

THE NATURAL AND CULTURAL HISTORY OF HONAUNAU, KONA, HAWAII

VOLUME I

THE NATURAL HISTORY OF HONAUNAU

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Foreword

By

Alexander Spoehr

In November, 1956, the U. S. National Park Service and the Bernice P. Bishop Museum entered into a contract whereby the Museum was to make a study of the natural and cultural history of the City of Refuge at Honaunau, Hawaii. The results of the consequent field and library research have been incorporated in the following series of reports by Museum staff and collaborators. These reports have been assembled in two volumes. This first volume deals with the natural history of the Honaunau area, in which the City of Refuge is located. The second volume will be devoted to the cultural history of the City of Refuge, with particular emphasis on the archaeology of this famous site. It is the Museum's hope that the two volumes will prove of substantial assistance to the U. S. National Park Service in its plans for developing the City of Refuge as a unique National Historical Park.

The Museum is grateful to the National Park Service for the opportunity

to undertake the City of Refuge research project. The project has been entirely within the scope of the Museum's purpose and activities as an institution devoted to scientific research and its interpretation. At the same time, through this project the Museum has been able to make a direct contribution to the welfare of the Territory of Hawaii. The general public is little aware that the proper establishment of a site such as the City of Refuge requires a thorough research study before the site can be restored and opened for public use. The purpose of this report is to make available to the National Park Service the results of such a research study.

Grateful acknowledgement is made for the thoughtful cooperation of the members of the Museum staff and the Museum collaborators whose individual reports comprise this volume. I also wish to express my personal appreciation to Mrs. James W. Anderson, Secretary to the Director, for the competent handling of numerous administrative details, and to Mrs. George Bacon, who typed the manuscript. And my thanks are extended to the Trustees of the Museum for their keen interest in the project and in bringing it to completion.

Lastly, the Museum acknowledges with gratitude the cooperation given by the National Park Service. Superintendent John B. Wosky and Dr. George C. Ruhle of Hawaii National Park were of great assistance throughout the field research. Both Superintendent Wosky and Dr. Ruhle participated in the field work at the City of Refuge and their advice and aid have been most valuable.

ECOLOGY OF HONAUNAU

By

Edwin H. Bryan, Jr.

Location

Honaunau is a land division (ahu-pua'a) located near the middle of the Kona Slope of the island of Hawaii. Like other such land divisions, which date back to prehistoric Hawaii, it is a narrow, wedge-shaped segment, stretching up from the sea coast onto the forested slope of Mauna Loa.

Such a method of dividing the land among the chiefs and their people gave each district a maximum supply of natural resources:- a stretch of sea and reef, with their marine products, together with access to the sea for transportation; a coastal flat on which homes could be built, and where coconut palms and other useful lowland plants could be grown; valley floors (where present, there were none in Kona), for growing taro, bananas, sugar cane, and other crops requiring an abundance of water; forehills and kula (upland) slopes, for the cultivation of sweet potatoes, upland taro, and similar plants of economic value; and forested upper slopes or ridges, from which could be had timber for making canoes, houses, utensils, weapons,

images and other artifacts.

Kona is one of a half dozen major districts of the island of Hawaii. The others, in clockwise rotation, were Kohala, Hamakua, Hilo, Puna, and Kau. For modern political purposes, three of these, Kona, Kohala, and Hilo, have each been divided in two (North and South). Each district occupies a facet of Hawaii, the largest island of the Hawaiian chain. Each facet extends from the sea coast up the mountain slope. Kona occupies the westernmost face of the island, extending up onto Mauna Loa and the volcano on its northwestern shoulder, Hualalai.

The island of Hawaii is located at the southeastern end of the Hawaiian chain, the youngest and loftiest of the group.

Kona's "Total Environment"

Life in a region can be understood best by examining the interrelations of all the environmental factors of the region, such as elevation, slope, rocks, soil, and climate. The interaction of all these factors produces what is called the "total environment" for the plant and animal life of the region.

Topography

The entire Kona coast, of which Honaunau is a small segment, is a great mountain slope, most of it descending from the summit of Mauna Loa (13,680) to sea level. In a line through Honaunau, the distance is about eighteen nautical miles. Although this slope is not entirely uniform, a simple calculation will show that this line, on the average, has an angle with the horizontal of 12.5 per cent or 7.2 degrees.

This geomorphic province has been called "Kona Slopes" by C.K. Wentworth (1936 and Territorial Planning Board 1939, plate 8). The province is bounded on the north by the "Kona Hualalai Slopes," and on the south and east by the "Mauna Loa Southwest Rift Zone," which runs in a southerly direction to South Point or Kalae. A line from Hualalai Saddle to Mokuaweoweo Caldera, on the summit of Mauna Loa, forms the northeast boundary between "Kona Slopes" and the "Northwest Mauna Loa Slopes."

The "Kona Slopes" continue beneath the sea to the 2,000 fathom line (12,000 feet below sea level) in about fourteen nautical miles, a gradient

of 14.1 per cent or about 8 degrees. Below this they tend to flatten out in a westerly direction.

A glance at a topographical map of the "Kona Slopes" will show the entire absence of valleys, even of gulches of any size. The ground is so porous and the rainfall so comparatively light that there are not even permanent streams here, such as one finds on the much wetter east and northeast slopes of the island of Hawaii. Furthermore, this portion of the island is geologically "young," so that no great amount of erosion has had time to take place. It is, at present, being built up as fast as, or even faster than, it is being worn away.

How Was This Slope Produced?

Geologists tell us that the Hawaiian Islands are the summits of a great range of volcanic mountains, which stretches a distance of nearly 2,000 miles from northwest of Kure and Midway Islands to southeast of the island of Hawaii. They suggest that these mountains were poured out during the late Pliocene era, continuing during the Pleistocene or glacial period, flow

upon flow of basaltic lava and deposits of other volcanic products, from a long crack or rift in the floor of the North Pacific.

The general sequence of activity is believed to have been from northwest to southeast. It is interesting to note, in passing, that Hawaiian legend agrees with this belief, in brief that Pele, goddess of the volcano, visited ~~in turn~~ each island in turn until now her home is in the calderas of Mokuaweoweo and Kilauea. The reasons given by geologists of the sequence is based on the relative age of the various sections of the chain.

Peaks at the northwestern end of the chain have been truncated, cut off below the present sea level, apparently by wave action at a period when the sea stood at a lower level than at present relative to the land. This would have been during one of the glacial periods of the Pleistocene, when a large amount of water from the oceans was deposited as ice on the continents. As the glaciers melted, the level of the sea rose again with reference to the land; and as the temperature became warmer, corals, coralline algae, and other marine organisms grew abundantly on the surface of the great platforms resulting from the cut-off mountain peaks, and their

skeletons formed reefs, particularly around the edges of the platforms. The northwestern islands of the Hawaiian chain consist of three atolls (Kure, Midway, and Pearl and Hermes Reef), two low sand islets surrounded by reefs (Lisianski and Laysan), and various reefs and shoals.

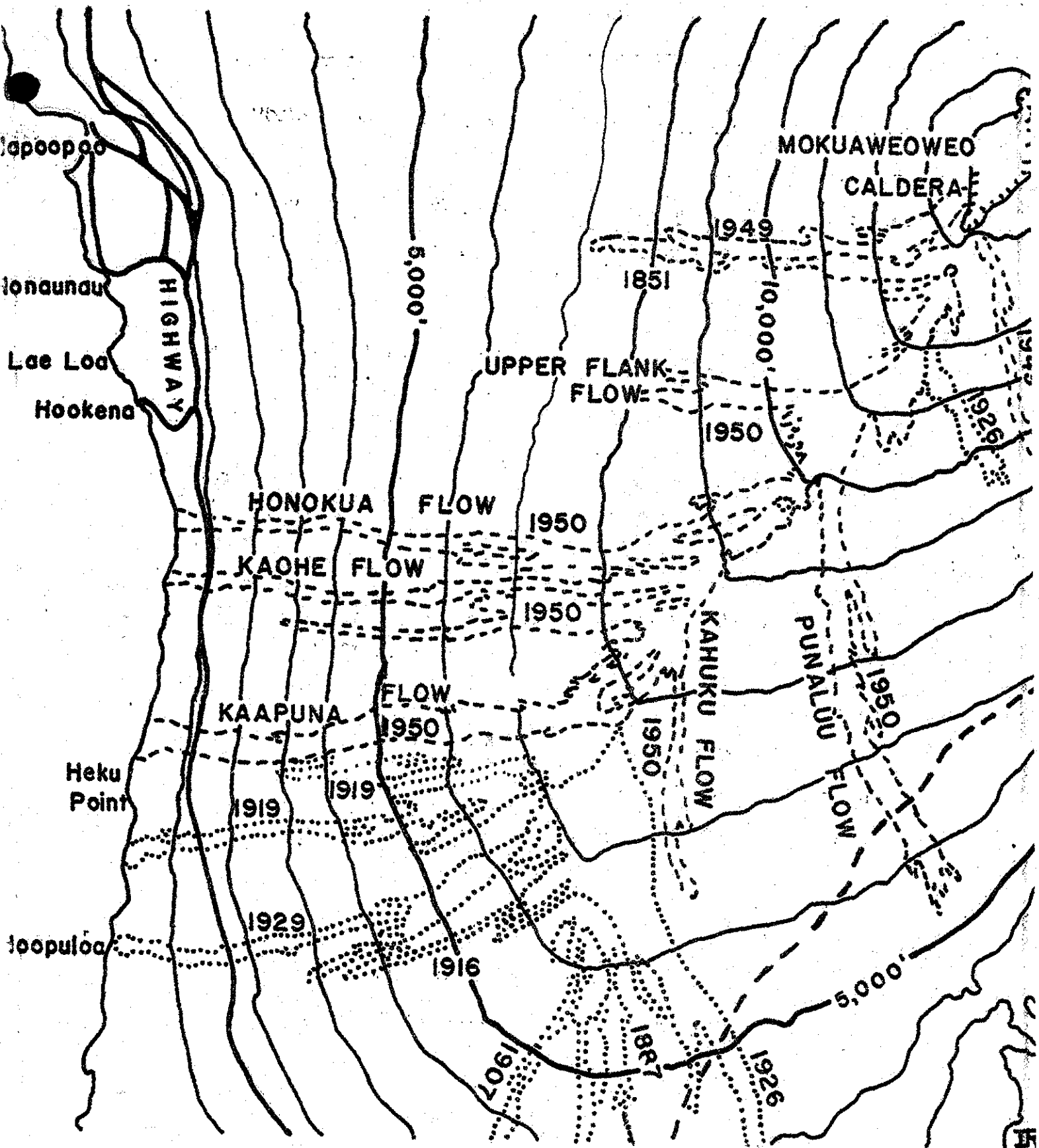
The islands in the middle portion of the Hawaiian chain can be assumed to be a little younger, for here we find rocky pinnacles, little remnants of the once much larger mountain peaks, protruding above the reefs and shoals. Gardner Pinnacles, La Perouse Pinnacle in French Frigate Shoal, Necker, and Nihoa Islands are the remaining portions of former, much larger and higher islands in this middle third.

The large islands of the chain are all at the southeastern end. Kauai is larger than Niihau, Oahu than Kauai. During the glacial era, Molokai, Lanai, Maui and Kahoolawe were all united into one great, growing island, separated into four when sea level rose and the land settled. Hawaii, at the southeastern end, is the youngest and largest of the chain. On this island, the Kohala Mountains are the oldest; Mauna Kea is next in age, its mature summit having been glaciated (see Wentworth and Powers, 1941);

Hualalai ceased to pour forth lava in 1801; only Mauna Loa and Kilauea remain volcanically active. Periodically Madam Pele puts in an appearance at the calderas (great craters) of these two peaks, or pours out her lava in flows down their flanks, from rifts, into Puna, Kau, Kona, or the saddle between Mauna Loa, Mauna Kea and Hualalai.

Thus, the Kona slopes can be seen to have been formed by volcanic activity. Most of the flows originated from vents along the Southwest Rift Zone of Mauna Loa. Some of the flows, especially those in North Kona, came from Hualalai, but those in the vicinity of Honaunau came from well up the slope of Mauna Loa at a time before recorded history. By human standards they are comparatively old, just how old it is difficult to say. To the geologist, they are recent. To the south are flows which can be dated. The dates seem to become more and more recent as one comes northward from Kau. In Kau there were flows in 1868 and 1877; near the Kona-Kau boundary is the 1907 flow; then coming northward, flows in 1916, 1919, 1926, and 1950. Higher on the slope are also flows dating from 1851 and 1949.

These flows weather very slowly. Parts of those which are nearly a



LAVA FLOWS

century old appear almost as fresh as those which were poured out during the past decade. Very little study has been made of the revegetation of Kona lava flows. A preliminary contribution was made by Charles N. Forbes (1912), but he died before he was able to complete his studies. He suggested (1914) that a few lower cryptogams are established first on pahoehoe lava, followed by ferns. On aa, lower cryptogams became established at an early date and eventually cover the flow to a considerable extent. It takes a relatively longer period of time for ferns to become established on aa than the same species on pahoehoe, other conditions being the same. Also, plants found on a newer flow are of the same kinds as those found on older flows in the immediate vicinity. A fertile soil apparently is formed in the cracks of pahoehoe sooner than among aa particles. Metrosideros polymorpha, the ohia lehua, is one of the first flowering plants to become established on pahoehoe. Its roots spread over this smooth lava, often from one crack to another, forming pockets to catch the soil formed of dead leaves and other debris. Mr. Forbes noted considerable variation depending upon the varied environmental factors.

Soils

A simple classification of general soil types found throughout the Hawaiian islands is given in a report on "Soils of Hawaii," by the late Zera C. Foster in The Territorial Planning Board's First Progress Report, 1939. He groups the soil types into eighteen soil associations, five of which are found at different elevations on the Kona Slopes, as follows:

His type XIV is found on the lower slopes from shore to about 1000 feet elevation. He calls this the Kawaihae - Kailua - Kalae Association, and describes it as follows: "These soils occupy areas of moderate to steep slopes on lee sides of Hawaii and Maui -- between sea level and elevations as high as 2000 feet. Rainfall is low and temperatures high, making for semi-arid conditions. Shallow soils with much rock outcrop are characteristic of the area as a whole. Where present, the soil consists of a brown or dark-brown loamy layer over a yellowish silty subsoil...."

"Land use is limited to pasture and the carrying capacity is low, especially in the lower sections. The quality or feeding value of such

pasturage as occurs is high, being well supplied with calcium and other bases."

His type XI is found between about 1000 and 2200 feet, and is called the Honokohau - Kealakekua Association. "Situated on the lee slopes where the climate is usually dry, this area receives from 30 to 80 inches of rain, due to diversion of air currents by the large mountain mass of Mauna Loa. An almost daily cloud bank is characteristic. The land is characterized by interspersed lava flows and ash pockets. Depth of material varies from a very thin mantle to pockets several feet thick. The soils are friable and have good moisture-holding capacity. They are slightly acid and generally low in potash."

"It is in this area that most of the coffee is produced. While high yields of good coffee can be produced with correct husbandry, steep slopes and shallow soils necessitate hand cultivation and increased transportation costs..."

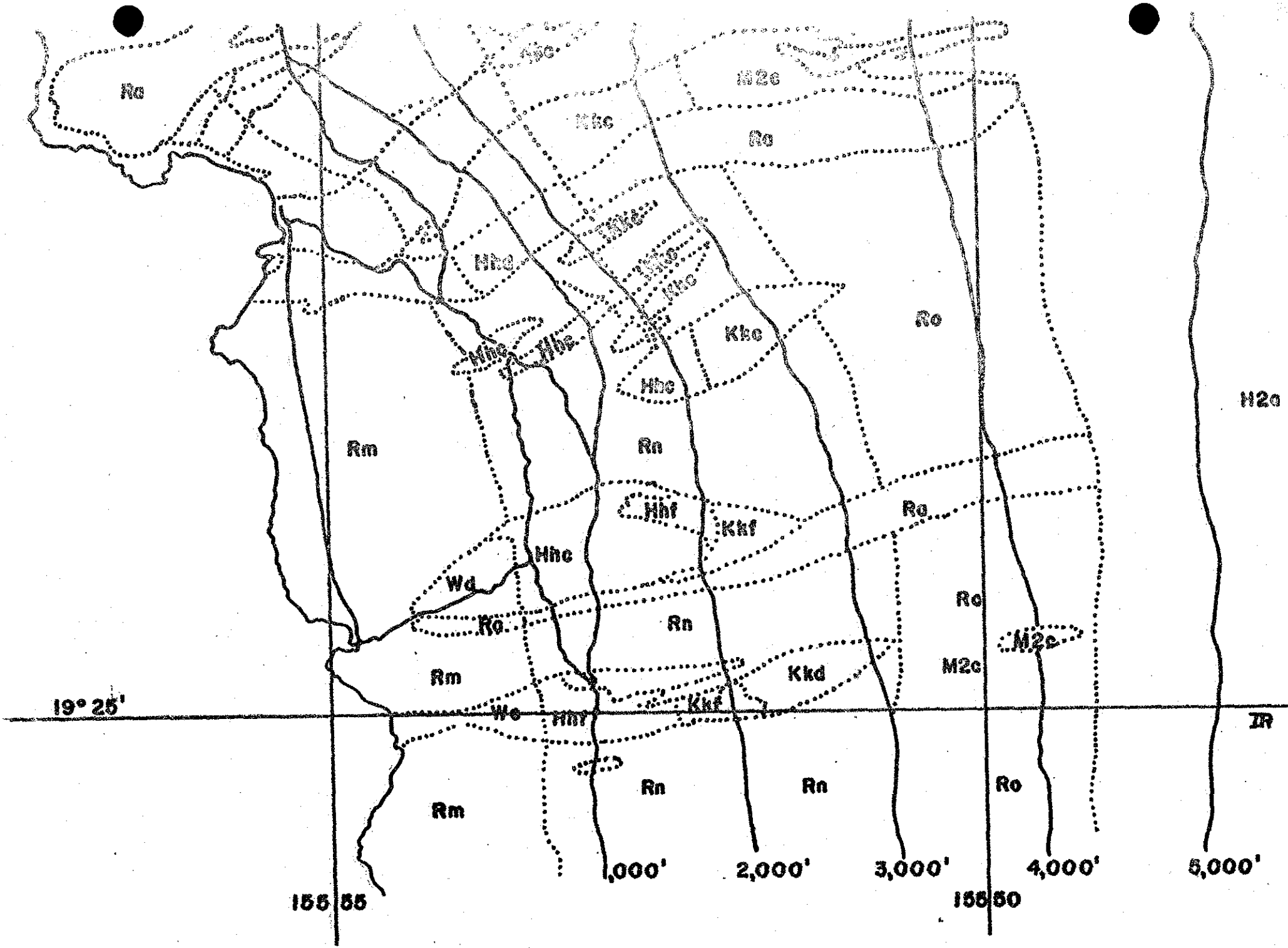
Type XIII is found between 2200 and 4500 feet elevation and called Honokaa-Kona Association. In an area with more rainfall (80 inches and up), leaching of bases and silica is greater. These areas are used mainly

for forests and pasture.

Between 4500 and 6900 feet is found type XV, Puu Lehua - Pauahi - Kapapala Association, comparatively flat land at high elevation on Hawaii. This has thin soil over pahoehoe lava, interspersed with aa flows. The climate is cool, moist, with fog. "The soils consist of a mat of organic matter over lava, with pockets of deeper soil. Clumps of koa trees with puakiawe, and a ground cover of grasses form the vegetation." The soils are generally too shallow to permit cultivation.

Above this last, the upper slopes of Mauna Loa are covered by lava flows, type XVIII. These are too recent for weathering to have developed any soil. These lands are either bare of vegetation or support scattered small ohia trees, clump grasses, mosses and lichens. At present these areas have no economic value.

The results of the U.S. Department of Agriculture Soil Conservation Service's Soil Survey of the Territory of Hawaii (1955) presents a much more detailed analysis of the soils of the Kona Slope. Taking just the Honaunau ahupuaa and immediately adjacent areas (map), the following types



Soils

of soils are found:-

The bulk of the Kona slope, at least in the vicinity of Honaunau, has soil classified as the type of Lithosol called "Rockland." Up nearly to the "belt road" is type Rm, "Rockland, pahoehoe lava with Kawaihae, Waikalooa or Naalehu soil material." This soil consists of a very thin covering of volcanic ash on young, relatively smooth and unbroken pahoehoe. In most places the soil layer is about four to six inches thick, seldom more than ten inches thick.

Above this zone (from about 1500 to 3000 feet elevation) is type Rn, "Rockland, pahoehoe with Kealakekua, Oloa, or Opia soil material." Much of the area is smooth pahoehoe outcrop, the rest is covered by very dark brown or, in places, black silty loam or silty clay loam, high in organic matter and generally saturated with water, due to the somewhat heavier rainfall in this zone.

Above this (3300 to 4400 feet elevation) the pahoehoe is overlain by still another type (Ro) "Puu Oo, Maile or Olinda soil, "Latosolic brown forest soils from four to six inches thick, resting directly on pahoehoe bed

rock, with outcrops in more than half the area. The soil is a dark brown to black fine sandy loam.

The upper slopes, above 4400 feet, are covered with H2a, shallow Hanipoe sandy loam, with outcrops of bed rock and with low water-holding capacity in an area of lighter precipitation. This area has scattered koa and mamani trees with bracken and alapai ferns and grasses.

Crossing the lower portions of the slope are narrow flows of young, barren aa lava (Ra) with practically no soil. One such flow traverses the land of Honaunau, narrowing as it approaches the sea, and ending about half a mile above the head of Honaunau Bay, south of the road.

There are also lens-shaped areas crossing these zones up to about 3500 feet. The nature of the soils in these lenses changes with the rainfall, consisting of the Waiaka series of reddish brown soils below, with light rainfall; the Honuaula series of Humic Latosols in the middle portion, with medium rainfall; and the Kealakekua series of Hydrol Humic Latosols at their upper ends, in the area of maximum rainfall. To the north and south of the Honaunau area, at still higher elevations (3300 to 4400 feet), are areas of

Manahaa loam.

The Waiaha series consists of shallow soils derived from volcanic ash in an area of low to moderate rainfall. Wd is this sandy clay loam, in a very shallow phase, over aa lava. We is the same over pahoehoe lava, four to ten inches deep, with stony surface and bed rock outcrops. The road which descends to Honaunau traverses a wedge of this soil for nearly a mile, ending at the same point as the aa flow (Ra), half a mile up the slope from Hanauma Bay.

The Honuaula series occupies an area with increased rainfall, which makes these soils, consisting of shallow clay loam, richer than the Waiaha soils, although they are also shallow and rocky. Hhc is the sloping phase; Hhe lies over aa lava; and Hhf is over pahoehoe lava. These soils, coupled with the type of rainfall, make this the coffee growing belt of Kona.

In the zone of still higher rainfall, at the upper end of these lens-shaped areas, the soil type changes to the "Kealakekua series of hydrol humic latosols." In this area is found the heaviest rainfall on the Kona Slopes. Kkf is the Kealakekua silty clay loam, very shallow phase over

pahoehoe; Kkd is the same over aa lava complex.

In the Manahaa series of latosolic brown forest soils there is again a decrease in the rainfall. The soils are derived from a thin layer of volcanic ash mixed with weathered particles derived from the underlying young lavas. Most of the soils are very shallow, seldom more than eighteen inches thick. The sloping phase is labeled M2c in the Kealakekua - Kahauloa area; M2e is Manahaa loam, very shallow phase - pahoehoe lava complex, in the Kuulae area.

The soils of the Kona Slopes have been derived from basaltic volcanic products. They owe their differences chiefly to rainfall, temperature, drainage, vegetation, and age. Where temperature is sufficiently high and rainfall sufficiently heavy, soil is produced by a process called laterization. The resulting Latosols are derived chiefly by the removal of bases and combined silica through weathering. The amount of humus in the soil depends upon the nature of the vegetation which grows on the soil, again related to climatic conditions.

Climate

The island of Hawaii lies within the tropics, but its climate is not really tropical, due to the expanses of ocean, with which it is surrounded, and the cool trade winds, which blow from the eastnortheast about 80 per cent of the time. At lower elevations the mean temperature varies from about 68 degrees Fahrenheit in January and February to 73.5 in September. Above this the temperature drops with increased elevation, about three degrees per thousand feet. Frost is rare below 4,000 feet, but freezing temperatures occur every night on the summits of Mauna Kea and Mauna Loa.

The heaviest rainfall occurs on the northeastern slopes of the island, where the great mountain masses of Mauna Kea and Mauna Loa intercept the trade winds. The maximum rainfall exceeds 240 inches a year at about 3,000 feet elevation on the slope of Mauna Kea behind Hilc. Above that it decreases to less than 40 inches in the saddle between Mauna Kea, Mauna Loa and Hualalai. The Kona Slopes are almost entirely cut off from the trade winds, these being replaced by on-shore, off-shore winds. Here the maximum rainfall exceeds 100 inches at about 2,500 feet elevation, above

Keauhou.

In Kona the morning usually dawns clear. "Between 8:00 and 10:00 a.m. cool breezes start to blow from the sea to replace the rising warm air over the land. Clouds form at about 2,000 feet and rain begins to fall. The top of the cloud layer rises during the day and usually reaches about 7,000 feet during late afternoon, but the rain falls chiefly below 5,000 feet. During the night the wind stops, the clouds dissipate, and the cool night air flows down the mountain toward the sea. This system of air circulation gives rise to light southwesterly winds nearly every day of the year."

(Stearns and Macdonald, 1946.)

The rainfall near the coast is low, but remains rather uniform throughout the year, highest in June, lowest in December. At higher elevations, such as Holualoa (1450 feet), rainfall is heavier, increasing from February to June, maintaining a rather even maximum through September, and then decreasing rapidly through November, with December and January a little higher. A maximum rainfall is found at about 2500 feet, about 120 inches a year. ~~Isohyetal lines are shown on the accompanying map.~~

Vegetation Zones

As a result of the various environmental factors, particularly rainfall, soil, elevation and slope, we find definite zones of plant life growing on the Kona Slopes.

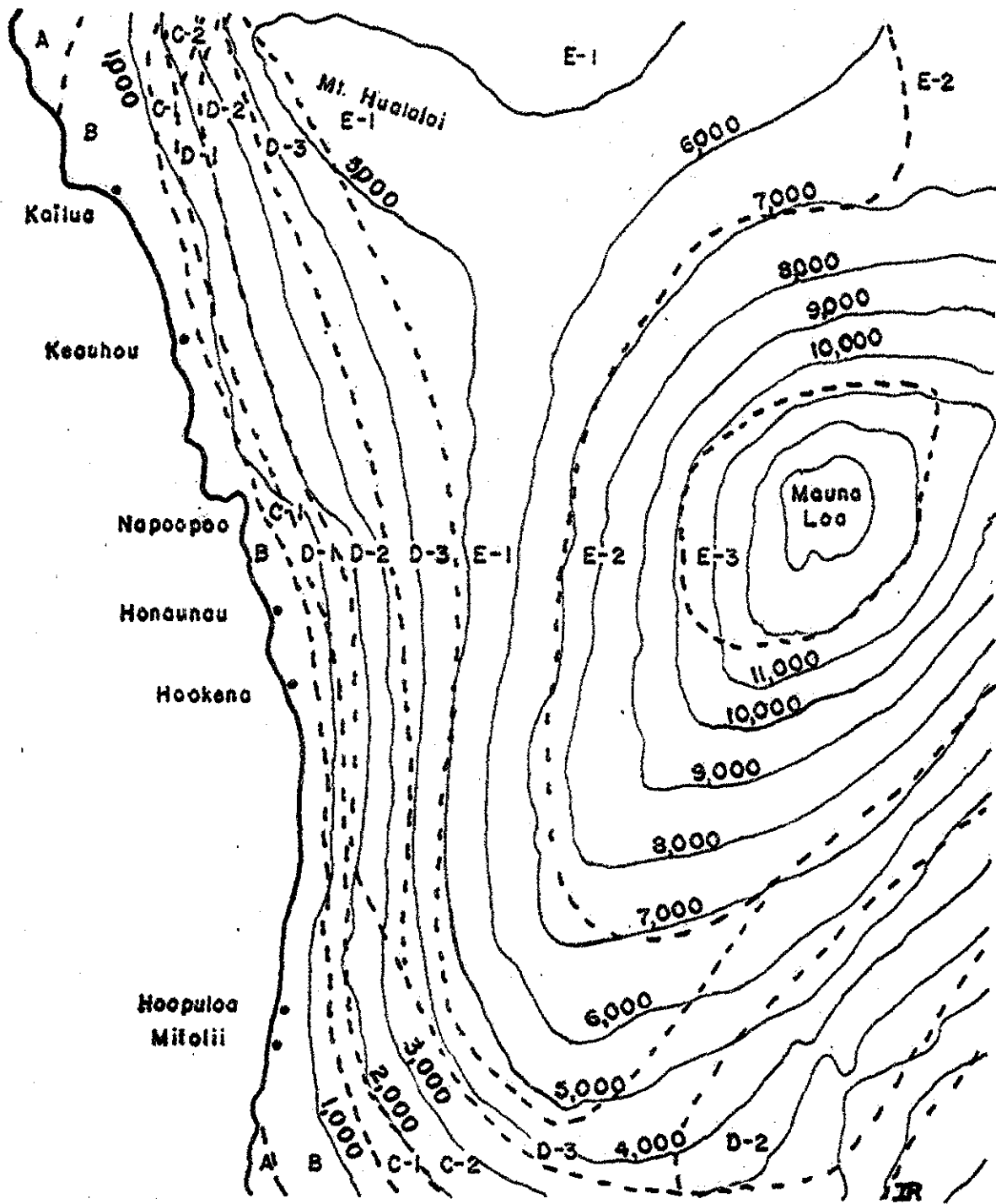
The vegetation zones of the main Hawaiian islands have been classified into five zones by J. C. Ripperton and E. Y. Hosaka (1942), and some of these further subdivided according to elevation, making ten in all.

All but two of these ten zones can be found between the shore line at Honaunau and the summit of Mauna Loa. A condensed tabulation summary of these is here given, together with a copy of the vegetation map of west central Hawaii, showing their boundaries.

Miss Amy Greenwell and Miss Marie C. Neal present a report on the flora of the Honaunau area and a list of species which have been suggested for planting in the park area, in order to approximate plant conditions which may have existed there prior to the great invasion of exotic vegetation.

VEGETATION ZONES ON THE KONA SLOPE (Adapted from Ripperton & Hosaka, 1942)

Zone- Phase	Elevation at Honaunau	Rainfall inches	Natural cover type	Representative species of plants
A	Absent from the Kona Slope	20 or less	Xerophytic scrub, coastal fringe	
B	Sea to 500 ft.	20 to 40	Xerophytic scrub with some trees	Opiuma, algaroba, coconut, lantana, koa haole, weeds
C-1, low	500 to 1000	40 to 60	Mixed open forest and shrubs	Indigofera, lantana, koa haole, Waltheria, guava
C-2, high	Absent from region			
D-1, low	1000 to 1600 ft.	60 to 80	Shrub and closed forest	Ohia lehua, koa, pandanus, kukui, guava, Boston fern
D-2, med.	1600 to 3400 ft.	80 and over	Closed forest	Cibotium and Sadleria ferns, kukui, ohia lehua, koa
D-3, high	3400 to 4800 ft.	80 to 50	Open forest	Koa, Dryopteris ferns
E-1, low	4800 to 7000 ft.	50 and less	Open forest and scrub	Koa, naio, mamani, puakeawe
E-2, med.	7000 to 10000	less than 40 inches	Upland open scrub	Mamani, naio, puakeawe
E-3, high	above 10,000	"	No seed-bearing plants; largely base lava.	Mosses and lichens; occasional grass, herbs, ferns



Vegetation Zones

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GEOLOGICAL NOTES ON HONAUNAU

By

Chester K. Wentworth

The Honaunau (City of Refuge) monument lies on the west shore of the the great volcano, Mauna Loa, where the 13,680 foot slope passes beneath the sea. It is almost due west of the summit of Mauna Loa, a little south of Kealahakua Bay where Captain Cook was killed and a little north of the old village of Hookena where Robert Louis Stevenson did some of his writing. The west slope of Mauna Loa is a long one, taking some 21 miles to make the descent of nearly 14,000 feet from the summit to sea level. For many miles both north and south the west slope of Mauna Loa is a great incline of both pahoehoe and aa lava flows, joining at the north with the similar slope of the volcano, Hualalai, which makes a slight bulge in the coast north of Kailua. Otherwise, for nearly 50 miles of north-south coast, the combined slopes of Hualalai and Mauna Loa, pass into the ocean as the major portion of the west shore of the island of Hawaii. At the northern end of the area enclosed in the monument is a lobate point some one thousand feet by one

thousand feet, just south of Honaunau Bay which is composed of a somewhat hummocky pahoehoe lava flow. It has a very slight seaward slope and its edge is marked by many small inlets and its surface by patches of sand and rubble, which is in part man-placed. As far as could be seen, the lava flows which form the slope in the immediate vicinity of the City of Refuge are pahoehoe flows, except that in places the festoon lava which came down over the Pali Kaholo fault cliff, turned to aa at the foot of the cliff and extended a short distance shoreward. It is not immediately evident that the festoon lava reached the coast at this point.

The general slope of the west slope of Mauna Loa is about ten per cent or around 500 feet to the mile. Between the elevations of 1000 and 2000 feet the slope is somewhat steepened to reach nearly twice that value and this zone is thought to be the buried southward extension of the Kealakekua Fault turned southward. On the contrary the immediate lava flows at the shore in this sector have a much more gentle slope of not over 200 feet to the mile which combined with the normal irregular surface of a large pahoehoe flow make a very intricate and interesting shoreline and surface.

At some time in the geologic past, probably some thousands of years ago, the sub-sea level part of Mauna Loa and part of the narrow shoreline slipped down in relation to the upper part of the mountain and left the cliff known as Pali Kaholo. This is a nearly straight cliff which reaches in places a height of 200 feet and forms the cliffed head of Kiilae Bay and Kauhako Bay at Hockena and parallel to the shore appears in a number of discontinuous alcoves with cliffs at the landward side for a distance of about 15 miles. Whether this fault is related to the buried probable southern part of the Kealakekua Fault is not exactly known. The Pali Kaholo fault in the intervening stretches of its occurrence appears to have been buried by the festoon lava flows, and in the various parts where it can be seen is also in part covered by the lava which plunged over the cliff, formed curtains and stalactites and hence got its name.

The festooning lava which had been known for a long time for its curious forms, was strongly shaken by the earthquake of 1951 and parts of it shaken down so that we can say that this earthquake was one of the more severe which had occurred in this region since the placement of the lava.

This earthquake, which was responsible for much damage in Kona, was due to a slip on the Kealakekua Fault. The northermost stretch of the Pali Kaholo which can be seen is in this monument area, in the middle of Keokea, a stretch of cliff a short distance inland from the head of Alahaka Bay. This cliff will be discussed further in another section.

It is interesting to notice the slow development of a cliff on the south shore of Honaunau Bay as one approaches the open ocean to the westward. At the head of the bay there is no cliff at all, the shore being marked by a slight sand beach. On the south side of the Bay the shore is formed by rounded and gently sloping lava flows which at first scarcely show any modification by wave action. In the bay are irregular islands which vary their size with the tide and boats entering to the head of the bay must watch ahead for rocks both above and below water.

Near the head of the bay the lava flows show molds of prostrate coconut trunks and those also of one or two vertical ones, showing that coconut trees grew when the last lava flow was placed, just as now. Coconut tree molds are also found at other places on the surfaces of the lava. It is interesting

to observe also that in places the coconut molds were formed in the early stages of lava flow, were sufficiently solid to be preserved, but have been disrupted in the formation of tumuli so that two portions of the same mold are found discordant on the two sides of a rift across the top of a tumulus. It appears evident that tumuli are formed in the later stages of cooling of a gently sloping lava flow of which the crust has already cooled, but certain parts of that crust are subjected to the pressure of liquid lava beneath. This still liquid lava pushes up the crust, which often locks in that position, and the liquid lava often forces up and dribbles out and down the slopes of the tumulus.

Resuming our trip toward the ocean we see an increase in the number of places where the waves have formed a low cliff at the shore, by plucking of the crust of the pahoehoe, by the joints and also by abrasion where cobbles have been caught in the crevices and agitated by the action of waves. There are pools, also, one or several yards in extent that are nothing but low places in the surface of the lava flows. Such pools, if rather effectively cut off from the ocean, and if there is no great spray wash will maintain

their own mean level, usually slightly higher than the ocean and with less fluctuation. However, usually the spray or waves break over and the water surface is often several feet higher than mean sea level.

Many small inlets are developed at the sea coast and as water gets deeper a shore cliff is developed, often with a goodly portion under water. Much depends on where the upper and lower limits of a given lava unit are in relation to sea level. Often an inlet controlled by joints may be ten feet deep with an incoming wave and only three or four when the wave goes out. Sometimes such inlets are roofed over and lusty spouting horns are produced. Sea urchin borings and the incrustation of various types of algae give very vivid testimony to the prevailing and average level of wave and spray action though this may be well above mean sea level if the inlet has the right shape and exposure.

The process of plucking by ocean water probably includes those methods of removal and lifting which depend primarily on pressure differences, either developing higher pressures inside by virtue of the drive of the waves, or the reverse, a partial vacuum by which rock fragments are moved.

Despite its common use for ice work it seems to be a good term. Many of the first plucked patches are very small, just a few inches square, but they are enlarged to a few feet or many feet across. Soon after they are formed they, as well as joints or any sort of fissure, including the cracks in tumuli become traps for any loose detritus and abrasion begins. The fragments begin to become rounded and the depression in the rock becomes smoothed and takes in part the shape of the loose blocks. Occasionally the block dislodged by plucking in a great storm may be so over-size and so placed that it is not soon moved and may become a local landmark, remaining for many years.

In places the Polynesians have made post holes, or sockets, which are somewhat geometrical in their arrangement. There are also at many points on the solid upper surface what can be called grinding holes which quite clearly have been used and enlarged in the course of grinding seeds and the parts of sea shells. But it is also evident that many of the more irregular or larger of these holes are of natural origin and in some cases they are still supplied with pebbles and cobbles and are in active process of being enlarged. Abrasion goes on both under sea level, in pocket beaches where

larger or smaller aggregations of boulders are trapped in fissures or inlets in rock, and in isolated pits and fissures of various sizes in or somewhat removed from normal work on the waves. In places a block or boulder of larger than usual size will be trapped in such a crevice and remain long enough to bring about enlargement of the fissure to somewhat fit the boulder. Cracks and the structure of the rock interact with the blocks or debris to influence the final form of the depression as well as the form of the boulder.

One of the products of abrasion is the chink-faceted boulder or pebble. This is a rock fragment, which has been retained in the interstices between larger fragments or against the rock in such a way that it was free to move repeatedly with a slight motion, thereby cutting one or more scars on its points of contact. Such pebbles or cobble have been found with as many as 20 such facets, sometimes spots on an otherwise rather symmetrical pebble and in other instances a quite grotesque form, and often two or three together which have to be extricated one at a time like the pieces of a puzzle.

One of the products of both abrasion and deposition on the open coast

is the patch of bench which appears to stand at a level usually about 1 to 3 feet above sea level. There is some question about the validity of this bench as being cut by abrasion on the basalt flows. It is not as sharply or definitely cut as it would be on tuff or limestone, yet in places patches of rock surface occur along the coast at about 2 to 3 feet above mean sea level which give the definite impression that they are incised against the coast have a landward nip cut into the higher rock inland, and are not wholly the fortuitous selection of surface which will support the yellow-brown sea-weed that grows on them. At a slightly higher level there is a growth of light green sea-weed which may be a different species favored by that elevation or it may be younger growth of the same species. There is a tendency for a bench to level itself, even when it has been potholed below the upper surf level by the growth of sea-weed and other algae which stabilizes the sand and pebbles and forms a very slightly sloping surface which occurs in patches a few tens or occasionally a few hundred feet long and commonly 25 to 50 feet wide. There is no doubt that these beaches are favored by the stripping of the upper units of a lava flow, where are situated at a

suitable level but it is believed that there is abrasional attack as well as the organic attack of sea-weed at that level.

To the southward of the projecting lobe of lava flows which forms the principal projecting part of the coast south of Honaunau Bay the coast is marked by low cliffs and intervening boulder beaches for a few hundred yards. Here it is perhaps several hundred yards inland to the talus which marks the foot of this section of Pali Kaholo. Between the coast and the talus is the surface of rugged pahoehoe flows and the trail leads past heiau platforms and other marks of ancient Hawaiian activity. In the face of the cliff at the top of the talus are several caves which show signs of walling and other usage before the coming of the last festooning lava flows which will be more fully described in the sequel.

Toward the south, Pali Kaholo comes out to the coast and at this point where it merges with the coast it forms a higher cliff from thence south to beyond the limits of this area. Just before it reaches the coast there has been built a sort of causeway which appears wide enough to have been used for carts to gain the top of the combined cliff of Kaholo and the sea cliff.

Whether this has been modified by Caucasians should be discussed in the main part of this booklet.

Along this cliff there are many places, both at the top of the boulder beaches and at other places where it is evident that there has been a recent fall of blocks and even of the festooning dribble. No doubt much of this was shaken down in the strong earthquake of August 21, 1951. At the point where the causeway stands in front of the cliff of Kaholo, there are surfaces along the vertical face that look much as if they had recently been molten. One is tempted to interpret that the festooning lavas had come over the face, but is more probable that the surface showing such evidence of liquidity is the landward side of a lava tube which has been broken into by the Pali Kaholo and even by the earthquake of 1951 been freshly disturbed.

Among the features of fascinating interest is the almost infinite variety in the flow of water and the relation of different pools along parts of the coast. At one point is a rather high surface of rock with lower rock back of it. On the top of the higher surface is a slight

depression and pool to which water is furnished by a particular kind of wave.

The high pool can be known as pool A. Behind it is pool D. On either side are pools B and C. Water commonly reaches pool D through pool B and thence through a narrow channel connecting the two. When pool D is high enough there may be flow into pool C on the other side.

Less frequently a high, direct wave sends water to fill pool A, which in turn spills into pool D which rises and may reverse the current through the channel to pool B. At times the conflict between current and counter current through the D-B channel is continuous because the availability of water to pool D is retarded by passage through pool A. Pool C is somewhat more remote than any and rises less frequently. No doubt there are many variations in the flow through channels B-D, D-C, and over the A-D spillway due to angle of approach of the waves, their height, and the stage of tide.

In places, most commonly close to the rock bound ends of boulder beaches, chink-faceted boulders may be seen. These are boulders on certain sides of which are closely delineated rubspots a fraction the size of the

boulder due to recurrent, restrained abrasion where the boulder has long been caught in a crevice or between larger boulders so that it could only move recurrently in a certain way. Most of the boulders, not so constrained, are flung about in a random way and assume smooth, rounded forms.

Some of the fragments, being near the limit of wave capacity, at the upper or storm margin, are much less rounded and often show large bubble holes, somewhat enlarged by etching, or they may be marked by more numerous sea urchin borings. In some few instances the two are not readily distinguished.

Often incipient erosion is shown by small areas where the surface layer of somewhat glassy selvage with its two to three inch jointing has been stripped off exposing the next layer with coarser jointing or even no visible jointing. Everywhere the erosion is subtle, etching out the flow-placed structure but where the waves are strong and boulders are larger doing so with an appropriate boldness of line and form.

A coarse grit forming some beaches close to the head of Honaunau Bay contains an amazing variety of identifiable. The following is just a start; basalt, rock glass, sections of sea urchin spines, pieces of coral, olivine

grains, bits of mollusca shells, olivines in basalt, small cone shells, worm-bored shells, and so forth. Further search under a low-powered glass would reveal other classes of objects as well as freakish curios. Sand or grit is defined by the geologist as grains that are comparatively durable that have been sorted for size and weight and are somewhat rounded by abrasion. But the original material can be nearly anything. Pebbles can be pieces of rock or mineral or fragments of shell, horn, bone, nuts, wood, pieces of glass, metal, or any other artificial object, just so its present shape is somewhat modified by the ceaseless play of waves on a beach. The material on a given beach depends on the material available and durable in a given locality. Hawaii's beaches have mostly commonly coral and shell fragments, basalt fragments come in where the organic debris is less available and waves are strong. There is no quartz, so common on most mainland beaches.

Natural bridges or sea arches are seen at certain places and stages of tide. Isolated rocks or small islets are offshore in certain places, some can be seen to have moved about by waves, others are still attached to the bedrock and rise above erosion platforms forming true stacks as the geologist call them.

FLORA OF HONAUNAU

By

Amy Greenwell

The present flora of the future National Park at Honaunau is a far cry from its pre-Captain Cook representatives. Today among the higher plants there is scarcely an endemic or indigenous one to be found among the tangle of exotics comprised mostly of kiawe (Prosopis sp.), klu (Acacia farnesiana), opiuma (Pithecel obium dulce), Lantana camara, panini (Opuntia sp.), ekoa (Leucaena glauca), uhaloa (Waltheria americana), Passiflora foetida, and monkeypod (Samanea saman). All but the last species have hampered survey operations in the area. To clear the land will be slow and expensive. However on the brighter side, the only area to be kept free from overall poisoning, cutting and burning is a very small section of Paumoa where an excellent stand of seedling to very old kou (Cordia subcordata) is situated.

Common natives, easily replaced are: ilima (Sida fallax), ilieo or hilie'e (Plumbago zeylanica), hinahina (according to Theo. Kelsey). All others hereafter listed are either very local or a single or two isolated

plants or small herbaceous plants not showing up at the time of the survey (rains began in late April, 1957). An isolated stand of puakala (Argemone glauca) was washed away by the high surf of late February, 1957.

Introductions of the last century can be found at housesites. The most outstanding of these is the tamarind (Tamarindus indicus), ki (Cordyline terminalis) and hala (Pandanus sp.) (natives); and a clove-scented basil (Ocimum sp.) and chili pepper (Capsicum frutescens var.) rarely found but bearing mute witness to old homes nearby.

Modern housesites have mostly remains of specimen plants, but have also aided in making up the following "probable" list. Fifty years ago the area above the beach road was covered with pili grass (Heteropogon contortus) which has since given way to introduced forage grasses and the above mentioned thicket. These sites are few in number but the variety found in them is great.

The plants on the "probable" list grow or can grow at similar elevations at nearby villages or lava fields. Several of the cultivated plants, usually grown at higher elevations, could have been grown around

houses for medicinal or religious purposes. Among these would be banana, sugarcane, 'awa, kukui, pia and yam. Breadfruit and taro have been omitted.

A famous grove of the former grew at a slightly higher elevation and about two miles north of Honaunau and this was the main source of kukui nuts also. Taro needs much fresh water even though growing in soil and was grown at a much higher elevation. Among the native plants all but Jaquemontia and Cuscuta, which are littoral, would grow on the flat land up to the upper boundary line. Certain littoral plants such as Scaevola frutescens, Portulaca sp, and other less common ones found elsewhere on the West Hawaii coast are absent in this section and hence not listed.

The lava molds at the Paumoa shoreline appear to be loulu (Eupritchardia) and kou (Cordia).

The following lists are as complete as dry weather, difficult terrain to cover, and the writer's limited knowledge of the lower plant groups can make them. Specialists in algae, mosses, and hepatics will find many species in the ocean and the numerous caves. In the rainy season, there will probably be numerous fungi and an increase in the already large lichen

population. On the whole, the higher plant life at Honaunau today is very monotonous, thorny, and introduced.

Endemic and Indigenous Plants -- Probable and Possible

Native--

Erythrina sandwicensis Degener-----	Wiliwili
Canthium odoratum (Forst.)-----	Alahe'e
Reynoldsia sp. -----	Ohe
Mycoporium sandwicense (DC.) Gray -----	Naio, Aaka (10'-10,000')
Dodonaea sp. -----	A'ali'i
Santalum sp. -----	'Iliahi
Bidens sp. -----	Ko'oko'olau
Lopochaeta sp. -----	Nehe
Euphorbia sp. -----	Koko
Tephrosia purpurea (L.)Pers.-----	'Auhuhu
Ipomoea sp. -----	Koali
Ipomoea acetosaefolia, Roem & Sch.-----	Hunakai
Jaquemontia sandwicensis Gray-----	Pa'u-o-Hi'iaka
Cuscuta sandwichiana Choisy-----	Kauna'oa

Cultivated--

Lagenaria siceraria(Molina)Standley-----	Ipu nui
Hibiscus tiliaceus L.-----	Hau
Broussonetia papyrifera(L.)Vent.-----	Wauke
Musa paradisiaca L.-----	Mai'a
Piper methysticum Forst.-----	'Awa
Curcuma domestica Valet.-----	'Olena
Dioscorea alata L. -----	Uhi
Tacca leontopetaloides(L.)O.Ktze.-----	Pia
Saccharum officinarum L.-----	Ko
Aleurites moluccana(L.)Willd.-----	Kukui

Incomplete List of Endemic and Indigenous Plants Found-1957

Ferns--

Psilotum nudum (L.)Grisb. -----	Hulumoa, Moa
Polypodium phymatodes L. -----	Laua'e
Pteris sp. -----	

Monocotyledons--

Pandanus odoratissimus L.f.-----Puhala, Hala
 Heteropogon contortus(L.)Beauv.-----Pili
 -----Hinahina
 -----Ahu'awa
 Pritchardia sp. -----Loulu
 Cocos nucifera L. -----Niu hiwa - green
 -----Niu lelo - deep yellow
 Cordyline terminalis(L.)Kunth-----Ki

Dicotyledons--

Peperomia sp. -----'Ala'alawainui
 Argemone glauca Nutt. -----Puakala
 Capparis sandwichiana DC -----Pilo, Puapilo
 Sida fallax Walp. -----'Ilima
 Thespesia popunea(L.)Sol. -----Milo
 Plumbago zeylanica L. -----Ilieo
 Ipomoea batatas(L)Poir -----'Uala
 Ipomoea pes-caprae(L.)Sweet -----Pohuehue
 Ipomoea sp. -----*
 Cordia subcordata Lam. -----Kou
 Morinda citrifolia L. -----Noni
 Plectranthus australis, R.Br. -----'Ala'alawainui

* Pilikai --no flowers. Hunakai grows along the coast north of Honaunau.
 Pilikai found in woods and damp places nearby.

LIST OF PLANTS SUGGESTED FOR HONAUNAU AREA

By

Marie C. Neal

All native except those indicated by *.

Meaning of symbols preceding names:

- *. Introduced by natives prehistorically, according to Hillebrand and others.
 - G, Native plants found in 1957 by Amy Greenwell.
 - G, " " possibly present (" ").
 - , " " found on sand dunes, Kailua, Hawaii, 6/57, by L.W. Bryan.
 - K, Mrs. Pukui: Will grow midway, between beach and mauka.
 - M, " " " " mauka.
 - P, " " " " near beach.
 - Pv, " " Some varieties will grow.
 - Pc, " " Will grow with care.
 - N, Plants checked as to possibility, in literature and by actual herbarium specimens, by Marie C. Neal.
- Hbd, Hillebrand's Flora of H.I.

<u>Scientific Name</u>	<u>Native Name</u>	<u>Family</u>	<u>Remarks</u>
N <i>Parmelia</i>	Unahi	[Lichen]	On rocks
G <i>Psilotum nudum</i>	Moa	Psilotum	
Pc <i>Asplenium nidus</i>	'Ekaha	Fern	Possible in tree crotches
MN <i>Doryopteris decora</i>	[Manawahua?]	Fern	On lava, Kona & Kau (Hbd)
PNG + <i>Polypodium phymatodes</i>	Laua'e	Fern	On lava, Kona & Kau (Hbd)
MN <i>Sadleria cyatheoides</i>	'Ama'u	Fern	Possible. Alt. 100+ ft.
PN <i>Sphenomeris chusant</i>	Pala'a	Fern	Possible. Grows in low, dry places.

<u>Scientific Name</u>	<u>Native Name</u>	<u>Family</u>	<u>Remarks</u>
G <i>Pandanus odoratissimus</i>	Hala	Pandanus	
[<i>Cenchrus hillebrandianus</i>	'Ume'alu, mau'u kuku	Grass	Undesirable burgrass]
PG <i>Heteropogon contortus</i>	Pili	Grass	
PN <i>Oplismenus hirtellus</i>	Honohono kukui	Grass	Most tropics
P* <i>Saccharum officinarum</i>	Ko	Grass	
MN <i>Cladium angustifolium</i>	'Uki	Sedge	Perhaps too low and dry
MN <i>Cladium meyenii</i>	'Ahaniu	Sedge	Perhaps too low and dry
PN <i>Cyperus brevifolius</i>	Kili'o'opu	Sedge	All tropics
PN <i>Cyperus javanicus</i>	Ehu'awa	Sedge	At Kalapana, needs some water.
<i>Cyperus laevigatus</i>	Makaloa	Sedge	Needs marshy places
G* <i>Cocos nucifera</i>	Niu	Palm	
PN <i>Pritchardia affinis</i> var. <i>rhopalocarpa</i>	Loulu	Palm	Napoopoo, acc. J.F.Rock
Pc* <i>Alocasia macrorrhiza</i>	'Ape	Taro	
Pv* <i>Colocasia esculenta</i>	Kalo	Taro	
PG* <i>Cordyline terminalis</i>	Ki	Lily	
P* <i>Tacca leontopetaloides</i>	Pia	Tacca	
P* <i>Dioscorea alata</i>	Uhi	Yam	
PN <i>Dioscorea bulbifera</i>	Hoi	Yam	
P* <i>Dioscorea pentaphylla</i>	Pi'a	Yam	In woods only?
Pc* <i>Musa sapientum</i>	Mai'a	Banana	

<u>Scientific Name</u>	<u>Native Name</u>	<u>Family</u>	<u>Remarks</u>
Pc* <i>Curcuma domestica</i>	'Olena	Ginger	
Pc* ? <i>Gingiber zerumbet</i>	'Awapuhi	Ginger	
PN <i>Peperomia leptostachya</i>	'Ala'alawainui	Pepper	On aa, Napoopoo
Pc* <i>Piper methysticum</i>	'Awa	Pepper	Too dry?
P* <i>Artocarpus incisus</i>	'Ulu	Fig	
PcM* g <i>Broussonetia papyrifera</i>	Wauke	Fig	Grows at Kealakekua
MN <i>Neraudia ovata</i>	Ma'aloa	Nettle	On hot, dry lava, also rain forests. Alt. too high
N g-- <i>Santalum ellipticum</i> (littoral var.)	'Iliahi	Sandal- wood	At Kailua, Napoopoo
NP <i>Chenopodium oahuense</i>	'Aheahea	Spinach	Alt. 10-8,250 ft. Napoopoo
? <i>Nototrichium sandwicense</i>	Kulu'i	Amaranth	Alt. 45-2,500 ft.
- <i>Boerhavia diffusa</i>	Alena	Four- o'clock	
MN <i>Phytolacca brachystachys</i>	Popolo-kumau	Pokeweed	Alt. 50-6,000 ft.
- <i>Sesuvium portulacastrum</i>	'Akulikuli	Carpet-weed	
PN <i>Portulaca hawaiiensis</i>	"	Purslane	Many by beach, South Pt.
PN <i>Portulaca lutea</i>	"	Purslane	
- <i>Portulaca oleracea</i>	'Akulikuli kula	Purslane	
G <i>Argemone alba</i> var. <i>glauca</i>	Puakala	Poppy	
G <i>Capparis sandwichiana</i>	Puapilo, Maipilo	Caper	Common Honaunau vicinity

<u>Scientific Name</u>	<u>Native Name</u>	<u>Family</u>	<u>Remarks</u>
MN <i>Pittosporum hosmeri</i> var. <i>longifolia</i>	Ho'awa	Pittosporum	Kapua, Kona. Alt. 200 high ?
PN <i>Osteomeles</i> <i>anthyllidifolia</i>	'Ulei	Rose	e.g., near shore, Puna
PN <i>Caesalpinia bonduie</i>	Kakalaioa	Bean	The rarer sp., no stipules, seed yel.- gray. Possible loc.
PN <i>Caesalpinia crista</i>	Kakalaioa	Bean	Possible loc.? - stipul seed gray. Kiilae
MN <i>Canavalia galeata</i>	'Awikiwiki	Bean	Grows at Kealakekua. (M. Carlson)
N <i>Cassia gaudichaudii</i>	Kolomona	Bean	Formerly grew near sea.
P g. <i>Erythrina</i> <i>sandwicensis</i>	Wiliwili	Bean	
PN <i>Mucuna gigantea</i>	Ka'e'e'e	Bean	Woods & shore?, Puna, Kau.
?/ <i>Sesbania tomentosa</i>	'Ohai	Bean	Possible
PN <i>Tephrosia purpurea</i>	'Auhuhu, 'auhola	Bean	All H.I. near coast
PN <i>Vigna marina</i>	Nanea	Bean	Near Beach. Nat. & many tropics.
PN <i>Tribulus cistoides</i>	Nohu	Tribulus	In N. Pacific (Hbd)
K* <i>Aleurites moluccana</i>	Kukui	Spurge	May be native (Hbd)
MN <i>Antidesma pulvinatum</i>	Hame, ha'a	Spurge	Kapua, Kona. But alt. too high
PN <i>Euphorbia degeneri</i>	'Akoko	Spurge	Near shore.
PN g. <i>Dodonaea viscosa</i>	'A'ali'i	Soapberry	Recorded at alts. 700 ft.

<u>Scientific Name</u>	<u>Native Name</u>	<u>Family</u>	<u>Remarks</u>
PN Colubrina asiatica	'Anapanapa	Buckthorn	Near shore.
MN Colubrina oppositifolia	Kauila	Buckthorn	Alt. too high.
PN? Gossypium tomentosum	Mao, huluhulu	Hibiscus	None in herb. from Hawaii, but from 4 other islands. Probably not on Hawaii.
P g + * Hibiscus tiliaceus	Hau	Hibiscus	
PG Sida fallax (wild forms)	'Ilima	Hibiscus	
P * Thespesia populnea	Milo	Hibiscus	
P * Calophyllum inophyllum	Kamani	Mangosteen	
PN Wikstroemia uva-ursi	'Akia?	Akia	"Puna, near the coast" (Hbd)
MN * Eugenia malaccensis	'Ohi'a 'ai	Myrtle	Near shore not possible; too dry, Honaunau alt. too low.
MN Metrosideros collina polymorpha	'Ohi'a lehua	Myrtle	Formely on Kau cliffs near sea.
MNg Reynoldsia sandwicensis	Ohe	Panax	Grows on lava Keei
PG Plumbago zeylanica	Ilie'e	Leadwort	
M Diospyros ferrea var. pubescens	Lama	Ebony	Kona, Kau, Hilo.
P g + Cuscuta sandwichiana	(Kauna'oa (" kahakai (" lei	Morning- glory	

<u>Scientific Name</u>	<u>Native Name</u>	<u>Family</u>	<u>Remarks</u>
G* Ipomoea batatas	'Uala	Morning-glory	
PN Ipomoea cairica	Kowali 'ai	Morning-glory	Herbm. spm. from near Honaunau
PN Ipomoea congesta	Kowali 'awa	Morning-glory	Herbm. spm. from near Honaunau
PG † Ipomoea pes-caprae	Pohuehue	Morning-glory	
PN Ipomoea tuboides	Kowali	Morning-glory	South Pt.
PN Jacquemontia sandwicensis	Pa'u-o-Hi'i-aka	Morning-glory	Vine on rocks
PN Stictocardia campanulata	Pilikai	Morning-glory	Herbm. spm. from near Honaunau
G* Cordia subcordata	Kou	Heliotrope	
- Heliotropium anomalum var. argenteum	Hinahina	Heliotrope	Grows Kailua and North on beach
- Heliotropium curassavicum	Nena, kipukai	Heliotrope	
PN Vitex trifolia var. simplicifolia	Pohinahina	Verbena	
PN Lycium sandwicense	'Ae'ae ('Ohelo kai)	Tomato	Probably at Honaunau
KN Solanum nodiflorum	Popolo	Tomato	Native acc. to Hbd.
PN g. Myoporum sandwicense	Naio	Naio	Grows Littoral at Milolii, S. Kona from near beach to 9,500 ft.
PN Plantago princeps var. laxifolia	Laukahi	Plantain	Near shore on Hawaii (Hbd.)
P g Canthium odoratum	Alahe'e	Coffee	
P G Morinda citrifolia	Noni	Coffee	

<u>Scientific Name</u>	<u>Native Name</u>	<u>Family</u>	<u>Remarks</u>
P g. <i>Lagenaria siceraria</i>	Ipu	Gourd	
PN <i>Bidens skottsbergii</i> var. <i>conglutinata</i>	Ko'oko'olau	Daisy	Low alt., Pahoa, Puna. Perhaps Honaunau. Various sp. low, lava country in N. and S. Kona.
PN <i>Gnaphalium sandwicense</i>	'Ena'ena	Daisy	Alts. 15-10,000 ft.
PN <i>Lipochaeta integrifolia</i>	Nehe	Daisy	South Pt., common. Another sp. in Kona

Limu (algae) and other low forms of plant life: lichens (see Parmelia),
 hepatics, mosses, fungi, may be the same as in prehistoric times. Ordinarily,
 these forms of plant life are not adapted to planting or transplanting.

INSECTS OF HONAUNAU

By

Amy Suehiro

Introduction

Except for an occasional kou tree (Cordia subcordata), a couple of Pritchardia palms, and coconut trees, little remains of the native vegetation that once must have covered the Honaunau park area. The destruction of the forest was speeded by the introduction of domesticated animals which destroyed the undergrowth and the subsequent invasion of introduced grasses and other plants which prevented the regrowth of the native plants. With the disappearance of the native plants went along many of the endemic insects that were associated with them. A few of these insects might have been able to adapt themselves to changing environments and new host plants if it had not been for the introduction of various predaceous and parasitic insects. One species in particular, the abundant and widespread ant Pheidole megacephala, has caused the destruction of

countless species of endemic insects. Early entomologists observed that as Pheidole invaded an area, the native insects, especially the beetles, disappeared before it.

At the present time, the insect fauna of the Honaunau park area consists, in the main, of common lowland species, either immigrants which have come in accidentally since the arrival of man in various ways such as on imported plants or with cargo, or purposely introduced species, brought in for work in biological control. A smaller percentage consists of the native species--either those that are considered endemic and found nowhere else but in the Hawaiian Islands, and those which are indigenous, species found in Hawaii and some other part of the world as well but which got here under their own power before the advent of man.

Summary of Insect Fauna

Although Kona, as a whole, has been collected in quite extensively, insect records are relatively few for the Honaunau park area. Of a total of 609 species recorded for the entire district, only 150 species have been

collected in the park area, and of these, 72 are considered native to the islands.

Chilopoda: Only one centipede has been recorded from Honaunau--the familiar, large brown species which is often found under stones or in dark, damp places.

Other arthropods: No millipeds, pseudoscorpions, mites, or scorpions have been reported from the area. Though 28 species of spiders are found in Kona, none have been recorded so far from Honaunau.

Orthoptera: Five species of cockroaches are found in the park area. Periplaneta americana and P. australasiae are two large household pests, extremely common all over the islands. Neostylopyga rhombifolia, first recorded from Hawaii in 1882 is a large flightless species; another, Allacta similis, is an immigrant from Australia, though it was earlier considered endemic to Hawaii. The fifth species, a prettily marked small insect, is a garden roach and seldom found in the house. One grasshopper and two cricket species collected at Kealakekua are endemic. As they are

flightless and arboreal, usually attached to a specific host plant, it is unusual to find them collected so far from their usual habitat and in such decidedly unfavorable surroundings.

Isoptera: The very destructive drywood termite, Cryptotermes brevis, and the lowland tree termite, Kaloterms immigrans, are found in Kealakekua. Both have been known in the islands for over three quarters of a century.

Dermaptera: Four species of earwigs are reported from Honaunau and Kealakekua. All are immigrants and because of their carnivorous habits are usually considered as beneficial.

Embiidina: The little silk-spinning embiid has also been reported from the park and it is common in the drier lowlands. It is small, dark and seldom seen and of no economic importance.

Hemiptera-Heteroptera: Surprisingly enough, all of the ten species of leafhoppers collected in the park area are endemic. Though no elevations are given on the specimens examined, they were collected on native plants such as Straussia, Myoporum, and Maba, and must have been found in the lower forests back of Honaunau. The two species of aphids are immigrants, although

one was collected on young koa leaves.

Five of the seven species of true bugs are endemic. They include members of the Nysius-Neseis group which, though largely endemic, show remarkable tolerance to the presence of the ubiquitous Pheidole ant, and are able to build up large populations in lowland areas. They also show a marked facility for adapting themselves to changing food plants, many of them living and breeding on introduced weeds as well as their original native hosts. Halobates sericeus, the endemic water strider, has been collected at sea far from land. Though little is known of its life history or habits, it is thought that the entire life cycle is spent on the water, eggs being laid on drifting pieces of seaweed or other floating objects. They are seldom seen except after a strong Kona storm when they are driven on shore in numbers. Zelus renardii, the large assassin bug, is common in the lowlands where it is a voracious feeder on other insects.

Neuroptera: Both species of green lace-wing flies found at Kealakekua are endemic. Though usually found at higher altitudes, they occasionally are found in the lowlands, feeding on a variety of small insects.

Odonata: One species of dragonfly, the cosmopolitan green darner, was caught at Honaunau, but the other common lowland species are strong fliers and undoubtedly present. Only one species of the many native little damselflies of the genus Megalagrion has been collected at Honaunau; this species is common and often found from sea level to the native forest, breeding in streams and forest pools.

Coleoptera: Except for an endemic species of wood borer, Kyletobius timberlakei, and a ladybeetle of doubtful endemicity, all 23 species of beetles from the park area are immigrants, the native species having vanished with their host plants. The Pheidole ant, too, may have been a contributing factor in their disappearance, bearing out the statement that the native beetles vanish as Pheidole takes over, leaving the field to the immigrant species which seem to be unaffected by it. The beetles collected in the park area are, for the most part, pests which do much damage to food crops such as sweet potatoes, eggplants, beans, and potatoes. Others bore in dead wood, while the scarab, Aphodius lividus, feeds and breeds in manure.

Lepidoptera: Of the butterflies, only the immigrant bean butterfly, Lampides boeticus, has been collected at Honaunau, but undoubtedly, some of the seven other species taken in Kona can be found there. They are mostly [all] strong fliers, and common on plants found throughout the region. Twenty species of moths are recorded; of these, 11 are native. Most of them were collected about the 1,200-foot level, presumably past the elevation where Pheidole and other predators are most effective. Of the immigrant species, Hymenia recurvalis is the common beet webworm of the mainland; a comparatively late arrival is the giant black witch moth, Erebus odora, which was first observed in the early 1930's, and feeds on monkeypod foliage.

Diptera: The flies found in the park are immigrants for the most part. The craneflies, however, have four native species out of five represented in the Honaunau collection; one, Limonia perkinsi, is an indigenous species also found in Samoa and Tahiti. Both species of day mosquito are represented; they are widely distributed in the tropics and subtropics. Aedes aegypti is the yellowfever mosquito, and both are

carriers of dengue fever. The night mosquito, *Culex*, has not yet been collected from Kona, though undoubtedly present as it is the commonest species in the lowlands.

Hymenoptera: Native bees are represented by species from the genera Odynerus, Nesoprosoapis, and Xenobrazro. Unlike most native insects, these genera are frequently found in the lowlands--Nesoprosoapis, in particular, may be found in hot, dry, coastal regions, often forming burrows in the ground or in dry twigs and hollow branches, and visiting immigrant plants for pollen. Species of Odynerus are also found in varying situations. They are all caterpillar hunters, attacking various introduced species. They show an unusual adaptation to locally changing conditions, not only shifting from native to introduced plants for pollen and honey, but also from caterpillars of native species to those of various foreign varieties. On the coast and lowlands, large colonies often occur, for some reason undisturbed by Pheidole ants.

Echthromorpha fuscator, a very common and conspicuous caterpillar wasp, was one of the very first insects to be collected and described from the

Hawaiian Islands. Though no record was kept of the collector, it may have been obtained by David Nelson, the botanist with Captain Cook's Third Expedition who collected on Hawaii. It was studied and described by Fabricius in 1793.

The greater number of Hymenoptera found in the park are immigrants, many of them purposely introduced for biological control work. Brachymeria obscurata was introduced from Japan in 1895 as a general parasite of lepidopterous larvae. Both species of Amblyteles were introduced from California to prey on armyworms and cutworms. The little cockroach wasp, Evania sericea, was described from Oahu in 1883, but is also known in Australia. It is common around houses, searching for egg cases of cockroaches to parasitize. Only two of the five species of ants recorded from Kona have been found in the park area; one, the abundant Pheidole ant, the other a blackish ant which is known locally as the "crazy ant" because of its rapid, erratic, and seemingly meaningless movements. Widely distributed in the islands, it comes from the Indo-malayan and neotropical regions.

The most abundant bee in the Honaunau area as well as in all the islands is the familiar honey bee, Apis mellifera. The first bees were introduced from California in 1857 and soon spread throughout the islands.

The following checklist of insects and related arthropods includes all species which have been reported to occur within the limits of the Honaunau park area, which, for the purposes of this report, includes localities along the Kona coast from Kealakekua Bay to Kiilae Bay, and mauka, to the lower boundaries of the Honaunau park area at an elevation of about 2,500'.

Records are taken from data on specimens in the collections of Bishop

Museum and of the Experiment Station of the Hawaiian Sugar Planters'

Association, as well as from the Museum catalogs which list references to

all insects described or reported from the Hawaiian Islands. An asterisk

before the species name indicates that it is native to the Hawaiian Islands.

CHILOPODA (Centipedes)

Henicopidae

Scolopendra subspinipes Leach Kona; City of Refuge, under stones

HEXAPODA (Insects)

ORTHOPTERA

Blattidae (Cockroaches)

<i>Allacta similis</i> (Saussure)	Kona: Kealakekua; immigrant from Australia
<i>Euthyrrhapha pacifica</i> (Coquebert)	Kona: Honaunau; first recorded in 1882
<i>Neostylopyga rhombifolia</i> (Stol)	Kona: Honaunau; Indomalayan, now tropicopolitan
<i>Periplaneta americana</i> (Linnaeus)	Kona, widely distributed and abundant.
<i>Periplaneta australasiae</i> (Fabricius)	Kona, widely distributed and abundant

Tettigoniidae (Long-horned grasshoppers)

<i>Banza nitida</i> (Brunner)	Kona: Kealakekua
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Gryllidae (Crickets)

<i>Paratrigonidium gracile</i> Perkins	Kona: Kealakekua, beneath bark of trees
<i>Paratrigonidium varians</i> Perkins	Kona: Kealakekua
<i>Metioche vittaticollis</i> Stal	Kona: Honaunau, in grass and low ve- getation

DERMAPTERA (Earwigs)

<i>Anisolabis eteronoma</i> Borelli	Kona: Honaunau
<i>Chelisoches morio</i> Fabricius	Kona: Honaunau
<i>Euborellia annulipes</i> (Lucas)	Kona: Honaunau
<i>Labia pilicornis</i> (Motschulsky)	Kona: Kealakekua

ISOPTERA (Termites)

Kalotermitidae

<i>Cryptotermes brevis</i> (Walker) (drywood termite)	Kona: Kealakekua, there before 1869.
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Kalotermes immigrans Snyder
(lowland tree termite)

Kona: Kealakekua; known in islands
since 1889.

EMBIIDINA

Oligotoma saundersi (Westwood)

Kona: Milolii (near Honaunau)

HOMOPTERA

Cicadellidae (Leafhoppers)

**Balolutha volcanicola* Kirkaldy

Kona: Honaunau; Kealakekua; usually
on Eragrostis

**Nesophrosyne eburneola* Osborn

Kona: Kealakekua, on Straussia

**Nesophrosyne insularis* Kirkaldy

Kona: Kealakekua, on Clermontia coerulea

Cixiidae

**Oliarus hevaheva* Kirkaldy

Kona: Hookena

Delphacidae (Leafhoppers)

**Aloha myoporicola* Kirkaldy

Kona: Kealakekua, ex Myoporum
sandwicensis

**Kelisia paludum* Kirkaldy

Kona: Honaunau

**Leialoha lehuae hawaiiensis* Muir

Kona: Kealakekua, ex Acacia koa

**Nesosydne rubescens pele* Kirkaldy

Kona: Kealakekua, ex Acacia koa

**Nesosydne umbratica* Kirkaldy

Kona: Kealakekua, ex Clermontia
coerulea

**Nesothoe maculata* (Muir)

Kona: Hookena, ex Maba sandwicensis

Aphididae (Plant lice)

Amphorophora sonchi (Oestlund)

Kona: region around Hualoa, on
Sonchus oleraceus leaves

Toxoptera aurantii (Boyer de Fons.)
(Black citrus aphid)

Kona: Keokea, at forest edge, on
young ohia leaves. Widespread,
long known in islands.

HETEROPTERA (True bugs)

Lygaeidae (Plant bugs)

- **Neseis nitidus pipturi* Usinger Kona: Kealakekua, in forest
- **Nysius terrestris* Usinger Kona: Honaunau, usually on pigweed;
many other hosts
- **Oechalia virgula* Van Duzee Kona: Kealakekua, on *Pipturus albidus*

Reduviidae

- Zelus renardii* (Kolenati) Kona: Honaunau; a common, widespread
(Assasin bug) predaceous insect

Nabidae (Damsel bugs)

- Nabis capsiformis* Germar Kona: Napoopoo, on various truck and
garden crops; common and wide-
spread

Miridae (Leaf bugs)

- **Sulamita lunalilo* Kirkaldy Kona: Kealakekua, on *Freycinetia*
arborea

Gerridae (Water striders)

- **Halobates sericeus* Eschscholtz Kona, waters off Honaunau

NEUROPTERA (Lacewing flies)

Chrysopidae (Green lacewings)

- **Anomalochrysa maclachlani* Kona: Kealakekua, on *Myoporum*
Blackburn *sandwicensis*
- **Anomalochrysa princeps* Kona: Kealakekua, beating fern leaves
Perkins

ODOMATA

Anisoptera (Dragonflies)

Aeshmidae

- Anax junius (Drury) (Common green darner) Kona: Honaunau; a widespread, strong flier. Probably in islands for several hundred years as a natural immigrant.

Zygoptera (Damsel flies)

Coenagriidae

- *Megalagrion nigrohamatum Kona: Honaunau
nigrolineatum (Perkins)

COLEOPTERA (Beetles)

Oedemeridae

- Sessinia livida Fabricius Kona: Honaunau, breeding in old wood

Elateridae (Click beetles)

- Melanoxanthus melanocephalus Kona: Kealakekua
Thunberg

Nitidulidae (Souring beetles)

- Carpophilus maculatus Murray Kona: Napoopoo

Anobiidae

- *Xyletobius timberlakei Perkins Kona: Kealakekua, on Clermontia and Byronia

Bostrichidae (Powderpost beetles)

- Xylopsocus castanoptera (Fairmaire) Kona: Kealakekua

Coccinellidae (Lady beetles)

<i>Curinus coeruleus</i> Mulsant	Kona: Kealakekua
<i>Hyperaspis jocosus</i> (Mulsant)	Kona: Honaunau
* <i>Scymnus ocellatus</i> Sharp	Kona: Honaunau
<i>Scymnus uncinatus</i> Sicard	Kona, general region around Holualoa, probably predatory on <u>Pseudococcus</u>

Cerambycidae (Long-horned beetles)

<i>Ceresium simplex</i> (Gyllenhal)	Kona: Honaunau, in dead branches
<i>Cyllene crinicornis</i> Chevrollet	Kona: Kealakekua, widespread algaroba beetle
<i>Lagocheirus obsoletus</i> Thoms.	Kona: Kealakekua
<i>Prosoplus bankii</i> (Fabricius)	Kona: Napoopoo; Kealakekua

Chrysomelidae (Leaf beetles)

<i>Lema trilineata californica</i> Schaeffer (Striped potato beetle)	Kona: Honaunau on eggplant, potato, and other solanums
<i>Octotoma scabripennis</i> Guerin (Lantana leaf miner)	Kona: Hookena, released May 1954

Bruchidae (Pea and bean weevils)

<i>Bruchus prosopis</i> Leconte	Kona: Honaunau
<i>Bruchus pruininus</i> Horn	Kona: Napoopoo, widely distributed in islands, infesting legume seeds
<i>Bruchus sallei</i> Sharp	Kona: Kawaihae to Napoopoo in green and ripe algaroba pods
<i>Caryoborus gonagra</i> Fabricius	Kona: Napoopoo; originally from India, first observed in islands about 1906

Curculionidae (Weevils)

<i>Cylas formicarius elegantulus</i> (Summers) (Sweet-potato weevil)	Kona: Napoopoo; serious pest of sweet potatoes and other Convolvulaceae
<i>Dryophthorus</i> species	Kona: Honaunau

Scolytidae (Bark beetles)

<i>Hypothenemus eruditus</i> Westwood	Kona: Napoopoo
<i>Poecilips persicae</i> (Hopkins)	Kona: Keopu, ex avocado
<i>Xyleborus confusus</i> Eichhorn	Kona: Kaawaloa

Scarabaeidae (Dung beetles)

<i>Aphodius lividus</i> Olivier	Kona: Honaunau; Kealakekua; breeding in manure
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LEPIDOPTERA

Rhopalocera (Butterflies)

Lycaenidae (Blues)

<i>Lampides boetica</i> (Linnaeus) (Bean butterfly)	Kona: Honaunau
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Heterocera (Moths)

Tortricidae

* <i>Cryptophlebia illepida fulva</i> Walsingham	Kona: Kaawaloa, 1500'
<i>Crociosema plebeiana</i> Zeller	Kona: Kaawaloa, 1500'
* <i>Tortrix chlorocalla</i> Walsingham	Kona: Kaawaloa, 1500'

Carposinidae

- **Heterocrossa dispar* Walsingham Kona: Kaawaloa, 1500'-2000'
**Heterocrossa solutella* Walsingham Kona: Kaawaloa, 2000'-3000'

Cosmopterygidae

- **Batrachedra microstigma* Kona: Kaawaloa, above 2000'
 Walsingham

Gelechiidae

- Stoberhinus testaceus* Butler Kona: Kaawaloa

Hyponomeutidae

- **Hyposmocoma domicolens* (Butler) Kona: Kaawaloa, 1500'
**Hyposmocoma longitudinalis* Kona: Kaawaloa, about 2000'
 Walsingham
**Hyposmocoma vermiculata* Kona: Kaawaloa, about 2000'
 Walsingham
**Prays fulvocanellus* Walsingham Kona: Kaawaloa, about 2000'

Pyraustidae

- Hymenia recurvalis* (Fabricius) Kona: Honaunau, in beets and spinach
 (Beet webworm)
**Phlyctaenia argoscelis* (Meyrick) Kona: Honaunau
**Scoparia siderina* Meyrick Kona: Honaunau

Tineidae

- **Ereunetis minuscula* Walsingham Kona: Kaawaloa, to 2000'
**Opogona aurisquamosa* (Butler) Kona: Kaawaloa, to 2000'
Setomorpha rutella Zeller Kona: Kaawaloa, 1500'
Tinea fuscipunctella Haworth Kona: Kaawaloa, 1500'

Geometridae

**Eucymatoge monticolans* (Butler) Kona: Honaunau

Noctuidae

Erebus odora (Linnaeus) (Black
witch) Kona: Honaunau, larvae in *Cassia*
nodosa

DIPTERA (Flies)

Tipulidae (Crane flies)

**Erioptera* (*Teimicra*) *lateralis* Kona: Honaunau
(Grimshaw)

Erioptera (*Trimicra*) *pilipes* Kona: Honaunau; Kaawaloa, 1500'
Fabricius

**Limonia* (*Dicranomyia*) *hawaiiensis* Kona: Honaunau; Kealakekua
(Grimshaw)

**Limonia* (*Dicranomyia*) *kauaiensis* Kona: Kealakekua
(Grimshaw)

**Limonia* (*Limonia*) *perkinsi* Kona: Kealakekua
(Grimshaw)

Culicidae (Mosquitoes)

Aedes aegypti (Linnaeus) Kona: Kealakekua

Aedes albopictus Skuse Kona: Kiilae Bay

Ceratopogonidae

**Dasyhelea calvescens* Macfie Kona: Kiilae Bay; Honaunau on rocks

Sciaridae

**Sciara molokaiensis* (Grimshaw) Kona: Honaunau

Dorilaeidae

* *Dorilas obscuratus* Hardy

Kona: Kealakekua, on Clermontia

Syrphidae (Hover flies)

Tubifera arvorum (Fabricius)

Kona: Napoopoo

Volucella (Ornidia) obesa
(Fabricius)

Kona: Kiilae Bay

Lauhaniidae

Homoneura unguiculata (Kertész)

Kona: Honaunau

Canacidae

Canaceoides nudata (Cresson)

Kona: Kiilae Bay

Sphaeroceridae

* *Limosina (Opacifrons) aequalis*
(Grimshaw)

Kona: Pauahi (8 miles E. of Captain
Cook)

Otitidae

Euxesta annonae (Fabricius)

Kona: Honaunau

Piophilidae

Piophila casei Linnaeus (Cheese
skipper)

Kona: Keokea, widespread pest of
stored cheeses

Dolichopodidae

Sciapus pachygyna Macquart

Kona: Napoopoo

Ephydriidae

Lytogaster gravida (Loew)

Kona: Pauahi

Chloropidae

Cadrema pallida (Loew)

Kona: Honaunau

Calliphoridae (Blowflies)

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| <i>Chrysomya rufifacies</i> (Macquart)
(Sheep maggot fly) | Kona: Honaunau; first reported from islands in 1918 |
| <i>Chrysomya vomitoria</i> (Linnaeus) | Kona: Keokea |

HYMENOPTERA (Bees, wasps, ants)

Braconidae

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|---|---|
| * <i>Chelonus blackburni</i> Cameron | Kona: Honaunau, in coffee field, parasitic on moth larvae, particularly the potato stem borer |
| * <i>Apanteles trifasciatus</i> Muesbeck | Kona: Napoopoo |
| * <i>Heterospilus prosopidis</i> Bridwell | Kona: Honaunau |

Ichneumonidae

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|---|--|
| <i>Amblyteles koebelei</i> (Swezey) | Kona: Keokea |
| <i>Amblyteles purpuripennis</i>
(Cresson) | Kona: Keokea |
| <i>Echthromorpha fuscator</i> (Fabricius) | Kona: Kiilae Bay |
| <i>Zuletopygus flavo-orbitalis</i>
(Cameron) | Kona: Napoopoo, bred ex <u>Plutella</u> larvae |

Eulophidae

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|--|----------------|
| * <i>Burksia viridimaculata</i> Fullaway | Kona: Honaunau |
|--|----------------|

Encyrtidae

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|--|---|
| * <i>Adelencyrtus odonaspidis</i> Fullaway | Kona: Honaunau |
| * <i>Anagyrus swezeyi</i> Timberlake | Kona: Honaunau |
| * <i>Calolelaps coeruleus</i> Timberlake | Kona: Kealakekua, on naio |
| * <i>Coelopencyrtus swezeyi</i> Timberlake | Kona: Kealakekua, bred from <u>Odynerus nigripennis</u> |
| <i>Encyrtus barbatus</i> Timberlake | Kona: Napoopoo |

<i>Encyrtus infelix</i> (Embleton)	Kona: Napoopoo
Eurytomidae	
* <i>Eurytoma tephritidis</i> Fullaway	Kona: Kealakekua
Chalcidae	
<i>Brachymeria obscurata</i> (Walker)	Kona: Kiilae Bay; in coffee fields
<i>Brachymeria polynesiensis</i> (Cameron)	Kona: Honaunau
* <i>Dirhinus giffardii</i> Silvestri	Kona: Honaunau
<i>Stomatoceras pertorvum</i> Girault	Kona: Honaunau
Figitidae	
<i>Eucoila impatiens</i> Say	Kona: Honaunau, parasite of sarcophagids
Evaniidae (Ensign flies)	
<i>Evania appendigaster</i> (Linnaeus) (Cockroach parasite)	Kona: Kiilae Bay; Honaunau
Bethylidae	
* <i>Sclerodermus muiri</i> Bridwell	Kona, above Kealakekua, in <u>Straussi</u> a wood
Formicidae (Ants)	
<i>Paratrechina longicornis</i> Latreille (Crazy ant)	Kona: Keokea; tropicopolitan, especially in Indo-Malaya and the Neotropics
<i>Pheidole megacephala</i> (Fabricius) (Common black ant)	Kona: Honaunau, and common in lowlands of all the islands; first observed about 1860; extremely prolific nuisance and pest
Vespidae (Wasps)	
* <i>Odynerus cooki</i> Perkins	Kona: Kealakekua, close to monument

*Odynerus heterochromus Perkins	Kona: Keokea
*Odynerus mesospilus Perkins	Kona: Honaunau
*Odynerus molokaiensis Perkins	Kona: Honaunau; Napoopoo
*Odynerus obscure-punctatus (Perkins)	Kona: Honaunau
*Odynerus nigripennis (Holmgren)	Kona: Honaunau, Napoopoo
*Odynerus sociabilis Perkins	Kona: Keokea
Nesodynerus rudolphi (Dalla Torre)	Kona: Honaunau
Polistes hebraeus Fabricius	Kona: Honaunau

Sphecidae

*Xenocrabro hawaiiensis Perkins	Kona: Honaunau, on <u>Ilex</u>
Xenocrabro polynesiensis (Cameron)	Kona: Keokea

Colletidae

*Nesoprosopis anthracina (Perkins)	Kona: Kealakekua Bay region
*Nesoprosopis obscurata Perkins	Kona: Kealakekua, rare; Keokea
+ Nesoprosopis rubrocaudatus Blackburn and Cameron	Kona: Keokea
*Nesoprosopis coniceps Perkins	Kona: Keokea
+ Nesoprosopis simplex Perkins	Kona; generally distributed around lowlands, up to Keokea mauka

Apidae

Apis mellifera Linnaeus (Honeybee)	Kona: Honaunau region and widespread throughout islands. First introduced into islands from California in 1857.
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The following list includes species which have been reported or collected from "Kona" or "South Kona" without further data. As many of them are widely distributed, lowland forms, it is quite probable that some of them were collected in the Honaunau park area.

CHILOPODA (Centipedes)

Henicopidae

<i>Lamycetes fulvicornis hawaiiensis</i> Silvestri	Kona, usually in mountains
<i>Pleotarsobius heterotarsus</i> (Silvestri)	Kona
<i>Scolopendra subspinipes</i> Leach (common large centipede)	Kona: City of Refuge, under stones

DIPLOPODA (Millipedes)

Julidae

<i>Aporodesminus wallacei</i> Silvestri	Kona, 2000'
<i>Julus luscus</i> Meinert	Kona
<i>Trigoniulus lumbricinus</i> (Gerst)	Kona

PSEUDOSCORPIONES

Cheliferidae

<i>Eumecochernes hawaiiensis</i> (Simon)	Kona
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ARACHNIDA

ACARINA (Mites)

<i>Phyllocoptes oleivorus</i> Ashmead	Kona, on <u>Citrus</u>
<i>Hoploderma dasypus</i> Duges (moss mites)	Kona,
<i>Neoliodes theleproctus</i> Herm	Kona
<i>Oribata oriformis</i> Pearce	Kona

SCORPIONIDA (Scorpions)

<i>Chelifer hawaiiensis</i> Simon	Kona
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ARANEIDA (Spiders)

Clubionidae

<i>Heteropoda regia</i> (Fabricius)	Kona; the large, brown house spider, native to the Orient but now widespread
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Theridiidae

<i>Argyrodes argyroides</i> Walckenaer	Kona, in mountains
<i>Argyrodes hawaiiensis</i> Simon	Kona

Sicariidae

<i>Theridion grillator</i> Simon	Kona
<i>Theridion melinum</i> Simon	Kona
<i>Theridion praetextum</i> Simon	Kona
<i>Theridion rufipes</i> Simon	Kona
<i>Teutana grossa</i> Koch	Kona

Attidae

<i>Ascyltus penicillatus</i> Koch	Kona, on vanilla
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<i>Hasarius adansoni</i> (Audouin)	Kona
<i>Sandalodes cruciatus</i> Simon	Kona
<i>Sandalodes navatus</i> Simon	Kona
<i>Sandalodes pubens</i> Simon	Kona

Thomisiidae

<i>Misumena anguliventris</i> Simon	Kona
<i>Misumena nesiotes</i> Simon	Kona
<i>Adrastidia stigmatica</i> Simon	Kona
<i>Diaea insulana</i> Keyserling, and varieties	Kona
<i>Pagiopalpus atomarius</i> Simon	Kona
<i>Synaema dimidiatipes</i> Simon	Kona
<i>Synaema impotens</i> Simon	Kona
<i>Synaema baevigerum</i> Simon	Kona

Lycosidae

<i>Lycosa hawaiiensis</i> Simon	Kona
<i>Syroloma major</i> Simon	Kona

Argiopidae

<i>Microneta insulana</i> Simon	Kona
<i>Cnephalocotes simpliciceps</i> Simon	Kona
<i>Tetragnatha restricta</i> Simon	Kona
<i>Tetragnatha sobrina</i> Simon	Kona
<i>Tetragnatha uncifera</i> Simon	Kona

HEXAPODA (Insects)

COLLEMBOLA (Springtails)

Entomobryidae

<i>Entomobrya insularis</i> Carpenter	Kona, 2000'
<i>Lepidocyrtus heterophthalmus</i> Carpenter	Kona, 2000'
<i>Salina maculata</i> Folsom	Kona, on coffee leaves

ORTHOPTERA

Blattidae (Cockroaches)

<i>Allacta similis</i> (Saussure)	Kona: Kealakekua
<i>Eoblatta notulata</i> (Stal)	Kona
<i>Euthyrrhapha pacifica</i> (Coquebert)	Kona: Holualoa
<i>Neostylopyga rhombifolia</i> (Stoll)	Kona: Honaunau
<i>Periplaneta americana</i> (L.)	Kona, abundant and widely distributed
<i>Periplaneta australasiae</i> (F.)	Kona, abundant and widely distributed
<i>Pycnoscelus surinamensis</i> (L.)	Kona: Kailua

Tettigoniidae (Long-horned grasshoppers)

<i>Banza nitida</i> (Brunner)	Kona: Kealakekua
<i>Conocephalus saltator</i> (Saussure)	Kona, in coffee fields
<i>Elimaea punctifera</i> (Walker)	Kona, on coffee
<i>Xiphidiopsis lita</i> Hebard	Kona

Gryllidae (Crickets)

<i>Gryllus oceanicus</i> Le Guillou	Kona
<i>Paratrigonidium gracile</i> Perkins	Kona: Kealakekua, beneath bark of tree:

<i>Paratrigonidium grande</i> Perkins	South Kona
<i>Paratrigonidium pacificum</i> Scudder	South Kona
<i>Paratrigonidium varians</i> Perkins	Kona: Kealahakua
<i>Metioche vittaticollis</i> Stal	Kona: Honaunau, in grass and low vegetation, first seen in 1951

Acrididae (Short-horned grasshoppers)

<i>Atractomorpha ambigua</i> Bolivar	Kona: Holualoa, first seen in 1945
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EMBIIDINA

<i>Oligotoma saundersi</i> (Westwood)	Kona: Milolii, near Honaunau
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CORRODENTIA (Psocids)

<i>Elipsocus criniger</i> Perkins	Kona, on <u>Suttonia</u> and <u>Sophora</u>
<i>Elipsocus erythrostickta</i> Perkins	Kona
<i>Elipsocus micranaurus</i> Perkins	Kona, 4000', on <u>Metrosideros</u> and <u>Gouldia</u>
<i>Elipsocus psylloides</i> Perkins	Kona
<i>Palistreptus inconstans</i> (Perkins)	Kona
<i>Psocus konae</i> Perkins	Kona
<i>Psocus immaturus</i> Perkins	Kona

THYSANOPTERA (Thrips)

<i>Hoplothrips barbatus</i> (Bagnall)	Kona, beneath decaying log in mountains
<i>Hoplothrips laticornis</i> (Bagnall)	Kona, 3000'
<i>Hoplothrips gowdeyi</i> (Franklin)	Kona. The black flower thrips has a long host plant list. First recorded in the territory in 1892.

HOMOPTERA

Cicadellidae (Leafhoppers)

<i>Acopsis minerva</i> (Ball)	Kona: Kailua
<i>Balclutha hospes</i> Kirkaldy	Kona, in coarse grass
<i>Balclutha plutonis</i> Kirkaldy	Kona
<i>Balclutha volcanicola</i> (Kirkaldy)	Kona: Honaunau; Kealakekua
<i>Nesophrosyne craterigena</i> Kirkaldy	Kona
<i>Nesophrosyne eburneola</i> Osborn	South Kona, 1400'
<i>Nesophrosyne giffardi</i> var. <i>interrupta</i> Osborn	Kona, on <i>Myoporum</i> in the mountains
<i>Nesophrosyne insularis</i> Kirkaldy	South Kona
<i>Nesophrosyne mabae</i> Osborn	South Kona road, on <u><i>Maba sandwicensis</i></u>
<i>Nesophrosyne montium</i> Kirkaldy	North Kona
<i>Nesophrosyne oceanides</i> Kirkaldy	South Kona Road, 1600', on <u><i>Straussia hawaiiensis</i></u>
<i>Nesophrosyne sylvigena</i> Osborn	South Kona, on <u><i>Wikstroemia</i></u>
<i>Nesophrosyne silvicola</i> Kirkaldy	Kona
<i>Nesophrosyne pluvialis</i> Kirkaldy	Kona

Membracidae (Tree hoppers)

<i>Stictocephala festina</i> (Say)	Kona: Alae; Holualoa. The alfalfa hopper
<i>Vanduzeeia segmentata</i> (Fowler)	Kona, on <u><i>Cassia</i></u> sp.

Cixiidae

<i>Iolania perkinsi</i> Kirkaldy	South Kona
<i>Oliarus filicicola</i> Kirkaldy	Kona
<i>Oliarus hevaheva</i> Kirkaldy	South Kona; Hookena

Oliarus koanoa Kirkaldy	Kona, ex <u>Maba sandwicensis</u> ; tree fern
Oliarus niger Giffard	South Kona, 1500-2000'
Oliarus pele Kirkaldy	Kona, in mountains
Oliarus tarai Kirkaldy and varieties	South Kona
 Delphacidae	
Aloha myoporicola Kirkaldy	Kona, on <u>Pelea volcanica</u> ; S. Kona on <u>Myoporum</u> ; Huehue, on <u>Myoporum</u>
Aloha swezeyi Muir	Kona: on <u>Anona cherimolia</u> ; weeds; <u>Bidens</u>
Kelisia paludum Kirkaldy	Kona: Honaunau
Leialoha hawaiiensis Kirkaldy	South Kona, on ohia
Leialoha ohiae (Kirkaldy)	Kona, on <u>Metrosideros</u>
Nesosydne blackburni Muir	South Kona
Nesosydne ipomoeicola (Kirkaldy)	Kona, on <u>Lythrum maritimum</u>
Nesothoë frigidula (Kirkaldy)	Kona
Nesothoë maculata (Muir)	Kona: Hockena, on <u>Maba sandwicensis</u> ; Government road, Kahuku to Kona, on <u>Metrosideros</u> .
Peregrinus maidis Ashmead	Kona: Honaunau, on corn. The widespread corn leafhopper; probably reached the islands about 1880.
 Flatidae (Torpedo bug)	
Siphanta acuta (Walker)	Kona: Holualoa, on wide range of host plants, and often injurious to coffee. Here about 1898.
 Psyllidae (Jumping plant lice)	
Trioza ohicola Crawford	South Kona, forming galls on Ohia lehua.

Aphididae (Plant lice)

<i>Aphis gossypii</i> Glover (cotton aphis)	Kona, in cotton fields.
<i>Amphorophora sonchi</i> (Oestlund)	Kona: Holualoa, on <u><i>Sonchus oleraceus</i></u> leaves
<i>Brevicoryne brassicae</i> (L.) (cabbage aphis)	Kona, on cabbages.
<i>Mycromyzus formosanus</i> (Takahashi) (onion aphid)	Kona, on onions; first seen prior to 1939.
<i>Toxoptera aurantii</i> (Boyer de Fons.) (black citrus aphis)	Kona: Keokea mauka, at forest edge, on young ohia leaves. Widespread, long known in the Hawaiian Islands.

Coccidae (Scales, mealybugs)

<i>Coccus viridis</i> (Green) (green scale)	Kona, producing coffee blight; wide range of host plants. Here since 1905.
<i>Odonaspis ruthae</i> Kotinsky	Kona, on manienie grass (<u><i>Cynodon dactylon</i></u>)
<i>Orthezia insignis</i> Brown	Kona, on Lantana
<i>Howardia biclavis</i> (Comstock)	Kona
<i>Pseudococcus brevipes</i> (Cockerell) (pineapple mealybug)	Kona, damaging coffee. Wide range of host plants.
<i>Pseudococcus vastator</i> (Maskell)	Kona, bad on terminal buds of orange. Probably introduced from Japan; here in islands before 1891.
<i>Pseudococcus nipae</i> (Maskell)	Kona, on guava leaves; in islands since 1902.
<i>Pulvinaria psidii</i> Maskell	Kona, especially bad on coffee plants.

HETEROPTERA (True bugs)

Cydnidae

<i>Geotomus pygmaeus</i> (Dallas) (negro bug)	Kona. Originally from India, in the islands a long time.
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Scutelleridae (Shield-back bugs)

Coleotichus blackburniae White
(koa bug)

Kona, usually on koa. A beautiful red and green bug, our largest native species.

Pentatomidae (Stink bugs)

Oechalia acuta Usinger

South Kona

Oechalia grisea (Burmeister)

Kona, widespread

Coreidae

Liorhyssus hualinus (Fabricius)
(grass bug)

Kona, on *Sonchus* and other weeds. Probably an early immigrant, first recorded in 1910.

Lygaeidae (Plant bugs)

Metrarga nuda White

Kona, under dead bark and in cavities of dead branches of Pipturus, Metrosideros, Cibotium

Neseis fasciatus fasciatus Usinger

Kona, in mountains on Straussia, Myrsine

Neseis nitidus comitans (Perkins)

Kona, near Kona-Kau line, on *Pipturus albidus*

Neseis nitidus pipturi Usinger

Kona; Kealakekua, 3500'; South Kona, on Pipturus

Neseis saundersianus (Kirkaldy)

Kona, on Urera; Sapindus

Neseis mauiensis Blackburn

Kona

Nysius communis Usinger

Kona: Huehue, 1800'

Nysius terrestris Usinger

Kona: Honaunau, usually on pigweed; many other host plants.

Nysius nemorivagus White

Kona, on Chinese cabbage and Solanum nodiflorum roots

Nesomartis psammophila Kirkaldy

Kona, on Sophora; Eragrostis; Sida

Oceanides bryani Usinger

South Kona, on Euphorbia, Straussia

Oceanides nubicola (Kirkaldy)	Kona, on <u>Mycoporum sandwicensis</u>
Orthaea nigriceps (Dallas)	Kona, occasionally on truck crops
Reduviidae (Assasin bugs)	
Empicoris rubromaculatus Blackburn (Thread bug)	Kona
Empicoris whitei (Blackburn)	Kona
Zelus renardii (Kolenati) (Leafhopper assasin bug)	Kona; Hcnaunau. A common, widespread, predaceous insect.
Nabidae (Damsel bugs)	
Nabis blackburni (White)	Kona; the commonest and most widespread of our native nabids
Nabis capsiformis Germar	Kona: Napoopoo, on various truck and garden crops; common and widespread.
Nabis giffardi Van Duzee	South Kona road
Nabis kahavalu (Kirkaldy)	Kona
Nabis lusciosus (White)	Kona, in grass and low herbage
Nabis tarai White	Kona, on <u>Styphelia</u> . Widespread in islands.
Anthocoridae (Flower bugs)	
Lasiochilus denigrata White	Kona, in dead tree-fern stem
Miridae (Leaf bugs)	
Cyrtopeltis modesta Distant	Kona, ex tomato
Hyalopeplus pellucidus (Stal)	Kona
Kalania hawaiiensis (Kirkaldy)	Kona, 3000'
Kamehameha lunalilo Kirkaldy	Kona

<i>Koanoa hawaiiensis</i> Kirkaldy	Kona
<i>Nesiomiris hawaiiensis</i> Kirkaldy	Kona, on <i>Byronia</i> , <i>Cheirodendron</i> , <i>Reynoldsia</i>
<i>Orthotylus daphne</i> Kirkaldy	Kona
<i>Psallus sharpianus</i> Kirkaldy	Kona, on <i>Euphorbia</i>
<i>Pseudoclerada morai</i> Kirkaldy	Kona
<i>Sulamita lunalilo</i> Kirkaldy	Kona; Kealahakua, on <i>Freycinetia arborea</i>
<i>Oronomiris hawaiiensis</i> Kirkaldy	Kona, usually in grasses

Saldidae (Shore bugs)

<i>Saldula oahuensis</i> (Blackburn)	Kona, among wet leaves on ground
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Gerridae (Water striders)

<i>Halobates sericeus</i> Eschscholtz	Kona, waters off Honaunau shore
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Notonectidae (Back swimmers)

<i>Buenoa pallipes</i> (F.)	Kona, abundant in lowlands; predaceous
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ODONATA

ANISOPTERA (Dragonflies)

Aeshnidae

<i>Anax junius</i> (Drury) (common green darner)	Kona: Honaunau; a widespread, strong flier. Probably in islands for several hundred years as a natural immigrant.
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<i>Anax strenuus</i> Hagen (giant Hawaiian dragonfly)	Kona, mostly in mountains but occasionally seen in lowlands. Our largest native insect, it was first captured by the Danish "Galathea" Expedition.
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ZYGOPTERA (Damsel flies)

Coenagriidae

<i>Megalagrion calliphya</i> (McLachlan)	Kona, in mountains, about 3000'
<i>Megalagrion calliphya microdemas</i> (Perkins)	Kona, in mountains
<i>Megalagrion nigrohamatum nigrolineatum</i> (Perkins)	Kona: Honaunau
<i>Megalagrion xanthomelas</i> (Selys-Longch.)	Kona, 3000'

NEUROPTERA (Lacewing flies)

Myrmeleonidae (Antlions)

<i>Formicaleo wilsoni</i> (McLachlan)	Kona
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Chrysopidae (Green lacewings)

<i>Anomalochrysa debilis</i> Perkins	Kona
<i>Anomalochrysa deceptor</i> Perkins	Kona, in mountains, 4000'
<i>Anomalochrysa frater</i> Perkins	South Kona
<i>Anomalochrysa peles</i> Perkins	Kona
<i>Anomalochrysa princeps</i> Perkins	Kona, 1800-3000'
<i>Anomalochrysa proteus</i> Perkins	Kona, 3000-4000'
<i>Anomalochrysa raphidioides</i> Perkins	Kona, in mountains, 4000'
<i>Anomalochrysa reticulata</i> Perkins	Kona
<i>Chrysopa microphya</i> McLachlan	Kona, in coffee fields; common all over in gardens

Hemerobiidae (Brown lacewings)

<i>Nesomicromus latipennis</i> Perkins	Kona
<i>Nesomicromus minimus</i> Perkins	Kona, in mountains, 4000'

Nesomicromus vagus Perkins

South Kona

COLEOPTERA (Beetles)

Carabidae (Ground beetles)

Colpocaccus hawaiiensis Sharp

Kona

Mecyclothorax gracilis (Sharp)

Kona, in mountains, 4000'

Mecyclothorax variipes (Sharp)

Kona, 3000'

Mecyclothorax proximus Britton

Kona, in mountains, 4000'

Mecyclothorax vulcanicus (Blackburn)

Kona, in mountains, 4000'

Metromenus extimus Sharp

Kona

Hydrophilidae (Waterbeetles)

Dactylosternum abdominale (F.)

Kona

Staphylinidae (Rove beetles)

Atheta coriaria Kr.

Kona, 2500'

Liophaena gracilipes Sharp

Kona

Oligota glabra Sharp

Kona

Oligota mutanda Sharp

Kona

Philonthus discoideus Grav.

Kona, predatory on papaya parasites

Thorachophorus blackburni (Sharp)

Kona

Thyreocephalus albertisi (Fauvel)

Kona, liberated April, 1950.

Cleridae

Necrobia ruficollis F.

South Kona

Necrobia rufipes DeGeer (Copra bug)

Kona

Oedemeridae

Sessinia livida F.

Kona: Honaunau, breeding in old wood

Cucujidae

*Parandrita kona*e Sharp

Kona

Elateridae (Click beetles)

Eopenthes cognatus Sharp

Kona

*Eopenthes kona*e Blackburn

Kona

Melanoxanthus melanocephalus Thunb.

Kona: Kealakekua

Simodactylus cinnamomeus Boisduval

Kona

Melasiidae

Ceratotaxia tristis Sharp

Kona

Dromaeolus arduus Sharp

Kona

Dromaeolus compressus Sharp

Kona

Dromaeolus coneus Sharp

Kona

Dromaeolus grandicornis Sharp

Kona

Dromaeolus konensis Sharp

Kona

Dromaeolus perkinsi Sharp

Kona

Dromaeolus solitarius Sharp

Kona

Dermestidae (Carpet beetles)

Labrocercus gravidus Sharp

Kona

Labrocercus simplex Sharp

Kona

Labrocercus vestitus Sharp

Kona

Histeridae

<i>Acritus fadilis hawaiiensis</i> Scott	Kona
<i>Acritus minor</i> Scott	Kona
<i>Saprinus lugens</i> Erichson	Kona, in mountains, 4000'

Colydiidae

<i>Antilissus aper</i> Sharp	Kona, 3000'
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Monotomidae

<i>Hesperobaenus capito</i> Perkins	Kona
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Ciidae

<i>Cis binaculata</i> Sharp	Kona
<i>Cis cognatissimus</i> Perkins	Kona, 3000'
<i>Cis gravipennis</i> Perkins	Kona, in mountains, 4000'
<i>Cis nudipennis</i> Perkins	Kona
<i>Cis roridus</i> Sharp	Kona, mountains to 5000'
<i>Cis setarius</i> Sharp	Kona, in mountains from 4000'-5000'
<i>Cis signatus</i> Sharp	Kona, on ohia, 2500'-4000'
<i>Cis subaeneus</i> Perkins	Kona, in mountains, 4000'

Nitidulidae (Souring beetles)

<i>Carpophilus humeralis</i> (F.) (yellow-shouldered souring beetle)	Kona: Kailua; widely distributed, common and often extremely abundant
<i>Carpophilus dimidiatus</i> (F.)	Kona: Holualoa
<i>Carpophilus maculatus</i> Murray	Kona: Napoopoo
<i>Haptoncus tetragonus</i> Murray	Kona

<i>Nesopeplus bidens</i> Sharp	Kona
<i>Nesopeplus inauratus</i> Sharp	Kona, in high mountains, around 5000'
<i>Nesopeplus nigricans</i> Sharp	Kona
<i>Nesopetinus apertus</i> (Sharp)	Kona
<i>Nesopetinus celatus</i> (Sharp)	Kona, high mountains
<i>Nesopetinus metallescens</i> (Sharp)	Kona, from 2000'
<i>Nesopetinus quadraticollis</i> (Blackburn)	Kona, mountains, 4000'
<i>Nesopetinus rudis</i> (Sharp)	Kona
<i>Nesopetinus scottianus</i> Sharp	Kona
<i>Nesopetinus varius</i> (Sharp)	Kona
<i>Eupetinus hawaiiensis</i> Sharp	Kona
<i>Orthostoelus guttatus</i> (Sharp)	Kona
<i>Orthostoelus sordidus</i> (Sharp)	Kona

Mycetophagidae

<i>Litargus balteatus</i> LeConte	Kona
<i>Litargus vestitus</i> Sharp	Kona: Holualoa
<i>Propalticus oculatus</i> Sharp	Kona

Anobiidae

<i>Holcobius affinis</i> Perkins	Kona
<i>Holcobius hawaiiensis</i> Perkins	Kona, in tree-fern stem
<i>Mirosternus amaurodes</i> Perkins	Kona
<i>Mirosternus simplex</i> Perkins	Kona
<i>Mirosternus tristis</i> Perkins	Kona

<i>Xyletobius hawaiiensis</i> Perkins	Kona
<i>Xyletobius oculatus</i> Sharp	Kona
<i>Xyletobius timberlakei</i> Perkins	Kona: Kealakekua, on <u>Clermontia</u> and <u>Byronia</u>
Bostrichidae (Powderpost beetles)	
<i>Xylopsocus castanoptera</i> (Fairmaire)	Kona: Kealakekua
Lathridiidae	
<i>Lathridius nodifer</i> Westwood	Kona
Coccinellidae (Lady beetles)	
<i>Coelophora inaequalis</i> (Fabr.)	Kona, in coffee fields
<i>Cryptolaemus montrouzieri</i> Mulsant	South Kona
<i>Curinus coeruleus</i> Mulsant	Kona: Holualoa; Kealakekua
<i>Hyperaspis jocosa</i> (Mulsant)	South Kona: Honaunau
<i>Lindorus ventralis</i> (Erichson)	Kona, in coffee fields
<i>Olla abdominalis</i> (Say)	Kona
<i>Orcus chalybeus</i> (Boisduval)	Kona
<i>Platyomus lividigaster</i> Mulsant	Kona
<i>Ptiliodes insignis</i> Scott	Kona
<i>Rodolia cardinalis</i> (Mulsant)	Kona: Holualoa
<i>Scymnus ocellatus</i> Sharp	Kona: Honaunau
<i>Scymnus uncinatus</i> Sic.	Kona: Holualoa, probably on <u>Pseudococcus</u> sp.
<i>Scymnus vividus</i> Sharp	Kona

Orthoperidae (Corylophidae)

Orthoperus aequalis Sharp Kona

Serocoderes pubipennis Sharp Kona

Ptilidae

Ptiliodes insignis Scott Kona, in mountains, 4000'

Malacodermidae

Carphuroides pectinatus (Sharp) Kona, in forest

Tenebrionidae (Darkling beetles)

Alphitobius laevigatus (F.) Kona: Kailua

Blapstinus dilatatus LeC. Kona

Gonocephalus seriatum Boisduval Kona, generally distributed in soil,
under stones and trash

Lobometopon diremptus Karsch Kona: Kailua, but generally distributed

Tribolium ferrugineum F. (Flour beetle) Kona, destructive to stored products;
widely distributed, cosmopolitan.

Cistelidae

*Cistela kona*e Perkins Kona

Cerambycidae (Long-horned beetles)

Aegosoma reflexum Karsch Kona, usually in forest, but
occasionally damaging coffee
plants and sugarcane. Largest
beetle found in the Hawaiian
Islands.

Ceresium simplex (Gyll.) Kona: Honaunau, in dead branches

<i>Cylene crinicornis</i> Chevrolat (algaroba beetle)	Kona: Kealakekua
<i>Lagocheirus obsoletus</i> Thoms.	Kona: Kealakekua
<i>Parandra puncticeps</i> Sharp	Kona
<i>Plagithmysus bilineatus</i> Sharp	Kona, on lehua
<i>Plagithmysus blackburni</i> Sharp	Kona
<i>Plagithmysus davisii</i> Swezey	Kona, in mountains
<i>Plagithmysus elegans</i> Sharp	Kona
<i>Plagithmysus frater</i> Perkins	Kona, 3000' on <u>Pelea</u>
<i>Plagithmysus immundus</i> Sharp	Kona
<i>Plagithmysus simplicicollis</i> Sharp	Kona
<i>Plagithmysus vicinus</i> Sharp	Kona, 3000'
<i>Prosopius bankii</i> (F.)	Kona: Napoopoo; Kealakekua
<i>Sybra alternans</i> Wied.	Kona: Kailua
Chrysomelidae (Leaf beetles)	
<i>Epitrix parvula</i> F. (Tobacco flea beetle)	Kona: Holualoa, on solanaceous plants
<i>Lema trilineata californica</i> Schaeffer	Kona: Honaunau on eggplant, potato, and other solanums.
<i>Octotoma scabripennis</i> Guer. (Lantana leaf miner)	Kona: Hookena, released May 1954.
Bruchidae (Bean weevils)	
<i>Bruchus prosopis</i> LeC.	Kona: Honaunau; Kailua
<i>Bruchus pruininus</i> Horn	Kona: Napoopoo; widely distributed in islands; infesting legume seeds.

Bruchus sallei Sharp

Kona: Kailua, Kawaihae to Napoopoo
in green and ripe kiawe pods

Caryoborus gonagra F.

Kona: Napoopoo. Originally from
India, first observed in islands
about 1908.

Megacerus alternatus Bridwell

Kona: Keauhou on *Ipomoea pes caprae*;
Kailua

Curculionidae (Weevils)

Acalles tuberculatus Perkins

Kona, in mountains

Anthonomus eugenii Cano (Pepper
weevil)

Kona: Holualoa, on peppers and
other solanums

Cylas formicarius elegantulus
(Summers) (Sweetpotato weevil)

Kona: Napoopoo; Kailua; serious pest
of sweet potatoes and other
plants of the morning-glory
family.

Diccalandra taitensis (Guerin)

Kona: Honuapo; Kailua

Dryophthorus declivis Sharp

Kona

Dryophthorus distinguendus Perkins

Kona

Dryophthorus gravidus Sharp

Kona

Dryophthorus homoeorhynchus
Perkins

Kona

Dryophthorus modestus Sharp

Kona

Dryophthorus species

Kona: Honaunau

Oodemas konanum Perkins

Kona

Oodemas mauiense Blackburn

Kona

Oodemas multiforme Perkins

South Kona, ex Cheirodendron

Oodemas solidum Perkins

Kona

Oodemas viridipenne Perkins

Kona, in mountains, 3000'-4000'

Pantomorus godmani Crotch (Fuller
rose beetle)

Kona, on Citrus. Widely distributed;
native of Mexico usually feeding
on rose, and a variety of plants.

<i>Phloeophagosoma tenuis</i> (Gemm.)	Kona
<i>Rhyncogonus giffardi</i> Sharp	Kona
Scolytidae (Bark beetles)	
<i>Hypothenemus eruditus</i> Westwood	Kona: Napoopoo
<i>Poecilips persicae</i> (Hopkins)	Kona: Keopu, ex avocado
<i>Xyleborus hawaiiensis</i> Perkins	South Kona, ex <u>Cheirodendron</u>
<i>Xyleborus immaturus</i> Blackburn	Kona
<i>Xyleborus confusus</i> Eichhorn	Kona: Kaawaloa
<i>Xyleborus lanaiensis</i> Perkins	South Kona
<i>Xyleborus tantalus</i> Schedl	South Kona, ex <i>Byronia</i>
<i>Xyleborus truncatus</i> Perkins	Kona; on most of the Hawaiian islands attacking wide variety of host plants
Anthribidae	
<i>Araecerus constans</i> Perkins	Kona, on coast
<i>Araecerus fasciculatus</i> (DeGeer)	Kona
<i>Araecerus varians</i> Jordan	South Kona, on <i>Clermontia</i>
Proterhinidae	
<i>Proterhinus affinis</i> Perkins	Kona
<i>Proterhinus ater</i> Perkins	Kona
<i>Proterhinus deceptor</i> Perkins	Kona
<i>Proterhinus deceptor konanus</i> Perkins	Kona, 3000'
<i>Proterhinus desquamatus</i> Perkins	Kona, 2000'
<i>Proterhinus hawaiiensis</i> Perkins	Kona
<i>Proterhinus hypotretus</i> Perkins	Kona, 3000'

<i>Proterhinus similis</i> Blackburn	Kona, in mountains, 4000'
<i>Proterhinus tarsalis</i> Blackburn and varieties	Kona
<i>Proterhinus vulcanus</i> Perkins	Kona, in mountains, 2000'

Scarabaeidae (Dung beetles)

<i>Adoretus sinicus</i> Burmeister (Chinese rose beetle)	Kona, common everywhere; here in islands before 1896
<i>Aphodius lividus</i> Oliv.	Kona: Honaunau; Kealakekua, breeding in manure.

LEPIDOPTERA

Heterocera (Butterflies)

Nymphalidae

<i>Danaida archippus</i> F. (Monarch)	Kona, common everywhere
<i>Vanessa atalanta</i> (L.) (Red Admiral)	Kona, abundant in the 1890's, feeding on <i>Pipturus albidus</i> .
<i>Vanessa cardui</i> L. (Painted lady)	Kona, common in uplands, feeding on <i>Pipturus</i> , occasionally on <i>Piper</i> .
<i>Vanessa virginiensis</i> Dryry (Painted beauty)	Kona, common on weeds

Lycaenidae (Blues)

<i>Lampydes boetica</i> (Linnaeus) (Bean Butterfly)	Kona, common on growing beans
<i>Lycaena blackburni</i> (Tuelly) (Native green)	Kona, uplands, on <i>Pipturus</i> ; <i>Dodonaea</i>
<i>Callicista thius</i> (Hübner)	Kona, around lantana blossoms

Pieridae

<i>Pontia rapae</i> (Linnaeus) (Cabbage butterfly)	Kona, abundant in cabbage and allies
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Heterocera (Moths)

Gelechiidae

<i>Thyrocopa fraudulentella</i> Walsingham	Kona
<i>Gnorimoschema operculella</i> (Zeller)	Kona: Kawaihae, in potato, tomato, etc. Especially injurious to tobacco
<i>Stoerberhinus testaceus</i> Butler	Kona: Kaawaloa
<i>Pectinophora gossypiella</i> (Saunders) (Pink bollworm of cotton)	Kona, in coffee field; in islands many years

Cosmopterygidae

<i>Pyroderces rileyi</i> Walsingham	Kona, in coffee fields
<i>Batrachedra rileyi</i> Walsingham	Kona: Kaawaloa

Hyponomeutidae

<i>Prays fulvocanellus</i> Walsingham	Kona: Kaawaloa, about 2000'
<i>Hyposmocoma domicolens</i> (Butler)	Kona: Kaawaloa, 1500'
<i>Hyposmocoma longitudinalis</i> Walsingham	Kona: Kaawaloa about 2000'
<i>Hyposmocoma lupella candidella</i> Walsingham	Kona
<i>Hyposmocoma vermiculata</i> Walsingham	Kona: Kaawaloa, about 2000'
<i>Neelysia cleodorella</i> Walsingham	Kona

Tineidae

<i>Opogona aurisquamosa</i> (Butler)	Kona: Kaawaloa
<i>Opogona purpuriella</i> Swezey	Kona
<i>Tinea fuscipunctella</i> Haworth	Kona: Kaawaloa, 1500'
<i>Setomorpha rutella</i> Zeller	Kona: Kaawaloa, 1500'
<i>Ereunetis simulans</i> (Butler)	Kona, in coffee fields
<i>Ereunetis minuscula</i> Walsingham	Kona: Kaawaloa, 1500'
<i>Philodoria basalis</i> Walsingham	South Kona, on ohia

Carposinidae

<i>Heterocrossa dispar</i> Walsingham	Kona: Kaawaloa, 1500-2000'
<i>Heterocrossa solutella</i> Walsingham	Kona: Kaawaloa, 2000'

Tortricidae

<i>Adenoneura montana</i> Walsingham	Kona
<i>Cryptophlebia fulva</i> Walsingham	Kona: Kaawaloa, 1500'
<i>Amorbia emigratella</i> Busck	Kona, on Macademia nut and various other leaves.
<i>Tortrix chlorocalla</i> Walsingham	Kona: Kaawaloa, 1500'
<i>Crociosema plebeiana</i> Zeller	Kona: Kaawaloa, 1500'

Galleriidae

<i>Meliphora grisella</i> Fabricius	Kona, feeding on combs in beehives
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Phycitidae

<i>Homoeosoma humeralis</i> (Butler)	Kona, from 1500' to 4000'
<i>Cryptobalbes aliena</i> Swezey	Kona

<i>Hypenodes altivolens</i> (Butler)	Kona, from 1500' to 4000'
<i>Hypocala velans</i> Walker	Kona
<i>Nesamiptis obsoleta</i> (Butler)	Kona, from 1500' to 4000'
<i>Phytometra chalcites</i> (Esp.)	Kona, from 1400' to 3000'
Oecophoridae	
<i>Ethmia colonella</i> Walsingham (Kou moth)	Kona coast between Kailua and Keauhou, defoliating kou.
Pterophoridae	
<i>Platyptilia pusillidactyla</i> (Walker)	Kona, around Lantana flowers. Introduced from Mexico in 1902.
Pyraustidae	
<i>Scoparia siderina</i> Meyrick	Kona: Honaunau
<i>Scoparia loxocentra</i> Meyrick	Kona: around 2000'
<i>Scoparia ombrodes</i> (Meyrick)	Kona, from 1500' to 4000'
<i>Scoparia rhombias</i> Meyrick	Kona
<i>Lineodes ochrea</i> Walsingham	Kona
<i>Lineodes subextincta</i> Walsingham	Kona
<i>Hyperectis dioctias</i> Meyrick	Kona
Geometridae	
<i>Eucymatoge monticolans</i> (Butler)	Kona: Honaunau
<i>Eucymatoge staurophragma</i> Meyrick	Kona, above 2000'

Selidosemidae

Scotorythra pachyspyla Meyrick South Kona

Scotorythra brachytarsa Meyrick South Kona

Agonoxenidae

Agonoxena argaula Meyrick Kona, between Kailua and Keauhou,
on coconut leaves

Geometridae

Anacamptodes fragilaria (Grossb.) Kona, lowlands; Kawaihae, on kiawe

Sphingidae (Sphinx moths)

Herse cingulata (Fabricius) Kona, on Ipomoea

Celerio lineata (Fabricius) Kona

Plutellidae

Plutella maculipennis Curt. Kona, on cabbage, from 1500' to 4000'

Noctuidae

Erebus odora (Linnaeus) (Black
witch) Kona: Honaunau, larvae in Cassia
nodosa

Heliothis armigera (Hubner) (Corn
earworm) Kona, on tomato, and other crops

Feltia dislocata (Walker) Kona, from 1500' to 4000'

Agrotis ypsilon Rott. (Cutworm) Kona, well-known garden cutworm,
widespread and troublesome.

Polydesma umbricola Boisduval
(Monkeypod moth) Kona, on monkeypod

Laphygma exempta (Walker) (Nutgrass
armyworm) Kona, widespread

Caradrina examinis Meyrick Kona, 1500', probably on Panicum
stems

Plusiadae

<i>Adrapsa manifestalis</i> (Walker)	South Kona
<i>Hypenodes altivolens</i> (Butler)	Kona
<i>Nesamiptis obsoleta</i> (Butler)	Kona
<i>Plusia biloba</i> Steph.	Kona

DIPTERA (Flies)

Tipulidae (Craneflies)

<i>Erioptera</i> (<i>Trimicra</i>) <i>lateralis</i> (Grimshaw)	Kona: Honaunau
<i>Erioptera</i> (<i>Trimicra</i>) <i>pilipes</i> Fabricius	Kona: Honaunau; Kaawaloa, 1500'
<i>Limonia</i> (<i>Dicranomyia</i>) <i>hawaiiensis</i> (Grimsh.)	Kona: Honaunau; Kealakekua
<i>Limonia</i> (<i>Limonia</i>) <i>perkinsi</i> (Grimshaw)	Kona: Kealakekua
<i>Styringomyia</i> <i>didyma</i> Grimshaw	Kona: Kapua

Psychodidae

<i>Psychoda alternata</i> Say	Kona, about 2000'
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Culicidae (Mosquitoes)

<i>Aedes aegypti</i> (Linnaeus)	Kona: Kealakekua
<i>Aedes albopictus</i> Skuse	Kona: Kiilae Bay

Heleidae (Ceratopogonidae)

<i>Dasyhelea calvescens</i> Macfie	Kona: Kiilae Bay; Honaunau on rocks
<i>Ceratopogon</i> sp.	Kona

Sciaridae

Sciara molokaiensis (Grimshaw) Kona: Honaunau

Fungivoridae

Platyura hawaiiensis Grimshaw South Kona

Stratiomyidae

Neocexaireta spinigera (Wiedemann) Kona, on Papaya

Dolichopodidae

Chrysosoma fraternum Van Duzee Kona

Cymatopus acrosticalis Parent Kona: Kailua, on rocks

Dolichopus exsul Aldrich South Kona

Medeterus [ciliifemorata?] South Kona

Sciapus pachygyna Macquart Kona: Napoopoo

Phoridae

Aphiochaeta xanthina (*Megaselia*
scalaris Loew) Kona, around 2000'

Dorilaeidae

Dorilas (*Dorilas*) *nigrotarsitus*
Grimsh. Kona, uplands

Dorilas obscuratus Hardy Kona: Kealakekua, on *Clermontia*

Syrphidae

Allograpta obliqua (Say) Kona, common

Volucella pusilla Macquart Kona: Kailua

Volucella (*Ornidia*) *obesa*
(Fabricius) Kona: Kiilae Bay

<i>Tubifera arvorum</i> (Fabricius)	Kona: Napoopoo
<i>Ischiodon scutellaris</i> (Fabricius)	Kona, lowlands
Lauzaniidae (Sapromyzidae)	
<i>Homoneura unguiculata</i> (Kertész)	Kona: Honaunau
Canacidae	
<i>Canaceoides nudata</i> (Cresson)	Kona: Kiilae Bay
Sphaeroceridae	
<i>Limosina</i> (<i>Opacifrons</i>) <i>aequalis</i> Grinshaw	Kona: Pauahi, 8 miles E. of Captain Cook
<i>Limosina punctipennis</i> Wiedemann	Kona
Ephydriidae	
<i>Lytogaster gravis</i> (Loew)	Kona [?]: Pauahi
Piophilidae	
<i>Piophila casei</i> Linnaeus (Cheese skipper)	Kona: Keokea; widespread pest of stored cheeses
Dolichopodidae	
<i>Cymatopus acrosticalis</i> Parent	Kona: Kailua, on rocks
Otitidae	
<i>Euxesta annonae</i> (Fabricius)	Kona: Honaunau
Tephritidae	
<i>Ceratitis capitata</i> (Wiedemann) (Mediterranean fruit fly)	Kona, on Citrus and other fruits

<i>Chaetodacus cucurbitae</i> (Coquillett) (melonfly)	Kona, in cucumber; tomato; and other cucurbits
<i>Dacus</i> (<i>Strumeta</i>) <i>dorsalis</i> Hendel (Oriental fruitfly)	Kona, on wide list of host plants; generally found from Hilo to Kona
<i>Procecidochares utilis</i> Stone	Kona
Drosophilidae (Pomace or vinegar flies)	
<i>Drosophila xanthostoma</i> Grimshaw	Kona
<i>Drosophila inaequalis</i> Grimshaw	Kona
<i>Drosophila perkinsi</i> Grimshaw	South Kona
<i>Drosophila plumosa</i> Grimshaw	Kona, about 2000'
<i>Drosophila sordidapex</i> Grimshaw	South Kona
Asteidae	
<i>Asteia apicalis</i> Grimshaw	South Kona
<i>Asteia hawaiiensis</i> Grimshaw	Kona
Milichiidae	
<i>Milichiella lacteipennis</i> Loew	Kona, uplands
Chloropidae	
<i>Rhodesiella scutellata</i> (Meigen)	Kona
<i>Prohippелates pallidus</i> Loew	Kona: Honaunau
Agromyzidae	
<i>Agromyza pusilla</i> Meigen (Serpentine leaf miner)	Kona, in cabbage leaves and many other plants
<i>Liriomyza minutiseta</i> Frick	Kona, in pole beans
<i>Ophthalmomyia lacteipennis</i> (Loew)	Kona

Larvaevoridae

<i>Archytas cirphis</i> Curran	Kona
<i>Chaetogaedia monticola</i> (Bigot)	South Kona

Sarcophagidae (Flesh flies)

<i>Ravinia lherminieri</i> (Robineau-Desvoidy)	South Kona
<i>Sarcophaga albiceps</i> Meigen	Kona

Calliphoridae

<i>Chrysomya rufifacies</i> Macquart	Kona: Honaunau
<i>Chrysomya megacephala</i> (Fabricius)	Kona, on sap from wound on Papaya
<i>Calliphora vomitoria</i> (Linnaeus)	Kona: Keokea
<i>Eucalliphora lilaea</i> (Walker)	Kona: Keokea
<i>Prostethochaeta lucilioides</i> Grimshaw	South Kona
<i>Phaenicia sericata</i> Meigen	Kona
<i>Prostethochaeta fasciata</i> Grimshaw	South Kona

Muscidae (including Anthomyidae)

<i>Stomoxys calcitrans</i> (Linnaeus) (Stablefly)	Kona, widespread pest of livestock. Here since about 1892.
<i>Musca domestica</i> Linnaeus (common housefly)	Kona; of world-wide distribution, intimately associated with man for ages
<i>Lispocephala dexioides</i> (Grimshaw)	Kona, about 2000'
<i>Lispocephala xenina</i> Malloch	South Kona
<i>Siphona irritans</i> (Linnaeus) (Hornfly)	South Kona; widely distributed, serious enemy of cattle and other animals. Established in Hawaii about 1896.

<i>Fannia canicularis</i> Linnaeus	South Kona
<i>Limnophora arcuata</i> Stein	South Kona

Hippoboscidae

<i>Olfersia acarta</i> Speiser	Kona, off short-eared owl
<i>Ornithoica pusilla</i> (Schiner)	Kona, off <i>Himatione stejnegeri</i> and <i>Vestiaria coccinea</i>

HYMENOPTERA (Bees, wasps, ants)

Braconidae

<i>Aphaereta muscae</i> Ashmead	South Kona
<i>Aspilota kona</i> Ashmead	South Kona
<i>Chelonus blackburni</i> Cameron	South Kona: Honaunau, in coffee fields parasite of lepidopterous larvae
<i>Heterospilus prosopidis</i> Bridwell	Kona: Honaunau
<i>Ecphylopsis nigra</i> Ashmead	Kona
<i>Opius humilis</i> Silvestris	Kona: Mediterranean fruitly parasite
<i>Hormiopterus vagrans</i> Bridwell	South Kona
<i>Ischiogonus palliatus</i> (Cameron)	South Kona, on <i>Pittosporum hosmeri</i>

Ichneumonidae

<i>Amblyteles koebelei</i> (Swezey)	Kona: Keokea
<i>Amblyteles purpuripennis</i> (Cresson)	Kona: Keokea
<i>Atrometrus delicatus</i> Ashmead	Kona, 2000'
<i>Atrometrus flavifrons</i> Ashmead	Kona, 2000'
<i>Coccygominus punicipes</i> (Cresson)	Kona
<i>Echromorpha fuscator</i> (Fabricius)	Kona: Kiilae Bay

<i>Echromorpha maculipennis</i> Holmgren	Kona
<i>Ephialtes hawaiiensis</i> Cameron	Kona, in coffee fields; moth parasite
<i>Enicospilus ashmeadi</i> Perkins	South Kona
<i>Enicospilus capnodes</i> Perkins	Kona
<i>Enicospilus castaneus</i> Ashmead	Kona
<i>Enicospilus nigrolineatus</i> Ashmead	Kona
<i>Enicospilus orbitalis</i> Ashmead	Kona
<i>Hemiteles tenellus</i> (Say)	Kona
<i>Horogenes blackburni</i> (Cameron)	South Kona
<i>Pristomerus hawaiiensis</i> Perkins	South Kona
<i>Zaleptopygus flavo-orbitalis</i> (Cameron)	South Kona; Napoopoo, bred ex Plutella larvae
 <i>Trichogrammatidae</i>	
<i>Uscana semifumipennis</i> Girault	Kona, ex Bruchid eggs
 <i>Aphelinidae</i>	
<i>Aneristus ceroplastae</i> Howard	Kona, parasite of scales
<i>Coccophagus lecanii</i> Fitch	Kona, parasite of <i>Coccus viridis</i>
<i>Coccophagus orientalis</i> Howard	Kona, parasite of <i>Coccus viridis</i>
<i>Prospatella transvena</i> Timberlake	Kona, reared from Hibiscus whitefly
 <i>Encyrtidae</i>	
<i>Adelencyrtus odonaspidis</i> Fullaway	Kona: Honaunau
<i>Anagyrus nigricornis</i> Timberlake	South Kona, on ohia
<i>Anagyrus swezeyi</i> Timberlake	Kona: Honaunau
<i>Calolelaps coeruleus</i> Timberlake	Kona; Kealakekua, on naio

<i>Coelopencyrtus swezeyi</i> Timberlake	Kona: Kealahakua, ex <i>Odynerus nigripennis</i>
<i>Encyrtus barbatus</i> Timberlake	Kona: Napoopoo
<i>Encyrtus infelix</i> (Embleton)	Kona: Napoopoo
<i>Omphale metallicus</i> Ashmead	Kona, lowlands around Kailua
<i>Quaylea whittieri</i> (Girault)	Kona
<i>Sympiesis kona</i> Ashmead	Kona
Eupelmidae	
<i>Anastatus koebelei</i> Ashmead	Kona
<i>Eupelmus chrysopinus</i> Perkins	Kona
<i>Eupelmus flavipes</i> Cameron	Kona
<i>Eupelmus kona</i> Ashmead	Kona
<i>Eupelmus vulgaris</i> Ashmead	Kona
<i>Solindenia picticornis</i> Cameron	Kona
Eulophidae	
<i>Burksia viridimaculata</i> Fullaway	Kona: Honaunau
<i>Tetrastichus hagenowii</i> (Ratzeburg)	Kona
<i>Tetrastichus</i> species	Kona, from puparium of <i>Tephritis</i> speci
<i>Eulophus citripes</i> Ashmead	Kona
<i>Hemiptarsenus hawaiiensis</i> Ashmead	Kona
Pteromalidae	
<i>Mesolelaps cyaneiventris</i> Ashmead	South Kona
Miscogasteridae	
<i>Toxeuma hawaiiensis</i> Ashmead	Kona

Eurytomidae

Eurytoma tephritidis Fullaway South Kona; Holualoa; Kealahou

Chalcidae

Brachymeria polynesiensis (Cameron) Kona: Honaunau

Brachymeria obscurata Walker Kona, in coffee field; Kiilae Bay

Dirhinus giffardii Silvestri Kona: Honaunau

Stomatoceras pertorvum Girault Kona: Honaunau; Keauhou

Proctotrypidae

Proctotrypes hawaiiensis Ashmead Kona

Figitidae

Eucoila impatiens Say Kona: Honaunau

Hexaplasta konensis Ashmead Kona

Hypodiranchis hawaiiensis Ashmead Kona

Evanidae (Ensign fly)

Evania appendigaster Linnaeus Kona
(cockroach parasite)
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Evania sericea Cameron Kona: Honaunau; Kiilae Bay

Bethylidae

Sierola aucta Fullaway Kona

Sierola dichroma Perkins Kona

Sierola konana Fullaway Kona, uplands

Sierola leuconura Cameron Kona

<i>Sierola molokaiensis</i> Ashmead	Kona
<i>Sierola monticola</i> Cameron	Kona
<i>Sierola spicata hawaiiensis</i> Fullaway	Kona
<i>Sierola testaceipes</i> Cameron	Kona
<i>Sclerodermus muiri</i> Bridwell	Kona above Kealakekua in <i>Straussia</i> wood
<i>Sclerodermus perkinsi</i> (Ashmead)	Kona
<i>Sclerodermus sophorae</i> Perkins	Kona, in <i>Sophora</i>

Formicidae

<i>Anoplolepis longipes</i> (Jerdon) (Argentine ant)	Kona airport; lowlands
<i>Monomorium latinode</i> Mayr	Kona, around Kailua region
<i>Paratrechina longicornis</i> Latreille	Kona: Keokea
<i>Pheidole megacephala</i> (Fabricius)	Kona, and all islands, from coast to 3000'
<i>Technomyrmex albipes</i> Smith	South Kona

Vespidae

<i>Eumenes campaniformis</i> (Fabricius)	Kona airport and lowlands
<i>Nesodynerus chelififer</i> Perkins	Kona
<i>Nesodynerus rudolphi</i> (Dalla Torre)	Kona: Honaunau
<i>Odynerus axestes</i> Perkins (native bees)	Kona district
<i>Odynerus chelififer</i> Perkins	Kona
<i>Odynerus cooki</i> Perkins	Kona: Kealakekua, close to monument
<i>Odynerus crypterythrus</i> Perkins	Kona

<i>Odynerus cyanopteryx</i> Perkins	Kona
<i>Odynerus cyphotes</i> Perkins	South Kona
<i>Odynerus dromedarius</i> Blackburn	South Kona
<i>Odynerus erythrognathus</i> Perkins	Kona
<i>Odynerus konanus</i> Perkins	Kona, 600' to 2000'
<i>Odynerus eutretus</i> Perkins	Kona
<i>Odynerus frater</i> Dalla Torre	Kona, about 1500'
<i>Odynerus heterochromus</i> Perkins	Kona: Keokea
<i>Odynerus holomelas</i> Perkins	South Kona
<i>Odynerus melanognathus</i> Perkins	Kona, around 1500'
<i>Odynerus pterocheilodes</i> Perkins	Kona
<i>Odynerus mesospilus</i> Perkins	Kona: Honaunau
<i>Odynerus molokaiensis</i> Perkins	Kona: Napoopoo; Honaunau
<i>Odynerus nigripennis</i> (Holmgren)	Kona: Honaunau; Napoopoo
<i>Odynerus obscure-punctatus</i> Perkins	Kona: Napoopoo; Honaunau
<i>Odynerus peles</i> Perkins	South Kona
<i>Odynerus rubropustulatus</i> Perkins	Kona, in mountains
<i>Odynerus scoriaceus</i> Perkins	Kona, on coast and in mountains
<i>Odynerus sociabilis</i> Perkins	Kona: Keokea
<i>Odynerus vulcanus</i> Blackburn	South Kona
<i>Pachodynerus simplicornis</i> Saussure	Kona
<i>Polistes hebraeus</i> Fabricius (Paper wasps)	Kona: Honaunau
<i>Polistes macaensis</i> Fabricius	Kona, common caterpillar hunter; builds paper nests
<i>Polistes aurifer</i> (Saussure)	Kona, common

Pseudopterocheilus pterocheilloides Perkins Kona

Sphecidae

Hylocrabro tumidoventris Perkins Kona
leucognathus Perkins

Deinomimesa hawaiiensis Perkins Kona

Melanocrabro curtipes Perkins Kona, uplands

Nesocrabro rubrocaudatus Blackburn and Cameron Kona

Nesomimesa hawaiiensis Perkins Kona, ex Cheirodendron

Pison hospes Smith (Spider wasp) Kona

Xenocrabro fulvicrus Perkins Kona, uplands

Xenocrabro hawaiiensis Perkins Kona: Honaunau

Xenocrabro atripennis Perkins Kona, common generally from lowlands to 5000'

Xenocrabro polynesiensis (Cameron) Kona: Keokea

Xenocrabro unicolor Smith Kona

Colletidae (Hylaeidae)

Nesoprosopis anthracina (Perkins) Kona: Kealahou Bay Region

Nesoprosopis assimulans Perkins Kona, coast

Nesoprosopis attripennis Perkins South Kona

Nesoprosopis coniceps Perkins Kona, Keokea

Nesoprosopis difficilis Perkins Kona

Nesoprosopis dimidiata Perkins Kona

Nesoprosopis kona Perkins Kona

Nesoprosopis obscurata Perkins Kona: Kealahou, rare

<i>Nesoprosopis ombrias</i> Perkins	Kona, south coast up to 2000'
<i>Nesoprosopis paradoxa</i> Perkins	Kona
<i>Nesoprosopis pubescens</i> Perkins	Kona
<i>Nesoprosopis setosifrons</i> Perkins	Kona
<i>Nesoprosopis simplex</i> Perkins	Kona, generally distributed around lowlands, up to Keokea mauka
<i>Nesoprosopis sphecoideoides</i> Perkins	Kona, in mountains
Megachilidae (Leaf-cutting bees)	
<i>Megachile diligens</i> Perkins	Kona
Apidae	
<i>Apis mellifica</i> Linnaeus (Honeybee)	Kona, and common throughout the islands. First hive bees introduced in 1857 from California.

MAMMALS, BIRDS AND REPTILES OF KONA

By

Edwin H. Bryan, Jr.

Mammals

The only mammals which occur naturally in Kona, except those which have escaped from domestication, are the bat, the house mouse, four species of rats, and the mongoose.

The Hawaiian Hoary bat, Lasiurus semotus (True and Allen), seems to have been reported first from Kona, by the artist and naturalist of the U.S. Exploring Expedition, Titian Peale. He says (

"At Kaa-la-kea-kua (Kealakekua) on the island of Hawaii, memorable as the place where the renowned circumnavigator Cook perished, a species of bat, which we believe new to naturalists, was quite common; it measures about twelve inches across the wings; it is of ferruginous gray color; the interfemoral membrane is large and includes the tail, which is about the length of the body."

This membrane, which forms the "wings" of the bat is covered with fur-like hair. The species is related to species of common bats in North and South America and one in the Galapagos Islands. This species was

described by True and Allen in 1890 as Atalopha semota, but later was placed in the genus Lasiurus. It has been found to occur on several of the larger Hawaiian islands, as far northwest as Kauai, but at present is most common in the Hualalai region of North Kona. It has been seen flying along the Kona and Kau coasts, at elevations between sea level and 4,000 feet, in both dry and wet regions, chiefly in the late afternoon and near sundown. It is no longer "quite common," as reported in the 1840's; to see one today is quite an event.

The little cosmopolitan house mouse, Mus musculus Linnaeus, appears to have reached the Hawaiian islands before the coming of foreigners, for Captain Cook's third voyage reported it as common and well established in Kona in 1778. The first missionaries also noted its presence, as did the naturalists of the U.S. Exploring Expedition. It measures about three inches long, with a tail three and a half to four inches in length.

One of the four varieties of rats was also of aboriginal introduction. This is called Rattus hawaiiensis Stone, and its close relationship to

members of the Rattus concolor group, of Indonesia and various Pacific islands suggests that it accompanied the Polynesians on their voyages across the Pacific, possibly as stowaways in their voyaging canoes. The Hawaiians made a sport of shooting rats and mice, using the bow and arrow, the only way in which they made use of this type of weapon.

The other three species of rats were accidental immigrants of a later date. Two are closely related varieties of a species rather similar in size and appearance to the Hawaiian rat. One is the white-bellied or Alexandrine rat, Rattus rattus alexandrinus Geoffroy, which builds nests in trees, and is also known as the roof rat, entering attics from roofs. It is known to damage fruits, such as mangos and avocados, eating small holes which cause the fruits to spoil. The other is the black rat, Rattus rattus Linnaeus, which prefers to live in burrows in the ground or double walls of buildings, causing great annoyance by scampering about at night. It does even more damage by eating food materials and soap, and leaving unsightly litter. Both these rats carry fleas, which in turn carry diseases, such as bubonic plague. These two species, particularly the black

rat, because of its domestic habits, are likely to bring these fleas into contact with people, who may become infected with the disease.

The largest of the four species of rats is the brown, Norway, or wharf rat, Rattus norvegicus Berkenhout. Its body averages eight or nine inches in length, with an additional six inches of tail, and it usually weighs about three quarters of a pound; large specimens may weigh as much as two pounds. This species was present in Hawaii before 1840, probably coming ashore from early trading ships. It nests on or near the ground, making runways and burrows with complicated galleries. It causes much destruction, chiefly in warehouses, but also in fields and to birds, as well as carrying fleas with disease.

The mongoose, Herpestes griseus (Geoffroy) is a carnivore of the civet family (Viverridae), native to India. It was introduced from Jamaica in 1883, and later from New Orleans in 1885, in the hope that it would destroy rats. Unfortunately, it has not had much effect in reducing the rat population, but it does eat insects and ground-nesting birds and their eggs.

CHECK LIST OF THE LAND BIRDS OF KONA

Those currently seen in the Honaunau area are marked with a star (*).

ANATIDAE, ducks and geese.

Anas wyvilliana wyvilliana Schlater, The Hawaiian duck, Koloa maoli.

[While this species has been found in Kona, it probably was never abundant in South Kona because of the absence of large bodies of fresh water. The same applies to migratory ducks.]

Branta (Nesochen) sandvicensis (Vigors), Nene or Hawaiian goose. Found on the upper slopes and visiting small ponds in North Kona just before mating.

ACCIPITRIDAE, hawks

Buteo solitarius Peale, Io, the Hawaiian hawk. Once abundant, it still is to be found on the slopes of Kona.

PHASIANIDAE, quail, partridges, pheasants

Phasianus torquatus Gmelin, the Ring-necked pheasant, is found throughout the Kona area (according to Schwartz and Schwartz, 1949).

RALLIDAE, rails, gallinules, coots.

[The Sandwich rail, moho, *Pennula sandwichensis millsii* Dole, is now extinct. The Hawaiian gallinule, alae ula, *Gallinula chloropus sandvicensis* Streets, and the Hawaiian coot, alae keokeo, *Fulica americana alai* Peale, probably were never abundant in Kona, due to the absence of marshes and ponds.]

CHARADRIIDAE, plover

(*) *Pluvialis dominica fulva* Gmelin, the Pacific Golden Plover, kolea, is a winter migrant which frequents the Kona coast in some numbers.

SCOLOPACIDAE, sandpipers, snipe

Numenius tahitiensis (Gmelin), the Bristle-thighed curlew, kioea, a winter migrant which has visited this area in small numbers, is now rarely seen.

Heteroscelus incanus (Gmelin), the Wandering tattler, ulili, a regular winter migrant, is not as abundant in the Honaunau area as the plover and the turnstone.

(*) *Arenaria interpres interpres* (Linnaeus), the Ruddy turnstone, akekeke, is a regular winter migrant, occurring in small flocks.

Other migratory species, particularly snipe and the sanderling or hunakai, Crocethia alba Pallas, occur as occasional migrants on sandy shores of Hawaiian islands, particularly those to the northwest, but probably are rare along the Kona coast.

RECURVIROSTRIDAE, stilts

Although the Hawaiian stilt, kukuluaeo or aeo, Himantopus himantopus knudseni Stejneger, is thought to have occurred on all the main islands of the Hawaiian group, there is no doubt that it was much more abundant on Kauai and Oahu than on Hawaii; there are few suitable places for it to live along the Kona coast.

PERISTRIDAE, doves and pigeons

(*) *Streptopelia chinensis* (Scopoli), the Turtle dove, laceneck or Chinese dove, in later days called "'ehako" by the Hawaiians, was an early introduction which is now present in Kona. "Medium density up to about 1000 feet; low density above this to 2000 feet or more."

[Schwartz and Schwartz, 1949.]

(*) *Geopelia striata striata* (Linnaeus), Barred dove, introduced from Singapore at various times since 1922, is fairly abundant in Kona. "Low density up to about 1000 feet." (Schwartz and Schwartz, 1949).

STRIGIDAE, owls

Asio flammeus sandvicensis (Bloxam), pueo, the Hawaiian short-eared owl. Seen flying at dusk over grassy forehills.

ALAUDIDAE, larks

Alauda arvensis Linnaeus, the Skylark, variously introduced since 1865, occurs on the upper slopes.

CORVIDAE, crows

Corvus tropicus Gmelin, alala, the Hawaiian crow; still to be found in small numbers on the upper forested slopes.

TIMELLIDAE, babbling thrushes

Leiothrix lutea (Scopoli), "Pekin nightingale," "Japanese hill robin," introduced since 1918, has become widespread and locally abundant, even being blown onto the high, barren slopes.

TURDIDAE, thrushes

Phaeornis obscura obscura (Gmelin), omao or kamao, a native Hawaiian thrush, is endemic to the island of Hawaii. Its present status in Kona is unknown.

MUSCICAPIDAE, Old World flycatchers

Chasiempis sandwichensis sandwichensis (Gmelin), the elepaio, is endemic on the island of Hawaii, and occurs in the lower rainforest.

STURNIDAE, starlings

(* *Acridotheres tristis* (Linnaeus), the mina or mynah, called by the Hawaiians in later days "piha'e-keho," was introduced from India in 1865, and has become widely distributed throughout lower regions of the Hawaiian islands.

DREPANIIDAE, Hawaiian honeycreepers. [The entire family found only in the Hawaiian islands; now confined to higher elevations and many species becoming rare and some extinct.]

Loxops virens virens (Gmelin), the Hawaii amakihi; endemic, island of Hawaii

Loxops maculata mana (Wilson) [formerly in *Himatione* and *Paroreomyza*], the Olive-green creeper; endemic to the island of Hawaii.

Loxops coccinea coccinea (Gmelin), the akepa or akepeuie; endemic island of Hawaii

Hemignathus obscurus obscurus (Gmelin), the Hawaii akialoa; endemic to island of Hawaii.

Hemignathus wilsoni (Rothschild) [formerly in *Heterorhynchus*], the akiapola'au; endemic to the island of Hawaii.

Psittirostra psittacea (Gmelin), the ou.

Psittirostra bailleui (Oustalet) [formerly in *Loxioides*], the palila; endemic Hawaii I.

Psittirostra palmeri (Rothschild) [formerly in *Rhodacanthis*], hopue, the Orange koa finch; endemic to the Kona district of Hawaii.

Psittirostra flaviceps (Rothschild) [formerly in *Rhodacanthis*]; the Lesser- or Yellow-headed koa finch; endemic to the Kona region of Hawaii.

Psittirostra kona (Wilson) [formerly in *Chloridops*]; grosbeak finch; endemic to Kona.

Himatione sanguinea sanguinea (Gmelin), the apapane.

Ciridops anna (Dole), Ula-ai-hawane; endemic to island of Hawaii.

Vestiaria coccinea (Forster), the iiwi.

Drepanis pacifica (Gmelin), the mamo; endemic to the Hilo forests of the island of Hawaii; possibly did not occur at all in Kona; long extinct.

MELIPHAGIDAE, honey suckers

Moho nobilis (Merrem) [also put in the genus *Acrulocercus*], the oo; endemic to the island of Hawaii, and no specimens positively seen for more than forty years.

Chaetoptila angustipluma (Peale), the kioea; endemic, doubtless extinct, Hawaii island.

PLOCEIDAE, weaver finches

Munia nitoria (Temminck), the Rice bird, called by later-day Hawaiians "'ai-laiki"; introduced about 1865, escaped and established on all the main Hawaiian islands; not abundant in Kona.

Passer domesticus (Linnaeus), the English sparrow; introduced before 1870; called by later day Hawaiians "manu li'i-li'i"; established on all the main Hawaiian islands, but not abundant in Kona.

FRINGILLIDAE, finches, sparrows, buntings

(*) *Richmondia cardinalis* (Linnaeus), the Red cardinal, "Kentucky" cardinal; introduced since 1929; established in Kona.

(*) *Carpodacus mexicanus frontalis* (Say), the house finch, "linnet", "papaya bird," 'ai-mikana; introduced before 1870; not common in Kona.

(Records of species of birds seen in Kona, particularly in the Honaunau area, would be much appreciated at Bishop Museum.)

REPTILES OF KONA

The reptiles found commonly on land in the Hawaiian Islands, including those known in Kona, are all species found widely distributed in the Pacific. They include three species of geckos (Gekkonidae) and three species of skinks (Scincidae). In certain parts of Hawaii a few other geckos and

skinks have been reported, also a small, slender burrowing snake, Typhlops
braminus (Daudin), but none of these is reported from the Honaunau area of
Kona.

Geckos and skinks are easy to tell apart, both in appearance and in
habits. Geckos have their body covered with small granules or minute scales,
the top of the head is without symmetrical shields, the digets (fingers of
the feet) are dilated, and the pupil of the eye is vertical. Skinks have
the body covered with larger, cycloid scales, the top of the head bears
large symmetrical shields, the digets are not dilated, and the pupil is
round. Geckos are active chiefly at night, being seen usually in houses or
on screens, catching insects which are attracted to lights. Skinks are
active in the daytime, commonly seen sunning themselves or darting in search
of insects in the open or from under rocks and trash. They are most active
in the late afternoon. They seldom invade houses, preferring loose piles of
leaves, rock piles and other places out of doors.

The Sad or Mourning gecko, Lepidodactylus lugubris (Dumeril and
Bibron) is the commonest gecko in Hawaii. Their coloration is variable,

ranging from brown, pale gray, tan or pinkish on the back, with dark spots or blotches, and with white or pinkish lower surface, to very dark specimens, with or without dark streak through the eye and along the side of the head. It lays pear-shaped eggs with hard, thick, white shells, 9 by 6.5 mm., capable of falling and bouncing without breaking. These are found sticking to a vertical surface or cemented together in clusters in cracks, against boards, or under loose bark or stones.

The Fox gecko, Hemidactylus garnoti Dumeril and Bibron, grows to a length of more than four inches, with a long, fox-like snout. Its general color is dark grayish-drab, varying with the changing size of a large number of black, white, and brown spots, the white spots on the back forming rows. The under surface is pale, with a lemon-yellow tinge on the belly, and salmon on the tail. It occurs commonly in houses, under stones and planks, and even in trees. It seems always to be on the alert and moves swiftly. The eggs are nearly spherical, 9 or 10 mm. in diameter, firm, but rather brittle, laid in crevices in tree trunks and other such hiding places.

The Stump-toed gecko, Peropus mutilatus (Wiegmann) gets its specific

name from the thin and tender nature of its skin. One can scarcely catch a specimen which is not "mutilated" in some way. Struggles of this gecko against one's fingers are likely to tear rents in the skin, and the tail is broken off easily. The tail is broad and flat, with a distinct constriction at the base. This species may reach a length of three and a half inches. It has a uniform drab color, with brownish markings on the head and a white stripe between the eyes. The under surface is whitish with a yellowish tinge on the hind legs and belly. Both surfaces are covered with minute black specks.

SKINKS

The Moth skink, Leiolopisma noctua (Lesson) is the smallest of the three skinks, measuring about two and a half inches in length. Its color is described as "glassy clay" above, paler beneath, white with dull brownish marbling on the tail. A pale band covers the two central rows of scales down the back; the sides of the head and a band on each side is dark brown, irregularly dotted with pale spots, which may continue on the legs.

In the woods we find the Azure-tailed skink, Emoia cyanura (Lesson),

largest of the Hawaiian skinks, measuring almost five inches long. It is recognized by its sharply defined, light mid-dorsal line, which extends from the tip of the snout to the tail. The ground color of most adults is dark brown, even black; some may have a yellowish or white stripe on each side of the central line. The middle six rows of scales on the black may be bronzed tawny olive. The under surface is lighter than the back, and may have a greenish tinge. Colors are more intense in young skinks, becoming duller with age.

The Snake-eyed skink, Ablepherus boutonii poecilopkeurus Wiegmann is a very agile species, up to four inches long. It lives generally at lower elevations, where the climate is drier, preferring sunshine to shaded woods. The color is variable, ranging from entirely dark, through brown, olive, slaty, even blue-green, uniform or with two to four lighter stripes on the back, but never an odd number (a stripe in the exact center). It seldom stays sufficiently still for you to see that it does not close its eyes, the eyelids not functioning. It lays oval pink eggs, measuring two-thirds

by one-third of an inch, deposited in damp earth.

For additional data about Mammals and Reptiles in Hawaii see

"Animals of Hawaii," by Spencer W. Tinker, Honolulu, 1938 and 1941.

A SURVEY OF THE MARINE BIOTA OF THE HONAUNAU BAY REGION, HAWAII

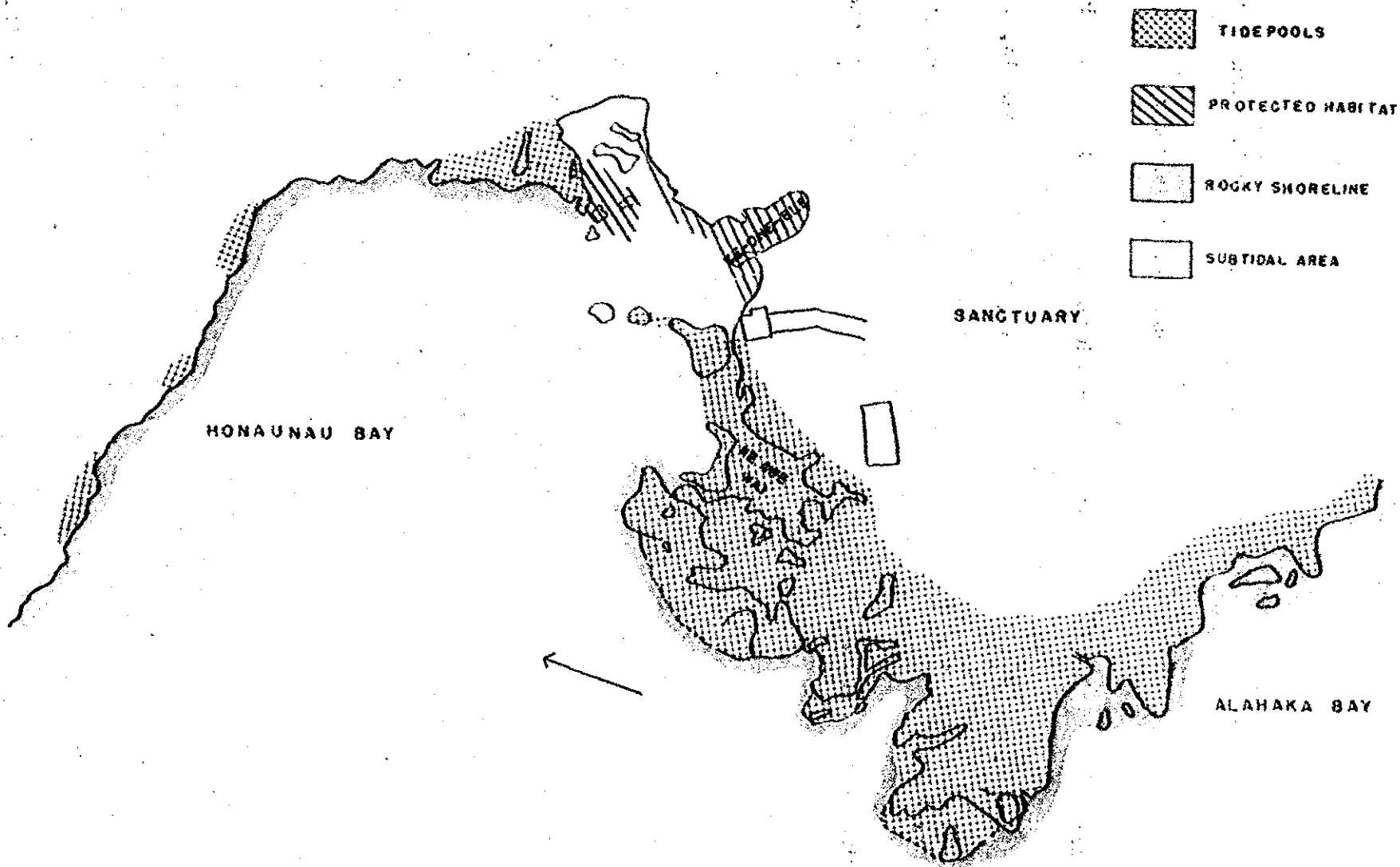
By

Alison Kay

The object of this survey is to present a generalized picture of the marine biota of the Honaunau Bay region of the Island of Hawaii. The survey was undertaken during two periods, one of five days in January, and one of three days in August, 1957. Because of the limited time available for collecting in the area, the following discussion comprises neither a comprehensive list of species which occur in the region nor an intensive ecological survey.

Geography and Other Factors

The Honaunau Bay region comprises approximately three miles of coastline extending from the north end of Honaunau Bay to the east shore of adjacent Alahaka Bay which lies to the south of Honaunau. Although the entire area presents a more or less constant topography, consisting of a fringing coastline of basalt, the distribution of the marine biota is not uniform. The region has been divided into four habitats for purposes of the



present discussion (Fig. 1). These habitats are influenced by factors such as the degree of wave action, tidal exposure, and type of substrate.

Tidepools form a habitat with a rich and varied biota which is easily accessible to the visitor. The coastline of the Honaunau Bay area presents considerable scope for the occurrence of tidepools, the most conspicuous region of their occurrence being on the lava flow which projects seaward directly in front of the Sanctuary. The edges of this flow form the south shore of Honaunau Bay and the north shore of Alahaka Bay. The flow extends approximately 500 feet from the shore seaward, and is about 400 feet in diameter at its greatest dimension. The surface of the lava is studded with small pits, crevices, shallow basins, etc. In addition there are several arms of the bays which indent the flow. The flow is exposed at 0.0 tides, at which time the majority of the pools are not in communication with the sea but subject to complete isolation. At tides higher than 0.0, the flow is variously covered by waves, and the tidepools are consequently replenished with sea water.

Although the tidepools on the lava flow are the most conspicuous in the

Honaunau Bay area, other tidepools occur along the coastline wherever the shore is wide enough to support a pool of water, and where it is close enough to sea level to be replenished by a high tide.

The second habitat which will be discussed is that which may be termed a protected habitat, where there is little surf action. This factor characterizes the shallow inlet, Ke-one-ele, at the south-east corner of Honaunau Bay adjacent to the Sanctuary and the Sanctuary lava flow. The inlet is partially constricted off from the bay by a basalt spit which forms a shallow bar across the entrance. The bar is interrupted by a narrow channel which permits small boats access to the bay. The substrate here is sand, but Ke-one-ele is bordered by the rocky shoreline and the walls of the Sanctuary.

An exposed habitat is the third type of habitat which will be discussed. This habitat comprises the major portion of the shoreline, occurring along the seaward face of the coast, and consists of an irregular fringe forming benches and bluffs varying in height between two and fifty feet above sea

level. In places the face of the shoreline is sheer; in other parts there is a gentle slope toward the sea, the slope frequently levelling off into benches which are washed continuously by waves. The seaward face of the coastline is subject to constant surf and tidal action.

The shallow waters of the bays form the fourth habitat, which may be considered as a sub-tidal habitat. Depth of the water varies from a few inches to six feet within 100 feet of shore, depending on the height of the tide and the degree of surf action. The waters of both Honaunau Bay and Alahaka Bay are extremely clear, and from the high areas of the shoreline it is possible to observe brightly colored fish swimming about submerged benches and boulders. Divers may be hampered by a fresh water lens which forms in areas where there are bubbling freshwater springs in the south-east corner of Honaunau Bay. The lens impairs visibility.

The prevailing wind direction is north-east. During the early morning there is little wind, and the waters of the bays and tidepools are calm and clear. At noon, with a rise in wind, ruffle appears, and visibility both in tidepools and in the bay is lessened.

The effects of wave action along the coastline and on the Sanctuary lava flow were considerably more noticeable in January than in August. The author observed both a high tide (1.7) with vigorous surf and a low tide (-0.1) with a calm sea in January. During the period of the January high tide, all but a few pools at the shoreward edge of the lava flow became inaccessible as the entire lava flow was covered at intervals by waves of considerable force. During the January low tide the entire lava flow was exposed; it was not possible, however to collect in pools at the seaward edge of the flow because of the force of the surf although these pools were visible between waves. In contrast to the conditions existing in January, in August the entire Sanctuary lava flow and coastline were accessible even during a 1.8 tide. Pools at the seaward edge of the Sanctuary flow and patches of seaweed growing on partially submerged benches along the coastline which during January had been hidden by surf could easily be examined in August.

Tidepools

Tidepools vary greatly in size, ranging from small depressions or crevices to wide stretches of water. They differ in character according to their distance from shore and the consequent degree of exposure which they experience.

Those pools which are nearest shore and which are replenished with water only at very high tides are barren. Animal life is limited to specimens of the periwinkle Nerita picea and Littorina pintado. Occasional bivalve molluscs such as Isognomon costellatum may be discovered by turning over rocks on the bottoms of the pools. The large black grapsid crab, Grapsus grapsus, frequently scrambles about on the lava between the pools.

Seaward the tidepools become richer both in fauna and algae. The walls of most of the pools are lined with the crisp green alga, Boodlea composita, which forms a dense mat in which are harbored numerous minute molluscs, annelids, and crustaceans. Occasional patches of another alga, the orange-brown Hydroclathrus clathratus cling to the walls of the pools also. The bright orange sponge, Spirastrella keaukaha, forms a thick growth in some

of the pools, and is also found on the undersurfaces of the loose rocks in the bottom of the pools. Also lining the walls of the pools and projecting between the small rocks on the bottom is the gray sea urchin, Echinometra mathaei mathaei. Patches of brightly colored sea anemones occur on the walls of the tidepools from the mid-section of the lava flow to the seaward edge. The bandanna prawn, Stenopus hispidus, frequents the edges of the deeper portions of the larger pools, seldom venturing forth into the open water, but visible by its antennae which protrude from beneath the pool ledges.

The substrate of the majority of pools is smooth basalt on which lie numerous small rocks, and among which may be some sand. The sea cucumbers Holothuria atra, Actinopyga mauritiana, and Stichopus sp. lie on the bottom of the pools, their tentacles spread out in front in a semicircular crown. Holothuria atra, a black species which is frequently coated with sand, is most numerous; twenty-five specimens have been counted in a pool four feet in diameter. Rosettes of moulded sand which are often noticeable on the bottoms of the tidepools are the egg cases of the gastropod mollusk

Natica macrochiensis. The only mollusk which occurs frequently in the pools is the small triton, Cymatium chlorostoma.

If the rubble of the substrate is examined, other forms of animal life become visible. Numerous small crabs such as Pachygrapsus and Carpilodes scurry about when the rubble is disturbed. Clinging to the undersurfaces of rocks are the bivalve mollusks Anomya and Isognomon costellatum, and the gastropod Peristernia chlorostoma. The snake-like sea cucumber, Ophiodesoma spectabilis also may be found under rocks in tidepools.

There are several species of fish in tidepools in addition to the invertebrates. Gobies and pool-hopping blennies are conspicuous both in pools near the shore and those which are at the seaward edge of the flow. In addition, small specimens of the silver and black-striped manini, Acanthurus triostegus, the black and white demoselle, Dascyllus albisella, and the yellow chaetodon, Chaetodon fremblii, are numerous. A small flounder, Bothus sp., was noted on one occasion.

As the seaward edge of the lava flow is approached, the tidepools become noticeably richer in algal growth and animal life is no longer

conspicuous. The algae form a thick, heavy covering over the substrate; the species comprising the algal turf include the small, fan-like, brown, Padina, the pink and white Jania, and the coarse brown Turbinaria. String-like white tentacles of a terebellid worm frequently move slowly over the algae; the worm itself lives in a moulded tube deep in the algal substrate. Brightly colored opisthobranch mollusks such as Micromelo guamensis and Hydatis may be noted wandering over the algal substrate.

The north shore of the lava flow is deeply indented by an arm of Honaunau Bay, Keawewai, which extends approximately 100 feet across the flow, varying in diameter from 50 to 100 feet. Keawewai is in constant communication with the sea and is thus subject to the rising and lowering of the tides. It varies in depth from three feet at its seaward entrance to less than six inches at the distal end. The substrate is formed of loose rubble consisting of small algal-covered rocks and pieces of dead coral. The rubble is interrupted in places by patches of sand studded with the green and white algae.

The walls of Keawewai are lined by several species of sea urchin, particularly the gray Echinometra mathaei mathaei noted in other tidepools, and the similar but black E. mathaei oblonga. In addition the bright orange sponge Spirastrella keaukaha and occasional heads of the pink coral Pocillopora damicornis line the walls. The bottom of the indentation is covered by numerous specimens of the large, short-spined sea urchin, Tripneustes, the spines of which frequently bear small bits of debris such pieces of algae and small mollusks. The purple test of this sea urchin is often found amid the rubble of the shoreline. The sea cucumbers Holothuria atra, Actinopyga mauritiana, and Stichopus sp. also lie about on the substrate. At the seaward edge small specimens of the red, flat-spined sea urchin, Heterocentrotus mamillatus and the long-spined wana, Centrochinus paucispinus, occur between the rocks and coral on the bottom.

The sand patches of Keawewai form a feeding ground for several species of carnivorous mollusks. Several species of the genus Conus occur partially buried in the sand during the day; Conus hebraeus, C. abbreviatus, C. lividus,

and C. nanus are particularly numerous. Other mollusks in this area include Cymatium chlorostoma, Mitra litterata, and the small strombid, Strombus maculatus.

The undersurfaces of the rubble substrate also present an interesting picture as regards animal life. Moving the stones and pieces of coral results in the disturbance of the rapidly moving brittle stars, Ophiocoma spp., which quickly disappear beneath adjacent rocks and coral. Clinging to the undersurfaces of the rocks are at least three different species of starfish, the large, smooth armed Linkia multiflora, the wide-armed Asterope carinifera, and a very small (inch or less in diameter) red species. Two small sea urchins also cling to the undersurfaces of the rocks, the blunt-spined Eucidarus metularia and the white Lytechinus verraculatus.

The Inlet, Ke-one-ele

The inlet, Ke-one-ele, with its sandy substrate, has little to offer in the way of either animal life or algae. However, the walls of the Sanctuary which border the inlet on the shoreward edge, the coastline on the two sides, and the basalt spit which denotes the seaward margin are

characterized by algae and animal life which are dark and sparse in comparison with the bright colors and rich variety of the tidepools.

Small beds of the mussel, Brachidontes cerebristriatus, cling to the basalt substrate of the northern edge. The southern edge and the walls of the Sanctuary are covered dense, deep mat of red algae. Harbored in the mat are numerous small annelid worms and mollusks. Larger mollusks such as Morula tuberculata, Drupa ricina, Thais harpa, Littorina pintado, and Nerita picea cling to the walls and exposed substrate. All of these species are dark gray or black, scarcely noticeable against the basalt and dark algal mat.

Seaward, the basalt flats which are exposed at low tides form a feeding ground for several species of the gastropod Conus, which during the day are partially buried in the sand and algae on the basalt. The white gastropod Morula ochrostoma also occurs here, as do small limpets such as Siphonaria and Phenacolepas. A minute purple barnacle clings to the exposed portions of the spit.

The Rocky Shoreline

The rocky shoreline is subject to almost constant wave action even at low tides, but it may be partially exposed by receding waves. The face of much of the shoreline has a pink hue owing to the cover of the coralline alga Porolithon. Occasional tufts of the brown Sphacelaria are also present. Animal life on the sheer face of the shoreline is limited to a few more or less sessile invertebrates such as the sea urchins Podophora atrata and Echinometra mathaei mathaei, the latter frequently occurring in deep pits in the substrate; mollusks such as the opihi Helcioniscus exaratus and Drupa morum; and the large barnacle Cthalamus hembeli.

On the boulders which lie below the sheer walls of the shoreline, and on the sea-level portions of the shoreline which form low-lying benches, there is a rich growth of brown algae, principally Sargassum and Turbinaria. Occasional patches of the bright green Ulva show through the browns. In several areas of the coastline there are thick patches of the crisp, golden Chnoospora pacifica.

Shallow Waters of the Bay

The bottom of the bay is covered by loose rock and dead coral rubble; at low tide the depth of the shallow regions within 100 feet of shore is less than three feet. The rocks are strewn with echinoderms; particularly noticeable are the bright red, flat-spined Heterocentrotus mamillatus which may be six inches in diameter, and the black, long-spined Centrochinus paucispinus. The debris-carrying Tripneustes also occurs here. The holothurians, Holothuria atra and Actinopyga mauritiana are also numerous. In the deeper water (five to seven feet) large heads of coral are present, the white Pocillopora meandrina var. nobilis, large yellow and purple heads of Porites spp. Numerous small fish were noted around the coral heads, particularly large specimens of the manini Acanthurus triostegus, the boxer Ostracion cubicus, and a red striped labrid.

Additional Faunal Notes

In addition to the living animals which have been recorded for this survey, evidence of the occurrence of various other species was obtained

from fishermen in the area and noted in the debris on the beaches well above the tidal mark.

Fishermen noted the occurrence of species such as the u'u (Myripristis murdjan), aweoweo (Priacanthus cruentatus), moi (Polydactylis sexfilis), maomao (Abudefduf abdominalis), ohua (Cantherines sandwichensis), akule (Selar crumenophthalmus), uku (Aprion virescens), kawelea (Sphyraena helleri), and hinalea (Thalassonia umbrostigma).

Various mollusk species were noted in the rubble at high tide level along the shore. Specimens of Cypraea granulata, C. mauritiana, C. helvola, C. poraria, Conus striatus, C. pulicarius, Distorsio anus, and Casmaria kalosmodix were noted. Examination of the rubble along the shoreline will probably lead to the recording of other species which have not been noted in the tidepools or along the shoreline.

A detailed faunal list is appended. This is not to be considered comprehensive, but merely indicates the species which were collected or noted during the survey.

Summary

The marine biota of the Honaunau Bay region has been discussed from the aspects of four habitats which are distinctive in their distribution of animal and plant life. The tidepools of the lava flow projecting directly seaward from the Sanctuary are most accessible to the visitor; short walks along the shoreline permit observation of the exposed rock habitat and the sub-tidal habitat.

The biota of the tidepools is rich, varied, and colorful. The tidepools differ in character, depending on their distance from the shore, those nearest the seaward edge of the flow support a dense population of the algae and animal life. The dominant animal group in the tidepools is the echinoderms, four classes of which are represented in considerable numbers. Sea urchins (Echinoidea) and sea cucumbers (Holothuria) are particularly noticeable, lining the walls and substrate of the pools. Molluscs are limited to a few species which occur principally on the undersides of rocks.

The seaward edge of the coastline, which has been considered as an exposed rock habitat, is also colorful, but relatively few animals occur

here. The color is imparted by the pink coralline alga Porolithon which encrusts the rocky substrate and the rich golden-brown Sargassum which covers the boulders and benches. Animal life is limited to a few more or less sessile invertebrates. The waters of the bays, the sub-tidal habitat, are clear and permit observation of brightly colored fish which hover near submerged benches and boulders. Divers in the bays may also observe large heads of coral and numerous large sea urchins.

By way of contrast to the three habitats above, the algae and animal life of the protected habitat, the inlet at the south-east corner of Honaunau Bay, is dark and limited to very few species.

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Check List of Invertebrates from Honaunau

Species	Tidepool	Inlet	Coast	Sub-tidal
Coelenterates				
<u>Pocillopora damicornis</u>	x			
<u>Pocillopora meandrina</u> var. <u>nobilis</u>				x
<u>Porites</u> sp.	x			
<u>Dendrophyllia manni</u>	x			
<u>Cyphastrea ocellina</u>	x			
Porifera				
<u>Spirastrella keaukaha</u>	x			
Black Sponge	x			
Annelids				
Terebellid	x			
<u>Eurythoe</u> sp.	x			
Mollusca - Gastropods				
<u>Bursa bufonia</u>	x			
<u>Cerithium nesioticum</u>	x			
<u>Conus abbreviatus</u>	x			
" <u>distans</u>	x			
" <u>hebraeus</u>	x	x		x
" <u>imperialis</u>	x			
" <u>lividus</u>	x			x
" <u>nanus</u>	x	x		

	Tidepool	Inlet	Coast	Sub-tidal
<u>Conus rattus</u>	x			
" <u>vermiculatus</u>	x			x
<u>Cymatium chlorostoma</u>	x			
" <u>gemmatum</u>	x			
" <u>pileare</u>	x			
<u>Cypraea caputserpentis</u>	x			
" <u>isabella</u>	x			
" <u>moneta</u>	x			
" <u>reticulata</u>	x			
<u>Drupa morum</u>			x	
" <u>ricina</u>			x	
<u>Helcioniscus exaratus</u>			x	
<u>Littorina pintado</u>	x	x		
<u>Melanella cumingi</u> <u>midpacifica</u>	x			
<u>Mitra litterata</u>	x			
<u>Morula ochrostoma</u>		x		
" <u>tuberculata</u>		x		
<u>Natica macrochiensis</u>	x			
<u>Nerita picea</u>	x	x		
<u>Peristernia chlorostoma</u>	x			
<u>Phenacolepas</u> sp.		x		
<u>Rhizochilus madreporum</u>	x			
<u>Siphonaria</u> sp.		x		
<u>Strombus maculatus</u>	x			

	Tidepool	Inlet	Coast	Sub-tidal
<u>Thais harpa</u>	x	x		
<u>Turris</u> sp.	x			
<u>Vexilla taeniata</u>	x			
Mollusca-Opisthobranchs				
<u>Haminoea crocata</u>	x			
<u>Hexabranchnus</u> sp.	x			
<u>Hydatina amplustre</u>	x			
<u>Micromelo guamensis</u>	x			
Mollusca - Lamellibranchs				
<u>Anomya nobilis</u>	x			
<u>Brachidontes cerebristriatus</u>	x			
<u>Ctena bella</u>	x			
<u>Isognomon costellatum</u>	x			
" <u>incisum</u>	x			
<u>Periglypta edmonsoni</u>	x			
<u>Spondylus hawaiiensis</u>	x			x
Echinodermata - Asteroids				
<u>Asterope carinifera</u>	x			
<u>Linkia multiflora</u>	x			
Unidentified small red sp.	x			
Echinodermata - Echinoidea				
<u>Centrechinus paucispinus</u>	x			x
<u>Echinometra mathaei mathaei</u>	x		x	x
" <u>mathaei oblonga</u>	x			x

	Tidepool	Inlet	Coast	Sub-tidal
<u>Eucidaris metularia</u>	x			
<u>Heterocentrotus mamillatus</u>	x			x
<u>Lytechinus verraculatus</u>	x			
<u>Podophora atrata</u>			x	
<u>Tripneustes gratilis</u>	x			x
Echinodermata - Holothuria				
<u>Actinopyga mauritiana</u>	x			x
<u>Chiridota rigida</u>	x			
<u>Holothuria atra</u>	x			x
<u>Ophiodesoma spectabilis</u>	x			
<u>Stichopus</u> sp.	x			
Echinodermata - Ophiuroidea				
<u>Ophiocoma erinaceus</u>	x			x
" <u>pica</u>	x			x
Arthropoda - Crustacea				
<u>Carpiloides bella</u>	x			
<u>Grapsus grapsus</u>		x		
<u>Leander debilis</u>	x			
<u>Leptodius sanguinensis</u>	x			
<u>Leptodius</u> sp.	x			
<u>Pachygrapsus minutus</u>	x			
<u>Platypodia eydouxi</u>	x			
<u>Pseudosquilla ciliata</u>	x			

	Tidepool	Inlet	Coast	Sub-tidal
<u>Stenopus hispidus</u>	x			
Arthropoda - Cirripedia				
<u>Cthalamus hembeli</u>			x	
Unidentified purple sp.		x		
Bryozoa				
<u>Loxosoma sp.</u>	x		x	
Fishes				
<u>Abudefduf abdominalis</u>	x			x
<u>Acanthurus triostegus</u>	x			x
<u>Aprion virescens</u>				x
<u>Bothus sp.</u>	x			
<u>Cantherines sandwichensis</u>				x
<u>Chaetodon fremblii</u>	x			x
<u>Dascyllus albisella</u>	x			
<u>Myripristis murjan</u>				x
<u>Naso unicornis</u>				x
<u>Ostracion cubicus</u>	x			x
<u>Polydactylis sexfilis</u>				x
<u>Priacanthus cruentatus</u>				x
<u>Selar crumenophthalmus</u>				x
<u>Sphyræna helleri</u>				x
<u>Thalassonia umbrostigma</u>				x

	Tidepool	Inlet	Coast	Sub-tidal
<u>Asparagopsis</u>	x		x	
<u>Boodlea composita</u>	x			
<u>Chnoospora pacifica</u>			x	
<u>Cladophora</u>	x	x		
<u>Dictyosphaeria</u>	x			
<u>Gracilaria</u>	x	x		
<u>Hydroclathrus clathratus</u>	x			
<u>Jania</u>	x			
<u>Laurencia</u>		x	x	
<u>Padina</u>	x		x	
<u>Porolithon</u>			x	
<u>Sargassum</u>			x	
<u>Sphacellaria</u>	x		x	
<u>Turbinaria</u>	x		x	
<u>Ulva</u>			x	
<u>Valonia</u>	x			