PAN-PACIFIC ENTOMOLOGIST
71(4): 199–203, (1995)

A NEW *ANAGRUS* (HYMENOPTERA: MYMARIDAE), EGG PARASITOID OF *PROKELISIA* SPP. (HOMOPTERA: DELPHACIDAE)

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Abstract.—*Anagrus sophiae* S. Trjapitzin, NEW SPECIES, is described and illustrated on the basis of a type-series from California and Florida. This species is a common egg parasitoid of the planthopper *Prokelisia marginata* (Van Duzee) that feeds on salt marsh cordgrass, *Spartina alterniflora* Loisel, in salt marshes along the Atlantic, Gulf, and Pacific Coasts of the United States, and *S. foliosa* Trinius on the Pacific Coast. The new species also parasitizes eggs of *P. dolus* Wilson in Florida. Differences in the biology as well as variability of some morphological characters of *A. sophiae* are discussed based on a comparative study of the two populations from California and Florida. The new species is compared with *A. delicatus* Dozier.

Key Words.—Insecta, Delphacidae, *Prokelisia* spp., Mymaridae, *Anagrus sophiae* NEW SPECIES, egg parasitoid

The sibling planthopper species of *Prokelisia* (Homoptera: Delphacidae), *P. marginata* (Van Duzee) and *P. dolus* Wilson, are common phloem feeders of the cordgrass *Spartina alterniflora* Loisel (Poaceae) in estuaries on the Atlantic seaboard and the Gulf of Mexico. In California, *P. marginata* feeds upon the native cordgrass *S. foliosa* Trinius, which is distributed as far north as Bodega Bay in Sonoma Co. The host planthoppers and their egg parasitoid *Anagrus sophiae* new species (Hymenoptera: Mymaridae) are also found on *S. alterniflora* that was introduced into San Francisco Bay in the mid 1970s (Daehler & Strong 1994). Probably because of the lack of native *Spartina* species in estuaries north of Bodega Bay, neither *A. sophiae* nor its host planthopper species occur upon the introduced populations of *S. alterniflora* at Florence, Oregon, or in Willapa Bay and Puget Sound, Washington.

A. sophiae new species (= *A. delicatus* Dozier of authors, misidentification) is a common egg parasitoid of *Prokelisia* planthoppers (Stiling & Strong 1982, Antolin & Strong 1987, Cronin & Strong 1990). *A. sophiae* has an extremely distinctive geographical distribution, very long and narrow, that rings North America in marine salt marshes where its hosts occur. Our study of this parasitoid has demonstrated that it represents a distinct morphospecies of *Anagrus* different from *A. delicatus*. The latter species was originally described by Dozier (1936) from a single female specimen (holotype) and a male allotype swept from along a creek bed near Elizabethtown, Illinois.

Investigative responsibilities have been divided between authors such that Trjapitzin worked on taxonomic aspects and Strong provided natural history information about the new species. Terminology for morphological features is that of Chiappini (1989). Measurements are given in micrometers (μm), with the mean followed, in parentheses, by the range.

Depositories.—Abbreviations for depositories are: CNCI, Canadian National Collection of Insects, Ottawa; INHS, Illinois Natural History Survey, Centralia; UCRC, University of California, Riverside; USNM, National Museum of Natural History, Washington, D.C. An abbreviation used in the description is: F = funicular (flagellar in males) segment.

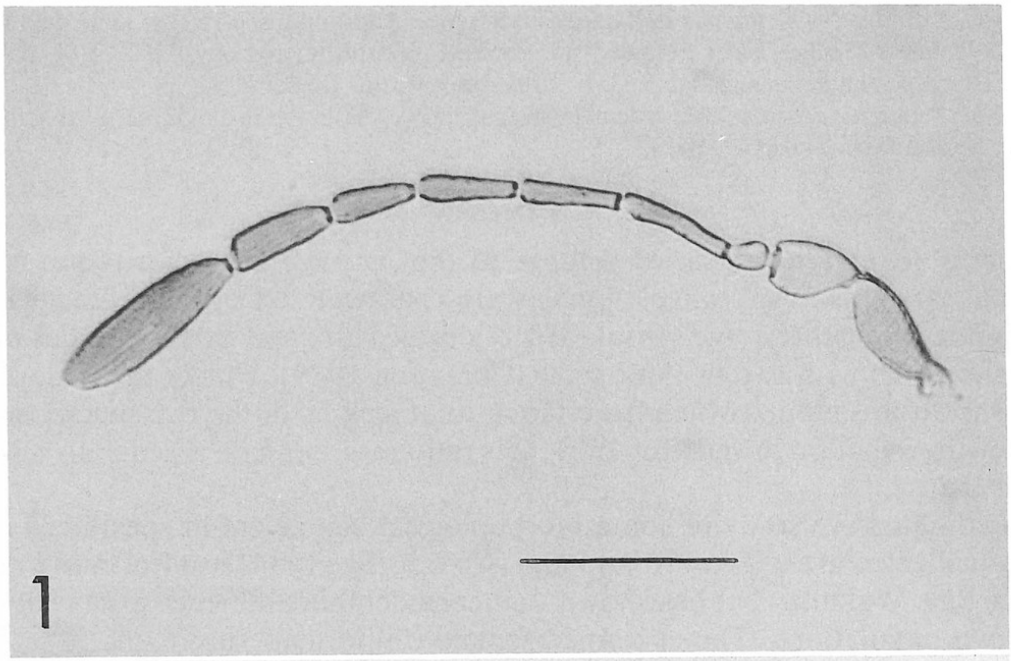
ANAGRUS SOPHIAE S. TRJAPITZIN, NEW SPECIES

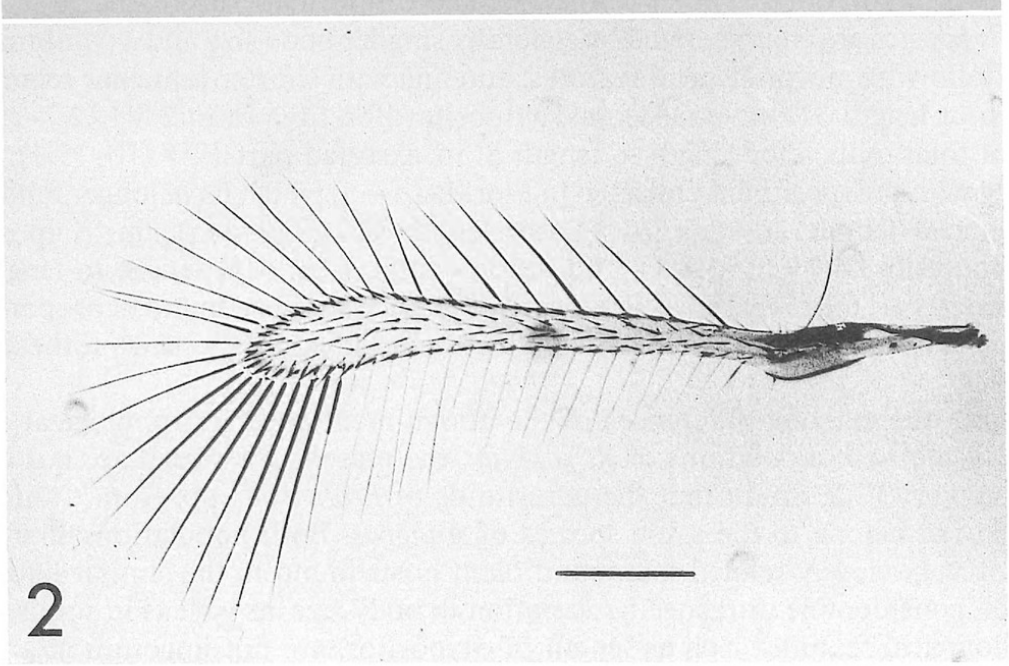
Types.—Holotype: female, labelled: 1. "*Anagrus sophiae* S. Trjapitzin HOLOTYPE female"; 2. "USA. FLORIDA. *WAKULLA Co.:* Oyster Bay, Dec. 1988, D. Strong, ex. *Prokelisia marginata* on *Spartina alterniflora*". Holotype deposited in USNM. Paratypes: USA. FLORIDA. *WAKULLA Co.:* same data as holotype, 2 females, 1 male [UCRC]; same data, 1 female, 1 male [CNCI]; same data, 1 male [USNM]; same data but Mar 1981, 1 female, 1 male [USNM]. CALIFORNIA. *SAN FRANCISCO Co.:* San Bruno Marsh, behind SamTrans bus terminal, Jul 1992, D. Strong, *Prokelisia marginata* on *Spartina alterniflora,* 3 females, 1 male [UCRC]; same data, 1 female [CNCI]; same data, 1 female [USNM].

Female.—(n = 10) *Color:* body light brown; with head, F2–F6, club, mesoscutum, and metasomal terga usually slightly darker; eyes dark brown. *Head:* about as wide as mesosoma or slightly narrower. Antenna (Fig. 1) sparsely setose, moderately short for genus; pedicel slightly more than 2× as long as F1 which is shortest of funicle; F2 longest of funicle; F3 and F4 subequal, without sensory ridges; F5 shorter than F3, F4, or F6, generally without sensory ridges, but sometimes with a small sensory ridge in some specimens; F6 slightly shorter than F2 but longer than F3–F5, bearing two sensory ridges; club with five sensory ridges. *Mesosoma:* 0.62 (0.53–0.69) × as long as metasoma. Mesoscutum with a pair of setae near notaulices. Forewing (Fig. 2) slightly shorter than body; 10.0 (9.2–10.6) × longer than wide; with three to five irregular rows of setae at broadest part, setae uniformly distributed on disk. Lengths of distal and proximal macrochaetae in ratio 2.4:1 (1.8–2.8:1). Marginal fringe with longest cilia more than 3× but less than 4× the wing width. Hindwing disk asetose except a complete row of small setae along posterior margin and another incomplete row along anterior margin on distal half. *Metasoma:* Ovipositor moderately long, generally markedly exserted beyond apex of metasoma, but in Californian specimens only slightly exserted. Ratio of total ovipositor length to length of its exserted part 9:1 (5–15:1). External plates of ovipositor each with three setae. Ovipositor: foretibia ratio 3.1:1 (2.7–3.8:1). *Measurements.—Body:* 743 (646–796) μm; Head: 117 (95–133) μm; Mesosoma: 234 (198–275) μm; Metasoma: 378 (338–403) μm; Ovipositor: 363 (293–445) μm. *Antenna:* Scape: 73 (63–76) μm; Pedicel: 42 (38–46) μm; F1: 20 (17–23) μm; F2: 54 (49–61) μm; F3: 46 (38–53) μm; F4: 47 (40–55) μm; F5: 44 (38–51) μm; F6: 51 (46–59) μm; Club: 98 (91–103) μm. *Forewing:* Length: 548 (494–597) μm; Width: 55 (48–65) μm; Venation: 165 (152–179) μm; Marginal vein: 46 (42–53) μm; Hypochaeta: 34 (32–38) μm; Proximal macrochaeta: 33 (27–42) μm; Distal macrochaeta: 76 (68–84) μm; Longest marginal cilia: 202 (186–217) μm. *Hindwing:* Length: 515 (471–567) μm; Width: 19 (15–22) μm; Venation: 142 (133–152) μm; Longest marginal cilia: 144 (133–152) μm. *Legs:* Given as Femur, Tibia, Tarsus: Fore legs: 114 (106–124) μm, 117 (109–125) μm, 152 (137–160); Middle legs: 96 (91–103) μm, 160 (146–175) μm, 137 (122–148) μm; Hind legs: 101 (91–108) μm, 191 (171–209) μm, 160 (152–167) μm.

Male.—(n = 5) Similar to female except general body coloration slightly lighter; forewing usually slightly wider (length : width ratio 9.1:1 (8.8–10.0:1), with disk more densely setose than in female. Genitalia typical for *incarnatus* species group (Chiappini 1989). *Measurements.—Body:* 675 (570–760) μm. *Antenna:* Scape: 68 (61–72) μm; Pedicel: 42 (41–42) μm; F1: 38 (34–43) μm; F2: 56 (49–63) μm; F3: 53 (48–57) μm; F4: 54 (49–57) μm; F5: 54 (48–59) μm; F6: 54 (49–58) μm; F7: 54 (49–57) μm; F8: 55 (49–61) μm; F9: 56 (49–61) μm; F10: 56 (51–61) μm; F11: 57 (51–65) μm. *Forewing:* Length: 587 (532–608) μm; Width: 64 (53–68) μm. *Genitalia:* 150 (129–163) μm.

Diagnosis.—This species is easily distinguished from all other described Nearctic species (i.e., *A. armatus* (Ashmead), *A. columbi* Perkins, *A. delicatus* Dozier, *A. epos* Girault, *A. nigriventris* Girault, *A. nigriceps* Girault, *A. puella* Girault, and





Figures 1–2. *Anagrus sophiae* S. Trjapitzin, NEW SPECIES, female paratype [UCRC]. 1. Antenna; 2. Forewing. Scale bars = 0.1 mm.

A. takeyanus Gordh) of the *incarnatus* group of *Anagrus* s. str., as defined by Chiappini (1989), by the lack of sensory ridges on F4 of the female antenna. *A. sophiae* also differs from *A. delicatus* Dozier by a combination of the following morphological features: relatively short antennae (long in *A. delicatus*); mesoscutum with a pair of setae near notaulices (apparently absent in *A. delicatus*); external plates of ovipositor each with three setae (two in *A. delicatus*); and much lower ovipositor: foretibia ratio (about 4.7:1 in *A. delicatus*). The latter species will be redescribed and illustrated by the senior author in a separate paper.

Etymology.—The specific name "*sophiae*" meaning "wise" was chosen to describe the astute oviposition behavior of this insect (Cronin & Strong 1993).

Material Examined.—*A. sophiae* new species: see types. Additional specimens: same data as holotype, 2 females, 2 males, parts mounted for scanning electron microscopy [UCRC]. *A. delicatus* Dozier: Holotype female on slide labelled: 1. "*Anagrus delicatus* Dozier Holotype female SL. 12927 I.N.H.S"; 2. "*Anagrus delicatus* Dozier female Swept from vegetation in bed of creek. Elizabethtown, Ill. Aug. 5-1932 H. L. Dozier" [INHS].

Comments

Anagrus sophiae new species belongs to the *incarnatus* species group of the subgenus *Anagrus* s. str. whose females are characterized by the following two morphological features: five sensory ridges on the club, and external plates of the ovipositor each with two or three setae (Chiappini 1989). Unlike the majority of species from this group, which have the ratio of lengths of the two macrochaetae on forewing venation lower than 2.0:1, this ratio in *A. sophiae* is generally slightly greater than 2.0:1.

The comparative study of some morphological characters in specimens of *A. sophiae* collected in California (San Francisco Bay, San Francisco Co.) and Florida (Oyster Bay, Wakulla Co.) has shown that considerable difference exists between these two populations. The examined female Californian specimens ($n = 5$) of the new species are characterized by generally smaller body size and a combination of the following morphological features: antenna with shorter funicular segments, ovipositor length 315 (293–331) μm, ovipositor: foretibia ratio 2.8:1 (2.7–2.9:1), ratio of total ovipositor length to length of its exserted part 12:1 (10–15:1); contrasting with the specimens collected in Florida ($n = 5$) which have longer funicular segments of female antenna, ovipositor length 410 (350–445) μm, ovipositor: foretibia ratio 3.4:1 (2.9–3.8:1), and ratio of total ovipositor length to length of its exserted part 6:1 (5–8:1). No significant difference has been found in proportions of funicular segments of female antenna between the populations from these two localities.

Despite the existing differences of the above-mentioned morphological characters in the two populations of *A. sophiae,* the reasons for which are not clear, we have very little doubt that the parasitoids of *Prokelisia* spp. from California and Florida belong to the same species of *Anagrus.* Both populations share the same or very closely related insect and plant hosts found in the similar habitats. Further, considerable intraspecific variation in body size, as well as in some other morphological features such as length of ovipositor, are not uncommon among the species of *Anagrus* and some other genera of the Mymaridae. For instance, considerable morphological differences on a host or geographical basis are known in *A. flaveolus* Waterhouse (Claridge et al. 1988; E. Chiappini, S. V. Trjapitzin & A. Donev, unpublished data) and *A. nigriventris* Girault (SVT, unpublished data).

Conducting cross-breeding experiments between individuals from these two populations of the new species would be very helpful to complement our morphological study and demonstrate conclusively that the two populations belong indeed to only one species. However, the existing differences in the type of reproduction between the two populations of *A. sophiae* make such experiments very difficult to conduct: whereas the Floridian population reproduces by arrhenotoky (Cronin & Strong 1990), the Californian population displays thelytoky, with no males found in the natural population and no mating occurring in laboratory cultures (DRS, unpublished data). Again, such differences in the biology of *Anagrus* species are not unusual. For instance, Claridge et al. (1988) reported that

different populations of *A. perforator* (Perkins) are arrhenotokous in Sri Lanka, but thelytokous in the Philippines. According to Claridge et al. (1988), populations of *A. optabilis* (Perkins) from Philippines and Sri Lanka are thelytokous, whereas Japanese populations of this species reproduce by both gamogenesis and arrhenotokous parthenogenesis (Sahad & Hirashima 1984). Furthermore, Asian *A. optabilis* show different morphological characters of larvae from those of Hawaii (Sahad & Hirashima 1984).

Acknowledgment

We thank Kathleen Methven (Illinois Natural History Survey, Champaign) for lending us the holotype of *A. delicatus* and Tatiana M. Tretiakova for technical assistance. Comments by anonymous reviewers improved the final draft.

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