

Summer Sport Fishery Angler Survey at Gull and Snipe Lakes, Alberta, 2017



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EXECUTIVE SUMMARY

High fishing pressure, coupled with slow-growing and late-maturing populations, has resulted in the overharvest of many of Alberta's sport fish populations, especially northern pike (*Esox lucius*) and walleye (*Sander vitreus*). To generate information required for the management of these species on Gull and Snipe lakes, we conducted a creel survey during the summer of 2017 (May 15 to August 31) to collect data on angling effort, catch rates, biological data, and other sport fishery demographics.

During the survey period, 1,831 anglers were interviewed at Gull Lake, and fishing pressure was estimated at 5.35 h/ha (95% CI = 4.54–6.22). Total catch-per-unit-effort (CPUE) was 1.0 fish/h and comprised 0.7 fish/h and 0.3 fish/h for walleye and northern pike, respectively. Total yield of walleye was 2,631.7 kg (95% CI = 1,346.4–1,986.9) or 0.32 kg/ha (95% CI = 0.26–0.39). Total yield of northern pike was 2,218.4 kg (95% CI = 1,678.7–2,878.7) or 0.27 kg/ha (95% CI = 0.21–0.35). Walleye ranged in size from 274 to 643 mm fork length (FL; n = 271). Northern pike ranged in size from 408 to 855 mm FL (n =109). The greatest number of anglers resided in Alberta's major cities of Red Deer, Calgary, and Edmonton.

During the survey period, 567 anglers were interviewed at Snipe Lake, and fishing pressure was estimated at 1.0 h/ha (95% CI = 0.8-1.2). Total CPUE was 0.6 fish/h and comprised 0.1 fish/h and 0.5 fish/h for walleye and northern pike, respectively. Total yield of walleye was 463.4 kg (95% CI = 307.2-662.0) or 0.11 kg/ha (95% CI = 0.07-0.16). Total yield of northern pike was 419.0 kg (95% CI = 295.3-567.9) or 0.10 kg/ha (95% CI = 0.07-0.13). Walleye ranged in size from 349 to 645 mm FL (n = 57). Northern pike ranged in size from 260 to 740 mm FL (n = 124). The majority of anglers were local, from Grande Prairie and High Prairie.

Key words: northern pike, walleye, angler survey, Gull Lake, Snipe Lake.

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TABLE OF CONTENTS

EXECU	JTIVE SUMMARYii
ACKN	OWLEDGEMENTSiii
TABLE	OF CONTENTSiv
LIST O	F FIGURESv
LIST O	F TABLESvi
LIST O	F APPENDICES
1.0	INTRODUCTION
2.0 2.1 2.2	STUDY AREA
3.0 3.1 3.2 3.3 3.4 3.5 3.6	MATERIALS AND METHODS3Access-point surveys3Ratio-of-use surveys4Angler interviews5Biological fish data5Test angling5Data management and analysis6
4.0 4.1 4.2	RESULTS
5.0 5.1 5.2	SUMMARY
5.0	LITERATURE CITED
6.0	APPENDICES

LIST OF FIGURES

Figure 1.	Map of Gull Lake showing the locations of the most popular access points2
Figure 2.	Map of Snipe Lake showing all of the access points
Figure 3.	Length distribution of walleye harvested by anglers and caught during test angling at Gull Lake, 2017
Figure 4.	Age distribution of walleye harvested by anglers at Gull Lake, 2017
Figure 5.	Length distribution of northern pike harvested by anglers and caught during test angling at Gull Lake, 2017
Figure 6.	Age distribution of northern pike harvested by anglers at Gull Lake, 201710
Figure 7.	Length distribution of walleye harvested by anglers and caught during test angling at Snipe Lake, 2017
Figure 8.	Age distribution of walleye harvested by anglers at Snipe Lake, 2017
Figure 9.	Length distribution of northern pike harvested by anglers and caught during test angling at Snipe Lake, 2017
Figure 10.	Age distribution of northern pike harvested by anglers at Snipe Lake, 201714

LIST OF TABLES

Table 1.	Number of available survey units and number of units surveyed during the angler
	surveys at Gull and Snipe lakes, 20174
Table 2.	Summary of ratio-of-use surveys conducted at Gull and Snipe lakes, 20175

LIST OF APPENDICES

Appendix 1.	Angler survey form for Snipe Lake, 2017
Appendix 2.	Angler survey form for Gull Lake, 2017
Appendix 3.	Biological information collected from fish caught during test angling, Gull Lake, 2017
Appendix 4.	Biological information collected from fish caught during test angling, Snipe Lake, 2017
Appendix 5.	Flow chart outlining the process used to calculate a whole-lake estimate for a multi-access lake using ratio-of-use at Gull and Snipe lakes, during the summer of 2017
Appendix 6.	Summary of information collected from anglers during the creel survey at Gull Lake, 2017
Appendix 7.	Lorenz curve and associated Gini coefficients for angler catch of walleye and northern pike at Gull Lake, 2017
Appendix 8.	Biological information collected from fish harvested by anglers during the creel survey at Gull Lake, 2017
Appendix 9.	Summary of information collected from anglers during the creel survey at Snipe Lake, 2017
Appendix 10.	Lorenz curve and associated Gini coefficients for angler catch of walleye and northern pike at Snipe Lake, 2017
Appendix 11.	Biological information collected from fish harvested by anglers during the creel survey at Snipe Lake, 2017

1.0 INTRODUCTION

High fishing pressure, coupled with slow-growing and late-maturing populations, has resulted in the overharvest of many of Alberta's sport fish populations (Sullivan 2003), including northern pike (*Esox lucius*) and walleye (*Sander vitreus*). Effective management requires an understanding of fishing pressure and harvest on lakes. In 2017, we conducted angler surveys on Gull and Snipe lakes to collect data on angler effort, sport fish catch, and harvest, to facilitate the development of management guidelines for the sport fisheries on these lakes.

2.0 STUDY AREA

2.1 Gull Lake

Gull Lake (52°32'N, 113°59'W) has a surface area of 8,110.2 ha, a maximum depth of 27.0 m, and a mean depth of 16.5 m (Government of Alberta 2017). It is located in the Red Deer River drainage, about 25 km northwest of Red Deer, Alberta (Figure 1). There are several access points to Gull Lake including one provincial park, several private campgrounds, public boat launches, and private docks.



Figure 1. Map of Gull Lake showing the locations of the most popular access points. Inset map shows the location of the lake within the province of Alberta.

2.2 Snipe Lake

Snipe Lake (55°7′N, 116°46′W) has a surface area of 4,211.6 ha, a maximum depth of 6.1 m, and a mean depth of 3.9 m (Government of Alberta 2017). It is located in the Peace River drainage, about 30 km east of Valleyview or 270 km northwest of Edmonton, Alberta (Figure 2). There are a few access points to Snipe Lake, including two campgrounds, one municipal boat launch, and an improvised launch off a lease site.



Figure 2. Map of Snipe Lake showing all of the access points. Inset map shows the location of the lake within the province of Alberta.

3.0 MATERIALS AND METHODS

3.1 Access-point surveys

We conducted reduced-effort angler surveys on Gull and Snipe lakes from May 15 to August 31, 2017. We performed single access surveys on multiple access point lakes accompanied by ratio-of-use (ROU) surveys to obtain whole lake estimates (Pollock et al. 1994, Government of Alberta 2015). We selected our access survey location using area knowledge from Alberta Environment and Parks regional biologists of the most popular launch sites, and confirmed them after the first ROU surveys. We stratified surveys at both lakes into four temporal sampling units: weekdays and weekends, further divided into morning (08:00–15:00) and evening (15:00–22:00) units. To account for typical angler travel and effort around weekends, we classified Sunday evenings as weekday units and Friday evenings as weekend units. Of 218

possible survey units, we surveyed 52 (23.8%) at Gull Lake and 54 (24.8%) at Snipe Lake, excluding ratio-of-use surveys (Table 1.)

				Sampling effort	
Lake	Stratur	n	Number of	Number of	Percentage
			available	units	coverage (%)
			sampling units	surveyed	
Gull	Weekday	AM	76	12	15.8
		PM	73	13	17.8
	Weekend	AM	33	12	36.4
		PM	36	15	41.7
Snipe	Weekday	AM	76	14	18.4
		PM	73	13	17.8
	Weekend	AM	33	13	39.4
		PM	36	14	38.9

Table 1.Distribution of survey sampling effort among various sampling strata during
summer angler survey at Gull and Snipe lakes, 2017.

3.2 Ratio-of-use surveys

During ROU surveys, we interviewed anglers on the lake as they were randomly encountered by boat. We completed the same questionnaire during the shore and ROU surveys; however, during the ROU interview, we also asked anglers to identify their planned landing site. We then used the percentage of anglers landing at each access point to extrapolate estimates of the creel parameters to create whole-lake estimates. We stratified ROU surveys in the same way as the shore surveys. We conducted eight and nine ROU surveys at Gull and Snipe lakes, respectively, during the survey period (Table 2).

		Number of	ROU surveys
Day stratum	Time stratum	Gull Lake	Snipe Lake
Weekday	08:00-15:00	1	1
	15:00-22:00	2	2
Weekend/holiday	08:00-15:00	3	3
	15:00-22:00	2	3

Table 2. Summary of ratio-of-use (ROU) surveys conducted at Gull and Snipe lakes, 2017.

3.3 Angler interviews

For both lakes, we interviewed anglers upon completion of their trip. We asked a series of questions, including number of hours fished; number of fish of each species caught, harvested, and released; number of legal-sized fish released; and angler residency (Appendix 1). At Gull Lake we also asked whether anglers had purchased a special harvest license and if they had filled it or not (Appendix 2).

3.4 Biological fish data

When permitted, we sampled harvested fish and recorded fork length (FL; mm), total length (TL, mm), weight (g), sex, and maturity. We determined sex and maturity following Duffy et al. (2000). We collected aging structures, including otoliths from walleye and the left cleithrum from northern pike. We prepared otoliths following Watkins and Spencer (2009) and prepared cleithra following Mackay et al. (1990). Fisheries managers for both locations expressed that fin clips from test-angled fish would be unnecessary as they are an inaccurate method and they intend to perform test netting on both lakes during fall 2017.

3.5 Test angling

Because sport anglers at both lakes are required to release walleye and northern pike that are protected by size limits or special harvest license, no data were available for these protected-length fish. To generate these data, we used test angling throughout the angler survey. We recorded the time spent angling, number of fish caught for each species, and FL and TL of all fish caught. To reduce handling time and fish stress, we did not weigh released fish. Instead, we estimated weight of protected-length fish using recent Fall Index Netting (FIN) data from the respective lakes. Biological data collected during test angling are listed in Appendices 3 and 4 for Gull and Snipe lakes, respectively.

3.6 Data management and analysis

Before analysis, we used length-weight plots to identify and omit outliers if measurement or recording error was suspected. We submitted angler survey data to the Government of Alberta for inclusion in its Fisheries and Wildlife Management Information System database.

We used bootstrapping to derive estimates and associated 95% confidence intervals (CI) for the number of anglers and for fish catch, harvest and release, following Sullivan (2004). We calculated angler catch rates as total ratio estimators, following Malvestuto (1983), and evaluated comparisons of angler success by calculating Gini coefficients and interpreting Lorenz curves, following Baccante (1995). Gini coefficients closer to zero indicate more even angler catch while coefficients closer to one indicate more uneven catch. We estimated release mortality by multiplying the estimated number of each species released by a release mortality rate of 5.3% based on previous studies by Alberta Conservation Association, following a multivariate analysis suggested by Reeves (2004). We calculated yield as the product of the average weight of harvested fish and the sum of estimated harvest, plus the product of the average weight of sub-legal fish (from the most recent FIN) and the sum of the estimated release mortality. A flow chart describing the steps used to calculate estimates is provided in Appendix 5.

We calculated illegal harvest as a ratio of observed illegal harvest and the predicted number of harvested fish to determine the rate of illegal harvest, following Sullivan (2002).

4.0 RESULTS

4.1 Gull Lake

4.1.1 Angler survey

We interviewed a total of 1,831 anglers during the survey. The greatest number of anglers resided in Red Deer (19.2%), Calgary (17.7%), and Edmonton (8.5%); 53.8% of anglers were split between 50 other locations within Alberta. The remaining anglers (0.8%) came from out of the province/country. Anglers fished for a total of 4,730.75 h, catching 3,731 walleye and 1,369 northern pike, of which 74 walleye and 73 northern pike were harvested (Appendix 6). Of the

anglers, 232 held special harvest tags for walleye. The minority of anglers (42.9%) fished with bait.

During ROU surveys, 36.8% of anglers launched at Aspen Beach Provincial Park (the creel site), followed by 9.9% at Sunset Bay, 9.4% at Stoner's Landing, and 9.2% at Meridian Beach. The remaining 34.6% of anglers launched from ten other sites. Based on angler interviews and ROU surveys, an estimated 17,436 anglers (95% CI = 14,828–20,247) fished at Gull Lake for 43,382.8 h (95% CI = 36,844.7–50,469.7) from May 15 to August 31, 2017. Total estimated angling effort within these dates was 5.35 h/ha (95% CI = 4.54-6.22).

4.1.2 Walleye harvest and yield

Anglers harvested an estimated 580 walleye (95% CI = 411–776) at a rate of 0.01 fish/h and released 29,000 fish (95% CI = 23,953–34,629) at a rate of 0.67 fish/h. The total catch rate was 0.68 fish/h. Based on individual angler catch rates, the Gini coefficient for walleye at Gull Lake was 0.85 (Appendix 7). Of the released fish, we estimated that 1,537 (95% CI = 1,270–1,835) likely perished as a result of hooking mortality. Total yield (harvest + release mortality) was 2,631.7 kg (95% CI = 2,142.4–3,197.9) or 0.32 kg/ha (95% CI = 0.26–0.39). No undersized walleye were harvested; however, one walleye was observed to be harvested without a tag. Biological data collected from sampled fish are listed in Appendix 8.

4.1.3 Walleye population structure

The length distribution of walleye harvested by anglers and those caught during test angling ranged from 274 to 643 mm FL (n = 271), with most harvested fish between 525 and 600 mm FL and most test-angled fish around 450 to 475 mm FL (Figure 3). Age of harvested fish ranged from 4 to 18 years (n = 54), with age 9 fish being the most prevalent (Figure 4).



Figure 3. Length distribution of walleye harvested by anglers and those caught during test angling at Gull Lake, 2017.



Figure 4. Age distribution of walleye harvested by anglers at Gull Lake, 2017 (n = 54).

4.1.4 Northern pike harvest and yield

Anglers harvested an estimated 616 northern pike (95% CI = 413–884) at a rate of 0.01 fish/h, and released 12,418 fish (95% CI = 10,186–14,982) at a rate of 0.29 fish/h. The total catch rate was 0.30 fish/h. Based on individual angler catch rates, the Gini coefficient for northern pike at Gull Lake was 0.77 (Appendix 7). Of the released fish, we estimated that 658 (95% CI = 413–884) likely perished as a result of hooking mortality. Total yield (harvest + release mortality) was 2,218.4 kg (95% CI = 1,678.7–2,878.7) or 0.27 kg/ha (95% CI = 0.21–0.35). Observed illegal harvest (harvested fish <630 mm TL) of northern pike was 6.1% (3 of 49 fish). Biological data collected from sampled fish are listed in Appendix 8.

4.1.5 Northern pike population structure

The length distribution of northern pike harvested by anglers and those caught during test angling ranged from 408 to 855 mm FL (n =109), with most harvested fish around 625 mm FL and most test-angled fish between 525 and 600 mm FL (Figure 5). Age of harvested fish ranged from 2 to 14 years (n = 49), with most fish age 5 (Figure 6).



Figure 5. Length distribution of northern pike harvested by anglers and those caught during test angling at Gull Lake, 2017.



Figure 6. Age distribution of northern pike harvested by anglers at Gull Lake, 2017 (n = 49).4.1.6 Other sport fish

In addition to walleye and northern pike, anglers at Gull Lake caught four yellow perch (*Perca flavescens*) and two burbot (*Lota Lota*). One of the yellow perch was harvested.

4.2 Snipe Lake

4.2.1 Angler survey

We interviewed a total of 567 anglers during the survey. The majority of anglers resided in Grande Prairie (34.8%) and High Prairie (18.5%); 45.3% of anglers were split between 36 other locations with Alberta. The remaining anglers (1.4%) came from out of province. The minority of anglers (17.8%) fished with bait. Anglers fished for a total of 1,078.75 h, catching 118 walleye and 775 northern pike, of which 45 walleye and 24 northern pike were harvested (Appendix 9).

During ROU surveys, 44.8% of anglers launched at Snipe Lake Community Campground (the creel site), while 49.8% launched at the municipal boat launch. The remaining 5.4% of anglers launched from South Shore Resort or an improvised boat launch at a lease site. Based on angler interviews and ROU surveys, an estimated 1,910 anglers (95% CI = 1,577–2,271) fished for

4,266.0 h (95% CI = 3,521.5–5,072.4) from May 15 to August 31, 2017. Total estimated angling effort within these dates was 1.01 h/ha (95% CI = 0.84–1.20).

4.2.2 Walleye harvest and yield

Anglers harvested an estimated 242 walleye (95% CI = 157–351) at a rate of 0.03 fish/h and released 473 fish (95% CI = 303–686) at a rate of 0.06 fish/h. The total catch rate was 0.09 fish/h. Based on individual angler catch rates, the Gini coefficient for walleye at Snipe Lake was 0.91 (Appendix 10). Of the released fish, we estimated that 25 (95% CI = 16–36) likely perished as a result of hooking mortality. Total yield (harvest + release mortality) was 463.4 kg (95% CI = 307.2-662.0) or 0.11 kg/ha (95% CI = 0.07-0.16). Observed illegal harvest (harvested fish <500 mm TL) of walleye was 2.4% (1 of 41 fish). Biological data collected from sampled fish are listed in Appendix 11.

4.2.3 Walleye population structure

The length distribution of walleye harvested by anglers and those caught during test angling ranged from 349 to 645 mm FL (n = 57), with most harvested fish around 550 to 575 mm and most test-angled fish around 450 mm FL (Figure 7). Age of harvested fish ranged from 2 to 13 years (n = 37), with most fish aged 9 (Figure 8).



Figure 7. Length distribution of walleye harvested by anglers and those caught during test angling at Snipe Lake, 2017.



Figure 8. Age distribution of walleye harvested by anglers at Snipe Lake, 2017 (n = 37).

4.2.4 Northern pike harvest and yield

Anglers harvested an estimated 174 northern pike (95% CI = 96–271) at a rate of 0.02 fish/h, and released 3,994 fish (95% CI = 2,928–5,242) at a rate of 0.49 fish/h. The total catch rate was 0.51 fish/h. Based on individual angler catch rates, the Gini coefficient for northern pike at Snipe Lake was 0.86 (Appendix 10). Of the released fish, we estimated that 212 (95% CI = 155–278) likely perished as a result of hooking mortality. Total yield (harvest + release mortality) was 419.0 kg (95% CI = 295.3–567.9) or 0.10 kg/ha (95% CI = 0.07–0.13). No illegal harvest was observed. Biological data collected from sampled fish are listed in Appendix 11.

4.2.5 Northern pike population structure

The length distribution of northern pike harvested by anglers and those caught during test angling ranged from 260 to 740 mm FL (n = 124), with most harvested fish between 550 and 575 mm FL and most test-angled fish in the 525 to 575 mm FL range (Figure 9). Age of harvested fish ranged from 3 to 9 years (n = 22), with most fish aged 4 and 5 years (Figure 10).



Figure 9. Length distribution of northern pike harvested by anglers and those caught during test angling at Snipe Lake, 2017.



Figure 10. Age distribution of northern pike harvested by anglers at Snipe Lake, 2017 (n = 22).

5.0 SUMMARY

5.1 Gull Lake

During the survey period, an estimated 17,436 anglers fished for 43,382.8 h at Gull Lake and captured 29,555 walleye and 13,030 northern pike, which equates to 5.35 h/ha of fishing pressure and a catch rate of 1.0 fish/h.

5.2 Snipe Lake

During the survey period, an estimated 1,910 anglers fished for 4,266.0 h at Snipe Lake and captured 717 walleye and 4,108 northern pike, which equates to 1.01 h/ha of fishing pressure and a catch rate of 0.6 fish/h.

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6.0 APPENDICES

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																					Party # i.e. 017	Creel Data rbody: Snipe
																					Angler number	Shee
																					Access Type (0=Shore, 1=Boat)	-
Totals																					# Anglers per boat Mark down only once per party	
																					Hours fished	
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																					# Total WALL Released	-
																					# Legal Released	
																					# NRPK Kept	
																					# Total NRPK Released	NDDX
																					# Legal Released (<75cm)	
																					# YLPR Kept	5
																					# YLPR Released	8
																					Complete trip data (1=No, 2=Yes)	_
																					Fishing style (1=Active, 2=Passive)	
																					Bait (1=No, 2=Yes)	Day 2 = 1 3 = 1 4 = 1
																					Residence	Code 5 : Tuesday 6 : Nednesday 7 : Thursday 8
Page of																					Comments? Record harvested fish of other SPP Record any noncompliance observed	 Friday No Ibank spaces Saturday No french 7s Sunday Total each sheet for daily summaries Holiday

Appendix 1. Angler survey form for Snipe Lake, 2017.





Species	Sample #	Fork length (mm)	Total length (mm)
NRPK	113	690	713
WALL	114	506	531
NRPK	115	611	638
NRPK	116	507	530
NRPK	117	540	576
WALL	118	549	575
NRPK	119	504	537
NRPK	120	464	495
NRPK	121	558	595
NRPK	122	589	621
NRPK	123	536	572
NRPK	124	510	542
NRPK	125	512	541
NRPK	126	475	512
NRPK	127	556	591
NRPK	128	525	556
NRPK	129	654	692
NRPK	130	558	589
WALL	131	533	556
WALL	132	468	444
WALL	133	599	636
WALL	134	394	416
WALL	135	369	391
WALL	136	453	454
WALL	137	481	517
WALL	138	362	383
WALL	139	545	572
WALL	140	544	568
WALL	141	460	482
WALL	142	579	605
WALL	143	363	383
NRPK	144	592	611
NRPK	145	560	586
WALL	146	454	474
WALL	147	345	362
WALL	148	407	426
WALL	149	449	471
WALL	150	535	560

Appendix 3. Biological information collected from fish caught during test angling, Gull Lake, 2017. Species codes: NRPK = northern pike, WALL = walleye.

Species	Sample #	Fork length (mm)	Total length (mm)
WALL	151	367	387
NRPK	152	537	575
WALL	153	373	389
WALL	154	510	534
WALL	155	485	506
WALL	156	513	538
WALL	157	410	425
WALL	158	432	457
WALL	159	455	476
WALL	160	348	372
WALL	161	432	450
WALL	162	401	420
WALL	163	343	362
WALL	164	439	462
WALL	165	447	469
WALL	166	503	527
WALL	167	465	493
WALL	168	470	489
WALL	169	380	402
WALL	170	520	554
WALL	171	454	478
WALL	172	352	371
WALL	173	526	557
WALL	174	532	562
WALL	175	444	465
WALL	176	519	547
WALL	177	449	469
WALL	178	438	459
NRPK	179	593	625
NRPK	180	536	584
NRPK	181	532	561
WALL	182	551	579
WALL	183	354	375
WALL	184	438	463
WALL	185	491	516
WALL	186	432	459
WALL	187	390	419
WALL	188	449	472
WALL	189	289	308

Species	Sample #	Fork length (mm)	Total length (mm)
WALL	190	365	384
WALL	191	298	317
WALL	192	438	463
WALL	193	482	511
WALL	194	274	292
WALL	195	517	545
WALL	196	436	457
WALL	197	454	474
WALL	198	392	416
WALL	199	470	496
NRPK	200	470	499
WALL	201	465	490
NRPK	202	628	665
WALL	203	379	395
NRPK	204	622	660
WALL	205	531	555
WALL	206	530	555
WALL	207	530	565
WALL	208	537	568
WALL	209	442	463
WALL	210	361	380
WALL	211	393	416
WALL	212	311	330
WALL	213	446	479
WALL	214	410	445
WALL	215	493	518
WALL	216	473	502
WALL	217	276	294
WALL	218	457	483
WALL	219	337	358
WALL	220	293	300
WALL	221	366	390
WALL	222	436	464
WALL	223	582	615
WALL	224	443	466
WALL	225	550	573
WALL	226	478	506
WALL	227	404	427
WALL	228	432	459

Appendix 3. Continued.

Species	Sample #	Fork length (mm)	Total length (mm)
WALL	229	387	413
WALL	230	482	512
WALL	231	528	562
WALL	232	535	562
WALL	233	399	417
WALL	234	571	594
NRPK	235	589	621
WALL	236	443	469
WALL	237	545	569
WALL	238	470	495
WALL	239	542	573
WALL	240	424	442
WALL	241	414	441
WALL	242	299	321
WALL	243	375	396
WALL	244	478	514
WALL	245	484	506
WALL	246	419	444
WALL	247	433	466
WALL	248	381	402
WALL	249	450	473
WALL	250	450	480
WALL	251	430	454
WALL	252	334	349
WALL	253	352	370
WALL	254	364	387
WALL	255	344	364
WALL	256	540	565
NRPK	257	507	538
WALL	258	512	537
WALL	259	560	589
WALL	260	420	443
NRPK	261	552	585
WALL	262	527	553
WALL	263	410	430
WALL	264	440	463
WALL	265	355	374
WALL	266	435	456
WALL	267	558	586

Species	Sample #	Fork length (mm)	Total length (mm)
WALL	268	432	453
WALL	269	460	487
WALL	270	377	396
WALL	271	562	593
NRPK	272	558	585
WALL	273	376	394
WALL	274	430	452
WALL	275	430	456
WALL	276	383	402
WALL	277	385	408
WALL	278	360	380
WALL	279	390	415
WALL	280	359	376
WALL	281	412	431
WALL	282	550	575
WALL	283	458	484
WALL	284	312	327
WALL	285	460	481
WALL	286	400	424
WALL	287	424	447
WALL	288	500	530
WALL	289	590	512
WALL	290	374	395
WALL	291	386	420
WALL	292	432	456
WALL	293	435	460
WALL	294	472	497
WALL	295	562	591
WALL	296	600	633
WALL	297	395	415
WALL	298	530	560
WALL	299	453	474
WALL	300	371	393
WALL	301	533	563
WALL	302	477	509
WALL	303	467	492
WALL	304	388	409
WALL	305	435	463
WALL	306	530	556

Appendix 3.	Continued.
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Species	Sample #	Fork length (mm)	Total length (mm)
WALL	307	471	498
WALL	308	398	423
WALL	309	553	571
WALL	310	451	473
WALL	311	447	476
WALL	312	465	488
NRPK	313	570	603
WALL	314	426	453
WALL	315	383	405
WALL	316	471	497
WALL	317	363	384
WALL	318	427	449
WALL	319	361	382
WALL	320	354	373
WALL	321	511	534
WALL	322	463	489
WALL	323	643	677
WALL	324	444	472
WALL	325	393	417
WALL	326	457	486
WALL	327	453	480
WALL	328	449	472
WALL	329	375	396
NRPK	330	498	529
NRPK	331	475	495
NRPK	332	624	661
WALL	333	455	476
WALL	334	362	375
NRPK	335	601	636
WALL	336	302	326
WALL	337	356	377
NRPK	338	491	526
NRPK	339	576	608
NRPK	340	498	533
NRPK	341	650	684
WALL	342	322	341
WALL	343	403	423
WALL	344	427	444
WALL	345	505	531

Appendix 3.	Continued.
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Species	Sample #	Fork length (mm)	Total length (mm)
NRPK	346	725	760
WALL	347	355	366
NRPK	348	623	654
WALL	349	471	494
WALL	350	379	402
WALL	351	365	382
WALL	352	440	461
WALL	353	456	480
WALL	354	455	479
WALL	355	510	529
WALL	356	456	480
WALL	357	519	548
NRPK	358	540	585
NRPK	359	630	660
WALL	360	453	475
WALL	361	430	454
WALL	362	463	485
WALL	363	300	308
WALL	364	363	386
WALL	365	398	419

Appendix 3. Continued.

Species	Sample #	Fork length (mm)	Total length (mm)
NRPK	63	597	630
NRPK	64	529	555
NRPK	65	527	559
NRPK	66	515	551
NRPK	67	529	561
NRPK	68	639	676
WALL	69	419	439
NRPK	70	628	664
NRPK	71	569	598
NRPK	72	548	583
NRPK	73	572	606
NRPK	74	495	538
NRPK	75	558	587
NRPK	76	554	587
NRPK	77	515	542
NRPK	78	541	577
NRPK	79	514	544
NRPK	80	514	533
NRPK	81	572	604
NRPK	82	551	586
NRPK	83	550	586
NRPK	84	569	603
NRPK	85	557	590
NRPK	86	518	550
NRPK	87	504	533
WALL	88	451	477
NRPK	89	546	580
WALL	90	437	483
NRPK	91	580	619
WALL	92	589	616
WALL	93	457	485
NRPK	94	572	609
NRPK	95	623	660
WALL	96	615	649
WALL	97	349	370
NRPK	98	554	584
NRPK	99	511	542
WALL	100	527	556

Appendix 4.Biological information collected from fish caught during test angling, Snipe
Lake, 2017. Species codes: NRPK = northern pike, WALL = walleye.

Species	Sample #	Fork length (mm)	Total length (mm)
NRPK	101	560	594
NRPK	102	524	556
NRPK	103	542	583
WALL	104	514	546
NRPK	105	470	508
NRPK	106	637	674
NRPK	107	526	559
NRPK	108	522	552
NRPK	109	537	569
NRPK	110	563	597
NRPK	111	500	533
WALL	112	486	505
WALL	113	577	586
NRPK	114	505	539
WALL	115	438	457
NRPK	116	530	564
NRPK	117	527	561
NRPK	118	540	572
NRPK	119	505	540
NRPK	120	506	538
NRPK	121	615	662
NRPK	122	543	570
NRPK	123	550	581
NRPK	124	558	584
NRPK	125	511	545
NRPK	126	545	577
NRPK	127	574	608
NRPK	128	641	680
NRPK	129	620	654
NRPK	130	522	547
WALL	131	519	545
WALL	132	620	643
NRPK	133	486	508
NRPK	134	577	619
NRPK	135	612	642
NRPK	136	509	540
NRPK	137	583	621
NRPK	138	510	540
WALL	139	450	481

Appendix 4. Continued.

Species	Sample #	Fork length (mm)	Total length (mm)
NRPK	140	539	572
NRPK	141	550	594
WALL	142	480	509
NRPK	143	525	558
NRPK	144	-	553
NRPK	145	-	580
NRPK	146	-	536
NRPK	147	-	568
NRPK	148	531	552
NRPK	149	473	515
NRPK	150	561	589
NRPK	151	496	516
NRPK	152	528	565
NRPK	153	540	574
NRPK	154	542	579

Appendix 4. Continued.

Appendix 5. Flow chart outlining the process used to calculate a whole-lake estimate for a multi-access lake using ratio-of-use at Gull and Snipe lakes, during the summer of 2017. Solid lines represent values with no variance, and dashed lines represent data with variance. WD = week day, WE = weekend/holiday.



29

Date	Number of	Fishing	NRPK	NRPK	WALL	WALL
(d/m/y)	anglers	effort (h)	harvest	release	harvest	release
19/05/2017*	48	58.75	0	11	0	2
20/05/2017	107	386	9	85	3	48
21/05/2017	70	179	3	13	1	14
22/05/2017	41	127.5	1	31	0	58
23/05/2017	9	38	1	9	0	34
24/05/2017	0	0	0	0	0	0
25/05/2017	2	3	0	0	0	0
26/05/2017	1	1	0	0	0	0
27/05/2017	34	72.75	0	18	0	2
28/05/2017	53	132.75	2	28	0	11
03/06/2017*	56	128.75	1	7	1	23
04/06/2017	26	58.25	1	9	2	4
05/06/2017	19	31.25	0	12	0	14
06/06/2017	13	36	0	23	0	30
07/06/2017	20	41.75	1	12	9	27
09/06/2017	14	25	2	14	0	10
10/06/2017	34	80	1	11	2	17
11/06/2017	43	91.25	3	32	2	144
17/06/2017	103	275.75	2	81	7	177
18/06/2017	98	204.25	6	49	0	40
19/06/2017*	13	59	1	16	1	87
20/06/2017	3	12	3	6	0	8
21/06/2017	0	0	0	0	0	0
22/06/2017	5	6	0	0	0	0
23/06/2017	18	40	1	7	0	19
24/06/2017*	125	186.5	3	64	8	151
25/06/2017	50	122	2	19	3	76
01/07/2017	52	135.5	6	45	2	58
03/07/2017*	46	85.75	0	36	4	66

Appendix 6. Summary of information collected from anglers during the creel survey at Gull Lake, 2017. Species codes: NRPK = northern pike, WALL = walleye. Note: * denotes ratio-of-use survey.

Date	Number of	Fishing	NRPK	NRPK	WALL	WALL
(d/m/y)	anglers	effort (h)	harvest	release	harvest	release
04/07/2017	45	91.25	4	28	0	38
05/07/2017	42	134.25	2	54	0	66
06/07/2017	15	42.25	1	33	0	38
07/07/2017	26	46	2	39	2	92
08/07/2017	75	198.5	2	66	7	193
09/07/2017	53	169.5	4	116	8	277
15/07/2017	24	96.25	1	33	4	122
16/07/2017	16	23	0	3	1	19
17/07/2017	4	16	0	2	0	3
18/07/2017*	43	132.5	0	57	0	167
19/07/2017	17	43	0	14	0	53
20/07/2017	17	66	0	13	1	78
21/07/2017	14	13.5	0	12	0	5
22/07/2017	80	342.25	4	65	13	388
23/07/2017	44	145	2	44	0	180
29/07/2017	78	242.75	6	28	4	195
30/07/2017	0	0	0	0	0	0
31/07/2017	38	65	1	25	0	63
01/08/2017	33	69	0	14	0	147
02/08/2017	22	51.25	0	11	0	76
03/08/2017	23	45.75	1	5	0	82
04/08/2017	16	22.5	0	4	0	18
05/08/2017	54	88.75	0	15	0	48
06/08/2017*	194	319.75	2	66	1	626
12/08/2017	38	87.75	1	16	0	97
13/08/2017	24	71.25	1	12	0	15
14/08/2017	19	38.25	0	8	0	33
15/08/2017	0	0	0	0	0	0
16/08/2017	32	65.25	0	13	4	54
17/08/2017	25	44.5	0	13	2	73

Appendix 6. Continued.

Date	Number of	Fishing	NRPK	NRPK	WALL	WALL
(d/m/y)	anglers	effort (h)	harvest	release	harvest	release
18/08/2017*	44	102.5	1	33	0	166
19/08/2017	48	114.25	1	23	0	69
20/08/2017	63	162.75	0	26	1	41

Appendix 6. Continued.



Lorenz curve and associated Gini coefficients for angler catch of walleye and northern pike at Gull Lake, 2017.



Species	Sample	Fork length	Total length	Weight	Sex	Maturity	Age
	#	(mm)	(mm)	(g)			(y)
NRPK	1	613	654	1,450	F	Mature	8
NRPK	2	680	719	1,870	F	Mature	7
NRPK	3	613	642	1,350	Μ	Mature	6
WALL	4	515	540	1,370	Μ	Mature	8
NRPK	5	623	660	1,600	F	Mature	5
NRPK	6	662	703	1,910	F	Unknown	5
NRPK	7	620	655	1,600	F	Mature	6
NRPK	8	610	641	1,250	F	Mature	7
WALL	9	637	665	2,240	F	Mature	14
WALL	10	634	667	2,570	F	Mature	15
WALL	11	582	605	2,010	М	Mature	9
WALL	12	524	587	1,930	F	Mature	9
WALL	13	534	560	1,590	Μ	Mature	7
WALL	14	557	583	1,850	F	Mature	9
WALL	15	556	581	1,730	М	Mature	7
WALL	16	528	562	1,510	F	Mature	9
WALL	17	513	538	1,640	Μ	Mature	18
WALL	18	542	572	1,540	F	Mature	9
WALL	19	517	540	1,690	Μ	Mature	10
WALL	20	501	525	1,400	Μ	Mature	13
WALL	21	516	540	1,370	Μ	Mature	8
NRPK	22	690	721	1,670	F	Mature	9
NRPK	23	748	791	2,950	F	Mature	8
NRPK	24	625	632	1,290	F	Mature	5
NRPK	25	611	647	1,470	F	Immature	4
WALL	26	542	571	1,540	F	Mature	8
WALL	27	526	610	2,050	F	Mature	8
WALL	28	589	615	2,090	F	Mature	9
WALL	29	534	562	1,640	М	Mature	-
WALL	30	526	553	1,840	М	Mature	9
WALL	31	597	613	1,840	F	Mature	9
NRPK	32	609	647	1,300	F	Mature	5
WALL	33	564	597	1,850	F	Mature	10
WALL	34	595	608	2,190	F	Mature	9
NRPK	35	675	708	1,690	F	Mature	9
NRPK	36	766	804	2,950	F	Mature	7
NRPK	37	539	571	980	F	Mature	2

Appendix 8. Biological information collected from fish harvested by anglers during the creel survey at Gull Lake, 2017. Species codes: NRPK = northern pike, WALL = walleye, YLPR = yellow perch.

Species	Sample	Fork length	Total length	Weight	Sex	Maturity	Age
	#	(mm)	(mm)	(g)			(y)
NRPK	38	582	620	1,450	F	Mature	3
NRPK	39	637	677	1,750	Μ	Immature	5
NRPK	40	646	689	1,580	F	Mature	8
NRPK	41	695	731	1,960	F	Mature	8
NRPK	42	855	895	4,200	F	Mature	9
NRPK	43	605	648	1,480	Μ	Mature	4
WALL	44	516	545	1,450	Μ	Mature	-
NRPK	45	724	768	2,300	F	Mature	7
NRPK	46	761	797	2,950	F	Mature	8
NRPK	47	620	658	1,350	F	Mature	5
NRPK	48	613	650	1,350	F	Mature	7
WALL	49	481	507	1,130	F	Mature	4
WALL	50	464	515	1,195	F	Mature	4
NRPK	51	588	617	1,250	F	Mature	5
NRPK	52	595	636	1,350	Μ	Mature	6
NRPK	53	686	731	1,890	F	Mature	6
NRPK	54	833	888	4,000	F	Mature	11
NRPK	55	605	641	1,150	Μ	Mature	9
NRPK	56	680	733	1,975	F	Mature	7
NRPK	57	673	713	1,500	М	Mature	10
NRPK	58	607	643	1,380	F	Mature	7
NRPK	59	662	701	1,670	F	Mature	6
WALL	60	518	545	1,560	М	Mature	9
WALL	61	540	568	1,630	М	Mature	9
YLPR	62	200	208	100	М	Mature	-
NRPK	63	644	686	1,640	F	Mature	5
WALL	64	517	545	1,460	F	Mature	9
WALL	65	629	654	1,860	F	Mature	15
WALL	66	620	651	1,730	F	Mature	17
NRPK	67	600	634	1,230	М	Mature	5
NRPK	68	613	650	1,440	М	Mature	5
NRPK	69	643	678	1,570	F	Mature	8
WALL	70	583	611	1,740	F	Mature	9
WALL	71	524	553	1,640	М	Mature	9
WALL	72	585	608	1,720	F	Mature	7
WALL	73	602	635	2,110	F	Mature	16
WALL	74	593	624	2,100	F	Mature	9
NRPK	75	644	685	1,610	F	Mature	6
WALL	76	577	600	1,820	F	Mature	9

Appendix 8. Continued.

Species	Sample	Fork length	Total length	Weight	Sex	Maturity	Age
	#	(mm)	(mm)	(g)			(y)
WALL	77	564	591	1,750	F	Mature	9
NRPK	78	666	707	1,670	F	Mature	5
WALL	79	537	555	1,690	F	Mature	9
NRPK	80	629	669	1,650	F	Mature	5
WALL	81	571	596	1,830	F	Mature	8
WALL	82	572	599	1,845	F	Mature	-
WALL	83	582	607	1,710	F	Mature	13
WALL	84	579	593	1,775	F	Mature	10
WALL	85	575	602	1,850	F	Mature	11
WALL	86	590	622	1,850	F	Mature	15
WALL	87	552	580	1,750	F	Mature	9
WALL	88	525	544	1,485	F	Mature	8
WALL	89	604	625	2,000	F	Mature	16
WALL	90	540	572	1,670	F	Mature	8
WALL	91	545	565	800	Μ	Mature	17
NRPK	92	638	687	1,480	F	Mature	5
WALL	93	475	502	1,170	Μ	Mature	5
WALL	94	543	570	1,530	F	Mature	-
WALL	95	505	533	1,500	U	Unknown	-
WALL	96	583	611	2,120	F	Mature	9
NRPK	97	691	721	1,910	F	Mature	8
WALL	98	485	511	1,100	Μ	Mature	7
NRPK	99	692	735	1,940	F	Mature	9
NRPK	100	620	659	1,355	F	Mature	5
NRPK	101	655	695	1,595	F	Mature	6
NRPK	102	775	815	2,940	F	Mature	14
NRPK	103	655	687	1,830	F	Mature	10
YLPR	104	205	214	-	U	Unknown	-
WALL	105	517	540	1,510	Μ	Mature	11
WALL	106	556	582	1,610	F	Mature	10
WALL	107	600	625	1,920	F	Mature	9
WALL	108	588	615	1,820	F	Mature	9
WALL	109	589	610	1,940	F	Mature	-
WALL	110	587	610	1,870	F	Mature	-
NRPK	111	632	673	1,300	F	Mature	6
WALL	112	500	524	1,400	Μ	Mature	9

Appendix 8. Continued.

Date	Number	Fishing	NRPK	NRPK	WALL	WALL
(d/m/y)	of anglers	effort (h)	harvest	release	harvest	release
18/05/2017	2	7.5	0	8	0	0
19/05/2017	7	13.5	0	1	0	0
20/05/2017*	38	103	1	114	0	0
21/05/2017	54	160.5	8	196	11	4
22/05/2017	24	40	0	94	7	6
23/05/2017	2	7.25	0	17	1	5
24/05/2017	0	0	0	0	0	0
25/05/2017	2	3	0	3	0	0
26/05/2017	4	13	0	3	0	0
27/05/2017	33	54	4	61	1	11
28/05/2017	14	27.75	1	105	0	0
03/06/2017*	27	92.5	3	61	3	5
04/06/2017	12	13.25	0	21	0	0
05/06/2017	9	35	0	8	0	0
06/06/2017	6	20.75	0	1	0	0
07/06/2017	18	43	0	19	1	4
08/06/2017*	7	8.25	1	2	1	1
09/06/2017	2	12	0	0	0	2
10/06/2017	23	50.25	2	12	0	0
11/06/2017	6	6.5	0	0	0	0
16/06/2017	0	0	0	0	0	0
17/06/2017	2	0.5	0	1	0	0
18/06/2017	6	8	0	0	0	0
19/06/2017*	4	20	0	12	0	0
20/06/2017	6	6	0	8	1	0
21/06/2017	0	0	0	0	0	0
22/06/2017	1	1.5	0	0	0	0
23/06/2017	8	27	0	14	2	7
24/06/2017*	26	28.75	0	4	3	4

Appendix 9. Summary of information collected from anglers during the creel survey at Snipe Lake, 2017. Species codes: NRPK = northern pike, WALL = walleye. Note: * denotes ratio-of-use survey.

Date	Number	Fishing	NRPK	NRPK	WALL	WALL
(d/m/y)	of anglers	effort (h)	harvest	release	harvest	release
25/06/2017	5	20.5	0	10	1	0
30/06/2017	0	0	0	0	0	0
01/07/2017	25	27.75	2	2	2	3
02/07/2017	64	106	1	22	2	7
03/07/2017	4	2.5	0	0	0	0
04/07/2017	9	19.75	0	5	1	0
05/07/2017	20	37.5	0	17	4	7
06/07/2017	8	18.25	0	21	3	8
07/07/2017	38	57.75	3	15	2	2
08/07/2017*	51	89.75	3	13	1	4
09/07/2017	24	43.5	1	7	2	4
15/07/2017	6	3	0	0	0	0
16/07/2017	6	3.5	0	2	0	0
17/07/2017	0	0	0	0	0	0
18/07/2017*	9	20.25	0	4	1	0
19/07/2017	9	16.5	0	5	1	0
20/07/2017	0	0	0	0	0	0
21/07/2017	3	1.25	0	0	0	0
22/07/2017	4	6.25	0	0	0	0
23/07/2017	2	1.75	0	0	0	0
28/07/2017	0	0	0	0	0	0
29/07/2017	36	70	0	2	0	2
30/07/2017*	20	29.5	1	1	0	1
31/07/2017	2	2	0	1	0	0
01/08/2017	11	14	0	0	0	0
02/08/2017	10	12	0	1	0	0
03/08/2017	4	12	0	0	1	0
04/08/2017	9	5.25	1	0	0	0
05/08/2017	7	6.5	1	0	0	0
06/08/2017*	21	11.25	0	1	0	0
11/08/2017	0	0	0	0	0	0

Appendix 9. Continued.

Date	Number	Fishing	NRPK	NRPK	WALL	WALL
(d/m/y)	of anglers	effort (h)	harvest	release	harvest	release
12/08/2017	4	2	0	0	0	0
13/08/2017	8	16.5	0	0	0	0
14/08/2017	3	3.25	0	0	0	0
15/08/2017	2	1.5	0	0	0	0
16/08/2017	0	0	0	0	0	0
17/08/2017	0	0	0	0	0	0
18/08/2017	0	0	0	0	0	0
19/08/2017	0	0	0	0	0	0
20/08/2017	4	10.25	0	2	0	0

Appendix 9. Continued.



Lorenz curve and associated Gini coefficients for angler catch of walleye and northern pike at Snipe Lake, 2017.



Species	Sample #	Fork length	Total length	Weight	Sex	Maturity	Age
		(mm)	(mm)	(g)			(y)
WALL	1	593	620	2,065	F	Mature	-
WALL	2	538	565	1,590	М	Mature	2
WALL	3	579	609	1,810	F	Mature	10
WALL	4	553	567	1,775	М	Mature	9
NRPK	5	610	650	1,380	F	Unknown	5
WALL	6	529	604	1,975	F	Mature	9
WALL	7	522	550	1,525	F	Mature	6
WALL	8	580	603	1,795	М	Mature	8
WALL	9	492	500	1,490	М	Mature	9
WALL	10	569	590	1,845	М	Mature	
NRPK	11	545	581	1,040	М	Mature	4
NRPK	12	695	731	1,585	F	Mature	9
NRPK	13	556	588	900	М	Immature	4
NRPK	14	521	558	890	F	Mature	3
NRPK	15	561	583	1,065	F	Mature	3
WALL	16	556	588	1,530	М	Mature	10
WALL	17	513	554	1,630	М	Mature	10
WALL	18	540	569	-	U	Unknown	-
WALL	19	621	646	2,380	М	Mature	9
WALL	20	572	588	1,445	М	Mature	8
WALL	21	543	574	1,400	М	Mature	9
WALL	22	532	551	1,430	М	Mature	8
WALL	23	546	568	1,620	F	Mature	7
WALL	24	541	567	1,700	М	Mature	6
NRPK	25	535	564	960	М	Immature	4
NRPK	26	540	572	815	М	Immature	4
NRPK	27	593	665	1,390	М	Unknown	7
NRPK	28	533	572	985	F	Immature	5
NRPK	29	594	619	1,045	М	Immature	5

Appendix 11. Biological information collected from fish harvested by anglers during the creel survey at Snipe Lake, 2017. Species codes: NRPK = northern pike, WALL = walleye.

Species	Sample #	Fork length	Total length	Weight	Sex	Maturity	Age
		(mm)	(mm)	(g)			(y)
NRPK	30	470	508	705	F	Immature	3
WALL	31	540	560	1,660	М	Mature	8
WALL	32	586	605	1,995	М	Mature	9
NRPK	33	582	618	1,110	F	Mature	5
NRPK	34	580	615	1,210	F	Mature	5
WALL	35	562	583	1,760	F	Mature	7
WALL	36	625	649	2,165	F	Mature	8
WALL	37	531	558	1,445	М	Unknown	8
WALL	38	481	509	1,175	F	Mature	-
WALL	39	619	646	2,020	F	Mature	9
WALL	40	514	534	1,555	F	Mature	5
NRPK	41	547	584	1,140	F	Immature	4
NRPK	42	551	586	1,045	М	Unknown	5
WALL	43	573	600	1,875	М	Mature	9
WALL	44	625	644	2,170	F	Mature	10
WALL	45	434	454	910	М	Immature	4
WALL	46	614	639	2,445	F	Mature	6
WALL	47	570	594	2,045	М	Mature	9
WALL	48	579	608	1,965	М	Mature	9
WALL	49	603	634	2,050	М	Mature	8
WALL	50	611	632	2,310	F	Mature	7
WALL	51	581	605	2,230	F	Mature	10
WALL	52	645	668	2,270	М	Mature	13
NRPK	53	550	584	925	М	Immature	3
NRPK	54	555	592	1,040	F	Immature	5
WALL	55	481	505	1,330	М	Mature	5
WALL	56	571	585	1,830	U	Unknown	10
NRPK	56b	544	582	1,110	F	Mature	4
WALL	57	505	533	1,400	F	Mature	5
WALL	58	498	525	1,130	F	Mature	5
NRPK	59	505	536	910	F	Mature	4

Appendix 11. Continued.

Species	Sample #	Fork length	Total length	Weight	Sex	Maturity	Age
		(mm)	(mm)	(g)			(y)
WALL	60	544	569	1,775	М	Mature	9
NRPK	61	565	600	1,230	F	Mature	4
NRPK	62	575	615	1,305	F	Mature	5

Appendix 11. Continued.

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