

Observations on the breeding behavior of the Variable Hawk (*Geranoaetus polyosoma*) in the Atacama Desert, Chile

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Received on 18 December 2016. Accepted on 05 December 2017.

ABSTRACT: Although the Variable Hawk (*Geranoaetus polyosoma*) is a common and broadly distributed raptor in the Neotropics, its breeding ecology is almost unknown. Using video cameras, we collected data on the parental and nestling behavior of this hawk at the early-brood rearing period from one location in the Atacama Desert of Chile. An attempt to collect data in a second nest failed due to methodological deficiencies, which suggested improvements to sampling design in future studies. As most accipitrid raptors, we found that the female performed the majority of the parental activities occurring at the nest: she fed the chicks, protected them from high solar radiation and stayed on the nest at night. Nestlings were fed with Chilean Iguana (*Callopistes macullatus*) and Darwin's Leaf-eared Mouse (*Phyllotis darwini*). We also describe some nestling behaviors. With these observations, we add information to the breeding ecology of this species and encourage the use of low-cost technology to monitor wildlife, but with certain considerations.

KEY-WORDS: Accipitridae, breeding ecology, natural history, parental investment, raptor.

Parental care is a set of traits that enhances the fitness of the offspring (Smiseth *et al.* 2012). In birds, care includes nest construction, egg incubation and the feeding and protection of nestlings, among other behavioral and non-behavioral traits (Collopy 1984, Byholm *et al.* 2011, Smiseth *et al.* 2012). This strategy is based on minimizing energy consumption and maximizing the survival of as many offspring as possible, and is determined by the natural history, the evolutionary history of the species and environmental conditions (Stearns 1992, Dawkins 2006).

The Variable Hawk (*Geranoaetus polyosoma*) is an Accipitridae raptor distributed from Colombia to southern Chile and Argentina (Ferguson-Lees & Christie 2010, Bierregaard-Jr. *et al.* 2016). Although this species has a broad distribution range, information about its breeding is scarce (Jiménez 1995, Bierregaard-Jr. *et al.* 2016) and there is no data from populations in the Atacama Desert. Therefore, our objective is to provide primary information about the parental care of Variable Hawks from two locations in the Atacama Desert of Chile.

We obtained pictures and video recordings from two nests: one was located in the Morado Canyon area (26°46'45"S; 70°42'52"W, 133 m a.s.l.) and another one in the Tamarico canyon area (28°26'17"S; 70°46'58"W, 628 m a.s.l.). In El Morado, we set a trail camera (Bushnell: Trophy Camera Brown HD, Model 119537C) near an active nest with two nestlings of approximately 30 days-old (*sensu* De Lucca 2011) on a rocky cliff 15 m high. The camera took video recording during the 1st and 2nd of December 2015, and took photographs between 02 and 04 December 2015. We also set an extra camera (Sony camera, model DSH-HX60V) at 6 m from the nest to obtain more detailed footages which continuously filmed for 26 min on the 2 December 2014, starting at 10:28 h. In Tamarico, the camera was set on a pole on 1 October 2015, 20 cm away from an active nest with three chicks of approximately 40 days-old (*sensu* De Lucca 2011). Video recording was made to assess if chicks became habituated to the camera, but this did not happen (see details below).

In the El Morado nest, 23 parental visits were recorded, almost all by the female (95.7%). Due to the limited visual range captured by the cameras, the parental

effort by the male could not be determined. De Lucca (2011) found the male was mainly focused on hunting for the nestlings and defending the nest; it mostly brought food to the nestlings, that was deposited in nearby perches where the female collected it to feed the nestlings. Such behavior may not be recorded by our camera system. Additionally, we have not recorded potential helpers in the nest, as suggested by Alvarado & Figueroa (2006) for this species, based on a nest whose defense against human intruders involved three individuals. In Tamarico we did not record any parental visits, because the proximity of the camera caused the female to fly away from the nest and watch us from a distance.

On 01 December 2015 the day was sunny with high temperature, and the female of El Morado stayed on the nest at noon (11:47–13:04 h). She protected the chicks from the direct solar radiation covering them with her body and wings (Fig. 1A). Similar behavior was recorded by De Lucca (2011) for this species, and for Black-chested Buzzard-Eagle (*Geranoaetus melanoleucus*) by Pavez (2001). This is a typical behavior for species that inhabit environments with high solar radiation, and aims to help nestlings to avoid hyperthermia (Whittow 1986). This behavior was not recorded during cloudy days. We also observed the chicks panting to avoid hyperthermia during the day.

In relation to nest predation, the female in El Morado stayed on the nest at night (from 20:55 to 06:57 h) always observing the surroundings. In Tamarico the female performed an immediate defensive reaction when we approached to install the camera: she perched near the nest or flew in circles in the surroundings. The nestlings reacted in a different way: they opened their wings and vocalized a wheezy sound with their beaks open. We think these actions are anti-predatory behaviors when chicks face an unknown threat. De Lucca (2011) reported similar behavior when he touched chicks.

The chicks from El Morado intentionally defecated outside the nest (chicks approached the nest edge raising the tail and ejecting feces far from the nest; Fig. 1B), which was proposed as an adaptation to avoid parasite proliferation (Ibáñez-Álamo *et al.* 2016). This kind of behavior has been reported in other Accipitridae species, which also use sanitizers on nests (Orians & Kuhlman 1956).

In El Morado, chicks were fed with Darwin's Leaf-eared Mouse (*Phyllotis darwini*) (Fig. 1C) and Chilean Iguana (*Callopistes maculatus*) (Fig. 1D). This matches the diet composition of this species found by Faúndez *et al.* (2015) for Variable Hawks, and confirms that not only adults feed on these species. The Chilean Iguana was heterogeneously given to chicks: it was divided in 45

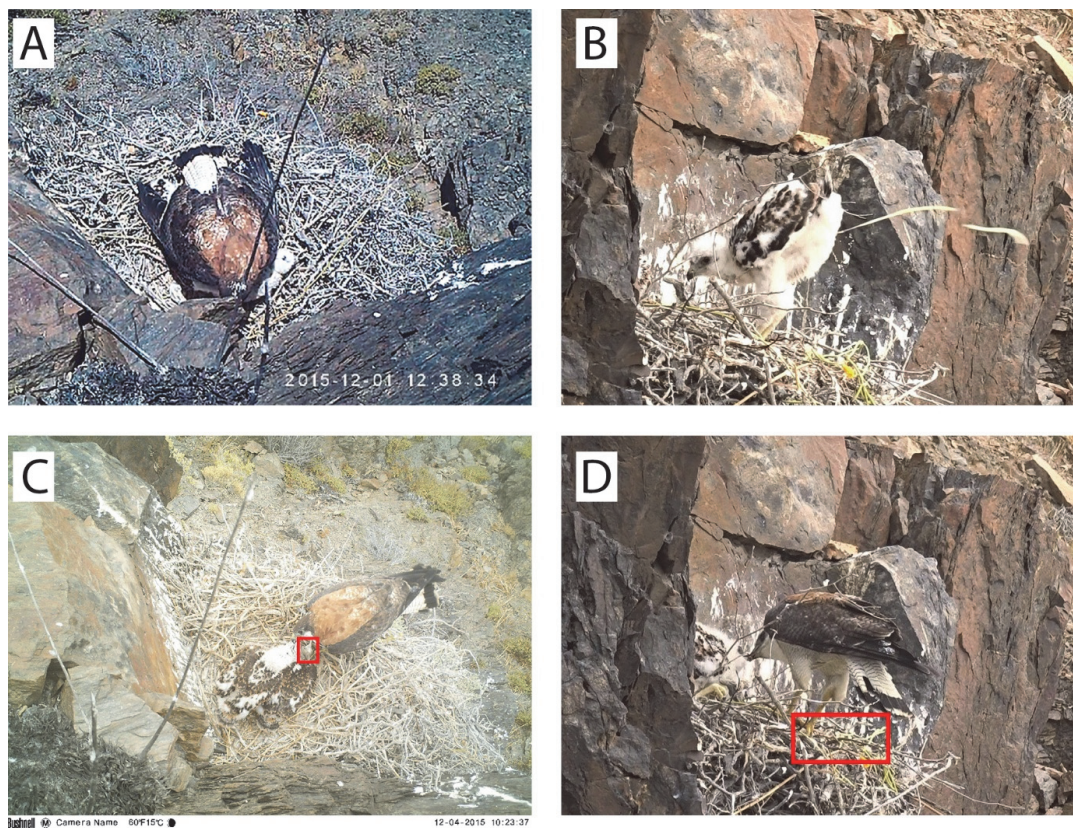


Figure 1. Female covering nestlings at midday (A). Chick defecating out of nest (B). Female feeding nestlings with *Phyllotis darwini* (red rectangle indicates the mouse position) (C). Female feeding nestlings with *Callopistes maculatus* (red rectangle indicates the reptile position) (D).

pieces and 30 of them were given to one of the chicks. One of the chicks tried to peck the prey and the female stopped it. This could indicate that parents control the feeding of nestlings. No aggression between chicks was recorded during feeding events, such as Pavez (2001) recorded for Black-chested Buzzard-Eagle.

Given that in South America most of the natural history of bird species is unknown, low cost and daily use technologies represent an opportunity to record basic information in this and other areas of animal life. However, the use of these tools must have adequate, ethical and careful planning so as not to intervene in an invasive way in behavior. The tests in the present study allowed us to conclude that a strange object, for instance a camera, placed directly in the nest can produce an anti-predatory behavior in nestlings. However, at a distance of 3 m and when parents are absent, the installation and permanence of the camera did not produce reaction.

Although this information corresponds to observations on only two nests, this study adds to the limited data that was available on the natural history of the Variable Hawk in the Atacama Desert. Also, the study confirms some behaviors for the species. We consider that descriptions from other environments and nests will be useful for discerning and understanding general patterns of parental care for this species.

ACKNOWLEDGEMENTS

We are grateful to Alexandra Elbakyan who created Sci-Hub, revolutionizing the way to practice science, to Nicolás Fuentes-Allende and an anonymous reviewer for their comments of the first draft of this article and to Caroline Sánchez, Derek Carne and John Black who helped us with the English details. F.M. thanks the grant CONICYT-PCHA/Magíster Nacional/2015-22150082.

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