Alaska Fisheries Data Series Report 2005-000

Comparison of Two Forms of Longnose Suckers on the Kenai National Wildlife Refuge, Alaska

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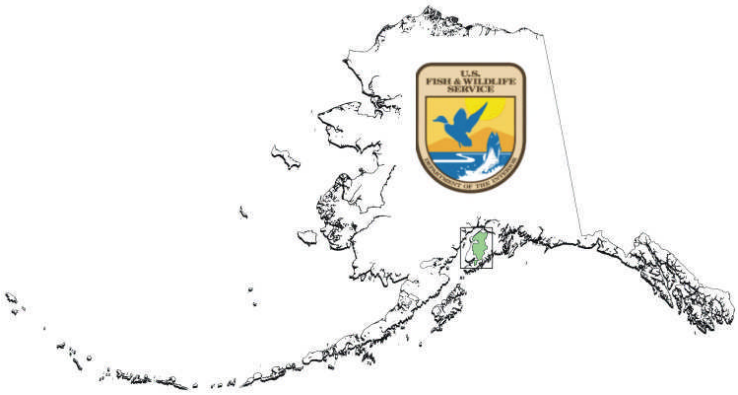

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by

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Key Words: *Catostomus catostomus*, longnose sucker, Finger Lakes, Kenai National Wildlife Refuge, opercules, life history, meristic characteristics

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Abstract.--Longnose suckers *Catostomus catostomus* are widely distributed throughout Alaska, including over 60 lakes on the Kenai National Wildlife Refuge (Refuge). Most of the lakes previously sampled on the Refuge have sucker populations that are morphologically similar to populations elsewhere in Alaska. However, a semi-dwarf form was documented in the Finger Lakes, a cluster of five land-locked lakes in the Swanson River watershed. In this study, we compare life history, morphology and meristic characteristics of "normal-sized" suckers from Kelly and Sucker Lakes with the semi-dwarf form from East Finger and both West Finger Lakes. In addition we found the semi-dwarf form in Wolf Lake, a body of water adjacent to the Finger Lakes system. Normal-sized suckers were significantly larger than the semi-dwarf form. The shortest mature normal-sized suckers had fork lengths of 345 mm for males and 391 mm for females; in contrast, maximum lengths of mature semi-dwarf suckers were 248 mm for males and 340 mm for females. Based on opercules, normal-sized suckers were older ($\leq$ 28 years) than semi-dwarfs ($\leq$ 13 years). In addition to smaller size and reduced longevity, semi-dwarf suckers showed several unique life history differences including slower growth rate, earlier maturity, and later and longer spawning period.

Introduction

Two sizes or forms of longnose sucker *Catostomus catostomus* were described by Dean (2002) for the Refuge. A larger form, found in 60 lakes on the Refuge, has morphometrics similar to longnose suckers elsewhere in Alaska (Morrow 1980) and is referred to as "normal" in this report. A smaller form occurs in the Finger Lakes, a cluster of four oligotrophic (nutrient poor) lakes that are land-locked, and Wolf Lake, part of an open water system (Fig. 2). This smaller form is larger than dwarf suckers described as *C.c. pocatello* in Idaho and Montana and *C.c. nannomyzon* in the east (McPhail and Lindsey 1970). Consequently, in this report, we refer to the smaller form on the Kenai as "semi-dwarf". This study was initiated at the request of Supervisory Fish and Wildlife Biologist Dr. John Morton in early 2003.

Our study objectives were to determine differences between the semi-dwarf and normal forms, specifically in life history, morphology and meristic characteristics. Pre-spawning semi-dwarf suckers in Wolf, East Finger, and both West Finger Lakes were compared with normal shoreline spawners in Kelly Lake and with a stream-spawning population from Sucker Lake. Kelly and Sucker Lakes were selected for this study because they have accessible spawning areas on the Refuge. In an effort to identify additional semi-dwarf sucker populations, we also set test nets in Headwater Lake and an unnamed lake we called Cricket Lake. Cricket Lake is a tributary to Wolf Lake and Headwater Lake's outlet stream is a tributary to Mink Creek.

Methods

We used experimental gill nets and a beach seine to collect longnose sucker specimens from various lakes on the Northern Kenai Peninsula (Fig. 1). Gill nets were 30.5-m long by 2.4-m deep with five 6-m panels of 25, 51, 64, 76, and 102-mm stretch monofilament mesh. These nets were easy to transport overland and safely used from a canoe. A 30-m seine was used primarily to collect spawning longnose suckers. Two sizes of hoop nets were initially used, but both were quickly abandoned due to limited success.

Fork lengths were measured to the nearest mm and weights recorded to the nearest 5 g on small fish and to 20 g on large specimens. A platform scale was used to weigh fish from Sucker Lake. This scale was difficult to tare so Homs ™ 2,000 g and Pescola™ 1,000 g spring scales were used to weigh fish from other study lakes. We determined the sex of each sucker by visual examination. Pre-spawning males had nuptial tubercules on the anal and the lower half of their caudal fins (Fig. 3 and 4). If there was any doubt as to sex, we examined specimens internally to determine the presence of eggs. We used 2-way analysis of variance (ANOVA) to model fork length and weight using FORM and SEX as main effects with interaction.

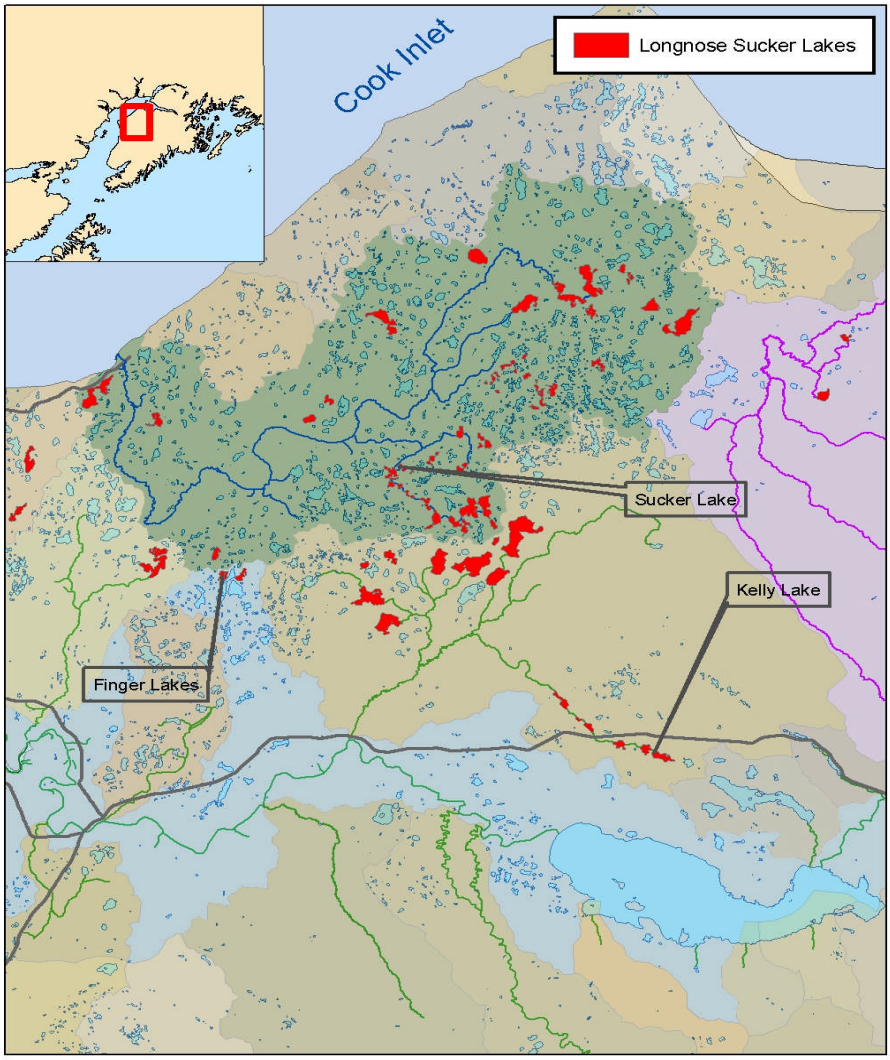

Figure 1. Known distribution of longnose sucker on the northern Kenai Peninsula.

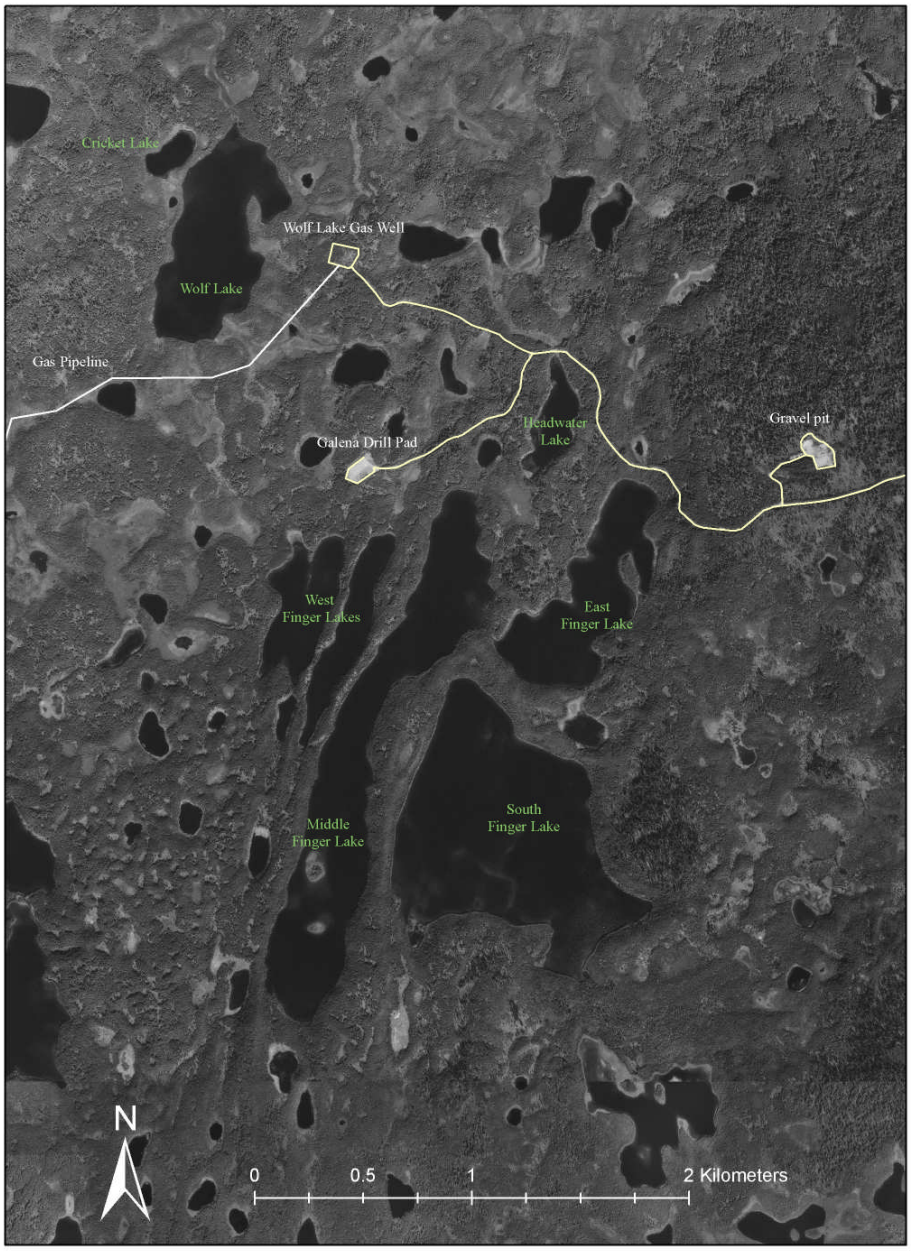

Figure 2. Map of the Finger Lakes Study Area.

Egg diameters were measured by arranging 10 eggs in a row on a millimeter ruler. Fins on the left side were removed for meristic counts and placed on 5 x 8 inch cards for drying. After drying, the fin rays were counted. Condition factor was calculated using the formula $C = W^5/L^3$ where W is weight (g) and L is length (mm).

Age and growth were determined from annuli of the opercule bone (LeCren 1947). This structure has been shown to provide more reliable ages than scales. This relationship is especially true for older and larger suckers where ages determined with scales can be underestimated as much as 50% (Scoppettone 1988). Opercules were aged with equipment that consisted of focused lab lights and a Ken-a-vision™ lens connected to a TV screen. The enlarged opercular images were photographed from the TV screen using a Sony™ (R) five MP digital camera, saved as JPEG files, and subsequently printed for analysis. We interpreted annuli from all semi-dwarf and most normal-sized specimens; however, Gary Scoppettone (USGS, Reno, NV) interpreted annuli from some problematic normal-sized specimens collected in Kelly and Sucker Lakes. Back calculations of lengths at each annulus were determined by direct proportion.

Figure 3. A pair of spawning female longnose suckers from Kelly Lake. The net diameter is 440 mm.

Figure 4. Nuptial tubercles on the anal fin of a mature longnose sucker.

Results

We captured longnose suckers in all six-study lakes (Table 1). No suckers were captured in gill nets set in Cricket Lake, a tributary of Wolf Lake, or in Headwater Lake at the top of the Mink Creek watershed.

Table 1. Longnose sucker study lakes, Kenai National Wildlife Refuge, 2003.

						Fish species present								
Lake	Size ha	Max. depth (m)	Inlet	Outlet	Land-locked	Arctic Char	Dolly Varden	Rainbow trout	Coho salmon	Longnose sucker	3- Spined stickleback	C.r. sculpin	Arctic lamprey	9-Spined stickleback
Cricket	4	7		X	No						x			
E. Finger	29	12	X	X	Yes	x				x	x	x	x	
Headwater	11	8		X	No						x			
Kelly	57	13	X	X	No			x	x	x	x			
Sucker	*	*	X	X	No		x	x	x	x	x	x	x	
W. Finger (2)	30	14			Yes					x	x			
Wolf	36	14	X	X	No	x		x		x	x	x	x	x
Total	167 hectares					2	1	3	2	5	7	3	2	1

* Lake has not been surveyed

We initially proposed to collect 50 pre-spawning adult suckers from each lake, but met that objective on only three lakes (Table 2). Thirty-eight adult and two immature suckers, 55 rainbow trout *Oncorhynchus mykiss* and one Dolly Varden *Salvelinus malma* were captured in one overnight gill net set in Sucker Lake. Because of this high catch of nontarget species, no additional netting was done at Sucker Lake. In order to reduce the by-catch of Arctic char *Salvelinus alpinus* from East Finger and Wolf Lakes, only the small mesh ends of the gill nets were fished. The sample from Wolf Lake was restricted to 12 fish due to concerns about taking too many small suckers from this 36-ha lake.

Table 2. Mean lengths, weights and condition factors for mature normal sized and semi-dwarf longnose suckers sampled from six Kenai National Wildlife Refuge lakes, 2003.

		Mature males				Mature females			
Lake	Form	Number	length (mm)	weight (g)	"C"	Number	length (mm)	weight (g)	"C"
Kelly	normal	34	421	890	1.18	25	459	1253	1.30
Sucker	normal	23	377	637	1.19	15	419	871	1.19
E. Finger	semi-dwarf	18	191	73	1.01	51	243	191	1.14
W.E. Finger	semi-dwarf	2	203	98	1.17	11	237	161	1.12
W.W. Finger	semi-dwarf	5	179	53	0.89	6	182	57	0.94
Wolf	semi-dwarf	3	183	66	1.05	7	208	105	1.11

Condition factor ("C"): poor < 1.10, normal $\geq$ 1.10 - 1.20, excellent $\geq$ 1.20

The two forms of longnose suckers were conspicuously different in size (Fig. 5). The smallest normal-sized mature male suckers from Sucker and Kelly Lakes had fork lengths of 345 and 366 mm, respectively. The shortest mature females from these lakes were 391 and 429 mm in fork length. The longest mature semi-dwarf male sucker from East Finger Lake was 249 mm in fork length. The shortest male with nuptial tubercules was only 173 mm. Two thirds of the shortest mature males in East Finger Lake were < 191 mm.

A skewed length frequency distribution suggests that mature males < 173 mm are probably present in this lake but were not captured because of the limitations of the smallest mesh in the gill nets used (Appendix 1). The longest mature female in East Finger Lake was 340 mm and weighed 490 g. This was the heaviest longnose sucker captured in Finger Lakes by the Alaska Fish and Game Department and the U.S. Fish and Wildlife Service since 1964 (n = 305). The average mature female was 244 mm long

Figure 5. The large suckers are spawners from Kelly lake. The small ones are spawners from Wolf Lake. The larger semi-dwarf has a fork length of 272 mm. This female is the largest sucker captured to date from this lake (n=38). Photograph by Fishery Biologist Doug Palmer.

while the shortest one had a fork length of 180 mm. The length frequency of mature females from this lake showed a normal distribution.

A 2-way ANOVA suggests that mean fork length (df = 3,196, F = 683.7, P < 0.0001) differed by SEX (F = 84.9, P < 0.0001) and FORM (F = 1977.5, P < 0.0001), but not their interaction (F = 0.52, P = 0.47). Similarly, a 2-way ANOVA suggests that mean weight (df = 3,196, F = 465.4, P < 0.0001) differed by SEX (F = 75.1, P < 0.0001), FORM (F = 1266.8, P < 0.0001), and their interaction (F = 25.55, P < 0.0001). Both ANOVA models indicate that FORM explains much more of the variance in fork length and weight than does SEX. However, the significant interaction term between SEX and FORM for weight indicates that the difference in mean weight between semi-dwarf males and females is greater than it is between normal males and females (Table 3). Similarly, the considerably higher coefficients of variation (CV) for weight and fork length in the semi-dwarf form suggest that there is much more body size variation in the semi-dwarf form of the longnose sucker (Table 3).

Table 3. Mean fork length of normal and semi-dwarf longnose suckers.

Sex	Form	N	Mean	SE	CV	MIN	MAX
F	semi-dwarf	75	233.9	4.380	16.21	167	340
F	normal	40	444.2	4.526	6.44	390	498
M	semi-dwarf	28	186.2	4.604	13.08	102	240
M	normal	57	403.4	3.681	6.88	345	452

Mean weight of normal and semi-dwarf longnose suckers.

Sex	Form	N	Mean	SE	CV	MIN	MAX
F	semi-dwarf	75	155.2	9.510	53.13	45	490
F	normal	40	1110	42.530	24.23	628	1660
M	semi-dwarf	28	70.3	5.290	39.86	45	160
M	normal	57	787.7	20.760	19.90	510	1130

There were 57 males and 40 females in our combined samples from Kelly and Sucker Lakes (sex ratio = 1.43 ♂:1 ♀). The sex ratio of the semi-dwarf sucker populations sampled was different (Table 2). Finger Lakes females outnumbered males 75 to 28 (2.68 ♀:♂). A sample of 15 small suckers from East Finger Lake in 1993 by the Kenai Fish and Wildlife Field Office (FWFO) included only 3 males (4♀:1♂)(Tobin and Palmer 1997). The reasons for these unbalanced sex ratios are unknown. Most of the males were in poor condition in East Finger, Wolf and the west basin of West Finger Lakes (Table 2). This poor condition may be responsible for a high post-spawning mortality rate, which could contribute to this unbalanced sex ratio.

Meristic (fin ray) counts from fish captured in the four primary study lakes did not appear to be substantially different (Table 4). Larger samples, however, may indicate otherwise. What is interesting from these counts are the differences these Kenai suckers show from those published for Alaskan populations. Morrow (1980) reports Alaskan suckers with 9 - 11 dorsal fin rays, 7 anal fin rays, 16 - 18 pectoral fin rays, and 10 - 11 pelvic fin rays. Spawning male Kenai longnose suckers do not have nuptial tubercules on their heads as reported for populations elsewhere (McPhail and Lindsey 1970). These fin ray and nuptial tubercule differences suggest they may have developed over time because of reproductive isolation from other Alaskan sucker populations.

Table 4. Meristic (fin ray) and egg diameter counts for longnose suckers from four Kenai National Wildlife Refuge lakes.

		Mean fin ray counts					Mean egg
Form	Number	dorsal	anal	pectoral	pelvic	Number	diameter (mm)
normal	13	11.5	7.5	14.4	10.0	3	1.9
normal	8	11.7	7.6	15.3	10.1	4	1.7
semi-dwarf	10	11.2	7.4	14.8	9.8	7	1.8
semi-dwarf	5	11.0	7.6	14.5	10.0	4	1.8

We found a depression on the snouts of most semi-dwarf suckers (Fig. 6). This depression may be another indication of the poor body condition of most of the semi-dwarf suckers in our samples.

We counted lateral line scales on three specimens from Sucker Lake and one semi-dwarf sucker from East Finger Lake. These four fish all had lateral line scale counts approximating 104. This is within the normal range for this species in Alaska (Morrow 1980).

Figure 6. Finger Lakes longnose suckers. Note the depression on the snout of the upper fish.

Even with substantial magnification of the opercules, interpretation was required to age many of these fish (Figs. 7, 8). Thick bone close to the hyomandibular socket obscuring the first annulus and false annuli made aging difficult. Aging the older suckers, with ten plus annuli after maturity, was also difficult and may be under or over estimated by two to three years.

Despite these technical difficulties with aging older individuals, it was apparent that the two normal populations were older than the pooled population of semi-dwarf suckers (Table 5). The oldest fish captured in Sucker Lake was 15 years old (Table 5). The oldest fish from Kelly Lake was 23 years old (Table 5), although one female sucker was subsequently estimated to be 28 years old (Scoppettone, unpublished data). In contrast, the oldest male in our sample from East Finger Lake was 8 years old (n = 9). Similarly, only one female > 10 years old was captured in this lake (n = 16) and the oldest female in

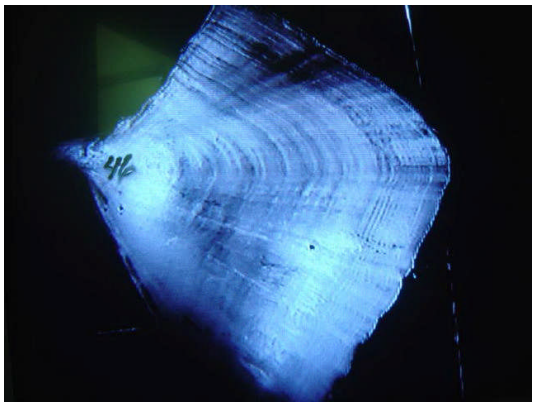

Figure 7. Opercule from a 432 mm male sucker captured at Kelly lake on May 28, 2003.

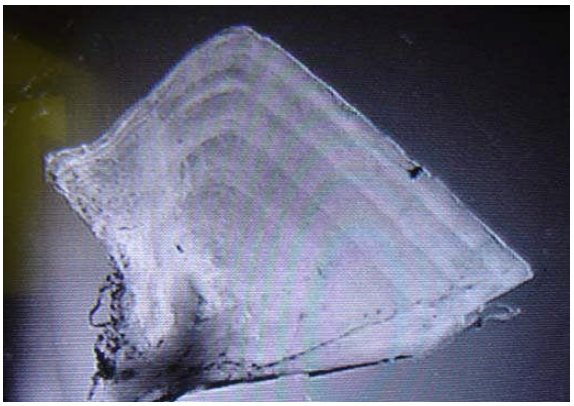

Figure 8. Opercule from a 180 mm sucker from E. Finger Lake taken on June 10, 2003. Four annuli are evident. There is probably a hidden first annulus and one at the outer edge of the opercule.

a small sample from Wolf Lake was 8 years old (n = 5).

In addition to reduced longevity, back-dated fork lengths suggest that growth rates of both female (Fig. 9) and male (Fig. 10) semi-dwarf longnose suckers were lower than those of normal suckers. By the fifth year class, semi-dwarf growth rates for both sexes significantly diverge from their normal counterparts captured in Kelly and Sucker lakes.

Table 5. Estimated ages and back calculated fork lengths in mm of longnose suckers in Alaska using the opercule bone. The number of fish used to determine each age class is in parentheses.

Age Class	E.Finger & Wolf Lakes	Sucker Lake	Sucker Lake	Kelly Lake	Popular Grove Creek
II	96 (24)	91 (2)		120 (15)	127
III	131 (30)	125 (7)		163 (15)	157
IV	159 (30)	160 (7)		204 (15)	183
V	184 (30)	205 (7)		242 (15)	210
VI	202 (27)	250 (7)		275 (15)	239
VII	226 (19)	298 (7)		300 (15)	269
VIII	241 (14)	328 (7)		326 (15)	297
IX	262 (07)	353 (7)		343 (15)	323
X	264 (03)	365 (6)	362 (1)	353 (14)	345
XI	272 (01)	381 (3)	383 (4)	363 (14)	363
XII	278 (01)	386 (3)	428 (1)	373 (14)	384
XIII	284 (01)	400 (3)	375 (2)	379 (13)	401
XIV		411 (2)		385 (11)	417
XV		420 (1)		394 (11)	
XVI				404 (11)	
XVII				414 (10)	
XVIII				419 (08)	
XIX				421 (07)	
XX				431 (06)	
XXI				447 (04)	
XXII				445 (02)	
XXIII				450 (01)	
Number	30	7	7	15	80
Source	Dean	Dean	Scoppettone	Dean	Pierce

Spawning activities of large suckers were observed between May 23 and June 3 (12 d) in Sucker Creek (Fig. 11); in the East Fork of the Moose River between May 24 and June 5 (13 d) and at Kelly Lake between May 26 - 31. Spawning at Kelly Lake apparently ceased sometime between May 31 and June 5. An unusually mild winter and an early spring may have influenced the initiation and duration of spawning in 2003. Longnose suckers reportedly spawn when water temperatures are 10 - 15° C (Edwards 1983). Spawning at Sucker Creek was first observed at an afternoon water temperature of 15° C. Water temperatures as high as 16.8° C were recorded during the sucker spawning run in

Sucker Creek. The surface temperature was 14° C when the first sucker spawning activities were observed at Kelly Lake (Fig. 12).

Figure 9. Mean fork length (+/- 1 SE) by year class for two forms of female longnose suckers.

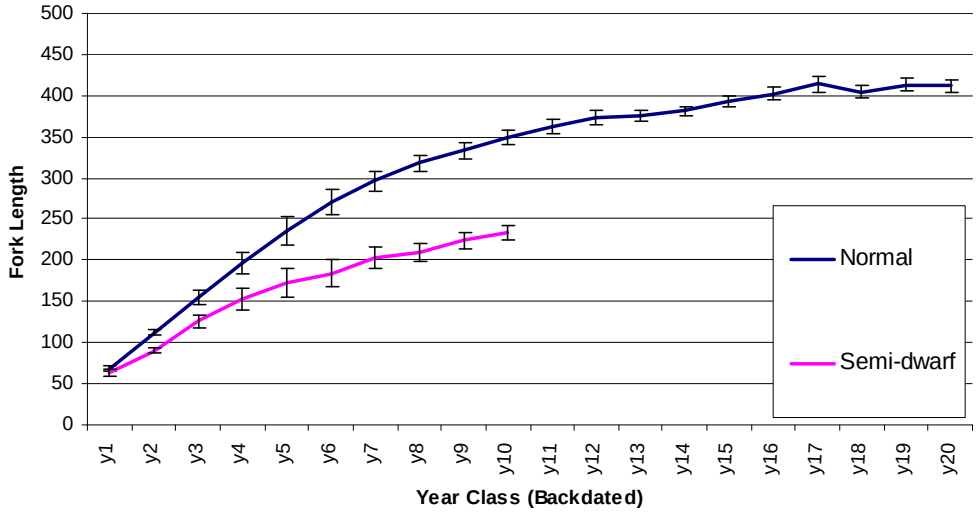

Figure 10. Mearn fork length (+/- 1 SE) by year class for two forms of male longnose suckers.

Only one spawning site for semi-dwarf suckers was located. We first observed spawning activity in front of the beaver dam at the outlet of East Finger Lake on May 28 when the surface temperature was 14° C. Spawning suckers were still present there on June 10

when the surface temperature was 15° C. Most of the female suckers captured in gill nets from three of the Finger Lakes on June 10 had not yet spawned, suggesting that they have a later and perhaps longer spawning period than the normal-sized suckers in Kelly and Sucker lakes.

Figure 11. Jack Dean at a Sucker Creek spawning riffle.

Figure 12. Boat launch spawning site at Kelly Lake.

Discussion

We found viable semi-dwarf sucker populations in both basins of West Finger Lake. Only two small suckers were captured in two gill nets set in the east basin of West Finger Lake by the Kenai Fish and Wildlife Field Office (FWFO) 10 years ago (Tobin and Palmer, 1997). Our sampling indicates this basin is now sustaining a viable semi-dwarf population in normal body condition (Table 2). The west basin had not been sampled since 1964 when it supported both Arctic char and longnose suckers.

The 1964 Good Friday Earthquake, which registered 9.2 on the Richter scale, significantly affected three of the Finger Lakes. Prior to the earthquake, West Finger Lake was connected to Middle Finger Lake during wet cycles. After the earthquake, a ridge separated these two lakes. A further separation created two lakes out of West Finger Lake. The Arctic char have apparently disappeared from both basins of West Finger Lake, probably from a lack of access to spawning habitat in Middle Finger Lake. Both West Finger Lakes may, however, be affected by rapid water level fluctuations during the next wet cycle if the east basin overflows and cuts a channel into the nearby west basin. If this occurs both sucker populations could be impacted if water level changes affect shoreline spawning habitats.

All evidence indicates that the five Finger Lakes were land-locked before the 1964 earthquake, as they are now. Longnose sucker populations within this cluster are geographically isolated from the other 60 lakes on the Refuge that contain populations of normal-sized longnose suckers. Consequently, we were surprised to find a semi-dwarf population in Wolf Lake, which is part of an open system. At higher water levels,

according to the 1:25,000 USGS Kenai (C-3) NE contour map, the east basin of West Finger Lake could overflow into Wolf Lake.

The presence of semi-dwarf suckers in Wolf Lake and upstream in the Finger Lakes suggests this connection has existed in the past. However, water levels in West Finger Lake would have to be substantially higher for overflow towards Wolf Lake to occur now. The outlet of Wolf Lake drains four miles north towards the Swanson River. We do not know if this outlet stream permits upstream passage of fish during wet cycles. However, the available evidence suggests that normal-sized longnose suckers have not been able to ascend this passageway, unless the two forms have been separated long enough to prevent hybridization.

There are still many questions surrounding these two forms of longnose suckers on the Kenai Peninsula. Did the Finger Lakes semi-dwarf sucker evolve from the normal-sized form since the end of the Wisconsin glaciation and become smaller because of some unusual set of physical, biological or limnological conditions unique to this cluster of lakes? Or perhaps the semi-dwarf sucker was the first one to colonize the Kenai Peninsula after the last (Wisconsin) glaciation and has persisted as a small form because of isolation? If they reached the Kenai Peninsula as a small form, where did they come from? Are there semi-dwarf sucker populations elsewhere in the Cook Inlet Region that could have served as the source?

This preliminary study identified several life history differences that included size and age at maturity, growth rate, reduced longevity, spawning timing and duration, and sex ratios between the normal and semi-dwarf forms of longnose suckers we studied on the Refuge. We conclude that there is enough evidence of phenotypic divergence to justify a more through investigation to determine if the Finger Lakes sucker is a significant evolutionary unit.

Suggestions for Further Study

1. There is clearly a need for a thorough study of the genetic lineage of these two forms.
2. Consider a long-term study to raise semi-dwarf and normal-sized suckers in captivity to evaluate growth rates in a controlled environment.
3. Conduct a morphometric analysis of selected semi-dwarf, intermediate and normal-sized longnose suckers on the Kenai Peninsula.
4. Future sampling efforts for semi-dwarf suckers should include gill nets with stretch mesh sizes < 25 mm or small frame nets with mesh sizes ≤ 12.5 mm to determine if semi-dwarf mature male suckers < 173 mm in fork length are present in the Finger Lakes.
5. Continue investigation of East Finger and Wolf Lakes with emphasis on locating spawning areas, duration of spawning and minimum sizes of spawners.

6. Sample a lake with intermediate sized suckers in the Bishop Creek watershed for a more detailed analysis of size at maturity, sex ratios, duration of spawning and morphology.
7. Continue monitoring the initiation and duration of spawning activities of lake and stream spawning normal sized suckers for comparative purposes. Monitor stream spawning habitat at Watson Lake. Continue monitoring boat ramp spawning activities at Kelly Lake.
8. Sample Middle Finger Lake and Ridge Lake, a tributary of Wolf Lake, to determine the status of its sucker population.
9. Experiment with minnow traps baited with cat food as a live capture method for semi-dwarf longnose suckers. If a live capture method proves effective, utilize radio transmitters in an effort to locate semi-dwarf sucker spawning areas in East Finger and Wolf Lakes.

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Jack Dean and Stephanie Rickabaugh working a gill net.

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