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SHORT COMMUNICATIONS

THE STATUS OF *ENALLAGMA CYATHIGERUM* (CHARP.) AND *E. VERNALE* GLOYD IN SOUTH-CENTRAL NEW YORK (ZYGOPTERA: COENAGRIONIDAE)

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In south-central New York *E. cyathigerum* is found in bogs and highly vegetated ponds. The sibling taxon *E. vernale* occurs typically in vegetated streams and small rivers, and has been found in a lightly vegetated pond. Populations of *E. cyathigerum* are variable in a manner suggesting incomplete genetic separation, and *vernale* cannot be considered more than an ecological and partly geographic subspecies of *cyathigerum*.

INTRODUCTION

The damselfly *Enallagma cyathigerum* is one of the most widely distributed Holarctic odonates, occurring in Northern Asia, Europe, and in North America except for the southeast and south-central states. I have examined numerous specimens from Germany, England, California, British Columbia, Arizona, New Mexico, Colorado, Wyoming, Montana, Michigan, Pennsylvania, Massachusetts, New Hampshire, New Brunswick, and New York. Geographical variations in the form of the male superior appendage are evident and have been commented on already (JURZITZA, 1975). In New York (and to a lesser extent in Pennsylvania, Massachusetts, and New Hampshire) these variations tend towards the distinctive *vernale* type and form the basis of this brief study.

GARRISON (1984) has described *E. cyathigerum* from the western United States. He notes a variation in the male mesostigmal laminae that are not related to the variations in terminal appendages reported here from eastern populations. My own observations suggest that eastern specimens of *cyathigerum* have variable laminae; in some cases differences might result from twisting of part of this structure, possibly post mortem. JURZITZA (1975) commented that some

cyathigerum from California might be attributable to another taxon, but Garrison, noting local variability, stated that he did "not believe that populations from California should be named".

Enallagma vernale was described by GLOYD (1943) from specimens from southeastern Michigan. Her description compares it with *boreale, hageni,* and *cyathigerum,* but does not clearly link it most closely to the latter species. Subsequently WALKER (1953) extended its range to Saskatchewan on the west to Ontario and Quebec on the east. I have examined specimens from central New York, and limited material from Ontario, Quebec, and New Hampshire (the last determined by L.K. Gloyd). Jurzitza also reported it from West Virginia.

There is a long history of observation of the two forms in Quebec, with WALKER (1953) first noting the occurrence of the species in this province. ROBERT (1963) noted that specimens from La Ferme he had called *cyathigerum* in an earlier (1944) paper were *vernale,* and in fact this species was widespread in Quebec. He states, "Dans les microhabitats ou les deux espèces se rencontrent, les individus intermédiaires, avec fossette plus ou moins accusée et bordure incomplètement tracée, sont nombreux. Peut-être, est-ce là l'indice que nous sommes en présence d'une espéce plus variable que d'ordinaire, et qu'en définitive les formes extrêmes actuellement décrites sous les noms de *E.cyathigerum* et *E. vernale* ne seraient que les extrêmes de la variation d'une même entité". Pilon and co-workers have noted the two forms in numerous places in Quebec, and have emphasized the variability of the forms. Thus, FERNET & PILON (1969) found only *cyathigerum* in the Gaspé Peninsula, emphasizing its variation towards *vernale.* FERNET & PILON (1969) reported only *vernale* in the Saguenay area. PILON (1980) reported only *cyathigerum* around St. Thérése. PILON & SYLVESTRE (1984) reported both species in the eastern townships of Quebec, and, interestingly, found them approximately equally distributed among diverse habitats.

LOCALITIES OF MATERIAL STUDIED

Enallagma cyathigerum: New York: Broome Co., Binghamton, pond at SUNY; Hawkins Pond, town of Windsor; — Cortland Co., bog near Landers Corners; — Chenango Co., Jam Pond near McDonough. — Pennsylvania: Monroe Co., Tobyhanna; — Centre Co., Scotia (H. White). — Massachusetts: Worcester Co., Petersham. — New Hampshire: Grafton Co., Kankamangos Highway (F. Carle). — New Brunswick: Westmorland Co., Fundy N.P. — [Western and central United States]: California: San Diego, Los Angeles, San Mateo, Napa (H. White), Yolo (H. White), Ventura Cos. — Montana: Flathead, Granite Cos. — Wyoming: Carbon Co. — Colorado: Park Co. — New Mexico: Valencia Co. — Arizona: Gila Co. (O.S. Flint, Jr). — Michigan: Benzonia and Otsego Cos.

Enallagma vernale: New York: Broome Co., Marsh Pond; — Madison Co., Sangerfield R. near Hubbardsville; — Cortland Co., Tioughnioga R. near Preble. — Ontario: Madoc (R. Gibbs). — Quebec: La Ferme (A. Robert). — New Hampshire: Hillsborough Co., Wilton (H. White, det. L.K. Gloyd).

All specimens were collected by T. Donnelly, except as noted.

MORPHOLOGICAL DISTINCTION BETWEEN THE TWO TAXA

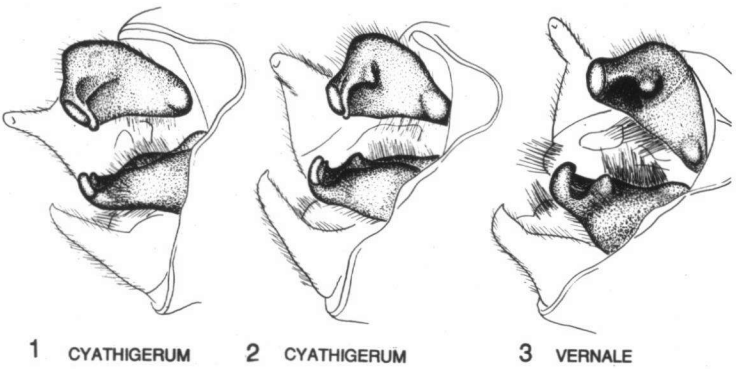
The distinction between males of the two taxa lies totally in the form of the superior appendage of the male. Both Gloyd and Walker state that there is sufficient variation in the color pattern to obviate a distinction based on this character, and my observations agree. The accompanying figures show three male specimens from south-central New York. The first and last are considered typical examples of eastern *cyathigerum* and *vernale;* the middle is a variant of *cyathigerum* that shows a strong tendency towards the *vernale* morphology. The male superior appendage in the two taxa consists of a major and minor part. The major part is a broad, dorso-ventrally flattened, apically widened appendage, and the minor part is a small, distinct, apical tubercle of paler color ("Lappen" of Jurzitza). The major part terminates apically in a rounded, mesally curved, widened and pointed tip that lies wholly proximal to the tubercle ("Zahn" of Jurzitza). In European specimens this widened part is broader and more conspicuous than for western U.S. specimens.

In *vernale* the apical tubercle is larger than that of *cyathigerum.* The apical tooth in my specimens is smaller than that of *cyathigerum,* and there is in addition a curved, thickened, and polished ridge that extends proximally from the tooth, expanding into a rounded, mesally leaning sub-central tubercle about 0.05 mm wide. The ridge borders a distinct subapical, mesal fossa.

MORPHOLOGY OF NEW YORK SPECIMENS

I have examined 25 males of *vernale* from three localities in south-central New York. These show little variation in the form of the male superior appendage, but 6 have tubercles distinctly smaller than for the remainder. A longer (60) series of *cyathigerum* males from the same general area shows far more variation, with at least two specimens having the apical tubercle overlapping the size range of *vernale.* New York specimens attributed to *cyathigerum* almost invariably show a small subsidiary curved ridge proximal to the apical tooth of *vernale.* About 3/4 of the specimens show at least a very small sub-central spine or tubercle (0.01-0.03 mm) at approximately the location of the larger sub-central tubercle of *vernale.* The fossa is variably developed but never as deep as that of typical *vernale.* At least 13 males lack any trace of a sub-central spine, but all show some trace of the thickened ridge. The bulk have what I would call a small or medium-sized spine at the location of the sub-tubercle of *vernale.* I have relatively few male specimens from Pennsylvania (4), New Hampshire (1), Massachusetts (2), and New Brunswick (7); almost all show some trace of the thickened ridge and many show a tiny spine, but none in my possession shows a prominent sub-central tubercle.

Specimens of *cyathigerum* from the western U.S., and from Europe, lack any trace of the subsidiary ridge, the central tubercle, or the subapical fossa. My 4



Figs 1-3- Tilted (dorso-lateral) view of male appendages of *Enallagma cyathigerum* (Figs 1, 2) and *vernale* (Fig. 3). Figure 1 (Cortland Co., Otselic Bog near Landers Corners) shows minimal development of the *vernale* morphology. Figure 2 (Chenango Co.; Jam Pond near McDonough) shows an intermediate morphology. Figure 3 (Cortland Co.; Tioughnioga R. near Preble) shows typical *vernale* morphology.

specimens of *cyathigerum* from northern and western Michigan show no traces of these structures.

I agree with Gloyd, Walker, and Jurzitza that there are two morphological types: the *cyathigerum* type that lacks any trace of the thickened subsidiary ridge and the sub-central tubercle or spine, or the subapical mesal fossa; and the *vernale* type that has these fully developed. In at least the local part of the range of *vernale,* many or perhaps most specimens of *cyathigerum* show some trace of the *vernale* morphology, trending to specimens which taken singly might be named *vernale.* However, I note that all local populations of *cyathigerum* show considerable variability between a close approximation of the European or western U.S. *cyathigerum* on the one hand and *vernale* on the other.

I have examined 11 females of *cyathigerum* and 16 of *vernale* from south-central New York. There appears to be no distinction between mesostigmal laminae of the two taxa, contrary to the conclusion of Gloyd. Walker describes a difference between the laminae of the two taxa, but I find considerable variation and doubt that further study will establish a difference. The major distinction between females of the two taxa based on my limited material is the dark mark on the dorsum of the 8th abdominal segment, as indicated by Walker. In 13 of my 16 females of *vernale* the dark mark does not or scarcely narrows proximally; the remaining 3 are narrowed but not pointed. In *cyathigerum* most of the 11 females have a stripe that tapers to a proximal point or thin line. A few specimens overlap in this character.

I have not examined larvae of the two taxa. WALKER (1953) found a distinction based on the caudal laminae. PILON & RIVARD (1979) demon-

strate a large variability in larvae of *vernale* but do not comment on the distinction between the two taxa. In a letter Dr J.-G. Pilon informed me that he has not reared *cyathigerum* for comparison.

HABITAT DISTINCTION BETWEEN THE TAXA

In south-central New York *cyathigerum* is found in bogs or highly vegetated small ponds. On the other hand *vernale* has been found in abundance only in two small rivers, and on one occasion on a pond with limited marginal vegetation. WALKER (1953) states, "*E. vernale* must be regarded as a lake rather than a pond species". PILON & RIVARD (1979) reported that *vernale* lived in an "étang de type dystrophe". However, PILON & SYLVESTRE (1984) found the two taxa in essentially the same proportions in a variety of aquatic habitats. In the western United States I have found *cyathigerum* at a wide variety of lentic habitats.

The habitat distinction between *cyathigerum* and *vernale* seems clear in south-central New York. While Walker does not address this point distinctly (he contrasted the habitats of *cyathigerum* and *boreale,* but failed to do so for *cyathigerum* and *vernale*), his habitat notes imply a difference in preferences between the species, with *vernale* a lake species and *cyathigerum* a pond species. It is interesting that Pilon and co-workers in Quebec have reported no difference in the habitat of the two taxa.

A possible resolution of the differences between the observations in New York and those in Quebec is that the difference of habitat preference varies throughout the range. An alternative explanation is that co-occurring *cyathigerum* and *vernale* in Quebec may all in reality be *cyathigerum* with a variable morphological tendency towards *vernale,* and that the true *vernale* has not been taken there. It is worth emphasizing that in the two localities in our area where *vernale* occurs abundantly, the specimens show very limited morphological variation.

In south-central New York the two taxa fly at virtually the same times. I have taken *cyathigerum* from 28 May to 3 July, and *vernale* from 6 to 26 June.

CONCLUSION

I concluded that in south-central New York the taxon *Enallagma vernale* is not genetically separated from *cyathigerum,* from which it was probably derived. In areas where the two forms occur, it has come to occupy certain habitats occupied by *cyathigerum* elsewhere and has subsequently displaced *cyathigerum* from these habitats. I further suggest that in the area of overlap between the two forms there exists a widespread exchange of genetic material. Thus the two taxa should be regarded as no more than subspecifically distinct. The synonymy of *vernale* is then as follows:

Enallagma cyathigerum vernale Gloyd 1943 new status
Enallagma vernale Gloyd, 1943, p. 1
Enallagma vernale Walker, 1953, p. 221
Enallagma vernale Jurzitza, 1975, p. 39

Although the new status is based on material from only a part of a large range (New York, West Virginia, New England and Quebec to Saskatchewan) for *vernale*, the intergradation in south-central New York is sufficient to demonstrate the incomplete genetic separation of the taxa. Further studies will be most desirable to further clarify the relationships between these taxa. In particular, it will be most interesting to study *cyathigerum* from elsewhere within the range of *vernale* to determine the extent of morphological variability of the former species. This study does not attempt to assess the status of other populations of *cyathigerum*, but does suggest that further studies of morphological variation might be most rewarding.

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