Ontario Gray Jays Help on the World Stage: Part 1

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Readers of *Ontario Birds* may not be generally aware of the phenomenon of "helping" in birds. Found in over 200 species worldwide and sometimes called cooperative or communal breeding, helping is characterized by more than two adults participating in parental activities such as nest building, attacking nest predators, and especially the feeding of nestlings. Ontario birders are also probably unaware that study of one of our province's common species, the Gray Jay (*Perisoreus canadensis*), may have provided a useful contribution to understanding this behaviour. In December 2001, Tom Waite of Ohio State University and I developed this idea in an article published in the *Canadian Journal of Zoology* (Strickland and Waite 2001). I am pleased to present a less technical version in this and the following issue of *Ontario Birds* which I hope will explain our idea to a wider audience. Here, in Part 1, I summarize the present thinking about communal breeding (as I much prefer to call helping) and describe the challenge to this thinking that the Gray Jay poses. In Part 2, I will discuss the hypothesis we offer to explain the Gray Jay's puzzling social behaviour. I will also suggest how our Gray Jay perspective may be extended to help explain the absence or presence of communal breeding around the world.

Communal breeding in birds was first reported in 1935 by Alexander F. Skutch, the great American naturalist who has spent over 70 years, mostly in Costa Rica, documenting the lives of neotropical birds. Skutch described how the nests of three species (Brown Jay *Cyanocorax morio*, Black-eared Bushtit *Psaltriparus minimus*, and Banded Cactus Wren *Campylorhynchus zonatus*) were regularly attended by more than two adults (Skutch 1935). Because the extra birds made numerous trips to the nest with food for the nestlings, Skutch called the extra birds (and his paper) "Helpers at the nest". Unfortunately, the words "helper, help, and helping" have stuck ever since (see box, "The Name 'Helping' is not Helpful!").

Little or no attention was paid to Skutch's discovery for several decades but, in the 1960s, people began to recognize what a paradox it represented. The intellectual underpinning of biology is evolution through natural selection. That is, everything we see in an organ-

The Name "Helping" is not Helpful!

The name "helping" is unfortunate because it carries an inescapable connotation of benefit. It may seem self-evident that nonbreeding birds must be doing something positive when they direct parent-like behaviour to another bird's young but, until proven, that idea is only presumption—not a fact.

Even worse is the equally widespread use of "helping" to designate the specific act of feeding another bird's young. To see why, consider the situation in the Florida Scrub-Jay (*Aphelocoma coerulescens*). In this well-known communal breeder, nonbreeders associate with, and feed the nestlings of, about half of all breeding pairs. Pairs with nonbreeders produce more young than do pairs without nonbreeders and it may therefore seem justified to conclude that the extra feeders are helping the breeders when they feed the nestlings. The trouble is that the improved production of young is brought about by the improved nest defence provided by the nonbreeders, not by the food they bring. If we were to use "helping" to designate the feeding of nestlings by nonbreeders, therefore, we would logically be able to say that "nonbreeding Florida Scrub-Jays help (i.e., confer benefit), but not when they help (i.e., feed nestlings)".

The way to avoid such confusion is to define and use clear terms that carry no presumption about the function of the behaviour they refer to. Thus, we should never use the terms "cooperative breeding" or "helping" unless we have evidence that actual cooperation or benefits are involved. Until then, when we see more than two birds involved in a nesting effort, we should say "communal breeding". Similarly, we should never assume that feeding another bird's nestlings amounts to "help". Instead, we should use the term "allofeed" as suggested by one of the leading scientists in the field, Jerram Brown (1987). Then we can say—sensibly this time—that nonbreeding Florida Scrub-Jays help, but not when they allofeed. And, if it seems that I am splitting hairs here, trust me; as far as Gray Jays are concerned, the old, still entrenched terms (helping and cooperative breeding) were serious impediments to understanding the behaviour of these birds.

ism, from its physical make-up to its behaviour, is thought to be the way it is because the feature in question results in the greatest survival and mating success—and ultimately in the greatest production of surviving young. Any individual that has some heritable property which results in a longer life or greater success in mating will, other things being equal, leave more descendants than its rivals and consequently the beneficial property will become more and more widespread

in the species with each passing generation. Conversely, if an individual has some new heritable physical feature or behaviour that results in a shorter life and/or less breeding success, the new feature will not spread or become established in the population. Instead, it will disappear—quickly weeded out by an unconscious "natural selection"—just as surely as if, say, a human animal breeder were deciding which individual dogs or pigeons will be prevented from passing on their properties to the next generation.

But, given this fundamental truth about the evolution of living organisms, how can we possibly explain "helping" or communal breeding in birds? How can individuals that refrain from breeding pass along the genes for such restraint to succeeding generations? How can individuals with a proclivity to forgo breeding themselves and instead to "help" the breeding of others possibly persist in a species? Seen in this light, communal breeding was recognized, not as some inconsequential side-show of nature, but as a major challenge to the idea of evolution by natural selection—and therefore to the very foundations of modern biology.

Attracted by the huge implications of resolving—or not resolving—such a big question, dozens of ornithologists began detailed, long-term studies of colour-banded populations of communally breeding species on every continent. In the 1970s and 80s, this became one of the hottest fields in ornithology and it continues to be one of the most fascinating to many scientists right up to the present. Specific studies have investigated Dunnocks (*Prunella modularis*) in Europe; Pied Kingfishers (*Ceryle rudis*), White-throated Bee-eaters (*Merops bullockoides*), and Green Woodhoopoes (*Phoeniculus purpureus*) in Africa; Superb Blue Wrens (*Malurus cyaneus*), Noisy Miners (*Manorina melanocephala*), and Grey-crowned Babblers (*Pomatostomus temporalis*) in Australia; Hoatzins (*Opisthocomus hoazin*) and Stripe-backed Wrens (*Campylorhynchus nuchalis*) in South America; and, closer to home, Florida Scrub-Jays, Mexican Jays (*Aphelocoma ultramarina*), Pinyon Jays (*Gymnorhinus cyanocephalus*), and Acorn Wood-peckers (*Melanerpes formicivorus*) here in North America. Although many of the original questions had been partly or completely solved by the 1990s (see box, "Why Stay at Home and Feed Young That Aren't Yours?"), there still remained a number of unanswered questions about communal breeding. One of these concerned the uneven distribution of communally breeding birds around the world. It was understandable that many would be tropical species because it is in the tropics that birds tend to be permanently territorial. Tropical species are also often at "saturation density" because their numbers aren't decimated once or twice a year in long and dangerous migrations. Both of

Figure 1: Nestling Gray Jays are fed exclusively by their own parents, never by any nonbreeder that may also be on the territory. Photo by *Dan Strickland.*

Figure 2: A fledgling Gray Jay like this one is sometimes fed by a nonbreeder as well as by its own parents. Photo by *Dan Strickland.*

Why Stay at Home and Feed Young That Aren't Yours?

Communal breeding turned out to be less of a paradox than it first appeared. For one thing, in most species, allofeeders (i.e., "helpers") were almost never refraining from breeding. They had little or no choice. Usually they were young birds still living with their parents because they had been unable to find territories of their own. Other times, they belonged to species where only older birds with a great deal of experience had any hope of breeding successfully. Either way, the young birds had almost no chance of breeding themselves. Still, this does nothing to explain why the nonbreeders should actually spend energy feeding young birds that aren't their own.

From various studies, it emerged that there was not just one possible answer to this important question. Indeed, the leading theoreticians in the field, both as it happens from just next door to Ontario (Jerram Brown of the State University of New York at Albany, and Steve Emlen of Cornell University in Ithaca), have listed at least nine hypotheses that may explain how communal breeding could be useful in one species or another (Brown 1987, Emlen et al. 1991). Basically, these hypotheses are of two types. In the first category, the proposed explanations suggest that the allofeeder benefits *directly* from his or her actions. One idea, for example, is that, by helping to raise young birds, the allofeeder gains valuable experience that will make it a more productive parent when it becomes a breeder itself. Another idea in this category is exemplified by the Florida Scrub-Jay (Woolfenden and Fitzpatrick 1984). In this species, a nonbreeding bird improves its chances of becoming a breeder by helping a breeding pair to raise more young birds than it would otherwise. The consequently enlarged family expands its territory at the expense of smaller neighbouring groups and then the nonbreeder "buds off" part of the

these factors tend to produce conditions where young birds can't find vacant territories and are therefore forced to stay at home as nonbreeders. Still, other features about the geographic distribution of communal breeders were not so obvious. In particular, such species are especially abundant in Australia. About 10 percent of birds down under breed communally, as opposed to only 2 percent elsewhere, even including ecologically apparently similar areas in Africa, Asia, and South America.

Another mystery was why some birds here and there around the world lived in family groups but, at least in the nestling period, did not exhibit communal breeding. These included the Western Scrub-Jay (*A.*

new, bigger territory and claims it as his own. The nonbreeder has become a breeder, in effect, by helping the adults to "raise an army" that ends up conquering a territory for his use.

The second type of explanation that has been proposed to explain communal breeding relies on the fact that allofeeders are usually still at home with their parents. The allofeeders are, therefore, feeding their own younger brothers and sisters. These younger siblings and the helpers consequently share half their genes. This is the same proportion of genes that would be shared by an allofeeder and its own offspring if it had any. In other words, by helping to raise more or healthier siblings, an allofeeder is *indirectly* advancing the cause of its own genes much the way it would be doing *directly* if it could raise young of its own.

Of course, all of these proposed explanations rest on the assumption that "helpers" really do gain and/or confer some benefit. But is this really true? At first blush, this may seem like a silly question. Surely it is self-evident that the act of putting food down the throats of nestlings can only be helpful. Everyone knows how hard bird parents have to work to find food for their young and a fundamental prediction of evolutionary theory is that birds should lay clutches that result in the maximum number of healthy, surviving young. Surely, under these circumstances, the efforts of nonbreeders can only be of benefit.

Well, not necessarily. Detailed studies in many species have failed to reveal any improvement in the production of young when allofeeders are present. That is, in some species, unaided parents do just as well as those supposedly benefiting from the "help" of allofeeders. And, as we shall see in Part 2, there is at least one way that allofeeding could be anything but helpful. It could be downright harmful.

californica) at the southern end of its range near Oaxaca, Mexico (Burt and Peterson 1993), and the Siberian Jay (*P. infaustus*; Blomgren 1971, Ekman et al. 1994), the Eurasian counterpart of our own Gray Jay. The Green Jays (*Cyanocorax yncas*) of Texas were another example of a species where nonbreeders are present in family groups but apparently never feed young (Gayou 1986). This was especially mysterious because an earlier study had shown that communal breeding does occur in Green Jays in Colombia (Alvarez 1975). Why would the same species exhibit the behaviour in one place but not in another?

The Gray Jay is also one of these exceptional species in which

nonbreeders in the family group do not feed nestlings (Strickland and Ouellet 1993) and for years I pondered why. If multiple good reasons had been proposed for communal breeding in other birds, why did Gray Jay nonbreeders fail to collect on these supposed benefits? In Algonquin Park, about 20 percent of all breeding pairs are accompanied by nonbreeders (most commonly one of their own young from the previous year) at the beginning of the breeding season around March 1. These nonbreeders are usually males and have no chance, at that late date, to find an unoccupied territory and a mate, let alone successfully breed. Why, then, since they have nothing better to do, do they not help Mom and Dad feed their current batch of nestlings? Would the nonbreeders not gain valuable experience by doing so? By increasing the production of younger brothers and sisters, would they not improve the transmission of their common genes to the next generation? And how could they fail to improve the production of nestlings by joining the adults in feeding them? Remember, the act of feeding nestlings by nonbreeders was universally known by the loaded term, "helping". And surely, if any species needed help with its nesting, it was the Gray Jay. Throughout the boreal and subalpine forests of North America, this species nests when the snow lies deep on the ground and the thermometer usually indicates well below freezing. It brings its young off the nest long before most migratory species have even returned to the boreal forest, let alone started to nest themselves. Under such conditions, how could a pair of nesting Gray Jays not benefit from the assistance of an extra forager? And yet, the truth was, as I saw many times, that nesting Gray Jays actively harassed any nonbreeder that was present, including their own young from the year before. Parental hostility towards nonbreeders usually begins in the nest-building period and reaches a peak in the nestling period. Most of the time any nonbreeder, if seen at all during the nesting season, is far from the nest. And, if the adults are present, they often chase it relentlessly.

I readily confess that this Gray Jay behaviour in the nesting season completely stymied me. And, if anything, things got even more mysterious before they got better. In 1994, Tom Waite, fresh from a Ph.D. based on his winter food storage studies of the Gray Jay in Alaska, came to Algonquin Park and made a surprising discovery. He found a group of fledglings being fed, not only by their parents, but also by GOSLWOPR (acronym for the bands Green Over Standard Left, White Over Purple Right), their older brother born on the same territory the year before. And, over the next two weeks, GOSLWOPR went on to account for fully 22 percent of observed feedings.

The following year, we made

further observations of the same pair and confirmed that the behaviour we watched in 1994 was not a fluke. In particular, we saw that, in our Algonquin Park Gray Jays at least, allofeeding behaviour starts only in the fledgling period. The 1995 nonbreeder tried to reach the nest many times in the nestling period but he never got there. He was vigorously chased, or even struck in mid-air, whenever he approached the nest. And yet, the day after the one young left the nest, the nonbreeder began to feed it. Indeed, the 1995 nonbreeder accounted for 39 percent of all the feedings of the fledgling (compared to 50 percent by the breeding male and 11% by the female). Since then, we have observed four more cases of nonbreeders (at least one of them completely unrelated to the family involved) failing to feed nestlings but starting to feed them in the fledgling period. We have also observed at least one case where a nonbreeder refused to feed his younger fledged siblings, even though he was not prevented from doing so by the adults and in spite of the fact that the fledglings often begged at him.

When we had assimilated the discovery that allofeeding sometimes occurs in Gray Jays, but only after those siblings have fledged, we saw that we had an even bigger problem to explain. No longer could we ask "merely" why communal breeding does not occur in this species. Now we had to explain why it does not occur in the nestling period but can sometimes occur in the fledgling period! Why would Gray Jay parents suppress allofeeding in the often wintry nestling period and then allow it in the fledgling period, precisely when new food is starting to become readily available and extra "help" from a nonbreeder would seem to be less important?

This, then, was the challenge in trying to understand Gray Jay social behaviour. In Part 2, to be published in the next issue of *Ontario Birds*, I will present what Tom Waite and I propose as an answer to this challenge. In the meantime, why not try to solve the puzzle yourself? Come up with as many hypotheses as you like, see if you can reconcile them with Gray

Jay behaviour as described above, and try to imagine ways that you might use to actually test your hypotheses. Have fun!*

*To be fair, you will need one more clue to come up with a hypothesis—or at least the same one we develop in our paper and through the same reasoning. Here it is: while we were watching adult Gray Jays feeding fledglings, we noticed that the young birds were fed by their parents much more frequently than in the nestling period.

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