Lac Bellevue Fall Walleye Index Netting Survey 2010

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LAC BELLEVUE

FALL WALLEYE INDEX NETTING SURVEY, 2010

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Sustainable Resource Development

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ABSTRACT

A Fall Walleye Index Netting (FWIN) survey was conducted at Lac Bellevue, Alberta in September, 2010 utilizing half-length FWIN nets to assess the abundance and structure of the walleye (*Sander vitreus*) population. This survey also allowed comparison to the 2003 FWIN survey in order to monitor the effects of management strategies for this fishery. Lac Bellevue contains a stocked walleye population and hence was classified as collapsed (stocked) in 1996. The population improved moderately to vulnerable status in 2003. A catch-and-release regulation for walleye has been in effect since 1996.

The 2010 walleye catch rate was 28.1 fish·100m^{-2}·24hrs^{-1}. This catch rate is considered moderate to high based on current ASRD criteria, and was an improvement of 26% over the 2003 catch rate of 20.8 fish·100m^{-2}·24hrs^{-1}. The 2010 age-class distribution was narrow and unstable, with three measurable juvenile age-classes (ages 1-3). There were no measurable (> 3 fish·100m^{-2}·24hrs^{-1}) mature age-classes to support the population; however there were nine mature age-classes present (ages 5 – 14). The age-class distribution was characterized by a moderate to fairly large cohort of juveniles (ages 1- 3) which made up approximately 50% of the sample indicating high levels of recruitment and potentially high natural mortality of older age classes. Walleye had fast growth rates, reaching a mean total length of 500 mm by age 5.5, and early maturation rates with males maturing at age four and females at age five. Walleye population metrics for Lac Bellevue in 2010 ranged from vulnerable to collapsed and the population status remains classified as vulnerable. No northern pike were captured in this survey.

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INTRODUCTION

The Fall Walleye Index Netting (FWIN) survey (Morgan 2000) is a standardized method for indexing walleye (*Sander vitreus*) populations that has been adapted as a fisheries management standard by Fisheries Management Branch of Alberta Sustainable Resource Development (ASRD). The FWIN protocol allows managers to compare trends over time or between walleye populations in order to monitor the effects of management strategies. Individual populations are assessed and classified as stable, vulnerable, or collapsed as per Alberta's Walleye Management and Recovery Plan (Berry 1995). Management strategies are implemented with the goal of recovering and/or maintaining, self-sustaining walleye fisheries.

Prior to the 1970's walleye, did not occupy Lac Bellevue. Lac Bellevue was stocked with walleye to establish a self-sustaining walleye population. In 1971 the lake was stocked with 250 adult walleye from the Beaver River (Patterson and Grossman 2005) and in 1991, 1992 and 1994 with approximately 63,000 walleye fingerlings (ASRD stocking records unpublished). In 1996, the Lac Bellevue walleye population was classified as collapsed and a catch-and-release regulation was implemented. A FWIN survey was conducted in 2003 to update the status of the walleye population (Patterson and Grossman 2005). The walleye population had improved moderately from a collapsed to a vulnerable classification. The catch-and-release regulation remained in effect.

The Fisheries Management Branch conducted a FWIN survey at Lac Bellevue on September 23 – 24, 2010 to obtain information regarding the current abundance and structure of the walleye population (*Sander vitreus*). Survey objectives included:

1. Determine the walleye catch rate (catch per unit effort) as an index of abundance.

2. Estimate other walleye population metrics including age-class distribution and stability, age-at-maturity, and growth rate.

3. Compare the 2010 FWIN results to the 2003 FWIN survey.

STUDY AREA

Lac Bellevue (Twp 56, Rge 9, W4M; FWMIS Waterbody ID# 4027) is located approximately 180 km northeast of Edmonton, Alberta and 25 km south of St. Paul, Alberta (Figure 1). The lake lies within the central parkland natural subregion and is mesotrophic. The lake is topographically isolated in rolling terrain with no permanent stream inlets or an outlet. It has a surface area of 461 hectares and historically was approximately 15m deep. Water levels in Lac Bellevue had declined from a high in 1974 by approximately 3 m in 2002 (ALMS, 2007). The lake water level is currently at a low stage, the maximum depth recorded at netting sites during this survey was 11.0 m (Appendix 1).

The Lac Bellevue watershed is largely a mix of developed pasture and aspen forest with some annual crop production. Much of the watershed lies within the St. Paul Provincial Grazing Reserve. Development near the shoreline consists of a summer village and two campgrounds. There are two access points, one each at the north and south ends.

Overall, Lac Bellevue is a very small walleye lake with limited productive capacity. There has been extensive landscape conversion around the lake to agriculture in the last 40 years (Landsat imagery 1976, 1984, 2002).

Figure 1. Lac Bellevue is located in the Northeast Region, approximately 25 km south of St. Paul, Alberta.

METHODS

Sampling Design

In general, the sampling design followed the Fall Walleye Index Netting (FWIN) protocol (Morgan 2000). A stratified random sampling design was employed. The lake was stratified by depth (shallow 2 – 5 m; deep 5 – 15 m) and sampling effort was allocated proportionately to the surface area of the depth stratum. A progressive sampling approach was used to ensure a minimal numbers of nets were set to reach precision levels adequate to detect biologically meaningful differences in the catch rate of walleye. Desired precision levels (< 20% relative standard error), and adequate biological samples were found after six sample sites: five of the sample sites were in the deep stratum, and one site was in the shallow stratum.

The FWIN nets used in this survey were *half the standard length*; consisting of eight panels of different mesh sizes (25, 38, 51, 64, 76, 102, 127, and 152 mm stretched mesh) sewn together in ascending order of size, 1.8 m deep x 3.8 m long with a total net length of 30.5 m and an area of 54.9 m^2 (the standard panel has an area of 109.8 m^2). Utilizing half-length FWIN nets has been reported as having a near 1:1 capture ratio for walleye when compared to full length FWIN nets (Pruden and Davis 2006) and may reduce lethal fish sampling impacts.

The nets included additional small mesh panels of 12 and 19 mm separated from the standard gang by ten meter leads to collect data on juveniles and small fish species. For the purposes of this report, only fish caught in the six half-length panels are reported.

Nets were set perpendicular to depth contours at each sample site. Net locations (Figure 2) were identified with handheld GPS units, and minimum and maximum depths for each net gang were identified by sonar. Surface water temperature was also recorded at most net locations. Nets were set for 24 hrs (+/- 3 hrs) before being retrieved and cleared of fish.

Biological Data

All fish species caught were collected, bagged and tallied at each sample site by mesh size. Upon sampling of each site, biological data collected from fish included: fork length (FL), total length (TL), weight, sex, maturity, gonad weight (mature female

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walleye only), and stomach contents. Otoliths were collected from walleye for ageing and prepared following Watkins and Spencer (2009). Walleye ages were determined and verified by A. Foss and D. Latty.

Data Analysis

 Walleye catch per unit effort (CUE) was reported as walleye·$100m^{-2}$·$24hrs^{-1}$. A CUE was calculated for each sample site:

$$CUE = \textit{No. of fish} \; \mathbf{x} \; \left(100 \text{ m}^2 / (109.8 \text{ m}^2/ 2)\right) \; \mathbf{x} \; (24 \text{ hrs } / \text{ set time hrs})$$

The CUEs were bootstrapped (50,000 replications) to determine upper and lower confidence intervals to 95% (Haddon 2001). The overall catch rate was calculated as a maximum likelihood estimate (MLE).

 Walleye total length and age distributions, age-at-maturity and length-at-age (growth rates) were determined to assess the stock status according to modified guidelines of the Walleye Management and Recovery Plan (Berry 1995, Sullivan 2003). Growth rate was estimated using the Von Bertalanffy growth equation and parameters were calculated using FAST 2.1 software (Slipke and Maceina 2001).

 All data were analysed and reported on Microsoft Office 2000 or 2007. The data set for this study is stored in the ASRD Fisheries and Wildlife Management Information System (FWMIS) provincial database under project number 14479.
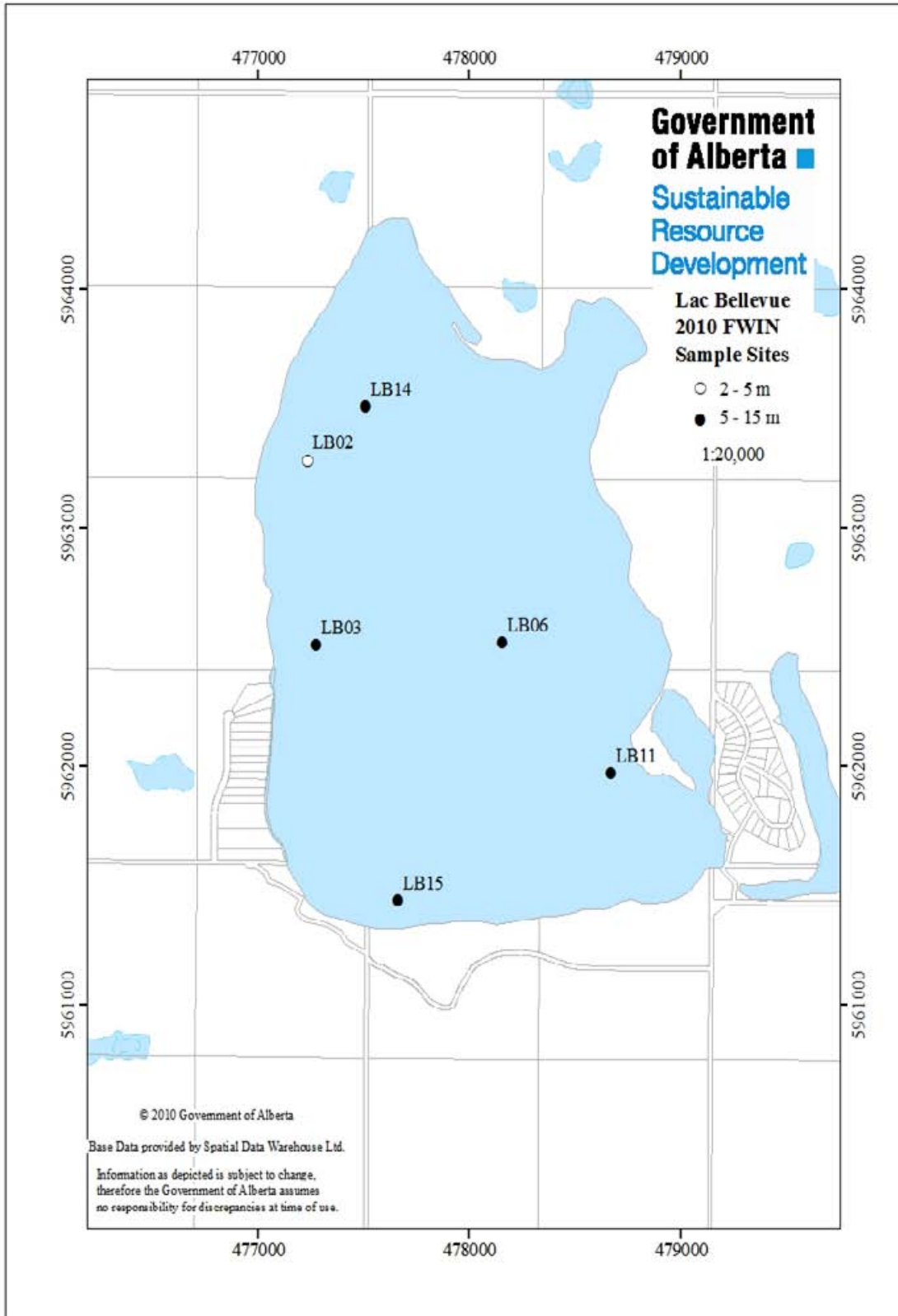
Figure 2.   Lac Bellevue 2010 FWIN survey sample locations.

RESULTS AND DISCUSSION

The 2010 FWIN survey at Lac Bellevue was conducted September 23 – 24, 2010. Water temperatures were 11.4ºC at all 6 sampling locations. Six half-length nets were set with a mean soak time of 23.8 hours, ranging from 23.3 to 24.2 hours.

Overall Catch

A total of 168 fish representing two species were caught, with walleye comprising just over half of the catch at 54% (n = 91). The remainder of the catch was composed of 46% yellow perch (n = 77) (Appendices 2 and 3). No other species were caught.

An additional 18 fish (walleye – 6, yellow perch – 13) were captured in the non-FWIN small mesh nets. These fish are excluded from FWIN analysis and are tabulated in Appendices 2 and 3.

Walleye Catch Rate

The catch per unit effort (maximum likelihood estimate) for walleye was 28.1 fish$\cdot$100m$^{-2}\cdot$24hrs^{-1} (95% C.I. 23.2 – 32.9) (Figure 3). The catch rate is considered moderate to high within the vulnerable status category. It is approaching the high (stable status) threshold of >30 fish (Table 1). The 2010 catch rate is a 26% increase from the 2003 catch rate of 20.8 fish$\cdot$100m$^{-2}\cdot$24hrs^{-1} (95% C.I. 16.8 – 25.0). The 2010 catch rate for Lac Bellevue ranks above the provincial average of 18.4 fish$\cdot$100m$^{-2}\cdot$24hrs^{-1} (Figure 4).
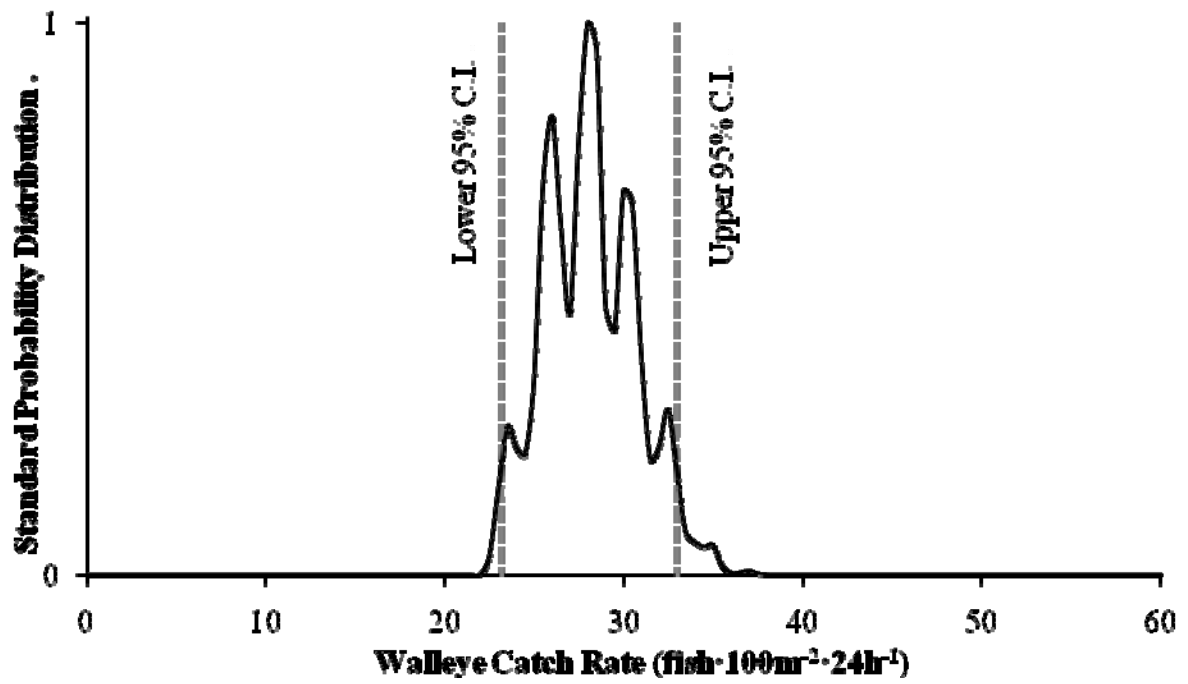
Figure 3. Walleye catch rate Lac Bellevue 2010 FWIN survey. Catch rate (MLE) = 28.1 fish·100m^{-2}·24hrs^{-1} (95% C.I. 23.2 – 32.9).
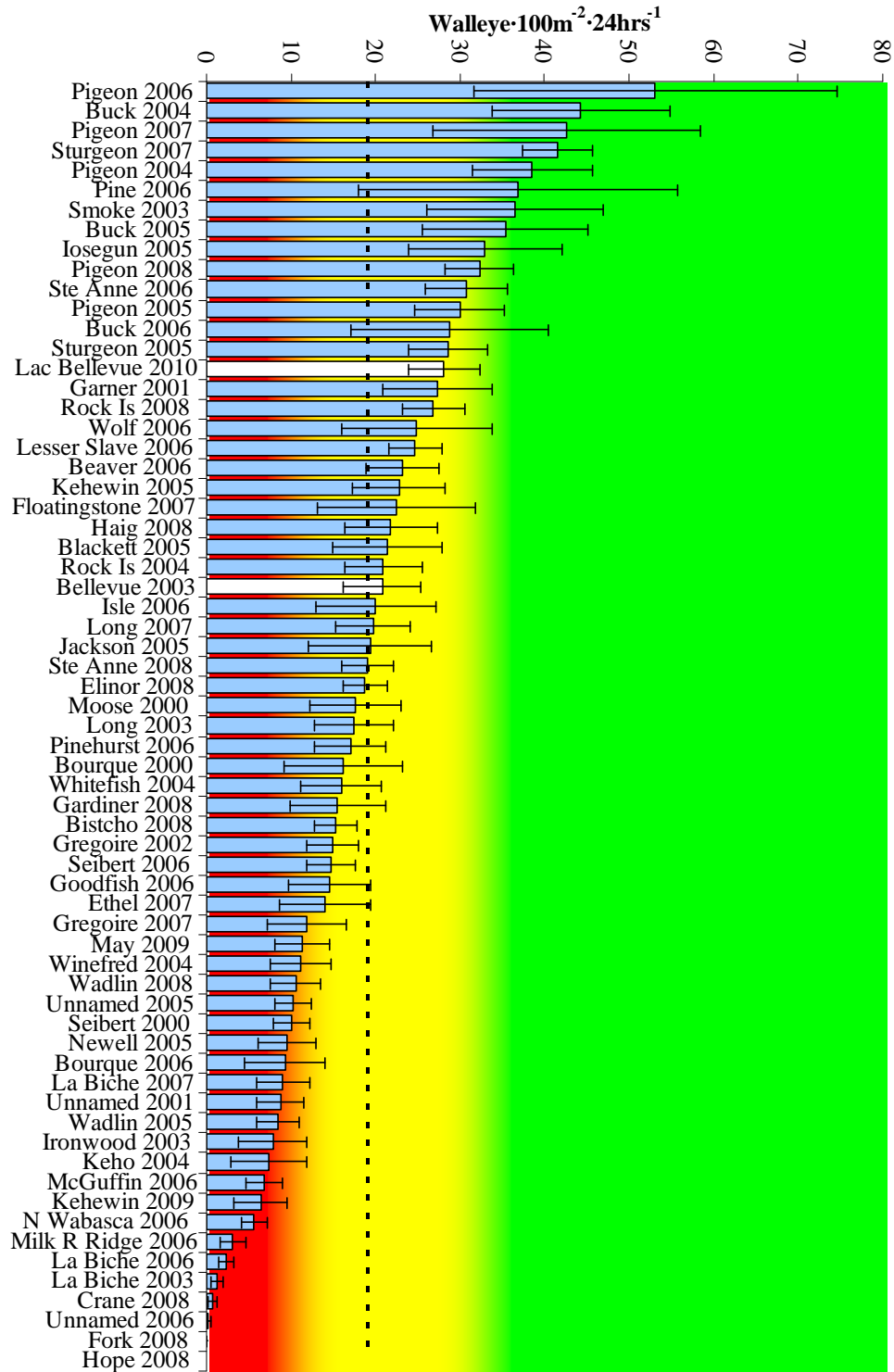
Figure 4. FWIN catches of walleye from 2003 and 2010 Lac Bellevue surveys compared to other Alberta FWIN surveys (with 95% CI bars). The dashed line represents the mean provincial catch rate of 18.4 fish·100m^{-2}·24hrs^{-1}. Collapsed, vulnerable, and stable catch rate ranges are indicated by red, yellow and green backgrounds.

Walleye Total Length Distribution

Walleye total lengths ranged from 189 – 655 mm TL with a mean of 392 mm (n = 91) (Figure 5). Total length distribution was characterized by groupings in length associated with age groups for the 1 and 2 year old age classes.. There were no young-of-the-year caught in the 8 panel nets but there is moderate recruitment of the age 1 and 2 year classes to the gear. Fish over 500 mm TL represented 32% of the sample. Based upon this distribution, we expect a poor recruitment year for the 2010 year-class.

Figure 5.   Walleye total length frequency distribution, Lac Bellevue 2010 FWIN survey.

Walleye Age-Class Distribution and Stability

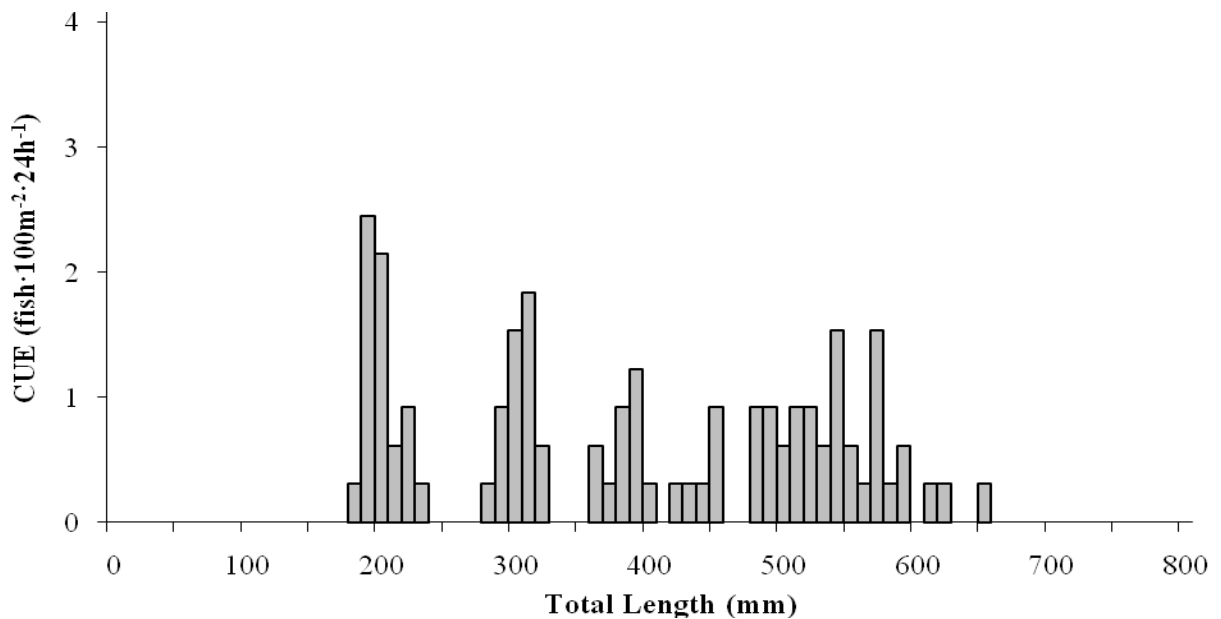Overall, the age-class distribution was characterized by a moderate to fairly large cohort of juveniles which made up approximately 50% of the sample and contributed to the low mean age (4.6 years). The 2010 walleye catch in Lac Bellevue displayed a narrow (vulnerable) and unstable (vulnerable) age-class distribution (Table 1).

The catch included 13 ages ranging from 1 to 14. The mean age was 4.6 years (n = 85). There were 3 measurable juvenile age-classes (ages 1 – 3; ≥ 3 fish·100m^{-2}·24hrs^{-1}) (Figure 6). There were no mature age-classes. Because these mature age classes were less than 3 fish·100m^{-2}·24hrs^{-1} we consider the reproductive support to this population to be moderate to low. The young-of-the-year age class is absent and only a few 8 year-olds were also present.

In 2003, the walleye age-class distribution displayed a narrow and unstable age-class distribution (Figure 6). There were 3 measurable age-classes (ages 3 – 5) that included one mature age-class as well as 6 additional under-represented mature age-classes. However there were several absent age-classes in 2003.
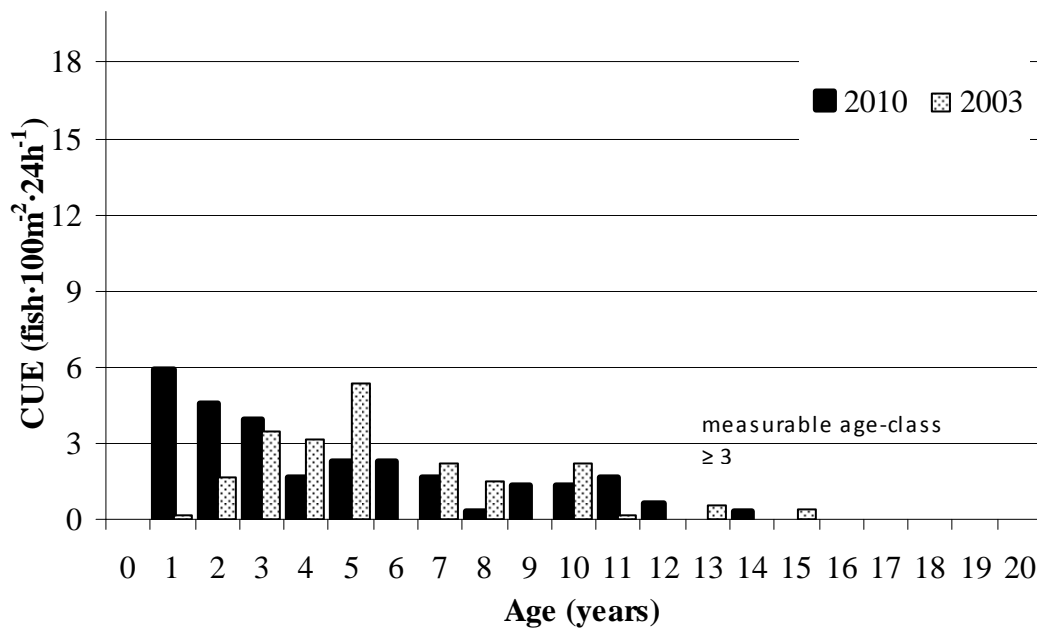
Figure 6.   Walleye age frequency distributions from Lac Bellevue 2010 FWIN survey
and 2003 FWIN survey.

Walleye Age-at-Maturity

A total of 79 walleye were identified to age, gender and sexual maturity. Mature female walleye (n = 19) ranged in ages from 5 – 14 (Figure 7). The minimum age-at-maturity for female walleye was age 5. Fifty percent female maturity was also reached at age 5, and all females were mature by age 6. Total lengths of mature females ranged from 491 – 655 mm, with only 5% of mature females being less than 500 mm TL. The small number of females maturing below 500 mm TL may have important implications in selecting an adequate size limit to protect spawning females if an open harvest regulation is considered.

Mature male walleye (n = 24) ranged in age from 3 – 12 (Figure 7). The minimum age-at-maturity for male walleye was age 3, >50% maturity at age 4, and all males were mature by age 4. Total lengths of mature males ranged from 317 – 575 mm TL with 58% of mature males less than 500 mm TL.

Catch rates for mature females (6.7 fish·100m^{-2}·24hrs^{-1}) was slightly lower than for mature males (8.5 fish·100m^{-2}·24hrs^{-1}).

Maturation for males at age 4 and females at age 5 is considered fast and is indicative of a 'collapsed' population. Although there were minor differences in maturation between the 2010 and 2003 surveys the age-at-maturity (> 50%) remained constant at age 4 for males and 5 for females.
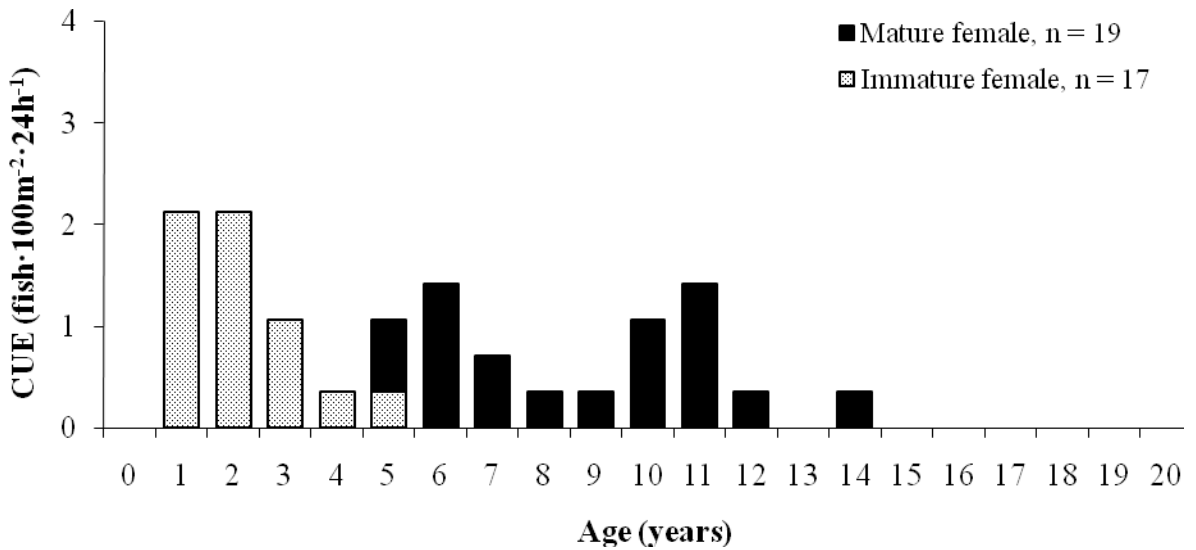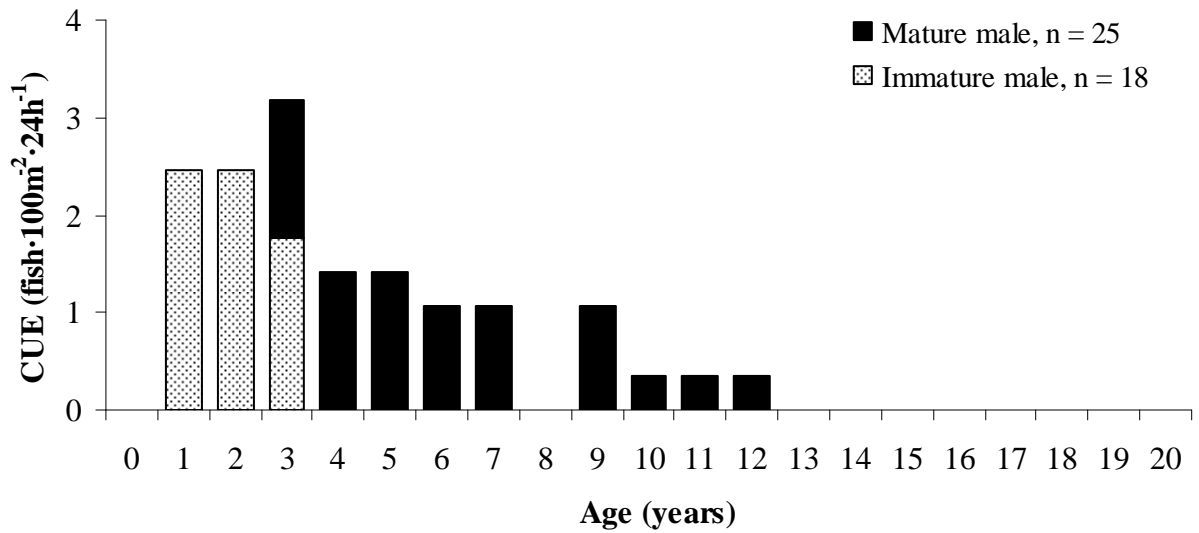
Figure 7. Age-at-maturity distributions for male and female walleye from the Lac Bellevue 2010 FWIN survey.

Walleye Length-at-Age

The length-at-age growth curve for the 2010 survey indicates a growth rate of 500 mm TL in approximately 5.5 yrs (Figure 8). This is a fast growth rate indicative of a 'collapsed' population (Table 1) and remains unchanged from the 2003 results.

Figure 8.   Walleye length-at-age from Lac Bellevue 2010 FWIN survey (L_{inf} = 610.5, K = 0.3, t_o = -0.4, R^2 = 1.0, n = 85) Compared with the 2003 FWIN survey (L_{inf} = 644.8, K =0.188, t_o = -0.55, R^2 =0.99, n = 112).

Table 1. Walleye population status indices for Lac Bellevue 2010. Criteria for classifying Alberta walleye fisheries modified for FWIN analysis (Sullivan 2003).

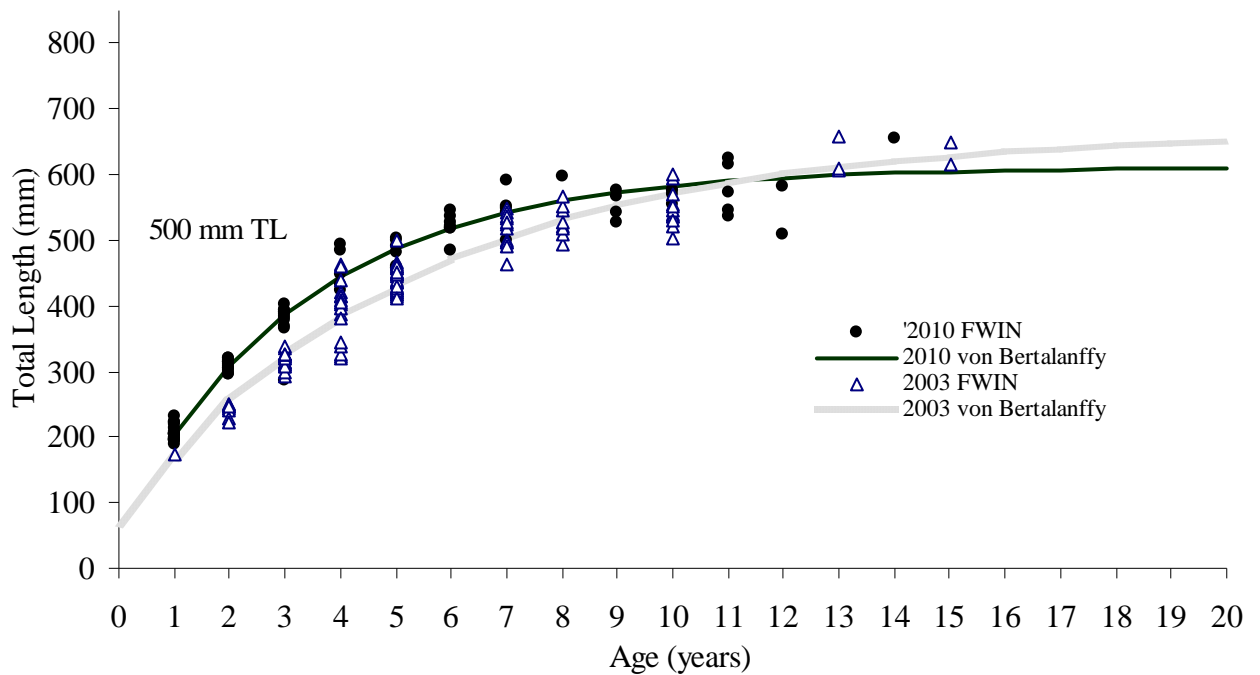| STATUS OF STOCK	TROPHY[1]	STABLE	VULNERABLE	COLLAPSED
Catch Rate		High >30 _per net_	Moderate 10-30 _per net_	Low <10 _per net_
2010			**28.1** (23.2-33.1)	
2003			20.8 (16.8-25.0)	
Age class[2] Distribution	Wide _>8 age-classes_ _Mean age >9_	Wide _>8 age-classes_ _Mean age = 6-9_	Narrow _1-3 age-classes_ _Mean age = 4-6_ _Few old fish (>10 yr)_	Wide or Narrow _Mean age = 6-10_
2010			**3 age-classes** **mean age = 4.6**	
2003			3 age-classes mean age = 5.6	
Age class[2] Stability	Very Stable _1-2 age-classes out of smooth catch curve_	Relatively Stable _2-3 age-classes out of smooth catch curve_	Unstable _1-2 age-classes support fishery_	Stable or Unstable _recruitment failures_
2010			**0 mature + 3 juvenile**	
2003			1 mature + 2 juvenile	
Age-at-Maturity (50% Maturity)	Females 10-20 Males 10-16	Females 8-10 Males 7-9	Females 7-8 Males 5-7	Females 4-7 Males 3-6 _Ages will vary with age-class distribution_
2010				**F = 5; M = 4**
2003				F = 5; M = 4
Growth (Length-at-Age)		Slow 50cm (TL) in 9-12 years	Moderate 50cm (TL) in 7-9 years	Fast 50cm (TL) in 4-7 years
2010				**5.5 years**
2003			7 years[3]	

[1] Trophy (old growth) fisheries are sensitive populations that support low densities of large old walleye.

[2] Measurable age-class $\geq$ 3 fish·100m^{-2}·24hrs^{-1}

[3] Adjusted from FL to TL.

SUMMARY

The 2010 walleye catch rate was 28.1 fish·100m^{-2}·24hrs^{-1}. This catch rate is considered moderate to high based on current ASRD criteria, and was an increase of 26% over the 2003 catch rate of 20.8 fish·100m^{-2}·24hrs^{-1}. The 2010 age-class distribution was moderately to weakly represented by nine mature age classes (5 – 14) and would be characterized as unstable. There were 3 measurable age-classes, all juvenile (ages 1- 3) which made up approximately 50% of the sample. This indicates fair levels of recruitment. Walleye had fast growth rates reaching a mean total length of 500 mm by age 5.5, and early maturation rates with males maturing at age four and females at age five.

Walleye population metrics for Lac Bellevue in 2010 ranged from vulnerable to collapsed, although catch rate was near the criteria for stable status. The population status is best classified as vulnerable.

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APPENDICES

Appendix 1.   Lac Bellevue 2010 FWIN net locations and site data.

Set ID	UTM[1] Easting	UTM Northing	Lift Date	Soak time (hrs)	Depth Stratum	Min Depth (m)	Max Depth (m)
LB 11	478667	5961968	24-Sep-10	23.28	Deep	10.0	10.4
LB 14	477508	5963507	24-Sep-10	24.07	Deep	9.6	9.9
LB 15	477662	5961439	24-Sep-10	24.22	Deep	5.5	8.5
LB 2	477235	5963283	24-Sep-10	23.58	Shallow	2.3	5.0
LB 3	477273	5962507	24-Sep-10	23.73	Deep	9.4	10.7
LB 6	478151	5962519	24-Sep-10	23.62	Deep	10.9	11.0

[1] Universal Transverse Mercator grid, NAD 83.

Appendix 2.   Catch summary of walleye at Lac Bellevue FWIN 2010.

Set ID	FWIN Nets - Mesh Size (mm)[1]									Non-FWIN Nets Mesh Size (mm)[2]		
	25	38	51	63	76	102	127	152	Total	12	19	Total
LB 11		3		4	1	2	2		12			
LB 14		1	1	2	5	2	1		12		2	2
LB 15	1	1	3	6	4	5	1		21		1	1
LB 2	1	9			1	1		1	13			
LB 3		2	2	3	3	1	2	1	14		1	1
LB 6	1	8	2	1	2	3	2		19		2	2
Total	3	24	8	16	16	14	8	2	91	0	6	6

[1] FWIN nets are half-length standard FWIN gang.
[2] Non-FWIN nets are additional small mesh experimental panels.

Appendix 3.   Catch summary of yellow perch at Lac Bellevue FWIN 2010.

Set ID	FWIN Nets - Mesh Size (mm)[1]									Non-FWIN Nets Mesh Size (mm)[2]		
	25	38	51	63	76	102	127	152	Total	12	19	Total
LB 11	9	1	6						16	2	1	3
LB 14	15	3	5						23	2	1	3
LB 15	6								6			0
LB 2	2	1							3			0
LB 3	11	5	7						23	3	3	6
LB 6	1	1	4						6		1	1
Total	44	11	22						77	7	6	13

[1] FWIN nets are half-length standard FWIN gang.
[2] Non-FWIN nets are additional small mesh experimental panels.