The reproductive behavior of the sparrow hawk

Falco sparverius cearae (Cory, 1915) in Bahia: a photographic essay

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ABSTRACT

There are 17 subspecies of the Falco sparverius distributed throughout the Americas and three occur in Brazil: F. sparverius cinnamominus (Swainson, 1833) which is found in the extreme south (Rio Grande do Sul state); F. sparverius isabellinus (Swainson, 1837) which occurs in the extreme North (Rio Grande do Norte state) and the F. sparverius cearae (Cory, 1915) which occurs in all the Brazilian maritime states (Pinto, 1978) (Sibley, 1990). This last species occurs in all the open habitats in Bahia. But in terms of studies on the behavior of this species, little or nothing has been documented. We have been studying the behavior of this subspecies in Bahia for more than twenty years. During this time, it was possible for us to study and conduct research on its reproductive behavior, its feeding sites, its incubation period, the size of its range, the dispersion of its chicks, the reintroduction to the wild of individuals captured in the illicit traffic, the use of artificial nests, etc.

The Falco sparverius cearae initiates its reproductive period in the month of September after the rainy period and can extend through the month of March. It feeds on insects, birds, reptiles and amphibians. This article seeks to contribute unprecedented data about the reproductive behavior of the F. sparverius cearae, as well as report on the food it eats, hunting techniques and improve the techniques for the re introduction, by IBAMA, of individuals captured in the wild animal trade. The photographic essay registers all the behavior of this subspecies and through the banding technique, with conventional and colored bands, we managed to uncover much of the behavior that would otherwise have been impossible.

INTRODUCTION

There are 17 subspecies of the Falco sparverius distributed throughout the Americas and three occur in Brazil: F. sparverius cinnamominus (Swainson, 1833) which is found in the extreme south (Rio Grande do Sul state); F. sparverius isabellinus (Swainson, 1837) which occurs in the extreme North (Rio Grande do Norte state) and the F. sparverius cearae (Cory, 1915) which occurs in all the Brazilian maritime states (Pinto, 1978) (Sibley, 1990).
Figure 2 – A) B) C) D) E) F) G) e H. A) and B) Courting, the female receiving food. C) Coupling. D) Different color eggs in the same nest batch. E) The female laying the first egg. F) The female heating up the newly born chick. G) The female in a defensive posture. H) The birth of the first chick.
raptor species: the Peregrine Falcon (*Falco peregrinus*) and the Bald Eagle (*Haliaeetus leucocephalus*). The great majority of studies on research studies on the reproductive behavior of raptors are through the evaluation of regurgitated pellets left at the bird’s feeding sites. (Lima, 2007, 2008, 2009), (Balgooyen, 1971). On the northern shore of Bahia, the subspecies occurs from Salvador all the way to the extreme north of the state in Mangue Seco, both in savannah and rainforest biomes though always on the forest edge. The *Falco sparverius ceaerae* initiates its reproductive period in the month of September after the rainy season and can extend all the way to March. It feeds on insects, birds, reptiles and amphibians. On the islands of Madeira, Selvagem Grande and Deserta in Portugal, the calls emitted by the *F. tinnunculus canariensis* during its reproductive period are very similar to those of the subspecies that occur in Bahia, the *F. sparverius ceaerae*. We recorded these calls of the Portuguese falcon and used them with our sparrow hawk (*F. sparverius ceaerae*) during the period when it was feeding its chicks. We observed that it reacts in the same manner as the Portuguese falcon to sounds related to feeding, alerting on the presence of an intruder in their territory. This article intends to contribute unprecedented data to the reproductive behavior of the *F. sparverius ceaerae*, in addition to reporting on the feeding habits, hunting techniques and improve techniques to reintroduce individuals captured by IBAMA from the illegal wild animal trade. The photographic essay registers all the behavior of this subspecies, and through the technique of banding, with conventional and colored bands, we managed to uncover behavior which without this technique would have been impossible.

**Methods and Materials**

The majority of the artificial nests studies was made of PVC and had a depth of 500 mm, a diameter of 200 mm and either a circular or rectangular entrance that measured 110 mm x 100 mm. The nests were lined with wood chips, palm fibers and dry leaves. A total of 50 artificial nests were hung with a nylon cord on the forest edges to facilitate permanent monitoring. The PVC nests were either painted with oil-based paints or were left in their original white color. Wooden boxes with the appropriate dimensions were also used. The boxes were placed in places where the falcon subspecies in question could be found. Using this methodology, we could determine the minimum distance between which two mating pairs could nest and the highest height used by the subspecies in question. The boxes were painted five different colors (red, yellow, green, brown and blue) in order to determine what the preferred colors of the falcons are. The nests were used by other species such as: *Otus chiluba*, *Glaucidium brasilianum*, *Aratina auripilago*, *Colaptes melanocephalus*, *Xiphorhynchus picus*, *Myiarchus ferox*, among others. The artificial nests were of fundamental importance for this research project, since in the area studied, there are few natural snags and this creates tough competition between species that reproduce in hollow natural cavities. All the nests were monitored three times a week, between the months of September and March, the period in which reproduction for most of the regional species is concentrated. For our direct observations, we used SWAROVSKI and Bushnell 10 x 40 binoculars, in addition to a Kowa TSN2 60x sight. In order to measure the temperature inside and outside the nest, we used a digital visor thermometer which registered the minimum and maximum temperature inside and outside the nest. This thermometer was affixed below the entrance of the nest and the temperature was checked three times a day. When we noted that a bird was using the nest, monitoring was carried out on a daily basis to register when the first egg was laid and in this way detect accurately the incubation period. After the laying of the last egg, the nest was monitored daily after the tenth day and until the birth of the all the chicks. After the birth of the first chick, the chicks were weighed daily at 6:00 a.m. with a TANITA Model 1479 analytical scale with a 0.1 g degree of accuracy, until they abandoned the nest. The calls were recorded on a digital recorder, the model EDIROL R-09HR and captured through the directional microphone Sennheiser K6. The photographs were taken with a digital Nikon COOLPIX 8800VR camera with a 35-350 mm lens, and a second digital NIKO D90 camera with a 500 TAMRON was used to photograph falcons from long distances. The chicks were banded with metal CEMAVE bands as well as colored bands. In order to identify food items brought to the chicks we used an observation hide built 20 meters from the nests. We started our observation at 5:00 a.m. and finished observations at 5:30 p.m. and this methodology was used from birth until he chicks abandoned the nest, which lasted 30 days. To capture the lizards which are part of the feeding menu of the *F. sparverius ceaerae*, 65 interception traps were used (AIQ) with a screen guide fencing made of PVC and with a height of 0.5 meter and a space of 10 meters between the buckets. The traps were visited daily between 6:30 a.m. and 4:30 p.m., always in two-hour intervals. The time constrained search (TCS) was also used daily and nightly through slow movement (around 60 to 70 meters per hour) in predefined transects in the study area.

**Reproductive Behavior**

There can be fights for territory between pairs when the stronger male can expel and then conquer the female and his adversary’s territory. This observation was only possible using metal and colored bands, put on the tarsus of the birds. In 1988, we witnessed a fight between two *F. sparverius* males in a reproductive territory that we had been studying for five years. The fight took place in August, in the courting period, and at the time we thought it might be a male adult expelling a chick that was still in its territory. In the year 2000, we witnessed another fight between two males in another area we had been studying for three years and this pair was banded with traditional and colored bands. This observation also occurred in August, again during the courting period. The next day, a young 10 month-old male we had banded with traditional and colored bands in October 1999, had conquered the territory and the female. They formed a new breeding pair and used the same nest as had been used by the old pair. The young male had been banded at Cetrel (“12° 40’ 00’’ S e 38°10’00’ W), located in the municipality of Camaçari (Bahia state), some 18 kilometers from the territory he had vanquished.

During courting, the male hunts prey which he takes to one of its landing sites near to the nest and calls the female with a short call repeated several times “crii, criii, criii, crii”. It raises and lowers its head several times, inviting his mate to approach and receive the offering. The female lands next to the male and flaps her wings and emits the same calls as those of chicks requesting food. She then takes the food which is being held in the male’s mouth and moves away and swallows the prey. Minutes later, she lowers her head and assumes a submissive position and it is then that copulation occurs. After copulation, she flies some distance away. This scene can be repeated four times within an hour. He can also arrive flying and land directly on the female to copulate (figure 2, A, B and C).

During the time I was responsible for Cetrel’s Wildlife Treatment Center (CETAS, its Portuguese acronym), I witnessed a four-month old male sparrow hawk grab small pieces of meat and place them in each corner of its cage. He raised and lowered his head, pointing to the food and emitting short calls as if he were
Figure 3 – A) B) C) D) E) F) G) and H. A) e B) Hollows produced by woodpeckers that are used by the *F. sparverius* and other species. C) Natural hollow being used by *F. sparverius*. D) *Pseudoseisura cristata* nest being used by *Glaucidium brasilianum*, that had been occupied before by *F. sparverius*. E) *Pitangus sulphuratus* nest used by *F. sparverius*. F) e G) Unpainted and painted artificial PVC nests. H) Painted wooden artificial nest.
courtship. This behavior is only observed during the reproductive period in wild birds. After starting copulation, the pair frequents the inside of the nest for the whole day. Before this, they visit the nest three times in the period of an hour and the last visit is made just before nightfall. The nest visits have two functions: cleaning and ownership assertion so that the nest will not be occupied by another bird or animal. The laying of the first egg can occur in a period that can vary between 25 to 30 days after copulation. We have witnessed a pair copulating eight days after initiating incubation.

In order to study the reproductive behavior of this subspecies, we monitored the artificial and natural nests from 5:30 a.m. to 5:30 p.m., with the intention of registering which species of animal were offered to the chicks during all the periods throughout the day. A hide was built some 20 meters from the nests to observe the food items offered to the chicks. Some items were collected from the inside of the nests to be identified and to collect biome-tric data (figure. 4. A, B, C, D, E, F, G, H and table. 1). To capture the lizards which were part of the sparrow hawk’s diet, we used 65 interception and fall traps (AIQ) with a screen guide fencing made of PVC and with a height of 0.5 meter and a space of 10 meters between the buckets. The biometrics of the reptile can be found in Table 2. The great majority of the feeding items bought to the chicks were reptiles. When the chick was breaking through the shell, it emitted calls when it was still in the shell. We recorded these calls. During the daily monitoring of the nests, we observed that when the chicks perceive the presence of intruders they lay down in the inside of the nest and pretend to be dead. When we tried to hold them, they raised up their tarsus and used their claws to attack us.

To monitor the deep nests or in places where we couldn’t reach the chicks with our hands, we created a technique which consisted of putting a small piece of thin mesh fishing net at the end of a stick. With this artifact, we stirred around the depths of the nest and the chicks attack this object with so much force that they get stuck to the fishing net. This technique is effective to capture chicks to undertake biometrics, exams and for banding. In one of the nests that had two chicks, we weighed both of them from birth until they abandoned the nest, and the daily weight gain can be seen in Graph 6.

The sparrow hawk emits several types of calls to communicate with their mate, their chicks and other members of their species and other animal species that find themselves in its range. During the reproductive period, the male hunts for food for himself and the female while she is still incubating. He brings over the food, lands near to the nest, and with a specific call, invites the female to leave the nest and receive the food. She takes advantage of this time for personal hygiene, to clean her feathers, defecate, exercise her tarsus and wings and carry out little flights. (Figure.5 A, B, C and D). The female takes advantage of the reproductive period to change her feathers.

When he senses an intruder, he emits strong and continuous calls and the female reacts immediately and she leaves the nest to join her mate and be ready to attack. (figure.6 A, B, C and D). When we were carrying out observations of the subspecies F. tin- nunculus canariensis (Peters, 1931-60) on the Islands of Madeira, Selvagem Grande and Desertas during the reproductive period, we verified that the behavior of the Portuguese falcon is very similar to the sparrow hawk. We recorded the song of the F. tin- nunculus canariensis and carried out an experiment with the F. sparverius cearae. These calls were used around the proximities of the nest to detect some kind of reaction. We used the call h uses when he brings food to the female or the chicks. She reacted by leaving the nest and landed at the entrance of the nest to wait for the male. She also reacted to the sound of a territorial invasion, quickly leaving the nest and looking for the potential intruder. The sparrow hawk defends his reproductive territory from possible predators, attacking and expelling anything near to its nest, from a small bird to a human being. (Balgooyen, 1987), reports the attack of a F. sparverius who had observed a F. peregrinus hidden in the middle of dense vegetation around the San José Airport in California in November of 1986. Immediately following this, another falcon, the (F. rusticolus) went in pursuit of the peregrine falcon and both were run over by a Boeing DC 10 that was approaching the airport to land. Both were killed.

During our research on the F. sparverius in several different places in the state of Bahia, we saw different reactions in defense of the nest during the reproductive period. In most of the nests that were studied, the female was always the more aggressive one and she carries out the more violent attacks against intruders that come too close to the nest. The male participates in these attacks, in the rear and this double attack has as its objective to remove the intruder from the proximities of the nest. The attacks are more intense in the period when they’re with their chicks. The day the chicks are to leave the nest, the female is extremely loud and attacks anything that approaches. This is a dangerous moment for the chick. We have witnessed a pair feeding a chick that fell out of the nest without yet being able to fly. The pair continued to feed the chick for two days until it managed to fly on its own. (figure. 9 G and H).

In some nests, neither the male nor the female attack, and in some cases only the female attacks, and in others only the male. When the chicks abandon the nest, they are constantly watched over by their parents and the pair will attack intruders who venture close to their chicks landing spots. Chicks that have abandoned the nest for at least three days can help their parents to attack intruders, thus practicing techniques for survival. One pair that we studied for six years right in the middle of urban Salvador, never got used to my presence monitoring the nest over this period of six years. When they sensed my presence, anywhere in their territory, they immediately attacked. Often I was at least a kilometer distant from the nest.

The sparrow hawk loves taking baths in the sand and in captivity loves taking baths in bowls of water, the bigger the better. Baths are necessary for the cleaning of the feathers, the skin and to remove ecto-parasites. We observed the F. sparverius attacking a flock of guira cuckoos (Guira guira) that had entered into its hunting territory. It protects its food sources, mostly reptiles and insects, from other competitors. In this same area there was a flock of smooth-billed anis (Crotophaga ani), that avoided frequenting the same hunting grounds of the F. sparverarius cea- rae.

Nests, eggs, chicks and feeding habits
As with other falcons, the subspecies Falco sparverius cearae, does not build nests. It utilizes abandoned woodpecker nests or snags on the North coast of Bahia. Four species of woodpecker produce hollows that can be used by this falcon species. They are: Celeus flavescentis, Colaptes melanochloros, Campephilus melano- nucleus and Colaptes campestris. These hollows are disputed by other species of bird such as: Otus choliba Glaucidium brasilia- num, Aratinga auricapillus and Amazona amazônica (figure.3 A, B and C). The sparrow hawk expels these species as well as mammals. We have found a nest with tropical screech-owl (O. choliba) eggs mixed with those of F. sparverius being incubated (Lima, 2009). The species also can use cavities in ravines and the hollows of termite nests and even the licy palm, the nests of the Caatinga Cacholote (Pseudoseisura cristata), cracks in buildings.
Figure 4 – A) B) C) D) E) F) G) and H. A) The remains of *Kentropyx calcarata*, reptile endemic to the Atlantic Rainforest. B) Remains of a *Tropidurus hygomi*. C) *Cnemidophorus abaetensis* D) Female bringing a cricket to her chicks. E) Female carrying na insect by its antenna. F) Female feeding on a grasshopper G) Remains of a tanager (*Thraupis sayaca*) found inside the nest. H) Frog found inside a nest.
and air conditioning units in the center of urban Salvador. (figure 3D).

We used 50 artificial PVC nests with a 500 mm depths, a diameter of 200 mm and a circular or rectangular entrance measuring 110 mm x 100 mm. The nests were lined in their interior with wood chips, palm fiber and dry leaves. The nests were hung at the forest edges on a nylon string to facilitate permanent monitoring. The PVC nests were either painted with oil-based green and orange paints or were left in their original white color. Wooden boxes with the appropriate dimensions were also used. The boxes were painted six different colors (orange red, yellow, green, brown and blue) in order to determine what the preferred colors of the falcons are.

Of the six colors, only yellow and orange were not used. The boxes were placed where the species occurs. In Cerrado Nevada, California, at an altitude of 1800 meters, the F. sparverius prefers cavities facing an east-west direction, in a cold environment. In the west of Venezuela, 29 mating pairs of F. sparverius were observed. Twenty-nine percent of the pairs chose entrances facing north and twenty-four percent chose entrances facing south, where the wind blew from north to south. The data suggest that the falcons choose their nests based on temperature considerations. (Balgooyen, 1990). On the North coast of Bahia, we observed 20 nests in cavities, and 60% choose to face west and the predominant winds blow in an east-west direction. Based on this data collected, we faced the entrance of the artificial nests toward the west, opposite from the direction of wind and rain. To study the temperature variation, for 24 hours both inside and outside the nest, we measured the maximum and minimum inside and outside the nest during the entire incubation period, when the female warmed the chicks, until they abandoned the nest. The internal temperature of the nest was higher than the outside temperature. At 5:00 a.m., the temperature ranged from 18.9°C to 26.9°C (external, internal) and the maximum at 12:30 p.m. was 26.9°C and 37.6°C (external, internal). These temperatures were taken with the female inside the nest and the bulb of the thermometer placed between the eggs. (fig. 11 – A, B, C, D and graph. 7).

Falco sparverius cearensis occupy territory very close to their nests, a maximum of 1000 meters away. The laying of three to five eggs, which are a uniform cream color, sometimes with reddish dots, occurs in alternating days. Incubation starts after the second egg which on an average weighs 13.4 grams (N=42) and measure 35 mm x 28 mm. The largest egg weighed 14.7 grams, the smallest 12.1 grams. (fig. 7 - E and F).

An egg that weighed 12.6 grams and after 40 days inside the nest did not hatch; it had lost 0.4 grams which is the equivalent of 3.17% of its weight. The egg shells weigh on average 1.2 grams which is 9.8% of the weight of the shell. The chick’s weight at birth is on average 10.5g (N=12). (Balgooyen, 1998) developed nest boxes to capture F. sparverius, where the lid was controlled by remote control to open and close it. The success of the trap was greater during the incubation period though by simply obstructing the entrance to the nest, the female remains inside.

The female is very sedentary during incubation. Males were rarely captured. During the incubation period, males hunt less. During the feeding periods, the parents visited the nest more frequently to feed the chicks. Only the female incubates. We managed to lower the artificial nest of a pair we had been monitoring while the female was laying her eggs, and the birth of the chick. The female remained in her nest and we took advantage of that time to band with metal CEMAVE bands as well as colored aluminum bands. She did not abandon her nest despite our presence. (fig. 2 - E, F and G). We also measured the temperature during incubation which was on average 39.3°C through the cloaca and per-
Figure 5– A) B) C) and D. Male and female cleaning their plumage.

Figura 6– A) B) C) e D. Ataques.
ple preferred to use natural or artificial poles located in fields and avoided the eucalyptus forest. *Falco sparverius cearae* used various observation poles in its hunting area and tried to diminish pressure on the species that are part of its feeding menu. We observed in the morning after daybreak (5:20 a.m.) that it hunts insects, crickets, grasshoppers, birds and frogs. (fig. 4 – D, E, F, G and H). After 6:00 a.m., it starts to capture reptiles belonging to the *Tropiduridae* family that forage earlier. (fig.4A, B e C). When the temperature goes up after 8:00 a.m., they prefer to capture reptiles from the *Teiidae* family which forage when the sun is hotter and at the end of the afternoon, they go back to capturing insects, birds and rarely bats. Graph 1 reports on the relative abundance of the principal reptile families in four municipalities where we studied the behavior of the *F. sparverius cearae*. Graphs 2, 3, 4 and 5 report on the relative abundance of the main reptile species in the four municipalities studied. Table 3. reports on the species that were observed to be part of the *F. sparverius cearae* feeding menu in the state of Bahia. (Lima, 91a, 91b and 96).

The ground vegetation of the restinga biome offers good protection for the reptiles and they look for their food ingrain in the vegetation. At that moment, when they are moving from one fragment to the other in open areas, they are vulnerable. Several times we have seen the sparrow hawk capture reptiles and grasshoppers at the edge of the restinga. On one occasion the hawk tore off a branch of a small leguminous plant (*Chamaecrista ramosa*), very common in the restinga areas of the north coast of Bahia. They can act as seed dispersers for this ground vegetation. We found several C. Ramosa in a water pipe on the roof of the Bahia Convention Center where for eight years we studied a pair of *F. sparverius* who reproduced in an open space below the roof. Studies carried out on the sparrow hawk in an enclave in the savannah at Cetrel (“12°40’00” S e 38°10’00” W) in the municipality of Camaçari, made it possible to collect data about the reproductive and feeding behavior of these birds. (fig. 4. A and C and table. 1).

Amongst these items, we would like to draw attention to the presence of the remains of the *Kentropyx calcarata*, which were found inside one of the nests we studied, which was at the edge of an arboreal restinga, right in the middle of the savannah. This reptile, however, is typical of the Atlantic Rainforest. Another noteworthy fact was the presence of the reptile *Cnemidophorus abae- tensis*, which is endemic to the restinga of the north coast of Bahia and is considered vulnerable and is on the list of endangered Brazilian fauna. (IBAMA, 2008). (del Hoyo et al 1999), report insects, small rodents and bats in the diet of *F. sparverius*. (SARASOLA et al., 2003) studied the feeding habits of *F. spar- verius* in Argentina over the four seasons of the year and analyzed 705 pellets and the leftovers of prey. The majority was of insects, followed in importance by vertebrates then mammals, birds and reptiles. The chicks eat more small reptiles and birds. (Balgooyen, 1971) undertook an experiment with the *F. sparve- rius*, in captivity, with an aim to measure the quantity, size and weight of the regurgitated pellets after the bird had ingested a series of food including rats, cow hearts, and birds. The number of pellets was one per day. The average time for regurgitation was at 21h: 33m, and the pellets were similar in weight and size coming from the same type of food. In cases where the bird ingested a large quantity of indigestible material, the quantity of pellets increased and their size varied because of retention in the ventricle which necessitated more time to regurgitate two or more pellets. In our studies, we collected pellets regurgitated by the chicks inside the nests and of the parents on their hunting posts near the nest. The samples from the chicks were reduced because they were destroyed in the nest by the parents stepping on them inside the nest. The pellets on average 0.7g and measured 22 mm x 16 mm different from those collected from the captive experiment. At the hunting poles (N=8) the pellet dimensions were 23.62 mm x 13.25 mm, and the largest measured 30.00 mm x 15 mm and the smallest 20.00 mm x 13.00 mm, and all of them were composed of the insects belonging to the family *Acrididae* (grasshoppers). We counted 76 ’queliceras’ which is the equivalent to 38 grasshoppers, three per pellet, and the ’queliceras’ measured 5 mm in length. We collected several retile heads (N=32) under a hunting post and their size varied from 5 mm to 10.5 mm (N= 7.75 mm). In addition to the retile heads we found tails, the head of a rat and the remains of a bat. Certain caution should be taken when the study of feeding habits is based on the pellets. Pellets of other species of raptors could be found in the study area. Pellets of the *F. peregrinus*, containing bat craniums and birds, and pellets from the *Tyto alba* containing rodent craniums (rats, cavies) and bats were found in an area where we were studying a pair of *F. sparverius cearae*. Pellets from an owl were deposited right below the nest of the *F. sparverius*. The owl was reproducing in a larger cavity below the sparrow hawk’s nest. Over a period of six years we monitored the nests, these two species never came into conflict due to the opposing diurnal and nocturnal habits of each species. The smallest and largest prey found in the nests that we studied was a grasshopper that weighed 0.1633 grams and a Rufous Hornero (*Furnarius rufus*), weighing 50 grams.

**REINTRODUCTIONS**

In 1997, Cetrel (An Environmental Protection Company for the Petro-chemical Pole in Camaçari) and IBAMA signed an agreement to create CETAS (Center for the Treatment of Wild Animals). I was responsible for this Center until 2003 and during this period we successfully re-introduced more than 10,000 birds from 140 different species amongst which included *F. sparverius*. More than 50 sparrow hawks in six years passed through the center, all being chicks that were captured in the wild animal trade. They depended on man for survival since they did not know how to hunt. Chicks that were one to five days old needed to be heated, if not they would die, since their thermal regulator system at that age is not efficient. If they are not heated in a temperature between 30 . C a 35 . C, they acquire omphalitis, an infection caused by aerobic and anaerobic micro-organisms that causes a general infection leading to death. Small chicks in captivity fed on red meat can atrophy and decalcification problems can occur which can cause death. (figure 8 B and C). To avoid after-effects and even death, they should be fed with bird or beef entrails: liver, kidney, heart and lungs (fig 9 – E). It is also recommended the ingestion of tissues containing little bones. Live feed is recommended for bigger chicks, rats and chicken chicks being ideal.

The sparrow hawk’s chicks in captivity love to capture insects that enter into their enclosure, even small ants. We have developed various techniques suited to each particular chick so that they become re-adapted to their natural habitat. If they are already able to fly, we put the food on a wooden platform near the coop and we free the bird, ensuring it is hungry. This technique conditions the bird to look for food at this spot whenever it is hungry. One month after being released, it had already learned hunting techniques without anybody teaching it and two months after this it would abandon the territory. Chicks that don’t yet fly, with ages of anywhere from 1-28 days, were looked after in artificial nests, made of wood or PVC, near to CETAS. On a daily basis we gave food to the chicks inside the nest. When they were ready to abandon the nest, we put a wooden platform with food above the nest. As soon as it completed its first flight, it would discover the food and thus
Figure 7 – (A) B) C) D) E) and F) *F. sparverius* eggs with different colors, shapes and weights.
conditioned they would look for food in this place until they had learned all the hunting techniques themselves. This last about two months. (fig. 9—C and D).

A third technique consisted in putting the chicks apprehended from the wild animal traffic in active nests of the F. sparverius cea-rae. We discovered that the age doesn’t matter, the falcons adopt them. The ideal is to put chicks to be adopted of the same age as the other chicks in the nest. We have placed up to three chicks in a nest already with four other chicks of around the same age and they were all accepted; the ideal is to put two in each nest. (fig. 9—B).

The fourth technique is for chicks that arrived at CETAS already able to fly. We tied a tape around they tarsus where we tied a nylon fishing string about 2 to 3 meters longs. We tied the chick to a bush, isolated in an open field, where a pair of F. sparverius would be feeding and teaching hunting techniques to its chicks. The chick should be on a diet to ensure that it is hungry the day before it is released. This rehearsal should start right after sun rise. The pair of F. sparverius will observe this chick for the time they are feeding their chicks. As time passes, the young sparrow hawk, which is very hungry, will emit begging calls for food, which results in the female approaching the chick and as she gets closer, the more he begs for food. At a certain point, the female hunts some prey and offers it to the young falcon. We can now remove the nylon string from the tarsus of the bird and he goes off with his adoptive siblings.

The fifth and last technique is appropriate for dealing with eggs apprehended in the wild animal trade. These eggs can be distributed among active nests of the sparrow hawk. The ideal is to put two eggs per nest and observe the development of the embryos in the eggs to be distributed in nests as well as those already distributed, to avoid a long interval between the birth of the chicks. (fig. 9—B). We have carried out an experiment where we placed eggs in the process of hatching in a sparrow hawk’s nest that had just laid its first egg. The adoptive chick hatched on the same day and was accepted. It was through this re-introduction technique that we formed a new pair of F. sparverius cea-rae. The female of a pair we were studying for five years suddenly disappeared; we are not sure if she was killed or enticed away by another male to another territory. We reintroduced a young, three-month old female, into the territory of the solitary male. We observed that at the beginning, the male’s reaction was of caution. He observed her from a distance and slowly approached and accepted her in the end. They formed a pair that stayed in this territory for three more years, although we never found the nest of this pair.

The re-introduction techniques that we elaborated are very useful for birds apprehended in the illicit traffic, not only for the F. sparverius cea-rae, but they can be used for an innumerable of other bird species. In this way, we avoid that they stay for a long time in places without adequate facilities where there is a high rate of mortality. Sending them to zoos should also be avoided or to bird breeders who falsely claim that the birds will not be able to adapt back to their natural environment. With very rare exceptions, any species of bird can be reintroduced. (Lima, 2005).

Acknowledgements

I would like to thank José Carlos Dias and Willianes Santana Batistamy helpers who dedicated themselves to discovering the nests which enabled me to study the behavior of the species. I would also like to thank Aloisio Ferreira da Rocha Neto for his help on the photographic exhibition. I am very grateful to my wife and biologist Rita de Cásia Ferreira da Rocha Lima who helped me a lot. Thanks also to Sidnei Sampaio dos Santos who participated in many of the studies and to my friend, the biologist Rolf Grantsau who has contributed much to enrich my knowledge. Thanks also Helen Hays and Joseph DiCostanzo researchers American Museum of Natural History who helped with bibliography. I am thankful also to the reviewers of AO (Atualidades Ornitológicas).

Bibliographic References:


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Figure 8 – A) B) C) and D). A) Chick with larva. B) Death through omphilitis. C) Under nourished chick. D) Chicks from an unfertilized egg.
Figure 9 – A) B) C) D) E) F) G) and H. A) Some reintroduction techniques that consist in increasing the number of eggs in natural nests. B) Introduction of chicks from the wild animal trade in artificial nests. C) and D) Food placed on the roof of the artificial nest, a reintroduction technique. E) Male chick feeding on the entrails during the reintroduction process. F) Male chick, banded with a traditional and a colored band, one of the techniques adopted to monitor reintroductions. F) Female chick, fallen from the nest lying close to the ground in order not to be seen. Female chick fallen from the nest in a position of attack after being seen.
Figure 10 – A) B) C) D) E) F) G) H) I) J) L) M) N) O) P) and Q). Phases of chick development highlighting the Black bar on its tail, the Gray wings of the male, at two weeks old.
Figure 11 – A) B) C) and D). A) Thermometer with external visor placed in the nest to measure minimum and maximum temperatures. B) Internal vision of the nest showing the wiring of the thermometer in the center of the nest. C) Minimum temperature at 5:00 a.m. inside and outside the nest. E) Maximum temperature at 12:30 p.m. inside and outside the nest.
Table 1 – List of species that are part of the feeding menu of the *F. sparverius cearae* in four municipalities in the state of Bahia: Camaçari, Cachoeira, Jeremoabo and Canudos.

<table>
<thead>
<tr>
<th>Reptiles</th>
<th>Bird</th>
<th>Mammals</th>
<th>Insects</th>
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<tbody>
<tr>
<td><strong>Teiidae</strong></td>
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<tr>
<td><em>Ameiva ameiva</em></td>
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<tr>
<td><em>Cnemidophorus ocellifer</em></td>
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<td><em>Cnemidophorus abaetensis</em></td>
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<td><em>Kentropyx calcarata</em></td>
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<tr>
<td><strong>Tropiduridae</strong></td>
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<tr>
<td><em>Tropidurus ccorobensis</em></td>
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<td><em>Tropidurus hygomi</em></td>
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<td><em>Tropidurus hispidus</em></td>
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<td><em>Tropidurus semiteniatus</em></td>
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<tr>
<td><strong>Iguanidae</strong></td>
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<td><em>Iguana iguana</em></td>
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<tr>
<td><strong>Scincidae</strong></td>
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<tr>
<td><em>Mabouya heathi</em></td>
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**Furnaridae**

- *Furnarius rufus*

**Thraupidae**

- *Thraupis sayaca*

**Emberizidae**

- *Sphorophila bouvreuil*

**Polioptidae**

- *Poliopilla plumbea*

**Phyllostomidae**

- *Artibeus sp*

**Acrididae**

- *Tropidacris sp*

**Gryllidae**
**Graph 1** – Relative abundance of the main reptile families in four municipalities in the State of Bahia highlighting the *Teiida* and *Tropiduridae*, the most important feeding species for the *Falco sparverius ceara*.

**Graph 2** – Relative abundance of some reptile species in the municipality of Cachoeira, the state of Bahia, where three species are particularly important in the feeding menu of the *Falco sparverius ceara*: *Tropidurus semetaeniatus*, *Cnemidophorus ocellifer* and *Tropidurus hispidus*. 
Graph 3—Relative abundance of some reptile species in the municipality of Camaçari, the state of Bahia where three species are particularly important in the feeding menu of the *Falco sparverius ceara*: *Tropidurus hygomi*, *Cnemidophorus ocellifer* and *Tropidurus hispidus*.

Graph 4—Relative abundance of some reptile species in the municipality of Jeremoabo, the state of Bahia where three species are particularly important in the feeding menu of the *Falco sparverius ceara*: *Cnemidophorus ocellifer*, *Ameiva ameiva*, *Tropidurus hispidus*, and *Tropidurus cocorobensis*. 
Graph 5—Relative abundance of some reptile species in the municipality of Canudos, the state of Bahia where three species are particularly important in the feeding menu of the *Falco sparverius cearae*: *Cnemidophorus ocellifer*, *Ameiva ameiva*, *Tropidurus hispidus*, and *Tropidurus cocorobensis*.

Graph 6—Daily weight gain and accumulated gain from birth to nest abandonment of the sparrow hawk (*F. sparverius cearae*), registered in an enclave in the savannah between 1 and 25 October, 2007 in the municipality of Camaçari, the state of Bahia.
Graph 7. *Falco sparverius cearae* maximum and minimum temperature inside and outside the nest x environment as a subject of time.