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NOTES ON THE GENUS NEMACLADUS

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The genus *Nemacladus* consists of about 12 species of small annual herbs limited to western North America, with by far the greatest concentration of taxa confined to California. *Nemacladus* is a rather well-defined genus of our western Lobeliaceae, distinguished in habit by its wiry or filiform, often diffusely branched stems, and its weakly to strongly zigzag branches.

The identification of species of *Nemacladus* is often difficult because in habit many bear a close similarity to each other and, moreover, vegetative characters are inconstant and generally do not offer reliable means for separating the taxa. The flowers possess a number of diagnostic characters, but they are so small that the important features are not readily recognized, particularly in dried specimens.

In the course of preparing a review of *Nemacladus* for a forthcoming account in Jepson's "A Flora of California", it has been necessary to realign certain taxa and to make some changes in the present nomenclature. In this evaluation of the genus, I have had the opportunity to study collections from the following herbaria: Jepson Herbarium, University of California, Berkeley (JEPS), University of California, Berkeley (UC), California Academy of Sciences (CAS), Dudley Herbarium, Stanford University (DS), Rancho Santa Ana Botanic Garden (RSA), California State Polytechnic College (OBI), and Pomona College (POM). I gratefully acknowledge the permission granted by the curators of these herbaria to study the collections in their care. The study of herbarium material has been supplemented with field observations of several taxa of *Nemacladus* and this has been particularly helpful in revealing a number of important corolla-characters which are seen to best advantage only in the living plant. Jepson's notes, accompanying many of his own collections of *Nemacladus*, have also been of help in providing information on floral structure. This study has been carried out under the direction of Dr. Rimo Bacigalupi, Curator of the Jepson Herbarium, to whom I am indebted for much valuable guidance and assistance.

1. THE STATUS OF NEMACLADUS GRACILIS EASTWOOD.

The type of *Nemacladus gracilis* was collected by Alice Eastwood in 1893 at Alcalde, western Fresno County, California, at the eastern base of the South Coast Ranges (holotype: CAS 772, studied). In her description (1903, p. 500), Miss Eastwood characterized *N. gracilis* as having flowers with a campanulate corolla, borne on capillary pedicels which exhibit a graceful double curve, and with a staminal-column which is white-hairy at the apex. These features characterize the type collection, but two additional collections cited by Eastwood, both from the interior of San Luis Obispo County in the South Coast Ranges, are believed to be referable to a species described herein as new. Munz (1924, p. 241) treated *N. gracilis* as a variety of *N. ramosissimus* Nutt., because both of these taxa possess

¹Contributions from the JEPSON HERBARIUM, No. 1.

campanulate corollas and have outwardly projecting terminal cells or rods on the staminal appendages. Munz referred to his concept of this variety not only plants from the South Coast Ranges but also plants from the Colorado and Mojave deserts, mostly from the mountains in and adjacent to the deserts. This disposition of *N. gracilis* was followed by Jepson (1925, p. 976). McVaugh (1939, p. 528) reinstated *N. gracilis* to specific rank, pointing out a number of features by which it could be distinguished from *N. ramosissimus*. McVaugh further noted that most of the specimens which were cited by Munz (*loc. cit.*, p. 242) as intermediate between *N. gracilis* and *N. ramosissimus* could be referred to *N. gracilis*. McVaugh's concept of *N. gracilis*, however, is essentially that employed by Munz, and includes plants from the Mojave and Colorado deserts, as well as from the South Coast Ranges. These desert plants, which also include most of the plants cited by Munz as intermediates with *N. ramosissimus*, are here assigned to a second undescribed species.

It seems, therefore, that the varied assemblage of plants, heretofore assigned to *N. gracilis*, can be treated more logically as comprising three separate species. These three species display differences in habit, morphology, and geographic range which seem to justify their taxonomic recognition. However, they do resemble each other closely in their floral structure and it is conceivable that further studies might call for their recognition as varieties of a single variable species.

The formal descriptions of the three species follow, with some further discussion of their similarities and differences:

NEMACLADUS GRACILIS Eastwood, Bull. Torrey Club 30: 500. 1903.

N. ramosissimus var. *gracilis* Munz, Am. Jour. Bot. 11: 240. 1924, in small part, as to plants of the inner South Coast Ranges and the San Joaquin Valley; Jepson, Man. Fl. Pl. Calif. 976. 1925, also in part.

Plants 2.5-10 cm. high; stems either solitary, simple or dichotomously branching about 6-12 mm. above base, or stems 2 to 4 from the base in larger plants, spreading-ascending, the lower portions dull reddish-brown, glabrous or sparingly puberulent; flowering branches simple, rarely branching, slender, nearly straight or weakly zigzag in older plants; basal leaves narrowly oblanceolate or somewhat spatulate, 5-8 mm. long, narrowed to a broad petiolar base, irregularly crenulate-dentate or sometimes subpinnatifid; pedicels finely capillary, weakly to strongly sigmoid, often somewhat recurved, abruptly upturned at tip so that flower is erect or nearly so; floral bracts oblong-linear, 2-4 mm. long, more or less conduplicate, slightly or not at all enfolding base of pedicel, often spreading or sometimes recurved from base of pedicel, acute to subacute; calyx-tube turbinate-campanulate in anthesis, becoming broadly campanulate as capsule develops, the lobes somewhat pungently acute, equalling to slightly longer than tube; corolla campanulate, or somewhat turbinate-campanulate, the tube short, included within or barely surpassing the calyx, white, lavender-veined, the lobes often lavender-tinged, sparingly ciliate, the inner surfaces hispidulous near the base; filament-column curved at tip, with a small tuft of moniliform hairs just below anthers; anthers oblong or narrowly oblong-elliptic, about $\frac{1}{3}$ mm. long; staminal appendages 2, each with a few vitreous rods digitately spreading anteriorly from near the base of the filaments; capsule about half inferior, shorter than or subequalling the calyx, acute; seeds broadly ellipsoid, alveolate-reticulate.

Habitat and range.—Rocky, gravelly slopes or sandy washes. Inner South Coast Ranges of California from Merced County south to Kern County and in the low foothills of the Tehachapi Mountains in Kern County.

Specimens to verify range.—CALIFORNIA. Merced County: Arburuas Ranch (2 mi. w.),

Hoover 4369 (UC); Ortigalita Peak (1 mi. ne.), Lyon 1554 (UC). San Benito County: New Idria (17.6 mi. n.), Raven 9227 (JEPS). San Luis Obispo County: Shandon (8.6 mi. s.), San Juan River Valley, Twisselmann 2000 (CAS). Kern County: Sunset, Heller 7729 (UC, DS); Caliente, T. S. Brandegee (UC); "Rock-pile region" [near mouth of Caliente Creek], Davy 1864 (UC).

My opportunity to study fresh material of this rarely collected species has been limited to a single collection, in partly dried and pressed condition, made by Mr. Peter H. Raven (his no. 9227, cited above). Observations on this collection, along with some information gathered from a few herbarium sheets, indicate that *N. gracilis* has certain floral characters which relate it to the two species described below. Further, these floral characters, in combination, serve to distinguish these three species from other taxa of *Nemacladus*. These floral features are: (1) a short, campanulate corolla, with a tube about one-third to one-half its length that equals or slightly exceeds the calyx; (2) concolorous corollas, without well-defined color markings, but which are often yellowish- or pinkish-tinted or -veined; (3) corolla-lobes more or less hispidulous on the inner surfaces near the base and the margins sparingly ciliate; and (4) a tuft of moniliform hairs on the filament-tube just below the anther-whorl. It would be of special interest to know if *N. gracilis* also shares an additional feature of corolla-form which has been observed in living specimens of the other two species, but which could not be determined from the herbarium material of *N. gracilis*. In these other species, the two upper corolla-lobes spread quite widely, leaving a gap on the upper side of the corolla, and assume a position subparallel to the plane of the adjacent lobes of the lower lip. Another feature of special interest concerns the nature of the vitreous rods on the staminal appendages. In the two species described below, the rods are digitately spreading from near the base of the filaments and their apices are narrowly acuminate. However, in Raven 9227, (*N. gracilis*, sensu stricto), the rods, although digitately spreading, have obtuse or truncate tips. It has not been possible to determine from the herbarium material whether or not this sort of rod is a constant feature of *N. gracilis*. The position and form of the rods, however, does appear to be a consistent and diagnostic feature in other taxa of *Nemacladus*.

As noted before, McVaugh (*loc. cit.*, p. 528), in raising *N. gracilis* to specific rank, pointed out a number of features by which it could be separated from *N. ramosissimus*, which, although a species principally of the mountains of Southern California, does extend northward in the inner South Coast Ranges in more limited occurrence to the Mt. Hamilton Range. Most of the features used by McVaugh to separate *N. ramosissimus* apply as well to our more restricted concept of *N. gracilis*, but it also seems that the two taxa are sufficiently distinct from one another to be recognized as separate species. The accompanying tabular summary (Table 1) emphasizes those features that serve to distinguish the two species.

Table 1. Characters Distinguishing *Nemacladus gracilis* from *N. ramosissimus*.

Character	<i>N. ramosissimus</i>	<i>N. gracilis</i>
Habit	Stems with few to several branches, often diffuse and bushy.	Stems simple or sparingly branched.
Stems	Straight, somewhat lax at tip.	Weakly zigzag, somewhat lax at tip.
Racemes	Strongly secund.	Distichous.
Pedicels	Lax, divaricate, not	Commonly with a well-

	consistently and symmetrically curved.	defined symmetrical double curve.
Corolla-pubescence	Glabrous, except for a small tuft of simple hairs on filament-tube.	More or less hirsutulous on the surface and margin of corolla-lobes; also with a small tuft of moniliform hairs on filament-tube.
Calyx-lobes	Oblong and obtuse.	Oblong-lanceolate and acute.
Seeds	Globular or nearly so.	Ellipsoid.

***Nemacladus secundiflorus* sp. nov.**

(Fig. 1)

Planta annua; ramis floriferis simplicibus vel interdum ramosis; racemis saepe vere secundis vel irregulariter distichis; foliis basalibus anguste oblanceolatis vel aliquanto spatulatis, basi lata petiolom simulanti angustatis, irregulariter crenulato-dentatis vel subpinnatifidis; pedicellis recte patentibus vel interdum demum leviter sigmoideis; corollae tubo calyce 1.5-2 plo. longiore; antheris elliptico-oblongis, circa 0.5 mm. longis.

Plants 2.5-12.5 cm. high; stems solitary, simple or dichotomously branching 6-25 mm. above base, or stems 2 to 6 (or 8) from base in larger plants, spreading-ascending, the lower portions dull reddish-brown, glabrous or sparingly puberulent; flowering branches simple or sparingly branched, slender, nearly straight or weakly zigzag in older plants, the racemes often strongly secund or irregularly distichous; basal leaves narrowly oblanceolate or somewhat spatulate, 3-6 mm. long, narrowed to a broad petiolar base, irregularly crenulate-dentate to subpinnatifid; pedicels capillary, stiffly or laxly spreading at right angles to the branches, or sometimes slightly sigmoid in older plants, abruptly upturned at apex so that flower stands erect; floral bracts ovate-lanceolate or oblong-lanceolate, acute or subacute, 2-3 mm. long, conduplicate, partially enfolding base of pedicel; calyx-tube campanulate, broadly so or nearly hemispheric as capsule matures, the lobes acute or sub-acute; corolla campanulate, or the tube often cylindric-funneliform and often 1½ to 2 times as long as calyx, the two upper lobes widely spreading and concolorous, the 3 lower lobes each with a yellow blotch at base just at mouth of tube, all the lobes hispidulous on their inner surfaces, except at tips, outer surfaces of tube and lobes sparingly hispidulous, lavender or pinkish-tinted and -veined; filament-column curved near tip, with a tuft of relatively long, moniliform hairs just below anthers; anthers elliptic-oblong, about 0.5 mm. long; staminal appendages 2, situated anteriorly near the base of the filaments, each with approximately 12 to 15 radially spreading, narrowly acuminate, vitreous rods; capsule about one-third inferior, rounded-acute, equalling or slightly exceeding calyx at maturity; seeds subglobose or broadly ellipsoid, alveolate-reticulate.

Type.—CALIFORNIA, San Luis Obispo County, East Fork of Huerhuero Creek, 3 miles north of Creston, elevation 1000 feet, *R. Bacigalupi & G. T. Robbins* 4504 (type, JEPS; isotypes to be distributed).

Habitat and range.—Dry, sandy or gravelly sites, 1000 to 5800 feet. South Coast Ranges in Monterey, San Benito, and San Luis Obispo counties; Greenhorn Mountains in Kern County.

Specimens to verify range.—CALIFORNIA. Monterey County: between Jolon and "The Indians", *Eastwood & Howell* 2398 (CAS); Junipero Serra Peak (s. slope of summit ridge), *Howell* 30,544 (CAS). San Benito County: Bear Valley, at jct. of road to Pinnacles National Monument, *Raven* 9138 (JEPS). San Luis Obispo County: El Dorado School, Santa Margarita,

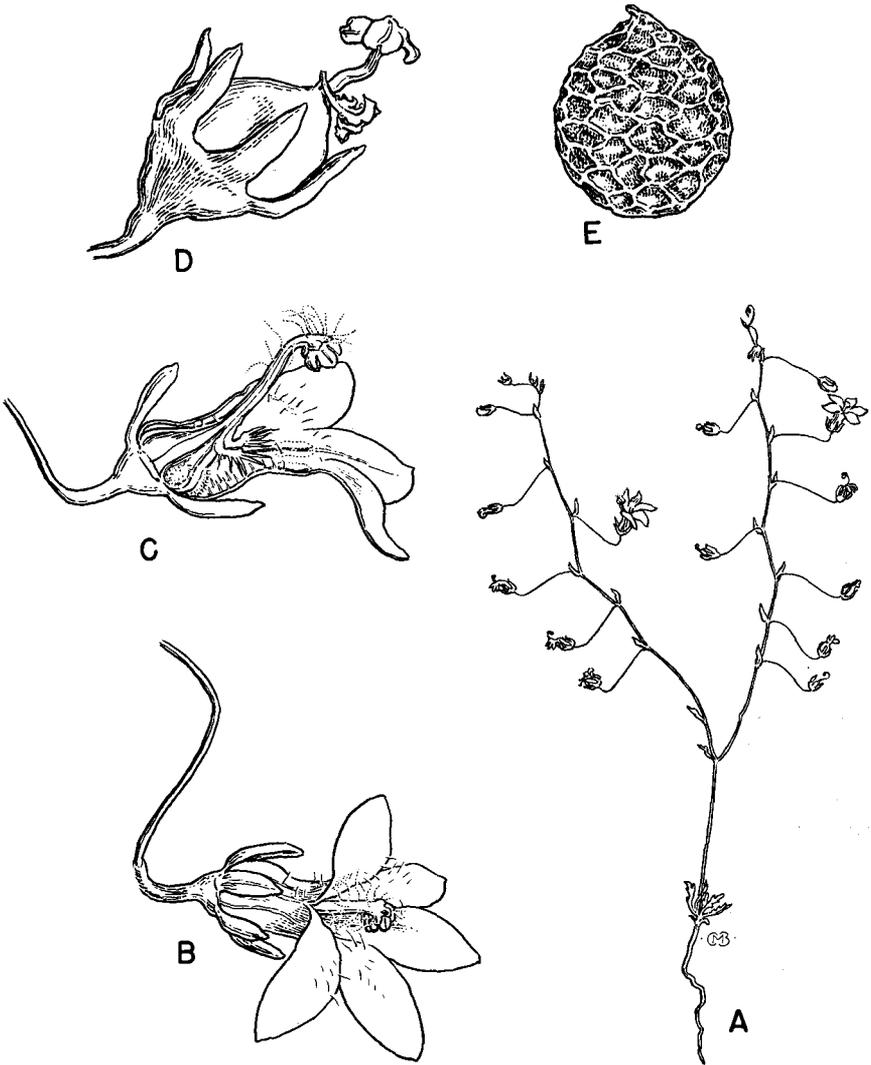


FIG. 1. *Nemacladus secundiflorus* G. T. Robbins, A, habit $\times 1$; B, lateral view of single flower, $\times 6\frac{1}{2}$; C, lateral view of sectioned flower showing filament-tube, the two staminal appendages with attached pointed rods, and one hirsutulous ovarian gland at base of flower, $\times 6\frac{1}{2}$; D, lateral view of mature calyx and capsule, $\times 6\frac{1}{2}$; E, seed, $\times 50$. From fresh material of type collection (*Bacigalupi & Robbins 4504*).

Wall (CAS); Dry Creek (4 mi. s. of Union), *Ferris* 9744 (UC, DS); Atascadero, *Mason* 3736 (UC); upper Arroyo Grande Creek (6 mi. above County Park), *Hoover* 6859 (OBI). Kern County: Greenhorn Mountain road (5 mi. above junction of road to Kernville), *Bacigalupi* 4538 (JEPS).

Nemacladus secundiflorus is distinguished by its relatively large corolla (up to 5 mm. long); its relatively long corolla-tube which often noticeably surpasses the calyx (for about a distance of 1 mm. or slightly more); its wide-spreading upper corolla-lobes; its relatively stout pedicels that commonly spread at right angles to the branches (although in older plants they may display more or less of a sigmoid curve); its often strongly secund racemes; and its large anthers. The collections cited from San Benito County (e.g. *Raven* 9138) as well as *Bacigalupi* 5649 (JEPS) from the same station, differ somewhat from the San Luis Obispo County material in having smaller corollas, less exerted corolla-tubes, smaller anthers, irregularly distichous rather than truly secund racemes, and weakly sigmoid pedicels. In other floral details, however, and in outline of the basal leaves, these specimens show no significant variations that would separate them from *N. secundiflorus*. Collections from the Greenhorn Mountains in Kern County (*C. N. Smith* 411 (JEPS) and *Bacigalupi* 4538) are assigned to *N. secundiflorus* on the basis of their large flowers and anthers and the outline of their basal leaves. However, these specimens show considerable variation in the degree of pedicel arching, and secund racemes are evident only on an occasional branch.

The following species, of wider distribution than either *N. gracilis* or *N. secundiflorus*, includes those desert and desert border plants to which the name *N. gracilis* has often been applied:

Nemacladus sigmoideus sp. nov.

Planta annua; ramis floriferis simplicibus vel saepe apud plantas majores iterum atque iterum furcatis; racemis distichis ramosissimis; foliis basalibus ambiter variabilibus, aut rhomboideo-ovatis petiolo brevi abrupte angustatis aut ovatis vel ellipticis petiolis latis ad basem versus attenuatis, margine integris vel interdum crenulatis saepe dentatis; pedicellis plus minusve saepe vel vere sigmoideis, demum saepe reflexis; corollae tubo calyce brevior vel calycem leviter excedente; antheris quadrato-oblongis, circa 0.25 mm. longis.

Plants 5-15 (or 20) cm high; stems solitary, simple or dichotomously branched about 6-25 mm. above base, or stems 2 to 6 from base in larger plants, spreading-ascending, the lower portions dull reddish-brown, glabrous or sparingly puberulent; flowering branches slender, nearly straight to weakly zigzag in older plants, simple or in larger plants often several times forked and intricately branched; basal leaves 2-8 mm. long, variable in outline, either rhomboid-ovate and narrowed abruptly to a short petiole or ovate to elliptic with broad, but attenuate petioles, the margins entire or often crenulate to irregularly dentate; pedicels slightly to strongly sigmoid, sometimes reflexing at maturity, abruptly upturned at tip so that flower is borne erect or nearly so; floral-bracts ovate-lanceolate or oblong-lanceolate, 1-2 mm. long, conduplicate, usually enfolding and partially concealing base of pedicel, the tips often with a minute callose mucro; calyx-tube campanulate to broadly so, or cup-shaped at maturity, the lobes acute or sub-acute; corolla campanulate, the two upper lobes widely spreading, the three lower lobes slightly longer, white with pale pinkish or yellowish-tinged tips and bases, corolla-tube included within or slightly exceeding calyx, sparsely hirsutulous or glabrous at mouth; filament-tube abruptly curved near tip with a few long, moniliform hairs just below anthers; anthers quadrate-oblong,

about 1/4 mm. long; staminal appendages 2, situated anteriorly near the base of the filaments, each with a few digitately spreading, narrowly acuminate, vitreous rods; capsule about half inferior, rounded, short-acute at summit, about equalling calyx at maturity; seeds broadly ellipsoid, alveolate-reticulate.

Type.—CALIFORNIA, Los Angeles County, slopes of South Fork of Little Rock Creek Canyon at an elevation of 5100 feet, San Gabriel Mountains, *R. Bacigalupi* & *G. T. Robbins* 4190 (type, JEPS; isotypes to be distributed).

Habitat and range.—Sandy washes and flats or gravelly slopes, 1500 to 7000 feet; chiefly in the Mojave Desert and on desert slopes of the bordering mountains; less frequent on the western borders of the Colorado Desert; Tehachapi Mountains and Mt. Pinos region; east to western Nevada and Arizona; south to Lower California.

Specimens to verify range.—LOWER CALIFORNIA. La Grulla, *Orcutt* in 1886 (UC). ARIZONA. Mohave County: Yucca (7 mi. se.), *Gould & Darrow* 4312 (UC). NEVADA. Clark County: Las Vegas, *Gooding* (UC). CALIFORNIA. San Diego County: Jacumba (6 mi. e.), *Munz* 8078a (POM); Banner (2 mi. e.), *Keck & McCully* 83 (POM). Riverside County: Cottonwood Spring, Eagle Mountains, *Jepson* 12,601a (JEPS); Chalk Hill, San Jacinto Mountains, *Hall* 2046 (UC); Dry Morongo Creek, Morongo Valley, *Alexander & Kellogg* 2076 (UC). San Bernardino County: Warrens Well (3 mi. e.), Little San Bernardino Mountains, *Munz & Johnston* 5191 (POM); Bear Valley, San Bernardino Mountains, *Munz* 10,552 (POM); Cajon Pass, *Bacigalupi* 5722 (JEPS); Barstow, *Jepson* 5822b (JEPS); Stoddard Well, *Jepson* 5915 (JEPS); Excelsior Talc Mine (4 mi. s.), Kingston Mountains, *Wolf* 10,383 (RSA); Kelso (5 1/2 mi. ne.), *Jepson* 20,573 (JEPS); Willow Springs Canyon, Old Dad Mountains, *Jepson* 20,509 (JEPS). Los Angeles County: Lancaster (4 mi. e.), *Peirson* 7265 (POM, RSA). Kern County: Tehachapi Pass, Tehachapi Mountains, *Benson* 3500 (POM); Ricardo (9 mi. n.), *Munz* 12,463 (UC); Walker Pass (one-half mi. e.), *Munz* 13,362 (RSA); Walker Basin, *Bacigalupi* 4528 (JEPS). Ventura County: Seymour Creek, Mt. Pinos area, *Hall* 6415 (UC). Inyo County: Little Lake, *Hall & Chandler* 7362 (UC); Lone Pine Creek, *Hall & Chandler* 7212 (UC); Independence (5 mi. w.), *Kerr* 610 (RSA); Bishop (foothills w. of), *Heller* 8278 (UC); Teufel Canyon, southern Inyo Mountains, *Jaeger* (POM); Pahrump Valley (w. side), *Wolf* 10,610 (RSA). Mono County: Benton Station, *M. E. Jones* (POM).

Nemacladus sigmoideus differs from both *N. gracilis* and *N. secundiflorus* in having a somewhat more robust habit with more numerous, sometimes intricately developed branches and in its broader, often entire-margined basal leaves. From *N. gracilis* it differs in having slightly larger corollas (1 to 2 mm. longer), pointed rods on the staminal appendages, and smaller anthers. From *N. secundiflorus* it differs usually in having distichous rather than secund racemes, a smaller corolla with a shorter, scarcely exerted corolla-tube, and smaller anthers. Some collections of *N. sigmoideus* from stations along the western border of the Mojave Desert (e.g. *Munz* 12,463 (UC), from Ricardo, Kern County) have somewhat larger corollas and anthers than usual. Sometimes specimens display rather stiffly ascending, non-sigmoid pedicels, but this condition seems to be associated mostly with plants in early flowering stages.

In summary, the following key will serve to distinguish these three species:

- Basal leaves rhombic-ovate, or ovate to elliptic, entire or irregularly crenate-dentate; flowering branches in large plants often repeatedly and intricately branched; pedicels mostly finely capillary, commonly forming a double curve; chiefly Mojave and Colorado deserts or bordering ranges. *N. sigmoideus*
- Basal leaves narrower (oblong-oblancoelate or somewhat spatulate), irregularly crenulate-dentate to subpinnatifid; flowering branches simple or sparingly branched; inner South Coast Ranges.
 - Racemes distichous; corolla-tube included within or barely surpassing calyx; pedicels finely capillary, commonly forming a double curve. *N. gracilis*
 - Racemes often strongly secund; corolla-tube equalling to twice as long as calyx; pedicels slightly stouter, commonly straight, becoming somewhat sigmoid with age. *N. secundiflorus*

2. THE STATUS OF NEMACLADUS RIGIDUS VAR. INTERIOR MUNZ

In his revision of *Nemacladus*, Munz (1924) recognized a number of California taxa as varieties of *N. rigidus* Curran. He characterized *N. rigidus* and its several varieties as having flowers with petals almost separate to the base and with staminal appendages bearing pendent terminal cells or rods. Munz employed the varietal epithet *interior* for plants from the western slope of the Sierra Nevada which display this combination of nearly separate petals and pendent rods. McVaugh (1939) re-assigned Munz's *N. rigidus* var. *interior* to varietal rank under *N. rubescens* Greene, a species which it superficially resembles in habit and in its relatively large, deeply divided corollas with large anthers and conspicuously exerted filament-tubes. As will be discussed below, there seems to be adequate justification, on morphological as well as geographical grounds, for separating the variety *interior* from both *N. rigidus* and *N. rubescens*. Consequently, I assign this variety to specific rank:

Nemacladus interior (Munz) comb. nov.

Based on *N. rigidus* var. *interior* Munz, Am. Jour. Bot. 11: 243. 1924; type locality: North Fork, Madera County, California, *Peckinpab* (type at POM not seen; isotypes at UC and CAS studied). *N. rubescens* var. *interior* McVaugh, Am. Midl. Nat. 22: 537. 1939.

The following features serve to distinguish *N. interior* from *N. rigidus*:

<i>N. rigidus</i>	<i>N. interior</i>
Stems spreading-decumbent, 1.2-10 cm. high; flowering to base of plant or nearly so.	Stems spreading-ascending, often stiffly ascending in well-developed plants, 5-30 cm. high; flowering branches arising about 1.2-5 cm. above base of plant.
Calyx-tube short-campanulate in anthesis, noticeably enlarged and hemispheric in fruit.	Calyx-tube turbinate in anthesis, slightly enlarged and turbinate-campanulate in fruit.
Corolla about 1 mm. long, shorter than or barely exceeding calyx.	Corolla 3-4 mm. long, clearly surpassing calyx.

There may be additional differences in the color markings of the corolla lobes of these two species, but I have not had the opportunity to see fresh material of *N. rigidus*. In the dried material of *N. rigidus*, the lobes appear to show a uniform pinkish or purplish cast, while in *N. interior*, the lobes are usually white with pink or rose-purple tips, and in addition show distinctive color markings on 3 of the lobes, a feature which serves to separate it from *N. rubescens* (see below).

The following features serve to distinguish *N. interior* from *N. rubescens* (including var. *tenuis* McVaugh):

<i>N. rubescens</i>	<i>N. interior</i>
Well-developed plants with rather diffuse and spreading branches.	Well-developed plants with more or less stiffly ascending branches.
Stems dull or somewhat lustrous brownish or purplish below.	Stems lustrous below, with a silvery-gray sheen.
Basal leaves dark green to brownish or purplish when dry; entire (or pinnatifid in var. <i>tenuis</i>).	Basal leaves yellowish-green to yellow or straw-colored when dry; usually crenulate-denticulate, sometimes entire.
Calyx-tube similar to <i>N. rigidus</i> (see above).	(Calyx-tube as previously described).

Corolla-lobes white with burnt-umber or brownish-purple tips; the 3 lower lobes ciliate.

Seed surface with several sinuous longitudinal ridges and relatively shallow grooves between.

Corolla-lobes white with pink or rose-purple tips; none of the lobes ciliate; the 3 *upper* lobes each with a yellow spot at base and 2 dark rose-purple spots just distal to these.

Seed surface with several longitudinal rows of minute pits, separated by irregularly angulate longitudinal ridges.

In addition to these features of habit and morphology, the three species have distinct geographic ranges. *N. rigidus* occurs at the western edge of the Great Basin and has a range extending along the eastern borders of California from Mono County north to southwestern Idaho. *N. rubescens* (and its var. *tenuis*) is a plant of the Mojave and Colorado deserts, ranging eastward to southern Nevada and western Arizona. *N. interior*, as mentioned before, is confined to the west slope of the Sierra Nevada, and ranges from Kern County north to Plumas County, California.

The only other species of *Nemacladus* known to occur in the Sierra Nevada is *N. capillaris* Greene, with which *N. interior* might be confused because of the more or less turbinate calyces common to the two species. In *N. capillaris*, however, the calyces are usually more narrowly turbinate and somewhat attenuate at the base, the pedicels are finely capillary and more lax, the flowers are considerably smaller (many barely exceeding the calyx), and the anthers are only about one-half as large.

I have seen no specimens that could be considered intermediate between *N. capillaris* and *N. interior*, although Munz (*loc. cit.* p. 244-245) cites some intermediate specimens. McVaugh (*loc. cit.* p. 538) has cited a specimen collected at Kane Springs, Ord Mts., San Bernardino County, California, as having the habit of *N. rubescens*, combined with the stem color, pedicels, and leaves of his var. *interior*. This specimen (*Hall & Chandler* 6819; UC) seems to be only an aberrant example of *N. rubescens*. The stem lacks the silvery-gray sheen usual in *N. rubescens* and is pale reddish-brown. The single basal leaf preserved is not very diagnostic and could well be within the range of variation in color or outline of the leaves of *N. rubescens*. The specimen lacks mature seeds, but the lower corolla-lobes are ciliate and the maturing calyx conforms to a hemispheric outline, features which are distinctive of *N. rubescens*. I have seen no specimens intermediate between these two species, and since they occupy distinct geographic ranges, it seems unlikely that there is intergradation between them.

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