

ACADEMIE ROYALE DES SCIENCES D'OUTRE-MER

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**A revision of the genus *Najas* L.
(Najadaceae)
in the Old World**

BY

Ludwig TRIEST

**Research Assistant of the National Fund
for Scientific Research, Belgium**

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A REVISION OF THE GENUS *NAJAS* L. (*NAJADACEAE*) IN THE OLD WORLD

BY

Ludwig TRIEST (Brussels)

INTRODUCTION

The polymorphism of aquatic macrophytes is a well-known source of taxonomic problems which must be tackled before the knowledge necessary for the management of either threatened or weedy species can be systematised. At present, considerable experience is necessary to identify species in genera such as *Najas*, *Potamogeton* and *Callitriche*, particularly in the tropics (GAUDET, MITCHELL & DENNY, 1981). The knowledge of aquatic plants is important as the relationship between plants and hydrology has significant implications in many fields: agriculture, irrigation, flood control, drainage, inland navigation, fisheries, wildlife conservation, public health and recreation.

One of the first obstacles to be faced before a rational programme can be formulated to deal with an aquatic weed problem is the accurate identification of the plants. An illustrated manual (on genus level and world-wide) has proved its value and importance to those who are dealing with aquatic macrophytes (COOK, 1974). Still, genera of aquatic macrophytes are in need of thorough revision, mainly to provide accurate information on species delimitations, their populational variations, distribution and general biology (life form, multiplication, reproduction, dispersal etc.). Identification of the troublesome species (or their infraspecific taxa) is important, since aquatic plant communities remarkably are often dominated by one species and superficially appear to be monospecific. Correct determination of *Najas* plants

has been much less straightforward, mainly because of the lack of comprehensive reference texts. This study aims to put the discrimination of *Najas* species from Europe, Africa, Asia and Australia on a sounder footing, and make identification easier. This is practically important since several tropical *Najas* species have become weeds of rice fields, irrigation systems and farm dams and their reactions to control measures are known, or may be inferred, to be taxonomically based, at least in part.

The revision of the African material has been produced for the annual competition of 1984 of the Royal Academy of Overseas Sciences, Brussels (TRIENT, 1987). This memoir, completed by the data of the present work, is complementary to the recent revisions of the North American species (HAYNES, 1979) and of the Central and South American species (LOWDEN, 1986). The revision of *Najas* from the Old World has involved examination of a large amount of material deposited in the major herbaria, as well as living specimens or viable seed collections of *N. marina* from Europe, Turkey, Israel, Egypt and Burundi and of *N. minor* and *N. gracillima* from Italy.

Strong grounds for accepting 32 species, 12 subspecies and 7 varieties have been found in characters of the leaves, flowers and seeds. This study also aims to indicate the taxonomical problematic areas and characters which must be investigated in particular. The genus also is very coherent in both vegetative and reproductive morphology and anatomy, as a result of extreme reductions. As usual in submerged vascular plants, the structure of root, stem and leaf is very simple. In addition, the structure of male and female flowers is simple. In spite of the evident homogeneity of the genus, *N. marina* differs sufficiently from all other *Najas* spp. to allow acceptance of the subgenera *Najas* and *Caulinia*. The four sections (*Spathaceae*, *Americanae*, *Euvaginatae* and *Nudae*) however do not reflect natural affinities between species or species groups and therefore are abandoned. Phenetic groups of species are characterized by using sets of leaf and seed structures and by features of the spathes and the anther.

Keys are based upon material possessing male flowers, female flowers and fruits. Dimensions are taken from mature parts and structures. Doubtful specimens, devoid of either male or female flowers or fruits, are mentioned separately. If a variation shows a distinct pattern, this is indicated in the notes to the species concerned.

It is often impossible to identify sterile material with certainty. In most cases, even both male flowers and seeds should be available and as W. J. J. O. DE WILDE (1962) pointed out : «Collectors should try to select fertile material either recognizable by the presence of fruit in the lower axils, or the presence of a yellowish or reddish tinged anther in the higher axils. In some species the sexual organs are very small. Dissection and examination of boiled herbarium specimens is a delicate, time-consuming work. Attention is called to the fact that sometimes more than one species is represented in a single habitat». We may add, that field observations on the monoecious or dioecious character of several species is strongly recommended, as well as on their life form.

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CHAPTER 1

GENERIC CONSIDERATIONS

1. History of the genus

LINNAEUS started with nomenclatorial problems by having two entirely different concepts of his *N. marina* in *Flora suecica* (1745) and *Species Plantarum* (1753). Casper (1979) has investigated the problem of typification of the genus and concluded that the basis for the name should be the reference to MICHELI (1729) in *Hortus cliffortianus* (LINNAEUS, 1737) and that there is no evidence that Linnaeus based his descriptions on specimens currently in the Linnaean herbarium (LINN). In 1785, Allioni united Micheli's 4-seeded (i.e. loculamenta) and 1-seeded species under *N. major*, thus ignoring *N. marina* L. He named Micheli's third species *N. minor*. WILLDENOW (1798) created the genus *Caulinia* with three species: *C. flexilis*, *C. fragilis* (= *N. minor* All.) and *C. indica*. However R. BROWN (1810) re-united *Najas* and *Caulinia*. On the basis of collections from Egypt, DELILE (1813) described *N. muricata* and *N. graminea* and PARLATORE (1858) added *C. pectinata*. ASCHERSON (1864) divided the genus *Najas* into two groups, without mentioning their rank: *Eunajas* (*N. marina*) and *Caulinia* (*N. minor* and *N. flexilis*). BRAUN (1864), was the first to revise the genus. He adopted Ascherson's concept of the «groups» and gave them the rank of sections. He found good characters in the shape of the leaf and the leaf teeth to distinguish the species. His assistant MAGNUS (1870) made a very important contribution to the knowledge of the morphology of flowers and fruits in *Najas*, and the differences he found are still the basis for taxonomic treatments. He also described several species. MAGNUS (1887) himself reduced *N. horrida* A. Br. ex Magn. as a synonym of *N. pectinata* (Parl.) Magn. MAGNUS (1889) separated the section *Caulinia* into two subsections: *Americanae* with rounded leaf sheaths and *Euvaginatae* with truncate to auriculate leaf sheaths. In 1894, he described *N. schweinfurthii* and further discussed the female spathe of *N. pectinata*. RENDLE (1899a) first described *N. welwitschii*, before describing more species at the end of the same year in his Systematic revision of the genus *Najas* (1899b, 1900). This monograph has been used worldwide as the basis for many flora accounts. Since then there has been no worldwide revision of the genus. He examined more specimens from tropical regions than were available to A. Braun and Magnus. Following BRAUN's (1864) concept in dividing *Najas* into two sections, he takes the sections to the subgenus level. He further divided the subgenus *Caulinia* into four sections: *Spathaceae*, *Americanae*, *Euvaginatae* and *Nudae*, according to the presence or

absence of a spathe around the male and female flower. However these sections have been generally ignored in later works. RENDLE (1901) wrote up the genus for Engler's *Pflanzenreich* since when little attention has been paid to it. It took several decades to discover that the knowledge of tropical *Najas* was rather fragmentary. MIKI (1935a, 1935b) re-evaluated the Japanese *Najas* and described *N. oguraensis* and *N. tenuicaulis*. In 1937, RENDLE described *N. testui* from Central Africa and in 1941, MAIRE described *N. arsenariensis* from Alger, now considered by us as a subspecies of *N. marina*, but a remarkable collection nevertheless. HORN AF RANTZIEN (1950, 1952) provided additional information about African *Najas*. He noticed that the species from West tropical Africa differ considerably from those from other geographic regions of the continent. However he had no opportunity to examine more than fifteen collections. HORN AF RANTZIEN (1950) first described *N. baldwinii* and *N. liberiensis* and afterwards (1952) he described *N. meikleii* and *N. hagerupii*. Horn af Rantzien's key and the species he recognized were accepted in many floristic works. W. J. J. O. DE WILDE (1961, 1962) revised the genus for *Flora Malesiana* and provided additional information about Asian species. He described *N. malesiana*, *N. marina* var. *sumatrana* and *N. graminea* var. *robusta* and considered the taxonomical and geographical problems (species, specimens and areas). His comments on the morphological evaluation and taxonomic value of the spathe should not be misinterpreted. The presence and absence of a spathe round the male or female flower, was proposed as being less useful as a sectional character (DE WILDE, 1961). Nevertheless this feature has an important diagnostic value among *Najas* species. As to *N. marina*, recently, there has been a strong tendency towards raising the remaining varieties to the subspecies level (VIINIKKA, 1976 ; CASPER, 1979), while TZVELEV (1976) raises them to the species level and accepts *Caulinia* as a genus. LOWDEN (1986) calls for a thorough revision of infraspecific variation patterns in *N. marina*, together with biosystematic studies to ascertain natural entities. He also states : «The fact that no infraspecific taxa of *N. marina* are recently recognized for the New World, does not exclude their existence depending on a thorough research of this species throughout its known geographic range».

2. Vegetative morphology

2.1. LIFE FORMS AND VEGETATIVE SPREAD.

Najas spp. are submerged hydrophytes (annual) and reproduce almost exclusively by seeds. Unfavourable seasons, especially periods of drying out of temporary pools, are survived solely as seeds. This way, the plants behave as therophytes. Rather exceptionally, species (or populations of a species) were reported as having also perennial propagation (ROSENDAHL, 1939 ; OBERMEYER, 1966 ; AGAMI *et al.*, 1986). From the U.S.A., ROSENDAHL (1939) first reported the American *N. olivacea* as perennating by means of both «persistent lower nodes» and «densely clustered apices of the main and lateral shoots» (see also SCULTHORPE, 1968, pp. 346-347). In the literature on *Najas* from the Old World, species were mentioned as «annuals» or

«mostly annuals» without any further information on a possible vegetative propagation. More accurate information should come from field observations. OBERMEYER (1966) reported *N. horrida* (sub *N. pectinata*) with «winterbuds in the form of thickened nodes and leaf bases». Several collections of *N. marina* subsp. *armata* were with creeping stems, suggesting a perennial propagation.

In *N. marina* from Northern and Western Europe and in *N. minor*, *N. graminea* and *N. gracillima* from rice fields near Vercelli (Italy), we observed no means of vegetative propagation. All plants from these habitats obviously are annual. The fact that in *N. marina*, branches commonly become fragmented, the detached shoots forming roots, should only be regarded as a more or less accidental mean of local dispersal and not as a turion propagation. These fragments might bear flowers and fruits and are not all overwintering buds. Detached fragments also are known to occur in many other *Najas* spp. Many collections were made of drifting material, sometimes in tangled masses at the edges of lakes. WAISEL & AGAMI (1983) proved that floating *N. marina* plants or fragments did not suffer when lacking roots. The fact that floating fragments develop roots must be seen in the light of their therophytic nature, so that plants never behave as real pleustophytes.

Recently, turions were observed in *N. marina* subsp. *armata* from several populations of Israel (AGAMI & WAISEL, 1986). There, plants behave as summer annuals (germinate, grow, flower, fruit and decay). However, before desintegrating, when water temperature becomes lower, the plants produce turions which sink to the bottom. They remain dormant throughout winter and sprout again only in spring. These turions are shoot tips with closely packed and coarser leaves. In warm-water habitats (Lake Baringo, Kenya), AGAMI & WAISEL (1986) observed that *N. marina* plants were actively growing throughout the year, thus being perennial (no specimens seen). On the other hand, in Burundi (Rusizi plain, Lake Dogodogo), *N. marina* certainly is observed as an annual. Young and male plants were collected in April 1983 and mature plants with fruits in July 1983 by Mpawenayo (BRVU). Nevertheless, it might be true that in warm-water habitats, the plants when mature (or full-grown) could persist longer than exactly one season.

2.2. ARCHITECTURE.

All *Najas* species have a common basic architecture which is characterized as follows :

- (a) the unbranched rhizome resembles the stem, but is provided with one to several adventitious roots, just below each node ;
- (b) the stems originate from lateral branches on the nodes of the rhizome ;
- (c) the leaves are in subopposite pairs, however mainly placed in pseudowhorls of three up to seven (the latter in the case of repressed branches) ;
- (d) the axillary branchings and flowers occur only in the axil of the lower leaf of the pseudowhorl ;
- (e) the second leaf of the pseudowhorl fully clasps the main stem and lacks axillary buds of branches or flowers ;

- (f) the nodes (and leaves) are more sparsely distributed in the lower parts of the plant and densely clustered at the top of each branch.

Differences in habit between *Najas* plants are characterized by :

- (a) the length of the internodes on the main stem and on the axillary branches ;
- (b) the number of very short or almost undeveloped internodes of the axillary branches, giving the impression of closely packed pseudowhorls of many leaves in each node (thus with repressed lateral branches) ;
- (c) the strength of the stem and leaves (lax, coarse, spiny) and the size of the leaf teeth.

2.3. ROOTS AND STEMS.

Roots are adventitious and unbranched. They arise only from certain nodes, though it may be observed on branches lying on the bottom that roots and leaves may develop from the same node. Following the trend in water plants to vascular reduction, the roots lack true vessels and are, indeed, almost totally devoid of any, even annular elements.

Stems are filiform, up to 1 m in length, rooted, branched and sparsely to very densely clothed with leaves. They are circular in transverse sections, with air-cavities in the cortex and they do not vary much in diameter. In most species the epidermal cells of the stem, closely resemble the underlying cells of the cortex, though in *N. marina* they are smaller. The internodes may be provided with spines, similar to those on the leaf margins.

2.4. SHOOT MORPHOLOGY AND NODAL COMPLEX (Fig. 1 A-B).

The following terminology and symbols are used in text and figures :

- main branch (B1) = the vegetative branch, which is clasped by the second leaf (L2) only.
- axillary or lateral branch (B2) = the branch which is clasped by the first leaf (L1) and might contain reproductive structures in its axil.
- leaves (L1, L2, L3), numbered after their age and consequently their size.
- scale or full-grown leaf (L4).

Leaves are mainly arranged in pseudowhorls of 3-7. The phyllotaxis originates as follows : the sheath of the incompletely amplexicaulous lower leaf (L1) of each pair imbricately overlaps the fully amplexicaulous sheath (L2) of the upper one. Only the lower leaf (L1) bears an axillary bud growing into a lateral branch. The first internode of this lateral branch is extremely short. Its first almost sessile node bears a leaf pair, of which only the upper one develops into a real leaf (L3). This then forms with the 2 leaves of the main stem the pseudowhorl. The lower leaf (L4) of the first node of the new branch is very much reduced (Magnus, 1870, 1894). Small intravaginal scales may be present in the leaves, but they are rather inconsistent.

Many aspects of the shoot morphology of *Najas* spp. have been described after MAGNUS' original description (1870). However, the ambiguous interpretation of the

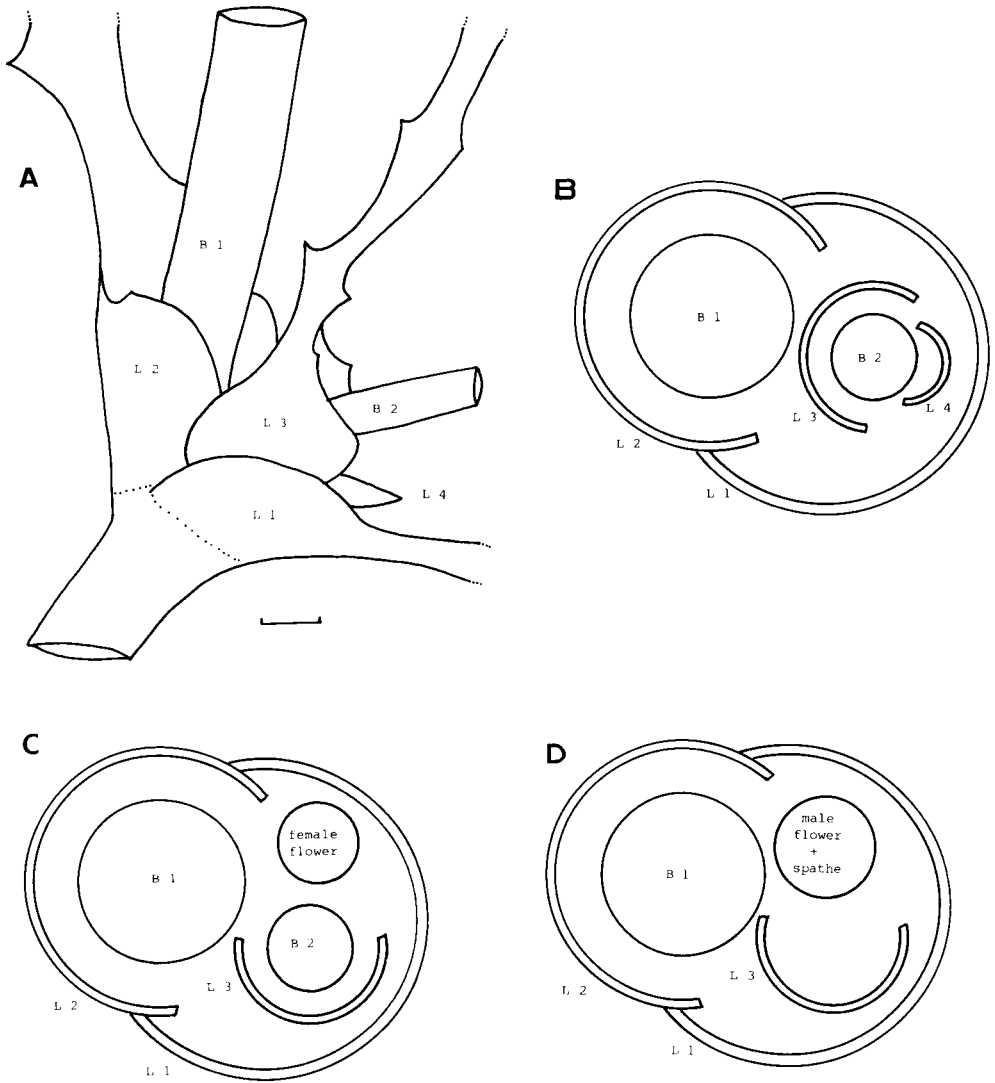


FIG. 1. — Schematic presentation of the nodal complex in *N. marina* L. with B 1 : main branch ; B 2 : axillary branch ; L 1-3 : leaves ; L 4 : scale (A, B, C : subsp. *marina* var. *marina*, Triest 174 ; D : subsp. *marina* var. *marina*, Triest 112b ; scale = 1 mm).

shoot morphology leads to generalized misinterpretations. Recently, an adequate review of the family was given by TOMLINSON (1982), who also emphasized the remaining confusions: «There is some confusion in the literature regarding the interpretation of the nodal complex which, when fully developed, is represented by a pseudowhorl of three leaves, a lateral vegetative branch, and a flower. All authors who have examined the morphology of *Najas* in detail follow MAGNUS (1869) and are agreed that the third leaf (leaf 3) of each pseudowhorl is a basal leaf on the lateral shoot subtended by leaf 1. MAGNUS (1869, 1870, 1894) and Rendle (1899b) indicate that there are two leaves at the base of this lateral shoot, of which one is reduced to a small scale of microscopical size bearing a bud in its axil. In flower-bearing pseudowhorls the scale and bud are said to be replaced by a flower. This interpretation is repeated by DE WILDE (1961). However, neither CAMPBELL (1897) nor POSLUSZNY & SATTLER (1976) illustrate or refer to such a basal scale. It is possible that earlier authors confused a squamule for a scale since there is an extra squamule at the base of the flower. The statement by SINGH (1965) is even more ambiguous, because he implies that staminate and pistillate flowers occupy different positions. His interpretation is based on the disposition of traces to appendages. Since the morphology of *Najas* is complex, the point should be resolvable by further comparative study».

In the present work, the shoot morphology has been checked in all species from the Old World, as well on sterile shoots as on shoots with male or female flowers.

2.4.1. Subgenus *Najas*.

In sterile plants (Fig. 1 A & B), each node consists of the main branch, an axillary branch, three full-grown leaves and a leaf-like scale. The latter may not be confused with the intravaginal scales which are much smaller and not at all leaf-like! The scale is slightly longer than the leaf sheaths, and has the appearance of a small leaf with a toothed apex, slightly protruding spine-cells on both margins and a well-developed sheath. Four full-grown leaves have not been observed.

In female plants (Fig. 1 C), the nodal complex, consists of the main branch, an axillary branch, three full-grown leaves and a female flower; the flower is inserted at the same place as the scale of sterile shoots. Both, flower and scale, were never observed together in the same node (MAGNUS, 1870; RENDLE, 1899b; DE WILDE, 1961). This is true for subgenus *Najas*, however, the female flower and the third leaf might occupy two different places of insertion (MAGNUS, 1870).

In male plants (Fig. 1 D), the nodes consist of the main branch, an axillary branch, three full-grown leaves and a male flower. The flower always was observed at the same position of insertion, i.e. between the first and the third leaf.

Thus, in subgenus *Najas*, the fourth leaf of each pseudowhorl is present as a scale in sterile shoots, but in fertile shoots, a naked female flower or a spathaceous male flower is inserted at the place of this scale. The female flower may be inserted at two different positions, one of which is similar to the place of insertion of the male flowers.

In subsp. *arsenariensis*, there are only the sub-opposite leaf pair and a male flower per node (eventually with an axillary branch).

2.4.2. Subgenus *Caulinia*.

Plants with or without an axillary branch should be discussed separately. In plants (Fig. 2 A) with nodes consisting of the main branch and an axillary branch, there are three full-grown leaves, but no leaf-like scales or any fourth leaf. In such nodes, there might be either a spathaceous male flower (cf. *N. horrida*, *N. welwitschii*), a spathaceous female flower (cf. *N. welwitschii*, *N. madagascariensis*, *N. testui*) or a naked female flower (cf. *N. horrida*).

In plants with nodes consisting of the main branch, but lacking an axillary branch, there are either three full-grown leaves or eventually a fourth leaf (scale or full-grown). In such nodes there might be a male or female flower, either naked or spathaceous cf. *N. hagerupii* (Fig. 2 B), *N. baldwinii* (Fig. 2 C), *N. schweinfurthii* (Fig. 2 D), *N. setacea*. Flower and fourth leaf (scale or full-grown) were observed together in the same node.

Thus in subgenus *Caulinia*, the fourth leaf seems to replace the axillary branch, independently from the presence or absence of floral structures (male, female, naked or spathaceous). in both cases, i.e. nodes with or without an axillary branch, the female flowers might be inserted at two different positions and the male flowers at one position (as in subgenus *Najas*).

2.5. LEAVES.

The leaf blade is linear (except for short leaves with large teeth) and generally consists of only two cell layers, the upper and lower epidermis. Only *N. marina* has additional subepidermal layers. On cross section, the midrib consists of short cells, accompanied by one or two cell layers, with air-cavities on both lateral sides. In several species, transverse septa are well developed. Sclerenchyma fibres may be formed on and near the midrib and on both margins. However, the presence or absence of fibres in the leaves sometimes is too inconsistent for use at the species level. The margin on each side may be minutely serrulate with inconspicuous spiny teeth, mainly consisting of a brownish spine-cell or may be more coarsely serrulate with conspicuous spiny teeth consisting of a brownish spine-cell situated on a small, broad or even very broad triangular excrescence. In the subgenus *Najas*, the spine-cell rests upon several elongate brown cells, and the midrib may be supplied with teeth similar to those on the leaf margins. The leaf sheaths are variously shaped. They are round, truncate or slightly to longly auriculate. The margins of the sheath or auricle mostly bear brownish spine-cells which are rather distantly arranged.

3. Reproductive morphology and biology

3.1. SPATHE.

The flowers of *Najas* are unisexual and solitary at the very base of an axillary shoot. The flowers of both sexes each may be surrounded independently with a spathe or

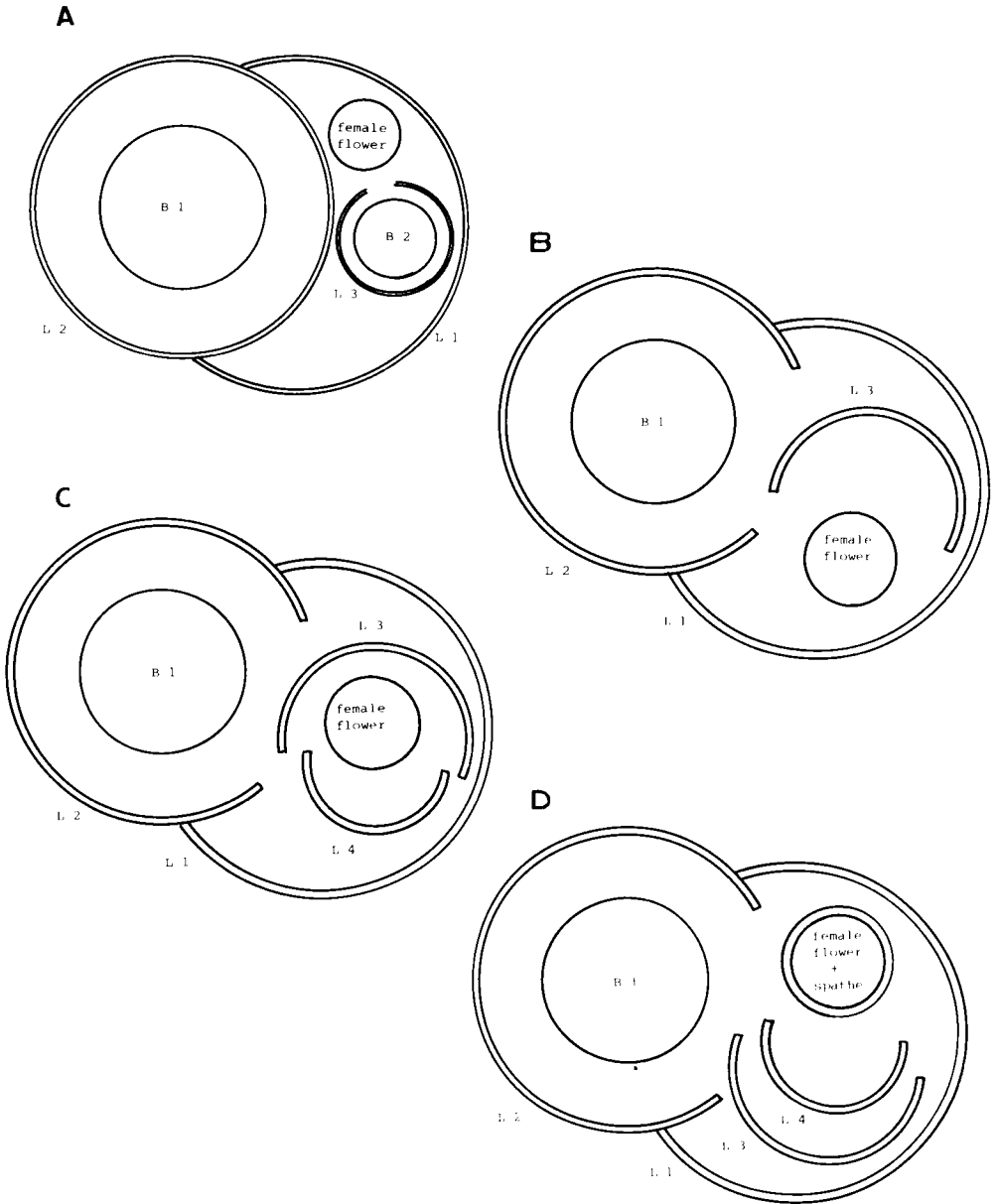


FIG. 2. — Schematic presentation of the nodal complex in subgenus *Caulinia* with B 1 : main branch ; B 2 : axillary branch ; L 1-3 : leaves ; L 4 : scale or leaf (A : *N. horrida*, de Wilde 5218 ; B : *N. hagerupii*, Hall CC 892 ; C : *N. baldwinii*, Chevalier 6582 ; D : *N. schweinfurthii*, Milne-Redhead & Taylor 9964).

may be naked. This spathe has been interpreted as a modified leaf and transitional structures between a spathe and the fourth leaf were observed (DE WILDE, 1961) and confirmed in this study. The specimen *Surbeck* 301 of *N. graminea* from Sumatra, has male flowers which are either naked or surrounded by a leaf-like more or less closed spathe. No other specimens were found with such leaf-like spathes as in *Surbeck* 301. It is clear that this collection is unique. However, its interpretation as well on the homology as on the taxonomic value of the spathe never should be generalized to the whole genus.

The hypothesis that the spathe is homologous to a leaf or leaflike structure is generally accepted in many genera. However, the assumption that in *Najas*, the spathe is homologous to the lower leaf of each axillary pair which in sterile shoots is normally developed as a minute scale, could only be partly true, namely for the male flower in subgenus *Najas* and for the plants with naked male and female flowers in subgenus *Caulinia* (*N. baldwinii*, *N. malesiana*, *N. graminea*).

There is no evidence to accept such hypothesis neither for the naked female flower in subgenus *Najas*, because the scale also is absent, nor for the male flower in subgenus *Caulinia* because either the scale can be absent as well as a spathe (e.g. *N. hagerupii*) or the scale can be present together with a spathe (e.g. *N. schweinfurthii*); for the female flower in subgenus *Caulinia* because either the scale can be absent as well as a spathe (e.g. *N. horrida*, *N. hagerupii*) or the scale can be present together with a spathe (e.g. *N. schweinfurthii*).

At this moment there is no straightforward explanation for this variation, but it is clear that the spathes can be homologous with more than one leaf among the different *Najas* spp.

3.2. FLOWERS.

The morphological nature of the floral parts has given rise to much discussion (MAGNUS, 1870; CAMPBELL, 1897; RENDLE, 1899b; DE WILDE, 1961; SWAMY & LAKSHMANAN, 1962; POSLUSZNY & SATTLER, 1976). However, it is generally accepted now that the male flower always has a cupular perianth and that the female flower lacks «perianth-like» structures.

The male flower is shortly stalked and consists of a solitary, almost sessile anther which is unisporangiate or tetrasporangiate. The anther is surrounded by a «perianth-like» inner envelope, which is two-lipped above. The entire structure may be naked or enclosed in a bottle-shaped spathe, which is always longer than the flower.

The female flower is unicarpellate and contains one basal anatropous ovule. The gynoecial wall ends in a 2-3 (-4)-lobed style. A homologous structure of the inner envelope in the male flower is not present in the female flower. The entire structure may be naked or enclosed in a spathe, the neck of which reaches halfway along the style.

3.3. FLORAL BIOLOGY.

No detailed studies have been devoted to the pollination of *Najas* species.

When mature, the short stalk of the anther elongates rapidly and pushes the flower out of the spathe (if present). The pollen then escapes apically through the cupular lobes of the inner envelope. The pollen grains are globular to ellipsoid, rich in starch and devoid of exine. When liberated through the apex of the inner envelope, they have often begun to germinate. This was observed in *N. marina* (MAGNUS, 1889) and in other *Najas* species (MIKI, 1935b). Pollination takes place under water and therefore is true hydrogamy.

There is a certain correlation between the monoecious or dioecious nature of the species, the size of the male flowers and their distribution along the branches.

In the case of dioecious plants (*N. marina* and most probably *N. horrida* and *N. indica*) and even in those plants with the male flowers on different branches than the female flowers, the anthers are always 4-locular and are present in every axil, this way providing a suitable amount of pollen and facilitating pollination of rather distant flowers.

In the case of monoecious plants with male and female flowers together on the top of the branches (e.g. *N. gracillima*), the anthers might be 1-locular or in some species even 4-locular, but then of a smaller size than those of dioecious plants. Few male flowers are present in the uppermost axils and none in the lower ones. A lesser amount of pollen seems to be effective enough for pollination when male and female flowers are in close proximity.

Since *Najas* plants usually grow in dense masses, the pollen grains are caught haphazardly on the stigmas. The partly grown pollen-tubes increase the effective surface and may facilitate pollination. No pollen groups or chains were observed. We observed successful self-pollination in *N. gracillima* and *N. minor* grown in aquaria.

3.4. FRUIT AND SEED.

The fruit is a one-seeded nutlet (achene) with a very thin membranous pericarp and bears the remaining parts of the style and the spathe (if present).

The seed has a testa composed of three or more cell-layers, with the inner layer somewhat membranous and the middle and outer layer quite stony. The outer layer, however, sloughs partly away in many species, this resulting in the pitting of areoles. These areoles are arranged either irregularly or regularly. The arrangement and the shape of the areoles are often a useful character at the species level (see phenetic groups and descriptions).

The endosperm development is of the nuclear type, but the endosperm is resorbed by the time of embryo maturation. A contribution to the embryology of two *Najas* species from India was given by SWAMY & LAKSHMANAN (1962). They concluded that the endosperm is initially free nuclear and not helobial. Cell-wall formation starts much later at the micropylar pole. A structural and histochemical approach has been given by VIJAYARAGHAVAN & KAPOOR (1985). They found that the embryo basal cell in *N. marina* has other functions to play, besides anchoring the embryo. It helps in the translocation of metabolites to the growing embryo during early stages, while at seed maturity, it acts as a barrier for the emergence of the initial root from the normal radicular end of the embryo. They envisaged that this phenomenon initiates the

development of the embryonic shoot apex and embryonic leaves at the epicotylary end and thus promotes precocious germination, so preventing seed dormancy in *N. marina*. However, if this process may occur in India, it may certainly not be generalized to regions where the seeds have to overcome a winter resting period.

3.5. DISPERSAL.

In *Najas*, the seed rain from a single individual may reach about 50-200 seeds. All seeds (detached or on mother plant) sink to the bottom at the site of the mother plant, unless they are dispersed by the following ways :

- (a) wind, wave action (detached floating fragments with seeds) ;
- (b) rain, flood which promotes the dispersal of plant-fragments and seeds throughout series of pools in close vicinity to a river ;
- (c) animals (fish, water-fowl) which retain seeds in the digestive tracts and which detach fragments with fruits in their movement ;
- (d) man (recreation activities such as fishing, navigation ; mechanical activities such as unefficient control methods ; agricultural activities such as accidental transport of seed lots).

Within a water body and between connected water bodies, the dispersal of *Najas* is achieved by fish, water-fowl, fishing activities, mechanical activities and wave action, which all promote the detachment of fragments with fruits.

Between unconnected and even newly formed water bodies, the dispersal is achieved mainly by water-fowl and to a lesser extent by accidental transport of crop plants and fish life-stocks. The effect of passage of *N. marina* seeds through the digestive system of the common mallard (*Anas platyrhynchos*) on their germinability was investigated by AGAMI & WAISEL (1986). Most of the seeds (c. 70%), which were consumed by the birds were digested. Germination of the remaining seeds was improved and reached similar percentages to seeds whose seed coats were cracked. Germination percentages of intact seeds i.e. of seeds that did not pass through the digestive tract of the mallards, was significantly lower than that of both treated groups. Seeds of *N. marina* are retained in the digestive tracts of mallards for over 10 hours and thus can be distributed over long distances.

Viable fruits or seeds may be accidentally transported with agricultural products. This dispersal is successful only, where the climate is exceptionally mild or where the water is artificially warmed up (by the effluents from factories). On this way, tropical or subtropical *Najas* species are reported as adventives or undergo range extensions to the northernmost rice field areas of Europe and Asia (e.g. *N. graminea* and *N. gracillima*). *N. graminea* from an isolated locality in Great Britain is thought to have arrived with Egyptian cotton and could survive in the warmer waters of the Reddish canal.

3.6. GERMINATION.

Germination experiments are known for *N. marina* from Sweden (FORSBERG, 1965), the Netherlands (VAN VIERSSEN, 1982) and Israel (AGAMI & WAISEL, 1986).

The germination of subsp. *intermedia* from Sweden (FORSBERG, 1965) was promoted by a low redox potential (E lower than + 400 mV), a dormancy of 1-3 months at 4°C, a temperature of 20-25°C and darkness.

The germination of subsp. *marina* from the Netherlands (VAN VIERSEN, 1982) was promoted by a very low redox potential (between - 300 and - 400 mV), a dormancy at 4°C and darkness (the temperature may be lower under dark, namely 12-25°C).

The germination of subsp. *armata* from Israel (AGAMI & WAISEL, 1986) was promoted by cracked seed coats, a temperature of 20-25°C and darkness. The viability was retained after 4 years drought.

As to *N. marina* subsp. *intermedia* from the Gnadensee, seeds were most difficult to germinate under the same conditions (cold treatment, darkness, 20-25°C, substrate with high organic content), when compared to those from the Baltic area and to seeds of subsp. *marina*.

Seeds of *N. marina* subsp. *armata* from Israel (Merkaz Sappir) and Burundi (Lake Dogodogo) germinate immediately after harvesting, when placed in dark and in tap water at 20-25°C.

Seeds of *N. gracillima* from Italy (Vercelli) germinated in tap water and in a pure sandy substrate. Seeds kept for two years in dry sand, germinated immediately when soaked in tap water. All seeds germinated almost simultaneously.

4. Chromosomes (see Table 1)

Several species of the genus *Najas* have been studied, but chromosome counts are mostly limited to material from Europe, Japan and North America. Counts on tropical species are rare. The basic chromosome number of all *Najas* species is $n = 6$, and the chromosome length lies between 1.6 and 11.3 μm . In subgenus *Najas*, the chromosomes are about 2.5 times longer than those in *Caulinia*.

Most supporting literature can be found in DARLINGTON & JANAKI AMMAL (1945), HARADA (1956), SHARMA & CHATTERJEE (1967) and VIINIKKA (1976).

Polyploidy is known in subgenus *Caulinia*, and most of the species investigated are polyploid, even with large ranges. In subgenus *Najas*, one polyploid has been observed, while accessory B-chromosomes are not unusual. In almost all species investigated, there might be different ploidy levels from different or the same geographical areas. However, it is not clear from the literature, whether the different levels of ploidy of species in a particular area, either were found mixed within a single population or were observed in distinct populations of these species. The following table summarizes the number of chromosomes known in all species from the Old World investigated together with their area of collection. Counts on species which also occur in North America are included for comparison.

4.1. SUBGENUS *Najas*.

The diploid cytodeme $2n = 12$ has been reported from Europe, U.S.S.R., China, Japan, N. America and Burundi. Two different karyotypes, named A and B are known

(VIINIKKA, 1976). They differ in the chromosome length and in the position of the centromere, the secondary constriction and the nucleolus organizing region.

Karyotype A is reported from Western Europe (GUIGNARD, 1899, 1901 ; MÜLLER, 1912 ; VIINIKKA, 1976), from the U.S.S.R. (TSCHERNOYAROV, 1914 ; LEWITSKY, 1931), from China (YOU *et al.*, 1985), from Japan (TAKAMINE, 1927 ; HARADA, 1943, 1956). Accessory B-chromosomes in this race, only were reported from Japan (HARADA, 1943, 1956). Karyotype A thus was found in subsp. *marina* var. *marina*, var. *grossedentata* and var. *ohwii*.

Table 1

Chromosome numbers in the genus *Najas*

spec. \ 2n	12	24	36	48	60
<i>N. marina</i>	(*)	Israel			
<i>N. ancistrocarpa</i>	Japan	Japan			
<i>N. flexilis</i>	N. America	N. America Europe			
<i>N. orientalis</i> (sub <i>N. foveolata</i>)	China Japan	Japan	Japan		
<i>N. kingii</i>	Thailand				
<i>N. gracillima</i>	China Japan	N. America	N. America		
<i>N. minor</i>	India Japan	China Europe N. America	Japan		
<i>N. oguraensis</i>		Japan			China
<i>N. graminea</i>		Japan	China	India	

(*) Europe, U.S.S.R., China, Japan, N. America and Burundi.

Karyotype B is reported from Northern and Central Europe (WINGE, 1927 ; TISCHLER, 1936 ; WULFF, 1937 ; VIINIKKA, 1976), from Ohio, N. America (VIINIKKA, 1976) and from Burundi, Africa (VIINIKKA *et al.*, 1987). Accessory B-chromosomes in this race were reported by VIINIKKA (1976) from Finland (Virolahti, Turku), the German Democratic Republic (Ober-Ueckersee) and the Federal Republic of Germany (Gnadensee, a part of the Bodensee). A tetraploid $2n = 24$ has been reported recently in plants from Israel (Merkaz Sappir), most likely an autotetraploid of karyotype B (VIINIKKA *et al.*, 1987). Karyotype B ($2n = 12$) thus was observed in subsp. *intermedia* and once in subsp. *armata*, while $2n = 24$ was found also once in subsp. *armata*.

4.2. SUBGENUS *Caulinia*.

N. ancistrocarpa ($2n = 12, 24$), has been found once on Japanese material (HARADA, 1943, 1956).

N. flexilis ($2n = 12, 16, 24$). The tetraploid cytodeme $2n = 24$ is known from Europe, while both cytodesmes $2n = 12$ and $2n = 24$ are known from N. America (CHASE, 1947; LÖVE & LÖVE, 1958). The cytodeme $2n = 16$ has been reported from the Detroit river, U.S.A. by Campbell (1897).

N. orientalis (as *N. foveolata*) ($2n = 12, 24, 34$). The diploid cytodeme $2n = 12$ is known from China (YOU *et al.*, 1985), while $2n = 12, 24, 34$ are known from Japan (HARADA, 1943, 1956).

N. kingii ($2n = 12$), has been reported from Thailand (LARSEN, 1963).

N. gracillima ($2n = 12, 24, 36$). The diploid cytodeme is known from China (YOU *et al.*, 1985) and Japan (HARADA, 1943, 1956). From N. America, mainly tetraploids were found, but only once hexaploids were observed (CHASE, 1947).

N. minor ($2n = 12, 24, 36$). The diploid is reported from India (SHARMA & CHATTERJEE, 1967) and Japan (HARADA, 1943, 1956). The tetraploid is reported from Europe (SCHOTSMAN, 1970), China (YOU *et al.*, 1985) and N. America (CHASE, 1947). The hexaploid is known from Japan (HARADA, 1943, 1956). The determination of the specimen from India (Calcutta) is doubtful and it could be as well *N. tenuis* or *N. indica*.

N. oguraensis ($2n = 24, 60$). The cytodeme $2n = 24$, is known from Japan (HARADA, 1943, 1956) and the cytodeme $2n = 60$ has been reported from China (YOU *et al.*, 1985).

N. graminea ($2n = 24, 36, 48$). The cytodeme $2n = 24$ is known from Japan (HARADA, 1943, 1956); $2n = 36$ from China (YOU *et al.*, 1985) and $2n = 48$ from India (SHARMA & CHATTERJEE, 1947).

According to the available information, there is much evidence to accept that recognition of many ploidy levels within single species of subgenus *Caulinia* might be expected. HARADA (1943, 1956) and CHASE (1947) pointed out, the subgenus *Caulinia* may be named as «a group of so-called oscillating chromosome numbers» and could be regarded as being in an unstable step of evolution.

5. Biochemistry

The study of secondary metabolites is still in a developing phase and, consequently, little is known about their taxonomic significance in *Najas*. Most constituents such as flavones, flavonols, tannin and lignin are lacking or useless for species distinctions (HEGNAUER 1963; BATE-SMITH, 1968).

VAN BEUSEKOM (1967) investigated the distribution of apiose, a pentose with a branched C-chain, in the *Alismatidae*. It is present in seagrasses and absent in some brackish water species (among which *N. marina*).

SAKAI & HAYASHI (1973) distinguished *Alismatidae* with either an accumulation

of sugar or starch in their leaves. They found *N. marina* and *N. oguraensis* to have non-starchy leaves.

An extensive study of the isozyme polymorphism in leaves and seeds of the following subspecies of *N. marina* has been carried out by us : subsp. *marina*, subsp. *intermedia* (both from Europe) and subsp. *armata* (Africa).

Investigated isozyme systems were : alcohol dehydrogenase (ADH), glucose-6-P-dehydrogenase (G6PDH), glutamate dehydrogenase (GDH), isocitric dehydrogenase (IDH), malate dehydrogenase (MDH), malic enzyme (ME), peroxidase (POD), 6-P-gluconate dehydrogenase (6PGDH), shikimic dehydrogenase (SkDH), superoxide dismutase (SOD), xanthine dehydrogenase (XDH) and glucose phosphate isomerase (GPI).

The diagnostic data of ADH, ME, SkDH and XDH in plants from Burundi were described previously and compared with the European taxa (TRIST & SYMOENS, 1985). Later, the Western European populations were discussed (TRIST *et al.*, 1986) as well as the nature and polymorphism of the ADH-isozymes (VAN GEYT *et al.*, 1987). Further results will be published later.

According to the populations and to the isozyme patterns studied here, it is clear that subsp. *armata* shows more affinities to subsp. *intermedia* than to subsp. *marina*, a feature which is also indicated by the karyotypes (VIINIKKA *et al.*, 1987).

Investigations on isozymes in *Najas marina* becomes a very useful tool to distinguish genetical entities within *N. marina* s.l. It also gives additional evidence to support the distinction of morphological entities, to assess polymorphisms and even to illustrate the natural affinities between population groups.

A comparative study on peroxidase isozymes and cytochromes of six species from China, revealed that four of these species (*N. gracillima*, *N. graminea*, *N. minor* and *N. oguraensis*) could be closely connected, but the relation of *N. foveolata* (probably *N. orientalis*) and *N. marina* with the above four species was not clear (YOU *et al.*, 1985).

6. Ecology

Najas species are widespread in many different fresh or brackish waterbodies : in freshwater pools, swamps, forest streams, shallow edges of lakes and rivers, dams, tanks, drinking-water reservoirs, irrigation canals, ditches and rice fields ; in saline or brackish waters of lakes, lagoons, mangroves coastal swamp areas and drains ; in temporary marshes and pools with fluctuating water level and changing total mineralization.

Najas species, together with numerous other hydrophytes, are often considered to be very extensively distributed, but in fact they are extremely local in occurrence over quite large sectors of their range. Their total distribution is the result of abiotic and biotic factors.

6.1. ABIOTIC FACTORS.

6.1.1. Soil.

N. marina grows on sand, clay, silt, clay with shells and on thick organic matter. In most cases, *N. marina* was observed on an organic substrate covered with a layer of sand or clay. For species of subgenus *Caulinia*, the soil may be muddy (sand, grey or black clay) or rocky (granite, basalt, laterite).

6.1.2. Water quality.

Najas marina is found in fresh and brackish waters. Supporting literature on the halophytic and glycophytic nature of *N. marina* can be found in FOSBERG (1961), PIETSCH (1981), CIRUJANO & LOPEZ ALBERCA (1984) and AGAMI *et al.* (1984).

The fresh and brackish water habitat of *N. marina* subsp. *intermedia* has been discussed by FOSBERG (1961). The relationship between the Scandinavian distribution in fresh and brackish water habitats and their conductivity shows that subsp. *intermedia* is restricted to waters of high conductivity and with a lower limit value of approximately $300 \mu\text{S}\cdot\text{cm}^{-1}$.

The freshwater habitat of subsp. *intermedia* and subsp. *marina* from lakes in the German Democratic Republic and W. Poland has been discussed by PIETSCH (1981). He concludes that, when compared to the habitat of *Hydrilla verticillata*, *N. marina* grows in waters with a significantly higher content of SO_4^- (17.8-114.7 mg/l), Cl^- (6.9-71.6 mg/l) and a lesser content of HCO_3^- (91.6-222.6 mg/l).

The habitat of *N. marina* subsp. *armata* from La Mancha (Spain) has been discussed by CIRUJANO & LOPEZ ALBERCA (1984). The analytical data of the water clearly indicate a high content of Ca^{++} and SO_4^- . AGAMI *et al.* (1984) proved that subsp. *armata* from Israel retains its halophytic nature with an optimal NaCl concentration of 37-55 mM, but that in fresh water habitats, *Najas* grows under suboptimal NaCl concentrations.

Subspecies *marina* grows mainly in Ca^{++} and HCO_3^- rich waters with a conductivity of $340\text{-}1250 \mu\text{S}\cdot\text{cm}^{-1}$ (remnants of meanders, pools or gravel-pits just near rivers Somme, Meuse, Mosel and Rhine) and exceptionally in Cl^- and SO_4^- rich waters with a conductivity of $2250 \mu\text{S}\cdot\text{cm}^{-1}$ (shallow marsh near a spoil heap of a coal-mine near Valenciennes, France). In the Alp region, conductivities range from $195\text{-}380 \mu\text{S}\cdot\text{cm}^{-1}$ in habitats of subsp. *marina* (Mindelsee, Zürichsee, Sempachersee). Subsp. *intermedia* has a larger range of habitats than subsp. *marina*, but seems to be absent in Ca^+ and HCO_3^- rich waters. In the Baltic area, subsp. *intermedia* grows as well in the brackish water of the sea (conductivity of $7000\text{-}9130 \mu\text{S}\cdot\text{cm}^{-1}$) as in freshwater lakes of the coastal area (conductivity of $170\text{-}250 \mu\text{S}\cdot\text{cm}^{-1}$). In the Netherlands and the German Democratic Republic, it grows in Cl^- and SO_4^- rich waters (conductivities of $700\text{-}800 \mu\text{S}\cdot\text{cm}^{-1}$). In the Alp region (Gnadensee, Sempachersee), it grows even in waters with conductivities of $195\text{-}250 \mu\text{S}\cdot\text{cm}^{-1}$, thus with a low mineral content. This concentration is comparable to that of some of the Scandinavian freshwater lakes. When looking at the distribution of subsp. *armata* in

Africa and Asia Minor, along coastal areas, lagoons and rift lakes, this subsp. seems to prefer Cl^- and SO_4^- rich waters. In Egypt, it grows in the Delta lakes, mainly in the brackish parts where conductivities range from 1,450-9,000 $\mu\text{S.cm}^{-1}$. There it is absent from as well the salt water as from the freshwater parts of the lakes. It also grows chiefly in drains with brackish water (conductivities of 3,450-3,700 $\mu\text{S.cm}^{-1}$).

As to subgenus *Caulinia*, most species occur extensively in fresh waters while only few are also known from saline or brackish waters of ephemeral pools and lagoons. Known from both temporary habitats and lagoons are *N. baldwinii* and to a lesser extent *N. malesiana*. Both species occur in a broad range of habitats. *N. setacea*, *N. halophila* and *N. browniana* were mainly collected from lagoons, mangroves and coastal areas.

6.2. BIOTIC FACTORS AND RELATIONS.

6.2.1. Associated aquatic macrophytes.

N. marina from brackish waters (conductivities never exceeded 10,000 $\mu\text{S.cm}^{-1}$) might be associated with *Potamogeton pectinatus* and species of *Chara*, *Ruppia*, *Zannichellia* and *Ceratophyllum*. *N. marina* from freshwaters might be associated with species of *Chara*, *Potamogeton*, *Ceratophyllum*, *Myriophyllum*, *Elodea* and *Zannichellia*.

Negative allelopathic relationships between *N. marina* subsp. *armata* and *Myriophyllum spicatum* from Israel were observed (AGAMI & WAISEL, 1985).

The species of subgenus *Caulinia* are, according to their distribution and habitat, associated with species of *Chara*, *Nymphaea*, *Ceratophyllum*, *Potamogeton*, *Utricularia*, *Hydrilla*, *Lagarosiphon*, *Najas*, *Vallisneria*, *Ottelia*, *Limnophila*, *Rotala*, *Brasenia*, *Ludwigia*, *Eleocharis* and *Cyperus*. Associated pleustophytes are *Azolla*, *Trapa*, *Eichhornia* and *Pistia*.

6.2.2. Biotic relations.

The biotic importance of *Najas* spp. is a more limited one. Though the tendency to form extensive pure stands, inhibiting colonization by potential competitors is characteristic of *Najas*, most species are of a very local occurrence and consequently of a local importance. However with respect to their vigorous growth and large amount of seeds, the biotic importance of *Najas* as a direct source of food for many sorts of waterfowl might be underestimated. In Lake Naivasha (Kenya), coots depend heavily on *N. horrida* (sub *N. pectinata*) while other waterfowl also feed on *N. horrida* (WATSON, SINGH & PARKER, 1970). Waterfowl has also been observed feeding on *N. marina* seeds at most places visited in Europe during our excursions. The periphyton growing on the surface of the macrophytes is quite important as fish food. To fish, submerged aquatics also give shade, shelter and spawning place. *Tilapia rendalli* and *Ctenopharyngodon idella* are feeding on aquatic macrophytes and some preference for submerged plants is known (*Elodea*, *Ceratophyllum*, *Najas*). Whether the foliage and fruits of *Najas* are important for mammals is not well known but it is generally

accepted that mammals in certain regions will graze on macrophytes. Giant tortoises have been observed feeding on *N. setacea* in Aldabra. In Sumatra (Lake Toba), *N. kingii* (sub *N. tenuifolia*) is used as pig food (BACKER, 1911). In Malaya, *N. kingii* (sub *N. minor*) serves as food for fish and is also collected as pig food (BURKILL, 1966). Most of the waterbodies with *N. marina* from western Europe are suitable places for angling.

7. *Najas* and man

7.1. EFFECT OF EXCESSIVE POPULATIONS.

The development of excessive *Najas* populations is almost exclusively the result of the large amount of seeds per individual and of their dispersal on detached plant fragments.

The effects of excessive *Najas* populations are mainly the impediment to flow in small drains and the occupation of useful volume in small water storage reservoirs or fish farms. As plants may rise close to the surface, they prevent boat movements which seriously inhibits fishing activities and recreational use. Most important to man are the animal vectors of human diseases such as schistosomiasis (bilharziasis), which are associated to the water and the aquatic macrophytes. The author observed bilharzial snails on *N. marina* subsp. *armata* and *Potamogeton crispus* in the Maryut swamp area (Alexandria, Egypt).

It is in irrigation canals and ditches that *Najas* spp. cause most trouble where they gradually reduce the flow of water (WILD, 1961). *N. marina* subsp. *armata* can colonize new habitats, even on a pure mineral substrate, this as well in irrigation drains as in newly formed lakes (e.g. Wadi Rayan, Egypt). Known from farm dams and irrigation ditches are: *N. marina* subsp. *armata*, *N. welwitschii*, *N. tenuis*, *N. horrida*, *N. gracillima*, *N. minor*, *N. schweinfurthii*, *N. baldwinii* and *N. graminea*.

7.2. *Najas* SPECIES AS RICE FIELD WEEDS.

Only few *Najas* species were reported until now as weeds in rice fields: *Najas minor* All., *Najas graminea* Del. and *Najas gracillima* (Engelm.) Magn. (VASINGER-ALEKTOROVA, 1931; MIKI, 1935b; KOCH, 1952, 1954; PIGNATTI, 1957; TALLON, 1958; UBRIZSY, 1961; MIYAWAKI, 1960; WILD, 1961; IMAM & KOSINOVA, 1972; COOK, 1973; HAYNES, 1979; CASPER & KRAUSCH, 1980; MOLINIER, 1980; BARRETT & SEAMAN, 1980; PODLECH & YARMAL, 1980; PICCOLI & GERDOL, 1981; FARRAS I DE BLAS, 1984).

More species are growing in paddy fields and adjacent ditches than was accepted before (TRIENT, 1986). (The information comes from herbarium records, literature and observations on *Najas gracillima* and *Najas minor* in the field and in cultivation).

The distribution of *Najas* species in rice fields of the Old World is presented in fig. 3 (species are numbered as in the text).

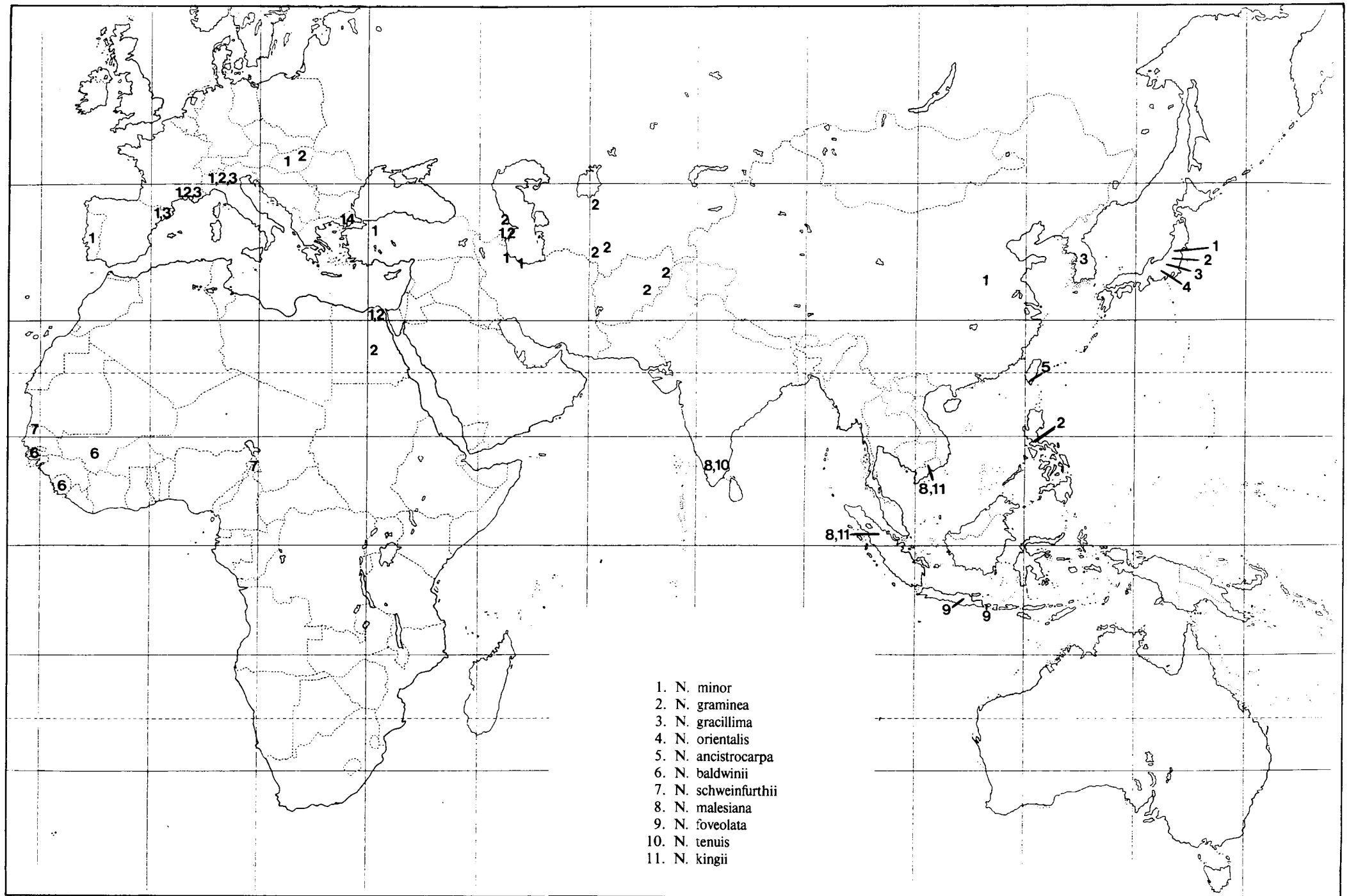
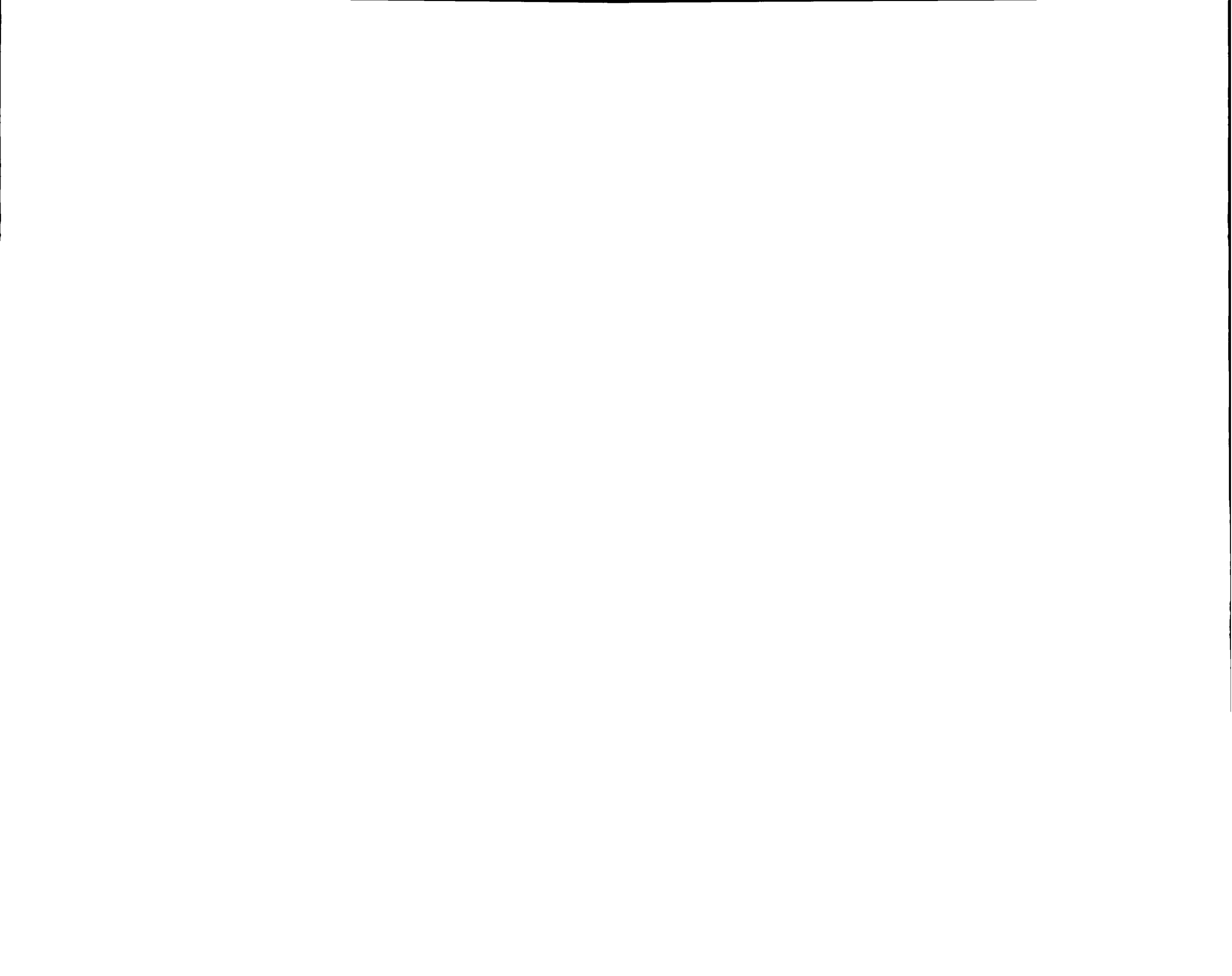


FIG. 3. — *Najas* spp. from rice fields and adjacent areas.



Temperate — warm regions.

N. minor All. (1), distributed in temperate — warm regions of the northern hemisphere, is recorded from rice fields in Portugal, Spain, France, Italy, Hungary, Turkey, Egypt, Iran, U.S.S.R. (Azerbaijdzhan S.S.R.), China (Shansi) and Japan. These records are situated within the native area of *N. minor*. It is the most widespread and most frequently found weed among *Najas* species. It is very abundant locally, and also grows in ditches and canals.

N. graminea Del. (2) which is distributed not only in temperate — warm regions, but also in tropical regions of the Old World, is common in rice fields and adjacent areas, which are situated at its northernmost limit of Europe (France, Italy and Hungary) and Asia (Azerbaijdzhan S.S.R., Uzbekistan and Turkmenistan). In these regions, *N. graminea* appears to be undergoing range extension to the north. This species is also recorded from paddy fields in Japan and in Egypt; however, there it occurs more often in irrigation channels. *N. graminea* is adventive in rice fields and adjacent ditches of California (U.S.A.).

N. gracillima (Engelm.) Magn. (3), distributed in northeastern United States, California (paddy?) and the Far East is very common in rice fields of the Far East (Korea, Japan) and also as an immigrant in southern Europe (Spain, France, Italy). Where introduced it is very abundant locally, in rice fields and to a lesser extent in adjacent ditches. *N. gracillima* as an introduced species however, has shown little tendency to spread outside of these original sites of entry.

N. orientalis Triest & Uotila (4), originally from the Far East (U.S.S.R., China and Japan) and common in rice fields in Japan (MIKI, 1935a, sub *N. foveolata*) only recently is reported as an immigrant in Turkey-in-Europe. The plants grew in a wide ditch within a rice field area (TRIEST & UOTILA, 1986).

N. ancistrocarpa Magn. (5), a rare species from the Far East is cited from fields in Japan (MIKI, 1935a) and in Taiwan (YANG, 1974).

N. guadalupensis (Spreng.) Morong, common in North and Central America is cited from rice fields and adjacent ditches in California, U.S.A. (BARRETT & SEAMAN, 1980).

Tropical regions.

The available information on tropical *Najas*, occurring in rice fields must be far from complete and the following information should be considered as a preliminary attempt to illustrate the species diversity.

In tropical West Africa, two native African species are infesting rice fields.

N. baldwinii Horn af Rantzien (6), rather common in West Africa (the Guinean zone), more rarely in Central Africa, is known from rice fields in Senegal, Mali and Sierra Leone.

N. schweinfurthii Magn. (7), a rare species from the Sudanese zone (and noted also once in Tanzania) is known from rice fields in northern Senegal and northern Cameroon.

In addition to being found in paddy fields, both species are known from temporary pools and ditches. *N. baldwinii* also occurs in lagoons and mangrove areas and tolerates salt.

In tropical Asia, five native species are known from rice fields, however, the information remains scattered.

N. malesiana de Wilde (8), distributed from India to Australia is reported from rice fields in India, South Vietnam and Sumatra (DE WILDE, 1962). *N. malesiana* is very closely related to the African *N. baldwinii*.

N. foveolata Rendle (9), distributed in Malaysia, was collected from paddy fields in Bali and Java.

N. tenuis A. Br. (10), though rare in rice fields, is distributed in irrigation systems and tanks (India).

N. kingii Rendle (11), known from southeastern Asia, is reported from ditches near rice fields (South Vietnam, Sumatra).

N. graminea (2), though widely distributed in the tropics, has not been collected much in rice fields (Malaysia). It occurs more often in irrigation channels.

These distribution data may suggest that *Najas* species native to temperate – warm regions are not in the tropics and vice versa. Species have spread from either the Far East or from North America to southern Europe. Such a spread has not yet been noticed between tropical Africa and tropical Asia.

All species considered here are slender in habit. *N. gracillima*, *N. baldwinii* and *N. malesiana* are extremely lax, with thin stems, thin and narrow leaves. This enables the plants to tolerate water level changes, especially decreasing levels. In vitro *N. gracillima* could grow, flower and set seeds in 5 cm of water which gradually dried out.

Najas species from rice fields are annual and dioecious plants, which develop many flowers. They reproduce exclusively by seeds. Their large seed production is the result of efficient pollination as well as of the position and number of male and female flowers. All these species (growing in rice fields) have male flowers together with 1-3 female flowers in the uppermost nodes on the top of the branches. In the lower nodes only female flowers are present. Nevertheless, in many species, there are 2-3 female flowers in a node instead of 1, thus ensuring a large seed production. Pollination is truly hydrogamous. In mature anthers, only free pollen was observed (no pollen groups or chains). Successful self pollination was noted for *N. gracillima* and *N. minor*. Thus, if the plants are not obligate cross pollinators, the position of male flowers just near the female flowers could be a very effective feature.

Reproductive activities are completed before drainage of the field. However, plants persist also in more open water areas at the periphery or in thinned rice stands or in wheel tracks.

Najas species have small seeds with a hard testa which prevent the embryo from drying out. It is an important feature that seeds survive dryness for more than one season. In *N. gracillima*, seeds were viable after being stored in dry sand for two years. After «flooding», a dense field of seedlings had formed within a week (*in vitro*). Dispersal of seeds in irrigation water and in soil adhering to farm machinery probably

is the most important way of local spread. Most of the *Najas* species growing in rice fields are also growing in adjacent ditches but the reverse is not always true.

Mixed stands of *Najas* spp. in rice fields and adjacent areas are common : *N. minor* + *N. graminea* or *N. minor* + *N. gracillima* in Italy ; *N. minor* + *N. orientalis* in Turkey and Japan ; *N. minor* + *N. graminea* in Azerb. S.S.R., *N. tenuis* + *N. malesiana* in India ; *N. minor* + *N. orientalis* + *N. gracillima* in Japan, etc. There are no morphological indications of hybrid forming between species in mixed stands.

As a summary, the annual life form, slender habit, efficient pollination and fertilization, large production of seeds and drought resistance of seeds promote the dispersal, establishment and colonization of many *Najas* spp. in rice fields.

7.3. CONTROL OF *Najas*.

The mechanical control of submerged weeds is a direct approach and has been traditionally used. The advantage of cutting is that it can be done very selectively and that the immediate result is predictable. The disadvantages are the high costs in both time and man power and uncertainty about long-term efficiency.

As to *Najas* spp., cutting would be most effective, but mainly when done on young and sterile plants. Cutting of full grown plants with mature fruits would be most ineffective because fruits will detach easily from the plants and sink to the bottom, and also because detached fragments with fruits will drift as well under the water as at the surface. It seems improbable to remove all plants and parts that were cut.

A more drastic method in controlling submerged weeds is the artificial fluctuation of the water level and even the drying out of a waterbody. As a weed in Portuguese rice fields, *N. minor* is controlled by drying out the fields for a few days (WILD, 1961).

Najas plants tolerate water level changes but are destroyed immediately by desiccation when exposed to the sun. This method seems to be effective in cases where such a total destruction is required (rice fields, drains, reservoirs). However, one should pay attention to several facts :

- (a) The seeds remain viable even when exposed to extreme dryness during long periods.
- (b) Part of the seed rain from the previous years remains viable in the soil.
- (c) The removal of annual species might be advantageous for other species that perennate by rhizomes (these may then develop rapidly and recolonize the newly filled waterbody).

Natural annual fluctuations in the number of individuals and even the absence for several years, are not unusual among *Najas* spp. Thus, seeds remain viable in the soil for several years.

There is nothing definitely known on chemical and biological control of *Najas* spp., but it is clear that *Tilapia rendalli* and *Ctenopharyngodon idella* species will feed on the foliage, converting vegetable food into edible flesh.

In North America and the West Indies, where *N. flexilis* grows abundantly, it is used sometimes as packing material. *N. marina* is eaten with salt like watercress by

the people of Hawaii and considered particularly appetising as a salad with raw fresh-water shrimps and crab. It is on sale in the markets of Honolulu (UPHOF, 1968).

8. Geographical distribution

The distribution maps (Figures 6-26) presented in chapter 2 : taxonomic treatment) are based on complete or undoubtful specimens investigated in the present work. Important additional localities after records from literature are indicated separately.

The genus *Najas* has an almost cosmopolitan distribution, with the greatest diversity in the tropical and subtropical regions. It is absent from the very cold areas. Both subgenera occupy large ranges which are almost sympatric. Subgenus *Caulinia* is much more differentiated, occupies more habitats and is also more commonly distributed than subgenus *Najas*.

Several species occur in both the Old and the New World : *N. marina*, *N. flexilis*, *N. gracillima*, *N. minor* and *N. graminea*. These species are taxonomically widely apart.

Subgenus *Najas* with only one species, *N. marina*, has an almost cosmopolitan distribution. However when considering the subspecific taxa, many are tropical or subtropical. Subspecies *marina* and subsp. *intermedia* occur in temperate regions of the northern hemisphere up to 53° and 62° latitude, respectively.

Subgenus *Najas* (= *N. marina* L. s.l.) most probably has its centre of differentiation in Asia Minor, where it is represented by five taxa, among which the three most widespread but taxonomically very distinct subspecies. In Asia Minor, subsp. *marina* var. *marina* and subsp. *intermedia* have their southernmost limit while subsp. *armata* has its northernmost limit. Other regions (which represent reasonably distinct phytogeographic elements) where *N. marina* is rather differentiated are Europe (4 taxa), Northern Africa, Central Asia and India (3 taxa each). The most widespread taxa are *N. marina* subsp. *marina* var. *marina* (temperate and temperate warm areas from Europe to C. Asia), subsp. *intermedia* (cold to temperate warm areas from Europe to C. Asia, extended towards few subtropical parts in Asia) and subsp. *armata* (Africa, C. Spain, Crete, Asia Minor, Sri Lanka and Australia). Closely related taxa generally are allopatric, f.e. subsp. *intermedia* versus subsp. *armata* ; subsp. *ehrenbergii* (W. Sahara, Asia Minor, S. Arabia and Socotra) versus subsp. *commersonii* (Madagascar and Mascarenes) and subsp. *latior* (Bali, Kai Islands, W. and E. Australia) ; subsp. *marina* var. *marina* (see above) versus var. *grossedentata* (Far East namely N.E. China, Corea, E. Russia), var. *ohwii* (Japan) and var. *kashmirensis* (India namely Kashmir and Rajasthan). Several taxa are local endemics f.e. subsp. *microcarpa* (Gran Canaria and N. Senegal), subsp. *aculeolata* (U.S.S.R., Volga delta) and subsp. *susiana* (S.E. Iraq and S.W. Iran), or are even confined to a single locality such as subsp. *arsenariensis* (Algeria, Lake Melah) and subsp. *sumatrana* (Sumatra, Lake Manindjau).

Subgenus *Caulinia* contains mainly tropical or subtropical species. Few occur in temperate regions (*N. minor*) or temperate warm regions (*N. ancistrocarpa*, *N.*

orientalis, *N. gracillima*, *N. graminea*). Only *N. flexilis* and *N. tenuissima* are species from cold areas (see also distribution maps of these species).

Subgenus *Caulinia* is most differentiated in tropical S.E. Asia and N. America, where it is represented by 10 taxa, India (9 taxa), Japan, W. tropical Africa (7 taxa each), Europe, China, tropical S. America (6 taxa each) and E. tropical Africa, Australia and C. America (5 taxa each). The centre of differentiation is considered to lie in tropical Africa. The most widespread taxa undoubtedly are *N. minor* (temperate and temperate warm areas of Europe, N. Africa, Asia and N. America) and *N. graminea* var. *graminea* (S.E. Europe, subtropical and tropical regions of Africa, Asia and Australia, as an adventive in California, U.S.A.). Other widely distributed species which even occur in both the Old as the New World are *N. flexilis* (N. Europe, N. Asia and N. America) and *N. gracillima* (Far East, N. America, as an adventive in S. Europe). Species which occupy large ranges within a continent or certain area apparently are *N. horrida* (Africa and Madagascar), *N. welwitschii* (tropical Africa), *N. malesiana* (India, tropical Asia and Australia), *N. guadalupensis* (America) and *N. conferta* (America). Closely related species with similar male, female flowers and seed characteristics, mostly are allopatric f.e. *N. tenuissima* (N.E. Europe) versus *N. gracillima* (Far East, N. America, as an adventive in S. Europe); *N. hagerupii* (W. tropical Africa and Central African Republic) versus *N. setacea* (Aldabra, Seychelles, Mauritius and N. Madagascar), *N. kurziana* (India), *N. halophila* (tropical Asia) and *N. browniana* (Australia); *N. baldwinii* (W. and C. tropical Africa) versus *N. malesiana* (tropical Asia and Australia). From tropical Africa, *N. testui* and *N. schweinfurthii* are closely related species which show affinities, at least in seed and leaf characters to the Asian *N. grossareolata* (Sri Lanka) and *N. foveolata* (S.E. Asia). Endemic species from Africa are *N. pectinata* (Egypt, incl. Sinai), *N. madagascariensis* (Central Madagascar), *N. australis* (Seychelles, Réunion, and Mauritius) and *N. setacea* (Aldabra, Seychelles, Mauritius, N. Madagascar and S.E. Africa). In Asia, several species are widely distributed throughout a phytogeographic region such as *N. indica*, *N. tenuis* (both India), *N. kingii*, *N. pseudograminea* (both S.E. Asia) and *N. orientalis* (Far East). In Australia, *N. tenuifolia* and *N. browniana* are common. They are rare in the adjacent areas. Species or varieties with a yet uncertain distribution or of a local occurrence are *N. ancistrocarpa* (Japan, Taiwan ?), *N. oguraensis* (N. India, Japan, China ?, Taiwan ?), *N. pseudograssillima* (Hong Kong), *N. celebica* (Celebes), *N. graminea* var. *longidentata* (Central Celebes) and *N. graminea* var. *robusta* (Lesser Sunda Islands, Wetar).

In fact, few species are reported as an adventive. There is a migration of *N. gracillima* from either N. America or the Far East to rice field areas in S. Europe; of *N. orientalis* from the Far East to Turkey-in-Europe and *N. graminea* most likely from the Far East to California (U.S.A.). *N. graminea* seems to extend to the north, where it occurs in rice field areas in S. Europe and C. Asia (See also § 7.2. *Najas* species as rice field weeds).

9. Affinities with closest relatives

The evolutionary history of members of the *Alismatidae* is in large part a story of floral reduction, associated with progressive adaptation to aquatic habitats, though not all the reductions can be interpreted in ecological terms (CRONQUIST, 1981).

Within the *Alismatidae*, the affinity of *Najas* to other genera is quite obscure, owing to the extremely simple flower, so that there are a number of opinions. The structure of *Najas* was formerly considered as primitive, while today, it is generally accepted that it is a derived and advanced state.

The closest related families discussed here are : *Zannichelliaceae*, *Potamogetonaceae* (s.s.), *Scheuchzeriaceae*, *Juncaginaceae* and submerged *Hydrocharitaceae*. The genera *Zannichellia* and *Potamogeton* often have been placed close to *Najas* and have been arranged in different ways at different levels : *Potamogeton*, *Zannichellia* and *Najas*, in separate families under the order *Najadales* (EHRENDORFER, 1978) ; *Potamogetonaceae* is a distinct family in the order *Potamogetonales*, while *Zannichellia* and *Najas* are placed in separate families, respectively *Zannichelliaceae* and *Najadaceae*, both grouped in the order *Najadales* (HUTCHINSON, 1959) ; *Potamogeton* and *Zannichellia* in separate families under *Zosterales*, while *Najas* only in the *Najadales* (DAHLGREN & CLIFFORD, 1982).

The nuclear endosperm formation has been used as an evidence to relate *Najadaceae* with *Scheuchzeriaceae* and *Juncaginaceae*, so they could be placed under *Najadales* s.l. (DAHLGREN & CLIFFORD, 1982).

Both *Najas* and *Zannichellia* are somewhat related to the submerged *Hydrocharitaceae* in view of the vegetative parts as well as of the production of flowers and a lateral shoot from the same axil (MIKI, 1937).

As a conclusion we consider, that despite the derived conditions, in view of their floral scheme, especially the anther structure, the *Najadaceae* are closer related to the *Zannichelliaceae* than to any other family.

CHAPTER 2

TAXONOMIC TREATMENT

NAJAS L.

Species Plantarum, ed. 1, 2 : 1015 (1753).

≡ *Fluvialis* Adans., Fam. Pl. 2 : 472 (1763).

≡ *Ittnera* C. C. Gmel., Fl. Bad. 3 : 590 (1808).

Submerged annuals, more rarely perennials, in fresh to brackish waters, monoecious or dioecious. *Roots* simple, adventitious, devoid of root caps. *Stems* rooting from the base and lower nodes, much branched, slender or robust, the internodes sometimes armed with spines (Subg. *Najas*). *Leaves* in subopposite pairs and mainly arranged in pseudowhorls of 3-7, sessile, with an open folded basal sheath and a linear blade. Blade one-nerved (mostly dorsally armed with spines on the midrib in subg. *Najas*) ; margins serrulate with (0-)4-60(-185) spines per side ; apex acute to acuminate, with 1-3 spines per side ; spine teeth not on excrescences or on excrescences to various degree ; leaf sheath of the second leaf clasping the main branch ; leaf sheath of the first and third leaf clasping a side branch or a flower ; leaf sheath variously shaped, upper part mostly serrulate or spiny-dentate, basal part enclosing two tiny axillary intravaginal hyaline scales (prophylls).

Inflorescences a unisexual, solitary flower at the very base of an axillary shoot, sessile or shortly stalked, the male flower often but the female flower more rarely enclosed in a thin membranous spathe ; spathe tapering to the top in male flowers or constricted into a cylindrical neck halfway along the style in female flowers ; the edge of the neck mostly with some spine-cells. *Male flower* consisting of a solitary almost sessile anther ; closely adhering to the anther is a thin inner envelope (often named «involucre» or «perianth») which is bilobed at its apex ; peduncle at first short, elongating at anthesis, pushing the anther through the envelope ; anther uni- or tetrasporangiate dehiscing irregularly ; pollination hydrogamous ; pollen globose to ellipsoid, monocolpate, 3-celled, the wall with shallow reticulations, thin, without exine, contains starch granules. *Female flower* consisting of an ovoid ovary only, ovary subsessile, unicarpellate, one-loculed, one-ovuled ; ovule solitary, subsessile, erect, anatropous, gynoecial wall two cell-layers thick, ending in a short cylindrical style with 2-3(-4) linear, often unequal stigmatic branches.

Fruit a one-seeded capsule, pericarp very thin, closely enveloping the seed, part of the style and surrounding spathe (if any) persistent. *Seed* elliptical oblong to ovate, occasionally asymmetrical at apex, somewhat recurved or U-shaped, with a basal raphe and a distinctly areolated testa ; testa hard, brittle, 3 or more cell-layers thick, pitted ; areoles formed by the 2 outer layers of the testa, variously shaped, irregularly arranged in longitudinal rows, each row of (9-)25-60(-100), the endwalls sometimes raised ; embryo straight ; hypocotyl and radicle large ; plumule well developed ; cotyledon terminal, blunt ; no endosperm.

TYPE SPECIES : *N. marina* L.

The genus comprises a total of 39 species. It is widely distributed, has its greatest diversity in tropical and subtropical regions and is absent from very cold areas only.

Five species occur in both the Old and the New World : *N. marina*, *N. flexilis*, *N. gracillima*, *N. minor* and *N. graminea* (cf. HAYNES, 1979 ; LOWDEN, 1986).

In the present work, after revision, 1 species with 12 subspecies and 4 varieties under subg. *Najas* and 31 species with 3 varieties under subg. *Caulinia* are retained. Of these 32 species, only 3 are largely distributed throughout parts of the Old World.

PHENETIC GROUPS (Table 2)

Several phenetic groups can be distinguished, especially according to leaf morphology and seed testa structure. In order to define these groups, the number of locules in the anther and the presence or absence of a spathe round a male or a female flower are of a more secondary importance. Easy to apply are the following diagnostic characters : shape of leaf teeth ; shape of leaf sheath ; presence or absence of septa or fibres in the blade and arrangement plus shape of seed areoles. These leaf and seed structures are very consistent, even over broad areas and they also better reflect the natural affinities between the species, than the formerly used characters (spathe ; number of locules) which seem to be rather artificial.

Using characters such as the presence or the absence of a spathe and the number of microsporangia in the anther, does not give rise to species groups which are related, because they do not necessarily have most characters in common as found in the leaves and seeds.

For the whole genus, when considering the species from the Old World, the following seven leaf types and eight seed types were distinguished :

Leaf types (Table 2 ; Fig. 4) :

- I. teeth on excrescences ; teeth on back of midrib ; no septa ; no fibres ; sheath rounded.
- II. teeth not on excrescences ; no septa ; fibres near margins ; sheath rounded.
- III. teeth on excrescences ; no septa ; no fibres ; sheath slightly auricled.
- IV. teeth on excrescences ; septa ; no fibres ; sheath slightly auricled.
- V. teeth not or on very small excrescences ; septa absent or present ; fibres absent or present ; sheath slightly to long-auricled.
- VI. teeth on excrescences ; septa ; no fibres ; sheath rounded.

Table 2

Phenetic groups

	Leaf type							Seed type								Locules		Spathe		
	I	II	III	IV	V	VI	VII	I	II	III	IV	V	VI	VII	VIII	1	4	♂	♀	
											a	b								
1. <i>marina</i>	+							+									+		+	-
2. <i>flexilis</i>		+							+								+		+	-
3a. <i>tenuissima</i>			+							+							+		+	-
b. <i>gracillima</i>				+							+						+		+	-
<i>pseudogracillima</i>				+							+						+		-	-
c. <i>ancistrocarpa</i>				+								+					+	+	+	+
4. <i>minor</i>					+								+				+		+	-
<i>oguraensis</i>					+								+				+		+	-
5a. <i>testui</i>						+								+			+		+	+
<i>schweinfurthii</i>						+								+			+		+	+
<i>grossareolata</i>					+									+			+		-	-
b. <i>foveolata</i>					+										+		+		+	-
c. <i>orientalis</i>							+								+		+		+	-
d. <i>indica</i>				+												+	+		+	-
6a. <i>horrida</i>							+									+	+		+	-
<i>australis</i>							+									+	+		+	-
<i>kingii</i>							+									+	+		+	-
b. <i>tenuis</i>							+									+	+		+	(+)
<i>madagascariensis</i>							+									+	+		+	+
<i>welwitschii</i>							+									+	+		+	+
c. <i>pectinata</i>							+									+	+		+	+
7a. <i>setacea</i>					+											+	+		+	-
<i>halophila</i>					+											+	+		+	-
b. <i>hagerupii</i>								+								+	+		+	-
<i>browniana</i>								+								+	+		+	-
<i>kurziana</i>								+								+	+		+	-
8a. <i>baldwinii</i>					+											+	+		-	-
<i>malesiana</i>					+											+	+		-	-
b. <i>celebica</i>								+								+	+		+	-
<i>pseudograminea</i>								+								+	+		+	-
<i>tenuifolia</i>								+								+	+		+	-
<i>graminea</i>								+								+	+		-	-

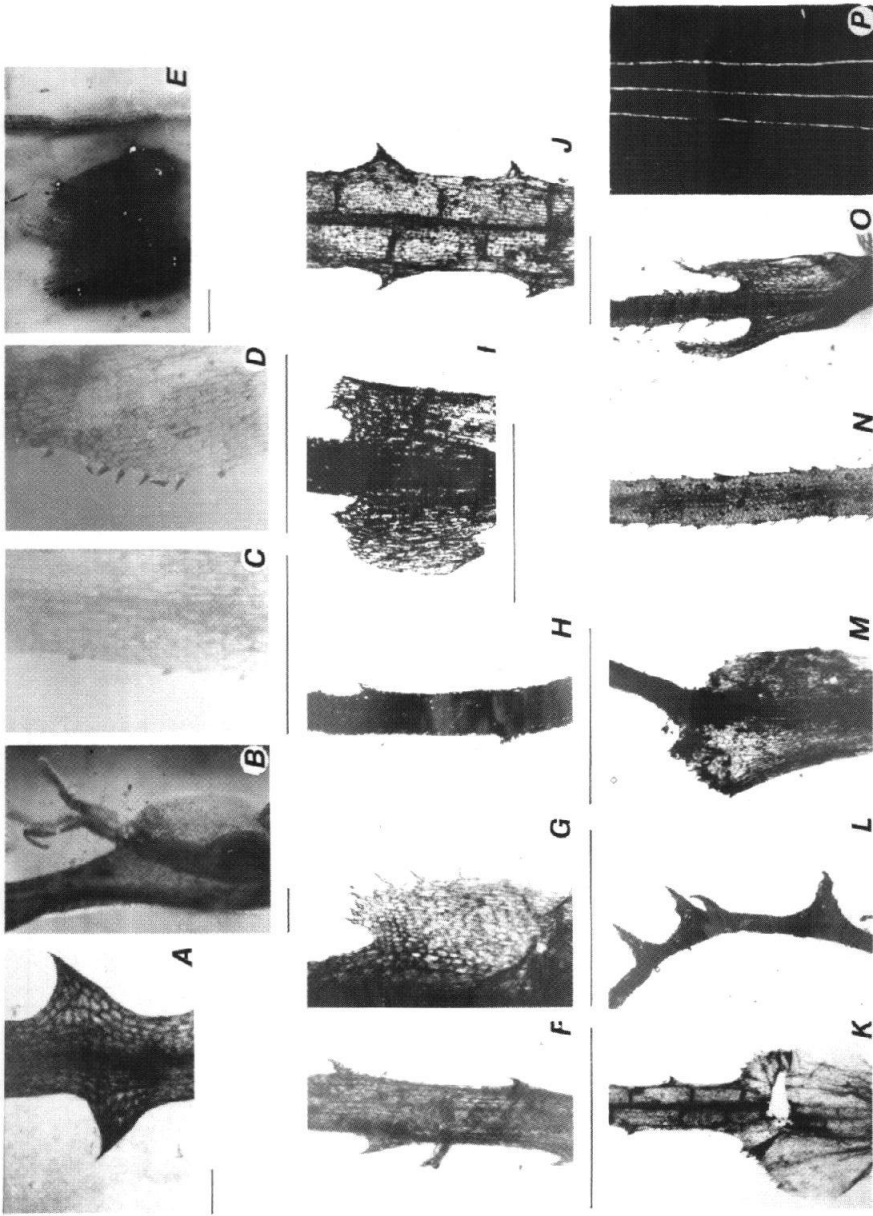


FIG. 4. — Part of leaf: A : *N. marina* (*J. DuVigneaud* 77F838) ; B : part of sheath in *N. marina* (*G. Rigo* in *P. Rigo* s.n., 30.VIII.1878) ; C : part of leaf and D : sheath in *N. flexilis* (*Hårø* s.n., 25.VII.1950) ; E : sheath and part of leaf in *N. tenuissima* (*Kurto & Helyranita* s.n., 16.VIII.1984) ; F : part of leaf and G : part of sheath in *N. minor* (*Smith* 6819) ; H : part of leaf and I : sheath in *N. schweinfurthii* (*Fotius* 1867ter) ; J : part of leaf and K : sheath in *N. kingii* (*King* s.n., IV.1890) ; L : part of leaf and M : sheath in *N. horrida* (*Schlechter* 11883) ; N : part of leaf and O : sheath in *N. graminea* (*Schweinfurth* s.n., 24.X.1885) ; P : part of leaf with fibres seen under polarized light in *N. graminea* (*Ramos* 11597) (scales = 1 mm).

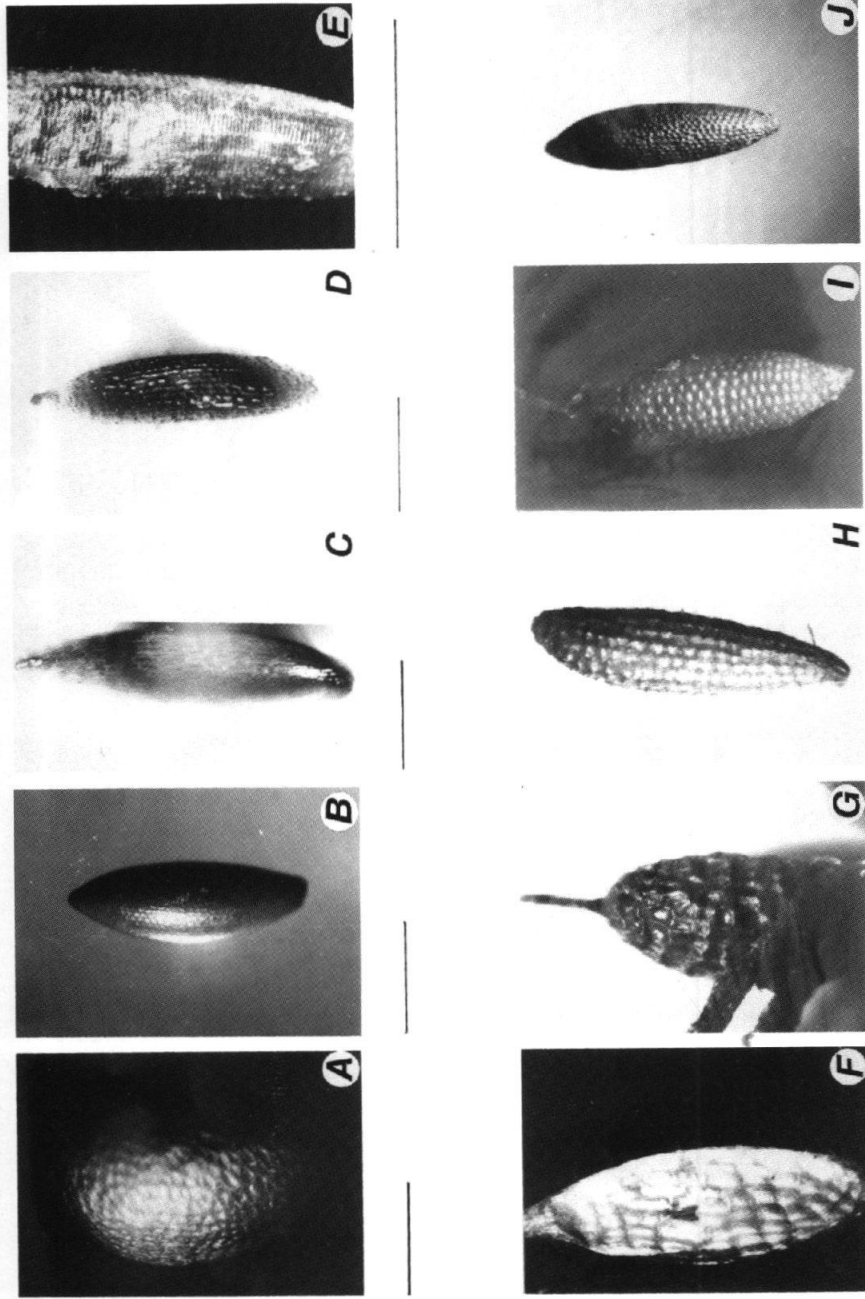


FIG. 5. — Surface view of seeds: A: *N. marina* (Kempe s.n.); B: *N. flexilis*, (Härö s.n., 25.VII.1950); C: *N. tenuissima* (Kurtto & Hebyranta s.n., 16.VIII.1984); D: *N. gracilima* (Triest 139); E: *N. minor* (Smith 6819); F: *N. schweinfurthii* (Schweinfurth 2140); G: *N. schweinfurthii* (Fotius 1687ter); H: *N. orientalis* (Faurie 4877); I: *N. browniana* (Caleys.n.1.1804); J: *N. graminea* (Schweinfurth s.n., 4.XI.1887) (scales = 1 mm).

- VII. teeth not on excrescences ; no septa (or up to halfway the margin in *N. pseudograminea*) ; fibres near margin ; near and on midrib ; sheath longly auricled.

Seed types (Table 2 ; Fig. 5) :

- I. areoles irregularly in shape and size, irregularly arranged ; testa rough.
- II. areoles hexagonal, regularly arranged ; testa smooth.
- III. areoles longer than broad ; regularly arranged ; testa smooth.
- IV. areoles longer than broad, rather irregularly arranged ; testa rough (a : straight ; b : curved).
- V. areoles broader than long, regularly arranged (ladder-like) ; testa rough.
- VI. areoles irregular in shape and size ; irregularly arranged ; testa rough ; cell walls raised.
- VII. areoles squarish to hexagonal or rectangular, rather regularly arranged ; testa rough, cell-walls raised.
- VIII. areoles squarish, slightly rectangular or hexagonal, regularly arranged ; testa rough.

According to these leaf and seed types, the number of locules in the anther and the presence or absence of a spathe round the male or female flower, 8 major phenetic groups can be distinguished, eventually divided into smaller groups. These are presented in Table 2.

KEY TO SPECIES BIASED IN FAVOUR OF EASILY SEEN VEGETATIVE CHARACTERS

1. Stems armed with spines ; backside of the midrib armed with few spines, similar to those on the leaf margins.
 2. Leaf sheath rounded ; leaves not differentiated with septa *N. marina*
 2. Leaf sheath truncate to auriculate ; leaves with septa (in very few cases, there are spines on the midrib ; but no spines on the stem) *N. minor*
1. Stems and backside of the midrib unarmed
 3. Leaf sheath rounded
 4. Leaf teeth unicellular (only consisting of the spine-cell) ; leaves without septa
 5. Leaves with fibres near each margin ; anther unisporangiate *N. flexilis*
 5. Leaves without fibres ; anther tetrasporangiate *N. australis*
 4. Leaf teeth multicellular (spine-cell on small to broad or very broad excrescences) ; leaves with or without septa ; fibres absent
 6. Leaves without septa
 7. Leaves 0.4-0.5 mm wide ; leaf teeth on small excrescences (3-10 cells) ; female flower in spathe ; seed curved *N. ancistrocarpa*
 7. Leaves 1.2-4.5 mm wide ; leaf teeth on very broad excrescences ; female flower not in spathe ; seed straight (in subsp. *ehrenbergii*, subsp. *commersonii* and subsp. *latior*) *N. marina*
 6. Leaves with septa
 8. Leaf margin constricted ; lower half without teeth *N. madagascariensis*
 8. Leaf margin not constricted ; whole margin provided with teeth
 9. Female flower (also fruit) in spathe

10. Anther unisporangiate *N. pectinata*
10. Anther tetrasporangiate
11. Male and female flowers on the same branches ; male flowers more to the top of the branches and often together with female flowers
N. welwitschii
11. Male and female flowers on different branches (or even plants ?)
N. tenuis
9. Female flower (also fruit) not in spathe ; anther tetrasporangiate
12. Male and female flowers on the same branches ; male flowers more to the top of the branches and often together with female flowers
13. Seed (2-)2.4-2.8 mm long ; areoles squarish or somewhat irregular
N. orientalis
13. Seed 1.6-1.85 mm long ; areoles hexagonal and regular *N. kingii*
12. Male and female flowers on different branches (or even plants ?)
14. Leaf 0.5-1.1 (-1.3) mm broad (incl. teeth on both sides) ; teeth 0.14-0.39 mm long ; seed 2.6-3.5 times longer than broad *N. tenuis*
14. Leaf 0.56-2.4 (-3.2) mm broad (incl. teeth on both sides) ; teeth 0.15-1.38 mm long ; seed 3.2-4.2 times longer than broad *N. horrida*
3. Leaf sheath truncate to auriculate
15. Leaves with septa
16. Leaves with septa up to halfway the margins
17. Male flower in spathe ; anther tetrasporangiate *N. pseudograminea*
17. Male flower not in spathe ; anther unisporangiate *N. malesiana* (occasionally)
16. Leaves with septa up to the margins
18. Leaf teeth unicellular (only consisting of the spine-cell)
19. Anther tetrasporangiate *N. testui*
19. Anther unisporangiate *N. schweinfurthii*
18. Leaf teeth multicellular (spine-cell on small to broad or very broad excrescences)
20. Seeds rough and irregularly pitted with areoles ; generally less than 20 areoles in each longitudinal row
21. Leaf margin regularly toothed ; male and female flower each in spathe
22. Anther tetrasporangiate *N. testui*
22. Anther unisporangiate *N. schweinfurthii*
21. Leaf margin often constricted ; female flower not in spathe
23. Male flower in spathe ; anther tetrasporangiate *N. foveolata*
23. Male flower not in spathe ; anther unisporangiate *N. grossareolata*
20. Seeds regularly pitted with areoles ; generally more than 20 areoles in each longitudinal row
24. Areoles broader than long, arranged ladder-like ; (60-)80-100 in each longitudinal row
25. Anther unisporangiate *N. minor*
25. Anther tetrasporangiate *N. oguraensis*
24. Areoles squarish to hexagonal (or slightly rectangular) ; areoles not arranged ladder-like ; 18-35 in each longitudinal row
26. Male flower in spathe ; female flower (also fruit) not in spathe
27. Anther unisporangiate *N. browniana*
27. Anther tetrasporangiate *N. indica*
26. Male and female flower (also fruit) not in spathe ; anther unisporangiate *N. malesiana*
15. Leaves without septa
28. Leaf teeth unicellular (only consisting of the spine-cell) ; leaves mostly with fibres (occasionally without fibres in *N. testui*, *N. schweinfurthii*, *N. baldwinii* and *N. graminea*)

DIAGNOSTIC FEATURES : *Plants* dioecious, mostly robust. *Stems* usually with spines on the internodes ; epidermis distinctly differentiated by smaller cells from the underlying cortex. *Leaves* with blade coarsely serrate, (0-)4-17 spiny teeth on each margin ; midrib mostly with spines on the abaxial side ; sheaths rounded ; intravaginal scales less than twice as long as broad, blunt, often asymmetrical. *Male flower* enclosed in a spathe ; anther tetrasporangiate. *Female flower* naked. *Seed* asymmetrically ovate ; testa more than 3 cell-layers thick ; areoles often unequally in shape and size, irregularly arranged.

SINGLE SPECIES AND TYPE SPECIES : *N. marina* L.

1. *Najas marina* L.

Sp. Pl., ed. 1, 2 : 1015 (1753) — TYPE : Vaillant (1722), tab. I, fig. 2, p. 62 ; in icone sub titulo *Fluvialis pisana foliis denticulatis* J.B. 1.38 p. 779. Lecto-iconotype designated by CASPER (1979).*

Plants submerged, dioecious, mostly robust. *Stems* up to 150 cm long, and up to 2.0 mm in diameter, mostly roughened with spines. *Leaves* 3.6-65 mm long, fleshy, acute, 1.1-5.7 mm wide (incl. teeth on both sides) 0.4-2.5 mm wide (excl. teeth on both sides) ; margin on each side serrulate with (0-)4-17(-40) conspicuous spiny teeth on broad triangular excrescences ; the spine-cell resting upon several elongate brown cells ; leaf teeth up to 2.0 mm long, the ratio of teeth length to leaf width being 0.4-2.5 ; abaxial side of midrib with (0-)2-8(-40) spines, similar to those on the leaf margin and on the stem ; septa and fibres always absent ; leaf sheath 1.5-5.0 mm by 1.0-5.5 mm (ratio = 0.4-1.2), rounded, entire or serrulate with 0-1(-3) spine-cells on each side.

Inflorescences axillary, solitary. *Male flower* enclosed in a spathe, 2-5 mm (incl. spathe-neck) by 0.8-3 mm ; the neck of the spathe being 0.5-1.0 mm, tapering at the top, bearing brownish spine-cells on the apex ; inner envelope protruding 0.2-0.7 mm above the anther ; anther 1.2-4 mm by 0.7-2.5 mm, tetrasporangiate. *Female flower* naked ; 2-5 mm long ; ovary 1-3.5 mm by 0.3-1.9 mm ; style and stigma 0.3-1.6 mm ; stigma (2-)3(-4) lobed.

Fruit with persistent, thin, membranous pericarp and the remaining parts of style. *Seed* ovate, slightly asymmetrical, 1.9-7.5 mm by 0.8-3.3 mm (ratio = 1.2-3.5) ; testa pitted with areoles, arranged irregularly ; areoles irregularly in shape and dimensions.

POLYMORPHISM AND INFRASPECIFIC VARIATION

Najas marina L. always has been considered as a polymorphic, widespread species (BRAUN, 1864 ; RENDLE, 1899b, 1900). However, the description of many superfluous varieties from Europe, together with those (either superfluous or justified) from the tropics, made the real infraspecific delimitations unclear. A. BRAUN (1864) was

* The type is referred to in VAILLANT's text (p. 17) as *Fluvialis vulgaris latifolia*.

the first to distinguish 6 varieties under *N. major* (= syn. *N. marina*). Later, RENDLE (1899b, 1900) accepted forms α , β and γ together with 15 varieties (of which 9 from the Old World). He described 6 new varieties (of which 4 from the Old World). In fact, only few of these taxa became accepted in literature since 1900 (f.e. subsp. *armata* by HORN AF RANTZIEN, 1952 ; var. *zollingeri* and var. *sumatrana* by DE WILDE, 1962 ; subsp. *marina* and subsp. *intermedia* by VIINIKKA, 1976 and CASPER, 1979, subsp. *brachycarpa* and subsp. *aculeolata* by TZVELEV 1976). In most studies and floristic works, only the species *N. marina* L. *sensu lato* was considered, without recognition of any subspecific taxon, this rather as a result of the incompletely understood variability (together with its taxonomic consequences) than of an underestimated polymorphism.

Obviously, when considering the habit, taxa or groups of taxa can be distinguished within the species. However, as *N. marina* is very uniform in most characters (nodal complex ; stem and leaf morphology ; flower structures ; seed areolation), only few diagnostic characters are left for use at lower taxonomic levels. Seed size, leaf size and number of spines on the stem were found to be of best diagnostic value. These three characters solely are seldom diagnostic and therefore should be used in combination with each other as much as possible. Herewith, taxa can be distinguished, though delimitation might remain difficult in some particular cases. The characters used are quantitative and thus may overlap occasionally.

Measurements were made on full-grown structures. The numbers of spines on stem were counted as the number of spines around 2 cm long uppermost parts of the internodes (thus, just below the nodal complex). The leaf length includes the sheath length. Seed sizes were taken instead of fruit sizes. Between these two, there is almost no difference in width, but the total length of the fruit depends too much on the place where the style breaks off.

Two main groups of taxa can be distinguished on the basis of seed size and to a lesser extent of leaf size. Group A, comprises taxa with seeds (3.3-) 5-6(-7.5) mm long whilst group B comprises taxa with seeds (2-)2.5-4(-5.1) mm long. Therefore in seeds, the female flower generally is larger in group A (6-9 mm) than in B (1.9-4.2 mm). However, the sizes of female flowers are rarely conclusive since their size changes continuously during development from bud, to flower to fruit and since many developmental stages can be found on a single individual. The size of the tetrasporangiate anther can be used rather to distinguish group A (3.8-4 mm) from group B (1-3.3 mm) than to determine subspecies or varieties. Moreover, plants with male flowers are not as frequently collected as plants with fruits.

(A) The large seeded forms of *N. marina*, grouped under subsp. *marina*, are widespread in the temperate regions of the Old World. They are absent from the subtropical, tropical and (northernmost) boreal areas. They do not occur in America. Collections mostly were from fresh water sites.

Subsp. *marina* var. *marina* has been collected mainly in Western-, Central-, Southeastern Europe and the European part of the U.S.S.R. Isolated localities are also known from Kazakhstan. Northernmost records are from the Netherlands, German

Democratic Republic and Poland, while the southernmost records are from the Balears, Sicily, Greece and Turkey.

Three other varieties of subsp. *marina* have a more restricted distribution. They differ from the typical variety in seed and leaf sizes. Var. *grossedentata* mostly has seeds of 4 mm long and is known from the Far East (U.S.S.R., Ussuri region and Northeastern China). Var. *ohwii* and var. *kashmirensis* have the largest seeds (6-7.5 mm long), even of the genus. The leaves may reach 6 cm in length. Var. *ohwii* is known from Japan (& Taiwan ?) while var. *kashmirensis* is known from India.

(B) The small seeded forms of *N. marina* are much more widespread throughout the Old World than the large seeded subsp. *marina*. The former occur not only in northern-, temperate-, subtropical and tropical regions of the Old World, but also in America and the Hawaii Islands. Collections were as well from fresh as brackish water sites. When regarding the characters and the geographical distribution, three main groups of subspecies can be distinguished, this mainly on the basis of the number of spines on the stem.

(a) Subspecies with unarmed or almost unarmed stems are *ehrenbergii* (Sahara, Arabia, Socotra), *commersonii* (Madagascar and Mascarenes), and *latior* (Bali, South Moluccas, Australia). The subspecies differ in seed sizes. They mainly occur in well isolated localities of the tropics (Islands, oases).

(b) Subspecies with moderately spined stems, namely (0-)2-15(-18) spines in 2 cm, are *intermedia* (Northern and Central Europe, Northwestern Turkey, Caspian Sea region, Central Asia and America), *brachycarpa* (Central Asia), *aculeolata* (U.S.S.R., Volga Delta), and *arsenariensis* (Alger). The subspecies differ in seed sizes. They occur in the northern, temperate and temperate warm regions.

(c) Subspecies with very spiny stems, namely (10-)15-30(-50) spines in 2 cm, are *armata* (Africa, Asia Minor, Sri Lanka, Australia), *microcarpa* (Gran Canaria, Senegal), *susiana* (Southern Iraq, southwestern Iran) and *sumatrana* (Sumatra). The subspecies differ in seed size. They occur in subtropical and tropical regions, are common in Africa and Asia Minor, but become rare or absent in parts of (sub-) tropical Asia.

The entities (a), (b) and (c), which are most likely natural groups, even when regarding their distribution, are arranged in the key as such. However, in the case of *N. marina*, it is preferable in a key to use the more reliable (constant) seed and leaf sizes before the «number of spines» character. This way, subspecies with very small seeds, viz. (1.9-)2-2.5(-2.9) mm long, are grouped against those with seeds (2.5-)3-4(-5.1) mm long. Seeds of subsp. *arsenariensis* are still unknown. This taxon is introduced in the key at two places.

SUBSPECIES AND VARIETIES LETTERED

- aa Subsp. *marina* var. *marina*
- ab Subsp. *marina* var. *grossedentata* Rendle
- ac Subsp. *marina* var. *ohwii* Triest

- ad Subsp. *marina* var. *kashmirensis* Triest
 b Subsp. *ehrenbergii* (A. Br.) Triest
 c Subsp. *brachycarpa* (Trautv.) Tzvelev
 d Subsp. *aculeolata* Tzvelev
 e Subsp. *microcarpa* (A. Br.) Triest
 f Subsp. *arsenariensis* (Maire) Triest
 g Subsp. *commersonii* Triest
 h Subsp. *latior* (K. Schum.) Triest
 i Subsp. *intermedia* (Gorski) Casper
 j Subsp. *armata* (Lindb. f.) Horn af Rantz.
 k Subsp. *susiana* Triest
 l Subsp. *sumatrana* (de Wilde) Triest

DIAGNOSTIC FEATURES OF SUBSPECIES AND VARIETIES

Brackets mean that the character is exceptional within the considered taxon. Seeds were not observed in f. Male flowers were not observed in b, c, d, h, k, l.

Stems unarmed or almost unarmed : b, g, h

Stems not very spiny : aa, ab, ac, ad, c, d, f, i

Stems very spiny : e, j, k, l

Leaves generally less than 20 mm long : b, c, d, e, f, h, i, j, k

Leaves generally more than 20 mm long : aa, ab, ac, ad, g, h, (i), (j), l

Leaves generally less than 3 mm broad (incl. teeth on both sides) : b, c, d, f, g, h, i, j, l

Leaves generally between 3 and 4 mm broad : aa, ab, ac, ad, e, (g), h, i, j, k

Leaves sometimes larger than 4 mm : ab, ad, j, k

Leaves generally less than 1.2 mm broad (excl. teeth on both sides) : (aa), (ab), (ad), b, c, d, e, f, g, i, j, l

Leaves generally between 1.2-2 mm broad : aa, ab, ac, ad, (g), h, i, j, k, l

Leaves generally more than 2 mm broad : (ad), (g), h, (j), k

Less than 4 teeth on each leaf margin : (ab), d, f, (i)

Between 4-10 (-17) teeth on each leaf margin : aa, ab, ac, ad, b, c, (d), e, g, h, i, j, k

Between 30-40 teeth on each leaf margin : l

Anther 1-3.3 mm long : e, f, g, h, i, j

Anther 3.8-4 mm long : aa, ab, ac, ad

Ovary 0.7-3.4 mm long : b, c, d, e, g, h, i, j, k, l

Ovary (3-)4-6 mm long : aa, ab, ac, ad

Ovary 0.4-1.7 mm wide : b, c, d, e, g, h, i, j, k, l

Ovary 2-2.5 mm wide : aa, ab, ac, ad

Style + stigma 0.2-1.4 mm long : b, c, d, e, g, h, i, j, k, l

Style + stigma 2-3 mm long : aa, ab, ac, ad

Seeds shorter than 2.8 mm : b, c, d, e, (j)

Seeds between 2.8 and 4.5 mm long : (aa), ab, g, h, i, j, l

Seeds between 4.5 and 7.5 mm long : aa, (ab), ac, ad, (i), k

Seeds narrower than 2 mm : (aa), (ab), b, c, d, e, g, h, i, j, (l)

Seeds broader than 2 mm : aa, ab, ac, ad, h, (i), (j), k, l

Length/width ratio of seeds, generally less than 2 : aa, (ab), b, c, e, h, (i), j, l

Length/width ratio of seeds, generally more than 2 : aa, ab, ac, ad, d, g, i, j, k, l

KEY TO SUBSPECIES AND VARIETIES

1. Seeds (3.3-)4-6(-7.5) mm long ; ovary (3-)4-6 × 2-2.5 mm ; style and stigma 2.0-3.0 mm long ; anther 3.8-4.0 mm long subsp. *marina*
2. Leaves (7-)20-30(-37) mm long ; seeds (3.3-)4-5.7(-7.5) mm long
 3. Leaves (14-)25-37 mm long ; seeds (3.3-)4.5-5.7(-6.5) × (1.3-)2-2.8(-3.3) mm
 - aa. subsp. *marina* var. *marina*
 3. Leaves (7-)15-30(-35) mm long ; seeds 4-4.5(-5.3) × (1.8)2-2.4(-2.7) mm
 - ab. subsp. *marina* var. *grossedentata*
 2. Leaves (20-)30-50(-65) mm long ; seeds 6-7.5 mm long
 4. Leaves (20-)30-37(-50) mm long ; seeds 6 × 2-2.2(-2.5) mm
 - ac. subsp. *marina* var. *ohwii*
 4. Leaves 30-50(-65) mm long ; seeds (6.1-)6.6-7.3(-7.5) × 2.2-2.6(-3) mm
 - ad. subsp. *marina* var. *kashmirensis*
 1. Seeds 1.9-4(-5.1) mm long ; ovary 0.7-3.4 × 0.4-1.7 mm ; style and stigma 0.2-1.4 mm long ; anther 1.0-3.3 mm long
 5. Seeds (1.9-)2-2.5(-2.9) mm long
 6. Stems and back of midrib unarmed or almost unarmed, about 0(-4) spines in 2 cm ; leaves 17-20 mm long, seeds 2-2.5 mm long b. subsp. *ehrenbergii*
 6. Stems and back of midrib (not very spiny to very) spiny, about (0-)2-30, spines in 2 cm
 7. Stems and back of midrib not very spiny, about (0-)2-10(-18) spines in 2 cm
 8. Seeds (2-)2.2-2.5(-2.8) × (1.3-)1.5-1.8(-2) mm ; seed areoles irregularly ; leaves 6-15(-20) mm long c. subsp. *brachycarpa*
 8. Seeds 2.6-2.9 × 0.9-1.1 mm ; seed areoles more or less regular ; leaves 4-9 mm long d. subsp. *aculeolata*
 7. Stems and back of midrib very spiny, about (10-)15-30 spines in 2 cm
 9. Leaves 8.3-11.3(-19) mm long, margins with 4-7 teeth ; seeds 1.9-2.3(-2.5) × 1.2-1.4(-1.6) mm e. subsp. *microcarpa*
 9. Leaves 3.6-4 mm long, margins with 0-2 teeth ; seeds unknown f. subsp. *arsenariensis* *
 5. Seeds 2.5-5.1 mm long
 10. Stems and back of midrib unarmed or almost unarmed, about 0(-2) spines in 2 cm
 11. Seeds 3.6-3.9 × 1.4-1.7 mm, but more than twice as long as broad (ratio = 2.1-2.7) g. subsp. *commersonii*
 11. Seeds (3-)3.4-4(-4.3) × (1.2-)1.6-2.4(-2.7) mm, but less than twice as long as broad (ratio = 1.4-1.9) h. subsp. *laticarpa*
 10. Stems and back of midrib not very spiny to very spiny, about (0-)2-30(-50) spines in 2 cm
 12. Stems and back of midrib not very spiny, about (0-)2-10(-15) spines in 2 cm ; seeds (2.8-)3-4(-5.1) × (0.9-)1.2-2.0(-2.8) mm i. subsp. *intermedia*
 12. Stems and back of midrib not very spiny, about (10-)15-30(-50) spines in 2 cm ; seeds 2.5-3.5(-5) × (0.8)1.5-2(-2.4) mm
 13. Seeds 2.5-3.5 mm × (0.8-)1.5-2(-2.1) mm

5 : 27 (1882) p.p. quoad Asterabad ; Tzvelev, Nov. Syst. Vysh. Rast. 13 : 17-18 (1976) ; Tzvelev in Fedorov, Fl. Eur. tsasti S.S.S.R. 4 : 200 (1979). — *N. marina* L. subsp. *major* (All.) Viinikka, Ann. Bot. Fenn. 13 : 128-129 (1976). — *N. monosperma* Willd., Sp. pl. 4 : 331-332 (1805) p.p. quoad syn. *Fluvialis latifolia fructu minus obtuso monosperma*. — TYPE (Lecto-iconotype) : Micheli, gen. 11, tab. 8, fig. 2 (1729), ♀ (design. CASPER, 1979).

= *N. muricata* Thuill., Fl. Paris (ed. 2) : 509-510 (1799). — *N. major* All. var. *spinulosa* DC, Fl. Franc. (ed. 3) 2 : 587 (1805). — *N. major* All. var. *muricata* (Thuill.) Coss. & Germ., Fl. Env. Paris ed. 1, 2 : 574 (1845). — TYPE : France, «Se trouve sur les bords de la Seine et de la Marne», Herb. *Thuillier* (holo- : *non vidi* ; iso- : BM).

= *N. fluvialis* Thuill., Fl. Paris (ed. 2) : 510 (1799). — *N. major* All. var. *laevis* DC, Fl. Franc. (ed. 3) 2 : 587 (1805). — TYPE : France, «se trouve dans l'étang de St. Gratien», Herb. *Thuillier* (*non vidi*).

= *N. tetrasperma* Willd., Sp. pl. 4 : 331 (1805) — TYPE [lecto-iconotype designated here : Mich., gen. 11, tab. 8, fig. 1 (1729) ♂, «Habitat in aquis Italiae»].

= *N. major* All. var. *multidentata* A. Br., Journ. Bot. 2 : 275 (1864). — *N. marina* L. var. *multidentata* (A. Br.) K. Schum. in Mart., Fl. Bras. 3 (3) : 725 (1894) ; Rendle ex Ascherson & Graebner, Syn. I : 369 (1897). — *N. marina* L. var. *marina* f. *multidentata* (A. Br.) Soó, Magyar Fl. 5 : 53 (1973). — TYPE : Italy, Lago di Nemi, s.d., *G. von Martens* s.n. (holo- : B † ; iso- : *non vidi*).

= *N. polonica* Zalewsky, Kosmos 21 : 326 (1896). — *N. marina* L. var. *polonica* (Zalewsky) Ascherson & Graebner, Syn. I : 369 (1897) («Rasse») ; Soó, Magyar Fl. 5 : 53 (1973). — *N. major* All. var. *polonica* (Zalewsky) Tzvelev, Nov. Syst. Vysh. Rast., 13 : 18 (1976) ; Tzvelev in Fedorov, Fl. Eur. tsasti S.S.S.R. 4 : 200 (1979). — TYPE : Poland, «In einem kleinen See zwischen Lipno und Kikol», IX. 1889, *Zalewsky* s.n. (holo- : *non vidi* ; iso- : BM).

= *N. marina* L. var. *communis* Rendle ex Ascherson & Graebner subvar. *luxurians* Rendle ex Ascherson & Graebner, Syn. I : 368 (1897) ; Ţopa in Săvulescu, Fl. Rep. Rom. 11 : 92 (1966). — *N. marina* L. var. *marina* f. *marina* subf. *luxurians* (Rendle ex Ascherson & Graebner) Soó, Magyar Fl. 5 : 53 (1973). — TYPE : Federal Republic Germany, Erlangen (holo- : B †).

= *N. fluvialis* K. Schum. in Mart. Fl. Bras. 3 (3) : 724 (1894), probably *lapsus calami* for *N. fluvialis* Thuill. or *N. fluviatilis* Poir.

Stems not very spiny, about (0-)2-10 spines in 2 cm. *Leaves* (14-)25-37 mm long and (2.1-)3-4 mm broad (incl. teeth on both sides) and 0.8-1.8(-2.0) mm broad (excl. teeth) ; margins each with (4-)6-8(-12) teeth. *Seeds* (3.3-)4.5-5.7(-6.5) mm and (1.3-)2-2.8(-3.3) mm broad, ratio : (1.4-)2-3(-3.5).

NOTES : 1. *N. marina* subsp. *marina* var. *marina* generally shows a low degree of polymorphism.

2. Specimens from lakes in the Alp region, growing rather deep (3-6 m) have shorter and narrower leaves, thus approaching subsp. *intermedia* which grows in the same area. Nevertheless, seed sizes remain different for the two taxa.

3. Seeds generally are not longer than 5.5 mm. However, a collection from N. Italy (Mantua) bore seeds of 6-6.5 × 3 mm, while the type of *N. polonica* has been described with seeds up to 7.5 × 4 mm. The latter however are measurements of the fruits together with the remaining parts of the style, as could be checked on the type.

4. Subsp. *marina* has its largest presence in Western Europe, the Volga and the Djnepr Delta. Elsewhere, it is more scattered.

5. ♂: (VI)-VII-VIII (Europe); VII (C. Asia); ♀: (VII)-VIII-IX (Europe); VII (C. Asia); fr: (VIII)-IX-X (Europe); VII-IX (C. Asia).

GEOGRAPHICAL DISTRIBUTION : Temperate and temperate warm areas, from Europe to C. Asia (Fig. 6).

SELECTED SPECIMENS :

The Netherlands : Noord-Brabant : Lith, 09.IX.1982, *Triest* 73 (BRVU) ; *ibid.*, 12.IX.1983, *Triest* 174 (BRVU) ; *ibid.*, 12.IX.1984, *Triest* 269 (BRVU).

Belgium : Brabant, Leuven, 1872 & 1892 Herb. *Dieudonné* s.n. (BR.) ; *ibid.*, in Herb. *Gandoger* (LY) ; Limburg, Lummen, *Tiewinkel*, 9.X.1985, *Andriessen* s.n. (BR).

Luxemburg : Remerschen, 28.VIII.1982, *Triest* 69 (BRVU).

France : Nord : Valenciennes, «Mare à Goriaux», 14.IX.1983, *Triest* 178 (BRVU) ; *ibid.*, 14.X.1985, *Triest* 479 (BRVU). Somme : Mareuil-Caubert, 15.IX.1983, *Triest* 195 (BRVU) ; Long, 14.IX.1983, *Triest* 181 (BRVU) ; Frise, 15.IX.1983, *Triest* 197 (BRVU). Paris, *Thuillier* in Herb. *Nolte* s.n. (BM). Val-de-Marne : Vitry-sur-Seine, 3.VIII.1862, Herb. *Agasse* s.n. (G.). Moselle : Ay-sur-Moselle, 31.VIII.1977, *J. Duvigneaud* 77F838 (BRVU, G) ; *ibid.*, 11.IX.1982, *Triest* 80 (BRVU) ; «Neudorfersee», 31.VII.1891, *Binz* s.n. (G). Meurthe-et-Moselle : Nancy, Meurthe, s.d., *Vuillemin* s.n. (LY-Gand.). Sarthe : Le Mans, Sarthe, 16.VIII.1886, Herb. *Coste* s.n. (MPU). Loire-Atlantique : «Lac du Grand Lieu», 24.VIII.1840, *Delalande* in Herb. *Revel* s.n. (MPU) ; *ibid.*, 20.IX.1911, *Bioret* s.n. (LY-Gand.). Maine-et-Loire : Angers, Maine, 30.VI.1842, *Boreau* (LY-Gand.) ; *ibid.*, 6.IX.1874, *Bouvet* s.n. (LY-Gand.), *ibid.*, 8.IX.1874 (LY-Rouy). Charente-Maritime : Nozan, 29.VI.1935, *Simon* s.n. (MPU). Gironde : St. Médard de Guizières, 24.VIII.1889, *Merlet* in Herb. *Simon* s.n. (MPU). Lot-et-Garonne : St. Pont de Lévigac, Dropt, 14.IX.1894, *Duffour* s.n. (LY-Gand.). Indre-et-Loire : Villandry, s.d., *Doucet* in Herb. *Carbonel* s.n. (MPU). Indre : Brenne, «Étang du Grand Salvart», 8.VIII.1969, *Charpin* 886924 (G). Cher : Canal de Berry, s.d., *Le Grand* s.n. (LY-Gand.). Côte-d'Or : St. Seine, Saône, VI.1822, *De Candolle* s.n. (G) ; *ibid.*, 23.VIII.1926, *Bijot* in Herb. *Sauvage* 658 (MPU) ; *ibid.*, Pouilly les Seurre, s.d., *Squivet de Carondelet* s.n. (MPU). Doubs : Besançon, 19.VII.1870,

Paillet (LY-Gand.). Saône-et-Loire : Mouthier-en-Bresse, «Étang de la Verre», 15.VII.1882, *Bigeard & Gillot* s.n. (G, LY-Gand., LY-Rouy). Yonne : Canal de Nivernais, 31.VII.1918, *Biau* 2836 (G, MPU-Coste ; MPU-de Vichet ; LY-Gand.). Ain : Dombes, «Le Peloux, an der Strasse St. Nizier-Dompierre», 12.VIII.1958, *John, Greuter, Gutzwiller, Peisl & Stafleu* s.n. (Z). Rhône : Lyon, Rhône, 3.IX.1867, *Gandoger* s.n. (LY-Gand.). Isère : Vienne, étang de Cadoret, 24.VIII.1955, *Simon* s.n. (MPU) ; VII.1858, *de Lacroix* s.n. in *Herb. Revel* s.n. (MPU). Pyrénées-Atlantiques : Bayonne, Lac de Chiberta, 15.IX.1894, *Squivet de Carondelet* s.n. (MPU). Hautes-Pyrénées : Lac de Lourdes, 16.VIII.1918, *Squivet de Carondelet* s.n. (MPU). Hérault : «Lattes à Mauvrin», 26.IX.1823, *Herb. Loret & Barrandon* s.n. (MPU) ; «Embouchure du Lez», 1834, *Bouchet* s.n. (MPU) ; «dans les eaux de l'Hérault», 27.IX.1853, *Herb. Loret & Barrandon* s.n. (MPU) ; Mauguio, 2.VIII.1891, *Herb. Loret & Barrandon* s.n. (MPU) ; *ibid.*, *Herb. Coste* (MPU) ; *ibid.*, *Herb. de Vichet* s.n. (MPU) ; *ibid.*, 26.IX.1914, *Squivet de Carondelet* (MPU) ; Doulon : 6.VIII.1840, *Delalande* in *Herb. Revel* s.n. (MPU) ; Dordogne : St. Martial d'Artenset, 19.VIII.1846, *Herb. Revel* s.n. (MPU).

Federal Republic Germany : Berlin, s.d., *Fritsche* 560 (G, L). Rheinland-Pfalz : Koblenz, 20.VIII.1857, *Wirtgen* s.n. (G, LY-Gand.) ; Trier ; s.d., *Löhr* s.n. (G) ; Maudach, 12.IX.1982, *Triest* 84a (BRVU) ; *ibid.*, 20.IX.1983, *Triest* 201 (BRVU) ; Altrip, 12.IX.1982, *Triest* 84b (BRVU). Saarland : Nennig, 11.IX.1982, *Triest* 75 (BRVU). Baden-Württemberg : Karlsruhe, Neureuth, 1.VIII.1900, *de Paluzieux* s.n. (G), Huttenheim, 12.IX.1982, *Triest* 87 (BRVU) ; Neuburgweiher, 13.IX.1982, *Triest* 93 (BRVU) ; *ibid.*, 20.IX.1983, *Triest* 205 (BRVU) ; Markelfingen, Lake Mindelsee, 14.IX.1982, *Triest* 112b (BRVU) ; *ibid.*, 21.IX.1983, *Triest* 215 (BRVU). Bayern : Oberfranken, Hochstadt a.d. Aisch, 6.X.1901, *Fischer* s.n. (G, Z) ; Oberbayern, Seefeld, 22.IX.1918, *Obermeyer* s.n. (Z).

German Democratic Republic : Brandenburg, VI.1864, *Jahn* s.n. (LY-Gand.) ; *ibid.*, Wupatz See, 20.VI.1889, *Hirte* s.n. (Z).

Switzerland : Zürich : Zürichsee, s.d., *Jäggi* s.n. (LE) ; *ibid.*, Bendlikon, 28.IX.1982, *Triest* 118 (BRVU) ; *ibid.*, 22.IX.1983, *Triest* 225 (BRVU) ; Pfäffiker See, «Seegräben», 9.IX.1970, *Simon* s.n. (G) ; Katzensee, W bank, 14.IX.1950, *Symoens* s.n. (*Herb. Symoens*) ; Robenhausen, 10.VIII.1878, *Jäggi* s.n. (LE) ; *ibid.*, 19.VIII.1883, *Jäggi* s.n. (LE) ; *ibid.*, 3.IX.1883, *Herb. Simon* s.n. (MPU) ; *ibid.*, 19.VIII.1889, *Wilczek* s.n. (MPU-Coste). Luzern : Nottwill, Sempacher See, 18.X.1985, *Triest* 485 ; 486 (BRVU) ; *ibid.*, Sempach, 18.X.1985, *Triest* 487 ; 488 (BRVU). Ticino : «Lago di Lugano», Melide, 9.IX.1931, *Koch* s.n. (TUR, ZT) ; Capo di Lago, 26.VI.1829, *Herb. Belanger* s.n. (G) : «Lago Maggiore, entre Locarno et Minusio», VIII.1859, *Herb. Mercier* s.n. (G) ; Magadino, 3.VIII.1899, *Chenevard* s.n. (G).

Austria : Nieder-Österreich, «Alte-Donau pr. Kaisersmühlen», IX.1910, *Keller* 5335 (G, H, LE, Z) ; Tirol : «Kalterer See», *Herb. Siegfried* s.n. (Z).

Spain : Baleares, Mallorca, IX.1949, *P. Ferrer* 283 (BRVU) ; *ibid.*, La Albufera, 9.VI.1966, *Bowden & Sims* 579 (BM).

Italy : Piemonte : Lago Maggiore, Pallanza, Lago di Mergozzo, 23.VI.1947, *Koch* 47/222 (ZT) ; Lombardia : Mantua, 1904, *Fiori* s.n. (LE) ; Bresica, Lago di Garda, 2.VIII.1983, *Akeroyd et al.* (BM). Veneto : Verona, Peschiera, 30.VIII.1878, *Rigo* s.n. (BRVU) ; Venetia, VIII.1869, *Porta* s.n. (G) ; *ibid.*, 2.IX.1897, *Rigo* s.n. (LY-Gand.) ; *ibid.*, Lido del Nazioni, 11.VII.1980, *Vleminckx* 340 (BR) ; *ibid.*, 7.VIII.1985, *Vleminckx* 494 (BR, BRVU). Lazio : Albano, 24.IX.1952, *Grönblad* s.n. (H). Campania, Napoli, Lago di Averno, *Pasquale* s.n. (BM). Sicily : Palermo, Mondello, VII.1892, *Ross* in *Herb. Siculum* 68 (FI, G, L).

Poland : Ilawa, «Lacus Jeziorak pr. insulam Wielki Ostrow», 24.VII.1974, *Rejewski & Gugnacka* s.n. (H, Z) ; Rypin, «In lacu Ilupie v. Orszulewskie», 6.IX.1895, *Zalewski* s.n. (LY-Gand.) ; Lipno, IX.1889, *Zalewski* s.n. (BM). Slask, Rybnik, 17.VIII.1952, *Kuzniewski* 422 (H, LE, TUR) ; «Lac Menolski, près de Sempalno», 5.VIII.1891, *Drümmer* s.n. (Z).

Czechoslovakia : Prag, s.d., *Böhmen* s.n. (LE).

Hungary : Budapest, Lagymanyos, 1970, *Szusak* s.n. (LE) ; «In insulae Danubialis, Poetschen ad Posonium», s.d., *Schiller* 1022 (G, H, LE).

Romania : Transsilvania : Distr. Gherla, «In lacu Taga pr. Taga», 3.VIII.1947, *Țopa & Codoreanu* 2990 (G, H, NSW, Z) ; Lake Merkei, 1912, *Pallis* s.n. (BM).

Yugoslavia : Crna Gora (Montenegro), S.W. Titograd, 11.IX.1972, *Uotila* 20628 (H).

Albania : Skodar Lake, 15.VII.1959, *Herb. Vilar* 101 (LE).

Greece : Macedonia, Kilkis, Doiran Lake near Doiran, 24.VIII.1977, *Greuter* 15800 (AAU) ; «Prin cande pr. locul fostii baltii Graecae», 21.VII.1970, *Popiou* s.n. (AAU).

U.S.S.R. (European part) ; River Don, 1881, *Zinger* s.n. (LY-Gand.) ; S.S.R. (White Russia), Mogiljov, 1855, *Pabo & Tscholowski* s.n. (LY-Gand.).

Turkey : Bolu, near Gerece, Lake Yeniçaga, 3.X.1961, *A. & T. Baytop* ISTE 6881 (ISTE).

Iran : Asterabad (Ashkhabad), s.d., *Herb. Ledebour* s.n. (LE).

U.S.S.R. (Asia) : Kazakhstan S.S.R. : Ural'sk Prov., Lake «Sadovskoje», 1.VII.1912, *Borodin* 629 (LE) ; Kustanay Prov., Semiozernyi region (7 lakes), 27.VI.1929, *Vernander* 400 (LE) ; Alma-Ata Prov., Balkhaz region, delta of river Ili, 2.IX.1957, *Katanskaja* s.n. (LE) ; *ibid.* 2, 26 and 31.VII.1957 ; 28.VIII.1957 (LE) ; Alma-Ata Prov., river «Topar», 29.VII.1919, *Granitov* 599 (LE) ; 601 (LE) ; Semipalatinsk, river «Ajaguz», V.1890, *Korshinsky* N 26 (BM). Uzbekistan S.S.R. : Amu-Darya delta, Muynak, 10.VII.1980, *Artemenko* s.n. (LE) ; Syr-Darya, «Ozero Chitankol», 25.VIII.1911, *Nikolsky* s.n. (LE). Turkmenistan (Turkmeniya S.S.R.) : Khira, 11.VII.1873, *Karolkow & Krause* s.n. (LE).

ab. *N. marina* L. subsp. *marina* var. *grossedentata* Rendle. — ≡ *N. marina* L. var. *grossedentata* Rendle, *Trans. Linn. Soc.*, ser. 2, Bot. 5 (12) : 396-397, pl. 39, fig. 6

(1899); Rendle in Engler Pflanzenr. H. 7 : 8 (1901). — TYPE : China, «Kianang Prov.», s.d. (probably before 1798), *Staunton* s.n. (holo- : BM ; iso- : G). — **Pl. I, F-I.**

= *N. tenuicaulis* Miki, Bot. Magaz. Tokyo 49 : 776-777 (1935); Ohwi (ed. Meyer & Walker, Engl. transl.), Fl. Jap. : 124 (1965), probably belongs here. — TYPES (*non vidi*) : Japan, Honshiu ; Prov. Shinano, Kizakiko, VIII. et XI.1934, *Kawajiri* s.n. (lecto- : OSA ?) ; Prov. Echigo : Fukushimagata et Asuhinuma, VII.1925, Miki s.n. (syn- : OSA ?) ; Prov. Inabo, Tanagaike, X.1923, Miki s.n. (syn- : OSA ?). Lectotype designated here (drawings of Miki 1935b : 777 are based on specimen from Kizakiko).

— *N. marina* auct. non L. : Rendle, Trans. Linn. Soc., ser. 2, Bot. 5 (12) : 391-392 (1899) p.p. quoad (var. α et β) ; Nakai, Fl. Koreana 31, 2 : 274-275 (1911) ; Yuzepczuk in Komarov, Fl. U.S.S.R. 1 : 270-273 (1934) p.p. ; Mori, Enum. Pl. Corea : 33 (1922) ; Nakai, Ord. Fam. etc. : 212 (1943) p.p. quoad syn. *N. tenuicaulis* Miki ; Icon. Cormoph. Sinic., Ac. Sc. Peking : 14, fig. 6858 (1976) ; Kitagawa, Neo-Lineamenta Fl. Manshuricae : 60 (1979).

— *N. major* auct. non All. ; Regel, Tent. Fl. Ussur. : 152 (1862) ; Tzvelev, Nov. Syst. Vysh. Rast. 13 : 17-18 (1976) p.p. ; Vegetation of China (1980), in index.

— *N. marina* L. (*genuina*) (det. Rendle 5.V.1903) in sched. *Litwinow* 2478 (LE).

— *N. marina* L. *genuina* (det. Rendle 26.I.1904) in sched. *Litwinow* 3345 (LE).

— *N. marina* L. *genuina* forma *luxurians* (det. Rendle 1903) in sched. *Litwinow* 2478 (LE).

Stems not very spiny, about (0-)2-5(-12) spines in 2 cm. *Leaves* (7-)15-30(-35) mm long and (2.1-)3-4(-5.7) mm broad (incl. teeth on both sides) and (1.1-)1.4-1.8(-2.0) mm broad (excl. teeth) ; margins each with (2-)4-6(-8) teeth. *Seeds* 4-4.5(-5.3) mm long and (1.8-)2-2.4(-2.7) mm broad, ratio : 1.8-2.2(-2.5).

NOTES : 1. Specimens from China had seeds 4 mm long. Only those from U.S.S.R. (Ussuri) had seeds 4(-4.5) mm long, whilst those of Lake Khanka were 5-5.3 mm long. Specimens from Japan have fruits (seeds ?) 4-5 × 1.2-2 mm (*non vidi* ; see Miki, 1935b, pp. 776-777 under *N. tenuicaulis* Miki).

2. The anther is 4 × 2 mm.

3. ♂ : (VI)-VII-(VIII) ; ♀ : VIII ; fr. : VIII-IX.

GEOGRAPHICAL DISTRIBUTION : Far East, i.e. N.E. China, Corea and E. Russia (Fig. 6).

SELECTED SPECIMENS :

U.S.S.R. (Far East) : Amursk Prov., river «Zeja» ?, VIII.1908, *Prochorov & Kuzeneva* 964 (LE) ; Vladivostok Prov., near river «Lefu», 12.IX.1979, *Tzvelev* 68 (LE) ; *ibid.*, 14.IX.1979, *Tzvelev* 117 (LE) ; In lake near Cape Kraskino, 20.IX.1979, *Tzvelev* 224 (LE) ; Lake Khanka, 5.IX.1926, *Melvil* s.n. (LE) ; Spassk, Dal'niy, 19.IX.1928, *E. ... ?*, 972 (LE) + 13 other collections from the Ussuri region (Lake Khanka and Spassk) at LE.

China : Heilungkiang (= Manchuria) : Ch'i-ch'i-ha-erh (= Tsitsihar), 10.VIII.1902, *Litwinow* 2478 (BM, LE) ; Sunghua Chiang river (= Sungari river), near Tao-lai-chao, 19.VII.1903, *Litwinow* 3345 (LE) ; Ha-erh-pin (= Harbin), 1951, Wang Wei 1221 (LE). Chi-lin (= Kirin) : Chi-lin Prov. (= Kirin), 24.VIII.1931, *Chen* 507 (BM, LE) ; *ibid.*, near river Mu-tan Chiang, 19.VII.1896, *Komarov* s.n. (LE). Liaoning : Liaoning prov., Chang-wu region, 15.VIII.1953, *Liou-Jing-ksin & Li Shu-ksin* 2738 (LE) ; Shen-Yang (= Mukden) Prov., in lake in valley of river Liao Ho (= Jaludsián), 10.VII.1897, *Komarov* s.n. (LE) ; *ibid.* 14.VIII.1897, *Komarov* Fl. Mandsh. n 9 (or 109 ?) (BM, P) ; *ibid.*, 18.VIII.1897, *Komarov* s.n. (LE) ; «Kianang Prov.», s.d., *Staunton* s.n. (BM ; G).

Corea (N/S ?) : Near «Njen-zchen», 23.VII.1900, *Schmidt* 450 (LE). Corea (South) : Kan Quen-to, VI.1901, *Faurie* s.n. (BM) ; in river Seoul, 23.IX.1901, *Faurie* 681 (G, P).

ac. ***N. marina*** L. subsp. ***marina*** var. ***ohwii*** Triest var. nov. — *Herba* submersa dioica, internodiis paucè spinulosis (spinulis 2-6 in 2 cm). *Folia* (20-)30-37(-50) mm longa ; lamina 3-3.5(-4) mm lata (inclusis spinulis) et 1.7-1.9 mm lata (exclusis spinulis), marginibus utrinque dentibus 7-8(-12) patentibus munitis. *Flores masculini* in spathella c.4 × 2 mm. *Flores feminei* c.6-9 mm longi ; ovarium c.4-6 × 2-2.5 mm ; stylus c.2-3 mm. *Semina* 6 × 2-2.2(-2.5) mm. — TYPE : Japan : Koaidame, IX.1953, *Ohwi* TSM 976 (holo- : K ; iso- : BM, BR, G, H, LE, NSW), ♂, fr. — **Pl. II, G-I.**

— *N. marina* auct. non L. : Rendle, Trans. Linn. Soc., ser. 2, Bot. 5(12) : 391-392 (1899) p.p. quoad Japan (var. a) ; Rendle in Engler, Pflanzenr. H.7 : 7 (1901) p.p. quoad Japan (var. a) ; Nakai, Ord. Fam. etc. : 212 (1943) p.p., excl. syn. *N. tenuicaulis* Miki ; Ohwi (ed. Meyer & Walker, Engl. transl.), Fl. Jap. : 124 (1965).

— *N. major* auct. non All. : Makino & Nemoto, Cat. Jap. pl. : 397 (1914) ; Makino, Ill. Fl. Jap. : 856 (1925) ; Makino & Nemoto, Fl. Jap. ed. 2 : 1287 (1931) ; Makino, Ill. Fl. Jap. 887 (1948).

Stems not very spiny, about 2-6 spines in 2 cm. *Leaves* (20-)30-37(-50) mm long and 3-3.5(-4) mm broad (incl. teeth on both sides) and 1.7-1.9 mm broad (excl. teeth) ; margins each with 7-8(-12) teeth. *Seeds* 6 mm long and 2-2.2(-2.5) mm broad (ratio : 2.4-3).

NOTES : 1. All seeds from 4 different collections were somewhat asymmetrically fusiform at the apex and exactly 6 mm long.

2. ♂ : VIII ; ♀ : VII, IX, X ; fr. : IX, X.

GEOGRAPHICAL DISTRIBUTION : Japan (Fig. 6).

SELECTED SPECIMENS :

Japan : Tokyo Prov., 21.IX.1910, Sakurai (= coll. or loc. ?) s.n. (H) ; Koaidame, IX.1953, *Ohwi* TSM 976 (BM, BR, G, H, K, LE, NSW) ; Shiga Prov., Lake Biwa, X.1898, *Schröter* s.n. (ZT) ; *ibid.*, 19.VII.1968, *Kitamura et al.* 918 (K, P) ; Mie

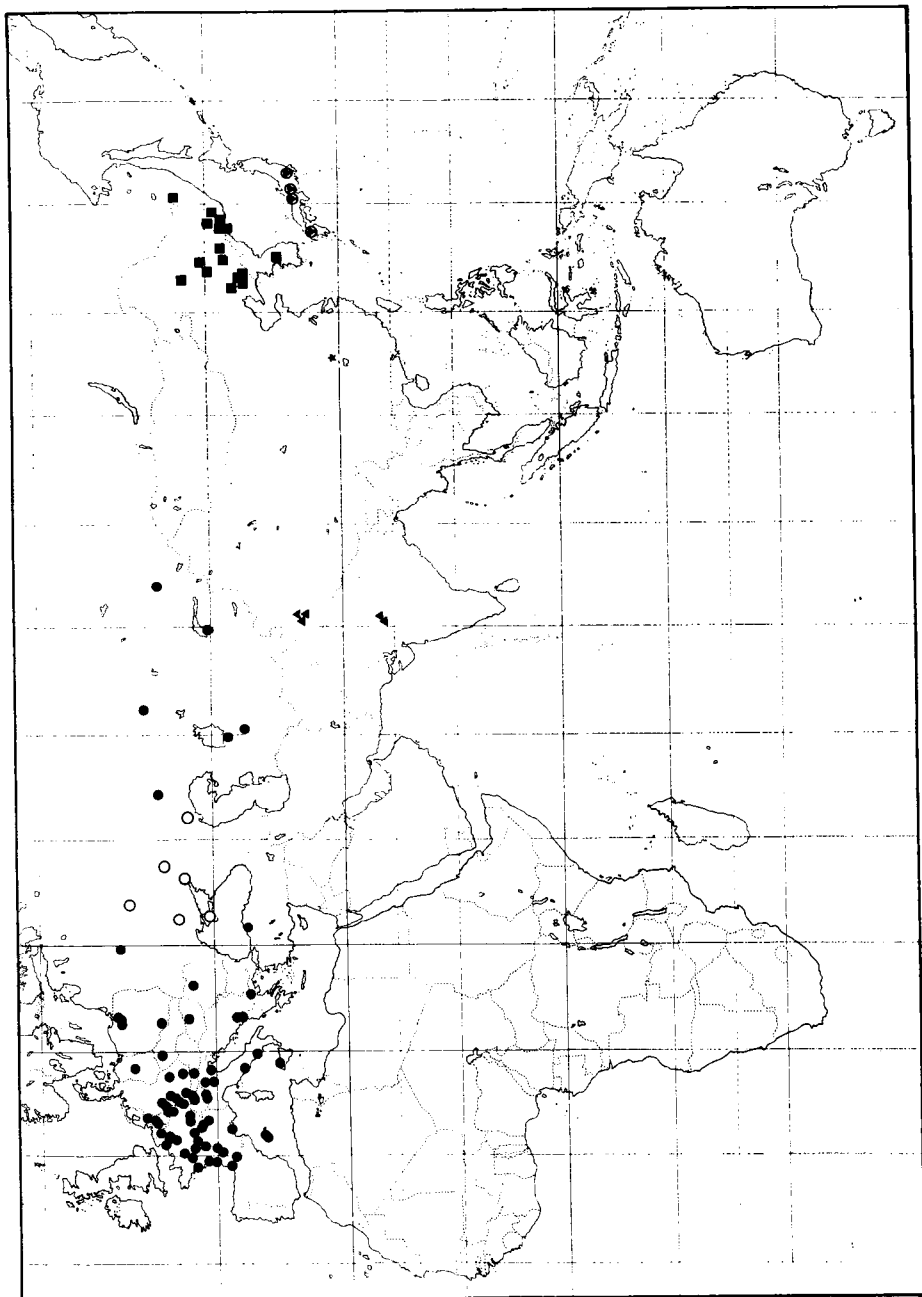


FIG. 6. — Distribution of *N. marina* subsp. *marina* var. *marina* (solid circles; each of the main regions of European part of U.S.S.R., i.e. Central, Ukraine, Krim, Rostov and Volga Delta is represented on map with a single open circle); var. *grossedentata* (squares); var. *kashmirensis* (triangles); var. *ohwii* (triangle in circle) and a literature record (star) of subsp. *marina*.

Prov., Kuwana, «Nagara» river, 2.VIII.1964, *Shimizu* 14426 (BR); «Ibi» river, 4.X.1964, *Shimizu* 14636 (BR); Kiusiu, between Waifu and Nagayama, 1863 iter sec., *Maximowicz* s.n. (BM, BR, G, K, L); «Plaine de Numasaki», VII-VIII.1897, *Faurie* 599 (G, K, P); Lake Hakone, 1907, *Dunn* 195-15 (K); ? Okayama, Ibara, s.d., *Sanchez* 649 (P); s.l., s.d. *Sanchez* 1349 (P).

ad. *N. marina* L. subsp. *marina* var. *kashmirensis* TRIEST var. nov. — *Herba* submersa dioica, internodiis pauce spinulosis (spinulis 1-5(-12) in 2 cm). *Folia* 30-50(-65) mm longa; lamina (2.3-)3-4(-4.7) mm lata (inclusis spinulis) et (0.7-)1.2-1.7(-2.4) mm lata (exclusis spinulis), marginibus utrinque dentibus 8-10(-14) patentibus munitis. *Flores masculini* in spathella 5-5.2 mm longa. *Flores feminei* c. 6 mm longi; ovarium c. 4 × 2 mm; stylus c. 2 mm. *Semina* (6.1-)6.6-7.3(-7.5) × 2.2-2.6(-3) mm. — TYPE: India, Kashmir, Anchar Lake, 25.VII.1937, *Ludlow & Sherriff* s.n. (holo-: BM) ♂, ♀ & fr. — **Pl. II, A-F.**

— *N. marina* auct. non L.: Rendle, Trans. Linn. Soc., ser. 2, Bot. 5 (12): 392 (1899) p.p. quoad India (var. β); l.c.: 393 p.p. quoad Cashmere (var. γ); Rendle in Engler, Pflanzenr. H.7: 7 (1901) p.p. quoad India (var. b); l.c. p.p. quoad Kashmir (var. c); Stewart in Nasir & Ali, Fl. West Pakistan: 31 (1972).

Stems not very spiny, about 1-5(-12) spines in 2 cm. *Leaves* 30-50(-65) mm long and (2.3-)3-4(-4.7) mm broad (incl. teeth on both sides) and (0.7-)1.2-1.7(-2.4) mm broad (excl. teeth); margins each with 8-10(-14) teeth. *Seeds* (6.1-)6.6-7.3(-7.5) mm long and 2.2-2.6(-3) mm broad, ratio: 2.5-2.8(-3.2).

NOTES: 1. ♂: (VI-)VII; ♀: (VI-)VII; fr.: (VI-)VII-VIII-IX (Kashmir).

2. anther 3.8-4 × 2-2.2 mm.

GEOGRAPHICAL DISTRIBUTION: India, only in Kashmir and Rajasthan (Fig. 6).

SELECTED SPECIMENS:

India: Kashmir State: Srinagar, Dal Lake, (rec. 1884), *Young* s.n. (BM); *ibid.*, 17.VIII.1917, *Stewart* 3346 (K); *ibid.*, IX.1932, *Newland* s.n. (BM); Anchar Lake, 27.VIII.1917, *Stewart* 3370 (BM); *ibid.*, 25.VII.1937, *Ludlow & Sheriff* 7695 (BM); Manasbal, 25.VI.1940, *Ludlow & Sheriff* 7678 (BM). Rajasthan State: Kota, «first large tank N. of Kota», 27.X.1970, *Cook & Gut* 1 (Z); *ibid.*, «Umedgunj tank N. of Kota», 28.X.1970, *Cook & Gut* 24 (K, Z).

b. *Najas marina* L. subsp. *ehrenbergii* (A. Br.) Triest. Mém. Acad. r. Sci. Outre-Mer, Cl. Sci. nat. méd., nouv. sér. in-8°, 21 (4) [et Et. Cont. afr., 6]: 24, pl. 3 A-D, F, H et fig. 1 (1987). — **Pl. III, A-G.**

— *N. marina* L. var. *angustifolia* auct. non (A. Br.) K. Schum. in Mart.: Rendle, Trans. Linn. Soc., ser. 2, Bot. 5 (12): 395 (1899), p.p. quoad *Bornmüller* 1838.

— *N. marina* auct. non L.: Dandy in Rechinger, Fl. Iranica 86: 1-2 (1971) p.p. quoad *Bornmüller* 1838; Dandy in Townsend & Guest, Fl. Iraq 8: 32-33 (1985) p.p. quoad *Bornmüller* 1838.

Stems unarmed or almost unarmed, about 0(-4) spines in 2 cm. *Leaves* 17-25(-40) mm long and 1.4-1.9(2.2) mm broad (incl. teeth on both sides) and 0.8-1.0(-1.5) mm broad (excl. teeth); margins each with 5-14 teeth. *Seeds* 2-2.5 mm long and 1.3-1.5 mm broad, ratio : 1.5-1.7.

NOTES : 1. Close to subsp. *commersonii* and subsp. *latior* because of the unarmed or almost unarmed stems.

GEOGRAPHICAL DISTRIBUTION : W. Sahara (Libya, Egypt), Asia Minor (Iraq), S. Arabia (Oman) and Socotra (Fig. 8).

SELECTED SPECIMENS :

Iraq : Mosul, «ad Ninivam», 1.VIII.1893, *Bornmüller* 1838 (G, K, LE).

«**Arabia**» : «Wady Djara et Kamme, in fluviis, febr. 1820-1826», *Ehrenberg* s.n. (BR, K, L, LE).

Oman : Dhofar Mts, «River mouth, coast», 1895, Bent 219 (K); Saläläh, 12.II.1973, *Parker* 0.68 (BM).

Socotra : Galamir, 18.V.1881, *Schweinfurth* 709 (K, P); III-IV.1880, *Balfour* 732 (BM, K).

c. *Najas marina* L. subsp. *brachycarpa* (Trautvetter) Tzvelev, Nov. Syst. Vysh. Rast. 13 : 17 (1976). — ≡ *N. marina* L. var. *brachycarpa* Trautvetter (1867), Bull. Soc. Imp. Nat. Moscou 40 (3) : 97; Rendle, Trans. Linn. Soc., ser. 2, Bot. 5 (13) : 439-440 (1900); Rendle in Engler, Pflanzenr. H.7 : 8 (1901). — TYPE : U.S.S.R., Kazakhstan S.S.R., «Songaria, Alakulj», VIII.1841, *Schrenk* 930 (holo- : LE; iso- : LE, BM). — **Pl. III, H-J.**

Stems not very spiny, about (0-)-2-10(-18) spines in 2 cm. *Leaves* 6-15(-20) mm long and 1.4-2(-3) mm broad (incl. teeth on both sides) and 0.5-0.9 mm broad (excl. teeth); margins each with 4-6(-10) teeth. *Seeds* (2-)-2.2-2.5(-2.8) mm long and (1.3-)-1.5-1.8(-2) mm broad, ratio : 1.2-1.8.

NOTES : 1. The specimens from China were more spiny than those from the U.S.S.R.

2. Close to subsp. *ehrenbergii* and subsp. *microcarpa* because of the broadly ovate and small seeds.

3. Vegetatively not distinguishable from subsp. *intermedia* and therefore certainly overlooked.

4. ♂ *non vidi*; fr. : VII, VIII.

GEOGRAPHICAL DISTRIBUTION : Central Asia (Fig. 7).

SELECTED SPECIMENS :

U.S.S.R. : Kushmurun, Lake Aksuat, 6.VII.1909, *Sjelinsky* 138 (LE). **Uzbekistan S.S.R.** : Aral desert, Syr-Darya region, Lake «Kotschanshu», 13.VIII.1858, *Borszczow* 846 (LE). **Kazakhstan S.S.R.** : Lake Alakol' («Songaria, Lake Alakulj»),

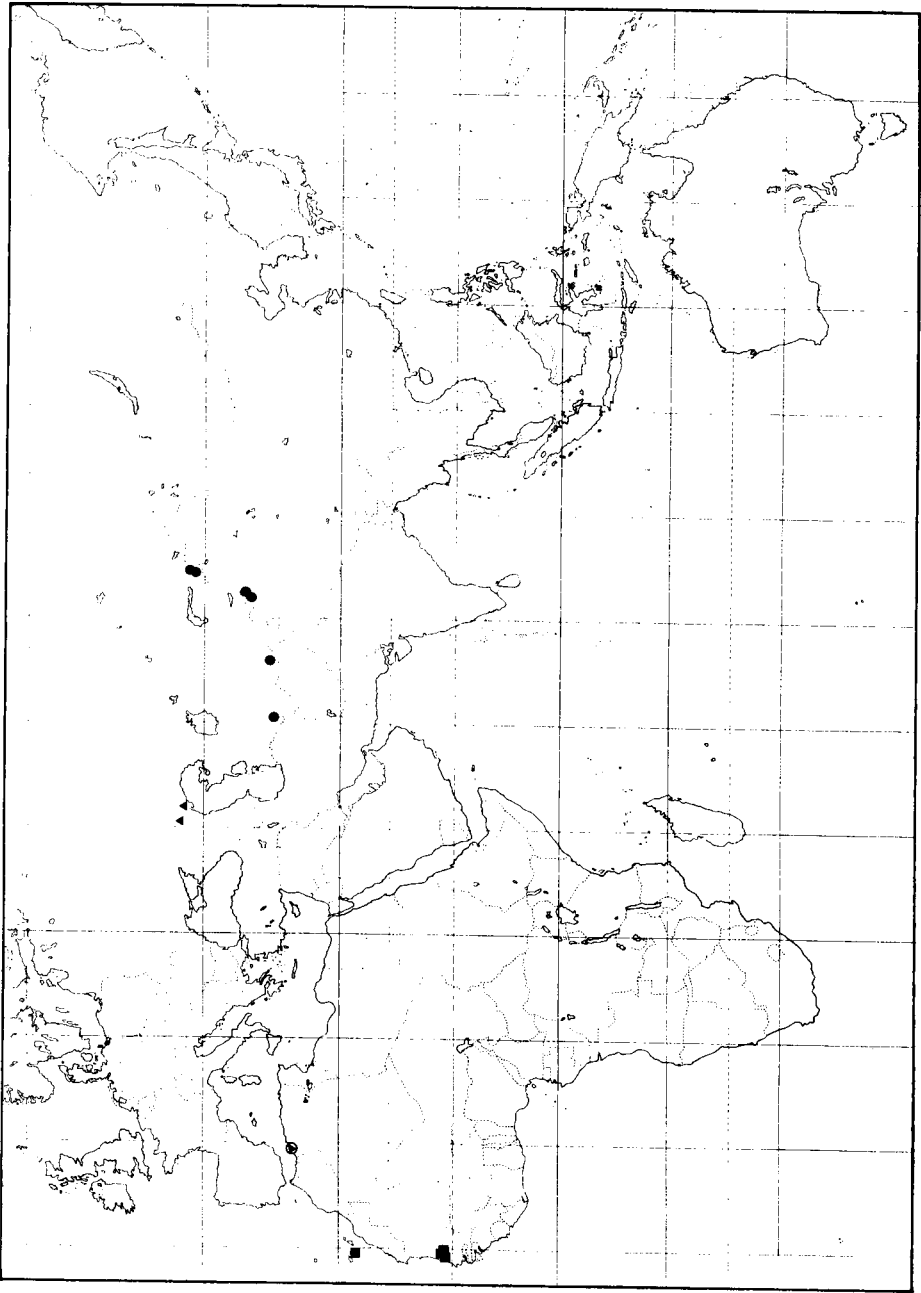


FIG. 7. — Distribution of *N. marina* subsp. *brachycarpa* (circles) ; subsp. *aculeolata* (triangles) ; subsp. *arsenariensis* (triangle in circle) and subsp. *microcarpa* (squares).

VIII.1841, *Schrenk* 930 (7 sheets at LE) ; *ibid.*, 1841, *Schrenk* s.n., Mus. Bot. Acad. Sc. Petrop, N 1094 (BM). Tadjikistan S.S.R. : Kurgan-Tyube, Vakhsh river, 2-14.VIII.1883, *Regel* s.n. (LE). Turkmeniya S.S.R. : Lake near Tedzhen, 15.VIII.1910, *Androsov* 53 (LE).

China : Sinkiang Prov. : Between Kashgar (Su-Fu) river and Maral-Bashi (Pa-ch'u), 8.VIII.1829, *Popov* N 633 (LE) ; N 715 (LE).

d. *Najas marina* L. subsp. **aculeolata** Tzvelev, Nov. Syst. Vysh. Rast. 13 : 17 (1976) ; Tzvelev in Fedorov, Fl. Eur. tsasti S.S.S.R. 4 : 200 (1979). — TYPE : U.S.S.R., Kalmytskaja A.S.S.R., Sarpinskoye lakes, Lake Chanata, Tsagan-Usun, 22.VIII.1958, *Katanskaja* s.n. (holo- : LE). — **Pl. IV, A-E.**

Stems not very spiny, about 0-8 spines in 2 cm. *Leaves* 4-9 mm long and 1.5-3.0 mm broad (incl. teeth on both sides) and 0.7-1.2 mm broad (excl. teeth) ; margins each with 2-5 teeth. *Seeds* 2.6-2.9 mm long and 0.9-1.1 mm broad, ratio : 2.6-2.9.

NOTES : 1. Seeds with more or less regularly arranged areoles.

2. Approaching subsp. *arsenariensis* in leaf characters.

GEOGRAPHICAL DISTRIBUTION : U.S.S.R., Volga delta (Fig. 7).

SELECTED SPECIMENS :

U.S.S.R. : Volga delta, Astrakhan, 12.VIII.1965, *Tzvelev & Kolesnikova* 303 (LE). Kalmytskaja A.S.S.R. : Sarpinskoye lakes, Lake Chanata, Tsagan-Usun, 22.VIII.1958, *Katanskaja* s.n. (LE).

e. *Najas marina* L. subsp. **microcarpa** (A. Br.) Triest, Mém. Acad. r. Sci. Outre-Mer, Cl. Sci. nat. méd., nouv. sér. in-8°, 21 (4) [et Et. Cont. afr., 6] : 25, fig. 2, pl. 2 D-G (1987). — **Pl. IV, F-J.**

Stems very spiny, about 20-30 spines in 2 cm. *Leaves* 8.3-11.3(-19) long and 3.5-3.7 mm broad (incl. teeth on both sides) and c.0.6-1.2 mm broad (excl. teeth) ; margins each with 4-7 teeth. *Seeds* 1.9-2.3(-2.5) mm long and 1.2-1.4(-1.6) mm broad, ratio : 1.4-1.6.

GEOGRAPHICAL DISTRIBUTION : Gran Canaria and N. Senegal (Fig. 7).

f. *Najas marina* L. subsp. **arsenariensis** (Maire) Triest, Mém. Acad. r. Sci. Outre-Mer, Cl. Sci. nat. méd., nouv. sér. in-8°, 21 (4) [et Et. Cont. afr., 6] : 32, pl. I D-E, fig. 2 (1987). — **Pl. IV, K-O.**

Stems not very spiny, about 0-10 spines in 2 cm. *Leaves* 3.6-4.0 mm long and 1.6-2.6 mm broad (incl. teeth on both sides) and c.1 mm broad (excl. teeth) ; margins each with 0-2 teeth. *Seeds* unknown.

GEOGRAPHICAL DISTRIBUTION : Lake Melah, Arzew ; Algeria (Fig. 7).

g. *Najas marina* L. subsp. *commersonii* Triest, Mém. Acad. r. Sci. Outre-Mer, Cl. Sci. nat. méd., nouv. sér. in-8°, 21 (4) [et Et. Cont. afr., 6] : 27, fig. 1, pl. 3 E, G, I, fig. 1 (1987). — **Pl. V, A-D.**

Stems unarmed or almost unarmed, about 0(-2) spines in 2 cm. *Leaves* (20-)30-40(-60) mm long and 1.2-2.9(-4) mm broad (incl. teeth on both sides) and 0.5-1.1(-2.2) mm broad (excl. teeth); margins each with 8-17 teeth. *Seeds* 3.6-3.9 mm long and 1.4-1.7 mm broad, ratio : 2.1-2.7.

GEOGRAPHICAL DISTRIBUTION : Madagascar and Mascarenes (Fig. 8).

h. *Najas marina* L. subsp. *latior* (K. Schum.) Triest stat. nov. — ≡ *N. marina* L. var. *latior* F. Muell. ex K. Schum. in Mart., Fl. Bras. 3 (3) : 725, 726 (1894). — ≡ *N. latior* F. Muell. ex K. Schum. in Mart., Fl. Bras. 3 (3) : 726 (1894). — **TYPE** : Australia, Murchison river, s.d., *Oldfield* s.n. (holo- : B † ; lecto- : K). — **Pl. V, E-G.**

— *N. marina* L. var. *zollingeri* Rendle, Trans. Linn. Soc., ser. 2, Bot. 5 (13) : 438-439 (1900); Rendle in Engler, Pflanzenr. H.7 : 7 (1901); van Steenis, Arch. Hydrobiol. Suppl. 11 : 271, 272, f. 2 (1932); Ruttner, l.c. 374, tab. II; de Wilde in van Steenis, Fl. Males. 1 (6) : 163. — **TYPE** : Indonesia, Lesser Sunda Islands, Bali : «In laculo (Danu) Bator», 8.IX.1857, *Zollinger* 3891 (holo- : W, *non vidi*; iso- : BM, LE).

— *N. major* auct. non All. : Benth., Fl. Austr. 7 : 181 (1878).

— *N. marina* auct. non L. : Rendle, Trans. Linn. Soc., ser. 2, Bot. 5 (12) : 392 (1899) p.p. quoad Australia (var. β); Rendle, l.c. (13) : 437 (1900) p.p. quoad Australia (var. α); Aston, Aquatic Pl. Austr. : 260-261 (1973) p.p.; Aston, Vict. Nat. 96 : 67 (1979) p.p.

— *N. marina* L. var. *angustifolia* auct. non A. Br. : Rendle, Trans. Linn. Soc., ser. 2, Bot. 5 (13) : 439 (1900) p.p. quoad West Australia.

Stems unarmed or almost unarmed, about 0(-2) spines in 2 cm. *Leaves* (8-)30-45(-55) mm long and (1.6-)2-3.5(-4.5) mm broad (incl. teeth on both sides) and (0.9-)1.5-2.5 mm broad (excl. teeth); margins each with (4-)10-15 teeth. *Seeds* (3-)3.4-4(-4.3) mm long and 1.6-2.4(-2.7) mm broad, ratio : 1.4-1.9.

NOTES : 1. internodes up to c. 8 cm.

2. ♂ : not seen ; ♀ : VI, IX ; fr. : VI, IX ; sterile : XII.

3. Close to subsp. *commersonii*.

4. In the first description by Rendle, seeds were measured 1.6 mm broad. This however most probably is an error. W. J. J. O. DE WILDE (1961) measured 2.4-2.6 mm, which corresponds with the type material examined here.

GEOGRAPHICAL DISTRIBUTION : Bali, Kai Islands, W. and E. Australia (Fig. 8).

SELECTED SPECIMENS :

Indonesia : Lesser Sunda Islands, Bali, Lake Batoer, 8.IX.1857, *Zollinger* 3891 (BM, LE) ; *ibid.*, 21.VI.1929, *Ruttner* 313 (L) ; *ibid.*, 30.XII.1930, *Ernst* s.n. (Z) ;

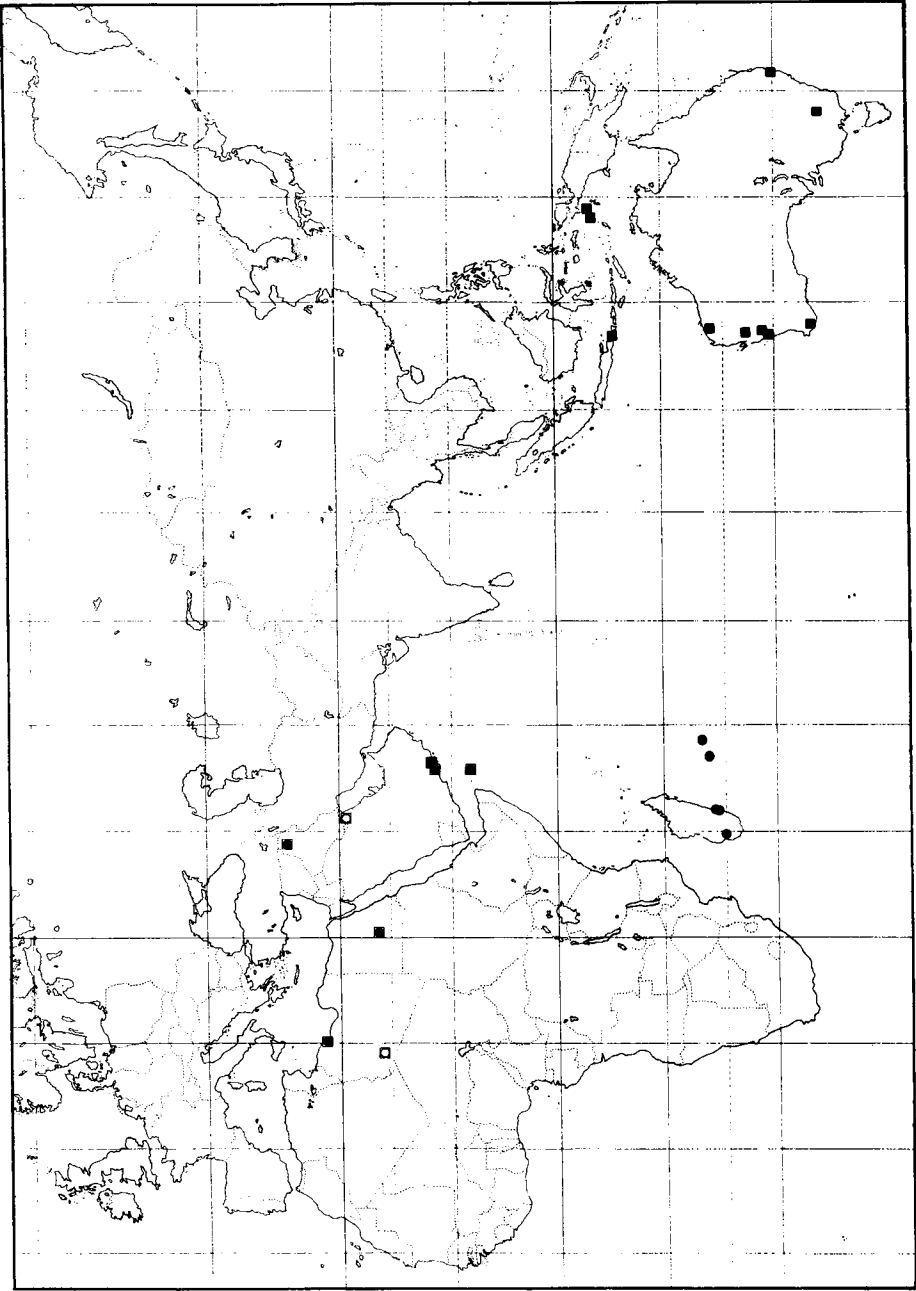


FIG. 8. — Distribution of *N. marina* subsp. *ehrenbergii* (solid circle in square; uncertain localities as open circle in square); subsp. *commersonii* (circles) and subsp. *latior* (squares).

ibid., 8.IV.1936, *van Steenis* 7971 (BM, K, L); «Bratan-See», XII.1930, *Renner* s.n. (M); Kai Islands, Kai Ketjil, IX.1873, *Beccari* 11808 (L); Ohoitiel, near Tual, 02.V.1922, *Jensen* 298 (L).

Australia : West Australia : Fortescue river, 1895, *Cusak* 222 (MEL); ibid., 1896, *Cusak* 246 (MEL); Gascoyne river, 1886, *Gribble* MEL 108953 (MEL); Murchison river, s.d., *Oldfield* s.n. (K); ibid., s.d., *Alof* MEL 108952; 108954 (MEL); Hutt river, Northampton Rd., 28.IX.1961, *Knight* s.n. (L); Lake Muir, 1881, *Herb. Von Mueller* MEL 108956 (MEL). New South Wales : 8 km W. Maclean, 10.III.1978, *Jacobs* 3328 (NSW); Lake Wyangan, 5 mls. N. Griffith, 4.II.1965, *Sainty* 98 (NSW); Uncertain locality : «Rocburn», 1886, *Lea* MEL 108958 (MEL).

i. ***Najas marina* L. subsp. *intermedia*** (Gorski) Casper, Feddes Repert. 90, 4 : 236 (1979); Triest & Symoens, Bull. Jard. bot. nat. Belg. 55 (1/2) : 261-269 (1985); Triest et al., Aquatic Bot. 24 : 373-384 (1986). — ≡ *N. intermedia* Wolfgang ex Gorski in Eichwald, Nat. Skizze : 126-127 (1830); Kunth, Enum. Plant. 3 : 112-113 (1841) p.p. — ≡ *N. major* All. var. *intermedia* (Gorski) A. Br., Journ. Bot. 2 : 276 (1864). — ≡ *N. marina* L. var. *intermedia* (Gorski) Ascherson, Fl. Brandenb. I : 670 (1864); Ascherson & Graebner, Syn. I : 369 (1897); Rendle, Trans. Linn. Soc., ser. 2, Bot. 5 (12) : 395 (1899); Rendle, Trans. Linn. Soc., ser. 2, Bot. 5 (13) : 439 (1900) p.p. quoad «South Austria and Russia»; Rendle in Engler, Pflanzenr. H.7 : 8 (1901) p.p. excl. «Sicilien, Afghanistan, Ost-Indien»; Ţopa in Săvulescu, Fl. Rep. Soc. Rom. 11 : 92 (1966). — ≡ *N. marina* L. var. *marina* f. *intermedia* (Gorski) Soó, Magyar Fl. 5 : 53 (1973). — ≡ *N. helvetica* Borb., Balaton Tud. Tanulm. Eredm. II : 327 (1900). — ≡ *N. marina* L. var. *genuina* K. Schum in Mart., Fl. Bras. 3 (3) : 724 (1894). — TYPE : Russia, Lithuania [«Gorski in Herb. Mus. Palat. Vindob.» in Rendle (1899) : 439] (holo- : W †, after CASPER, 1979). Finland, «marina l. Åland», *Linnaeus* 1156.1 (neo- : LINN) designated by CASPER (1979). — **PI. VI, K-Q.**

= *N. marina* L. var. *muricata* Hartm. (non Del. nec Thuill.), Handb. Skand. Fl. ed. 9 : 196-197 (1864) — TYPE : Sweden, Gotland, Fardume träsk (*non vidi*).

= *N. marina* L. var. *brevifolia* Rendle ex Ascherson & Graebner, Syn. I : 369 (1897); Rendle, Trans. Linn. Soc., Ser. 2, Bot. 5 (12) : 396 (1899); Rendle in Engler, Pflanzenr. H.7 : 8 (1901). — *N. marina* L. var. *marina* f. *brevifolia* (Rendle ex Ascherson & Graebner) Soó, Magyar Fl. 5 : 53 (1973). — TYPE : Federal Republic Germany, «Schlon-See bei Heringsdorf», *Herb. Braun* s.n. (holo- : B †; iso- : JE, *non vidi*).

= *N. marina* L. var. *denticulata* Rendle, Trans. Linn. Soc., Ser. 2, Bot. 5 (13) : 438 (1900); Rendle in Engler, Pflanzenr. H.7 : 7 (1901). — TYPE : U.S.S.R., Semipalatinsk, River Ajaguz, s.d., *Korschinsky* s.n. (holo- : LE).

= *N. major* All. var. *paucidentata* A. Br., Journ. Bot. 2 : 276 (1864). — *N. marina* L. var. *paucidentata* (A. Br.) K. Schum in Mart. Fl. Bras. 3, 3 : 725 (1894). — TYPE : France, SE France, *Duvernoy* s.n. (holo- : *non vidi*; iso- : MEL).

- = *N. fucoides* Griffith, Notul. Pl. Asiat. 3 : 182, t. 251, f. 1 (1851). — TYPE : Pakistan, «Gurmab, Porta Bolan», s.d., *Griffith* 5609 (holo- : K ; iso- : BM).
- *N. marina* L., Fl. suec. ed. 2 : 345 (1735) nom. illeg., non L. (1753) ; Ascherson & Graebner, Syn. I : 368-369 (1897) p.p. ; Rendle, Trans. Linn. Soc., ser. 2, Bot. 5 (12) : 389 (1899) p.p. quoad syn. *N. fucoides* ; Yuzepczuk in Komarov, Fl. U.S.S.R. 1 : 270-273 (1934) p.p. ; Parsa, Fl. Iran 5 : 37 (1951), p.p. ; Dandy in Rechinger, Fl. Iranica 86 : 1-2 (1971) p.p. quoad *Bobrov & Tzvelev* 363, *Brown* 3477, *Sintenis* 1231 et *Griffith* 5609 ; Dandy in Tutin et al., Fl. Eur. 5 : 13-14 (1980) p.p. ; Uotila in Davis, Fl. Turkey 8 : 16 (1984) p.p. ; Dandy in Townsend & Guest, Fl. Iraq 8 : 32-33 (1985) p.p. quoad *Hasan Rawi* 32137.
- *N. monosperma* auct. non Willd. : Willd., Sp. pl. 4 : 331 (1805) p.p. quoad «Sueciae, Germaniae, Helvetiae».
- *N. major* auct. non All. : Boissier, Fl. Or. 5 : 27 (1882) p.p. quoad *Borzczow* ; Hooker J. D., Fl. Brit. India 6 : 569 (1894) ; Haines, H. H., Bot. Bihar & Orissa 5 : 850 (1924).
- *N. marina* auct. non L. subsp. *marina* : Viinikka, Ann. Bot. Fenn. 13 : 128-129 (1976) ; Tzvelev, Nov. Syst. Vysh. Rast. 13 : 16-17 (1976) ; Tzvelev in Fedorov, Fl. Eur. tsasti S.S.S.R. 4 : 200 (1979).
- *N. major* All. var. *angustifolia* auct. non A. Br. : A. Br., Journ. Bot. 2 : 275 (1864) p.p. quoad «similar forms also found on the coast of Germany».
- *N. marina* L. var. *angustifolia* auct. non (A. Br.) K. Schum. : K. Schum. in Mart. Fl. Bras. 3, 3 : 725 (1894) pro majore parte ; Rendle ex Ascherson & Graebner, Syn. I : 368-369 (1897) ; Rendle, Trans. Linn. Soc., ser. 2, Bot. 5 (12) : 395 (1899) pro majore parte ; Rendle, l.c. (13) : 439 (1900) p.p. quoad «Caspian Sea» ; Rendle in Engler, Pflanzenz. H.7 : 8 (1901) pro majore parte ; Ţopa in Săvulescu, Fl. Rep. Soc. Rom., 11 : 92 (1966).
- *N. marina* L. var. γ auct. non Rendle : Rendle, Trans. Linn. Soc., ser. 2, Bot. 5 (13) : 438 (1900) p.p. quoad «North Asia» (Altai, *Politow* s.n.).
- *N. marina* L. var. *marina* f. *marina* subf. *angustifolia* auct. non (A. Br.) Soó : Soó, Magyar Fl. 5 : 53 (1973), p.p.
- *N. marina* L. var. *subacantha* Borb., Balaton Tud. Tanulm. Eredm. II : 327 (1900). — *N. marina* L. var. *marina* f. *subacantha* (Borb.) Soó, Magyar Fl. 5 : 53 (1973), *nomen nudum*.
- *N. marina* L. var. *anacantha* Borb., Balaton Tud. Tanulm. Eredm. II : 327 (1900).
- *N. marina* L. var. *marina* f. *anacantha* (Borb.) Soó, Magyar Fl. 5 : 53 (1973), *nomen nudum*.
- *N. maritima* Pallas, Reise I : 369, 375 (1791), probably *lapsus calami* for *Najas marina* L.
- *N. spinosa*, Buch. — Ham. ex Wallich list No. 5182 (1828-1849) *nomen nudum* ; in sched. *Hamilton* 1994 (E) ; *Wallich* in Herb. *Richard* 5782 (P).

Stems not very spiny, about (0-)2-10(-15) spines in 2 cm. *Leaves* (4-)8-20(-50) mm long and 1.1-3.3(-4) mm broad (incl. teeth on both sides) and 0.4-1.5(-2) mm broad (excl. teeth); margins each with (2-)4-8(-12) teeth. *Seeds* (2.8-)3-4(-5.1) mm long and (0.9-)1.2-2.0(-2.8) mm broad, ratio: (1.4-)2-2.6(-3.1).

NOTES: 1. Subsp. *intermedia* morphologically is the most polymorphic among the *N. marina* subspecies. However polymorphism was found within a single population (checked on many old and recent collections from same growing places, e.g. collections of the Gnadensee, Sempacher see, Baltic area etc.).

2. The delimitation of subsp. *intermedia* can be difficult with:

- (a) subsp. *marina* from the Alp region (e.g. Zürichsee), because of the smaller leaves in subsp. *marina*, when growing deep;
- (b) subsp. *armata* in Turkey, because the number of spines on stem solely is not always of a clearly diagnostic value (especially in young plants) and leaf and seed sizes are broadly overlapping;
- (c) subsp. *brachycarpa* in central Asia, when no seeds are available to distinguish both taxa.

3. Seed sizes may vary among large population groups namely:

- (a) Baltic area: $3-4 \times (1-)1.2-1.8(-2)$ mm
- (b) Central Europe: $3-3.2 \times 1.1-1.5$ mm
- (c) Gnadensee + Sempachersee: $2.8-5.1 \times 0.9-2.7$ mm;
Europe (a + b + c): $(2.8-)3-4(-5.1) \times (0.9-)1.2-2(-2.7)$ mm
- (d) Turkey, Iraq, Caucasus, C. Asia: $3-3.5 \times 1.5-2.0$ mm
- (e) Altai: $(3.5-)4-4.5 \times 1.5-1.6$ mm
- (f) Balkhash: $3.5(-4) \times 1.8-2.5(-2.8)$ mm;
Asia (d + e + f): $3-3.5(-4.5) \times 1.5-2.0(-2.8)$ mm
- (g) N. + C. America: $2.2-4.5 \times 1.2-2.2$ mm (after HAYNES, 1979);
C. + S. America: average 3.0 mm long (after LOWDEN, 1986).

4. *N. marina* plants from Hawaii Islands are very close to subsp. *intermedia* but deviate in the smaller and narrower seeds ($2.3-3 \times 1-1.2$ mm).

5. ♂: VII-VIII(-IX); ♀: (VII-)VIII-IX; fr.: (VIII-)IX-X.

GEOGRAPHICAL DISTRIBUTION: Cold to temperate warm areas from Europe to C. Asia, extended towards few subtropical parts in Asia (Fig. 9).

SELECTED SPECIMENS:

Great Britain: England, Norfolk E., Michlin Broad, VII.1885, *Nevill* s.n. (H); Upton Broad, 11.IX.1983, *Chater* s.n. (BM).

The Netherlands: Zuid-Holland: Nieuwekoopse plassen, in channels, 12.VIII.1972, *Øllgaard & Lojtrant* s.n. (AAU); *ibid.*, Slikkendam, 1975, *Viinikka* 14 (TUR); *ibid.*, 9.IX.1982, *Triest* 71 (BRVU); *ibid.*, 12.IX.1983, *Triest* 162 (BRVU); *ibid.*, 10.IX.1984, *Triest* 256 (BRVU); Utrecht, Loosdrecht, Loenerveense plas, 28.IX.1979, *Botshol* s.n. (L).

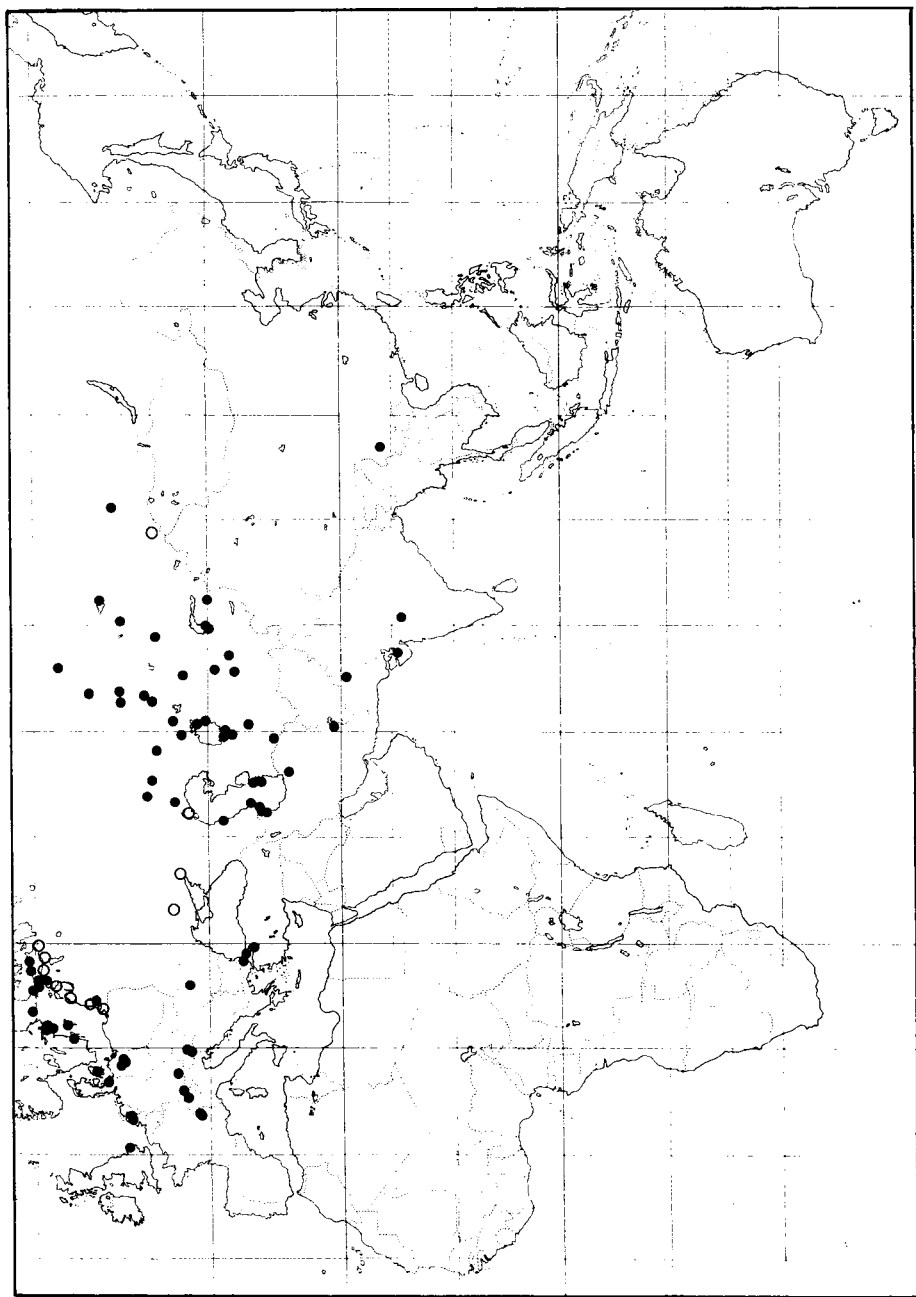


Fig. 9. — Distribution of *N. marina* subsp. *intermedia* (solid circles ; uncertain localities as open circles).

Denmark : Sjælland : Gaunø, 7.VIII.1868, *Nielsen* s.n. (TUR) ; Næstved, 2.VIII.1892, *Baagø* s.n. (LY-Gand).

German Democratic Republic : Templin, Kleiner Krienersee, 22.IX.1983, *Arendt* s.n. in Herb. *Triest* 229 (BRVU).

Federal Republic Germany : Schleswig-Holstein : Gelting, 10.VII.1874, *Hinrichsen* s.n. (L, LY-Rouy, LY-Gand.) ; Kappeln, VIII.1878, *Weideman* (LY-Gand.) ; Lübeck, Niendorf, 26.VII.1901, *Hegi* s.n. (Z) ; ibid., 13.VII.1903, *Hirth* s.n. (G). Oberbayern : «Pilsensee», Seefeld, 22.IX.1918, *Obermeyer* s.n. (L, Z). Baden-Württemberg : Gnadensee (part of Lake Konstanz), Markelfingen, 2.X.1875, *Jack* s.n. (G) ; ibid., «Markelfinger Hafen», 14.IX.1982, *Triest* 112b (BRVU) ; ibid., 21.IX.1983, *Triest* 215 (BRVU) ; ibid., «Markelfinger Winkel», 15.IX.1982, *Triest* 117 (BRVU) ; ibid., Reichenau, 21.IX.1983, *Triest* 220 (BRVU) ; ibid., Radolfzell, 31.VIII.1892, *Jack* s.n. (G) ; Hegne, 1907, *Baumann* s.n. (ZT) ; ibid., 1909, *Baumann* s.n. (H, ZT), 31.VIII.1965, Markgraf s.n. (Z) ; Zellersee (part of Lake Konstanz), Moos, 5.IX.1907, *Baumann* s.n. (H).

France : Haute-Savoie : «Lac d'Annecy», 20.IX.1922, *Romieux* s.n. (G, H) ; ibid., 22.IX.1921, *Beauverd* s.n. (G) ; «Lac du Bourget», 21.IX.1906, *Chabert* s.n. (FI, MPU) ; ibid., 16.X.1872, *Songeon* s.n. (G) ; ibid., 10.IX.1890, *Cave* s.n. (G). Corsica : Ajaccio, 16.VIII.1962, *van Steenis* 20336 (L).

Switzerland : Zürich : Robenhäusen, (Aa, Pfäffikersee canal), 24.VIII.1871, *Jäggi* s.n. (G, LY-Rouy) ; ibid., «Lac de Pfäffikon», VIII.1873, Herb. *Bernet* s.n. (G) ; ibid., «Canal de l'Aa», s.d., Herb. *Bernet* s.n. (G) ; ibid., 10.VIII.1878, *Käser* s.n. (G) ; ibid., 3.IX.1883, *Käser* in Herb. *Schulz* 1670 (G, LY-Rouy, MPU) ; ibid., 19.VIII.1889, *Wilczek* s.n. (H, LY-Gand, MPU-Coste). Luzern : Sempachersee, 1943, *Koch* s.n. (ZT) ; ibid., Norwil, 18.X.1985, *Triest* 484 (BRVU).

Austria : Kärnten : St. Georgen, Längsee, 21.VIII.1899, *Degen* 3894 (G, H, L, LE, MPU, MPU-Simon, Z, ZT) ; ibid., s.d., *Wilczek* s.n. (H) ; Feldkirchen, 21.IX.1926, *Drobný* s.n. (Z).

Romania : Transsilvania, Gherla, «Lacu Sic prope pag. Sacalata», 1.VIII.1947, *Topa & Codoreanu* (FI, Rom. exc. 2991) (G, H, K, LE, NSW, Z).

Sweden : Upland : Lidिंगö, VIII.1889, *Peyron* s.n. (G, TUR) ; Taggrod, 6.VIII.1950, *Koch* 50/614 (ZT) ; Söderålje, VIII.1895, *Hagström* (G) ; ibid., 28.VII.1926, *Asplund* s.n. (G) ; Stockholm, s.d., *Nyman* s.n. (G) ; ibid., 20.IX.1869, *Nordstedt* s.n. (G). Kalmar : Gamleby, 14.IX.1888, *Pettersson* s.n. (TUR). Gotland : Visby, 18.VII.1868, *Roos* s.n. (TUR) ; «Holmiae, in sinu maris», s.d., *Nyman* s.n. (G).

Finland : Åland : «1156.1 marina 1 Åland» (LINN) ; «1156.2 (Sm) fructus unilocularis monospermus» (LINN) ; 1156.3 (LINN) ; s.l., VII-VIII.1878, *Kihlmann* s.n. (LY-Gand.) ; Mariehamn, Espohlm, SE shore bay, 2.IX.1985, *Triest* 407 (BRVU) ; Jomala, Möckelo, Torpfjärden, 3.IX.1985, *Triest* 416 (BRVU) ; Finström, Bjärström, Lake Bjärströmsträsk, 3.IX.1985, *Triest* 420 (BRVU). Varsinais-Suomi : Rymättylä, E part of Lake Nuikonperä, 10.X.1971, *Viinikka* s.n. (TUR) ; ibid.

Leiklahdenjärvi, 4.IX.1985, *Triest* 425 (BRVU); Turku, Hirvensalo, Mustalahti, 4.IX.1985, *Triest* 429 (BRVU); Uusikaupunki, 16.VIII.1964, *Laine & Vistanen* s.n. (G); Kustavi, 5.IX.1965, *Laine* s.n. (G). Uudenmaa (Uusimaa): Tvärminne, Namnsholmssundet in Tvärminne Byviken, 5.IX.1985, *Triest* 447 (BRVU); Danskog Island, Björkviksfladan, 5.IX.1985, *Triest* 452 (BRVU). Helsinki, VIII.1898, *Schochin* s.n. (G); Borgå (Porvoo) 17.VIII.1938, *Magnusson* s.n. (G), s.l., 15.VIII.1880, *Öhrnberg* s.n. (LY-Gand.); s.l., 30.VII.1932, *Färdig* s.n. (ZT).

U.S.S.R. (Baltic Republ.): Estonian S.S.R.: «Svig-See», 27.VIII.1909, *Mühlen* s.n. (H). Litonian S.S.R.: Vilnjoes, 1831, *Besser* s.n. (G, H).

Turkey: Turkey-in-Europe: Kirklareli, Kasatura, 11.VIII.1967, *A. & T. Baytop* ISTE 11876 (E, ISTE); Istanbul, Cilingor, 16.VIII.1967, *A. & T. Baytop* ISTE 11946 (E). Anatolia: Bursa, Iznik, Iznik Gölü, 20.VII.1981, *Uotila* 20309 (H); *ibid.*, 21.VII.1981, *Uotila* 20313 (H); *ibid.*, XI.1985, *A. Baytop* s.n. (BRVU, H).

Iran: Semnân, Sâ idâbâd (= Sirjan), 18.XI.1960, *Brown* 3477 (K); Sistan, Lake Hamûn, 21.V.-3.VI.1896, *Korowiakow* s.n. (LE).

U.S.S.R. (Asia): Dagestan S.S.R., Makhachkala, Sulak, 6.VII.1958, *Prochanov* 170 (LE). Azerbaydzhan S.S.R.: Baku, Apscheron, 1863, *Goebel* s.n. (LE); Ali-Bayramly, Lake Adzhikabul, 10.VIII.1963, *Bobrov & Tzvelev* 1250 (LE); Sal'yany, «Novo-Waziljevka», 15.VII.1930, *Karjagin* s.n. (LE); Lenkoran, 14.VII.1946, *Bogdanov* s.n. (LE); *ibid.*, 15.VII.1963, *Bobrov & Tzvelev* 363 (LE); «Iter Kubanicum», 26.VIII.1926, *Shiffers* 1496 (LE); «In litt. mar. Casp.», 1836, *Sublozky* s.n. (BM). Siberia: Omsk region: Tobol'sk 13.VII.1913, *Varentsov* s.n. (LE); Kurgan, Yurgamysh, 18, 20, 21.VII.1959, *Katanskaja* s.n. (LE). Novosibirsk region: Novosibirsk, Lake Sartlan, 9.VIII.1946, *N. Jakubova* s.n. (LE); *ibid.*, Lake Inder, 5.VIII.1945, *N. & G. Jakubov* s.n. (LE). Altai region: Krasnoyarsk, Minusinsk, 13.VII.1892, *Krylov* 739 (LE); *ibid.*, VIII.1892, *Martynov* 1110 (LE); «Altai», s.l. s.d., *Politow* s.n. (BM, E, LE). Kazakhstan S.S.R.: Kamysh-Somarsky lake, 19-20.VII.1958, *Katanskaja* s.n. (LE); Uralsk, 28.VII.1928, *Nikitin* 652 & 653 (LE); *ibid.*, Ilinskoye, 27.VII.1927, *Rozhevy & Zhezhel* 704 (LE); *ibid.*, Dzambeyty, 11.VII.1927, *Rozhevy & Zhezhel* 584 (LE); Atktyubinsk, 23.VIII.1937, *Levitsky* s.n. (LE); Turgay, Kustanay, 25.VIII.1911, *Borodin* s.n. (LE); *ibid.*, river Ubagan, 2.IX.1921, *Pavlov* 29 (LE); *ibid.*, Ak-Suat, 12.VIII.1908, *Kraschenninnikow* 1038 (LE); *ibid.*, 6.VII.1909, *Sjelinsky* 138 (LE); Irgiz, near Chelkar, 3.VII.1910 *Androsov* 54 (LE); *ibid.* Sankel, 1931, *Gorschkowa & Tschernow* 6 (LE); Lake Kokaral, 7.VII.1921, *Raikova* 1219, 1220 (LE); Pavlodar, Irtyshskoye, 22.VII.1906, *Tzvelev* 1206 (LE); Karaganda, Dzhana-Arka, river Sarysu, 22.VII.1936, *Melvil* s.n. (LE); Perovsk, 31.VIII.1931, *Nikolsky* s.n. (LE); Delta Syr-Darja, 11.VII.1926, *Raikova* 1426 (LE); Dzhezkazgan, Lake «Tsubar-Teniz», 18.VIII.1929, *Pavlov* 767 (LE); Suzak, Lake Kara-Kol, 30.VI.1930, *Zapragae* 320 (LE); 80 km from station Arys', river Bugun, 21.VIII.1955, *Soskov* s.n. (LE); Taldy-Kurgan, river Karatal, 21.IX.1968, *Pavlov* 1268 (LE); Alma-Ata Prov., Balkhash, Delta river Ili, 18.IX.1955, *Katanskaja* s.n. (LE); *ibid.*, 18.VIII.1957,

Katanskaja s.n. (LE) ; Lake Balkhash, 14.VII.1909, *Ptaschicki* 216 (LE) ; Aunzat, Lake Biylikol, 5.VII.1917, *Raikova* 54 (LE). Uzbekistan S.S.R. (Kizil-Kum) ; «Ad littora lacus Aral», 28.VII.1900/1902 ?, *Berg* s.n. (BM, LE) ; Amu-Dar'ya Delta, 18.IX.1925, *Knorring* 63 (LE) ; *ibid.*, 18.VII.1928, *Rusanov* 380 (LE) ; *ibid.*, Nukus, 7.IX.1928, *Rusanov* 541 (LE), *ibid.*, Lake «Bizenkol», 29.VII.1953, *Katanskaja* s.n. (LE) ; *ibid.*, Lake «Duzmachan», 11.IX.1954, *Katanskaja* s.n. (LE) ; «Delta», 28.VIII.1915, *Koziyetsov* 785 (LE) ; Syr-Dar'ya Prov., X.1869, *Fedchenko* s.n. (LE) ; *ibid.*, 12.VIII.1912, *Filatov* 345 (LE) ; «Jaxartica in fl. Syr-Darja, prope Verchenevolynskoë in deserta Mirza-Tschul, Golodnaja steppe», 3.VII.1923, *Popov* 414 a (BM, G, K, LE) ; *ibid.*, 8.VII.1923, *Popov* 414 b (E, LE, Z), «Syr-Darya», 17.VIII.1911, *Nikolsky* s.n. (LE). Turkmeniya S.S.R. (Kara-Kum) ; Krasnovodsk, 3.IX.1897, *Fedchenko* s.n. (LE) ; *ibid.*, 23.VI.1912, *Lipsky* 3973 (LE) ; *ibid.* 18.VIII.1912, *Lipsky* 4005 (LE) ; *ibid.*, 3.X.1963, *Zaberzhinskaja* s.n. (LE) ; Ogurchinskiy, 7.X.1963, *Zaberzhinskaja* s.n. (LE) ; Ashkhabad, Batushkina-Tsar, 23.IX.1900, *Sintenis* 1231 (BM, E, LE, K) (Loc ?) Pribalkhash section at LE !, 8.VIII.1857, *Borszczow* 169 (LE) ; 25.VII.1913, *Androsow* s.n. (LE) ; 10.VII.1930, *Cherniakowska* 148 (LE).

Pakistan : Quetta : Bolan Pass, s.d., Herb. *Griffith* 5609 (BM, K).

India : Gujarat State : Jamnagar, 12.X.1949, *Santapan* 1043 (K) ; Madhya Pradesh state ; Khandwa Distr. «Pools in bed of Nerbudda (= Narbada = Narmada) river», 13.I.1889, *Duthie* 8549 (K) ; «Hab in Magadha stagnies», Herb. *F. Hamilton* 1994 (E) ; «Paingti», 15.I.1811, *Wallich* in Herb. *Richard* 5782 (P).

China : Yunnan, Lake Ta-Li, 24.VI.1887, *Delavay* 2804 (P).

Thailand : W. side of island «Koz Nau du Talesap», s.d., *Vaughan* 300 (K).

j. *Najas marina* L. subsp. *armata* (Lindb. f.) Horn af Rantz., Kew Bull. 7, 1 : 29-30 (1952) ; Triest, Mém. Acad. r. Sci. Outre-Mer, Cl. Sci. nat. méd., nouv. sér. in-8°, 21 (4) [et Et. Cont. afr., 6] : 28, pl. 1 A-C, F-I, pl. 2 A-C, fig. 2 (1987). — ≡ *N. delilei* Rouy, Fl. France 13 : 294 (1912) ; Mouterde, Nouv. Fl. Liban et Syrie 1 : 24 (1966) ; Feinbrun-Dothan, Fl. Palaest. 4 : 18, fig. 25 (1986). — ≡ *N. marina* L. var. *delilei* (Rouy) Maire, Fl. Afr. Nord 1 : 205-206 (1952) ; Cirujano & Lopez Alberca, Anal. Jard. Bot. Madrid, 40 (2) : 415-419 (1984). — Pl. VI, A-J.

— *N. marina* auct. non L. : Aston, Aquatic Pl. Austr. : 260-261 (1973) p.p. ; Aston, Vict. Nat. 96 : 67 (1979) p.p. ; Dandy in Tutin et al., Fl. Eur. 5 : 13-14 (1980) p.p. ; Uotila in Davis, Fl. Turkey 8 : 16 (1984) p.p.

Stems very spiny, about (10-)15-25 spines in 2 cm. *Leaves* 6-20(-24) mm long and (1.1-)1.5-5.3 mm broad (incl. teeth on both sides) and 0.5-2.3 mm broad (excl. teeth) ; margins each with 4-10 teeth. *Seeds* 2.5-3.5 mm long and 0.8-2.1 mm broad, ratio : 1.3-2.3(-3.2).

GEOGRAPHICAL DISTRIBUTION : Africa (mainly coastal areas and rift lakes), C. Spain, Crete, Asia Minor (Turkey, Syria, Israel, Iraq), Sri Lanka and Australia (Fig. 35).

SELECTED SPECIMENS (for Africa, see TRIEST, 1987) :

Spain : Toledo : Quero, Laguna Chica del Taray, 4.IX.1980, *Cirujano* s.n. (Z).

Greece : Crete, Lake Kournas, 9.VIII.1974, *Mallot* 16065 (BM).

Turkey : Eskişehir, Çifteler, Sakaryabaşı, 18.VI.1980, *Leblebici, Seçmen & Behat* 3409 (H) ; Afyon, Bolvadin, N of Eber Gölü, 27.VII.1979, *Leblebici & Behat* 3162 (H) ; Konya, E of Beyşehir, 12 km from Beyşehir to Şarkikaraağaç, 25.VII.1979, *Seçmen & Leblebici* 3004 (H) ; *ibid.*, 3.VIII.1981, *Baytop, Tuzlaci & Meriçli* ISTE 41431 (ISTE).

Syria : Lake Khatuniya, 14.V.1955, *Pabot* s.n. (G) ; E of Latakia, valley of Nahr el Kébir, 26.VII.1955, *Pabot* s.n. (G).

Iraq : Hawr al Habbāniyah, 14.VII.1962, *Hassan* 32.137 (K).

Israel : Lake Hula, 18.IX.1935, *Jones* 145 (BM) ; Rift valley, Merkaz Sappir, 29.IX.1985, *Agami* s.n. (BRVU).

Sri Lanka : E. Prov., Kalmunai, V.1885, *Nevill* s.n. (BM, K).

Australia : West-Australia : Nickol-Bay, 1883, *Palak* MEL 108950 (MEL). Northern Territory : Finke river, 1885, *Kempe* in *Herb. Mueller* s.n. (MEL). New South Wales : Myall Lakes, 12.I.1964, *Earp* 6451 (NSW) ; Marimley Lake, Oxley Rd., 12.II.1981, *Jones* NSW 180801 (NSW). Victoria : East Gippsland, 7.XII.1978, *Corrick* MEL 541709 (MEL). Uncertain localities : «Tweed river», 1886, *Grime* MEL 108957 (MEL) ; «Lake Bootharaba», 18.VII.1910, *Keys* 296 (K) ; «Horn Exped.», Palm Creek, NSW 2553 (NSW).

k. *Najas marina* L. subsp. *susiana* Triest subsp. nov. — *Herba* submersa dioica, internodiis dense spinulosis (spinulosis 10-30(-35) in 2 cm). *Folia* 16-22 mm longa ; lamina 4 mm lata (inclusis spinulis) et 1.2-1.3 mm lata (exclusis spinulis), marginibus utrinque dentibus 6-8 patentibus munitis. *Flores masculini et feminei* non vidi. *Semina* c. 5 × 2.2 mm. — TYPE : Iraq, LSM District, Hawr-al-Hawizah, 18 km E of Qal'at Sālih, 17.V.1977, *Thamer, Wedad & Hana* in *Nat. Herb. Iraq* 46794 (holo- : K) ; *ibid.*, 5.IV.1977, *Thamer* in *Nat. Herb. Iraq* 46705 (topo- : K). — **Pl. VII, A-C.**

— *N. marina* auct. non L. ; Dandy in Townsend & Guest, *Fl. Iraq* 8 : 32-33 (1985) p.p. quoad *Thesiger*.

Stems very spiny, about 10-30(-35) spines in 2 cm. *Leaves* 16-22 mm long and 4-6 mm broad (incl. teeth on both sides) and 1.2-2.6 mm broad (excl. teeth) ; margins each with 5-8 teeth. *Seeds* c. 5 cm long and 2.2 mm broad (ratio : 2.3).

NOTES : 1. The specimens cited hereunder are robust in all characters. They apparently are close to subsp. *armata*, but deviate in the much larger seeds. Perhaps a polyploid form ? DANDY (1985) also noted the more robust plant collected by *Thesiger*.

2. Sterile : III, IV, V ; fr. : V.

GEOGRAPHICAL DISTRIBUTION : S.E. Iraq and S.W. Iran (Fig. 10).

SELECTED SPECIMENS :

Iraq : Hawr al Suwaygiyah, 14.V.1952, *Thesiger* s.n. (BM) ; Hawr-al-Hawizah, 18 km E of Qal'at Sàlih, 5.IV.1977, *Thamer* in Nat. Herb. Iraq 46705 (K) ; *ibid.*, 17.V.1977, *Thamer, Wedad & Hana* in Nat. Herb. Iraq 46794 (K) ; Sahain loc., Amara, 7.VIII.1973, *Hilli* s.n. (CAI).

Iran : Khuzestan, «Arabestan, Schalalka», 4.III.1904, *Gadd* 507 (LE).

1. ***Najas marina*** L. subsp. ***sumatrana*** (de Wilde) Triest stat. nov. — ≡ *N. marina* L. var. *sumatrana* de Wilde, Acta Bot. Neerl. 10 : 169 (1961) ; de Wilde in van Steenis, Fl. Males. 1 (6) : 163 (1962). TYPE : Sumatra, Lake Manindjau, X.1917, *Jacobson* s.n. Hort. Bog. 149 (holo- : L ; iso- : BO, *non vidi*). — **Pl. VII, D-F.**

Stems very spiny, about 30-50 spines in 2 cm. *Leaves* 35-45 mm long and 2-2.5 mm broad (incl. teeth on both sides) and 1.-1.5 mm broad (excl. teeth) ; margins each with 30-40 teeth. *Seeds* (3.8-)4-4.4 mm long and (1.7-)2.1-2.5 mm broad, ratio : 1.7-2.2.

NOTES : 1. Only known from the type locality.

2. The only subsp. which is so robust and provided with so many spines on stems and leaves. Should be checked for polyploidy.

3. Male flowers unknown.

4. ♀ : X ; fr. : X.

GEOGRAPHICAL DISTRIBUTION : Sumatra (Fig. 10).

SELECTED SPECIMENS :

Sumatra : Lake Manindjau, X.1917, *Jacobson*, Hort. Bog. 149 (L) ; *ibid.*, 20.II.1954, *Alston* 13743 (BM).

II. SUBGENUS ***Caulinia*** (Willd.) A. Br. ex Rendle
Trans. Linn. Soc., ser. 2, Bot. 5 (12) : 398 (1899)

≡ Genus *Caulinia* Willd., Mém. Acad. Roy. Sci. Hist. Berl. : 87 (1798). —
≡ «Group» *Caulinia* (Willd.) Ascherson, Fl. Prov. Brandenb. 1 : 670 (1864), stat. non ind. — ≡ Section *Caulinia* (Willd.) A. Braun, Journ. Bot. 2 : 276 (1864). —
≡ Genus *Hyas* Dumort., Anal. Fam. Pl. 61 (1829).

DIAGNOSTIC FEATURES : *Plants* monoecious (more rarely dioecious ?), mostly slender. *Stems* unarmed ; epidermis not distinctly differentiated from the underlying cortex. *Leaves* with blade minutely to coarsely serrate, (2-)5-60(-185) spiny teeth on each margin ; midrib glabrous ; sheaths rounded, truncate or auriculate ; intravaginal scales lanceolate to filiform. *Male flower* naked or enclosed in spathe ; anther uni- or tetrasporangiate. *Female flower* naked or enclosed in spathe. *Seed* elliptical oblong ; testa 3 cell-layers thick ; areoles all about of same shape and size (except near raphe), mostly regularly arranged.

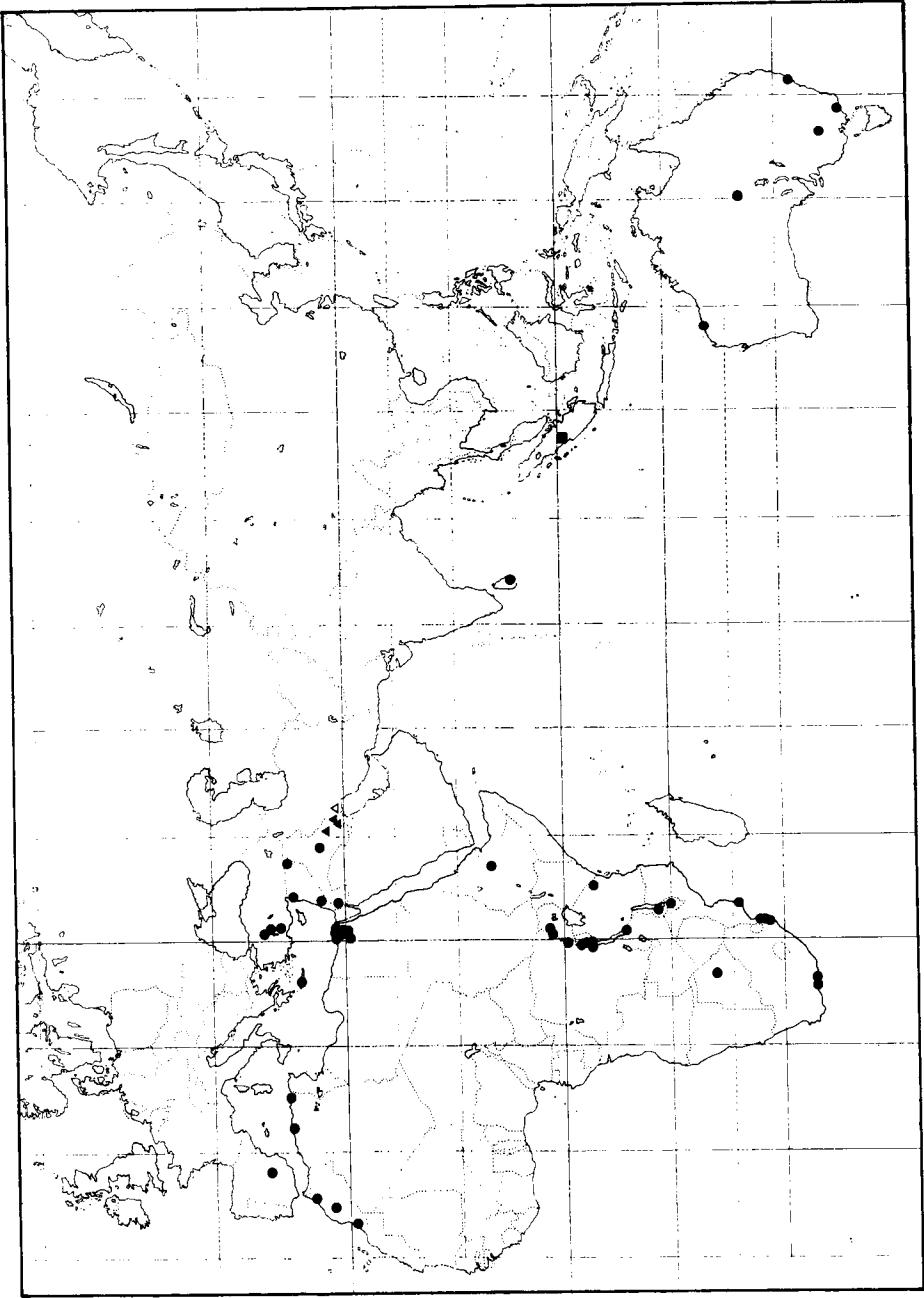


FIG. 10. — Distribution of *N. marina* subsp. *armata* (circles) ; subsp. *susizana* (solid triangles) ; uncertain locality as open triangle) and subsp. *sumatrana* (square).

LECTOTYPE SPECIES : *Caulinia flexilis* Willd. — *Najas flexilis* (Willd.) Rostk. & Schmidt (Lectotype designated by HAYNES, 1979).

SPECIES NUMBERED

1. *N. ancistrocarpa* Magn.
2. *N. flexilis* (Willd.) Rostk. & Schmidt
3. *N. australis* Rendle
4. *N. madagascariensis* Rendle
5. *N. welwitschii* Rendle
6. *N. pectinata* (Parl.) Magn.
7. *N. orientalis* Triest & Uotila
8. *N. kingii* Rendle
9. *N. tenuis* Magn.
10. *N. horrida* Magn.
11. *N. tenuissima* (A. Br.) Magn.
12. *N. gracillima* (Engelm.) Magn.
13. *N. pseudogracillima* Triest
14. *N. testui* Rendle
15. *N. schweinfurthii* Magn.
16. *N. foveolata* Magn.
17. *N. grossareolata* Triest
18. *N. minor* All.
19. *N. oguraensis* Miki
20. *N. hagerupii* Horn af Rantz.
21. *N. setacea* (A. Br.) Rendle
22. *N. halophila* Triest
23. *N. browniana* Rendle
24. *N. kurziana* Rendle
25. *N. celebica* Koorders
26. *N. pseudograminea* Koch
27. *N. tenuifolia* R. Br.
28. *N. indica* (Willd.) Cham.
29. *N. baldwinii* Horn af Rantz.
30. *N. malesiana* de Wilde
31. *N. graminea* Del.
 - a. var. *graminea*
 - b. var. *longidentata* Triest
 - c. var. *robusta* de Wilde

DIAGNOSTIC FEATURES OF SPECIES

Plants monoecious : all spp. from 1 to 31.

Plants dioecious ? : 9, 10, 27, 28.

Plants with male and female flowers generally on different branches : 3, 5, 9, 10, 14, 15, 16, 18, 20, 21, 25, 26, 27, 28.

Ditto on same branch : 1, 2, 4, 5, 6, 7, 8, 11, 12, 13, 16, 17, 18, 19, 22, 23, 24, 26, 29, 30, 31.

If male and female flowers on same branch, then plants with male and female flowers at separate nodes (δ on top) : 1, 2, 4, 5, 6, 8, 11, 13, 16, 17, 18, 19, 22, 23, 24, 26, 29, 30, 31.

Ditto, with male and female flowers at same node (δ and ♀ on top) : 1, 2, 6, 7, 8, 11, 12, 13, 17, 18, 22, 23, 24, 29, 30.

Leaf 0.2-0.6 mm wide (incl. teeth on both sides) : 1, (2), (3), (4), (5), (7), (8), (9), (10), 11, 12, 13, 14, 15, (16), (17), (18), 20, 21, 22, 23, 24, (26), 27, (28), 29, 30, 31.

Leaf 0.6-1.0 mm wide : 2, 3, 4, 5, 7, 8, 9, 10, 12, 14, 15, 16, 17, 18, 19, 20, 22, 25, 26, 27, 28, 29, 30, 31.

Leaf 1.0-4.0 mm wide : 5, 6, 8, (9), 10, (14), 18, (28), (31).

Less than 20 leaf teeth on each margin : 1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, (21), 22, 23, 28, 29, 30, (31).

More than 20 leaf teeth on each margin : 2, 3, (9), 14, 20, 21, (22), 23, 24, 25, 26, 27, 29, 30, 31.

Leaf teeth as single unicellular outgrowths : 2, 3, 14, 15, 20, 21, 24, 25, 26, 30, 31.

Leaf teeth on small excrescences (3-10 cells) : 1, 4, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, (26), 27, 29.

Leaf teeth on broad to very broad excrescences : 5, 6, 7, 8, 9, 10, 16, 18, 19, 28.

Leaf teeth up to 0.1 mm long : 1, 2, 3, 4, (8), 11, 12, 13, 14, 15, 16, 17, (18), 20, 21, 22, 23, 24, 25, 26, 27, (28), 29, 30, 31.

Leaf teeth 0.1-0.25 mm long : 3, 4, 5, (6), 7, 8, 9, 10, (11), (12), 14, 15, 16, 18, 19, (21), 22, 23, (26), (27), 28, 29, (31).

Leaf teeth 0.25-0.5 mm long : 5, 6, 8, 9, 10, 15, 18, 28.

Leaf teeth 0.5-1.4 mm long : (5), (6), 10.

Leaves with septa up to the margins : 4, 5, 6, 7, 8, 9, 10, 14, 15, 16, 17, 18, 19, 23, 28, 29.

Leaves with septa up to halfway the margins : 26, 30.

Leaves without septa : 1, 2, 3, 11, 12, 13, 14, 15, 20, 21, 22, 24, 25, 27, 29, 30, 31.

Septa constricting the margin : 4, (5), (16), (17).

Septa not constricting the margin : other species.

Leaves with fibres only near margin : 2, 25, 26, 30.

Leaves with fibres only on or near midrib : 30.

Leaves with fibres only near each margin and on midrib : 14, 15, 23, 24, 25, 29.

Leaves with fibres only near each margin, on and near midrib : 14, 15, 20, 23, 24, 27, 29, 31.

Leaves without fibres : 1, 3 → 19, 21, 22, 23, 28, 29, 30, (31).

Leaf sheath sloping : 1, 2, 4, 5, 6, 7, 8, 9, 10.

Leaf sheath rounded : 1, 3, 4, 5, 8, 9, 10.

Leaf sheath slightly auricled : (8).

Leaf sheath truncate to lacerate : 11, 12, 13, 14, 15, 16, 17, 18, 19, 21, 22, 23, 28, 29.

Leaf sheath shortly auricled : 11, 12, 14, 15, 16, (17), 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, (31).

Leaf sheath longly auricled : 20, 24, 25, 26, 27, 29, 30, 31.

Auricle absent : 1, 2, 3, 4, 5, 6, 7, 8, 9, 10.

Auricle up to 0.2 mm long : (8), 11, 12, 13, 15, (22), 23, 29.

Auricle 0.2-0.5 mm long : (11), 12, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, (26), (27), 28, 29, 30, (31).

Auricle 0.5-1.0 mm long : 12, (20), (21), 25, 26, 27, 28, (29), 30, (31).

Auricle 1.0-2.6 mm long : 25, (26), 27, (30), 31.

Auricles without teeth on inner edge : 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, (26), 28, 29, (30).

Auricles with teeth on inner edge : 23, 25, 26, 27, 30, 31.

Male flower in spathe : 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28.

Male flower naked : 13, 17, 29, 30, 31.

Male spathe up to 1.5 mm long : 1, 2, (8), (10), 11, 12, 14, 15, (16), 20, 21, 22, 23, 24, (26), (28).

Male spathe 1.5-2.5 mm long : 3, (4), 5, 6, 7, 8, 10, 14, (15), 16, 18, 19, 23, 25, 26, 27, 28.

Male spathe 2.5-4.0 mm long : 4, 5, 9, 10, (16), 19, (27), 28.

Anther up to 1 mm long : 3, 5, 8, (10), 11, 12, 13, (14), 15, (16), 17, 18, 20, 21, 22, 23, 24, 25, (26), (28), 29, 30, 31.

Anther 1.0-1.5 mm long : 2, 4, 6, (7), 8, 10, 14, 16, 18, 19, 26, 27, 28, 29, (30), 31.

Anther 1.5-2.7 mm long : 7, 9, 10, 14, (16), 19, (28), (31).

Anther unisporangiate : 2, 6, 11, 12, 13, 15, 17, 18, 20, 21, 22, 23, 24, 29, 30.

Anther tetrasporangiate : 1, 3, 4, 5, 7, 8, 9, 10, 14, 16, 19, 25, 26, 27, 28, 31.

Female flower in spathe : 1, 4, 5, 6, (9), 14, 15.

Female flower naked : 2, 3, 7, 8, 9, 10, 11, 12, 13, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31.

Stigma 2-3-lobed : 1, 3 → 31.

Stigma 4-lobed : 1, 2.

Seed curved : 1.

Seed straight : 2 → 31.

Seed length between (0.88-)1-1.5 mm : (9), 15, 17, 20, (21), 23, 24, 26, (28), 29, 30, (31).

Seed length between 1.5-2.0 mm : 3, 5, 8, 9, (10), 12, 13, 14, (15), 16, 20, 21, 22, (23), 25, 27, 28, 29, 31.

Seed length between 2.0-2.5 mm : 2, 4, 5, 6, 7, 9, 10, 11, 12, 14, (16), 18, 25, 27, 28, (29), (31).

Seed length between 2.5-3 mm : 1, 2, 4, (6), 7, (10), 11, (12), 14, 18, 19, (27), (28), 31.

Seed length between 3-4.2 mm : (2), (10), 19.

Seed ratio between 2-3 : (2), 5, 7, 8, 9, (14), 15, 16, 17, (20), (21), 22, 23, 24, (25), 26, 27, (28), (29), 30, 31.

Seed ratio between 3-4 : 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, (15), 16, 18, 20, 21, 22, 23, 25, 26, 27, 28, 29, 30, 31.

Seed ratio between 4-5 : (10), 11, 12, 18, 19, 20, (21), (26), 27, (29), (31).

Seed ratio between 5-6 : 12, (18), (31).

Seed ratio between 6-7 : 1.

Seed areoles regularly arranged in rows : 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 16, 18, 19, 20 → 31.

Seed areoles irregularly arranged in rows : 1, 7, 11, 12, 13, 14, 15, 16, 17.

Areoles per 9-20 in each longitudinal row : (10), 12, 13, 14, 15, 16, 17, (23), 24, (26), (29).

Areoles per 20-30 in each longitudinal row : 1, (4), 5, 6, 7, 8, 9, 10, (14), (16), 20, (21), 23, 26, 28, 29, 30, 31.

Areoles per 30-40 in each longitudinal row : 1, 2, 3, 4, (5), 9, 10, 21, (23), 25, 27, 28, (29), 30, 31.

Areoles per 40-60 in each longitudinal row : (2), 22, 27, (31).

Areoles per 60-100 in each longitudinal row : 18, 19.

Areoles arranged ladder-like : 18, 19.

Areoles not arranged ladder-like : 1 → 17, 20 → 31.

Areoles slightly rectangular : 3, 4, 5, 6, 9, 10, (16), (17), 25, 26, 29, 30.

Areoles squarish : 2, 4, 5, 6, 7, 9, 10, 16, (17), 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30.

Areoles hexagonal : 2, 4, 8, 9, (10), 16, 20, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31.

Areoles longer than broad (rather irregular) : 1, 11, 12, 13.

Areoles broader than long : 18, 19.

Areoles irregular : 14, 15, 16, 17.

Areoles 0.03-0.05 mm long : 18, 19, 20, 21, 22, 23, 25, 26, 27, 30, (31).

Areoles 0.05-0.1 mm long : 1, 3, 4, 5, 6, (7), 8, 9, 10, 11, (12), (16), 20, 21, 24, 25, 26, 27, 28, 29, (30), 31.

Areoles 0.1-0.23 mm long : 7, 11, 12, 13, 14, 15, 16, 17.

Seed surface rough and irregular, clearly pitted (areoles with cell walls raised) : 7, 14, 15, 16, 17.

Seed surface clearly pitted : 3, 4, 5, 6, 8, 9, 10, 18, 19, 20 → 31.

Seed surface not clearly pitted : 1, (11), 12, 13.

Seed surface smooth : 2, 11.

KEY TO SPECIES

1. Leaf sheath sloping, rounded to broadly rounded
 2. Seed curved (horseshoe-like shaped) ; seed surface not clearly pitted ; areoles rather irregularly arranged, longer than broad ; seed 6-6.7 times longer than broad 1. *N. ancistrocarpa*
 2. Seed straight (or only slightly curved at the apex) ; seed surface smooth or clearly pitted, areoles regularly arranged, slightly rectangular, squarish or hexagonal ; seed 2.1-4.2 times longer than broad
 3. Seed surface smooth ; style with 4 stigmatic branches ; leaf with fibres near each margin, but absent on or near the midrib ; leaf teeth not on excrescences ; septa absent . . . 2. *N. flexilis*
 3. Seed surface clearly pitted ; style with 2-3 stigmatic branches ; leaf without fibres ; leaf teeth mostly on broad excrescences ; septa mostly present
 4. Leaf teeth not on excrescences ; septa absent 3. *N. australis*
 4. Leaf teeth on broad to very broad excrescences ; septa clearly visible up to the margins
 5. Male and female flower each in a spathe
 6. Anther tetrasporangiate
 7. Leaf margin constricted, the lower half without teeth . . . 4. *N. madagascariensis*
 7. Leaf margin not constricted, the whole margin provided with teeth
 8. Male and female flowers on the same branches ; male flowers more to the top of the branches and often together with female flowers ; anther 0.9-1.0 × 0.3-0.5 5. *N. welwitschii*
 8. Male and female flowers on different branches (or even plants ?) ; male flowers distributed throughout the branch ; anther 1.8-2.4 × 0.64-1.0 mm 9. *N. tenuis* *
 6. Anther unisporangiate 6. *N. pectinata*
 5. Male flower in a spathe ; female flower naked
 9. Male and female flowers on the same branches ; male flowers more to the top of the branches and often together with female flowers
 10. Seed (2-)2.4-2.8 mm long ; areoles squarish or somewhat irregular, (0.09-)0.11-0.13 mm long ; cell walls raised 7. *N. orientalis*
 10. Seed 1.6-1.85 mm long ; areoles hexagonal and regular, 0.05-0.07(-0.08) mm long ; cell walls not raised 8. *N. kingii*
 9. Male and female flowers on different branches (or even plants ?)
 11. Leaf 0.5-1.1(-1.3) mm broad (incl. teeth on both sides) ; teeth 0.14-0.39 mm long ; seed (1.2-)1.7-2.4 mm long ; seed 2.6-3.5 times longer than broad ; areoles (0.034-)0.05-0.08 mm long 9. *N. tenuis* *
 11. Leaf 0.56-2.4(-3.2) mm broad (incl. teeth on both sides) ; teeth 0.15-1.38 mm long ; seed (1.6-)1.9-2.6(-3.2) mm long ; seed 3.2-4.2 times longer than broad ; areoles 0.05-0.1 mm long 10. *N. horrida*
1. Leaf sheath truncate, lacerate, short-to long-auricled
 12. Seed surface smooth, with areoles longer than broad, somewhat irregularly arranged 11. *N. tenuissima*
 12. Seed surface pitted
 13. Seed areoles rather irregularly arranged ; areoles (0.06-)0.1-0.23 mm long
 14. Seed surface not clearly pitted ; areoles longer than broad ; cell walls not raised ; leaves without septa ; anther unisporangiate
 15. Male flower in spathe 12. *N. gracillima*
 15. Male flower naked 13. *N. pseudogracillima*
 14. Seed surface clearly pitted ; rough and irregular ; areoles irregularly shaped ; cell walls raised ; leaves with septa up to the margins ; anther uni- or tetrasporangiate

* *N. tenuis*, which has female flower either in spathe or naked, is introduced in the key at two places.

16. Male and female flower each in a spathe; leaf margins regularly toothed
17. anther tetrasporangiate; anther 1.0-2.4 mm long; seed (1.85-)2.1-2.3 (-2.6) mm long 14. *N. testui*
17. anther unisporangiate; anther 0.73-0.81 mm long; seed (1.1-)1.3-1.45(-1.6) mm long 15. *N. schweinfurthii*
16. Male flower in spathe or naked; female flower naked; leaf margins often constricted
18. Male flower in spathe; anther tetrasporangiate; seed 1.6-2(-2.4) mm long; areoles per 16-20(-22) in each longitudinal row 16. *N. foveolata*
18. Male flower naked; anther unisporangiate; seed 1.4-1.5 mm long; areoles per c.12 in each longitudinal row 17. *N. grossareolata*
13. Seed areoles regularly arranged; areoles 0.03-0.08(-0.1) mm long
19. Seed areoles per (60-)80-100 in each longitudinal row, arranged ladder-like; areoles broader than long, c.0.03 mm long and 0.1 mm broad
20. Anther unisporangiate; anther 0.56-1.3 mm long; seed 1.74-2.74 mm long ...
18. *N. minor*
20. Anther tetrasporangiate; anther 1.3-1.8 mm long; seed 2.6-3.5 mm long
19. *N. oguraensis*
19. Seed areoles per 16-45(-60) in each longitudinal row, not arranged ladder-like; areoles slightly rectangular, squarish to hexagonal, 0.03-0.8 mm long and about as broad.
21. Male flower in spathe (female naked)
22. Anther unisporangiate; anther 0.5-0.65(-1.0) mm long; spathe 0.7-1.0(-1.8) mm long; leaves mostly without septa
23. Seed 1.3-2.2 mm long; areoles per 21-50 in each longitudinal row;
24. Leaves with (8-)22-30(-36) teeth on each margin; seed 1.3-1.8 mm long; areoles per 21-36 in each longitudinal row; areoles 0.04-0.06 mm long
25. Leaves with fibres near each margin, near and on the midrib; seed areoles per 21-30 in each longitudinal row, leaf sheath 1.3-1.5(-1.8) mm long 20. *N. hagerupii*
25. Leaves without fibres; seed areoles per 28-36 in each longitudinal row; leaf sheath 1.7-2.4 mm long 21. *N. setacea*
24. Leaves with 13-24 teeth on each margin; seed 1.6-2.2 mm long; areoles per 30-50 in each longitudinal row; areoles 0.03-0.04 mm long 22. *N. halophila*
23. Seed (0.7-)0.9-1.3(-1.7) mm long; areoles per 16-25(-35) in each longitudinal row
26. Leaves 0.30-0.40 mm wide (incl. teeth on both sides) and 0.16-0.27 mm wide (excl. teeth on both sides); septa present; fibres absent; seed areoles per 18-25(-35) in each longitudinal row, areoles 0.03-0.05 mm long 23. *N. browniana*
26. Leaves 0.43-0.45 mm wide (incl. teeth on both sides) and 0.34-0.37 mm wide (excl. teeth on both sides); septa absent; fibres present; seed areoles per 16-20 in each longitudinal row; areoles 0.06-0.07 mm long 24. *N. kurziana*
22. Anther tetrasporangiate; anther (0.8-)1-1.6(-2.0) mm long; spathe (1.37-)1.6-2.5(-3.5) mm long; leaves mostly with septa
27. Leaves with (26-)30-50(-70) teeth on each margin; leaf teeth 0.05-0.11(-0.15) mm long; septa absent or present up to halfway the leaf margin, fibres present; sheath auricle with teeth on inner edge
28. Leaves with fibres only near margins
29. Seed 1.89-2.25 × 0.50-0.65 mm; leaf without septa
25. *N. celebica*

29. Seed 1.0-1.3 × 0.24-0.43 mm ; septa present up to halfway the margin 26. *N. pseudograminea*
28. Leaves with fibres near margins, near and on midrib ; seed 1.7-2.6 mm long 27. *N. tenuifolia*
27. Leaves with 8-20 teeth on each margin ; leaf teeth (0.08-)0.2-0.3 mm long ; septa present up to the margins ; fibres absent ; sheath auricle without teeth on inner edge 28. *N. indica*
21. Male flower naked (female flower naked)
30. Anther unisporangiate ; leaf with or without septa ; sheath auricle 0.12-0.65(-1.13) mm long
31. Leaf teeth on small excrescences ; leaf without septa or with septa up to margins ; sheath auricle without teeth on inner edge ; seed 1.21-1.7(-2.1) mm long ; areoles per 18-32 in each longitudinal row ; areoles 0.05-0.08 mm long 29. *N. baldwinii*
31. Leaf teeth not on excrescences ; leaf with septa up to halfway the margins ; sheath auricle with teeth on inner edge ; seed 0.88-1.2-1.3(-1.5) mm long ; areoles per (20-)30-35(-40) in each longitudinal row ; areoles 0.03-0.04(-0.055) mm long 30. *N. malesiana*
30. Anther tetrasporangiate ; leaf without septa ; sheath auricle (0.4-)0.8-2.6(-5.5) mm long 31. *N. graminea*

1. *Najas ancistrocarpa* A. Braun ex Magnus

Beiträge VII, 24, t. 3, fig. 1-5 (1870) ; Rendle, Trans. Linn. Soc., ser. 2, Bot. 5 (12) : 403 (1899) ; Rendle in Engler, Pflanzenr. H.7 : 11 (1901) ; Makino & Nemoto, Fl. Japan : 1515 (1925) ; Makino & Nemoto, Fl. Japan ed. 2 : 1286 (1931) ; Miki, Bot. Magaz. 49 (586) ; 690-692 (1935) ; Nakai, Journ. Jap. Bot. 13 : 853 (1937) ; Ohwi, (ed. Meyer & Walker) Fl. Japan, Engl. Transl. : 124 (1965) ; Yang, Taiwana 19 : 106 (1974) ; Yang in Li, Fl. Taiwan 5 : 36-37 (1978). — ≡ *Caulinia ancistrocarpa* (A. Br. ex Magn.) Nakai, Ord. fam. tribi etc. : 212 (1943). — TYPE : Japan, Yokohama, 25.IX.1860, *Wichura* 813 (holo- : B † ; lecto- : HBG, *non vidi*). Lectotype designated by HAYNES (1985). — PL. VIII, A-D.

Plants submerged, monoecious, slender. *Stems* unarmed, c.0.5 mm in diameter. *Leaves* 11-20 mm long, flat, linear-lanceolate, acute, 0.4-0.5 mm wide (incl. teeth on both sides), 0.22-0.35 mm wide (excl. teeth on both sides) ; margin on each side serrulate with 8-15 conspicuous spiny teeth on small excrescences ; leaf teeth c.0.1 mm long ; the ratio of teeth length to leaf width 0.4 ; midrib without spines ; septa absent ; fibres absent ; leaf sheath sloping, rounded, 1.2-1.3 mm (incl. spine-cells) by 1.3-1.4 mm (ratio = c.0.9-1.0), serrulate or lacerate with 4-5 spine-cells on each side.

Inflorescences axillary, male and female flowers at different nodes, but the male ones more to the top of the plant (occasionally together at the same nodes on the top of the plant ?). *Male flower* enclosed in a spathe, which tapers at the top, bearing brownish spine-cells on the apex ; anther tetrasporangiate (*non vidi*). *Female flower*

enclosed in a spathe, c.0.5 mm (incl. spathe-neck) by 0.25 mm, the neck of the spathe reaching about halfway up the style with small brownish spine-cells on the apex; ovary 0.4-0.5 mm by 0.2-0.25 mm; style and stigma 0.5-0.6 mm; stigma 2-3-lobed.

Fruit with persistent, thin, membraneous pericarp and the remaining parts of the spathe and the style. *Seed* curved (U-shaped), elliptical oblong, 2.5-2.7 mm by 0.35-0.4 mm (ratio = 6.6-7); testa clearly pitted with areoles, the latter regularly arranged in longitudinal rows, each row of c.30; areoles squarish to rectangular, longer than broad, 0.09-0.1 mm long; cell walls not raised.

DIAGNOSTIC FEATURES: leaf sheath rounded; seed areoles regularly arranged per c.30 in each longitudinal row, squarish to rectangular; seed 2.5-2.7 mm × 0.35-0.4 mm, enclosed in spathe; male flower enclosed in spathe, tetrasporangiate; leaves without septa and without fibres.

NOTES: 1. *N. ancistrocarpa* is the only *Najas* taxon with such curved seeds. However, slightly curved seeds occasionally occur among some of the largest *N. graminea* seeds in African specimens (e.g. *Chevalier* 34009, 6751).

2. Besides the cited specimens, also known from Honshiu, Shikoku, and Yokohama (MIKI, 1935a) and Taiwan (YANG, 1974).

3. It is a very rare species.

4. *N. ancistrocarpa* differs from the North American *N. filifolia* HAYNES (1985) by the much more recurved (almost horseshoe-shaped!) seed. *N. filifolia* has seeds with a more horizontal directed apex and with a much more papillose appearance of the testa. The vegetative parts are quite similar. Both species can be regarded as species-pairs (either genetic relationship or convergent evolution).

GEOGRAPHICAL DISTRIBUTION: Japan and Taiwan (Fig. 11).

SELECTED SPECIMENS:

Japan: Miyagi Pref., Katura Isl. 15.X.1914, *Jisiba* s.n. (G) (mixed with *N. minor*!).

2. *Najas flexilis* (Willd.) Rostkovius & Schmidt

Fl. Sedin.: 382 (1824); Cham., *Linnaea* 4: 501-502 (1829); Kunth, *Enum.* 3: 114-115 (1841); A. Br., *Journ. Bot.* 2: 276-277 (1864) p.p., excl. var. β, γ, δ, ε; Rendle, *Trans. Linn. Soc., ser. 2, Bot.* 5 (12): 403-405, t. 40 fig. 92-98 (1899); *Ibid.* (13): 441 (1901); Rendle in Engler, *Pflanzenr.* H.7: 12 (1901); Yuzepczuk in Komarov, *Fl. URSS* 1: 273 (1934); Dandy in Tutin et al., *Fl. Eur.* 5: 14 (1980). — ≡ *Caulinia flexilis* Willd., *Mém. Acad. Roy. Sci. (Berl.)*: 89, t. 1, fig. 1 (1798). — ≡ *Fluvialis flexilis* (Willd.) Persoon, *Syn. Plant.* 2: 530 (1807). — **TYPE:** U.S.A., Pennsylvania, s.d., Herb. *Willdenow* s.n. (holo-: B; microfiche 17094 IDC 7440. 1224: III.2.). — **PI. VIII, E-J.**

= *N. flexilis* (Willd.) Rostk. & Schmidt var. *microcarpa* Nilsson, *Bot. Notis.*: 147 (1881); Rendle, *Trans. Linn. Soc., ser. 2, Bot.* 5 (12): 404 (1899); Rendle in

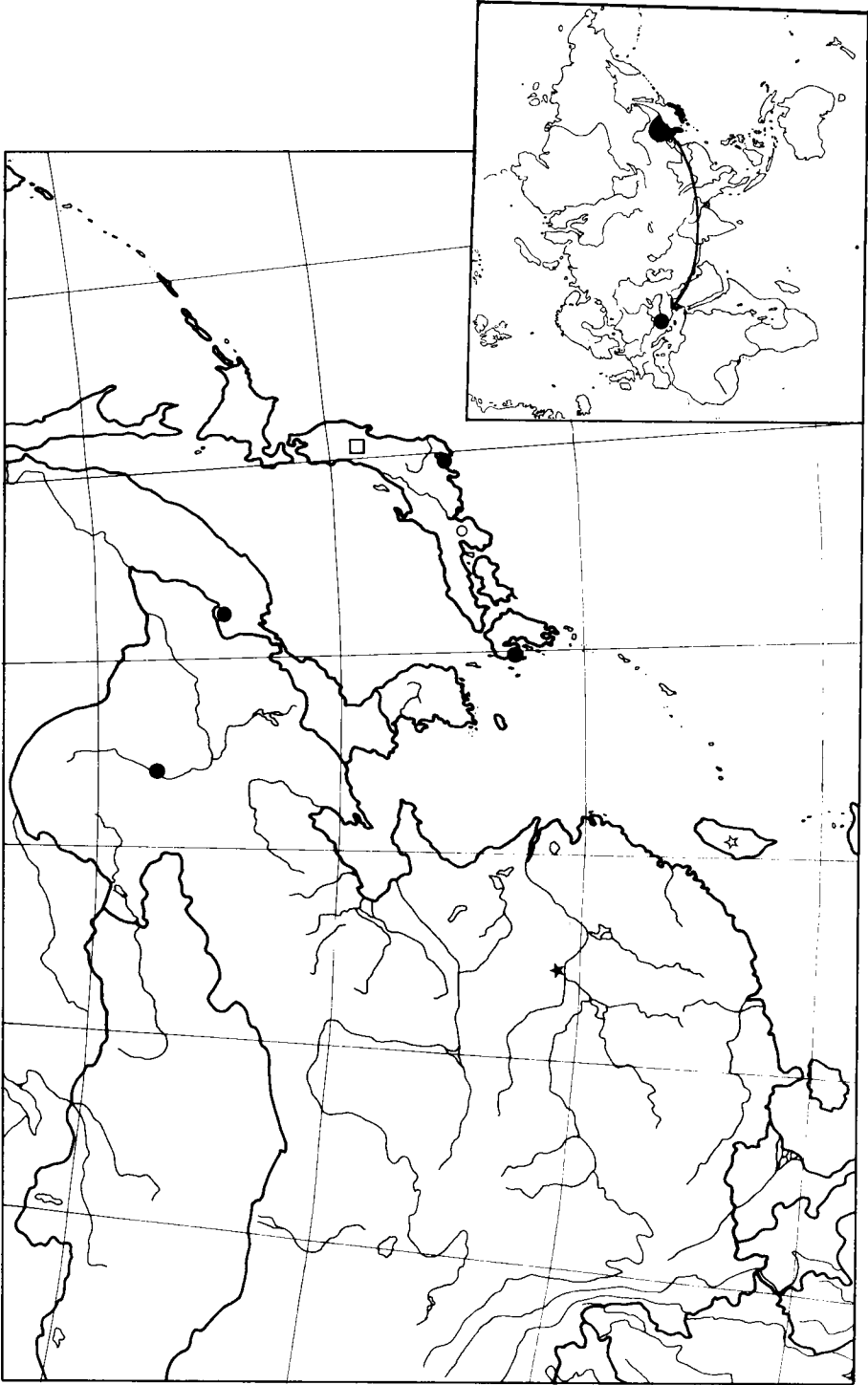


FIG. 11. — Distribution of *N. ancistrocarpa* (open square = uncertain locality) and *N. orientalis* (solid circles; uncertain localities as open circle). The solid star is a literature record for both species and the open star is an uncertain locality from literature of *N. ancistrocarpa*. Inset = adventive distribution of *N. ancistrocarpa*.

Engler, Pflanzenr. H.7 : 10 (1901). — TYPE : Sweden, Lake Ringsjön, 1878, *Nilsson* in Herb. *Schultz* s.n. (holo- : probably at LD or UPS, *non vidi* ; iso- : BM).

Plants submerged, monoecious, slender. *Stems* unarmed, c.0.5 mm in diameter. *Leaves* 10-20(-25) mm long, flat, acute, linear-lanceolate, 0.58-1.0 mm wide (incl. teeth on both sides), 0.5-0.85 mm wide (excl. teeth on both sides) ; margin on each side serrulate with 25-38 inconspicuous spiny teeth ; leaf teeth 0.025-0.075 mm long ; the ratio of teeth length to leaf width being 0.03-0.1 ; midrib without spines ; septa absent ; fibres near each margin ; leaf sheath sloping, 1.3-2.1 mm (incl. spine cells) by 1.5-1.85 mm (ratio = 0.86-1.2), serrulate or lacerate with 4-12 spine-cells on each side.

Inflorescences axillary, male and female flowers at different nodes, but the male ones more to the top of the plant (occasionally together at the same nodes on the top of the plant. *Male flower* enclosed in a spathe, 1.2-1.5 mm (incl. neck of spathe) by 0.5-0.7 mm, which tapers at the top, bearing brownish spine-cells on the apex ; inner envelope protruding c.0.1 mm above the anther ; anther 1-1.3 mm by 0.42-0.64 mm, unisporangiate. *Female flower* naked ; ovary 1.6-2.1 mm by 0.6-0.9 mm ; style and stigma 0.8-2 mm ; stigma 4-lobed.

Fruit with persistent, thin, membranous pericarp and the remaining parts of the style. *Seed* straight, elliptical oblong, 2-3(-3.5) mm by 0.69-0.91(-1.0) mm (ratio = (2.3-)3-3.5) ; testa smooth, with areoles regularly arranged in longitudinal rows, each row of 30-40(-50) ; areoles squarish to hexagonal, 0.065-0.075 mm long ; cell walls not raised.

DIAGNOSTIC FEATURES : leaf sheath rounded ; seed surface smooth ; seed areoles regularly arranged per 30-40(-50) in each longitudinal row, squarish to hexagonal ; seed 2-3(-3.5) mm × 0.69-0.91(-1.0) mm, not enclosed in spathe ; male flower enclosed in spathe, unisporangiate ; leaves without septa and with fibres near each margin.

NOTES : 1. *N. flexilis* is clearly distinct from all other *Najas* species by the smooth seed surface and by the leaf characters (e.g. sheath, teeth, fibres).

2. *N. flexilis* is an endangered species, at least in Europe.

GEOGRAPHICAL DISTRIBUTION : Northern Europe, N. Asia and N. America (Fig. 12).

SELECTED SPECIMENS :

Great Britain : Cumbria, Esthwaite Water, 25.VII.1936, *Willmott* 36725 (BR, L) ; Kintyre, Tanga Loch, IX.1973, *Kenneth* s.n. (BM).

Norway : Rogaland, Klepp Grudevannet, 30.IX.1898, *Landmark* s.n. (K).

Sweden : Lake Ringsjön, 1878, *Nilsson* in Herb. *Schultz* s.n. (BM) ; *ibid.*, 16.IX.1881, *Nordstedt* s.n. (BR) ; *ibid.*, 1881, *Nilsson* (K, L) ; *ibid.*, VIII.1882, *Möller* s.n. (LY-Bonaparte, LY-Gandoger, LY-Rouy, MPU-Coste) ; *ibid.*, VIII.1883, *Nordstedt* s.n. (Z) ; Upland, «Drakeberg», s.d., *Fries* s.n. (LY-Rouy) ; Lake «Hedereviken», 20.VIII.1858, *Krok* s.n. (BR).

Finland : Karelia, Liperi, Käsämä, Lake Särkijärvi, 27.VI.1961, *Veijola* s.n. (Z) ; ibid., 25.VIII.1950, *Härö* s.n. (BRVU, K, L, Z, ZT) ; ibid., 30.VIII.1950, *Paananen* s.n. (K, Z, ZT).

Federal Republic Germany : Baden, «Bodenseegebiet, Untersee», Gehrenmoos, Hegne, 20.VIII.1909, *Bauman* s.n. (TUR).

German Democratic Republic : Angermünde, «Pasteiner», VIII.1857, *Braun* s.n. (BR) ; ibid., IX.1869, *Braun* s.n. (L.).

Poland : Szczecin (Stettin), «Binowschen See, Seehaus», 3.IX.1852, *Braun* s.n. (BR).

U.S.S.R. : Lithuania, «Lacu Switez», 1898, *Dybowski* s.n. (K, LY-Gand.). Central : Pavlodar, 22.VII.1955, *Tzvelev* 1107 (LE). Altai region : Tomsk Prov., Narym Distr., 1912, *Klopotov* 945 (LE). Amyr : Sklad, 24.VII.1914, *Prochorov & Kuzeneva* 525 (LE).

3. *Najas australis* Bory ex Rendle

Trans. Linn. Soc., ser. 2, Bot. 5 (12) : 421-422, pl. 42, fig. 172-176 (1899) p.p. quoad Mauritius et Bourbon ; Triest, Mém. Acad. r. Sci. Outre-Mer, Cl. Sci. nat. méd., nouv. sér. in-8°, 21 (4) [et Et. Cont. afr., 6] : 35-36, fig. 3, pl. 4 (1987).

DIAGNOSTIC FEATURES : leaf sheath rounded ; seed areoles regularly arranged per 30-35 in each longitudinal row, rectangular ; seed 1.6-1.9 mm × 0.5-0.6 mm, not enclosed in spathe ; male flower enclosed in spathe, tetrasporangiate ; leaves without septa and without fibres.

GEOGRAPHICAL DISTRIBUTION : Seychelles, Réunion and Mauritius.

4. *Najas madagascariensis* Rendle

Trans. Linn. Soc. ser. 2, Bot. 5 (12) : 402-403, pl. 10, fig. 55-63 (1899) ; Triest, Mém. Acad. r. Sci. Outre-Mer, Cl. Sci. nat. méd., nouv. sér. in-8°, 21 (4) [et Et. Cont. afr., 6] : 36-39, fig. 3, pl. 5 (1987).

DIAGNOSTIC FEATURES : leaf sheath rounded or slightly auricled ; seed areoles regularly arranged per 28-40 in each longitudinal row, rectangular to hexagonal ; seed 2.2-3.0 mm × 0.65-0.76 mm, enclosed in spathe ; male flower enclosed in spathe, tetrasporangiate ; leaves with septa constricting the margin and without fibres.

GEOGRAPHICAL DISTRIBUTION : Central Madagascar.

5. *Najas welwitschii* Rendle

Welwitsch Catal. Afr. Pl. 2, 1 : 95 (1899) ; Triest, Mém. Acad. r. Sci. Outre-Mer, Cl. Sci. nat. méd., nouv. sér. in-8°, 21 (4) [et Et. Cont. afr., 6] : 39-43, fig. 4, pl. 6 (1987).

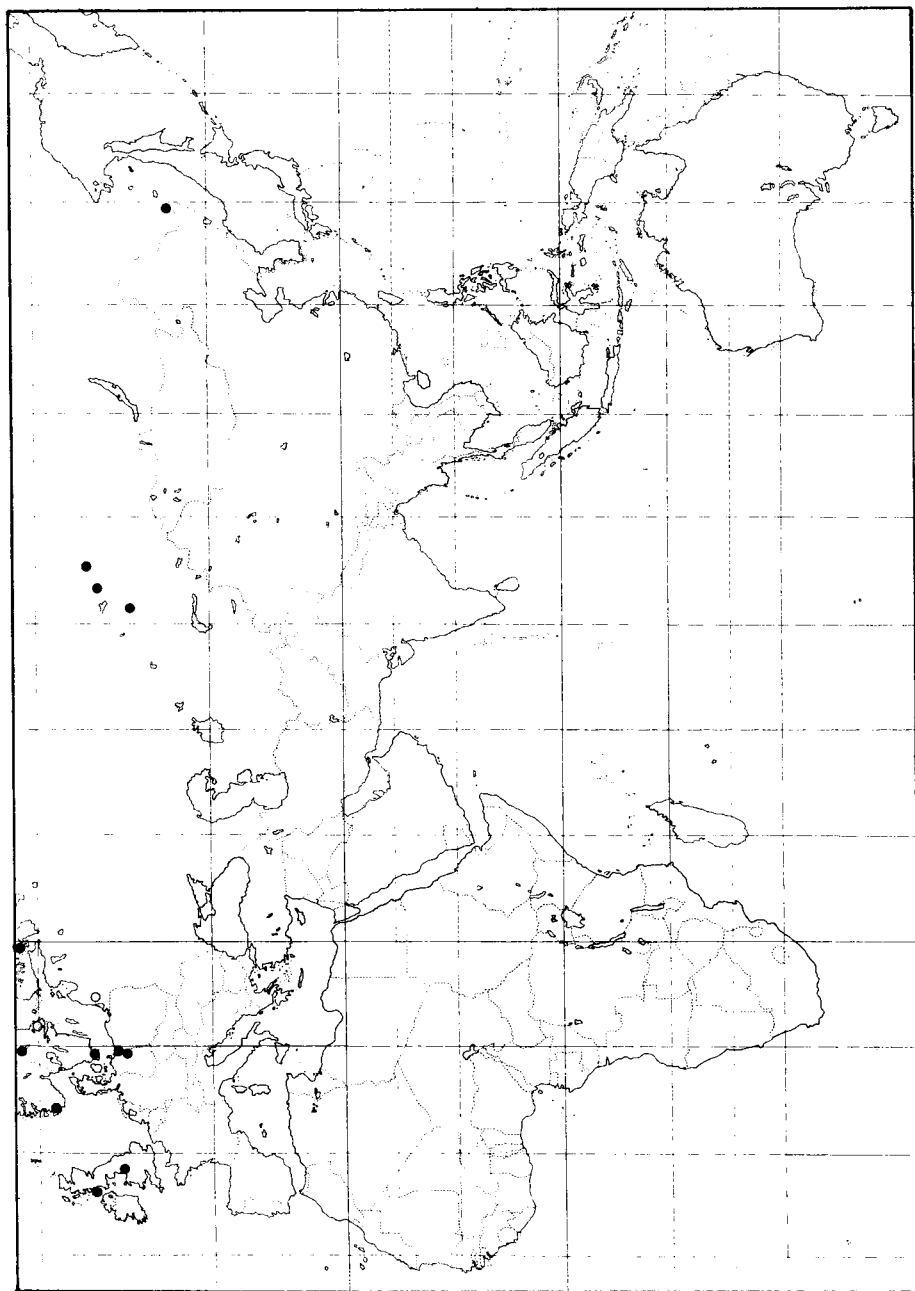


FIG. 12. — Distribution of *N. flexilis* (solid circles; uncertain localities as open circles).

DIAGNOSTIC FEATURES : leaf sheath rounded ; seed areoles regularly arranged per 20-32 in each longitudinal row, squarish to rectangular ; seed 1.6 mm × 2.5 mm, enclosed in spathe ; male flower enclosed in spathe, tetrasporangiate ; leaves with septa and without fibres.

GEOGRAPHICAL DISTRIBUTION : Tropical Africa.

6. *Najas pectinata* (Parl.) Magn. in Aschers. & Schweinf.

Ill. Fl. Egypt (Mém. Inst. Egypte 2, 1) : 145 (1889) p.p. quoad Figari ; Triest, Mém. Acad. r. Sci. Outre-Mer, Cl. Sci. nat. méd., nouv. sér. in-8°, 21 (4) [et Et. Cont. afr., 6] : 43-44, fig. 4, pl. 7 (1987).

DIAGNOSTIC FEATURES : leaf sheath rounded ; seed areoles regularly arranged per 20-30 in each longitudinal row, squarish to rectangular (more rarely hexagonal) ; seed 2-2.3(-2.8) mm × 0.53-0.71 mm, enclosed in spathe ; male flower enclosed in spathe, unisporangiate ; leaves with septa and without fibres.

GEOGRAPHICAL DISTRIBUTION : Egypt, incl. Sinai.

7. *Najas orientalis* Triest & Uotila

Ann. Bot. Fennici 23 : 169-171 (1986). — TYPE : Japan, Nagasaki, s.d., *Oldham* 823 p.p. mixed with *N. graminea* (holo- : K). — **Pl. IX.**

— *N. foveolata* auct. non A. Braun ex Magnus ; Rendle, Trans. Linn. Soc., ser. 2, Bot. 5 (12) : 416-417 (1899) p.p ; quoad Japan ; Makino & Nemoto, Fl. Jap. ed. 2 : 1286 (1931) ; Yuzepczuk in Komarov, Fl. U.S.S.R. 1 : 274 (1934) ; Miki, Bot. Mag. (Tokyo) 49 : 692-693 (1935) ; You et al., Journ. Wuhan Univ. 4 : 111-118, 131, 132 (1985).

— *Caulinia foveolata* auct. non (A. Braun ex Magnus) Nakai ; Nakai, Ord., Fam. etc. : 212 (1943) ; Tzvelev in Nov. Syst. Vysh. Rast. 13 : 19 (1976).

— *N. indica* auct. non (Willd.) Cham. ; Ohwi, Fl. Japan, Engl. transl : 124 (1965).

— *N. minor* auct. non All. : Uotila in Davis, Fl. Turkey 8 : 16-17 (1984) p.p.

Plants submerged, monoecious, slender.

Stems unarmed, c.0.5-0.7 mm in diameter, often plumose above because of closely packed leaves. *Leaves* 15-25(-35) mm long, flat, acute, linear-lanceolate, 0.5-0.8(-1.0) mm wide (incl. teeth on both sides), 0.3-0.5(-0.7) mm wide (excl. teeth on both sides) ; margins serrulate with 6-20 conspicuous spiny teeth, situated on triangular excrescences ; leaf teeth 0.11-0.20 mm long ; the ratio of teeth length to leaf breadth being 0.25-0.37 ; midrib without spines ; septa visible in the largest leaves ; fibres absent ; leaf sheath sloping (1.9-)2.2-2.4 mm by (1.8-)2.4-2.7 mm (ratio = 0.8-1.3), serrulate with 5-10(-15) spine cells on each side.

Inflorescences axillary, male and female flowers on the same branch and in the same axil on the top of the plant. *Male flower* enclosed in a spathe, c.1.8-2.2 mm (incl. neck of spathe) by 0.8-1.0 mm, the neck of the spathe being c.0.3-0.4 mm, which tapers at the top, bearing brownish spine-cells on the apex; inner envelope protruding c.0.1 mm above the anther; anther c.1.5-1.8 mm by 0.6-0.8 mm, tetrasporangiate. *Female flower* naked; ovary c.1.5 mm by 0.5 mm; style and stigma 2-lobed.

Fruit with thin, membranous pericarp and the remaining parts of the style. *Seed* (2-)2.4-2.8 mm by 0.63-0.85 mm, elliptical oblong, testa pitted with areoles, the latter regularly arranged in longitudinal rows, each row of 20-30; areoles squarish or somewhat irregular (0.09)-0.11-0.13 mm long; cell walls raised.

DIAGNOSTIC FEATURES: leaf sheath rounded; seed areoles regularly arranged per 20-30 in each longitudinal row, squarish or somewhat irregular; seed (2-)2.4-2.8 mm × 0.63-0.85 mm, not enclosed in spathe; male flower enclosed in spathe, tetrasporangiate; leaves with septa and without fibres.

NOTES: 1. *Najas orientalis* is evidently native to Honshu (Japan), Manchuria (China) and the Ussuri region (U.S.S.R.). Perhaps the species also occurs in Korea and in Taiwan. Its presence in European Turkey must be considered as an introduction (TRIST & UOTILA, 1986).

In its native area *Najas orientalis* chiefly grows in rice fields (MIKI, 1935a). The Turkish collection was from a wide ditch along the road from Ipsala to the Greek border. Rice fields were not noted there, but rice is cultivated close to that locality. In Turkey *N. orientalis* grew mixed with *N. minor* All. Mixed collections are apparently common in its native area. We have seen mixed collections of *N. orientalis* with *N. graminea* (Oldham 823), with *N. minor* (Litwinow 2422), with *N. gracillima* (Faurie 4877), and with *N. minor* and *N. gracillima* (Savatier 1348).

2. The historical background of this taxonomic problem dates to RENDLE (1899, 1900), who mentioned doubtful specimens from Japan under *Najas foveolata* A. Braun ex Magnus. He cited in 1899 «Japan (?), Miquel (B)», and in 1900 «Japan, Yokoska, Savatier 1348 (P); Faurie (?) 470 (Herb. Drake); Yokohama, Naumann s.p.», Miquel's collection at B has been destroyed, sheets of Faurie and Naumann are *N. minor*, and Savatier 1348 does not match with the type of *N. foveolata* which is from tropical Asia: «Sumbawa Insel», Zollinger 3398 (G!, L!). Following Rendle, MAKINO & NEMOTO (1925) accepted the name *Najas foveolata* in their Flora of Japan. MIKI (1935a) cited 12 specimens from Honshu (Japan) and 2 from Taiwan under *N. foveolata*. His drawings clearly show the rounded leaf sheath and the presence of flowers of both sexes in the same axil. Further, the name was used by NAKAI (1943), even if in a new combination under the genus *Caulinia*: *C. foveolata* (A. Braun ex Magnus) Nakai. As DE WILDE (1962), in a revision of the Malesian *Najas*, placed *N. foveolata* under the synonymy of *N. indica* (Willd.) Cham., the latter name was used for the Japanese taxon in the revised edition of the Flora of Japan by OHWI (1965). However, as the seed areoles of *N. foveolata* (verified on the type) are different from those of *N. indica*, it is not possible to consider them conspecific. The name *N.*

foveolata was used by YUZEPCZUK (1934) in KOMAROV's *Flora of the U.S.S.R.*, however, with a note that the identification of the Ussuri plant with the authentic *N. foveolata* A. Braun needs confirmation. The same epithet (under the genus *Caulinia*) was also accepted for the Soviet material by TZVELEV (1976).

3. The nearest affinities of *Najas orientalis* are with *N. foveolata*. The latter differs from *N. orientalis* in having auricled leaf sheaths, in possessing consistently male and female flowers each in different axils, and in having less seed areoles (16-22) per longitudinal row.

4. *N. gracillima* Magnus, native in rice fields of Honshu, Japan, (MIKI, 1935b), and known as an adventive in rice fields of North Italy (KOCH, 1952), clearly differs from *N. orientalis* in having auricled leaf sheaths, a unisporangiate anther, longer and narrower seeds and smooth, longitudinally elongated areoles.

5. KUZMIN & SKVORTSOV (in BARANOV & SKVORTSOV, 1943) described both *Najas gracilis* and *N. minor* var. *mandschurica* from the region of the Sungari River near Harbin, Manchuria (China). The type material is probably preserved at Harbin Forest Academy but we have not seen it, and many diagnostic characters are missing in the descriptions and figures. We especially lack information on the shape of leaf sheath, number of locules in the anther, presence or absence of the spathe round a male or female flower, dimensions of the seeds and areolation of the testa, and so we cannot place these two species of Kuzmin & Skvortsov. However, *Najas gracilis* of these authors is an invalid name because it is supercoded by *N. gracilis* (Morong) Small (SMALL, 1903), based on *N. marina* var. *gracilis* Morong.

GEOGRAPHICAL DISTRIBUTION: Far East (U.S.S.R., China and Japan); as an adventive in European Turkey (Fig. 11).

SELECTED SPECIMENS :

U.S.S.R. (Far East) Ussuri region, s.l., 1.IX.1930, *Komarov* s.n. (LE); Lake Khanka, 16.VII.1909, *Lipsky* s.n. (LE).

China : Manchuria, Ch'i-ch'i-ha-erh, «Tsitsikar», 10.VIII.1902, *Litwinow* 2422 p.p. mixed with *N. minor* (BM, LE).

Japan : Honshu, Bakan, X.1901, *Faurie* 4877 p.p. mixed with *N. gracillima* (BM, P, ZT); Yokoska, 1866-74, *Savatier* 1348 p.p. mixed with *N. minor* on 1 sheet and mixed with *N. minor* and *N. gracillima* on 2 other sheets (P); Nagasaki, s.d., *Oldham* 832 p.p. mixed with *N. graminea* (K).

As an adventive :

Turkey : Turkey-in-Europe : Edirne, 1 km W of Ipsala, 5 km E. of Greek border, 5.IX.1972, *Uotila* 20253 p.p. mixed with *N. minor* (H, Z).

8. *Najas kingii* Rendle

Trans. Linn. Soc., ser. 2, Bot. 5 (12) : 415, t. 41 fig. 126-131 (1899); Rendle, *Ibid.* (13) : 442 (1900); Rendle in Engler, *Pflanzenr.* H.7 : 15, f. 5A-C (1901); Ridley, *Mat. Fl. Mal. Pen.* 2 : 129 (1907); Camus, *Fl. Gén. Indochine* 6 : 1213

(1942); Heine, Aquar. Terr. Zeitschr. 12 : 375-377 (1958); Pham-Hoàng hõ, Cày-cõ Miên Nam Vietnam : 550 (1960); Larsen, Dansk Bot. Arkiv. 20 (3) : 251 (1963). — TYPE : India, South Andaman, «Navy Bay Tea Gardens», IV.1890, *King* s.n. (holo- : CAL, *non vidi*; iso- : BM). — Pl. X, XI.

- *N. minor* auct. non All. ; Rendle, Trans. Linn. Soc., ser. 2, Bot. 5 (12) : 410-413 (1899) p.p. quoad *Griffith* 5609/7 ; Rendle in Engler, Pflanzenr. H.7 : 14 (1901) p.p. ; Ridley, Mat. Fl. Mal. Pen. 2 : 129 (1907) ; de Wilde in van Steenis, Fl. Males. 1 (6) : 164-165 (1962) p.p. quoad *Griffith* 5609/7.
- *N. foveolata* auct. non A. Br. ; Rendle, Trans. Linn. Soc., ser. 2, Bot. 5 (12) : 416-417 (1899) p.p. quoad *Commerson* ; Rendle in Engler, Pflanzenr. H.7. : 15 (1901) p.p ; Camus, Fl. Gén. Indochine 6 : 1213-1214 (1942).
- *N. tenuifolia* auct. non R. Br. ; Back., Teysm. 22 : 514 (1911).
- *N. indica* auct. non (Willd.) Cham. ; Heine, Aquar. Terr. Zeitschr. 7 : 212-214 (1969).
- *N. maerandra* Griffith ; in sched. *Griffith* 5609/7 (K).

Plants submerged, monoecious, slender. *Stems* unarmed, 0.5-0.8 mm in diameter. *Leaves* (14-)20-30(-42) mm long, flat, acute, linear-lanceolate, (0.5-)0.7-1.0(-1.45) mm wide (incl. teeth on both sides), (0.3)-0.4-0.5-(0.75) mm wide (excl. teeth on both sides) ; margin on each side serrulate with (5-)8-15-(20) conspicuous spiny teeth on broad to very broad excrescences ; leaf teeth (0.09-)0.12-0.25(-0.36) mm long ; the ratio of teeth length to leaf width being (0.19)0.3-0.5(0.69) ; midrib usually without spines ; septa clearly visible up to the margin ; fibres absent ; leaf sheath rounded, sloping or rarely slightly auricled, (1.5-)2.0-2.6(-3.1), (incl. spine-cells) by (1.1-)1.5-2.9(-3.9) mm (ratio = (0.6-)0.8-1.2(-1.4)), serrulate or lacerate with 4-8(-12) spine-cells on each side. In few cases, the auricle being 0-16(-26) mm long (incl. spine-cells).

Inflorescences axillary, male and female flowers together at the same nodes on the top of the plant or at different nodes with the male ones more to the top of the plant. *Male flower* enclosed in a spathe, (1.0-)1.6-2.2 mm (incl. neck of spathe) by (0.3-)0.4-0.6 mm, which tapers at the top, bearing brownish spine-cells on the apex ; inner envelope protruding c.0.1 mm above the anther ; anther (0.6-)1.0-1.4 mm by (0.3-)0.4-0.6 mm, tetrasporangiate. *Female flower* naked ; ovary 0.6-1.8 mm by 0.3-0.7 mm ; style and stigma 0.8-1.4 mm ; stigma 2-3-lobed.

Fruit with persistent, thin, membranous pericarp and remaining parts of the style. *Seed* straight, elliptical oblong, 1.6-1.85 mm by 0.5-0.8 mm (ratio = (2.1-)2.7-3.2(-3.5)) ; testa clearly pitted with areoles, the latter regularly arranged in longitudinal rows, each row of (20-)24-30 ; areoles hexagonal, 0.053-0.07(0.08) mm long ; cell walls not raised.

DIAGNOSTIC FEATURES : leaf sheath rounded ; seed areoles regularly arranged per (20-)24-30 in each longitudinal row, hexagonal ; seed 1.6-1.85 mm × 0.5-0.8 mm,

not enclosed in spathe ; male flower enclosed in spathe, tetrasporangiate ; leaves with septa and without fibres.

NOTES : 1. The specimens from Thailand and Vietnam are very uniform (much in correspondance) with the type.

2. The specimens from Malaya are deviating in having a constricted lower margin (*Sinclair* 10837) or spines on midrib (*Griffith* 5609/7) ; leaf teeth are up to 0.33 mm and the ratio to the leaf width is more than 0.5.

3. The specimens from Sumatra are deviating in having a much broader leaf sheath (L/B ratio < 1) which are slightly auricled (just a sinus of 0.16-0.24 mm, not a real auricle) ; septa are weak or absent ; leaf teeth are up to 0.36 mm and the ratio to the leaf width is more than 0.5.

4. *N. kingii* is recorded from rice fields in Vietnam (*Vù-vân-Cüöng* 502) and Sumatra (*Schneider* s.n., 4.VII.1936).

5. *N. kingii* is used as an ornamental plant in aquaria (HEINE, 1958).

GEOGRAPHICAL DISTRIBUTION : Southeastern Asia (Fig. 13).

SELECTED SPECIMENS :

India : South Andaman, Navy Bay Tea Gardens, IV.1890, *King* s.n. (BM).

Thailand : E. Prov., Chaiyaphum Distr., Tunkamang, 14.XII.1971, *Van Beusekom*, *Geesinck*, *Phenkhilai* & *Wongwan* 4245 (K) ; Krung Thep (Bangkok), 4.II.1920 ; *Kerr* 3989 (K) ; Khiri Khan, 22.III.1971, *Bogner* 415 (K) ; Ranong, 2.V.1974, *K. & S. Larsen* 33541 (AAU).

Vietnam : Hanoi, X.1886, *Balansa* 4130 (P) ; *ibid.*, IV.1889, 4089 (P) ; X.1890, 4563 (P) ; 4573 (P) ; XI.1890, 4651 (K, P) ; Tonighémo, s.d., Herb. *E. Drake* 471 (P) ; Lake Hung Yên, 18.VII.1907, Herb. Jard. Bot. Hanoi 60 (P) ; s.l. «Cochinchine», 1862-1866, *Thorel* s.n. (P) ; Phu Cuong, 24.V.1967, *Vù-vân-Cüöng* 502 (P) ; Chan Phu, 3.XI.1967, *Vù-vân-Cüöng* 662 (P) ; «Rivière des Parfums», 19.VII.1967, *Vù-vân-Cüöng* 605 (P).

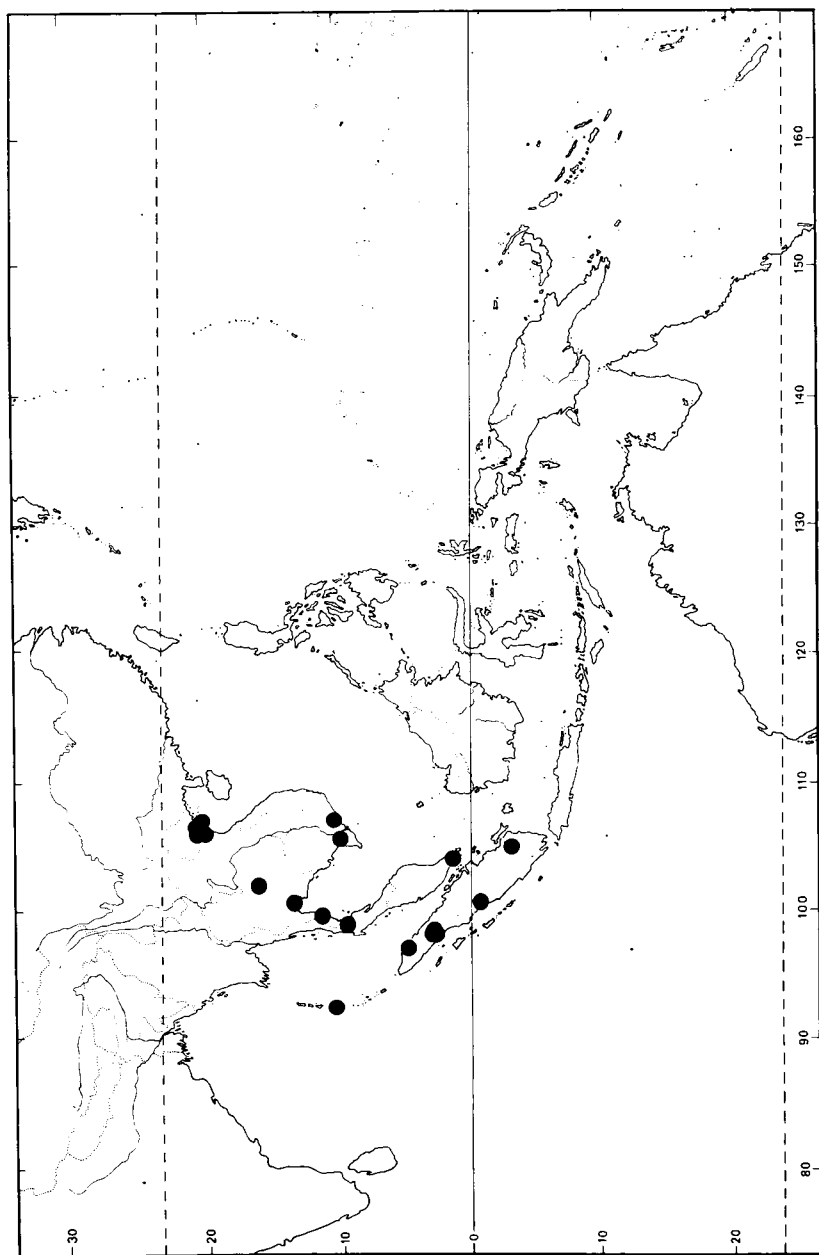
Malaya : Singapore, University Pond, s.d., *Sinclair* 10837 (L) ; s.l., *Griffith* 5609/7 (K) (as *N. maerandra* Griffith !) ; s.l., *Griffith* 5609/5 (BM, P).

Sumatra : Atjeh Prov., *ibid.*, 4.VII.1936, *Schneider* s.n. (ZT) ; Lake Toba 1891, *Modigliani* s.n. (LY-Gand.) ; *ibid.*, 1911, *Sohns* 8 (L) ; Prapat, 1931, *Frey-Wyssling* s.n. (ZT) ; Palembang, 10.I.1930, *De Voogd* 550 (L).

Philippines : s.l., s.d., *Commerson* s.n. (P).

9. *Najas tenuis* A. Br. ex Magnus

Beiträge : VII, 22, 45, 46, t. III, f. 11 (1870) ; J. D. Hooker, Fl. Brit. India 6 : 570 (1893) (as indeterminable species). — TYPE : India, Behar, s.d., *J. D. Hooker* 639 (holo- : B † ; lecto- : K). Lectotype designated here (perhaps iso- in Herb. Magnus at HBG ?). — Pl. XII.

FIG. 13. — Distribution of *N. kingii*.

- *N. indica* auct. non (Willd.) Cham. ; Rendle, Trans. Linn. Soc., ser. 2, Bot. 5 (12) : 399-400 (1899) p.p. quoad Hook f. & Thomson et Soc. Unit. Fratr. 1778 ; Rendle in Engler, Pflanzenr. H.7 : 10 (1901) p.p. quoad syn. *N. tenuis* ; Haines, Bot. Bihar & Orissa : 850 (1924) p.p. quoad syn. *N. tenuis*.
- *N. minor* auct. non All. ; Rendle, Trans. Linn. Soc., ser. 2, Bot. 5 (12) : 410-413 (1899) p.p. quoad Kurz 3309 ; Rendle in Engler, Pflanzenr. H.7 : 14 (1901) p.p.
- *N. minor* All. var. *spinosa* auct. non Rendle ; Fisher in Gamble, Fl. Madras 9 : 1604 (1931) p.p.
- *N. foveolata* auct. non All. ; Rendle, Trans. Linn. Soc., ser. 2, Bot. 5 (12) : 416-417 (1899) p.p. quoad Clarke 31879 et Hook. f. 639 ; Rendle in Engler, Pflanzenr. H.7 : 15 (1901) p.p.
- *N. graminea* Del. var. *minor* auct. non Rendle ; Rendle, Trans. Linn. Soc., ser. 2, Bot. 5 (12) : 426-427 (1899) p.p. quoad Kurz 3310 (also mixed *N. malesiana*) Rendle in Engler, Pflanzenr. H.7 : 18 (1901) p.p. quoad Kurz 3310.
- *N. welwitschii* auct. non Rendle ; Blatter & Hallberg Fl. Ind. desert 26 (4) : 974 (1920) (*non vidi*) ; Bhandari, Fl. Ind. Des. : 359 (1978) probably belongs here.
- *N. palustris* auct. non Blanco ; Venkatesh, Bot. Notis ; 109 (1) : 75-82 (1956) probably belongs here.

Plants submerged, monoecious, (dioecious ?), slender. *Stems* unarmed, 0.5-1.0 mm in diameter. *Leaves* (9.3-)15-25(-30) mm long, flat, acute, linear-lanceolate, 0.5-1.1(-1.3) mm wide (incl. teeth on both sides), 0.23-0.56 mm wide (excl. teeth on both sides) ; margin on each side serrulate with 5-15(-30) conspicuous spiny teeth on broad excrescences ; leaf teeth 0.14-0.39 mm long ; the ratio of teeth length to leaf width being 0.46-1.06 ; midrib without spines ; septa clearly visible up to the margin ; fibres absent ; leaf sheath rounded or sloping, 1.77-2.9(-3.5), (incl. spine-cells) by 1.3-2.4(-3.1) mm (ratio = 0.9-1.5(-2.2)), serrulate or lacerate with 4-12(-18) spine-cells on each side.

Inflorescences axillary, male and female flowers on different branches (plants ?). *Male flower* enclosed in a spathe, 2.6-3.6 mm (incl. neck of spathe) by 0.7-1.0 mm, which tapers at the top, bearing brownish spine-cells on the apex ; inner envelope protruding c.0.1 mm above the anther ; anther 1.8-2.4 mm by 0.64-1.0 mm, tetrasporangiate. *Female flower* occasionally enclosed in a spathe ; 1.5-2.2 mm (incl. spathe-neck) by 0.5 mm, the neck of the spathe reaching about halfway up the style, with or without brownish spine-cells on the apex ; ovary 1.1-1.2 mm by 0.5 mm ; style and stigma 0.6-1.6 mm ; stigma 2-3-lobed.

Fruit with persistent, thin, membranous pericarp and the remaining parts of (eventually the spathe and) the style. *Seed* straight, elliptical oblong, (1.2-)1.7-2.4 mm by 0.46-0.8 mm (ratio = 2.6-3.5) ; testa clearly pitted with areoles, the latter regularly arranged in longitudinal rows, each row of 25-35 ; areoles (squarish to) hexagonal, (0.034-)0.05-0.08) mm long ; cell walls not raised.

DIAGNOSTIC FEATURES : leaf sheath rounded ; seed areoles regularly arranged per 25-35 in each longitudinal row, (squarish to) hexagonal ; seed (1.2-)1.7-

2.4 mm × 0.46-0.8 mm, occasionally enclosed in spathe ; male flower enclosed in spathe, tetrasporangiate ; leaves with septa and without fibres.

NOTES : 1. MAGNUS described the female flower of *N. tenuis* with a spathe (pp. 21-22).

2. Presence or absence of a spathe is inconsistent in *Kurz* s.n. ; a spathe is present in *Hooker* 639 but absent in *Hook & Thomson* s.n. Both are recorded from Bihar.

3. *Kurz* 3310 (BM) is mixed with *N. malesiana*.

4. *N. tenuis* is recorded from paddy fields in India (*Cook & Gut* 276 ; *Cook, Rix & Schneller* 279).

GEOGRAPHICAL DISTRIBUTION : India, Sri Lanka, S.W. China and Burma (Fig. 14).

SELECTED SPECIMENS :

1. With female flower naked :

India : Bihar State, *Hook. f. & Thomson* s.n. (P). Punjab State : Saharanpur, 27.X.1925, *Allen* s.n. (BM). Andhra Pradesh State : Cuddapah, VII.1884, *Gamble* 15119 (K) ; Godivari, Dummagudem, I.1885, *Gamble* 15815 (K) ; Bihar/Madhya Pradesh State : Chota Nagpur, I.1881, *Gamble* 9180 (K). Karnataka State : Bangalore, 6.XI.1970, *Cook & Gut* 139 (Z) ; Rajasthan State : Devikot, IV.1928, *Sedgwick* 3948 (K) ; Kota, 28.X.1970, *Cook & Gut* 36 (K, Z) ; *ibid.*, 41 (Z) ; *ibid.*, 29.X.1970, *Cook & Gut* 59 (Z) ; Kerala State : Kottayam, 25.XI.1970, *Cook & Gut* 276 (Z) ; *ibid.*, 8.IX.1973, *Cook, Rix & Schneller* 159 (Z) ; 160 (Z) ; Ernakulam, between Tripunittura & Piravam, 18.IX.1973, *Cook, Rix & Schneller* 279 (K, Z) ; Tamil Nadu State : Nilgiris, Ootacamund, VI.1883, *Lawon* in *Herb. Gamble* 12856 (K) ; «Bengal», 11.II.1877, *Clarke* 31879 (K).

China : Haldwani, United Provinces, 28.XII.1927, *Parker* s.n. (G).

2. With female flower in spathe :

India : Bihar State, s.d., *Hooker* 639 (K) ; Tamil Nadu State, Tranquebar, 1778, *Soc. Unit. Frat.* s.n. (BM, L).

Burma : Pegu, 26.XII.1870, *Kurz* 3310 (BM, LE) ; *ibid.*, 3309 (LE) ; *ibid.*, 3295 (BM).

3. Sterile :

India : Rajasthan State : Jodhpur, IV.1950, *Venkatesh* s.n. (BM) ; Madhya Pradesh State : Gwalior, *Maries* s.n. (BM).

Sri Lanka : Anuradhapura Exp. Stat., 3.IX.1931, *Simpson* 8533 (BM).

10. *Najas horrida* A. Br. ex Magn.

Beitr. : VII, 46, 47 (1870) ; Triest, Mém. Acad. r. Sci. Outre-Mer, Cl. Sci. nat. méd., nouv. sér. in-8°, 21 (4) [et Et. Cont. afr., 6] : 44-52, fig. 5, pl. 8-10 (1987).

DIAGNOSTIC FEATURES : leaf sheath rounded ; seed areoles regularly arranged per (18-)25-35(-40) in each longitudinal row, squarish to rectangular (more rarely

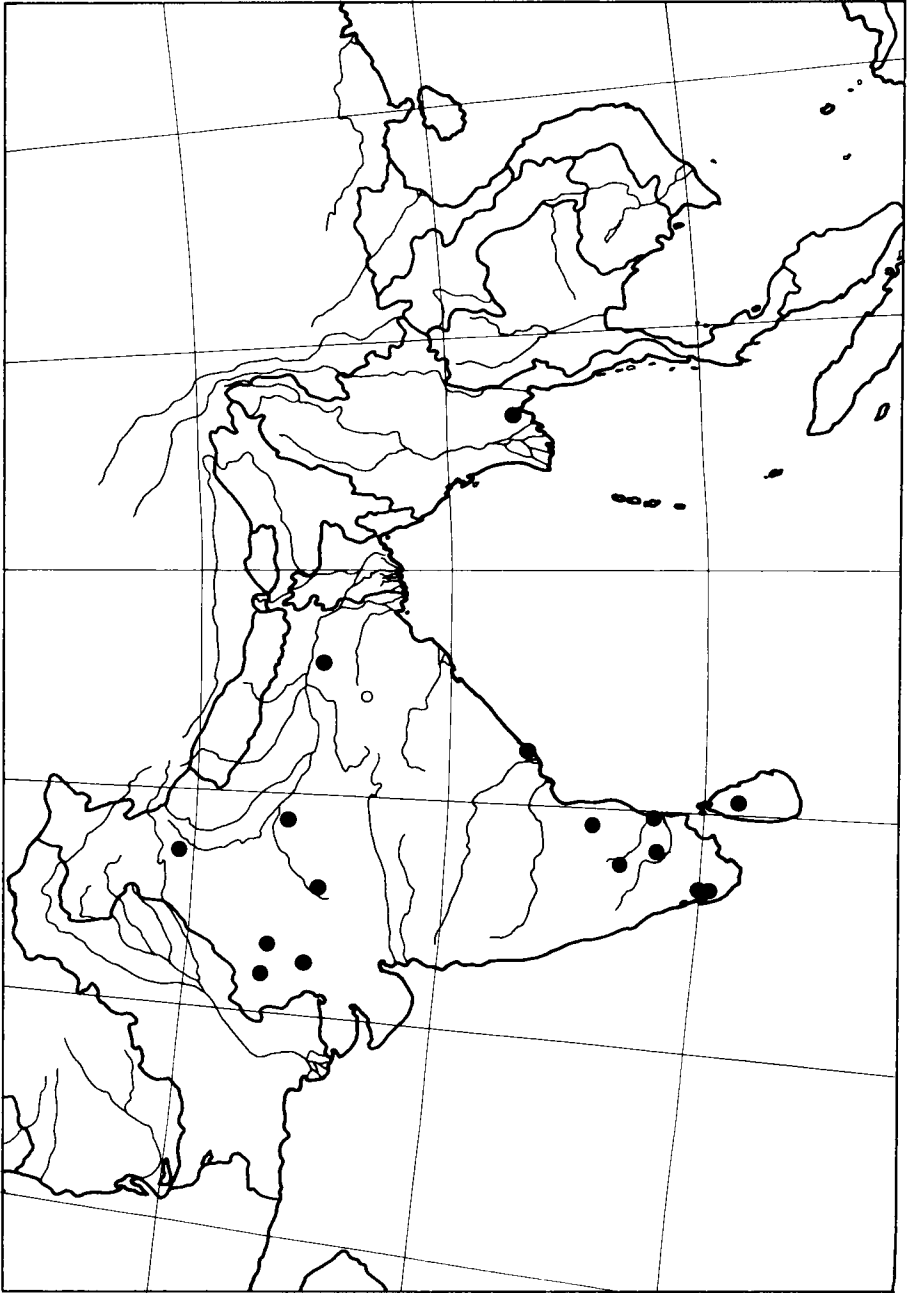


FIG. 14. — Distribution of *N. tenuis* (solid circles ; uncertain locality as open circle).

hexagonal); seed 1.6-3.2 mm × 0.48-0.84 mm, not enclosed in spathe; male flower enclosed in spathe, tetrasporangiate; leaves with septa and without fibres.

GEOGRAPHICAL DISTRIBUTION: Africa and Madagascar.

11. *N. tenuissima* (A. Br.) A. Br. ex Magnus

Beitr. 24, 45, 47, t. IV, f. 1-4, t. V, f. 13, 14 (1870); Rendle, Trans. Linn. Soc., ser. 2. Bot. 5 (12): 414 (1899); Rendle in Engler, Pflanzenr. H.7: 15 (1901); Yuzepczuk in Komarov, Fl. USSR 1: 274 (1934); Dandy in Tutin et al., Fl. Eur. 5: 14 (1980). — ≡ *N. minor* All. var. *tenuissima* A. Br., Journ. Bot. 2: 277-278 (1864). — ≡ *Caulinia tenuissima* (A. Br.) Tzvelev, Nov. Syst. Vysh. Rast. 13: 18-19 (1976), p.p. quoad subsp. *tenuissima*; Tzvelev in Fedorov, Fl. Eur. tsasti SSSR. 4: 201 (1979). — ≡ *Caulinia tenuissima* (A. Br.) Tzvelev subsp. *tenuissima*; Tzvelev, Nov. Syst. Vysh. Rast. 13: 18-19 (1976). — TYPE: Finland, s.l., s.d., *Hisinger* s.n. (holo-: B †). Neotype: Finland, Varsinais-Suomi, Karjaa, Lake Lepinjärvi, 16.VIII.1984, *Kurtto & Helynranta* s.n. (neo-: H; iso-: BRVU). Neotype designated here. — **PI. XIII.**

Plants submerged, monoecious, slender. *Stems* unarmed, 0.5 mm in diameter. *Leaves* 7-20 mm long, flat, acute, linear-lanceolate, 0.4-0.5 mm wide (incl. teeth on both sides), 0.23-0.29 mm wide (excl. teeth on both sides); margin on each side serrulate with 8-11 conspicuous spiny teeth on small excrescences; leaf teeth 0.09-0.11 mm long; the ratio of teeth length to leaf width being 0.30-0.46; midrib without spines; septa absent; fibres absent; leaf sheath truncate, lacerate to shortly auricled 1.3-2.4 mm (incl. spine-cells) by 1.4-1.9 mm (ratio = 1.1-1.3), serrulate or lacerate with 4-6 spine-cells on each side, the auricle being 0.19-0.32 mm long (incl. spine-cells) and 0.48-0.7 mm wide (ratio = 0.4-0.46(-0.67), serrulate or lacerate with 4-6 spine-cells on each side but no on the inner edge; apex of the auricle rather obtuse.

Inflorescences axillary, male and female flowers at different nodes, but the male ones more to the top of the plant or together at the same nodes on the top of the plant. *Male flower* enclosed in a spathe, 1-1.2 mm (incl. neck of spathe) by 0.2 mm, which tapers at the top, bearing brownish spine-cells on the apex; inner envelope protruding 0.15-0.17 mm above the anther; anther 0.6-0.7 mm by 0.15-0.18 mm, unisporangiate. *Female flower* naked; ovary 0.7-1.3 mm by 0.2-0.52 mm; style and stigma 0.7-1.2 mm; stigma 2-3-lobed.

Fruit with persistent, thin, membranous pericarp and the remaining parts of the style. *Seed* straight, elliptical oblong, (2.2)-2.5-2.8(-3) mm by 0.46-1.0 mm (ratio = 3.2-5); testa smooth, with areoles rather irregularly arranged in longitudinal rows, each row of 25-30(-35); areoles rather irregularly shaped, longer than broad, 0.06-0.16 mm long and c. 0.032 mm wide; cell walls not raised.

DIAGNOSTIC FEATURES: leaf sheath truncate to auriculate; seed areoles more or less irregularly arranged per 25-30(-35) in each longitudinal row, rather irregularly

shaped ; seed (2.2-)-2.5-2.8(-3) mm × 0.46-1.0 mm, not enclosed in spathe ; male flower enclosed in spathe, unisporangiate ; leaves without septa and without fibres.

NOTE : *N. tenuissima* is a clearly distinct but very rare and endangered species.

GEOGRAPHICAL DISTRIBUTION : Finland and N.W. part of U.S.S.R. (Fig. 15).

SELECTED SPECIMENS :

Finland : Varsinais-Suomi : Vihti, Vanhala, Tarttilansalmi, 12.VIII.1941, *Linkola* s.n. (K, Z) ; Karjaa : lake Lepinjärvi, 16.VIII.1984, *Kurto & Helynranta* s.n. (BRVU, H). Uudenmaa ; Borgä, 12.IX.1899, *Lindberg* s.n. (BM, MPU-Coste, Z) ; Häme, (Tavast), Vesijärvi, 17.VIII.1864, *Norlin* s.n. (K) ; *ibid.*, 10.VIII.1935, *Levanto* 1801 (K).

U.S.S.R. Europe : Karelia : Viborg, 12.VIII.1908, *Lindberg* s.n. (BM, BRVU, CAI, K, Z) ; Leningrad, Gorskaja, 9.IX.1954, *Juzepchuk & Tzvelev* s.n. (BM, K, LE).

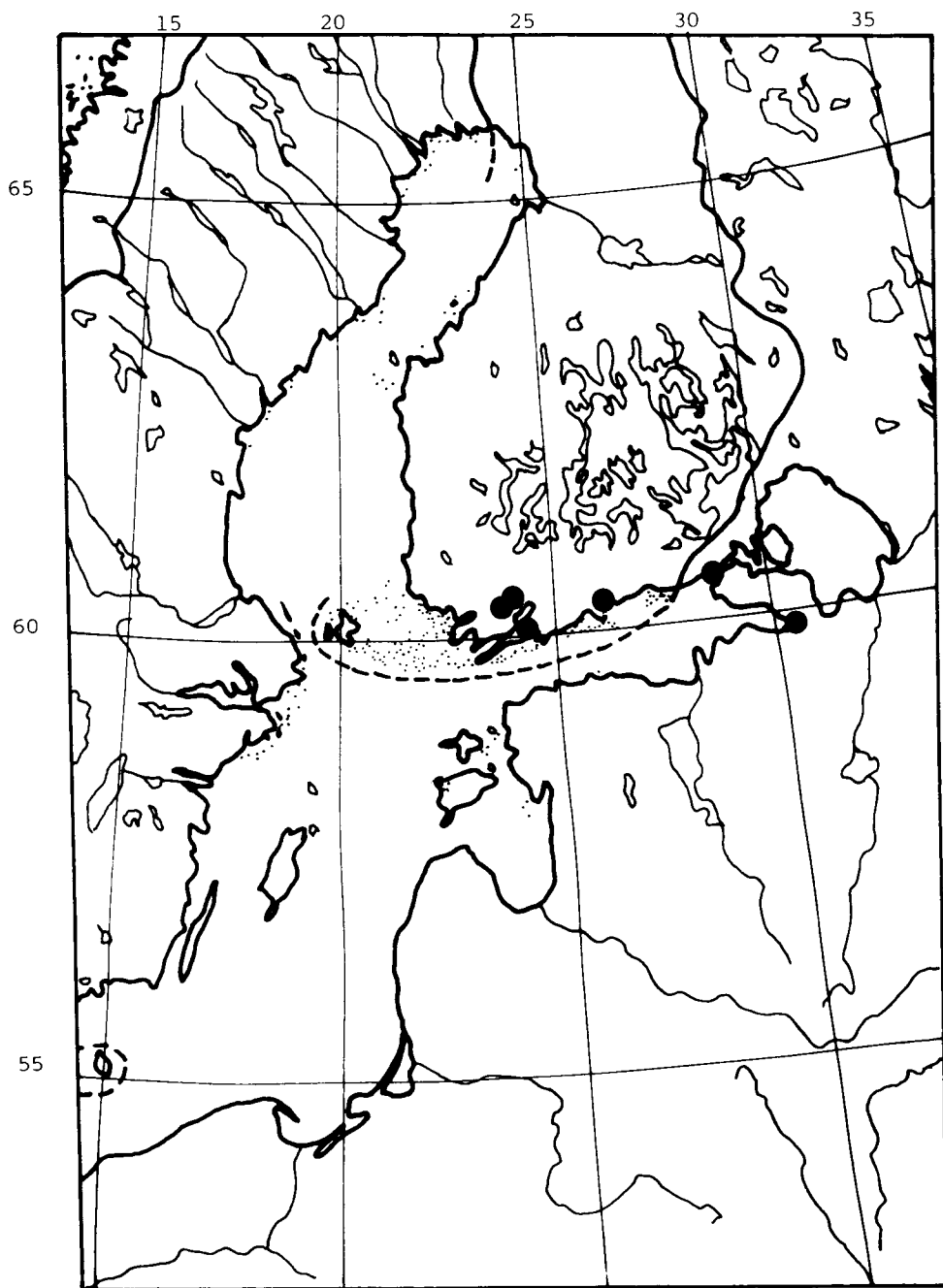
12. *Najas gracillima* (A. Braun ex Engelmann in Gray) Magnus

Beitr. : 23 (1870) ; Rendle, Trans. Linn. Soc., ser. 2, Bot. 5 (12) : 414, t. 41 f. 122-125 (1899) ; Rendle in Engler, Pflanzenr. H.7 : 15 (1901) ; Miki, Bot. Mag. Tokyo 49 : 773-774 (1935) ; Koch, Ber. Schweiz. Bot. Ges. 62 : 632-634 (1952) ; de Wilde in Van Steenis, Fl. Males. 1 (6) : 165-166 (1962), in a note under *N. browniana* ; Cook, Ber. Schweiz. Bot. Ges. 83 : 61 (1973) ; Molinier, Bull. Mus. Hist. Nat. Marseille : 65 (1980) ; Dandy in Tutin et al., Fl. Eur. 5 : 14 (1980) ; Farras I de Blas, Butll. Inst. Catal. Hist. Nat. 51 (5) : 178 (1984) ; Cook, J. Aquatic Plant Manage. 23 : 1-6 (1985) ; You et al., Journ. Wuhan Univ. 4 : 111-118, 131, 132 (1985). — ≡ *N. indica* (Willd.) Cham. var. *gracillima* A. Braun ex Engelmann in Gray, Man. Bot. ed. 5 : 681 (1868). — ≡ *Caulinia gracillima* (A. Braun ex Engelm. in Gray) Nakai, Ord. Fam. etc. : 213 (1943). — TYPE : U.S.A., Missouri, s.d., *Engelmann* s.n. (holo- : MO, non vidi). — ≡ *N. yezoensis* Miyabe in Miyabe & Kudo, Journ. Fac. Agric. Sapporo 26 : 97-99 (1931) ; Ohwi, (ed. Meyer & Walker), Fl. Japan, Engl. transl. : 124 (1965) ; Tzvelev, Nov. Syst. Vysh. Rast. 18 : 241 (1983), probably belongs here. — TYPES : Japan, Yezo, Prov. Kushiro, Lake Toro, 20.IX.1927, *Miyabe* s.n. (syn- : non vidi) ; *ibid.*, 14.IX.1929, *Odagiri* s.n. (syn- : non vidi). A lectotype should be chosen among these specimens. — **PI. XIV.**

— *Caulinia tenuissima* (A. Br.) Tzvelev, Nov. Syst. Vysh. Rast. 13 : 18-19 (1976) p.p. quoad subsp. *amurensis*.

— *Caulinia tenuissima* (A. Br.) Tzvelev subsp. *amurensis* Tzvelev, Nov. Syst. Vysh. Rast. 13 : 19 (1976) ; Tzvelev in Fedorov, Fl. Eur. tsasti S.S.S.R. 4 : 201 (1979).

— *Caulinia amurensis* (Tzvel.) Tzvel. Nov. Syst. Vysh. Rast. 16 : 241 (1983). — TYPE : U.S.S.R., Amur region, «In lacubus ad ostium fl. Tungusca», 1.IX.1895, *Komarov* s.n. (holo- : LE).

FIG. 15. — Distribution of *N. tenuissima*.

- *N. japonica* Nakai, Journ. Jap. Bot. 13 : 853 (1937); Ohwi, (ed. Meyer & Walker), Fl. Jap. : 124 (1965) Engl. transl. ; Yang, Taiwania 19 : 106 (1974); Yang in Li, Fl. Taiwan 5 : 37 (1978); Kitagawa, Neo-Lineamenta Fl. Mansh. : 60 (1979);
- *Caulinia japonica* (Nakai) Nakai, Ord. Fam. etc. : 212-213 (1943); Tzvelev, Nov. Syst. Vysh. Rast. 18 : 241 (1983). – No type specimen cited.
- *N. graminea* Del. f. *intermedia* Zahariadi & Țopa in Săvulescu, Fl. Rep. Soc. Rom. XI, add. : 849. – TYPE : «Reg. Bucuresti, in oryzetis ad Chirnogi (r. Oltenita)» (no specimen cited), probably belongs here or under *N. graminea*?
- *Caulinia tenuissima* auct. non (A. Br.) Tzvelev; Tzvelev, Nov. Syst. Vysh. Rast. 18 : 241 (1983) p.p. quoad syn. *N. yezoensis*.
- *N. japolina* Nakai; Casper & Krausch, Susswasserfl. Mitteleur. 23 (1) : 147 (1980), *lapsus calami* for *N. japonica* Nakai.

Plants submerged, monoecious, slender. *Stems* unarmed, up to 30-50 cm long, c.0.5 mm in diameter. *Leaves* 9.3-18.7 mm long, flat, acute, linear-lanceolate, 0.21-0.55 mm wide (incl. teeth on both sides), 0.11-0.28 mm wide (excl. teeth on both sides); margin on each side serrulate with 4-14 conspicuous spiny teeth on small excrescences; leaf teeth 0.05-0.11(-0.18) mm long; the ratio of teeth length to leaf width being 0.27-0.5(-0.9); midrib without spines; septa absent; fibres absent; leaf sheath rounded, slightly auricled, truncate to lacerate or shortly auricled, 1.1-2.26 mm (incl. spine-cells) by 1.1-1.7 mm (ratio = 0.9-1.6), serrulate or lacerate with 2-8 spine-cells on each side, the auricle being 0.1-0.43 mm long (incl. spine-cells) and 0.28-0.38 mm wide (ratio = 0.55-1.25), serrulate or lacerate with 2-8 spine-cells on each side but no on the inner edge; apex of the auricle rather obtuse.

Inflorescences axillary, male and female flowers at different nodes, but the male ones more to the top of the plant and together at the same nodes on the top of the plant. *Male flower* enclosed in a spathe, 0.71-1.29 mm (incl. neck or spathe) by 0.2-0.35 mm, which tapers at the top, bearing brownish spine-cells on the apex; inner envelope protruding c.0.1 mm above the anther; anther 0.53-0.89 mm by 0.18-0.31 mm, unisporangiate. *Female flower* naked; ovary c.0.6 mm by 0.2 mm; style and stigma 0.6 mm; stigma 2-3-lobed.

Fruit with persistent, thin, membranous pericarp and the remaining parts of the style. *Seed* straight, elliptical oblong, (1.77-)1.9-2.2(-2.66) mm by 0.40-0.58 mm (ratio = 3.5-5.7); testa clearly pitted with areoles, irregularly arranged in longitudinal rows, each of 8-19; areoles irregularly shaped, longer than broad, 0.09-0.21 mm long and 0.03-0.05 mm wide; cells walls not raised.

DIAGNOSTIC FEATURES : leaf sheath truncate; seed areoles irregularly arranged per 8-19 in each longitudinal row, irregularly shaped and longer than broad; seed (1.77-)1.9-2.2(-2.66) mm × 0.4-0.58 mm, not enclosed in spathe; male flower enclosed in spathe, unisporangiate; leaves without septa and without fibres.

NOTES : 1. *N. gracillima* is known from the Far East, N. America and as an adventive in Southern Europe. Vegetatively, specimens do not differ from one region to another. The only possible difference lies in their seed length, namely: Far

East — (1.77-)1.9-2.2(-2.66) mm ; S. Europe — 1.7-2.1 mm ; N. America — 2.58-3.0(-3.22) mm. It is not clear where the adventive plants in rice fields of S. Europe have originated, but the seed lengths seem to correspond more with those of the Far East than with those of N. America. However, HAYNES (1979), mentioned 2-3.2 mm long seeds from N. America.

2. Specimens from N. America (U.S.A.) examined here (but not included in the description) are : North Carolina, Orange country, Lake margin on Hogan Farm, 1 mile E. of Calvander off Homestead Rd., 17.VII.1967, *Bozeman* 10719 (BR, UNA) ; Illinois, Pope county, Lake Glendale, 11.VII.1979, *Davenport* 1302 (UNA) ; Pennsylvania, Sullivan County, 5.5 km S.E. of Lopez, 17.VIII.1980, *Schuyler* 5512 (UNA) ; Alabama, Chambers County, Lafayette City lake, 12.VI.1979, *Haynes* 7204 (UNA) ; *ibid.*, 2.VII.1979, *Haynes* 7380 (UNA) ; 29.VIII.1983, *Haynes* 8721 (UNA).

3. *N. gracillima* was collected mixed with *N. orientalis* in Japan (*Faurie* 4877, *Savatier* 1348) ; with *N. minor* in Spain (*Farras I de Blas* 1) and Italy (*Lambinon* 75/I/818) ; with *N. gracillima* in Japan (*Faurie* 13920). In the Vercelli region (Italy), *N. gracillima* was observed in the rice fields and growing mixed with *N. minor* in the adjacent ditches.

4. *N. gracillima* grows chiefly in rice fields in Japan (e.g. *Faurie* 7211, *Savatier* 1348), Corea (*Komarov* s.n., 5 & 15.VIII.1897) and as an adventive locally in Italy (Provinces of Novara, Vercelli, Pavia and Varese), France (Camargue, MOLINIER, 1980) and Spain (Catalunya).

GEOGRAPHICAL DISTRIBUTION : Far East (China, U.S.S.R., Corea, Japan, Taiwan) ; as an adventive in S. Europe (Spain, France, Italy) ; also in N. America (Fig. 16).

SELECTED SPECIMENS :

U.S.S.R. (Far East) : Amyr region : «In lacubus ad ostium fl. Tungusca», 9.IX.1895, *Komarov* s.n. (LE) ; Sklad Dambuk, 24.VII.1914, *Prochorov & Kuzeneva* 535 (LE). Ussuri region : Cape near Kraskino, 20.IX.1979, *Tzvelev* 225 (BRVU, LE).

N. Corea : Kenge prov., Yalu river, 5.VIII.1897, *Komarov*, Fl. Mansh. 111 (BM, K) ; Yalu river, «fl. Amnokgan, prope oppidum Chudschu ubi», 15.VIII.1897, *Komarov* s.n. (LE). Pennian Prov. : Yalu river, 31.VIII.1897, *Komarov* s.n. (LE).

China : Yunnan, Ta-li, 20.IX.1888, *Delavay* 4745 (P).

Japan : Aomori Prov., X.1899, *Faurie* 2926 (G, P) ; Akita Prov., 9.IX.1897, *Faurie* 601/9 (P) ; *ibid.*, *Faurie* s.n. (G) ; Migayi, Shiogama, X.1905, *Faurie* 7211 (BM) ; Yokoska, 1866-1871, *Savatier* 1348 (P) ; Bakan, X.1901, *Faurie* 4877 (BM, G, P, ZT) ; Minnasaki, 17.VII.1897, *Faurie* 599 (P) ; Kamioka, 30.VIII.1897, *Faurie* 907 (K) ; Morioki, 1894, *Faurie* 13920 (G, K, L, LY, P) ; s.l., 23.VIII.1878, *Yatabe* s.n. (ZT).

Taiwan : «Suitenka», 22.VI.1909, *Faurie* 828 (G, P) ; *ibid.*, s.l. 829 (G) ; Chu-chih, 23.V.1982, *Kao* 9752 (TAI).

N. gracillima as an adventive :

Italy : Piemonte : Varese Prov., Ispra, 16.IX.1975, *Lambinon* 75/I/818 (WAG). Vercelli Prov., Prarolo, 10.IX.1980, *Cook* 1120 B, (Z) ; *ibid.*, Villarboit, 30.IX.1982, *Triest*, *Cook & Vuille* 119 ; 123 (BRVU) ; *ibid.*, 28.VII.1983, *Triest* 139 (BRVU) ; *ibid.*, 12.VII.1969, *Charpin* s.n. (G) ; *ibid.*, S.W. of Albano, 23.VIII.1972, *Cook & Rix* 37A (K) ; *ibid.*, Albano, 9.IX.1980, *Cook* 1110 (Z) ; 4.2 km S. Novara, 5.IX.1951, *W. Koch & H. Hess* 51/631 (ZT).

Spain : Catalunya, *Farras I. de Blas* 1 and 2 (BRVU, alcohol preserv.).

13. *Najas pseudogracillima* Triest sp. nov.

*Herba submersa, monoica, caulibus filiformibus. Folia 9.3-10.7 mm longa ; lamina 0.29-0.32 mm lata, marginibus utrinque 6-10 spinis 0.065-0.085 mm longis conspicuisque munitis ; vagina auriculata, 1.2-1.3 × 1.0-1.1 mm. Flores masculini sine spathella, anthera 1-sporangiata. Flores feminei sine spathella. Semina 1.85-2.0 × 0.50-0.55 mm ; testa areolata, areolis in 12-15 seriebus dispositis, 0.11-0.20 mm longis, 0.03-0.04 mm latis. — TYPE : China : Hong Kong, Chung Chi Campus, 22.XI.1971, *Shiu Ying Hu* 11263 (holo- : K), ♂, ♀, fr. — Pl. XV.*

Plants submerged, monoecious, slender. *Stems* unarmed, c.0.5 mm in diameter. *Leaves* 9.3-10.7 mm long, flat, acute, linear-lanceolate, 0.29-0.32 mm wide (incl. teeth on both sides), 0.15-0.16 mm wide (excl. teeth on both sides) ; margin on each side serrulate with 6-10 conspicuous spiny teeth on small excrescences ; leaf teeth 0.065-0.085 mm long ; the ratio of teeth length to leaf width being 0.40-0.56 ; midrib without spines ; septa absent ; fibres absent ; leaf sheath truncate to lacerate 1.2-1.3 mm (incl. spine-cells) by 1-1.1 mm (ratio = 1.2-1.29), serrulate or lacerate with 3-5 spine-cells on each side, the auricle being 0.15-0.2 mm long (incl. spine-cells) and 0.20-0.25 mm wide (ratio = 0.75-0.80), serrulate or lacerate with 3-5 spine-cells on each side but no on the inner edge ; apex of the auricle rather acuminate.

Inflorescences axillary, male and female flowers at different nodes, but the male ones more to the top of the plant or together at the same nodes on the top of the plant. *Male flower* naked ; inner envelope protruding c.0.1 mm above the anther ; anther 0.64-0.73 mm by 0.16-0.24 mm, unisporangiate. *Female flower* naked ; ovary c.1 mm by 0.3 mm ; style and stigma c.1 mm ; stigma 2-3-lobed.

Fruit with persistent, thin, membranous pericarp and the remaining parts of the style. *Seed* straight, elliptical oblong, 1.85-2.0 mm by 0.5-0.55 mm (ratio = 3.3-3.6) ; testa not clearly pitted with areoles, irregularly arranged in longitudinal rows, each of 12-15 ; areoles rather irregularly shaped, longer than broad, 0.11-0.20 mm long and 0.03-0.04 mm wide ; cell walls not raised.

DIAGNOSTIC FEATURES : leaf sheath truncate ; seed areoles rather irregularly arranged per 12-15 in each longitudinal row, rather irregularly shaped and longer than

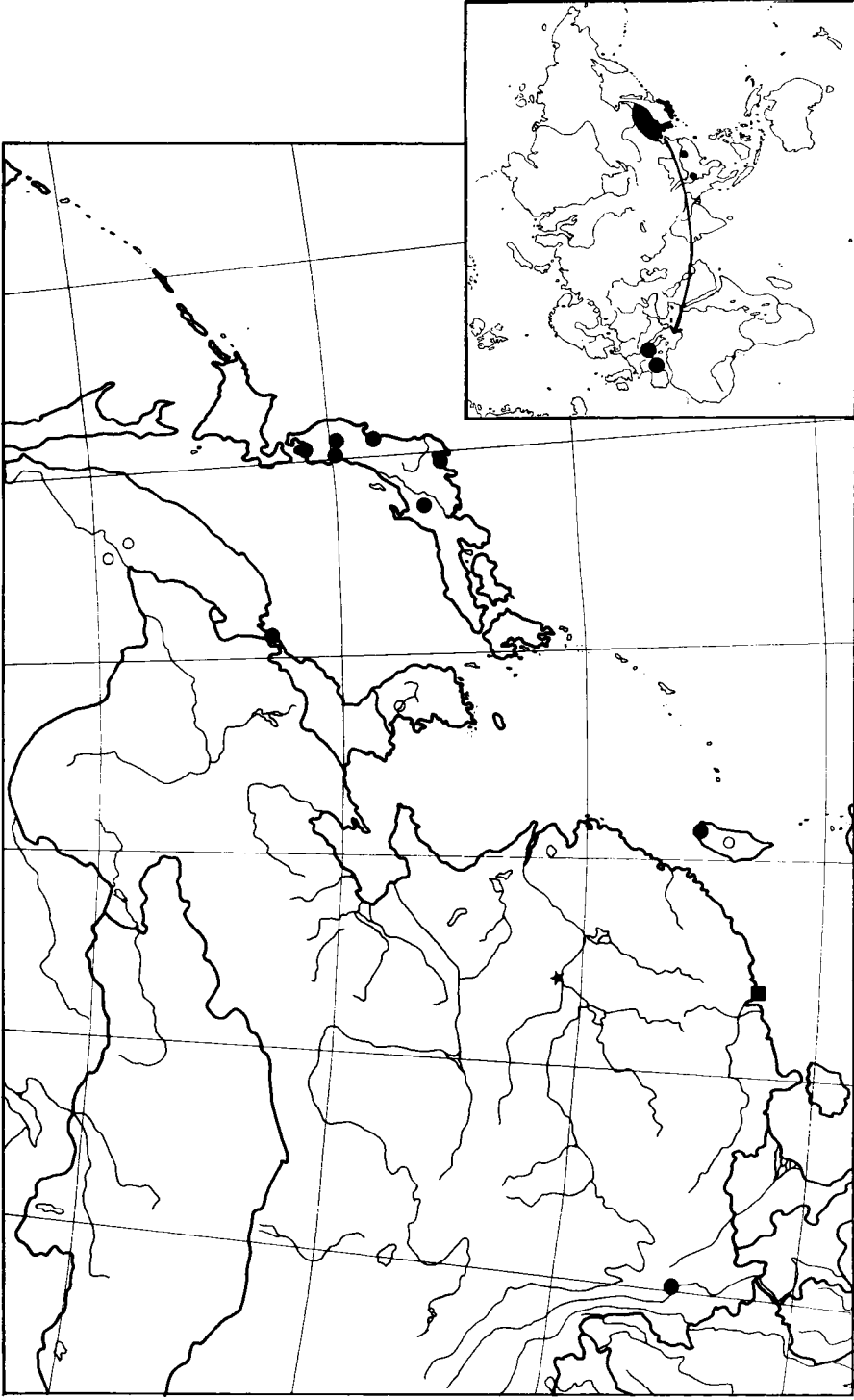


FIG. 16. — Distribution of *N. gracillima* (solid circles) ; uncertain localities as open circles ; literature record as solid star) and *N. pseudogracillima* (solid square). Inset = adventive distribution of *N. gracillima*.

broad ; seed 1.85-2.0 mm × 0.5-0.55 mm, not enclosed in spathe ; male flower not enclosed in spathe, unisporangiate ; leaves without septa and without fibres.

NOTES : 1. Very close to *N. gracillima* but differs in having naked male flowers.
2. Found mixed with *N. pseudograminea* (Woo 2).

GEOGRAPHICAL DISTRIBUTION : Found only in Hong Kong but could occur also in S.E. China or Taiwan. (Fig. 16).

SELECTED SPECIMEN :

China : Hong Kong, Chung Chi Campus, VII.1970, *J. P. W. Woo* Aq. P 2 (P) ; *ibid.*, 22.XI.1971, *Shiu Ying Hu* 11263 (K).

14. *Najas testui* Rendle

Journ. Bot. 75 : 51-53, fig. A-I (1937) ; Triest, Mém. Acad. r. Sci. Outre-Mer, Cl. Sci. nat. méd., nouv. sér. in-8°, 21 (4) [et Et. Cont. afr., 6] : 52-55, fig. 6, pl. 11 (1987).

DIAGNOSTIC FEATURES : leaf sheath truncate to auriculate ; seed areoles irregularly arranged per 10-14(-23) in each longitudinal row, irregularly shaped ; seed (1.85-)2.1-2.3(-2.60) mm × (0.41-)0.56-0.79 mm, enclosed in spathe ; male flower enclosed in spathe, tetrasporangiate ; leaves with or without septa and with or without fibres.

GEOGRAPHICAL DISTRIBUTION : Tropical Africa.

15. *Najas schweinfurthii* Magn.

Ber. Deutsch. Bot. Gesell. 12 : 219-220, fig. 3 (1894) ; Triest, Mém. Acad. r. Sci. Outre-Mer, Cl. Sci. nat. méd., nouv. sér. in-8°, 21 (4) [et Et. Cont. afr., 6] : 55-58, fig. 7, pl. 12 (1987).

DIAGNOSTIC FEATURES : leaf sheath truncate to auriculate ; seed areoles irregularly arranged per (9-)11-13(-15) in each longitudinal row, irregularly shaped ; seed (1.13-)1.30-1.45(-1.61) mm × 0.48-0.64 mm, enclosed in spathe ; male flower enclosed in spathe, unisporangiate ; leaves with or without septa and with or without fibres.

GEOGRAPHICAL DISTRIBUTION : Tropical Africa.

16. *Najas foveolata* A. Br. ex Magnus

Beitr. : VII, 43 (1870) ; Rendle, Trans. Linn. Soc., ser. 2, Bot. 5 (12) : 416-417, t. 41, fig. 139-144 (1899) p.p. quoad Sumbawa et prob. Philippines, excl. var. minor ; Rendle, *Ibid.* (13) : 443 (1900) excl. tot. ; Rendle in Engler, Pflanzenr.

H.7 : 15, fig. 4W (1901) p.p. quoad Sumbawa et prob. Philippinen, excl. var. minor. — TYPE : Indonesia, Lesser Sunda Islands, Sumbawa Islands «In flumine Utan», s.d., *Zollinger* 3398 (holo- : B † ; lecto- : G ; iso- : L) ; *ibid.*, *Zollinger* 3386 (topo- : K, P). Lectotype designated here. — PI. XVI.

= *N. falciculata* A. Br. Journ. Bot. 2 : 278 (1864) p.p. quoad *Martens* ; Backer, Handb. Fl. Java 1 : 51 (1925) ; Backer, Onkruidflora Jav. Suikerrietgrond. : 20 (1928) ; van Steenis & Ruttner, Arch. Hydrob., Suppl. 11 : 271 (1932) ; Backer, Bekn. Fl. Java 10 (210) : 1 (1949), probably belongs here. — TYPE : Philippines, Manila, S.D., *Martens* s.n. (syn- : B † ; isosyn- : *non vidi*). India Madras, s.d., *Wight* s.n. (syn- : B † ; isosyn- : *non vidi*). No lectotype designated.

— *N. indica* auct. non (Willd.) Cham. ; Hassk., Pl. Jav. Rar. : 142 (1848) ; Zoll., Syst. Verzeichn. H.1 & 2 : 74 (1854) ; de Wilde in Van Steenis, Fl. Males. 1 (6) : 166-167 (1962) pro majore parte ; Backer, Fl. Java 3 : 11 (1968) ; Yang in Li, Fl. Taiwan 5 : 37 (1978). — *N. minor* All. var. *indica* auct. non (Willd.) A. Br., A. Br. Journ. Bot. 2 : 278 (1864) p.p. quoad Sumbawa (*Zollinger*).

— *N. indica* (Willd.) Cham. var. *macrodictya* A. Br. ex Miquel, Ill. Fl. Archip. Ind. : 44 (1871), *nomen nudum*.

— *N. indica* (Willd.) Cham. var. *rigida* A. Br. ex Miquel, Ill. Fl. Archip. Ind. : 45 (1871), *nomen nudum*.

— *N. palustris* Blanco, Fl. Filip. : 660 (1837) ; Kunth, Enum. 3 : 590 (1841) ; Navez, Nov. App. : 297 (1880) ; Rendle, Trans. Linn. Soc., ser. 2, Bot. 5 (12) : 427 (1899) ; Rendle in Engler, Pflanzenr. H.7. : 18 (1901) ; Merrill, Spec. Blanconae : 57 (1918) ; Merrill, Enum. Philip. 1 : 25 (1923).

— *N. lobata* Blanco, Fl. Filip. ed. 2 : 459-460 (1845) ; Naves, Fl. Filip. ed. 3 (3) : 65 (1879) ; Navez, Nov. App. : 298 (1880) ; Rendle, Trans. Linn. Soc., ser. 2, Bot. 5 (12) : 427 (1899) ; Rendle in Engler, Pflanzenr. H.7 : 18 (1901). — The description of *N. lobata* (1845) is word for word that one of *N. palustris* (1837). — *N. tenuifolia* Navez, Nov. App. : 297 (1880), non R. Br., Prodr. 1 : 345 (1810). — *N. paludosa* Blanco in schedula *Ramos* Bur. Science 24079 *lapsus calami* for *N. palustris* Blanco. — Probably belong here or must be considered as *species dubia*. — TYPE : we have no information about herbarium & types of Blanco.

Plants submerged, monoecious, slender. *Stems* unarmed, up to 60 cm long, 0.5-1.0 mm in diameter. *Leaves* 16-30(-39) mm long, flat, acute, linear-lanceolate, (0.5)-0.7-0.9 mm wide (incl. teeth on both sides), (0.3-)0.4-0.5 mm wide (excl. teeth on both sides) ; margin on each side serrulate with (6-)8-12(-15) rather conspicuous spiny teeth on broad excrescences ; leaf teeth 0.11-0.26 mm long ; the ratio of teeth length to leaf width being (0.2-)0.3-0.5(0.92) ; midrib without spines ; septa clearly visible up to the margin ; septa constricting the margin at least in the lower part of the leaf ; fibres absent ; leaf sheath truncate to shortly auricled (1.5-)2-2.5(-3.5) mm (incl. spine-cells) by (1.3-)1.8-2.5(-3.3) mm (ratio = (0.75-)1-1.3(-2), serrulate or lacerate with 3-6(-12) spine-cells on each side, the

auricle being (0.2-)0.4-0.5 mm long (incl. spine-cells) and 0.32-0.65(-1.13) mm wide (ratio = (0.43-)0.75-1.50), serrulate or lacerate with 3-6(-12) spine-cells on each side but no on the inner edge; apex of the auricle rather obtuse. *Inflorescences* axillary, male and female flowers on different branches or at different nodes, but the male ones more to the top of the plant. *Male flower* enclosed in a spathe, (1.4)1.7-2.1(-2.9) mm (incl. neck of spathe) by (0.3-)0.4-0.6(-0.9) mm, which tapers at the top, bearing brownish spine-cells on the apex; inner envelope protruding c.0.1 mm above the anther; anther (0.6-)1.1-1.4(-1.9) mm by (0.3-)0.4-0.6(-0.9) mm, tetrasporangiate (often difficult to observe because of the unclear division). *Female flower* naked; ovary 0.9-1.6 mm by 0.3-0.8 mm; style and stigma 1.1-2.2 mm; stigma 2-3-lobed.

Fruit with persistent, thin, membranous pericarp and the remaining parts of the style. *Seed* straight, elliptical oblong, 1.6-2(-2.4) mm by (0.5-)0.6-0.8(-0.9) mm (ratio = (2.15-)2.6-3.3(-3.8)); testa smooth, with areoles rather irregularly arranged in longitudinal rows, each row of 16-20(-22); areoles regularly to irregularly shaped, squarish to hexagonal or rectangular; (0.06-)0.09-0.125 mm long; cell walls raised.

DIAGNOSTIC FEATURES : leaf sheath truncate to auriculate; seed areoles more or less irregularly arranged per 16-20(-22) in each longitudinal row, irregularly to regularly shaped, squarish to hexagonal or rectangular; seed 1.6-2(-2.4) mm × (0.5-)0.6-0.8(-0.9) mm, not enclosed in spathe; male flower enclosed in spathe, tetrasporangiate; leaves with septa and without fibres.

NOTES : 1. Plants from Sulawesi, Java, Sumbawa and New Guinea have leaves with a constricted margin.

2. Plants from Sumbawa have 6-8(-10) teeth on each leaf margin and have seeds 2.4 × 0.6-0.8 mm while the other collections have (8-)10-15 leaf teeth and seeds 1.6-2 × 0.5-0.9 mm.

3. In some cases, the ♂ flowers are on separate branches and then clearly tetrasporangiate (1.5-1.9 mm long) while in other cases, the ♂ flowers are together with the female flowers (mostly on top of branches) and then not clearly tetrasporangiate (0.6-1.4 mm long). In the latter case, it was possible to observe 4 microsporangia after cross section of the anther though there remains some doubt for the following specimens: *Elmer* 14420, *Noerkas* 138, *van Ooststroom* 13025 and *Schröter* s.n.

4. Provided with few spines on back of midrib were: *Elmer* 18112; *Loher* 1588.

5. *N. foveolata* is recorded from rice fields in Java (*Schröter* s.n., 15.V.1927) and Bali (*Jaag* 1777).

GEOGRAPHICAL DISTRIBUTION : E. Tropical Asia and Australasia (Fig. 17).

SELECTED SPECIMENS :

Taiwan : Bakuryo, Kobi-gun, 16.VIII.1936, *Suzuki* s.n. (TAI).

Philippines : Luzon : Sorsogon prov., Irosin, X.1915, *Elmer* 14420 (BM, K, L, P, Z, ZT); Rizal Prov., XII.1915, *Ramos* Bur. Sciences 24079 (K, L, P); Buluan lake, 26.IV.1954, *Santos* 5973 (L).

Sulawesi : Tondano lake, Manado, 20.XI.1932, *Wisse* 690 (L) ; Gorontalo lake, XI.1837, *Beccari* FI 11811 (L) ; *ibid.*, *Gay* 1 (K, L) ; Senkang, 6.IV.1912, *Noerkas* 138 (K) ; Makassar, Tello river, 11.III.1906, *Ernst* 369 (Z) ; *ibid.*, between Mahassan & Bantimoeroeng, 16.VI.1938, *Jaag* 1655 (BM, L) ; «Popontollen, near Tumpaän, 27.VII.1954, *Alston* 16500 (BM).

Java : Djakarta & Antjol, s.d., *Junghuhn* s.n. (L) ; Tjenkareng, between Tangerang and Djakarta, 19.III.1950, *van Ooststroom* 13025 (L) ; Purwakarta, 15.VI.1914, *Backer* 13777 (K, L) ; Kroja, 15.V.1927, *Schröter* s.n. (ZT) ; Djepara, 5/6.1899, *Koorders* 33567 a (L) ; between Weleri & Soebah, 26.IX.1914 *Backer* 16555 (L) ; «Roemah gila», Garut, 29.X.1894, *Burck* s.n. (L) ; «Pelaga patengan», s.d., *Junghuhn* 273 (L) ; Tjankuang, «Berge um Garut», 6.XI.1905, *Ernst* 73 (L) ; Near Garut, Tjipanas, 11.II.1894, *Schiffner* (L) ; Pasuruan, 24.I.1905, *Hochreutiner* 391 (Z) ; *ibid.*, 12.V.1913, *Backer* 7780 (L).

Kangean Archipel : Sabunting, 11.V.1919, *Backer* 2990 (K).

Bali : «Kampong Tjoemarga», 21.VI.1938, *Jaag* 1777 (K, ZT).

Sumbawa : «In flumine Utan», s.d., *Zollinger* 3386 (K, P) ; *ibid.*, *Zollinger* 3398 (G, L) ; Binsa, near Raba, 14.XII.1909, *Elbert* 3776 (L) ; Kowangge, 26.XII.1909, *Elbert* 4089 (L) ; Sayoerang, XI.1879, *Colfs* 157 (L) ; s.l., s.d., *Colfs* 52 (L).

Sumba : «Karita», s.l., *Teysmann* 10680 (K).

Papua-New Guinea : Morobo Distr., Markham river, near Markham Bridge, Lae-Bulolo rd., 12.XII.1962, *Van Royen* NGF 16058 (K, L) ; *ibid.*, 7.VII.1970, *Streimann & Kair* NGF 47868 (L) ; Aush N.G., Port Moresby, *Van Royen* 4282 (L).

Australia : Northern Territory, Elcho Island, Mittjirriur swamp, 5.VII.1975, *Latz* 6115 (MEL).

Probably *N. foveolata* (without seeds) :

Philippines : Luzon : Manila, 1846, *Barthe* s.n. (P) ; *ibid.*, IX.1914, *Merrill* 519 (K, L) ; Laguna Prov., Los Banos, VI-VII.1917, *Elmer* 18112 (BM, K, L, P, Z) ; *ibid.*, 17.III.1906, *Merrill* 5109 (BR, K, L, P) ; Panganiran Prov., IV-VI.1914, *Otanes* Bur. Science 18299 (P) ; Albay, V.1908, Curran For. Bur. 12262 (K) ; Sorsogon Prov., Irosin, 11.V.1957, *Edano & Gutierrez* Phil. Nat. Herb. 40467 (K, L) ; s.l., Central Luzon, s.d., *Loher* 1588 (K).

17. *Najas grossareolata* Triest sp. nov.

Herba submersa, monoica, caulibus filiformibus. Folia 13.3-16.7 mm longa ; lamina 0.56-0.72 mm lata, marginibus utrinque 9-15 spinis 0.08-0.17 mm longis conspicuisque munitis ; vagina auriculata, 2.40 × 2.25 mm. Flores masculini sine spathella, anthera l- sporangiata. Flores feminei sine spathella. Semina 1.45 × 0.60 mm ; testa areolata ; areolae 12 per longitudinalem seriem dispositae, subquadrangulares vel quadrangulares. — TYPE : Sri Lanka, North Central Prov.,

Polonnaruwa Distr., Ellawewa, 6.IX.1970, *Balakrishnan* NBK 353 (holo- : K) ♂, ♀, fr. — Pl. XVII.

Plants submerged, monoecious, slender. *Stems* unarmed, c.0.5 mm in diameter. *Leaves* 13.3-16.7 mm long, flat, acute, linear-lanceolate, 0.56-0.72 mm wide (incl. teeth on both sides), 0.35-0.40 mm wide (excl. teeth on both sides); margin on each side serrulate with 9-15 conspicuous spiny teeth on rather small excrescences; leaf teeth 0.08-0.17 mm long; the ratio of teeth length to leaf width being 0.20-0.42; midrib without spines; septa clearly visible up to the margin, occasionally constricting the margin; fibres absent, leaf sheath truncate to lacerate c. 2.4 mm (incl. spine-cells) by 2.25 mm (ratio = 1.1), serrulate or lacerate with 4-6 spine-cells on each side, the auricle being 0.30-0.40 mm long (incl. spine-cells) and 0.25-0.30 mm wide (ratio = 1.2-1.3, serrulate or lacerate with 4-6 spine-cells on each side but no on the inner edge; apex of the auricle rather acuminate.

Inflorescences axillary, male and female flowers at different nodes, but the male ones more to the top of the plant or together at the same nodes on the top of the plant. *Male flower* naked; inner envelope protruding c.0.1 mm above the anther; anther 0.80 mm by 0.35 mm, unisporangiate. *Female flower* naked; ovary 1.0 mm by 0.64 mm; style and stigma 1.6 mm; stigma 2-lobed.

Fruit with persistent, thin, membranous pericarp and the remaining parts of the style. *Seed* straight, elliptical oblong, 1.45 mm by 0.60 mm (ratio = 2.4); testa clearly pitted with areoles, the latter irregularly arranged in longitudinal rows, each row of 12; areoles rather irregularly shaped, subquadrangular to quadrangular; c.0.12 mm long; cell walls raised.

DIAGNOSTIC FEATURES : leaf sheath truncate; seed areoles irregularly arranged per 12 in each longitudinal row, rather irregularly shaped, subquadrangular to squarish; seed 1.45 mm × 0.60 mm, not enclosed in spathe; male flower not enclosed in spathe, unisporangiate; leaves with septa and without fibres.

GEOGRAPHICAL DISTRIBUTION : Only known from the type locality, Sri Lanka (Fig. 17).

NOTE : 1. With respect to sculpture of the seed coat and to leaf morphology, very close to *N. testui*, *N. schweinfurthii*, *N. foveolata* and *N. orientalis*, however different by the naked male flower and the naked female flower.

SELECTED SPECIMEN :

Sri Lanka : North Central Prov., Polonnaruwa Distr. Ellawewa, 6.IX.1970, *Balakrishnan* NBK 353 (K).

18. *Najas minor* All.

Auct. Syn. Stirp. Horti Taur. : 3 (1773); Idem in Misc. Taurin. Phil. Math. Soc. R. Turin. 5 : 55 (1774-1776); All., Fl. Pedem. 2 : 221 (1785); Kunth, Enum. 3 : 113 (1841); A. Br., Journ. Bot. 2 : 277 (1864) p.p. excl. Bengal (Hook & Thoms.) et excl. var. β, γ, δ; Rendle, Trans. Linn. Soc., ser. 2, Bot. 5 (12) :

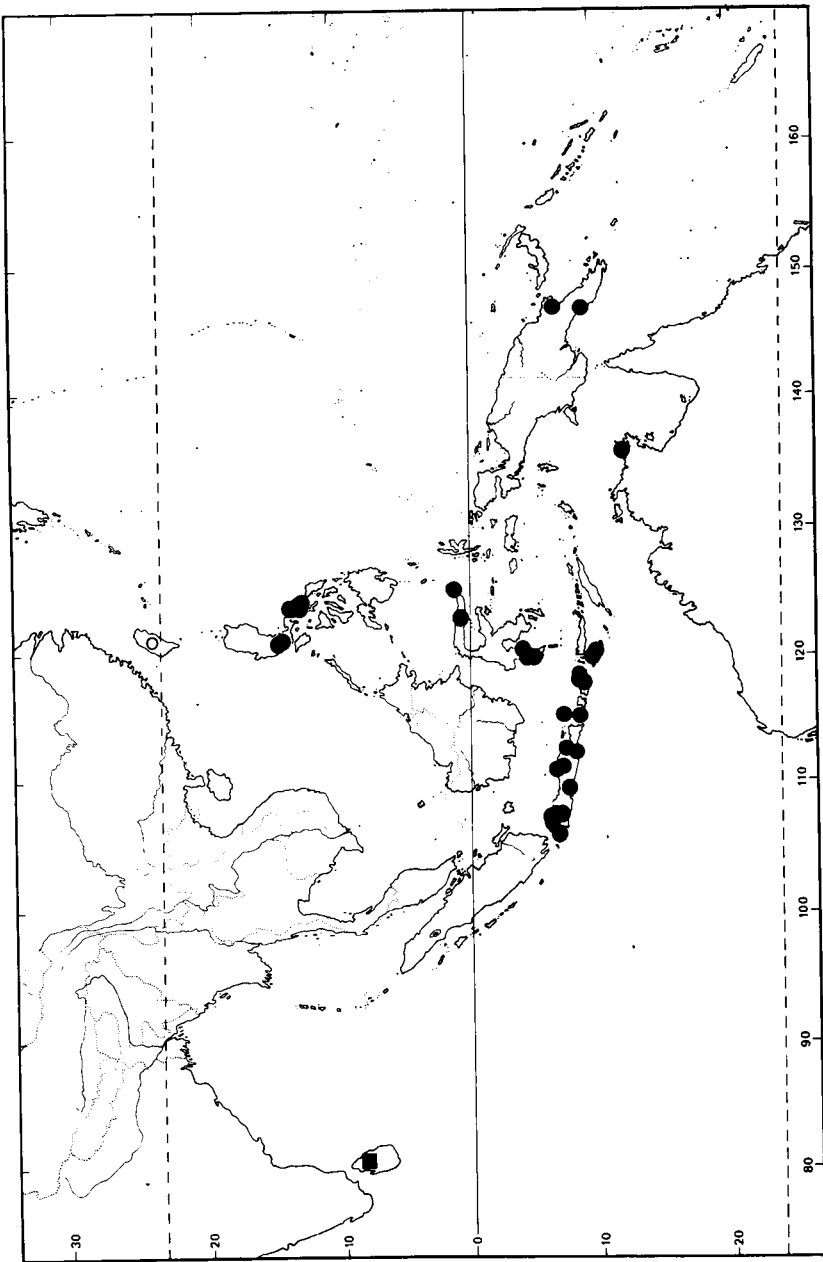


FIG. 17. — Distribution of *N. foveolata* (solid circles; uncertain locality as open circle) and *N. grossareolata* (solid square).

- 410-413, t. 41, fig. 105-115 (1899) pro majore parte, excl. India, Burma, Malacca and excl. var. *spinosa*; Rendle, *Ibid.* (13): 442 (1900); Rendle in Engler, *Pflanzenr.*, H.7: 14, fig. 1D-F, fig. 4ST (1901); Nakai, *Fl. Koreana* 2: 275 (1911); Makino & Nemoto, *Cat. Jap. Pl.*: 397 (1914); Yuzepczuk in Komarov, *Fl. USSR* 1: 273-274 (1934); Mori, *Enum. Pl. Corea*: 33 (1922); Makino, *Ill. Fl. Jap.*: 857 (1925); Makino & Nemoto, *Fl. Jap. ed 2*: 1287 (1931); Makino, *Ill. Fl. Jap.*: 888 (1948); Parsa, *Fl. Iran.* 5: 37-38 (1951); Makino, *Ill. Fl. Japan ed. 2*: 888 (1955); de Wilde in van Steenis, *Fl. Males.* 1 (6): 164-165 (1962); Ohwi (ed. Meyer & Walker) *Fl. Japan, Engl. transl.*: 124 (1965); Mouterde, *Fl. Lib.-Syr.* 1: 24 (1966); Sharma & Chatterjee, *Cytologia* 32: 287, 289 (1967); Backer, *Fl. Java* 3: 10 (1968); Dandy in Rechinger, *Fl. Iranica* 86: 2 (1971); Yang in Li, *Fl. Taiwan* 5: 39 (1978); Kitagawa, *Neo-Lineamenta Fl. Mansh.*: 60 (1979); Dandy in Tutin et al., *Fl. Eur.* 5: 14 (1980); Uotila in Davis, *Fl. Turkey* 8: 16-17 (1984), pro-majore parte; Cook, *J. Aquat. Plant Manage* 23: 1-6 (1985); You et al., *Journ. Wuhan Univ.* 4: 111-118, 131, 132 (1985); Dandy in Townsend & Guest, *Fl. Iraq* 8: 33-35 (1985); Feinbrun-Dothan, *Fl. Palaest.* 4: 18, fig. 26 (1986); Triest, *Mém. Acad. r. Sci. Outre-Mer, Cl. Sci. nat. méd., nouv. sér. in-8°*, 21 (4) [et. *Et. Cont. afr.*, 6]: 58-61, fig. 8, pl. 13 (1987). — ≡ *Fluvialis minor* (All.) Persoon, *Syn. Plant.* 2: 530 (1807). — ≡ *Itnera minor* (All.) C. C. Gmel., *Fl. Bad.* 3: 590 (1808). — ≡ *Caulinia minor* (All.) Cosson & Germain, *Fl. Paris* 2: 575 (1845); Tzvelev, *Nov. Syst. Vysh. Rast.* 13: 19 (1976); Tzvelev in Fedorov, *Fl. Eur. Tsasti S.S.S.R.* 4: 201-202 (1979). — TYPE (lecto-iconotype) Micheli, *Nov. Pl. Gen.* 2, t. 8, fig. 3 (1729). — **Pl. XVIII (A-D).**
- = *N. subulata* Thuill. *Fl. Paris, ed. 2*: 510 (1799). — TYPE: France: «Se trouve sur les bords de l'île de Charenton», *Herb. Thuillier* (holo-: *non vidi*); *ibid.* in *Herb. Delessert* (iso-: G).
- = *N. laevis* Lojacono-Pojero, *Fl. Sicula* 3: 193-194 (1908). — TYPE: Italy, Sicily, Palermo, s.d., *Herb. Pan* (*non vidi*), probably belongs to *N. minor*.
- = *N. gracilis* Kuzmin & Skvortzov in Baranov & Skvortzov, *Diagn. Pl. Nov. Mandsh.* 2, tab. 1, f. 3-5 (1943). — TYPE: China, Manshuria, «In lacus fl. Sungari prope Harbin», 7.VII.1930, *Skvortzov* s.n. (holo-: Harbin, *non vidi*) probably belongs to *N. minor*.
- = *N. minor* All. var. *mandshurica* Kuzmin & Skvortzov in Baranov & Skvortzov, *Diagn. Pl. Nov. Mandsh.*: 2, tab. 1, fig. 1-2 (1943). — TYPE: China, Manshuria, «In lacus stagnalis prope Harbin, fl. Sungari», 10.VIII.1937, *Kuzmin* s.n. (holo-: Harbin, *non vidi*) probably belongs to *N. minor*.
- *N. alagnensis* auct. non Poll.; Masé, *Atti Soc. It.* 11: 668 (1868).
- *N. australis* auct. non Rendle; Blatter & Hallberg, *Fl. Ind. Des.* 26 (4): 974 (1920); Bhandari, *Fl. Ind. Des.*: 359 (1978) probably belongs here or even under *N. indica*?

Plants submerged, monoecious, slender or robust. *Stems* unarmed, less than 0.5 mm in diameter, plumose above because of the closely packed leaves or bushy

above because of the curved leaves. *Leaves* (5-)7-22 mm long, flat, acute, linear-lanceolate, (0.32-)0.65-1.10(-1.77) mm wide (incl. teeth on both sides), (0.19-)0.40-0.53(-0.73) mm wide (excl. teeth on both sides); margin on each side serrulate with (6-)10-18 conspicuous spiny teeth on small or broad triangular excrescences; leaf teeth (0.07-)0.17-0.34(-0.52) mm long; the ratio of teeth length to leaf width being (0.11-)0.34-0.81(-0.9); midrib occasionally with spiny teeth; septa clearly visible up to the margins; fibres absent; leaf sheath 1.10-2.26 mm (incl. auricle and spine-cells) by 1.1-2.4 mm (ratio = 1-2), truncate to auriculate, the auricle being 0.13-0.37 mm long (incl. spine-cells) and 0.3-0.4 mm wide (ratio = 0.5-0.8), serrulate or lacerate with (3-)8-13 spine-cells on each side but no on the inner edge; apex of the auricle rather obtuse.

Inflorescences axillary, male and female flowers on different branches or at different nodes, but the male ones more to the top of the plant, even together at the same nodes on the top of the plant. *Male flower* enclosed in a spathe 1.6-1.9 mm (incl. spathe-neck) by 0.2-0.9 mm, the neck of the spathe being c.0.5 mm, which tapers at the top, bearing occasionally brownish spine-cells on the apex, inner envelope protruding 0.1 mm above the anther; anther 0.56-1.30 mm by 0.20-0.90 mm, unisporangiate. *Female flower* naked; 3.2-4.0 mm long; ovary 1.6-2.0 mm by 0.42-0.65 mm; style and stigma 1.6-2.3 mm; stigma 2-lobed.

Fruit with persistent, thin, membranous pericarp and the remaining parts the style. *Seed* straight, elliptical oblong, slightly curved at the apex, 1.74-2.74 mm by 0.45-0.65(-0.73) mm (ratio = 3.3-5.1); testa clearly pitted with areoles, the latter regularly and ladder-like arranged in longitudinal rows, each row of (60-)80-100; areoles rectangular; broader than long c.0.03 mm long and 0.1 mm wide.

DIAGNOSTIC FEATURES: leaf sheath truncate; seed areoles regularly arranged per (60-)80-100 in each longitudinal row, rectangular and broader than long; seed 1.74-2.74 mm × 0.45-0.65(-0.73) mm, not enclosed in spathe; male flower enclosed in spathe, unisporangiate; leaves with septa and without fibres.

NOTES: 1. *N. minor* is an easy species to distinguish when ripe seeds are available. Nevertheless, the unisporangiate anther as well as the seed length should always be verified, especially in Asian material to avoid confusion with *N. oguraensis* (with tetrasporangiate anther and somewhat larger seeds).

2. *N. minor* is very plastic in leaf shape, especially in the length of the leaf teeth. Therefore, in Northern Africa, the general appearance of *N. minor* can be very similar to *N. horrida* and *N. pectinata*. In few Asian specimens, the back of the midrib is provided with spines, similar to those on the margins (e.g. *Litwinow* 3118).

3. Found mixed with *N. orientalis* (*Uotila* 20253, *Litwinow* 2422, *Savatier* 1348) with *N. gracillima* (*Lambinon* 75/1/818, *Farras I de Blas* 1); with *N. graminea* and *N. malesiana* (*Griffith* 5609/1); with *N. ancistrocarpa* (*Jisiba* 15.X.1914); with *N. graminea* (*Bobrov & Tzvelev* 1081, 1091, *Griffith* 5609/1, *Vihodcevsky* 504); with *N. marina* subsp. *intermedia* (*Knorring* 63, *Schmid* 6606).

4. *N. minor* is an endangered species in Western Europe.

5. Specimens are recorded from rice fields in the provinces of Novara, Vercelli and

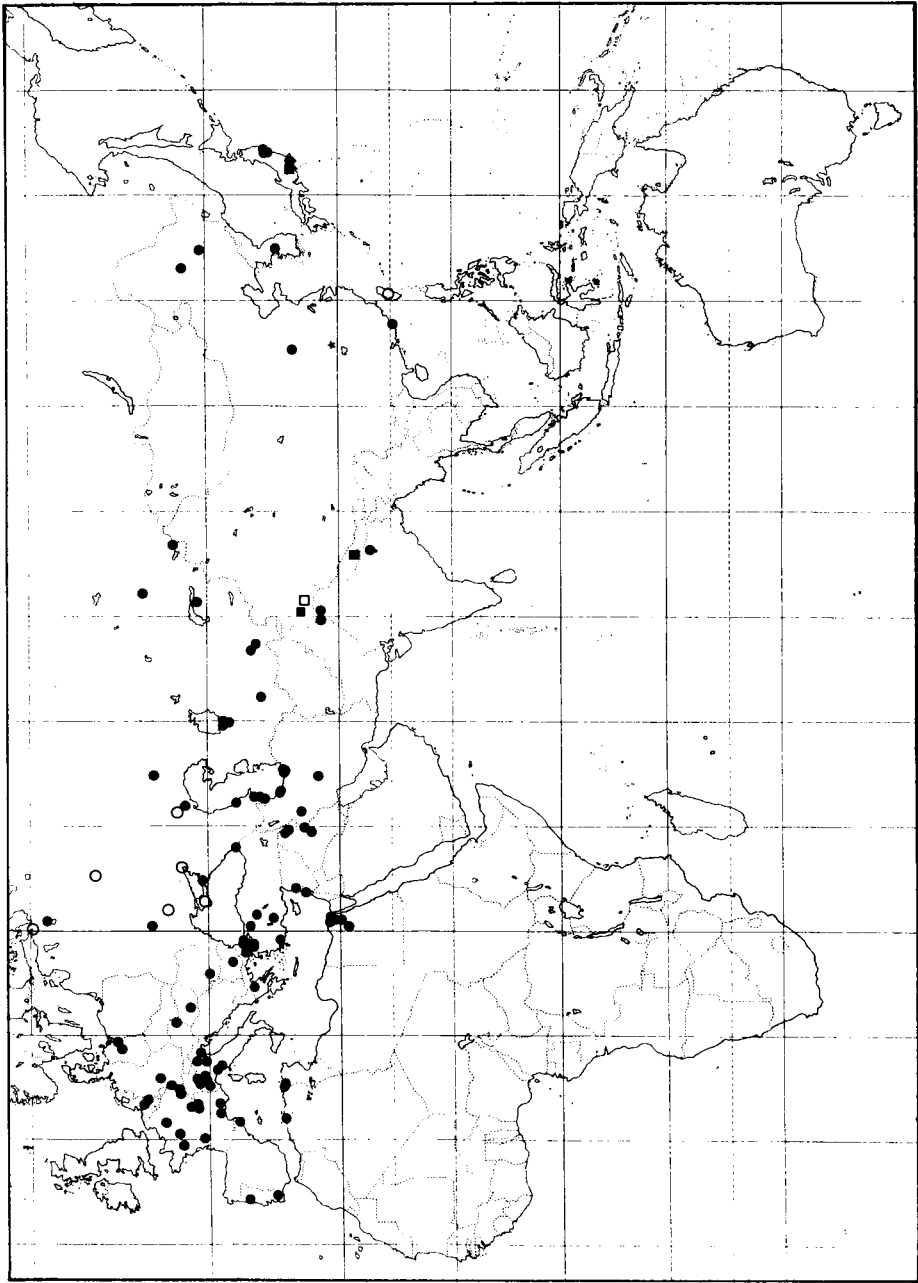


FIG. 18. — Distribution of *N. minor* (solid circles ; uncertain localities as open circles) and *N. oguraensis* (solid squares ; uncertain locality as open square). The solid star is a literature record for both species.

Pavia (Italy), Turkey (Hormia 543, Baytop 40867a), Iran (*Alexeenko* 48, *Schmid* 6605, *Uotila* 19244), Azerbaydzhan S.S.R. (*Woronow* s.n., 23.VI.1917), China (*Smith* 6819), Japan (*Cowdry* 1983, *Faurie* 7211, *Savatier* 1348).

6. ALLIONI (1785) in *Flora Pedemontana* referred to his previous work in *Miscellanea Taurinensia* (1774-1776), under «Fluvialis minor foliis angustissimis denticulatis, deorsum reflexis, fructu acuto, tenuiori, monospermo», of Mich., Nov. Pl. Gen. p. 11, tab. 8, f. 3. However, the binomial *Najas minor* was published earlier in an independently paged preprint (ALLIONI, 1773) and reprinted in a contribution of the fifth volume of the Royal Society of Turin's «Miscellanea Taurinensia» (ALLIONI, 1774-1776). These overlooked first places of publication have been discussed by TJADEN (1970) and DANDY (1970).

GEOGRAPHICAL DISTRIBUTION : temperate and temperate warm areas of Europe, N. Africa, Asia and N. America (Fig. 18).

SELECTED SPECIMENS :

Belgium : Prov. Antwerpen : Herentals, «Kempens Kanaal», VI-VII.1869, *Baguet* s.n. (LY-Gand.) ; Prov. Limburg : Hasselt, «Kempens Kanaal», VIII.1880, *C. Bamps* s.n. (LY-Gand.) ; *ibid.* 1886, *Thielens* s.n. (LY-Gand.).

France : Paris : Bois de Vincennes, Étang des Minimes, 5.IX.1913, *P. Le Brun* s.n. (BRVU). Val-de-Marne : Marne, St. Maur, 23.VIII.1873, *Herb. de Vésian* (LY-Rouy) ; «Se trouve sur les bords des îles de Charenton», *Thuillier* in *Herb. Delessert* (G). Maine-et-Loire : Angers, Maine, 24.VI.1842, *Boreau* s.n. (LY-Gand.) ; *ibid.*, 20.VII.1842, *Boreau* s.n. (MPU-Revel). Loir-et-Cher : Lanthenay, 2.IX.1861, *Martin* s.n. (LY-Gand.). Charente, Martrou, Echillais, 28.VII.1890, *Foucaud* s.n. (LY-Gand.). Bas-Rhin, Strasbourg, 1850, *Buchinger* s.n. (LY-Gand.). Doubs : «Canal du Rhône au Rhin», 16.X.1858, *Paillot* s.n. (G, LE, LY-Gand., LY-Rouy) ; Baume-les-Dames, 5.IX.1886, *Gérard* s.n. (MPU-Coste) ; Besançon, 19.VII.1870, *Paillot* s.n. (LY-Gand.). Saône-et-Loire : Le Breuil, Étang du Montaubry, VIII.1888, *Sebille* s.n. (LY-Gand.). Rhône : Lyon, 3.IX.1867, *Gandoger* s.n. (LY-Gand.). Isère : Vienne, 1.IX.1864, *Lussac* s.n. (LY-Rouy) ; *ibid.*, 6.VIII.1916, *Simon* s.n. (MPU). Loire, Montbrison, 22.VIII.1869, *Legrand* s.n. (LY-Gand.). Hérault : Montpellier, Le Lez, 1807, *Bouchet* s.n. (G) ; *ibid.*, 1834, *Bouchet* s.n. (MPU) ; *ibid.*, s.d., *Herb. Salzman* s.n. (MPU) ; Salicate, Le Lez, 10.VIII.1864, *Barrandon* s.n. (MPU). Bouches-du-Rhône : Tarascon, 12.IX.1887, *Pellat* s.n. (LY-Gand.).

Portugal : Porto, Vila Nova, 1848, *Welwitsch* 410 (LE). Alentejo Prov., VI-VII 1886, *Daveau* s.n. (MPU).

Spain : Catalunya, *Farras I de Blas* 1 (BRVU, alcohol preserv.).

Italy : Piemonte : Torino, s.d., *Balbis* s.n. (MPU-Delile) ; Varese Prov., Ispra, 16.IX.1975, *Lambinon* 75/1/818 (WAG) ; Lago di Mergozzo, Pallanza, 23.VI.1947, *Koch* 47/221 (ZT) ; Novara, Vercelli, VIII.1875, *Gibelli* s.n. (ZT) ; *ibid.*, Villarboit, 30.IX.1982, *Triest, Cook & Vuille* 121 ; 130 (BRVU) ; Lombardia : Pavia, 1881, Coll. ? (LY-Gand.) ; N. of Zeltata, 11.IX.1980, *Cook* 1133 (Z) ;

Trentino-Alto Adige : Trento, 25.VII.1887, *Gehmi* (LY-Gand., LY-Rouy) ; Veneto : Verona, Peschiera, 28.VIII.1897, *Rigo* s.n., (LY-Gand.) ; ibid. VIII.1904, *Rigo* s.n. (LY-Bonaparte) ; Venetia, VII.1870, *Goiran* s.n. (FI) ; Liguria : La Spezia, IX.1857, s. coll., LY-Gand.) ; Toscana : Pisa, 27.VII.1808, Herb. *de Candolle* s.n. (G).

Federal Republic Germany : Rheinland-Pfalz : Mannheim, s.d., Herb. *Delile* s.n. (MPU) ; Berlin, «Grünwald», *Fritsche* (LE).

German Democratic Republic : Brandenburg : Angermünde, Parsteiner See, s.d., *Braun* s.n. (LY-Gand.).

Switzerland : Ticino : Lago di Lugano, 11 & 12.IX.1931, *Koch* s.n. (TUR).

Czechoslovakia : Bratislava (Pressburg), 1867, *Gottlieb* s.n. (LY-Gand.).

Hungary : Kalocsa, VII.1877, *Haynald* s.n. (LY-Gand., LY-Rouy).

Romania : Oltenia, Mehedinti Distr., 29.VIII.1944, *Țopa* Fl. Rom. Exc. 2619 (G).

Bulgaria : Plovdiv, Ribarnika, 24.X.1954, *Vihodcevsky* 504 (G, H, LE) ; ibid. («Philippopolis»), 21.V.1888, *Charrel* s.n. (LY-Gand.).

Yugoslavia : «Fl. Croatica», s.d., Herb. *Schlosser* s.n. (LE).

Greece : Macedonia, 1889, *Charrel* s.n. (LY-Gand.). Thessalia, Between Trikkala & Larisa, 30.VII.1885, *Haussknecht* s.n. (LE).

Turkey : Turkey-in-Europe : Edirne, 1 km W Ipsala, 5.IX.1972, *Uotila* 20253 (H, Z) ; Istanbul, Durusu (Terkos Gölü), 12.VII.1978, *Uotila & Baytop* 27364 (H) ; ibid., 12.VII.1978, *Baytop & Uotila* 40250 (ISTE) ; Terkos to Karaburum, 9.X.1967, *Baytop* 12201 (ISTE) ; Ormanli to Hisarbeyli, 29.IX.1967, *Baytop* 12120 (E, ISTE) ; Izmit, Sapanca Gölü, 1.IX.1972, *Uotila* 20151 (H) ; Canakkale, Güleçköyü, 16 km S Karabiga, 22.VII.1981, *Uotila* 30405 (H) ; ibid., 22.VII.1981, *Hormia* 543 (H) ; Ankara, Kizilcahamam, 19.VIII.1978, *Baytop*, 40867a (ISTE) ; Mugla, between Koycegiz to Gökova, Kara Gölü, 30.VI.1979, *Seçmen & Leblebici* 2872a (H) ; ibid., 26.VII.1981, *Uotila & Leblebici* 30629 (H) ; Konya, E of Beysehir Gölü, 12 km from Beysehir to Sarkiharaagaç, 29.VII.1979, *Seçmen, Leblebici & Behat* 3002 (H) ; ibid., 3.VIII.1978, *Baytop, Tuzlaci & Meriçli* 41429 (ISTE).

U.S.S.R. (Europe) : Novgorod, 1-13.VII.1895, *Boridine* s.n. (LY-Gand.) ; Kiev, 1867, *Rogowicz* s.n. (LY-Gand.) ; Kiev, 1903, *Ostanuov* s.n. (LE) ; Astrakhan, Delta Volga, 12.VIII.1965, *Tzvelev & Kolesnikova* 304 (LE, TUR) ; Temryuk, 9.VIII.1926, *Schiffers* 1901 (LE) ; Astrakhan, 1818/78 ?, *Baer*.

U.S.S.R. (Asia) : Dagestan A.S.S.R. ; Derbent, 2.VII.1961, *Tzvelev & al.* 2756 (LE) ; Azerbaydzhan A.S.S.R. : Baku, near Lenkoran, 23.VI.1917, Herb. *Woronov* s.n. (LE) ; ibid., Port Il'ich, 15.VII.1963, *Bobrov & Tzvelev* 317 (LE) ; ibid., Astara, 22.VII.1963, *Bobrov & Tzvelev* 728 (LE) ; ibid., near Shurun, 30.VII.1963, *Bobrov & Tzvelev* 1081 ; 1091 (LE) ; Ali-Bayramli, Lake Adzhikabul, 10.VIII.1963, *Bobrov & Tzvelev* 1266 (LE) ; Gruzija A.S.S.R. (Georgia) ; Batumi, 1917, Herb. *Woronov* s.n. (LE). Kazakhstan A.S.S.R. : Between Uralsk & Ilinskoe, 27.VII.1927, *Rozhebij & Zhezheh* 705 (LE) ; Pavlodar, near Lebyazh'ye 17.VIII.1955, *Tzvelev* 1861 (LE). Altai, Kaldzhirska plain, Kaldzhir, near river Irtysh, 17.VIII.1908, *Kellerom* s.n.

(LE) ; Markakol, near Irtysh, 9.VIII.1930, *Goncharov & Borisova* 1018 (LE) ; Lake Balchaz, Karatal river, 10.VII.1930, *Cherniakowska* 147 (LE). Turkmenistan (Kara-kum) : Bukhara, 5.VIII.1913, *Androsov* s.n. (LE) ; *ibid.*, 15.VIII.1913, *Androsov* s.n. (LE). Uzbekistan (Kizil-kum) : Amu-Darya Delta : 14.VII.1873, *Karolkow & Krause* (LE) ; *ibid.*, 14.VII.1911, *Molchanov* s.n. (LE) ; *ibid.*, 21.VI.1921, *Raikova* 585 (LE) ; *ibid.*, 18.IX.1925, *Knorring* 63 (LE) ; *ibid.*, 22.VI.1928, *Rusanov* 115 (LE) ; *ibid.*, 13.VII.1928, *Rusanov* 345 (LE) ; *ibid.*, 7.VI.1953, *Rodin & al.* 577 (LE) ; *ibid.*, 20.VII.1953, *Katanskaja* s.n. (LE) ; *ibid.*, 29.VII.1954, *Katanskaja* s.n. (LE) ; Tashkent prov., 2.VII.1957, *Ergashchov* 237 (LE) ; Kokand Prov., 4.VII.1934, *Prozorowski* 39 (LE).

Lebanon : «Lit du Nahr Beyrouth», X.1947, *Napoléon* NP20 (G) ; «Nahr Beyrouth», 5.IX.1931, Herb. *Mouterde* 472 (G) ;

Syria : «Nahr Abrach, vers Hamidié», 24.VI.1934, Herb. *Mouterde* 3226 (G) ; *ibid.*, *Gombault* 2793 (P). Birket-er-Râm, 26.VII.1892. Herb. *Post* 295 (BM, G, K).

Iraq : Kurdistan, between Arbil and Altin Köprü, 1867, *Haussknecht* s.n. (K, LE) ; Kirkuk, Hawija, s.d., *Lyman & Rawi* 15158 (K) ; Bagdad, Zafarariyah, s.d., *Haines* s.n. (E) ; Darbandikhan, 30 km Diyala, 25.X.1960, *Agnew, Hadai, Haines* s.n. (E).

Iran : Gilan Prov., near Rasht, 13.VII.1902, *Alexeenko* 48 (LE) ; 69 (LE) ; *ibid.*, 6.IX.1956, *Schmid* 6605 (G) ; 6606 (G). Mazandaran Prov., 5 km E Babol, 7.VIII.1972, *Uotila* 19244 (H, Z) ; 5 km N Amol, 8.VIII.1972, *Uotila* 19272a (H) ; 20 km E Chalus, 9.VIII.1972, *Uotila* 19327 (H, LE, M, Z). Luristan Prov., Sarab-e Nilufar, near Kermansjah, IX.1867, *Haussknecht* s.n. (BM, K, LE) ; Esfahan Prov., near Esfahan, IX.1868, *Haussknecht* s.n. (BM, K, LE).

Afghanistan : s.l., s.d., Herb. *Griffith* 5 (K).

Pakistan : Lahore, 40 km NW of Lahore on road to Rawalpindi, 7.VII.1972, *Uotila* 18363 (H, Z) ; «Embouchure de l'Askalos-Dère, près Bluzé», 21.IX.1866, *Balansa* s.n. (K, P).

India : Punjab, N. of Jullundur, 15 km N Mukerian, 1.VII.1972, *Uotila* 18230 (H, K, Z) (could also belong to *N. oguraensis*).

Bangla Desh : «East Bengal», *Griffith* 5609/1 (M) ; Bihar, Champaran 7.IV.1963, *Thothathri* 9940 (CAL).

China : Manchuria, «Tsitsikar», Ch'i-ch'i-ha-erh, 10.VIII.1902, *Litwinow* 2422 (BM, LE) ; «Charbin», Ha-erh-pin, 8.VIII.1902, *Litwinow* 2329 (LE) ; *ibid.*, Sungari river, 10.VIII.1903, *Litwinow* 3118 (BM, LE) ; near Kin Chau, VII.1893, *Newton* s.n. (BM) ; Shansi, Chin-shui, 10.VIII.1924, *Smith* 6819 (BM) ; Kwangtung, «Swatow», Shan-tou, 3.IV.1901, Herb. *Dalziel* s.n. (E).

Taiwan : Sun Moon Lake, Mantou Hsien, 2.VIII.1971, *Huang* 5653 c (TAI).

S. Korea : Seoul river, 23.IX.1901, *Faurie* 680 (G, P).

Japan : Pref. Miyagi, Katura Isl., 15.X.1914, *Jisiba* s.n. (G) ; Lake Onuma, 22.VIII.1931, *G. & A. Claraz Schenkung.* s.n. (Z) ; Yokoska, 1866-74, *Savatier* 1348 (P) ; Kalgan Chihli, VIII.1921, *Cowdry* 1983 (K) ; «Fatssaumo», s.d., Herb.

Drake 470 (P). Tokyo Prov., 31.VIII.1910, *Sakurai* s.n. (H) ; *Shiogama*, X.1905, *Faurie* 7211 (BM).

19. *Najas oguraensis* Miki

Bot. Mag. Tokyo 49 : 775-776 (1935) ; Ohwi (ed. Meyer & Walker), Fl. Japan, Engl. transl. : 124 (1965) ; You et al., Journ. Wuhan Univ. 4 : 111-118, 131, 132 (1985). — ≡ *Caulinia oguraensis* (Miki) Nakai, Ord. Fam. etc. : 212 (1943). — TYPE : Japan, Prov. Yamashiro, Oguranoike, VII.1923, *Miki* s.n. (lecto- : OSA, *non vidi*) ; *ibid.*, VIII.1934, *Miki* s.n. (syn- : OSA, *non vidi*). Lectotype designated here (drawings of Miki, 1935b, are based on specimen collected on VII.1923). — Pl. XVIII, E-F.

— *N. minor* auct. non All. ; Stewart in Nasir & Ali, Fl. West Pakistan : 31 (1972) p.p. quoad RRS 3347 (perhaps more cited specimens belong to *N. oguraensis*).

Plants submerged, monoecious, slender. *Stems* unarmed, up to 100 cm long, 1-1.4 mm in diameter. *Leaves* 15-30 mm long, flat, acute, linear-lanceolate, 0.59-0.70 mm wide (incl. teeth on both sides), 0.29-0.40 mm wide (excl. teeth on both sides) ; margin on each side serrulate with 8-15 conspicuous spiny teeth on broad excrescences ; leaf teeth c. 0.15 mm long ; the ratio of teeth length to leaf width being c.0.52 ; midrib without spines ; septa clearly visible up to the margin ; fibres absent ; leaf sheath slightly auricled, 2.7-3.0 mm (incl. spine-cells) by 1.9-3.0 mm (ratio = 1-1.4) serrulate or lacerate with 6-19 spine-cells on each side, the auricle being 0.40 mm long (incl. spine-cells) and c. 0.2 mm wide (ratio = c. 1.5), serrulate or lacerate with 6-19 spine-cells on each side but no on the inner edge ; apex of the auricle obtuse.

Inflorescences axillary, male and female flowers at different nodes, but the male ones more to the top of the plant. *Male flower* enclosed in a spathe, 2.3-2.5 mm (incl. neck of spathe) by 0.6 mm, which tapers at the top, bearing brownish spine-cells on the apex ; inner envelope protruding 0.16-0.32 mm above the anther ; anther 1.3-1.8 mm by 0.5-0.7 mm, tetrasporangiate. *Female flower* naked ; ovary 1-1.5 mm by 0.3-0.4 mm ; style and stigma c.1 mm ; stigma 2-lobed.

Fruit with persistent, thin, membranous pericarp and the remaining parts of the style. *Seed* slightly curved at the apex, elliptical oblong, 2.6-3.5 mm by 0.64-0.77 mm (ratio = 4-4.4) ; testa clearly pitted with areoles, the latter regularly and ladder-like arranged in longitudinal rows, each row of 80-100 ; areoles rectangular, broader than long, c. 0.03 mm long and 0.1 mm wide ; cell walls arranged ladder-like.

DIAGNOSTIC FEATURES : leaf sheath truncate ; seed areoles regularly arranged per 80-100 in each longitudinal row, rectangular and broader than long ; seed 2.6-3.5 mm × 0.64-0.77 mm, not enclosed in spathe ; male flower enclosed in spathe, tetrasporangiate ; leaves with septa and without fibres.

NOTES : 1. An imperfectly known species, perhaps more widespread in the Far East ; certainly overlooked because of the large similarity with the common *N. minor*.

2. Besides the cited specimen, also reported from Japan (MIKI, 1935b) and China (YOU *et al.*, 1985).

GEOGRAPHICAL DISTRIBUTION : N. India, Nepal, China and Japan (Fig. 18).

SELECTED SPECIMENS :

India : Kashmir, Srinagar, Dal Lake, 17.VIII.1917, *Stewart* 3347 (K) ; *ibid.*, 4.VII.1937, *Ludlow & Sheriff* 2 (BM) ; Manasbal, 25.VI.1940, *Ludlow & Sheriff* 7674 (BM). s.l., s.d., Herb. Lugd. Bat. 908.139-1060 (L).

Nepal : Pokhara, 11.IX.1954, *Stainton et al.* 7159 (BM).

Japan : 40 km from Tokyo, Teganuma, 1933, *Nakano* s.n. (L).

20. *Najas hagerupii* Horn af Rantzien

Kew Bull. 7, 1 : 35-38, fig. 3 (1952) ; Triest, Mém. Acad. r. Sci. Outre-Mer, Cl. Sci. nat. méd., nouv. sér. in-8°, 21 (4) [et Et. Cont. afr., 6] : 61-64, fig. 9, pl. 14 (1987).

DIAGNOSTIC FEATURES : leaf sheath truncate to auriculate ; seed areoles regularly arranged per 21-30 in each longitudinal row, squarish to hexagonal ; seed 1.3-1.8(-1.9) mm × 0.37-0.45 mm, not enclosed in spathe ; male flower enclosed in spathe, unisporangiate ; leaves without septa and with fibres on and near both sides of the midrib and near each margin.

GEOGRAPHICAL DISTRIBUTION : West tropical Africa and Central African Republic.

21. *Najas setacea* (A. Br.) Rendle

Trans. Linn. Soc., ser. 2, Bot. 5 (12) : 422, pl. 42, fig. 177-182 (1899) ; Triest, Mém. Acad. r. Sci. Outre-Mer, Cl. Sci. nat. méd., nouv. sér. in-8°, 21 (4) [et Et. Cont. afr., 6] : 64-65, fig. 11, pl. 15 (1987) ; Triest, Bull. Jard. bot. nat. Belg. 58 : 260-261 (1988).

DIAGNOSTIC FEATURES : leaf sheath truncate to auriculate ; seed areoles regularly arranged per 28-36 in each longitudinal row, squarish ; seed 1.4-1.77 mm × 0.43-0.55 mm, not enclosed in spathe ; male flower enclosed in spathe, unisporangiate ; leaves without septa and without fibres.

GEOGRAPHICAL DISTRIBUTION : Aldabra, Seychelles, Mauritius, N. Madagascar and S.E. Africa [see Distr. (l. Afr. 35 : map 1188 (1988))].

22. *Najas halophila* Triest sp. nov.

Herba submersa, monoica, caulibus filiformibus. Folia 11-22 mm longa ; lamina 0.32-0.91 mm lata, marginibus utrinque 13-24 spinis (0.04-)0.06-0.12(-0.15) mm longis conspicuisque munitis ; vagina auriculata, 1.12-1.90 × 1.21-1.90(-2.30) mm. Flores masculini in spathella, anthera l-sporangiata. Flores feminei sine spathella.

Semina 1.61-1.70 × 0.42-0.62 mm ; testa areolata ; areolae 40-50 per longitudinalem seriem dispositae, quadrangulares vel hexagonales. — TYPE : Java, Koewoe, «Zoutwatervijver bij grote Bladoeg», 26.I.1913, Backer 6540 (holo- : L ♂, ♀, fr. ; iso- : K). — PI. XIX.

— *N. falciculata* auct. non A. Br. ; Rendle, Trans. Linn. Soc., ser. 2, Bot. 5 (12) : 417-418 (1899) p.p. quoad *Horsfield* ; Rendle in Engler, Pflanzenr. H.7 : 15-16 (1901) p.p. quoad *Horsfield*.

— *N. browniana* auct. non Rendle ; de Wilde in van Steenis, Fl. Males 1 (6) : 165-166 (1962) excl. type ; Backer, Fl. Java 3 : 11 (1968) ; Yang, Taiwania 19 : 106 (1974) ; Yang in Li, Fl. Taiwan 5 : 37 (1978).

Plants submerged, monoecious, slender. *Stems* unarmed, c. 0.5 mm in diameter. *Leaves* 11-22 mm long, flat, acute, linear-lanceolate, 0.32-0.91 mm wide (incl. teeth on both sides), 0.20-0.60 mm wide (excl. teeth on both sides) ; margin on each side serrulate with 13-24 rather conspicuous spiny teeth on small excrescences ; leaf teeth (0.04-)0.06-0.12(-0.15) mm long ; the ratio of teeth length to leaf width being 0.15-0.53 ; midrib without spines ; septa absent ; fibres absent ; leaf sheath slightly auricled, truncate to lacerate 1.12-1.9 mm (incl. spine-cells) by 1.21-1.9(-2.3) mm (ratio = 0.76-1.3), serrulate or lacerate with 2-12 spine-cells on each side, the auricle being 0.15-0.4 mm long (incl. spine-cells) and 0.20-0.3(-0.52) mm wide (ratio = (0.7-)1-1.6), serrulate or lacerate with 2-12 spine-cells on each side but no on the inner edge ; apex of the auricle rather acuminate.

Inflorescences axillary, male and female flowers at different nodes, but the male ones more to the top of the plant or together at the same nodes on the top of the plant. *Male flower* enclosed in a spathe, 0.7-0.8 mm (incl. neck of spathe) by 0.25 mm, which tapers at the top, bearing brownish spine-cells on the apex ; inner envelope protruding c. 0.1 mm above the anther ; anther 0.60-0.65 mm by 0.20 mm, unisporangiate. *Female flower* naked ; ovary 0.6-1.6 mm by 0.16-0.42 mm ; style and stigma 0.6 mm ; stigma 2-3-lobed.

Fruit with persistent, thin, membranous pericarp and the remaining parts of the style. *Seed* straight, elliptical oblong, 1.61-1.70 mm by 0.42-0.62 mm (ratio = 2.74-3.8) ; testa clearly pitted with areoles, the latter regularly arranged in longitudinal rows, each row of 40-50 ; areoles squarish to hexagonal, 0.03-0.04 mm long ; cell walls not raised.

DIAGNOSTIC FEATURES : leaf sheath truncate to auriculate ; seed areoles regularly arranged per 40-50 in each longitudinal row, squarish to hexagonal ; seed 1.61-1.70 mm × 0.42-0.62 mm, not enclosed in spathe ; male flower enclosed in spathe, unisporangiate ; leaves without septa and without fibres.

NOTES : 1. All localities are coastal waterbodies, with brackish or salt water.

2. Close to *N. browniana*, but the leaves and seeds are different (fibres lacking ; leaf teeth larger ; seeds shorter ; areoles smaller in *N. halophila*).

GEOGRAPHICAL DISTRIBUTION : S.E. Tropical Asia, Australia, New Guinea (Fig. 44).

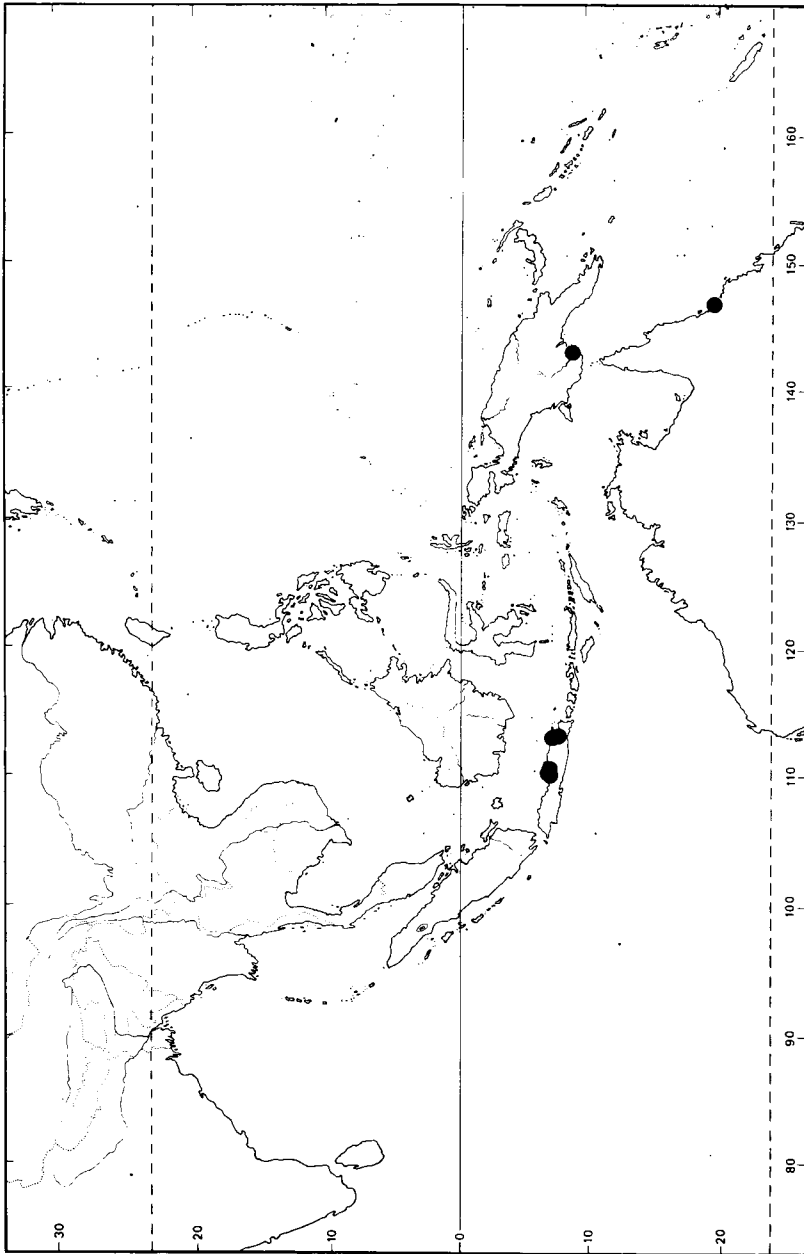


FIG. 19. — Distribution of *N. halophila*.

SELECTED SPECIMENS :

Java : Semarang, 1802-18, *Horsfield* s.n. (L) ; Madura, Bangkalan, 26.II.1915, *Backer* 19319 (L) ; Koewoe, s.d., *Koorders* 42665 (L) ; *ibid.*, 26.I.1913, *Backer* 6540 (K, L) ; «Kepoetik», 2.IV.1933, *Rant* 1073 (L).

New Guinea-Papua : Coast between Oriono & Fly rivers, IV.1936, *Brass* 6471 (BM, L).

Australia : Queensland : Ayr, IV.1958, *George* s.n. (K, L).

Prob. *N. halophila* :

Indonesia : Madura, Bangkalan, 26.II.1915, *Backer* 19139 (K).

23. *Najas browniana* Rendle

Trans. Linn. Soc., ser. 2, Bot. 5 (12) : 420, t. 42 f. 163-167 (1899) ; Rendle in Engler, Pflanzenr. H.7 : 17 (1901) ; de Wilde in Van Steenis, Fl. Males. 1 (6) : 165-166 (1962), p.p. quoad type collection ; Aston, Aq. Pl. Austr. : 259 (1973).
— TYPE : Australia, Northern Territory, Cavern Isl., Gulf of Carpentaria, 14.I.1803, *Brown* s.n. (holo- : BM). — PL. XX.

Plants submerged, monoecious, slender. *Stems* unarmed, c.0.5 mm in diameter. *Leaves* 10-18 mm long, flat, acute, linear-lanceolate, 0.30-0.40 mm wide (incl. teeth on both sides), 0.16-0.27 mm wide (excl. teeth on both sides) ; margin on each side serrulate with 10-25(45) rather conspicuous spiny teeth ; leaf teeth 0.05-0.16 mm long ; the ratio of teeth length to leaf width being 0.18-0.50 ; midrib without spines ; septa present ; fibres absent ; leaf sheath shortly auricled, 1.3-1.7 mm (incl. spine-cells) by 1.1-1.3 mm (ratio = 1.2.-1.4), serrulate or lacerate with 4-6 spine-cells on each side, the auricle being 0.3-0.5 mm long (incl. spine-cells) and 0.18-0.25 mm wide (ratio = 1.2-2.5) serrulate or lacerate with 4-6 spine-cells on each side and (0-)2-3 on the inner edge ; apex of the auricle rather obtuse.

Inflorescences axillary, male and female flowers at different nodes, but the male ones more to the top of the plant or together at the same nodes on the top of the plant. *Male flower* enclosed in a spathe, c.1.8 mm (incl. neck of spathe) by 0.3 mm, which tapers at the top, bearing brownish spine-cells on the apex ; inner envelope protruding 0.25 mm above the anther ; anther 1 mm by 0.3 mm, unisporangiate. *Female flower* naked ; ovary 0.5-0.7 mm by 0.25 mm ; style and stigma 0.4-0.7 mm ; stigma 2-3-lobed.

Fruit with persistent, thin, membranous pericarp and the remaining parts of the style. *Seed* straight, elliptical oblong, (0.7-)0.9-1.3(-1.7) mm by 0.3-0.5 mm (ratio = 2.2-3.9) ; testa clearly pitted with areoles, the latter regularly arranged in longitudinal rows, each row of 18-25(35) ; areoles squarish to hexagonal ; 0.03-0.05 mm long ; cell walls not raised.

DIAGNOSTIC FEATURES : leaf sheath shortly auriculate ; seed areoles regularly arranged per 18-25(-35) in each longitudinal row, squarish to hexagonal ; seed

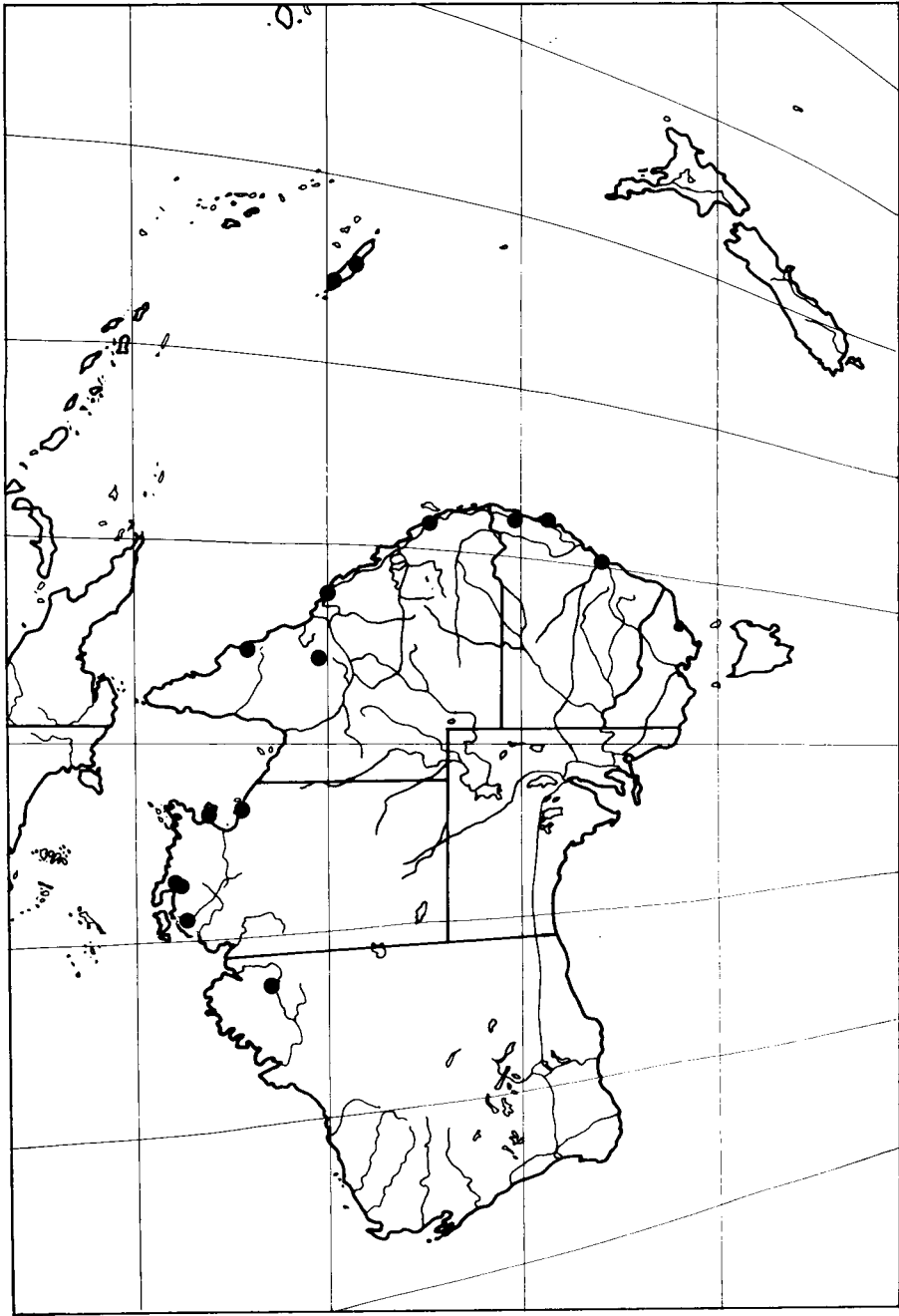


FIG. 20. — Distribution of *N. browniana*.

(0.7-)0.9-1.3(-1.7) mm × 0.3-0.5 mm, not enclosed in spathe ; male flower enclosed in spathe, unisporangiate ; leaves with septa and without fibres.

GEOGRAPHICAL DISTRIBUTION : Australia (Fig. 20).

SELECTED SPECIMENS :

Australia : West Australia : S.E. Kimberley, 17 km S. Turkey Creek, 14.V.1984, *Willis* MEL 1534536 (MEL) ; Albion, White water, 1892, *Birck* MEL 108983 (MEL). Northern Territory : Adelaide river flood plain, 17.IV.1980, *Rankin* 2238 (K) ; Mudginberry station, 5 km N. Homestead, 20.VII.1980, *Henshall* 3354 (MEL) ; Jabiru, Coonjimba Billabong, 21.VII.1980, *Henshall* 3361 (MEL) ; Cavern Islands, 14.I.1803, *Brown* s.n. (BM) ; Caranbiri lagoon, approx. 140 km from mouth of McArthur river, 3.III.1978, *Sharam* NSW 180800 (NSW). Queensland : 18 km N. Lyndhurst homestead, 24.V.1982, *Aston* 2292 (MEL) ; Bowen, V.1981, *Jacobs* 4049 (NSW) ; 10 km W. Agnes waters, 8.V.1981, *Jacobs* 3987 (NSW) ; Daintree river, 1890, *Pentzcke* MEL 108979 (MEL) ; *ibid.*, 1928-29, *Tandy Geoffrey* s.n. (BM) ; Port Jackson, 1892, *Leary* MEL 532043 (MEL). New South Wales : 2 km W. Pillar Valley, 9.III.1978, *Jacobs* 3316 (NSW) ; E. Kempsey, I.1971, *Johnson* 6805 (MEL). Probably *N. browniana* (male flower non vidi) : New Caledonia : Ouégoa, Diahot river, 8.I.1961, *McKee* 8010 (K) ; Houailu, 31.XII.1960, *McKee* 7858 (K).

24. *Najas kurziana* Rendle

Trans. Linn. Soc., ser. 2, Bot. 5 (12) : 413-414 pl. 41 f. 116-121 (1899) ; Rendle in Engler, Pflanzenr. H.7 : 15 fig. 411 (1901) ; Haines, Bot. Bihar & Orissa : 851 (1924) ; Horn af Rantz., Kew Bull. : 37 (1952) ; de Wilde in van Steenis, Fl. Males. 1 (6) : 165 (1962) p.p. quoad *Kurz* s.n. — TYPE : India, Madhya Pradesh «Between Kishengarh and Oolabena», 26.IX.1868, *Kurz* s.n. (holo- : CAL, non vidi ; iso- : BM). — **Pl. XXI.**

Plants submerged, monoecious, slender. *Stems* unarmed, c.1 mm in diameter. *Leaves* 15-22 mm long, flat, acute, linear-lanceolate, 0.43-0.45 mm wide (incl. teeth on both sides), 0.34-0.37 mm wide (excl. teeth on both sides) ; margin on each side serrulate with (20-)30-40(-58) inconspicuous spiny teeth ; leaf teeth 0.03-0.065 mm long ; the ratio of teeth length to leaf width being 0.08-0.19 ; midrib without spines ; septa absent ; fibres on or near both sides of the midrib and eventually near each margin or absent ; leaf sheath shortly auricled to longly auricled, 1.5-1.6 mm (incl. spine-cells) by 0.8-1.12 mm (ratio = 1.4-1.8), serrulate or lacerate with 3-8 spine-cells on each side, the auricle being 0.27-0.48 mm long (incl. spine-cells) and 0.20-0.32 mm wide (ratio = 0.84-2.4), serrulate or lacerate with 3-8 spine-cells on each side but none on the inner edge ; apex of the auricle rather acuminate.

Inflorescences axillary, male and female flowers at different nodes, but the male ones more to the top of the plant or together at the same nodes on the top of the plant. *Male flower* enclosed in a spathe 0.7-1 mm (incl. neck of spathe) by 0.2 mm,

which tapers at the top, bearing brownish spine-cells on the apex ; inner envelope protruding c.0.1 mm above the anther ; anther 0.5-0.6 mm by 0.16 mm, unisporangiate. *Female flower* naked ; ovary 0.6 mm by 0.35 mm ; style and stigma 0.6 mm ; stigma 2-3 lobed.

Fruit with persistent, thin, membranous pericarp and the remaining parts of the style. *Seed* straight, elliptical oblong, 1.0-1.3 mm by 0.4-0.5 mm (ratio = 2.5-2.6) ; testa clearly pitted with areoles, the latter regularly arranged in longitudinal rows, each row of 16-20 ; areoles squarish to hexagonal, 0.06-0.07 mm long ; cell walls not raised.

DIAGNOSTIC FEATURES : leaf sheath truncate to auriculate ; seed areoles regularly arranged per 16-20 in each longitudinal row, squarish to hexagonal ; seed 1.0-1.3 mm × 0.4-0.5 mm, not enclosed in spathe ; male flower enclosed in spathe, unisporangiate ; leaves without septa and without or with fibres on or near both sides of the midrib and eventually near each margin.

NOTES : 1. A rare and imperfectly known species.

2. The two specimens cited here were fertile (♂, ♀, fr.) but differ somewhat in leaf characters.

GEOGRAPHICAL DISTRIBUTION : India (Fig. 21).

SELECTED SPECIMENS :

India : Madhya Pradesh State : between Kishengarh and Oolabena, 26.IX.1868, Kurz s.n. (BM) ; Tuwa, s.d., Dashpande 1728 (L).

Probably *N. kurziana* or *N. malesiana* (seeds 0.8-1.0 mm ; 18-20 areoles per length row) but male flower not observed :

India : West Bengal, «Narkelbaria», 12.IX.1962, Ghosh 956 (CAL) ; «Mluberia», 11.X.1965, Bennet 1197 (CAL).

25. *Najas celebica* Koorders

Minahassa, Meded. 's Lands Plantentuin 19 : 270, 637 (1898) ; Rendle in Engler, Pflanzenr. H.7 : 18 (1901) ut species dubia vel excludenda ; Koorders-Schum, Syst. verz. (Cel.) 9 (1914). — = *N. tenuifolia* R. Br. subsp. *pseudograminea* (Koch) de Wilde var. *celebica* (Koord.) de Wilde ; de Wilde in van Steenis, Fl. Males. 1 (6) : 168-169 (1962). — TYPE : Sulawesi, Tondano Lake, s.d., Koorders s.n. (holo- : BO, *non vidi*). — Pl. XXII, A-E.

— *N. tenuifolia* auct. non R. Br. subsp. *tenuifolia* ; de Wilde in van Steenis, Fl. Males. 1 (6) : 167-168 (1962) p.p. quoad Beccari 11810.

— *N. graminea* auct. non Del. : Miquel, Ill. Fl. Archip. Ind. 45 (1871), p.p.

Plants submerged, monoecious, slender. *Stems* unarmed, c.1 mm in diameter. *Leaves* 13.3-30 mm long, flat, acute, linear-lanceolate, 0.63-0.81(-1.2) mm wide (incl. teeth on both sides), 0.47-0.68 mm wide (excl. teeth on both sides) ; margin

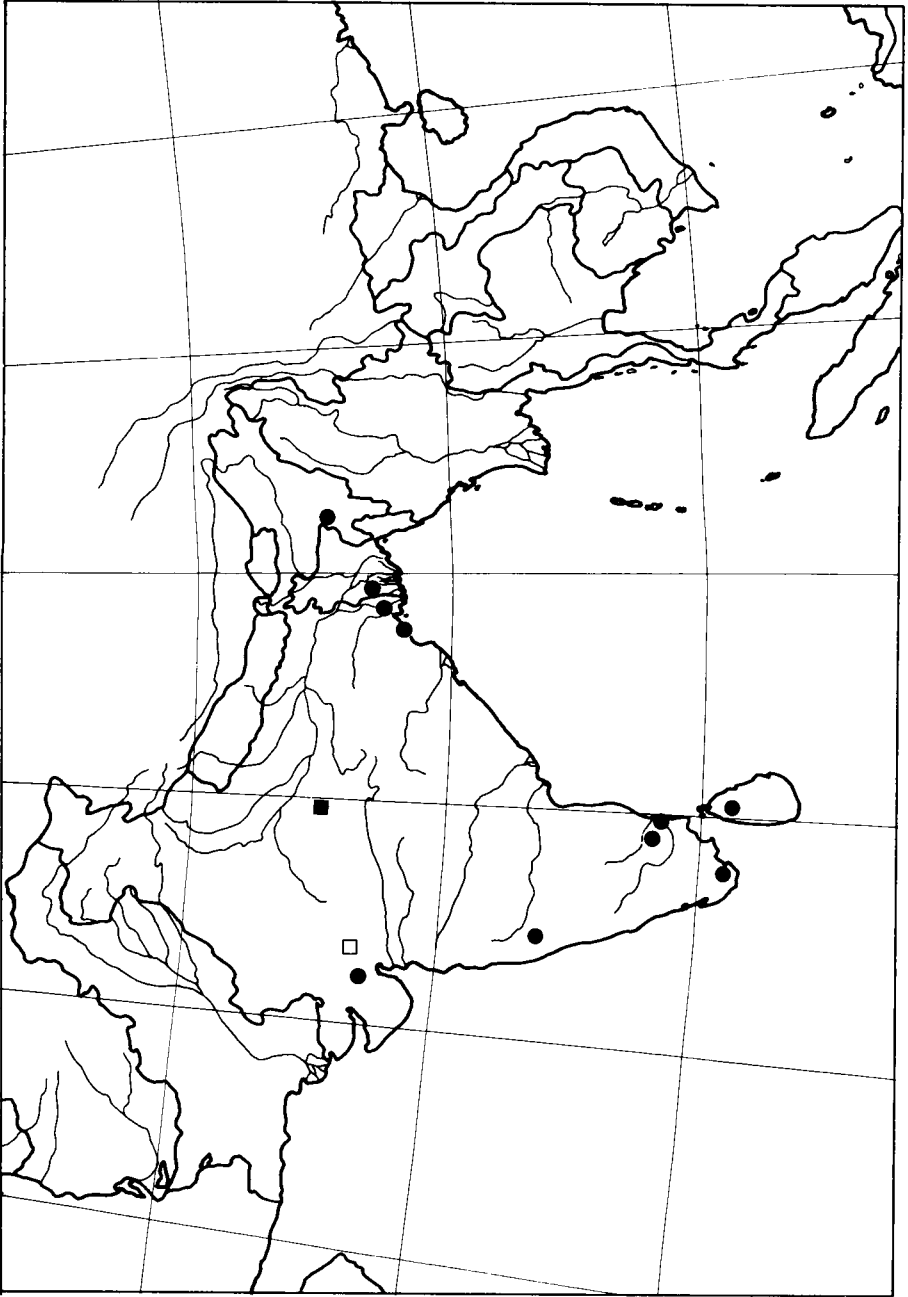


FIG. 21. — Distribution of *N. kurziana* (solid square ; uncertain locality as open square) and *N. indica* (solid circles).

on each side serrulate with (26-)30-44(-70) inconspicuous spiny teeth, protruding few; leaf teeth 0.05-0.1 mm long; the ratio of teeth length to leaf width being 0.1-0.22; midrib without spines; septa absent; fibres near each margin; leaf sheath shortly auricled to longly auricled, 2.26-3.16 mm (incl. spine-cells) by 1.29-1.45 mm (ratio = 1.75-2.2), serrulate or lacerate with 3-10(-25) spine-cells on each side, the auricle being 0.71-1.48 mm long (incl. spine-cells) and 0.26-0.45 mm wide (ratio = 3.2-5) serrulate or lacerate with 3-10(-25) spine-cells on each side and 2-6 on the inner edge; apex of the auricle rather acuminate.

Inflorescences axillary, male and female flowers on different branches. *Male flower* enclosed in a spathe 2.2-3.5 mm (incl. neck of spathe) by 0.4-0.6 mm, which tapers at the top, bearing brownish spine-cells on the apex; inner envelope protruding c.0.1 mm above the anther; anther 1-2 mm by 0.37-0.50 mm, tetrasporangiate. *Female flower* naked; ovary 0.7-1.0 mm by 0.2-0.35 mm; style and stigma 1-1.7 mm; stigma 2-3-lobed.

Fruit with persistent, thin, membranous pericarp and the remaining parts of the style. *Seed* straight, elliptical oblong, 1.89-2.25 mm by 0.50-0.65 mm (ratio = 2.95-3.46); testa clearly pitted with areoles, the latter regularly arranged in longitudinal rows, each row of 30-35(-45); areoles squarish to hexagonal or rectangular, 0.03-0.08 mm long; cell walls not raised.

DIAGNOSTIC FEATURES: leaf sheath truncate to auriculate; seed areoles regularly arranged per 30-35(-45) in each longitudinal row, squarish to hexagonal or rectangular; seed 1.89-2.25 mm × 0.50-0.65 mm, not enclosed in spathe; male flower enclosed in spathe, tetrasporangiate; leaves without septa and with fibres near each margin and sometimes on the midrib.

GEOGRAPHICAL DISTRIBUTION: Sulawesi (Fig. 22).

SELECTED SPECIMENS:

Sulawesi: Minahassa Peninsula, Manado, 7.II.1895, *Koorders* 17347 (L); Lepo Lepo near Kendari, VII.1874, *Beccari*, Fl. no. 11810 (L); s.l., 1859-60, *De Vriese & Teyssmann* s.n. (L).

26. *Najas pseudograminea* W. Koch

Ber. Schweiz. Bot. Ges. 44: 339-340 (1935); Horn af Rantz., *Kew Bull.* 37 (1952).
 — ≡ *N. tenuifolia* R. Br. subsp. *pseudograminea* (Koch) de Wilde; de Wilde in van Steenis, *Fl. Males.* 1 (6): 168 (1962); Backer, *Fl. Java* 3: 11 (1968). — ≡ *N. tenuifolia* R. Br. subsp. *pseudograminea* (Koch) de Wilde var. *pseudograminea*; de Wilde in van Steenis, *Fl. Males* 1 (6): 168 (1962). — TYPE: Java, Jogjakarta, 1934, *Thung* s.n. (holo: ZT; iso: L). — **Pl. XXII, F-J.**

— *N. tenuifolia* auct. non R. Br.; Backer, *Handb. Fl. Java* 1: 51 (1925).

— *N. kurziana* auct. non Rendle; de Wilde in van Steenis, *Fl. Males.* 1 (6): 165 (1962) p.p. quoad *van Steenis* 18226.

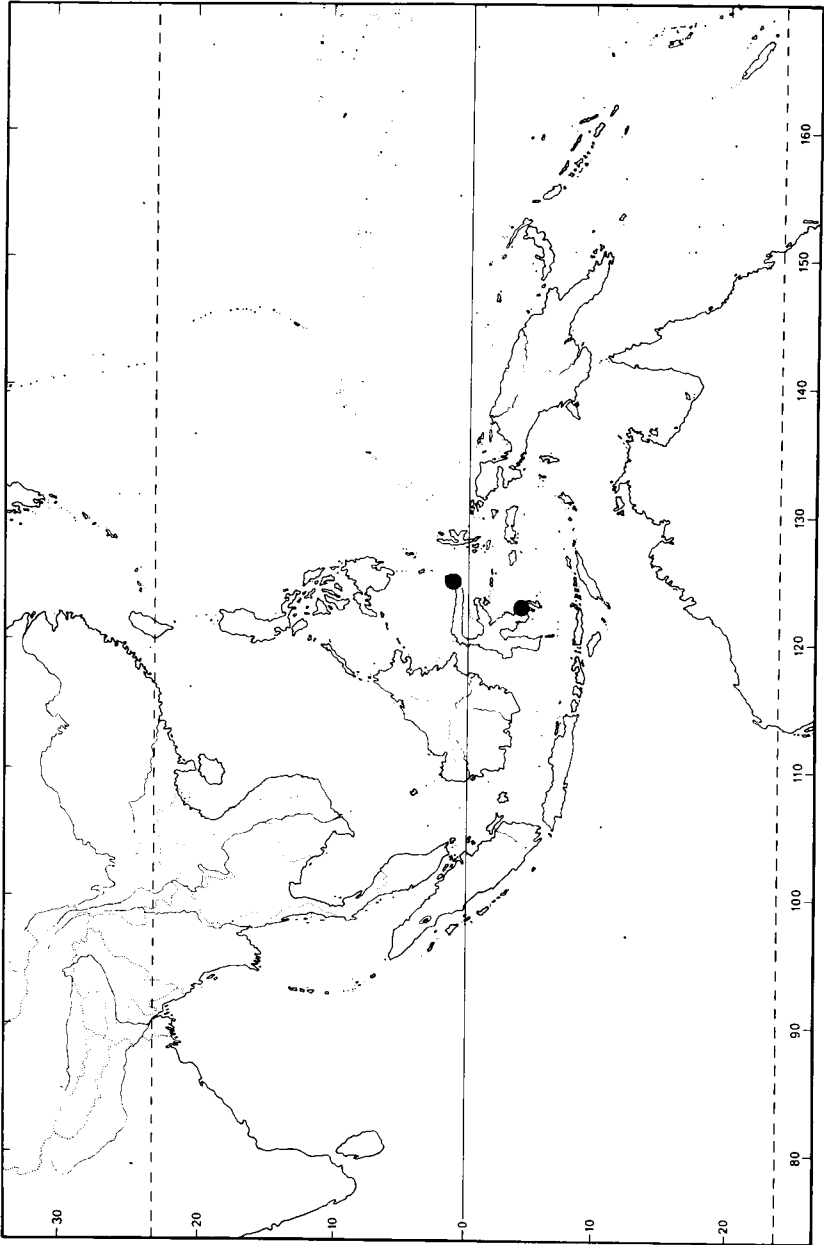


FIG. 22. — Distribution of *N. celebica*.

Plants submerged, monoecious, slender. *Stems* unarmed, c.1 mm in diameter. *Leaves* (11-)16-20(-24) mm long, flat, acute, linear-lanceolate, (0.48-)0.65-0.97 mm wide (incl. teeth on both sides), (0.34-)0.44-0.81 mm wide (excl. teeth on both sides); margin on each side serrulate with (26-)34-50 inconspicuous spiny teeth protruding few; leaf teeth 0.08-0.11(-0.145) mm long; the ratio of teeth length to leaf width being 0.11-0.24; midrib without spines; septa clearly visible up to halfway the margin; fibres near each margin but absent on and near both sides of the midrib; leaf sheath shortly auricled to longly auricled, 2.0-2.6(-3.0) mm (incl. spine-cells) by (1.35)1.6-1.8(-2.26) mm (ratio = 1.0-1.62), serrulate or lacerate with 3-8 spine-cells on each side, the auricle being (0.39-)0.6-1.1 mm long (incl. spine-cells) and (0.13-)0.4-0.5 mm wide (ratio = (1.7)2-2.4(-3.7)) serrulate or lacerate with 3-8 spine-cells on each side and 0-2 on the inner edge; apex of the auricle rather acuminate.

Inflorescences axillary, male and female flowers on different branches or at different nodes, but the males ones more to the top of the plant. *Male flower* enclosed in a spathe (1.37-)1.6-2.26 mm (incl. neck of spathe) by 0.4-0.55 mm, which tapers at the top, bearing brownish spine-cells on the apex; inner envelope protruding c.0.1 mm above the anther; anther (0.88-)1.13-1.37 mm by 0.40-0.52 mm, tetrasporangiate. *Female flower* naked; ovary c.0.7 mm by 0.25 mm; style and stigma c.0.7 mm; stigma 2-3-lobed.

Fruit with persistent, thin, membranous pericarp and the remaining parts of the style. *Seed* straight, elliptical oblong, 1.0-1.3 mm by 0.24-0.43 mm (ratio = (2.3-)2.5-3.3(-4.6)); testa clearly pitted with areoles, the latter regularly arranged in longitudinal rows, each row of (18-)25-30; areoles squarish to hexagonal or rectangular, 0.033-0.066 mm long; cell walls not raised.

DIAGNOSTIC FEATURES: leaf sheath truncate to auriculate; seed areoles regularly arranged per (18-)25-30 in each longitudinal row, squarish to hexagonal or rectangular; seed 1.0-1.3 mm × 0.24-0.43 mm, not enclosed in spathe; male flower enclosed in spathe, tetrasporangiate; leaves with septa up to halfway the margin and with fibres near each margin.

NOTES: 1. The specimen *Jaag* 1689 from Bali, has longest leaf teeth (up to 0.145 mm) and has smallest male flowers (spathe 1.37 mm long and anther 0.88 mm long).

2. The specimen *Schröter & Coert* 20 differs by the low number of areoles (18-20 rows).

3. Fibres are always present near each leaf margin. Occasionally, a weak fibre zone on the midrib may be present.

4. *Merrill* 4243 has male flowers in L, but female flowers and fruits in P; *Merrill* 9807 has male flowers in P, but female flowers and fruits in L.

5. Found mixed with *N. pseudogracillima* (*Woo* Aq. Pl. 2).

GEOGRAPHICAL DISTRIBUTION: E Tropical Asia, SW Pacific, Australia (Fig. 23).

SELECTED SPECIMENS:

China: Hong Kong: Chung Chi, VII.1970, *Woo* Aq. Pl. 2 (P).

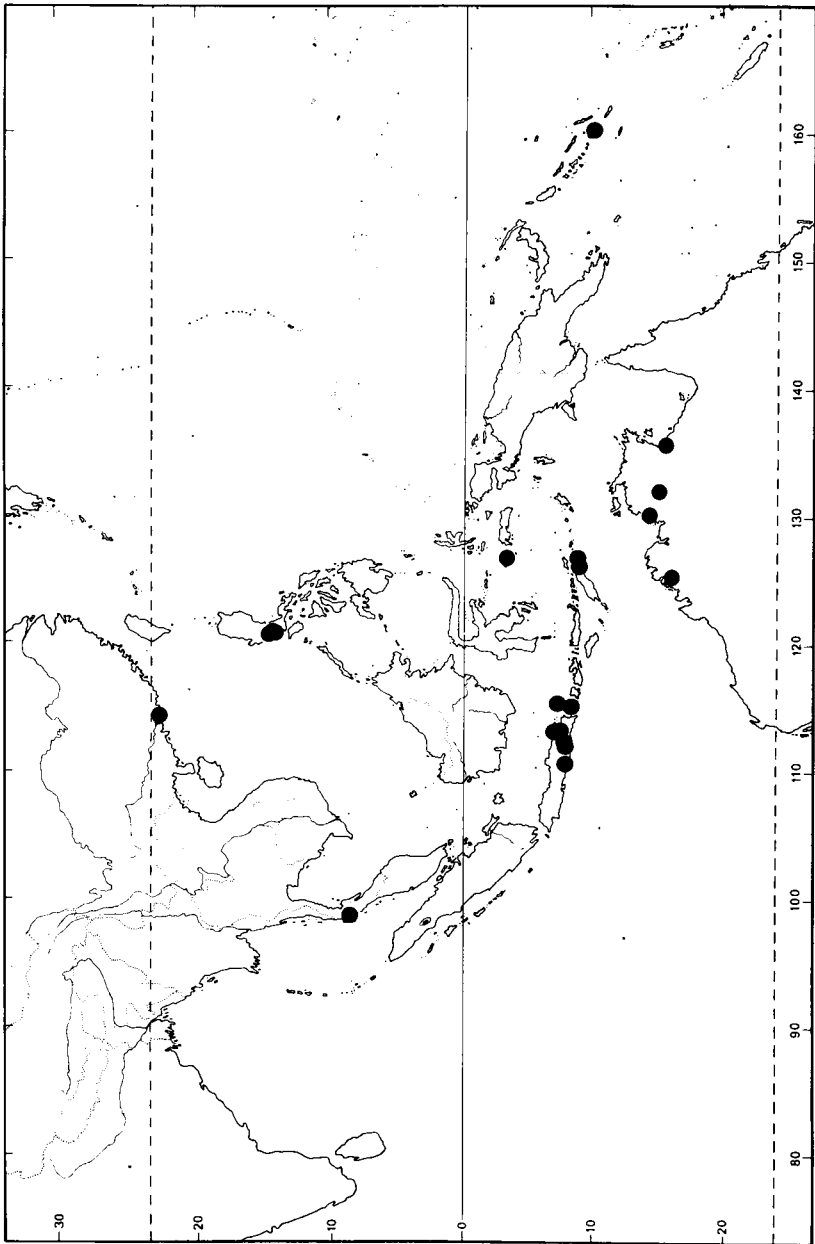


Fig. 23. — Distribution of *N. pseudogrammea*.

Thailand : Pangna Prov., Kan Bow koranee cascade, 9.V.1973, *Geesink & Santinuk* 5299 (E, K).

Philippines : Luzon, «Calumpit, Prov. of Pangranga», IX.1905, *Merrill* 4243 (K, L, P) ; Manila & vicinity, XII.1914, *Merrill* 9807 (K, L, P).

Java : Djakarta, 11.V.1913, *Backer* 1903 (L) ; Jogjakarta, 1934, *Thung* s.n. (L, ZT) ; Kediri, «Rawah Bening», 26.VI.1927, *Schröter* 20 (ZT), *ibid.*, *Schröter & Coert* 20 (L, ZT) ; Madura Isl., Sampang, 5.III.1915 *Backer* 19781 (L) ; Kangean Isl., 28.III.1919, *Backer* 27811 (L) ; «Besoehi, Boegan, Suikerfabriek», 28.II.1932, *Clason-Laarman* 120 (L) ; «Oost-Java», 4.VIII.1935, *Coert* 1147 (L) ; W. Bantam, N. Labuan, 1.I.1931, *van Steenis* 4710a (L) ; Bawean Isl., 5.VII.1928, *Karta* 53 (L) ; s.l., 1859-60, *de Vriese & Teysmann* s.n. (L).

Bali : Lagoon near Sengkidoe, 24.VI.1938, *Jaag* 1689 (BM, L).

Buru : Ranu Lake, 6.VII.1921, *Toxopeus* 254 (L).

Timor (Portuguese) : Lautem, «Rio de Surebeco», 19.XII.1953, *van Steenis* 18168 (BM, L) ; «Uato-Carabao», 22.XII.1953, *van Steenis* 18226 (L).

Solomon Islands : Guadalcanal Island, 16 mls E. Honiara, 28.XI.1970, *Gray* 14 (K).

Australia : West Australia, 41 km S. Gibb river station, 27.V.1971, *Taylor* 88 (MEL) ; Northern Territory, Katherine, 14.II.1961, *McKee* 8424 (K, NSW) ; Kakadu Nat. Park., 23 km S. Cooina, 7.V.1980, *Lazarides* 9222 (MEL).

Prob. *N. pseudograminea* (but septa missing) or *N. malesiana* (but fibres missing, more leaf teeth and longer auricle) :

Sumatra : «Aik Kwasan, Negaga», Asahan river, 27.IX.1936, *Schneider* s.n. (ZT) (= sterile).

Prob. *N. pseudograminea* (male flower in spathe ; anther tetrasporangiate ; seed 1.3 mm long), but septa missing and fibres near margins lacking.

Australia : Northern Territory, 5 km N. Nathan river station, 8.V.1985, *Leach* 6156 (MEL).

27. *Najas tenuifolia* R. Brown

Prod. 1 : 345 (1810) ; Kunth, Enum. 3 : 114 (1841) ; Benth. Fl. Austr. 7 : 181 (1878) ; Rendle, Trans. Linn. Soc., ser. 2, Bot. 5 (12) : 419, t. 42 f. 158-162 (1899) ; Rendle, *Ibid.* (13) : 443 (1900) ; Rendle in Engler, Pflanzenz. H.7 : 17 f. 5 G-H (1901) ; Williamson, Vict. Natur. 44 : 247 (1928) ; de Wilde in van Steenis, Fl. Males. 1 (6) : 167-169 (1962) p.p. quoad subsp. *tenuifolia*, excl. subsp. *pseudograminea* ; Aston, Aq. Pl. Austr. : 261-263 (1973). — ≡ *N. graminea* Del. var. *tenuifolia* (R. Br.) A. Br., Journ. Bot. 2 : 278 (1864). — ≡ *N. tenuifolia* R. Br. subsp. *tenuifolia* ; de Wilde in van Steenis, Fl. Males. 1 (6) : 167-168 (1962) p.p. quoad Australia. — TYPE : Australia, Northern Territory, Cavern Isl., Gulf of Carpentaria, 1803, *Brown* s.n. (holo- : BM ; iso- : E). — **Pl. XXIII.**

= *N. leichhardtii* Magnus, Beitr. 46, t. VIII f. 1-8 (1870); Rendle, Trans. Linn. Soc., ser. 2, Bot. 5 (12) : 420, t. 42 f. 168-171 (1899); Rendle in Engler, Pflanzenr. H.7 : 17 (1901); Aston, Aq. Pl. Austr. : 260 (1973). — TYPE : Australia, s.l., s.d., *Leichhardt* s.n. (holo- : B † ; lecto- : K).

Plants submerged, monoecious, (dioecious ?), slender. *Stems* unarmed, c. 0.5-1.0 mm in diameter. *Leaves* 12-25 mm long, flat, acute, linear-lanceolate, 0.43-0.92 mm wide (incl. teeth on both sides), 0.32-0.81 mm wide (excl. teeth on both sides); margin on each side serrulate with (22-)52-68(-90) rather inconspicuous spiny teeth; leaf teeth 0.03-0.06(-0.13) mm long; the ratio of teeth length to leaf width being 0.05-0.17(-0.289); midrib without spines; septa absent or occasionally present; fibres on and near both sides of the midrib and near each margin; leaf sheath long-auricled, (1.4-)2.3-3.4(-4.2) mm (incl. spine-cells) by 1.0-1.6(-2.4) mm (ratio = 1.4-2.1), serrulate or lacerate with (3-)8-9(-16) spine-cells on each side, the auricle being (0.48-)1.1-1.5 mm long (incl. spine-cells) and 0.2-0.6 mm wide (ratio = 2-5), serrulate or lacerate with (3-)8-9(-16) spine-cells on each side and (1-)2-6 on the inner edge; apex of the auricle acuminate.

Inflorescences axillary, male and female flowers on different (plants ?) branches. *Male flower* enclosed in a spathe 1.9-2.7 mm (incl. neck of spathe) by 0.6-0.7 mm, which tapers at the top, bearing brownish spine-cells on the apex; inner envelope protruding 0.1-0.2 mm above the anther; anther 1.1-1.3 mm by 0.6-0.7 mm, tetrasporangiate. *Female flower* naked; ovary 2.0-2.5 mm by 0.4-0.5 mm; style and stigma 1-2 mm; stigma 2-3-lobed.

Fruit with persistent, thin, membranous pericarp and the remaining parts of the style. *Seed* straight, elliptical oblong, 1.7-2.6 mm by 0.40-0.72 mm (ratio = 2.7-4.8); testa clearly pitted with areoles, the latter regularly arranged in longitudinal rows, each row of (30-)35-48; areoles squarish to hexagonal, 0.04-0.06 mm long; cell walls not raised.

DIAGNOSTIC FEATURES : leaf sheath auriculate; seed areoles regularly arranged per (30-)35-48 in each longitudinal row, squarish to hexagonal; seed 1.7-2.6 × 0.40-0.72 mm, not enclosed in spathe; male flower in spathe, tetrasporangiate; leaves mostly without septa and with fibres on and near both sides of the midrib and near each margin.

NOTES : 1. *N. tenuifolia* was described by BROWN (1810) first as having unisporangiate anthers. W. J. J. O. DE WILDE (1962) already proved them to be tetrasporangiate.

GEOGRAPHICAL DISTRIBUTION : Australia (Fig. 24).

SELECTED SPECIMENS :

Australia : Northern Territory : Saddle Creek, 19 km W. West Baines river, 22.IV.1983, *Wilson & Baker* 4782 (K); Darwin river Dam, 8.IV.1982, *Rankin* 2595 (MEL); Naurkangie Aboriginal Paintings Area, 14.VIII.1978, *Beaglehole & Erroy* 58680 (MEL); Island lagoon, Magela Creek, 16.VI.1975, *Dunlop* 3718 (MEL);

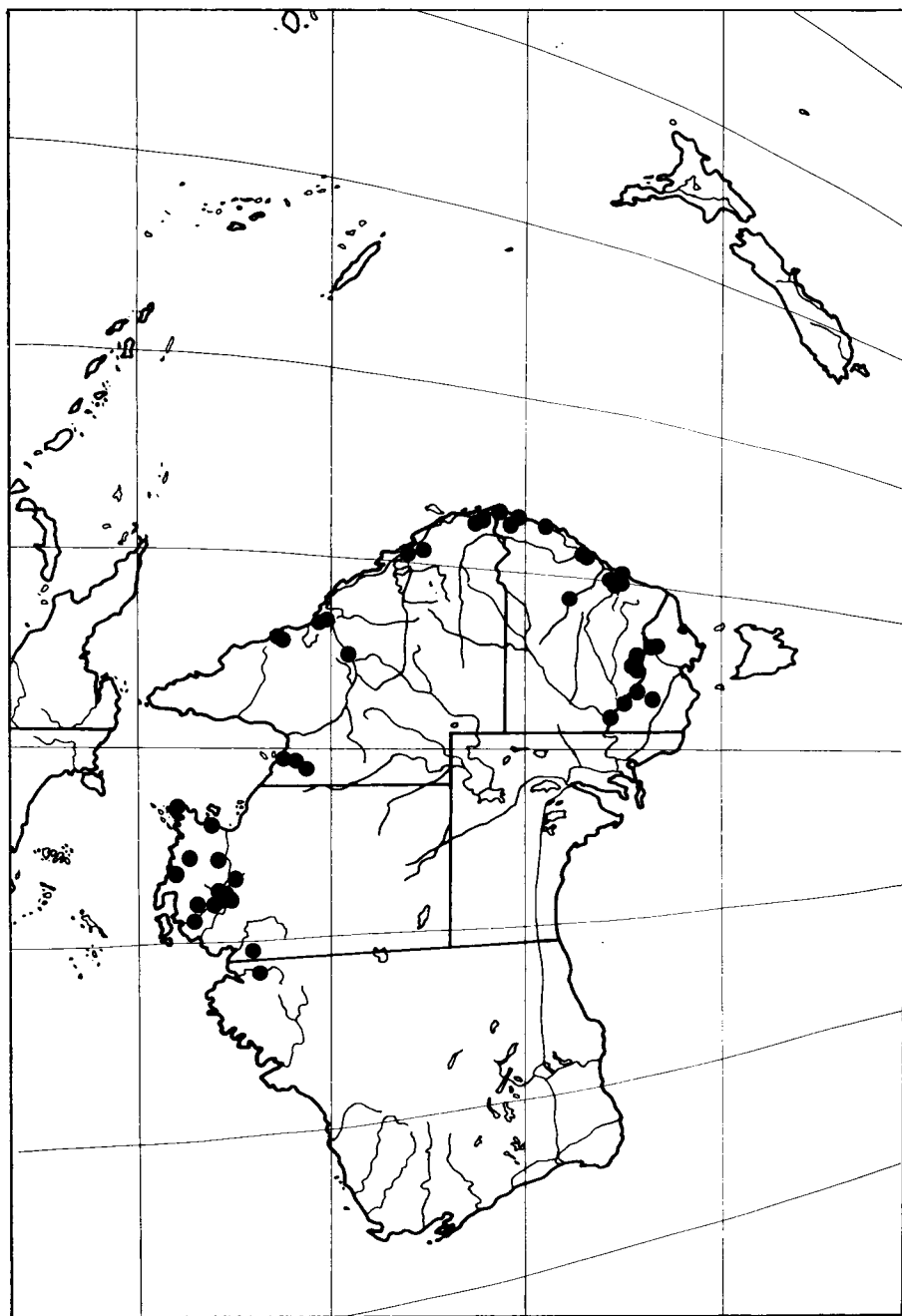


FIG. 24. — Distribution of *N. tenuifolia*.

Jabiru Retention Dam 1, 19.IV.1982, *Henshall* 4006 (MEL); Nourlangie Safari Camp, 24.III.1965, *Lazarides & Adams* 327 (K); Katherine, 12.IV.1967, *Adams* 1749 (E, K); Katherine river, 19.VII.1965, *Beaglehole* 10868 (MEL); Katherine Gorge 29.IV.1980, *Jacobs* 3763 (NSW); *ibid.*, 7.IV.1981, *Craven* 6732 (MEL); 5-8 km N.N.E. Katherine, 7.V.1976, *Aston* 1894 (MEL); Mataranka Hot Springs, 7.VIII.1978, *Beaglehole & Erroy* 58261 (MEL); Flying Fox Creek, Beswick-Mainoru Rd, 21.V.1974, *Jacobs* 1714 (NSW); Cavern Island, 1803, *Brown* s.n. (BM, E); Gove Peninsula, Nerowanoi lagoon, 15.VIII.1969, *Higginson* 44 (NSW); Fogg CK Dam near Beatrice Hill, 29.V.1974, *Jacobs* 1759 (NSW). Queensland: North Queensland, 1891, *Birck* MEL 108981 (MEL); Richmond, *Woolfs* MEL 108975 (MEL); Richmond, XI.1803, *Brown* s.n. (K); *ibid.*, *Caley* s.n. (BM); Gorge Creek, Mareeba, 22.IV.1962, *McKee* 9278 (K, NSW); Westmoreland, 11.V.1974, *Jacobs* 1546 (NSW); Corinda, 6.V.1974, *Jacobs* 1476 (NSW); Burke 18.V.1983, *Wilson* 5534 (MEL); 5 km N.W. Clare, 14.V.1981, *Jacobs* 4057 (NSW); 5 km W. Agnes Waters, 8.V.1981, *Jacobs* 3985 (NSW); Palm Creek, 23 km S. Miriam Vale, 8.V.1976, *Jacobs & Rodd* 2544 (NSW); Brisbane river, VII.1855, *Mueller* 13; MEL 108970 (MEL); *Baily* s.n. (BM); Enoggen Creek near Brisbane, XI.1914, *White* s.n. (K); Trinity Bay, Barron river, *Bailey* MEL 108978; MEL 528966 (MEL); Toivomba, *Lamsborough* MEL 108972 (MEL); Junction Creek, 1891, *Birck* MEL 108973 (MEL). New South Wales: Richmond river, 1886, *Edwards* MEL 529763 (MEL), Dalmonton, 30 mls W. Grafton, I.1907, *Boorman* NSW 27292 (NSW); New England Range, s.d., *Stuart* MEL 108976 (MEL); MacLeay river, 1891, *Casement* MEL 108984 (MEL); Hunters river, s.d., *Leichhardt* s.n. (K); *ibid.*, Coll ? MEL 108969 (MEL); Macquarie river, 1882, *Ramsay* MEL 108965 (MEL); *ibid.*, II.1901, *Betche* MEL 108966 (MEL); Nepean river, Menangle, 15.V.1954, *McBarron* 6303 (NSW); 4.III.1963, 7575bis (MEL); *ibid.*, 26.II.1975, *Aston* 1831 (K, MEL); *ibid.*, Glasbrook, 4.I.1959, *McKee* 6788 (NSW); *ibid.*, Cobbity, 7.IV.1968, *Briggs* NSW 101793 (NSW); *ibid.*, Coll ? MEL 108974 (MEL); *ibid.*, *Mueller* s.n. (K); Walla Walla, 24.I.1950, *McBarron* 4398; 7.VII.1950, 4686 (NSW); S. Tocumwal-Berrigan road, 13.XII.1978, *Mulham* 1401 (NSW); Albury, Rand, 22.II.1967, *Flynn* NSW 96423 (NSW); Clarence river, Ewingbar-Baryngil road, 12.II.1977, *Jacobs & Pickard* 2976 (NSW). Uncertain localities: «Allyn river», VIII.1906, *Boorman* NSW 2550 (NSW); «Demioun», 1889, *Birck* 108964, MEL 529762 (MEL); 1888, *Weir* MEL 108980 (MEL). Victoria: Murray river, junction of the Darling river, 1892, *Eckert* 105 (MEL); Murray river, *Mueller* s.n. (K); MEL 108985; *ibid.*, Galgal Creek, *Wight* MEL 108963 (MEL); *ibid.*, Coll ? MEL 108961 (MEL); 24 mls E.S.E. Robinvale, 19.III.1965, *Aston* 1375 (MEL); Koondrook, 6.III.1974, *Corrick* 101 (MEL); Wimmera river, 1892, *Eckert* 52 (MEL); 9 mls E.N.E. Benalla, 12.II.1959, *Aston* WS 21 (MEL); 15.XI.1960 s.n. (MEL); Cobram, 20.II.1969, *Aston* 1742, 1743 (MEL); Lake Moodemere, 4 mls W. Rutherglen, 17.II.1965, *Aston* 1346, 1362 (MEL). Uncertain localities: «Boat river», IV.1804, *Brown* s.n. (K); «Clyde, Duch Creek», III.1916, *Lucas* NSW 2552 (NSW); «River II, above junction with Grove», I.1804, *Caley* s.n. (BM).

Probably *N. tenuifolia* (sterile) :

Australia : Northern Territory : Darwin area, Humpty Doo, 10.II.1961, *McKee* 8341 (K). Queensland : Caboolture, 21.I.1959, *Blake* 20513 (K) ; Brisbane, 22.IV.1957, *Blake* 20106 (MEL). New South Wales : Allyn river, VIII.1906, *Boorman* s.n. (K), «Hankesbury river», 10.I.1947, *Woods* NSW 2548 (NSW).

The following specimens could as well belong to *N. tenuifolia* as *N. graminea* :

Australia : W. Australia, Harding river, 1895, *Cusack* MEL 108960 (MEL) ; Nickol Bay, 1896, *Cusack* MEL 108959 (MEL).

28. *Najas indica* (Willd.) Cham.

Linnaea 4 : 501 (1829) ; *Kunth*, *Enum.* 3 : 113-114 (1841) p.p. quoad *Klein* ; *Griffith* in *Voigt*, *Hort. Suburb. Calcut.* : 694 (1845) ; *Miq.* *Ill. Fl. Arch. Ind.* 44-45 p.p. ; (1871) ; *Magnus*, *Ber. Deutsch. Bot. Ges.* 2 : 218-219 (1894) ; *Rendle*, *Trans. Linn. Soc.*, ser. 2, *Bot.* 5 (12) : 399, t. 39 f. 31-45 (1899) p.p. quoad *Klein* in *Herb. Willdenow* 17092 ; *Rendle* in *Engler*, *Pflanzenr.* H.7 : 10 f. 3 R-T (1901) p.p. excl. syn. *N. tenuis* ; *Haines*, *Bot. Bihar & Orissa* : 850 (1924) excl. syn. *N. tenuis* ; *Fischer* in *Gamble*, *Fl. Madras* 9 : 1064 (1931) ; *de Wilde*, *Willdenowia* 2 : 595 (1960) ; *de Wilde*, *Acta Bot. Neerl.* 10 : 167 fig. 6-9 (1961) ; *de Wilde* in *Van Steenis*, *Fl. Males.* 1 (6) : 166-167 (1962) p.p. quoad «trop. cont. Asia». — ≡ *Caulinia indica* *Willd.*, *Mém. Ac. Roy. Sc. (Berl.)* 89 t. 1 f. 3 (1798) ; *Willd.*, *Sp. pl.* 4 : 182 (1805) ; *Spreng.*, *Syst.* 1 : 20 (1825). — ≡ *Fluvialis indica* (*Willd.*) *Pers.*, *Syn. Plant.* 2 : 530 (1807). — ≡ *N. minor* *All.* var. *indica* (*Willd.*) *A. Br.*, *Journ. Bot.* 2 : 278 (1864) p.p. quoad *Tranquebar*. — TYPE : India, *Tranquebar*, s.d., *Klein* 1799 in *Herb. Willdenow* no. 17092, ♂ (holo- : B, *non vidi* ; microfiche : K), 1799 in *Herb. Schreberianum* 484, ♂ (iso- : M). — **Pl. XXIV, XXV.**

= *N. heteromorpha* *Griffith* in *Voigt*, *Hort. Suburb. Calcut.* : 694 (1845) ; — TYPE : India, *Serampore*, «West Bengal» *Griffith* 5609/4 (holo- : CAL, *non vidi* ; iso- : K, P).

= *N. falciculata* *A. Br.*, *Journ. Bot.* 2 : 278, f. 4 p. 274 (1864) p.p. quoad *Madras*, *Wight* ; *Martens*, *Preuss. Exp. Ost-As.*, *Bot. teil Tange* : 143 (1866) ; *Hooker* f., *Fl. Brit. Ind.* 6 : 569 (1893) ; *Rendle*, *Trans. Linn. Soc.*, ser. 2, *Bot.* 5 (12) : 417 t. 42 f. 145-151 (1899) p.p. quoad *Wight* ; *Rendle* in *Engler*, *Pflanzenr.* H.7 : 15 (1901) p.p. quoad *Wight* ; *Fischer* in *Gamble*, *Fl. Madras* 9 : 1604 (1931), probably belongs here. — TYPE : India, *Madras*, s.d., *Wight* s.n. (syn- : B †) : probably a different collection from the syntype of *N. lacerata* ? ; *Philippines*, *Manila*, s.d., *Martens* s.n. (syn- : B †).

= *Najas minor* *All.* var. *spinosa* *Rendle*, *Trans. Linn. Soc.*, ser. 2, *Bot.* 5 (12) : 413 (1899) ; *Rendle* in *Engler*, *Pflanzenr.* H.7 : 15 (1901) ; *Fischer* in *Gamble*, *Fl. Madras* 9 : 1604 (1931), p.p. — TYPE : India, s.l., s.d., *Wight* 2793 (holo- : K ; iso- : BM).

= *N. lacerata* Rendle, Trans. Linn. Soc., ser. 2, Bot. 5, (12) : 416, t. 41 f. 132-138 (1899) ; Rendle in Engler, Pflanzenr. H.7 : 15 f. 5 E-F (1901) ; Fischer in Gamble, Fl. Madras : 1603-1604 (1931) ; Swamy & Lakshmanan, Journ. Ind. Bot. Soc. 41 (2) : 246-267 (1962). — TYPE : India, «Tinnevely», s.d., *Beddome* 8202 (lecto- : BM) ; Madras, IX.1849, *Wight* s.n. (syn- : K) ; «Bengal, Upper Cobaduc, Zillah Jessore», s.d., *Clarke* 4366 (syn- : K). Lectotype designated here.

= *N. foveolata* A. Br. var. *minor* Rendle, Trans. Linn. Soc., ser. 2, Bot. 5 (12) : 417 (1899) ; Rendle in Engler, Pflanzenr. H.7 : 15 (1901). — TYPE : India, Belgaum, Kaktee tank, s.d., Herb. Calcutta (holo- : CAL, *non vidi*). Probably 2 sheets at E (*Ritchie* 1161) are isotypes ?

— *N. minor* auct. non All. ; Hook. f., Fl. Brit. Ind. 6 : 569 (1893) pro majore parte, pro syn. *N. indica* ; Rendle, Trans. Linn. Soc., ser. 2, Bot. 5 (12) : 410-413 (1899) p.p. quoad Griffith 5609/1 (in part mixed *N. graminea*) et Griffith 5609/4 ; Rendle in Engler, Pflanzenr. H.7 : 14 (1901) p.p. ; Haines, Bot. Bihar & Orissa : 851 (1924) ; Fischer in Gamble, Fl. Madras 9 : 1604 (1931) ; de Wilde in van Steenis, Fl. Males 1 (6) : 164-165 (1962) p.p. quoad *Saxton* 491.

— *N. graminea* auct. non Del. ; Rendle, Trans. Linn. Soc., ser. 2, Bot. 5 (12) : 426-427 (1899) p.p. quoad Griffith 5609/1 (also mixed *N. graminea*) ; Rendle in Engler, Pflanzenr. H.7 : 18 (1901) p.p. quoad *Griffith* ; Camus, Fl. gén. Indochine 6 : 1211 (1942) p.p. quoad *Thorel*.

— *N. graminea* Del. var. *minor* auct. non Rendle, Trans. Linn. Soc., ser. 2, Bot. 5 (12) : 426-427 (1899) p.p. quoad *Griffith* 5609/1 (in part mixed with *N. graminea*) ; Rendle in Engler, Pflanzenr. H.7 : 426-427 (1901) p.p. quoad *Griffith*.

— *N. foveolata* auct. non A. Br. ex Magnus ; Camus, Fl. gén. Indochine 6 : 1211 (1942) ; Haines, Bot. Bihar & Orissa : 851 (1924).

— *N. australis* auct. non Rendle ; Blatter & Hallberg, Fl. Ind. Des. 26 (4) : 974 (1920) ; Bhandari, Fl. Ind. Des. : 359 (1978) probably belongs here or even under *N. minor*.

— *N. dichotoma* Roxb., Hort. Bengal. : 71 (1814) ; Roxb., Fl. Ind. 3 : 749 (1832) ; Kunth, Enum. 3 : 114 (1841) ; Griffith in Voigt, Hort. Suburb. Calcut. : 694 (1845) ; Haines, Bot. Bihar & Orissa : 851 (1924) pro syn. sub *N. minor*. — *Nomen nudum*.

Species dubiae or probably under *N. indica* are : — *N. rigida* Griff., Notul. Pl. Asiat. 3 : 181 (1851). — *N. ternata* Roxb. ex. Griff. Notul. Pl. Asiat. 3 : 183-184, pl. 252 (1851).

Plants submerged, monoecious, (dioecious ?) slender. *Stems* unarmed, c.1-1.3 mm in diameter. *Leaves* 10-26 mm long, flat, acute, linear-lanceolate, 0.56-0.90(-1.21) mm wide (incl. teeth on both sides), 0.22-0.5(-0.8) mm wide (excl. teeth on both sides) ; margin on each side serrulate with 8-20 conspicuous spiny teeth on broad excrescences ; leaf teeth (0.08)-0.2-0.3 mm long ; the ratio of teeth length to leaf width being (0.25-)0.4-0.8(-1.15) ; midrib generally without spines ; septa clearly visible up to the margin ; fibres absent ; leaf sheath slightly auricled/truncate/lacerate to shortly auricled, 1.6-3.7 mm (incl. spine-cells) by 1.2-3.2 mm

(ratio = (0.77-)1-1.9), serrulate or lacerate with 4-10 spine-cells on each side, the auricle being 0.22-1.0 mm long (incl. spine-cells) and 0.20-0.64(-0.8) mm wide (ratio = 0.6-1.6), serrulate or lacerate with 4-10 spine-cells on each side but no on the inner edge; apex of the auricle rather obtuse.

Inflorescences axillary, male and female flowers on different (plants?) branches. *Male flower* enclosed in a spathe, (1.3-)2-3 mm (incl. neck of spathe) by 0.55-0.9 mm, which tapers at the top, bearing brownish spine-cells on the apex; inner envelope protruding c. 0.1 mm above the anther; anther (0.8-)1.4-1.6 mm by 0.5-0.8 mm, tetrasporangiate. *Female flower* naked, ovary 1 mm by 0.4 mm; style and stigma 0.6 mm; stigma 2-3-lobed.

Fruit with persistent, thin, membranous pericarp and the remaining parts of the style. *Seed* straight, elliptical oblong, (1.45-)1.8-2.6 mm by 0.6-0.8 mm (ratio = (2.6-)3-3.44); testa clearly pitted with areoles, the latter regularly arranged in longitudinal rows, each row of 25-35; areoles squarish to hexagonal, 0.06-0.07 mm long; cell walls not raised.

DIAGNOSTIC FEATURES: leaf sheath truncate to auriculate; seed areoles regularly arranged per 25-35 in each longitudinal row, squarish to hexagonal; seed (1.45-)1.8-2.6 × 0.6-0.8 mm, not enclosed in spathe; male flower in spathe, tetrasporangiate; leaves with septa and without fibres.

NOTES: 1. *N. indica* formerly was a poorly understood species, but may be distinguished from *N. tenuis*, *N. minor*, *N. kingii* or *N. foveolata*, because of the leaves with large teeth and large septa; the auricled leaf sheath; the tetrasporangiate anther and the seed testa with regularly arranged areoles.

2. *N. indica* is most probably dioecious (should be checked on the field).

3. *Wight* 2793 has spines on back of midrib.

GEOGRAPHICAL DISTRIBUTION: India, Sri Lanka, Burma (and Vietnam?) (Fig. 21).

SELECTED SPECIMENS:

India: Maharashtra State: Bombay, Anaheri, Salsette Island, 15.I.1946, *Wallace*, 5808 (BM), 5909, 5910 (BM, L). Karnataka State: Belgaum, Kaktee Tank, s.d., *Richie* 1161 (E). Tamil Nadu State: IX.1849, *Wight* s.n. (K); Tirunelveli, s.d., *Beddome* 8202 (BM); Ganges Distr., XII.1889, *Gamble* 21710 (K); Tranquebar, 9.I.1799, Herb. Schreberianum 484 (M). Gujarat State: Kharaghoda, 11.X.1914, *Saxton* 491 (K). «West Bengal»: Calcutta, s.d., *Griffith* 5609/4 (K, P); «Bengal Or.», *Hook. f.* s.n. (G).

Bangla Desh: «East Bengal», Jessore, s.d., *Clarke* 4366 (K); s.l., s.d., *Wight* 2793 (K).

Burma: *Griffith* 5609/1 (BM, G, K, L, M, ZT).

Sri Lanka: North Central Prov.: Anaradhapura Distr., Dambulla to Madatugama, 10.VII.1972, *Hepper & Jayasuriya* 4607 (K).

Probably *N. indica* (sterile or only male plants):

India: Orissa State: Sambalpur, Brahmani river, 27.IV.1950, *Mooney* 3785 (K). Ind. Occ., 1808, ex Herb. *Thunberg* s.n. (H); Beng. Or., s.d., *Hook. f. & Thomson*

s.n. (G, P); «K. Ens.», Coromandel, *Macé* (P), only male; Assam, Haflong, 30.VIII.1908, *Craib* 554 (CAL), only male; W. Bengal, Digha, 27.IV.1963, *Ghosh* 880 (CAL); Tamil Nadu State, Javadi Hills, 28.IX.1916, *Fischer* 4012 (CAL).

Vietnam: Wat-Bocor, 1883-1885, *Couderc* s.n. (P).

29. *Najas baldwinii* Horn af Rantzien

Acta Horti Gotoburg. 18 : 187-190, fig. 11-19 (1950); Triest, Mém. Acad. r. Sci. Outre-Mer, Cl. Sci. nat. méd., nouv. sér. in-8°, 21 (4) [et Et. Cont. afr., 6] : 65-69, fig. 10, pl. 16 (1987).

DIAGNOSTIC FEATURES: leaf sheath truncate to auriculate; seed areoles regularly arranged per 18-32 in each longitudinal row, hexagonal or rectangular; seed 1.21-1.70(-2.10) mm × 0.38-0.54(-0.83) mm, not enclosed in spathe; male flower not enclosed in spathe, unisporangiate; leaves with or without septa and with or without fibres.

GEOGRAPHICAL DISTRIBUTION: West and central tropical Africa.

30. *Najas malesiana* de Wilde

Acta Bot. Neerl. 10 : 168-169 (1961); de Wilde in van Steenis, Fl. Males. 1 (6) : 169 (1962); Backer, Fl. Java 3 : 11 (1968). — TYPE: Sumatra, Bukittinggi, 7.V.1957, *Meyer* 5772 (holo- : L). — PL. XXVI.

= *N. graminea* Del. var. *minor* Rendle, Trans. Linn. Soc. ser. 2, Bot. 5 (12) : 426-427 (1899) p.p. quoad *Griffith* 5609/6 et *Kurz* 3310 (in part mixed with *N. tenuis*); Rendle in Engler, Pflanzenr. H.7 : 18 (1901) p.p. quoad *Griffith* 5609/6 et *Kurz* 3310; Camus, Fl. Gén. Indochine 6 : 1212 (1942) p.p. quoad *Lebon* (Tonkin). — TYPES: India, «E. Bengal», s.d., *Griffith* 5609/6 (lecto- : P), Burma, Pegu, s.d., *Kurz* 3310 (syn- : BM) p.p. mixed *N. tenuis*; *ibid.*, *Kurz* 3192 (*non vidi*); Burma, *Griffith* 5609/1 (syn- : BM; isosyn- : G, K, L, M, ZT). Lectotype designated here.

= *N. graminea* Del. var. *angustifolia* Rendle, Trans. Linn. Soc., ser. 2, Bot 5 (12) : 427, Pl. 42, fig. 202 (1899); Rendle in Engler, Pflanzenr. H.7 : 18 (1901); Ridley, Mat. Fl. Mal. Pen. 2 : 128 (1907); Gibbs, Journ. Linn. Soc. Bot. 42 : 172 (1914). — TYPE: Malaya; Singapore, 1897, *Ridley* 8946 (lecto- : K); Borneo, Bandjarmasin, *Motley* 8946 (syn- : BM). Lectotype designated here.

— *N. graminea* auct. non Del.; Ridley, Fl. Mal. Pen. 4 : 365 (1924); Camus, Fl. Gén. Indochine 6 : 1211-1212 (1942) p.p. quoad *Harmand*.

— *N. indica* auct. non (Willd.) Cham.; Merrill, Enum. Philip. Flow. Pl. 1 : 25 (1925).

— *N. bengalensis* Horn af Rantz., Acta Horti Gotoburg. 18 : 192-193 (1950), ad int.; Horn af Rantz., Kew Bull. 39 : (1952) in clav., angl.

Plants submerged, monoecious, slender. *Stems* unarmed, 0.5-1.0 mm in diameter. *Leaves* 10-19 mm long, flat, acute, linear-lanceolate, (0.29-)0.4-0.5(-0.56) mm wide (incl. teeth on both sides), (0.15-)0.25-0.35(-0.44) mm wide (excl. teeth on both sides); margin on each side serrulate with (12-)20-40(-50) rather inconspicuous spiny teeth, leaf teeth 0.05-0.1 mm long; the ratio of teeth length to leaf width being (0.14-)0.2-0.3(-0.47); midrib without spines; septa visible up to halfway the margin or absent; fibres absent, more rarely near both sides of the midrib or near each margin; leaf sheath shortly auricled to longly auricled, (1.37-)1.5-2.5(-3.4) mm (incl. spine-cells) by 0.95-1.5(-1.9) mm (ratio = 1.1-2.1), serrulate or lacerate with 3-10 spine-cells on each side, the auricle being 0.34-0.65(-1.13) mm long (incl. spine-cells) and 0.23-0.48(-0.56) mm wide (ratio = 1.1-1.8) serrulate or lacerate with 3-10 spine-cells on each side and 0-3 on the inner edge; apex of the auricle rather acuminate.

Inflorescences axillary, male and female flowers at different nodes, but the male ones more to the top of the plant or together at the same nodes on the top of the plant. *Male flower* naked; inner envelope protruding 0.1 mm above the anther; anther 0.5-0.8(1.1) mm by (0.1-)0.15-0.3(-0.4) mm, unisporangiate. *Female flower* naked; ovary 0.4-1.0 mm by 0.2-0.3 mm; style and stigma 0.6-0.9 mm; stigma 2-3-lobed.

Fruit with persistent, thin, membranous pericarp and the remaining parts of the style. *Seed* straight, elliptical oblong, (0.88-)1.2-1.3(-1.42) mm by 0.34-0.48 mm (ratio = (2.6-)2.8-3.2(-3.6)); testa clearly pitted with areoles, the latter regularly arranged in longitudinal rows, each row of (20-)30-35(-40); areoles squarish to hexagonal or rectangular, 0.033-0.044(-0.053) mm long; cell walls not raised.

DIAGNOSTIC FEATURES: leaf sheath truncate to auriculate; seed areoles regularly arranged per (20-)30-35(-40) in each longitudinal row, squarish to hexagonal, rectangular; seed (0.88-)1.2-1.3(-1.42) × 0.34-0.48, not enclosed in spathe; male flower not enclosed in spathe, unisporangiate; leaves without septa or with septa up to halfway the margin and leaves without fibres or more rarely with fibres near both sides of the midrib or near each margin.

NOTES: 1. *Brass* 18610 (Australia) has smallest fruits (0.88 × 0.34 mm) and less rows of areoles (20).

2. The only plants with fibres near the leaf margin are *Ridley* 8946 and *Griffith* 5609/6, while the only plants with fibres on and near the midrib are *Koeltz* 13324 and *Brass* 18610.

3. Leaf septa are absent, in plants from India, Vietnam and Borneo, however weakly visible in those from Malaya, Sumatra, Java and Australia.

4. Taxonomically, very close to the African *N. baldwinii*.

5. All specimens cited were fertile (♂, ♀ and fr.).

6. *N. malesiana* is recorded from rice fields in India (*Cook, Rix & Schneller* 324), Vietnam (*Vũ-vân-Cường* 133) and Sumatra (*Meijer* 5772).

7. *Griffith* 5609/1 is mixed with *N. indica* & *N. minor*.

GEOGRAPHICAL DISTRIBUTION: Tropical Asia and Australia (Fig. 25).

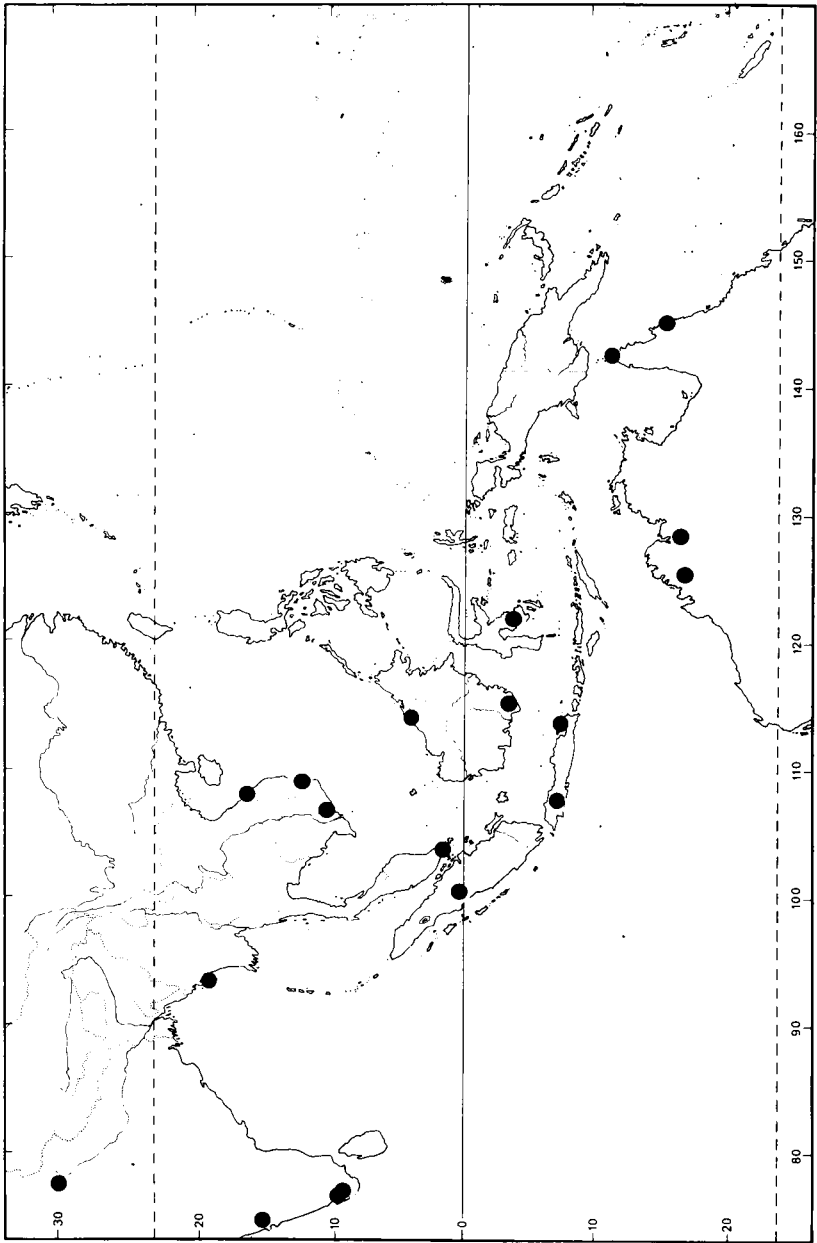


FIG. 25. — Distribution of *N. malesiana*.

SELECTED SPECIMENS :

India : Punjab State : Saharanpur, 27.X.1925, *Allen* s.n. (BM) ; Karnataka State : Londa, 28.II.1938, *Koeltz* 13324 (M) ; Kerala State, Ernakulam, 16.IX.1973, *Cook, Rix & Schneller* 238 (Z) ; Kottayam, 22.IX.1973, *Cook, Rix & Schneller* 324 (Z).

Bangla Desh : «East Bengal» *Griffith* 5609/1 (BM, G, K, M, ZT) p.p. ; *Griffith* 5609/6 (K, P) (as *N. graminea* Del. var. *minor* Rendle p. 427).

Burma & Malay Peninsula : Pegu, Kurz 3310 (BM) ; Ramree island, VII.1945, *Wallace* 9109 (K) ; Singapore : 1897, *Ridley* 8946 (K).

Vietnam : Da Nang (Tourane), V-VII.1927, *Clemens* 4213 (BM) ; Nha Trang, 30.XII.1967, *Vũ-vân-Cüông* 857 (P) ; Phu Cuong, V.1967, *Vũ-vân-Cüông* 133 (P) ; «Iles de Poulo-Condor ?», IX.1876, *Harmand* 918 (P) ; s.l., 1883-1891, *Le Bon* (P).

Sumatra : Bukittinggi, «Karbou canyon», 7.V.1957, *Meyer* 5772 (L) ; Asahan, Soengu Piring, XII.1936, *Schneider* s.n. (ZT).

Java : Bogor (Buitenzorg), 10.III.1933, Inst. voor Plantenziekten 1 (L) ; Tjitjadas, near Bandoeng, 18.VI.1933, *van Steenis* 5402 (L).

Borneo : Kalimantan : Bandjarmasin, VIII.1957, *Motley* 343 (K) ; *ibid.*, 1894, *Motley* 8946 (BM). Sarawak, Jesselton, 14-18.XII.1925, *Clemens* 6999 (L).

Sulawesi : Lasahoe, 2.IV.1929, *Kjellberg* 1186 (L) ; Tenimber Isl., Timoerlaet, 31.III.1938, *Buwalda* 4506 (L).

Australia : Queensland : Cape York Peninsula, Somerset, 3.V.1948, *Brass* 18610 (K, L) ; West Australia, March Fly Glen, Derby, 30.V.1982, *Jacobs* 4324 (NSW) ; Ord river dam, 6.VI.1982, *Jacobs* 4447 (NSW). Queensland : Cooktown, 15.V.1970, *Blake* 23291 (K, MEL).

Probably *N. malesiana* or *N. halophila* :

Borneo : Kalimantan, Deont Prov., I.1910, *Gibbs* s.n. (BM) ; Sarawak, Melugu, s.d., *Bogner* 1382 (Z)

Probably *N. malesiana* or *N. kurziana* (seeds 0.8-1.0 mm, 18-20 areoles per length row) but male flower not observed :

India : West Bengal, «Narkelbaria», 12.IX.1962, *Ghosh* 956 (CAL) ; «Mluberia», 11.X.1965, *Bennet* 1197 (CAL).

31. *Najas graminea* Del.

Descr. Egypte, Hist.-Nat. 2 : 282, pl. 50, fig. 3 (1813). — TYPE : Egypt, «Dans les canaux des rizières, à Rosette et dans le Delta», s.d., *Delile* s.n. (holo- : MPU — Herb. Delile ; iso- : H — Herb. Steven). The locality is given in the original description, but not mentioned on the label.

SPECIES DESCRIPTION.

Plants submerged, monoecious, slender or robust. *Stems* unarmed up to 60 cm high, 0.4-1.5(-2.3) mm in diameter, often plumose above because of the closely

packed leaves. *Leaves* (7.5-)14-25(-60) mm long, flat, acute, linear-lanceolate, (0.24-)0.5-0.9(-4.0) mm wide (incl. teeth on both sides), (0.19-)0.40-0.8(-3.8) mm wide (excl. teeth on both sides); margin on each side minutely serrulate with (18-)34-60(-185) inconspicuous spiny teeth, mainly consisting of the brownish spine-cell (a unicellular teeth, invisible to the unaided eye); leaf teeth 0.02-0.07(-0.29) mm long; the ratio of teeth length to leaf width being 0.03-0.10(-0.39); midrib without spiny teeth; septa absent; fibres mostly present on margin and near midrib; leaf sheath (1.4-)2.0-4.0(-10.5) mm (incl. auricle and spine-cells) by 0.9-2.1(-8.5) mm (ratio = 1-1-1.9(-3.7)), deeply auriculate, the auricle being (0.4-)0.8-1.2(-2.6) mm long (incl. spine-cells) and (0.16-)0.2-0.3(-0.5) mm wide (ratio = (1.4-)2.0-4.5(-6.5)), serrulate with 3-14(-50) spine-cells on each side and 1-7(-20) on the inner edge; apex of the auricle acute.

Inflorescences axillary, male and female flowers solitary, or 2-4 together at the same nodes, but the male ones more to the top of the plant. *Male flower* naked; inner envelope protruding 0.05-0.13 mm above the anther; anther 0.7-1.3(-2.7) mm by 0.3-0.5(-0.65) mm, tetrasporangiate. *Female flower* naked; 1.6-3.7 mm long; ovary 0.7-1.8 mm by 0.26-0.87 mm; style and stigma 0.5-2.6 mm; stigma 2(-3) lobed.

Fruit with persistent, thin, membranous pericarp and the remaining parts of the style. *Seed* elliptical oblong, (1.26-)1.5-2.4(-4.20) mm by (0.42-)0.5-0.7(-0.90) mm, sometimes slightly recurved (ratio = (2.2-)2.6-4.0(-5.2)); testa pitted with areoles, the latter regularly arranged in longitudinal rows, each row of (23-)25-35(-60); areoles squarish to hexagonal or rectangular; areoles (0.046-)0.06-0.08 mm.

DIAGNOSTIC FEATURES: leaf sheath auriculate; seed areoles regularly arranged per (23-)25-35(-60) in each longitudinal row, squarish to hexagonal or rectangular; seed (1.26-)1.5-2.4(-4.20) × (0.42-)0.5-0.7(-0.90), not enclosed in spathe; male flower not enclosed in spathe, tetrasporangiate; leaves without septa and with fibres on and near both sides of the midrib and near each margin.

KEY TO THE VARIETIES

1. Leaves (7.5-)14-25(-33) mm long and (0.24-)0.5-0.9(-1.3) mm broad (incl. teeth on both sides); provided with up to 74 teeth on each margin; stem up to 1.5 mm thick; leaf sheath up to 5 mm long, auricles up to 2.6 mm long; slender habit.
2. Leaves (9.2-)14-25(-33) mm long, provided with (18-)34-60(-74) teeth on each margin; teeth 0.02-0.07(-0.12) mm long; the ratio of leaf teeth to leaf width being 0.03-0.01(-0.22);
31a. var. *graminea*
2. Leaves 7.5-12(-17) mm long, provided with 18-24(-35) teeth on each margin; teeth 0.12-0.29 mm long; the ratio of leaf teeth to leaf width being 0.25-0.39 . . . 31b. var. *longidentata*
1. Leaves 50-60 mm long and 2.6-4.0 mm broad (incl. teeth on both sides), provided with 160-185 teeth; stem (1.6-)2-2.3 mm thick; leaf sheath (4-)7.5(-10.5) mm; auricles up to (2-)4-5.5 mm long; robust habit 31c. var. *robusta*

31a. *Najas graminea* Del. var. *graminea*

de Wilde in van Steenis, Fl. Males 1 (6) : 169-170 (1962). — ≡ *Najas graminea* Del., Descr. Egypte, Hist.-Nat. 2 : 282 pl. 50, fig. 3 (1813); Kunth, Enum. 3 : 115 (1841); A. Br. Journ. Bot. 2 : 278 (1864) excl. var. β; Miquel, Ill. Fl. Archip. Ind. : 45 (1871) p.p.; Navez, Nov. App. 297 (1880); Hooker, Fl. Brit. Ind. 6 : 569 (1893); Rendle, Trans. Linn. Soc., ser. 2, Bot. 5 (12) : 424-426, pl. 42, fig. 192-202 (1899) pro maj. parte excl. var. *minor* et var. *angustifolia*; Rendle, Ibid. (13) : 443 (1900); Rendle in Engler, Pflanzenr. H.7 : 18, fig. 5 q-v (1901); Merrill, Fl. Manila : 68 (1912); Makino & Nemoto, Cat. Jap. Pl. : 397 (1914); Blatter & Hallberg, Fl. Ind. Des. 26 (4) : 973 (1920); Haines, Bot. Bihar & Orissa : 851 (1924); Makino, Ill. Fl. Jap. : 856 (1925); Merrill, Enum. Philip. Flow. Pl. 1 : 24 (1925); Makino & Nemoto, Fl. Jap. ed. 2 : 1287 (1931); Fischer in Gamble, Fl. Madras 9 : 1604 (1931); Yuzepczuk in Komarov, Fl. USSR 1 : 275 (1934); Koch, Ber. Schweiz. Bot. Ges. 44 : 340 (1935); Blatter : 472 (1919-1936); Miki, Bot. Mag. Tokyo : 774, t. 6 M-R (1935); Camus Fl. Gén. Indo Chine 6 : 1211 (1942); Parsa, Fl. Iran. 5 : 38-39 (1951); Venkatesh, Bot. Not. 109 : 75-82 (1956); Swamy & Lakshmanan, Journ. Ind. Bot. Soc. 41 (2) : 247-267 (1962); de Wilde, Acta Bot. Neerl. 10 : 167 (1965); Ohwi (ed. Meyer & Walker), Fl. Jap., Engl. transl. : 124 (1965); Mouterde, Fl. Lib.-Syr. 1 : 24 (1966); Sharma & Chatterjee, Cytologia 32 : 287, 289 (1967); Backer, Fl. Java 3 : 11-12 (1968); Dandy in Rechinger, Fl. Iranica 86 : 2 (1971); Sinha & Sahai, Trop. Ecol. 14 : 19-28 (1973); Bhandari, Fl. Ind. Des. : 359 (1978); Yang in Li, Fl. Taiwan 5 : 37 (1978); Kitagawa, Neo-Lineamenta Fl. Mansh. : 60 (1979); Podlech & Yarmal, Mitt. Bot. München 16 : 466-467 (1980); Dandy in Tutin et al., Fl. Eur. 5 : 14 (1980); Uotila in Davis, Fl. Turkey 8 : 17 (1984); Cook, J. Aquat. Plant Manage. 23 : 1-6 (1985); You et al., Journ. Wuhan Univ. 4 : 111-118, 131, 132 (1985); Dandy in Townsend & Guest, Fl. Iraq 8 : 35 (1985); Triest, Mém. Acad. r. Sci. Outre-Mer, Cl. Sci. nat. méd., nouv. sér. in-8°, 21 (4) [et Et. Cont. afr., 6] : 69-74, fig. 11, pl. 17, 18 (1987). — ≡ *Caulinia graminea* (Del.) Battand. in Battand. & Trabut, Fl. Algérie 1, 2 : 10 (1895); Tzvelev, Nov. Syst. Vysh. Rast. 13 : 20 (1976). — ≡ *N. graminea* Del. var. *delilei* Magn., Ber. Deutsch. Bot. Ges. 1 : 522 (1883); K. Schum in Mart. Fl. Bras. 3 (3) : 731 (1894). — TYPE as for *N. graminea*. — Pl. XXVII, XXVIII, A-B.

= *Caulinia alagnensis* Pollini, Hort. & Prov. Veron. : 26 (1816). ≡ *N. alagnensis* (Pollini) Pollini, Fl. Veron. 3 : 49 (1824); Cham., Linnaea 4 : 502 (1829); Kunth, Enum. 3 : 115 (1841). — *Caulinia alaganensis* Pollini; Bertolini, Fl. Ital. 10 : 296 (1854), *lapsus calami* for *C. alagnensis*. — *Caulinia intermedia* Balb., Mem. Roy. Acad. Sci. Torin. 23 : 105 (1818), *nomen nudum*; Nocca & Balb., Fl. Ticin. 2 : 163 t. 15 (1821). — *N. minor* All. f. *intermedia* (Balb.) Cesati, Compt. Fl. Ital. : 204 (1871); Țopa in Săvulescu, Fl. Rep. Soc. Rom. 11 : 93 (1966). — *N. minor* All. var. *intermedia* (Balb. & Nocca) Cesati, Passerini & Gibelli, Comp. Fl. Ital. 1 : 204 (1886); Soó, Magyar Fl. 5 : 54 (1973). — TYPE : Italy, Alagna, Ticino, s.d., Pollini s.n. (*non vidi*, prob. at VER).

- = *N. seminuda* Griff. ex Voight, Hort. Suburb. Calc. : 694 (1845) ; Griff. Not. Pl. Asiat. 3 : 184 et Icon. Pl. Asiat. t. 251 f. 2, 253-254 (1851), probably belongs here. — TYPE : India, Serampore, s.d., *Griffith* s.n. (holo- : *non vidi*).
- = *N. serristipula* Maximowicz, Bull. Acad. Sci. St. Petersb. 12 : 72 (1868) ; Yuzepczuk in Komarov Fl. URSS 1 : 275 (1934), as a note ; Mori, Enum. Pl. Corea : 33 (1922). — *N. graminea* Del. var. *serristipula* (Maxim.) Nakai, Fl. Koreana 2 : 275 (1911). — *Caulina serristipula* (Maxim.) Nakai, Ord. Fam. etc. 212 (1943). — *N. graminea* Del. var. *serristipula* non Makino sed Nakai : Makino, Ill. Fl. Jap. : 888 (1948) ; Makino, Ill. Fl. Jap. (ed. 2) : 888 (1955). — *N. serristipula* Maxim. ; Magn. Beitr. : 44 (1870) ; Engler & Prantl., Pflanzenfam. 2 (1) : 218 (1889) probably *lapsus calami* for *N. serristipula*. — *N. graminea* Del. var. *serristipula* (Maxim.) Nakai, *lapsus calami* ; Kitagawa, Neo-Lineamenta Fl. Mansh. : 60 (1979). — *N. semistipula* Balb., *lapsus calami* ; Hook., Fl. Brit. Ind. 6 : 569 (1893). — TYPE : Japan, Nippon «In fossis Yokohaman», 1862, *Maximowicz* s.n. (holo- : LE ; iso- : G, K).
- = *N. brevistyla* Rendle, Trans. Linn. Soc., ser. 2, Bot. 5 (12) : 418-419 t. 42, f. 152-157 (1899) ; Rendle in Engler, Pflanzenr. H.7 : 16-17 (1901). — TYPE : India, Assam, 30.IX.1847, *Jenkins* s.n. (lecto- : K). India, Calcutta, s.d., herb. Hook 1867 (syn- : *non vidi*). Lectotype designated here.
- = *N. nipponica* Ito, Encycl. Jap. 1 : 698 (1908) ; Okuyama, Journ. Jap. Bot. 18 : 43 (1942), probably belongs here. — TYPE : Japan, Hondo, Owari Prov., s.d., T. *Ito* s.n. (holo- : *non vidi*).
- *N. graminea* Del. f. *intermedia* Zahariadi & Topa, in Săvulescu, Fl. Rep. Soc. Rom. 11, add. : 849 (1966). — TYPE : «Reg. Bucuresti, in oryzetis ad Chirnoigi (r. Oltenita)» (no type specimen cited), probably belongs here or under *N. gracillima*?
- *N. vallisnerioides* Griff. Notul. Pl. Asiat. 3 : 180 (1851) *nomen nudum*.
- *N. tenuifolia* auct. non R. Br. ; Aschers., Att. Soc. Ital. Sci. Nat. 10 : 267 (1867).
- *N. minor* auct. non All. ; Rendle, Trans. Linn. Soc., ser. 2, Bot. 5 (12) : 410-413 (1899) p.p. quoad *Griffith* 5609/1 (in part mixed with *N. indica*) ; Rendle in Engler, Pflanzenr. H.7 : 14 (1901) p.p.
- *N. foveolata* auct. non A. Br. ; Rendle, Trans. Linn. Soc., ser. 2, Bot. 5 (12) : 416-417 (1899) p.p. quoad *Maries* ; Rendle in Engler, Pflanzenr. H.7 : 15 (1901) p.p.
- *N. graminea* Del. var. *minor* auct. non Rendle, Trans. Linn. Soc., ser. 2, Bot. 5 (12) : 426-427 (1899) p.p. quoad *Griffith* 5609/1 (mixed with *N. indica*) ; Rendle in Engler, Pflanzenr. H.7 : 18 (1901) p.p. quoad *Griffith*.
- *N. densa* Griff., in sched. *Griffith* 5609/2.
- *N. denudata* Griff., in sched. *Griffith* 5609/3.

Characters as for the species but : *Plants* slender. *Stems* 0.4-1.5 mm in diameter. *Leaves* (9.2-)14-25(-33) mm long and (0.24-)0.5-0.9(-1.1) mm wide (incl. teeth on both sides), (0.19-)0.4-0.8(-0.93) mm wide (excl. teeth on both sides), provided

with (18-)34-60(-74) teeth on each margin ; teeth 0.02-0.07(-0.12) mm long ; the ratio of the leaf teeth to the leaf width being 0.03-0.10(-0.22) ; leaf sheaths (1.4-)2.0-4.0(-5.0) mm by 0.9-2.1(-2.7) mm ; auricles (0.4-)0.8-1.2(-2.6) mm long, with 3-14 spine-cells on each side and 1-7 on the inner edge.

NOTES : 1. *N. graminea* from tropical Africa always has leaves with fibres near the midrib and on the margins. These fibres are mostly, but not always lacking in specimens from Egypt and Arabia. MAGNUS (1833) considered the latter as a distinct variety. However, these specimens can be distinguished by no other character. In Asia, all specimens have leaves with fibres near each margin and on the midrib. Occasionally, fibres near both sides of the midrib might be present.

2. Extremes (Asia) : Specimens from Japan have longer but smaller seeds (2.1-2.2 × 0.5 mm ; ratio 4.2-4.7 ; 40 rows of areoles) ; those from Philippines have longer & broader seeds (c.2 × 0.9 mm ; ratio : 2.3 ; 45 rows of areoles) ; male flowers generally are 0.9-1.2 mm long, except in Moseley s.n. (Philippines), the anthers are 2.7 mm long. The collection *Surbeck* 301 (Sumatra) has male flowers with a bract of c.2 mm long.

3. *N. graminea* was collected mixed with *N. minor* from Bulgaria (*Vihodcevsky* 504), Azerbaydzhan (*Bobrov & Tzvelev* 1081, 1091) ; with *N. gracillima* from Japan (*Faurie* 13920 ; *Faurie* s.n., 9.IX.1897) ; with *N. orientalis* from Japan (*Oldham* 823).

4. *N. graminea* was recorded from Asian rice fields in U.S.S.R. (all collections from Azerbaydzhan and Tadzhikistan ; *Rusanov* 514) ; Japan (*Faurie* 13773, to Hara N8/40) ; Philippines (*Banlugan* 259).

5. Besides the cited specimens *N. graminea* is also reported in Europe from the Camargue, France (no specimens seen).

GEOGRAPHICAL DISTRIBUTION : S. Europe, subtropical and tropical regions of Africa, Asia and Australia. As an adventive in California, U.S.A. (Fig. 26).

SELECTED SPECIMENS :

Great Britain : Lancashire, Manchester, 14.IX.1883, *Bailey* s.n. (G, ZT) ; *ibid.*, 9.IX.1885, *Bailey* s.n. (G, LY-Gand., LY-Rouy).

Italy : Piemonte : Torino, 9.IX.1899, *Ferrari* s.n. (MPU) Novara, Vercelli, 3.VII.1864, *Beccari* s.n. (FI) ; IX.1874, *Gibelli* s.n. (FI) ; VIII.1875, *Gibelli* s.n. (FI, G, K, LY-Gand., ZT) ; VIII.1876, *Gibelli* s.n. (MPU) ; 30.VII.1867, *Malinverni* s.n. (K, LY-Rouy, MPU) ; XI, 1875, *Malinverni* s.n. (FI, LY-Gand.) ; 28.VIII.1897, *Ferrari* s.n. (FI) ; 10.VIII.1902, *Petrys* s.n. (FI, G) ; Lombardia : Milano, s.d., *Reynier* s.n. (G) ; Pavia, s.d., *Balbis* s.n. (FI).

Bulgaria : Plovdiv, Ribarnika, 24.X.1954, *Vihodcevsky* 504 (CAI, G, H) (mixed with *N. minor*).

U.S.S.R. : Azerbaydzhan A.S.S.R. : Baku : Kuba, near Khachmas, 25.VI.1899, *Alexeenko* N 722 (LE) ; Lenkoran : «Gjirdani», 1.VII.1956, *Aliiev* s.n. (LE) ; «near Shurun», 30.VII.1963, *Bobrov & Tzvelev*, 1081, 1091 (LE) ; near «Vel», 30.VII.1963, *Bobrov & Tzvelev* 1133 (LE). Uzbekistan (Kizil-kum) ; Amu-Darya

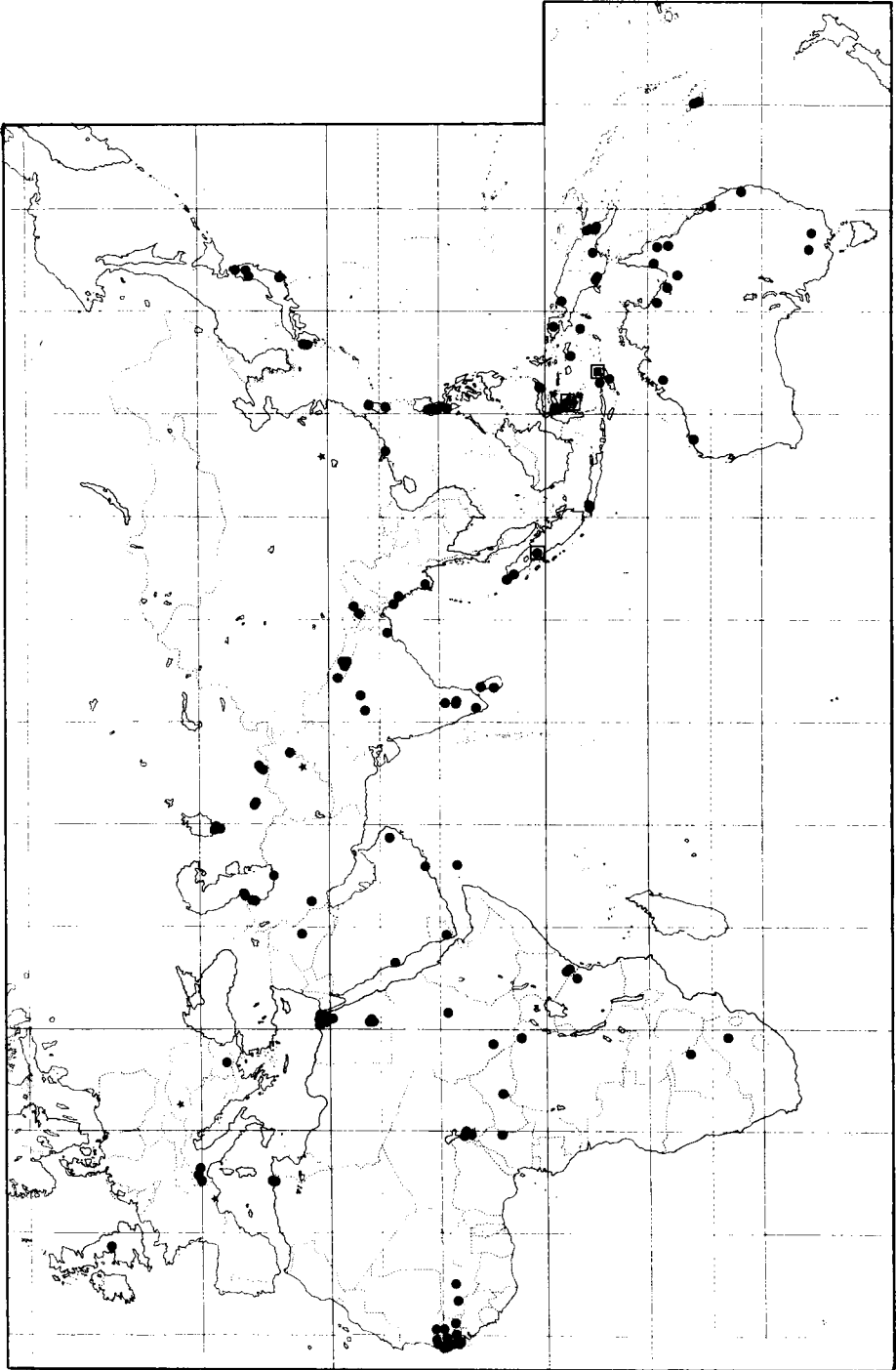


FIG. 26. — Distribution of *N. graminea* var. *graminea* (solid circles), *N. graminea* var. *longidentata* (triangle in square) and *N. graminea* var. *robusta* (solid square in open square). The specimen with a leaf-like spathe is indicated as a circle in square. The solid star is a literature record of *N. graminea*.

Delta : «Kara-Kul», 20.VII.1954, *Katanskaja* s.n. (LE) ; s.l., 29.VIII.1928, *Rusanov* 514 (LE) ; s.l., 1874, *Smirnow* s.n. (LE). Turkmenistan (Kara-kum) : Bukhara Prov. : lake near Amu-Darya, 23.VII.1910, *Androsov* 61 (LE) ; lake near Chardzhou, 12.VIII.1912, *Androsov* 91 (LE) ; lake near Amu-Darya Chardzou, 28.VI-15.VIII.1913, *Seidmuradov & Androsov* 2447 (BM, H, LE) lake on East Chardzhou, 2.VIII.1913, Herb. *Dubiansky* s.n. (LE) ; lake near Novi Chardzhou, 5.VIII.1913, *Androsov* s.n. (LE). Tadjhikistan (Pamiro-Alai) : Gissar Mts. region : Dushanbe, 28.VIII.1934, *Chernov & Sioa* 477 (LE), 492 (LE), 497 (LE) ; Ordzhonikidzeabad, 15.VIII.1937, *Goncharov & Michailovski* 255 (LE) ; Dushanbe, near Varzob river, 19.VIII.1942, coll. ? 720 (LE).

Lebanon/Syria : s.l., 3.IX.1831, *Homs* 381 (G).

Iraq : Baghdad, Hurriyah, 30.IV.1958, *Haines* W 1444 (E, K).

Saudi Arabia : Wady Fatima, 24.XI.1946, *Vesey-Fitzgerald* s.n. (BM) ; Al Hasà Oasis, «Ayn Umm al Lif», 17.VIII.1973, *Mandaville* 3937 (BM).

Yemen : Jebel Raymah, Al Hudaydah, 27.IV.1976, *Wood* 1048 (K).

Oman : Dhufar, foot of Jebel Qara, Ayn Jarsis, 12 km N. Salalah, 7.X.1979, *Miller* 2581 (K) ; Nazwa, exper. farm, 12.II.1973, *Parker* 059 (BM).

Iran : Mazandaran Prov., 5 km of Amol, 8.VIII.1972, *Uotila* 19272b (H, Z). Khuzistan : Shusch «In fossis prope Susan», VIII.1868, *Hausknecht* s.n. (BM, K).

Afghanistan : Nangarhar Prov. : Kunar valley near Kunar bridge near Darbanak, 21.IX.1978, *Podlech* 32593a (M) ; lower Kunar valley near Bazarak, 7 km S.W. Shewa, 21.IX.1978, *Podlech* 32609 (M).

India : Rajasthan State : Kota, «Abheda Palace tank», 29.X.1970, *Cook & Gut* 58 (Z) ; Madhya Pradesh State : Gwalior, IX.1890, *Maries* 391 (BM ; P) ; Andhra Pradesh State : Bukkapatnam, Chitravati river, VII.1889, *Gamble* 20934 (K) ; Karnataka State : Bangalore ; 5.XI.1970, *Cook & Gut* 115 (K, Z) ; *ibid.*, Anekal, 11.XI.1970, *Cook & Gut* 164 (Z) ; West Bengal : Champahati, 27.XI.1962, *Ghosh* 839 (CAL) ; Serampore, s.d., *Griffith* 5609/3 (K) (as *N. denudata* Griff.) «Plan. Ganget. inf.», s.d., Herb. *J. D. Hooker & Thomson* (ZT) ; Butampur, *McClelland* 1846 (BM). Tamil Nadu State : *Wight* (K) ; Tranquebar, s.d., Soc. Unit. Frat. 1775 (BM). Kerala State : Ernakulam, Alwaye, 17.IX.1973, *Cook, Rix & Schneller* 264 (K, Z).

Nepal : Pokhara, 11.IX.1954, *Stainton et al.* 7152 (BM) ; Tikoli, 26.VIII.1967, *Williams & Stainton* 8279 (BM) ; Jumba, 6.VIII.1952, *Polunin et al.* 5002 (BM) ; 5469 (BM) ; Lothar-Bharatpur, 27.VIII.1967, *Shakya* 9101 (BM).

Bangla Desh : Chittagong, Cox's Bazar, 22.VIII.1943, *Sinclair* 3151 (E) ; «East Bengal», s.d. *Griffith* 5609/2 (K, P) (as *N. densa* Griff. in K) loc. ? «Assam», 30.IX.1847 *Jenkins* s.n. (K) (as *N. brevistyla* Rendle) ; «Bengal Or.», *Hook. f. & Thomson* (P, M).

Burma : Arracan, XI.1869, *Kurz* s.n. (BM) ; Murawaddi, IV.1859, *Brandis* s.n. (BM).

Sri Lanka : Northern Prov. : Jaffna, 8.VII.1971, *Jayasuriya & Meyer* 231 (K) ; Ratmalana, II.1955, *Pillai* s.n. (LE).

Philippines : Luzon : Manila, «San Francisca des Monte», 28.VI.1890, *Loher* 1586 (K) ; *ibid.*, 1587 ; 1589 ; 1590 ; 1591 (K) ; Nueva Vizcaya Prov., Vicinity of Dupax, III-IV.1912, *Mc Gregor* Bur. Science 14166 (E, K, L, P) ; Mt. Prov., Banave, 19.VIII.1961, *Banlugan* 259 (L) ; *ibid.*, 27.XI.1962, *Mendoza & Buwaya* 712 (K, L) ; *ibid.*, 8.XII.1962, *Conklin & Buwaya* PNH 78622 (K, L) ; Bontac, VII.1923, *Vanoverbergh* 1773 (P) ; Baguio, V.1904, *Elmer* 6312 (K, P) ; Laguna de Bay, Mt. Maquiling, VI-VII.1917, *Elmer* 18112 (BM, K, L, P, Z), «? Lanaemi», I.II.1875, *Moseley* s.n. (BM) ; s.l., s.d., *Ramos* 11597 (BM).

Sumatra : Atjeh Prov., Blangkedjeren, 15.IV.1975, *de Wilde & de Wilde-Duyffes* 16438 (K) ; Seulimeum, 16.XII.1899, *Giesenhagen* s.n. (M) ; Bengkoeloe, XI.1921, «*Volksgezondheid*» 1111 (L) ; Tapanoeli, XI.1921, «*Gezondheidsdienst*» s.n. (L) ; Padangsidempuan, Ajumi river, III.1941, *Surbeck* 301 (L).

Java : Djakarta, s.d., *de la Savinierre* 1588 (BR) ; Bogor, 1.II.1950, *van Oostroom* 12666 (L).

Alor Isl. : 12.V.1938, *Jaag* 988, 1207 (L).

Timor (Portuguese) : Lautem, 18.XII.1953, *van Steenis* 18104 (L).

Sulawesi : Rec. Menado, Subdiv. Poso, «between Gintoe & Lengkekas», s.d., *Eyma* 1703 (K) ; Subdiv. Malili, Saroako, 9.VIII.1938, *Eyma* 3329 (L) ; Subdiv. Kolonodale, «beyond Tambajoli», 19.VIII.1938, *Eyma* 3413 (K, L) ; Minahassa, Between Suwaan & Sukur, 17.III.1877, *de la Savinierre* 503 (BR, P). Anboina Isl., s.d. *Gay* 4 (L) ; *ibid.*, *Beccari* FI 11808, 11812 (L) ; Kai Isl., Toeal, *Jensen* 299 ; 412 (L).

West Irian : Mamberamo, Rombebai Lake, 28.VIII.1953, *Versteegh* 107 (K).

Papua-New Guinea : N.E. Distr. : Padoga, 26.VII.1948, *Curtwell* 95 (K) ; Lolorua 24.II.1935, *Carr* 11511 (BM, K, L) ; Kanosia, 5.IV.1935, *Carr* 11792 (BM, L) ; Southern highland Distr. : lake Kutubu «near Wasemi», 28.IX.1961, *Schodde* 2321 (L) ; Atinjoe lake, 12.II.1949, *Bergman* s.n. (L). Morobe Distr. : Lake Wanum, 19 mls W. of Lae, 23.I.1962, *Hartley* 9800 (K) ; *ibid.*, 16.IX.1964, *van Royen* NGF 20093 (K, L) ; *ibid.*, 2.V.1959, *Brass* 29369 (L) ; Vicinity of Kajabit Mission, 22.VIII.1939, *Clemens* 10599 (E, H) ; Merauke Distr. s.d., *van Royen* 4742 (L) ; «Alkmaar», 23.VII.1907, *Lorentz* 14 (L).

New Caledonia : Lebris Bay, Ourai river, 1868-70, *Balansa* 1713 (BM) ; s.l., s.d., *Franc* 3068 (BM, K) ; Nouméa, 23.II.1925, *Däniker* 2933 (Z) ; Gomen river, 9.I.1961, *McKee* 8044 (K, NSW) ; La Foa, 13.I.1961, *McKee* 8088 ; 19.I.1961, 8225 (K, NSW).

Australia : West : Dampier Archipelago, s.d., *Naumann* s.n. (BM) ; Upper Lennard river, Mt. Hart, 29.V.1982, *Jacobs* 4311 (NSW). Northern territory : Snake lagoon on road to seven Emu, 10.V.1985, *Leach* 654 (MEL) ; Calvert river, 13.IX.1972, *Byrnes* 2775 (MEL). Queensland : Cook Distr., Edward river,

12.X.1980, *Clarkson* 3540 (MEL); Flats at E. base of divide on Palmer R. — Cooktown road, 20.V.1976, *Jacobs & Rodd* 2708 (NSW); About two thirds of the way from Chillagoe to Mungana, 27.V.1982, *Aston* 2306 (MEL); Plain Creek Dam, Wernadinga, 30.IV.1974, *Jacobs* 1355 (K); Rockhampton, 10.V.1981, *Jacobs* 4015 (NSW); Loc? «Moradabuc», VIII.1845, *Thomson* 1412 (K).

China: Hong Kong: 1853-56 *Wright* in herb. US. North Pacific Expl. 511 (BM, K).

Taiwan: Taitung Co., Yeh-you to Lang-tao, 30.VII.1968, *Hsu* 4944 (TAI); Lake Nichigetsutan, Bokkitsu, 18.IX.1929, *Kudo & Sasaki* s.n. (TAI); «in paludis Suitenka», 22.VI.1903, *Faurie* 527 (P); *ibid.*, 22.VI.1903, *Faurie* s.n. (BM). «In paludis Taipeh», s.d., *Faurie* 528 (BM).

Japan: Aomori, X.1886, *Faurie* 128 (P); Akita, 9.IX.1897, *Faurie* s.n. (G, P), mixed with *N. gracillima*; *ibid.*, 6-7.IX.1894, *Faurie* 13773 (K); Morioka, 1894, *Faurie* 13920 (G, K, LY, P) mixed with *N. gracillima*. Nagasaki, *Oldham* 823 (K) mixed with *N. orientalis*; Tokyo, 9.IX.1907, *Sakurai* s.n. (H); Omura, 13.IX.1940, *To Hara* N8/40; N8a/40 (K); Yokohama, 1862, *Maximowicz* s.n. (G, K, LE), Hossumo, 08.IX.1880, *Makino* (Z); *ibid.*, VIII.1890, *Makino* (ZT); s.l., X.1899, *Faurie* 2926 (G).

Probably *N. graminea* Del. (sterile):

Sumatra: Asahan, Aik Kwasan, 27.IX.1936, *Schneider* s.n. (ZT), cited as *N. malesiana* in DE WILDE (1961).

31b. *N. graminea* Del. var. *longidentata* Triest, nov. var.

Herba submersa, monoica, caulibus filiformibus. Folia 7.5-12(-17) mm longa; lamina 0.67-1.32 mm lata, marginibus utrinque 18-24(-35) spinis 0.12-0.29 mm longis conspicuisque munitis; vagina auriculata, 2.2-2.9 × 1.7-2.6 mm. Flores non vidi. Semina non vidi. — TYPE: Sulawesi, Mantana Lake, XI.1929, *Kjellberg* 3820 (holo-: L). — Pl. XXVIII, C-G.

— *N. graminea* auct. non Del. var. *graminea*; de Wilde in Van Steenis, Fl. Malesiana 1 (6): 170 (1961) p.p. quoad note.

Characters as for the species but: *Plants* slender. *Stem* c.1.0 mm in diameter. *Leaves* 7.5-12(-17) mm long and 0.67-1.32 mm wide (incl. teeth on both sides), 0.4-0.7 mm wide (excl. teeth on both sides), provided with 18-24(-35) teeth on each margin; teeth 0.12-0.29 mm long; the ratio of the leaf teeth to the leaf width being 0.25-0.39; leaf sheaths 2.2-2.9 mm by 1.7-2.6 mm; auricles 1-1.2 mm long, with 4-7 spine-cells on each side and 2-5 on the inner edge.

NOTE: Presently distinguished from var. *graminea* by shorter leaves with less teeth on the margins but with much more prominent leaf teeth. Male, female flowers or fruits were not available. Examination of fertile specimens could reveal that this taxon is much more different from var. *graminea* or even belongs to a distinct species.

GEOGRAPHICAL DISTRIBUTION : Central Sulawesi (Fig. 26).

SELECTED SPECIMENS :

Sulawesi : Mantana Lake, XI.1929, *Kjellberg* 3820 (L) ; Towuti Lake, 31.X.1909, *Nasche* 4 (K, L).

31c. *N. graminea* Del. var. *robusta* de Wilde

Acta Bot. Neerl. 10 : 169 (1960) ; de Wilde in Van Steenis, Fl. Males. 1 (6) ; 170 (1962). — TYPE : «Lesser Sunda Islands», Wetar Isl., 26.II.1910, *Elbert* 4521 (holo- : K ; iso- : L). — **Pl. XXIX.**

Characters as for the species but : *Plants* robust. *Stems* (1.6-)2-2.3 mm in diameter. *Leaves* 50-60 mm long and 2.6-4.0 mm wide (incl. teeth on both sides), 2.5-3.8 mm wide (excl. teeth on both sides), provided with 160-185 teeth on each margin ; teeth 0.05-0.1 mm long ; the ratio of the leaf teeth to the leaf width being 0.03-0.2 ; leaf sheaths (4-)7.5(-10.5) mm by (4-)6.2(-8.5) mm ; auricles (2-)4-5.5 mm long, with 16-50 spine-cells on each side and 12-20 on the inner edge.

GEOGRAPHICAL DISTRIBUTION : Only known from the type locality, Wetar Isl. (Fig. 26).

- NOTES : 1. Clearly distinct from all other known *N. graminea* collections.
2. Should be checked for ploidy level.

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INDEX OF NAMES

Accepted names are in bold

Caulinia Willd.

- alaganensis Pollini, probably *lapsus calami* for *C. alagnensis* Pollini = *N. graminea* Del. var. **graminea**
 alagnensis Pollini = *N. graminea* Del. var. **graminea**
 alternifolia Cham. = *N. australis* Rendle
 alzanensis Pollini, probably *lapsus calami* for *C. alagnensis* Pollini = *N. graminea* Del. var. **graminea**
 amurensis (Tzvelev) Tzvelev = *N. gracillima* (Engelm.) Magn.
 ancistrocarpa (Magn.) Nakai = *N. ancistrocarpa* Magn.
 flexilis Willd. = *N. flexilis* (Willd.) Rostk. & Schmidt
 fragilis Willd. = *N. minor* All.
 gracillima (Engelm.) Nakai = *N. gracillima* (Engelm.) Magn.
 graminea (Del.) Battand. = *N. graminea* Del. var. **graminea**
 indica Willd. = *N. indica* (Willd.) Cham.
 intermedia Balb. & NoCCA, nomen nudum = *N. graminea* Del. var. **graminea**
 japonica (Nakai) Nakai = *N. gracillima* (Engelm.) Magn.
 minor (All.) Cosson & Germain = *N. minor* All.
 muricata (Del.) Sprengler = *N. marina* L. subsp. **armata** (Lindb. f.) Horn af Rantz.
 oguraensis (Miki) Nakai = *N. oguraensis* Miki
 pectinata Parl. = *N. pectinata* (Parl.) Magn.
 serristipula (Maxim.) Nakai = *N. graminea* Del. var. **graminea**
 tenuissima (A. Br.) Tzvelev = *N. tenuissima* (A. Br.) Magn.
 - subsp. amurensis Tzvelev = *N. gracillima* (Engelm.) Magn.
 - subsp. tenuissima = *N. tenuissima* (A. Br.) Magn.

Fluvialis Adans.

- flexilis (Willd.) Persoon = *N. flexilis* (Willd.) Rostk. & Schmidt
 indica (Willd.) Persoon = *N. indica* (Willd.) Cham.
 minor (All.) Persoon = *N. minor* All.

Ittnera C. C. Gmel.

- minor (All.) C. C. Gmel. = *N. minor* All.
 najas (L.) C. C. Gmel. = *N. marina* L. subsp. **marina** var. **marina**

Najas L.

- affinis Rendle = *N. welwitschii* Rendle
 alaganensis Pollini, *lapsus calami* for *N. alagnensis* Pollini = *N. graminea* Del. var. **graminea**

alagnensis Pollini = *N. graminea* Del. var. *graminea*

alternifolia A. Br. = *N. australis* Rendle

ancistrocarpa Magn.

armata Lindb. f. = *N. marina* L. subsp. *armata* (Lindb. f.) Horn af Rantz.

arsenariensis Maire = *N. marina* L. subsp. *arsenariensis* (Maire) Triest

australis Rendle

baldwinii Horn af Rantz.

bengalensis Horn af Rantz., in clav., descr. angl., ad int., nom. inval. = *N. malesiana* de Wilde

brevistyla Rendle = *N. graminea* Del. var. *graminea*

browniana Rendle

celebica Koorders

delilei Rouy = *N. marina* L. subsp. *armata* (Lindb. f.) Horn af Rantz.

densa Griff. (in sched. Griffith 5609/2), not published = *N. graminea* Del. var. *graminea*

denudata Griff. (in sched. Griffith 5609/3), not published = *N. graminea* Del. var. *graminea*

dichotoma Roxb., nomen nudum = *N. indica* (Willd.) Cham.

falculata A. Br., probably *N. foveolata* Magn. or *N. indica* (Willd.) Cham.

flexilis (Willd.) Rostk. & Schmidt

– var. *microcarpa* Nilsson = *N. flexilis* (Willd.) Rostk. & Schmidt

fluvialis Thuill. = *N. marina* L. subsp. *marina* var. *marina*

fluviatilis Poir. in Lam. = *N. marina* L. subsp. *marina* var. *marina*

foveolata Magn.

– var. *minor* Rendle = *N. indica* (Willd.) Cham.

fragilis (Willd.) Del. = *N. minor* All.

fucoides Griff. = *N. marina* L. subsp. *intermedia* (Gorski) Casper

gracilis Kuzmin & Skvortzov = *N. minor* All.

gracillima (Engelm.) Magn.

graminea Del. = *N. graminea* Del. var. *graminea*

– f. *intermedia* Zahariadi & Topa = *N. gracillima* (Engelm.) Magn. or *N. graminea* Del. var. *graminea*

– var. *angustifolia* Rendle = *N. malesiana* de Wilde

– var. *delilei* Magn. = *N. graminea* Del. var. *graminea*

– var. *graminea*

– var. *longidentata* Triest

– var. *minor* Rendle = p.p. *N. tenuis* Magn. & *N. malesiana* de Wilde

– var. *minor* (in sched. *Chevalier* 6582), not published = *N. baldwinii* Horn af Rantz.

– var. *robusta* de Wilde

– var. *serristipula* (Maxim.) Nakai = *N. graminea* Del. var. *graminea*

– var. *serristipula* (Maxim.) Nakai, *lapsus calami* for var. *serristipula* (Maxim.) Nakai = *N. graminea* Del. var. *graminea*

– var. *tenuifolia* (R. Br.) A. Br. = *N. tenuifolia* R. Br.

– var. *vulgata* Magn. = *N. graminea* Del. var. *graminea*

grossareolata Triest

hagerupii Horn af Rantz.

halophila Triest

helvetica Borb. = *N. marina* L. subsp. *intermedia* (Gorski) Casper

heteromorpha Griff. = *N. indica* (Willd.) Cham.

horrida Magn.**indica** (Willd.) Cham.

- var. *africana* (in sched. Leprieur s.n. ; Bory s.n.), not published = *N. welwitschii* Rendle
- var. *gracillima* Engelm. = *N. gracillima* (Engelm.) Magn.
- var. *macrodictya* Miq., nomen nudum = *N. foveolata* Magn.
- var. *rigida* Miq., nomen nudum = *N. foveolata* Magn.

intermedia Gorski = *N. marina* L. subsp. *intermedia* (Gorski) Casper

interrupta K. Schum. = *N. horrida* Magn.

japolina Nakai, probably *lapsus calami* for *N. japonica* Nakai = *N. gracillima* (Engelm.) Magn.

japonica Nakai = *N. gracillima* (Engelm.) Magn.

kingii Rendle**kurziana** Rendle

lacerata Rendle = *N. indica* (Willd.) Cham.

laevis Lojacono-Pojero = *N. minor* All.

laticarpa K. Schum. = *N. marina* L. subsp. *laticarpa* (K. Schum.) Triest

leichhardtii Magn. = *N. tenuifolia* R. Br.

liberensis Horn af Rantz. = *N. baldwinii* Horn af Rantz.

lobata Blanco = *N. foveolata* Magn.

madagascariensis Rendle

maerandra Griff. (in sched. *Griffith* 5609/7), not published = *N. kingii*, Rendle

major All. = *N. marina* L. subsp. *marina* var. *marina*

- var. *angustifolia* A. Br. = *N. marina* L. subsp. *commersonii* Triest, p.p.
- var. *ehrenbergii* A. Br. = *N. marina* L. subsp. *ehrenbergii* (A. Br.) Triest
- var. *intermedia* (Gorski) Casper = *N. marina* L. subsp. *intermedia* (Gorski) Casper
- var. *laevis* D.C. = *N. marina* L. subsp. *marina* var. *marina*
- var. *microcarpa* A. Br. = *N. marina* L. subsp. *microcarpa* (A. Br.) Triest
- var. *multidentata* A. Br. = *N. marina* L. subsp. *marina* var. *marina*
- var. *muricata* (Thuill.) Coss. & Germ. = *N. marina* L. subsp. *marina* L. var. *marina*
- var. *paucidentata* A. Br. = *N. marina* L. subsp. *intermedia* (Gorski) Casper
- var. *polonica* (Zalewsky) Tzvelev = *N. marina* L. subsp. *marina* var. *marina*
- var. *spinulosa* D.C. = *N. marina* L. subsp. *marina* var. *marina*

malesiana de Wilde**marina** L.

- var. *anacantha* Borb. = *N. marina* L. subsp. *intermedia* (Gorski)
- var. *angustifolia* (A. Br.) K. Schum. = *N. marina* L. subsp. *commersonii* Triest, p.p.
- var. *bollei* (A. Br.) K. Schum. = *N. marina* L. subsp. *microcarpa* (A. Br.) Triest
- var. *brachycarpa* Trautv. = *N. marina* L. subsp. *brachycarpa* (Trautv.) Triest
- var. *brevifolia* Aschers. & Graebn. = *N. marina* L. subsp. *intermedia* (Gorski) Casper
- var. *communis* Ashers. & Graebn. = *N. marina* L. subsp. *marina* var. *marina*
 - subvar. *luxurians* Aschers. & Graebn. = *N. marina* L. subsp. *marina* var. *marina*
- var. *delilei* (Rouy) Maire = *N. marina* L. subsp. *armata* (Lindb. f.) Horn af Rantz.
- var. *denticulata* Rendle = *N. marina* L. subsp. *intermedia* (Gorski) Casper
- var. *ehrenbergii* (A. Br.) K. Schum. = *N. marina* L. subsp. *ehrenbergii* (A. Br.) Triest
- var. *genuina* K. Schum. = probably *N. marina* L. subsp. *intermedia* (Gorski) Casper
- var. *genuina* Rendle (in sched. *Litwinow* 2478, 3345) = *N. marina* L. subsp. *marina* var. *grossedentata* Rendle
- var. ? *genuina* Rendle f. *luxurians* Rendle (in sched. *Litwinow* 2478) = *N. marina* L. subsp. *marina* var. *grossedentata* Rendle

- var. *grossedentata* Rendle = *N. marina* L. subsp. *marina* var. *grossedentata* Rendle
 - var. *intermedia* (Gorski) Aschers. = *N. marina* L. subsp. *intermedia* (Gorski) Casper
 - var. *latior* K. Schum. = *N. marina* L. subsp. *latior* (K. Schum.) Triest
 - var. *marina*
 - f. *anacantha* (Borb.) Soó = *N. marina* L. subsp. *intermedia* (Gorski) Casper
 - f. *brevifolia* (A. Br.) Soó = *N. marina* L. subsp. *intermedia* (Gorski) Casper
 - f. *intermedia* (Gorski) Soó = *N. marina* L. subsp. *intermedia* (Gorski) Casper
 - f. *marina* = *N. marina* L. subsp. *marina* var. *marina*
 - subf. *angustifolia* (A. Br.) K. Schum. = *N. marina* L. subsp. *intermedia* (Gorski) Casper
 - subf. *luxurians* (Aschers. & Graebn.) Soó = *N. marina* L. subsp. *marina* var. *marina*
 - f. *multidentata* (A. Br.) Soó = *N. marina* L. subsp. *marina* var. *marina*
 - f. *subacantha* (Borb.) Soó = *N. marina* L. subsp. *intermedia* (Gorski) Casper
 - var. *microcarpa* (A. Br.) Rendle = *N. marina* L. subsp. *microcarpa* (A. Br.) Triest
 - var. *multidentata* (A. Br.) K. Schum. = *N. marina* L. subsp. *marina* var. *marina*
 - var. *muricata* Hartm. = *N. marina* L. subsp. *intermedia* (Gorski) Casper
 - var. *muricata* (Del.) K. Schum. = *N. marina* L. subsp. *armata* (Lindb. f.) Horn af Rantz.
 - var. *paucidentata* (A. Br.) K. Schum. = *N. marina* L. subsp. *intermedia* (Gorski) Casper
 - var. *polonica* (Zalewsky) Aschers. & Graebn. = *N. marina* L. subsp. *marina* var. *marina*
 - var. *subacantha* Borb. = *N. marina* L. subsp. *intermedia* (Gorski) Casper
 - var. *sumatrana* de Wilde = *N. marina* L. subsp. *sumatrana* (de Wilde) Triest
 - var. *zollingeri* Rendle = *N. marina* L. subsp. *latior* (K. Schum.) Triest
 - subsp. *aculeolata* Tzvelev
 - subsp. *armata* (Lindb. f.) Horn af Rantz.
 - subsp. *arsenariensis* (Maire) Triest
 - subsp. *brachycarpa* (Trautv.) Tzvelev
 - subsp. *commersonii* Triest
 - subsp. *delilei* (Rouy) Oberm. (incorrectly attributed to Maire) = *N. marina* L. subsp. *armata* (Lindb. f.) Horn af Rantz.
 - subsp. *ehrenbergii* (A. Br.) Triest
 - subsp. *intermedia* (Gorski) Casper
 - subsp. *latior* (K. Schum.) Triest
 - subsp. *major* (All.) Viinikka = *N. marina* L. subsp. *marina* var. *marina*
 - subsp. *marina*
 - var. *grossedentata* Rendle
 - var. *kashmirensis* Triest
 - var. *marina*
 - var. *ohwii* Triest
 - subsp. *microcarpa* (A. Br.) Triest
 - subsp. *sumatrana* (de Wilde) Triest
 - subsp. *susiana* Triest
- maritima* Pallas, probably *lapsus calami* for *N. marina* L. = *N. marina* L. subsp. *intermedia* (Gorski) Casper
- meikleii* Horn af Rantz. = *N. testui* Rendle
- microcarpa* (A. Br.) Christ. = *N. marina* L. subsp. *microcarpa* (A. Br.) Triest
- minor* All.
- f. *intermedia* (Balb.) Cesati = *N. graminea* Del. var. *graminea*
 - f. *laxa foliis angustis* (A. Br.) (in sched. *de la Perraudière* in Herb. Cosson 2.VII.1861) = *mixtum* *N. minor* All. and *N. graminea* Del. var. *graminea*

- var. *indica* (Willd.) A. Br. = *N. indica* (Willd.) Cham. p.p. and *N. australis* Rendle p.p.
- var. *intermedia* (Balb. & NoCCA) Cesati, Passerini & Gibelli = *N. graminea* Del. var. **graminea**
- var. *longifolia* Corti = *N. minor* All.
- var. *mandshurica* Kuzmin & Skvortzov = *N. minor* All.
- var. *setacea* A. Br. = *N. setacea* (A. Br.) Rendle
- var. *spinosa* Rendle = *N. indica* (Willd.) Cham.
- var. *tenuissima* A. Br. = *N. tenuissima* (A. Br.) Magn.

monosperma Willd. = *N. marina* L. subsp. *marina* var. **marina**

muricata Del. = *N. marina* L. subsp. *armata* (Lindb. f.) Horn af Rantz.

muricata Thuill. = *N. marina* L. subsp. *marina* var. **marina**

nipponica Ito = *N. graminea* Del. var. **graminea**

oguraensis Miki

orientalis Triest & Uotila

paludosa Blanco (in sched. Ramos 24079), probably *lapsus calami* for *N. palustris* = *N. foveolata* Magn.

palustrella (in sched. *Commerson* 132), not published = *N. marina* L. subsp. **commersonii** Triest

palustrina (in sched. *Commerson* 132), not published = *N. marina* L. subsp. **commersonii** Triest

palustris Blanco = *N. foveolata* Magn.

pectinata (Parl.) Magn.

pluvialis K. Schum., probably *lapsus calami* for *N. fluvialis* Thuill. or *N. fluviatilis* Poir. = *N. marina* L. subsp. **marina** var. **marina**

polonica Zalewsky = *N. marina* L. subsp. *marina* var. **marina**

pseudogracillima Triest

pseudograminea W. Koch.

rigida Griff. = *N. indica* (Willd.) Cham.

schweinfurthii Magn.

seminuda Griff. = *N. graminea* Del. var. **graminea**

serristipula Maxim., *lapsus calami* for *N. serristipula* Maxim. = *N. graminea* Del. var. **graminea**

serristipula Maxim. = *N. graminea* Del. var. **graminea**

setacea (A. Br.) Rendle

spinosa Wall., *nomen nudum* = *N. marina* L. subsp. *intermedia* (Gorski) Casper

subulata Thuill. = *N. minor* All.

tenuicaulis Miki = *N. marina* L. subsp. *marina* var. **grossedentata** Rendle

tenuifolia R. Br.

tenuifolia Navez = *N. foveolata* Magn.

tenuifolia R. Br.

- subsp. *pseudograminea* (W. Koch) de Wilde = *N. pseudograminea* W. Koch

- var. *celebica* (Koord.) de Wilde = *N. celebica* Koord.

- var. *pseudograminea* = *N. pseudograminea* W. Koch

- subsp. *tenuifolia* = *N. tenuifolia* R. Br.

tenuis Magn.

tenuissima (A. Br.) Magn.

ternata Griff. = *N. indica* (Willd.) Cham.

testui Rendle

tetrasperma Willd. = *N. marina* L. subsp. *marina* var. **marina**

vallisneroides Griff., *nomen nudum* = *N. graminea* Del. var. **graminea**

welwitschii Rendle

yezoensis Miyabe = *N. gracillima* (Engelm.) Magn.

SPECIES EXCLUDENDAE

Caulinia composita Buch.-Ham. ex Wall. List. No. 5184 = **Ceratophyllum**.

Caulinia microphylla (Reich.) Nocchi & Balb., Fl. Ticin. 2 : 163 (1821) = **Ceratophyllum**.

Najas microphylla Reich., Fl. germ. Exc. : 843 (1832) = **Ceratophyllum**.

Najas obvoluta Blanco, Fl. Filip. : 460 (1845) = **Ceratopteris**.

INDEX OF SPECIMENS

EUROPE

(incl. Turkey, excl. U.S.S.R.)

- Agasse* s.n., 3.VIII.1862 : *N. marina* subsp. *marina* var. *marina*.
Akeroyd et al. s.n., 2.VIII.1983 : *N. marina* subsp. *marina* var. *marina*.
Andriessen s.n., 9.X.1985 : *N. marina* subsp. *marina* var. *marina*.
Arendt s.n., in Herb. Triest 229 : *N. marina* subsp. *intermedia*.
Asplund s.n., 28.VII.1926 : *N. marina* subsp. *intermedia*.
Baagae s.n., 2.VIII.1892 : *N. marina* subsp. *intermedia*.
Baguet s.n., VI-VII.1869 : *N. minor*.
Bailey s.n., 14.IX.1883 : *N. graminea* var. *graminea*.
Balbis s.n. : *N. minor*. — s.n. : *N. graminea* var. *graminea*.
Bamps, C. s.n., VIII.1880 : *N. minor*.
Barrandon s.n., 10.VIII.1864 : *N. minor*.
Bauman s.n., 20.VIII.1909 : *N. flexilis*. — s.n., 1907 ; s.n., 5.IX.1907 ; s.n., 1909 : *N. marina* subsp. *intermedia*.
Baytop, A. 12120 ; 12201 ; 40867a : *N. minor*.
Baytop, A. s.n., XI.1985 : *N. marina* subsp. *intermedia*.
Baytop, A. & T. ISTE 6881 : *N. marina* subsp. *marina* var. *marina*.
Baytop, A. & T. ISTE 11876 ; ISTE 11946 : *N. marina* subsp. *intermedia*.
Baytop, Tuzlaci & Meriçli 41429 : *N. minor*.
Baytop & Uotila 40250 : *N. minor*.
Beauverd s.n., 22.IX.1921 : *N. marina* subsp. *intermedia*.
Beccari s.n., 3.VII.1864 : *N. graminea* var. *graminea*.
Belanger s.n., 26.VI.1829 : *N. marina* subsp. *marina* var. *marina*.
Bernet s.n., VIII.1873 ; s.n. : *N. marina* subsp. *intermedia*.
Biau 2836 : *N. marina* subsp. *marina* var. *marina*.
Bigeard & Gillot s.n., 15.VII.1882 : *N. marina* subsp. *marina* var. *marina*.
Bijot in Herb. Sauvage 658 : *N. marina* subsp. *marina* var. *marina*.
Binz s.n., 31.VII.1891 : *N. marina* subsp. *marina* var. *marina*.
Bioret s.n., 20.IX.1911 : *N. marina* subsp. *marina* var. *marina*.
Böhmen s.n. : *N. marina* subsp. *marina* var. *marina*.

- Boreau* s.n., 24.VI.1842 ; s.n., 20.VII.1842 : N. minor. — s.n., 30.VI.1842 : N. marina subsp. marina var. marina.
- Botshol* s.n., 28.IX.1979 : N. marina subsp. intermedia.
- Bouchet* s.n., 1807 ; s.n., 1834 : N. minor. — s.n., 1834 : N. marina subsp. marina var. marina.
- Bouvet* s.n., 6.IX.1874 ; s.n., 8.IX.1874 : N. marina subsp. marina var. marina.
- Bowden & Sims* 579 : N. marina subsp. marina var. marina.
- Braun* s.n., 3.IX.1852 ; s.n., VIII.1857 ; s.n., IX.1869 : N. flexilis. — s.n. : N. minor.
- Buchinger* s.n., 1850 : N. minor.
- Cave* s.n., 10.IX.1890 : N. marina subsp. intermedia.
- Chabert* s.n., 21.IX.1906 : N. marina subsp. intermedia.
- Chater* s.n., 11.IX.1983 : N. marina subsp. intermedia.
- Charpin* 886924 : N. marina subsp. marina var. marina. — s.n., 12.VII.1969 : N. gracillima.
- Charrel* s.n., 21.V.1888 ; s.n., 1889 : N. minor.
- Cirujano* s.n., 4.IX.1980 : N. marina subsp. armata.
- Cook* 1110 ; 1120B : N. gracillima. — 1113 : N. minor.
- Coste* s.n. ; s.n., 16.VIII.1886 : N. marina subsp. marina var. marina.
- Daveau* s.n., VI-VII.1886 : N. minor.
- De Candolle* s.n., 27.VII.1808 : N. minor. — s.n., VI.1822 : N. marina subsp. marina var. marina.
- Degen* 3894 : N. marina subsp. intermedia.
- de Lacroix* s.n. in Herb. Revel ; s.n., VII.1858 : N. marina subsp. marina var. marina.
- Delalande* s.n., in Herb. Revel s.n., 6.VIII.1840 ; s.n., in Herb. Revel s.n., 24.VIII.1840 : N. marina subsp. marina var. marina.
- Delile* s.n. : N. minor.
- de Paluzieux* s.n., 1.VIII.1900 : N. marina subsp. marina var. marina.
- de Vichet* s.n. : N. marina subsp. marina var. marina.
- Dieudonne* s.n., 1872 & 1892 : N. marina subsp. marina var. marina.
- Doucet* s.n. in Herb. Carbonel s.n. : N. marina subsp. marina var. marina.
- Drümmer* s.n., 5.VIII.1891 : N. marina subsp. marina var. marina.
- Drobny* s.n., 21.IX.1926 : N. marina subsp. intermedia.
- Duffour* s.n., 14.IX.1894 : N. marina subsp. marina var. marina.
- Duvernoy* s.n., in Herb. Sonder 1812-1881 : N. marina subsp. intermedia.
- Duvigneaud, J.* 77F838 : N. marina subsp. marina var. marina.
- Färdig* s.n., 30.VII.1932 : N. marina subsp. intermedia.
- Farras I De Blas* 1 : N. minor. — 1 and 2 : N. gracillima.
- Ferrari* s.n., 9.IX.1899 ; s.n., 28.VIII.1897 : N. graminea var. graminea.
- Ferrer* 283 : N. marina subsp. marina var. marina.
- Fiori* s.n., 1904 : N. marina subsp. marina var. marina.
- Fischer* s.n., 6.X.1901 : N. marina subsp. marina var. marina.
- Foucaud* s.n., 28.VII.1890 : N. minor.
- Fries* s.n. : N. flexilis.
- Fritsche* 560 : N. marina subsp. marina var. marina. — s.n. : N. minor.

- Gandoger* s.n. ; s.n., 3.IX.1867 : *N. marina* subsp. *marina* var. *marina*. — s.n., 3.IX.1867 : *N. minor*.
- Gérard* s.n., 5.IX.1886 : *N. minor*.
- Gehmi* s.n., 25.VII.1887 : *N. minor*.
- Gibelli* s.n., IX.1874 ; s.n., VIII.1876 : *N. graminea* var. *graminea*. — s.n., VIII.1875 : *N. minor*.
- Goiran* s.n., VII.1870 : *N. minor*.
- Gottlieb* s.n., 1867 : *N. minor*.
- Greuter* 15800 : *N. marina* subsp. *marina* var. *marina*.
- Gronblad* s.n., 24.IX.1952 : *N. marina* subsp. *marina* var. *marina*.
- Hagström* s.n., VIII.1895 : *N. marina* subsp. *intermedia*.
- Härö* s.n., 25.VII.1950 : *N. flexilis*.
- Hausknecht* s.n., 30.VII.1885 : *N. minor*.
- Haynald* s.n., VII.1877 : *N. minor*.
- Hegi* s.n., 26.VII.1901 : *N. marina* subsp. *intermedia*.
- Herb. de Vessian* s.n., 23.VIII.1873 : *N. minor*.
- Herb. Linnaeus* 1156.1 ; 1156.2 ; 1156.3 : *N. marina* subsp. *intermedia*.
- Hinrichsen* s.n., 10.VII.1874 : *N. marina* subsp. *intermedia*.
- Hirte* s.n., 20.VI.1889 : *N. marina* subsp. *marina* var. *marina*.
- Hirth* s.n., 13.VII.1903 : *N. marina* subsp. *intermedia*.
- Hormia* 543 : *N. minor*.
- Jack* s.n., 2.X.1875 ; s.n., 31.VIII.1892 : *N. marina* subsp. *intermedia*.
- Jäggi* s.n., 24.VIII.1871 : *N. marina* subsp. *intermedia*. — s.n., s.d. ; s.n., 19.VIII.1883 : *N. marina* subsp. *marina* var. *marina*.
- Jahn* s.n., VI.1864 : *N. marina* subsp. *marina* var. *marina*.
- John, Greuter, Gutzwiller, Peisl & Stafleu* s.n., 12.VIII.1958 : *N. marina* subsp. *marina* var. *marina*.
- Käser* s.n., 10.VIII.1878 ; in *Herb. Schultz* 1670 : *N. marina* subsp. *intermedia*.
- Keller* 5335 : *N. marina* subsp. *marina* var. *marina*.
- Kenneth* s.n., IX.1973 : *N. flexilis*.
- Kihlmann* s.n., VII-VIII.1878 : *N. marina* subsp. *intermedia*.
- Koch* 47/222 ; s.n., 9.IX.1931 : *N. marina* subsp. *marina* var. *marina*. — 47/221 ; s.n., 11 & 12.IX.1931 : *N. minor*. — 50/614 ; s.n., 1943 : *N. marina* subsp. *intermedia*.
- Koch & Hess* 51/631 : *N. gracillima*.
- Krok* s.n., 20.VIII.1858 : *N. flexilis*.
- Kurtto & Helynranta* s.n., 16.VIII.1984 : *N. tenuissima*.
- Kuzniewski* 422 : *N. marina* subsp. *marina* var. *marina*.
- Laine* s.n., 5.IX.1965 : *N. marina* subsp. *intermedia*.
- Laine & Vistanen* s.n., 16.VIII.1964 : *N. marina* subsp. *intermedia*.
- Lambinon* 75/1/818 : *N. gracillima*. — 75/1/818 : *N. minor*.
- Landmark* s.n., 30.IX.1898 : *N. flexilis*.
- Leblebici & Behat* 3162 : *N. marina* subsp. *armata*.
- Leblebici, Seçmen & Behat* 3409 : *N. marina* subsp. *armata*.
- Le Brun* s.n., 5.IX.1913 : *N. minor*.
- Le Grand* s.n. : *N. marina* subsp. *marina* var. *marina*.

- Le Grand* s.n., 22.VIII.1869 : N. minor.
Levanto 1801 : N. tenuissima.
Lindberg s.n., 12.IX.1899 : N. tenuissima.
Linkola s.n., 12.VIII.1941 : N. tenuissima.
Löhr s.n. : N. marina subsp. marina var. marina.
Loret et Barrandon s.n., 26.IX.1823 ; 27.IX.1853 ; 2.VIII.1891 : N. marina subsp. marina var. marina.
Lussac s.n., 1.IX.1864 : N. minor.
Magnusson s.n., 17.VIII.1938 : N. marina subsp. intermedia.
Malinverni s.n., 30.VII.1867 ; s.n., XI.1875 : N. graminea var. graminea.
Mallot 16065 : N. marina subsp. armata.
Markgraf s.n., 31.VIII.1965 : N. marina subsp. intermedia.
Martin s.n., 2.IX.1861 : N. minor.
Mercier s.n., VIII.1859 : N. marina subsp. marina var. marina.
Merlet s.n. in Herb. Simon s.n., 24.VIII.1889 : N. marina subsp. marina var. marina.
Möller s.n., VIII.1882 : N. flexilis.
Nevill s.n., VII.1885 : N. marina subsp. intermedia.
Nielsen s.n., 7.VIII.1868 : N. marina subsp. intermedia.
Nilsson s.n., 1881 ; in Herb. Schultz s.n., 1878 : N. flexilis.
Norbin s.n., 17.VIII.1864 : N. tenuissima.
Nordstedt s.n., 20.IX.1869 : N. marina subsp. intermedia. — s.n., 16.IX.1881 ; s.n., VIII.1883 : N. flexilis.
Nyman s.n. : N. marina subsp. intermedia.
Obermeyer s.n., 22.IX.1918 : N. marina subsp. marina var. marina. — s.n., 22.IX.1918 : N. marina subsp. intermedia.
Öhrnberg s.n., 15.VIII.1880 : N. marina subsp. intermedia.
Øllgaard & Lojtrant s.n., 12.VIII.1972 : N. marina subsp. intermedia.
Paananen s.n., 30.VIII.1950 : N. flexilis.
Paillot s.n., 16.X.1858 ; s.n., 19.VII.1870 : N. minor. — s.n., 19.VII.1870 : N. marina subsp. marina var. marina.
Pallis s.n., 1912 : N. marina subsp. marina var. marina.
Pasquale s.n., s.d. : N. marina subsp. marina var. marina.
Pellat s.n., 12.IX.1887 : N. minor.
Petry s.n., 10.VIII.1902 : N. graminea var. graminea.
Pettersson s.n., 14.IX.1888 : N. marina subsp. intermedia.
Peyron s.n., VIII.1889 : N. marina subsp. intermedia.
Popiou s.n., 21.VII.1970 : N. marina subsp. marina var. marina.
Porta s.n., VIII.1869 : N. marina subsp. marina var. marina.
Revel s.n., 19.VIII.1846 : N. marina subsp. marina var. marina.
Rejewski & Gugnacka s.n., 24.VII.1974 : N. marina subsp. marina var. marina.
Reynier s.n. : N. graminea var. graminea.
Rigo s.n., 30.VIII.1878 ; s.n., 2.IX.1897 : N. marina subsp. marina var. marina. — s.n., 28.VIII.1897 ; s.n., VIII.1904 : N. minor.

- Romieux* s.n., 20.IX.1922 : *N. marina* subsp. *intermedia*.
Roos s.n., 18.VII.1868 : *N. marina* subsp. *intermedia*.
Ross in *Herb. Siculum* 68 : *N. marina* subsp. *marina* var. *marina*.
Salzmann s.n. : *N. minor*.
Schiller 1022 : *N. marina* subsp. *marina* var. *marina*.
Schlosser s.n. : *N. minor*.
Schochin s.n., VIII.1898 : *N. marina* subsp. *intermedia*.
Sebille s.n., VIII.1888 : *N. minor*.
Seçmen & Leblebici 2872a : *N. minor*.
Seçmen & Leblebici 3004 : *N. marina* subsp. *armata*.
Seçmen, Leblebici & Behat 3002 : *N. minor*.
Siegfried s.n. : *N. marina* subsp. *marina* var. *marina*.
Simon s.n., 3.IX.1883 ; s.n., 29.VI.1935 ; s.n., 24.VIII.1955 ; s.n., 9.IX.1970 : *N. marina* subsp. *marina* var. *marina*. — s.n., 6.VIII.1916 : *N. minor*.
Songeon s.n., 16.X.1872 : *N. marina* subsp. *intermedia*.
Squivet de Carondelet s.n., 15.IX.1894 ; s.n., 26.IX.1914 ; s.n., 16.VIII.1918 : *N. marina* subsp. *marina* var. *marina*.
Symoens s.n., 14.IX.1950 : *N. marina* subsp. *marina* var. *marina*.
Thielens s.n., 1886 : *N. minor*.
Thuillier s.n., s.d. : *N. marina* subsp. *marina* var. *marina*.
Thuillier in *Herb. Delessert* : *N. minor*.
Topa Fl. Rom. Exc. 2619 : *N. minor*.
Topa & Codoreanu 2990 : *N. marina* subsp. *marina* var. *marina*. — s.n., I.VIII.1947 : *N. marina* subsp. *intermedia*.
Triest 69 ; 73 ; 75 ; 80 ; 84a ; 84b ; 87 ; 93 ; 112b ; 118 ; 174 ; 178 ; 181 ; 195 ; 197 ; 201 ; 205 ; 215 ; 225 ; 269 ; 479 ; 485 ; 486 ; 487 ; 488 : *N. marina* subsp. *marina* var. *marina*. — 71 ; 112b ; 117 ; 162 ; 215 ; 220 ; 256 ; 407 ; 416 ; 420 ; 425 ; 429 ; 447 ; 452 ; 484 : *N. marina* subsp. *intermedia*. — 139 : *N. gracillima*.
Triest, Cook & Vuille 119 ; 123 : *N. gracillima*. — 121 ; 130 : *N. minor*.
Tuzlaci & Meriçli ISTE 41431 : *N. marina* subsp. *armata*.
Uotila 20151 ; 20253 ; 30405 : *N. minor* (20253, mixed with *N. orientalis*). — 20309 ; 20313 : *N. marina* subsp. *intermedia*. — 20628 : *N. marina* subsp. *marina* var. *marina*.
Uotila & Baytop 27364 : *N. minor*.
Uotila & Leblebici 30629 : *N. minor*.
Veijola s.n., 27.VI.1961 : *N. flexilis*.
Vihodcevsky 504 : *N. minor*. — 504 : *N. graminea* var. *graminea*.
Viinikka 14 ; s.n., 10.X.1971 : *N. marina* subsp. *intermedia*.
Vilar 101 : *N. marina* subsp. *marina* var. *marina*.
Vleminckx 340 ; 494 : *N. marina* subsp. *marina* var. *marina*.
Vuillemin s.n. : *N. marina* subsp. *marina* var. *marina*.
Weideman s.n., VIII.1878 : *N. marina* subsp. *intermedia*.
Welwitsch 410 : *N. minor*.

Wilczek s.n., 19.VIII.1889 : *N. marina* subsp. *marina* var. *marina*. — s.n. ; s.n., 19.VIII.1889 : *N. marina* subsp. *intermedia*.

Willmott 36725 : *N. flexilis*.

Wirtgen s.n., 20.VIII.1857 : *N. marina* subsp. *marina* var. *marina*.

Zalewski s.n., IX.1889 ; s.n., 6.IX.1895 : *N. marina* subsp. *marina* var. *marina*.

U.S.S.R.

Alexeenko N722 : *N. graminea* var. *graminea*.

Aliev s.n., 1.VII.1956 : *N. graminea* var. *graminea*.

Androsov 53 : *N. marina* subsp. *brachycarpa*. — 54 ; s.n., 25.VII.1913 : *N. marina* subsp. *intermedia*. — 61 ; 91 ; s.n., 5.VIII.1913 : *N. graminea* var. *graminea*. — s.n., 5.VI.1913 ; s.n., 15.VIII.1913 : *N. minor*.

Artemenko s.n., 10.VII.1980 : *N. marina* subsp. *marina* var. *marina*.

Baer s.n., 1818/78 ? : *N. minor*.

Berg s.n., 28.VII.1900/1902 : *N. marina* subsp. *intermedia*.

Besser s.n., 1831 : *N. marina* subsp. *intermedia*.

Bobrov & Tzvelev 317 ; 728 ; 1081 ; 1266 : *N. minor*. — 363 ; 1250 : *N. marina* subsp. *intermedia*. — 1081 ; 1091 ; 1133 : *N. graminea* var. *graminea*.

Bogdanov s.n., 14.VII.1946 : *N. marina* subsp. *intermedia*.

Borodin 629 : *N. marina* subsp. *marina* var. *marina*. — s.n., 25.VIII.1911 : *N. marina* subsp. *intermedia*.

Boridine s.n., 1-13.VI.1895 : *N. minor*.

Borszcow 169 : *N. marina* subsp. *intermedia*. — 846 : *N. marina* subsp. *brachycarpa*.

Cherniakowska 147 : *N. minor*. — 148 : *N. marina* subsp. *intermedia*.

Chernow & Sioa 477 ; 492 ; 497 : *N. graminea* var. *graminea*.

Dubiansky s.n., 2.VIII.1913 : *N. graminea* var. *graminea*.

Dybowski s.n., 1898 : *N. flexilis*.

Ergashchov 237 : *N. minor*.

Fedschenko s.n., X.1869 ; s.n., 3.IX.1897 : *N. marina* subsp. *intermedia*.

Filatov 345 : *N. marina* subsp. *intermedia*.

Goebel s.n. 1863 : *N. marina* subsp. *intermedia*.

Goncharov & Borisova 1018 : *N. minor*.

Goncharov & Michailovski 255 ; 720 : *N. graminea* var. *graminea*.

Gorschkowa & Tschernow 6 : *N. marina* subsp. *intermedia*.

Granitov 599 ; 601 : *N. marina* subsp. *marina* var. *marina*.

Jakubova s.n., 9.VIII.1946 : *N. marina* subsp. *intermedia*.

Jakubov, N. & G. s.n., 5.VIII.1945 : *N. marina* subsp. *intermedia*.

Juzepchuk & Tzvelev s.n., 9.IX.1954 : *N. tenuissima*.

Karjagin s.n., 15.VII.1930 : *N. marina* subsp. *intermedia*.

Karolkow & Krause s.n., 11.VII.1873 ; s.n., 14.VII.1873 : *N. marina* subsp. *marina* var. *marina*.

Katanskaja s.n., 2.IX.1957 : *N. marina* subsp. *marina* var. *marina*. — s.n., 22.VIII.1958 : *N. marina* subsp. *aculeolata*. — s.n., 29.VII.1953 ; s.n., 11.IX.1954 ; s.n., 18.IX.1955 ; s.n., 18.VIII.1957 ; s.n., 19-20.VII.1958 ; s.n., 21.VII.1959 : *N. marina* subsp. *intermedia*. — s.n., 20.VII.1953 ; s.n., 29.VII.1954 ; *N. minor*. — s.n., 20.VII.1954 : *N. graminea* var. *graminea*.

- Kellerom* s.n., 17.VIII.1908 : *N. minor*.
Klopotov 945 : *N. flexilis*.
Knorring 63 : *N. marina* subsp. *intermedia*. — 63 : *N. minor*.
Komarov s.n., 1.IX.1930 : *N. orientalis*. — s.n., 9.IX.1895 ; s.n., 15.VIII.1897 ; s.n., 31.VIII.1897 : *N. gracillima*.
Korshinsky N26 : *N. marina* subsp. *marina* var. *marina*.
Kozietov 785 : *N. marina* subsp. *intermedia*.
Kraschenninnikow 1038 : *N. marina* subsp. *intermedia*.
Krylov 739 : *N. marina* subsp. *intermedia*.
Levitsky s.n., 23.VIII.1937 : *N. marina* subsp. *intermedia*.
Lindberg s.n., 12.VIII.1908 : *N. tenuissima*.
Lipsky 4005 : *N. marina* subsp. *intermedia* ; s.n., 16.VII.1909 : *N. orientalis*.
Martynov 1110 : *N. marina* subsp. *intermedia*.
Mehvil s.n., 5.IX.1926 : *N. marina* subsp. *marina* var. *grossedentata*. — s.n., 22.VII.1936 : *N. marina* subsp. *intermedia*.
Molchanov s.n., 14.VII.1911 : *N. minor*.
Mühlen s.n., 27.VIII.1909 : *N. marina* subsp. *intermedia*.
Nikitin 652 & 653 : *N. marina* subsp. *intermedia*.
Nikolsky s.n., 25.VIII.1911 : *N. marina* subsp. *marina* var. *marina*. — s.n., 17.VIII.1911 ; s.n., 31.VIII.1931 : *N. marina* subsp. *intermedia*.
Ostanuov s.n., 1903 : *N. minor*.
Pabo & Tscholowski s.n., 1855 : *N. marina* subsp. *marina* var. *marina*.
Pavlov 29 ; 767 ; 1268 : *N. marina* subsp. *intermedia*.
Politow s.n. : *N. marina* subsp. *intermedia*.
Popov 414a ; 414b : *N. marina* subsp. *intermedia*.
Prochanov 170 : *N. marina* subsp. *intermedia*.
Prochorov & Kuzeneva 525 : *N. flexilis*. — 535 : *N. gracillima*. — 964 : *N. marina* subsp. *marina* var. *grossedentata*.
Prozorovski 39 : *N. minor*.
Ptaschicki 216 : *N. marina* subsp. *intermedia*.
Raikova 54 ; 1219 & 1220 ; 1426 : *N. marina* subsp. *intermedia*. — 585 : *N. minor*.
Regel s.n., 2-14.VIII.1883 : *N. marina* subsp. *brachycarpa*.
Rodin & al. 577 : *N. minor*.
Rogowicz s.n., 1867 : *N. minor*.
Rozhev & Zhezhel 584 ; 704 : *N. marina* subsp. *intermedia*. — 705 : *N. minor*.
Rusanov 115 ; 345 : *N. minor*. — 514 : *N. graminea* var. *graminea*. — 380 ; 541 : *N. marina* subsp. *intermedia*.
Schiffers 1901 : *N. minor*.
Schrenk 930 ; s.n., 1841 : *N. marina* subsp. *brachycarpa*.
Seidmuradov & Androsov 2447 : *N. graminea* var. *graminea*.
Schiffers 1496 : *N. marina* subsp. *intermedia*.
Sintenis 1231 : *N. marina* subsp. *intermedia*.

- Sjelinsky* 138 : *N. marina* subsp. *brachycarpa*. — 138 : *N. marina* subsp. *intermedia*.
Smirnow s.n., 1874 : *N. graminea* var. *graminea*.
Soskov s.n., 21.VIII.1955 : *N. marina* subsp. *intermedia*.
Sublozky s.n., 1836 : *N. marina* subsp. *intermedia*.
Tzvelev 68 ; 117 ; 224 : *N. marina* subsp. *marina* var. *grossedentata*. — 225 : *N. gracillima*. — 1107 : *N. flexilis*. — 1206 : *N. marina* subsp. *intermedia*. — 1861 : *N. minor*.
Tzvelev et al. 2756 : *N. minor*.
Tzvelev & Kolesnikova 303 : *N. marina* subsp. *aculeolata*. — 304 : *N. minor*.
Varentsov s.n., 13.VII.1913 : *N. marina* subsp. *intermedia*.
Vernander 400 : *N. marina* subsp. *marina* var. *marina*.
Woronov s.n., 23.VI.1917 ; s.n., 1917 : *N. minor*.
Zaberzhinskaja s.n., 3.X.1963 ; s.n., 7.X.1963 : *N. marina* subsp. *intermedia*.
Zapragev 320 : *N. marina* subsp. *intermedia*.
Zinger s.n. 1881 : *N. marina* subsp. *marina* var. *marina*.

ASIA

(incl. Sinai, excl. Turkey and U.S.S.R.)

- Agami* s.n., 29.IX.1985 : *N. marina* subsp. *armata*.
Alexeenko 48, 69 : *N. minor*.
Allen s.n., 27.X.1925, sheet 1 : *N. malesiana*. — sheet 2 : *N. tenuis*.
Alston 13743 : *N. marina* subsp. *sumatrana*. — 16500 : *N. foveolata*.
Backer 1903 : *N. pseudograminea*. — 2990 ; 7780 ; 13777 ; 16555 : *N. foveolata*. — 6540 ; 19139 ; 19319 : *N. halophila*. — 19781 ; 27811 : *N. pseudograminea*.
Balakrishnan NBK 353 : *N. grossareolata*.
Balansa 4089 ; 4130 ; 4563 ; 4573 ; 4651 : *N. kingii*. — s.n., 29.IX.1866 : *N. minor*.
Banlugan 259 : *N. graminea* var. *graminea*.
Barthe s.n. 1846 : *N. foveolata*.
Beccari FI 11808 : *N. marina* subsp. *laticor*. — 11808 ; 11812 : *N. graminea* var. *graminea*. — 11810 : *N. celebica*. — 11811 : *N. foveolata*.
Beddome 8202 : *N. indica*.
Bennet 1197 : *N. kurziana* or *N. malesiana*.
Bent 219 : *N. marina* subsp. *ehrenbergii*.
Bergman s.n., 12.II.1949 : *N. graminea* var. *graminea*.
Bogner 415 : *N. kingii*. — 1382 : *N. malesiana*.
Bornmüller 1838 : *N. marina* subsp. *ehrenbergii*.
Brandis s.n., IV.1859 : *N. graminea* var. *graminea*.
Brass 29369 : *N. graminea* var. *graminea*.
Brown 3477 : *N. marina* subsp. *intermedia*.
Burck s.n., 29.X.1894 : *N. foveolata*.
Buwalda 4506 : *N. malesiana*.

- Carr* 11511 ; 11792 : *N. graminea* var. *graminea*.
Chen 507 : *N. marina* subsp. *marina* var. *grossedentata*.
Claraz Schenkung G. & A. s.n., 22.VIII.1931 : *N. minor*.
Clarke 4366 : *N. indica*. — 31879 : *N. tenuis*.
Clason-Laarman 120 : *N. pseudograminea*.
Clemens 4213 ; 6999 : *N. malesiana*. — 10599 : *N. graminea* var. *graminea*.
Coert 1147 : *N. pseudograminea*.
Colfs 52 ; 157 : *N. foveolata*.
Commerson s.n. : *N. kingii*.
Conklin & Buwayo PNH 78622 : *N. graminea* var. *graminea*.
Cook & Gut 1 ; 24 : *N. marina* subsp. *marina* var. *kashmirensis*. — 36 ; 41 ; 59 ; 139 ; 276 : *N. tenuis*.
— 58 ; 115 ; 164 : *N. graminea* var. *graminea*.
Cook, Rix & Schneller 159 ; 160 ; 279 : *N. tenuis*. — 238 ; 324 : *N. malesiana*. — 264 : *N. graminea*
var. *graminea*.
Couderc s.n., 1883-1885 : *N. indica*.
Cowdry 1983 : *N. minor*.
Craib 554 : prob. *N. indica*.
Curran s.n., For. Bur. 12262 : *N. foveolata*.
Curtwell 95 : *N. graminea* var. *graminea*.
Dalziel s.n., 3.IV.1901 : *N. minor*.
Däniker 2933 : *N. graminea* var. *graminea*.
Dashpande 1728 : *N. kurziana*.
de la Savinierre 503 ; 1588 : *N. graminea* var. *graminea*.
Delavay 2804 : *N. marina* subsp. *intermedia*. — 4745 : *N. gracillima*.
De Voogd 550 : *N. kingii*.
De Vriese & Teyssmann s.n., 1859-60 : *N. celebica*. — s.n., 1859-60 : *N. pseudograminea*.
de Wilde & de Wilde-Duyffes 16438 : *N. graminea* var. *graminea*.
Drake 470 : *N. minor*. — 471 : *N. kingii*.
Dunn 195-15 : *N. marina* subsp. *marina* var. *ohwii*.
Duthie 8549 ; s.n., 13.I.1889 : *N. marina* subsp. *intermedia*.
Edano & Gutierrez s.n., Phil. Nat. Herb. 40467 : *N. foveolata*.
Ehrenberg s.n., II.1820-1826 : *N. marina* subsp. *ehrenbergii*.
Elbert 3776 ; 4089 : *N. foveolata*. — 4521 : *N. graminea* var. *robusta*.
Elmer 6312 ; 18112 : *N. graminea* var. *graminea*. — 14420 ; 18112 : *N. foveolata*.
Ernst 73 ; 369 : *N. foveolata*. — s.n., 30.XII.1930 : *N. latior*.
Eyma 1703 ; 3413 ; 3329 : *N. graminea* var. *graminea*.
Faurie 128 ; 527 ; 528 sub ; 2926 ; 13773 ; 13920 ; s.n., 9.IX.1897 ; s.n., 22.VI.1903 : *N. graminea* var.
graminea. — 599 ; 601/9 ; 828 ; 829 ; 2926 ; 4877 ; 7211 ; 13920 ; s.n. : *N. gracillima*. — 599 :
N. marina subsp. *marina* var. *ohwii*. — 680 ; 7211 : *N. minor*. — 681 ; s.n., VI.1901 : *N. marina*
subsp. *marina* var. *grossedentata*. — 4877 : *N. orientalis*.
Fischer 4012 : prob. *N. indica*.
«Fl. Malay Isl.» 1703 : *N. graminea* var. *graminea*.

- Frey-Wyssling* s.n., 1931 : *N. kingii*.
Gadd 507 : *N. marina* subsp. *susiana*.
Gamble 9180 ; 15119 ; 15815 : *N. tenuis*. — 20934 : *N. graminea* var. *graminea*. — 21710 : *N. indica*.
Gay 1 : *N. foveolata*. — 4 : *N. graminea* var. *graminea*.
Geesink & Santinuk 5299 : *N. pseudograminea*.
«Gezondheidsdienst» s.n., XI.1929 : *N. graminea* var. *graminea*.
Ghosh 839 : *N. graminea* var. *graminea*. — 880 : Prob. *N. indica*. — 956 : prob. *N. kurziana* or *N. malesiana*.
Gibbs s.n., I.1990 : *N. malesiana*.
Giesenhagen s.n., 16.XII.1899 : *N. graminea* var. *graminea*.
Gombault 2793 : *N. minor*.
Griffith 5 : *N. minor*. — 5609 : *N. marina* subsp. *intermedia*. — 5609/1 : mixed, *N. minor*, *N. indica* or *N. malesiana*. — 5609/2 ; 5609/3 : *N. graminea* var. *graminea*. — 5609/4 : *N. indica*. — 5609/5 : *N. kingii*. — 5609/6 : *N. malesiana*.
Haines W 1444 : *N. graminea* var. *graminea*. — s.n., 25.X.1960 ; s.n. : *N. minor*.
Hamilton 1994 : *N. marina* subsp. *intermedia*.
Harmand 918 : *N. malesiana*.
Hartley 9800 : *N. graminea* var. *graminea*.
Hassan 32137 : *N. marina* subsp. *armata*.
Haussknecht s.n., VIII.1868 : *N. graminea* var. *graminea*. — s.n., IX.1867 ; s.n., IX.1868 ; s.n., 1867 : *N. minor*.
Hepper & Jayasuriya 4607 : *N. indica*.
Herb. Jard. Bot. Hanoi 60 : *N. kingii*.
Herb. Lugd. Bot. 908139-1060 : *N. oguraensis*.
Herb. Schreberianum 484 : *N. indica*.
Hilli s.n., 7.VIII.1973 : *N. marina* subsp. *susiana*.
Hochreutiner 391 : *N. foveolata*.
Homs 381 : *N. graminea* var. *graminea*.
Hook s.n. : *N. indica*.
Hooker 639 : *N. tenuis*.
Hooker & Thomson s.n. ; s.n. : *N. graminea* var. *graminea*.
Hook & Thomson s.n. : *N. tenuis*. — s.n. : *N. indica*.
Horsfield s.n., 1802-18 : *N. halophila*.
Hsu 4944 : *N. graminea* var. *graminea*.
Huang 5653c : *N. minor*.
Instituut voor Plantenziekten 1 : *N. malesiana*.
Jaag 1689 : *N. pseudograminea*. — 1655 ; 1777 : *N. foveolata*. — 988 ; 1207 : *N. graminea* var. *graminea*.
Jacobson Hort. Bog. 149 : *N. marina* subsp. *sumatrana*.
Jayasuriya & Meyer 231 : *N. graminea* var. *graminea*.
Jensen 298 : *N. marina* subsp. *latior*. — 299 ; 412 : *N. graminea* var. *graminea*.
Jisiba s.n., 15.X.1914 : *N. ancistrocarpa*. — s.n., 15.X.1914 : *N. minor*.

- Jones* 145 : *N. marina* subsp. *armata*.
Junghuhn 273 ; s.n., s.d. : *N. foveolata*.
Kao 9754 : *N. gracillima*.
Karta 53 : *N. pseudograminea*.
Kerr 3989 : *N. kingii*.
King s.n., IV.1890 : *N. kingii*.
Kitamura et al. 918 : *N. marina* subsp. *marina* var. *ohwii*.
Kjellberg 1186 : *N. malesiana*. — 3820 : *N. graminea* var. *longidentata*.
Koeltz 13324 : *N. malesiana*.
Komarov s.n., 19.VII.1896 ; s.n., 10.VII.1897 ; s.n., 14.VIII.1897 ; s.n., 18.VIII.1897 : *N. marina* subsp. *marina* var. *grossedentata*.
Komarov Fl. Mansh. 111 : *N. gracillima*.
Koorders 17347 β : *N. celebica*. — 33567a : *N. foveolata*. — 42665 β : *N. halophila*.
Korowiakow s.n., 21.V-3.VI.1896 : *N. marina* subsp. *intermedia*.
Kudo & Sasaki s.n. : *N. graminea* var. *graminea*.
Kurz 3295 ; 3309 ; 3310 : *N. tenuis*. — 3310 : *N. malesiana*. — s.n., 26.IX.1868 : *N. kurziana*. — s.n., XI.1869 : *N. graminea* var. *graminea*.
Larsen K. & S. 33541 : *N. kingii*.
Lawon in Herb. Gamble 12856 : *N. tenuis*.
Le Bon s.n., 1883-1891 : *N. malesiana*.
Ledebour s.n. : *N. marina* subsp. *marina* var. *marina*.
Liou-Jing-Ksin & Li Shu-Ksin 2738 : *N. marina* subsp. *marina* var. *grossedentata*.
Litwinow 2329 ; 2422 ; 3118 : *N. minor*. — 2422 : *N. orientalis*. — 2478 ; 3345 : *N. marina* subsp. *marina* var. *grossedentata*.
Lohr 1586 ; 1589 ; 1590 ; 1591 : *N. graminea* var. *graminea*. — 1588 : *N. foveolata*.
Lorentz 14 : *N. graminea* var. *graminea*.
Ludlow & Sheriff 2 ; 7674 : *N. oguraensis* ; 7678 ; 7695 : *N. marina* subsp. *marina* var. *aculeolata*.
Lyman & Rawi 15158 : *N. minor*.
McClelland 1846 : *N. graminea* var. *graminea*.
McGregor Bur. Science 14166 : *N. graminea* var. *graminea*.
Makino s.n., 8.IX.1880 ; s.n., VIII.1890 : *N. graminea* var. *graminea*.
Mandaville 3937 : *N. graminea* var. *graminea*.
Maries 391 : *N. graminea* var. *graminea*. — s.n., s.d. : prob. *N. tenuis*.
Maximowicz s.n., 1862 : *N. graminea* var. *graminea*. — s.n. : *N. marina* subsp. *marina* var. *ohwii*.
Mace s.n. : *N. indica*.
Mendoza & Buwaya 712 : *N. graminea* var. *graminea*.
Merrill 519 ; 5109 : *N. foveolata*. — 4243 ; 9807 : *N. pseudograminea*.
Meyer 5772 : *N. malesiana*.
Miller 2581 : *N. graminea* var. *graminea*.
Modigliani s.n., 1891 : *N. kingii*.
Mooney 3785 : *N. indica*.

- Moseley* s.n., I & II.1875 : *N. graminea* var. *graminea*.
Motley 343 ; 1894 ; 8946 : *N. malesiana*.
Mouterde 472 ; 3226 : *N. minor*.
Nakone s.n., 1933 : *N. oguraensis*.
Napoléon NP 20 : *N. minor*.
Nasche 4 : *N. graminea* var. *longidentata*.
Nevill s.n., V.1885 : *N. marina* subsp. *armata*.
Newland s.n., IX.1932 : *N. marina* subsp. *marina* var. *kashmirensis*.
Newton s.n., VII.1893 : *N. minor*.
Noerkas 138 : *N. foveolata*.
Ohwi TSM 976 : *N. marina* subsp. *marina* var. *ohwii*.
Oldham 823 : *N. graminea* var. *graminea*. — 832 : *N. orientalis*.
Otanes s.n., IV-VI.1914 : *N. foveolata*.
Pabot s.n., 14.V.1955 ; s.n., 16.VII.1955 : *N. marina* subsp. *armata*.
Parker 059 : *N. graminea* var. *graminea*. — 068 : *N. marina* subsp. *ehrenbergii*. — s.n., 28.XIII.1927 : *N. tenuis*.
Pillai s.n., II.1955 : *N. graminea* var. *graminea*.
Podlech 32593a ; 32609 : *N. graminea* var. *graminea*.
Polunin, Sykes & Williams 5002 ; 5469 : *N. graminea* var. *graminea*.
Popov N 633 ; N 715 : *N. marina* subsp. *brachycarpa*.
Post 295 : *N. minor*.
Ramos 11597 : *N. graminea* var. *graminea*. — s.n., Bur. Science 24079 : *N. foveolata*.
Rant 1073 : *N. halophila*.
Renner s.n., XII.1930 : *N. marina* subsp. *latior*.
Richie 1161 : *N. indica*.
Ridley 8946 : *N. malesiana*.
Ruttner 313 : *N. marina* subsp. *latior*.
Sakurai s.n., 9.IX.1907 : *N. graminea* var. *graminea*.
Sakurai s.n., 31.VIII.1910 : *N. minor*. — s.n., 21.IX.1910 : *N. marina* subsp. *marina* var. *ohwii*.
Sanchez 649 ; 1349 : *N. marina* subsp. *marina* var. *ohwii*.
Santapan 1043 ; s.n., 12.X.1949 : *N. marina* subsp. *intermedia*.
Santos 5973 : *N. foveolata*.
Savatier 1348 : *N. orientalis*. — 1348 : *N. gracillima*. — 1348 : *N. minor*.
Saxton 491 : *N. indica*.
Schiffner s.n., 11.II.1894 : *N. foveolata*.
Schmid 6605 ; 6606 : *N. minor*.
Schmidt 450 : *N. marina* subsp. *marina* var. *grossedentata*.
Schneider s.n., 4.VII.1936 : *N. kingii*. — s.n., 27.IX.1936 : *N. pseudograminea*. — s.n., 27.IX.1936 : *N. graminea* var. *graminea*. — s.n., XII.1936 : *N. malesiana*.
Schodde 2321 : *N. graminea* var. *graminea*.
Schröter 20 : *N. pseudograminea*. — s.n., X.1898 : *N. marina* subsp. *marina* var. *ohwii*. — s.n., 15.V.1927 : *N. foveolata*.

- Schröter & Coert* 20 : *N. pseudograminea*.
Sedgewick 3948 : *N. tenuis*.
Shakya 9101 : *N. graminea* var. *graminea*.
Shimizu 14426 ; 14636 : *N. marina* subsp. *marina* var. *ohwii*.
Shiu Ying Hu 11263 : *N. pseudogracillima*.
Simpson 8533 : prob. *N. tenuis*.
Sinclair 3151 : *N. graminea* var. *graminea*. — 10837 : *N. kingii*.
Smith 6819 : *N. minor*.
Soc. Unit. Frat. 1775 : *N. graminea* var. *graminea*. — 1778 : *N. tenuis*.
Sohns 8 : *N. kingii*.
Stainton, Sykes & Williams 7152 : *N. graminea* var. *graminea*. — 7159 : *N. oguraensis*.
Stewart 3346 ; 3370 : *N. marina* subsp. *marina* var. *kashmirensis*. — 3347 : *N. oguraensis*.
Staunton s.n. : *N. marina* subsp. *marina* var. *grossedentata*.
Streimann & Kair NGF 47868 : *N. foveolata*.
Surbeck 301 : *N. graminea* var. *graminea*.
Suzuki s.n., *N. foveolata*.
Teysmann 10680 : *N. foveolata*.
Thamer in Nat. Herb. Iraq 46705 : *N. marina* subsp. *susiana*.
Thamer, Wedad & Hana in Nat. Herb. Iraq 46794 : *N. marina* subsp. *susiana*.
Thesiger s.n., 14.V.1952 : *N. marina* subsp. *susiana*.
Thorel s.n., 1862-1866 : *N. kingii*.
Thothathri 9940 : *N. minor*.
Thunberg s.n., 1808 : *N. indica*.
Thung s.n., 1934 : *N. pseudograminea*.
To Hara N8/40 : N8a/40 : *N. graminea* var. *graminea*.
Toxopeus 254 : *N. pseudograminea*.
Uotila 18230 ; 18363 ; 19244 ; 19272a ; 19327 : *N. minor*. — 19272 : *N. graminea* var. *graminea*.
van Beusekom, Geesink, Phengkhlai & Wongwan 4245 : *N. kingii*.
van Ooststroom 13025 : *N. foveolata*. — 12666 : *N. graminea* var. *graminea*.
Vanoverbergh 1773 : *N. graminea* var. *graminea*.
van Royen 4282 ; NGF 16058 : *N. foveolata*. — 4742 ; NGF 20093 : *N. graminea* var. *graminea*.
van Steenis 4710a ; 18168 ; 18226 : *N. pseudograminea*. — 5402 : *N. malesiana*. — 7971 : *N. marina* subsp. *latior*. — 18104 : *N. graminea* var. *graminea*.
Vaughan 300 : *N. marina* subsp. *intermedia*.
Venkatesh s.n., IV.1950 : prob. *N. tenuis*.
Versteegh 107 : *N. graminea* var. *graminea*.
Vesey-Fitzgerald s.n., 24.XI.1946 : *N. graminea* var. *graminea*.
«Volksgezondheid» III : *N. graminea* var. *graminea*.
Vù-Vân-Cüong 133 ; 857 : *N. malesiana*. — 502 ; 605 ; 662 : *N. kingii*.
Wallace 5908 ; 5909 ; 5910 : *N. indica*. — 9109 : *N. malesiana*.
Wallich in Herb. Richard 5782 : *N. marina* subsp. *intermedia*.

- Wang Wei* 1221 : *N. marina* subsp. *marina* var. *grossedentata*.
Wight 2793 ; s.n., IX.1849 : *N. indica*. — s.n. : *N. graminea* var. *graminea*.
Williams & Stainton 8279 : *N. graminea* var. *graminea*.
Wisse 690 : *N. foveolata*.
Woo Aq. Pl. 2 : *N. pseudogracillima* & *N. pseudograminea*.
Wood 1048 : *N. graminea* var. *graminea*.
Wright in Herb. US. North Pacific Expl. 511 : *N. graminea* var. *graminea*.
Yatabe s.n., 23.VIII.1878 : *N. gracillima*.
Yokoska s.n., 1866-1874 : *N. orientalis*.
Young s.n. : *N. marina* subsp. *marina* var. *kashmirensis*.
Zollinger 3386 ; 3398 : *N. foveolata*. — 3891 : *N. marina* subsp. *latior*.

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- Adams* 1749 : *N. tenuifolia*.
Alof MEL 108952 ; 108954 : *N. marina* subsp. *latior*.
Aston s.n., 15.XI.1960 ; WS 21 ; 1346 ; 1362 ; 1375 ; 1742 ; 1743 ; 1744 ; 1831 ; 1894 : *N. tenuifolia*.
 — 2292 : *N. browniana*. — 2306 : *N. graminea* var. *graminea*.
Bailey s.n. ; MEL 108978 ; MEL 528966 : *N. tenuifolia*.
Balansa 1713 : *N. graminea* var. *graminea*.
Beauglehole 10868 : *N. tenuifolia*.
Beauglehole & Erroy 58261 ; 58680 : *N. tenuifolia*.
Betche MEL 108966 : *N. tenuifolia*.
Birck MEL 108964 ; MEL 108973 ; MEL 108981 ; MEL 529762 : *N. tenuifolia*. — MEL 108983 :
N. browniana.
Blake 20106 ; 20513 : prob. *N. tenuifolia*. — 23291 : *N. malesiana*.
Boorman NSW 2550 ; NSW 27292 : *N. tenuifolia*. — s.n., VIII.1906 : prob. *N. tenuifolia*.
Brass 18610 : *N. malesiana*.
Briggs NSW 101793 : *N. tenuifolia*.
Brown s.n., 14.I.1803 : *N. browniana*. — s.n., 1803 ; s.n., XI.1803 ; s.n., IV.1804 : *N. tenuifolia*.
Byrnes 2775 : *N. graminea* var. *graminea*.
Caley s.n., 2/9.XI.1803 ; s.n., XI.1803 ; s.n., I.1804 : *N. tenuifolia*.
Casement MEL 108984 : *N. tenuifolia*.
Clarkson 3540 : *N. graminea* var. *graminea*.
Corrick MEL 541709 : *N. marina* subsp. *armata*. — 101 : *N. tenuifolia*.
Craven 6732 : *N. tenuifolia*.
Cusak 222 ; 246 ; MEL 108959 ; MEL 108960 : *N. tenuifolia* or *N. graminea* var. *graminea*.
Dunlop 3718 : *N. tenuifolia*.
Earp 6451 : *N. marina* subsp. *armata*.
Eckert 52 ; 105 : *N. tenuifolia*.
Edwards MEL 529763 : *N. tenuifolia*.

- Flynn* NSW 96423 : *N. tenuifolia*.
Franc 3068 : *N. graminea* var. *graminea*.
George s.n., IV.1958 : *N. halophila*.
Gray 14 : *N. pseudograminea*.
Gribble MEL 108953 : *N. marina* subsp. *latior*.
Grime MEL 108957 : *N. marina* subsp. *armata*.
Henshall 3354 ; 3361 : *N. browniana*. — 4006 : *N. tenuifolia*.
Herb. MEL 108969 ; MEL 108974 ; MEL 108961 : *N. tenuifolia*.
Herb. NSW 2553 : *N. marina* subsp. *armata*.
Herb. Von Mueller MEL 108956 : *N. marina* subsp. *latior*.
Higginson 44 : *N. tenuifolia*.
Jacobs 1355 ; 4015 ; 4311 : *N. graminea* var. *graminea*. — 1476 ; 1546 ; 1714 ; 1759 ; 3763 ; 3985 ; 4057 : *N. tenuifolia*. — 3316 ; 3987 ; 4049 : *N. browniana*. — 3328 : *N. marina* subsp. *latior*. — 4324 ; 4447 : *N. malesiana*.
Jacobs & Pickard 2976 : *N. tenuifolia*.
Jacobs & Rodd 2544 : *N. tenuifolia*. — 2708 : *N. graminea* var. *graminea*.
Johnson 6805 : *N. browniana*.
Jones NSW 180801 : *N. marina* subsp. *armata*.
Kempe in *Herb. Mueller* : *N. marina* subsp. *armata*.
Keys 296 : *N. marina* subsp. *armata*.
Knight s.n., 28.IX.1961 : *N. marina* subsp. *latior*.
Lamsborough MEL 108972 : *N. tenuifolia*.
Latz 6115 : *N. foveolata*.
Lazarides 9222 : *N. pseudograminea*.
Lazarides & Adams 327 : *N. tenuifolia*.
Lea MEL 108958 : *N. marina* subsp. *latior*.
Leach 616 : prob. *N. pseudograminea*. — 654 : *N. graminea* var. *graminea*.
Leary MEL 532043 : *N. browniana*.
Leichhardt s.n., s.d. : *N. tenuifolia*.
Lucas NSW 2552 : *N. tenuifolia*.
McBarron 4398 ; 4686 ; 6303 ; 7575 : *N. tenuifolia*.
McKee 6788 ; 9278 : *N. tenuifolia*. — 8044 ; 8088 ; 8225 : *N. graminea* var. *graminea*. — 8424 : *N. pseudograminea*. — 7858 ; 8010 : prob. *N. browniana*. — 8341 : *N. tenuifolia*.
Mueller s.n. ; 13 ; MEL 108970 ; MEL 108985 : *N. tenuifolia*.
Mulham 1401 : *N. tenuifolia*.
Naumann s.n. : *N. graminea* var. *graminea*.
Oldfield s.n., s.d. : *N. marina* subsp. *latior*.
Palak MEL 108950 : *N. marina* subsp. *armata*.
Pentzcke MEL 108979 : *N. browniana*.
Rankin 2238 : *N. browniana*. — 2595 : *N. tenuifolia*.
Ramsay MEL 108965 : *N. tenuifolia*.

Sainty 98 : *N. marina* subsp. *latior*.

Sharam NSW 180800 : *N. browniana*.

Stuart MEL 108976 : *N. tenuifolia*.

Tandy s.n., 1928-29 : *N. browniana*.

Taylor 88 : *N. pseudograminea*.

Thomson 1412 : *N. graminea* var. *graminea*.

Weir MEL 108980 : *N. tenuifolia*.

White s.n., XI.1914 : *N. tenuifolia*.

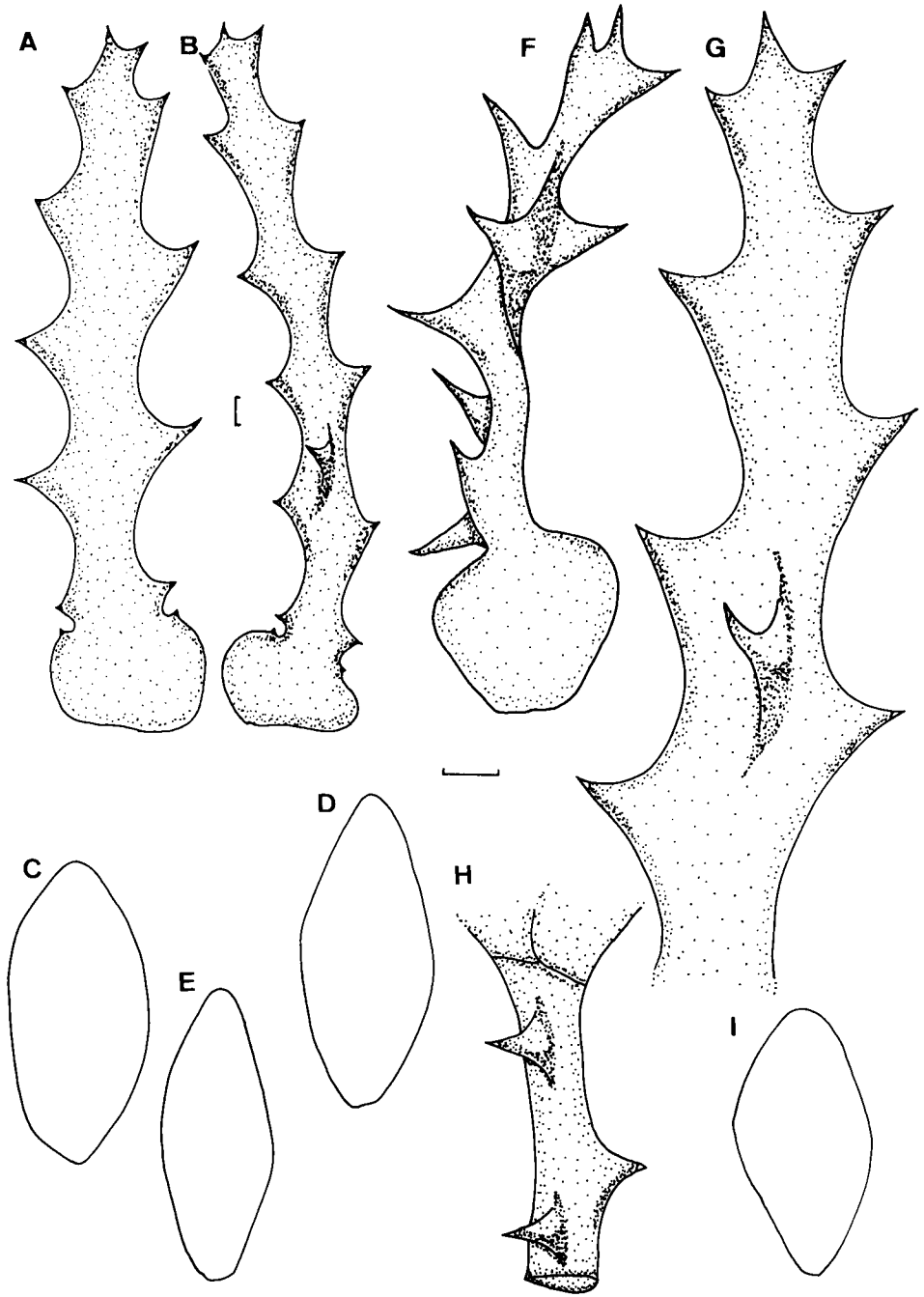
Wight D. W. s.n. ; MEL 108963 : *N. tenuifolia*.

Willis MEL 1534536 : *N. browniana*.

Wilson 5534 : *N. tenuifolia*.

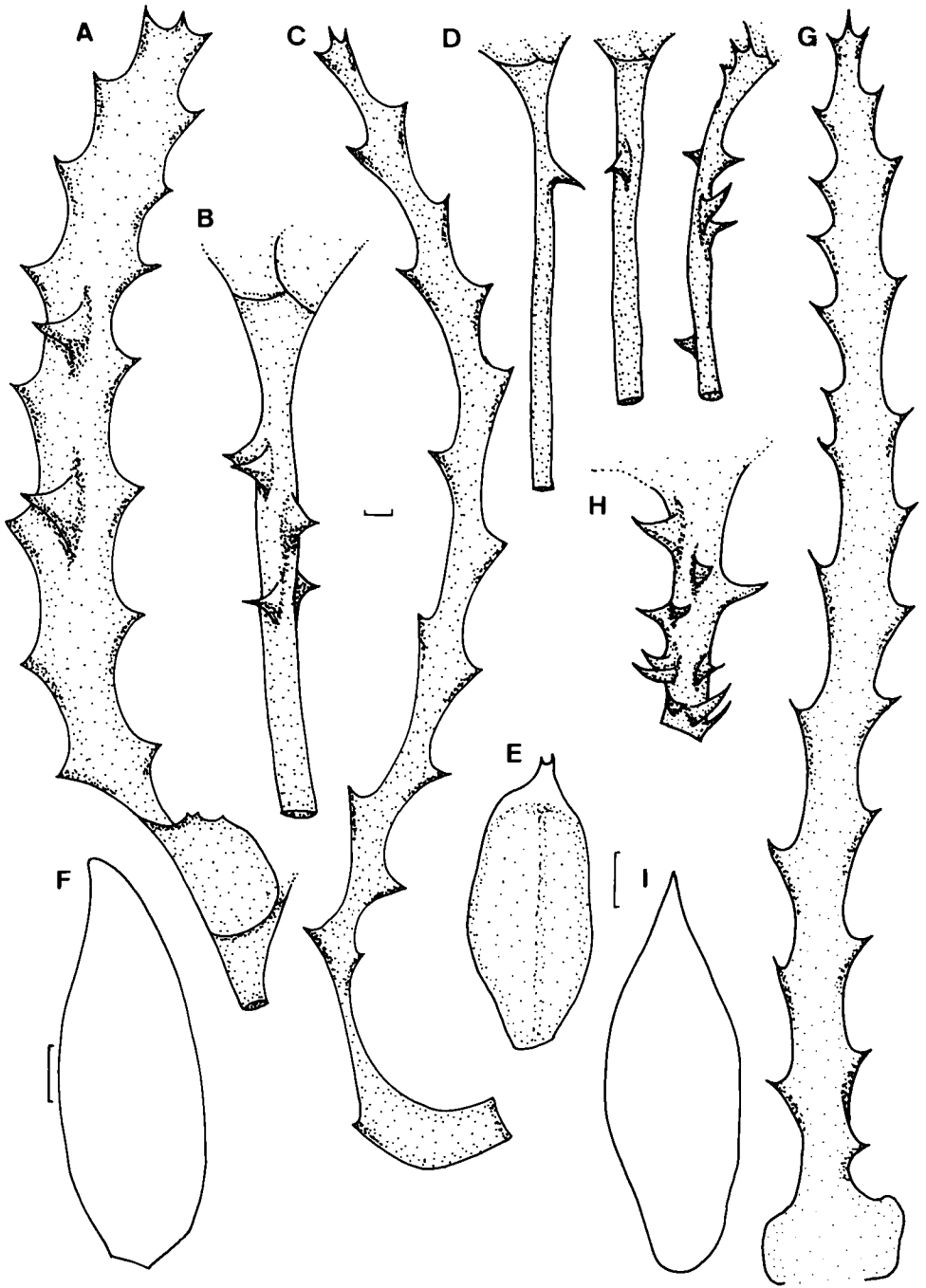
Wilson & Baker 4782 : *N. tenuifolia*.

Woolfs MEL 108975 : *N. tenuifolia*. — NSW 2548 : prob. *N. tenuifolia*.



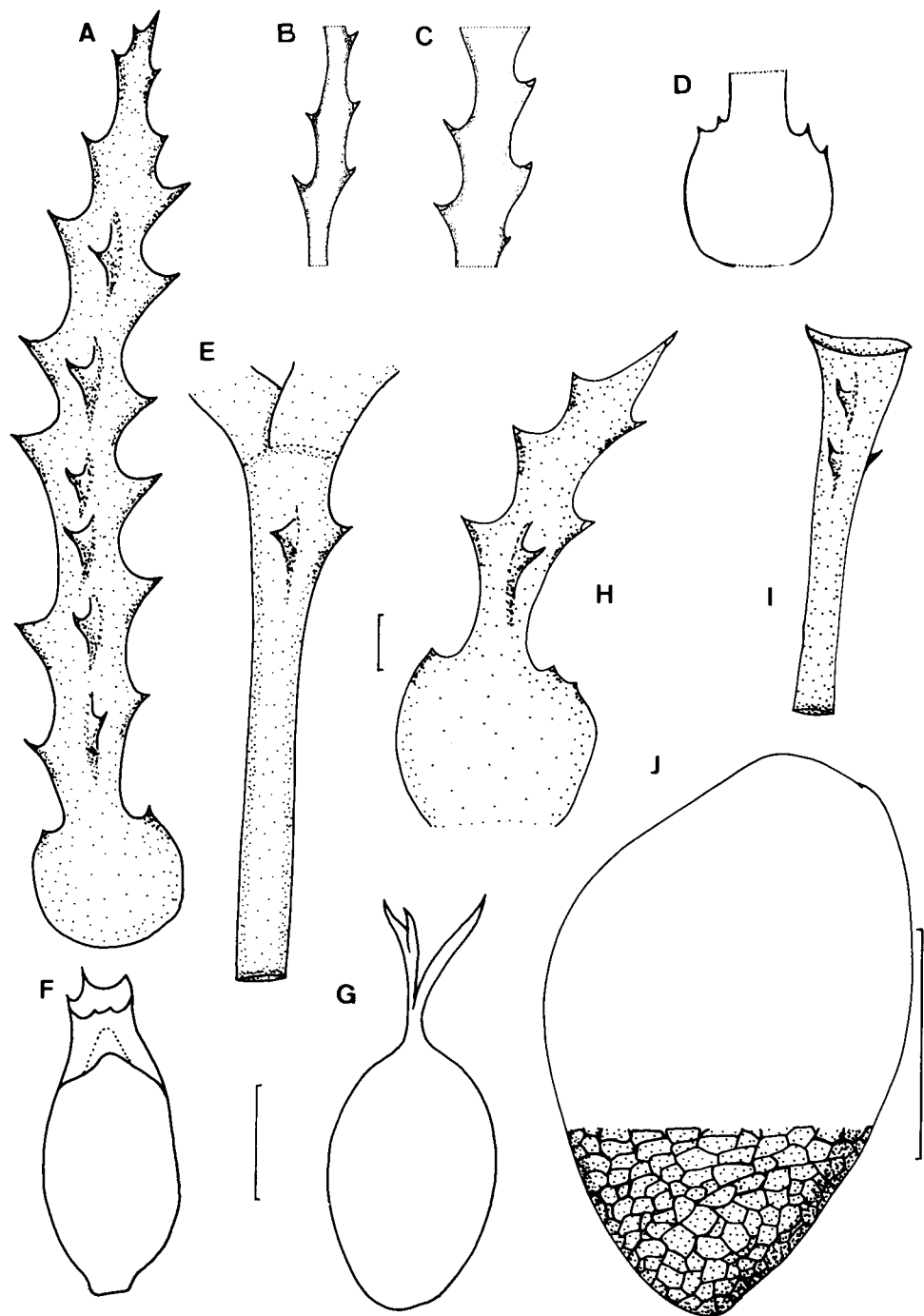
N. marina subsp. *marina* var. *marina* (A-E)
and *N. marina* subsp. *marina* var. *grossedentata* (F-I)

A : leaf (*Triest* 197) ; B : leaf (*Triest* 269) ; C : seed (*Triest* 197) ; D : seed (*Triest* 269) ; E : seed (*Triest* 487) ; F : leaf (*Stanton* s.n.) ; G : part of leaf (*Tzvelev* 224) ; H : part of stem (*Tzvelev* 224) ; I : seed (*Tzvelev* 224). (A, B : 3.5 × ; C-I : 7.5 × ; scales = 1 mm).



N. marina subsp. *marina* var. *kashmirensis* (A-F)
 and *N. marina* subsp. *marina* var. *ohwii* (G-I)

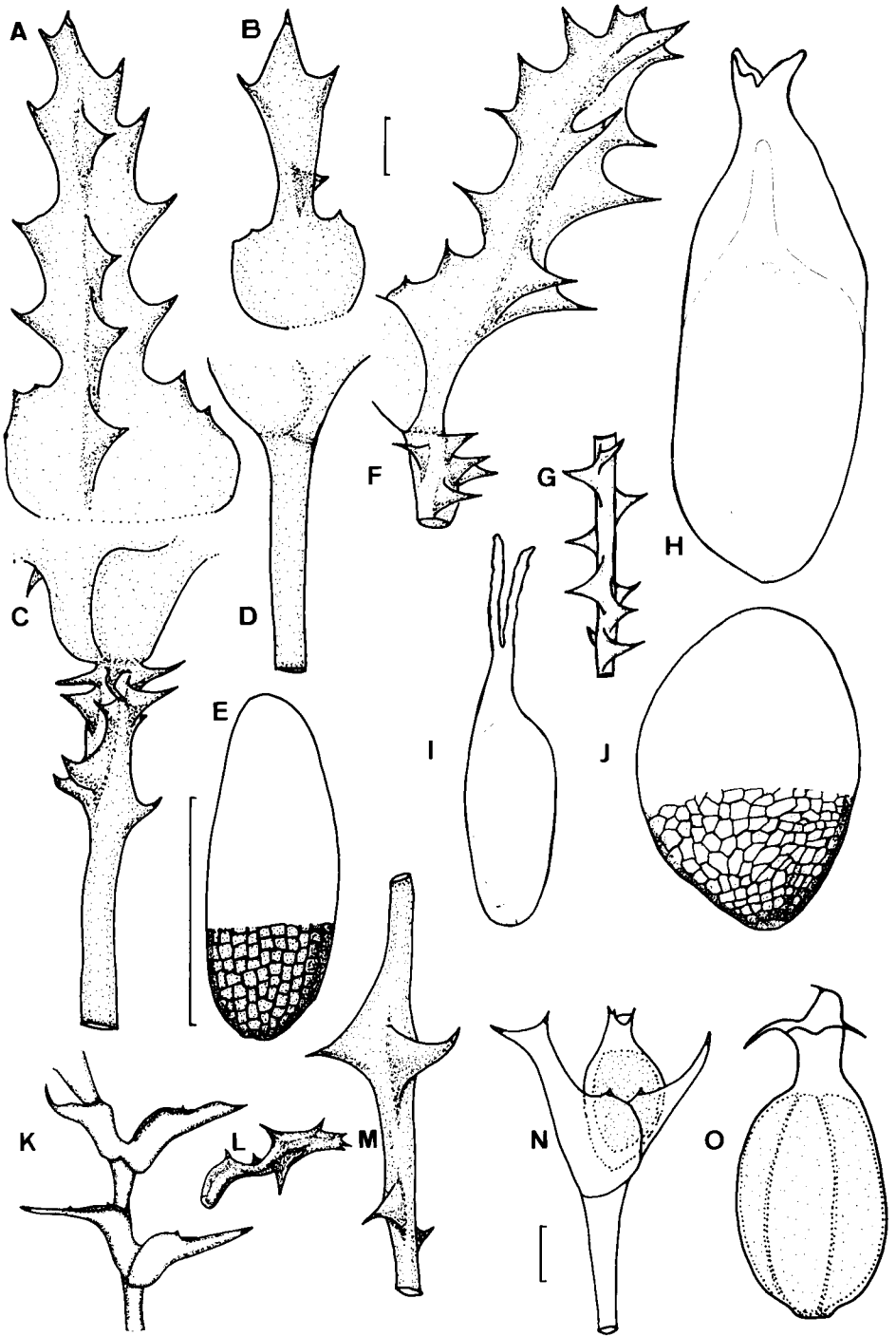
A: leaf (Cook & Gut 24); B: part of stem (Cook & Gut 24); C: leaf (Newland s.n.); D: parts of stems (Newland s.n. and Young s.n.); E: male flower (Ludlow & Sherriff 7695); F: seed (Ludlow & Sherriff 7695). — G: leaf (Ohwi TSM 976); H: part of stem (Schröter s.n.); I: seed (Schröter s.n.). (A-D, G, H: 3.5 ×; E, F, I: 7.5 ×; scales = 1 mm).



N. marina subsp. *ehrenbergii* (A-G)
and *N. marina* subsp. *brachycarpa* (H-J)

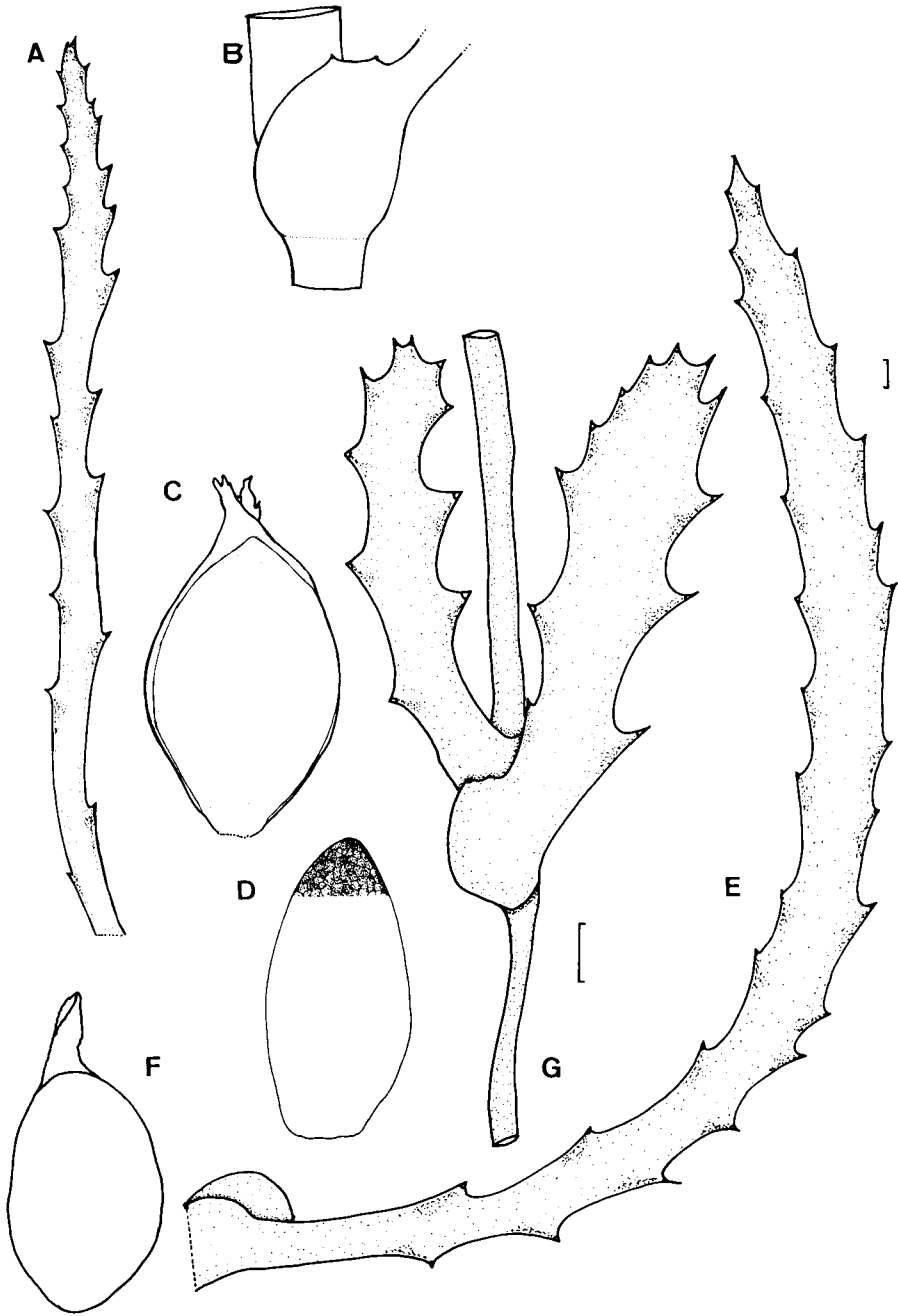
A: leaf (*Ehrenberg* s.n.); B & C: part of leaf (*Killian* s.n. in Herb. Maire); D: leaf sheath (*Balfour* 732); E: part of stem; F: male flower; G: seed (All *Ehrenberg* s.n.). — H: leaf; I: part of stem; J: seed (All *Schrenk* s.n.). (A-E, H, I: 7.5 ×; B-D: 5.5 ×; F, G: 16 ×; J: 32 ×; scales = 1 mm).

Plate IV



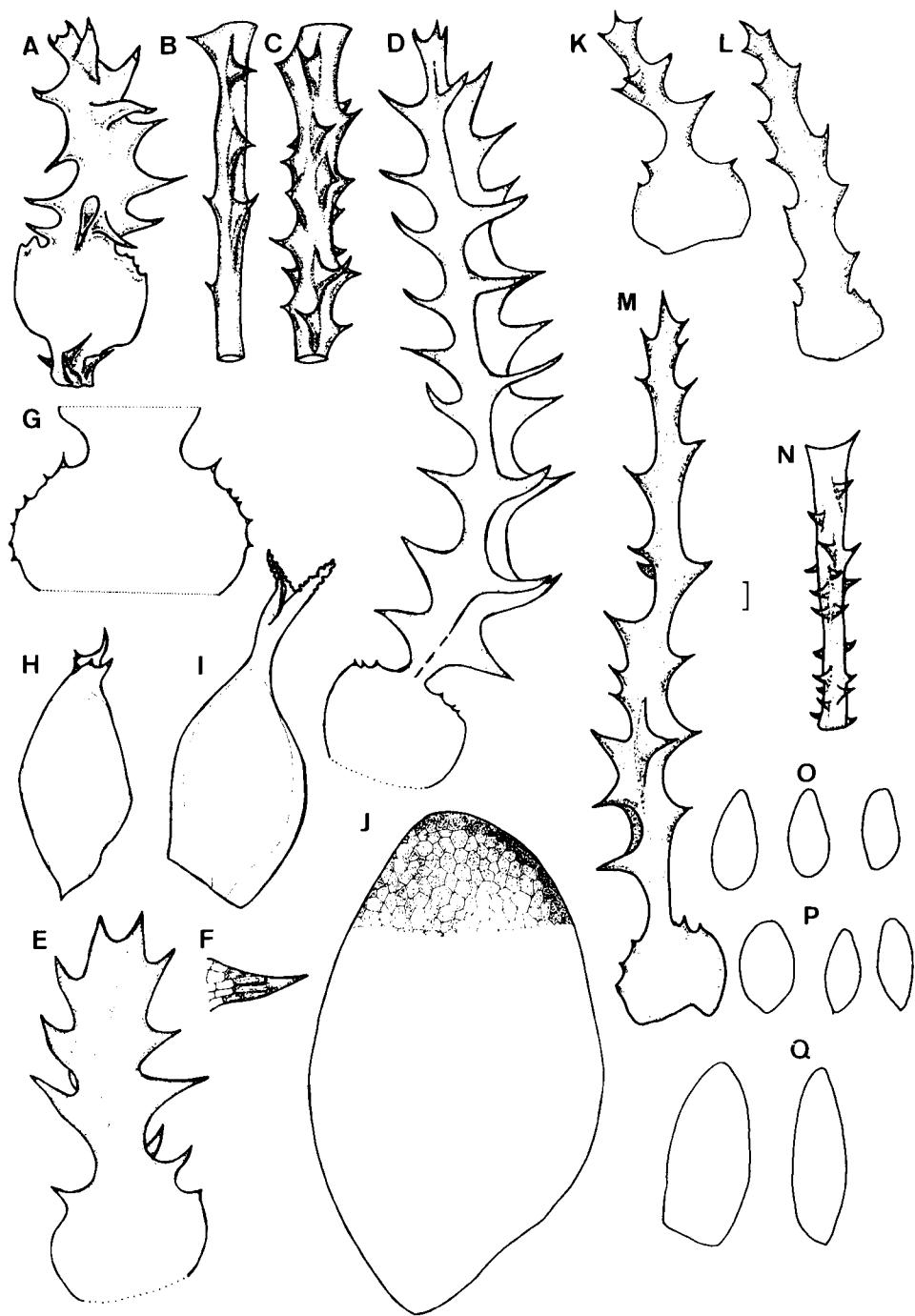
N. marina subsp. *aculeolata* (A-E), *N. marina* subsp. *microcarpa* (F-J) and *N. marina* subsp. *arsenariensis* (K-O)

A: leaf (Tzvelev & Kolesnikova 303); B: leaf (Katanskaja s.n.); C: part of stem (Tzvelev & Kolesnikova 303); D: part of stem (Katanskaja s.n.); E: seed (Katanskaja s.n.). — F: leaf; G: part of stem; H: male flower; I: female flower; J: seed (All Audru 3315). — K: part of shoot; L: leaf; M: part of stem; N: node with male flower; O: male flower (Battandier s.n. in Herb. Maire). (A-D, F, M-O: 7.5 ×; E: 32 ×; G, K, L: 5.5 ×; H-J: 25 ×; scales = 1 mm).



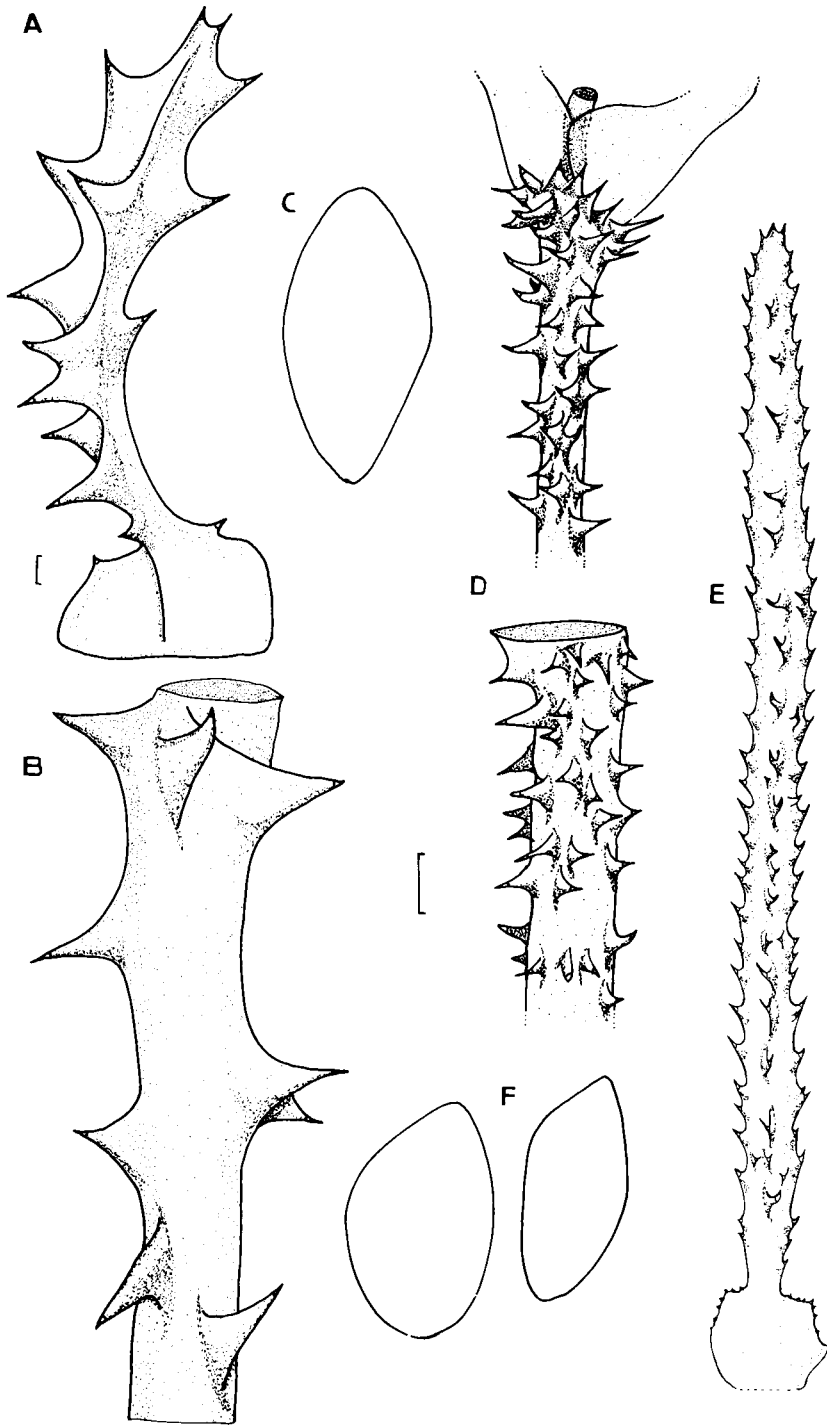
N. marina subsp. *commersonii* (A-D)
and *N. marina* subsp. *latior* (E-G)

A : leaf ; B : part of stem ; C : male flower ; D : seed (*Commerson* 132). — E : leaf (*Ernst* s.n.) ; F : fruit (*Ruttner* 313) ; G : part of shoot (*Jensen* 298). (A : 5.5 × ; B-D : 11 × ; E : 3.5 × ; F, G : 7.5 × ; scale = 1 mm).



N. marina subsp. *armata* (A-J)
and *N. marina* subsp. *intermedia* (K-Q)

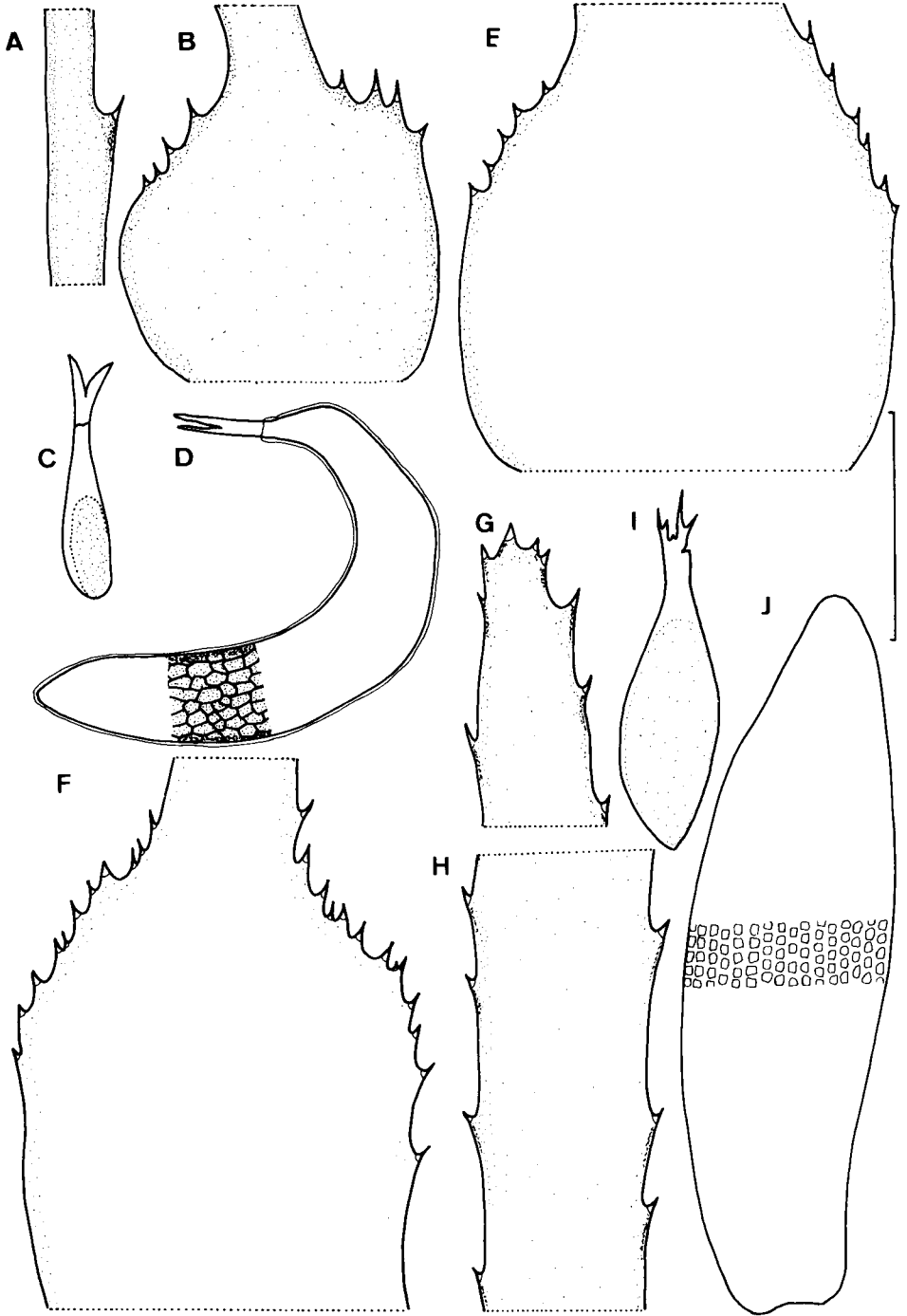
A: leaf (*Simpson* 1649); B: part of stem (*Hassan* 4246); C: part of stem (*Shuttleworth* s.n.), D: leaf (*Cunnington* 9); E: leaf; F: leaf tooth (*Mpawenayo* s.n.); G: leaf sheath (*Simpson* 5434); H: male flower (*von Reichenbach* in *Herb. Sieber*); I: female flower (*Simpson* 1001); J: seed (*Letourneux* s.n.). — K: leaf (*Triest* 162); L: leaf (*Triest* 215); M: leaf; N: part of stem (*Popov* 414a); O: seeds (*Triest* 429); P: seeds (*Triest* 407); Q: seeds (*Triest* 484). (A-D: 5.5 ×; E, G-I: 11 ×; F, J: 25 ×; K-Q: 3.5 ×; scales = 1 mm).



N. marina subsp. *susiana* (A-C)
and *N. marina* subsp. *sumatrana* (D-F)

A : leaf (*Thesiger* s.n.) ; B : part of stem ; C : seed (*Thamer Wedad & Hana* Nat. Herb. Iraq 46794).
- D : parts of stem ; E : leaf ; F : seeds (*Jacobson* Hort. Bog. 149). (A, E : 3.5 × ; B-D, F : 7.5 × ; scales = 1 mm).

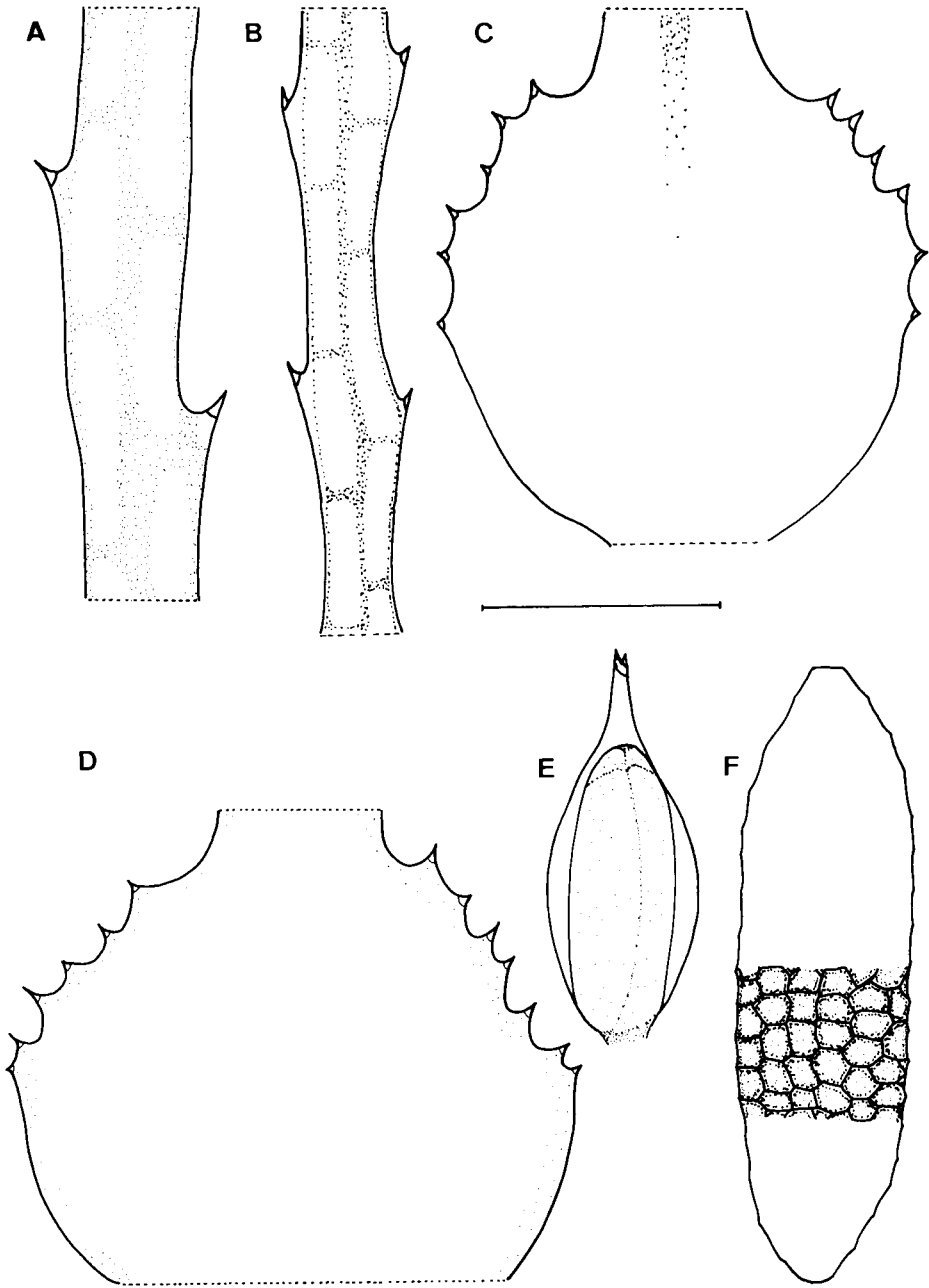
Plate VIII



N. ancistrocarpa (A-D) and *N. flexilis* (E-J)

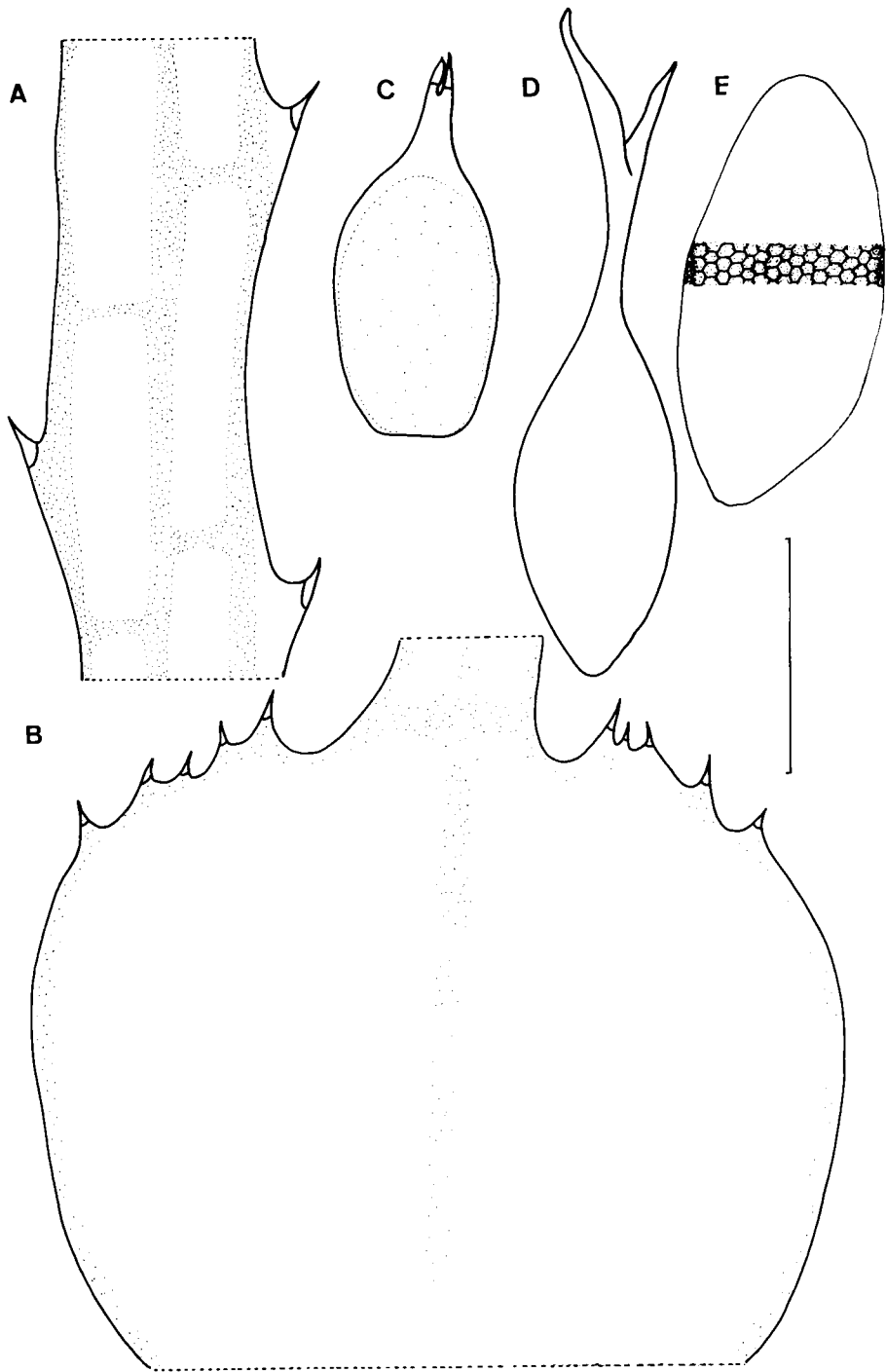
A : part of leaf ; B : leaf sheath ; C : female flower ; D : fruit (*Jisiba* s.n.). — E : leaf sheath (*Braun* s.n.) ; leaf sheath ; G : leaf apex (*Tzvelev* 1107) ; H : part of leaf (*Braun* s.n.) ; I : male flower (*Prochorov & Kuzeneva* 525) ; J : seed (*Braun* s.n.). (All figures 32 × ; scale = 1 mm).

Plate IX



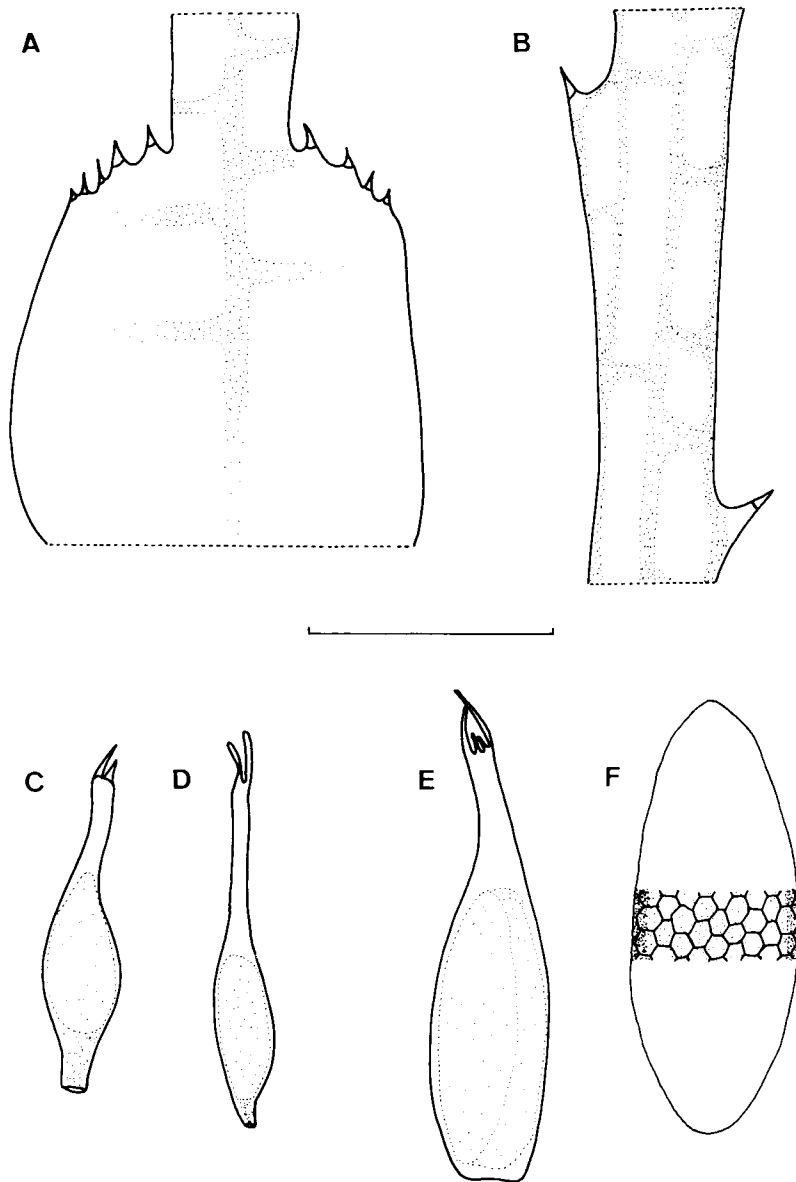
N. orientalis

A : part of leaf (*Faurie* 4877) ; B : part of leaf ; C : leaf sheath (*Uotila* 20253) ; D : leaf sheath (*Oldham* 823) ; E : male flower ; F : seed (*Uotila* 20253). (All figures 32 × ; scale = 1 mm).



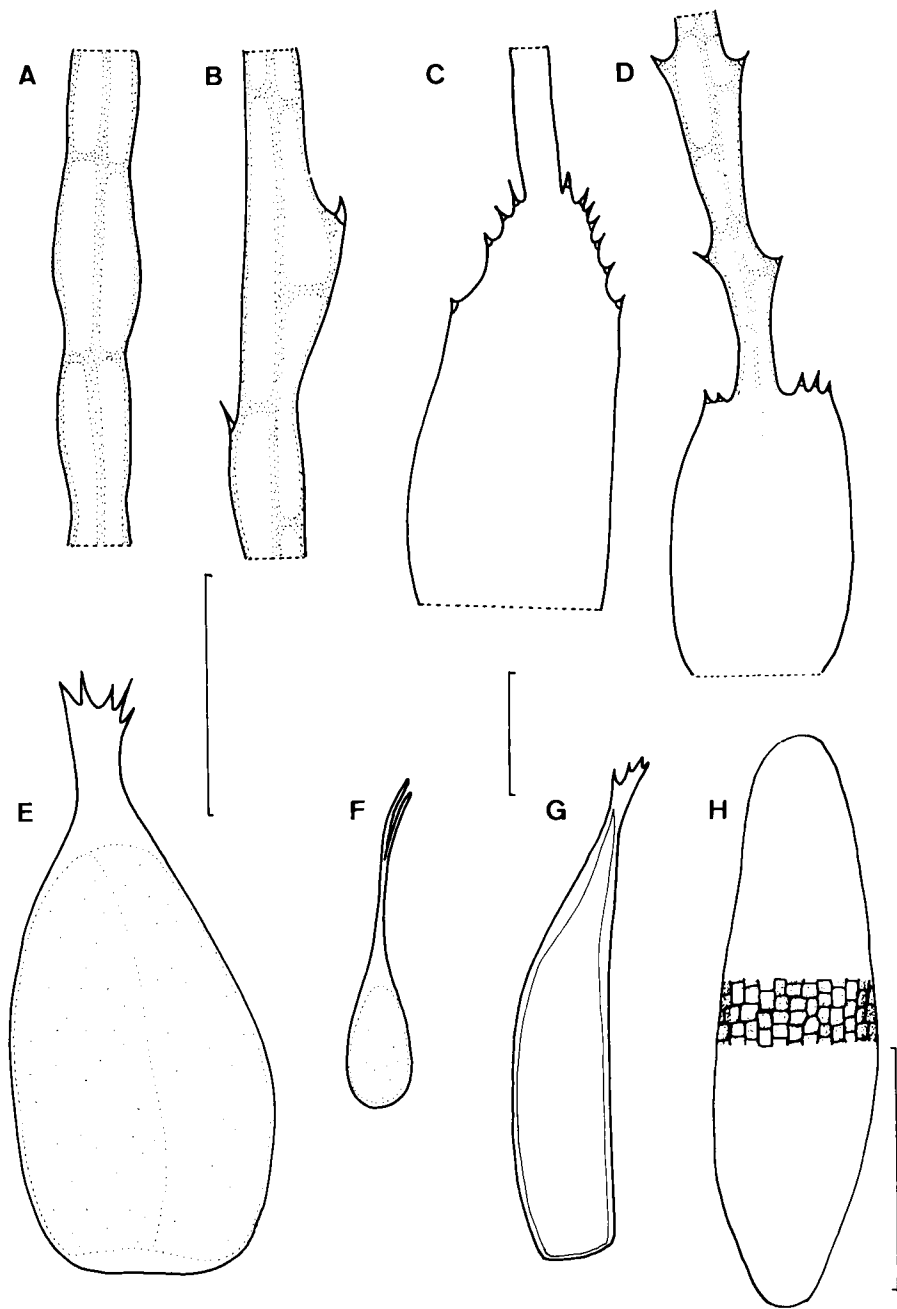
N. kingii

A : part of leaf ; B : leaf sheath ; C : male flower ; D : female flower ; E : seed (*King* s.n.). (All figures 32 × ; scale = 1 mm).



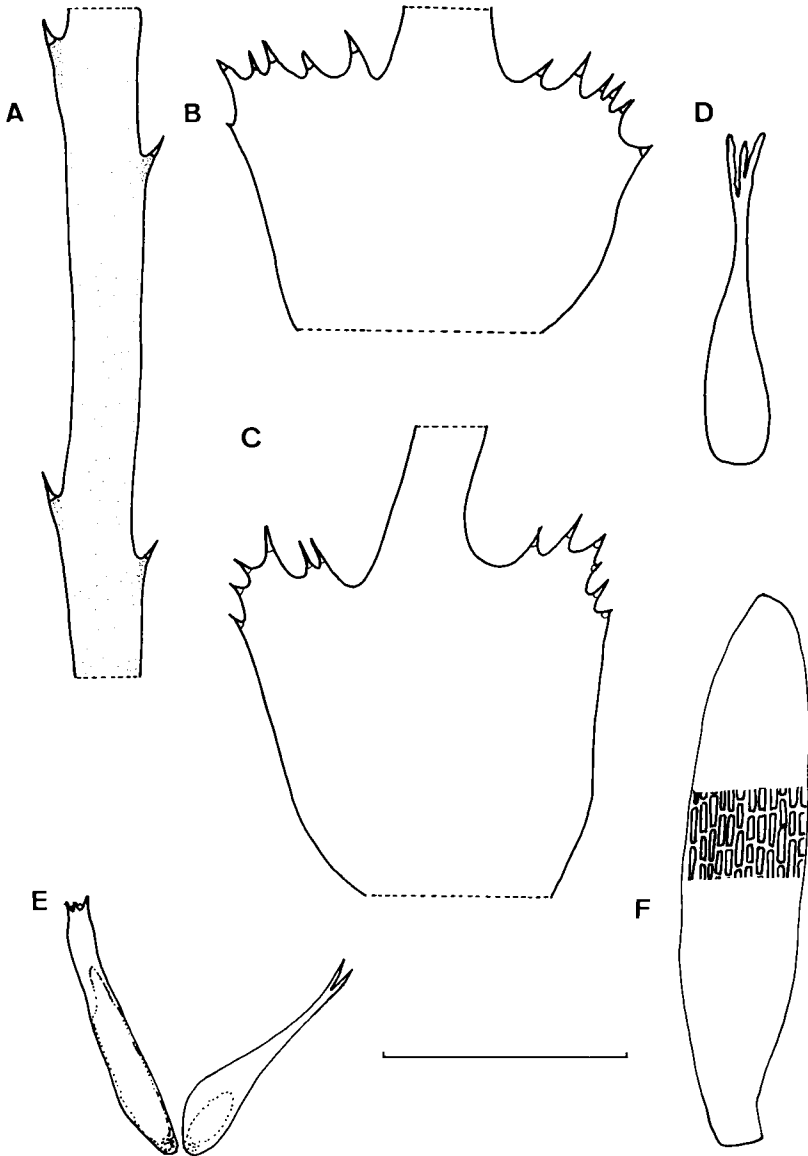
N. kingii

A : leaf sheath ; B : part of leaf ; C : male flower ; D : female flower (*Bogner 415*) ; E : male flower ; F : seed (*Vũ-vân-Cũng 662*). (All figures 32 × ; scale = 1 mm).



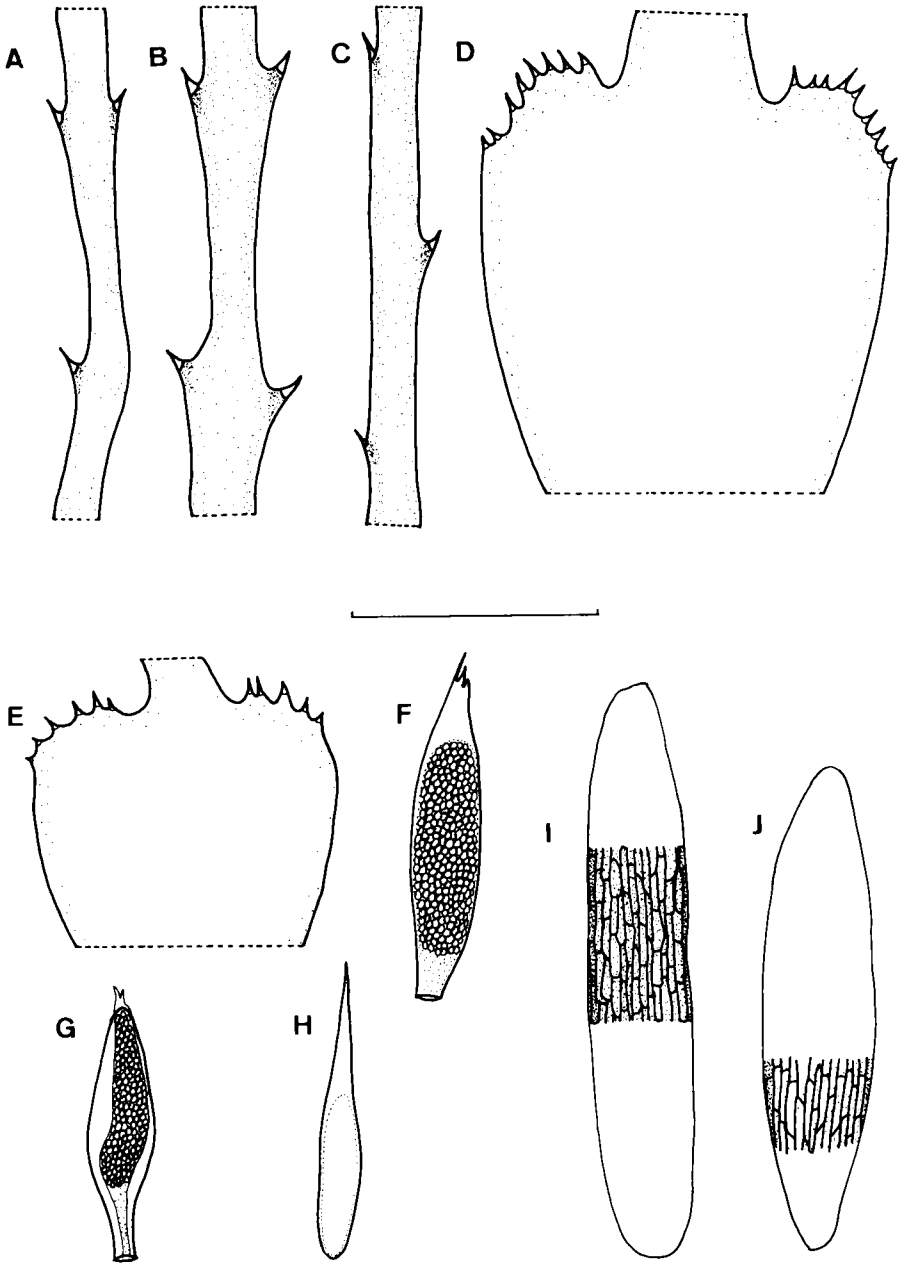
N. tenuis

A : part of leaf (*Kurz 3310*), B : part of leaf ; C : leaf sheath (*Hooker 639*) ; D : leaf sheath (*Soc. Unit. Frat. 1778*) ; E : male flower (*Cook & Gut 59*) ; F : female flower without spathe (*Hooker & Thomson s.n.*) ; G : female flower with spathe (*Kurz 3310*) ; H : seed (*Hooker 639*). (A, B, E, H : 32 × ; C, D, F, G : 16 × ; scales = 1 mm).



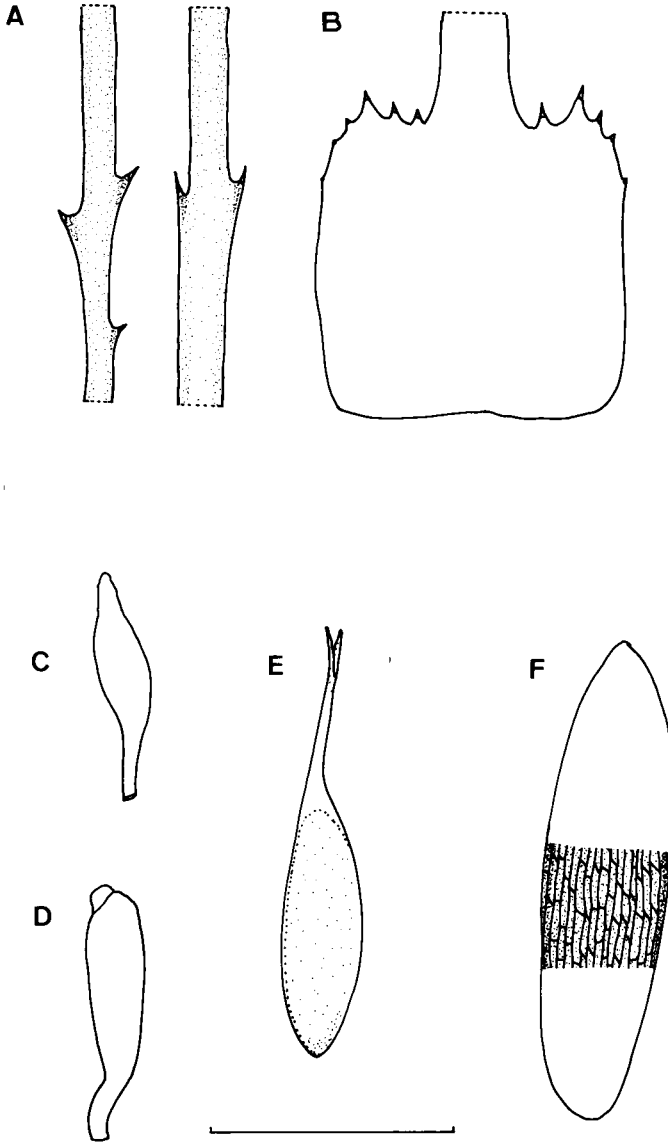
N. tenuissima

A : part of leaf ; B & C : leaf sheath ; D : female flower ; E : Male and female flower ; F : seed (*Kurto* & *Helynranta* s.n.). (All figures 32 × ; scale = 1 mm).



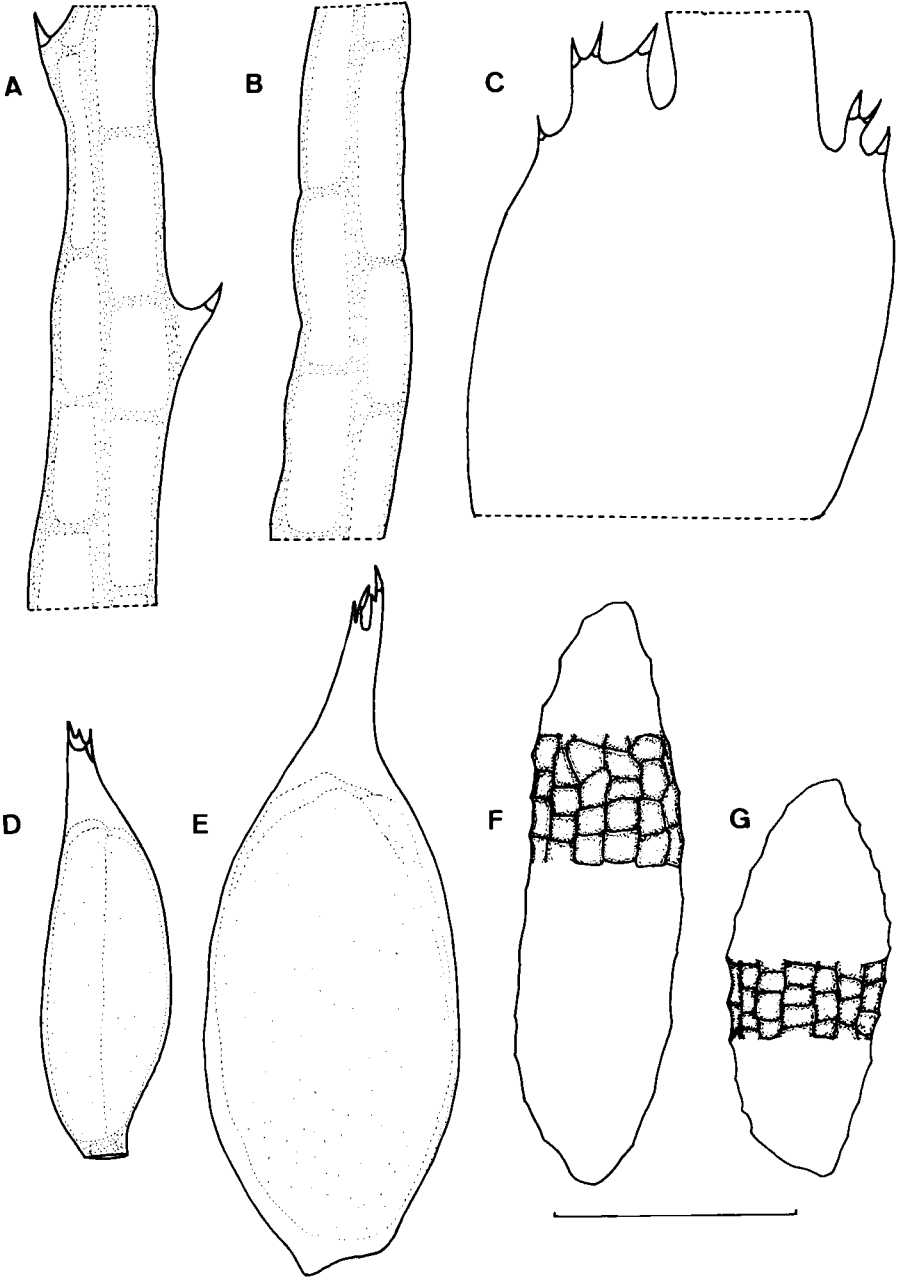
N. gracillima

A : part of leaf (*Faurie 4877*) ; B : part of leaf (*Delavay 4745*) ; C : part of leaf (*Triest 139*) ; D : leaf sheath (*Delavay 4745*) ; E : leaf sheath (*Triest 139*) ; F : male flower (*Faurie 4877*) ; G : male flower (*Delavay 4745*) ; H : female flower ; I : seed (*Faurie 4877*) ; J : seed (*Triest 139*). (All figures 32 × ; scale = 1 mm).



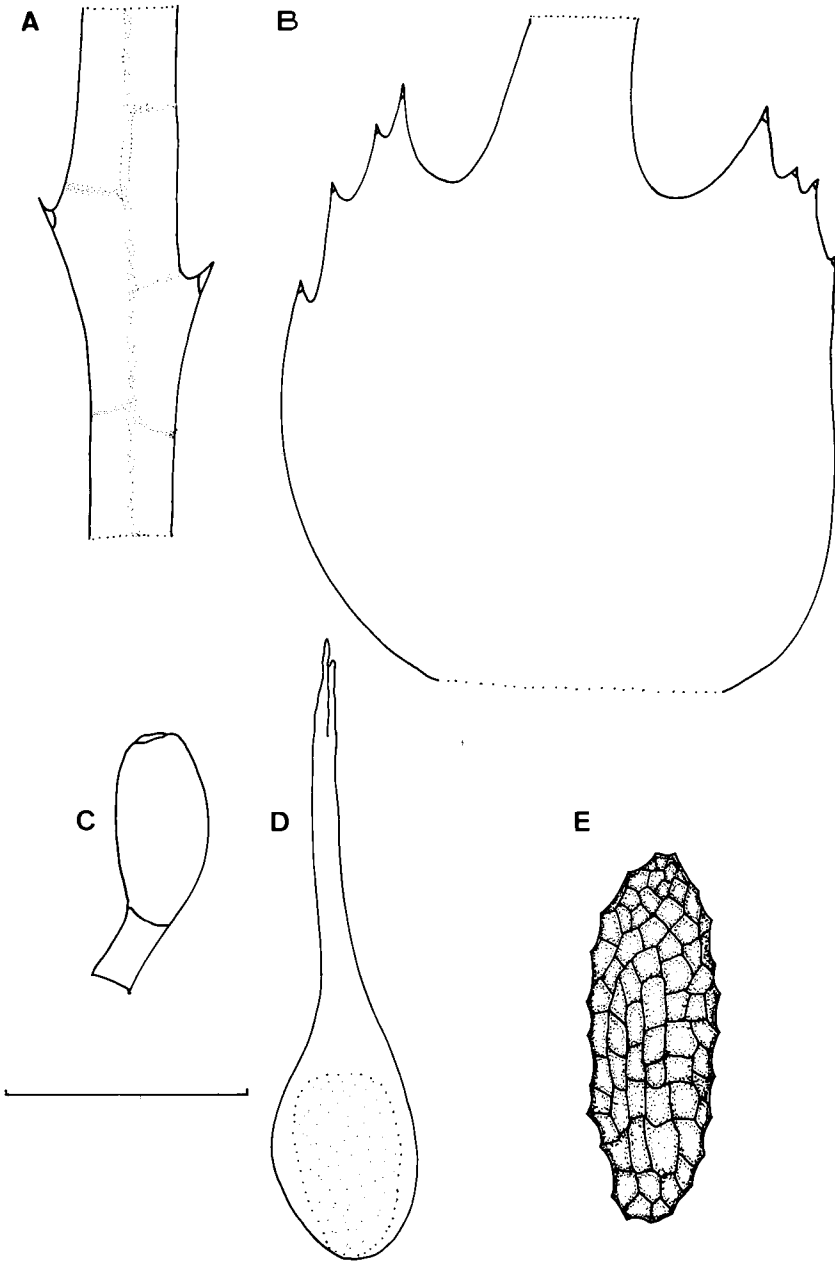
N. pseudogracillima

A : parts of leaf ; B : leaf sheath ; C : male flower (*Hu* 11263) ; D : male flower ; E : female flower ; F : seed (*Woo* Aq. Pl. 2). (All figures 32 × ; scale = 1 mm).



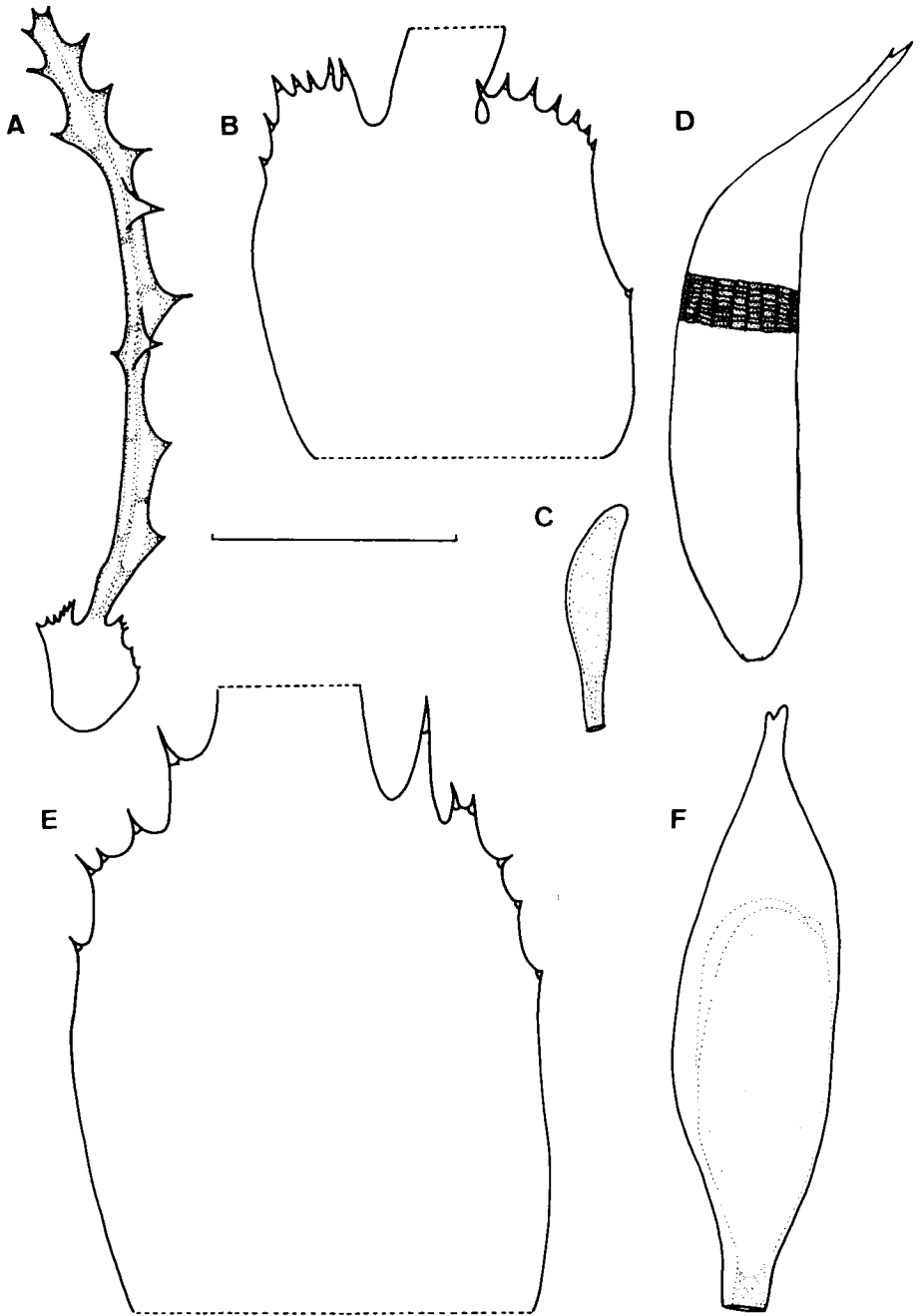
N. foveolata

A : part of leaf (Zollinger 3398) ; B : part of leaf ; C : leaf sheath (Zollinger 3386) ; D : male flower (Jaag 1777) ; E : male flower (Junghuhn 273) ; F : seed (Zollinger 3398) ; G : seed (Jaag 1777). (All figures 32 × ; scale = 1 mm).



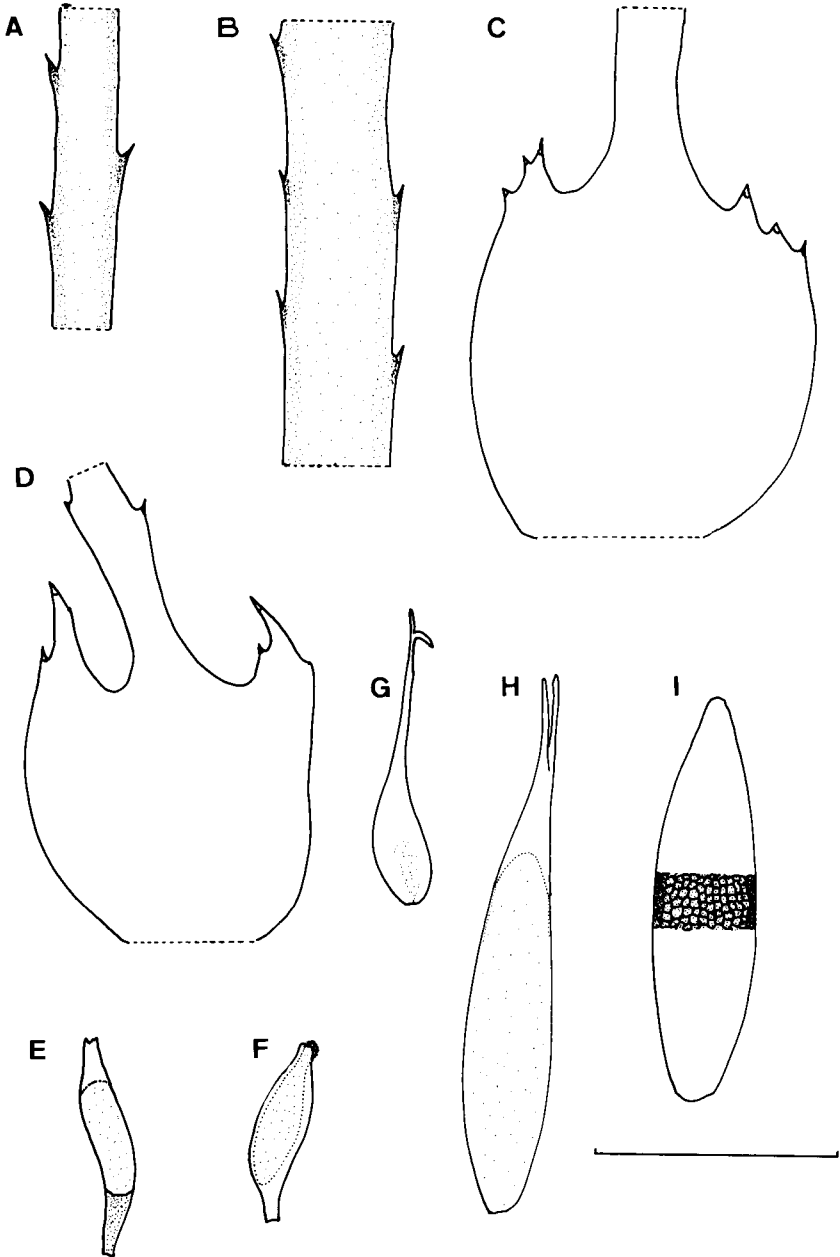
N. grossareolata

A : part of leaf ; B : leaf sheath ; C : male flower ; D : female flower ; E : seed (*Balakrishnan* 353). (All figures 32 × ; scale = 1 mm).



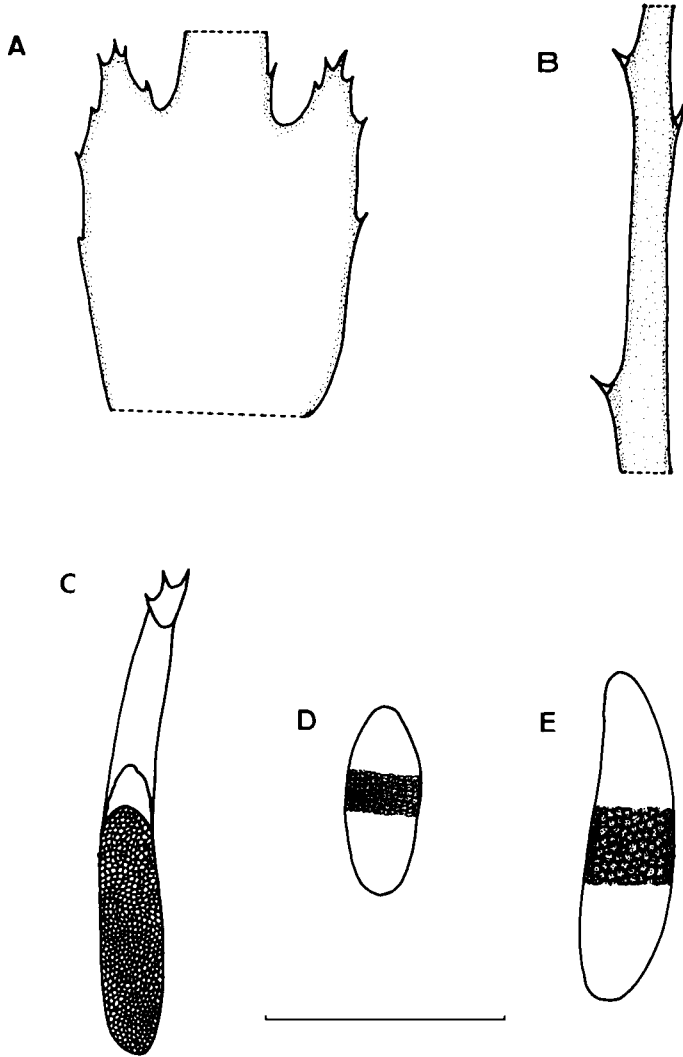
N. minor (A-D) and *N. oguraensis* (E-F)

A : leaf (*Litwinow* 3118) ; B : leaf sheath (*Dalziel* s.n.) ; C : anther (*Litwinow* 3118) ; D : seed (*Dalziel* s.n.). – E : leaf sheath ; F : male flower (*Stewart* 3347). (All figures 32 × ; scale = 1 mm).



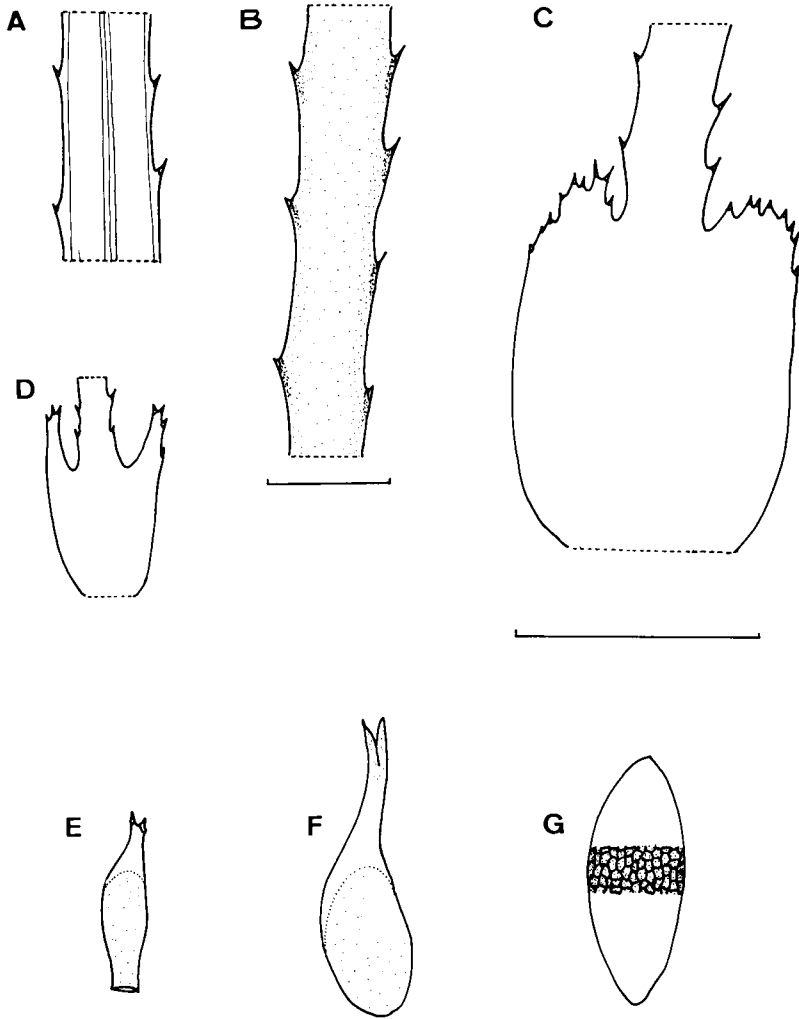
N. halophila

A : part of leaf (*Backer 6540*) ; B : part of leaf (*Brass 6471*) ; C : leaf sheath (*Backer 6540*) ; D : leaf sheath ; E : male flower (*Brass 6471*) ; F : male flower ; G : female flower (*Backer 6540*) ; H : fruit ; I : seed (*Backer 19139*). (All figures 32 × ; scale = 1 mm).



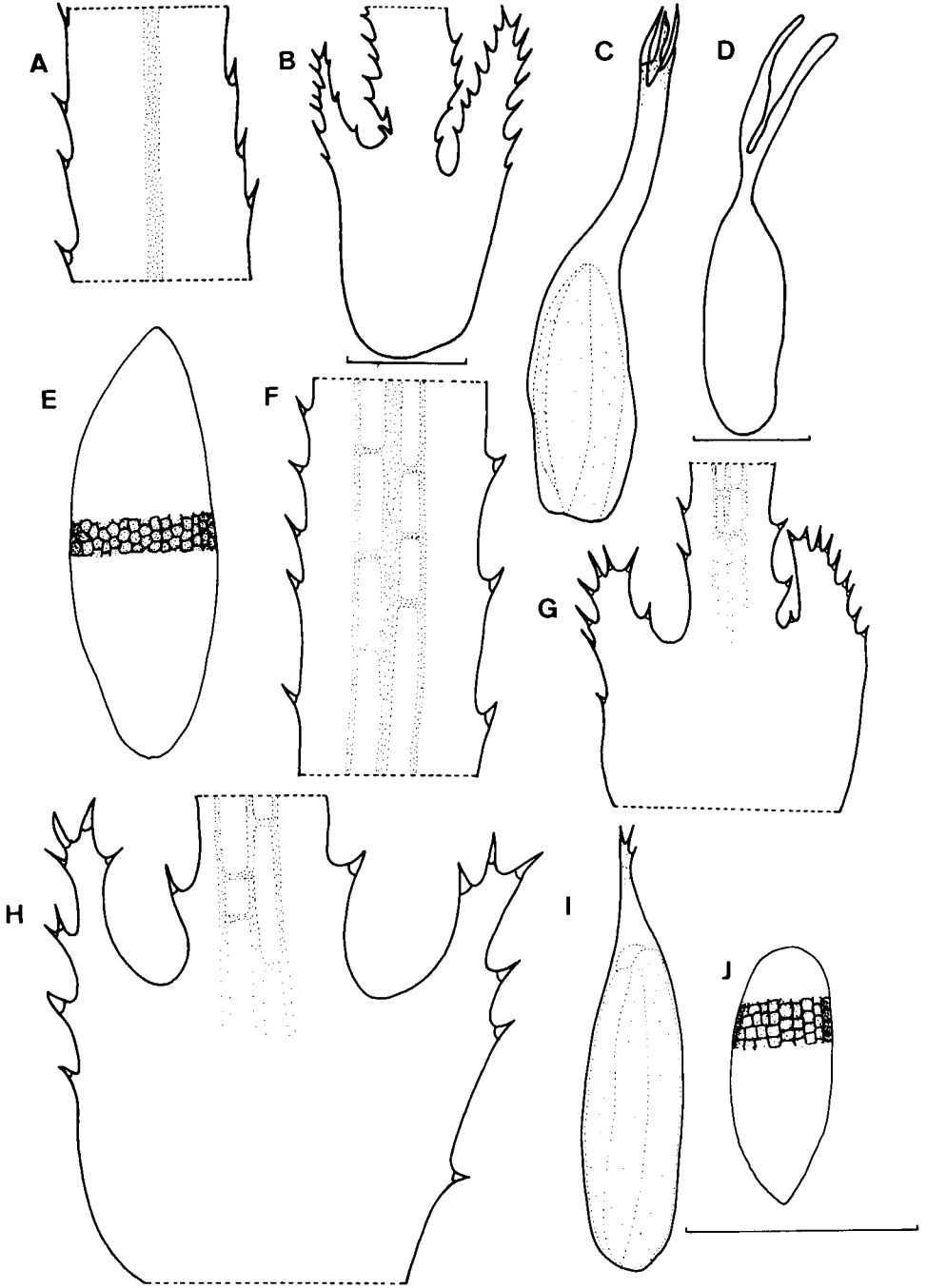
N. browniana

A : leaf sheath (*Jacobs* 4049) ; B : part of leaf (*Aston* 2292) ; C : male flower (*Henshall* 3354) ; D : seed (*Henshall* 3361) ; E : seed (*Jacobs* 3987). (All figures 32 × ; scale = 1 mm).



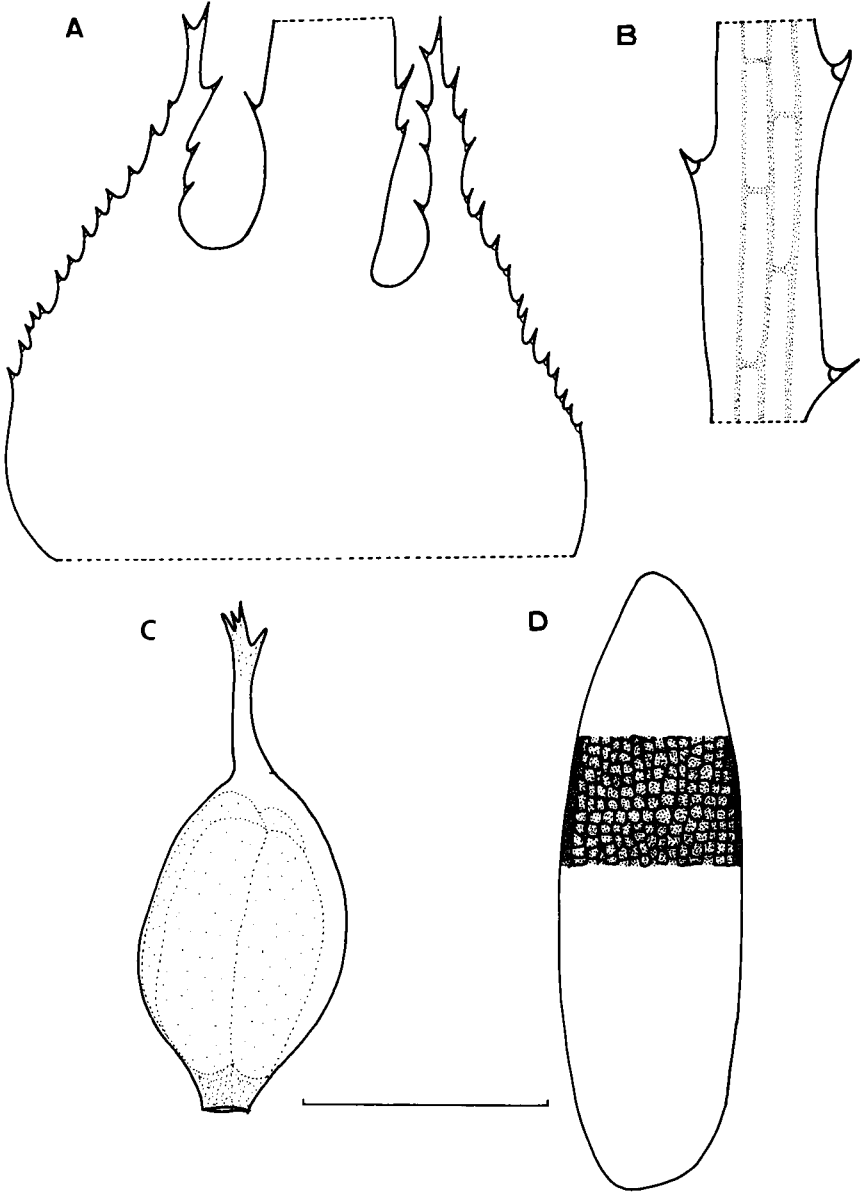
N. kurziana

A : part of leaf ; B : leaf sheath (*Dashpande 1728*) ; C : part of leaf ; D : leaf sheath ; E : male flower ; F : female flower ; G : seed (*Kurz s.n.*). (A, C-G : 32 × ; B : 16 × ; scales = 1 mm).



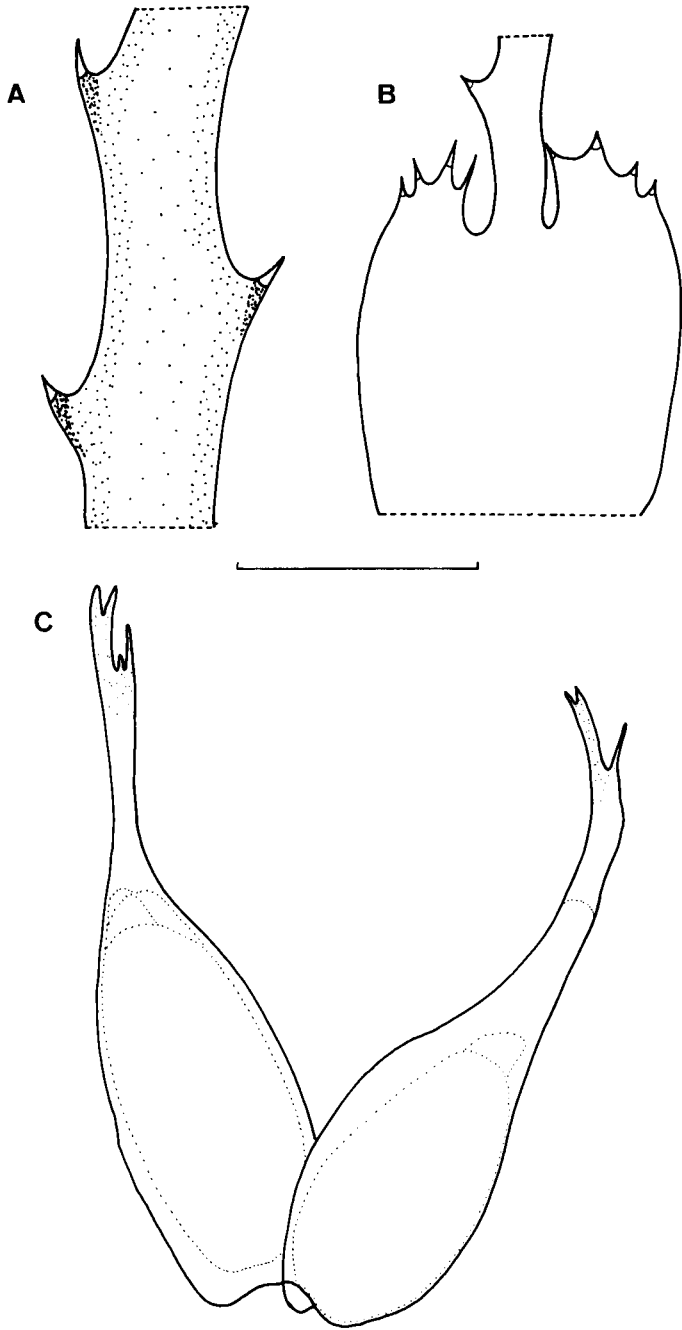
N. celebica (A-E) and *N. pseudograminea* (F-J)

A : part of leaf ; B : leaf sheath (*De Vriese & Teysmann* s.n.) ; C : male flower (*Koorders* 17347 β) ; D : female flower (*De Vriese & Teysmann* s.n.) ; E : seed (*Beccari* 11810). – F : part of leaf (*Thung* s.n.) ; G : leaf sheath (*Merrill* 4243) ; H : leaf sheath (*Schröter & Coert* 20) ; I : male flower (*Thung* s.n.) ; J : seed (*Schröter & Coert* 20). (A, C, E-J: 32 \times ; B, D: 16 \times ; scales = 1 mm).



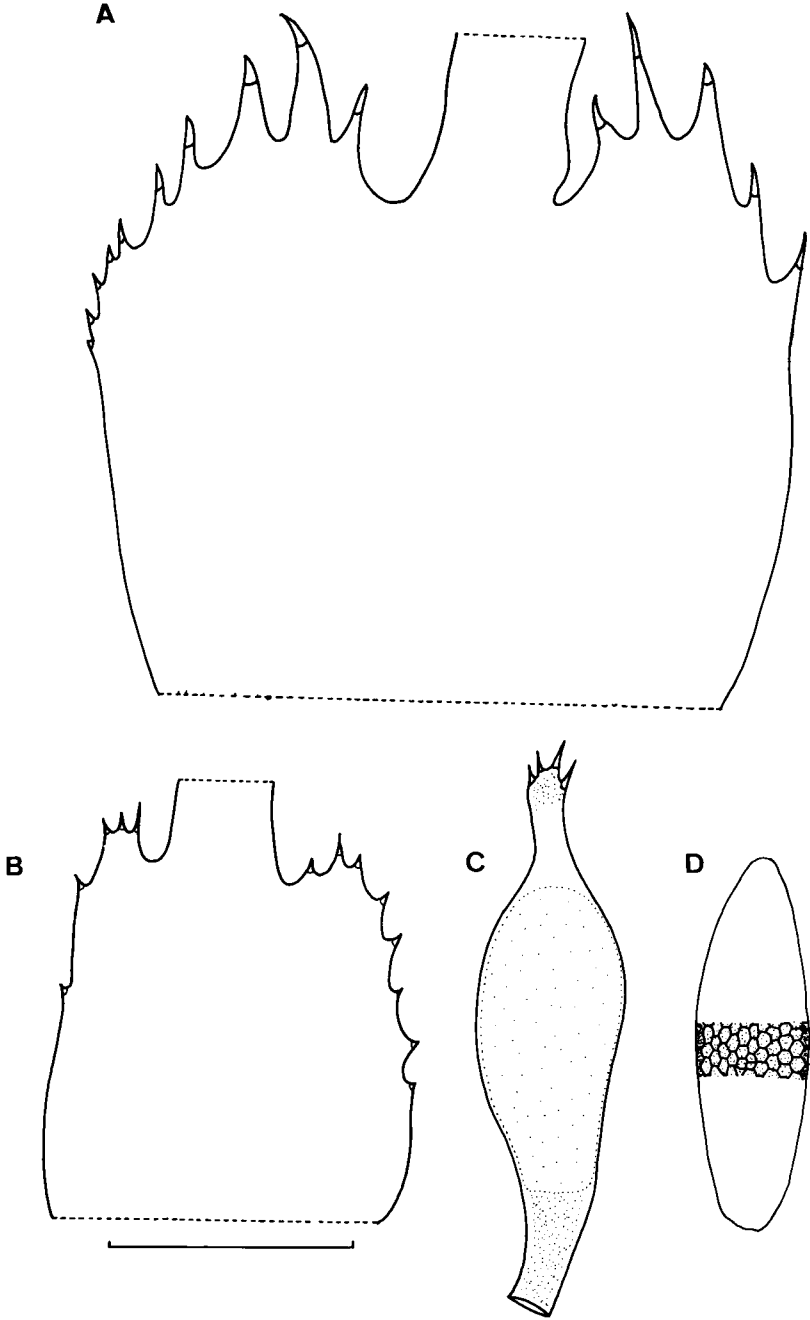
N. tenuifolia

A : leaf sheath (Adams 1749) ; B : part of leaf (McBarron 6303) ; C : male flower (Adams 1749) ; D : seed (Briggs NSW 101793). (All figures 32 × ; scale = 1 mm).



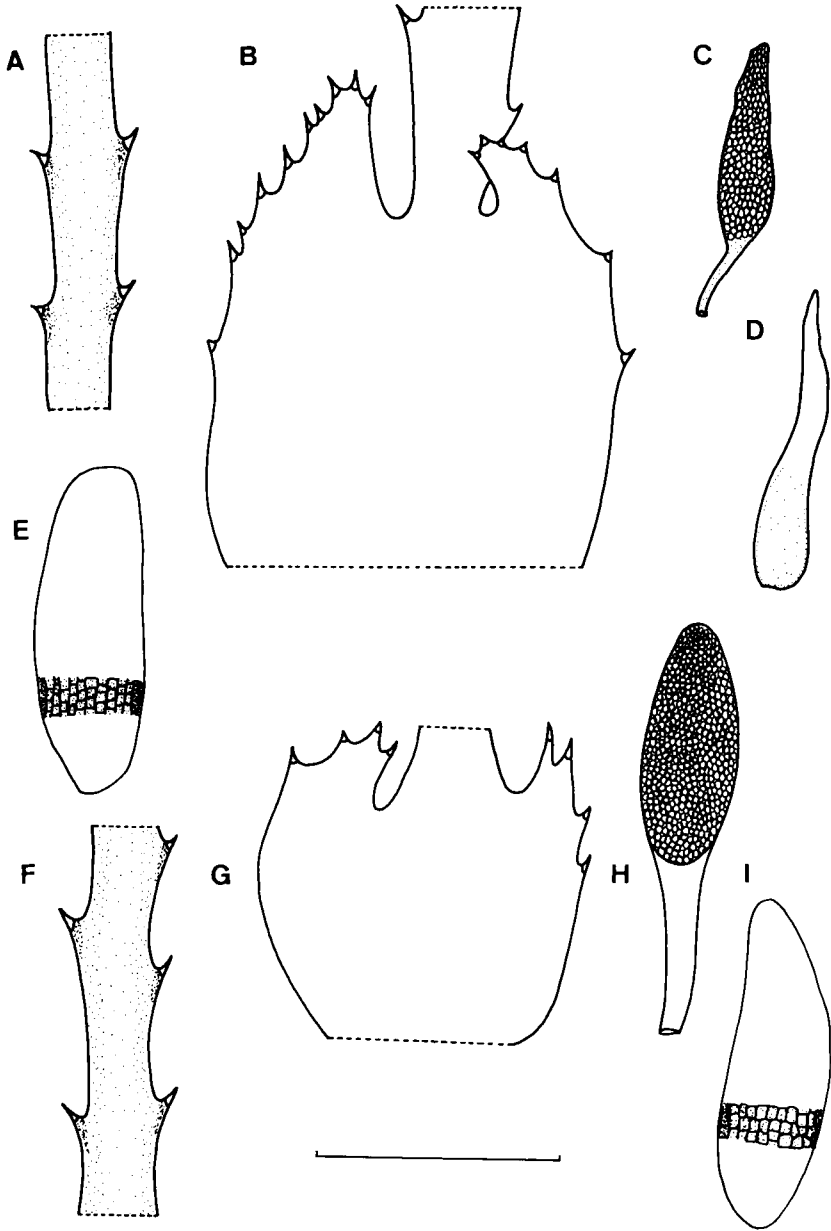
N. indica

A : part of leaf ; B : leaf sheath ; C : male flowers (Herb. Schreberianum 484). (A, C : 32 × ; B : 16 × ; scales = 1 mm).



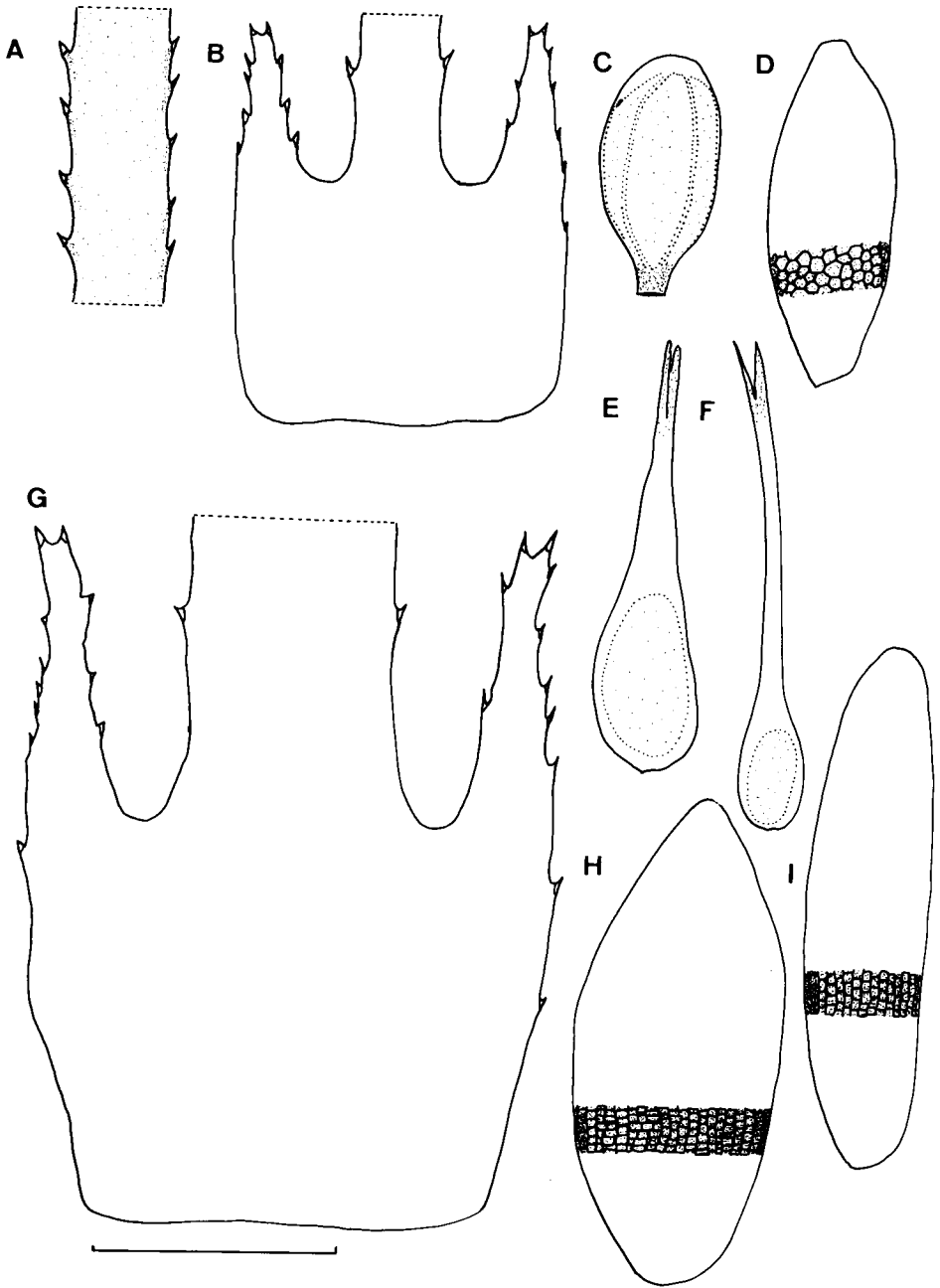
N. indica

A : leaf sheath (*Beddome* 8202) ; B : leaf sheath ; C : male flower ; D : seed (*Ritchie* 1161). (All figures 32 × ; scale = 1 mm).



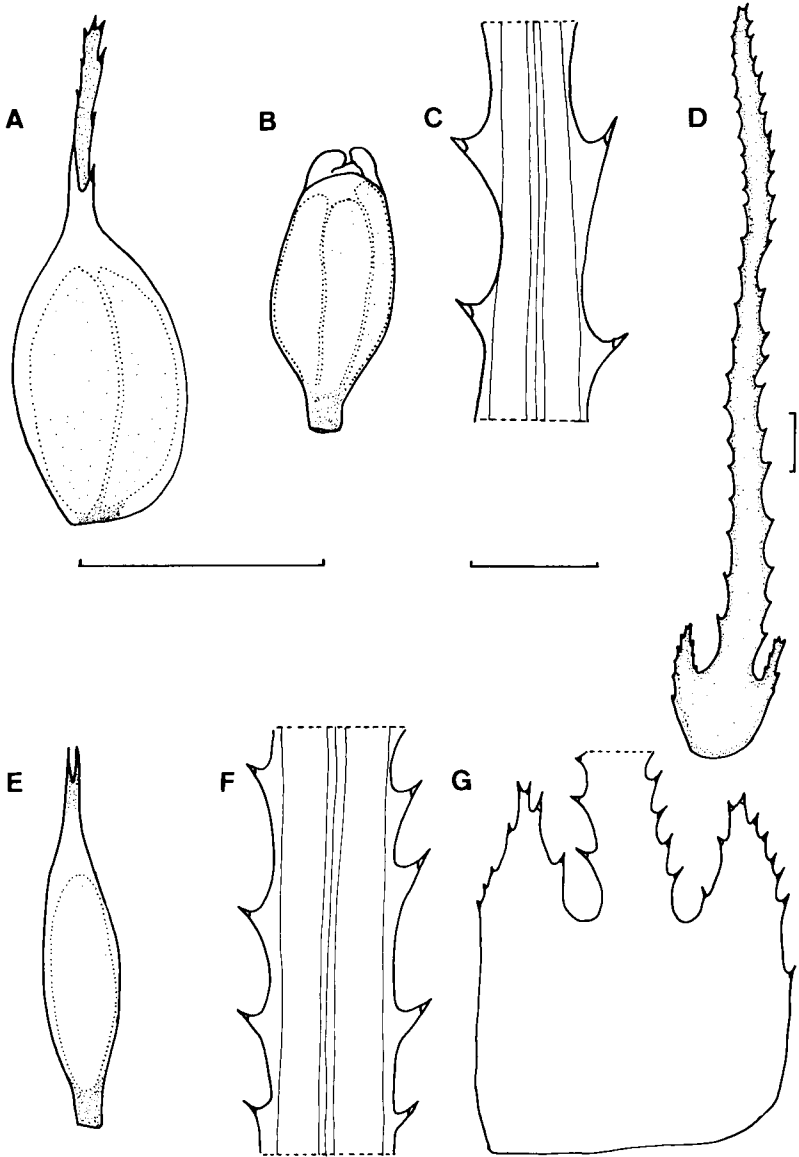
N. malesiana

A : part of leaf ; B : leaf sheath ; C : male flower ; D : female flower ; E : seed (Meijer 5772) ; F : part of leaf ; G : leaf sheath ; H : male flower (Cook, Rix & Schneller 324) ; I : seed (Cook, Rix & Schneller 238). (All figures 32 × ; scale = 1 mm).



N. graminea var. *graminea*

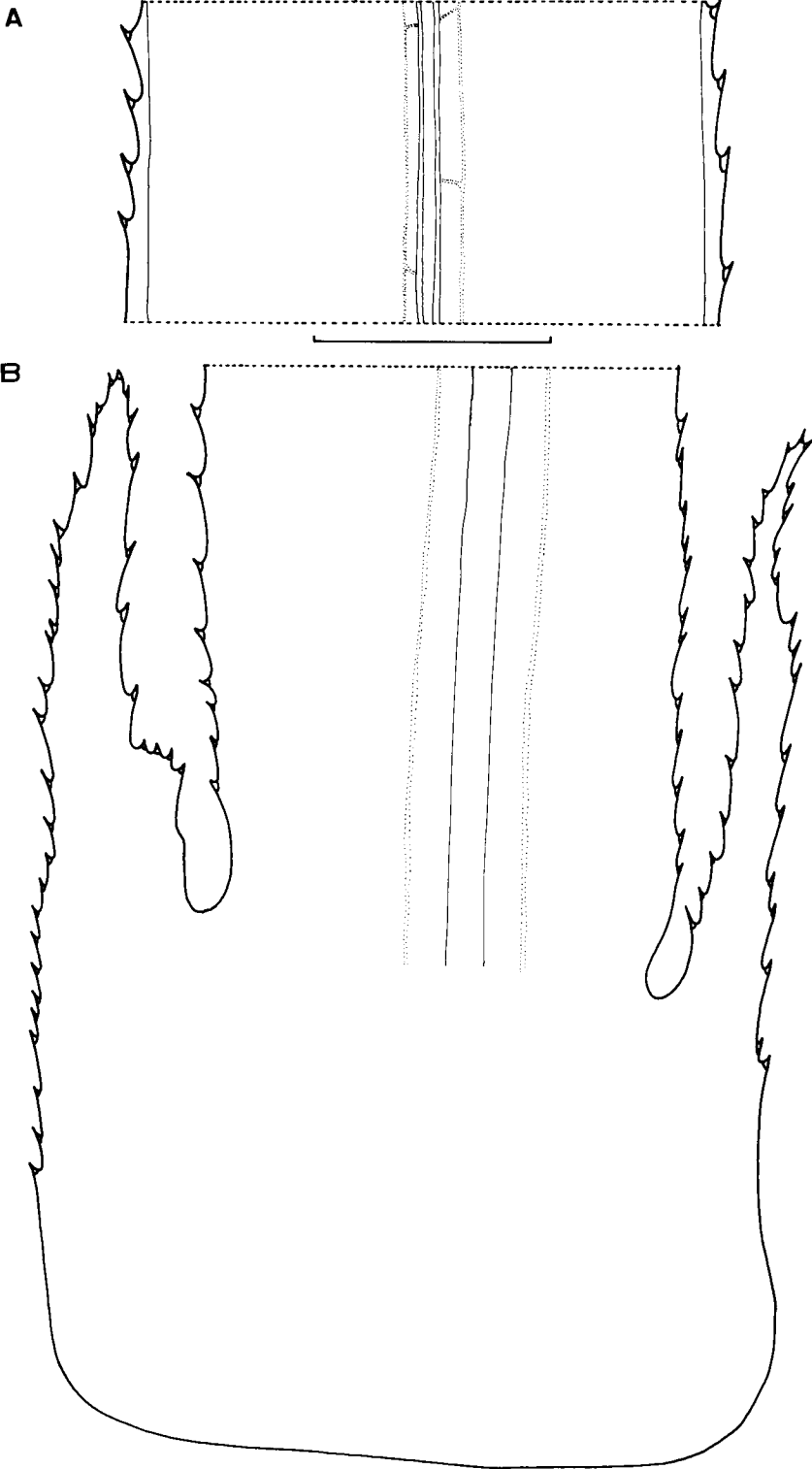
A : part of leaf ; B : leaf sheath ; C : male flower ; D : seed (*Cook & Gut 58*) ; E : female flower (*Jaysuriya & Meijer 231*) ; F : female flower (*Faurie s.n.*) ; G : leaf sheath ; H : seed (*Mendoza & Buwaya PNH 76750*) ; I : seed (*Faurie 13773*). (All figures 32 × ; scale = 1 mm).



N. graminea var. *graminea* (A-B)
and *N. graminea* var. *longidentata* (C-G)

A : male flower with leaf-like spathe ; B : male flower (*Surbeck* 301). – C : part of leaf ; D : leaf ; E : female flower (*Kjellberg* 3820) ; F : part of leaf ; G : leaf sheath (*Nasche* 4). (A, B, F : 32 × ; C, E, G : 16 × ; D : 7.5 × ; scales = 1 mm).

Plate XXIX



N. graminea var. *robusta*

A : part of leaf ; B : leaf sheath (*Elbert* 4521). (All figures 32 × ; scale = 1 mm).

