FISHERY RESEARCH

LIFE HISTORY, POPULATION DYNAMICS, AND HABITAT USE OF NORTHERN PIKE IN THE COEUR d'ALENE LAKE SYSTEM, IDAHO

Annual Progress Report

By

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JOB PERFORMANCE REPORT

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ABSTRACT

Northern pike Esox lucius distribution, abundance, and life history characteristics were studied in the Coeur d'Alene Lake system, Idaho, during 1989. In the lateral lakes, brown bullheads Ictalurus nebulosus and yellow perct Perca flaveseus were highest in abundance, while northern pike comprised about 7% of the catch. Population estimates of northern pike in Cave Lake and MedicinE Lake, two of the lateral lakes, were 132 (95% CI=87-271) and 30 (95% CI=22-47), while standing crops were 1.2 and 0.8 kg/hectare, respectively. Mortality estimates of pike in the lateral lakes consistently showed low natural mortality. Total mortality was highest in Killarney and Medicine lakes, the two morE accessible lakes. Creel census indicated the majority of anglers in the lateral lakes were seeking pike, and most anglers believed that the quality of pikE fishing has remained similar in the last several years. The majority of pikE sampled in the spring (74%) and fall (71%) had empty stomachs. Yellow perch was: the dominant food item in the spring, whereas a wider variety of fishes were consumed in the fall. Largest growth increments was in young-of-the-year fish. Growth rates were high compared to those throughout the native range, and alone with condition factors and standing crops suggest a low density, rapid growing population in the Coeur d'Alene Lake system.

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INTRODUCTION

Northern pike Esox lucius are an important sport and commercial fish throughout their natural range (Simpson and Wallace 1982). In the northern hemisphere, northern pike have circumpolar distribution, but in North America, their natural range extended east of the Great Plains region (Carlander 1969). Northern pike have been commonly introduced outside their natural range in North America as a sport fish and for prey fish control (Carlander 1969).

The Coeur d'Alene Lake system supports the only significant northern pike fishery in Idaho. Northern pike were illegally introduced into the system in the early 1970s, probably in the lateral lakes of the lower Coeur d'Alene River (Ned Horner, Region I Fishery Manager, Idaho Department of Fish and Game, personal communication). Catches of northern pike were uncommon until about 1980, when popular pike fisheries developed in several of the lateral lakes. While cold water fisheries have traditionally been most important in Idaho, angler interest and management emphasis on warm water species have recently increased (Rieman 1987). These trends have made apparent the need for basic population dynamics and habitat use information of northern pike, with a goal of developing criteria for managing northern pike in the Coeur d'Alene Lake system.

Coeur d'Alene Lake, a natural glacial lake with a surface area of 12,743 hectares, is located in the Idaho Panhandle. The lake level was raised approximately 2.5 m in 1906 when Post Falls Dam was constructed on the outlet by Washington Water Power. The normal maximum pool elevation is 849 m through the summer, but is typically drawn down 1 to 2.5 m during the fall and winter months (Rieman et al. 1980).

The elevated level of Coeur d'Alene Lake created several connected lateral lakes along inundated sections of the Coeur d'Alene River. Water levels in these lakes fluctuate annually in response to precipitation patterns and operations at Post Falls Dam. In addition to annual lake level fluctuations, the lakes are affected by heavy metals from the Silver Valley mining and smelting area (Rabe and Bauer 1977).

Four lateral lakes and Cougar Bay of the main Coeur d'Alene Lake were selected as sampling areas (Figure 1). Cave and Medicine Lakes were chosen because of high fisherman use and accessibility, Killarney Lake because of its reputation as a good pike fishery among anglers, and Swan Lake because of its relative inaccessibility and close proximity to Cave Lake. These four lakes range in surface area from approximately 100 to 200 hectares and have an average maximum depth of 6 m (Bowles 1985). Cougar Bay of Coeur d'Alene Lake was chosen because of its proximity to a major population center and its increasingly popular and successful pike fishery.

Since their illegal introduction, northern pike have produced variable fisheries in the lateral lakes. A state-wide daily bag limit of five northern pike was initiated in 1988 because of public concern (Cindy Robertson, Regional Fishery Biologist, Idaho Fish and Game Department, personal communication). No

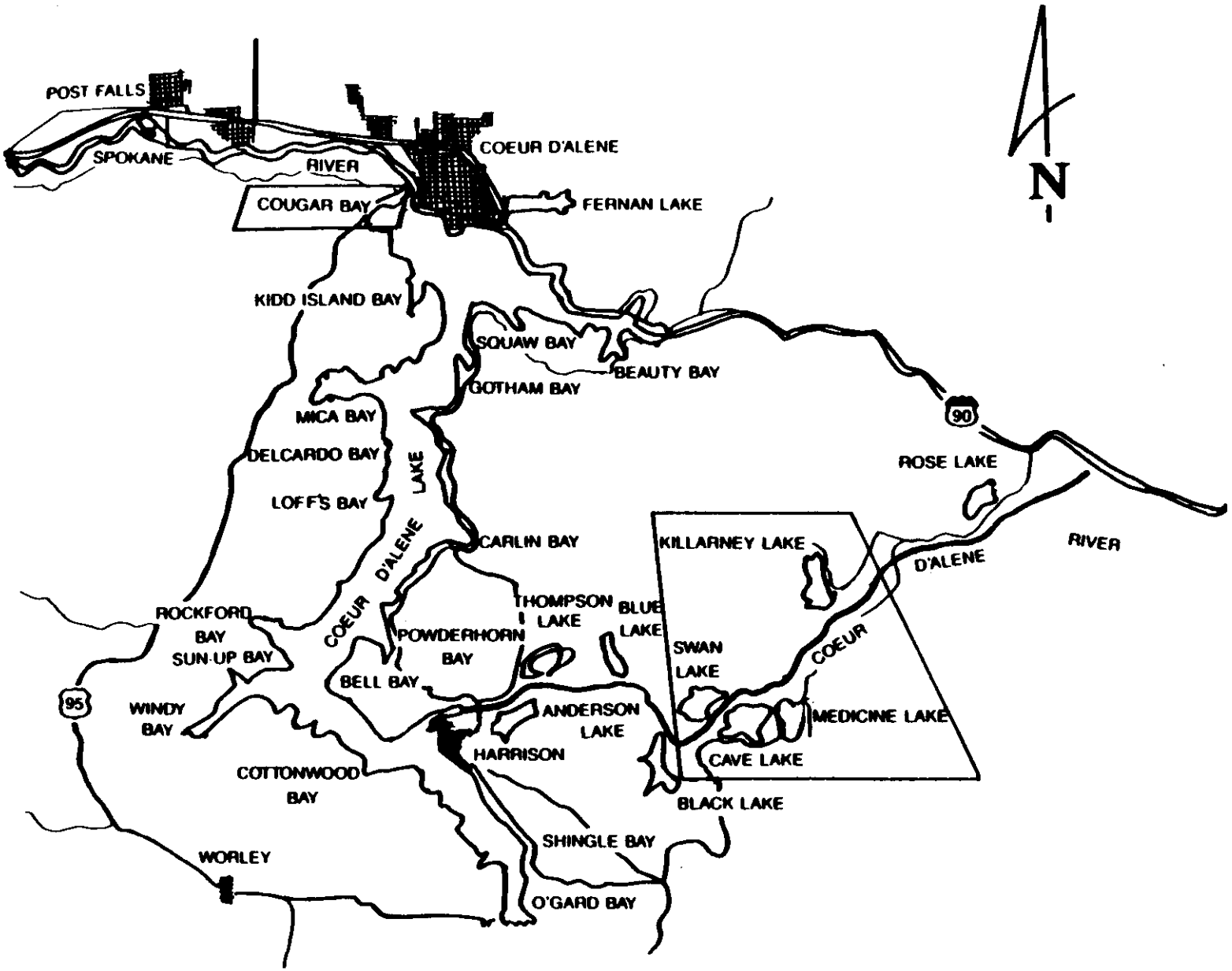

Figure 1. Map of Coeur d'Alene Lake system with principal northern pike sampling areas outlined in boxes.

other regulations have been imposed for northern pike. The purpose of this study was to provide life history information and baseline population dynamics data necessary for future management direction.

OBJECTIVES

1. To assess distribution and habitat preferences of northern pike in the Coeur d' Alene Lake system.

2. To assess relative abundance of northern pike in selected waters of the Coeur d' Alene Lake system.

3. To determine timing, location, and habitat utilization for spawning activities by northern pike in the Coeur d'Alene Lake system.

4. To evaluate food habits and feeding activities of northern pike in the Coeur d' Alene Lake system.

5. To assess age and growth characteristics of northern pike in the Coeur d'Alene lake system.

METHODS:

Recruitment

We sampled during the early life stage for larvae and young-of-the-year (YOY) pike. During the month of April, we sampled for eggs and larvae of northern pike at regular intervals along transects in suspected spawning areas within a .5 m^2 sampling box. In June and July, all habitat types were seined for fingerling northern pike with a 5 m, 3 mm mesh seine, whereas blocks of emergent vegetation (primarily Eauisetum sp.) were sampled with rotenone. All vegetation was manually removed from the (165 m^2) enclosures, and then the cleared areas were treated with rotenone (5 mg/1). Fish were removed by dip netting or snorkeling. In October and November, YOY pike were sampled by boat electrofishing using pulsed DC current at 500 Volts and 3 amps.

Adult northern pike were sampled by gill netting during spring 1989. Total lengths, weights, and scales were collected from each northern pike. Scales were taken between the lateral line and the posterior half of the dorsal fin (Toner and Lawler 1969). All northern pike caught were inspected for tags and anomalies. Unmarked individuals longer than approximately 350 mm were tagged on the maxillary bone with a $5 reward tag (metal band).

Acetate impressions of scales were read on a microfiche reader, and lengths were back-calculated using the Fraser-Lee formula (Everhart and Youngs 1981) in the DISBCal program (Frie 1982):

PROGREP

$$L_t = C + S_t / S\ (L - C)$$

Where: L_t = the calculated length of a fish at age t

L = length of fish at time of capture

S_t = scale radius at age t

C = a correction factor representing fish length at scale formation; 35 mm was used as reported by Carlander (1969).

S = Scale radius at time of capture

Instantaneous mortality **(Z)** was computed for northern pike caught in the lateral lakes by catch curve. Exploitation was determined by angler returns of reward tags (Lackey and Hubert 1977):

$$E = r/m$$

where: E = Annual exploitation rate

r = Number of recaptures

m = Number of marked fish

To increase return of reward tags, a press release was made informing anglers of the tagging program. Signs were also posted at area bait shops and access points.

Instantaneous fishing mortality (F) was calculated as:

$$= \frac{\mathbf{E \times Z}\ F}{A}$$ (Lackey and Hubert 1977)

Where: E = Exploitation rate

Z = Total instantaneous mortality

$A = 1 - S = 1 - e^{Z}$

Instantaneous natural mortality (M) was then found by subtraction: M =

Z - F

PROGREP

Creel Survey

A creel survey was conducted from late March to early May, 1989, to determine catch rates and harvest, to acquaint anglers with the study, and to procure stomach and scale samples. Instantaneous angler counts were also made in conjunction with the creel survey. Both interviews and instantaneous angler counts were randomly conducted while sampling the four lateral lakes.

Tournament Monitoring

Three local pike tournaments were monitored on the Coeur d'Alene Lake system during 1989. We attended daily weigh-ins to determine angler catch rates and harvest. All tournament fish were sampled for length, weight, scales, and stomach contents. Live northern pike were tagged with jaw tags and released.

Population Density

Population estimates were made using mark-release and recapture techniques from spring gill and trap netting. Schumacher and Eschmeyer's estimate (Ricker 1975) was used to calculate population size (95% confidence interval):

$$\frac{1}{\hat{N}} = \frac{(m_t r_t)}{(C_t m_t^2)}$$

where: $\hat{N}$ = estimated population size.

m_t = total marked fish at large at the start of the t^{th} day.

C_t = total sample taken on day t.

r_t = number of recaptures in the sample C_t.

t = number of catches examined

with a variance of

$$s^2 = \frac{(r_t^2 / C_t) - (r_t m_t)^2 / (C_t m_t^2)}{t - 1}$$

PROGREP

$$\text{variance of } \frac{1}{\hat{N}} = \frac{s^2}{C_t m_t^2}$$

Standing crops were calculated for each lake. The population estimate was multiplied by the average weight to provide standing crop, which was then divided by surface area to give population density.

Food Habits Analysis

Stomachs of fish caught by gill netting and electrofishing were evacuated using the lavage technique. Some food items were identified in the field, measured for total length, and then disposed. Stomach contents not readily identified were preserved for laboratory identification.

Movement

Movement data were obtained from comparison of reported location of angler-caught fish bearing serially numbered jaw tags with original tagging locations.

RESULTS

Frequency of catch was highest for brown bullhead Ictalurus nebulosus and yellow perch Perca flavescens in the lateral lakes by all gears (Table 1).

A total of eight YOY northern pike were taken in 110 seine hauls in June and early July. At least 60 were taken by electrofishing in October and November.

The adult northern pike population estimate for Cave Lake was 132 (95% CI = 87 - 271). For Medicine Lake, the estimate was 30 (95% CI = 22 - 47). An insufficient number of recaptures were made at Killarney and Swan lakes to estimate population size.

Standing crops of adult northern pike were calculated at 1.2 kg/hectares (95% CI - 0. 8 - 2.5), and 0.8 kg/hectares (95% CI = 0.6 - 1.2), for Cave and Medicine *Lakes,* respectively.

The spring length frequency distribution for the lateral lakes shows a relatively uniform distribution of northern pike from 200 to 975 mm, with minor peaks at 400 and 775 mm (Figure 2). In comparison, the length frequency distribution of northern pike from Killarney Lake in fall 1989 had peaks at 250, 475, and 600 mm (Figure 3).

PROGREP

Table 1. Relative abundance of fishes collected from the lateral lakes, Coeur d'Alene Lake, Idaho. Species other than northern pike and trout were not targeted for sampling.

	No. Sampled	Frequency (%)
Black crappie	175	5
Brook trout	1	<1
Brown bullhead	2,120	64
Cutthroat trout	7	<1
Largemouth bass	45	1
Largescale sucker	1	<1
Northern pike	235	7
Northern squawfish	2	<1
Pumpkinseed	39	1
Tench	164	5
Yellow perch	522	16
TOTAL	3,311	100

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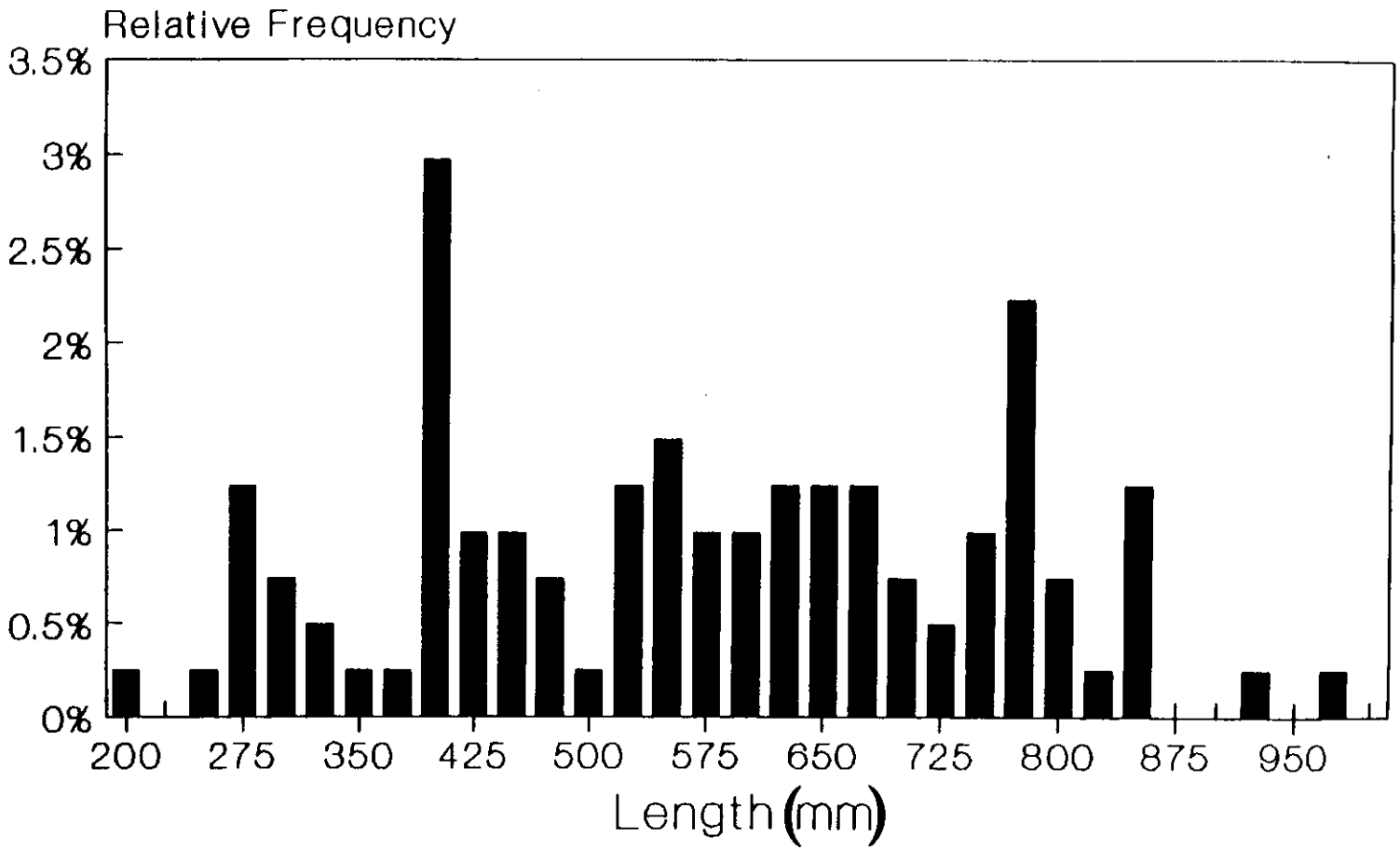

Figure 2. Length frequency distribution of northern pike captured by gill netting in the lateral lakes during spring 1989.

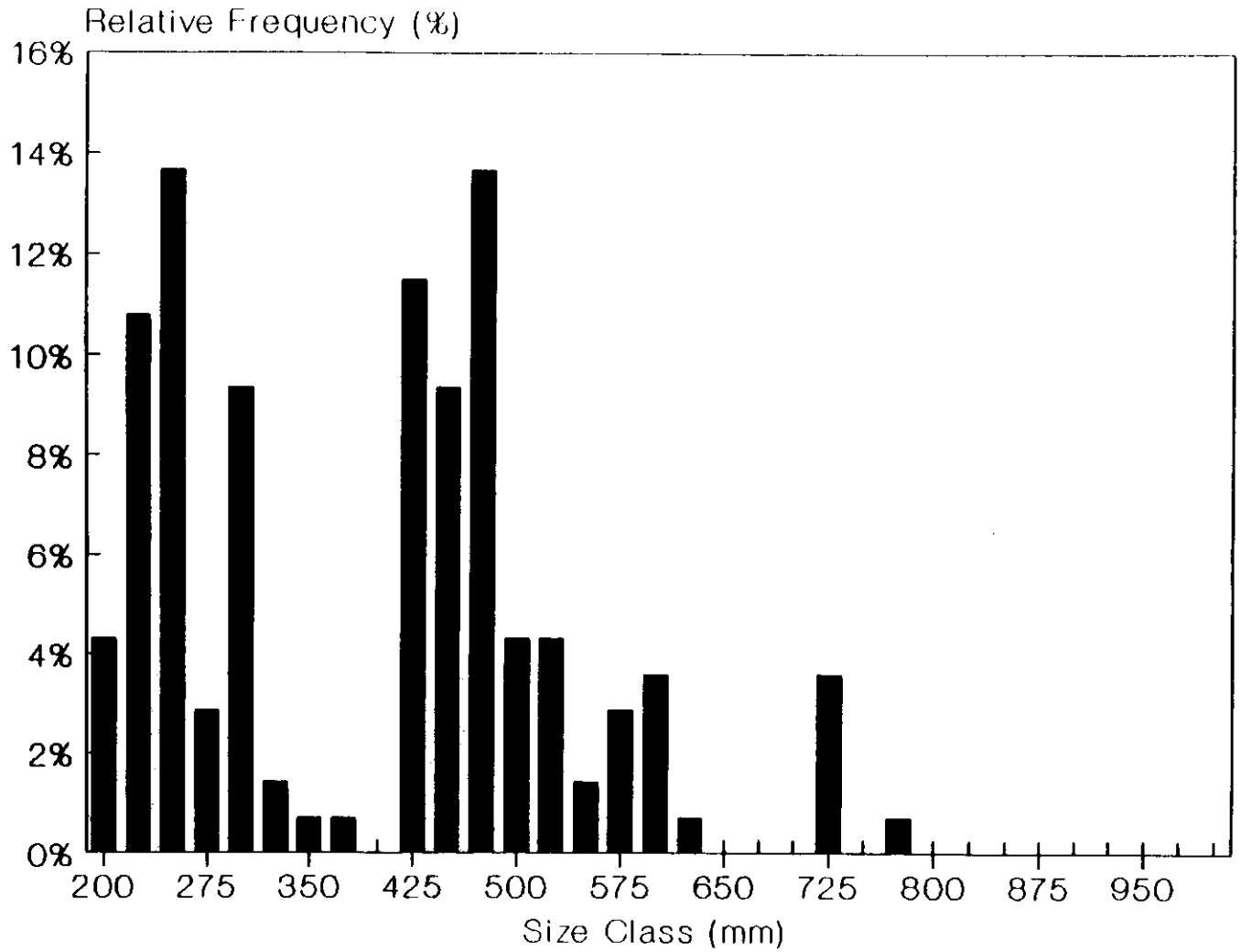

Figure 3. Length frequency of northern pike captured by electrofishing in Killarney Lake during fall 1989.

Mortality estimates for the four lateral lakes sampled consistently showed low natural mortality (Table 2). Mortality was highest in Killarney and Medicine lakes, the two more accessible lakes.

Tournament angling was most successful (largest fish size and highest catch per unit effort) in fall, and least successful in winter (ice fishing) (Table 3). Fall fishing was ostensibly the best.

Creel census results indicated that 77% of the anglers interviewed were seeking pike, and of those, the majority thought that pike fishing quality on the lateral lakes had remained the same in the last several years (Figure 4).

A total of 146 pike stomachs were sampled, 66 in the spring and 80 in the fall. Of these, 74% and 71% were empty. Yellow perch was the dominant food item in the spring (Figure 5), whereas a wider variety of species were found in the fall (Figure 6). Mean length and back-calculated mean weight of yellow perch found in stomachs was 113 mm and 14.7 g. While cutthroat trout were third overall in numerical abundance in stomachs (Figure 7), in fall samples they were second to yellow perch in frequency of occurrence. Mean length and calculated mean weight of cutthroat trout found in stomachs was 215 mm and 118 g.

Largest growth increment of northern pike from the lateral lakes was in YOY fish (Table 4). Preliminary results from a small sample of Coeur d'Alene Lake pike indicate average back-calculated lengths to be slightly larger than those from the lateral lakes (Table 5).

Movement of pike among lakes was limited. A fish tagged at Killarney Lake was caught in Black Lake indicating some movement while the majority of fish were caught in the lake where they were tagged.

Length-weight relationships and condition factors indicated high weights per unit length. Mean condition factors (Wr - relative weights) were calculated at 1.09 for spring (lateral lakes) and 0.94 for fall (Killarney Lake). Length-weight relationships were: LogW= -6.018+3.308 LogL and LogW= -6.408+3.436 LogL, where:

LogW = common log of weight (g)

LogL = common log of length (mm).

Table 2. Summary of mortality and exploitation estimates for lateral lakes northern pike, 1989. E=exploitation rate; Z=total instantaneous mortality rate; A=annual mortality rate; F=instantaneous fishing mortality rate; M=instantaneous natural mortality rate.

	E	Z	A	F	M
Cave Lake	.11	.22	.22	.12	.10
Medicine Lake	.22	.33	.33	.26	.07
Swan Lake	.30	.29	.29	.41	0
Killarney Lake	.59	.43	.43	.73	0
Above lakes combined	.26	.31	.31	.30	.01

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Table 3. Summary of northern pike tournament data for the Coeur d'Alene Lake system, 1989.

Date	anglers	Effort (h)	fish (>559 mm)	Catch rate		weight (g)
				Fish/h	H/fish	
2/11	20	140	1	.007	140	975
4/21-4/22	50	700	9	.013	77.8	2,402
9/16-9/17	30	540	21	.04	25.7	3,200

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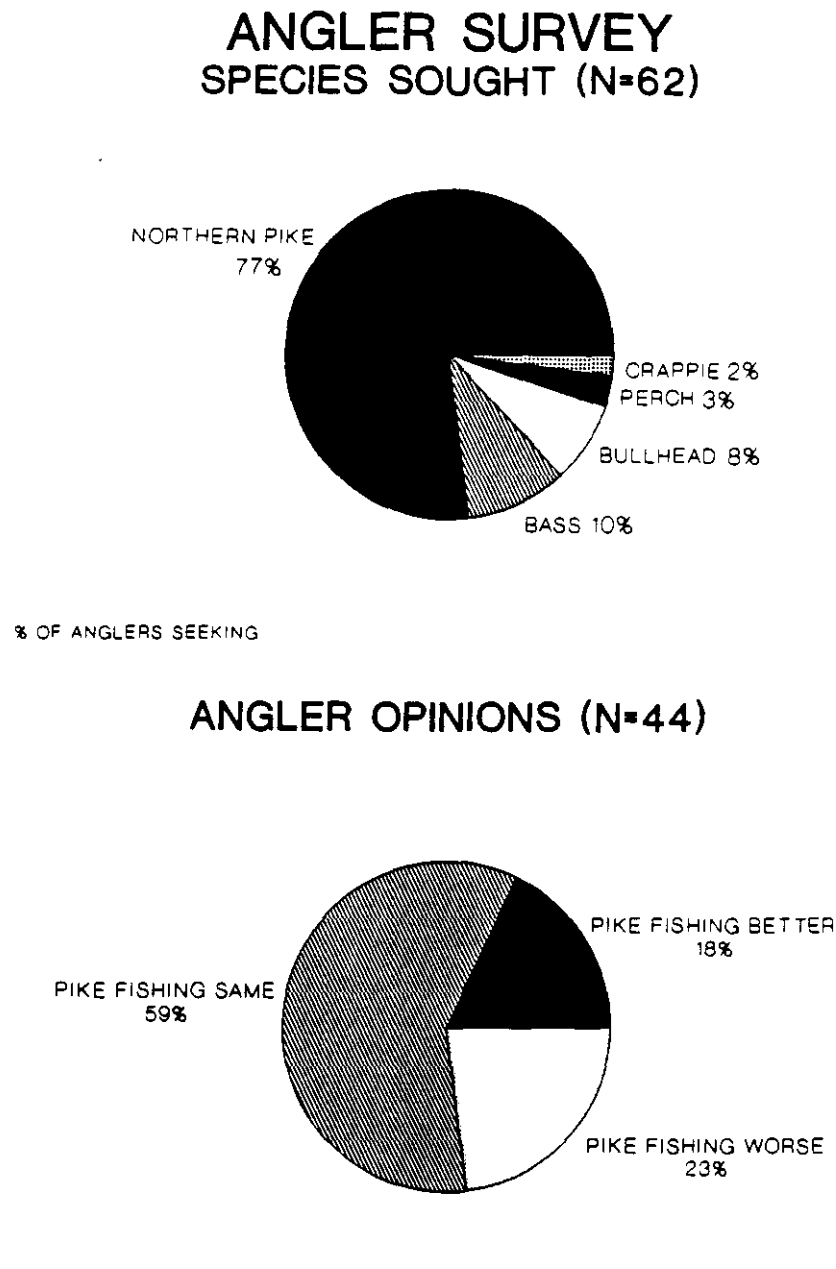


Figure 4. Results of angler surveys (upper) and opinions (lower) on the lateral lakes during April, 1989.

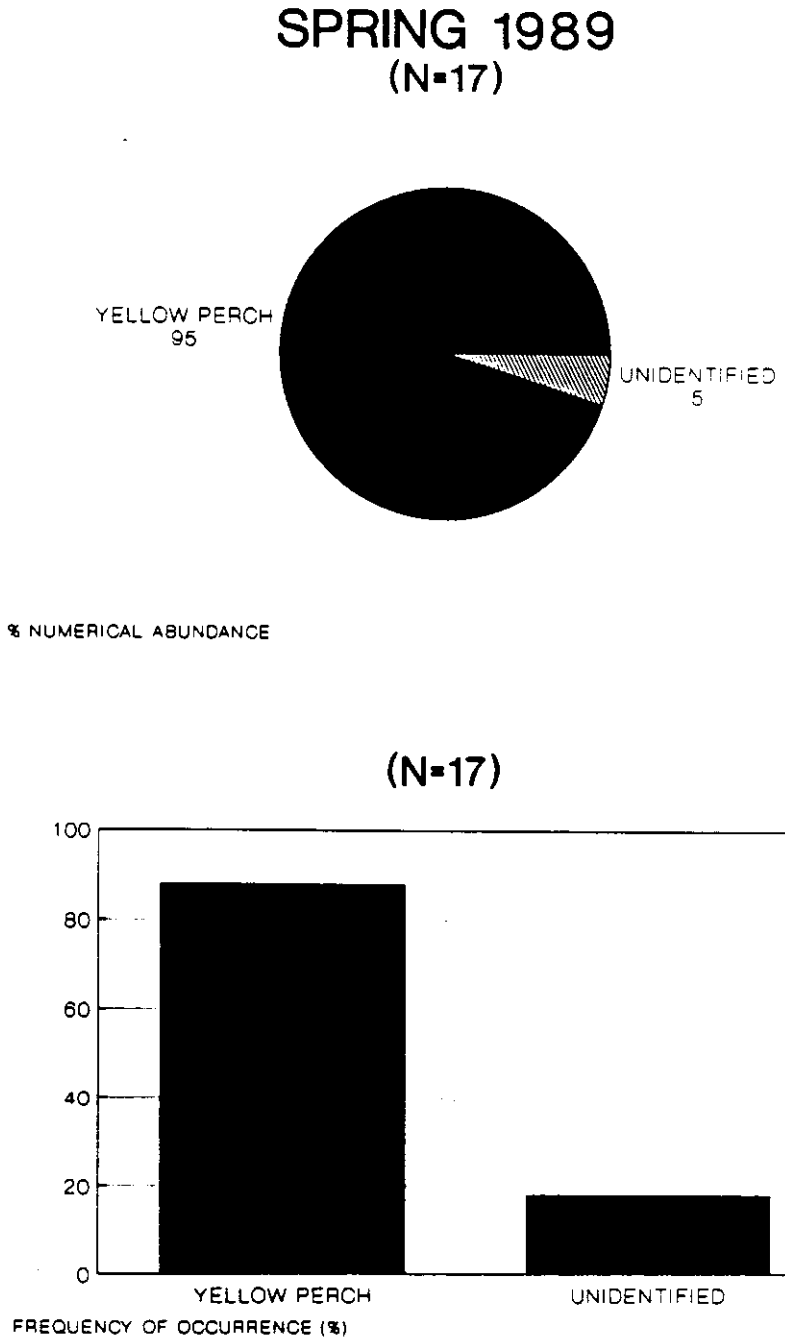
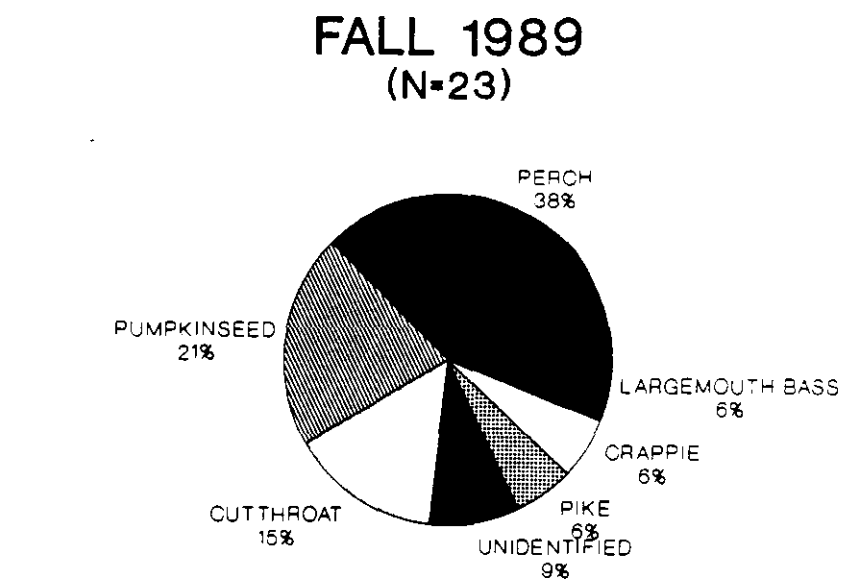


Figure 5. Numerical (upper) and frequency of occurrence (lower) of specific food items in stomachs of 17 northern pike from the lateral lakes during spring, 1989. A total of 66 stomachs were examined.



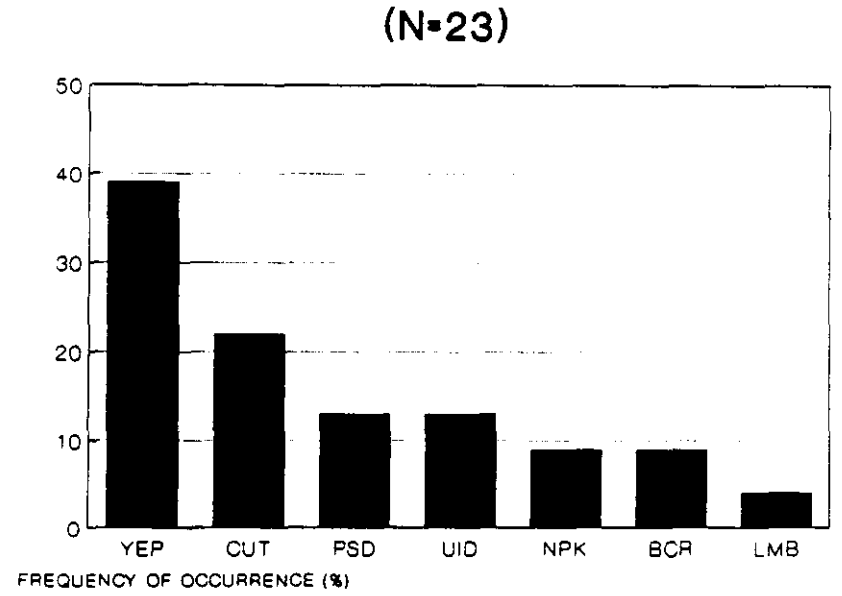


Figure 6. Numerical abundance (upper) and frequency of occurrence (lower) of food items from 23 stomachs of northern pike from the lateral lakes during fall 1989. A total of 80 stomachs were examined. Abbreviationsused: YEP-yellow perch; CUT-cutthroat trout; PSD-pumkinseed; UID-unidentified fish; NPK-northern pike; BCR-black crappie; LMB-largemouth bass.

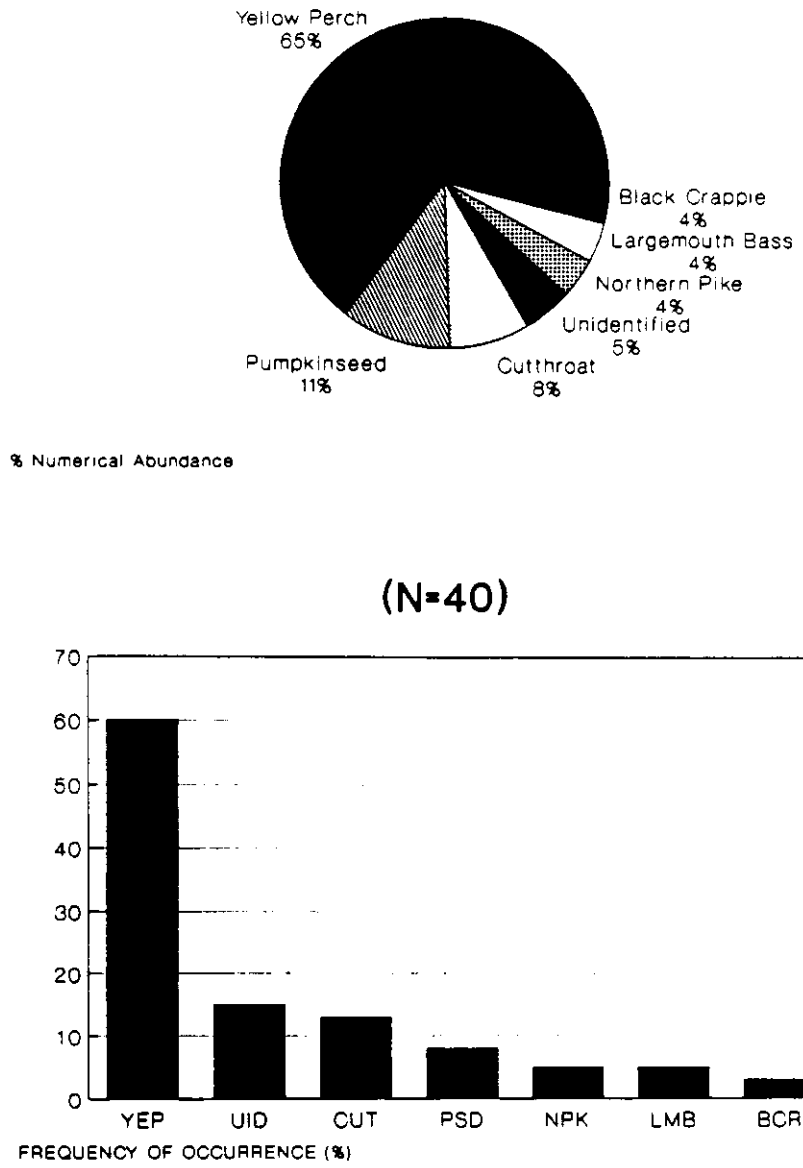


Figure 7. Numerical abundance (upper) and frequency of occurrence of food items from 40 northern pike from the lateral lakes during 1989. A total of 146 pike stomachs were examined. Abbreviations used: YEP-yellow perch; CUT-cutthroat trout; PSD-pumkinseed; UID-unidentified fish; NPK-northern pike; BCR-black crappie; LMB-largemouth bass.

Table 4. Mean back-calculated lengths-at-age of northern pike from the lateral lakes.

Year Class	Age	N	Age 1	2	3	4	5	6	7	8	9	10
1988	1	15	280									
1987	2	30	286	447								
1986	3	23	293	456	568							
1985	4	20	300	500	613	678						
1984	5	18	286	479	639	715	751					
1983	6	6	290	456	584	724	786	817				
1982	7	2	258	398	600	776	849	935	1000			
1981	8	1	333	544	680	807	876	947	966	978		
1980	9	0	0	0	0	0	0	0	0	0	0	
1979	10	1	273	514	629	708	766	842	873	905	922	930
All Classes			289	466	603	705	771	856	960	942	922	930
N		116	116	101	71	48	28	10	4	2	1	1

ESOXLAT1

Table 5. Mean back-calculated lengths at age of northern pike from Coeur d'Alene Lake.

Year Class	Age	N	Age 1	2	3	4	5	6
1988	1	5	280					
1987	2	2	337	566				
1986	3	2	356	502	658			
1985	4	0	0	0	0	0		
1984	5	2	299	443	612	728	770	
1983	6	3	369	580	728	886	939	960
All Classes			320	529	674	822	871	960
N		15	14	9	7	5	5	3

ESOXLAT1

DISCUSSION

We made limited habitat preference observations during 1989, but plan to increase effort during 1990. Use of biotelemetry in 1990 will greatly expand our opportunity to collect the data required to assess habitat preferences. Successful spawning and rearing of YOY occurred in Medicine and Killarney Lakes and Cougar Hay. Young-of-the-year pike were collected most effectively during the fall by electrofishing. Sampling eggs, larvae, and fry was not successful, probably because of the low numbers and vast amounts of habitat during the spawning and early rearing period. These stages coincide with runoff which generally floods these areas.

Population estimates indicate low abundance and low standing crops of northern pike in the lateral lakes. The lateral lakes have about 25% of average standing crops reported by Carlander (1955) (Figure 8).

Differences in spring and fall length frequencies are probably due in some part to selectivity of the principal gears used (gill netting in spring and electrofishing in fall). Several authors describe selection for small pike by electrofishing (Raat 1988), and for larger pike by gill netting (Frost and Kipling 1967).

Mortality estimates for the lateral lakes suggest low proportions of natural mortality (Table 2). Total mortality estimates are about 50% of typical literature values (A= 0.50 - 0.60; Raat 1988). We believe that sampling bias in spring gill netting has contributed to low estimates of annual mortality. By far, the highest proportion of mortality is due to fishing, which is typical of exploitation on northern pike populations (Raat 1988).

Finnell (1988) reported substantial occurrence of rainbow trout Onchorhynchus mykiss and kokanee O. nerka in northern pike stomachs. Other authors have reported northern pike predation on salmonids, particularly during spring and fall migrations and concentration (Raat 1988). Food habits indicate that yellow perch is the predominant prey of northern pike in the lateral lakes.

Growth rates of northern pike in the Coeur d'Alene Lake system are high (Figure 9). Relative weights for Idaho fish during spring (1.04) and fall (0.96) 1989 indicate excellent condition, suggest moderate to low population density, and moderate to high growth rates (Willis 1989).

Little movement of pike among lateral lakes was observed. Most pike were captured in the same body of water where they were tagged. However, significant movements among lakes may occur in from late fall to early spring.

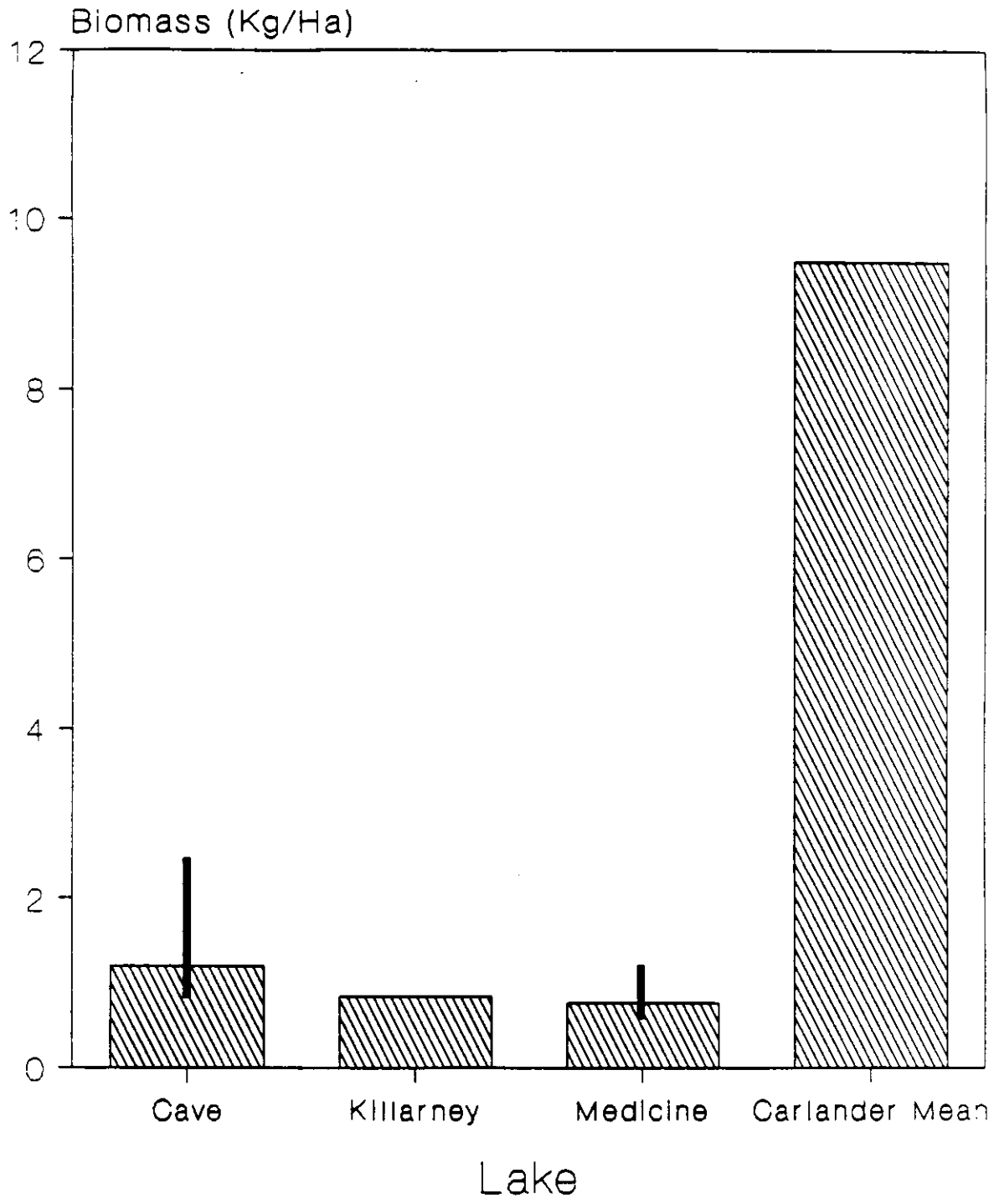


Figure 8. Comparison of estimated standing crops of northern pike for Cave, Killarney, and Medicine Lakes and mean literature value from Carlander (1955).

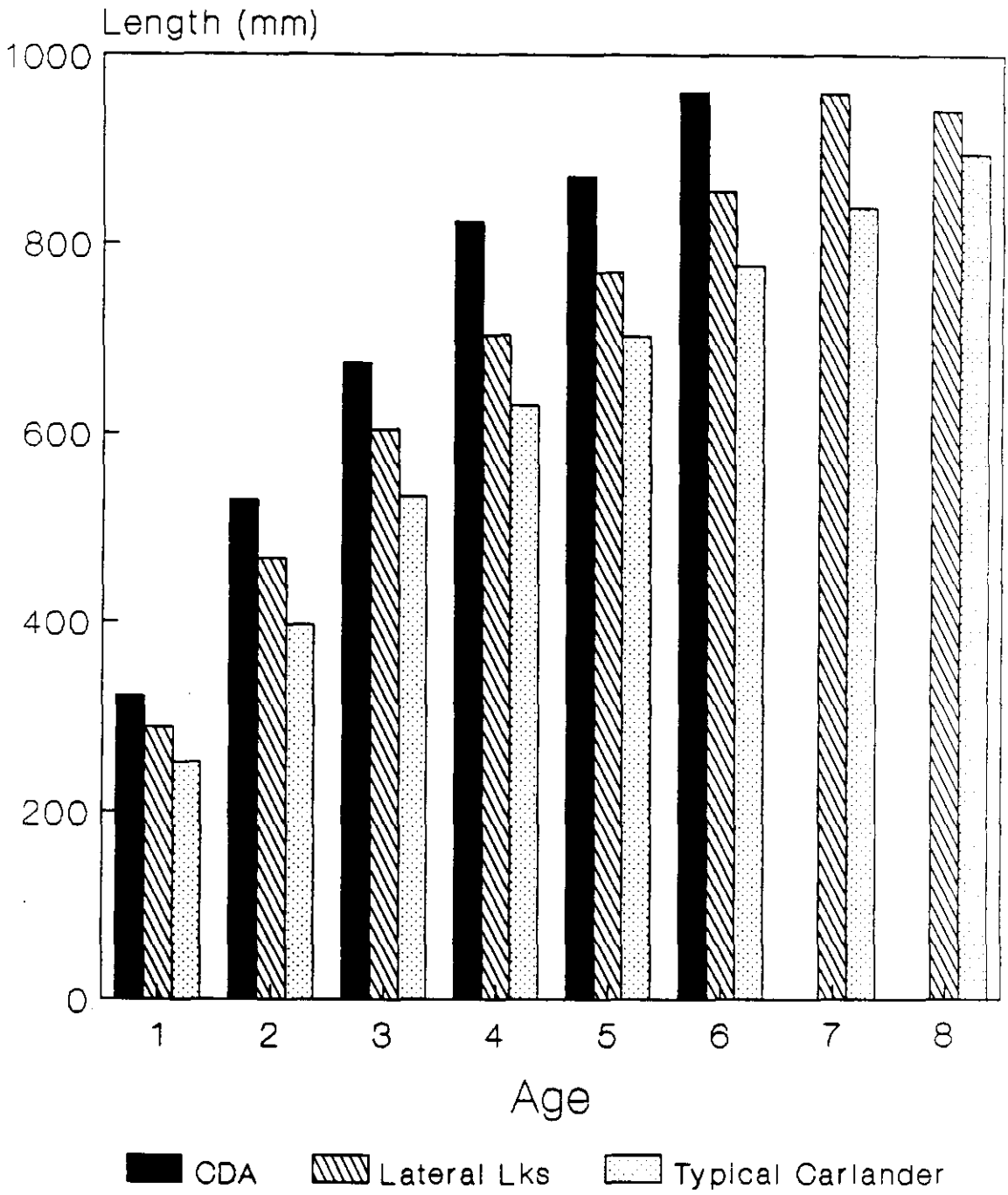


Figure 9. Comparison of average back-calculated total lengths at age for northern pike collected at the lateral lakes and Coeur d'Alene Lake and representative literature value (Carlander 1969).

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