Habitat use and home range of the Aplomado Falcon in an agricultural landscape of central Argentina

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Summary

The Aplomado falcon is a widely distributed species in South America but there is little information about its ecology. The antecedent of population declines suffered in North America as a consequence of the alteration of natural habitats through agricultural intensification makes it an excellent study model to evaluate the effects of agricultural intensification in Argentina where a large proportion of the global population breeds. Hence, to understand how land use changes may affect the ecology of this species is particularly important for its conservation. The objectives of this work were: to locate nest sites of Aplomado falcons and to relate these locations with surrounding landscape features, and to determine range use and movements of Aplomado falcons in the agroecosystem of central Argentina. 30 reproductive territories were found and monitored during the 2012 season. From the 30 pairs, 10 adults were captured, and in five of these a tracking unit (VHF radio tag or GPS data-logger) was attached. No tag provided any useful information, for various reasons. Valuable information about reproductive and foraging ecology was obtained, however, as well as information about land uses changes and its consequences for nest site selection and reproductive success.

Introduction

Aplomado falcons (*Falco femoralis*) (Figure 1) are medium-sized falcons that inhabit the Americas. There are three recognized subspecies, Halcón Plomizo [*F.f. femoralis* (Temminck)], Halcón Perdiguero [*F.f. pichinchae* (Chapman)], and the Northern Aplomado Falcon, [*F.f. septentrionalis* (Temminck)]. *F. f. femoralis* occurs in South and Central America, and represents approximately 20% of the species' population, in Argentina (Keddy-Hector 1990).

Figure 1. Female (left) and male (right) of *Falco femoralis femoralis*.

Despite being a widely distributed species in South America, there is scarce information about its ecology. More detailed studies have been carried in North America on the Northern Aplomado falcon (Héctor 1985,1986, Pérez et al 1996, Montoya et al 1997), where populations have suffered drastic declines due to habitat alteration and pesticide use, such that near-extinction prompted reintroduction programs (Brown et al 2006). In South America studies on this species have been mostly on feeding ecology (Jiménez 1993, Silveira et al 1997, Bó 1999, Figueroa Rojas and Corales Stappung 2004, 2005), and there are just three that deal with reproductive aspects (De Lucca and Saggese 1996, Lencione-Neto 1996, Granzinolli et al 2002) but none of this research has been conducted on a long term basis.

Objectives and Rationale

The specialist character of this species in relation to its diet, and the population declines suffered in North America due to agricultural alteration of their natural habitat, makes the Aplomado Falcon an excellent study species to evaluate the agricultural intensification effects on wild fauna and, especially, on raptorial birds. Besides this, and given that pampean ecosystems cover the biggest geographic area in Argentina, where a large proportion of the Aplomado Falcon's

world population is found, to understand how land use change may affect the ecology of this species in Argentina is particularly important for its global conservation.

The objectives of this work were:

- To locate breeding territories of Aplomado falcons and to relate these locations to surrounding landscape features.
- To determine behavioural patterns, distribution and range use of breeding Aplomado falcons.

These objectives are part of a wider PhD project, whose main goal is to evaluate the possible effects of agricultural intensification and different land uses on Aplomado falcon ecology in agroecosystems of central Argentina.

Study Area

Field work was undertaken in an agricultural area of approximately 7,000 km^2 near to Santa Rosa city in La Pampa province of Argentina (Figure 2). This area is characterized by the rotation of diverse agricultural uses, constituting a mosaic of arable crops, artificial and natural pastures, and exotic tree plantations, with some remnants of native arboreal vegetation.

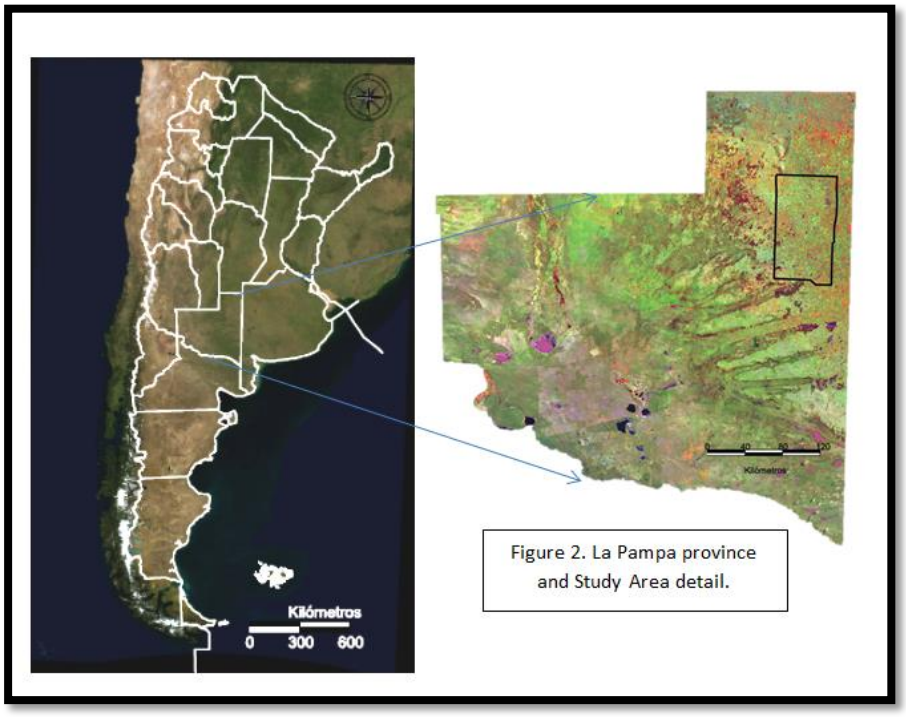

Figure 2. La Pampa province and Study Area detail.

Methods

To locate the nest sites of Aplomado falcons, the search began on September 2012 at the beginning of the breeding season. During all the journeys to locate nest sites approximately 10,000 km were completed by car. Each located nest was monitored periodically to assess the reproductive success using a mirror on a telescopic fishing rod, to avoid disturbance. Any nestlings were banded when they were at least 20 days old. The characteristics of macro and microhabitat were recorded around each nest, with special focus on the agricultural land uses surrounding the nests. At each territory pellets and prey remain samples were collected to evaluate diet composition, from subsequent laboratory identification using references keys. To estimate prey availability, bird surveys were conducted around each nest site.

Adult individuals were captured during the reproductive season, when it was possible, using bal-chatri traps (Berger and Muller 1959) and do-gazha nets (Bloom *et al* 2007). Once captured, the individuals (adults and nestlings) were marked with coloured PVC rings to allow field identification of falcons during observations and with an aluminum ring with an identification number and an address to remit information on the discovery details.

For each bird captured we recorded its basic biometrics and the moult pattern. Additionally, individuals were examined to estimate ectoparasite prevalence. A blood sample was extracted from the brachial vein of each captured bird (0.5 ml approximately): a) to detect infections and endoparasites; b) to determine physical condition through serum analysis (Sarasola *et al* 2004); c) to determine sex by molecular techniques for those individuals whose sex could not be determined obviously by biometrics (Ellegren and Sheldon, 1997) and finally; d) to allow possible future genetic and agrochemical exposure studies.

To quantify home range and movement patterns, two adult birds (females) were tagged with VHF radio transmitters (Figure 3- a, b). These VHF transmitters, with a total weight of 8.5 g (less than 3% of the bird weight: Fuller *et al* 2005), were attached using a backpack harness.

Three birds (two females and one male) were supplied with a GPS geolocator data logger (commercial CatTrack^{TM}, Figure 3c). Unlike the other tags that can be used in conjunction with remote receivers, in these cases the birds must be recaptured to recover the information on their movements.

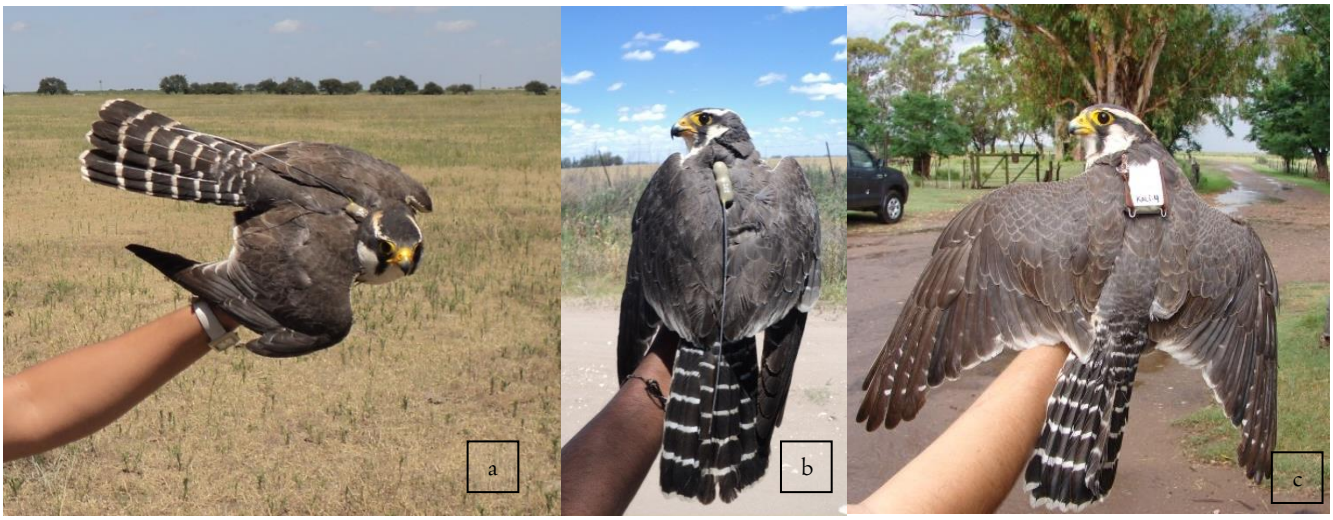

Figure 3. a, b) Adult Aplomado falcons with a VHF transmitter. c) Aplomado falcon with a GPS data-logger.

Habitat analysis

Each territory (nest site) occupied by the Aplomado Falcon was included on a Geographic Information System using the free software gvSIG. Generalized Linear Models (GLM) will be constructed to examine if land-use and topographic variables have any influence over the pattern of habitat use by the Aplomado Falcon, or habitat availability, around these nest sites (Donázar *et al.* 1993, Tella *et al.* 1996).

Results

Reproductive ecology

Thirty nest sites were located and subsequently monitored. Most were found during the incubation stage. The number of eggs per nest was between two and four: three being the modal average. Reproductive success (taking a successful attempt as when at least one nestling fledged) was approximately 40 %. Nest failures occurred mostly during incubation, due to weather and predators. Depredation of nestlings also occurred at eight nests (Figure 4).

Aplomado falcons don't construct their own nest, using those built by other species. In the study area the nests used had been built mainly by the firewood-gatherer (*Anumbius annumbi*), but abandoned nests of Crested caracara (*Caracara plancus*), Monk Parakeet (*Myopsitta monachus*) and Chimago Caracara (*Milvago chimango*) were also used. Trees where nests were used included native (*Prosopis caldenia*) and introduced species (*Ecualiptus* spp., *Ulmus* spp.).

Figure 4. Nest with three nestlings predated by a Geoffrey's cat (*Leopardus geoffroyi*).

Foraging ecology

During the 2012 reproductive season 125 pellets and 48 prey remains were collected under nests and perches. At the moment we have been analysed 67 prey remains and 209 pellets from previous years (Figure 5). 601 prey items have been identified, belonging to four vertebrate classes and four insect orders. Numerically, the main trophic constituents were birds (50.7 %), with the Eared dove (*Zenaida auriculata*) being the most commonly recorded bird species (20.3 %). Insects appeared at a frequency of 46 %, with only 4 % contributed by mammals, amphibians and reptiles.

Figure 5. Aplomado falcon pellet and its contents: feathers, arthropod parts and seeds.

The bird surveys around nest sites suggested a high positive association with the observed numerical species composition in the diet analysis: from 3845 birds counted in surveys (of 49 species) 47.3 % was represented by Eared doves.

Capture, banding and tagging

10 adults (8 females and 2 males) and 12 nestlings were captured, banded and measured (Figure 6 a, b).

Figure 6. Adult female (a) and nestling (b) ringed with a PVC coloured and a metal ring.

The morphometric measures shown in the table below are averages obtained from the 10 breeding adults: wing chord, tarsus, forearm, culmen, hallux and tail lengths, tarsus diameters, and weight.

	Weight (g)	Tail (cm)	Wing Chord (cm)	Hallux (mm)	Tarsus (mm)	Forearm (mm)	Tarsus diameters (mm)	
Female (n = 8)	380.61	181.25	277.50	16.58	48.81	82.10	6.50	5.04
Male (n = 2)	247.35	154.50	252.50	14.50	44.33	74.20	5.45	4.00

Nestlings were sexed using the technique based on the PCR (Polymerase Chain Reaction) for the genes CHD1-Z and CHD1-W (Ellegren 1996, Fridolfson and Ellegren 1999). The results obtained for the 12 nestlings in 2012 gave a sex ratio of: female - male = 1 – 0.2. (Note: over the

complete study the wider sex ratio records were near 1:1, and the bias observed in the 2012 results of this report could be related to a low sample).

No results were obtained from the two VHF radio-tagged birds. In one case the female could not be re-located after the transmitter colocation, probably because the nest failed, and so it is possible that the adult moved behind the antenna reach. In the second case, the transmitter fell off, and was recovered below a perch.

No results were obtained from the three individuals with the GPS geolocator data-loggers. The tag on the male fell off quickly, and was not found. The females retained their tags for more than a year, but could not be recaptured, despite several attempts using several capture techniques. At the moment, these females are free from the data loggers, but the units have not been found. Further attempts to tag falcons will be made in the future, learning from the lessons of the 2012 season.

Habitat analysis

The habitat analysis is being developed as part of the PhD study and multivariate models will be constructed using the following metrics as response variables: reproductive success, territory occupancy; and, as explanatory variables: nest height, tree height, nest constructor, surrounding habitat (percentage of land use type), and avian prey abundance. These analyses will involve the gvSIG free software and the statistical program R (R Development Core Team).

Discussion/Conclusions

During the 2012 season supported by NR funds, 30 Aplomado falcon nests were found. Valuable information was obtained from them, and added to that obtained in previous years suggests that the Aplomado falcon is a susceptible species reliant on the agroecosystems of central Argentina. Over the reproductive season the global reproductive success was very low, at 46 %, showing an increase of failure from previous years. The land uses changes on the study area have apparently generated a large population of Eared doves, causing important economic damages on cultivated crops. This species has become the main prey item of the Aplomado falcon, but the dove's explosive population growth may have also caused an increase of other predator

populations that may compete with the falcons. This may be one of the reasons of the low reproductive success of Aplomado falcons observed in 2012.

This low reproductive success played an important role on the low success of finding nests; and capturing adults, and their re-capture. Once the nest is lost, adults become less reactive to the capture methods employed, and left the nest area, preventing their resighting and tracking, if tagged. The GPS geolocator tags also generated no useful results, and this technique may be more successfully used on other species that are more susceptible to recapture.

Further anticipated publications will include:

- "Ecología del Halcón Plomizo (*Falco femoralis*) en agroecosistemas pampeanos". Author: **María Soledad Liébana**. PhD thesis, in progress.
- "*Ornithonyssus bursa* (Mesostigmata: Macronyssidae): a common mite of neotropical birds". New hosts from Argentina. Authors: Miguel Ángel Santillán, Juan Manuel Grande, **María Soledad Liébana**, Pablo Martínez, Luís Adrián Díaz, Laura Araceli Bragagnolo, Claudina Solaro, Maximiliano Adrian Galmes and José Hernán Sarasola. *Medical and Veterinary Entomology, on revision.*
- "Predation on *Philodryas patagoniensis* (Squamata, Colubridae) by *Falco femoralis* (Aves, Falconiformes, Falconidae) in central Argentina". Authors: **María Soledad Liébana**, Miguel Ángel Santillán, José Hernán Sarasola. *Herpetology Notes, under review.*

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