

THE PHENOLOGY OF RAINFOREST PLANTS IN TUTUILA, AMERICAN SAMOA

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INTRODUCTION

Geography. American Samoa, an unincorporated territory of the United States, is comprised of five volcanic high islands and two coral atolls in the south-central Pacific, at about 14° S and 170° W. The total land area of these islands is 197 km^2 , with Tutuila, the largest island, accounting for 142 km^2 .

Biogeographically, American Samoa is part of the Samoan archipelago, which also includes the independent country of Western Samoa. Western Samoa, located approximately 100 km west of Tutuila, is comprised of the two large islands of 'Upolu (area 1114 km^2) and Savai'i (area 1821 km^2).

Tutuila, the site of the present study, is the highly eroded peak of a volcano. Most of the interior of the island consists of steep ridges and deep, narrow stream valleys, with scattered peaks composed of erosion-resistant trachyte. The highest of these peaks, Mt. Matafao, reaches 649 m elevation. The coastal strip is narrow in most places, with the notable exception of the Tafuna Plain in the south-central part of the island. This almost flat plain is a relatively recent lava flow.

Modern human settlement is concentrated along the coastal strip, especially surrounding Pago Pago Bay, and in the Tafuna Plain. In these areas, only small fragments of native forest remain. Small-scale plantations of bananas, taro, and cassava are established in most valley bottoms and lower slopes. Nevertheless, most of the steep ridges of the interior,

particularly on the north side of the island, are still covered with native rainforest, though modified to varying degrees by human activities and by hurricanes. The human population of Tutuila is now approximately 50,000, and is increasing at a rate of 3.8% per year.

Climate. Tutuila has a tropical maritime climate, characterized by abundant rainfall and year-round high temperatures and humidity. The average annual rainfall from 1963-1992 was 3144 mm, with a well-marked wet season from October-May and a dry season from June-September (Figure 1). Relative humidity is high throughout the year, with monthly averages from 82-86% (Amerson et al. 1982). Temperature varies little through the year, with the warmest month (March) averaging 27.2° C and the coolest month (August) averaging 25.9° C.

The hurricane season in American Samoa extends from October-April, with most recorded storms in December-March (Tatekawa 1987). Strong hurricanes are relatively infrequent in the Samoan archipelago, but three severe hurricanes have struck the islands in the past ten years: Tusi in March 1987, Ofa in February 1990, and Val in December 1991. Tusi had relatively little effect on Tutuila, but the latter two storms caused severe damage to forest vegetation and to wildlife populations (Craig et al. in press; Elmqvist et al. in press, Pierson et al. in press).

Flora. The native flora of Tutuila consists of 417 species of vascular plants, of which 301 are flowering plants and 116 are ferns and fern allies (Whistler 1994). A total of approximately

179 additional flowering plant species have been introduced and naturalized, mostly since European contact (Whistler 1994).

The vegetation of American Samoa has been surveyed in a series of studies by Whistler (Amerson et al. 1982, Whistler 1992, Whistler 1993, Whistler 1994). Whistler identifies three main types of primary forest on Tutuila: littoral forest, lowland rainforest, and montane rainforest.

Littoral forest occupies a narrow coastal strip, rarely extending much further than 100 m in from the shore. This is dominated by large trees, including Barringtonia asiatica, Terminalia catappa, Calophyllum inophyllum, and, on sandy shores, Hernandia nymphaeifolia. The fruits of both Terminalia and Calophyllum are of major importance in the diet of fruit bats.

Lowland rainforest, as defined by Whistler (1994), is the predominant forest type of Tutuila, extending from just inland of the coastal strip up to about 350 m elevation. It can be divided into three major types: valley lowland forest, coastal lowland forest, and ridge lowland forest (Whistler 1994). Valley lowland forest is found in alluvial valleys near the coast. Dominant tree species include Dysoxylum maota, Planchonella samoensis, and Cananga odorata. This is a relatively rare forest type today, since most alluvial valleys on Tutuila are now occupied by villages. Coastal lowland forest occurs on ridges from inland of the littoral forest to approximately 200 m elevation (Whistler 1994). Being found on ridges, it is drier than valley lowland forest, and is dominated by different trees, including Diospyros

samoensis, Garuga floribunda, Barringtonia asiatica, and Planchonella garberi. Finally, ridge lowland forest occurs from about 200-350 m elevation on ridges. It intergrades extensively with lowland ridge forest, but is most characteristically dominated by Syzygium inophylloides, Calophyllum neo-ebudicum, Canarium vitiense, and Buchanania merrillii. Almost all the data for this study were collected in lowland rainforest, particularly coastal lowland forest and ridge lowland forest.

Montane rainforest occurs at elevations above 350 m on Tutuila. Similar in stature to ridge forest, it is dominated by different trees, including Dysoxylum huntii, Syzygium samoense, Crossostylis biflora, and Palaquium stehlinii (Whistler 1994). Again, this vegetation type intergrades with ridge lowland forest. It is of limited extent on Tutuila, and has been damaged by the recent hurricanes.

METHODS

PLANT PHENOLOGY DATA

Most plants included in this study were located along four transects that had been established for forest bird surveys. Both primary and secondary forests were represented on these transects, which also included areas with varying degrees of damage from Hurricanes Ofa and Val. These transects were: MAL (on Tuasina Ridge south of Maloata in western Tutuila); FGO (the upper Matafao Stream valley, south of Pago Pago in central Tutuila); VAT (on Sauma Ridge east of Vatia in central Tutuila); and AAA (between Alofau and Aoa in eastern Tutuila). Locations of these transects are shown on Figure 2, and other information on the transects is summarized in Table I.

In addition, plants were surveyed at several other sites that had good views over extensive forested areas. These were: A'asu lookout, east of Aoloau (Fig. 2, Site 1); Malaeimi valley, west of Nu'uuli (Fig. 2, Site 2); the Lion's Park area on the western shore of the Pala Lagoon (Fig. 2, Site 3); Alava ridge, east of Fagasa (Fig. 2, Site 4); and Amalau valley, west of Afono (Fig. 2, Site 5). Finally, I conducted special surveys each month for the two banyan species, Ficus prolixa and F. obliqua. These surveys were conducted along the main coastal highway from Tula west to Futiga, and throughout the Tafuna plains. I also recorded data on selected plant species other than banyans along these routes.

In total, approximately 800 individual plants were surveyed each month between September 1992 - January 1994. The exact number of plants varied somewhat between months as I added additional plants to the survey or as plants died. A total of 76 plant species was included in the study. This includes all the non-cultivated plants known to be important food sources for the fruit bats, pigeons, and fruit-doves of American Samoa. Cultivated plants, including coconut, breadfruit, and papaya, were not included in the phenology study.

Each plant in the survey was assigned a number. If the plant was accessible, it was marked with a numbered strip of plastic flagging. Many of the surveyed plants were not accessible, as they were on cliffs or across valleys. In that case, their location was carefully described in my notes, and often marked on a sketch-map of the area. The plants located on the bird transects were surveyed with 8x40 binoculars. These were all located along the trails and could be accurately assessed with binoculars. The banyans and the plants at the "lookout" sites (e.g. Amalau and Malaeimi) were typically more distant, and were surveyed with a Questar Field Scope (maximum magnification 90x). No plants were included in the survey if their flowering and fruiting status could not be accurately assessed with the optics available at the site.

The goal of this study was to produce a comprehensive survey of the phenology of rainforest plants used by the wildlife of American Samoa, particularly the frugivorous birds and bats. I

therefore attempted to be relatively balanced and inclusive in my selection of individual plants. Thus, I attempted to include a good sample of common trees (e.g. Myristica fatua, Dysoxylum samoense, and Syzygium inophylloides) from the eastern, central, and western areas of Tutuila. For localized species, I attempted to survey an adequate number within the one surveyed area where they occurred (e.g. Elaeocarpus ulianus in the Matafao valley transect). Because of the varied distribution and abundance patterns of the many species in this study, it was not feasible to follow a single principle in selecting individual plants for the study. Plants were added as they were encountered, with allowance made for good visibility of the crown and for sample size considerations.

Data collection for this study began in August 1992. For most plant species, the data collection period extended from September 1992 through January 1994. A few species had adequate samples beginning in August 1992, and extending as late as May 1994. The banyans Ficus prolixa and F. obliqua were a special focus of study, and data were collected on them from July 1992-June 1994.

Phenological data were collected on each plant in the study once per month. All data were collected by myself, eliminating observer effects. For each plant, the following data were collected: status of foliage; stage of flowering; stage of fruiting; crop size (if any); and ripeness of fruit (if any). The data categories for each parameter are summarized below.

Foliage: Categories were: Bare (few or no leaves on the tree); New (at least some newly-emerged leaves); Prime (almost all leaves unblemished, though not newly-emerged); Middle-Aged (most leaves with signs of aging, including insect or physical damage and color changes); and Old (most leaves heavily damaged, withered, or yellowing).

Flowers: Stages were: None (no flowers or flower buds present); Early (flower buds with very few if any open flowers); Peak (many open flowers; could also be buds and post-peak flowers present in the tree); and Late (no buds, few if any open flowers, and many past-peak flowers).

Fruiting: Stages were: None (no fruit of any size present on the tree); Early (only unripe fruit present; this includes all stages from very early nubs to full-size but unripe fruit); Peak (at least some ripe fruit present; unripe and past-peak fruit could also be present in the tree); and Late (most of crop gone from the tree; the remaining fruit might be all ripe or might be old and dry). In this report, "available fruit" refers to the proportion of trees in the peak and late fruit stage combined, because these were the trees with fruit acceptable to frugivores.

Crop: Categories were: Poor (only scattered fruit in the crown, or only one small part of the crown with fruit); Fair (a moderate amount of fruit available, but considerably less than the maximum yield for that plant species); Good (a large amount of fruit, distributed throughout the crown, approaching the typical maximum yield for that species); and Unknown (used only

for trees in very early fruiting, when it was impossible to assess how large the fruit set would be). Note that these categories are for within-species comparisons only, and provide no information about absolute amount of fruit available. For example, a Pipturus bush with a good crop would have far less fruit than a banyan tree with a poor crop.

Ripeness: This was estimated based on color change, the opening of capsules, or, in a few cases, the activities of frugivores. Many fruits eaten by the birds and bats did not change color when ripe, in which case their ripeness was coded as 9, for unknown. This also applied to some trees with capsules, particularly nutmegs (Myristica), whose capsules opened asynchronously and whose fruit were typically removed very soon after the capsules opened. The other categories were: 0 (no ripe fruit); 1 (1-25% of fruit ripe); 2 (26-50% of fruit ripe); 3 (51-75% of fruit ripe); 4 (76-99% of fruit ripe); and 5 (100% of fruit ripe).

The present report focuses on fruiting phenology. I do not present here any of the foliage data, and report flowering information only for those plant species in which flowers are an important food resource for the fruit bats (e.g. Erythrina, Ceiba, and Syzygium inophylloides).

FRUGIVORE FEEDING DATA

Time and manpower constraints made it impossible to collect systematic data on frugivore use of plant species, for example by observing a series of plant species under standardized conditions. Instead, records were kept of all observations of birds or bats feeding, no matter what the circumstances of the observation. Most observations were made during the course of bird or bat surveys, or during the recording of phenology data. This feeding data gives a valuable information on the diet of the frugivorous birds and bats, but does not allow analysis of relative preference or importance in the diet. For example, it is much easier to observe a bird or bat feeding in the crown of a canopy tree (e.g. Syzygium inophylloides or Canarium vitiense) or an edge species (e.g. Pipturus or Cananga) than it is to detect feeding on vines or understory shrubs (e.g. Alyxia, Psychotria, or Antidesma). Further, the very large crop sizes of some trees, such as the banyans, attracts many frugivores, allowing the observer to record many feeding data in a short session. On the other hand, the smaller, asynchronously-ripening crops of other plants, such as Myristica and Inocarpus, are probably visited only briefly by frugivores "traplining" for ripe fruit. This makes feeding very difficult to detect.

These facts mean that the data on "Food for Birds" and "Food for Bats" in this report need to be interpreted with caution. Some plants, such as the vine Alyxia bracteolosa, bear fruit that

appear suitable for birds, and yet were never seen to be eaten. It would be inappropriate to conclude that this plant was not utilized. On the other hand, the paucity of feeding observations on such abundantly-fruited canopy trees as Garuga and Alphitonia probably does indicate that these species are little-used, because it would be easy to document feeding if it was frequent. I have attempted to take the various factors of plant abundance, plant conspicuousness, and crop characteristics into consideration in my subjective assessment of plant importance in the diet of the frugivores, given in following plant species accounts.

Sandra Banack is currently conducting systematic sampling of feeding activity at a variety of plant species used by fruit bats on Tutuila. This work should provide much better information than is currently available on the importance of various plants in the diet of Pteropus tonganus and P. samoensis.

RESULTS

The Results section is divided into a series of plant species accounts. An account is provided for every species included in the phenology study (total = 76 species), as well as for a few species that were not included in the study, but for which some observations on phenology or frugivore use were made (total = 8 species). This includes all native and naturalized plants known to be important in the diet of the frugivorous birds

and bats; it does not include some cultivated species important to the bats, such as breadfruit (Artocarpus altilis, Moraceae).

For each species, a brief description is given as an aid to identification, followed by the herbarium number in the DMWR Herbarium (e.g. H-24). These herbarium specimens serve as vouchers for the plant indentifications. The taxonomy in this report follows Whistler (1994), which is also the source for much of the information in the plant descriptions. Then flowers, fruit, and seeds are described. If the fruit and/or seeds are held in the DMWR Fruit and Seed Collection, the specimen number is given (e.g. FS-104). The fruit phenology pattern is then described, and illustrated with a figure if sufficient data were collected ($n \geq 10$ plants for most of the study). The mean sample size for each illustrated species is given, along with the range in number of samples per month of the study. For those species in which the lower value in the range is well below the mean, this almost always represents the first month of the study (August 1992).

Note that flower phenology is not presented here, with the exception of a few plants whose flowers are of major importance to the bats (e.g. Erythrina variegata). Finally, sections are given summarizing data on use of the plant as food for birds and bats on Tutuila. These include a subjective assessment of the importance of the plant for various frugivores, subject to the caveats outlined in the Methods section.

ACKNOWLEDGEMENTS

This study would have been impossible without the assistance of Dr. W. Arthur Whistler, who generously shared his unmatched knowledge of the Samoan flora. Further help with plant identification was provided by Fia Tiapula and Natasha Tuato'o-Bartley. Help with data collection was provided by Natasha Tuato'o-Bartley and Ailao Tualaulelei. Sandra Banack shared her extensive observations of Pteropus diet and provided additional data on the phenology of many species. Joshua Craig assisted with the curation of the DMWR Herbarium. Finally, I wish to thank the many Samoan families who provided access to their land so that this work could be conducted.

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Table I. Characteristics of major survey areas for the forest phenology study. Number of plants surveyed varied between months; the number given is for December 1993, except for A'asu, which is for October 1993. The degree of storm damage is a subjective assessment of the degree of physical damage caused by Hurricane Val (December 1991): Light = few major limbs or trunks broken; Moderate = major limbs and trunks broken throughout the area, but canopy remains closed; Severe = many major limbs and trunks broken, causing opening of the canopy in many places.

<u>SITE</u>	<u>Number of Plants</u>	<u>Forest Types</u>	<u>Degree of Storm Damage</u>	<u>Dates Surveyed</u>
MAL	149	Ridge Lowland	Moderate-Severe	9/92-1/94
FGO	177	Ridge Lowland	Moderate	9/92-5/94
VAT	119	Coastal Lowland	Moderate	8/92-1/94
AAA	142	2 ⁰ Ridge Lowland	Severe	9/92-1/94
A'asu	49	Lower Montane	Light-Moderate	8/92-10/93
Malaeimi	48	Valley Lowland	Light	8/92-4/94
Lion's Park	20	Littoral/Village	Light-Moderate	8/92-5/94
Alava Ridge	35	Coastal Lowland	Light	8/92-12/93
Amalau	37	Valley Lowland	Light	8/92-1/94
Banyan Routes	79 bnyns 56 non- banyans	Coastal Lowland & Disturbed Areas	Variable, mostly Moderate-Severe	6/92-5/94 8/92-5/94

Rainfall Patterns

Tutuila, American Samoa

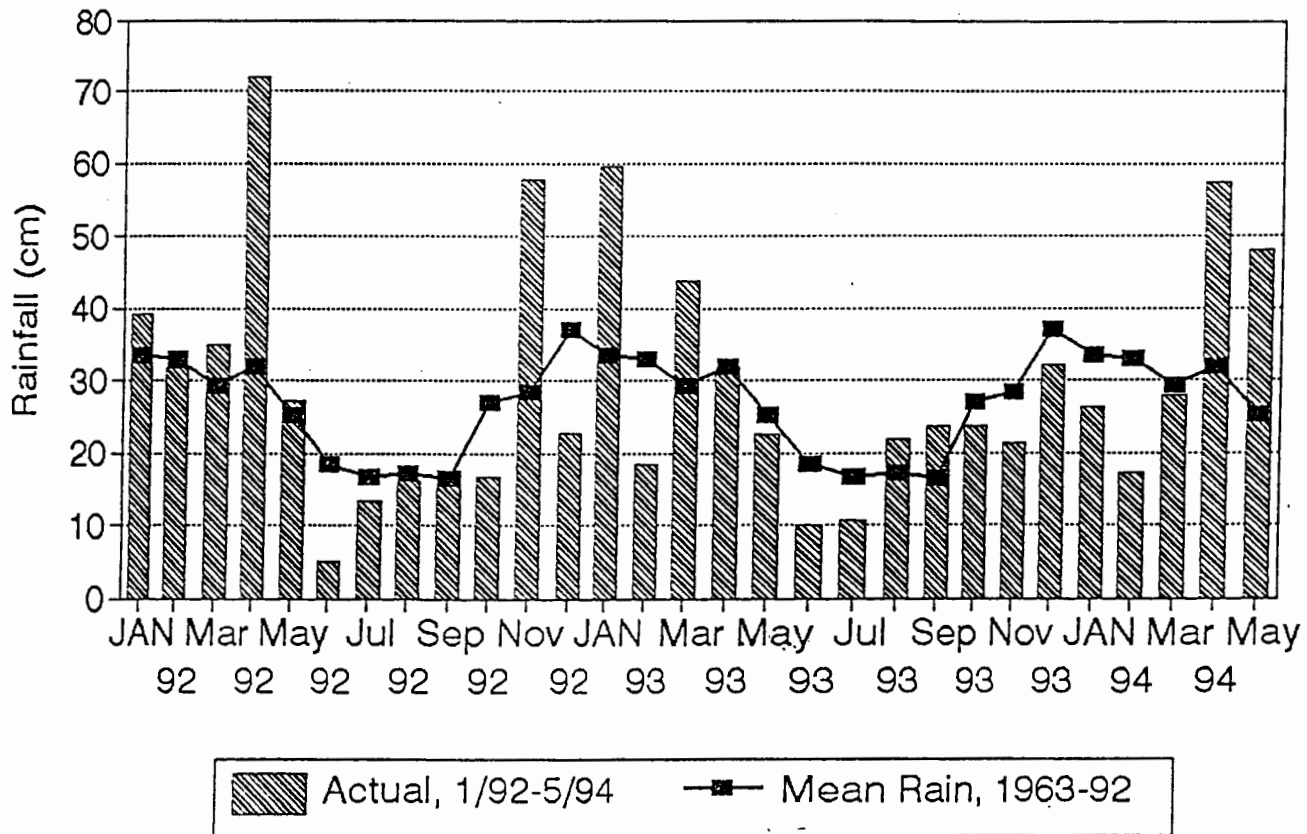


Figure 1. Monthly rainfall, Tutuila, American Samoa. Histogram bars show actual rainfall, in cm, from January 1992 - May 1994. The line shows the average monthly rainfall for the 30-year period 1963-1992. The phenology data for most species in this paper were collected from August 1992 - January 1994, with data for some species extending to May 1994. Rainfall measurements were made at the airport in Tafuna (south of site 3 on Figure 2).

TUTUILA, AMERICAN SAMOA

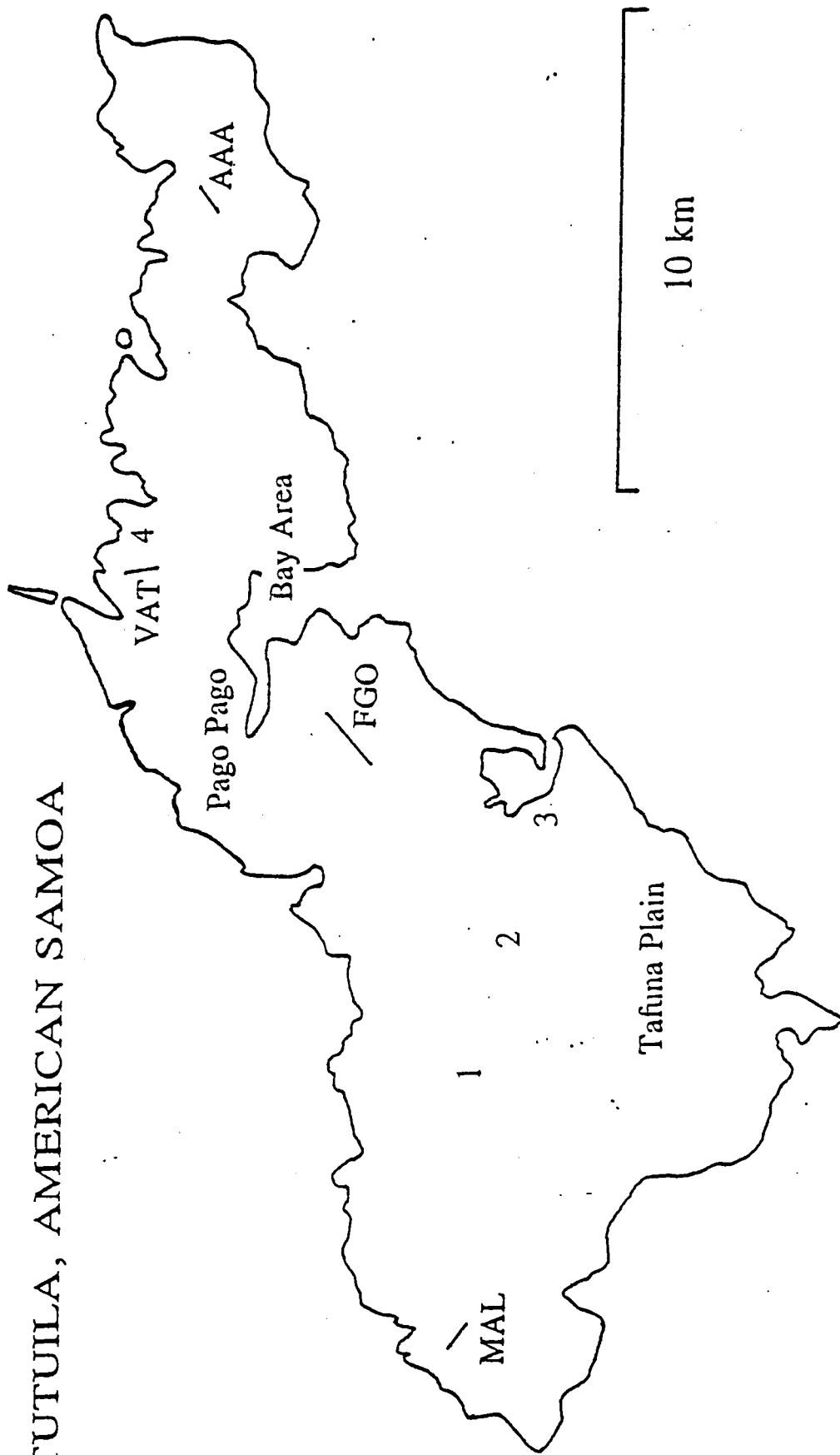


Figure 2. Phenology study sites, Tutuila, American Samoa. The sites identified with initials are forest transects with length and orientation as shown. The sites identified with numbers are viewpoints where forested areas were scanned with a telescope. 1 = A'asu; 2 = Malaeimi; 3 = Lion's Park, Tafuna; 4 = Mt. Alava ridge; 5 = Amalau. Further description of sites can be found in the text and in Table I.

MONOCOTYLEDONAE

AGAVACEAE

Cordyline fruticosa (ti)

Shrub with long, parallel-veined leaves. Common around villages as an ornamental (numerous varieties) and naturalized in primary and secondary forest. A Polynesian introduction. H-29, 64.

Flowers: Branching panicles of showy pink or white flowers.

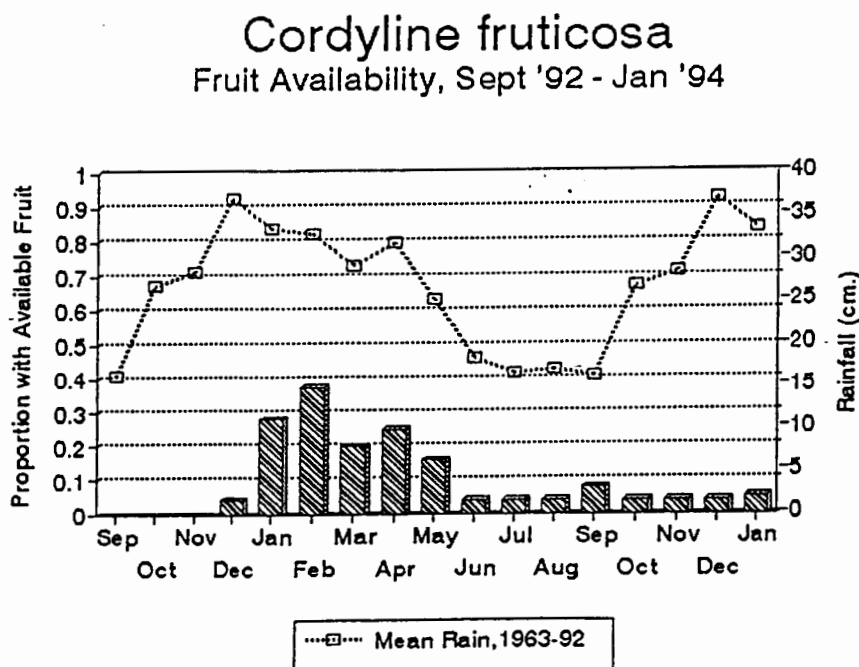
Fruit: Bright red berries borne on drooping panicles.

Seed: Numerous tiny shiny black seeds. FS-43.

Phenology: Peak from Jan-May 1993, with little fruiting before or after. Mean sample size = 24, range 12-25.

Food for Birds: Eaten by Purple-capped Fruit-Doves (2 observations).

Food for Bats: No known use.



PANDANACEAE

Freycinetia reineckei ('ie'ie)

Coarse climber with tough, tooth-edged leaves encasing the stem. Common in primary and well-developed secondary forest. NOTE: The congeneric F. storckii is more gracile, with narrower leaves, and more slender fruits with lumpier surface. Endemic. H-318.

Flowers: Unisexual; oblong inflorescences.

Fruit: Fat, oblong compound fruit, orange to red; usually two or three per fruiting bract.

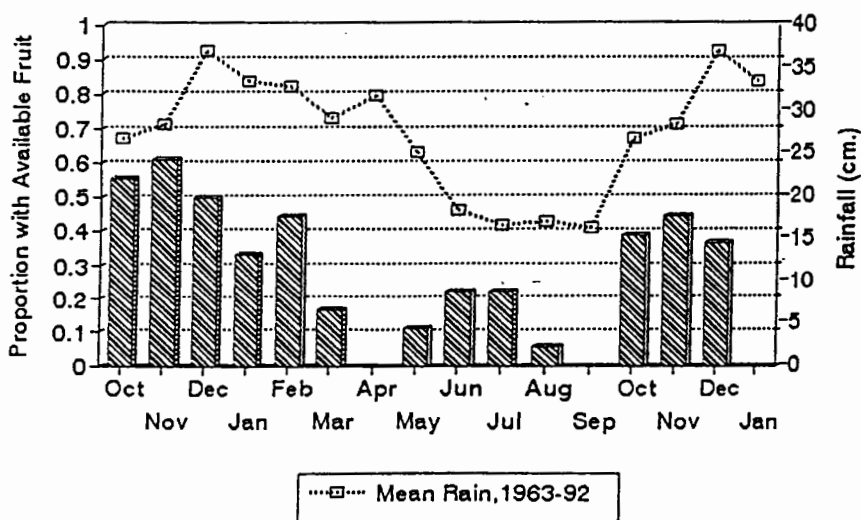
Seed: No information.

Phenology: Pattern appears cyclical rather than seasonal: several months of fruiting followed by a month with no fruiting. Mean sample size = 18 (range 18-19).

Food for Birds: Fed upon by starlings: Polynesian Starling (1 observation); Samoan Starling (4 observations). These rip out pieces of the fruits.

Food for Bats: Both the flowers and fruit are important foods for P. samoensis; no observations of feeding by P. tonganus.

Freycinetia reineckei
Fruit Availability, Oct '92 - Jan '94



DICOTYLEDONAE

ANACARDIACEAE

Buchanania merrillii

Large tree of primary or well-developed secondary forest. Uncommon. Leaves simple, alternate, oblanceolate with long petioles, appearing whorled. Endemic. H-24, 240.

Flowers: Small and white, in axillary panicles. Difficult to distinguish stage of flowering, or between flower buds and fruit nubs.

Fruit: Distinctive: lens-shaped, about 2 cm in diameter. Borne in clusters. Hard, with very thin mesocarp. Held on tree in green unripe state for a long time, ripening to dark red or purple.

FS-103.

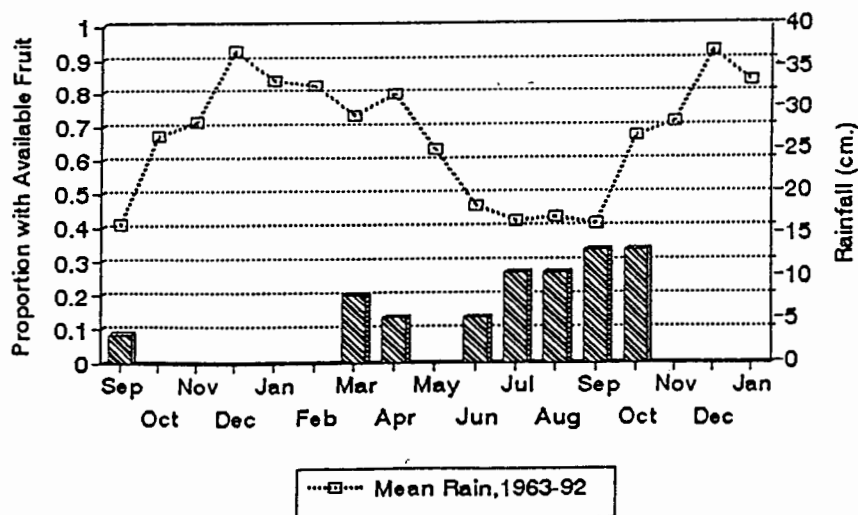
Seed: Single large, lens-shaped seed. FS-104.

Phenology: Predominantly dry-season pattern. Ripe fruit observed February-October; peak July-October. Mean sample size = 14 (range 8-15).

Food for Birds: Fruit eaten by Pacific Pigeon; appears to be a favored food source. Six feeding and fruit-inspection observations, a large number considering the rarity of the tree. The fruit is also probably eaten occasionally by Purple-capped Fruit-Doves; one fruit-inspection observation.

Food for Bats: Not known to be used.

Buchanania merrillii Fruit Availability, Sept '92 - Jan '94



ANACARDIACEAE

Rhus taitensis (tavai)

Large tree, principally of secondary forest. Common to abundant; one of the dominant trees in early successional habitats. Leaves alternate, pinnately compound, with smooth leaf margins (in contrast to the toothed margins of the similar Garuga floribunda).
Indigenous. H-1, 58, 321.

Flowers: Tiny white flowers densely clustered in panicles. Flower clusters on top of crown; hard to see from beneath.

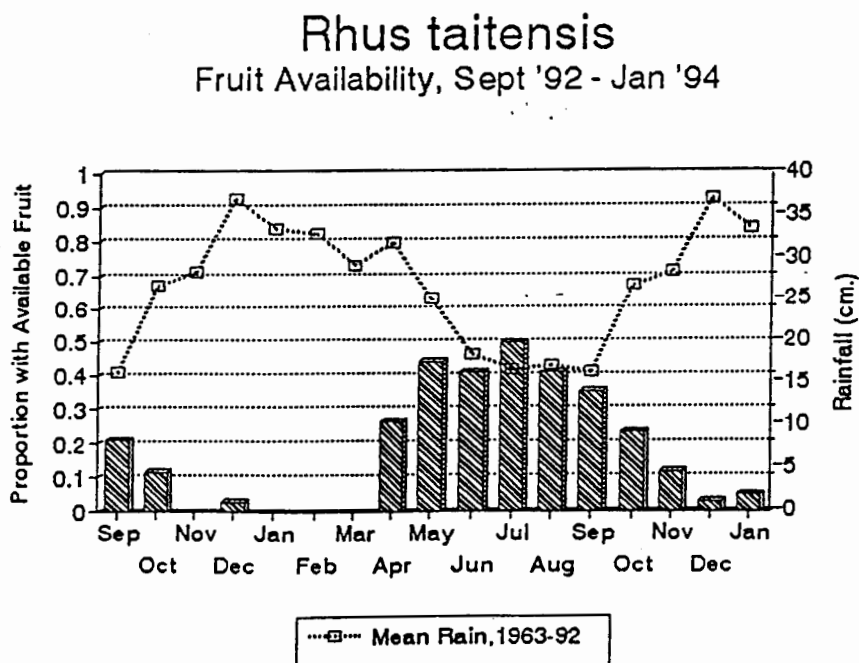
Fruit: Small fleshy fruit in dense clusters. Fruit 2-3 mm in diameter. Purple when ripe. Fruit may dry to a brown color and remain on the tree for months; in this state it probably has little or no food value for wildlife. FS-70.

Seed: Typically one or two small, irregular seeds per fruit. FS-56.

Phenology: Dry-season pattern. Ripe fruit seen in all months except February and March, but well-marked peak from April-October. End of fruiting difficult to determine as fruit are held on the tree after they are dry and probably inedible. Mean sample size = 32 (range 21-34).

Food for Birds: Despite its abundance, this tree appears to be of limited importance. Fed upon by Pacific Pigeons (three observations), Polynesian Starlings (1 observation), and Samoan Starlings (one observation).

Food for Bats: Not known to be used.



ANNONACEAE

Cananga odorata (moso'oi)

Medium-sized tree with straight trunk. Leaves alternate, all in one plane. Limbs often unbranched, drooping. Common, particularly in edges and early secondary forest; also in villages and agroforest. Brittle trunk makes this tree susceptible to hurricane damage. Polynesian introduction (or possibly indigenous). H-242.

Flowers: Showy, fragrant, yellow apocarpus flowers clustered along stems. Commonly used to make ula (necklaces).

Fruit: Oval, 3-4 cm long, borne in open clusters on stout petioles. Dark green to black; ripeness appears to be better estimated by size than color. Mesocarp thick, with oily texture.

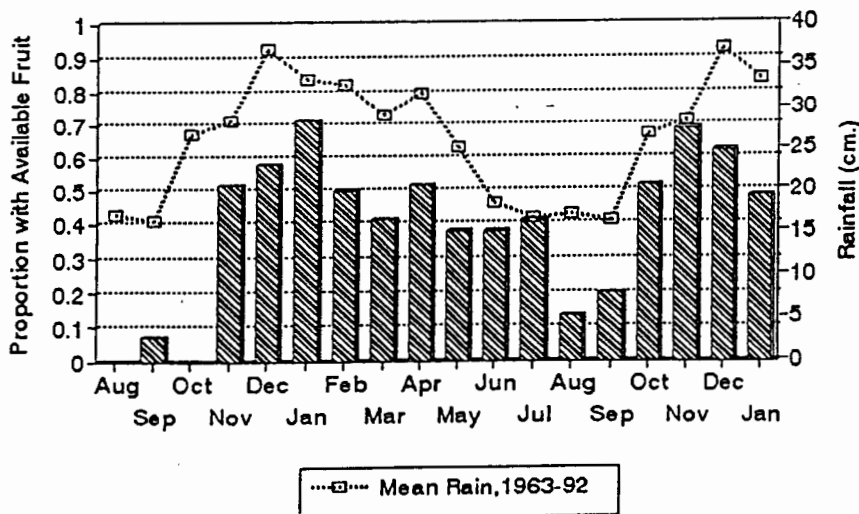
Seed: Several flat seeds, arranged in a loose stack perpendicular to long axis of fruit. FS-36.

Phenology: Apparently flowers and fruits year-round. Early lack of fruiting (Aug-Oct 1992) reflects hurricane effects; since then there has been ripe fruit in all months, with the only significant drop in August and September. This aseasonal fruiting makes Cananga a very important food source for pigeons and doves. Mean sample size = 28 (range 17-31).

Food for Birds: Very important food source for Pacific Pigeon (13 observations) and Purple-capped Fruit-Dove (15 observations). Also eaten by Samoan Starling, but appears of limited importance (3 observations).

Food for Bats: Confirmed feeding by P. samoensis, and appears likely to be eaten by P. tonganus, though unconfirmed. Apparently not a highly favored food source.

Cananga odorata
Fruit Availability, Sept '92 - Jan '94



APOCYNACEAE

Alyxia bracteolosa (lau maile)

Vine with milky sap and opposite leaves. Very common in primary and secondary forest. Commonly used to make leaf ula (necklaces). Indigenous. H-169, 170, 202, 419.

Flowers: Small and trumpet-shaped, white or yellowish.

Fruit: Marble-sized (1-2 cm), hard, round fruits. Green, ripening to bluish-black. Very thin, milky mesocarp.

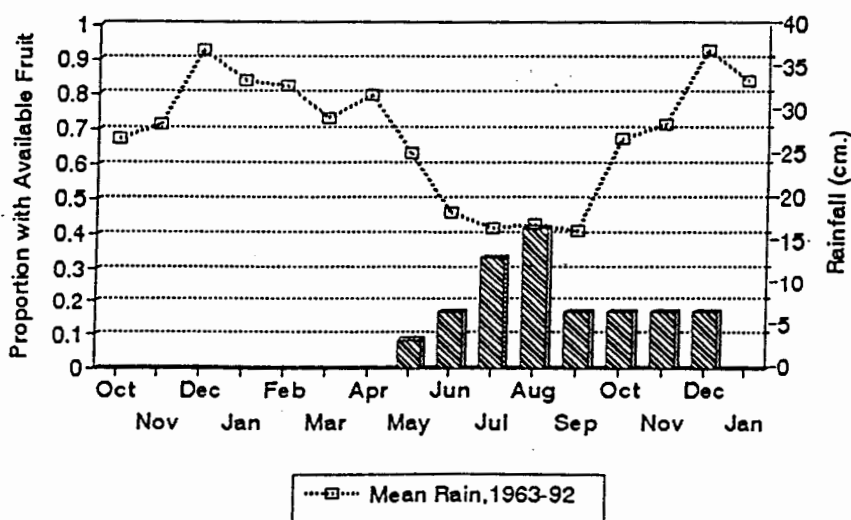
Seed: Single large seed. Round, with fine white longitudinal lines. FS-74.

Phenology: Dry-season pattern. Ripe fruit from May-December, with peak in July and August. Mean sample size = 11 (range 8-12).

Food for Birds: No confirmed feeding observations. However, the captive Pacific Pigeon fed avidly on these fruits, and cleaned seeds (as from fed-upon fruits) are often found in the forest. As with other understory plants, feeding observations would be difficult to obtain; I believe that Pacific Pigeons and Purple-capped Fruit-Doves probably feed on this plant.

Food for Bats: No known use.

Alyxia bracteolosa Fruit Availability, Oct '92 - Jan '94



BARRINGTONIACEAE

Barringtonia asiatica (futu)

Large, spreading tree with large, glossy, alternate, obovate leaves. Common to abundant in littoral zone, and occasional in ridge forest. Indigenous.

Flowers: Very large flowers with numerous long pink and white stamens.

Fruit: Large green top-shaped fruit.

Seed: Single large seed, within a corky coat that provides flotation.

Phenology: No quantitative data, but appears to have flowers and fruit year-round.

Food for Birds: No known use.

Food for Bats: One observation of P. samoensis feeding on flowers; one apparently bat-chewed fruit found by S. Banack.

BARRINGTONIACEAE

Barringtonia samoensis (falaga)

Medium-sized tree with large alternate leaves. Leaves red when old. Uncommon in primary and secondary forest; found particularly in stream valleys. Indigenous. H-15, 62, 203.

Flowers: In hanging racemes, with numerous showy red stamens.

Fruit: Large (10-15 cm), hard, spindle-shaped fruits, hanging on long stalks. Green, acquiring a red blush as they mature. FS-86.

Seed: Single large seed, surrounded by corky layer..

Phenology: Limited data (typical N=4). Appears to flower and fruit almost continually. Fruit ripeness difficult to assess; full-size fruit seen in all months except Mar, Apr, and Dec.

Food for Birds: No known use. Because of very large size and hardness, only potential users would seem to be starlings ripping off pieces of the fruit.

Food for Bats: One observation of a P. samoensis sniffing at fruits, as if assessing ripeness. This bat did not feed.

BOMBACACEAE

Ceiba pentandra (vavae)

Medium sized tree with palmate leaves. Typically slender straight trunks; used for fale poles. Widespread along roadsides and in villages; not seen in forest. Introduced. H-149.

Flowers: Prominent white petals and orange stamens.

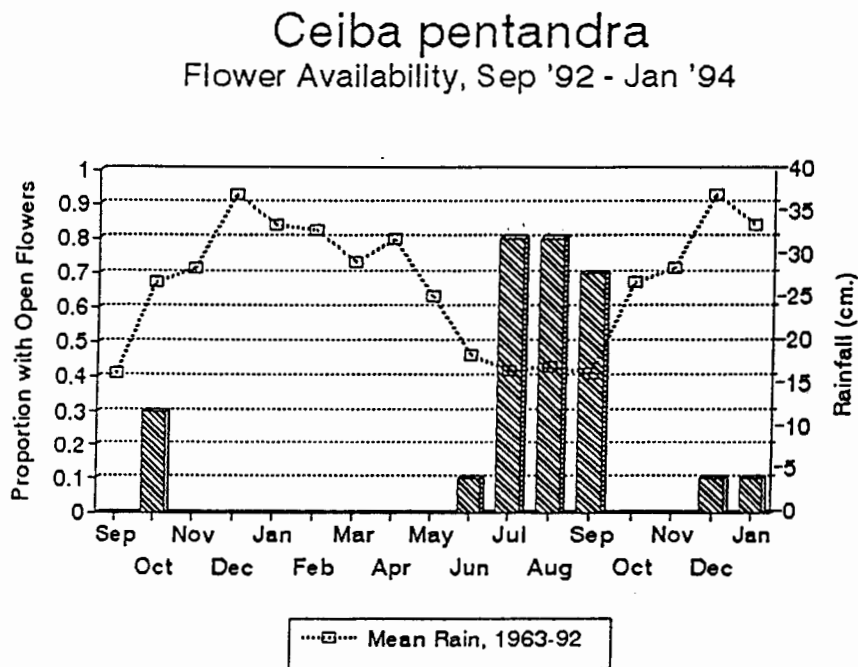
Fruit: Elongate capsules hanging on long petioles. Green, turning brown and splitting to reveal copious white "cotton".

Seeds: Small, round, brown, and hard, buried in cotton.

Phenology: This data is for flowers, which have a dry-season pattern. Sharp peak in flowering in July-September; limited flowering also seen in June, December, and January. Mean sample size = 10 (range 9-10).

Food for Birds: Fruit not eaten. Flowers presumably visited by honeyeaters for nectar, though no recorded observations.

Food for Bats: An important nectar source for P. tonganus; occasionally used by P. samoensis.



BURSERACEAE

Canarium harveyi (mafoa?)

Medium-sized tree with alternate, pinnately compound leaves. Leaflets 5-9, ovate to oblong. Leaves have a distinctive coarse appearance. Generally rare, but locally common on ridges between Afono and Vatia. Probably a modern introduction. H-232.

Flowers: Tiny and orange, in loose panicle. Very inconspicuous in the foliage.

Fruit: Oval and purple, 3-4 cm long.

Seed: No information; presumably similar to C. vitiense (q.v.).

Phenology: Limited data (typical N=5). Appears to flower almost continually, though flower stage is difficult to assess. I rarely saw fruit: in Jun and Sep 93. Appears to have low fruit set.

Food for Birds: No known use; not surprising since almost no fruiting recorded. When it fruits, it is probably used like C. vitiense (q.v.).

Food for Bats: No known use.

BURSERACEAE

Canarium vitiense (ma'ali)

Large tree with alternate, pinnately compound leaves. Leaflets 7-13, elliptical to lanceolate. Has an aromatic resin. Bark smooth and white; trunk often rises quite high before branching. Common to uncommon in primary and well-developed secondary forest. Indigenous. H-238.

Flowers: Small, white to pale orange, in loose clusters. Very difficult to assess flower stage, or to distinguish buds from young fruit.

Fruit: Oval, 3-4 cm long, on petiole with small cap-like bracts at point of fruit attachment. Fruit has a whitish "bloom"; green ripening to blue-black. Mesocarp thin. FS-59, 84.

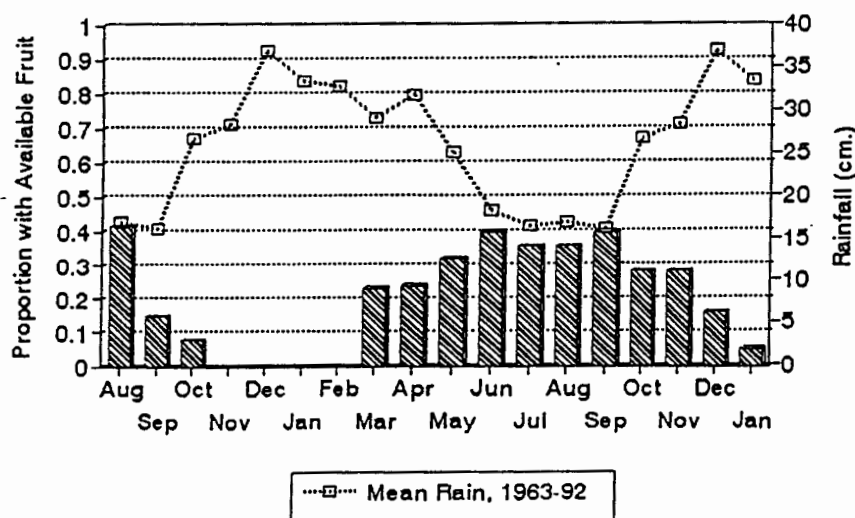
Seed: Single large seed, oval like the fruit. Numerous fine pits in the surface. FS-85.

Phenology: Not strongly seasonal. Broad peak in fruiting from March to November; ripe fruit seen in all months but February. Mean sample size = 24 (range 12-26).

Food for Birds: Important food for Pacific Pigeon (19 observations). No feeding by other species observed.

Food for Bats: No feeding observations.

Canarium vitiense Fruit Availability, Aug '92 - Jan '94



BURSERACEAE

Garuga floribunda (vi vao)

Large tree with alternate, pinnately compound leaves. Leaves similar to Rhus but with finely toothed margins. Bark has scattered bumps, lacking in Rhus. Flowers and fruit very different from Rhus. Uncommon in primary and well-developed secondary forest; also sometimes left uncut in agroforest and near villages. Indigenous.

Flowers: Small and pinkish, in small, loose clusters (not large, thick white sprays, like Rhus).

Fruit: Round, 1-1.5 cm, hanging in loose clusters. Green, slowly ripening to blackish. Mesocarp thin, rubbery. FS-26.

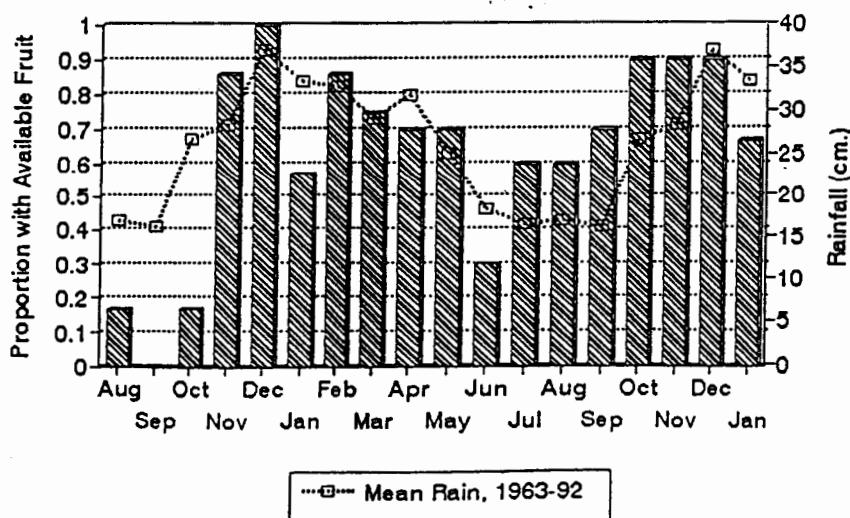
Seed: Three or four irregular seeds per fruit. FS-61.

Phenology: Fruit continuously available; however, ripeness difficult to assess (and fruit apparently little-used). Mean sample size = 9 (range 6-10).

Food for Birds: Little importance. S. Banack observed Pacific Pigeon feeding on the fruit on one occasion, and one apparent fruit-inspection by Pacific Pigeon observed. Wattled Honeyeater observed to feed on nectar.

Food for Bats: No observed use in American Samoa. This is reported to be an important food for P. samoensis in Savai'i, Western Samoa (Elmqvist 1992).

Garuga floribunda
Fruit Availability, Aug '92 - Jan '94



CARICACEAE

Carica papaya (esi)

Small tree with large, alternate, palmately lobed leaves and few if any branches. Common in disturbed areas and cultivated in villages, occasionally naturalized in forest. A modern introduction.

Flowers: Dioecious. Male flowers cream-colored, in pendulous racemes. Female flowers solitary and axillary.

Fruit: Very large, orange, with abundant edible flesh.

Seed: Numerous round, shiny black seeds, ≤ 0.5 cm.

Phenology: No quantitative data. Fruit available year-round.

Food for Birds: Favored by Samoan Starlings, which peck holes into the fruit and sometimes completely hollow it out. No other species have been recorded feeding on the fruit.

Food for Bats: Fruit fed upon by P. tonganus; not used by P. samoensis.

CLUSIACEAE

Calophyllum inophyllum (fetau)

Large tree with fissured, sometimes scaly bark. Leaves obovate, glossy, finely veined, opposite. Common in littoral forest; sometimes seen on lower ridges. Often left standing in coastal villages. Indigenous. H-28, 121.

Flowers: Showy, with white or pinkish petals and yellow centers, in open clusters.

Fruit: Large (3-5 cm), subglobose, with nipple-like tip. Green, sometimes turning yellowish or brown (but often ripe when green).

Seed: Single large seed, round, hard, and smooth. FS-30.

Phenology: Limited data (typical N=5). Apparently ripe fruit available continuously from Oct 92-Aug 93, then no ripe fruit from Sep 93-Jan 94. Casual observations revealed ripe fruit again beginning in Mar 94 and through end of observations in June 94.

Food for Birds: No feeding observations.

Food for Bats: Fruit is an important food for both species.

CLUSIACEAE

Calophyllum neo-ebudicum (tamanu)

Large tree with fissured (but not scaly) bark. Leaves oblanceolate, glossy, finely veined, opposite. When not in flower, can be difficult to distinguish from C. inophyllum; in general, inophyllum has scallier bark, larger leaves, and larger fruit with a noticeable terminal "nipple" (tamanu fruit is more spherical). Indigenous. H-130, 247.

Flowers: Showy pink or white flowers in open cluster; more blooms per cluster than fetau, and each flower smaller.

Fruit: Round or subglobose drupe, smaller than typical for fetau (3 cm). Green, turning tan and eventually purple or brown; may be ripe when tan. FS-54.

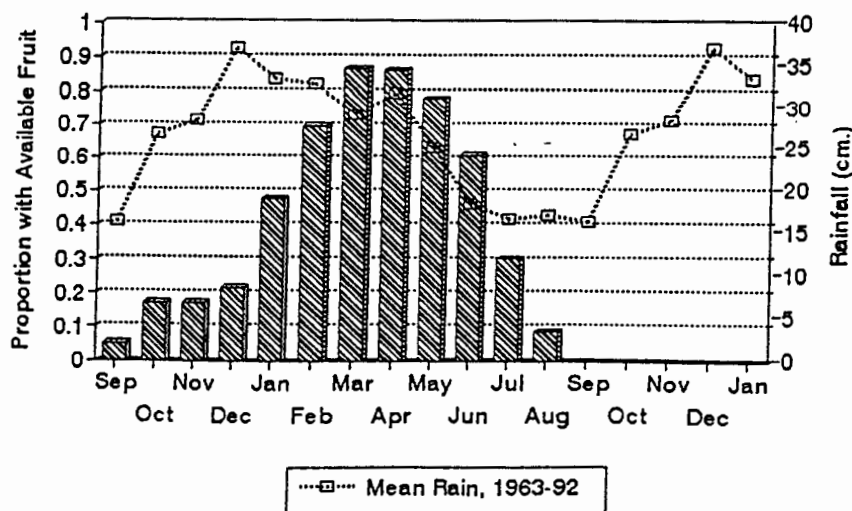
Seed: Single large seed, round and hard. FS-29, 55.

Phenology: Very abundant fruiting with well-marked peak Jan-Jun 93. Very little flowering or fruiting thereafter, suggesting that this species has a biennial pattern. Mean sample size = 23 (range 19-23).

Food for Birds: Eaten by Pacific Pigeon; two birds seen feeding in a tree on one occasion. Therefore doesn't appear to be of major importance. However, when in peak fruit it is an extremely abundant food source, and may be more important than my observations suggest.

Food for Bats: No observations of feeding.

Calophyllum neo-ebudicum Fruit Availability, Sept '92 - Jan '94



COMBRETACEAE

Terminalia catappa (talie)

Large tree with alternate, subsessile, obovate leaves. Leaves turn red when old. Arrangement of branches into horizontal planes is conspicuous, especially on younger trees. Occasional in littoral and lowland forest; more common in and near villages. Probably a European introduction. H-412.

Flowers: A spike of small white flowers.

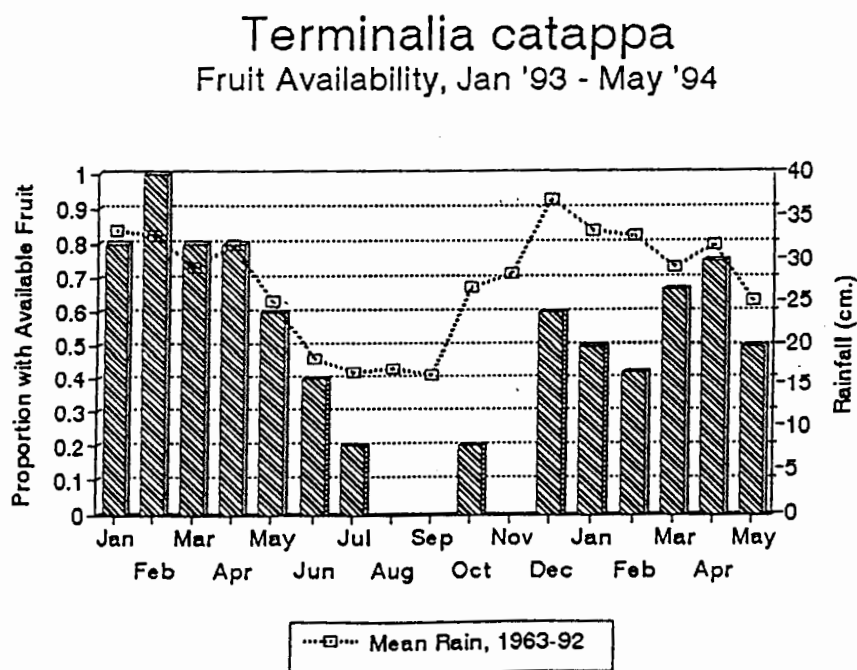
Fruit: Large (6-8 cm), almond-shaped fruit, yellow or red when ripe. FS-44.

Seed: Single large almond-shaped seed.

Phenology: High levels of fruiting Dec-May, with little or no fruiting June-Nov. This data is mostly from trees in Tafuna, but the pattern in Amalau is similar (S. Banack, pers. comm.). Mean sample size = 7 (range 5-12).

Food for Birds: No documented observations, but pieces of the fruit are probably occasionally eaten by Samoan Starlings.

Food for Bats: Important, highly favored food item for both species of bats.



COMBRETACEAE

Terminalia richii (malili)

Large tree with alternate, lanceolate leaves. Hard to identify when sterile; leaf shape resembles Elatostachys, but that has compound leaves. Flowers and fruit distinctive. Uncommon in ridge forest; seems to be locally common in a few areas (esp. Maloata). Indigenous. H-260.

Flowers: Spikes of very small white flowers; usually flowers profusely, so crown is covered with spikes.

Fruit: Compressed, oval to almost rectangular, 3-4 cm. Green, ripening to burgundy red or purple.

Seed: Single large seed, shaped like fruit. FS-42.

Phenology: Limited data (typical N=3). Appears to have a strong wet-season peak: fruit from Dec 92-Mar 93 and from Dec 93-Jan 94.

Food for Birds: Seemingly highly favored by Pacific Pigeon. Only three feeding observations, but these correspond to only times I saw the species in fruit. Fia Tiapula states the tree is well known to lupe hunters as a favorite food of the bird.

Food for Bats: No observations, but seems likely to be eaten by the bats.

CUCURBITACEAE

Momordica charantia

Herbaceous vine with deeply palmate, lobed, alternate leaves. Common in sunny disturbed places in the lowlands, including storm-caused clearings within forest. A modern introduction.

Flowers: Conspicuous unisexual yellow flowers on long pedicels.

Fruit: Unique spindle-shaped (fusiform) fleshy, lumpy orange fruit, 4-6 cm. This splits open to display seeds, which are surrounded by a bright red pulp. FS-100.

Seed: Gray and flattened. FS-101.

Phenology: No quantitative data. Seems to fruit and flower year-round.

Food for Birds: One observation each of Red-vented Bulbul and Polynesian Starling feeding on the red seeds of split-open capsules.

Food for Bats: No observations.

EBENACEAE

Diospyros samoensis ('au'auli)

Medium-sized to large tree, common in lowland and ridge forest. Leaves alternate, usually less pointed than 'anume. Much more common than 'anume. Indigenous. H-31, 37, 113, 220.

Flowers: Cream-colored, campanulate-type, 4-merous. Larger than 'anume flowers, but still often very hard to see in thick foliage.

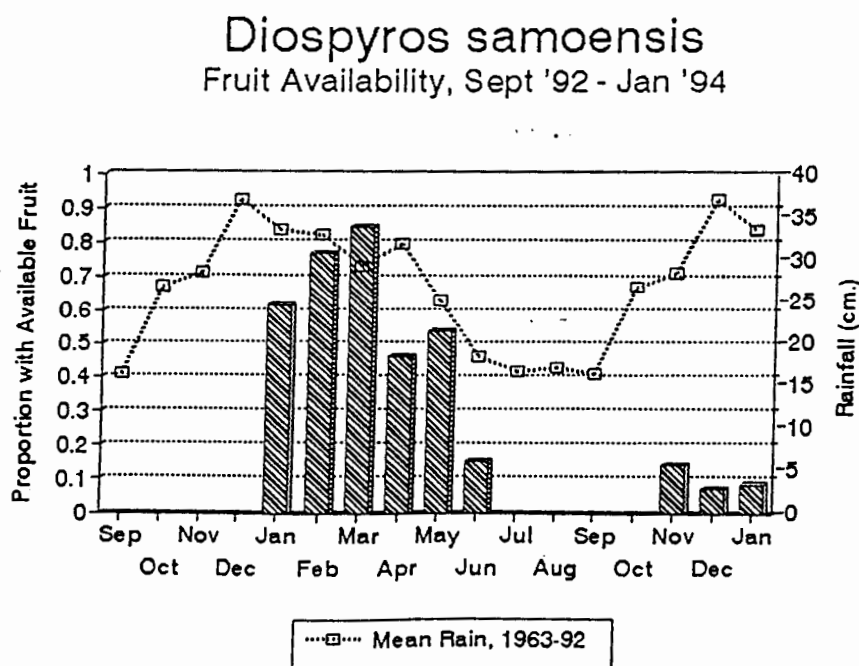
Fruit: Globose, with persistent calyx of 4 reflexed lobed; resembles small persimmon (3 cm. diameter). Remains on tree a long time after it turns yellow; occasionally turns orange. FS-79.

Seed: Several elongate shiny seeds packed into round fruit.

Phenology: During phenology study (Sep 1992-Jan 1994), appeared to be wet-season pattern. Ripe fruit seen from November-June, with well-marked peak in January-May. However, in 1994, fruiting seems much later, and will probably peak in the dry season. Mean sample size = 32 (range 26-34).

Food for Birds: Despite the abundance of the tree, only one fruit-feeding observation, by Samoan Starling. Fruit is extremely bitter to human tastebuds. Pacific Pigeons were observed feeding on this tree's new leaves on two occasions (five birds involved).

Food for Bats: No known use.



EBENACEAE

Diospyros elliptica ('anume)

Small to medium-sized tree with alternate leaves, fairly common in lowland and forest. Seems especially common in talus and cliff sites. Leaves more lanceolate than 'au'auli, but without fruit the two species can be difficult to distinguish. Indigenous. H-27, 137, 263, 432.

Flowers: Small, elongate, 3-merous, often in small clusters. Tree dioecous.

Fruit: Pointed, ellipsoid fruit, 3-4 cm. Yellow to red; ripeness difficult to assess.

Seed: Single large, smooth, fusiform seed. FS-64.

Phenology: Limited data (typical N=5). Apparently bears fruit continuously, with a few old fruits persisting while younger fruits mature. Ripeness difficult to assess.

Food for Birds: No feeding observations, but S. Banack has found fallen fruits with beak marks.

Food for Bats: Not known to be used.

ELAEOCARPACEAE

Elaeocarpus ulianus (a'amati'e)

Medium-sized tree with alternate, ovo-lanceolate leaves with finely serrated margins. Leaves angled from the petiole. Leaves appear to be clustered at twig tips, giving the effect of "sprays" of leaves. Occasional to locally common in ridge forest; particularly common along Fagatogo Transect. Endemic. NOTE: I am not comfortable with the distinction between this species and E. tonganus. Whistler says that ulianus has pointed buds and tonganus has rounded buds, but I'm not convinced this is not age-related. He also states that ulianus has ovoid fruits and tonganus has blue spherical fruits. I have never seen an Elaeocarpus with spherical fruits in Samoa. All my mature Elaeocarpus appear to be the same to me, so I assume they are all ulianus. H-325.

Flowers: White, bell-like, many-petaled flowers hanging from clusters.

Fruit: Large, ovoid green fruit, 5-7 cm, hanging from long pedicels; rather resemble small mangoes. May darken with age, but are eaten by frugivores when green. FS-108.

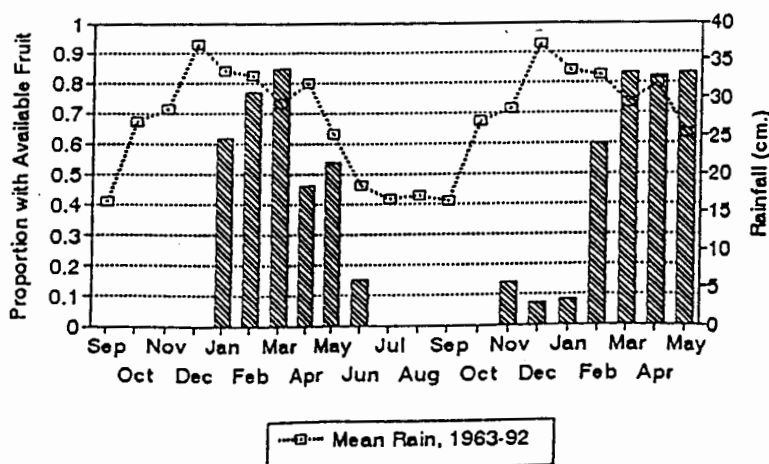
Seed: Very distinctive: single large, hard, flat, sharply edged seed. Reminds me of an Indian artifact. FS-40.

Phenology: Clear wet-season pattern: peak from Jan-May '93 and Feb-May (probably Jun) '94. Mean sample size = 13 (range 10-13).

Food for Birds: Eaten by Pacific Pigeon, though apparently not of major importance (two observations). Fruit is probably the maximum size the lupe can take. Members of this genus are important Ptilinopus and Ducula food in Australia.

Food for Bats: Eaten by P. samoensis; feeding by P. tonganus likely but unconfirmed. I believe this may be an important food, though observations are few. S. Banack has observed both species feeding at the flowers.

Elaeocarpus ulianus
Fruit Availability, Sep '92 - May '94



EUPHORBIACEAE

Antidesma sphaerocarpum (lau vaitusi)

Shrub or small tree with alternate leaves. Leaves rather rounded, with acuminate tip. Most easily identified by fruit, which it bears most of the time. Locally common, especially in secondary forest. More common at the east end of Tutuila in my experience. Indigenous. H-36, 80, 174, 239, 425.

Flowers: Tiny yellow flowers in a raceme.

Fruit: Small (0.5-1 cm), spherical purple berries, with staining purple juice.

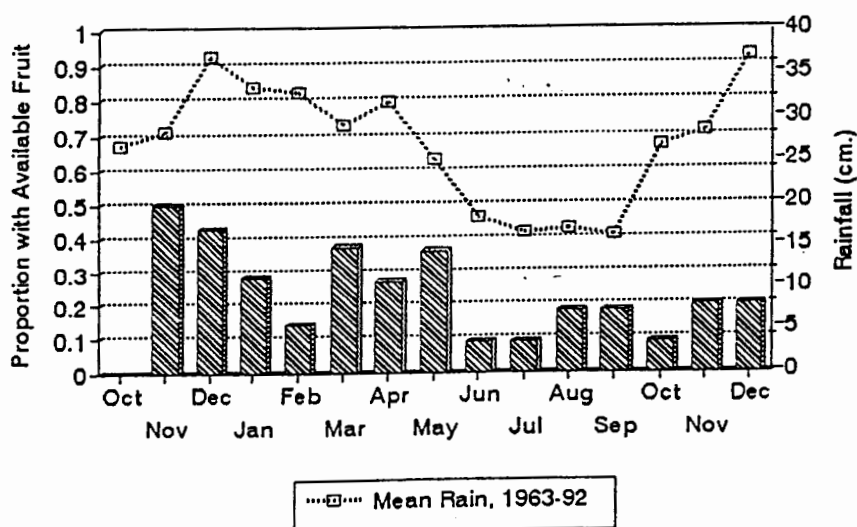
Seed: Several seeds per berry, hard and compressed, with off-center spike. FS-12.

Phenology: No apparent pattern; some ripe fruit in every month. Mean sample size = 9 (range 6-11).

Food for Birds: No observations, though almost certainly used sometimes by fruit-doves and starlings.

Food for Bats: No known use.

Antidesma sphaerocarpum Fruit Availability, Oct '92 - Dec '93



EUPHORBIACEAE

Bischofia javanica ('o'a)

Medium-sized to large tree with alternate trifoliate leaves. Dark brown, textured bark. Fairly common around villages and in secondary forest, uncommon in primary forest. Indigenous or possibly Polynesian introduction. Bark is the source of the dye for making siapo. H-12, 297, 334.

Flowers: Tiny greenish flowers in small, inconspicuous panicles. Very hard to assess flower stage.

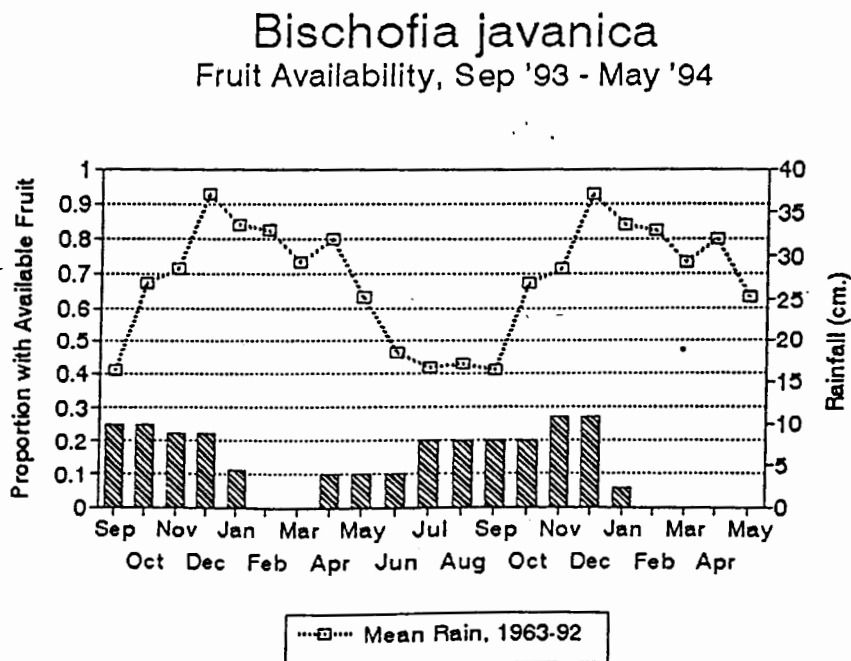
Fruit: Small (1 cm) brown (or sometimes reddish) spherical fruits in hanging clusters, like loose bunches of grapes. FS-63.

Seed: Several small whitish irregular seeds per fruit. FS-73.

Phenology: Low level of fruiting, with an apparent peak in the dry and early wet seasons. Mean sample size = 11 (range 8-18).

Food for Birds: Fruit eaten by Pacific Pigeon (two observations), Purple-capped Fruit-Dove (four observations), and Samoan Starlings (one observation). May be favored food of fruit-doves.

Food for Bats: No known use.



EUPHORBIACEAE

Flueggea flexulosa (poumuli)

Small tree with simple alternate leaves. Usually a single straight trunk and primarily horizontal unbranched limbs around it. Common in villages, but does not spread into forest. A modern introduction. H-342, 402.

Flowers: Small greenish flowers clustered in axils.

Fruit: Numerous small, dark purple berries clustered along the branches.

Seeds: Small and orange-tan, shaped like one quarter of a sphere. FS-71.

Phenology: No quantitative data. Appears to bear fruit most of the year.

Food for Birds: One observation of three Red-vented Bulbuls feeding on fruits. Very little time spent watching this tree species; probably used by starling and occasionally fruit-doves, but of little importance to forest birds because it isn't fully naturalized.

Food for Bats: No known use.

EUPHORBIACEAE

Glochidion ramiflorum (masame)

Small tree with glabrous alternate leaves with acuminate tips. Leaf size variable. Common in disturbed areas and secondary forest. Indigenous. NOTE: I am not comfortable with the distinction between this species and G. cuspidatum; however, that species is apparently restricted to higher elevations. H-13, 51, 112, 181, 418.

Flowers: Tiny yellow 3-merous flowers in axils.

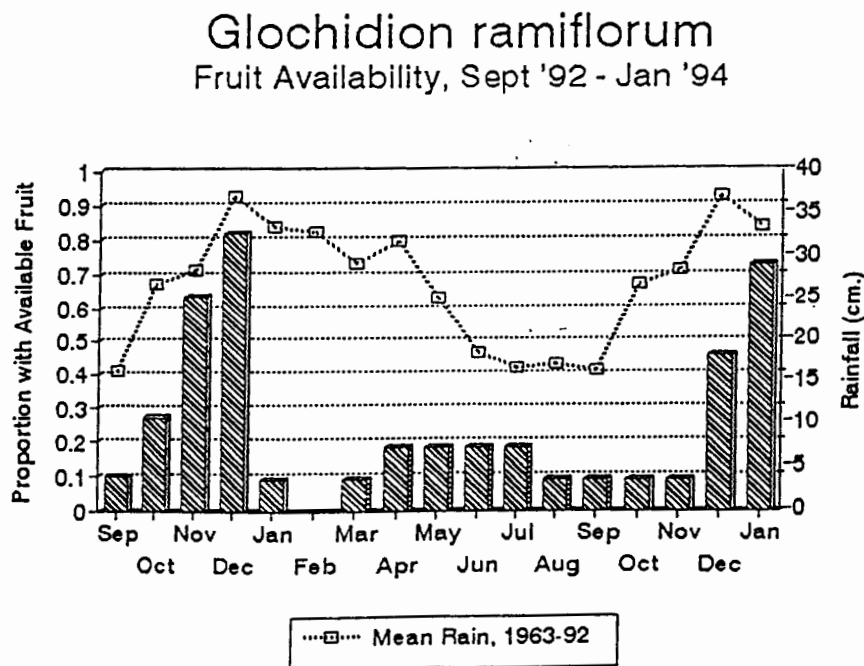
Fruit: Distinctive wheel-like fruits, green ripening to pale yellow or white. Split open when ripe to reveal brown or red seeds. FS-96.

Seed: Brown or red, packed vertically into wheel-like fruit. FS-32.

Phenology: Seems to be wet-season peak. Some ripe fruit seen in all months except February, but sharp peaks in November and December 1992 and December 1993-January 1994. Mean sample size = 11 (range 10-11).

Food for Birds: Favored by starlings: four feeding observations by Samoan Starling and one by Polynesian Starling. Not used by pigeons or doves.

Food for Bats: P. Cox lists this as a food for bats, but no confirmation from Tutuila.



EUPHORBIACEAE

Macaranga harveyana (lau pata)

Small tree with large peltate alternate leaves. Leaves often reduced to lacy skeletons by insect damage. Common in disturbed sites (e.g. roadsides) and secondary forest. Indigenous. H-16, 114, 335.

Flowers: Tiny green flowers in spreading axillary panicles.

Fruit: Distinctive: round and green with numerous soft spines.
Leathery, not juicy. FS-78, 83.

Seed: Several per fruit; hard to separate from leathery fruit.

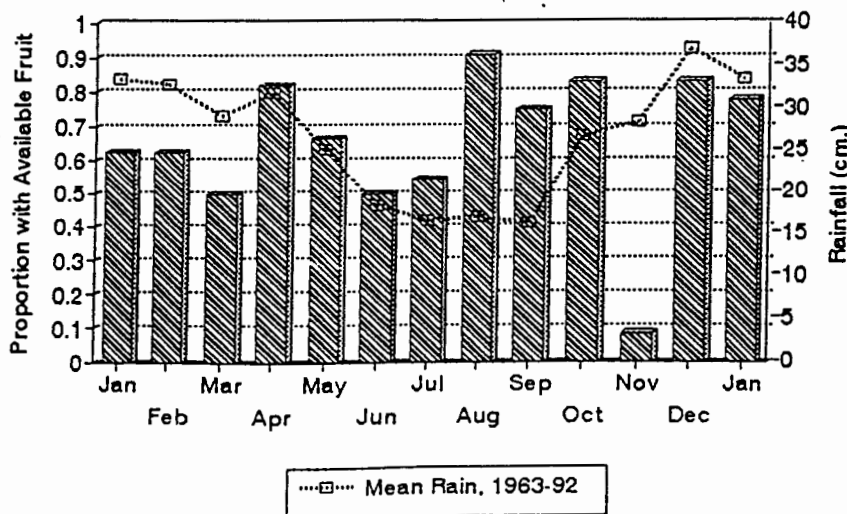
Phenology: No seasonal pattern: fruit seen in all months, and only November 1993 had less than 50% of sample trees with fruit. Ripeness difficult to assess. Feeding records by starlings scattered over the year: March, April, September, October, and November. Mean sample size = 10 (range 10-12).

Food for Birds: Favored by starlings: 30 feeding observations by Samoan Starlings, and one by Polynesian Starling. Certainly a staple for Samoan Starlings. Not used by pigeons or fruit-doves.

Food for Bats: No known use.

Macaranga harveyana

Fruit Availability, Jan '93 - Jan '94



EUPHORBIACEAE

Macaranga stipulosa (lau fatu)

Medium-sized tree with huge peltate, alternate leaves. Leaves, especially young ones, often shiny. Uncommon in secondary and primary forest, especially in clearings. Indigenous. H-266.

Flowers: Tiny green flowers in spreading axillary panicles.

Fruit: Small, round, three-lobed fruit in clusters. FS-49.

Seed: Single round, bumpy seed per lobe. FS-49.

Phenology: Limited data (typical N=5). Appears to have a wet-season pattern, or perhaps is cyclical rather than seasonal. Ripe fruit from Nov 92-Apr 93, and from Sep 93-Dec 94. Feeding observations in November, December, February, and March.

Food for Birds: One feeding observation by Purple-capped Fruit-Dove. Favored by starlings: seven feeding observations by Samoan Starlings and one by Polynesian Starling.

Food for Bats: No known use.

FABACEAE

Entada phaseoloides (fue inu; tupe or tifa for the seed)

High-climbing woody vine with alternate, pinnately compound leaves. Tends to form dense mats where it occurs. Locally common in primary and secondary forest. Indigenous.

Flowers: Small dense racemes of flowers bearing showy white stamens.

Fruit: Large woody pods.

Seed: Large flat round seeds with darker band around the middle (tifa in Samoan); sometimes found on beaches.

Phenology: No quantitative data. Appears to flower and fruit very infrequently; I've never seen a vine with pods.

Food for Birds: The young leaves of this vine are eaten by Pacific Pigeon: I have six observations.

Food for Bats: No known use.

FABACEAE

Erythrina variegata (gatae)

Large tree with alternate trifoliate leaves, broadly ovate leaflets. Trunk with scattered thorns, especially on young plants. Fairly common in disturbed sites and secondary forest. H-165, 201.

Flowers: Large showy red flowers in racemes; this is "coral tree".

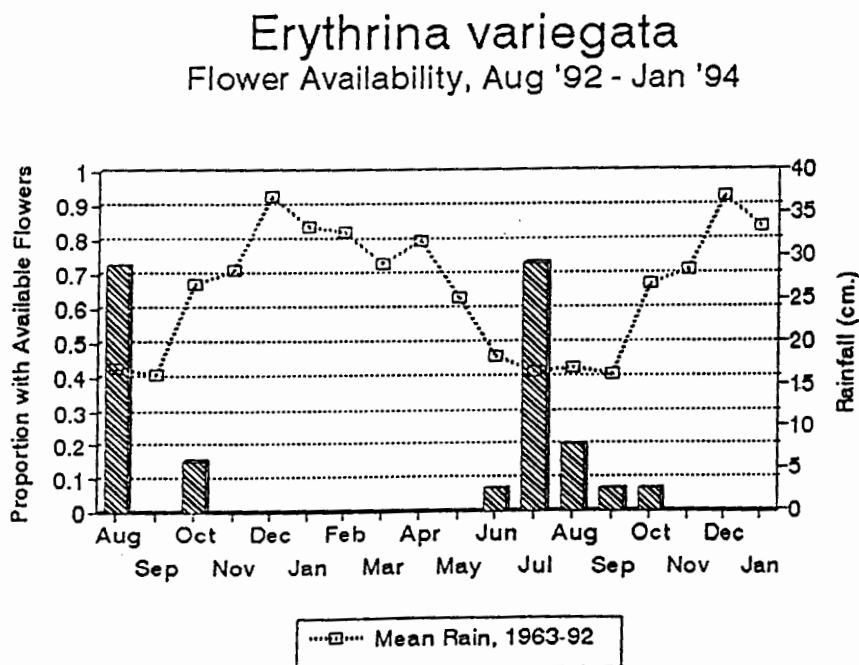
Fruit: Large dark brown or black cylindrical pods.

Seed: Red-brown beans, resembling kidney beans. FS-22.

Phenology: NOTE: Flowers shown in the figure. Flowering is sharply seasonal in the dry season. Fruit is held on the tree year-round. Mean sample size = 14 (range 11-15).

Food for Birds: Nectar from the flowers is favored by lories, honeyeaters, and bats. One observation of a Pacific Pigeon apparently feeding on nectar or flowers. No known use of the fruits. One observation of Pacific Pigeon feeding on the young leaves of this tree.

Food for Bats: Nectar from flowers is avidly fed upon by both species of fruit bat; a seasonal but very important resource.



FABACEAE

Inocarpus fagifer (ifi)

Medium-sized to large tree with fluted trunk and large, simple, alternate leaves. Fairly common in secondary forest and also around villages. A Polynesian introduction. H-86.

Flowers: Small yellow or white flowers, usually in short-stemmed clusters.

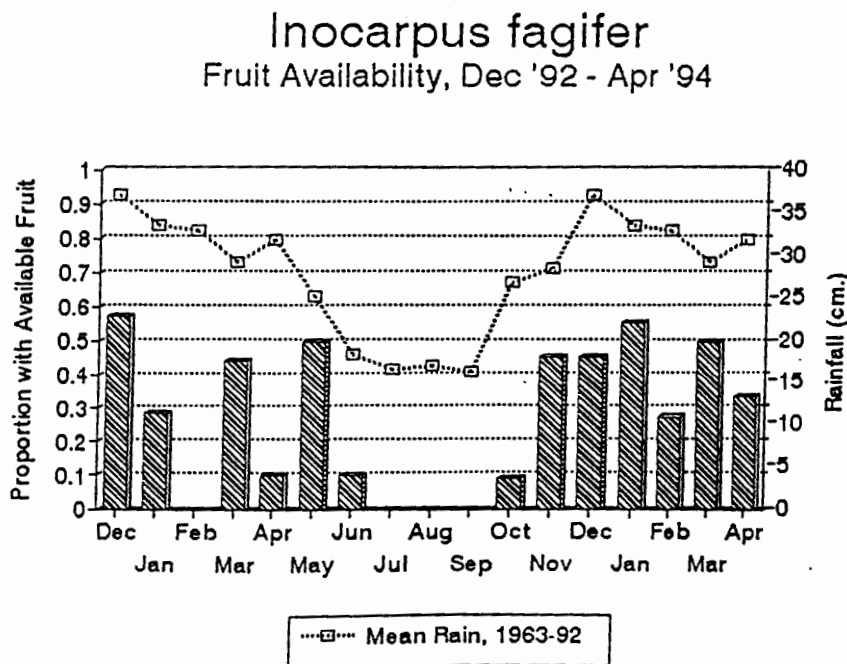
Fruit: Large (10-15 cm) and thick-shelled. Green, sometimes ripening to yellow (but may be eaten by bats when green and immature).

Seed: Single large seed, eaten by people.

Phenology: I don't have a large sample of this species (mean sample size = 10, range 7-12), and the pattern is not clear. However, there is a suggestion of a wet-season peak, with little fruit from Jun-Oct 93.

Food for Birds: The large young leaves are eaten by Pacific Pigeon (eight observations). No use of the fruit.

Food for Bats: The fruits are a favorite food of both species of fruit bats. Also one observation of a Samoan Fruit Bat feeding on the young leaves.



FLACOURTIACEAE

Casearia sp.nova

Shrub or small tree with alternate leaves. Leaves broadly ovate, with acuminate tips. Difficult to identify if sterile. Local in ridge forest; I have seen it only in the Afono-Vatia area, where it is uncommon. Endemic. H-210, 222, 223.

Flowers: Tiny white flowers in axils.

Fruit: An ovoid capsule.

Seed: No information.

Phenology: Limited data (typical N=2). No fruits observed on the two plants I kept track of; is this species dioecious? Flower buds often seen, but the only months I saw open flowers were Sep, Oct, and Feb.

Food for Birds: No known use.

Food for Bats: No known use.

FLACOURTIACEAE

Flacourtia rukam (filimoto)

Small tree with alternate leaves with toothed margins. Young leaves pinkish-red. Fairly common in disturbed areas and secondary forest. Indigenous. H-38, 81, and 240.

Flowers: Small, white, apetalous, with many stamens.

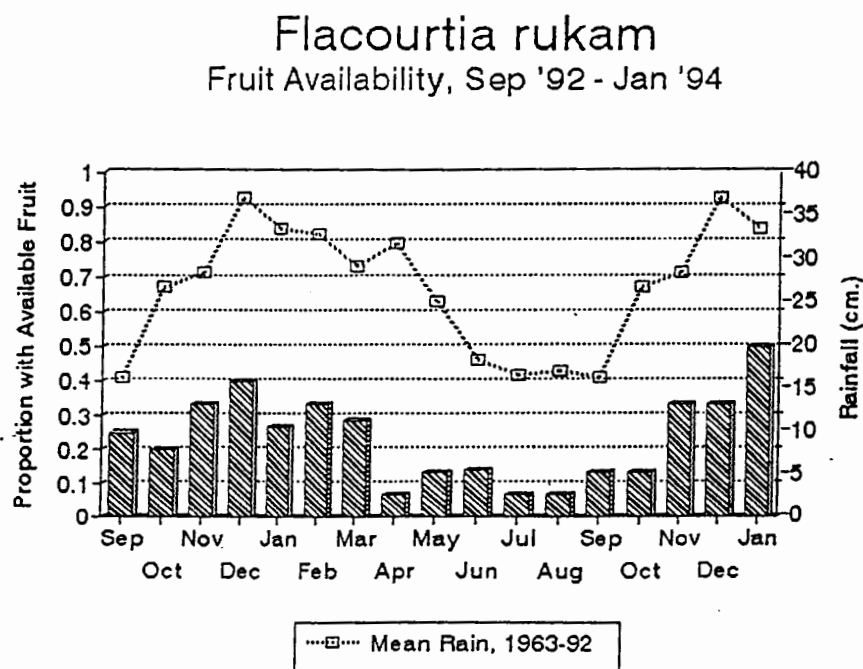
Fruit: Red, spherical (2-3 cm); resembles a crabapple. Fruit edible to humans. FS-48.

Seed: Irregular, hard, with sharp spikes. FS-28.

Phenology: Appears to be weak wet-season peak. Ripe fruit seen in all months, but broad peak from November-March. Mean sample size = 14 (range 8-15).

Food for Birds: Seems likely to be used by pigeons and Samoan Starlings, but no confirmed observations. One possible incident of feeding by Pacific Pigeon. Captive lupe readily ate fruit.

Food for Bats: No known use.



GESNERIACEAE

Cyrtandra samoensis

Shrub with large elliptical to ovate, opposite leaves. Uncommon in forest, found especially at streamsides, banks, and other wet sites. Indigenous. H-43, 261.

Flowers: Small white sympetalous flowers in axillary cymes.

Fruit: Fleshy elongate white to orange berries.

Seed: Numerous and very tiny.

Phenology: No information; the one fruit-feeding observation was in April.

Food for Birds: No known use.

Food for Bats: One observation of a young P. samoensis feeding on the fruit.

GOODENIACEAE

Scaevola taccada (to'ito'i)

Shrub with waxy, opposite, spatulate leaves. Undersides of leaves and stems white-powdery. Abundant at margin of littoral scrub and forest, and sometimes inland on cliffs (e.g. Tau Mountain). Indigenous. H-218.

Flowers: Distinctive white-petaled "half-flowers".

Fruit: White spherical berries (1-1.5 cm) with mealy pulp. FS-05.

Seed: White, with prominent ribs. FS-33.

Phenology: No quantitative data. Some fruit is apparently produced year-round, but there is a wet-season peak, which corresponds to the hurricane season.

Food for Birds: Important post-hurricane resource for Pacific Pigeon (and probably for fruit-doves, though that is not confirmed). This coastal plant seems to come through storms with fruits, and immediately following Val large numbers of pigeons and doves gathered in Vaitogi, where feeding on Scaevola was confirmed for Pacific Pigeon. Also one observation of pigeon at Tau Mountain swallowing more than 100 Scaevola fruit in one session.

Food for Bats: No known use.

HERNANDIACEAE

Hernandia moerenhoutiana (pipi)

Medium-sized to large tree with ovo-lanceolate leaves on long petioles. Uncommon in ridge forest. Indigenous. H-91, 117.

Flowers: White-petalled flowers in prominent upright clusters.

Fruit: Inflated bell-like fruit surrounding large black seed. Fruit white, ripening to orange. FS-88.

Seed: Single large black seed with lumpy ridges. FS-35.

Phenology: Limited data (typical N=9). Flowers and fruit seen in all months of the year.

Food for Birds: No known use. The fleshy "bell" would seem suitable for starlings, who could rip pieces from it.

Food for Bats: No known use.

HERNANDIACEAE

Hernandia nymphaeifolia (pu'a)

Large tree with alternate, peltate leaves. Common in littoral forest. Indigenous. H-32, 49.

Flowers: White-petalled flowers in prominent upright clusters.

Fruit: Inflated globose fruit surrounding large black seed. Fruit white, ripening to red. FS-21.

Seed: Single large black seed with lumpy ridges. FS-23.

Phenology: Limited data (typical N=5). May be a primarily wet-season pattern: ripe fruit from Sep 92-Apr 93. Ripe fruit also recorded in Aug 93 and Jan 94.

Food for Birds: No known use; as with H. moerenhoutiana, the fleshy fruits would seem suitable for starlings.

Food for Bats: No known use.

ICACINACEAE

Citronella samoensis

Small tree with glossy, alternate leaves with acuminate tips. Leaves can be confused with Antidesma, but Citronella is usually a tree, not a shrub. Uncommon to locally common in lowland and ridge forest. Indigenous. H-141, 159, 206.

Flowers: Showy racemes of white flowers.

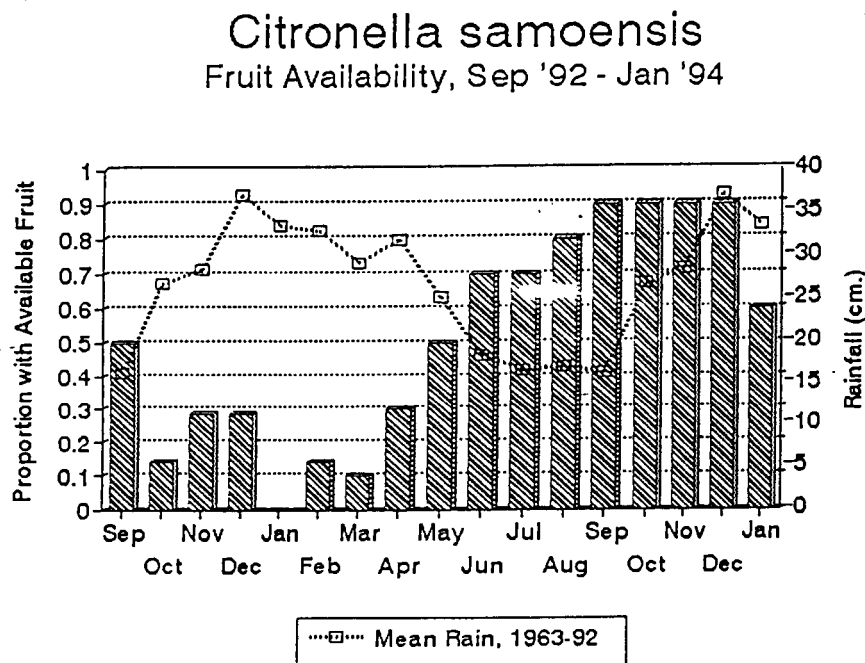
Fruit: Large (3-4 cm) ellipsoid fruit, green ripening to dark purple.

Seed: Single large seed with longitudinal raised ridges. FS-62, 105.

Phenology: A broad dry-season to early wet-season pattern. Ripe fruit seen in all months of the year, but relatively little fruiting from Oct 1992 - Apr 1993, followed by sustained peak from May 1993 - January 1994. My impression from February - April 1994 is that there is very little ripe fruit. Mean sample size = 9 (range 6-10).

Food for Birds: No observations of use. Captive lupe swallowed one fruit, but ignored most that she was given. At maximum size they could swallow.

Food for Bats: No known use.



LAURACEAE

Cinammomum verum (tinamoni)

Shrub or small tree. Leaves have obvious plicate venation and a strong smell of cloves when crushed. Uncommon in secondary forest, especially at the west end of Tutuila, but now occurring throughout the island. A modern introduction. H-30, 213, 259, 416.

Flowers: Showy panicle of small white flowers.

Fruit: A small (0.7 cm) fruit with a cap at the base; green ripening to dark blue.

Seed: No information.

Phenology: Limited data (typical N=2). .Seemingly a wet-season pattern: fruit from Nov 92-Mar 93, and in Jan 94 (also fruit in Aug 92).

Food for Birds: No known use.

Food for Bats: No known use.

LAURACEAE

Litsea samoensis (papaono)

Medium-sized to large tree with alternate leaves, reddish when young. Rare in ridge forest. Indigenous. H-438.

Flowers: Small orange flowers.

Fruit: Ovoid reddish-purple fruit (1.5-2.5 cm), with persistent, cup-like calyx. FS-93.

Seed: Single slightly compressed seed, with raised ridge on each side. FS-94.

Phenology: Little data. Fruit in November and December, at least.

Food for Birds: One feeding observation by Purple-capped Fruit-Doves. Seems likely to be used by Pacific Pigeon as well, but of limited importance because of rarity.

Food for Bats: No known use.

LOGANIACEAE

Fagraea berteriana (pualulu)

Crown-forming epiphyte or large tree with glossy opposite leaves. Common, especially in primary forest. Indigenous. H-26, 85.

Flowers: Large, showy, tubular flowers, white to pale orange.

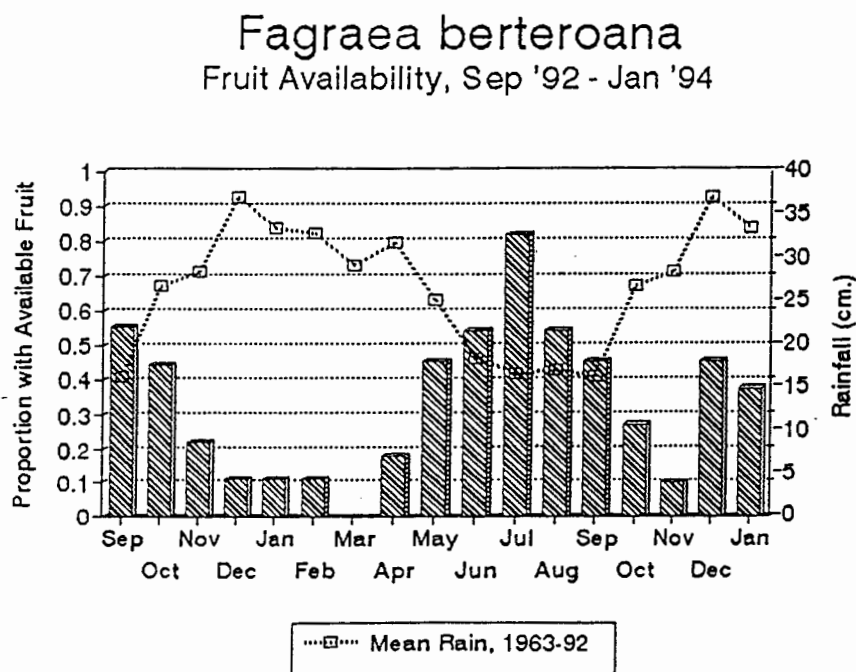
Fruit: Large (4-5 cm) oval fruit with sharp tip. Green and shiny, ripening to orange. FS-04.

Seed: Very numerous tiny, fig-like seeds. FS-65.

Phenology: Appears to be a dry-season pattern. Well-defined peak from May-September, but ripe fruit seen in all months except March. However, substantial wet-season fruiting in Dec 1993-Jan 1994. Mean sample size = 10 (range 8-11).

Food for Birds: Favored by Samoan Starlings (ten feeding observations), who use their strong beaks to rip open the tough outer layer. No other birds observed to feed.

Food for Bats: One bat-chewed fruit collected by S. Banack; flowers may also be used.



LOGANIACEAE

Geniostoma rupestre (taipoipo)

Small tree with simple, opposite leaves. Fairly common in primary and secondary forest. Indigenous. Not very distinctive, as indicated by the number of specimens I collected: H-59, 225, 258, 389, and 417.

Flowers: Tiny white flowers along the stem.

Fruit: Small greenish capsules.

Seed: Numerous red seeds.

Phenology: Data from one plant only. Appears to fruit continuously; apparently ripe fruit seen in all months except June and July.

Food for Birds: No observations of use.

Food for Bats: No known use.

LORANTHACEAE

Decaisnina forsteriana (tapuna)

Hemiparasitic shrub with opposite, gray-green leaves. Uncommon in ridge forest. Indigenous.

Flowers: Remind me of matchsticks: long, narrow, erect red and yellow flowers with flared calyx. In upright clusters.

Fruit: Small ellipsoid fleshy green fruit. Whistler indicates fruit turns red, but I believe it is ripe when green.

Seed: No data.

Phenology: Data from one plant only. Ripeness difficult to assess. Full-size fruit present in Feb-Mar 93, Jul-Aug 93, and Oct-Nov 93. One feeding record in Mar 94.

Food for Birds: One observation of Samoan Starlings feeding on the fruit.

Food for Bats: No known use.

MELASTOMATACEAE

Astronidium pickeringii

Shrub or small tree with opposite leaves 3-5 veined from the base. Petioles red. Uncommon in primary and secondary forest. Endemic. H-143, 158, 178.

Flowers: Flat clusters of 5-merous white flowers.

Fruit: Subglobose berry with a hollow end, borne in flat clusters.

Seed: No information.

Phenology: Limited data (typical N=2). Apparently a dry-season pattern: seemingly ripe fruit seen in Sep-Oct 92 and Aug and Oct 93.

Food for Birds: No known use. Fruit appears dry and pithy.

Food for Bats: No known use.

MELIACEAE

Aglaiia samoensis (laga'ali)

Shrub or small tree with alternate, pinnately compound leaves. Twigs and under-leaf midribs are a distinctive brown color. Fairly common in primary and well-developed secondary forest. Endemic.
H-04, 50.

Flowers: Tiny, yellowish, and fragrant, in long panicles. Present on the tree for long periods; very difficult to assess status.

Fruit: An ellipsoid drupe, ripening to yellow-orange and sometimes splitting open.

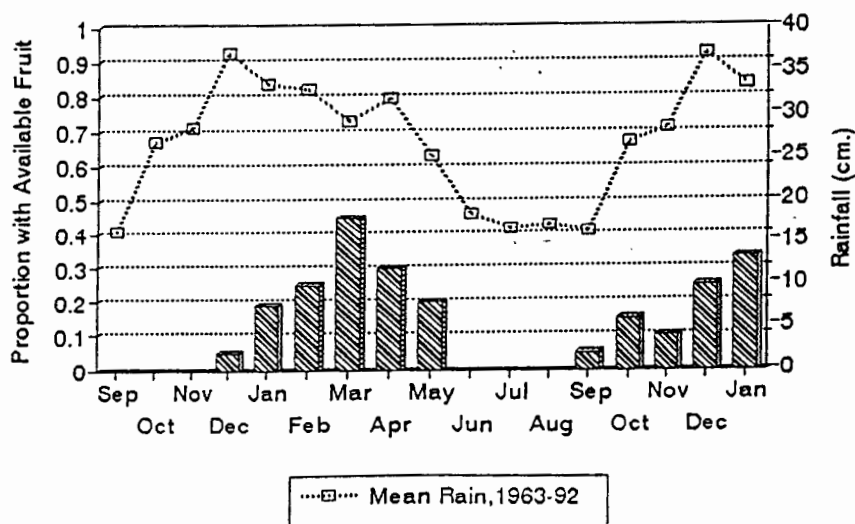
Seed: One or sometimes two oval seeds with rough brown skin. FS-41, 52, and 98.

Phenology: Wet-season peak; Jan-May 1993. Also a second, less well-marked peak Oct 1993-Jan 1994. Mean sample size = 19 (range 11-21).

Food for Birds: Only one feeding observation, by a Samoan Starling. Seems suitable for Pacific Pigeons, but no observations.

Food for Bats: P. Cox lists this species as bat food; no observations on Tutuila.

Aglaiia samoensis Fruit Availability, Sep '92 - Jan '94



MELIACEAE

Dysoxylum huntii (maotamea)

Large tree with alternate, pinnately compound leaves and 4-6 pairs of leaflets. Leaflets tend to be more oval, less lanceolate than other Dysoxylum. Rare in primary forest below 250 m. elevation; reportedly common higher up. Endemic. NOTE: Separation of this species from D. samoense is difficult. The most reliable character seems to be number of leaflets per compound leaf.

Flowers: White tubular flowers in short panicles.

Fruit: Subglobose tan capsules that splits when ripe to reveal four red seeds. Not sure if huntii and samoense can be distinguished by fruits.

Seed: Hard and round, with thin red endocarp; four seeds per capsule.

Phenology: Limited data (typical N=2). Ripe fruit from Jan-Aug 93.

Food for Birds: One fruit-inspection by Pacific Pigeon observed. I have very few observations of trees with ripe fruit. Starlings presumably feed on this species, but not seen.

Food for Bats: No known use.

MELIACEAE

Dysoxylum maota (maota)

Large tree with alternate, pinnately compound leaves having more than six pairs of leaflets. Leaflets often hang down giving "tented" effect. Cut bark has little odor; slightly sweet only. Common in primary and secondary forest, especially at lower elevations. Indigenous. H-173 and 265.

Flowers: White tubular flowers in racemes with a whorl of bracts below the calyx.

Fruit: Subglobose capsule, yellow-brown to yellow-orange when ripe. Splits open when ripe. Often wrinkled with a nipple-like tip when mature; rarely appears smooth and globose. FS-89.

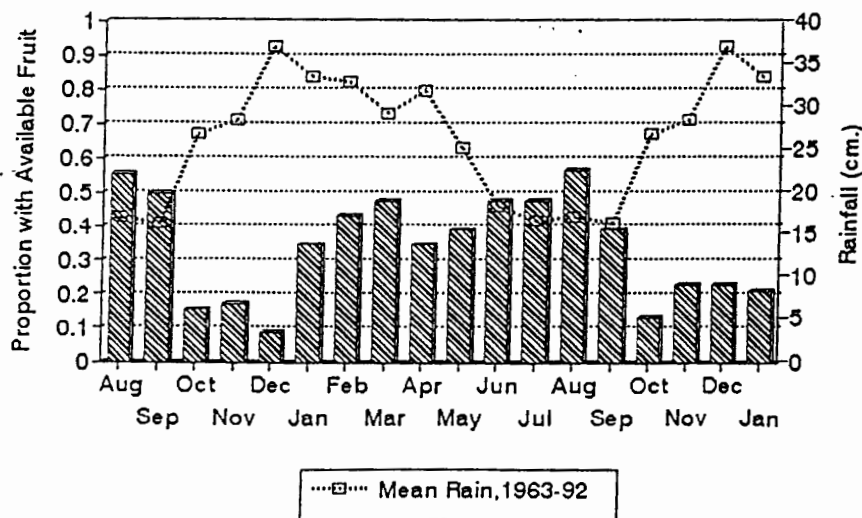
Seed: Four seeds per capsule, round with red endocarp.

Phenology: Some fruit in all months, with minimum values in the first half of the wet season. Mean sample size = 22 (range 9-24).

Food for Birds: Favored by starlings and pigeons. Fifteen feeding and fruit-inspection observations by Pacific Pigeon, twenty-four by Samoan Starling, and three by Polynesian Starling. No observations of feeding by fruit-doves.

Food for Bats: No known use.

Dysoxylum maota Fruit Availability, Aug '92 - Jan '94



MELIACEAE

Dysoxylum samoense (mamala)

Large tree with alternate, pinnately compound leaves, more than 6 pairs of leaflets. Typically fewer leaflets per leaf than maota, and without the tented effect. Cut bark has a strong odor of onion or garlic. Common in primary and secondary forest. Endemic.
H-78, 204.

Flowers: White tubular flowers in racemes, lacking bracts.

Fruit: Subglobose capsules, typically round, smooth, and tan; never yellow-orange. Splits open when ripe.

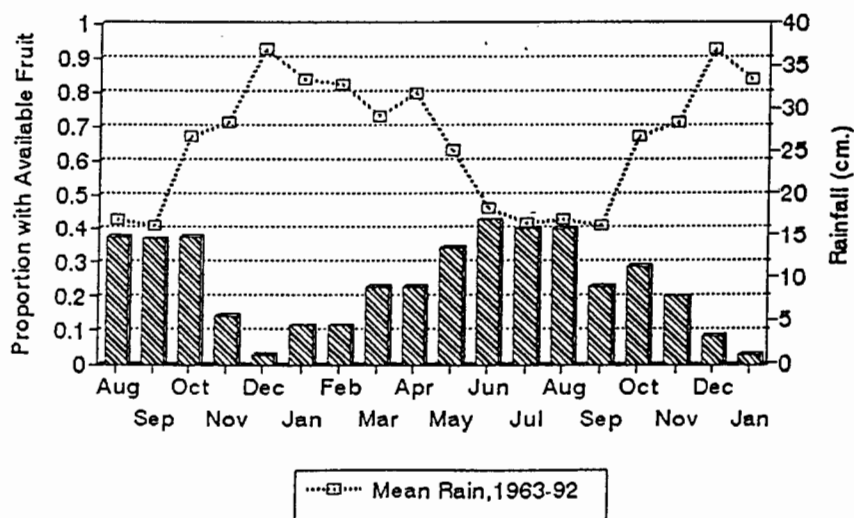
Seed: Four per capsule; hard with red endocarp.

Phenology: Apparently more seasonal than maota. Some fruit in all months, but a peak in the dry season (May-August). Mean sample size = 33 (range 8-35).

Food for Birds: Favored by starlings: 52 observations of feeding by Samoan Starlings and 3 by Polynesian Starlings. Interestingly, no observations of Pacific Pigeon feeding on this species, although they readily eat maota seeds.

Food for Bats: No known use.

Dysoxylum samoense Fruit Availability, Aug '92 - Jan '94



MONTMIACEAE

Hedycarya denticulata

Small tree with alternate leaves with yellow petioles. Difficult to identify when sterile; yellow petioles are best character. Uncommon to fairly common in ridge forest. Endemic. H-57, 160, 231, 244, 245.

Flowers: Distinctive, disk or cup-like yellow inflorescences; remind me of cup fungi.

Fruit: Glossy, green, ripening to dark red. Two to four fruit attached to a central hub.

Seed: No information.

Phenology: Limited data (typical N=2). In both flower and fruit most of the time. Seemingly ripe fruit seen Nov 92-Jun 93, and in Oct 93.

Food for Birds: No known use; appears suitable for pigeons and fruit-doves.

Food for Bats: No known use.

MORACEAE

Ficus obliqua (aon)

Large banyan, typically with columnar trunk and few hanging roots. Alternate, lanceolate leaves with trim margins and glossy appearance. Fairly common to common in forest; seems especially common in talus and cliff sites. Indigenous. H-84, 115, 360.

Flowers: within developing fruit.

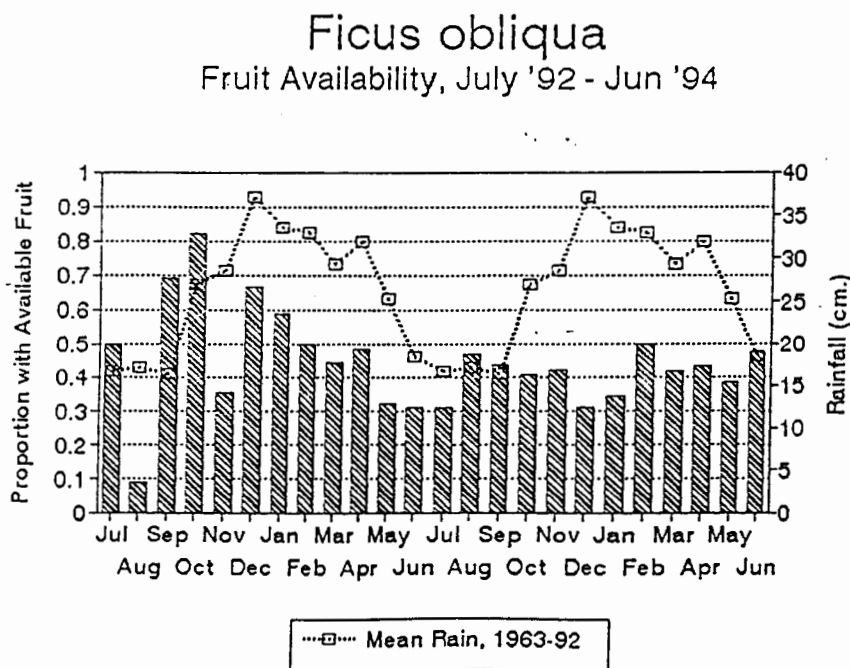
Fruit: Small, round, ripening to orange or red.

Seed: Numerous tiny seeds.

Phenology: Fruit available in all months, with no apparent peak. Proportion of trees with fruit averages higher than for prolixa. Mean sample size = 25 (range 6-32).

Food for Birds: Eaten by all frugivores, though seemingly less preferred by most than Ficus prolixa. Total feeding observations as follows: Many-colored Fruit-Dove (47), Purple-capped Fruit-Dove (3), Pacific Pigeon (1), Polynesian Starling (19), Samoan Starling (69), Red-vented Bulbul (2).

Food for Bats: Used by both P. samoensis and P. tonganus. As with the birds, this banyan species seems less preferred by bats than prolixa.



MORACEAE

Ficus prolixa (aoo)

Large banyan, typically with spreading form and many hanging roots. Trunk more net-like than columnar. Leaves alternate, lanceolate, with a wavier margin than obliqua, and not glossy. Uncommon in lowland forest, usually avoiding sites with steep slopes.

Flowers: inside developing fruit.

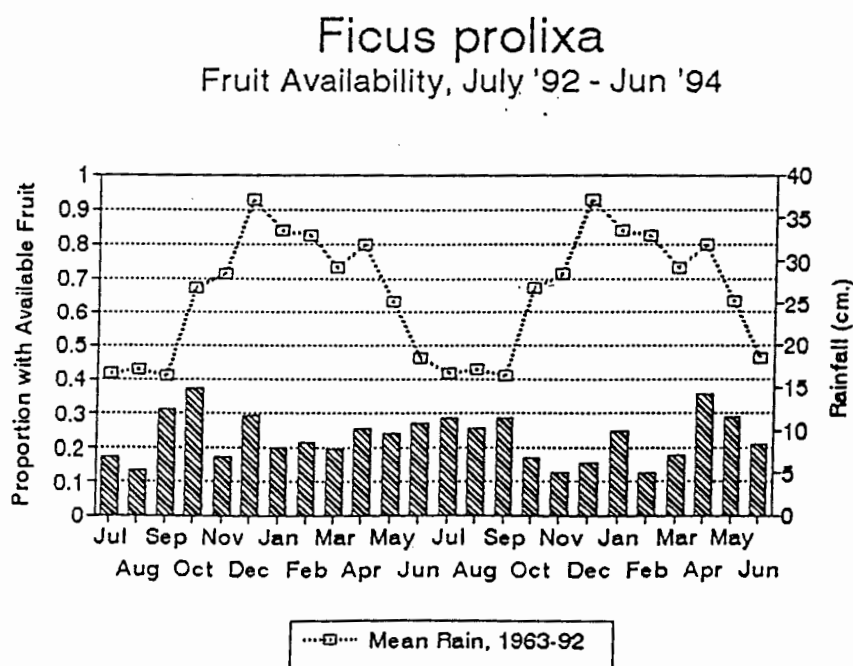
Fruit: Small, green, and subglobose, with persistent bracts. Fruits may turn yellowish or brownish when ripe, but not always.

Seed: many tiny seeds.

Phenology: Fruit available in all months, with no apparent peak. Mean sample size = 63 (range 56-66).

Food for Birds: Very important food for all frugivores, seemingly preferred to obliqua by all species except perhaps the Many-colored Fruit-Dove. Total feeding observations are: Many-colored Fruit-Dove (51), Purple-capped Fruit-Dove (86), Pacific Pigeon (35), Polynesian Starling (60), Samoan Starling (168), Jungle Myna (3), Red-vented Bulbul (68). A vital resource for native frugivores.

Food for Bats: Fed on actively by P. samoensis; 17 observations. S. Banack has several observations of P. tonganus feeding on this banyan.



MORACEAE

Ficus scabra (mati'ata)

Shrub to small tree with alternate lanceolate leaves and milky sap. Leaves are rough and "sandpapery"; this is more apparent on dried specimens than on fresh leaves, but should always be detectable. Leaves tend to be broad and cordate. Common to abundant in littoral forest; less common in ridge forest. Indigenous. H-90.

Flowers: within developing fruit.

Fruit: Typically yellow when ripe, sometimes red. Surface usually slightly scabrous.

Seed: many tiny seeds.

Phenology: Limited data (typical sample size = 8). Bears fruit year-round: ripe fruit recorded in every month of the study.

Food for Birds: One feeding observation, by Samoan Starling. Presumably taken by other species on occasion; I have little observation time at this species.

Food for Bats: One observation of P. samoensis feeding; probably also occasionally used by P. tonganus.

MORACEAE

Ficus tinctoria (mati).

Shrub or small tree with milky sap, glossy alternate leaves, and bracts at the base of the peduncle. Often epiphytic. Common in disturbed areas and forest. Indigenous. H-8, 414.

Flowers: within developing fruit.

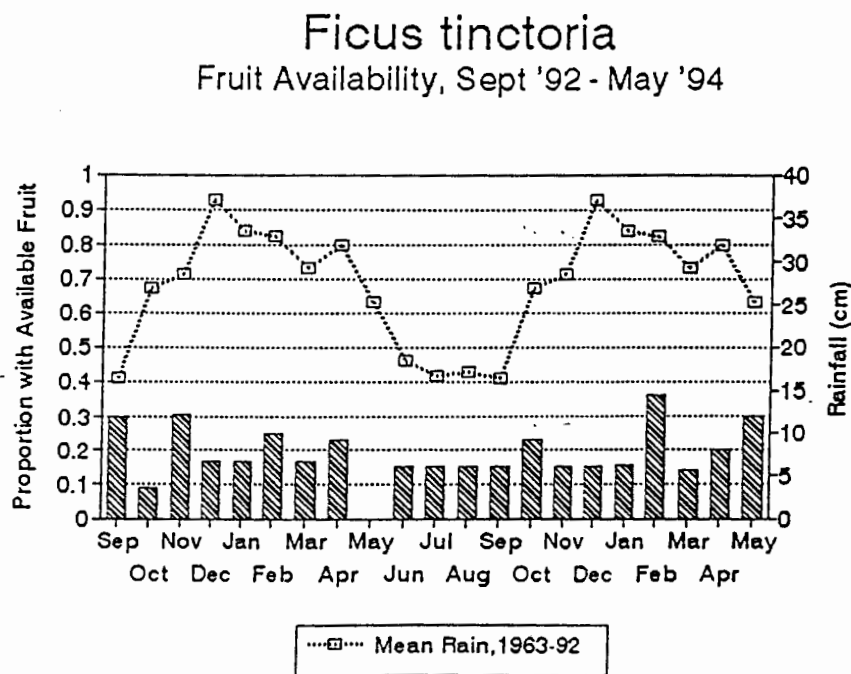
Fruit: Subglobose fruit of variable color: yellow, dark red, or (most commonly) orange. Not scabrous. FS-76, -82.

Seed: many tiny seeds.

Phenology: Fruit seen in all months; usually 15-25% of trees with fruit. Mean sample size = 13 (range 10-14).

Food for Birds: An important food source, used by most frugivores: Purple-capped Fruit-Dove (5 observations), Pacific Pigeon (1 observation), Polynesian Starling (1 observation), and Samoan Starling (7 observations).

Food for Bats: Two feeding observations involving P. samoensis; none with P. tonganus.



MORACEAE

Ficus uniauriculata (mati vao)

Shrub to middle-sized tree, with milky sap, alternate leaves with a one-sided auriculate base, and scabrous surfaces. Leaves typically long, narrow, and pointed, in contrast to scabra. Uncommon in primary and secondary forest. Endemic. H-20, 163.

Flowers: within developing fruit.

Fruit: Subglobose, larger than other Samoan fig species (2 cm). Usually dark red when ripe. Slightly scabrous surface. FS-06, 87.

Seed: many tiny seeds.

Phenology: Limited data (typical N=4). Bears fruit year-round; ripe fruit seen in every month of the year.

Food for Birds: One feeding observation, of a Samoan Starling. Presumably utilized like other shrubby figs.

Food for Bats: No known use.

MYRTACEAE

Syzygium clusiifolium (asi vai)

Medium-sized tree with finely-veined opposite leaves. Most easily identified by cauliflorous flowers and fruit. Locally common in ridge forest, for example in the Amalau area. Indigenous. H-211.

Flowers: Cauliflorous, widely-branching panicles of pink and white flowers.

Fruit: On cauliflorous stalks; white when unripe, turning purple when ripe. Ellipsoid, medium-sized (3 cm) fruit. FS-27.

Seed: Single large ellipsoid seed. FS-7 and 99.

Phenology: Limited data (typical N=4). Well-defined wet-season pattern: ripe fruit from Dec 92-Feb 93 and Nov 93-Jan 94 (and perhaps later). Flowering occurred in the 1-2 months before ripe fruit appeared. The one feeding observation was in Jan 94.

Food for Birds: One observation of feeding by Pacific Pigeon.

Food for Bats: No observations of use, though flowers and fruit appear suitable.

MYRTACEAE

Syzygium dealatum (asi vai)

Medium-sized to large tree with quite large, finely-veined leaves. Uncommon in primary ridge forest. Indigenous. H-129.

Flowers: Terminal inflorescences of white flowers with many stamens.

Fruit: Large ovoid fruit (4 cm), ripening to purple.

Seed: Single large seed in thick skin. FS-45.

Phenology: Limited data (typical N=4). Fruiting appears to be slightly later than clusiifolium: ripe fruit seen Jan 93-Mar 94. Peak flowering seems to be in Nov and Dec.

Food for Birds: No observations, but presumably sometimes eaten by Pacific Pigeon (probably too large for fruit-doves).

Food for Bats: S. Banack has observed both fruit and flowers eaten by P. tonganus; no confirmed observations of use by P. samoensis.

MYRTACEAE

Syzygium inophylloides (asi)

Large tree with finely veined leaves with a twisted, attenuate tip. Leaves reddish when young. Common in primary and well-developed secondary forest, often dominant on ridges. Indigenous. H-5, 241.

Flowers: White terminal inflorescences with numerous stamens; often flowers very densely.

Fruit: Large (4-6 cm) ovoid fruit, green ripening to yellow or yellow-orange. Longitudinal ribbing often evident, especially on green fruit. FS-110.

Seed: Single large smooth ellipsoid seed, in thick skin. FS-66.

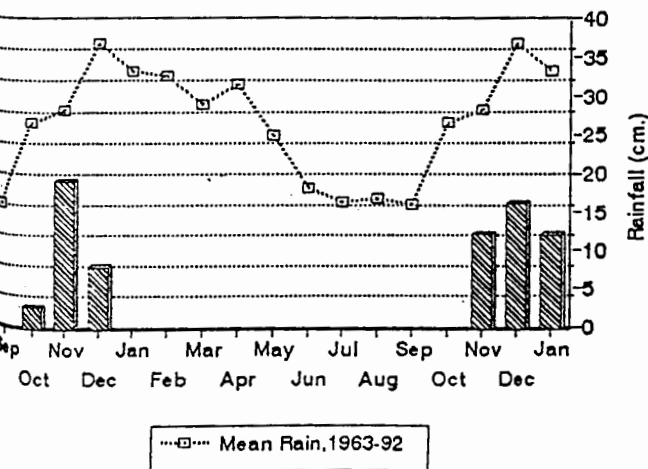
Phenology: Both flowering and fruiting patterns shown, as both are important resources for wildlife. Flowering has a sharp peak in the early wet season, especially November and December. Fruit has a sharp peak in the early dry season, May-July. Mean sample size = 23 (range 12-30).

Food for Birds: One observation of a juvenile Pacific Pigeon inspecting fruit. Though many asi fruit will be too large for even a lupe to swallow, I'm sure lupe do feed on them sometimes.

Food for Bats: The nectar is a very important food source for both species of bats, and the fruits are also highly favored.

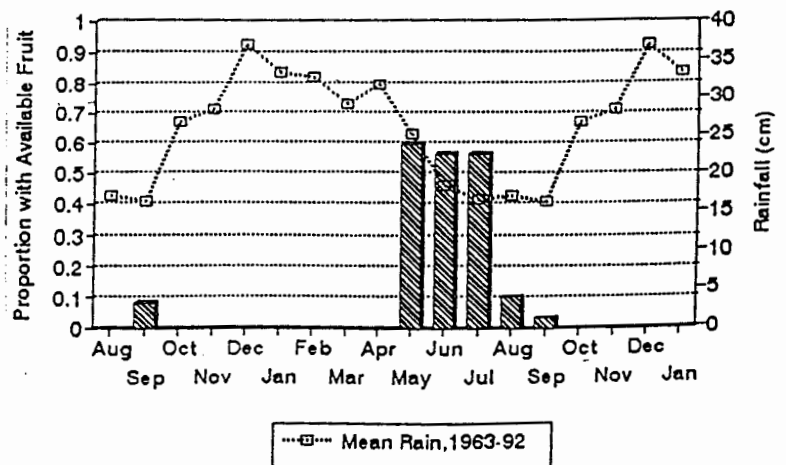
Syzygium inophylloides

Flower Availability, Sept '92 - Jan '94



Syzygium inophylloides

Fruit Availability, Aug '92 - Jan '94



MYRTACEAE

Syzygium samarangense (nonu vao)

Small to medium-sized tree with opposite, subsessile leaves. Leaves wavy-margined, often look insect-damaged or old. Uncommon in secondary and primary forest. Seemed to be particularly common at mid-elevations on Ta'u. Probably a modern introduction.

Flowers: Showy white flowers with numerous stamens. Appears to flower rarely; I have never seen the species in flower.

Fruit: Large red fruits.

Seed: Large two-part seed in thick skin. FS-90.

Phenology: Very limited data (typical N=2). No fruiting or flowering seen in either plant under observation.

Food for Birds: No known use.

Food for Bats: No known use. Seems likely to be used by both bats.

MYRTACEAE

Syzygium samoense (fena vao)

Medium-sized tree with opposite obovate leaves, appearing to be whorled at twig tips. Leaves appear thick. Petioles are red. Generally uncommon; may be more common at higher elevations. Endemic. H-251, 434.

Flowers: White flowers with pink bracts and numerous stamens.

Fruit: Ovoid fruit, dark purple when ripe. Distal end typically has a hollow with a short projecting spine. FS-91.

Seed: No information.

Phenology: Limited data (typical N=4). No fruiting or flowering seen in any of the plants under observation. However, ripe fruit was noted in a non-study tree at the A'asu lookout in Oct 93.

Food for Birds: No observed use; small enough to be eaten by Pacific Pigeon and perhaps fruit-doves.

Food for Bats: No known use; seems suitable for both species.

MYRISTICACEAE

Myristica fatua ('atone)

Small to medium-sized tree with large, alternate leaves pale silvery beneath. Typically has prop roots. Most easily separated from hypargyrea on the basis of the fruit. Common to abundant in primary and secondary forest. Indigenous. H- 136, 182, 243.

Flowers: Small, fusiform, brown with yellow mouth. Emerge from twigs on short pedicels.

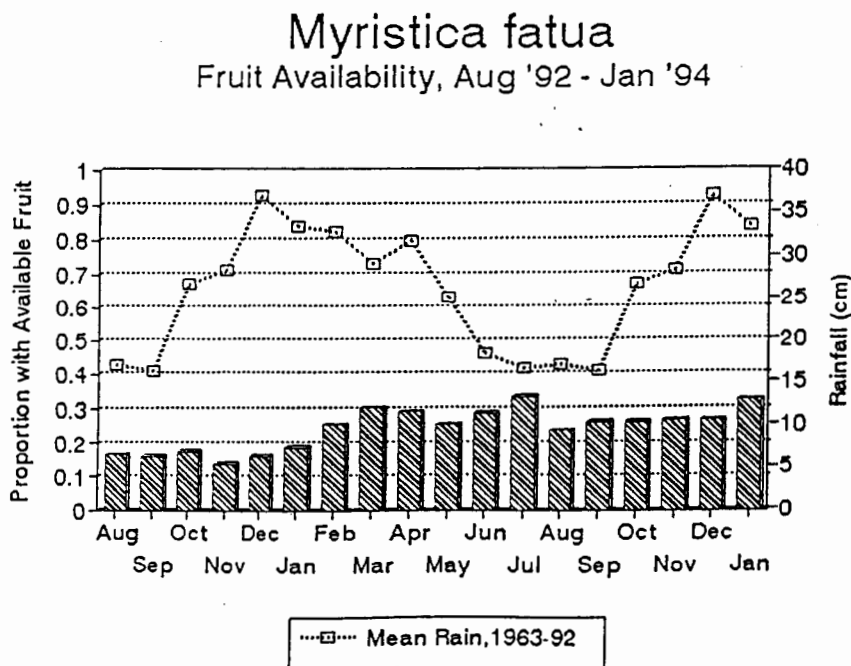
Fruit: A tan, ellipsoid capsule that splits when ripe into two valves. The exposed seed is covered by a red aril. FS-109.

Seed: A single large, grooved seed, dark brown and shiny. FS-72.

Phenology: No seasonality whatsoever; very little variation through the year. Relatively low values in the first six months of the study probably due to hurricane effects. Mean sample size = 41 (range 18-43).

Food for Birds: A favorite food of the Pacific Pigeon: five feeding observations and five other fruit-inspection observations. Gulped down instantly by captive lupe, in preference to all other fruit. Probably also sometimes eaten by Purple-capped Fruit-Doves: eight fruit-inspection observations, though no feeding observed. 'Atone is probably the maximum size fruit Purple-caps can take.

Food for Bats: No known use.



MYRISTICACEAE

Myristica hypargyrea ('atone)

Medium-sized tree with very large alternate leaves gray-green beneath. Typically has prop roots. Can be distinguished from common fatua by its larger leaves and especially by its rufous-brown, not tan, fruit capsules. Uncommon to fairly common in primary and well-developed secondary forest. Indigenous. H-116.

Flowers: Small and fusiform, brown with yellow mouth. Similar to fatua, but tend to be more robust and on longer, stouter pedicle.

Fruit: Rufous-brown capsule splitting open in two valves when ripe. Capsule usually more rounded than in fatua. Aril is typically yellow-orange, not red as in fatua.

Seed: Typically more rounded, less shiny, and less deeply grooved than fatua. FS-39.

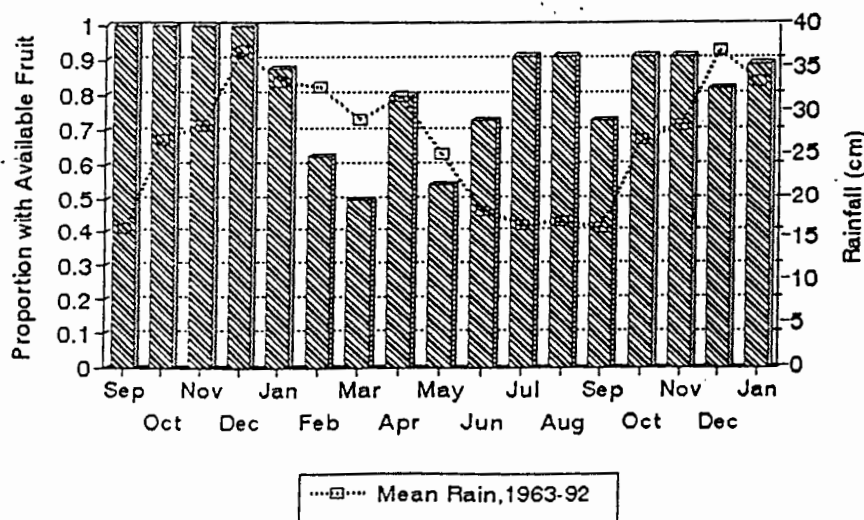
Phenology: Very high rates of fruiting, with no seasonal pattern. Fruiting rates may be artificially inflated because I probably key in on this species based on its fruit. Mean sample size = 10 (range 8-11).

Food for Birds: One observation only, of a Pacific Pigeon inspecting fruit. Fruit is probably too large to be swallowed by fruit-doves.

Food for Bats: No known use.

Myristica hypargyrea

Fruit Availability, Sep '92 - Jan '94



RHAMNACEAE

Alphitonia zizyphoides (toi)

Medium-sized to large tree with alternate lanceolate leaves, silvery-gray beneath. Crown usually rather flat or umbrella-shaped. Common in secondary forest; an early successional dominant. Indigenous. H-35, 326.

Flowers: Clusters of small white flowers, often densely covering the crown.

Fruit: Globose fruit (1-2 cm), held on tree in green state for a long time. Ripening to dark purple, and sometimes persisting on tree when brown and dry.

Seed: Shiny flat black seed with red "skin", inside two-lobed woody capsule. FS-19.

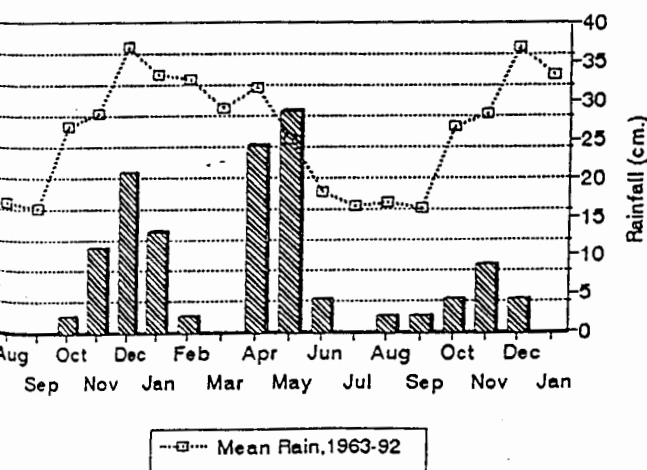
Phenology: Both flowering and fruiting patterns shown, as both are resources for wildlife. Fruiting has well-defined dry-season and early wet-season peak, especially August-October. End of fruit availability is hard to assess in this species, as fruit remains on the tree after it is dry and probably inedible. Mean sample size = 17 (range 9-19).

Food for Birds: Eaten by Samoan Starlings (7 observations), Purple-capped Fruit-Dove (3 observations), and Pacific Pigeon (1 observation). Leathery fruit splits to reveal red seed coats; seeds are pulled out and swallowed. Given the abundance of toi fruit in season, I have observed relatively little feeding; it doesn't appear to be a preferred food item.

Food for Bats: One observation of P. samoensis feeding on the flowers. No known use of the fruit.

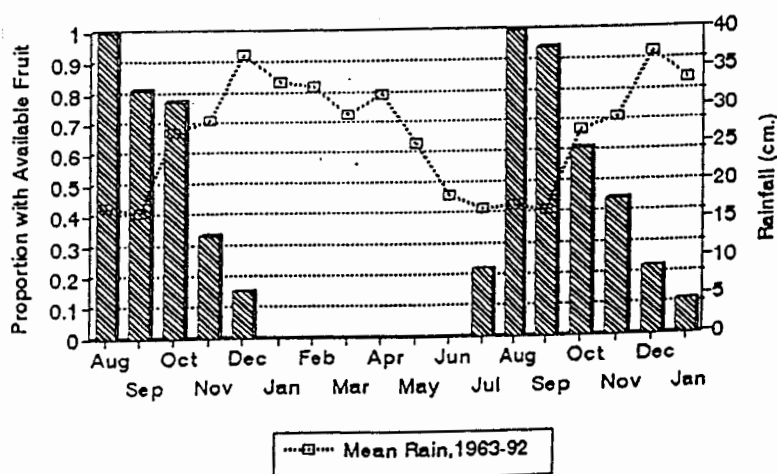
Alphitonia zizyphoides

Flower Availability, Aug '92 - Jan '94



Alphitonia zizyphoides

Fruit Availability, Aug '92 - Jan '94



RHIZOPHORACEAE

Crossostylis biflora (saitamu)

Small to medium-sized tree with opposite leaves and stilt or aerial roots. Uncommon and local in ridge forest, seemingly more common at higher elevations (e.g. locally abundant on higher forested ridges on the trail up Mt. Matafao). Indigenous. H-195, 217.

Flowers: White flowers with green sepals and many stamens.

Fruit: Distinctive green-white, top-shaped, grooved fruit with star-like bracts.

Seed: No information.

Phenology: Limited data (typical N=2). In continuous flower and fruit. Fruit ripeness difficult to assess, but full-size fruit present in all months.

Food for Birds: One observation of two Samoan Starlings feeding on the fruit.

Food for Bats: No known use.

RUBIACEAE

Canthium merrillii (ola sina)

Medium-sized tree with opposite leaves and twigs with prominent knobs at nodes (these knobs are best character for identification). Uncommon to rare in primary and secondary forest. Indigenous. H-322.

Flowers: White axillary flowers.

Fruit: Subglobose fruit in axillary clusters. Laterally compressed, blue when ripe.

Seed: No information.

Phenology: Data from one plant only. No fruit ever seen on this tree; peak flowering seen in Sep 93.

Food for Birds: No known use.

Food for Bats: No known use.

RUBIACEAE

Guettarda speciosa (puapua)

Medium-sized tree with opposite obovate leaves with prominent veins. Uncommon in lowland and ridge forest; may be more common in littoral forest (e.g. Aunu'u, Manu'a). Indigenous. H-191.

Flowers: Showy white, long-tubed flowers, turning orange with age.

Fruit: Globose, lumpy or irregularly ridged fruit, green ripening to white or brownish. FS-8.

Seed: Single seed with prominent ridges. Sometimes found on the beach. FS-8, 15.

Phenology: Limited data (typical N=2). In almost continuous flower and fruit. Ripeness difficult to assess, but apparently ripe fruit seen in all months. The one feeding observation was in Jan 94.

Food for Birds: One feeding session by Pacific Pigeon observed on Ofu.

Food for Bats: S. Banack has several observations of P. tonganus feeding on the fruit in Ofu.

RUBIACEAE

Gynochtodes epiphytica

Woody vine with opposite leaves. Sterile plants easily confused with Faradaya, but leaves of Gynochtodes are typically rounded with more pronounced acuminate tips (these vines are easy to distinguish based on flowers and fruit). Has the peculiar characteristic that the leaves turn black when dried, as in herbarium specimens. Indigenous. H-229, 237.

Flowers: Tubular white flowers with star-like pointed corolla, in axils.

Fruit: Round and green, ripening to dark purple. Has distinctive paler round scar on distal end. Often found on forest floor with the vine out of sight in the canopy. FS-111.

Seed: Single large seed with four shallow grooves. FS-34.

Phenology: Data from one vine only. I saw ripe fruit on this plant in Jan, Feb, and Apr 93. Ripe fruit also noted elsewhere Oct 93 and May 94. The one fruit-inspection observation was in Apr. Seems to be predominantly a wet-season pattern.

Food for Birds: Would appear to be suitable for Pacific Pigeon and perhaps fruit-doves, but no confirmed feeding. One observation of juvenile Pacific Pigeon apparently inspecting fruit.

Food for Bats: Ejecta pellets from the fruit of this species collected in one of S. Banack's tarps. No observations of use.

RUBIACEAE

Ixora samoensis (filofiloa)

Shrub with opposite leaves. Has dense, bushy branching pattern. Leaves often damaged; plant often has messy or unhealthy appearance. Uncommon in ridge forest. Endemic. H-103, 209, 396.

Flowers: Small, tubular, star-like white or pink flowers. Resemble the red flowers of the ornamental Ixora, but not in clusters.

Fruit: Small (0.5-0.75 cm) ellipsoid to globose fruit, usually paired. No pedicle. Green, sometimes turning brown.

Seed: Small, light brown, with irregular bumps. FS-11.

Phenology: Limited data (typical N=2). Continuously in fruit. Ripeness difficult to assess.

Food for Birds: No observed feeding.

Food for Bats: No known use.

RUBIACEAE

Morinda citrifolia (nonu)

Shrub or small tree with large, glossy, opposite leaves. Common around villages and in disturbed areas, occasional in forest. Probably a Polynesian introduction.

Flowers: Small white flowers emerging from fleshy compound structure.

Fruit: Large fleshy compound fruit, irregular in shape, yellow and malodorous when ripe.

Seed: Numerous flat black seeds.

Phenology: No quantitative data, but appears to fruit and flower continuously.

Food for Birds: Fruit eaten by Samoan Starlings and Red-vented Bulbuls (one recorded observation each, though used more than this would suggest). The flowers are favorites of Cardinal Honeyeaters, and are also visited by Wattled Honeyeaters.

Food for Bats: No known use.

RUBIACEAE

Psychotria insularum (matalafi)

Shrub with opposite leaves. Leaves often slightly shiny. Typically has an open branching pattern, very different from dense bushy pattern of Ixora. Common in secondary and primary forest. Indigenous. H-61, 83, 267. NOTE: The congeneric P. forsteriana is similar, but has larger leaves and flowers and fruit in denser and more coherent clusters (H-429, 430). Unlike Whistler, I have very rarely seen this species; perhaps it is more common at higher elevations.

Flowers: Small white tubular flowers in small open clusters.

Fruit: Small (0.5-1 cm) globose fruit, shiny and red when ripe. FS-81.

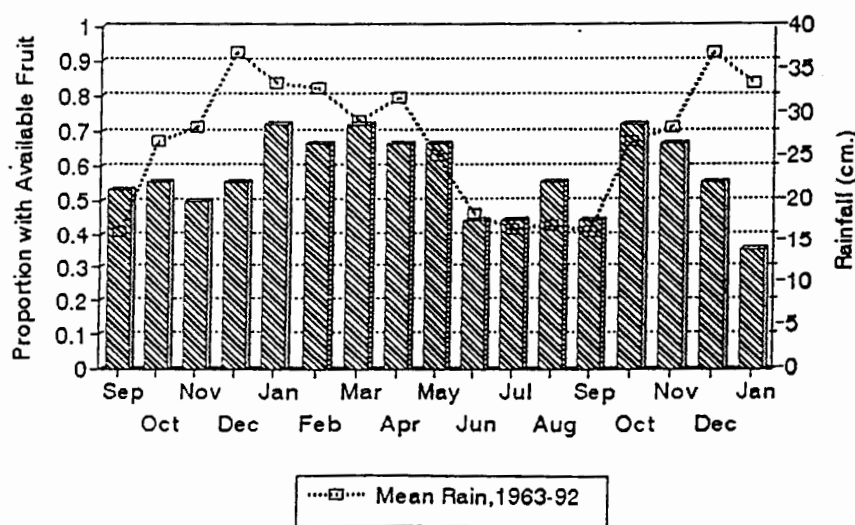
Seed: Small and brown. Two per fruit, flat on one side, raised and ridged on the other. FS-3, 31.

Phenology: High level of fruiting with little or no seasonality. Mean sample size = 18 (range 15-18).

Food for Birds: One observation of feeding by Purple-capped Fruit-Dove. Probably used more frequently by frugivores, but confirmation of feeding in understory shrubs is difficult.

Food for Bats: No known use.

Psychotria insularum
Fruit Availability, Sept '92 - Jan '94



RUTACEAE

Micromelam minutum (talafalu)

Shrub or small tree with alternate, pinnately compound leaves. Leaflets are asymmetrical; broader on one side than the other. Uncommon in primary forest. Indigenous. H-212, 394.

Flowers: Small white flowers in a cluster at crown of plant.

Fruit: Small, oval, in clusters. Orange when ripe, with white lenticels.

Seed: No information.

Phenology: Limited data (typical N=3). Ripe fruit seen in Sep, Oct, and Dec 92 and Jan 93.

Food for Birds: No observations of feeding.

Food for Bats: No known use.

SAPINDACEAE

Arytera brackenridgei (taputo'i)

Medium-sized tree with alternate, pinnately compound leaves. Leaflets lanceolate. Difficult to distinguish from Elatostachys (but that has more falcate leaflets) and Sapindus. Uncommon in ridge forest. Indigenous. H-255.

Flowers: Tiny white flowers in open panicles.

Fruit: Typically two-lobed, often heart-shaped, green capsules.

Seed: No information.

Phenology: Limited data (typical N=3). Apparently mature fruit seen Jan-Apr 93. Peak flowering seen in Jan 94; the pattern in 1993 indicates that the next crop would follow in a few months.

Food for Birds: No known use.

Food for Bats: No known use.

SAPINDACEAE

Elattostachys falcata (taputo'i)

Medium-sized to large tree with pinnately compound leaves. Leaflets falcate. Uncommon to fairly common in primary and secondary forest. Indigenous.

Flowers: Inconspicuous white flowers in open panicles.

Fruit: A three-lobed green to brown capsule, splitting when ripe.

FS-67.

Seed: Small, brown, with a cap at one end. FS-113.

Phenology: Limited data (typical N=4). Appears to fruit almost year-round, with perhaps a decline in the dry season. Mature fruit seen in all months except Sep. Feeding observations in Jan, Apr, May, Oct, and Nov.

Food for Birds: Favored by starlings: 3 feeding observations by Polynesian Starling and 4 by Samoan Starlings. Also eaten by Pacific Pigeons: two birds feeding in a tree on one occasion.

Food for Bats: No known use.

SAPINDACEAE

Pometia pinnata (tava)

Large buttressed tree with alternate, pinnately compound leaves. Leaflets have serrate margins. Young leaves red. Formerly common in lowland forest, but now very localized; largest remaining stands are in Ottoville Rain Forest and adjacent land. Indigenous. H-14.

Flowers: Dense panicles of reddish apetalous flowers.

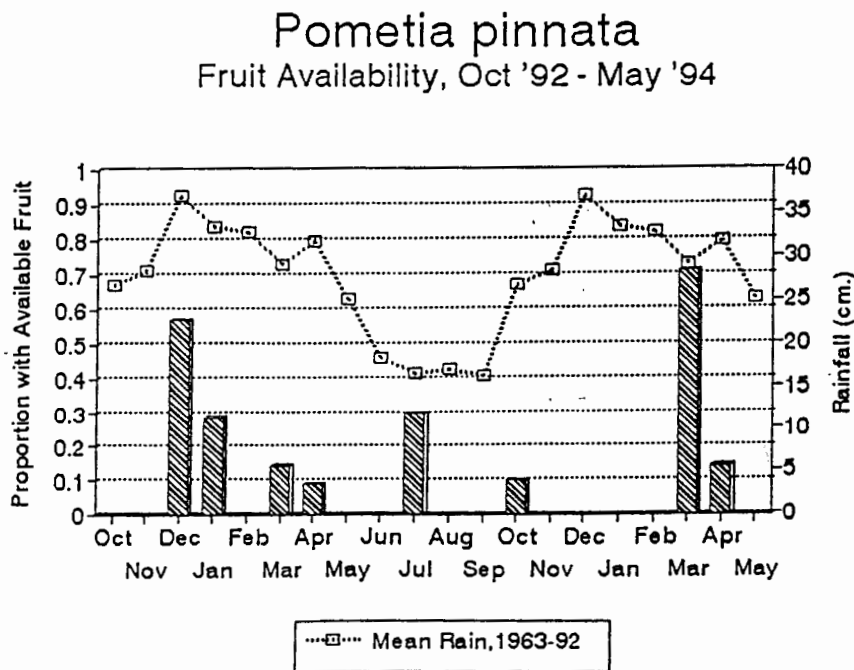
Fruit: Large (3-4 cm) subglobose fruits. Red when very small, turning green when older. Have a lychee-like flesh, edible to people.

Seed: Single large flattened seed, half dark brown and half light brown. FS-80.

Phenology: No clear pattern: this species may fruit in a cyclical rather than seasonal pattern. Mean sample size = 11 (range 7-14).

Food for Birds: Feeding has been observed by Red-vented Bulbul (3 observations) and Samoan Starling (2 observations), both of which species ripped pieces from the large fruit.

Food for Bats: Fruit eaten by bats; known to be a very important P. samoensis food in Savai'i.



SAPINDACEAE

Sapindus vitiensis

Large tree with alternate, pinnately compound leaves. Whistler states that petioles are winged, at least in saplings. Sterile specimens very difficult to distinguish from Arytera. Uncommon to rare in lowland and ridge forest. Indigenous. H-421.

Flowers: Apetalous flowers in a large panicle.

Fruit: Subglobose whitish fruit (1 cm) in open panicle. Fruit has two distinctive nipple-like projections where petiole attaches to fruit. FS-58.

Seed: Single large hard seed. FS-68.

Phenology: Data from a single tree. Fruit in May-Jul 93; may have been in fruit earlier as well.

Food for Birds: No feeding observations on this rare plant; appears suitable for pigeons and doves.

Food for Bats: No known use.

SAPOTACEAE

Palaquium stehlinii (nasu)

Large tree with ovo-lanceolate leaves and milky sap. Uncommon and local in good-quality primary forest. Endemic.

Flowers: Match-stick shaped, clustered around twigs among the leaves. Flower stage difficult to assess.

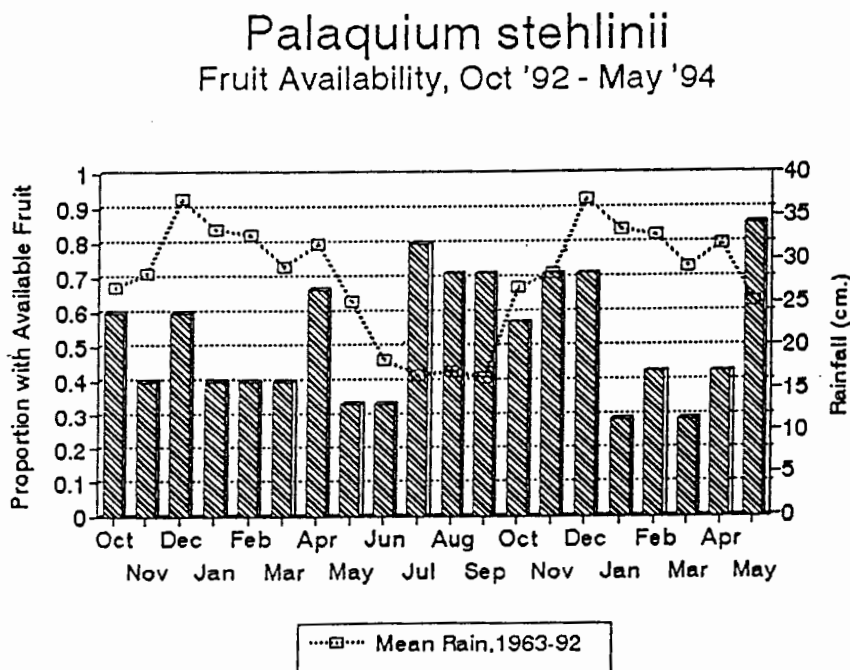
Fruit: Very large (7-8 cm) ellipsoid fruit, brown with white lenticels. Ripeness difficult to assess. FS-92.

Seed: Single very-large seed, appears eroded on one side, and with a shiny "scar" on the other. FS-16.

Phenology: Limited data (mean sample size = 6, range 5-7). Full-sized fruit recorded in all months, but ripeness difficult to assess.

Food for Birds: No observed feeding. Due to large size, the only possible feeding method would be to rip out pieces, ruling out pigeons or doves.

Food for Bats: Important and favored food of P. samoensis, both fruits and flowers.



SAPOTACEAE

Planchonella garberi (ala'a)

Medium-sized to large tree with lanceolate, often shiny leaves in dense sprays. Leaves are often a particularly vivid green, and the crown often has a few red leaves. Milky sap. I have found this a difficult tree to identify when sterile, resembling Diospyros and Ficus obliqua, among other species. Fairly common in primary and secondary forest, both lowland and ridge. Indigenous. H-22, 68, 93, 110, 139, 315.

Flowers: Small and inconspicuous, in leaf axils. Easily missed.

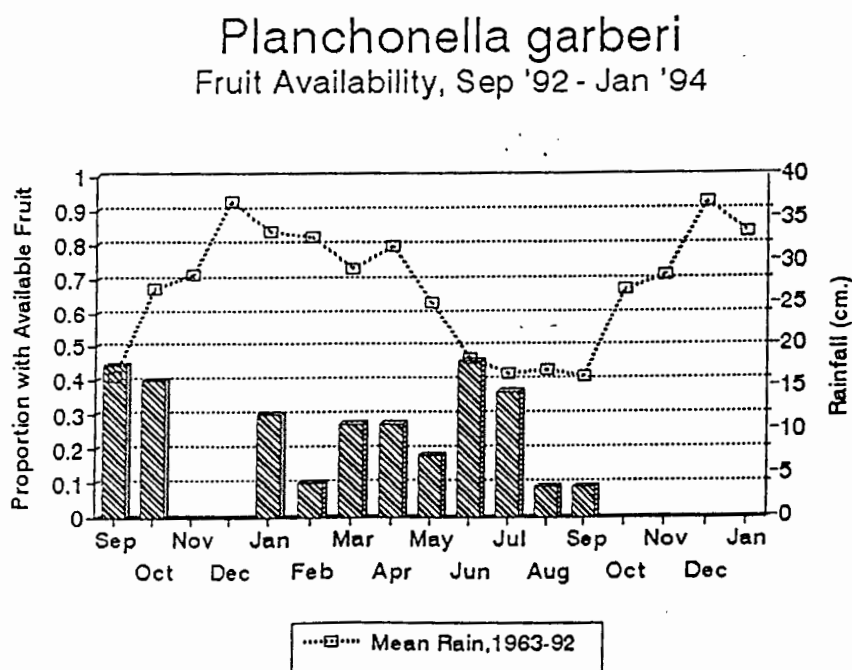
Fruit: Subglobose, 2.5-3 cm. Red to purple-black when ripe; resembles a small plum. FS-107.

Seed: Several dark brown to black, shiny, canoe-shaped seeds. FS-75, 114.

Phenology: Not a clear pattern, but seems to be a peak in late wet and early dry season, and little or no fruiting in early wet season (November and December). Mean sample size = 11 (range 9-16).

Food for Birds: Favored by Pacific Pigeons (5 feeding and fruit-inspection observations). Fruit is probably too large for fruit-doves.

Food for Bats: Fruit is an important food for P. samoensis, and presumably P. tonganus as well.



SAPOTACEAE

Planchonella grayana (ala'a)

Large tree with elliptic leaves appearing whorled at twig tips. Leaves often appear old and damaged. Milky sap. Fairly common in littoral and coastal forest, uncommon to rare in ridge forest. Indigenous. H-317.

Flowers: Small axillary flowers.

Fruit: Globose green fruit. FS-09, 14.

Seed: Several shiny, canoe-shaped seeds. Similar to garberi, but appear to be typically larger and plumper, and not as dark a shade of brown. FS-95.

Phenology: Limited data (typical N=5). May have ripe fruit year-round. There was ripe fruit in Aug-Sep 93 at AAA site; S. Banack reports ripe fruit in Amalau from Nov 93-Jun 94.

Food for Birds: No observed feeding, but probably used by Pacific Pigeon.

Food for Bats: Fruits favored by fruit bats.

SAPOTACEAE

Planchonella samoensis (mamalava)

Large tree with large, alternate, prominently veined leaves. Undersides of leaves pale, emphasizing brown veins. Milky sap.

Common in lowland forest, fairly common in ridge forest. Indigenous. H-56, 151, 246.

Flowers: Matchstick-shaped, clustering around twigs in axils. Difficult to assess status.

Fruit: Long ellipsoid fruit (4-5 cm long). Green with whitish bloom when unripe, ripening to yellow, orange, or red. Difficult to see among leaves, especially when unripe. Tree often seems to bear fruit in only part of the crown, so careful inspection is necessary when gathering phenology data. FS-10.

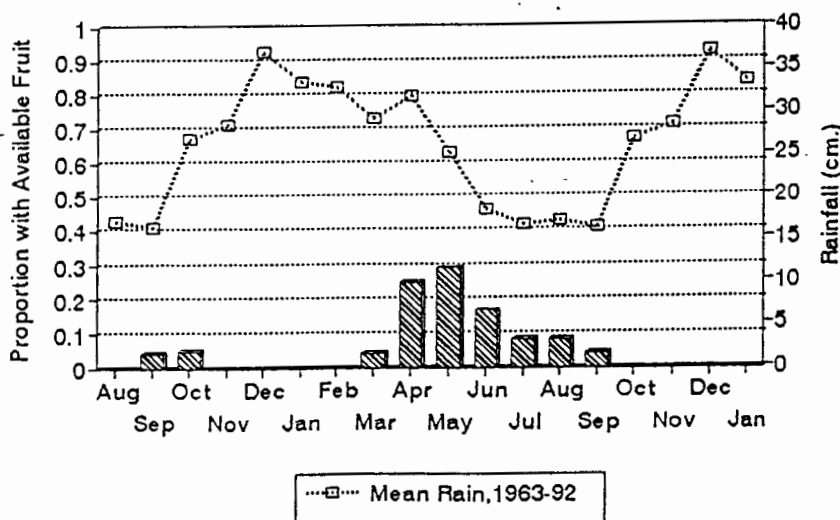
Seed: Single elongate shiny brown seed. FS-112.

Phenology: Peak of ripe fruit in late wet and early dry season, April-June. Rates of fruiting appear to be low, but it may have a biennial pattern: appeared to be much more fruit in 1994 than in 1993. Mean sample size = 23 (range 12-24).

Food for Birds: Eaten by Pacific Pigeons (3 feeding and fruit-inspection observations). Probably too big for fruit-doves.

Food for Bats: Important and favored food for both species; both fruit and flowers used.

Planchonella samoensis Fruit Availability, Aug '92 - Jan '94



STERCULIACEAE

Kleinhovia hospita (fu'afu'a)

Small to medium-sized tree with alternate cordate leaves. Common in disturbed places and young secondary forest. Indigenous. H-48.

Flowers: Numerous showy panicles of pink flowers.

Fruit: Inflated three-part capsules.

Seed: Whitish, slightly bumpy seeds.

Phenology: No quantitative information. Flowering at least in March-May.

Food for Birds: One observation of Pacific Pigeon feeding on flower buds.

Food for Bats: No known use.

STERCULIACEAE

Sterulia fanahio (fana'io)

Medium-sized tree with alternate leaves. Leaves have net-like venation; leaves often lacy due to insect damage. Deciduous: periodically sheds leaves. Indigenous. H-162, 185, 377, 395.

Flowers: Axillary racemes of small reddish flowers.

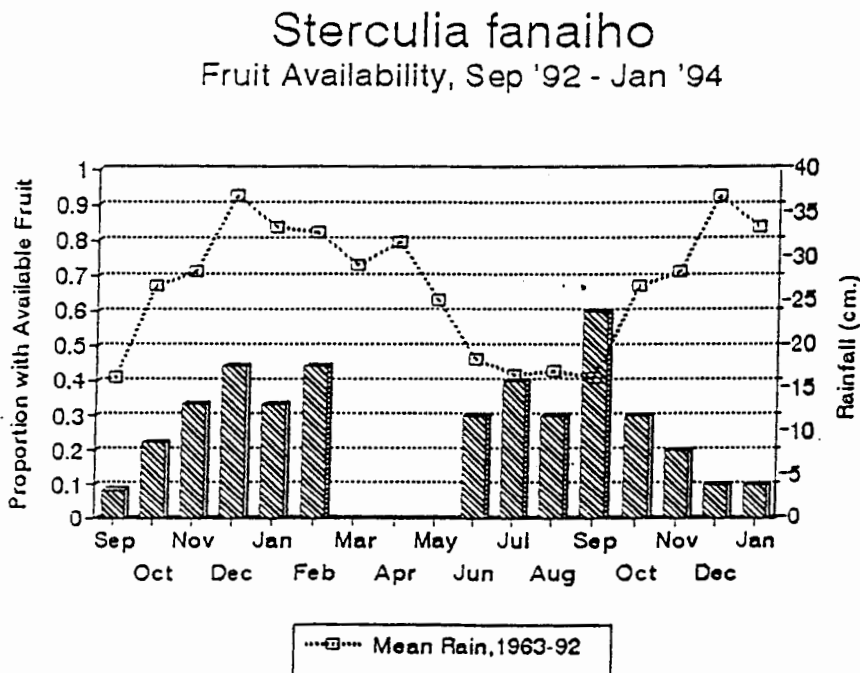
Fruit: Large canoe-shaped capsules, cinnamon-brown to red when ripe. Split when ripe to reveal large seeds. FS-69.

Seed: Large blackish seeds surrounded by sticky pulp. FS-69.

Phenology: Odd pattern, with apparent peaks in both rainiest and driest months, and no fruiting in March-May. Perhaps cyclical, rather than seasonal. Mean sample size = 10 (range 9-12).

Food for Birds: No known use.

Food for Bats: No known use.



URTICACEAE

Pipturus argenteus (soga)

Shrub or small tree with alternate, denticulate leaves gray underneath. Common to abundant in disturbed places, streamsides, and early secondary forest. Indigenous. H-11.

Flowers: Tiny flowers in branching inflorescences. I am quite sure that this species is monoecious, but this needs confirmation.

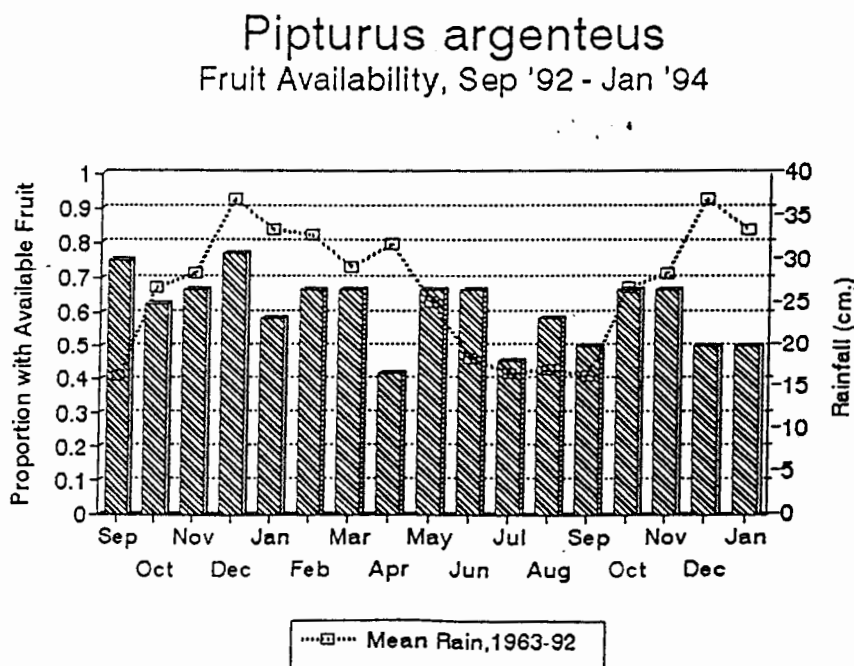
Fruit: White, fleshy, compound berries. FS-77.

Seed: Tiny black seeds embedded in surface of white berries.

Phenology: Ripe fruit in all months, with no seasonal pattern. Mean sample size = 12 (range 8-16).

Food for Birds: Favored food source for most frugivores: Purple-capped Fruit-Dove (10 observations), Many-colored Fruit-Dove (1 observation); Red-vented Bulbul (3 observations), Wattled Honeyeater (7 observations); Polynesian Starling (10 observations); and Samoan Starling (52 observations).

Food for Bats: No observations of feeding on flowers or fruit. In the post-hurricane period, I observed both P. samoensis and P. tonganus licking at wounds in the bark of Pipturus, apparently for the sticky sap. It is unknown if the bats made the wounds in the bark. This has not been observed since.



VERBENACEAE

Faradaya amicorum (mamalupe)

Woody vine with opposite leaves. Leaves usually larger and less rounded than the otherwise similar Gynochtodes epiphytica, and without acuminate tips. Common to abundant in primary and secondary forests at all elevations. Indigenous. H-118, 235, 257.

Flowers: Distinctive: white tubular flowers with exserted stamens.

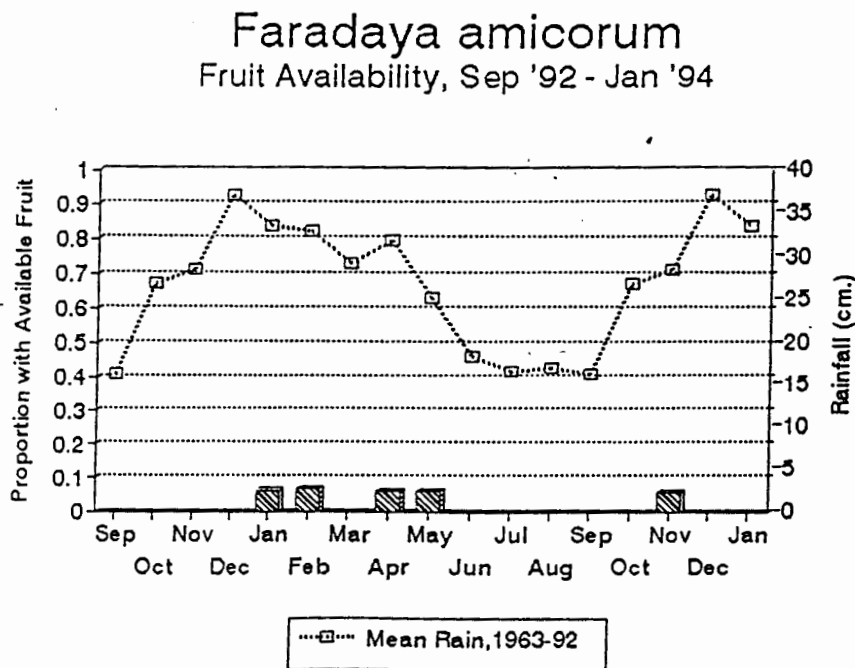
Fruit: Large, curved-ellipsoid fruit, red when ripe.

Seed: Single large seed, same shape as fruit. FS-57.

Phenology: Low levels of fruiting. Ripe fruit seen in Jan, Feb, Apr, May, and Nov. Probably fruits at a low level year-round. Fruit-feeding observations in May. Mean sample size = 15 (range 8-18).

Food for Birds: Fruit eaten by Pacific Pigeon (2 observations). The name **mamalupe** means "pigeon's mouthful".

Food for Bats: Ejecta pellets from this species have been found.



VERBENACEAE

Premna serratifolia (aloalo)

Shrub, sometimes epiphytic. Broad leaves with acuminate tips; frequently scarred by leaf miners. Common in littoral zone, uncommon in lowland and ridge forest. Indigenous. H-39, 97.

Flowers: Tiny greenish flowers in umbels.

Fruit: Small globose purple-black berries.

Seed: Distinctive small, ribbed, tear-drop shaped seeds. FS-37.

Phenology: Limited data (typical N=3). Appears to be a wet-season pattern: ripe fruit seen in Jan-Apr 93 and Jan 94. Feeding observed in Apr 92.

Food for Birds: Fed upon by Purple-capped Fruit-Dove (2 observations), and probably by other frugivores occasionally.

Food for Bats: No known use.