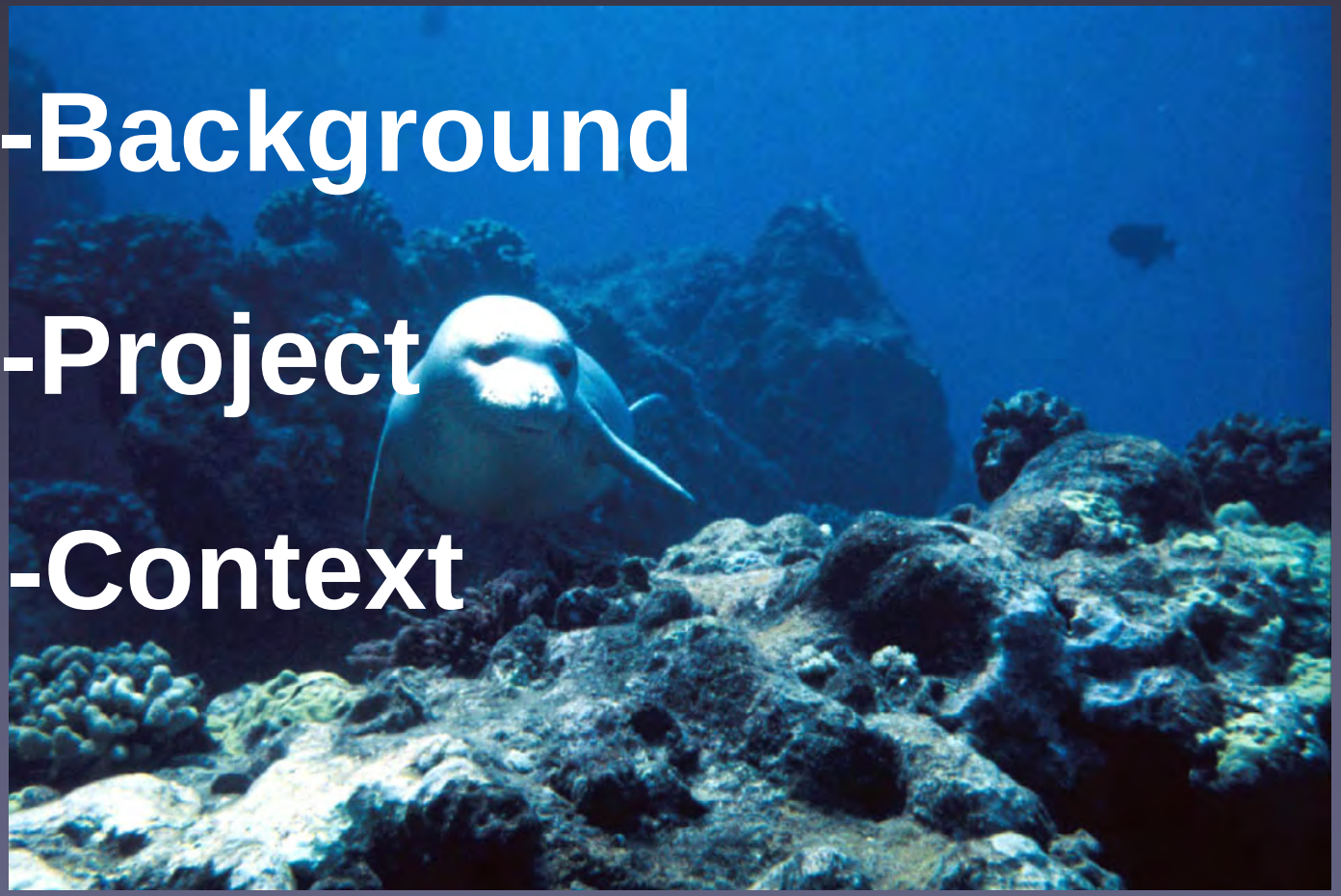
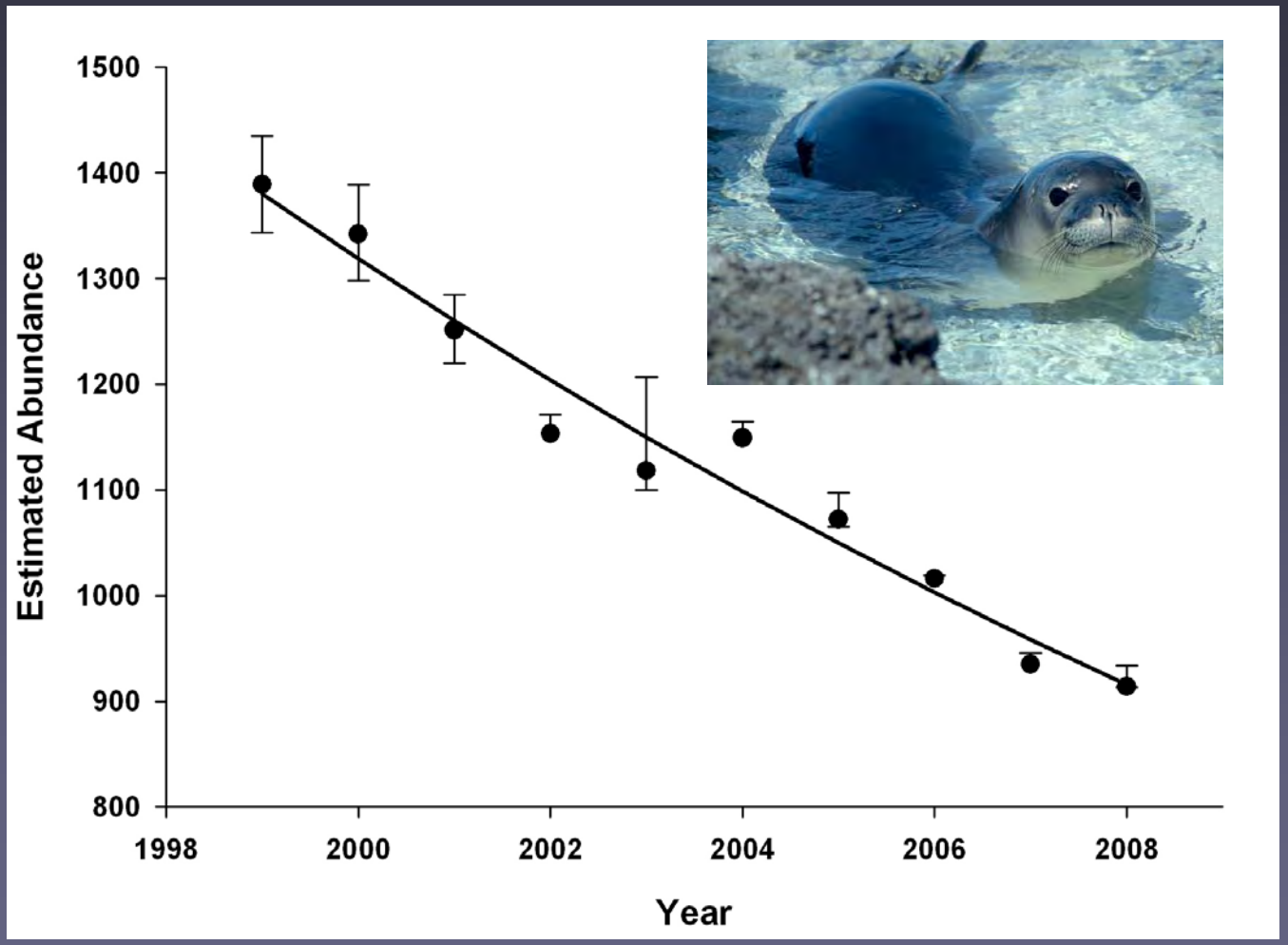
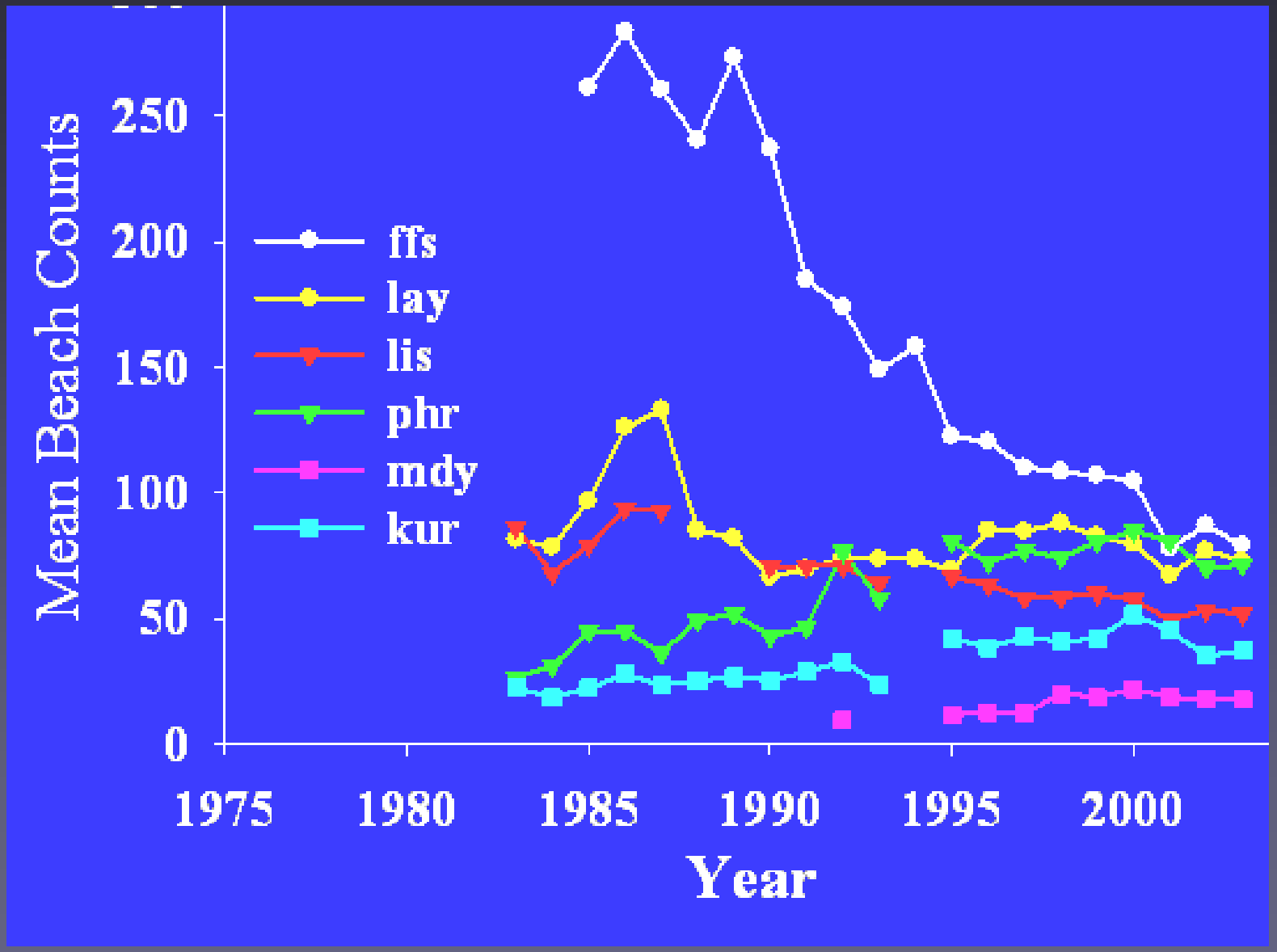
Hawaiian monk seals exerting top down pressure in subphotic ecosystems.

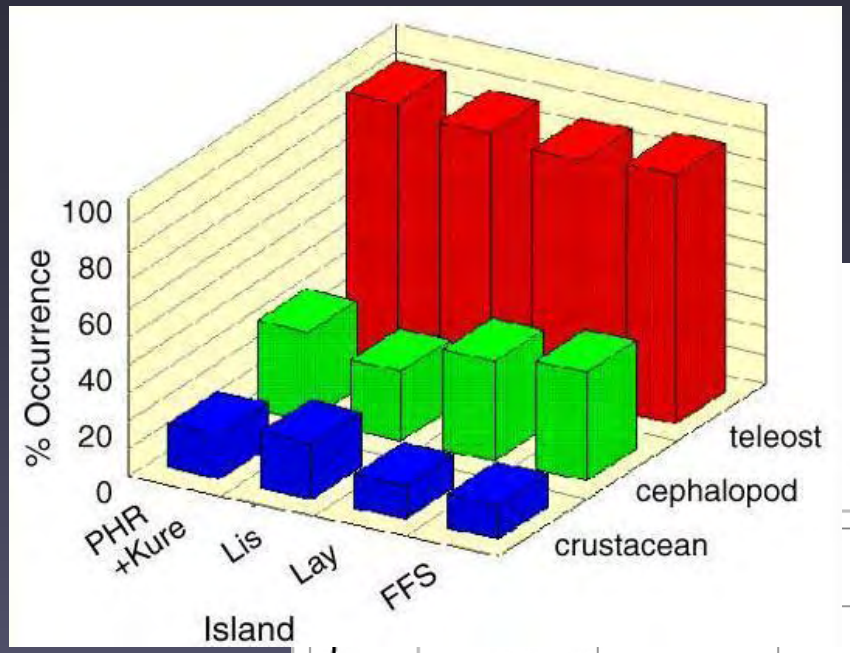
Outline

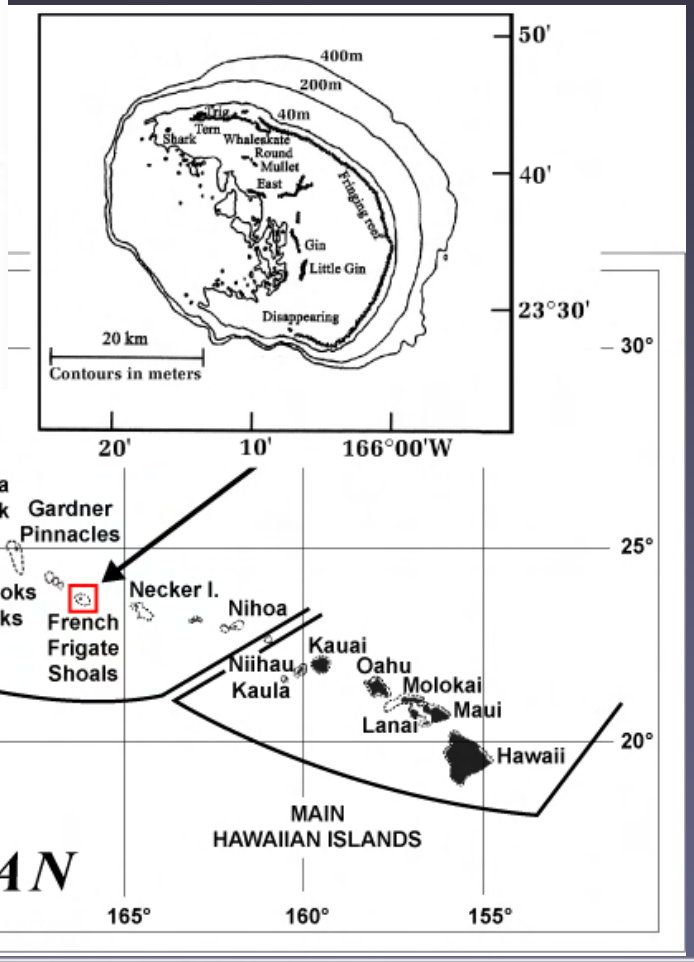


Background

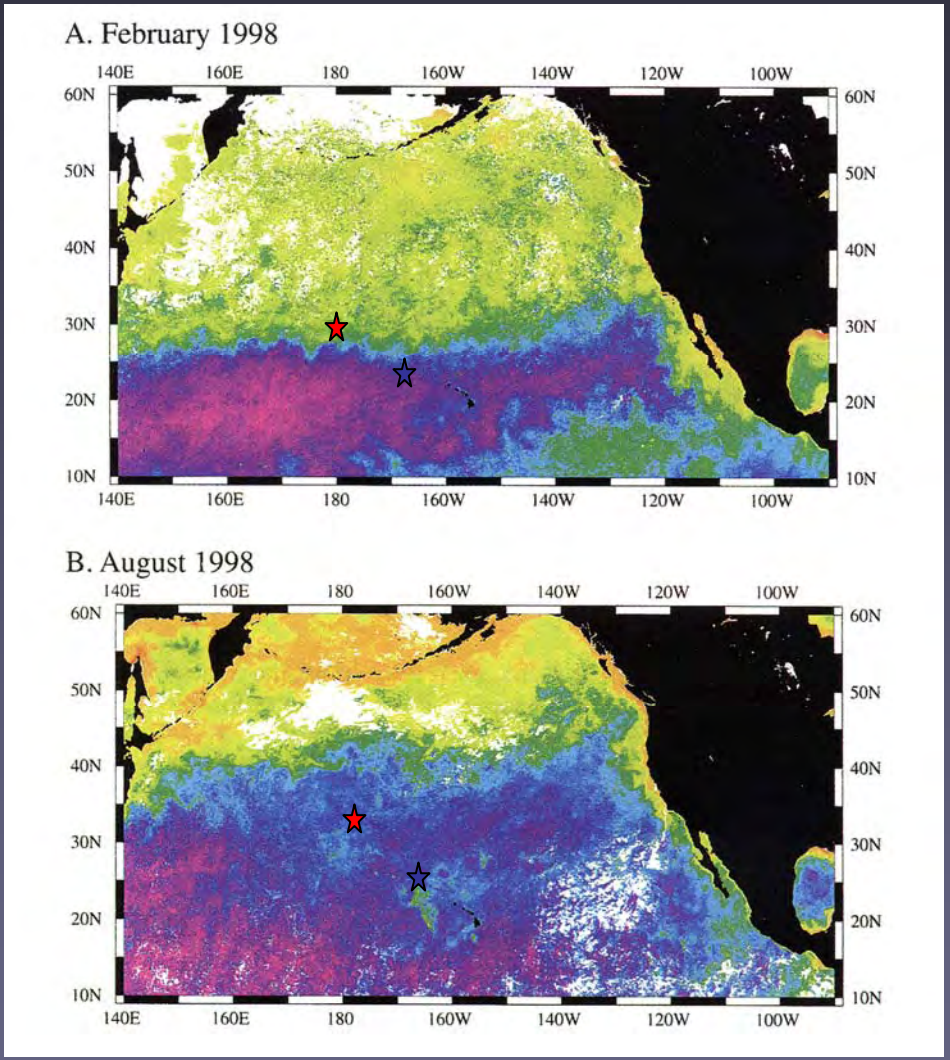

1500
1400
1300
1200
1100
1000
900
800
Estimated Abundance
1998
2000
2002
2004
2006
2008
Year

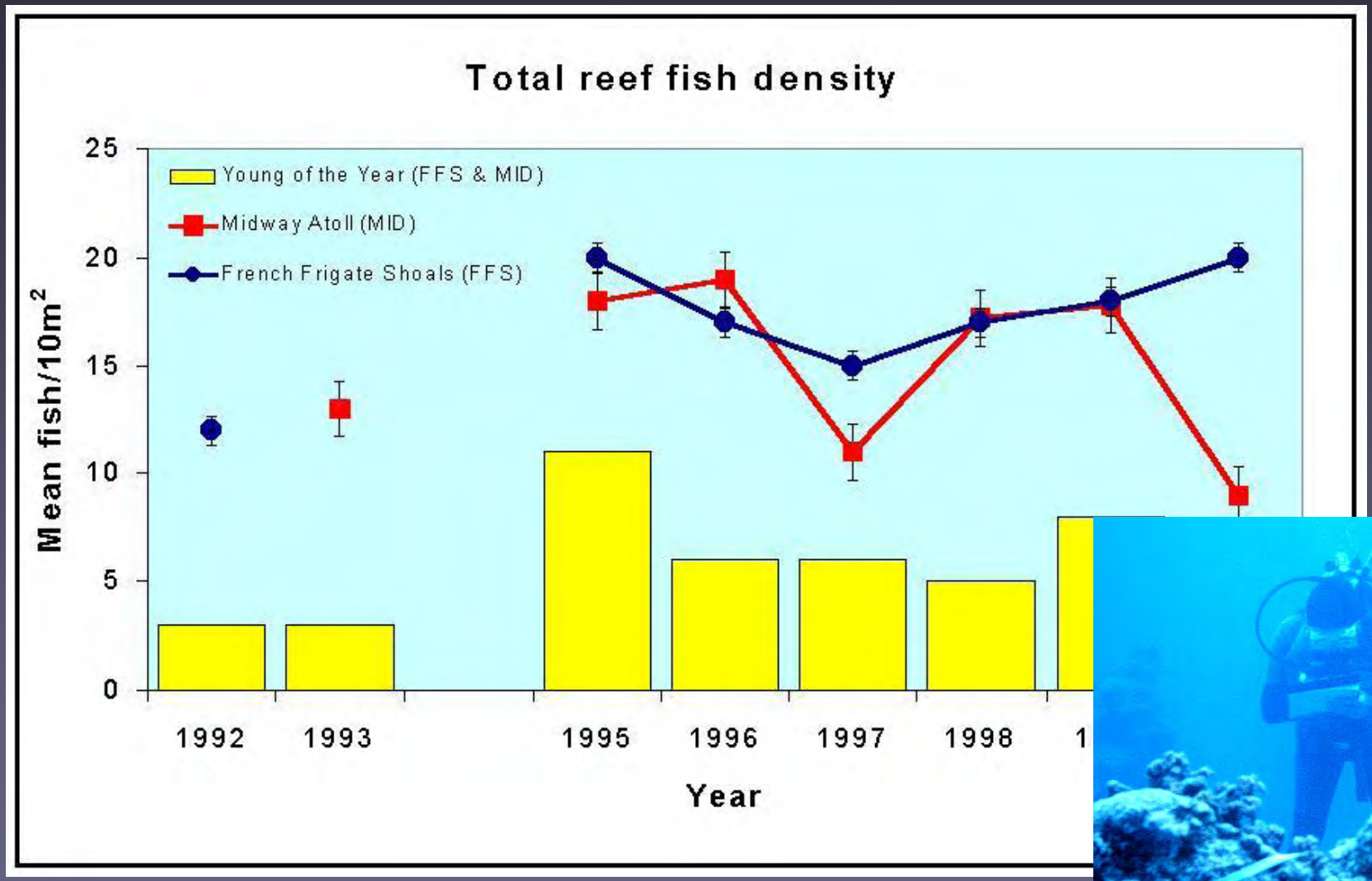

Mean Beach Counts
250
200
150
100
50
0
ffs
lay
lis
phr
mdy
kur
1975
1980
1985
1990
1995
2000
Year

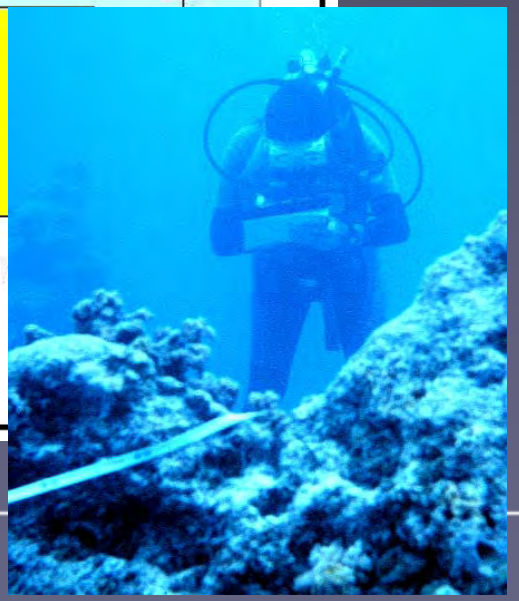

% Occurrence
100
80
60
40
20
0
PHR +Kure
Lis
Lay
FFS
Island
teleost
cephalopod
crustacean


400m
200m
40m
Trig
Tern
Shark
Whalesskate
Round
Mullet
East
Fringing reef
Gin
Little Gin
Disappearing
20 km
Contours in meters
50'
40'
23°30'
20'
10'
166°00'W
30°
25°
20°
Midway I.
Pearl & Hermes Reef
Laysan I.
Lisianski I.
Raita Bank
Gardner Pinnacles
Maro Reef
Brooks Banks
French Frigate Shoals
Necker I.
Nihoa
Kauai
Niihau
Kaula
Oahu
Molokai
Maui
Lanai
Hawaii
NORTHWESTERN HAWAIIAN ISLANDS
MAIN HAWAIIAN ISLANDS
PACIFIC OCEAN
180°
175°
170°
165°
160°
155°

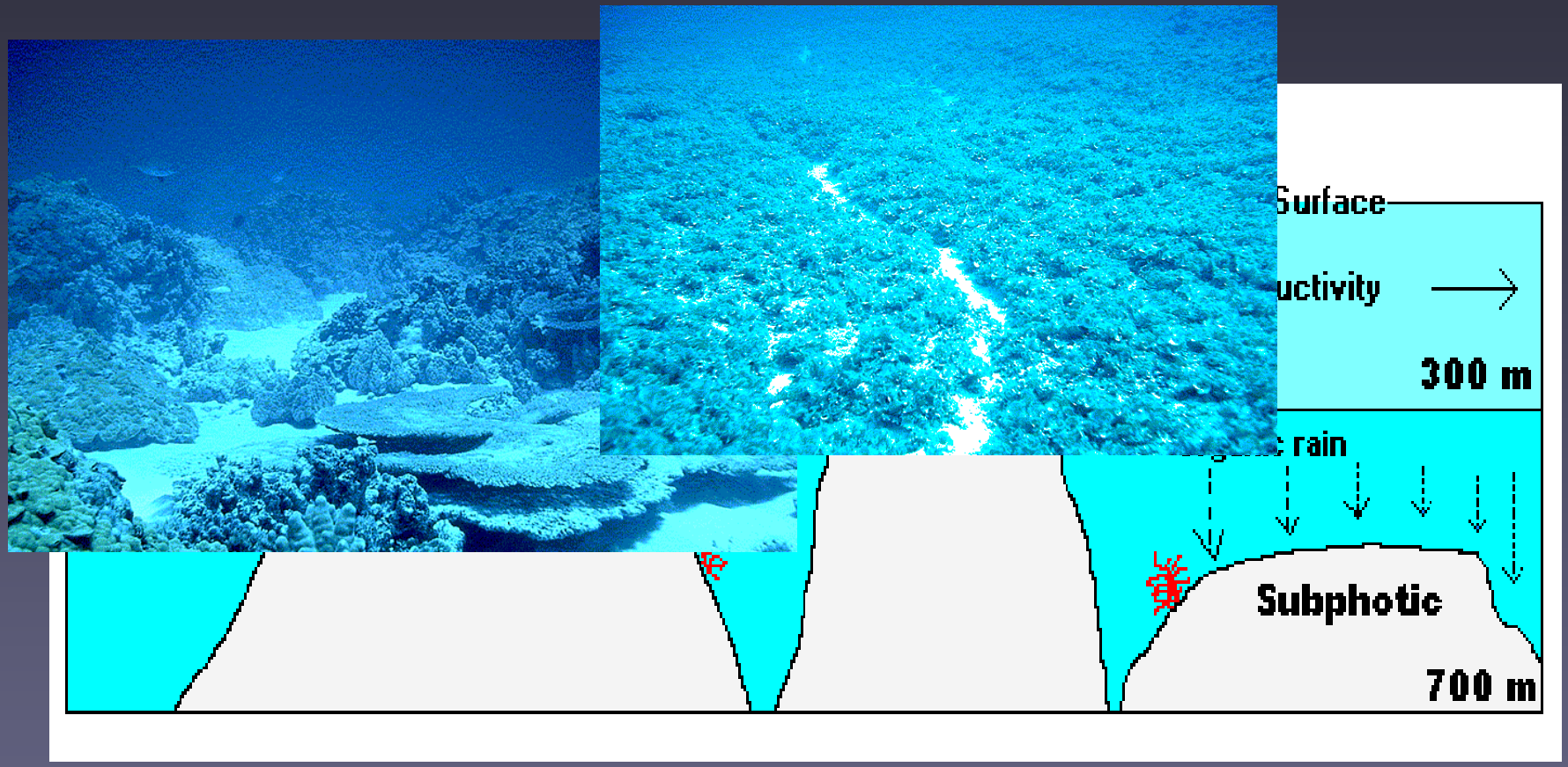
Oceanographic Patterns




Total reef fish density
Young of the Year (FFS & MID)
Midway Atoll (MID)
French Frigate Shoals (FFS)
Mean fish/10m2
25
20
15
10
5
0
1992
1993
1995
1996
1997
1998
Year



Subphotic realm as an alternative to shallow regional biomass surveys

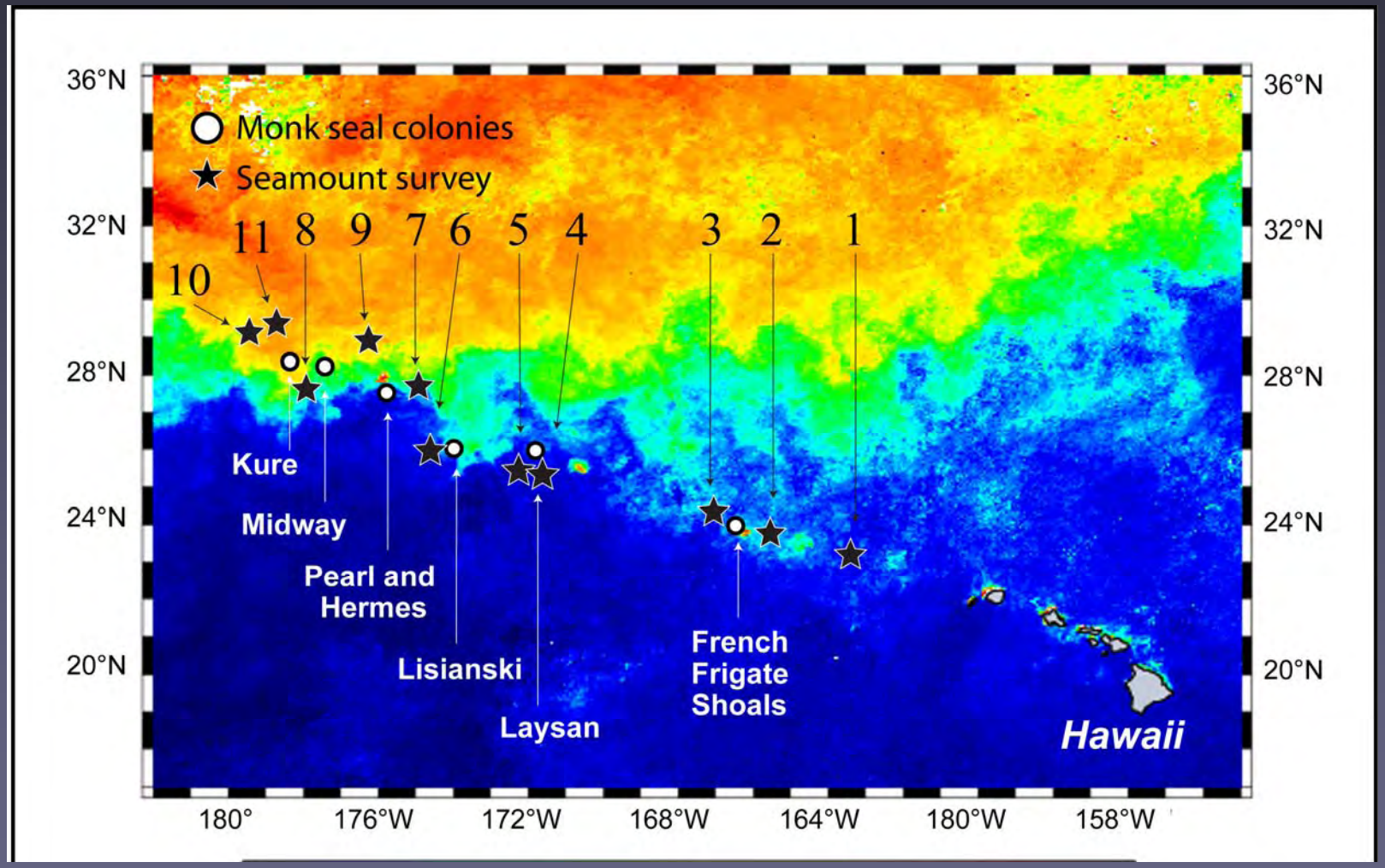


Feeding on seamounts

500 meters

Video courtesy of Amy Baco

Project survey sites



Hawai`i Undersea Research Laboratory: University of Hawai`i & NOAA's Undersea Research Program

2 *Pisces* submersibles: 2000 meters.

2 observers, 1 pilot.

Can deploy both on the same day.

Some stations sample multiple years to look for temporal effects – none detected

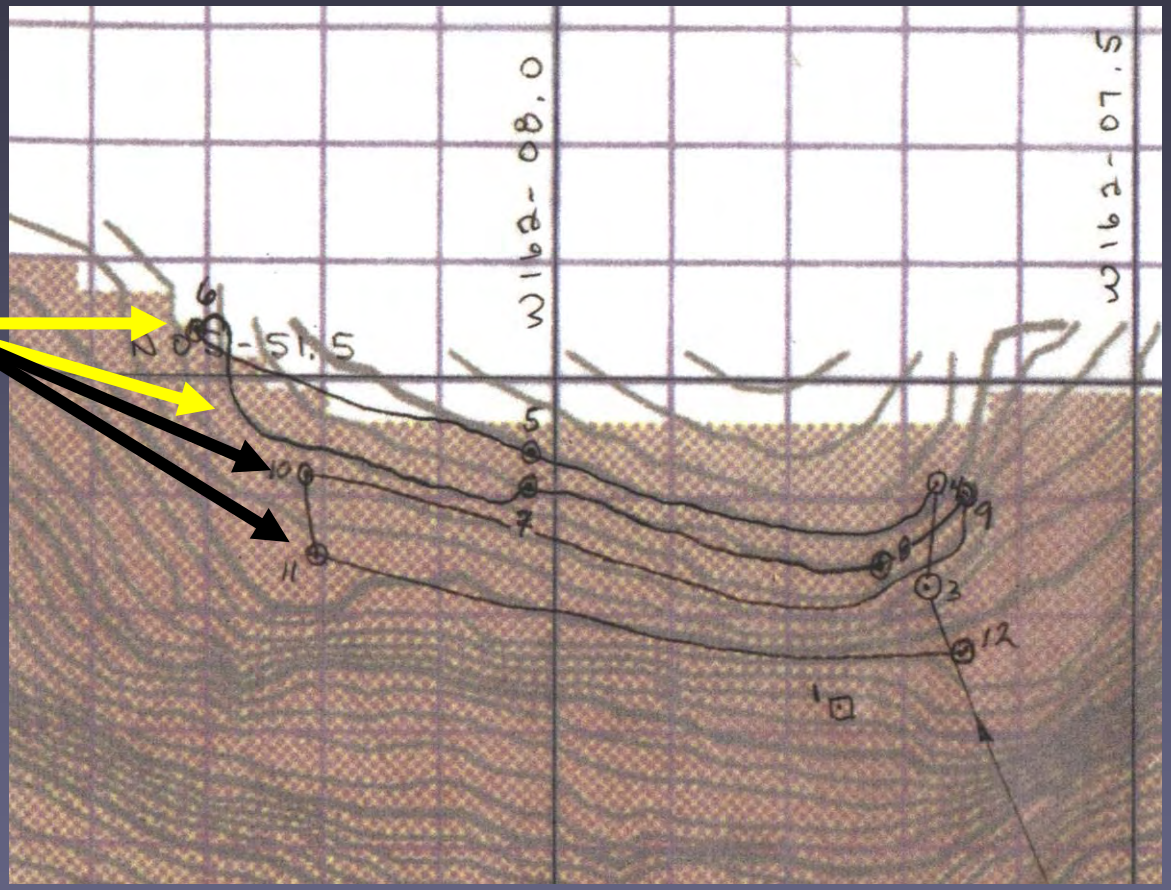
Quantitative transects.

Four 30-minute transects: 500, 450, 400, and 350 m.

Observers counted animals;

estimated sizes.

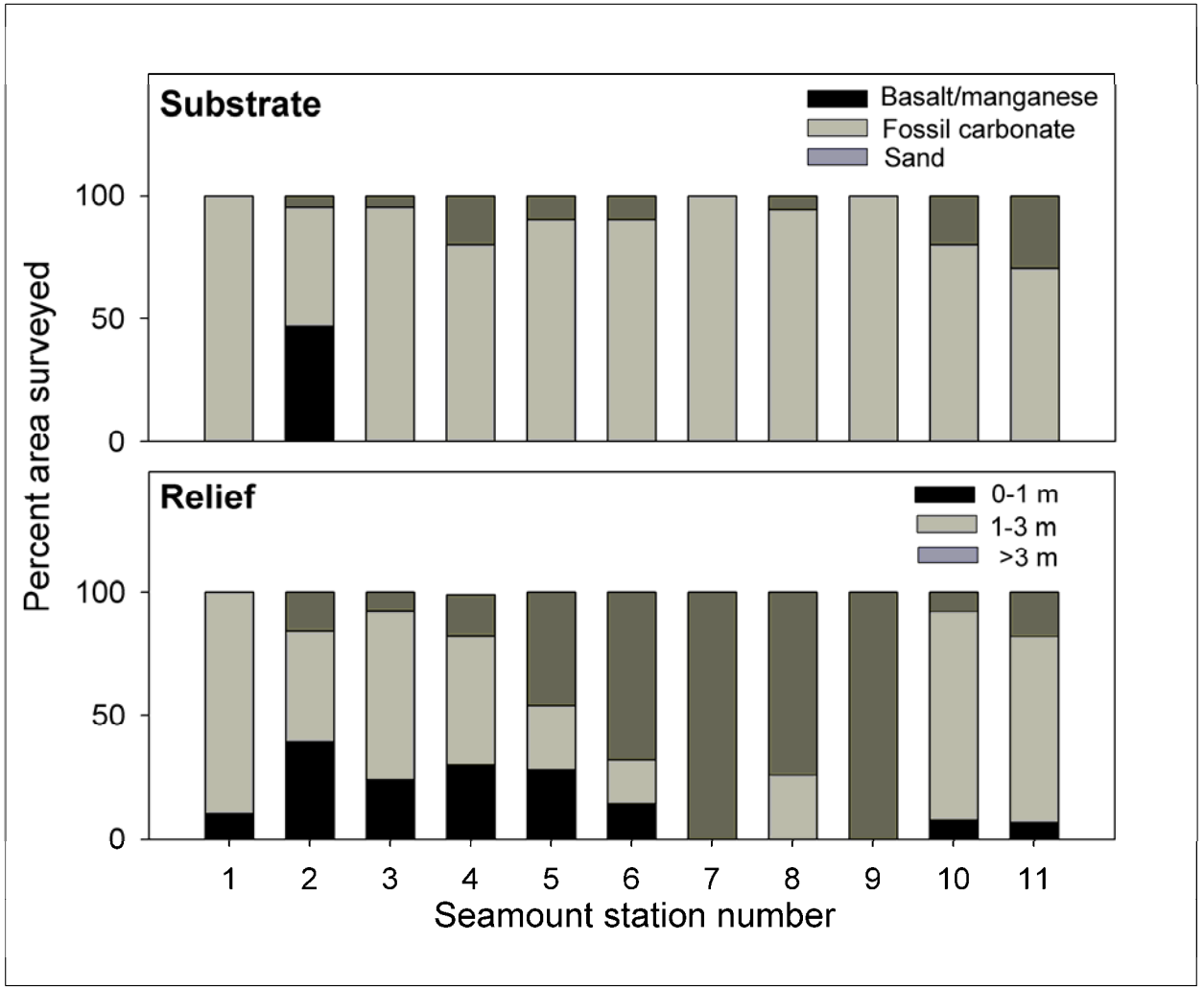
5 min replicates



Habitat observations

- **Substrate**
- **Relief**

Habitat


Substrate
Basalt/manganese
Fossil carbonate
Sand
100
50
0
Relief
0-1 m
1-3 m
>3 m
100
50
0
Percent area surveyed
1
2
3
4
5
6
7
8
9
10
11
Seamount station number

Subphotic fish community

- Bottom associated
- Low density, high variability
- Slow growing
- Not subject to fisheries

Examples of the fish



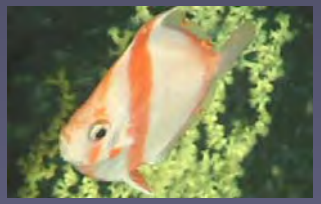










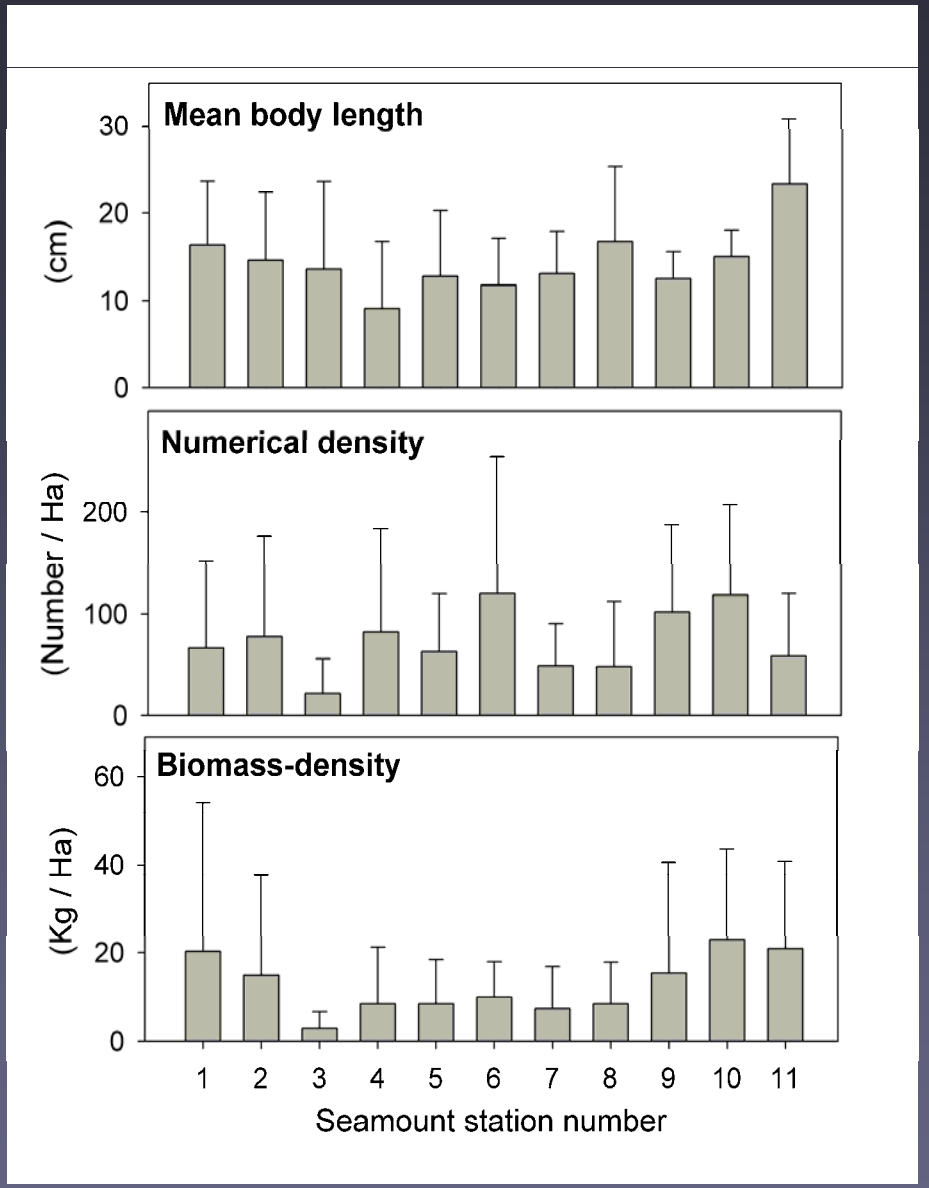







42 Taxa 18000 fish

- 5% of the fish assemblage found shallower
- Sig diff in
  - Body size
  - Density
  - Biomass
- Post hoc test show no regional groupings



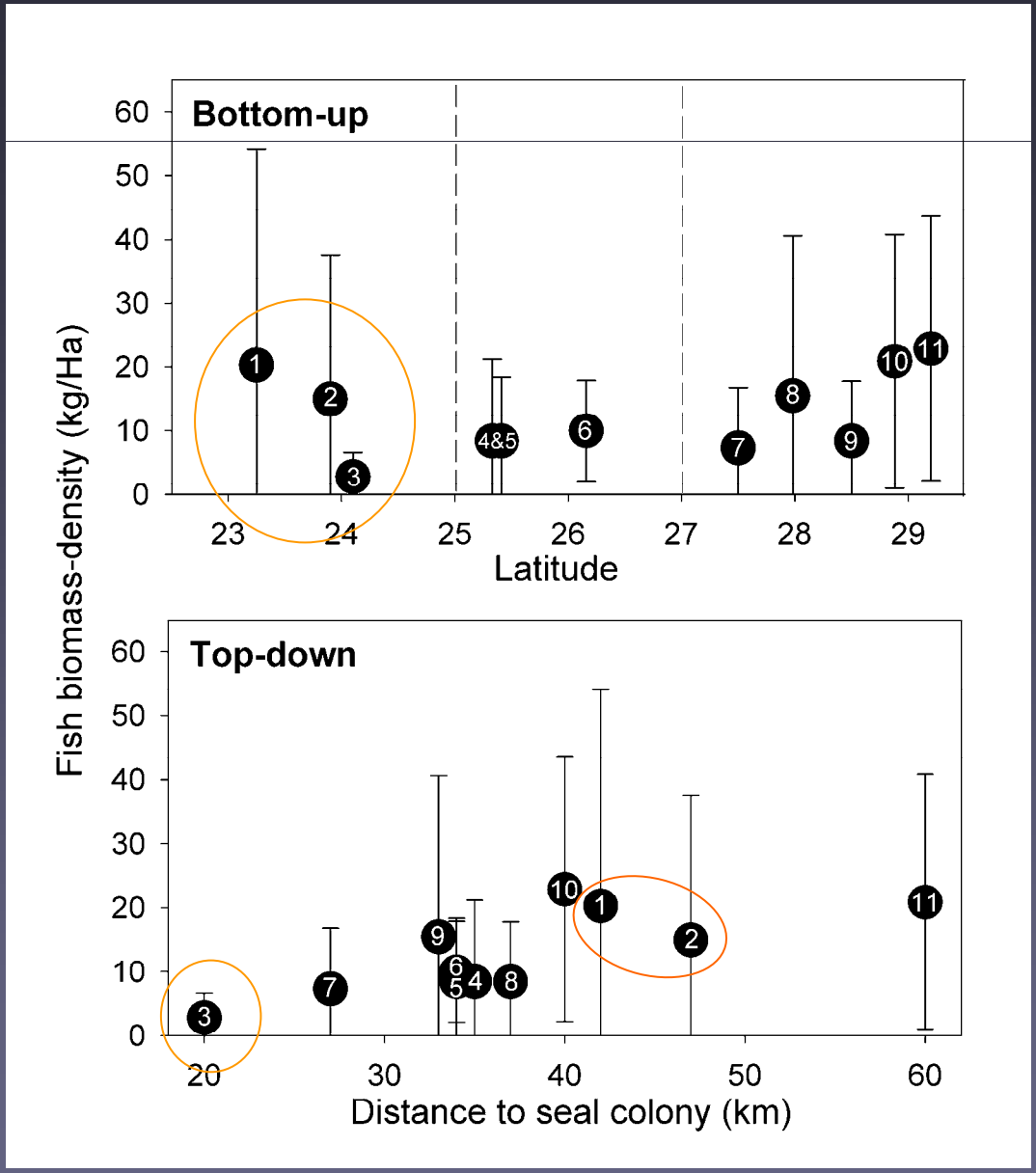
Analysis

- **Stepwise multiple regression**
  - **Substrate**
  - **Relief**
  - **Latitude (proxy for productivity)**
  - **Summit depth**
  - **Number of seals at colony**
  - **Proximity to seal colony**

r^2 =0.31 P<0.001

r^2 =0.38 P<0.001 Re-sampling

Seamounts in FFS region



Summary

- **Patterns in the seals subphotic prey base better explained by the top-down hypothesis despite regional differences in productivity.**
- **Seals are the only known predator that commutes from the atolls.**
- **Consistent with a population close to carrying capacity.**

Other evidence of carrying capacity at FFS

- Satellite tag data
- CRITTERCAM data
- ECOPATH modeling