Evolution and Extinction of Oceanic Land Crabs, an Example from the Hawaiian Islands

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Abstract

Although widespread among oceanic islands, in the remote Hawaiian Islands, land crabs are strikingly absent and this absence is the result of extinction, rather than dispersal limitation. Analysis of fossil remains show that an endemic Geograpsus was abundant before human colonization, grew larger than any congener, and extended further inland and to higher elevation than other land crabs in Oceania. Land crabs are major predators of nesting sea birds, invertebrates and plants, affect seed dispersal, and control litter decomposition; their removal can lead to large-scale shifts in ecological communities.

Methods

Fossil crab specimens from Hawaii were compared with specimens of the four known extant species of Geograpsus. Chelae, carapace, and 4th sternite (Fig 1, 2, 3) were measured in selected specimens. Twenty discrete morphological characters were also coded in each Geograpsus species and a species from the sister genus, Grapsus tenuicrustatus. Discrete character data were analyzed with PAUP v4.0, using maximum parsimony, with characters unweighted, character states unordered, with ACCTRAN character state optimization, treating multiple states as polymorphism, and running an exhaustive search. Bootstrap analysis with 10,000 replicates was used to evaluate clade robustness. Previous records of land crabs from the Hawaiian Islands were reviewed based on literature and selected specimen records.

Extinction

Geograpsus severnsi is known only from the Hawaiian Islands, where the terrestrial biota are as well documented and no inland crabs have been recorded during historic times. Abundant Geograpsus fossils were taken from two excavations with well-dated stratigraphic context on Maui [1] and Kaua‘i [2]. On Maui, G. severnsi survived to, but disappeared rapidly, after human arrival (C. Pittman (in litt. 11.IV.2004). On Kaua‘i crabs are present in all pre-human layers, decrease in size during the early human period, and are absent from recent strata. Geograpsus severnsi appears to be the first documented crab extinction in the Holocene.

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Literature