

## Some aspects of the feeding habits of the Cormorant (*Phalacrocorax carbo sinensis*) wintering in the Maremma Natural Park (Grosseto, Central Italy).

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**Abstract** - The feeding habits of the Cormorant wintering in the Maremma Natural Park have been assessed through the analysis of pellets collected in the winter of 1991-92 and 1992-93. In both years the quantitative-qualitative analysis of the pellets showed the presence of a much greater percentage of Mulletts (*Mugilidae*) than of other fishes: 60% in number and 90% by weight; the mean size of the fish was 21.5 cm. The mean fish weight ingested daily, estimated from the pellet contents, was 278 g in 1991-92 and 377 g in 1992-93.

### Introduction

In the last 10-15 years, there has been a remarkable increase in the number of Cormorants *Phalacrocorax carbo sinensis* wintering in Italy, estimated at around 13,000 birds in 1987-88 (Baccetti 1989).

However little research has been carried out on food selection and the feeding strategies of the species outside of the breeding season.

Studies on the diet in the wintering season have been carried out in France (Im and Hafner 1984), in the Netherlands (Marteijn and Dirksen 1991), in Switzerland (Suter 1991) and only recently in Central Italy by Martucci and Consiglio (1991) and Sarà and Baccetti (1993).

In view of the necessity and urgency to evaluate the impact of these birds on commercial fishing we have established the diet of the Cormorants wintering in the Maremma Natural Park, by evaluating the daily food intake of each bird.

### Methods

The Maremma Natural Park (42°38' Lat. N, 11°00' Long. E), situated near Grosseto with the Ombrone River running through it, has a large concentration of Cormorants which have been observed diving for food.

Since the winter of 1990, after the temporary closure of the angling season, the birds have started to use trees along the Ombrone River as night roosts

(Giovacchini in press). The habitual fishing grounds and the night roosts are shown in Figure 1.

A census of the night roosts was taken every fifteen days, from October to April in 1991-92 and 1992-93. The maximum number of birds was recorded on 18 January 1992 with 151 individuals and, in the following season, on 16 February 1993 with 143 specimens.

During the two winters we collected weekly the pellets (fragments of undigested material wrapped in mucus) dropped during the night every 24 hours (Duffy and Laurenson 1983, Johnstone *et al.* 1990).

Pellet analysis is usually indicated as the most effective method for studying the food choice of these birds without disturbing them unduly (Marteijn and Dirksen 1991).

The remains of fish ingested by the birds, useful for the determination of species or genus (otoliths, pharyngeal bones), have been identified by using the tables described in Libois and Hallet-Libois (1988) and in Härkönen (1986). Fish size has been estimated by using the regression formulae that enable calculation of the length and weight of fish by measuring otoliths and pharyngeal bone length (Härkönen 1986, Martucci *et al.* 1993).

### Results

In the winter of 1991-92, 21 of the 80 pellets collected (26%) contained only mucus or unidentified remains,

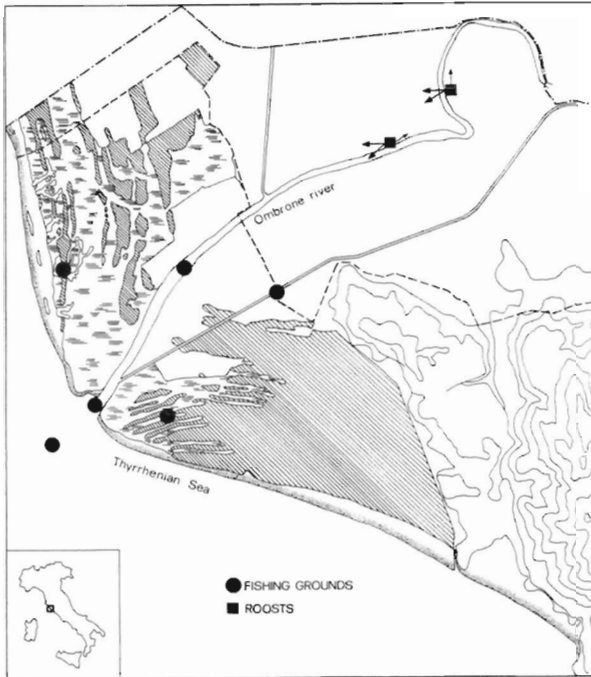


Figure 1. In the map of the Maremma Natural Park are localized the night roosts, the main fishing grounds and the flight directions.

whereas 194 kinds of fish were identified in the remaining pellets. In the winter of 1992-93, 15 of the 80 pellets collected (19%) yielded only unidentified remains while 236 prey items were identified in the other pellets.

The results are shown in Table 1. The largest proportion was represented, in both years, by Mulletts

(Mugilidae): 63.6% and 64.4% in number.

Ciprinidae (*Scardinius erythrophthalmus*, *Carassius carassius*, *Chondrostoma soetta*, *Alburnus alburnus alborella*, *Leuciscus cephalus cabeda*) were 9.5% and 10.1% in number respectively in 1991-92 and the following year.

In both seasons there was only a small percentage of Eels (1.5% and 2.1%); the unimportance of this species in the diet has been noticed elsewhere (Im and Hafner 1984, Martucci and Consiglio 1991, Sarà and Baccetti 1993).

Mulletts represented, in both years, 90% of the weight of the Cormorant food (Figure 2), while the other species constituted a very small part of the diet.

The mean size of Mulletts caught by Cormorants was 21.5 cm (SD = 7.8, min = 5.8 cm, max = 39.6 cm, N = 243), which corresponds to a weight of 110 g.

The mean daily weight of all fish ingested by each bird (calculated from the contents of the pellets, which enabled the recalculation of the weight of the ingested fish, and considering that each bird produces one pellet per day) was 278 g in 1991-92 (SD = 231, min = 16 g, max = 864 g, N = 46). The mean number of fish per pellet was 3.5 (SD = 5.1, range 1-30). In the following winter the mean daily food intake was remarkably higher at 377 g (SD = 318, min = 10 g, max = 1,370 g, N = 49), and the mean number of fish per pellet was 3.7 (SD = 3.3, range 1-21).

The difference in weight of fish ingested was highly significant (chi-square test:  $\chi^2 = 35$ , d.f. = 1,  $p < 0.001$ ).

The Cormorant catches Mulletts of varying size and the mean size is quite large (Figure 3).

Table 1. Results of the pellet analysis.

Prey Species	Number		Frequency (%)		Occurrence in pellets (%)	
	91-92	92-93	91-92	92-93	91-92	92-93
<i>Anguilla anguilla</i> , Eel	3	5	1.5	2.1	3.1	7.5
<i>Atherina boyeri</i> , Sandsmelt	31	20	15.7	8.5	4.6	3.0
Ciprinidae	19	24	9.6	10.2	25.0	15.1
<i>Ictalurus melas</i> , Catfish	3	—	1.5	—	4.6	—
Mugilidae	126	152	63.6	64.4	65.6	68.1
<i>Dicentrarchus labrax</i> , Sea Bass	11	29	5.6	12.3	4.6	19.6
Sparidae	—	1	—	0.4	—	1.5
<i>Umbrina cirrosa</i> , Umbrine	1	—	0.5	—	1.5	—
<i>Lepomis gibbosus</i> , Sunfish	—	1	X	0.4	X	1.5
Not identified	4	4	2.0	1.7	6.2	6.0
Total	198	236	100	100		

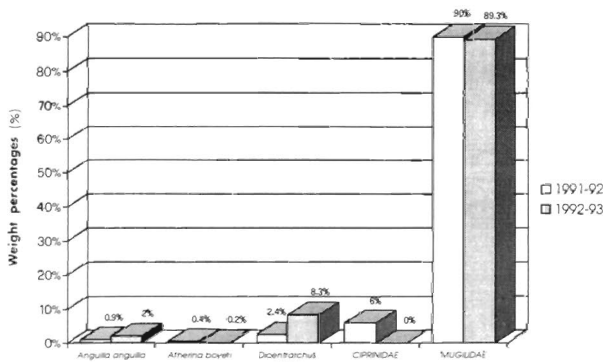


Figure 2. Composition of the food of the Cormorants on the base of the weight, referred to the fish for which it was possible to calculate the weight, in 1991-92 (N=163), and 1992-93 (N=206).

## Discussion

We have no information regarding fish population of the Ombrone River, and it is not possible to establish whether the Cormorant selects food while fishing.

Almost all the fish caught were Mugilidae, which is probably the most abundant and largest fish at the mouth of the Ombrone River, being the most resistant to pollution of organic origin.

In other European countries the mean size of the prey does not exceed 10-15 cm (Marteijn and Dirksen 1991, Suter 1991, Van Dobben 1952).

The scarcity of Eels in the diet is remarkable and could be due to mistakes in the pellet analysis, because the otolith of the Eel is small (2-3 mm) and might be completely dissolved by gastric secretions (Martucci *et al.* 1993).

The mean daily weight of the fish ingested agrees with the results obtained by Marteijn and Dirksen (1991) and by Suter (1991), and corresponds to the theoretical energy requirements (330 g) calculated by Voslamber (1988).

The difference between the weight of 1991-92 and that of the following winter could be due to effective differences in the availability of the fish, or to the random selection of the samples tested, because many pellets were lost.

The economic impact of the wintering population of Cormorants is evident considering that the total weight of fish consumed in a season is about 3.3 tons. One can appreciate the necessity to increase our knowledge about feeding strategies, in order to devise remedies and deterrents to reduce fish depredation and economic losses where conflicts arise with commercial fishing.

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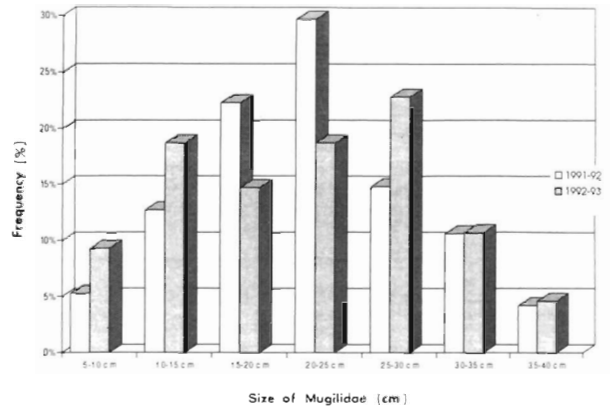


Figure 3. Size-frequency distribution of Mugilidae. The mean size of these fish preyed upon by the Cormorants is 21.5 cm.

**Riassunto** - Nel corso dell'inverno 1991-92 e del successivo 1992-93 si è provveduto a raccogliere e analizzare le borse prodotte dai Cormorani *Phalacrocorax carbo sinensis* svernanti nel Parco Naturale della Maremma (GR). L'analisi è stata effettuata utilizzando le chiavi diagnostiche e le formule di regressione reperibili in bibliografia. Nelle due stagioni esaminate il 90% della dieta è rappresentato dai Muggini (Mugilidae), la cui taglia media è di 21.5 cm; le altre specie segnalate alla foce dell'Ombrone non compaiono che con percentuali molto scarse. Il pasto medio giornaliero è risultato essere di 278 grammi nel corso del 1991-92 e di ben 377 grammi durante l'inverno seguente.

## References

- Baccetti N. (red.) 1989. Lo svernamento del Cormorano in Italia. Suppl. Ric. Biol. Selvaggina, 15.
- Duffy D.C. and Laurenson L.J.B. 1983. Pellets of the Cape Cormorant as indicator of diet. *Condor* 85: 305-307.
- Giovacchini P. (in press). Lo svernamento del Cormorano *Phalacrocorax carbo sinensis* nel Parco Naturale della Maremma nell'inverno 1990. Atti del VI Conv. Ital. Orn., Torino 1991.
- Im B.H. and Hafner H. 1984. Impact des oiseaux piscivores et plus particulièrement du Grand Cormorant (*Phalacrocorax carbo sinensis*) sur les exploitations piscicoles en Camargue, France. Rapport CEE, St. Biol. Tour du Valat, Arles.
- Johnstone I.G., Harris M.P., Wanless S. and Graves J.A. 1990. The usefulness of pellets for assessing the diet of adult Shag *Phalacrocorax aristotelis*. *Bird Study* 37: 5-11.
- Härkönen T. 1986. Guide to the otoliths of the bony fishes of Northeast Atlantic. Danbiu Aps, Hellerup.
- Libois R.M. and Hallet-Libois C. 1988. Eléments pour l'identification des restes crâniens des poissons dulçaquicoles de Belgique et du Nord de la France, n. 2. Centre de Recherche Archéologique du CNRS.
- Marteijn E.C.L. and Dirksen S. 1991. Cormorants *Phalacrocorax carbo sinensis* feeding in shallow eutrophic freshwater lakes in The Netherlands in the non-breeding period: prey choice and fish consumption. In: Van Eerden M.R. and Zijlstra M. (eds) 1991. Proceedings workshop 1989 on Cormorants *Phalacrocorax carbo*. Lelystad: 135-155.

- Martucci O. and Consiglio C. 1991 (1993). Activity rhythm and food choice of cormorants *Phalacrocorax carbo sinensis* wintering near Rome, Italy. *I.e Gerfaut* 81: 151-160.
- Martucci O., Pietrelli L. and Consiglio C. 1993. Fish otoliths as indicators of the cormorant *Phalacrocorax carbo* diet (Aves, Pelecaniformes). *Boll. Zool.* 60: 393-396.
- Sarà M. and Baccetti N. 1993. Food habits of the Great Cormorant (*Phalacrocorax carbo sinensis*) on a shoal (Secche della Meloria) in the Tyrrhenian Sea. In: Aguilar J.S., Montbailliu X., Paterson A.M. *Estatus y Conservación de Aves Marinas. Actas del II Simposio MEDMARAVIS*. SEO, Madrid: 221-227.
- Suter W. 1991. Food and feeding of Cormorants *Phalacrocorax carbo* wintering in Switzerland. In: Van Eerden M.R. and Zijlstra M. (eds). *Proceedings workshop 1989 on Cormorants Phalacrocorax carbo*. Lelystad: 156-165.
- Van Dobben W.H. 1952. The food of the cormorant in The Netherlands. *Ardea* 40: 1-63.
- Voslamber B. 1988. Visplaatskeuze, foerageerwijze en voedselkeuze van Aalscholvers *Phalacrocorax carbo* in het IJsselmeergebied in 1982. *Flevovericht* nr. 286. Rijksdienst voor de IJsselmerpolders. Lelystad.