QUALITATIVE AND QUANTITATIVE ESTIMATION OF THE GREAT CORMORANT PHALACROCORAX CARBO DIET

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Introduction

In France, the winter population of the great cormorant *Phalacrocorax carbo* reached about 4,000 birds along the sea coasts in 1970. Lebreton and Gerdeaux (1996) observed an exponential growth in numbers during 20 years, up to a mean of 70,000 birds (out of a total of 300,000 in January). Moreover, 55 % of the total population gather near lakes or large rivers. It can be recalled that :

- Cormorants usually eat twice a day (Im and Hafner, 1984).
- The cormorant is an opportunist predator, catching the most vulnerable prey, not necessarily the most abundant (Im and Hafner, *loc. cit.* ; Martucci and Consiglio, 1991; Zanu-Kratky and Mann, 1995). Birds often feed on schooling species (Pedroli and Zang, 1995, *in* Mathieu, 1997).
- The undigested parts of the eaten prey are rejected in pellets. It seems that only one pellet is regurgitated a day (Zijlstra and Van Eerden, 1995, *in* Mathieu, 1997).

Key words : Predation ; great cormorant ; rivers ; France.

Study methods

Diet composition can be studied by pellet dissection or by analysis of stomach content. This last method allows an easier recognition of the prey (species and length) but birds have to be killed. This method is rarely used.

121 pellets from 3 large rivers (Moselle, Allier, Loire) were sampled during spring 1997 (Fig. 1) by the French "Conseil Supérieur de la Pêche". All identified structures were sorted: Otoliths (sagittae), vertebrae, maxillae, opercula bones, cleithra, scales, and for cyprinids pharyngeal teeth and chewing pads. Identification was carried out by determination keys (Spillmann, 1961 ; Wheeler, 1978 ; Brylinski, 1986 ; Libois *et al*., 1987 and 1988). Prey length is estimated after dissection of fishes of different lengths and measurement of specific structures.

Figure 1 : Sampling areas
1. Moselle
2. Loire
3. Allier

Results

Technical adjustment

The most useful structures for identifying the prey were for cyprinids the chewing pad and the pharyngeal teeth. Scales (and also vertebrae) were used for age determination.
Otoliths were used for perch *Perca fluviatilis* and pike *Esox lucius*. Opercula bone examination (Lecren, 1974) was also used for age determination of perch.
There is a good correlation between fish length and the length of some structures for most species : chewing pad for roach *Rutilus rutilus* (Veldkamp, 1995), rudd *Scardinius erythrophthalmus* and chub *Leuciscus cephalus* (Le Louarn, 1998), pharyngeal teeth for chub (Neophitou, 1988), roach and rudd (Le Louarn, 1998), otolith for perch (Doornbos, in Mathieu, 1977). For bleak *Alburnus alburnus*, the abacus method of Petrova and Zivkov (1989) was used. Weight can then be estimated by length-weight relationships, which are well known for the most common species.

Qualitative results

738 fishes from 14 species were determined[1] (Table I). 121 pellets were analysed, which is probably sufficient for a correct estimation of the diet composition: Paillard (1985) used 48 pellets to show the major eaten species. In all pellets from the 3 rivers, roach represented 68 % of the prey. Predation mainly concerned fishes from 80 to 150 mm length (fork length), one year or two years old. The same pattern was observed for rudd (4 % of the prey). The second

most abundant prey was perch (8 %) with fishes from medium length, 100 to 150 mm. Chub was the third prey in abundance (6 %), length varying between 110 and 160 mm, one or two years old.

Table 1. Prey determination

Species	**river/number**			**N**	**%**
	Loire	**Allier**	**Moselle**		
Roach *Rutilus rutilus*	279	144	83	506	68
Rudd *Scardinius erythrophthalmus*	18	15		33	6
Chub *Leuciscus cephalus*	10	28	8	46	4
Carp *Cyprinus carpio*	11	1		12	
Dace *Leuciscus leuciscus*	1	5		6	
Bream *Abramis brama*		6		6	
Silver bream *Blicca björkna*	9	1		10	
Barbel *Barbus barbus*	3	7	1	11	
Bleak *Alburnus alburnus*	5	10		15	
Schneider *Alburnoïdes bipunctatus*	2	6		8	
Nase *Chondrostoma nasus*	3	7	4	14	
Perch *Perca fluviatilis*	19	13	27	59	8
Pike *Esox lucius*	1	5	5	11	
Catfish *Ictalurus melas*	1			1	
Total number	**362**	**248**	**128**	**738**	
Unidentified cyprinids	4	4	1	9	

[1]Study carried out by a CSP (High Fisheries Council)
INRA (Agronomical Research Institute) agreement

Quantitative results

Daily food intake was estimated by a precise study of 65 pellets. Most of the time, the weight ranged from 100 to 300 g. The average weighed 280 g, but some "meals" could reach 440 to 540 g, and 600 to 700 g. Comparison of these values with pellet volume calculated from their 2 largest dimensions did not show any clear relationship. One can think that :

- Small pellets come from an unusual meal (like the second daily pellet of the nocturnal birds of prey).
- Medium sized pellets with bones derived from big fishes can result from a partial consumption of the prey.

Discussion

Total predation can be estimated when the number of cormorants and the duration of the fishing period are known. For example, the 400 individuals present on the River Allier can eat 75,000 fishes a month (about 4,000 perch and 58,000 cyprinids from the most current species). However, without an estimation of home ranges of the cormorant, river production (and possible changes in food habits), impact of predation cannot be assessed. In this study, most of the prey eaten were juveniles of common species : roach (and rudd), chub. So, future production could be modified. Suter (1991) however, notes that in Switzerland, predation by great cormorants does not exceed in most cases the compensatory mortality threshold, and does not disturb the population dynamic of the prey.

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