Feeding Ecology of the Black Caiman (*Melanosuchus niger*) in Manu National Park, Peru

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Resumen

Entre 1992 y 1994 se capturaron 88 individuos del lagarto negro en la laguna de Cocha Cashu en el Parque Nacional del Manú, localizado en la Amazonia peruana. De los individuos capturados, se colectaron muestras de contenido estomacal y se tomaron diferentes medidas de tama o. Dentro de las muestras colectadas, se contarón cerca de 15 categorías de alimento, incluyendo vertebrados e invertebrados. Caracoles del género *Pomatia* spp y peces fueron las categorias más importantes encontradas. La presencia de caracoles fué más abundante en los estómagos de animales jovenes, mientras que los peces fueron más abundantes en los estomagos de animales adultos. Vertebrados, tales como batracios, peque as aves, y mamíferos, también se encontrarón en forma esporádica. Los resultados del análisis estadístico y descriptivo indican que existe un efecto ontogénico significativo en la composicion de la dieta. También se encontarón, diferencias estacionales significativas en la composición de la dieta, lo cual indicaría que el lagarto negro modifica su comportamiento alimenticio de acuerdo a la disponibilidad de alimento.

El estudio de distribución de hábitat en el área del Parque Nacional del Manú permitió determinar areas naturales como lagunas y áreas ribere as que presentan una alta diversidad de organismos de varios niveles tróficos y son alimento para el lagarto negro. La conservación de esta especie, que ha sufrido fuertemente por caza indiscriminada, tiene que tomar en cuenta la proteción de su hábitat natural en la Amazonía.

Abstract

During 1992 and 1994, eighty eight individuals of the endangered species Black Caiman *Melanosuchus niger* were captured in an oxbow lake in Manu National Park located in the Peruvian rain forest. Stomach contents and body dimensions were collected and recorded from the captured animals. A total of 15 items among invertebrates and vertebrates were found in the stomachs. Snails (*Pomatia* spp) and fish were the main items of the diet composition. The category snails was the most abundant in the stomachs of juvenile black caimans while the category fishes was the most common in the stomachs of adult animals. Vertebrates such as frogs, birds and mammals were found in few stomach content samples. The results of the statistical and descriptive analyses indicated that there was a significant effect of ontogeny on diet composition. Also significant seasonal differences were recorded in the composition of the diet suggesting that black caimans modify their feeding behavior according to changes in prey ocurrence.

The study of habitat distribution in the study area allowed the determination of natural habitats like oxbow lakes, river margins and flooded floodplains that host a high diversity of organisms that represent prey items for the Black Caiman. The conservation of this species that has been heavily exploited in the past should consider the protection of ist natural habitat in Amazonia.

Introduction

The Black Caiman, *Melanosuchus niger*, is the largest Alligatoridae of South America. It is also one of the largest top predators in the aquatic environment. It has been reported that adults can reach more than 5 m in body length. According to Medem (1983), the Black Caiman exploitation started between 1930 and 1940. Nowadays, the species is considered endangered (R.M. No. 1082-90 AG) in Peru, and it is protected in Manu National Park and Pacaya-Samiria National Reserve. In addition, Black Caiman is listed in the appendix I of the CITES (Pulido 1991).
Although this caiman species has a wide distribution in the Amazon region, few information is available on its food habits and diet composition under natural conditions. For instance, Gorzula (1978) found that *C. crocodilus* in Venezuela, had a more diverse diet composition during the wet season (29 items/caiman) than during the dry season (3 items/caiman). According to Fitzgerald (1988), with the changes in habitat, season, or age, the caimans substitute their prey categories.
To understand more about Caiman ecology and behavior in its natural habitat, it is interesting to know which organisms constitute their food source and whether their diet composition change seasonaly and as they get older and bigger. This information is important to identify the habitat preferences of this species and for developing conservation and management plans that include the conservation of its habitat. Also this information helps to determine the impact of the Black Caimans on their prey populations and on human activities such as fishing.

Objectives

The main objective of this study was to analyse the diet composition of a population of Black Caiman in the Peruvian Amazon and investigate whether it changes seasonally and ontogenetically. Aditionally, it was planned to give a general overview of the available habitat for this species within Manu National Park.

Methodology

Study Area

Cocha Cashu lies in the Manu National Park area and is located in the Western Amazonian Floodplain of the Rio Manu, Peru. Cocha Cashu is a shallow oxbow lake located within large old-growth stands of pristine tropical lowland rain forests. The weather in the area follows a cyclic pattern with the strong period of rain occurring between January and April (Terborgh et al. 1985). Precipitation is scarce between July and September and the rainy season starts in October. The rains are frequent and sometimes on a daily basis from November to December. Annual mean precipitation for Cocha Cashu is about 2080 mm. The lake has an approximate area of 20 ha, a perimeter of 4 km, and a maximum depth of 2.95 m (Otte 1978, Herron 1985, Terborgh et al. 1985)

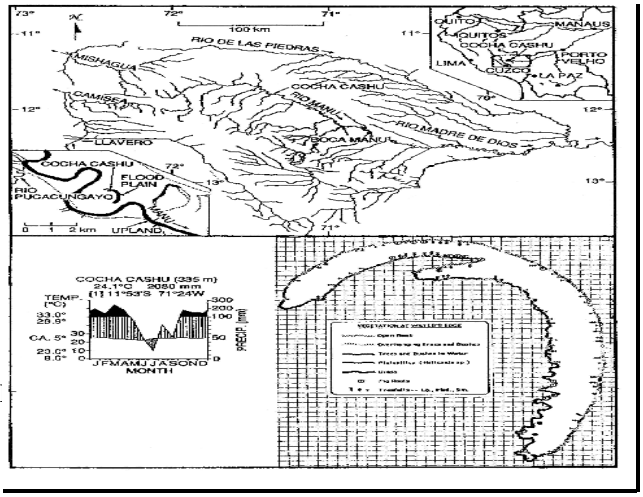


Figure 1. Geographic location of the study area in Manu National Park, Peru.

Stomach Content Collection

During three consecutive years, eighty-eight individuals of the endangered species *Melanosuchus niger* (Black Caiman) were captured in Cocha Cashu. Small caimans were captured at nighttime from a boat by catching the animal by hand at the neck, while large animals were capture using a lace placed on the neck of the animal and rapidly tightened (Vasquez 1981). For all individuals of Black Caiman we measured total lenght, snout-vent length, head length, weight, and determined the sex for each individual. The caimans were marked by cutting off one of the caudal crest scales following a binary code according to Vasquez (1981).
Stomach contents were collected using the stomach flushing method (Webb et al. 1982). The collected stomach content samples were preserved in ethanol. The caimans were released to their habitat immediately after investigation.

Habitat Identification

The habitat determination was done from a composite Synthetic Aperture Radar image taken by a side looking airborne during 1993 by a NASA's AIRSAR mission over the area of the Manu River

Results

Diet Composition

About 15 different remnants of invertebrates and vertebrates were found as stomach contents. Snails (*Pomatia* spp) and various fish species were the main items observed in the diet. Snails were more abundant in juvenile caimans and fish in the adult animals. Vertebrates such as frogs, birds, and mammals were also eaten by Black Caimans (Table 1). The most numerous item found in the diet, independent of the caiman size, were snails, mainly *Pomatia* spp., which are very abundant at the Cocha Cashu lake and constitute an important food supply for other vertebrates such as fishes, wading birds, and aquatic mammals.

Caiman Size and Diet Composition

The diet composition had a strong positive and significant relationship with size classes of Black Caimans ($r = 0.887$; $df = 1$; $p < 0.003$). Therefore, the results of MDS analysis clearly suggests that the diet composition changes as Black Caimans grow older. There was a tendency to increase the frequency of fish with increasing size class. The opposite tendency was observed for snails and aquatic beetles. For the rest of the prey items there was no clear tendency (Figure 2).

Table 1. Diet composition items according to different size classes of Black Caimans in Cocha Cashu, Manu National Park, Peru. Numbers are mean number of the diet items. The numbers in parenthesis are the sample sizes (number of stomachs analysed).

	Black Caiman body-length (cm)

Diet items	< 46 (n=3)	46-55 (n=16)	56-65 (n=12)	66-75 (n=11)	76-85 (n=15)	86-95 (n=13)	96-125 (n=11)	> 125 (n=5)
Snails	0.70	6.70	13.90	23.30	21.40	20.00	15.60	42.20
Fish	0.00	0.17	0.00	0.17	0.32	0.33	0.40	0.60
Crabs	1.57	4.00	2.60	0.17	0.58	0.88	0.00	0.00
Larvae	8.00	6.00	13.30	4.25	1.84	0.78	0.40	0.60
Terrestrial beetles[1]	3.00	8.10	3.50	2.00	2.10	0.40	0.60	2.40
Aquatic beetles[2]	0.00	0.28	0.42	0.25	0.32	0.89	0.40	0.60
Centipedes[3]	0.14	0.39	0.00	0.17	0.21	0.00	0.20	0.20
Spiders	0.43	1.06	0.42	0.50	0.26	0.22	0.00	0.20
Ants	3.40	1.70	0.08	0.33	0.68	0.22	0.20	0.20
Other insects	0.00	0.06	0.00	0.17	0.05	0.11	0.00	0.00

[1]= Coleoptera; [2]= Belastomatidae; [3]= Miriapoda

Seasonal Variation of the Diet

The results of a post-hoc multivariate test suggested that there were significant seasonal differences in the diet composition of Black Caimans (Pillai Trace F = 3.736; df = 4, 166; p = 0.006. Some individuals of Black Caiman had significantly more snails, spiders, aquatic beetles, and other insects in their stomachs during the wet season than during the dry season.

Habitat Distribution

The floodplain area along the Manu River offers a variety of habitat conditions for Black Caimans (Figure 3). Oxbow lakes like Cocha Cashu are one of the most important habitats, because they provided a mix of open water and well protected lake shores were adult females build their nests. This habitat undergoes an annual transition from low to high water levels which also means that the lake is either isolated from or connected with the main river channel of the Manu River. As it was observed from the seasonal variation of diet composition the seasonality in the habitat also determines the availability of different preys.

During the rainy season the floodplain of the Manu River offers a large area were caimans are moving easily between adjacent flooded areas and take advantage of a broader variety of prey items.

The main river banks are also habitat for black caimans, but mainly for larger size animals.

Conclusions

The results from both, descriptive statistics and multivariate ordination analyses, indicate a significant effect of ontogeny on diet composition. There was a clear tendency in diet change with caiman age and growth

The significant seasonal differences in the diet composition suggest that Black Caimans adjust their feeding behavior according to changes in prey abundance and occurrence. Although Black Caimans are top predators, they depend on both, invertebrates and vertebrates to satisfy their energetics needs during their development.

The conservation of this heavily hunted species has to consider the protection of natural areas such as lakes, cochas, and rivers containing a high diversity and abundance of organisms at various trophic levels. Also, experiments aimed to monitor controlled harvesting in protected areas are urgently needed for developing realistic management plans for Black Caimans in the Amazon.

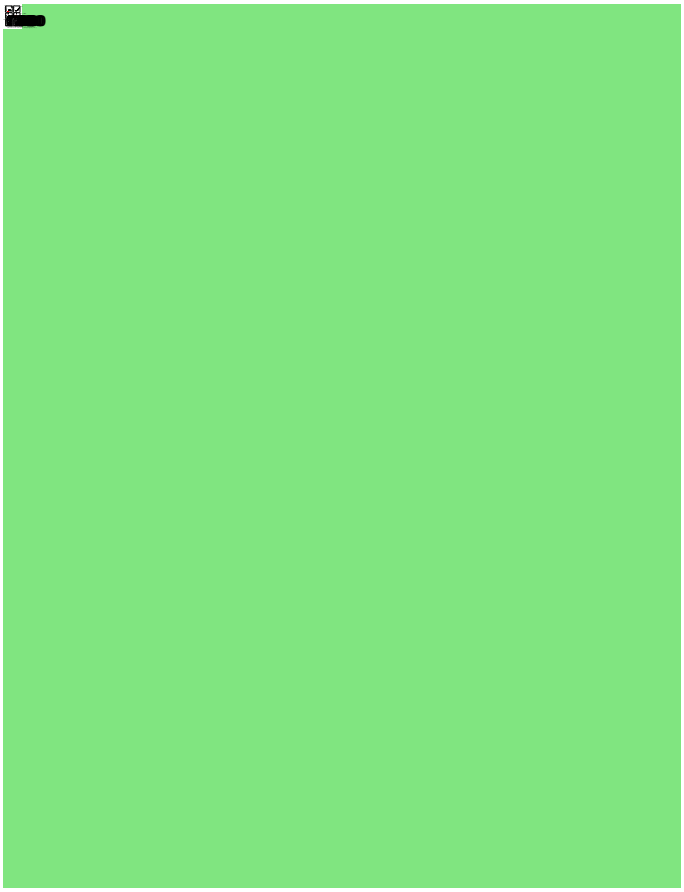
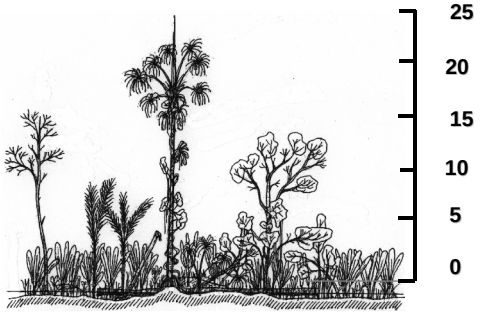
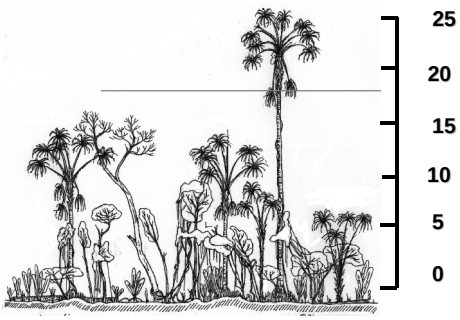


Figure 2. Relationship between mean number of the diet items found in the stomach contents and Black Caiman total body length (cm). The equation for snails: y = 0.3369x – 8.9448; for fish: y = 0.0060x – 0.2284; and for insect larvae: y = -0.1012 x + 12.4852.

Cocha Brasco, an oxbow lake along the Manu River which is isolated during low water in the dry season.



Old, stagnant water oxbow with dense Heliconia understory and few *Mauritia flexuosa* palms in the canopy (S 12° 14.13', W 70° 56.01')



Old oxbow with seasonally stagnant water and an open mixed canopy (S 12°11.75', W 70°58.36')

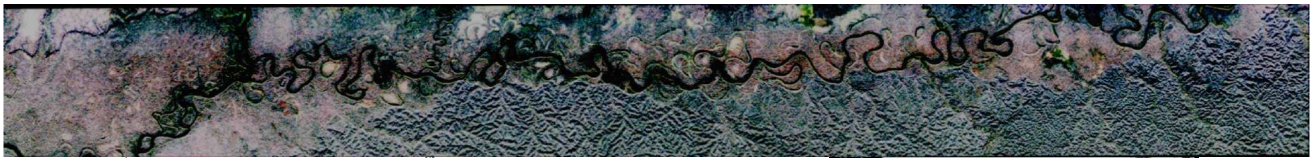


Figure 3. Floodplain of the Rio Manu and its vegetation (right). This side looking airborne Synthetic Aperture Radar image was taken in 1993 during NASA's AIRSAR mission. The radar signal partially penetrates the forest canopy and allows separation of structural vegetation units. The right side of the Manu river shows the wide floodplain with tall rain forests and palm swamps (reddish and yellow signatures). A mosaic of newly formed oxbow lakes and older sedimented up Cochas intersect the flat terrain. The left side of the Manu river shows predominantely hill forests on rugged topography. During the wet season most of the floodplain is flooded allowing the movement of caimans within the floodplain forests between lakes. During the dry season the habitat for the black caiman is reduced to the oxbow lakes and swamps.

Old dry oxbow, with open Heliconia understory and *Mauritia flexuosa* in the canopy (S 12º 15.70', W 70º 55.97')

Cocha Cashu, Manu N.P. Floating vegetation and sedges at the northern end of the Cocha Cashu oxbow lake. The adjacent old growth floodplain forest in the background reaches tree heights of 55 to 60 m

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We ... a la Conservación (CDC) a... ncia y Tec... ogistic support and fundin... John Ter... e field season at Cocha Cashu

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