FEEDING HABITS OF CORMORANTS IN EASTERN LAKE ONTARIO

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Introduction

Regurgitated digestive pellets of double-crested cormorants collected at Little Galloo Island in eastern Lake Ontario were analyzed for the presence of fish remains during 1992 and 1993. The study was funded by National Biological Survey, the United States Fish and Wildlife Service, and the New York State Department of Environmental Conservation.

The objectives of this study were (1) to determine changes in feeding habits and food types eaten during the cormorant nesting cycle; and (2) assess fish losses from cormorant predation in the eastern basin of the lake, including stocked salmonids (trout and salmon) juveniles.

Results

Researchers found otoliths (inner ear stones of fish), bones, scales and eye lenses of 23 fish species in 982 cormorant pellets collected in 1992 and similar remains from 20 fish species in 1307 pellets collected during 1993 (**Figure 1**).

The average number of fish found per individual adult cormorant pellet collected during the 1-month chick feeding period (early June to early July) decreased by nearly one-half compared to the pre-chick and post-chick feeding periods during both years of the study (**Figures 2 , 3**), suggesting that the amount of fish eaten by adult cormorants declined so as to feed the cormorant chicks during that time period of the nesting cycle. During the chick-feeding period of both years, however, the percentage of alewives in adult cormorant pellets was greater than the pre-chick and post-chick periods. (**Figures 4, 5**). Yellow perch predation by cormorants decreased during the chick feeding periods of both years (**Figures 4, 5**).

The average numbers of individual fish per pellet during the entire sampling seasons nearly doubled between 1992 and 1993, from 6.2 fish/pellet to 12.3 fish/pellet (**Figure 6**). Researchers felt that these observed trends may either be due to a cormorant feeding preference or may reflect a different means of processing the pellets in the laboratory.

Overall diet compostion of cormorants also appeared to change between the two years. Numbers of fish per pellet for the two most common prey fish species eaten in 1992 were alewife at 2.4/pellet and sunfish at 0.8/pellet (**Figure 6**). Expressing these as a percentage of cormorants diets: 41% of the fish eaten were alewives and 13.9% were sunfish (**Figure 5**). Only 0.2% of the cormorant diets were salmonids during 1992 (**Figures 6, 7**). Most of alewives (53.1% of the total) were eaten during the chick feeding period in 1992; whereas most of the sunfish and salmonids were eaten during the pre-chick-feeding period during 1992 (**Figure 4**).

Numbers of fish found per pellet, by most common species, in 1993 were alewife (3.2/pellet) and yellow perch (1.9/pellet), replacing sunfish as the second most important prey. Salmonids averaged less than 0.1 fish per pellet during both years (**Figure 6**). Again, as a percentage of the cormorant diets: 26% of the fish eaten were alewives, 15.6% yellow perch and 12.1% sunfish. During the entire 1993 sampling season, less than 1% of the diets (0.4%) were comprised of salmonids, similar to the 1992 season (**Figures 8**). As in 1992, most alewives (38.6%) were eaten during the chick feeding season, whereas yellow perch and salmonids were eaten largely during the pre-feeding period (**Figure 8**).

Of other game fish species, smallmouth bass remains were found in pellets during both years, however, this species only made up about 1% of the diet during both years (**Figures 4 – 8**).

From the presence of 60 coded wire tags (CWT) found in cormorant pellets collected and analyzed during 1993, researchers were able to identify the salmonid species eaten by cormorants in 1993 as lake trout. The lake trout remains appeared in the pellets shortly after a stocking event at nearby Stony Point. These tags are inserted in the snouts of pre-stocked lakers in an effort to identify stocking location and strain as these fish are later caught by anglers or through fisheries assessment programs.

Estimated Cormorant Impacts on Fish Populations

Using some calculations based on the recent cormorant diet data and several assumptions about cormorant biology, behavior and their estimated population size, researchers were able to estimate the total fish losses due to cormorant predation in the eastern basin of Lake Ontario during 1993. Fish losses were estimated at 2.15 million pounds of fish eaten by cormorants, representing 55% of the estimate from a previous studies (**Figure 9**).

When the lake trout losses were calculated for a single stocking (Stony Point) on May 25, 1993, an estimated 2,623 lake trout or 3.4% of the stocking were consumed by cormorants. An additional 28 coded wire tags were recovered following other stocking events at different locations, suggesting another 2,295 lake trout were eaten by cormorants (**Figure 10**).

Acknowledgments

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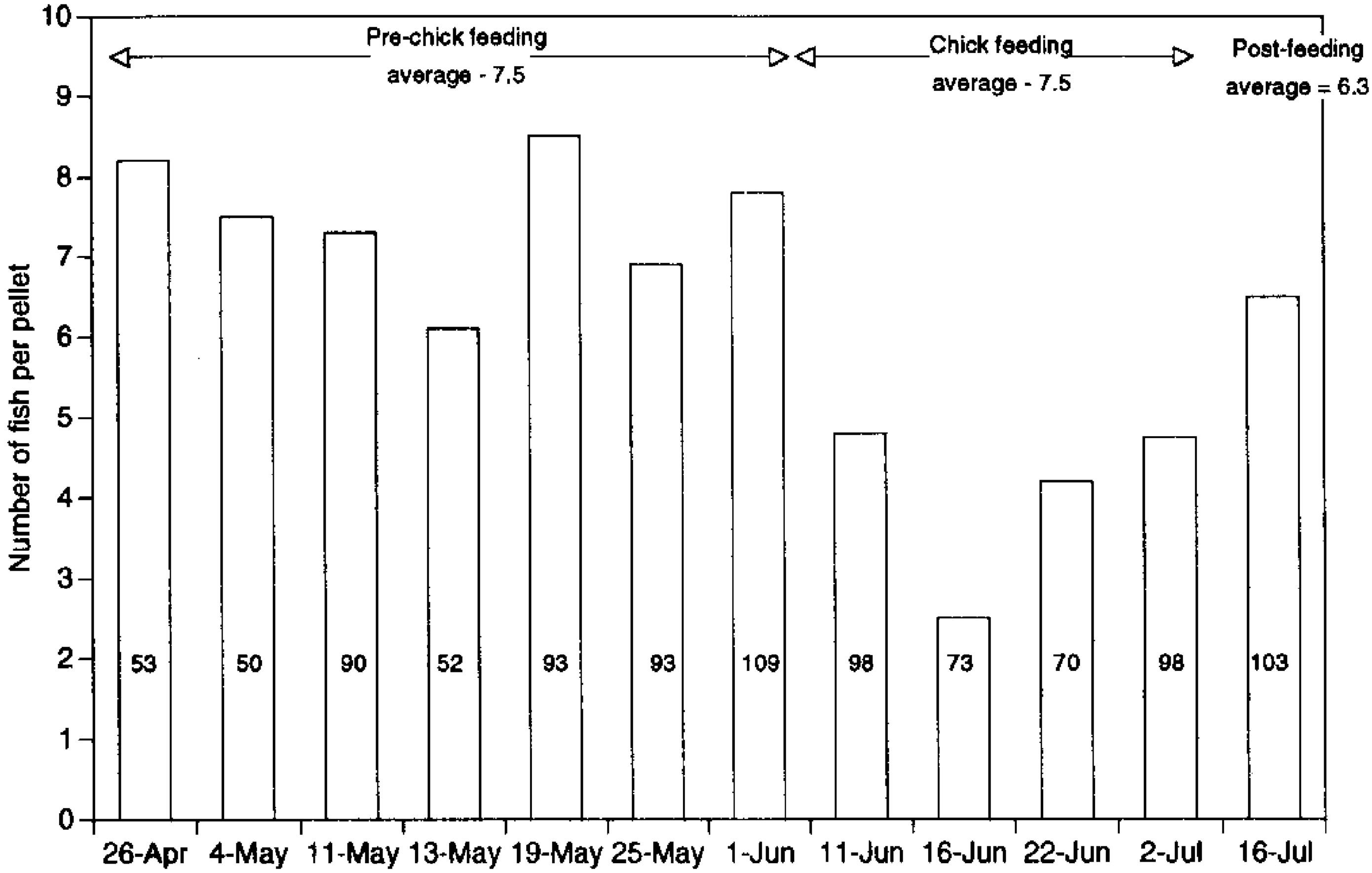
Figure 1. Fish Species Identified in Cormorant Pellets.

Species	1992 (from 982 pellets)	1993 (from 1307 pellets)
Sea lamprey	✖	
Alewife	✖	✖
Gizzard shad	✖	
Cisco (lake herring)		✖
Lake whitefish	✖	✖
Lake trout		✖
Rainbow smelt	✖	✖
Atlantic salmon		✖
Northernpike	✖	✖
Minnows(3 spp.)	✖	✖
White sucker	✖	✖
Brown bullhead	✖	✖
Trout perch	✖	✖
Burbot (freshwater cod)	✖	
Whiteperch	✖	✖
Rock bass	✖	✖
Pumpkinseed	✖	✖
Bluegill	✖	
Smallmouth bass	✖	✖
Largemouth bass	✖	
Black crappie	✖	
Johnny darter		✖
Yellowperch	✖	✖
Walleye	✖	✖
Freshwater drum (sheepshead)	✖	
Slimy sculpin	✖	✖
Total	23	20

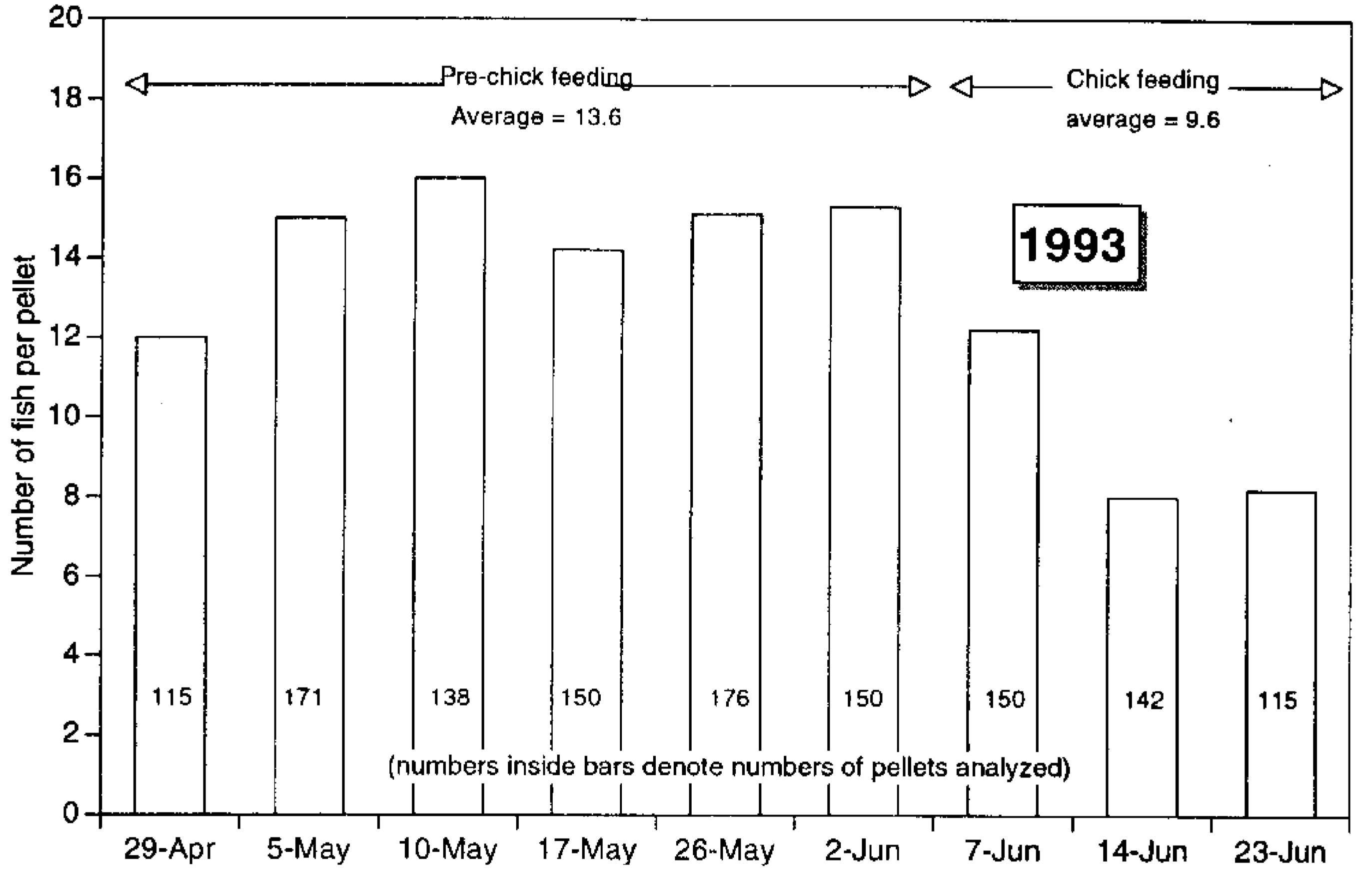
Data from Ross and Johnson (1994)

Figure 2. Cormorant feeding level over the 1992 nesting cycle.



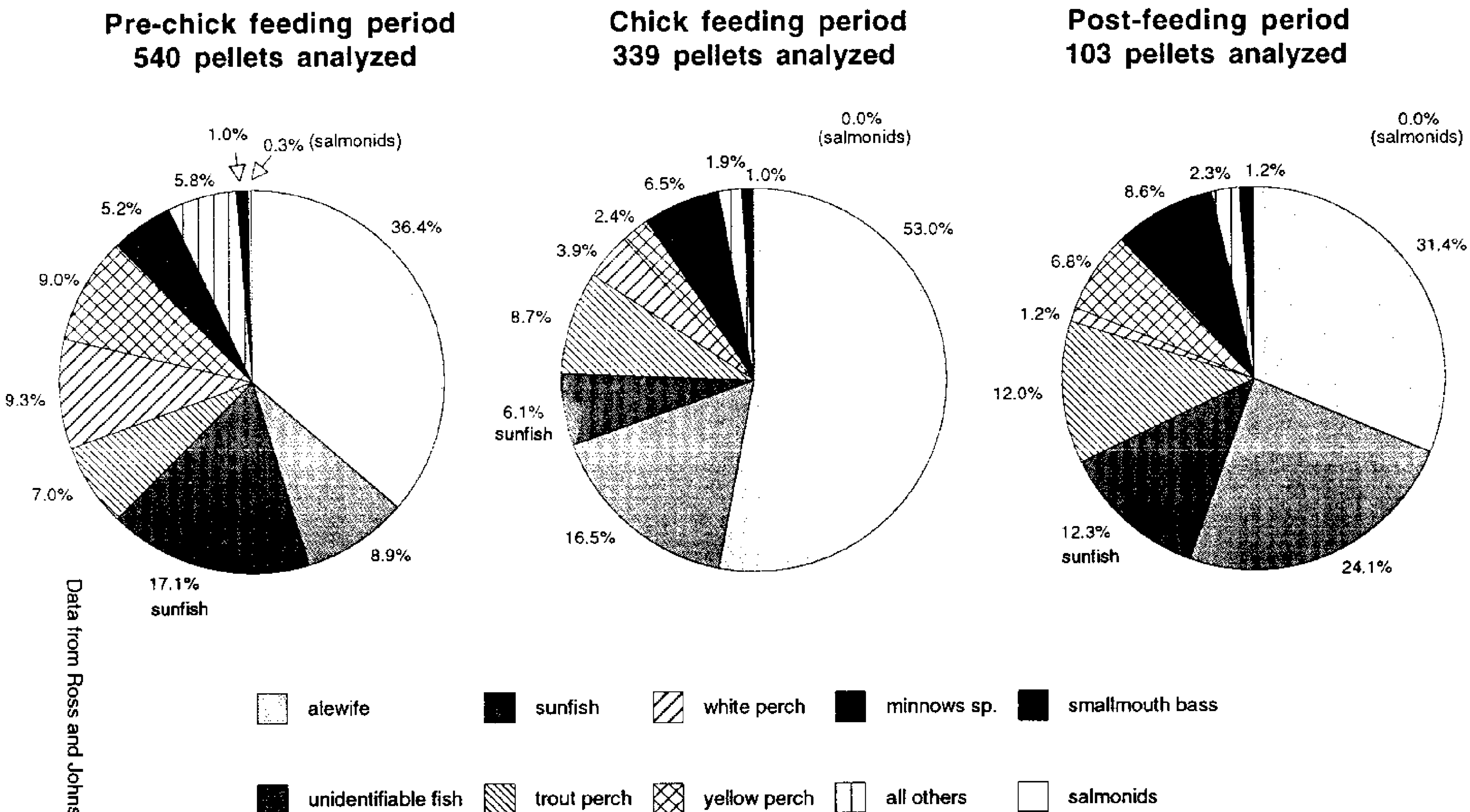
Data from Ross and Johnson (1994)

Figure 3. Cormorant feeding levels over the 1993 nesting cycle.



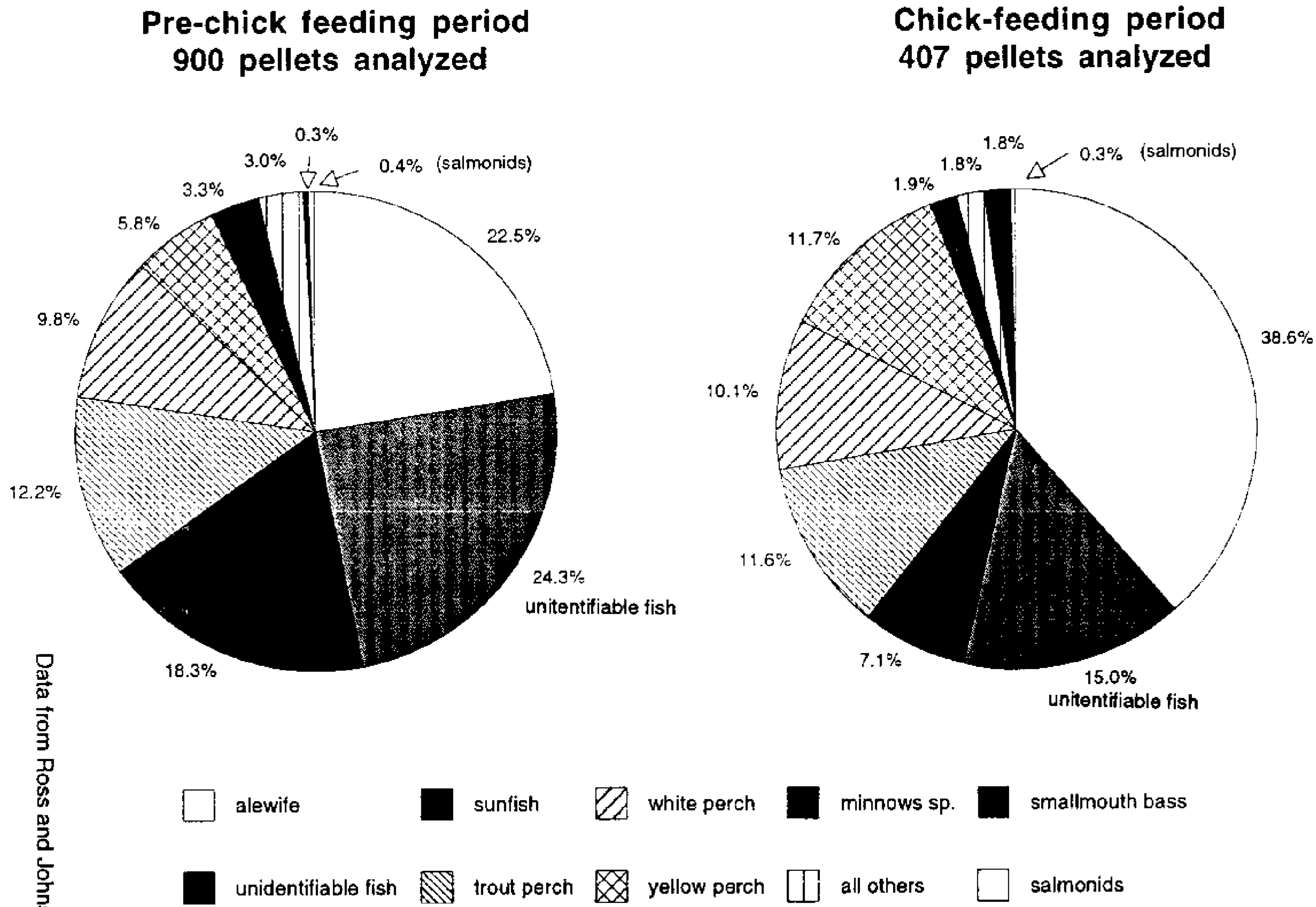
Data from Ross and Johnson (1994)

Figure 4. Percent of each preyfish in cormorant pellets by stages of the 1992 breeding cycle.



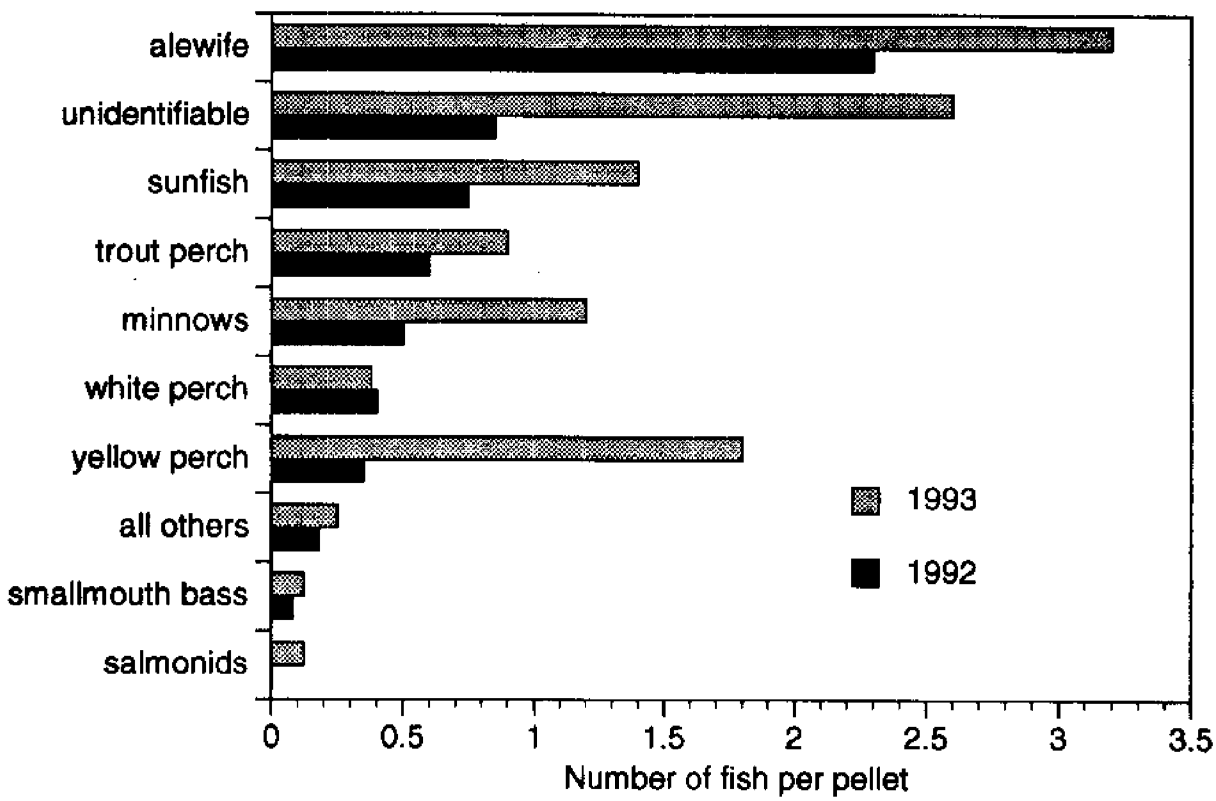
Data from Ross and Johnson (1994)

Figure 5. Percent of each preyfish in cormorant pellets by stages of the 1993 breeding cycle.



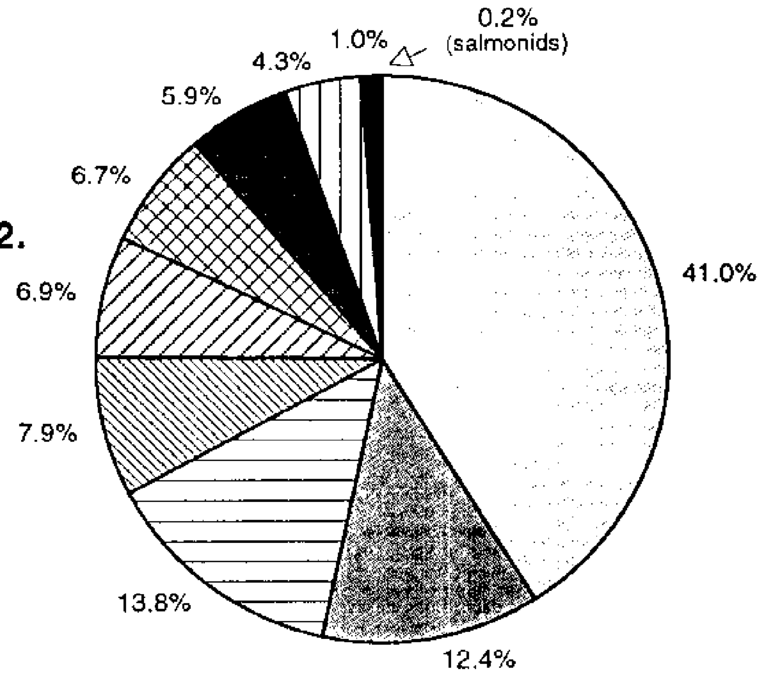
Data from Ross and Johnson (1994)

Figure 6. Average annual composition of cormorant pellets by fish species.



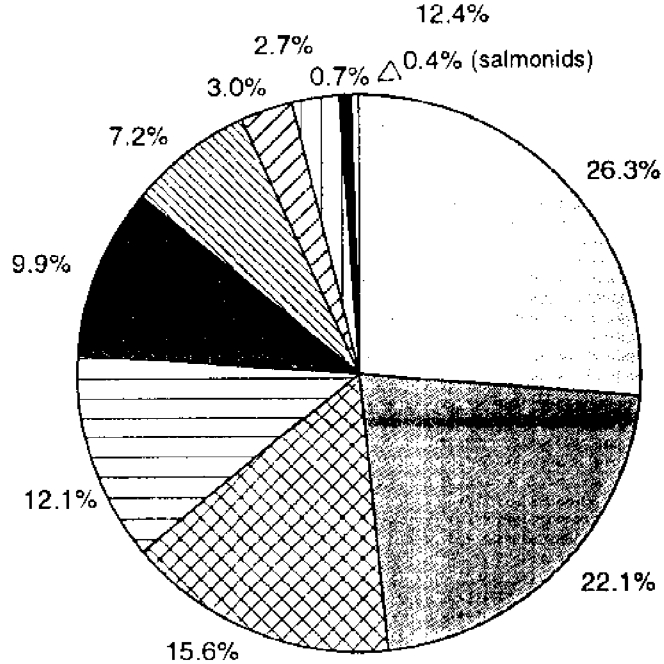
Data from Ross and Johnson (1994)

Figure 7. Percent of each preyfish in cormorant pellets during 1992.



982 pellets analyzed

Figure 8. Percent of each preyfish in cormorant pellets during 1993.



1,307 pellets analyzed

Data from Ross and Johnson (1994)

Figure 9. Calculations of estimated fish losses in eastern Lake Ontario due to cormorant predation in 1993.

Facts/givens:

- 6,067 nests and 12,134 adult birds
- 13.5 cm alewife or yellow perch = 25g = .875 oz.
- 12.3 fish per pellet (1,307 pellets analyzed)

Assumptions:

- Residence times for cormorants (Weseloh & Casselman in prep.)

Breeding adults	=	158 days
Immatures	=	112 d
YOY	=	92 d

- Fledgling production rate = 2.0/nest (12,134 YOY)
- Number of immatures ≈10% of adults = 1,213 (Weseloh personal communication)
- Pellet production rate = 1/day per cormorant (Johnstone et al. 1990; Orta in Hoyo et al. 1992)
- Average fish eaten = 13.5 cm in Great Lakes (Orta in Hoyo et al. 1992)

Calculation of fish losses:

- 12,134 adults x 158 days + 12,134 YOY x 92 days + 1,213 immatures x 112 days = 3.17 million cormorant days
- 3.17 x 106 cormorant days x $\frac{\text{12.3 prey fish}}{\text{cormorant day}}$ = 39.0 million prey fish
- 39.0 prey fish x $\frac{\text{25 g}}{\text{fish}}$ = 0.975 x million kg prey fish = 2.15 x million lbs fish consumed in 1993

Data from Ross and Johnson (1994)

Figure 10. Calculations of Estimated Predation on Lake Trout Stocked at Stony Point, Eastern Lake Ontario, on May 25, 1993.

Facts/givens:

- 76,500 lake trout stocked (@ Stony Point May 25 , 1993)
- Each lake trout carried one coded wire tag (CWT) with identification
- 32 CWT recovered from cormorant pellets on May 26, 1993
- A total of 176 cormorant pellets were collected/examined
- 10,796 adults on Little Galloo Island

Assumptions:

- Pellet production rate = 1/day/cormorant
- Pellets were collected randomly from island
- 75% of pellets were fresh (produced since stocking)

Calculation of loss of stocked fish due to cormorants:

$$75\% \times 176 \text{ pellets} = 132 \text{ fresh pellets sampled}$$

$$\frac{132 \text{ pellets sampled}}{10{,}796 \text{ pellets produced}} = 0.0122 = 1.22\%$$

$$\frac{1.22\%}{32 \text{ CWT}} = \frac{100\%}{\chi \text{CWT}}$$

$$\chi = 2{,}623 \text{ lake trout from stocking eaten}$$

$$\frac{2{,}623 \text{ eaten}}{76{,}500 \text{ stocked}} = 0.034 = 3.4\% \text{ of stocking eaten}$$

Note: an additional 28 CWTs recovered from other stocking times (May 21–June 4) or locations (Selkirk, Stony Creek, and Sodus) equates to an additional 2,295 stocked lake trout eaten.

Data from Ross and Johnson (1994)