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Chapter 26 *Largest Parasitoid Brood*

JUAN MANUEL ALVAREZ A.

Department of Entomology & Nematology
University of Florida, Gainesville, Florida 32611-0620

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The largest parasitoid broods are produced by polyembryonic parasitoids in the genus Copidosoma *(Hymenoptera: Encyrtidae). The largest broods reported in the literature are for* Copidosoma floridanum *(Ashmead). This cosmopolitan wasp is an obligate egg-larval parasitoid of moths in the subfamily Plusiinae (Noctuidae). Broods for this species commonly exceed 2000 wasps/host. The largest brood reported is 3,055 individuals. The runner-up is another encyrtid* Copidosoma (=Berecyntus) bakeri, *which produces broods exceeding 1,500. Polyembryonic wasps reported in other families (Dryinidae, Platygasteridae and Braconidae) produce broods much smaller than this.*

A parasitoid brood consists of the individuals that hatch from a single egg or clutch of eggs laid by one parasitoid in a single host. Polyembryony is the development of multiple embryos due to the mitotic division of a single egg (Ode & Strand 1995). The largest parasitoid broods are produced by polyembryonic parasitoids. This paper discusses some of the characteristic features of the polyembryonic parasitoids, identifies the insect group that has been reported with the largest parasitoid broods and names a representative from this group as champion.

The Candidates

All candidates for the largest parasitoid brood are polyembryonic parasitoids. Polyembryony has evolved in four families of parasitic Hymenoptera: Braconidae, Platygasteridae, Drynidae and Encyrtidae (Strand et al. 1991). Parasitoids reported to have the largest broods belong to the family Encyrtidae. The total number and sex ratio of embryos in a brood are highly variable both within and between species and are influenced by various factors (Leiby 1926, Walter & Clarke 1992). Some of those factors are host species, fertilization, developmental time of the host, temperatures within the host larvae, size of the parasitized host, the host juvenile hormone (JH) and ecdysteroid titers, host-egg age and host encounter rates (Leiby 1926, Nenon 1978, Strand et al.1991, Ode & Strand 1995).

The Champion

The largest broods reported in the literature are for *Copidosoma floridanum* (Ode & Strand 1995). Like all polyembryonic encyrtids, this wasp is an obligate egg-larval parasitoid of moths in the subfamily Plusiinae (Lepidoptera: Noctuidae). In Florida it is usually found in *Trichoplusia ni* or *Pseudoplusia includens* (Strand, personal communication). The largest brood in the literature was displayed in a scatter plot and was ca. 2,750 individuals (Ode & Strand 1995). Dr. Strand confirmed that the real datum was 2,796 individuals. Two other larger broods (2,941 and the largest 3,055) have never been included in any paper as part of a data set (Strand, pers. comm.). Broods reported by Ode and Strand (1995) were counted as all emerged wasps plus dead offspring remaining in the mummy. The record of 3,055 was counted similarly and the dead offspring accounted for less than 2% of this brood (Strand, pers. comm.). The brood of 2,941 was just total emerged adults (Strand, pers. comm.).

opment in the final (fifth) instar of the host (Strand 1989). Females produce female or male broods by laying one egg per host (male or female), and mixed broods by laying two eggs (always one male and one female) (Strand 1989; Ode & Strand 1995). On average, mixed broods are larger than single-egg broods, although single-sex female broods can be as large as any two-egg mixed brood (Strand, pers. comm.). The 2,796 and 3,055 broods were all female and almost certainly derived from a single egg (Strand, pers. comm.). The 2,941 brood was both male and female and thus arose from one male and one female egg (Strand, pers. comm.). Female and mixed broods decrease in size with increasing host-egg age, and the body sizes of female and male broods are negatively correlated with clutch size (Ode & Strand 1995).

Some authors have found polymorphism in the larvae of polyembryonic parasitoids. *C. floridanum* larvae that develop from the multiple embryos can be divided into either precocious larvae that never become adult, or reproductive larvae that develop into reproductive adults (Ode & Strand 1995). Grbic et al (1992), and Ode & Strand (1995) believe that this polymorphism in *C. floridanum* is related to the host-egg age affecting the sex ratio of the broods. Multiparasitized host of *C. floridanum* produce either a brood of *C. floridanum* or die without any parasitoid emergence. However, Strand et al. (1990) found no direct evidence that physical attack by *C. floridanum* precocious larvae killed the other parasitoid. Cruz et al. (1990) found that precocious larvae of the encyrtid parasitoid *Copidosomopsis tanytmemus* may themselves be polymorphic and believe that larval polymorphism is related to the efficacy of polyembryonic species as parasitoids. Cruz (1981) demonstrated that the precocious larvae of *Pentalitomastix* sp. constitute a defender morph, eliminating other internal parasites that would otherwise compete with their normal sibs.

The morphology, development and growth of *C. floridanum* have been investigated in relation to the development of its host, the noctuid *Trichoplusia ni*. Development of the parasitoid is synchronized with that of its host (Strand 1989; Baehrecke & Strand 1990).

Discussion

Polyembryonic wasps in other families produce smaller broods than *C. floridanum*. For example, the mean number of the braconid *Macrocentrus grandii* per brood on parasitized *Ostrinia nubilalis* larvae is 39.8 (Orr *et. al*., 1994). Platygastrid broods produce as many as 18 individuals and some drynid broods have as many as 60 young developing from a single egg (Borror *et al*., 1989). The second largest parasitoid brood reported in the literature (2,500) was for *Copidosoma truncatellum*, a parasite of the cabbage looper (Leiby, 1926). *Copidosoma truncatellum* was recently synonomized with *C. floridanum* by John S. Noyes (British museum) (Noyes 1988). *Litomastix truncatellus* and *Paracopidosomopsis truncatellus* (or *floridanus*) were used in the old literature and are also almost certainly *C. floridanum* (Strand, pers. comm.). *Copidosoma* (=*Berecyntus*) *bakeri* is the apparent runner-up to *C. floridanum*, producing broods as large as 1511 (Snow 1925).

High rates of parasitism by polyembryonic species are not always desirable, since they can increase crop damage and complicate control recommendations. This was the case of *Euxoa auxiliaris* parasitized by *C. bakeri*. Parasitized larvae feed more and longer than unparasitized larvae (Byers et al. 1993). Parasitized larvae also grow considerably larger than unparasitized larvae and may have a supernumerary instar. Larger hosts supported larger broods of *C. bakeri* and apparently a successful strategy of *C. bakeri* is to prolong host development so as to maximize an acquired resource (Byers et al. 1993).

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