Review: **WILLIAM F. KEEGAN**
FLORIDA MUSEUM OF NATURAL HISTORY,
UNIVERSITY OF FLORIDA

Thirty years have now passed since Robert MacArthur and Edward O. Wilson proposed the theory of island biogeography (MacArthur and Wilson 1967). As Wilson recollects, he had reams of data on ant distributions on Pacific islands, but no process to bring general order to the "exciting chaos." Spreading his notes and graphs on MacArthur's coffee table next to the fireplace, the two speculated on the possible causes for observable patterns. They were struck by the importance of geometrical properties, the spatial relations between islands, as the key elements affecting the species equilibrium on islands (Wilson 1985:455-459).

Armed with predictions about species composition in relation to island

geometry, islands were viewed as laboratories, or natural experiments, in which some dimensions were constant (e.g., distance from a mainland) while others varied (e.g., island size). This quantitative and experimental approach was the foundation for much of evolutionary ecology, and the study of islands provided much of its clearest documentation (MacArthur and Wilson 1967:3).

A decade ago, Jared Diamond and I used the theory of island biogeography as a framework to compare the colonization of islands by humans in all the world's oceans (Keegan and Diamond 1987). We were following in a tradition of interarchipelago comparisons that our colleagues had initiated shortly after the MacArthur and Wilson monograph first appeared. In our article we pointed to a few of the most obvious contradictions to the theory. These contradictions emerged from the fact that the theory does not consider the motives of the colonists or the means by which they reached an island. For the theory, all that matters is that there is a balance between arrivals and extinctions. To a large degree we maintained that perspective in our review. Navigation and the skills needed to reach an island were simply assumed to exist; for if they did not, then an island would not have been colonized.

That view was formalized by proposing "autocatalysis" as the process by which the colonization of Pacific islands progressed. Autocatalysis is simply a positive feedback loop in which voyagers returning to announce the discovery of a new island or islands stimulated the search for additional islands (Keegan and Diamond 1987:67-68). Irwin is critical of this concept (p. 63), yet our objective was to counter two prevailing notions. The first was that having to move to a new island was bad, and the second was that return voyaging was not possible. However, because our suggestion that Polynesians were making return voyages was "not an established view" (p. 63), we were encouraged by several reviewers to include an alternative version of the theory in which return voyaging was not required. Irwin has shown that this alternative is no longer necessary.

At the time it was clear to us that a more comprehensive theory was needed, one that took into account human motives and abilities. This view was also expressed by others (e.g., Cherry 1981; Kirch 1984; Terrell 1986; Watters 1982). Our suggestion was a scalar approach beginning with very general theories, such as island biogeography, incorporating abstract models of process, such as those developed through the application of neo-Darwinian evolutionary principles and predictive models like those in economics, and concluding with a healthy dose of realism, meaning what the world was like when the island was colonized (Keegan 1991).

In this vein Geoff Irwin's book is an exciting addition to the study of island colonization. His theory of navigation fills a major void, and his

emphasis on exploration, the important first stage in a colonization event, opens new vistas. Furthermore, his conclusions regarding "safe sailing" and the notion that explorers traveled into the wind so they could more easily return home if their quest failed are brilliant insights. Lastly, he challenges the sense of isolation that is a basic element of the laboratory model of cultural development on islands. It is clear from Irwin's work that Pacific archaeologists and anthropologists must give greater consideration to inter-island contacts, even over substantial distances.

My contribution to this forum is a view from beyond the Pacific. And although the Caribbean is much more like the Mediterranean than Oceania, research in the West Indies shares a number of elements with the Pacific studies (Watters 1982, 1989). The most important of these concern renewed interest in maritime capabilities and an enhanced appreciation for socio-cultural interactions throughout the region (see Keegan 1994 and 1996 for reviews).

For the West Indies, navigation and seamanship appear to be less critical problems. The islands are arrayed as stepping stones that are largely inter-visible so ocean-going canoes were rarely out of sight of land (Figure 1). In addition, sails were not used until after the arrival of Europeans, probably because travel distances were short. Native West Indians may have paddled against wind and currents to explore new areas ("safe sailing"), but these expeditions would have been of short duration. The absence of archaeological sites on Grand Cayman suggests that the search for new islands was limited in scope (Stokes and Keegan 1996).

Using computer simulations, Callaghan has shown that "direct crossings between Puerto Rico or Hispaniola and the South American mainland were not only possible but faster and safer than following the Lesser Antilles" (1995:186). In addition, one of the widest water gaps in the region is between Cuba and Florida (about 150 kilometers), a distance that recently was crossed by numerous makeshift rafts and in June 1996 was almost breached by a swimmer. Clearly, the pre-Columbian cultures of the Caribbean should not have developed in isolation.

Yet despite the relative ease with which people could have moved around the West Indies, the trend among archaeologists has been to assume that movement between islands, and between islands and mainlands, was difficult (Rouse 1986). For example, the conventional wisdom is that a single culture from the Orinoco River drainage was responsible for peopling the West Indies. Called "Saladoid," for the type site of Saladero, Venezuela, it is assumed that this one group entered the Antilles about 500 B.C. and advanced slowly, island by island, until they reached the Greater Antilles (Rouse 1992).

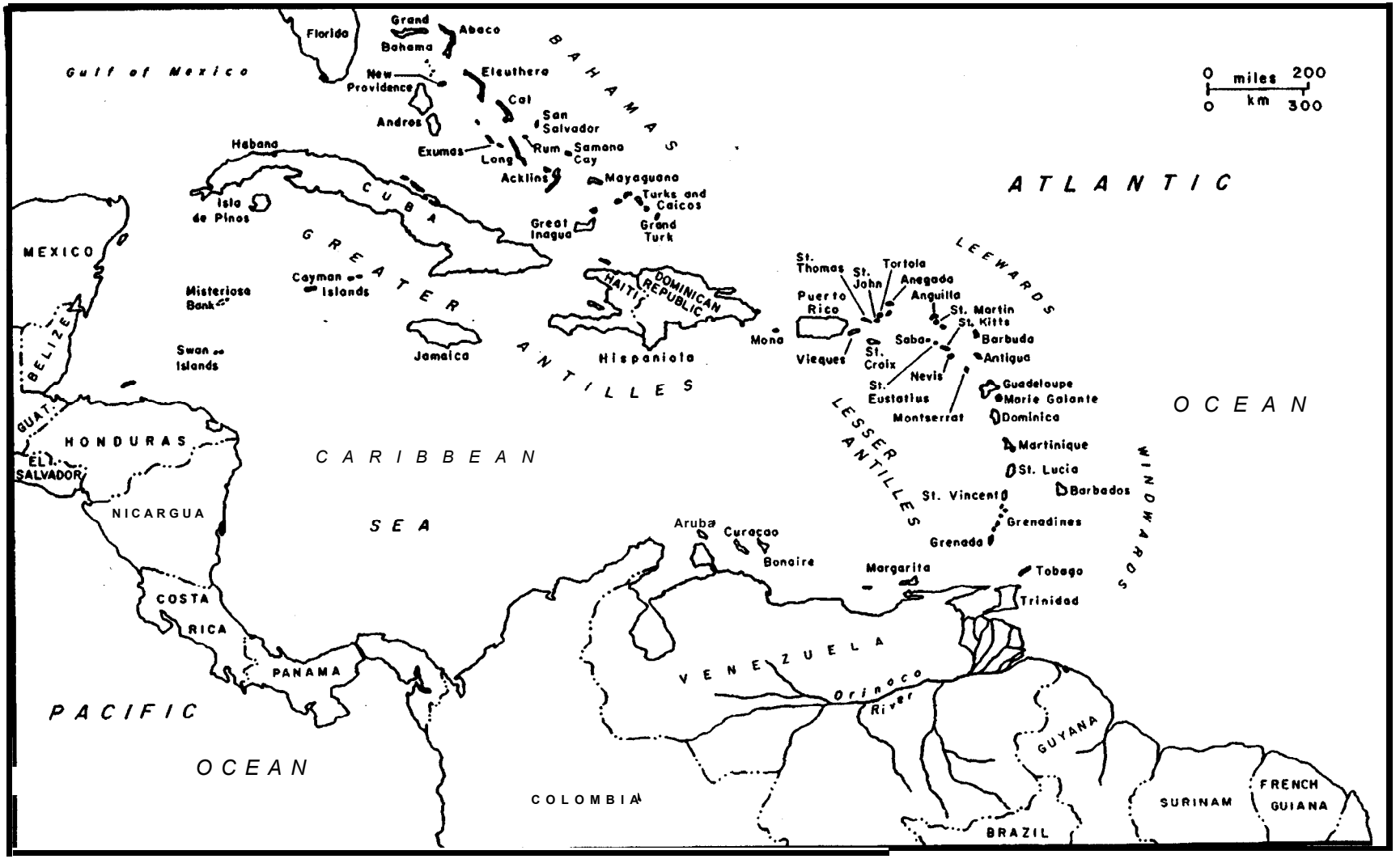

FIGURE 1. **Islands of the West Indies** (Source: Keegan 1994).

This emphasis on the expansion of a single people or culture emerged to counter efforts to explain every cultural change in the Caribbean as the product of new immigrants (e.g., Chanlatte Baik and Narganes Storde 1990; Rainey 1940; Veloz Maggiolo 1993:77-80; Zucchi 1990, 1991). While others proposed multiple migrations into the West Indies to account for changes in pottery styles, Rouse has maintained a unilineal model in which the Saladoid culture and its descendants have become increasingly impervious to outside influences (Rouse 1986, 1992). All variability and change are attributed to ***in situ*** developments from an initial cultural endowment, though this "development" occurs largely though the loss of variability (Roe 1989:270). The devolution of ceramics is such an important process that it has been suggested that, like Pacific islanders, the natives of the Bahamas were in the process of abandoning pottery when Europeans arrived in the late fifteenth century (Watters 1982:6), a view that I do not share.

In a sense, the Saladoid peoples were viewed as living in cultural isolation. There were mainland Arawaks and there were "Island Arawaks," and once these people moved to the islands there was no going back. Despite remarkably short water passages, communication with South America is thought to have ceased around **A.D.** 500, and exchange with Central and North America apparently never developed (but cf. Lathrap 1987).

Recently, a new view of the ceramic-age colonization of the West Indies has begun to emerge. It is now known that Puerto Rico was settled by 400 **B.C.,** and that the earliest known settlements are clustered in the central Caribbean on the Leeward Islands, Virgin Islands, and Puerto Rico (Haviser 1997). The inescapable conclusion is that most of the Lesser Antilles were bypassed or leapfrogged in a direct jump from Venezuela or Trinidad to Puerto Rico and its neighboring islands (Keegan 1995).

The Windward Islands of the Lesser Antilles were then settled later by peoples moving south from Puerto Rico and north from South America. Until the populations in the Antilles achieved an equilibrium with those in South America, the conditions that stimulated the initial migration continued to fuel emigration from South America. Thus, the Saladoid expansion was not the single-culture migration usually portrayed (Rouse 1992): more likely it involved the movements of a variety of competing ethnic groups from the South American mainland over the next millennium (Roe 1989).

Just as in the Pacific, the sense of isolation and remoteness attributed to Caribbean islands is breaking down. But while Pacific archaeologists are laboring to dispense with the so-called long pause between the colonization of western and eastern Polynesia, an equally long pause has emerged in the West Indies. Ceramic-age colonists settled 'Puerto Rico by 400 **B.C.,** yet there is no evidence for expansion out of Puerto Rico until after **A.D.** 500 (Keegan 1995).

When expansion finally resumed, settlements appeared simultaneously in Hispaniola, Cuba, Jamaica, and the Bahamas. For now, the presence of well-established foraging populations (called "Archaic") on Hispaniola and Cuba are used to account for the development of a frontier between Puerto Rico and the Dominican Republic (Rouse 1986, 1992). However, given the speed with which the second wave of expansion took place, it is likely that the Saladoid invaders melded with indigenous Archaic groups to form the population from which the historic Tainos emerged (Chanlatte Baik and Narganes Storde 1990). Future research will tell.

In this brief commentary I have emphasized questions concerning the ceramic-age colonization of the West Indies because these best fit the frameworks developed in Geoff Irwin's book. As in the Pacific, archaeologists in the Caribbean are moving away from isolationist models to models that recognize the presence of multiple ethnic groups and cultural mosaics or matrices (Hulme 1993; Keegan 1996; Whitehead 1995:9-22; Wilson 1993). It will be especially interesting to compare how the "long pauses" in the Pacific and Caribbean are finally resolved.

New perspectives notwithstanding, the notion of "islands as laboratories" is not dead. The geometrical properties that provided the foundations on which the theory of island biogeography was established remain important structures for evaluating the colonization and development of insular societies. However, because all formal models oversimplify reality, we tend to be disappointed, or critical of their use, when the models fail to provide realistic answers to complex questions. Yet it is exactly these failures of the models to explain observed phenomena that provide our most significant insights.

In sum, the theory of island biogeography is important because it identifies variables that are useful to measure. Its significance, in the sense of a laboratory or natural experiment, derives not from what it explains or predicts, but from those observations that deviate from expectations. It is in these deviations that human choice and cultural norms can be observed.

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