

## CHANGES IN BERMUDA'S BIOTA

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**ABSTRACT.** Bermuda's total biodiversity, marine and terrestrial, consists of at least 8022 known species. This paper identifies major changes, most of them anthropogenic, in the Island's biota since the Pleistocene, and highlights noteworthy appearances and disappearances in Bermuda's biotic spectrum.

Located at 32° 18' N and 64° 46' W and made up of 50 square kilometers of rolling sandstone hills amidst 750 square kilometers of shallow coral reef, Bermuda has been explored at least since 1515, and its natural history is documented in more than 3000 books and papers. Pioneering contributions are those of JONES (1859), LEFROY (1877), GOODE (1876), HEILPRIN (1889), A. AGASSIZ (1895), HURDIS (1897), VERRILL (1902, 1907), BRITTON (1918), and BEEBE & TEE-VAN (1933). More recent comprehensive accounts are of HAYWARD et al. (1981), AMOS (1991), and STERRER (1986, 1992), and annotated checklists of earthworms (REYNOLDS), echinoderms (PAWSON & DEVANEY), fishes (SMITH-VANIZ et al.), and terrestrial (SLAPCINSKY) and marine mollusks (JENSEN) are in preparation.

As a tiny oceanic island situated 1000 km from the nearest continent, and an extreme northern outpost of the tropics, Bermuda can be expected to have a high natural turnover of species (MACARTHUR & WILSON 1967). In addition, several biodiversity crises can be identified:

1. Pleistocene sea level fluctuations of as much as 150 m alternately favored terrestrial and shallow marine biota, resulting in the demise of land snails, birds, and a tortoise.
2. From 1609, human colonization led, among others, to the near-extinction (WINGATE 1961) of the endemic petrel (*Pterodroma cahow* (NICHOLS & MOWBRAY)) and of local sea turtle populations, and the introduction of a host of foreign agricultural species, pets, and pests.
3. The near-extinction of the endemic cedar (*Juniperus bermudiana* L.), by the accidental introduction of coccoid scale insects in the early 1940s, was followed by yet

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another wave of introductions of exotic plants (e.g., *Casuarina equisetifolia* L.) and biological control agents.

4. Construction of an airport in 1941-44 necessitated extensive dredging which permanently altered the ecology of a large inshore basin (Castle Harbour), and caused massive coral die-offs (DODGE & VAISNYS 1977).

5. From the mid-1960s on, most inshore waters experienced a eutrophication-related bloom (LAPOINTE & O'CONNELL 1989) of the unattached benthic green alga *Cladophora prolifera* Kütz.

6. Recent events such as coral bleaching (COOK et al. 1990), mangrove retreat with rising sea level (ELLISON 1993), and the Caribbean-wide, pathogen-caused mass mortality (LESSIOS et al. 1984) of *Diadema antillarum* (Philippi) demonstrate the degree to which Bermuda may be affected by regional and global changes.

In an effort to document changes to Bermuda's biota and to determine their causes, the recently initiated "Bermuda Biodiversity Project" has begun to compile a comprehensive list of all species, marine or terrestrial, plant or animal, freeliving or parasitic. The current species count stands as follows:

<b>BERMUDA</b>	<b>Total species</b>	<b>Endemic spp.</b>	<b>Non-Indigenous spp.</b>
Blue-green bacteria	65	0	0
Algae & other protists	928 +	0	0
Fungi & lichens	747	50	0
Flowering plants	1010	11	886
Other plants	69	5	4
Mollusks	931	38	41
Insects	1090	43	55
Other arthropods	1267	11	11
Other invertebrates	1086	5	2
Fish	430	10	1
Amphibians	3	0	3
Reptiles	8	1	3
Birds	345	2	9
Mammals	43	0	3
<b>Total</b>	<b>8022</b>	<b>176</b>	<b>1018</b>

At this early stage, the survey has uncovered a number of biotic changes of which only some are connected to the biodiversity crises listed above:

1. The disappearance of commercial sponges (Porifera) by the 1940s, and the

conspicuous appearance of a red boring sponge (*Cliona lampa* de Laub.) since then (RÜTZLER 1974).

2. The appearance of the alcyonarian *Briareum polyanthes* (DUCH. & MICH.) in the 1970s and the stony coral *Scolymia cubensis* (MILNE-EDW. & HAIME) in the 1960s, and the near-disappearance of the zoanthid *Isaurus duchassaingi* (Andres) since 1907.

3. The appearance of the whip scorpion *Phrynus marginemaculatus* Koch (Amblypygi) by the 1980s, and the recent extinction of endemics such as the cicada *Tibicen bermudiana* Verrill and the flightless grass hopper *Paroxya bermudensis* Rehn (HILBURN & WILSON, in prep.).

4. The apparent extinction of Bermuda's last three surviving species of pleistocene land snails, *Poecilozonites* spp., probably due to the introduced carnivorous snail *Euglandina rosea* Férussac.

5. The local extinction of the West Indian top shell *Cittarium pica* L., the re-appearance of the pleistocene clam *Macrocallista maculata* (L.), and many other molluscan changes (ABBOTT & JENSEN 1967).

6. Only two of four starfish species that were common around 1900 are still found in local waters (STERRER 1986).

7. Bermuda's only non-avian land vertebrate, the endemic skink (*Eumeces longirostris* Cope), is endangered.

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