EXTINCTION AND CONSERVATION IN THE ST HELENA FLORA: THE PALAEOBIOLOGICAL AND ECOLOGICAL BACKGROUND

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ABSTRACT. Patterns of extinction and survival through time of the native vascular plant species of St Helena are presented and discussed (together with comparative information on Ascension Island). There is evidence that the endemic genera represent ancient relict survivals from the Miocene. Since the origin of the island 14.5M years ago, plants have colonised the island at an approximate rate of 1 per 100,000 years. There is some evidence for extinction before the discovery of the island by Man in 1502. After 1502, human interference has destroyed more than 99% of the original vegetation. This has caused the extinction in the wild of 8 species of vascular plant (although 2 of these species are still in cultivation). A further 5 species are critically endangered. To explain the colonisation of the island and the extinction of species, island biogeography theory is of very limited use, as the immigration rate and hence species numbers have been so low, and the destruction has been so rapid (allowing relict survival of populations too small to be viable) that the system has never reached equilibrium. Conservation measures now in progress will probably prevent the extinction of all the remaining critically endangered species, with the possible exception of the endemic monotypic genus, *Nesiota*, which is proving resistant to conservation and may become extinct shortly.

INTRODUCTION

St. Helena's endemic plants are mainly relicts of a Tertiary wet forest flora, which may have been richer on St. Helena during the Miocene and

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Pliocene (Cronk, 1987 and 1990). There is some evidence that the endemics of the arid low altitudes are more recent, possibly associated with greater aridity during the Quaternary. Almost all the natural vegetation of St. Helena has now been destroyed (Cronk, 1989), mostly in two phases:

1) 1501-1659: severe grazing by introduced vertebrates mainly goats, and cutting for firewood by Portuguese, Dutch and English ships' crews. This appears to have fragmented the woodland below 600m although large areas of wood and scrub remained at the end of the period.

2) 1659-c.1750. The destruction of vegetation was completed by settlers whose clearance, cutting for timber and tanning, vastly increased fuelwood demand (from trees that do not coppice) and increased husbandry of goats and other stock on goat ranges meant that the island faced severe ecological crisis in the 18th century. By this time there was so little native timber left that (despite legislation, goat extermination, fencing and planting) the crisis was only eased by the introduction of exotic species in the late 18th and early 19th centuries.

As there was so little native vegetation left, 19th century changes were comparatively minor although destruction gradually continued and the further introduction of exotic plants made any recovery of the native species impossible. Six of the naturally rarer endemics became extinct during the 19th century.

There has been no case of a complete post-1880 extinction although by 1980 4 species existed as less than 3 individuals each. *Commidendrum rotundifolium* became extinct in the wild in 1986, and were it not for the conservation efforts of the last 3 years would now be entirely lost. Conservation in St. Helena must be threefold:

1) The protection of existing populations by fencing and clearance of exotics.

2) The propagation and widespread planting of critically endangered endemics (natural regeneration is unlikely).

3) The encouragement of the endemics that are spreading naturally onto the barren Crown Wastes in places (from relict populations on cliffs) by fencing (goat, sheep and donkey control) and planting.

The most worrying conservation problem is the endemic genus *Nesiota* only known from a single tree which resists attempts at propagation and may only last 5 or 10 years judging by the die-back that has already disfigured the canopy. Clearly a major, and possibly international, effort with detailed research is needed to save this tree.

PALAEOBIOLOGY

St. Helena

The least taxonomically isolated endemics have their closest allies in Africa from where the prevailing winds and currents come. The most isolated and peculiar of the endemics tend to have allied species with a disjunct (often Australian or S. American) distribution. This has been interpreted (Cronk, 1987) as indicating that these species are ancient relicts dating from the Miocene or Pliocene (St. Helena is 14.5M years old). Their allies may have become extinct in Africa because of the post-Miocene deterioration and drying up of the climate associated with the establishment of the Cape and veldt floras.

Further evidence for this comes from a Miocene pollen and spore deposit (Muir and Baker, 1968; Cronk, 1990) which contains pollen of the Asteraceae and pollen closely related to the pollen of present day *Trochetiopsis* species, demonstrating that at least some of the endemics (or their ancestors) have been on the island at least 8M years (table 1).

TABLE 1. Pollen and spores in a Miocene deposit from St. Helena (after Muir and Baker, 1968).

%	Muir and Baker name	Name	Status
75	*Polypodiaceae (incert. sed.)*	*Dryopteris*	Extant?
4.5	*Vittaria* sp.	*Hymenophyllum*	Extant
1.9	*Grammitis* sp.	*Grammitis*	Extant
0.8	*Pteris* sp.	*Pteris*	Extant
6.8	*Lygodium* sp.	*Dicksonia*	Extant
c.0.3	*Lycopodium saururus* gp.	*Lycopodium axillare*	Extant
c.0.3	*Lycopodium* sp.	*Lycopodium*	Extinct
<1	*Cycadopites* sp. A	*Palmae*	Extinct
1.9	*Cycadopites* sp. B	*Palmae*	Extinct
2	*Echitricolporites spinosus*	*Lachanodes*	Extant
<1	*Malvaceae (incert. sed.)*	*Trochetiopsis*	Extant
1.4	Others (singletons)	?	?

The unusual relict endemic genera of St. Helena constitute an important resource for science. There is potential here for studying extinctions and evolution in adjacent Continental regions and *in situ* evolution.

Ascension Island

Ascension Island's depauperate native vascular flora of c. 20 spp. has now been superseded by a synanthropic flora of c. 200 spp. Of the 10 endemic vascular plants, 4 may now be extinct. The depauperacy of the vascular flora is due to the island's youth (1.5M years) and isolation. It is tempting to see Ascension Island as a very young version of St. Helena. However during the first 1.5M years of St. Helena's subaerial existence (14.5 - 13M years BP), grasses (characteristic of the indigenous flora of Ascension) would have been much rarer on the African Continent (grasses are rare in the indigenous flora of St. Helena). The evolution of plants in Africa has strongly differentiated the natural colonization of the two islands. A natural rate of colonization of around 1 species per 10^5 years (Cronk, 1987) seems to be approximately correct for both islands. The large scale introduction of exotics during the 19th century is thought to have caused most of the plant extinction, and as the pace of introduction has now slowed it is likely that populations of endemics that remain are stable within the new ecosystem. Continued monitoring is necessary however to ensure that further decline does not occur.

EXTINCTION

Causes of Extinction on St. Helena

Since the Tertiary, there has been some natural extinction on St. Helena. For instance Muir and Baker (1968) report Miocene palm (Arecaceae) pollen from St. Helena, but there are no records of native palms on St. Helena in modern times (table 1). These extinctions were probably caused by climatic change.

In the historical period the following 6 plants are known to have become extinct (table 2 and 3): *Heliotropium pannifolium* (c. 1808), *Mellissia begonifolia* (1875), *Bulbostylis neglecta* (1806), *Acalypha rubra* (c. 1865), *Wahlenbergia burchellii* (1877), *Wahlenbergia roxburghii* (1872). The first three plants are of low altitudes (now the essentially barren Crown Wastes), and their extinction is linked to the almost total destruction of vegetation in these areas between 1502 and 1750 (by wild goats from 1502 - 1659, and after settlement in 1659 by the periodically pounded herds roaming freely on specified "goat ranges"). The last three grew in the tree-fern thicket and cabbage tree woodland of the central ridge, of which huge areas were cleared for pasture by the English East India Company settlers between 1659 and 1750. Experiments with the planting of *Cinchona* spp, other exotics introduced by Kew, and *Phormium tenax* on the ridge in the late 19th century may have hastened their end. Interestingly, there is no evidence that the plants now extinct were ever very common, and they are all comparatively short lived plants. Probably the profound vegetation changes between 1502 and 1750 had reduced these plants, already rare or local with low population densities, to critically low levels at which extinction in 100 years or so was inevitable. Populations of commoner or longer lived plants were able to maintain themselves for longer.

TABLE 2. Plant Extinction on St. Helena

Period	Nos. of Species
1. Before 1501 (Pliocene-Pleistocene)	<50?
2. After 1501	
a) 1502-1659 (goats)	c. 0-6?
b) 1659-1805 (settlement)	c. 0-6?
c) 1805-1900	6
d) 1900-present (extinct in wild but cult)	2
e) Next 100 yrs (will be extinct but cult)	5
3. Still extant	37

Several plants are now nearly extinct: *Trochetiopsis melanoxylon* (2 plants in wild), *Commidendrum rotundifolium* (extinct in wild, 1986), *Commidendrum spurium* (2 plants in wild), *Trochetiopsis erythroxylon* (extinct in wild), *Nesiota elliptica* (one plant only remains). The first two plants are dryland ones, while the remainder grow or grew on the Central Ridge. The causes of decline are the same as those already discussed. The decline of *Trochetiopsis erythroxylon* and *T. melanoxylon* are discussed in greater detail elsewhere (Cronk, 1983 and 1986). For the upland endemics the spread of introduced plants and the widespread planting of flax (*Phormium tenax*) on the ridge at the beginning of this century probably brought their populations down to critical levels where they are vulnerable to stochastic events. *Nesiota* has probably survived by being long lived: Melliss (1875) recorded about a dozen trees and the present old tree may possibly be one of these. Likewise *Commidendrum rotundifolium*: the single remaining old tree that died in 1986, may be one of the two small plants found by Roberts in 1887 in the same locality (there were only 3 trees then known).

There is also the possibility that some plants became extinct before they were ever recorded, as the first thorough botanizing of St. Helena was in 1805-

10, by W.J. Burchell (Cronk, 1988), long after the most catastrophic changes to the environment had already taken place (by about 1750). Evidence for this possibility comes from the discovery of *Heliotropium pannifolium*: Burchell only saw this once, and this single specimen is the first record, the last record and the type!

TABLE 3. Extinct Plants of St. Helena

Species	Last Record
Bulbostylis neglecta	1806
Heliotropium pannifolium	1808
Acalypha rubra	1865
Wahlenbergia roxburghii	1872
Mellissia begonifolia	1875
Wahlenbergia burchellii	1877
Trochetiopsis erythroxylon	c. 1950 (extinct in wild, but in cultivation)
Commidendrum rotundifolium	1986 (extinct in wild, but in cultivation)
Nesiota elliptica	Extant but non-viable (wild pop. of 1)
Trochetiopsis melanoxylon	Extant but non-viable (wild pop. of 2)
Commidendrum spurium	Extant but non-viable (wild pop. of 2)
Lachanodes arborea	Extant but non-viable (wild pop. of c.10)
Wahlenbergia linifolia	Extant but non-viable (wild pop. of c.20)

Causes of Extinction on Ascension Island

The following plants (with date of last record) may be extinct: *Sporobolus durus* (1886), *Oldenlandia adscensionis* (1889), *Dryopteris ascensionis* (1889), *Anogramma ascensionis* (1958) (Cronk, 1980). Goat grazing probably began the decline of *Oldenlandia adscensionis*, and many of the early specimens are of compact plants with short internodes which may be the result of goat grazing. The introduction of exotic shrubs that would have competed with *Oldenlandia* at all altitudes probably completed its decline. Exotic plants are certainly the cause of the other extinctions. *Anogramma ascensionis* for instance must once have been widespread on bare damp scoria which are now covered with grass or thickets. Even the vertical cinder banks where paths are cut round the mountain now have numerous exotics on them, especially sporelings of *Christella dentata*. The *Anogramma* was seen fairly recently however, and it is possible that it will be refound (it may be inconspicuous when perennating in its prothallial stage). Some endemics however, have fitted well into the new ecosystems created by the introduction of exotic plants. *Marattia purpurascens*, for instance, thrives in the thickets of bamboo at the summit of Green Mountain.

DISCUSSION

Generally speaking the vascular plants of St. Helena are fairly well known, but the lower plants are, in many cases, scarcely studied at all. This knowledge has enabled conservation measures to be taken for the higher plants, in many cases saving them from certain extinction. More knowledge must accrue before similar measures can be taken for the lower plants. In the case of the flowering plants however, the ancient relicts give the flora great interest. They include a wealth of endemic genera, which give St. Helena a particularly high significance for conservation.

The very low rate of immigration, coupled with the successful naturalization of several hundred plant species in historic times indicates that the native flora never achieved an equilibrium between immigration and extinction. Thus island biogeographic theory is inadequate as an explanation of the numbers of native species. Similarly the relict survival of long lived woody endemics, after the destruction of the native vegetation, indicates a considerable lag phase in the establishment of an equilibrium between habitat destruction and extinction. This has enabled conservation measures to be taken before the inevitable extinction of plants like *Nesiota elliptica* (reduced to a single individual).

Dahl (1986) calculated an index of "Conservation Interest" (C.I.) for islands of the Pacific, based on endemic flora and fauna, geography, ecology and other factors. Using the same index, the score for St. Helena of 51 is slightly higher than Lord Howe Island (46) and considerably higher than Norfolk Island (35), New Britain (28), Tahiti (25), Henderson Island (22) and Easter Island (15). In the Pacific only the islands of Juan Fernandez, the Galapagos and Hawaii (not treated by Dahl) are likely to exceed St. Helena in Conservation interest. In the Atlantic, the Canary Islands have a larger number of endemic plant species, but the large number of endemic genera place St. Helena in contention for an equally high position of significance. It certainly seems that St. Helena must take its place amongst islands of the first rank in biological importance.

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