Whitefish Investigations
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1.0 Introduction

The environmental monitoring program for whitefish is based on the "*Whitefish Work Plan, Environmental Assessment, Bruce A Units 3 & 4 Restart Follow-up Program*". This plan was developed by a Technical Working Group (TWG) comprised of stakeholders and experts in the field (Canadian Nuclear Safety Commission (CNSC), Environment Canada, (EC), Ministry of Environment, (MOE), Ministry of Natural Resources, (MNR), University of Guelph, The Saugeen Ojibway Nation (SON) and Bruce Power Environmental Management). The official Bruce A Units 3 & 4 Environmental Assessment Follow-up program was accepted as complete by the CNSC in 2005. This report provides an annual status update on Bruce Power's ongoing whitefish monitoring investigations as required by the CNSC for the completion of the Bruce A Units 3 & 4 Restart Follow-up Program.

Whitefish investigations are ongoing as part of the Bruce A Unit 1 & 2 Refurbishment Environmental Assessment Follow-up Monitoring Program which was accepted by the CNSC on June 24, 2009. This is an interim progress report. An annual work plan is developed in conjunction with stakeholders and this work plan is currently being carried out as scheduled.

2.0 Mark – Recapture Results

The last year for tag recoveries was 2009 and further detail on this program is available in Ebener [2009]. In 2009 and 2010, gillnetting was conducted over a larger spatial area resulting in an increased number of fish collected with fin clips (marked) compared to previous years (2005 to 2008) where gillnetting was only conducted at Loscombe Bank and Gunn Point. All recaptured Lake Whitefish in 2010 were identified by fin clips as they no longer carried numbered tags. All recaptured Round Whitefish in 2010 were also identified by fin clips, however two retained numbered tags and further information with regard to these recaptures has been requested from the organizer of the mark-recapture program (Table 1, Figure 1).

Table 1: The number of individuals of marked Lake Whitefish and Round Whitefish that were recaptured by year.

Year	Lake Whitefish	Round Whitefish	Total
2005	1	0	1
2006	2	0	1
2007	0	0	0
2008	0	0	0
2009	7	0	7
2010	2	4	6
Total	12	4	15

3.0 Whitefish Studies for 2010

The objective of whitefish studies for 2010, which were conducted for the Bruce A Unit 1 & 2 Refurbishment Environmental Assessment Follow-up Monitoring Program, was to continue the gillnetting program over an extended spatial area in order to look for recaptures and to collect samples for genetic analysis for population discrimination.

Gillnetting began October 25, 2010 and continued until December 4, 2010. The study region was divided into eight sites and included the two sites that were continued to be assessed (Loscombe Bank and Gunn Point) as part of the mark-recapture program. Gillnetting locations are depicted in Figure 1 (red lines). Table 2 summarizes the whitefish results of the 2010 field season by site. Otoliths, scales, fin clips and gonadal condition were collected from all whitefish. Results will also be available in Golder Associates [2011, in progress].

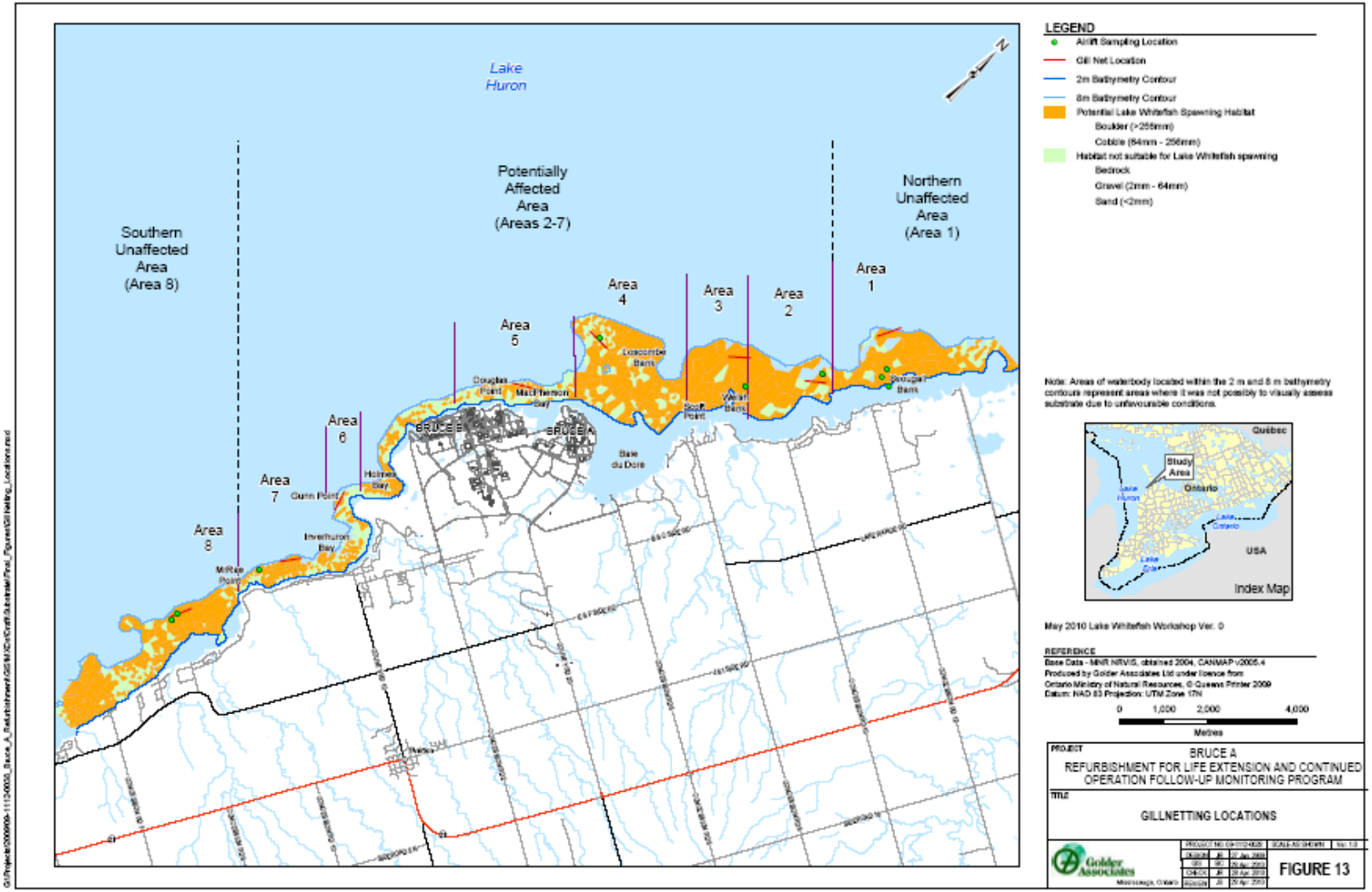

Figure 1: Map of the study region depicting the northern unaffected area, the area potentially affected by the thermal plume and the southern unaffected area. Substrate was mapped between the 2-8m depth contours and potential whitefish spawning habitat (boulder/cobble substrates) is depicted in orange and the habitat not suitable for spawning is depicted in green. Red lines indicate the locations of gill net sets. Green circles indicate the locations of air lift sampling transects. The figure is from Golder Associates [2010].

Table 2: Effort, number and catch per unit effort (CUE) of Lake and Round Whitefish caught during the 2010 field season.

Site		Effort		Number of Whitefish		CUE Lake Whitefish		CUE Round Whitefish	
Number	Name	m of gill net	hrs of soak	Lake	Round	per km	per hr	per km	per hr
1	Scougall	2850	128.5	171	82	60.00	1.33	28.77	0.64
2	Welsh Bank	2850	131.0	50	42	17.54	0.38	14.74	0.32
3	Scott Point	2850	131.0	85	38	29.82	0.65	13.33	0.29
4	Loscombe Bank	3800	181.5	19	32	5.00	0.10	8.42	0.18
5	MacPherson Bay	2850	131.0	10	28	3.51	0.08	9.82	0.21
6	Gunn Point	3325	150.5	17	43	5.11	0.11	12.93	0.29
7	Inverhuron Bay	2375	110.5	13	25	5.47	0.12	10.53	0.23
8	McRae Point	1900	89.5	78	23	41.05	0.87	12.11	0.26
	Total	22800	1053.5	443	313	19.43	0.42	13.73	0.30

Lake Whitefish generally had a higher catch per unit effort (CUE) in 2009 compared to 2010 at most sites with the exception of Scougall Bank (Figure 2). Catch per unit effort was generally higher for Lake Whitefish compared to Round Whitefish, with the exception of MacPherson Bay and Inverhuron Bay (Figure 3). Catches were variable over time within a site.

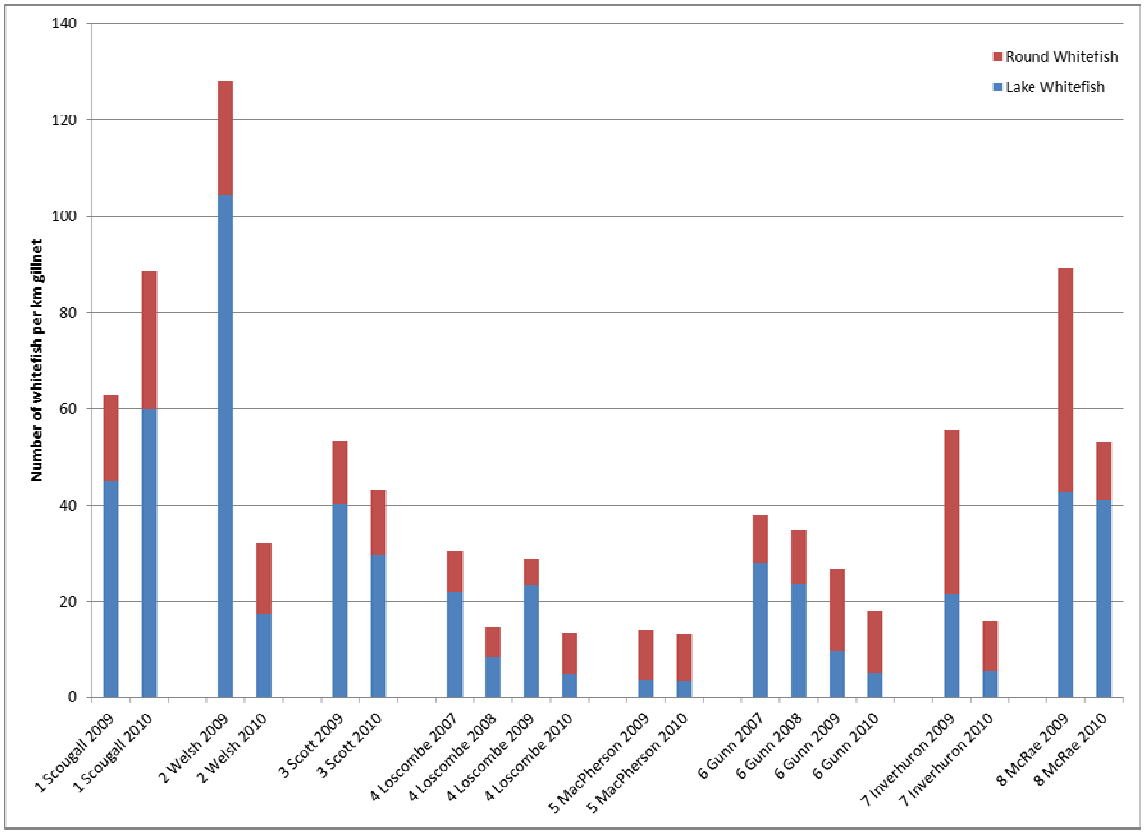

Figure 2: Number of whitefish per km gillnet for each of the eight sites by year.

At the onset of netting, October 25, few Lake Whitefish were captured. All of the individuals captured at the onset of netting were not ripe (i.e., not yet ready to spawn). However, the number of Lake Whitefish captured increased during successive sampling events; therefore, it is likely that gillnetting commenced prior to the onset of spawning season when water temperatures were approximately 12.5^{o}C. For the three sites (Scougall Bank, Scott Point and McRae Point) with the greatest CUE for Lake Whitefish, CUE increased in late November, corresponding to a water temperature drop to approximately 10^{o}C, and declined in late November to early December. The number of Lake Whitefish at sites 4, 5 and 6 (Loscombe Bank, MacPherson Bay and Gunn Point) was generally lower throughout the season (Figure 3). Round Whitefish catches were generally lower than Lake Whitefish catches at the north and south ends of the study area. Round Whitefish had less variability in CUE across all sites compared to Lake Whitefish (Figure 3).

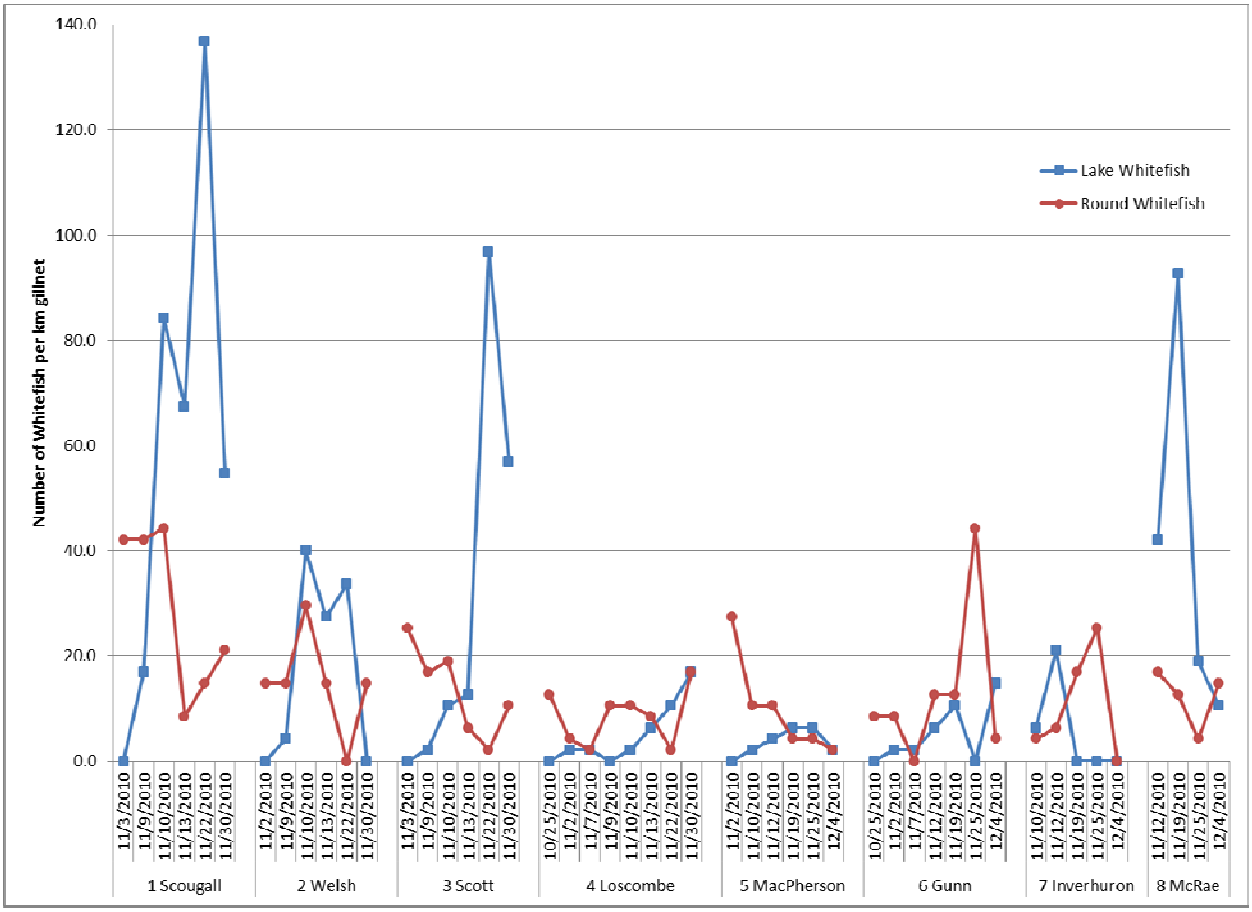

Figure 3: Daily catch rates (CUE/km gillnet) of Lake and Round whitefish during the 2010 field season by site.

A total of 418 Lake Whitefish were measured for physical characteristics. Male Lake Whitefish outnumbered females by 4.1:1, with the sex ratio particularly skewed at the onset of gillnetting. Mature and ripe male and female Lake Whitefish were found in all eight sites. No spent female Lake Whitefish were found at sites 2, 5 or 7 (Figure 4).

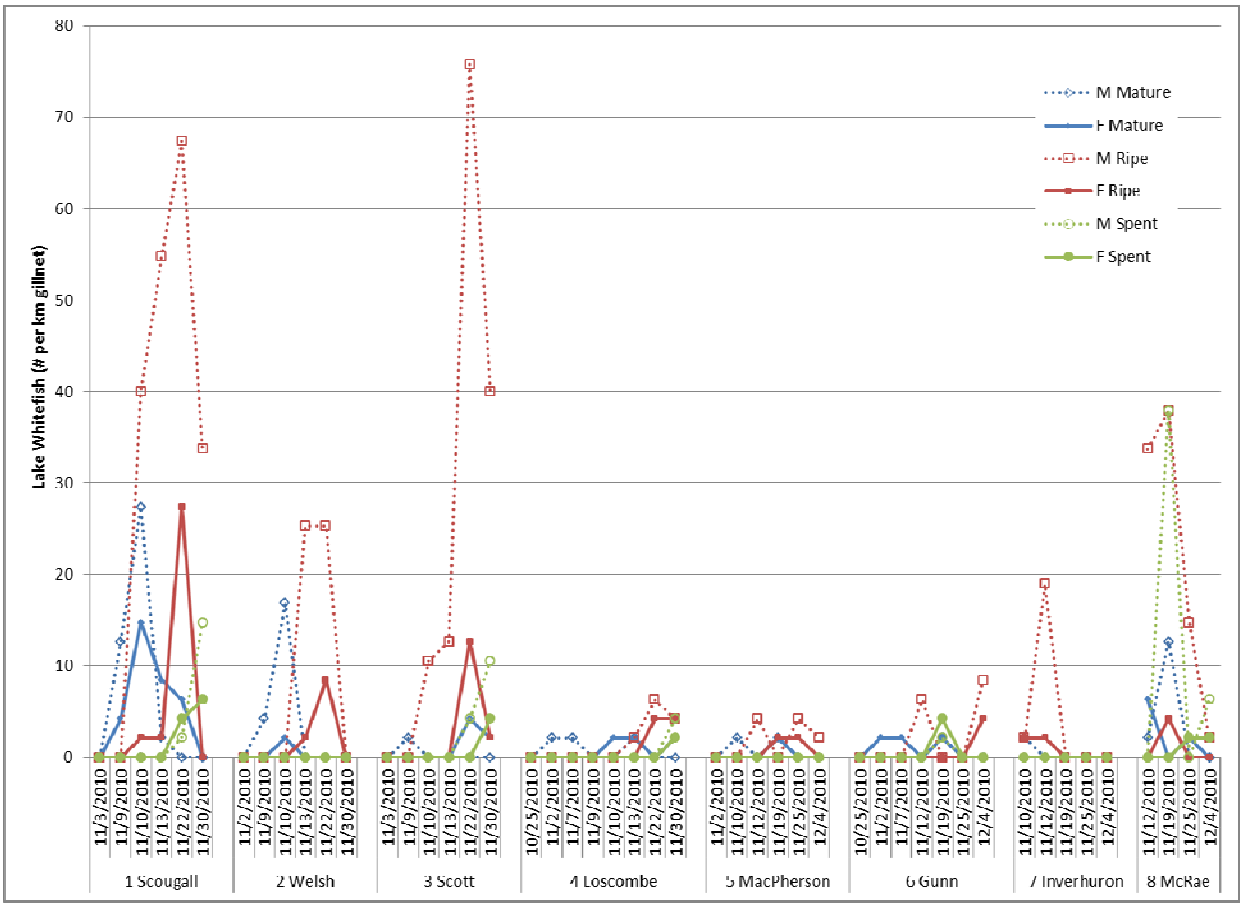

Figure 4: Spawning condition of male (M) and female (F) Lake Whitefish (CUE/km gillnet) by lift date and site.

A total of 308 Round Whitefish were measured for physical characteristics. The sex ratio was fairly even for Round Whitefish, with a 1.1:1 ratio for female to male Round Whitefish. Mature male and female Round Whitefish were found in all sites, whereas ripe males had the greatest CUE at site 1. The CUE for spent male Round Whitefish was low, whereas spent female Round Whitefish had higher CUE values at sites 1 through 3 (Figure 5).

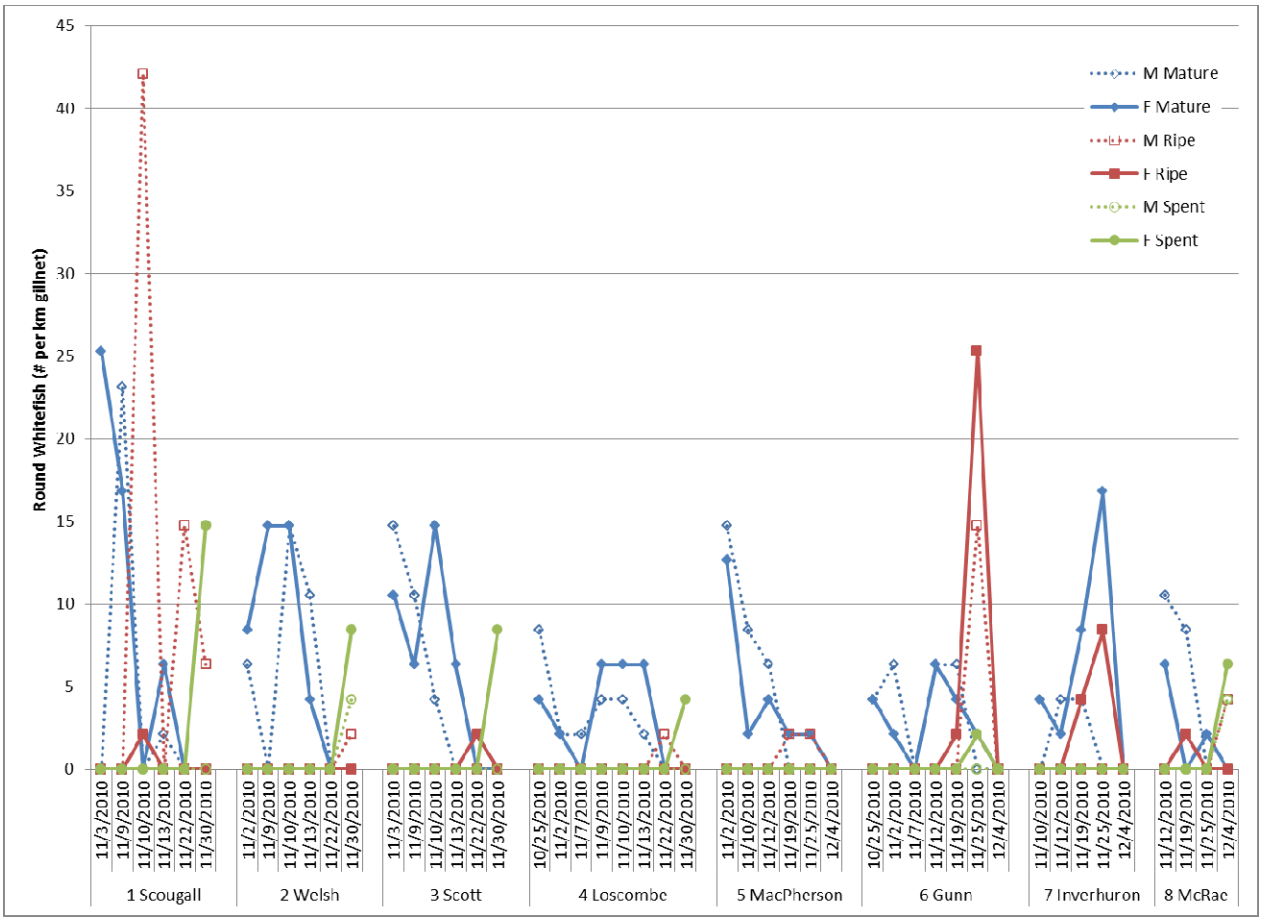

Figure 5: Spawning condition of male (M) and female (F) Round Whitefish (CUE/km gill net) by lift date and site.

4.0 Genetics Studies

Results from a collaborative lake-wide study investigating the presence of genetically discrete Lake Whitefish populations in Lake Huron was published in 2010 in the Journal of Great Lakes Research in a special edition on the health of Lake Whitefish populations [Stott et al, 2010].

Genetic samples were collected from Lake Whitefish (n=191) and Round Whitefish (n=181) across all sites during the 2010 gillnetting program. Future analysis of these samples is pending.

The Ontario Ministry of Natural Resources (OMNR) is also collecting fin clips from whitefish capture during index netting programs in Southampton and Grand Bend as these are the adjacent index netting locations to the Bruce Power site.

5.0 Impingement

Bruce Power's impingement monitoring by operators collected a total of 15,524 fish from both Bruce A and Bruce B including 57 Lake Whitefish and 10 Round Whitefish for 2010. None of the impinged whitefish were tagged from the international lake wide study.

At Bruce A, a total of 2760 fish were impinged with 97% of these fish being Gizzard Shad. Five Lake Whitefish and 2 Round Whitefish were impinged at Bruce A in 2010.

At Bruce B, total of 12,764 fish were impinged with 67% of these being Gizzard Shad, Spottail Shiner and Round Goby. Fifty-two Lake Whitefish and 8 Round Whitefish were impinged at Bruce B in 2010. Fish species with impingement abundances greater than 100 individuals are given in Table 3, with these species representing 99% of the fish impinged at Bruce A and 97% of the fish impinged at Bruce B.

Table 3: Number of individual fish impinged at Bruce A and Bruce B by species.

	# Individuals	
Fish Species	Bruce A	Bruce B
Gizzard Shad	2686	3199
Spottail Shiner	0	3101
Round Goby	15	2272
Emerald Shiner	8	1495
Alewife	0	1158
Yellow Perch	3	458
White Sucker	1	243
Redhorse Sucker	3	232
Longnose Sucker	9	174

6.0 Future work

The ongoing whitefish monitoring work will be conducted as part of Bruce Power's Integration Department. A workshop is being in the summer of 2011 to discuss the future of fish impingement and entrainment efforts at Bruce Power as part of the Bruce A Unit 1 & 2 Refurbishment Environmental Assessment Follow-up Monitoring Program. Continuation of the spawning assessment survey in the vicinity of Bruce Power will also be discussed. Any samples collected will be archived for genetic analysis and processing of these samples may commence in late 2011. Collaborative efforts are being developed with universities, local First Nations and stakeholders in the environmental assessment process.

7.0 References

Ebener, M. (2009) United States Fish and Wildlife Service Great Lakes Restoration Act: 2008 Project Progress Report, Agreement Number 301813J229 – Lake Huron Lake Whitefish Distribution Study.
Golder Associates (2010) 2009 Lake Whitefish Field Studies Summary: Bruce A Refurbishment Follow-up Program. Report No. 09-1112-0038. 47pgs.

Golder Associates (2011, in progess) Annual Follow-up Monitoring Program Report, 2010: Bruce A Refurbishment for Life Extension and Continued Operations Environmental Assessment.

Stott, W., VanDeHey, J. and Sloss, B. (2010) Genetic diversity of lake whitefish in lakes Michigan and Huron; sampling, standardization and research priorities. Journal of Great Lake Research (36(sup1)): 59-65.

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