Biological Sustainability of Commercial Fishing In the Inland Waters of Kemptville District

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1.0 Background

In 2005, public concern regarding the impact of commercial fishing on the Upper Rideau Lake fishery arose. The public were primarily concerned with the sustainability and quality of the fishery on their lake with the increase in commercial fishing harvest. They were concerned that the increase in commercial fishing was negatively affecting the rehabilitating walleye population by reducing available forage fish for walleye. They were also concerned about the number of panfish/coarse fish species commercially harvested (yellow perch, black crappie, bluegill, pumpkinseed, bullhead and rock bass) on an annual basis. Additionally, they were concerned about a decline in the size quality of panfish species available for anglers.

To address these concerns, Kemptville District staff led a scientific review of the commercial fishing license quota and harvest for Upper Rideau Lake and the other lakes (Newboro Lake, Loon Lake, Benson Lake, Mosquito/Pollywog Lake and Lower Rideau Lake) within that particular license. This review unitized the most current fisheries assessment data and science available. Kemptville district staff led a consultation process with all interested groups to ensure the sustainability of the resource to benefit all resource users (commercial fisherman, resident recreational anglers, non-resident recreational anglers and tourist operators) on the lake.

The overall guiding objective of this analysis is as follows:

- To determine the appropriate allocation of the fishery resource for each resource user group on Upper Rideau Lake and other inland lakes within the licensed area

2.0 Yield

The capacity of a body of water to support fish biomass (carrying capacity) and to provide sustainable fish harvest is useful information to fishery managers. The most well known predictor of fishery productivity in natural lakes is the morphoedaphic index (MEI), which is the concentration of total dissolved solids (TDS) divided by mean depth (Ryder *et al.* 1974). Although the concentration of TDS is a less accurate indicator of nutrient availability than are direct measurements, the relative ease of measuring TDS is attractive for use in an index. The MEI remains the best predictor of productivity. The MEI is used to provide fisheries managers with an **estimate** of **potential** fish yield (kg/ha/yr) that can be expected from a given lake (Kohler and Hubert 1999). However, MEI predicts the **potential** yield for all species combined within a waterbody and is not species specific. Exploitation of a fishery to **potential** MEI is not sustainable since it is an **estimate** and there is a need to provide a margin of safety in the event of weak year classes (OMNR 1982).

The objectives of this yield analysis are as follows:

- To determine the potential annual yield (kg/ha/yr) for all species combined on Upper Rideau Lake and other lakes under the license
- To determine the 2004 commercial harvest (kg/ha/yr) for all species combined on Upper Rideau Lake
- To determine/estimate the angler harvest (kg/ha/yr) for all species combined on Upper Rideau Lake and other lakes under the license
- To compare the annual commercial harvest and angler harvest to the potential annual yield

2.1 Lake Yield

The following metric equation was utilized to predict potential fish yield:

MEI = TDS (mg/l) / Mean depth (m)

Yield = 1.38 $(MEI)^{0.446}$

In August 2005, totals dissolved solids measurements were utilized to provide current data analysis for all lakes within the license. TDS measurements from the 2 meter depth of the water column were utilized in the MEI equation, which is a water quality provincial standard. Table 1 summarizes the calculation values and yield estimate for each lake within the license. Figure 1 represents the percentage of lake area available for commercial harvest. Figure 2 represents the percentage of total potential fish weight available for commercial harvest.

Table 1.

Lake	TDS (mg/l)	Mean depth (m)	MEI	Lake Size (ha)	Potential Yield (kg/ha/yr)	Total Potential Weight (kg)
Upper Rideau	98.7	8.1	12.2537	1362.8	4.2194	5749.9
Newboro	95.5	3.2	30.1072	1847.0	6.3004	11636.6
Benson	76.0	2.5	30.0217	209.3	6.2924	1317.1
Mosquito/Pollywog	72.5	1.1	67.9157	205.3	9.0560	1858.9
Loon	74.0	2.7	27.5708	249.0	6.0579	1508.3
Lower Rideau	91.5	12.3	7.4257	6481.8	3.3747	21873.8
			Total	10355.1		43944.5

Figure 1.

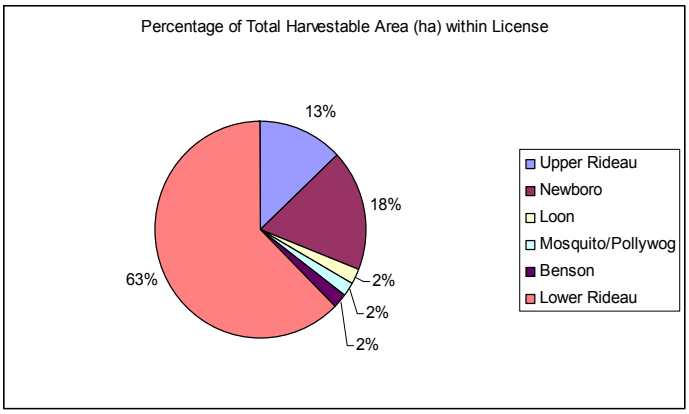
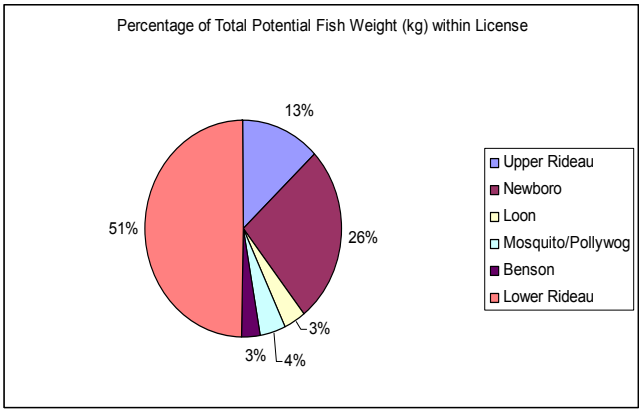


Figure 2.

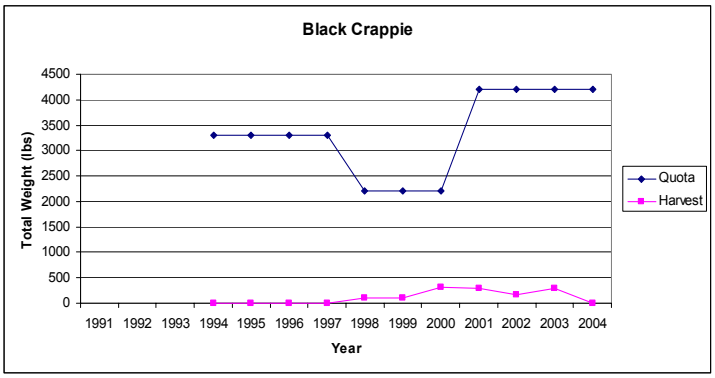


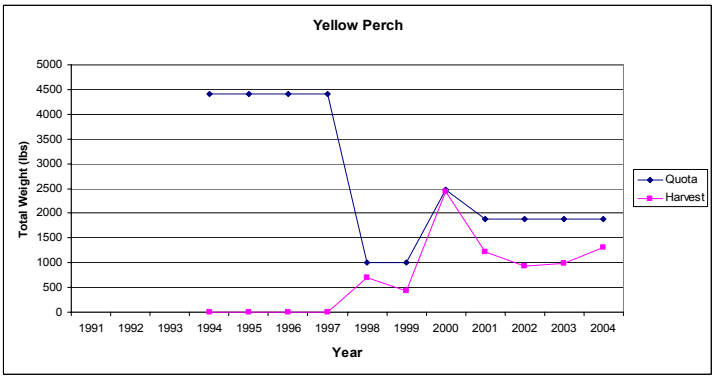
2.2 Commercial Harvest

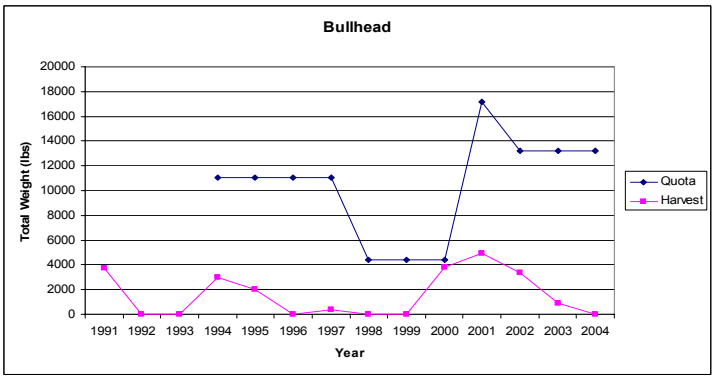
The following figures (Figure 3) represent the commercial quota and harvest within this particular license. The following points should be taken into consideration when interpreting the graphs:

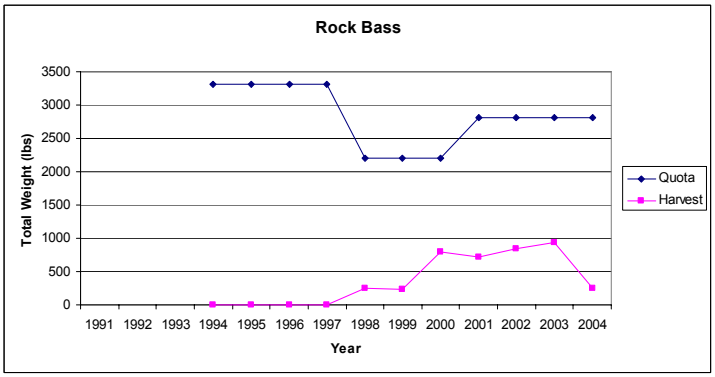
- Total weight is in pounds (lbs) not kilograms (kg)
- The "sunfish" quota and harvest includes both pumpkinseed and bluegill species
- The "bullhead" quota and harvest includes both brown and yellow bullhead species
- The harvest for 2004 was taken from Upper Rideau Lake and no other lake within the license
- In 2004, the harvest was significantly less than the allocated quota with the exception of yellow perch.
- Bullheads were not harvested in 2004.

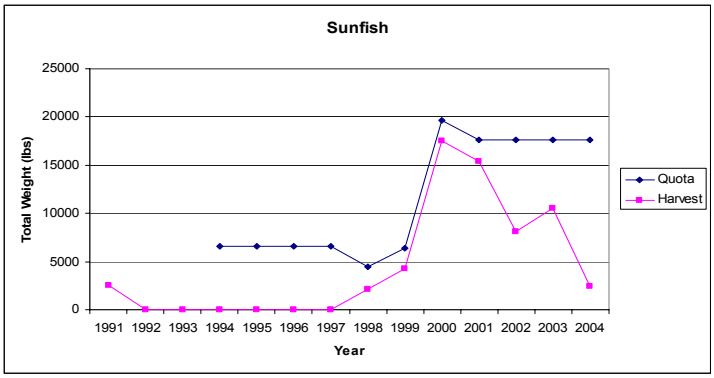
Figure 3.







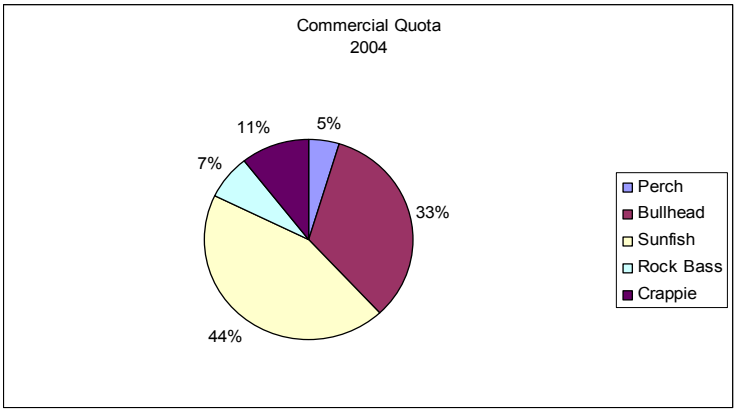


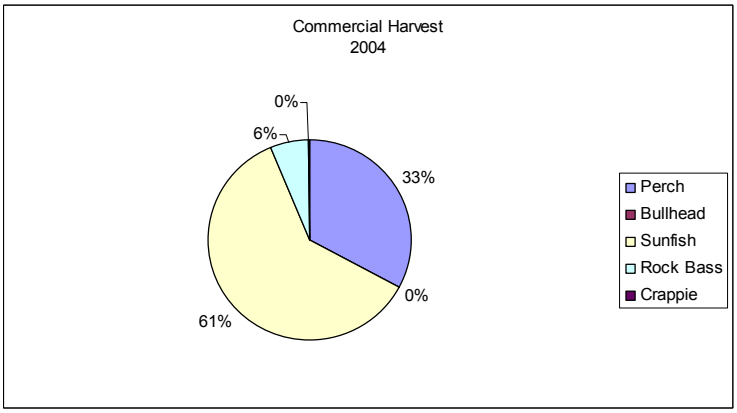


The following figures (Figure 4) represent the species composition of the total commercial fishing quota and harvest within this particular license in 2004. The following points should be taken into consideration when interpreting the graphs:

- The yellow perch is 4.7% of the quota; however this species represents 32.9% of the harvest in 2004.
- Sunfish is 44.4% of the quota; however this species represents 60.7% of the harvest in 2004.

Figure 4.





Knowing that the entire harvest was taken from Upper Rideau Lake in 2004, commercial yield (kg/ha/yr) can be calculated. Table 2 summarizes these calculations.

Table 2.

Lake	Lake Size (ha)	Total Harvest (Kg)	Yield (kg/ha/yr)
Upper Rideau	1362.2	1796.2	1.3186

2.3 Recreational Harvest

Recreational angler harvest or yield for select fish species, primarily sport fish species, can be estimated through angler creels. However, a recent angler creel has not been conducted for Upper Rideau Lake. To estimate angler harvest, data was utilized from a 1993 summer creel on Big Rideau Lake (Praskey and Smith 1993), which is part of the same watershed adjacent to Upper Rideau Lake, and receives similar angling pressure from the various surrounding communities. The data summarized in Table 3 only provides an estimated yield for select species in Upper Rideau Lake.

Table 3.

Species	Estimated Yield (kg/ha/yr)
Walleye	-
Northern Pike	0.10
Smallmouth Bass	0.18
Largemouth Bass	0.35
Yellow Perch	0.03
Panfish	-
Total	0.66

2.4 Conclusion

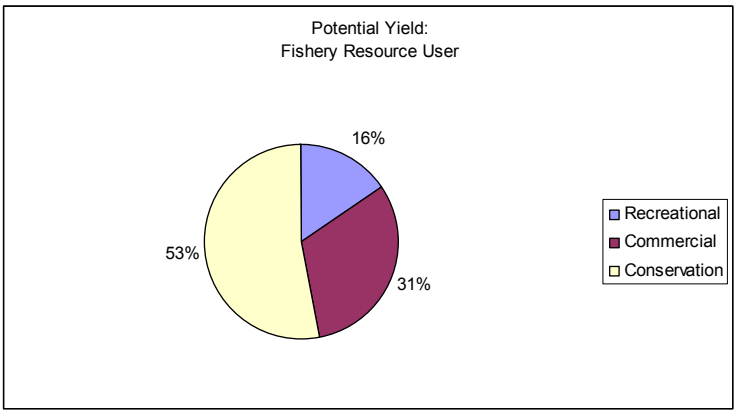
All Lakes

Based upon current TDS measurements the potential yield for all the lakes within the license was determined. Then the individual lake area was used to calculate the total potential weight of all fish produced within the lake. The current quota is 39 696 lbs or 18 043 kg (Figure 3) of harvestable fish and the total potential fish weight available is 43 944 kg (Table 1). Therefore, 41.2% of the available total potential fish weight within all lakes combined is allocated to commercial fishing.

Upper Rideau Lake

Based upon current TDS measurements the potential yield for Upper Rideau is 4.2194 kg/ha/yr for all fish species combined. The recreational angler harvest is estimated to be 0.66 kg/ha/yr for major sport fish species. However, it is recognized that angler harvest is likely underestimated because the angler harvest of panfish species is unknown. The commercial fishing harvest in 2004 was 1.3186 kg/ha/yr. Therefore, 2.2408 kg/ha/yr or 53% of the fishery resource is remaining for conservation/reproduction. Figure 5 illustrates these results.

Figure 5.



3.0 Population Exploitation

It is known that the entire commercial fish harvest for 2004 was taken from Upper Rideau Lake. Comparison of fisheries assessment data pre-commercial harvest and post-commercial harvest would indicate if the level of commercial harvest is causing a negative impact on species population size and angling quality in Upper Rideau Lake. An Early Summer Trap Netting (ESTN) protocol was implemented on Upper Rideau Lake in 2002 (pre-commercial harvest) and 2005 (post-commercial harvest). Various biological/population parameters were compared between 2002 (Coombs 2002) and 2005 for each commercially harvested species. The parameters investigated include:

- Mean age
- Mean length
- Mean weight
- Catch per unit effort (CPUE)

The objective of this population exploitation analysis is as follows:

- To determine if angling quality (ie. fish length and weight) and quantity has declined since the onset of commercial fishing on Upper Rideau Lake, as identified by public concerns

None of these parameters are meant to indicate that commercial fishing is the sole cause of fish angling quantity or quality on their own. Each provides a clue or suggestion that, when taken into consideration holistically, can give evidence to support to dispute that a change in exploitation occurred. It was recognized that one year of pre and post assessment data does not allow for annual variability in growth, recruitment, etc; and this was taken into consideration when interpreting the data. It was also recognized that the population/biological impacts after one year of commercial harvest may not be measurable. It may take many years of commercial harvest for the true biological sustainability impacts, if any at all, to be detected.

3.1 Black Crappie

Table 6.

	ESTN 2002 (Value +/- SE)	**ESTN 2005 (Value +/- SE)**
Mean Age	5.3 +/- 0.2	3.9 +/- 0.1
Mean Total Length (mm)	243.6 +/-5.2	210.8 +/- 5.3
Mean Fork Length (mm)	231.8 +/-4.6	200.8 +/- 5.6
Mean Weight (g)	237.4 +/- 14.1	163.5 +/- 13.6
CPUE	1.7	4.6

3.2 Rock Bass

Table 7.

	ESTN 2002 (Value +/- SE)	ESTN 2005 (Value +/- SE)
Mean Age	6.0 +/- 0.2	5.9 +/- 0.1
Mean Total Length (mm)	183.9 +/- 4.0	206.2 +/- 4.1
Mean Fork Length (mm)	177.0 +/- 3.9	198.6 +/- 4.8
Mean Weight (g)	138.9 +/- 8.5	188.6 +/- 13.0
CPUE	3.8	3.5

3.3 Yellow Perch

Table 8.

	ESTN 2002 (Value +/- SE)	ESTN 2005 (Value +/- SE)
Mean Age	6.5 +/- 0.3	7.5 +/- 0.3
Mean Total Length (mm)	262.2 +/- 3.7	259.1 +/- 6.6
Mean Fork Length (mm)	251.5 +/- 3.5	247.7 +/- 6.2
Mean Weight (g)	245.2 +/- 12.9	218.8 +/- 21.0
CPUE	1.3	0.6

3.4 Pumpkinseed

Table 9.

	ESTN 2002 (Value +/- SE)	ESTN 2005 (Value +/- SE)
Mean Age	6.2 +/- 0.1	5.9 +/- 0.1
Mean Total Length (mm)	175.6 +/- 2.3	183.2 +/- 1.9
Mean Fork Length (mm)	169.1 +/- 1.8	177.5 +/- 1.6
Mean Weight (g)	119.6 +/- 3.7	133.7 +/- 4.3
CPUE	24.0	38.0

3.5 Bluegill

Table 10.

	ESTN 2002 (Value +/- SE)	ESTN 2005 (Value +/- SE)
Mean Age	6.3 +/- 0.7	5.6 +/- 0.1
Mean Total Length (mm)	185.8 +/- 1.8	182.5 +/- 1.8

Mean Fork Length (mm)	175.8 +/- 1.7	174.2 +/- 1.8
Mean Weight (g)	138.1 +/- 6.3	124.7 +/- 4.0
CPUE	35.6	69.2

3.6 Brown Bullhead

Table 11.

	ESTN 2002 (Value +/- SE)	**ESTN 2005 (Value +/- SE)**
Mean Total Length (mm)	320.1 +/- 3.4	301.7 +/- 2.3
Mean Weight (g)	542.6 +/- 16.7	398.7 +/- 10.0
CPUE	15.8	102.3

3.7 Yellow Bullhead

Table 12.

	ESTN 2002 (Value +/- SE)	**ESTN 2005 (Value +/- SE)**
Mean Total Length (mm)	-	278.6 +/- 56
Mean Weight (g)	-	318.1 +/- 17.1
CPUE	1.2	40.1

3.8 Conclusion

The results of the ESTN comparison did not demonstrate any significant differences pre and post commercial harvest. Definitive conclusions cannot be determined at this time because of annual variation in growth, recruitment and catch variability and it may take several years for commercial harvest to demonstrate an effect.

Yellow Perch revealed some indication of an increase in harvest or over-exploitation; such as decrease in mean size and lower CPUE. Currently, the walleye population is attempting to be rehabilitated through stocking and spawning bed rehabilitation. Since yellow perch is the primarily forage species for walleye, the declining yellow perch population is of some concern (Burns 2002). Black crappie weights and lengths declined despite low harvest in 2004. Sunfish weights and lengths increased despite high harvest in 2004. Bullhead weights and lengths declined despite no harvest in 2004.

4.0 Recommendations

A number of recommendations have been derived from the review of this commercial fishing license. These recommendations can be separated into operational and quota sections.

4.1 Operational

- Divide license into three separate areas (A, B and C) to allow for lake specific quota allocation and management. Since Newboro, Benson, Loon, Pollywog and Mosquito are essentially the same waterbody, they should all be group together as "Newboro Lake".
  Area A – Upper Rideau Lake
  Area B – Lower Rideau Lake
  Area C – Newboro Lake

- Place condition on license to lift nets twice a week, minimally, to reduce fish mortality on non-allocated fish species (ie. walleye, smallmouth bass) or small undesirable allocated species.

- Reach verbal agreement with commercial fisherman to adhere to best management practices to alleviate public concerns (ie. number of nets, etc).

4.2 Quota

The original intent of the commercial fishing license was to allow for lake specific management. Resource managers wish to return to the original system of individual lake management to appropriately address any commercial fishing issues. In 2004, a 31% commercial fishing harvest of the available fish biomass/yield in Upper Rideau Lake was deemed unacceptable by fisheries resource managers (Figure 5). This level of harvest was deemed to be unacceptable because the fisheries allocation policy for Ontario (OMNR 1978) states that priority of a fisheries resource, in order of priority, is conservation, native fishing rights, sport fishing and commercial fishing. Therefore, it is unreasonable that one commercial operation could harvest 31% of the total potential fish yield within a lake and should not surpass that of the angler harvest. Additionally, lake specific quotas would allow resource managers to address issues or concerns.

The commercial fishing quota was originally allocated 41.2% of the total available fish biomass for all lakes combined. A 41.2% quota allocation of the available fish biomass within the commercial fishing license was deemed unacceptable by fisheries resource managers for the above stated reasons and there are resource sustainability concerns. There are resource sustainability concerns because previous quotas were allocated/increased with no biological rationale. For example, if the average commercial fishing harvest (since 2001) was taken from one particular lake in a given year, the harvest yield would exceed that of the available potential fish yield for Upper Rideau Lake and Lower Rideau Lake. With respect to Newboro Lake, approximately 69% of the available fish yield would be harvested through commercial fishing. In addition, productivity of these waterbodies have declined over the past 20 years, therefore cannot sustain the current levels of harvest. Indicators of a decline in productivity are demonstrated by a number of data sources:

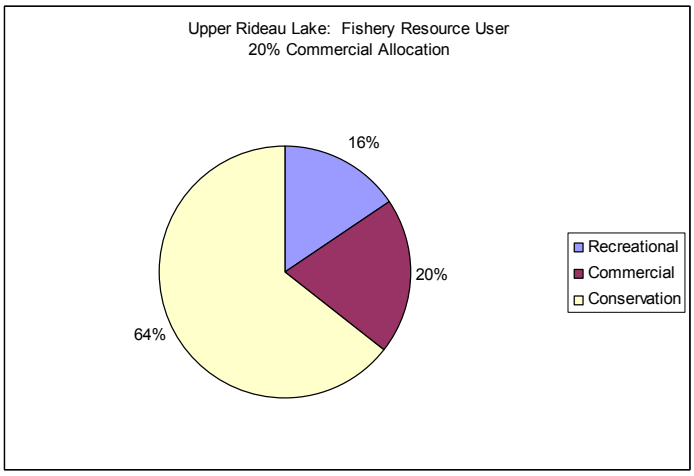
- MNR index netting data from 1982-2001 in Upper Rideau Lake indicated a decline in the CPUE of all species since the mid 1990s (Burns 2002)
- MNR and partner water quality data from 1972-2005 in Upper Rideau Lake indicate an increase in mean secchi depth since the mid 1990s
- MNR TDS data and calculated yield from 1992 and 2005 indicates that productivity of both Upper Rideau and Lower Rideau Lakes have declined by 17% and 19.2%, respectively.

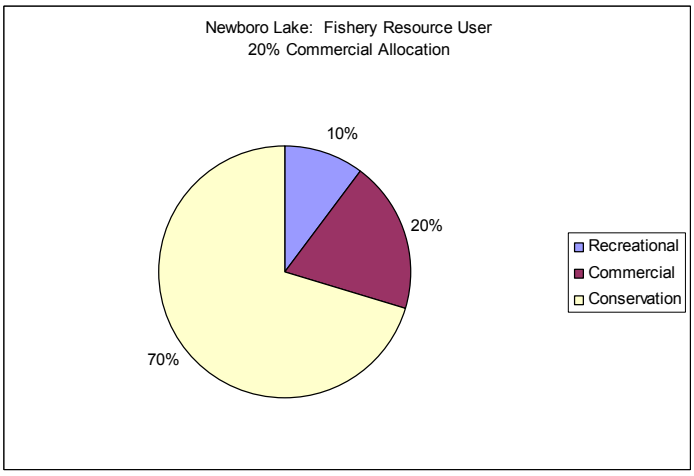
It is proposed that the commercial fishing quota be allocated 20.0% of the total available fish biomass for all lakes combined, as opposed to the original 41.2% allocation. This decision was based upon priorities of fishery resource user allocations in OMNR policy documentation (OMNR 1978) and sustainability concerns. A 20% commercial fishing allocation will result in a reduction of quota. However, the proposed quota is similar to the average harvest since the commercial

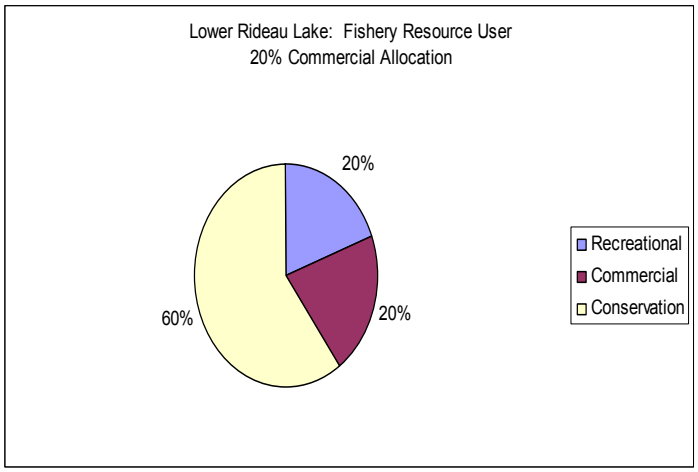
fishing license was obtained in 2001. In addition, a partitioning of the quota will occur to effectively manage the resource on a lake-by-lake basis. Proportions (%) of the existing quotas will be redistributed into the three areas or lakes within the license. The proportions utilized to redistribute the quota in each lake/area will be based upon the total potential fish weight available within the license (Table 1; Figure 2).

The proportions are as follows:
Area A (Upper Rideau Lake) – 13%
Area B (Lower Rideau Lake) – 51%
Area C (Newboro Lake) – 36%

Figure 6 illustrates the proposed fishery resource user partitioning (ie. 20% commercial fishing allocation) for each lake.







The corresponding proposed quotas (lbs) will be as follows (Table 13):

Table 13.

Species	Quota (Current)	20% Resource Allocation Quota (Proposed)	Area A (Proposed)	Area B (Proposed)	Area C (Proposed)		Average Commercial Harvest (Since 2001)	Commercial Harvest (2004)
Yellow Perch	1880	696	90	355	250		1109	1303
Rock Bass	2805	1038	135	529	374		687	247
Sunfish	17609	6515	847	3323	2346		9093	2404
Bullhead	13200	4884	635	2491	1758		2300	0
Black Crappie	4202	1555	202	793	560		192	6
Total:	39696	14688	1909	7491	5288		13381	3960

5.0 References

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