WATER WITHDRAWAL EFFECTS ON NINESPINE STICKLEBACK AND ALASKA BLACKFISH

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Introduction

Information obtained in 2002 provided evidence that high levels of water withdrawal in lakes do not effect ninespine stickleback populations. Lakes along the ConocoPhillips Alaska ice road into eastern NPRA were previously sampled in 1999 and 2000 with gill nets and minnow traps (in 1999) to assess fish populations possibly present in the lakes. At that time, depth information was obtained to estimate water volume. The information obtained indicated that, in general, the lakes were shallow thaw lakes that did not provide habitat for whitefishes and arctic grayling. The sampling did not detect smaller species in some of the lakes and these lakes were treated as non-fish bearing lakes in subsequent permitting for winter water withdrawal. Gill nets have been used as the primary sampling method in lakes used to support exploration because previous experience in the Colville Delta demonstrated that fyke nets were not efficient in lakes with steep banks (Moulton 1997). Sites suitable for fyke net sampling are often scarce or non-existent in many lakes. Minnow traps were used to supplement gill net sampling in order to detect smaller species, such as ninespine stickleback and Alaska blackfish, but met with limited success.

In 2002, lakes in the eastern NPRA region were re-sampled as part of the baseline studies for potential oil field development in the area. Lakes were sampled with fyke nets, which are quite effective in detecting smaller fish species that are not vulnerable to gillnet sampling. This sampling revealed that all lakes in the area contain ninespine stickleback and some contain Alaska blackfish as well.

Both ninespine stickleback and Alaska blackfish are known to be resistant to low dissolved oxygen. Ninespine sticklebacks have been found in waters with dissolved oxygen concentrations ranging from below 2 ppm to 12 ppm (Lewis et al. 1972). In one stagnant ditch, sticklebacks were found in waters that smelled strongly of hydrogen sulfide and rotting vegetation. Many small tundra streams on the arctic coastal plain of Alaska contain populations of ninespine stickleback (Hemming 1996, Moulton and George 2000). Flow in these streams ceases during winter and it is thought that successful overwintering by ninespine stickleback in these streams is possible because of their tolerance to low dissolved oxygen levels. No winter-time dissolved oxygen concentration readings are available from these streams, but it is thought that concentrations fall below 2 ppm and in some cases approach zero. Alaska blackfish are known for their ability to breathe atmospheric oxygen and will line up at cracks in the ice to breathe when dissolved oxygen is low (see for example the Alaska Wildlife Notebook online at www.state.ak.us/adfg/notebook/notehome.htm)

Methods

Water withdrawal records from the past two winters (2000/2001 and 2001/2002) were examined to ascertain whether some of the lakes previously identified as not supporting fish populations had been subjected to substantial water withdrawal. This examination revealed four lakes that had supplied a substantial portion of their winter volume to ice road construction. Based on the withdrawal histories, these four lakes were selected as test lakes and five nearby lakes were selected as reference lakes (Table 1).

Approximately 75% of the water use occurs by the end of February, with almost all use over by the end of March (Figure 1a). In recent years, ice thickness has grown from about 4 feet in mid-January to over 5 feet by mid-March (Figure 1b). Based on these water use and ice growth patterns, the amount of water available under 5 feet of ice was selected as the threshold amount for measuring potential effects to resistant fish species.

Detailed bathymetric surveys were conducted on all study lakes in 2002 to obtain more accurate volumetric estimates for the study lakes. These surveys consisted of six to seven transects per lake using a continuously recording integrated GPS/depth sounder. Location and depth were recorded at approximately 1 to 2 second intervals. The resulting data files were exported to ArcView 3.2 GIS software. A base map developed from 2001 aerial photography of the eastern NPRA region was used to obtain lake surface area and to map depth contours.

Fyke nets were set in the study lakes from late July into early August. Each lake was sampled for 3 to 6 days, except for lake M9914, which was sampled for 10 days in late July. All lakes contained ninespine sticklebacks, with four lakes also containing Alaska blackfish. Arctic grayling were captured only in M9914, which has a seasonal connection to a stream system.

Results

Results of the fyke net sampling and volumetric estimates are summarized in Table 2. Lake L9317 was the most heavily used lake, with almost all the water deeper than 5 feet used for ice road construction in both 2001 and 2002. Despite this heavy use, the catch rate of ninespine stickleback in this lake was higher than in any of the other sampled lakes. Lake M0024, which had been used heavily during 2001, had the third highest catch rate. Lake M9912, from which almost 90% of the water deeper than 5 feet had been removed, had the lowest catch rate for ninespine sticklebacks, but had the second highest catch rate for Alaska blackfish. In general, the reference and withdrawal lakes had similar ranges of catch rates aside from the very high catches in L9817.

Conclusions

Catch rates of ninespine stickleback and Alaska blackfish in some shallow NPRA lakes that had been heavily used as winter water sources were not different from shallow lakes that were not used as water sources. In at least one case, almost all the water deeper than 5 feet had been withdrawn and ninespine stickleback densities were the highest among the lakes surveyed. Populations of these two species do not appear to be affected by water withdrawal at rates used to support exploration activities in eastern NPRA.

References

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Table 1. Summary of NPRA lakes used in effects of water withdrawal on ninespine sticklebacks, 2002.

Area	Lake Name	Latitude (NAD27)	Longitude (NAD27)	Town	Range	Section	Surface Area[1] (acres)	Maximum Depth[2] (feet)	Calculated Volume[2] (mill. gals)
Water Use Lakes									
	L9817	70.23343	151.33681	10N	3E	10	65.4	8.9	101.09
	M9912	70.25211	151.55356	10N	2E	2	34.8	9.6	61.93
	M9914	70.23333	151.62855	10N	2E	9/10	151.1	6.4	205.08
	M0024	70.21116	151.64799	10N	2E	16/21	148.2	8.2	236.90
Reference Lakes									
	L9807	70.26131	151.10809	10N/11N	4E	4/33/34	140.6	10.1	223.78
	M9922	70.22878	151.58368	10N	2E	10/11/14/15	195.9	6.1	246.94
	M9923	70.22787	151.52110	10N	2E	12/13	255.0	6.7	289.60
	M0254	70.25314	151.58414	10N	2E	3	30.1	12.7	59.40
	M0256	70.24473	151.60480	10N	2E	3	30.1	9.0	48.00

[1] digitized from 2001 aerial photography

[2] based on 2002 measurements

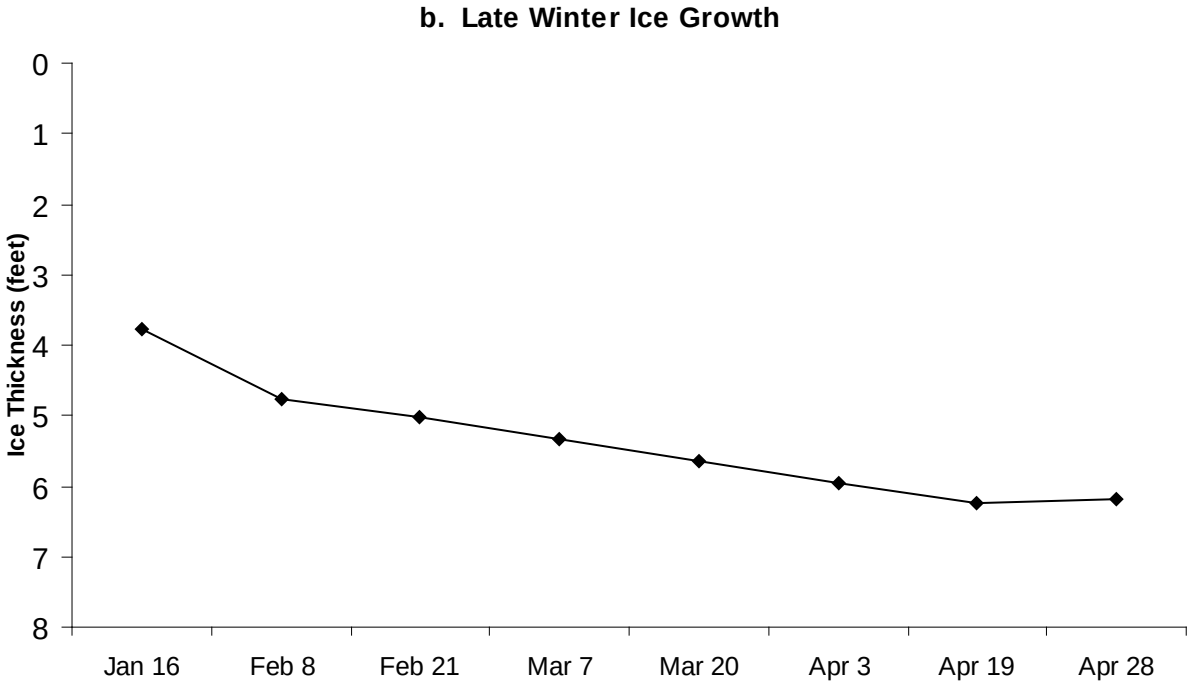
Appendix Table 1. Fish catches NPRA study lakes from July 20 to August 6, 2002

Class	Lake	Duration (hours)	Species	Number Caught	CPUE
Test Lake					
	L9817	140.5	Ninespine stickleback	31,754	5,423
	M9912	136.7	Alaska blackfish	53	9.3
		136.7	Ninespine stickleback	76	13.3
	M9914	235.1	Ninespine stickleback	507	51.8
			Alaska blackfish	4	0.4
			Arctic grayling	3	0.3
	M0024	115.1	Ninespine stickleback	778	162.2
Reference Lake					
	L9807	114.8	Ninespine stickleback	183	38.3
	M0254	69.8	Ninespine stickleback	1,347	462.9
			Alaska blackfish	45	15.5
	M0256	24.7	Ninespine stickleback	54	52.5
			Alaska blackfish	1	1.0
	M9922	135.9	Ninespine stickleback	199	35.1
	M9923	116.0	Ninespine stickleback	632	130.8
	M9924	68.0	Ninespine stickleback	633	223.4

Table 2. Catch rates of resistant fish species in shallow lakes of eastern NPR-A.

Lake Class	Lake	Withdrawal Year	Volume deeper than 5 feet (mill. Gals.)	Million Gallons Used	Percent deeper than 5 feet Withdrawn	Ninespine Stickleback 2002 CPUE (fish/day)	Alaska Blackfish 2002 CPUE (fish/day)
Withdrawal Lakes							
	L9817	2001	16.15	15.66	97%	--	--
		2002	16.15	17.29	107%	5,422.9	0.0
	M9912	2002	11.22	10.03	89%	13.3	9.3
	M9914	2001	11.48	2.24	20%	51.8	0.4
	M0024	2001	37.79	19.59	52%	162.2	0.0
Reference Lakes							
	L9807		27.38			38.3	0.0
	M9922		4.39			35.1	0.0
	M9923		15.63			130.8	0.0
	M0254		26.45			462.9	15.5
	M0256		9.72			52.5	1.0

Note: Catch rate of Arctic grayling in lake M9914 = 0.3 per day



Source: February-April from 2001 lake recharge studies at Alpine-area lakes, January value from 2002.

Figure 1. Winter water use and ice growth in lakes near eastern NPRA, 1999-2002.