A Fundamental Approach to Coral Reef Monitoring and Assessment in the

CNMI and American Samoa

Peter Houk

Marine Biologist
CNMI Division of
Environmental Quality

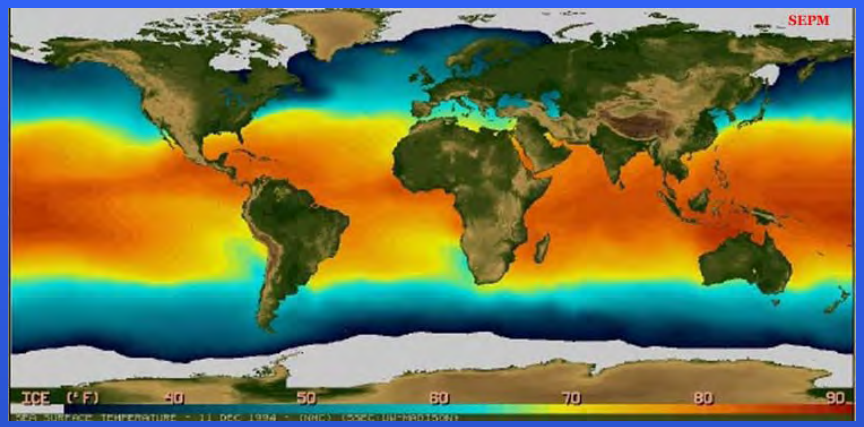
PhD Candidate
Florida Institute of
Technology

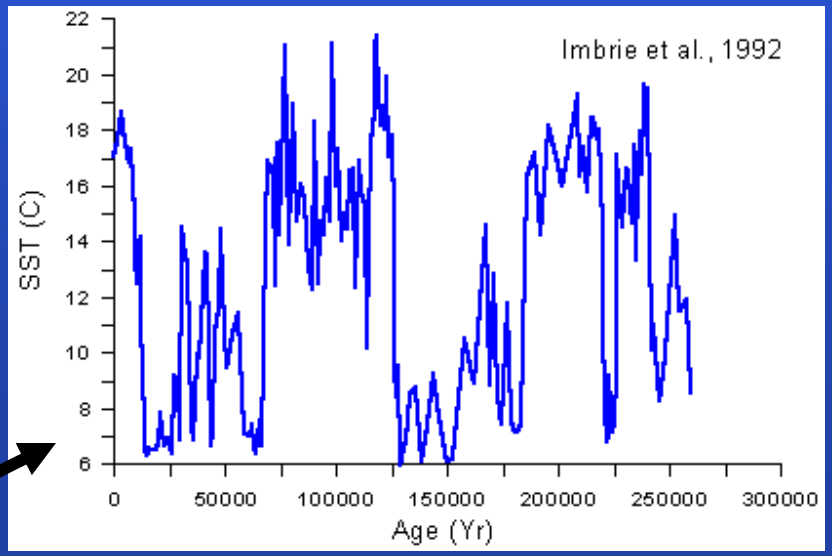
Fundamental Approach to Monitoring and Assessment of Reefs

- Processes Regulating Reef Development
- Example 1 – Northern Mariana Islands, CNMI
- Example 2 – Southern Mariana Islands, CNMI
- Example 3 – American Samoa

Processes Regulating Reef Development

- Initially, volcanic activity created islands, substrate for reefs to grow
- Location and extent of reef growth are dictated by (Macro-scale Factors)
  - Temperature
  - Historical sea level fluctuations
  - Tectonics
  - Wave energy
- Historical Temperature and Sea Level Relationship
  - Historical growth created today's reef structure

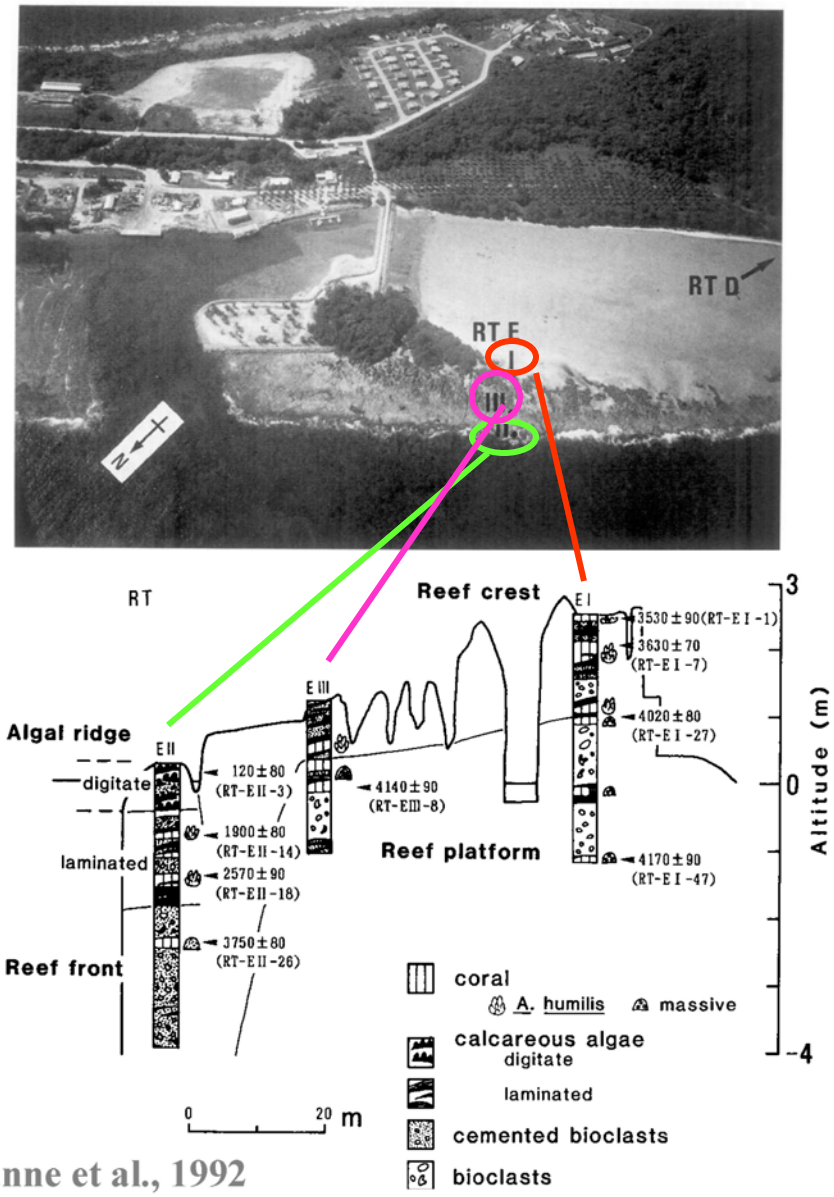




Foram fossil cores

Processes Regulating Reef Development

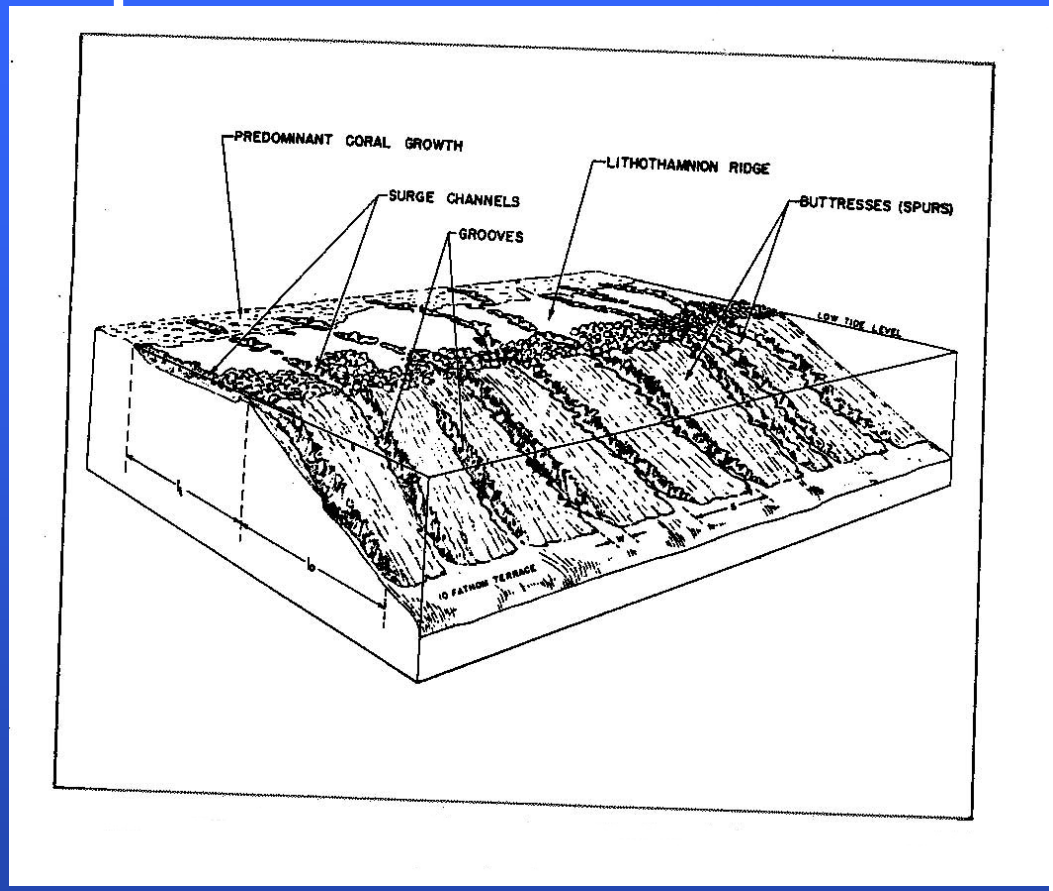
- Tectonic Activities on Rota
  - Uplifting
  - Cores identify coral reef growth in the past
  - Uplifted Holocene deposits prevent “normal” Mariana Islands reef flat communities



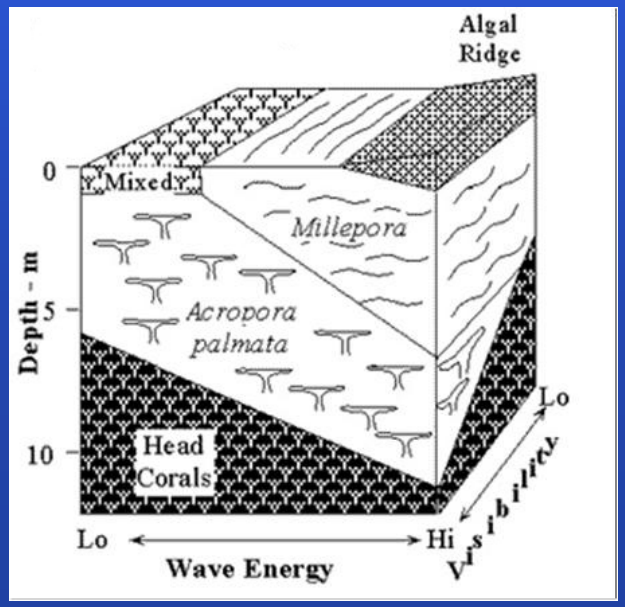
Kayanne et al., 1992

Processes Regulating Reef Development

- Wave energy
  - Determines the type of community growth
  - Wave energy acts differently along a depth gradient



Munk and Sargent, 1948



Geister, 1977

Processes Regulating Reef Development

The integrated result that we see is the

- reef geomorphology (reef structure)
- Living “organic” reef

Understanding macroecology is key for present monitoring and assessment of coral reefs

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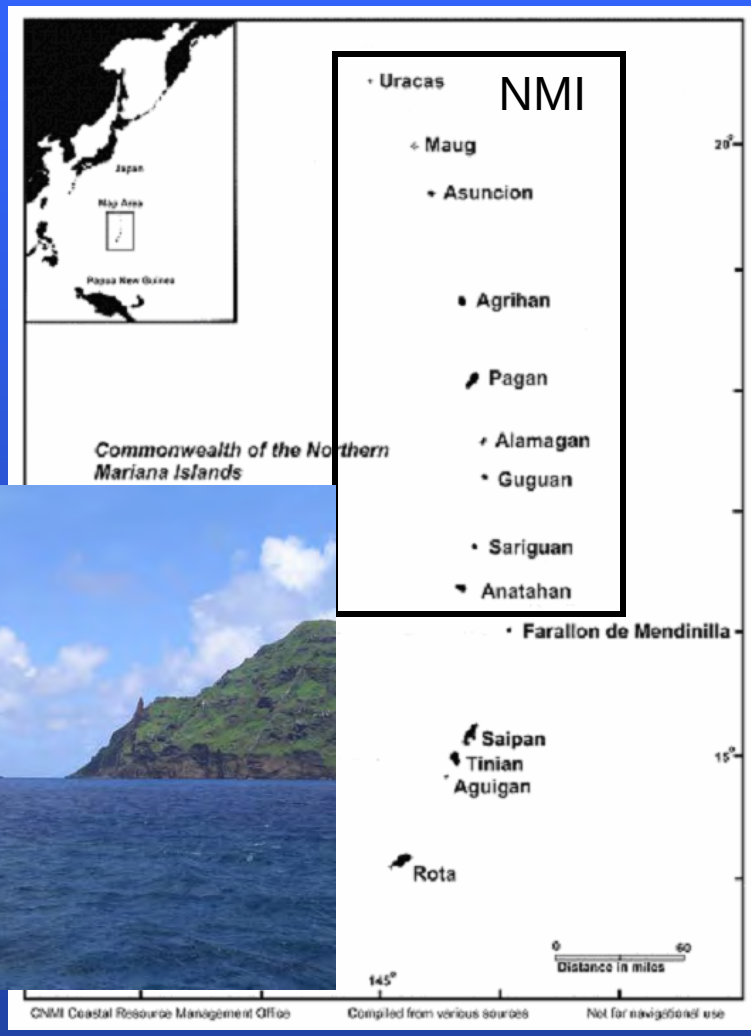
Example 1 – Northern Mariana Islands

- Situated on active Marianas Ridge
- 1 – 5 million years old
- Mostly uninhabited
- Few previous studies
- Management plans for coral reefs desired



Example 1 – Northern Mariana Islands

- Different present communities from different geological settings
- What processes are acting against these settings?
- Is it possible to classify setting before compare and contrast sites?

Example 1 – Northern Mariana Islands

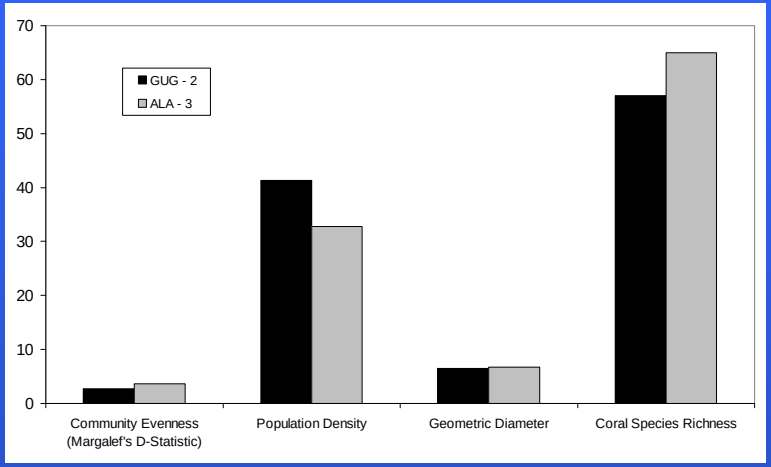
- To begin to understand impacts of feral animals we first use regional characteristics
  - GUG 2, ALA 3 have living, organic reef situated mainly on limestone reef deposits, not volcanic rock
  - wave energy

Feral Animals

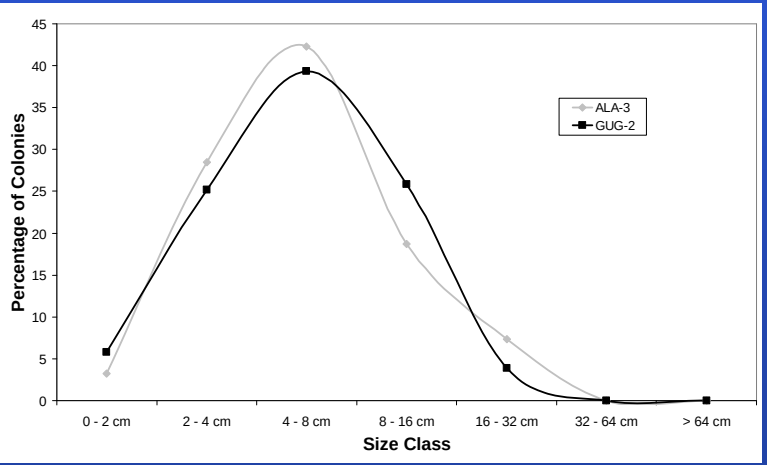
No Feral Animals

Example 1 – Northern Mariana Islands

- Several coral community measures show little difference between sites



- What is impact of feral animals compared with natural community regulation processes at this site?



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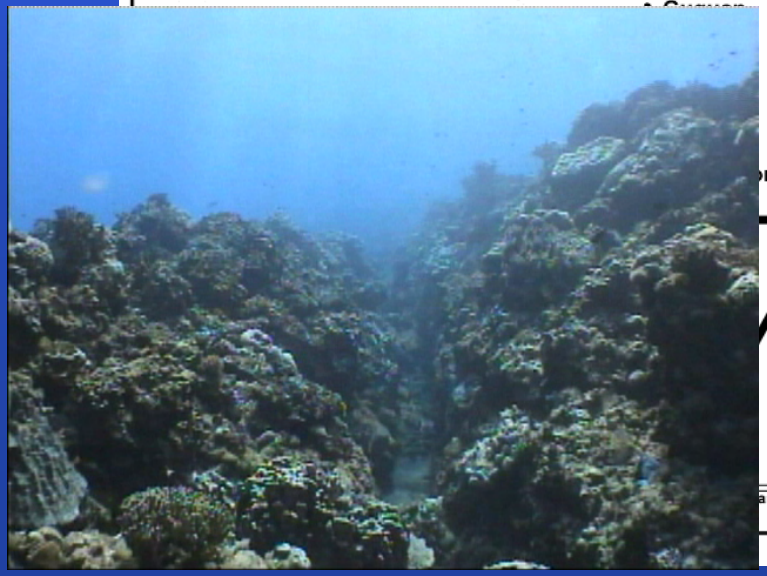
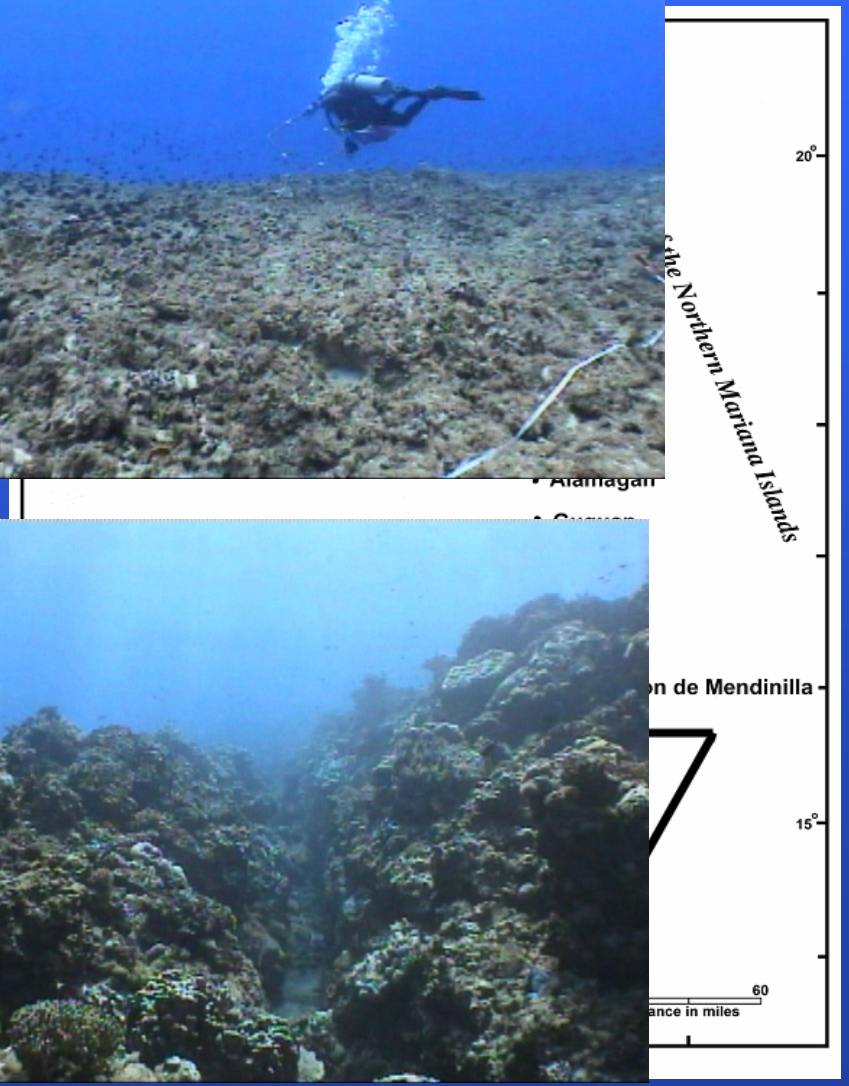
Example 2 – Southern Mariana Islands

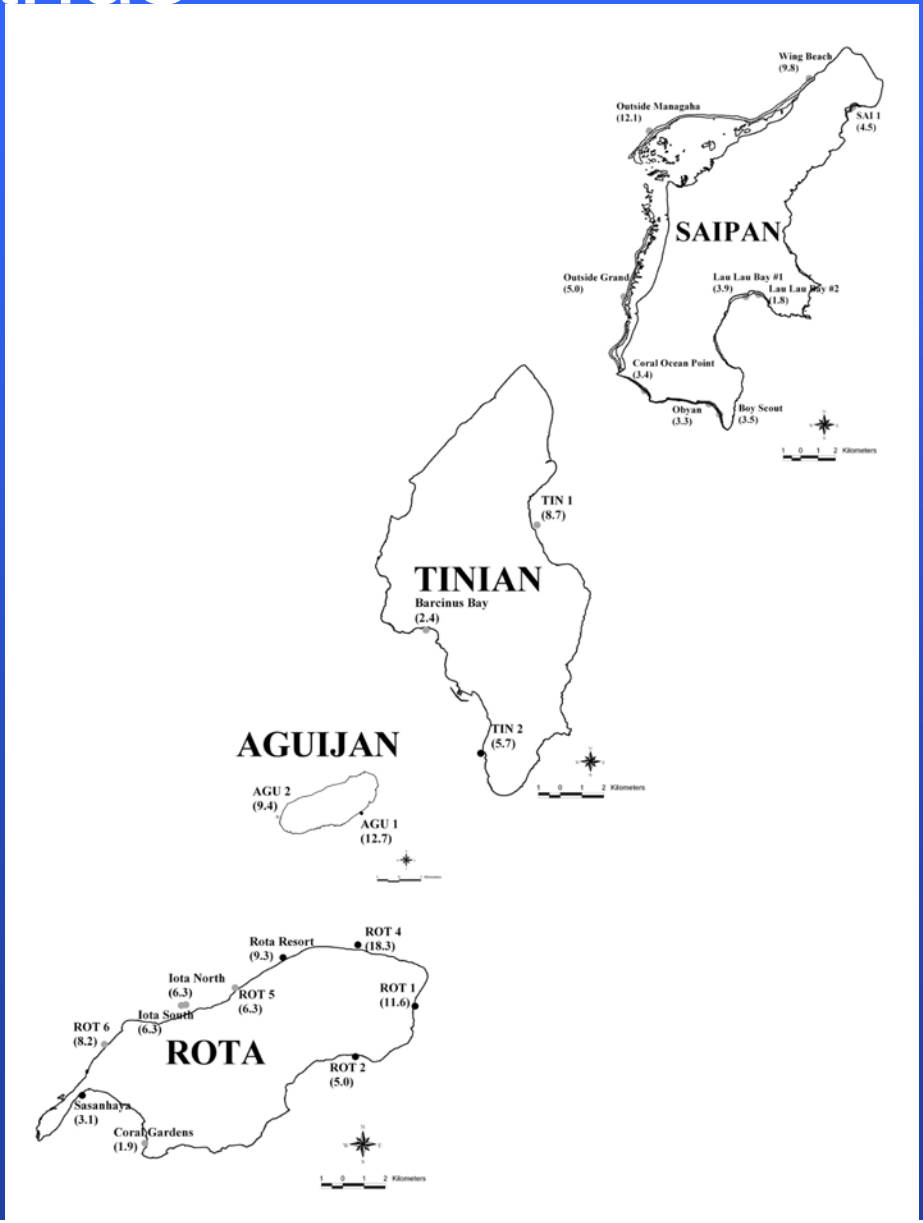
- Increased complexity in geological settings
  - 1) Antecedent, Holocene Deposition (indicator)
  - 2) Pleistocene or earlier only (indicator)
- Wave energy consideration





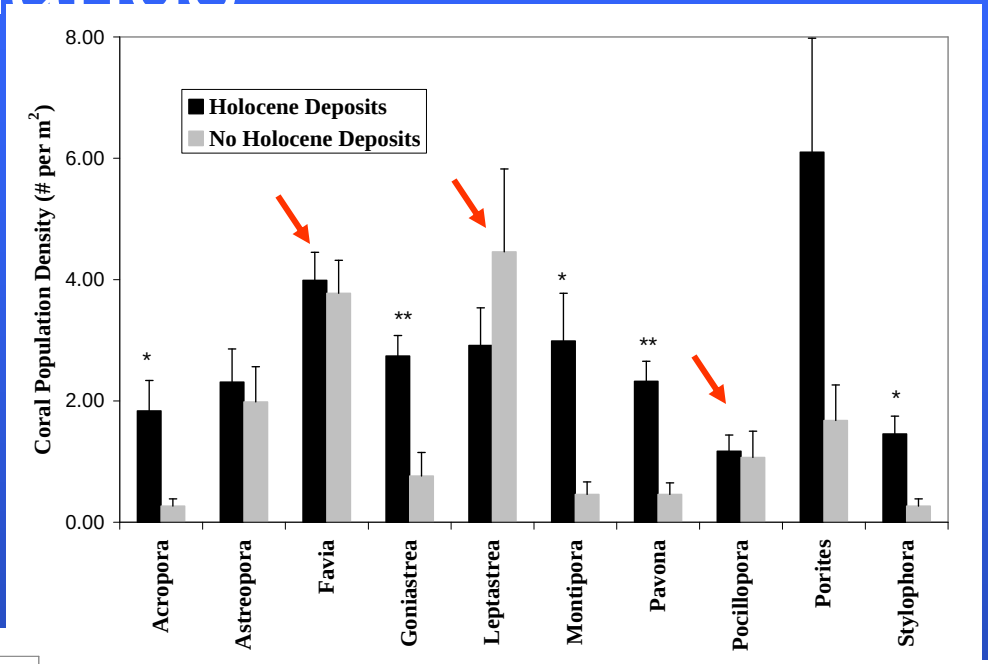
Example 2 – Southern Mariana Islands

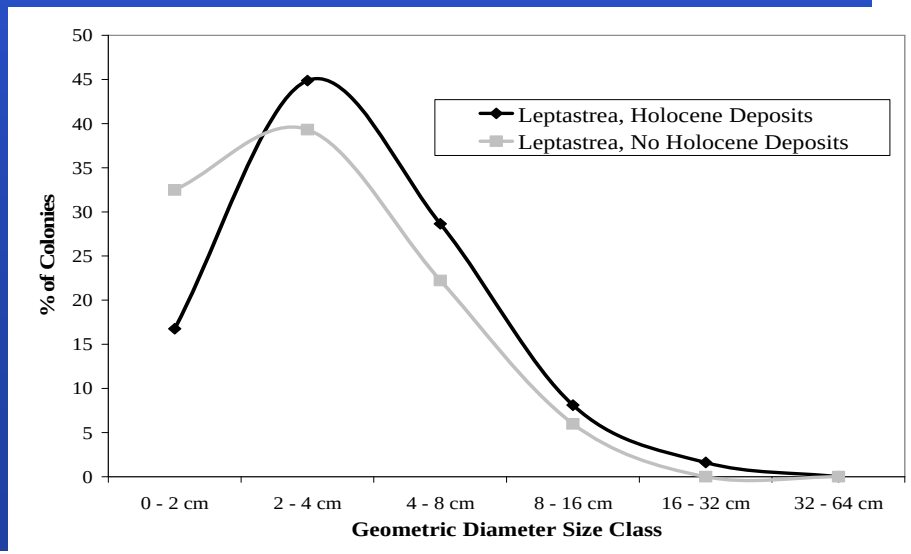
- Holocene (recent) deposits **not** related to exposure
- Deposits = topographic complexity, result of sediment trapping
- In circular nature, topographic relief provides refuge from scouring physical environment, and continues to build

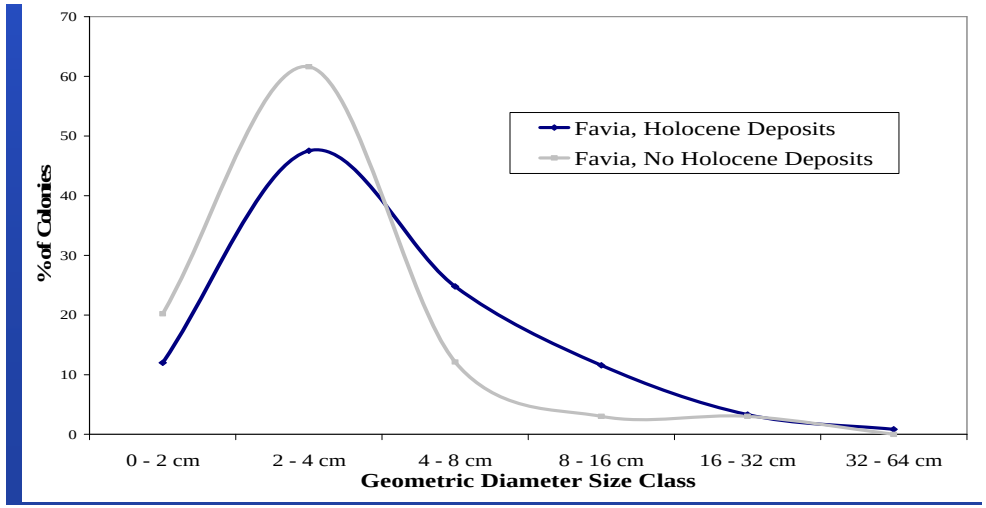


Example 2 – Southern Mariana Islands

- Living organic reef community
  - Favia, Leptastrea, Pocillopora account for >30% of measured coral
  - * = significant difference
  - ↘ = no significant difference





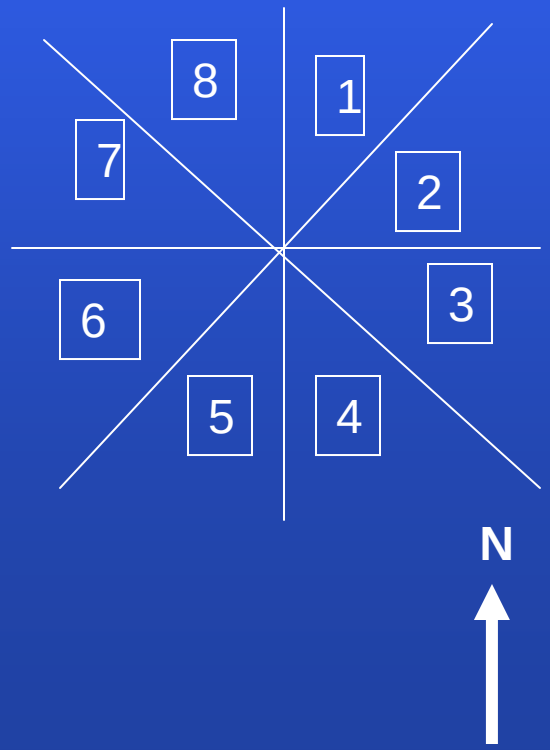


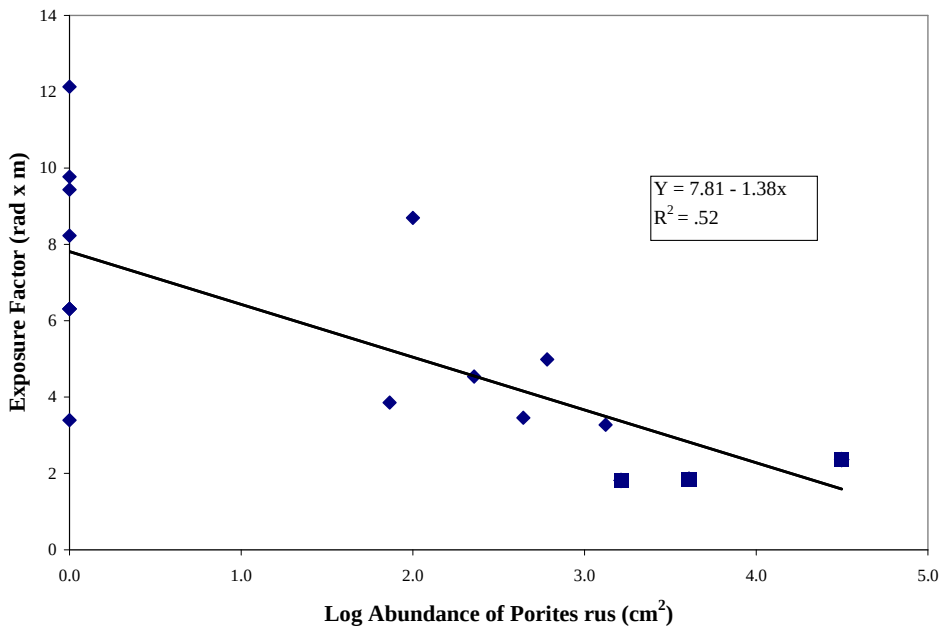
Example 2 – Southern Mariana Islands

- Wave energy considerations
  - Holocene reefs
  - *P. rus* dominant reefs in extremely sheltered locations with Holocene deposition

Quadrant	Exposure Direction	Exposure Degrees	Average Wave Height (m)
1	N - NE	0 - 45	1.5
2	NE - E	45 - 90	1.4
3	E - SE	90 - 135	1.2
4	SE - S	135 - 180	0.7
5	S - SW	180 - 225	0.7
6	SW - W	225 - 270	0.7
7	W - NW	270 - 315	0.7
8	NW - N	315 - 360	0.9

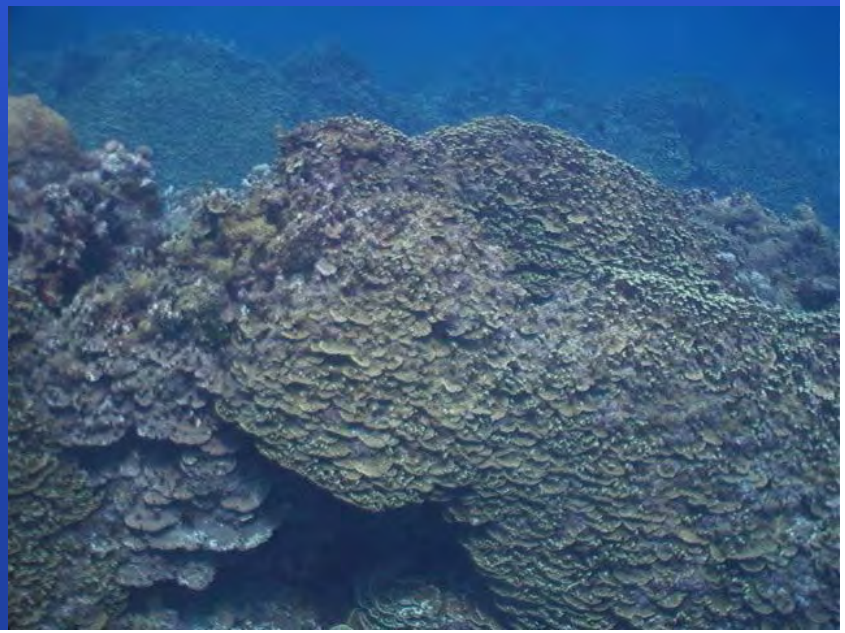
From NOAA buoy data

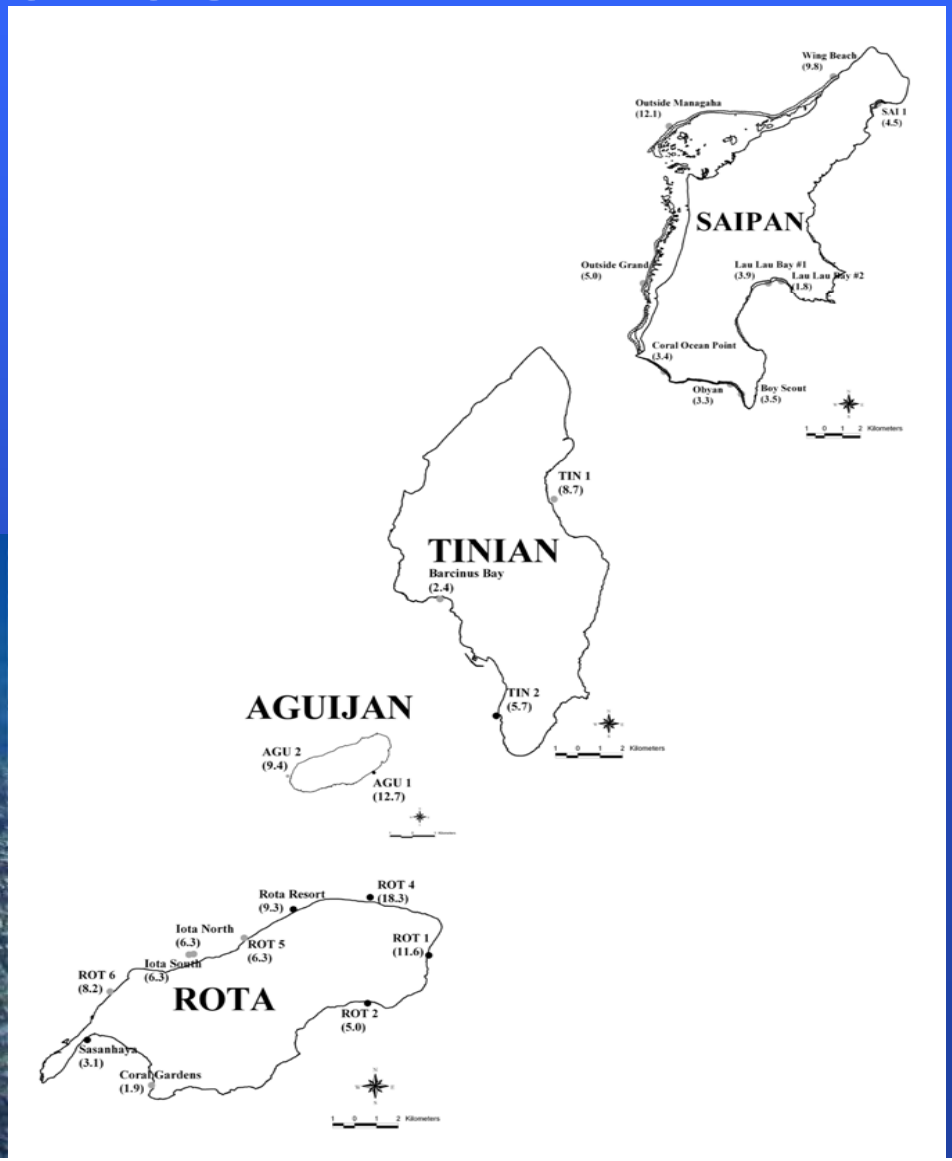




Example 2 – Southern Mariana Islands

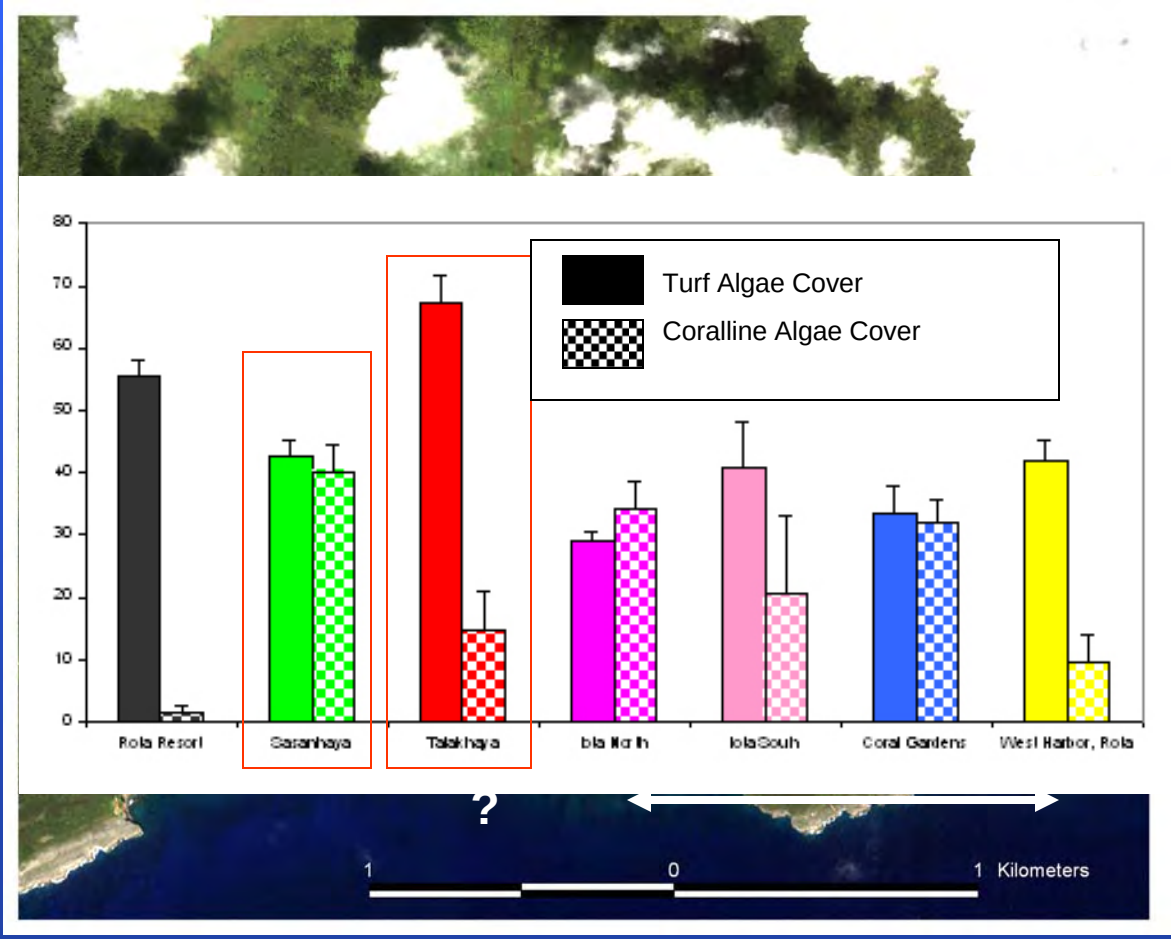
- Porites rus dominance, lower species diversity in extremely sheltered regions expected =





Example 2 – Southern Mariana Islands

- Macroecology information required before assessments of land based disturbances and such
- Compare site in questions with regional information
- Use watershed characteristics, stream flow rates, water quality data, and others, to compliment reef community data (site specific studies)



Talakhaya Watershed, Rota Island

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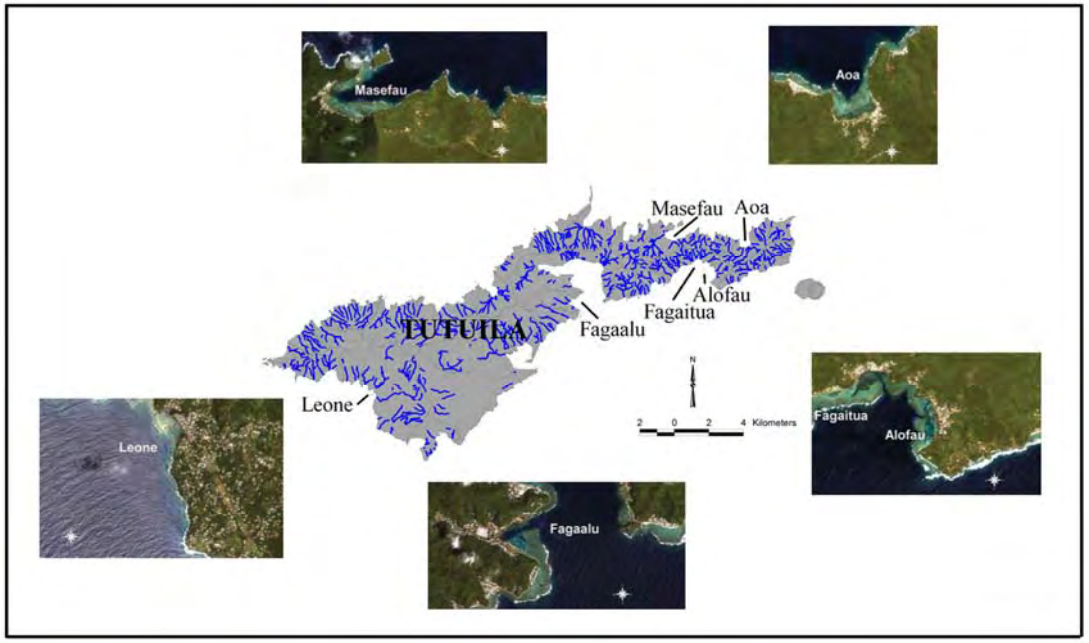
Example 3 – American Samoa

- Watershed based management and water quality monitoring
- Reefs used as bio-criteria indicators to water quality health (EPA guidance)
- Simultaneously, initiate long term

  monitoring

  baseline



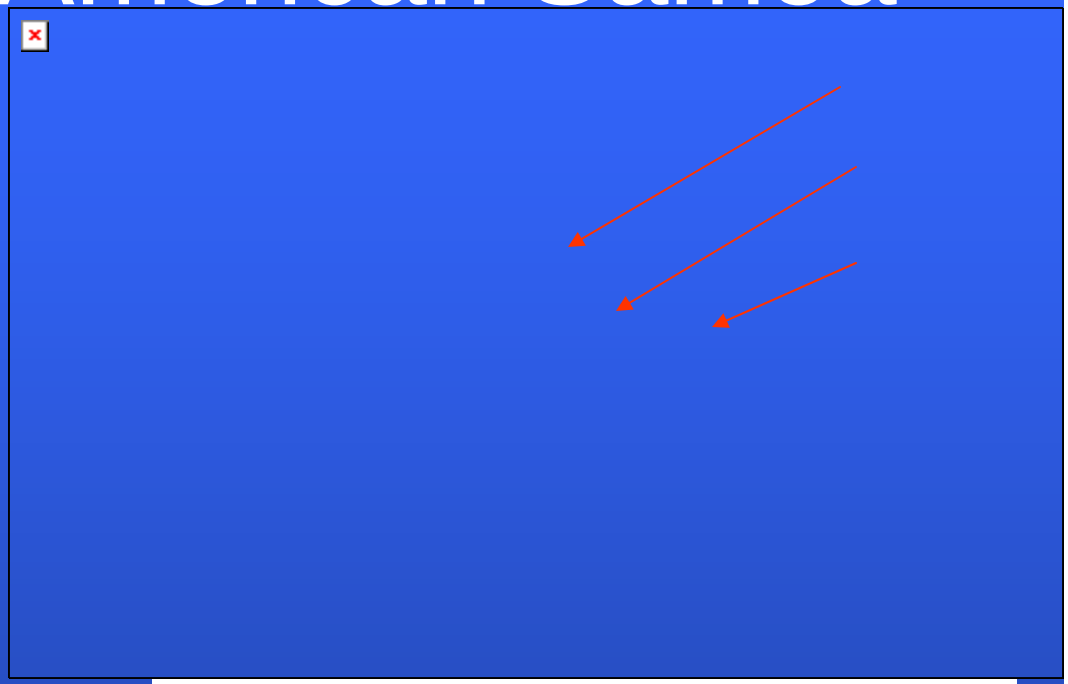
Arrows indicate similar geomorphology

Example 3 – American Samoa

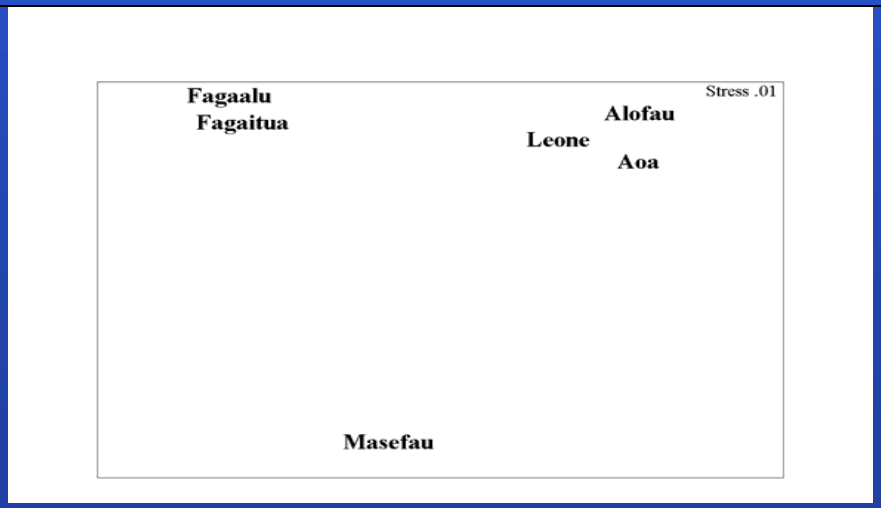
- Similar geomorphology at Aoa, Leone, and Alofau
- This setting allows for larger corals, greater coverage, due to stable abiotic environment
- NOT imply “better condition” (low community evenness)
- Stability ≠ Diversity

Example 3 – American Samoa

- Size Distribution of Coral Colonies



- Multivariate exploratory techniques (Multi-Dimensional Scaling), using coral relative abundances



Houk, Didonato, and Iguel, submitted EMAS

Example 3 – American Samoa

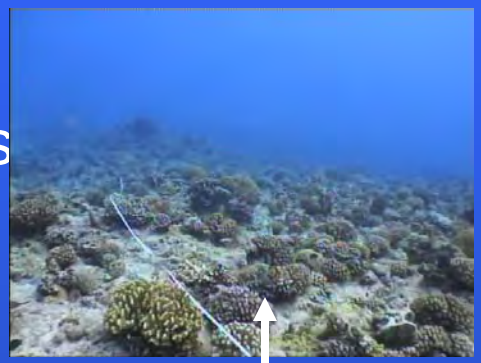
- Compare Sites with same regional characteristics
- Coral cover crude indicator for reef health assessment based upon coral community
  - Community evenness
  - Geometric diameters
  - Overall diversity

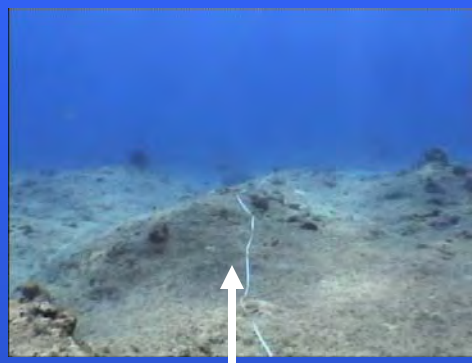
Acropora clathrata

Houk, Didonato, and Iguel, submitted EMAS

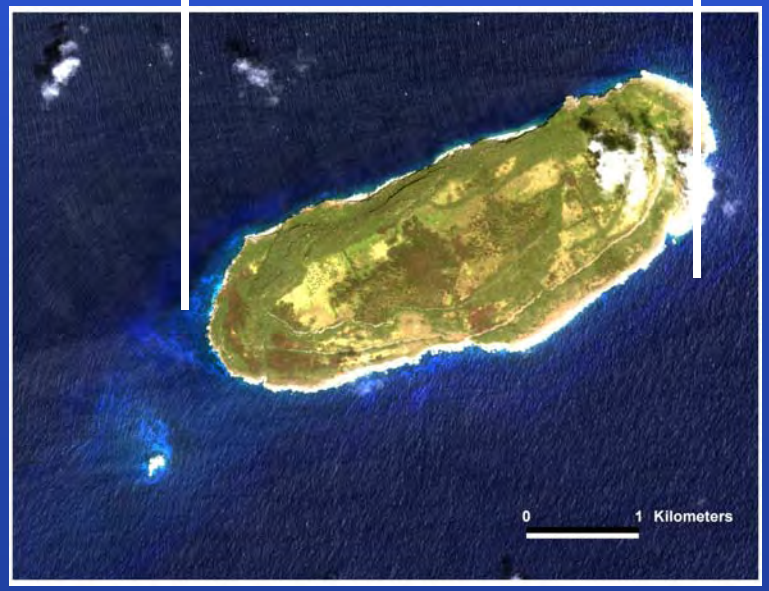
Conclusion

- Environmental settings are important for understanding living reefs
- Elucidate processes that regulate coral communities
- Gain regional understanding to provide context for local assessments





Aguijan Island, CNMI



Conclusion

- Through monitoring we greatly enhance the ability to properly manage and protect coral reefs

- Thanks to:
  - US Environmental Protection Agency
  - CNMI Division of Environmental Quality
  - CNMI Coastal Resources Management Office
  - American Samoa Environmental Protection Agency
  - CNMI Marine Monitoring Team
  - NOAA MARAMP, NOAA CREI Division