

A large school of yellow tang fish swimming in clear blue water. The fish are densely packed, with many individuals visible in the foreground and background. They have a yellowish-brown body with a lighter stripe along the side and a yellow patch near the eye.

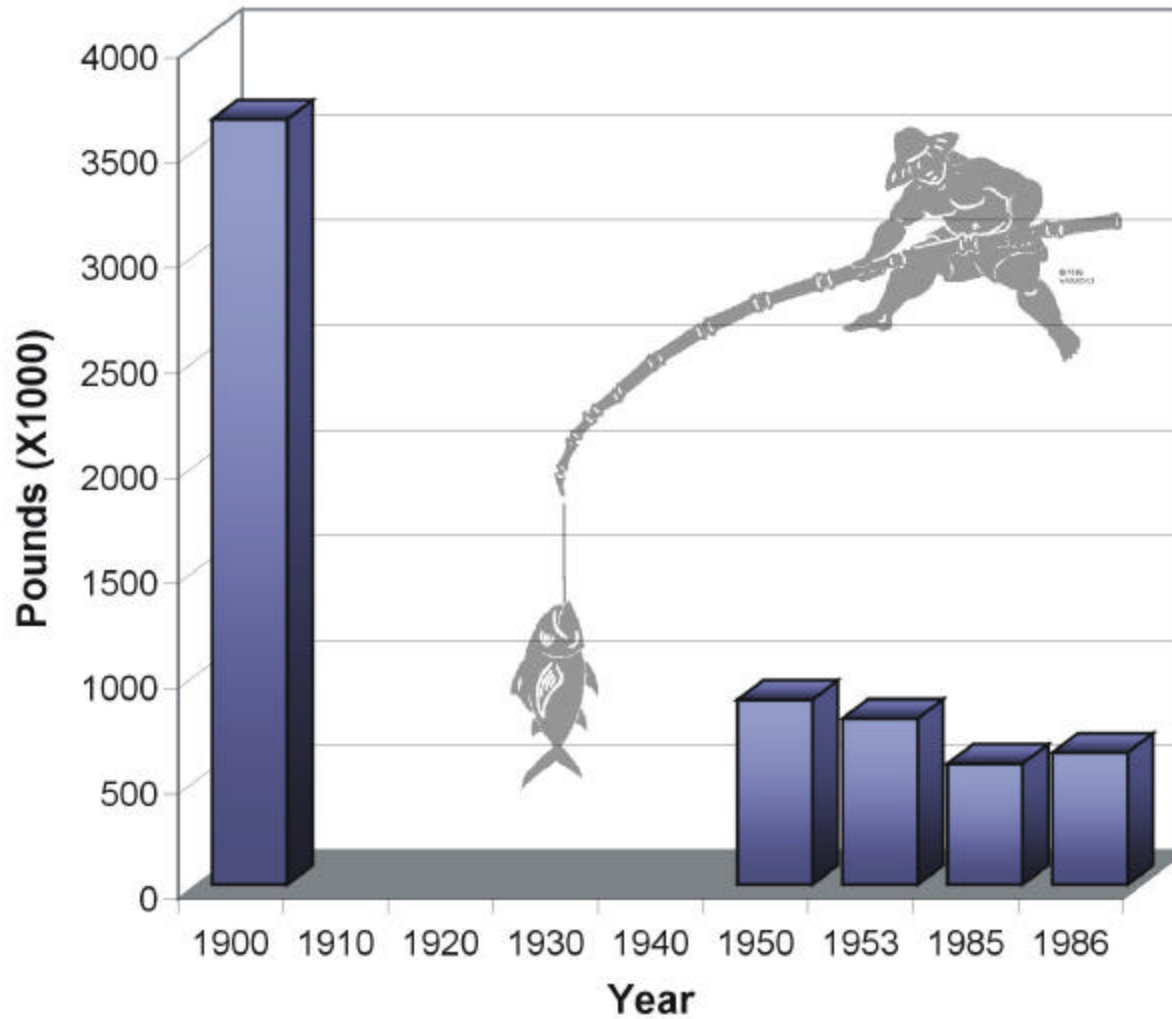
# **FISH HABITAT UTILIZATION PATTERNS AND EVALUATION OF THE EFFICACY OF MARINE PROTECTED AREAS IN HAWAII**

**Alan Friedlander**

**NOAA/NOS/NCCOS/CCMA  
Biogeography Program**

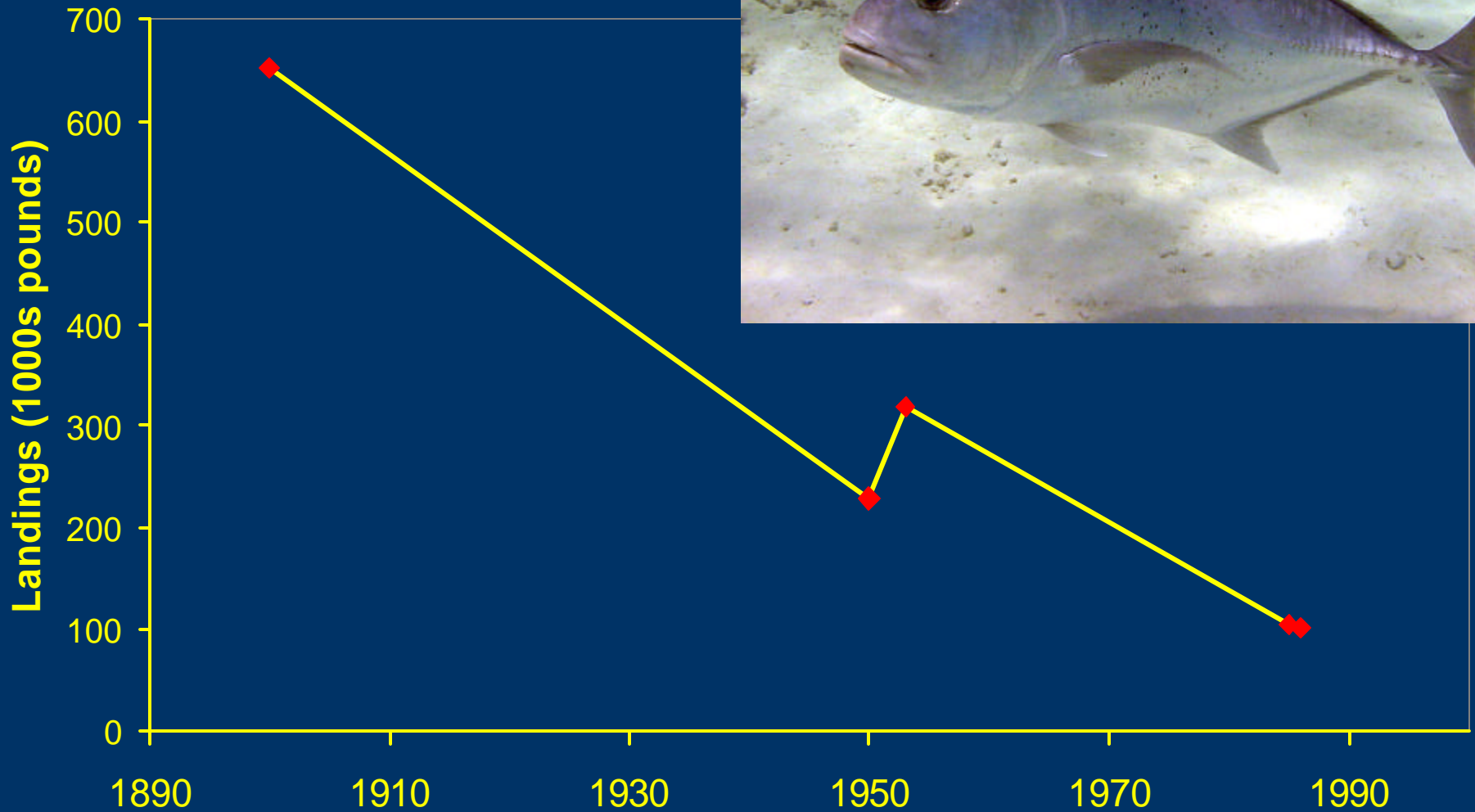


# Hawai'i Commercial Catch of Coastal Species 1900-1986

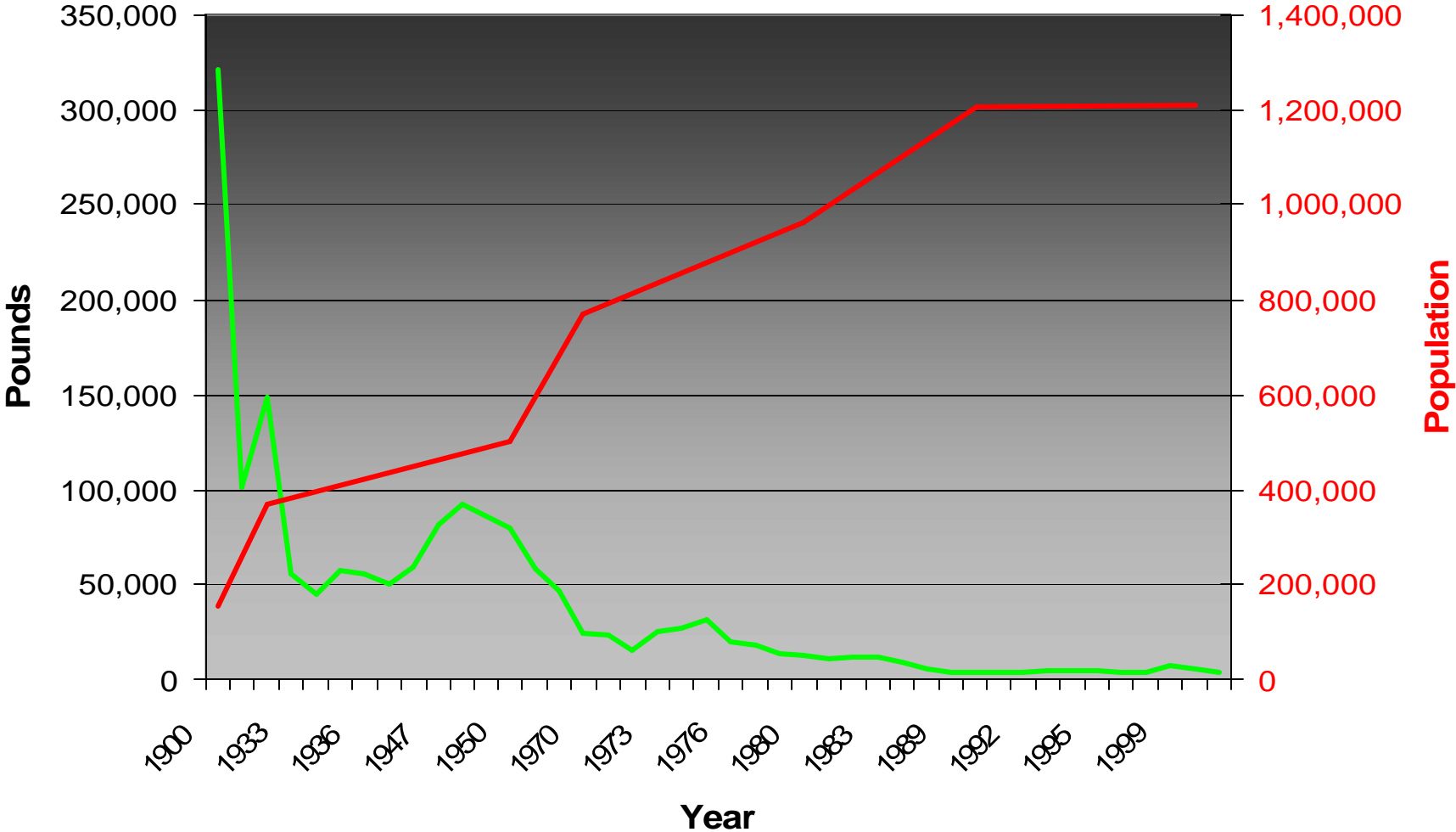


(Shomura, 1987)

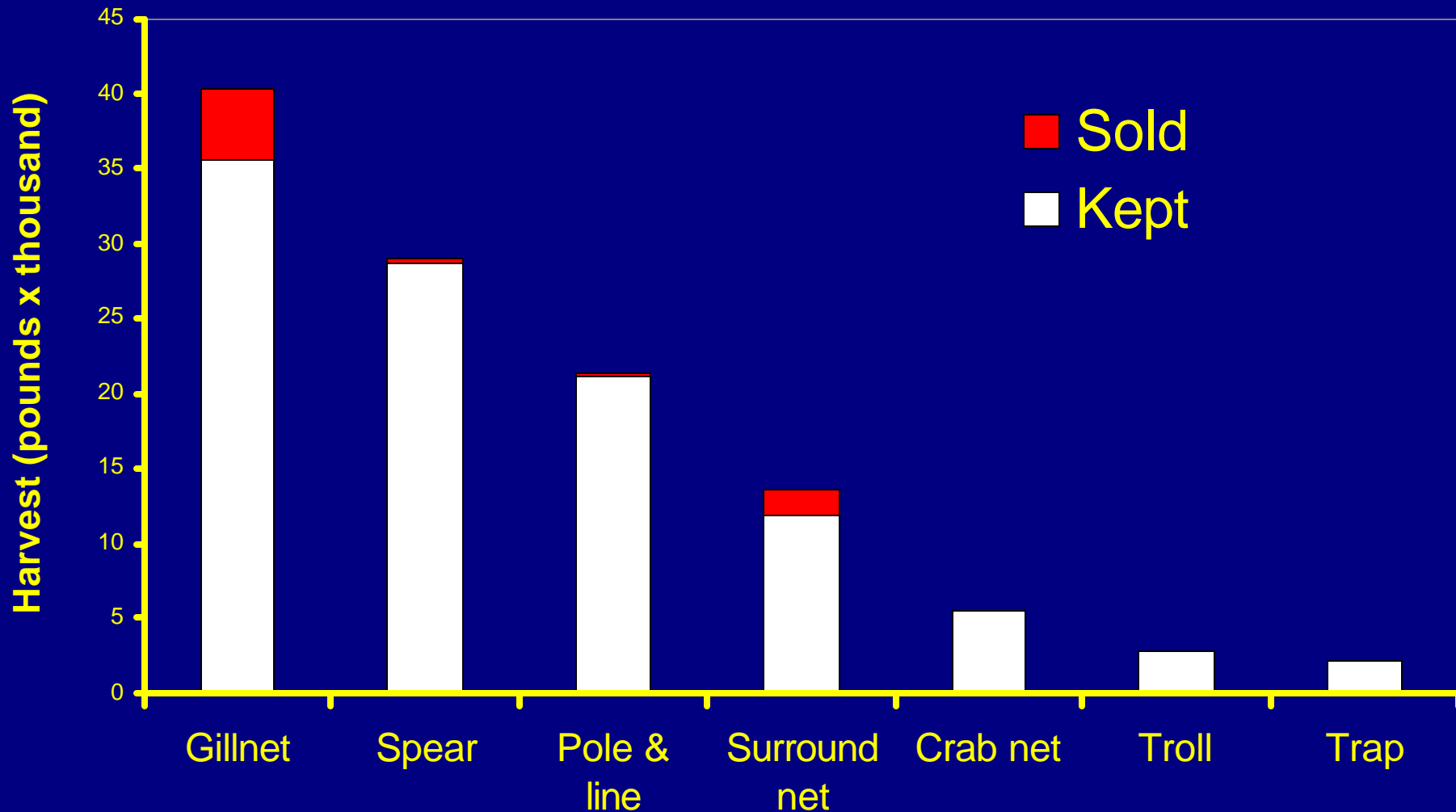
# Commercial landings for coastal jacks in Hawaii



# Commercial Oï`o 1900-2001



## Annual harvest for major fishing methods in Kaneohe Bay, Oahu 1991-92



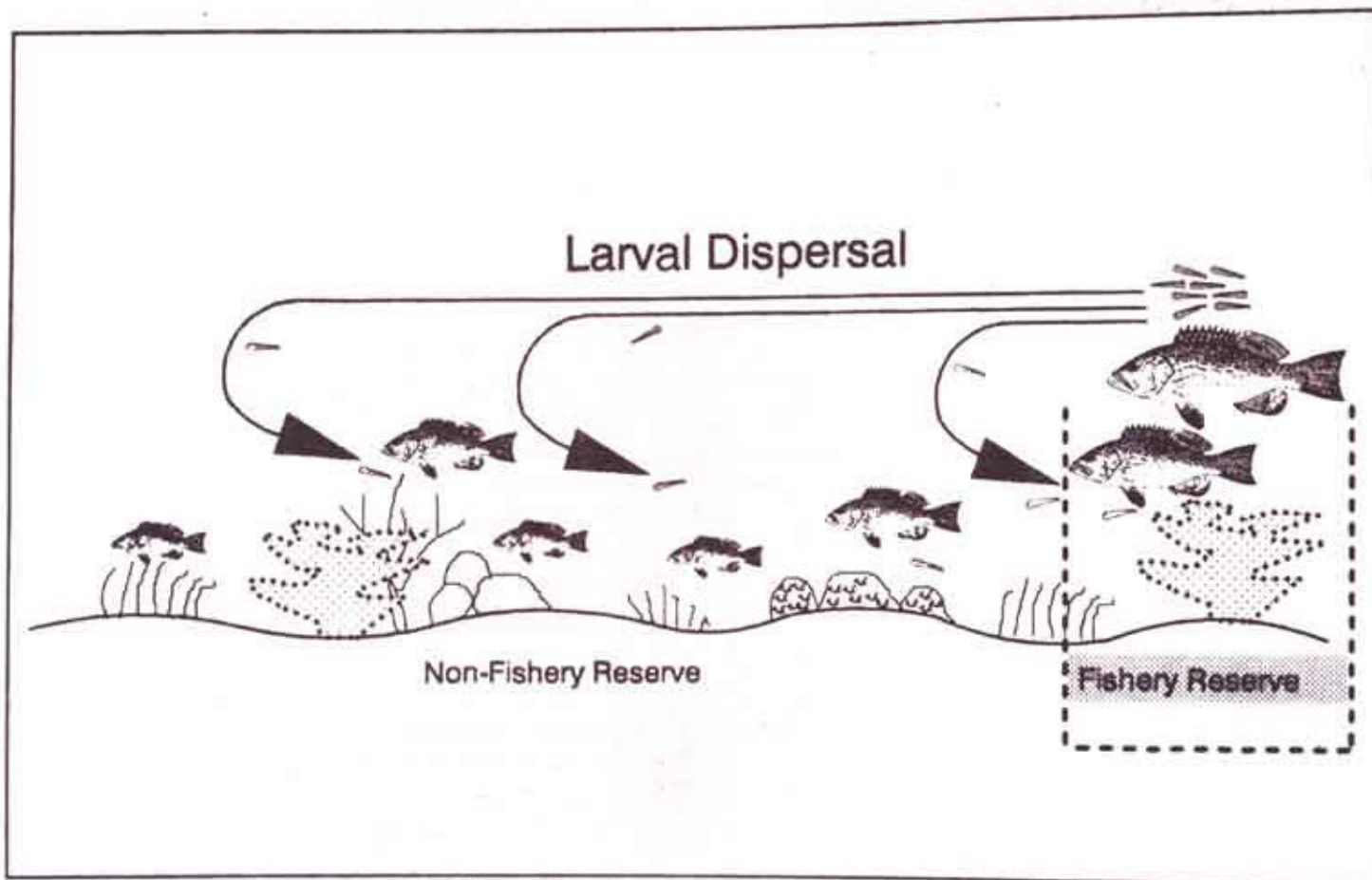
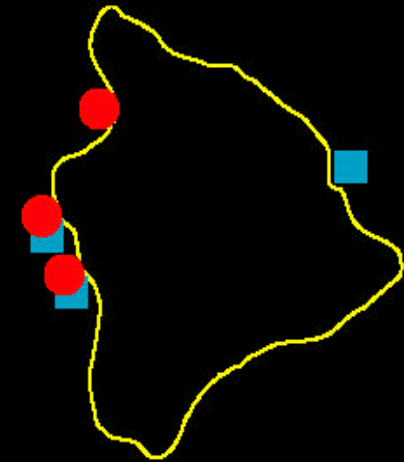
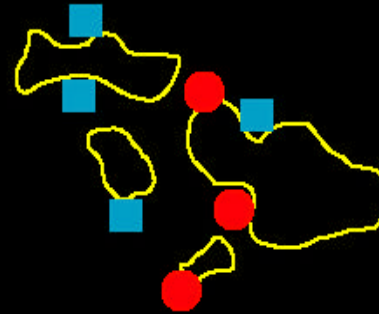
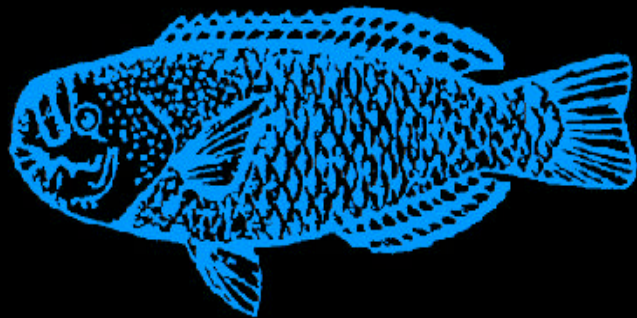


Figure 11. Many larvae generated by adults in marine fishery reserves should disperse and recruit to harvested areas.

# Main Hawaiian Islands

## Regulated Fishing Areas

- No fishing area
- Fishing activities restricted





# NOAA Molokai Test Area



Draw Boundary

Delineate Habitats

Generate Random  
Points

Map Accuracy Analysis

Rapid Assessment Transects- Fish/benthic Community

Identify Essential Fish Habitat

Evaluation of Marine Protected Areas

# Detailed Habitat Classes

Generated by Photointerpretation of Hyperspectral Imagery

*South Shore Oahu*

Including Waikiki MLCD

500 0 500 1000 Meters



## LEGEND

- Sand
- Mud
- Macroalgae/10%-50%
- Macroalgae/50%-90%
- Encrusting Coralline Algae(10%-50%)
- Spur and Groove Reef
- Patch Reef (Individual)
- Colonized Pavement
- Colonized pavement with Sand/Surge Channels
- Uncolonized Pavement
- Reef Rubble
- Land
- Hardened Shoreline
- Other Man Made Structures
- Unknown

# Major Habitat Classes

Derived from Aggregating Detailed Habitat Classes

*South Shore Oahu*






Including Waikiki MLCD

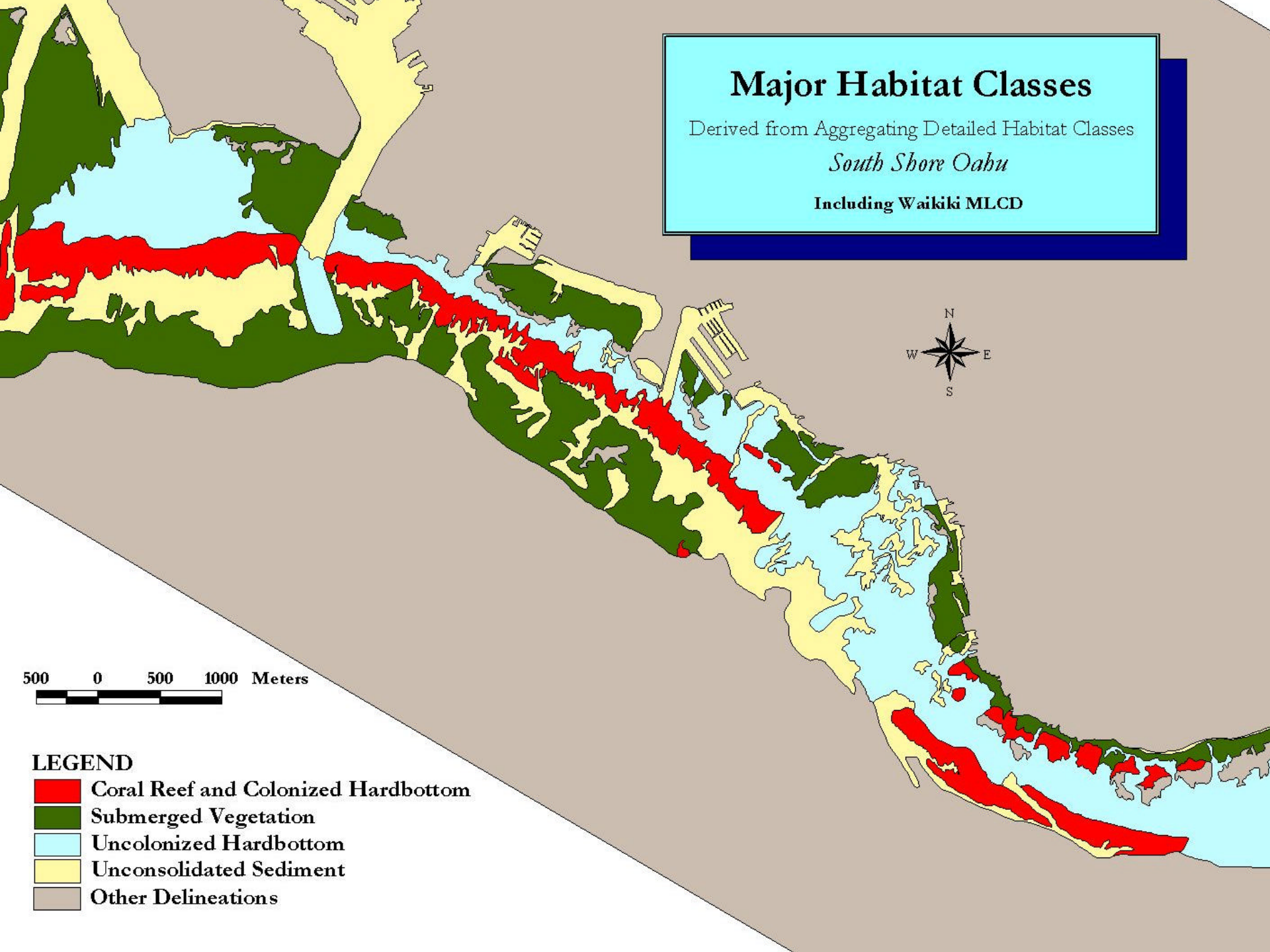


500 0 500 1000 Meters

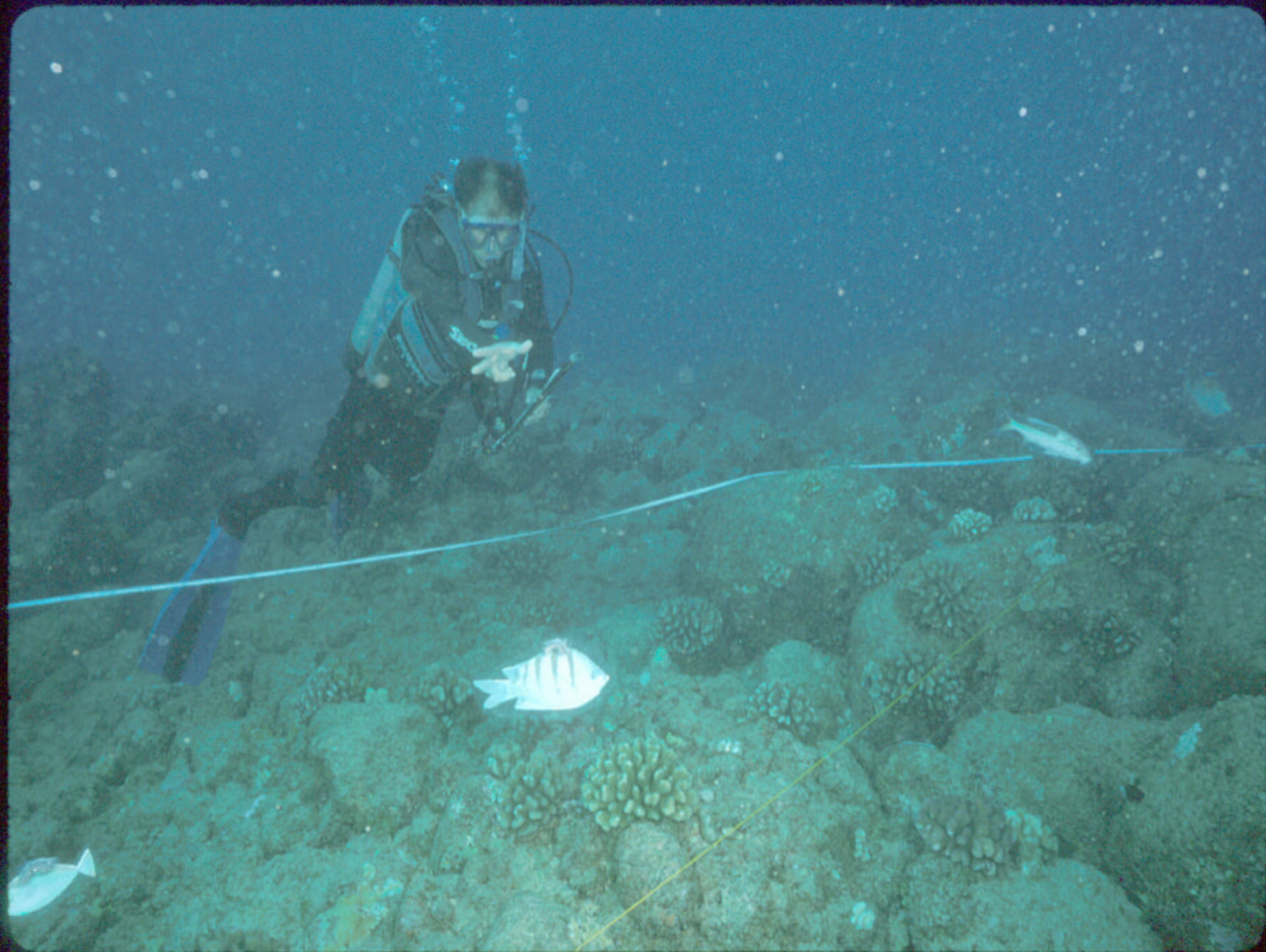


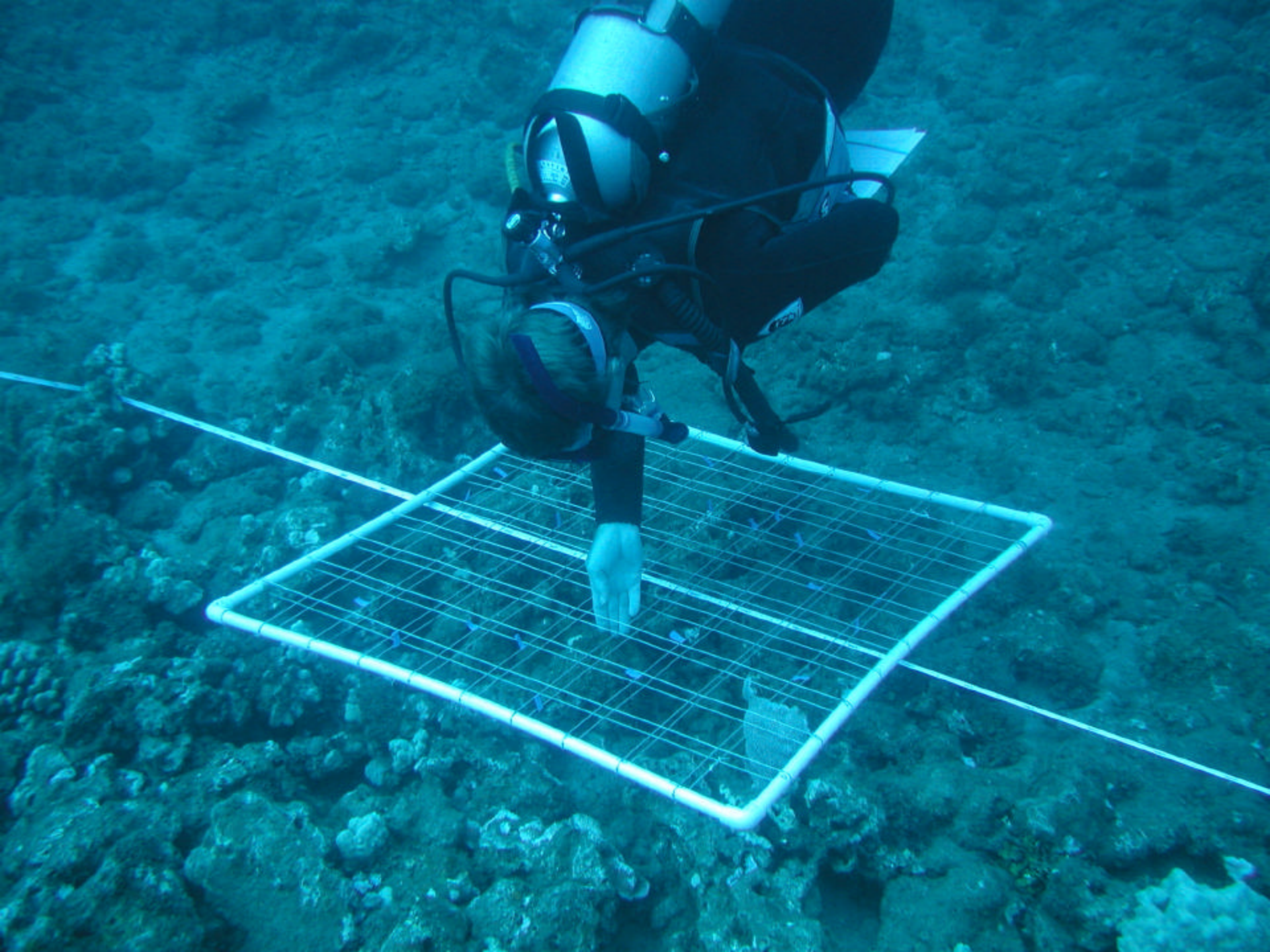
## LEGEND

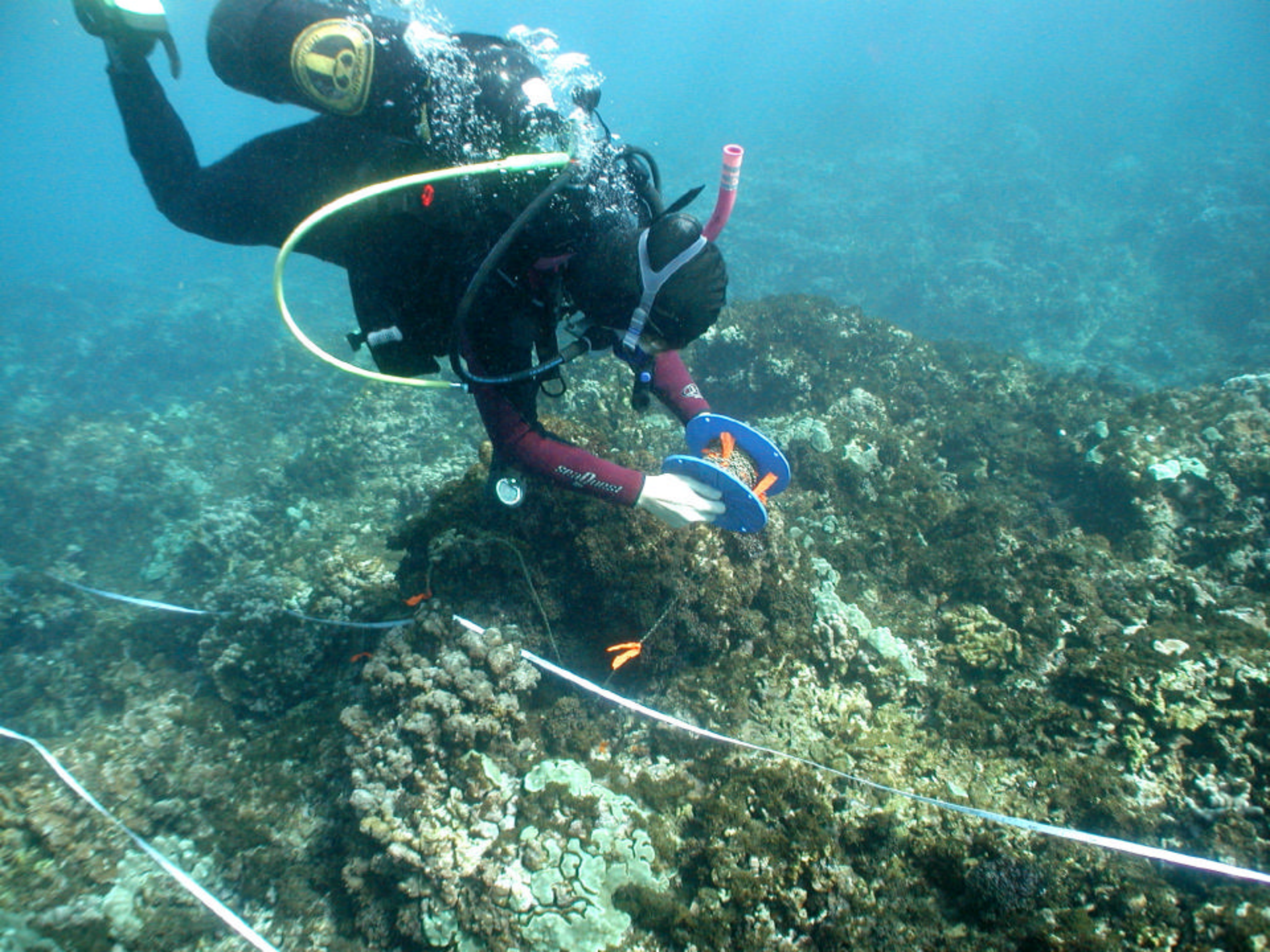
-  Coral Reef and Colonized Hardbottom
-  Submerged Vegetation
-  Uncolonized Hardbottom
-  Unconsolidated Sediment
-  Other Delineations



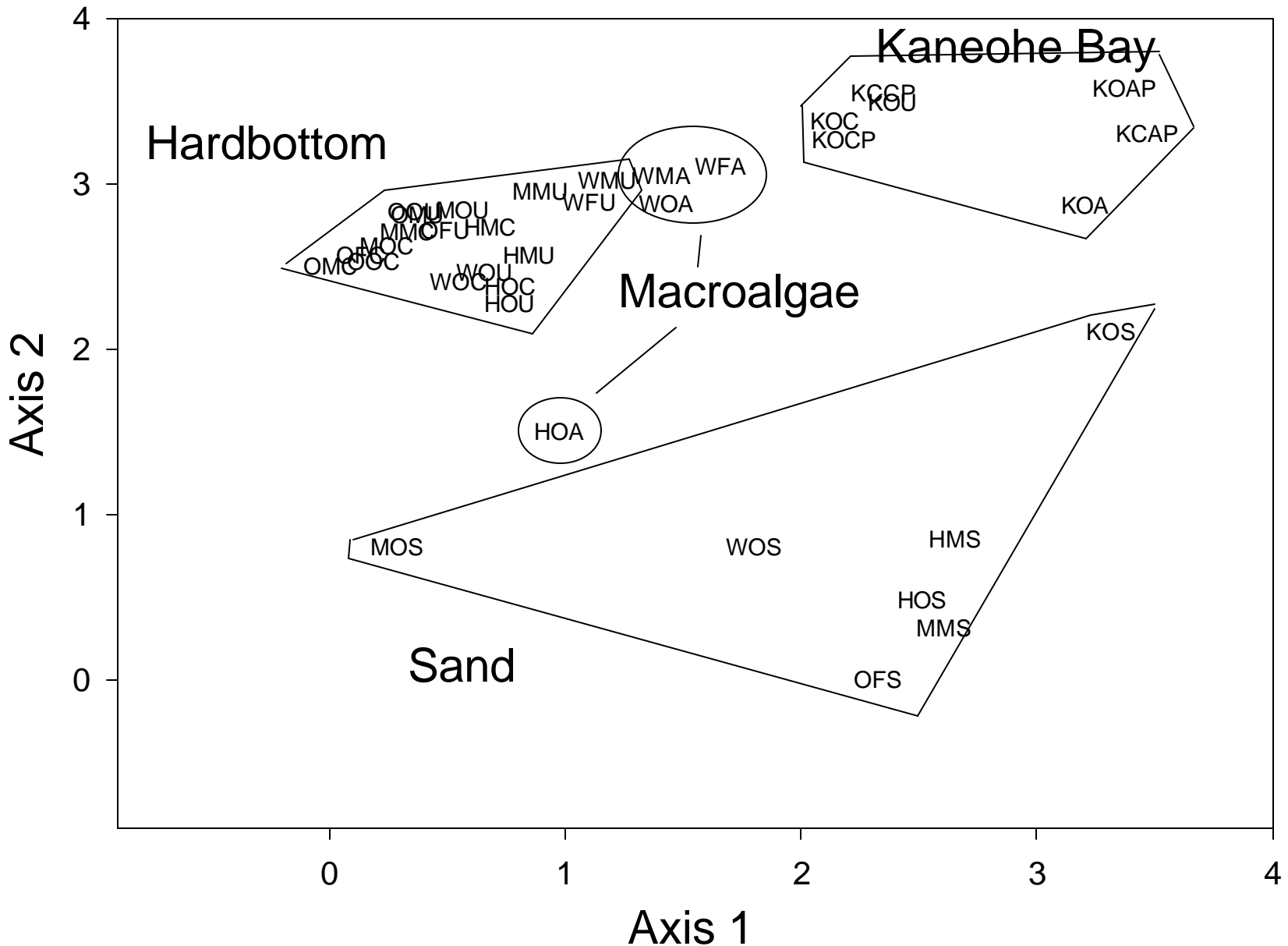






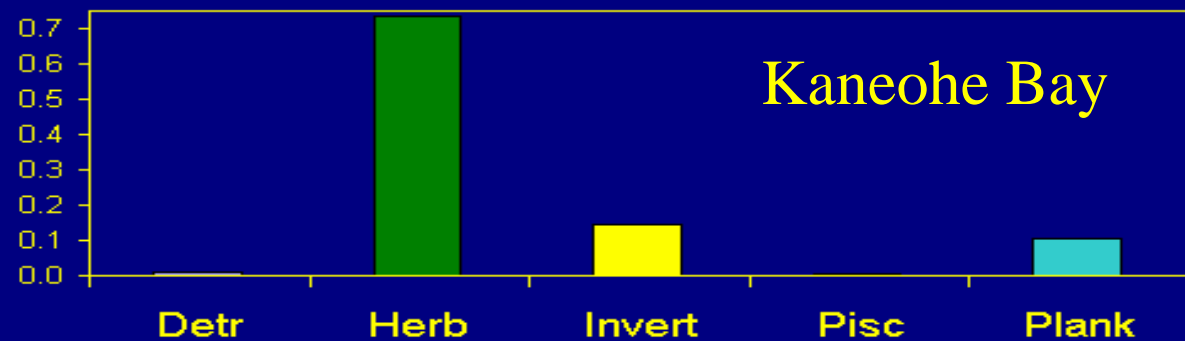
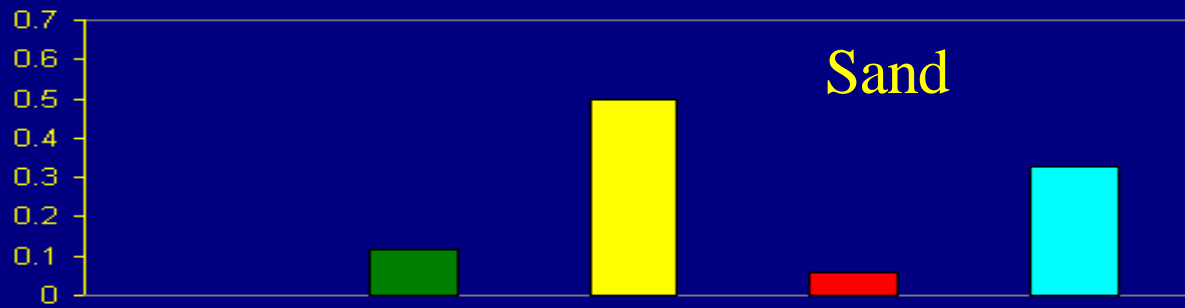
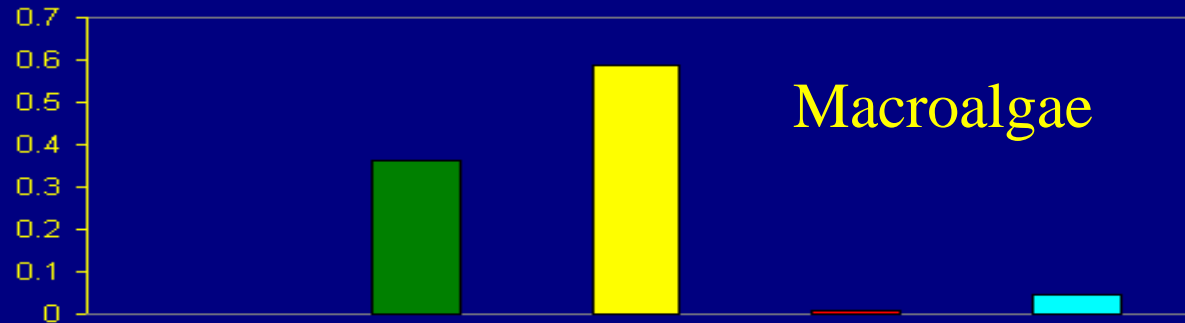
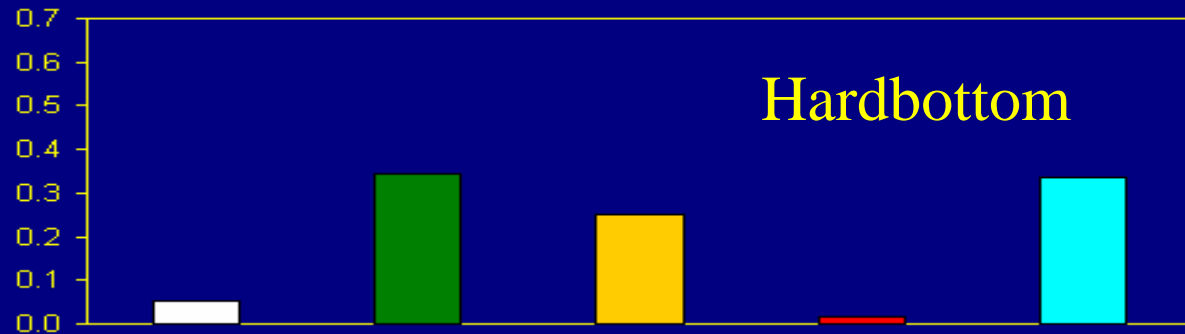


# Fish Habitat Sampling Locations in Ordination Space based on Number of Individuals (N = 36, n = 449)

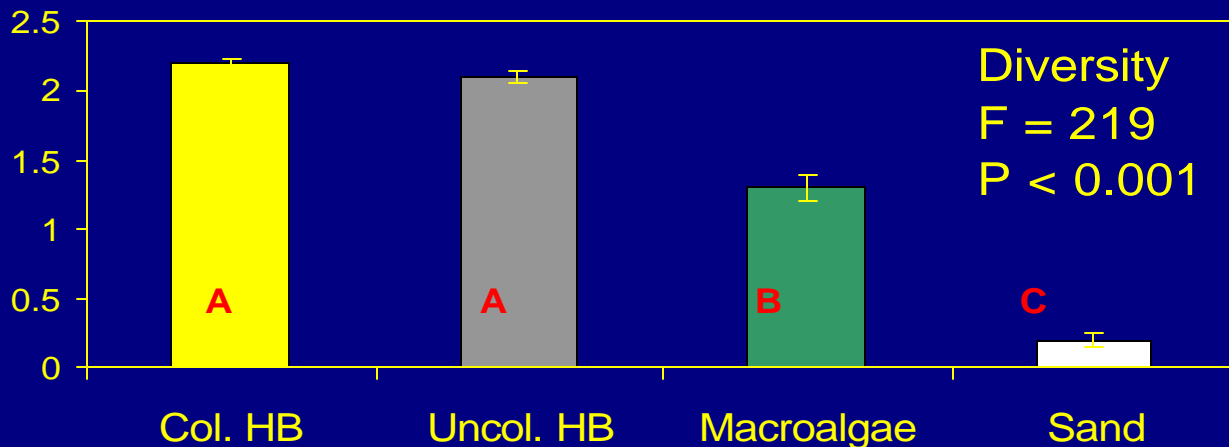
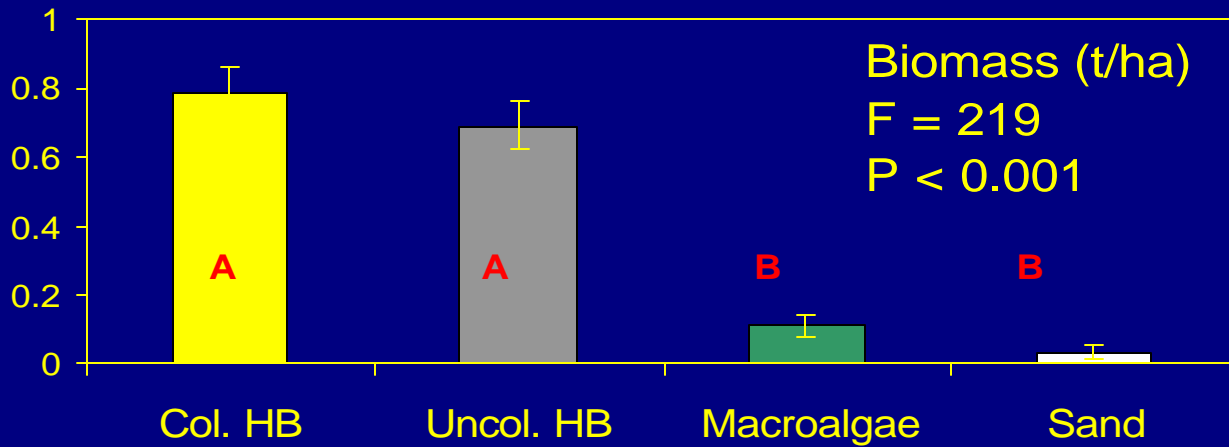
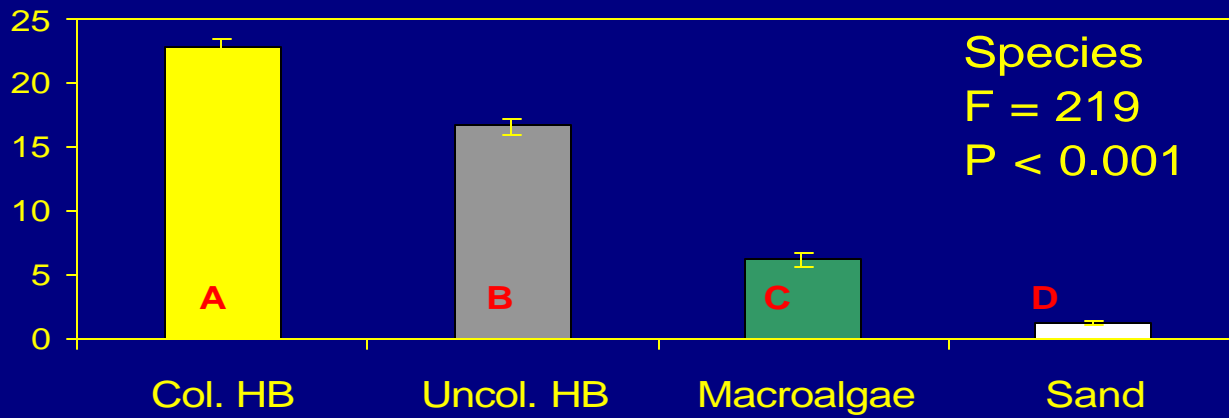




# Trophic Comparisons among Major Habitat Types in Hawaii



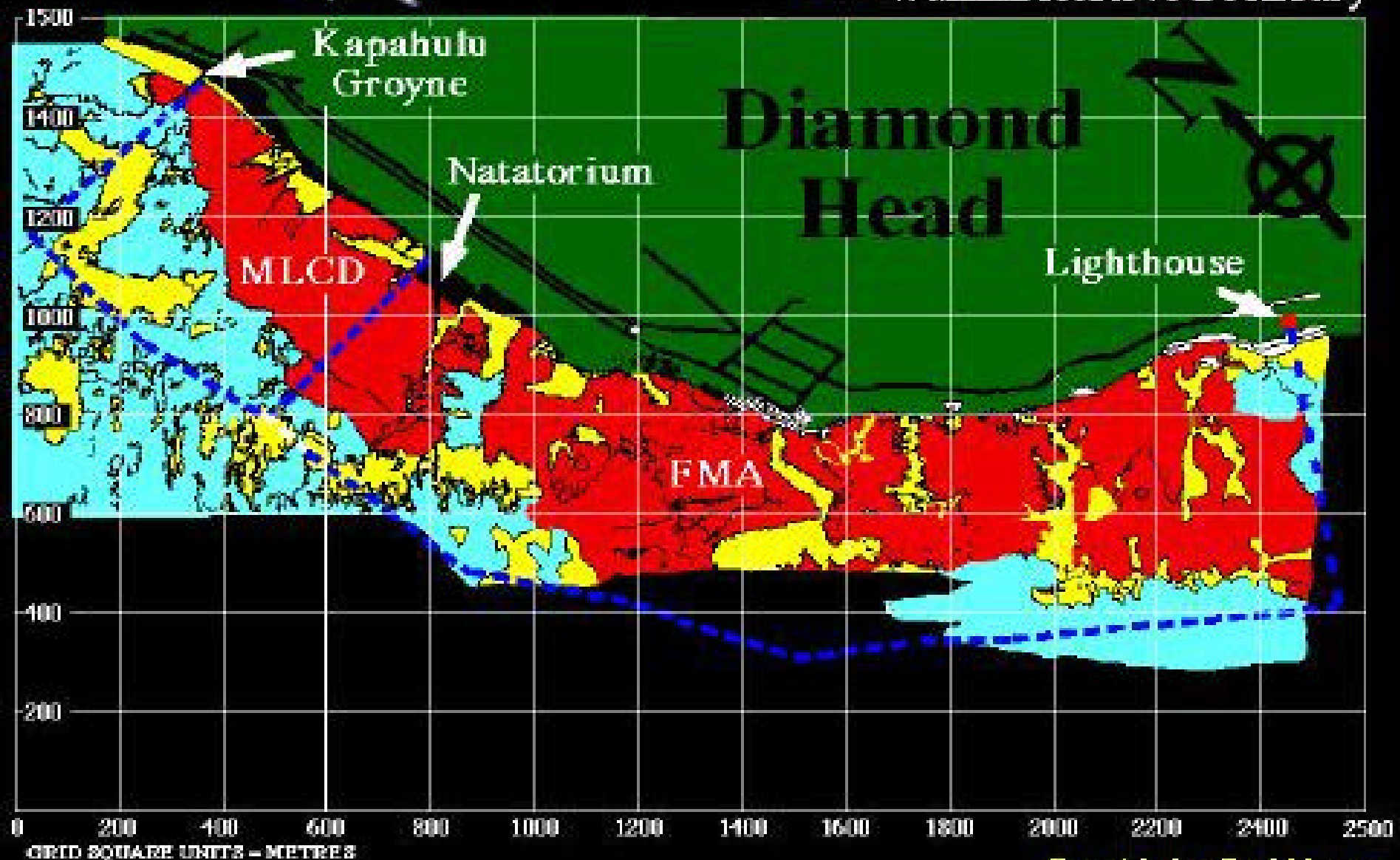
# Fish Assemblage Characteristics among Major Habitat Types n = 345



# Waikiki Marine Reserve



-  Consolidated Reef
-  Spur and Groove
-  Sand
-  Waikiki Reserve Boundary

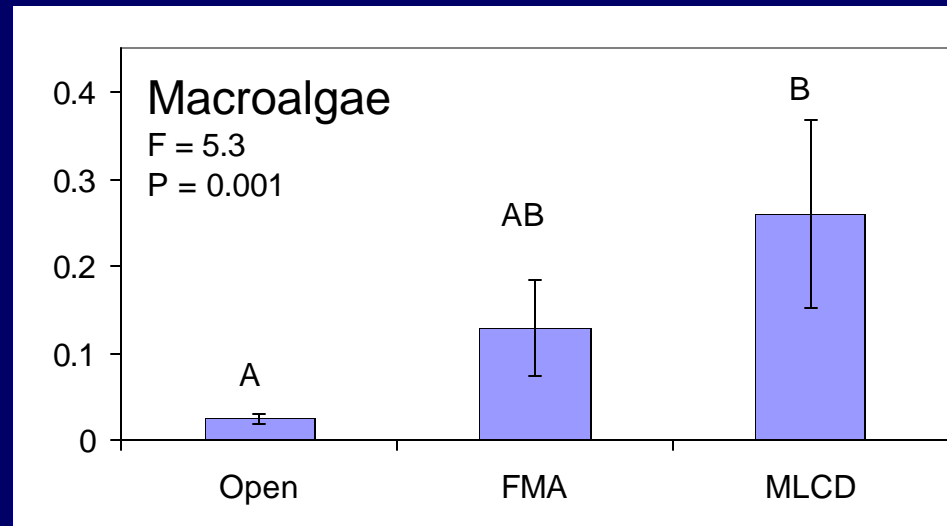


Graphic by Carl Meyer

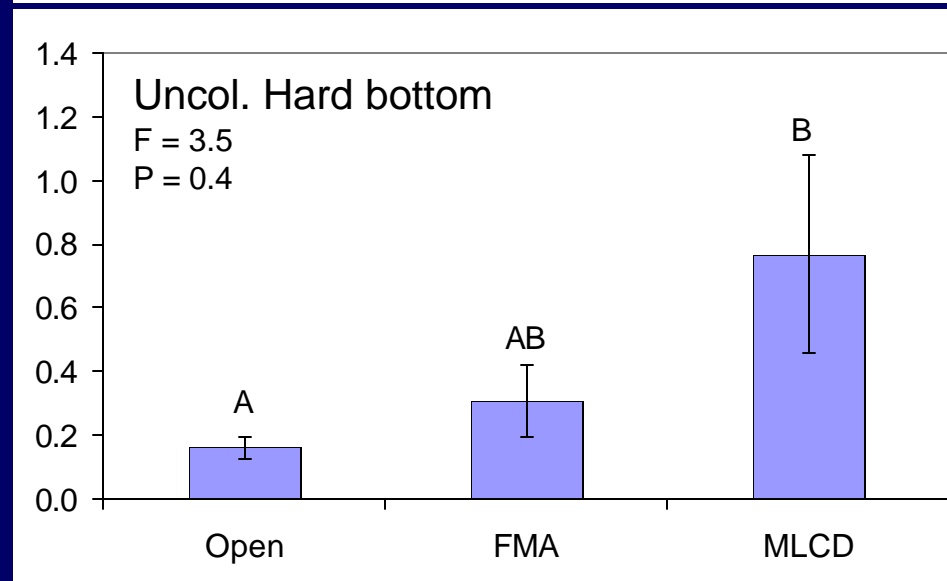


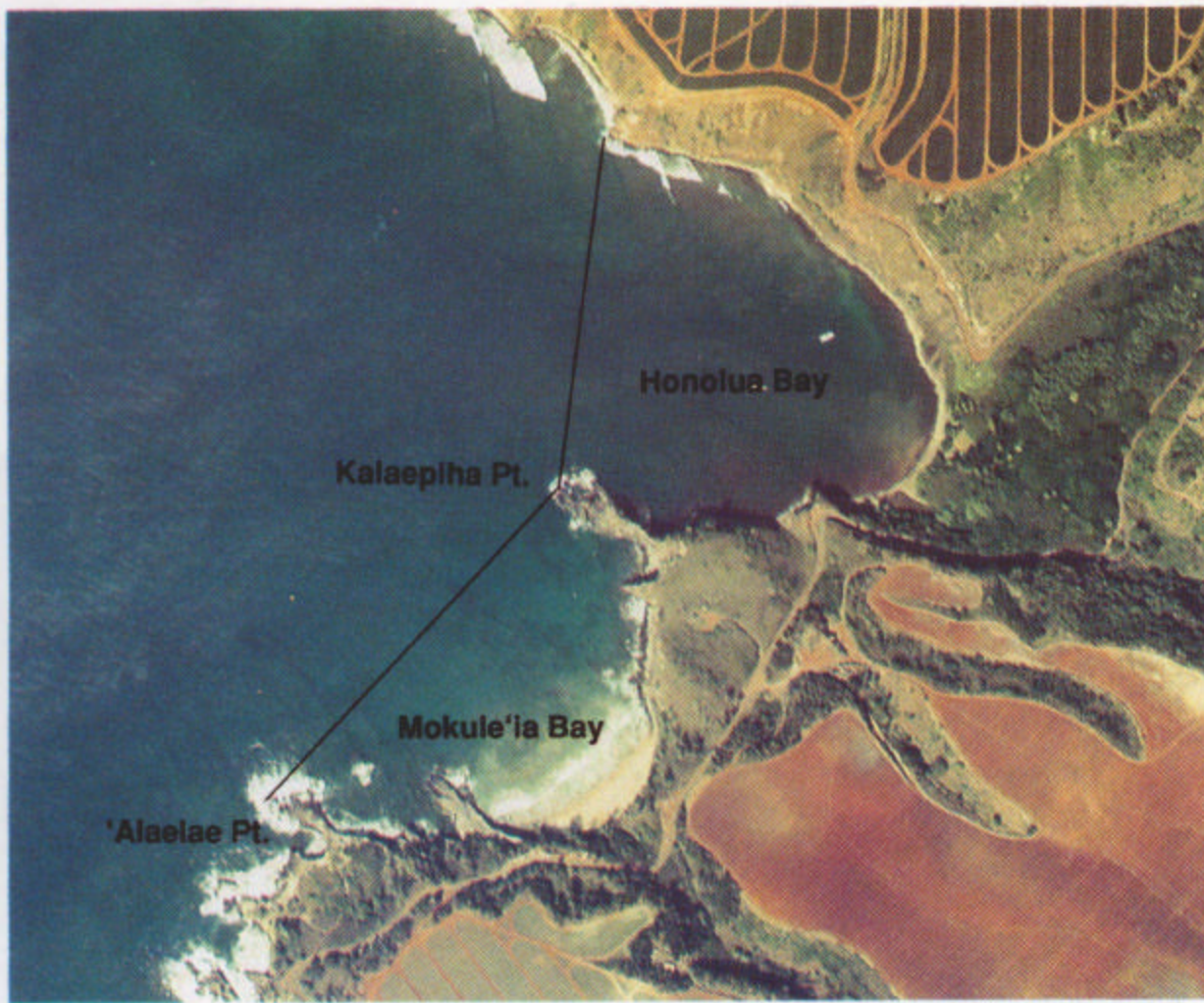
Photo:Richard Sullivan

# Fish biomass in Waikiki study area under various management regimes



Biomass (t/ha)





# HONOLUA - MOKULE'IA BAY

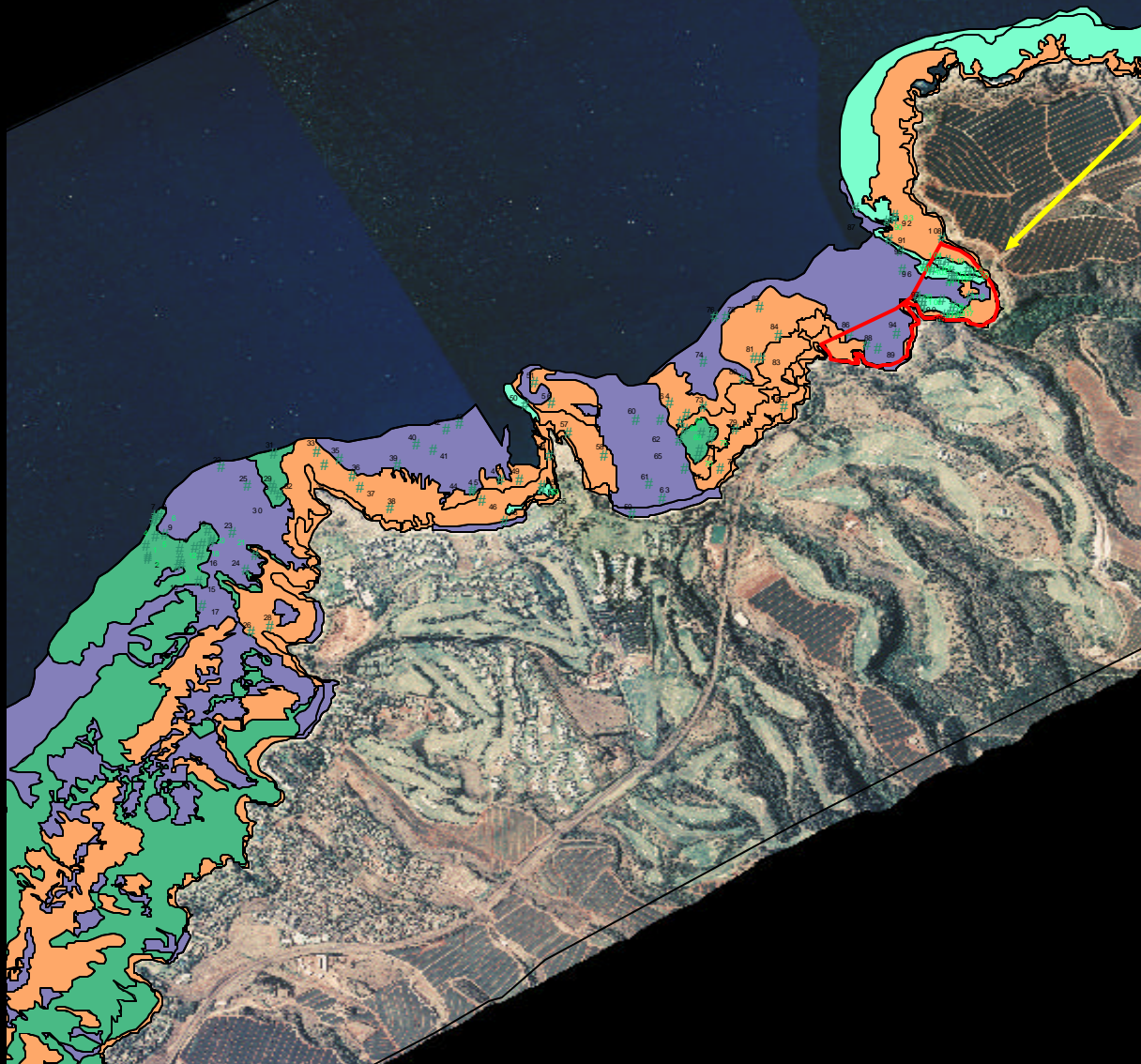
45 acres

Established 1978

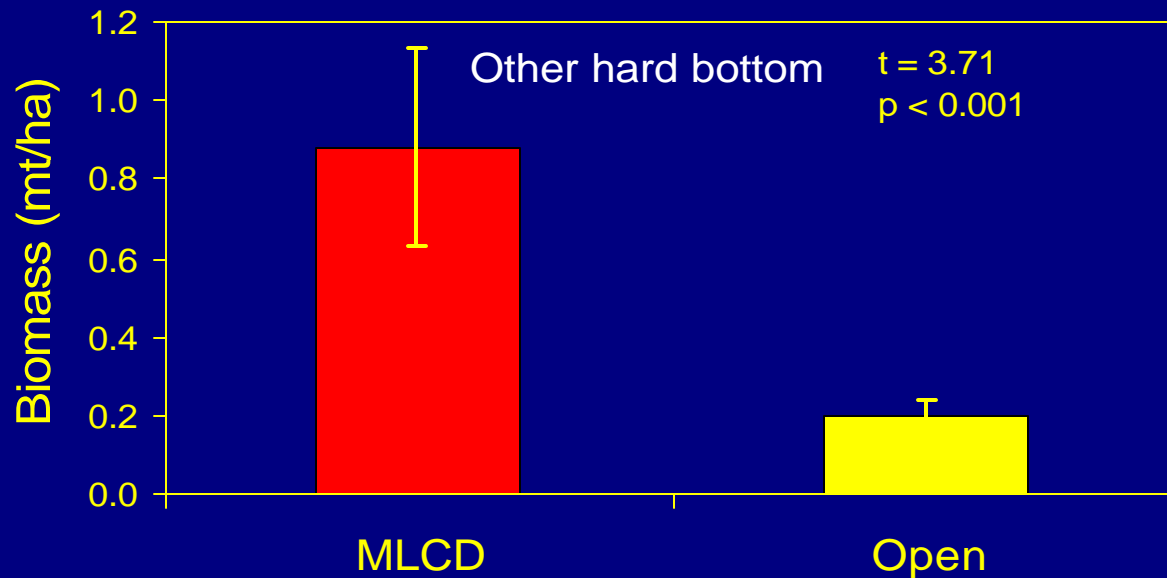
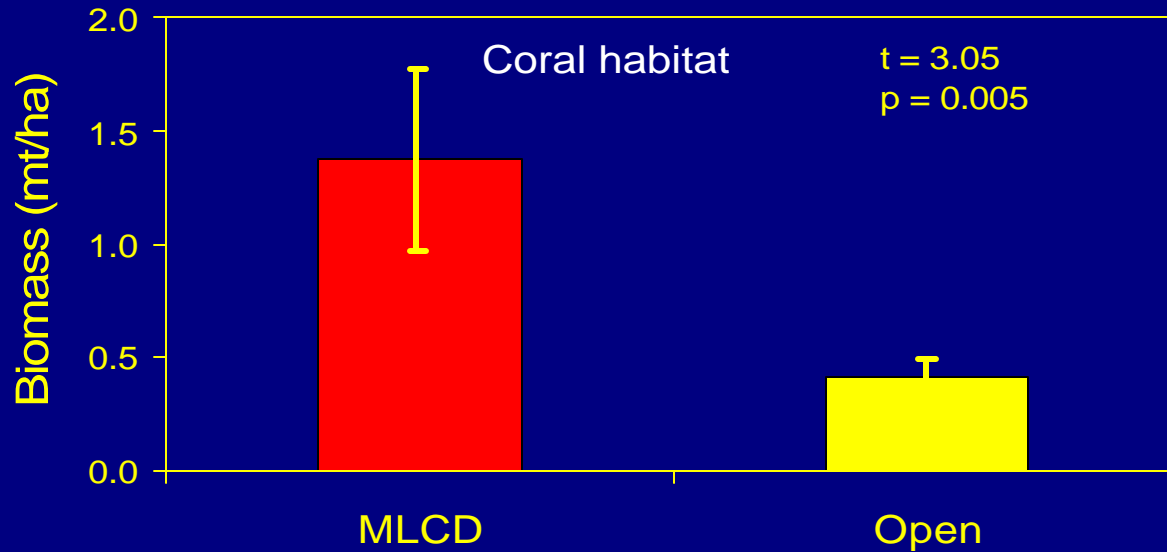


West Maui study area

Honolua/Mokulei  
MLCD



# Comparison of fish biomass between Honolua-Mokule'ia MLCB and areas open to fishing

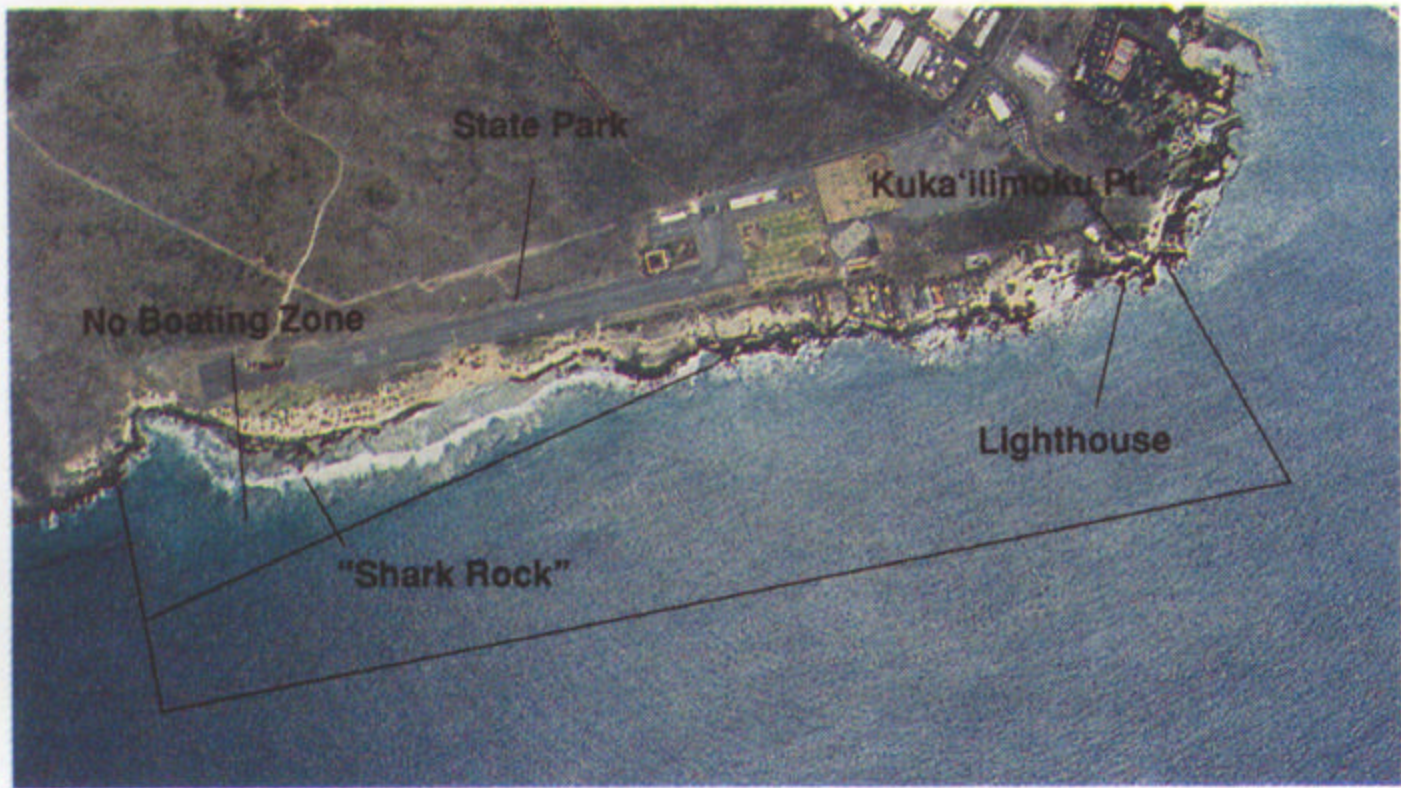




# West Maui study area



Honolua/Mokulei MLCD



# OLD KONA AIRPORT

217 acres

Established 1992





Kaloko-Honokohau

No Boating Zone

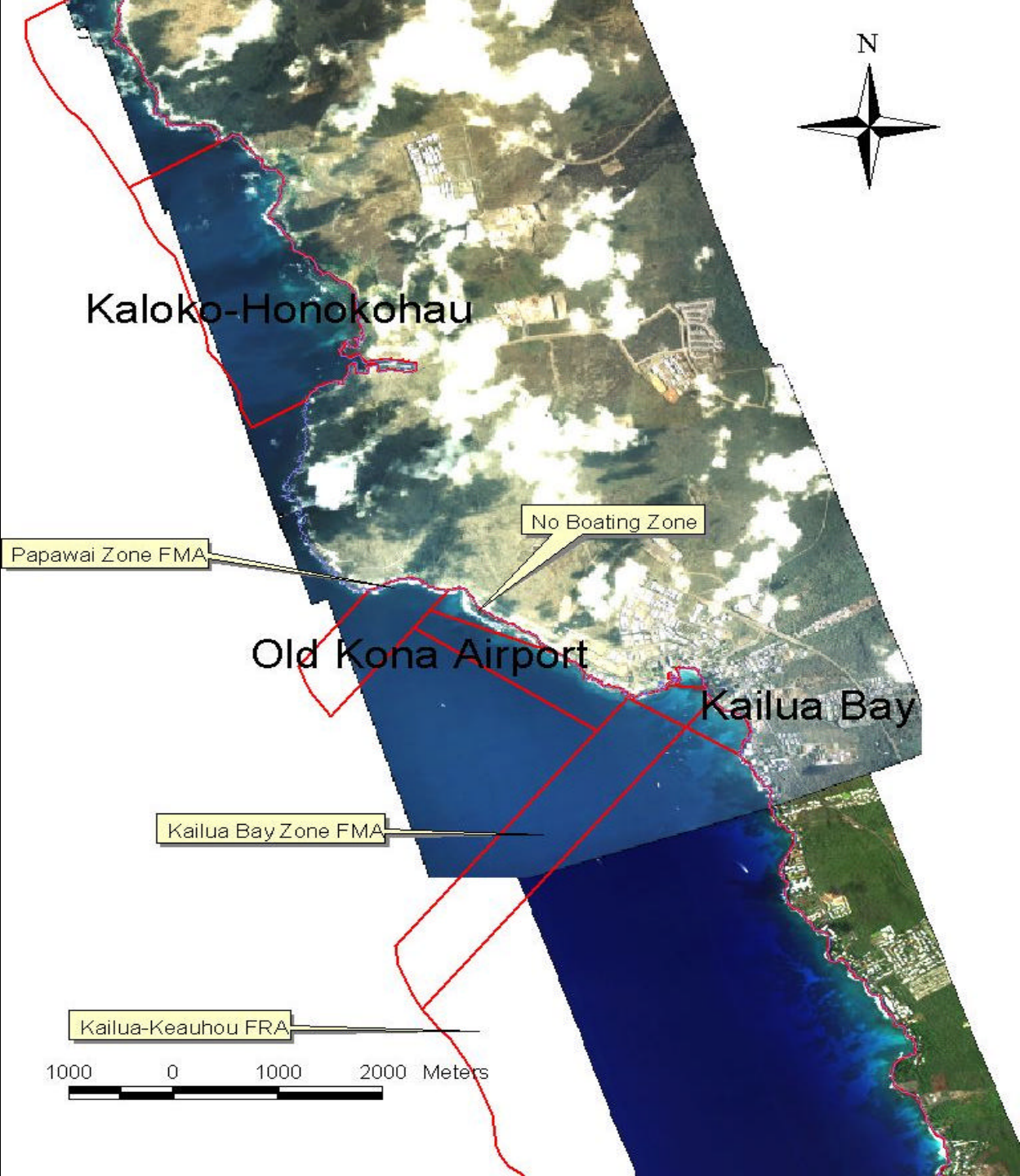
Papawai Zone FMA

Old Kona Airport

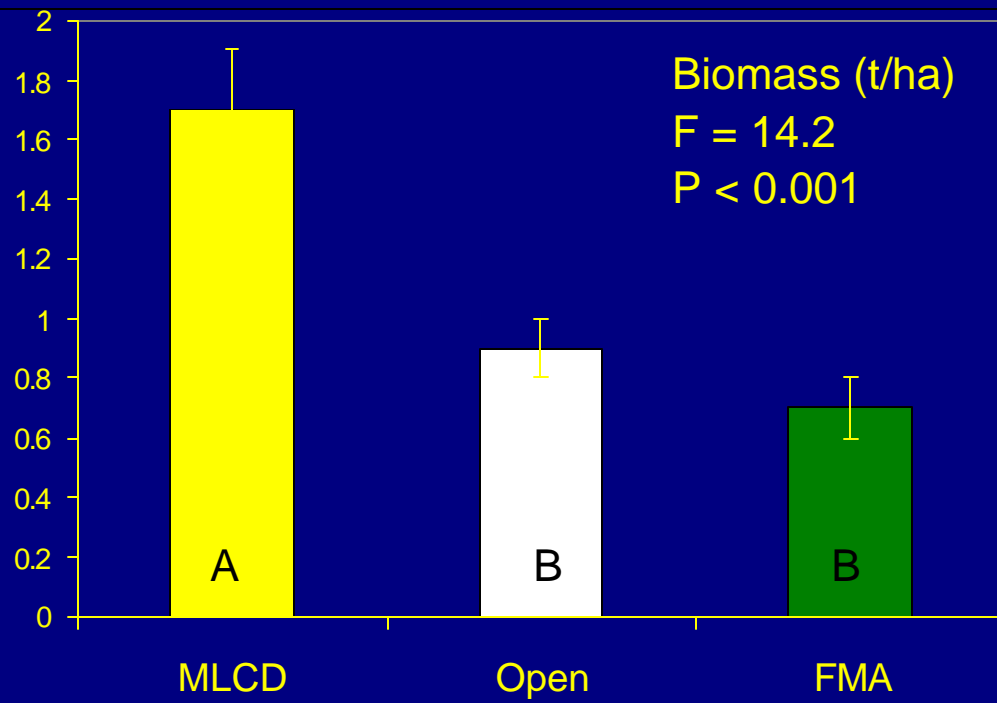
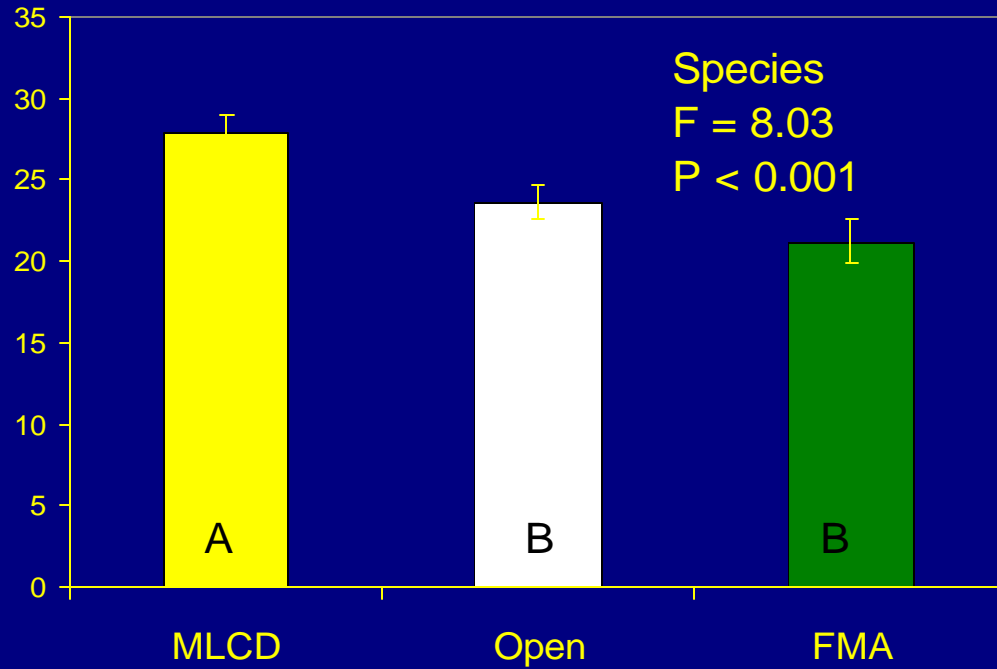
Kailua Bay

Kailua Bay Zone FMA

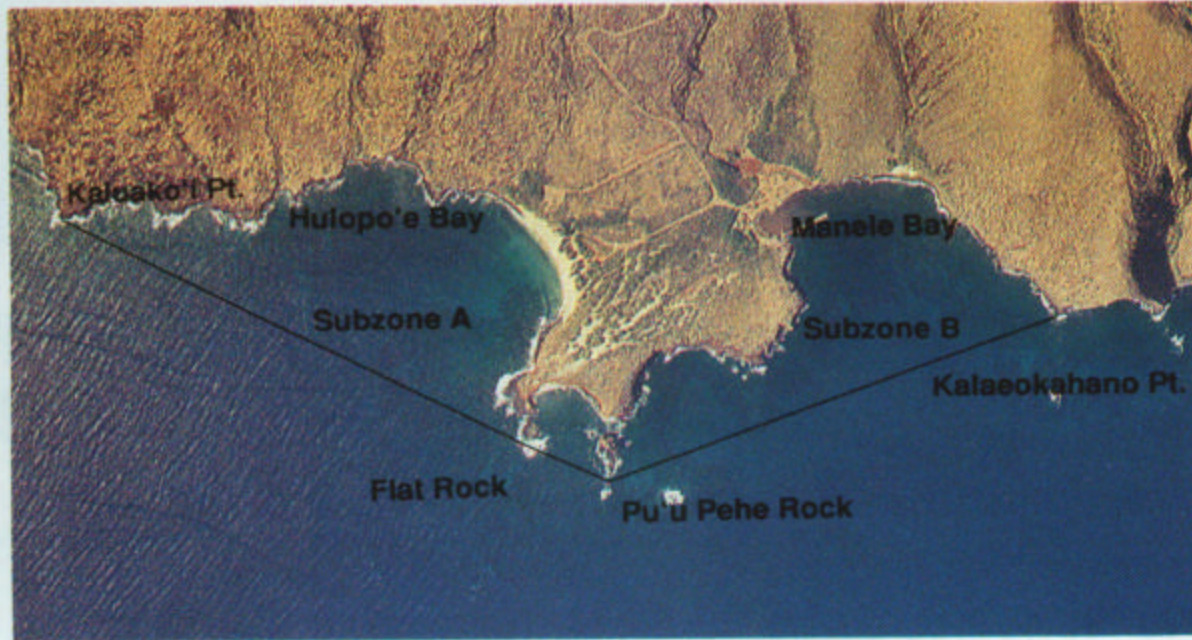
Kailua-Keauhou FRA



# Comparison of Fish Assemblage Characteristics In Hardbottom Habitats among various Management Regimes in and around Old Kona Airport MLCD



# LANA'I



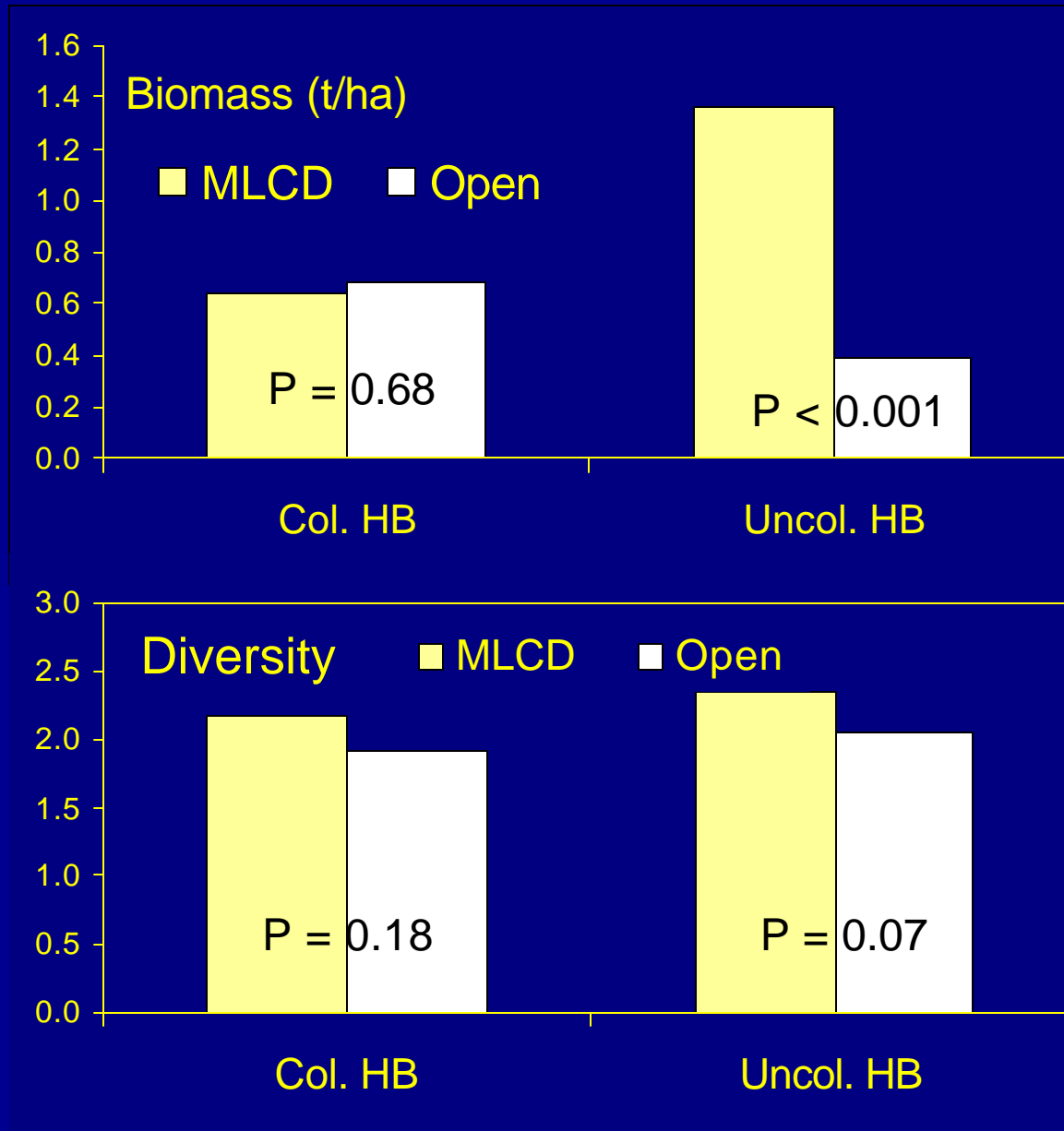
## MANELE - HULOPO'E



309 acres

Established 1976

# Fish Biomass and Diversity in Manele Bay MLCD and adjacent Habitats on Lanai





# NO FISHING NO TAKING OF MARINE LIFE

Hawai'i Marine Laboratory Refuge

#### BOUNDARIES:

The Hawai'i Marine Laboratory Refuge consists of the reefs and waters surrounding Moku-o-Ike (Coconut Island) from the high water mark on the island seaward to 25 feet beyond the outer edges of the reefs.

#### PROHIBITED:

Unlawful to take any aquatic life within the refuge.

#### EXCEPTIONS:

Researchers and other agents of the University of Hawai'i may catch or take aquatic life for scientific purposes.

#### PENALTIES:

Maximum \$500 fine and/or 30 days in jail.

To report violations, call 587-0077.

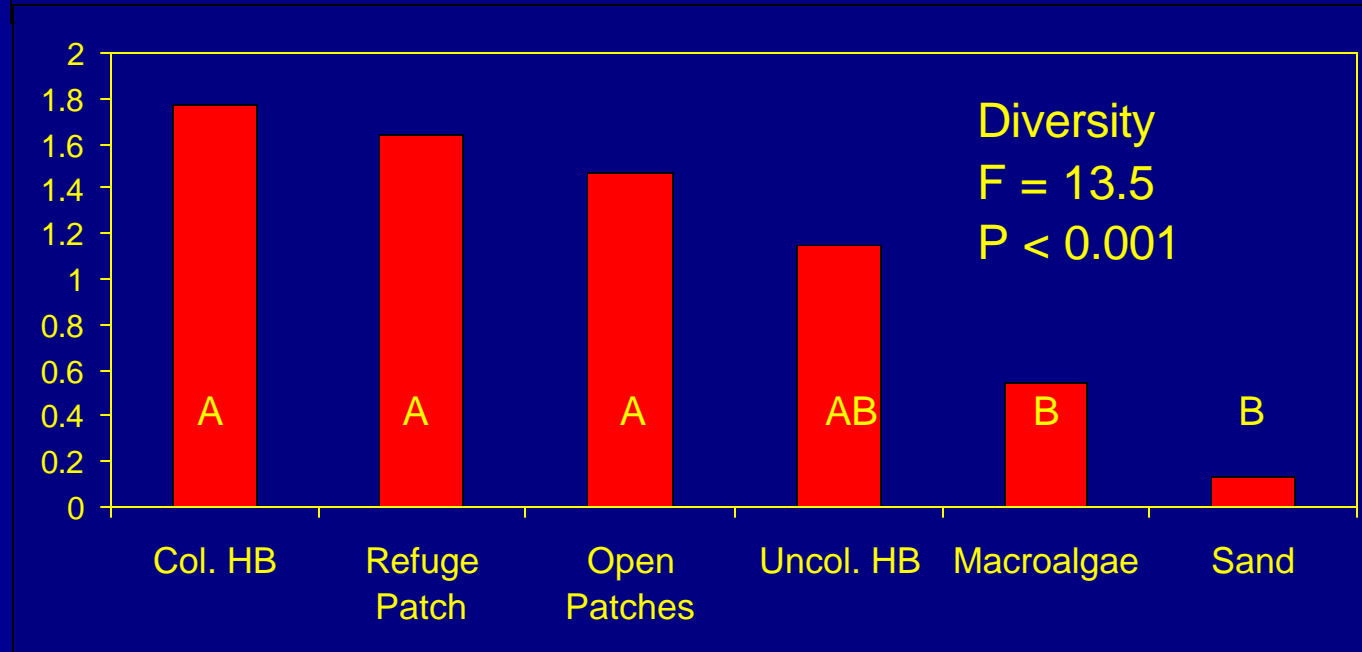
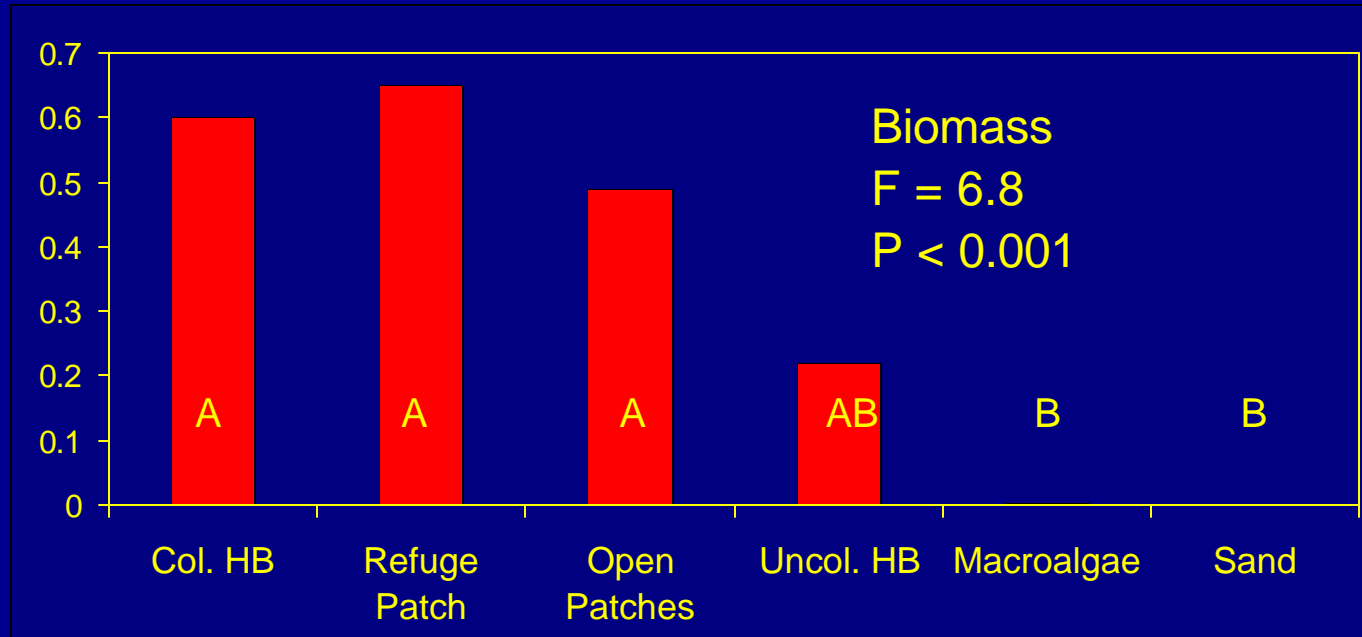


State of Hawai'i  
Department of Land and Natural Resources  
Hawai'i Revised Statutes § 103-106

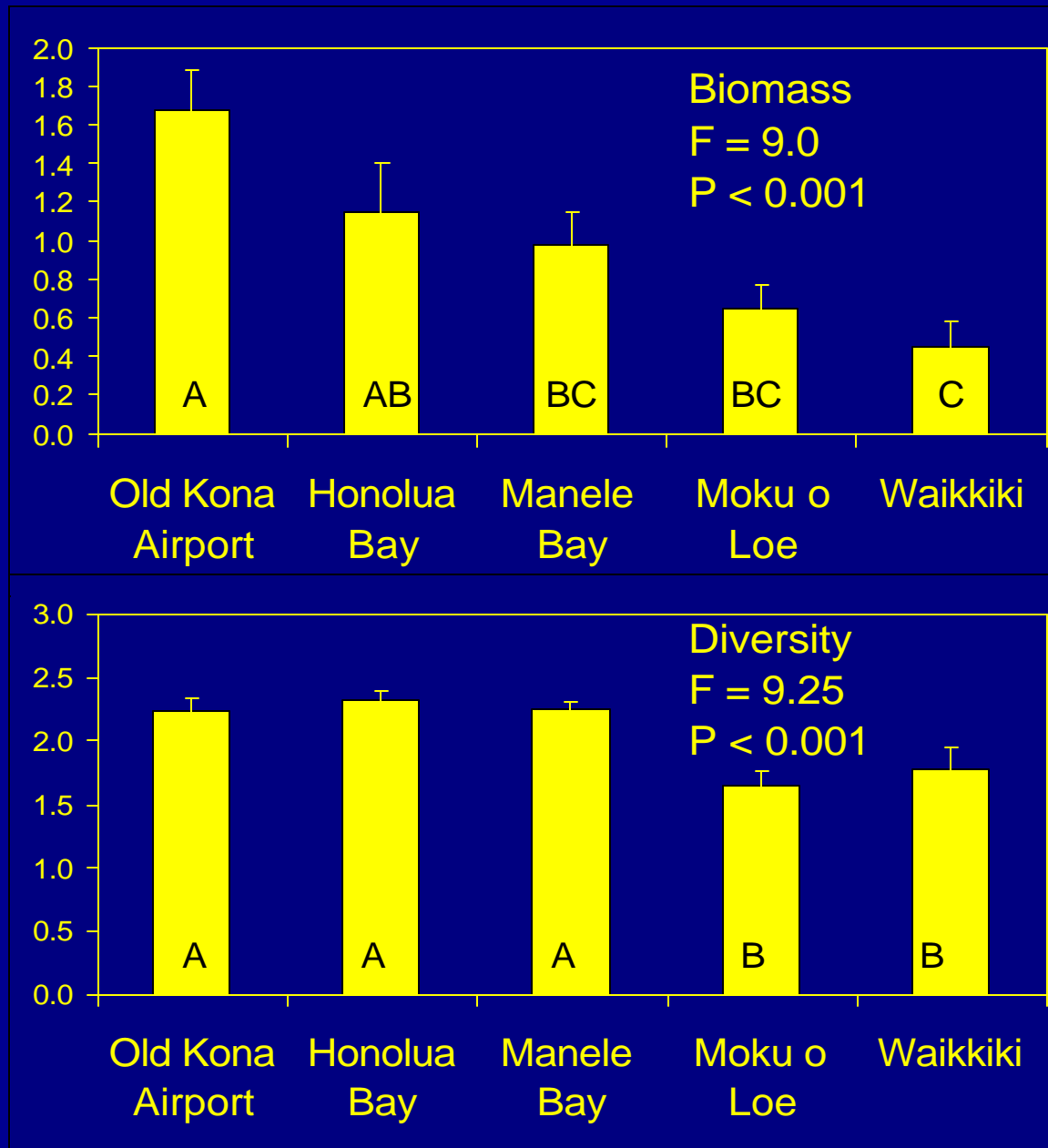
*"Sustaining Hawai'i's Natural Resources  
for the Future"*

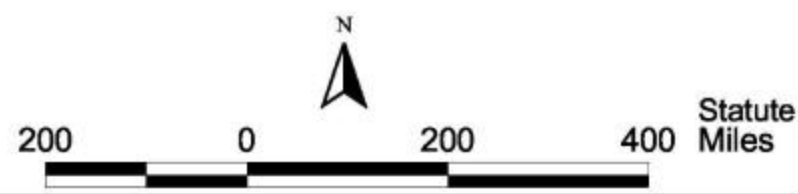
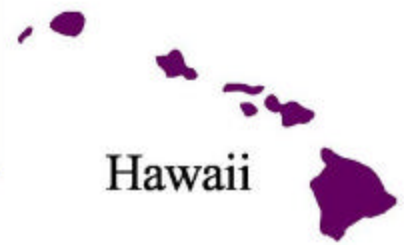
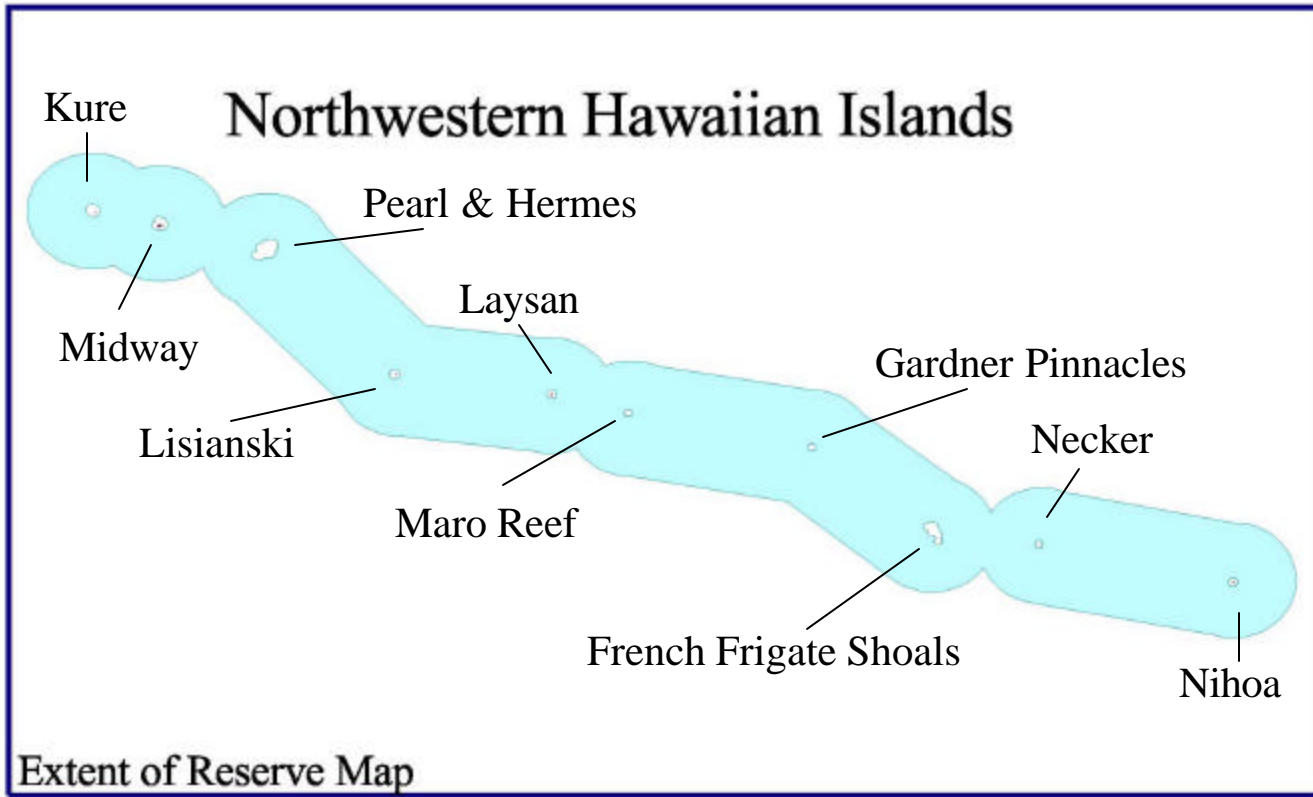


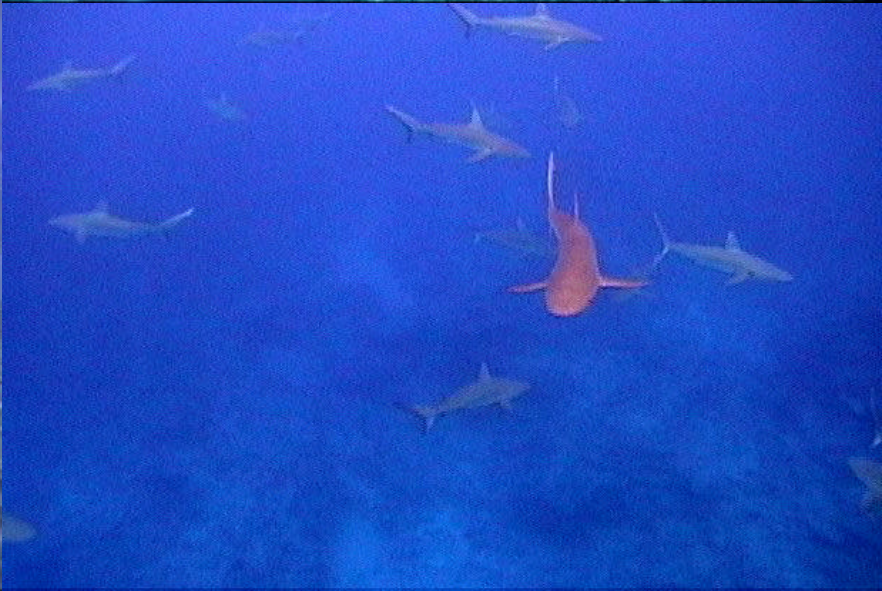
# Biomass and Diversity among Habitat Types in Kaneohe Bay, Oahu



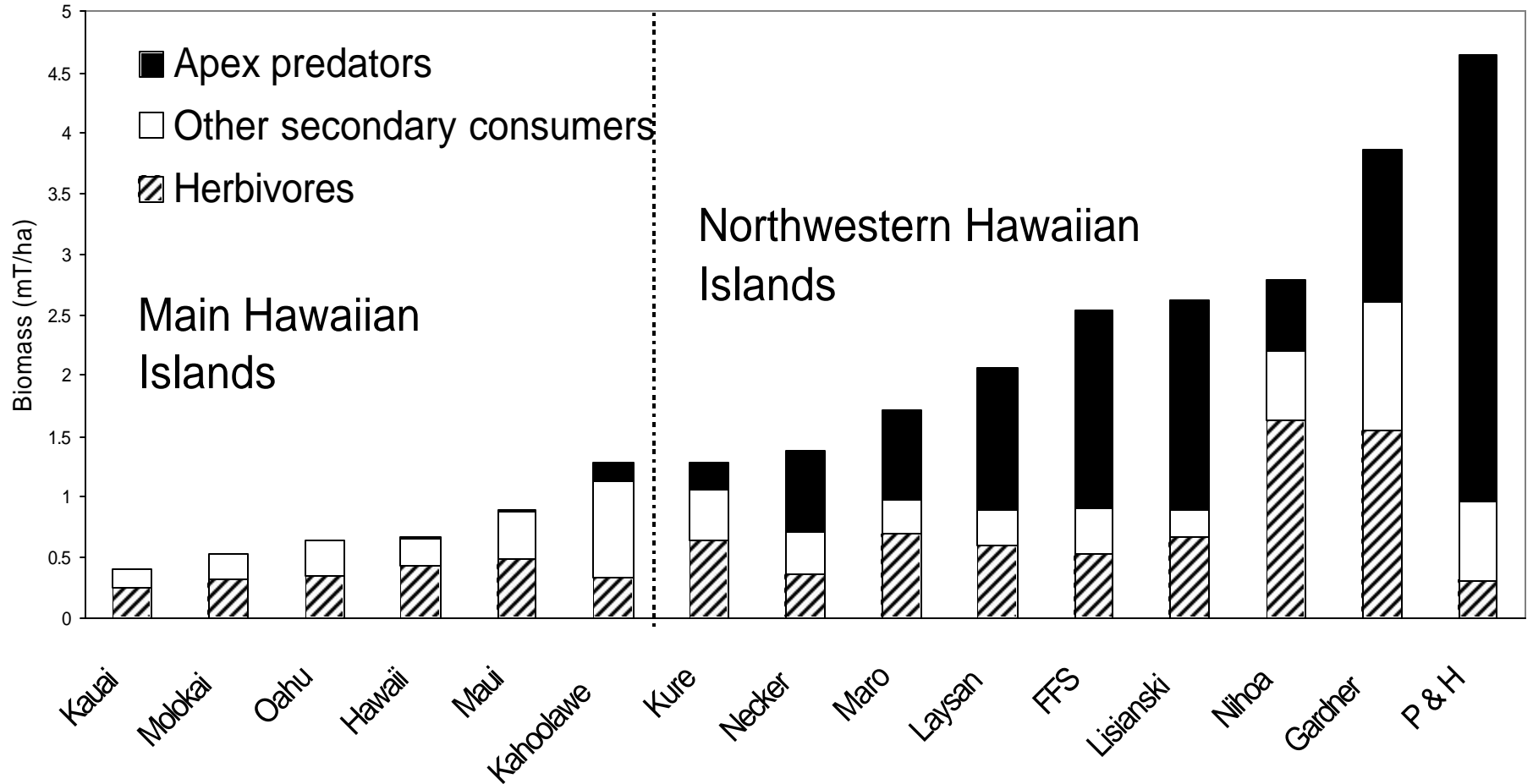
# Biomass and Diversity among Protected Areas on Hardbottom Habitats







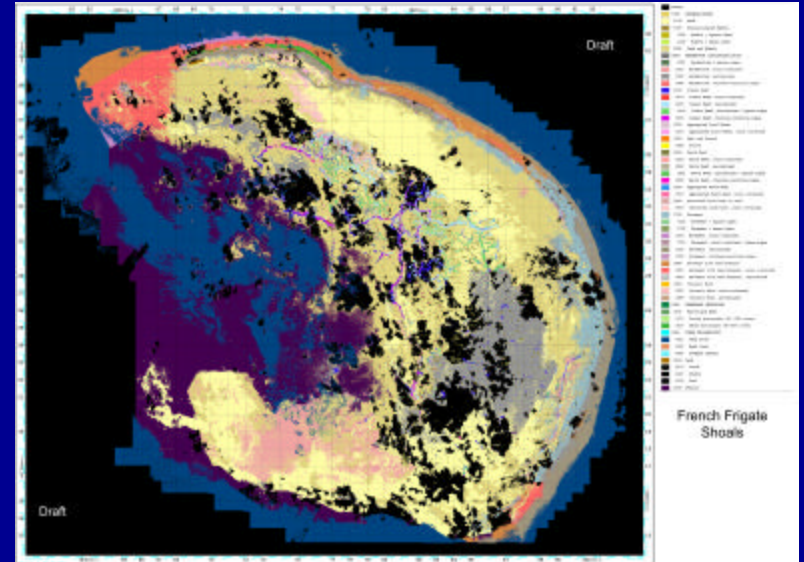
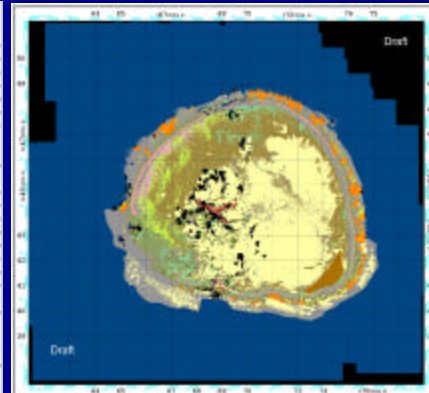
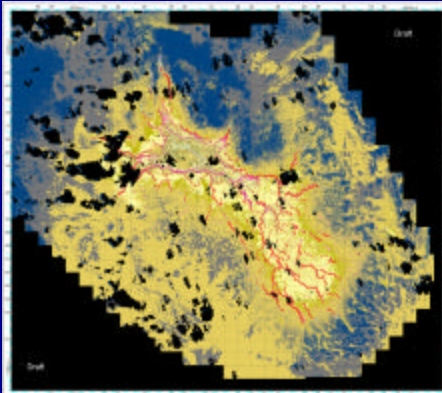
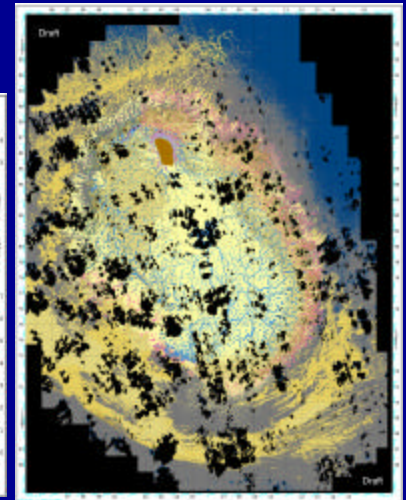
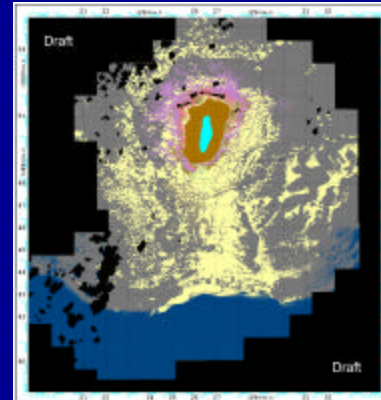
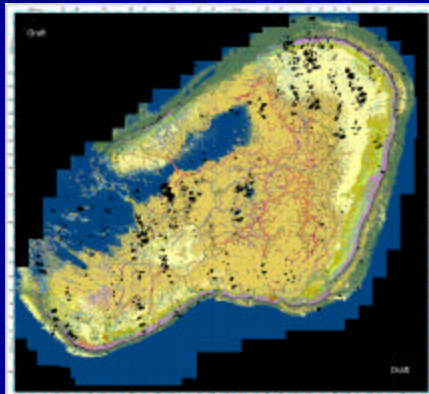
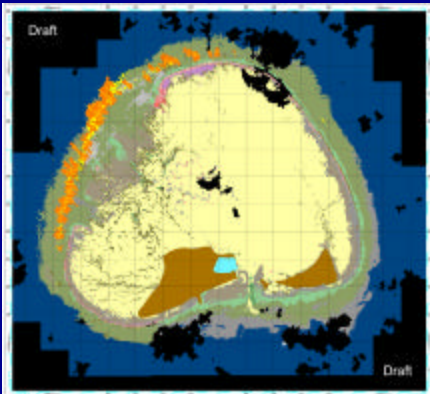
# Mean fish biomass among islands in the Hawaiian archipelago



# NWHI Coral Reef Mapping

## Area Mapped (km<sup>2</sup>)

Kure Atoll - 70	Laysan Is. - 128
Midway Is. - 96	French Frigate Shoals - 411
Pearl & Hermes Atoll - 389	Maro Reef - 518
Lisianski Is. - 439	Total - 2,050





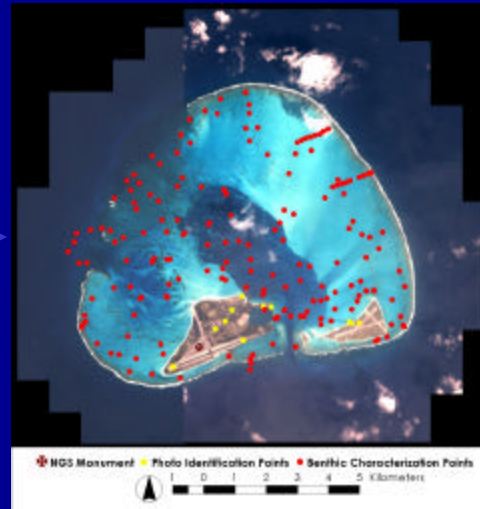
# NOS Coral Reef Ecosystem Mapping Program

## Integrated Mapping and Monitoring Activities

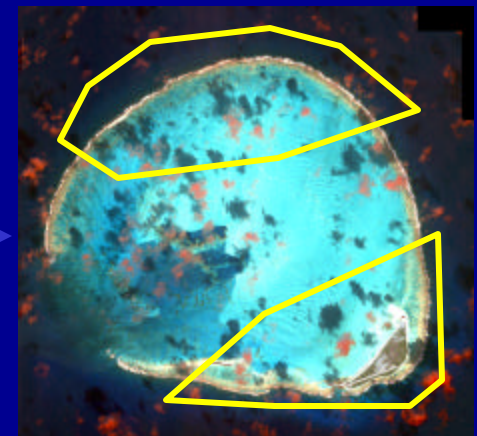
Completed coral reef ecosystem map



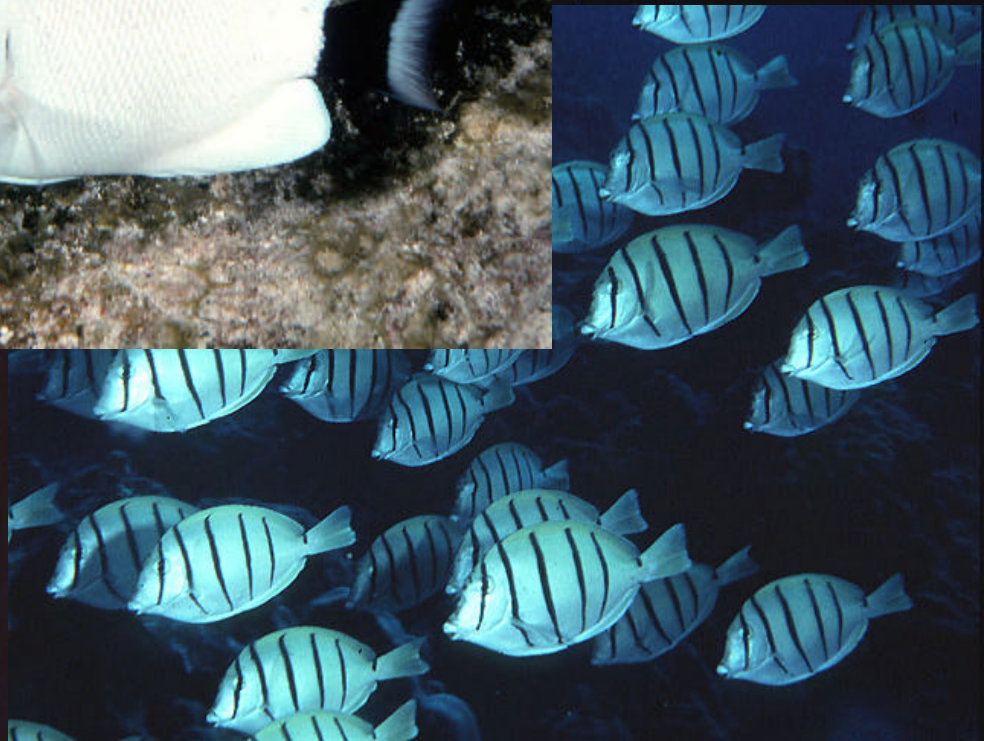
Monitoring program established using map



Assessment to answer management questions

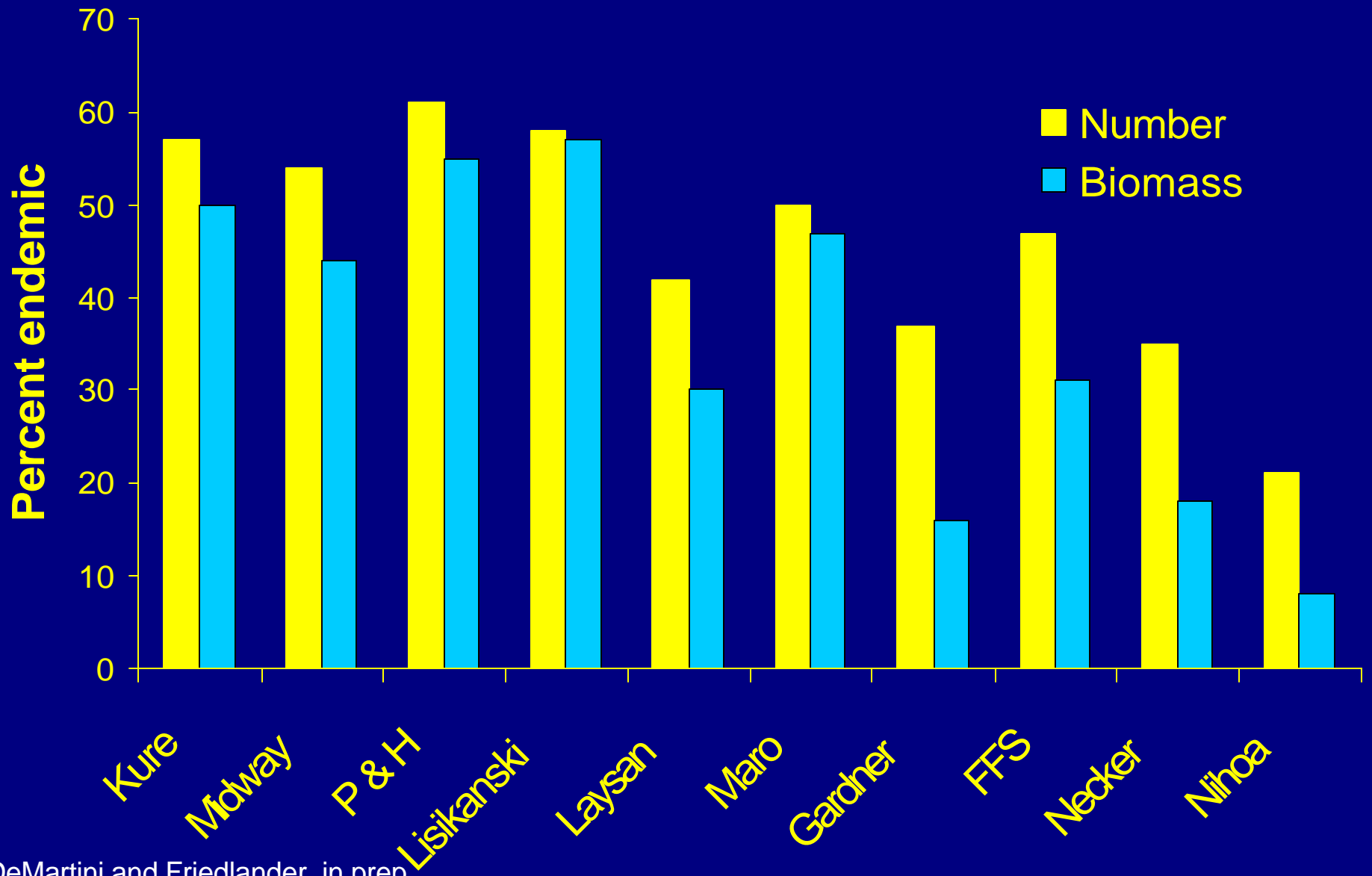


# Endemic Hawaiian Fishes 24%





# Percent Endemism in NWHI Fishes



# Fish habitat utilization

- Identify major habitat types
- Stratify fish/benthic sampling by habitat
- Define fish habitat utilization patterns
- Identify essential fish habitat
- Examine efficacy of existing MPAs
- Develop ecological criteria for future MPAs

