A Fundamental Approach to Coral Reef Monitoring and Assessment in the CNMI and American Samoa

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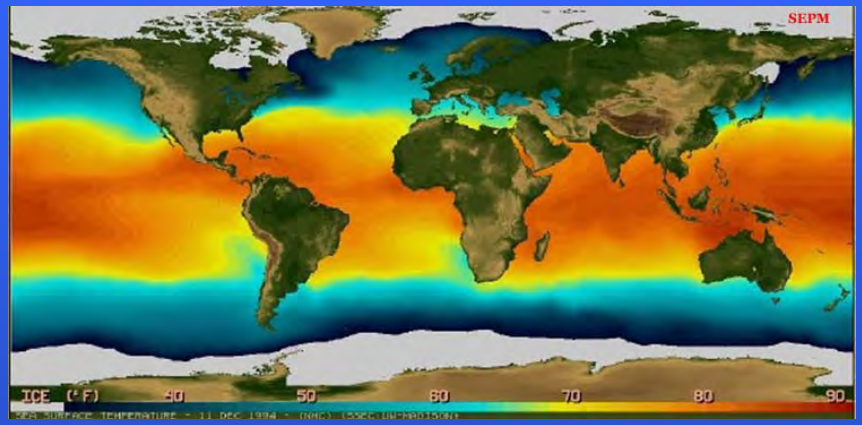
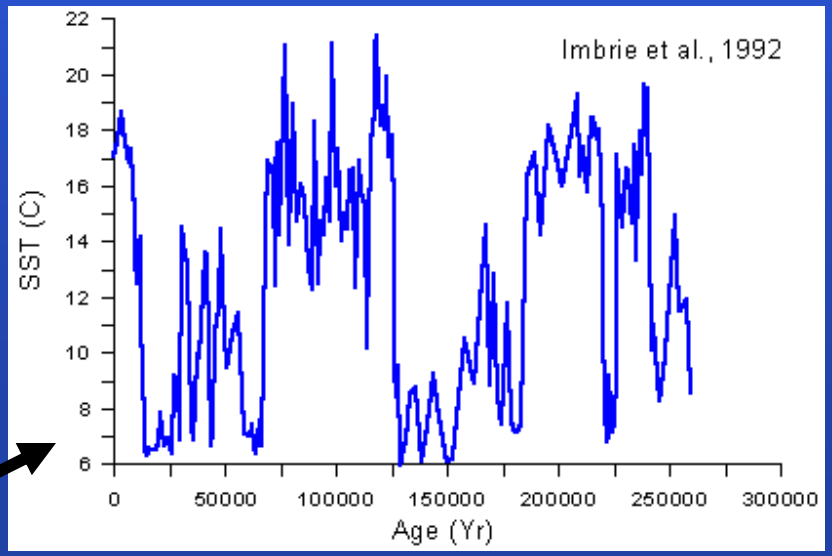
Fundamental Approach to Monitoring and Assessment of Reefs

- 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

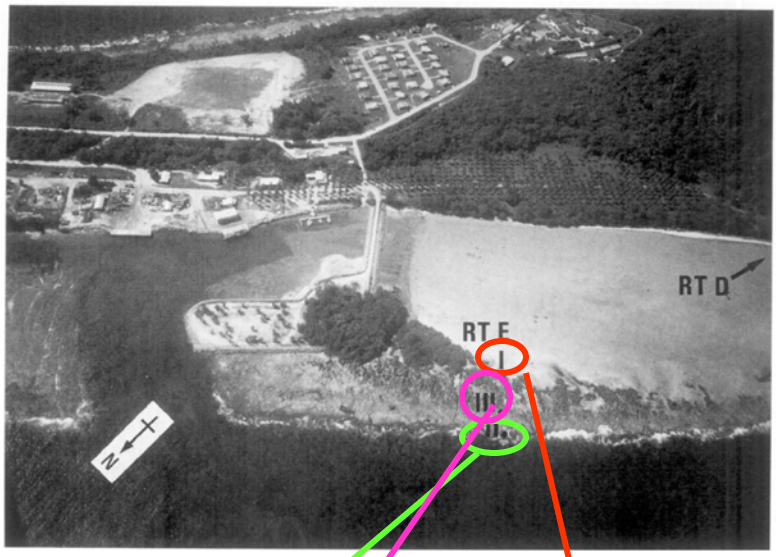


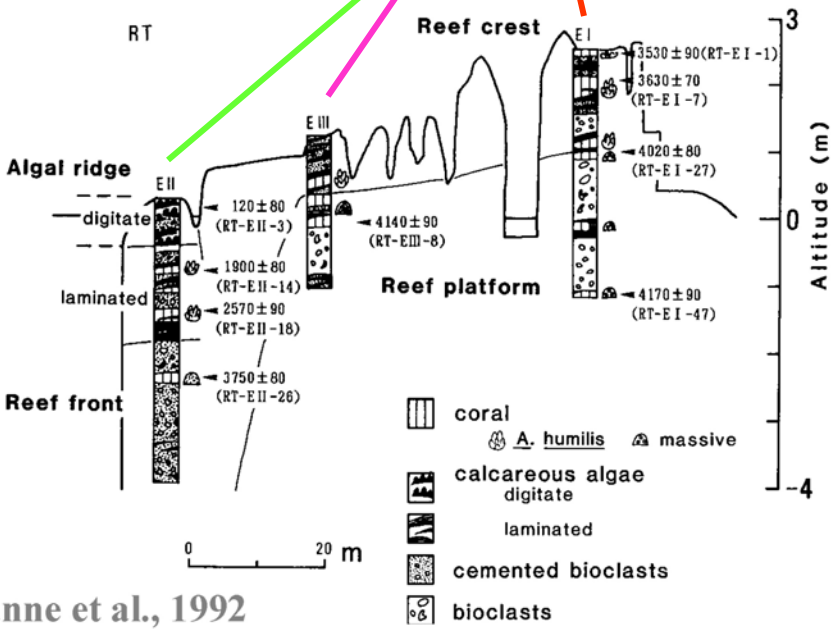


Foram fossil cores

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

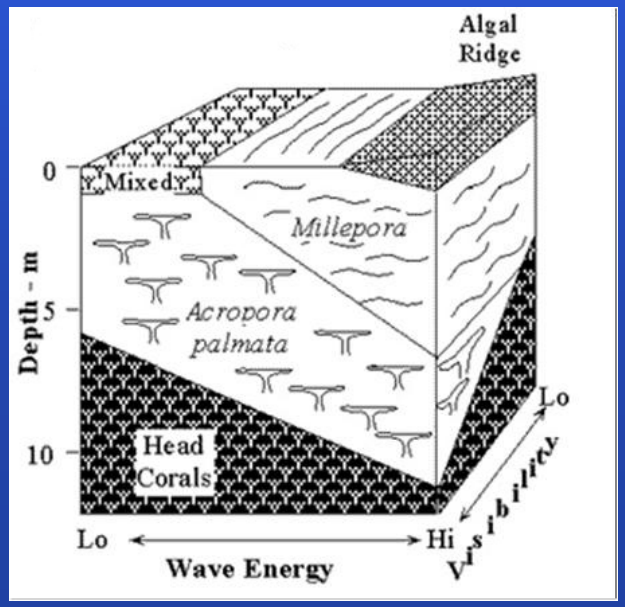




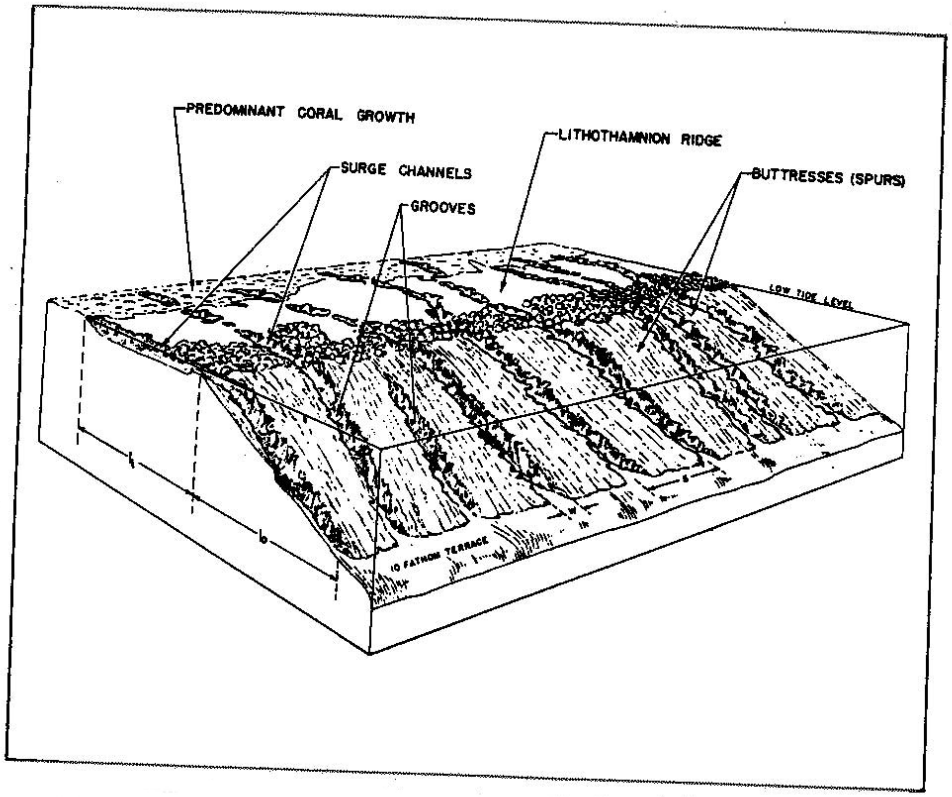
Kayanne et al., 1992

Processes Regulating Reef Development

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



Geister, 1977



Munk and Sargent, 1948

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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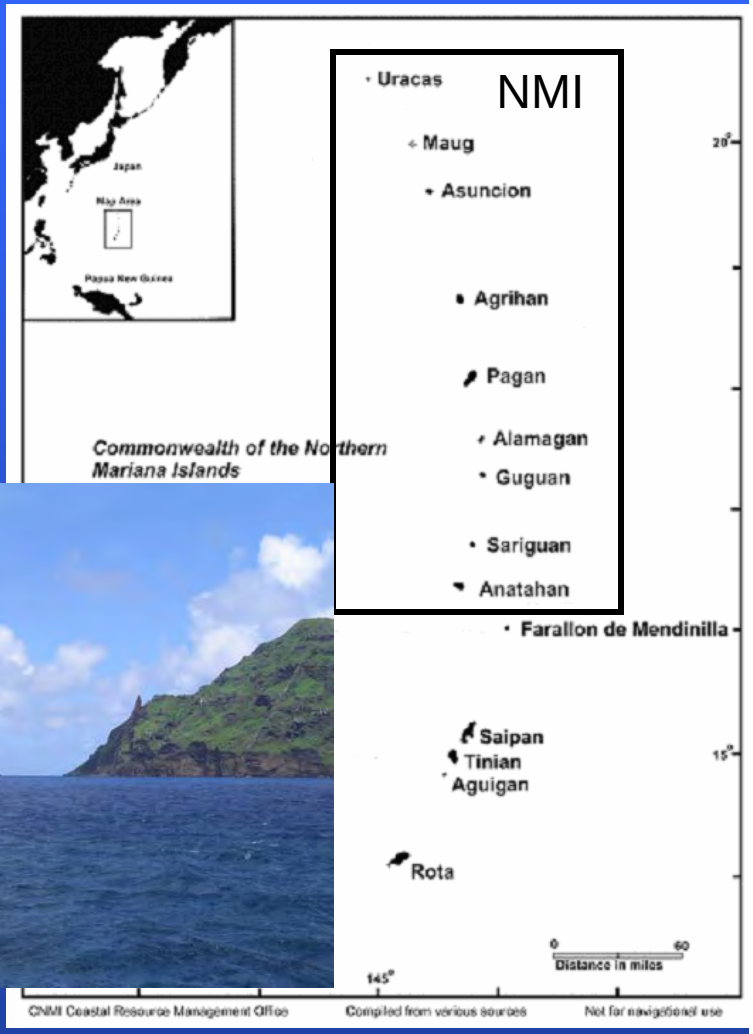
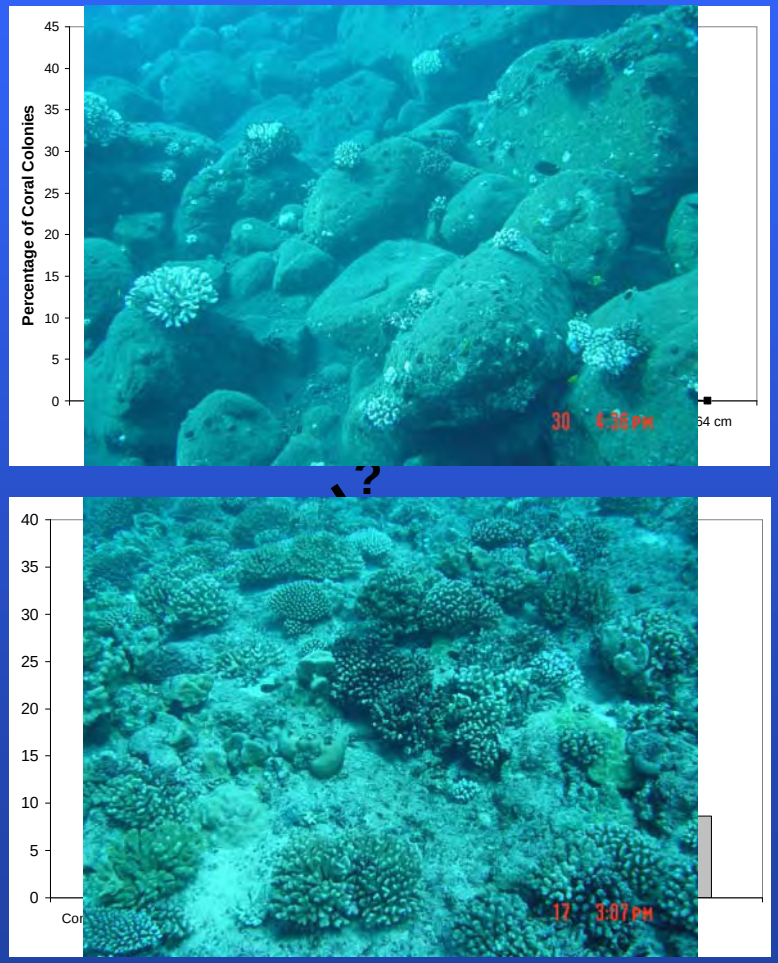
Example 1 – Northern Mariana Islands

- 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

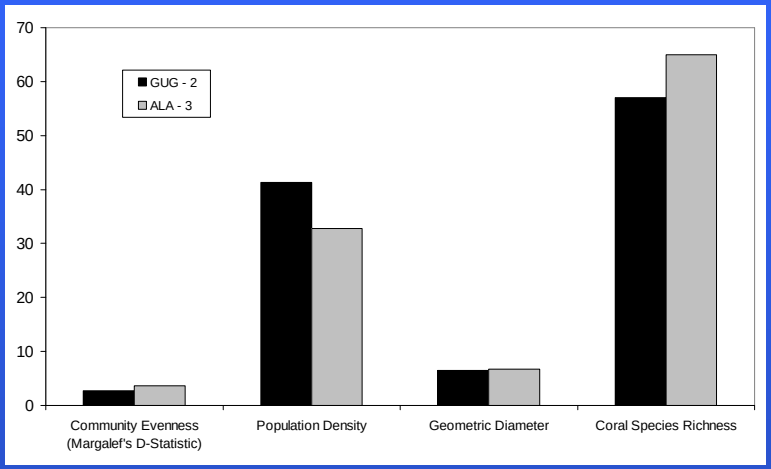
- To begin to understand impacts of feral animals we first use regional characteristics
  - GUG 2, ALA 3 have living, organic reef situated mainly on limestone reef deposits, not volcanic rock
  - wave energy

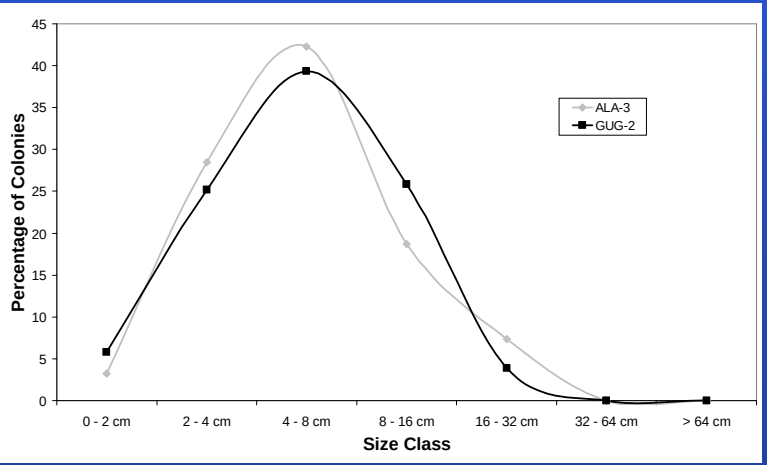
Feral Animals

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?





Fundamental Approach to Monitoring and Assessment of Reefs

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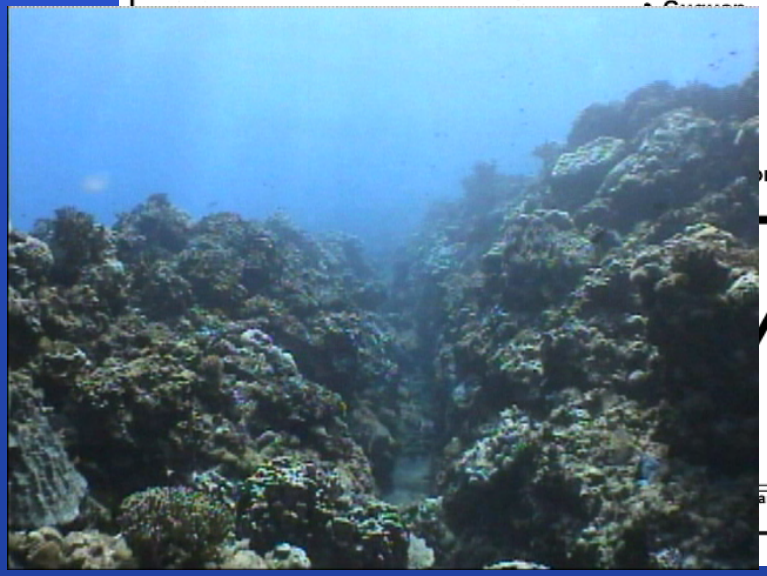
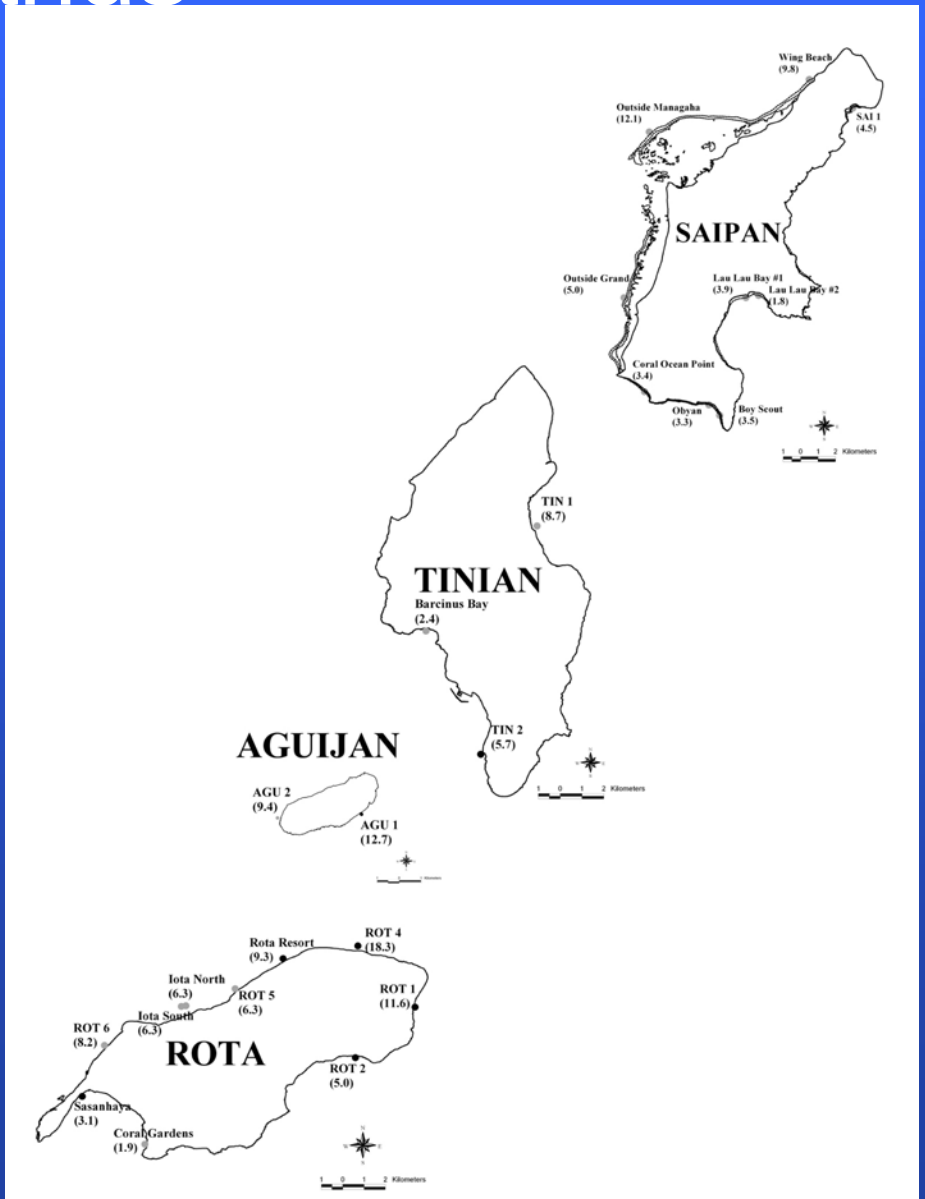
Example 2 – Southern Mariana Islands

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



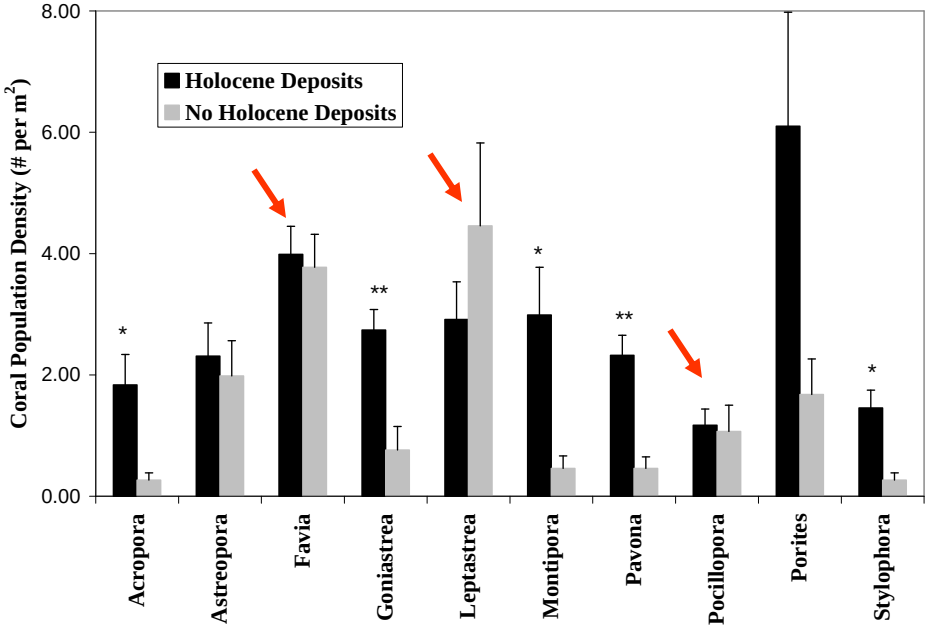
Example 2 – Southern Mariana Islands

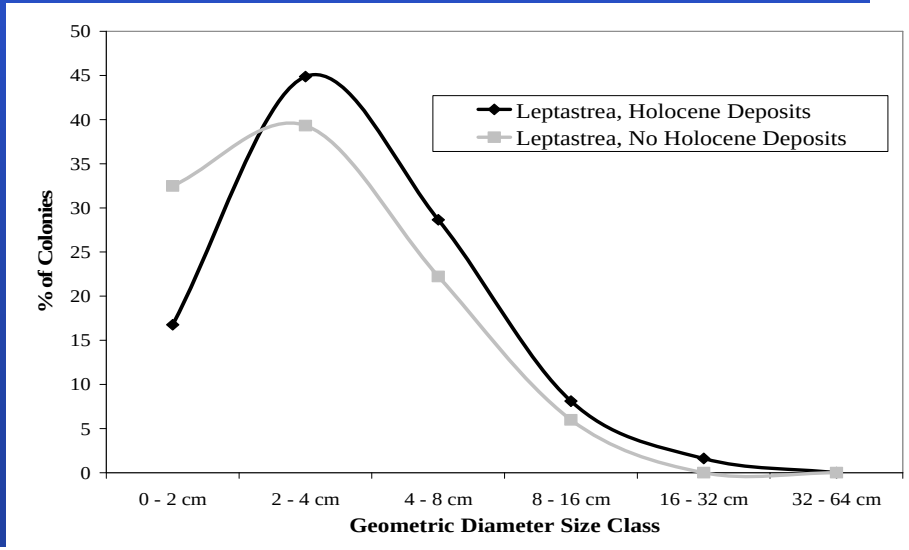
- Holocene (recent) deposits **not** related to exposure
- Deposits = topographic complexity, result of sediment trapping
- In circular nature, topographic relief provides refuge from scouring physical environment, and continues to build

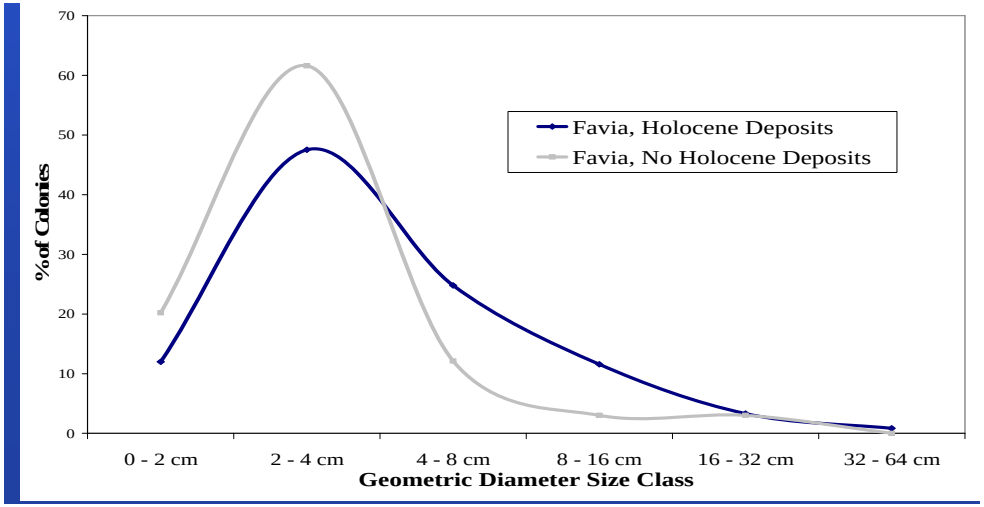


Example 2 – Southern Mariana Islands

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





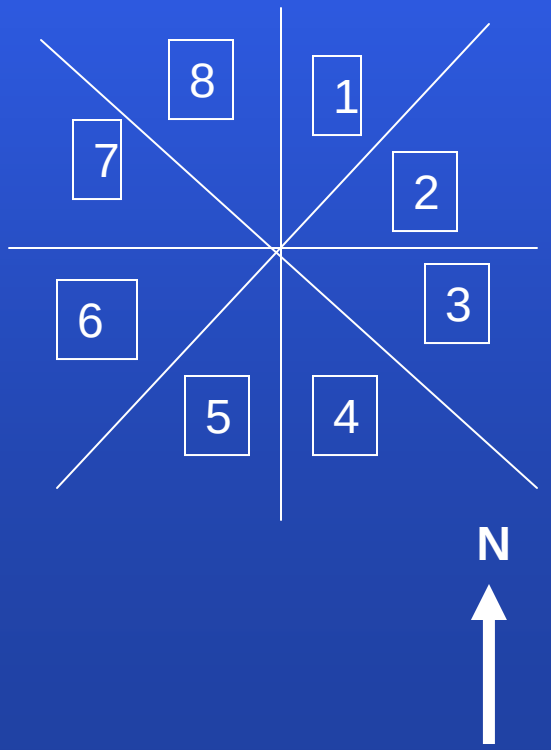


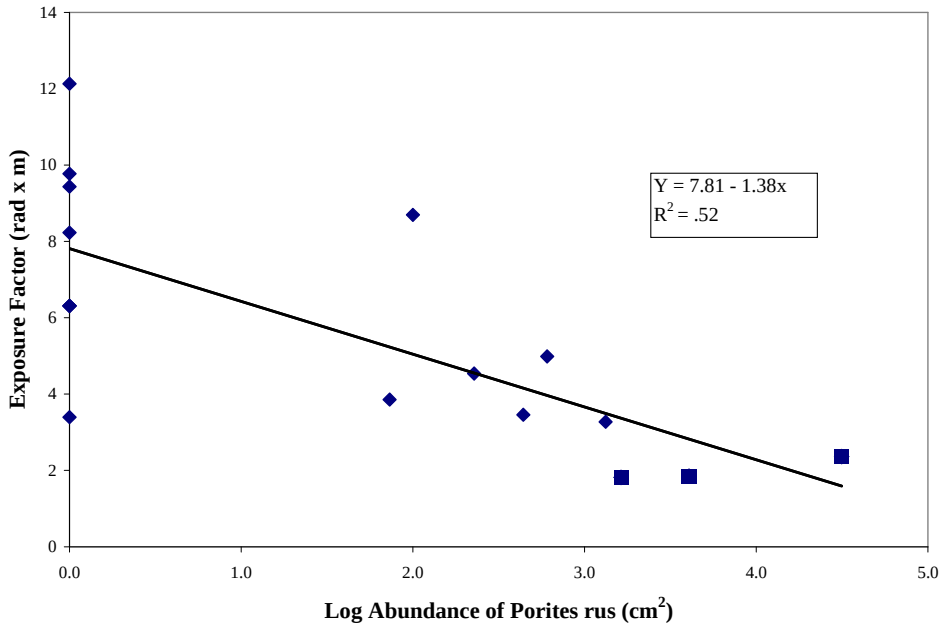
Example 2 – Southern Mariana Islands

- 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

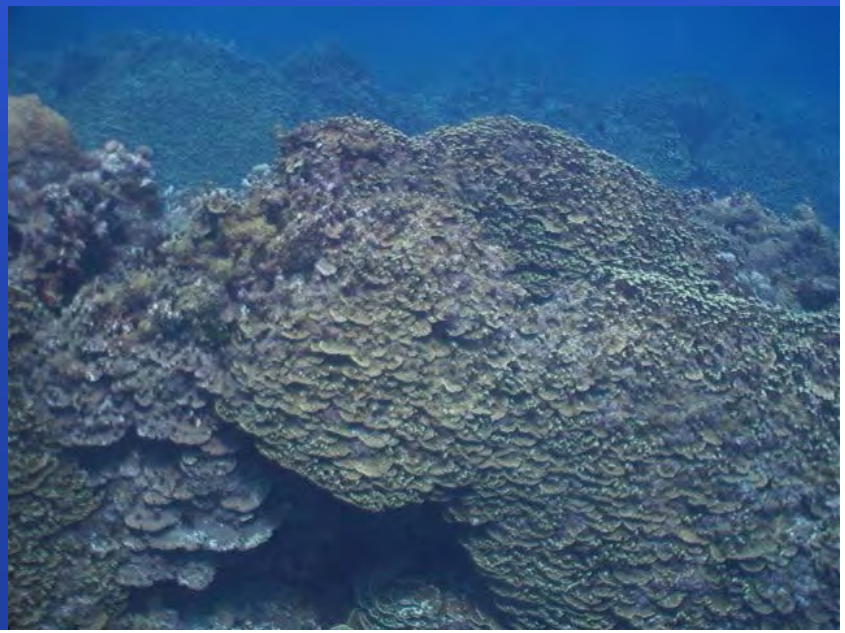
From NOAA buoy data

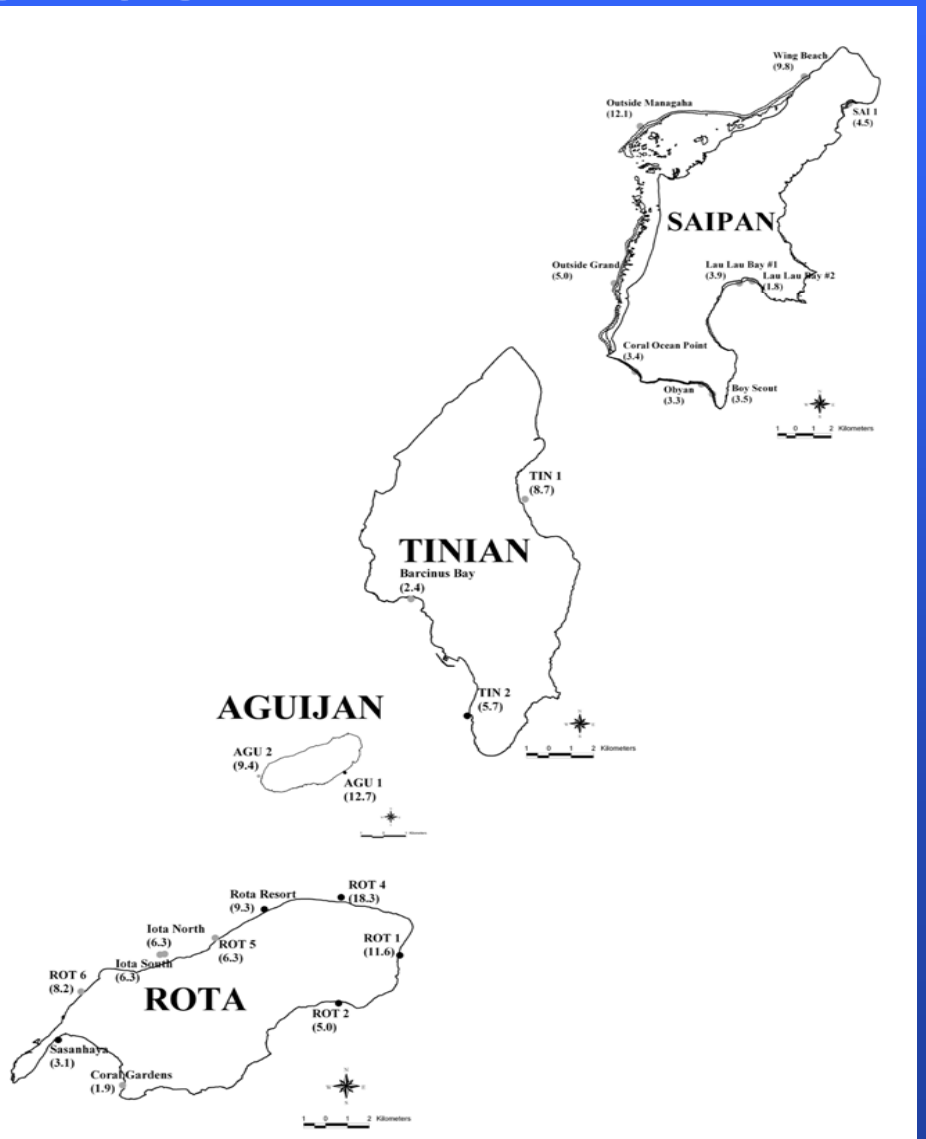




Example 2 – Southern Mariana Islands

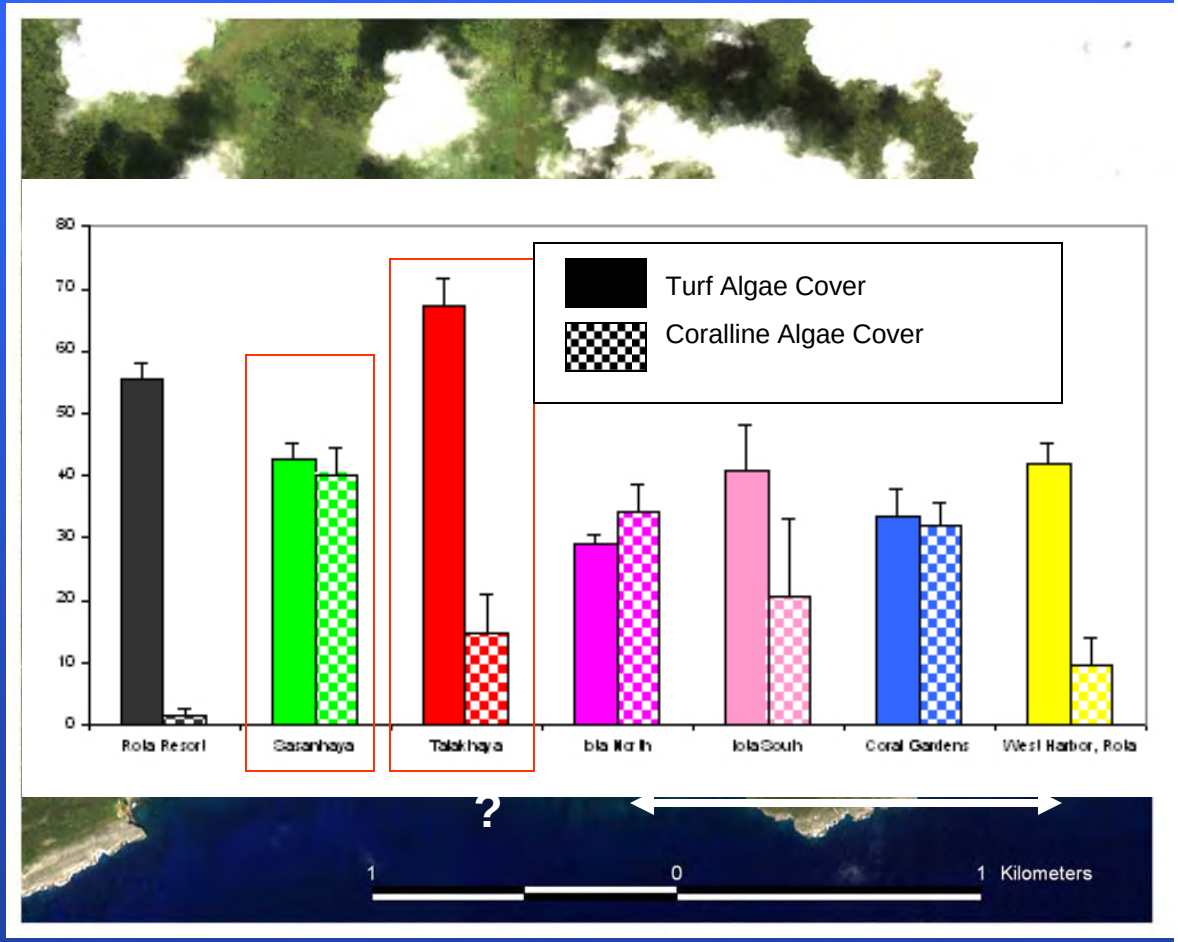
- Porites rus dominance, lower species diversity in extremely sheltered regions expected =





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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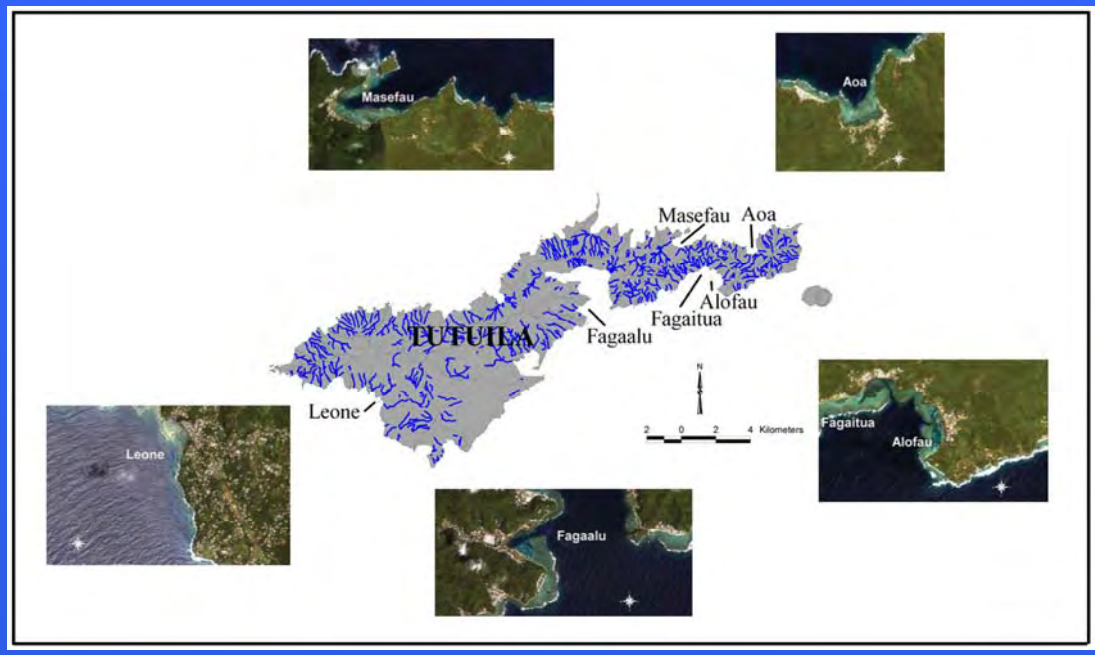
Example 3 – American Samoa

- 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



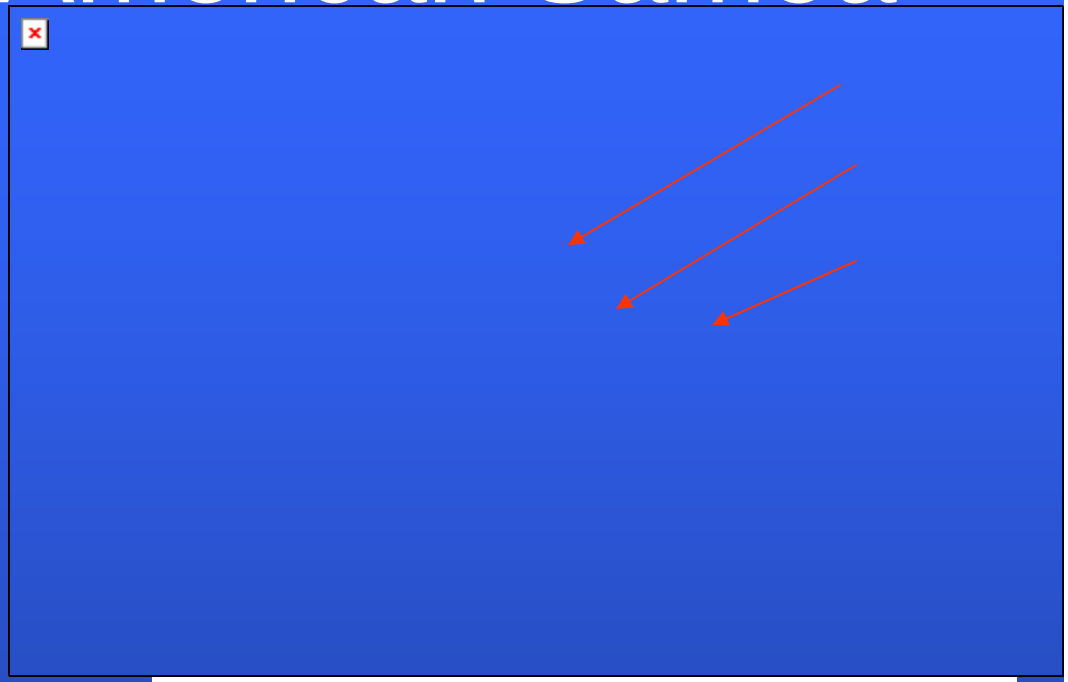
Arrows indicate similar geomorphology

Example 3 – American Samoa

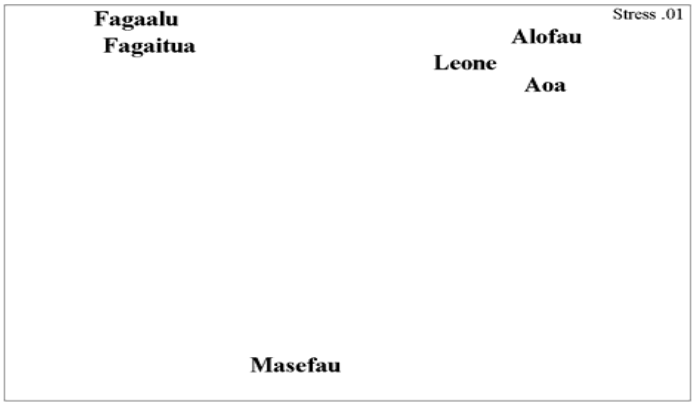
- Similar geomorphology at Aoa, Leone, and Alofau
- This setting allows for larger corals, greater coverage, due to stable abiotic environment
- NOT imply “better condition” (low community evenness)
- Stability ≠ Diversity

Example 3 – American Samoa

- Size Distribution of Coral Colonies



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

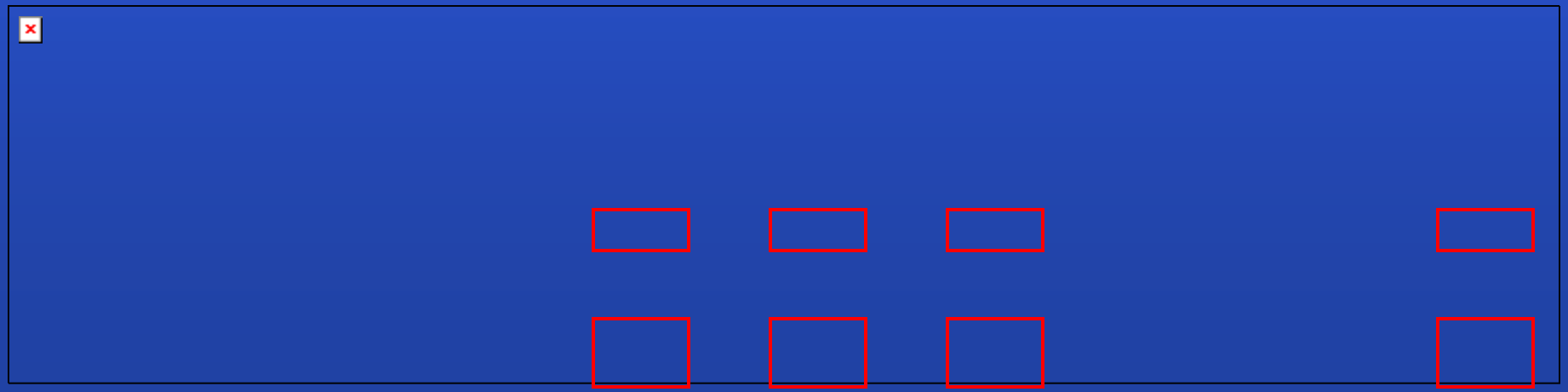


Houk, Didonato, and Iguel, submitted EMAS

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



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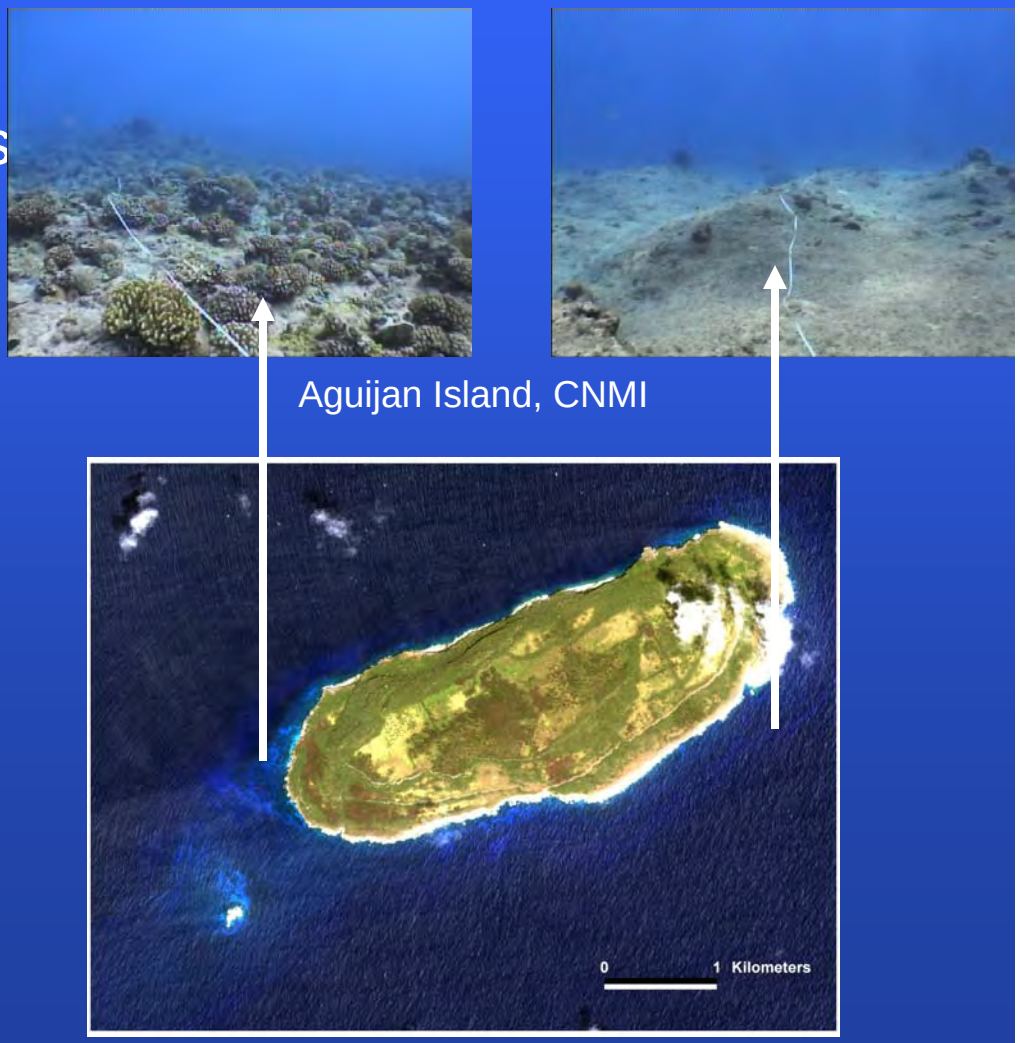
Conclusion

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



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