Gleniffer Lake Fall Walleye Index Netting (FWIN) Survey 2011

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ABSTRACT

From September 21 to the 23rd, 2011 Fish and Wildlife staff conducted a Fall Walleye Index Netting survey on Gleniffer Lake to assess the abundance and structure of the Walleye population, and to provide a baseline survey for future FWIN's. The mean Walleye catch rate of 3.4 fish·100m^{-2}·24hrs^{-1} ranks the 3rd lowest out of 41 previous FWIN's conducted across Alberta. Walleye fork length distribution ranged from 204-617 mm; with a mean length of 386 mm. Walleye ranged from 2-12 years of age but had low overall catch rates for all age classes, with no strong age classes present to support high recruitment to this fishery. The mean age of the Walleye was 6 years. The fork-length and age class distributions were consistent with a collapsed population having unstable and depressed recruitment. Male Walleye were early maturing, reaching maturity by the age of 4 years. While female Walleye appear to be fully mature by the age of 9 years, an insufficient number of samples restrict the ability for females to be accurately classified beyond collapsed. Walleye reached a total length of 500 mm by the age of 6 years, accounting for 33.3% of Walleye collected.

Low catch rates, unstable age structure, low recruitment, fast growth rates, and early maturity are all characteristics of this Walleye population being classified as collapsed when compared to the benchmarks described in Alberta's Walleye Management and Recovery Plan.

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INTRODUCTION

For several years in Alberta Walleye have been subjected to high angling pressure resulting in over harvesting and large declines in catch rates and reduced densities. Prior to 1995, Walleye were managed on a province wide scale, but this management practice failed to protect individual lakes with high angling pressure. Subsequently, *Alberta's Walleye Management and Recovery Plan* (WMPR) (Berry, 1995) was implemented to aid in the recovery and to help maintain Alberta's Walleye populations. In support of this plan Fisheries Management staff have examined Walleye populations and identified four status categories: trophy, stable, vulnerable and collapsed. This classification was derived from a computer model (Sullivan, 1994) analyzing five biological characteristics: age-class distribution, age-class stability, growth (length-at-age), age-at-maturity and catch rate. The Fall Walleye Index Netting (FWIN) protocol (Morgan, 2002) is currently being used to obtain biological samples required for analysis. This protocol was developed in Ontario by the Ministry of Natural Resources (MNR) and has been adapted as a standard for fisheries management in Alberta.

No data has been collected on the status of the sports fishery on Gleniffer Lake in recent years. Historical data consists of fall netting from 1983 to 1987 and a summer creel was performed in 1987 neither of which showed any presence of Walleye (Moore, 1990). From 1988-1999 approximately 350,000 Walleye were introduced to Gleniffer Lake in efforts to create a sustainable Walleye fishery, since this time there has been no data collected to assess the status of the Walleye fishery. Gleniffer Lake is currently being managed for Walleye with a regulation harvest limit of zero Walleye (catch and release) and is open to angling all year.

Historical species composition within Gleniffer Lake consists of: Northern Pike (*Esox lucius*), Burbot (*Lota lota*), Mountain Whitefish (*Prosopium williamsoni*), Rainbow Trout (*Oncorhynchus mykiss*), Brown Trout (*Salmo trutta*), Brook Trout (*Salvelinus fontinalis*), Bull Trout (*Salvelinus confluentus*), Trout-perch (*Percopsis omiscomaycus*), Longnose Sucker (*Catostomus catostomus*), White Sucker (*Castostomus commersoni*), Spottail Shiner (*Notropis hudsonius*) and Spoonhead Sculpin (*Cottus ricei*) (Moore, 1989, FWMIS database 2011).

The main objectives of the Fall Walleye Index Netting were to;

(1) provide a baseline survey for comparison with future FWIN's

(2) assess current sport fish found within Gleniffer Lake

(3) Estimate the Walleye stock assessment parameters (catch rate, age-distribution and stability, age-at-maturity and length-at-age) and classify the Walleye population as per the WMPR

STUDY SITE

Gleniffer Lake, commonly known as Dickson Dam (ATS–30-35-2-W5M; UTM Zone 11, E 687267 N 5767875) was constructed in 1983 as a reservoir for the Dickson Dam which regulates the flow of the Red Deer River. This serves two main purposes 1) an assured water supply for downstream communities, and 2) improved water quality downstream. During the spring and summer, runoff water is captured in the reservoir and is released in the winter to ensure a minimum flow of at least 16 $m^3 s^{-1}$ (Moore 1990). Gleniffer Lake is situated 22 km west of the town of Innisfail or 50 km south west of the City of Red Deer, with vehicle access via highway 54. There are currently three boat launches available for public use these are located at the North Dyck, South Dyck and Cottonwood day-use areas. There are two commercially owned campground resorts; one on the north shore between the North Dyke and Dickson Point day-use areas and the other located on the south shore near the South Dyke day-use area (Mitchell and Prepas 1990). The lake has a surface area of 1773.4 ha and a maximum depth of 33.5m and a mean depth of 11.6m (Alberta Sustainable Resource Development, FWMIS database 2011).

METHODS

Red Deer Fisheries Management staff conducted a FWIN from September 21 to 23, 2011. A description of equipment and methodology can be found in the Manual of Instruction Fall Walleye Index Netting (FWIN) (Morgan 2002). The sample locations were randomly selected on a bathymetric map using GIS and weighted by surface area and depth strata. Netting effort consisted of nine nets being set, with one net being located in the shallow strata (2-5m), 4 in the medium strata (5-15m), and the remaining four nets being placed in the deep strata (>15m).

FWIN nets are 1.8m in depth by 61m in length and consist of 8 ascending monofilament stretched mesh. Mesh sizes include 25, 38, 51, 64, 76, 102, 127, 152 mm. According to FWIN protocol nets must be set for a time period of 24 hours (+/- 3 hours) during a period when surface temperature is between 10 and 15°C. Nets were set perpendicular to depth contours and minimum and maximum depths were recorded (Appendix 1). After the required time had lapsed nets were pulled and cleared of fish. Nets were then moved and reset at a new location. If the depth of the pre-selected location was unsatisfactory an attempt was made to relocate it within 250 m of the original site. If one could not be found within that distance then a new site was selected from a list of pre-determined sample sites. The net location was recorded in Universal Transverse Mercator (UTM) projection coordinates using the North American Datum (NAD 83) using a hand held GPS unit. Surface temperature, dates and times nets were set and pulled were also recorded (Appendix 1).

All fish were retrieved and bagged according to the set ID and mesh size, fish where then processed on land to collect biological information. Biological information for all species was recorded on sample envelopes and a data sheet which included: fork length (FL), and total length (TL) to the nearest millimetre and weight (g). Walleye and Northern Pike were also examined for sex and maturity, and an aging structure removed for further analysis. Gonad weight was also collected for female Walleye. The number of fish from each set ID was then totalled up in order to calculate the catch per unit effort (CUE). Catch rates were

calculated as fish•100m^{-2}•24hrs^{-1} and confidence intervals to 95% were determined by boot strapping net catches to 50 000 replications (Haddon, 2001).

The cleithrum was used to age Northern Pike according to the methods described by Mackay et al (1990). Walleye otoliths were prepared and assigned ages according to the protocol defined by Watkins and Spencer (2008). M. Wells was responsible for determining all ages. The following equation was used to help identify the 1st annulus (Watkins and Spencer, 2008):

$S_c = (ORxL_{0)}/L_c$
S_c = radius distance from focus to 1st annulus of otolith cross-section at capture,
0R = otolith radius,
L_0 = length at age-0,
L_c = length of fish at capture.

Size and age distributions, maturity rates and von Bertalanffy growth curves were calculated to assess the stock status according to modified guidelines of the *Walleye Management and Recovery Plan* (Berry, 1996).

To portray fish population as a function of time (i.e., length-at-age). The von Bertalanffy growth equation was used:

$Lt = L_\infty(1 - e^{-k\,(t-t0)})$.
L_∞ = maximum theoretical length (fork length infinity) that can be obtained;
k = growth coefficient;
t = time of age in years;
t_0 = is the time in years when length would theoretically be equal to zero and;
e = exponent for natural logarithms.

L_{∞}, t0, and k were calculated using the Fishery Analysis and Simulation Tools (FAST) software ver. 2.1 (Slipke and Maceina, 2001). Length-at-age data were fitted to the population growth model by applying the equation to each individual sample.

All Glennifer Lake data was analyzed and written using Microsoft Office 2003 and 2007, a complete summary of the Gleniffer Lake FWIN, 2011 data set is stored in the Alberta Sustainable Resource Development, Fisheries and Wildlife Management Information System database (FWMIS) under the project number 15731 (Waterbody ID# 4685).

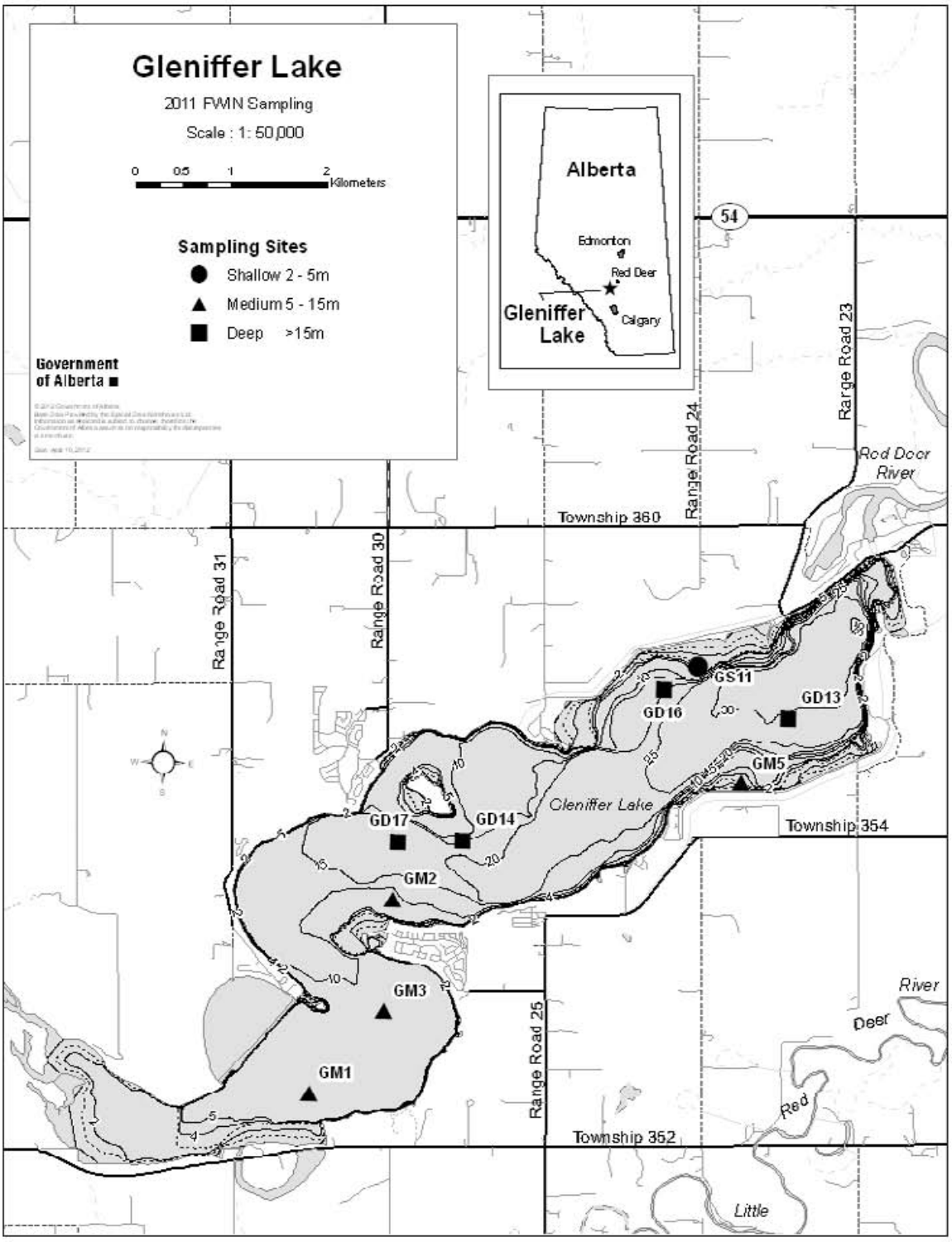

Figure 1. Location within Alberta and sampling locations for the Gleniffer Lake FWIN, 2011.

RESULTS

Catch Composition

From September 21 through 23, 2011 a Fall Walleye Index Netting (FWIN) Survey was conducted. A total of nine nets were set with a mean soak time of 23.7 hours and water temperature varied from 13.1 and 14.8 °C (Appendix 1). A total of 133 fish were caught representing 5 different species during the survey, with Longnose Suckers comprising the highest catch (55.6%, n=74). The remainder of the catch was composed of Walleye (24.8%, n=33), White Sucker (17.3%, n=23), Northern Pike (1.5%, n=2) and Burbot (0.8%, n=1) (Appendix 1).

Walleye Catch Rate and Abundance

The 2011 catch per unit effort (CUE) was estimated at 3.4 fish·100m^{-2}·24hrs^{-1} (95% confidence interval of 2.1-4.8). Refer to appendix 2 for CUE of remaining species caught. When compared to recent FWIN surveys conducted in Alberta, Gleniffer Lake CUE ranks 3rd lowest out of 41 lakes. This places Gleniffer Lake well below the provincial average of 21.1 fish·100m^{-2}·24hrs^{-1}. CUE's for provincial lakes ranged from 1.0 – 46.7 fish·100m^{-2}·24hrs^{-1} (Figure 3).

Walleye were caught in all nets and in all mesh sizes excluding the 25mm and 152mm meshes. The highest catch appeared in the 51 mm mesh attaining a CUE of 0.9 fish·100m^{-2}·24hrs^{-1} (27.3%, n=9) this was closely followed by the 63 and 76 mm nets both with a CUE of 0.8 fish·100m^{-2}·24hrs^{-1} (24.2%, n=8) respectively (appendix 3). The deep sets had the highest catch rate of 5.6 fish·100m^{-2}·24hrs^{-1} (72.7%, n=24), (appendix 6). This was followed by the medium sets (18.2%, n=6) and shallow set (9.1%, n=3), (appendix 5 and 4), respectively.

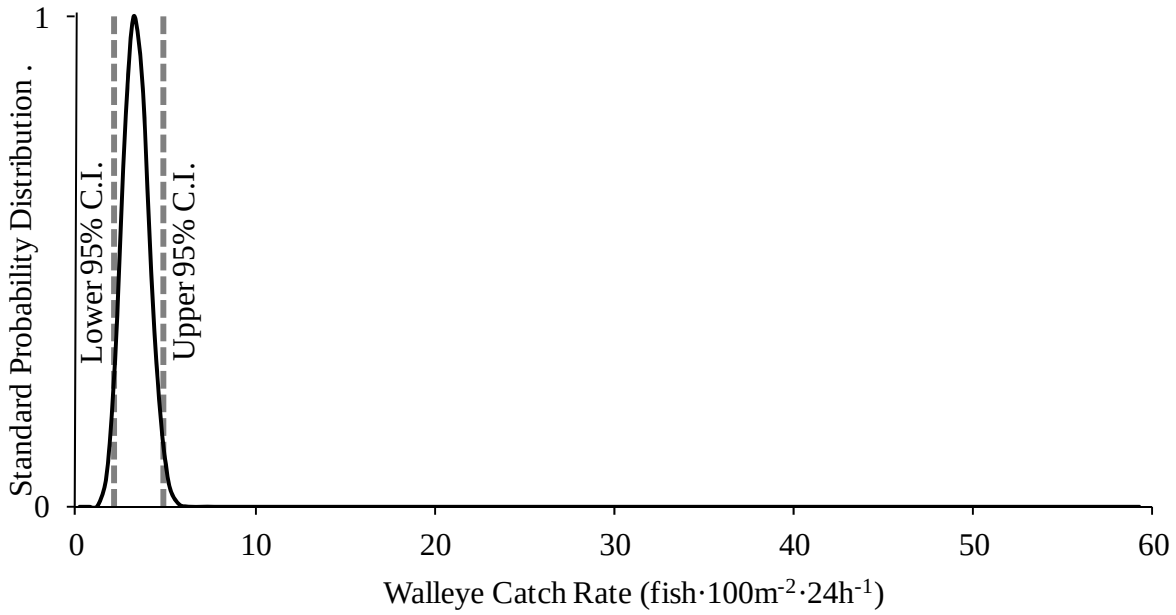

Figure 2. Walleye catch frequency distribution, Gleniffer Lake, 2011. Catch rate was 3.4 fish·100m^{-2}·24hrs^{-1} (95% confidence interval of 2.1-4.8) obtained from bootstrapping to 50, 000 replicates.

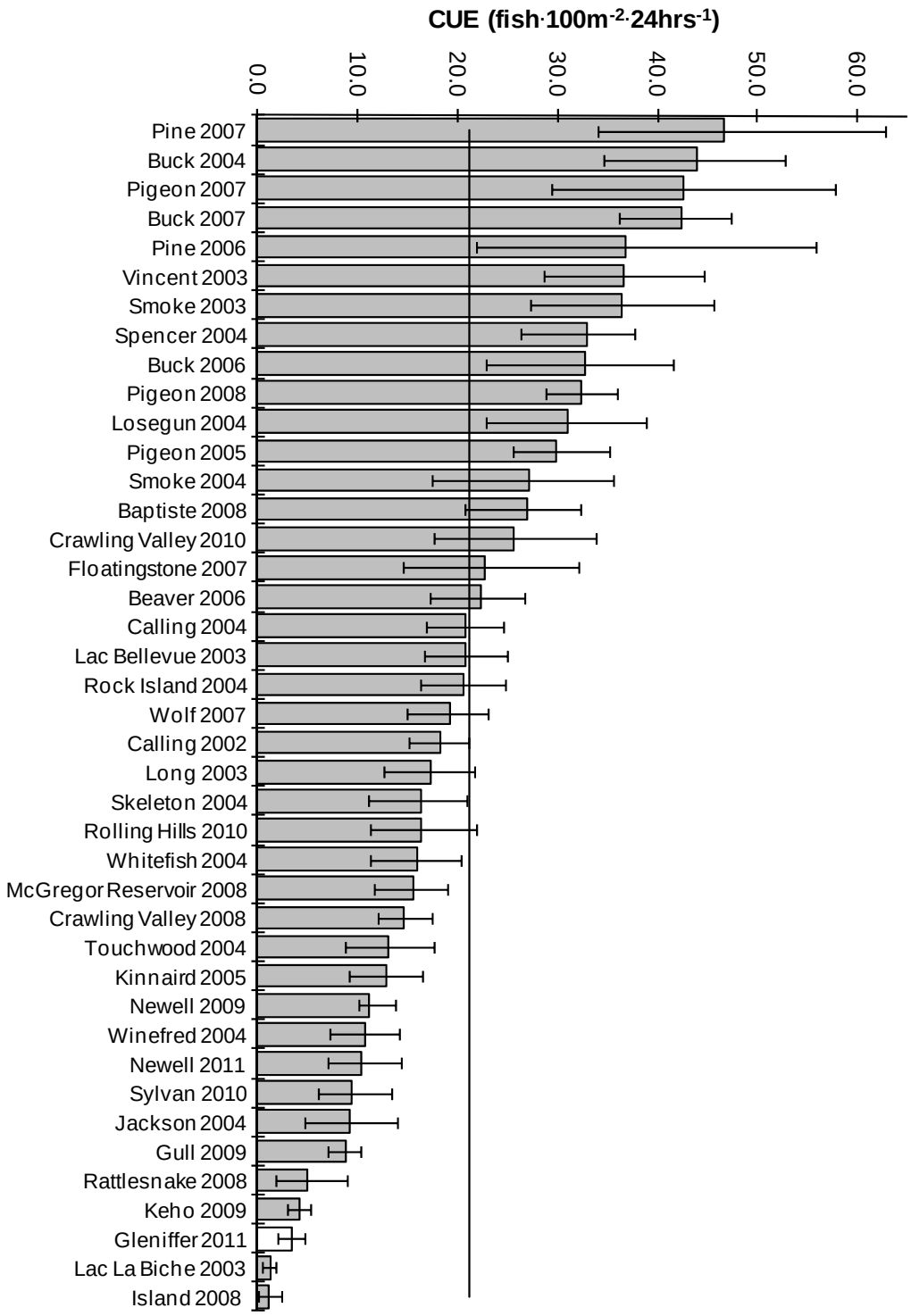

Figure 3. Mean Walleye catch rates for 41 FWIN surveys across Alberta. Error bars depict 95% confidence intervals and horizontal line represents mean provincial catch rate.

Walleye Fork-Length Distribution

Walleye fork lengths (n=33) ranged from 204-617 mm, with a mean size of 386 mm. Walleye with a fork length of 270-300 mm were the most dominant size class representing 42.4% of the total Walleye catch (n=14). The CUE of Walleye found within this size class was 1.4 fish·100m^{-2}·24hrs^{-1}, (95% CI = 0.7-2.2). Walleye whose total length equalled or exceeded 500 mm (470 mm FL) had a CUE of 0.9 fish·100m^{-2}·24hrs^{-1}, (95% CI = 0.3-1.7), representing 27.3% (n=9) of the total Walleye catch. All other size classes showed little to no recruitment.

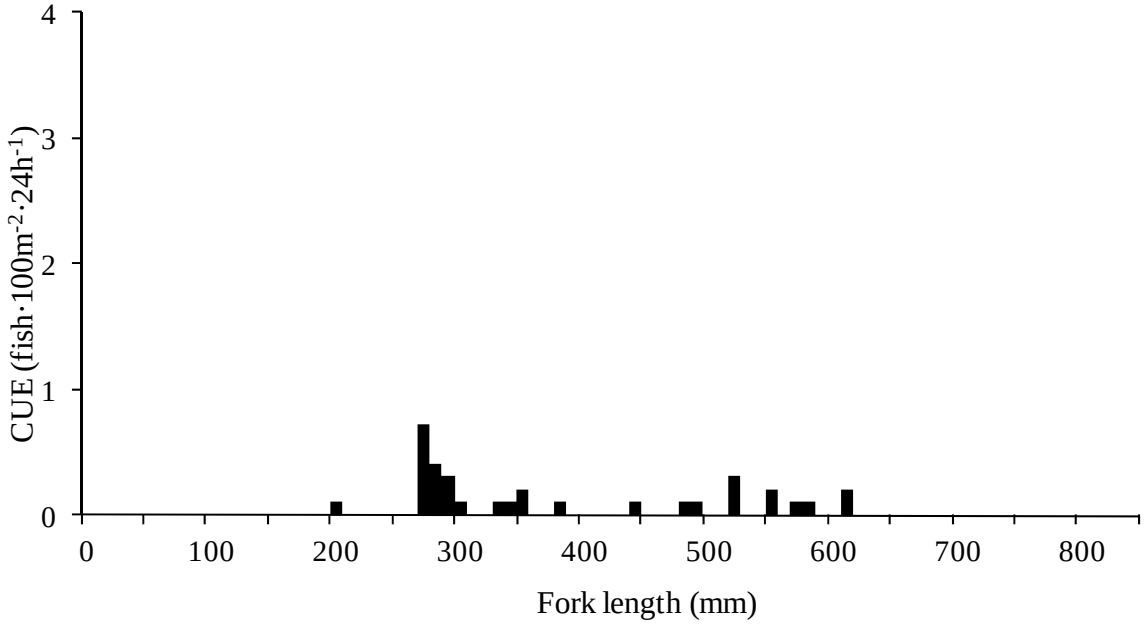

Figure 4. Walleye fork length frequency distribution, Gleniffer Lake FWIN, 2011.

Walleye Age-Class Distribution and Stability

The Walleye (n=33) ranged in age from 2 to 12 years, with a mean age of 6 years. The four year olds (2007) age class was the most abundant accounting for 54.4% (n=18) of the total Walleye catch with a CUE of 1.8 fish·100m^{-2}·24hrs^{-1} (95% CI = 1.3-2.4). The mean age, and age-frequency distribution represent a population dominated by low and unstable recruitment

with several age classes missing (0,1,3,7 and 8 years of age). The remaining age classes were poorly represented and the population is not supported by any abundant age classes.

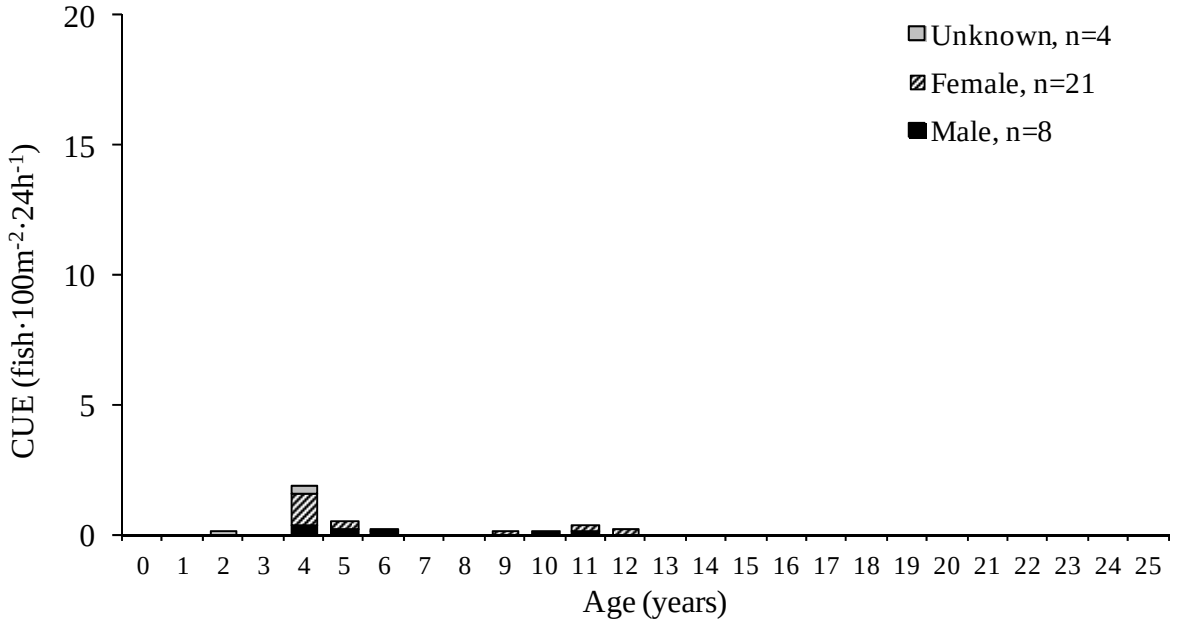

Figure 5. Walleye age class frequency distribution, Gleniffer Lake FWIN, 2011.

Walleye Age-at-Maturity

Of the 33 Walleye that were sampled 12 were considered mature (36.4%, n=12) with a CUE of 1.3 fish·100m^{-2}·24hrs^{-1} (95% CI= 0.5-2.1). Of these, 5 were female and the remaining 7 were male. The earliest confirmed maturity of males was 4 years and females 9 years. A low sample number reduces the reliability of the maturity of the females. Consequently, the age at maturity of the females may show to be at a lower age with an increased sample size. With all males reaching maturity by age 4, combined with an inadequate number of female samples is indicative of a collapsed population.

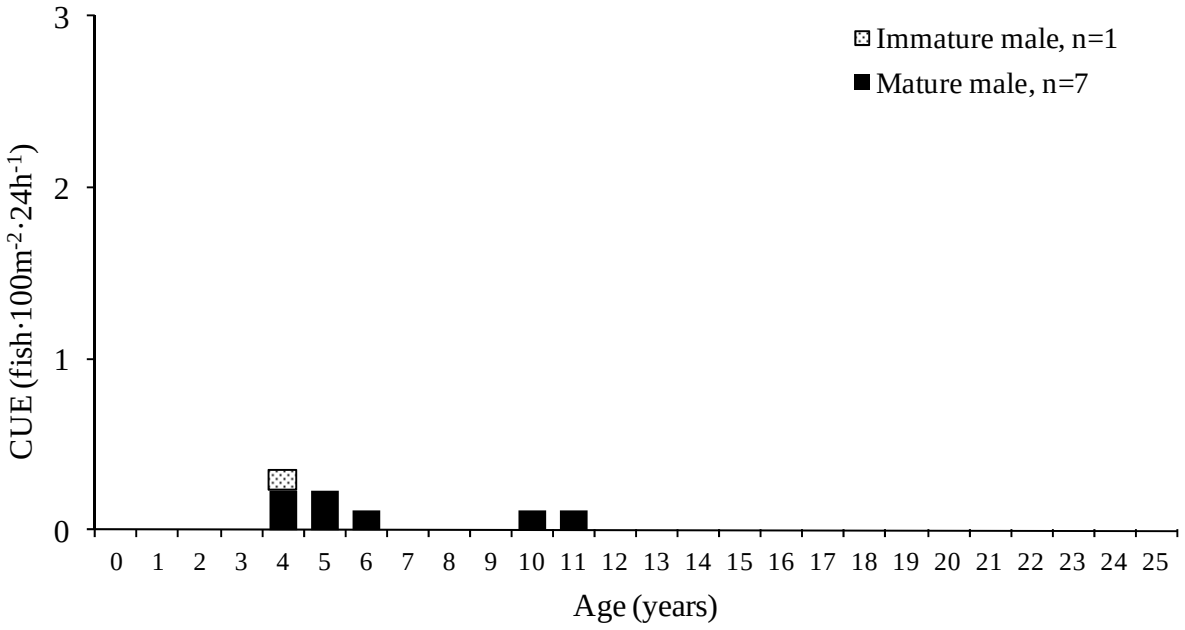

Figure 6. Age at maturity distribution for male Walleye, Gleniffer Lake FWIN, 2011

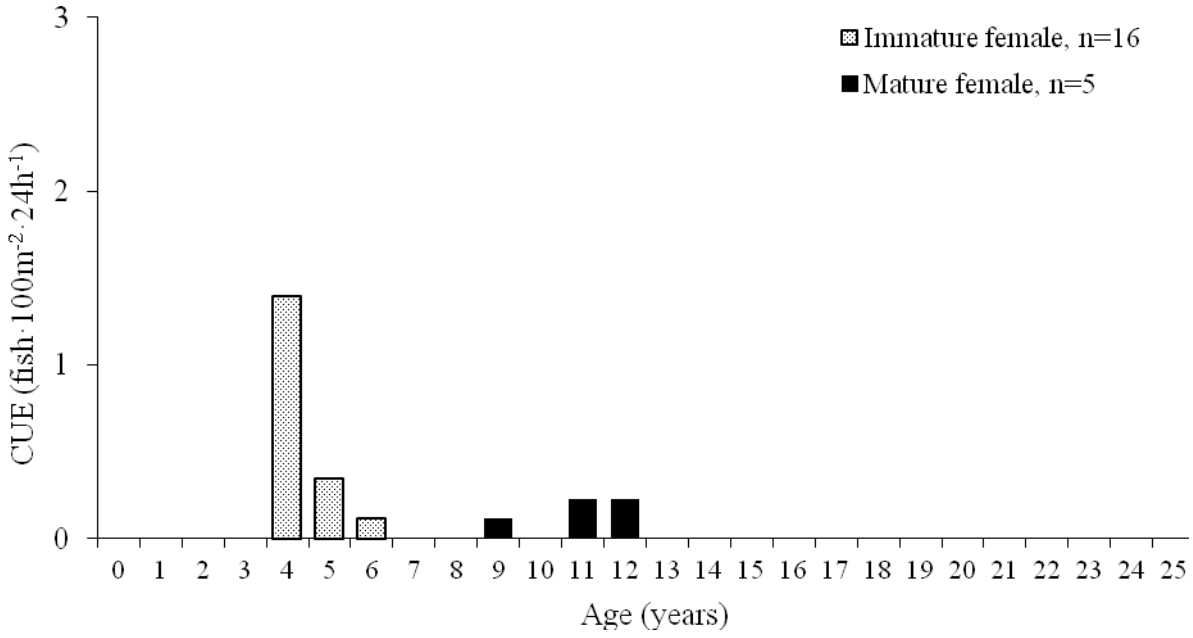

Figure 7. Age at maturity distribution for female Walleye, Gleniffer Lake FWIN, 2011.

Walleye Length- at -Age

Overall, Walleye exhibited fast growth rates particularly at younger ages with Walleye in Gleniffer Lake reaching a mean total length of 500 mm in approximately 6 years. A total of 11 (33.3%) of Walleye collected were equal to or greater than 500 mm TL, with ages ranging from 5 to 12 years of age. Low sample size and insufficient age-classes present precluded comparisons of growth rates to be made between female and male Walleye. This fast growth rate is indicative of a collapsed population.

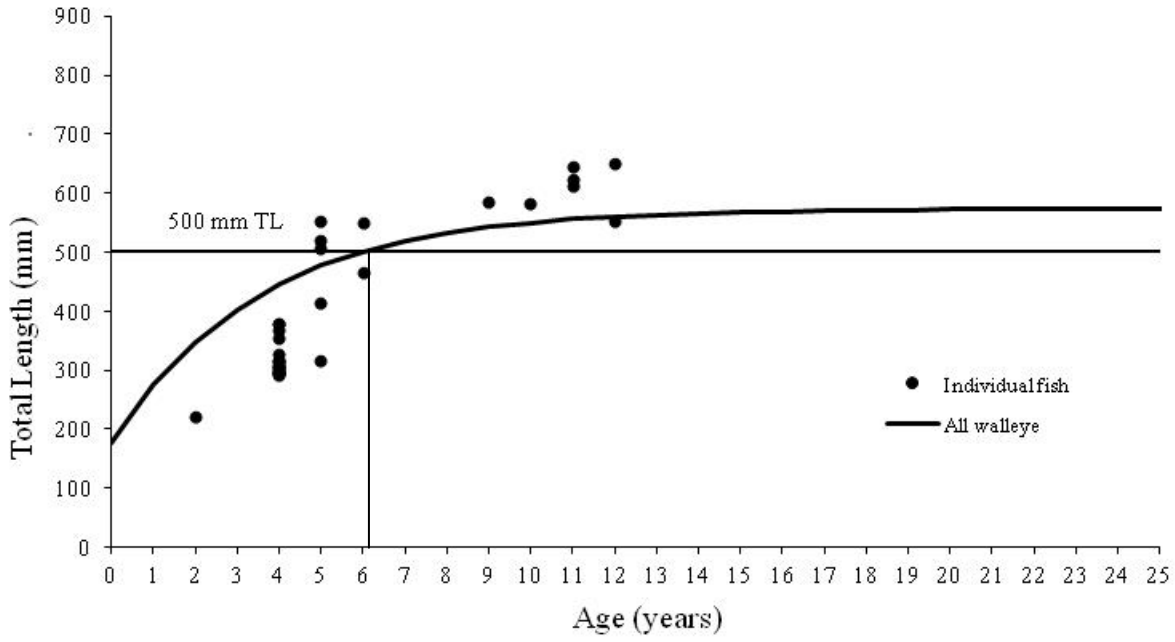

Figure 8. Total length-at-age for Gleniffer Lake FWIN, 2011. (L_{inf} = 573.4 mm, K = 0.283, t_o = - 1.296, P<0.0001, n = 33).

	Trophy	Stable	Vulnerable	Collapsed
Catch Rate		High, > 30 per net	Moderate, 15-30 per net	Low, <10 per net
Gleniffer Lake, 2011				**CUE = 3.4 fish·100m^{-2}·24hrs^{-1}**
Age-class Distribution	Wide, 8 or more age-classes. Mean age >9.	Wide, 8 or more age-classes. Mean age 6-9.	Narrow, 1-3 age-classes. Mean age 4-6, few old fish (>10).	Narrow or wide. Mean age 6-10
Gleniffer Lake, 2011				**Mean age = 6 years**
Age-class Stability	Very stable, 1-2 age-classes out of smooth catch curve	Relatively stable, 2-3 age-classes out of smooth catch curve	Unstable, 1-3 age-classes support fishery	Stable or unstable. Recruitment failures
Gleniffer Lake, 2011				**Low, unstable recruitment; few young or old fish. No age classes support fishery.**
Age-at-Maturity	Females 10-20, Males 10-16.	Females 8-10, Males 7-9.	Females 7-8, Males 5-7.	Females 4-7, Males 5-6.
Gleniffer Lake, 2011				**Female 9*, Male 4**
Length-at-Age	Very slow, 50 cm (TL) in 12-15 years.	Slow, 50 cm (TL) in 9-12 years.	Moderate, 50 cm (TL) in 7-9 years.	Fast, 50 cm (TL) in 4-7 years.
Gleniffer Lake, 2011				**6 years**

* Insufficient amount of samples to accurately categorize beyond collapsed.

Table 1. Walleye population indices from the Gleniffer Lake FWIN 2011 compared to criteria for classifying Walleye fisheries in Alberta modified for FWIN analysis (Sullivan, 2003).

DISCUSSION

Gleniffer Lake is in the bottom third of all reported FWIN Walleye catch rates annually from across Alberta. The population status classification for the Gleniffer Lake Walleye fishery indicates a collapsed population, according to the criteria outlined in *Alberta's Walleye Management and Recovery Plan* (Berry 1995). Of the five biological population metrics used as criteria for classifying the status of Walleye fisheries, modified for FWIN analysis from Sullivan (2003), all five (catch rate, age-class distribution, age-class stability, age-at-maturity and length-at-age) indicate that the population is in a collapsed state.

The age-at-maturity distribution shows males being fully mature by the age of 4 years. Early maturity can be an indicator of low abundance, as there is less competition for resources. Maturity is regulated largely by fish size and fish with less competition grow and reach maturity more quickly as a result of lower intraspecific competition. Female Walleye were completely mature by the age of 9 years, but mean age-at-maturity was difficult to determine due to age-class gaps and low sample sizes. Walleye reached a mean total length of 500 mm by the age of 6 years, with ages ranging from 5-12 years.

The survey revealed low, unstable recruitment based on the limited abundance of Walleye in each age-class and several age-class gaps, indicative of year class failures. The 4 year-olds dominated the sample representing 54.4% of the total catch, but no reproductively mature age-classes can be considered to support the fishery, as they all had an unstable CUE of less than 3 fish·100m^{-2}·24hrs^{-1}. Approximately 350,000 Walleye were stocked in Gleniffer Lake from 1988 through to 1990, but despite these stockings a stable, naturally reproducing population has not perpetuated. Fluctuating water levels, fine substrates, lack of littoral zone, spawning habitat limitations, shoreline alteration, etc. could all be contributing factors to the limited success of the Walleye population within Gleniffer Lake.

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APPENDICES

Appendix 7. Catch composition, Gleniffer Lake FWIN, 2011.

							Number Of Species Caught					
Set No.	UTM E	UTM N	Temp (°C)	Depth (m) Min-Max	Lift Date	Soak Time (hr)	WALL	NRPK	BURB	LNSC	WHSC	Total
GD 13	690232	5769022	14.8	26.5 - 28.0	22-Sep	22.92	5	0	1	16	0	**22**
GD 16	688177	5769276	unknown**	18.8 - 19.8	23-Sep	23.67	6	0	0	6	2	**14**
GD17	686196	5767595	14.4	17.8 - 18.4	23-Sep	24.00	5	1	0	7	0	**13**
GM 5	689753	5768336	unknown*	unknown*	23-Sep	22.83	1	1	0	1	6	**9**
GM 1	685341	5764942	13.1	5.1 - 5.5	22-Sep	25.00	2	0	0	8	2	**12**
GD 14	686868	5767634	14.4	14.1 - 17.8	22-Sep	23.75	8	0	0	10	1	**19**
GM 2	686153	5766996	14.3	7.7 - 8.6	23-Sep	23.50	1	0	0	1	2	**4**
GM 3	686095	576827	13.9	7.3 - 7.5	23-Sep	23.75	2	0	0	25	0	**27**
GS 11	689254	5769525	14.0	2.8 - 4.3	22-Sep	23.92	3	0	0	0	10	**13**
							33	**2**	**1**	**74**	**23**	**133**

* specific depth was not recorded, net was within the 5-15m stratum

** specific temperature was not recorded

Appendix 8. Catch rates for all species, Gleniffer Lake FWIN, 2011.

Species	Mean CUE	95% CI
Burbot	0.1	0 - 0.3
Northern Pike	0.2	0 - 0.5
Walleye	3.4	2.1 - 4.8
Long Nose Sucker	7.6	3.4 - 12.6
White Sucker	2.4	0.7 - 4.4

Appendix 9. Catch composition for all species by mesh size, Gleniffer Lake FWIN, 2011.

WALL

Set No.	Depth (m) Min-Max	Soak Time (hr)	25	38	51	63	76	102	127	152	Total
GD 13	26.5 - 28.0	22.92	0	0	1	2	1	1	0	0	5
GD 16	18.8 - 19.8	23.67	0	1	0	4	1	0	0	0	6
GD17	17.8 - 18.4	24.00	0	1	2	0	1	0	1	0	5
GM 5	unknown*	22.83	0	0	1	0	0	0	0	0	1
GM 1	5.1 - 5.5	25.00	0	0	1	0	1	0	0	0	2
GM 14	14.1 - 17.8	23.75	0	1	2	1	2	2	0	0	8
GM 2	7.7 - 8.6	23.50	0	0	0	1	0	0	0	0	1
GM 3	7.3 - 7.5	23.75	0	0	1	0	0	1	0	0	2
GS 11	2.8 - 4.3	23.92	0	0	1	0	2	0	0	0	3
		Total	0	3	9	8	8	4	1	0	33

* specific depth was not recorded, net was within the 5-15m stratum

NRPK

Set No.	Depth (m) Min-Max	Soak Time (hr)	25	38	51	63	76	102	127	152	Total
GD 13	26.5 - 28.0	22.92	0	0	0	0	0	0	0	0	0
GD 16	18.8 - 19.8	23.67	0	0	0	0	0	0	0	0	0
GD17	17.8 - 18.4	24.00	0	0	0	0	1	0	0	0	1
GM 5	unknown*	22.83	0	0	0	1	0	0	0	0	1
GM 1	5.1 - 5.5	25.00	0	0	0	0	0	0	0	0	0
GM 14	14.1 - 17.8	23.75	0	0	0	0	0	0	0	0	0
GM 2	7.7 - 8.6	23.50	0	0	0	0	0	0	0	0	0
GM 3	7.3 - 7.5	23.75	0	0	0	0	0	0	0	0	0
GS 11	2.8 - 4.3	23.92	0	0	0	0	0	0	0	0	0
		Total	0	0	0	1	1	0	0	0	2

* specific depth was not recorded, net was within the 5-15m stratum

BURB

Set No.	Depth (m) Min-Max	Soak Time (hr)	25	38	51	63	76	102	127	152	Total
GD 13	26.5 - 28.0	22.92	0	0	0	0	0	1	0	0	1
GD 16	18.8 - 19.8	23.67	0	0	0	0	0	0	0	0	0
GD17	17.8 - 18.4	24.00	0	0	0	0	0	0	0	0	0
GM 5	unknown*	22.83	0	0	0	0	0	0	0	0	0
GM 1	5.1 - 5.5	25.00	0	0	0	0	0	0	0	0	0
GM 14	14.1 - 17.8	23.75	0	0	0	0	0	0	0	0	0
GM 2	7.7 - 8.6	23.50	0	0	0	0	0	0	0	0	0
GM 3	7.3 - 7.5	23.75	0	0	0	0	0	0	0	0	0
GS 11	2.8 - 4.3	23.92	0	0	0	0	0	0	0	0	0
		Total	0	0	0	0	0	1	0	0	1

* specific depth was not recorded, net was within the 5-15m stratum

WHSC

Set No.	Depth (m) Min-Max	Soak Time (hr)	25	38	51	63	76	102	127	152	Total
GD 13	26.5 - 28.0	22.92	0	0	0	0	0	0	0	0	0
GD 16	18.8 - 19.8	23.67	0	1	1	0	0	0	0	0	2
GD17	17.8 - 18.4	24.00	0	0	0	0	0	0	0	0	0
GM 5	unknown*	22.83	0	0	0	4	1	1	0	0	6
GM 1	5.1 - 5.5	25.00	0	0	0	0	0	2	0	0	2
GM 14	14.1 - 17.8	23.75	0	0	0	1	0	0	0	0	1
GM 2	7.7 - 8.6	23.50	0	0	0	0	2	0	0	0	2
GM 3	7.3 - 7.5	23.75	0	0	0	0	0	0	0	0	0
GS 11	2.8 - 4.3	23.92	0	0	1	1	2	6	0	0	10
		Total	0	1	2	6	5	9	0	0	23

* specific depth was not recorded, net was within the 5-15m stratum

LNSC

Set No.	Depth (m) Min-Max	Soak Time (hr)	25	38	51	63	76	102	127	152	Total
GD 13	26.5 - 28.0	22.92	0	2	4	3	6	1	0	0	16
GD 16	18.8 - 19.8	23.67	0	1	2	1	2	0	0	0	6
GD17	17.8 - 18.4	24.00	0	0	3	2	2	0	0	0	7
GM 5	unknown*	22.83	0	0	0	1	0	0	0	0	1
GM 1	5.1 - 5.5	25.00	0	0	1	1	2	4	0	0	8
GM 14	14.1 - 17.8	23.75	0	0	3	2	2	2	1	0	10
GM 2	7.7 - 8.6	23.50	0	0	0	1	0	0	0	0	1
GM 3	7.3 - 7.5	23.75	0	0	2	7	6	10	0	0	25
GS 11	2.8 - 4.3	23.92	0	0	0	0	0	0	0	0	0
		Total	0	3	15	18	20	17	1	0	74

* specific depth was not recorded, net was within the 5-15m stratum

Appendix 10. Catch composition for shallow set (2-5m), Gleniffer Lake FWIN, 2011.

		Total Species Caught					
Set No.	**Depth (m) Min-Max**	**WALL**	**NRPK**	**BURB**	**LNSC**	**WHSC**	**Total Per Net**
GS11	2.8 - 4.3	3	0	0	0	10	13
	Total Number of Species	3	0	0	0	10	13

Appendix 11. Catch composition for medium set (5-15m), Gleniffer Lake, 2011.

		Total Species Caught					
Set No.	**Depth (m) Min-Max**	**WALL**	**NRPK**	**BURB**	**LNSC**	**WHSC**	**Total Per Net**
GM 1	5.1 - 5.5	2	0	0	8	2	12
GM 2	7.7 - 8.6	1	0	0	1	2	4
GM 3	7.3 - 7.5	2	0	0	25	0	27
GM 5	unknown*	1	1	0	1	6	9
	Total Number of Species	6	1	0	35	10	52

Appendix 12. Catch composition for deep set (>15m), Gleniffer Lake, 2011.

		Total Species Caught					
Set No.	**Depth (m) Min-Max**	**WALL**	**NRPK**	**BURB**	**LNSC**	**WHSC**	**Total Per Net**
GD 13	26.5 - 28.0	5	0	1	16	0	22
GD 16	18.8 - 19.8	6	0	0	6	2	14
GD17	17.8 - 18.4	5	1	0	7	0	13
GD 14	14.1 - 17.8	8	0	0	10	1	19
	Total Number of Species	24	1	1	39	3	68