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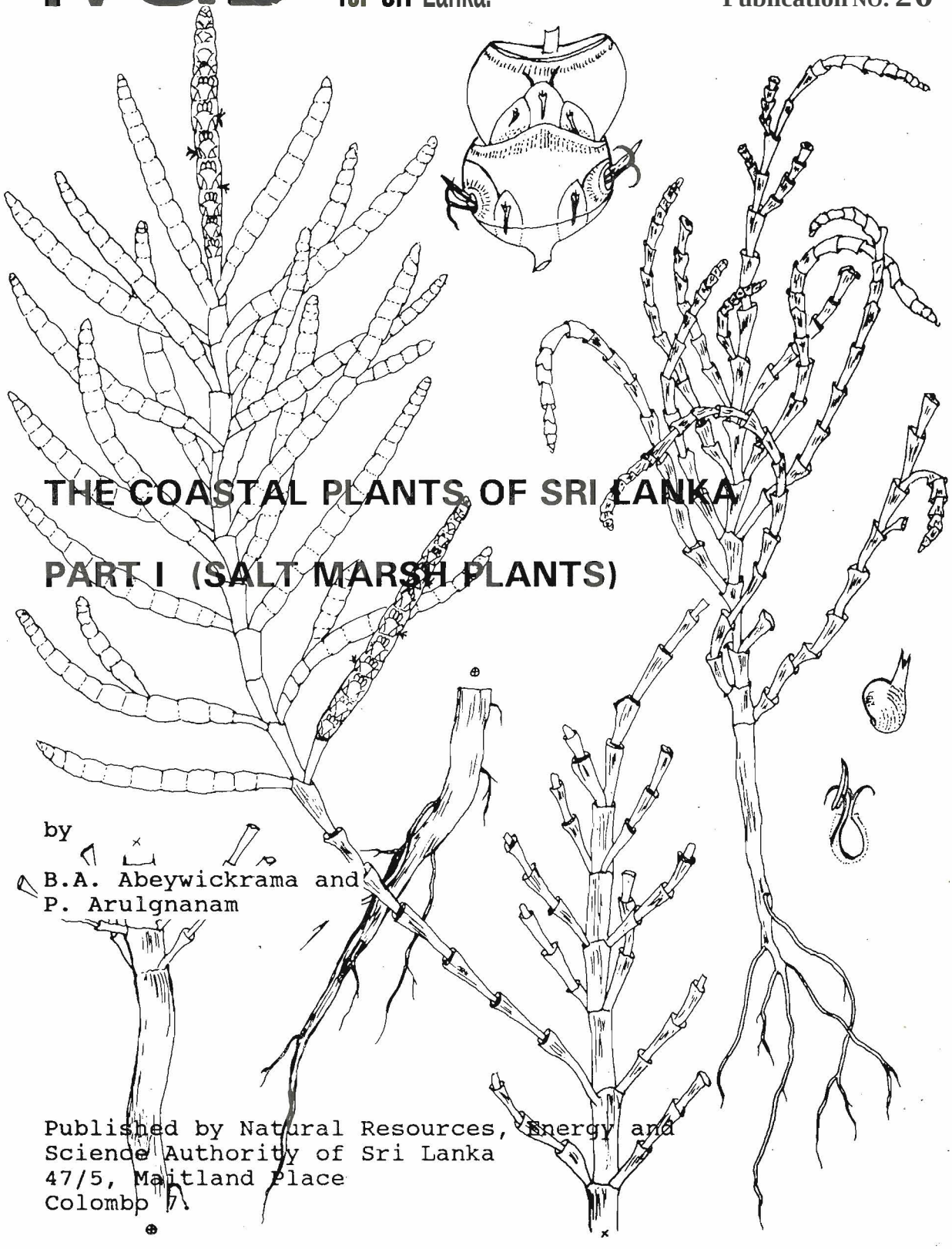

THE COASTAL PLANTS OF SRI LANKA

PART I (SALT MARSH PLANTS)

by

B.A. Abeywickrama and
P. Arulgnanam

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PUBLICATIONS OF UNESCO - MAB NATIONAL COMMITTEE FOR SRI LANKA

The absence of Handbooks and Guides to most groups of plants and animals of Sri Lanka has limited the development of interest in our flora and fauna, and this has also been a very serious handicap to ecological studies in this island.

The **UNESCO -** MAB National Committee set up jointly by the Ministries of Science and Education and functioning under the aegis of the Natural Resources, Energy and Science Authority of Sri Lanka has been sponsoring the publication of checklists of species and Handbooks to the identification of Genera of various groups of plants and animals. The Committee welcomes any additions, corrections and suggestions for improvement of these publications.

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J.P.N.R. Chandrasena

CONTENTS

PLATES

THE COASTAL PLANTS OF SRI LANKA

PART 1 - SALT MARSH PLANTS

Three main vegetation types can be recognised on the landward side of the coasts of Sri Lanka.

These are :

1. The Salt Marsh Vegetation
2. The Mangroves, and
3. The Sandy Seashore Vegetation

These vegetation types are all successional ones and are in some locations continuous with the marine angiosperm vegetation (I) on the seaward side.

Sri Lanka's coastline stretches over about 1500 km of sandy beaches, bays and lagoons, and river estuaries. The plant distribution on it is determined mainly by edaphic factors but the influence of the proximity to the sea is often clearly evident. Much of the coastal vegetation in the island has been cleared for the establishment of human settlements or for other development activities and only a few small patches, and in some places only remnants, of the former extensive vegetation types now remain.

In this work the characteristic species of the salt marshes are illustrated and described. Species commonly associated with these are listed and a key to their identification is provided. Drawings and descriptions of these associated species will be provided in Part III of this series, which will deal with the species present on sandy seashores, where the salt marsh associates are more commonly present.

The Salt Marsh Plants are often referred to as Halophytes (=salt-plants) or as being halophilous (= salt-loving). The characteristic plants grow well only when they are supplied with salt water, but those associated with them, especially on higher qround, can grow without it.

In Sri Lanka Salt Marsh Plants are present in intertidal flats in a few coastal areas on the northwestern, northern, northeastern and south eastern parts of the island, where rainfall is seasonal and its annual average seldom exceeds 1200 mm. Further these areas receive little or no rain for about five months from April to about August or September. During the rainless periods the mid-day temperatures may go up to about 35 degrees Centigrade or more and strong dry winds often sweep over these areas.

Where such climatic conditions prevail the salt marsh plants are present in the intertidal flats covered with sand, silt or clay, especially where the flats are protected by sand bars or reefs from the erosive action of waves or the scour of strong currents.

In the salt marshes the plants at different ground levels are covered by sea water for very different lengths of time; those at the lowest levels being covered for the longest period whilst plants at higher levels are covered for shorter lengths of time. During the rainy season the waters are often brackish but by the end of the dry season salinity rises and free salt may even crystallize out.

The plant species often show a very marked zonation in their distribution. This is largely due to the variations in the relative lengths of time each zone is submerged or is exposed to the air. Of the characteristic genera Salicornia and Arthrocnemum are generally found at the lower levels, whereas Suaeda is present on higher ground. As the land level rises and is less and less subject to inundation the salt marsh species become more and more associated with various other species which are commonly present on sandy seashores and are ultimately replaced by the latter.

THE CHARACTERISTIC SPECIES

All the characteristic species belong to the family Chenopodiaceae. In this list the first figure after the plant name indicates the publication given in the references at the end of this paper, and the second figure to the page in it.

1. Chenopodiaceae

1. Arthrocnemum Moq.
   1. A. indicum (Wifld.) Moq. 9:407
2. Salicornia L.
   2. S. brachiata Roxb. 9:408
3. Suaeda Forsk. ex Scop.
   3. S. maritima (L.) Dumort. 9:409
   4. S. monoica Forsk. ex J.P. Gmel. 9:408
   5. S. nudiflora (Willd.) Moq. 9:409

CHENOPODIACEAE

Annual or perennial herbs or undershrubs. Leaves exstipulate, alternate or opposite, simple, often fleshy; plants sometimes seemingly leafless with the leaves reduced to scales. Flowers small; solitary and axillary or variously clustered; regular; bisexual or unisexual; bracts sometimes present. Calyx 2-5 lobed; lobes mare or less united at basal end, imbricate or almost valvate. Petals absent. Stamens as many as or fewer than sepals, and opposite them. Ovary normally free and superior, unilocular. Stigmas 2 - 5. Ovule solitary. Fruit a membranous utricle enclosed in a persistent perianth. Endosperm present ox absent.

KEY TO THE CHARACTERISTIC GENERA

1 (Herbs or semishrubs; leaves seemingly absent. Flowers in spikes .....2.
(Shrubs; leaves present. Flowers in clusters...Suaeda

2 (Plants semishrubby. Stems usually prostrate with ascending branches. Flowers in short spikes .....Arthrocnemum
(Plants herbaceous. Stems usually erect. Flowers in long spikes.....Salicornia

1. Arthrocnemum Moq.

Perennial herbs or very slightly woody shrubs. Stems erect or decumbent. Plants seemingly leafless. Young stems fleshy and jointed and built up of numerous superposed green fleshy segments, the outer portions of which shrivel and fall away as stems become older. Each segment forming a little cup at the apex with two short teeth and embracing the base of the next segment above.

Fertile segments forming spikes terminally on main stem and Lateral branches. Spikes short, stout, cone-like, Flowers minute, bisexual, arranged in clusters of twos or threes in the axils of fertile segments which are formed of coalescent bracts. Fertile segments obpyramidal and spongy at apices. Stamens 1, or rarely 2 per flower. Ovary unilocular with a single ovule; styles 2. Fruit a utricle with a membranous or horny pericarp. Seed compressed; embryo curved; endosperm present.

PLATE I

Arthrocnemum indicum (Willd.) Moq. (Fig. 1.)

a - Part of plant (xl). b - Sterile shoots (xl).
c - Young flowering spike (x3/2). d - Apex of flowering spike (x3). d' - one segment of the flowering spike.
e- fruiting spike (x3/2). f - Fruiting spike breaking up (x3/2). g - L.S. of female flower (x12). h - Ovary and style (x12). i - Fruit (x12). j and k - Groups of three female flowers showing exertion of stigmas at different stages (diagrammatic). l,m and n - Different views of 3 fruiting caiyces (x 12). o - A segment of fruiting spike seen obliquely from below showing 2 groups of three fruiting calyces originating in axils of next segment below (x6). p - same as "o" in face view with segment below removed to show fruiting calyces with styles exserted in one (x6). q - Seed (X 24). r - T.S. of seed (diagrammatic). s - Seed with testa removed showing embryo on left and endosperm to the right (X 24).

[h,i and p after Wight (13); all others after Brenan (2).]

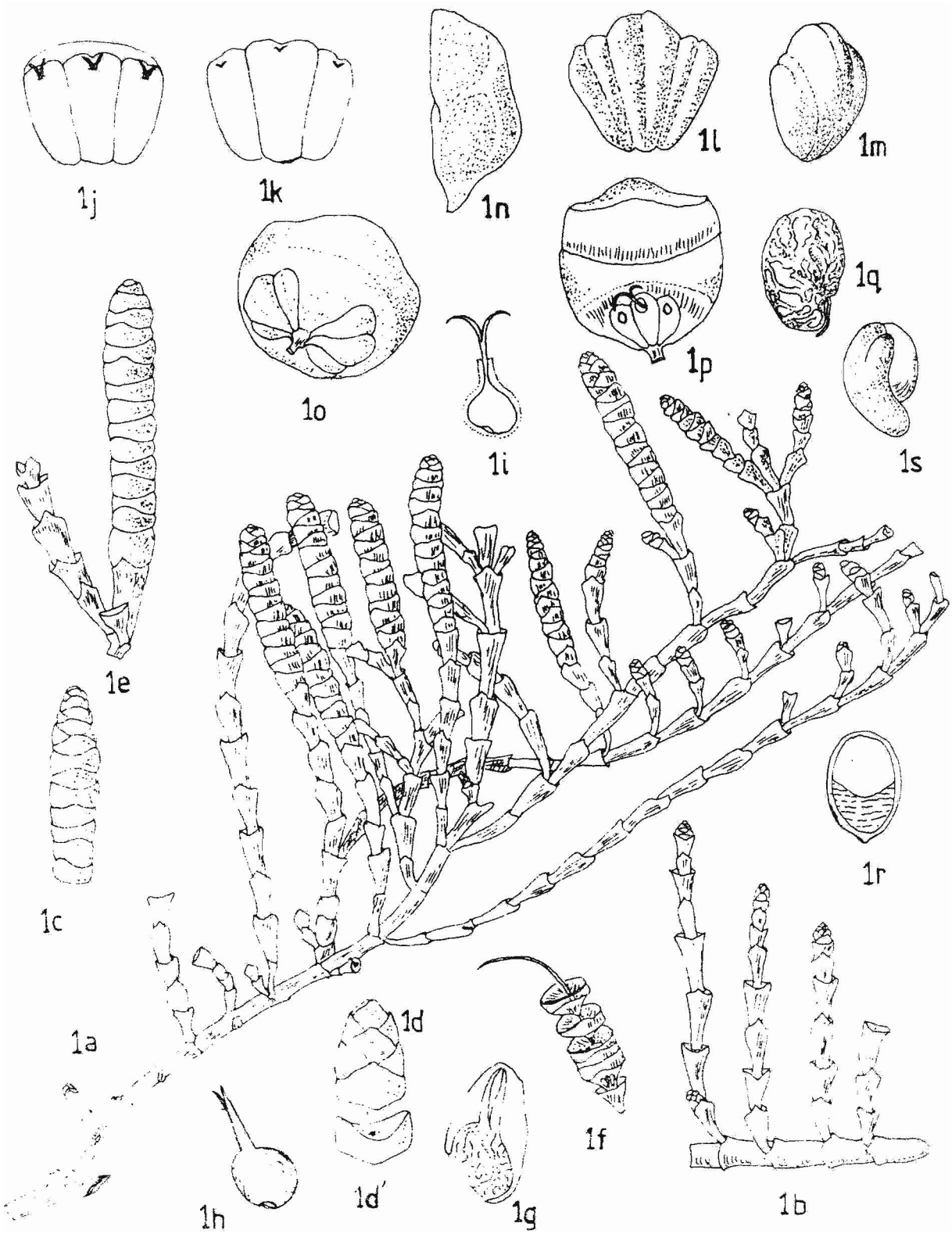


PLATE I

1. A.indicum (Willd.) Moq. Trimen Fl. Ceyl. 3:407; Plate I. Fig. 1. Tam. Kotanai.

Perennial. Stems prostrate with a woody core; branches numerous, erect or ascending, jointed and fleshy. Sterile segments broadened at upper end and 2 - toothed. Fertile segments shorter and broader than sterile segments forming more or less cylindrical spikes. Spikes disarticulating when mature. Mature fruiting segments more or less obtriangular, truncate at apex, and adherent to pericarps.

In salt marshes in the drier parts of the island. Locally abundant in Jaffna, Mannar and Puttalam. Flowering from about December to February.

2. Salicornia L.

Herbs or small shrubs, generally similar in habit to Arthrocnemum but plants usually erect and more slender. Axes made up of superposed, tubular or barrel-shaped, green or reddish, succulent segments. Basal segments ultimately shrivelling and narrowing and forming little cups at upper ends. Each cup usually with two short teeth and surrounding base of next higher segment.

Fertile segments in terminal spikes. Spikes not dis-articulating when mature. Flowers minute, bisexual, usually in groups of threes, more or less connate; floral groups immersed and in pairs, with one on each side of axis. Floral structure and fruit much as in Anthrocnemum but endosperm absent in seed.

1. S.brachiata Roxb. Trimen Fl. Ceyl. 3:408. Plate II. Fig. 2.

Stem more or less erect, 15 to 30 cm high; older plants much branched. Segments slender, slightly dilated and two-toothed at upper end. Spikes slender, more or less cylindrical. Seeds pale brown, hispid with white hairs.

In salt marshes in the drier parts of the island. Puttalam, Mannar, Jaffna, Hambantota. Also around salt pans at Kirinda etc.

Flowering from about December to February.

3. Suaeda Forsk. ex Scop.

Annual or perennial, herbs or shrubs. Leaves alternate fleshy, linear, cylindrical or somewhat flattened.

Flowers very small, axillary or adnate to subtending leaf, solitary or in clusters. Usually bisexual, Calyx 5-lobed or 5-partite, sometimes thickened or inflated in fruit, Stamens 5, but reduced or absent in female flowers. Ovary sessile on a broad base or partly adnate to the calyx. Stigmas 2 to 3. Fruit a utricle. Seed laterally compressed. Embryo spiral. Endosperm scanty or absent.

1 (Stems erect, Spikes slender and lax. Bracts entire..... 2
1 (Stems prostrate. Spikes dense and many flowered. Bracts with serrate margins..... S. nudiflora

2 (Branches with prominent leaf-scars and vertically cracked bark. Leaves linear with apices blunt,.. .....S. monoica
2 (Leaf-scars not prominent. Leaves narrowly linear with subacute apices..S.maritima

1. S. maritima (L.) Dumort. Trimen Fl. Ceyl. 3:409.
Plate III, Fig. 3.

Annual or perennial plants with woody bases; erect, 45 - 60 cm high, Branches slender numerous and ascending. Leaves narrowly linear, 10-15 mm long, fleshy, often tinged with purple or entirely purple, apex sub-acute. Spikes very slender elongated, lax. Flowers in small globose clusters; each cluster in the axil of a small leaf. Bracts with margins entire. Perianth with 5 segments. Male flower with 5 stamens and a small ovary. Female flower with stamens reduced or absent; styles 2 to 3. Seeds very small, suborbicular to ovoid, smooth, black.

Present in moist or swampy, sandy or clayey, saltish soils in coastal regions in the drier parts of the island from Kalpitiya to Kirinda. Abundant in Jaffna.
Flowering from about December to January.

2. S. monoica Forsk. ex J.F.(Gmel. Trimen Fl. Ceyl. 3:408
Plate IV. Fig. 4.

Perennial shrub, 1 - 6 m high; much branched; branches marked with prominent leaf scars; bark in older stems vertically cracked. Leaves alternate, sessile or very shortly petioled; bright green, fleshy; 1.3 - 3.3 cm long, narrowed at base, apex acute to sounded.

PLATE II

Salicornia brachiata Roxb. Fig. 2.

a - fruiting plant drawn in three sections (xl). b- sterile plant with segments partially shrivelled.

c - Two floral segments (face-view) showing fruiting calyces (x6).

d - Pistil and a stamen (X 12).

e - fruit (X 12).

[All except b after Wight (13).]

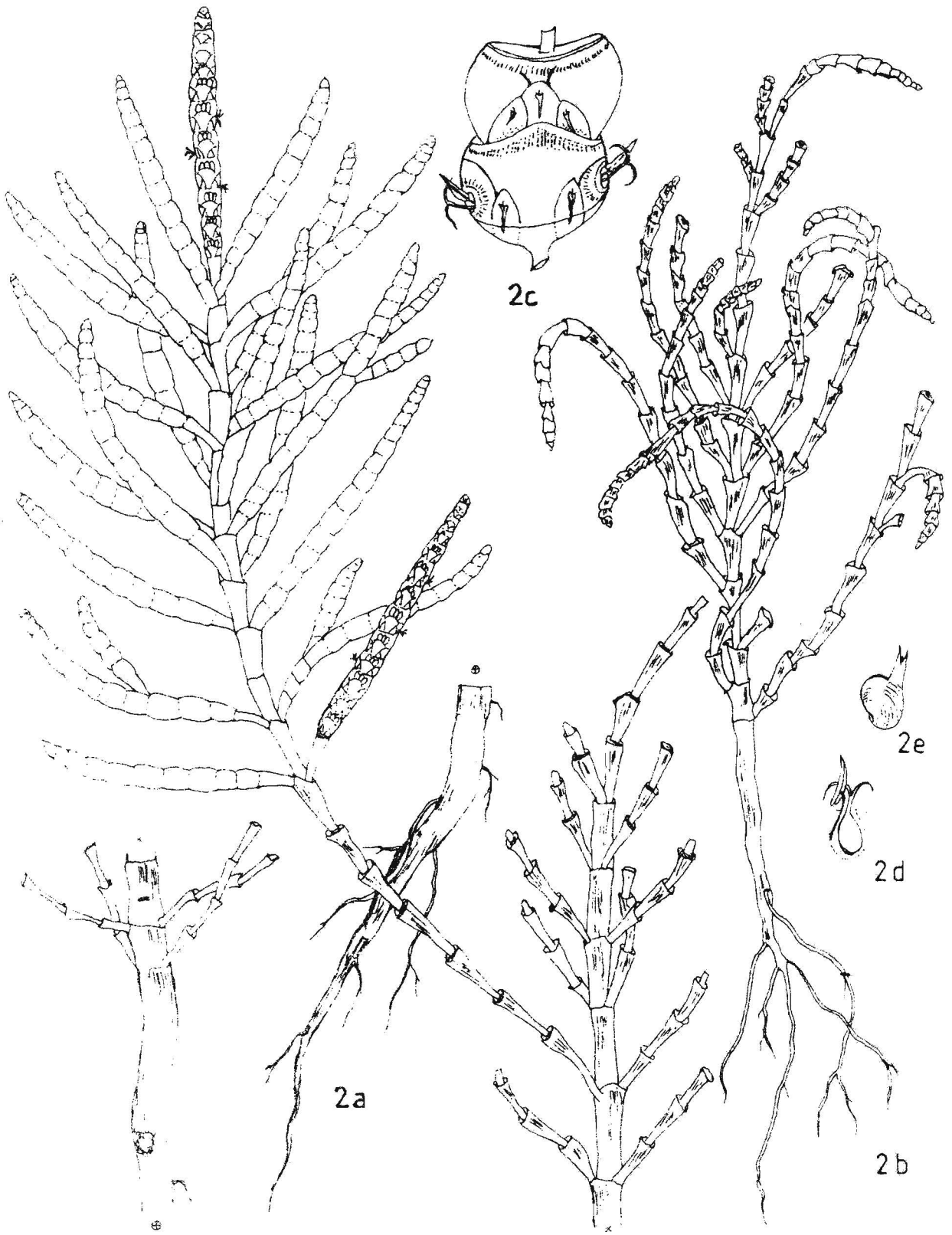


PLATE II

PLATE III

Suaeda maritima (L.) Dumort. Pig. 3.

a - Part of plant (xl). b - a portion of same enlarged. c and d - bracteoles and calyx of a flower separated (x 10). e - Male flower showing stamens and a rudimentary ovary (x10). f - Calyx opened to show stamens (x 10). g - Two views of a stamen (x10). h - a female flower (x10). i - A female flower opened to show ovary as seen from above (x10). j - ovary (x10). k - Seed (x10). 1 - section of seed showing embryo (x10). m - embryo (x10).

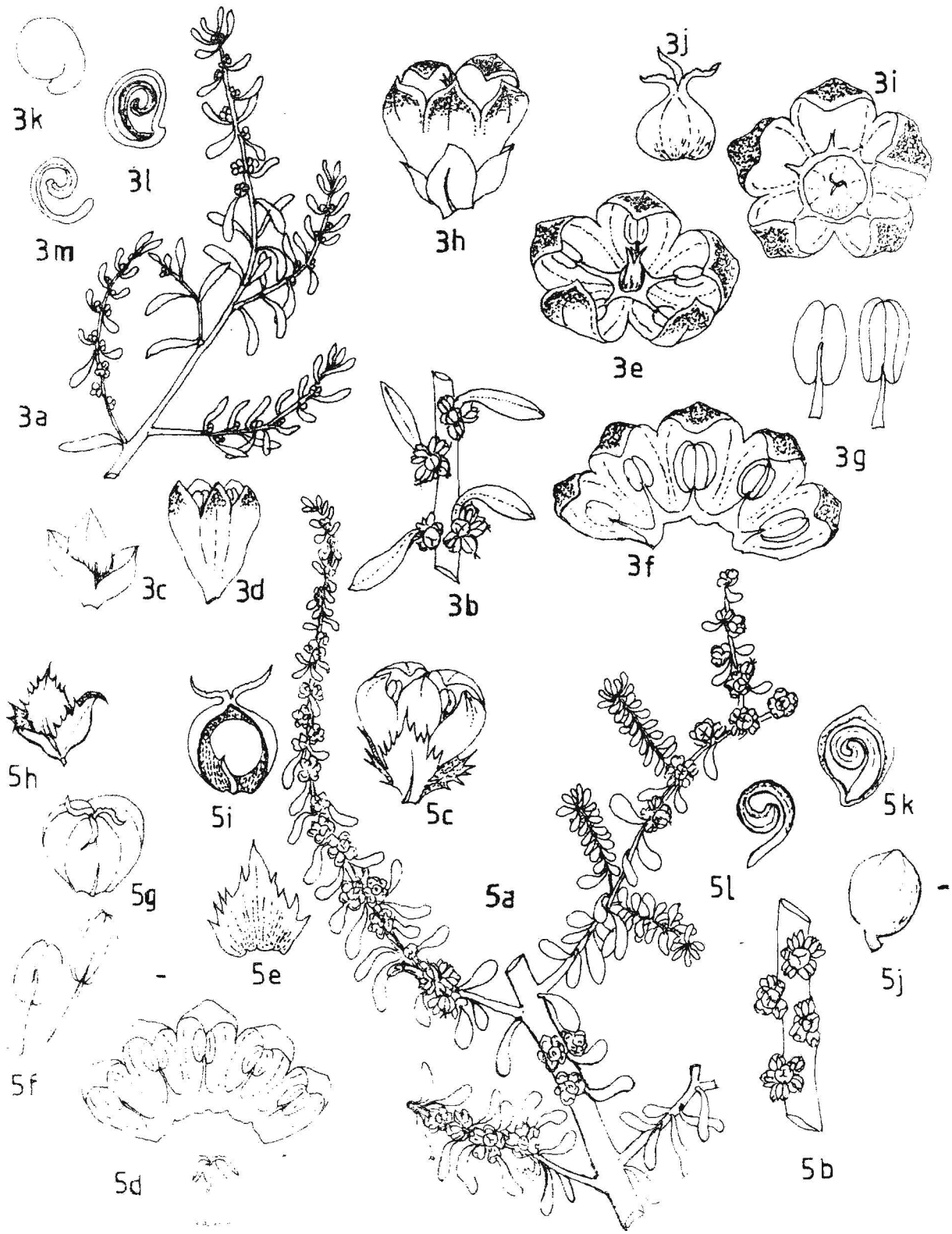
[All after Wight (13).]

(See Plate IV for Fig. 4. S. monoica Forst.)

Suaeda nudiflora (Willd.) Moq. Fig. 5

a - Part of plant (xl). b- portion of same enlarged to show cluster of flowers on stem. c- Male flower (x10). d - Male flower opened to show stamens and rudimentary ovary (x10). e- A single bracteole (x10). f - two views of stamens (x10). g - Ovary (x10). h - bracteoles (enlarged) i. - L.S. of ovary (x10). j - seed x10). k - L.S. of seed (x 10). 1 - embryo (x 10)

[All after Wight (13).]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3l
3m
3a
3h
3j
3i
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3f
3b
3c
3d
5h
5i
5c
5k
5l
5g
5a
5e
5j
5f
5d
5b

PLATE III

PLATE IV

Suaeda monoica Forsk. ex J.F. Gmel. Fig. 4.

a - Part of Plant (x1). b - enlarged view of a portion of same. c - terminal portion of a flowering branch (X 4). d - a single flower cluster showing a large male flower surrounded by smaller female flowers (X 10). e- and f - bracteoles (x10). g- male flower (X 10). h - L.S. of male flower with rudimentary ovary removed (x10). i - stamens, different views (x10). j - Calyx of a male flower opened out, with anthers removed (x10). k- centre of a male flower showing rudimentary ovary (x10). k^{t} - same opened to show ovule (X 10). 1 - rudimentary ovule X 15). m and p - Female flowers at two different stages of development (X 10).n - part of calyx of a female flower opened out to show staminodes (x10). o - a female flower with no staminodes, opened out (x10). q -L.S. of an ovary (x10). r - Ovary with part of wail removed to show ovule (x10). s - seed (x10). t-embryo (x10).

[b, k',m, o and q after Wight (13), all other drawings after Brenan (2).]

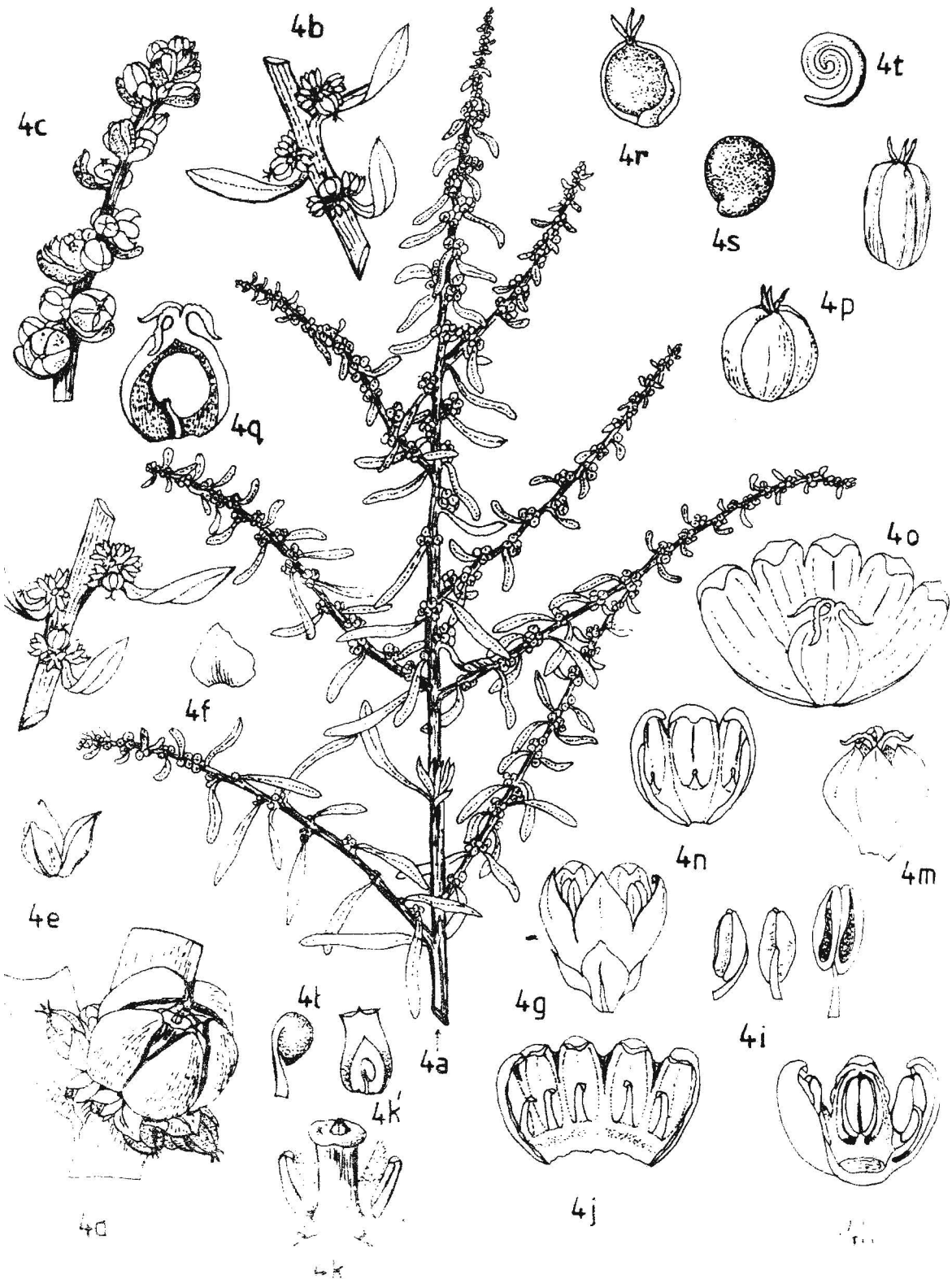

PLATE IV

Spikes slender with green flowers aggregated in clusters. Flowers unisexual or bisexual with male and female flowers on same plant or plants bearing female flowers only. Bracts small and with entire margins. Male flowers with 5 sepals, 5 stamens and a rudimentary ovary. Female flowers with the sepals fused almost upto apex; stamens rudimentary or absent; ovary with 3-4 stigmas. Pericarp membranous. Seeds black, glossy.

Common and gregarious on tidal flats in the dry zone.
Flowering about August, and from December to March.

3. S. nudiflora (Willd.) Moq. Trimen Fl. Ceyl. 3:409.
Plate III Fig. 5.

Perennial shrubs. Stems much-branched; branches prostrate and spreading; bark smooth, yellowish. Leaves numerous; lower leaves broadly linear, flattish, and falling off early; upper ones semi-cylindrical, succulent and glaucous-green, apices blunt. Flowers bisexual; in axillary, dense globose, many-flowered clusters. Bracts with serrate or pectinate margins, persistent after fruits ripen. Perianth obovoid, about 2.5 mm long; segments oblong. Ovary with 3 stigmas. Utricle ovoid. Seed smooth, black.

Common and gregarious in tidal flats on northwestern and northeastern coasts of the island.
Flowering about December to March.

The various species of Suaeda are of much use in stabilising sands and in reclaiming saline soils. For fixing sandy soils on coastal areas seed of Suaeda maritima may be sown about 3m apart on wet soil in tidal zones. Within a short time plants then cover the areas and bind the soils. If the plants are periodically harvested before the leaves are shed the salt present in soils can be progressively removed. This results in a lowering of the salt content in the soils.

The young leaves of S.maritima and S. nudiflora are edible and these are considered a wholesome vegetable (14).

THE COMMON ASSOCIATES OF SALT-MARSH PLANTS ON HIGHER GROUND

Check List of the Associates

1. Acanthaceae

1. Dyschoriste Nees
   1. D. madurensis (Burm.f.) Kuntze 12:225

2. Avicenniaceae

2. Avicennia L.
   2. A. officinalis L. 4:132

3. Chenopodiaceae

3. Atriplex L.
   3. A. repens Roth 9:406

4. Compositae

4. Blumea DC.
   4. B. obliqua (L.) Druce 3:174

5. Convolvulaceae

5. Cressa L.
   5. C. cretica L. 3:304
6. Evolvulus L.
   6. E. alsinoides (L.) L. 3:309

6. Cyperaceae

7. Cyperus L.
   7. C. rotundus L. 5:181
8. Pycreus Beauv.
   8. P. pumilus (L.) Nees 5:224
9. Schoenoplectus (Reichb.) Palla
   9. S. littoralis (Schrad.) Palla 5:157

7. Gramineae

10. Cynodon Rich.
    10. C. dactylon (L.) Pers. 11:274
11. Eragrostis Beauv.
    11. E. tenella (L.) Beauv.ex R.& S. 6:69
12. Zoysia Willd.
    12. Z. matrella(L.) Merr. 12:329

8. Lythraceae

13. Lawsonia L.
    13. L. inermis L. 12:129
14. Pemphis J.R.& G. Forst.
    14. P. acídula J.R. & G. Forst 8:227

9. Portulacaceae

15. Portulaca L.
    15. P. tuberosa Roxb. 7:90
    16. P. wightiana Wall. ex W. & A. 7:89

10. Violaceae

16. Hybanthus Jacq.
    17. H. enneaspermus (L.) F. Muell. 12:13

KEY TO THE COMMON ASSOCIATES OM HIGH GROUND

1. Leaves parallel-veined 2
   Leaves net-veined..... 7

2. Leaf-sheath closed; anthers basifixed.....3
   Leaf-sheath open on one side; anthers versatile..5

3. Flowering glurnes spirally arranged; hypogynous bristles present in flower.....Schoenoplectus littoralis
   Flowering glumes distichously arranged; hypogynous bristles absent..... 4

4. Style 3 - fid. Achene triquetrous, trigonous or dorsoventrally flattened with a flat side facing rachilla.....Cyperus rotundus
   Style 2-fid. Achene bilaterally flattened with one edge facing rachilla.....Pycreus pumilus

5. Stems erect or ascending and densely tufted; spikelets pedicelled and many-flowered.....Eragrostis tenella
   Stems creeping or rhizomatous, and rooting at the nodes; spikelets sessile and each one-flowered.... 6

6. Leaves stiff, ending in a rigid sharp point. Spikes solitary.....Zoysia matrella
   Leaves soft, apex not as above. Spikes digitate.....Cynodon dactylon

7. Leaves fleshy.....8
   Leaves not markedly fleshy.....10

8. Flowers unisexual. Petals absent.....*Atriplex repens*
   Flowers bisexual. Perianth differentiated into sepals and petals...9

9, Leaves oblong-spathulate, stipular appendages absent. Flowers in clusters..*Portulaca oleracea*
   Leaves oval, stipular appendages present. Flowers solitary.....*Portulaca wightiana*

10. Flowers in capitula; fruit an achene with a yellowish-white pappus.....*Blumea obliqua*
    Flowers not in capitula; fruit not as above..... 11

11. Plants with numerous, erect, pencil-like pneumatophores round base... .....*Avicennia officinalis*
    Plants not as above.....12

12. Ovary unilocular. Ovules numerous and on three parietal placentas.....*Hybanthus enneaspermus*
    Ovary 2-or more locular. Ovules few and not on parietal placentas.....13

13. Plowers gamopetalous. Stamens 2-5.....14
    Flowers polypetalous. Stamens 8-12.....16

14. Flowers bilaterally symmetrical, 2-lipped.....*Dyschoriste madurensis*
    Flowers radically symmetrical.....15

15. Styles 2, simple. Stigmas globose.....*Cressa cretica*
    Styles 2, each bifid. Stigmas linear...*Evolvulus alsinoides*

16. Flowers in terminal panicles; Stamens 8 .....*Lawsonia inermis*
    Flowers axillary and solitary; Stamens 12.....*Pemphis acidula*

References

1. Abeywickrama, B.A. & Arulgnanam P. (1991): The Marine Angiosperms of Sri Lanka. NARESA - MAB Publication No. 18. Colombo.

2. Brenan, J.P.M. (1954): Chenopodiaceae in Flora of Tropical East Africa. Crown Agents, London.

3. Dassanayake, M.D. & Fosberg, F.R. (Editors) (1980): A Revised Handbook to the Flora of Ceylon. Vol. 1. Amerind Publishing Co. New Delhi

4. -------(1983): Ibid. Vol. IV.

5. -------(1985): Ibid. Vol. V.

6. Senaratna, S.D.J.E. (1956): The Grasses of Ceylon. Colombo.

7. Trimen, H. (1893): A Handbook to the Flora of Ceylon. Part I. Dulau & Co. London.

8. --------(1894): Ibid. Part II

9. --------(1895): Ibid. Part III

10. --------(1898): Ibid. Part IV

11. -------(1900): Ibid. Part V

12. -------(1931) : Ibid. Part VI. Supplement by A.H.G. Alston.

13. Wight, R. (1852): Icones Plantarum Indiae Orientalis. Vol. 5. Madras.

14. Wealth of India (1976): Vol. X. Sp. - W. (Entry under Suaeda pp. 70,71.) CSIR. New Delhi.

INDEX TO THE GENERA