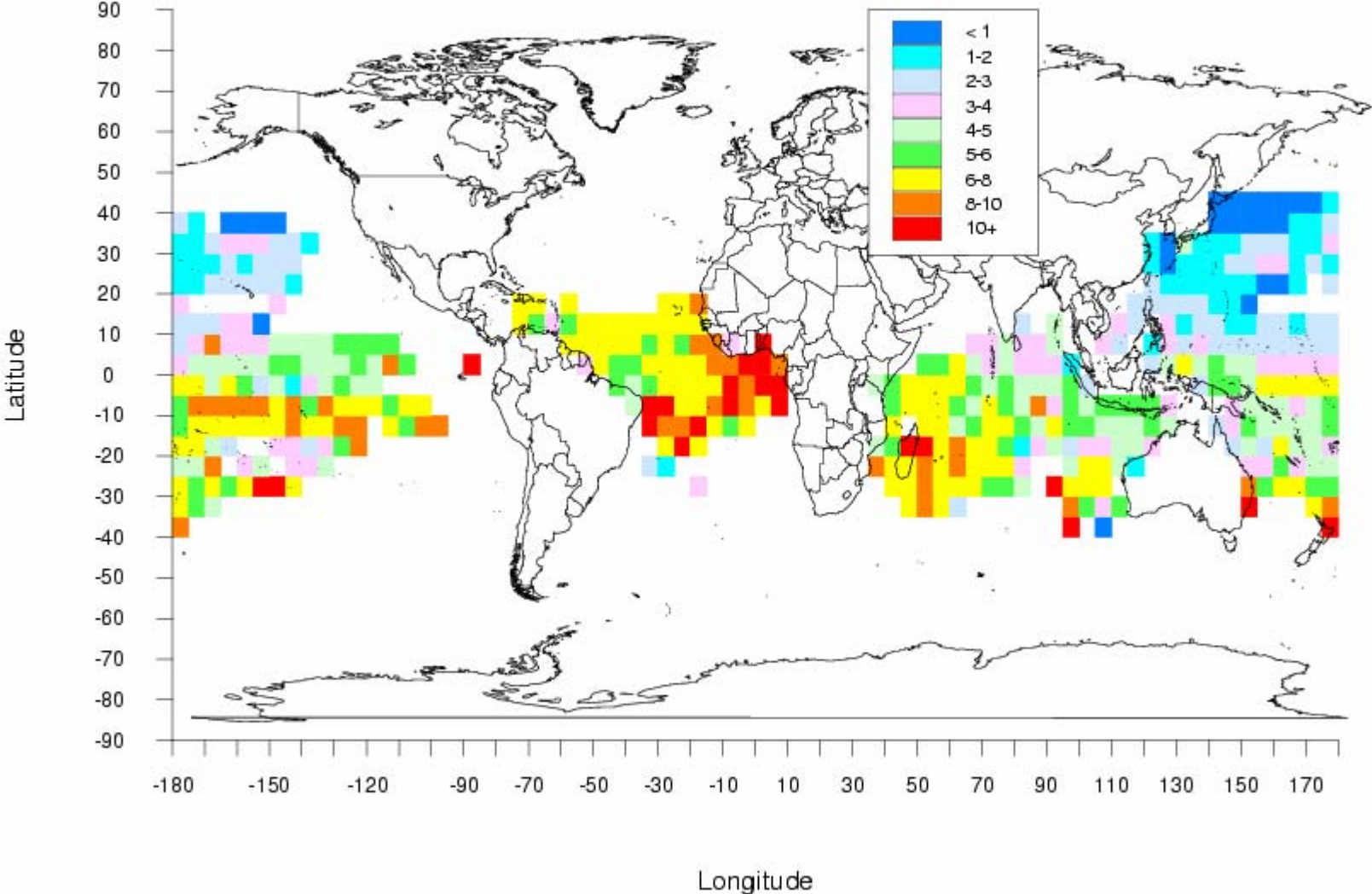
Catch Per Hundred Hooks, Year = 1958



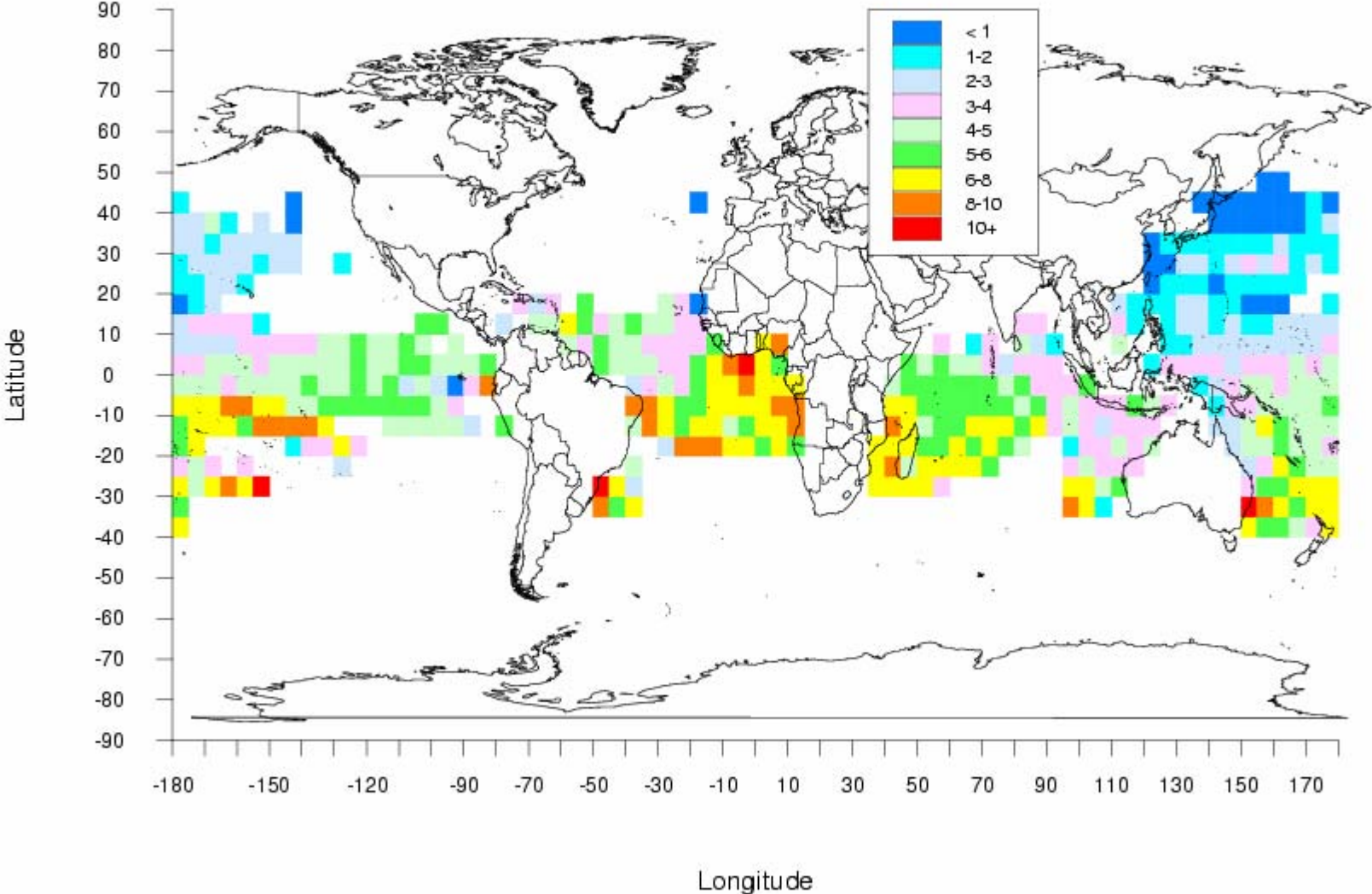
Catch Per Hundred Hooks, Year = 1959



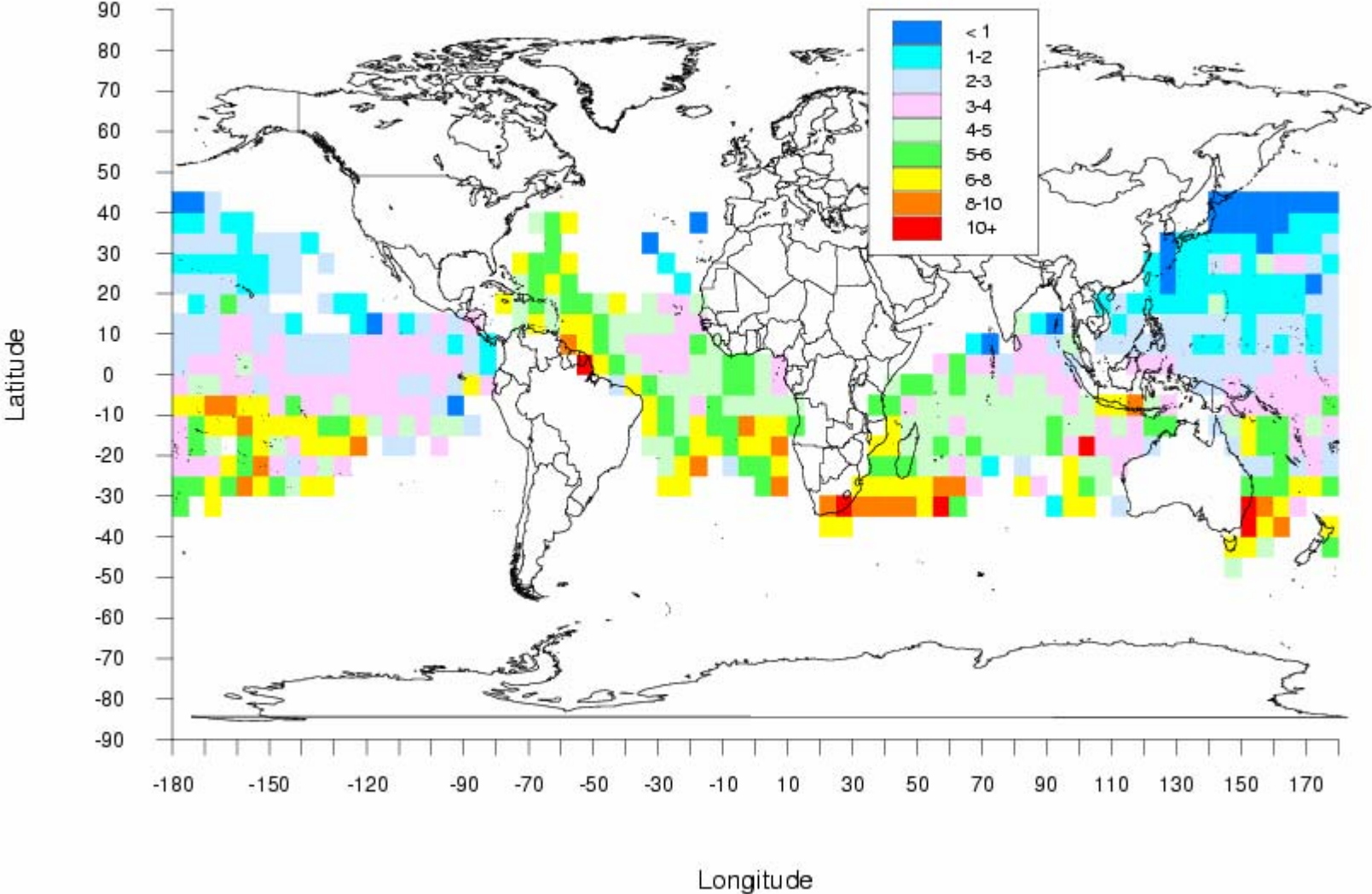
Catch Per Hundred Hooks, Year = 1960



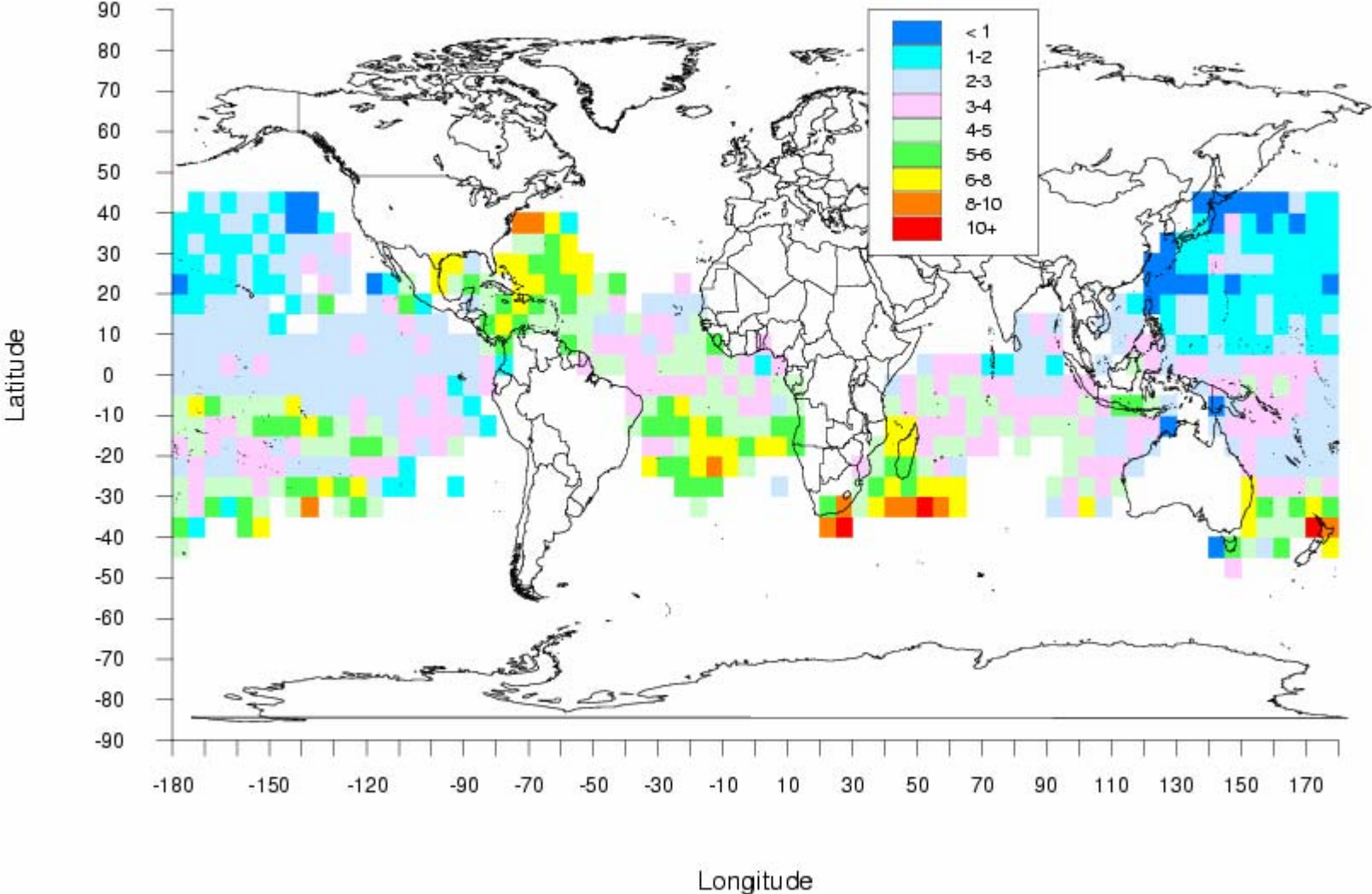
Catch Per Hundred Hooks, Year = 1961



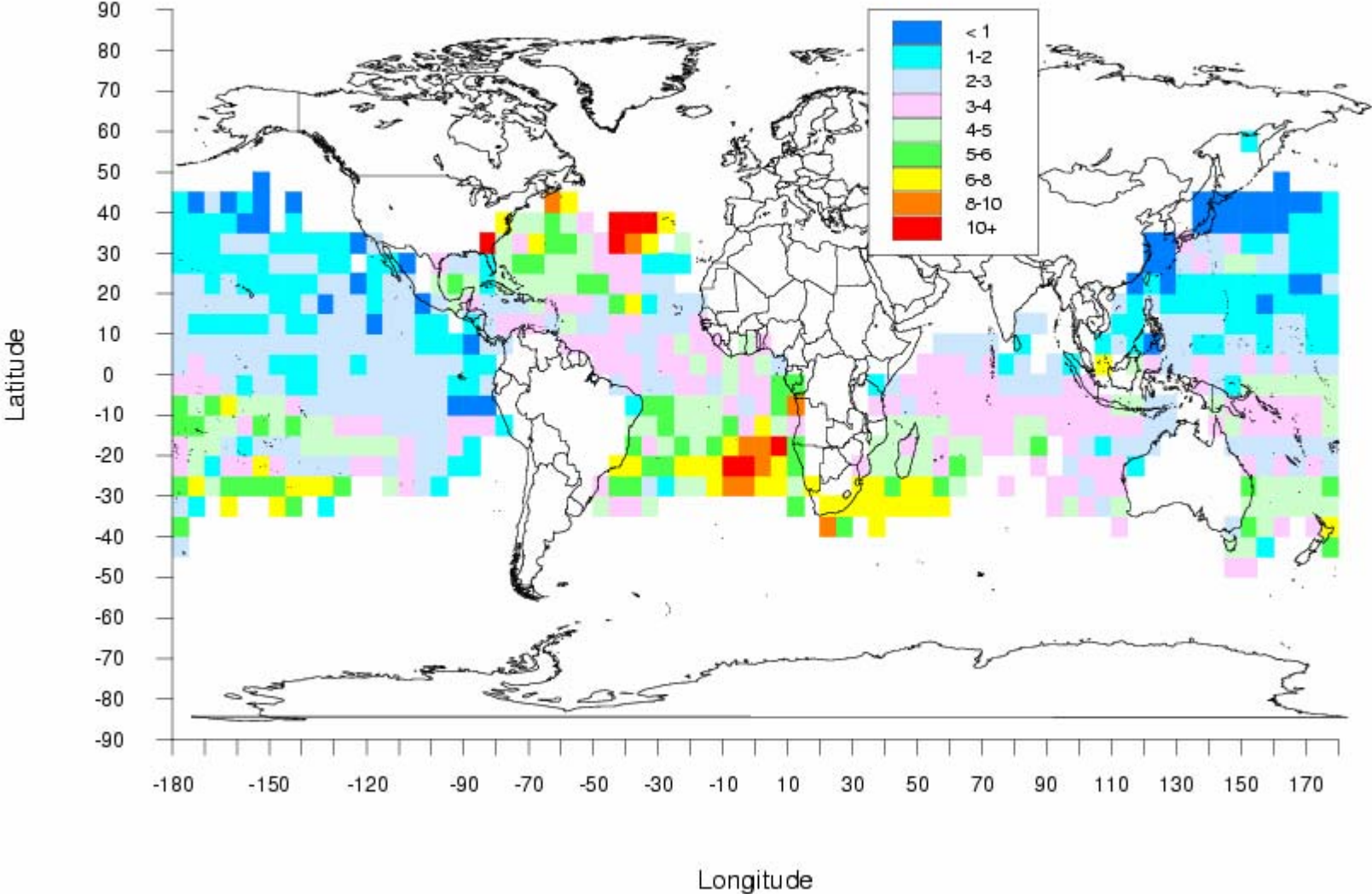
Catch Per Hundred Hooks, Year = 1962



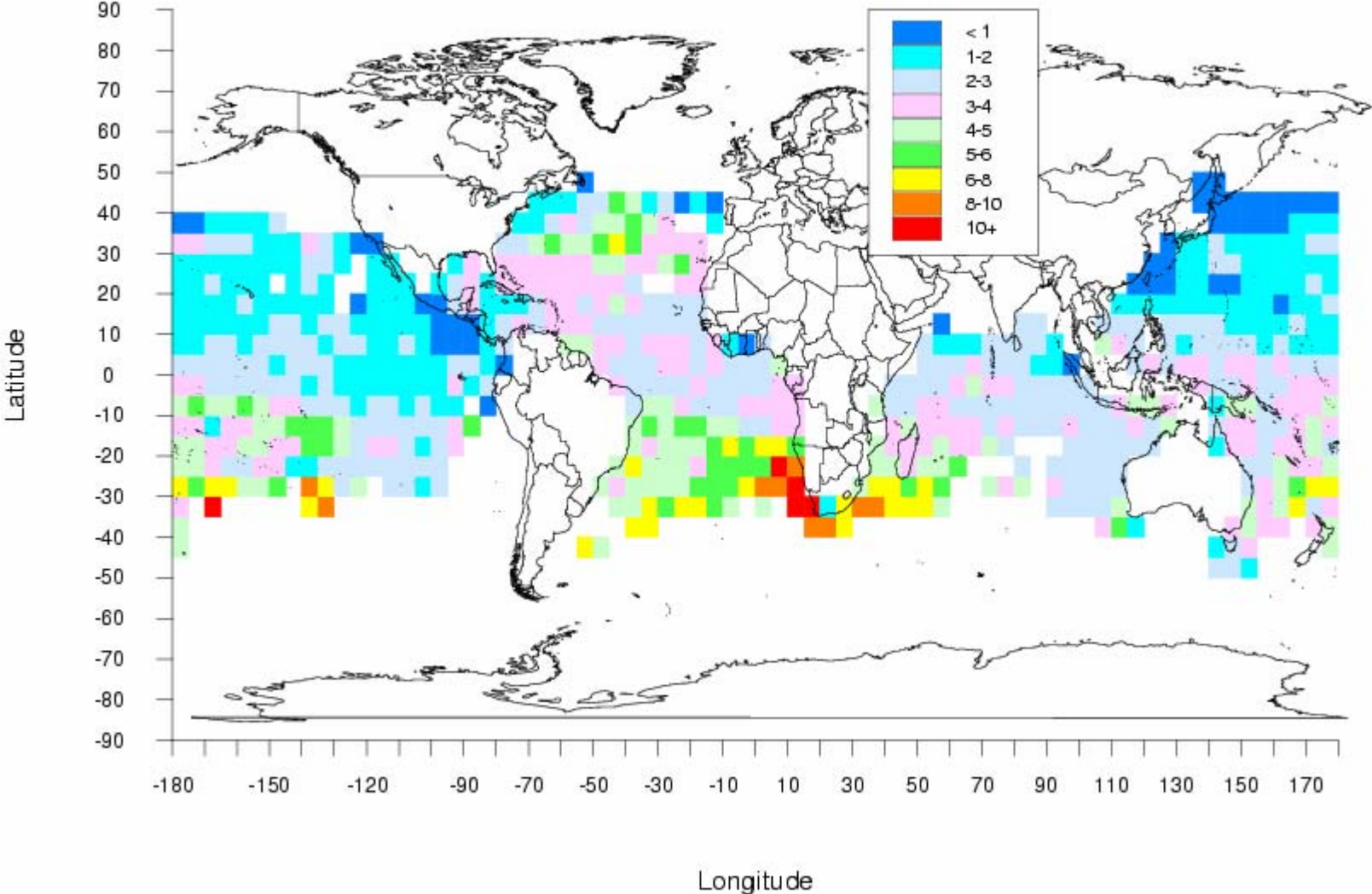
Catch Per Hundred Hooks, Year = 1963



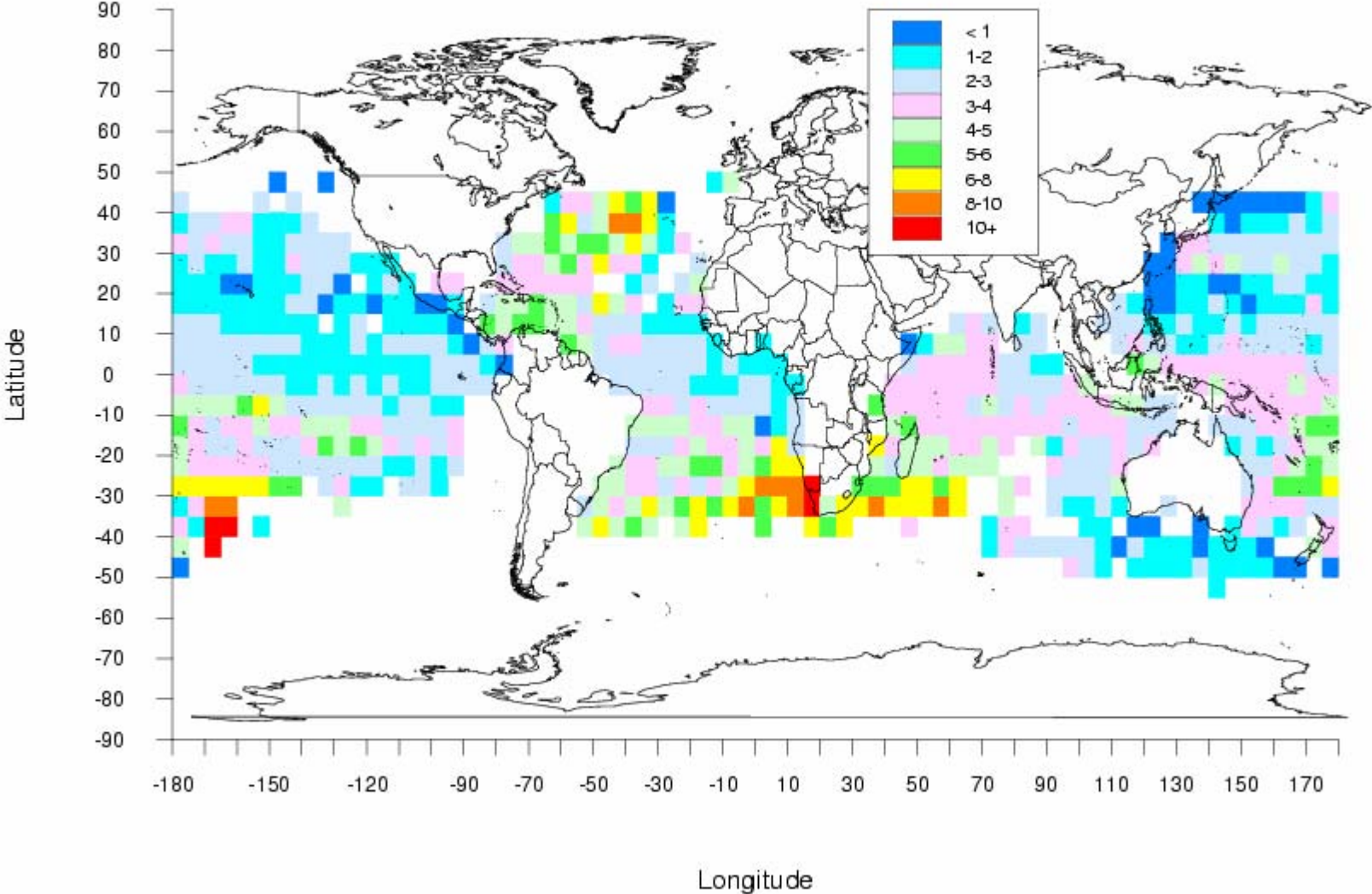
Catch Per Hundred Hooks, Year = 1964



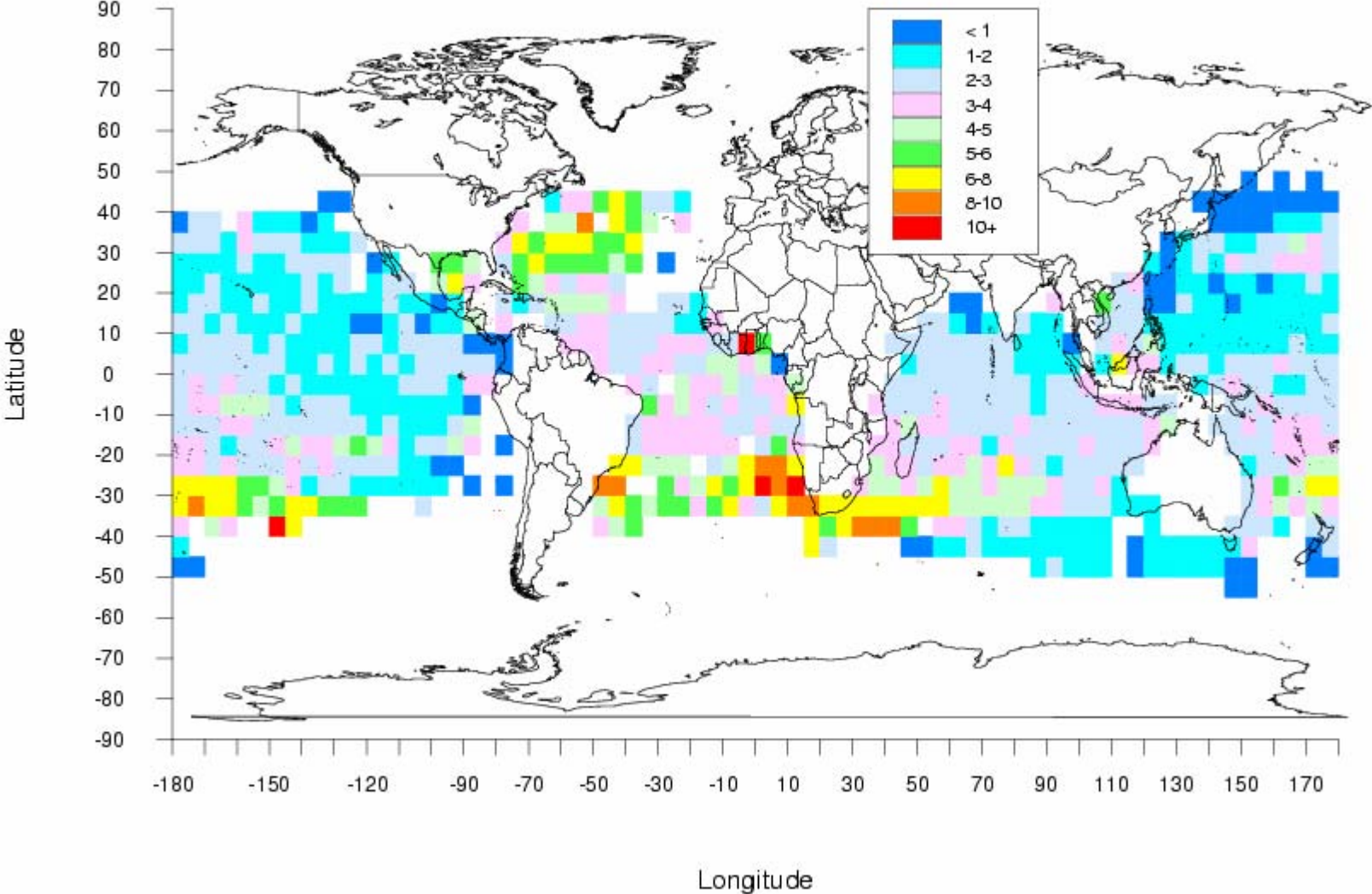
Catch Per Hundred Hooks, Year = 1965



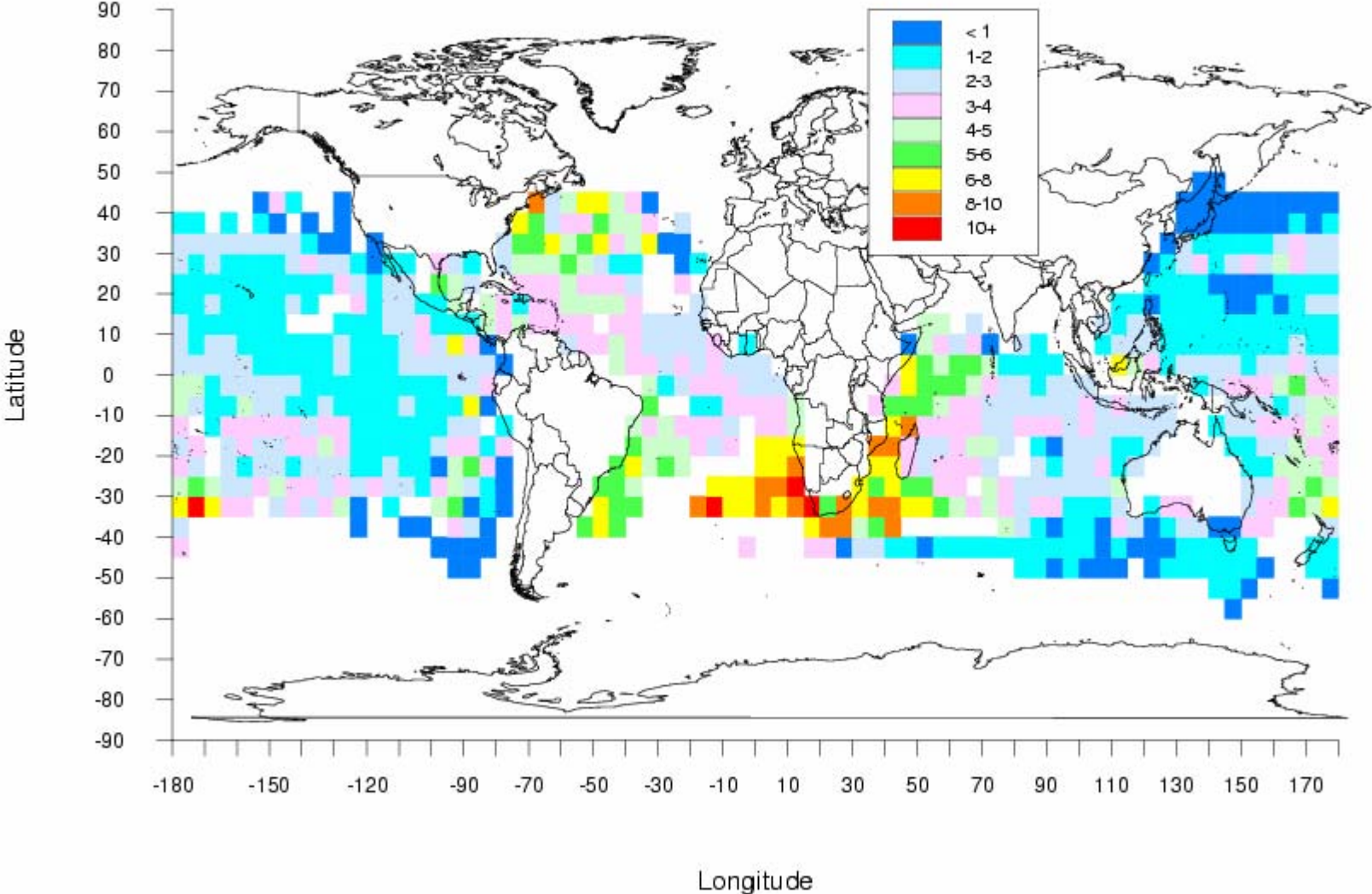
Catch Per Hundred Hooks, Year = 1966



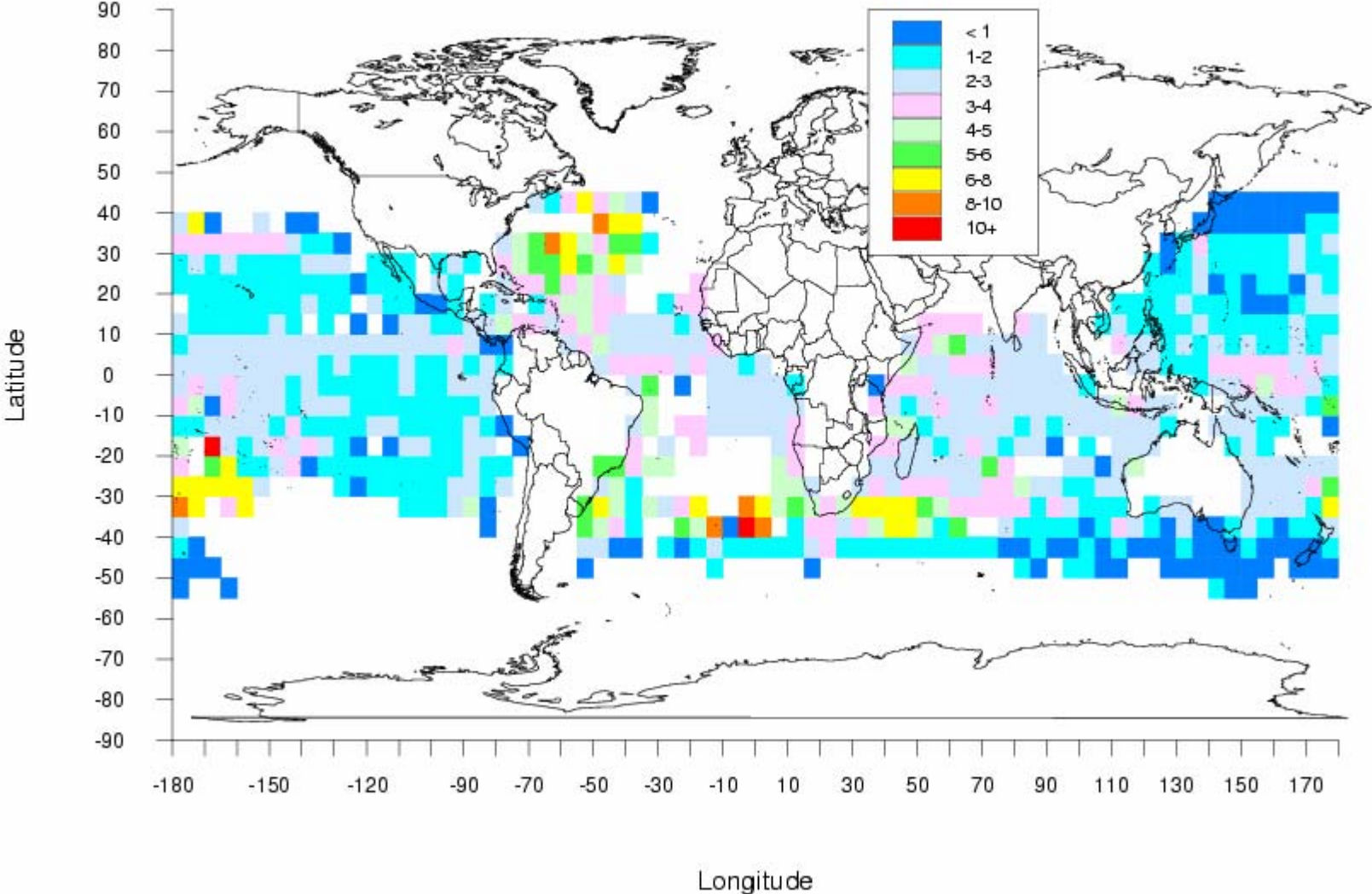
Catch Per Hundred Hooks, Year = 1967



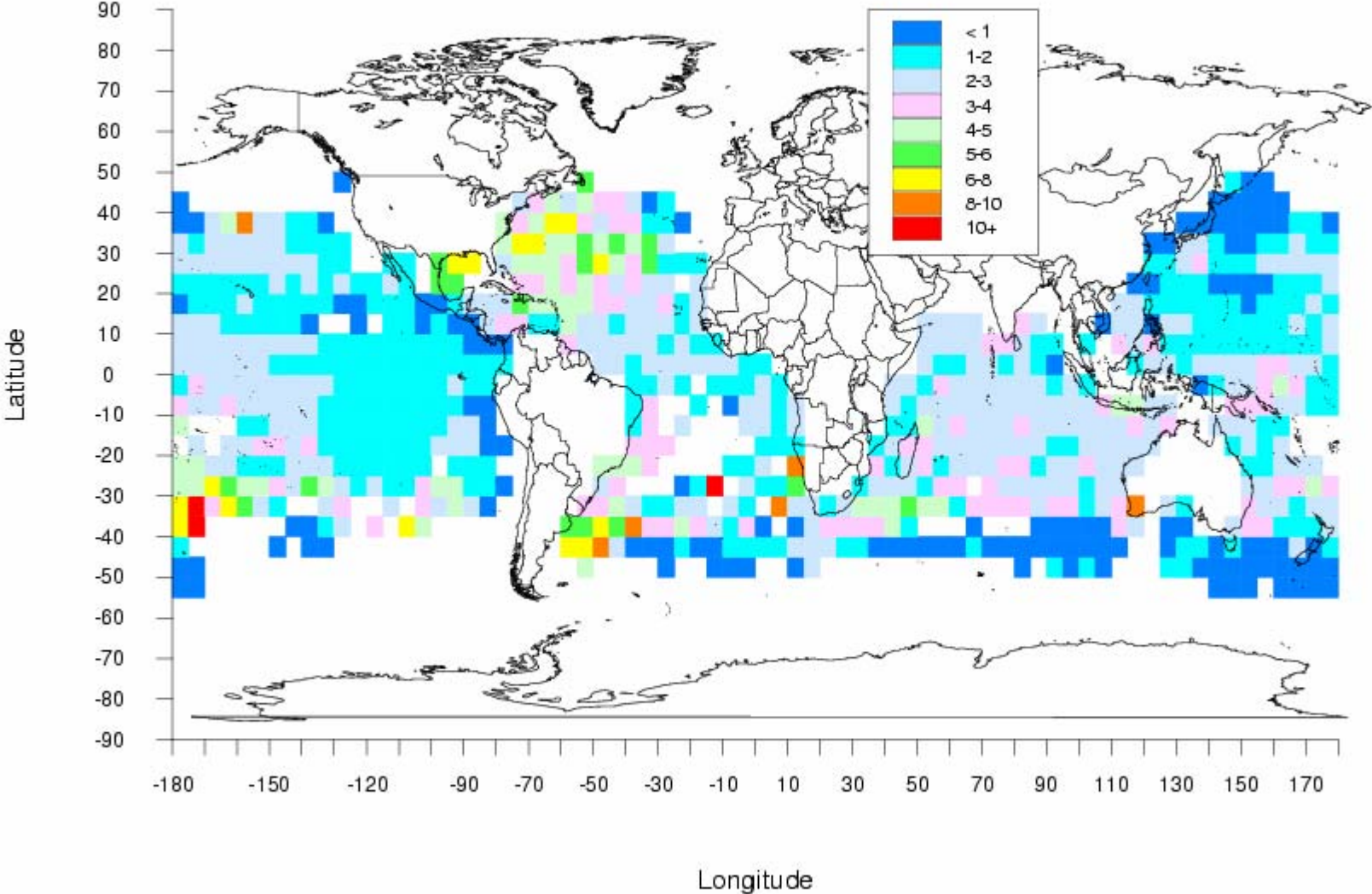
Catch Per Hundred Hooks, Year = 1968



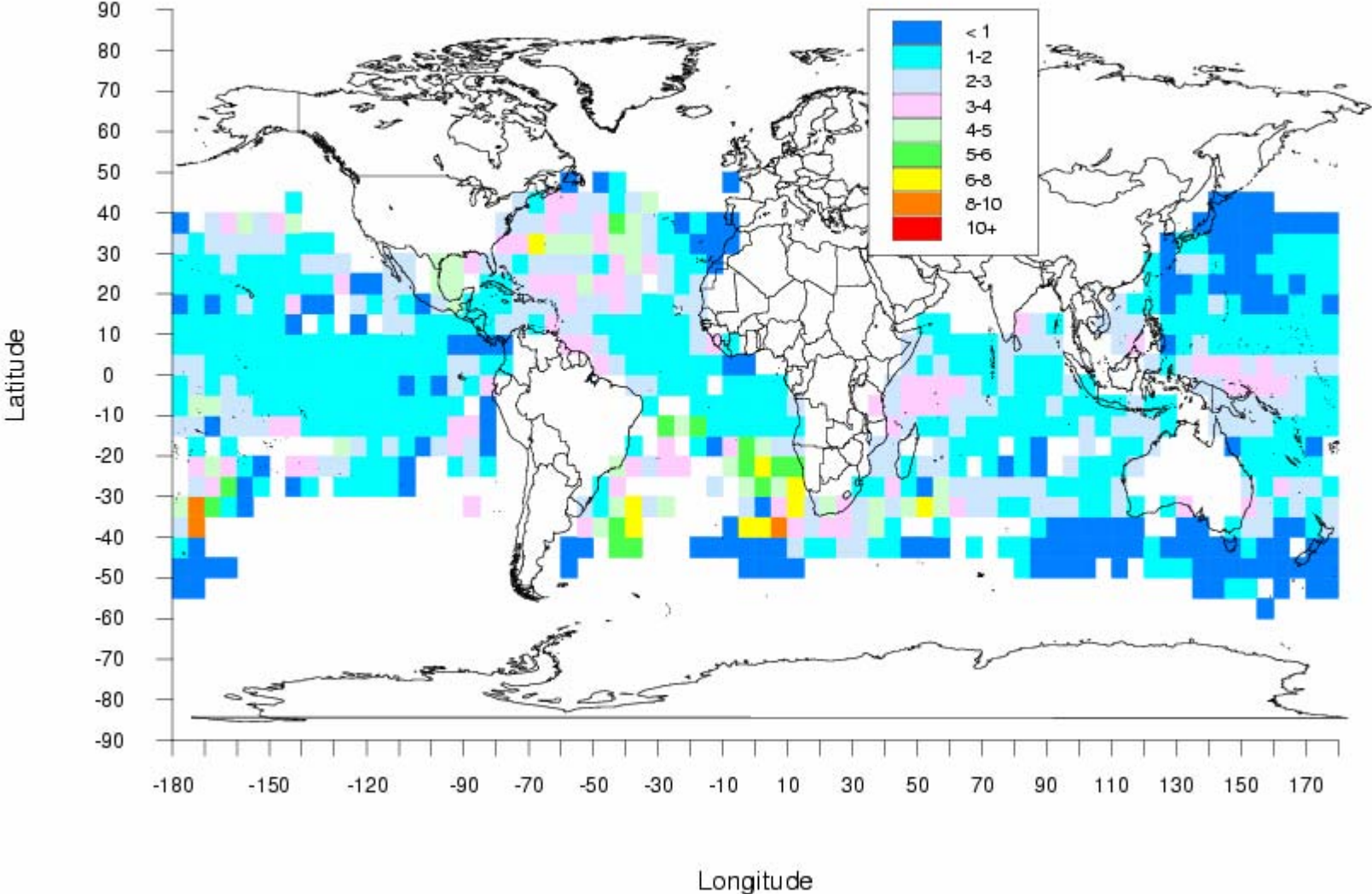
Catch Per Hundred Hooks, Year = 1969



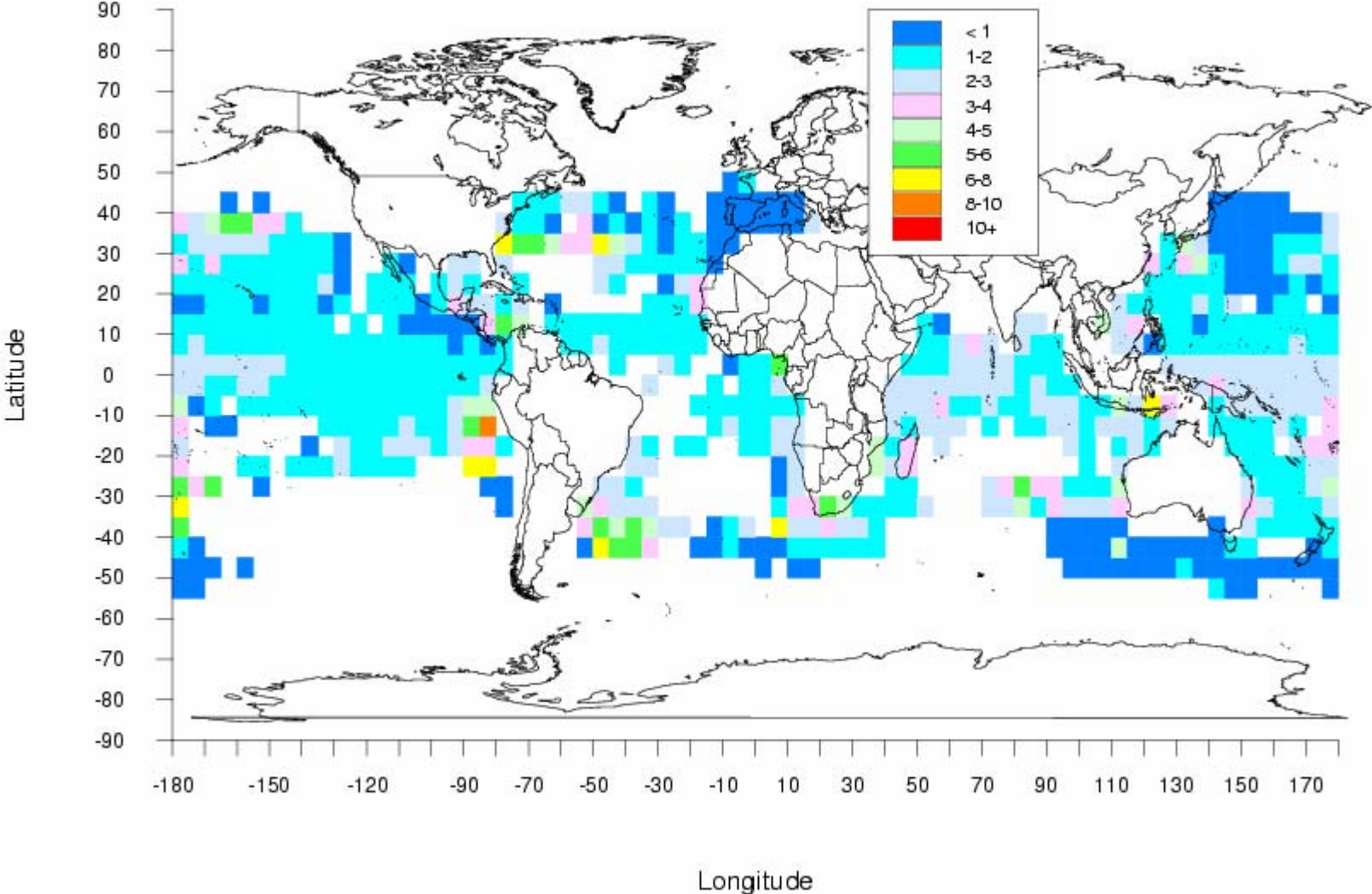
Catch Per Hundred Hooks, Year = 1970



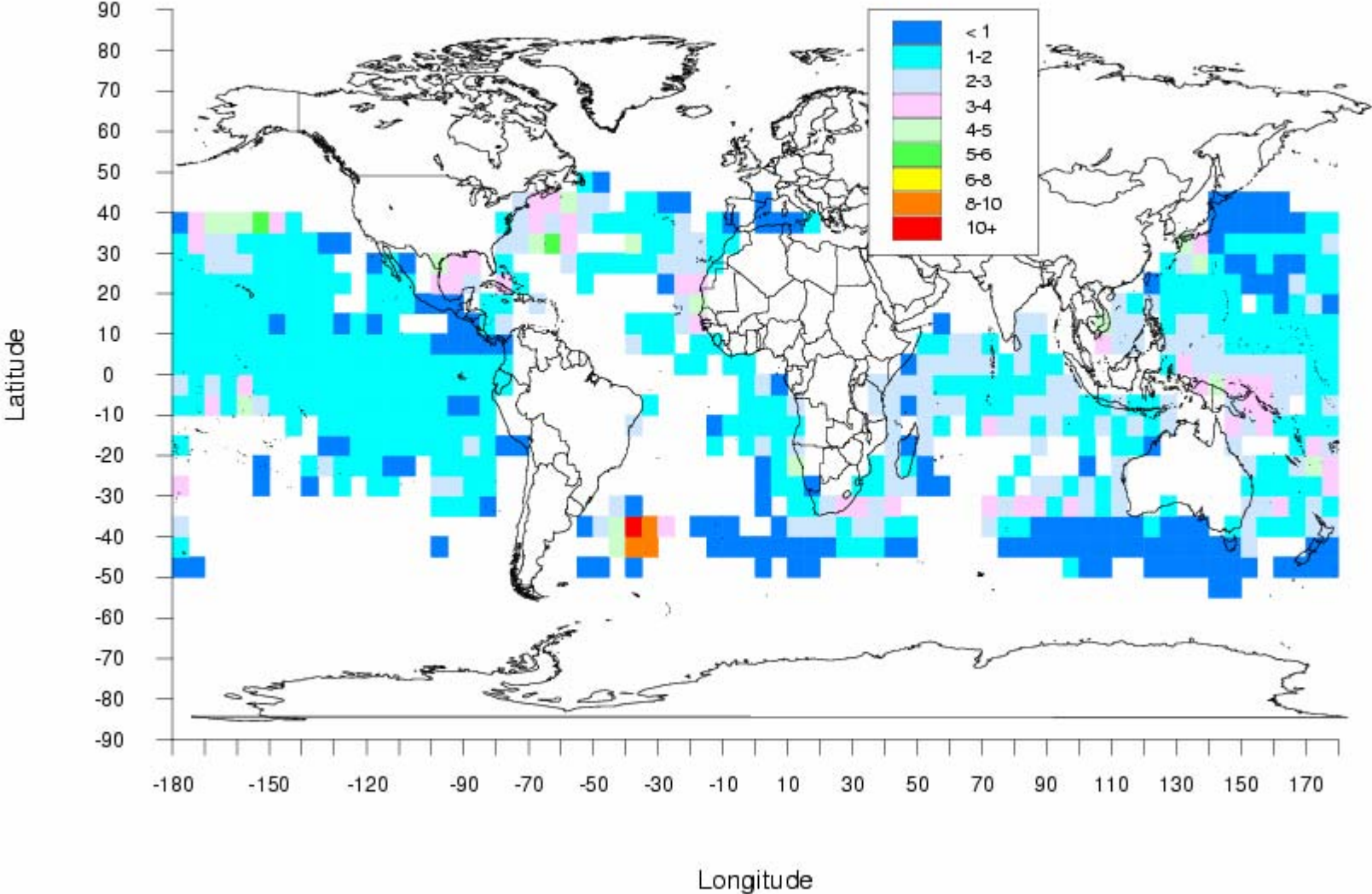
Catch Per Hundred Hooks, Year = 1971



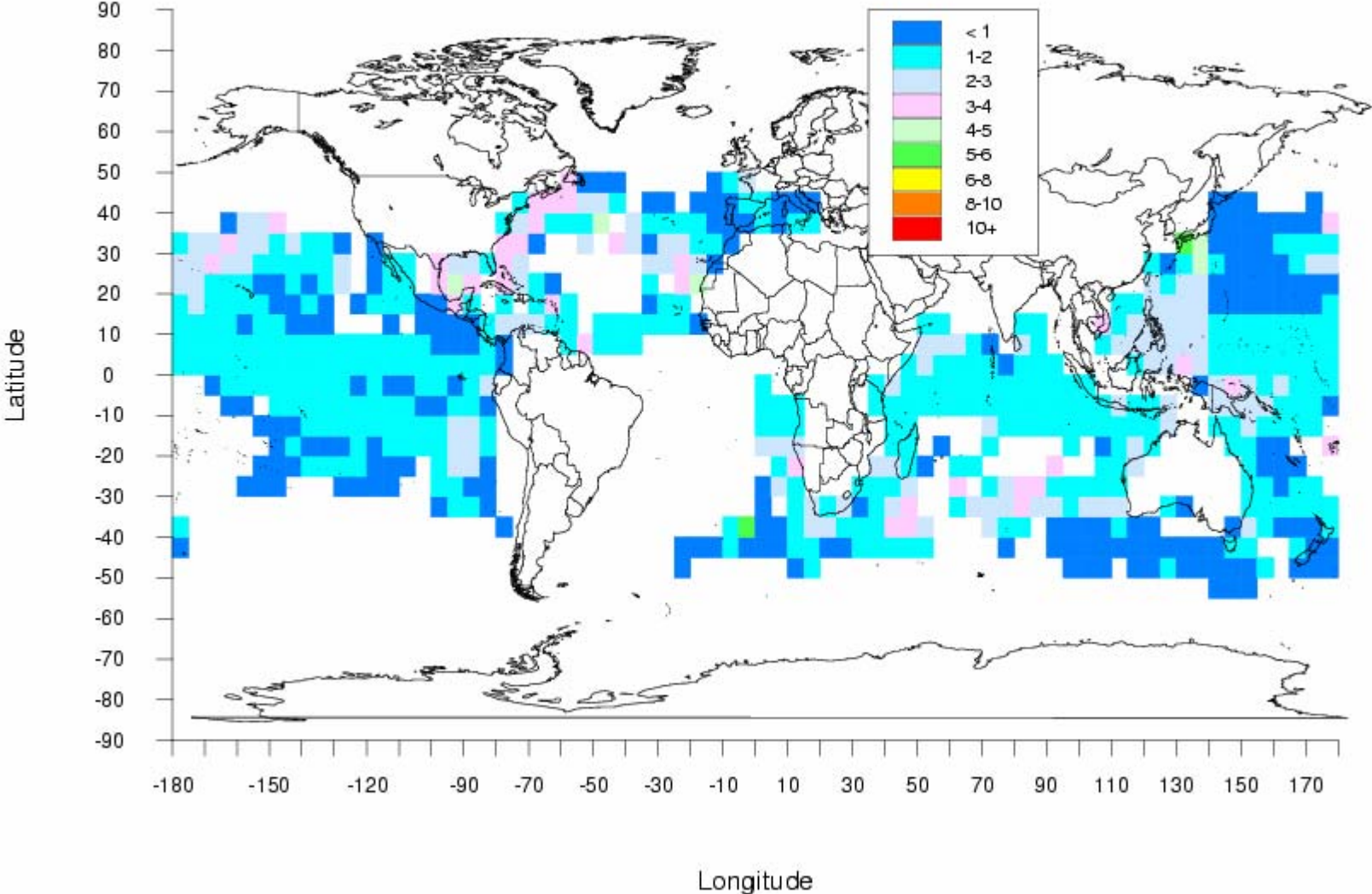
Catch Per Hundred Hooks, Year = 1972



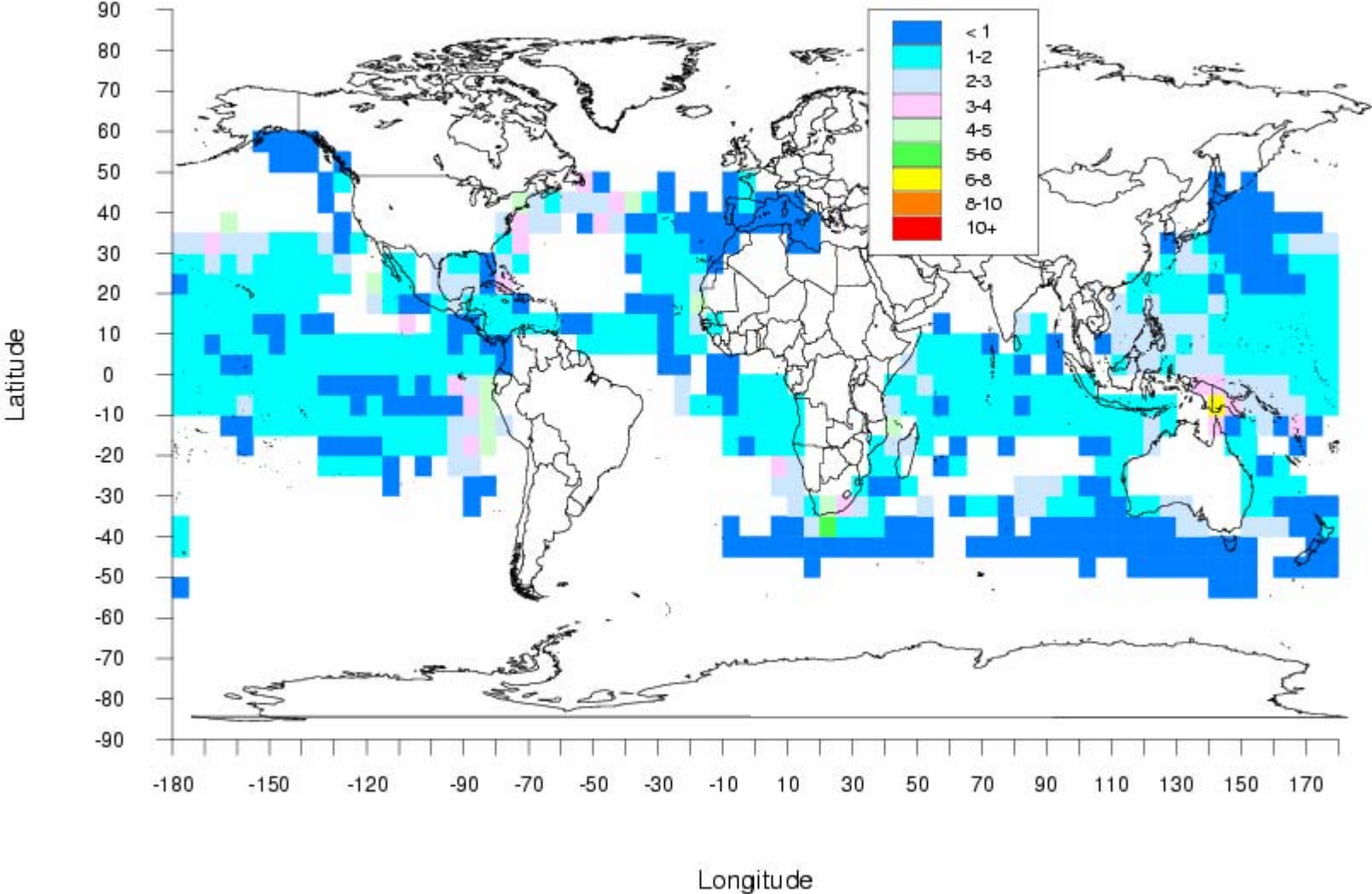
Catch Per Hundred Hooks, Year = 1973



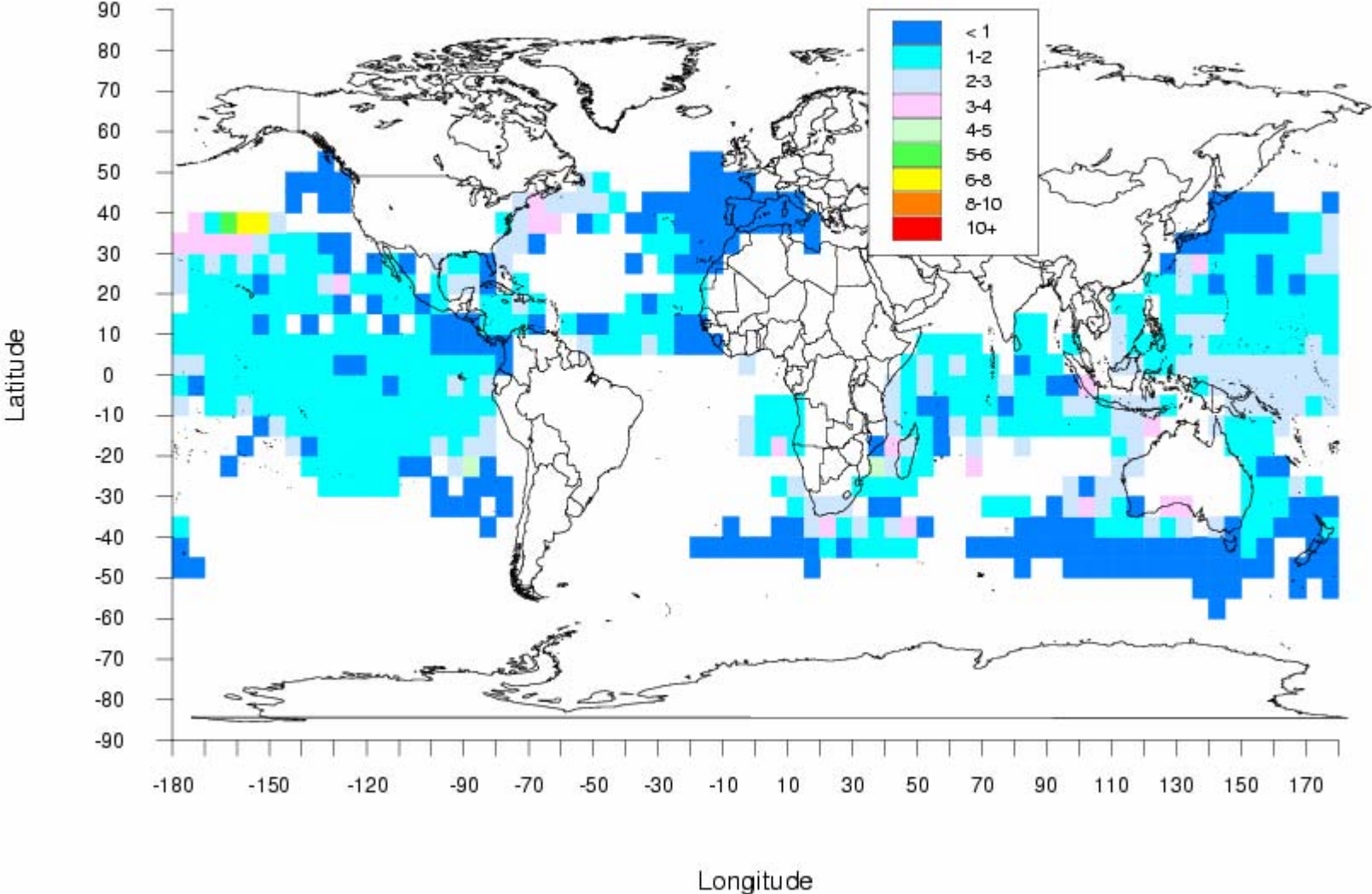
Catch Per Hundred Hooks, Year = 1974



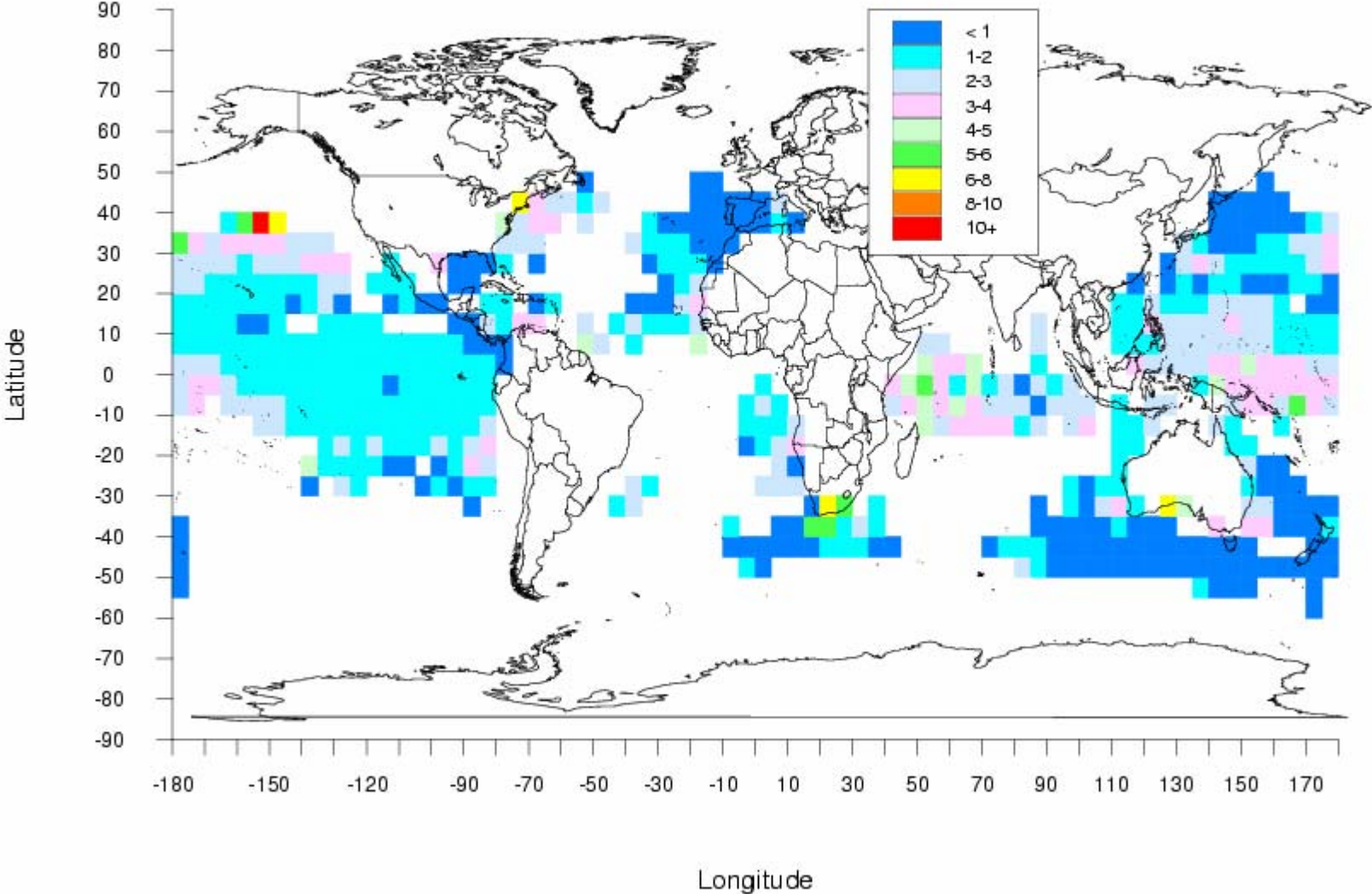
Catch Per Hundred Hooks, Year = 1975



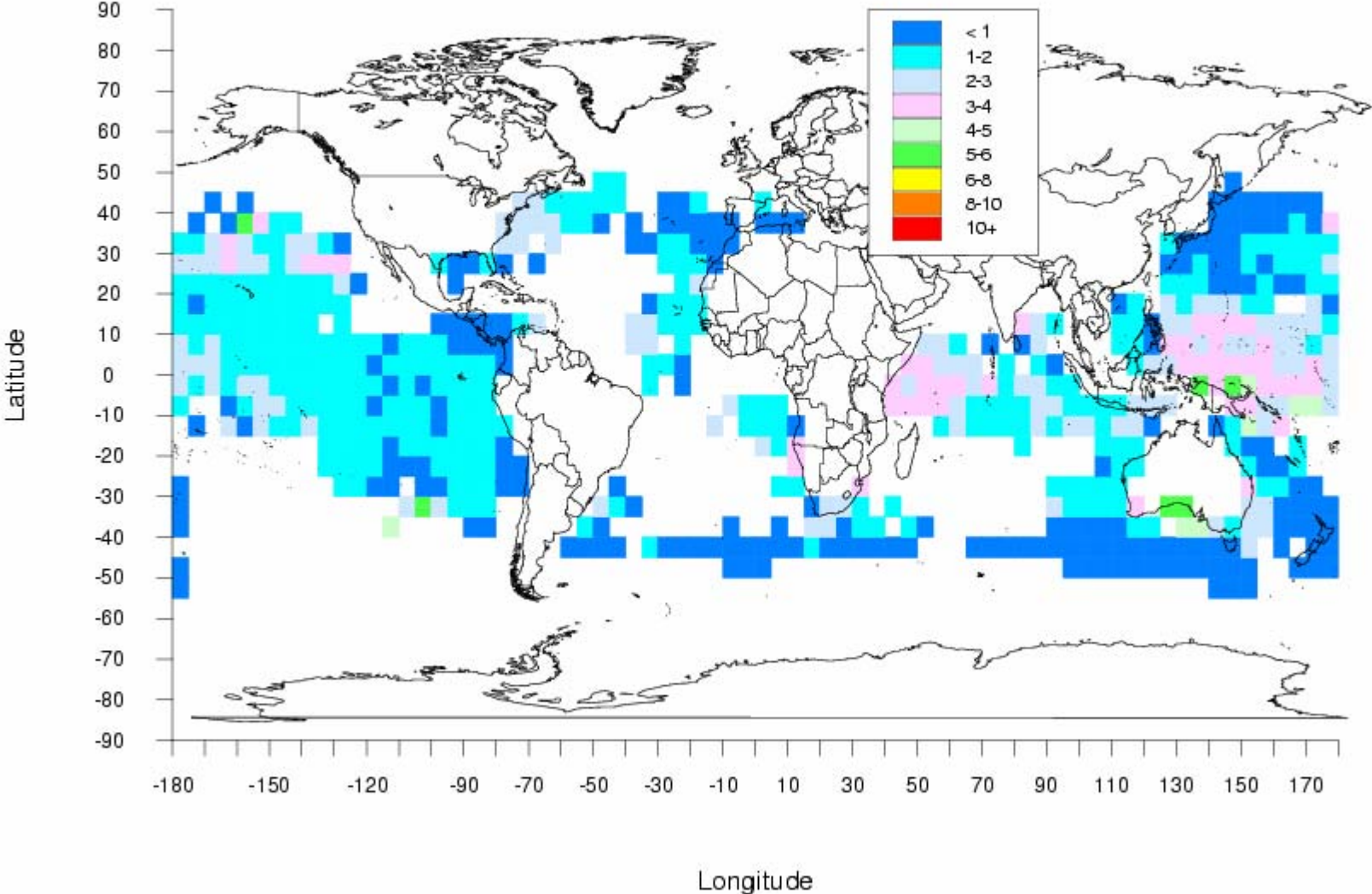
Catch Per Hundred Hooks, Year = 1976



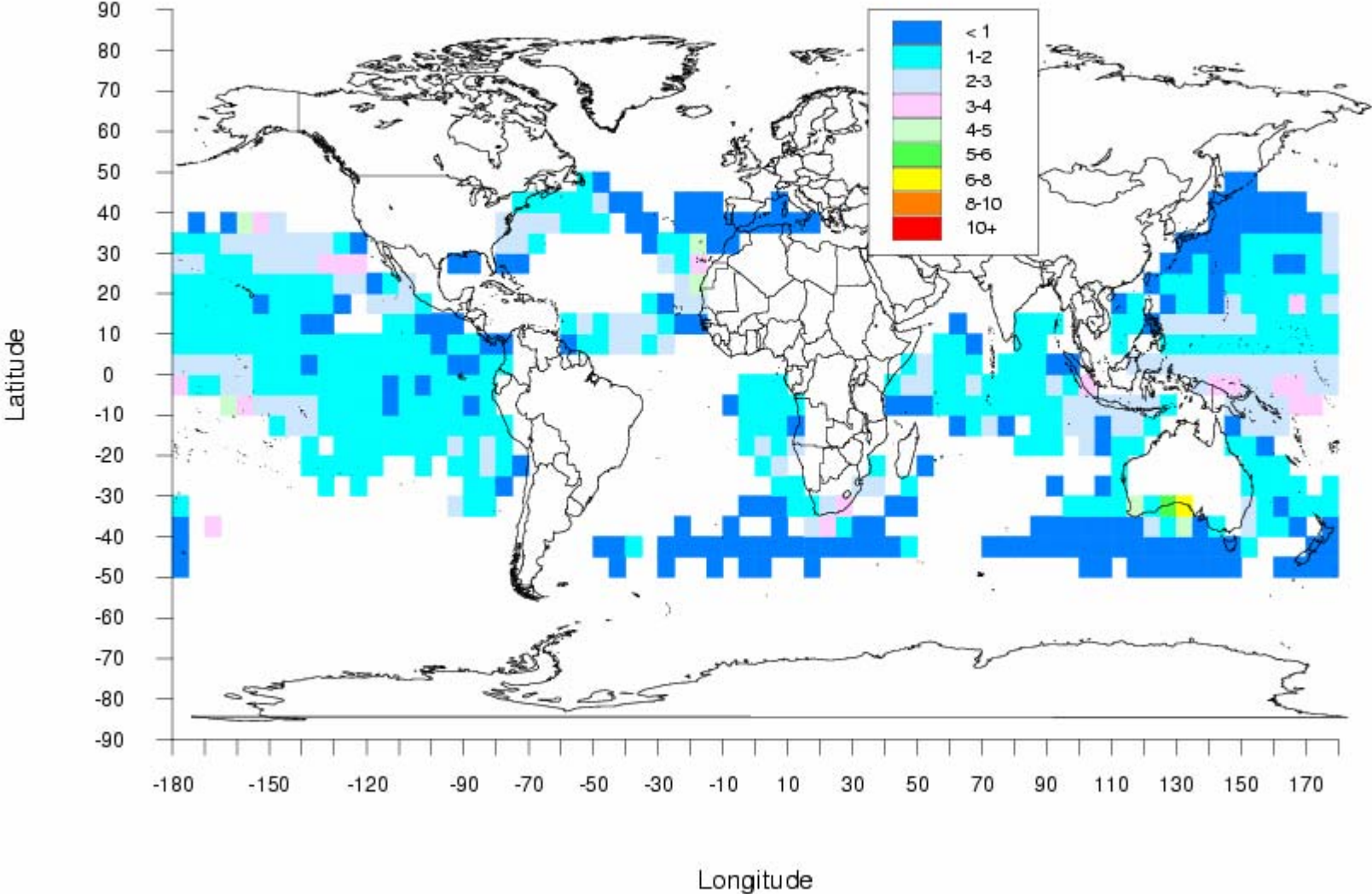
Catch Per Hundred Hooks, Year = 1977



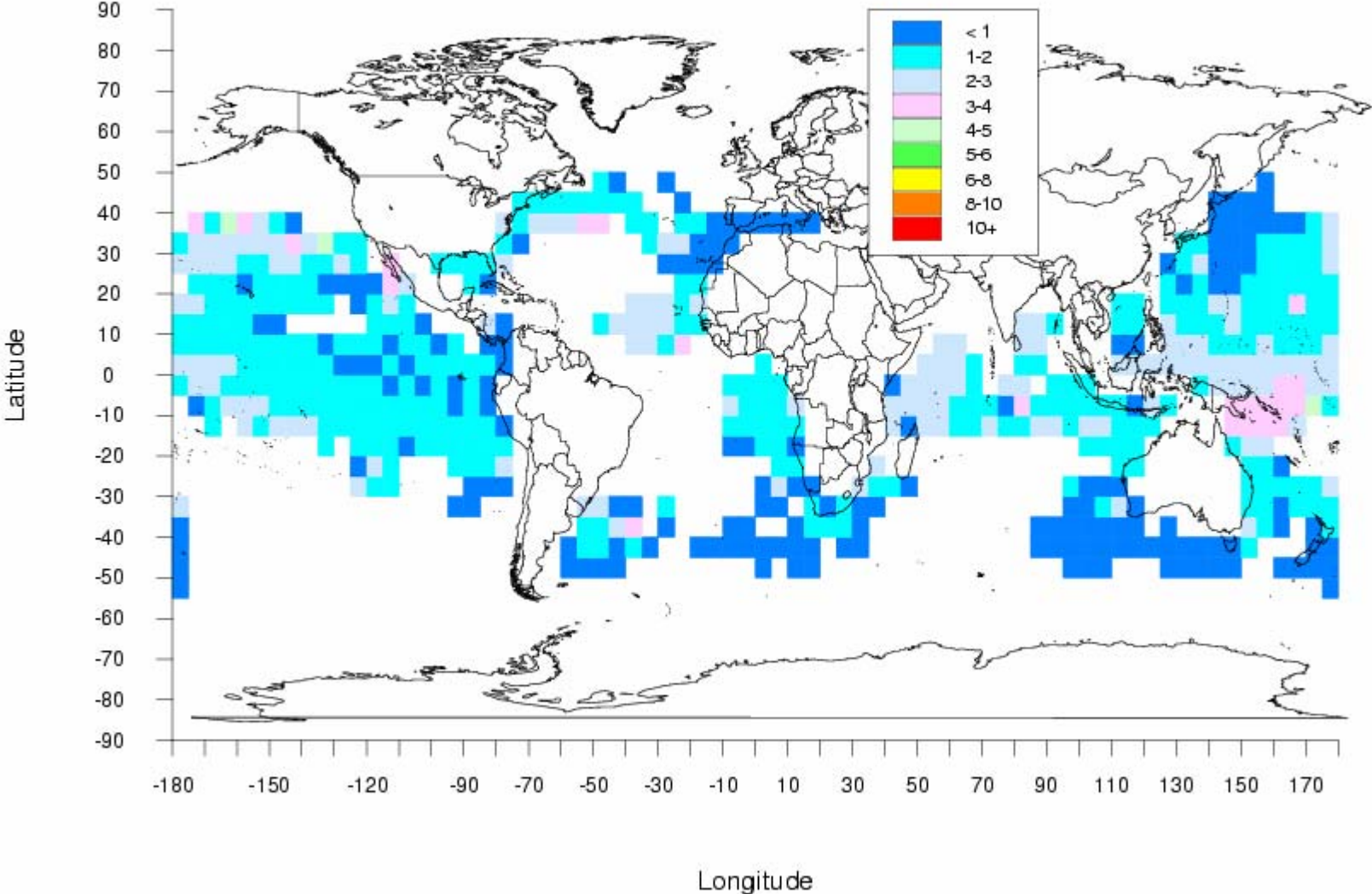
Catch Per Hundred Hooks, Year = 1978



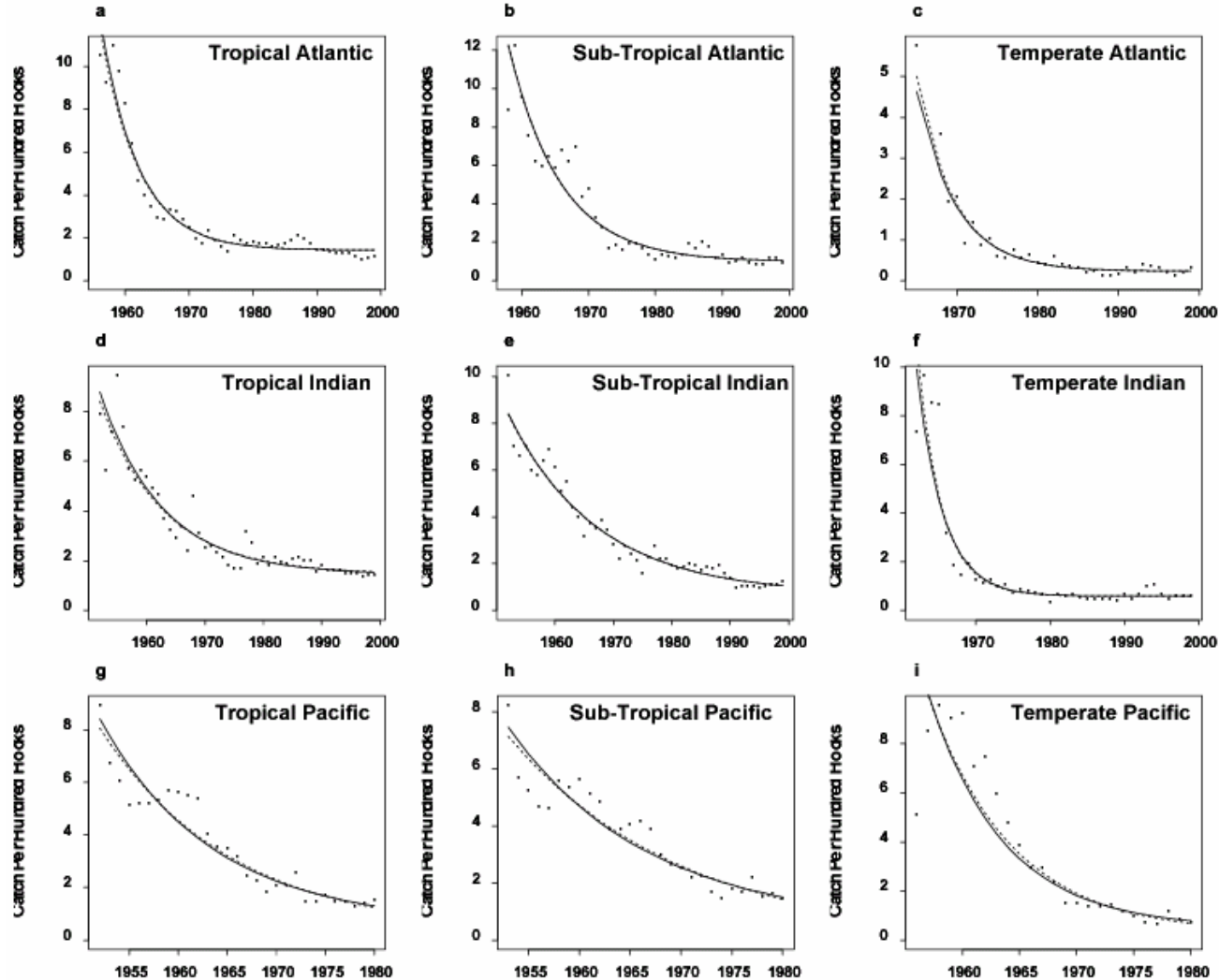
Catch Per Hundred Hooks, Year = 1979



Catch Per Hundred Hooks, Year = 1980

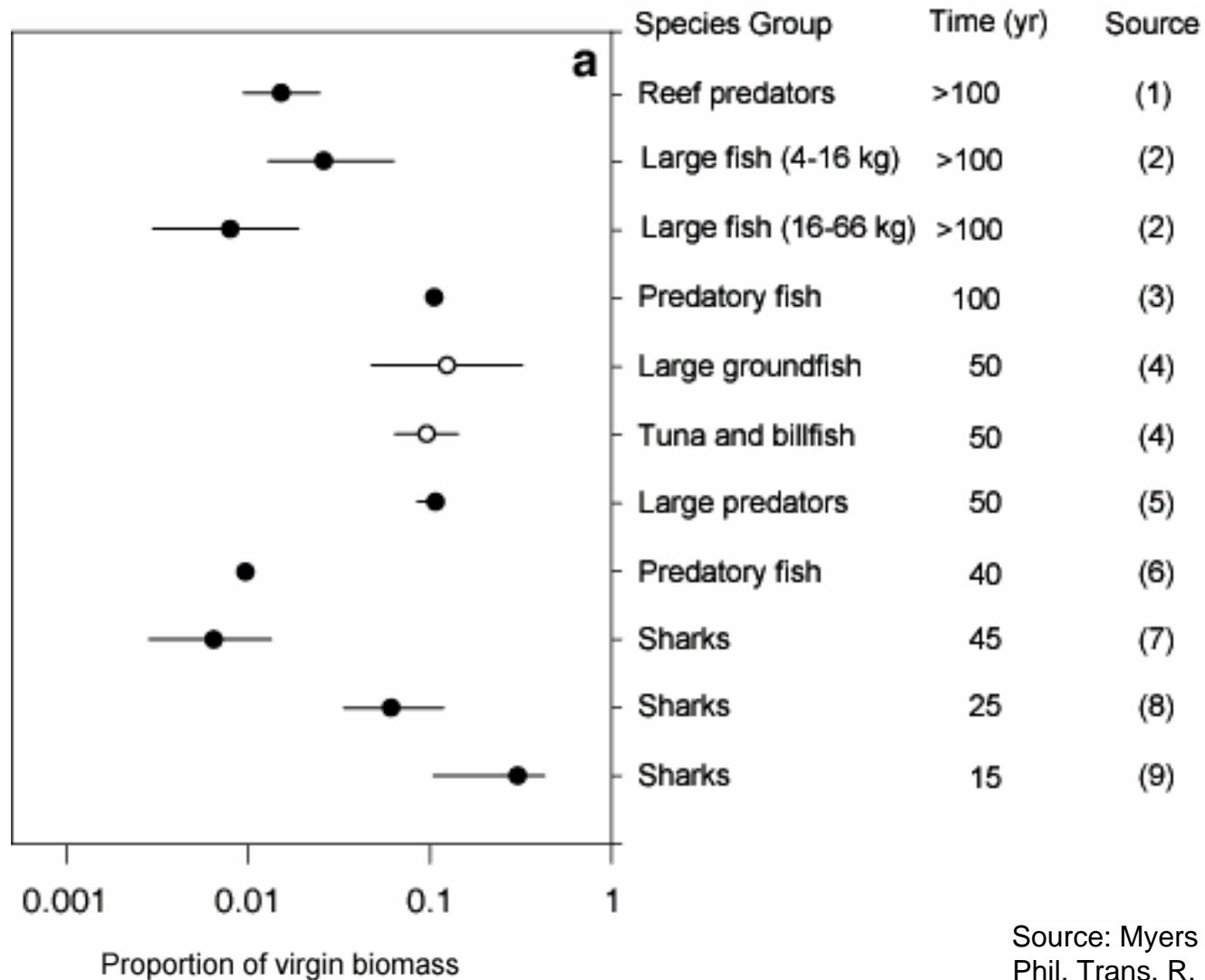


Common patterns of global depletion



Source: Myers and Worm 2003.
Nature 423: 280-283

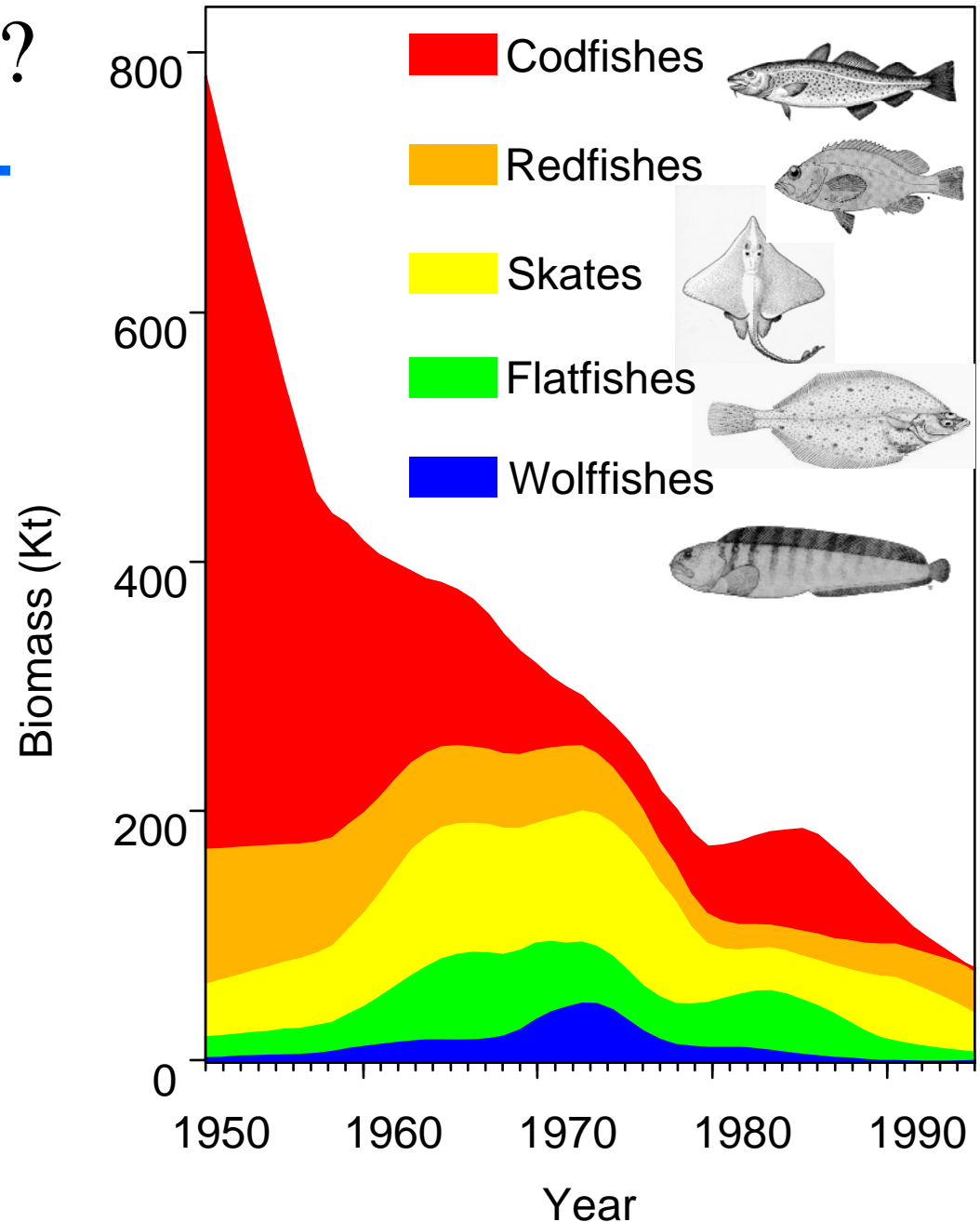
...seen in all available data sets



Source: Myers and Worm 2005.
Phil. Trans. R. Soc. B 360:13-20

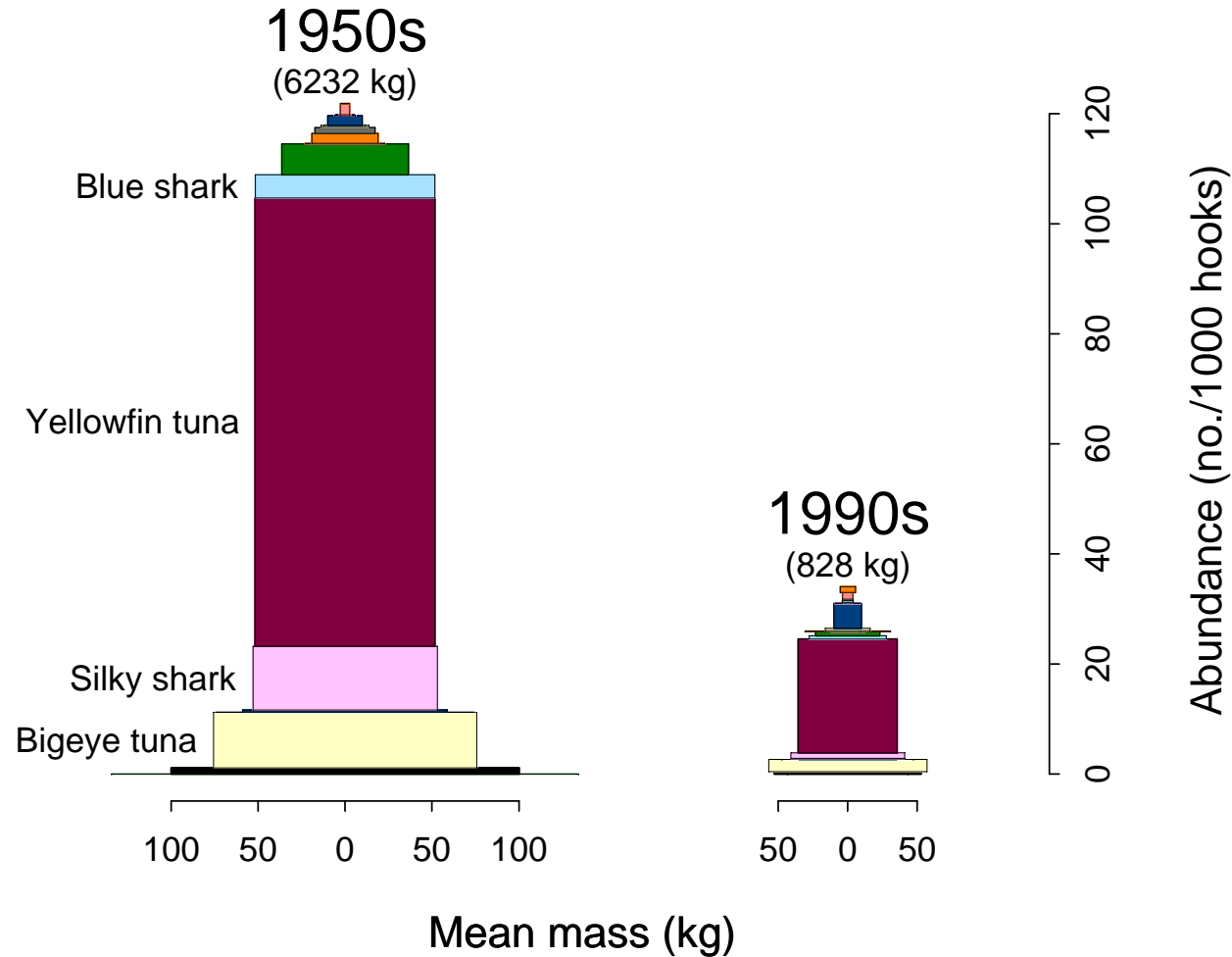
What has changed?

- 90% decline in numbers
- Approx. 50% decline in size
- Large changes in species composition



Hawaiian survey data: the brave new ocean

- 87% decline in numbers
- Approx. 50% decline in size
- Large changes in species composition



Source: Ward and Myers 2005.
Ecology 86:835–847

What are the causes?

- Industrialized fishing is the driving cause
 - Increasing effort
 - Increasing efficiency
 - Increasing global coverage



- Problem is exacerbated by habitat destruction, eutrophication, and climate change

Global problem #2:

Habitat destruction

Before trawling

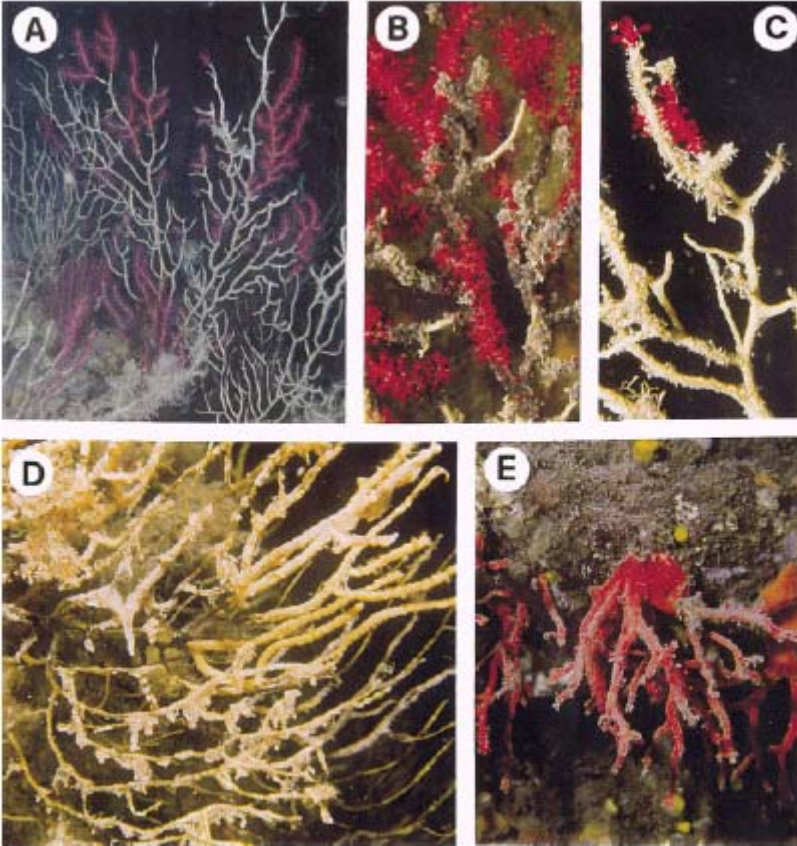


After trawling



Problem #3: Climate change and eutrophication

Coral bleaching



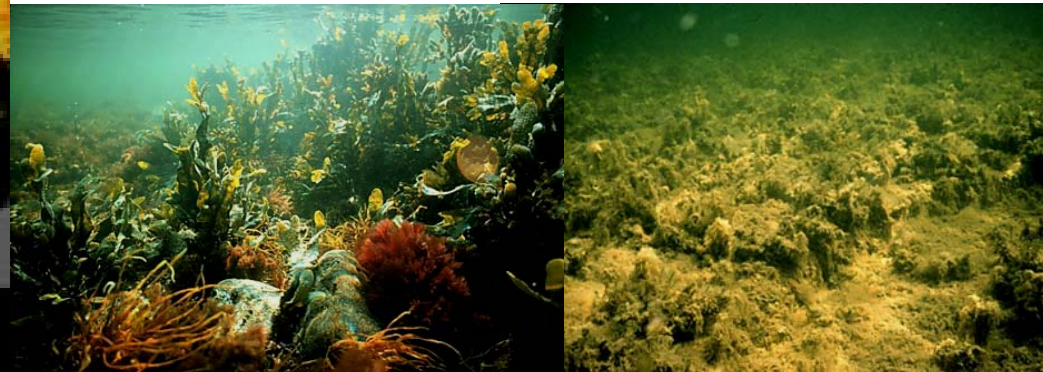
Source: Cerrano et al. 2000. Ecol. Lett. 3: 284-293

Seagrass die-off



Source: Reusch et al. 2005. PNAS: 102:2826-2831

Algal blooms



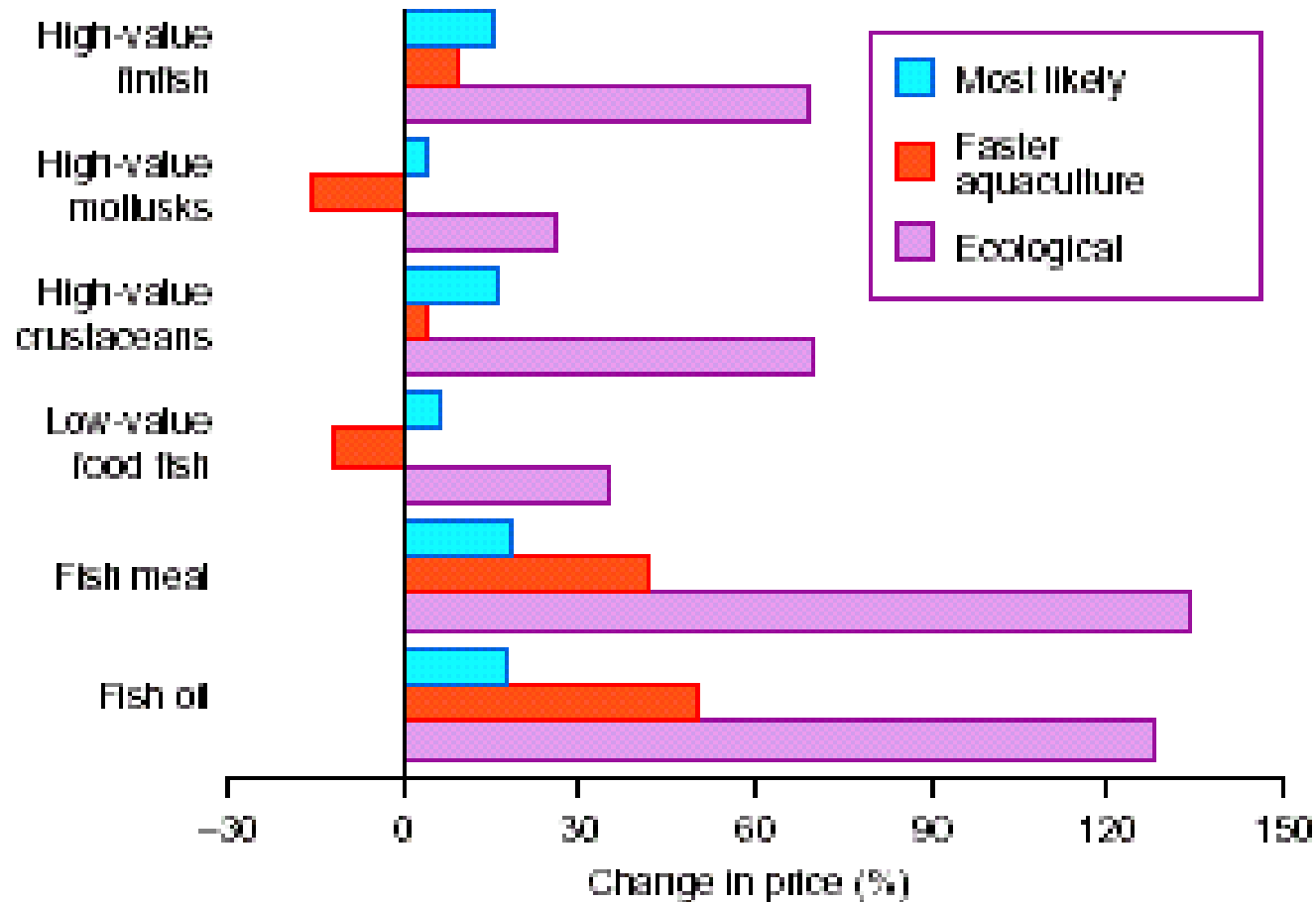
Source: Worm and Lotze. 2005. Limnol. Oceanogr.: in press

Source: NASA

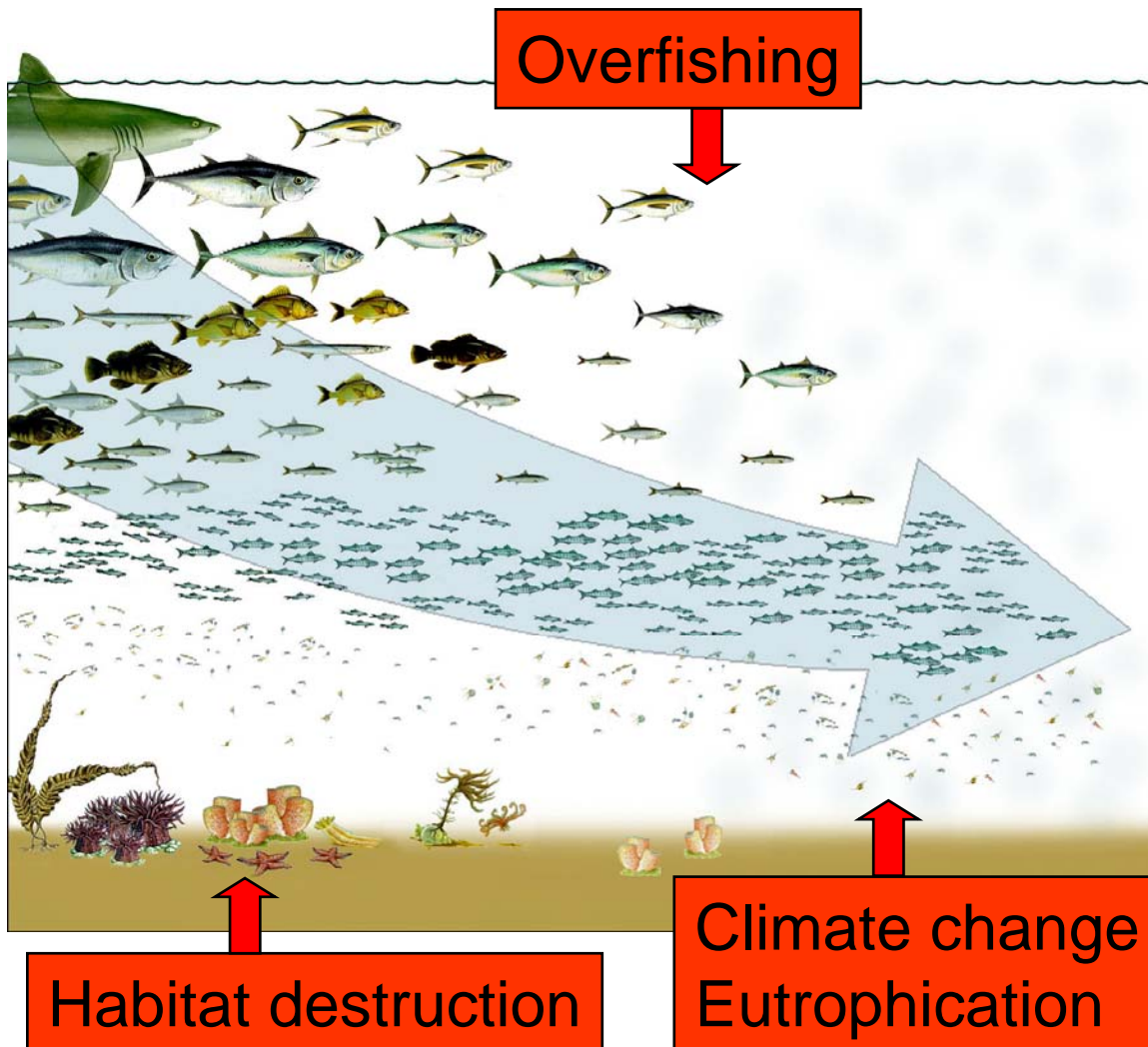
Question II: What does this mean?



Seafood bound to become a luxury item



Loss of biodiversity and economic opportunities



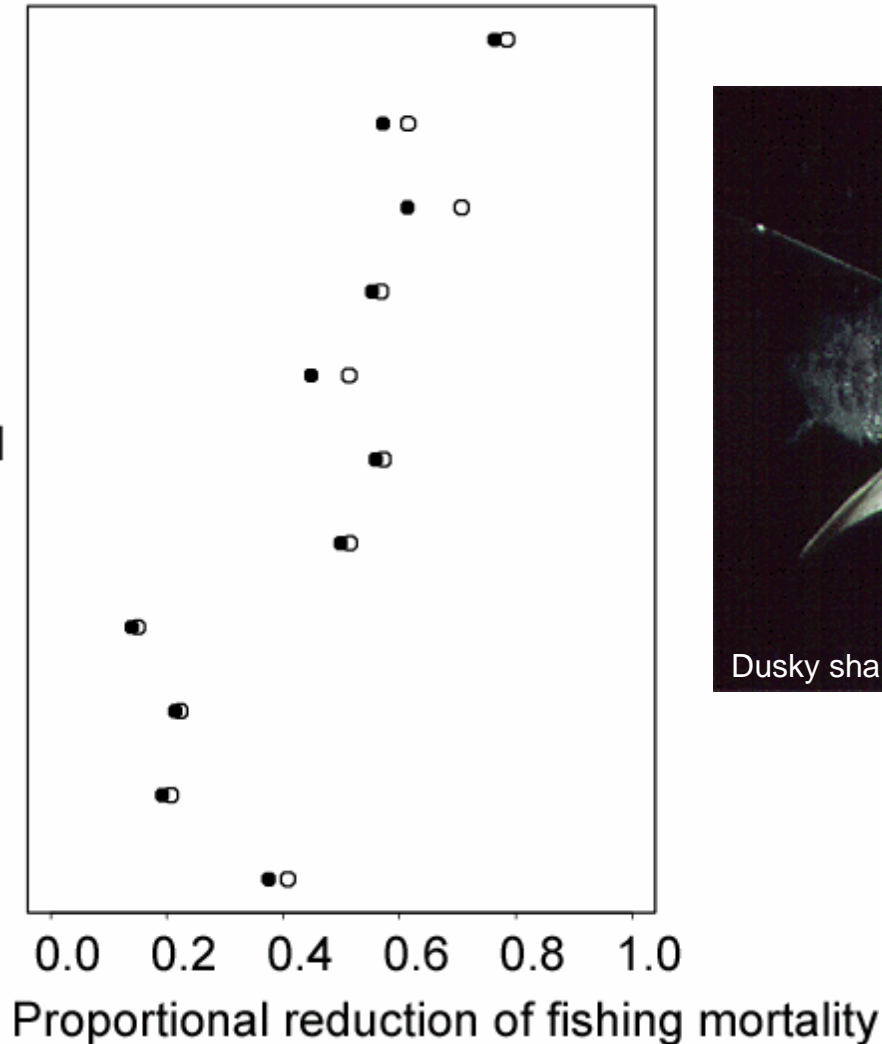
- Loss of consumer and habitat species
- Fishery collapses
- Algal blooms
- Decline of water quality
- Loss of resilience

Question III. What can we do?



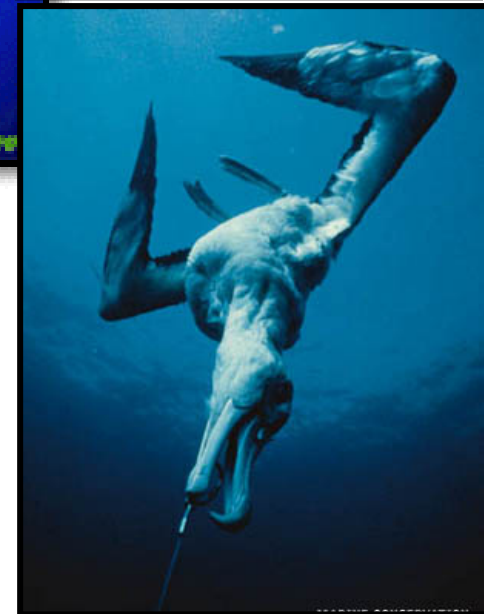
Reduce fishing mortality for sensitive species

Dusky
Silky
Blacktip
Bigeye thresher
Common thresher
Scalloped hammerhead
White
Mako
Tiger
Blue
Oceanic whitetip

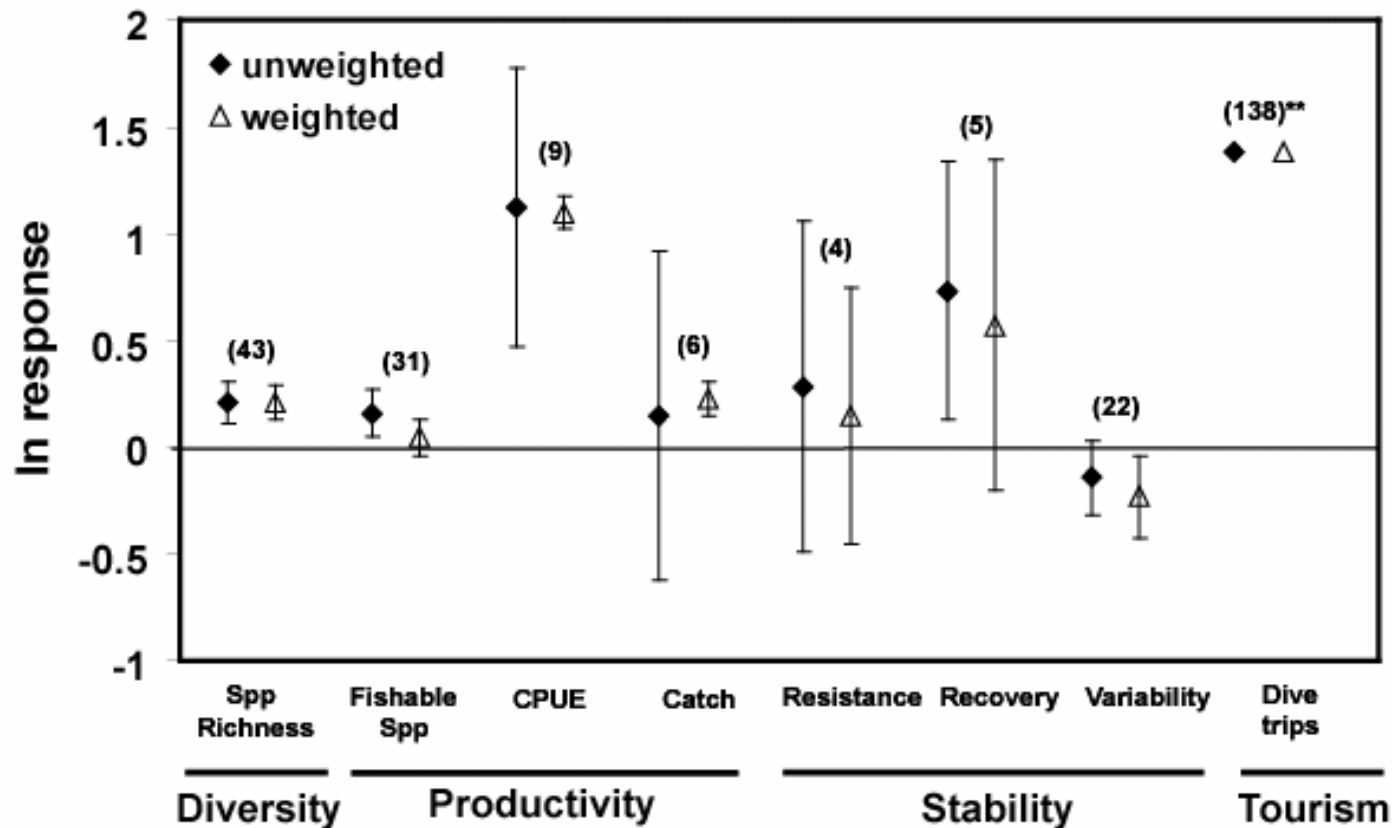


Modify or ban use of unselective fishing gears

- Driftnets
- Bottom trawls
- Longlines
- Fish aggregating devices



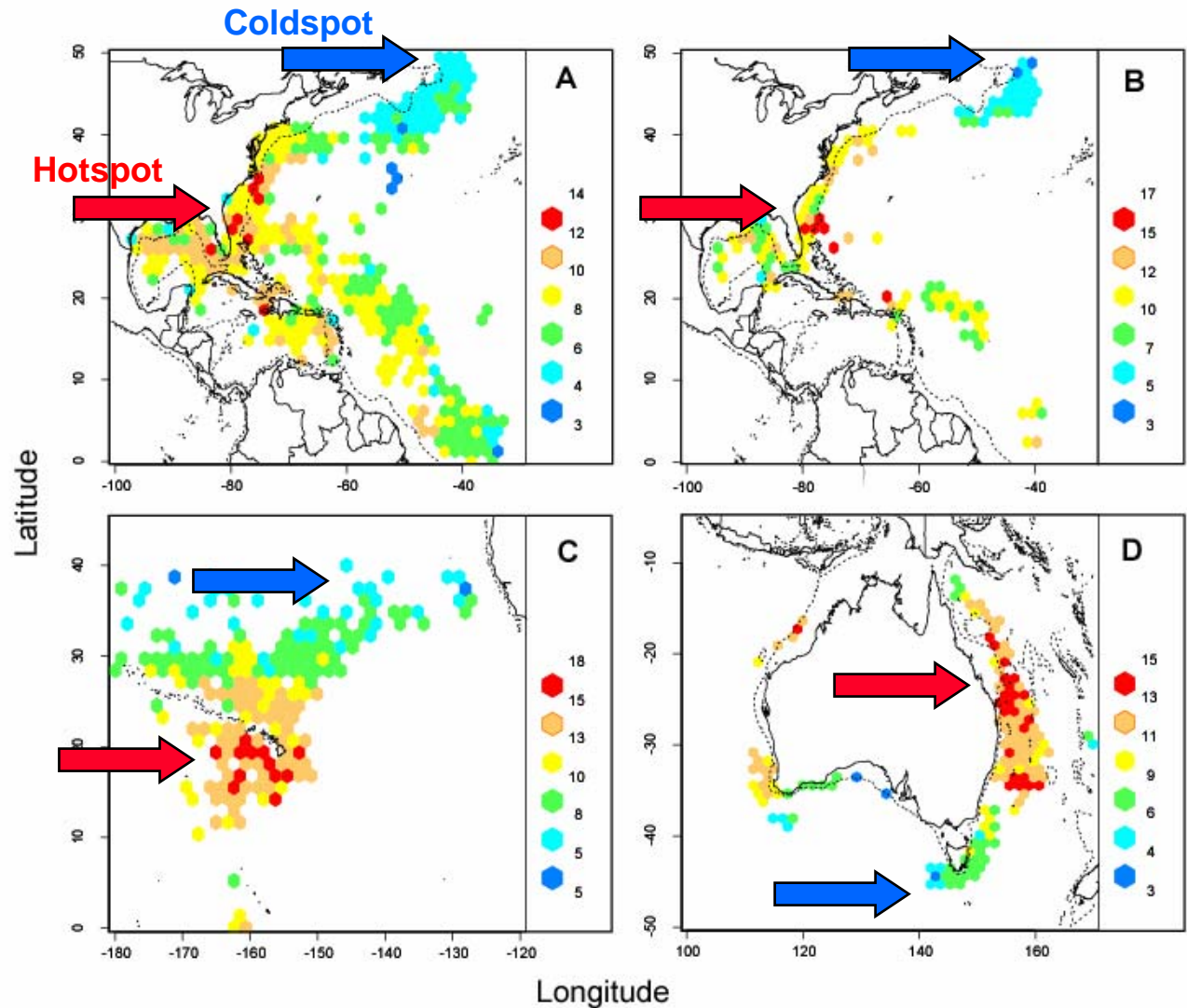
Protect key areas to recover diversity, productivity



Source: Worm et al. (in preparation)

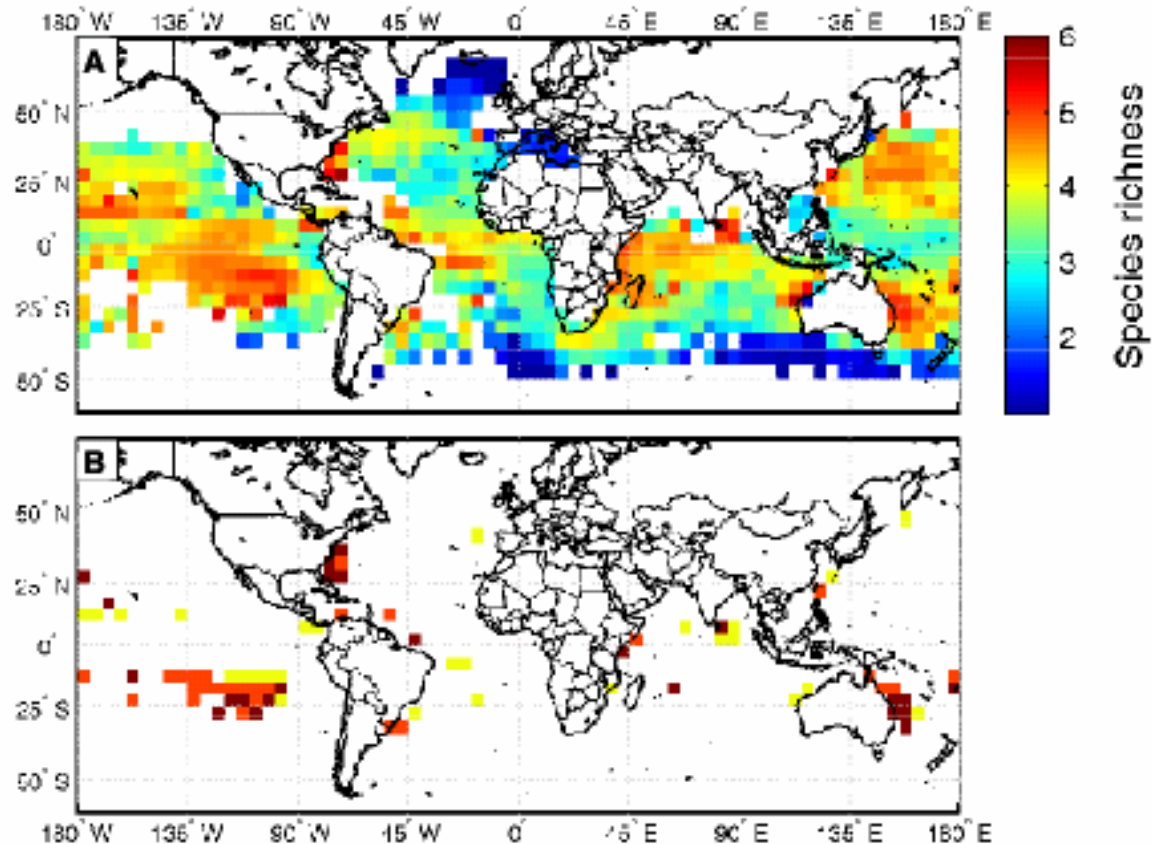
Some key areas are in national waters

- Special places where many species aggregate
- Key habitats
- Food supply



Worldwide hotspots for high-seas conservation

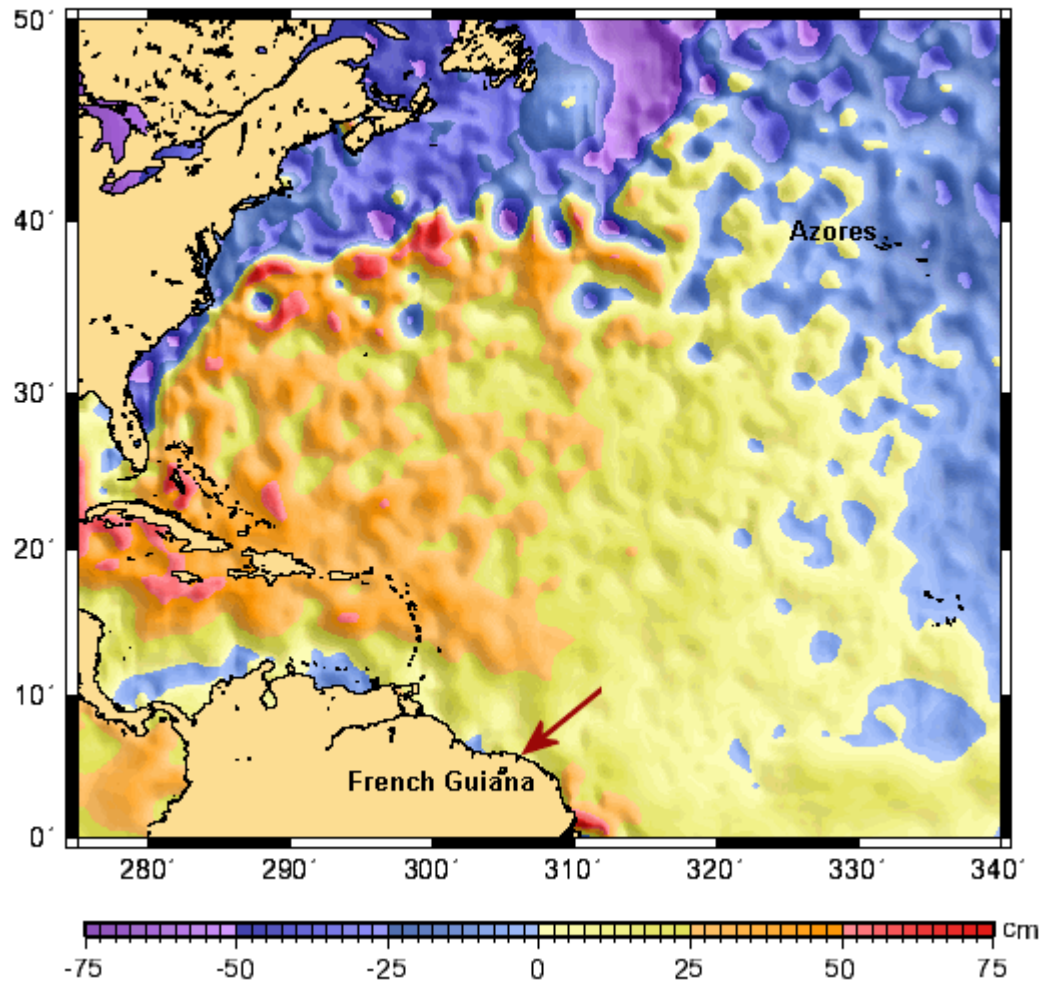
- Major hotspots
 - U.S. east coast
 - Hawaiian chain
 - Southeast Pacific
 - Australian east coast
 - Sri Lanka



Source: Worm et al. 2005.
Science: accepted manuscript

Leatherback turtle habitat use from satellite tracks

21 juin 2000



Source: Ferraroli et al. 2004.
Nature 429: 521-522

Conclusions



- The oceans have been depleted on a global scale
- Overfishing, habitat loss, eutrophication and climate change impair marine ecosystem services and threaten food security

We must strive to

- minimize destructive impacts
- maintain diversity
- establish networks of protected areas