1998 Doe Lake
Synoptic Trap-net Survey Report

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Summary:

A synoptic, trap-net survey consisting of 33 - 8' trap-net sets was conducted on Doe Lake during the late summer of 1998. Similar surveys have previously been conducted in 1982 and '88. Over-all fish productivity (35.8 kg. of fish per net night) was exceptionally high relative to similar surveys which have been conducted in the Parry Sound Area. The fish community is dominated by walleye and smallmouth bass which comprised 35 and 31% of the total catch biomass respectively.

All indices (CUE number and biomass; size and age class distribution; growth rate) point to an exceptionally healthy and robust walleye population; largely similar to results observed in previous studies. Smallmouth bass have experienced considerable expansion between this and previous studies. Catch -per-unit-effort (CUE), in terms of both number and biomass for smallmouth bass is up substantially. As with walleye, all smallmouth bass indices point to a healthy and robust population. Indices of northern pike population indicate that the population has remained stable between surveys.

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1.0 Introduction:

Doe Lake is a large, 1,180 hectare (2,914 acres) lake; parts of which are in four geographic townships: Ryerson, McMurrich, Armour and Perry. The lake forms part of the extensive Magnetawan River watershed and is located approximately 25 kilometers north of Huntsville. It is composed of three distinct sections separated by narrows (Figure 1). The large southern portion is relatively shallow (maximum depth 58') and is locally known as "Big Doe." The smaller and deeper (maximum depth 79') northern portion is known as "Little Doe." These two basins are connected by a relatively narrow and shallow (less than 30' deep) section known as "Middle Doe."

The lake has a mean depth of 5.9 metres (OMNR, 1972). Visibility is 'fair' with a secchi reading of 2.1 metres. Total dissolved solids is 34 - 36 mg/l (OMNR, 1972) with a Morphoedaphic Index (T.D.S. / mean depth) of 5.9. This index of productivity is relatively "*moderate*" for a Canadian shield lake.

There are numerous small inlets. The Beggsborough Creek on the southeast shore of "Big Doe" is the primary inlet. The Magnetawan River at the north end, adjacent to the village of Katrine is the solitary outlet (Figure 1). This river has the peculiar feature of actually becoming an inlet during the peak of the spring freshet. The Magnetawan River essential by-passes Doe Lake with the exception of a small connection at the north end. With high water levels during the peak of the spring freshet, for a short period of time - water flows from the swollen Magnetawan River into Doe Lake. Resultant lake water levels for this short period of time are exceptionally high with spring-time levels exceeding the *optimal, summer regulated water level* by more than a metre (McIntyre, 1996). The lake is also subject to late winter draw-down by Ministry *water control staff* in anticipation of spring flooding. Consequently, the Ministry's 'operating range' for water level control on Doe Lake has a remarkable fluctuation of 2.5 metres (McIntyre, 1996)! Within this range the Ministry strives for an "*optimal water level fluctuation*" of 1.9 metres. These drastic fluctuations, especially during the walleye spawning run and incubation period, - have always been of concern to fisheries staff. The chronic fear has been that walleye eggs laid during high water levels are subsequently exposed during the incubation period when water levels drop precipitously. Remarkably though - several Ministry netting studies over two decades have shown consistently strong walleye year classes in spite of this annual phenomena!

The lake is moderately developed and readily accessible with several public access points. The 1972 lake survey (OMNR, 1972) recorded 175 cottages and 11 tourist resorts.

Doe Lake is managed as a natural, self-sustaining cool water fishery. Primary game species include: walleye (*Stizostedion vitreum*), smallmouth bass (*Micropterus dolomieui*) and northern pike (Esox lucius). Cisco (*Coregonus artedii*) and lake whitefish (*Coregonus clupeaformis*) are deep, cold-water species present. A small winter sport fishing is directed at these species. Common white sucker (*Catostomus commersoni*), brown bullhead (*Ictalurus nebulosus*), pumpkinseed (*Leponis gibbosus*) and yellow perch (*Perca flavecens*) are the other species present.

A variety of inventory and assessment surveys involving trap and gill nets have been conducted on Doe Lake over an extended period of time. The first was a rudimentary lake survey conducted in 1952, which notes that northern pike were first observed in the lake in 1949. It also documents the presence of ling in the lake - which is unrecorded after 1963. A gill-netting survey conducted in 1963 to assess lake trout planting - wisely recommended that they be discontinued. In 1972, a standard "Aquatic Habitat Inventory Survey" (lake survey) was conducted. In 1977 a gill net project was conducted to collect fish samples for ascertaining mercury contaminant levels in various species. Results indicated moderately high levels of background mercury present in all game fish. In 1982, the first synoptic, trap-net survey was conducted

MacMillan, 1985). This was the first survey which objectively established the relative abundance and community structure of fish species in the near-shore fish community. A similar, but more extensive

synoptic, trap-nets survey was conducted in 1988 (Sober, 1988). Both surveys indicated an exceptionally healthy fish community dominated by walleye and smallmouth bass.

In recent years, the Ministry of Natural Resources has heard several comments from residents of Doe Lake that angling quality, especially for walleye, has declined drastically. As one of the premier sport fisheries in the Parry Sound Area, the 1998 survey was conducted to determine the current status of the Doe Lake fish community (particularly game species) in response to these comments.

2.0 Methods:

It was intended that this survey be directly comparable to the comprehensive, synoptic, trap-net survey that was conducted in 1988. The 1988 survey duplicated the 10 - 8' trap-net sets[(1)] made during the 1982 synoptic, trap-net survey and considerably expanded the effort with an additional 23 sets. The 1988 survey was conducted from August 9 - 31st. Due to scheduling problems related to manpower availability, our survey took place from August 24th - September 18th.

The '88 survey utilized three different sizes of trap-nets consisting of: 15 - 4' trap net sets; 12 - 6' trap-net sets; and 33 - 8' trap-net sets. Data from that survey clearly indicated that 8' trap-nets were highly effective at catching all near-shore fish species and clearly out-fished 4 and 6' trap-nets at catching walleye and smallmouth bass. Consequently, being most interested in these particular game species, we exclusively used 8' trap-nets. All comparisons made between this survey and the 1988 and 1982 surveys pertain exclusively to data collected from 8' trap-net sets.

Thirty-four (34) 8' trap net sets were recorded in the 1988 survey. No catch data however was presented for set No. 4. We assume this was due to tampering with the net, damage to the net, or an improper set such that the catch data was not valid. We followed the identical set numbering used in the 1988 survey. Consequently, there are 34 set numbers (Appendix A), but in actuality only 33 net sets, as there is no net set No. 4. Nets were moved daily such that all sets were approximately of 24 hours duration. Nets were set at the same locations as those of the 1988 survey (Figure 1). MacMillan (1985) noted that … "*trap-net set locations were chosen with the objective of sampling as many as possible of the existing habitat types throughout the lake, bearing in mind the limitations imposed by water depth and gradient*".

Complete catch enumeration was conducted for all sets (Appendix A). Biosampling, consisting of total length, fork length and round weight determination for walleye, smallmouth bass and northern pike. Additionally, scale samples were collected from walleye for subsequent age determination. Random weight samples were taken from all other species caught for calculation of mean weights (Appendix B). Due to the large number of smallmouth bass and walleye caught, only a random and representative number were biosampled (Appendix C and D). To eliminate biases, either all walleye and bass from a particular net were biosampled or none at all. Aging was conducted by District fisheries staff (Eric McIntyre).

Walleye age determination was by the scale reading method. As there are no *known age* walleye in this lake - we had no method of validating the accuracy of our scale aging. Ease of age determination however was quite high up to age 5. Beyond this age, difficulty increased dramatically in assigning age - and we assume that accuracy decreased proportionately.

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(1) The 1982 survey (MacMillan, 1985) presents conflicting information with respect to netting effort. The text states that 11 - 8' trap-net sets were made, but Appendix 3 indicates only 10 - 8' sets. We generated CUE values based on data presented in Appendix 3 of that report.

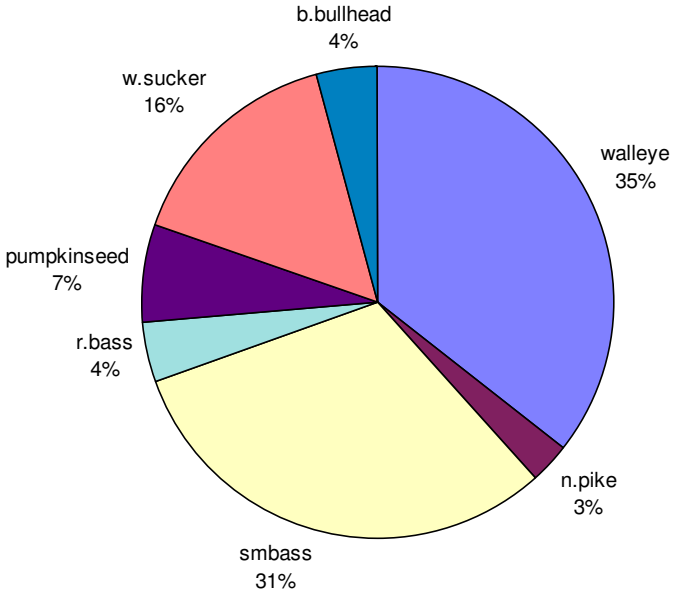
3.0 Results:

3.1 Near-shore Fish Community Structure:

From 33 - 8' trap net sets, a total of 2,061 fish comprised of eight different fish species were caught (Appendix A). Total catch biomass for all species was estimated to be 1,180.3 kilograms (Appendix 2).

The catch biomass was dominated by walleye (35%), smallmouth bass (31%) and common white sucker (16%) (Figure 1). Northern pike, brown bullhead, pumpkinseed, rock bass and cisco comprised the remaining 18% of the catch biomass.

Figure 2. Catch composition (by weight) from 33 - 8' trap-nets, Doe Lake, 1998. (See Appendix B for specific catch weight by species.)



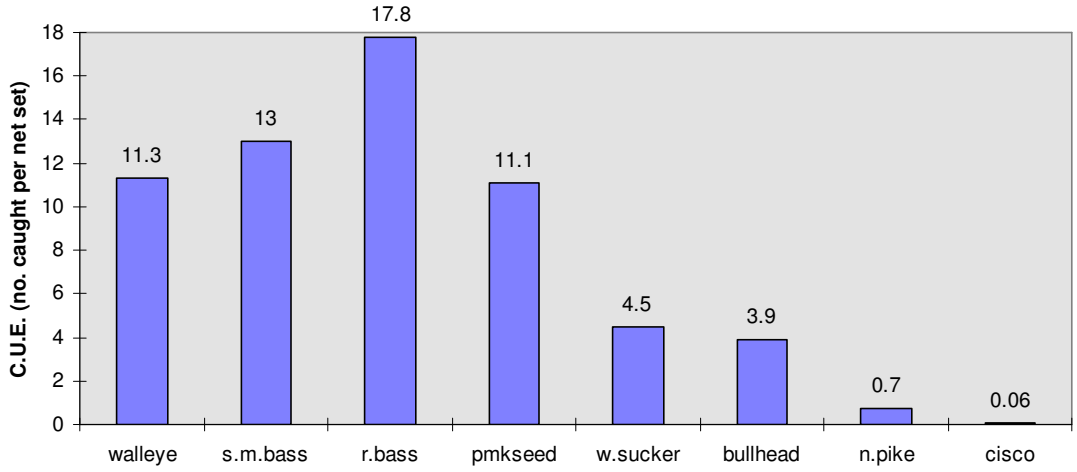
Total estimated biomass of the catch: 1,180.3 kg.

3.2 Relative Abundance Indices (CUE):

Rock bass was the most commonly caught species - averaging 17.8 ± 18.5 ($P > 0.05$) **fish caught per 8' trap-net set** (Appendix A). This was followed by smallmouth bass with a CUE of 13.0 ± 4.7; walleye 11.3 ± 4.7; pumpkinseed 11.1 ± 4.1; and the remaining species with a CUE less than 5.0 each (Figure 3).

Figure 3. Relative Abundance Indices (Catch per Unit Effort C.U.E - number caught per 8' trap-

net set) for 1998 Doe Lake Synoptic Trap-net Survey.) (Total number of net sets: 33. See Appendix A for Catch Summary).



3.3 Biosampling Results:

Complete biosampling (total length, fork length, round weight, scale sample collection and aging) was conducted on a random sample of 152 walleye from the 374 captured. Mean size of walleye captured was 46.4 ± 1.16 cm. ($P > 0.05$) total length and 1.12 ± 0.092 kilograms (Figure 4 and Appendix C). Mean age was 4.9 years ± 0.3 ($P > 0.05$) (see Figure 5).

Figure 4. Size Distribution of walleye sampled from Doe Lake, 1998 synoptic, trap-net survey.

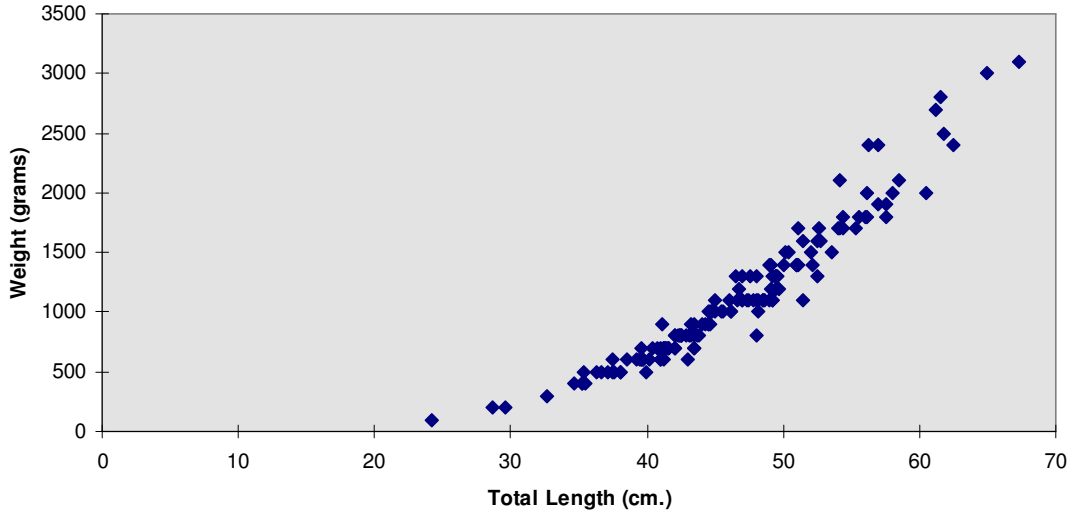
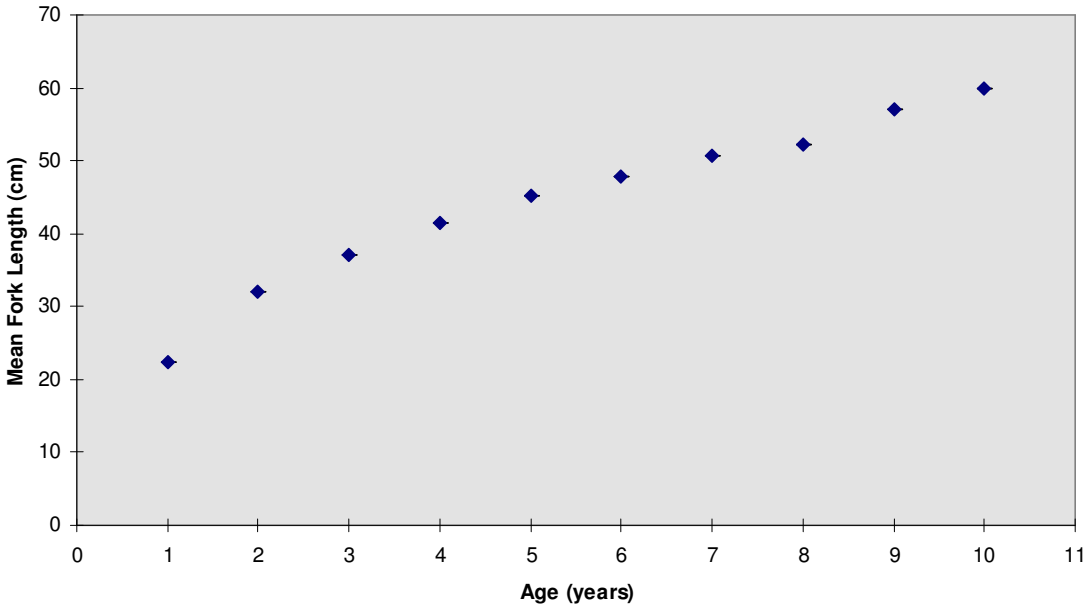


Figure 5. Age distribution of walleye sampled from Doe Lake, 1998 synoptic trap-net survey. (Data from Appendix C.)



Mean fork length at age data is presented in Figure 6. The significance of the resulting growth curve generated from this data is further discussed in Section 4.3.1 of this report. *(We caution readers that although the relatively tight error bars (95% confidence interval) represent a high degree of precision in assigning age to fish of similar size, this does not necessarily indicate a high degree of age assessment accuracy. What we mean by this, is that we may have been very consistent in age assessment errors. This is further discussed in Section 4.3.1.)*

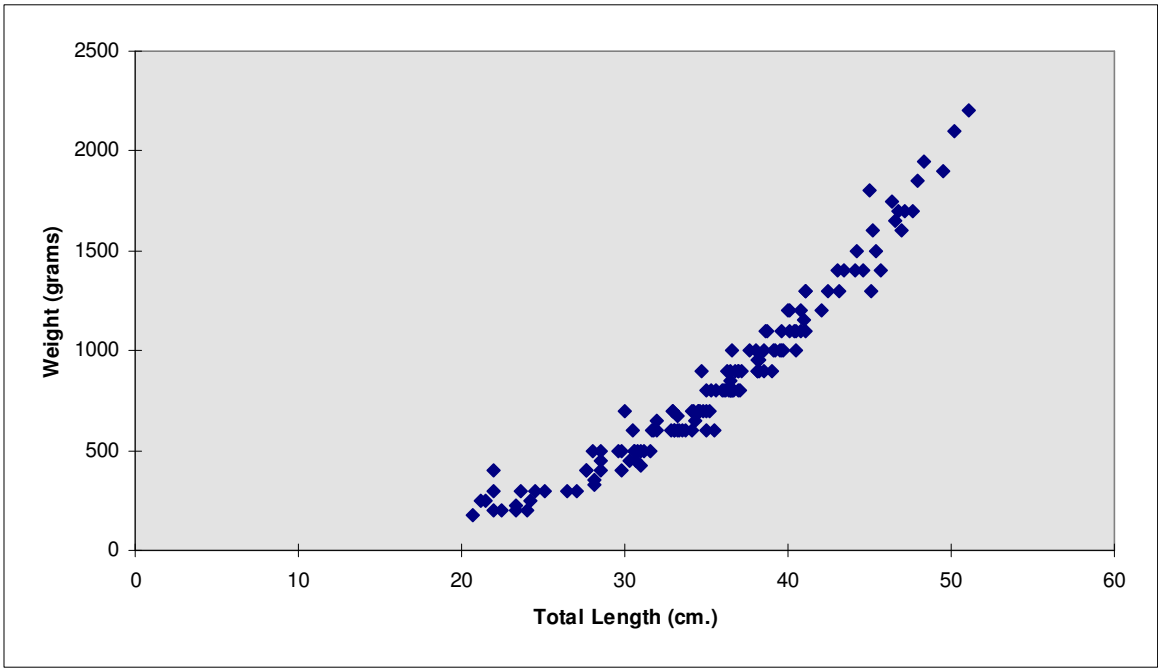
Figure 6. Mean fork length at age for walleye sampled from Doe Lake, 1998. (See Appendix F for raw data.)



Error bars represent 95% confidence interval.

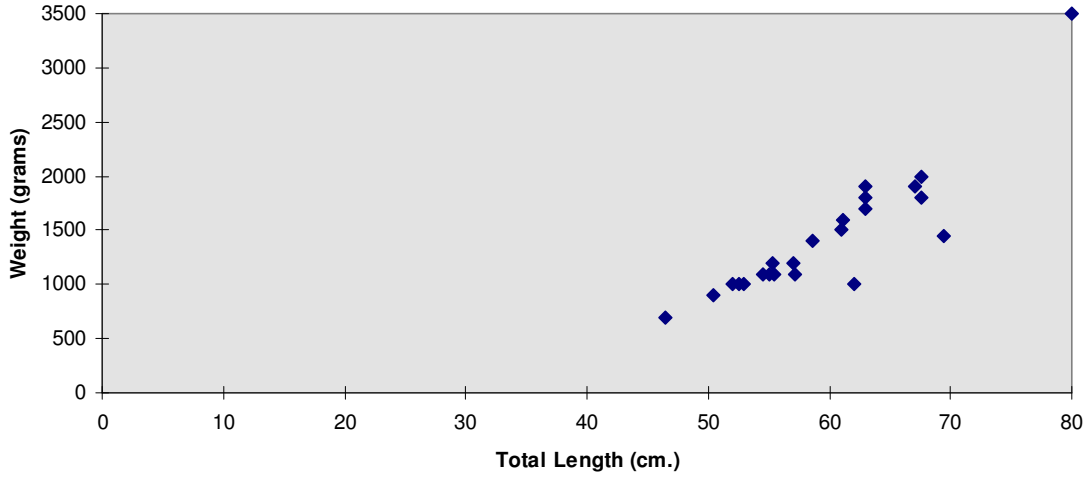
Biosampling (size) data was collected from 140 smallmouth bass of the 429 caught. Mean total length was 35.6 cm. ± 1.15 ($P > 0.05$) and mean weight 856 grams ± 73.8 (Figure 7).

Figure 7. Smallmouth bass size distribution, Doe Lake 1998 synoptic trap net survey. (See Appendix D for biosampling data.)



Mean size of northern pike captured during the survey was 59.7 cm. ± 3.25 ($P > 0.05$) total length and 1.432 kilograms ± .252 (Appendix E and Figure 8).

Figure 8. Size distribution of northern pike sampled from Doe Lake, 1998 synoptic, trap-net survey.



4.0 Discussion:

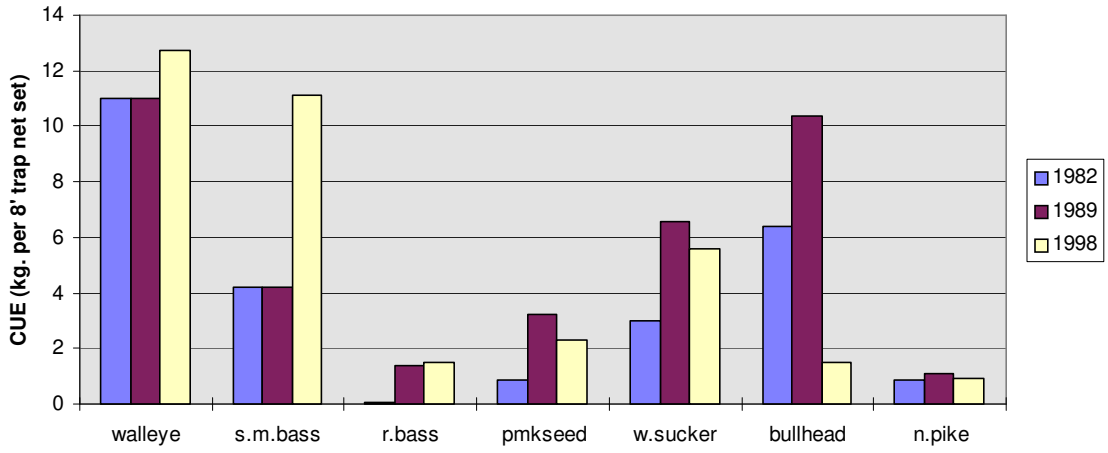
4.1 Near-shore Community Structure:

Three synoptic trap-net surveys have been conducted on Doe Lake. One in 1982 (MacMillan, 1985), one in 1988 (Sober, 1988) and this survey in 1998. This survey followed selected portions of the methodology of the 1988 survey, such that 8' trap-net data from the two studies is directly comparable. The 1982 survey was comprised of only 10 - 8' trap-net sets (as opposed to this and the '89 surveys which had 33), but they were at locations covered by the latter surveys. Bearing these differences in mind, we reworked the data of the previous studies using the mean catch or CUE (catch per unit effort) of 8' trap nets to compare catch composition (and indirectly community structure) between years. We also used the CUE for biomass (kilograms of fish caught per net night) as opposed to CUE for number - considering this a better indicator of changes in community structure.

Using total catch weight per trap-net set as an indicator of over-all productivity, in 1982 there was 26.4 kg. of fish caught per 8' trap net set; 37.9 in 1988 and 35.7 in 1998. **Walleye, rock bass and northern pike have remained fairly constant between surveys (Figure 9). Most notably, smallmouth bass increased dramatically in the 1998 catch while brown bullhead decreased dramatically. The dominance of walleye and bass in the 1998 catch is clearly indicative of a fishery dominated by these highly desirable game species. They comprised 35 and 31% of the total catch biomass respectively (Figure 2) and averaged 12.7 kg. of walleye and 11.1 kg. of smallmouth bass per net set (Figure 9).**

(It should be noted that 8' trap-net catch data is probably not truly reflective of species composition in the fish community. For instance, rock bass and pumpkinseed are probably more abundant than the catch data typically indicates - because these are warm and shallow water species which are not as vulnerable to 8' trap-nets which tend to fish in deeper waters. Similarly, northern pike are "ambush feeders" and consequently are not very active swimmers. Consequently they are less susceptible to capture by trap-nets and their actual abundance is probably under-represented in the catch data.)

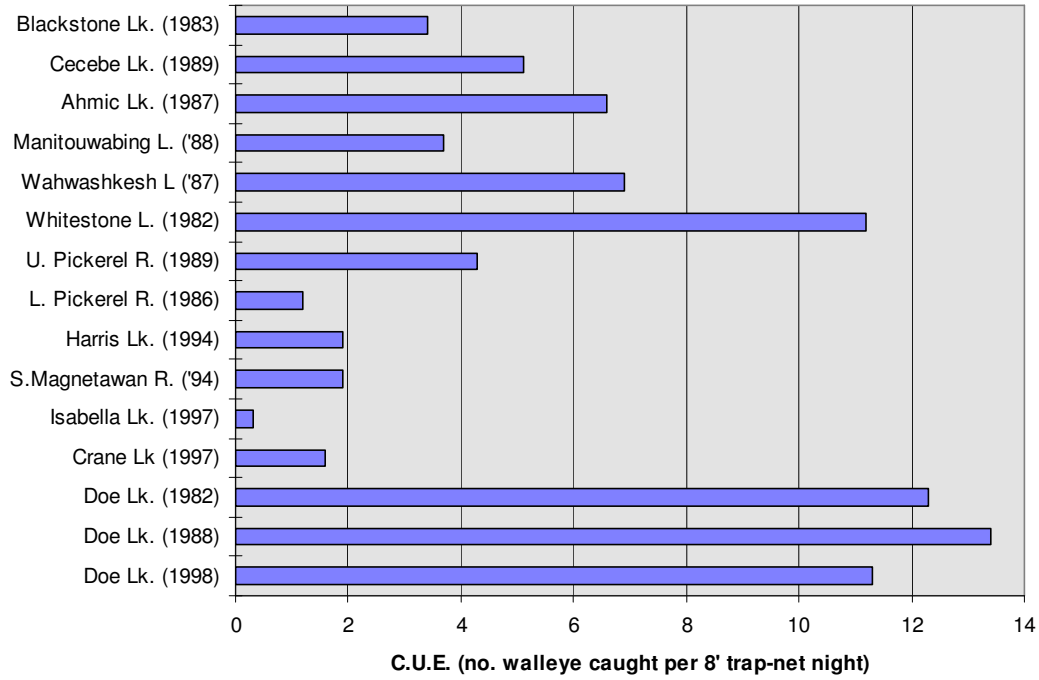
Figure 9. Comparison of "Catch Per Unit Effort - weight" (CUE - wt.) as an index of relative abundance for species captured in three synoptic, trap-net surveys on Doe Lake, 1982, 1988 and 1998.



4.2 Relative Abundance:

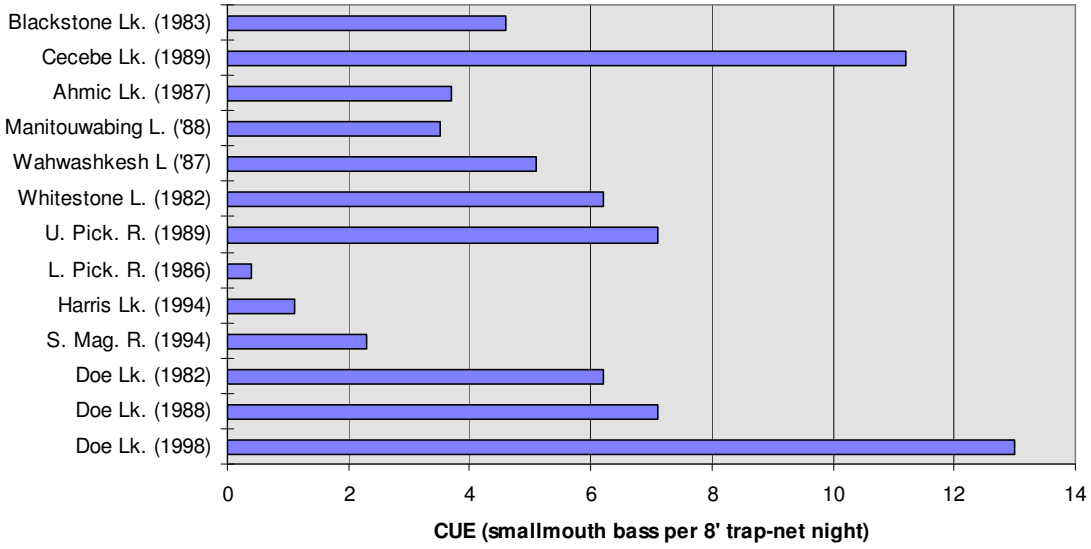
Numerous synoptic, trap-net surveys have been conducted on Parry Sound Area lakes by the Ministry of Natural Resources over the past couple of decades. Each lake has unique biotic and abiotic factors which determines fish community composition and individual species abundance. Consequently, surveys **between** lakes are not directly comparable. They do however provide a relative (albeit imprecise) means by which abundance of walleye can be approximately measured. **Clearly, Doe Lake has the distinction of having the highest walleye CUE of any lake thus surveyed in the Parry Sound Area** (see Figure 10). **Also noteworthy, is the fact that it has maintained this high abundance of walleye from 1982 to 1998.**

Figure 10. A comparison of walleye relative abundance (CUE - no. of walleye caught per 8' trap-net night) for several Parry Sound Area lakes on which synoptic, trap-net surveys have been conducted (1982 - 1998).



In conducting a similar analysis for smallmouth bass, again, in 1998 - Doe Lake has the distinction of having the highest CUE of any lake thus far surveyed in the Parry Sound Area (Figure 11). We are unable to speculate on what has caused the recent dramatic increase of smallmouth bass in Doe Lake.

Figure 11. A comparison of smallmouth bass relative abundance (CUE - no. of bass caught per 8' trap-net night) for several Parry Sound Area lakes on which synoptic, trap-net surveys have been conducted (1982 - 1998).



4.3 Biosampling Data Implications:

4.3.1 Walleye:

Our walleye biosampling data shows a wide range of size (Figure 4) and age classes (Figure 5). The abundance of small fish and consistently well represented age and size classes indicates that this walleye population is exhibiting strong and consistent reproduction and recruitment. It is also probably indicative of a satisfactory mortality rate.

Unfortunately, we were unable to estimate *mortality rate* from this study. Age determination by scale reading tends to underestimate the age of older fish, resulting in an upwardly biased estimate of mortality (Kushneriuk et al, 1996). Aging difficulties for walleye over 5 years of age strongly suggests to us that aging errors beyond this age class are significant. Nonetheless, our size sampling data (Figure 4) indicates that a considerable portion of the catch is comprised of large and presumably old fish (27% of walleye catch was in excess of 50 cm total length; Appendix C). We interpret this as indicating that the mortality rate is probably consistent with maintaining a healthy, natural, self-sustaining walleye population - which appears evident over the past two decades.

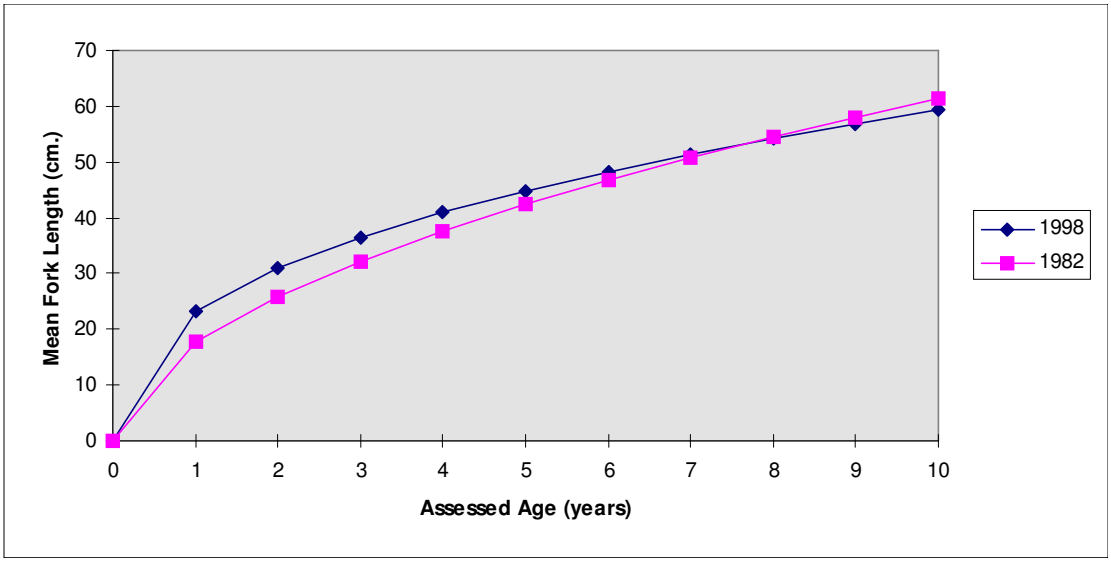
Mean age of walleye caught in this survey was 4.9 years (Appendix C), - identical to that determined in the 1988 survey (Sober, 1988). In 1982, the mean age was 3.8 years (MacMillan, 1985). The age class composition of this walleye population appears to have remained relatively stable and consistent between 1988 and 1998.

There is no statistically significant difference ($P > 0.05$) in the *relative abundance* of walleye (as measured by CUE) between this and previous studies (Figure 10). Statistically the same is true for *mean size* of walleye. It is interesting to note however that in 1998, mean weight of walleye caught was 1,122 grams

(Appendix C), whereas in 1988 it was 827 grams (Sober, 1988) and in 1982 it was 897 grams (MacMillan, 1985).

Based on mean fork length at age data (Appendix F), we used a bivariate curve fitting program to generate the following growth (*Power Curve*) equation for walleye: $y = 23.32\ x^{0.406}$ (r = .996) (Figure 11). This growth equation is very similar to the one calculated by MacMillan (1985) from data collected in 1982. Growth is a potentially useful indicator of population status because it responds readily to changes in abundance and therefore tends to increase as exploitation increases (Lester, et al. 1991). The implication here is that walleye abundance and exploitation as manifested in growth - has not changed substantially between 1982 and 1998.

Figure 11. Comparison of walleye growth rates between 1982 and 1998, Doe Lake.



To a large extent - we find the above indices of an exceptionally healthy walleye population quite perplexing. Why has Doe Lake been able to withstand high angling pressure (28.1 rod hours per hectare; Sober, 1989); high walleye harvest (1.386 kg. / hectare; Sober, 1989) and still maintain a healthy walleye population, when almost every other walleye lake in the Parry Sound Area subject to similar stresses is exhibiting acute signs of depressed walleye stocks? Baccante and Colby (1991) observed that fishing success for walleye in northern Ontario declines rapidly when annual angling effort exceeds 10 rod hours per hectare. How is it that Doe Lake can exceed this threshold effort level by almost three times and still maintain a healthy walleye population? Unquestionably, fish community of Doe Lake has been remarkable at maintaining productive, natural, self-sustaining game fish populations despite considerable angling and water level stresses.

4.3.2 Smallmouth bass:

Our smallmouth bass sample exhibited a wide range of sizes with all size classes being well represented in the catch (Figure 7). As with the walleye sample, our interpretation is that smallmouth bass are exhibiting strong and consisted reproduction and recruitment. Based on size class distribution (Figure 7), it appears

that the current mortality rate - although unknown, is consistent with maintaining a healthy, self-sustaining population.

Not only has the number of smallmouth bass increased substantially (Figure 11) between this and previous surveys; but so has the mean size. In 1998, mean weight was 857 grams (Appendix D); in 1988 it was 590 grams (Sober, 1988); and in 1982 it 679 grams (MacMillan, 1985).

4.3.3 Northern Pike:

The comparatively low level of vulnerability of pike to trap-nets and the resulting small sample size (N = 22; Appendix E) makes interpretation of size data more difficult for this species. The absence of small pike in the sample is partially due to gear selectivity which targets adult pike in waters of mid-depth. Juvenile and sub-adult pike frequent warmer and shallower waters. Similarly, the absence of very large pike is probably attributable to the deep water and more sedentary nature of these fish.

Neither the mean size (1.12 kg. in 1982; 1.58 kg. in 1988 and 1.43 kg. in 1998) nor the productivity (Figure 9) of pike has changed much between surveys. We interpret this as indicating that the pike population has remained stable between surveys - although we are unable to accurately translate this into how abundant or dominant pike are in the Doe Lake fish community. We certainly believe however that it is much greater than its representation in the catch.

5.0 Summary:

- Eight foot trap-nets fished in 1998 averaged 35.77 kilograms of fish per net night. Relative to other Parry Sound Area synoptic, trap-net surveys, this is an exceptionally high catch rate and is indicative of relatively high productivity from this lake.

- The catch composition as an index of fish community structure is excellent. Walleye comprised 35% of the catch weight; smallmouth bass 31%; common white sucker 16% and five additional species the remaining 18%.

- Walleye CUE (both weight and number) is essentially unchanged between 1982 and 1998. CUE values are the highest recorded in the Parry Sound Area for numerous studies of a similar nature. A wide size distribution of caught walleye indicates consistent and successful reproduction and recruitment and probably satisfactory mortality levels. Mean size of walleye has increased since 1988. Walleye growth rate is similar to that observed in 1982 suggesting that walleye abundance and exploitation have remained constant. All indices point to an exceptionally healthy and robust walleye population. Considering intense levels of fishing effort and harvest on this lake, we find the above observations quite remarkable and inconsistent with deteriorating walleye fisheries exhibited on lakes with similar stresses elsewhere in the Parry Sound Area.

- The smallmouth bass population appears to have experienced considerable expansion between this and previous studies. CUE for both number and weight, is up substantially in 1998 relative to 1988 and ’82. Size distribution of the smallmouth catch indicates consistently successful reproduction and recruitment. Mortality rate - although unknown, is probably satisfactory. Mean size is up substantially in 1998 relative to previous studies. These indices point to an exceptionally healthy and robust smallmouth bass population.

- The northern pike population has remained stable between surveys. CUE for both number and weight has essentially remained unchanged between 1982 and '98. Due to gear selectivity, we are unable to accurately translate catch data into northern pike abundance in the near shore fish community. The catch sample for northern pike is limited (N = 23) making reliable interpretation difficult.

6.0 Acknowledgments:

Project coordination was provided by Senior Fish and Wildlife Technician, Chip Duncan. Field operations were supervised by Jim Palmer who acted as field crew leader. Able field assistance was provided by numerous Ministry staff including: Ken Molyneaux, Rollie Fry, Dean Timson, Alex Pountney, Oliver Pastinak, Ron Black, Chip Duncan, Rob Viejou and Eric McIntyre. Map perpetration (Figure 1) was courtesy of Rob Viejou, Parry Sound GIS. Thanks also to Steve Kerr for very helpful and constructive comments in reviewing this report.

The Ministry would also like to acknowledge and thank the "Girl Guides of Canada" for use of their outdoor camp for access and storage of equipment during the survey.

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