Effects of Diet, Migration, and Breeding on Clay Lick Use by Parrots in Southeastern Peru.

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Introduction

Soil consumption (aka geophaghy) is very common among mammals worldwide. A wide variety of mammals eat soil including wild and domestic ungulates, rodents and primates (including humans). In fact there are mammals that eat soil on every continent except Antarctica. Among birds, geophagy is less well known and intensive scientific studies are much less common. Parrots and pigeons are the most common avian soil consumers, but a fair number of game birds (Galliformes) and perching birds (Passeriformes) have also been recorded consuming soil. The common feature of most soil-eating vertebrates is that they feed almost exclusively on plants. As a result you will rarely find wild cats, hawks or other predators eating soil.

A wide variety of reasons have been proposed for why animals eat soil. I will focus here on the three most widely accepted theories: grit for grinding food, mineral supplementation and adsorption of dietary toxins. Many birds are known to eat small pebbles or gravel to help them grind the hard seeds in their diet. This includes robins, game birds and others (Best & Gionfriddo 1991). These species ingest relatively large particles (> 0.5 mm diameter) that remain in the muscular gizzard where grinding occurs. However the evidence suggests that the parrots and pigeons that I study in Peru do not consume soil as grit because the birds choose the finest clays with particles much too small to aid in grinding (Brightsmith & Aramburú 2004; Gilardi et al. 1999).

Another common explanation for why animals consume soil is mineral supplementation. In general nutrients are often in short supply in many ecosystems. In particular sodium is often cited as an important reason why animals eat soils. In fact in temperate areas most geophagy sites are referred to as salt licks. Sodium is scarce in the diets of herbivorous animals because it is found in low concentrations in most plants. In fact many plants actively avoid uptake of sodium. However sodium is vital for a wide variety of animal functions including maintenance of osmotic balance, nerve transmission etc. For this reason humans and other animals show such strong cravings for sodium and actively seek it out. In Peru studies show that parrots have diets with extremely low concentrations of sodium and that these birds eat the soils with the highest concentrations of sodium (Brightsmith & Aramburú 2004; Gilardi et al. 1999).

Most plants contain toxic defense chemicals that function to keep animals from eating them. Many of these toxins are well known to people including caffeine, nicotine, tannins (that make wine and tea taste dry), digitalis, cocaine, opium etc. In high concentrations many plant chemicals can be fatal. Many such compounds occur in the seeds and unripe fruits that make up the bulk of parrot diets. As a result parrots consume a large number of toxic substances each day. Work at UC Davis by James Gilardi has shown that the clays consumed by parrots in southeastern Peru can bond to certain types of toxic chemicals and prevent their uptake by parrots. In this way the clay lick soil may help protect the parrots from the toxins in the seeds that they eat. In summary the scientific evidence suggests Peruvian parrots do not eat soil for grit but they do consume soil that provides an important source of dietary sodium and helps neutralize the plant toxins in their diet.

In this article I provide data on the seasonal patterns of clay lick use by parrots at Tambopata Research Center. I then show how parrot "migrations," breeding and diet may be interacting to produce these seasonal changes in lick use.

Study site

The study was conducted at Tambopata Research Center an ecotourism lodge run by the Peruvian owned and operated company Rainforest Expeditions. The site is in the southwestern Amazon Basin at an elevation of 250 m above sea level and receives over 3000 mm of rain per year. The clay lick is about 500 m long and 20 to 30 meters high and is a formed by the erosion of the upper Tambopata River. The site has a weak dry season from April to September.

Methods

Clay lick use data was collected from February 2000 to November 2002. Observers arrived before sunrise and recorded the number of birds on the lick every 5 minutes. On 606 mornings the observers remained until the early morning rush of activity ended (7:00 – 7:30 AM), while on 280 days the observers remained until the late afternoon (4:30 PM or later). Additional data from 2003 have been collected and are currently being processed.

Over 1000 bird censuses were conducted in the afternoons from January – December 2003 in the areas surrounding TRC. Censuses lasted 10 minutes each and were conducted at 20 different points in the forest. They were conducted in the afternoon at the time of minimum lick use so that birds moving to and from the clay lick would not unduly influence the counts of birds in the forest.

Scarlet macaw nests and chick growth were monitored in the forests around Tambopata Research Center from November 1999 to March 2003. In total 26 nests were monitored and 24 chicks weighed and measured from hatching to fledging.

Crop samples were taken from Scarlet Macaw chicks from December 2003 – February 2004 following the protocol outlined by (Enkerlin-Hoeflich et al. 1999). A total of 29 samples were taken from chicks ranging in age from 20 to 80 days.

Results and Discussion

My assistants and I recorded 16 species of parrots, two guans and three pigeons on the clay lick during data collection, including: Green-winged, Scarlet, Blue and gold, Severe, Red-bellied and Blue-headed Macaws; Mealy, Yellow-crowned, Orange-cheeked (Barraband's) Parrots; Blue-headed Pionus; White-bellied Caique; White-eyed and Dusky Conures; Amazonian and Dusky-billed Parrotlet; and Cobalt-winged Parakeet. This includes ALL the common parrot species at the site. On some days over 1,300 parrots were seen arriving at in the area of the lick. In total we logged over 300,000 records of parrots using the lick making this one of the world's largest data sets on wild parrots.

Lick use showed two marked seasons: a high season from August through January and a low season from February through July. These seasons did not match up with the changes from wet season to dry season. Instead I found that the birds' lick use closely paralleled the abundance of birds in the forest recorded during the afternoon parrot censuses. In fact it looks like low lick use season may be due in part to the fact that many of the parrots "migrate" away from the area. The reason why the birds leave is unknown, but data from nearby Manu National Park suggest that the period of low lick use and parrot migration away from the area corresponds with a period of very low fruit availability (Terborgh 1983). This suggests that the birds may be leaving the area due to a general lack of food. To date I do not know where the parrots go upon departure.

The high season of lick use is apparently due to a mixture of factors. The birds return to the area probably due to an increase in the food supply or in anticipation of breeding or both. However there are marked differences among species in their peak month of lick use: Blue-headed Pionus (*Pionus menstruus*) peak in July while the three large macaws peak in January. Ten of the twelve species for which we have breeding data show their strongest peak in lick use during the breeding season. This suggests that some physiological need during the breeding season is driving the birds to increase their consumption of soil. I have two hypotheses for the association between lick use and breeding that I will discuss here:

1. Clay lick use increases during breeding because females need additional calcium to make the eggs.
2. Clay lick use increased during breeding because the adults need to feed clay to the chicks.

The data on the timing of breeding and clay lick use by Scarlet Macaws shows that the peak in lick use does not occur in November at the time of egg laying, thus making it unlikely that the birds are using the lick as a source of calcium. Instead lick use spikes in December just as the chicks hatch. However, lick use drops in February about one month

before the majority of the chicks fledge. This suggests that the annual peak lick use by Scarlet Macaws is due in part to the parents' need to feed clay to young chicks. This finding is corroborated by the food samples taken from the crops of chicks: chicks from 20 to 30 days old had soil in seven of eight samples collected while only one of eight samples collected from chicks over 50 days contained soil.

The reason why chicks need more soil during the first few weeks of life is unclear, but may be due to nutrient needs or low resistance to toxicity. Chick growth data collected from Tambopata show that chicks grow very quickly when young and that their weight reaches that of adults (about 900 grams) by approximately 50 days of age. This suggests that the greatest nutritional needs of the chick are during these first 50 days.

At all ages the parents are feeding the chicks a mix of seeds that probably contain reasonable quantities of toxins. While adult macaws and parrots have a very high resistance to toxins (as much as 50 times higher than adult humans for quinine, (Gilardi et al. 1999), the young chicks may have very low resistance to toxins. If chicks develop their natural resistance to toxins with age, this too could produce a pattern of lick use similar to that found here. The resolution of this dilemma awaits further detailed studies.

In summary, clay lick use in southeastern Peru is highly seasonal. Most species show simultaneous annual lows in lick use during the end of the wet season and beginning of the dry season (April – June). At this time the birds apparently leave the area possibly in response to low food supplies in the area. Annual highs in lick use occur between July and February and differ among species. The peaks in lick use for most species studied coincide with breeding. In particular it seems that adults are feeding clay to their young chicks during the period of maximum growth and perhaps lowest resistance to natural toxins found in their diet.

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