

CLIPPERTON ISLAND: PIG STY, RAT HOLE AND BOOBY PRIZE

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Received 10 August 2005, accepted 28 February 2006

Clipperton Island (10°18'N, 109°13'W) lies roughly halfway between the tip of Baja California, Mexico, and the equator in the eastern tropical Pacific Ocean. A French possession, it is a small, uninhabited desert atoll with a history of introduced animal problems.

In the earliest explorer accounts (from 1711, 1825 and 1839), this 1.6 km² of exposed land area was described as home to vast numbers of tropical seabirds. In 1892, humans settled on the island to mine the guano deposits, and by the time they left in 1917, they had made two important changes to the island ecology: they had introduced coconut palm trees *Cocos nucifera* to an otherwise plant-free landscape, and they released pigs *Sus scrofa* (Sachet 1962, 1963). During the human occupation, many thousands of Masked *Sula dactylatra* and Brown *S. leucogaster* boobies were breeding on the island, but by the time the Los Angeles County Museum ornithologist Ken Stager visited in 1958, feral pigs had reduced the birds to about 500 Brown Boobies and 150 Masked Boobies (Stager 1964). Appalled by the devastation that had occurred, Stager raised his shotgun and eliminated the entire population of 58 pigs, with the expressed hope that the booby colony might recover. His efforts succeeded beyond his wildest dreams. Using aerial photographs taken in 2003, we counted a minimum of 25 000 Brown Boobies and more than 112 000 Masked Boobies on the island. This makes Clipperton Island the second largest Brown Booby colony on record and by far the largest Masked Booby colony in the world. In a recently submitted paper (Pitman *et al.*, unpubl.), we suggested that possibly half of the Masked Boobies in the world currently breed on this tiny atoll.

In addition to being carpeted with boobies, Clipperton Island has another conspicuous inhabitant: a large orange land crab *Gecarcinus planatus* that swarms over the island by the millions. After eliminating nearly all of the ground-nesting seabirds, the pigs subsisted primarily on the land crabs, which brought about an unanticipated side effect. The crabs are omnivorous, and before the pigs were introduced, they kept the island completely free of vegetation except for mature palm trees. But once the pigs decimated the crabs, weedy vegetation spread over the island. After Stager removed the pigs, the crabs rebounded again, and by the time we began our visits in the mid-1980s, the vegetation was once again limited to the few tiny islets in the lagoon and scattered palm trees. The crabs also consumed almost every sprouting coconut, and it appeared that, before too long, the island would revert back to what it was before the advent of human enterprise.

Recently, however, two important and probably related events occurred at Clipperton. Between our visits in 1999 and 2000, two large fishing boats wrecked on the island. In 2000 we saw the first

Black Rat *Rattus rattus* ever reported at Clipperton; presumably this species came ashore with the ships. By 2003, rats were common and we could detect changes on the island: for the first time in our 20 years of visiting the island, vegetation was starting to grow on the main island. In 2005, we participated as ornithologists on a French scientific expedition to Clipperton that lasted from December 2004 to April 2005. During our three weeks there in March, we witnessed even more changes. The rats were widespread, and they were feeding heavily on the land crabs. And, as the land crab population declined, areas that had previously been only sun-baked coral rubble were now supporting large patches of lush vegetation, with more than a dozen new plant species. Most significantly, hundreds of coconut palms were sprouting around the island. As this vegetation spreads, it will provide more habitat for rats, which will likely increase predation pressure on the land crabs—a snowball effect.

The presence of rats on Clipperton is starting to negatively affect the nesting seabirds, in ways that are both direct and indirect. During our stay in March, we saw rats on the lagoon islets. (These rats swim readily.) These islets are the only places where Sooty Terns *Sterna fuscata* breed on Clipperton, but this situation will now change. We saw only two Sooty Tern eggs on the islets during our stay: one was less than a day old, and the other had recently been eaten by a rat. If the rats are not eradicated soon, all of the small species of nesting seabirds will probably be eliminated from the island, including the ground-nesting Sooty Tern and Brown Noddy *Anous stolidus* and the tree-nesting White Tern *Gygis alba* and Black Noddy *A. tenuirostris*.

Rats are also known to depredate chicks and eggs of large seabirds, such as boobies, but this probably does not occur frequently enough to have significant population-level effects in large colonies. However, by increasing the amount of vegetation on Clipperton, rats can indirectly bring about major changes in abundance even of large species. For example, only a few hundred Red-footed Boobies *Sula sula* currently breed on the island because this species typically requires shrubs or trees for nesting. Masked Boobies, in contrast, are larger and heavier. They require a clear, flat area to take off and land, and consequently, they avoid areas of dense vegetation. If rats ultimately cause most of the island to become covered with coconut palms and other exotic plants, we expect that the number of Red-footed Boobies will increase and that of Masked Boobies will decline sharply.

The changes we describe here have not yet progressed far, because the island still supports relatively little vegetation. At this time, eradicating rats should be a fairly straightforward process. Once the rats are removed, we expect that the land crabs will once again eliminate most (or all) of the vegetation on the island, including palm

seedlings, and the seabird community composition will be restored to its pre-human state. But action is required now, because as the vegetation spreads, the rats will become increasingly difficult to eliminate. Given the global significance of the booby populations at Clipperton Island, we strongly recommend that rats be eradicated as soon as funding can be obtained and that the palm trees be kept in check to prevent them from spreading across the island. The history of Clipperton Island is an all too familiar story of introduced species altering island ecosystems and devastating seabird communities. Modern eradication techniques are available to address this problem; all that is needed is the will and a way to pay for it.

ACKNOWLEDGMENTS

We thank Jean-Louis Etienne and his expedition staff for providing generous research support at Clipperton in March 2005 (for a look

at the island and the expedition see <http://www.jeanlouisetienne.fr/clipperton/default.cfm>). We also acknowledge National Oceanic and Atmospheric Administration Fisheries and the photogrammetry group at Southwest Fisheries Science Center for their support of our research at Clipperton Island.

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