Main Hawaiian Islands Coral Reef Monitoring

Melissa Bos,
Coral Reef Management Specialist
State of Hawaii Division of Aquatic Resources

Monitoring Program Principal Investigators:
Bill Walsh, Ivor Williams, & Dave Gulko

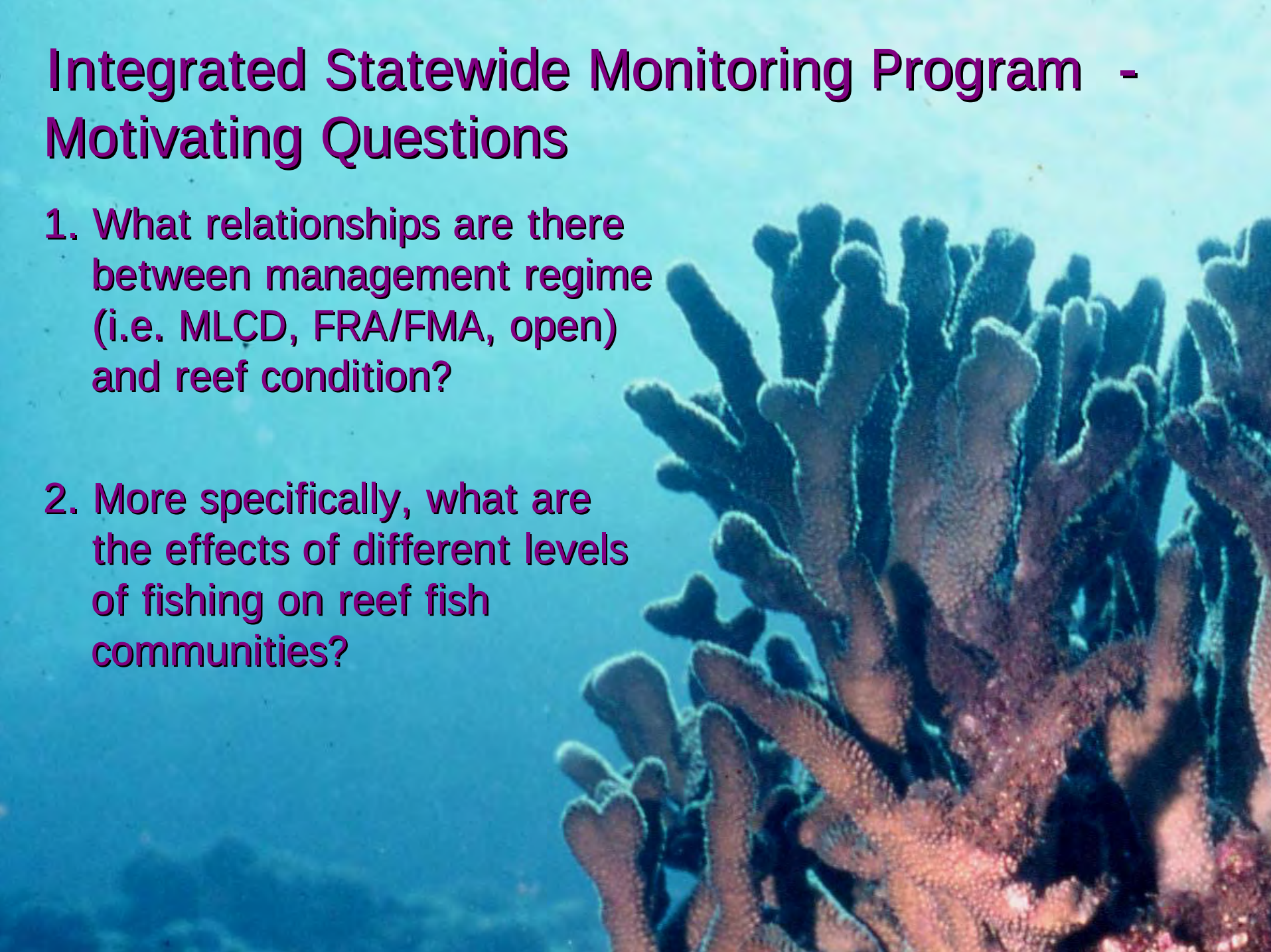
Three components:

- Integrated Statewide Coral Reef Monitoring
- Rapid Ecological Assessments of select sites
- Indicator monitoring in three watersheds (land-based pollution local action strategy)

Integrated Statewide Monitoring Program - Motivating Questions

1. What relationships are there between management regime (i.e. MLCD, FRA/FMA, open) and reef condition?

2. More specifically, what are the effects of different levels of fishing on reef fish communities?



Integrated Statewide Monitoring Program

Now:

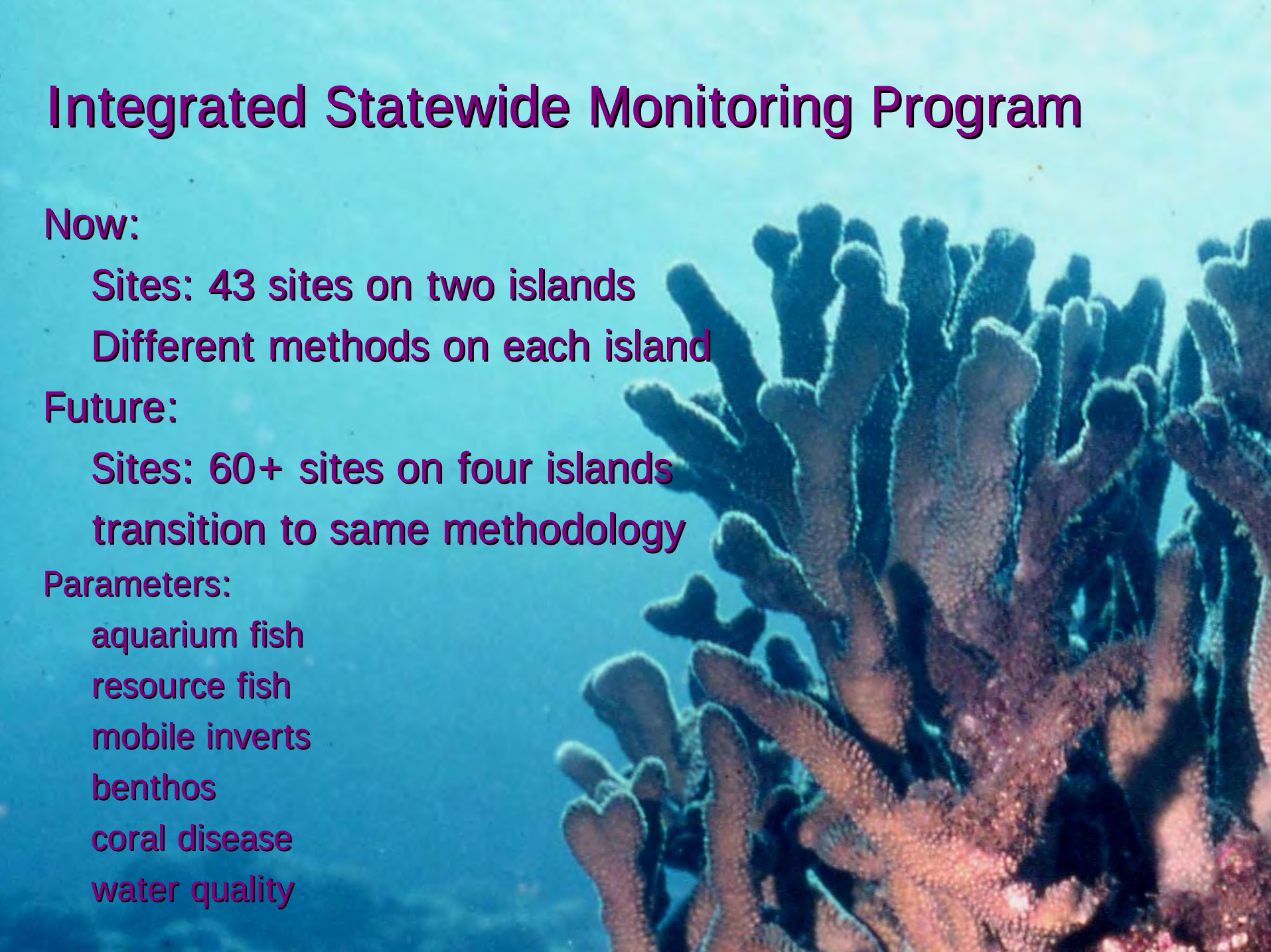
- Sites: 43 sites on two islands
- Different methods on each island

Future:

- Sites: 60+ sites on four islands
- transition to same methodology

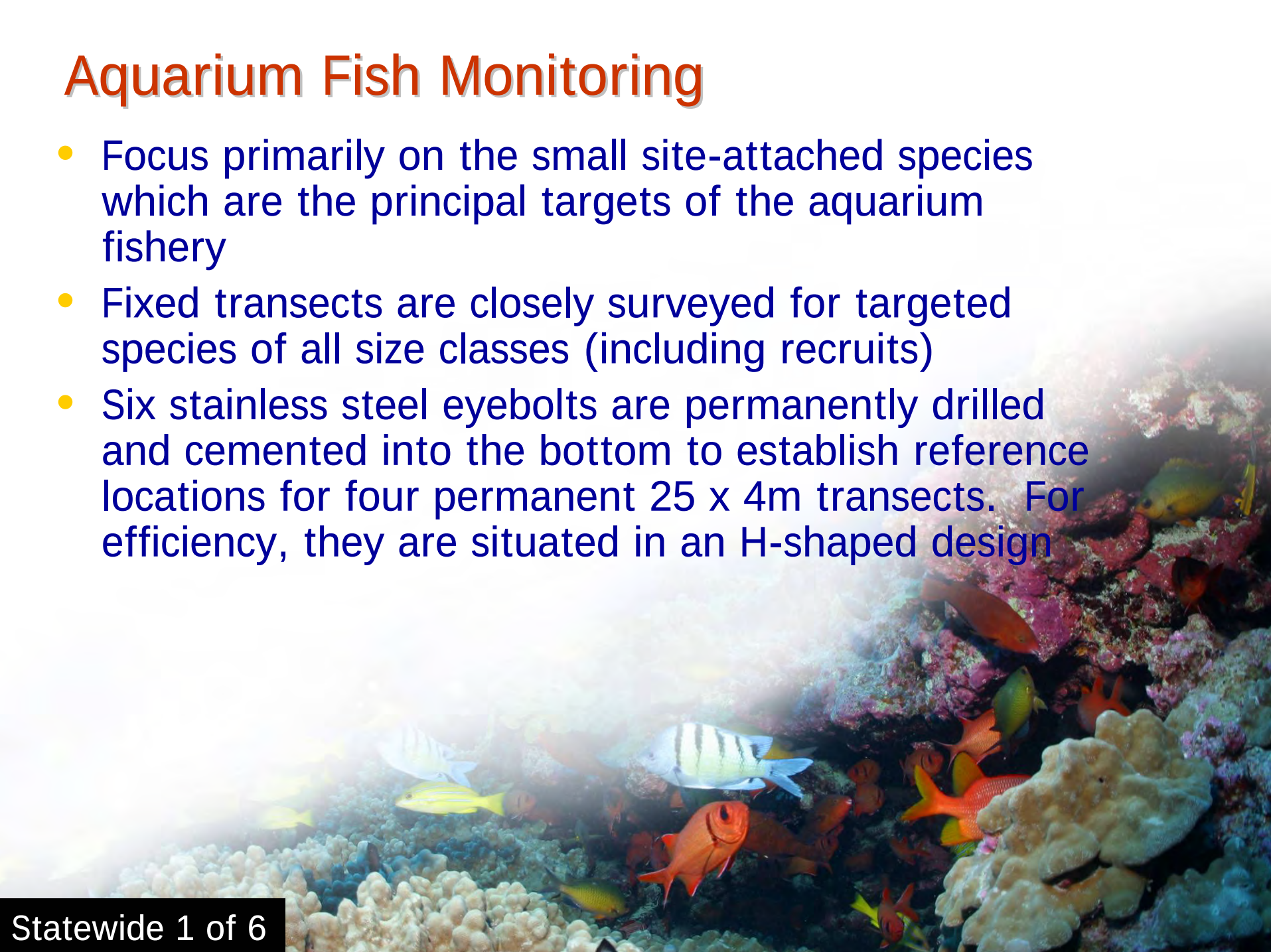
Parameters:

- aquarium fish
- resource fish
- mobile inverts
- benthos
- coral disease
- water quality



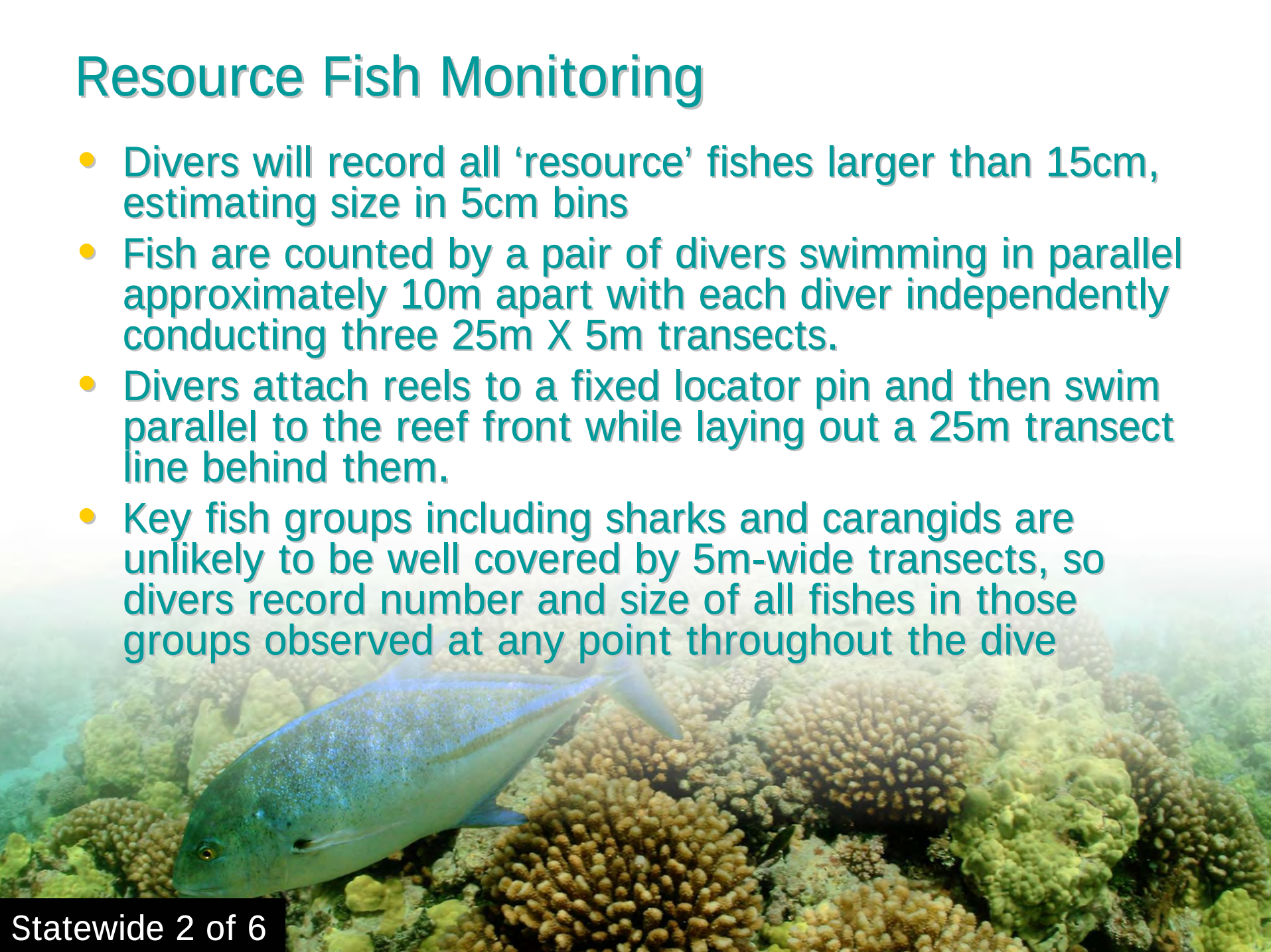
Aquarium Fish Monitoring

- Focus primarily on the small site-attached species which are the principal targets of the aquarium fishery
- Fixed transects are closely surveyed for targeted species of all size classes (including recruits)
- Six stainless steel eyebolts are permanently drilled and cemented into the bottom to establish reference locations for four permanent 25 x 4m transects. For efficiency, they are situated in an H-shaped design



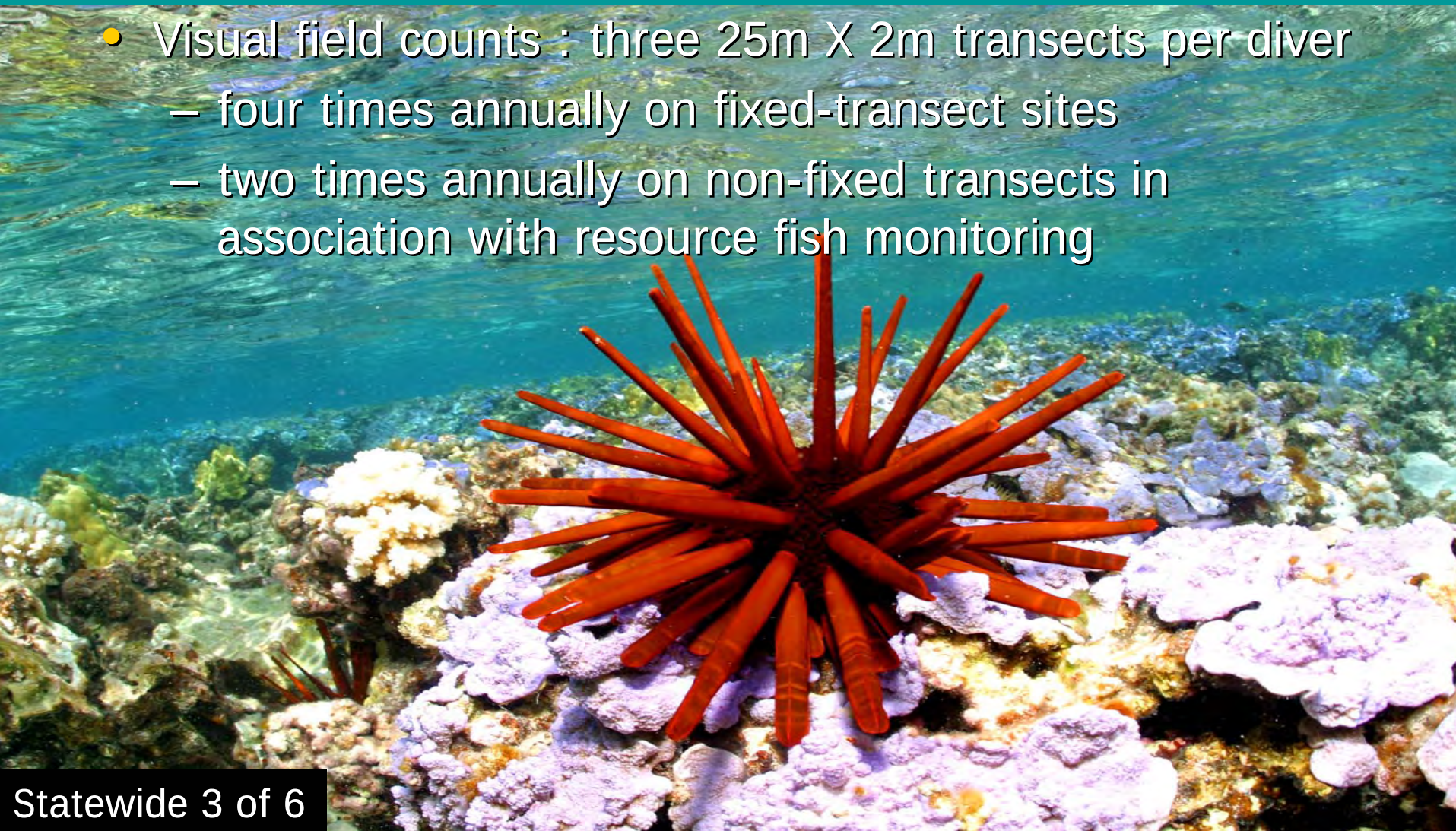
Resource Fish Monitoring

- Divers will record all ‘resource’ fishes larger than 15cm, estimating size in 5cm bins
- Fish are counted by a pair of divers swimming in parallel approximately 10m apart with each diver independently conducting three 25m X 5m transects.
- Divers attach reels to a fixed locator pin and then swim parallel to the reef front while laying out a 25m transect line behind them.
- Key fish groups including sharks and carangids are unlikely to be well covered by 5m-wide transects, so divers record number and size of all fishes in those groups observed at any point throughout the dive



Mobile Invertebrate Monitoring

- Urchins, sea cucumbers, crown of thorns and other inverts with important ecological roles
- Visual field counts : three 25m X 2m transects per diver
  - four times annually on fixed-transect sites
  - two times annually on non-fixed transects in association with resource fish monitoring



Benthos Monitoring

- Corals, sessile inverts, algae, substratum
- Visual estimation of the percent cover of categories of benthos and substratum along the 25 m transects (annually at non-fixed transects)
- Digital still photography surveys (every three years at fixed transects)
  - PhotoGrid® is used to overlay a number of random points on each image, and then the benthic component under each of the random points is identified.
  - analyze 25 images per transect and 20 points per image

Coral Disease Monitoring

- Initial stages of gathering baseline data
- In NWHI, coral disease was found at over half of the sites surveyed but the overall prevalence of disease (proportion of colonies examined that had disease) was low (average = 0.5%)
- Recent Oahu surveys revealed numerous disease states
- Initial analysis of West Hawaii reefs suggests low prevalence

Condition as Proportion of Total Coral Cover – West Hawaii Sites					
Site	**% Coral Cover**	**% Healthy**	**% Bleached**	**% Necrotic**	**% Recently Dead**
Lapakahi	19.5%	98.8%	1.0%	**0.2%**	0.0%
Kamilo	49.5%	98.4%	0.2%	**0.7%**	0.6%
Waiakailio	54.4%	96.3%	0.7%	**1.9%**	1.0%
Puako	49.9%	94.9%	1.9%	**1.5%**	1.6%
`Anaeho`omalu	41.2%	93.7%	1.3%	**3.5%**	1.4%
Keawaiki	29.9%	92.4%	6.1%	**0.8%**	0.6%
Ka`upulehu	40.9%	96.5%	1.2%	**1.7%**	0.6%
Makalawena	45.2%	92.7%	4.3%	**2.2%**	0.8%
Wawaloli	37.9%	91.0%	6.6%	**0.5%**	1.8%
Honokohau	48.3%	100.0%	0.0%	**0.0%**	0.0%
Papawai	32.8%	94.9%	1.9%	**1.5%**	1.8%
Kualanui	53.3%	96.0%	1.9%	**1.2%**	0.9%
Kealakekua	27.7%	94.9%	1.8%	**1.1%**	2.3%
Ke`ei	31.3%	99.1%	0.3%	**0.5%**	0.2%
Kalahiki	37.1%	96.1%	1.8%	**0.5%**	1.6%
Ho`okena	28.5%	89.0%	9.7%	**0.3%**	1.0%
Omaka`a	30.2%	94.1%	2.5%	**1.9%**	1.4%
Manuka	30.8%	95.1%	3.0%	**0.3%**	1.6%
Average	**37.4%**	**95.1%**	**2.5%**	**1.0%**	**1.3%**

Objective is to get a baseline assessment of the abundance and distribution of disease in corals at numerous sites including sites with different levels of anthropogenic stress

Methods

- Permanent transects to document the abundance and distribution of diseased coral
- Diseased colonies are described, photographed, and in some cases, small samples of diseased and healthy (for controls) coral are collected for histopathological analyses.
- The total search area recorded to determine the density of affected corals
- Testing digital still photography methods

Water Quality Monitoring

- In development – stay tuned!
- The Hawai`i Dept. of Health has established criteria (threshold concentrations) for most water quality constituents but since water quality is so variable over time these guidelines require a minimum of 10 samples to compare the geometric mean with the criteria.
- In the future, anticipate using sensor systems that can measure temperature, salinity, and nutrients (nitrate, ammonium)
- Present instrumentation either has to be calibrated too often for long-term deployment is prohibitively expensive or has insufficient limits of detection for clear coral reef waters
- Portable turbidity meters are being purchased to be employed in ‘incident’ situations as recommended by the EPA

Rapid Ecological Assessments

- Hawaii REA protocol differs from other REA protocols and long-term monitoring protocols in its focus on descriptive sub-habitat classification and ecological function
- Goal is to document
  - habitat diversity and ecological function
  - biodiversity and biomass comparative values
  - range and coverage of both native and alien flora and fauna;
- Site Selection: 3-7 sites per island that
  - represent areas of extremely high biodiversity, habitat complexity, and ecological function
  - high priority for immediate management response given pressures
- Methods
  - GPS to map species distribution and ecological function area,
  - digital stills to document species diversity and habitat complexity, and
  - limited collections for voucher specimens to establish species identification

Rapid Ecological Assessments

Preliminary results of Oahu offshore islet REAs reveal

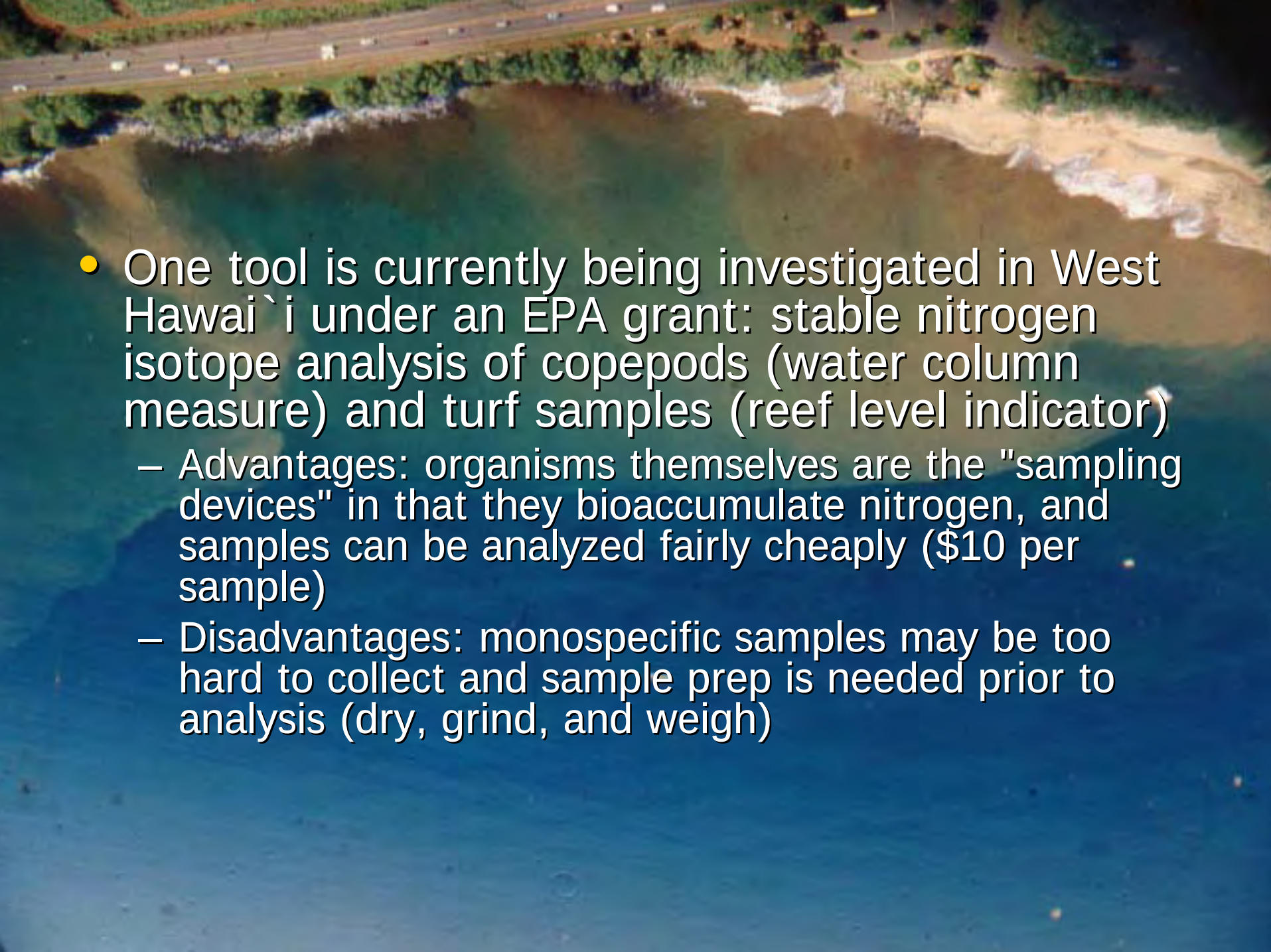
- a large variety of complex habitats, the vast majority of which had not been previously described (and do not appear in the NOAA Benthic Habitat maps)
- some of the smaller islets hold extremely high biodiversity and fish biomass on levels that exceed many of our existing MPAs and which trophically are different than many sites on O‘ahu
- unique subhabitats such as parazoanthid walls, seagrass meadows, *Sinularia* and zoanthid fields which had previously not been described
- at least one suspected new species of parazoanthid which probably functions as a keystone species within the cave habitat that it dominates
- documentation of previously unknown human site usage including destructive and illegal fishing techniques that have resulted in an active enforcement investigation

Indicators of Pollution Stress

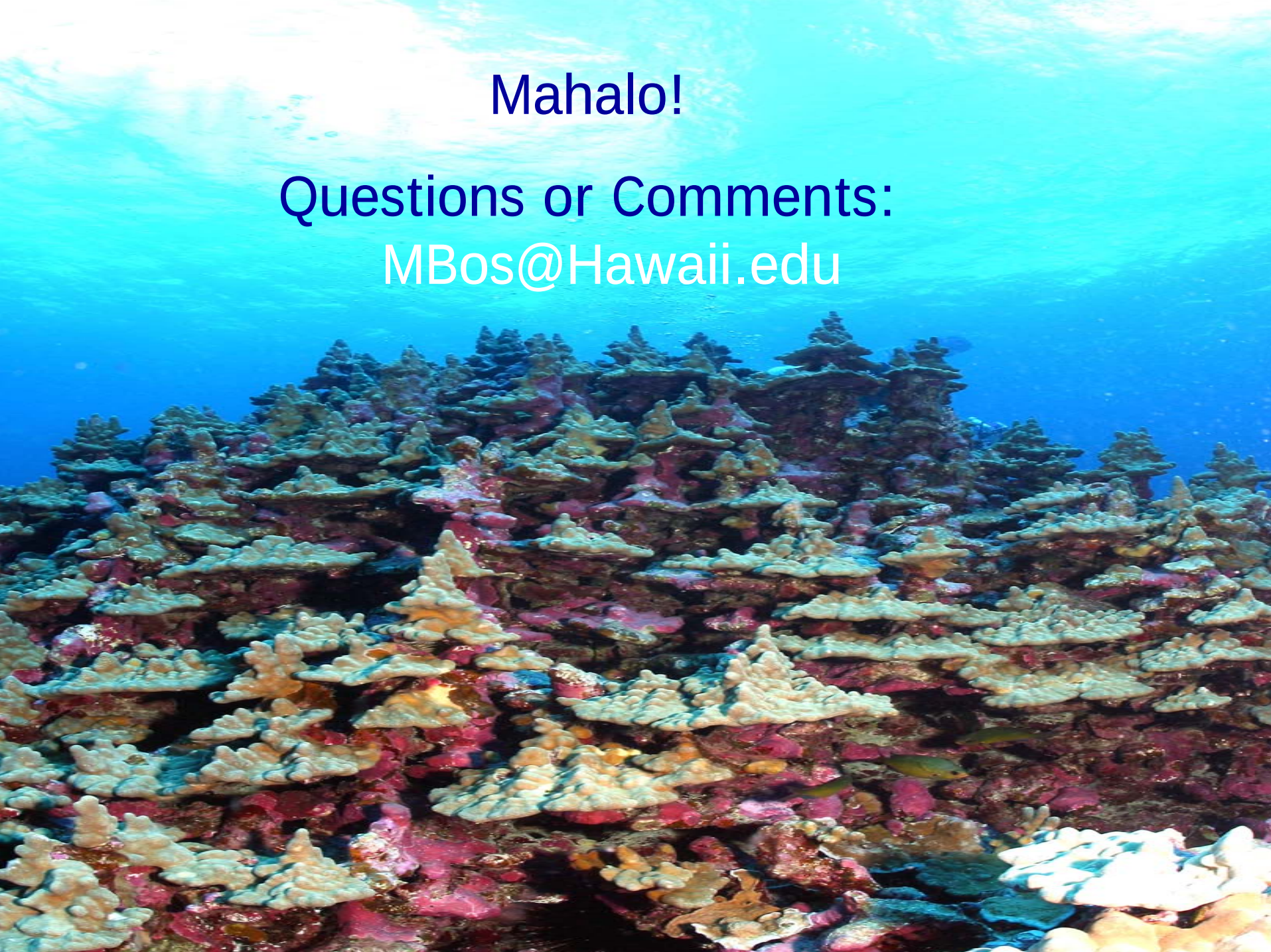
- A recent EPA/NOAA workshop on Assessing Land-Based Pollution Stress on Coral Reefs noted that while there are some tools available now for the monitoring and assessment of water quality over coral reefs, the most powerful and appropriate tools are still under development or in the experimental state.

- LAS steering committee is investigating potential tools and gathering funding to implement pilot studies in three priority watersheds

Bernardo Vargas-Angel	histopathology
Ruth Gates	gene expression profiling
	coral-associated mircobial community profiling
Mike Field	photography
Bob Richmond	coral physical exam
	protein expression profiling
Marlin Atkinson	conductivity sensors with live feeds to internet
Celia Smith	Pulse Amplitude Modulation (PAM) Fluorometry to gradients in algal composition
	sediment pore water nutrients
Mark Fonseca	coral recovery modeling
Dave Gulko	Rapid Ecological Assessments (REAs)
Jim Jacobi	remote sensing/AGNPS
Alan Friedlander	Interactive Mapping, monitoring and assessment
Mike Risk	bioindicators



- One tool is currently being investigated in West Hawai`i under an EPA grant: stable nitrogen isotope analysis of copepods (water column measure) and turf samples (reef level indicator)
  - Advantages: organisms themselves are the "sampling devices" in that they bioaccumulate nitrogen, and samples can be analyzed fairly cheaply ($10 per sample)
  - Disadvantages: monospecific samples may be too hard to collect and sample prep is needed prior to analysis (dry, grind, and weigh)


Mahalo!
Questions or Comments:
MBos@Hawaii.edu