```
1621    IF ERL = 680 THEN RESUME 670
1622    IF ERL = 700 THEN RESUME 690
1640   IF ERL <> 1060 THEN 1670
1650    PRINT " ERROR OPENING OUTPUT FILE - TRY AGAIN"
1660    RESUME 1040
1670   PRINT " ERROR IN PROGRAM"
1680    PRINT " ERROR #";ERR;" OCCURRED AT LINE ";ERL
1690    RESUME 1700
1700 END
```


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Birch, L. C. 1948. The intrinsic rate of natural increase of an insect population. J. Anim. Ecol. 17: 15-26.

DELTA CAMPANIFORME RENDALLI (BINGHAM) AND *ZETA ARGILLACEUM* (LINNAEUS) ESTABLISHED IN SOUTHERN FLORIDA, AND COMMENTS ON GENERIC DISCRETION IN *EUMENES s. l.* (HYMENOPTERA: VESPIDAE: EUMENINAE)

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Abstract

Delta campaniforme rendalli (Bingham), an African wasp, and *Zeta argillaceum* (Linnaeus), a South American wasp, are established in southern Florida. These insects add two more genera to the North American fauna. The existing key to the North American genera is modified to include *Delta* and *Zeta*.

Resumen

La avispa africana *Delta campaniforme rendalli*, y la avispa sudamericana *Zeta argillaceum* (Linnaeus) están establecidas en el sur de la Florida. Estas añaden dos géneros a más de insectos a la fauna de Norteamérica. Se modificó la clave de los géneros de Norteamérica para incluir a *Delta* y a *Zeta*.

Two exotic species of potter wasps are now established in southern Florida. *Delta campaniforme rendalli* is an immigrant from Africa and *Zeta argillaceum* comes from South America. Like the related genus *Eumenes* Latreille, species of *Delta* Saussure and *Zeta* Saussure make nests of mud that are often affixed to substrates easily transported by man. Thus it is not surprising that *D. c. rendalli* and *Z. argillaceum* were accidently introduced to Florida, where both have become established in the region around Miami and Fort Lauderdale. Unlike most North American species of the native genus *Eumenes* that are black and yellow, the two introduced wasps are largely reddish brown and black. However, one of the two Floridian *Eumenes*, *smithii* Saussure, is similarly colored. The steplike apical margin of tergum II, a generic feature of *Eumenes*, distinguishes *E. smithii* from *D. c. rendalli* and *Z. argillaceum*, both of which have simple terga. The key to genera presented below will identify the two introduced wasps.

Voucher material of the two species is in the Florida State Collection of Arthropods in Gainesville, and the National Museum of Natural History, Washington DC. We would like to thank Jim Carpenter, Museum of Comparative Zoology, Harvard University, Cambridge, Mass. and Frank Parker, Bee Biology and Systematics Lab., USDA, Utah State Univ., Logan, Utah for their comments on this paper.

Delta campaniforme rendalli (Bingham)

This wasp was described from Nyasaland, now Malawi, by Bingham (1902), and the species was later recorded from Zaire and Zimbabwe by Bequaert (1926). Carpenter (in litt.) says that there is a specimen from Mozambique in the Museum of Comparative Zoology. *D. c. rendalli* was apparently first collected in Broward County in December, 1981, a few miles southwest of Fort Lauderdale at Davie (1 female), and also at Fort Lauderdale (3 males). These, as well as subsequent material, were collected by J. A. Reinert. The following year three additional males and one female were collected at Fort Lauderdale (January), and three more males and one female were taken at Davie (September) visiting flowering *Borreria verticillata* (L.) G. F. W. Meyer (= *Spermacoce verticillata* for a total of 12 specimens.

This material compares well with specimens of *Delta campaniforme rendalli* in the USNM from Zaire that were determined by J. Bequaert, and also runs to *rendalli* in Bequaert's key (1926) to the African species of *Eumenes* s. l. In most of the Florida males the pronotal dorsum is reddish brown except for black posterolaterally and traces of yellow along the transverse carina. In one male the reddish brown is replaced by yellow. The four Zaire males studied (USNM) display both patterns.

Bequaert (1926) treated *rendalli* as a subspecies of the widely distributed Old World species *campaniforme* (Fabricius). Some subspecies of this wasp have been elevated to species status in recent years, and *rendalli* may warrant the same treatment. In his brief report on this wasp, Freeman (1984) treated *rendalli* (misspelled *randalli*) as a species without comment, but as far as we can determine, no one has formally elevated *rendalli* to species. Both Giordani Soika (in litt.) and Carpenter (in litt.) have expressed the opinion that *rendalli* should be treated as a species, but lacking evidence for this we have followed a conservative interpretation of the taxon.

Bingham described both sexes of *rendalli*, but Bequaert (1926) indicated that the male and female syntypes were not conspecific. He restricted the name to the female syntype, and later (1928) effectively selected it (according to the provisions of Article 74 (a) of the current Code) as the lectotype.

Interestingly, *Delta c. rendalli* is also established on the West Indian island of Jamaica (Freeman, 1984) where it was first captured in 1979. Freeman included a

photograph of the mud nest that was attached to the wall of a building. The abandoned nest was apparently taken over by a species of *Pachodynerus*.

Zeta argillaceum (Linneaus)

This is a widespread, common neotropical potter wasp (Mexico to Argentina—see Soika, 1975), but apparently it does not occur in the West Indies except on Trinidad. We have seen 21 specimens that were collected in Dade Co. over a period of 10 years. The earliest example was taken in July, 1975 at Miami. By 1980 the wasp had been collected at Miami Springs and Hialeah, and by 1981 had reached Fort Lauderdale. In 1983 Stange and Woodruff found a single celled nest of *argillaceum* attached to the underside of a foam pad on the ground at Hialeah, indicating that the species was established and reproducing.

Soika (1975), in his review of the genus *Zeta*, recognized 10 subspecies of *argillaceum*. The Florida population belongs to the typical subspecies which occurs in the Guianas and Brasil.

The biology of *argillaceum* was discussed by Taffe (1979) under the name *canaliculatum*. He estimated that in Trinidad this wasp had 6 generations per year, each lasting about 60 days. Taffe stated that *argillaceum*'s biology was similar to the related *Z. abdominale* (Drury) whose life history has been discussed in a number of papers (Freeman and Taffe, 1974, Taffe and Ittyeipe, 1976, and Taffe, 1978, 1979, 1983—the name *Eumenes colona* was used in the earlier papers). These authors studied *abdominale* in Jamaica. The mud nests are built on sunlit substrates sheltered from rainfall, and are usually 1.5 m from the ground. The nests contained 1 to 22 cells, but single celled nests predominated. Various lepidopterous caterpillars were provisioned, especially geometrid loopers. Four to 14 prey were provisioned per cell depending on caterpillar size. Provisioning of a cell takes 2 to 3 days. The egg is suspended from a filament attached to the rear of the cell. Development from egg to adult takes 5 to 6 weeks. *Zea abdominale* and *Z. argillaceum* are attacked by eulophid wasps of the genus *Melittobia* Westwood, and miltogrammine flies of the genus *Amobia* Robineau-Desvoidy. Mud nests of *abdominale* may persist for 5 years and they are utilized by a variety of inquilines: *Pachodynerus nasidens* (Latreille), *P. jamaicensis* Bequaert, *Monobia mochii* Soika (all Eumeninae), *Megachile concinna* Smith (Megachilidae), and *Trypoxylon texense* Saussure (Sphecidae).

Zeta argillaceum may be established in Tahiti also. There is a single male in the National Museum of Natural History collected by Jack Clarke at the Fautaua River, Oct. 17, 1961, in Tahiti.

These introductions add two more genera to the eumenine fauna of North America: *Delta* and *Zeta*[1], both names attributable to Saussure (1855). For complete generic citations and synonyms of these two genera see Carpenter (in press). Both genera run to the genus *Minixi* Soika in the recent key to the North American genera of Eumeninae by Carpenter and Cumming (1985). We have emended their key to include *Delta* and *Zeta*. The characters employed here for *Delta* may not work for all other species of this genus.

3. Apical margin of tergum II depressed, set off from rest of tergal surface as a lamella ..... 3a.
— Apical margin of tergum II not depressed, not set off from rest of tergal surface ..... 3b.

[1]The gender of *Delta* and *Zeta*, which are letters of the Greek alphabet, is neuter.

3a. Pronotum without pretegular carina ..... *Eumenes* Latreille[2].
— Pronotum with pretegular carina (fig. 1) ..... *Minixi* Soika.
3b. Pronotum with incomplete humeral carina (fig. 2); petiole spiracle located at midpoint of segment ..... *Zeta* Saussure.
— Pronotum without humeral carina; petiole spiracle located beyond midpoint of segment ..... *Delta* Saussure.

A few comments on the recognition of *Delta* and *Zeta* as genera are warranted because their history is scattered in the literature. *Eumenes*, in its original sense as exemplified by Saussure's (1852, 1855) pioneering work on eumenine wasps, contained a number of groups that he (1855) called divisions and to which he applied "generic" names. These division names later were recognized as subgenera (Bequaert, 1926, for examples), and eventually as separate genera (Soika, 1961, Bluthgen, 1961, for example). Bequaert (1926) said "*Eumenes* . . . contains over 200 . . . species, many of which differ greatly in shape." "If the fauna of a limited area be considered, they are rather easily arranged in natural groups, but whether these are of sufficient value to be regarded as valid subgenera is a troublesome question." He recognized subgenera, anyway. By the 1960's some of these subgenera (*Delta* for one) had been elevated to genera (Soika, 1961, Bluthgen, 1961). Soika's paper was a world survey of the groups within *Eumenes* in the old sense. He elevated most of the subgenera to genera, and subdivided the component species into groups. *Zeta* Saussure, another section of the old *Eumenes*, was treated as a genus by Soika (1975) when he reviewed its species. He had recognized *Zeta* as a genus in 1972 but did not define its characters. Soika continued his generic fragmentation of *Eumenes* s. l. by publishing a large work in 1978 in which nine new genera were proposed, mostly for species groups recognized in his 1961 paper under the genus *Omicron*. One of these new genera was *Minixi*.

The total number of "eumenes-like" genera now recognized worldwide is about 25 according to Carpenter (in litt.), but this tally is not easy to elucidate due to the piecemeal fashion in which they have been recognized and the lack of a definitive global review of these taxa with descriptions and keys to them. This "evolution" of *Eumenes* s. l. into many genera is paralleled throughout the entire subfamily. In our opinion this

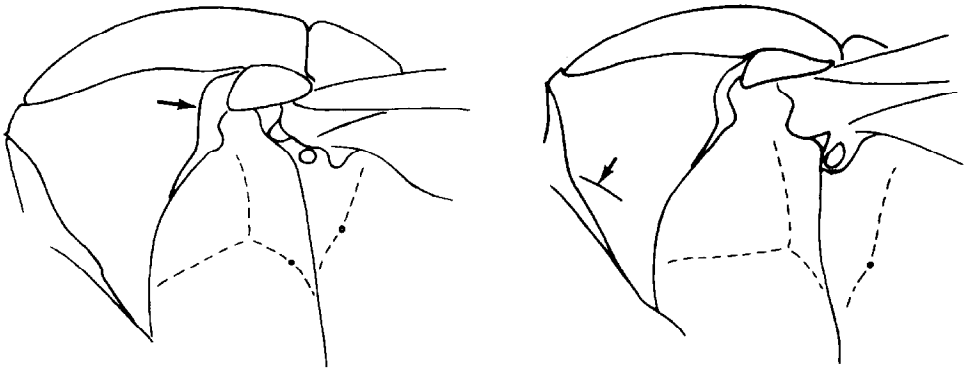

Fig. 1-2, left profile of part of thorax. Fig. 1, *Minixi* showing pretegular carina (arrow); Fig. 2, *Zeta* showing incomplete humeral carina (arrow).

[2]See Grissell (1974) for identification of the two Florida species.

splitting is extreme, and it reflects the fact that specialists in the family fail to appreciate that genera have an important practical component: a generic name should convey information to the broad user community. The old cliche "unable to see the forest for the trees" applies to those who have split *Eumenes*, a meaningful taxon, into many small genera with similar facies. Granted, *Eumenes* in its original sense may not be monophyletic (Carpenter, in litt. says that it probably was) and thus is open to taxonomic refinement via some splitting, but we believe this has progressed to an irrational point. Carpenter and Cumming (1985) quoted Bequaert's 1939 cogent assessment of the trend that he saw toward extreme splitting of eumenine genera: "Such a procedure, however, not only leaves out the many annectant species, but it fails as a guide to the study of natural relationships." As Carpenter and Cumming point out, this statement is still an appropriate criticism of the current state of affairs in this subfamily (and indeed in the family). Unfortunately, the recent cladistic analysis by Carpenter and Cumming (1985) only hints at possible future lumping of some eumenine genera. Because they dealt primarily with the North American fauna, they did not attempt to make decisions on the validity of many of the "genera" split off from the old *Eumenes*, but Carpenter (in litt.) agrees that some are doubtless untenable. In fact, some of the "eumenes"-like genera are probably paraphyletic.

The many "eumenes"-like genera now recognized are separated for the most part by characters that may be more appropriately used at the species group level than at the generic: presence or absence of various thoracic carinae, petiole shape, presence or absence of a lamella on tergum II and so on. It is unknown how these hold up on a world basis, but variation seems likely, for as early as 1875 Saussure wrote: "This genus [*Eumenes* s. l.] . . . . is broken up into peculiar types". "These types are connected by natural transitions which embarrass one in assigning them very fixed limits." The genus *Ammophila* in the Sphecidae contains a number of groups that are as distinctive as some of the genera derived from *Eumenes*. To elevate these to genera would destroy a concept that denotes a substantial amount of information content, a generic concept that is meaningful, hence practical, to a large audience. The old *Eumenes* was an easily recognized taxon. We are not suggesting that everything be put back into *Eumenes*, but surely some of the current "genera" are at best subgenera or at most species groups.

Endnote

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ANTLION PIT CONSTRUCTION AND KLEPTOPARASITIC PREY

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ABSTRACT

At a site on Archbold Biological Field Station (Lake Placid, Florida), 25% of the diet of antlion larvae (*Myrmeleon* spp.) consisted of a single species of an ant (*Conomyrma* sp.); however, in about 10% of antlion pits containing prey, *Conomyrma* successfully kleptoparasitized, or stole prey from, the antlion. Stolen prey were significantly larger than other prey items. Features that increase the capture efficiency of the pit (steep slope and a layer of fine sand on the walls) are disrupted during the attempted escape of large prey; this decreases the risk of predation by antlions on kleptoparasitic ants. In the laboratory, antlions preferred fine sand over coarse, and moved longer distances when placed on coarse sand. The former behavior will increase prey capture success and reduce the risk of kleptoparasitism. The latter behavior increases the probability of finding a more suitable habitat.