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SOME PREDATORS AND PARASITOIDS OF DUNG-BREEDING DIPTERA FROM CENTRAL CALIFORNIA

ROBERT A. WHARTON
Somerset, California

During a recent study of the biology of alysiine Braconidae (Wharton, 1976), several non-braconid predators and parasitoids were observed attacking various dung-breeding Diptera. Data on habits, prey, and hosts of these species are presented here to provide baseline information for possible future studies on the biological control of such important dung-breeding pests as the face fly, *Musca autumnalis* (DeGeer) (Muscidae) and the horn fly, *Haematobia irritans* (L.) (Muscidae).

Poorbaugh et al. (1968), MacQueen and Beirne (1974), Merritt (1976) and Merritt and Anderson (1977) collected numerous predacious and parasitoid Coleoptera and Hymenoptera from open pastures and rangeland in Western North America, but presented little information on habits, prey, and hosts of these species. MacQueen and Beirne (1975), however, provided some information on the importance of *Philonthus* (Staphylinidae) and *Sphaeridium* (Hydrophilidae) as predators of coprophagous Diptera in southern British Columbia. Peschke and Fuldner (1977) recently reviewed the biology of parasitoid aleocharines, and contributed much new data.

Materials and Methods

Data were collected from isolated dung pats in open pastures. The fauna of accumulated dung masses differs considerably, and has been treated in detail elsewhere (Legner and Olton, 1970, 1971).

Individual bovine dung pats 0–7 days old were collected at monthly or bi-monthly intervals in 1974 and 1975 from the following California localities: Amador Co., 8 km E Plymouth, walnut orchard pasture, irrigated weekly; El Dorado Co., 5 km SW Somerset, partially cleared, non-irrigated, foothill woodland; Mendocino Co., 10 km N Ft. Bragg, cleared, coastal pasture, bordering fen; Monterey Co., Jolon, partially cleared, non-irrigated, oak woodland pasture; San Luis Obispo Co., San Luis Obispo, partially cleared, non-irrigated oak-sycamore woodland pasture; Yuba Co., 8 km E Browns Valley, totally cleared, heavily irrigated (gravity flow) pasture. Additional collections and behavioral observations were made at the Yuba Co. locality in the spring and summer of 1977.

Pats were placed in rearing trays until all flies had pupated. Puparia were sorted to species and stored in glass and plastic vials until emergence of

parasitoids. Behavioral observations on predators and parasitoids were made in the field. Due to lack of equipment, rearing conditions could not be standardized, but closely approximated ambient meteorological conditions for Placerville, El Dorado Co., California. All material was reared at the Somerset locality listed above. Developmental time was one month for all non-overwintering parasitoids reared during the study. Fifteen overwintering *Aleochara bimaculata* Gravenhorst (Staphylinidae) and one *Xyalophora quinquelineata* (Say) (Cynipidae) spent eight months in developmental and resting stages before emergence in late spring.

Most of the parasitoid species treated here were rarely encountered; and rates of parasitism were low. Rates were calculated by dividing the number of parasitoids reared by the number of puparia (parasitized + unparasitized) of the host species on a specific sampling date. Calculations were made on samples containing 100–300 puparia.

Results and Discussions

The following predators were observed: *Oxybelus similis* Cresson (Sphecidae) and *Pogonomyrmex californicus* (Buckley) (Formicidae) in El Dorado Co., and *Philonthus* sp. (Staphylinidae) in Yuba Co.

An unshaded pat dropped at approximately 11 am, V/24/75, was visited 3 hours later by several *O. similis*. Wasps ran rapidly in circles over the pat surface immediately after landing. Three wasps captured adult *Orthellia caesarion* (Meigen) (Muscidae) within 5 sec of landing. The latter was the most abundant fly on the surface. Flies were immobilized in 1–3 sec, then carried away. *Orthellia* was held venter up, beneath the wasp's body during flight. Although the prey of *similis* does not appear to have been previously recorded, several Nearctic *Oxybelus* species are known to provision other muscids (Bohart et al., 1966; Peckham et al., 1973).

Ants may be the most important natural enemies of dung-breeding Diptera in cleared, non-irrigated, foothill pastures during the dry summer and early fall months. Observations from 1974–1977 indicate that most other parasitoids and predators are relatively inactive at this time. In 1974, many of the dry season pats at the El Dorado Co. locality were removed, piece by piece, by swarms of *P. californicus*. The ants carried off fly eggs and early instar larvae in addition to pieces of dung and undigested seeds. Pimental (1955) discussed the significance of ants in fly control in general, and Illingworth (1923) and Wingo et al. (1974) mentioned the importance of ants as predators in association with manure.

Philonthus adults were observed on moist, 1–2 hour old pats in October of 1974 and 1977. Two individuals successfully attacked adults of *O. caesarion* and *Copromyza* sp. (Sphaeroceridae), respectively. *Philonthus* was also observed capturing early instar larvae of *Ravinia querula* (Walker)

(Sarcophagidae) and *O. caesarion,* the two most abundant muscoids in the pats examined. As MacQueen and Beirne (1975) noted, *Philonthus* is non-selective, and appeared to take whatever it encountered. Because of its non-selective habits, its role as a biological control agent will have to be carefully assessed. This is particularly true since several authors (notably Valiela, 1969; Thomas and Morgan, 1972; Wingo et al., 1974) have stressed the importance of *Philonthus* as a predator of face and horn flies.

Three staphylinids (*Aleochara tristis* Gravenhorst, *A. bimaculata,* and an unidentified *Aleochara* species), and three cynipoids (*Eucoila* sp. near *rufocincta* Kieffer,[1] *X. quinquelineata,* and a *Figites* sp.) were reared as parasitoids.

Thirteen *A. tristis* were reared from puparia of *O. caesarion* collected in Yuba Co., IX/3/77. Although *Orthellia* was very abundant, the rate of parasitism was only 1.7%. *A. tristis* was not recorded during previous studies of arthropods associated with isolated dung pats in western North America (Poorbaugh et al., 1968; MacQueen and Beirne, 1974, 1975; Merritt, 1976; Merritt and Anderson, 1977). Moreover, none of the 36,300 beetles released in northern California (Legner, 1978) in 1968 was ever recovered from the release sites (Hawthorne, pers. comm.). Moore and Legner (1971) cited Drea (1966), Jones (1967), and Wingo et al. (1967) in listing the face fly as the only host in America. They also state that *tristis* was "probably not established." Although rates of parasitism are low, field collections of adult beetles for the last three years indicate that *tristis* is now established in at least one pasture in north-central California. While it is recognized that numerous factors may be involved, competition with *A. bimaculata* may be retarding the build-up of *tristis* populations.

Drea (1966) and Jones (1967) both conducted studies on *A. tristis* prior to its release as a biological control agent. Although capable of attacking the face fly, the importance of *tristis* as a natural enemy of beneficial species may have been overlooked. Of the *Aleochara* species reared in this study, one attacked a predator, and two attacked flies important in pat decomposition. Because of possible harmful effects due to non-specific feeding habits, more careful consideration should be given to the use of *Aleochara* in the biological control of dung-breeding Diptera.

A. bimaculata was reared from Amador, El Dorado, Monterey, San Luis Obispo, and Yuba Co. It was collected in all types of pastures (heavily irrigated, totally cleared to dry, natural woodland), from sea level to 1600 m, and from July through September. Forty-nine specimens were reared from *R. querula,* 10 from *O. caesarion,* and four from *Ravinia planifrons* (Aldrich). Lindquist (1936), Wingo et al. (1967), and Thomas and Wingo (1968) discussed parasitism of *bimaculata* on *caesarion* and *querula,* but *planifrons* is a new host record for this species. In a small sample from Yuba Co., rates of parasitism were 18.0% for *querula* and 1.0% for *cae-*

sarion. *R. querula* thus appears to be the preferred host in this locality, especially since *Orthellia* was more abundant in this particular sample.

Five specimens of an unidentified *Aleochara* species were reared from *Scatophaga stercoraria* (L.) (Scatophagidae) collected in Yuba Co., IV/77. The beetles emerged as full grown larvae from their hosts' puparia.

Only a few species of parasitoid Cynipoidea have been studied in detail (Sychevskaya, 1974). All cynipoids in this study developed as solitary parasitoids and emerged from their host's puparia. Ten *X. quinquelineata* and four *Eucoila* sp. emerged from *R. querula,* one *Eucoila* emerged from *Ravinia lherminieri* (Robineau-Desvoidy), and one *Figites* sp. emerged from *Sepsis biflexuosa* Strobl. (Sepsidae). All *Eucoila* were collected in Yuba Co., and the *Figites* in El Dorado Co.

X. quinquelineata was easily the most commonly encountered cynipoid. It was found in moderate numbers in El Dorado, Mendocino, and Yuba Co. from May through November. Adults were most active on moist pats; and oviposited primarily in crevices on the pat surface. They also crawled down beetle holes. Mohr (1943) recorded similar activity for this species in Illinois. *X. quinquelineata* occurs across North America, and has been collected in nearly every study of North American bovine dung fauna. *R. querula* appears to be the preferred host, though other sarcophagids have been recorded (Mohr, 1943; Turner et al., 1968; Hays and Turner, 1971). Reported rates of parasitism are generally low. In one sample collected during this study, 6.0% of the *querula* were parasitized by *quinquelineata*.

Several thousand horn flies and approximately 200 face flies were reared during this study; however, no parasitoids were collected from either species. *R. querula* was by far the most heavily parasitized fly in the study area.

In biological control programs, care must be taken to introduce natural enemies specific to face and horn flies. If not, then the reduction of the pest species by non-specific predators or parasitoids must be great enough to offset the harmful effects resulting from the attack of beneficial fly species.

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Footnote

[1] Comparison of reared specimens with the lectotype male of *E. rufocincta* (in the California Academy of Sciences) revealed differences indicating the two may not be the same.

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Opinion No.

1107 (p. 88) Conservation of *Dermacentor andersoni* Stiles, 1908 (Acarina, IXODIDAE).

1110 (p. 99) *Microterys* Thomson, 1875 (Hymenoptera, CHALCIDOIDEA): conserved under the plenary powers.

1111 (p. 101) *Leucospis gigas* Fabricius, 1793 (Hymenoptera, LEUCOSPIDAE) conserved under the plenary powers.

1112 (p. 104) *Madiza* Fallén, 1810 (Diptera, MILICHIIDAE): designation of a type-species under the plenary powers.

(See Bulletin of Zoological Nomenclature, Volume 35, part 3, February '79.)

Opinion No.

1115 (p. 175) *Nysson* Latreille (Hymenoptera, SPHECIDAE) validated as from 1796.

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