



Hell yeah I'm a botanist! Fear my
botany powers!

*Plants of Samoa:
A unique but threatened flora*

*Art Whistler
Isle Botanica*

OUTLINE

What is “flora”?

What is a native species?

Where did Samoa’s plants come from and how did they get here?

How large and unique is the flora?

Some of the highlights of the flora

What are the threats to the flora and native forests?

What can we do to help save our unique plants?

The “holy grail” of the Samoan flora, *Corybas betchei*



Flora is the goddess of flowers in Roman mythology

- “Plants collectively; especially, the plants of a particular region or time”
- “A systematic compilation describing such plants”

Until now there has been no complete “flora of Samoa”

- Only checklists and partial floras
- To be useful, it should have keys and descriptions to identify plants

Floras can include **native** species only, native and **naturalized**, or all species including ornamentals

- The most common of flora type includes all native and naturalized plants, not ornamentals



Heldberg, Henry Thode

Auf Laisward, H. 113, D. 043

Flora

Flora
1882

Flore

The current preparation of the flora began in 1971 after my three years in Peace Corps in Samoa. The manuscript is now finished after 45 years of hobby and two years of funding from the xxxx (censored).

It will be published as a book and an interactive website once the editors and I come to agreement on the details, probably next year. It will probably be over 600 pages long, and at least the website will probably include photos of most of the ca. 840 spp.



In the old days the names and uses of most plants were well known by the population, but this knowledge has long since disappeared

- New useful plants introduced, many old ones disappeared
- Men rarely go into the forest other than to plantations
- Forest products no longer used

This presentation will show many native and traditional species

If we do not know the names of our disappearing native plants, how can we save them?



fagu



How did Samoa get its native flora?

Samoa is an “oceanic” (as opposed to a “continental”) archipelago

- It arose out of the sea, island by island, starting a couple of million years ago**

In the earliest stages, it was entirely barren lava and cinder, but soon seeds and spores arrived and became established

**This occurred by “long distance dispersal” since Samoa is so isolated
Over thousands of years more complex vegetation evolved**

Categories of Samoan Species Origins

Native

- Naturally occurring on the island (i.e., arriving by means other than humans)
 - ▶ Endemic—Found only one place
 - ▶ Indigenous—Also found elsewhere

Alien (Introduced)

- Not of natural occurrence to the island (i.e., arriving by human transport)
- Further divided into **Polynesian** and **modern introductions**
- These are further divided into **accidental** and **intentional introductions**

All plants present before human settlement are native



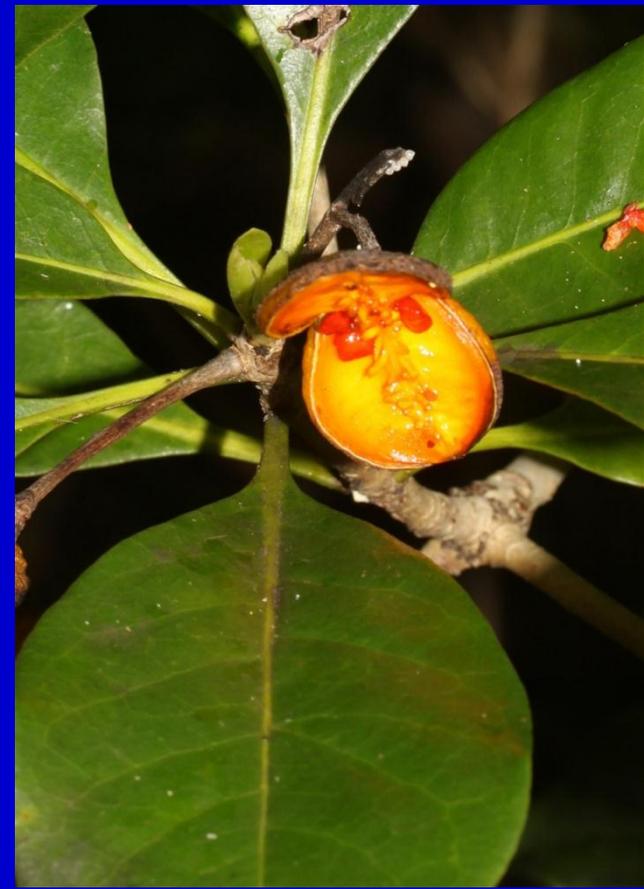


**Ancestors of native plants have been arriving for over two million years
Their seeds arrived in one of three major ways: seawater flotation,
borne by wind transport, and borne on birds and bats
Seawater is a very effective means of dispersal, but the species
dispersed in this way must be “littoral” and have long-lived,
floating seeds or fruits to survive the sea drift**



Windborne fruits or seeds are adapted to transport by wind, and do this by several different methods

- “Parachute fruits” or seeds with bristles to make them lightweight
 - “Wings” that allow them to be carried in strong winds
 - Tiny size of seeds or spores, like orchids and ferns
- Very effective: orchids comprise Samoa’s largest plant family



Seeds are commonly dispersed by birds (and to a lesser extent, bats) either internally or externally

- **Plants with conspicuous fruits (often red) attract fruit-eating birds**
- **Birds with seeds in their stomach sometimes fly or get blown long distances to a new island, where the seeds are deposited and grow**

Especially important for inland forest trees (eaten by inland birds)



Only a few species in Samoa have seeds that are carried externally by birds or bats

- **Mostly widespread seashore plants**

The seeds or fruits must cling to feathers or fur for long distances by means of hooks or a sticky substance on the outside of the seed or fruit



The source of the Samoan flora is predominantly Indo-Malayan to Fiji

- This despite winds and currents coming from the east

Two thirds of the Samoan flora also occurs in Fiji (nearly all of the non-endemic, i.e., the indigenous, species)

Only a few native species have an “American” origin, including *Gyrocarpus americanus*



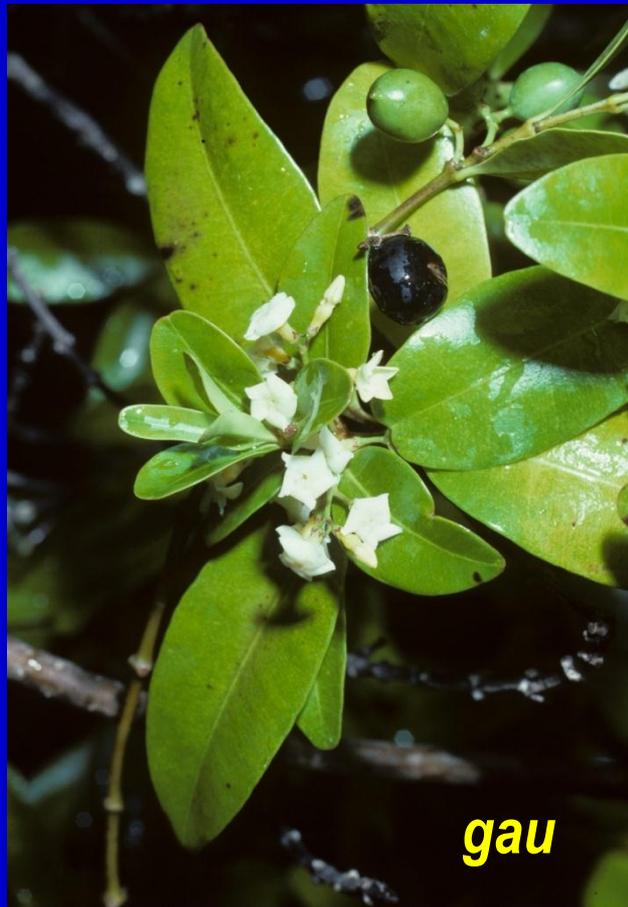
An “Austral” element comprises some species with origins in the temperate Southern Hemisphere

Mostly montane forest species, many belonging to New Zealand genera, such as *Weinmannia* (Cunoniaceae), *Ascarina* (Chloranthaceae), and *Hedycarya* (Monimiaceae)

These are the species most threatened by climate change



lau maile



gau



leva

The Samoan flora comprises ca. 540 native species of flowering plants
These belong to about 303 genera, the category comprising species
They belong to 96 native families, the category comprising genera
Of these 540, 174 are endemic, unique to Samoa

- This equals a rate of endemism of 30%
- High compared to Niue (0%) but low compared to Hawai'i (90%)

a'atasi



soi



lopa



vao mini



In addition to native plants, naturalized alien plants are included since they are now a natural and self-reproducing part of the environment
About 294 species are weeds are naturalized in Samoa

- About 49 *Polynesian introductions*, the rest *modern introductions*
- Some of these were intentional, brought for a purpose, but then escaped and became naturalized
- Most were *unintentional* (accidental) introductions

nonu vao



a'amati'e



Some species are of uncertain status, since they have only been collected recently and may have been intentionally introduced. Possibly modern introductions from nearby islands, making their origins difficult to determine, e.g., *Syzygium samarangense*, *Elaeocarpus floridanus*, and *Drypetes vitiensis*



Some species may appear to be rare or extinct because of mistakes

- ***Serianthes melanesica* collected once by Whitmee (ca. 1870)**
- ***Solanum amicum* likewise collected only by Whitmee**

Others are mistakes in
location of collection

- Common among
specimens collected by the
U.S. Exploring Expedition
(1839)

Two Samoan endemic species
have the incorrect last name
“*taitensis*” (Tahiti)

E.g., the endemic palm
Balaka taitensis

- *Baccaurea taitensis*, a
small forest tree with no
Samoan name

-



māniuniu



'u'unu



māniuniu



Only two genera are endemic to Samoa

Sarcopygme in the Rubiaceae (Coffee Family)

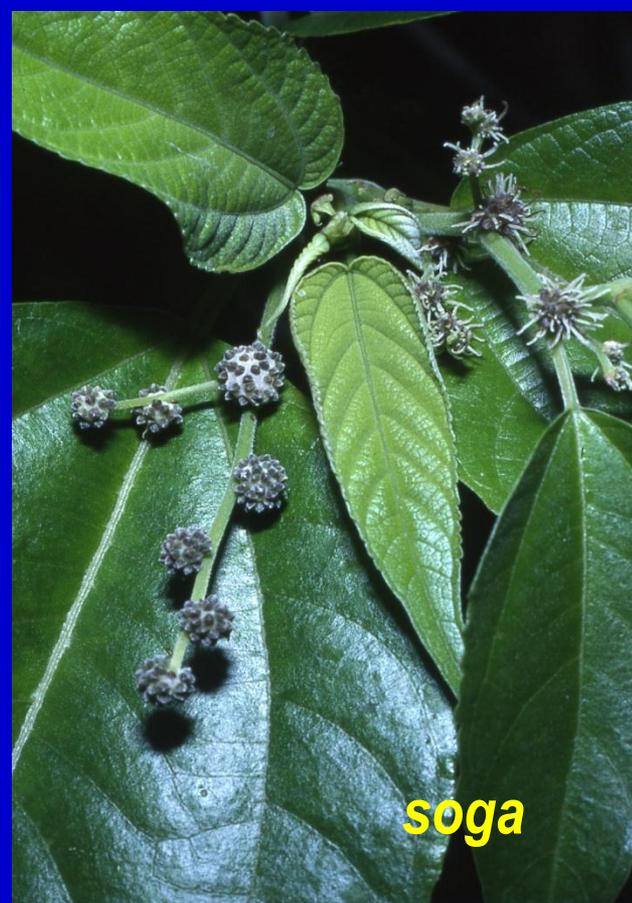
- Comprises one or two species (although five have been recognized), but some authors now put this in *Morinda* (*nonu togī*)

Solfia samoensis in the Arecaceae (Palm Family)

- Comprises one species (i.e., it is monotypic), but some botanists put this in the genus *Balaka*



ateate



soga



so'opini

The Samoan flora is derived from new arrivals and by changes to these plants over time to form new species

- Some arrivals change little with time (esp. littoral species), and are widespread and similar from island to island, e.g., *Wollastonia biflora***
- Others readily change genetically and speciate (form new species), especially when spreading to new islands, e.g., *Melicope***

Species recently arriving by

natural means are **indigenous**

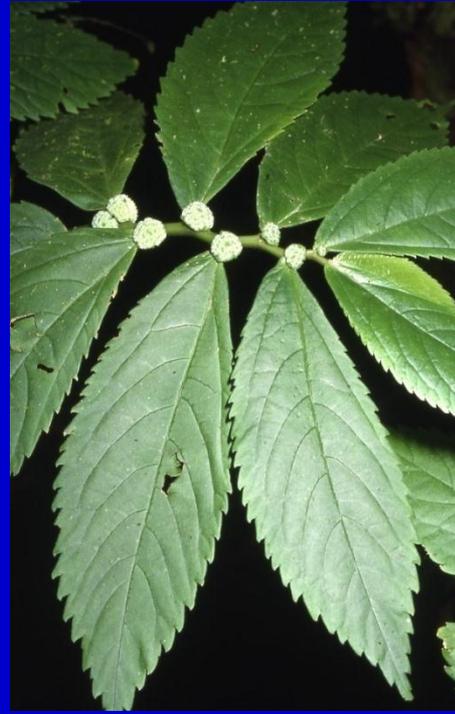
- If they change little over time, they remain indigenous
- If they change a lot over time to become different from their overseas ancestors, they can form many **endemic** species

New species form when populations become isolated from each other (e.g., on different islands) and evolve into different related species

Cyrtandra and *Psychotria*, readily form new species and comprise the two largest genera in Samoa



afa



Largest Flowering Plant Genera in Samoa

<i>Cyrtandra</i>	Gesneriaceae	(20 spp.)
<i>Psychotria</i>	Rubiaceae	(19 spp.)
<i>Syzygium</i>	Myrtaceae	(16 spp.)
<i>Elatostema</i>	Urticaceae	(15 spp.)
<i>Dendrobium</i>	Orchidaceae	(14 spp.)
<i>Bulbophyllum</i>	Orchidaceae	(12 spp.)
<i>Ficus</i>	Moraceae	(9 spp.)



***Cyrtandra*, the largest genus, has about 20 species, 19 of them endemic**

- Only *Cyrtandra samoensis* is found elsewhere (Tonga and Niue)

Some have large showy flowers, other have smaller tubular flowers

Only one common name recorded, but this is probably now entirely forgotten

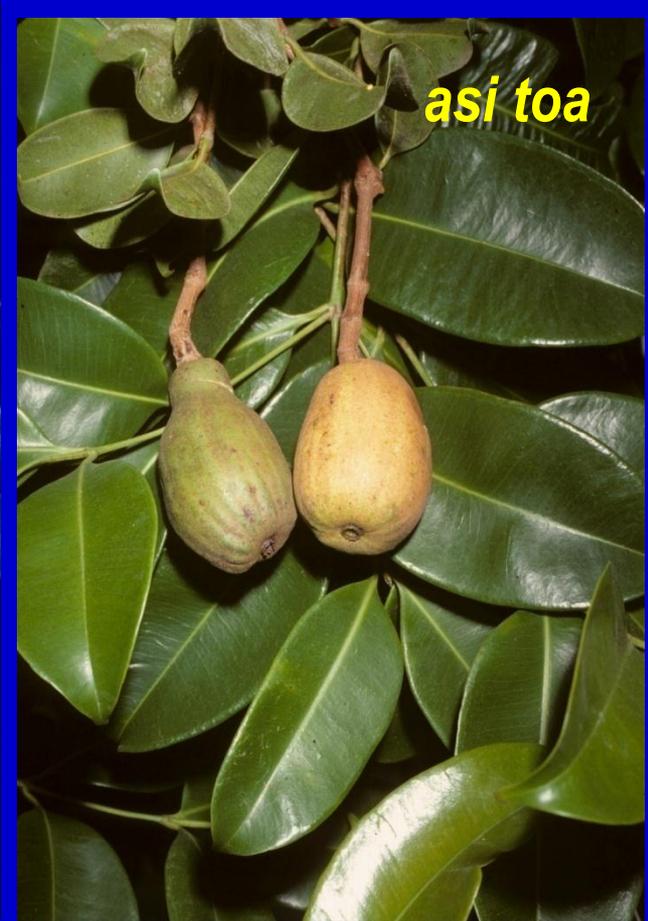
matalafi



***Psychotria*, the second largest genus in Samoa has 19 species**

- Sixteen of them of them are endemic, and the other three are found in Tonga, Niue, and/or Fiji

One is an important medicinal plant believed to have the power to repel *aitu*

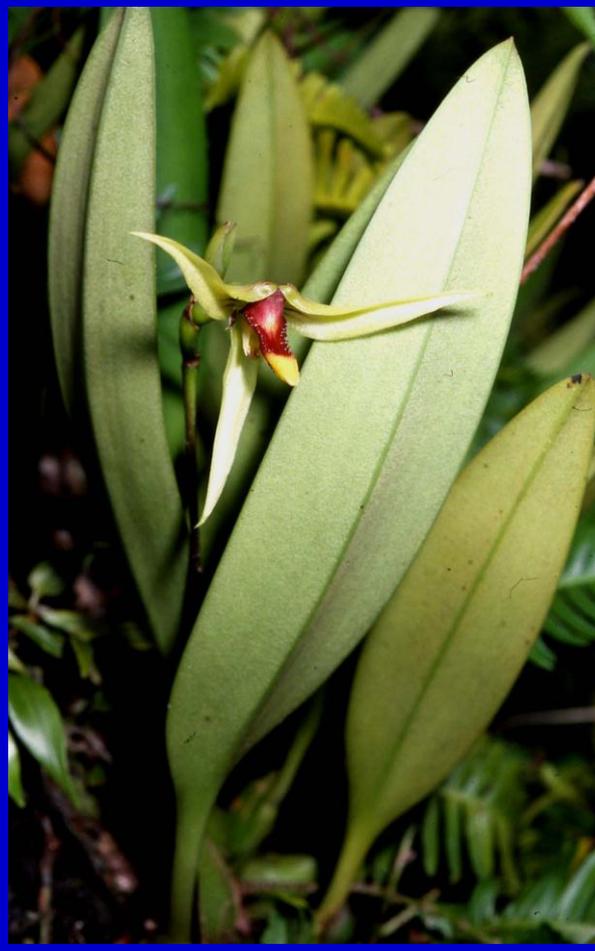


***Syzygium* (Myrtaceae) is third largest angiosperm genus in Samoa
It comprises 16 native tree species, nine of them endemic
The most common ones are *Syzygium clusiifolium*, *Syzygium savaiiense*, and *Syzygium inophylloides*
Some, like *seasea*, *nonu vao*, and *nonu fi'afi'a*, are alien species
Some are important timber trees, and food for pigeons**



The fifth largest genus of native Samoan plants is *Dendrobium* in the orchid family Orchidaceae

- It has 14 epiphytic species, several of them endemic



The sixth largest genus of native Samoa plants is *Bulbophyllum* in the orchid family Orchidaceae

- It has 12 epiphytic species, none of them endemic



The orchid family Orchidaceae is the largest of the 96 native families in Samoa

Two distinct types exist, “terrestrial orchids,” which grow mostly on the forest floor, and “epiphytic orchids,” which grow on trees

Most Samoans would recognize none of them (also no known names)

Nearly 20% (100 species) of the flora comprises orchids

They readily spread from island to island by means of tiny spores



Threats to the flora and environment

Threats to the environment and flora can be **natural** or **man-made**

- **Natural** includes cyclones, tsunamis, droughts, and rarely fires
- These are not caused directly by human activities
- They have always occurred and little can be done to prevent them

Since the plants of Samoa have been exposed to these for eons, they are somewhat adapted to them and have always managed to survive or at least cope with them



Man-made threats, especially since modern times (since 1830)

- Introduction of animals that destroy habitat, e.g., pigs & cats
- Over-kill of birds and bat fruit dispersers
- Introduction of aggressive weeds that compete with native species
- Clearing forest for villages, agriculture, pastures, and clear-cutting forests for timber
- Climate change
- Ignorance (not knowing what is being lost)





Alien weeds have caused great ecological damage, particularly mile-a-minute vine (*Mikania micrantha*), Koster's curse (*Clidemia hirta*), and the even the native *Merremia peltata*



Alien tree species, such as *Funtumia elastica*, *Castilla elastica*, and *Spathodea campanulata*, have become aggressive weeds of disturbed forests

The loss of native vegetation on 'Upolu between 1953 and 1990

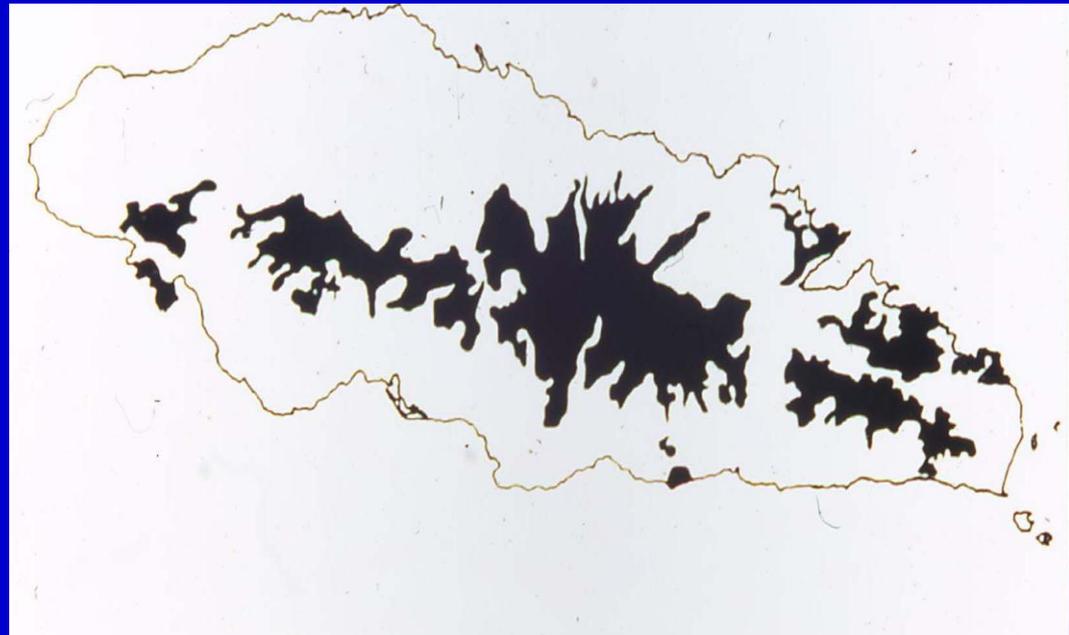
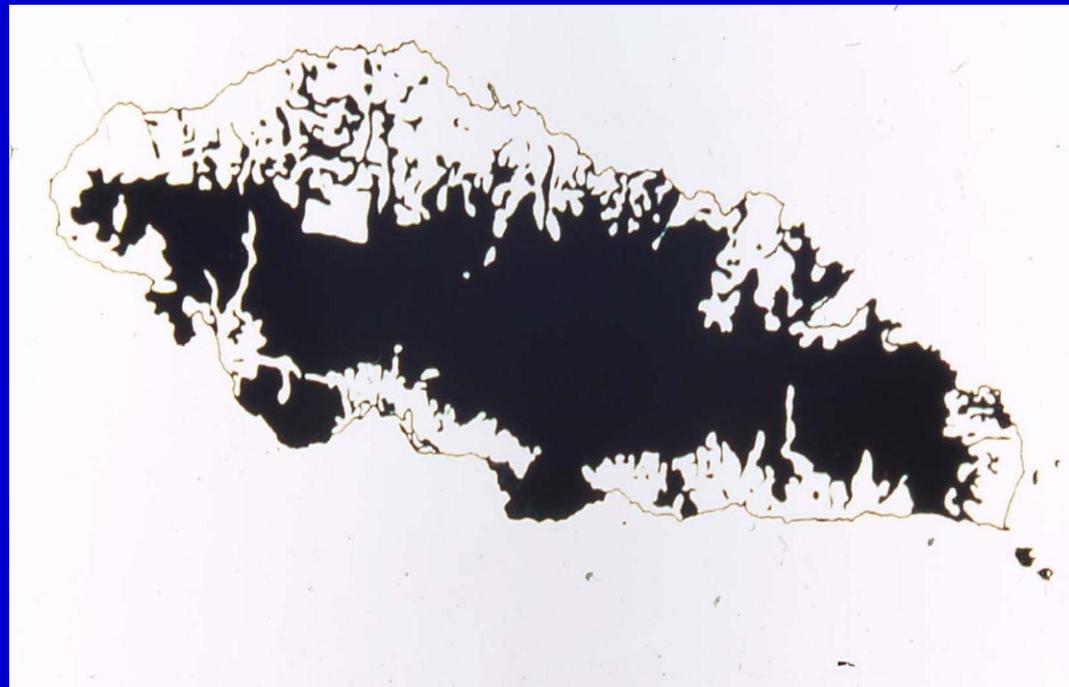
In ancient times the people lived in the interior of the islands, but they moved to villages after the arrival of the missionaries

For a long time the forest recovered

But then in European times forests were cut down to make coconut plantations

Later more was cleared for timber for export and local

Then later for growing taro and raising cattle

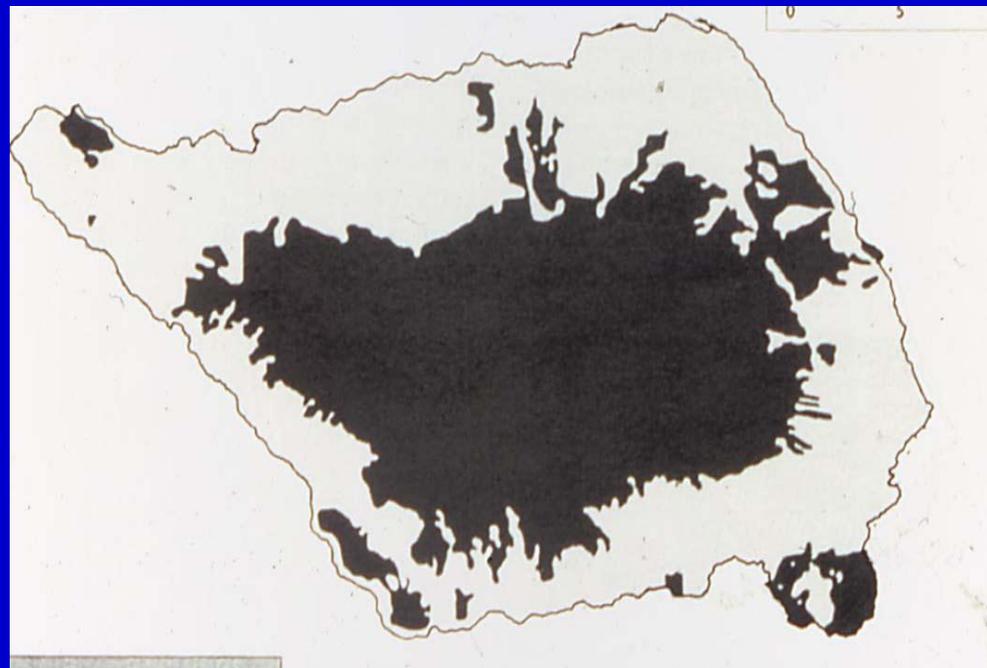
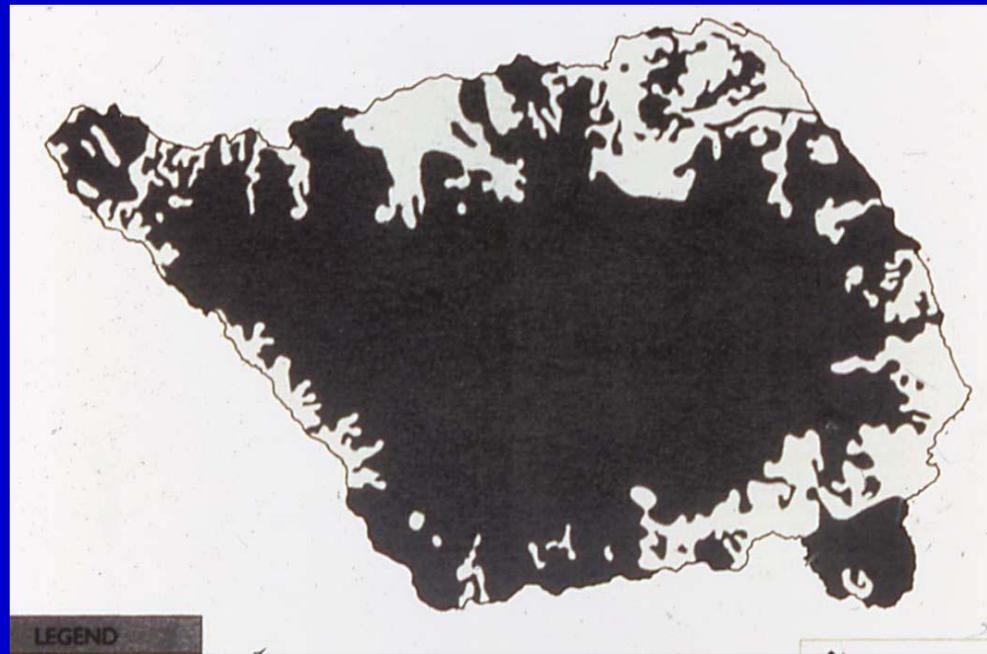


Loss of native vegetation on Savai'i between 1953 and 1990

Very little undisturbed lowland forest is left now because of timbering and plantations

Even so, the island has the largest intact rainforest left in Polynesia

It is under threat because of short-sighted thinking and lack of it having protection (e.g., as in a park) and people not understanding its value



Another threat is **climate change** caused by global warming
It is caused mostly by the use of fossil fuels, increasing CO₂ in the atmosphere, which over time makes the climate warmer
This is a threat that Samoa has very little control over, it is a global problem
As the climate in Samoa warms, it can become too hot for some species to survive
Some can adapt by growing at higher elevations
But plants already at the highest elevations have nowhere to go and will disappear





tamaligi



iukalipi



rattan palm

Ignorance

Many mistakes have been made by those who are supposed to be helping the environment, e.g. overseas funding agencies

E.g., *Albizia chinensis*, *Eucalyptus deglupta*, and rattan palm

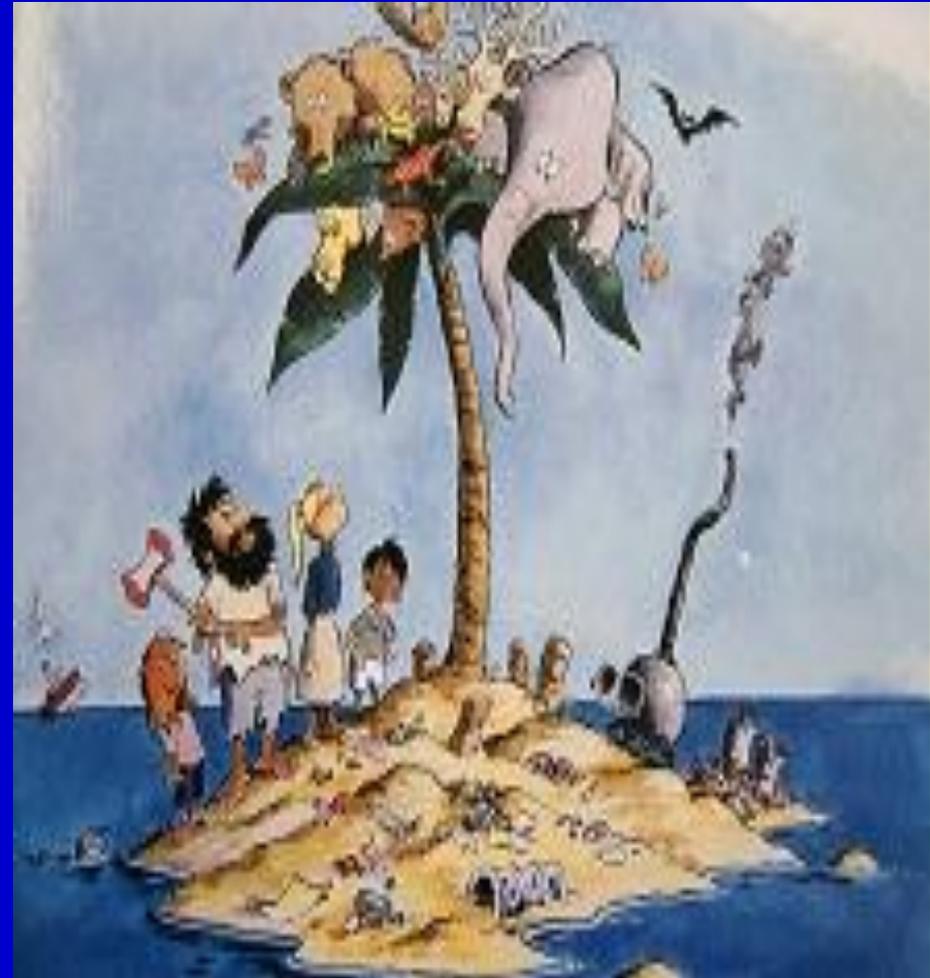
The problem is that few Samoans even know what plants are here

We need to know our plants and their place in the environment



Environmental damage is occurring even today and is promoted by the government
Watershed above Moamoa was illegally subdivided and nearly all of the forest destroyed
More environmental damage will undoubtedly occur

The flora of Samoa is under pressure and species are becoming extinct or extirpated
Some unique Samoan species have already been lost forever
Further work is needed to determine which plants are being lost or becoming rare, and where they are still found
Public education is needed to help understand the dire problem
Native forest needs protection
Samoa needs local experts to save their own biota
I have worked on the plants for a half century
Ua alu atu le afi!



Climate change

salato



sogā



fua lole



The third largest native plant family in Samoa is the nettle family Urticaceae, with 25 native species. It includes trees, shrubs, and herbs, such as *Dendrocnide harveyi* (stinging nettle tree), *Pipturus argenteus*, and *Procris pedunculata*.

'anoso



ifilele



gatae



The fourth largest family in Samoa is the pea family Fabaceae, with 22 native species, including some important timber trees
This includes *Caesalpinia bonduc*, *Intsia bijuga*, and *Erythrina variegata*



The genus *Ficus* is the seventh largest genus, comprising nine native species of trees, about five of which are endemic
Most (seven species) are normal trees, such as *Ficus scabra*
The other two are banyans that start as a seed in bird feces and geminate to be an epiphyte and eventually surrounds the “host” tree

maniuniu



maniuniu



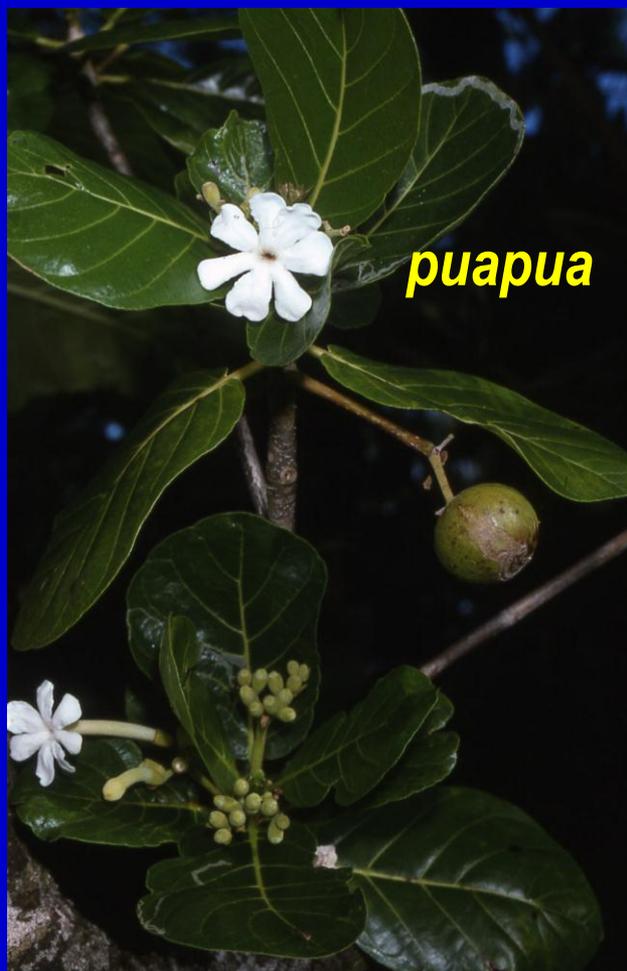
niu vao

Palms are very attractive ornamental plants

Four genera of palms (Arecaceae) are native to Samoa

Balaka (ca. 5 spp.), *Solfia* (1 sp.), and *Clinostigma* (3 spp.), all have just endemic species

Coconut is indigenous



The second largest native Samoan plant family is the coffee family Rubiaceae, with 46 species

- It includes native species such as *Guettarda speciosa*, *Mussaenda raiateensis*, and *Morinda citrifolia*
- It also includes the second largest Samoan genus, *Psychotria*