Chapter 1

SCIENTIFIC STUDIES ON ALDABRA ATOLL

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1. THE ECOLOGY OF ISLANDS

Oceanic islands have been recognised since the time of Darwin and Wallace to be of special significance in the study of biogeography and evolution. The work done in the past century, particularly in the Lesser Antilles, the Australasian archipelagoes, and the Hawaiian Islands, has permitted the formulation of general principles of dispersion, colonisation, and speciation in island biotas. By the time that these problems were being recognised, however, and hypotheses were being formed about them, many of the more accessible and congenial islands were being newly settled by man, with the resulting disruption of many unique assemblages of plants and animals by economic activities, or by the unexpected impact made by introduced species. This has happened particularly on the more accessible tropical islands, in many of which the opportunity to study undisturbed indigenous floras and faunas has gone for ever.

Much recent work on island ecology has, therefore, concentrated on those islands where disturbance has been minimal, particularly in the more remote and hostile environments of the southern cold temperature zone (Holdgate and Wace 1961; Wace 1965) (for all references see the "Bibliography of Aldabra", Chapter 6 of this Bulletin); on Amsterdam, Kerguelen, Crozet and St Paul in the southern Indian Ocean; on Macquarie, Auckland and Campbell Islands; and, in the south Atlantic, on Tristan da Cunha, Inaccessible and Gough Islands. Here the problems of insularity have been linked with that of the circumpolar distribution of many plants and animals (Pantin 1960; Darlington 1965). Within the tropics, classic studies have been carried out in the Galapagos Islands, initiated by Darwin himself and recently intensified since the opening of the Charles Darwin Research Station there (Bowman 1966). Other islands, including some in low latitudes, have been studied for the light they throw on the processes of replacement of native by introduced species, as in the case of St Helena and Ascension in the Atlantic Ocean, and Clipperton in the Pacific.

From these studies of islands, certain principles of island ecology emerge (Hesse and others 1951, 621-635; Darlington 1957, 476-544; Gulick 1932; Holdgate 1960; Carlquist 1965). First, islands are isolated by the sea, which acts as a barrier or filter of variable intensity for different groups of plants and animals, and the degree of isolation is a function not only of distance but also of the time available for colonisation: the older the island, the greater the probability that successful introduction has occurred. In this property of isolation we may include Wallace's distinction between oceanic and continental islands. Second, islands have limited area, and hence carrying capacity, which for larger animals may be less than a minimum threshold for survival, and they also possess unique environmental characteristics, particularly in climate. Work so far has concentrated on volcanic islands, such as the Tristan group, but coral islands, with a narrower range of environments, have the advantage for study of a simpler biota. Third, the combination of a peculiar environment with the fact that successful colonisation is dependent on a capacity for long-distance over-water dispersal and for survival in new habitats means that the biota of islands tend to be small and disharmonic. The absence of many continental genera and species means that competition is reduced,

and island species may increase their ranges. Infrequent colonisation and prolonged isolation favour the evolution of endemic varieties, species, and genera, especially on the older and larger islands such as Hawaii. Finally, the smallness of the biota, and its under-exploitation of the island environment, means that such communities are often unstable and are specially liable to large-scale disruption by invading alien plants and animals. This is well seen in the disappearance on many islands of large breeding colonies of sea birds, and of such ungainly creatures as the dodo, which are clearly unfitted to compete with introduced predatory mammals and competitors.

The islands of the Indian Ocean include granitic islands, volcanic islands, sea-level coral reefs and atolls, and islands formed of elevated reef limestones. Of the islands of coralline origin, the atolls have been studied in some detail at the beginning of the century, particularly in the Maldives (bibliography in Stoddart 1966, 107-122) and at Cocos-Keeling, on which Darwin worked and which has been studied more recently by Gibson-Hill (bibliography in Sachet and Fosberg 1955). The elevated limestone island of Christmas, near Java, was monographed by Andrews in 1900, and has been studied since. The high islands of the Andamans and Nicobars, visited by Seymour Sewell, have attracted comparatively little attention by comparison with those of the western Indian Ocean.

These latter, between the African coast and the approximate line of the mid-ocean ridge (Figure 1), are of considerable importance in the study of the geography and land ecology of islands. They include, besides the great landmass of Madagascar, the volcanic Mascarene Islands (Mauritius, Rodriguez, Reunion), the granitic Seychelles, the coral atolls extending from the Laccadives through the Maldives to the Chagos Archipelago, and the cluster of reef islands, many of them elevated, to the north of Madagascar, from Aldabra to the Amirantes and the Seychelles Ridge. Our knowledge of the biogeography of this area derives largely from a series of expeditions led by Professor Stanley Gardiner in 1899-1900, 1905, and 1908-09, culminating in the Fauna and Geography of the Maldive and Laccadive Archipelagoes (Gardiner 1903-06) and in the eight volumes of Reports of the Percy Sladen Trust Expedition (Gardiner 1907-36). Since Gardiner's work, several of the islands, particularly in the southwest Indian Ocean, have been devastated beyond the possibility of further useful work, mainly by guano diggers, and even when he wrote, many of the most interesting forms, such as the giant flightless land birds of the Mascarene Islands and the giant land tortoises of the southwest Indian Ocean, had been hunted to extinction or near-extinction by man and his introduced predators.

Of the elevated reef islands of the western Indian Ocean, only Aldabra has escaped massive interference by man. By contrast, the guano reserves of nearby Assumption have been mined for many years, and this applies also to St Pierre, Astove and others (Baker 1963, 110-127; review by Hutchinson 1950; and Chapter 3 of this Bulletin). The lack of economically workable guano deposits on Aldabra, together with an environment unsuited to agriculture or even to human settlement, has meant that here isolation has continued to the present day.

The ecology of Aldabra is of interest for three main reasons. First, it is an uplifted atoll, and hence provides a wider range of habitats than most

sea-level reef islands. Second, it is oceanic, in the sense that there is no evidence of any former land connections with continental areas, and hence the biota must have been derived by normal dispersal processes; but at the same time its relative proximity to Africa, and particularly to Madagascar and the Comoros, means that the probability of successful colonisation from these sources has been high. Combined with the diversity of habitat, this has produced a fauna and flora exceptionally rich for a coral atoll. And third, its isolation has not only led to the development of endemic species of both plants and animals, but has favoured the development or survival of such creatures as flightless land birds and the giant land tortoise. With the devastation of nearby islands which originally possessed very similar ecosystems, Aldabra is thus of special importance in the category of elevated coral atolls. Most of the similar high limestone islands in the Pacific have been devastated for guano (Ocean Island, Nauru, and Makatea being the worst examples), and those which remain (such as Henderson and Vostok) are so far from continental land as to be biologically impoverished. Scientific understanding of elevated reef-limestone islands can thus only be obtained by detailed work on Aldabra Atoll.

2. PREVIOUS INVESTIGATIONS

Much early information on Aldabra was frankly speculative, and once it appeared in the literature it was repeated by many authors. Horsburgh, for example, states that "from the appearance of these islands, water is perhaps plentiful, and also timber of sufficient size to be useful to any ship in distress for spars" (Horsburgh 1852, 176), and according to Pridham (1846, 307) "water would appear to be plentiful". Opinions such as these were clearly not based on any real knowledge of the atoll.

Table 1 lists the scientific expeditions, official parties, and some of the more significant individuals to visit Aldabra since the first hydrographic survey in 1878. Of these investigations, four resulted in large collections of flora and fauna: those of Abbott in 1892, of Voeltzkow in 1895, of Dupont in 1906 and on several later occasions, and of Fryer in 1908-09, in connection with Professor Gardiner's last expedition. The most important general memoirs are those of Voeltzkow (1897, 1902), Dupont (1907), and Fryer (1911), and an outline of the salient features of the ecology of Aldabra has been given by Stoddart and Wright (1967a). More detailed papers are referred to in this Bulletin, and an attempt to give a complete bibliography is made in Chapter 6. Early voyages to Aldabra, with comments on the origin of the name, are listed by Voeltzkow (1897, 40-41).

In recent years, mention must be made of Ommanney's visit in 1948 and the popular account he later wrote (Ommanney 1954); of the visit of the Calypso, Commander J.-Y. Cousteau, in 1954, which resulted in large additions to our knowledge of the birds, crustacea and Lepidoptera; and of the Bristol Seychelles Expedition in 1964-65. This party, led by M. J. Penny, visited Aldabra first between 11 November and 14 December 1964; a second visit was made by one member, R. Gaymer, between 4 October and 20 November 1965.

Table 1.--Previous Investigations at Aldabra

Date	Investigator	Field of Study	General Publication
1878 July	H.M.S. Fawn, Dr. Wharton	Survey	Wharton 1879, 1883
1892 May	H.M.S. Redbreast, Mr T. R. Griffith	General	Fairfield, Griffith and Abbott 1893
1892 Sep-Dec.	Dr W. L. Abbott	Birds, insects, plants	Abbott 1893
1895	Mr Wilson	Molluscs	Von Martens and Wiegmann 1898
1895 Apr-May	Dr A. Voeltzkow	Geology; all groups	Voeltzkow 1897, 1902b
1904 Dec.	Mr F. R. Mortimer	Birds	-
1905	Anon.	General	Anon. 1920
1906 May	Valhalla, Lord Crawford	Birds, insects	Nicoll 1908, 114-123
1906 Oct-Nov.	Mr R. P. Dupont	Plants, insects, birds	Dupont 1907
1907	Mr H. P. Thomasset	Insects, birds	-
1908 Aug.-1909 Feb.	Mr J. C. F. Fryer	Geology; all groups	Fryer 1910, 1911
1916	Mr W. Fox	Botany	Hemsley 1919
1937 Oct.	Mr D. Vesey-FitzGerald	Birds, vegetation	Vesey-FitzGerald 1940, 1941, 1942
1948	Seychelles-Mauritius Fisheries Survey Mr J. F. G. Wheeler Dr F. D. Ommanney	Commercial fisheries Turtles	Ommanney 1952, 258-294; Wheeler and Ommanney 1953
1953 Nov.	Italian Zoological Expedition: C. Prola, F. Palombelli, F. Prosperi, S. Nievo	General; insects	Prosperi 1955, 1956, 1957; Berio 1956, 1959

Table 1. --(continued)

Date	Investigator	Field of Study	General Publication
1954 May	Calypso, J.-Y. Cousteau G. Cherbonnier	General, crustacea birds	Cousteau 1959, 1963
1956	Mr W. Travis	Turbo	Travis 1959, 157-193
1957 Dec.	Yale Seychelles Expedition Dr A. J. Kohn Dr W. D. Hartman	General, tortoises	
1959	H.M.S. Leopard	Birds	Boulton 1960
1959	Mr H. Legrand	Lepidoptera	Legrand 1965
1960 Sep. 1961 Jan.	Dr B. H. Baker, Mr C. J. Piggott	Geology	Baker 1963
1962 Jan.	H.M.S. Owen	Birds	Morris 1963
1964	R. E. Honegger	Birds, tortoises	Honegger 1966a, b
1964 Mar.	H.M.S. Owen	Birds	Bourne 1966
1964 Nov.-Dec.	Bristol Seychelles Expedition: M. J. Penny, C.M. Penny, R. Gaymer, R. Blackman, P. G. Dawson	Birds, tortoises	Blackman 1966
1965 Oct.-Nov.	R. Gaymer	Birds, tortoises	Gaymer 1966b
1966 Sep.-Oct.	Dr D. R. Stoddart Dr C. A. Wright	Geomorphology, land ecology	Stoddart and Wright, 1967a

3. PRESENT INVESTIGATIONS

Aldabra has recently been considered as a possible site for the construction of a military airfield by the Ministry of Defence. With the co-operation of the then Minister of Defence for the Royal Air Force, Lord Shackleton, and of the Hydrographer, Rear-Admiral G. S. Ritchie, it has been possible, with the support of the Southern Zone Research Committee of the Royal Society, to

begin detailed investigation of the geography and land and marine ecology of Aldabra, for the purposes of preparing long-term conservation plans and of gaining knowledge of this unique island ecosystem. Dr C. A. Wright and the author were attached, in September and October 1966, to the British Broadcasting Corporation's Expedition Turtle, as a result of which further investigations are now being planned. This Bulletin has been designed to summarise present knowledge of Aldabra, within the framework of the work carried out during the 1966 expedition. Chapter 2 covers the whole range of geography and ecology, so far as is known. Chapter 3 summarises the very scanty and often old information on the islands near to Aldabra, to provide comparative data for the assessment of the importance of Aldabra itself. In Chapter 4 Mr C. W. Benson presents a full analysis of the birds of the atoll and the neighbouring islands, with special reference to the land birds, based on his own field experience in the Comoro Islands and an exhaustive study of the collections made by Abbott, Voeltzkow, Dupont and others. Chapter 5 presents some observations by Mr R. Gaymer, made during his two visits as a member of the Bristol Seychelles Expedition, on the natural history of the birds, again with reference to the land birds. Finally, Chapter 6 gives a full bibliography. It is intended that this account will not only stimulate scientific interest in this too-much neglected atoll, but will serve as a working paper for the project of further investigations now being planned.

From our knowledge of the biota, it is clear that the importance of Aldabra stems first of all from its population of the giant land tortoise, a relic of a once wider population which demands both urgent study and effective conservation, and second, from the isolation of the atoll and the distinctive assemblage of both plants and animals which has formed as a result. Many species of both plants and animals may be distinct; and it was on such endemic species that scientific interest at Aldabra, as indeed in most insular biotas, formerly centered. Some of the endemics, such as the rail Dryolimnas, last flightless bird of the Indian Ocean islands, are of special concern, but their interest is far below that of the giant tortoises. More important from an ecological viewpoint are the island populations of more widely ranging species, particularly the great colonies of frigate birds and boobies, and the breeding populations of the migratory green turtle. Other species, while probably not distinct, no longer exist in large numbers, and efforts must be made to preserve them before they disappear: this applies to the Sacred Ibis, and particularly to the Flamingo.

With the possibility of military development, these problems immediately become acute: for while we already know a great deal about the composition of the biota, in the sense of lists of plants and animals, we know very little about the island ecology and its areal variation. Many ecological problems, such as those of food chains and population structure, cannot be adequately studied during brief visits. The realisation of the scope and importance of purely ecological problems, as opposed to taxonomic ones, coincides, furthermore, with a changing emphasis in island biology, from the simple recognition of peculiar species to the study of the genetics of change in remote, insular populations (Carlquist 1966). Studies in population genetics again require detailed long-term work. It is not too much to say that only now are theoretical concepts becoming available which can enable us to understand structure,

function, and change in island ecosystems, but by this time few island ecosystems remain to be studied.

The Royal Society, with the active assistance of the Ministry of Defence, and following a conference in London in January 1967 attended by many scientific and conservation organisations from Britain and the United States, is organising a programme of further scientific work at Aldabra in 1967–68. The Royal Society Expedition to Aldabra 1967–68 will consist of three parts. The first, in August and September 1967, during the dry season, will concentrate on further land reconnaissance, and on lagoon ecology. A resident party to carry out long-term studies of the sea bird colonies, of the land birds, of the lagoon biota, and of the tortoises and turtles, will remain on the atoll for the second part of the expedition, from August 1967 to March 1968, some members spanning both wet and dry seasons. Finally, in January to March 1968, the third part of the expedition, a wet-season party will concentrate on land flora and vegetation and land zoology. By the end of this programme, enough data will have been gathered to serve as a permanent record of an unspoiled oceanic island, and as a basis for meaningful conservation measures if military development takes place. If, on the other hand, military development is averted, then this scientific project will provide a base-line for continuing studies of this remote and still largely unspoiled unique island ecosystem.

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