

PALESTINE LAKE
Kosciusko County
2006 Fish Management Report

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EXECUTIVE SUMMARY

- A largemouth bass population estimate was conducted on Palestine Lake once a week from April 19 to May 9, 2006. In addition, a creel survey was conducted on this lake from April 3 to August 16, 2006.
- A total of 1,193 largemouth bass was collected while night electrofishing in May to calculate a population estimate. Overall, 29 bass of any size per acre and 24 stock-size bass per acre were estimated.
- A total of 419 parties of anglers was interviewed on Palestine Lake during a creel survey from April 3 to August 16, 2006, which included 900 individuals with an estimated total fishing pressure of over 17,000 h or 59 h/acre. The majority of the fish reported released after capture were largemouth bass under 14 in TL (331 fish). Palestine Lake had the greatest number of anglers per hour in the month of July and the lowest number in May and June. Overall, the total expanded harvest of fish from Palestine Lake was 30,000, which translated to a total of 1.76 fish/h harvested from the lake.
- Of the anglers that were interviewed on Palestine Lake, 32% were from Kosciusko County. Forty-five percent of the interviewed anglers believed that the overall quality of fishing on Palestine Lake was staying the same, while 43% believed it to be improving and 12% thought that the fishing quality was declining. When anglers were asked if they were satisfied with their fishing experience on the day they were interviewed, 98% said they were satisfied and 2% said they were not.
- In Palestine Lake, the DFW should maintain the 14-inch minimum size limit on largemouth bass, begin to discuss options for maintaining the quality bluegill fishery, and support control of curly-leaf pondweed.

INTRODUCTION

Palestine Lake, located in Kosciusko County, Indiana, is a 290-acre shallow lake where maximum depth is 30 feet and average depth is only 4 feet. This lake suffered a winterkill in 1978, which allowed undesirable fish, such as carp and gizzard shad, to become the dominant fish (Braun 1991). By 1982, these fish had also migrated into Caldwell Lake and, consequently, they dominated both lake communities (Kittaka 2000). Once these species were abundant, the game fish populations were unable to recover in number, and as a result, rotenone was applied in 1988 to the lake, its tributaries, and Caldwell Lake to remove all fish. Restocking of largemouth bass, bluegill, redear sunfish, and channel catfish occurred in the fall of 1988 and minimum length limits for largemouth bass were imposed on both lakes in order to protect the fish from harvest and enable the establishment of a sizable population. In addition, northern pike were stocked into Palestine Lake in 1991, 1993, 1994, and 1995, but due to poor survival and a decrease in the production of northern pike in Indiana state hatcheries, stocking was discontinued. State hatcheries started producing muskellunge and the excess fingerlings were stocked into the lake with slightly higher success than northern pike in 1997, 1998, 1999, 2002, and 2003. A general fish population survey was last conducted in Palestine Lake in 2003 and showed a population structure that was different from the one expected based on previous stocking efforts (Benson 2004). The largemouth bass population estimate and concurrent creel survey were conducted to evaluate the condition of the fishery.

METHODS

Largemouth bass population estimation

A largemouth bass population evaluation was conducted on Palestine Lake during April-May as part of DFW Work Plan 204478. Largemouth bass were collected by pulsed D.C. electrofishing the shoreline at night with two dippers for 4 h per night, once per week, from April 19 to May 9, 2006 and marked with a left pectoral fin clip. All fish collected were measured to the nearest 0.1 in TL. Scale samples were taken for age and growth analysis and an age-length key was created (Anderson and Neumann 1996; DeVries and Frie 1996). Proportional stock density (PSD) and relative stock density (RSD) were calculated for largemouth bass (Anderson and Neumann 1996). A Schnabel estimator was used to calculate a population estimate (N) for largemouth bass

$$N = \frac{\left(\sum C_t M_t\right)}{\left(\sum R_t + 1\right)},$$

where C_t is the number of captured bass in sample period t , M_t is the number of marked bass in sample period t , and R_t is the number of recaptured bass in sample period t . Confidence intervals were calculated using normal approximation,

$$\frac{1}{N} \pm t_\alpha \times SE,$$

which is different from the default of Poisson distribution in the calculation worksheet, because more than 50 bass were recaptured during the survey. The value t_α is from a t-table for (100- α)% confidence limits and

$$SE = V\left(\frac{1}{N}\right) = \frac{\sum R_t}{\left(\sum C_t M_t\right)^2}.$$

Annual mortality was estimated using Heincke's method

$$A = \frac{n_0}{N},$$

where n_0 is the number of fish in the youngest age class being considered (i.e., the earliest age class where fish are fully recruited to the gear, in this case age 4), N is the sum of all fish being considered (i.e., the sum of all fish from the youngest, fully recruited age class to the oldest age class captured), and A is annual mortality. Standard error is calculated by

$$S_A = \frac{[A(1-A)]}{N},$$

where A is annual mortality and N is the sum of all fish being considered, as stated above. Since this method does not rely on the accurate aging of older fish, this is a safer, more robust method for calculating annual mortality of a population.

Creel survey

Palestine Lake has public access at one location and private access from many private homes with piers along the lakeshore. Because this lake has limited public access and a relatively large amount of private access, a roving-access creel survey was conducted from April 3 to August 16, 2006. The survey was conducted using stratified random sampling where the 15 h weekend and weekdays were split between 2 periods, each lasting 7.5 h. In each hour, the creel clerk counted shore and boat anglers and conducted interviews. Each angler was asked

about their fishing preference, number and species of fish harvested and caught and released, county of residence, whether they thought the fishery was improving, staying the same, or declining, and whether or not they were satisfied with their fishing experience. Our primary interest from this creel survey was to determine the impacts of angler harvest on largemouth bass with a minimum length limit of 14 in. This survey combined with the data from the population estimate should enable us to determine whether the current regulation is suitable for the largemouth bass population in this lake.

RESULTS

Largemouth bass population estimation

A total of 1,193 largemouth bass was captured during the weekly electrofishing surveys on Palestine Lake. The number of bass, regardless of size, estimated from the survey was 8,436 fish (95% confidence interval = 6,651 to 11,066 fish; Table 1). The population of stock-size bass was estimated at 7,072 fish (95% confidence interval = 5,565 to 9,300 individuals). This translates to 29 bass of any size per acre and 24 stock-size bass per acre. The largemouth bass PSD at this time was 87 and the RSD-14 was 69, indicating that the bass population is skewed towards large fish. The overall mean length for bass in this survey was 13.8 in (Table 2). Mean length-at-age data from the age-length key indicated that largemouth bass reached 14 in (i.e. harvestable size) between their 4th and 5th year of growth (Table 2). The estimated total annual mortality rate for this population was 0.30 (standard error = 0.00024).

Creel survey

A total of 419 parties of anglers was interviewed on Palestine Lake during this creel survey, which included 900 individuals. On weekdays, 425 individual anglers were interviewed, compared to 475 individuals on weekends. The average trip for boat and shore anglers was 4.6 h and 3.0 h, respectively, and the total average trip overall was 4.6 h. Weekdays had slightly more fishing pressure (10,177 h) than weekends (6,846 h). Total fishing pressure was over 17,000 h. The month with the highest amount of fishing pressure, July, had over 5,500 hours of fishing, which translates into approximately 19 h/acre of fishing. Palestine Lake had the greatest number of anglers per hour in the month of July and the lowest number in May and June. The total number of anglers interviewed in July was 337, whereas in May and June only 120 and 121

anglers, respectively, were interviewed. Overall, fishing pressure for the 4.5-month creel survey was 59 h/acre.

The creel clerk measured 40 largemouth bass (mean length, 13.9 in; length range, 6.5 to 19.0 in), most of which were harvested in July by boat anglers. This expanded into an estimated harvest of 178 bass. In contrast, a total of 6,015 bluegill (mean length, 7 in; length range, 5.0 to 12.0 in) was harvested by boat anglers. This expanded into a total harvest of 27,309 bluegill overall or 94 bluegill/acre. Other fish harvested included yellow perch (37 fish; mean length, 8.0 in; length range, 6.0 to 13.0 in), redear sunfish (8 fish; length range, 7.5 to 11.0 in), channel catfish (1 fish; length, 24.0 in), and crappie (10 fish; length range, 8.0 to 12.0 in). Overall, the total expanded harvest of fish from Palestine Lake was 30,000 fish, which translated to an average of 1.76 fish/h harvested from the lake.

The majority of the fish reported released were largemouth bass over 14 in TL (965 fish). The number of largemouth bass less than 14 in that were reported captured and released was 343. The other 158 fish that were reported captured and released were primarily bluegill and yellow perch. In total, the expanded catch-and-release of largemouth bass less than 14 in TL was 1,206, whereas the catch-and-release of bass greater than 14 in TL was 3,370. There was an observed total of 1,412 fish captured and released and an expanded catch-and-release total of 5,464 fish.

Of the anglers that were interviewed on Palestine Lake, 32% were from Kosciusko County. Forty-five percent of the interviewed anglers believed that the overall quality of fishing on Palestine Lake was staying the same, while 43% believed it to be improving and 12% thought that the fishing quality was declining. Anglers who thought that fishing was declining were asked why and they responded that there was too much vegetation, too many fish harvested, too much fishing pressure, or bass tournaments that caused the decline. When anglers were asked if they were satisfied with their fishing experience on the day they were interviewed, 98% said they were satisfied and 2% said they were not. Some of the reasons most often noted for lack of satisfaction with fishing was that no fish were caught, there was a bass tournament going on, or it was too weedy.

DISCUSSION

Largemouth bass and bluegill dominated the creel at Palestine Lake. Overall, the quality of the largemouth bass fishery is good based on fast growth and the relatively high PSD (87) and RSD-14 (69). According to the creel data, relatively few bass are harvested compared to the number that are captured and released. The reason for this may be that most bass fishermen that fish Palestine Lake participate in the bass tournaments that take place throughout the summer and therefore catch-and-release more bass than they harvest. This may have contributed to the 13.8-in mean length of bass in this lake which is higher than many other lakes. Many more bluegills were harvested than largemouth bass. In fact, many anglers that were interviewed removed more than 40 bluegills during a trip. So not only does the largemouth bass fishery produce large, quality fish, so does the bluegill fishery. In fact, some bluegills removed from the lake were up to 12 inches long. Based on the monetary value of bluegill in the Great Lakes states, the estimated value of the expanded harvest of bluegill was \$65,252.47 (Southwick and Loftus 2003).

The muskie fishery in Palestine Lake does not appear to be of interest to most of the anglers that fish the lake. In addition, no muskie were reportedly caught or harvested during the 4.5-month survey. With that in mind, the expense of stocking muskie into the lake every year when these fish are not popular may be unwarranted. The DFW should reevaluate stocking excess muskie fingerlings into Palestine Lake and probably remove the lake from the stocking list.

Based upon data from the U.S. Department of the Interior, Fish and Wildlife Service and U.S. Department of Commerce, U.S. Census Bureau (2004), anglers in Indiana spent an average of \$50 for each day of fishing. Expenditures included food, lodging, transportation, equipment, licenses, and other fishing related items. Using this cost estimate per day of fishing, the estimated economic value of the Palestine Lake fishery from April to August 2006 was \$185,029.

RECOMMENDATIONS

- The DFW should maintain the 14-inch minimum size limit on largemouth bass at Palestine Lake.
- The DFW should begin to discuss options for maintaining the quality bluegill fishery in Palestine Lake.

- The DFW should reevaluate stocking muskie into Palestine Lake and probably remove the lake from the muskie stocking list.
- Curly-leaf pondweed should be controlled as necessary, but disallow any large-scale treatment of natives beyond the 625 ft² permissible under a general license in order to protect the quality of the largemouth bass and bluegill fisheries.

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Table 1. Largemouth bass population estimate results for all bass and stock-size bass in Palestine Lake in May 2006.

LAKE: Palestine			YEAR: 2006		SIZE: All Bass					
CATCH	MARKED	RECAPS	C*M	POPULATION	SE	SE %	95% LOW	95% HIGH	90% LOW	90% HIGH
372	0	0								
172	372	11	63984	5332	1539	29	3246	10437	3433	8881
360	533	27	191880	6561	1051	16	4905	9244	5094	8639
289	866	21	250274	8436	1089	13	6651	11066	6867	10514

SAMPLING RESULTS

TOTAL RECAPTURES:	59
CATCH WITH RECAPS:	1193
CATCH W/O RECAPS:	1134
PERCENT CAPTURED:	13.44%
NIGHTLY EFFICIENCY:	2.36%

LAKE: Palestine			YEAR: 2006		SIZE: ≥ Stock-size Bass					
CATCH	MARKED	RECAPS	C*M	POPULATION	SE	SE %	95% LOW	95% HIGH	90% LOW	90% HIGH
354	0	0								
155	354	11	54870	4573	1320	29	2784	8951	2944	7616
310	498	26	154380	5507	893	16	4103	7797	4262	7279
266	782	21	208012	7072	921	13	5565	9300	5748	8832

SAMPLING RESULTS

TOTAL RECAPTURES:	58
CATCH WITH RECAPS:	1085
CATCH W/O RECAPS:	1027
PERCENT CAPTURED:	14.52%
NIGHTLY EFFICIENCY:	2.56%

Table 2. Age-length key for largemouth bass captured using night electrofishing on Palestine Lake in April and May 2006.

Length group	# in sample	age 2	age 3	age 4	age 5	age 6	age 7	age 8	age 9	age 10	age 11	age 12
4.5	4	4										
5.0	12	12										
5.5	26	26										
6.0	22	22										
6.5	18	18										
7.0	11	11										
7.5	10		10									
8.0	14		10	4								
8.5	15	8	8									
9.0	13	3	10									
9.5	6		6									
10.0	8		8									
10.5	9		9									
11.0	20		20									
11.5	51	7	29	15								
12.0	51		20	31								
12.5	57		34	23								
13.0	44		9	35								
13.5	43			29	14							
14.0	89			89								
14.5	112			37	37	37						
15.0	107				107							
15.5	75				50	25						
16.0	46					23	23					
16.5	63					16	32	16				
17.0	59					12	24	24				
17.5	69						17	17	17	17		
18.0	53							18	18	18		
18.5	32							16	16			
19.0	17							6			6	6
Total	863	112	173	262	209	113	95	96	51	35	6	6
Mean length		6.5	10.9	13.3	14.9	15.6	16.7	17.6	18.0	17.8	19.0	19.0
Variance		2.819	2.683	1.203	0.255	0.759	0.272	0.575	0.165	0.064	0.000	0.000

APPENDIX 1

Lake Pages

Back-calculated lengths-at-age for largemouth bass.

Largemouth bass Intercept = 0.8	Year	Number	Back Calculated Length (inches) at Each Age											
	Class	Aged	1	2	3	4	5	6	7	8	9	10	11	12
	2005	0												
	2004	27	4.5	6.2										
	2003	29	4.2	8.8	10.2									
	2002	20	4.1	9.2	11.6	12.7								
	2001	8	4.5	9.7	12.3	14.2	15.0							
	2000	4	4.4	9.9	12.2	14.3	15.2	15.7						
	1999	4	4.1	8.5	11.6	13.7	14.9	16.1	17.0					
	1998	7	4.6	8.9	12.3	14.3	15.6	16.6	17.4	17.9				
	1997	4	4.7	9.4	12.1	13.9	15.8	16.8	17.5	18.0	18.3			
	1996	2	3.7	4.3	10.3	12.4	14.8	16.0	16.5	16.9	17.4	17.7		
	1995	1	4.4	7.8	10.9	13.7	15.2	16.3	17.5	17.9	18.6	18.9	19.1	
	1994	1	4.0	8.8	11.6	13.5	15.4	16.4	17.0	17.4	18.1	18.7	19.1	19.2

APPENDIX 2

Creel Data Pages

WD = weekday, WE = weekend, S = shore, B = boat, T = total, TFP = total fishing pressure

LMB = largemouth bass, BLG = bluegill, CCF = channel catfish, CRP = crappie, RES = redear sunfish, YEP = yellow perch, MUE = muskie

Distribution of party and angler numbers as well as the average amount of time for each fishing trip broken down by month.

	April	May	June	July	August	Total
WD Parties	40	30	37	66	49	222
WE Parties	42	26	22	81	26	197
S Parties	0	8	1	0	1	10
B Parties	82	48	58	147	74	409
Total Parties	82	56	59	147	75	419
WD Anglers	76	54	63	136	96	425
WE Anglers	98	66	58	201	52	475
S Anglers	0	14	2	0	1	17
B Anglers	174	106	119	337	147	883
Total Anglers	174	120	121	337	148	900
WD Avg. Trip	4.25	3.92	4.04	4.00	4.13	4.08
WE Avg. Trip	6.51	4.11	5.08	4.90	4.55	5.14
S Avg. Trip	0.00	3.02	0.00	0.00	0.00	3.02
B Avg. Trip	5.41	4.21	4.54	4.49	4.26	4.62
T Avg. Trip	5.41	4.02	4.54	4.49	4.26	4.59

Total number of interview hours, trip hours, reported number of fish harvested, and reported number of fish caught-and-released by month of survey.

Month	Total h	Harvest							Catch-and-Release		
		LMB	BLG	CCF	CRP	RES	YEP	MUE	LMB >14	LMB <14	Other
April	984	8	245	0	5	2	0	0	323	136	0
May	526	4	468	0	1	1	19	0	54	17	26
June	774	6	1,249	1	1	2	181	0	205	75	6
July	1,638	25	2,931	0	7	2	168	0	341	91	0
August	648		1,701	0	0	0	154	0	42	25	126

Total number of fishing hours, reported number of fish harvested, and reported number of fish caught and released by weekday (WD) or weekend-day (WE).

Day	Total h	Harvest							Catch-and-Release		
		LMB	BLG	CCF	CRP	RES	YEP	MUE	LMB >14	LMB <14	Other
WD	1,962	32	4,352	0	6	5	332	0	391	152	32
WE	2,609	11	2,242	1	8	2	190	0	574	192	126

Distribution of weekday (WD), weekend (WE), shore (S), and boat (B) interview hours as well as weekday, weekend, shore, boat, and total fishing pressure (TFP) broken down by month.

	April	May	June	July	August	Total
WD interview h:	319.9	205.6	258.6	566.3	419.0	1,769.4
WE interview h:	664.5	320.6	323.5	1,071.7	229.0	2,609.4
S interview h:	0.0	35.8	8.0	0.0	4.1	47.8
B interview h:	984.4	490.5	574.1	1,638.1	643.9	4,330.9
Total interview h:	984.4	526.2	582.1	1,638.1	648.0	4,378.8
WD TFP:	1,309.1	1,438.4	2,668.3	3,019.8	1,741.5	10,177.1
WE TFP:	532.8	868.8	2,046.0	2,490.0	908.0	6,845.6
S TFP:	68.3	263.8	276.9	159.6	70.0	838.6
B TFP:	1,773.6	2,043.4	4,437.4	5,350.2	2,579.5	16,184.1
T TFP:	1,841.9	2,307.2	4,714.3	5,509.8	2,649.5	17,022.7
Hours/acre:	6.4	8.0	16.3	19.0	9.1	58.7