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Diet of great cormorants *Phalacrocorax carbo sinensis* wintering in Malause (South-West France)

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With 1 figure and 2 tables

Abstract: The diet of cormorants roosting at Malause on the Garonne River (South-West France) was studied by analyzing pellets collected during the winter 2001–2002. This roost held a mean of 550 cormorants between October 2001 and March 2002, making it one of the most important winter roosts in France. The diet contained 14 fish species, including 10 cyprinids. Cyprinids were the most abundant prey, representing 90 % of individual fish. Bream *Abramis brama* between 100 and 150 mm in length were the most abundant food items, while large bream (>300 mm total length) were also consumed. The proportion of pellets containing bream increased from 26 % in October–November to 69 % in February–March. There was no significant change in the size of the bream over time. The next most abundant species was pikeperch *Sander lucioperca* present in 15.4 % of the pellets from December–January but only 2.6 % in February–March.

Key words: cormorants, wintering, diet composition, pellets.

Introduction

Although the foraging behaviour and diet of cormorants has been studied previously in breeding and non-breeding areas, there has been no published work on interactions between cormorants and the fish communities in French rivers. Although the impact of cormorants on some fish ponds may be significant (Im & Hafner 1984, Dobrowolski & Dejtrowski 1997), little is known about their feeding in freshwater rivers (Feltham & Davies 1997, Noordhuis et al. 1997, Suter 1997). As a consequence of the increase of the cormorant as a

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breeding bird in NW-Europe since the early 1980 s (MARION 1997), the numbers of wintering individuals in the Midi-Pyrénées Region of south-west France have increased substantially (BOUSQUET 1992). This increase in the population of cormorants has caused many complaints from anglers, who have called for measures to reduce cormorants number. In this study we censused the cormorant population and examined its diet at the most important site in this region.

Methods

Malause is situated near Moissac at the Garonne and Tarn Rivers confluence in the central part of the Garonne floodplain. Weekly censuses of cormorants were carried out from September 2001 to April 2002 at a night roost located at Malause on an island in the Garonne River. Counts were made using a telescope (20×60) at dusk when all the birds were present.

Diet of wintering cormorants was studied using pellet analyses. Pellets were collected under the night roost once a week from October 2001 to March 2002. Only fresh and complete ones were taken. Pharyngal bones were separated and cyprinid species were identified. Dental and other hard parts allowed the identification of other fish such as predators (for methods see MATHIEU 1997 and CARSS & MARQUISS, 1997). No attempt at correction of wear was made (only non-eroded hard parts were used to estimate total fish length). The percent occurrence of fish items in the pellets (i.e. the percentage of individual pellets in which each fish species was recorded) was calculated and compared among three different periods (Oct–Nov, Dec–Jan and Feb–Mar) for each species, using Yates corrected χ^2 tests.

Results

During our study period a migrant peak was noted in October (850 birds), then the number of cormorants remained relatively stable from November to January (about 700 birds). The number of wintering birds started to decrease in February, the last birds leaving the site at the end of April.

Identifiable fish remains were found in 68 % of the pellets (n = 425), 22 % only contained unidentifiable remains, while 10 % were completely empty. A total of 545 individual prey items was found (for 343 of them measures were taken), belonging to 14 different species of fish (Table 1). The size range of the fish taken was considerable; fish from 58 to 480 mm were found. Cyprinids were dominant with 10 species, representing 90 % of all individual fish. Within this family, bream (*Abramis brama*) was the most common prey species (Table 2). Silver bream (*Blicca bjoerkna*), rudd (*Scardinius erythrophthalmus*) and roach (*Rutilus rutilus*) were also common prey species. The percid pikeperch (*Sander lucioperca*) was also abundant in the food of the cormorants.

Table 1. Fish species preyed upon by cormorants in the winter of 2001/02 at Malause, South-West France.

Scientific name	Name	Fish length, cm			N
		Mean	Min	Max	
Abramis brama (L., 1758)	Bream	16.4	6.2	40.2	162
Albumus albumus (L., 1758)	Bleak	8.7			1
Barbus Barbus (L., 1758)	Barbel	17.4	13.3	23.8	6
Blicca bioerkna (L., 1758)	Silver bream	20.8	8.9	37.5	36
Carassius carassius (L., 1758)	Crucian carp				
Cyprinus carpio (L., 1758)	Carp	19.5	17.0	27.2	5
Leuciscus cephalus (L., 1758)	Chub	21.6	5.8	37.6	19
Rutilus rutilus (L., 1758)	Roach	20.7	5.8	43.0	34
Scardinius erythrophthalmus (L., 1758)	Rudd	12.2	6.3	24.1	35
Tinca tirca (L., 1758)	Tench				3
Esox lucius (L., 1758)	Pike	43.0	38.1	48.0	2
Ictalurus melas (Rafinesque, 1820)	Black bullhead				2
Perca fluviatilis (L., 1758)	Perch				1
Sander lucioperca (L., 1758)	Pikeperch	30.9	19.0	43.0	43

Table 2. Percent occurrence of fish items in the pellets of cormorants wintering in Malause.

Name	Oct–Nov (N = 82)	Dec–Jan (N = 130)	Feb–Mar (N = 78)
Bream	25.6	46.2	69.2
Bleak	1.2	0.0	0.0
Barbel	11.0	0.8	1.3
Silver bream	11.0	12.3	6.4
Crucian carp	1.2	1.5	0.0
Carp	13.4	4.6	1.3
Chub	8.5	5.4	3.8
Roach	8.5	10.0	9.0
Rudd	9.8	12.3	9.0
Tench	1.2	2.3	0.0
Pike	1.2	1.5	2.6
Black bullhead	0.0	2.3	0.0
Perch	0.0	1.5	0.0
Pikeperch	11.0	15.4	2.6

Differences in percent occurrence between the three periods (Oct–Nov, Dec–Jan, and Feb–Mar) were tested for the two most abundant prey species, bream and pikeperch. For bream, a significant increase was noted from Oct–Nov (n = 26) to Dec–Jan (n = 46) and from Dec–Jan to Feb–Mar (n = 69) (Fisher's exact test: P = 0.018 and P = 0.012). No significant differences were found for the pikeperch between Oct–Nov and Dec–Jan, but a significant decrease was

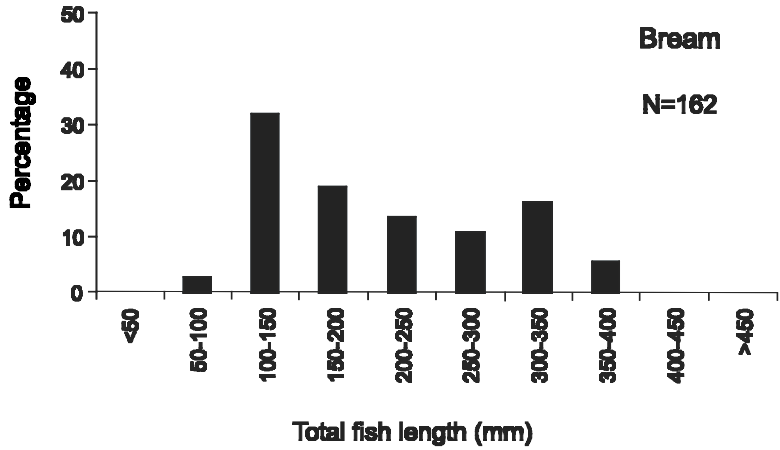

Fig. 1. Size frequency of bream (*Abramis brama*) caught by cormorants from September 2001 to April 2002.

detected from Dec–Jan (n = 15) to Feb–Mar (n = 3) (Fisher's exact test: P <0.001). No significant change in the size of the bream was found between the different periods (Mann-Whitney test). Most bream were between 100–150 mm in total length. However, large bream up to 300 mm were also often consumed (Fig. 1).

Discussion

Pellet analysis is a commonly used method to assess the diet of fish-eating birds, although there are some potential biases. The principal one is that small fish can be underrepresented in pellets owing to digestion of identifiable remains (Duffy & Laurenson 1983, Suter & Morel 1996, Zijlsta & Van eerden 1995). However, we do not expect that we overlooked any prey species. The pellet analysis is considered a rather "weak" method by some authors while others consider it good enough and also very important (Carss et al. 1997, McKay et al. 2003).

This is the first study on cormorant predation on a fish community in a French river. The increasing numbers of wintering cormorants in south-west France are likely to have an increasing impact on the fish populations in this region. We lack sufficient data on fish densities in the Garonne River and on distances moved by feeding birds to make a good estimate of what proportions of fish stocks were consumed during our study. However, given that each cormorant's daily food ration is about 500 g (Feltham & Davies 1997, Keller & Visser 1999), we estimate that the cormorant population was consuming about 450 kg of fish per day when the numbers of birds peaked in October.

Hence, for the whole wintering period the estimation of bird predation was about 65 tons of fish. Some cormorants using our roost site fed in adjacent wetlands of the Garonne River (e. g. gravel pits) and the proportion of birds doing this is difficult to estimate. Thus, more work is required to estimate the impact of cormorants on fish stocks in each wetland.

Numerous studies have found that the main prey species of cormorants are cyprinids, representing between 50 % and more than 90 % of the species found in cormorants' diet (Keller 1995, Veldkamp 1995, Boudewijn & Dirksen 1997, Van eerden & Zijlstra 1997, Privileggi 2003, Trauttmansdorff 2003). However, numerous publications (Voslamber 1988, Boudewijn & Dirksen 1991, Platteeuw et al. 1992) state that bream are rarely eaten by cormorants because of their high, laterally flattened body. In our study, bream was the most important species caught by cormorants, and although the bulks of these prey were between 100–150 mm, our results showed that cormorants can also forage on large bream (see also Veldkamp 1995). Large bream are relatively abundant in the Garonne River and isolated fishing cormorants often eat these large fish as we witnessed during our field work.

The diet of cormorants may vary considerably between locations and seasons (Kirby et al. 1996). In the Malause roost, bream dominated the food composition and the proportion of this species in the diet of the cormorants increased during the wintering period. Noordhuis et al. (1997) suggested that the seasonal changes in the species composition of the pellets are probably related to changes in water temperature and in distribution and behaviour of the fish. The often highly turbid waters in rivers can force the birds to turn to mass flock fishing on shoals of small fish (Noordhuis et al. 1997). Solitary feeding birds generally take larger fish (Suter 1997). In the Garonne River, both fishing techniques are used regularly (Santoul, unpubl. data).

Unlike in our study, pikeperch were almost absent from many previous studies of cormorant diet (e. g. Keller 1995, 1998). Most of the pikeperch present in our pellets were juvenile fish (mean 30.9 cm). They shoal in winter and may become more available for mass flock fishing. This may explain the higher predation we detected from October to January. The percentage of occurrence of pikeperch in pellets decreased in February and March, the beginning of the spawning period for pikeperch when fish leave shoals and become less available for cormorants (Craig 1987). The dynamics of predatory fish can fluctuate considerably (Craig 1987), thus a good reproductive success of pikeperch in 2000 may also explain the abundance of pikeperch in the diet of cormorants in our study.

This initial research on cormorants in a French river establishes the composition of diet throughout the winter. Further studies of both this predator and its prey species are required to quantify the impact of cormorants on fish communities.

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