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Item Type	Journal Contribution
Authors	Isaac, W.E.
Download date	24/05/2021 04:12:07
Link to Item	http://hdl.handle.net/1834/7176

MARINE BOTANY OF THE KENYA COAST

4. ANGIOSPERMS

By

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ACKNOWLEDGEMENTS

The author acknowledges with thanks the generous financial assistance of the Rockefeller Foundation, Dr. C. den Hartog of the Rijksherbarium for identification of specimens; the British Museum of Natural History and Kew Herbarium for working facilities and the provision of photostat copies of literature which was not available in East Africa.

INTRODUCTION

Marine flowering plants are a prominent feature of the intertidal zone of the Kenya coast. They extend from the low water level of neap tides (i.e. they are rarely exposed except at spring tides) to situations well beyond the reef in deep water. Some are exposed for considerable periods during spring tides while others, although situated high on the shore, grow in pools and depressions where a certain amount of water is left by the receding tide.

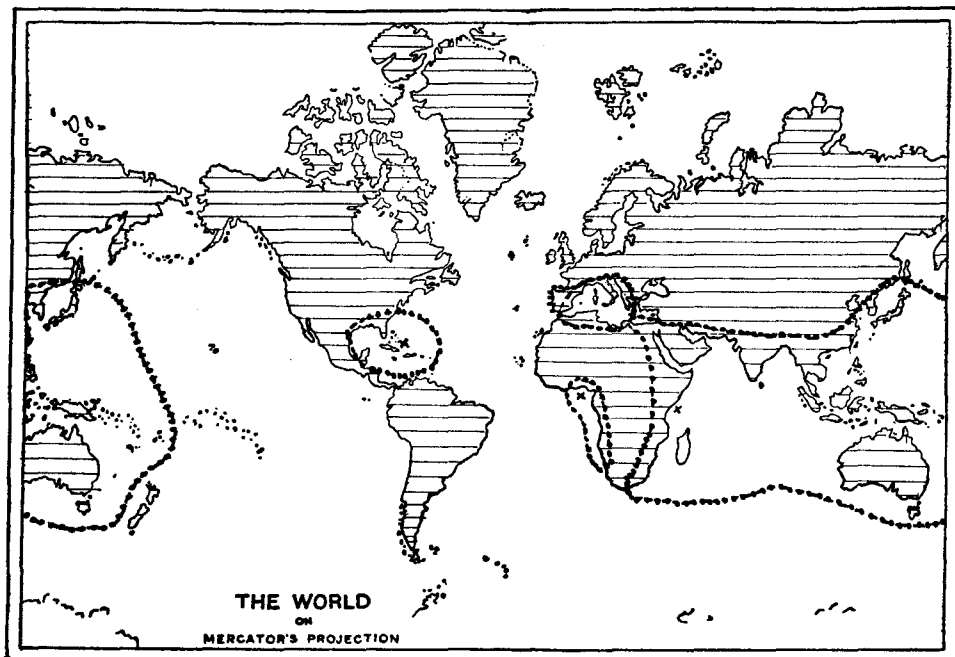


Fig. 1

Map showing World distribution of the marine forms of Potamogetonaceae and Hydrocharitaceae which occur on the coast of Kenya (with the exception of *Zostera*.)

These plants are frequently referred to in literature as "Sea Grasses". Only *Zostera* and *Halodule* however, on this coast, are grass-like in appearance.

The genera represented in Kenya all possess a creeping stem which may be on or near the surface of the mud or sand; these stems give rise at intervals to upright branches or leafy shoots and to a root system which anchors the plants firmly in the substratum. These stems may be slender and soft, thick and tough or woody.

The plants belong to the following families:— **Zosteraceae**, *Zostera*; **Potamogetonaceae**, *Cymodocea*, *Syringodium*, *Halodule*; **Hydrocharitaceae**, *Halophila*, *Thalassia*, *Enhalus*.

The pattern of distribution of these genera throughout the world is of considerable interest to botanists and plant geographers. These genera, with the exception of *Zostera*, occur only on the shores enclosed within the dotted lines on the map on page 29 (Fig. 1). The crosses on the map indicate *Halodule wrightii*, the only species which is common to East Africa, West Africa and the Caribbean.

Zostera grows on shores within the dotted lines shown in Fig. 2.

In a paper on the "Status of the Dugong", Jarman (1966) states that these animals feed exclusively on marine herbs of the Hydrocharitaceae and Potamogetonaceae. He mentions *Cymodocea rotundata*, *Halodule wrightii*, *Halophila ovalis* and *H. stipulacea* (*H. balfourii*) but omits *Syringodium isoetifolium* which according to Mr. Ian Prit-

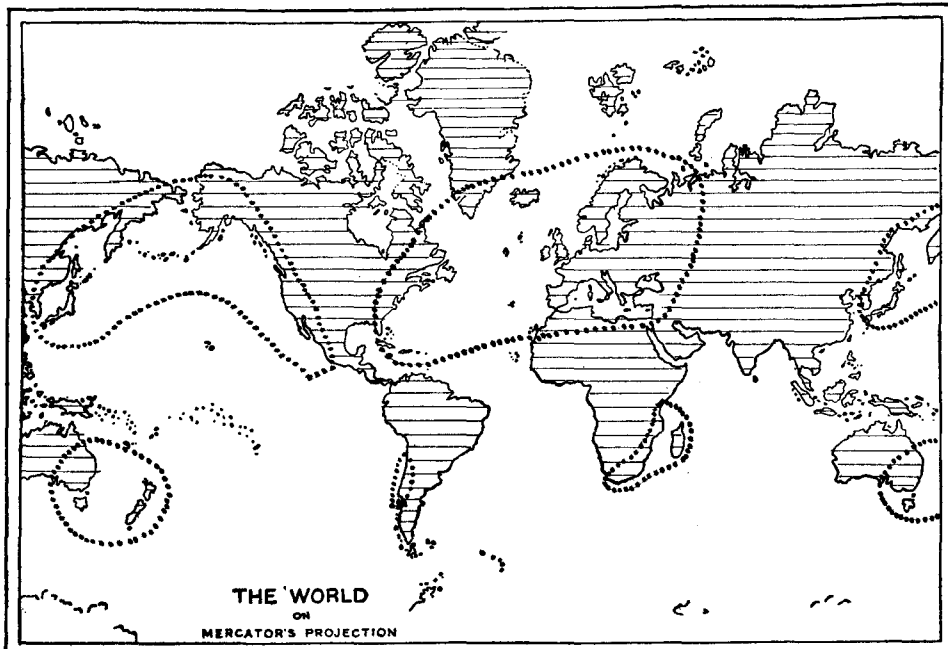


Fig. 2

Map showing World distribution of the genus *Zostera*. Only on the east coast of Africa is it found really in the tropics.

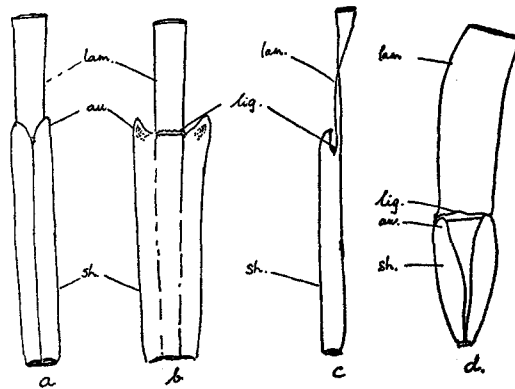


Fig. 3

chard, who observed the dugongs for a number of years, is a principal item in their diet.

In the following descriptions the terms sheath, ligule and auricle occur frequently in descriptions of leaves. The following illustrations will explain how these terms are applied. lam-lamina; lig.-ligule; au-auricle; sh.-sheath.

Halodule uninervis (Forsk.) Aschers. a. basal part of leaf b. sheath opened to show ligule c. side view.

Cymodocea ciliata Ehrenb. ex Aschers. d. basal part of leaf showing, infolded sheath and ligule.

Key to the Genera

- 1. Leaves cylindrical *Syringodium*
- 1'. Leaves flat 2
- 2. Leaves ovate, lanceolate or linear, petiolate *Halophila*
- 2'. Leaves linear straplike without petioles 3
- 3. Leaf apices toothed *Halodule*
- 3'. Leaf apices rounded 4
- 4. Leaves up to 2 mm. broad *Zostera*
- 4'. Leaves more than 2 mm. broad 5
- 5. Creeping stem woody more than 1 cm. in diam. and covered in long, stiff bristles . . . *Enhalus*
- 5'. Creeping stem woody or soft less than 1 cm. diam. with scales at nodes at least when young 6
- 6. Leaves arising from a conspicuous upright stem *Cymodocea*
- 6'. Leaves arising from the creeping stem or on a short shoot there-from 7
- 7. Leaves usually falcate, shoot enclosed in a shaggy agglomeration of old leaf-bases ligule absent *Thalassia*
- 7'. Leaves usually straight, leaf-bases if present, distinguishable as sheaths of former leaves with auricles and ligules *Cymodocea*

Zostera capensis Setchell (Plate 1, a—c)

Plants monoecious. *Rhizome* slender creeping, rooting at nodes, 1–2 mm. in diam. *Leaves* sheathing; sheath open but incurved to enclose the younger leaves, 2–5 cm. long, auricles rounded; ligules short, delicate; lamina linear 8–20 cm. or more in length, 1–2 mm. broad, tip rounded, apex narrowly deep-notched, median vein fairly conspicuous. *Flowers* not found as yet on the Kenya coast but Setchell describes them as follows: "Flowers borne on a short erect stem 5–9 cm. high, 3–4 internodes, spathe twice as broad as the peduncle; spadix 1–3 mm. broad, 10–15 mm. long, with about 7 flowers, retinaculi (bracts opposite the stamens) ovate-lanceolate, 1–1.5 mm. long, 0.5–1 mm. broad. *Seeds* about 2 mm. long, 1 mm. broad, broadly cylindrical in the dry state with about 20 fine grooves (when wet these are less distinct)".

WORLD DISTRIBUTION: South Africa and Mozambique. It has also been reported from Dar es Salaam.

KENYA: Lamu, Greenway & Rawlins 8902, F. M. Isaac A 187; Mombasa, F. M. Isaac A 105; Gazi, F. M. Isaac A 98.

Flowers have so far not been observed on the East African coast but Setchell's description of the type specimens of *Z. capensis* and a drawing of an inflorescence have been included so that collectors may be encouraged to seek them and having found them will have some help in interpreting them.

Descriptions of the nature of the inflorescence in *Zostera* are vague but Willis's Dictionary of Flowering Plants and Ferns (1960) is quoted:

"*Inflorescence* a flattened spadix, enclosed at flowering time in a spathe (the sheath of the uppermost leaf). This is open down one side and on the corresponding side of the spadix the flowers are borne, the essential organs forming two vertical rows, each composed of a carpel and a stamen alternately. On the outer side of the spadix next the stamens is often a small leaf (retinaculum). Each carpel contains one ovule and has two flat stigmas. The stamen consists of two half anthers, joined by a small connective. It is difficult to decide what is the actual 'flower' in this plant; the usual view is that each stamen with the carpel on the same level forms a flower, the retinaculum representing the bract. Flowers are submerged like the rest of the plant. The pollen grains are long threads of the same specific gravity as salt water so when discharged they float freely at any level. The stigmas are large and have a good chance of catching some of the grains.

"The flowers are protogynous, i.e. the stigmas are receptive in any given spadix before the anthers are ripe and ready to shed pollen."

This genus is, in general, found in cold or cool temperate regions. Thus its occurrence in the tropical waters of East Africa is of considerable interest. So far it has only been found in the ports of Lamu and Mombasa and at Gazi, which is an ancient port, hence the possibility that it has been carried in by ships cannot be completely overlooked.

Cymodocea König

This genus is at present under revision. Dr. den Hartog of the Rijksherbarium considers that *C. ciliata* belongs to a distinct and as yet unpublished genus. The author would also place *C. serrulata* in this new genus. So little is known about the floral structure of *C. rotundata* that no suggestions can be made at this stage. *Cymodocea nodosa* which is found in the Mediterranean appears to be quite distinct in many respects from both *C. ciliata* and *C. serrulata*.

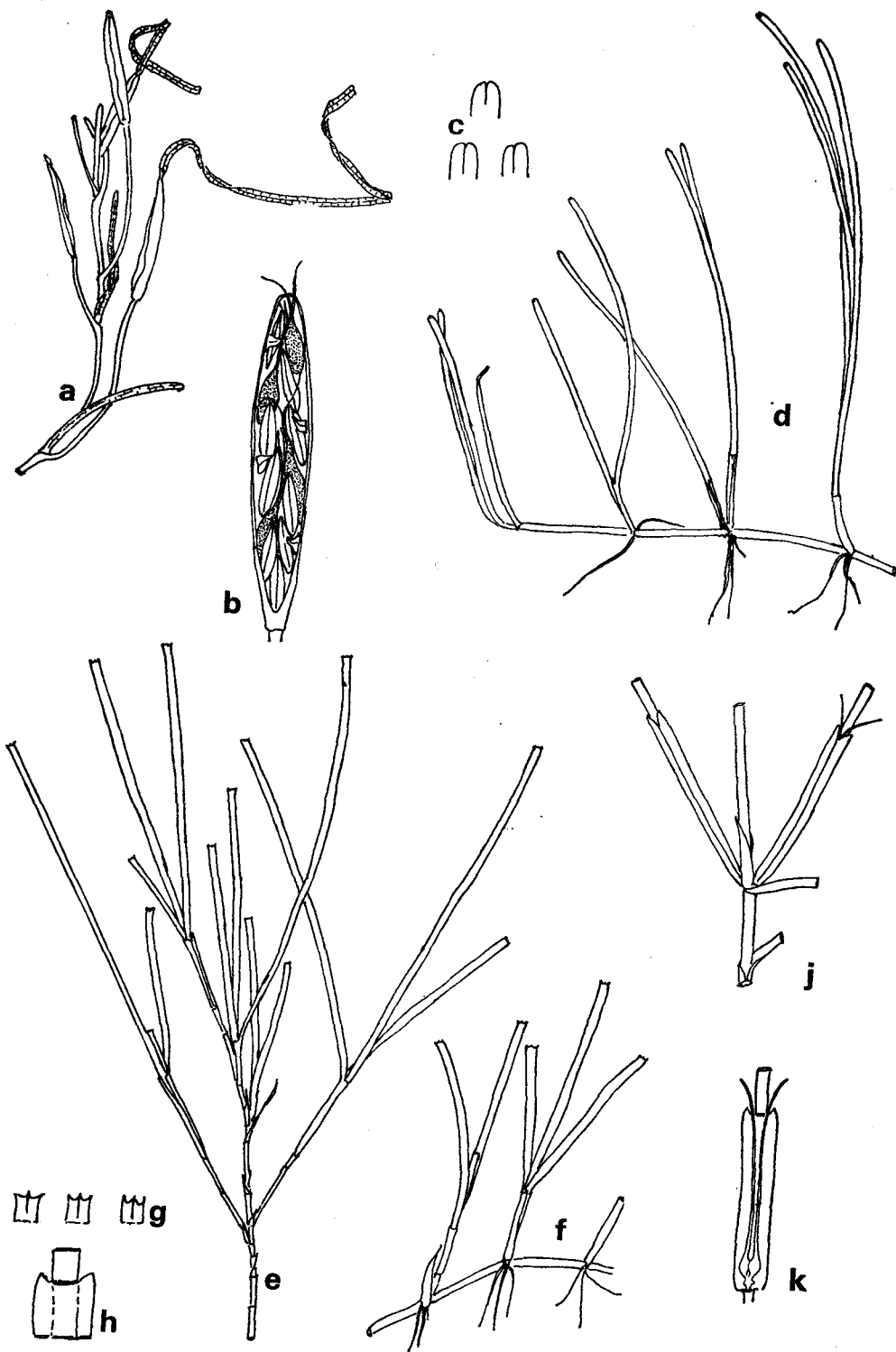


Plate 1

Zostera capensis Setchell a. portion of plant with inflorescences $\times 1$; b. inflorescence $\times 2$; c. leaf tips showing variation $\times 4$; d. plant showing habit $\times 1$; a & b were taken from drawings made by Miss J. McGillivray. e. *Halodule uninervis* (Forsk.) Aschers.—deep water form $\times \frac{1}{2}$; f. shallow water form $\times \frac{1}{2}$; g. *Halodule uninervis* leaf tips showing variation $\times 1$; h. upper part sheath $\times 1$; j. branch with female flower $\times 2$; k. sheathing leaf base opened to show female flower $\times 2$.

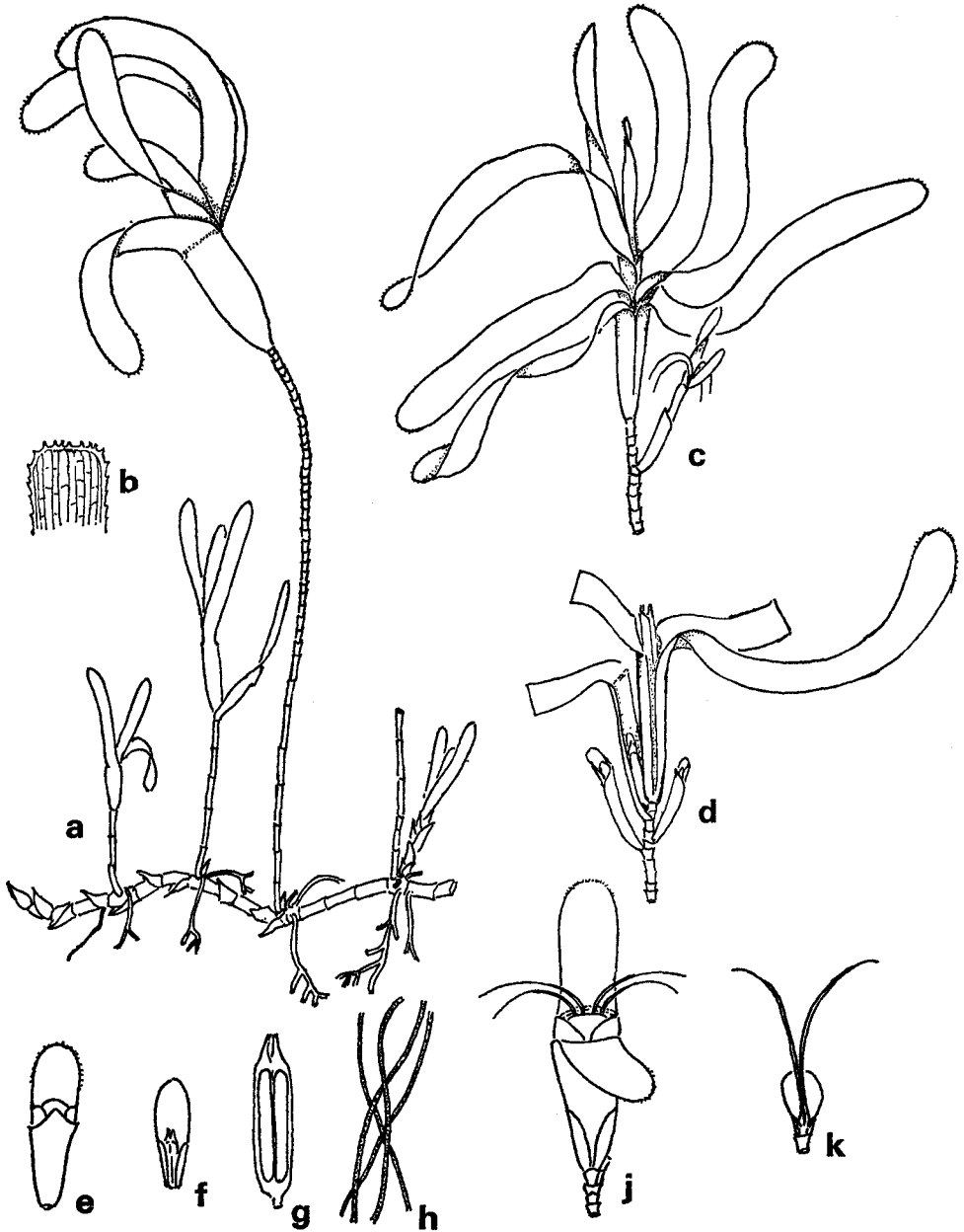


Plate 2

Cymodocea ciliata. Ehrenb. ex Aschers: a. plant $\times \frac{1}{2}$; b. leaf tip $\times 1$; c. branch bearing female flower $\times \frac{1}{2}$; d. branch bearing male flower $\times \frac{1}{2}$; e. male flower $\times 1$; f. bracts removed to show anther $\times 1$; g. anther $\times 2$; h. pollen threads (greatly enlarged); i. female flower $\times 1$; k. three outer bracts removed to show gynaeceum $\times 1$.

Key to the East African species of *Cymodocea*

1. Leaves borne on erect woody branches with conspicuous annular scars *ciliata*
- 1'. Leaves borne on short shoots close to the rhizome or rarely on branches of the rhizome which grow erect and bear leaves at the apex 2
2. Leaf apices markedly serrate at all times *serrulata*
- 2'. Leaf apices entire or only minutely and irregularly toothed in young stages *rotundata*

***Cymodocea ciliata* Ehrenb. ex Aschers. (Plate 2)**

Plants dioecious. *Rhizomes* stout, woody 5–10 mm. in diam. with several wiry branching roots arising at a node; internodes 5–25 mm. long, becoming obscure on older rhizomes; scales broad, obtuse and blackish, adhering at the nodes on young rhizomes. *Branches* erect, usually 15–30 cm.—but often as much as 70 cm. high, woody, simple or branching, laterally compressed with conspicuous annular leaf scars. *Leaves* 5–7 at the apex of a branch, opposite, arising on the flattened axis of the stem; sheathing bases often pinkish in colour, vaginate, fan shaped, the older enclosing the younger, 2–4 cm. long, 10–15 mm. broad at the apex; ligules conspicuous as a flap extending across the leaf at the junction between the sheath and the lamina; lamina ligulate, usually somewhat falcate, 5–12 cm. long, 10–15 mm. broad, apex obtuse or rounded, margin densely serrulate in the upper part. *Flowers*. Male and female flowers occur immediately below the terminal leaf tuft, sometimes the young flowers are subtended by the lower leaves which are shed as the flower matures. The female flower is borne on a short lateral branch. The young flower and the pedicel are enclosed in a sheathing bract (1) which usually persists throughout the life of the flower. *Pedicel* 5–7 mm. long bearing the 3 alternating sheathing bracts at its apex; bract 1 has a sheath but no lamina, bracts 2 and 3 have a short lamina, bract 4 is small at the onset of anthesis but grows rapidly after the flower matures. *Gynaecium* composed of two separate carpels which are situated on a flattened receptacle between bracts 3 and 4; ovaries oblong ovoid 0.5–0.7 mm. in diam., each containing a single pendulous ovule and each with a style 3–5 mm. long which bifurcates into two sigmas 3–4 cm. long which are curved and extruded, one pair on either side of the flower. After fertilization only one ovary develops in almost all the flowers examined. A few have been found with both ovaries equally developed but only one case has been seen where both fruits germinate. The mature fruit germinates within the flowers which remain attached to the plant. The young plant is released only when it has 4–6 leaves and a well developed adventitious root system (Isaac F.M. Unpublished paper). *The male flowers* are smaller than the female, sessile or subsessile. There are four sheathing bracts, the first is similar in form to the corresponding one in the female flower but narrower, the second and third have short green laminae, the fourth is extremely small and transparent and does not encircle the anther at the base. There are also two short transparent erect, hairlike structures on either side of the anther for which there seems to be no corresponding structure in the female flower. The solitary anther, surmounted by two incurved, beak-like processes is four-celled and dehisces, after it has been released from the flower by means of a vertical slit in each cell. The anthers are bright pink in colour. *Pollen* threadlike, clinging in ropey masses.

WORLD DISTRIBUTION: Arabia, Red Sea, East coast of Africa to Mozambique and an impoverished form has been recorded from the coast of Zululand, Madagascar, Réunion, Seychelles, Mauritius, Queensland.

KENYA: *Cymodocea ciliata* grows at most places along the coast. It extends from small beds of stunted plants in rock pools high on the shore into deeper water both inside the reef and beyond it. It is extremely abundant with plants reaching maximum size for these coasts at Majunguni off the

island of Pate (Lamu Archipelago) and also at Turtle Bay and Watamu where it forms dense undersea meadows and where the amount of debris, chiefly old leaves, which is deposited on the beach indicates the presence of vast beds off shore.

F. M. ISAAC, Diani A134; Watamu A68; RAYNER, Mombasa 293.

TANZANIA: MILNE-REDHEAD & TAYLOR, Lindi, 7479; 7554.

ZANZIBAR: GREENWAY 1136.

***Cymodocea serrulata* (R. Br.) Aschers. (Plate 3)**

Plants probably dioecious. *Rhizomes* usually fleshy but may become tough and somewhat woody with age, whitish usually mottled purple with one or more branching roots at the nodes; internodes 2–5 cm. long; at certain times, perhaps when flowers are produced, branches of the rhizome grow erect with one (rarely two) leafy shoots. These leafy shoots are usually at right angles to the erect portion of the rhizome which bears them and they also produce roots although no longer in contact with the sand. *Leaves* usually produced on short shoots on the rhizome proper; sheathing bases often bright pink in colour, obconical 2–3 cm. long, 1–1.2 cm. broad at the apex, auricles acute or subacute, the oldest leaf base from which the lamina has fallen usually encloses the other leaves in the shoot; ligule conspicuous at the junction of lamina and sheath, lamina ligulate straight or slightly curved 15–30 cm. long, 0.7–1.5 cm. broad, margins smooth except near the apex where there are widely spaced teeth at least in young leaves; apex rounded or sub-acute, rarely slightly emarginate. *Flowers* unknown except for one female flower found in flotsam at Diani Beach on Jan. 12th. 1967. This was on a short shoot on a portion of the rhizome. There was an old leaf base enclosing a normal leafy shoot at the apex of which was the flower. The flower comprised four bracts similar to those of *C. ciliata*, bract 1, without a lamina; bract 2, with a well developed ligulate lamina and a short sheathing base; bract 3, with a broad obovate lamina but no sheath; bract 4, small and undeveloped. *Gynaecium* 2 separate ovoid ovaries with styles bifurcating, all as in *C. ciliata* but somewhat larger and stouter and the styles relatively shorter.

WORLD DISTRIBUTION: Australia, Japan, Philippines, India, Ceylon, Red Sea, Seychelles, Mauritius, Madagascar, Mozambique.

KENYA: This species is to be found at most places along the coast.

C. serrulata is a plant of relatively quiet water and is found in beds in sheltered bays or fringing pools fairly high on the shore. It reaches its maximum size in creeks and inlets such as Mokowe, Mida Creek and Gazi.

F. M. ISAAC, Mokowe A25; Gazi A 119, A 97; Shimo la Tewa 114.

***Cymodocea rotundata* Aschers. et Schweinf. (Plate 4, a, b)**

Rhizome fleshy and rather brittle, becoming tougher with age. *Roots* arising at the nodes, branching. *Leaves* 2 or 3 in a shoot arising from the rhizomes. *Sheaths* 2–4 cm. long, 3–6 mm. broad, a few persisting after the laminae have dropped, auricles ovate-acute; lamina linear straight 10–30 cm. long, 3–6 mm. broad, margins entire when mature, slightly toothed when young, apex rounded or somewhat obtuse. *Flowers* not seen.

WORLD DISTRIBUTION: Japan, Philippines, Pacific Islands, Queensland, Australia, India, Madagascar, Mozambique.

KENYA: ubiquitous.

F. M. ISAAC, Malindi A 144; Diani A 13; GREENWAY & RAWLINS, Osine 9299.

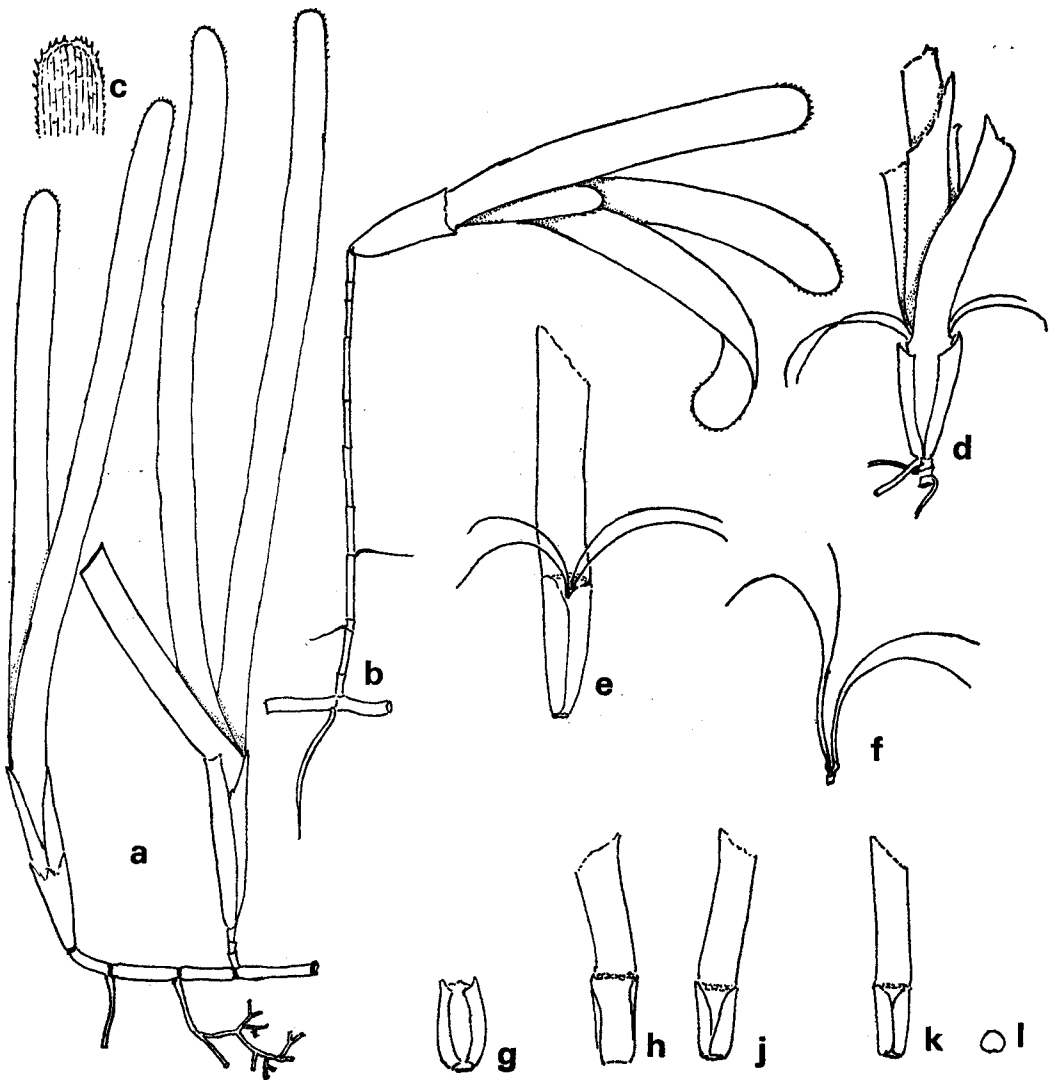


Plate 3

Cymodocea serrulata (R.Br.) Aschers. a. plant common form $\times \frac{1}{2}$; b. plant showing erect growth of rhizome bearing leaves, $\times \frac{1}{2}$; c. leaf tip $\times 1$; d. shoot with female flower $\times 1$; e. female flower with outer bracts removed $\times 1$; f. gynaecium $\times 1$; g. old leaf base $\times \frac{1}{2}$; h, j, k, l, flower bracts $\times \frac{1}{2}$.



Plate 4

Cymodocea rotundata Aschers. & Schweinf. a. portion of plant $\times \frac{1}{2}$; b. young leaf tip $\times 1$; *Syringodium isoetifolium*, (Aschers.) Dandy; c. plant with female inflorescence $\times \frac{1}{2}$; d. female inflorescence $\times 1$; e. leaflike bract which encloses female flower $\times 3$; f. female flower in bract side view $\times 3$; g. gynaecium $\times 3$; h. young fruits $\times 3$; j. piece of plant showing leafy shoots $\times \frac{1}{2}$.

There is a record of male flowers and fruits having been found on the island of Timor but no description or illustration has been traced in literature. Thus it would be of considerable interest if flowers were found on the East African coasts where there are extensive growths of *C. rotundata*.

In appearance *C. rotundata* is often very similar to narrow-leafed forms of *Thalassia hemprichii* but the plants can be distinguished on closer examination by the presence in *Thalassia* of a mass of old leaf sheaths persisting at the base of a shoot. In *C. rotundata* persisting sheaths are few and widely spaced.

It is of interest to note that no trace of *C. rotundata* was seen in the Seychelles.

Syringodium Kuetz (Plate 4, c—j)

There are two species in this genus. The second species *S. filiforme* Kuetz is found on the coasts of Florida, the gulf of Mexico, the Caribbean, Bahamas and Bermuda where it is known as "manatee grass". This is of considerable interest since *S. isoetifolium* is said to be one of the favourite foods of the dugongs on the northern coast of Kenya.

Syringodium isoetifolium (Aschers.) Dandy

Plants dioecious. *Rhizome* creeping fleshy, brittle whitish 1.5–3 mm. in diam., internodes 1–2 cm. long. *Roots* usually simple but sometimes branching. *Branches* erect terete, with several internodes exposed near the base from which roots may arise, often the lower portion has persistent sheaths of leaves from which the lamina has fallen. *Leaves* distichous; sheaths long narrow, curving round to enclose the bases of the upper and younger leaves and the apex of the shoot, 1.5–2.5 cm. long, auricles broadly ovate, margins minutely fimbriate; lamina succulent terete 10–30 cm. long, 2–3 mm. in diam. tips when present, minutely toothed. *Female flowers* in a branching cymose inflorescence, each flower enclosed in a sheathing bract with a short leaf-like tip which drops as the flower matures, flowers pedicellate with two elongated ovaries 3–4 mm. long, 1 mm. in diam. at the base, tapering to the apex where each bifurcates to form two slender recurved styles 6–7 mm. long which protrude conspicuously from the sheathing bract. *Ovules* solitary attached to the inner facing walls of the ovaries. *Male flowers* not found by the author but according to Osterfeld they consist of a double stamen (anthers dorsally fused) in similar inflorescences and bracts to those of the female flower. (Osterfeld). **WORLD DISTRIBUTION:** New Caledonia, Australia, Mozambique, Indian Ocean.

KENYA: Widespread along the coast.

F. M. ISAAC, Watamu A 93; Diani A 103.

TANZANIA: DRUMMOND & HEMSLEY, Tanga 3315.

Inshore *S. isoetifolium* is found fringing pools, seldom in dense beds but there must be much denser growths in deeper water since, at times, large quantities of leaves and stems are washed up on the beaches. There are said to be extensive beds in places such as the mouth of Mida Creek where the dugongs feed on this plant.

Halodule Endl.

This genus has a number of species but only two have so far been found on the East African coast.

Key to *Halodule*

- Leaf blade usually 1 mm. or more in width, lateral teeth not conspicuously longer than the median point *uninervis*
 Leaf blade usually less than 1 mm. in width, lateral teeth conspicuously longer than the median point *wrightii*

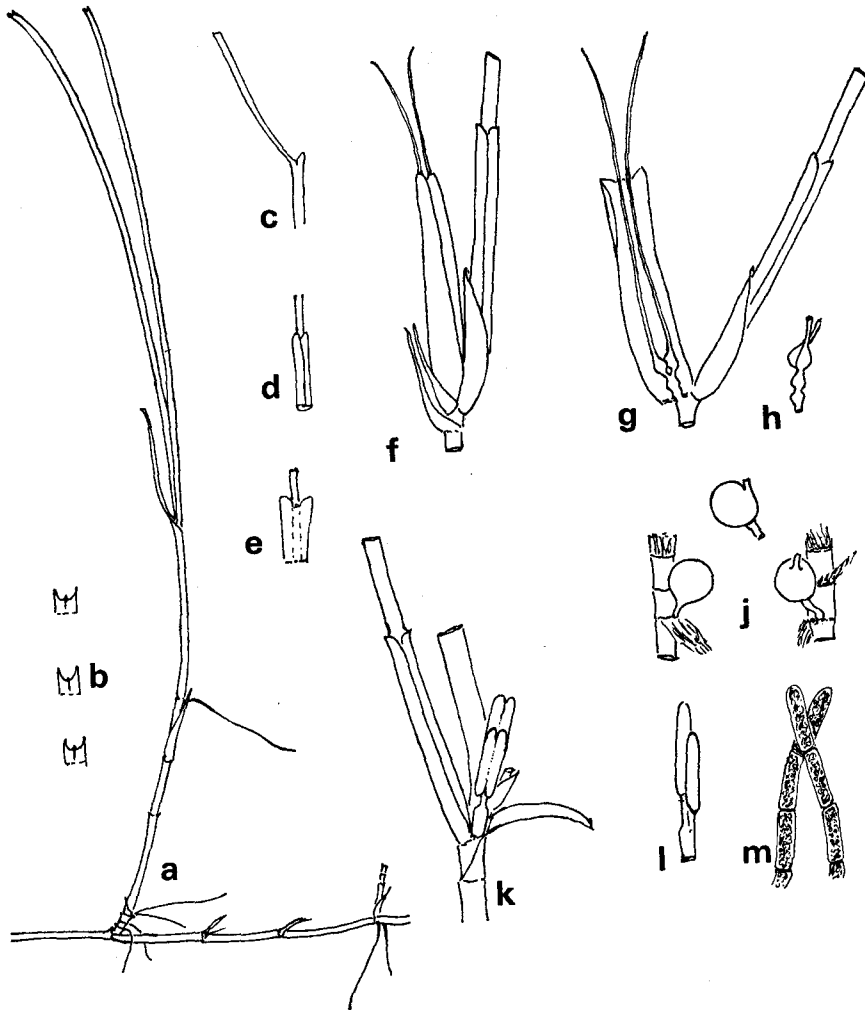


Plate 5

Halodule wrightii Aschers. a. piece of a plant $\times 1$; b. leaf tips showing variation $\times 2$; c, d, e, leaf sheath $\times 1$; f. shoot with female flower $\times 3$; g. sheath open to show gynaecium $\times 3$; h. ovaries side view $\times 3$; j. fruits $\times 3$; k. bract opened to show male flower $\times 3$; l. stamens side view $\times 3$; m. pollen chains (greatly enlarged).

H. uninervis (Forsk.) Aschers. (Plate 1, e—k)

Plants dioecious. Rhizome creeping, rather fleshy 1.5–2.5 mm. in diameter, 1–6 roots and an erect stem at the nodes. Stems usually short 1–5 cm. but in deep pools they may be 30 cm. or more with many branches and the leaves floating on the surface at low water; internodes 0.5–5 cm. long. Scales

elliptic, transparent and with an entire margin when young, becoming dark brown and ragged with age. *Leaf-sheaths* 1–3.5 cm. long, ligule inconspicuous. *Leaf-blade* linear, 10–15 cm. long, 1–3 mm. wide (rarely as narrow as 1 mm.), narrowed slightly to the junction with the sheath, usually straight rarely somewhat falcate; midrib more conspicuous in dried or preserved material than in the living plant; leaf-tip with 2 short lateral teeth and an obtusely rounded median tooth in which the mid-rib ends. *Female flower* 2.5–3 cm. long; ovaries long-ovate, 2 mm. long, style 2–2.5 cm. long apices extruded from the leaf sheath. *Male flower* and fruit not seen by the author.

WORLD DISTRIBUTION: Coasts of the Indian Ocean and Western Pacific. Coast of Africa from the Red Sea to Delagoa Bay. Madagascar, Seychelles Islands, Persian Gulf and Ceylon, Gulf of Siam, Japan, Malaysia, Australia and the Tonga Archipelago.

KENYA: Occurs at all places where collections were made.

F. M. ISAAC, Diani A 9; Gazi A 77.

TANZANIA: AGNEW, Dar es Salaam 8513.

H. uninervis as found in shallow water where it is rarely if ever exposed, is a plant with rather fleshy rhizomes giving rise to the nodes to short shoots with 2–3 leaves. No flowers have as yet been found on the shallow water plants. In creeks and deeper water the plants are more luxuriant with branching, almost woody upright stems and tougher, somewhat narrower leaves. It was on this form that female flowers were found at Gazi in August 1965. This form may be sufficiently distinct to be regarded as a variety when more information is available.

H. wrightii Aschers. (Plate 5)

Plants dioecious. *Rhizome* slender, creeping, brittle with several roots and a short stem at each node (in pools these stems may be long and branched); internodes 5–20 mm. long. *Scales* elliptic. *Leaf-sheaths* 12–20 mm. long ligule small and inconspicuous. *Leaf-blades* grass-like, 8–10 cm. long, rarely as much as 1 mm. in width; leaf-tips with two well developed lateral teeth; mid-rib blackish and conspicuous at the apex, usually produced to form a short point or small tooth. *Female flower* about 1.5 cm. long, ovaries ovoid, up to 1 mm. long, styles 1.2–1.4 cm. long, extruded from the leaf-sheath. *Male flower* 5–6 mm. long, the longer anther of the pair about 4 mm., the shorter 3 mm. long. *Pollen* threadlike. *Fruit* sphaerical blackish, about 2 mm. in diam., with the base of the style persisting.

WORLD DISTRIBUTION: Caribbean Islands, West Indies, Florida, Bermuda, Africa—East & West coasts, Madagascar, Mauritius, Persian Gulf.

KENYA: ubiquitous.

F. M. ISAAC, Diani A 51, A 123, A 10; Malindi A 146. GREENWAY & RAWLINS, Osine 9305.

TANZANIA: AGNEW Dar es Salaam 8512

ZANZIBAR: GREENWAY 1130.

H. wrightii, sometimes in association with *Halophila ovalis* and *Halophila minor* is found higher on the shore than any of the other species considered in this paper. The plants of *H. wrightii* growing on sand highest on the shore have the narrowest leaves, and can withstand several hours of exposure to the air. Those in pools and shallow water are larger and more luxuriant in all respects. This species does not appear to grow lower on the shore than the low water level of spring tides.

The typical forms of *H. uninervis* and *H. wrightii* are readily distinguished by the character of their leaf-tips and the width of their leaves. There is, however, a multiplicity of intermediate forms which are difficult to assign to either species. These may have arisen as a result of hybridisation.

Halophila Du Petit-Thouars

Halophila is widely distributed and locally very abundant on the Kenya coast, where it is represented by three species. There is a specimen of *H. decipiens* Ostenf. in the East African Herbarium (M.C. 908)

which was found at a depth of 50 ft. off the coast of Zanzibar. This species, as well as *H. linearis* recorded for Mozambique, may possibly be found on the Kenya coast when more extensive search can be made.

Key to the species of Halophila

- | | |
|---|------------------|
| 1. Leaves ovate or linear, oblong with a slender petiole | 2 |
| 1'. Leaves linear elliptic, narrowed to the base but not markedly petiolate | <i>balfourii</i> |
| 2. Leaves with 3–8 pairs of cross veins ascending at an angle of 70–90° | <i>minor</i> |
| 2'. Leaves with 12–25 pairs of crossveins ascending at an angle of 45–60° | <i>ovalis</i> |

***H. ovalis* (R. Br.) Hook. f. (Plate 6, a–g)**

Plants dioecious—one monoecious plant was found indicating that the same plant may produce male and female flowers but not usually simultaneously. *Rhizomes* slender, internodes 1–5 cm. long. *Root*, one, unbranched produced at each node. *Scales* 2, 5–6 mm. long, transparent, sub-orbicular, apex emarginate, margin wavy or crinkled, slightly keeled and enclosing the leaf bases, new shoots and flower buds. *Leaves* one pair at each node, petiolate, blades oblong-elliptic to ovate, glabrous, 1–3 cm. long, 5–13 mm. broad; apex rounded or sub-apiculate, base rounded or decurrent into the petiole, margin entire, mid-rib and intramarginal nerves connected by 11–15 pairs of cross veins; petioles 1–7 cm. long. *Flowers* solitary, enclosed in two membranous bracts one embracing the other; bracts broadly ovate, apex sub-acute, 3–5 mm. long. *Male flower* pedicellate, pedicels 1–2.5 cm. long., perianth segments 3, ovate, cucullate, recurving strongly as soon as the flower opens, yellowish in colour, 3–4 mm. long, 2–3 mm. broad; anthers 3, 3–4 mm. long, erect, adhering, dehiscing longitudinally. Pollen in long chains. *Female flower* consists of an elliptic or long-ovate ovary 2–3 mm. long produced into a beak 3–10 mm. long bearing 3 rudimentary perianth segments and 3 styles, 10–25 mm. long. *Fruit* globular, smooth with the base of the style persisting. *Seeds* many.

WORLD DISTRIBUTION: South and East African Coasts, Madagascar, Red Sea, Malaysia, South Pacific, Australia, Tasmania and Japan.

KENYA: present in most places along the coast where conditions are suitable.

F. M. ISAAC, Diani A 40; Watamu A 66.

ZANZIBAR: OXTOBY 908(a).

H. ovalis is found on mud exposed at low spring tides but more frequently in shallow pools and channels where it is only partially exposed or not exposed at all. It reaches its maximum size in such places. Flowers were found in July and August, the female flowers appearing before the males—only one collection was made when both sexes were found.

***H. minor* (Zoll.) Hartog. (Plate 6, h–p)**

This species differs from *H. ovalis* in size, being smaller in all respects and in having a smaller number of cross-veins (6–8 pairs) connecting the mid-rib with the intra-marginal nerves. The angle between the mid-rib and the cross-vein is wider than in *H. ovalis*. Small forms of *H. ovalis* can readily be distinguished from *H. minor* on this feature.

WORLD DISTRIBUTION: India, Malaysia and East Africa.

KENYA: This species appears to be less common and has been found only in the Lamu area and Gazi.

F. M. ISAAC, Mokowe A 100; Lamu A 22; Gazi A 116.

These were the first records of this species for the African coast.

H. minor occurs, often in association with *Halodule wrightii*, at the highest levels on the shore. It

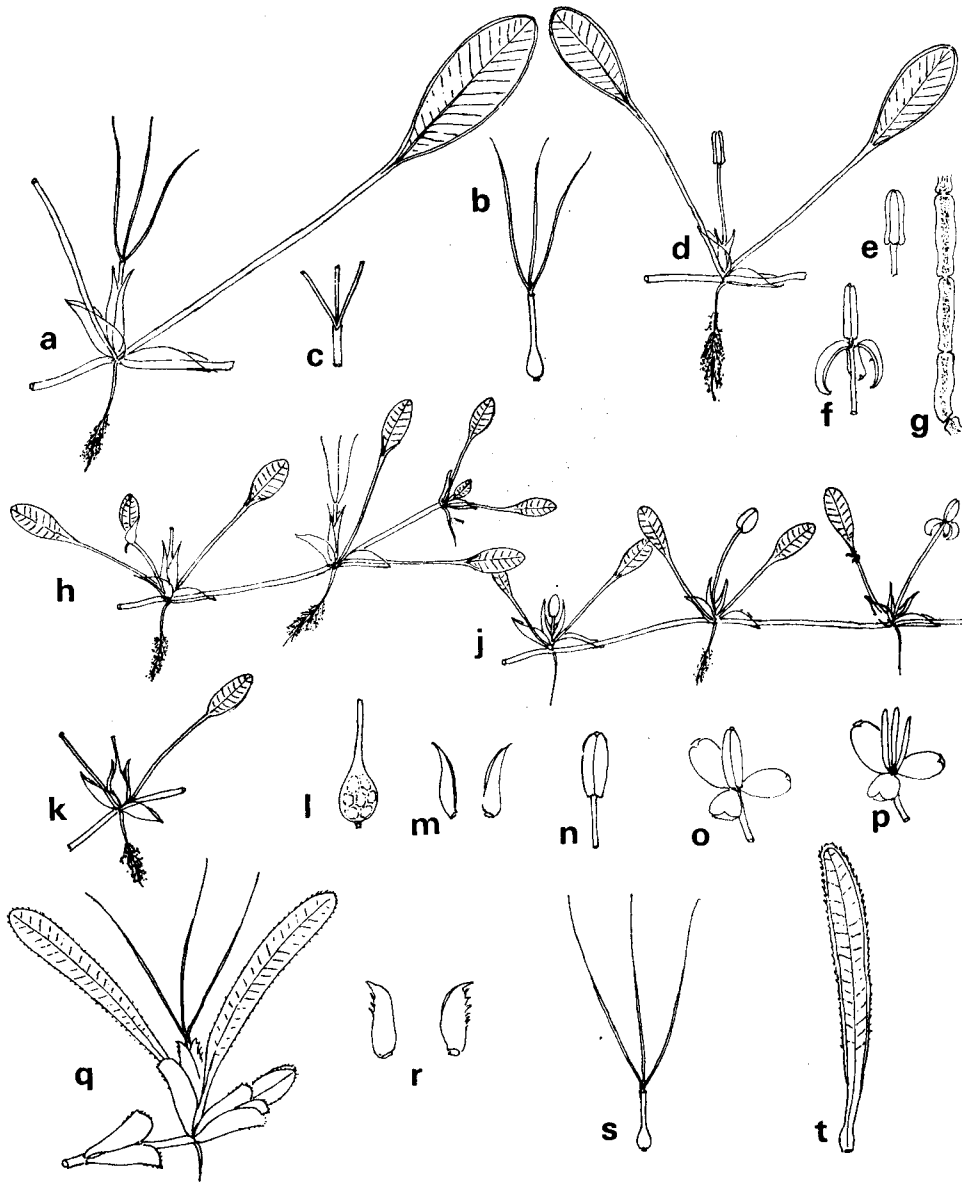


Plate 6

Halophila ovalis (R. Br.) Hook. f. a. portion of female plant $\times 1$; b. gynaecium $\times 1$; c. base of styles and corolla vestiges, $\times 2$; d. male plant with bud $\times 1$; e. bud $\times 2$; f. bud open to show reflexed corolla and erect stamens $\times 2$; g. pollen chain (greatly enlarged) *H. minor* (Zoll.) Hartog.; h. portion of female plant with young and old flower (in which stigmas have fallen) $\times 1$; j. portion of male plant showing buds and open flower $\times 1$; k. young fruit enclosed in bracts $\times 1$; l. older fruit $\times 2$; m. floral bracts which persist to enclose the young fruit $\times 2$; n. stamen $\times 2$; o. male flower $\times 2$; p. male flower in which stamens have dehisced $\times 2$; *H. balfourii* Solered. q. portion of plant with female flower $\times 1$; r. floral bracts $\times 1$; s. gynaecium $\times 1$; t. leaf $\times 1$.

seems less able to stand long exposure than *H. wrightii* and disappears at times to regenerate from the rhizomes when conditions are favourable.

***H. balfourii* Solered. (Plate 6, q—t)**

Plants dioecious. *Rhizomes* thicker and more brittle than those of *H. ovalis* or *H. minor*; internodes 1–3 cm. long. *Scales* conspicuous, obovate, transparent, markedly emarginate, strongly keeled, usually toothed on either side of the apex and sometimes on the keel but otherwise margins smooth, 10–12 mm. long, 7–10 mm. broad. *Leaves* arising in pairs from a short stem which also bears flowers, linear-elliptic often slightly falcate, base attenuate with age, 2.5–8 cm. long, 4–6 mm. broad, margins serrulate, apex rounded, mid-rib and intramarginal veins well developed, cross-veins less conspicuous, leaf bases sheathing the apical bud and flower bud. *Male flowers* not seen. *Female flower* consists of 2 ovate, emarginate bracts with entire margins but a marked keel with an irregular series of upward pointing teeth on its outer surface. Ovary elliptic or long ovate, 2 mm. long, beak 3–5 mm. bearing 3 rudimentary perianth segments and 3 stigmas, 2–2.5 cm. long. *Fruit* and seeds not seen.

WORLD DISTRIBUTION: East Africa, Madagascar, Mauritius, Rodrigues.

KENYA: fairly widespread.

F. M. ISAAC, Diani A 57; Shimo la Tewa A 108; GREENWAY & RAWLINS, Osine 9325.

H. balfourii is less common than *H. ovalis* and tends to be local in its distribution. It is never completely exposed and only rarely found in very shallow water at low tide. Most frequently it is found at a depth of 2–3 ft. at low water spring tides. At times it is found in fair quantities in the debris on the shore at Diani and it seems reasonable to suppose that there are more extensive beds as yet undiscovered in deeper water.

This has been regarded by many authors as conspecific with *H. stipulacea* (Forsk.) Aschers. which is common in the Red Sea but having seen and collected both forms in their natural surroundings the author prefers to follow Solereder and regard the forms from East Africa and Madagascar as a distinct species.

***Thalassia* Banks ex Konig.**

This genus comprises two species; one, *T. hemprichii*, is common in the tropical parts of the Indian Ocean and western Pacific, the other, *T. testudinum* Konig., occurs in the West Indies where it is known as "Turtlegrass".

***T. hemprichii* (Ehrenb.) Aschers. (Plate 7)**

Plants dioecious. *Rhizome*, 5–6 mm. in diam. creeping, usually much branched, brittle and somewhat fleshy membranous scales at the nodes in the younger parts which fall to leave annular scars. *Roots* unbranched but densely covered with a mass of long fine hairs in which sand collects and which is easily detached from the roots. *Leaves* distichous usually falcate but almost straight in deep water, 2–6 in a shoot which is enclosed at the base by a coat of shaggy old leaf bases; lamina 4–40 cm. long, more usually 5–15 cm., 5–10 mm. broad, margin entire, apex rounded. *Inflorescences* pedunculate, 1-flowered, arising laterally between the leaves; peduncles up to 4 cm. long; spathe segments 2, lanceolate with sub-acute apices, connate at the base on both sides in the female, on one side only in the male. There may be one or two inflorescences on a male plant but they seem to appear singly on the female. *Flowers* with a floral tube 3–3.5 cm. long, bearing 3 elliptic cucullate perianth segments 10–11 mm. long and 2–3 mm. broad, reflexing and revolute at anthesis, rosy or brownish pink in colour. *Female flower* has 5–6 styles each forking 5–6 mm. from the base into a pair of spreading stigmas 7–10 mm. long. Ovary 1-celled imperfectly divided by cross septa. *Male flower* with 5–6 erect stamens up to 1 cm. long; pollen grains more or less spherical cohering in a gelatinous mass when released from the anthers. *Fruit* broadly conical, surface echinate with about four seeds.

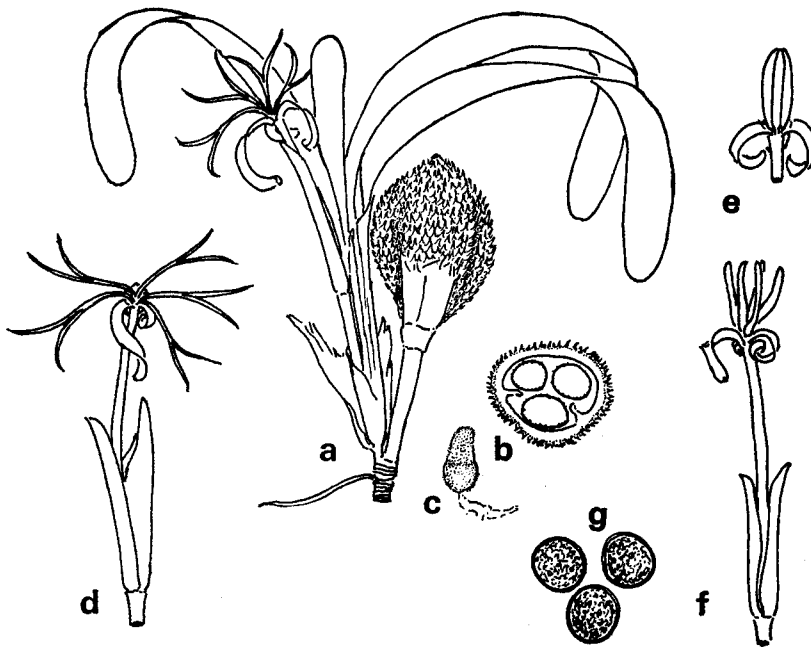


Plate 7

Thalassia hemprichii (Ehrenb.) Aschers. a. portion of plant showing female flower and almost mature fruit $\times \frac{1}{2}$; b. section of fruit $\times \frac{1}{2}$; c. ovule removed from fruit with gelatinous streamer $\times \frac{1}{2}$; d. female flower $\times 1$; e. male flower with undehiscent anthers $\times 1$; f. male flower with anthers dehiscent $\times 1$; g. pollen grains $\times 100$.

Thalassia hemprichii together with *Cymodocea ciliata* is perhaps the most widely spread and abundant angiosperm in Kenya coastal waters. Extensive beds of this plant often provide a base in which many algae and small animals are able to live.

It occurs fairly high on the shore where it may be exposed at low water springs and also extensively in deeper water between the shore and the reef. It has also been found in a luxuriant form in some of the creeks.

WORLD DISTRIBUTION: Indo-Pacific Oceans extending north to Japan.

KENYA: ubiquitous.

F. M. ISAAC, Diani A 84; Mida Creek A 86; Malindi A 152.

TANZANIA: MILNE-REDHEAD & TAYLOR, Lindi 7480.

Enhalus Rich.

This genus has only one species.

Enhalus acoroides (L.f.) Rich. ex Steud. (Plate 8)

Plants dioecious. *Rhizome* stout, branching 2-3 cm. in diam. densely covered with a fibrous coat of old leaf bases as well as stiff black bristles which are the remains of the marginal nerves of leaves. *Roots* unbranched, numerous, whitish, in appearance somewhat like the velamenous roots of orchids

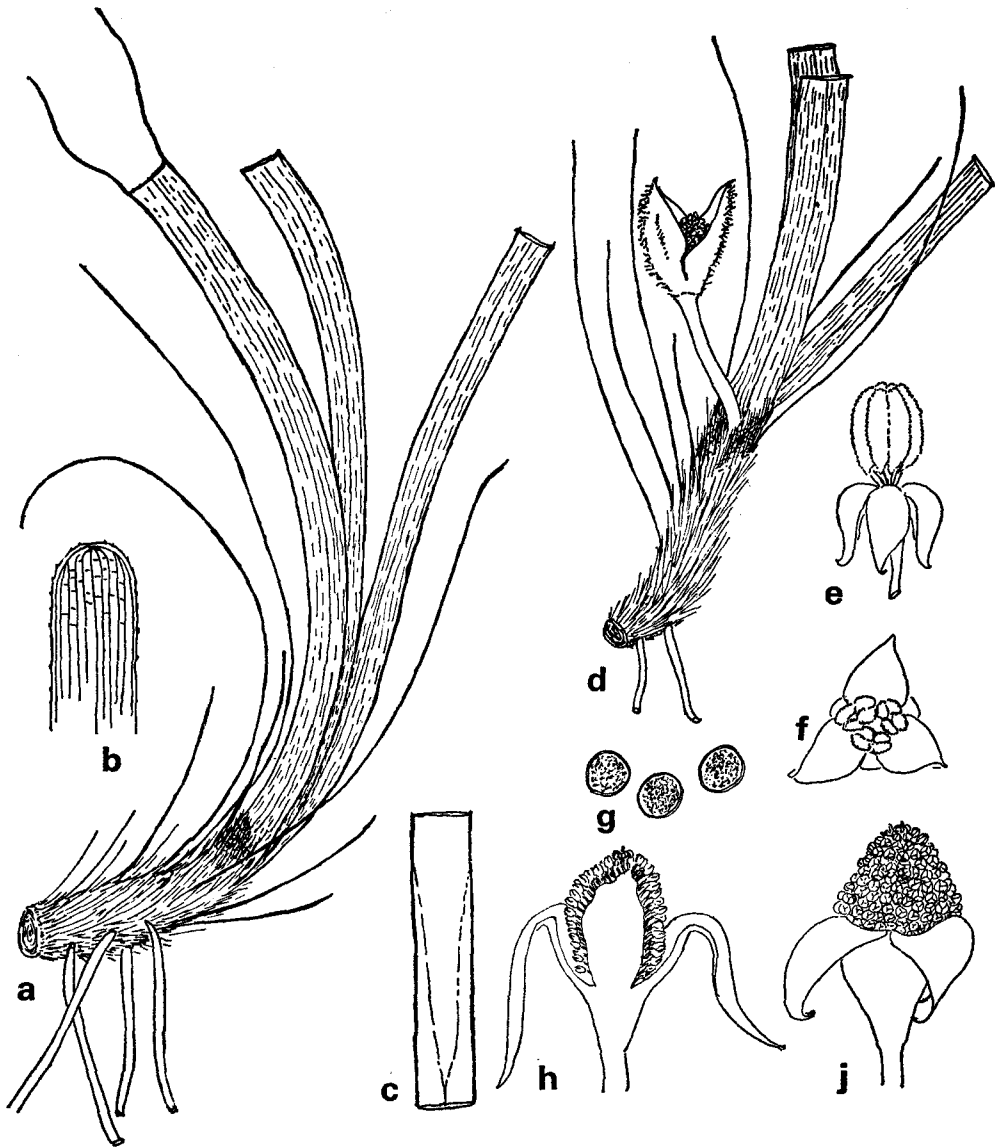


Plate 8

Enhalus acoroides (L.F.) Rich. ex Steud. a. portion of plant showing rhizome, leaf bases, bristles from old leaves, and fleshy roots $\times \frac{1}{2}$; b. leaf tip $\times 1$; c. leaf base showing sheath and thickened margins $\times \frac{1}{2}$; d. rhizome with male inflorescence $\times \frac{1}{2}$; e, f, male flowers $\times 8$; g. pollen grains $\times 100$; h. section of young male inflorescence $\times 1$; j. young male inflorescence $\times 1$; in h & j. the involucrel bracts were folded back to show the flowers arranged on a central cone.

3–5 mm. in diam. 7–20 cm. long. *Leaves*, 3–6 in a shoot, sheathing each other at the base, sheaths closed; lamina 30–100 cm. long, 15–25 mm. broad, tough in texture; apex rounded or obtuse; 11–13 parallel nerves, the marginal ones thickened towards the base. These marginal nerves form the ridges on the edges of the sheath, i.e. the infolded sheaths are lateral extensions of the lamina on the outer side of the marginal nerves. *Inflorescence* pedunculate with two spathe valves connate at the base. Female inflorescence (not as yet seen in Kenya), with a solitary flower with sepals 3, petals 3, a beaked ovary of 6 carpels unilocular with 6 parietal placentas protruding from the walls and forming 6 cavities; styles 6, each forked from the base; ovules many, each with 2 integuments, embedded in mucilage. *Fruit* ovate acuminate. *Seeds* 8–14, obconical, angular containing starch. The female inflorescence grows to the surface of the water and after the flower has been pollinated coils up to draw the developing ovary down into deeper water. The description of the female inflorescence has been taken from Flora Malesiana (Dr. C. den Hartog). *Male inflorescence*, unlike the female, remains submerged and the flowers break off the central axis and float up to the surface where pollination is effected; flowers many, massed in a cone, pedicels 2–10 mm. long with an abscission layer about 1 mm. from the apex; sepals 3, petals 3, ovate with incurved margins and cucullate apices, white tinged mauve, about 2 mm. long and 1 mm. broad reflexing at anthesis; stamens white, surface irregular, bullate, 1–2 mm. long. *Pollen* spherical as seen in anthers in bud.

WORLD DISTRIBUTION: *Enhalus acoroides* occurs in the tropical parts of the Indian Ocean—Madagascar, Seychelles, Red Sea, Ceylon, Nicobar & Andaman Islands; in Malaysia and Queensland and the tropical parts of the Western Pacific—the Solomon Islands and New Caledonia. It has only recently been recorded on the East African coast. (Greenway & Rawlins 1957 no. 9377 in the E. A. Herbarium).

KENYA: Lamu Archipelago, Mida Creek.

F. M. ISAAC, Mokowe A 42, A 195; GREENWAY & RAWLINS 9377; F. M. ISAAC, Mida Creek A 82.

TANZANIA: F. M. ISAAC, Mafia Is. A 245.

It occurs in dense, pure stands in the channel at Mokowe and in Mida Creek. It is usually in fairly deep water, where only the upper parts of the leaves are visible but not fully exposed at low water spring tides, and where it roots in a muddy substratum. The older leaves are usually heavily encrusted with epiphytic organisms.

The rhizomes are eaten by people living in the Lamu area where the plant is known by the name of *Mtimbi*.

All the marine angiosperms act as hosts to a number of epiphytic algae as well as giving shelter to many small marine animals. It is proposed to deal with the aspect of the epiphytic algae in a subsequent paper.

BIBLIOGRAPHY

DEN HARTOG, C. (1957), *Flora Malesiana* 5, 401–413. Hydrocharitaceae.

JARMAN, P. J. (1966), *E.A. Wildlife Journ.* 4, 82–88, 1966. The Status of the Dugong. (*Dugong dugon* Muller)

SETCHELL, W. (1933), *American Journ. of Bot.* 19, 1933. *Zostera capensis*.

WILLIS, J. C. (1960), *Dictionary of Flowering Plants and Ferns*. Sixth Edit.

(Received 28th November 1967)