Consumption of Larvae by the Austral Parakeet (*Enicognathus ferrugineus*)

Soledad Díaz¹,³ and Salvador Peris²

ABSTRACT.—We report observations of the Austral Parakeet (*Enicognathus ferrugineus*) feeding on larvae in the northern part of its distribution in the austral temperate forests of Argentine Patagonia during the pre- and post-reproductive seasons. Larvae consumed were *Aditrochus fagicolus* (Chalcidoidea: Pteromalidae) in leaf galls of *Nothofagus pumilio* (79 observations), larvae from Homoptera, Lepidoptera, and Diptera in seed galls of *N. pumilio* (12 observations), and larval Nemonychidae (Coleoptera) in male cones of *Araucaria araucana* (69 observations). Our observations suggest *Enicognathus ferrugineus* could be more insectivorous than previously thought, perhaps to help meet their demand for high-quality food during the pre- and post-reproductive seasons.

Received 3 December 2010. Accepted 8 October 2010.

Temperate birds apparently time breeding to coincide with annual peaks in food availability as food can be an important limiting factor, especially in habitats with sharply defined cold and warm seasons (Newton 2003). Breeding behavior involves a large parental investment prior to the laying period, when birds search for high-quality food to attain adequate physiological condition (Krebs and Davies 1993).

Parrots (Psittaciformes) are generally known for being mostly seed-eaters (Collar 1997), but their diet can vary depending on the habitat. Parrots breeding in temperate forests experience a markedly seasonal environment where protein-rich food (important during pre-breeding stage; Martin 1987, Koutsos et al. 2001) is scarce prior to summer, and is limited primarily to pollen and nectar, which become available in late spring (Diaz and Kitzberger 2006), or larvae (Moorhouse 1997). Protein requirements are high for nestlings and females with large broods (Koutsos et al. 2001). Parrots with large broods inhabiting temperate habitats must find an extra protein supply before and during the reproductive season, just when protein-rich foods may be most scarce.

The Austral Parakeet (*Enicognathus ferrugineus*) is restricted to Andean temperate forests in Patagonia from 36 to 54° S (Collar 1997), and information on its biology, ecology, and population status is scarce. Given their extreme southern distribution, the lack of knowledge about their adaptations to the austral climate highlights the importance of understanding their ecological and reproductive requirements. Pairs breed once per year; laying starts in December (late spring) and nestlings fledge in March (late summer). Broods are large with respect to body size with females laying between five and eight eggs (Collar 1997). Only anecdotal data concerning the bird’s ecology (mainly diet and breeding aspects) were available prior to 2001. Leaves, flowers, fruits, seeds, and occasionally larvae comprise its known diet (Forshaw 1989, Collar 1997, Díaz and Kitzberger 2006). Diaz and Kitzberger (2006) report that Austral Parakeets in lenga beech (*Nothofagus pumilio*) forest varied seasonally, following forest phenology and availability of food resources. The diet of the Austral Parakeet includes buds and pollen from lenga beech and its hemiparasite *Misodendrum* in the pre-reproductive period; leaves of both species and seeds of *Misodendrum* during the reproductive season; and lenga beech seeds during the first part of the post-reproductive season. Food becomes scarce as winter approaches, and their diet is then comprised of low nutritional food such as *Cyttaria* spp. fruit bodies and buds. We found sporadic intake of larvae was more frequent than previously known and report observations of these unusual feeding habits of this species.

OBSERVATIONS

We conducted field research from 2007 until 2009 to document the basic foraging behavior of the Austral Parakeet in an Argentine mixed lenga beech and pehuén (or monkey puzzle tree) (*Araucaria araucana*) forest (hereafter MF),...
within the northern part of the Austral Parakeet’s distribution (37° S, 71° W) near the Chilean border at 1,050 m elevation. Feeding behavior of Austral Parakeets from a southern location was also recorded during November–December 2005, 2008, and 2009 in a pure old-growth Nothofagus pumilio forest (hereafter PF) at 41° S, 71° W; 1,300 m elevation.

Observations were made while systematically walking along human and animal trails, covering the entire study area between 0800 and 1100 hrs in the morning (720 hrs in MF and 288 hrs in PF). We recorded the exact location each time a parakeet or flock was detected, and the identity of food items consumed to species level. If the parrots changed to another food source during the period of observation, the new material was recorded as a different feeding bout (Galetti 1993). Each feeding bout varied from a few seconds to several minutes with the entire flock participating in each observation.

Flocks of five to 39 birds were observed within MF on 43 occasions during November and December eating Aditrochus fagicolus (Chalcidoidea: Pteromalidae) larvae (Nieves-Aldrey et al. 2009) in lenga beech leaf galls. Additionally, we recorded occasional consumption of lenga leaf galls 36 times during November–December in 2005, 2008, and 2009 in PF. Flocks of between 60 and 80 individuals were seen eating the contents of leaf galls, always in the same PF patch within each of the 3 years. We observed 221 Austral Parakeets (flocks between 4 and 7 birds) during December between 2007 and 2009 in MF on 69 different occasions eating larvae of Nemonychidae (Coleoptera) inside male pehuén cones. Austral Parakeets were observed 12 times (136 individuals in flocks of 8–11 birds) eating lenga beech seed galls (Mar–Jun 2008 and 2009). These galls housed insects in the Orders Homoptera, Lepidoptera, and Diptera. The parakeets ate only the larvae and discarded the vegetative parts of the gall (lenga beech leaf and seed galls) or pehuén male cone in all cases.

### DISCUSSION

Consumption of larvae was mainly concentrated during the pre-reproductive period (92.5% of the observations), indicating synchronization between demand for high-quality food, and the sporadic and concentrated appearance of galls and cones. Food availability in MF throughout the pre-reproductive period (Dec) of Austral Parakeets is relatively low and primarily consists of pollen of 10 different species (SD, unpubl. data). Austral Parakeets were selective during this period and only consumed lenga beech, pehuén, and Misodendrum pollen. All observations of Austral Parakeets foraging on larvae contained within male pehuén cones were obtained during this period. These cones take half a year to complete their development and are hard to open while green. December, when the pollen is released, is the only time of the year when the male cones are fully developed and easy for Austral Parakeets to open and take advantage of the opportunity to forage on them. Larvae develop partially inside the cones until the cones are mature and fall from the trees, making them unavailable to parakeets. There are no observations of Austral Parakeets feeding on male cones or larvae contained within them once they have fallen to the ground. Lenga beech gall consumption was also concentrated in the pre-reproductive period in both locations. Parakeets consumed mature and immature galls, which are distinguishable by their color, suggesting that larvae of different sizes were ingested. Parakeets were not observed to feed on larvae or insects during the reproductive season, when alternative sources of food were more available. The parakeets fed primarily on leaves and seeds (SD, unpubl. data for MF: Diaz and Kitzberger 2006 for PF) during this period.

The consumption of larvae contained in lenga beech seed galls was only observed during the post-fledging period, when almost all lenga beech seeds are mature. These larvae may represent an important protein source for juveniles as the galls are available until winter (SD, unpubl. data), and lenga beech seeds have only 12% protein and 19% lipids (Diaz and Kitzberger 2006). This suggests post-reproductive events, including juvenile dispersal and molting, rather than nesting, coincide with a short period of elevated protein-rich food availability.

Adult arthropods infest galls and cones in a locally aggregated way (e.g., stand of trees) (J. L. Nieves-Aldrey, pers. comm.). Parakeets appear to know the precise location and timing of this food source, because they used it year after year in the pre-reproductive season. Thus, Austral Parakeets maximize exploitation of ephemeral protein-sources during the period of high nutritional demand that occurs after winter scarcity.

Forshaw (1989) indicated parrots are far more insectivorous than generally suspected. Insects are
common in the diet of some Australian parrots, including Major Mitchell’s Cockatoo (*Lophochroa leadbeateri*) (Rowley and Chapman 1991), Western Corella (*Cacatua pastinator*) (Smith and Moore 1991), and New Zealand Kaka (*Nestor meridionalis septentrionalis*) (Moorhouse 1997), as well as Rüppell’s Parrot (*Poicephalus rueppelli*) (Selman et al. 2002), but only when other food is scarce.

The consumption of arthropods by neotropical parrots may be more common and widespread than previously thought. Seasonal variations in diet with occasional ingestion of adult insects and spiders have been noted for some species (Galetti 1993, Wermundsen 1997). Diptera larvae have been found in stomach contents of Blaze-winged Parakeet (*Pyrrhura devillei*) (Moojen et al. 1941) and Peach-fronted Parakeet (*Aratinga aurea*) (Schubart et al. 1965). The Painted Parakeet (*Pyrrhura picta*) has been reported extracting and eating arboreal termites from their nests (de Faria and Forshaw 2002). Our results suggest the Austral Parakeet is more insectivorous than previously thought. They inhabit temperate forests with marked seasonal shortages of food which may have led them to occupy a broader dietary niche than other parrots by supplementing their intake of high-quality food, such as pollen (Diaz and Kitzberger 2006), during the pre- and post-reproductive season with novel items such as insect larvae.

**ACKNOWLEDGMENTS**

The authors thank Cameron Naficy for his support, John Blake, Kristina Cockle and Nigel Collar for their constructive comments that helped to improve this manuscript, and Delegación de Parques Nacionales and especially the staff of Lanin National Park. Financial support was from the Spanish MEC, project CGL2004-01716-Feder, and a CONICET doctoral grant to S.D. This research is part of the Doctoral studies of the senior author.

**LITERATURE CITED**


