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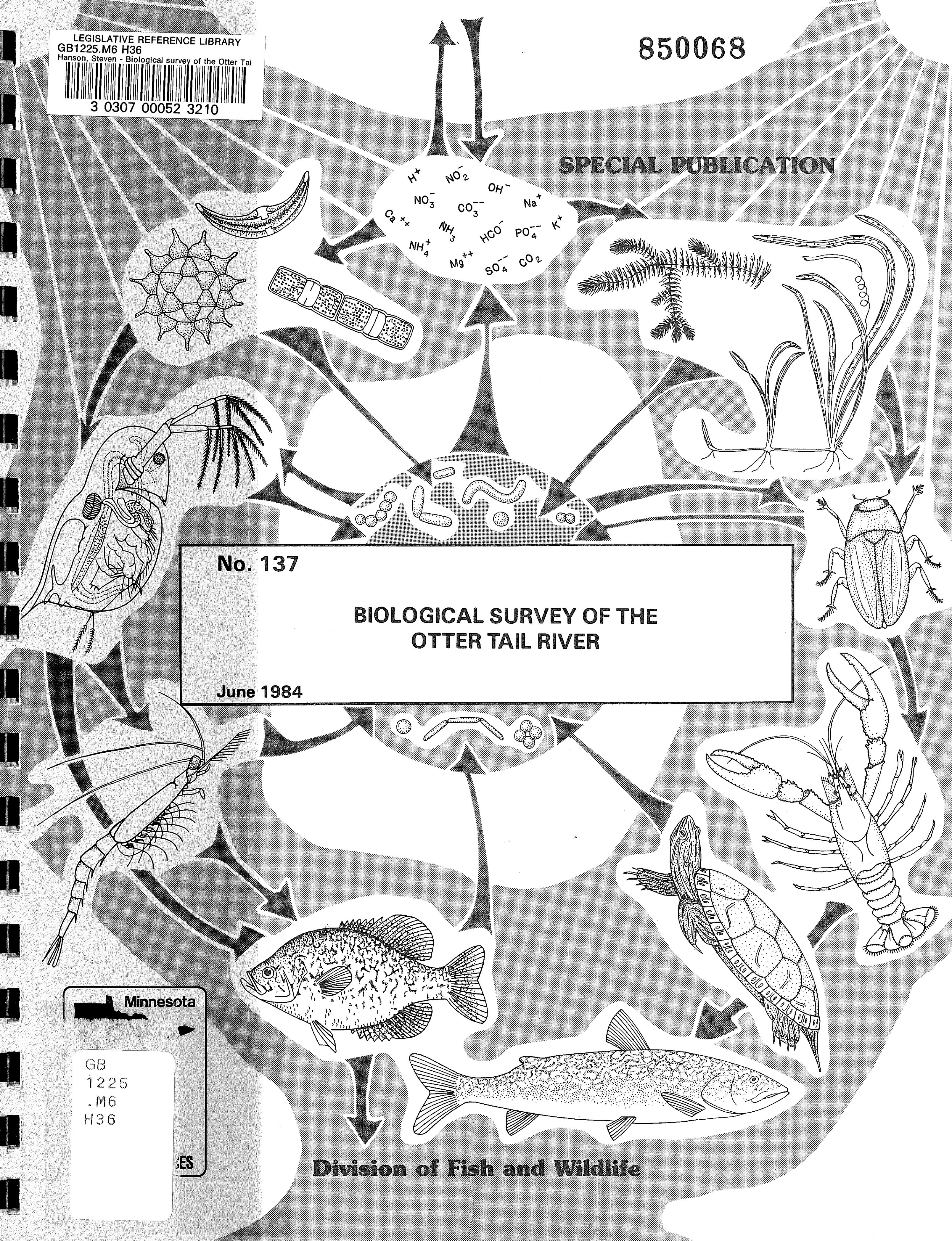

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BIOLOGICAL SURVEY OF THE OTTER TAIL RIVER

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Division of Fish and Wildlife

BIOLOGICAL SURVEY OF THE OTTER TAIL RIVER [a]

by

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ABSTRACT

A stream survey was conducted on the Otter Tail River during the summers of 1978, 1979 and 1980. Stream characteristics and various fish and wildlife habitat parameters were delineated. A total of 24.2 mi of river were electrofished in 17 study sectors. The catch was comprised of 49 fish species representing 11 families. Game fish comprised 7.1% of the overall large fish catch which is well below the statewide average (14%) for electrofishing samples on larger streams. Fish distribution was predictably responsive to physical stream parameters. The numerous large lakes in the upper two-thirds of the flowage as well as gradient, substrate, water clarity and depth exhibited the greatest influence. Serious problems associated with the river are the low flows induced by hydroelectric power dams, fluctuating water levels from the Orwell flood control dam and appropriation of water for cooling at the Hoot Lake power station. Qualitative and quantitative sampling of benthic invertebrates was carried out to describe biological conditions in the river. Members of the taxonomic groups Trichoptera, Chironomidae and Ephemeroptera were the most commonly collected organisms. Differences in species and generic composition from upstream to downstream sites were most noticeable in the family Hydropsychidae (Trichoptera). Sampling sites with coarser substrates exhibited greater volumes and species diversity.

[a] The project was partially funded by Federal Aid in Fish and Wildlife Restoration FW-1-R.

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INTRODUCTION

The Otter Tail River was surveyed to collect baseline data on the fish and wildlife resources of the river corridor and document environmental conditions and problems. This type of information is necessary for resource management decisions by a variety of local, state and federal agencies. The initial phase of the survey was done by canoe during July, August and September, 1978. Vegetation, wildlife and stream physical characteristics data was compiled and the river was divided into 17 sectors based on changing stream characteristics. The second phase consisted of electrofishing portions of 14 of the 17 sectors (similiar reaches) to determine fishery characteristics. This was done during the summers of 1979 and 1980. Sampling for benthic invertebrates was also carried out during this time. The map series at the end of this report shows the locations of the 17 sectors, electrofishing runs, river miles and access points.

PHYSICAL CHARACTERISTICS

The Otter Tail River is part of the Red River of the North watershed and drains an area of 1,922 mi^2. It begins near the northern edge of Becker County and flows for 190 mi to its confluence with the Red River of the North at Breckenridge. The first 116 mi of river pass through an area of glacial moraine and outwash plains containing numerous lakes and depressions. West of Fergus Falls in the lower reaches of the river the watershed is a flat lowland plain with fertile soils derived from lake clays and silts from the bottom of glacial Lake Agassiz.

The river passes through 18 lakes and 21 dams. The overall gradient of the river is 2.9 ft/mi (not excluding dams) with a total drop of 550 ft from its source at Elbow Lake to where it joins the Bois de Sioux River to form the Red River of the North. Sector 4 has the highest gradient at 10.4 ft/mi (Appendix Table 1). The natural river channel varies in width from 20-120 ft.

Flow Data

The two main tributaries to the Otter Tail River are the Pelican and Toad Rivers with average flows of 80 and 40 cfs, respectively. In addition to these, there are 43 other tributaries (Appendix Table 2).

High flows generally occur in spring when snowmelt combines with rainfall resulting in large amounts of runoff. Flow fluctuations in the Otter Tail are not as extreme as other rivers in the state. It is naturally regulated by the many lakes it flows through and artificially maintained by over 20 dams, many of which are located at lake outlets.

The only gaging station on the river is just below Orwell Lake dam. Mean monthly discharge flows from October 1975 to September 1979 ranged from 8 to 972 cfs (Table 1). Average annual flows for 1976-80 ranged from 37 to 455 cfs (Table 2). The 1978 and 1979 average flows (399 and 455 cfs, respectively) both exceeded the 50 year average flow of 305 cfs. Data on flows and physical characteristics by sector are in Appendix Table 1.

Dams and Other Obstructions

There are 21 functional dams on the Otter Tail River (Appendix Table 3). Eleven of these control lake levels and have hydraulic heights of 6 ft or less. There are four hydroelectric dams in the Fergus Falls area. Of the remaining six functional dams, three are for river level control, two are for water supply and flood control and one diverts water to the Hoot Lake steam electric and hydroelectric station.

Table 1. Monthly average flow (cfs) of the Otter Tail River below Orwell Dam.

Water year [a]	Average Monthly Flow Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1976	334	321	241	248	306	433	519	318	171	110	57	9
1977	9	8	8	20	22	30	46	14	55	60	50	128
1978	201	299	363	403	357	385	814	812	519	402	137	96
1979	140	109	104	98	132	296	621	972	918	804	702	551
1980	343	356	325	358	393	489	549	505	346	167	103	41

[a] A water year extends from October of the previous year to September of the year indicated.

Table 2. Average flow (cfs) at the U.S.G.S. gauging station on the Otter Tail River below Orwell Dam for years of record and for water years 1976-1980.

Year	1976	1977	1978	1979	1980	1930-1980
Flow (cfs)	255	37	399	455	331	305

The four hydroelectric dams in the Fergus Falls area are owned and operated by Otter Tail Power Company. Friberg Dam (RM 76.1) is located approximately 6 mi north of Fergus Falls and has a width of 54 ft and a 30 ft hydraulic head. Central Dam (RM 54.2) is 78 ft long and has a 24 ft head. Pisgah Dam (RM 52.7) is 48 ft long and has a 34 ft head. Dayton Hollow Dam (RM 44.5) is 80 ft long and has a 35 ft head.

Orwell Dam (RM 40.4) was built in 1953 by the Army Corps of Engineers for flood control. It has a 43 ft head and a width of 33 ft.

There are two collapsed dams that are hazards to navigation. The City Electric Light Dam, 1 mi east of Fergus Falls (RM 57.2), washed out in 1907. It obstructs most of the river channel. The other collapsed dam is in Breckenridge (RM 6.2) and has a 1 ft head at normal water levels.

There are several locations where culverts constrict the river channel and obstruct navigation. At RM 175.0, just upstream of Chippewa Lake, the river flows through three culverts that restrict passage. The river flows through two large metal culverts 5 mi north of Fergus Falls and during high water a portage is required. There are four small culverts 2 mi northeast of Fergus Falls that are obstructions at all flows. One-third of a mile downstream of Central Dam in Fergus Falls a sewage pipe and metal grating cross the river just 2 ft above the water surface. This area should be avoided by canoeists because the banks are too steep for portaging and the pipe and grating can easily swamp a canoe, especially in high water. There are two large concrete culverts 1 mi west of Fergus Falls that do not obstruct the passage of canoes at low flow, however, higher flows create dangerous conditions because of current velocity and the 100 ft length of the culverts.

WATER QUALITY

The Otter Tail River begins as a clear stream at its source and increases in turbidity, total solids and fertility towards the mouth. During the summer, variations in water transparency are frequently exhibited downstream of the lakes in the upper portions of the watershed. This can be attributed to fluctuations in algal densities. At Fergus Falls the river receives municipal sewage, power plant cooling water and wastes from a resident flock of approximately 2000 Canada geese. From Fergus Falls to the mouth agriculture is more intensive and eroding streambanks more common causing increased turbidity. At Breckenridge, the municipal waterworks intermittantly discharges water treatment wastes which violate water quality standards for turbidity. Secchi disc transparency readings ranged from 8.0 ft near the source of the river to 1.4 ft near the mouth.

The river is classified by the Minnesota Pollution Control Agency (MPCA) as a 1C, 2B, 3B intrastate stream. This indicates suitability for the propagation of cool and warmwater fish, aquatic recreation of all kinds and use for public water supply with treatment. The river generally conforms to this classification; however, fecal coliform counts and turbidity levels sometimes exceed the standards of 200 organisms/100 ml and 25 FTU, respectively. These violations generally occur at times of high runoff.

The MPCA prepared a water quality report (Anderson, Bishop and Affeldt 1969) on the Otter Tail River upstream of Fergus Falls. Their findings indicate that water quality in the Otter Tail and major tributaries was very good. On several occasions low oxygen readings were noted downstream of lake and marsh areas due to natural conditons. Water quality is routinely monitored at Breckenridge by the MPCA. Two former water quality monitoring stations were located just upstream and downstream of Fergus Falls (MPCA 1967-68). The downstream station exhibited total phosphorus values that were generally more than two times the upstream values. The median downstream value was 0.15 mg/l, which is sufficient to stimulate algal blooms in the downstream reservoirs.

WATER USES

Water Appropriation

Water is appropriated from the Otter Tail River by four major users. Upstream of Fergus Falls, a diversion dam bypasses water from 12.5 mi of original river channel. The flow is channeled through Hoot and Wright Lakes and utilized for steam and hydroelectric power production at the Otter Tail Power Company, Hoot Lake Plant and the municipal water supply for Fergus Falls (1.6-3.0 mgd). From 1 June - 30 September, power plant water usage exceeds 112 mgd and for the remainder of the year 79 mgd are appropriated. This is the majority of flow in the river during some periods. The two other major users are the city of Breckenridge and Mid-America Dairymen which pump 0.58 mgd and 0.45 mgd, respectively. There are approximately 15 private users that appropriate for irrigation.

Waste Discharges

The 1981 Industrial and Municipal Waste Inventory (MPCA) lists Perham and Fergus Falls as cities which discharge effluent directly to the Otter Tail River at 0.38 and 2.87 mgd, respectively. Perham has a stabilization pond and Fergus Falls operates a wastewater treatment plant. Several other sources listed in the inventory discharge waste to tributary waters.

Otter Tail Power Company operates the Hoot Lake steam electric station at Fergus Falls. A MPCA discharge permit outlines four separate discharge points for this facility with the primary one being condenser cooling water at an average rate of 98 mgd. The permit states that during April and May water temperature at the edge of the mixing zone shall not be raised more than 5° F above the natural temperature, based on the monthly average of the maximum daily temperatures. At all times, the daily average water temperature at the edge of the mixing zone shall not be raised above 86° F. Other associated plant discharges are bearing cooling water at a maximum rate of 0.15 mgd, metal cleaning wastes at a maximum rate of 0.30 mgd and material storage runoff. The Otter Tail Power Company also discharges 0.22 mgd of non-contact cooling water from their office building in Fergus Falls. Mid-America Dairymen in Fergus Falls discharges 0.63 mgd of non-contact cooling water. The City of Breckenridge discharges 0.01 mgd from their water treatment plant.

Recreational Uses

The Otter Tail River and its corridor provide for many recreational activities with excellent opportunities for fishing and hunting. Fishing is concentrated below the dams and on the many lakes the river flows through. Wild rice harvesting is common in the headwaters lake area, especially in the Tamarac National Wildlife Refuge. Hubbel Pond Wildlife Management Area is located just west of Height-of-the-Land Lake and has areas that are open to public hunting.

Orwell Wildlife Management Area is south of Fergus Falls and surrounds the 396 A reservoir created by Orwell Dam. Hunting is allowed over most of its area, however, the northwest corner is a wildlife sanctuary. The reservoir has poor fisherman access and due to extreme water level fluctuations for flood control purposes has not realized its potential fishery.

The river is used by canoeists although upstream of Otter Tail Lake canoeing can be difficult. Between the many lakes, the river often becomes a marsh with undefined channel boundaries and thick growths of wild rice and cattails. The river is narrow and shallow with many riffle areas for 5 mi downstream of the Hubbel Pond dam. The remainder of the river is suitable for canoeing with short portages at the dams and culverts. Except for the lakes and reservoirs of the flowage, most of the stream is too shallow for motorized craft.

Ice fishing, snowmobiling and cross-county skiing are the most popular winter activities.

AQUATIC VEGETATION

Twenty-seven species of emergent and 25 species of submerged vegetation were observed along the Otter Tail River (Table 4). The greatest abundance and widest variety occur in the river-lake portion of the Otter Tail River in the first three sectors. The low gradient and clear water are conducive to aquatic plant growth. Wild rice, Canada waterweed, coontail and claspingleaf pondweed are some of the more common aquatic plants that occur in this section.

In Sectors 4 through 11, the Otter Tail becomes more riverine with well defined banks. Aquatic plants are still abundant but there is less diversity than in the first three sectors. In this stretch, wild rice is still common, as is coontail, flatstem pondweed and river pondweed.

In Sector 12 turbidity increases and rooted aquatic plant abundance declines. Sewage effluent from the City of Fergus Falls is discharged in this sector and the two shallow, turbid reservoirs are not conducive to the growth of rooted submerged plants. In the remaining sectors, river pondweed is the species of primary occurrence. The turbidity again increases from Orwell Reservoir to the mouth at Breckenridge due to exposed clay banks and agricultural runoff. In this reach submerged aquatic plants are scarce.

Table 4. Aquatic plants noted during the Otter Tail River survey, 1978-79.

Scientific name	Common name
	Emergent
Acorus calamus	Sweet flag
Agrostis alba	Redtop grass
Ascelpias incarnata	Swamp milkweed
Carex spp.	Narrow-leaf sedge
Cyperus esculentus	Chufa
Eleocharis acicularis	Needlerush
Eleocharis palustris	Spikerush
Equisetum fluviatile	Swamp horsetail
Iris versicolor	Blue flag
Lemna minor	Lesser duckweed
Lemna trisulca	Star duckweed
Nuphar microphyllum	Little yellow waterlily
Nuphar variegatum	Yellow waterlily
Nyphaea tuberosa	White waterlily
Phalaris arundinacea	Reed canary grass
Phragmites communis	Cane
Polygonum spp.	Smartweed
Potentilla palustris	Marsh cinquefoil
Sagittaria latifolia	Arrowhead
Sparganium chlorocarpum	Greenfruited burreed
Sparganium eurycarpum	Giant burred
Spartina pectinata	Cord grass
Scirpus acutus	Hardstem bulrush
Scirpus fluviatilis	River bulrush
Scirpus validus	Softstem bulrush
Typha latifolia	Common cattail
Zizania aquatica	Wild rice

Table 4. Continued.

Scientific name	Common name
Submerged	
Ceratophyllum demersum	Coontail
Chara spp.	Muskgrass
Elodea canadensis	Canada waterweed
Hippuris vulgaris	Marestail
Lemna minor	Lesser duckweed
Megalodonta Beckii	Water marigold
Myriophyllum exalbescens	Water milfoil
Najas flexilis	Bushy pondweed
Potamogeton amplifolius	Largeleaf pondweed
Potamogeton crispus	Curled pondweed
Potamogeton nodosus	River pondweed
Potamogeton obtusifolius	Bluntleaf pondweed
Potamogeton pectinatus	Sago pondweed
Potamogeton praelongus	Whitestem pondweed
Potamogeton Richardsonii	Claspingleaf pondweed
Potamogeton strictifolius	Narrowleaf pondweed
Potamogeton vaginatus	Largesheath pondweed
Potamogeton zosteriformis	Flatstem pondweed
Rumex orbiculatus	Great water dock
Sagittaria rigida	Stiff wapato
Sparganium fluctuans	Floatingleaf pondweed
Spirodela polyrhiza	Greater duckweed
Utricularia intermedia	Bladderwort
Utricularia vulgaris	Greater bladderwort
Vallisneria americana	Wild celery

TERRESTRIAL VEGETATION

A variety of plant communities is found along the banks of the Otter Tail River. The forest is expansive and relatively undeveloped in the headwaters lake area but dwindles to smaller plots of woods as the river passes through the prairie region that stretches from Fergus Falls to Breckenridge (Table 5). South of the headwaters lake area the woodlands decrease to a narrow corridor running along the river banks. Beyond this fringe of trees, the land is used extensively for crops and grazing.

The headwaters lake area is in the transition zone between coniferous and hardwood forest. Originally, conifers were the dominant tree species in the upper reach. Logging companies and homesteaders exploited this area and by 1900 little of the pine forest was left. Hardwood species succeeded conifers in cut-over areas and are dominant today. The main hardwoods are quaking aspen, white birch, sugar maple, basswood and red oak. White pine, jack pine and black spruce are the most common conifers. Box elder, willow and American elm occasionally reach high proportions in small tracts next to the river. Also present but to a lesser extent are mossycup oak, balsam poplar, tamarack and red cedar. The more common species that make up the understory in this upper stretch are speckled alder, beaked hazelnut, ironwood and dogwood.

In areas that are well forested and ungrazed, there is a good representation of trees, shrubs and various herbaceous plants. These combined with the abundant aquatic plants in the lake-river region provide good forage for a variety of wildlife.

Cropland predominates in the non-forested areas adjacent to the river. The remainder consists of grazed land and residential districts. There are only fragments of the once vast prairie grasses growing along the river banks and these have not been exploited because of inaccessibility. Most of the agriculture along the river is in the fertile soils of the gently sloping prairie region.

From Otter Tail Lake to the mouth of the river at Breckenridge, the diversity of hardwoods is significantly lower than on the upper half of the river. The most common trees seen along this section of river are American elm, green ash, box elder, cottonwood and willow. Other trees that occur occasionally are mossycup oak, white birch and rock elm.

Table 5. Trees and other woody plants noted during the Otter Tail River survey, 1978-79.

Scientific name	Common name
Trees	
Abies balsamea	Balsam fir
Acer negundo	Box elder
Acer saccharinum	Silver maple
Acer saccharum	Sugar maple
Betula papyrifera	White birch
Carpinus caroliniana	Ironwood
Fraxinus nigra	Black ash
Franixus pennsylvanica	Green ash
Juniperus virginiana	Red cedar
Larix laricina	Tamarack
Ostrya virginiana	Hornbeam
Picea glauca	White spruce
Picea mariana	Black spruce
Pinus banksiana	Jack pine
Pinus resinosa	Red pine
Pinus strolus	Eastern white pine
Populus balsamifera	Balsam poplar
Populus deltoides	Eastern cottonwood
Populus tremuloides	Quaking aspen
Quercus bicolor	Swamp oak
Quercus macrocarpa	Mossycup oak
Quercus rubra	Red oak
Salix spp.	Willow
Tilia americana	American basswood
Ulmus americana	American elm
Ulmus thomasi	Rock elm
Shrubs and Vines	
Acer spicatum	Mountain maple
Alnus rugosa	Speckled alder
Cornus alternifolia	Alternate-leaf dogwood
Cornus rugosa	Roundleaf dogwood
Cornus stolonifera	Red-osier dogwood
Corylus americana	American hazelnut
Corylus cornuta	Beaked hazelnut
Parthenocissus quinquefolia	Virginia creeper
Rhus typhina	Staghorn sumac
Salix spp.	Willow
Sambucus canadensis	Common elderberry
Vitis spp.	Grape

WILDLIFE CHARACTERISTICS

The Otter Tail River originally intersected three major vegetation zones: coniferous forest, hardwood forest and prairie. Today the remnants of presettlement vegetation and the upland communities that have succeeded provide a rich interspersion of cover types. Wetlands, lowland conifer, upland conifer, birch-aspen, upland hardwoods, oak savanna, bottomland hardwoods and prairie are some of the communities present along the Otter Tail corridor. The diversity of wildlife species found here is a reflection of the vegetative variety. During the survey, 83 species of birds and 14 species of mammals were observed. Many additional species are known to be present.

The Otter Tail River watershed provides good waterfowl habitat. Wild rice and other aquatic plants are abundant along the main channel and in the lakes and marshes of the upper watershed. Areas such as the Tamarac National Wildlife Refuge contain prime waterfowl nesting sites. Wood ducks, mallards and blue-wing teal were the most frequently observed waterfowl. Numerous waterfowl species utilize the area during migration and there is a resident population of Canada geese in Fergus Falls (Table 6). Non-game birds of interest include the bald eagle, osprey, white pelican, sandhill crane and common loon.

Whitetail deer occur throughout the watershed in varying densities and are the most important big game animal. The most favorable deer habitat is along the middle reach of river which has forest cover interspersed with farmland. When the vegetation along the river is the only cover, deer and other wildlife use the river corridor as a travel route between forests and marsh habitat. Other important game species include black bear, cottontail rabbit, ruffed grouse and ring-necked pheasant.

Table 6. Resident and migrant bird species of the Otter Tail River area.[a]

	Scientific name	Common name
*	*Gavia immer*	Common loon
	Podiceps grisegena	Red-necked grebe
	Podiceps auritus	Horned grebe
	Podiceps caspicus	Eared grebe
*	*Podilymbus podiceps*	Pied-billed grebe
	Aechmophorus occidentalis	Western grebe
*	*Pelecanus erythrorhynchos*	American white pelican
*	*Phalacrocorax auritus*	Double crested cormorant
*	*Casmerodius albus*	Great egret
*	*Ardea herodias*	Great blue heron
*	*Butorides virescens*	Green-backed heron
*	*Nycticorax nycticorax*	Black-crown night-heron
*	*Botaurus lentiginosus*	American bittern
*	*Ixobrychus exilis*	Least bittern
	Olor columbianus	Tundra swan
*	*Branta candensis*	Canada goose
	Anser albifrons	Greater white-fronted goose
	Chen hyberborea	Snow goose
*	*Anas platyrhynchos*	Mallard
	Anas acuta	Northern pintail
*	*Anas rubripes*	American black duck
	Anas strepera	Gadwall
*	*Spatula clypeata*	Northern shoveler
*	*Anas discors*	Blue-winged teal
	Anas carolinensis	Green-winged teal
	Anas americana	American widgeon
*	*Aix sponsa*	Wood duck
	Aythya americana	Redhead
	Aythya valisineria	Canvasback
	Ahthya collaris	Ring-necked duck
	Aythya marila	Greater scaup
	Ahthya affinis	Lesser scaup
	Bucephala clangula	Common goldeneye
	Bucephala albeola	Bufflehead
	Melanitta fusca	White-winged scoter
	Oxyura jamaicensis	Ruddy duck
	Mergus merganser	Common merganser
	Laphodytes cucullatus	Hooded merganser
	Mergus serrator	Red-breasted merganser
	Cathartes aura	Turkey vulture
	Accipiter gentilis	Northern goshawk
	Accipiter cooperii	Cooper's hawk
	Accipiter striatus	Sharp-shinned hawk
*	*Circus cyaneus*	Northern harrier
*	*Buteo lagopus*	Rough-legged hawk
*	*Buteo jamaicensis*	Red-tailed hawk
	Buteo lineatus	Red shouldered hawk

Table 6. Continued.

Scientific name	Common name
* Buteo platypterus	Broad-winged hawk
Buteo swainsoni	Swainson's hawk
Haliaeetus leucocephalus	Bald eagle
* Pandion haliaetus	Osprey
Aquila chrysaetos	Golden eagle
* Falco sparverius	Kestrel
Falco peregrinus	Peregrine falcon
Falco columbarius	Merlin
* Bonasa umbellus	Ruffed grouse
* Phasianus colchicus	Ring-necked pheasant
* Perdix perdix	Gray partridge (Hungarian)
Tympanuchus cupido	Greater prairie chicken
Tympanuchus phasianellus	Sharp-tailed grouse
Grus canadensis	Sandhill crane
Rallus elegans	King rail
* Rallus limicola	Virginia rail
Porzana carolina	Sora
* Fulica americana	American coot
Charadrius semipalmatus	Semipalmated plover
Pluvialis dominica	Lesser golden plover
Pluvialis squatarola	Black-bellied plover
* Charadrius vociferus	Killdeer
Limosa fedoa	Marbled godwit
Bartramia longicauda	Upland sandpiper
* Tringa solitaria	Solitary sandpiper
* Actitis macularia	Spotted sandpiper
Calidris himantopus	Stilt sandpiper
Limnodramus scolopaceus	Long-billed dowitcher
Limnodramus griseus	Short-billed dowitcher
Calidris alba	Sanderling
Calidris mauri	Western sandpiper
Tringa melanoleuca	Greater yellowlegs
Tringa flavipes	Lesser yellowlegs
Calidris canutus	Red knot
Calidris melanotos	Pectoral sandpiper
Calidris fuscicollis	White-rumped sandpiper
Calidris bairdii	Baird's sandpiper
calidris minutilla	Least sandpiper
Calidris alpina	Dunlin
Calidris pusilla	Semipalmated sandpiper
Philohela minor	American woodcock
* Capella gallinago	Common snipe (Wilson's)
Recurvirostra americana	American avocet
Phalaropus tricolor	Wilson's phalarope
Phalaropus lobutus	Red-necked phalarope
* Larus argentatus	Herring gull
* Larus delawarensis	Ring-billed gull
Larus pipixcan	Franklin's gull

Table 6. Continued.

Scientific name	Common name
Larus philadelphia	Bonaparte's gull
Sterna forsteri	Forester's tern
Sterna hirundo	Common tern
Sterna caspia	Caspian tern
Chilodonias niger	Black tern
* Columba livia	Rock dove
* Zenaidura macroura	Mourning dove
Coccyzus americanus	Yellow-billed cuckoo
* Coccyzus erythropthalmus	Black-billed cuckoo
Otus asio	Eastern screech owl
* Bubo virginianus	Great horned owl
* Strix varia	Barred owl
Aegolius acadicus	Northern saw-whet owl
Nyctea scandiaca	Snowy owl
Strix nebulosa	Great gray owl
Asio otus	Long-eared owl
Asio flammeus	Short-eared owl
Aegolius funereus	Boreal owl
Caprimulgus vociferus	Whip-poor-will
Chordeiles minor	Common nighthawk
* Chaetura pelagica	Chimney swift
* Archilochus colubris	Ruby-throated hummingbird
* Megaceryle alcyon	Belted kingfisher
* Colaptes auratus	Northern flicker
* Dryocopus pileatus	Pileated woodpecker
* Melanerpes erythrocephalus	Red-headed woodpecker
* Sphyrapicus varius	Yellow-bellied sapsucker
* Dendrocopos villosus	Hairy woodpecker
* Dendrocopos pubescens	Downy woodpecker
Picoides arcticus	Black-backed woodpecker
* Tyrannus tyrannus	Eastern kingbird
* Tyrranus verticalis	Western kingbird
* Myiarchus crinitus	Great crested flycatcher
* Sayornis phoebe	Eastern phoebe
Empidonax flaviventris	Yellow-bellied flycatcher
Empidonax alnorum	Alder flycatcher
Contopus borealis	Olive-sided flycatcher
Empidonax traillii	Willow flycatcher
Empodonax minimus	Least flycatcher
* Contopus virens	Eastern wood pewee
Eremophila alpestris	Horned lark
* Hirundo rustica	Barn swallow
* Petrochelidon pyrrhonota	Cliff swallow
* Iridoprocne bicolor	Tree swallow
Riparia riparia	Bank swallow
Stelgidopteryx ruficollis	Northern rough-winged swallow
* Progne subis	Purple martin
Perisoreus canadensis	Gray jay

Table 6. Continued.

Scientific name	Common name
* *Cyanocitta cristata*	Blue jay
Pica pica	Black-billed magpie
* *Corvus branchyrhynchos*	American crow
Corvus corax	Common raven
* *Parus atriacapillus*	Black-capped chickadee
* *Sitta carolinensis*	White-breasted nuthatch
Sitta canadensis	Red-breasted nuthatch
Certhia americana	Brown creeper
Troglodytes aldon	House wren
* *Telmatodytes palustris*	Marsh wren
Cistothorus platensis	Sedge wren
Troglodytes troglodytes	Winter wren
* *Dumetella carolinensis*	Catbird
* *Toxostoma rufum*	Brown thrasher
* *Turdus migratorius*	Robin
Hylocichla mustelina	Wood thrush
Catharus guttatus	Hermit thrush
Catharus ustulatus	Swainson's thrush
Catharus minimus	Gray-cheeked thrush
* *Hylocichla fuscescens*	Veery
Sialia sialis	Eastern bluebird
Regulus satrapa	Golden-crowned kinglet
Regulus calendula	Ruby-crowned kinglet
Anthus spinoletta	Water pipit
Bombycilla garrulus	Bohemian waxwing
* *Bombycilla cedrorum*	Cedar waxwing
Lanius excubitor	Northern shrike
Lanius ludovicianus	Loggerhead shrike
* *Sturnus vulgaris*	European starling
Vireo flavifrons	Yellow-throated vireo
* *Vireo olivaceus*	Red-eyed vireo
Vireo gilbus	Warbling vireo
Vireo solitarius	Solitary vireo
Vireo philadelphicus	Philadelphia vireo
* *Mniotelta varia*	Black-and-white warbler
Vermivora chrysoptera	Golden-winged warbler
Vermivora peregrina	Tennessee warbler
Vermivora celata	Orange-crowned warbler
Parula americana	Northern parula
Vermivora ruficapilla	Nashville warbler
* *Dendroica petechia*	Yellow warbler
Dendroica tigrina	Cape May warbler
Dendroica caerulescens	Black-throated blue warbler
Dendroica coronata	Yellow-rumped warbler
Dendroica magnolia	Magnolia warbler
Dendroica virens	Black-throated green warbler
Dendroica fusca	Blackburnian warbler
Dendroica castanea	Bay-breasted warbler

Table 6. Continued

Scientific name	Common name
Dendroica striata	Blackpoll warbler
Dendroica pinus	Pine warbler
Dendroica palmarum	Palm warbler
Dendroica pensylvanica	Chestnut-sided warbler
Seiurus aurocapillus	Ovenbird
Seiurus noveboracensis	Northern waterthrush
Oporornis agilis	Connecticut warbler
Wilsonia canadensis	Wilson's warbler
Wilsonia pusilla	Canada warbler
* Geothlypis trichas	Common yellowthroat
Oporornis philadelphia	Mourning warbler
* Setophaga ruticilla	American redstart
* Passer domesticus	House sparrow
* Dolichonyx oryzivorus	Bobolink
Sturnella magna	Eastern meadowlark
Sturnella neglecta	Western meadowlark
* Xanthocephalus xanthocephalus	Yellow-headed blackbird
* Agelaius phoeniceus	Red-winged blackbird
Euphagus cyanocephalus	Brewer's blackbird
Euphagus carolinus	Rusty blackbird
Euphagus cyanocephalus	Brewer's blackbird
* Quiscalus quiscalus	Common grackle
Molothrus ater	Brown-headed cowbird
Piranga olivacea	Scarlet tanager
* Icterus galbula	Northern oriole
Pheucticus ludovicianus	Rose-breated grosbeak
* Passerina cyanea	Indigo bunting
Coccothraustes vespertinus	Evening grosbeak
Carpodacus purpureus	Purple finch
Pinicola enucleator	Pine grosbeak
Carduelis hornemanni	Hoary redpoll
Carduelis flammea	Common redpoll
* Spinus pinus	Pine siskin
* Spinus tristis	American goldfinch
Spiza americana	Dickcissel
Cardinalis cardinalis	Northern cardinal
Loxia curvirostra	Red crossbill
Loxia leucoptera	White-winged crossbill
Pipilo erythrophthalmus	Rufus-sided towhee
Ammodramus leconteii	LeConte's sparrow
Chondestes grammacus	Lark sparrow
Junco hyemalis	Dark-eyed junco
Spizella arborea	American tree sparrow
Zonotrichia querula	Harris' sparrow
Zonotrichia leucophrys	White-crowned sparrow
Passerella iliaca	Fox sparrow
Melospiza lincolnii	Lincoln's sparrow
Melospiza georgiana	Swamp sparrow

Table 6. Continued.

Scientific name	Common name
Calcarius lapponicus	Lapland longspur
Plectrophenax nivalis	Snow bunting
Passerculus sandwichensis	Savannah sparrow
Ammodramus savannarum	Grasshopper sparrow
Poeecetes gramineus	Vesper sparrow
* Spizella passerina	Chipping sparrow
Spizella pallida	Clay-colored sparrow
Spizella pusilla	Field sparrow
Zonotrichia albicollis	White-throated sparrow
* Melospiza melodia	Song sparrow

[a] From Hennings, Parker and Hansen, 1980.
* Observed

The first three inhabit forested areas along the river north of Fergus Falls. Pheasants prefer the prairie region between Fergus Falls and Breckenridge where agriculture dominates the landscape.

Muskrat and beaver are most common in the headwater lake area. Six beaver dams were noted during the first phase of the survey. Four of the six dams are less than 13 river miles from the source. Beaver lodges and fresh cuttings were also seen sporadically over the entire river. A total of three mink were observed. No raccoons were observed but their tracks were evident in every sector. River otters are believed to inhabit the upper stretches of river but none were observed. Coyote, red fox and whitetail jackrabbits are among the other mammals present along the Otter Tail River (Table 7). Bobcats and wolves are reported occasionally in the northern reaches but must be considered sporadic visitors to the region.

The western painted turtle, red-bellied snake, eastern tiger salamander and northern leopard frog were the reptiles and amphibians sighted along the Otter Tail River. Other representatives of these two classes, known to be present in the area, are given in Table 8.

Table 7. Mammal species list for the Otter Tail River.[a]

Scientific name	Common name
Didelphis marsupialis	Opossum
* Sorex cinereus	Masked shrew
Sorex palustris	Northern water shrew
Sorex arcticus	Arctic shrew
Microsorex horji	Pygmy shrew
Blarina brevicauda	Shorttail shrew
Condylura cristata	Starnose mole
Myotis lucifugus	Little brown myotis
Myotis keeni	Keen myotis
Lasionycteris noctivagans	Silver-haired bat
Eptesicus fuscus	Big brown bat
Lasiurus borealis	Red bat
Lasiurus cinereus	Hoary bat
Procyon lotor	Raccoon
Mustela erminea	Shorttail weasel
Mustela nivalis	Least weasel
Mustela frenata	Longtail weasel
* Mustela vison	Mink
Lutra canadensis	River otter
Taxidea taxus	Badger
Mephitis mephitis	Striped skunk
Canis latrans	Coyote
Canis lupus	Wolf
Urocyon cinereoargenteus	Gray fox
Vulpes vulpes	Red fox
Lynx rufus	Bobcat
Lynx canadensis	Lynx
* Marmota monax	Woodchuck
Spermophilus richardsoni	Richardson ground squirrel
* Spermophilus tridecemlineatus	Thirteen-lined ground squirrel
Spermophilus franklini	Franklin's ground squirrel
* Tamias striatus	Eastern chipmunk
Eutamias minimus	Least chipmunk
* Sciurus carolinensis	Eastern gray squirrel
* Sciurus niger	Eastern fox squirrel
* Tamiasciurus hudsonicus	Red squirrel
Glaucomys sabrinus	Northern flying squirrel
Geomys bursarius	Plains pocket gopher
Perognathus flavescens	Plains pocket mouse
* Castor canadensis	Beaver
Peromyscus maniculatus	Deer mouse
Peromyscus leucopus	White-footed mouse
Onychonmys leucogaster	Northern grasshopper mouse
Microtus ochrogaster	Prairie vole
* Ondatra zibethica	Muskrat
Ratus norvegicus	Norway rat
Mus musculus	House mouse
* Zapus hudsonius	Meadow jumping mouse

Table 7. Continued.

Scientific name	Common name
Napaeozapus insignis	Woodland jumping mouse
Erethizon dorsatum	Porcupine
Lepus townsendi	Whitetail jackrabbit
Lepus americanus	Snowshoe hare
* Sylvilagus floridanus	Eastern cottontail
Odocoileus hemionus	Mule deer
* Odocoileus virginianus	Whitetail deer
Synaptomys cooperi	Southern bog lemming
Clethrionomys gapperi	Southern redback vole
Microtus pennsylvanicus	Meadow vole

[a] From Hennings, Parker and Hansen, 1980.
* Observed

FISHERIES

Fisheries survey work was conducted on the Otter Tail River during August 1979 and June 1980. Electrofishing sampling stations were established over 160 mi of river. Previous studies include the Otter Tail Power Company Thermal Plume Monitoring Program (May 1976-February 1978). The report consists of two volumes delineating the measured extent of the thermal plume downstream of the plant, results of electrofishing survey work completed above and below the plant and a time-temperature study using selected indigenous species to determine survival characteristics in the thermal plume (Swanson Environmental, Inc. 1978). The Center for Environmental Studies (1975), Tri-College University, Fargo, N.D. carried out an environmental assessment study of the Lake Orwell area in 1974. The report discussed the socio-economic and environmental impacts of the Orwell Dam project. Part of this study included a limited fishery evaluation as well as some detailed limnological studies of the reservoir. The fishery work included shoreline seining and trapnetting.

Table 8. Reptile and amphibian species list for the Otter Tail River.[a]

Scientific name	Species	Common name
	Turtles	
Chelydra serpentina		Common snapping turtle
* Chrysemys picta belli		Western painted turtle
	Lizards	
Eumeces septentrionalis septentrionalis		Northern prairie skink
	Snakes	
* Storeria occipitomaculata		Red-bellied snake
Thamnophis sirtalis sirtalis		Eastern garter snake
Thamnophis sirtalis parietalis		Red-sided garter snake
Thamnophis radix haydeni		Western plains garter snake
Heterodon nasicus		Western hognose snake
Opheodrys vernalis blanchardi		Western smooth green snake
	Salamanders	
Necturus maculosus		Mudpuppy
Ambystoma laterale		Blue-spotted salamander
* Ambystoma tigrinum tigrinum		Eastern tiger salamander
	Toads	
Bufo hemiophrys hemiophrys		Canadian toad
Bufo americanus		American toad
Bufo cognatus		Great plains toad
	Frogs	
Hyla versicolor & H. chrysoscelis		Gray treefrog
Pseudacris triseriata maculata		Boreal chorus frog
Pseudacris triseriata triseriata		Western chorus frog
Rana sylvatica		Wood frog
* Rana pipiens		Northern leopard frog

[a] From Conant (1975).
* Observed

During the reconnaissance phase of the MDNR survey, stream characteristics were recorded. Parameters such as stream width, depth, bank height, vegetation and substrate were noted as well as differentiation of habitat types (pools, riffles, runs). Sector subdivisions were made on the basis of changing stream characteristics from the source at Elbow Lake to the mouth at Breckenridge.

Electrofishing stations were located to include representative stream habitats within the various study sectors. The number of electrofishing sampling stations per sector was determined by the length of the sector and diversity of habitat. One to five timed electrofishing runs were completed per sector. A total of 30 timed electrofishing samples were taken in 14 of the 17 designated sectors. Because of low flow levels, Sectors 1, 2 and 4 were considered insignificant for fish and were not shocked. The accumulated shocking time was 13.8 hours. All electrofishing samples were collected during daylight hours. A legal description of each electrofishing run is given in Appendix Table 4 and runs are shown on the map series.

Two types of electrofishing equipment were used due to the variation in the river's physical conditions. In areas too shallow for the conventional boomshocker, a streamshocker was used. Typical electrofishing parameters were 250 VDC, 5 amps, 35 pulses/sec and 35% pulse width.

A primary factor limiting electrofishing success in large warmwater rivers is depth. In general, water over 6-8 ft deep is not effectively sampled by conventional electrode systems. The reach of river for several miles below Orwell reservoir was characterized by intermittant pools over 6 ft deep and some gravel-rubble substrates. It is likely that there was some negative sampling bias for such species as walleye and channel catfish. The very clear, shallow water found in the upper portions of river probably allowed some avoidance of the electrical field, particularly by large fish.

Catch

A total of 3,624 fish were collected in the 14 electrofished sectors. The catch consisted of 49 species representing 11 families of which 25 species were minnows and other small fishes (Table 9). Although minnows and other small fishes are an integral part of the ichthyofauna of the Otter Tail River (comprising approximately 40.0% of the total catch) they are excluded from the percent composition analysis of the catch. They are tabulated by numbers in the catch in Appendix Table 5.

Table 9. Fish species taken by electrofishing in the Otter Tail River, 1979 and 1980.

Scientific name	Family	Common name
	Amiidae	
Amia calva		Bowfin
	Hiodontidae	
Hiodon alosoides		Goldeye
	Umbridae	
Umbra limi		Central mudminnow
	Esocidae	
Esox lucius		Northern pike
	Cyprinidae	
Campostoma anomalum		Central stoneroller
Cyprinus carpio		Common carp
Nocomis biguttatus		Hornyhead chub
Notropis atherinoides		Emerald shiner
Notropis cornutus		Common shiner

Table 9. Continued.

Scientific name	Family	Common name
	Cyprinidae	
Notropis heterodon		Blackchin shiner
Notropis heterolepis		Blacknose shiner
Notropis hudsonius		Spottail shiner
Notropis spilopterus		Spotfin shiner
Notropis stramineus		Sand shiner
Notropis texanus		Weed shiner
Notropis volucellus		Mimic shiner
Phoxinus eos		Northern redbelly dace
Pimephales notatus		Bluntnose minnow
Pimephales promelas		Fathead minnow
Rhinichthys atratulus		Blacknose dace
Rhinichthys cataractae		Longnose dace
Semotilus atromaculatus		Creek chub
	Catostomidae	
Carpiodes cyprinus		Quillback
Catostomus commersoni		White sucker
Hypentelium nigricans		Northern hogsucker
Ictiobus cyprinellus		Bigmouth buffalo
Moxostoma anisurum		Silver redhorse
Moxostoma erythrurum		Golden redhorse
Moxostoma macrolepidotum		Shorthead redhorse
Moxostoma valenciennesi		Greater redhorse
	Ictaluridae	
Ictalurus melas		Black bullhead
Ictalurus natalis		Yellow bullhead
Ictalurus nebulosus		Brown bullhead
Ictalurus punctatus		Channel catfish
Noturus gyrinus		Tadpole madtom
	Gadidae	
Lota lota		Burbot
	Centrarchidae	
Ambloplites rupestris		Rock bass
Lepomis cyanellus		Green sunfish
Lepomis gibbosus		Pumpkinseed
Lepomis macrochirus		Bluegill
Micropterus salmoides		Largemouth bass
Poxomis nigromaculatus		Black crappie

Table 9. Continued.

Scientific name	Family	Common name
	Percidae	
Etheostoma exile		Iowa darter
Etheostoma nigrum		Johnny darter
Perca flavescens		Yellow perch
Percina caprodes		Logperch
Percina maculata		Blackside darter
Stizostedion vitreum vitreum		Walleye
	Sciaenidae	
Aplodinotus grunniens		Freshwater drum

Peterson (1975) examined electrofishing catches from various Minnesota streams and compiled some average statistics describing fish composition. In an electrofishing catch from a large river (X flow > 100 cfs) game fish (walleye, sauger, white bass, smallmouth bass, largemouth bass, catfish and muskellunge) averaged 14.0% of the large fish catch by number and 9.0% by weight [1]. Carp and catostomids averaged 71.0% by number and 90.0% by weight. Otter Tail River survey results, in comparison, showed game fish to be 7.1% of the overall large fish catch by number and 4.1% by weight (Appendix Table 6). Carp and catostomids were 65.1% by number and 89.0% by weight. A catch composition comparison of four streams surveyed by the River Surveys Project is given in Table 10.

Walleye were the most common game fish at 2.8%. Most walleye were taken in Sectors 13, 14 and 15. Sector 15 had 44.3% of all the walleye taken in the survey. Northern pike were the most evenly distributed game fish and the second most abundant by number at 2.6%. They were collected in all sectors except Sector 10. Northern pike were most abundant in Sector 7 where they comprised 8.7% of the catch.

Table 10. Percent of the large fish catch for two groups of fishes (game fish; carp and catostomids) in four northwestern Minnesota streams with X flows > 100 cfs.

Stream	Game fish % (no)	Game fish % (wt)	Carp & catostomids % (no)	Carp & catostomids % (wt)
Otter Tail River (1979, 80)	7.1	4.1	65.1	89.0
Red Lake River (1976, 77)	6.0	6.1	67.5	74.3
Wild Rice River (1976)	3.8	5.0	83.7	89.0
Roseau River (1976)	39.0	25.0	48.8	72.1

[1] Small fish species were not included in Peterson's catch composition analysis for the larger rivers because they are difficult to sample in relation to abundance in many electrofishing surveys and were often not quantified in historical data.

The remainder of the game fish, largemouth bass and channel catfish, accounted for 1.7% of the overall catch. Largemouth bass were the third most frequently collected game fish at 1.5%. Channel catfish were collected in only two sectors and were 0.2% of the overall catch.

White sucker, shorthead redhorse and carp were the three most abundant species in the catch. White suckers dominated the catch with 19.1% and were collected in all but Sector 6. Carp were the second most common fish collected at 14.1%. They were collected in Sectors 9 and 12-17. Golden and silver redhorse were not collected upstream of Sector 10. Golden redhorse comprised 50.0% of the catch in Sector 10. Greater redhorse were not collected before Sector 13. A 9.5 lb specimen was collected during some incidental MDNR sampling in the reservoir (Red River Lake) above the Friberg Dam. This species comprised 15.6% of the catch in Sectors 14 and 16. Overall, greater redhorse comprised 4.1% of the catch. Northern hogsuckers were collected in Sectors 11, 12 and 13, exclusively and were 10.6% of the catch in Sector 11.

Tables 7 and 8 of the Appendix provides total species weight and percent composition by weight for the study area. Northern pike were the most abundant game fish by weight at 1.8% of the overall catch and walleye were 1.6%.

Carp were the most abundant by weight overall at 28.5% and white suckers were second at 16.2%. In Sectors 12-17, carp comprised over 30% of the total weight and in Sectors 14 and 17, nearly 50%. White sucker were over 50% of the catch by weight in Sectors 7 and 8. In Sectors 3 and 6, brown bullhead comprised over 75% of the catch by weight.

A total of 13.8 hrs of electrofishing was carried out on the Otter Tail River. Table 9 of the Appendix gives the catch per unit of effort (CPUE) for each of the 14 sectors surveyed. For the large fish species, catch rates ranged from 50.0-336.6 fish/hr with a average CPUE of 158.2 fish/hr. Northern pike were the most frequently taken game fish at 4.0 fish/hr and walleye averaged 1.4 fish/hr. Sector 15 had the highest CPUE for game fish at 24.9 fish/hr, of which 22.5 fish/hr were walleye. Sector 5 had the highest CPUE of northern pike at 18.7 fish/hr.

Sector 15 had the highest CPUE at 336.6 fish/hr. The high CPUE of Sector 15 was primarily due to high catches of carp and catastomids which accounted for 255.6 fish/hr. White suckers were the most frequently collected large fish at 29.5 fish/hr and were taken in all sectors but Sector 6. Sector 7 had the highest CPUE of white suckers for all sectors at 57.5 fish/hr. The second most frequently captured species was carp at 21.9 fish/hr in spite of the fact that they were collected in only half the sectors sampled. Shorthead redhorse were the third most frequently collected large fish at 20.5 fish/hr.

A representation of the percentages of three categories of sexual maturity (young-of-the-year, immature and adult) is given in Figure 1 for eight important species. No young-of-the-year walleye were collected in this study. The redhorse species were combined to include 65 unidentified young-of-the-year. Over 80% of the redhorse species were adults. Nearly two-thirds of the carp taken were immature.

Table 10 of the Appendix shows the overall length-frequency of the catch for the study area followed by Tables 11 through 24 which contain the individual data for each sector.

The diversity index ($\bar{d}$) is a statistical expression that can be used as an indicator of the quality of the aquatic environment. Environmental stress on fish populations may be reflected by the diversity of the catch. The index is a measure of species variety and the distribution of individuals among the species and for purposes of this investigation was computed using the formula $\bar{d} = N\ (N \log_{10} N - \ \ n_i \log 10 n_i)$ (Lloyd, Zar and Karr 1968).

Peterson (1975) compiled information from 21 different stream reaches and found that the usual range of $\bar{d}$ for Minnesota's warm water streams is 1.8 - 2.6 with a median of 2.2 for the large fish species. In Peterson's analysis the genus moxostoma was not broken down to separate species because of taxonomic problems with some of the data used. In situations where numbers of more than one redhorse species are present, this method underestimates the actual diversity.

Diversity index values for the Otter Tail River were calculated with all fish as distinct species. For the large fish, the median value was 2.6 with a range of 1.8 - 3.3 (Table 11). Some of the highest $\bar{d}$ values were in Sectors 13, 14 and 15. These corresponded with the river reaches

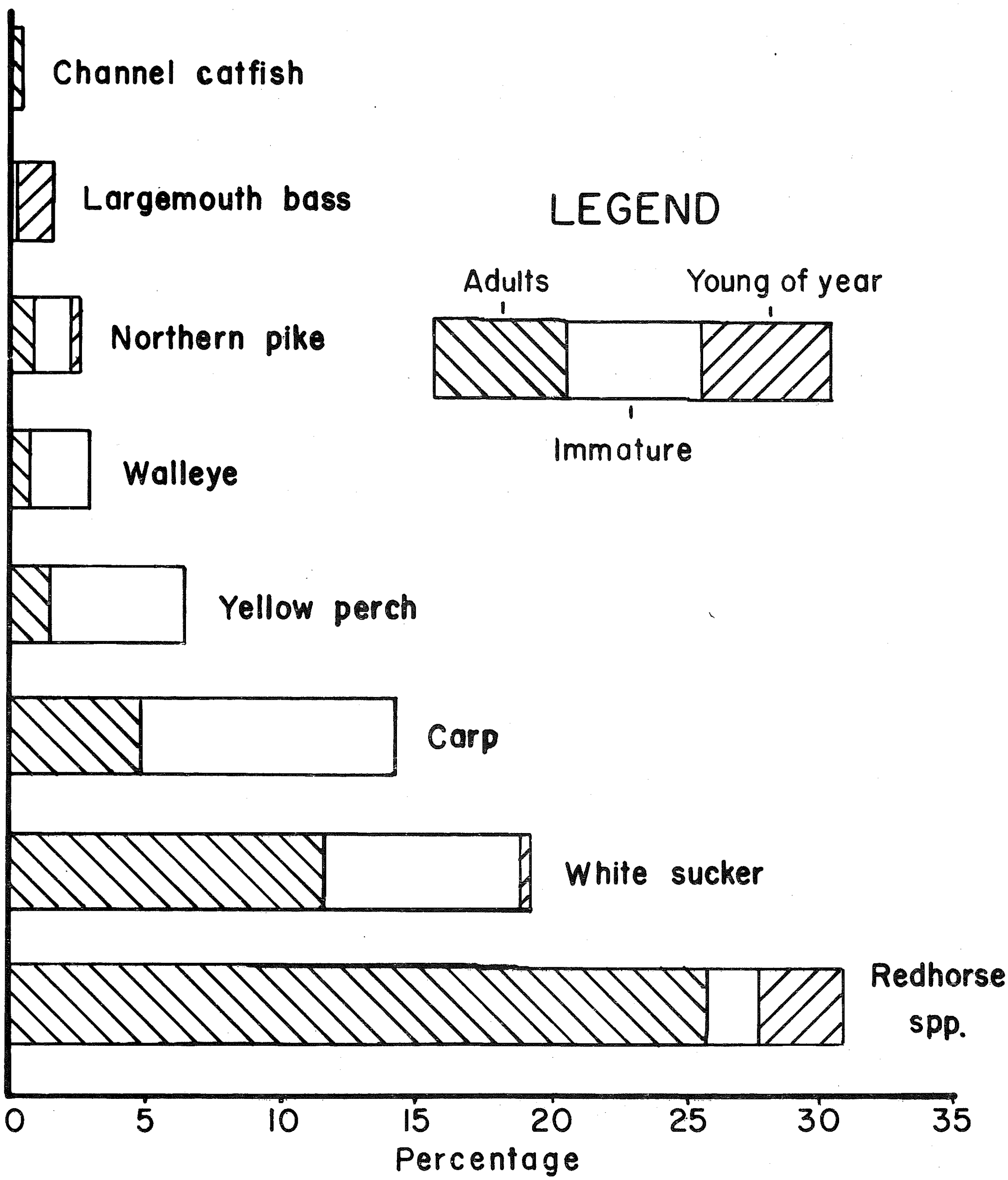


Figure 1. Comparative abundance of the primary fish species and levels of sexual maturity for the catch of the Otter Tail River, August and September, 1979 and June 1980.

below Taplin Gorge, Dayton Hollow and Orwell Dams where coarse substrates, a variety of habitats and higher numbers of fish species were present.

Table 11. Diversity index for the 17 sectors sampled of the Otter Tail River, 1979-80.

Sector	Large fish	All fish
3	1.9	2.3
5	1.9	2.2
6	1.8	2.5
7	2.0	2.4
8	2.9	3.4
9	2.1	2.6
10	1.9	2.1
11	2.8	3.2
12	2.5	2.6
13	3.0	3.6
14	2.9	3.9
15	3.3	3.7
16	3.1	3.0
17	2.7	3.1

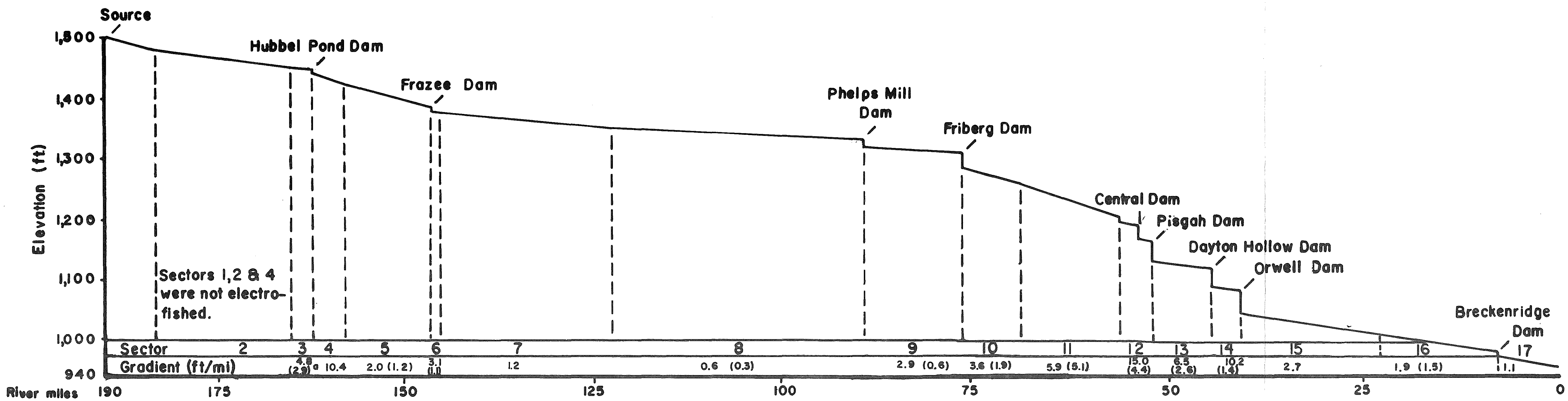
Peterson (1975) stated that a $\bar{d}$ below 1.8 may be the result of some environmental stress. Sectors 3, 5 and 6 had $\bar{d}$ values of 1.9, 1.9 and 1.8 respectively. The river in this region was shallow, clear and had few deep holding areas for the larger species. In Sector 5, the catch was almost exclusively small fish species and the habitat in Sectors 3 and 6 favored disproportionately high numbers of brown bullhead and white sucker which suppressed the $\bar{d}$ value. Observations of other aquatic parameters did not indicate any further stress to the fish populations.

Fish distribution was predictably responsive to physical stream parameters along the Otter Tail River. Four characteristics (depth, water clarity, gradient and substrate) had major influences. Table 2 of the Appendix outlines physical characteristics by sector. The many dams in the flowage influence the fishery by impeding normal movement, and lakes provide alternative habitats. The stream profile and percent of catch by number, for the predominant species in the Otter Tail River, are expressed in Figure 2. Fish are listed in order of their overall abundance in the stream and the considerable variation in percent composition between sectors is a result of changes in stream characteristics.

The upper nine sectors exhibited a variety of substrate types with sand and gravel the most prevalent. There were many areas of abundant submerged aquatic plants. The shallow, clear-to-bottom stream flowing between the many lakes tended to favor large numbers of brown and yellow bullhead, white sucker, yellow perch and small northern pike as well as large numbers of shiners, daces and chubs. Carp were first collected below the Phelp's Mill Dam (Sector 9) where a single specimen was collected but they are reported to be present in the river upstream to Frazee.

The sectors included in the segment between Taplin Gorge Dam and Orwell Dam (Sectors 10-14) represent the area of highest stream gradient which is characterized by intermittant areas of coarse substrate types. Flow and average depth increase as well as a slight increase in turbidity at the lower end of this segment. Golden and silver redhorse began to show up in the catch below Taplin Gorge Dam and shorthead redhorse were collected more frequently. Carp were sampled in Sector 12 (below Hoot Lake power station) after which they became a regular component of the fishery.

From Orwell Dam to the mouth (Sectors 15-17) the river exhibits a noticeable change in physical character. The channel becomes increasingly meandered and less stable with substrate particle size diminishing. In the upper end of this reach the substrate consists mostly of rubble and



	Total %														
Wh. sucker	19.1	11.7	25.0		59.0	28.0	20.3	9.4	34.4	3.7	16.2	13.4	12.4	7.8	2.6
Carp	14.2						0.8			11.0	22.4	30.2	24.3	25.0	36.0
Sh. redhorse	13.3				2.5	7.2	0.8	28.1	5.3	43.9	28.6	6.7	13.9	10.9	26.8
Y. bullhead	7.3	1.8	12.5	1.9	6.2	19.5	46.6		8.4	2.4	2.0				
Gold. redhorse	7.1							50.0	16.0	23.2	9.7	11.2	9.7	9.4	0.7
Br. bullhead	6.6	58.6		61.1	12.4	6.5			1.5			0.6			
Y. perch	6.4	16.2	25.0	1.9	7.5	19.9	21.1			1.2	0.7	1.7	2.0	1.6	
Gr. redhorse	4.1										0.7	15.6	11.4	15.6	0.7
Sil. redhorse	3.2							6.3	2.3	1.2	5.5	7.3	4.5	6.3	6.5
Walleye	2.9				0.6	2.0	0.8				2.6	9.0	6.7	1.6	0.7
N. pike	2.6	3.6	37.5	3.7	8.7	2.6	2.3		3.1	1.2	3.3	0.6	0.3	1.6	2.6
Quillback	2.0												6.9	15.6	3.3
Largemouth bass	1.5				2.5	3.3	5.3	3.1	1.5	4.9	1.0	1.1			
Rock bass	1.5					5.2	0.8	3.1	1.5	1.2	0.3	1.7	0.5	1.6	3.3
B. buffalo	1.5										1.6		2.5	1.6	11.1
Chan. catfish	0.2												0.5		2.0

Figure 2. Otter Tail River stream profile and percent of catch by sector sampled for the primary species, August and September, 1979 and June, 1980.

[a]Dams have reduced the gradient to the figure in parentheses.

gravel with some boulder areas. Farther downstream the substrate particle size grades to mostly sand with some gravel. Pools and riffles are common in the upper half of this reach. Turbidity increases progressively downstream with secchi disc readings ranging from 3.0-0.7 ft. Channel catfish were first captured in the upper ends of the reach and the CPUE for walleye was highest here. Quillback and goldeye were collected in the lower ends of this reach.

Stocking activities within the last 10 years have been confined primarily to the lakes and reservoirs of the flowage upstream of Fergus Falls. Walleye was the most frequently stocked species and there have been some bullhead removal efforts. Muskellunge, northern pike and walleye have been stocked in Many Point Lake. The small upper reservoir in Fergus Falls is regularly stocked with winter rescue sunfish and northern pike to provide an urban fishing opportunity. Downstream in Dayton Hollow Reservoir walleyes were stocked until 1977 when Otter Tail Power Company denied public access.

BENTHIC INVERTEBRATES

Qualitative and quantitative sampling of benthic invertebrates was done on the Otter Tail River in September 1979. Additional qualitative sampling was done in August 1982. Seven sites were sampled (Appendix Table 25). The purpose of the sampling was to discover what common invertebrate taxa are characteristic of the Otter Tail River, and to estimate quantities of organisms present in a variety of substrates.

Four of the seven sites were sampled quantitatively with a petite Ponar dredge (area 232 sq. cm.). Four replicates were collected in riffle or run habitat at each of the four quantitative sampling sites

(Table 12). The following substrates were sampled: sand (Breckenridge); gravel and sand (Wilkin county Road 19); rubble and gravel (Orwell) and gravel with aquatic vegetation (Broken Down Dam). Quantitative sample areas at the Broken Down Dam and Orwell sites were chosen because they appeared to be major fish food producing substrates. Quantitative samples at Wilkin County Road 19 and Breckenridge were more characteristic of the predominant substrate in that stretch of river.

Bottom material from quantitative samples was sieved in the field with a U.S. Standard No. 30 sieve and preserved in 5% formaldehyde. In the laboratory, organisms were sorted under 10X power. Volumes of organisms were measured with a 5 ml microburet (accuracy $\pm$ 0.01 ml).

Qualitative samples were collected with a dip net by disturbing substrate and vegetation. Rocks and sticks were also examined for additional organisms. Because many aquatic insects cannot be identified to species as immatures, adults in the vicinity of the sampling sites were also collected whenever possible. Methods used to collect adults were net sweeping, a black light trap and a gas lantern. The black light trap captured large numbers of Trichoptera while Chironomidae were more easily collected by aspiration or in alcohol near a gas lantern, or by sweeping.

Findings

There were large differences among the four sets of quantitative samples, both in terms of volumes of benthos present and the total number of taxa present at each site. The ratio of total volumes recorded for the four quantitative sampling sites (Breckenridge, County Road 19,

Table 12. Characteristics of four Otter Tail River sites sampled with a petite Ponar dredge, September 1979.

Station	River mile	Substrate	Secchi disc (m)	Depth (m)	Velocity (cm/sec)	Water temperature (C)	# Taxa (4 replicate & totals)	Total # Specimens (4 replicate & totals)	Volume/ dredge (ml)
A (Breckenridge)	10.5	sand	0.5	0.9	52	15	3	5	<0.02
							3	4	<0.02
							11	26	0 03
							1	2	<0.02
							14	**37**	
C (Co. Rd. 19)	30.5	gravel/sand	0.9	0.6	61	19	23	162	0.11
							25	160	0.12
							17	106	0.08
							17	79	0.04
							34	**507**	
E (Below Orwell Reservoir)	40.1	rubble/gravel	0.9	0 6	55	17	31	1 137	1 25
							31	893	0.92
							25	639	0.73
							30	1,216	2.34
							39	**3,885**	
F (Broken Down Dam)	57.0	gravel (with plant growth)	2.9	0.5	61	17	35	174[a]	0.16
							45	525	0.57
							38	417	0.40
							49	409	0.35
							68	**1,525**	

[a] Dry weight of plant material for replicates 1-4, respectively, was 1.3, 8.6, 5.8 and 5.1 grams.

Orwell, Broken Down Dam) was 1:7:105:30. This was based on a total volume of 0.05 ml from the four sand samples at Breckenridge. The largest number of taxa from a set of quantitative samples was recorded from Broken Down Dam (68), and the lowest was recorded from Breckenridge (14). These results generally agree with the discussion of substrates and quantitative sampling in Hynes (1970), with sand being the poorest substrate, increasing abundance occurring on gravel and rubble, and the presence of aquatic vegetation increasing the densities of organisms.

A total of 242 taxa, including records from both quantitative and qualitative samples, were collected from the Otter Tail River (Appendix Table 26). The major groups of taxa, according to the number of taxa collected in each group, were Diptera (40%), Trichoptera (20%), Ephemeroptera (8%) and Coleoptera (8%). Some groups were identified only to phylum or class, but most of the insects, oligochaetes, leeches and molluscs were identified to genus or species.

Chironomidae were the most abundant family of Diptera. The percent composition of taxa of chironomid subfamilies was: 15% Tanypodinae; 63% Chironominae (47% tribe Chironomini, 16% tribe Tanytarsini); and 22% Orthocladiinae. Some common chironomid taxa present were _Polypedilum convictum_, _Polypedilum illinoense_, _Rheotanytarsus_ spp., and _Cricotopus bicinctus_ grp. In quantitative sampling, _Parametriocnemus_ (Orthocladinae) was the most abundant chironomid in gravel and vegetation samples at Broken Down Dam, while below Orwell the filter feeder _Microtendipes caducus_ was dominant. The fauna of sand substrates at Breckenridge was very sparse, being comprised mainly of the chironomids _Robackia_, _Paratendipes connectens_ #3, and _Cordites_. Other Diptera commonly collected in the Otter Tail River were Simuliidae (_Simulium vittatum_, _S. luggeri_) and

Empididae.

The greatest number of Trichoptera taxa collected belonged to the family Leptoceridae (17), but most of these species were collected in light traps, and were not very common in aquatic samples. The hydropsychidae, which are filter feeding caddisflies, were very abundant, and 11 species were present. In quantitative sampling of gravel and vegetation (Broken Down Dam), rubble and gravel (Orwell) and gravel and sand (Wilkin Co. Rd. 19), Hydropschidae were 26%, 69% and 32% of the total numbers collected. They ranged from 25-74% of the total volume in quantitative samples at Broken Down Dam and from 74-93% of the total volume at Orwell.

Filter-feeding organisms such as Hydropsychidae are noted to be abundant below lakes because of the increase in food material in the form of plankton (Hynes, 1970). The presence of large numbers of filter feeders in quantitative samples in the Otter Tail River is not surprising, since the river flows through 18 lakes and several shallow reservoirs.

The Hydropsychidae also showed major changes in species composition from upstream to downstream sites. *Cheumatopsyche petteti*, *Hydropsyche betteni*, and *Symphitopsyche bifida* were the most common hydropsychid adults at Hubbel Pond. Two other species of *Symphitopsyche*, *riola* and *bronta*, were also collected there. At Orwell light traps, *Cheumatopsyche campyla*, *Symphitopsyche bifida*, and the larger river species *Hydropsyche bidens* and *Potamyia flava* were found.

Ward and Stanford (1979) list several factors which can affect the abundance and composition of stream organisms: temperature, flow, substrate, aquatic and riparian vegetation, dissolved substances, food and biotic interactions. Based on this limited sampling, it would be difficult to make any conclusive statement about the factors affecting the distribution and abundance of Hydropsychidae in the Otter Tail River. However, the appearance of Potamyia flava and Hydropsyche bidens below Orwell coincides with the change in the river from a fairly clear, woodland river above Fergus Falls to a low gradient, turbid river after flowing through several reservoirs below Fergus Falls. Cheumatopsyche campyla also may be a species characteristic of larger, more turbid rivers. Cheumatopsyche campyla was the only species collected in the light trap at Orwell and very few were collected in light traps at Hubbel Pond.

Other common Trichoptera taxa were Psychoymia flavida (Psychomyiidae) and Protoptila (Glossosomatidae). Hydroptilidae were not common in aquatic collections, but adults were very abundant in light traps, numbering in the thousands. Hydroptila armata at Hubbel Pond and Hydroptila perdita at Orwell were common species collected in light traps.

The most abundant taxa of Ephemeroptera collected in the quantitative at the Broken Down Dam, Orwell, and Wilkin County Road 19 sites were Pseudoeloeon spp. (Baetidea) and Potamanthus spp. (Potamanthidae). Heptageniidae, mainly Stenacron interpunctatum and Stenonema mediopundatum, were commonly found in qualitative sampling of coarse substrate or logs in shallow water. Adults of Caenidae were very abundant in light traps but were uncommon in aquatic sampling. Hexagenia (Ephemeridae) nymphs were present in mud and aquatic vegetation at a site below Orwell. A few adults of Ephoron album were collected in light traps at Orwell and were also collected in sweep samples upstream of Wilkin County Road 19 bridge, but no nymphs were found.

Families of Coleoptera collected included Dytiscidae, Gyrinidae, Elmidae and Hydrophilidae. Stenelmis larvar (Elmidae) were found in quantitative samples collected at Broken Down Dam, below Orwell and at Wilkin County Road 19, but were most abundant at Broken Down Dam. Other taxa were mainly collected in qualitative sampling.

Other insect orders collected were Hemiptera, Plecoptera, Neuroptera and Lepidoptera. A few non-insect orders, including 15 species of Oligochaeta, were also found. Bryozoans were common on rocks below Orwell Reservoir. Ferrisia (Mollusca:Gastropoda) was common throughout the river. Lampsilis siliquoidea (Mollusca:Pelecypoda) was present at Hubbel Pond site.

Molluscs were also collected below Orwell Reservoir during a period of extremely low flow (Table 13). During the third week of September 1978, flows were reduced below Orwell Reservoir dam to accommodate exploratory drilling operations in the stream bed. This provided an opportunity to examine mussel populations, as some were stranded by low water levels. Sampling was conducted by hand picking live organisms and the shells of recently dead mussels.

Cvancara (1967) carried out a survey of mussel distribution in the Red River and 18 of its tributaries during the summer of 1965 and 1966. Eleven species of mussels were identified from the Ottertail River. Cvancara's collecting methods here consisted of hand picking specimens from the lower portions of the river. Two species Lasmigona compressa, Anadontoides ferussacianus were unique to Cvancara's sampling. Two species, Elliptio dilatatus and Actinonaias carinata, were unique to the MDNR survey. Actinonaias carinata had previously been reported by Dawley (1947) but examination of available literature indicates that this is the first record of Elliptio dilatatus from the Red River drainage. In general the diversity of mussel fauna, in this river segment, indicates suitable substrates and relatively stable water quality parameters.

Few comprehensive benthic macroinvertebrate surveys of larger rivers in Minnesota have been done, so comparisons to other rivers are difficult to make. No major invertebrate survey has been done on the Otter Tail River previous to this one. The Minnesota Pollution Control Agency took a Ponar sample at Breckenridge in 1976 (MPCA, 1976) during that year's biological monitoring program and reported Cladocera, Oligochaeta and 4 genera of Chironomidae being present.

The number of species recorded in this study should be regarded as a conservative figure. These collections represent only ten days of collecting during the August 1982 and September 1979 sampling periods. Certain groups such as Plecoptera and Orthocladiinae (Chironomidae) are probably underestimated during August and September sampling and are usually more abundant in winter and early spring. Most of the common taxa present during summer sampling were probably recorded in this study.

Problems affecting abundance and distribution of benthic invertebrates are similar to those outlined in the fisheries section concerning problems related to fisheries, mainly organic pollution from sewage and water level fluctuations. Water fluctuations are known to adversely affect biomass of benthic invertebrates and may alter species composition (Ward and Short, Fisher and LaVoy 1972).

Table 13. Mussel species identified in the Ottertail River below Orwell Reservoir, September 1978.

Scientific name	Common name
* Fusconaia flava (Rafinesque)	Wabash pigtoe
* Amblema plicata (Rafinesque)	Three ridge
Elliptio dilatatus (Rafinesque)	Spike
Actinonaias carinata (Barnes)	Mucket
Ligumia recta (Lamarck)	Black sand shell
Lampsilis radiata siliquoidea (Barnes)	Fat Mucket
Lampsilis ventricosa (Barnes)	Pocketbook
Lasmigona complanata (Barnes)	White heel splitter
Lasmigona costata (Rafinesque)	Fluted shell
* Anodonta grandis (Say)	Floater
Strophitus undulatus (Say)	Squaw foot, strange floater

* These species were combined with their closely related species because of identification problems. Some malacologists recognize only three species to be valid from the group of six. Combined are: Amblema plicata and A. peruviana, Anodonta grandis and A. corpulenta. Fusconaia flava and Pleurobema cordatum are also combined because indentification is a matter of judgement.

CONCLUSIONS AND RECOMMENDATIONS

1. Local conservation efforts should be directed at improvements in land use practices including the protection of streamside vegetation. This is especially needed in the segment of stream between Orwell Dam and the mouth, where intensive agricultural activity frequently abuts the stream. Restoration of tree and other natural riparian cover types would enhance fish and wildlife values, water quality and receational opportunity.

2. The potential for expanded recreational use exists in that portion of the river channel from the Hoot Lake diversion dam downstream 12.8 mi to the Hoot Lake power station. This reach of the river has limited resource value due to the appropriation of large volumes of water by Otter Tail Power Company. The river is reduced to flows as low as 3 cfs in this reach. Otter Tail Power Company has the capability to operate on "helper" and "closed cycle" cooling modes to reduce water appropriation needs. The MDNR water appropriation permit for the Hoot Lake facility should be revised to maintain adequate instream flows. This will require Otter Tail Power Company to utilize the cooling mode that will achieve instream flow requirements. Minimun flow, as suggested by Tennant (1976), should be no less than 20% of average annual flow October through March and no less than 40% April through September.

3. Stream gaging stations should be established upstream and downstream of Fergus Falls to monitor flows and provide information for adjustment of Otter Tail Power Company operations, to accommodate instream flow requirements. These gaging stations would provide the necessary information for proper operation of the Hoot Lake power station (steam and hydro) and the OTP hydro power dams, which utilize reservoir peaking cycles in the production of hydroelectric power.

4. Area fisheries personnel should consider stocking smallmouth bass in several reaches of the river: below Orwell Dam; below Dayton Hollow Dam; at the junction with the Pelican River; and the 12.8 mi of original river channel below the diversion dam at Fergus Falls. These areas indicate suitable habitat and, with the establishment of minimum flows, warrant further investigation.

5. Lake Orwell exhibits potential as a fishery resource. The reservoir is currently operated with 20 ft annual drawdowns which prevent the establishment of normal biological communities. A reservoir management plan should be developed by the Corps of Engineers and MDNR that integrates flood control, fisheries, wildlife, recreation and instream flow needs.

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A P P E N D I X

Table 1. Stream physical characteristics of the Otter Tail River, 1978.

Sector	1	2	3	4	5	6
Date	24 July 1978	25-26 July 1978	27 July 1978	27 July 1978	28 July 1978	22 Aug. 1978
T.R.S. to T.R.S.	142, 39, 24 141, 38, 18	141, 38 18 139, 39, 5	139, 39, 5 139, 40, 12	139, 40 12 139, 40, 35	139, 40, 35 138, 40, 35	138, 40, 35 138, 40, 35
Upstream end of sector (RM)	190.0	183.5	165.2	162.1	157.2	146.5
Length of sector (miles)	6.5	18.3	3.1	5.0	10.8	1.0
Sinuosity value	1.2	1.7	1.3	1.5	1.7	1.6
Width - average (ft)	52	20		29	50	
Depth - thalweg ave. (ft)	2.2	2.4	3.0	1.8	2 5	3.1
Depth - maximum (ft)	3.0	6.0	9.0	8.0	10.0	5.5
Number of riffles	1	11	1	43	2	1
Flow (cfs)	13.0	-	-	-	28.0	-
Gradient (ft/mi) [a]	0.7	2 2	4 8 (2.9)	10.4	2.0 (1.2)	3 1 (1.1)
Stream stage	normal	normal	normal	normal	normal	normal
Secchi disc transparency (ft)	12.5					
Dams (by river mile)	188.3,185.5	183.5,173.2,169.2	165.2	162.1,161.3	-	146.5
Substrate types (in order of abundance, excluding reservoirs)	sand-gravel-silt	sand gravel silt-rubble-boulder	sand gravel rubble-boulder	gravel-rubble boulder-sand	gravel-sand rubble-boulder-silt	sand gravel-rubble-boulder-silt

Table 1. Continued

Sector	7	8	9	10	11	12
Date	22 Aug. 1978	22-24 Aug. 1978	24,25,29 Aug. 1978	29 Aug.1978	29,30 Aug. 1978	31 Aug. 1978
T.R.S. to T.R.S.	138, 40, 35 136, 38, 17	136, 38, 17 134, 41, 35	134, 41, 35 134, 42, 31	134, 42, 31 133 43, 19	133, 43, 19 133, 43, 36	133, 43, 36 132, 43, 5
Upstream end of sector (RM)	145.5	122.9	88.7	76.1	68.6	56.2
Length of sector (miles)	22.5	34.3	12.0	7.4	12.6	3.6
Sinuosity value	1.7	1.2	1.3	1.6	6.0[b]	1.2
Width - average (ft)	50	53		37		50
Depth - thalweg ave. (ft)	3.3	2.8		2.8	3.7	3.9
Depth - maximum (ft)	7.0	9.0	13.5	5.0	9.0	9.0
Number of riffles	2			3	9	1
Flow (cfs)	92.2	90.0	170.1	178 8	--	243 0
Gradient (ft/mi) a	1.2	0.6 (0.3)	2.9 (0.6)	3.6 (1.9)	5.9 (5.1)	15.0 (4.4)
Stream stage	normal	normal	normal	normal	normal	normal
Secchi disc transparency (ft)	8.0	7.5	12.5			6.5
Dams (by river mile)	145.5	122.9,108.6,96.1	88.7	76.1	68.6	57.2,56.2
Substrate types (in order of abundance, excluding reservoirs)	sand-gravel-rubble	sand-gravel-rubble	gravel-sand-boulder-rubble	sand-gravel-rubble-silt-boulder	sand-gravel-rubble boulder	gravel-rubble-sand-boulder

Table 1. Continued.

Sector	13	14	15	16	17
Date	1,19 Sept. 1978	20 Sept. 1978	21 Sept. 1978	21,22 Sept. 1978	22 Sept. 1978
T.R.S. to T.R.S.	132, 43, 5 132, 43, 20	132, 43, 20 132, 44, 26	132, 44, 26 131, 45, 31	131, 45, 31 132, 47 11	132, 47, 11 132, 47 8
Upstream end of sector (RM)	52.6	44.6	40.4	23.0	8.1
Length of sector (miles)	8.0	4.2	17.5	15.0	7.9
Sinuosity value	2.3	1.4	1.8	1.7	2.6
Width - average (ft)	67	120		80	85
Depth - thalweg average (ft)	2.6	1.5	2.0	1.8	1.8
Depth - maximum (ft)	6.0	7.0	13.5	5.0	10.0
Number of riffles	12	13	10	3	2
Flow (cfs)	289.0 (9/1/78)		104.0 [c]	155.5	
Gradient (ft/mi) [a]	6.5 (2.6)	10.2 (1.4)	2.7	1.9 (1.5)	1.1
Stream stage	normal	normal	normal	normal	normal
Secchi disc transparency (ft)	4.0	4.0	3.0	1.6	1.4
Dams (by river mile)	52.6	44.6	40.4		8.1, 6.2 [d]
Substrate types (in order of abundance, excluding reservoirs)	Sand-gravel-rubble-silt boulder	sand-gravel-boulder-rubble	sand-gravel-silt-rubble boulder	sand-gravel-silt	sand-silt

[a] Dams have reduced gradient to figure in parenthesis.
[b] This high sinuosity value is caused by the loop-like configuration of the stream channel in this sector.
[c] Daily average value as measured at USGS gaging station. Flows were highly variable during this period due to operation of Orwell Dam.
[d] Collapsed dam.

Table 2. Tributaries to the Otter Tail River, H-26-81.

Name	Location of mouth T.	R.	S.	Source	County	Flow	Tributary number
Unnamed	132	47	3	Ditch	Wilkin	Inter.[a]	H-26-81-1
Unnamed	132	47	3	Ditch	Wilkin	Inter.	H-26-81-2
Ditch	132	46	17	Ditch	Wilkin	Inter.	H-26-81-3
Unnamed	132	46	17	Ditch	Wilkin	Inter.	H-26-81-4
Unnamed	132	46	21	Runoff	Wilkin	Inter.	H-26-81-5
Unnamed	132	46	22	Ditch	Wilkin	Inter.	H-26-81-6
Unnamed	132	46	26	Ditch	Wilkin	Inter.	H-26-81-7
Ditch	132	46	25	Ditch	Wilkin	Inter.	H-26-81-8
Ditch	132	45	33	Ditch	Wilkin	Inter.	H-26-81-9
Ditch	132	45	26	Ditch	Wilkin	Inter.	H-26-81-10
Unnamed	132	45	36	Runoff	Wilkin	Inter.	H-26-81-11
Unnamed	132	44	30	Marsh	Otter Tail	Inter.	H-26-81-12
Pelican River	133	43	31	Lake	Otter Tail	80 cfs	H-26-81-13
from Wall Lake	132	42	5	Lake	Otter Tail	Inter.	H-26-81-14
from Long Lake	134	41	32	Lake	Otter Tail	Inter.	H-26-81-15
from Leon Lake	134	41	35	Lake	Otter Tail	6.3 cfs	H-26-81-16
from Lake Blanche	134	39	31	Lake	Otter Tail	1 cfs	H-26-81-17
Dead River	134	40	12	Lake	Otter Tail	12 cfs	H-26-81-18
Unnamed	135	39	34	Marsh	Otter Tail	Inter.	H-26-81-19
from Boedigheimer Lake	135	39	14	Lake	Otter Tail	2 cfs	H-26-81-20
Unnamed	135	38	30	Marsh	Otter Tail	Inter.	H-26-81-21
Willow Creek	135	38	18	Marsh	Otter Tail	Inter.	H-26-81-22
Alvis Creek	136	38	14	Marsh	Otter Tail	Inter.	H-26-81-23
Unnamed	136	38	4	Marsh	Otter Tail	1.5 cfs	H-26-81-24
Unnamed	137	38	33	Marsh	Otter Tail	Inter.	H-26-81-25
Unnamed	137	38	32	Marsh	Otter Tail	Inter.	H-26-81-26
Toad River	137	38	32	Marsh	Otter Tail	40 cfs	H-26-81-27
from Long Lake	137	40	23	Lake	Otter Tail	2 cfs	H-26-81-28
Wolf Skull Creek	137	40	14	Lake	Otter Tail	1 cfs	H-26-81-29
from Town Lake	138	40	35	Lake	Becker	Inter.	H-26-81-30
from Fischer Lake	138	40	35	Lake	Becker	Inter.	H-26-81-31
from Trisglaff Lake	138	40	24	Lake	Becker	Inter.	H-26-81-32
Unnamed	138	40	13	Marsh	Becker	Inter.	H-26-81-33
from Jones Lake	138	40	11	Lake	Becker	Inter.	H-26-81-34
from Rice Creek	139	40	36	Lake	Becker	Inter.	H-26-81-35
from Cotton Lake	139	40	12	Lake	Becker	Inter.	H-26-81-36
Unnamed	140	39	34	Marsh	Becker	Inter.	H-26-81-37
from Johnson Lake	140	39	22	Lake	Becker	Inter.	H-26-81-38
from Booth Lake	140	39	11	Lake	Becker	Inter.	H-26-81-39
Egg River	141	39	34	Lake	Becker	8 cfs	H-26-81-40
from Ice Cracking Lake	141	39	24	Lake	Becker	1 cfs	H-26-81-41
Unnamed	141	38	7	Lake	Becker	Inter.	H-26-81-42
Solid Bottom Creek (Elbow Lake Creek)	142	38	6	Lake	Becker	3 cfs	H-26-81-43
Bear Creek	142	38	5	Marsh	Becker	Inter.	H-26-81-44
from Moore Lake	142	38	5	Lake	Becker	Inter.	H-26-81-45

[a] Intermittant

Table 3. Dams and other obstructions on the Otter Tail River as observed during July, August and September 1978.

Type of dam or obstruction	River mile	Hydraulic height	Length of dam	Type of control structure	Use	Fish barrier	Year built/Owner
Log dam	188.3	1'	20'	None	Lake level control	No	1938/DNR
Concrete dam	185.5	2'	25'	None	Lake level control	Yes	1938/DNR
Concrete dam	183.5	2'	30'	None	Lake level control	Yes	1938/DNR
Beaver dam	179.0	5'	34'	-	-	Yes	
Beaver dam	178.3	3'	30'	-	-	Yes	
Beaver dam	178.1	3'	27'	-	-	Yes	
Beaver dam	177.6	3'	24'	-	-	Yes	
Metal culverts (3)	175.0	-	-	-	-	No	
Concrete dam	173.2	5'	30'	Stoplogs	Lake level control	Yes	1941/U.S.F.W.S.
Concrete dam	169.2	3'	40'	Stoplogs	Lake level control	Yes	1941/U.S.F.W.S.
Concrete dam	165.2	3'	30'	Stoplogs	Lake level control	Yes	1938/DNR
Beaver dam	164.1	3'	38'	-	-	Yes	
Concrete & earthen dam	162.1	6'	15'	None	Lake level control	Yes	1958/DNR
Rock dam	161.3	5'	42'	None	Farm pond	Yes	
Concrete dam	146.5	15'	46'	None	None	Yes	1881, 1979/DNR
Concrete dam	145.5	4'	60'	Stoplogs	Lake level control	Yes	1938/DNR
Concrete dam	123.0	2'	85'	Stoplogs	Lake level control	Yes	1937/DNR
Concrete dam	108.6	1'	60'	Stoplogs	Lake level control	No	1937/DNR
Concrete dam	96.1	3'	85'	Stoplogs	Lake level control	Yes	1936/DNR
Concrete dam	88.7	11'	100'	Stoplogs	None	Yes	1873/Otter Tail Co.
Concrete & earthern dam	76.1	30'	54'	Gate	Diverts water for hydroelectric	Yes	1930/Otter Tail Power Co.
Metal culverts (2)	74.3	-	-	-	-	No	
Concrete & earthen dam	68.6	8'	56'	Stoplogs	Water supply to Otter Tail Power Co., recreation	Yes	1908/Otter Tail Power Co.
Metal culverts (4)	66.8	-	-	-	-	No	
Concrete (broken up) dam	57.2	Rapids	-	-	-	No	1906, washed out in 1907
Concrete	56.1	8'	43'	None	River level control	Yes	Otter Tail Power Co.
Earthen, masonry & concrete dam	54.2	24'	78'	Stoplogs, gates	Hydroelectric	Yes	1871/Otter Tail Power Co. rebuilt in 1964
Pipe & metal grate	54.1	-	47'	-	Sewage pipe	No	City of Fergus Falls
Earthen, masonry & contrete dam	52.7	34'	48'	Gates	Hydroelectric	Yes	1918/Otter Tail Power Co.
Concrete culverts (2)	51.9	-	-	-	-	No	
Earthen & concrete dam	44.5	35'	80'	Stoplogs	Hydroelectric	Yes	1870/Otter Tail Power Co. rebuilt in 1963
Earthen & concrete dam	40.4	43'	33'	Gates	Flood control and water supply	Yes	1953/Army Corps of Engineers
Earthen & concrete dam	8.1	6'	40'	Stoplogs	Water supply	Yes	1935/City of Breckenridge
Concrete (broken up) dam	6.2	1'	40'	None	None	No	N/A

Table 4. Location and lengths of electrofishing stations on the Otter Tail River, 1979-80.

Electrofishing stations	Legal description T.	R.	S.	Length (miles)
3[a]	139	39	5	0.3
5a	138	40	11	0.3
6[a]	138	40	35	0.2
7a	137	40	11 & 14	1.1
7b	137	40	23 & 24	0.7
7c	137	39	18, 19 & 20	1.2
8a	136	38	17 & 18	0.9
8b	135	38	18	0.7
8c	135	39	34 and	
	134	39	3	1.2
8d	133	40	4, 5 & 8	1.2
8e	133	41	36	1.2
9a	134	41	26 & 27	0.9
9b	134	42	25 & 26	1.3
10	133	42	6 & 7	1.5
11a	133	42	20 & 29	1.1
11b	133	42	28 & 33	1.3
12	133	43	35 & 36	0.7
13a	132	43	5	0.3
13b	132	43	5 and	
	133	43	32	0.7
13c	132	43	6	0.8
13d	132	43	6 & 7	0.8
14a[a]	132	43	20	0.2
14b	132	43	20	0.3
14c	132	43	20, 29 & 30	0.8
15a	132	44	26	0.4
15b	132	44	34	0.6
15c	132	44	30	0.8
15d	132	45	25 & 36	0.7
16	132	46	17 & 18	0.7
17	132	47	4,8 & 9	1.3

[a]These stations were done with a stream shocker, others with a boom shocker.

Table 5. Total numbers of fish for the 17 sectors of the Otter Tail River, 1979 -80.

Species	Sector 1	2	3	4	5	6	7	8	9	10
Bowfin									1	
Goldeye										
Northern pike			4		3	2	14	8	3	
Carp									1	
Quillback										
White sucker			13		2		95	86	27	3
Northern hogsucker										
Bigmouth buffalo										
Silver redhorse										2
Golden redhorse										16
Shorthead redhorse							4	22	1	9
Greater redhorse										
Black bullhead										
Yellow bullhead			2		1	1	10	60	62	
Brown bullhead			65			33	20	20		
Channel catfish										
Burbot								3		
Rock bass								16	1	1
Green sunfish			1			1				
Pumpkinseed			7			11	1	5	1	
Bluegill								10		
Hybrid sunfish			1			4				
Largemouth bass							4	10	7	1
Black crappie						1				
Yellow perch			18		2	1	12	61	28	
Walleye							1	6	1	
Freshwater drum										
Subtotal			111		8	54	161	307	133	32
Central mudminnow			11		5	1		1		
Stoneroller										
Hornyhead chub					50	2	2	32		
Emerald shiner										
Common shiner					195	47	10		8	41
Blackchin shiner			3			14	1	1		
Blacknose shiner			1		10					
Spottail shiner							1	25	4	
Spotfin shiner										
Sand shiner										
Weed shiner					2			2		34
Mimic shiner								6		
Northern redbelly dace					1					
Bluntnose minnow										
Fathead minnow					2					
Blacknose dace					57	1				
Longnose dace										
Creek chub					3	1				
Tadpole madtom									1	
Iowa darter					2				1	
Johnny darter					7					
Logperch							1		12	
Blackside darter					9			8	113	
Subtotal			15		343	66	15	75	139	75
Total number by sector			126		351	120	176	382	272	107
Effort(hrs)			.41		.16	.34	1.65	2.65	1.50	.45

Table 5. Continued.

Species	11	12	13	14	Sector 15	16	17	Total
Bowfin								1
Goldeye							2	2
Northern pike	4	1	10	1	1	1	4	56
Carp		9	69	54	98	16	55	302
Quillback					28	10	5	43
White sucker	45	3	50	24	50	5	4	407
Northern hogsucker	14	4	2					20
Bigmouth buffalo			5		10	1	17	33
Silver redhorse	3	1	17	13	18	4	10	68
Golden redhorse	21	19	30	20	39	6	1	152
Shorthead redhorse	7	36	88	12	56	7	41	283
Greater redhorse			2	28	46	10	1	87
Black bullhead	20		5		15	1		41
Yellow bullhead	11	2	6					155
Brown bullhead	2			1				141
Channel catfish					2		3	5
Burbot								3
Rock bass	2	1	1	3	2	1	5	33
Green sunfish								2
Pumpkinseed			1					26
Bluegill			6					16
Hybrid sunfish								5
Largemouth bass	2	4	3	2				33
Black crappie		1	3	2	4		2	13
Yellow perch		1	2	3	8	1		137
Walleye			8	16	27	1	1	61
Freshwater drum							2	2
Subtotal	131	82	308	179	404	64	153	2127
Central mudminnow								18
Stoneroller	12	4	2	22	1			41
Hornyhead chub	56	1	8	5				156
Emerald shiner							3	3
Common shiner	74	72	34	4	11			496
Blackchin shiner								19
Blacknose shiner								11
Spottail shiner				1	118			149
Spotfin shiner			51	1	41	36	24	153
Sand shiner					17		2	19
Weed shiner								38
Mimic shiner				6				12
Northern redbelly dace								1
Bluntnose minnow			3					3
Fathead minnow								2
Blacknose dace	9							67
Longnose dace				39	1			40
Creek chub								4
Tadpole madtom								1
Iowa darter		1						4
Johnny darter	1				1			9
Logperch			3	28	47			91
Blackside darter	1		20	7		2		160
Subtotal	153	78	121	113	237	38	29	1497
Total number by sector	284	160	429	292	641	102	182	3624
Effort(hrs)	1.00	.40	1.85	.93	1.20	.50	.75	13.79

Table 6. Percent composition (numbers) of fish for the 17 sectors of the Otter Tail River, 1979 80.

Species	Sector 1	2	3	4	5	6	7	8	9	10
Bowfin									.7	
Goldeye										
Northern pike			3.6		37.5	3.7	8.6	2.6	2.2	
Carp									.7	
Quillback										
White sucker			11.7		25.0		59.0	28.0	20.3	9.3
Northern hogsucker										
Bigmouth buffalo										
Silver redhorse										6.2
Golden redhorse										50.0
Shorthead redhorse							2.4	7.1	.7	28.1
Greater redhorse										
Black bullhead										
Yellow bullhead			1.8		12.5	1.8	6.2	19.5	46.6	
Brown bullhead			58.5			61.1	12.4	6.5		
Channel catfish										
Burbot								.9		
Rock bass								5.2	.7	3.1
Green sunfish			.9			1.8				
Pumpkinseed			6.3			20.3	.6	1.6	.7	
Bluegill								3.2		
Hybrid sunfish			.9			7.4				
Largemouth bass							2.4	3.2	5.2	3.1
Black crappie						1.8				
Yellow perch			16.2		25.0	1.8	7.4	19.8	21.0	
Walleye							.6	1.9	.7	
Freshwater drum										

tr. = less than .1 percent

Table 6. Continued.

Species	11	12	13	14	Sector 15	16	17	Total
Bowfin								tr.
Goldeye							1.3	tr.
Northern pike	3.0	1.2	3.2	.5	.2	1.5	2.6	2.6
Carp		10.9	22.4	30.1	24.2	25.0	35.9	14.1
Quillback					6.9	15.6	3.2	2.0
White sucker	34.3	3.6	16.2	13.4	12.3	7.8	2.6	19.1
Northern hogsucker	10.6	4.8	.6					.9
Bigmouth buffalo			1.6		2.4	1.5	11.1	1.5
Silver redhorse	2.2	1.2	5.5	7.2	4.4	6.2	6.5	3.1
Golden redhorse	16.0	23.1	9.7	11.1	9.6	9.3	.6	7.1
Shorthead redhorse	5.3	43.9	28.5	6.7	13.8	10.9	26.7	13.3
Greater redhorse			.6	15.6	11.3	15.6	.6	4.0
Black bullhead	15.2		1.6		3.7	1.5		1.9
Yellow bullhead	8.3	2.4	1.9					7.2
Brown bullhead	1.5			.5				6.6
Channel catfish					.4		1.9	.2
Burbot								.1
Rock bass	1.5	1.2	.3	1.6	.4	1.5	3.2	1.5
Green sunfish								tr.
Pumpkinseed			.3					1.2
Bluegill			1.9					.7
Hybrid sunfish								.2
Largemouth bass	1.5	4.8	.9	1.1				1.5
Black crappie		1.2	.9	1.1	.9		1.3	.6
Yellow perch		1.2	.6	1.6	1.9	1.5		6.4
Walleye			2.5	8.9	6.6	1.5	.6	2.8
Freshwater drum							1.3	tr.

tr. = less than .1 percent

Table 7. Total weights(lbs) of fish for the 17 sectors of the Otter Tail River, 1978 - 80.

Species	Sector 1	2	3	4	5	6	7	8	9	10
Bowfin									4.6	
Goldeye										
Northern pike			1.6		.8	.8	12.5	5.8	.9	
Carp									7.9	
Quillback										
White sucker			1.5		.7		132.5	170.8	10.6	4.6
Northern hogsucker										
Bigmouth buffalo										
Silver redhorse										9.1
Golden redhorse										36.7
Shorthead redhorse							10.6	61.3	1.9	20.6
Greater redhorse										
Black bullhead										
Yellow bullhead			tr.		.2	tr.	7.4	27.4	24.5	
Brown bullhead			15.8			12.8	8.9	6.9		
Channel catfish										
Burbot								.7		
Rock bass								7.9	.6	.9
Green sunfish			.1			tr.				
Pumpkinseed			.3			1.4	.4	.1	tr.	
Bluegill								3.3		
Hybrid sunfish			tr.			.1				
Largemouth bass							.1	.3	.1	.1
Black crappie						.4				
Yellow perch			.9		.6	.5	2.7	7.9	3.1	
Walleye							.1	9.7	.1	
Freshwater drum										
Total weight by sector			20.3		2.3	16.1	175.2	302.1	54.3	72.0

tr. = less than .1 percent

Table 7. Continued.

Species	Sector 11	12	13	14	15	16	17	Total
Bowfin								4.6
Goldeye							2.2	2.2
Northern pike	6.5	2.3	9.7	.3	.2	.6	10.7	52.7
Carp		32.8	207.3	168.2	211.3	37.9	142.1	807.5
Quillback					70.2	10.3	8.9	89.4
White sucker	46.6	.9	33.5	13.7	34.4	3.3	5.4	458.5
Northern hogsucker	11.1	1.0	.2					12.3
Bigmouth buffalo			51.9		48.6	1.3	40.3	142.1
Silver redhorse	8.7	3.9	57.2	28.6	45.6	5.4	21.4	179.9
Golden redhorse	33.8	11.5	48.8	23.7	62.3	6.8	1.1	224.7
Shorthead redhorse	6.2	22.9	130.3	7.8	71.8	12.2	49.7	395.3
Greater redhorse			7.9	89.0	86.9	30.2	3.9	217.9
Black bullhead	6.2		1.9		2.7	.1		10.9
Yellow bullhead	1.7	1.4	2.1					64.8
Brown bullhead	.7			.2				45.3
Channel catfish					12.3		4.3	16.6
Burbot								.7
Rock bass	1.0	.4	.6	.9	.8	.6	2.0	15.7
Green sunfish								.1
Pumpkinseed			.2					2.4
Bluegill			.6					3.9
Hybrid sunfish								.1
Largemouth bass	.2	2.6	2.1	2.1				7.6
Black crappie		.8	.5	.8	1.3		.8	4.6
Yellow perch		.1	.1	.2	.5	tr.		16.6
Walleye			9.8	3.4	22.2	.1	.1	45.5
Freshwater drum							1.8	1.8
Total weight by sector	122.7	80.6	564.7	338.9	671.1	108.8	294.7	2823.9

tr. = less than .1 percent

Table 8. Percent composition (weights) of fish for the 17 sectors of the Otter Tail River, 1979 - 80.

Species	Sector 1	2	3	4	5	6	7	8	9	10
Bowfin									8.4	
Goldeye										
Northern pike			7.8		34.7	4.9	7.1	1.9	1.6	
Carp									14.5	
Quillback										
White sucker			7.3		30.4		75.6	56.5	19.5	6.3
Northern hogsucker										
Bigmouth buffalo										
Silver redhorse										12.6
Golden redhorse										50.9
Shorthead redhorse							6.0	20.2	3.4	28.6
Greater redhorse										
Black bullhead										
Yellow bullhead			.2		8.6	.3	4.2	9.0	45.0	
Brown bullhead			77.8			79.5	5.0	2.2		
Channel catfish										
Burbot								.2		
Rock bass								2.6	1.1	1.2
Green sunfish			.4			.3				
Pumpkinseed			1.4			8.6	.2	tr.	tr.	
Bluegill								1.0		
Hybrid sunfish			.2			.6				
Largemouth bass							tr.	tr.	.1	.1
Black crappie						2.4				
Yellow perch			4.4		26.0	3.1	1.5	2.6	5.7	
Walleye							tr.	3.2	.1	
Freshwater drum										

tr. = less than .1 percent

Table 8. Continued .

Species	11	12	13	Sector 14	15	16	17	Total
Bowfin								
Goldeye							.7	tr.
Northern pike	5.2	2.8	1.7	tr.	tr.	.5	3.6	1
Carp		40.6	36.7	49.6	31.4	34.8	48.2	28
Quillback					10.4	9.4	3.0	3
White sucker	37.9	1.1	5.9	4.0	5.1	3.0	1.8	16
Northern hogsucker	9.0	1.2	tr.					
Bigmouth buffalo			9.1		7.2	1.1	13.6	5
Silver redhorse	7.0	4.8	10.1	8.4	6.7	4.9	7.2	6
Golden redhorse	27.5	14.2	8.6	6.9	9.2	6.2	.3	7
Shorthead redhorse	5.0	28.4	23.0	2.3	10.6	11.2	16.8	13
Greater redhorse			1.3	26.2	12.9	27.7	1.3	7
Black bullhead	5.0		.3		.4	tr.		
Yellow bullhead	1.3	1.7	.3					2
Brown bullhead	.5			tr.				1
Channel catfish					1.8		1.4	
Burbot								tr.
Rock bass	.8	.4	.1	.2	.1	.5	.6	
Green sunfish								tr.
Pumpkinseed			tr.					tr.
Bluegill			.1					
Hybrid sunfish								tr.
Largemouth bass	.1	3.2	.3	.6				
Black crappie		.9	tr.	.2	.1		.2	
Yellow perch		.1	tr.	tr.	tr.	tr.		
Walleye			1.7	1.0	3.3	tr.	tr.	1
Freshwater drum							.6	tr.

tr. = less than .1 percent

Table 9. Catch per unit of effort (fish/hr) for 17 sectors of the Otter Tail River, 1979 - 80.

Species	Sector 1	2	3	4	5	6	7	8	9	10
Bowfin									.6	
Goldeye										
Northern pike			9.7		18.7	5.8	8.4	3.0	2.0	
Carp									.6	
Quillback										
White sucker			31.7		12.5		57.5	32.4	18.0	6.6
Northern hogsucker										
Bigmouth buffalo										
Silver redhorse										4.4
Golden redhorse										35.5
Shorthead redhorse							2.4	8.3	.6	20.0
Greater redhorse										
Black bullhead										
Yellow bullhead			4.8		6.2	2.9	6.0	22.6	41.3	
Brown bullhead			158.5			97.0	12.1	7.5		
Channel catfish										
Burbot								1.1		
Rock bass								6.0	.6	2.2
Green sunfish			2.4			2.9				
Pumpkinseed			17.0			32.3	.6	1.8	.6	
Bluegill								3.7		
Hybrid sunfish			2.4			11.7				
Largemouth bass							2.4	3.7	4.6	2.2
Black crappie						2.9				
Yellow perch			43.9		12.5	2.9	7.2	23.0	18.6	
Walleye							.6	2.2	.6	
Freshwater drum										
Subtotal			270.7		50.0	158.8	97.5	115.8	88.6	71.1
Central mudminnow			26.8		31.2	2.9		.3		
Stoneroller										
Hornyhead chub					312.5	5.8	1.2	12.0		
Emerald shiner										
Common shiner					1218.7	138.2	6.0		5.3	91.1
Blackchin shiner			7.3			41.1	.6	.3		
Blacknose shiner			2.4		62.5					
Spottail shiner							.6	9.4	2.6	
Spotfin shiner										
Sand shiner										
Weed shiner					12.5			.7		75.5
Mimic shiner								2.2		
Northern redbelly dace					6.2					
Bluntnose minnow										
Fathead minnow					12.5					
Blacknose dace					356.2	2.9				
Longnose dace										
Creek chub					18.7	2.9				
Tadpole madtom									.6	
Iowa darter					12.5				.6	
Johnny darter					43.7					
Logperch							.6		8.0	
Blackside darter					56.2			3.0	75.3	
Subtotal			36.5		2143.7	194.1	9.0	28.3	92.6	166.6
Total cpue by sector			307.3		2193.7	352.9	106.6	144.1	181.3	237.7
Effort(hrs)			.41		.16	.34	1.65	2.65	1.50	.45

tr. = less than .1 percent

Table 9. Continued.

Species	11	12	13	14	Sector 15	16	17	Total
Bowfin								tr.
Goldeye							2.6	.1
Northern pike	4.0	2.5	5.4	1.0	.8	2.0	5.3	4.0
Carp		22.5	37.3	58.0	81.6	32.0	73.3	21.9
Quillback					23.3	20.0	6.6	3.1
White sucker	45.0	7.5	27.0	25.8	41.6	10.0	5.3	29.5
Northern hogsucker	14.0	10.0	1.0					1.4
Bigmouth buffalo			2.7		8.3	2.0	22.6	2.3
Silver redhorse	3.0	2.5	9.1	13.9	15.0	8.0	13.3	4.9
Golden redhorse	21.0	47.5	16.2	21.5	32.5	12.0	1.3	11.0
Shorthead redhorse	7.0	90.0	47.5	12.9	46.6	14.0	54.6	20.5
Greater redhorse			1.0	30.1	38.3	20.0	1.3	6.3
Black bullhead	20.0		2.7		12.5	2.0		2.9
Yellow bullhead	11.0	5.0	3.2					11.2
Brown bullhead	2.0			1.0				10.2
Channel catfish					1.6		4.0	.3
Burbot								.2
Rock bass	2.0	2.5	.5	3.2	1.6	2.0	6.6	2.3
Green sunfish								.1
Pumpkinseed			.5					1.8
Bluegill			3.2					1.1
Hybrid sunfish								.3
Largemouth bass	2.0	10.0	1.6	2.1				2.3
Black crappie		2.5	1.6	2.1	3.3		2.6	.9
Yellow perch		2.5	1.0	3.2	6.6	2.0		9.9
Walleye			4.3	17.2	22.5	2.0	1.3	4.4
Freshwater drum							2.6	.1
Subtotal	131.0	205.0	166.4	192.4	336.6	128.0	204.0	154.2
Central mudminnow								1.3
Stoneroller	12.0	10.0	1.0	23.6	.8			2.9
Hornyhead chub	56.0	2.5	4.3	5.3				11.3
Emerald shiner							4.0	.2
Common shiner	74.0	180.0	18.3	4.3	9.1			35.9
Blackchin shiner								1.3
Blacknose shiner								.8
Spottail shiner				1.0	98.3			10.8
Spotfin shiner			27.5	1.0	34.1	72.0	32.0	11.0
Sand shiner					14.1		2.6	1.3
Weed shiner								2.7
Mimic shiner				6.4				.8
Northern redbelly dace								tr.
Bluntnose minnow			1.6					.2
Fathead minnow								.1
Blacknose dace	9.0							4.8
Longnose dace				41.9	.8			2.9
Creek chub								.2
Tadpole madtom								tr.
Iowa darter		2.5						.2
Johnny darter	1.0				.8			.6
Logperch			1.6	30.1	39.1			6.6
Blackside darter	1.0		10.8	7.5		4.0		11.6
Subtotal	153.0	195.0	65.4	121.5	197.5	76.0	38.6	108.5
Total cpue by sector	284.0	400.0	231.8	313.9	534.1	204.0	242.6	262.8
Effort(hrs)	1.00	.40	1.85	.93	1.20	.50	.75	13.79

tr. = less than .1 percent

Table 10. Length frequency distributions in the Otter Tail River for all sectors, 1979-80.

Total* length (in)	Species and numbers of fish by length groups					
	Bowfin	Goldeye	Northern pike	Carp	Quill-back	White sucker
1						
2						
3						
4			1			6
5			2		1	12
6			2			21
7			3			17
8					2	10
9			4		4	19
10			5	2		41
11			2	8		36
12			3	20		34
13			2	33	1	29
14		1	2	26	1	19
15		1	4	20	2	15
16			6	23		29
17			2	27	10	51
18			3	39	15	43
19			4	30	5	21
20			2	22	2	3
21			3	13		1
22			1	12		
23			1	9		
24				9		
25	1		1	3		
26			1	2		
27			2	3		
28				1		
29						
30						
31						
32						
33						
34						
35						
36						
Totals	1	2	56	302	43	407

* 1 inch group = 0.0-0.9 ; 2 inch group = 1.0-1.9; etc.

Table 10. Continued.

Total* length (in)	Species and numbers of fish by length groups				
	Northern hog sucker	Big-mouth buffalo	Silver redhorse	Golden redhorse	Short-head redhorse
1					
2					
3	2				
4	1				
5					2
6					
7				5	
8				1	1
9	1			1	4
10	3			1	9
11	4			7	11
12	3			8	36
13	5	1	1	24	21
14	1	8	9	27	40
15		6	6	12	44
16			5	24	41
17			5	17	36
18			10	19	16
19		2	12	5	10
20		4	12	1	9
21		2	5		3
22		1	3		
23		2			
24		3			
25					
26		1			
27					
28		2			
29		1			
30					
31					
32					
33					
34					
35					
36					
Totals	20	33	68	152	283

* 1 inch group = 0.0-0.9; 2 inch group = 1.0-1.9; etc.

Table 10. Continued.

Total* length (in)	Species and numbers of fish by length groups					
	Greater redhorse	Black bull-head	Yellow bull-head	Brown bull-head	Channel catfish	Burbot
1						
2			2	4		
3			2	1		
4			5	2		
5			24	9		
6		6	24	13		
7		17	6	11		
8		7	7	26		1
9		8	21	58		1
10		3	27	13		
11			28	4		
12			8			
13	3		1			1
14	1					
15	3				1	
16	11				1	
17	9					
18	15				1	
19	10					
20	6					
21	9					
22	13				1	
23	7					
24						
25						
26						
27					1	
28						
29						
30						
31						
32						
33						
34						
35						
36						
Totals	87	41	155	141	5	3

* 1 inch group = 0.0-0.9; 2 inch group = 1.0-1.9; etc.

Table 10. Continued.

Total* length (in)	Species and numbers of fish by length groups				
	Rock bass	Green sunfish	Pumpkin-seed	Bluegill	Hybrid sunfish
1					
2					2
3		2	8	1	2
4	3		6	3	1
5	2		2		
6	2		7	6	
7	4		2	5	
8	12		1		
9	6			1	
10	4				
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					
36					
Totals	33	2	26	16	5

* 1 inch group = 0.0-0.9 ; 2 inch group = 1.0-1.9; etc.

Table 10. Continued.

Total* length (in)	Species and numbers of fish by length groups				
	Large-mouth bass	Black crappie	Yellow perch	Walleye	Fresh-water drum
1					
2	7		11		
3	14		32		
4	5		10		
5	1	1	26		
6		2	21	6	
7		2	13	13	
8		4	13	14	
9		2	8	2	
10	1	2	3	4	
11	2			2	1
12	2				
13				4	
14				1	
15	1			3	1
16				5	
17				2	
18				1	
19				2	
20					
21				1	
22					
23					
24					
25					
26					
27				1	
28					
29					
30					
31					
32					
33					
34					
35					
36					
Totals	33	13	137	61	2

* 1 inch group = 0.0-0.9; 2 inch group = 1.0-1.9; etc.

Table 11. Length frequency distributions in the Otter Tail River for Sector 3, 1979-80.

Total* length (in)	Species and numbers of fish by length groups							
	Northern pike	White sucker	Yellow bull-head	Brown bull-head	Green sunfish	Pumpkin-seed	Hybrid sunfish	Yellow perch
1								
2			1	2			1	
3			1	1	1	4		10
4		6		2		3		1
5		4		7				6
6				9				1
7				5				
8		1		15				
9		1		18				
10	1	1		6				
11	1							
12								
13	1							
14								
15								
16	1							
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								
32								
33								
34								
35								
36								
Totals	4	13	2	65	1	7	1	18

* 1 inch group = 0.0-0.9; 2 inch group = 1.0-1.9; etc.

Table 12. Length frequency distributions in the Otter Tail River for Sector 5, 1979-80.

Total* length (in)	Species and numbers of fish by length groups			
	Northern pike	White sucker	Yellow bullhead	Yellow perch
1				
2				
3				1
4				
5				
6				
7			1	
8				1
9		2		
10	3			
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				
Totals	3	2	1	2

* 1 inch group = 0.0-0.9; 2 inch group = 1.0-1.9; etc.

Table 13. Length frequency distributions in the Otter Tail River for Sector 6, 1979-80.

Total* length (in)	Species and numbers of fish by length groups							
	Northern Pike	Yellow bull-head	Brown bull-head	Green sunfish	Pumpkin-seed	Hybrid sunfish	Black crappie	Yellow perch
1								
2						2		
3				1	3	1		
4					2	1		
5					1			
6		1	4		5			
7			2					
8			3					
9			17					1
10			6				1	
11			1					
12								
13								
14	1							
15	1							
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								
32								
33								
34								
35								
36								
Totals	2	1	33	1	11	4	1	1

* 1 inch group = 0.0-0.9; 2 inch group = 1.0-1.9; etc.

Table 14. Length frequency distributions in the Otter Tail River for Sector 7, 1979-80.

Total* length (in)	Species and numbers of fish by length groups								
	Northern pike	White sucker	Short-head redhorse	Yellow bull-head	Brown bull-head	Pumpkin-seed	Large-mouth bass	Yellow perch	Walleye
1									
2							1		
3							3		
4	1								
5	1	4						4	
6	1	10						4	1
7	1	5			1	1			
8					2			2	
9		3		1	7			2	
10		2		4	8				
11				5	2				
12	1	7							
13		4							
14		4							
15		4							
16	1	9							
17	2	21							
18	2	20							
19	2	2	2						
20	1		2						
21	1								
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
32									
33									
34									
35									
36									
Totals	14	95	4	10	20	1	4	12	1

* 1 inch group = 0.0-0.9; 2 inch group = 1.0-1.9; etc.

Table 15. Length frequency distributions in the Otter Tail River for Sector 8, 1979-80.

Total* length (in)	Species and numbers of fish by length groups					
	Northern pike	White sucker	Short-head redhorse	Yellow bull-head	Brown bull-head	Burbot
1						
2				1	2	
3						
4				4		
5	1			7		
6	1	2		6	2	
7		1		1	3	
8		1		2	5	1
9				13	6	1
10				14	1	
11		1		8	1	
12				4		
13		1				1
14	1					
15	3	1				
16	1	15	1			
17		22	2			
18		23	4			
19		16	5			
20		2	7			
21	1	1	3			
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						
34						
35						
36						
Totals	8	86	22	60	20	3

* 1 inch group = 0.0-0.9; 2 inch group = 1.0-1.9; etc.

Table 15. Continued.

Total* length (in)	Species and numbers of fish by length groups					
	Rock bass	Pumpkin-seed	Bluegill	Large-mouth bass	Yellow perch	Walleye
1						
2					9	
3				9	12	
4	1	1		1	2	
5	1	1			9	
6		2	4		9	
7	3		5		7	
8	6	1			8	
9	4		1		2	
10	1				3	1
11						1
12						
13						
14						
15						
16						1
17						
18						1
19						1
20						
21						1
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						
34						
35						
36						
Totals	16	5	10	10	61	6

* 1 inch group = 0.0-0.9; 2 inch group = 1.0-1.9; etc.

Table 16. Length frequency distributions in the Otter Tail River for Sector 9, 1979-80.

Total* length (in)	Species and numbers of fish by length groups					
	Bowfin	Northern pike	Carp	White sucker	Short-head redhorse	Yellow bull-head
1						
2						
3						1
4						1
5				2		15
6				9		13
7				7		
8				3		
9						5
10				2		9
11						13
12		1				4
13		1		1		1
14						
15				1		
16		1			1	
17				1		
18						
19						
20				1		
21						
22						
23						
24						
25	1					
26						
27			1			
28						
29						
30						
31						
32						
33						
34						
35						
36						
Totals	1	3	1	27	1	62

* 1 inch group = 0.0-0.09; 2 inch group = 1.0-1.9; etc.

Table 16. Continued.

Total* length (in)	Species and numbers of fish by length groups				
	Rock bass	Pumpkin-seed	Large-mouth bass	Yellow perch	Walleye
1					
2			6		
3		1	1	4	
4				3	
5				6	
6				5	1
7				5	
8				2	
9	1			3	
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					
32					
34					
35					
36					
Totals	1	1	7	28	1

* 1 inch group = 0.0-0.9; 2 inch group = 1.0=1.9; etc.

Table 17. Length frequency distributions in the Otter Tail River for Sector 10, 1979-80.

Total* length (in)	Species and numbers of fish by length groups					
	White sucker	Silver red-horse	Golden red-horse	Short-head redhorse	Rock bass	Large-mouth bass
1						
2						
3						1
4						
5						
6						
7						
8						
9						
10					1	
11						
12	1					
13						
14						
15			1			
16	1					
17	1		4	5		
18			6	4		
19			4			
20			1			
21		1				
22		1				
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						
34						
35						
36						
Totals	3	2	16	9	1	1

* 1 inch group = 0.0-0.9; 2 inch group = 1.0-1.9; etc.

Table 18. Length frequency distributions in the Otter Tail River for Sector 11, 1979-80.

Total* length (in)	Species and numbers of fish by length groups				
	Northern pike	White sucker	Northern hog-sucker	Silver red-horse	Golden red-horse
1					
2					
3					
4					
5					
6					
7		2			1
8		1			
9	1	7			
10		6	1		
11		2	4		
12	1	5	3		1
13		6	5		
14		4	1		2
15		1			7
16		1			5
17		6			2
18		1		2	3
19		3		1	
20	1				
21					
22					
23					
24					
25					
26					
27	1				
28					
29					
30					
31					
32					
33					
34					
35					
36					
Totals	4	45	14	3	21

* 1 inch group = 0.0-0.9; 2 inch group = 1.0-1.9; etc.

Table 18. Continued.

Total* length (in)	Species and numbers of fish by length groups					
	Short-head redhorse	Black bull-head	Yellow bull-head	Brown bull-head	Rock bass	Large-mouth bass
1						
2						
3						
4						2
5			2			
6		2	4		1	
7		5	3			
8		5	2			
9		7		2	1	
10		1				
11						
12	1					
13	1					
14						
15						
16	3					
17	1					
18						
19	1					
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						
34						
35						
36						
Totals	7	20	11	2	2	2

* 1 inch group = 0.0-0.9; 2 inch group = 1.0-1.9; etc.

Table 19. Length frequency distributions in the Otter Tail River for Sector 12, 1979-80.

Total* length (in)	Species and numbers of fish by length groups					
	Northern pike	Carp	White sucker	Northern hog-sucker	Silver red-horse	Golden red-horse
1						
2						
3				1		
4						
5						
6						
7						
8			1			
9			1	1		1
10			1	2		1
11						7
12						3
13						6
14						1
15		2				
16		1				
17		1				
18		1				
19						
20						
21		1				
22	1	2			1	
23						
24		1				
25						
26						
27						
28						
29						
30						
31						
32						
33						
34						
35						
36						
Totals	1	9	3	4	1	19

* 1 inch group = 0.0-0.9; 2 inch group = 1.0-1.9; etc.

Table 19. Continued.

Total* length (in)	Species and numbers of fish by length groups					
	Short-head redhorse	Yellow bull-head	Rock bass	Large-mouth bass	Black crappie	Yellow perch
1						
2						1
3						
4				1		
5						
6						
7						
8			1			
9		1				
10				1	1	
11	7	1				
12	24			2		
13	3					
14	1					
15	1					
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						
34						
35						
36						
Totals	36	2	1	4	1	1

* 1 inch group = 0.0-0.9; 2 inch group = 1.0-1.9; etc.

Table 20. Length frequency distributions in the Otter Tail River for Sector 13, 1979-80.

Total* length (in)	Species and numbers of fish by length groups					
	Northern pike	Carp	White sucker	Northern hog-sucker	Bigmouth buffalo	Silver red-horse
1						
2						
3				1		
4				1		
5						
6						
7	2					
8			1			
9	2		2			
10		1	16			
11	1	1	10			
12		5	6			
13		21	7			
14		10	2			
15		4	4			
16	1	1	2			
17		2				
18	1	1				5
19	2					3
20		1				6
21		1				2
22		3				
23		6				1
24		7			1	
25	1	1				
26		2			1	
27		2				
28					2	
29					1	
30						
31						
32						
33						
34						
35						
36						
Totals	10	69	50	2	5	17

* 1 inch group = 0.0-0.9; 2 inch group = 1.0-1.9; etc.

Table 20. Continued.

Total* length (in)	Species and numbers of fish by length groups					
	Golden red-horse	Short-head redhorse	Greater redhorse	Black bull-head	Yellow bull-head	Rock bass
1						
2						
3						
4						
5						1
6						
7				2	1	
8				1	3	
9					1	
10		3		2		
11					1	
12		1				
13	1	6				
14	8	17				
15	1	21				
16	12	16	1			
17	6	17				
18	2	5				
19		2				
20						
21						
22						
23			1			
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						
34						
35						
36						
Totals	30	88	2	5	6	1

* 1 inch group = 0.0-0.9; 2 inch group = 1.0-1.9; etc.

Table 20. Continued.

Total* length (in)	Species and numbers of fish by length groups					
	Pumpkin-seed	Bluegill	Large-mouth bass	Black crappie	Yellow perch	Walleye
1						
2					1	
3		1			1	
4		3				
5			1	1		
6		2		2		
7	1					1
8						1
9						
10						
11			2			1
12						
13						
14						
15						
16						3
17						2
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						
34						
35						
36						
Totals	1	6	3	3	2	8

* 1 inch group = 0.0-0.9; 2 inch group = 1.0-1.9; etc.

Table 21. Length frequency distributions in the Otter Tail River for Sector 14, 1979-80.

Total* length (in)	Species and numbers of fish by length groups					
	Northern pike	Carp	White sucker	Silver red-horse	Golden red-horse	Short-head redhorse
1						
2						
3						
4						
5			1			2
6						
7			2			
8			2			
9			3			
10	1		3			3
11			2			3
12		2	7		3	
13			3	1	10	
14			1	4	2	
15		1		2	3	2
16		3		1	1	2
17		3		1	1	
18		14				
19		19		2		
20		6		1		
21		3		1		
22		3				
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						
34						
35						
36						
Totals	1	54	24	13	20	12

* 1 inch group = 0.0-0.9; 2 inch group = 1.0-1.9; etc.

Table 21. Continued.

Total* length (in)	Species and numbers of fish by length groups						
	Greater redhorse	Brown bull-head	Rock bass	Large-mouth bass	Black crappie	Yellow perch	Walleye
1							
2							
3						2	
4			2	1			
5						1	
6							2
7							4
8		1					5
9					2		2
10			1				3
11							
12							
13	1						
14							
15	1			1			
16	1						
17							
18	12						
19	7						
20							
21							
22	3						
23	3						
24							
25							
26							
27							
28							
29							
30							
31							
32							
34							
35							
36							
Totals	28	1	3	2	2	3	16

* 1 inch group = 0.0-0.9; 2 inch group = 1.0-1.9; etc.

Table 22. Length frequency distributions in the Otter Tail River for Sector 15, 1979-80.

Total* length (in)	Species and numbers of fish by length groups				
	Northern pike	Carp	Quill-back	White sucker	Big-mouth buffalo
1					
2					
3					
4					
5				1	
6					
7					
8					
9	1				
10		1		9	
11		6		19	
12		11		8	
13		5		5	
14		3		7	
15		8	2	1	
16		11			
17		12	7		
18		16	14		
19		10	3		2
20		7	2		4
21		5			2
22		2			
23		1			
24					2
25					
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					
36					
Totals	1	98	28	50	10

* 1 inch group = 0.0-0.9; 2 inch group = 1.0-1.9; etc.

Table 22. Continued.

Total* length (in)	Species and numbers of fish by length groups: Silver red-horse	Golden red-horse	Short-head redhorse	Greater redhorse	Black bull-head
1					
2					
3					
4					
5					
6					3
7		4			10
8		1	1		1
9			4		1
10			3		
11					
12			4		
13		2	5		
14	2	7	14		
15	2	7	9	2	
16	1	6	9	9	
17	2	3	6	8	
18	3	8	1	3	
19	1	1		2	
20	5			4	
21	2			8	
22				7	
23				3	
24					
25					
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					
36					
Totals	18	39	56	46	15

* 1 inch group = 0.0-0.9; 2 inch group = 1.0-1.9; etc.

Table 22. Continued.

Total* length (in)	Species and numbers of fish by length groups				
	Channel catfish	Rock bass	Black crappie	Yellow perch	Walleye
1					
2					
3				2	
4				4	
5					
6				2	
7					7
8		2	4		9
9					
10					
11					
12					
13					4
14					1
15					3
16					1
17					
18					
19					1
20					
21					
22	1				
23					
24					
25					
26					
27	1				1
28					
29					
30					
31					
32					
33					
34					
35					
36					
Totals	2	2	4	8	27

* 1 inch group = 0.0-0.9; 2 inch group = 1.0-1.9; etc.

Table 23. Length frequency distributions in the Otter Tail River for Sector 16, 1979-80.

Total* length (in)	Species and numbers of fish by length groups						
	Northern pike	Carp	Quill-back	White sucker	Big-mouth buffalo	Silver red-horse	Golden red-horse
1							
2							
3							
4							
5			1				
6							
7							
8			2				
9			4				
10				1			
11		1		2			
12							1
13		1		2	1		3
14		1				2	1
15		1				1	
16	1	2				1	
17		3					1
18		4	1				
19			2				
20		2					
21		1					
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							
34							
35							
36							
Totals	1	16	10	5	1	4	6

* 1 inch group = 0.0-0.9; 2 inch group = 1.0-1.9; etc.

Table 23. Continued.

Total* length (in)	Species and numbers of fish by length groups					
	Short-head redhorse	Greater redhorse	Black bull-head	Rock bass	Yellow perch	Walleye
1						
2						
3					1	
4						
5						
6			1			
7						1
8						
9						
10				1		
11	1					
12						
13	1	2				
14		1				
15						
16	1					
17	2	1				
18	2					
19		1				
20		2				
21						
22		3				
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						
34						
35						
36						
Totals	7	10	1	1	1	1

* 1 inch group = 0.0-0.9; 2 inch group = 1.0-1.9; etc.

Table 24. Length frequency distributions in the Otter Tail River for Sector 17, 1979-80.

Total* length (in)	Species and numbers of fish by length groups				
	Goldeye	Northern pike	Carp	Quill-back	White sucker
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12			2		
13			6	1	
14	1		12	1	1
15	1		4		3
16			5		
17			6	2	
18			3	1	
19			1		
20			6		
21		1	2		
22			2		
23		1	2		
24			1		
25			2		
26		1			
27		1	1		
28					
29					
30					
31					
32					
33					
34					
35					
36					
Totals	2	4	55	5	4

* 1 inch group = 0.0-0.9; 2 inch group = 1.0-1.9; etc.

Table 24. Continued.

Total* length (in)	Species and numbers of fish by length groups				
	Big-mouth buffalo	Silver red-horse	Golden red-horse	Short-head redhorse	Greater redhorse
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12				6	
13				5	
14	8	1	1	8	
15	6	1		11	
16		1		8	
17		2		3	
18					
19		5			
20					
21					1
22	1				
23	2				
24					
25					
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					
36					
Totals	17	10	1	41	1

* 1 inch group = 0.0-0.9; 2 inch group = 1.0-1.9; etc.

Table 24. Continued.

Total* length (in)	Species and numbers of fish by length groups				
	Channel catfish	Rock bass	Black crappie	Walleye	Fresh-water drum
1					
2					
3					
4					
5					
6		1		1	
7		1	2		
8		3			
9					
10					
11					1
12					
13					
14					
15	1				1
16	1				
17					
18	1				
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					
36					
Totals	3	5	2	1	2

* 1 inch group = 0.0-0.9; 2 inch group = 1.0-1.9; etc.

Table 25. Description of seven Otter Tail River benthos sampling sites.

Station/ sector	Type of sample a	Date (day, month, year)	Sites:
A/17	2	200979	Location: RM 10.5 above Breckenridge Lake Bottom material: sand Description: These were sand samples taken in midchannel. Bank erosion was present and some channeling was done upstream.
B/16	1,3	200979	Location: RM 20 Wilkin County Road 17 Bottom material: mud Description: Habitat was similar to that above Breckenridge. Only a limited amount of near shore qualitative sampling could be done because of the steep banks and rapid dropoff.
C/15	2	190979	Location: RM 30.5 upstream of County Road 19 bridge Bottom material: gravel, sand, rubble, rooted aquatic vegetation Description: Upstream of this area the bank vegetation is oak, basswood and birch. In this area, bank vegetation is characterized by emergent and lowland vegetation. Samples were taken in midchannel in gravel/sand.
D/15	1,3	190979	Location: RM 33-33.5, 6-7 miles downstream of Orwell Dam Bottom material: fine sand/silt Description: Silty areas around bends were sampled and corixids, and burrowing mayflies were common. Rooted vegetation in the sample area included river pondweed and bulrush.
E/15	1,2,3,4	180979 200979 180882 190882	Location: 40-40.1 Orwell Dam Bottom material: boulder, rock, gravel Description: rocks, sticks and fine substrate around rocks were sampled qualitatively. Bank vegetation consisted of reed canary grass, willow, oak and basswood. During the September 1979 sampling, weather was warm during the day and many Chironomidae were swarming along the banks. The weather was very warm and humid during the August 1982 samples. Thousands of insects were caught in only 45 minutes of black light trap operation. Water levels during 1979 were fairly stable below the dam, with flows greater than 500 cfs throughout the summer. In 1982, flows were more varibale. At the 1982 sampling, flow was 340 cfs, but was only 40 cfs about 5 days before.

Table 25. Continued.

Station/ sector	Type of sample [a]	Date (day, month, year)	Sites:
F/11	2	210979	Location: RM 57.0 Broken Down Dam Park Bottom material: gravel, sand, aquatic vegetation Description: Samples were taken in gravel/aquatic vegetation. Water levels at this area were also variable. In 1978 flows were as low as 3-5 cfs, and in 1979 flow was around 500 cfs throughout the summer.
G/4	1,4	160882 170882	Location: RM 162.0 Hubbel Pond WMA Bottom material: boulder, rock, gravel, aquatic vegetation Description: Samples were taken below Hubbel Pond Dam. Qualitative samples were taken in rocks, vegetation and gravel. Black light trap was successful in attracting many frogs and one beaver as well as numerous organisms of the winged and six-legged variety.

[a] 1 = Qualitative - aquatic
2 = Quantitative - Petite Ponar quantitative samples
3 = Qualitative - adult sweep sample
4 = Qualitative - black light trap and/or gas lantern

Table 26. Occurrence of invertebrate taxa collected at seven sampling sites on the Otter Tail River, September 1979 and August 1982.

FAMILY	GENUS	SPECIES	Occurrence A	B	C	D	E	F	G	Quantitative stations (Total of four 232 sq cm Petite ponars) A	C	E	F
Porifera									+				
Coelenterata													
Hydridae	*Hydra*						+					14	
Turbellaria						+	+		+			2	
Nematoda					+		+	+			10	10	4
Bryozoa							+						
Oliogchaeta													
Naididae	*Dero*							+					2
	Nais	*behningi*			+		+	+			4	9	10
		pardalis					+					1	
		simplex							+				
		variabilis							+				
	Ophidonais	*serpentina*					+					1	
	Pristina	*longisoma*							+				
	Stephensoniana	*trivandrana?*						+					1
	Stylaria	*lacustris*							+				
Tubificidae	*Aulodrilus*	*limnobius*			+						1		
	Limnodrilus	*hoffmeisteri*					+						
		udekemianus			+						16		
		spp.			+		+		+		34	4	
	Tubifex	*harmani?*			+			+			2		2
		sp.-w/cap. chaetae			+		+	+			4	1	3
		sp.						+					4
Lumbriculidae	*Lumbriculus*	*variegatus*			+			+			1		3
Hirudinea													
Glossiphoniidae	*Glossiphonia*	*complanata*						+					1
	Helobdella	*stagnalis*			+	+	+		+		2	17	
	Dina or *Erpodbella*					+	+					12	
Cladocera													
Sididae	*Sida*	*crystallina*				+	+					16	
Undetermined							+					5	
Amphipoda													
Talitridae	*Hyalella*	*azteca*	+	+		+		+	+	1			22
Hydracarina								+					1
Collembola													
Poduridae								+					1
Plecoptera													
Taeniopterygidae	*Taeniopteryx*							+					
Perlidae	*Paragnetina*	*media*							+				
	Perlesta	*placida*					+		+				
	Phasganophora	*capitata*					+					1	
Ephemeroptera													
Baetidae	*Baetis*	*intercalaris*					+						
		pygmaeus							+				
		spp.				+	+	+				4	7

Table 26. Continued.

FAMILY	GENUS	SPECIES	Occurrence A	B	C	D	E	F	G	Quantitative stations (Total of four 232 sq cm Petite ponars) A	C	E	F
	Callibaetis								+				
	Centroptilum								+				
	Pseudocloeon	*dubium*					+						
		parvulum					+						
		spp.			+	+	+	+			13	9	183
Ephemeridae	*Hexagenia*	*limbata*					+						
		spp.				+							
Heptageniidae	*Epeorus*							+					1
	Heptagenia	*inconspicua?*					+						
		maculipennis grp.					+		+				
	Stenacron	*interpunctatum*					+		+				
		spp.					+		+				
	Stenonema	*mediopunctatum*					+	+	+				1
		terminatum					+						
		vicarium							+				
		spp.				+	+	+				2	19
Leptophlebiidae	*Paraleptophlebia*		+	+		+		+		1			1
Oligoneuriidae	*Isonychia*	*rufa*					+						
		spp.					+	+					1
Polymitarcidae	*Ephoron*	*album*				+	+						
Potamanthidae	*Potamanthus*	*myops*					+						
		spp.			+		+	+			53	44	14
Caenidae	*Caenis*	*sp.* 1 (*hilaris?*)					+		+				
		sp. 2 (*simulans?*)					+		+				
		spp.		+			+	+				2	1
Tricorythidae	*Tricorythodes*		+			+	+	+		1			50
Odonata													
Calopterygidae	*Calopteryx*								+				
Coenagrionidae	*Enallagma*					+		+	+				1
Lestidae	*Lestes*			+									
Hemiptera													
Gerridae	*Gerris*	*comatus*							+				
		dissortis				+							
		spp.							+				
	Metrobates	*hesperius*				+							
Hydrometridae	*Hydrometra*	*martini*						+					1
Corixidae	*Callicorixa*	*audeni*					+						
	Cenocorixa	*dakotensis*				+							
	Hesperocorixa	*michiganensis*		+									
		vulgaris				+	+						
	Sigara	*alternata*				+	+		+				
		bicoloripennis				+	+		+				

Table 26. Continued.

FAMILY	GENUS	SPECIES	Occurrence A	B	C	D	E	F	G	Quantitative stations (Total of four 232 sq cm Petite ponars) A	C	E	F
	Sigara	*decoratella*					+						
		grossolineata				+	+						
		spp.				+	+						
	Trichocorixa	*naias*					+						
Nepidae	*Ranatra*					+							
Tricoptera													
Hydropsychidae	*Cheumatopsyche*	*campyla*					+		+				
		petteti							+				
		speciosa							+				
		spp.	+		+	+	+	+	+	1	11	1222	71
	Hydropsyche	*betteni*						+	+				1
		bidens			+		+				1	47	
		placoda					+						
		valanis?	+		+	+	+	+		2	2	2	4
		spp.	+		+					1	1		
	Potamyia	*flava*	+		+		+			1	52	2	
	Symphitopsyche	*bifida*				+	+		+				
		bronta							+				
		riola							+				
		bifida grp.	+		+	+	+	+	+	3	5	1406	244
		spp.						+					
		early instars	+		+	+	+		+	1	87		
Philopotamidae	*Chimarra*	*obscura*							+				
	Polycentropus	*cinereus*							+				
		remotus							+				
		spp.					+		+				
	Neureclipsis						+						
Psychomyiidae	*Psychomyia*	*flavida*					+	+	+			269	40
Glossosomatidae	*Protoptila*	*erotica*					+						
	Protoptila	*spp.*			+		+	+			22	32	20
Hydroptilidae	*Agraylea*	*multipunctata*					+		+				
	Hydroptila	*armata*							+				
		perdita					+						
		waubesiana					+		+				
		spp.					+	+	+				16
	Mayatrichia	*ayama*					+						
	Oxyethira	*serrata*							+				
		verna							+				
		spp.							+				
Brachycentridae	*Micrasema*							+					2
Helicopsychidae	*Helicopsyche*	*borealis*						+	+				2
Lepidostomatidae	*Lepidostoma*	*togatum*							+				
Leptoceridae	*Ceraclea*	*alagma*							+				
		ancylus							+				
		cancellata					+		+				

Table 26. Continued.

FAMILY	GENUS	SPECIES	Occurrence A	B	C	D	E	F	G	Quantitative stations (Total of four 232 sq cm Petite ponars) A	C	E	F
	Ceraclea	*maculata*					+		+				
		transversa							+				
	Mystacides	*interjecta*							+				
		sepulchralis							+				
	Nectopsyche	*candida*		+									
		diarina		+			+		+				
		exquisita		+					+				
		spp.				+	+	+	+				1
	Oecetis	*avara*						+	+				8
		cinarescens					+		+				
		immobilis					+						
		inconspicua					+		+				
		ochracea					+						
	Traenodes	*marginata*							+				
		tarda					+		+				
		spp.							+				
Limnephilidae	*Limnephilus*	*hyalinus*				+							
	Pychopsyche								+				
Molannidae	*Molanna*	*uniophila*							+				
Phryganeidae	*Agrypnia*	*vestita?*							+				
Neuroptera													
Sisyridae	*Sisyra*								+				
Lepidoptera													
Pyralidae	*Paraponyx*								+				
	Parargyractis						+					12	
Pyralidae		*spp.*							+				
Coleoptera													
Dytiscidae	*Desmopachria*							+					2
	Hygrotus					+	+	+					1
	Laccophilus			+		+							
	Liodessus			+		+	+	+	+				3
Gyrinidae	*Dineutus*					+							
	Gyrinus			+		+			+				
Haliplidae	*Haliplus*	*immaculicolis*							+				
Elmidae	*Optioservus*							+	+				22
	Stenelmis	*vittipennis*						+					1
		spp.			+	+	+	+			2	1	70
Hydrophilidae	*Berosus*					+			+				
	Crenitis							+					1
	Cymbiodyta						+		+				
	Enochrus						+		+				
	Helophorus					+	+						
	Hydrobius								+				
	Hydrochus								+				
	Laccobius						+						

Table 26. Continued.

FAMILY	GENUS	SPECIES	Occurrence A	B	C	D	E	F	G	Quantitative stations (Total of four 232 sq cm Petite ponars) A	C	E	F
	Tropisternus			+		+	+						
Diptera													
Ceratopogonidae									+				
Chaoboridae	*Chaoborus*	*flavicans*					+						
Chironomidae	*Procladius*	*bellus*					+						
		freemani					+						
		spp.				+							
	Ablabesmyia	*mallochi*					+						
		monilis					+		+				
		pulchripennis					+						
		sp. 1							+				
		sp. 2					+		+				
		sp. 3				+							
	Conchapelopia	*dusena*					+		+				
	Thienemannimyia	grp.					+		+			5	
	Labrundina	*pilosella*					+		+				
		sp. 2							+				
	Paramerina	*fragilis*					+						
	Pentaneura								+				
	Telopelopia	*okoboji*					+						
	Glyptotendipes	*lobiferus*					+						
		paripes					+		+				
		spp.					+		+			2	
	Chironomus	*decorus*					+		+				
		tentans					+						
		spp.				+							
	Dicrotendipes	*modestus*							+				
		neomodestus					+						
		nervosus					+		+				
		spp.							+				
	Cladopelma	*viridula*					+						
	Cryptotendipes	*n. sp.?*					+						
	Parachironomus	*frequens*					+						
		hirtalatus							+				
		potamogeti					+						
		tenuicaudatus					+						
		abortivus grp.					+						
		frequens grp.					+						
	Cryptochironomus	*fulvus*					+						
		spp.			+		+	+			13		18
	Endochironomus	*nigricans*					+		+				
		subtendens					+		+				
	Microtendipes	*caducus*			+		+	+			12	271	5
		pedellus					+		+				
	Paratendipes	*albimanus*					+		+				

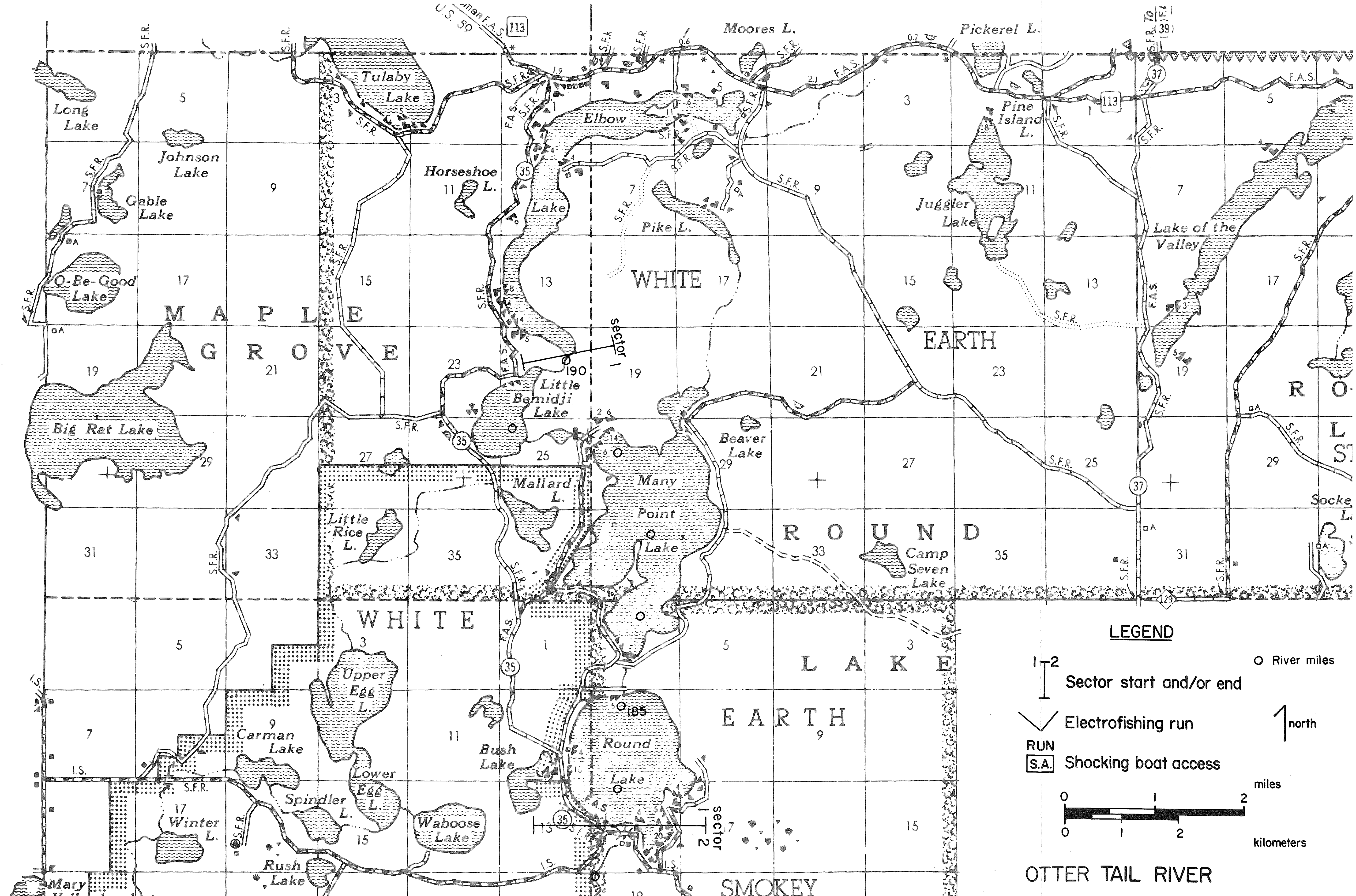
Table 26. Continued.

FAMILY	GENUS	SPECIES	Occurrence A	B	C	D	E	F	G	Quantitative stations (Total of four 232 sq cm Petite ponars) A	C	E	F
	Paratendipes	connectens #3	+							4			
	Phaenopsectra	flavipes							+				
		punctipes							+				
	Polypedilum	acifer			+		+	+			25	13	68
		convictum			+		+	+	+		4	93	15
		digitifer					+						
		griseopunctatum					+						
		illinoense				+	+		+				
		laetum						+	+				1
		scalaenum grp.					+	+	+				2
		simulans							+				
		simulans grp.			+		+	+			21	1	12
		sordens							+				
		trigonum							+				
		tritum					+						
	Pseudochironomus						+						
	Robackia		+							1			
	Stenochironomus	macateei							+				
		taeniapennis							+				
		spp.							+				
	Cladotanytarsus	sp. A [a]					+						
		sp. B					+						
		sp. 1			+		+	+			16	11	38
	Micropsectra	sp. A					+						
		sp. 1							+				
	Paratanytarsus	sp. A					+						
		sp. B					+		+				
		sp. 1					+		+				
		sp. 2							+				
		sp. 3					+		+				
	Rheotanytarsus	sp. A					+						
		sp. B					+		+				
		sp. C					+		+				
		distinctissimus grp.			+	+	+	+	+		3	3	17
		exiguus grp.			+		+	+	+		26	56	1
	Tanytarsus	sp. A					+						
		sp. 1							+				
		sp. 2							+				
		sp. 3							+				
		sp. 4							+				
	Brilla							+					3
	Cardiocladius							+					16
	Cordites		+					+		1			29
	Corynoneura				+			+			1		1
	Cricotopus	bicinctus					+		+				

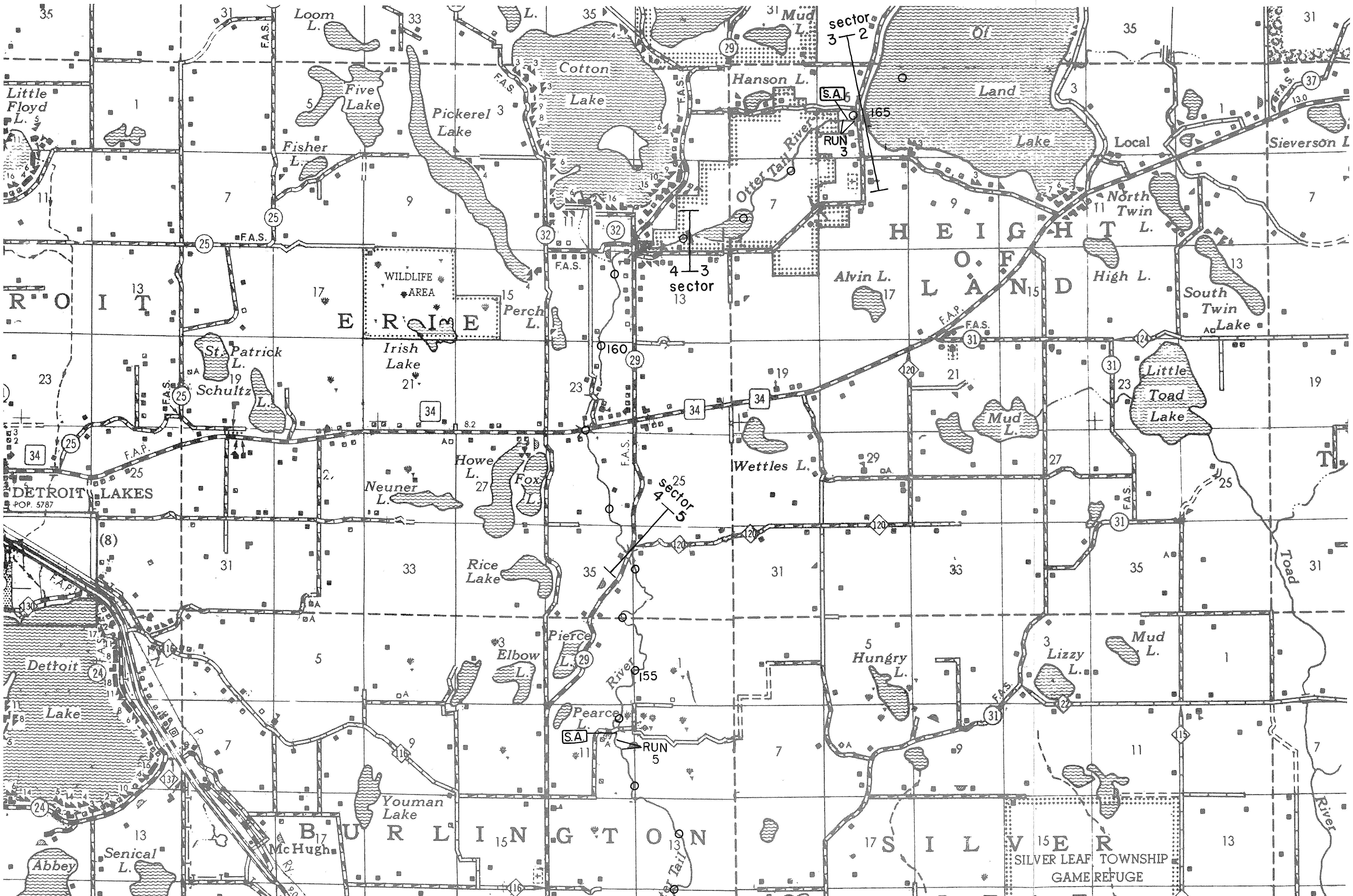
Table 26. Continued.

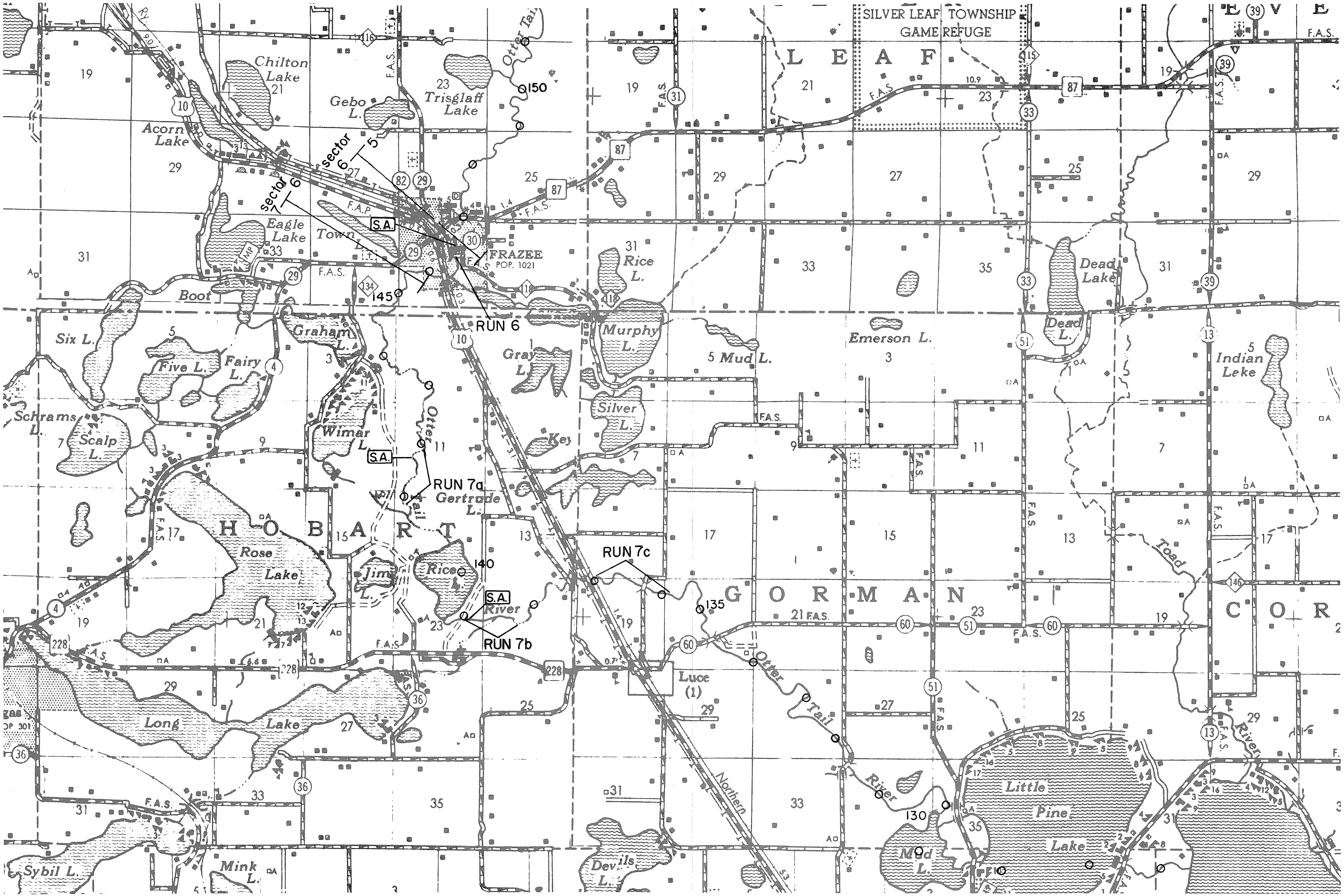
FAMILY	GENUS	SPECIES	Occurrence A	B	C	D	E	F	G	Quantitative stations (Total of four 232 sq cm Petite ponars) A	C	E	F
	Cricotopus	vierriensis					+		+				
		bicinctus grp.			+		+	+	+		3	10	6
		tremulus grp.			+		+	+			1	27	1
		sylvestris grp.					+						
		trifascia grp.			+		+	+			2	31	29
	Eukiefferiella	brevicalcar grp.						+					1
		dicoloripes grp.							+				5
		spp.							+				
	Limnophyes	hastulatus					+						
	Nanocladius	rectinervis					+						
		spp.	+							1			
	Parametriochemus							+	+				99
	Psectrocladius								+				
	Rheocricotopus							+					2
	Thienemanniella	sp. 1						+	+				10
		sp. 2						+					3
Culicidae	Anopheles					+			+				
Dixidae	Dixella					+		+					1
Psychodidae									+				
Simuliidae	Simulium	luggeri					+						
		vittatum							+				
		spp.	+		+	+	+	+		14	21	19	70
Tipulidae	Antocha							+	+				5
	Dicranota							+					2
	Gonomyia								+				
	Helius								+				
	Limnophila								+				
Dolichopodidae				+			+						
Empididae							+	+	+			22	33
Ephydridae							+		+				
Rhagionidae	Atherix							+					1
Sciomyzidae							+						
Syrphidae							+						
Gastropoda													
	Amnicola							+					2
	Campeloma							+					1
	Ferrisia		+		+	+	+	+	+	4	4	152	76
	Physa		+	+						1			
	Sphaerium				+			+			3		11
Pelecypoda													
	Lampsilis	radiata siliquoidia							+				

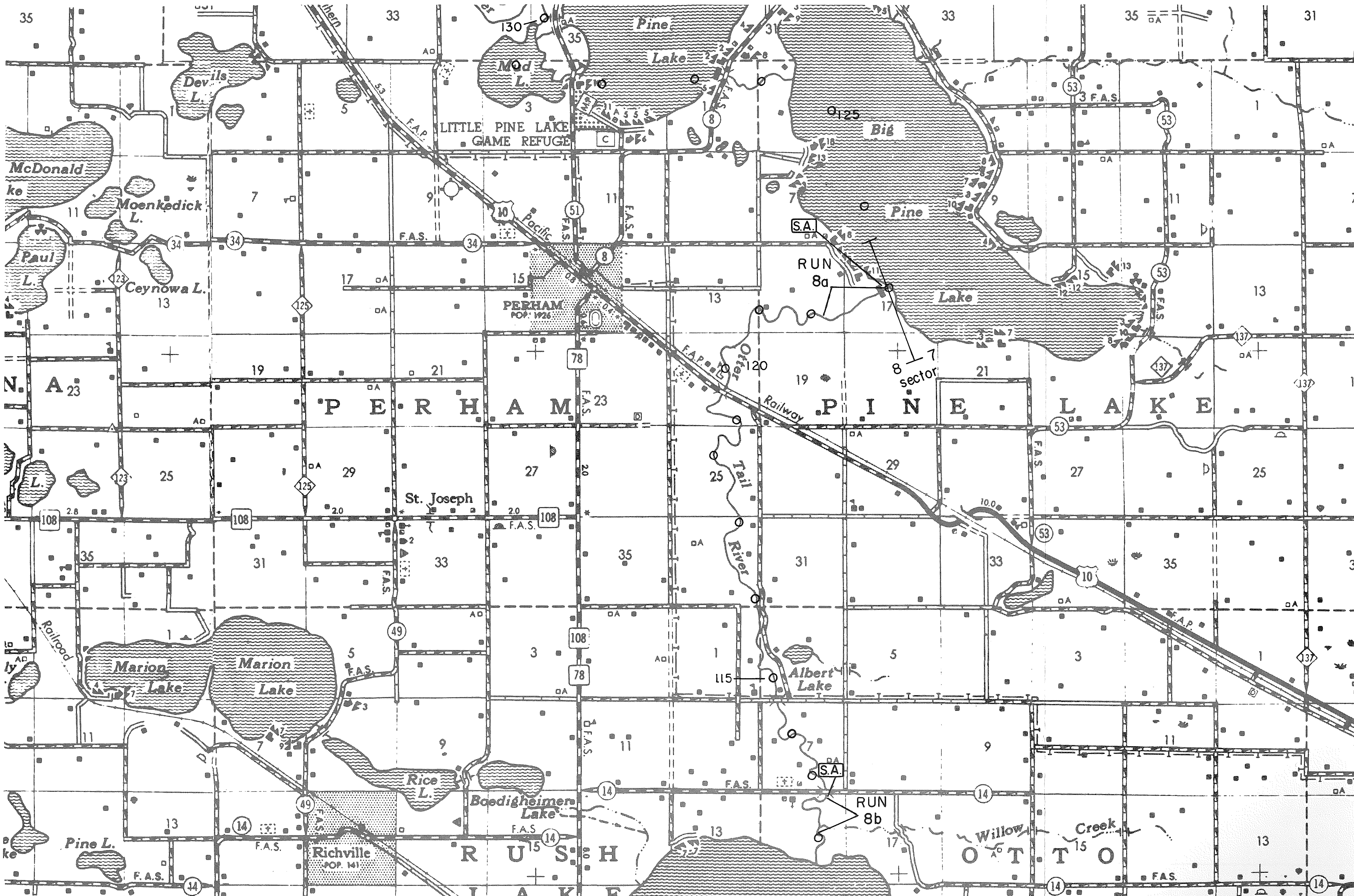
[a] Capital letters denote unassociated adults. Numbers denote unassociated larvae.

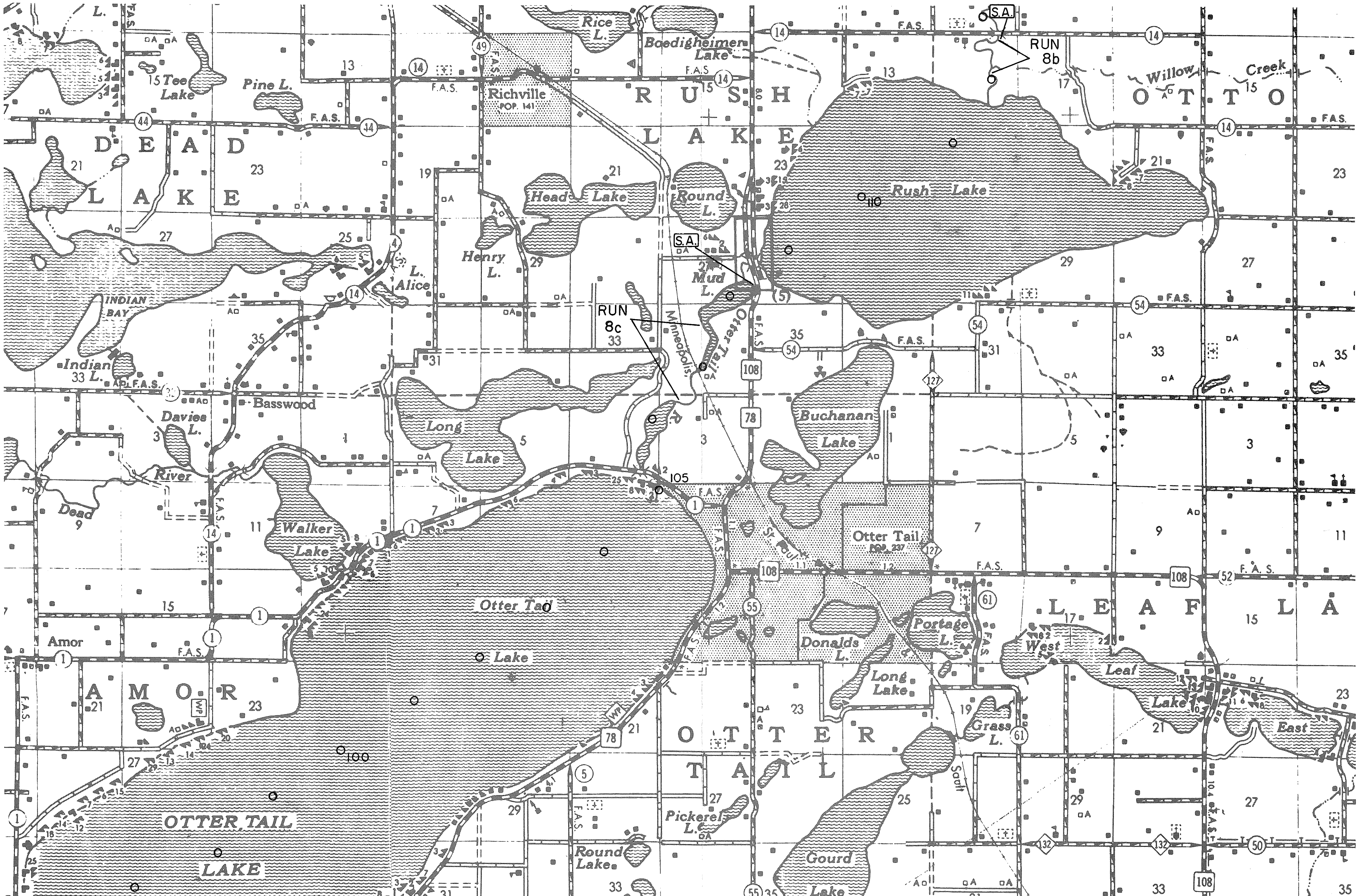

Moores L.
Pickerel L.
Tulaby Lake
Long Lake
Johnson Lake
Gable Lake
Horseshoe L.
Elbow Lake
Pike L.
Pine Island L.
Juggler Lake
Lake of the Valley
O-Be-Good Lake
M A P L E
G R O V E
WHITE
EARTH
Big Rat Lake
Little Bemidji Lake
Beaver Lake
Mallard L.
Many Point Lake
Little Rice L.
R O U N D
Camp Seven Lake
WHITE
L A K E
E A R T H
Upper Egg L.
Carman Lake
Lower Egg L.
Bush Lake
Round Lake
Spindler L.
Waboose Lake
Winter L.
Rush Lake
Mary Yellowhead
SMOKEY
sector 1
sector 2
190
185
LEGEND
Sector start and/or end
River miles
Electrofishing run
north
RUN
S.A. Shocking boat access
miles
kilometers
OTTER TAIL RIVER

141 N
Mary Yellowhead Lake
Eß River
Rush Lake
SUGAR BUSH
Otter Tail River
180
175
170
TAMARAC
NATIONAL
WILDLIFE
REFUGE
(FEDERAL)
Little Flat Lake
Flat Lake
Flat Lake
Balsam Lake
Chippewa Lake
Booth Lake
Blackbird Lake
Johnson Lake
Rice L.
Tamarack Lake
Pine Lake
Stunk L.
Mud L.
Hanson L.
Twin Lakes
Height Of Land
GRAND PARK
Island Lake
Ice Cracking Lake
SMOKEY HILLS
Green Water Lake
INDIAN RESERV
Big Rush Lake
Mud L.
Aspinwall Lake
Mission Lake
Mud L.
Shell Lake
Jones L.
Island Lake
Dumbbell Lake
SHELL LAKE
Bass Lake
Linbom L.
Shell
CAR
STAT
Pons
Snellman
F.A.S.
F.A.P.
I.S.

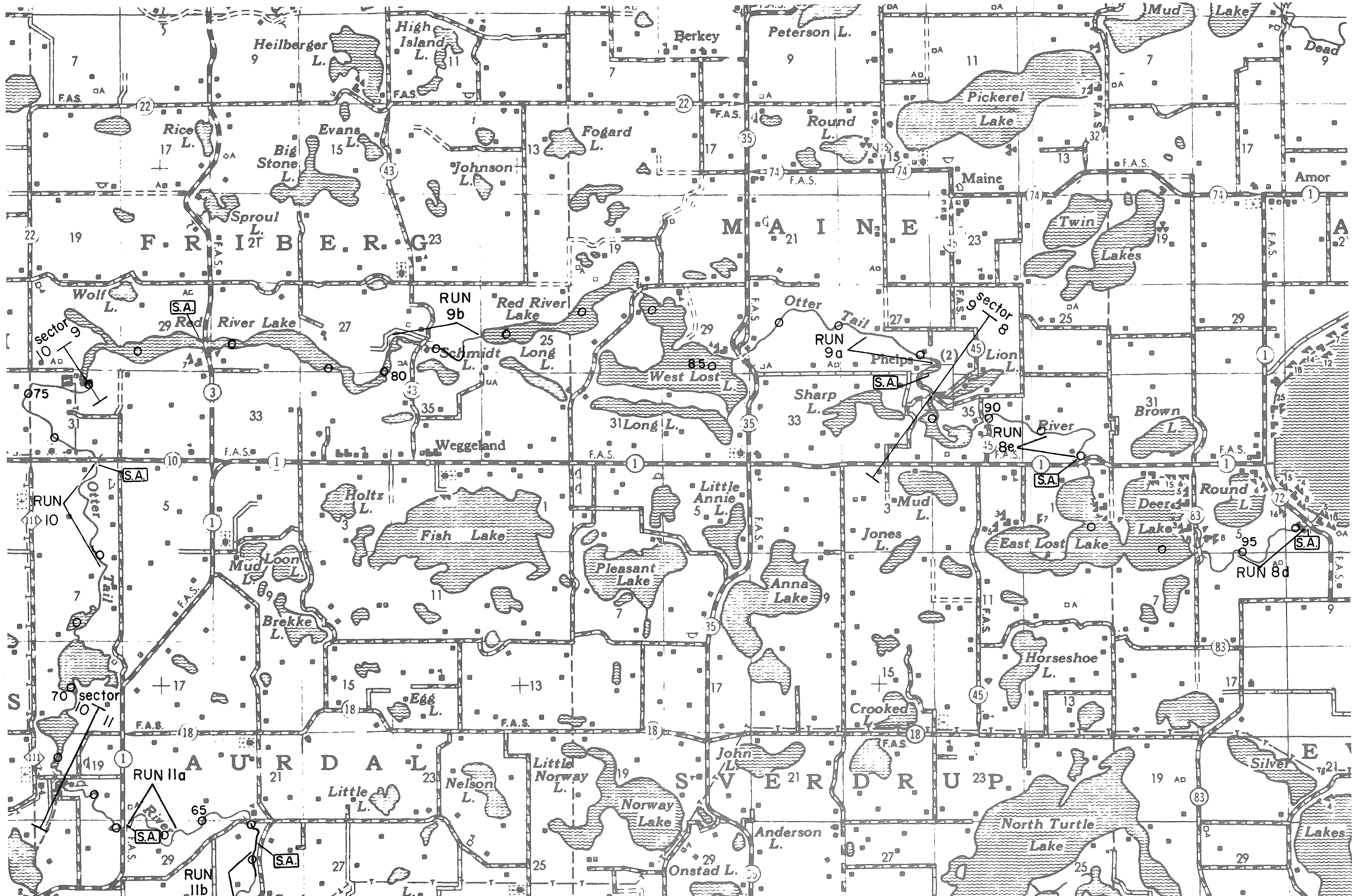

sector 3 2
sector 4 3
sector 4 5
RUN 3
RUN 5
S.A.
165
160
155
Little Floyd L.
Loom L.
Five Lake
Fisher L.
Pickerel Lake
Cotton Lake
Mud L.
Hanson L.
Otter Tail River
Ottertail River
Ot Land Lake
Local
Sieverson L.
North Twin L.
High L.
South Twin Lake
H E I G H T O F L A N D
Alvin L.
Perch L.
WILDLIFE AREA
E R I E
Irish Lake
St. Patrick L.
Schultz L.
R O I T
DETROIT LAKES
POP. 5787
Howe L.
Fox L.
Neuner L.
Wettles L.
Mud L.
Little Toad Lake
Toad River
Rice Lake
Pierce L.
Elbow L.
Pearce L.
Hungry L.
Lizzy L.
Mud L.
Detroit Lake
Youman Lake
Senical L.
Abbey
McHugh
B U R L I N G T O N
S I L V E R
SILVER LEAF TOWNSHIP GAME REFUGE
F.A.S.
F.A.P.
WILDLIFE AREA


SILVER LEAF TOWNSHIP
GAME REFUGE
LEAF
HOBART
GORMAN
Chilton Lake
Acorn Lake
Gebo L.
Trisglaff Lake
Eagle Lake
Town L.
FRAZEE
POP. 1021
Rice L.
Dead Lake
Dead L.
Murphy L.
Emerson L.
Mud L.
Indian Lake
Boot
Six L.
Five L.
Fairy L.
Graham L.
Gray L.
Silver L.
Key
Schrams L.
Scalp L.
Wimar L.
Gertrude L.
Rose Lake
Jim L.
Rice L.
Long Lake
Sybil L.
Mink L.
Devils L.
Little Pine Lake
Mud L.
Luce
Otter Tail River
Toad River
Northern
sector 6
sector 7
RUN 6
RUN 7a
RUN 7b
RUN 7c
S.A.
F.A.S.
F.A.P.
150
145
140
135
130

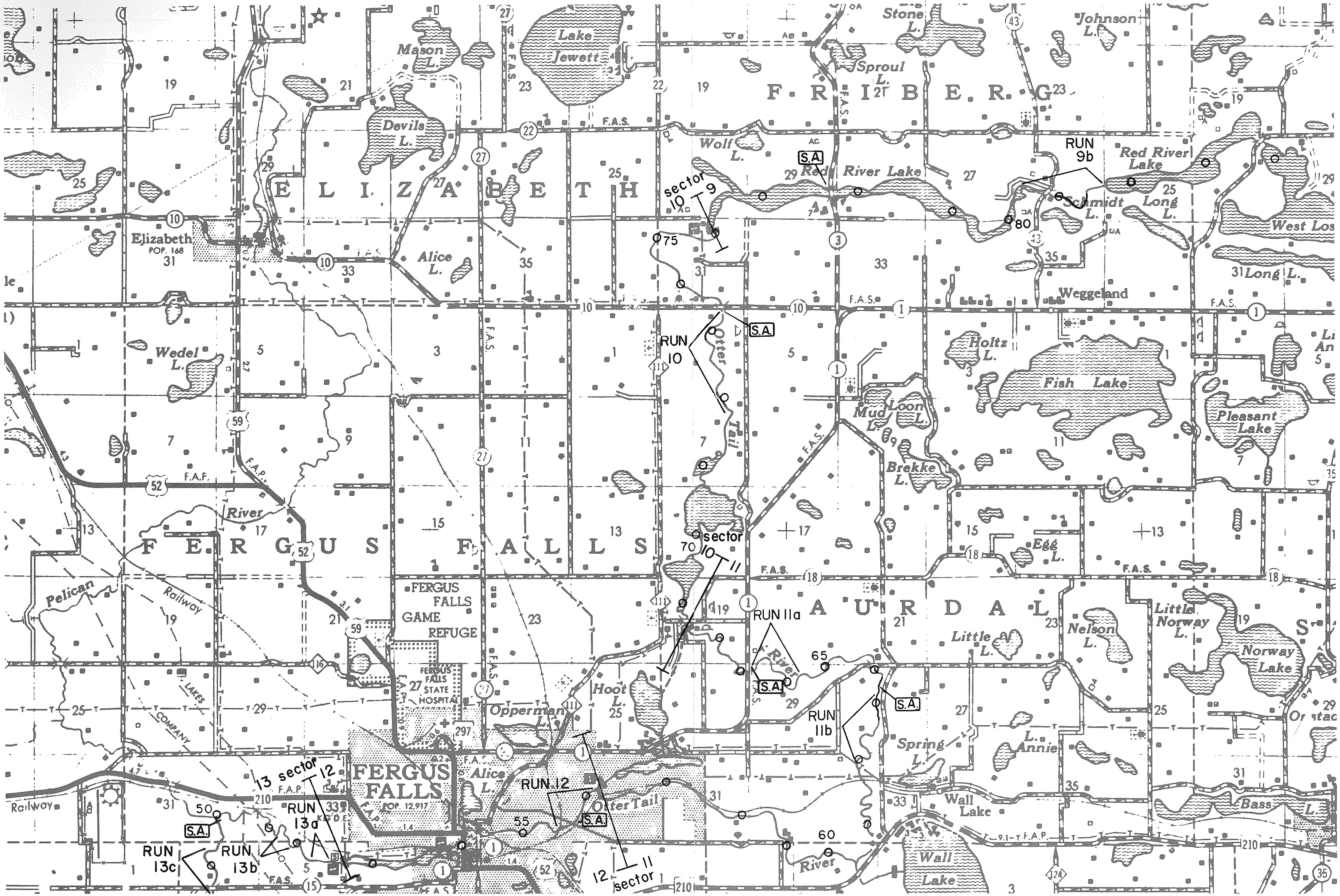

Pine Lake
Mud L.
Devils L.
McDonald Lake
Moenkedick L.
Paul L.
Ceynowa L.
LITTLE PINE LAKE GAME REFUGE
Big Pine Lake
PERHAM POP. 1926
Otter Tail River
Pacific Railway
RUN 8a
8 7 sector
S.A.
PERHAM
PINE LAKE
St. Joseph
Railroad
Marion Lake
Albert Lake
Rice L.
Boedigheimer Lake
RUN 8b
Willow Creek
Pine L.
Richville POP. 141
RUSH LAKE
OTTO
F.A.S.
F.A.P.



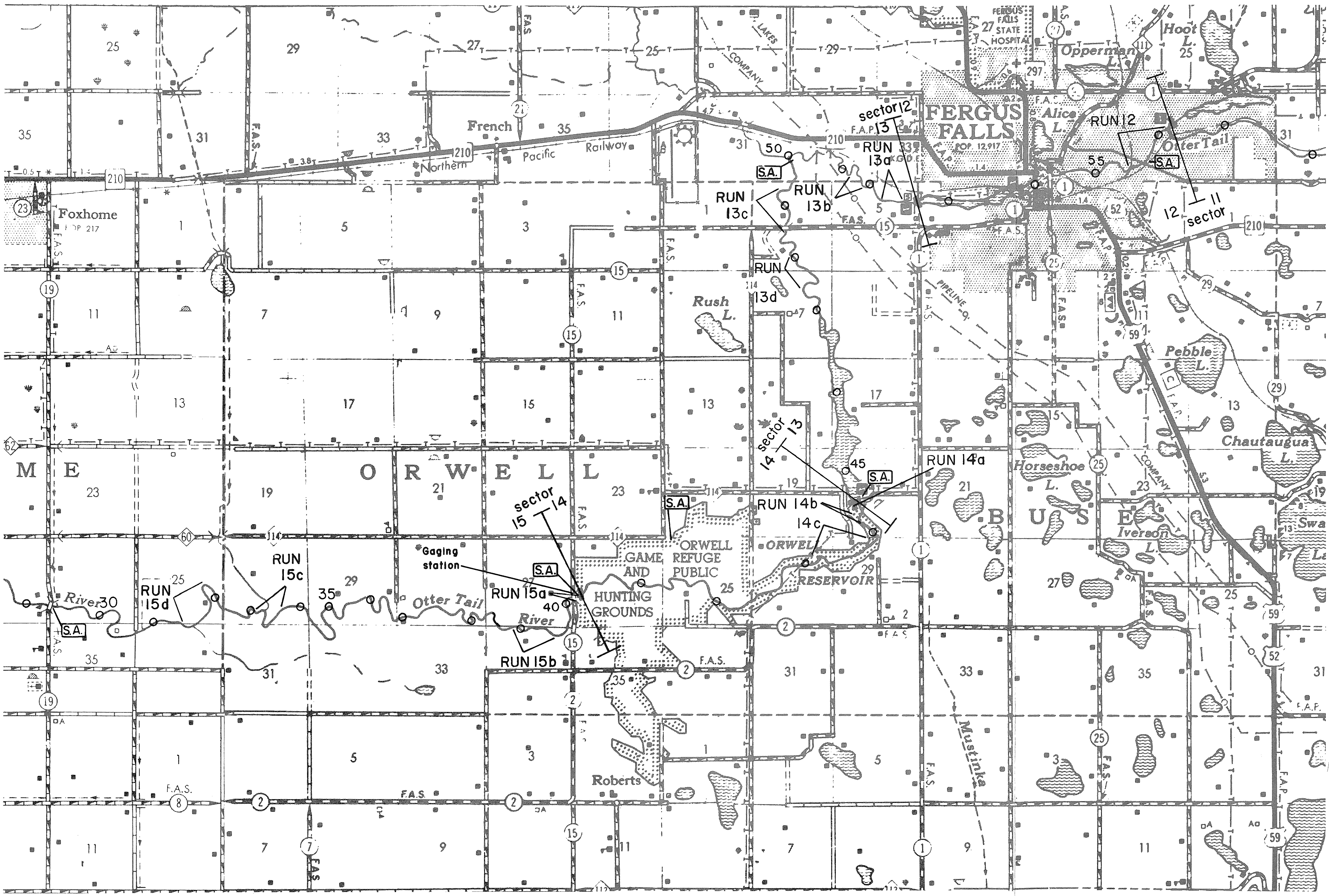
RUN
8b
S.A.
RUN
8c
S.A.
Rice L.
Boedigheimer Lake
Tee Lake
Pine L.
Richville
POP. 141
RUSH LAKE
OTTO
Willow Creek
DEAD LAKE
Head Lake
Round L.
Rush Lake
Henry L.
L. Alice
Mud L.
INDIAN BAY
Indian L.
Basswood
Daviee L.
Long Lake
Buchanan Lake
River
Dead
Walker Lake
Otter Tail
POP. 237
Otter Tail Lake
Minneapolis
St. Paul
Amor
Portage L.
Donalds L.
West Leaf Lake
East
LEAF LA
Long Lake
AMOR
OTTER TAIL
Grass L.
Soo
Pickerel L.
Round Lake
Gourd Lake
OTTER TAIL LAKE
F.A.S.



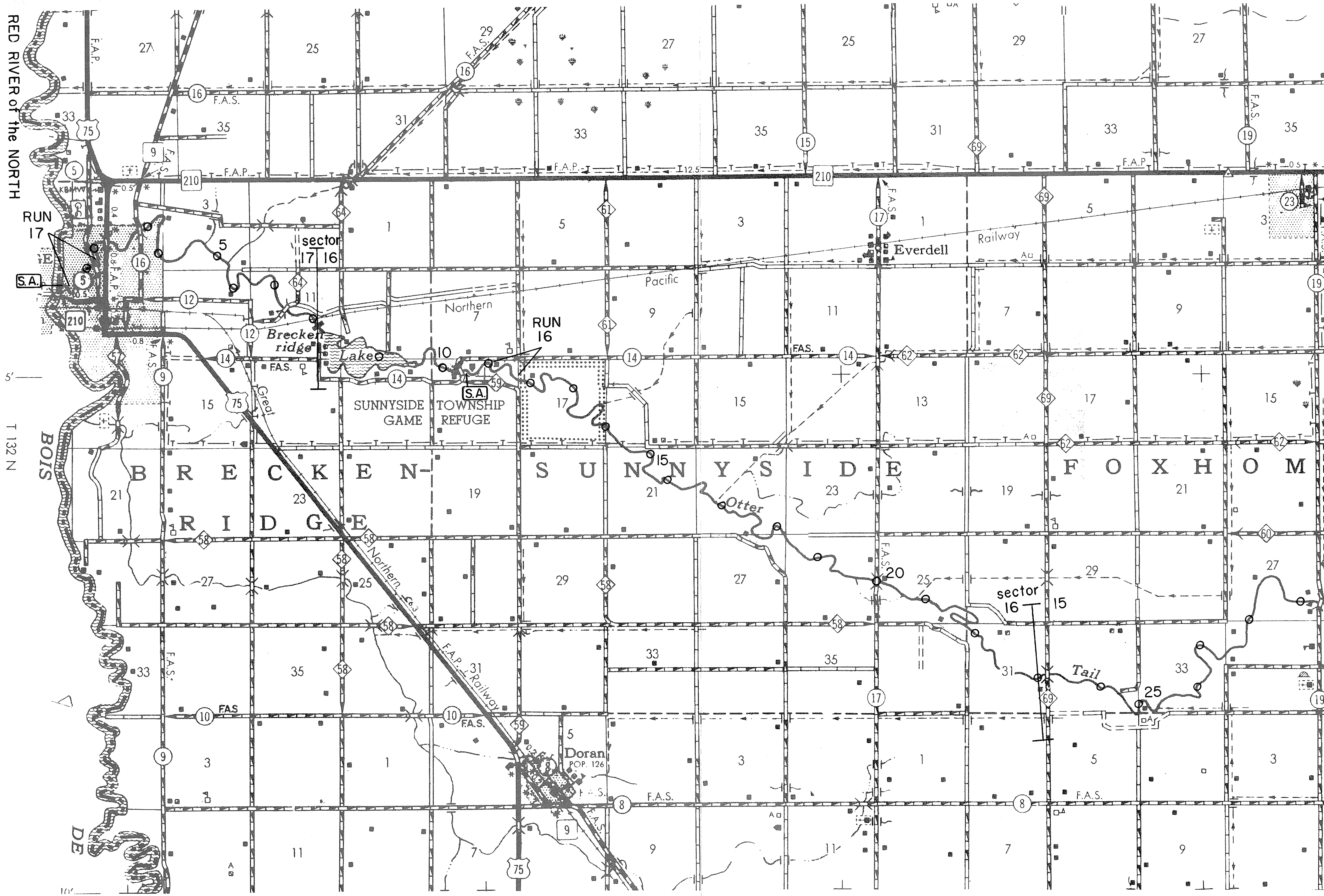
Heilberger L.
High Island L.
Berkey
Peterson L.
Mud Lake
Dead
Pickerel Lake
Round L.
Rice L.
Big Stone L.
Evans L.
Johnson L.
Fogard L.
Sproul L.
Maine
Amor
FRIBERG
MAINE
Twin Lakes
Wolf L.
Red River Lake
Red River Lake
Schmidt L.
Long L.
West Lost L.
Otter Tail
Phelps
Lion L.
Sharp L.
Long L.
Brown L.
River
Weggeland
RUN 9b
RUN 9a
RUN 8e
RUN 8d
RUN 10
RUN 11a
RUN 11b
sector 10 9
sector 9 8
sector 10 11
S.A.
Otter Tail
Holtz L.
Fish Lake
Little Annie L.
Mud L.
Jones L.
East Lost Lake
Deer Lake
Round L.
Mud L.
Loon L.
Brekke L.
Pleasant Lake
Anna Lake
Horseshoe L.
Egg L.
Crooked L.
AURDAL
SVERDRUP
Little L.
Nelson L.
Little Norway L.
Norway Lake
John L.
Anderson L.
Onstad L.
North Turtle Lake
Silver
Lakes
River
F.A.S.
75
80
85
90
95
70
65



FRIBERG
ELIZABETH
FERGUS FALLS
AURDAL
Elizabeth
POP. 168
FERGUS FALLS
POP. 12,917
FERGUS FALLS GAME REFUGE
FERGUS FALLS STATE HOSPITAL
Weggeland
Mason L.
Lake Jewett
Devils L.
Alice L.
Wedel L.
Stone L.
Sproul L.
Johnson L.
Wolf L.
Red River Lake
Red River Lake
Schmidt L.
Long L.
West Los
Long L.
Holtz L.
Fish Lake
Pleasant Lake
Mud L.
Loon L.
Brekke L.
Egg L.
Little L.
Nelson L.
Little Norway L.
Norway Lake
Hoot L.
Opperman L.
Alice L.
Spring L.
L. Annie
Wall Lake
Wall Lake
Bass L.
Otter Tail
Otter Tail
River
Pelican
River
Railway
Railway
LAKES COMPANY
F.A.S.
F.A.P.
RUN 9b
RUN 10
sector 10 9
sector 10 11
RUN 11a
RUN 11b
RUN 12
sector 12 11
13 sector 12
RUN 13a
RUN 13b
RUN 13c
S.A.
75
80
70
65
60
55
50



FERGUS FALLS
POP. 12,917
FERGUS FALLS STATE HOSPITAL
Foxhome
French
Northern Pacific Railway
Rush L.
Alice L.
Opperman L.
Hoot L.
Otter Tail
Pebble L.
Chautauqua L.
Horseshoe L.
Iverson L.
ORWELL
BUSE
ORWELL RESERVOIR
ORWELL GAME AND PUBLIC HUNTING GROUNDS REFUGE
Otter Tail River
Roberts
Mustinka
Gaging station
RUN 12
RUN 13a
RUN 13b
RUN 13c
RUN 13d
RUN 14a
RUN 14b
14c
RUN 15a
RUN 15b
RUN 15c
RUN 15d
sector 12 13
sector 12 11
sector 14 13
sector 15 14
S.A.
PIPELINE
LAKES COMPANY


RED RIVER of the NORTH
RUN
17
S.A.
sector
17 16
Breckenridge
Lake
RUN
16
S.A.
SUNNYSIDE GAME
TOWNSHIP REFUGE
Northern
Pacific
Railway
Everdell
Great
Northern
F.A.P. Railway
B R E C K E N - R I D G E
S U N N Y S I D E
F O X H O M
Otter
Tail
sector
16 15
Doran
POP. 126
BOIS
DE
T 132 N
F.A.S.
F.A.P.

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