

GALAPAGOS COMMENTARY

PROTECTION OF SHALLOW MARINE ECOSYSTEMS IN GALAPAGOS BY PERMANENT MOORINGS

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SUMMARY

We describe a new system of permanent moorings designed for tour boats, to be installed throughout Galapagos, and the deployment of a research and monitoring vessel to Wolf Island.

RESUMEN

La protección de los ecosistemas costeros de Galápagos por los atracaderos permanentes. Describimos un nuevo sistema de atracaderos permanentes, diseñados para los barcos de turismo y para ser instalados a lo largo de las islas Galápagos, así que el despliegue de un barco de investigación y monitoreo a la isla Wolf.

GALAPAGOS CORALS AND THE NEED FOR FIXED MOORINGS

The tropical location of the Galapagos Islands might suggest that its underwater volcanic slopes should be covered with hard corals, as in the West Pacific. This is not the case due to the variable water temperatures, which do not provide the stable environment that corals thrive in. Notwithstanding, the Galapagos have 21 species of zooxanthellate corals, including 19 reef-forming species. Moreover, especially in the northern islands of Darwin and Wolf, some extensive coral reefs have developed.

In recent times, higher water temperatures and severe El Niño events, apparently associated with climate change, have led to extensive coral mortality. Growing awareness of the fragility of corals worldwide and in the Galapagos inspired the development of a project to locate coral reefs, study their diversity in Darwin and Wolf, and establish sustainable mechanisms to protect them for the long term. This was important given the growing dive tourism that has stimulated increasing and indiscriminate deployment of anchors in the archipelago. This work concentrated on the management of anchorage sites and the search for alternative methods of securing vessels.

Traditional mooring techniques (without use of the vessel's own anchors) utilizing heavy weights and chains, may still cause considerable bottom damage as the chains scrape across the bottom, creating a large circle of impact around the mooring centre. New techniques now available are designed to reduce such impact. These use methods of

penetrating the sea floor and inserting solidly-fixed steel components, from which lines run to the surface where they are attached to mooring buoys. These techniques, specifically helix and Halas moorings, have been tested in various regions with considerable success.

MOORING DESIGNS

Calculations based on the type of vessels used at Darwin and Wolf (live-aboard dive vessels) and the most extreme oceanographic conditions likely to be encountered led to a decision to utilize in sandy bottoms two 3 m helix screws, driven deeply into the sand by a hydraulically powered reduction head coupled to a rotating socket. For rocky bottoms, stainless steel U-bolts (316 grade) of up to 25 mm diameter (a Halas design) were chosen for installation by using a hydraulic drill and bit to perforate the rock to a depth *c.* 35 cm. The two coarse-threaded shafts of the U-bolts are cemented into the substrate with epoxy glue.

THE ZERO ANCHORS PROJECT

Although the project was initially designed for the northern islands, it quickly became apparent that the problem was not unique to them. For example, it was estimated that 5500 anchors were deployed yearly at Bartolomé Island, on a bottom that is home to the endemic bat fish *Ogcocephalus darwini* and razor fish *Xyrichthys victori*, and native flatfish *Aseraggodes herrei*. In the archipelago as a whole, at least ten other species of endemic fish and

invertebrates (Brittle Sea-Star *Ophionereis albomaculatus*, Green Sea-Urchin *Lytechinus semituberculatus*, Galapagos Sand Dollar *Encope galapagensis*, Galapagos Porgy *Calamaturus taurinus*, Blue and Yellow Snapper *Archosargus pourtalesii*, Yellow-mouth Blenny *Chaenopsis schimitti*, Galapagos Puffer-fish *Spherooides angusticeps*, Galapagos Garden Eel *Taenioconger klausewitzii*, Galapagos Tongue-Fish *Ophidion* sp., Galapagos Eel *Quassiremum evionthas*) and many native ones, such as the spectacular Blunt-head Triggerfish *Pseudobalistes naufragium*, inhabit, feed on or nest on sandy bottoms at the depth range (10–30 m) at which anchors are normally dropped. Thus the initial idea to conserve Wolf and Darwin led to the new concept of “Zero Anchors” for the whole archipelago, involving dozens of moorings. This idea now has the support of the Ecuadorian government and is being implemented by the Galapagos National Park Service (GNPS).

So far, five permanent moorings have been installed at an experimental pilot site at Bartolomé (Fig. 1). Bartolomé was chosen because, according to GNPS data, it is the uninhabited island with the highest visitation in the Galapagos group. Virtually every tour boat in the archipelago visits the island, so beginning there allowed for priority impact reduction along with high visibility and use, thus generating valuable feedback from users regarding mooring adequacy. Also, being relatively near to the GNPS base, the moorings can be monitored daily and inspected regularly for wear, tear and performance.

Both helix screw and stainless steel U-bolt moorings were employed. For experimental purposes the lines to

the surface were of two types: a novel synthetic 20 mm fibre rope (French-manufactured DELTEX line), and 25 mm nylon rope utilizing an expandable section (Swedish-made SEAFLEX line) to reduce shocks on the mooring. Both systems have plastic mooring buoys equipped with solar-powered flashing lights and radar reflectors.

The moorings have been enthusiastically accepted by the tourism community, with captains and owners of vessels pleased with their efficiency and the saving of wear and tear on their ground gear. Preliminary monitoring results are already allowing selection of better materials for future permanent moorings.

COMPLEMENTARY PROTECTION FOR WOLF AND DARWIN ISLANDS

These two remote islands remain a priority and their coral reefs require urgent protection, complementary to the deployment of fixed moorings. These islands are a hub for large schools of Scalloped Hammerhead Shark *Sphyrna lewini*, and it is imperative not only to save the coral reefs with which these animals are associated, but also to end the slaughter of these creatures for their fins. These needs have resuscitated a project that was started seven years ago: the stationing of a live-aboard platform for science and management at Wolf Island. The vessel, the *Tiburón Martillo*, is a 23-m steel hull with living quarters for eight persons. It was successfully deployed in October 2008 to Wolf, where it will be permanently moored and from where expeditions will be made periodically to Darwin to ensure that corals are not being damaged and to control shark fishing there. The permanent moorings will be monitored regularly from the boat to ensure their safety for use and security from vandalism.

CONCLUSION

The state of the biodiversity of the Galapagos Islands is becoming more worrisome, especially with global climate change looming larger. Corals are at the forefront of these concerns. Permanent moorings will not only offer protection to the corals but will also help to conserve habitat for many other benthic organisms. At the same time their installation is helping to raise awareness of conservation issues and enabling tour operators and tourists to feel that their impact has been minimized.

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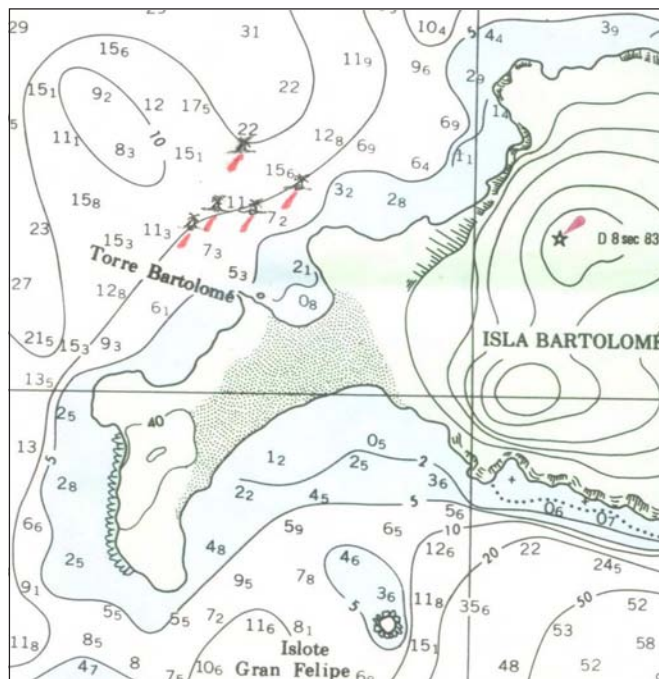


Figure 1. Permanent moorings at Bartolomé. This chart is the first of a series showing permanent moorings in Galapagos, generated by Ecuador's Oceanographic Institute of the Navy (INOCAR).