

SEXUAL DIMORPHISM OF CORY'S SHEARWATER  
*CALONECTRIS DIOMEDEA BOREALIS* ON SELVAGEM  
GRANDE  
(30° 09' N, 15° 52' W)

By F. Zino \*, M. Biscoito \*\*, E. Blandy† , H. C. Neves \*\*\*

RESUMO: Neste trabalho é dado conta de um estudo levado a cabo na Selvagem Grande para encontrar um método simples e de fácil aplicação no campo, que permita a determinação do sexo das Cagarras (*C. diomedea borealis*).

Entre 30 de Abril e 12 de Maio de 1986 foram estudados 98 pares reprodutores. Através de uma simples medida do bico foi possível determinar o sexo em 70% destas aves com 100% de certeza. Com a ajuda de uma outra medida do bico foi possível determinar o sexo nas restantes 30% com uma certeza de 87.5%. Este método é simples de operar no campo.

A medida dos bicos de juvenis imediatamente antes de estarem aptos a voar não mostrou qualquer distinção dos sexos.

ABSTRACT: In order to devise a simple method, easily applicable in the field, of sexing Cory's Shearwaters (*C. diomedea borealis*), 98 breeding pairs were studied on Selvagem Grande between April 30th and May 12th 1986.

We found that from a single bill measurement we were able to sex 70% of these birds with 100% accuracy, and with the aid of one further bill measurement we were able to sex the remaining 30% to a 87.5% degree of accuracy. This method is simple to operate in the field.

The bill measurement of chicks just prior to fledging showed no separation of the sexes.

## INTRODUCTION

The ability to sex birds in the field has obvious advantages. Some species show considerable sexual dimorphism and present no problem. Many seabirds do not show obvious sexual characteristics even when examined during the breeding season when sexual dimorphism should be at its greatest.

---

\* Rua do Dr. Pita, 7 - 9000 Funchal

\*\* Museu Municipal do Funchal - 9000 Funchal

\*\*\* Parque Natural da Madeira - 9000 Funchal

In 1979 RISTOW & WINK (1980) working on the Aegean subspecies *C. diomedea diomedea*, made several computations of head and bill measurements, in an attempt to sex pairs of breeding Shearwaters. These birds (38 pairs) were then unequivocally sexed. By multiplying "L x W" (Fig. 1). they were able to sex 95% of the study group, the remaining 5% falling into an area of overlap.

In March 1984 we first applied RISTOW & WINK theory to the colony of *C. diomedea borealis* on Selvagem Grande. Whilst measuring the height at "W" (Fig. 1) we also measured it at "FZ" (Fig. 1). Due to their size and strength, measuring beaks of struggling Cory's is never an easy matter. We found that measuring the height at "FZ" is easier to carry out and consequently more precise.

Because this study was carried out in March we found relatively few pairs (25) on the nest and although our results supported those of RISTOW & WINK (1980), it was felt that the sample was too small to merit publication.

In 1985 MOUGIN *et al.* (1986) applied a third variation to RISTOW & WINK's measurements on Selvagem Grande and measured bill height at "M" (Fig. 1). They worked on a very large sample of 779 birds including 361 pairs and concluded that -- "the computation of the beak index based on a multiplication of culmen length x culmen height allows determination of sex of 67% of the solitary birds and 90% of paired birds".

Although each of the combinations "L x W, L x FZ" and "L x M" (Fig. 1) showed clear potential for sexing birds when seen in pairs, their ability to sex a solitary bird is far from satisfactory. We therefore decided to expand our study, which was started in 1984, and concentrate more on finding a method for sexing solitary breeding birds.

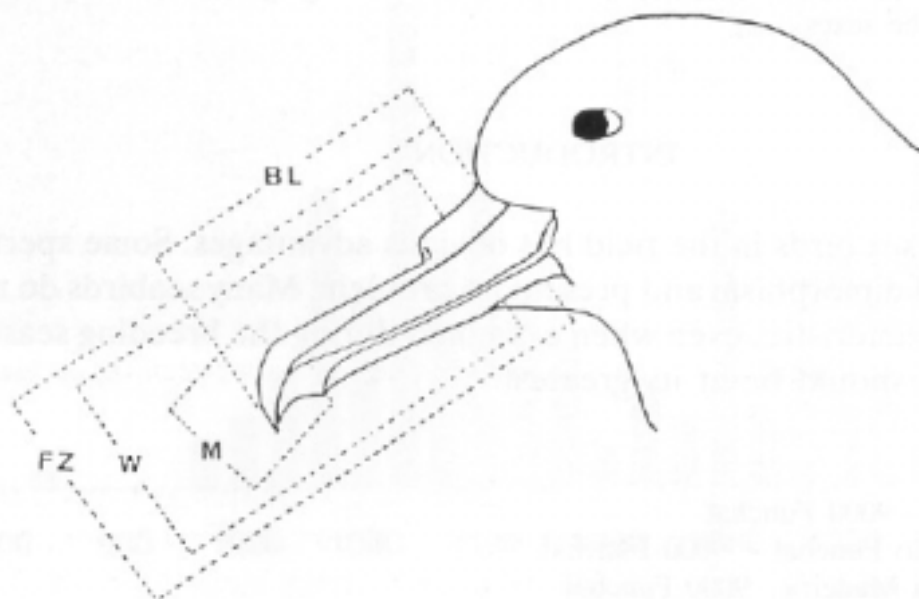


Fig. 1 -Measurements used for computations.

## METHODS

We visited Selvagem Grande from April 30th to 12th of May 1986.

One of our study areas, where all the nests were already numbered and the majority of birds ringed, was visited daily. These visits were made in the late evening when the birds started coming ashore and continued well into the night.

Every pair in a nest was observed. The nest number was noted and the pair sexed visually, assuming the male bird as the bigger and more robust, with an apparently larger head and bill (OGILVIE-GRANT, 1896, LOCKLEY, 1942, MOUGIN, *et al.*, 1986, RISTOW & WINK, 1980, ROBERTSON & JAMES, 1988). Sexing was sometimes confirmed by the bird calling (CRAMP & SIMMONS 1978) or by observing the pair mating (Fig. 2).

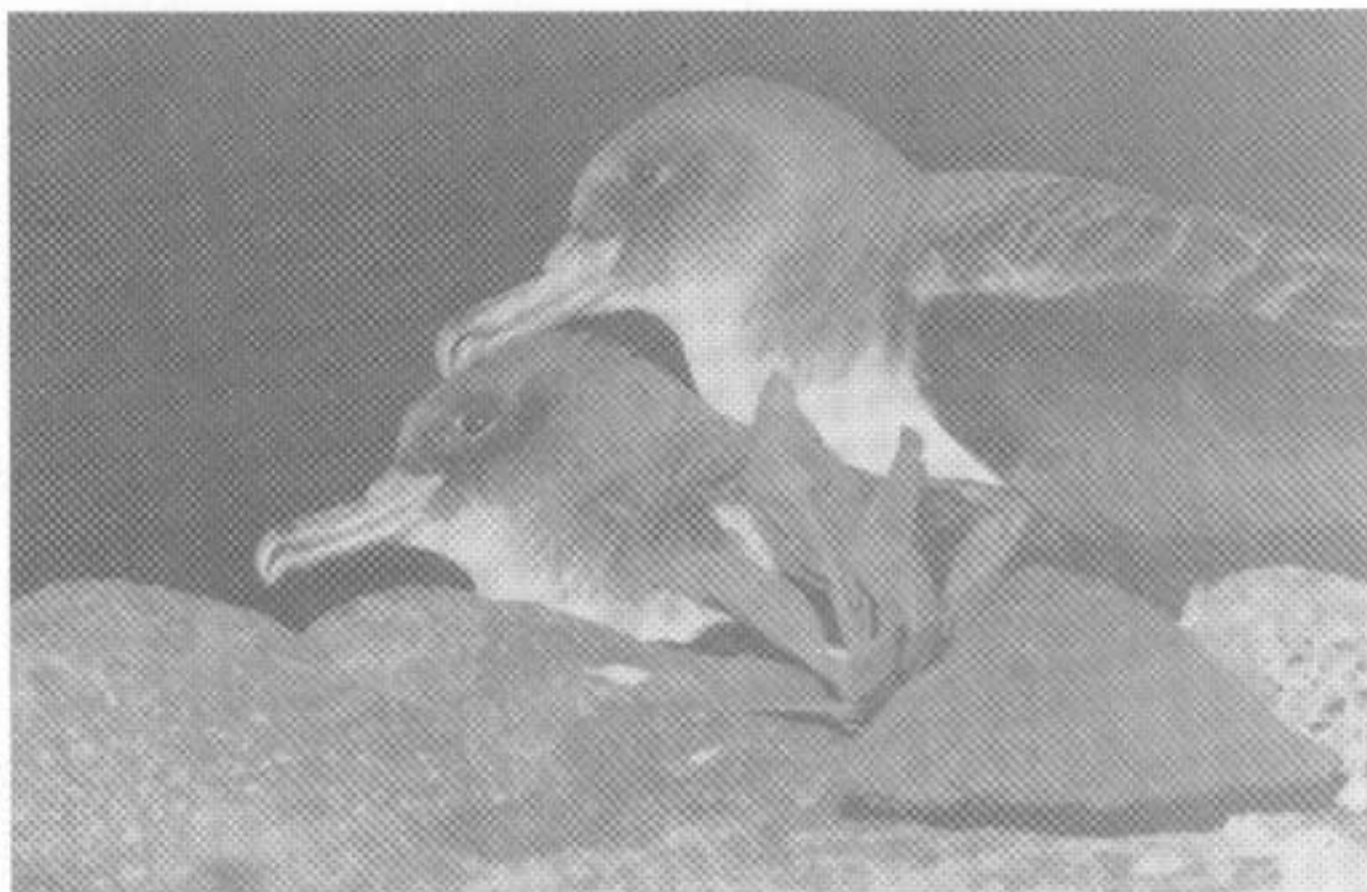


Fig. 2 - Mating Cory's shearwaters on Selvagem Grande. As can be seen the male's bill and head are clearly larger. (Pkoto. F.Z.).

Once the bird had been sexed visually, their ring number was noted ; they were then weighted and the four bill measurements as shown in Fig. 1 were taken.

Whereas weight at this time of the year, when both birds are free to feed, is an excellent indicator of sex (ZINO, 1971) it becomes less indicative during the in

incubation period when one of the pair may not feed for long periods. Also, under windy conditions, common on the Selvagens, it can be difficult to obtain precise weights.

During our stay 98 pairs of *C. d. borealis* were observed on their nests. These 98 pairs were made up from 190 birds rather than the 196 expected. The reason for this was that an individual bird was observed with a different partner on different nights. One male was seen mating with a different female on two consecutive nights. As many as five different birds were observed in a single nest at different times. Whereas this gives a possibility of six different pairings, only when two birds were seen together on a nest did we consider this an observed pair.

In October/November 1984 and October 1985 while working on the fledging period of *C. d. borealis* (ZINO *et al.*, 1987), bill measurements were taken (bill length and FZ) of 193 Cory's just prior to fledging.

All data collected were processed using a standard electronic spreadsheet.

## RESULTS

We found that we were able to sex 70% of our sample (134 birds) by a single measurement. All birds with an "M" measurement of 17 mm. or more proved to be males, and those with "M" measurement of 15 mm. or less, females. (Table 1).

This left us 56 birds with an "M" measurement of 16.5 mm. (10), 16.0 mm. (23) and 15.5 mm. (23).

With all bill measurements from the full sample, various computations were made in an attempt to produce the best separation of the sexes.

The four most successful computations are as follows:

1. Plotting "M" against "L x M" 9 wrong answers are obtained (83,9% chances of accurately sexing a bird) (Fig. 3).

2. Plotting "M" against "FZ + L" 6 wrong answers are obtained and one indeterminate (87.5% chances of accurately sexing a bird) (Fig. 4).

3. Plotting "M" against "FZ" 7 wrong answers are obtained (87.5% chances of accurately sexing a bird) (Fig. 5).

4. Plotting "L x M" against "FZ" 6 wrong answers are obtained and one indeterminate (87.5% chances of accurately sexing a bird) (Fig. 6).

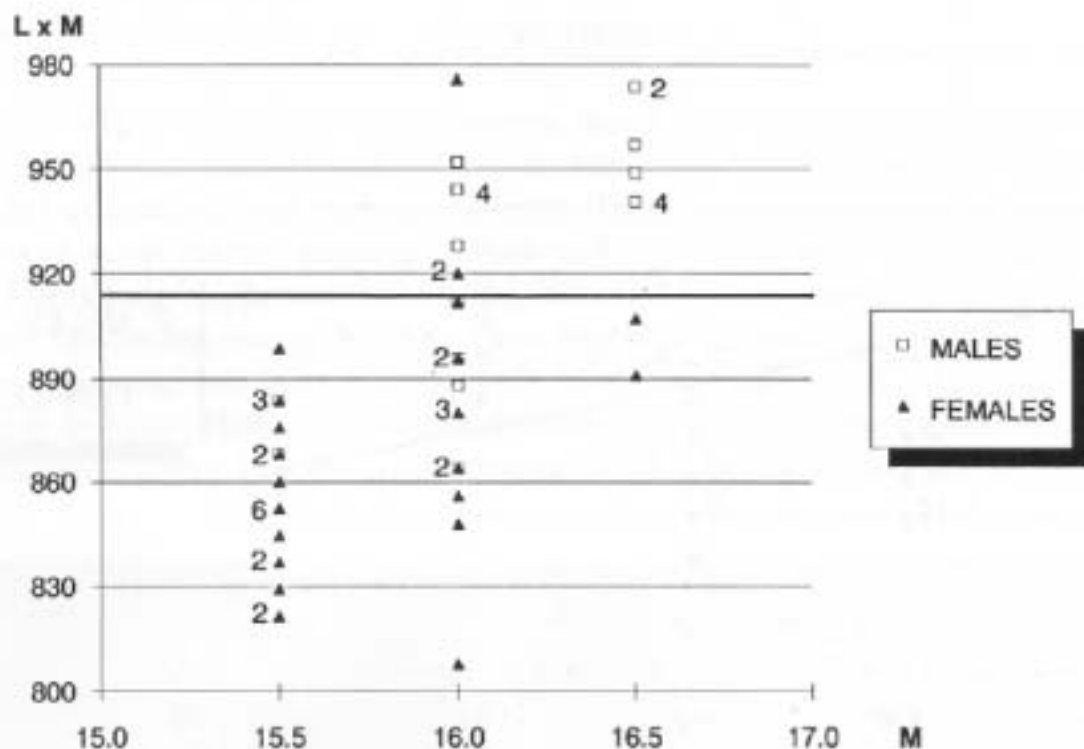


Fig. 3 - Plot of "M" against "M x BL". The linear regression line was calculated for the whole sample ( $n=196$   $r=-0.0001$ ), but only the birds with  $15 < M < 17$  are plotted. (Figures correspond to overprinted plots; males on the right and females on the left).

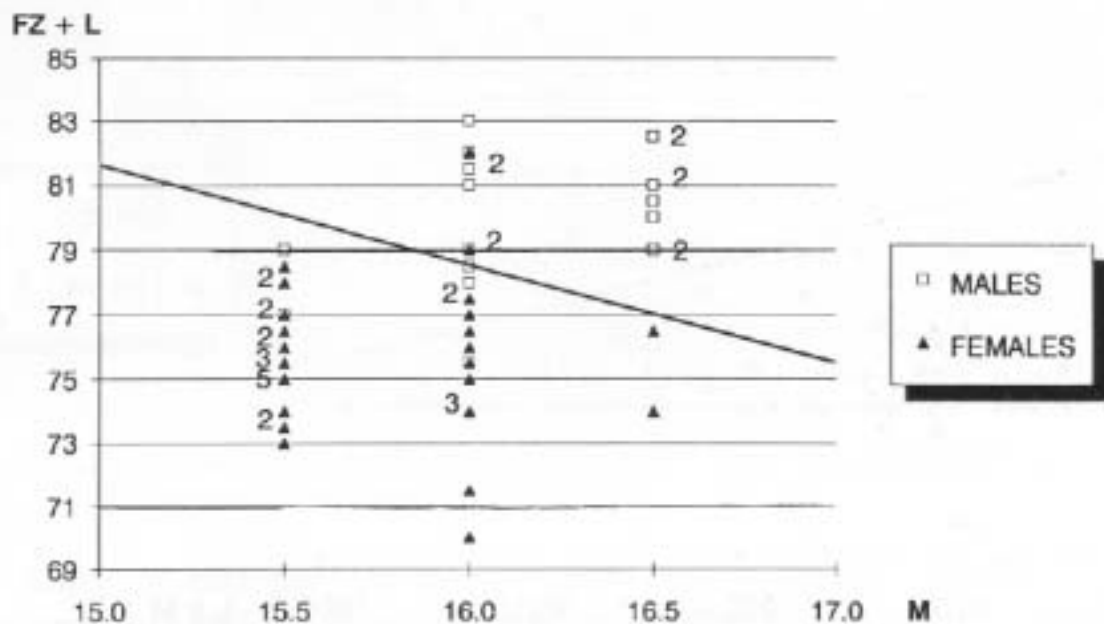


Fig. 4 - Plot of "M" against "FZ + BL". The linear regression line was calculated for the whole sample ( $n=196$   $r=2.904$ ), but only the birds with  $15 < M < 17$  are plotted. (Figures correspond to overprinted plots; males on the right and females on the left).

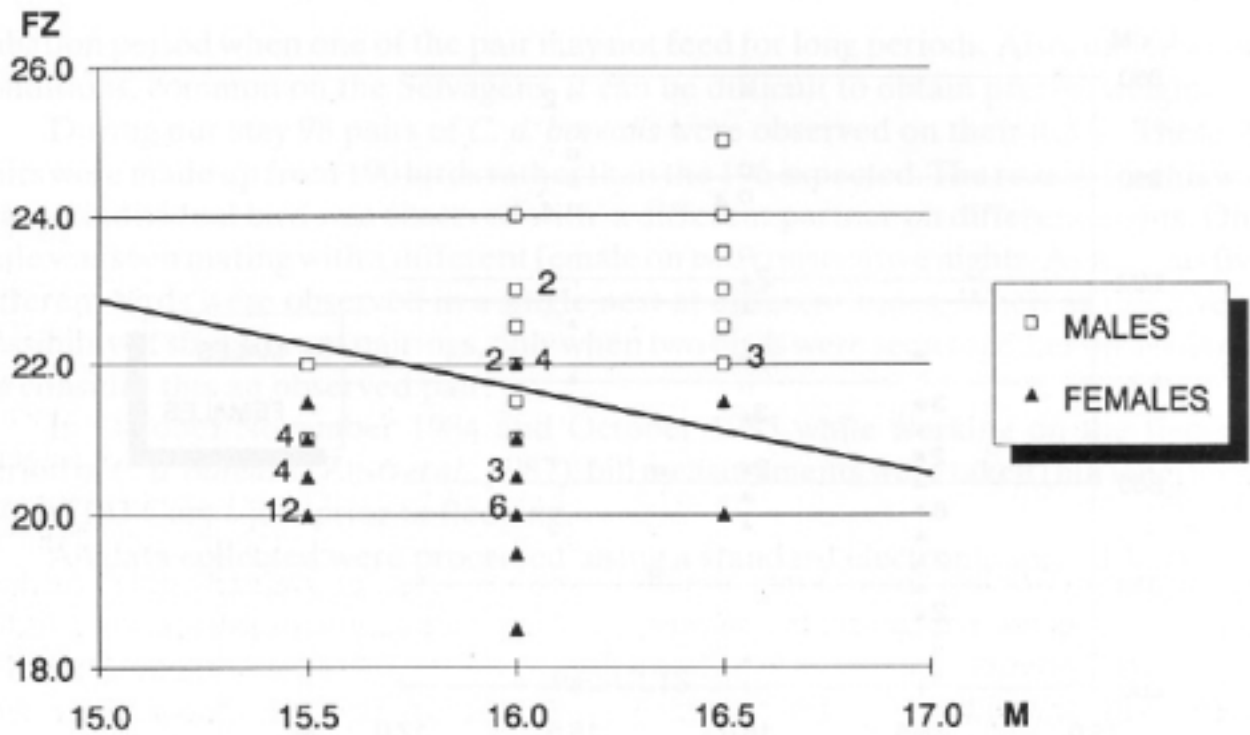


Fig. 5 - Plot of "M" against "FZ". The linear regression line was calculated for the whole sample ( $n=196$   $r=1.17$ ), but only the birds with  $15 < M < 17$  are plotted. (Figures correspond to overprinted plots; males on the right and females on the left).

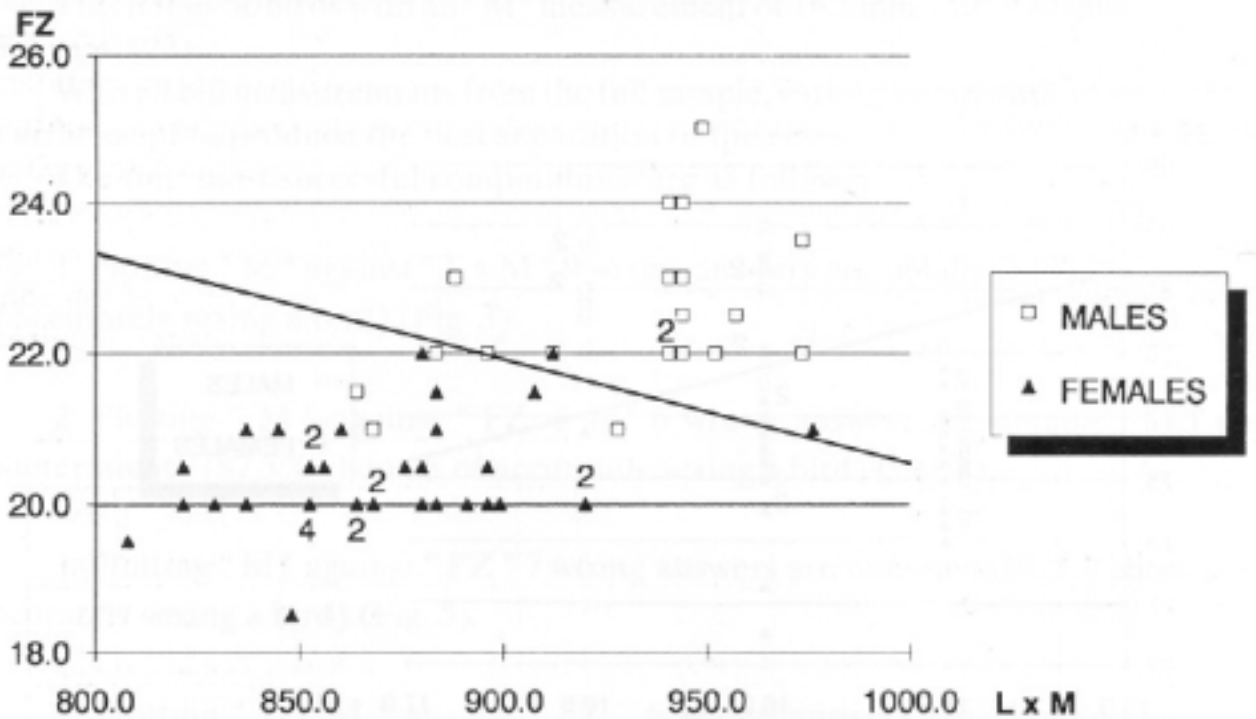


Fig. 6 - Plot of "BL x M" against "FZ". The linear regression line was calculated for the whole sample ( $n=196$   $r=0.013$ ), but only the birds with  $15 < M < 17$  are plotted. (Figures correspond to overprinted plots).

Computations of bill measurements of young Cory's just prior to fledging did not show any degree of separation (Table 1 and Fig. 7).

#### DISCUSSION AND CONCLUSIONS

The relationship between bill measurements and sex was again demonstrated.

Since we were able to sex 70% of the breeding population absolutely, the real problem of sexing applies to the remaining 30%.

Bearing in mind that the aim of this study was to produce a simple method with easy application in the field for sexing breeding Cory's Shearwater on Selvagem Grande, we would suggest using the computation shown in Fig. 5 (M against FZ).

When a bird is handled the "M" measurement should be taken first. If this is greater than 17 or less than 15 mm. the bird's sex has been determined and no further measurements are necessary. If however, the "M" measurement falls in the middle range ("M" greater than 15 or less than 17 mm.) the "FZ" measurement should be taken. With the aid of a graph on which a line has already been drawn these two parameters may be plotted.

The coordinates for this line are: when  $x = 15$  then  $y = 22.8$ ; when  $x = 17$  then  $y = 20.5$ . This will produce an answer with an 87.5% chance of correctly sexing a bird.

It is important to note that our study was carried out on breeding birds as was that of RISTOW & WINK (1980) and MOUGIN *et al.* (1986). RISTOW & WINK (1980) measured several of their birds repeatedly over a five year period and could find no age dependent change. Bill measurements taken of young Cory's Shearwater on Selvagem Grande just prior to fledging showed no degree of separation (Fig. 7). The same methodology when applied to our breeding sample showed a distinct separation of two groups, corresponding to males and females (Fig. 8). Also these bill measurements are on average smaller in the juveniles than in the breeding adults (Table 1). We must thus assume that the dimorphism shown in the bills of adult breeders must be a sexual acquired character.

	Bill Length	FZ	M	W
MALES n=98	58.65 ± 2.15 (54.00 - 65.50)	22.83 ± 0.87 (21.00 - 25.00)	16.98 ± 0.6 (15.50 - 19.00)	21.49 ± 0.9 (18.00 - 23.50)
FEMALES n=98	54.87 ± 1.86 (50.50 - 61.00)	20.2 ± 0.75 (18.00 - 23.00)	15.2 ± 0.54 (14.00 - 16.50)	19.23 ± 0.75 (17.00 - 21.00)
JUVENILES n=193	55.57 ± 2.51 (50.00 - 63.00)	19.48 ± 1.12 (17.00 - 22.50)		

Table 1 - Summary of bill measurements (average ± standard deviation) for males, females and juveniles. Figures in brackets represent maximum and minimum values.

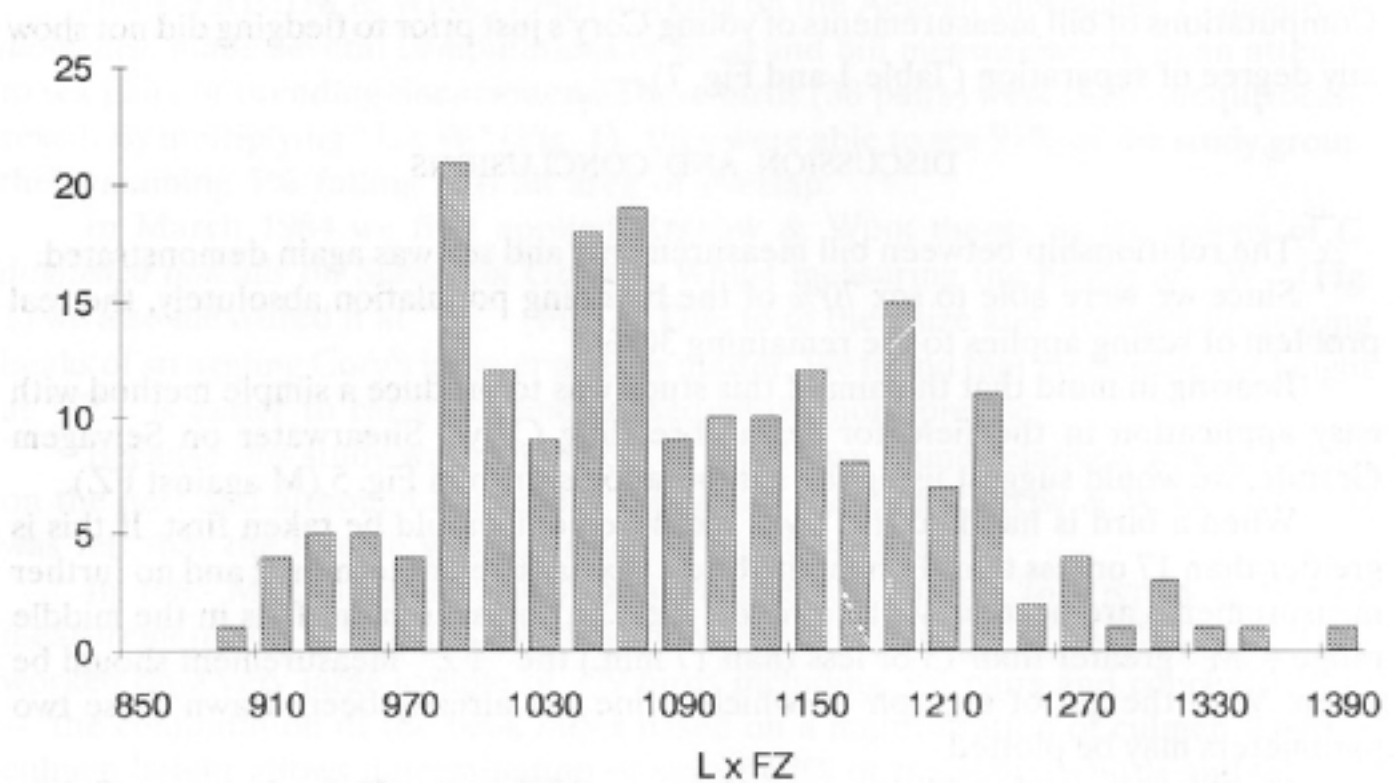


Fig. 7 - Frequency of bill measurements "BL x FZ" in 193 juvenile Cory's shearwaters just prior to fledging.

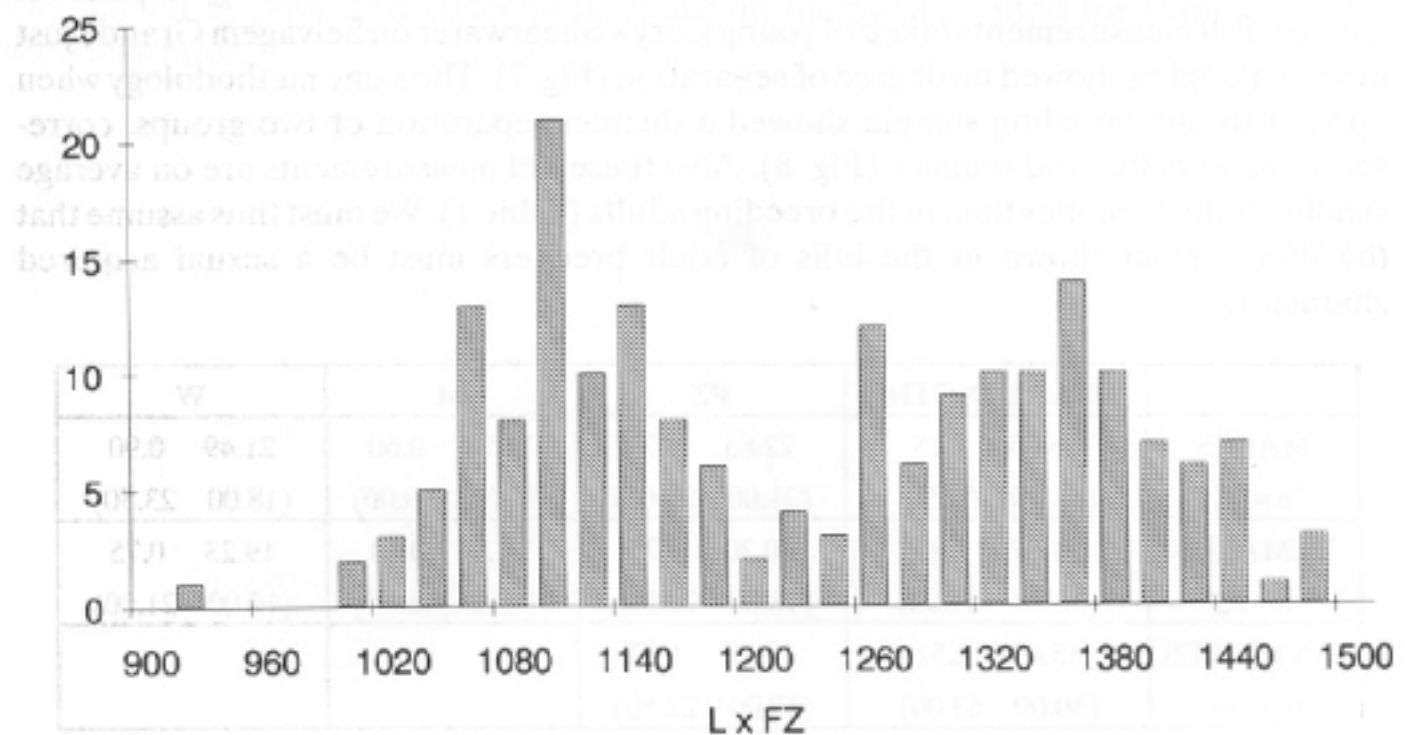


Fig. 8 - Frequency of bill measurements "BL x FZ" in 196 breeding Cory's shearwaters.



## ACKNOWLEDGEMENTS

We would like to express our gratitude to:

TED GERRARD for untiring help and encouragement and JOERG ZENGERER for his help with computer processing and statistical advice; The Marinha de Guerra Portuguesa for transport to and from the Selvagens and their traditional hospitality; The wardens from the Reserva Natural das Ilhas Selvagens for their help with work in the field; PAUL A. ZINO, ELISABETH A. ZINO and ADELAIDE BISCOITO for their help with the manuscript and during our stays at the Selvagens.

## REFERENCES

- CRAMP, S. & SIMMONS, K. E. L. (Eds.):  
1978. *Handbook of the Birds of Europe the Middle East and North Africa. The Birds of the Western Palearctic*. Vol. 1, Ostrich to Ducks. Oxford University Press. Oxford, London, New York.
- LOCKLEY, R. M.:  
1942. *Shearwaters*. J. M. Dent & Sons. London.
- MOUGIN, J.-L., B. DESPIN & F. ROUX:  
1986. La détermination du sexe par mesurement du bec chez le Puffin Cendré *Calonectris diomedea borealis*. *C. R. Acad. Sc. Paris*, t. 302, Ser. III (3), 1986: 91 - 96.
- OGILVIE-GRANT, W. R.:  
1896. On the Birds observed at the Salvage Islands, near Madeira. *Ibis* (7), 2: 41-55.
- RISTOW, D. & M. WINK:  
1980. Sexual dimorphism of Cory's Shearwater. *III - Merrill*, 21, 1980: 9 - 12.
- ROBERTSON, H. A. & P. C. JAMES:  
1988. Morphology and egg measurements of seabirds breeding on Great Salvage Island, North Atlantic. *Bull. B. O. C.*, 108 (2): 79 - 87.
- ZINO, P. A.:  
1971. The breeding of Cory's Shearwater *Calonectris diomedea* on the Salvage Islands. *Ibis*, 113 (1971): 212 - 217.
- ZINO, P. A., F. ZINO, T. MAUL, & M. J. BISCOITO:  
1987. The laying, incubation and fledging periods of Cory's Shearwater *Calonectris diomedea borealis* on Selvagem Grande in 1984. *Ibis*, 129 (1987): 393 - 398.