Hawai‘i Coral Reef Assessment and Monitoring Program (CRAMP)

A Program of the Hawaii Coral Reef Initiative (HCRI)
First Quarterly Report 2001
CRAMP 2001-2002+ Objective:

To develop a functional, defensible scheme for determining reef community condition in relation to reference conditions (pristine state) for use in the application of biocriteria (indicator species, biological integrity) that can describe the condition of Hawaiian coral reef ecosystems.

This scheme will enable investigators to quantitatively define status of Hawaiian coral reef communities in an efficient and defensible manner.

“At this time, sufficient information does not exist to draft biocriteria guidance for coral reef ecosystems.”

However, since 1998 CRAMP has developed a significant amount of information relevant to this task.
Objective: To describe spatial and temporal variation in Hawaiian coral reef communities in relation to natural and anthropogenic forcing functions.

spatial = assessment
temporal = monitoring
Coral reefs are biologically complex, but it has been shown that relatively few biological attributes are needed to provide reliable signals about biological condition of reef communities. Therefore coral reefs are analogous to all other aquatic systems, as discussed by Karr and Chu (1999).

We propose that:

Analysis of benthic reef communities (corals and algae) along with reef fish communities provide reliable signals that enable quantification of the condition of Hawaiian reef communities.

Reef corals, reef fish and benthic algae are the bioindicators of choice in defining the biological status of coral reef communities.
Reef corals, benthic algae, and reef fish meet all the criteria described by Jameson et al (1998) for desirable bioindicator organisms:

- Primary habitat forming organisms (corals and benthic algae).
- Narrow environmental tolerance (corals).
- Respond to a variety of anthropogenic stressors (corals, algae, reef fish).
- Sessile benthic organisms that remain in place and are continually exposed to a stress (corals and benthic algae).
- Long-lived organisms that provide an integrated signal of prevailing stresses (corals).
- Abundant throughout the monitoring area (corals, macroalgae, fish).
- Organisms easy to sample objectively (corals, benthic algae, fish).
- Not subject to human exploitation (corals).
- Stable taxonomy and easily taught to non-specialists (corals and fish)
Biological status at a given site must be viewed in the framework of physical habitat:

- Wave energy
- Substrate Type
- Sediment Grain Size and Composition
- Depth
- Slope, Relief
- Rugosity
- Water Quality Parameters
- Delivery rate of land-derived materials, etc.
Process of building the model:

Each environmental factor and biological attribute is tested for its merit.

Relevant parameters are integrated into the model.

Preliminary work has clearly identified the feasibility of this approach.

Three examples developed from the CRAMP database follow:
1. rugosity (physical)
2. wave energy (physical)
3. fishing pressure (anthropogenic)
Rugosity (bottom complexity) is one of the parameters that measured at each site and will be one of the parameters included in the model used to define the physical environment.
Wave energy is another important physical factor controlling reef coral, algae and reef fish community structure. Our analyses to date have used crude estimates (north exposed, north sheltered, south exposed, south sheltered, bay. Nevertheless clear patterns develop in both the coral and fish data sets when plotted using Detrended Correlation Analysis:
The wave energy analysis will be refined with use of improved estimates of wave energy using the U.S. Naval Oceanographic Office WAM wave model. We are currently downloading the nowcasts on a daily basis.
Forcing function (natural): wave energy

Ocean areas colored black are not modeled and contain no useful information.
Comparison of fish biomass in MPAs and areas open to fishing

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These preliminary results suggest that:

1. It is possible to develop a model that will describe expected community composition (benthic and reef fish assemblage) under a given set of physical conditions (wave exposure, substrate type, rugosity, depth, etc.) and

2. Such a model could be applied to identify reefs where the biological communities are being significantly impacted by anthropogenic activity.
However, development of the model and application of the model requires methodology for quickly and inexpensively obtaining an adequate quantitative description of a given reef habitat.

Thus we have developed the CRAMP Rapid Assessment Technique (RAT).
Main features of the Rapid Assessment Technique (RAT):

• reduced number of transects (5 per site) but sufficient statistical power for spatial comparisons.

• quantitative data on benthos (corals and algae), reef fish, rugosity, etc. equivalent to monitoring sites.

• use of GPS to describe location, no pins, no photoquads.

• requires 2 divers (1.25 h bottom time each) and 8 h for data entry (fish and benthos) per site.
Cramp Monitoring Network 2001
(excellent temporal data, restricted spatial data)

All sites (green completed and in 2nd cycle of monitoring. Kawaihae and Waikiki additional sites being completed (yellow)
This research will rely on methodology that can readily be applied within the existing capabilities of local, state and federal agencies responsible for management of our coral reef resources.

Training of management personnel in these techniques will be accomplished through statewide workshops and continual joint assessment activities with management personnel on a “time-available” basis to accommodate work schedules.
A major complication on Hawaiian reefs is that introductions of non-indigenous species can alter reef communities in an unpredictable manner and cause serious environmental impact. Such invaders (fish as well as benthic organisms) will be considered in the proposed model.

Temporal trends in mean number of introduced blue-spotted grouper (*Cephalopholis argus*) observed per transect (250 square meters) at selected CRAMP sites along the West Maui coastline.
Changes in coral and algae cover in Kane‘ohe Bay at CRAMP sites
Dramatic overgrowth of live coral by the native algae *Dictyosphaeria cavernosa* in Kaneohe Bay, Oahu.