Coral Health Atlas: a web application for disseminating geospatial ecoinformatics

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Coral reefs

• Foundation for productive ecosystems
• High levels of biodiversity
• Immense economic value
• Facing multiple local and global stressors
Coral Diseases

- Increase in reports of diseases worldwide
- Etiologies and physiological impacts unknown
- Detrimental effects on ecosystem function
Investigating coral health

- Epizootiology: The science dealing with the character, ecology, and factors controlling the presence of a disease in an animal population

- Prevalence “How many have it?”
- Severity “How bad is it?”
- Cofactors: “What affects likelihood of disease?”
- Impact: “How are biological functions impaired?”
Project objective

• Collate biological and ecological data pertaining to coral health to disseminate ecoinformatics on a web platform
• Work together with researchers from a variety of disciplines to develop a collaborative product with community benefit
• Why investigate coral health?
  – Directly affects well-being of Hawaiian Communities
  – “Canary in a coal mine”
Web application goals

- Provide general information pertaining to coral health and marine ecosystem research
- Integrate findings from multiple datasets collected at sites throughout Hawai‘i
- Display data in an interactive and visual manner
Web application features
Coral Health

Importance of Corals:

Reef forming corals provide habitat for highly diverse and productive communities of organisms throughout the world’s tropical and subtropical oceans. Corals are invertebrate animals related to jellyfish and sea anemones. Inside a coral is a consortium of algae, bacteria, archaea, viruses, and fungi all living in a dynamic equilibrium with the coral that acts as a host to them (1,2). These coral-microorganism communities all work together as a functional symbiosis called the ‘coral holobiont’ (3,4). The coral holobiont is responsible for the trophic and structural foundation of coral reef ecosystems (5). It is because of the mutualistic symbiosis between corals and photosynthetic dinoflagellates, which fix large quantities of carbon dioxide, coral reefs are among the most productive ecosystems on the planet.

Efforts to monitor and protect corals have increased over the last decade as coral reefs have been declining around the globe. These systems proved economic and environmental services to millions of people as sources of food, jobs, chemicals, pharmaceuticals, and shoreline protection. The intensity and occurrence of perturbations affecting nearshore environments is projected to increase, thus placing nearshore coral reef ecosystems in a precarious position (6). Corals, just like other animals, succumb to diseases especially when the environmental and biological stressors around them work synergistically against them. Protection and conservation of coral reef ecosystems will require a thorough understanding of the dynamics of coral health and disease.
History

Cultural importance:

In the Hawaiian worldview, corals are perceived as ancestral beings with spiritual energies, which are integrated within the natural environment and wider consciousness (1-5). The Kumulipo (Source of deep darkness), a Hawaiian genealogical and evolutionary chant, denotes the history of all life forms came and evolved from corals (1). Thus, the genealogy of the Hawaiian Islands and people begins with the coral polyp (Figure 1). Papahānaumokuākea, the oldest and most northern islands/atolls, are considered “kupuna” or respected elders because coral reefs are the ancestral connection with the gods and cosmos.

Traditionally, many Native Hawaiians understand the ocean to be spiritually connected to Kanaloa, one of the major gods (along with Kāne, Kū, Lono, and Hina). However, the realm or domain of Kanaloa is that of the open ocean. The inner region from the ‘āe kai (water’s edge) and kai he’e nalu (wave breakers) appears to be the realm of Hina and to a lesser extent her husband Kū (2,6). This region is collectively known as Hinahele. Many sub-deities and kinolau (body forms) of Hina reside in this Hinahele or coral reef realm. Specifically, Hinaopuhalako’a is the goddess associated with corals and the spiny creatures of the ocean (7). This association of a deity to a kinolau, such as Hinaopuhalako’a to coral, signifies that the kinolau was important in Hawaiian culture from either a practical use or spiritual standpoint, or both.

Figure 1. Montipora flabellata coral polyps (Photo credit: Makani Gregg)
Interactive Data Map
User Controlled Data Display

Severity of all disease

Prevalence of all disease

Specific disease information

Individual species information
Additional Data Layers
Key elements of success

• Dataset pertains to a an environmental issue that has local and global implications

• Integration of information from multiple datasets

• Utilization of technology through collaboration
  – Field scientists, image acquisition and spatial analysis, data management, web application development

• Provides general information for broad impacts

• Caretakers committed to data management and maintenance of the web application
Outreach Benefits

- Provides access to information and data for the public and local communities affected by resources
- Managers can utilize data to track changes in coral health and identify areas at risk
Future goals and deliverable
Current progress and steps forward

• Improve interactive map to display information pertaining to multiple ecosystem characteristics
• Re-design site architecture to improve the aesthetics and availability of information
• Acquire funds to collect and obtain additional data and visualization products
• Increase public awareness of website
  – http://coralhealth.spatial.hawaii.edu/
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Questions?
(Please visit) http://coralhealth.spatial.hawaii.edu/