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KAW TAO,  
ITS PHYSICAL FEATURES AND VEGETATIONS.

BY A. KERR, M. D., F. L. S.

WITH TWO MAPS AND PLATES 8-12.

*Introduction.*

About 1925 Dr. Hugh McCormick Smith suggested to the writer the advisability of investigating the fauna and flora of Kaw Tao, the most isolated island in the Gulf of Siam. It was not, however, till the end of December 1926 that Dr. Smith and the writer were able to visit the island. A week was then spent there, and as much as possible of the fauna and flora collected. Later, in 1927, the writer alone paid two further visits to the island, one in April and one in July, spending a week there on each occasion. On these last two visits attention was directed almost entirely to the flora.

Here it should be said that it was owing to the courtesy and kindness of the Siam Steam Navigation Company, and of the officers of their ships, that a visit to the island was possible at all. Kaw Tao is not on the direct route of the West Coast Service, so a detour had to be made to reach the island, and considerable time spent in landing the party.

The collections made on the island are being worked out by various specialists, and it is proposed to publish the results of their studies from time to time as they come in. The object of the present paper is to give a general sketch of the geography, geology and vegetation of Kaw Tao.

*General.*

The island in an irregular oblong in shape, about 6 kilometres long and 3 kilometres broad. It is uninhabited, but in the dry season is regularly visited by fishermen, who come to get the eggs laid by turtles on the sandy beaches; often catching the turtles too. They also collect wood-oil, from the 'yang' trees (*Dipterocarpus alatus*) growing in the valleys, and some other minor products.

*Geographical Position.*

Kaw Tao is the northernmost of the group of islands, of which Kaw Samui and Kaw Pa-ngan are the largest members, lying off the Gulf of Bandawn. It is situated opposite the coast of the Province of Chumpawn. The nearest point of the mainland, Lem Chang Hin, the southern cape of Sawi Bay, is distant between 66 and 67 kilometres (41 miles). The nearest point of Kaw Pa-ngan is about 35 kilometres (22 miles) distant. There is, however, one spot of land still nearer to Kaw Tao, that is the small islet marked on the British Admiralty charts as Sail Rock, but known to the local fishermen as Kaw Lom Mu. This rock reaches a height of about 20 metres above sea-level, and is nearly half way between Kaw Tao and Kaw Pa-ngan. It can hardly have played much part as a stepping stone in the spread of plants and animals from Kaw Pa-ngan to Kaw Tao, or vice-versa. At the same time it is not a bare rock. Fishermen describe it as being covered with 'ya'; probably meaning low-growing vegetation, rather than strictly grass. This rock would be well worth investigating from the natural history point of view.

*Bathymetrics.*

The sea surrounding Kaw Tao is comparatively deep, reaching depths of 20 to 25 fathoms all round it at a distance of two or three kilometres. On the north a depth of 25 fathoms is recorded within about a kilometre of the shore. On the east, quite close up to the shore, depths of 10 to 16 fathoms are shown. On the other sides the water deepens somewhat more gradually, but still comparatively quickly. Sail Rock rises abruptly from deep water; quite close to it the chart shows depths of 13 and 14 fathoms, while farther out the water deepens to 21 fathoms or more. Kaw Pa-ngan and







DRIFT ON THE BEACH OF WEST BAY.

There are also to be seen the erect roots of fallen *Casuarina* trees, which do not belong to the drift.



Kaw Samui, on the other hand, are surrounded by shallower water. They, and most of the islands to the west of them, are included and joined to the coast by the 10-fathom line. Curiously enough, however the small island of Kaw Katen, lying only about three kilometres from the southern point of Kaw Samui, is in deeper water. The chart shows a depth of 20 fathoms in the narrow channel between these two islands.

#### *Climate and Drift.*

But little definite information can be given about the climate of Kaw Tao. In the times of its seasons it probably does not differ much from the opposing mainland. Judging from the type of vegetation, and the scanty water in the streams during several months of the year, it would seem that the rainfall is small. It is probable that the greatest rainfall occurs during the north-east monsoon. The fact that the streams were dry in July and full in December suggests this view.

There is good evidence that the strongest winds on Kaw Tao are from the south-west. This is shown by the large amount of drift found on those parts of the coast exposed to the south-west winds. Bamboos are particularly abundant in this drift, not only culms but also large rootstocks; branches and roots of trees are also common. Such drift material must be regarded as a possible vehicle for the conveyance of seeds and small animals to the island from the mainland. Drift seeds and fruit are plentiful, most of them belonging to plants already present in the littoral flora of the island. Some of the seeds and fruit, however, are of plants that have not established themselves on the island. Among these the fruit of the nipa palm is common, and often to be seen germinating on the sand, but it soon dies off from lack of the necessary tidal mud. The fruit of *Nesia* sp., *Zalacca* sp. and an acorn were also seen in the drift, though none of these has succeeded in entering the flora of the island. Coco-nuts were very abundant in the drift, but most of them were empty husks, having been rifled of their contents by squirrels before they set out on their voyage. Another interesting drift material, found thrown up in quantity on the beach at South Bay, was punice.



In all likelihood this pumice came from Krakatau, the volcanic island in the Sunda Straits, distant over 2000 kilometres (1250 miles).

The most striking testimony to the strength of the south-west wind is, however, the way in which the vegetation is closely clipped on exposed headlands. On such headlands, where there are also granite boulders, a curious appearance, resembling parallel hedges, is produced. Wherever there is a granite boulder it acts as a wind-break for the vegetation, which comes exactly level with the top of the boulder on its lee side, and from there stretches away as a level-topped hedge in a line to the north-east, as long as the shelter of the boulder lasts, which may be for a distance of 100 metres or more.

#### *Geology.*

The rocks of Kaw Tao, like those of Kaw Samui and Kaw Pa-ngan, seem to be entirely granite. It is possible that the granite of these islands belongs to the same laccolith as that which outcrops on the mainland at Kao Luang and Kao Nawng. Probably the whole range running north from Kao Luang is granite. Another feature which suggests that these islands are the remains of the submerged, northern end of the Kao Luang Range, is that these granite islands have a series of limestone islands running paralld with them on their western side, just as there is a series of limestone hills running paralld to the Kao Luang Range on its western side. The more interrupted series of limestone hills on the eastern side of the Kao Luang Range does not seem to be represented in this group of islands.

Except in the two main valleys of the island, it is likely that the granite is nowhere very far from the surface. Immense boulders of it are scattered over the slopes of the hills and along the ridges; a few, like Red Rock, rising well above the surrounding trees. In some places the granite very clearly shows jointing in two planes. One set of joints is vertical and runs from E. by N. to W. by S. The other set is slightly tilted out of the vertical and runs about S.E. half S. and N.W. half N.

Recent raised beaches in West Bay and South Bay suggest that the island, like the coast of the mainland, is now gaining on the sea.







The above rough sketch map is compiled partly from compass bearings partly from charts.  
 The positions of the mountains and streams are only approximate.



*Surface Features.*

The surface of Kaw Tao is hilly. The hills may be divided into three groups, though these groups are more or less connected with each other. The smallest and most isolated group occupies the south-western corner of the island. The largest group forms the main ridge of the island, running nearly north and south. It starts from the southern corner of the island and runs north to join the third group, which stretches east and west across the northern end of the island. The highest peak is in the third group, and is situated in the north-west corner of the island. It reaches a height of about 385 metres (1283 feet). Two or three peaks in the second group come very close to this in height.

There is very little level ground on the island. Apart from the beaches, there are only two level stretches of any size: one of these is along the stream flowing into South Bay, the other along a stream flowing into the northern end of West Bay.

On the west side of the island there is a long bay, West Bay, fringed by a sandy beach. This beach stretches, with but one short interruption, for about two kilometres. About the middle of it there is a granite boulder which has engraved on it King Chulalongkorn's monogram and the date 118 (1899-1900), commemorating a Royal visit to the island. There is another, smaller, beach at South Bay, and a few others, still smaller, in other parts of the island. Elsewhere the coast of the island is steep and rocky.

Off the north-west corner of Kaw Tao, and close to its coast, are two small islands joined together by a spit of sand. These islands are known as Kaw Nang Yuan. Off the south-east corner is another, and smaller island.

Here a few words may be said about landing on the island. The two best beaches for camping on, and where water is most readily obtainable, are those of West Bay and South Bay. The southern end of West Bay is fairly well sheltered from the south-west by a projecting point of rocks, and boats can land there throughout the year; unless there is a strong wind from the west or north-west. The northern end of West Bay, where water is also usually



to be had, is more exposed and boats cannot get close up to the land at low tide. Running across the entrance to West Bay there is a line of rocks, almost awash at low tide, which have to be avoided. South Bay is a good place for landing during the north-east monsoon. In the south-west monsoon it is more exposed. Moreover, during that season the water in the bay at low tide is very shallow, so much so that a boat cannot come within quarter of a mile of the shore.

There are no permanent streams on Kaw Tao. When the island was first visited, at the end of December, there were quite a number of running streams. The largest of these, which may be called Hui Wai, rises from the main ridge of the island near its centre, and flows into South Bay. There were also several streams flowing into West Bay. Another, smaller stream was seen running into a small bay, Sandy Cove, on the east side of the island. At least one stream, and probably others, flows down the northern slope of the third group of hills to the rocky northern coast. The main stream, Hui Wai, carried a considerable volume of water.

At the time of the second visit, about the middle of April, there was no running water seen in any of the streams. Their beds were quite dry in most cases. In the bed of Hui Wai, however, there were some fairly large water-holes, one of them had water to a depth of about  $1\frac{1}{2}$  metres. The streams flowing into West Bay were most of them quite dry; but one of them, flowing into the south end of the bay, had about a gallon of water in a rocky hole. This must have been a spring, for it served as the sole water supply for the camp during the whole week. Another stream, Hui Yang, flowing into the north end of this bay, had one or two very small water holes, not containing more than a couple of gallons apiece.

On the third visit to the island, in the third week of July, there was still less water. Many of the April water-holes, including that which had supplied the camp, were quite dry. On the Hui Wai there were still two fairly large water-holes, but they were a long way in from the beaches. One small stretch of running water was found, though, just below North-west Peak, on its northern face; too far away to be taken into account as a possible water supply for a camp on the beach.





DRY EVERGREEN FOREST.

The large tree to the left is *Hydnocarpus ilicifolia*.

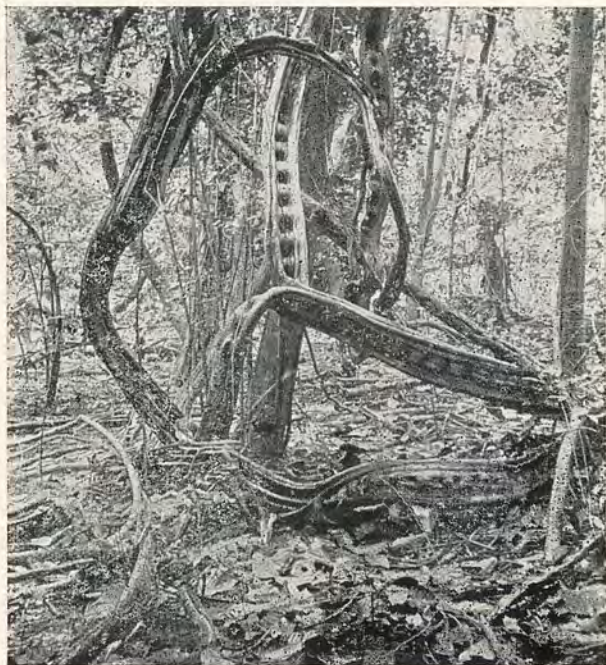












A. A large liane, *Bauhinia calcicola*, in dry evergreen forest.



B. A fern, *Microlepia speluncae*, occupying a glade in dry evergreen forest.



*Vegetation.*

The conditions obtaining on Kaw Tao have naturally had a profound influence on the vegetation. Rocky slopes with a shallow soil, watered probably by a small rainfall, cannot be expected to support a luxuriant vegetation. As might be anticipated then, the greater part of Kaw Tao is covered with a fairly uniform vegetation suited to these conditions, a forest which may be called Dry Evergreen Forest. There are places, however, where different conditions obtain, and these support other types of vegetation.

The chief plant communities found on Kaw Tao may be broadly classified as follows:—

1. Dry Evergreen Forest
2. High Evergreen Forest
  - a. High Evergreen Forest of Low-land Valleys
  - b. High Evergreen Forest of Hills
3. Mangrove Forest
4. Littoral Vegetation
  - a. Pes-caprae Formation
  - b. Littoral Woodland

1. *Dry Evergreen Forest.*

As has already been remarked, this forest occupies most of the surface of the island, from near sea-level to high up on the hills. It is composed of small to medium-sized trees, not clearly marked off into tiers. Many of the trees have regular, round boles with smooth pale bark, often blotched with crustaceous lichens. The leaves of the majority of the trees are more or less of the sclerophyllous type, leathery and dark green. The flowers of these trees are often small and inconspicuous. In the depths of the forest there is no herbaceous vegetation, and few or no shrubs. The ground is covered with dead leaves, which seem to disintegrate but slowly. A conspicuous feature on the ground, though hardly to be classed as vegetation, is the large number of empty, bleached shells of an operculate snail. Woody lianes are abundant, often forming tangles not at all easy to get through. Epiphytes, with the exception of crustaceous lichens and a few tenuous mosses, are absent in the denser parts of the



forest. Such a forest has a sombre and monotonous appearance, hardly relieved by the great blocks of granite which crop up here and there. The whole forest, however, is not like this, for there are open rocky spots and glades where a more varied vegetation makes its appearance. Before going on to speak of this, however, a brief sketch may be given of the components of the typical, or denser parts of the forest. The commonest trees there are :—

<i>Taxotrophis ilicifolia</i>	<i>Diospyros</i> spp.
<i>Hydnocarpus ilicifolia</i>	<i>Cyclostemon</i> sp.
<i>Phyllochlamys spinosa</i>	<i>Pterospermum</i> sp.
<i>Celtis</i> sp.	<i>Bassia</i> sp.
<i>Plectronia didyma</i>	<i>Memecylon edule</i>

Among the common lianes may be mentioned :—

<i>Hippocratea</i> sp.	<i>Bauhinia calcicola</i>
<i>Jasminum</i> spp.	<i>Strychnos</i> sp.
<i>Glossocarya mollis</i>	<i>Aganosma marginata</i>
<i>Olae scandens</i>	

A species of *Balanophora*, a curious root parasite, is occasionally to be met with in this forest.

In rocky places, where the trees are not able to reach their full development, and the canopy is not complete, more sun reaches the forest floor, and a more abundant vegetation is developed. The characteristic plant of such places is the bird's-nest fern (*Asplenium Nidus*\*), which is to be seen perched on rocks, on the lower part of tree trunks, and even on the ground. Associated with the *Asplenium* is often another fern, *Vittaria elongata*, which, on Kaw Tao, was never seen but on the root mass of the *Asplenium*. Another epiphyte not uncommon in these places, and penetrating some way into the forest, is *Saccolabium tenuicaule*, a pendulous orchid with narrow leaves and small yellow flowers. In addition to the *Asplenium* the larger granite boulders often carry a thick cap of ferns, such as *Polypodium phymatodes*, *Drynaria quercifolia* and

\* The writer is indebted to Dr. Eryl Smith and the Director of the Royal Botanic Gardens, Kew, for the determination of the ferns. He also has to thank the Director of the Royal Botanic Gardens, Kew, for supplying most of the identifications of grasses.





THE BIRD'S-NEST FERN (*Asplenium Nidus*)  
with another fern, *Vittaria elongata*, growing from its root-mass.













HIGH EVERGREEN FOREST.  
Collecting wood-oil from *Dipterocarpus alatus*.



*Nephrolepis acutifolia*, the latter with long pendulous fronds which hang down over the edge of the rock. Occasionally also, an orchid, *Cirrhopetalum* sp., appears on the rocks, but not at low altitudes. Another orchid, *Trichoglottis* sp., is not uncommon on rocks along stream beds. In these rocky spots some shrubs and herbs are also found. Among the shrubs the commonest are *Croton Cumingii*, *Chloradenia discolor*, *Pseuderanthemum graciliflorum*, and *Actephila* sp. The herbs are not very plentiful, but a species of *Amorphophallus* is often seen, and also a *Stemona*. Open patches in the dry evergreen forest may also occur through the fall of old trees. In the early stages of these patches the ground is often covered with a small herb, *Oldenlandia pterita*; sometimes a grass, *Oplismenus compositus*, takes possession of the open space. One fern, *Microlepia speluncae*, is peculiarly characteristic of such glades. It is to be found in nearly every glade, but is rarely to be seen elsewhere. These glades, no doubt, revert very quickly to the original forest.

## 2. *High Evergreen Forest.*

This forest may be divided into (a) The High Evergreen Forest of the Low-land Valleys, and (b) The High Evergreen of the Hills. Transition stages between High Evergreen Forest and Dry Evergreen Forest occur wherever the two come in contact.

a. *High Evergreen Forest of the Low-land Valleys* is well developed in only two places on the island. One is along the stream, Hui Wai, flowing into South Bay. The other, of larger extent, is along the streams flowing into the northern end of West Bay. In both these places the ground is fairly level, and not many metres above sea-level. The vegetation of this forest is much more abundant and varied than that of the dry evergreen forest. It can fairly readily be divided into several tiers. The topmost tier, however, does not form a continuous canopy. It is formed of the tops of lofty trees, such as *Dipterocarpus alatus*, *Hopea odorata*, *Sterculia campanulata* and *Parinarium* sp. The tops of these high trees project here and there above the canopy formed by the next tier of lower trees, of which there are a great variety of species, belonging



to such genera as *Aglaiia*, *Dysoxylum*, *Alstonia*, *Mangifera*, *Garcinia*, *Dracontomelum*, *Bouea*, *Cryptocarya*, *Beilschmiedia*, *Palaquium*, and *Ficus*. Beneath these comes another tier of smaller trees. Here several species with characteristic form will at once catch the eye: one is a tufted palm, *Caryota mitis*; another is a tall, broad-leaved *Dracaena*, and a third is a lofty screw-pine, *Pandanus* sp. In the next tier come shrubs, among which may be mentioned *Ixora stricta*, with bright red flowers, *Anaxagorea* sp., *Randia* sp. and a dwarf, erect, or semi-erect *Calamus*. The lowest tier is composed of herbs, though in no great abundance, in fact this tier is absent in the denser parts of the forest. Where it is present there may be found *Geophila reniformis*, *Corymbis longiflora*, *Pteris ensiformis* and *Hetaeria* sp. Lianes are common, chiefly belonging to the genera *Gnetum*, *Aganosma*, *Mussaenda*, *Acacia* and *Strychnos*. Epiphytes are absent, or very rare.

Glades also occur in these high evergreen forests, and in them a more varied herbaceous vegetation springs up, chiefly sedges (species of *Cyperus*, *Scleria* and *Mariscus*) and ferns (*Nephrolepis biserrata*).

b. *High Evergreen Forest of the Hills* is found in valleys and on ridges near the tops of some of the higher hills. It is somewhat similar to the high evergreen forest of the low-land valleys, but certain species, like *Dipterocarpus alatus* and *Sterculia campanulata*, are not found in these upper forests. On the other hand the upper forests contain species like *Lophopetalum* sp., *Livistona* sp., *Elaeocarpus ovalis* and *Elaeocarpus robustus*, not found in the lower forests. The dwarf *Calamus* in these forests often forms thickets, difficult to penetrate. Instead of the red *Ixora*, a small white-flowered species appears here.

### 3. *Mangrove Forest.*

There is only one small patch of mangrove forest on Kaw Tao, and that is at the mouth of the creek flowing into South Bay, and extending back to some low-lying ground behind the bay. For a considerable part of the year, during the south-west monsoon, the tides are not high enough to reach this forest regularly. In the



north-east monsoon, however, it is daily inundated at high tide. Towards the mouth of the creek *Rhizophora conjugata* is dominant, its maze of stilt roots occupying the whole channel of the creek. On the low-lying ground further inland it disappears, its place being taken by *Bruguiera* spp., *Excoecaria Agallocha*, *Cynometra bijuga*, *Dolichandrone spathacea* and *Heritiera littoralis*, to mention the chief species. Neither *Acanthus ilicifolius* nor *A. ebracteatus* is to be found here, though other species of the smaller plants characteristic of the mangrove swamps, such as *Flagellaria indica*, *Acrostichum aureum* and *Derris trifoliata* are to be seen. An epiphytic fern, *Cyclophorus adnascens*, is often abundant on the trees.

#### 4. *Littoral Vegetation.*

Throughout the eastern tropics the vegetation of the sea-shores is very similar, and that of Kaw Tao is no exception to the general rule. It is, as elsewhere, divided into two zones: (a) the open formation of the sandy beach, often known as the Pes-caprae Formation, and (b) Littoral Woodland.

a. *The Pes-caprae Formation* usually shows an abundant growth of the characteristic *Ipomoea pes-caprae* running out over the sand. Three grasses are also abundant: *Thuarea sarmentosa*, *Sporobolus virginicus* and *Lepturus repens*. *Spinifex littoreus*, a common grass on many sandy shores, was only seen in a small patch at one spot. *Remirea maritima*, another usually common shore plant, was not seen at all. *Canavalia obtusifolia* was present but by no means common. The parasitic *Cassytha filiformis* in some places formed, with its yellowish-brown threads, a regular net-work over the sand, attacking particularly *Thuarea sarmentosa*. The only plants seen of *Canavalia obtusifolia* were badly infested with this parasite, which may be the reason it was not commoner.

b. *The Littoral Woodland* is chiefly developed on level sandy ground above the level of the beach at West Bay and South Bay. On the seaward edge of the littoral woodland occurs a fringe of various shrubs and small trees, particularly *Scaevola frutescens*, *Thespesia populnea*, *Hibiscus tilaceus*, *Cordia subcordata*, *Sophora*



*tomentosa*, *Barringtonia asiatica*, *Guettarda speciosa*, *Wedelia biflora* and *Pemphis acidula*. On Kaw Tao this vegetation is but a fringe; though on some coasts it forms a considerable belt with the *Barringtonia* predominating. Inland from this fringe comes, in West Bay, a narrow strip of open woodland, formed chiefly of, *Casuarina equisetifolia*. In other places are found *Calophyllum inophyllum*, *Pandanus* sp., *Hernandia ovigera*, *Erythrina variegata*, *Terminalia Catappa*, *Cerbera lactaria*, and such littoral-species. The ground between these trees is sometimes more or less open, and then supports a number of shrubs and herbs, like *Pseuderanthemum* sp., *Cycas Rumphii*, *Colubrina asiatica*, *Clerodendron inerme*, *Caesalpinia crista*, *Tacca pinnatifolia*, *Crinum asiaticum*, *Euphorbia Atoto*, *Portulaca* sp., and the same three grasses that extend on to the beach, with the addition of *Ischaemum muticum*. A number of climbers are also to be found here, among them *Pisonia aculeata*, *Calonietyon album*, *Derris scandens* and *Tylophora asthmatica*. Here, too, *Cassytha filiformis* is to be found, spreading its network over the bushes.

Flowers are much more conspicuous in the littoral vegetation than elsewhere on the island, and often make quite a brave show. One of the brightest plants is the *Pseuderanthemum*, which produces its purple flowers through a great part of the year. Yellow-flowered species are, perhaps, the commonest, being represented by *Thespesia*, *Hibiscus*, *Wedelia*, *Sophora* and the small herbaceous *Portulaca*. The last, however, only opens its blossoms for a few hours in the forenoon. The chief white flowered species are *Clerodendron*, *Guettarda*, *Calophyllum* and *Barringtonia*. The large flowers of the last seem to open only at night, and drop in the early morning. These delicate, tassel-like flowers, scattered over the sand, in the deep shade of the tree, make a sight not readily forgotten.

The above account includes the principal associations of plants to be found on the island, but there are some smaller communities that do not come under those heads. One of these is the vegetation of exposed rocky headlands, where a tufted, scented grass,

*Cymbopogon* sp., predominates. In similar places, but with a little more soil, a species of *Memecylon* sometimes forms a nearly pure growth. In one or two rocky spots on the higher ridges and peaks the rocks carry quite a number of plants, such as mosses, filmy ferns and orchids. No doubt these high points catch a good deal of cloud, the extra moisture so obtained making possible this development of lithophytes. Behind South Bay, and further inland than the mangrove swamp, along the banks of Hui Wai, there is some low-lying ground, swampy in the rains, where a regular grove of a swamp rattan, *Daemonorops* sp., grows. Such communities, however, occupy but a small place in the general vegetation.

On Kaw Tao man has had but little influence on the vegetation. There are, perhaps a dozen species of plants that may have been introduced through his agency; but they are present in small numbers, which do not alter the face of the existing vegetation. Six or seven feeble looking blades of that scourge, lalang, were seen in one spot. They are likely to be choked out, however, unless they gain human assistance. A few trees have been felled here and there near the coast. Two or three small partial clearings have been made, and a few coco-nut seedlings put down in them; but the seedlings do not seem to be doing well and the clearings are quickly reverting to the original forest. Only in one place is there a plantation which has reached a further stage. This is a plantation of some eight or nine areca palms. These have now attained their full size, but for some reason or another they show no sign of flower or fruit.

Grazing animals, which often have great influence on the vegetation, are absent from Kaw Tao.



