

NOTES ON THE MANGROVE SWAMPS OF KENYA.

By R. M. GRAHAM.

It is estimated that the Mangrove Swamps in Kenya cover an area of about 180 square miles. All have been gazetted as Forest Reserves. Since only four creek systems have been surveyed, it is obvious that the area given is only approximate, but the composition of the gazetted areas does not vary very much.

Judging by the four swamps that have been surveyed, it seems probable that only about two-thirds of the total area can be classed as merchantable forest. The remainder consists of scrub mchu, lilana and undersized mkandaa. Of the merchantable forest, probably 70% consists of well-grown mkoko, with scattered muia and mkandaa, and 30% of badly-shaped mkandaa which, however, finds a market as fuel.

THE FLORA.

Few species are recognised in the Kenya swamps. Whether this is because only a few species are actually represented, or because no one has worked over the area systematically, I do not know, but I imagine that (a) there are more species in Malay and the Philippines than there are in Kenya, and (b) some of the Kenya species still remain to be identified. It is unfortunate that botanical specimens from the swamps are almost always very difficult to preserve, owing to their somewhat succulent nature. Atmospheric conditions also are usually against quick drying out, in the swamps.

The following are the principal species recognised:—

	NATIVE NAME.
1. RHIZOPHORACEÆ.	
<i>Rhizophora mucronata</i> , Lam.	Mkoko (Swa.).
<i>Bruguiera gymnorrhiza</i> , Lam.	Muia (Swa.).
	Msindi (Swa.).
	Mrifu (Swa. Lamu).
	Mchofi (Swa. Gazi).
	Mkandaa (Swa.).
<i>Ceriops candolleana</i> , Arn.	
2. SONNERATIACEÆ.	
<i>Sonneratia acida</i> , Linn.	Mlilana (Swa.).
	Mpia (Swa.).
3. VERBENACEÆ.	
<i>Avicennia officinalis</i> , L.	Mchu (Swa.).
	Mtu (Swa. Vanga).
	Mutu (Bajun).

SUBSIDIARY SPECIES.

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| 4. CASUARINACEÆ. | | |
| | <i>Casuarina equisetifolia</i> , L. | Mvinji (Swa.). |
| 5. COMBRETACEÆ. | | |
| | <i>Lumnitzera racemosa</i> , wild. | Kikandaa (Swa.).
Mnyanywa (Swa. Vanga). |
| 6. LYTHRACEÆ. | | |
| | <i>Pemphis acidulata</i> , Forst. | Mnyinyuwa (Swa. Vanga).
Mnyanywa (Swa. Vanga). |
| 7. MELIACEÆ. | | |
| | <i>Carapa obovata</i> , Bl. | Mkomafi (Swa.).
Mronga (Swa. Vanga). |
| 8. STERCULIACEÆ. | | |
| | <i>Heritiera littoralis</i> , L. | Msikundazi (Swa.).
Mkukushu (Swa. Vanga).
Mkokoshi (Swa. Vanga).
(Aleni Island). |

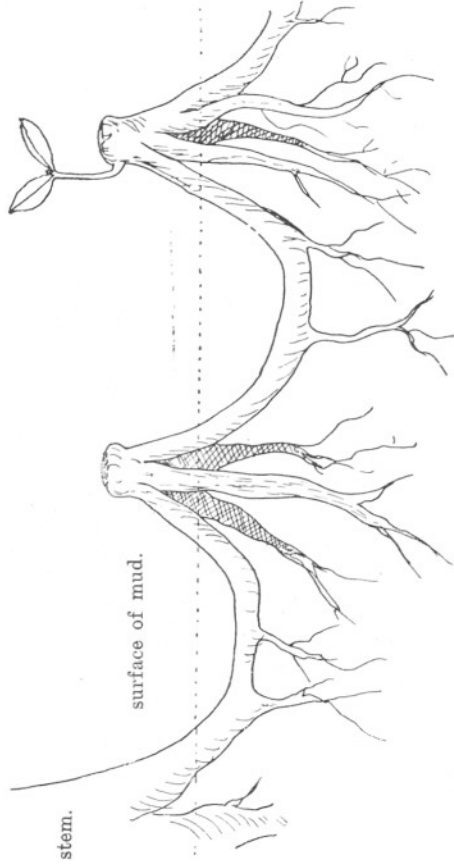
Apart from these a few small shrubs, herbs and grasses, and one fern-like plant found at Vanga can live on land which is occasionally covered by salt-water for a short period, but they are quite negligible.

FOREST CHARACTERISTICS.

Rhisophora mucronata.—This is the commonest tree of the swamps and is by far the most important. It forms about ninety per cent. of the stock in good mud. It grows to a height of about 60 ft. with a diameter of about 15 inches, though it is rarely that one can find stands of trees of this size nowadays, owing to the fact that the large trees have mostly been felled for their bark. Further, few young trees are allowed to grow beyond the pole size before they are felled.

When grown in close stands in good mud, Mkoko has a straight cylindrical bole. The leaves are about six to seven inches long, with a small but pronounced mucro. The bark is somewhat rough on old trees, and resembles crocodile leather. It is easily stripped from the stems.

The most striking point about the species is its stilt roots. These appear about the second or third year a few inches up the stem, and grow down into the mud. Well-grown trees have roots starting about three feet or more up the stem, though by that time the lower part of the stem, together with the roots first formed, has disappeared. As a matter of fact, the lower part of the stem does not develop a diameter of more than two to three inches before it becomes unnecessary to the tree, and rots away. Young roots are fairly smooth, brown, soft, cylindrical, easily broken, and are capped with a distinctive black root cap, which can easily be detached from a root which



Knee-roots of *Brugiera* and *Ceriops*. (Diagram.)

NOTE.—*Brugiera* sometimes grows twigs from the knee-roots.
Ceriops does not do so.

has not yet reached the mud. Old roots are tough and woody, very gnarled-looking, and sometimes branched. Roots may be sent down from the stem or from branches as much as twenty feet up, but they never, as far as I know, take root in the mud under these circumstances. Such roots are usually to be seen growing from trees in the most exposed positions, and probably require light and possibly wind for their development.

The flowers are yellowish-white, and pleasantly scented, the scent resembling that of nutmeg. The seeds germinate on the trees, the resulting embryos being usually about 15 inches long, and $\frac{3}{4}$ in. in diameter before they fall, though specimens over 2 ft. in length can be found. They are pointed at the base, and are somewhat thickened for a few inches above this point, so that when they fall they automatically plant themselves in the mud if the tide is out. At high tide they fall into the water, and float away vertically, with not more than $\frac{1}{4}$ in. of the plumule showing above the surface of the water. They can probably retain their vitality for many weeks in salt water, and are carried considerable distances by the tides and ocean currents.

The embryos are normally olive-green in colour, but very pale yellow specimens can sometimes be found. In good mud roots will be sent out below the surface about 15 days after planting, shortly followed by the appearance of a pair of leaves from the plumule. In sandy mud, however, roots may not appear for three or four weeks, and in pure sand they may fail to grow at all.

Mkoko is a hardy tree, and can be found growing in the most unlikely localities, on coral out-crops, etc., but such trees are stunted and deformed. Very large old trees do not seem to set many seed, or the seed may not be fertile, so that good stands of big trees have practically no undergrowth. Trees about 25 feet high, however, are, in good mud, always surrounded by dense masses of regeneration. Three year old trees have been observed flowering, but they probably do not set fertile seed until the fourth or fifth year. Most of the embryos fall between March and June, but flowers and fruits can always be found on odd trees. Mkoko does not coppice when it is felled.

Bruguiera gymnorhiza.—This is the largest of the Kenya Mangroves. It grows to a height of about 80 feet, though large trees are almost always stag-headed. The bark is dark and rough. The leaves are very like those of Mkoko, but have no mucro. There are no stilt roots, but the tree is buttressed at the base and it also throws up "knee-roots." It does not coppice when felled, but leafy shoots will sometimes grow from the exposed portion of the knee-roots. Whether these shoots ever develop into large trees or not, I do not know; nor have I seen this appearance mentioned in any work on mangroves.

The flowers are usually red and scentless, but there is also a yellow-flowered variety, which may be *B. eriopetela*. The embryos are only 6 in to 8 in. long, thick and smooth.

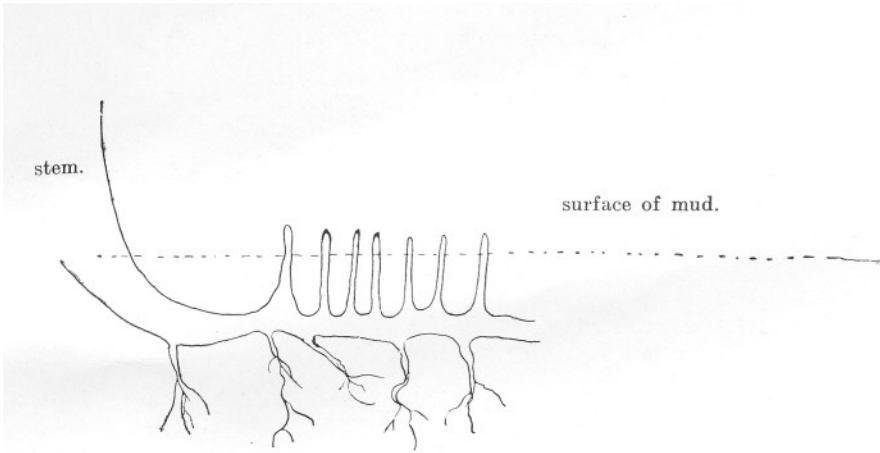
This is not such a common tree as Mkoko, but it may sometimes be found in pure stands. It seems to be able to thrive in drier areas than Mkoko. Like that species, it will flower and set fruit while it is still very young.

Ceriops candolleana.—Often described as a scrub, but actually, under optimum conditions, it will grow into a fair sized tree, yielding poles which are said to last better than those of Mkoko or Muia. The bark is reddish, fairly smooth and rich in tannin. Mkandaa has no stilt-roots, but it is buttressed and has knee-roots like Muia. The flowers are small, numerous, white, scentless. The leaves are about 2½ ins. long, roundish, and somewhat crowded at the ends of the twigs. The embryos are usually 10 ins. to 12 ins. long, thin and distinctly ribbed. Plants not more than two to three feet high may be found flowering and fruiting freely.

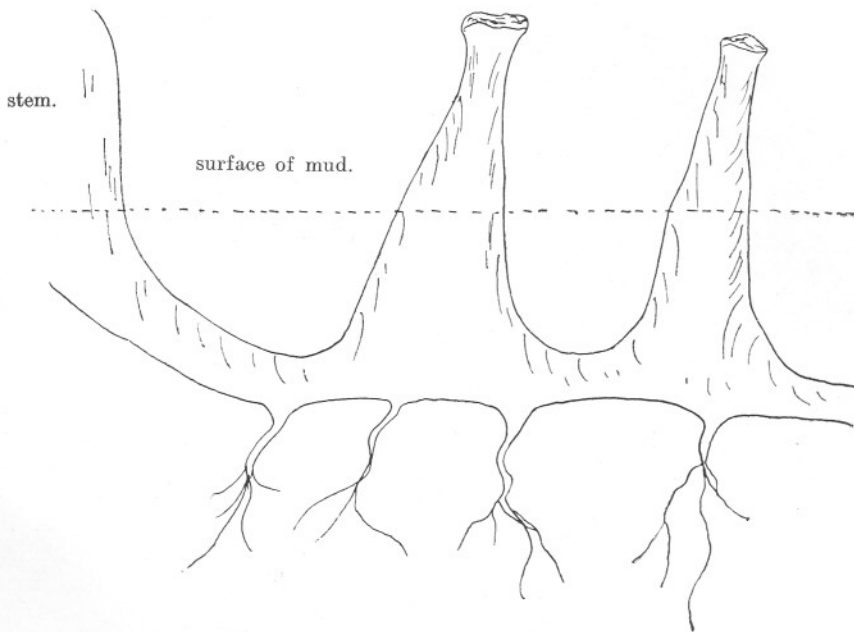
Avicennia officinalis.—Mehu is by far the commonest swamp tree, apart from the tree mangroves (*Rhizophoraceæ*). It covers an area of about 30% of the swamps, and will grow in any land which is ever covered by salt water, provided that it is not covered for more than about 20 hours a day. In optimum conditions it can be a fine, well-shaped tree, but normally it is very branchy. The bark is smooth yellow and somewhat powdery, and the leaves are about 2½ in. x ¾ in. The undersides are often covered with salt crystals. The flowers are very small, brownish, with a sweet and somewhat sickly scent. The seeds germinate on the tree, and fall when they are about 1 in. in diameter, flattish, and about ¼ in. thick. The roots send up numerous asparagus-like pneumatophores, about as thick as a pencil, which protrude as much as 15 in. above the level of the mud, where they are frequently covered by tidal water. When this is not the case, they frequently do not protrude at all in sandy soil. These pneumatophores consist of a layer of spongy substance surrounding a thin fibrous core.

It is the most accommodating of all the swamp species, and will sometimes form a complete fringe round a creek on the landward and seaward sides. It is a handsome tree when well-grown, resembling a willow, and its light green foliage shows up very well against the dark green of the *Rhizophoraceæ*. The timber is soft, white, with a peculiar criss-cross grain. Big stems have a dark brown centre, but they are usually rotten. It is possible that there are two or more species of *Avicennia* in Kenya, but only one is recognised at present. The trees will often coppice when felled.

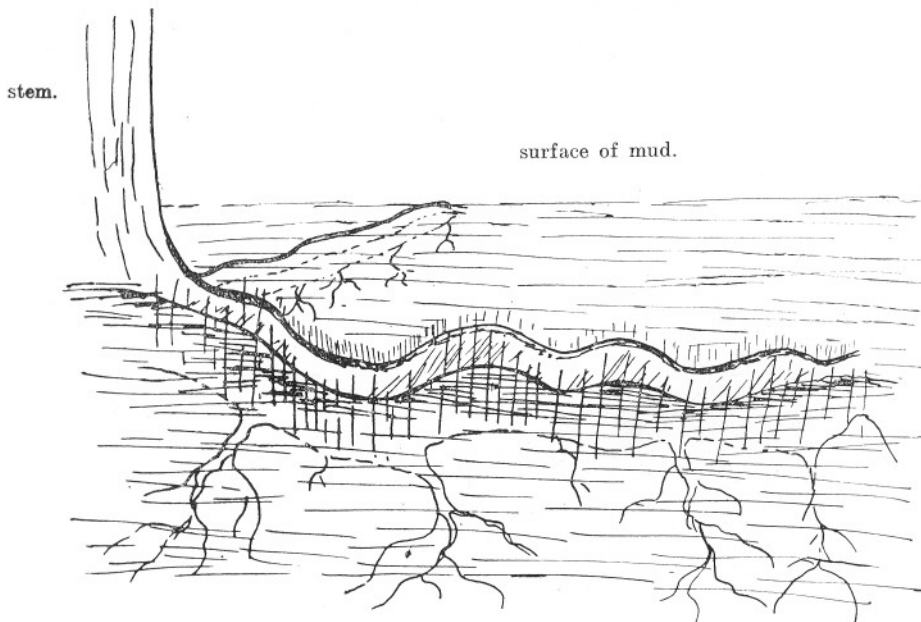
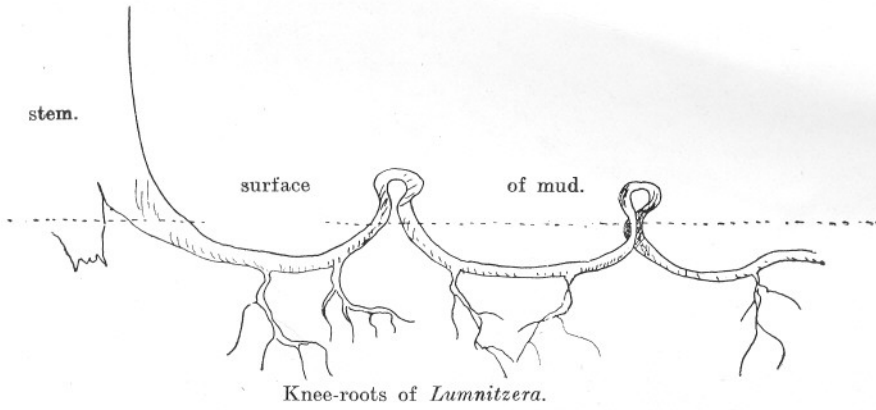
Sonneratia acida.—Usually a small tree of no importance in itself. Its chief claim to fame lies in the fact that it can exist on land less frequently exposed to the air than any other tree of these swamps.



Pneumatophores of *Avicennia*. (Diagram.)



Pneumatophores of *Sonneratia*. (Diagram.)



Ribbon root of *Carapa* or *Heritiera* running along surface with the upper edge exposed to the air. (Diagram.)

It is usually found forming a fringe along the edge of the deep water in the creeks, and performs a useful service by raising the level of the mud. In the Vanga swamps, however, where it is very common, it grows into quite a large tree.

The leaves are about 3 inches in diameter, and roundish, and the white flowers are large and showy. The fruits are $1\frac{1}{2}$ in. in diameter, round, flattened, with a small point or peg above. The name *mpia* is given, because *pia* means a top, and the fruits rather resemble one. The seeds are very small. There are no stilt-roots, but very large pneumatophores are formed, which may be 10 inches in diameter at the base, and $2\frac{1}{2}$ feet high. They are formed of a light corky material, and are used locally as floats for fishing nets.

Pemphis acidulata.—A scrub of no importance growing to a height of about 12 feet—usually 6 feet—on barren coral outcrops covered only by spring tides. It is very common round the Vanga swamps, and I have seen one specimen at Mida. The flowers are white, delicate, $\frac{1}{2}$ in. in diameter. The leaves are succulent, $\frac{1}{2}$ in. x $\frac{1}{4}$ in., pubescent. Bark rough, dark grey.

Carapa obovate.—A small tree occurring in most swamps, but particularly common at Vanga. It grows usually some distance up the creeks where it can get a certain amount of fresh water, as well as sea water. The flowers are yellowish, pink at the base, small. Leaves about 3 in. x 2 in., somewhat rounded at the apex. The fruits are about the size of a small football, and weigh about 12 lbs. They split up into large angular bodies which are the seed-covers. These float for long distances in the sea, and apparently retain their vitality for many months. The bark is smooth and yellowish. The roots are vertically flattened ("ribbon-roots") and the upper edges protrude above the mud.

Heritiera littoralis.—A fine tall straight-growing tree, much in demand for use as dhow-masts, for which reason it is seldom found growing near Mombasa. The base of the stem is buttressed, and the bark is smooth. It throws out ribbon-roots like *Carapa*, and is found in similar localities, except that it likes a greater admixture of fresh water. The flowers are small, and the keeled, brown, woody fruits, 3 in. to $3\frac{1}{2}$ in. long, can float for great distances in the sea.

Lumnitzera racemosa.—Normally a straight-growing shrub, 6 to 9 feet high, of no importance, but in the Vanga swamps growing sometimes into a fair-sized tree, providing useful poles and firewood. The flowers are white and scented, and the leaves about $1\frac{1}{2}$ in. long. At first sight the plant can easily be mistaken for a *Mkandaa*. The bark on small specimens is smooth and red, but on large trees it is dark and rough.

Casuarina equisetifolia.—This tree occurs in places growing in pure sand just above high tide level. It is thus not a true swamp species,

but neither can it be included in the description of any of the inland forests. It is straight-growing, and if it were more plentiful, it would be a useful species. It appears to be spreading, and may be a comparatively recent arrival in Kenya.

ECONOMIC ASPECTS.

The most important item produced in the swamps is poles. In 1929, about 470,000 were sold, and about 40,000 issued free to natives for housebuilding. About 30,000 headloads of withies also came from the swamps. Of the poles, nearly 300,000 were exported to Arabia and India.

Mangroves seed very freely, but blank areas are treated by the Forest Department, and in 1929, about 1,300,000 embryos of Mkoko were planted out. The vast majority of poles and withies are obtained from Mkoko, though Muia and Mkandaa supply a few. The Government royalty on poles is from cents 73 to Shs. 1/50 per 20, according to size, and for withies, cents 10 for 20 (one headload). It costs about Shs. 3/50 to plant an acre of Mkoko (*i.e.*, 1,120 embryos).

The most important item is firewood, of which 446,000 stacked cubic feet were sold in 1929. Of the *Rhizophoraceæ*, Mkandaa provides the most popular household fuel, followed by Mkoko, and then Muia. Mehu is not used as a household fuel at all, but on the other hand, it is always used in the manufacture of lime from coral.

Formerly, large quantities of Mkoko bark were sold for the sake of its tannin, but since trees under 6 ins. in diameter produce bark of no value, and since practically all stands of large Mkoko have been cut out, very little revenue is obtained from this source nowadays. Bark from Muia and Mkandaa is rich in tannin, but finds no sale.

The timber of the three species of *Rhizophoraceæ* is hard, heavy, and dark-brown in colour. A small quantity of timber from Muia and Mkoko is still used for dhow-building, chiefly at Lamu, but otherwise there is no sale for it as timber.

Milana produces a few poles in the Vanga area, and occasionally a tree is cut for timber. Mkomafi has a pinkish timber, easily worked, which is used a little. It would be more popular if large trees were commoner. Msikundazi timber is said to be very good, but large trees are few and scattered. Poles of this species are much used for dhow masts. Poles of Mvinji are also used for dhow masts, but the timber is not used.

GENERAL CHARACTERISTICS.

Except during heavy rains, the water in the swamps is quite clear. When travelling by boat up the creeks, one is almost invariably faced by a fringe of Mehu or Milana where the soil is sandy.

Where there is good mud, however, Mkoko grows right down to the edge of the channels. In among the Mkoko are scattered Muia and Mkandaa, but the Mkoko are the commonest trees and hold the eye more because of their tangled stilt-roots. Dense patches of young seedlings are normally present under the parent trees. In places usually far up the creeks, one notices a few Mkomafi, and still further up, one may find Msikundazi.

On the landward side, there are frequently fringes of palms—*Hyphaene*, or south of Mombasa, *Borassus sp.*, mixed with the "tooth-brush tree" (*Salvadora persica*—Msuaki) and *Sideroxylon diospyroides* (Mkoko-bara), etc., etc. These come down to within a yard or so of high-water mark. Next, if the ground is level, there will be a strip varying from 10 yards to half a mile in width, of scrubby Mchu, and finally one reaches the *Rhizophoraceæ* in the swamps proper. Normally the Mkoko are separated from the Mchu by a belt of small Mkandaa.

FAUNA.

In the creeks, many birds, such as Kingfishers white and blue Herons, Kites, Curlew, Sandpipers of different sizes, Fish-eagles, etc., are common. Oriels and a few other land-birds are also found, and in the wide shallow sandy-bottomed reaches at the mouths of many creeks, one meets with pelicans, flamingoes, ducks and large stork-like birds. Stone-curlew (Dikkop) and several species of francolins live just on the edges of the swamps in some places, and provide fair sport.

On the landward side countless small crabs, each with one disproportionately large red or blue claw, seem to do the work normally done by earthworms. Another larger crab, up to 6in. to 7in. across, with bright red claws, is common. This is the species which is responsible for some damage to Mkoko seedlings. It feeds on green vegetation, and is particularly fond of Mchu leaves. The small variety mentioned above seems to feed on decaying organic matter. The large edible crab is found in fairly deep holes in good mud which is covered by the tide daily, and can be caught by means of a hooked stick which is thrust down into the hole, and quickly withdrawn. Many fine fish enter the creeks and large edible prawns are common. The natives catch these, and the fish, by means of nets, fishtraps of various sorts, as well as by using the ordinary hook and line. Sometimes pools are poisoned with the juices extracted from various plants, and the fish are taken as they float away in a stupified condition.

Manitu ("Mermaids") probably occur in most creeks, and are sometimes caught. Amphibious mudfish are common, and two or three Chinamen make their living in the creeks by catching and exporting bêche-de-mer. Stilt-roots of Mkoko and pneumatophores of *Mlilana* are often found with small oysters which, however, the

natives do not eat, though in Vanga they collect quantities of " tiger-shells " and eat the occupants.

Small green tree snakes are often seen well inside the swamps, and jackals, genets, civets, mongoose spp. and probably cats come down at night and hunt for crabs and fish.

Many species of buck, such as topi, a gazelle-like Granti (probably Petersi), waterbuck, lesser kudu, greater kudu (north of Malindi), roan antelope, duiker spp., sable antelope (Vanga), bushbuck, etc., come down at night to eat salt earth, or to browse on Mchu leaves, which contain much salt. They do not venture into the mud, but stay on the mchu-covered sand-ghats. Zebra, elephant, rhino, leopard and lion also come down to these flats at night, while troops of baboons are commonly found there by day. At the mouths of the creeks there are often small islands covered with Mvinji and scrubby growth, and on these live many dik-dik. They feed on succulent leaves, and do entirely without fresh water.

Crocodiles are found in many of the creeks, living in salt water, though they are more plentiful higher up where there is often a slight flow of fresh water as well.

Very few insects seem to eat the leaves of the swamp trees, but mosquitos are numerous, commonly living in crab-holes at low tide, and retiring to the leaves of Mchu, etc., at high tide. Fire flies are present, but are not very numerous.

SPECIAL FEATURES OF SWAMP TREES.

Most swamp trees differ from the land-flora in two respects :

- (a) The seeds of some, *i.e.*, the *Rhizophoraceæ* and *Mchu* germinate on the trees, so that they waste no time in taking root once they fall.
- (b) Their roots (with the exception of *Mvinji* and *Pemphis* which do not grow in mud) have special adaptations in order to secure aeration.

i.e., Mkoiko keeps a great part of its roots out of the mud altogether.

Muia, Mkandaa, and Lumnitzera have knee-roots.

Mlilana and Mchu have pneumatophores.

Mkomafi and Msikundazi have ribbon-roots.