

# THE USE OF CHEWING PADS FOR ESTIMATING THE CONSUMPTION OF CYPRINIDS BY CORMORANTS *Phalacrocorax carbo*

RONNIE VELDKAMP

De Rikking 46, NL-8332 CG Steenwijk, The Netherlands.

Analysis of regurgitated stomach contents showed that cyprinid fishes Cyprinidae, especially Roach *Rutilus rutilus*, Bream *Abramis brama* and White Bream *Abramis bjoerkna*, can be an important food of Cormorants (Van Dobben 1952, De Boer 1972, Veldkamp 1991). In the colony of Wanneperveen, The Netherlands, the food choice of Cormorants during the breeding season has been investigated by means of regurgitated stomach contents since 1989. According to this method cyprinids comprised 72-86% of the biomass consumed during the breeding seasons 1989-93 (Veldkamp 1995a, Veldkamp 1995b).

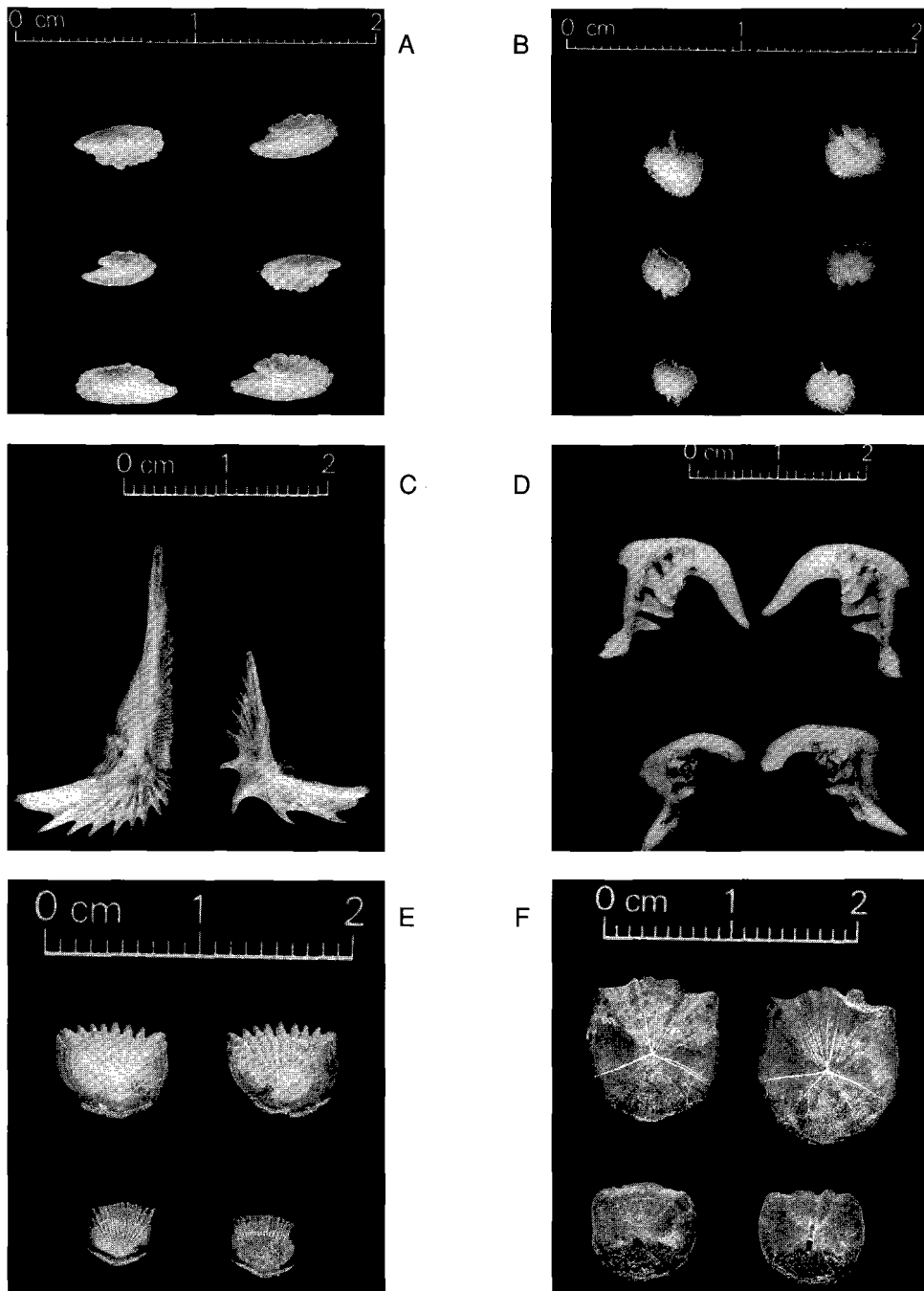
Nowadays studies on food choice of Cormorants in The Netherlands, mostly are based on pellet analysis. Fish remains in pellets, like otoliths and pharyngeal bones, are often specific for the fish species eaten. The length of fish consumed can be estimated by regression equation between otolith or pharyngeal bone length and fish length (Doornbos 1980). In several studies (Voslamber 1988, Boudewijn & Dirksen 1991, Boudewijn *et al.* 1991, Martejijn & Noordhuis 1991, Platteeuw *et al.* 1992, Dirksen *et al.* 1995), cyprinid species were mainly

distinguished by their specific pharyngeal bones, since partly digested and even fresh otoliths of most cyprinids are more or less non-specific. Because pharyngeal bones are often completely digested or become unrecognisable in the Cormorant stomach, a large proportion of the cyprinids eaten could not be identified to the species level (69% Boudewijn *et al.* 1991, 63% Martejijn & Noordhuis 1991, 79-87% Dirksen *et al.* 1995). In the studies concerned Bream was identified in very small quantities in pellets, despite its abundance in many Dutch inland waters.

At Wanneperveen year-round pellet analysis has been carried out since 1991. The use of chewing pads as an alternative method of recognising cyprinids in pellets made it possible to reduce the proportion of unidentified cyprinids to a small fraction (12% in 1991 and, being more experienced, less than 1% in 1992 and 1993). Regression formulae were obtained from a reference collection of dried chewing pads which was constituted from regurgitated cyprinid fishes collected in the colony of Wanneperveen in March-July 1990-93 (Table 1). Of a few rarer species (*Bleak Alburnus*

**Table 1.** Regression formulae to calculate fork length (*FL*) from chewing pad length (*P*).  $FL = b \cdot P + a$ . Measurements in mm.

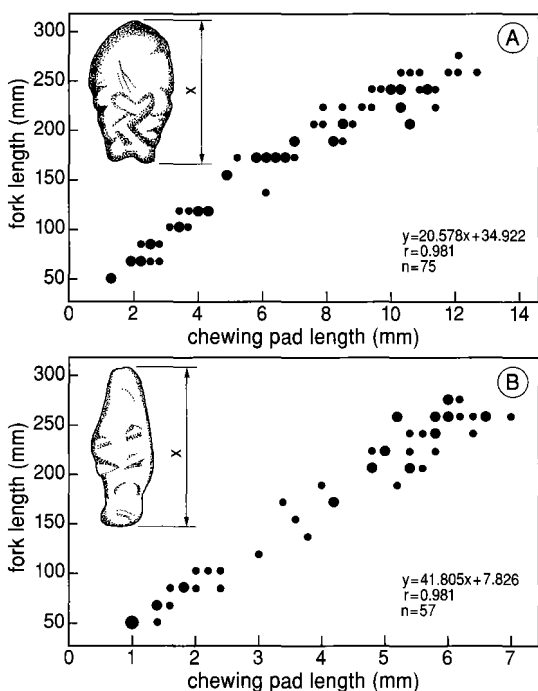
fish species	<i>a</i>	<i>b</i>	<i>R</i> <sup>2</sup>	<i>N</i>
Bream <i>Abramis brama</i>	7.826	41.805	0.962	57
White Bream <i>Abramis bjoerkna</i>	24.239	33.031	0.904	60
Bleak <i>Alburnus alburnus</i>	-2.973	45.924	0.871	8
Ide <i>Leuciscus idus</i>	-53.497	41.974	0.938	7
Roach <i>Rutilus rutilus</i>	34.922	20.578	0.962	75
Rudd <i>Scardinius erythrophthalmus</i>	24.462	23.607	0.912	16
Tench <i>Tinca tinca</i>	-17.614	32.226	0.770	15



Fish remains useful for prey identification from regurgitates or pellets of Cormorants. (A) Otoliths of Perch *Perca fluviatilis*; (B) idem of Roach *Rutilus rutilus*; (C) Prae operculum of Perch (l) and Pike Perch *Stizostedion lucioperca* (r.); (D) Pharyngeal bones of Roach (above) and Carp *Cyprinus carpio* (below); (E) Scales of Perch (above) and Ruffe *Gymnocephalus cernuus* (Below); (F) Scales of Roach (above) and Carp (below). (Photographs D. Visser)

**Table 2.** Maximum number of Bream and Roach identified by chewing pads (CP) and pharyngeal bones (PB), based on analysis of 299 pellets collected at Wanneperveen between 14 March-8 June 1992. For both species also the total number is given.

fish species	CP	PB	Total
Bream <i>Abramis brama</i>	211	48	233
Roach <i>Rutilus rutilus</i>	2014	865	2056



**Fig. 1.** Relationship between fork length and chewing pad length in (A) Roach *Rutilus rutilus* and (B) Bream *Abramis brama* ejected by Cormorants at Wanneperveen. Data from 1990-93.

*alburnus*, Ide *Leuciscus idus*, Rudd *Scardinius erythrophthalmus*), specimens were obtained from local fishermen.

Like otoliths and pharyngeal bones, lengths of chewing pads are correlated to fish length (Table 1,

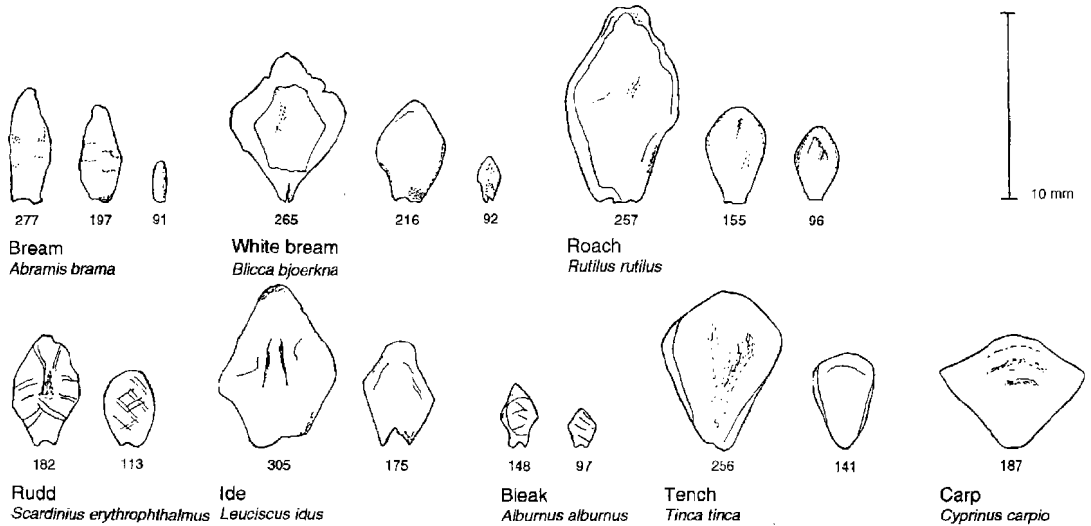
Fig. 1). The use of chewing pads has advantages to otoliths and pharyngeal bones in the recognition of cyprinids in pellets:

(1) contrary to otoliths, chewing pads are specific in shape (Fig. 2), (2) chewing pads are unpaired organs, so every chewing pad found in a pellet, represents one fish, while left and right otoliths and pharyngeal bones always have to be sorted out first to determine the number of fishes eaten, and (3) chewing pads seem to be less vulnerable to gastric juices (Table 2).

The use of chewing pads, in combination with otoliths and pharyngeal bones in pellet analysis, revealed that on mass basis, c. 70% of the total fish consumption of the colony of Wanneperveen consisted of cyprinids in 1991 and c. 72% in 1992. In 1991 and 1992 respectively 17% and 15% of the total consumption consisted of Bream (Veldkamp 1995 a, b).

## REFERENCES

- Boudewijn, T.J. & S. Dirksen 1991. Monitoring van biologische effecten van verontreiniging: Aalscholvers in de Dordtse Biesbosch en op de Ventjagersplaten in 1991. Bureau Waardenburg bv, Culemborg.
- Boudewijn, T.J., E.C.L. Marteiijn & S. Dirksen 1991. Voedselkeuze van Aalscholvers rond het Ketelmeer in het seizoen 1990-91. Bureau Waardenburg bv, Culemborg.
- De Boer, H. 1972. De voedselbiologie van de Aalscholver. Zoöl. Lab. Rijksuniversiteit Groningen/Rijksinstituut voor Natuurbeheer, Leersum.
- Dirksen, S., T.J. Boudewijn, R. Noordhuis & E.C.L. Marteiijn 1995. Cormorants *Phalacrocorax carbo sinensis* in shallow eutrophic freshwater lakes: prey choice and fish consumption in the non-breeding period and effects of large-scale fish removal. *Ardea* 83:167-184.
- Doornbos, G. 1980. Aantallen, verspreiding, activiteit, voedsel en konditie van Nonnetjes *Mergus albellus* L. in het zuidwestelijk IJsselmeergebied, winter 1977. RIJP-rapport 20 Abw, Lelystad.
- Marteijn, E.C.L. & R. Noordhuis 1991. Het voedsel van Aalscholvers in het Maasplassengebied in Midden- en Zuid-Limburg. *Limburgse Vogels* 2:59-69.



**Fig. 2.** Size and shape of chewing pads (dried) of cyprinids ejected by Cormorants at Wanneperveen. Figures below the chewing pads refer to the corresponding fork lengths in mm. Drawings by the author.

Platteeuw, M., J.H. Beekman, T.J. Boudewijn & E.C.L. Martejn 1992. Aalscholvers *Phalacrocorax carbo* in het Ketelmeer buiten de broedtijd: aantallen, prooikeuze en voedselaanbod. *Limosa* 65:93-102.

Van Dobben, W.H. 1952. The food of the Cormorant in The Netherlands. *Ardea* 40:1-63.

Veldkamp, R. 1991. Colony development and food of Cormorants *Phalacrocorax carbo sinensis* at Wanneperveen. In: M.R. Van Eerden & M. Zijlstra (eds) Proceedings workshop 1989 on Cormorants *Phalacrocorax carbo*: 170-174. Rijkswaterstaat Directorate Flevoland, Lelystad.

Veldkamp, R. 1995a. Voedselkeuze van Aalscholvers *Phalacrocorax carbo sinensis* in Noordwest-Overijssel. Rapport Bureau Veldkamp, Steenwijk.

Veldkamp, R. 1995b. Diet of Cormorants *Phalacrocorax carbo sinensis* at Wanneperveen, The Netherlands, with special reference to Bream *Abramis brama*. *Ardea* 83:143-155.

Voslamber, B. 1988. Visplaatskeuze, foerageerwijze en voedselkeuze van Aalscholvers *Phalacrocorax carbo* in het IJsselmeergebied. *Flevobericht* 286, Rijksdienst voor de IJsselmeerpolders, Lelystad.