



# TEN YEAR RESURVEYS OF THE BIODIVERSITY OF MARINE COMMUNITIES AND INTRODUCED SPECIES IN PEARL HARBOR, HONOLULU HARBOR, AND KE'EHILAGOON, O'AHU, HAWAII

Project # 07-343

## Background:

Introduced marine species are considered one of the major ecological challenges facing the continuation of balanced and diverse marine communities and ecosystems. This project compared marine introduced species in Pearl Harbor and Honolulu Harbor/Keehi lagoon to conditions of 10 years ago. The 1996-97 DOD Legacy Project Number 106 determined that in Pearl Harbor 96 out of a total of 434 marine species, or 22%, were introduced or cryptogenic (i.e. of indeterminate) origin. These percentages were among the highest of any areas that had been surveyed in the world, suggesting that O'ahu's harbors have historically been major recipients of introduced marine species and a possible point from where they may have been distributed elsewhere in Hawaii. The other major finding from the 1996 Pearl Harbor Legacy project was that reef corals, formerly missing from Pearl Harbor due to earlier poor water quality, were becoming re-established in the harbor.

## Objective:

The study compared environmental conditions and the marine biota in Pearl Harbor and Honolulu Harbor/Ke'ehi Lagoon in 2007-2008 with the results of 1996-97 surveys using similar sampling sites, sampling methods, and the same project manager as for the previous study. Efforts were to also focus on determining whether coral colonization in Pearl Harbor, first noted in 1996, had continued in the last decade and whether invasive algae, especially *Gracilaria salicornia*, were spreading and interfering with coral settlement and survival.

## Summary of Approach:

Sampling and observations of biota were made at or near 14 of the 15 Pearl Harbor stations previously surveyed in 1996 and at six stations in Honolulu Harbor/Ke'ehi Lagoon that were previously surveyed in 1997 duplicating, wherever possible, the locations of stations previously surveyed. In addition, a series of snorkeling surveys were made in 2007-8 along the shorelines of Pearl Harbor and on shallow areas of Ke'ehi Lagoon to determine invasive algae relative abundance and the locations of all reef corals sighted along the transects, which were mapped using coordinates recorded by GPS.

## Benefit:

Pearl Harbor is one of the most strategically located naval bases in the Pacific and is subject to both receiving and distributing introduced species to and

from other ports. Knowledge of the species composition and abundance of introduced species is therefore a major requirement for determining risk assessment from organisms that may contribute to vessel and equipment fouling and interfere with native marine communities. The project has provided information on present levels of introduced species in Pearl Harbor that can be compared with conditions in 1996 and with other locations. Determination of proliferation of reef corals in Pearl Harbor provide a biological indicator of the success of clean up measures that have been undertaken in the harbor in the last two decades. However invasive algae *Gracilaria salicornia* is intensely competing with reef corals and other shallow reef organisms, and the study provides the first comprehensive information on the distribution of this alga in the harbor that might be used in its management.

## Accomplishments:

All objectives proposed for the project were completed. A total of 298 species or higher taxa were collected or observed from the 14 stations sampled in Pearl Harbor and 195 in Honolulu Harbor-Ke'ehi Lagoon. Ninety-six genera or species, or 32%, of the total taxa in Pearl Harbor and 68, or 35% for Honolulu-Ke'ehi Lagoon are designated as introduced or cryptogenic. These values are comparable to but somewhat higher than the percentages determined for the 1996-97 studies. The findings support the conclusion from the 1996 Legacy study that environmental physical conditions in the Pearl Harbor have improved since naval shipboard effluent release ceased in the 1970s and most sewage discharges were removed in the 1980s. This and other recent surveys have found considerable numbers of reef corals colonizing hard substrata in the harbor and previously unreported reefs of *Porites compressa* that have existed well into West Loch. Unfortunately, the improved environmental conditions that have developed in Pearl Harbor in the last two decades are being negated by the proliferation of the invasive alga *Gracilaria salicornia* and to a lesser extent, the alga, *Acanthophora spicifera*, and by the sponge *Mycale grandis*.

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