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Robert L. King
State University of Iowa

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Mixed Colonies in Ants

By ROBERT L. KING

Mixed colonies of ants, in which different species live together in a single nest and raise their young in common, are usually the result of temporary social parasitism or of slave-making activities.

Temporarily mixed colonies may be produced by the invasion of an already established nest of one species by a young fertilized female (queen) of another species that is unable to start a colony independently. The brood produced by this parasitic queen is raised by the workers of the host species, whose queen may be permitted to live out her life or who may have been killed, either by her own workers or by the invading queen. The workers of the host species may die out and so leave a pure colony of the parasite (temporary social parasitism) or may be replenished by slave-making raids (dulosis, or slavery). Colonies of the slave-making species (Sanguinea group of *Formica* and *Polyergus*) are always mixed. Temporary social parasitism is represented in the genera *Formica* by the *Rufa*, *Exsecta* and *Microgyna* groups, which are temporarily parasitic on colonies of the *Fusca* group and of the subgenus *Neoformica*. Mixed nests of the latter group are very rare, but there are usually many pure colonies, of temporary parasite as well as of host species.

One-queen ant nests survive only if the queen survives. This problem of the "indispensable individual" has been solved among many species by the adoption of newly fertilized females of the same species: nest daughters or others who may be found after the marriage flight in the vicinity of the nest. In this way large populous colonies may come to have many queens, so that the existence of the community is no longer dependent on the life of a single individual. This occurs in many species of the *Rufa* and *Exsecta* groups of the genus *Formica*, where colonies are extremely long-lived. Wheeler ('10) has mentioned the fact that such adoption of young queens may be extended to include females "of a different subspecies." A "taxonomic mistake" in the capture of newly fertilized queens might also result in mixed colonies.

Whenever a species is found only in mixed nests it is usually assumed that slave-making is the basis upon which the colonies in question are sustained. However, there are nondulotic, permanent social parasites in which the nests are always mixed when the parasite has workers, which are usually few in number. This condition was unknown in the genus *Formica* until Buren ('42) re-

ported that *Formica reflexa* might possibly represent such a condition. Buren found several nests of this species in which the colony consisted of only a few *reflexa* workers but numerous workers of the host species *Formica fusca subsericea*.

It is the purpose of this paper to present further evidence concerning *Formica reflexa* and to record mixed nests of *Formica oreas comptula* and *Formica fossiceps*. The latter may have resulted from "taxonomic errors" in the capture and adoption of newly fertilized queens of the "wrong" species.

Nine mixed colonies of *Formica reflexa* and *Formica fusca subsericea* have been found in the vicinity of the Iowa Lakeside Laboratory in Dickinson County, Iowa. As in Buren's colonies from the same vicinity, each of these consisted of relatively small numbers of *reflexa* workers and large numbers of *fusca*. Two of these were found in 1945, two in 1946 and three in 1947. These were marked when found but none survived the following winter. It seems that a *reflexa* female invades a nest of *fusca* in the late summer and in the next season completely exploits the resources of the host species by producing great numbers of winged forms late in the summer. One nest was dug out in 1947, when both males and females were found on the surface of the nest mound. There were many more winged forms of *reflexa* than workers of either *reflexa* or of *fusca*. Two new nests were found in 1948, and plans have been made to make experiments in 1949 concerning the adoption of queens of *reflexa* by *fusca*.

It may usually be assumed that a colony of ants contains only a single species unless some such relationship as dulosis or social parasitism has been established. Mixed colonies of *Formica fossiceps* and *Formica oreas comptula* have led to confusion since the two species are superficially similar and are usually found in pure colonies. Five such mixed colonies have been found; in addition, six pure colonies of *o. comptula* and five of *fossiceps* have been recorded. Both species are relatively rare in the region of the Iowa Lakeside Laboratory; sexual forms appear at approximately the same season. One of the pure *fossiceps* colonies has been under observation for four years, and one pure *o. comptula* for three years. One of the mixed nests (XU) was found in 1946: collections made in that year included 68 workers and 33 males; of the workers 42 (62%) were *o. comptula* and 26 (38%) were *fossiceps*; all the males were *o. comptula*. In 1947, 130 workers and six males were collected; 93 (72%) of the workers were *o. comptula* and 37 (28%) were *fossiceps*; all of the males were *o. comptula*. In 1948,

when the mixed nature of the colony was first recognized, extensive collections were made: of the 779 workers, 491 (63%) were *o. comptula*, 288 (37%) were *fossiceps*; all of the 26 males collected were *o. comptula*. The collections included 69 workers attending aphids on milkweed, of which 47 (68%) were *o. comptula* and 22 (32%) *fossiceps*. Of 35 workers attending membracids on sunflower, 28 (80%) were *o. comptula* and 7 (20%) *fossiceps*. The records for the three years 1946, 1947 and 1948 include 977 workers and 65 males; all the males were *o. comptula*; 626 (64%) of the workers were *o. comptula* and 351 (36%) were *fossiceps*. Many callow workers were collected from the chambers of the nest itself in 1948.

Another colony (XV) was found in 1946; all 87 workers collected were *o. comptula*. In 1947, of 22 workers, 10 (45%) were *o. comptula* and 12 (55%) were *fossiceps*. In 1948, when the mixed nature of the colony was first noticed, 270 workers and a single male were collected: 115 (43%) workers were *o. comptula* and 155 (57%) were *fossiceps*; the single male was *o. comptula*. This colony was pure *o. comptula* in 1946 and mixed since that time.

In the collections of 1945 a sample of nest S-1 was found to contain 42 (95%) *o. comptula* and 2 (5%) *fossiceps*. This colony was not found in 1946 or in later years.

In 1948 a new mixed colony was found (48K). The specimens included 72 (96%) *o. comptula* and 3 (4%) *fossiceps*. Very extensive collections were made in 1948 from three other colonies of *o. comptula* found in that year: all were pure.

A pure nest of *Formica fossiceps* (IN) was found in 1945, and several hundred workers and one male collected; all were *fossiceps*. Collections made in 1946 included 17 (44%) *o. comptula* workers, 22 (56%) *fossiceps* workers. Collections were made from the same colony in 1947 but were lost before their mixed nature was known. In 1948 the nest was eclipsed by the establishment of a vigorous colony of *Polyergus* nearby. However 26 workers were collected from the vicinity of the nest; 11 (42%) were *o. comptula* and 15 (58%) *fossiceps*; these were attending membracids on sunflower.

Thus, we have one colony which was pure *F. oreas comptula* in 1946 and first became mixed in 1947 with *F. fossiceps*, and remains so; one colony which was pure *F. fossiceps* in 1945, became mixed in 1946 with *F. o. comptula* and remains so; and one colony which has been mixed since its discovery in 1946. All these remain under

observation; will they ever revert to the unmixed condition? How did their mixed nature originate?

The most reasonable explanation of such mixed colonies seems to be that the ants in capturing and adopting new queens have succeeded in their efforts but have made the same taxonomic errors which are so often made by myrmecologists. These observations raise the question of recognition by members of an ant community. It may be that queens (fertilized females) have some special odor which transcends the chemical sense that makes an ant colony such an exclusive organization.

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DEPARTMENT OF ZOOLOGY
 STATE UNIVERSITY OF IOWA
 IOWA CITY, IOWA
 and
 IOWA LAKESIDE LABORATORY
 MILFORD, IOWA