STATE OF ALASKA

Jay S. Hammond, Governor

Annual Performance Report for

SPORT FISH STUDIES

by

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RESEARCH PROJECT SEGMENT

State: ALASKA

Name: Sport Fish Investigations of Alaska.

Project No.: F-9-7

Study No.: G-II

Study Title: SPORT FISH STUDIES

Job No.: G-II-K

Job Title: Studies of Introduced Blackfish in Waters of Southcentral Alaska.

Period Covered: July 1, 1974 to June 30, 1975.

ABSTRACT

Since it's original introduction, the range of the Alaska blackfish, *Dallia pectoralis*, has spread naturally through inter-connecting waterways. It has also been transplanted, contrary to state law, by private individuals into several adjacent lakes which are annually stocked with rainbow trout, *Salmo gairdneri*. Preliminary investigation indicates growth and survival of rainbow trout may be substantially reduced if there is serious competition for available food resources and habitat. In order to accumulate data to be used for control of this problem, distribution, food studies, aging, and tolerance to rotenone, were conducted on blackfish specimens collected from Meadow Lakes, Anchorage International Airport.

A literature survey on Alaska blackfish was conducted and filed in the Anchorage Sport Fish Division library.

RECOMMENDATIONS

1. Discontinue research project, Studies of Introduced Blackfish in Waters of Southcentral Alaska, as a separately funded project. Incorporate this study and funding into Catalog and Inventory.

2. A predetermined Pro-Noxfish concentration is not recommended to selectively eliminate blackfish in lakes containing stocked rainbow trout.

3. Systems potentially able to support stocked rainbow trout, but currently containing blackfish, be considered for rehabilitation.

OBJECTIVES

1. To determine the general distribution and spread of Alaska blackfish in waters of the Anchorage area.

2. To determine the ecological relationship of Alaska blackfish to stocked rainbow trout in managed lakes.

3. To determine through bioassay the minimum effective rotenone concentration required to control and eliminate blackfish populations.

TECHNIQUES USED

Distribution of blackfish in lakes and streams of the Anchorage area was determined through collection of fish by seine, traps, electrofishing, and visual observation.

Stomachs from 320 electroshocked blackfish, September 27, 1974 were removed, preserved in 4% formalin, and the contents later analyzed by the numerical (identification and count of individual items present) and frequency (percent occurrence of food items identified) methods.

Scales and otoliths were collected from electroshocked fish used for stomach analysis. Detailed methods and procedures used in estimating age from scales and otoliths may be found in the Aging of Fish (Bagenal, ed., 1973). Scales from individual fish were placed between two microscope slides which were taped together. Age was estimated from scale annuli by use of a binocular microscope. Otoliths were immersed in xylene solution (a clear liquid) in a black otolith tray and light shined at an angle from above. As viewed through the scope the opaque zones (which obstruct the passage of light) of the otoliths appeared as shadowed rings and the hyaline zones (which permit passage of light) appeared as semi-clear rings.

Field experiments were conducted to determine the toxicity of different concentrations of Pro-Noxfish to blackfish. In each experiment, 10 22.7 liter glass jars were each filled with 15 liters of water from Meadow Lake. The containers were then attached to a preconstructed floating array. Five jars were placed on each side of the array labeled A and B, respectively. Jars were numbered A-1---A-6 and B-1---B-6 (Figure 1).

Blackfish were captured with a Smith-Root Type V backpack electroshocker and 10 young-of-the-year fish, 30-50 mm, were placed in each jar.

The product used to determine the toxicity to blackfish was Pro-Noxfish (rotenone 2.5%, related sulfoxide compounds 0.3%, and other cube extractives

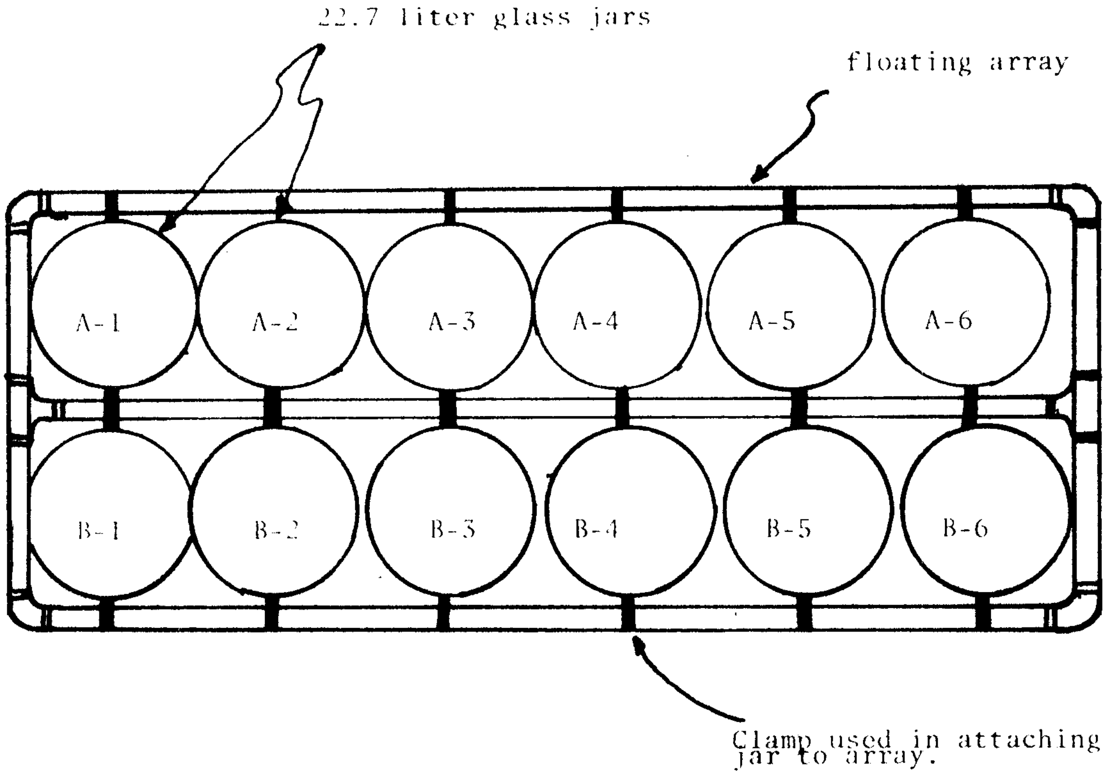

Figure 1. Floating array used in blackfish toxicity study.

5.0%). Prior to the addition of Pro-Nox, and after the end of each experiment, dissolved oxygen and temperature were determined and recorded. Jar numbers A-1 and B-1 were held as controls, i.e., no Pro-Nox was added.

Blackfish were retained in the test jars containing water 24 hours prior to addition of Pro-Nox at which time water chemistry was conducted. The experimental period lasted 72 hours, after which each container was emptied elsewhere than in Meadow Lake, and thoroughly cleaned. Tests were conducted from August 12-17, August 19-24, and August 26-31.

FINDINGS

Distribution

Since T. H. Bean's collection of blackfish specimens in 1880, near St. Michael, Alaska, the range has been described by Walters (1955) as the lowland freshwaters of Siberia, Chukchi Peninsula (east of the Kolyma Basin) south to St. Lawrence and Mechigmen Bays; St. Lawrence Island (Alaska), south of Bering Strait; Alaska, Kuskokwin River system north to but not including Point Barrow, then east to the Ikpikpuk River system. Documented inland range was extended after Blackett (1962) collected blackfish specimens from the junction of the Yukon and Tanana rivers to Big Eldorado Creek near Fairbanks. Distribution of blackfish is shown in Figures 2, 3, and 4. More recent literature indicates an expanded range resulting possibly from artificial introduction.

Accidental introduction of blackfish in the Anchorage area occurred in the early 1950's in the Hood-Spenard Lake complex. They have since spread through interconnecting waterways and are occasionally transplanted by private individuals into lakes of the Anchorage area. Distribution of blackfish in lakes and streams during 1974 is presented in Table 1 and Figure 4.

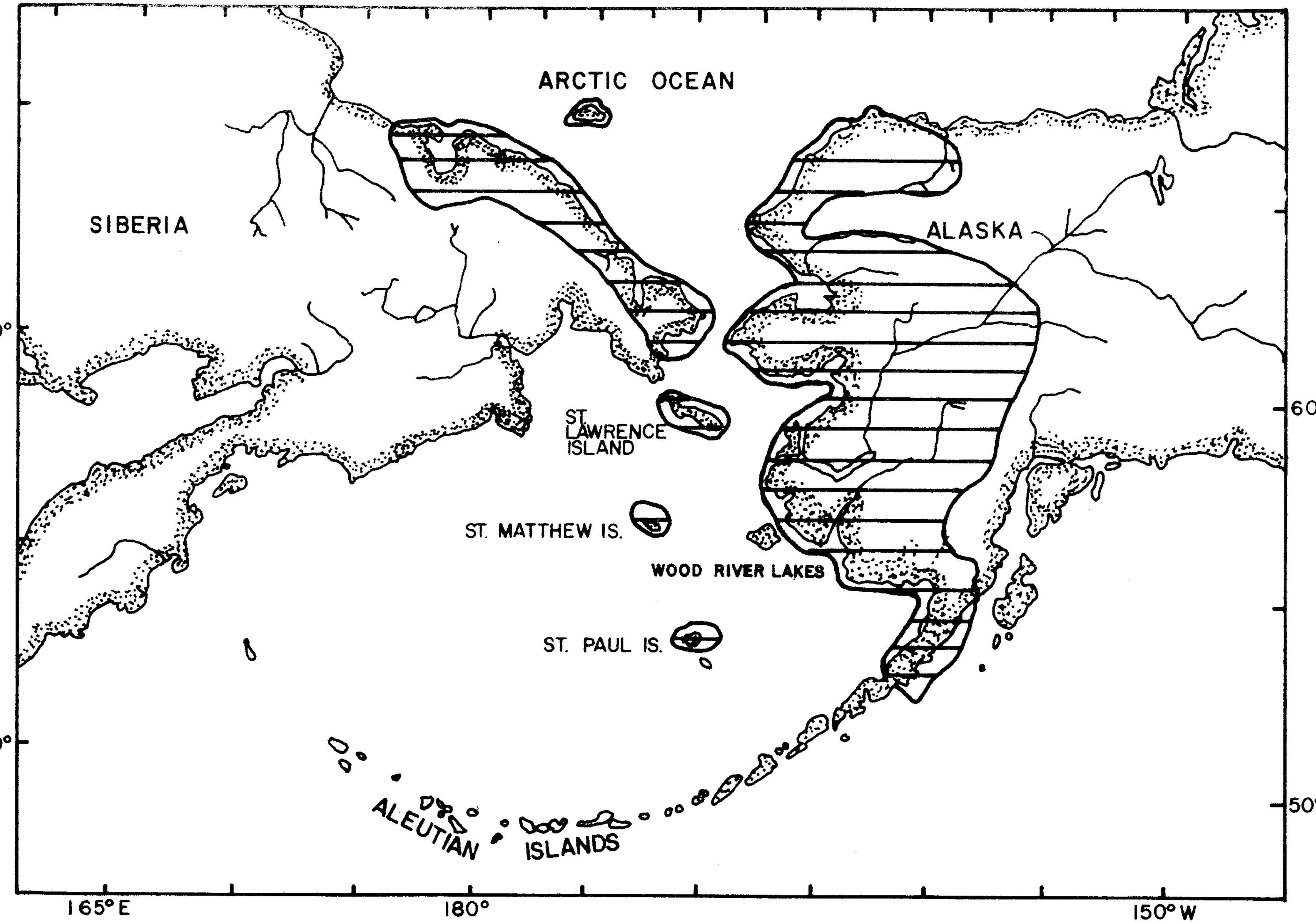

Figure 2. Distribution of the Alaskan Blackfish, *Dallia pectoralis*.

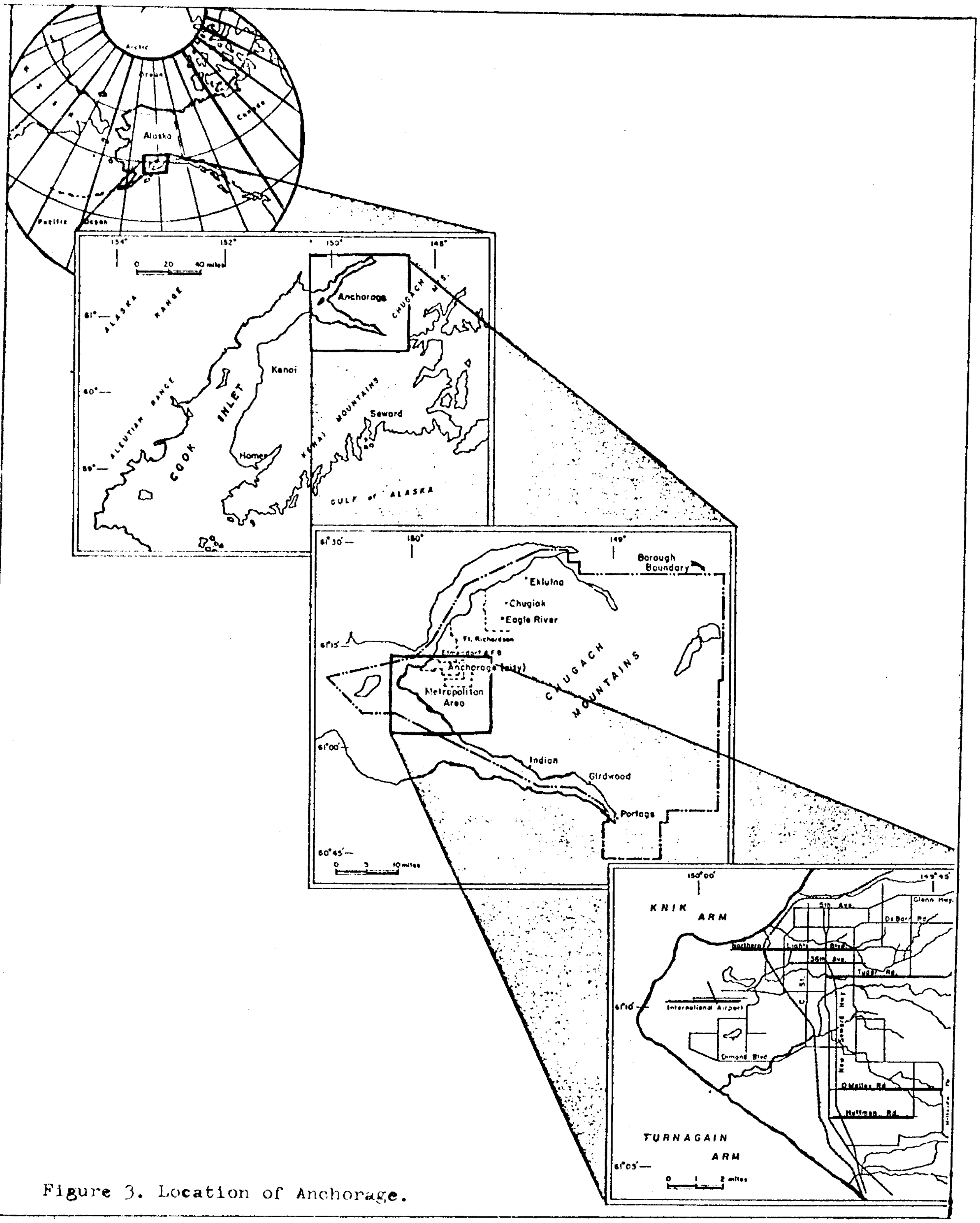

Figure 3. Location of Anchorage.

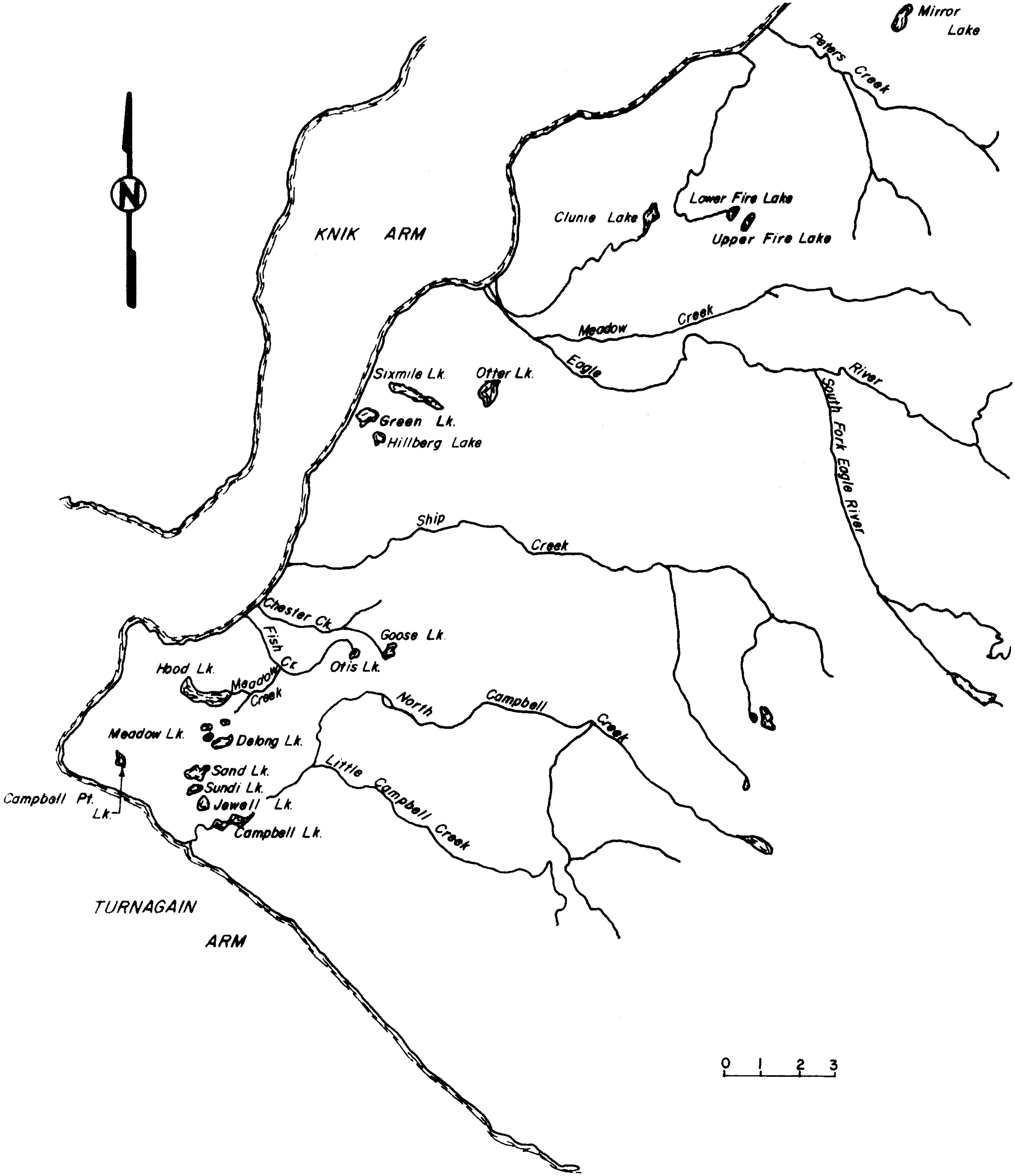

Figure 4. Distribution of Alaska Blackfish in Lakes and Streams of the Anchorage Area, 1974.

Table 1. Anchorage Area Lakes and Streams Checked for Alaska Blackfish.*

Lake/Stream	Capture Method	Blackfish Recorded 1973	1974
Fire Lake, Lower**	Gillnet-Electro	X	-
Fire Lake, Upper	Gillnet-Electro	-	-
Otis Lake	Gillnet-Electro	-	-
Goose Lake	Gillnet-Electro	-	-
Sundi Lake	Gillnet-Electro	-	-
Fire Creek, Upper	Electro	-	-
Fire Creek, Lower	Electro	X	X
Marsh, Tudor & Lake Otis	Electro	-	-
Chester Creek	Electro	-	-
Delaney Lake	Gillnet-Electro	-	-
Sand Lake	Gillnet-Electro	-	-
DeLong Lake	Gillnet-Electro	-	-
Meadow Lakes	Gillnet-Electro	X	X
Six-Mile Lake	Gillnet-Electro	-	-
Peters Creek	Electro	-	-
Mirror Lake	Gillnet-Electro	-	-
Eklutna River	Electro	-	-
Campbell Creek at BLM	Electro	-	-
Otter Lake	Gillnet-Electro	-	-
Jewell Lake	Gillnet-Electro	-	-
Green Lake	Gillnet-Electro	-	-
Hillberg Lake	Gillnet-Electro	-	-
Beach Lake	Gillnet-Electro	-	-
Clunie Lake	Gillnet-Electro	-	-
Connors Lake	Gillnet-Electro	X	X

* Blackfish distribution studies in Anchorage area were conducted in each lake/stream once every four weeks, June-September.

**Lower Fire Lake was rehabilitated, 1973.

Food Study

Food relationships do at least in part determine population levels, rates of growth, and condition of fish. They serve as a partial basis for determining the status of various predatory or competing forms. For any species food habits change with the seasons, with the life history stages, and with the kinds of food available (Lagler, 1956).

Studies by Ostdiek and Nardone (1953) indicate that ostracods, cladocerans, and diptera larva are the principal foods of the blackfish. In western Alaska, food of the adult is predominately smaller blackfish and pike (memorandum from Rae Baxter, 1973).

The numerical and frequency of occurrence methods of studying food habits were used in stomach analysis of electroshocked blackfish from Meadow Lake (Figure 4). Food items found in stomachs were of Phylum Orthropoda; Class Crustacea, Orders Cladocera and Copepoda; Class Insecta, Orders Ephemeroptera, Hemiptera, Diptera, and Odonata. Other items present were of Class Pelecypoda of Phylum Mollusca, Order Hirudinea of Phylum Annelida, and Class Osteichthyes of Phylum Chordata. Total number of food items present and percent occurrence in Alaska blackfish is presented in Table 2.

Table 2. Number of Food Items Present and Percent Occurrence in Alaskan Blackfish from Meadow Lake, 1974.

Systemics	Number of Food Items Present	Percent Occurrence
Phylum Anthropoda		
Class Crustacea		
Order Cladocera	11,385	58.67
Order Copepoda	6,105	31.46
Class Insecta		
Order Ephemeroptera	38	0.19
Order Hemiptera	781	4.02
Order Diptera	726	3.74
Order Odonata	143	0.74
Phylum Mollusca		
Class Pelecypoda		
Order Eulamellibranchia	88	0.45
Phylum Annelida		
Class Hirudinea	6	0.00
Phylum Chordata		
Class Osteichthyes		
Order Salmoniformes	132	0.68

Occurrence and frequency of food items relative to length interval groupings are indicated in Table 3.

Table 3. Number of Food Items Present and Percent Occurrence in 20mm Length Groups of Alaskan Blackfish from Meadow Lake, 1975.

Food Category	Length of Fish in mm: 70-90	90-110	110-130	130-150	150-170	170-190	190-210
Phylum Arthropoda							
Class Crustacea							
Order Cladocera	8,250(64)	2,747(58)					
Order Copepoda	4,405(34)	1,700(36)					
Class Insecta							
Order Ephemeroptera		6(0)	10(2)	14(2)	8(2)		
Order Hemiptera	11(0)		330(72)	440(50)			
Order Diptera	151(0)	187(4)	55(12)	66(7)	267(80)		
Order Odonata	1(0)		44(10)			49(60)	49(35)
Phylum Mollusca							
Class Pelecypoda							
Order Eulamellibranchia		48(1)	18(4)	22(2)			
Phylum Annelida							
Order Hirudinea	2(0)	1(0)	2(0)	1(0)			
Phylum Chordata							
Class Osteichythes							
Order Salmoniformes				8(1)		32(40)	92(65)

The greatest limitation of the numerical method lies in the fact that the organism occurring in largest numbers need not necessarily constitute the most important food items (Lagler, 1956). The frequency of occurrence method is biased by the accumulation within individuals of remains of certain food organisms which are resistant to digestion (Lagler, 1956). This makes the frequency of consumed organisms greater than the actual frequency consumed during feeding periods. In addition, it does not reflect the bulk relationships of the various categories of food items (Lagler, 1956).

Literature reviews indicate the primary foods of rainbow trout are aquatic and terrestrial insects (McConnell, et. al., 1957; Stocek and McCrimmon, 1965). Fish are eaten by larger trout in many lakes (McConnell, et. al., 1957; Stocek and McCrimmon, 1965; Johannes and Larkin, 1961). Cladorera and other plankton are a considerable part of the food in some lakes (Wales, 1946; Johannes and Larkin, 1961).

Documented food studies of rainbow trout indicate similarities to the food items consumed by blackfish. It appears that rainbow trout and blackfish in the same lake system would compete for many of the same food items; however, the exact interactions in food competition are not known and cannot be tested statistically at this time.

Age-Length

Aging of both scales and otoliths from electroshocked blackfish are presented on the same histogram in Figure 5. Age-length frequency is graphically presented (Figure 6). A total of 556 scale samples and 320 otoliths were collected of which ages from 186 scales and 71 otoliths could not be determined. Regeneration of scales prevented aging of some samples. Differences of opacity and narrow hyaline splits created difficulty in age determination of otoliths. In such cases, no attempts were made to determine an age.

Rotenone Toxicity

Rotenone kills fish by blocking a chemical reaction in the gill filaments, preventing adequate oxygen intake and suffocating the fish (Lindahl and Oberg, 1961). Its toxicity depends on species, size of fish, age of fish, and water temperature (Calhoun, ed. 1966). Toxicity is greatest at water temperatures between 50°-75°F, while toxicity drops at lower temperatures (Post, 1958). The ppm of Pro-Noxfish required to kill 50% of the fish using the specified formulations at approximately 40°F and 70°F is presented in Table 4. No data was found in usage of Pro-Noxfish in bioassay experiments involving rainbow trout; however, in California, rotenone concentrations of 0.025-0.050 ppm were observed to kill rainbow trout.

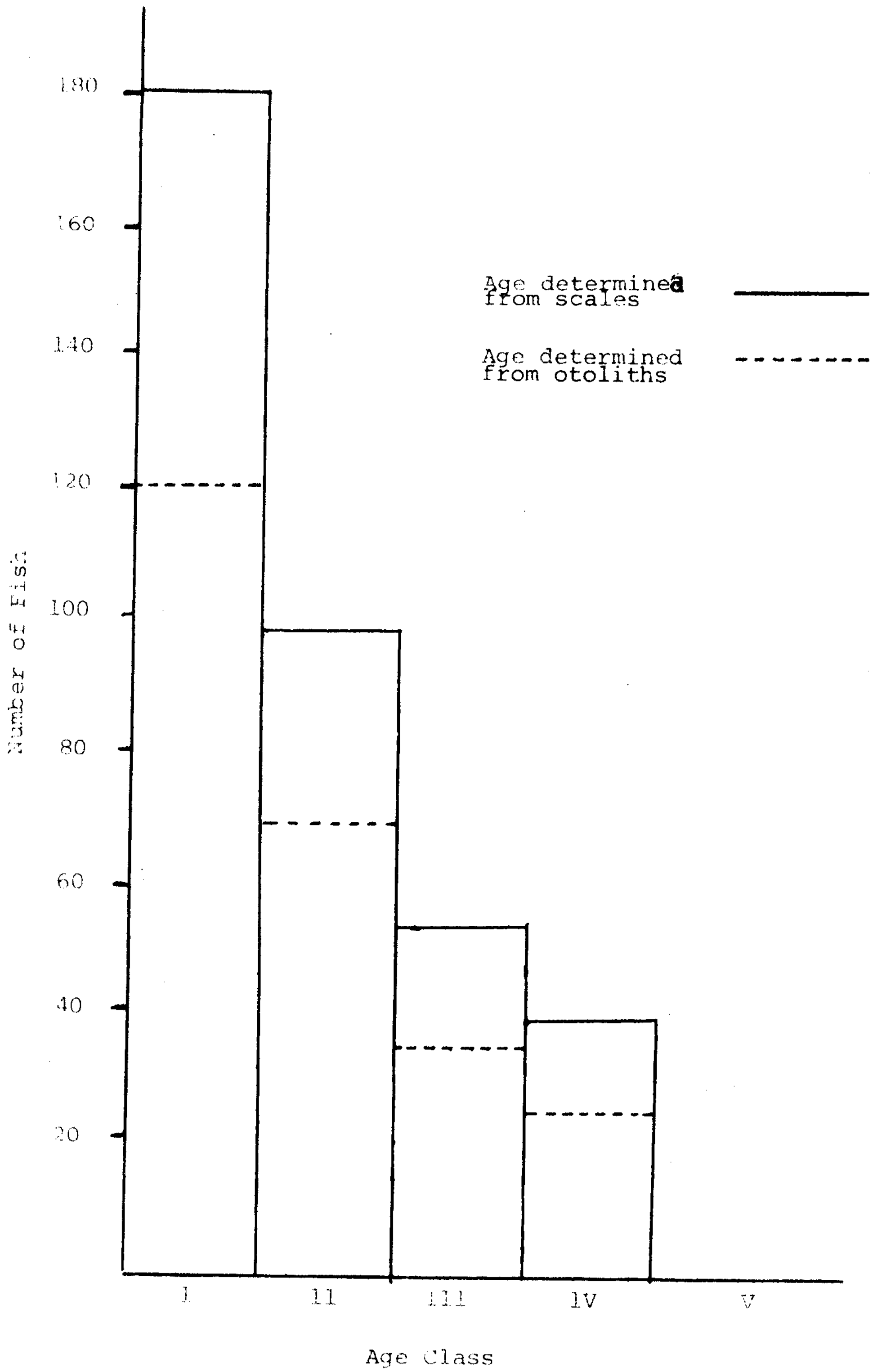

Figure 5. Number of Alaskan Blackfish in Each Age Class from Meadow Lake, 1974

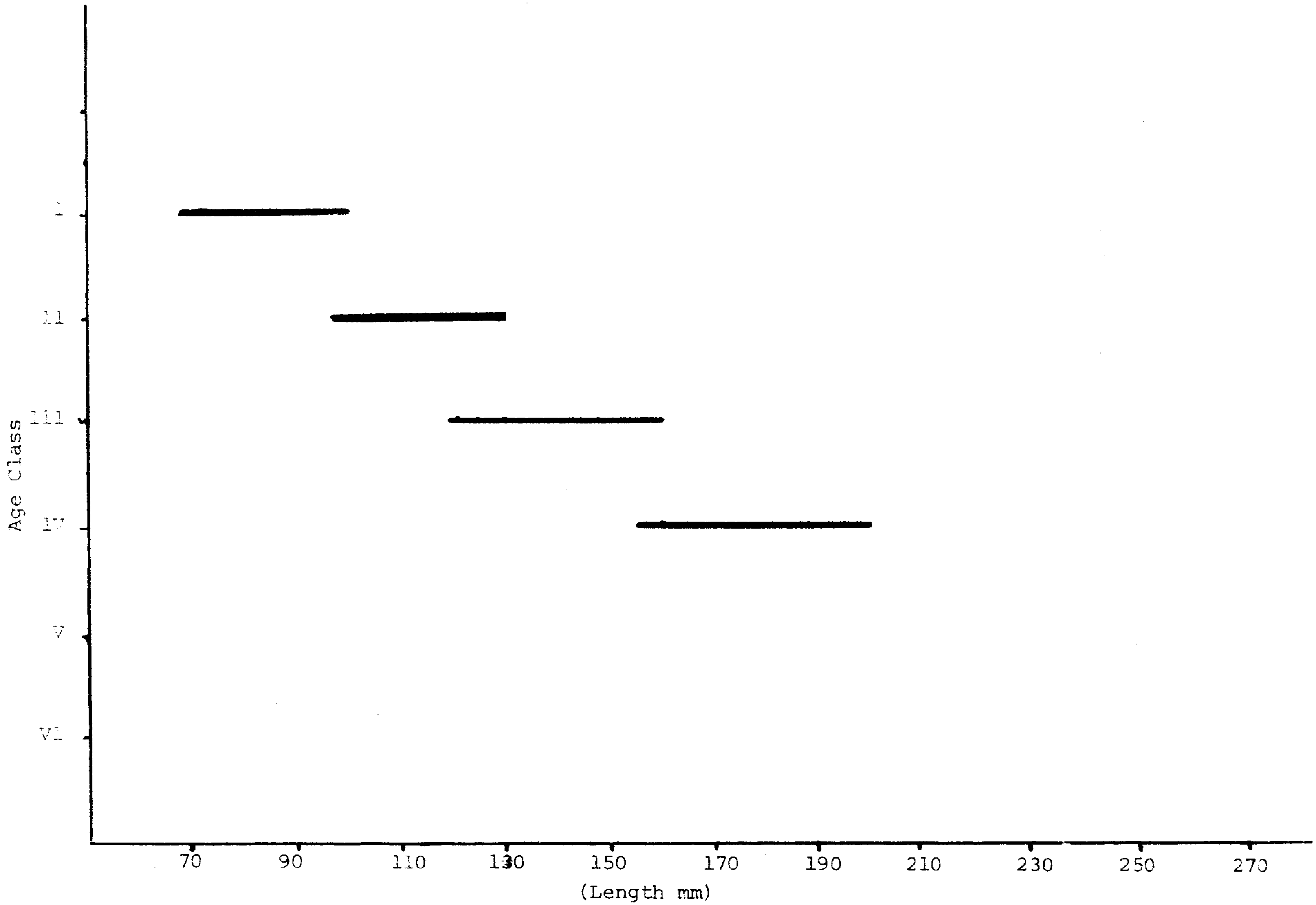

Figure 6. Range in Length Per Age Group for Alaska Blackfish, Meadow Lake, 1974

Table 4. The ppm of Pro-Noxfish to Kill 50% of the Fish Using the Following Formulations at Approximately 40°F and 70°F.

Species	Temperature 40°F	70°F
Carp	0.008ppm	0.004ppm
Bass	-	0.005ppm
Fatheads	0.008ppm	0.006ppm
Green Sunfish	-	0.006ppm
Goldfish	0.050ppm	0.006ppm
Bluegills	0.010ppm	0.014ppm
Golden Shiners	0.018ppm	0.010ppm
Speckled Bullheads	0.025ppm	0.026ppm

In treatment of blackfish from Meadow Lake, 14 different concentrations of Pro-Noxfish were used in duplicate testing (Table 5). Mortality results and water chemistry data are presented in Tables 5 and 6. During experiments 1 and 2, physical conditions, i.e., cloud cover, temperature, and wind speed were stable. Prior to experiment 3, there were five days of 5°C lower temperatures and winds of 10-20 mph. This is evident in the lower water temperatures and higher dissolved oxygen content at the time experiment 3 was being carried out (Table 5). Evidence of Pro-Nox toxicity to Blackfish was present at concentrations greater than .004ppm. It should be noted however, that water temperatures were 3°C lower during experiment 3 and may have influenced the results. Comparing the three experiments, concentrations greater than 0.004ppm eradicated blackfish. Four mortalities were recorded in experiment 3, jar A-5, concentration of 0.004ppm. Six mortalities were observed in jar B-5 of the same experiment (#3) though the concentration of Pro-Nox used was the same as in jar A-5. As both water temperature and dissolved oxygen content were similar in both A-5 and B-5, no explanation can be given for the resulting difference. Data recorded for the number of blackfish observed down at each six-hour interval showed that fish down did not necessarily die, but recovered without addition of fresh water or neutralizing solution; e.g., experiment 3, jar 5: two fish in the down condition state recovered. Mortality due to incidental injury was assumed to be low as no condition state recovered. Mortality due to incidental injury was assumed to be low as no control fish died in any of the experiments.

TABLE 5. Mortalities of Blackfish at Six Hour Intervals Under Varying Concentrations of Rotenone.

Experiment	Date	Side	Jar	Toxicant Concentration (ppm)	Dissolved Oxygen (ppm)	Temperature °C	Condition* of Blackfish At Six Hour Intervals Mortalities/Down 24**	6	12	18	24	30	36	42	48	54	60	66	72	Water Temperature °C	Dissolved Oxygen (ppm)
Experiment 1	8/12/74	A	1	-	8.8	22.0	ø	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	21.0	8.8
			2	0.0002	8.8	22.0	ø	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	21.0	8.8
			3	0.00036	8.8	22.0	ø	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	21.0	8.8
			4	0.00063	8.8	22.0	ø	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	21.0	7.6
			5	0.0011	8.8	22.0	ø	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	21.0	8.8
			6	0.002	8.8	22.0	ø	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	21.0	8.8
	8/12/74	B	1	-	9.2	22.0	ø	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	22.0	8.8
			2	0.0002	9.2	22.0	ø	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	22.0	8.6
			3	0.00036	9.2	22.0	ø	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	22.0	8.6
			4	0.00063	9.2	22.0	ø	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	22.0	7.2
			5	0.0011	9.0	22.0	ø	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	22.0	7.2
			6	0.002	9.2	22.0	ø	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	22.0	8.8
Experiment 2	8/19/74	A	1	-	7.5	20.5	ø	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	20.5	7.5
			2	0.028	7.5	20.5	ø	9/1	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	20.5	7.5
			3	0.048	7.5	20.5	ø	7/3	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	20.5	7.5
			4	0.084	7.5	20.5	ø	5/5	7/3	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	20.5	7.5
			5	0.154	7.5	20.5	ø	0/3	1/3	6/4	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	20.5	7.5
			6	-	7.5	20.5	ø	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	20.5	7.5
	8/19/74	B	1	-	7.5	20.5	ø	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	20.5	7.5
			2	0.028	7.5	20.5	ø	9/1	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	20.5	7.5
			3	0.048	7.5	20.5	ø	6/4	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	20.5	7.5
			4	0.084	7.5	20.5	ø	5/5	6/4	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	20.5	7.5
			5	0.154	7.5	20.5	ø	0/3	2/4	6/3	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	20.5	7.5
			6	-	7.5	20.5	ø	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	20.5	7.5
Experiment 3	8/29/74	A	1	-	8.8	17.0	ø	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	17.0	8.8
			2	0.02	8.8	17.0	ø	9/1	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	17.0	8.8
			3	0.01	8.9	17.0	ø	7/3	8/2	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	17.0	8.9
			4	0.0063	8.8	17.0	ø	0/4	3/6	7/3	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	17.0	8.8
			5	0.004	8.8	17.0	ø	0/0	0/0	0/0	2/1	3/1	4/0	4/0	4/0	4/0	4/0	4/0	4/0	17.0	8.8
			6	0.002	8.8	17.0	ø	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	17.0	8.8
	8/29/74	B	1	-	8.8	17.0	ø	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	17.0	8.9
			2	0.02	8.8	17.0	ø	8/2	9/1	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	17.0	8.8
			3	0.01	8.8	17.0	ø	2/2	6/2	7/3	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	17.0	8.8
			4	0.0063	8.8	17.0	ø	0/0	0/0	4/2	9/1	10/0	10/0	10/0	10/0	10/0	10/0	10/0	10/0	17.0	8.8
			5	0.004	8.8	17.0	ø	0/0	0/0	0/1	4/3	6/2	6/2	6/1	6/0	6/0	6/0	6/0	6/0	17.0	8.8
			6	0.002	8.8	17.0	ø	0/0	0/0	0/1	0/1	0/1	0/0	0/0	0/0	0/0	0/0	0/0	0/0	17.0	8.6

* Note: Condition of blackfish noted as; mortalities, down, or no mortalaties: e.g. 9/ (mortalities), /1 (down), ø no mortalities.
** Note: Blackfish in jar for 24 hours prior to addition of Pro-Noxfish.

Table 6. Water Chemistry Data for Meadow Lake, August 12 and August 31, 1974.

Water Chemistry Data	August 12		August 31	
Depth	1m	2m	1m	2m
DO	8.8	8.6	8.8	8.8
pH	7	7	7	7
Hardness	<17.1mg/ℓ	<17.1mg/ℓ	<17.1mg/ℓ	<17.1mg/ℓ
CO_2	<5mg/ℓ	<5mg/ℓ	<5mg/ℓ	<5mg/ℓ
Phenolphthalein alkalinity	0	0	0	0
Methyl orange alkalinity	<17.1mg/ℓ	<17.1mg/ℓ	<17.1mg/ℓ	<17.1mg/ℓ
Free acid	0	0	0	0
Total acid	0	0	0	0

DISCUSSION

A literature review of the effects of Pro-Noxfish on various species of fish indicates that some species are more resistant to specific Pro-Noxfish formulations than others. Even if species resistance or non-resistance to Pro-Nox formulations were known, application of the toxicant at a uniform concentration in a body of water is next to impossible. Due to the limited amount of information concerning Pro-Noxfish toxicity to rainbow trout, selective elimination of blackfish in lakes containing both species is not recommended. The occurrence of blackfish in lakes stocked with trout can however be effectively controlled for management purposes by introducing minimum doses of Pro-Noxfish into these lakes after the sport fishery has terminated for the season. Based on preliminary information of competition between trout and blackfish, even an incomplete kill could result in subsequent years of good fishing for stocked fish.

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