

appear even slightly more spherical than those of the first two species.

Some authors reduce *S. densa* to a variety of *S. rupestris*; however, its constant vegetative and spore characters would indicate that it is a distinct species. In no cases were the spores found to vary from tetrad formation in *S. densa*. Further work on the *S. rupestris* group is now in progress.

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COE COLLEGE, Cedar Rapids, Iowa.

THE GENUS *NAJAS* IN MINNESOTA

C. O. ROSENDAHL AND F. K. BUTTERS

(Plate 382)

THREE species of *Najas* have hitherto been recorded for Minnesota. These are *N. marina*, *N. guadalupensis*, and *N. flexilis*. The first named species is represented in the University herbarium by only two collections, one from Lake Minnewashta in Pope County, the other from Big Stone Lake on the western border. Both are fresh water lakes. *N. guadalupensis* is likewise known from only two stations, one at Winona, the other in Jefferson Township, Houston County, in the extreme southeastern corner of the state. The two species are obviously rare within our borders, but undoubtedly more careful search in the respective areas would locate more stations. *N. flexilis*, on the other hand, is very generally distributed throughout the entire state except in the northeastern corner, and in many of our lakes it is one of the most abundant species of aquatic plants. It is quite variable as regards size and habit of growth, ranging from small tufted forms 2–3 inches high on sandy or rocky bottoms in shallow water to long stringy plants 3–4 feet long, rooting in the muck at depths of 4–8 feet. In addition to vegetative differences, there is considerable variation in the form and size of the seed, but whether these variants can be referred to some of the subspecific segregates that have already been described or whether they represent new varieties or forms can be determined only by more detailed investigation.

Our preliminary work has, however, resulted in two noteworthy additions to the known Naiad flora of Minnesota. First, the undoubted occurrence in the vicinity of the Twin Cities of the local and apparently rare *N. gracillima*, and, second, the discovery of an entirely distinct and undescribed species from a lake in Kandiyohi County near the middle of the state. The former was found mixed with a collection of *N. flexilis* (Rosendahl No. 5509, Oct. 1927) from a small pond in northwestern Ramsey County, about 5 miles north of Minneapolis. The distribution of *N. gracillima* is given in Gray's New Manual (7th Ed.) as "e. Mass. to e. N. Y., N. J., and Pa.; Mo." Since then, Dr. Fernald¹ has questioned the authenticity of its reputed occurrence in Missouri and has shown that in all probability the report was based on the misreading of the label on a sheet in Engelmann's Herbarium. He calls attention to the fact that the species is localized, occurring in muddy, peaty, or sandy ponds or pools from southern N. J. and eastern Pa. northeastward near the coast to Knox County, Me., and up the Hudson River Valley to Saratoga County. Very recently, however, Dr. Fassett² has reported the species from three stations in Wisconsin, two of which are situated along the middle eastern border of the Driftless Area and the third in Sawyer County some distance to the northwestward. The station for *N. gracillima* in Minnesota is situated in an area of sandy plains and low morainic ridges, throughout which occurs a considerable number of the so-called Atlantic Coastal Plain species. The explanation of its disrupted range, *i. e.* Atlantic Coast from Knox County, Me., to eastern Pa. and eastern New York and in ponds of the acid, sandy areas of western Wisconsin and eastern Minnesota, is obviously linked up with the larger problem of the isolated presence of characteristic elements of the Atlantic Coastal Plain flora near the middle interior of the continent.

The new species of *Najas* referred to above was discovered in the course of a field excursion undertaken in September, 1933. The plant at once attracted attention because of its very different appearance from the ubiquitous *N. flexilis*. In fact, when first seen through the water, it was suspected of being *N. marina*, but an examination of the leaves soon revealed that they lacked the characteristically wavy-toothed margin and spiny midrib of that species. Closer study in the laboratory brought out the fact that it was entirely distinct from the

¹ Fernald, RHODORA 25: 105. 1925.

² Fassett, RHODORA 36: 149. 1934.

other species recorded for the state and further that it could not be referred to any of the species treated in the latest monograph of the genus.

In the material collected in 1933, no staminate flowers could be found. Accordingly, the description and publication of the species was deferred with the expectation of securing more adequate specimens the following season, and the station was revisited last September. Although it happened to be a very stormy day and the water was roiled to such an extent that it was impossible to see the lake bottom, after a considerable amount of blind fishing with a garden rake, we finally procured a few plants that contained the desired staminate flowers.

NAJAS olivacea, n. sp. (TAB. 00). Planta densa olivacea monoeca ramis ad 25 cm. longis 1–1.5 mm. latis inferne repentibus ad nodos radicanibus superne prostratis vel ascendentibus crebro furcatis, internodiis inferioribus 2–3 cm. longis, his superioribus brevioribus; foliis lineari-lanceolatis apicem versus subacutum angustatis 9–18 mm. longis 1.5–2 mm. latis serrulatis 20–40 spinulis minutis in latere singulo, vaginis declivibus 2.5–3.4 mm. latis in latere singulo 4–8 spinulis munitis; floribus solitariis, masculis spatha ovoidea 2.5 mm. longa spinulas 3–5 apicem versus ferente, anthera quadri-oculari circa 1 mm. longa, 0.7–0.8 mm. lata, filamento crasso; floribus femineis nudis, 2.8 mm. longis, ovario vix crassiore quam stylo stigmatibus binis subulatis atque processibus binis spiniferis instructo; seminibus ellipsoidalibus leviter falcatis atque compressis 2.3–2.5 mm. longis flavescentibus levibus sed haud politis areolas plurimas subsexangulares permonstrantibus his mediis paulum transversim elongatis $87 \times 125 \mu$, illis fines seminis versus minoribus vix elongatis; testa e stratis cellularum tribus composita, cellulis extimis (areolis) majusculis parietibus percrassis (39μ), eis strati medii magis minoribus parietibus crassiusculis, eis strati intimi paullis depressis parietibus tenuibus.

Plants monoecious, olive-green, of bushy habit, shoots repent towards the base and freely rooting at the nodes, spreading to ascending and dichotomously much-branched, up to 25 cm. long, 1–1½ mm. thick (living), lower internodes 2–3 cm. long, gradually shortening towards the ends of the branches; leaves 9–18 mm. long, linear-lanceolate, 1.5–2 mm. wide at the top of the sheath, gradually tapering to the sub-acute apex, with 20 to 40 minute marginal spines on each side; sheaths 2.5–3.4 mm. wide, each margin with 4–8 spines (sheath of upper leaf at each node regularly wider than that of the lower).

Spathe with enclosed staminate flower narrowly ovoid, 2.5 mm. long, bearing 3–5 minute spines at the apex; anther quadrilocular, about 1 mm. long, 0.7 to 0.8 mm. wide, filament stout: pistillate flower 2.8 mm. long, ovary only slightly thicker than the style, stigmas 2, tapering, alternating with 2 slightly longer, spine-tipped

processes; pericarp purple-tinged, seeds ellipsoidal, slightly falcate and flattened, 2.3–2.5 mm. long, pale yellow, smooth but not lustrous, areolae conspicuous under a lens, those of the middle portion of the seed largest, averaging $87 \times 125 \mu$, their longest diameter transverse to the axis of the seed, those towards the ends of the seeds somewhat smaller and more nearly isodiametric; seed coat consisting of three layers of cells, those of the outer layer—the areolae—with very thick, minutely pitted walls (averaging 39μ thick), cells of the middle layer much smaller and with moderately thickened walls, those of the inner layer thin-walled and flat.

Growing in 1–3 feet of water, on muddy bottom, Norway Lake, Kandiyohi County, Minnesota. TYPE (*Rosendahl and Butters* No. 6446, Sept. 6, 1933) in the Herbarium of the University of Minnesota.

The species belongs to the Section *Americanae* of which the only other known representatives in the United States are *Najas flexilis* and *Najas guadalupensis*. It is readily distinguished from the former by the olive-green color, the more spreading habit of growth, the wider and shorter leaves, but especially by the quadrilocular anther and the non-lustrous, blunter, slightly falcate seeds with much larger, thicker-walled areolae. In *N. flexilis* the areolae are inconspicuous under a hand lens, and in the middle portion of the seed average $67 \times 41 \mu$, with the longer axis parallel to the long axis of the seed. In *N. olivacea* the areolae are very conspicuous under low magnification, and in the corresponding area of the seed average $125 \times 87 \mu$, with the longer axis transverse to the long axis of the seed. In the former the walls of the areolae average 23μ thick, while in the latter they are 39μ and more finely and evenly pitted.

From *N. guadalupensis*, *N. olivacea* differs in its much stouter habit, larger seeds, and especially in the structure of the testa. In *N. guadalupensis* the cells of the outer layer of the testa are large and very thin-walled, collapsing at length upon the thick-walled middle layer to produce shallow pits on the surface of the ripe seed.

UNIVERSITY OF MINNESOTA.

EXPLANATION OF PLATE

NAJAS OLIVACEA n. sp. FIG. 1, part of branching shoot $\times 1.2$; FIG. 2, lower leaf; FIG. 3, upper leaf from same node $\times 3$; FIG. 4, margin of leaf showing one-celled spines $\times 67$; FIG. 5, young pistillate flower $\times 15$; FIG. 6, one stigma lobe with adjoining sterile process $\times 67$; FIG. 7, staminate flower, with enclosing spathe $\times 15$; FIG. 8, mature fruit $\times 15$; FIG. 9, ripe seed $\times 17$; FIG. 10, epidermal cells of testa (areolae) from near the middle of the seed $\times 54$; FIG. 11, cross section of testa $\times 160$.

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Rosendahl, Carl Otto and Butters, F. K. 1935. "The genus *Najas* in Minnesota." *Rhodora* 37, 345–348.

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