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BEHAVIORAL STUDIES OF BLACK-CAPPED CHICKADEES
AT THE UWM FIELD STATION

ABSTRACT

This report summarizes studies of the behavior of Black-capped Chickadees (*Parus atricapillus*) conducted at the UWM Field Station since 1970. Vocalizations and responses to predators are emphasized. Chickadees are very social and their calls are more complex than those of non-social avian species.

REVIEW

For the past 15 years, a number of different workers at the Field Station have conducted intensive studies of Black-capped Chickadees (*Parus atricapillus*). The chickadee is an excellent subject for many types of ecological and ethological studies. It is abundant, a year-round resident and easily trapped and marked so that individuals may be recognized. Chickadees are of special interest because they are highly social for much of the year (July to April in Wisconsin) and demonstrate some intriguing behavioral and ecological adaptations associated with sociality. Here I present a brief progress report of some of the highlights of studies of chickadee behavior, and a future article will deal with their ecology.

Charles Weise initiated the studies of chickadee ecology in 1967. Since 1970, standardized procedures have been used, including the operation of six feeders at which studies are conducted from November 15 to late April each year, with most individuals captured, individually color-banded and assessed as to age and sex. I began studies of chickadee vocalizations in 1970. In addition to studies of chickadees during the winter, I also examined certain aspects of reproductive behavior for several years.

One interesting problem concerning social animals is why they form groups at all. Chickadees form flocks in fall and winter but are territorial during the

breeding season. Why do they live in groups during the non-reproductive season? The most likely explanation is that group living enhances feeding efficiency and/or decreases chances of predation. Chickadees have a variety of predators such as hawks and shrikes during the winter. We have engaged in several studies of the chickadee flock as an anti-predator strategy. Chickadees seem to have an excellent system of predator recognition. For example, they recognize the calls of certain predators such as Sharp-shinned Hawks (Accipiter striatus) and decrease their feeding in response to playback of these calls (Apel 1975, 1978). Apel (1975) also studied their responses to a tethered Saw-whet Owl (Aegolius acadicus) during the winter, and the flock mobbed the owl very strongly, giving many "Chick-a-dee" calls.

Chickadees have a very effective vocal warning system when a predator is spotted (Ficken and Witkin 1977; Witkin and Ficken 1979). The first bird to detect a predator such as a flying hawk or a perched shrike emits High Zees, a high-pitched call which has some interesting acoustic features that may make it difficult for a predator to localize as it fades out with no sharp termination and covers only a narrow frequency range (Ficken and Witkin 1977). One bird gives the alarm and all immediately freeze in place, probably decreasing the chances of the predator seeing them. After the predator has left the vicinity, one bird gives the "all clear" call, a "Chick-a-dee" call. Thus, flock living has advantages in that there are more eyes and ears to detect predators and a very efficient system of warning the entire flock.

Why should the first bird to spot the predator warn the flock? He may be putting himself in some danger by giving the alarm even if the call is hard for a predator to localize. As chickadee flocks do not consist of close relatives, he is not warning his kin of imminent danger. There are several other possibilities for selection favoring warning calls, but we suggest chickadees may behave altruistically in this context to save the mate (Witkin and Ficken 1979). By mid-winter, chickadees have formed a monogamous pair bond which may last for years. If the mate is lost, it may be difficult to find another. Thus, natural selection would favor behavior by an individual that would decrease the chances of a mate falling victim to a predator.

Karen Apel has hand-raised young chickadees at the Field Station so that after 14 days of age they were never exposed to their parents' calls. Soon after leaving the nest, at approximately 16 days of age, they began giving High Zees (Apel and Ficken 1981). However, the young birds do not yet recognize predators as such, and they first call and freeze in response to any sort of moving objects, such as plants swaying in a breeze. Evidently, they have an innate basis for giving the call to moving objects and the form of the call itself is innate, but they have to learn the appropriate object (a predator) to which to direct the call.

Chickadees communicate mainly by vocal means, and a key to understanding their social lives may lie in understanding their vocalizations (Ficken et al. 1978).

Adult chickadees have 11 different vocalizations and the young several additional ones. Two calls are unusual in their complexity compared to those of non-social songbirds. One, the commonly uttered "Chick-a-dee" call from which the chickadee derives its name, has some particularly interesting features. Most bird vocalizations show no indication of "syntax," i.e. rigid rules for the ordering of syllables. However, chickadees use four different syllables in the "Chick-a-dee" call (A, B, C and D; the first three are the "Chick-a-" component and the D corresponds to "dee"). If all four syllables are included in the call, they must occur in that order. For example, a call may be ABCD, but never CBDA or ADBC (Ficken and Hailman, in prep.). Thus chickadees have a "grammar" ruling the construction of these calls. The "Chick-a-dee" call is a multipurpose call with some variations being used to keep the flock together, other syllable combinations indicating alarm. For example, the syllable combination BC is often given in flight, but BCD is always given when perched. The system becomes more complicated because each syllable may be repeated a number of times in the same call, and calls with different numbers of syllables may communicate somewhat different information (Ficken, in prep.). For example, when chickadees are mobbing an owl, they sometimes give calls with long strings of D syllables, as many as 30 in a single call (Apel 1975). Thus, the chickadee has a very complex call that may communicate varied information, depending on the syllabic content of the call.

Another very complex call is a very sputtery sounding one which we have termed the "Gargle" (Ficken et al. 1978). This call is usually given only by males and is often associated with aggression. Gargles are often uttered at feeders when one bird attempts to gain access to the food and another is present. We think this call has a message "If you don't move away now I will attack you" because the recipient usually leaves, but if he does not, he is usually attacked (Ficken, Weise and Reinartz, in prep.). As was the case with the "Chick-a-dee" call, Gargles are comprised of an array of syllables. Gargles are even more complex than "Chick-a-dee" calls in having more syllables and a complex pattern of syllable combinations. Again, there seem to be rules; some syllables are more typical at the beginning, others at the end of the call. The syllables at the beginning of the Gargle may identify the population to which the chickadee belongs, while those at the end just specify "This is a Black-capped Chickadee calling" (Ficken and Weise, in prep.). Local dialects occur in Gargles. For example, chickadees at Riveredge Nature Center, only 5.7km from the Field Station, have quite different Gargles than Field Station birds, and those from Grafton 9.8km from the Field Station are very different. Dialects are quite common in bird songs but are unusual in vocalizations such as the Gargle, which is not involved in territorial advertisement or in attracting a female from a distance.

We studied winter flock organization in one flock at the Field Station (Ficken et al. 1981). By recording the frequency with which different individuals associated, we determined that the strongest bonds were between members of a mated pair,

with weaker bonds to other members of the flock. In this particular flock, several of the young and more socially subordinate members were somewhat peripheral to the rest of the flock.

Wipf (1981) studied agonistic encounters of chickadees at feeders and found that the orientation of one chickadee to another was an important indicator of the outcome of encounters. When one bird faced another directly, it was likely to be the winner of an encounter. Responses to mirrors were also studied at a feeder; chickadees decreased feeding more when the mirror rather than the foil-covered control was present, while a few of the more dominant birds even threatened the mirror (Censky and Ficken 1982).

Vocalizations are influenced by weather as shown by Plonczynski (1977). She analyzed the effect of six weather factors (temperature, light, precipitation, wind speed, humidity and barometric pressure) on six chickadee vocalizations and found a complex interrelationship occurring in the influence of weather on vocalizing. She also studied the annual cycle of vocalizing, finding that singing peaked in April (probably associated with territorial advertisement), but that many calls were common throughout the year.

While our other studies emphasized frequency and temporal aspects of vocalizations, Witkin (1975) performed a detailed sound amplitude study of different chickadee vocalizations, the first such analysis that had ever been performed in a field study of avian vocalizations. He found a general correlation between amplitude and call function, e.g. calls used at close range had lower amplitudes than those used over longer distances. Also, there was a link between amplitude of a call and the motivational state of the caller. Aggressive calls given by dominants had a higher amplitude than the same calls uttered by more subordinate birds. The amplitude of certain call notes tended to be greater when birds were separated from flocks than when they were all together in the flock.

Song in chickadees is different from that of most other birds in several respects (the whistled "Fee-bee" is considered the song of this species) (Ficken 1981). In most birds, song is the most complex vocalization in the species' repertoire. However, in chickadees, calls with social functions such as the Gargle and "Chick-a-dee" call are more complex than song. Another difference is that in most species song is confined to the breeding season, but chickadees sing almost year-round. Song may have a reduced role in pair formation in chickadees, since pairing takes place in winter and song is not used to attract a female from a distance, unlike most species. However, chickadee song is similar to the songs of other species in being used in territorial advertisement during the breeding season. In addition, song in chickadees is sometimes used in directing flock movements. When a male moves off from the flock and initiates feeding in a new area, he may sing and the flock often responds by approaching him (Ficken et al. 1978).

Songs of different species, even closely related ones, are usually quite different and may function in reproductive isolation. Abbey (1979) played the songs

of Black-capped Chickadees, Mountain Chickadees (*P. gambeli*) and Carolina Chickadees (*P. carolinensis*) to Black-capped Chickadees at Riveredge Nature Center. Black-capped Chickadees responded only very weakly to Mountain Chickadee songs, but 50% of Black-capped Chickadees responded to Carolina Chickadee songs as well as to their own species' songs. Black-capped and Carolina Chickadees hybridize occasionally, and this may be facilitated by response to the other species' vocalizations.

The major conclusion of the studies of vocalizations is that chickadee vocalizations are much more complex than those of non-social songbirds. In fact, the "Chick-a-dee" call and the Gargle are the most complex non-song vocalizations that are known in birds. The reasons for their complexity probably lie in the role of calls in mediating social interactions such as flock coordination and alarm (the "Chick-a-dee" call) and aggressive interactions (the Gargle). In other words, vocalizations of social species may have been subjected to selection for communicating information such as subtle motivational states including degrees of alarm in response to predators, which is less important in birds that do not live in groups.

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