

DIET OF THE MAGELLANIC PENGUIN *SPHENISCUS MAGELLANICUS*  
DURING THE CHICK - REARING PERIOD AT PUNTA CLARA, ARGENTINA

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INTRODUCTION

The status and population size of the Magellanic Penguin *Spheniscus magellanicus* were unknown to Murphy (1936) and are still largely unknown. Boswall & MacIver (1974) suggested that large populations would be found along a wide range of distribution with about 8-10 million birds. Breeding sites on the southern Atlantic continental coast have recently been surveyed in detail (Scolaro *et al.* 1980). The position of each colony has been carefully checked to eliminate the confusion in the earlier literature: there are 21 breeding colonies along some 1 500 kilometres of coast and small offshore islands, between 42 and 52 South.

Murphy (1936) also summarized all the literature then available on feeding and concluded that cephalopods and sardines (possibly anchovies) were the principal food of Magellanic Penguins during the breeding season in Patagonia. Johnson (1965) and Boswall & MacIver (1974) mentioned anchovy, as well as various squid and fish species as prey of the Magellanic Penguin. Scolaro (1978) recorded a list of prey species based on undigested pieces of food collected from penguin nests at the Punta Tombo colony when adults tried to feed their chicks. He also calculated (Scolaro 1980) the possible incidence of preying on squid and fish populations during a reproductive cycle from the total population estimated by Boswall & MacIver (1974). Recently, Gosztonyi (1984) has estimated the total amount of food consumed by the species at Punta Tombo.

Since the Magellanic Penguin has a wide distribution, in an equally wide range of environments and ecosystems, detailed studies may show differences in the diet. This study aims to determine the prey of the Magellanic Penguin at one breeding locality during chick-rearing.

METHODS

This study was undertaken at Punta Clara colony (43 58S, 65 16W) Chubut Province, Argentina during the chick-rearing season (December 1979 to February 1980). During this period random samples were irregularly taken (every 7-13 d) by collecting a total of 57 breeding adults (Table 1) as they returned from the sea with food. Stomach contents were first weighed, and then stored in 70 % alcohol with 10 % formalin.

TABLE 1  
 STOMACH CONTENTS AND PERCENTAGES OF DIFFERENT PREY TYPES  
 OF MAGELLANIC PENGUINS DURING THE CHICK-REARING PERIOD AT PUNTA CLARA, 1979-1980

Date	Mean body mass (g)		N	Mean stomach content mass (g)		% relative abundance of prey					
	Males	Females		Males	Females	Anchovy	Hake	Silversides	Squid	Others	
9 Dec	4 986	4 533	3	765	553	50,0	-	44,4	5,5	-	
15 Dec	5 150	4 513	4	736	761	60,0	-	13,3	13,3	13,3	
22 Dec	5 380	4 238	4	696	538	52,6	5,4	21,0	21,0	-	
5 Jan	5 370	4 325	4	793	466	50,0	6,2	25,0	12,5	6,2	
17 Jan	5 050	4 425	2	677	745	47,0	-	29,4	11,8	11,8	
2 Feb	4 900	4 350	5	621	686	50,0	7,1	14,3	28,6	-	
Total	5 178	4 386	22	714	632	51,6	3,1	24,6	15,5	5,2	

The undigested parts from each stomach were mixed and 20 % of the whole mass was taken for quantitative analysis. This undigested mass was washed through a fine sieve and separated into different components. These were studied under a binocular lens, identifying and counting otoliths and squid beaks of each prey type. When the otoliths were not recognizable because of taxonomic difficulties, they were assigned to the "other fish" item. Very broken otoliths were discarded.

The total undigested mass of each prey species was estimated by assuming a similar composition to the analysed subsample and multiplying the amount five times. The relative abundance of prey was then determined by expressing the number of prey items of one species (undigested prey plus half the number of otoliths or squid beaks counted) as a percentage of the total number of identified prey items in all stomachs of the sample. The birds were weighed on a 10 kg balance to an accuracy of  $\pm 50$  g; stomach contents on a 2 kg balance to an accuracy of  $\pm 0,1$  g. Birds were sexed on dissection.

## RESULTS

The mean mass of stomach contents was 686 g (range 292 - 1 032 g), representing 14 % of body mass (range 7,1 - 22,5 %). There was no apparent correlation between the mass of the bird and the mass of stomach contents ( $r = 0,31$ ;  $n = 51$ ). The mass of stomach contents was not significantly different between male or female penguins (range 405 - 1 032 g, mean 714 g, s.d. = 148 g and range 292 - 1 002 g, mean 632 g, s.d. = 176 g respectively), or between birds with one-chick and two-chick broods (range 477 - 805 g, mean 629 g, s.d. = 92 g,  $n = 9$  and range 405 - 915 g, mean 681 g, s.d. = 164 g,  $n = 7$ , respectively) (Mann-Whitney U test;  $P > 0,05$ ).

Although previous sampling carried out when the chicks hatched (within the first two days) suggested that a smaller quantity of food was supplied initially, a comparison of the average quantities brought by each parent throughout the chick-rearing period did not show significant differences (Student's t test).

Composition of the diet varied with season (Fig. 1). Anchovy *Engraulis anchoita* was a principal element of the diet throughout the breeding cycle. Hake *Merluccius hubbsi* occurred rarely, most often toward the middle and end of chick rearing. Species of Silversides, mainly *Austroatherina smitti*, were present in the diet throughout the season, at significant level during the first half (early December; Mann-Whitney U test;  $P < 0,05$ ) and during two weeks previous to chick-independence (test for significance of differences between two proportions;  $P < 0,01$ ). Cephalopods, particularly squid *Illex* and *Loligo* sp. (Baldás & Brunetti pers. comm.), formed only a small part of the diet at the start but increased in proportion up to the first half of January (Mann-Whitney U test;  $P < 0,07$ ), after then decreased. The point of maximum percentage was reached at the end of the chick-rearing period showing significant differences (test for significance of differences between the two proportions;  $P < 0,01$ ).

The largest undigested fish found in a Magellanic Penguin

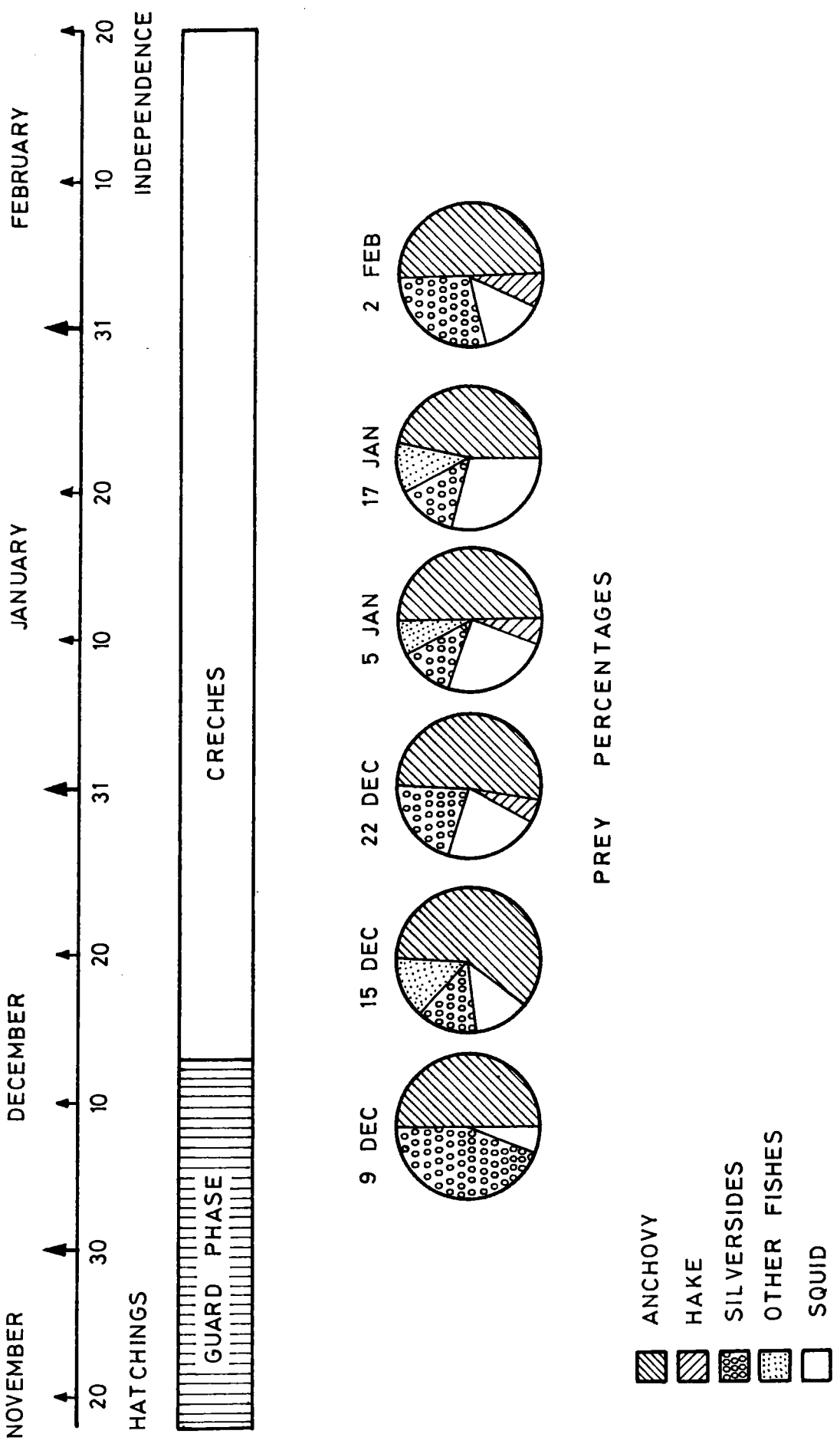


FIGURE 1

Changes in percentage relative abundance of prey during the chick-rearing period of the Magellanic Penguin at Punta Clara, 1979-1980.

stomach was an Anchovy of about 160 mm long and weighing 23 g, but the stomach in which it was found also held 64 Anchovies of different sizes and degrees of digestion. One exceptional stomach contained six almost undigested squid of about 300 mm length each and totalling 1 032 g.

#### DISCUSSION

These preliminary results only give percentage relative abundance of each prey species. Further, more detailed studies could contribute with information about the order in which the prey is caught, and thus help define the foraging area of the species. Nevertheless, these findings may serve as a guide to the qualitative composition of food in the Punta Clara fishing area, showing also the quantity of food delivered by both sexes of Magellanic Penguins.

Anchovy is a principal component of the diet of the Magellanic Penguin at Punta Clara throughout the chick-rearing period. This coincides with a high concentration of spawning shoals and large nursery areas of Anchovy in the coastal waters of the southern region. After summer, when trophic activity of the Anchovy decreases and the schools remain in cold demersal waters (Angelescu 1982), breeding Magellanic Penguins start their annual migration.

Occurrence of other prey, such as Hake and squid in the diet of the Magellanic Penguin coincides with the time when these species come close to the coast to spawn (Otero *et al.* 1983).

The chicks receive roughly the same amount of food throughout the rearing period from each parent, but as their needs become greater, the number of foraging trips increases. During the guard stage, the supply seems to last over the two days that each parent is normally present; later, adults feed their chicks daily (Scolaro 1984). Because of this, we differ with the estimations that Gosztonyi (1984) has recently proposed for the same species at Punta Tombo colony (very close to Punta Clara), based on the application of Rand's (1960) concept of individual meals and extending this to calculate the whole mass of food consumption by the population in the area. Other findings recorded during the 1980-1981 breeding season by Gosztonyi (1984) do not differ to those presented here.

The relationship between the mass of food in the stomachs and the mass of adult Magellanic Penguins is similar to that reported by Croxall & Prince (1980) for the Gentoo Penguin *Pygoscelis papua* and the Macaroni Penguin *Eudyptes chrysolophus*. In comparison to Jackass Penguins *Spheniscus demersus*, there is a remarkable similarity in diet since Anchovy *Engraulis capensis* is the major prey item at most of its breeding localities (Wilson 1985). The cephalopod diet of the Jackass Penguin (Randall *et al.* 1981) is also similar to that of the Magellanic Penguin.

## RESUMEN

### DIETA DEL PINGUINO DE MAGELLANES *SPHENISCUS MAGELLANICUS* DURANTE LA FASE DE CRIANZA DE LOS PICHONES EN PUNTA CLARA, ARGENTINA

Se analizan los contenidos estomacales de 57 Pingüinos de Magallanes *Spheniscus magellanicus* de ambos sexos, colectados al azar y cubriendo la mayor parte de la fase de crianza de pichones durante el ciclo reproductivo 1979-1980, en la colonia de Punta Clara (Chubut, Argentina). Se analiza la composición de la dieta como porcentajes de la frecuencia de ocurrencia de cada categoría de presa y cantidad del alimento acarreado por los padres durante la crianza. El peso medio del contenido estomacal fue 660 g (rango 292 - 1 032 g) representando entre 7 - 22,5 % del peso del ave adulta. No se encuentran diferencias estadísticas en la cantidad del alimento acarreado y el tamaño (peso) o sexo del padre, como tampoco depende del número de pichones de la camada. La Anchoita es la principal presa a través de todo el ciclo de crianza, seguida por orden de frecuencia de ocurrencia por la Merluza, las especies de Pejerrey y los Calamares; estos últimos son más frecuentemente capturados sobre el final del periodo ( $P < 0.01$ ).

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