Ministry of Natural Resources

Ontario

Natural. Valued. Protected.

Background Information for the Development of a Fisheries Management Plan in Fisheries Management Zone 5

January 2012

Ontario Ministry of Natural

Table of Contents

Executive Summary

The FMZ5 Fisheries Management Background Information Document was developed by the Ministry of Natural Resources (MNR) and will be used to facilitate the preparation of Fisheries Management Plan for FMZ 5. This Plan will apply to all waterbodies across FMZ 5, with the exception of six Specially Designated Waterbodies (SDWs) and there associated waterbodies (Figure 1-1) that will have their own Plans and monitoring strategies developed separately from this exercise.

Preparation of a Fisheries Management Plan requires certain baseline information. This information provides the basis for making decisions on such planning components as Fisheries Management Objectives and Management Actions and for assessing the effectiveness of the Management Actions to achieve the stated Management Objectives. It provides a picture of the current status of fisheries resources and the challenges to management within the zone. The FMZ 5 Fisheries Management Background Information Document provides the following information in a summarized and concise format:

- Physical Characteristics of the Fisheries Management Zone
- Biological Description of the Fisheries Resources
- Habitat Status of the Fisheries Resources
- Socio-Economic Description of the Fisheries Management Zone
- Current Fisheries Management Actions
- User Expectations of Fisheries Resources
- Fisheries Management Challenges/Issues

From the information provided in the FMZ 5 Background Information Document, broad management goals specific to FMZ 5 will be identified through the analysis of fisheries data and collaborative discussions between the MNR and members of the public, Aboriginal Communities and non-government organizations represented on the Fisheries Management Zone 5 Advisory Council. These goals will be used to direct objectives and regulatory and non-regulatory actions associated with management issues identified for FMZ 5.

The Background Information Document will form part of the Fisheries Management Plan for FMZ 5. The background report will be updated as part of the review process specified for the Fisheries Management Plan. A summary version of this document has also been prepared that is available from MNR offices in FMZ 5 or online at *www.ontario.ca/zonecouncils*.

1.0 Introduction

With the implementation of *A New Ecological Framework for Recreational Fisheries Management in Ontario (EFFM)* (OMNR 2005a), the Province of Ontario has undertaken a broader, landscape level approach to fisheries management. This approach allows the Ontario Ministry of Natural Resources (OMNR) to more effectively manage the use of our fisheries resources and assess fisheries sustainability at a scale most appropriate given current fisheries objectives, public expectations and government resources.

The *EFFM* follows the principles outlined in *Our Sustainable Future* (OMNR 2005b), *Ontario's Biodiversity Strategy* (OMNR 2005c), *Science for Our Sustainable Future* (OMNR 2005d), and the *Strategic Plan for Ontario's Fisheries II* (OMNR 1992a). These documents provide broad, high level policy direction for fisheries management in Ontario, and emphasize both an ecosystem and adaptive management approach to resource stewardship. Ensuring the ecological sustainability of fish populations and aquatic communities is fundamental to realizing social benefit from these resources.

Twenty Fisheries Management Zones (FMZs) provide the geographic basis for implementation of the *Framework* in Ontario. FMZs are defined by similar ecological, physical, social and economic attributes and are intended to delineate areas that are expected to react similarly to external changes, pressures and management actions. An adaptive management planning cycle is employed for each Zone; through setting ecological and socio-economic objectives, applying appropriate management actions, allocations, and performing regular monitoring that focuses on fisheries quality and objective achievement across the entire Zone rather than on individual lakes. This methodology allows fisheries managers to adapt to a changing environment or circumstances, such as climate change or increasing fishing effort, learn from past management actions, and apply the most current science and knowledge to make continual improvements through time at a scale that is most practical and feasible.

This document presents specific physical, biological, and socio-economic background data and information related to the fisheries and fisheries management in Fisheries Management Zone 5 (Figure 1-1). As part of the first step towards the development of a Fisheries Management Plan specific to this Zone, it is also intended to provide the current context around the status of the fisheries resource, predicted trends, other factors influencing fisheries management, and the prioritization of potential management issues and challenges.

Starting in early 2011, a Fisheries Advisory Council comprised of members of the public, First Nation and various stakeholders led by OMNR will use this background information to help frame discussions on developing realistic expectations of the fisheries resource, biological thresholds and objective setting as a FMZ 5 Fisheries Management Plan is written. As more current fisheries data from the Broadscale Monitoring (BsM) performed in the summer of 2010 becomes available, this information will be incorporated into their decision making.

This plan will apply to all waterbodies across FMZ 5, with the exception of six Specially Designated Waterbodies (SDWs) and their associated waterbodies (Appendix 1-1) that will have their own plans and monitoring strategies developed separately from this exercise.

The area of FMZ 5 also encompasses Quetico Provincial Park, a large Wilderness Class park that currently has a Fisheries Stewardship Plan in place that is up for review in 2010 (OMNR 2006a). Quetico Park staff will participate in the planning process at the project team and steering group levels and will use information gained from Broadscale Monitoring, the FMZ5 background report and the draft objectives and management actions developed for the zone to inform and update the Quetico Park Fisheries Management Plan such that it is complimentary and meets park management plan objectives.

It is seemingly inevitable that government reports get filled with technical jargon and acronyms. While attempts have been made to limit their use in this document, a glossary that explains technical terms and acronym meanings has been provided in Appendix 1-1 for those that have remained.

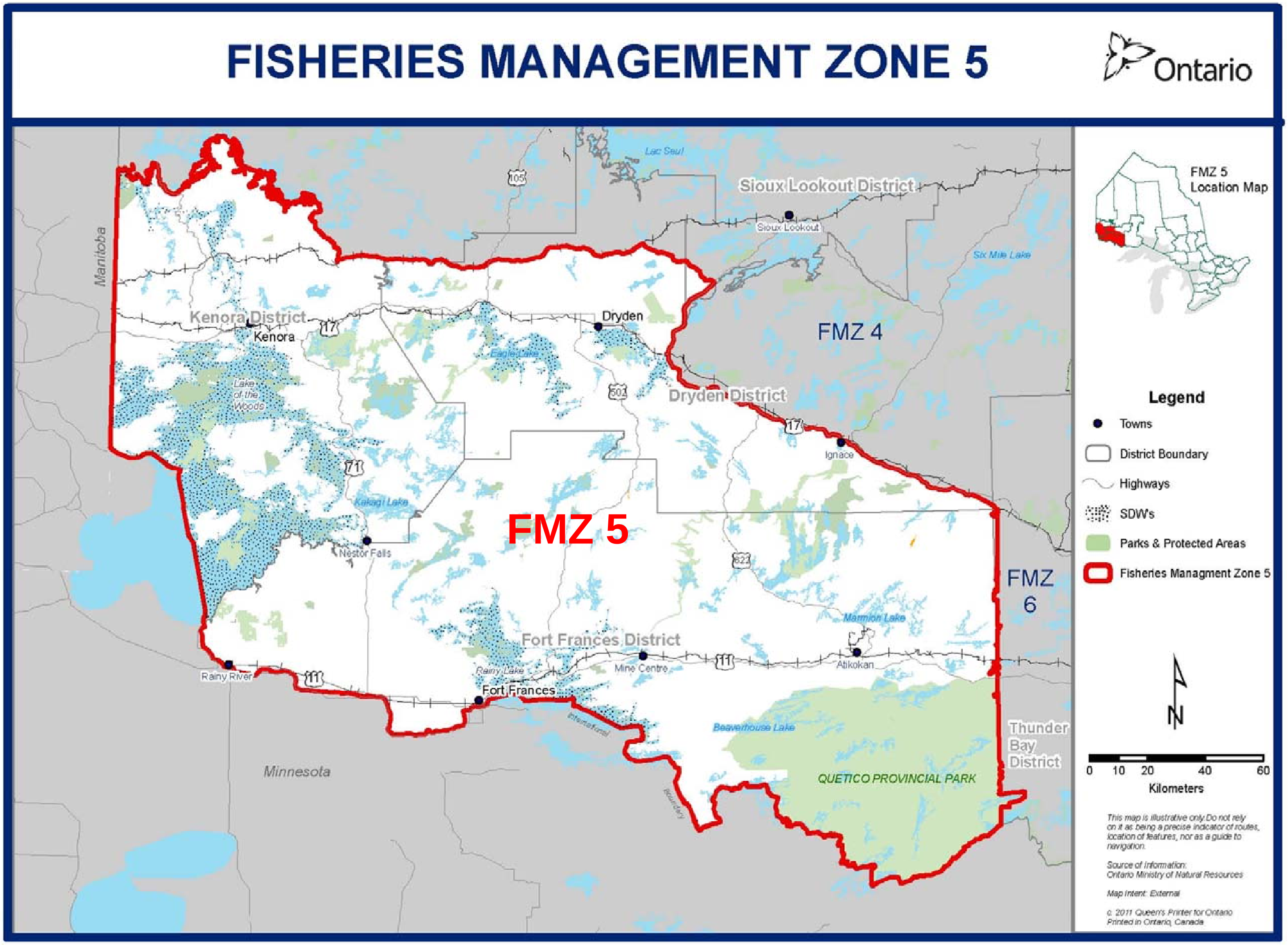


Figure 1-1. Fisheries Management Zone (FMZ) 5 boundaries with Specially Designated Waterbodies (SDW's) identified.

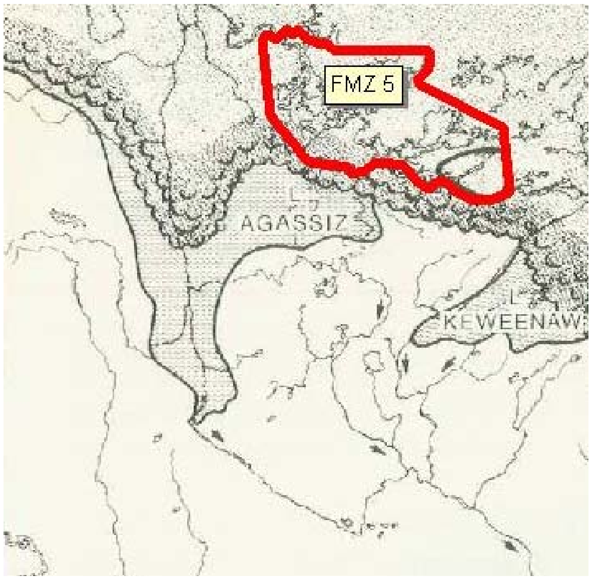
2.0 Physical Description

2.1 Surficial Geology and Soils

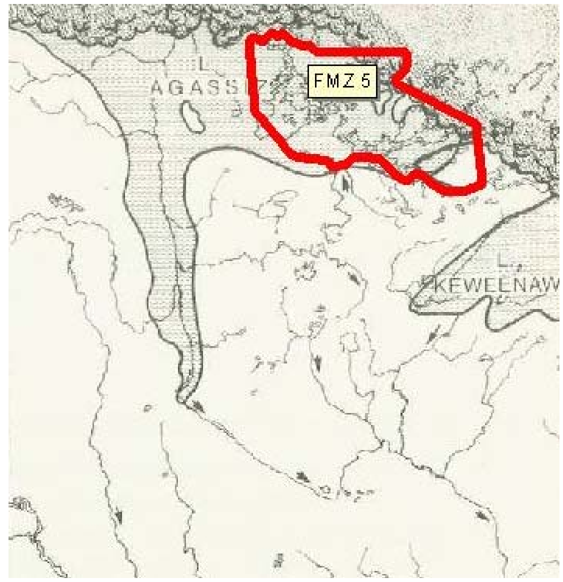
Like much of the rest of Canada, the current pattern of landform features and interspersion of lakes and rivers across FMZ 5 was defined by the actions of glaciers. Approximately 13,000 years ago, all of FMZ 5 was buried by thick glacial ice of the Laurentide Ice Sheet (see Sims and Baldwin, 1991 for a more complete glacial history of northwestern Ontario) (Figure 2.1-1a). The glaciers had the effect of reshaping and modifying the ground surface; stripping most of the soils and depositing them further south, gouging the bedrock into what would become lakes and rivers in the future and leaving deposits of sand and gravel that would become landscapes features such as moraines and eskers.

As the glaciers began retreating from this area around 12,000 years ago, the water from the melting ice resulted in the formation of huge glacial lakes. The largest one, which at one point covered almost all of FMZ 5, is referred to as Lake Agassiz (Figure 2.1-1b). At this time, all water from Lake Agassiz and Lake Keweenaw (predecessor of Lake Superior) drained south through what would become known as the Mississippi River basin. These southern connections allowed fish that had survived the glaciation of Canada in refuge areas to the south to gain access and populate the waterbodies. As the glaciers retreated further north, land levels which had been depressed from the weight of the glaciers, rebounded and this, along with the continued retreat of glaciers to the north, resulted in changes to the drainage patterns of the FMZ 5 area. By 9,500 years ago, Lake Agassiz drained to the north, the predecessor of Lake Superior (now referred to as Lake Minong-Houghton) drained to the east and the connection to the Mississippi system to the south had been lost. Lake Agassiz began to shrink and leave only puddles of water in the deeper pockets of bedrock; these puddles would become the lakes we see today. It is thought that by 5,000-6,000 years ago, the lakes and drainage patterns look much as they do today (Figure 2.1-1d).

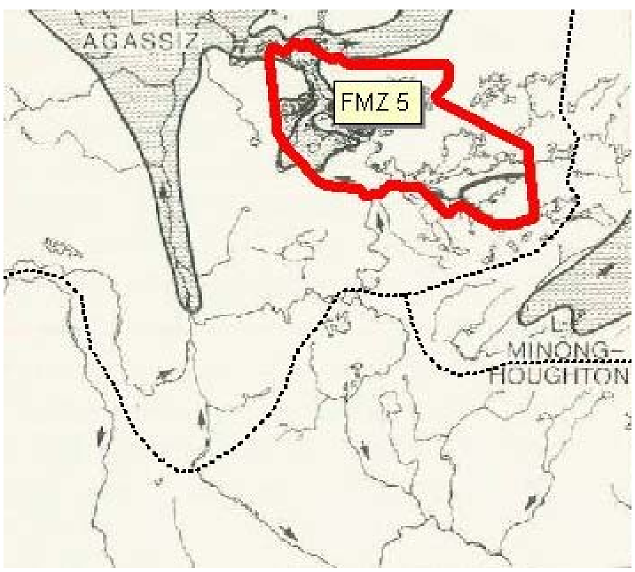
The fish communities that we see today are very much influenced by glaciation history. During the restructuring of the landscape, the creation of complex temporary drainage systems acted as refuge areas and dispersal routes for fish and other aquatic species in northwestern Ontario (Gunn and Pitblado 2004). Coldwater fish species like lake trout (*Salvelinus namaycush*) appear to have persisted in the colder, less productive lakes and rivers that formed along the edge of the receding glaciers. Coolwater species likely recolonized the area from the Mississippi drainage to the south, as well as from areas to the west and northwest (Wilson and Mandrak 2004). Species requiring warmer water to survive would have only been able to move north as the retreating glaciers allowed lake conditions to warm and become more favourable. With the loss of the southern drainage connections 9,500 years ago, all ability for newer species to colonize from the south was lost. By 7,000 years ago all of Ontario was ice free, and as the land slowly sprung back from the removal of the weight of the glaciers over the next few thousand years, the present day boundaries and connectivity of our lakes and rivers was established. The result is that the lakes in FMZ 5 have a higher diversity than areas further to the north but lower than areas to the south.



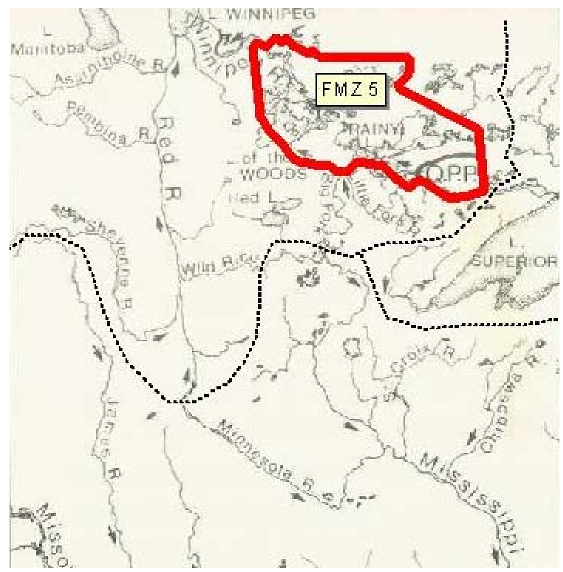
a) ~13,000 yrs before present



b) ~12,500 years before present



c) 9,500 years before present



d) Present

Figure 2.1-1. Glaciation and drainage history of Fisheries Management Zone 5 area over the past 13,000 yrs (adapted from Crossman, 1976)

Glaciation also affected the surface geology of the landscape in FMZ 5 that we see today. The topographic "grain" of the landscape was formed by the scraping action during the advance of the ice sheet and was then modified by mineral deposits carried by meltwaters along the front edges as they retreated. Major linear morainal features resulting from final minor advances of the glaciers tend to run southeast-northwest and include the Eagle-Finlayson Moraine which runs from Pickerel Lake in Quetico Park to Eagle Lake near Dryden and provides the base for much of highway 622.

The top layer of soil and rock that we can observe is known as the surficial geology[1]. In Fisheries Management Zone 5, it is dominated by bedrock landforms which make up over 70% of the land area (Figure 2.1-2; Table 2.1-1). This high proportion of bedrock dominated landscape tends to result in lakes that are clear and relatively unproductive compared to other parts of northwestern Ontario (Cano and Parker, 2007; discussed further in section 3.4). Mixed in the bedrock dominated areas are areas composed of sand, gravel and boulders resulting from the former large glacial rivers known as glaciofluvial and morainal deposits. Together, these areas make up about 7% of the land area.

Table 2.1-1. Composition of surficial geology landforms for FMZ 5.
(based on Northern Ontario Engineering Geology Terrain Study (NOEGTS) data)

Landform	Area	% of land area
Bedrock	2,497,671	73%
Glaciolacustrine	408,786	12%
Glacialfluvial	77,748	2%
Morainial	180,055	5%
Organics	280,971	8%
Total	*3,445,231*	

Glaciolacustrine landforms are deposits of finer textured silts and clays that accumulated during periods of slower ice recession and the formation of lakes and slower moving rivers at the edge of the glaciers. These landforms are concentrated in the southwest portions of FMZ5 between the communities of Fort Frances and Rainy River and in the north part of the zone in the area around Dryden and make up about 12% of the area. These areas tend to be very productive as characterized by the amount of agricultural activity occurring on them. They can also be significant to fisheries productivity and fish habitat as lakes within and downstream of these areas tend to have high levels of TDS (Total Dissolved Solids), an important component of the nutrient levels, and therefore productivity, within aquatic ecosystems (Ryder 1965). However, the majority of the lakes in FMZ5 are located outside and upstream of these landforms deposits and are not able to benefit from the increased productivity. Most of the remaining area is made up of organic soils or peatlands. While some peatlands are scattered throughout the zone, the highest concentration is found in southwest area of the zone associated with the glaciolacustrine deposits found there. The influence of soils and surficial geology on fish productivity is discussed further in section 3.4.

[1] Landform features were summarized into 5 classifications using Northern Ontario Engineering Geology Terrain Study (NOEGTS) data.

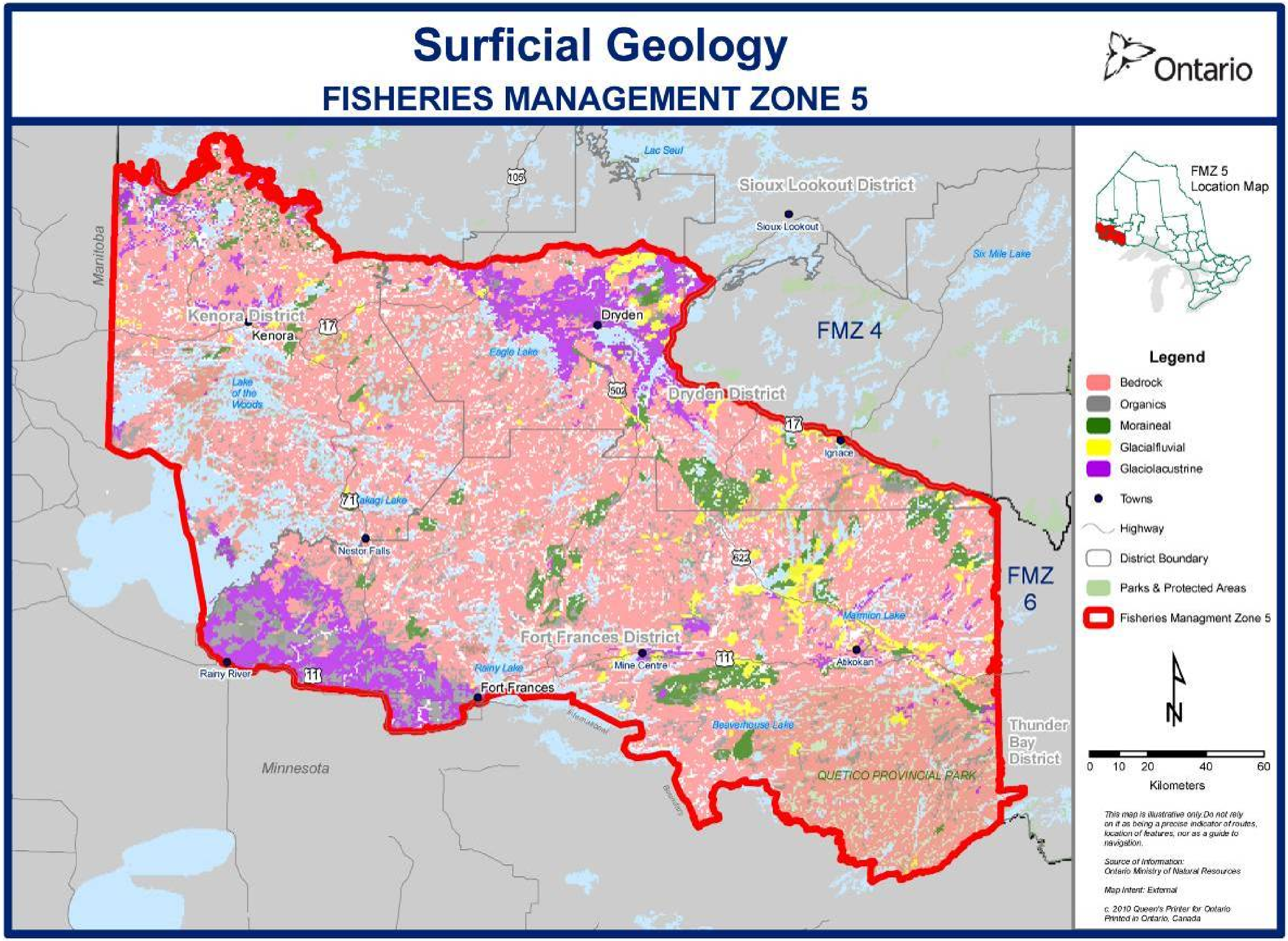


Figure 2.1-2. Surficial geology of Fisheries Management Zone 5 (based on Northern Ontario Engineering Geology Terrain Study (NOEGTS) data)

The various landforms, soils and climate in FMZ 5 have produced a forest cover that is a transition zone between the Great Lakes/St. Lawrence Forest with red pine, white pine and deciduous/mixed forests in the southern portion, to the primarily conifer dominated Boreal Forest, with jack pine and black spruce the most common species in the northern portion of the zone. Conifer forest types generally have a higher susceptibility to forest fire disturbance events (Steedman et al. 2004), and fires have always had a significant role in boreal ecology and productivity, including aquatic habitats in FMZ 5. The influence of natural disturbance events on fish and fish habitat is discussed further in section 4.1.

2.2 Water

FMZ 5 typifies the abundance and wide range of aquatic habitat types found in northwestern Ontario. Over 5000 lakes larger than 10 ha (1,007,450 ha) and thousands of kilometres of rivers and streams cover more than 23% of the total area in permanent water, with an additional 7% in associated wetlands (Figure 2.2-1). Of that water, the six Specially Designated Waterbodies (SDWs) and associated waterbodies account for over 35% of the total water area of the Zone (Table 2.2-1). Appendix 2-1 indicates the individual lakes and areas associated with SDW water bodies. Besides the SDW waterbodies, there are 8 lakes in FMZ 5 that are greater than 5,000 hectares (ha) in surface area, with only Kakagi Lake (11,080 ha) being larger than 10,000 ha in Ontario. As the SDW lakes will be managed under their own fisheries management plans, the FMZ 5 plan is to provide fisheries management direction for approximately 5,000 lakes accounting for over 630,000 ha of water area.

Table 2.2-1. Specially Designated Waterbodies (SDWs) within FMZ 5.

Specially Designated Waterbody	Surface Area (ha) (Ontario waters only)	OMNR District
Lake of the Woods/Rainy River	209,095	Kenora/Fort Frances
Rainy Lake	72,120	Fort Frances
Eagle Lake	31,825	Dryden
Winnipeg River system	25,190	Kenora
Shoal Lake	24,800	Kenora
Wabigoon/Dinorwic Lake	18,245	Dryden

A number of lakes in FMZ 5 lie along the United States border to the south and, to a lesser degree, the Manitoba border to the west. While some of these border lakes such as Rainy Lake Lake of the Woods and Shoal Lake are managed as SDW's, others including Namakan, Sandpoint, Lac La Croix, the Quetico Park border lakes (shared with Minnesota) and High Lake (shared with Manitoba) are part of the FMZ 5 fisheries management plan. As fish stocks in these waterbodies are a shared resource, fisheries management decisions involving these lakes needs to involve the partner agency such as the Minnesota DNR or Manitoba Conservation to strive for compatibility of fisheries objectives and, where possible, harmonization of regulations *(see section 8.1 for further discussion).*

All of FMZ 5 falls within the Nelson River primary watershed, flowing through the Winnipeg River, Lake Winnipeg, then via the Nelson River to Hudson Bay. FMZ 5 sits as part of the headwaters of this large watershed which usually indicates area dominated by lakes and lower volume rivers with lower productivity than areas downstream in the watershed. Water from approximately 85% of the landbase flows westward via the Rainy River through Lake of the Woods or directly into the Winnipeg River. The remaining 15% of the zone flows through the English River before entering the Winnipeg River. Twelve whole or partial tertiary watersheds cover FMZ 5, the largest of these being the Central Rainy River watershed which accounts for just over 33% of FMZ 5 (Figure 2.2-1).

Watersheds have been described as the link between upland environmental processes and the water bodies they surround. The condition of soils and the amount and type of disturbance in a watershed strongly influences runoff, water quality and aquatic biota, with various impacts on fisheries and fish habitat (Steedman *et al.* 2004, Carignan and Steedman 2000). The *Ecological Framework for Recreational Fisheries Management in Ontario* (OMNR 2005a) incorporates these broad-level watershed characteristics to guide management and monitoring objectives within each fisheries management zone.

Almost 900 lakes in FMZ 5 have been surveyed by OMNR as part of a provincial lake survey program, or Aquatic Habitat Inventory (AHI), which began in the 1960's and essentially concluded in the late 1980's and early 1990's. A typical lake survey would include: measuring the physical features of the lake, such as depth mapping, shoreline features, and water clarity (secchi[2]); measuring chemical and physical features, such as temperature and dissolved oxygen profiles, total dissolved solids (TDS), and conductivity; as well as small and large fish sampling and identification (OMNR 1981).

Each FMZ in the province was delineated in part by watershed boundaries and climate conditions (OMNR 2005a). As a result, waterbodies in each FMZ contain unique physical characteristics that in turn support diverse aquatic communities. Compared to other zones in northwest Ontario, lakes in Fisheries Management Zone 5 can be characterized as being deeper, clearer and naturally well below the average productivity as measured by the morpheodaphic index (MEI), an indicator of productivity based on average depth and total dissolved solids in the water (Ryder 1965). Table 2.2-2 provides a summary of some of the physical characteristics of lakes within FMZ 5 and provides a comparative view of the differences between FMZ 5 to other FMZ's in the Northwest Region (Cano and Parker 2007). Detailed physical information from lakes within zones, as represented in Table 2, along with fish species presence and other environmental measures, form some of the basic data required to estimate fish yields and trends in fisheries productivity. Some zones have greater productivity potential than others, as physical characteristics such as lake depth, TDS (total dissolved solids) and MEI are directly related to trends in fish yield. Information on how physical characteristics influence aquatic communities is described further in section 3.0.

[2] Water clarity values are based on the depth (m) at which a black and white *Secchi disk* disappears from view.

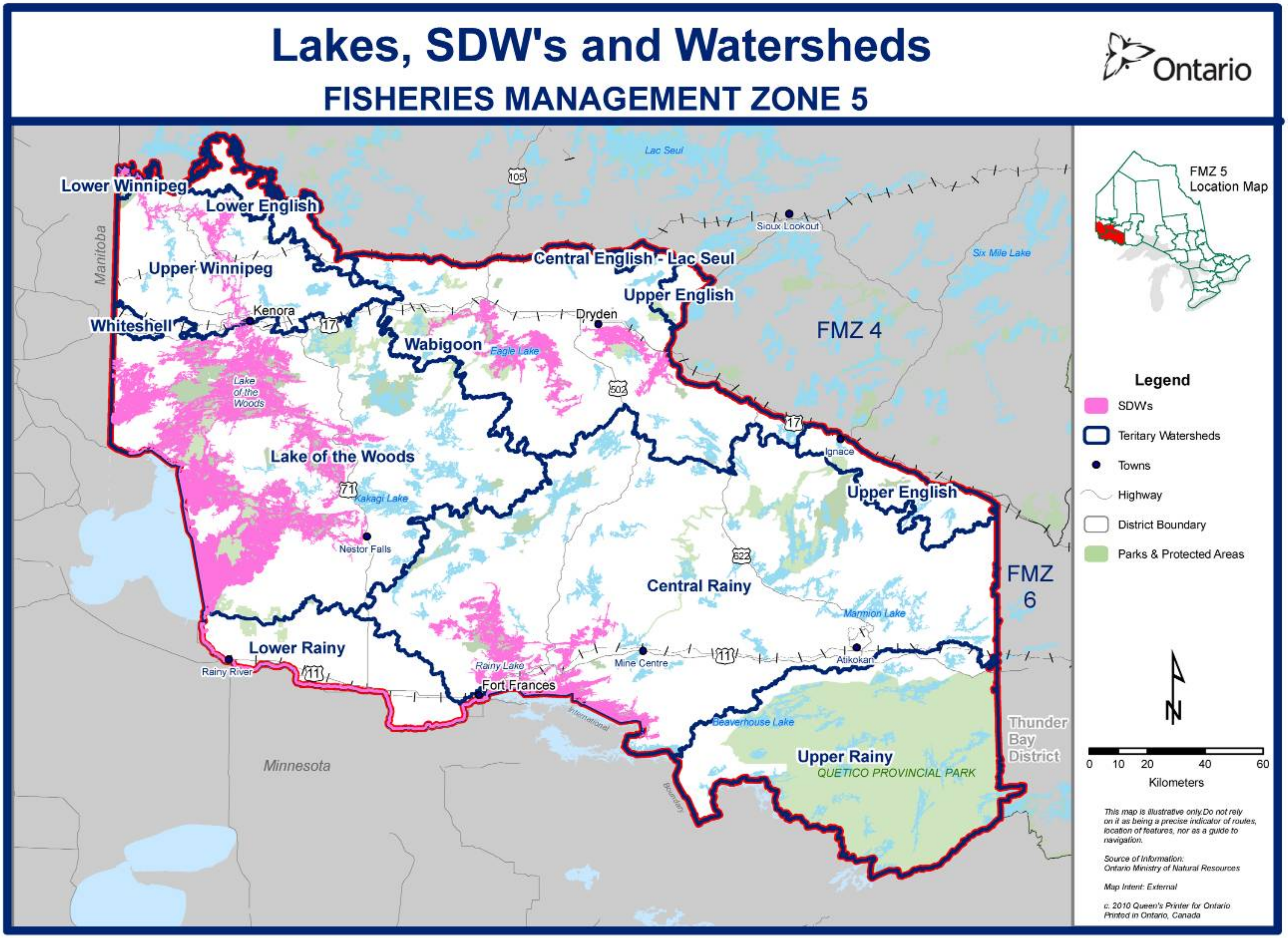


Figure 2.2-1 Fisheries Management Zone 5 Specially Designated Waters (SDW's) and tertiary watersheds.

Table 2.2-2 Lake characteristics summary for FMZ 5 and northwest region FMZ's.

FMZ	Number of lakes surveyed**	Average Surface Area (ha)**	Average Depth (m)**	Average Max Depth (m)**	Average Secchi (m)*	Average MEI*
5	***889***	***438***	***8.1***	***24.2***	***3.8***	***6.2***
2	422	1782	4.2	16.2	2.8	24.6
4	652	759	5.9	16.9	2.9	10.1
6	412	375	6.2	18.7	3.1	13.2
7	786	301	5.6	19.5	3.7	23.7

* data from OMNR Natural Resources Values Information System (NRVIS)
** data from OMNR AHI surveyed lakes

FMZ 5 contains thousands of kilometres of rivers and streams that make up an important part of the total water of Zone 5. These waterbodies are significant features as they serve as spawning and nursery habitat for many native fish species as well as support native river dependent species such as lake sturgeon (*Acipenser fluvescens*). The major rivers and streams that connect the interior of FMZ 5 to Hudson Bay through Lake Winnipeg and the Winnipeg River and include the Namakan River, the Seine River, the Turtle River and the Manitou Rivers flowing through the Rainy River system, the Wabigoon River and the English River. Information on rivers and streams within FMZ 5 is very sparse with the exception of some of the SDW rivers such as Winnipeg River and Rainy River which have monitoring programs. Some larger river systems such as the Namakan River and the Seine River have had aquatic community monitoring occurring in them where activities tend to be concentrated within the lake portions or below dams. At present, the only small stream monitoring occurring in FMZ 5 is in some streams west of Fort Frances (LaVallee River, Sturgeon Cr. etc).

Major river systems that have either significant development (such as current or proposed water power facilities) or significant aquatic ecosysytem components (such as the presence of species at risk) will have fish community and management objectives defined for them in a separate document. These documents will be guided by the FMZ 5 Fisheries Management Plan when they are prepared.

2.3 Climate

2.3.1 Climate Pattern

Information on climate is collected from Environment Canada weather stations across northwestern Ontario and includes both temperature and precipitation data.

Within the Northwest Region, FMZ 5 has the most moderate climate, indicated by the highest average number of growing degree days (GDD) greater than 5^{o}C at 1,662 compared to between 1,372 to 1,594 for the other zones for the period 1990 - 2003 (Cano and Parker 2007). Growing degree days (GDD) are commonly used to determine the amount of heat accumulated annually during spring, summer and fall. It is calculated as the sum over the entire growing season of the number of degrees by which the daily average temperature exceeds 5˚C (Browne 2007). Lake productivity is directly related to the number of growing degree days with longer growing seasons resulting in the ability of a lake to produce more kilograms of fish per year. For example, growing degree days was found to be the most significant factor in explaining how fast walleye grow and, in turn, the sustainable harvest levels for walleye in Ontario (Lester et al. 2000).

Based on the average temperatures for the period 1971-2000, the annual temperatures within FMZ 5, show a pattern of warmest in the south west and cooling as you move north and east across the zone with Atikokan in the east having the coolest temperatures (Figure 2.3-1). Average summer temperatures show a slightly different pattern with Kenora and Fort Frances having similar temperatures in spite of Kenora being further north and temperatures cooling towards the east (Figure 2.3-2).

Cumulative growing degree days based on 1971-2000 normals (Environment Canada) for Fort Frances, Kenora, Dryden and Atikokan were 1821, 1759, 1635 and 1467 respectively, indicating a longer growing season in the south and western portion of the FMZ and a shorter growing season in the northern and eastern portions.

Average winter temperature across the zone (November – March) varies from southwest to northeast, with temperatures being warmer in the south and western portion of the zone (Fort Frances area) than the northern or eastern portions (towards Atikokan and Dryden). Winter temperatures across the majority of FMZ 5 permit ice cover from November to late April/early May, with ice-out occurring earlier in western portions of the zone.

Historically, the area encompassing FMZ 5 has been within the Height of Land climactic region, which typically receives an annual pattern of low winter and high summer precipitation. Data from precipitation normals between 1971-2000 in Kenora, Fort Frances, Dryden and Atikokan support this observation with higher summer precipitation levels and lower winter levels across the zone (Figure 2.3-5). In addition to seasonal fluctuations, average precipitation in FMZ 5 also varies from east to west within the zone, with the western portion of FMZ 5 receiving on average less precipitation than the eastern portions (Figure 2.3-6).

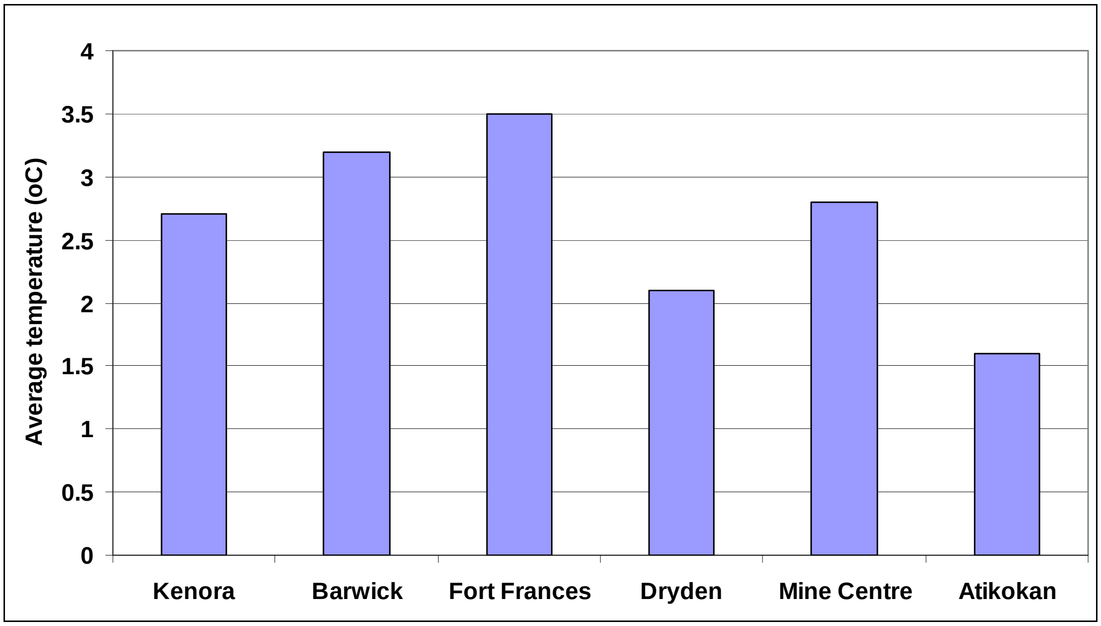


Figure 2.3-1. Average annual temperature (1971-2000) in FMZ 5.

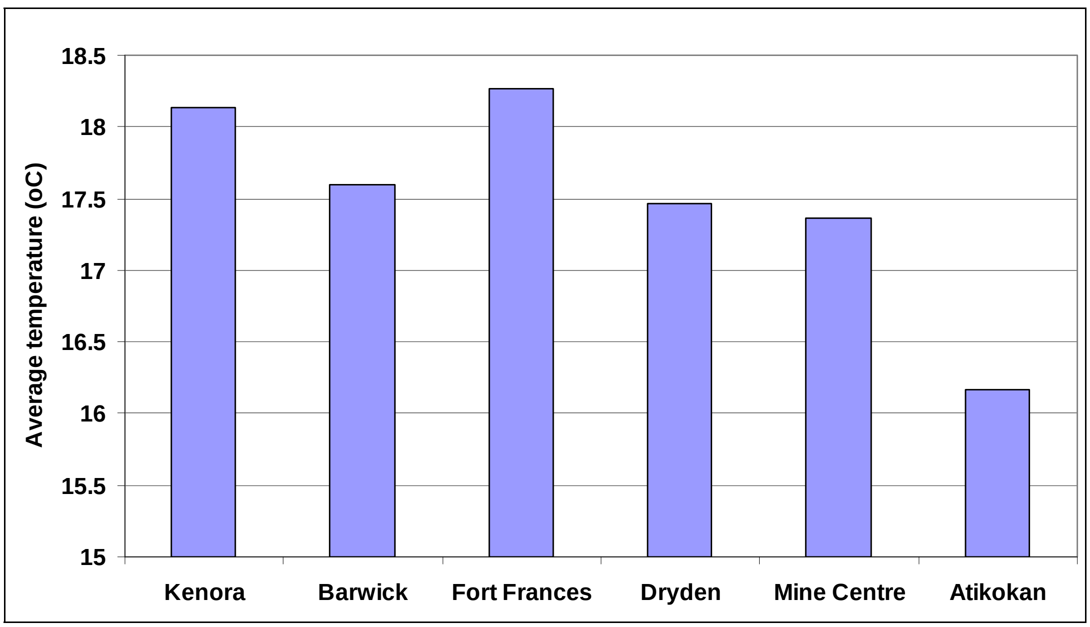


Figure 2.3-2. Average summer temperatures (1971-2000) in FMZ 5.

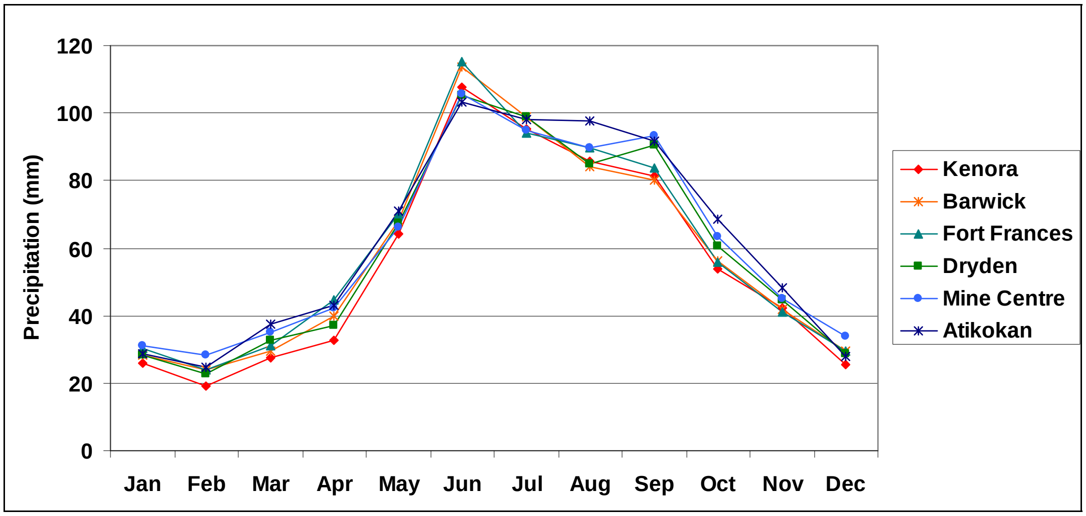


Figure 2.3-3. Average monthly precipitation in FMZ 5 (1971-2000)

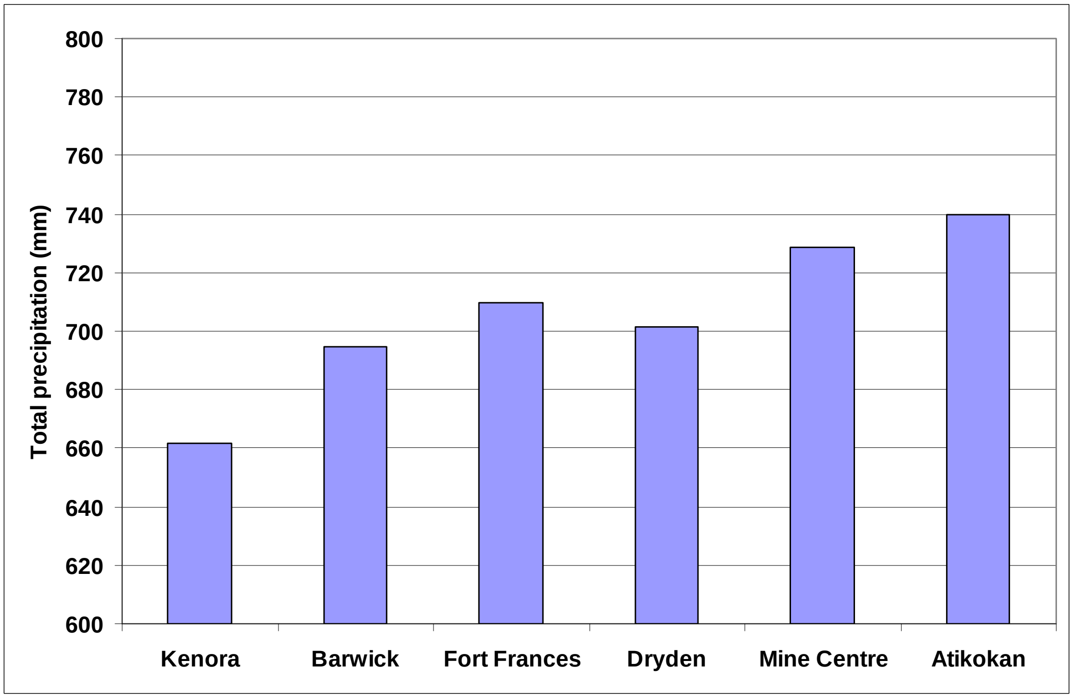


Figure 2.3-4. Average annual precipitation in FMZ 5 2000-2007

2.3.2 Climate Trends

Trends in climate in the Northwest Region have been changing towards a warmer condition. All zones have experienced a warming trend over the past 40 years with FMZ 5 experiencing the greatest increase. The number of GDD for FMZ 5 increased almost by 200 between the 1968 to 1988 period and the 1990 to 2003 period (Cano and Parker 2007). Data from Atikokan have shown increases in average annual temperatures of a full degree from 1.6 ^{o}C for the period 1971-2000 to 2.6^{o}C for the period 1980-2010 (Jackson 2007). Climate change models suggest that the Northwest Region will experience some of the largest impacts of climate change in Ontario (Racey 2004). These changes can have a major impact on the productivity, fish communities and distribution of those communities within FMZ 5 in future years. Over the past 3 decades (1980-2007) summer temperatures have been increasing in FMZ 5 (Figure 2.3-5).

Over the past 3 decades, winter temperatures have gradually increased with noticeably warmer winter temperatures experienced in 2000-2007 than in 1980-1989 (Figure 2.3-6). Information from Rainy Lake has shown that ice-out is happening an average of a week earlier now than 70 years ago (Figure 2.3-7). Similar observations have been made for Lake of the Woods with both later ice-on dates and earlier ice-off dates (T. Mosindy, pers comm.). Recent work in Minnesota has shown that walleye spawning is related to ice out and for each day that ice-out occurs earlier, walleye spawning is advanced by 0.5 to 1 day suggesting that walleye are now spawning about a week earlier now as well (Schneider et al. 2010).

Precipitation has shown a generally increasing trend over the past three decades, particularly in the eastern portion of the zone (Figure 2.3-9). Annual precipitation data from Atikokan has shown that although the average amount of precipitation has changed very little there, the difference between years may be increasing with both the highest and the lowest amounts of precipitation occurring in the last 15 years (Figure 2.3-8).

These changes are associated with a warming climate, which is particularly evident in northern regions across the globe (Racey 2004). These warming trends are consistent across northwestern Ontario and raises concerns about the impacts a warming environment associated with climate change will have on fisheries communities. A more detailed discussion on the implications of climate change to aquatic communities, fish productivity and habitat can be found in section 4.2.

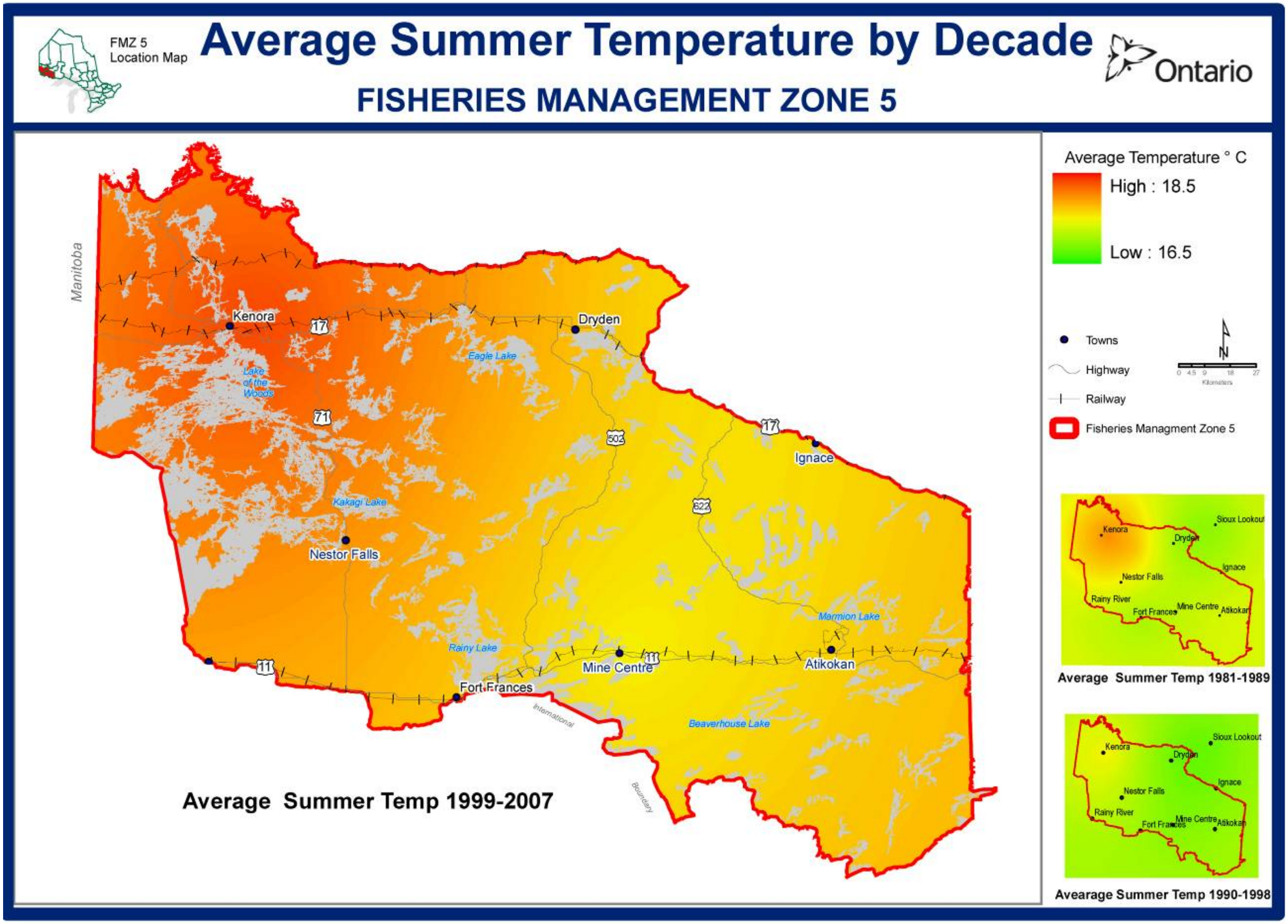


Figure 2.3-5. Average summer temperature by decade since 1980 in FMZ 5.

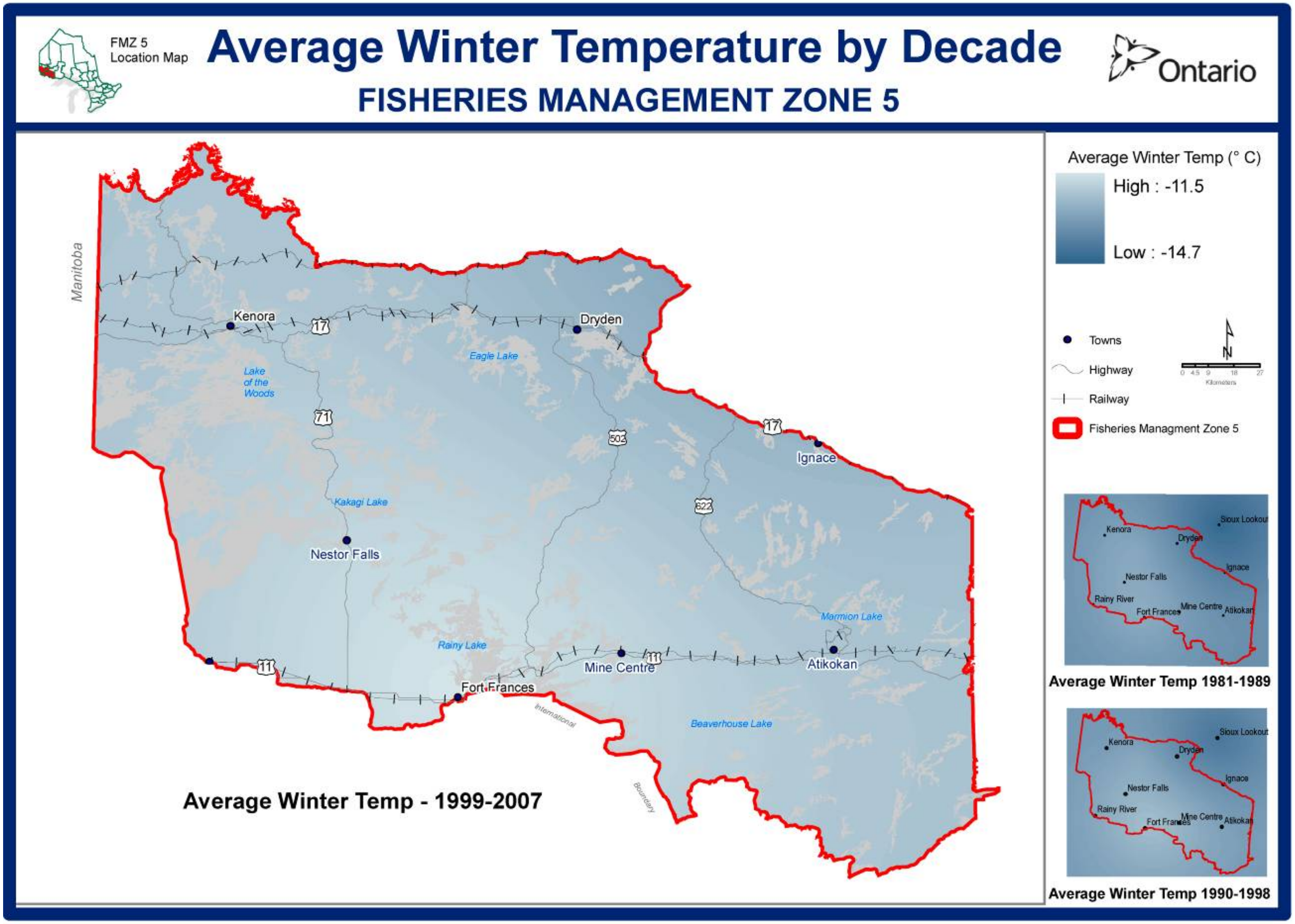


Figure 2.3-6. Average winter temperature by decade since 1980 in FMZ 5.

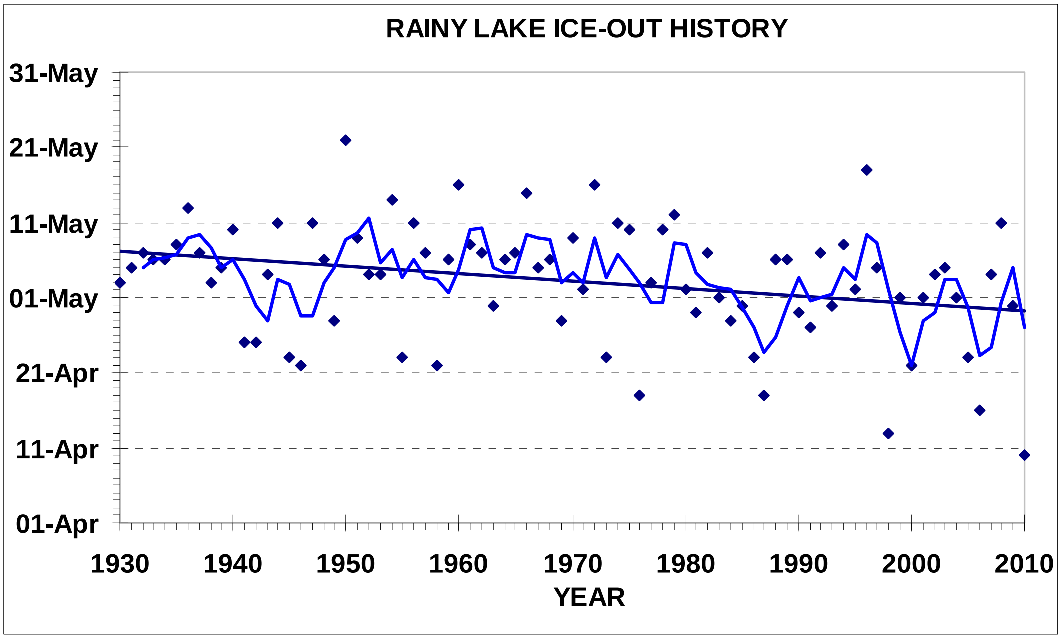


Figure 2.3-7. Ice-outs dates for Rainy Lake for the period 1930-2010.

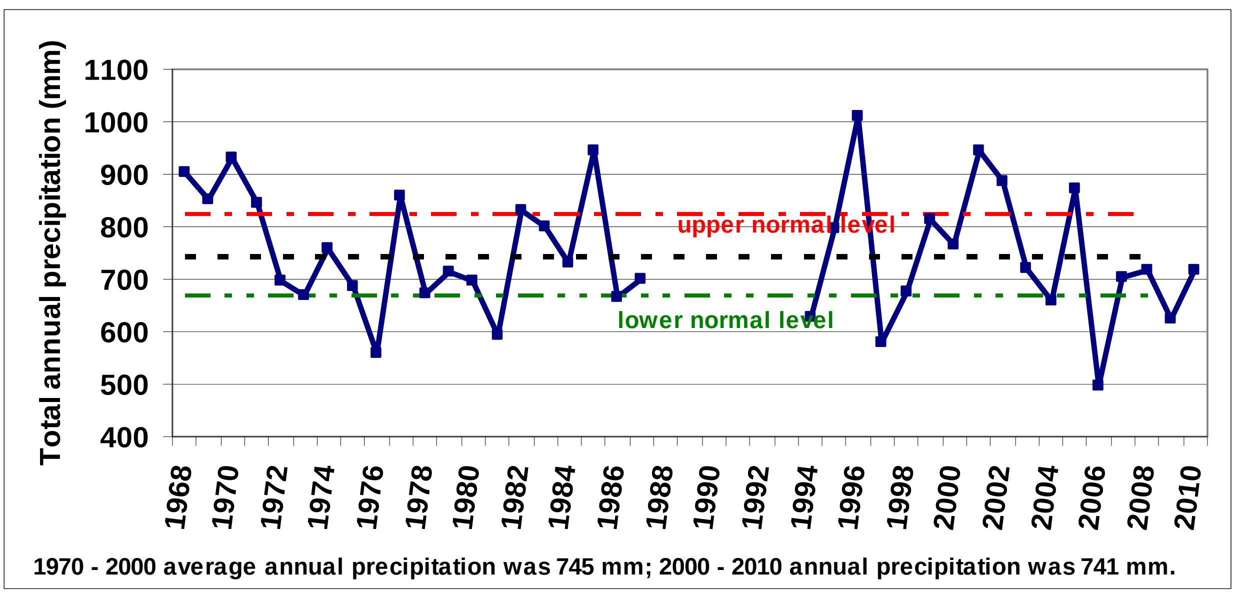


Figure 2.3-8. Total annual precipitation at Atikokan for the period 1968-2010 (Environment Canada data).

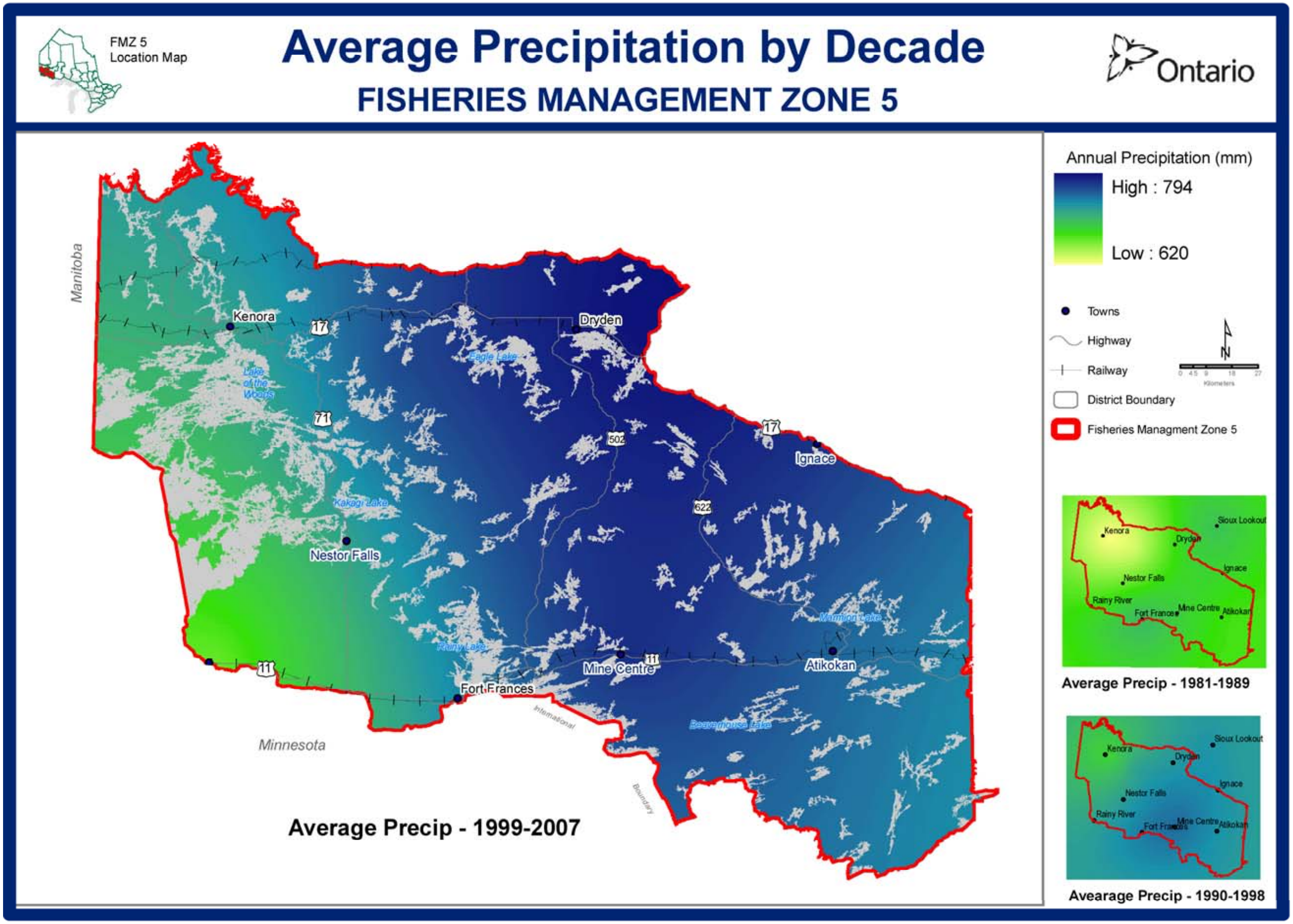


Figure 2.3-9. Average annual precipitation by decade since 1980 in FMZ 5.

2.4 Access

In general, road based access to the fisheries of Fisheries Management Zone 5 is well distributed throughout the zone with the exception of Quetico Provincial Park (Figure 2.4-1). Scattered within road accessed areas are areas primarily accessed by air. These areas are primarily utilized by a well developed fly-in tourism industry. Major highways that provide primary access including highways 11, 17, 502, 71, and 622 among others, account for 1,900 km of road within FMZ 5. Almost 13,000 km of gravel roads[3] extend from these main corridors, of which approximately 45% are classed as operational roads. In terms of road density across the zone, there is 0.48 km of road/km^2 of land (0.42 km/km^2 gravel roads and 0.06 km/km^2 of paved roads). Most of these roads were built for the purpose of providing access to forested areas scheduled for cutting by forest management companies, but may now also provide fisheries users with access to fishing opportunities.

To illustrate this gradient of road based access Figure 2.4-1 shows the FMZ 5 landbase classified into four zones of relative road density: none, low, medium, and high (see Appendix 2-2 for road classification methodology). The area classified as no roads is mostly made up of Quetico Park and land within Lake of the Woods (i.e. the Aulneau Peninsula). The majority of FMZ 5 (45% of the land area) is considered low density and is distributed throughout the rest of the zone. Moderate density area (17% of land area) is associated with farming area around Dryden and west of Fort Frances and an area of logging roads west of Ignace while high density roads area makes up 1% of the area and is associated with the larger communities.

Over 2,400 lakes (46% of lakes larger than 10 ha) in FMZ 5 are currently within 500m of a road, a distance that is considered accessible by anglers or other resource users (Hunt and Lester 2009) (Figure 2.4-2). With increased use of all terrain vehicles (ATVs) and snowmobiles, the zone of influence of road based users may now be much wider than in the past. Increased access across an FMZ does diffuse angler effort over a large area, allowing for increased fishing effort (Hunt and Lester 2009). Interestingly, while roads provide a way for users to benefit from the fisheries resource, increased access also results in higher exploitation and lower quality of fish in the long term (from an unexploited or low exploitation starting condition) (Hunt and Lester 2009). Smaller lakes or lakes with sensitive species such as lake trout are particularly susceptible to overexploitation as well as impacts from introductions of invasive or introduced species such as smallmouth bass or black crappie which may follow new access into an area (Kaufman *et al.* 2009a).

Access within an FMZ is a fine balance between providing angling opportunities and appropriately distributing fishing effort within the overall goal of preventing overexploitation and maintenance of sustainable fisheries resources. Lakes within FMZ 5 that are presently associated with medium and high density road zones may be currently most at risk to overexploitation. Comparison of current road density data within FMZ 5 to the results from the 2010 Broadscale Monitoring Program may provide additional data to examine present abundance of specific species (i.e. walleye, lake trout) to current user access within the zone.

---

[3] Due to various levels of roads data file completeness across the different OMNR Districts actual kilometres of drivable gravel roads in some areas may be overestimated or underestimated; however the broad trend of road densities across the Zone is accurate.

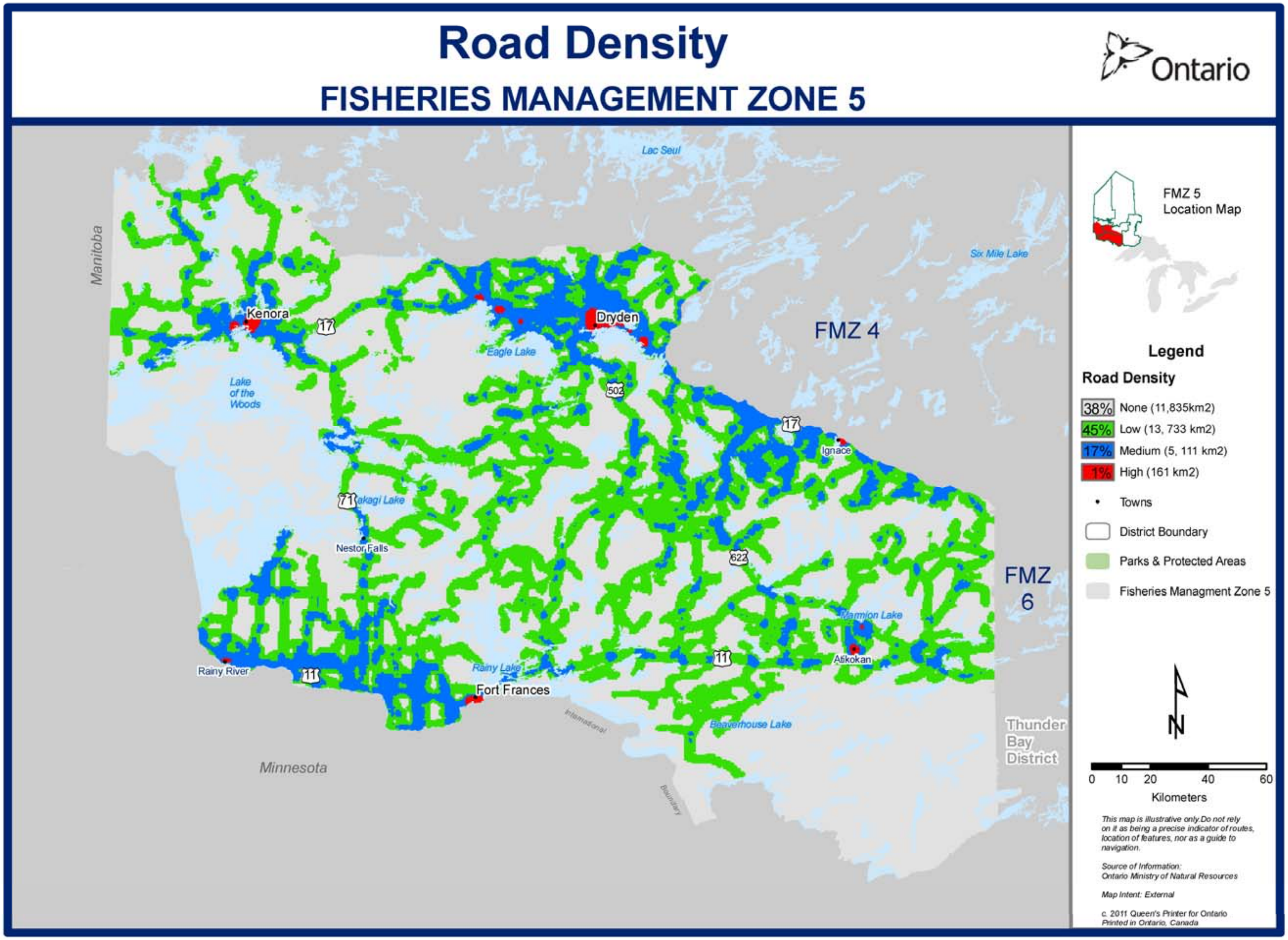


Figure 2.4-1. Fisheries Management Zone 5 road densities.

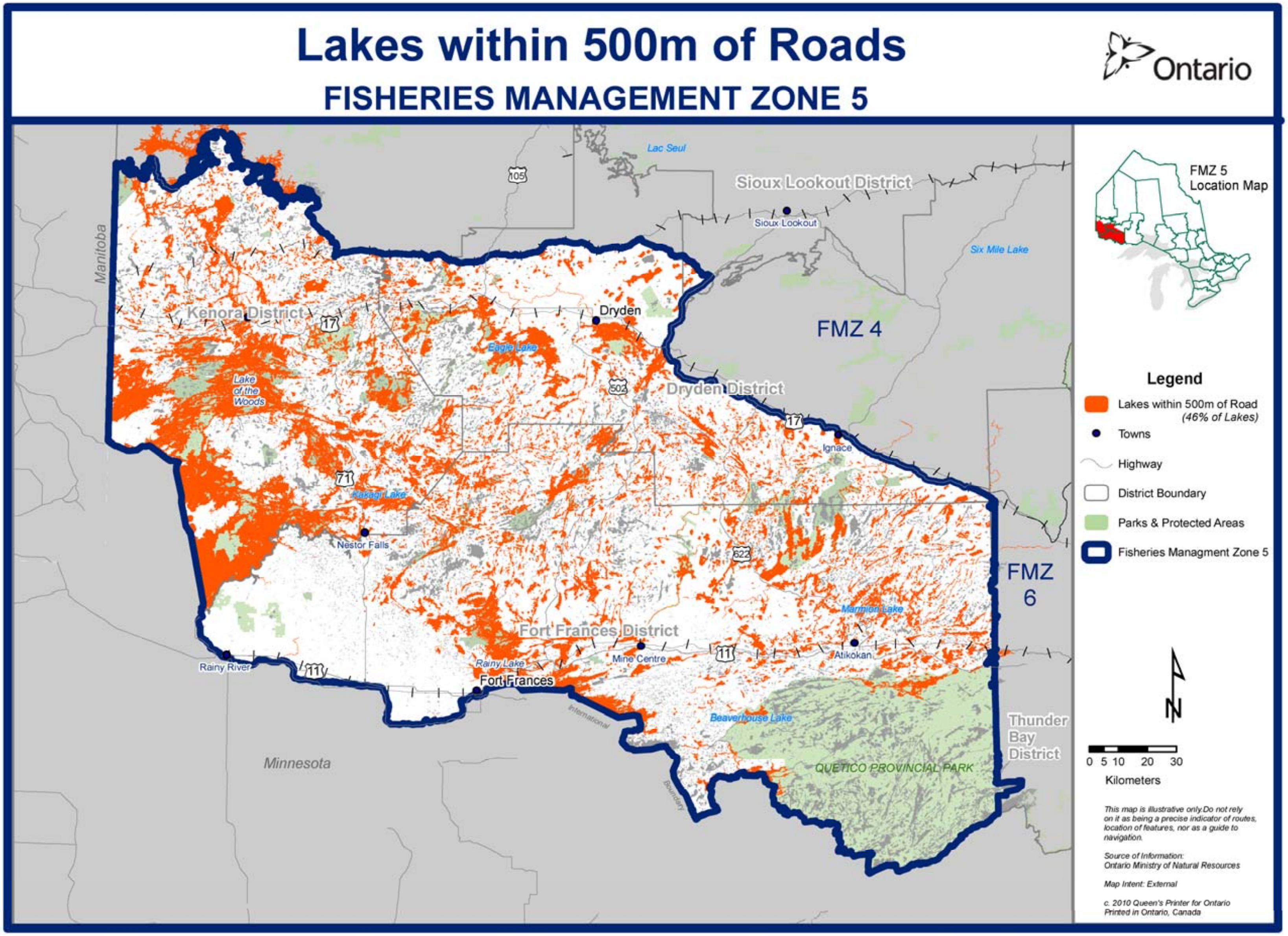


Figure 2.4-2. Lakes located within 500 m of a driveable road within FMZ 5

There are a few limitations to access for most users interested in reaching the majority of lakes and rivers across FMZ 5. These limitations include:

- Crown land road use restrictions on forest access roads to preserve remoteness and meet remote tourism objectives. Access restrictions may be through natural abandonment and re-vegetation, signage or gate as a condition of the FMP. Specific road use restrictions can be found in Forest Management Planning documents. Examples include the Trout Road in Fort Frances district and Mayburn and Cameron roads in Kenora district.
- Restrictions to access Ontario Parks and Protected Areas to a few specific entry/exit points to preserve remoteness or restricting the number of people accessing the park through entry quotas such as in Quetico Provincial Park.

Access, or lack of access, to fisheries resources continues to be a contentious issue between different user groups across the Northwest. In the past, OMNR has restricted access to certain individual lakes or areas usually in association with land use (e.g. parks and protected areas) or socio-economic objectives (e.g. remote tourism). Real or perceived concerns about sustainability of fisheries or declining fishing quality tend to be linked with these decisions, however user conflicts are frequently the ultimate root of the problem as restricting or permitting access may benefit one group while negatively affecting others (Hunt and Lester 2009). Creating or limiting access opportunities require considerable planning. On one hand, reducing or restricting access to fisheries to meet fisheries quality objectives may lead to more user conflicts and problems with enforcement. Alternatively, increasing access may distribute fishing pressure across a zone, but may also create issues surrounding sustainability and fishing quality if fisheries are exploited (Hunt and Lester 2009).

Maintaining or increasing road densities in areas of FMZ 5 with relatively lower fishing effort and numerous angling opportunities may be an effective way to spread out angling effort and maintain a high quality of fishing opportunities throughout the zone. This was one of the objectives outlined in the Fisheries Management Plans for the Fort Frances, Atikokan, Kenora, Dryden and Ignace Districts from 1987 – 2000, which provide some historical management direction regarding the development of access throughout FMZ 5 (Table 2.4-1). Management direction to preserve remoteness, remote tourism opportunities or to limit access in areas of greater fishing pressure (i.e. near major roads and communities) were identified within the plans as areas where access would be limited or maintained. Areas of access development were also identified to distribute fishing pressure and provide additional angling opportunities for resident and non-resident anglers associated with the development of roads through forest harvesting activities. New opportunities for access may be explored during this management planning process, however development would have to occur as part of a larger land use planning exercise that would need to consider other landbase users, policies and objectives, and would eventually form a linkage between Fisheries Management Zone planning and the Crown Land Use Policy Atlas (CLUPA).

Table 2.4-1 . Direction for the limitation/maintenance or development of access in Fisheries Management Plans (1987 – 2000) for Fort Frances, Kenora, Atikokan, Dryden and Ignace Districts.

Fisheries Management Plan	**Access Direction – Limit/Maintain***	**Access Direction – Development***
Kenora District Fisheries Management Plan 1987 – 2000 (OMNR 1988)	• Limit new access to lakes containing walleye or lake trout • Implement travel restrictions on Maybrun Rd.	• Manage for increased road access to lakes that don't contain walleye or lake trout.
Fort Frances District Fisheries Management Plan 1987 – 2000 (OMNR 1988)	• Control resource access road use to protect remote angling opportunities where it is consistent with other resource management plans and policies (Zones 2,3,4,5,6,A3)	
Atikokan District Fisheries Management Plan 1988 – 2000 (OMNR 1989)	• Zone 2/4 (Division 32) – protect remote angling opportunities for all resource users.	
Dryden District Fisheries Management Plan 1987 – 2000 (OMNR 1988)	• Zone 3, 19 and 21- reserve areas for remote angling opportunities. • Zone 3, 19 and 21 - manage for existing road based angling opprtunities	• Zone 18 - plan the location of resource access roads to access underutilized lakes.
Ignace District Fisheries Management Plan 1987 – 2000 (OMNR 1988)	• Manage for existing road accessible recreational opportunities. No new roads are proposed in the near future and are limited within the time frame of this plan. • Establish remote angling areas where road access will be prohibited or controlled:	• Division 21 Some road access may be permitted to some warm water lakes to encourage fishing for alternate species such as smallmouth bass or whitefish. • Division 22, 25 Increase road accessible recreational opportunities for residents and tourism based non-residents to spread out pressure.

2.5 Populations Centres

Situated in the southwest corner of northwestern Ontario, FMZ 5 has the highest density of people in the Northwest Region outside of Thunder Bay. The population of Rainy River District in 2006 was 21,565 all of which reside in FMZ 5. The population of Kenora District in 2006 that would reside within FMZ 5 was over 35,000.

Major communities (more than 2,000 residents) in FMZ 5 include Fort Frances, Kenora, Dryden and Atikokan (Table 2.5-1). There are also a number of smaller communities, particularly in the farming district west of Fort Frances.

There are 23 First Nations totally or partially within FMZ 5 (Table 2.5-2). These communities are all Ojibway and are signatory to Treaty 3. All communities are within Ontario except Buffalo Point which is located on the south west portion of Lake of the Woods within Manitoba. The estimated on reserve population in 2009 by Indian and Northern Affairs Canada (INAC) is 7114 individuals with an additional 7585 individuals who live off reserve lands. Communities range in size from 95 to over 800 individuals, however most communities are 100 to 300 on reserve residents.

Figure 2.5-1 shows the location of major towns and First Nation communities within FMZ 5.

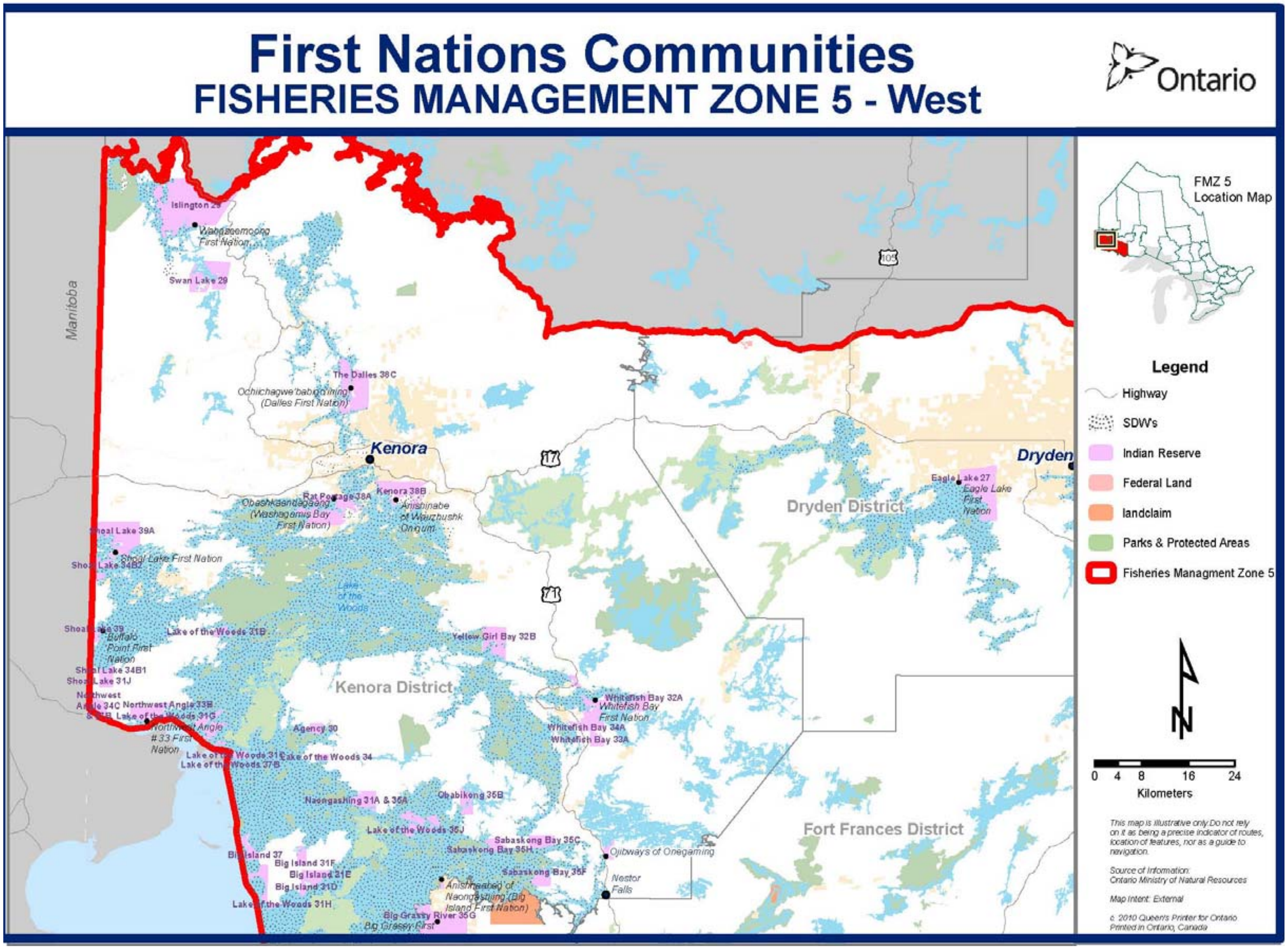
Table 2.5-1. Populations of major communities in FMZ 5.

Community	Population size	OMNR District
Kenora	15, 175	Kenora
Dryden	8,195	Dryden
Fort Frances	8,100	Fort Frances
Atikokan	3,295	Fort Frances
Ignace	1,430	Dryden
Emo	1,300	Fort Frances
Rainy River	910	Fort Frances
Sioux Narrows-Nestor Falls	670	Kenora
Rainy River unincorporated	1,430	Fort Frances
Kenora unincorporated	7,040 (only a portion with FMZ 5)	Kenora/Dryden

Table 2.5-2. Populations of major First Nation communities in FMZ 5 (source: INAC 2009).

Community Name	**On Reserve Population**	**Off Reserve Population**
Mishkosiimiiniiziibing (Big Grassy)	180	459
Couchiching First Nation	590	1373
Lac La Croix First Nation	271	125
Naicatchewenin	246	112
Rainy River First Nations	270	416
Seine River First Nation	304	372
Anishnaabeg of Naongahsiing First Nation (Big Island)	138	210
Mitaanjigaming (Stanjikoming)	95	38
Ojibways of Onegaming	425	283
Naotkamegwanning (Whitefish Bay)	669	459
Northwest Angle #33 First Nation	194	271
Northwest Angle #37 First Nation	167	170
Iskatewizaagegan Independent First Nation (Shoal Lake #39A)	289	282
Shoal Lake # 40 First Nation	262	288
Anishinabe of Wauzhushk Onigum (Rat Portage)	322	312
Eagle Lake First Nation	253	200
Wabigoon Lake Ojibway Nation	225	300
Ochiichagwe'babigo'ining First Nation (Dalles)	131	209
Obashkaandagaang First Nation (Washagamis Bay)	140	142
Wabaseemong Independent Nations	837	895
Asubpeeschoseewagong Netum Anishnabek First Nation (Grassy Narrows)	841	511
Buffalo Point First Nation (Manitoba)	125	NA
Total	7114	7585

a)


First Nations Communities
FISHERIES MANAGEMENT ZONE 5 - West
Ontario
FMZ 5 Location Map
Legend
Highway
SDW's
Indian Reserve
Federal Land
landclaim
Parks & Protected Areas
Fisheries Managment Zone 5
0 4 8 16 24
Kilometers
This map is illustrative only. Do not rely on it as being a precise indicator of routes, location of features, nor as a guide to navigation.
Source of Information: Ontario Ministry of Natural Resources
Map Intent: External
© 2010 Queen's Printer for Ontario Printed in Ontario, Canada
Kenora
Dryden
Kenora District
Dryden District
Fort Frances District
Manitoba
Islington 29
Swan Lake 29
The Dalles 38C
Kenora 38B
Eagle Lake 27
Yellow Girl Bay 32B
Whitefish Bay 32A
Whitefish Bay 34A
Whitefish Bay 33A
Agency 30
Lake of the Woods 34
Lake of the Woods 31B
Lake of the Woods 35J
Lake of the Woods 31H
Obabikong 35B
Sabaskong Bay 35C
Sabaskong Bay 35H
Sabaskong Bay 35F
Big Island 31F
Big Island 31E
Big Island 31D
Big Island 37
Big Grassy River 35G
Ojibways of Onegaming
Nestor Falls
Shoal Lake 39A
Shoal Lake First Nation
Shoal Lake 34B1
Shoal Lake 31J
Northwest Angle 33B
Naongashing 31A & 36A

b)

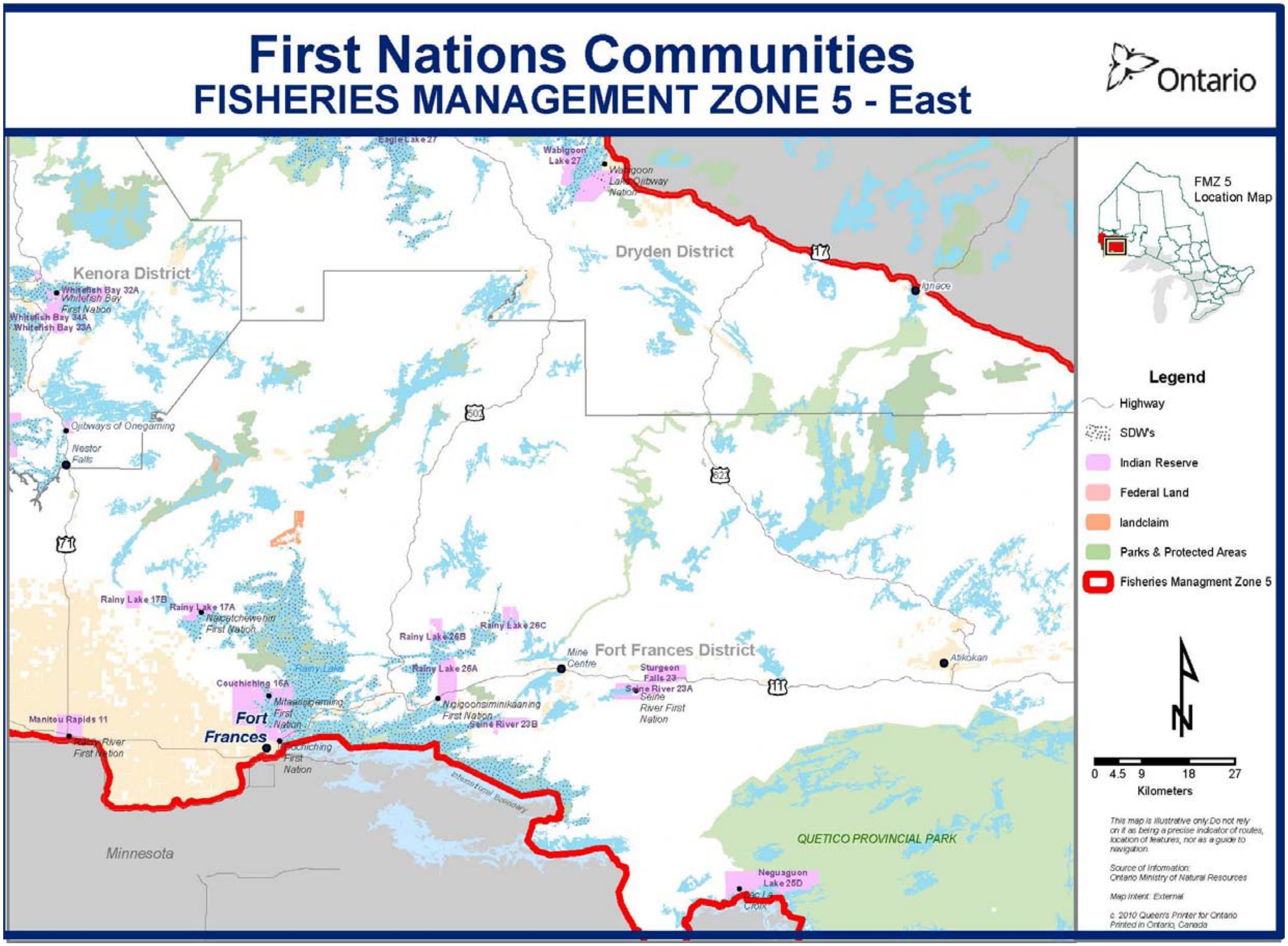


Figure 2.5-1 Location of major towns and First Nation communities within a) west and b) east portions of FMZ 5.

In addition to Ontario residents, FMZ 5 is adjacent to a large population of anglers from neighbouring jurisdictions, including the Upper Midwest states in the US. The states of Minnesota (5.3 million), and Wisconsin (5.7 million) account for most of the US overnight visitation to FMZ 5 according to a 2003 tourism study (Pannell Kerr Forster 2003) and have a combined population of over 11 million, just less than the entire population of Ontario of 13 million. The 2003 study also showed a significant amount of visitation from Manitoba (1.2 million) of which the largest city of Winnipeg (~750,000) is less than 2 hours from the Ontario border and FMZ 5.

The border crossings at Fort Frances and Rainy River are among the more popular with tourists visiting Canada with the Fort Frances border crossing recording the 10th highest number of U.S. vehicles entering Canada for multiple night stays in 2009. In 2009, over 66,000 U.S. automobiles crossed the border for a multi-night trip with an additional 13,000 vehicles entering at Rainy River. While not all of these visitors are coming to fish or are staying within FMZ 5, studies show that the most popular activity of multiple night visitors from the U.S. is angling (Pannell Kerr Forster 2003).

2.6 Land Use

Fisheries Management Zone 5 extends over a large and varied geographic range covering an area of approximately 44,360 km^2 including land and water. The southern boundary is defined by the international boundary between Ontario, Canada and Minnesota, U.S.A. Lake of the Woods and the Manitoba border make up the western boundary, while the north and eastern boundaries are defined by the English River system, TransCanada Highway 17 and the Canadian National Railway (CNR), and the Fort Frances- Thunder Bay District boundaries, respectively (Figure 2.6-1).

Located in the southern portion of the Northwest OMNR Region, FMZ 5 spans across 4 OMNR administrative districts, including the whole of the Fort Frances District, and portions of the Kenora and Dryden districts, and a very small piece of Sioux Lookout District.

Over 90% of the area within FMZ 5 is Crown Land, with approximately 18% of that area located in provincial Parks and Protected Areas (PAPAs) (OMNR 2010a). Large areas of private or patent land are found in the west end of the Fort Frances District, as well as smaller areas scattered throughout the zone, totalling 8% of the area in the zone (OMNR 2010a). FMZ 5 also falls entirely within the boundaries of lands covered by Treaty 3. First Nation Reserve lands make up 3% of FMZ 5 land in addition to a small portion of lands that have been used in the settling of certain land claims (<0.1% of FMZ 5) (OMNR 2010a). Fisheries resources for all waterbodies within the Zone are administered by each representative OMNR District, or by Ontario Parks.

The lands and waters of FMZ 5 have a varied history of use, including settlement, industry, agriculture, logging, mineral exploration and mining, as well as commercial and recreational fishing. Many of these land uses do or have the potential to impact aquatic ecosystems and fish through increased sedimentation in waterways, changes in water flow, habitat fragmentation, release of pollutants, and increased access for recreational fishing (Browne 2007). Impacts of these will be discussed further in Section 4.0.

Today, forest resource harvesting is the main resource extraction activity within the zone, and several Forest Management Units are located within the Zone. This includes the whole of the Crossroute and Sapawe Forests, as well as portions of the Dryden, English River, Kenora, Wabigoon, and Whiskey Jack Forests. A Forest Management Plan is in place for each of these units, which includes both strategic long-term planning as well as operational planning for timber harvesting and its associated activities, and includes varying levels of protection for the many natural resource features, land uses and values of the area, such as spawning sites and outpost camps. Peat harvesting also occurs within FMZ 5, where peat bogs are drained and stripped of peat for use in horticulture. Currently there is < $4km^2$ in use for peat harvesting in FMZ 5 by one peat producer, in the Fort Frances District.

Some of the private lands within FMZ 5 are patented mining claims, reminders of the area's mining history. Several mines operated within FMZ 5 historically, most notably the Steep Rock open pit iron ore mines in Atikokan, and the several gold mines around Atikokan, Mine Centre, Shoal Lake and Lake of the Woods that at one point accounted for 55% of the gold production in Ontario (Hinz 2002). Much smaller mines extracting metals such as copper, nickel, and gold also operated throughout the area in the 19th and early 20th centuries. Today, much of FMZ 5 is actively explored for mineral development, with many active mining claims staked. Current exploration and development activity is focused in the southern and western portions of FMZ 5, in the Marmion Lake, Mine Centre, Cameron Lake, Shoal Lake and Werner Lake areas, among others. A few mineral development projects in FMZ 5 are currently moving towards possible development of a mine, including a deposit in Richardson Township, the Hammond Reef deposit northeast of Atikokan and the Kenbridge deposit near Sioux Narrows. Most of these development projects and mines are adjacent to water bodies, rely on them as a water source, and store waste rock (tailings) nearby. Building stone and industrial minerals and aggregates have been produced in the area since the late 19th century (Hinz 2002). There are currently 3 granite quarries in production near Kenora and Vermilion Bay, and over 400 aggregate pits.

Hydroelectric development is a significant form of land use on waterways in FMZ 5. The abundant waterways and natural features in FMZ 5 make them attractive for development. Several of the waterways in FMZ 5 have single or multiple waterpower dams built on them. There are currently 10 operating hydroelectric facilities in FMZ 5 which are found on the Seine River, Eagle River, Wabigoon River, Manion Creek, Rainy River and Winnipeg River systems (the last two are Specially Designated Waters). In addition to the hydroelectric dams are a number of water control dams that manage water deliver to the power dams or were historically used to provide water to transport logs, many of which are now owned by OMNR. There are also currently proposed facilities on the Namakan, Seine, and Wabigoon rivers (OMNR 2010b). These hydroelectric developments can impact aquatic ecosystems by creating reservoirs, acting as barriers to fish movement, fragmenting habitat and altering the flow patterns of a system (Browne 2007). More information on the potential impact of hydroelectric development of fish populations can be found in section 4.5.

Agriculture is concentrated around the towns of Kenora and Dryden, and in a large portion of the west end of the Fort Frances District in FMZ 5. In 2006, there were 404 farms, or 16.3% of Northern Ontario farms (HCA 2009a, b). Farmland represents <3% of land in FMZ 5 (1003 km^2) (HCA 2009a, b). The primary farm types in declining order are: beef cattle production, producing hay/fodder crops, other animal production (e.g. sheep, horses, elk, rabbits, etc.), dairy production, and horticulture (e.g. greenhouses, nurseries) (HCA 2009a, b).

Information on land use intent and management direction in FMZ 5 is documented in the Crown Land Use Policy Atlas (2003). The Atlas outlines land use direction for public lands in the Province of Ontario and managed by the Ontario Ministry of Natural Resources. The primary sources for the content of the Atlas are the Ontario's Living Legacy (OLL) Land Use Strategy (1999) and the District Land Use Guidelines (1983). Crown land within the management unit boundary has been divided into land use areas, and received one of the following primary land use designations: provincial park, conservation reserve, forest reserve, wilderness area, general use area, and enhanced management area. Based on the land use intent for a designated land use area, a variety of different land uses may be permitted in a given area, for example bait harvesting, timber harvesting, boat caches, cottaging, and recreation. Most of the areas in FMZ 5 are designated General Use Areas, which permit most types of development and activities, some with specific constraints related to resource extraction or development. Based on fish and wildlife consumption, many of the General Use Areas within FMZ 5 have restrictions placed on tourism facility expansion on Crown land and road access to ensure the sustainability of the resources. Detailed land use direction for each area within FMZ 5 can be found online through the Crown Land Use Policy Atlas at http://crownlanduseatlas.mnr.gov.on.ca/

The Experimental Lakes Area is an area of 58 lakes located between Dryden and Kenora that have been closed to angling under an agreement with Department of Fisheries Oceans to provide an area for research (see section 6.6 for more information).

2.7 Parks and Protected Areas

Fisheries management is legislated under the Fisheries Act and the Ontario Fisheries Regulations (OFR's) and includes the management of fisheries in parks and protected areas. In addition, parks and conservation reserves are legislated under the Provincial Parks and Conservation Reserves Act (2006). The Act has specific direction and principles that guide all aspects of planning and management in parks and conservation reserves, one of which is that "*the maintenance of ecological integrity shall be the first priority…*" Although the maintenance of ecological integrity is important on all lakes managed by the OMNR, management of sport and commercial fisheries within an ecosystem context is usually identified as a primary objective in lakes outside of parks and protected areas whereas management of aquatic ecosystems as a whole is the primary objective in protected areas with providing for sport fishing opportunities a secondary objective. Parks have the ability to implement regulation changes to achieve ecological integrity objectives but currently the direction is that parks, with the exception of large wilderness parks such as Quetico Park, will be managed under the direction of the Fisheries Management Zone plans.

Most commercial activities are prohibited in provincial parks, including forest resource harvesting, aggregate extraction, and hydro development (OMNR 1992b). Commercial bait harvesting, wild rice harvesting, commercial tourism and trapping may be permitted, depending on the park classification (OMNR 1992b). Commercial fishing is generally not permitted within any Conservation Reserves or Parks within FMZ 5.

Parks and protected areas are located throughout FMZ 5, with 16 provincial parks and 22 conservation reserves, representing 16% of the total area (6,991 km^2). The majority of protected areas are less than 5,000 ha and do not have a significant fishery. Three parks within the zone have significant fisheries, including Quetico, Turtle River – White Otter and Eagle – Dogtooth provincial parks. Campus Lake Conservation Reserve abuts Turtle River – White Otter PP and also has a number of lakes wholly within the boundaries of the protected area.

The parks and protected areas located in FMZ 5 are identified in Figure 2.7-1.

Turtle River-White Otter (493 km^2) and Eagle-Dogtooth (410 km^2) provincial parks are both waterway class parks. A preliminary management plan has been prepared for Turtle River – White Otter and the management planning process has been initiated for Eagle-Dogtooth. Both parks are similar to the surrounding landscape in terms of angling pressure and access, and therefore there are no plans to develop separate fisheries plans. However, restrictions to unauthorized access points may be employed to maintain the ecological integrity of these protected areas.

Quetico, a wilderness class park, is the largest park in FMZ 5, with a total area of 4750km^2. Approximately 21% of the park is comprised of water, with 2,943 lakes in the park of which 678 lakes (of the 5,000 in FMZ 5) are larger than 10 ha.

Visitation is managed by a quota system, and access is restricted to a small number of entry points around the periphery of the park. No roads are located in the park, with the exception of the French Lake Campground. The majority of park visitors are from the United States and the primary reason for visiting Quetico is for angling walleye and bass and to a lesser extent northern pike and lake trout.

Mechanized travel is not permitted in the park. However, through an Agreement of Co-existence between the Lac La Croix First Nation and the Province of Ontario, use of motor boats is currently allowed on 21 designated lakes. These lakes are located within the western portion of the park, and are for use by the Lac La Croix Guides Association. Of these 21 lakes, only 10 lakes are active in a given year, of which one lake may be designated for air access. The limited access and the lack of motorized use in Quetico has resulted in a high quality fishery due to low fishing effort compared to lakes on the surrounding area.

Quetico's designation as a wilderness class park, combined with the principles of the Provincial Park and Conservation Reserve Act, means that Quetico has a very different set of objectives for managing the fishery in the park. As such, Quetico has a Fisheries Stewardship Plan (OMNR 2006a) and when this plan is updated, it will follow a similar process as the FMZ 5 fisheries management plan.

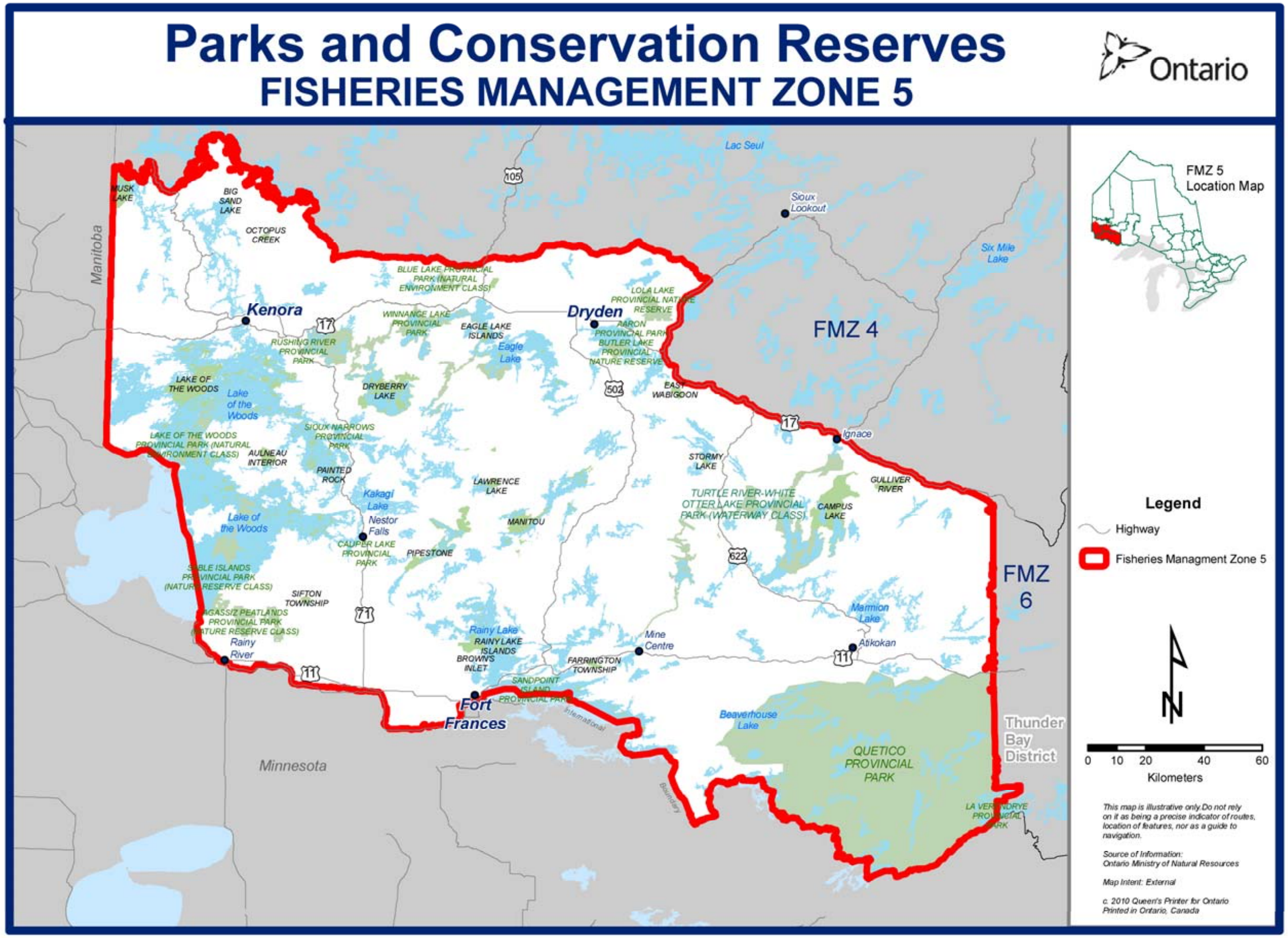


Figure 2.7-1. Location of Parks and Protected Areas in FMZ 5.

3.0 Biological Description

The biological description of the fisheries resource in FMZ 5 is a critical component of the background report. Understanding the biological status of the fisheries resources and the factors that affect that resource are crucial to producing a sustainable fisheries management plan. This section will describe the status of the fish resources including what currently exists and the population health as well any limitations or potentials that may exist based on the capabilities of the FMZ 5 landscape. The data used to prepare this section is based on the best available science and most current information available to fisheries managers. Because this plan is concerned with the management of fish population from non-SDW lakes, status and information is based mainly on those lakes although in cases where information is lacking, data from SDW lakes may be included as well.

3.1 Biodiversity

Biodiversity refers to the variety of life as expressed through genes, species and ecosystems , that is shaped by ecological and evolutionary process. The current aquatic biodiversity of FMZ 5 is a reflection of colonization following the retreat of the Laurentide glacial ice sheet approximately 12,000 years ago (see 2.1 for more detail). As the glacier retreated over a 6,000 year period the melt water flowed into different watersheds at different time periods. This phenomenon provided an opportunity for colonization from a wide variety of aquatic life and this diversity was sustained as glacial rebound created a high diversity of habitat, from remnant coldwater environments to shallower warmwater environments. Increases in biodiversity are also the result of human introductions of fish species, either accidentally or intentionally. Consequently, aquatic biodiversity of FMZ 5 is higher than other zones in northwest Ontario with 67 species identified from its waterbodies (Table 3.1-1). For comparison, FMZ 4 immediately to the north of FMZ 5 has had 46 species of fish and FMZ 6 to the east has had 49 species of fish identified in its waterbodies. Relatively high diversity does not necessarily equate to “better” ecosystems but rather more appropriately viewed as a measure of community complexity. The aquatic diversity of life is reflected in species composition for many organisms such as aquatic insects, aquatic plants, and fish as well as less recognized forms such as zooplankton, algae and bacteria. To simply illustrate this diversity consider the species composition of fish in FMZ 5 summarised in Table 3.1-1.

Table 3.1-1 Fish species found within FMZ 5.

Family	Common name	Scientific name
PETROMYZONTIDAE	Lamprey family	
	Silver lamprey	*Ichthyomyzon unicuspis*
	Chestnut lamprey *	*Ichthyomyzon castaneus*
ACIPENSERIDAE	Sturgeon family	
	Lake sturgeon*	*Acipenser fulvescens*
AMIIDAE	Bowfin family	
	Bowfin	*Amia calva*
SALMONIDAE	Salmon family	
	Lake trout	*Salvelinus namaycush*
	Lake whitefish	*Coregonus clupeaformis*
	Cisco (Lake herring)	*Coregonus artedii*
	Shortjaw cisco *	*Coregonus zenithicus*
	Round whitefish	*Prosopium cylindraceum*
OSMERIDAE	Smelt family	
	Rainbow smelt	*Osmerus mordax*
HIODONTIDAE	Mooneye family	
	Mooneye	*Hiodon tergisus*
	Goldeye	*Hiodon alosoides*
UMBRIDAE	Mudminnow family	
	Central mudminnow	*Umbra limi*
ESOCIDAE	Pike family	
	Northern pike	*Esox lucius*
	Muskellunge	*Esox masquinongy*
CYPRINIDAE	Minnow family	
	Golden shiner	*Notemigonus crysoleucas*
	Common shiner	*Notropis cornutus*
	Emerald shiner	*Notropis atherinoides*
	Blacknose shiner	*Notropis heterolepis*
	Spottail shiner	*Notropis hudsonius*
	Sand shiner	*Notropis stramineus*
	Mimic shiner	*Notropis volucellus*
	Bluntnose minnow	*Pimephales notatus*
	Fathead minnow	*Pimephales promelas*
	Blacknose dace	*Rhinichthys atratulus*
	Longnose dace	*Rhinichthys cataractae*
	Northern redbelly dace	*Chrosomus eos*
	Finescale dace	*Chrosomus neogaesus*
	Pearl dace	*Semotilus margarita*
	Lake chub	*Couesius plumbeus*
	Brassy Minnow	*Hybograthus hankinsoni)*
	Blackchin Shiner	*Notropis heterodon*
	Hornyhead chub	*Nocomis biguttatus*
	Creek chub	*Semotilus atromaculatus*

Family	Common name	Scientific name
CATOSTOMIDAE	Sucker family	
	Common white sucker	*Catostomus commersoni*
	Longnose sucker	*Catostomus catostomus*
	Quillback	*Carpiodes cyprinus*
	Shorthead redhorse	*Moxostoma macrolepidotum*
	Silver redhorse	*Moxostoma anisurum*
	Bigmouth buffalo*	*Ictiobus cyprinellus*
ICTALURIDAE	Catfish family	
	Brown bullhead	*Ameiurus nebulosus*
	Black bullhead	*Ameiurus melas*
	Tadpole madtom	*Noturus gyrinus*
CYPRINODONTIDAE	Killifish family	
	Banded killifish	*Fundulus diaphanus*
GADIDAE	Cod family	
	Burbot	*Lota lota*
GASTEROSTEIDAE	Stickleback family	
	Brook stickleback	*Culea inconstans*
	Ninespine stickleback	*Pungitius pungitius*
PERCOPSIDAE	Troutperch family	
	Troutperch	*Percopsis omiscomaycus*
CENTRARCHIDAE	Sunfish family	
	Rock bass	*Ambloplites rupestris*
	Pumpkinseed	*Lepomis gibbosus*
	Longear sunfish	*Lepomis megalotis*
	Bluegill	*Lepomis macrochirus*
	Green sunfish	*Lepomis cyanellus*
	Black crappie	*Pomoxis nigromaculatus*
	Smallmouth bass	*Micropterus dolmieui*
	Largemouth bass	*Micropterus salmoides*
PERCIDAE	Perch family	
	Yellow perch	*Perca flavescens*
	Walleye	*Sander vitreus*
	Sauger	*Sander canadensis*
	Logperch	*Percina caprodes*
	River darter	*Percina shumardi*
	Iowa darter	*Etheostoma exile*
	Johnny darter	*Etheostoma nigrum*
	Blackside darter	*Percina maculata*
COTTIDAE	Sculpin family	
	Mottled sculpin	*Cottus bairdi*
	Slimy sculpin	*Cottus cognatus*
	Deepwater sculpin	*Myoxocephalus quadricornis*
	Spoonhead sculpin	*Cottus ricei*

* - Species at Risk

The fish species found in Fisheries Management Zone 5 are widely distributed throughout the lakes, rivers and streams within the zone with almost every permanent waterbody having some fish species within it. Fish diversity is spread across 18 different families. The most diverse group in FMZ 5 are the minnows (C*yprinidae*) of which there are 19 species. Other diverse groups within the zone include perches (*Percidae*), suckers (*Catostomidae*), sunfish (*Centrarchidae*), and whitefish (*Coregoninae*).

Some fish species have been introduced, such as rainbow smelt, considered an invasive as well as species such as smallmouth bass considered "naturalized" (see invasives section 3.3). In addition to those identified in Table 3.1-1 there are three species currently stocked by OMNR for angling (brook trout *Salvelinus fontinalis*, rainbow trout (*Oncorhynchus mykiss)* and splake (*Salvelinus fontinalis* x *Salvelinus namaycush)* but are not known to have established self-sustaining populations. Within this list of species are keystone species, such as lake trout, that strongly influence ecosystem function or have high social value, rare species that are limited in distribution and infrequently encountered as well as species at risk of extirpation.

The fish communities that we manage today are very much influenced by the coldwater remnant species such as lake trout which would have been one of the first species to colonize the cold glacial melt waters as well as the wide variety of warm water species that originated from the Mississippi drainage. Contrast this drainage pattern to today where the waters within FMZ 5 flow north-westward and ultimately enter the ocean at Hudson Bay and the connection to the Mississippi drainage to the south has been lost.

Sustaining these resources is consistent with Ontario's Biodiversity Strategy (OMNR 2005c) where the goals are: 1) Protect the genetic, species and ecosystem diversity of Ontario and, 2) Use and develop the biological assets of Ontario sustainably, and capture benefits from such use for Ontarians.

3.1.1 Fish Communities

Information on species distribution is available for over 1,550 lakes of the 5,000 lakes larger than 10 ha in FMZ 5. For some of these lakes, species presence information is based on netting surveys or complete lake surveys and considered relatively complete, especially for large bodied species. In other cases, the information is based on confirmed angler catch data and is therefore only reliable for sport fish species and may be lacking for other species (eg. lake whitefish, cisco, small fish, etc.). Also, the majority of the fish species presence effort has been focussed on lakes or lake portions of large river systems. For this reason, the following discussion on species distribution will be based mainly on sport fish species from lakes. It should also be considered a minimum estimate, as there are many more lakes that we have no information on even the sport fish species composition.

The most common sportfish within FMZ 5 include northern pike (*Esox lucius*), walleye (*Sander vitreus)*, lake trout (*Salvelinus namaycush*), and smallmouth bass (*Micropterus dolomieui*), all of which are found in 35% or more of the lakes and over 60% of the lake area (Table 3.1-2). Other sportfish species with more limited distribution include muskellunge (*Esox masquinongy*), sauger (*Sander canadensis*) largemouth bass (*Micropterus salmoides)* and black crappie *(Pomoxis nigromaculatus).*

Table 3.1-2. Sport fish species composition of FMZ 5 lakes (note: only includes 1564 lakes with species composition information; total lake area = 455,450 ha)

Species	% of lakes larger than 10ha.	% of lake area
northern pike	75%	89%
walleye	52%	66%
lake trout	36%	65%
smallmouth bass	36%	62%
lake whitefish	23%*	58%
muskellunge	6%	18%
largemouth bass	6%	12%
black crappie	6%	10%

* - likely an underestimate; see text

Compared to the rest of the fisheries management zones in the region, FMZ 5 is notable for having a higher presence of lake trout, smallmouth bass and muskellunge and fewer brook trout populations, all of which are stocked (Figure 3.1-1).

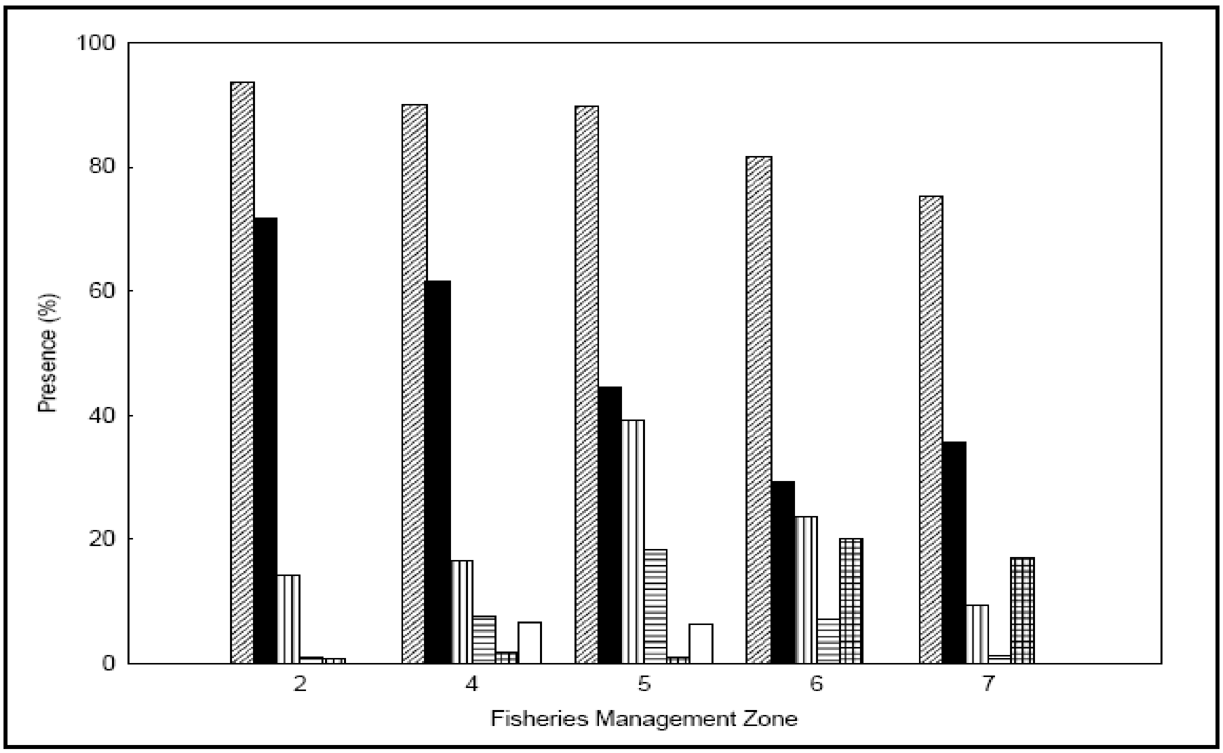


Figure 3.1-1. Percent occurrence of northern pike (diagonals), walleye (solid bars), lake trout (vertical bars), smallmouth bass (horizontal bars), brook trout (hatched bars) and muskellunge (open bars) in surveyed lakes by fisheries management zone (Cano and Parker 2007).

These species are distributed across the landscape of FMZ 5 in lakes, streams and rivers in a variety of unique groupings that can be summarized into community types based on environmental and physical factors including temperature, lake size, productivity and interactions between predators and prey (Jackson et al. 2001). Communities have also been named on the basis of the dominance of a particular species or group of species that are of economic value, a convenient approach for resource managers (Ryder and Kerr 1978). For the purpose of this background report and to reflect a landscape-scale approach to describing fisheries resources, fish communities in zone 5 will be classified broadly as coolwater and coldwater assemblages with emphasis on dominant sport fish species for each community type. Coldwater and coolwater fish communities exist independently of each other in separate waterbodies but can also be found within the same waterbody depending on the shape, depth and productivity of the lake. Definitions of coldwater and coolwater communities are based mainly on the presence or absence of trout species, primarily lake trout in FMZ 5, which are dependent on coldwater habitat for their survival. Although defined by the fish species, coolwater and coldwater lakes differ in their physical and chemical characteristics with coolwater lakes being generally smaller, shallower, more productive and with lower water clarity than coldwater lakes (Table 3.1-3).

Table 3.1-3. Physical and chemical characteristics (median values and quartile range) for coolwater and coldwater lakes in FMZ 5.

Lake Type	Area (ha)	Maximum depth (m)	Average depth (m)	Productivity (morphoedaphic index)	Water clarity (m)
Coolwater	82 ha (40-158)	13.0 m (8.0-19.0)	4.7 m (3.1-6.4)	5.6 (3.3 – 10.5)	2.7 m (2.0-3.7)
Coldwater	188 ha (79-478)	31.0 m (24.0 – 41.0)	10.6 m (8.2 –14.3)	2.2 (1.5 – 3.3)	4.7 m (3.8 – 5.9)

Fish community can be an important factor in the productivity of fisheries. Walleye in a simple walleye-yellow perch-white sucker community may act differently and have different population dynamics than walleye in a more complex community; for example one that also includes cisco (lake herring), smallmouth bass and lake trout. Lake characteristics such as size and depth may also affect how much the fish community influences individual species. For example, walleye and lake trout may co-exist in larger, more complex waterbodies but not in smaller, simple, single basin lakes (Jackson 2008). Beyond just understanding the species distribution across the zone, an understanding of the fish communities is important in understanding populations and species productivity.

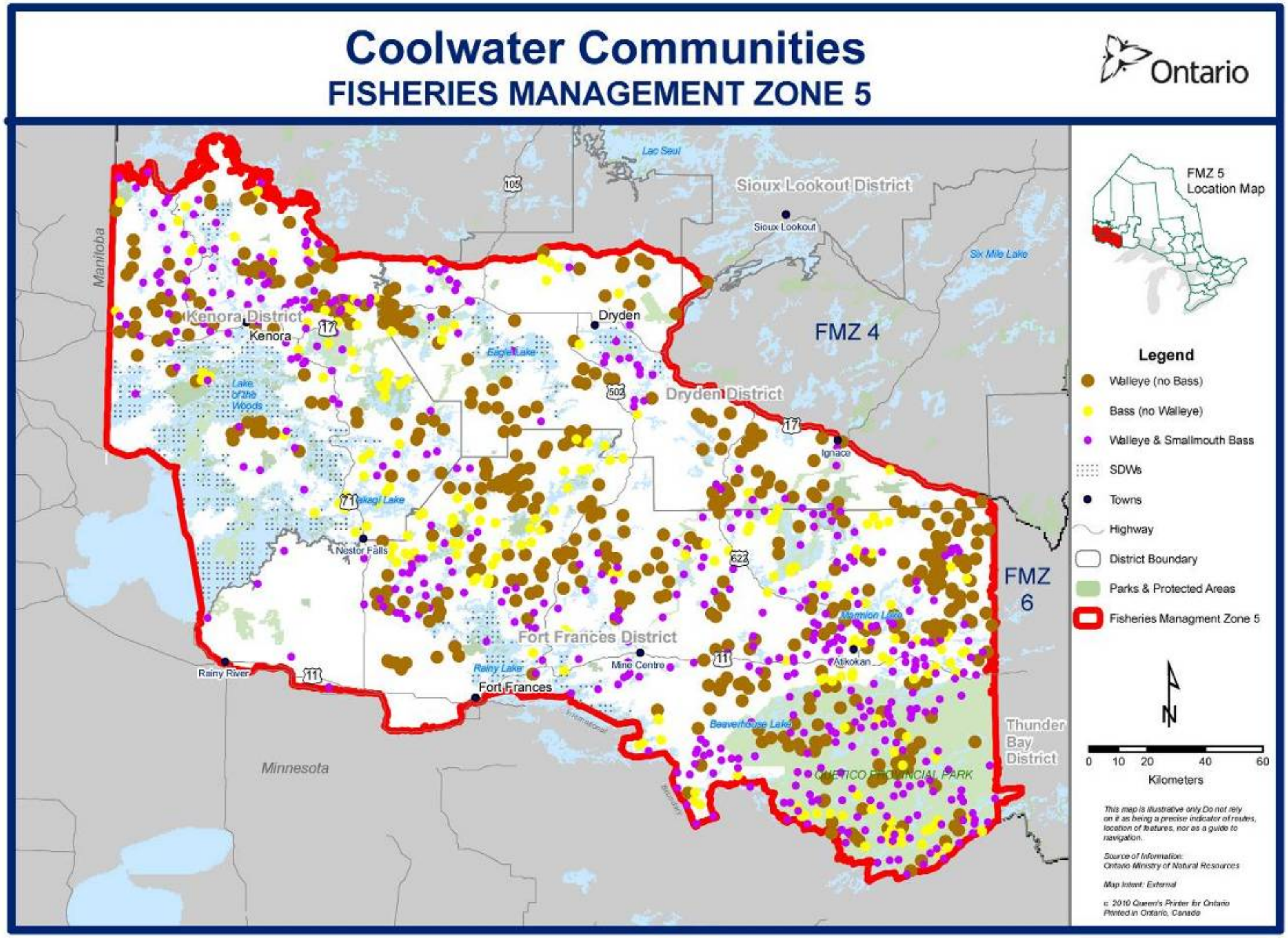
3.1.1.1 Coolwater Communities

Coolwater fish communities are found in moderately productive, shallower waters and support species with an optimum growth temperature between 15-25°C, and are typified in FMZ 5 by sport fish such as walleye, northern pike and smallmouth bass. The majority of sport fish species within this community spawn during spring, though actual time of spawning depends on water temperature and latitude. In northern waters, spawning of sport fish species in coolwater communities may occur later in the spring than in southern water bodies. Latitude can also affect growth and survival of coolwater fish species. Though initial growth of walleye, northern pike and muskellunge is rapid, populations in northern Ontario exhibit slower overall growth rates, and longer take longer to reach maturity, than populations in the south (Lester et al. 2000). This is in part due to the greater number of growing degree days (GDD) which results in a longer growing season for coolwater fish in southern water bodies, as well as the higher degree of exploitation in the south, which can shift populations towards earlier maturation (Venturelli et al. 2010).

Coolwater species communities are the most abundant fish community within FMZ 5 and are widely distributed throughout the zone (Figure 3.1-2). In addition, almost all of the SDW's in FMZ 5 are coolwater communities (only four bays of Lake of the Woods are classified as coldwater communities). Of the over 1,500 lakes that have species information, over 1000 (65%) are classified as coolwater fish communities. The most common sport fish grouping within these lakes is the walleye/northern pike community which is found in at least 50% of coolwater lakes. The second most common grouping is walleye/northern pike/smallmouth bass community which is found in at least 22% of the coolwater lakes. In addition to the presence of walleye, northern pike and smallmouth bass, coolwater communities commonly include yellow perch, white sucker and a wide variety of minnows (Brown 2007). In lakes with deeper waters (>8 m) lake whitefish, cisco (*Coregonus artedi*) and burbot (*Lota lota*) are also common species (Brown 2007). Muskellunge, are found in a smaller portion of coolwater communities (5% of coolwater lakes). Smallmouth bass, largemouth bass and black crappie are present as a naturalized species in many coolwater lakes where they have been introduced within the zone. A further discussion on the introduction, distribution and spread of these sport fish species in FMZ 5 can be found in section 3.3.

Walleye are an important component of the coolwater fish community, both from an ecological perspective and from an angling viewpoint. Walleye populations can potentially be impacted by the introduction or increase in population of other predator species. In particular, concern has been raised by the public about the presence of non-native species on walleye populations such as black crappie, smallmouth bass and largemouth bass. Walleye and smallmouth bass are the most common combination with smallmouth bass being found in at least 46% of the 800+ known walleye lakes in FMZ 5. Black crappie are found in about 10% of the known walleye lakes and largemouth bass are found in 7%. Further discussion of impacts of non-native species can be found in section 3.3.

a)



Coolwater Communities
FISHERIES MANAGEMENT ZONE 5
Ontario
Manitoba
Kenora District
Kenora
Lake of the Woods
Sioux Lookout District
Sioux Lookout
Lac Seul
Six Mile Lake
Dryden
Eagle Lake
Dryden District
Ignace
FMZ 4
FMZ 6
Nestor Falls
Fort Frances District
Mine Centre
Atikokan
Rainy River
Rainy Lake
Fort Frances
Beaverhouse Lake
QUETICO PROVINCIAL PARK
Thunder Bay District
Minnesota
FMZ 5 Location Map
Legend
Walleye (no Bass)
Bass (no Walleye)
Walleye & Smallmouth Bass
SDWs
Towns
Highway
District Boundary
Parks & Protected Areas
Fisheries Managment Zone 5
0 10 20 40 60
Kilometers
This map is illustrative only. Do not rely on it as being a precise indicator of routes, location of features, nor as a guide to navigation.
Source of Information: Ontario Ministry of Natural Resources
Map Intent: External
© 2010 Queen's Printer for Ontario Printed in Ontario, Canada

b)

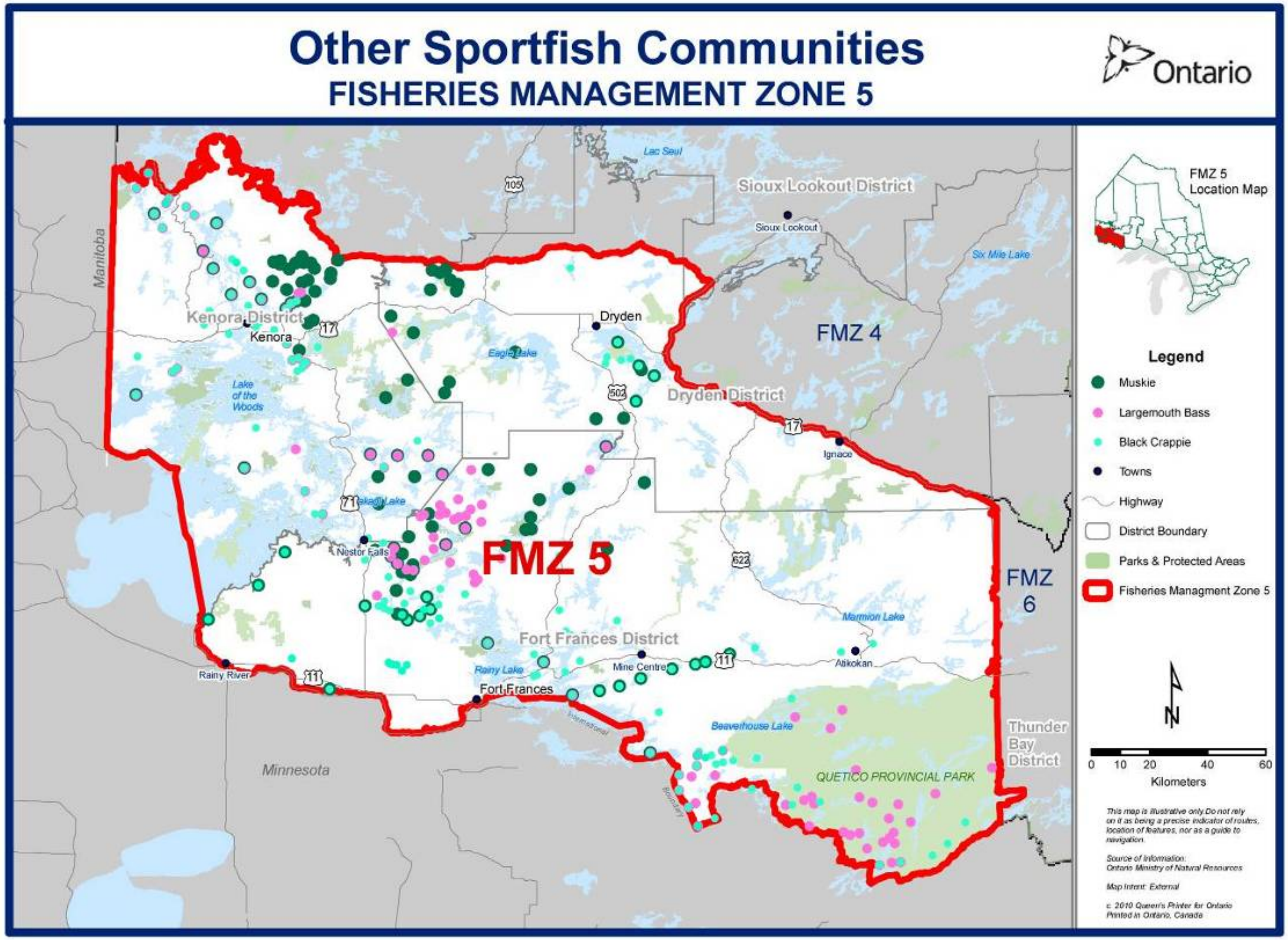


Figure 3.1-2 Distribution of a) walleye and bass dominated and b) other coolwater fish communities in FMZ 5.

3.1.1.2 Coldwater communities

Coldwater communities typically exist in less productive, deeper waters and support species with an optimum growth temperature <15°C such as lake trout, lake whitefish, cisco and burbot. Often, coolwater species such as walleye, smallmouth bass and northern pike also coexist in the same lakes but use the warmer, shallower portions of the lakes. This is particularly true of larger lakes which are more likely to have complex fish communities. Coldwater specific species, such as lake trout and lake whitefish, are restricted to the deep, colder portions of a waterbody during summer months when surface water temperatures become warm (Scott and Crossman 1973) however these species do make occasional forays to warmer, more productive waters to forage. These species are also unable to tolerate low oxygen environments, and factors that reduce deepwater oxygen concentrations, such as high nutrient input from development or sewage point sources, may cause declines in coldwater fish populations.

Coldwater fish communities are more common in FMZ 5 than other FMZ's in northwest Ontario (Cano and Parker 2007). Within the boundaries of the zone, they are widely distributed with areas such as Quetico Park, the White Otter Lake area north of Atikokan, the Manitou Lake area north of Fort Frances and the area midway between Kenora and Dryden having higher densities of these lakes (Figure 3.1-2). Of the 558 known coldwater or lake trout lakes, 28% of them have only lake trout as a predator species. An important factor in lake trout productivity and life history characteristics is the presence of a deepwater prey species such as whitefish or cisco or the introduced rainbow smelt. In lakes with cisco or whitefish, lake trout tend to growth faster and reach much larger size but have lower population densities. They also tend to be larger lakes than those without deepwater prey species. Based on the species data available for FMZ 5 lake trout lakes, over 40% of the lake trout populations have no deepwater prey species and rely on invertebrates or small inshore fish such as minnows or perch when temperatures are cool enough that they can access them. Because the data contains lakes that have species identified by angling this may be an over-estimate as anglers are more likely to report catching lake trout than whitefish or cisco. A review of more detailed lake species data for just the Atikokan and Kenora areas of FMZ 5 found that around 30% of the lake trout lakes were without deepwater fish prey species (Jackson 2008, Kenora AHI).

Coolwater predator species can also impact lake trout populations. An analysis of lake trout lakes in the Atikokan area found that lake trout could co-habit with northern pike in relatively small lakes but were much less likely to co-exist with walleye or smallmouth bass in small lakes or lakes that did not have whitefish or cisco in them (Jackson 2008). Approximately 20% of the coldwater lakes have only lake trout and northern pike as sport fish species in them. Approximately 24% of the coldwater lakes have both smallmouth bass and walleye existing with lake trout while the proportion of lakes with walleye and lake trout and those with smallmouth bass and lake trout is about the same at around 13%.

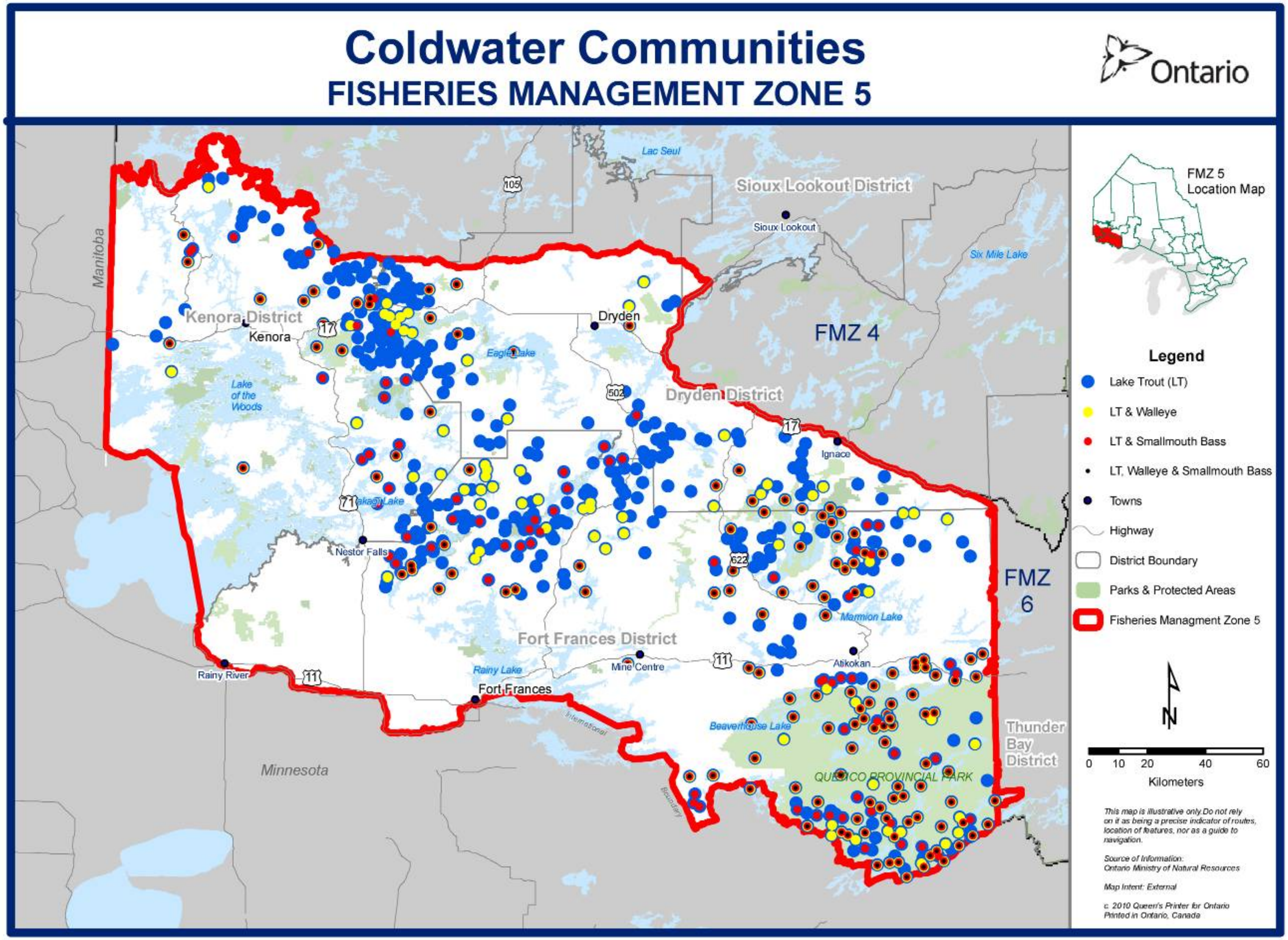


Figure 3.1-3 Distribution of coldwater fish communities in FMZ 5.

3.1.2 Primary Predator Communities

Another way of grouping lakes is to group lakes by primary predator. In FMZ 5, the two primary predators are often walleye (804 known lakes) in coolwater habitat and lake trout (507 known lakes) in coldwater habitats. These two species can exist in separate lakes or together in the same lake. This also reflects the species grouping that the broad scale monitoring program uses to select lakes and assess fish population status.

Both the walleye lakes and lake trout lakes tend to be smaller than the lakes that have both species (Table 3.1-4). As expected, the walleye lakes are shallower, more productive with more stained water than the lake trout only lakes. Lakes with both species are very similar to lake trout-only lakes in terms of depth, water clarity and productivity.

Table 3.1-4. Physical and chemical characteristics (median values and quartile range) for walleye, lake trout and walleye/lake trout lakes in FMZ 5.

Lake Type	Number of lakes	Area (ha)	Maximum depth (m)	Average depth (m)	Productivity (morphoedaphic index)	Water clarity (m)
Walleye lakes (without lake trout)	603	102 ha (49-214)	12.0 m (8.0-18.9)	4.6 m (3.2-6.1)	6.1 (3.6 – 10.8)	2.5 m (1.9-3.4)
Lake trout lakes (without walleye)	306	120 ha (57-288)	29.9 m (23.0 – 37.8)	10.4 m (8.1 – 13.1)	2.2 (1.6 – 3.9)	5.0 m (3.8 – 6.0)
Walleye and lake trout lakes	201	419 ha (194–1091)	35.0 m (25.0 – 47.0)	11.3 m (8.2 – 16.4)	2.2 (1.4 – 3.0)	4.6 m (3.6 – 5.6)

3.2 Species at Risk (SAR)

Species at Risk legislation applies at both the Federal and Provincial scales. Federally the Species at Risk Act (SARA 2002) applies to aquatic organisms and affords similar protection provisions as the provincial Endangered Species Act, 2007 (ESA 2007). The classification of a species may or may not be the same under both Acts. Each Act relies on an independent scientific body to make recommendations on classification of species as either extirpated, endangered, threatened, special concern or not at risk and is based on a review of species status and evaluation of threats to the species. In the case of the Ontario ESA 2007, these recommendations are carried forward into legislation within three months of submission. Recommendations of the Federal body, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) are not necessarily incorporated into legislation under SARA. As a result there are three listings of species that are important to recognize, ESA 2007 listed species, SARA listed species and COSEWIC recommendations. Table 3.2-1 illustrates Species at Risk (SAR) fish species found within FMZ5.

Table 3.2-1 Species at Risk (SAR) fish species found within FMZ5.

Species	PROVINCIAL STATUS (SARO list)	FEDERAL STATUS (SARA list)	COSEWIC Designation (Federal)
Bigmouth Buffalo	Not at Risk		Special Concern
Chestnut Lamprey			Special Concern
Deepwater Sculpin	Not at Risk		Special Concern
Lake Sturgeon – Rainy R. /Lake of the Woods	Threatened[2009]	Under review	Special Concern
Lake Sturgeon Winnipeg R.– English R.	Threatened[2009]	Under review	Endangered
Shortjaw Cisco	Threatened		Threatened

The ESA 2007 provides species and habitat protection to species listed as extirpated, endangered or threatened on the Species at Risk Ontario (SARO) list. Species of Special Concern are afforded conservation planning measures under the Act.

Two species are particularly important from a fisheries management perspective, lake sturgeon (*Acipenser fulvescens*) and shortjaw cisco (*Coregonus zenithicus*).

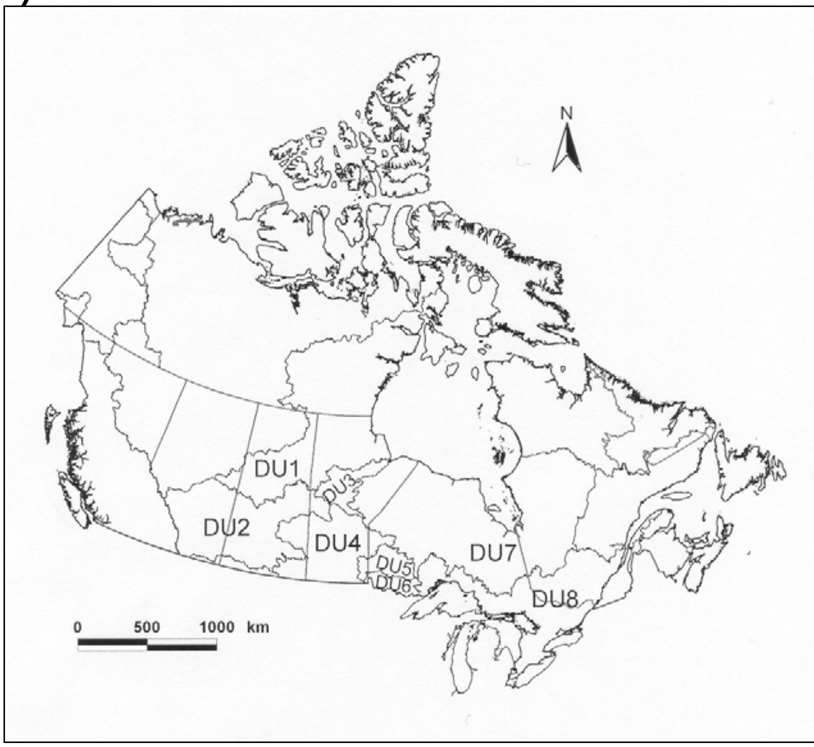
3.2.1 Lake Sturgeon

As shown in Figure 3.3-1 COSEWIC has proposed two designatable units (DU's) within FMZ 5 be identified federally. While not currently afforded legal protection under SARA 2002, lake sturgeon populations located within DU 5 are considered endangered by COSEWIC while populations within DU 6 are considered Special Concern. The proposed DU's for Canada are displayed in figure 3.2-1 below and is in contrast to legislated populations under the Provincial ESA, 2007.

In 2009 the Committee on the Status of Species at Risk in Ontario (COSSARO) evaluated the status for lake sturgeon in Ontario and identified three regions for classification. The northwestern Ontario populations, including populations within FMZ 5 were classified as threatened (an up listing from Special Concern") and therefore afforded species and habitat protection under the ESA, 2007.

Lake sturgeon is a prominent component of the FMZ 5 fish community and is well represented in the larger waterbodies. Lake sturgeon is found primarily in the southwestern portion of the zone (Figure 3.2-2).

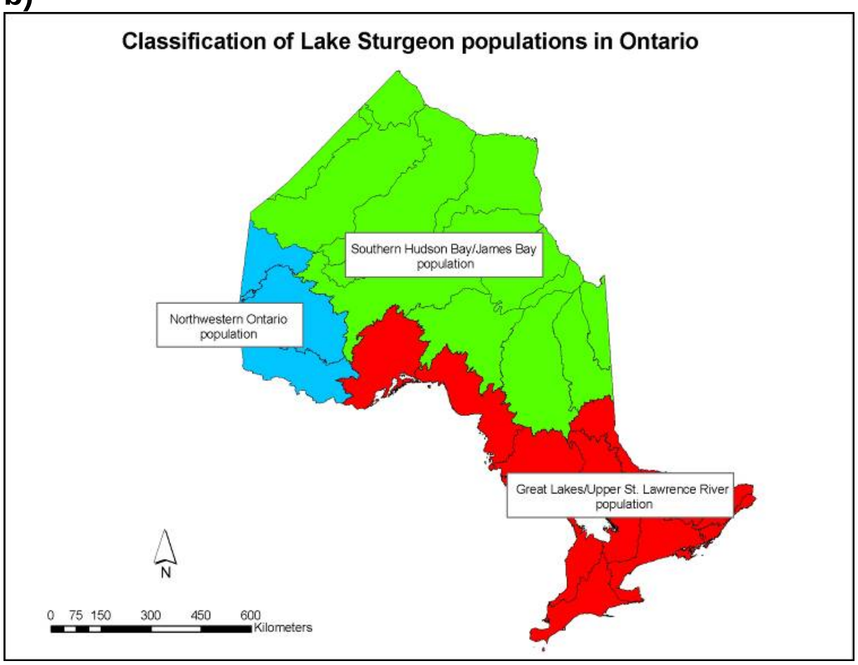
a)



Designated Endangered:
DU1 Western Hudson Bay,
DU2 Saskatchewan River,
DU3 Nelson River,
DU4 Red-Assiniboine Rivers-Lake Winnipeg
DU5 Winnipeg River - English River.
Designated Threatened:
DU8 Great lakes-Upper St. Lawrence
Designated Special Concern;
DU6 Lake of the Woods-Rainy River
DU7 Southern Hudson Bay-James Bay

Federal Designated Units (DU) proposed by COSEWIC, 2006 (Note no legal context provided via SARA 2002, at this time)

b)



COSSARO classification of Lake Sturgeon in Ontario where blue and red areas are Threatened and Green is Special Concern.

Threatened populations afforded protection under the ESA

Figure 3.2-1 Comparison of the division of sturgeon populations under a) federal and b) provincial endangered species legislation.

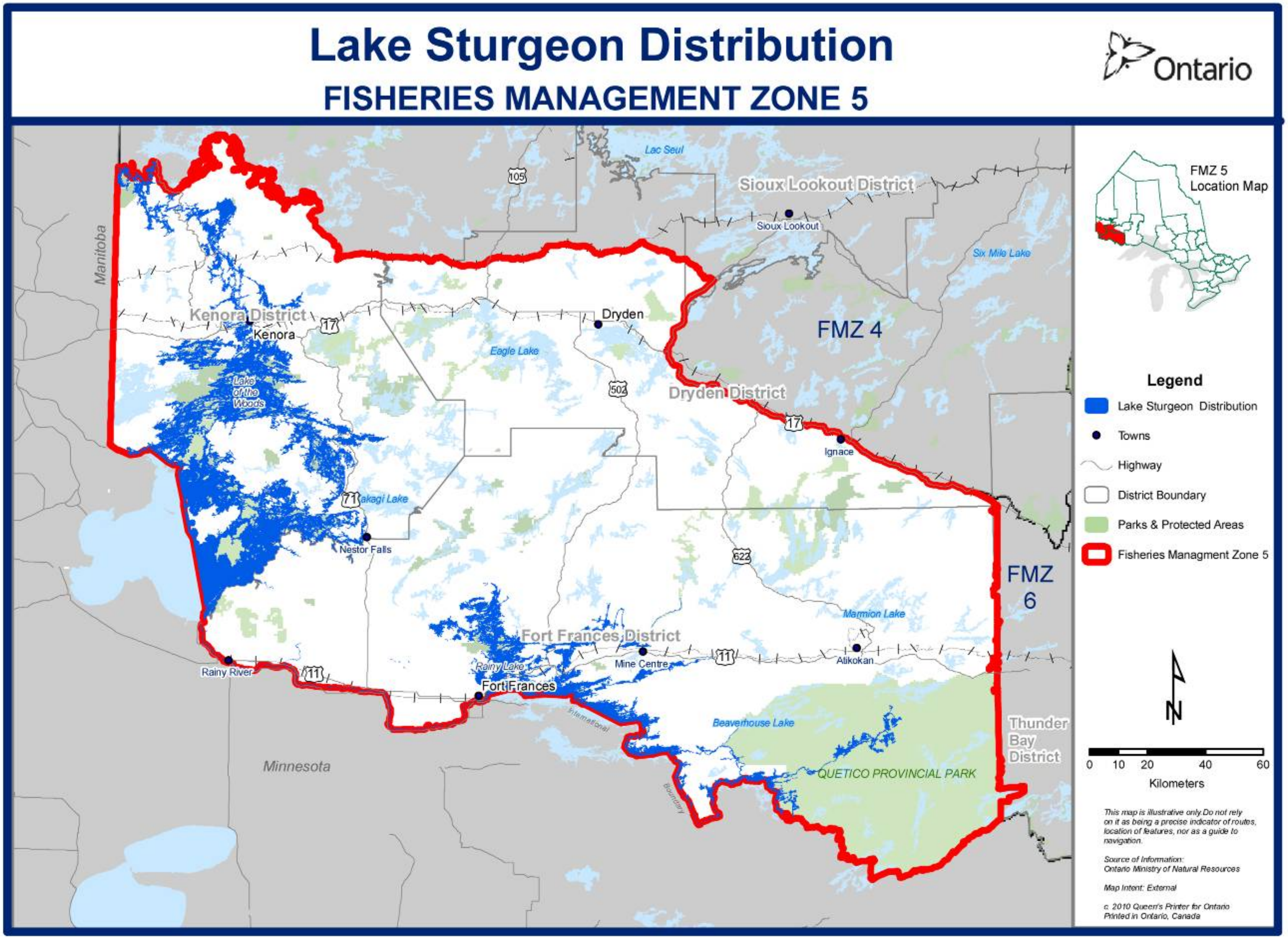


Figure 3.2-2. Fisheries Management Zone 5 lake sturgeon distribution.

The life history characteristics of lake sturgeon contribute to their vulnerability to extirpation. An evolutionary ancient species with a long life span, lake sturgeon have survived on a life history strategy that depends on a relatively low level of recruitment into the population. On average, females do not spawn until they reach 26 years of age and spawn periodically at intervals that range between 4 to 9 years (Mosindy and Rusak 1991, Scott and Crossman 1973). The habitat that they select for spawning is also specialized and generally reached through a long migration. Sturgeon spawn within rivers in areas of fast flowing water at depths between 0.6 and 4.5 m (OMNR 2009b). Spawning substrate is typically gravel, rubble and angular rock (Seyler 1997). Movements to these areas of 200 to 400 km have been documented for some populations (Kempinger 1988, Rusak and Mosindy 1997, Scott and Crossman 1973). Their vulnerability is compounded by the fact that they strongly prefer to use the same spawning sites (DeHaan et al. 2006), thereby increasing the importance of these areas to their sustainability. High adult survival rates and longevity (exceeding 150 years) are two positive attributes that help sustain populations.

Late maturation, spawning periodicity and reliance on specialized habitat for spawning make lake sturgeon vulnerable to threats. The main threats to lake sturgeon are exploitation, habitat alteration/destruction and fragmentation of migration corridors due to the construction of dams.

Both research and past experience have shown that even low levels of commercial and/or angling exploitation can exceed sustainable levels. With the northwestern Ontario population designation in 2009 as “threatened” under the ESA, 2007 recreational and non-aboriginal commercial fisheries were curtailed. However, within FMZ 5, sturgeon exploitation was significantly reduced well in advance of the designation. Non-aboriginal commercial quotas were purchased and extinguished and recreational harvest was virtually non-existent due to a highly restrictive minimum size limit that exceeded the length of all but the most exceptional fish in the area. A minimum total length equivalent of 190 cm (75 inch) essentially resulted in a catch and release fishery throughout the zone. Lake sturgeon continue to be harvested though aboriginal subsistence fisheries. These fisheries are generally believed to contribute to a modest harvest although harvest levels are largely unknown. Lake sturgeon is highly valued by many First Nations and can have immense cultural significance.

Historically, lake sturgeon has been subjected to extensive habitat alteration throughout their range (OMNR 2009b). There is extensive evidence from the scientific literature that construction of dams as water control structures and for hydroelectric power generation can impact lake sturgeon and this has probably happened in FMZ 5. Dams fragment sturgeon habitat and prevent, or highly restrict, access to historic spawning, nursery and rearing habitats (OMNR 2009b). Dam operations that alter natural hydrologic patterns are also a significant threat that can lead to recruitment issues and impact the aquatic community that lake sturgeon rely on for food (OMNR 2009b). Within FMZ 5 construction of new dams within lake sturgeon waters as well as management of existing dams continue to be a major concern. These concerns are now afforded consideration under the ESA, 2007.

With the implementation of the ESA, 2007 and designation of lake sturgeon as a threatened species, recreational angling was no longer permitted beginning September 12, 2009.

Significant lake sturgeon work has been undertaken in FMZ to evaluate population health and assess threats particularly in Namakan Lake, Rainy Lake/Seine River and Lake of the Woods/Rainy River (McLeod 1999, McLeod and Debruyne 2009, Mosindy and Rusak 1991).

3.2.2 Shortjaw Cisco

Shortjaw cisco (*Coregonus zenithicus*) is identified as a Species at Risk by COSEWIC and under provincial legislation. COSEWIC recommended a threatened designation in 1987. This recommendation however has not yet been incorporated into Federal legislation. More recently, a threatened designation under provincial statute (ESA, 2007) afforded shortjaw cisco both species and habitat protection under the Act. This species is extremely difficult to identify and recent efforts as part of the Broadscale Monitoring program have verified, otherwise suspect occurrences within FMZ 5. The relative health of these populations is unknown. In the Great Lakes where this species has been studied no single factor has been identified as being responsible for the decline of the shortjaw cisco (Todd 2003). Factors that contributed to the decline of shortjaw cisco in the Great lakes include exploitation for food, eutrophication, alteration of the biological community, competition and predation from invasive species such as smelt an alewives, weather and thermal changes (Todd 2003). Within FMZ 5, exploitation in the form of angling is likely very minimal in the lakes that contain shortjaw cisco. Climate change and introduction of invasive species, however, are threats (see section 4.2 for further discussion). Todd (2003) suggested that in smaller Canadian lakes that this species may be a main forage for predators in some circumstances. Ciscoes (spp.) are important prey item for predators such as lake trout and burbot (*Lota lota*).

Shortjaw cisco is only known a few lakes within FMZ 5 (Saganaga Lake, Basswood Lake and Loonhaunt Lake as well as Lake of the Woods). Since shortjaw cisco are found in a number of lakes in central Canada and as far west as Great Slave Lake, it is possible that other populations exist in lakes within the zone.

3.3 Introduced and Invasive Aquatic Species

The Ontario Ministry of Natural Resources describes an *alien* species as any introduced, non-native exotic plant, animal or micro-organism introduced into an area beyond the species normal range as a result of human actions. Introductions of alien species may be deliberate or accidental, beneficial or harmful, from other continents, neighbouring countries or from other ecosystems within Canada (OMNR 2008a). Alien species are sometimes introduced intentionally to provide benefits to society and to ecosystems (for example, authorized fish stocking and intentional introductions of biological controls (OMNR 2008a)). In these cases, alien species are considered to be *introduced* rather than invasive.

Invasive species are those harmful alien species whose introduction or spread threatens the environment, the economy or society, including human health.

Introduced species and invasive species represent two distinctive groups in terms of management intent but may overlap with respect to consequence where an introduced species may become an invasive. This is best illustrated by the management action of stocking. The planned introduction of a fish species may be undertaken to enhance fishing opportunities on the receiving waterbody. The same species moved to another waterbody without environmental consideration can have significant consequences and become invasive. For both groups the pathway for introduction into an ecosystem can be either intentional or unintentional. In all cases of the establishment of invasive/introduced species will have impacts to some degree on native aquatic communities.

Table 3.3-1 lists aquatic introduced species, invasive species as well as threats within FMZ 5.

Table 3.3-1 Aquatic introduced species invasive, species as well as threats within FMZ 5

Aquatic Introduced Species		
	Black Crappie	
	Smallmouth Bass	
	Largemouth Bass	
	Brook trout	
	Splake	
	Rainbow trout	
	Walleye	
Aquatic Invasive Species		
	Rainbow Smelt (Osmerus mordax),	
	Rusty Crayfish (Orconectes rusticus)	
	Spiny Water flea (Bythotrephes longimanus)	
	Freshwater Jellyfish (Craspedacusta sowerbyi)	
	Purple Loosestrife (Lythrum salicaria)	
	Invasive Common Reed Grass (Phragmites australis subsp. Australis)	
Invasive Threats		**Pathways of invasion**
	Faucet Snail (Bithynia tentaculata)	
	Common Carp (Cyprinus carpio)	Manitoba
	White bass (Morone chrysops)	Manitoba
	Feral (wild) goldfish (Carassius auratus)	Manitoba
	Silver Carp (Hypohthalmichthys molitrix)	Mississippi drainage
	Zebra mussels (Dreissena polymorpha)	Border surveys/Minnesota
	Chinese mystery snails (Bellamy crispus)	
	Eurasian water milfoil (Myriophyllum spicatum)	Minnesota
	Viral Hemorrhagic Septicemia (VHS)	Southern Ontario/U.S.
	Curly-leaf pondweed (Potamogeton crispus)	Manitoba
	Asian tapeworm (Bothriocephalus acheilognathi)	Manitoba
	Koi herpesvirus - (KHV)	Manitoba
	Eubosmina coregoni - small zooplankton	Manitoba, Lake Superior
	Black algae (Lyngbya wollei) - cyanobacteria	Manitoba
	Flowering Rush (Butomus umbellatus)	Manitoba

3.3.1 Introduced Species in FMZ 5

Introduced species in FMZ 5 are non-native species that have become established in ecosystems outside of their natural historic range as a result of human assistance. Once established, introduced species are often referred to as being *naturalized* (Williamson and Fitter 1996). Introduced species are often released to provide economic, social and occasionally, ecological benefits. Some species of economic and social value have been introduced to FMZ 5 through stocking programs by the OMNR.

Fish Stocking

Historically walleye, lake trout, black crappie and to a lesser degree, muskellunge and whitefish were stocked or transferred within FMZ 5 as part of a management strategy to increase angling opportunities. While stocking is a valid fisheries management tool, current stocking guidelines aim to protect genetic integrity of indigenous communities and favour the management of naturally reproducing populations through regulations (OMNR 1992a). Authorized introductions of smallmouth bass or black crappie no longer occur within the Northwest due to impacts on native fish communities, however unauthorized introductions of these species still takes place. Stocking of splake, brook trout, rainbow trout and walleye still occurs within FMZ5 *(see section 6.3 for further discussion on stocking policy and impacts).*

In FMZ 5, **smallmouth bass** introductions were made in the Kenora area in the early 1900's (Krishka et al. 1996) by government agencies to increase angling opportunities and to promote tourism. In other parts of the zone, smallmouth were introduced from the US into Rainy Lake in the 1920's and Knife Lake on the south border of Quetico Park in the early 1940's. Since that time smallmouth bass have spread throughout FMZ 5, largely as a result of unauthorized introductions and dispersal from previous introductions through drainage networks. Government introductions occurred as late as the 1960's.

At present, smallmouth bass are estimated to be found in over 550 FMZ 5lakes with new populations being discovered annually. Today many populations are considered naturalized, but this is not to suggest that they have not had ecosystem consequences in some cases. Studies of northern populations have found that this species can have a dramatic impact on fish communities in waterbodies where it does not exist naturally, displacing other fish species through competition and predation (Vander Zanden et al. 2004, Kaufman et al. 2009a). Smallmouth bass introductions have been found to dramatically reduce littoral prey species abundance and diversity some lake communities, particularly those without existing littoral zone predators (Vander Zanden et al. 1999, MacRae and Jackson 2001, Jackson 2002). Similar findings have been documented when other predator species such as walleye (Radomski and Goeman 1995) or northern pike (He and Kitchell 1990) have been introduced into lakes.

In turn, reductions in prey fish populations can have adversely impacts top predators and popular sport fish such as lake trout (Vander Zanden et al. 2004, Jackson 2011), brook trout (Vander Zanden et al. 1999). Some of these studies indicate that impacts of introductions are more severe in lakes that are small and/or have simple fish communities. Results of studies of smallmouth bass impacts on other species are less conclusive (Kriskha et al. 1996, Neuswanger 2009, Sawula

1999). Several recent suggest that there is little evidence to suggest that smallmouth bass cause a reduction in walleye populations (Krishka 1996, Neuswanger 2009, Wuellner 2009). However, most researchers caution that in situations where walleye populations are suppressed due to over harvest or poor recruitment, smallmouth bass should not be introduced, a finding that is supported by observations from northwest Ontario populations. Also, interactions between the two species are likely to be greatest in small lakes if the habitat favours one species over the other (Kerr et al. 2000). Largemouth bass, another species that has been introduced into many lakes in FMZ 5, has been found to prey upon and compete with walleye, especially in lakes with high amounts of aquatic vegetation (Neuswanger 2009)

The distribution of **black crappie** (*Pomoxis nigromaculatus*) has been expanding since their original introduction into Rainy Lake and Lake of the Woods in the 1920's (Wepruk et al. 1992), mostly as a result of unauthorized introductions and through natural dispersal via connected waterbodies. In more recent times, there is only one case of black crappie being intentionally stocked by the Ontario government. In early 1990's, OMNR and partners stocked black crappie into Big Sawbill Lake to improve the existing northern pike fishery and to create new angling opportunities. This stocking was highly effective and created a popular fishery which further stimulated interested in this species for recreation. Since this time unauthorized stocking has become more prevalent. Many of the more than 90 black crappie lakes within FMZ 5 are the result of intentional unauthorized introductions without consideration of environmental impacts to native fish communities. Black crappie introductions can have significant impacts on native fish communities. They occupy similar habitats to yellow perch and walleye and have been linked to significant alterations in percid communities after introductions. Competition for food, predation of fry and fingerlings combined with angling exploitation of walleye can lead to declines in walleye populations (Schiavone 1983, Schiavone 1985).

Walleye are one of the most valued sport fish species in FMZ 5 and provide considerable economic and social benefits to resident and non-resident anglers who target this species almost year round. Although a widespread native species, walleye have historically been stocked by the OMNR as well as by the public supported Community Fisheries and Wildlife Involvement Program (CFWIP). Historically, stocking through the OMNR occurred in new lakes where walleye were not originally present, and in lakes where overexploitation depleted native fish populations. In the Atikokan area, approximately 20% of the existing known walleye lakes are the result of stocking introductions. Presently in FMZ 5, the only stocking of walleye occurs in the Atikokan area and it is restricted to the stocking of walleye into new waters to create additional angling opportunities.

Similar to introductions of other predator species, introductions of walleye into a lake has been shown to cause a decrease in abundance of other forage species including yellow perch (Siep 1995, Pierce and Tomcko 1998), golden shiners and suckers (Green 1994), native minnows, darters, crayfish and suckers (McMahon and Bennet 1996), and cisco (Crossman 1991). In studies of lakes where both walleye and smallmouth bass occurred, it was observed that walleye often became dominant in lakes with sand, gravel or detritus substrates, exposed shoals and suitable areas for spawning and feeding, and a large population of forage fishes (Kerr and Grant 2000). Smallmouth bass were found to be more dominant in lakes a high degree of shoreline irregularity including rocky substrate, sheltered bays for spawning, a moderate degree of shoreline development and smaller populations of small fish (Kerr et al. 1996). Potential interactions between these two species are likely to be greatest in small lakes where the habitat is more favourable for one species over the other (Kriska et al 1996). Interactions between these two species are not well understood (Kerr and Grant 2000), but in some instances the introduction of walleye have been implicated in the decline of native smallmouth bass (Eschmeyer 1950; Kempinger et al 1975; Krishka et al 1996).

Walleye introductions into waters with trout have generally been negative (Kerr and Grant 1999). There is also evidence that the abundance of lake trout is negatively correlated with walleye (Carl et al 1990), and lake trout populations in small southeastern Ontario lakes are believed to have been extirpated from widespread walleye introductions to the area (Evans et al. 1991). Evaluation of fish communities in the Atikokan are found that native walleye and lake trout populations do not co-exist in lakes less than 250 ha and are only found in the same lakes if deepwater prey species such as cisco or whitefish are present (Jackson 2010c). It is recommended in Ontario that walleye should not be stocked into small lakes with native lake trout populations Oliver et al. (1991)

3.3.2 Invasive Species in FMZ 5

Rainbow smelt were originally introduced into the Great Lakes Basin in 1912 when they were intentionally introduced into Crystal Lake, Michigan as forage for lake trout (Krishka et al. 1996). They spread in to inland lakes in northwestern Ontario sometime between 1970-1990 as a result of unauthorized and unintentional introductions as well as downstream dispersal (Krishka et al. 1996). Rainbow smelt are generally introduced into lakes inadvertently by people cleaning smelt or using freshly caught smelt from another water body as bait. Eggs can be inadvertently fertilized when mixed together with milt in the container used to carry smelt caught during the spring spawning run and can persist for several days out of water. The use and possession for use of smelt as bait has been prohibited since 1989.

Introduction of rainbow smelt into inland lakes can lead to the extirpation of native fish species (e.g. yellow perch, cisco) through competitive and predatory interactions (Hrabik and Magnuson 1998, Hrabik et al. 2001). Rainbow smelt may also have negative impacts to walleye and whitefish/cisco populations. A study by Mercado-Silva et al. (2007) observed a decline in walleye recruitment in a small number of lakes after rainbow smelt invasions due to competition and predation of walleye young of year. Rainbow smelt young-of-year occupy warmwater habitats, yearlings coolwater habitats and adults coldwater habitats. This aspect of their life history allows rainbow smelt to occupy the entire water column and potentially interact with a wide variety of fish species (Krishka et al. 1996). Rainbow smelt are opportunistic feeders that prey largely on invertebrates, however small fish, including juvenile sport fish species, are often important components of their diet at certain times of year. Combined with the pressures of exploitation on popular sport fish species, presence of rainbow smelt in lakes can have significant impacts on sustainability of native fish populations (Mercado-Silva et al. 2007). Smelt can become important prey for species such as walleye and lake trout and often result in increased growth rates when they species switch their diet to primarily smelt.

Within FMZ 5, rainbow smelt were first found in Crystal Lake, Marion Lake and Eva Lake (all northeast of Quetico Park) in the early seventies. A separate introduction led to smelt entering in the southeast corner of Quetico Park. They have since spread through Quetico Park and downstream from Lac La Croix and Namakan reservoir and are now found in the SDW's of Rainy Lake and Lake of the Woods and the Winnipeg River system.

Rusty crayfish are aggressive invaders that drive out or hybridize with native crayfish. They can impact fish communities by feeding on their eggs and young and eliminate aquatic vegetation, reducing spawning habitat for some species. Rusty crayfish are spreading into new waters within FMZ 5.

Rusty crayfish are native to parts of North America and have become invasive. They originated from streams in Ohio, Kentucky and Tennessee and were introduced as bait to Ontario by non-resident anglers in the 1960's. Since then they have spread rapidly throughout Ontario. Rusty crayfish have a high metabolic rate, and consequently consume aquatic plants much faster than native species of the same size. Loss of aquatic plants in areas where this species has become established results in reduction of habitat and food for many aquatic invertebrates and juvenile fish that depend on vegetated littoral areas for habitat. Rusty crayfish also consume large quantities of aquatic invertebrates, fish eggs and young fish and compete directly with native species including juvenile sport fish and forage fish species. Rusty crayfish can become important forage for larger smallmouth bass. Once introduced, Rusty Crayfish are difficult to control.

Rusty Crayfish are known to be found in Basswood Lake at the southern border of Quetico Park , Sand Point Lake, Little Vermillion Lake and Lake of the Woods in FMZ 5.

Spiny water fleas are zooplankton (microscopic animals) that were introduced into the Great Lakes by ballast water discharged from ocean-going ships and have spread to inland water (Figure 3.4-1). They were first discovered in Lake Ontario in 1982, spread to Lake Superior in 1987 and were identified in Saganagons lake within FMZ 5 in 2003, Rainy Lake in 2006 and Lake of the Woods by 2007. Spiny water fleas eat other small zooplankton, including Daphnia, which are an important food for native fishes. In some cases, a decline in the number of small fish, including juvenile sport fish has been documented as result of the invasive. This is believed to be in part attributed to the inability of small fish to feed on spiny water flea as the long spine makes them inedible to fish smaller than 10 cm (3.9 in) In some lakes, they have also caused the decline or elimination of some species of native zooplankton. Spiny water flea feed voraciously on native zooplankton, and in waterbodies where populations are high, consumption can be significant. This in turn places additional pressure on fish populations, including many juvenile fish that feed on zooplankton. Spiny water flea can be a significant threat to biodiversity.

Figure 3.3-1. Hundreds of spiny water flea captured in drift nets in Rainy River 2007.

Spiny water flea are currently (2010) known to be present in the following water bodies: Winnipeg River, Lake of the Woods, Rainy River, Rainy Lake, Namakan Lake, Sand Point Lake (Fort Frances District), Loon Lake and Bisk Lake, Bud Lake, French Lake, Pickerel Lake, Rawn Narrows, Saganagons Lake, Sturgeon Lake, Sydney Lake, and Tanner Lake (Quetico Provincial Park) (Figure 3.3-2).

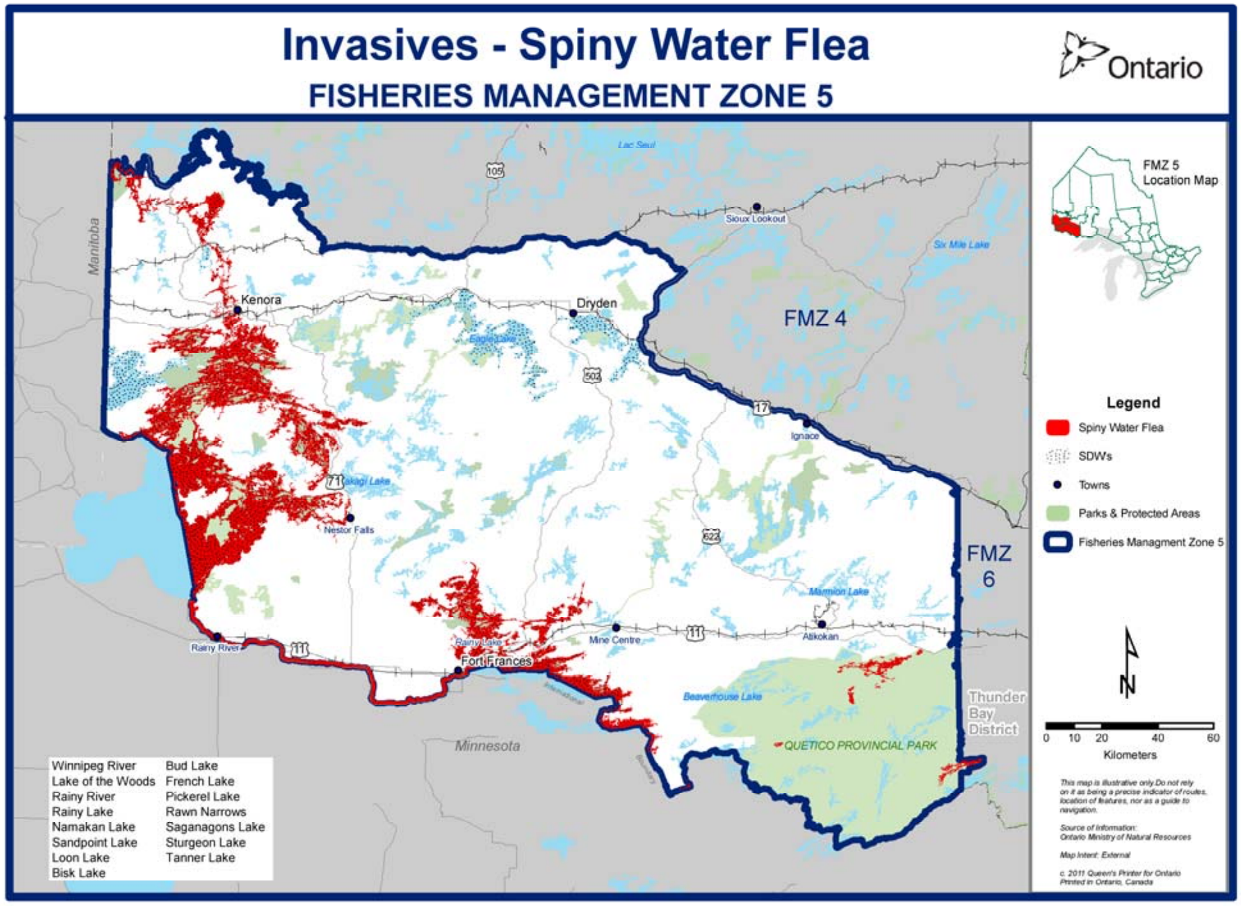


Figure 3.3-2. Known locations of spiny water flea in FMZ 5.

Freshwater jellyfish (*Craspedacusta sowerbyi)* is indigenous to the Yangtze River valley in China, where it can be found in both the upper and lower river valley (Slobodkin and Bossert, 1991). They have been known in Ontario since 1980 (Peard, 2002). They have an erratic distribution and are known to be in several lakes within FMZ5 including Burditt Lake, Lac La Croix, Manitou lakes, Marmion lakes, Namakan Lake and White Otter Lake. They spend most of their lives as relatively non-descript polyps attached to the bottom substrate and only sporadically appear in their most visible "jelly fish" form which makes identification of presence in lakes difficult.

Purple loosestrife (*Lythrum salicaria*) is an invasive wetland plant species that arrived in eastern North America in the early 1800s. Since it was introduced, purple loosestrife has spread westward and is now found across much of Canada. The main concern about this invasive species is degradation and displacement of native wetland plant communities. Wetlands are a very important habitat feature for fish, providing spawning locations for some species and serving to produce biomass which fish consume. Purple loosestrife has a limited but persistent footprint within FMZ 5 being found mainly near Atikokan and west of Fort Frances with some other pockets known along Highway 11 (eg. Price Creek area), in the town of Kenora and along the Winnipeg River. It is largely confined to drier sites and although present in some wetlands, has yet to dominate wetlands plant communities to the degree seen in other locations in North America. In response to the presence of purple loosestrife, OMNR introduced a biological control at some locations and encouraged, and facilitated, active removal of plants.

3.4 Productive Capacity

The productive capacity (or amount of fish that can be produced) of fish-bearing waterbodies is an important biological concept in the management of fish populations. Lakes, rivers and streams have a limited capacity to produce fish that is directly linked to the productivity of that waterbody. Many factors influence productivity including climate (i.e. length of the growing season), nutrients, shape and depth of lakes, natural disturbances on the landscape, and human landscape disturbances including forestry and other land use practices. By measuring a combination of these factors, an estimate of productive capacity can be developed. Knowledge of productive capacity for a group of waterbodies is important in setting user expectations, goals and objectives around allocation and harvest and is the foundation of sustainable fisheries management.

The main physical factors affecting productivity of inland lakes are; 1) temperature (often measured by growing degree days (GDD>5^{o}C)); 2) nutrients measured by total dissolved solids (TDS) in the waterbodies which are influenced by geology, soils, topography, vegetative cover and hydrology of the surrounding watershed; 3) lake shape and depth; and 4) water clarity (measured by secchi depth readings) which is influenced from dissolved organic matter and particulate matter. Table 3.4-1 displays the physical characteristics and associated fish communities typical of lakes found within FMZ 5 compared with other zones in northwest Ontario.

Growing Degree Days >5^{o}C (GDD>5^{o}C) or often just referred to as Growing Degree Days (GDD) are commonly used to in fisheries management to estimate the amount of energy a lake receives by measuring the cumulative amount of temperature throughout the season. The daily GDD value is determined by the difference between the average daily temperature and 5^{o}C. For example, a day with an average temperature of 15^{o}C would have 10 GDD>5^{o}C (15^{o}-5^{o}=10^{o}). The GDD value for the year is calculated by adding together all the daily values for the year. These annual value can be summed for the life of a fish to determine what is known as the Cumulative Growing Degree Days (CGDD) or an estimate of the amount of energy a fish has been exposed to over its life. Lake productivity has been found to be related to the number of growing degree days with warmer conditions resulting in faster growth and earlier maturity for fish (Venturelli et al. 2010).

Table 3.4-1. Average lake characteristics and associated dominant fish communities for lakes in Fisheries Management Zone 5 compared with other FMZ's in northwestern Ontario *(from Cano and Parker 2007).*

FMZ	Dominant Fish Community	Average Depth	Average surface area	Water Clarity	Morphoedaphic Index (MEI*)	Growing Degree Days
5	**Walleye Northern pike Lake Trout Smallmouth Bass**	**Deep**	**Small**	**Clear**	**Low**	**Warm**
2	Walleye Northern pike	Shallow	Large	Stained	High	Cold
4	Walleye Northern pike	Intermediate	Medium	Stained	Intermediate	Warm
6	Walleye Northern Pike Lake Trout Brook Trout	Intermediate	Small	Stained	Intermediate	Intermediate
7	Walleye Northern Pike Brook Trout	Intermediate	Small	Clear	High	Cold

* see text for explanation of how this is determined

Nutrients in lakes and rivers depend on the amount of rainfall, topography and soil characteristics its catchment basin (Wetzel 1975). The glacial history, vegetation types, fire and land use practices in FMZ 5 influence the total dissolved solids (TDS) found within its waterbodies. Lakes overlying ancient glacial lakes such as in the Wabigoon area near Dryden, have greater TDS since the finer particles found in lake sediments are more easily transported and absorbed by the water, while lakes overlying coarser materials or bedrock, typical of many lakes in FMZ 5, have lower TDS levels. Organic inputs of carbon resulting from direct leaf fall and decomposing litter from surrounding vegetation increase nutrient levels. Large influxes of ash and other nutrients can occur following fire disturbances and is an important source of nutrient input in boreal ecosystems (St-Onge and Magnan 2000). Human-caused activities such as forestry practices, agriculture and land clearing also increase nutrient input into lakes and rivers, however these loads can be overwhelming to aquatic ecosystems and often are associated with erosion, sedimentation and increased runoff. As the nutrient levels within aquatic ecosystems increase, so does the productivity of the system. However, too many nutrients (also referred to as eutrophication) can also be a problem and result in reduced abundance or even die-offs of fish. While this can be a major fisheries habitat in some areas, to date this has not been a widespread concern in FMZ 5.

Lake shape, size area and depth affect nearly all chemical, physical and biological parameters of a waterbody. There is a wide variety of lake shapes and size in FMZ 5 which is influenced by how the waterbody was created through glacial process, water movement and the type of soils in the surrounding drainage basin. Shallower lakes with a larger littoral zone (i.e. shallow areas were aquatic plants can grow) are more productive than deep lakes with steep shorelines. This is important to aquatic communities as the littoral zone is the area of greatest productivity in aquatic ecosystems. FMZ 5 lakes generally have greater average depth than other zones in northwestern Ontario (Table 3.4-1) and therefore, tend to be less productive.

Water clarity is influenced by dissolved and particulate matter as well as dissolved organic matter. Turbid lakes with a low secchi depth reading tend to have greater total dissolved solids (TDS) and greater productivity. Lake trout lakes, for example, are generally clear, cold, nutrient poor lakes (low TDS) and light penetrates further into the water column, while walleye/northern pike lakes tend to be coolwater lakes that contain more nutrients and have darker stained waters.

A number of both simple and complex models utilizing many of the attributes described above (temperature, nutrients, lake morphology, water clarity) have been used to estimate productive capacity of aquatic ecosystems. Some of these models are more general in their productivity predictions while others are better at identifying fish production of a particular species or species assemblage. One of the simplest and most common estimates of productive capacity is the Morphoedaphic Index (MEI) which uses the average depth and the amount of nutrients measured by Total Dissolved Solids (TDS) in a simple ratio to predict productive capacity for the entire fish community (MEI = TDS/average depth (Ryder 1965)). This estimate has been partitioned by species in order to get individual species estimates (OMNR 1982). As shown in Table 2.2-2, the productive capacity of FMZ 5 with an MEI of 6.2 is the lowest of the Northwest Region (range of 6.2-24.6) and well below the reginal average of 15.6. This is a reflection of the greater abundance of cold water lakes in FMZ 5.

More recently, two new methods of estimating productive capacity have become commonly used in Ontario. The Lake Trout Life History Model (Shuter *et al.* 1998) uses lake morphology (lake size) and total dissolved solids, two easily measured water body characteristics, to predict productive capacity of lake trout in Ontario lakes. More recently, Lester *et al.* (2004) described a method for determining walleye yield for Ontario lakes based on Thermal-Optical Habitat Area (TOHA) a combination of physical and chemical characteristics including lake size and depth, nutrient levels (TDS), water clarity (secchi) and temperature (GDD>5°C). Information required for all three models are gathered routinely during lake surveys that in the past have followed the Aquatic Habitat Inventory Manual (OMNR 1981). Over 900 lakes in FMZ 5 have had lake surveys conducted on them in the past and therefore productivity estimates can be calculated for these lakes.

Although Aquatic Habitat Inventories are not routinely conducted any more, the new methodology surrounding the Broad Scale Monitoring Program will collect this same information on the selected set of lakes being monitored and will also provide the data that will allow us to see if and how productivity changes over time.

In general based on the physical and chemical characteristics of its lakes, FMZ 5 is the least productive of the zones in northwestern Ontario (Table 3.4-1). However, it is also the warmest zone which may offset some of its inherent low productivity as long as that is not limited by other factors.

3.5 Biological Status

Since the development of standard monitoring techniques in the early to mid-nineties, investigations into the status of fisheries within the province of Ontario have increased. Techniques were developed primarily for walleye, lake trout and bass populations and include Fall Walleye Index Netting (FWIN), Spring Littoral Index Netting (SLIN), Nearshore Community Index Netting (NSCIN), End of Spring Trap Netting (ESTN) and summer and winter creel surveys (see Appendices 3.5-1 to 3.5-3 for list of completed surveys in FMZ 5). The following sections will use the most recent standardized survey data for analysis of the status of fisheries resources by species within FMZ 5. Each species section will present the current status and trend followed by a section describing the data used and how that data was interpreted to come up with the status assessment. In most cases, the status of a species will be assessed relative to fish populations in other parts of the region or, lacking a sufficient regional data set, the entire province.

Starting in 2008, the Broad Scale Monitoring program became the standard monitoring technique for assessing the status of fish populations in Ontario. An assessment of 130 lakes from across the entire FMZ 5 using this technique occurred in 2010 (Appendix 3-4). The results of these surveys will be added as an addendum to this background information document when they become available (final results are currently expected in 2012).

3.5.1 Walleye

3.5.1.1 Population Status and Trend Summary

Walleye Population Status

Data collected from 86 Fall Walleye Index Netting (FWIN) projects conducted on non-SDW lakes in FMZ 5 consistently shows that FMZ 5 has walleye populations with traits that indicate they are at a lower density than other populations in northwestern Ontario with reduced survival to older age classes (Table 3.5.1-1). Data such as the reduced number of larger, older mature fish suggest that some of these differences may be due to higher exploitation levels compared to other parts of the region.

In comparing catch and size of walleye to northwest Ontario benchmarks, 23 (36%) of the populations fall into the medium size and medium catch category with only 5 (6%) of the lakes being classified as having small size and low abundance, the category of highest potential concern (Figure 3.5.1-1). An additional 23 lakes (27%) were classified as either low catch/medium size or medium catch/small size, which suggests an increased level of concern with those populations. Only 10 lakes (11%) had catches that would be classified as high, regardless of the size of fish caught.

In addition to these indicators, walleye from FMZ 5 also tend to be faster growing and mature earlier than other populations in northwest Ontario, both of which can be responses of walleye populations to reduced densities or higher temperatures in this zone. FMZ 5 walleye populations may have a lower capacity for reproduction and recruitment due to having fewer mature fish and as a result, FMZ 5 walleye populations may be more susceptible to additional stressors than other lakes in northwestern Ontario and be providing lower quality angling opportunities.

Table 3.5.1-1. Proportion of FMZ 5 walleye populations compared to the northwest region data benchmarks based on 1993 to 2009 FMZ 5 FWIN projects (number = 86) (benchmarks from Morgan et al. 2003; see text in section 3.5.12. for further explanation).

Indicator	Above average (top 50% of data)	Slightly below average (25-50%ile of data)	Well below average (bottom 25% of data)
Geometric average CUE	**32%**	**27%**	**40%**
Geometric average CUE >450 mm total length	**26%**	**60%**	**14%**
Number of age classes	**37%**	**26%**	**37%**
Maximum age (years)	**51%**	**28%**	**21%**
Spawning Diversity Index	**37%**	**41%**	**22%**

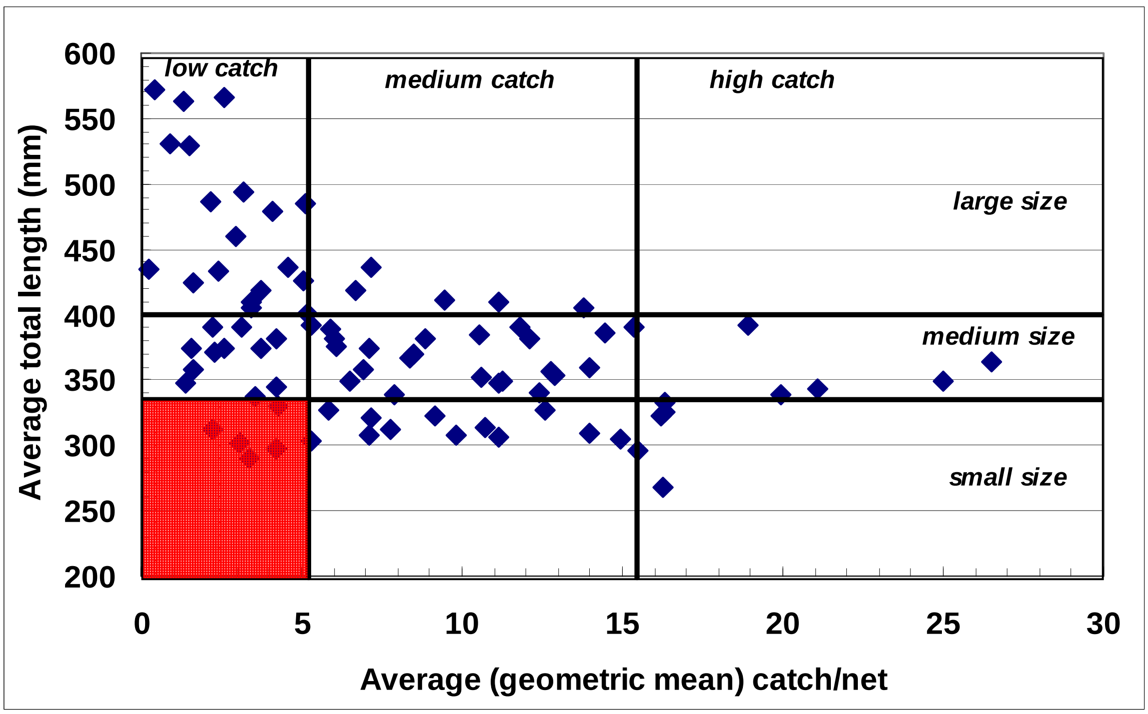


Figure 3.5.1-1. Comparison of walleye catch and size from FMZ 5 lakes (n = 86) netted using the Fall Walleye Index Netting (FWIN) method. Lines show regional benchmarks for catch and size *(from Morgan et al. 2003)*.

Although FMZ 5 walleye populations have signs of stress compared to the rest of the region, they would still be considered healthier than most of those in other parts of the province such as southern Ontario. For example, while the average overall walleye catch/net from FMZ 5 of 7.9

walleye/net is lower than the northwest regional average of 10.7 walleye/net, it is slightly higher than the provincial average (7.5 walleye/net) and higher than both the northeast average (6.4 walleye/net) and the southcentral average (2.8 walleye/net).

Walleye Population Trends

There are seventeen lakes that have been sampled using the FWIN protocol more than once in FMZ 5. These lakes were all in the southeast portion of FMZ 5 so are only representative of trends in that area. The first sampling dates for each lake ranged from 1995-2000, and the second sampling dates ranged from 2000-2009. Although lakes were not all sampled in the same years, these data can be used to get a general impression of changes in walleye populations over time.

Out of these 17 lakes, 8 showed an increase in walleye catch/net of more than 1 per net; 6 showed a decline of more than 1 per net, and 3 remained the same. On average, there was a slight increase in average catch of walleye from this sample of lakes from 7.3 walleye/net to 8.1 walleye/net. In terms of size, 7 of the lakes showed an increase in average total length of more than 1 cm; 7 showed a decrease of more than 1 cm and 3 lakes had walleye sampled that remained the same length. On average, there was a very small decrease in average length from 37.4 cm to 36.9 cm.

Between the two time periods, on the lakes that were sampled twice, the average length of walleye caught remained almost identical while the average catch increased slightly by less than 1 fish/net suggesting that walleye populations are changing very little, if at all, over the approximately 10 years between assessments of this set of lakes (Figure 3.5.1-2).

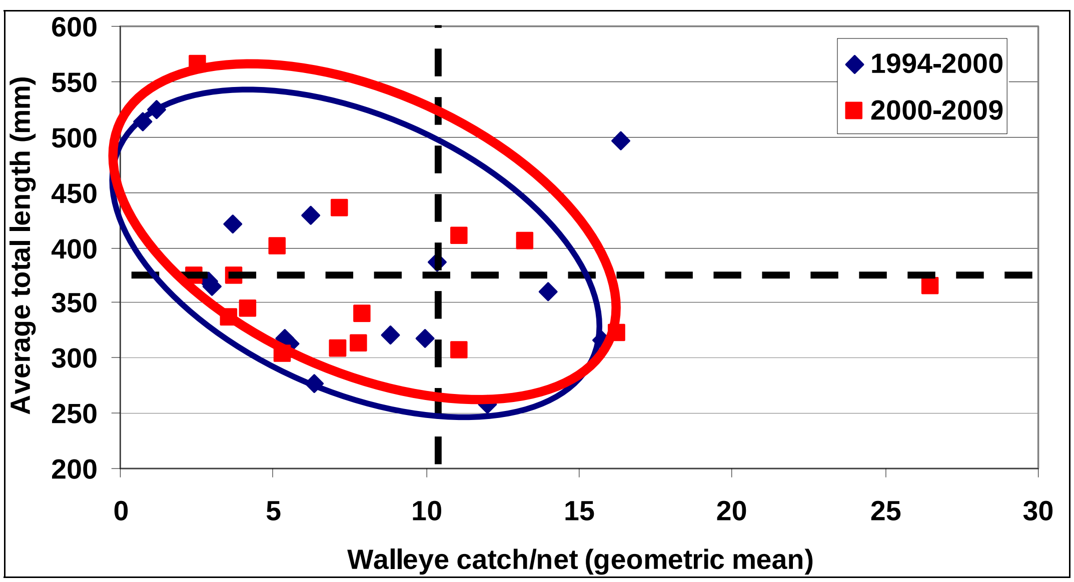


Figure 3.5.1-2 Average total length and catch per net of walleye for FMZ 5 lakes that have been sampled once in the period 1994 to 2000 (blue diamonds) and once between 2000 to 2009 (red squares). Dotted lines indicate the northwest regional average for catch (vertical) and size (horizontal).

3.5.1.2 Walleye Data Analysis and Interpretation

Walleye (*Sander vitreus*) are found in both coldwater and coolwater lakes all across FMZ 5 (Figure 3.5.1-3). Populations of walleye are found in a wide variety of lake types from small lakes with relatively simple fish communities where they might exist as the only predator species to large complex lakes with highly diverse mix of predator and prey species. They are commonly the top predator in coolwater lakes or the coolwater portion of coldwater lakes when they occur there.

Walleye spawn in the spring on in rapids or shallow rock cobble shoals when temperatures reach about 6^{o}C. Walleye are very productive with a 50 cm female walleye from northwestern Ontario producing an average of about 50,000 eggs (Morgan et al. 2003). The eggs receive no adult protection and are dependent upon constant supply of cool oxygenated water for successful hatching. They are very sensitive to siltation at this time of year which can cover the eggs and reduce oxygen levels resulting in high egg mortality. Following hatching, the fry feed on zooplankton and aquatic insects before switching to feeding mainly on fish during the summer of their fist year. Walleye have large, light sensitive eyes that have adapted it to feeding best in low light or stained water conditions (Holm et al 2009). As adults, they feed primarily on fish with yellow perch being a very important part of their diet. In lakes were they coexist with cisco or smelt, these can form an important prey source, particularly with larger fish and can allow fish to reach larger sizes and higher levels of egg production (Kaufman 2009b, Jackson 2010a).

Walleye productivity is affected by a number of factors. Early models were able to approximately predict productivity based on the depth of lakes and the amount of nutrients in the water with shallow lakes with high levels of nutrients being most productive (Ryder 1965). In more recent years, the importance of both temperature and water clarity has become better understood and resulted in new ways to measure walleye from lakes that include all of these factors (Lester et al. 2004).

The method used to assess walleye populations is through conducting Fall Walleye Index Netting (FWIN) projects (Morgan 2002). This standardized netting method consists of randomly placed overnight gill nets set during the fall and allows for comparison among FWIN projects to assess the relative health of the walleye populations. FWINs provide information on walleye abundance, population age and length structure, maturity, mortality, and growth. FWIN projects have been conducted on over 10% of the known walleye lakes across the zone with the heaviest concentration occurring in the southeast area between Fort Frances and Atikokan (Figure 1). There were no FWINs conducted on non-Specially Designated Waters (SDW) lakes in the northwest part of the zone. Much of the fisheries assessment effort has been directed at assessing populations in SDW lakes such as Lake of the Woods and Winnipeg River. Results from Specially Designated Waters are not included in this report because they are managed separately. The results presented below are most reflective of the geography that was sampled, which is closer to the United States border than many of the lakes in the zone.

Morgan et al. (2003) analyzed all FWIN data available across Ontario from 1993 to 2001. They used these data to develop benchmarks by dividing this large dataset into quartiles for both the entire province and the Northwest Region. FWIN data can be compared against these benchmarks for key life history parameters as shown in Table 3.5.1-2 (Morgan et al. 2003). The benchmarks are divided into 3 categories: “above average”, “slightly below average”, and “well below average”. “Above average” includes all data that falls in the upper half of the regional data. This label implies that the population is stable and currently not at risk of overharvest and is not likely experiencing negative habitat impacts. “Slightly below average” includes data that falls in the lower half but above the bottom quarter of the data (i.e. the 25%-50% quartile), and may indicate that these populations are at risk of further declines if additional stresses are added. “Well below average” populations are those that fall in the bottom quarter of data across the region. These populations raise a higher level of concern and may not be sustainable. The low values may be a result of high harvest pressure or lower quality habitat conditions. Some populations categorized as slightly below average or well below average may actually have low values due to the particular naturally occurring environmental conditions in that lake, rather than being a result of overharvest. Regardless of the reason why populations may have low or high values, categorizing the data in this way is useful to determine where FMZ 5 lakes fit relative to the rest of Northwest Region.

Table 3.5.1-2. Northwest region walleye status benchmarks based on 1993 to 2002 FWIN projects (adapted from Morgan et al. 2003).

Indicator	**Above average** (top 50% of data)	**Slightly below average** (25-50%ile of data)	**Well below average** (bottom 25% of data)
Geometric average catch/net	**≥9.8**	**5.1-9.7**	**≤5.0**
Geometric average catch/net >450 mm total length	**≥2.00**	**0.44-1.99**	**≤0.43**
Number of age classes	**≥11**	**8-10**	**≤7**
Maximum age (years)	**≥16**	**13-15**	**≤12**
Spawning Diversity Index	**≥0.77**	**0.59-0.76**	**≤0.58**

The data presented in this section comes from 86 FWINs conducted between 1994 and 2009 on a variety of lakes in FMZ 5. This data been summarized in a report by Cano and Parker (2007) which compares average results between Northwest Region zones. However, the data presented below includes more recent projects for FMZ 5 as well looking at repeated assessments to assess the trend of population status. In addition, the number of lakes assessed within FMZ 5 allows us to look at the range of walleye status conditions for lakes within the zone rather than just an average condition for the zone. When FWINs were conducted on the same lake for multiple years, only the most recent year was used. Data for all parameters was not available for all FMZ 5 FWINs, so the number of FWINs used for each analysis is shown in each graph.

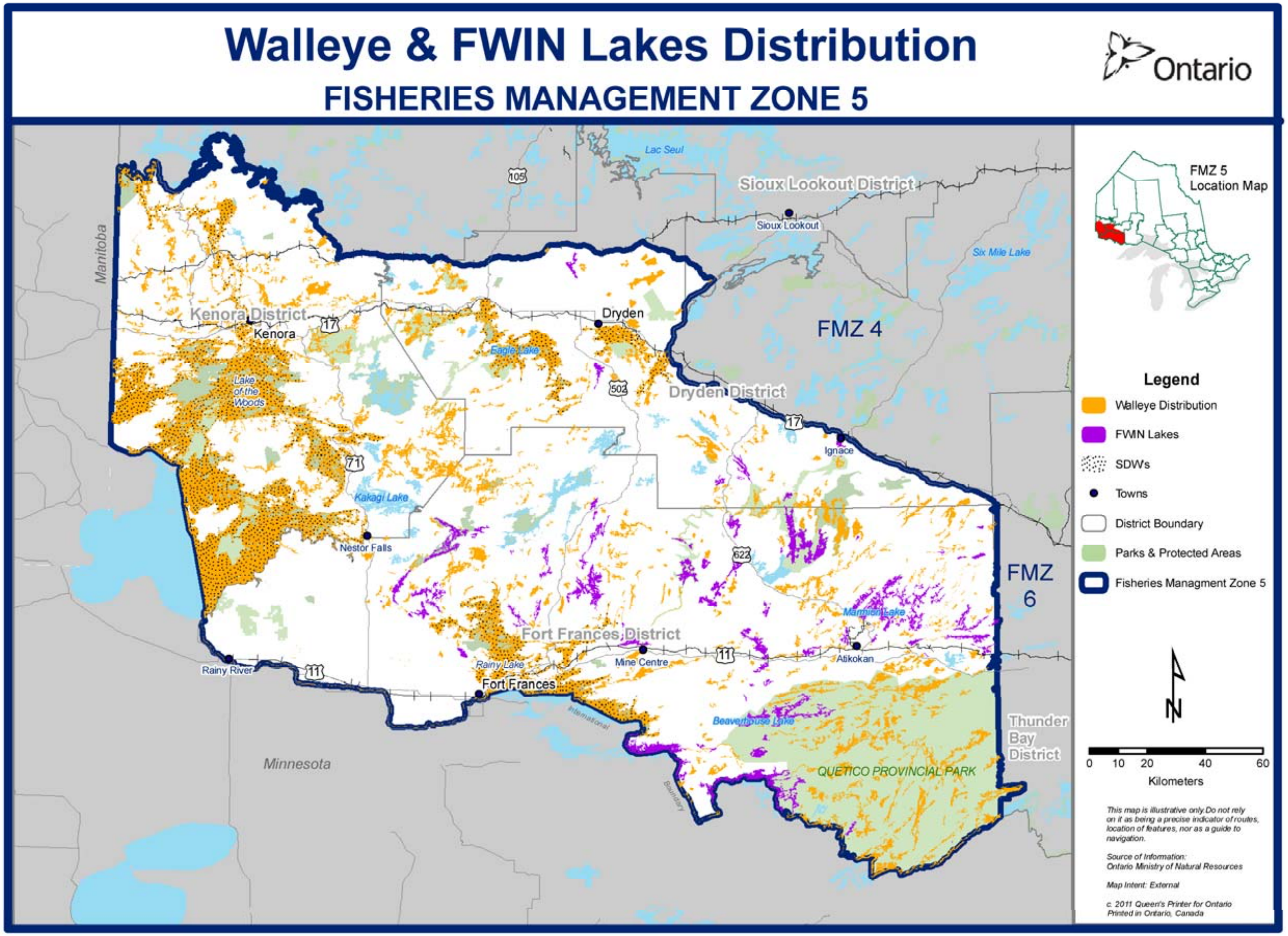


Figure 3.5.1-3. FMZ 5 walleye lakes (non-SDW) that have had Fall Walleye Index Netting (FWIN) surveys conducted between 1994 and 2009.

Abundance

Walleye abundance is impacted by harvest as well as quality or productivity of habitat. Walleye abundance is estimated by the average number of walleye caught per net set also known as catch per unit effort (CUE). Geometric means are used to show the central tendency of the data. Geometric mean catch per net ranges from 0 walleye/net to 26.5 walleye/net for FMZ 5. Of all the FWINs conducted on FMZ 5 lakes, only 32% of the catches were in the upper half of the Northwest regional catch data with the remaining 67% were below the median CUE for the NW region (Figure 3.5.1-4). Only 12% of the FMZ 5 catches were within the top 25% of all Northwest Region's data.

The average CUE value of all FMZ 5 FWINs is 7.9 (+/- C.I.=1.2) walleye per net, which is the lowest of the FMZ's in the Northwest Region (Figure 3.5.1-5). In general, the relatively low abundance of walleye is likely due to high fishing pressure in FMZ 5 in combination with the lower natural productivity of many of its lakes.

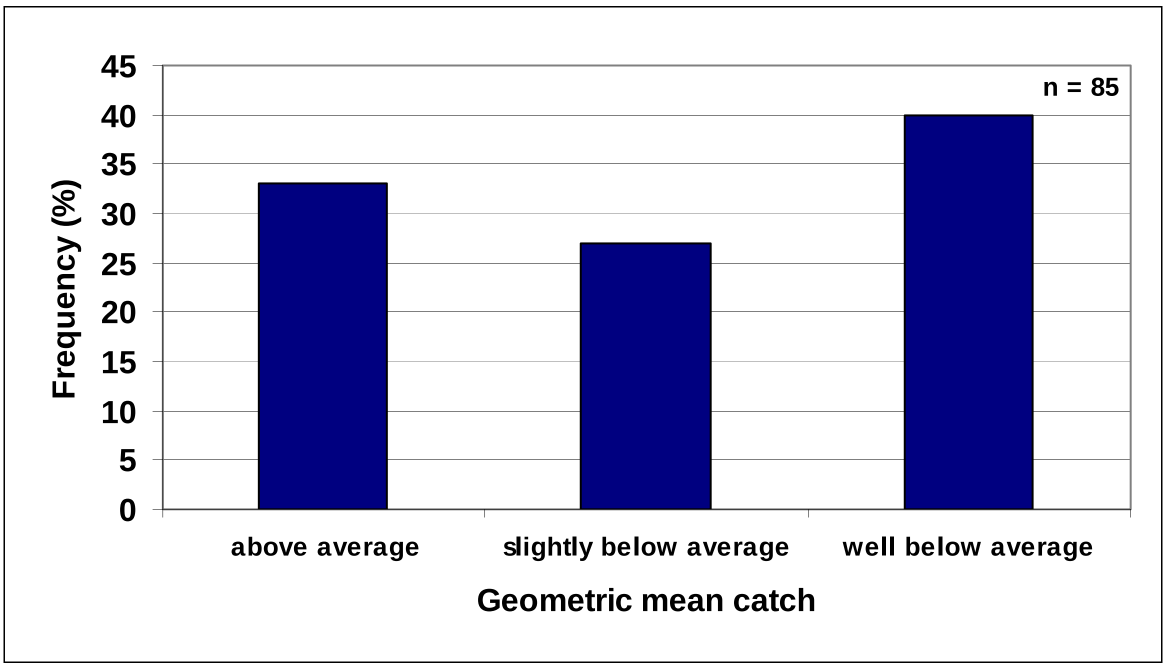


Figure 3.5.1-4. Frequency of average walleye catch (geometric mean #/net) from FMZ 5 FWIN surveys relative to the benchmarks for Northwest Region.

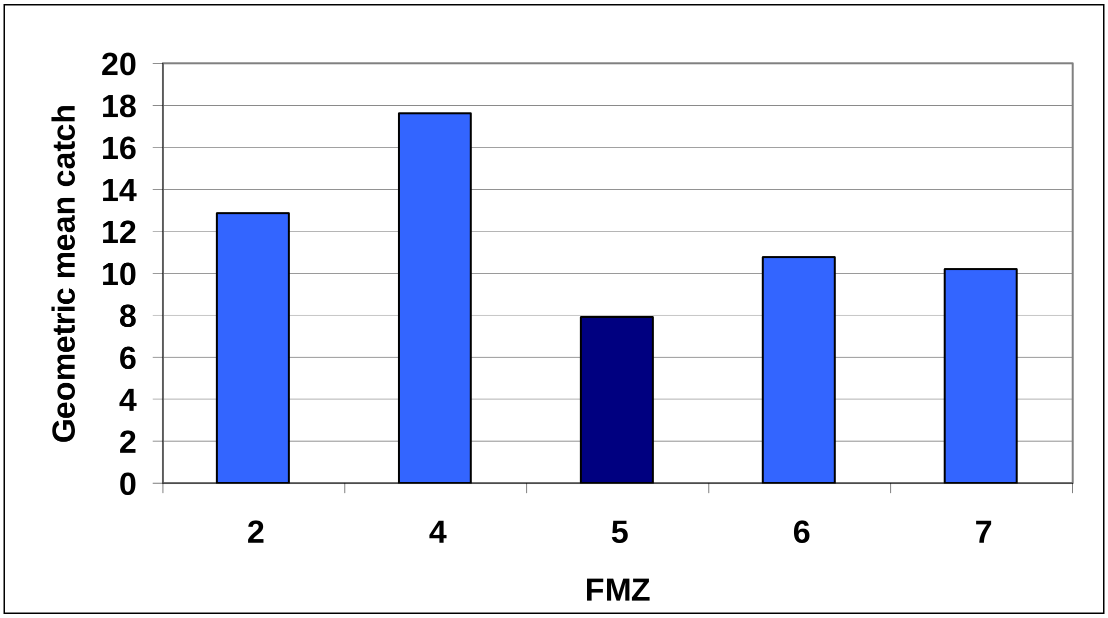


Figure 3.5.1-5. Average Fall Walleye Index Netting (FWIN) walleye catch per net (geometric means) for Fisheries Management Zones in the Northwest Region (average regional catch is 10.7 walleye/net).

The average catch of walleye >450 mm in total length has been used to estimate the proportion of mature female walleye in the population. The majority (60%) of FWINs in FMZ 5 resulted in catches of walleye >450 mm that fell within the slightly below average category compared to the rest of the region (Figure 3.5.1-6). Compared to other FMZs, FMZ 5 has the lowest average catch of walleye larger than 450 mm (Figure 3.5.1-7). This finding suggests that mature female walleye may be less common in FMZ 5 compared to the rest of the region. This may reflect higher mortality from angling harvest and one of the consequences of this may be a lower ability to reproduce and reduced population stability.

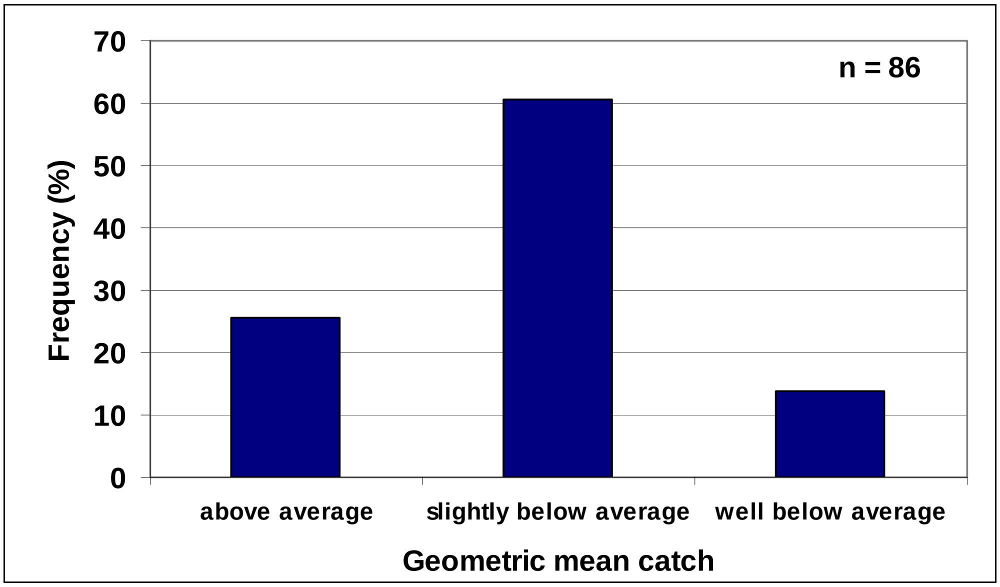


Figure 3.5.1-6. Frequency of FMZ 5 FWINs with average catch of walleye >450 mm total length compared to the benchmarks for Northwest region.

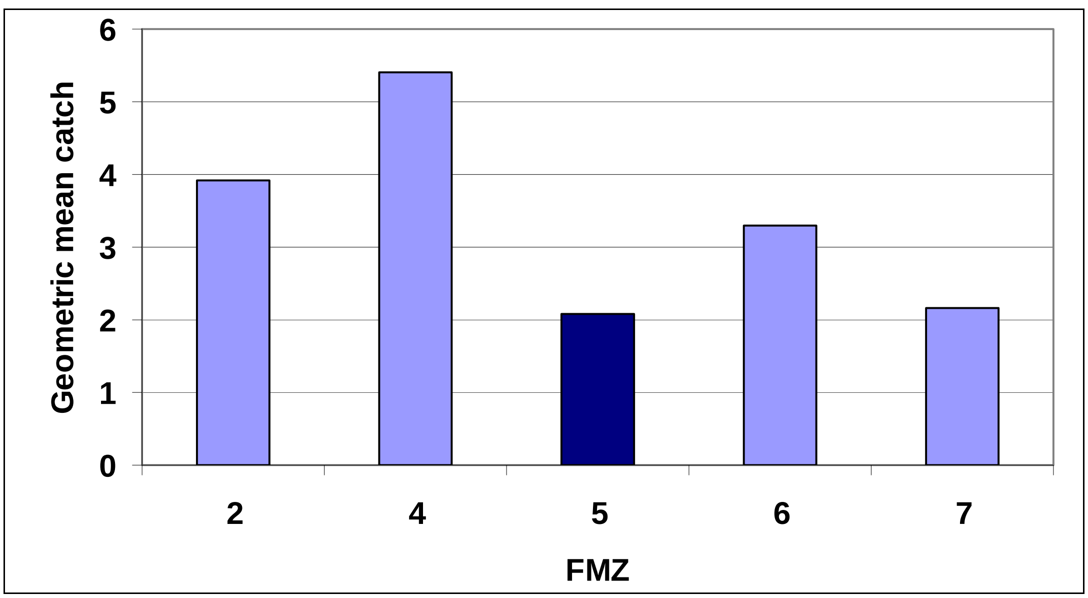


Figure 3.5.1-7. Catch per net of walleye greater than 450mm total length by Fisheries Management Zone.

Age

Average age, number of age classes and maximum age of fish sampled through the FWIN program provide indicators of a population's ability to reproduce and sustain itself. Healthy walleye populations typically have more age classes than unhealthy walleye populations. The number of age classes is lower if mortality is high or if there is weak recruitment. Regional FWIN benchmarks categorize lakes based on the number of walleye age classes observed and the maximum age in the catch (Table 3.5.1-2). FMZ 5 FWINs have shown a range of 2 to 16 age classes, with the average of 8 age classes (Figure 3.5.1-8). Compared to number of age classes observed in FWIN's across the Northwest Region, approximately 25% of FMZ 5 lakes were above average, 50% were slightly below average, and 25% were well below average (Figure 3.5.1-8). The maximum age of walleye observed in FMZ 5 ranged from 3 years to 24 years, with an average of 14. The observed maximum age also suggests that more FMZ 5 walleye populations are younger with lower survival to older ages; compared to rest of northwestern Ontario, 26% were above average, 22% were slightly below average and 52% of walleye populations from FMZ 5 lakes were well below average (Figure 3.5.1-9).

Compared to other FMZs in the Northwest Region, FMZ 5 has the lowest number of age classes older than 10 years of age, lowest total number of age classes, and lowest maximum age (Figure 3.5.1-10). These results also suggest that walleye populations in FMZ 5 are more exploited with lower survival of walleye into older ages than other FMZs in the Northwest Region.

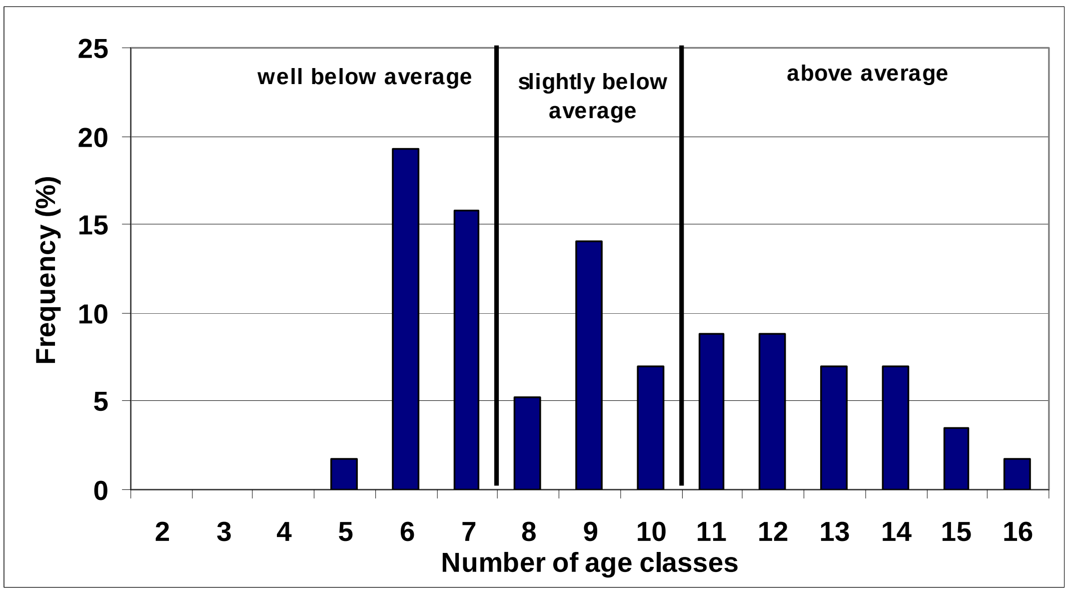


Figure 3.5.1-8. Frequency of observed number of walleye age classes observed in FWINs from FMZ 5 relative to benchmarks for the Northwest region *(note: only data from lakes that aged more than 50 walleye shown – number of lakes = 57).*

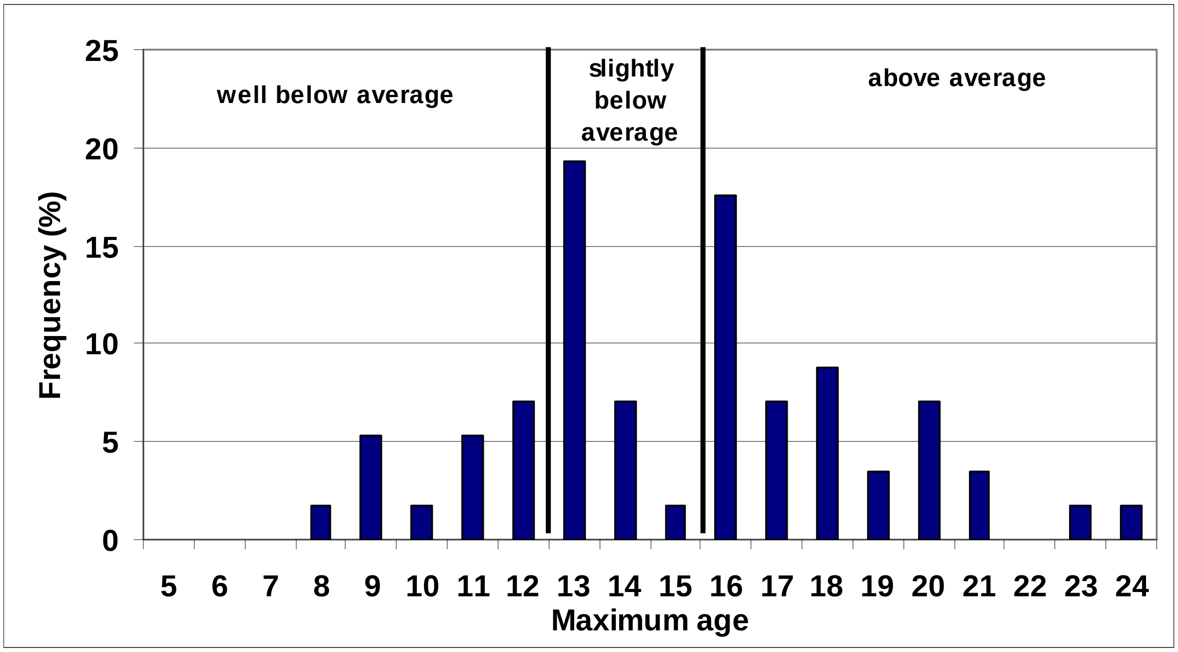


Figure 3.5.1-9. Frequency of maximum age of walleye observed in FWINs from FMZ 5 relative to benchmarks for the Northwest region (note: only data from lakes that aged more than 50 walleye shown – number of lakes = 57).

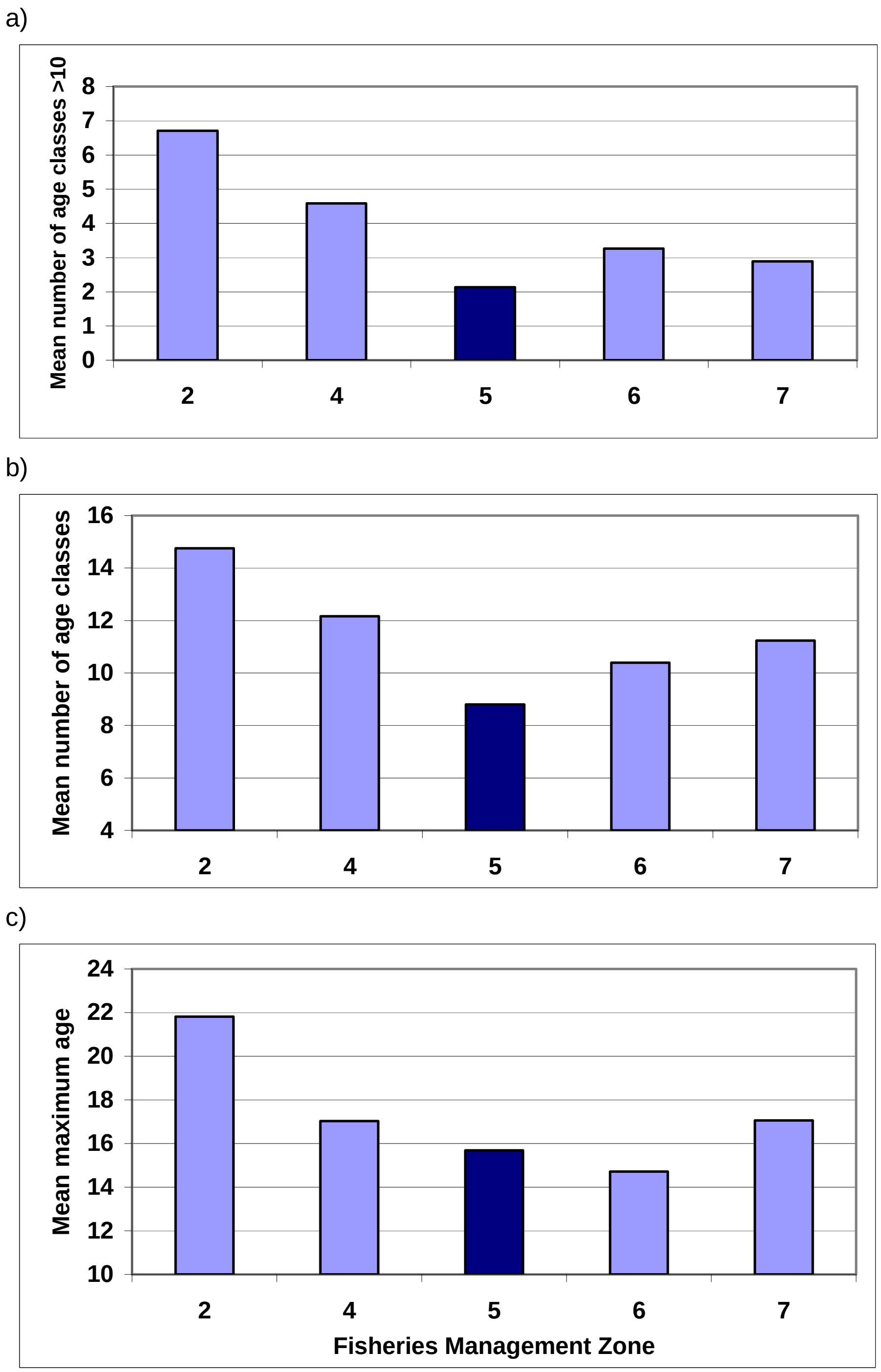


Figure 3.5.1-10. Northwest Region average FWIN data for a) average number of age classes >10 years, b) average total number of age classes, and c) average maximum age for walleye by Fisheries Management Zone.

Growth and Maturity

Growth rate of fish is impacted both by the physical environment, and the amount of food resources. Temperature has been demonstrated to be important in determining how fast walleye grow and variation in temperatures between years have been found to change walleye growth rates (Venturelli et al 2010). The abundance of food resources depends partly on the number of predators feeding on these resources. When there are fewer predatory fish, there is generally more prey available for the remaining fish. In walleye populations with low abundance, more food may be available for each walleye causing faster growth. Therefore, fast growth rates can indicate a population with a low density which may be a result of high exploitation. Other species which compete with walleye for food resources and the physical environment must also be considered because optimal conditions can speed growth.

FMZ 5 lakes exhibit a range of walleye growth rates, with the average total length at age 2 varying from 210 mm to 403 mm. The average for FMZ 5 lakes was a total length of 312 mm at age 2. When compared to other FMZs in the Northwest Region, FMZ 5 has the largest total length at age 2, indicating the fastest growth (Figure 3.5.1-11). This fast growth rate is likely due to some combination of lower walleye densities, possibly from higher exploitation and/or lower productivity lakes and a favourable growing environment due to warmer temperatures.

Similarly, when fish grow faster, they also tend to mature earlier. Early maturity can be an indicator of a low density population or favourable environmental conditions. For both males and females, the average age at maturity was lower in FMZ 5 than in any of the other FMZs (Figure 3.5.1-12). This result may reflect the FMZ 5 having a lower density of walleye than other zones.

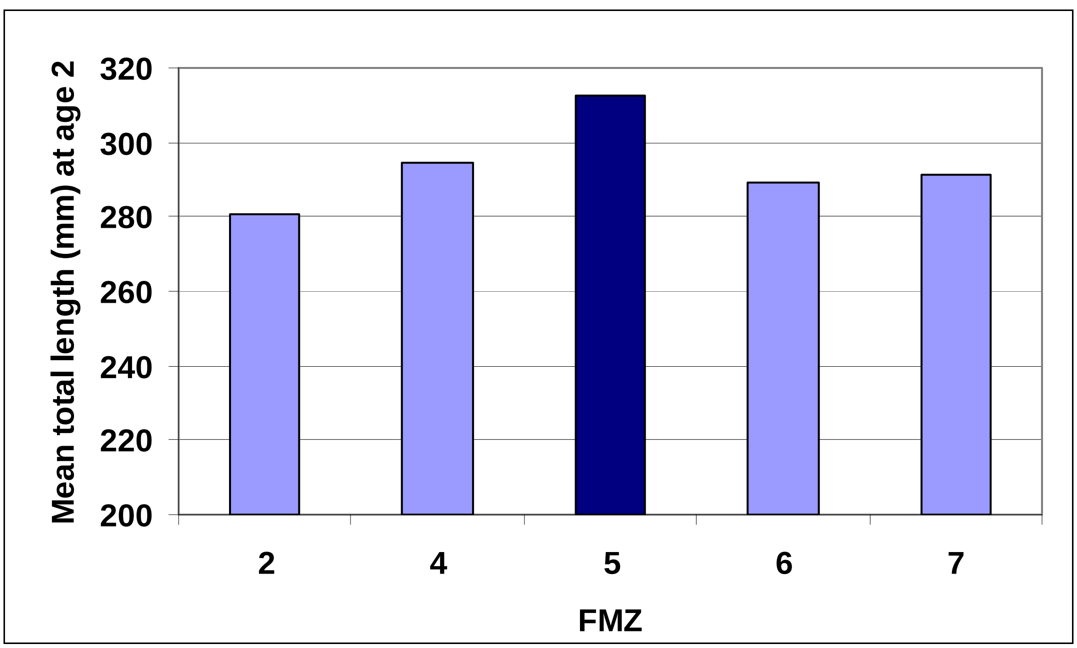


Figure 3.5.1-11. Average length of walleye at age 2 by northwestern Ontario Fisheries Management Zone.

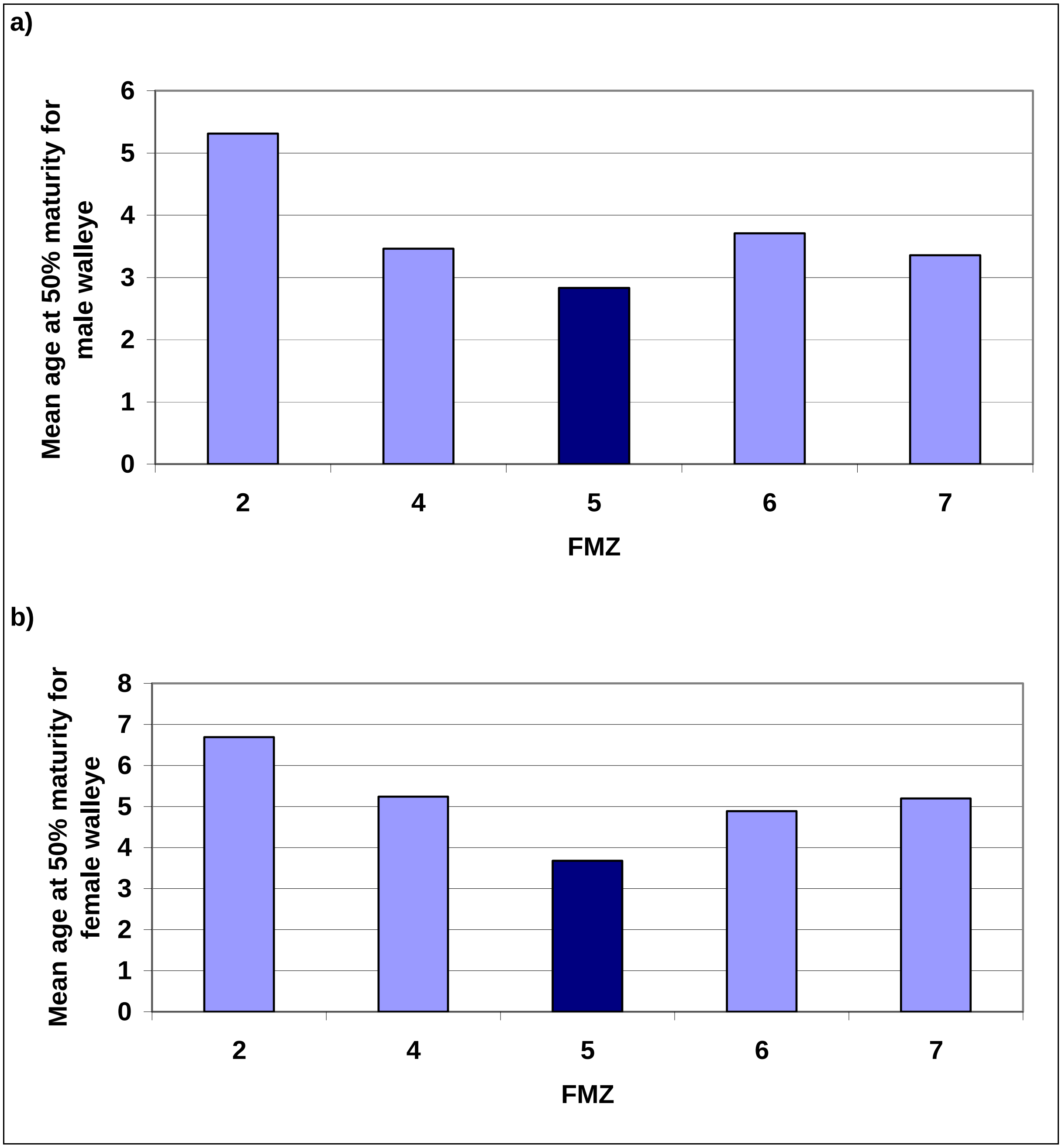


Figure 3.5.1-12. Average age of 50% maturity of a) male and b) female walleye by Northwest Region Fisheries Management Zone.

Mortality

The Robson-Chapman mortality rate estimates the proportion of a population that dies each year, both from exploitation and natural causes. Mortality rates were highest for FMZ 5, 6, and 7, and lowest in FMZ 2 (Figure 3.5.1-13). The more accessible zones (5, 6, 7) receive greater fishing pressure, which contributes to the high mortality observed compared to the more remote lakes of zones 2 and 4. Warmer temperatures also result in higher natural mortality and would expect to see slightly higher mortalities from temperatures impacts alone in FMZ 5 walleye populations (Lester 2000). The upper limit of safe mortality rates for FMZ 5 has been estimated to be approximately 40% ((Lester 2000).

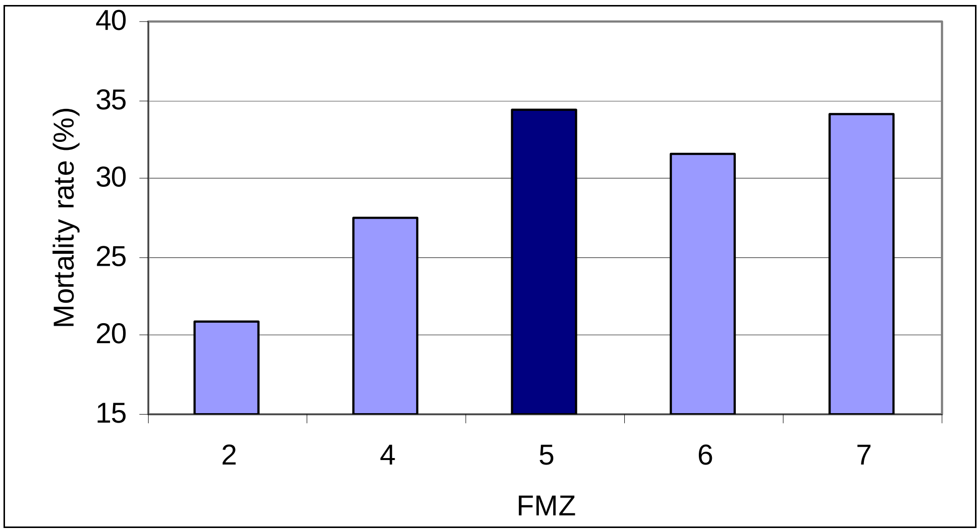


Figure 3.5.1-13. Average mortality rates of walleye by northwestern Ontario Fisheries Management Zones.

Female Spawning Diversity Index

The Spawning Diversity Index measures the number and abundance of age classes of mature female fish in a population. Populations with a good number of mature females spread across several age classes have a higher Index value and are considered more stable with a greater ability to sustain itself into the future. For FMZ 5, 44% of the walleye populations were in the above average category, with 19% in the below average and 37% of the populations in the well below average category. The average Spawning Diversity Index for all FWINs in FMZ 5 is 0.57 which is usually considered stressed. When compared to other FMZs in northwestern Ontario, FMZ 5 has the poorest Spawning Diversity Index (Figure 3.5.1-14). These results suggest that FMZ 5 is the zone in Northwest Region with the least stability for reproduction and sustaining itself through population stresses into the future and, as with many of the other indicators, reflects the lower survival of fish into older age classes.

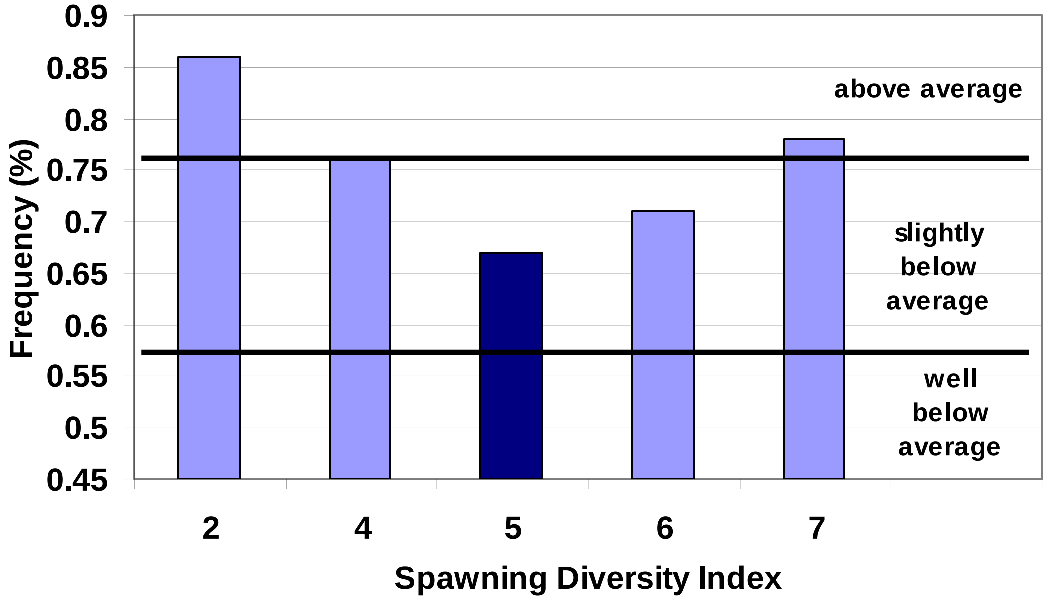


Figure 3.5.1-14. Average Spawning Diversity Index by Northwest Region Fisheries Management Zone.

3.5.2 Lake Trout

3.5.2.1 Population Status and Trend Summary

Lake trout monitoring in FMZ 5 has been primarily by Spring Littoral Index Netting (SLIN), a method that uses small mesh gill nets set for short duration (90 min) in the spring to capture fish while attempting to limit mortality. Thirty three lake trout assessments on 23 lakes have been conducted since 1993 in FMZ 5 with the majority having occurred in the southeast area of the zone (Figure 3.5.2-1).

Lake Trout Population Status

From the results of the SLIN assessments, the abundance of mature lake trout was estimated using methods provided by Janoscik and Lester (2003) and compared to what the expected abundance would be if populations were being harvested at maximum sustainable level, as shown in Figure 3.5.2-2 below. The graph includes a reference line indicating what the expected abundance would be if lake trout populations were harvested at the maximum sustainable level. Expected abundance decreases as size of fish in the population gets larger implying that a population of small size fish would need to have higher abundance to be considered healthy than a population of very large sized fish. The management objective is to maintain lake trout numbers above this line, and the position of points relative to this line indicates the status of the resource (Janoscik and Lester 2003). The results from the FMZ 5 surveys indicate that the majority of lakes that were assessed (16 of 19 or 84%) have higher abundance than the threshold level suggesting that they are being harvested at sustainable levels.

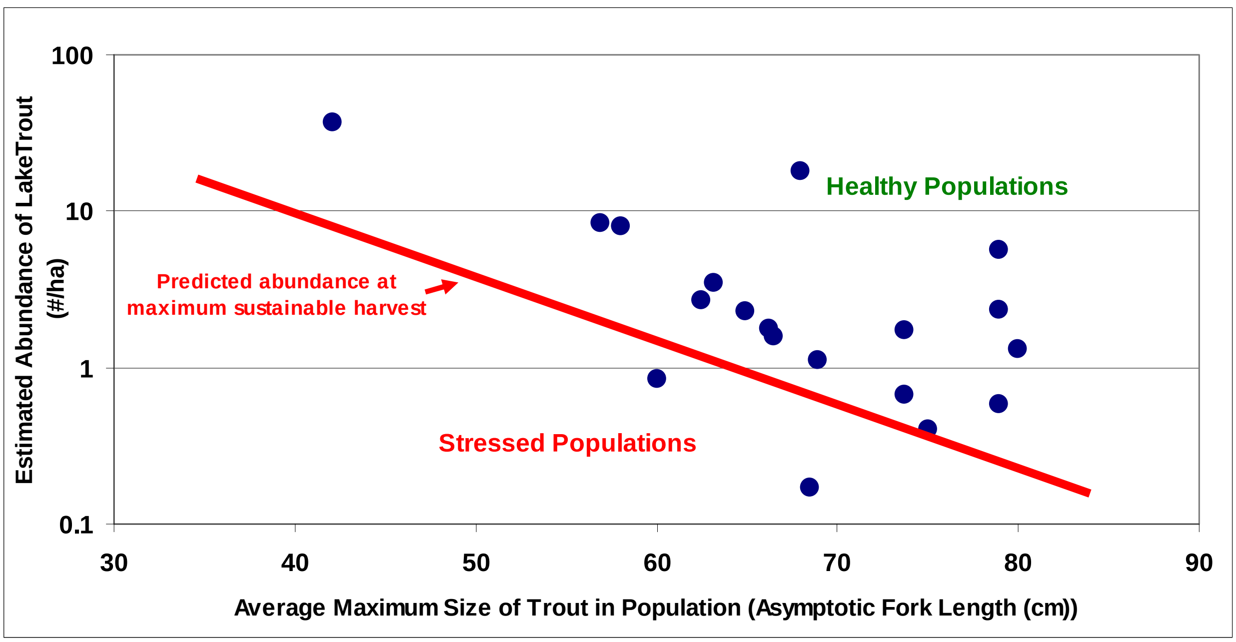


Figure 3.5.2-2: Estimated abundance of lake trout vs. expected density at sustainable harvest level for 19 lake trout populations assessed using Spring Littoral Index Netting (SLIN) from Fisheries Management Zone 5 1993-2010.

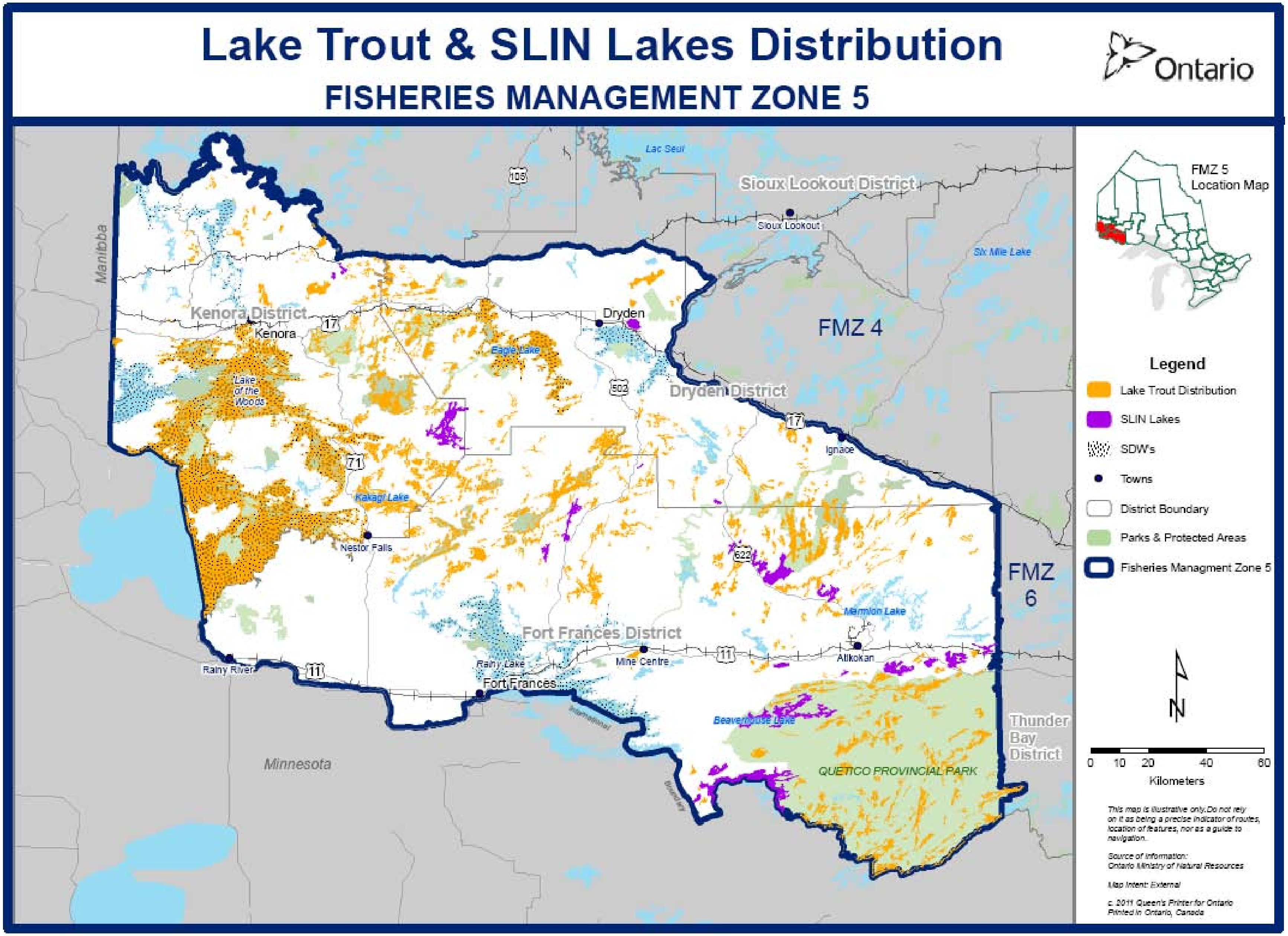


Figure 3.5.2-1 Distribution of lake trout lakes in Fisheries Management Zone 5 with lakes assessed between 1993 and 2010 identified..

Lake Trout Population Trends

Lake trout data collected by the Atikokan Area MNR from 1993 to 2010 is the only data set in FMZ 5 that provides information on how a lake trout population may have changed over time where 8 lakes were assessed between 1993 and 2000 and then again between 2003 and 2010. The results of those assessments have been used here. It is expected that as stresses on lake trout populations increase to unsustainable levels, this would be reflected in a decrease in the number of lake trout caught per net or the size of trout caught or both.

As shown below, in Figure 3.5.2-3, several of the Atikokan lakes have experienced a decline in abundance. In the first round of assessments from 1993 to 2003, all the catches were in the medium to high range. In the second round of assessments from 2004 to 2010, of the 8 sampled, only 1 is in the high ranges, and 4 (50%) have dropped to the low catch range. In terms of size, there has been a shift from small to medium size fish in the earlier assessments (6 of the 8 lakes) with only 2 lakes in the large size range, to medium to large fish (7 of the 8 lakes) in the most recent assessments, with only 1 lake having fish in the small size range.

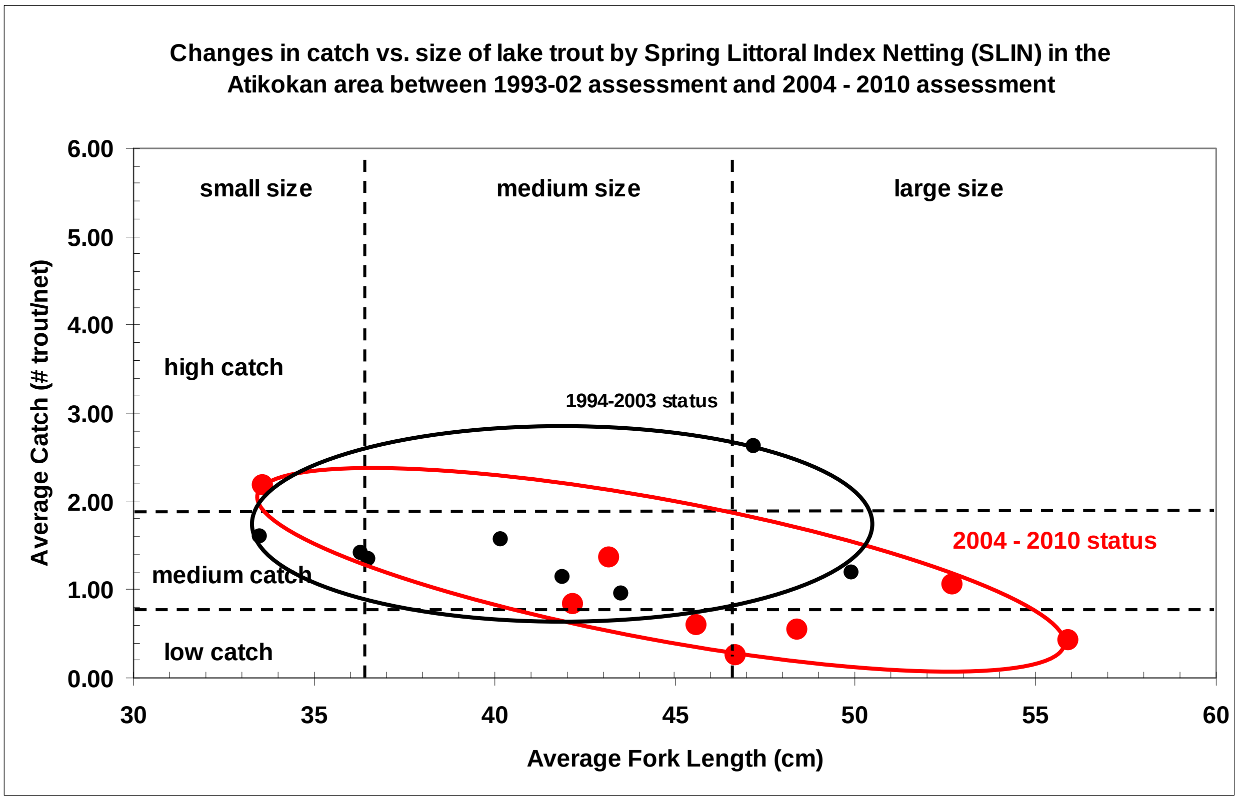


Figure 3.5.2-3: Changes in catch vs. size of lake trout by Spring Littoral Index Netting (SLIN) in the Atikokan area between 1993-2002 assessment and 2004-2010 assessment periods

Results indicate that the majority of the lakes (10 of 12 or 83%) continue to have higher abundance than the threshold level, suggesting that they are being harvested at levels below the maximum sustainable level. It should be noted, however, that 4 of these have dropped closer to the maximum sustainable level, and 2 have dropper further below than before. This trend indicates that these lakes are being exploited very near to or above the maximum sustainable level and are stressed. These lakes are likely to become overexploited in the future unless management action is taken.

3.5.2.2 Lake Trout Data Analysis and Interpretation

FMZ 5 has more lake trout lakes than any other zone in the province. Of the 888 lake trout lakes in the Northwest Region, 63% (562) fall within FMZ 5. These lakes in FMZ 5 also account for 27% of the provincial total. Of the 2074 natural LT lakes in Ontario, 888 are found in the Northwest Region, 817 in the Northest Region, and 369 in the South Region (OMNR 2005). Lake trout lakes occur across the vast majority of FMZ 5 (Figure 3.5.2-1) and are an important sport fish, particularly in winter and spring.

Lake trout (*Salvelinus namaycush*) are found primarily in deep cold lakes within FMZ 5. Populations of lake trout within the zone are diverse; some may exist exclusively as the top predator in association with other coldwater fish species (i.e. lake whitefish, cisco), they may be found in small, cold waterbodies with little to no additional fish community structure where they feed on zooplankton and invertebrates, and they may also be found in waterbodies containing both cool water and coldwater communities where they exist alongside other predatory fish species such as northern pike and walleye (Scott and Crossman 1973). All of these community types have the capacity to produce sustainable lake trout populations; however it is within the simple coldwater fish communities often found in small, deep lakes that lake trout populations reach highest abundance in the absence of coolwater competitors and predators (Vander Zanden et al. 1999).

Lake trout have strict habitat requirements of deep, cold, well-oxygenated lakes with clean, windswept rock rubble shorelines for spawning. Mean depth for lake trout lakes in FMZ 5 is 12 m, compared to 7.8 m for walleye lakes, with a maximum depth of 115.2m. Lake trout spawn in the fall when water temperatures drop from 10-14°C and disperse after spawning (Scott and Crossman 1973). The type of lakes that provide this habitat (also known as oligotrophic lakes) tend to be very unproductive and low in nutrients.

Lake trout are able to survive in these low productivity environments due to a variety of unique adaptations such as being slow growing, late maturing, long living and reaching large body size that allows them to survive on limited resources. These traits limit how fast they can reproduce and ultimately how many young fish can be produced. Ultimately the slower reproductive rates limit the number of fish that can be harvested sustainability from a population. They also have a highly adaptable feeding behaviour and can shift their forage from zooplankton to insect larvae to fish depending on the availability of prey. As a result, lake trout may be found at various levels within the food chain depending on the community of prey within a waterbody (Vander Zanden et al. 1999). Lake trout that are found in lakes with prey fish species such as cisco or lake whitefish are piscivorous (fish eating), while lake trout found in lakes without prey fish species are planktivorous (zooplankton eating) and are generally smaller and have slower growth rates.

Despite having varied and flexible foraging behaviour, lake trout are very susceptible to disturbances. Their specific habitat requirements make lake trout sensitive to habitat change. Populations in northwestern Ontario have been impacted over the years by overexploitation and non-native fish introductions. Increased productivity in lakes due to nutrient runoff from residential, cottage or commercial septic systems or agriculture can also negatively impact lake trout populations. The increase in nutrients can result in a greater amount of algae and other organisms in a lake which, as the die and decompose, can reduce the amount of oxygen in deep, cold waters where it is required by lake trout. Shoreline developments such as docks, boathouses, artificial beaches or nutrient run-off can also result in degraded or lost spawning areas.

Lake trout monitoring by the OMNR has been composed of two monitoring protocols: Spring Littoral Index Netting (SLIN) and Summer Profundal Index Netting (SPIN). Both netting assessments have been conducted on a relatively small number of these lakes across the zone. Forty two lake trout assessments (33 SLIN's and 9 SPIN's) have been conducted since 1993 in FMZ 5 with the majority having occurred in the Atikokan area. For the purposes of reporting, only SLIN results will be discussed here.

The SLIN netting protocol attempts to limit mortality of lake trout through the use of short (90 minute) sets of 90 m nets which use small mesh ranging from 38mm (1.5in) to 64mm (2.5in) (Hicks 1999). The intent of the short sets of small mesh nets is to entangle the fish allowing them to be released after sampling rather than killing them through gilling. These nets are set perpendicular to shore during the spring (water temperatures less than 13^{o}C) when lake trout are expected to be actively foraging in shallow water and more randomly distributed along the shorelines of the lake. SLIN's provide some information on lake trout abundance, population structure, maturity, mortality, and growth. As a result of minimizing mortality however, the protocol also limits the amount of information collected from each fish and makes it harder to get a clear picture of the status of these populations as compared to other methods such as the FWIN protocol used to assess walleye status (Cano and Parker 2007). In addition, lakes were not randomly selected for SLIN assessment but were selected to provide a range of lake community types and sizes from lakes where active sport fisheries were present (i.e. lakes where current trout populations did not support a sport fishery are not part of this data). The results presented below are most reflective of the geography and lakes that was sampled.

Size

The average fork length from the 26 lakes from FMZ 5 assessed by Spring Littoral Index Netting (SLIN) was 45.3 cm, with average sizes in individual lakes ranging from a minimum of 32.8 cm to a maximum of 59.7 cm (Figure 3.5.2-4). This demonstrates the wide range in LT size across FMZ 5, likely as a result of different prey communities, lake productivity, and exploitation levels.

To look at the impact of prey community on the size of lake trout, information from all fifty-eight lake trout assessment projects conducted in the Northwest Region were grouped according to prey type in the lake; either piscivorous (i.e. lake trout feeding mainly on cisco, lake whitefish, or rainbow smelt) or polyphagous (mainly feeding on invertebrates but also includes feeding on nearshore fish community such as minnows and perch). Seventy-six percent of the lakes assessed were piscivorous lakes. The average length of trout in piscivorous lakes were found to be significantly larger at 46.8 cm as compared to 37.4 cm in polyphagous populations (Figure 3.5.2-5) (Cano and Parker 2007). This larger body size translated to differences in round weight with piscivorous populations weighing approximately 700 g more than polyphagous populations (Cano and Parker 2007). In the lakes assessed in FMZ 5, the majority of lakes (91%) were piscivorous populations. Another factor that may be affecting size of lake trout in FMZ 5 is the presence of rainbow smelt. The three lakes that had smelt as a prey species all had average lengths of lake trout greater than 52 cm.

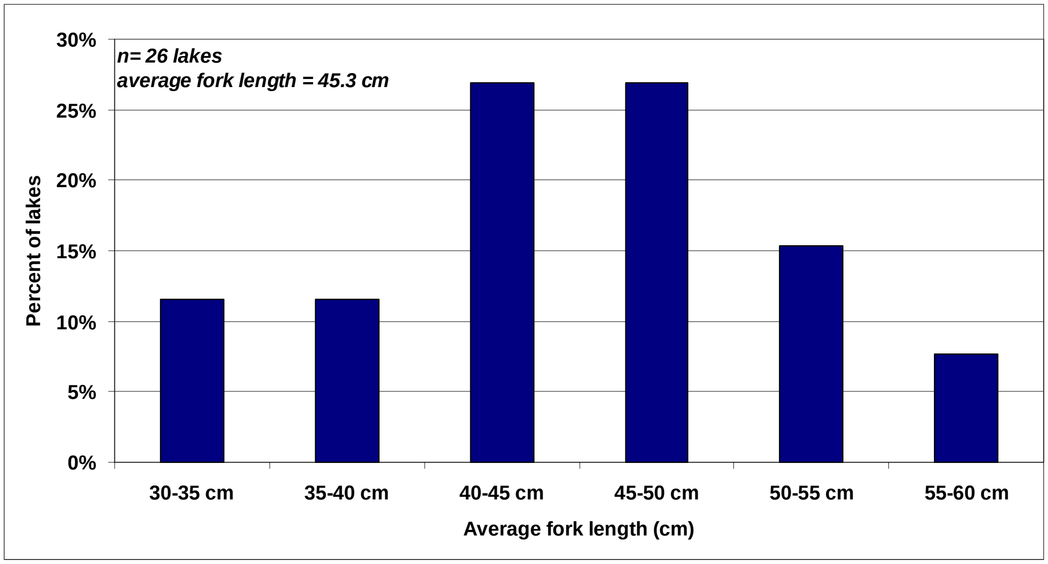


Figure 3.5.2-4. Frequency of observed average length of lake trout from FMZ 5 lakes netted using the Spring Littoral Index Netting (SLIN) method (1993 - 2010)

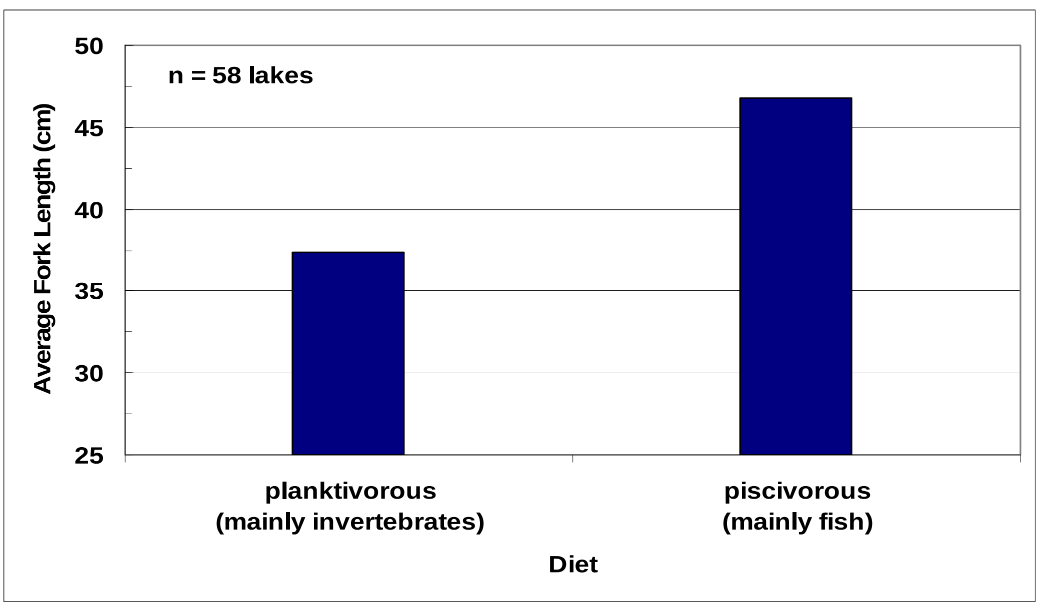


Figure 3.5.2-5: Average fork length of lake trout in piscivorous and polyphagous in Northwest Region (adapted from Cano and Parker 2007).

Maturity

Maturity of a given lake trout population can be estimated from the percentage of fish in a sample older than age 7. Age 7 is used as the threshold as it has been found that 50% of lake trout in northeast Ontario are sexually mature by age 7 (Selinger et al. 2006). In the sample of FMZ 5 lakes, 15 of the 20 lakes (75%) had populations with greater than 50% mature fish in the catch (Figure 3.5.2-6). Nine of the 20 lakes (45%) had populations with greater than 75% mature fish.

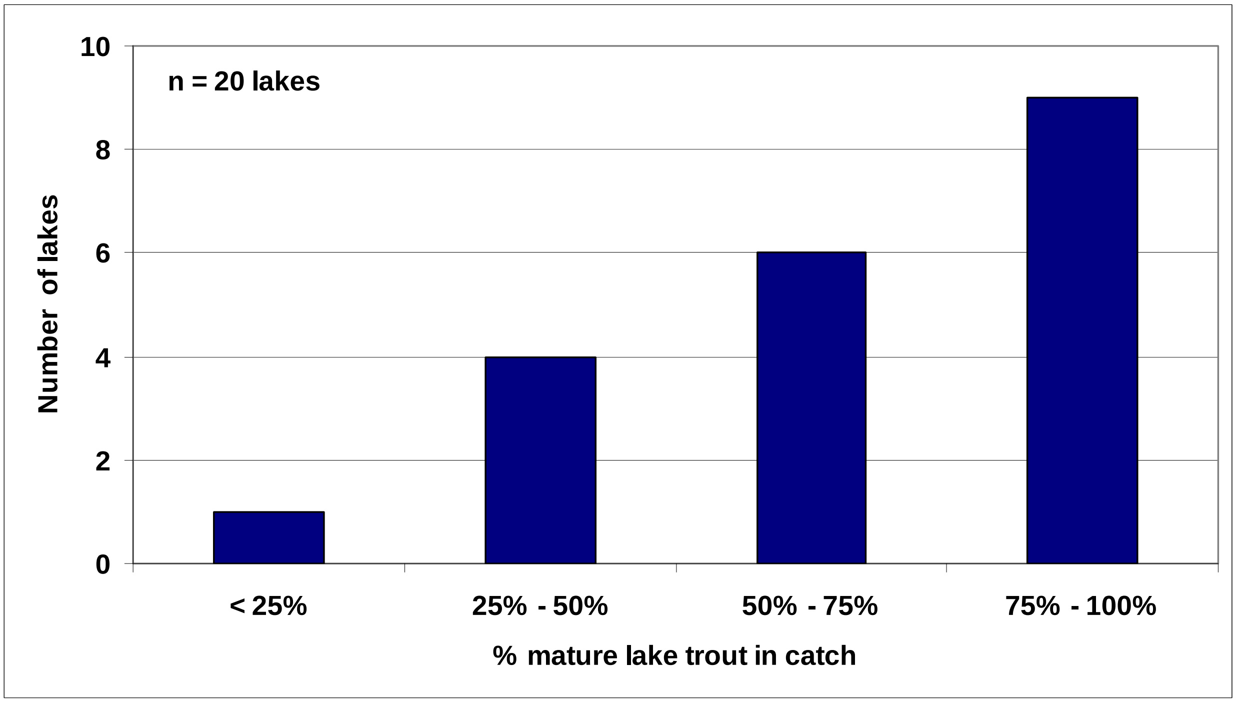


Figure 3.5.2-6: Proportion of mature lake trout in catch (defined as older than age 7) from Spring Littoral Index Netting (SLIN) for FMZ 5 lakes (1993-2010).

Abundance

Estimating catch per unit of effort (CUE) is the simplest method of estimating abundance of lake trout populations. From the 26 lakes in FMZ 5 for which SLIN data was available, the average CUE was 1.54 lake trout caught per net. CUE among these lakes ranged from a low of 0.25 trout/net to a high of 5.54 trout/net, with catches in most lakes ranging between 1 to 2 trout/net (Figure 3.5.2-7). As the results indicate, abundance of lake trout is quite variable across the FMZ 5 landscape. A number of factors can influence abundance of lake trout including angling harvest, fish community and habitat conditions in the lake.

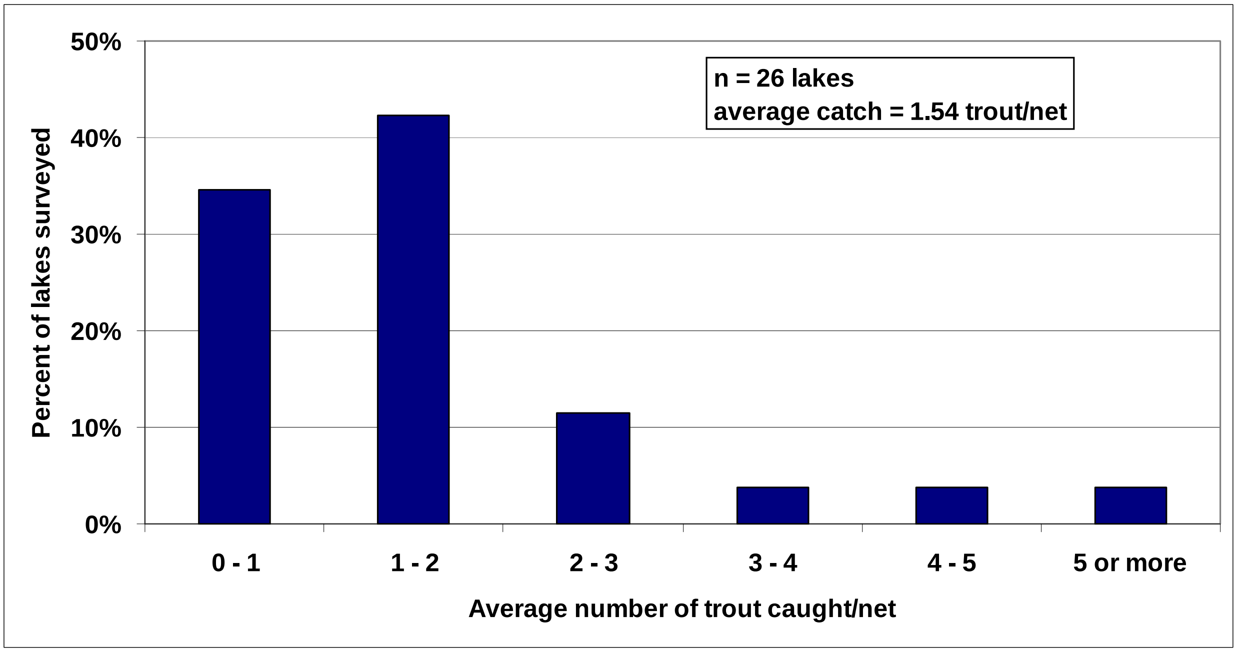


Figure 3.5.2-7: Spring Littoral Index Netting (SLIN) catch of lake trout for FMZ 5 lakes (1993-2010)

The catch (lake trout caught per net) and size of lake trout from FMZ 5 lakes can be compared to catch and size classes established from Ontario data (Figure 3.5.2-8). Catch of trout (number per net) has been divided into low, medium, and high based on the 25th and 75th percentiles of trout populations assesses in Ontario (OMNR 1999). Size has also been divided into small, medium, and large based on the 25th and 75th percentiles of lake trout populations in Ontario (OMNR 1999). Compared to other lake trout lakes in Ontario, the lake trout lakes sampled to date in FMZ 5 are dominated by medium catches (13 lakes, or 50%), with another 6 (23%) in the high catch category, and 7 (27%) in the low catch category. In terms of size, most lakes had medium to large size fish with 13 lakes in the medium category (50%) and 9 lakes in the large category (35%). Only 4 lakes fell within the small size category (15%).

To assess the biological health of the population, lakes with small size and low catches would represent a sustainability concern. Lakes with small size/medium catches to medium size/low catches may indicate lakes which are showing signs of stress. Based on the available information, lake trout populations in FMZ 5 generally have medium to large-bodied trout populations, and have a wide range of abundance across the zone (Figure 3.5.2-8). Twenty-one of the twenty-six lakes (81%) fall within size and catch ranges that would be expected from healthy lake trout population. Five of the twenty-six lakes (19%) fall within the medium size/low catch range or small size/low catch that suggest lake trout populations showing signs of stress. Overall, most of the lakes sampled within FMZ 5 are showing signs of healthy lake trout populations.

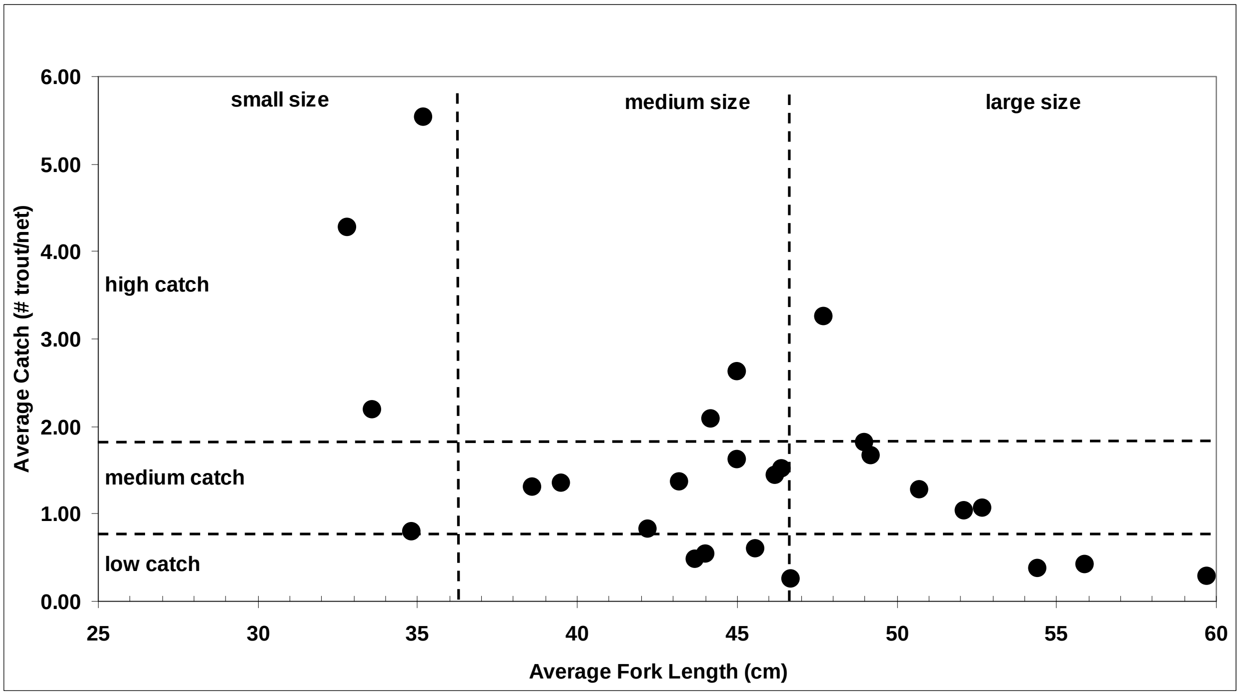


Figure 3.5.2-8: Catch vs. size of lake trout by Spring Littoral Index Netting (SLIN) in FMZ 5 (1993 - 2010)

3.5.3 Northern Pike

3.5.3.1 Population Status and Trend Summary

Northern Pike Population Status

Northern pike data was collected from 86 Fall Walleye Index Netting (FWIN) projects conducted on non-SDW lakes in FMZ 5. Within FMZ 5, the status of pike populations appears to vary widely. In general, FMZ 5 has intermediate pike populations when compared to other zones across northwestern Ontario. Compared to provincial benchmarks, FMZ 5 pike abundance was very similar to the rest of the province with almost half of the lakes being above average catch/net; a third being slightly below the average and the remaining 19% being well below average (Table 3.5.3-1). Female mortality estimates were above provincial averages with 71% of the mortality estimates being above average. In comparing catch and size of northern pike to provincial benchmarks, most populations (36%) fall into the medium size and medium catch category with only 2 (3%) of the lakes being classified as having small size and low abundance, the category of highest potential concern (Figure 3.5.3-1). An additional 13 lakes (18%) were classified as either low catch/medium size or small size/medium size, which suggests an increased level of concern with those populations

Table 3.5.3-1. Distribution of FMZ 5 northern pike populations compared to the provincial data benchmarks based on 1993 to 2009 FMZ 5 FWIN projects (number = 86) (*benchmarks from Malette and Morgan 2005; see text in section 3.5.3.2 for further explanation*).

Indicator	**Above average** (top 50% of data)	**Slightly below average** (25-50% of data)	**Well below average** (bottom 25% of data)
Relative abundance (number/net)	**49%**	**33%**	**19%**
Female adult mortality (%)	**71%** lower mortality than average	**16%** slightly higher mortality than average	**13%** mortality well above average

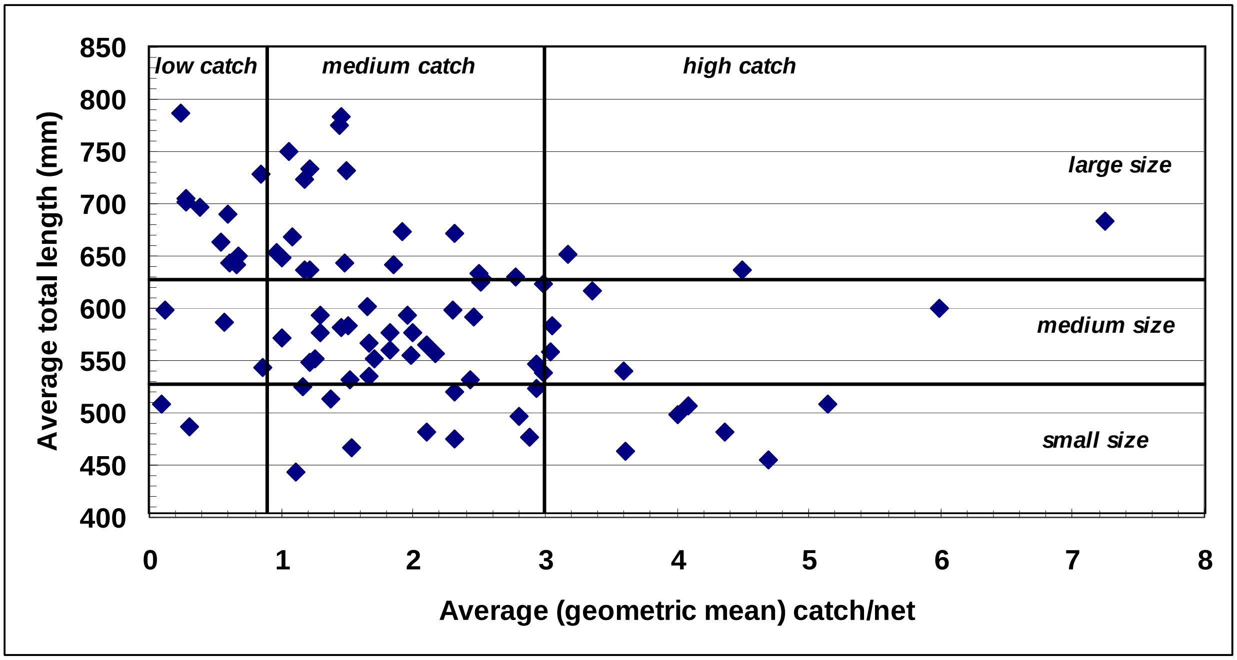


Figure 3.5.3-1. Comparison of northern pike catch and size from FMZ 5 lakes (n = 73) netted using the Fall Walleye Index Netting (FWIN) method. Lines show provincial quartiles for catch and size (from Malette and Morgan, 2005).

Population Trends

Eighteen different lakes were found to have been sampled using the FWIN protocol more than once, resulting in 2 or more years of CUE data available for northern pike. These lakes were all in the southeast portion of FMZ 5 so are only representative of trends in that area. The first sampling dates for each lake ranged from 1995-2000, and the second sampling dates ranged from 1999-2009. Out of the 18 lakes, 9 showed an increase in northern pike CUE, and 9 showed a decline (Figure 3.5.3-2). The first and second CUEs were used to calculate a percent change for each lake. The greatest decrease was to 33% of the first CUE measurement, which occurred over 4 years. The greatest increase was to 898% of the first CUE measurement, which occurred over 8 years. On average, there was an increase to 141 (+/-S.E. 46) % of the first CUE measurement. The data was then standardized by dividing by the number of years between FWINs to get an estimate of change in CUE per year. The average for all lakes was a 22 (+/- S.E. 6)% increase from the first CUE measurement per year. Although pike CUE increased on average, half of the lakes did show a decrease. The results should be interpreted cautiously because FWINs are not specifically designed to monitor northern pike abundance. The size of pike also increased between the two time periods with 11 of 16 lakes having larger average size pike in the second assessment.

Northern pike angling regulations protected fish between 70 – 90 cm from harvest starting in 1999. This follows a change in the late eighties to allow the harvest of only 1 pike larger than 70 cm. These changes may have had some effect on the observed increase in pike size.

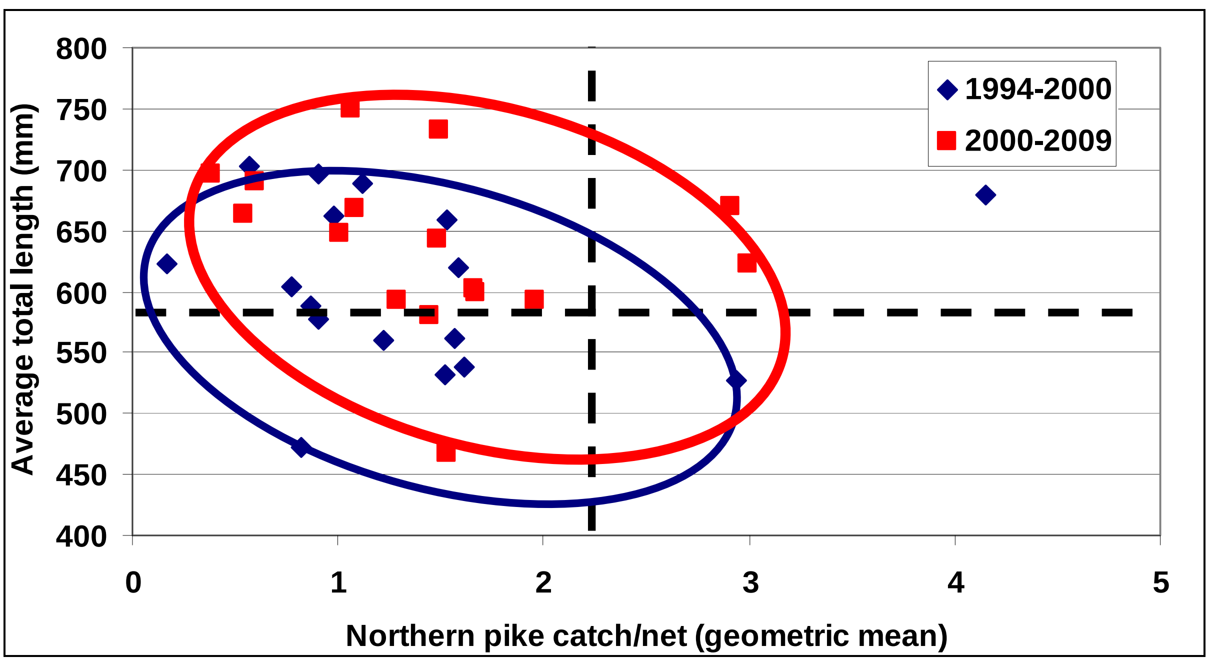


Figure 3.5.3-2. Comparison of northern pike catch and size from FMZ 5 lakes netted between 1994-2000 (blue diamonds) and 2000-2010 (red squares) using the Fall Walleye Index Netting (FWIN) method. Black dotted lines show provincial averages for catch and size (from Malette and Morgan, 2005).

3.5.3.2 Data Analysis and Interpretation

Northern pike are the most common predator across FMZ 5 occurring in a wide variety of lake types ranging from very small, shallow lakes to large, unproductive lake trout lakes (Figure 3.5.3-3). The only habitat requirements they seem to require is some flooded vegetation in the spring to spawn on, enough depth that the lakes don't winterkill (i.e. lose all their oxygen during the period of ice cover) and something to eat, which in the case of pike can be almost anything. The size and depth of lakes has been found to determine a number of northern pike characteristics with shallower lakes dominated by larger numbers of smaller sized fish while larger, deeper lakes tend to have fewer but larger sized pike (Pierce and Tomcko 2005).

Northern pike are generally found in shallow, moderately productive, vegetated waters less than 4 m deep. For most of the year, pike are sedentary and somewhat territorial, although they may make short upstream spawning migrations. Northern pike spawn in spring, shortly after the ice has melted. Mature fish move up tributaries to flooded marshes or shallow pools where the water has warmed to 8-12ºC. Eggs are laid on submerged grasses and vegetation to keep them from falling into silt and muck which would reduce their survival (Casselman 1995).

Pike have a legendary ability to consume impressive quantities of prey, which can include not only fish but also frogs, invertebrates and the occasional mammal. The primary prey of adult northern pike is usually yellow perch, with opportunistic use of other species when fishes are unavailable (Chapman and Mackay 1990; Venturelli and Tonn 2005). These other species include leeches, frogs, crayfishes, mice, muskrat and ducks, with a preferred prey size being one-third to one half the pike's body length (Crossman 1973). The type of feeding used by northern pike is often described as an ambush style of predation that relies on camouflage with aquatic vegetation (Casselman 1995). While the abundance of prey affects growth rate, it is not usually critical to survival, because pike are opportunistic feeders and will switching to invertebrates and even each other when normal prey is scarce (Casselman 1995).

While pike are quite tolerant of a wide range of temperature and oxygen conditions, they do move within the water column in response to changes in these factors. In summer, adults typically move to deeper, cooler water. In winter, they stop feeding in winter when oxygen drops below 2 mg/l and can be susceptible to winterkill if low oxygen conditions persist (Casselman 1995). Pike are also susceptible to numerous parasites, bacterial and viral diseases, tumorous lesions and the bioaccumulation of environmental toxins (Harvey 2009).

Information to assess northern pike populations in FMZ 5 was collected from the same Fall Walleye Index Netting (FWIN) projects used to assess walleye status (Morgan 2002). Although the FWIN protocol does not specifically target northern pike, this species is susceptible to gillnets used in these projects and the data can be used to analyze northern pike populations; however, the results should be interpreted with some caution. Northern pike often seem to be attracted to small mesh nets where prey fish are captured, and therefore may not be randomly encountering the nets. The number of pike caught from each lake also tends to be less than other species such as walleye resulting in fewer fish to analyze biological characteristics such as age distribution and growth. This may be partially because they move around less than other species such as walleye and therefore do not encounter the nets as often. As mentioned in the walleye status section, the FWIN projects were conducted mainly on lakes in the south portion of the zone; therefore, the data presented will best reflect this geography (Figure 3.5.3-3).

Malette and Morgan (2005) analyzed all Ontario FWIN data available from 1993 to 2002 for northern pike. Unlike walleye data, they found no significant differences in pike data between the different regions in the province so used the results of the entire provincial FWINs database to develop benchmarks for comparison of individual lake results (Table 3.5.3-2). The benchmarks are divided into 3 categories: "above average", "slightly below average", and "well below average". "Above average" includes all data that falls in the upper half of the provincial data. This label implies that the population is stable and currently not at risk of overharvest and is not likely experiencing negative habitat impacts. "Slightly below average" includes data that falls in the lower half but above the bottom quarter of the data (i.e. the 25%-50% quartile), and may indicate that these populations are at risk of further declines if additional stresses are added. "Well below average" populations are those that fall in the bottom quarter of data across the region. These populations raise a higher level of concern and may not be sustainable. The low values may be a result of high harvest pressure or low quality habitat conditions. Some populations categorized as slightly below average or well below average may actually have low values due to the particular naturally occurring environmental conditions in that lake, rather than being a result of overharvest.

Table 3.5.3-2. Northern pike life history parameters for Ontario water bodies sampled using FWIN methods between 1993 and 2002 (adapted from Malette and Morgan, 2005).

Indicator	**Above average** (top 50% of data)	**Slightly below average** (25-50% of data)	**Well below average** (bottom 25% of data)
Relative abundance (number/net)	**≥1.7**	**0.9-1.6**	**≤0.8**
Female adult mortality (%)	**≤39**	**40-49**	**≥50**

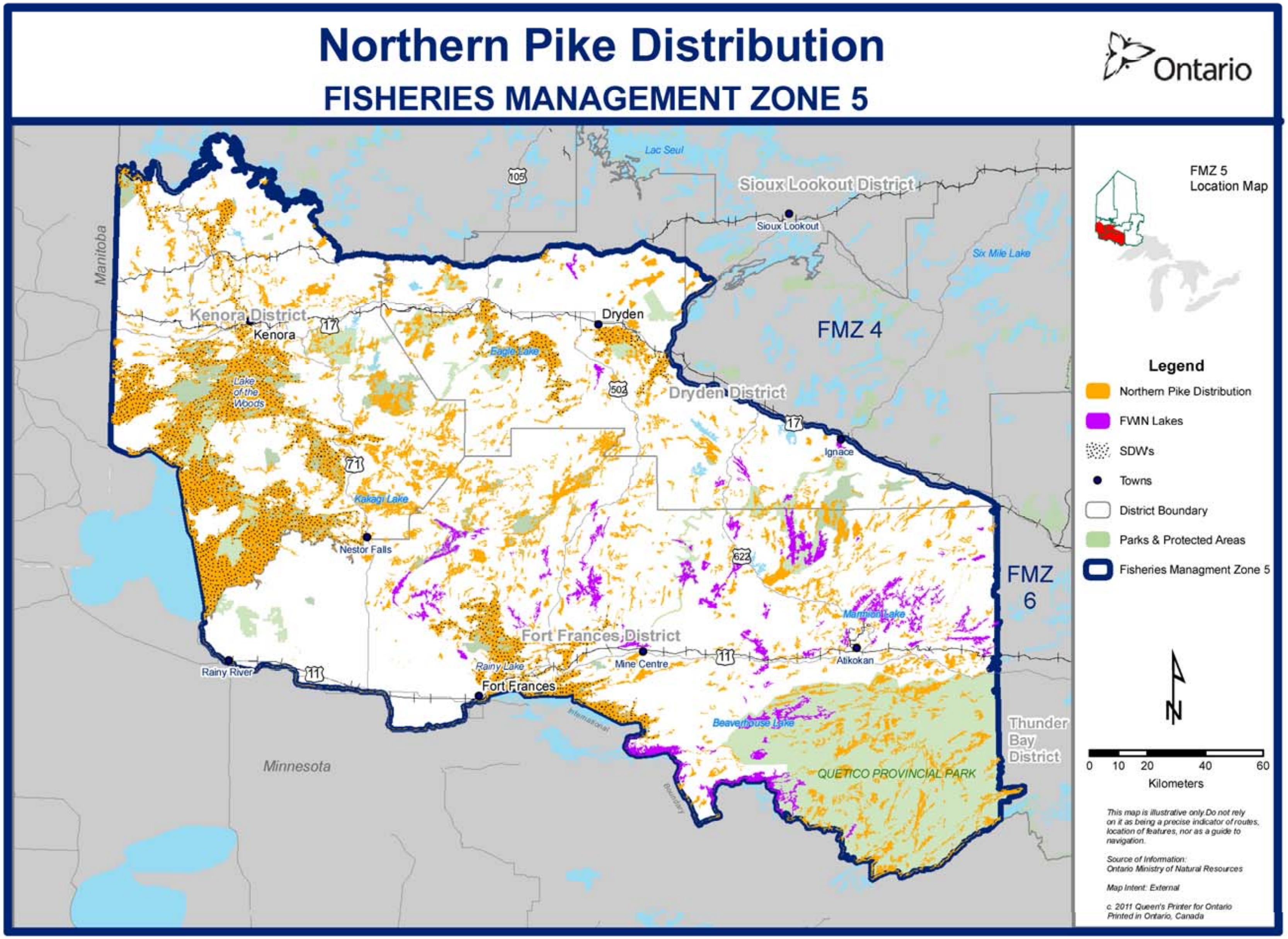


Figure 3.5.3-3. Northern pike lakes (non-SDW) that have had Fall Walleye Index Netting (FWIN) surveys conducted between 1994 and 2009.

Abundance

Northern pike abundance is measured by catch per unit effort (CUE) or average number of pike caught per net set. There is a wide range of average CUE for northern pike in FMZ 5 lakes, with a minimum of 0 to a maximum of 7.2 northern pike per net. Distribution of average catch of pike in FMZ 5 was very similar to the rest of the province with almost half of the lakes being above average catch/net; a third being slightly below the average and the remaining 19% being well below average (Table 3.5.3-1; Figure 3.5.3-4).

A comparison across Northwest Region FMZs shows that northern pike CUE was greatest for FMZ 4 and 2, and lowest in FMZ 6 (Figure 3.5.3-4). FMZ 5 had the second lowest CUE for northern pike. Some of this difference may reflect the lower productivity of FMZ 5 lakes.

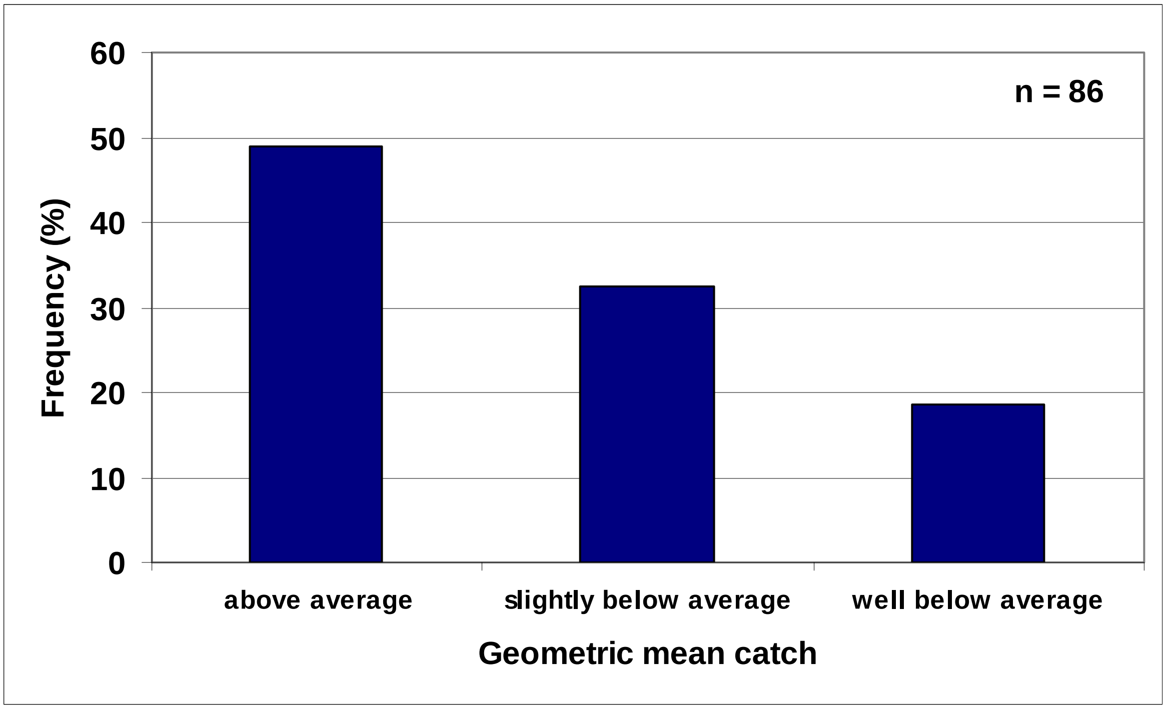


Figure 3.5.3-4. Frequency of average northern pike catch (geometric mean #/net) from FMZ 5 FWIN surveys relative to the benchmarks for Ontario.

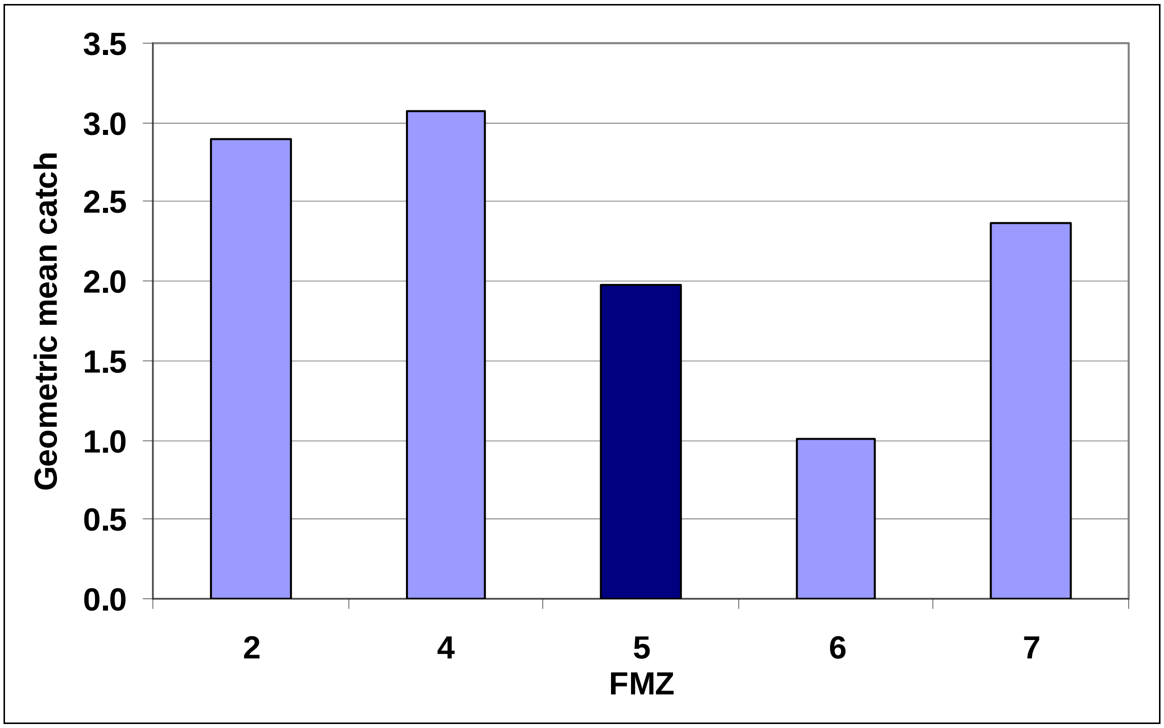


Figure 3.5.3-4. Catch per net of northern pike by northwestern Ontario Fisheries Management Zones.

Size

The average total length of northern pike can be used to investigate patterns in fish size among lakes. As a general rule, the average length is smaller when food resources are limited such as by a high abundance of predators, or by environmental conditions or when exploitation is higher and survival to older, larger fish is low. Therefore, the average size of northern pike caught is useful to describe what populations look like across the zone but must be interpreted along with other data before it can be used as an indicator of population status. For the lakes in FMZ 5, the average total length of northern pike ranged from 444 mm to 787 mm with an overall average of 596 mm (Figure 3.5.3-5).

There is high variability in average length of northern pike among lakes for each FMZ, and as a result the average values for each zone are not considerably different (Figure 3.5.3-6). FMZ 5 has intermediate average lengths, with FMZ 2 and 4 having higher average lengths, and FMZ 6 and 7 with slightly lower lengths.

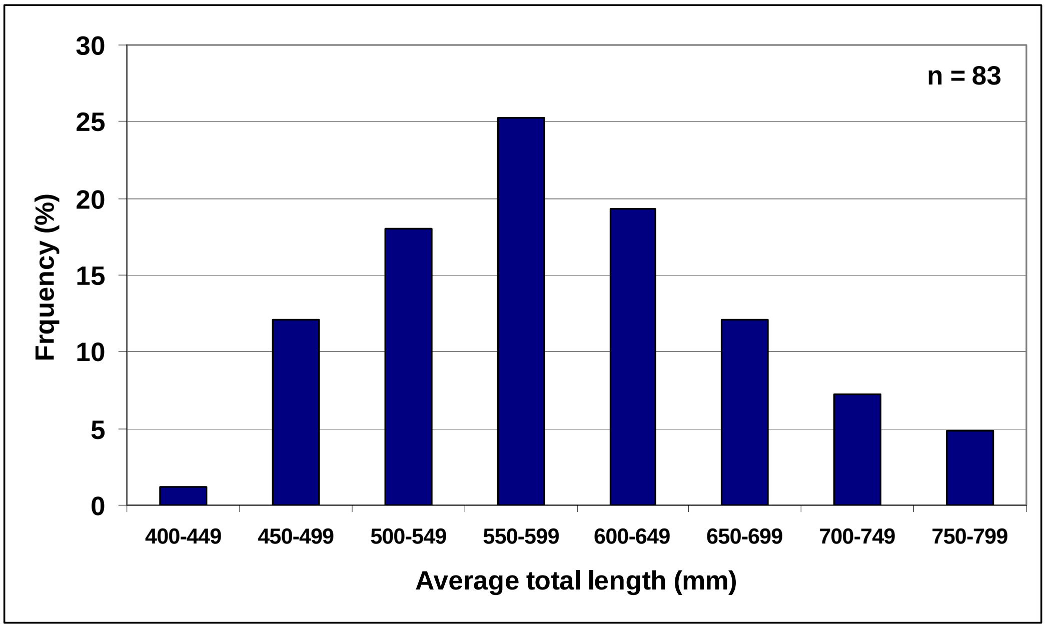


Figure 3.5.3-5. Distribution of average total lengths of northern pike observed in FWINs from lakes in FMZ 5.

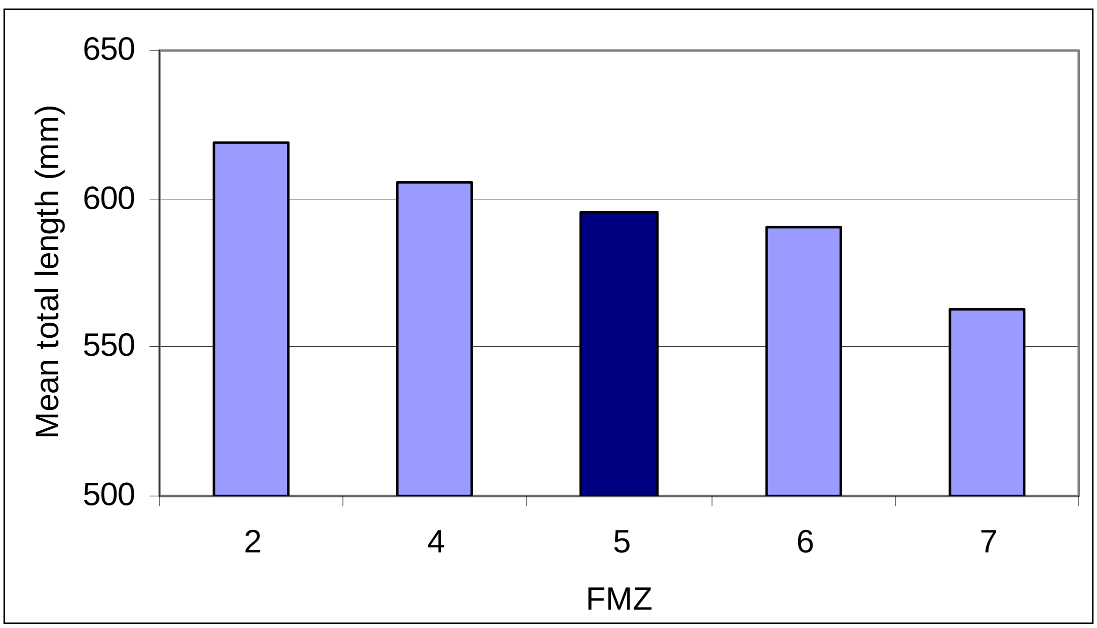


Figure 3.5.3-6. Average total length of northern pike FWIN catch by northwestern Ontario Fisheries Management Zones.

As mentioned above, average total length can be affected by fish abundance. This relationship can be examined by categorizing pike data from FMZ 5 lakes into low, medium, or high abundance and small, medium, or large body size using provincial benchmarks (Malette and Morgan 2005) (Figure 3.5.3-7). There were some populations present in each category, showing a wide range in population status. Two lakes fell within the small size/low catch category, which suggests that they may be at a high risk of overharvest. Ten lakes fell into the small size/medium catch category, and 3 in the medium size/low catch category, which both suggest unhealthy populations. The majority of lakes fell within the medium size/medium catch category, similar to pike populations across most of Ontario.

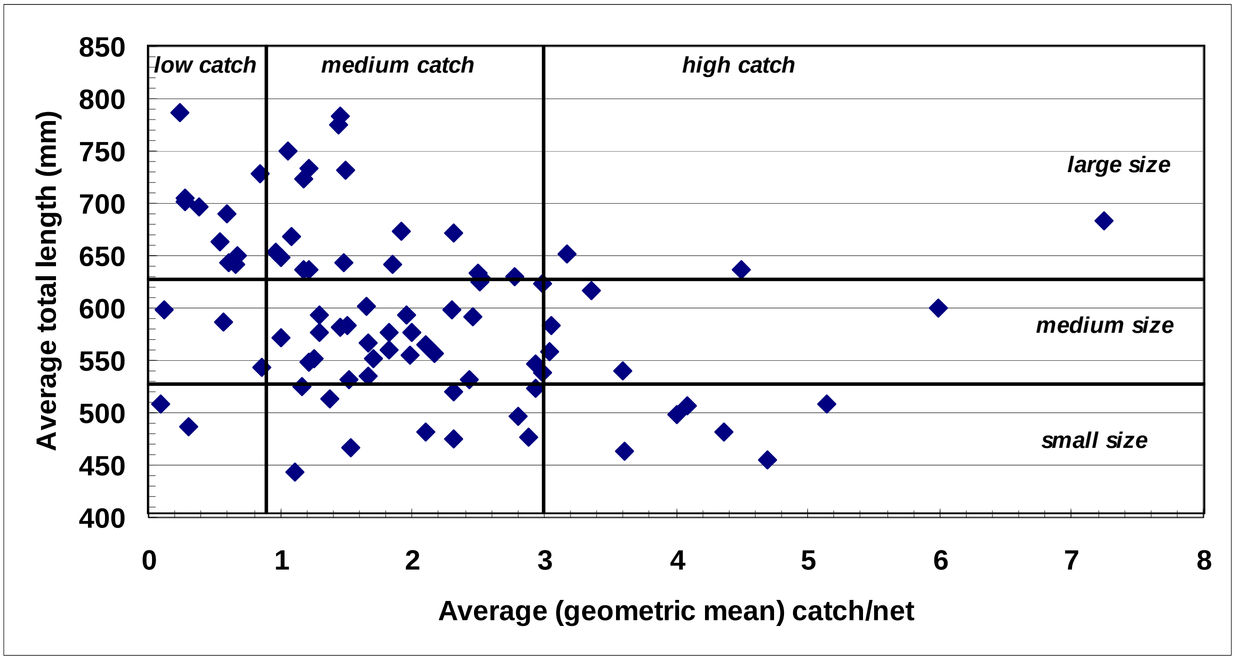


Figure 3.5.3-7. Comparison of northern pike catch and size from FMZ 5 lakes relative to provincial benchmarks *(benchmarks from Malette and Morgan 2005)*.

Age

Average age of a population can give clues to the age structure. For example, a lower average age can suggest fewer mature age classes are present. The average age of northern pike ranged from 2.0 years to 6.8 years for lakes in FMZ 5. Most lakes had an average age between 3.0 and 4.9 with an overall average of 4.1 years (Figure 3.5.3-7). Compared to other FMZs, FMZ 5 has an intermediate average age (Figure 3.5.3-8).

Growth can be monitored by determining the age fish reach a given size with a younger age indicating faster growth rates. In FMZ 5, most pike (84%) were age 2 at 400 mm total length. The minimum female age at 400 mm was 1 year and the maximum was 4 years. The overall average female age at 400 mm for FMZ 5 is 2.16 years. The results for FMZ 5 were similar for the other FMZs across the region, with all averages ranging between 2 and 2.25 years (Figure 3.5.3-9).

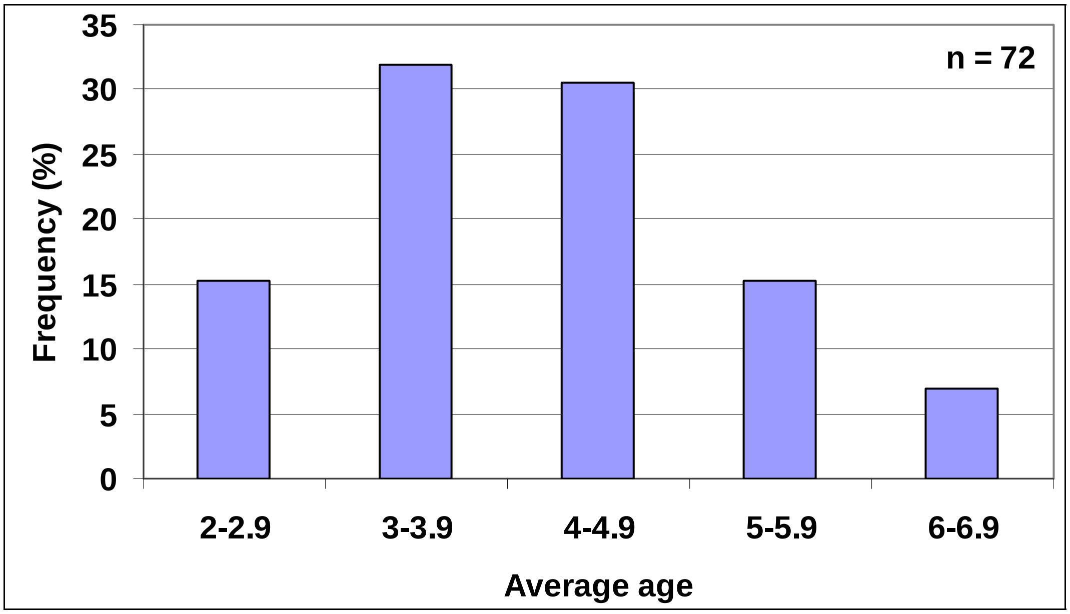


Figure 3.5.3-7. Distribution of average age of northern pike observed in FMZ 5 lakes sampled by FWIN between 1994 and 2009.

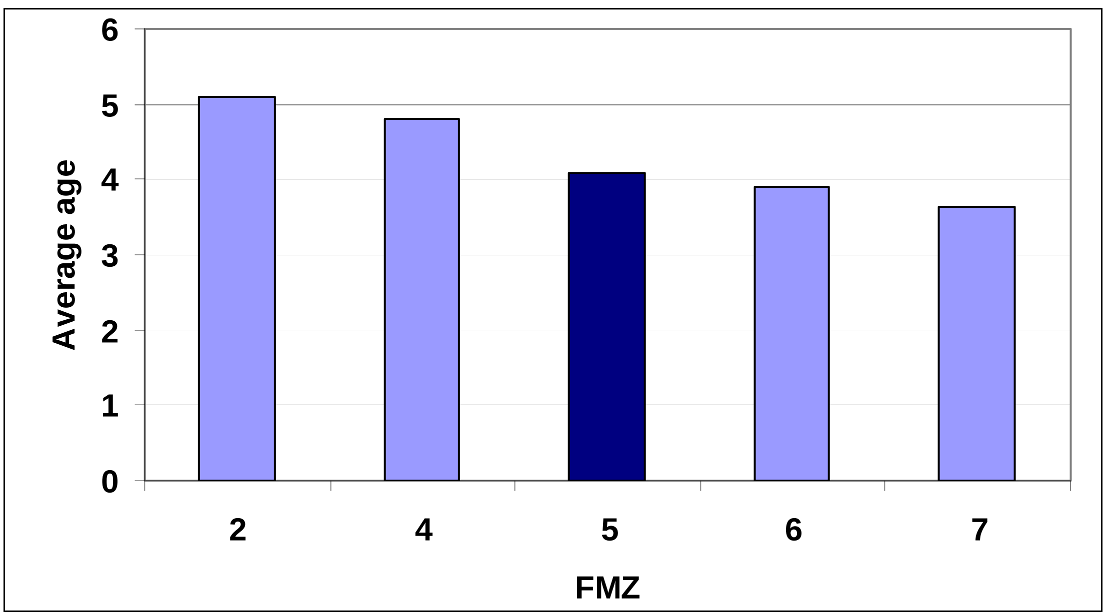


Figure 3.5.3-8. Average age of northern pike observed in FWIN catches from northwestern Ontario Fisheries Management Zones.

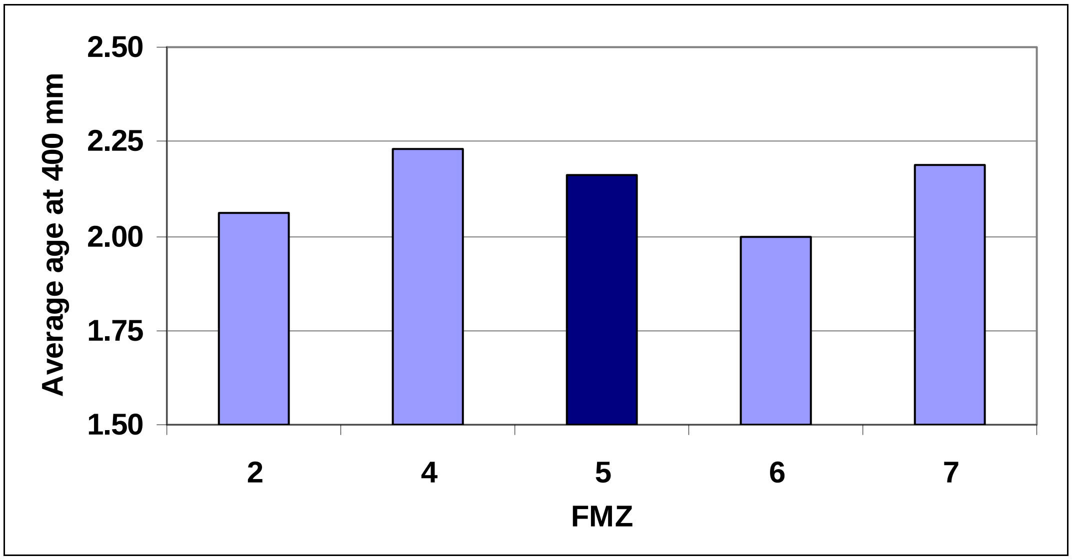


Figure 3.5.3-9. Average age of female northern pike at 400 mm total length by northwestern Ontario Fisheries Management Zone.

Mortality

The calculated female mortality rate ranges widely from 4 to 65% for FMZ 5, with an average of 32%. Approximately 70% of lakes fell within the healthy range for mortality rates (Figure 3.5.3-10). This finding suggests that female northern pike mortality in FMZ 5 is lower than the average mortality estimate for the whole province. There is high variability in mortality rates for each FMZ; nevertheless, the averages are all between 30 and 35% which are considered within the healthy range (Figure 3.5.3-11).

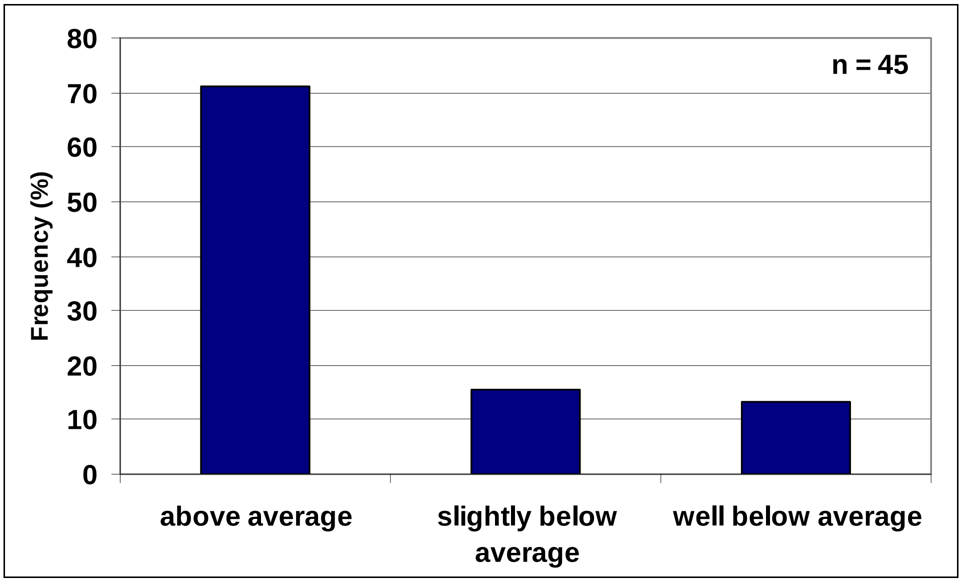


Figure 3.5.3-10. Distribution of estimated mortality of northern pike populations from FMZ 5 compared to the benchmarks for Ontario *(from Malette and Morgan 2005)*.

.

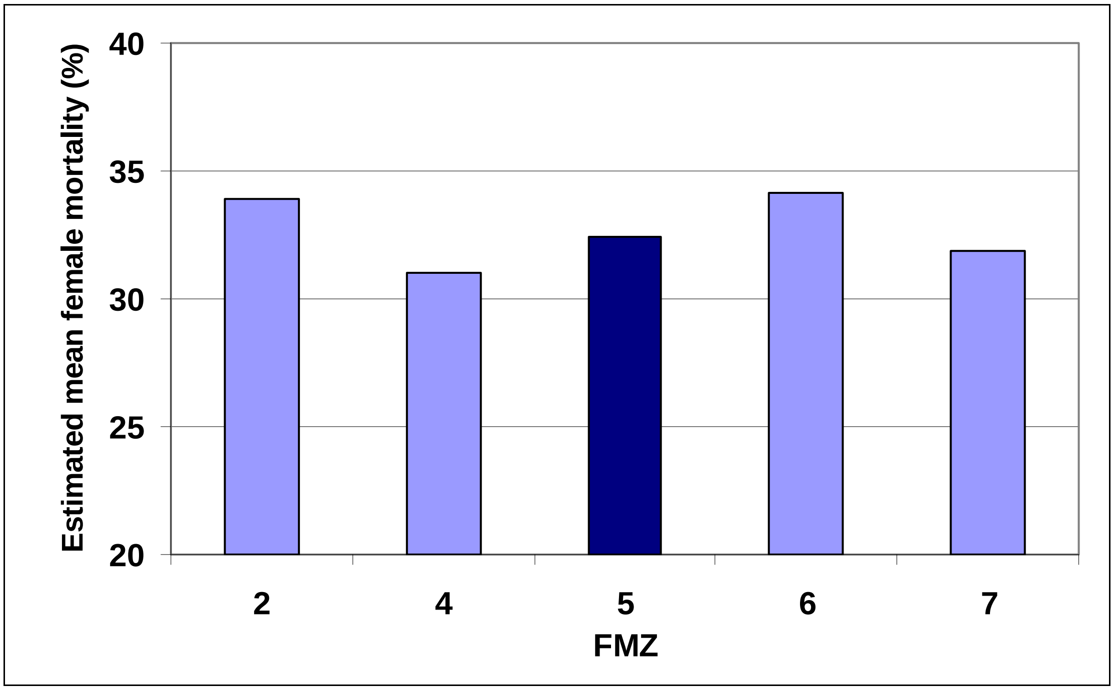


Figure 3.5.3-11. Average estimated mortality rates of female northern pike by northwestern Ontario Fisheries Management Zone.

3.5.4 Smallmouth Bass

3.5.4.1 Population Status and Trend Summary

Smallmouth Bass Population Status

The Ontario standard trapnetting method is known as Nearshore Community Index Netting (NSCIN) is the most effective standard netting method to assess smallmouth bass populations (Stirling 1999). While it is more commonly used in southern parts of the province, NSCIN has been used in the Atikokan area of FMZ 5 to assess smallmouth bass and other littoral zone species populations Twelve lakes were assessed using this method between 1998 and 2004 (Figure 3.5.4-1) and six of these lakes have been reassessed between 2004 and 2010. This allows a status assessment of bass populations in this area compared to other Ontario lakes and also assesses how these populations are changing over time.

Compared to other parts of Ontario, the lakes sampled by NSCIN in FMZ 5 generally have medium to high density populations of average to large sized bass based on the results from 1999 to 2010 (Figure 3.5.4-2). Notably, there were no FMZ 5 populations sampled that fell into the small size or low catch categories which were based on all NSCIN projects in Ontario from 1991-1998 (52 lakes; mostly from southern and central Ontario). In addition to the catch and size data, smallmouth bass assessed by FMZ 5 NSCIN surveys tend to have growth rates and mean ages similar to those measured in the rest of the province.

The available data suggests that smallmouth bass populations are healthy with little sign of over-exploitation.

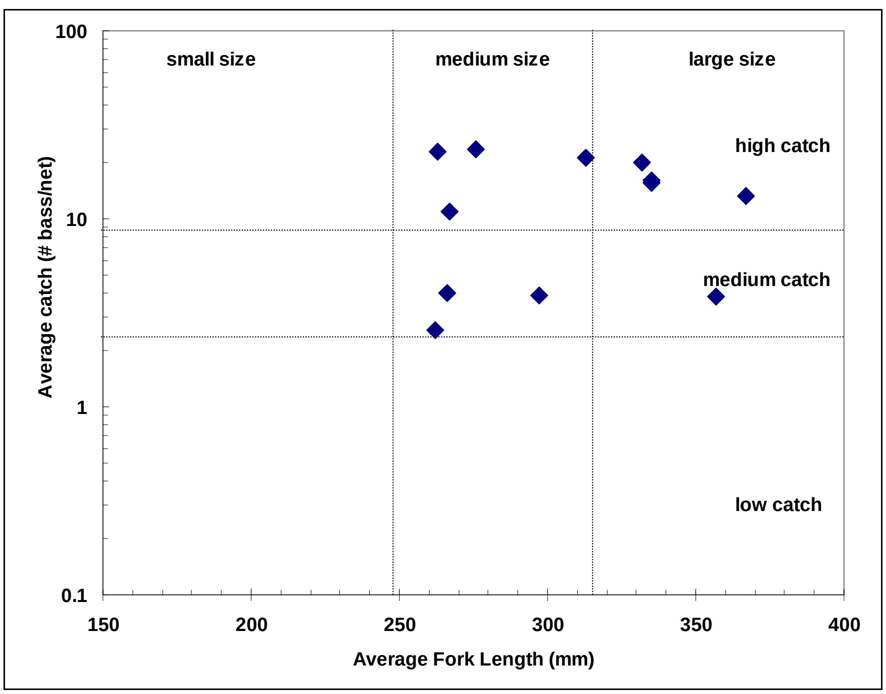


Figure 3.5.4-2 Catch and size of smallmouth bass caught from FMZ 5 lakes using the Nearshore Community Index Netting (NSCIN) method between 1999 and 2010. Catch and size categories are based on results from across Ontario (Brereton 2000).

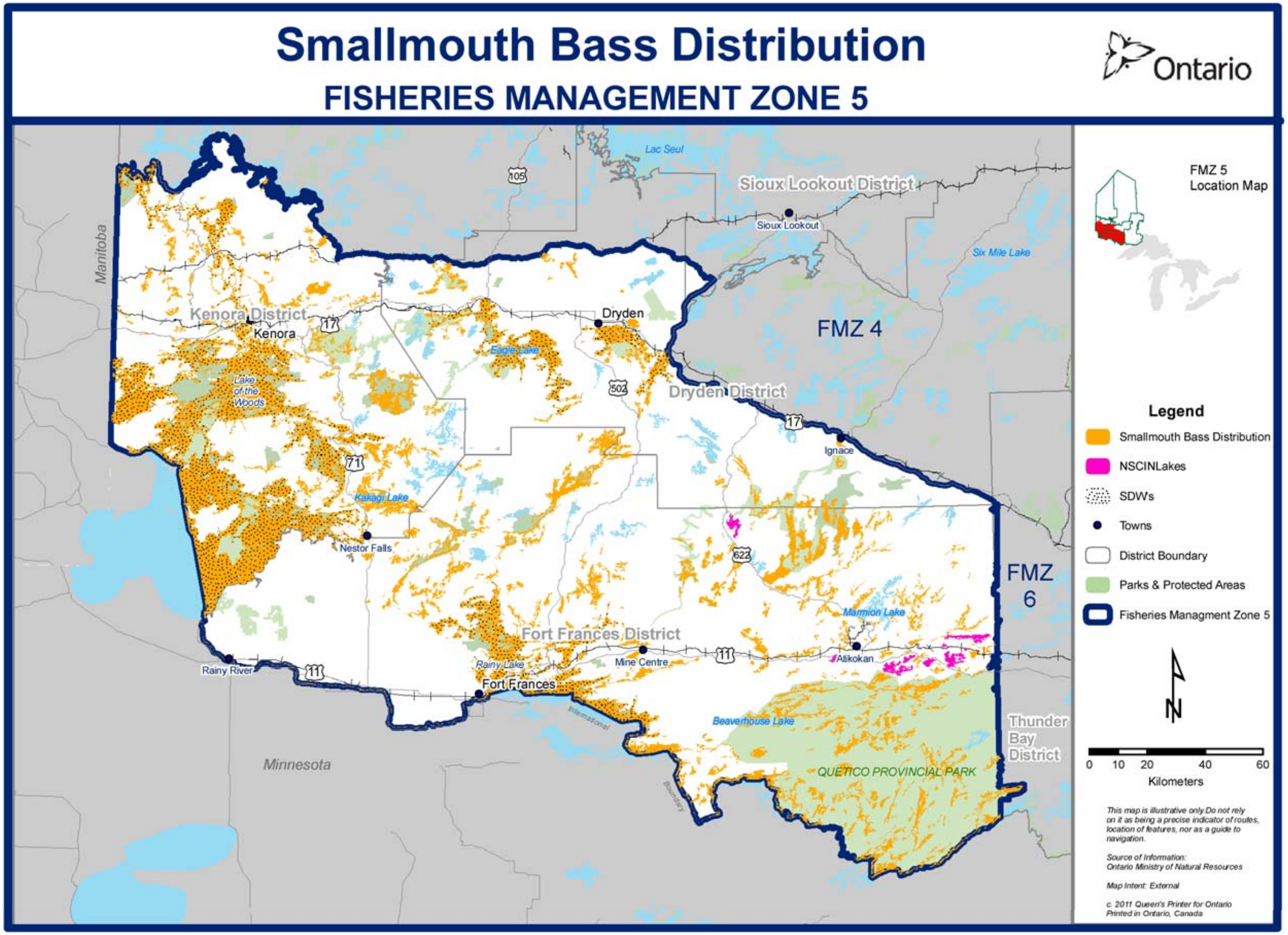


Figure 3.5.4-1 Smallmouth bass distribution and lakes where Nearshore Community Index Netting (NSCIN) projects have been conducted in FMZ 5.

Population Trend

Six lakes have had NSCIN completed on them twice, once between 1997 and 2004 and a second time between 2004 and 2010. In all lakes, although the trend of the catch varied, the size of bass sampled has increased over time (Figure 3.5.4-3). Variations in year class and growth rates appear to be affected mainly by changes in environmental conditions, most importantly spring and summer temperatures.

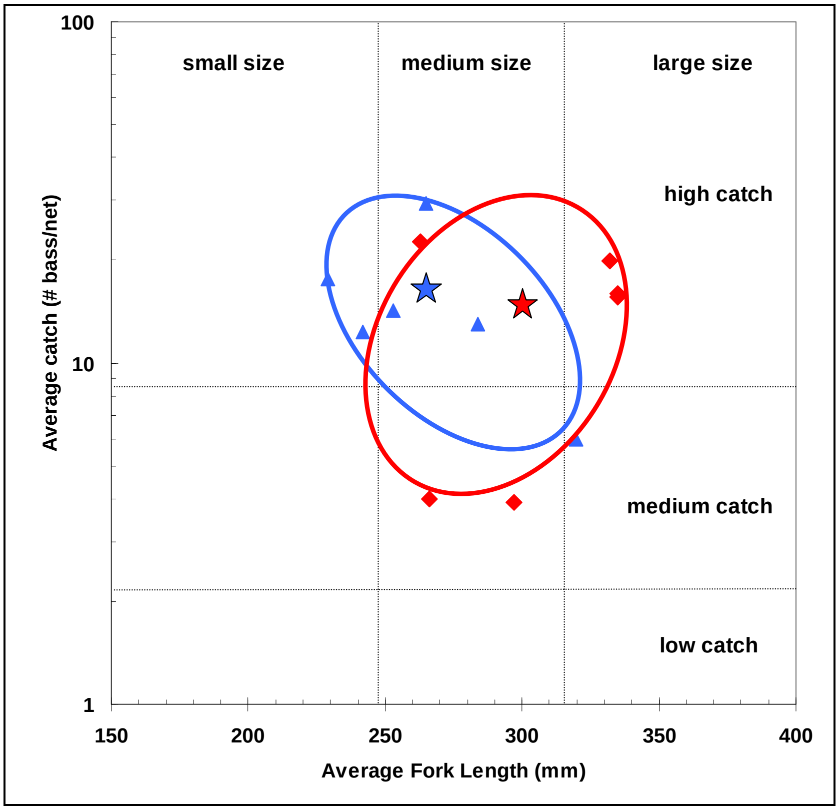


Figure 3.5.4-3. Comparison of smallmouth bass catch and size from FMZ 5 lakes netted between 1997-2004 (blue triangles) and 2004-2010 (red diamonds) using the Nearshore Community Index Netting (NSCIN) method. Stars indicate averages for the two periods (size/abundance categories from Brereton 2000).

3.5.4.2 Data Analysis and Interpretation

Smallmouth bass (Micropterus dolmieu) are a non-native species to FMZ 5 that has been introduced into this area starting in the early 1900's. As smallmouth bass are not native to northwestern Ontario, distribution tends to be by introductions of bass into lakes and subsequent movement (particularly downstream) of these populations into connected waterbodies. New populations of bass are still being found, many of which are the result of movement from previous introductions. Currently, almost all areas of FMZ 5 have had bass introduced into lakes with every tertiary watershed having bass present (Figure 3.5.4-1) Smallmouth bass are known to be found in 559 lakes in FMZ 5 which accounts for about 36% of the number of lakes and 61% of the area of lakes with species information. They are most commonly found with northern pike (85% of smallmouth bass lakes) and walleye (66% of lakes with smallmouth bass). Approximately one third (36%) of smallmouth bass lakes are coldwater lakes.

Smallmouth bass prefer cool waters of clear lakes, bays, and rivers and are often found in areas of rocky bottoms with various cover such as sunken logs (Holm et al. 2009). Adults have a wide temperature preference and optimal summer water temperatures of 21-27 ^{o}C are reported which are slightly warmer than walleye (19-23 ^{o}C) (Browne et al. 2009, Coker et al. 2001). They tend to be in shallow waters in spring and early summer moving into deeper waters as the summer progresses into fall. During winter, bass often congregate together in deeper water and become sluggish with very little feeding occurring (Hartviksen and Momot 1987).

As with other members of the sunfish family, smallmouth are nest builders and spawn in spring when temperatures reach approximately 15-16^{o}C (Scott and Crossman 1973, Holm et al. 2009). Smallmouth bass mature at around 4 years of age in northern areas of their range (Brown et al. 2009). Smallmouth bass diet is often made up mainly of crayfish but can also include a variety of other items including fish, aquatic insects, and frogs (Holm et al. 2009).

Being a species that does well in warm environments, they are one of the species that would be expected to benefit from the warmer waters predicted by climate change modelling.

There has not been as much population status data collected for smallmouth bass as for other species such as walleye or lake trout. Fall Walleye Index Netting (FWIN) projects are the most widespread fish assessment method in FMZ 5 and information from FWINs conducted on non-SDW lakes in FMZ 5 show that, compared to the other zones in the region, FMZ 5 has higher bass catches and bass are captured from more lakes (Cano and Parker, 2007). However gill nets are not very effective in capturing bass and numbers of bass caught in any single project are generally low.

A more effective method to assess smallmouth bass population than using gill nets is to use trap netting gear. The Ontario standard trap netting method is known as Nearshore Community Index Netting (NSCIN) and uses overnight trap net sets to assess smallmouth bass and other littoral zone species populations. Twelve lakes in the Atikokan area were selected to represent a range of lake type conditions that smallmouth bass live in and netted using this method between 1998 and 2004 to provide information on the status of smallmouth bass relative to other populations in

Ontario (Figure 3.5.4-1). Since then, six of these lakes have been reassessed between 2004 and 2010 to determine how these populations are changing over time.

Fall Walleye Index Netting (FWIN) data

Although FWIN is not a very effective method of capturing bass, it is the assessment method that is most widespread across FMZ 5 and can provide a coarse overview of smallmouth bass densities to compare with areas in the region. Compared to the other zones in northwestern Ontario, FMZ 5 has highest bass catches and highest proportion of surveys which captured bass (Cano and Parker, 2007).

Within FMZ 5, smallmouth bass were captured from 59 FWIN projects (61% of all FWIN's conducted between 1994 and 2009). Bass catches ranged from 0.07 bass/net (geometric mean) to 4.4 bass/net (Figure 3.5.4-4). The average size of bass caught in FMZ5 FWIN surveys was 33.9 cm (range from 21.4 cm to 48.0 cm).

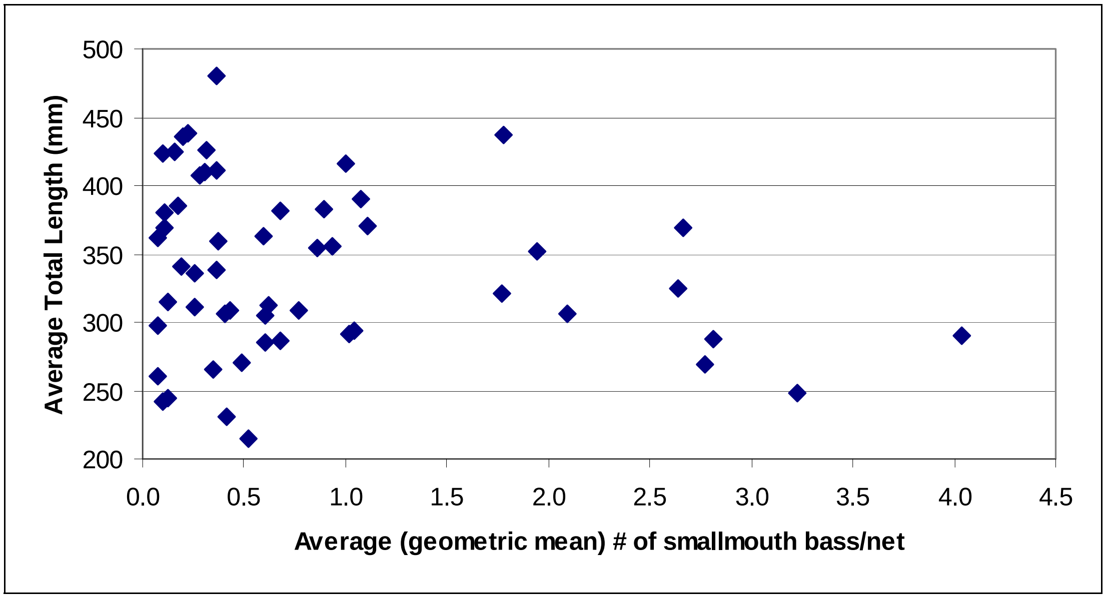


Figure 3.5.4-4 Size and catch of smallmouth bass from Fall Walleye Index Netting (FWIN) for lakes assessed between 1994 and 2009 (only includes 59 lakes where bass were captured).

Nearshore Community Index Netting (NSCIN) data

Although fewer populations have been assessed using NSCIN, this method generally captures more bass and provides a more detailed assessment of bass status.

Compared to other parts of Ontario, the lakes sampled by NSCIN in FMZ 5 generally have medium to high density populations of average to large sized bass based on the results from 1999 to 2010 (Figure 3.5.4-2). The average age of bass from these lakes was 4.6 yrs. (range from 3.6yrs. to 5.6 yrs.) which is very similar to the provincial average of 4.3 years. On average, bass populations from FMZ 5 lakes are dominated with fish up to 6 or 7 years of age with relatively few fish older than age 10 (Figure 3.5.4-5). The number of different age classes sampled from these populations averaged 10 and ranged from 8 to 12 with maximum ages ranging from 8 – 15 years (average of 11 years). The maximum age of smallmouth bass reported from northwest Ontario is a 23 year old bass from Rainy Lake in 1999 (D. McLeod, biologist, OMNR Fort Frances; pers. comm.).

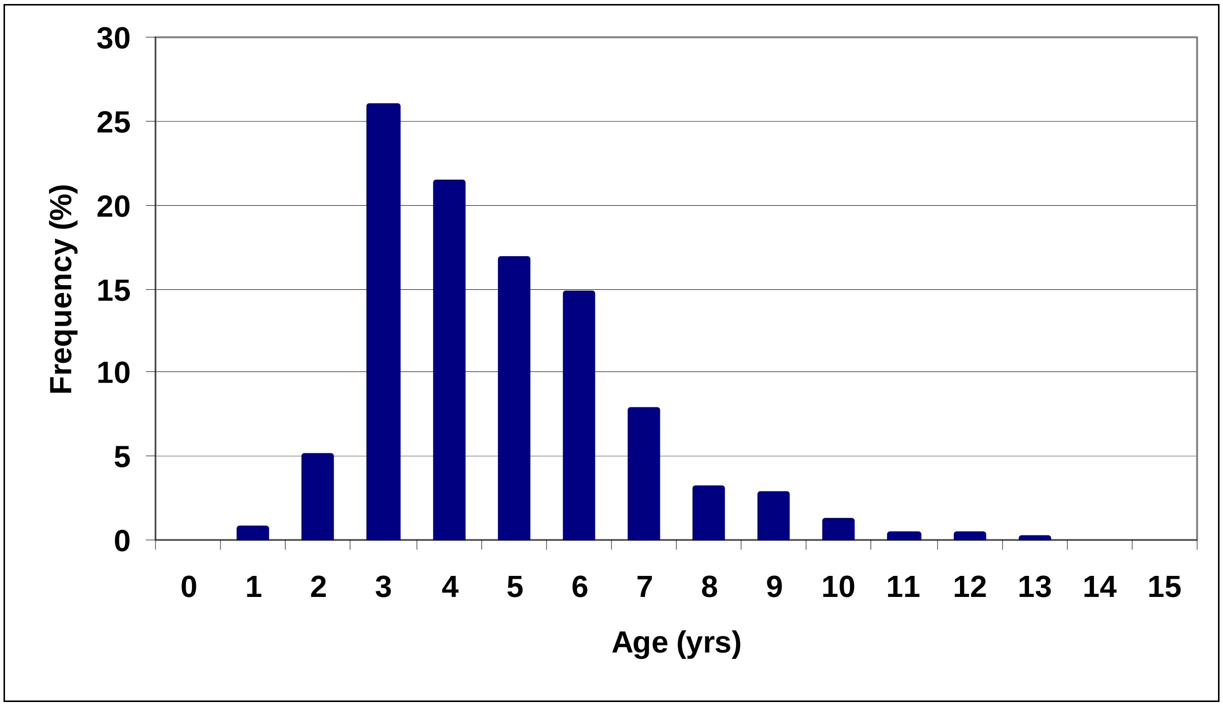


Figure 3.5.4-5 Average age distribution of smallmouth bass caught from FMZ 5 lakes using the Nearshore Community Index Netting (NSCIN) method between 1998 and 2010 (n=9 lakes).

The average growth of bass was also almost identical to the provincial average (Figure 3.5.4-7). The average fork length of a 4 year old bass was 28 cm (30 cm total length) although it was quite variable between lakes ranging from 23 cm to 34.5 cm. Further investigation into this variability has shown that differences in water clarity are related to differences in bass growth with bass from clearer lakes growing slower than bass from darker, more stained lakes which are typically more productive (Jackson 2005)(Figure 3.5.4-7). Bass condition varied as well between lakes with the average bass with a fork length of 30.0 cm (total length of 32.0 cm) weighing 440 g but values ranged from 371g to 467 g (Figure 3.5.4-8).

Figure 3.5.4-6. Average growth (length at age) of smallmouth bass caught from FMZ 5 lakes using the Nearshore Community Index Netting (NSCIN) method between 1998 and 2009 (n=9). (dotted lines indicate maximum and minimum values)

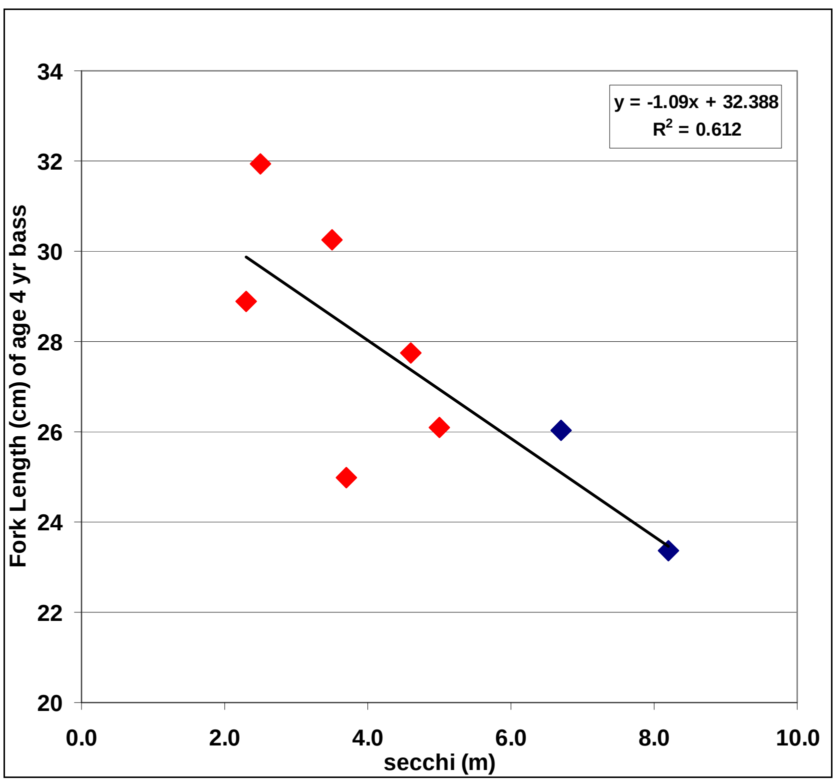


Figure 3.5.4-7 Average length of a 4 yr old smallmouth bass versus water clarity as measured by secchi depth for FMZ 5 lakes assessed by Nearshore Community Index Netting (NSCIN) between 1997 and 2004 (n=8 lakes). (red diamonds indicate coolwater lakes, blue diamonds indicate coldwater lakes)

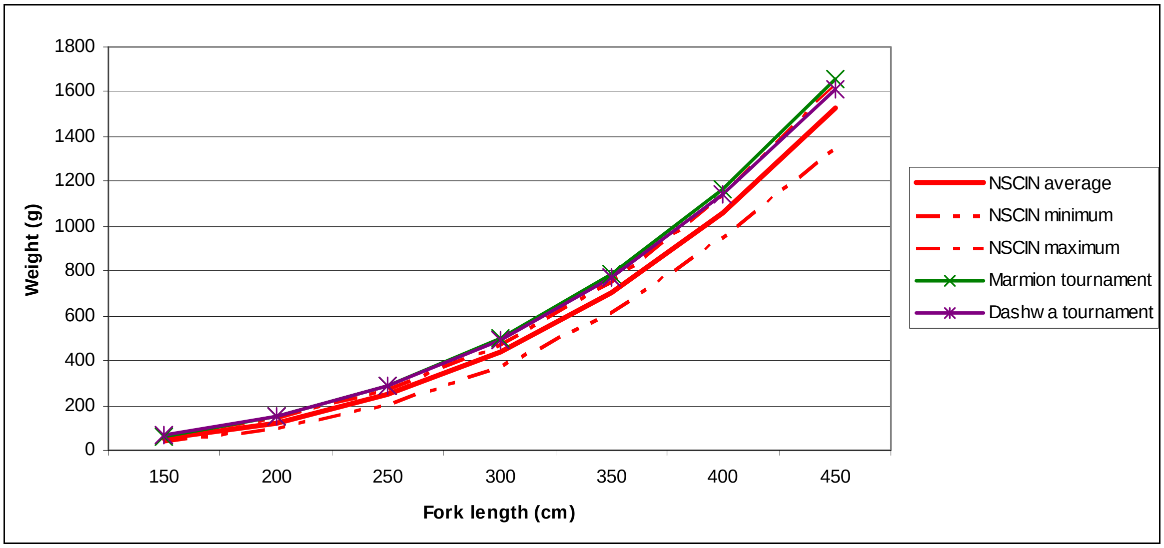


Figure 3.5.4-8 Average condition (weight at length) of smallmouth bass caught from FMZ 5 lakes using the Nearshore Community Index Netting (NSCIN) method between 2000 and 2010 (n=10 lakes). (dotted lines indicate maximum and minimum values)

Competitive Fishing Event Data

Bass fishing tournaments can provide valuable annual information on bass populations. In the Northwest Region, OMNR has sampled smallmouth bass at 3 tournaments for long periods, the Kenora Bass International on Lake of the Woods (1992 – 2010), the Fort Frances Canadian Bass Championship (1995–2010) on Rainy Lake and the Atikokan Bass Classic on Dashwa/Turtle/Crowrock lakes (1994 – 2007). More recently, data has been collected on Lower Marmion/Upper Floodwaters as the Atikokan Bass Classic moved there starting in 2008. Although Lake of the Woods and Rainy Lake are Specially Designated Waters and not part of the FMZ 5 planning process, some of the data from these lakes can provide information on area bass populations.

Although collection occurred at roughly the same time (mid-July to mid-August), bass sampled from angling tournaments tended to have higher growth rates than the bass sampled during NSCIN although all but one were within the range of NSCIN growth rates (Figure 3.5.4-9). It is not known whether this is due to a bias of anglers selecting for the largest fish of each age class or due to the type of lakes tournaments are held on. Similar to growth, the condition of bass sampled at tournaments tended to be somewhat higher than the average from the NSCIN data (Figure 3.5.4-8).

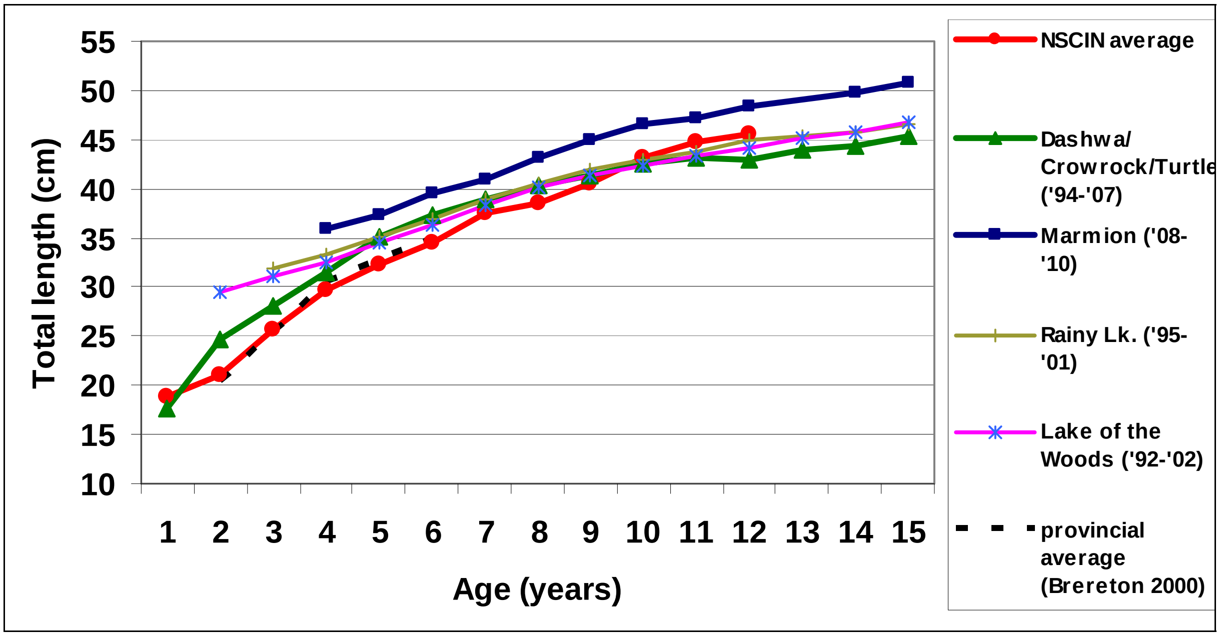


Figure 3.5.4-9 Average growth (length at age) of smallmouth bass sampled from angling tournaments in FMZ 5 lakes.

As was observed with the increase in size of bass in the NSCIN results between the 1997-2004 period and the 2005-2010 assessments, the average size of bass sampled at angling tournaments on both Rainy Lake and Dashwa/Crowrock/Turtle lakes have also increased over time (Figure 3.5.4-10). While the increase in size of bass has been shown to be related to an increase in temperatures over this period (Jackson 2005), other factors such as the introduction of rainbow smelt into Rainy Lake may also be impacting changes in fish size.

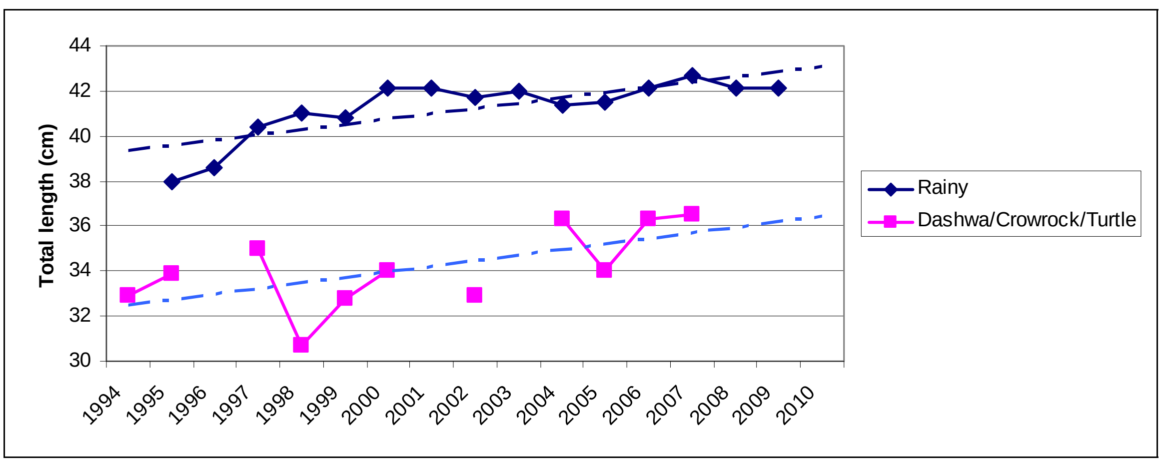
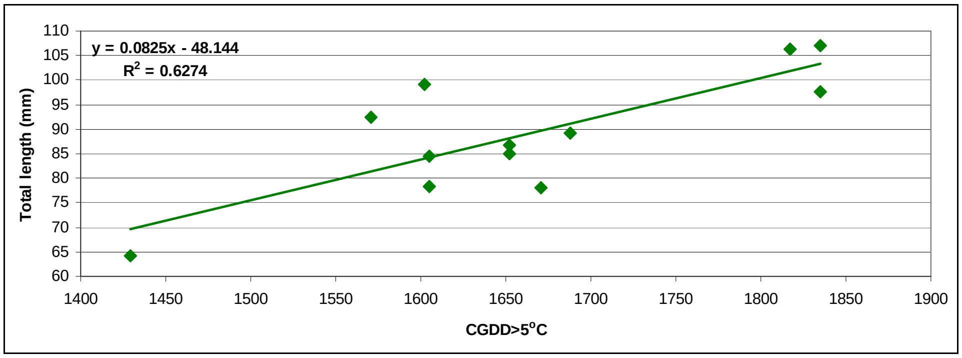


Figure 3.5.4-10. Average size smallmouth bass sampled at angler tournaments from Rainy Lake (1995 – 2009) and Dashwa/Crowrock/Turtle (1994-2007).

Annual variation in temperature has long been known to have an important role in determining both year class strength and growth rates of bass (Shuter et al 1980; Dunlop and Shuter 2006). Data from FMZ 5 bass populations has indicated bass populations have shown that growth of both young bass (Figure 3.5.4-14a) and older bass (Figure 3.5.4-14b) increases with warmer temperatures (Jackson 2010b; Jackson 2005). Data from tournament data on both Dashwa/Crowrock/Turtle lakes and Rainy Lake have also shown that temperature is an important factor in determining the amount of bass produced in a year (Figure 3.5.4-15). The length and warmth of the growing season has been found to determine the size of bass fry entering winter, and larger young-of-the-year bass in autumn have higher over-winter survival (Jackson and Mandrak 2002).

a) age 1 bass



b) age 4 bass

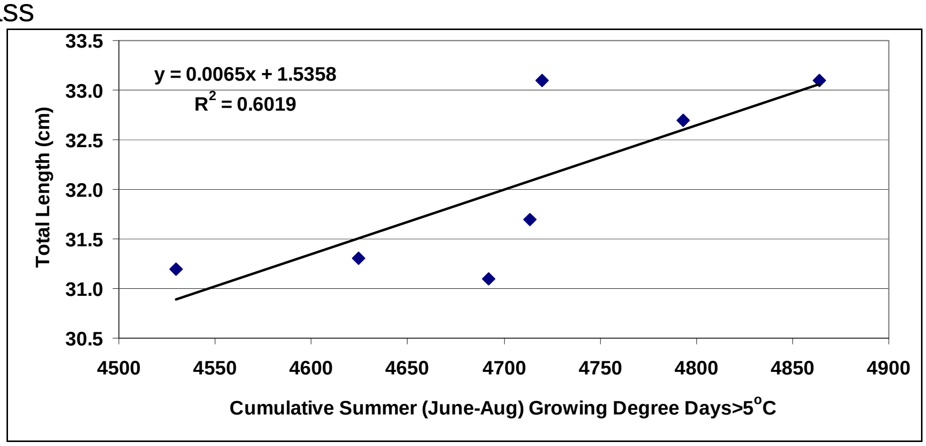
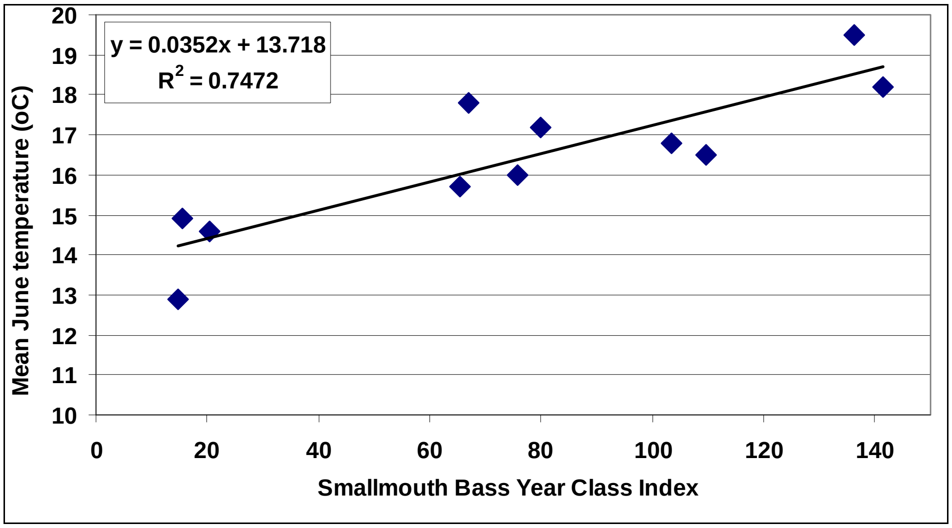


Figure 3.5.4-14. Average size of a) age 1 smallmouth bass sampled from four Atikokan area lakes (1995-2005) and b) age 4 smallmouth bass sampled at angler tournaments on Dashwa/Crowrock/Turtle (1994-2007) compared to the Cumulative Growing Degree Days (CGDD)>5^{o}C.

a) Dashwa/Crowrock/Turtle bass



b) Rainy Lake bass

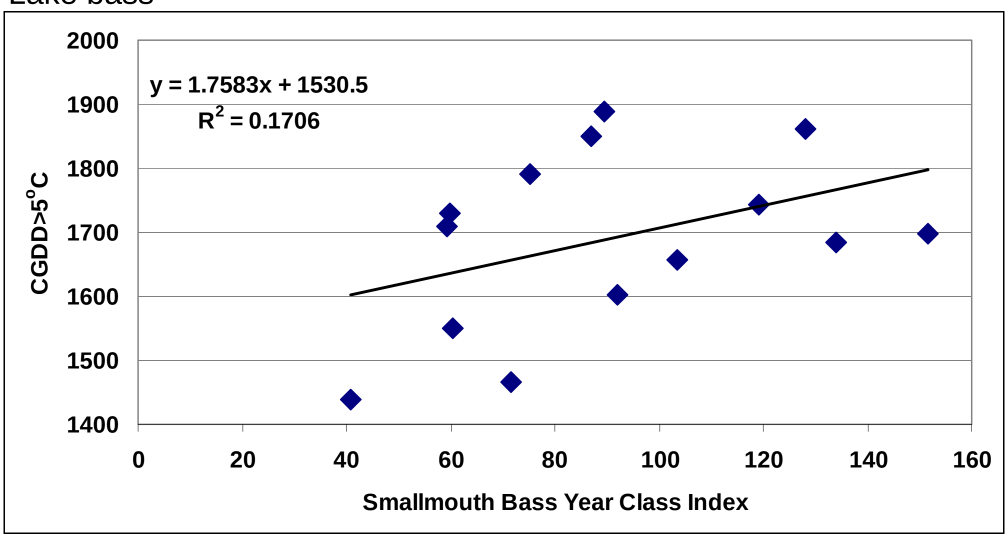


Figure 3.5.4-14. Year class strength of smallmouth bass sampled at angler tournaments on Dashwa/Crowrock/Turtle (1994-2007) and Rainy Lake (1995-2008) compared to first year temperature indices.

3.5.5 Other Sport Fish Species

Besides walleye, lake trout, northern pike, and smallmouth bass, there are other species which, while not as widespread or popular with anglers, are important to the overall ecological and angling resource of FMZ 5. These include muskellunge, black crappie, largemouth bass, yellow perch, whitefish and cisco. Because they are rarely the target of assessment programs, information on their biological status tends to be limited to incidental catch from other surveys or a few special project surveys.

3.5.5.1 Muskellunge

Muskellunge (*Esox masquinongy*) are the largest sport fish in FMZ 5, capable of reaching lengths of over 55" (OMNR unpublished data). They are known to live in 88 lakes (6%) of the lakes in FMZ 5 although, because they tend to prefer larger lakes, this accounts for 18% of the lake area. They are found only in the west half of FMZ 5 (Figure 3.5.5.1-1). The FMZ 5 area is considered important to the Ontario muskellunge resource as it contains approximately 30% of the known populations in the province (OMNR 1987). It is also considered in some ways to be unique because of the number of muskellunge populations occurring in simple community lakes (T. Mosindy, LOWFAU Fisheries Biologist, OMNR). In 20 (23%) of the muskellunge lakes in FMZ 5, muskellunge are the only shallow water predator.

Related to northern pike, muskellunge are similar in many respects with both spawning in the spring in areas of flooded vegetation and both are ambush predators feeding primarily on fish (Holm et al. 2009). Pike often spawn 2-3 weeks earlier than muskellunge. Since northern pike spawn earlier than, and in similar areas to, muskellunge, predation by young-of-the-year pike on young-of-the-year muskellunge is often believed to have a negative influence on muskellunge abundance (Caplin 1982, Dombeck et al. 1986, Inskip 1986) although in FMZ 5, 68% of the muskellunge lakes also have northern pike. These negative interactions seem most pronounced in waters where muskellunge are native and northern pike were introduced (Hanson et al. 1986).

Because of their low density relative to other species, muskellunge are not often caught in normal assessment programs. In order to better manage muskellunge populations in Ontario, much work was focussed on determining population characteristics, particularly growth and relative population density, from the cleithra of angler caught fish (Casselman et al. 1999). Based on this information and the maximum observed size in each lake, muskellunge populations in FMZ 5 were placed in one of three categories for the purpose of setting minimum size lengths, the primary management technique for this species at this time (Figure 3.5.5.1-1). Currently, 75% of the 87 known muskellunge populations in FMZ 5 are classed as having average growth rates and relatively high density populations. A number of lakes (22% of lakes) were identified as having high growth rates and fish populations capable of producing quality sized fish. A relatively few larger lakes (3%) were identified as having growth rates and population characteristics capable of producing trophy fisheries.

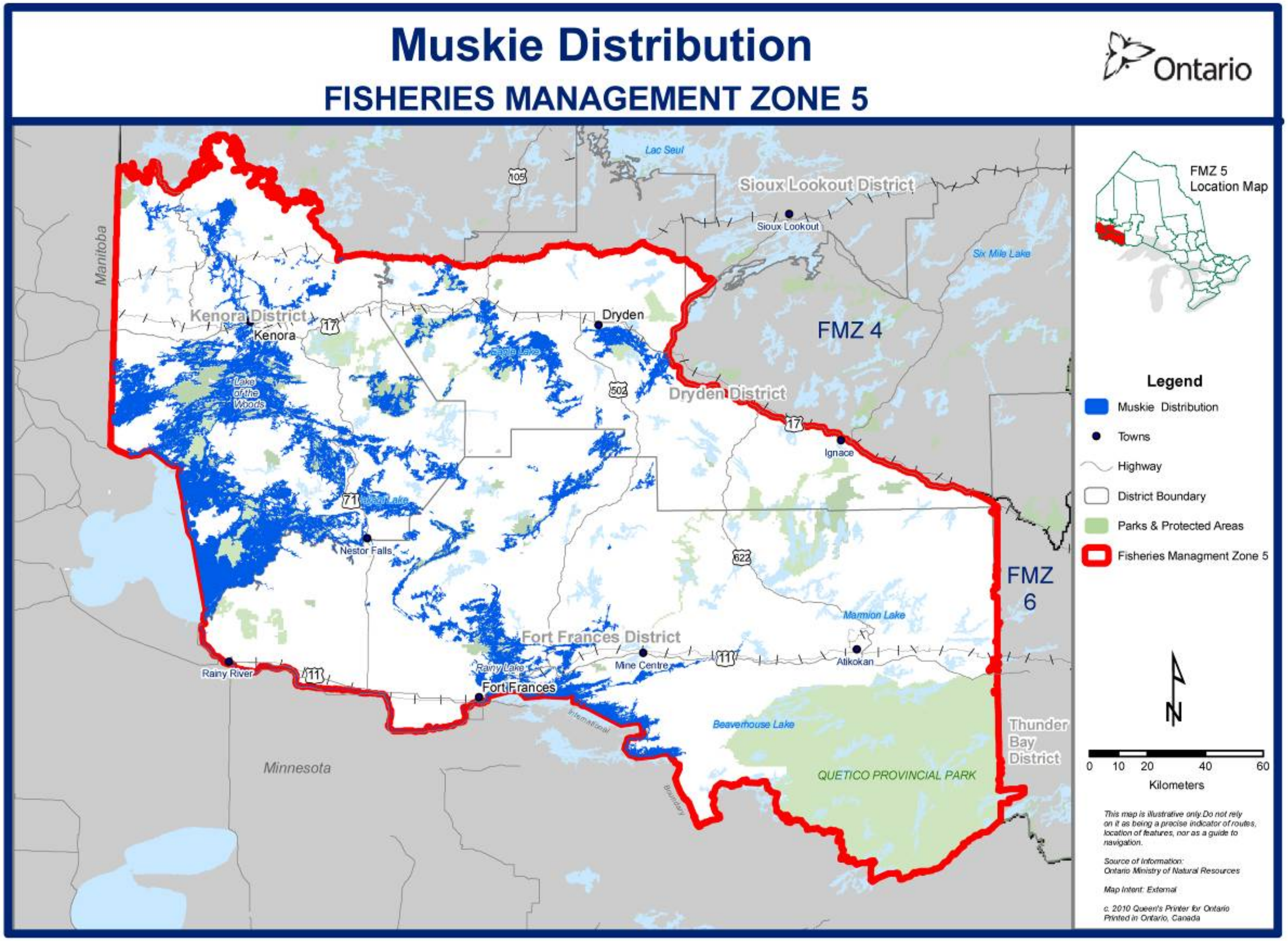


Figure 3.5.5.1-1 Distribution of muskellunge within Fisheries Management Zone 5

.

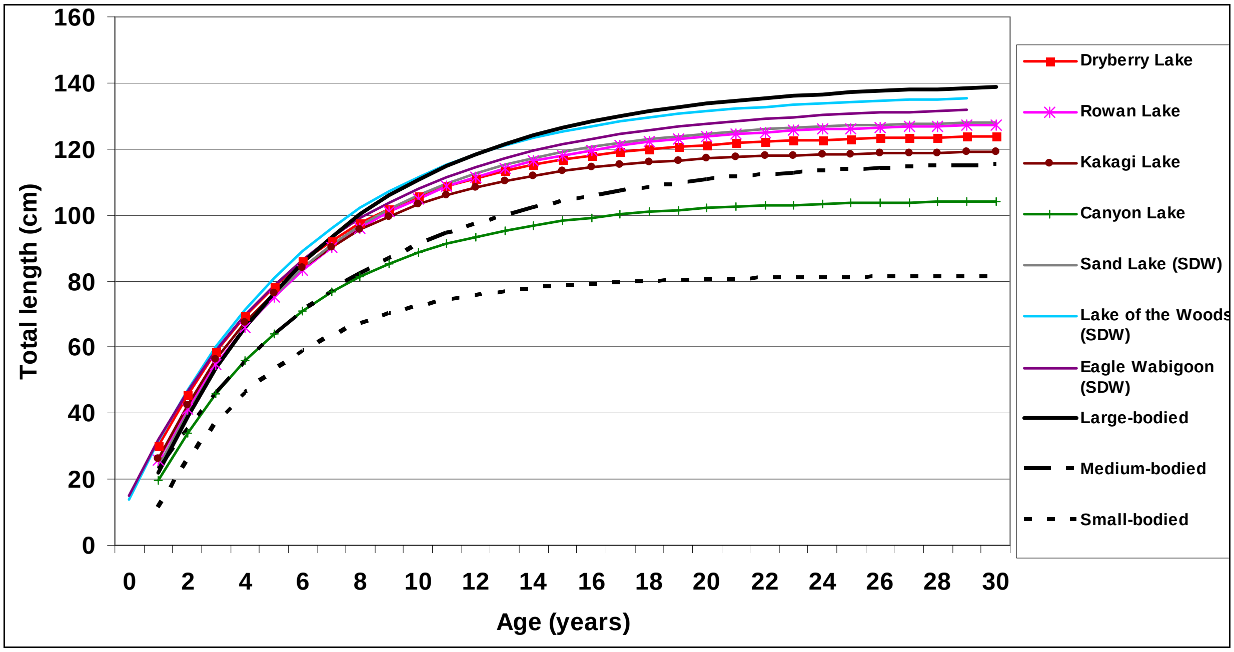


Figure 3.5.5.1-2. Calculated growth rates of selected muskellunge populations within Fisheries Management Zone 5.

3.5.5.2 Black Crappie

Black crappie (*Pomoxis nigromaculatus*) are a non-native species that has been introduced into FMZ 5 area starting in the 1920's. New populations are still being found with recent expansions into both Atikokan and Dryden area lakes being reported within the last five years. Black crappie are known to be found in 93 lakes in FMZ 5 which accounts for about 10% of both the number and area of lakes with species information. They are found mainly in the western portions of FMZ 5 (Figure 3.5.5.2-1). Black crappie are most commonly found with northern pike (92% of black crappie lakes) and walleye (89% of lakes with black crappie). Only 15% of the black crappie lakes are coldwater lakes.

Black crappie prefer relatively shallow productive lakes, bays, and rivers with extensive areas of aquatic macrophytes (Kerr and Grant 1999, Scott and Crossman 1973). They are found most often in clear, calm water and prefer summer water temperatures of 20-25 ^{o}C, slightly warmer than walleye (19-23 ^{o}C) and similar to smallmouth bass (20-26 ^{o}C (Coker *et al*. 2001). Black crappie occupy shallow areas but they are also open-water predators and often suspend over deeper water (McNeil 1992).

As with other members of the sunfish family, black crappie are nest builders and spawn in late spring (Holm *et al*. 2009). They mature by 4 years and are prolific breeders (Scott and Crossman 1973, McNeil 1992). Black crappie feed most often in low light conditions, near dawn and dusk (Holm *et al*. 2009). While they are young their diet consists mainly of zooplankton or a combination of zooplankton and small insects but by the time they are 15 cm (6"), they feed mainly on other fish (Dockendorf and Allen 2005, Ellison 1984). Because of their ability to do well in a variety of physical and environmental conditions and their wide range of diet, they can exploit habitats similar to those used by walleye and yellow perch (Keast 1968).

Because of their preference for warmer waters, they are one of the species that would be expected to benefit from the increasing temperatures predicted by climate change modelling. Research indicates that black crappie introductions can have a negative influence on native fish populations; especially yellow perch and walleye populations (Kerr and Grant 1999). Black crappie have been found to prey on walleye fry and fingerlings (Schiavone 1985, Krishka *et al.* 1996, Kerr and Grant 1999) and impact walleye populations through both direct predation and competition for food. This may impact walleye year class strength and lead to walleye recruitment failures (Schiavone 1985, Mosindy 1995, Krishka *et al.* 1996). About 10% of known walleye lakes are currently shared with black crappie populations in FMZ 5.

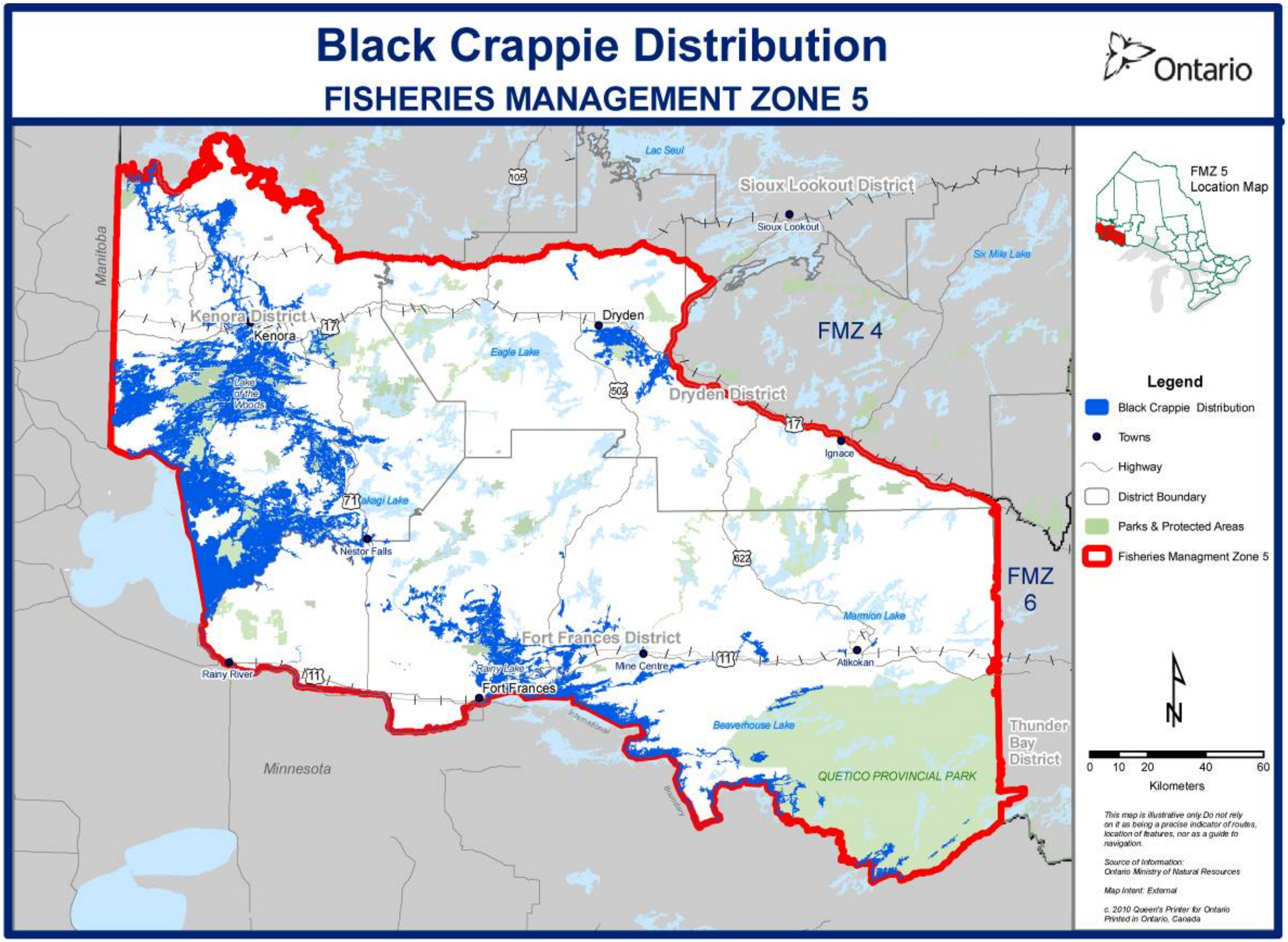


Figure 3.5.5.2-1 Distribution of black crappie within Fisheries Management Zone 5.

Biological data on black crappie populations in FMZ 5 lakes is limited with information available from only two lakes (Caliper Lake and Big Sawbill Lake) along with two SDW lakes - Rainy Lake and Lake of the Woods. It does however provide some insight into local crappie populations. Age distribution show that populations tend to be dominated by young fish with few fish over 10 years of age being present (Figure 3.5.5.2-2). Growth rates were relatively slow from two of the lakes, with fish taking 5 or 6 years to reach 25 cm (10”) and 8 years or longer to reach 30 cm (12”) (Figure 3.5.5.2-3). Fish sampled from Caliper Lake showed higher growth rates reaching 25 cm (10”) in about 4 years and 30 cm (12”) in about 6 years although there was a relatively small number of only 28 fish sampled from that population. In spite of similar age distributions, because of differences in growth rates, the size of crappie from Big Sawbill Lake was much smaller than the population sampled from Caliper Lake (Figure 3.5.5.2-4).

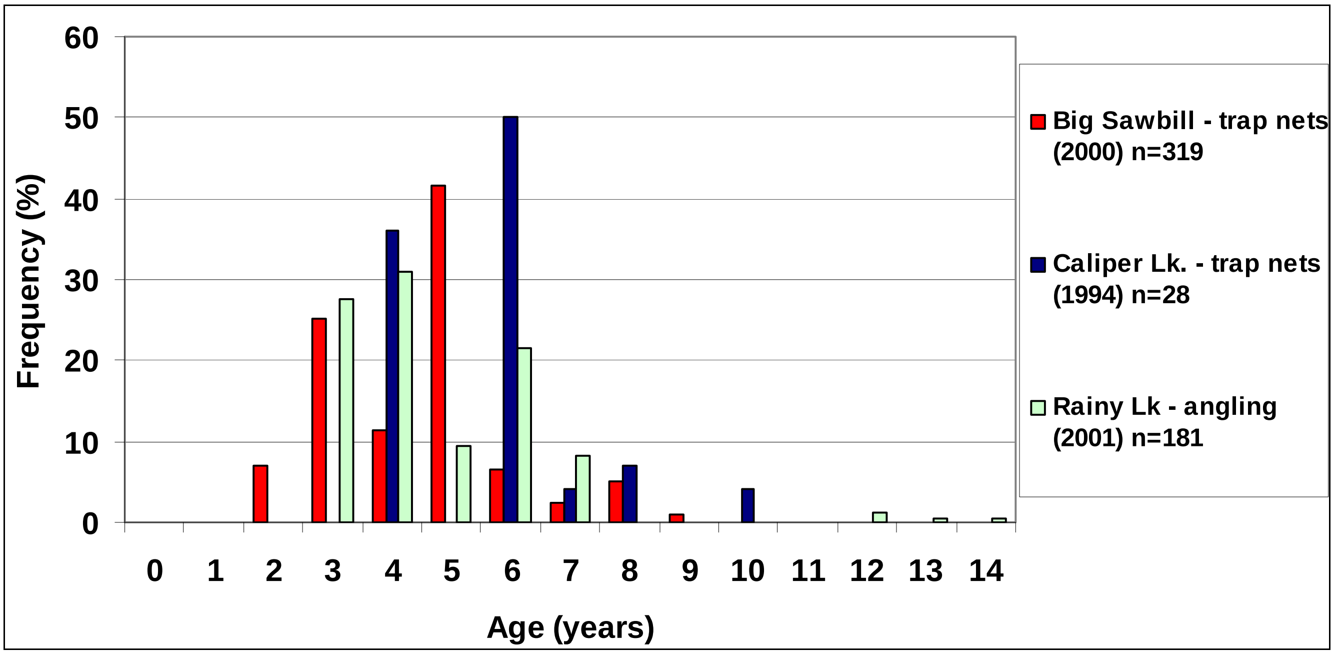


Figure 3.5.5.2-2 – Age distribution of black crappie sampled from FMZ 5 lakes.

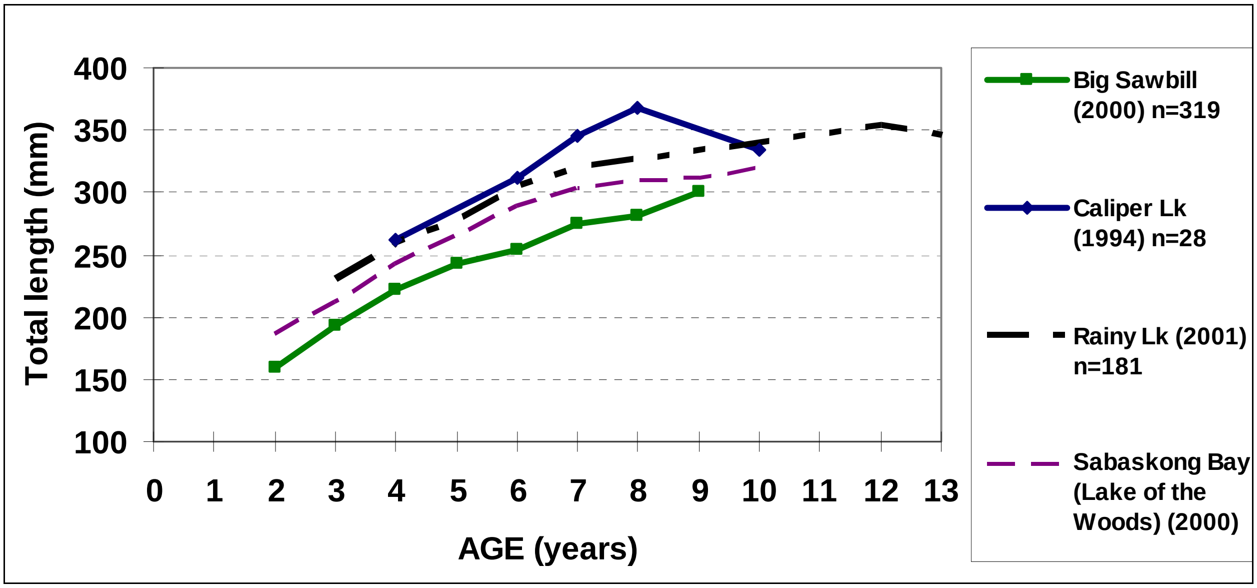


Figure 3.5.5.2-3 – Length at age (growth) of black crappie sampled from FMZ 5 lakes.

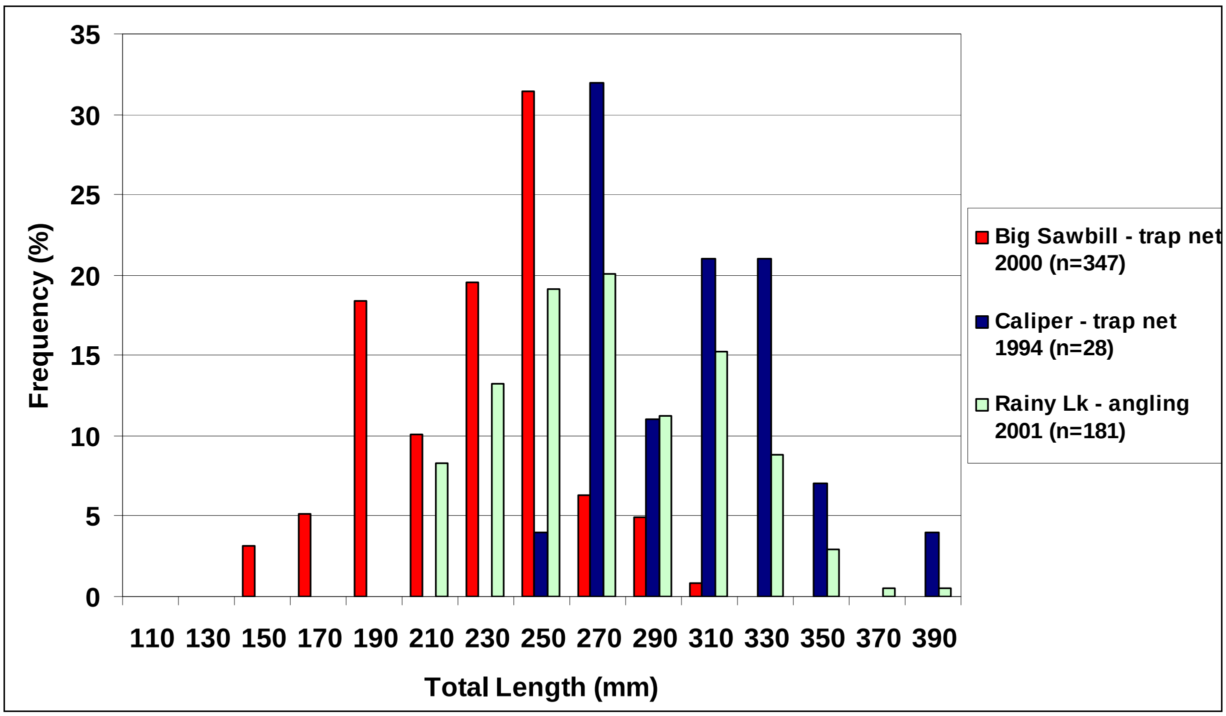


Figure 3.5.5.2-4 – Length distribution of black crappie sampled from FMZ 5 lakes.

3.5.5.3 Largemouth Bass

Largemouth bass (*Micropterus salmoides)* are an introduced species throughout most if not all of FMZ 5 (reports from the southern edge of Quetico Park prior to 1900 give some suggestion that they may be native in that area (Peruniak 2000)). Compared to the more common smallmouth bass, largemouth prefer softer bottom habitat, usually with aquatic vegetation or cover such as submerged trees and prefer warmer temperature water (Holm *et al*. 2009). Their diet includes a wide range of items including fish, frogs, and crayfish. They spawn in the spring by laying their eggs in nests made in soft substrate with males guarding the nests and fry until the young disperse from the nest site. Largemouth bass are known to be found in 93 lakes in FMZ 5 which accounts for about 10% of the lakes with species information and 12% of the lake area. They are found mainly in the south and west portions of FMZ 5 (Figure 3.5.5.3-1). They are most commonly found with northern pike (88% of largemouth lakes) and smallmouth bass (74% of lakes with largemouth). Walleye are found in 60% of largemouth bass lakes. In spite of being considered a warmwater species, about 40% of the largemouth bass lakes are coldwater lakes.

There is little information about the status of largemouth bass populations in FMZ 5 lakes although they can reach high densities and relatively large sizes of 2 kg (4.5 lbs) or more even in some of the smaller lakes (Caron 1994, B. Jackson, OMNR biologist; pers. comm.). Some observations indicate that they appear to reach higher densities in shallow, stained water lakes which may absorb more heat energy in shallow bays, particularly in the spring and allow for early spawning and longer growing seasons (B. Jackson, OMNR biologist; pers. comm.). In larger lakes, they often have limited distribution, occurring only in a limited area such as a shallow weedy bay and are rarely found outside that area. From the limited number of FMZ 5 lakes that have largemouth bass data (2 small lakes plus the SDW of Lake of the Woods), largemouth bass have been found to live up to 15 years (Caron 1994, Mosindy 1998). Growth rates were quite variable ranging from very slow growth in Helen Lake, a very small lake (22 ha) with an atypical population that fed mainly on insects to intermediate growth rates of bass from Skinny Lake, a small 66 ha lake where bass had a more typical diet of crayfish and small fish to the very large waterbody of Lake of the Woods which had growth rates similar to the Ontario average for younger ages but slower growth after age 6 (Figure 3.5.5.3-2). It is expected that most FMZ 5 largemouth bass populations would have growth rates somewhere between Skinny Lake and Lake of the Woods fish. As with growth, the weight at length (condition) varied greatly between the sampled populations from the very skinny fish from the almost non-fish eating Helen Lake population to the heavier fish from Lake of the Woods (Figure 3.5.5.3-3). As with the growth, it is expected that most FMZ5 largemouth populations would fall in the range between Skinny Lake and Lake of the Woods bass. Evidence from Lake of the Woods would suggest that at any age, largemouth bass tend to be longer and weigh more compared to smallmouth bass (Figure 3.5.5.3-4; Corbett et al. 2007).

Being a warmwater species, they are one of the species that would be expected to benefit from the increasing temperatures predicted by climate change modelling. Wisconsin studies have show that in lakes in that state, largemouth bass had a negative impact on walleye populations while little or no impact on walleye was found from the three other species looked at (smallmouth bass, northern pike and muskellunge). About 7% of known walleye lakes are shared with largemouth bass populations in FMZ 5.

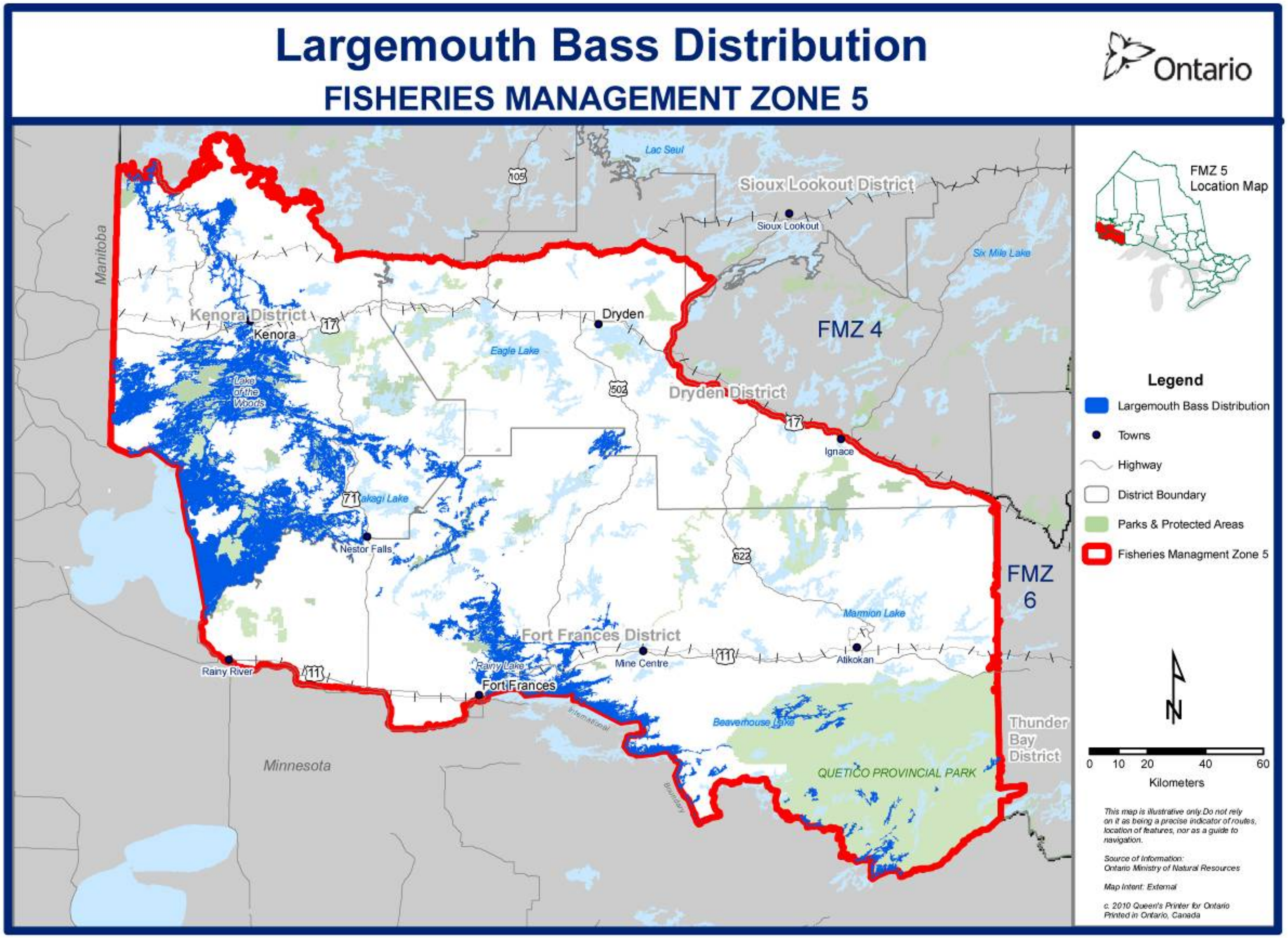


Figure 3.5.5.3-1 Distribution of largemouth bass within Fisheries Management Zone 5.

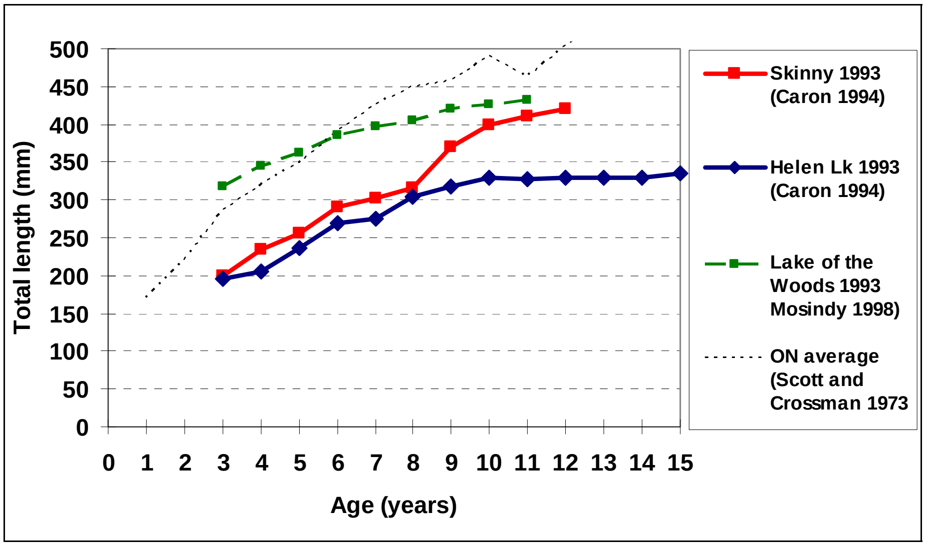


Figure 3.5.5.3-2 – Length at age (growth) of largemouth bass sampled from FMZ 5 lakes.

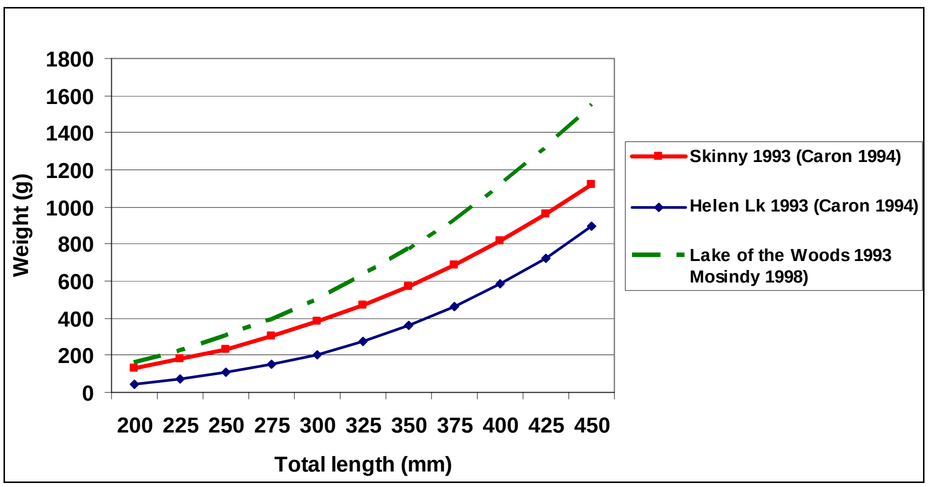
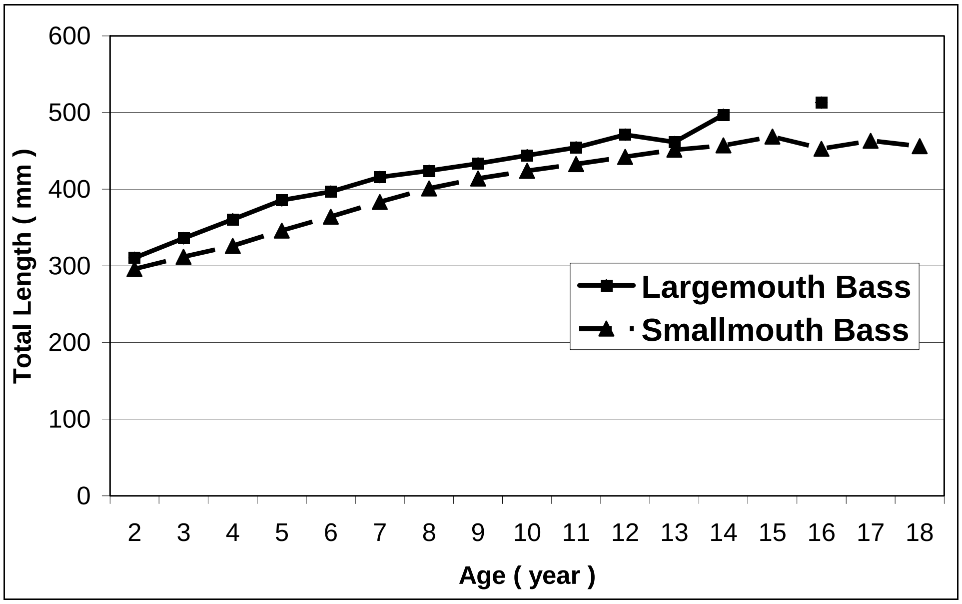


Figure 3.5.5.3-3 –Predicted weight at length (condition) relationship for largemouth bass populations sampled from FMZ 5 lakes.

a)



b)

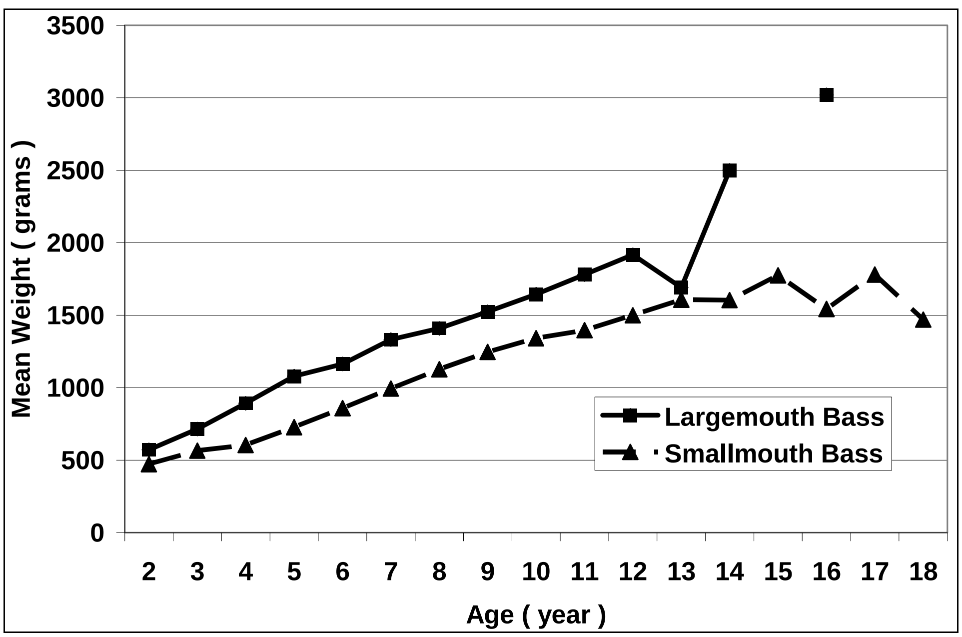


Figure 3.5.5.3-4 Comparison of Lake of the Woods largemouth bass and smallmouth bass between a) length at age and b) weight at age from samples collected at the Kenora Bass International 1992 – 2001 (from Corbett et al. 2007)

3.5.5.4 Lake Whitefish and Cisco (Lake Herring)

Lake whitefish and cisco (also known as lake herring) are both species that prefer deeper, open water and feed mainly on zooplankton and other invertebrates. Both species spawn in the fall, laying their eggs over rocky or gravel bottoms or in the case of whitefish, in rocky rapids (Holm *et al*. 2009). The eggs hatch the following spring shortly after ice out. Of the two, whitefish tend to spend more time near the bottom of lakes while cisco often form large schools in the mid-depths near the thermoclines of lakes. Although classed as cold water species, they are less demanding of cold water habitat than lake trout and often exist in cool water lakes that do not meet the habitat requirements of trout.

Whitefish

Whitefish are widely distributed throughout FMZ 5 and are known to be found in at least 365 of lakes with species information (36% of lakes) (Figure 3.5.5.4-1). Because some of the species information in these lakes is based only on angler catches, it is likely that whitefish are even more widespread than these numbers would suggest. They are most commonly found with northern pike (90% of whitefish lakes) and walleye (65% of lakes with whitefish). Over 60% of whitefish lakes are cold water lakes that are shared with lake trout.

Whitefish have primarily been allocated to the commercial fishery and sport fisheries are currently established in relatively few lakes in FMZ 5 and in many cases, they are an incidental catch by anglers targeting other species. Even in lakes that appear to have relatively high abundance of whitefish, they can be difficult to catch consistently and techniques that work well in one lake do not appear to work as well in other lakes. However, there are lakes in FMZ 5 where excellent sport fisheries have been developed. There are also locations where traditional fall dip net fisheries have been established. Commercial fishing for whitefish is done on only a few lakes in FMZ 5 as well as some of the larger SDW lakes such as Rainy Lake and Lake of the Woods (see section 5.2 for more information on commercial fishing in FMZ 5).

Information on the status of whitefish is usually collected incidental to other population assessments such as Fall Walleye Index Netting Surveys (FWIN) and Spring Littoral Index Netting (SLIN) surveys. In addition, there has been some sampling of commercially caught whitefish from FMZ 5 lakes that can provide some information on population characteristics. The data from the FWIN surveys show a wide range in average size of fish caught ranging from average total lengths of around 300mm (12”) to 600mm (24”) with most populations having an average size of 450 mm (18”) (Figure 3.5.5.4-2). Surveys of coldwater lakes in the Atikokan area found that whitefish size was inversely related to density as measured by catch in SLIN surveys with some lakes having high numbers of relatively small fish and other lakes having lower numbers of large sized fish (Figure 3.5.5.4-3). FWIN data also tends to show a similar pattern (Figure 3.5.5.4-2).

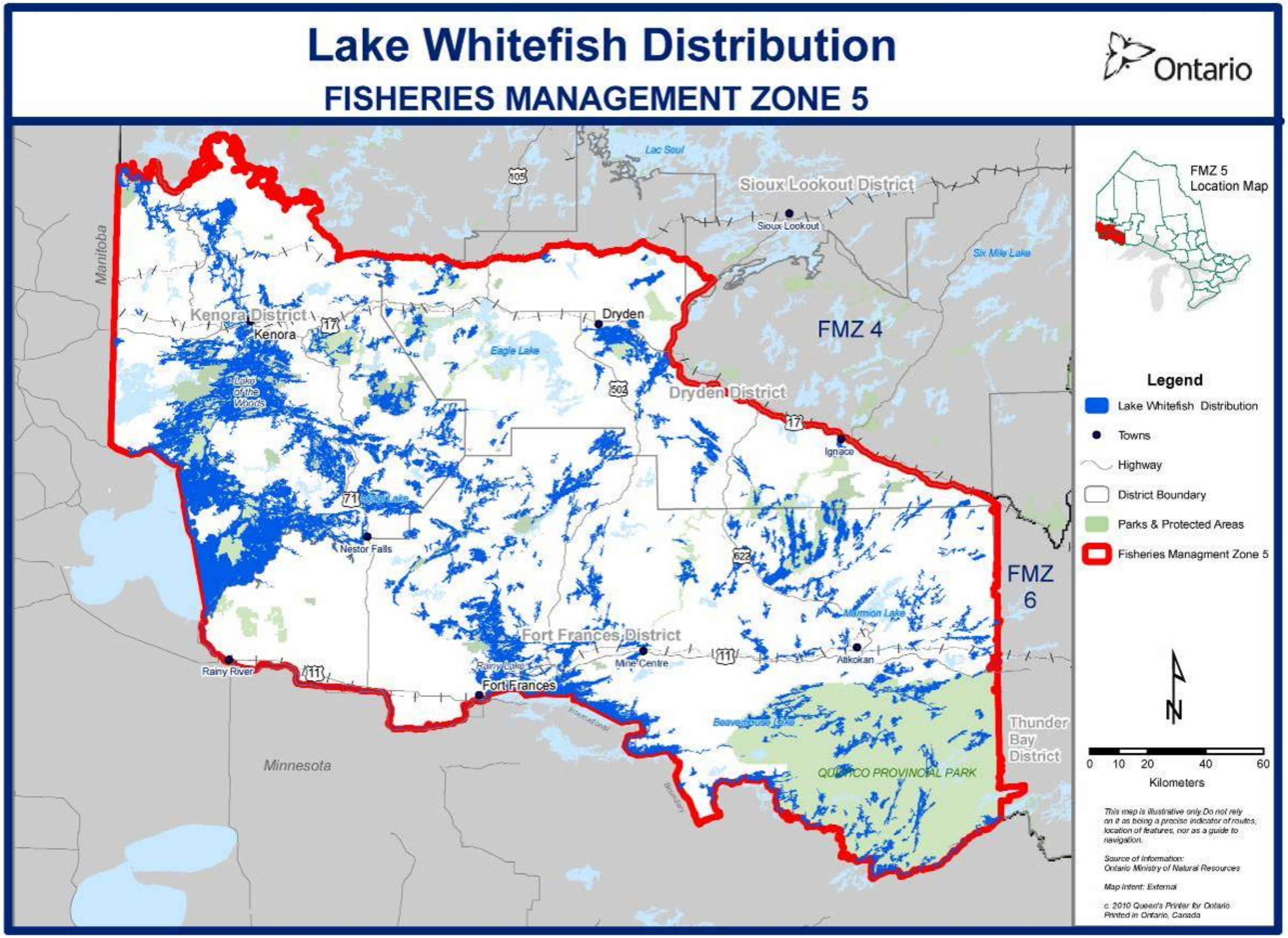


Figure 3.5.5.4-1. Distribution of lake whitefish within Fisheries Management Zone 5.

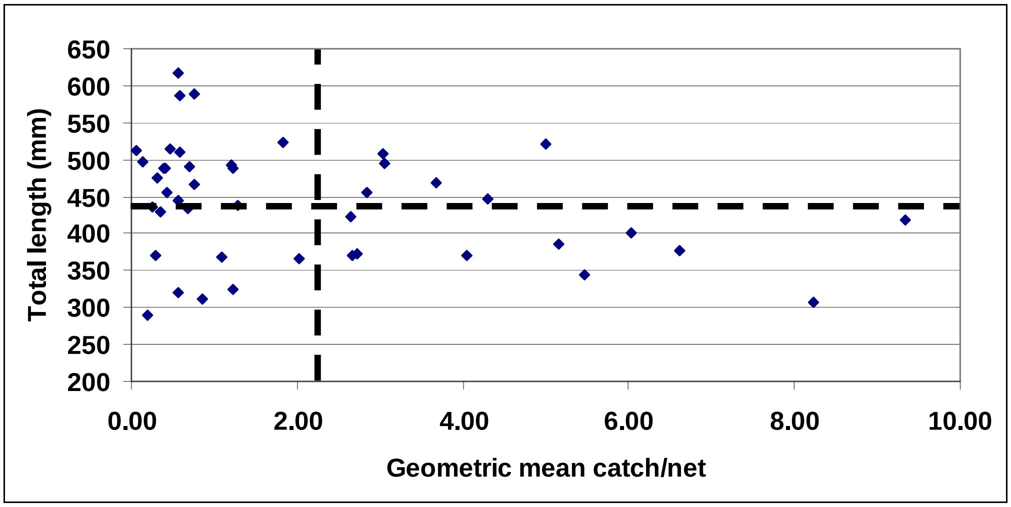


Figure 3.5.5.4-2. Average size versus catch of lake whitefish from Fall Walleye Index Netting Surveys (FWIN) within Fisheries Management Zone 5 (number of lakes = 44) (Dashed lines indicates FMZ 5 averages).

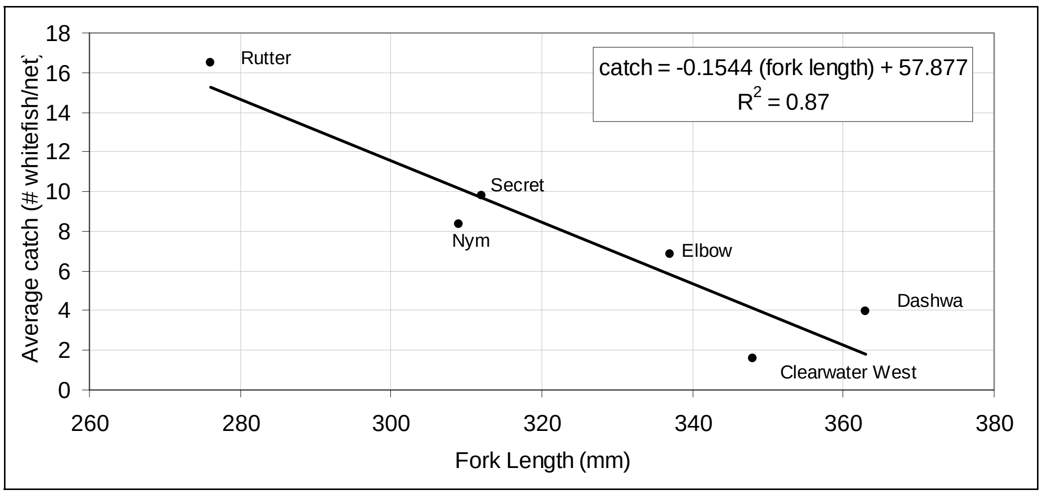


Figure 3.5.5.4-3. Average size versus catch per net from Spring Littoral Index Netting (SLIN) surveys for FMZ 5 lakes in the Atikokan area.

Data from commercial fish sampling indicates that lake whitefish are relatively long lived with maximum ages over 20 years reported for most populations (Figure 3.5.5.4-4). For the FMZ 5 populations, there was a wide variation in growth between populations with the average length of a 15 year fish ranging from 450mm (18") to 550mm (22") (Figure 3.5.5.4-5). Growth also slows dramatically after maturity with little difference in size between 10 year old and 20 year old fish in most lakes. Compared to Rainy Lake, the whitefish from other FMZ 5 lakes with commercial catch data are generally older slower growing suggesting that exploitation stress and mortality is less on these lakes and populations are healthy. The slow growth also results in populations that tend to have smaller size fish than those found on Rainy Lake (Figure 3.5.5.4-6).

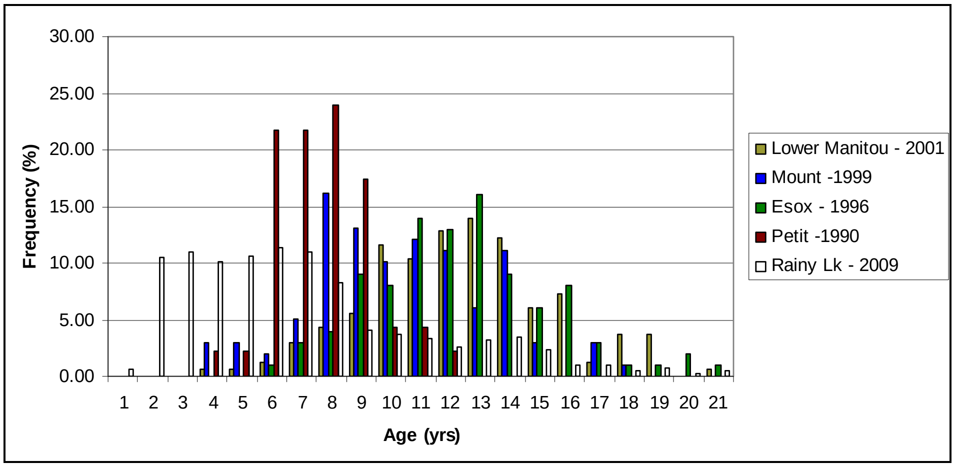


Figure 3.5.5.4-4. Age distributions of lake whitefish sampled from commercial catches of FMZ 5 lakes.

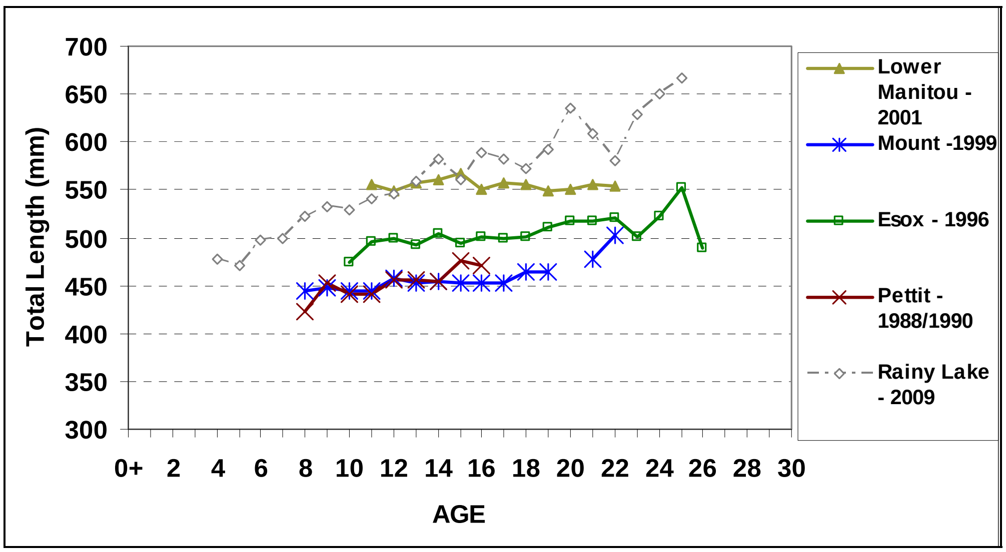


Figure 3.5.5.4-5 – Length at age (growth) of lake whitefish sampled from commercial catches of FMZ 5 lakes

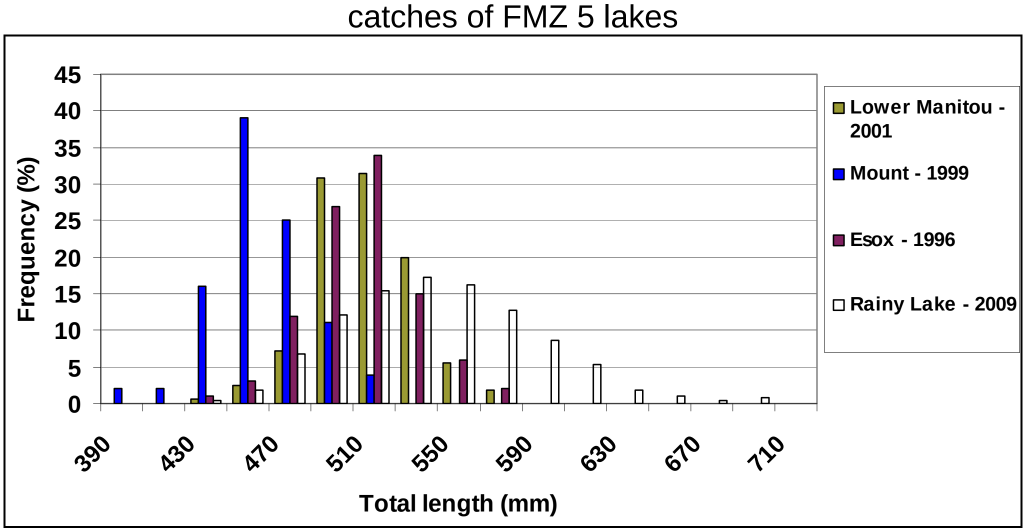


Figure 3.5.5.4-6 – Length distribution of lake whitefish sampled from commercial catches of FMZ 5 lakes

Cisco (Lake Herring)

Cisco occur widely across FMZ 5, being reported from over 380 lakes and are undoubtedly present in many more. Of the known lakes with cisco, 45% are coldwater lakes shared with lake trout and the remaining 55% are coolwater communities. Cisco are one of the more important prey species in FMZ 5 lakes. When they are present, they can form a nutrient rich forage base for species such as lake trout and walleye and, to a lesser degree, northern pike and smallmouth bass, and are particularly important for the larger, mature portions of these populations. About a third of both walleye and lake trout lakes have cisco reported from them although the actual proportion is likely higher. The presence of cisco in their diet allows those species to reach larger sizes and produce more eggs (Kaufman et al. 2009b). Because of they require cold water but live in the zone where cold water and warm water meet, they are also a very useful species to monitor impacts of climate change on fish populations (Jacobson 2010)

Cisco are less utilized as a sportfish in FMZ 5. Because of their zooplankton diet and tendency to suspend over open water, they are often difficult to catch utilizing conventional fishing tackle and appear to be most frequently caught while ice fishing for other species such as black crappie. In addition, in many lakes, they reach relatively small sizes. There is a small commercial fishery for cisco by baitfish harvesters for sale as bait. Baifish harvesters are quite selective about the size of cisco as the marketable size range for bait is fairly restricted. FWIN catches from 44 lakes across FMZ indicate that average size ranges from just over 10 cm (4”) to over 40 cm (16”) (Figure 3.5.5.4-7). Most populations have an average size of around 20 cm (8”), a perfect size for prey for large lake trout and walleye but generally too small to interest anglers as a sportfish species. FWIN surveys results show that average size of cisco caught tends to increase in shallow lakes with higher productivity (Figure 3.5.5.4-8).

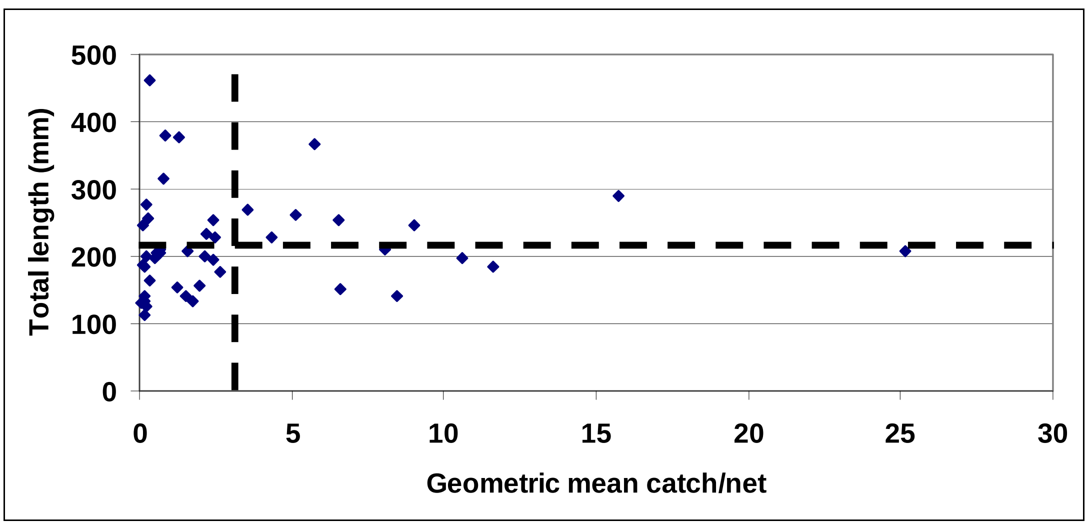
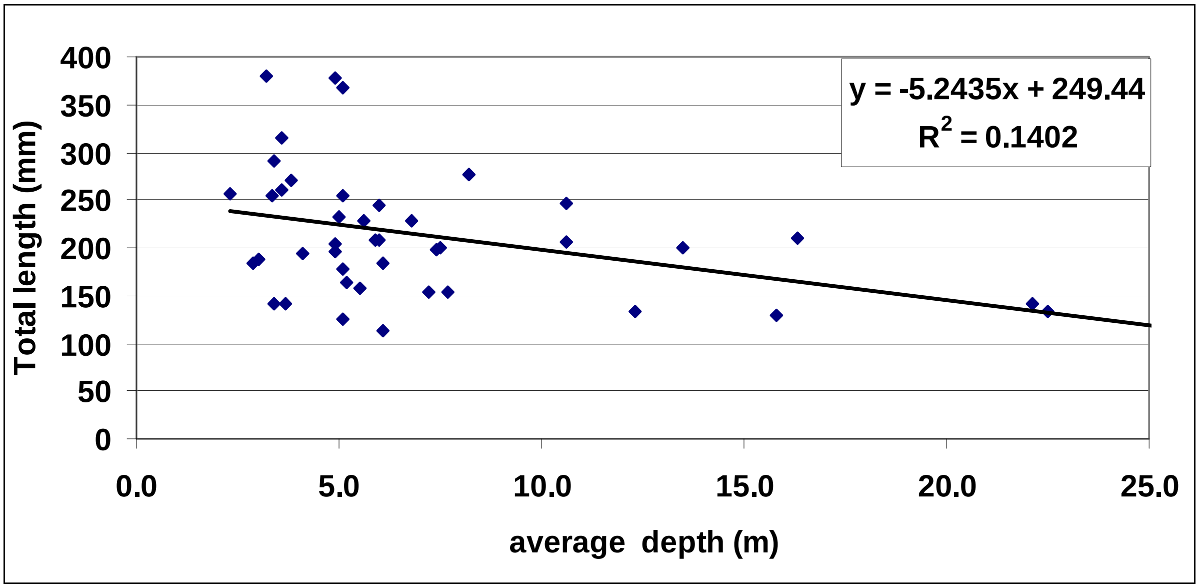


Figure 3.5.5.4-7. Average size versus catch of cisco (lake herring) from Fall Walleye Index Netting Surveys (FWIN) within Fisheries Management Zone 5 (number of lakes = 44)(Dashed lines indicate average size and catch for FMZ 5).

a)



b)

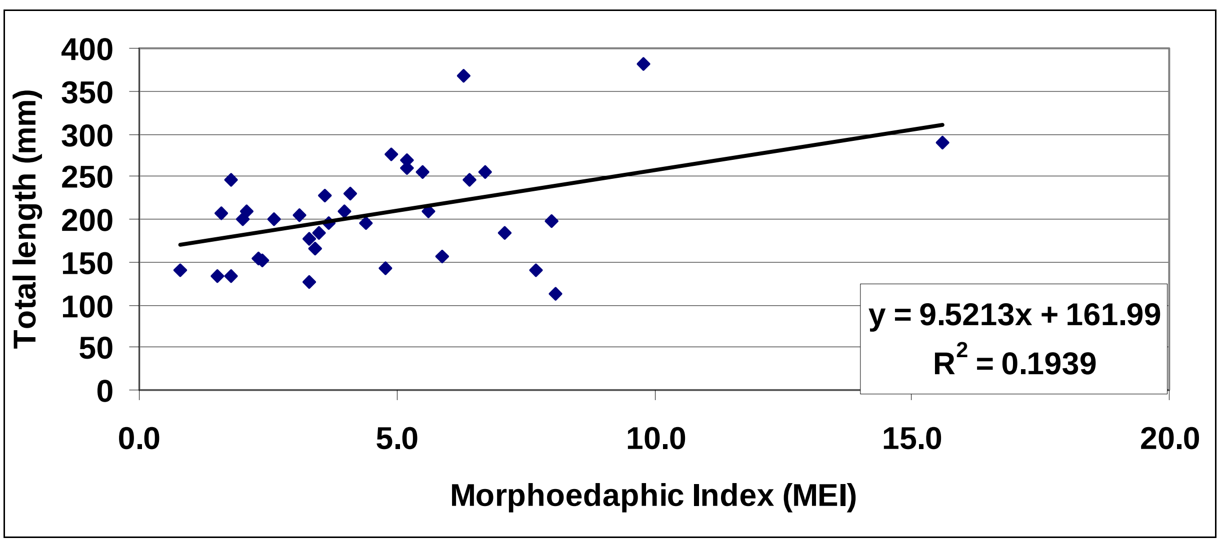


Figure 3.5.5.4-8. Average size of cisco (lake herring) from Fall Walleye Index Netting Surveys (FWIN) within Fisheries Management Zone 5 versus a) average lake depth and b) lake productivity as measured by MEI (number of lakes = 44).

3.6 Fish Health

3.6.1 – Disease and Parasites

Like any species, fish are vulnerable to a wide variety of diseases and parasites. In the majority of cases, parasites are a normal part of the ecosystem in which the fish lives and they rarely cause issues such as large scale fish deaths. An exception to this would be newly introduced diseases such as Viral Hemorrhagic Septicemia (VHS) which can be a threat to fish populations. The following information was taken mainly from the Guide to Eating Ontario Sport Fish 2009-2010 (OMOE 2009) produced by the Ministry of Environment and available free from Service Ontario offices. If more information is required on fish parasites and contaminants and any consumption restriction, it is recommended that you refer to this book.

Parasites are organisms which obtain food and/or shelter from another host organism, usually without killing the host. They often have complex life cycles involving several different species before they can mature and reproduce. Anglers may notice parasites on fish as worms in or around the intestines of the fish or fungus growths on the skin, fins or gills. While not aesthetically pleasing, the edible portions containing parasites do not present a health hazard if properly and thoroughly cooked. The following is a brief description of disease and parasites commonly observed on fish species in FMZ 5.

3.6.1.1 Black spot

Black spot, one of the most frequently observed parasites of fish in pike, bass and small walleye, appears as small black spots or cysts in the skin, fins and flesh of fish. The black spot life cycle involves fish-eating birds such as herons and kingfishers snails and fish. This organism does little harm to the fish, but does give them an unsightly appearance. Infected fish can be consumed with proper cooking.

3.6.1.2 Yellow Grub

Yellow grub is closely related to black spot and has a similar life cycle. It appears as yellow or white spots in the flesh, sometimes over one-half cm long. Smallmouth bass and yellow perch tend to be the species most commonly inflicted with yellow grub in Ontario. If only a few grubs are found in a fillet, they can be easily removed with a knife tip. Otherwise, infected fish can be consumed with proper cooking.

3.6.1.3 Tumours in fish

Occasionally, anglers catch fish with external growths, tumours, sores or other lesions. Such abnormalities generally result from viral or bacterial infections. Some of the more common growths on game fish in FMZ 5 caused by viruses include lymphocystis, dermal sarcoma and lymphosarcoma.

Lymphocystis, a viral disease affecting walleye and perch, is common throughout Canada. Viruses infect the fish's skin through contact with infected fish during the spring spawning run, forming pale or white cauliflower-like growths. Lymphocystis does not kill affected fish. Tagging studies have shown that these fish can lose the growths by the following spring.

Dermal fibral sarcoma, another viral disease affecting walleye, is caused by viruses which infect cells and cause growths just under the skin. These growths can be removed by skinning the fish. A study by the Ministry of the Environment and the Ministry of Natural Resources has shown that walleye with external skin lesions such as lymphocystis and dermal sarcoma do not have higher contaminant levels than unaffected fish.

Lymphosarcoma is a viral disease affecting muskellunge and northern pike. This virus is transmitted at spawning, but the lesions caused by it can vary depending on the season and stage of the disease. In the spring, affected fish have thick white patches on their skin from which viruses are shed and these in turn infect other fish. Later in the year these patches may heal, forming blotchy red sores or even normal skin. The virus causing lymphosarcoma infects the white blood cells of the fish and can spread throughout the body during the summer or over several years. This disease can kill infected fish.

3.6.1.4 Viral Hemorrhagic Septicemia

Viral Hemorrhagic Septicemia (VHS) is an infectious disease of fish and is a relatively new pathogen in the province of Ontario. At present, VHS is found in Lake Ontario, Lake Huron, Lake Michigan, Lake St. Clair and Lake Erie, with recent reports of VHS occurring in Lake Superior. The virus affects many fish species including sport fish such as smallmouth bass, muskellunge and walleye. Visual signs of VHS in fish vary substantially and can be categorized into three forms; some fish show obvious signs and rapid mortality in acute infection (rapid onset); delayed signs and high mortality in chronic infection; and no signs and low total mortality in latent or dormant infections. VHS does not affect humans, and fish carrying the virus are safe to handle and eat. Again, as a precaution, avoid fish that appear to be sick or are dead or dying when caught. Though VHS is not an immediate threat to FMZ 5, the potential for introduction does exist.

3.6.1.4 Fish "Die-offs"

Periodically, large fish die-offs have occurred in Ontario lakes. Fish die-offs can impact one or more species of fish at the same time and may be caused by a combination of factors including fluctuating temperature, spawning stress, or bacterial or viral infections. This most frequently occurs with species such as whitefish, cisco or smelt living in coolwater lakes. The factors that cause the die-off are generally not a threat to humans but any observation of a number of dead fish at one place should be reported to the OMNR. so it can be investigated and the fish left untouched.

3.6.2 – Contaminants

Contaminants are substances that are found in fish flesh that can be hazardous, either to the fish or whatever may eat fish such as humans. There are many naturally occurring substances which, at levels normally found in air, water and food, pose no hazard to the environment or to human health. A number of naturally occurring substances such as mercury, and synthetic compounds, such as PCBs, mirex and dioxins, may also be found in the environment at levels that are hazardous. Top predators, such as larger walleye and pike, usually have the highest contaminant levels. Smaller, younger fish and fish that are not top predators, such as whitefish, panfish and yellow perch, are lower in contaminants. Contaminants found in sport fish originate not only from local sources, but some are transported thousands of kilometres in the atmosphere before being deposited with rainfall. Mercury, PCBs and toxaphene are a few of the contaminants that are known to be transported long distances and can cause low-level contamination even in isolated lakes and rivers.

Consumption guidelines developed for use by Ontario anglers are based on tolerable daily intake guidelines provided by the Food Directorate of Health Canada and can be food in the MOE booklet “Guide to Eating Ontario Sport Fish” (OMOE 2009).

3.6.2.1 Mercury

Mercury is a naturally occurring metal which is found in very low levels in air, water, rocks, soil, and plant and animal matter. At one time mercury was widely used in industry; however, government and industry took action to reduce its use in the late 1960s and early 1970s and direct discharges of mercury from major industrial sources have been virtually eliminated. Significant quantities of mercury still enter the aquatic environment from the atmosphere from both man-made and natural sources. Flooding of land (e.g hydroelectric reservoirs) can also increase the amount of mercury in aquatic systems. Mercury in water is converted methylmercury which can be absorbed by a fish either directly from water passing over its gills or ingested with its diet. Since fish eliminate mercury at a very slow rate, concentrations of this substance gradually accumulate in its fat tissues.

There are many lakes within FMZ 5 that have consumption restrictions based on mercury levels in fish and it is the one contaminant that is always tested for from area lakes. Other metals such lead, copper, nickel, zinc, cadmium, manganese, chromium, arsenic and selenium are sometimes found in fish tissue but not at levels that would suggest a need for consumption restrictions in fish from FMZ 5.

Polychlorinated biphenyls (PCBs) are a group of chlorinated organic compounds first commercially developed in the late 1920s. They are not formed naturally in the environment, so their presence is always attributed to human activity. PCBs persist for years in the natural environment and bioaccumulate readily in the aquatic ecosystem. As a result, top predator species of fish with a high fat content such as salmon and trout (but not walleye and pike which have a low fat content) have accumulated PCBs in some Ontario waters to levels which restrict consumption. Other industrial chemicals such as dioxins, furans and dioxin-like PCBs Dioxins and furans are unintentional byproducts of several industrial processes and in some cases, incomplete combustion. Testing of fish for these contaminants is only typically done in FMZ 5 lakes which are downstream of potential industrial sources (eg. pulp and paper mills)

4.0 Habitat Status

Fish populations within FMZ 5 have evolved in a variable environment and have some natural resilience to change, showing increases or decreases in year class strength over time (usually climate related). Fish populations are dependent on both the environment and habitat they live in. Therefore, the management of fish populations cannot be uncoupled from the management of their habitats.

The majority of stressors on fish habitat in FMZ 5 are primarily man-made in nature, impacting adjacent watersheds as well as waterbodies and watercourses directly. Stresses on fish habitat can be local such as roads and water crossings, water power development, mineral exploration, extraction and rehabilitation and cottage development. Other stresses can occur over much larger scales and include impacts such as climate change. Man made stressors may induce habitat changes that exceed the natural resilience of fish populations and aquatic communities. While fish habitat across FMZ 5 is considered to be in relatively good shape, there have been no studies to quantify habitat condition and the cumulative impacts of development on a landscape scale. Historically, many of our larger rivers were developed for hydroelectric power generation resulting in loss of fish habitat and changes in flows and levels. Some rivers such as the Wabigoon River are still degraded from past effluent discharges from pulp and paper mills.

Resource managers need to be able to evaluate the interaction of current activities with those of the past and future and understand the combined effect on the environment (Reid 1993). This interaction of current, past and future activities within a watershed, need to be considered if fisheries resource managers are to avoid significant cumulative watershed impacts (Reid 1993). The Council on Environmental Quality (CEQ) in the United States provides the following definition of cumulative impacts:

> "Cumulative impact" is the impact on the environment that results from the incremental impact of the action when added to other past, present and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. (CEQ Regulation 1508 Subsection 1508.7 1971)

While there seems to be recognition in many jurisdictions of the need to monitor development activities within a watershed and to understand cumulative impacts of those developments, there is currently no work being conducted in FMZ 5 or generally in Ontario to address this management issue.

The federal government has a constitutional responsibility for inland fisheries. The *Fisheries Act* (*FA*) is the principal statute which protects fish and fish habitat in Canada, and is administered by the Department of Fisheries and Oceans (DFO). Specific responsibilities include ensuring fish passage (Sections 20 and 22), the protection of fish (Sections 30 and 32), the protection of fish habitat (Section 35) and prevention of pollution (Section 36). These sections are described in more detail in Table 8. In addition, DFO has policy guidance that is described in the "Policy for the Management of Fish Habitat "(DFO 1986). An important component of this policy is the principle of "no net loss". DFO also has the legislated responsibility for the protection and recovery of aquatic species at risk under the *Species at Risk Act* (SARA) and to conduct environmental assessments under the Canadian Environmental Assessment Act.

The Ministry of Natural Resources (MNR) is responsible for managing the fisheries resources of Ontario. Specific responsibilities include administering and enforcing the Ontario Fishery Regulations, Fish and Wildlife Conservation Act, Public Lands Act and Lakes and Rivers Improvement Act, fisheries management actions, fisheries management planning, fish and fish habitat information management and fish habitat rehabilitation. MNR and a number of other agencies in Ontario have permitting responsibilities under a wide variety of provincial legislation that provide protection to the aquatic environment. MNR also has the legislated responsibility for the protection and recovery of aquatic species at risk under the *Endangered Species Act* (ESA).

A protocol entitled "Fish Habitat Referral Protocol for Ontario" has been prepared that describes the responsibilities of DFO and other agencies in Ontario and how these various agencies work together to streamline the approvals process and avoid duplication (ARMAC 2009).

Table 8. Fish passage, protection of fish, protection of fish habitat and, prevention of pollution provisions of the Fisheries Act.

Section	Intent
Section 20	The Minister may require fishways to be constructed
Section 22	The Minister may require sufficient flow of water for the safety of fish and flooding of spawning areas as well as free passage of fish during construction.
Section 30	The Minister may require fish guards or screens to prevent the entrainment of fish at any water diversion or intake.
Section 32	Prohibits the destruction of fish by any means other than angling.
Section 35	Prohibits works or undertakings that may result in harmful alteration, disruption or destruction of fish habitat unless authorized by the Minister or under regulations.
Section 36	Prohibits the deposit of deleterious substances into waters frequented by fish unless authorized under regulations.

4.1 Natural Disturbances

The landscape of FMZ 5 has been subject to extensive natural disturbance from blowdown, insect damage and fire although the extent of fire disturbance has been reduced as most fires in FMZ 5 receive full or intensive suppression. From 1960 – 2007, approximately 63 fires over 200 ha in size have burned, with most large fires occurring in the northwest section of FMZ 5 during the late 1970's to the early 1960's. A number of large fires have also occurred in the south eastern section of FMZ 5 in Quetico from 1995 – 2007.

Fire is the main natural disturbance event in FMZ 5 and in most of northern Ontario that has a significant effect on aquatic systems. Some of the influences include: decreased stream channel stability, greater and/ or variable discharge, increase in woody debris, increase in nutrient availability, sedimentation, altered water temperature regimes and increased solar radiation (Dunham et al. 2003). The extent to which fire affects aquatic ecosystems is dependant on many factors, including: timing, location, severity, extent, characteristics of both the aquatic and terrestrial systems affected and the characteristics of the aquatic species present (Gesswell 1999).

Fire can cause an influx of nutrients, minerals and organic matter through both the removal of vegetation resulting in run off and through ash that is blown into nearby lakes and streams. In some cases, nutrient input results in an increase in primary production, which can increase productivity and alter food web interactions through changes in the abundance of primary consumers such as zooplankton (Planas *et al*. 2000). The most common mineral inputs from fire ash are calcium, magnesium and sulphate (Carignan *et al*. 2000). Sedimentation may also result from runoff, which can impact invertebrate communities and negatively impact spawning and nursery habitat of river spawning species (Kiffney *et al*.2003). Although sedimentation can cause short term negative impacts to habitat, the addition of course woody debris by fire in streams and lakes benefits many species by proving cover and shade.

One of the negative effects associated with fire is the movement of mercury from soils into waterbodies. Natural sources of mercury found in fish flesh are often a result of past forest disturbance events. Mercury is a toxic metal that is widely distributed in the environment and occurs naturally in both aquatic and terrestrial environments, generally in low concentrations. During forest fires, mercury is liberated through soil erosion and transformed into more soluble forms through the decay of organic matter (Porvari *et al*. 2003). Mercury is then able to leach into waterbodies through surface waters (runoff, streams and rivers). Uptake of mercury may be hastened in aquatic communities impacted by fire as associated nutrient loading from erosion and runoff may increase primary productivity resulting in an increased rate of mercury incorporation into aquatic organisms (Kelly *et al*. 2006). Mercury is biomagnified upwards within the food chain, it is found in low concentrations in primary producers and high concentrations in predators such as walleye or northern pike. Mercury is the most common contaminant found in the flesh of sport fish in northwestern Ontario (OMOE 2009).

Although there are some negative impacts from fire, the impacts are generally short in duration. As well, aquatic species in fire prone areas have generally evolved to benefit from fire overall (Dunham *et al*. 2003).

4.2 Climate Change

An overarching challenge to freshwater ecosystems within Fisheries Management Zone 5 is the impact to fisheries habitat and community assemblages associated with global climate change. These threats are global in scope, global warming is caused by increased levels of atmospheric carbon dioxide and other gasses (National Research Council 1983) and impacts are predicted to include global temperature increases of between 1.4°C and 5.8°C, with the greatest temperature changes experienced in northern boreal and arctic ecosystems.

Models that describe the effects of climate change suggest the Northwest Region will experience some of the most acute impacts of climate change in Ontario. These predictions include increases of approximately 5°C in growing season temperature over the next 90 years, changes to annual precipitation patterns and an increase in the frequency of extreme weather events (Racey 2004). A warming of 1.8°C has already taken place over the past 150 years and lake and river ice patterns have demonstrated significant trends over this time frame towards earlier breakup and shorter duration of ice cover in the northern boreal forests (Benson et al. 2001). Temperature changes and changes in precipitation as predicted by these models have already been observed within the FMZ 5 within the past 50 years (Jackson 2007). It is predicted that climate change will continue to impact boreal freshwater ecosystems by affecting ice cover, water temperatures, total water volumes (due to decreases in precipitation and increases in evaporation), and water quality with the magnitude of these impacts differing depending on existing waterbody characteristics and impacts associated with existing anthropogenic disturbances (Brown 2007). These changes, in turn, are expected to have significant impacts on aquatic ecosystems, including freshwater fish communities.

At the time this background report was drafted, climate data for FMZ 5 was only available up to the year 2007. In more recent years 2008 and 2009 have experienced colder than normal winter and summer temperatures and GDD, while the winter and spring of 2010 were considerably warmer than normal. Data collected from Environment Canada show average summer temperatures and average winter temperatures as well as growing degree days (GDD) (Figure 4.2-1) for Fisheries Management Zone 5 indicate warming trends across the zone through the last three decades. Warmer conditions appear to be greater in the western and southern portions of the zone, however warming trends are apparent throughout all of FMZ 5 within the last thirty years.

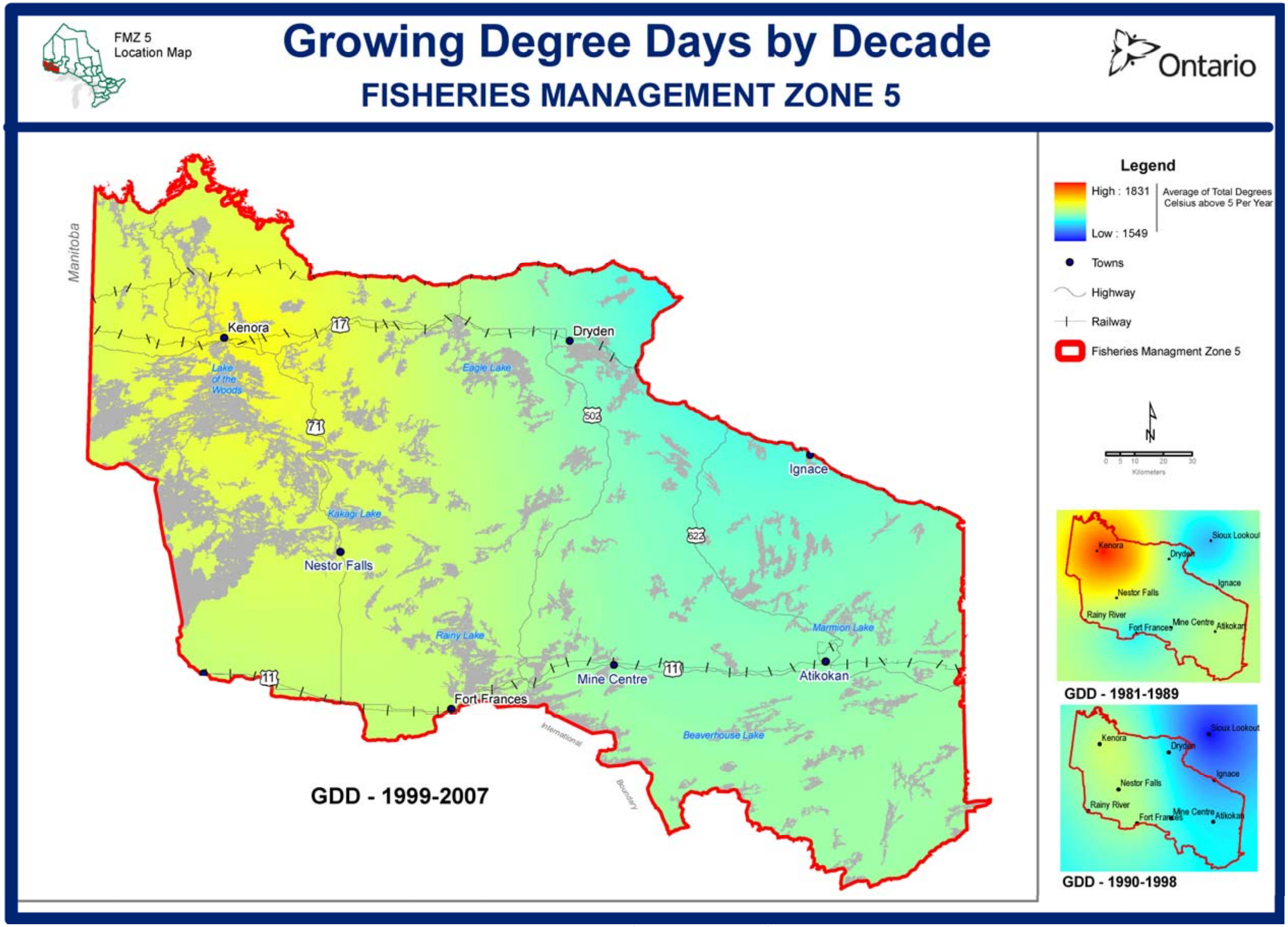


Figure 4.2-1 – Average annual growing degree days > 5°C (GDD>5 °C) by decade for Fisheries Management Zone 5 (1981-2007).

Fish are directly affected by the temperature of their environments, as it plays an important role in the regulation of all of their physical processes; foraging, reproduction (i.e. spawning) and growth. Recent work in Minnesota has shown that walleye spawning is related to ice out and for each day that ice-out occurs earlier, walleye spawning is advanced by 0.5 to 1 day suggesting that walleye are now spawning about a week earlier now as well (Schneider et al. 2010). Temperature also affects geographic distribution of fish, and they are often found at temperatures close to their optimal preferences; which is usually close to their optimum temperature for maximizing growth (McCauley and Cassleman 1981). In addition, strong relationships also exist between year-class strength and specific temperature conditions; and this relationship can be used to forecast the occurrence of large year classes (Venturelli et al. 2010).

Impacts to freshwater ecosystems as a result of warming associated with climate change are currently the focus of concern for many researchers. Data on climate change impacts to freshwater ecosystems that have been undertaken show that threats are real and changes to waterbodies and aquatic communities, specifically those in northern biomes, are imminent.

Lakes in temperate climates generally undergo a process known as thermal stratification as water warms from spring into summer. As the temperature of the air increases, the surface of waterbodies warm while bottom layers remain relatively cool. A thermocline separates these two layers, the transition area between the warmer surface water layer and the colder, deeper water layer. During the summer periods, the warmer water layer reaches its maximum depth (depth of the thermocline is specific to each individual water body) and stratification of these two layers is maintained for the remainder of the summer. As air temperatures increase as a result of climate change, associated warming in surface water temperatures are predicted to take place. This could result in changes to the length of seasonal stratification of lakes and the depth of the thermocline resulting in changes to the amount and quality of habitat for both fish that live above and below the thermocline.

A number of hypotheses exist on the impacts of climate change to thermocline development and water temperatures. Shallower thermoclines have been predicted due to the rapid onset of spring stratification as a result of earlier, warmer temperatures (Snucins and Gunn 2000). Rapid warming of the surface lawyer, versus gradual warming, is predicted to create a more extreme thermocline, with surface waters increasing in temperature as the spring and summer progress and amplifying the divide between the warmer and cooler layers. This would have major implications on aquatic communities, particularly in cold water lakes, as the warm layer of water within a waterbody (epilimnion) is the greatest zone of productivity. A reduction in the depth of this layer would have significant impacts on productivity of the entire lake and the ability of that lake to support complex food webs.

Alternatively, Schindler et al. (1990) suggests that reduced runoff due to less surface water (less precipitation and more evaporation) will result in reduced DOC (Dissolved Organic Carbon) inputs and increased water clarity which would cause thermoclines to form at greater depths. Schindler (2001) also predicts that deepening of the thermocline will occur as a consequence of warmer water generated from increased air temperatures and longer ice-free seasons, resulting in a deeper warmer layer of water within lakes.

Total water volumes are also expected to be impacted by climate change. Predicted warming will result in greater evaporation of surface waters, which is expected to exceed precipitation (Lofgren 2002). Water loss through evaporation will have major impacts to watersheds. Estimates of up to 1m declines in water levels could result in loss of wetland surface area, decreased river and stream flows and reduced connectivity between waterbodies (Mortsh et al. 2000, Schindler 2001). Decreased flow from streams and rivers would result in fewer nutrient inputs and increased water clarity, which could have significant negative impacts to primary producers and result in impacts throughout the entire food web.

The advent of climate change and the associated physical impacts to aquatic communities will vary greatly depending on lake characteristics and community assemblages. It is expected that responses to climate change in freshwater species will be directly associated with temperature requirements of individual species; and that impacts to species will vary according to temperature groups; warmwater (preferences greater than 25°C), coolwater (15-25°C) and coldwater (below 15°C) communities. However these impacts may range widely from beneficial to adverse for all community groups depending on the combination of environmental variables at play with individual lake characteristics and fish communities affecting the amount of impact observed. What is known and generally agreed upon across the scientific community is that impacts will be diverse and widespread, potentially positive for some warmwater groups such as bass and crappie and negative for other cold water species such as lake trout.

Warming air temperatures, changes in ice cover patterns and lengthening of the growing season will increase growth and productivity of all temperature guilds if suitable thermal habitat is available and nutrients are not limited. For example, an increase in yield and productivity of walleye in northern waters is predicted to occur as air temperatures increase (Shuter *et al*. 2002). Much of these predictions are dependent on existing lake characteristics and fish communities with unique impacts to each individual water body. If warming temperatures are accompanied by changes in water quality (decrease in DOC and an increase in water clarity) and dropping water levels it is likely that there would instead be a decline in walleye productivity. Decreases in dissolved organic carbon (DOC) has also been predicted to lead to increased UV penetration which may negatively impact survival of fish eggs, fry and photosensitive fish species such as walleye (Huff et al. 2004). Lakes that remain unstratified and shallow may warm to greater than optimum temperatures for some cool water species (greater than 25°C) such as walleye resulting in an overall decline in populations due to reduced productivity.

Coldwater fish species such as lake trout are predicted to be most adversely affected by climate change with predicted range recession expected as water temperatures increase (Shuter *et al*. 2002). Increased evaporation and potential decreases in thermocline depth means that there will be decreased deep water habitat available for coldwater species for foraging and spawning, leading to an overall decrease in productivity in coldwater lakes (Schindler 2001, Cassleman 2002). Longer periods of stratification will result in lower oxygen levels and a loss of habitat for coldwater species.

Climate change is also expected to have indirect effects on fish species through impacts such as changes in fish species geographical distribution and associated changes to community interactions and competition for resources. Species that are adapted to warmer water conditions such as smallmouth bass, largemouth bass, black crappie and rock bass are expected to benefit the most from the warming of shallow waters and are predicted to exhibit a northward range expansion as the climate warms and increased populations along their current northern distribution.

Climate warming may also accelerate the spread of invasive and introduced species are currently at the northern edge of their geographic range (i.e. zebra mussels, round goby, VHS), and many of these species have the potential for range expansion with climate warming.

Impacts to aquatic communities as a result of a changing climate must be considered in association with existing impacts including overexploitation, development of hydroelectric facilities, habitat loss and impacts associated with introductions of invasive and introduced species. For example, levels of exploitation that are currently sustainable may become unsustainable in the future if climate changes negatively impacts the productivity of a species. There is considerable need for continued research to interpret impacts to fish and fisheries due to complex ecosystem and community interactions.

In 2009, an annual lake temperature monitoring program was initiated on lakes in the northwest region. The purpose of this project is to monitor annual changes in thermocline depth in relationship to air temperature (OMNR 2010c). This research is important because changes in thermocline depth can have a significant impact on the amount of available fish habitat in a lake for species living above the thermocline (e.g. walleye) and species living in or below the thermocline (e.g. lake trout). Changes in thermocline can also change fish foraging behaviour affecting their productivity and survival. By understanding the relationship between air temperature and thermocline depth, biologists will be able to provide a more accurate assessment of the potential risk to fish populations, especially lake trout, if the increase in temperature predicted by climate change models for the northwest region occur. This program will provide a better understanding of potential changes and will also help guide future management decisions within FMZ 5.

4.3 Residential Disturbances

Residential disturbances can be categorized into two main groups: urban centers and seasonal or recreational residences. In FMZ 5, the main urban centers, Kenora, Fort Frances, and Dryden are adjacent to Specially Designated Waters (Lake of the Woods, Winnipeg River, Rainy Lake, Rainy River, Wabigoon River and the Wabigoon Lake). These water bodies also have high densities of seasonal residences. Generally, residential disturbances on Non-Specially Designated Waters (Non-SDW) are primarily seasonal residents. However, Non-SDW water bodies, particularly those in close proximity to urban centers, may have significant numbers of year round residents.

Presently, MNR does not have an electronic data base that can identify where and how many cottages are associated with each water body in FMZ 5. This ability would be beneficial in terms of managing fisheries and water quality expectations in the future. FMZ 5 possesses a well developed and extensive road network and it is reasonable to assume that most water bodies with road or trail access have some level of residential development. In addition, many remote lakes have “fly-in” seasonal residences.

Residential developments on the shore of lakes and rivers can have impacts on water quality, fish habitat and fish populations. Water quality can be impaired through increased nutrient loading (e.g. phosphorous). High levels of phosphorous in lake water will promote eutrophication resulting in excessive plant and algae growth, reduced water clarity, depletion of dissolved oxygen and a loss of habitat for some species of coldwater fish such as lake trout. The primary human source of phosphorous in land lakes comes from septic systems associated with cottages, year round residences and other recreational facilities (OMOE 2007). Shoreline clearing, fertilizer use, erosion, and overland run off also contribute phosphorus.

All three districts within FMZ 5 have extensive cottage developments on a wide range of lake types and sizes. The largest concentration occurs on Lake of the Woods with over 6000 cottage lots. Cottagers on Lake of the Woods are organized and represented by the Lake of the Woods Property Owners Association (LOWPA). Lake associations are common throughout the zone and some participate in the Ministry of Environment’s Lake Partner Program. Volunteers collect total phosphorous samples and make monthly water clarity observations on their lakes. This information will allow the early detection of changes in the nutrient status and/or the water clarity of the lake.

Fish habitat can be harmfully altered, disrupted or destroyed (HADD) by shoreline developments. This usually occurs when shoreline developments such as docks, boathouses, beaches etc. are built on or adjacent to critical fish habitat such as spawning habitat. Fish populations, specifically fishing quality can be reduced with increased angling effort and harvest exerted by cottagers and year round residents.

New residential developments are regulated under the Planning Act. In organized municipalities, it is the responsibility of the municipality to distribute and seek comments from contributing agencies. For example, Ministry of Natural Resources and Ministry of Environment would review new proposals and provide comments regarding natural heritage values, water quality and the potential for these to be impacted by the proposed development. In unorganized territories, it is the responsibly of the Ministry of Municipal Affairs and Housing to act as the “one window” and seek comments from the respective agencies.

The federal Fisheries Act does not allow the harmful alteration, disruption or destruction (HADD) of fish habitat. The Department of Fisheries and Oceans (DFO) has developed a series of fact sheets for cottagers on how to reduce or mitigate the impacts of shoreline development. If the shoreline development does not conform to DFO’s fact sheet recommendations, it is the responsibility of the cottager or developer to obtain a letter of advice from DFO to prevent a HADD occurring. In addition, many types of shoreline developments require a work permit from MNR. Permits are issued under the authority of the Public Lands Act (PLA) or the Lakes and Rivers Improvement Act (LRIA) and provide conditions to reduce impacts on fish habitat and water quality.

Oligotophic lakes or those with lake trout populations are the water bodies most vulnerable to nutrient loading. In 2008, an amendment to the Land Disposition Process protected lakes listed in the Inland Ontario Lakes Designated for Lake Trout Management (OMNR 2006c). The main direction of this amendment indicates that MNR will not dispose of vacant, undeveloped Crown land on lake trout lakes, where this could subsequently lead to impacts to habitat or lakeshore carry capacity for lake trout.

4.4 Roads and Water Crossings

FMZ 5 encompasses four main communities: Kenora, Dryden, Fort Frances, and Atikokan. Each of these communities has, or has had in the recent past, processing facilities such as pulp or saw mills for the forest industry. Forested areas that are relatively close to processing facilities tend to bear greater forest harvesting pressure due to the comparatively lower shipping costs to get the wood to the facility. This intensive forestry pressure has resulted in a highly roaded landscape within the FMZ.

Roads within FMZ 5 fall into two main categories: active, and inactive or abandoned roads. Each category has its own set of potential and actual effects on the fisheries resource. Driveable forest access roads can be further subdivided into Primary, Branch, or Operational Roads based upon their purpose and anticipated duration of use. Forest access roads are primarily the responsibility of the Sustainable Forest Licencee (SFL). Some inactive or abandoned roads have been transferred or have reverted back to the Crown. Local Roads Boards maintain responsibility for some roads adjacent to communities.

Roads also alter the lateral movement of surface runoff and may cause the movement of sediment from ditches and approach slopes into water courses (Toman 2004, Luce 2002, Wemple *et al*. 2001). Effects on lateral movement of surface runoff can also affect ground water recharge, impact spawning habitat, incubation habitats, (Curry and Devito 1996) and water quality (Curry *et al*. 1993).

New road construction can lead to increased human access to previously remote lakes and rivers. This access is often long-term as even decommissioned roads can be utilized by the public through the use of ATVs (Browne 2007). Access to these lakes can result in increased recreational and commercial angling, as well as the potential transfer of invasive or non-native species.

Proper construction and maintenance of water crossings is critical to maintaining functioning aquatic ecosystems. Improper installations can result in road surface erosion into waterways, perched culverts and increased water velocity that act as barriers to fish passage, and waterway channel realignment resulting in habitat loss and conversion. Lack of appropriate maintenance most often leads to continuing erosion of materials into the waterway and road washouts due to accumulation of debris or beaver material.

When roads intersect a river or stream, water crossings are established to facilitate extension of the road system. Water crossing are where the main habitat impact that roads have on fish habitat occurs. There are estimated to be 3433 water crossings on Crown land within FMZ 5 (Table 4.4-1).

Table 4.4-1. Total estimated number of water crossings in FMZ 5.

District	Number of Water Crossings
Kenora	727
Fort Frances	1930
Dryden	776
Total for FMZ	**3433**

Corrugated metal culverts are the most common structure used in water crossings in FMZ 5. Water crossing sites are assessed for hydrology requirements using the Culvert Analysis Program developed by OMNR Northwest Region Engineering. This program determines the appropriate diameter of culvert that is required to pass flows associated with 5, 10, 25, and 100 year storm events. The most commonly approved size will pass enough water associated with a flood event that would occur once every 25 years. It is assumed that a culvert of this size should provide adequate flows to permit fish passage. Water crossing sites are also assessed for Species at Risk presence, high risk site conditions such as steep slopes or rocky terrain, and the potential effects on known aquatic habitat values.

On smaller watercourses culvert diameter may span the active channel but rarely are culverts sized to provide for bank-full flows. On larger watercourses culverts rarely span the active channel resulting in fill slopes that encroach on the active channel. Harper and Quigley (2000) demonstrated that stream crossings can produce direct losses in fish habitat (channel loss, riparian loss and benthic loss) due to encroachment. Water crossings that utilize culverts as the crossing structure are known to significantly fragment habitat and fish populations (Gibson *et al.* 2005). Upstream and downstream passage and migration of fish can be impaired or prevented by culverts that are perched (Langill and Zamora 2002). High water velocities through improperly sized culverts can also act as barriers to upstream movement (Gibson *et al.* 2005).

Erosion of material from insufficiently stabilized fill slopes can be a significant source of suspended sediment at water crossings (Harper and Quigley 2000). Additional input of sediment can have detrimental effects on downstream primary productivity (Lloyd *et al.* 1987). Stream crossings can alter ecological processes by changing the hydrology of the water course.
Changes in hydrological processes alter natural suspended and bedload sediment movement, especially in the case of perched or undersized culverts. Similarly, the movement of organic material and woody debris can be altered or interrupted causing changes in downstream habitat for fish and wildlife. Cumulative impacts of a large number of water crossings on individual watercourses have not been quantified. However, the scientific literature suggests that cumulative impacts are certainly possible. In the short to medium term there is a need to examine the number of water crossings on individual river systems and remove the ones that are no longer required. In the longer term, consideration needs to be given to reducing the number of crossings on a given watercourse and the cumulative impacts of multiple water crossings needs to be formally investigated.

Water crossings provide ideal locations for beavers to dam flowing water to create beaver ponds. Due to the high number of water crossings on forest access roads, it is highly unlikely that all water crossings are monitored for beaver activity. Every year breaches in beaver dams occur that result in the “washout” of forest roads. The road material (sand and gravel) can wash downstream. This can have many detrimental effects on fish and fish habitat through the: deposition of material on spawning beds, flush of excessive water through the system, changing of natural stream channels, reducing local water depths, and restriction of upstream passage.

4.5 Waterpower and Water Control Structures

Water power and water control structures can have significant effects on the aquatic ecosystem by altering water levels and flows, temperatures, sediment and water quality. There is a great amount of scientific literature describing the adverse effects of dams. Clarke *et al.* (2008) provide a detailed discussion of the effects of water control structures on fish and fish habitat which is summarized below.

Dams and related facilities can cause a direct loss of fish habitat because they are often placed at falls, rapids or riffle areas in waterways. Dams can physically impede upstream and downstream movement and migration of fish and other aquatic organisms. The effect of a physical barrier to upstream and downstream movement can be the loss of access to critical spawning, feeding or over wintering areas or separate large populations into smaller ones that are more vulnerable to exploitation and other stresses.

Another important impact of dams that has the potential to be critical to fish populations is changing the flows and levels of the watercourse. Flow management can change the amount of water that flows down a river as well as changing the duration, frequency, timing and rate of change of flows which in turn results in physical and ecological processes in a river system. Regular flooding of wetlands adjacent to the river may no longer occur or occur too frequently. These flooding events connect the river with riparian vegetation which is important for nutrient cycling and creation of habitats. Changing flows can also prevent fish from using spawning and feeding habitats thus reducing fish community diversity and productivity.

Rapid changes in flow below dams at peaking facilities can result in alteration of the amount and quality of habitat available to fish. Effects can be direct such as stranding, mortality and habitat abandonment or indirect such as downstream displacement, reduced food supply and increased physiological stress. Increased drift of food organisms can occur with positive and negative effects on feeding efficiency. High flows can increase energy costs resulting in reduced foraging ability and decreased growth of fish.

The movement of resident fish can also be impacted. Changes in movement patterns may cause changes in fish community composition, reduce genetic diversity and reduce the ability for a species to survive in a stretch of river.

Temperature is considered one of the most significant factors affecting the life history of fish and other aquatic organisms such as the timing of migration and spawning. In addition, water temperature affects growth and susceptibility to disease. Dams that cause the creation of reservoirs can significantly alter the temperature patterns of a river. The establishment of reservoirs essentially changes a portion of the river from a flowing water system to a lake system. Just like in lakes, heat from the sun can cause the water column of the reservoir to stratify with warmer water in the top layer and cooler water in the bottom layer. The location in the water column where water is drawn from a reservoir can have significant effects on downstream water temperatures. Bottom draw dams can result in colder waters downstream while flow over dams can result in an increase in temperatures downstream. Higher flows can extend the extent of the temperature effect downstream. Overall, changes in temperature have been observed to change fish community composition, year class strength and predation. Such changes may also facilitate the establishment of invasive species.

Dams generally reduce the amount of suspended sediment and bedload sediment that is carried by a watercourse. Essentially, dams act as sediment traps by stopping the natural movement of sediments down a river and causing them to build up behind the dam structure. Changes in sediment movement and patterns of soil deposition downstream can affect habitat establishment or maintenance which ultimately affects biomass and productivity of fishes. The loss of species diversity and species richness has commonly been observed.

The establishment of reservoirs has also been known to increase mercury concentrations in water due to releasing mercury that was once bound in sediments. This means that it is more available to aquatic organisms and bio-magnification can result in increasing levels in species that are higher in the food chain such as walleye or northern pike.

The area or zone of influence upstream and downstream of a dam that is affected by changes to the flow, temperature or water quality regimes upstream can vary between site and effect. The point downstream from a dam where changes in the natural flow pattern are no longer detectable may be a considerable distance from the dam. However, changes to the biological characteristics of the river that result from changes in the flow may extend even further downstream (Vinson 2001). Changes to flows can cause changes in erosion and sedimentation that can been measured hundreds of kilometres downstream (Poehlman 1996). The distance downstream of a dam that the water temperature is affected varies depending on the position of the dam in the watershed, how the dam is operated and the depth from which water is released (Olden and Naiman 2009). Predicting the distance upstream and downstream of a proposed facility can be difficult and may be largely subjective at the planning stage.

Currently, there are nine large hydroelectric generating stations in FMZ 5 ((Table 4.5-1; Figure 4.5-1) along with one micro-generation site (Manion Creek). All are owned by private industry with the exception of the Whitedog Falls and Caribou Falls Generating Station which are operated by Ontario Power Generation. Management of water levels and flows falls under a number of different forms depending on the site. In addition to hydroelectric generating facilities, there are many other dams in FMZ 5 which are used for a variety of uses including providing water for power production, maintaining water levels for social desires and reduction of flood risk (Figure 4.5-1). Many of these structures are owned by MNR.

Table 4.5-1 Hydroelectric generating facilities in FMZ 5.

District	Site	River	Water Management Direction
Dryden	Wainwright	Wabigoon	Wabigoon and Eagle River Water Management Plan
Dryden	Eagle River	Eagle River	Wabigoon and Eagle River Water Management Plan
Dryden	McKenzie	Eagle River	Wabigoon and Eagle River Water Management Plan
Fort Frances	Valerie Falls Power	Seine River	Seine River Water Management Plan
Fort Frances	Sturgeon Falls dam	Seine River	Seine River Water Management Plan
Fort Frances	Calm Lake dam	Seine River	Seine River Water Management Plan
Fort Frances	Fort Frances dam	Rainy River	International Joint Commission
Kenora	Norman dam	Winnipeg River	Lake of the Woods Control Board
Kenora	Whitedog Falls	Winnipeg River	Lake of the Woods Control Board

In 2008, the Green Energy Act was proclaimed. The main goals of the Green Energy Act are to make it easier to bring new renewable energy projects on line and to foster a culture of conservation by assisting homeowners, government, schools and industry to transition to lower and more efficient energy use. There are three primary drivers for the Green Energy Act. The first is climate change and a desire to reduce greenhouse gas emissions especially from coal fired electricity generation facilities by 2014. The second is a stronger, greener economy and in particular the creation of 50,000 new jobs over the next 3 years and encourage major investment to help address the current economic downturn. The last driver is the need to upgrade Ontario’s aging electricity infrastructure.

The implementation of this act has changed MNR’s role in the management and authorization of renewable energy activities on Crown land. MNR’s mandate and role still include management of fisheries and wildlife resources in Ontario’s Crown lands and waters. MNR is still expected to administer its mandate through the various legislations that are the responsibility of MNR. However, MNR also has a role in the new process is to provide access to Crown land for renewable energy projects and contribute to achievement of renewable energy projects. MNR has a role in permitting these projects but is no longer the decision maker on whether or not projects will move forward. Other changes that are significant from a fisheries management perspective include changes to how natural values and risk to those values is considered in decision making. Natural values cannot be used to reject renewable energy projects.

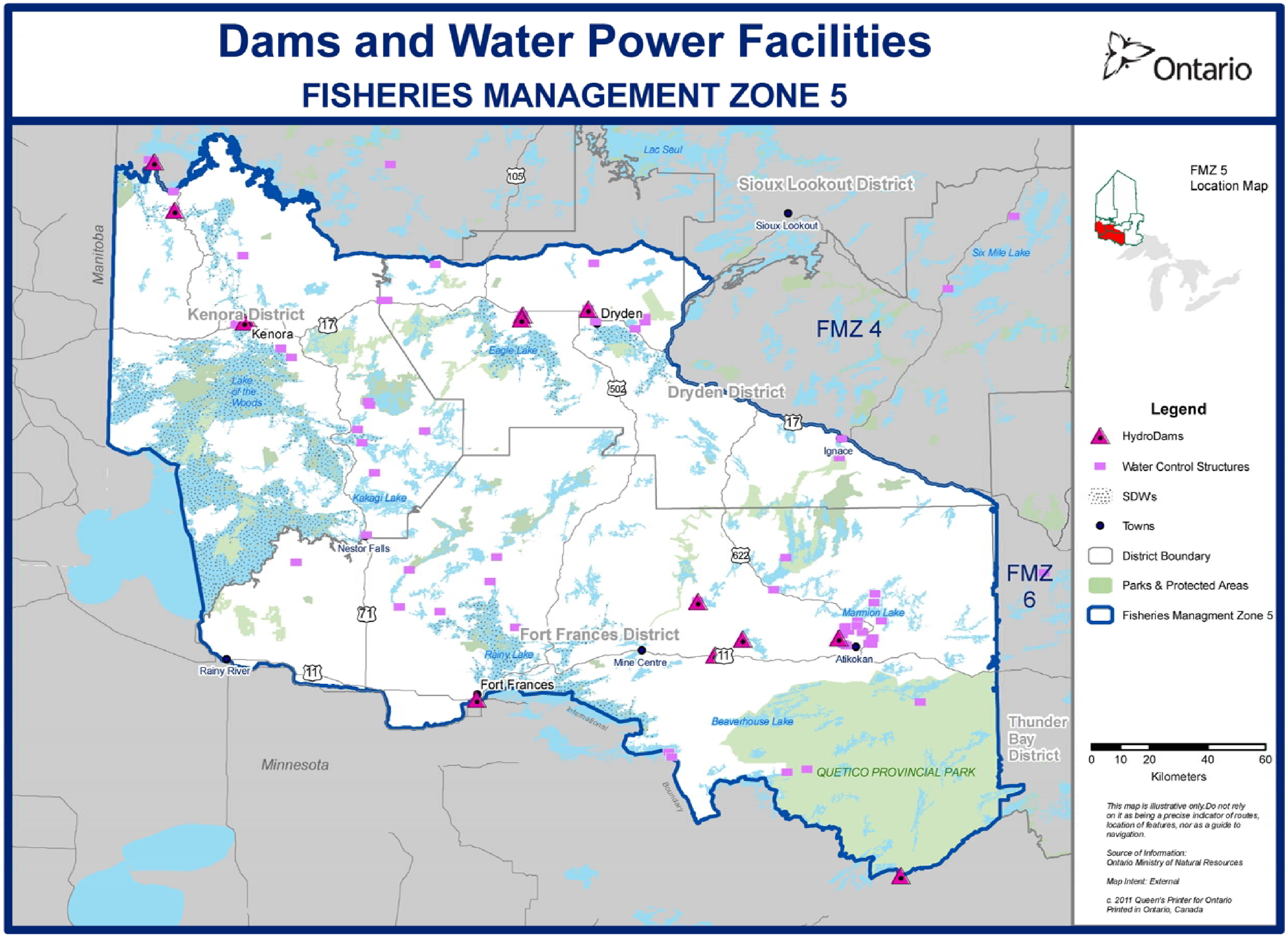


Figure 4.5-1. Waterpower facility and dam locations in Fisheries Management Zone 5

4.6 Mining Exploration, Extraction and Rehabilitation

Mining has the potential to have long-term impacts on aquatic ecosystems due to habitat destruction and water pollution associated with mine development, mineral extraction, mine effluent production and tailings and slag disposal/storage. Currently, there is high potential for mining activity in northwestern Ontario, and a number of new claims and mining developments have been made within the Northwest Region. Compared to other human caused impacts to fish habitat such as forestry, mining has the potential for more severe and long term environmental impacts due to the potential release of toxic contaminants into the environment. However, on a landscape scale, mining tends to impact smaller areas than forestry or hydroelectric development.

One of the main impacts of mines on aquatic ecosystems is a result of the discharge of mine effluent to surface and ground water. Effluent from mining activities is produced through two main activities. The first is the contamination of water used in the mining and milling process by releasing metals, acids, salts, fine particles and/or synthetic chemicals into the mine discharge. The second is through the contamination of surface water when precipitation falls on or runs through waste rock and mine tailings stored on the surface. Effluent enters the watershed through surface water runoff or ground water discharge which has been contaminated by either or both of these processes. Contaminants are either diluted or concentrated in receiving bodies of water or aquifers within the watershed. Mining can also result in the impact of large areas of watersheds or even loss of lakes and streams through creation of open pit mines, and tailing or waste rock disposal areas.

Current policy surrounding mine development and environmental assessments for new mining projects need to consider the effectiveness of mitigation measures at compensating lost fish habitat and preventing impacts to aquatic communities through pollution events such as acid mine drainage. Regulations for mine closure plans within Ontario through the Mining Act (OMNDM 1990) require mine operators to submit a detailed remediation plan. Mine closure and reclamation measures currently attempt to contain, rather than remove, potential sources of water pollution such as tailings and waste rock. Policy recommendations identified by Brown (2007) include 1) the prevention of cumulative effects of mining in northern Ontario by considering new mine development in the context of comprehensive land-use planning and incorporating consideration of cumulative effects in the environmental assessment process; 2) improvement of methods used for the collection of fish production data prior to mine development to allow for assessment of habitat compensation measures; 3) requirement of permanent containment of mine tailings or removal of tailings from the site prior to mine closure in order to prevent long term contaminant risk in remote locations.

Another activity associated with mining is peat extraction. Potential peat extraction areas in FMZ 5 exist mainly west of Fort Frances. The main fisheries impacts from peat extraction are related to impacts on water flow. At present, no policy exists regulating the extraction of peat within Ontario.

Current mine and peat extraction activity within the boundaries of FMZ 5 is limited, but has the potential to increase with a number of new locations being actively explored at this time. Examples of these sites include the Hammond Reef project northwest of Atikokan, the Bending

Lake Iron Group project south east of Ignace, the Kenbridge deposit near Sioux Lookout and the Rainy River Resources project west of Fort Frances. The old Steep Rock mine site in the Atikokan area is currently dealing with water quality issues that has the potential to affect downstream waterbodies when water starts flowing out of the site.

4.7 Forest Management Activities

Forest harvesting is a significant portion of the economy in Northwestern Ontario and occurs throughout most of FMZ 5. The use of the clearcut harvest system and the need for access roads into previously remote areas create the potential for forestry activity to impact on aquatic ecosystems. The removal of trees and other vegetative ground cover alters groundwater flow and surface runoff. This has been documented to result in the release of mercury, nutrients, decaying organic matter and sediment to adjacent water bodies with potential impacts on fish and other aquatic organisms (Brown 2007). The creation of logging roads may have direct or indirect effects on fish and fish habitat. The following discussion explores some of the potential impacts of forestry related activities on aquatic ecosystems.

4.7.1 Mercury

Mercury is a toxic metal that is widely distributed in the environment and occurs naturally in both aquatic and terrestrial environments, generally in low concentrations. Mercury loading in aquatic communities has been linked with forest removal through a number of processes. During forestry activities, the exposure of the mineral soil leads to the change of mercury into more soluble forms through the decay of organic matter (Porvari *et al.* 2003). Mercury, as well as soil nutrients, is then able to flow into waterbodies through surface water runoff, streams and rivers. The nutrient loading may increase primary productivity in these waterbodies, resulting in an increased rate of mercury uptake by aquatic organisms (Kelly *et al.* 2006). Mercury is biomagnified upwards within the food chain, meaning it is found in lower concentrations in species lower on the food chain (minnows, etc) and higher concentrations in predators such as walleye or northern pike. Mercury is the most common contaminant found in the flesh of sport fish in Northwestern Ontario (OMOE 2009). To date, there is little research that differentiates the impacts of fires and forestry activities on mercury contamination of boreal aquatic ecosystems (Brown 2007). For more discussion on mercury and fish, see section 3.5.2.1.

4.7.2 Nutrient Input

The removal of vegetative cover and root mat structure through forestry operations allows soil to more easily be eroded by surface water flows. The suspended soil may be carried into waterbodies, resulting in an influx of nutrients, minerals and organic matter (Brown 2007). Research has shown that in some cases, nutrient input results in an increase in primary production, and alters food web interactions through changes in the abundance of primary consumers (i.e. zooplankton) (Planas *et al.* 2000). However, in some research findings, increases in DOC (dissolved organic carbon) concentrations following logging activities can reduce water clarity sufficiently to offset nutrient inputs and primary productivity remains unaltered or declines (McEachern *et al.* 2000). Reductions in water clarity may also cause shallower thermoclines (the line of transition between cool water and cold water habitat in a lake), which may impact associations between cold water and cool water fish species. Current research indicates that impacts are highly dependent on the characteristics of each individual water body and the surrounding landscape.

Logging and forest fires are the two significant disturbances on the landscape in FMZ 5. When comparing the two, total nutrient input appears to be similar for both disturbance events (McEachern *et al.* 2000). Logging appears to be associated with greater inputs of DOC as well as nitrogen and phosphorous (Lamontagne *et al*. 2000); while forest fires generally result in higher inputs of minerals found in ash such as calcium, magnesium and sulphate (Carignan *et al*. 2000).

4.7.3 Runoff and Sedimentation

The removal of vegetative cover through forestry operations can result in an increase in surface water runoff and changes to the flow regime of forest streams. This can lead to impacts on physical stream habitat, species distributions and primary productivity (Poff *et al.* 1997). Sedimentation associated with runoff and erosion can also alter stream environments and impact biota, including fish species. Sedimentation associated with both harvesting and the development of forestry access roads is the most dominant impact of logging on stream and river ecosystems (Crooke and Hairsine 2006). Increased loading of fine sediments has been demonstrated to impact invertebrate communities, spawning and nursery habitat of river spawning species (Kiffney *et al.* 2003).

The creation of roads and the disturbance of soils by forestry machinery generally results in greater sedimentation than from natural disturbances (Martin and Hornbeck 2000). Roads associated with logging activity are often a greater source of sedimentation and erosion of forest soils than the act of harvesting (Crooke and Hairsine 2006). The duration of sedimentation due to erosion is dependent on the rate of vegetation re-growth at the disturbance, site conditions (such as ecosite or slope), and appropriate design and construction of water crossings. Impacts can last 3-10 years in areas with rapid re-growth, or can persist for decades in areas with steep slopes or poor road placement and ineffective water crossing design (Martin and Hornbeck 2000). Proper forest management planning requires conscientious placement of roads, consideration of cumulative effects on a watershed, consideration of slope when delineating the width of buffers (OMNR 2009a), scheduling of operations to minimize impacts on fish populations, and the effective design and installation of water crossings that will reduce the impacts of sedimentation to forest streams and rivers.

4.7.4 Loss of Riparian and Littoral Vegetation

Cutting vegetation at stream edge (riparian) or lake edge (littoral) zones can affect lake and river ecosystems. Clear cutting to shore can result in increased wind speeds, warmer water temperature in the littoral zone and increased sedimentation due to the loss of the vegetative filter mat (Steedman *et al*. 2001). Increased wind velocities, particularly on small lakes (surface area >20 ha) may deepen lake thermoclines, resulting in a larger layer of warmer water, or prevent stratification of shallow waterbodies due to increased water column mixing (Brown 2007). Warmer water temperatures may increase primary productivity and create habitat that favours survival of warm water species such as smallmouth bass and walleye while reducing habitat for coldwater species such as lake trout.

Harvesting of trees along the edge of waterbodies may reduce shade and result in warmer water temperatures. This is particularly significant in rivers where spawning or nursery habitat of species that prefer cooler temperatures may be affected.

Impacts associated with the loss of riparian or littoral vegetation are similar for both logging events and natural disturbances such as blowdown and forest fires. Forest management practices in Ontario require buffers around portions of lake and all stream and river habitat where forest management activities are to occur in order to reduce the impacts of terrestrial vegetation loss to aquatic communities. New directions in the Stand and Site Guide (OMNR 2009a) recommend cutting littoral vegetation on some waterbodies in order to better emulate natural disturbance events on the landscape such as fire and blowdown which occur to the edge of riparian and littoral zones. Retaining shoreline forest in the Stand and Site Guide (OMNR 2009a) includes maintaining 50% residual on ponds and small lakes (>8 and <100 ha), 75% residual on medium lakes (>100 and <1000 ha) and 90% on large lakes (>1000 ha).

4.7.5 Logging Roads

Forestry operations require an extensive network of roads to access the forest. The impacts of these roads can last long after logging operations have ended. Poorly designed water crossings, erosion of road surfaces and increased access by humans to formerly remote lakes and rivers can have adverse effects on aquatic ecosystems. A detailed description of the impacts that roads and water crossings can have on aquatic ecosystems can be found in section 4.5 of the background report.

4.7.6 Forest Harvesting

A wide variety of techniques have been developed to reduce the impacts of forest harvesting activities on aquatic ecosystems. Use of riparian buffer strips which range in widths from 30 to 90 metres based upon shoreline slope is common in Ontario forest management planning and is effective at reducing sedimentation, erosion and temperature impacts of clear cut logging on aquatic communities (Rashin *et al.* 2006, OMNR 2009a). When buffer zones are used in association with careful planning of road construction, appropriate timing of harvesting activities and well constructed water crossings, impacts such as sediment loading can be greatly reduced or even eliminated (Rashin *et al.* 2006). In Fisheries Management Zone 5, all the Crown Land area of the zone, aside from provincial parks or conservation reserves, are active in forest management planning. In total, 8 active Forest Management Units exist either fully or in part within the zone (Table 10). Forest management activities within Zone 5 have the potential to contribute significantly to the cumulative impacts to aquatic ecosystems at a watershed scale.

Forest management planning in Ontario is designed to approximate natural disturbance events such as fire which have been reduced in frequency and size on the landscape as a result of human intervention. Though these harvesting systems are similar in pattern to natural disturbance events, they do not recreate all of the stand level dynamics or chemistry associated with events such as wild fire (McRae *et al*. 2001). Implementing best practices, such as using buffer strips to reduce sedimentation, selecting strategic road locations, and effectively constructing water crossings, in association with forest harvesting techniques modeled after natural disturbance regimes, collectively may help in reducing impacts to aquatic communities. Continued research of the short and long term effects of forestry activities on waterbodies is required in order to better understand the cumulative impacts of forest management to fisheries resources.

Table 4.7-1. Forest Management Plans and Renewal Dates within Fisheries Management Zone 5

MNR District	Forest Management Unit	Renewal Date (either Term 1 or Term 2)
Fort Frances	Crossroute	2012
Dryden	Dryden	2011
Dryden	English River	2014
Kenora	Kenora	2012
Sioux Lookout	Lac Seul	2011
Fort Frances	Sapawe	2015
Dryden	Wabigoon	2013
Kenora	Whiskey Jack	2012

4.8 Water Quality/Nutrient loading

Water quality in FMZ 5 is influenced by a number of natural and man-made factors, including geology, climate, and land use. The waters of FMZ 5 are considered clear in comparison to other fisheries management zones in northwest Ontario (Cano and Parker 2007). This is a result of the natural features of the area, including vegetation, geology, and hydrology, unlike many lakes in southern Ontario, where water quality and clarity has improved and become clear due to the actions of invasive species such as zebra mussels that filter the water. On average, lakes in FMZ 5 are the least productive in the Northwest Region FMZ's, based on the morpheodaphic index (MEI), an indicator of productivity based on average lake depth and total dissolved solids (Cano and Parker 2007) although there is wide variability within zones. The longer growing season in FMZ 5 may compensate for this poorer nutrient status and, in some lakes, result in higher productivity (Cano and Parker 2007).

A number of lakes within FMZ 5 have total phosphorus (TP) concentrations close to or greater than 20 ug/L which can indicate a tendency to have persistent, nuisance algal blooms and resulting in degraded water quality (OMNR, unpubl. data; OMOE 2005). A few (<10) blue-green algae blooms are reported within FMZ 5 each year (typically on inhabited lakes with cottage developments). Although blue-green algae blooms have the potential to be toxic, the toxicity of the blooms in FMZ 5 is generally not known, as not every bloom will produce the harmful toxins that can cause illness or death if ingested.

The very low density of urban areas in FMZ 5, and the fact that the larger centres are downstream of most of the waters of FMZ 5 (such as Fort Frances, Kenora, and Rainy River) has ensured that human waste and nutrient inputs to the waters of FMZ 5 have been relatively limited, and thus have had only a small impact on the productivity of the waters. Agricultural runoff occurs in the west end of the Fort Frances District, into streams and rivers which drain into the Specially Designated Waters of Rainy River, Lake of the Woods, the Winnipeg River system and out of FMZ 5. This runoff may include fertilizers, animal waste, pesticides and sediments which degrade water quality. The potential for agricultural runoff also exists in the farm areas around Dryden and Kenora, increasing the nutrient loading in those local waters as well. Increased nutrient loading decreases water quality, usually through excessive phosphorous commonly resulting in algae blooms. It can also result in reduced oxygen concentrations which in turn affects the abundance and distribution of the fish community. In extreme situations, this can result in fish kills due to lack of oxygen, toxins in the water as a result of algae blooms, or due to bacterial or viral outbreaks as a result of the change in water chemistry. Partnerships with the Rainy River First Nations Watershed Program, the Rainy River District Stewardship Council, and interested farmers have resulted in local improvements to water quality by using fencing to keep cattle and other stock from waterways, establishing vegetative buffers between cropland and waterways, and education on better agricultural practises to prevent runoff into waterways.

Many of the cottage developments are concentrated on the large lakes already designated as Specially Designated Waters (SDWs) such as Lake of the Woods and Rainy Lake. Many of the inland lakes, however, do have cottage developments, lodges, and outpost camps which contribute to nutrient loading in FMZ 5, and can be significant on some of the more developed lakes. Excessive development on smaller lakes can exceed the capability of lakes to absorb the excess nutrients if not controlled. The Northwestern Health Unit (NWHU) is responsible for permitting and inspecting private sewage systems in the Fort Frances, Dryden, and Kenora districts, and is a key partner in ensuring human waste and excess nutrients do not leach from these systems into the waters of FMZ 5. If upon inspection a system is found to be improperly installed or not working properly, the NWHU has the ability to order the system repaired (NWHU 2010).

Water quality monitoring is the responsibility of the Ontario Ministry of Environment (MOE). There are no monitoring stations within FMZ 5 for surface or ground water quality, other than those at the Atikokan, Dryden, Fort Frances, and Kenora water treatment plants, where drinking water quality is monitored (OMOE 2008). However, as part of the Broad-scale Monitoring Program for FMZ 5, some water quality sampling will be conducted on the 130 selected lakes on a 5 year rotation, and will be used to form a baseline data set for future reference and to inform the process of setting management strategies for the zone.

5.0 Socio-economic Description

An important component of fisheries management is ensuring that social and economic benefits from fisheries resources are made available as opportunities for people, particularly to the residents and communities in the area. It is important to recognize that these benefits cannot be realized unless the fisheries resource is maintained in a healthy and sustainable state. This section describes the current social and economic uses of the fisheries found within FMZ 5.

5.1 Sport Fishing

The largest use of the fisheries resource in FMZ 5 is by sport fishing. It is also the largest potential source of stress from overharvest on the fisheries resource. In the past, OMNR has generally attempted to monitor the angling fishery through individual lake creel surveys which involve interviewing anglers and sampling fish they have caught. Several other monitoring techniques including mail surveys aerial surveys, angler diaries and sampling catches at competitive fishing events have also been used to assess all aspects of the sport fishery.

5.1.1 Recreational Angling

In general, participation in fishing has been declining in Canada. Hofmann (2008) indicated that the national recreational fishing survey results showed a decline in the number of days fished from 48.8 million in 1995 to 37.7 million days fished in 2005. The days fished per angler appear to have remained the same so participation must have declined. It has been suggested that this decline appeared to be due to the aging population and urbanization.

The Survey of Recreational Fishing in Canada is a mail survey of anglers that has been conducted at five-year intervals since 1975. The results of this survey were used to identify recreational angler effort, characteristics and expenditures for Ontario and specifically for FMZ 5 (Hogg et al., 2010a). The most recent survey conducted in 2005 is unique in that the data can now be geo-referenced to allow analysis by specific geographic areas.

In Ontario, the 2005 survey solicited information from approximately 23,993 anglers, representing 1.8% of licensed anglers. An estimated 87 million hours of recreational fishing occurred province-wide, with 20 million hours (23%) expended in Northwest Region.

A total of 251,520 anglers were estimated to have fished in FMZ 5 in 2005, providing 9,219,920 hours of fishing effort. This represents 46% of the total angler effort in Northwest Region. An estimated 93% of the effort occurred on lakes, with the remaining 7% on rivers and streams. A significant proportion of this effort occurred on larger lakes in the zone, including the five Specially Designated Waters (SDW's) of Lake of the Woods and the Rainy River, Shoal Lake, Rainy Lake, Eagle Lake and Wabigoon/Dinorwic Lakes. These designated lakes represent approximately 35% of the total lake surface area in FMZ 5. Estimated angling effort on the SDW lakes was estimated at 5.1 million hours (55%) compared to 4.1 million hours (45%) on the remaining inland lakes and rivers. It should be noted that the Winnipeg River system is an additional SDW that currently exists in the zone; however it was not included in the analysis by Hogg et al. (2010a). Cano and Parker (2007) estimated a much lower level of angling effort from creel surveys at 2.4 million hours (57%) compared to 1.8 million hours (43%) on non-SDW waters without special regulations.

Anglers in FMZ 5 fished an average of 11 days with an average fishing day length of 6 hours. This differed by angler origin with Ontario residents fishing more often but fewer hours each day than non-residents. Fishing intensity was also classified based on effort and lake surface area, and was used to compare fishing stress among zones. FMZ 5 represented medium fishing intensity at 11 hours/ha, and was the highest observed in Northwest Region (Hogg et al., 2010a).

In FMZ 5, 85% of anglers were male and 15% were female. The average age of male and female anglers across all residency categories was 49 years and 46 years respectively. However, anglers that are 65 years and older and under 18 years are not required to purchase a licence in Ontario, and are not represented in the sample of licensed anglers for this mail survey.

It is estimated that the fisheries resources in FMZ 5 (including SW lakes) provided 251,520 anglers with 1.5 million angler-days of recreational fishing in 2005. The majority (72%) of fishing effort resulted from angling by 180,853 non-residents of Canada, while 50,976 Ontario residents contributed 20% followed by 19,692 Canadian residents who exerted the least amount of open-water angling effort at 8%. Cano and Parker (2007) indicated that a greater proportion of resident anglers utilise the fisheries of Northwest Region during the winter, while open-water anglers are primarily non-residents of Canada. The exception was in FMZ 5 where there are a large number of non-resident anglers fishing during the winter, most likely targeting black crappie and lake trout. During the open-water season in FMZ 5, non-resident anglers represented 81% of the fishing effort, compared to only 55% in the winter season.

Fishing effort by Ontario residents, Canadian residents and non-residents of Canada was distributed across 768,000 ha of lake area, with 55% on SDW's which represent only 35% of the total lake area. It was clear that the majority of fishing effort was focused on larger lakes in the fisheries management zone. These results also demonstrate the social and economic importance of the largest, most well-developed lakes. It is also expected that fishing effort by Ontario residents is largely focused in the lakes in close proximity to the urban centres of Atikokan, Dryden, Fort Frances, Kenora, Nestor Falls, Sioux Narrows and Vermilion Bay. Lakes in the northwest portion of the zone are closer to Manitoba and likely provide a higher proportion of the Canadian resident effort (8%), which is the highest of all zones in Ontario. The close proximity of FMZ 5 to the Minnesota and other mid-west states in the US would also contribute to the high proportion (72%) of non-resident anglers. In addition, there are a significant number of recreational properties owned by both non-residents of Canada and Canadian residents from Manitoba in FMZ 5.

When anglers across all angler origins were asked about their most preferred fish species in FMZ 5, the most frequent was walleye followed by smallmouth bass and northern pike. The results of the 2005 survey for "*fish caught*" indicate that walleye (47%), northern pike (22%), smallmouth bass (14%), yellow perch (8%) and panfish (5%) in that order were the most common fish species. For "*fish harvested*", walleye (58%), northern pike (13%), panfish (12%), yellow perch (8%), and smallmouth bass (5%) were the most common species kept. Lake trout represented 3% of the fish harvested and only 1% of the fish caught. Based on known distribution, black crappie were likely the most preferred species included in the panfish category. These results also demonstrate that a catch and release philosophy is clearly part of the angling experience in FMZ 5. In particular, northern pike and smallmouth bass were harvested at a lower proportion than they were caught. Meanwhile, walleye and panfish (crappie) were harvested at a higher proportion than they were caught. A summary of creel survey projects (Cano and Parker, 2007) confirmed that anglers are primarily targeting walleye, while smallmouth bass has emerged as an important target species in FMZ 5.

Estimates of fish harvest are available by species. For example, the estimated catch of walleye in FMZ 5 was 6,188,000 for all lakes, and 2,988,000 excluding the SDW's (except Winnipeg River). In proportion, these large SDW lakes and rivers represent approximately 50% of the walleye caught in the zone, and 35% of the total lake area in the zone.

It was estimated that anglers fishing in FMZ 5 in 2005 spent a total of $199.1 million on fishing activities. The majority of these expenditures ($107.6 million) were on consumable goods and services such as accommodation, meals, travel, boats and boat rentals, fishing supplies, licence fees, guide fees and access fees. Package deals represented $53.0 million or 49% of this value. Expenditures on investment goods (wholly or partially attributable to fishing) such as boating, camping and fishing equipment, special vehicles, land and buildings were estimated to be $91.5 million. Investment goods wholly attributable to recreational fishing represented $48.4 million or 53% of this estimate. The economic impact of non-resident of Canada angler participation in the fisheries is apparent as this group represents 72% of the anglers in FMZ 5.

5.1.1.1 Ontario Residents

An estimated 50,976 Ontario resident anglers fished in FMZ 5 in 2005 representing 20% of the total fishing effort. The average age of these anglers was 42 years for males and 42 years for females, and represented the youngest age of all angler origin categories. Creel surveys conducted on 41 selected zone lakes suggest that the resident angler effort averaged 23%, ranging from a low of 0% to a high of 100% on some lakes. Some remote tourism lakes and individual lakes (e.g. Namakan, Sand Point, and QPP) along on the Ontario-Minnesota border have negligible fishing effort by Ontario residents.

In terms of recreational opportunities, the fisheries resources of FMZ 5 provided an estimated 1.8 million angler hours or 461,000 angler-days for Ontario residents. This angler group fished an average of 21 days each year and 4 hours each day. The fisheries in FMZ 5 are very important to local communities, including First Nations. Open-water fishing and ice fishing are both important recreational activities for residents. In addition, these fisheries are vital to the economic well being of local communities.

5.1.1.2 Canadian Residents

An estimated 19,692 Canadian resident anglers fished in FMZ 5 in 2005 representing 8% of the total fishing effort. The average age of these anglers was 46 years for males and 42 years for females, and was very similar to Ontario residents. The majority of Canadian residents fishing in FMZ 5 likely originate from Manitoba, due to close proximity to northwest portions of the zone and much of that effort would be directed to Lake of the Woods, Shoal Lake and the Winnipeg River.

In terms of recreational opportunities, the fisheries resources of FMZ 5 provided an estimated 0.7 million angler hours or 147,500 angler-days for Canadian residents. This angler group fished an average of 12 days each year and 5 hours each day.

5.1.1.3 Non-residents of Canada

The majority of non-residents of Canada fishing in FMZ 5 utilized the services of the resource based tourist outfitters. A significant portion also use provincial parks, in particular Quetico Provincial Park (QPP) which is the largest wilderness park in the zone. The resource based tourism industry is well developed within FMZ 5 with approximately 328 main base lodges and 156 outpost camps. These facilities include drive-to facilities and remote fly-in or water access facilities. Most non-resident anglers in FMZ 5 are based at commercial facilities clustered around Atikokan, Dryden, Fort Frances, Kenora, Nestor Falls, Sioux Narrows and Vermillion Bay in association with the Highway 11, 17, and 71 corridors. Given the close proximity to Minnesota, a considerable portion of the non-resident anglers are day-use travellers in the southern part of the zone or based at privately owned cottages throughout the zone. Some angling effort and harvest is also from non residents camping on Crown land although this is restricted those the

An estimated 180,853 non-resident anglers fished in FMZ 5 in 2005 representing 72% of the total fishing effort. The average age of these anglers was 51 years for males and 50 years for females. The average age of 51 years for non-residents of Canada is considerably older than Ontario residents at 42 years. Creel surveys conducted on 41 selected zone lakes suggest that the non-resident angler effort averaged 77%, ranging from a low of 0% to high of 100% on some lakes. Some remote tourism lakes and individual lakes (e.g. Namakan, Sand Point, and Quetico Provincial Park) along on the Ontario-Minnesota border have almost 100% fishing effort by non-residents of Canada. In 2004, non-residents comprised 85% of QPP visitors (OMNR, 2005e). Of the 76 tourist outfitters servicing the park, 55 (72%) are located in Minnesota. In 2003, 99% of all fishing license sales in QPP were to non-residents anglers, and 89% of these were conservation licenses.

In terms of recreational opportunities, the fisheries resources of FMZ 5 provided an estimated 6.6 million angler hours or 948,000 angler-days for non-residents of Canada. This angler group fished an average of only 8 days each year and 7 hours each day. They fished fewer days than residents, but fished more hours each day while staying in Ontario. The fisheries in FMZ 5 are clearly very important to the tourism industry, provincial parks and non-resident anglers. Open-water fishing and ice fishing are both important recreational activities for US based non-residents. In addition, these fisheries are vital to the continued well being of local communities.

Hogg *et al.* (2010b) completed an analysis and statistical comparison of the recreational mail survey to traditional creel survey effort estimates on selected waters. In Ontario, the mail survey effort estimates tended to be higher than creel survey estimates, but were well correlated with them. On average, mail survey estimates were 2 fold higher for effort, 3 to 9 fold higher for catch, and 2 to 3 fold higher for harvest. Although zone estimates may be high, there is no reason to believe that the sampling bias varies among zones. The results appear to be very effective in describing the relative distribution of fishing effort across the province, as well as the relative catch and harvest of various species.

Most District information on angling effort and demographics are obtained from traditional creel (angler) surveys conducted on specific lakes. These surveys may include standard roving, access or mail survey designs. Many of these creel surveys have focused on SDWs, but several have been completed on other zone lakes since 1970. A summary of the most recent creel surveys conducted on lakes/rivers in FMZ 5 since 1986 is provided in Appendix 5-1. Average fishing intensity from 41 individual creel surveys was 6.4 hours/ha, with a range from 0.5 to a high of 21.6 hours/ha. The highest fishing effort was on Lake of the Woods at 832,666 angler hours in 2008, followed by Rainy Lake at 302,469 hours in 2001/02, Upper Winnipeg River at 189,830 in 2007 and Eagle Lake at 136,339 hours in 2010. The highest fishing effort on non-SDW lakes were the Despair/Footprint/Jackfish chain (56,900 hours in 2003), Lac La Croix (46, 200 hours in 1996) and Seine River chain (39,425 hours in 1989). The highest observed fishing intensity was on Burditt (Clearwater) Lake at 21.6 hours/ha in 2003 followed by the Despair/Footprint/Jackfish chain with 16.1hrs/ha in 2003 and McAree Lake with 12.1 hrs/ha in 1996. Of the 36 non-SDW lakes with creel survey information, 5 lakes (14%) had estimated angling intensity of more than 10 hrs/ha which is considered high angling intensity. An additional 15 lakes (42%) had angling intensity estimates between 5 hrs/ha and 10 hrs/ha which is considered moderately high.

Effort estimates were also derived from aerial surveys as part of the 2000/01 State of the Resource Reporting (SORR) pilot project in tertiary watershed 5PB, which covered a large portion of FMZ 5. Fishing intensity on the 807 sampled zone lakes during the open-water season averaged 2.1 hours/ha, and ranged from a low of 0 hours/ha (no fishing) to a high of 35.0 hours/ha on Scattergood Lake. Similarly, ice fishing during the winter season averaged 0.4 hours/ha, and ranged from 0.0 to a high of 54.5 hours/ha on Pal Lake (a very small, previously stocked rainbow trout lake). The average annual fishing effort across the zone was 2.5 hours/ha, with 84% occurring during open-water and 16% was ice fishing during the winter.

Angler catch rates were also derived from individual creel surveys (n=38) completed since 1986 (Appendix 5-2). A measure of angler success or catch per unit effort (CUE) is based on the number of fish caught per angler-hour (rod-hours during open water) by species targeted. For all lakes, smallmouth bass anglers had the highest CUE, averaging 0.67 fish/hour with a range of 0.11 to 1.61 fish/hour. Walleye CUE averaged 0.53 fish/hour, ranging from a low of 0.01 to a high of 1.24 fish/hour on Eagle Lake. Northern pike CUE was third highest averaging 0.45 fish/hour; compared to 0.18 fish/hour for lake trout and only 0.04 fish/hour for muskellunge. The low catch rates for muskellunge anglers are not unexpected and are consistent across most waterbodies with a range of 0.02 to 0.09 fish/hour. Angling success on only the non-SDW lakes was very similar to SDW lakes although walleye angling success tended to be somewhat lower.

These FMZ summaries do not include other less intensive investigations of angler effort and harvest. For example, an extensive winter roving and check station creel survey was conducted on 15 lakes in the Fort Frances District in 1983 (McLeod, 1987). Angler check stations were previously operated on the Highway 502 corridor during the winter lake trout season from 1975-

1982. Other winter creel surveys have also been completed on Wabigoon Lake, Upper Manitou, Thompson Lake, Kakagi Lake and Lake of the Woods (Cano and Parker, 2007). In addition, fly-in surveys were conducted at local air carriers in Fort Frances from 1974-77, and a winter/spring/summer survey on the Manitou Lakes System (Upper Manitou, Lower Manitou, Manitou Stretch and Esox Lake) was completed in 1987 (Gibb, 1988). A winter survey of Upper Manitou Lake was also completed by Dryden District in 1994 (MNR file records). In 2003, Kenora District completed winter angler counts on 43 selected lake trout lakes north of the border waters area to Hwy 17. For those lakes where angling was observed, effort estimates ranged from 0.02 hours/ha on Dogtooth Lake to 1.50 hrs on Veronica Lake. Nineteen of the lake trout lakes (44% of those surveyed) had no confirmed angler effort (MNR file records).

Unlike other sport fish, a significant portion of fishing effort directed towards lake trout occurs in the winter, making winter creels more useful in assessing the angling fishery of this species. In comparing angling success data from winter creel surveys to open water surveys, angling success is generally higher for lake trout in the winter (Figure 5.1-1).

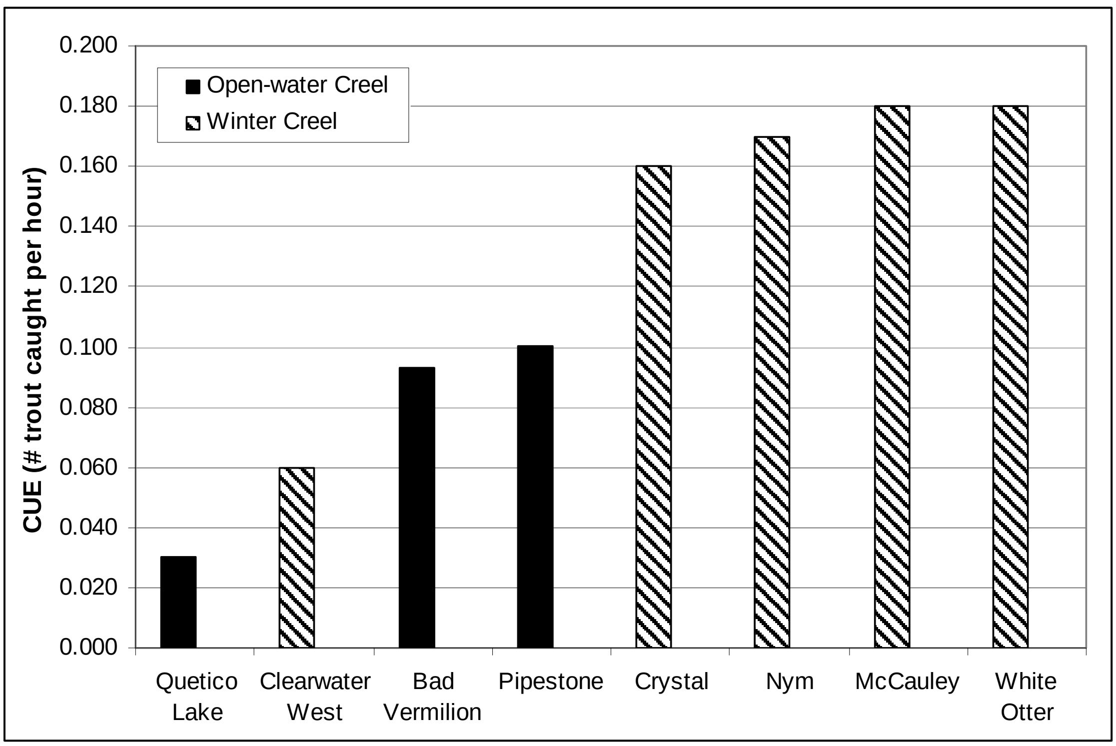


Figure 5.1-1: CUE of lake trout from open-water and winter creels, 1988-1994

5.1.2 Competitive Fishing Events

A significant number of competitive fishing events take place each year in FMZ 5, although many of these are conducted on the larger lakes (SDWs) such as Lake of the Woods, Winnipeg River, Rainy River and Rainy Lake. A summary of the 38 events that occurred or were planned in 2010 provided information on the location, fish species and type of event (Appendix 5-3). Of the 38 events in FMZ 5, 27 (71%) were held on SDW's and contribute significant social and economic benefits to the communities in which they are held. A smaller proportion (29%) of the 2010 events occurred on inland lakes outside the SDW's. Most event occurred in the Kenora District (22) followed by Fort Frances (9) and Dryden (7). Catch and release was the most common event type (84%), and most events were held during the open-water season (84%).

The majority of 2010 events targeted smallmouth and/or largemouth bass (42%) followed by walleye (29%), with a few events open to any fish species including lake trout. MNR data collection efforts generally only occur at the larger, more significant community events. Annual fish sampling and long-term monitoring has occurred at the Atikokan Bass Classic, Bass'n For Bucks, Fort Frances Canadian Bass Championship and Shaw Kenora Bass International.

MNR has completed surveys of competitive fishing events in Ontario in 1999 and again in 2004 (Kerr, 1999; Kerr, 2004). Information was summarized from 680 events in 2004, which represented a 31% increase from the number of events documented in 1999. An estimated 7% of the events occurred in Northwest Region. Bass (smallmouth and largemouth) were the most commonly targeted species accounting for 43% of all events. Other popular species included walleye (13%) and northern pike (9%). Events occurred throughout the year, but summer season was most common at 65%, followed by fall at 18%, spring at 11% and winter at 6%. Most events had durations of one day (74%) or two days (12%).

The following are specific issues or concerns with competitive events that have been identified by fisheries managers in Northwest Region:

- Fish mortality
- Hooking/handling injuries
- Number of events per waterbody
- Timing of events
- Displacement
- Allocation (events on international waters, social conflicts)
- Organizational procedures (off-site weigh-in, water weigh-in systems)
- Invasive species
- Disease.

Several recommendations were made from the 2004 provincial survey to resolve some of these issues. These included: promoting new techniques to minimize handling and air exposure; encourage MNR biologists to use large and long-running event for biological information; work cooperatively with the Ontario Competitive Fishing Council to develop guidelines and best management practices; discourage event for walleye and pike during summer months; and to discourage events which target native lake trout and brook trout.

In 2007, regulations were revised to permit anglers fishing a boat to catch, hold and selectively live release, more walleye, northern pike, smallmouth or largemouth bass than the daily limit under certain provisions. These requirements include an operating livewell with mechanical aerator; fish comply with applicable size limits; daily catch and retain limits for walleye and pike by license type are not exceeded; and no more than six largemouth or smallmouth bass are retained under Sport Fishing license (or specific limit for Conservation Fishing license). These new rules were implemented to improve compliance and advance competitive fishing activities.

5.1.3 Tourism

The majority of non-Canadian residents fishing in FMZ 5 utilize the services of resource based tourism outfitters. The resource based tourism industry is well developed within FMZ 5 with approximately 328 main base lodges and 156 outpost camps (Figure 5.1-1), and 88% of those offer angling opportunities (95% in the Rainy River District) (PFK Consulting 2003). These facilities include drive-to facilities and remote fly-in or water access facilities. Drive-to lodges are clustered around the communities of Atikokan, Fort Frances, Dryden, Kenora, Nestor Falls, and Sioux Narrows, in association with the Highway 11, 17, and 71 corridors (Figure 5.1-1). The remainder are scattered throughout FMZ 5. Angling effort across the zone is influenced to a large degree by the distribution and type of tourist facilities and the amount of road access.

In FMZ 5, 72% of the anglers were non-residents of Canada, according to the summarized results of the 2005 Survey of Recreational Fishing in Canada (Hogg et al 2010a). This is a higher proportion than adjacent FMZ 6 - Thunder Bay (61%), but less than FMZ 4 - Red Lake/ Sioux Lookout (78%). An economic impact study for the Sunset Country tourism area (encompasses FMZ 5) found that U.S. residents accounted for 88% of overnight guests at tourism establishments, with 27% originating from Minnesota and 61% from other states (PFK Consulting 2003). FMZ 5 also has the highest proportion of Canadian resident anglers (excluding Ontario) at 8%, compared to the rest of the FMZ's in Ontario (Hogg et al. 2010). This may be explained in part by the fact that FMZ 5 borders Manitoba and is only a couple hours drive from the large urban centre of Winnipeg. Non-Canadian residents typically fished fewer days (8 days per angler) than Ontario residents (21 days) and Canadian residents (12 days) in FMZ 5 (Hogg et al. 2010).

Sport fishing in FMZ 5 makes a significant contribution to the local economy each year. Angling goods and services contribute on average an estimated $42.6 million per Fisheries Management Zone (including meals, accommodations, guide services, bait and tackle, license fees, etc.), with the most spending occurring in FMZ 5, with an estimated $107.6 million being spent (Hogg et al. 2010a). These numbers do not include package deals, which averaged $9.4 million per zone (Hogg et al. 2010a). Package deal spending (typically through tourism outfitters) in FMZ 5 was estimated at $53.0 million, second only to spending in FMZ 4 ($55.8 million) (Hogg et al. 2010a).

A significant portion of the economic contribution made by sport fishing in FMZ 5 is attributed to visitors to Quetico Provincial Park. Approximately 26,000 people visit Quetico each year, spending approximately $7.2 million on permit fees, food, equipment, etc (OMNR 2005e). Of the 16,000 people that enter the interior each year, 85% took part in fishing activities to some extent and 37% visited Quetico for the primary purpose of fishing (OMNR 2005e). More than 90% of interior park users are from the U.S.. This reflects the distribution of tourism outfitters, as 55 of the 76 that service QPP are located in the U.S., and all of the outfitters typically provide services to non-resident clients (OMNR 2005e).

The economic importance of non-Canadian resident anglers and the tourism industry to local communities and the general economy of FMZ 5 is very clear from the results of the 2005 recreational fishing survey. This is consistent with the findings of an economic analysis on the impact of resource based tourism in Sunset Country conducted in 2001 by PFK Consulting and the Canadian Tourism Research Institute. This analysis indicated that over $360 million was contributed by tourism to the economy in the Kenora and Rainy River Districts in 2001, with $260 million in expenditures retained in the area (Pannel Kerr Forster 2003). Spending on accommodations was the primary source of tourism expenditures (Pannel Kerr Forster 2003). A total of 8,209 jobs were created by the tourism industry in these districts, of which 5,832 were direct jobs (Pannel Kerr Forster 2003).

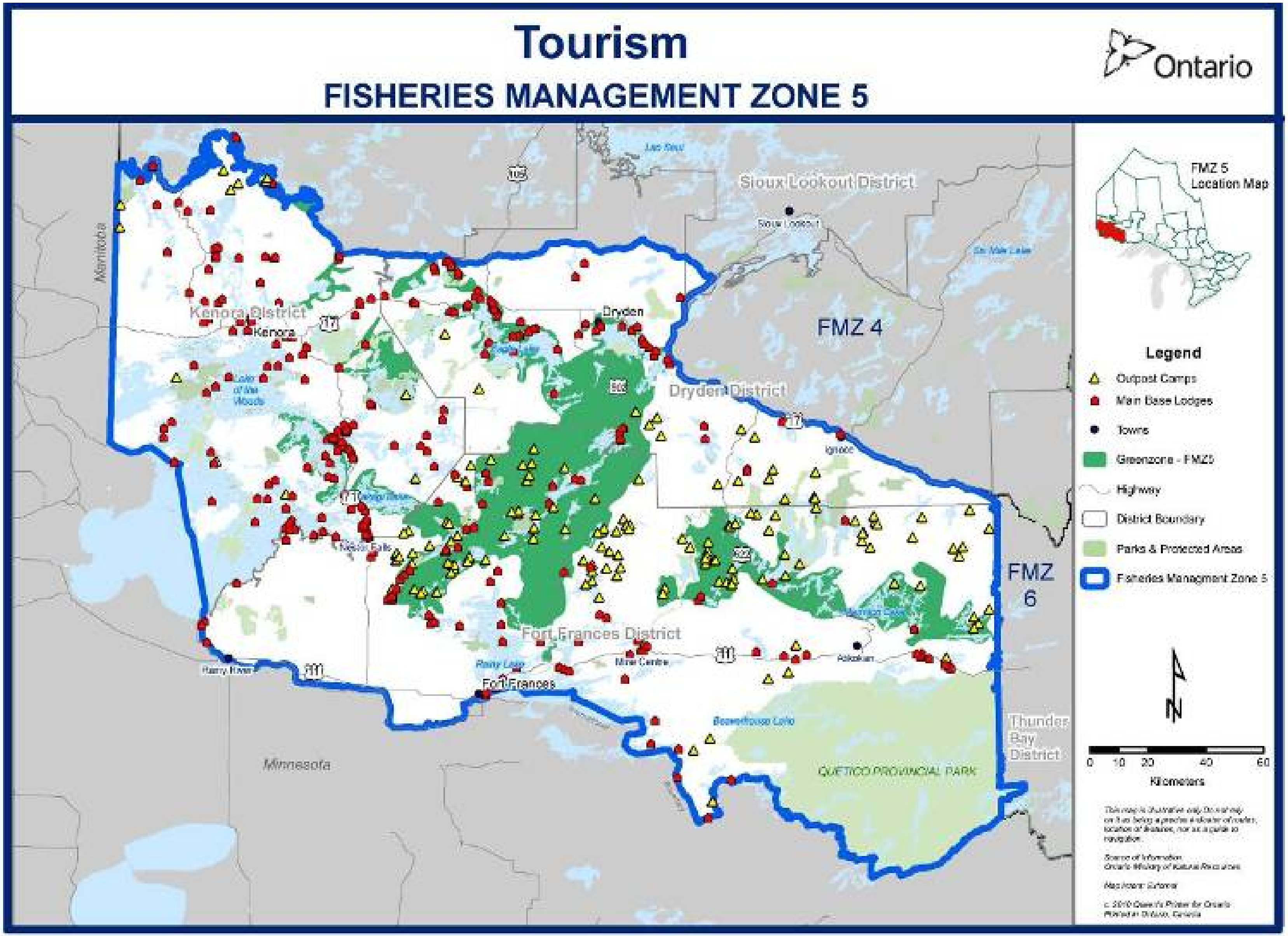


Figure 5.1-1 Tourism development in Fisheries Management Zone 5.

5.2 Commercial Fishing

5.2.1 Commercial Food Fishing

Commercial fishing occurs in all three districts, Kenora, Dryden and Ft. Frances within FMZ 5. Although participation and harvest has declined from historic levels, it is still an important economic activity for a number of individuals and communities found within FMZ 5.

Presently there are 46 commercial licences on 29 FMZ 5 water bodies (Appendix 5-4). Eight of these water bodies are classified as Specially Designated Waters (SDW) while the remaining 21 are Non – Specially Designated Waters (Non-SDW) (Figure 5.2-1).

The majority of commercial licences or allocations (Table 5.2-1) are held by aboriginal individuals or communities or individuals claiming Metis status (36). Over half of the licences and more significantly 77% of the quotas occur in SDW waters. The most important of these is Lake of the Woods with 11 licences or allocations that account for 46% of the total commercial quotas within FMZ 5. In comparison the 21 Non-SDW quotas represent 23% of the total potential harvest.

Table 5.2-1. Commercial licences and allocations within FMZ 5.

District	Aboriginal	Non-Aboriginal	SDW	Non-SDW	Total
Kenora	20	2	15	7	22
Dryden	7	4	3	8	11
Fort Frances	9	4	7	6	13
Total	**36**	**10**	**25**	**21**	**46**

Species commercially harvested within FMZ 5 include primarily lake whitefish, northern pike and walleye with lesser amounts of black crappie, yellow perch and sauger taken annually (Table 5.2-2). Most species are captured using gillnets, although trap nets are used for a small number of fisheries. Mesh sizes are generally large to ensure the targeted species have grown large enough to ensure one or more spawning opportunities. In some situations small mesh gillnets are used to target smaller species such as yellow perch and sauger.

Table 5.2-2. Commercial quotas (lbs) by species for SDW and Non-SDW waters in FMZ 5.

Species	**SDW**	**Non-SDW**	**Total**
Lake Whitefish	207,100	163,230	370,330
Northern Pike	168,488	13,504	181,992
Walleye	117,307	7,565	124,872
Black Crappie*	46,107	1,000	47,107
Yellow Perch*	47,100		47,100
Sauger*	31,500		31,500
Lake Sturgeon	2,850	400	3,250
Total	**620,452**	**185,699**	**806,151**

Lake whitefish is the primary targeted commercial species in Non- SDW waters. Quotas for walleye and northern pike are generally considered incidental catches. That is, the commercial fisher while targeting lake whitefish will often capture other species "incidentally". By including an incidental quota this allows the fisher to market and not waste any bycatch.

Although lake whitefish is the largest quota allocation in the SDW waters, but there are also significant commercial quotas for walleye and northern pike. Once again, these fisheries occur mostly on Lake of the Woods and to a lesser extent on Rainy Lake.

Table 5.2-2 shows an asterisk beside black crappie, yellow perch and sauger. This indicates in some water bodies there is no quota and unlimited amounts of these species may be harvested commercially. In many cases this is to accommodate incidental catch taken using large mesh gill nets. However, there are a small number of licences that target and allow an unlimited harvest of both black crappie and northern pike using trap nets.

Commercial quotas for the commercial harvesting of lake sturgeon still exist. The largest of these is held by Rainy River First Nation. However, in 1995 Rainy River First Nation imposed a moratorium on commercial harvesting to assist in the recovery of this species. In 2010, the Ontario Ministry of Natural Resources designated the Great Lakes and Northwest Ontario Lake sturgeon populations as threatened under the Endangered Species Act (ESA 2007). This prohibits the harvest or sale of any sturgeon taken in the waters within these watersheds.

Ontario commercial licences are regulated under the Fish and Wildlife Conservation Act 1997 Section 51.1. Commercial harvesters are required to submit catch returns and records of sale to the Ministry of Natural Resources. The licence identifies who is authorized to fish, on which water body and what species and amounts can be harvested. Additional conditions that restrict the season of commercial activity, gear type and or mesh size can also be included. These are typically used to protect the targeted species during the spawning season and to ensure the species has had one or more opportunities to spawn.

Current management direction for commercial fisheries is also provided in the District Fisheries Management Plans (DFMP) for Fort Frances District, Kenora District, Dryden District, Ignace District (now part of the Dryden District) and Atikokan District (now part of Fort Frances District). Table 5.2-3 summarizes direction within the four DFMP's that affect FMZ 5. These documents will provide management direction only until the completion of the FMZ 5 Fisheries Management Plan.

Table 5.2-3. Commercial fisheries management direction in District Fisheries Management Plans.

District Fisheries Management Plan	Commercial Fisheries Management Direction
Atikokan	Any new commercial fishing allocation will only be for whitefish and coarse fish on designated lakes and gear will be restricted to live trapping gear.
Fort Frances	Encourage the harvest of commercial fish under quota management where it meets biological, economic and social acceptance. Reduce walleye quotas to 0 kg/yr; reduce commercial harvest to specific targets for northern pike, whitefish and sturgeon. Commercial harvest targets for crappie to be above allowable yield.
Kenora	Reduce commercial harvest of sportfish species by 1) reducing commercial quota from non-SDW waters to 0 kg/yr for sturgeon and lake trout; 2) reduce existing quotas of sportfish species; 3) manage for continued harvest of other fish species; 2) continue with willing seller, willing buyer initiative to buy out commercial quotas of walleye and pike
Dryden	Reduce commercial harvest of sportfish species by 1) buying out existing quotas of walleye, pike and lake trout; 2) direct commercial fishermen to use of live capture gear and seasons when sportfish species are less vulnerable.
Ignace	Maintain a viable commercial fishing industry where it is biologically, economically and socially acceptable. Encourage the harvest of species which do not provide recreational opportunities such as whitefish and coarse fish by 1) providing for a maximum annual harvest of 41, 600 kg/year of whitefish, 2) providing for a harvest of coarse fish, and 3) provide a small quota on some sportfish species, not as a target, but as an incidental quota to be reduced over the duration of the plan.

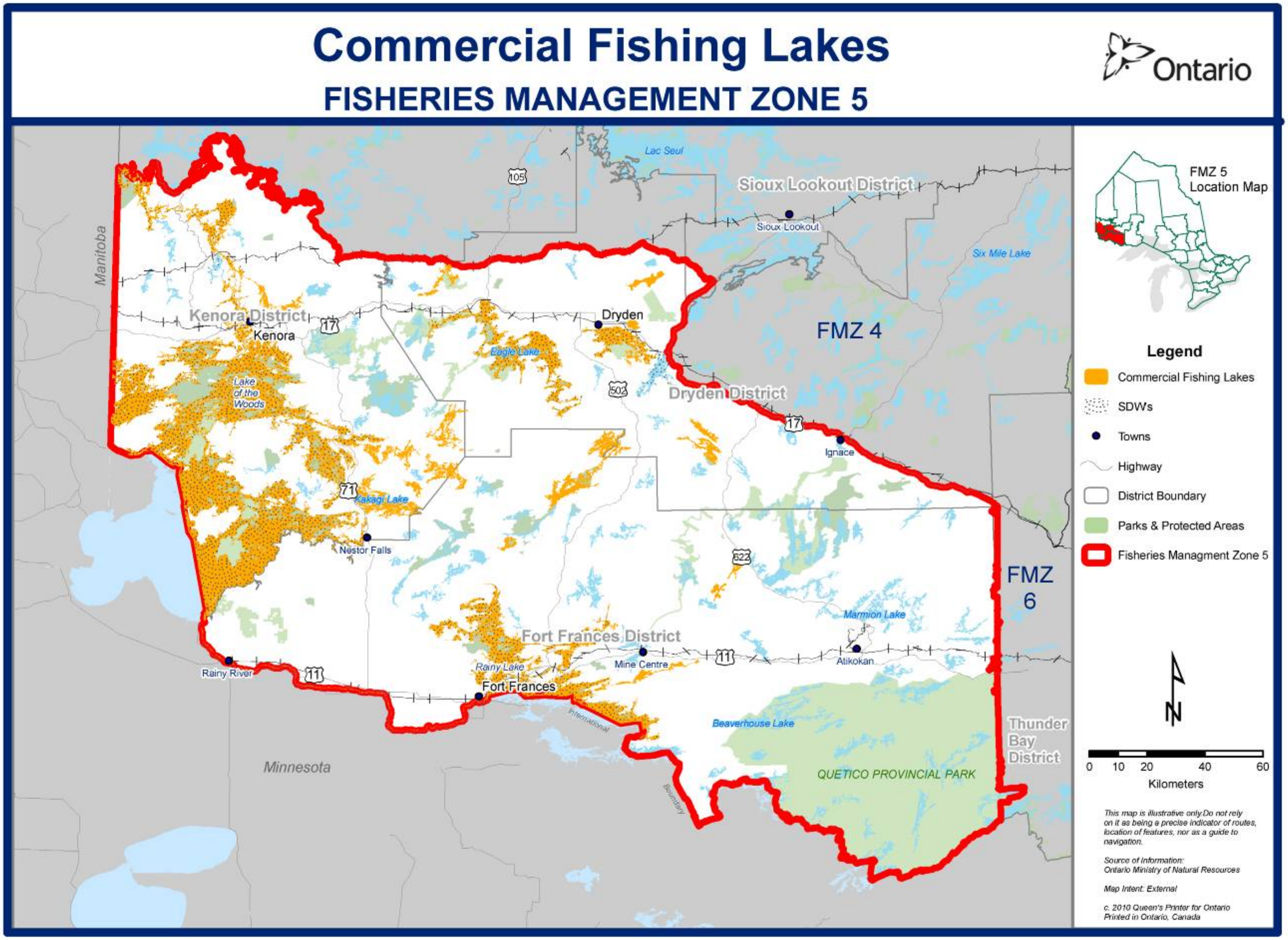


Figure 5.2-1. Waterbodies with commercial fisheries in FMZ 5.

5.2.2 Commercial Baitfish Harvesting

Baitfish are commonly used by anglers throughout Ontario to assist in the capture of desired sport species. There are over 65 species of legal baitfish in Ontario. Most species belong to the minnow or cyprinidae family, but species of suckers, sticklebacks, sculpins and darters are used. The definition of baitfish also includes organisms such as leeches, crayfish and frogs.

Baitfish may be collected by individual anglers possessing a valid resident fishing licence or by licenced commercial bait harvesters. Restrictions listing the species of baitfish that can be used and the number an individual angler may possess are described in the Ontario Recreational Fishing Regulations Summary (Appendix 5.5). In addition, the summary identifies areas and water bodies where the use of bait is prohibited such as Quetico Provincial Park. Species considered game fish, some non-native species and species at risk (listed as Extirpated, Endangered or Threatened) under Schedule 1 of the Federal Species at Risk Act (SARA) and Ontario's Endangered Species Act (ESA) cannot be used as baitfish. It is also illegal to bring any crayfish or salamanders or live fish or leeches into Ontario to be used as bait.

The commercial baitfish industry comprised of over 2000 harvesters and dealers licenced by the Province is represented by the Bait Fish Association of Ontario (BAO). The commercial baitfish licence is regulated under the Fish and Wildlife Conservation Act 1997 Section 51.1. Licence holders are required to keep a log book with information regarding harvest (dates and locations) and sales (selling, purchases and quantities) and an annual report must be submitted to the Ministry of Natural Resources.

There are 311 baitfish blocks totally or partially within the boundaries of FMZ 5 (Figure 5.2-2), although because one harvester can fish multiple blocks, the number of harvesters is much less than that. There are four types of bait harvester and/or dealer licences:

1. Regular harvester/dealer – this licence allows the holder to harvester and sell bait to retail outlets, the public and tourist lodges.
2. Tourist harvester/dealer – is assigned a designated water body for harvest and can sell bait only to guests registered at their Tourist facility.
3. Regular dealer – can sell from their own facility to public or to other dealers.
4. Tourist Dealer – can sell bait only to guests registered at their Tourist facility.

The commercial baitfish industry retail worth has been estimated at 23 million for the entire province (B. Koenig pers.comm). Table 5.2-3 shows the estimated harvest from FMZ 5 for 2009.

Table 5.2-3 Reported baitfish and leech harvest from FMZ 5 for 2009.

	Dozens	**Gallons**	**Pounds**
Baitfish	820218	13670	136706
Leeches	317061	1585	15853

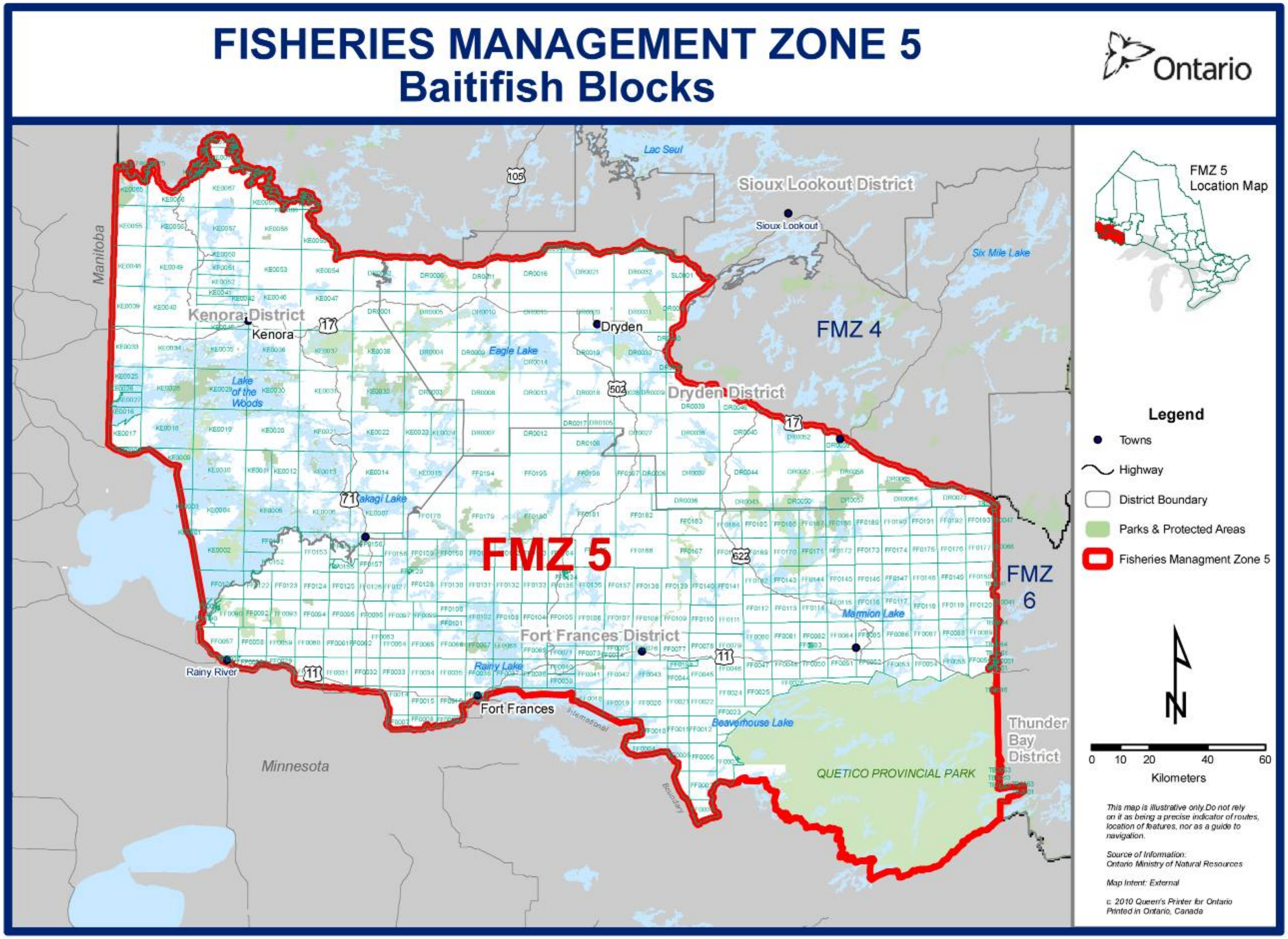


Figure 5.2-1. Commercial baifish harvesting blocks within FMZ 5.

Assuming an average cost of $5.00 per dozen for baitfish and $4.00 per dozen for leeches, the estimated retail value of commercial baitfish and leeches harvested in FMZ 5 was 5.4 million dollars for 2009.

Although baitfish are popular with anglers and represent a valuable industry in Ontario, their use has potential negatives impacts on fisheries and ecosystems. The main concern is the introduction of non-native species and diseases (e.g. VHS) into recipient water bodies. To reduce this problem, it is illegal to release any live bait or dump the contents of a bait bucket including the water, into any waters or within 30 meters of any waters. In addition the baitfish industry must now develop a Hazard Analysis and Critical control Point (HACCP) plan to minimize the risk of invasive species and disease transfer. The HACCP plan considers methods, equipment, timing and species harvested allowing both the baitfish harvester and MNR to identify invasive species hazards, establish controls, and monitor controls to prevent the spread of invasive species and diseases.

Increased education and awareness are essential to prevent and control the spread of invasive species and diseases. The Ontario Federation of Anglers and Hunters in partnership with MNR have developed an Invasive Species Awareness Program.

5.3 First Nation/Métis Subsistence Harvest

Fishery resources within FMZ 5 have a significant cultural and economic importance to First Nation communities within and adjacent to FMZ 5. Historically, the Aboriginal peoples of this area relied heavily on fish as a source of food and trade with other Aboriginals and European settlers and this reliance continues into present times. The majority of commercial fish licences are held by First Nation individuals or communities. Employment within the tourist industry is an important source of income for many Aboriginals and more recently many First Nation communities are generating revenue through the sponsorship of competitive fishing events.

Similar to non-Aboriginal residents of this zone, angling is an important form of recreation for many Aboriginals. Besides the recreational component, Aboriginals can angle or use gill nets to harvest fish for subsistence or ceremonial purposes. This right is guaranteed under Treaties signed with the Crown.

Subsistence harvest estimates are based on dated estimations of harvest per individual. In Kenora District, an annual per capita consumption rate of 35 kg (77 lbs) of fish per First Nation resident is used (Hough et al. 1982) whereas Fort Frances uses an estimate of 18 kg (40lbs) per resident. In the absence of more recent information, subsistence harvest estimates based on the last population census of on reserve residents (7114) would range from 128,052 kg (284,560 lbs) to 248,990 kg (547,778 lbs). Fort Frances District suggests the harvest is comprised primarily of walleye (30%), northern pike (30%), and lake whitefish (30%), while bass and crappie make up the remaining 10%. Historically, lake sturgeon has been an important food item to the peoples of this zone and continues to have high cultural and spiritual significance today.

There are no accurate estimates of Métis population or harvest within FMZ 5. However there are currently self-identified Métis Associations within four FMZ 5 communities of Kenora, Fort Frances, Dryden and Atikokan.

In Ontario, the first allocation priority is for resource maintenance, the protection of the self-renewing production of the fisheries resource (OMNR 2004). The next priority is for First Nations subsistence and traditional needs. Remaining available surpluses are managed for the benefit of the resident angler and the commercial fisheries. Commercial fisheries include both the commercial net fishery and the commercial angling fishery (tourism-based angling and competitive tournaments). To ensure Treaty obligations are met, it is essential a more accurate and current estimate of First Nation subsistence harvest and species preference is documented and utilized in future management of FMZ 5.

6.0 Current Fisheries Management Actions

6.1 Catch and Possession Limits, and Seasons

Seasons and catch and possession limits are in place in FMZ 5 for the following species: walleye, sauger, largemouth bass, smallmouth bass, northern pike, muskellunge, yellow perch, crappie, sunfish, brook trout, rainbow trout, lake trout, splake and lake whitefish. Lake sturgeon are closed all year to fishing all year. In addition, aggregate limits apply to brook trout, lake trout and splake. Seasons and limits for all of these species are described further in Table 6.1-1. In general, season objectives for most sport fish species are to protect while they are moving to and from spawning areas or while they are spawning. Slot size objectives are to protect individuals within the population that may be at risk to over exploitation, such as large mature, sexually reproductive individuals that contribute to maintaining naturally occurring populations. In cases where possession of a single fish greater than a specified size limit was permitted, the objective was to allow anglers to retain a trophy fish if they so desired. Limits associated with regulations are intended to protect populations from over-harvesting by limiting the number of fish of a particular species that can be harvested or possessed by anglers.

Beyond the seasons and limits listed in Table 6.4-1, there are several lakes in FMZ 5 that have exceptions to the general rules such as fish sanctuaries where no fishing for any species is allowed during the time of the sanctuary or lakes where angling is closed year round. There are also species specific regulations on certain lakes for walleye, muskellunge, lake trout and bass. The most common of these are increased minimum size limits for muskellunge in lakes that have been identified as being managed for higher quality fisheries. Other species specific regulations generally involved reduced limits in some lakes. The lake specific regulations are identified in the “Exceptions to Zone 5 Regulations” section of the Ontario Recreational Fishing Regulations Summary.

There are two types of possession limits. A sport possession limit is for anglers who have purchased a sport fishing licence and represents the full allowable limit for each sport fish species. The second limit, which is normally half of the limit associated with a sport fishing licence, is for anglers who have purchased a conservation licence. In the southern part of FMZ 5 (see Ontario Recreational Fishing Regulations Summary for map of area), non-residents of Canada have reduced sport fishing licence daily catch limits for walleye and lake trout to 2 and 1 fish respectively (same as conservation daily catch limits) although the possession limits remain the same as residents at 4 walleye and 2 lake trout. Also, all non-residents who are camping on Crown Land are restricted to conservation limits for all species.

Table 6.1-1. Fisheries Management Zone 5 Current (2010) Seasons and Limits

Species	Season	Limits and Size Restrictions
Walleye* & Sauger or any combination	Jan. 1 to Apr. 14 & 3rd Sat. in May to Dec 31.	S – 4; not more than 1 greater than 46 cm (18.1 in) C – 2; not more than 1 greater than 46 cm (18.1 in)
Smallmouth Bass* and Largemouth Bass* or any combination	Open all Year	S – 2; must be less than 35 cm (13.8 in) from Jan. 1 – June 30 & Dec. 1 – Dec. 31. S – 4; no size limit from July 1 – Nov 30 C – 1; must be less than 35 cm (13.8 in) from Jan. 1 – June 30 & Dec. 1 – Dec 31 C – 2; no size limit from July 1 – Nov. 30
Northern Pike	Open all Year	S – 4; none between 70-90 cm (27.6-35.4 in.), not more than 1 greater than 90 cm (35.4 in) C – 2; none between 70-90 cm (27.6-35.4 in), not more than 1 greater than 90 cm (35.4 in).
Muskellunge*	3rd Sat in June to Dec. 15	S – 1; must be greater than 102 cm (40 in) C – 0
Yellow Perch	Open all Year	S – 50 C – 25
Crappie	Open all Year	S – 15 C – 10
Sunfish	Open all Year	S – 50 C – 25
Brook Trout	Open all Year	S – 5 C – 2
Lake Trout*	Jan. 1 – Sept. 30	S – 2; not more than 1 greater than 56 cm (22 in.) from Sept. 1 to Sept. 30 C – 1; no size limit
Splake	Open all Year	S – 5 C – 2
Lake Whitefish	Open all Year	S – 12 C – 6
Lake Sturgeon	Closed all Year	

* individual lake exceptions exists for these species

The last significant change in general fisheries regulations occurred in 1999 when both the catch limits and size limits were reduced for most species. For example, the sport fishing possession limits for walleye, northern pike and bass were reduced from 6 to 4 and conservation licence limits were reduced from 3 to 2. Size limits were also changed for several species. The one over maximum size limit for walleye was reduced from 50 cm to 46 cm; a maximum size limit of 35 cm and reduced limit was instituted for spring smallmouth bass fishery and a protected slot of 70 cm to 90 cm was implemented for northern pike anglers. Since that time, most regulation changes have consisted of implementing increased minimum size limits on quality management muskellunge lakes (2001) and elimination of a number exception lakes where the exception regulations was considered not to be required any longer.

Toolkits to guide decisions regarding regulatory options for sport fish species have been developed for the province of Ontario as part of the Ecological Framework for Recreational Fisheries Management in Ontario (OMNR 2005a) (Table 6.1-2). The toolkits are aimed towards:

- providing effective science based management strategies that ensure sustainability of the resources while providing for optimum angling opportunities;
- providing a standard suite of regulations for use as new regulations;
- facilitating the review of existing regulations; and
- simplifying and streamlining the regulations.

The regulatory options in these tool kits are meant to be applied on a zone wide basis. Some exceptions for stressed or quality fisheries may be considered but they must be consistent with the direction in the tool kits and will be subject to a more rigorous review and approval process. Table 16 describes the regulations toolkits that exist for the province.

Table 6.1-2. Provincial regulation toolkits by species, status and implementation date.

Species	Status	Implementation
Muskellunge	Completed	2005
Splake	Completed	2004
Yellow Perch	Completed Ban on sale of angler caught perch	2007 2005
Crappie	Completed	2007
Sunfish	Completed	2007
Brown Trout	Completed	2007
Lake Whitefish	Completed	2005
Non-angling methods	Completed	2007
Lake Sturgeon	Currently in preparation	Pending
Channel Catfish	Completed	2007
Ice Hut registration	Awaiting approval	Pending
Rainbow trout/pacific salmon	Completed	2007/2008
Atlantic salmon	Completed	2007/2008
Bass	Completed	2006
Walleye	Draft Completed	Draft 2008
Northern pike	Completed	2006
Lake trout	Completed	2007
Brook trout	Completed	2007

6.2 Exceptions

The Ecological Framework for Recreational Fisheries Management in Ontario (OMNR 2005a) recommends simplification of the fishing regulations summary which includes reducing the amount of exceptions to zone wide regulations in each Fisheries Management Zone. This would eliminate exceptions that may be considered redundant as new fisheries management objectives and actions are taken. Within the past decade, a number of exceptions that were considered no longer appropriate were removed. There are currently 109 exceptions to Zone 5 regulations. Of these exceptions 32 are related to fish sanctuaries, 66 are related to species specific management (15 walleye, 10 lake trout, 33 muskellunge, 4 sauger, 1 northern pike, 3 small and largemouth bass). An additional 10 exceptions restrict use of bait or tackle and one relates to the closure of 20 experimental lakes to all angling.

All lakes in the northwest region were reviewed using a systematic process that involved the use of biological, social and economic criteria. Based on the results of this review, specific lakes within each fisheries management zone were chosen as specially designated waters (SDW's). This means that these lakes will continue to be managed on an individual lake basis. These lakes will eventually have lake specific management plans prepared to manage the fisheries resources. Within FMZ 5, Lake of the Woods/Rainy River, Shoal Lake, Rainy Lake, Eagle Lake, Wabigoon/Dinorwic Lake and the Winnipeg River system and their associated waterbodies (see Appendix 2-1) were selected for management as specially designated waters.

6.3 Stocking

Fish stocking is a management tool that is used in response to a fisheries management problem such as loss of fish stocks from habitat degradation or to provide additional angling opportunities in areas that receive high angling pressure to disperse activity. There are two broad objectives of fish stocking projects within FMZ 5:

1) introductions to establish natural reproducing populations
2) stocking fish to provide hatchery dependent fisheries (also known as put-grow-take (PGT) fisheries)

Greater than 95% of the fish caught in Ontario are from naturally reproducing populations across the province; as a result, priority in the province is placed on sustaining these naturally reproducing fish communities (OMNR 1992a). Intensive stocking of hatchery reared fish can dilute native stocks which are often locally adapted to specific lake conditions, which leads to decreased fitness and potential loss of native populations (Evans and Willox 1991). Due to this threat, the OMNR identified in the Strategic Plan for Ontario Fisheries (SPOF) II that supplemental stocking of native fish species in areas of overexploitation of natural populations should not be encouraged and that emphasis should be placed on setting appropriate management actions and regulations to maintain those populations instead of encouraging Put Grow Take fisheries.

Risk management of social and economic benefits versus ecological impacts is a major consideration when fisheries managers make choices regarding stocking programs. Caution needs to be exercised when introducing any species into an ecosystem where they are not established naturally, particularly when establishment may result in competition with native species that are already stressed due to habitat loss, development pressures and overexploitation. Though introduced species may provide social and economic benefits, the ecological impacts of introductions must be considered. Traditionally, OMNR has introduced top predators such as walleye, rainbow trout or smallmouth bass to create or enhance angling opportunities. Past experiences have shown that all introductions will have some sort of impact to existing fish communities. These can range from reducing prey and forage species abundance to competing with and possibly eliminating other sport species. Before introducing a new species, the risk to the existing fish community and adjacent water bodies must be thoroughly understood and justified. OMNR's mandate has expanded beyond providing increased angling opportunities and includes the protection of biodiversity.

Prior to the development of a stocking program, an environmental assessment under the Class Environmental Assessment for MNR Resource Stewardship and Facility Development Projects is required to weigh potential impacts of introducing stocked species. Fish stocking falls under two potential categories in the Class EA; the first is for ongoing fish stocking events in inland lakes which falls under Category A: projects with the potential for low negative environmental effects and/or public or agency concern. The second citatory is for the introduction of native or non-native fish species which falls under Category C: projects with the potential for medium to high negative environmental effects and/or public or agency concern. This precautionary approach to stocking introduced fish species aims to reduce the risks associated with stocking which include dilution of native stocks and decreased fitness of naturally reproducing populations (Brown 2007).

Over the past century, a wide variety of fish species have been stocked within the waters of FMZ 5 including muskellunge, black crappie, rainbow trout, lake trout, splake, brook trout, walleye smallmouth bass and whitefish. The purpose of these efforts was usually to establish new populations to provide new or increased angling opportunities. Initially many of these were done by government agencies but with increasing awareness of the negative impacts of introduced species on native fish populations, the number of introduction stocking has declined dramatically. Currently, the only approved introductions in FMZ5 are in the Atikokan Area where the Atikokan Sportsmen's Conservation Club is introducing walleye into three lakes with walleye fry from their hatchery with the intent of producing self-sustaining populations. The majority of introductions occurring at this time are illegal introductions being undertaken by people who are intending to improve angling opportunities but could be causing irreparable harm to native fish communities by introducing both native and non-native fish species into lakes.

Supplemental stocking, or the stocking of fish with the intent of improving the status of an existing self-sustaining population, has been less used as a management technique in FMZ 5. A government hatchery existed in Fort Frances during the fifties with the purpose of improving area walleye and whitefish populations through the supplemental stocking of eyed eggs and fry. After several years, studies showed that the stocking efforts were having no noticeable affect on fish populations. For a brief period in the late eighties, an OMNR walleye pond culture facility operated with the purpose of stocking fingerlings to improve the walleye population in the North Arm of Rainy Lake but it too was closed after a few years. Stocking of adult walleye as a rehabilitative technique was also conducted in Rainy Lake but evaluation showed limited success (McLeod and Gillon 2000). Numerous studies have demonstrated the lack of success from supplemental stocking in lakes where there are not habitat issues and currently, supplemental stocking is not recommended in Ontario except under specific circumstances.

Put Grow Take (PGT) fisheries and the rehabilitation of degraded fisheries through stocking programs are still practiced within Ontario, and fish hatcheries continue to play a role in the provision of additional fishing opportunities. However, it is important to note that any use of hatchery-dependent (PGT, rehabilitation) fisheries is based on the analysis of long-term ecological, social and economic benefits and costs associated with the introduction. In recent times, stocking in FMZ5 has been focussed mainly upon PGT fisheries in an effort to provide alternate angling opportunities and divert angling harvest from native populations as well as some limited introduction stocking to establish self reproducing populations of walleye (Figure 6.3-1). A complete stocking list of species and lakes can be found in Appendix 6-1.

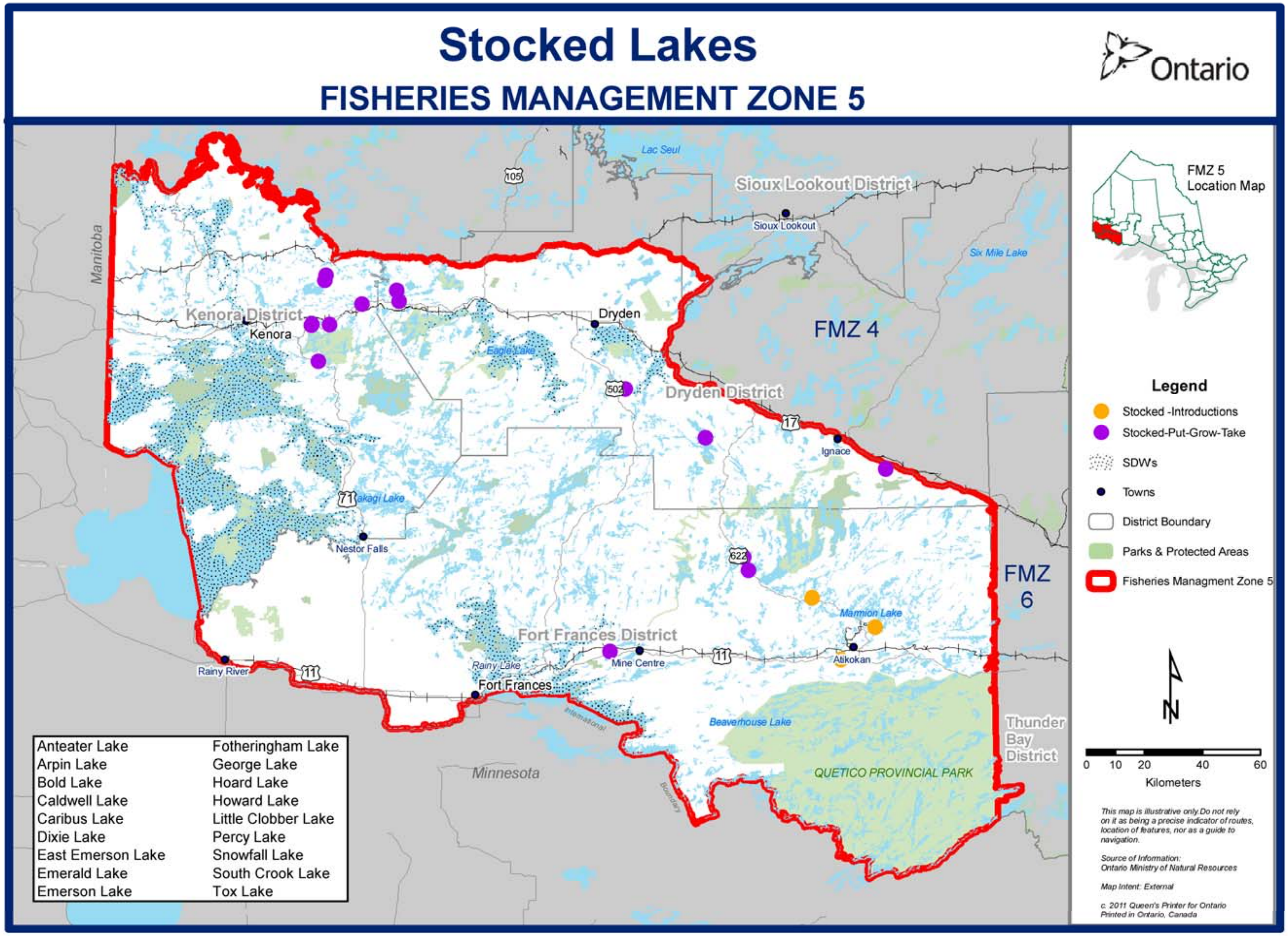


Figure 6.3-1. Lakes in Fisheries Management Zone 5 that have been stocked between 2000 and 2010.

6.4 Indirect Fisheries Management Methods

Fisheries management can occur through several different ways besides regulating sport fishing activities through fishing regulations. Those methods are commonly thought of as indirect management actions and typically attempt to restrict users and access to lakes in an effort to prevent overexploitation or declines in fishing quality. Several different indirect methods are used in FMZ 5 including the boat cache program, green zones/crown land camping restrictions on outpost camp capacity and land use decisions.

Boat Cache Program

In the old Northwest Region, which today includes the Dryden, Fort Frances, Kenora, Red Lake, and Sioux Lookout Areas and a portion of the Atikokan Area, the storing of boats for the purposes of tourism on remote lakes (commercial boat cache), recreational fishing by residents on remote lakes (recreational boat cache), to access a trap line or conduct bait harvesting (resource user boat cache), or for non-residents to access private property (transport only) has been controlled by the Northwest Region Boat Cache Program. To store a boat on any lake within this area, operators/anglers are required to file an application with their local MNR office for approval, where the ability of the fishery to sustain this pressure (potential yield) is evaluated against the future harvest levels proposed by the applicant. Standard potential harvest levels have been developed for commercial boat caches (used by the tourism industry) as well as for recreational angling. The approval process is an important component of fisheries resource management, as it is valuable to resource managers to know how many boat caches exist on a waterbody and across the landscape. Records of boat cache locations and numbers is also of importance to tourism outfitters, resource harvesters and recreational anglers as boat caches are considered values during land use planning activities. Table 6.4-1 shows the number of boat caches in the zone by boat cache type. For boats cached for purpose of angling (i.e. recreational and commercial boat caches combined), there are a total of 1390 boats on 745 lakes across FMZ 5.

Table 6.4-1 Number of boat caches in FMZ 5 by user type – 2010 data

Area	Boat Cache Type					
	Recreational Users		Commercial Users		Resource Users	
	# of boats	# of lakes	# of boats	# of lakes	# of boats	# of lakes
Fort Frances	232	85	300	146	254	73
Dryden (FMZ 5 only)	222	122	190	145	36	12
Kenora (FMZ 5 only)	115	76	331	171	-	-
FMZ 5 Total	569	283	821	462	290+	85+

The original intent of the program was to control the proliferation of boats cached on local lakes, primarily by non-residents and non-resident outfitters, as well as provide a controlled opportunity to access lakes in remote areas. The large number of boat caches was leading to overcrowding on small lakes, conflict between users, and overexploitation of some fisheries. When the boat cache program came into being in the early 1980's, only those boats cached by Ontario residents or Ontario businesses were permitted to remain, resulting in a dramatic reduction in the numbers of boats on the landscape. The vast majority of remaining boats were "grandfathered in", and subject to renewal every 3 years. New applicants were, and continue to be screened through a biological review process that considers access, lake productivity and the associated angling pressure on the fishery through the allocation of a boat cache. A gradual reduction in the number of boat caches has resulted through the combined factors of attrition (boat cache holders no longer wanting or needing the boat cache, tourism establishments closing down, etc.) and by MNR working co-operatively with tourism establishments to reduce pressure on select lakes by allowing opportunity elsewhere.

There are some issues with the current boat cache system. The approvals process for boat cache agreements requires administration, monitoring and enforcement and generates no revenue, in addition little to no information exists on how often boat caches on individual lakes are accessed or exactly how many angler hours are associated with each boat cache. In some cases, outfitters are required to submit an angler diary each year as a condition of their agreement. Data on fisheries resources for each lake where a boat cache exists is also limited, depending on if the lake was surveyed or not. Therefore, from a management perspective it is difficult to associate fishing effort with boat cache distribution, though it is likely that lakes with greater numbers of boat caches receive greater amounts of angling pressure. Enforcement of agreements is also difficult due to remote locations and access issues.

Green Zones and the Crown Land Camping Program

Prior to 1984, non-residents were permitted to camp anywhere on Crown Land in Northwestern Ontario. Concerns arose over congested camping areas where competition for resources and conflict between resident and non-resident land use was occurring and where the fishery was under stress and non-residents were the primary users (OMNR 2008c). As well, the tourism industry voiced concerns that many of these non-resident campers were not contributing to the local economies as they were purchasing the majority of their supplies outside of the local area, mostly in the U.S.

In the Fort Frances District, significant fisheries concerns were arising on some of the larger inland lakes, including Lower Manitou, Marmion, and Pipestone, from non-resident fishing pressure. Due to its proximity to the Minnesota border, many U.S. residents would day trip into the area, or spend the weekend, in such numbers that conflict between residents and non-residents arose for camp sites on these lakes. Also of concern was the fact that angling quality was declining on many lakes and non-resident angler harvest accounted for the greatest harvest of sport fish in the Fort Frances District. Other districts, including Dryden and Kenora, had similar problems, although to a lesser degree.

As a result, in consultation with the commercial resource-based tourism operators, "green zones" were established that prohibited camping by non-residents in certain popular recreation areas in the late 1980's, and a new Crown land camping permit (with a fee) was instituted for non-Canadian residents to camp outside of these areas. Instead, non-residents were required to use a camping unit rented from a commercial tourism operator with land tenure in the green zones. This restricted access by non-residents to some of the more popular and productive fisheries in the area, unless they were willing to pay for the services of an outfitter. The Fort Frances District Fisheries Management Plan 1987-2000 (1988) specifically mentions that the Crown land camping program "… also serves to limit non-resident angling effort in areas where sport fish harvest is considered high". While popular with resident anglers and commercial tourism outfitters, the new green zones had a detrimental impact on some local small businesses that once catered to the non-resident tourists who typically avoided the use of outfitters, and some were forced to close due to lack of business.

Implementation of the green zones, in addition to other access controls, has been credited with improving many of the fisheries in FMZ 5, through the reduction of fishing pressure and more evenly spread pressure across the zone.

Outpost Camp Bed Capacity

Another indirect method of controlling fishing pressure in FMZ 5 has been through the use of bed capacity restrictions on commercial outpost camps, at the time of transfer to a new owner. In the past, when a camp owner wished to transfer the outpost to another party, MNR would review the bed capacity on that lake to determine whether the harvest levels associated with the number of beds in the camp were within the sustainable fisheries capacity of the lake in question. A "benchmark allocation" was set for a bed on both walleye and trout dominated lakes, and while it was not a fisheries allocation or a measure of sustainability, it was to be used as a flagging mechanism that might indicate that a fishery may or may not be under too much pressure, jeopardizing the sustainability of the fishery. An Interim Approach for Reviewing Remote Outpost Camp Bed Capacities, MNR Northwest Region (OMNR 2006b) was finalized in 2006 with the co-operation of the MNR, Ministry of Tourism, Ministry of Northern Development and Mines, NOTO, and the tourism industry (called the Resource-Based Tourism Working Group (RBTWG)). A key point of this interim approach was that there would be no forced reductions in bed capacity by MNR upon review at time of transfer.

In September 2010, the RBTWG decided that MNR would no longer use bed capacity conditions as a fisheries management tool; all bed capacity conditions on outpost camps on single-operator lakes would be removed; and bed capacity conditions on multi-operator lakes would remain in effect as an interim measure until alternative approaches are investigated and implemented. In the absence of bed capacity restrictions on commercial outpost camps, management planning for FMZ 5 should consider broad fisheries management strategies across the zone to address fishing pressure from outpost camps.

Land Use Decisions

Land use planning activities, such as Forest Management Planning, may be accompanied by fisheries regulation changes to protect fisheries resources and values or to create additional opportunities for angling as access to remote areas is increased. Land use planning may also result in road use restrictions to reduce or restrict access to fisheries to meet fisheries quality or remote tourism objectives and has also resulted in restrictions to access Ontario Parks and Protected Areas to a few specific entry/exit points to preserve remoteness. For more detail and specific land use controls as a result of Forest Management Planning, see sections 2.4-Access, 2.5-Parks and Protected Areas, and 2.7-Land Use.

6.5 Enforcement and Compliance

Compliance and enforcement activities within FMZ 5 are guided by an annual compliance operating plan (ACOP). The ACOP is a risk based plan that incorporates provincial, regional and local priorities.

Provincial enforcement priorities:

- Sport fishing where sustainability is an issue
- Species At Risk (e.g. lake sturgeon)
- Unregulated or illegal commercial harvest and sale of fisheries resources
- Controlling the spread of disease and invasive species
- Food safety

Regional enforcement priorities:

- Heavily exploited walleye lakes
- Protection of sensitive fish or fisheries
- Protection of fisheries that support remote tourism opportunities
- Commercialization of fish from a sustainability and food safety perspective

Local enforcement priorities:

- Focusing enforcement effort on the fisheries of the specially designated waters
- Lakes receiving moderate fishing pressure
- Sensitive fisheries
- Protection of spawning runs
- Compliance with sanctuaries
- Preventing the introduction of invasive species and the movement of VHS
- Promotion of public understanding of the regulations in place for FMZ 5

6.6 Research

Several research projects and activities occur on fisheries populations in the FMZ 5 area. These range from long term formal study areas that involve research scientists and academic institutions to shorter term research conducted by OMNR districts. All this information helps to inform managers of both local scale and large scale processes that impact fish populations and allows for better fisheries management.

Experimental Lakes Area

The Experimental Lakes Area (ELA) is located south of Highway 17 approximately halfway between Dryden and Kenora. The following summary of activities at the ELA site was taken from their website at www.experimentallakesarea.ca. More information on the research conducted at the ELA can be found at that location.

The ELA is operated by the Department Fisheries and Oceans Canada (DFO) from its Freshwater Institute in Winnipeg, Canada, although research at this unique facility is jointly conducted by researchers from DFO and from a variety of partner organizations. The ELA includes 58 small lakes (1 to 84 ha) and their drainage basins, which have been set aside and are managed through a joint agreement between the Canadian and Ontario governments (Figure 6.6-1). Only research activities, or activities compatible with that research, are permitted within or adjacent to these watersheds.

The Experimental Lakes Area (ELA) occupies a unique position, not only in Canada but in the world, as a dedicated research facility for ecosystem-scale experimental investigations and long-term monitoring of ecosystem processes. Because of its location, the ELA is relatively unaffected by external human influences and industrial activities. As such, it serves as a natural laboratory for the study of physical, chemical and biological processes and interactions operating on an ecosystem spatial scale and a multi-year time scale. The major goals of the ELA are:

- **To better understand global threats** to the environment through knowledge gained from whole-ecosystem, experimental, scientific research
- **To monitor and demonstrate the impacts of human activities** on watersheds and lakes
- **To develop appropriate environmental stewardship strategies** for the preservation, restoration and enhancement of ecosystems
- **To educate and promote environmental protection and conservation** through an integrated approach to ecosystem stewardship

Several major areas of study dominated on site activities over the history of the ELA. Data records from these watersheds began in 1967 and experimental studies began in 1969. Between 1968 and 1975, eutrophication (pollution by excess nutrients) was the primary focus and the subject of several whole ecosystem studies. Between 1976 and 1992, the primary focus shifted to studies of lake acidification and the impacts of acid rain, also referred to as Long Range Transport of Atmospheric Pollutants (LRTAP). From

1993 through 2003, much of the ELA research has focused on the impacts of reservoir creation and associated flooding. In the past few years, the impacts of Cage Aquaculture have been a primary focus. Throughout most of this period, ELA researchers have also been monitoring unmanipulated lakes, their terrestrial drainage areas, and the atmosphere above these lakes to better understand the natural variability attributable to climatic factors and other natural processes. In recent years, these monitoring studies have been formalized under a Long Term Ecosystem Research (LTER) program.

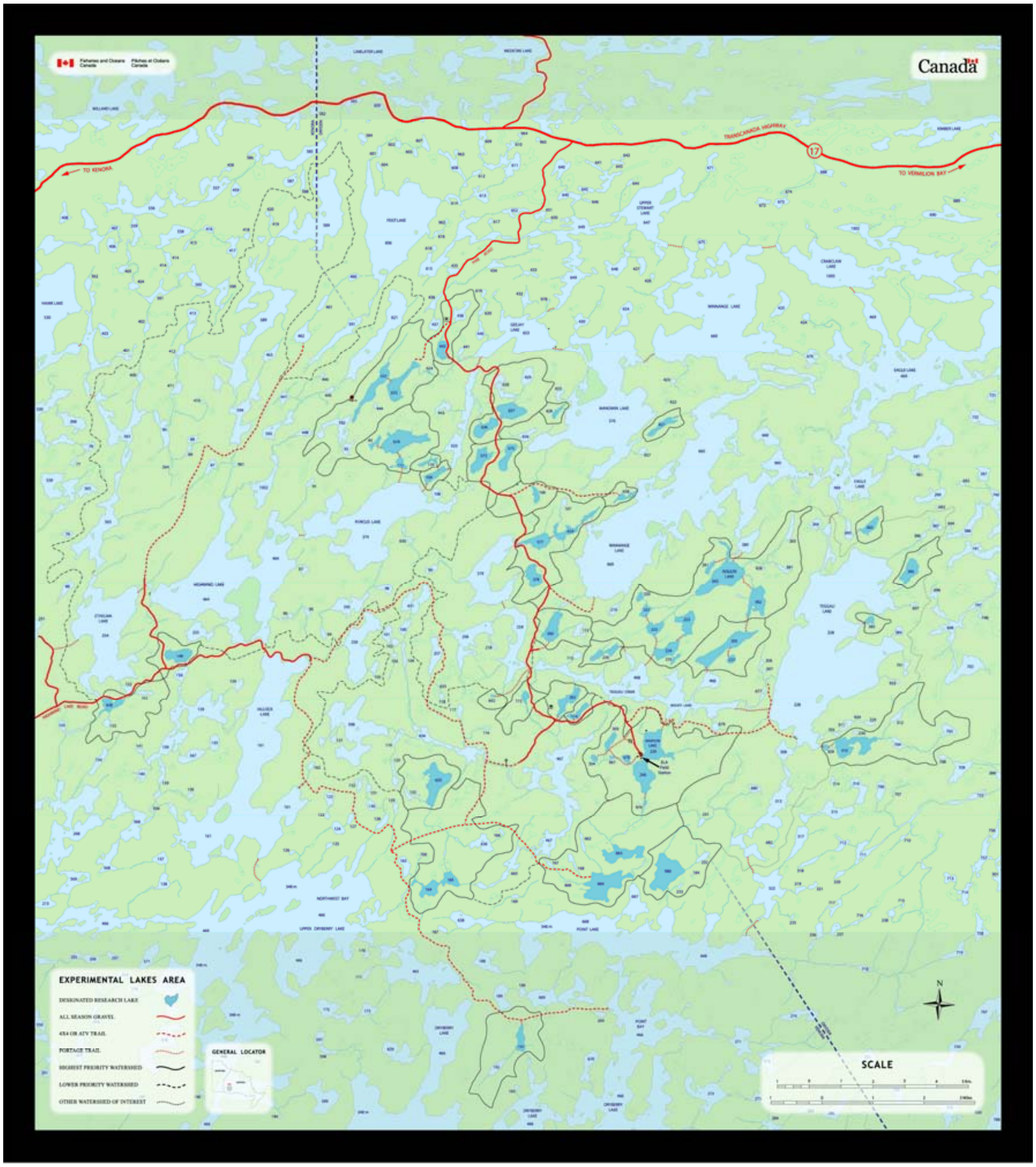


Figure 6.6-1. Lakes designated for research as part of the Experimental Lakes Area (ELA) located between Dryden and Kenora *(map from www.experimentallakesarea.ca)*

CNFER Coldwater Lakes Experimental Watershed Project

The Coldwater Lakes Experimental Watershed Research Area consists of 4 small lake trout lakes and their associated watersheds located about 60km northwest of Atikokan. Research at the Coldwater Lakes project was conducted through the Centre for Northern Forest Ecosystem Research (CNFER) located on the campus of Lakehead University in Thunder Bay, Ontario, Canada. This group is comprised of Ontario Ministry of Natural Resources staff and members of the university community. The focus of this study was to provide detailed information about the environmental effects of forestry operations on fish populations and in particular lake trout and evaluate the effectiveness of existing timber management guidelines in preventing undesirable impacts. Research at this area was conducted for about 10 years starting from the early 90’s.

Fisheries Assessment Units

In the late seventies, the realization that it just wasn't possible to collect detailed information on each lake in the province led to the creation of Fisheries Assessment Units (FAUs). The Assessment Units mandate was to collect long-term data on fish populations, fish habitat and associated stresses such as over harvest, species introductions, water level fluctuations, etc.. This data is analyzed to give MNR biologists a better understanding of how fish communities respond to different pressures and how this may affect the number or type of fish that a lake can produce. With this information, MNR can adjust its fisheries management strategies in areas such as angling regulations. They also work at developing netting standards and assessment protocols to allow more consistent and comparable understanding of fish populations across the province.

Of the 12 assessment units in the province, two are located in the FMZ 5 area; the Lake of the Woods FAU which conducts assessment work on Lake of the Woods and the Quetico-Mille Lacs FAU which includes a number of smaller FMZ 5 lakes in the Atikokan/Quetico area in the lakes it assesses. These inland fisheries assessment units conduct long-term monitoring studies on a set of representative fish communities and lakes across the province.

Regional and District Research

In addition to these larger research activities, a number of smaller scale research projects are conducted by the district staff as part of their jobs. These can range from small studies in conjunction with population monitoring through standardized netting projects (such as looking at the effect of annual temperature changes on year class strength or growth rates of fish) to research that look at the impact of existing development or potential impact of proposed developments. Some of these projects have been co-ordinated at the regional level often through the Regional Fisheries Forum. An example of this is the Lake Temperature Monitoring Project initiated in 2009 where temperatures throughout the water column of over 20 lakes across the region are being monitored to assess the effect of changes in air temperature on the thermal structure and, ultimately, the amount of fish habitat within different types of lakes. There are also co-operative studies with other agencies such as lake sturgeon and water level impact studies on border lakes such as Namakan Lake with Voyageurs National Park and Minnesota DNR from the USA.

Districts also partner with other agencies and groups to conduct research on fish populations including partnerships with Lakehead University, South Dakota State University and Manitoba to study lake sturgeon and their habitat as well as partnering with Rainy Lake Fisheries Charity Trust to support research by Carleton University on smallmouth bass.

7.0 User Expectations of Fisheries Resources

One of the more difficult questions for fisheries managers to address is whether the current state of the fisheries resources is meeting the expectations of the users. Part of the problem is that both the expectation of the user and what the user experiences are both variable. For example, two anglers could have identical fishing experiences and might rate them differently because their expectation of what they going to experience may be different. Anglers place different values on different components of their experience. For example, some might place a higher value on ease of accessibility to the resource while others might put more importance on the size or number of fish caught. Angler expectations can also change through time. Post *et al.* (2002) described what they termed the "invisible collapse" part of which is because as fish populations declined, angler expectations also declined so that angler expectations always remained similar despite of what was happening with the fish resource.

Managers have tried several methods to attempt to address the question of meeting angler expectations. In 1996 a "fisheries needs analysis" was conducted in the Northwest Region to support development of a Fisheries Action Plan (OMNR 1997a, OMNR 1997b). At that time the needs analysis identified that the primary users of the fisheries resources were:

- present and future generations
- recreational anglers
- commercial food fishing industry
- commercial bait fishing industry
- resource based tourism (commercialized recreational angling)
- First Nations
- Metis

The 1996 "fisheries needs analysis" identified that the broad expectations of these users. These are summarized as follows:

- Continuing opportunities for recreation, a healthy environment and jobs;
- The supply of fish and the quantity and quality of opportunities (for recreation, jobs and healthy environment) are maintained or improved;
- That decisions, impact assessment and measuring resource status would be knowledge based and;
- People want to be involved in planning and decision making but want an understandable process.

In 2000 a review of the Fisheries Action Plan for the Northwest Region was undertaken (OMNR 2003). This review reconfirmed these expectations.

7.1 User Expectation by Group

The 1996 needs analysis provided sufficient information to permit the broad user expectations to be examined in greater detail by specific user group (OMNR 1997b). The expectation of the specific user groups is summarized and discussed in the following paragraphs.

7.1.1 Present and Future Generations

- Healthy environment and continued opportunities for recreation
- Species at risk are protected and rehabilitated
- Prevent the introduction or expansion of invasive species
- Want to be involved in decision making

In general this group was more interested in the general health of the aquatic environment. They were interested in having opportunities for recreation whether or not they actually accessed those opportunities. It would appear in many cases that this group just wanted to know that these opportunities were there. This group was concerned about the protection of species at risk and the introduction and/or expansion of invasive species. These concerns are consistent with this group's general concern about the health of the environment.

7.1.2 Recreational Anglers (residents and non-resident anglers)

- Healthy environment and in particular protection of fish populations and habitat. (concerns about contaminants, introduced species, invasive species
- Fish populations are managed sustainably
- Maintain and/or increase the diversity of angling opportunities
- High quality fishing opportunities (focus is on walleye, lake trout and bass primarily).
- Access to fishing opportunities (the concern here is primarily related to physical access e.g. via roads, but access to resources restrictions imposed by regulation is also a concern)
- Muskellunge anglers want to maintain muskellunge in lakes that currently support muskellunge populations, want lakes with muskellunge managed so that the growth potential of muskellunge is reached and that muskellunge are managed as a "trophy' species.
- Want to be involved in decision making

Recreational anglers were also concerned about maintaining a healthy environment but their focus was on the protection of fish habitat and fish populations. Recreational anglers in the Northwest Region expect that high quality fishing opportunities for walleye, northern pike, lake trout and bass are maintained but want all fish populations to be managed sustainably.

The 2005 Survey of Recreational Fishing in Canada for FMZ 5 also asked which issues were of most concern to recreational anglers (Hogg et al. 2010a). In order by frequency, the issues most important to all angler groups were:

- Over-harvest
- Habitat loss
- Fish contaminant levels
- Changes in fish productivity
- Impacts of invasive species
- Complexity of regulations
- Resource user conflicts
- Climate change
- Loss of wetlands
- Lack of access
- Inadequate enforcement
- Lack of information.

This group also expects that access to fishing opportunities will continue. In the case of this "expectation" the concern is related to physical access to the fisheries resources via the road system but access restriction imposed by regulatory controls is also a concern. The 2005 Survey of Recreational Fishing in Canada for FMZ 5 indicated that access was 10^{th} overall of recreational angler concerns (Hogg *et al*. 2010a).

This group expected to be involved in making decisions on management of the fisheries resources and supported joint decision making with all user groups. This group also expected that future management planning exercise would address topics that were placed in a "parking lot" as part of the process in 1998 to institute region wide fishing regulations. One of these topics was the management of lake trout (M. Sobchuk pers. comm. 2010).

Recreational angler expectations can to change over time and may be influenced by geographic location where they are fishing or intend to fish (Post *et al*. 2002). Armstrong *et al.* (1999) reported that recreational anglers in different areas have different motivations and behaviours. They also reported that non-catch motivations (to enjoy a pristine environment; to have a stimulating and exciting experience; to be with friends and family; and to get away from the usual demands of life) appear to be more important to anglers than catch related motivations when asked directly although other research indicates that when asked to choose between different fishing experiences, fishing quality (size and/or number caught) tend to be most important (Haider and Hunt 1997)

During the 2005 Survey of Recreational Fishing in Canada, a mail survey sent to randomly selected anglers who fish across the country, anglers were asked to rate their angling success (Figure 7.1.-1). 61 % rated it as very good or excellent, higher than the average response for all Ontario anglers (45%) but lower than anglers fishing in FMZ's 2 and 4 located north of FMZ 5 (Hogg *et al*. 2010a). They were also asked whether they thought their angling experience had changed compared to previous years. For anglers fishing in FMZ 5, 13% reported they thought it had improved and 53% thought it remained the same. This is very similar to results for all anglers fishing in Ontario (13% improved, 49% remained the same) (Hogg *et al.* 2010a). Compared to northwest Ontario, more anglers in FMZ 5 thought that their angling experience had declined than in other zones, particularly Zones 2 and $ located north of FMZ 5 where only 20% thought their fishing experience had declined. The caution around using this data is there is no indication about what factor(s) changed that caused anglers to feel that there fishing experience had changed.

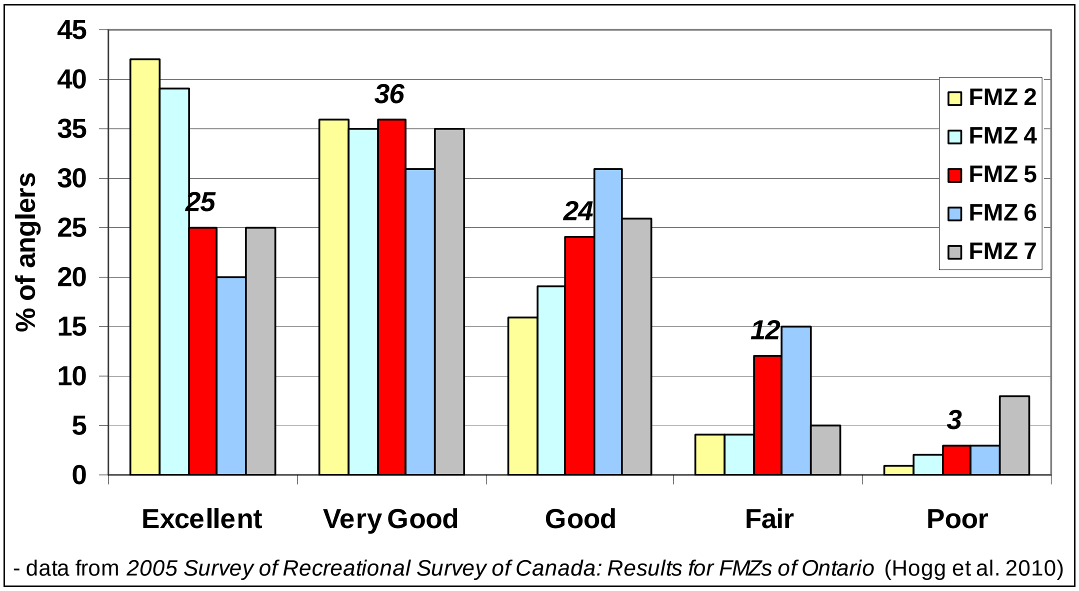


Figure 7.1-1 Rating of angling success by anglers fishing northwest Ontario Fisheries Management Zones (Hogg *et al.* 2010a)

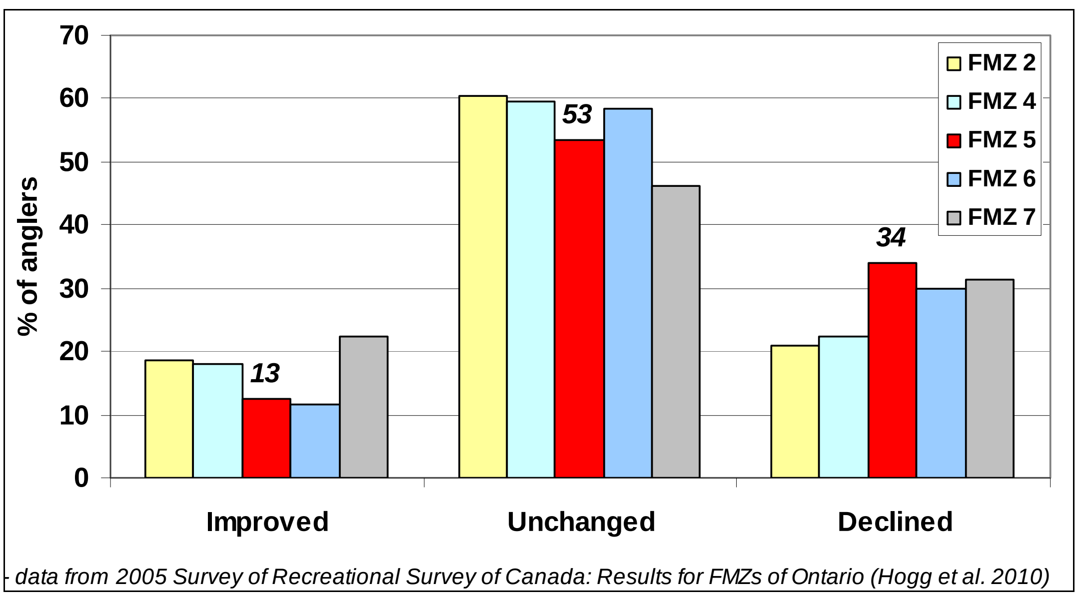


Figure 7.1-2 Rating of how the 2005 angling experience compared to previous years by anglers fishing northwest Ontario Fisheries Management Zones (Hogg *et al.* 2010a)

7.1.3 Commercial Food Fishing Industry

- Continued opportunities for jobs and being able to make a living
- Healthy products so that access to markets is maintained
- Fish populations are managed sustainably
- Want to be involved in decision making

Commercial fishers also indicated that they wanted fish populations managed sustainably. If fish populations could support commercial use, this group expected that they would continue to have access to commercial fishing opportunities. Native commercial fishers expectations were slightly different in that they were interested in additional commercial fishing opportunities within their traditional use areas.

In general, this group expected that the government would continue to manage contaminant levels so the commercial fishing industry continued to have healthy products to sell. This would help to ensure that access to markets is maintained.

Once again, this group expected to be involved in making decisions on management of the fisheries resources.

7.1.4 Commercial Bait Fishing Industry

- Continued opportunities for jobs and being able to make a living
- Access to markets
- Want to be involved in decision making

This group expected that they would continue to have access to commercial bait fishing opportunities that would support jobs. They also expected that they would continue to have access to markets in the region. Related to this expectation of access to markets was the concern that regulations could be imposed that restricted the use of bait fish.

Once again, this group expected to be involved in making decisions on management of the fisheries resources.

7.1.5 Resource Based Tourism (commercialized recreational angling)

- Business flexibility to deal with changing business environment
- Consistency in the application of policies and processes
- Certainty of continued access to land and the fisheries resources
- Protection of remoteness for semi-remote and fly-in businesses
- Fish populations are managed sustainably
- High quality fishing opportunities (focus is on walleye, northern pike, bass and lake trout).
- Want to be involved in decision making

The expectations of the resource based tourism industry that were identified in the 1996 “needs analysis’ received further clarification in 2005 as a result of an issue that arose of the use of bed capacities by MNR as the way resource use is linked to resource capacity. (M. Sobchuk pers. comm. 2010)

The resource based tourism industry in the Northwest Region expects that fish populations will be managed sustainably with a focus on maintaining high quality fishing opportunities for walleye, northern pike, lake trout and bass.

The resource-based tourism industry indicated that they needed “certainty” in terms of their ability to use the fisheries resources that their lodges and outpost camps are based on. The concern related to “certainty” focused on security of land tenure and on continued use of the fisheries resources at a level that sustained the business. Security of land tenure is important to the industry because most outpost camp and lodge facilities are located on Crown land. The resource-based tourism industry would like increased business flexibility to meet changing market conditions.

The resource-based tourism industry would like to see consistency in all aspects of the land and fisheries management process. The industry would like to see a consistent process no matter where you are in the province. Of particular concern is what happens when an operator wants to sell or transfer an outpost camp.

The protection of the remote and semi remote nature of outpost camps and lodges remains an expectation of the resource based tourism industry.

Once again, this group expected to be involved in making decisions on management of the fisheries resources. There is the general expectation that decisions on fisheries management will recognize the importance of the resource-based tourism industry to Ontario's tourism sector and the overall well-being of Ontario. This expectation is consistent with the Resource Based Tourism Policy (OMNR 1998).

7.1.6 First Nations

- Recognition of treaty and aboriginal rights
- Government must meet consultation responsibilities and obligations
- Want to be directly involved in decision making (government to government discussions)

First Nations in FMZ 5 expect to be directly involved in decisions related to fisheries management within their traditional use areas as part of government to government discussions. Associated with this involvement is the expectation that treaty and aboriginal rights will be respected and upheld in fisheries management decisions. First Nations expect that the government will meet all their consultation responsibilities and obligations.

Although it was not discussed specifically as part of the 1996 “needs analysis” it is also clear from other planning processes that First Nations expect that fish populations will be managed sustainably. (M. Sobchuk pers. comm. 2010)

7.1.7 Metis

- Recognition of aboriginal rights
- Government must meet consultation responsibilities and obligations
- Want to be involved in decision making

The Metis community also expects to be involved in decisions related to fisheries management within their traditional use areas. Associated with this involvement is the expectation that Metis rights will be respected and upheld in fisheries management decisions and that the government will meet all their consultation responsibilities and obligations.

Although it was not discussed specifically as part of the 1996 “needs analysis” it is also clear from other planning processes that Metis expect that fish populations will be managed sustainably. (M. Sobchuk pers. comm. 2010)

7.2 General Discussion

A common “expectation” among all user groups is the desire to see the fisheries resource managed sustainably. Within the Northwest Region, the decision was made 1980’s when the first district fisheries management plans were being developed that MNR would manage for high quality fishing opportunities based on self sustaining, naturally reproducing fish populations. This management philosophy was carried forward into the fisheries action plans that were developed in 1997 (OMNR 1997a) and 2000 (OMNR 2003) and fisheries management plan that have been (FMZ 6 (OMNR 2009c)) or are being developed (FMZ 4) in the region. Much of the current understandings of whether expectations are being met are based on past discussions (eg. 1996 need analysis) or past mail surveys (2005 Recreational Fishing survey). Discussion within the FMZ 5 advisory council and public information sessions will be an important part of the FMZ 5 planning process to help clarify current understandings of expectations and how they are being met.

It should be made clear that it may not be possible to achieve all expectations within small geographic areas within FMZ 5. However, since MNR is managing fisheries on a landscape basis it may be possible to achieve all expectations across the fisheries management zone.

8.0 Landscape Legacy

This section is intended to identify things on the landscape that need to be considered in fisheries management but cannot really be changed during this planning process. Many of these, such as the access and development and past species introductions have been identified and discussed previously in the document.

8.1 Collaborative Management of Joint Fish Stocks with United States

Several fish populations are considered shared stocks in the lakes and rivers situated on the international border between Ontario, Canada and Minnesota, United States. These stocks are species specific and are generally determined through joint studies on fish movement (tagging, telemetry) or genetics. Although this collaborative work usually involves Lake of the Woods, Rainy River and South Arm of Rainy Lake, there are other shared fish populations in FMZ 5 that are considered separately from these SDWs. These lakes would include Namakan Lake, Sand Point Lake, Little Vermilion Lake, Loon Lake, Lac La Croix, and the numerous lakes in Quetico Provincial Park upstream to Saganaga Lake.

Some fish populations in Lake of the Woods upstream to Little Vermilion Lake, are cooperatively managed and assessed through the auspices of the Ontario-Minnesota Fisheries Committee. The Committee is comprised of senior resource professionals from OMNR and Minnesota Department of Natural Resources (2 from Ontario, 2 from Minnesota). The group relies on technical/scientific advice, assessment and research information provided by local fisheries managers from both agencies, as well as staff from Voyageurs National Park. Sub-committees are established were necessary to address specific fisheries management issues e.g. Lake Sturgeon Management, Rule Curve Monitoring, and Rainy River Peaking. The Committee has existed in various forms since 1983, and continues to recognize the sovereignty of each jurisdiction over their fisheries resources, while working towards cooperative management. A revised Term of Reference for the Committee was supported in 2000.

Through this international Committee, an Ontario-Minnesota Boundary Waters Fisheries Atlas is prepared on a regular basis for Lake of the Woods, Rainy River, Rainy Lake, Namakan Lake and Sand Point Lake. The Atlas was first published in 1984, with subsequent versions released in 1992, 1998 and 2004. The latest edition presents fisheries resource information and related socio-economic data from 1997-2002 surveys and monitoring programs within the boundary waters area (OMNR and MDNR, 2004). The Atlas considers management objectives, allocation, potential yields and target harvest levels for the major fish species including walleye, northern pike, smallmouth bass/black crappie, lake sturgeon, and whitefish. In addition to public communication and data sharing, the primary purpose of the document is to provide the necessary background information to allow development of options for managing these border water fisheries.

The first cooperative fisheries investigation on Rainy Lake was initiated in 1959. Since that time there have been significant efforts to develop and conduct collaborative studies while sharing financial and staffing resources. Several examples of this collaboration include:

- Lake sturgeon population assessments and tagging on Rainy River/Lake of the Woods, Rainy Lake/Seine River, and Namakan Reservoir
- IJC rule curve monitoring studies on Rainy River, Rainy Lake and Namakan Reservoir;
- Fall walleye index netting and gear comparisons on Rainy Lake
- Walleye tagging on Rainy River and Rainy Lake
- Water level management on Rainy lake and Namakan Reservoir
- Cormorant and pelican foraging and nesting on Lake of the Woods and Rainy Lake
- Invasive species monitoring
- Water quality monitoring and research on Lake of the Woods and Rainy River.

Several of these cooperative studies involve additional project partners or principle investigators including Voyageurs National Park, Superior National Forest (Boundary Waters Canoe Area), Minnesota Pollution Control Agency, Ontario Ministry of the Environment, Rainy Lake Conservancy, Lake of the Woods Sustainability Foundation, Lake of the Woods Control Board, International Rainy Lake Board of Control, International Rainy River Water Pollution Board and the International Joint Commission. In addition, there have been numerous educational institutions engaged in these aquatic studies including Lakehead University, Northland College, Rainy River Community College, South Dakota State University, and North Dakota State University.

9.0 Fisheries Management Issues, Challenges or Opportunities

The FMZ 5 Advisory Council and MNR Project Team met several times individually throughout the spring and summer or 2011 to identify the issues and challenges affecting the fisheries to be used as a basis for developing management objectives, strategies and actions in the FMZ 5 Fisheries Management Plan. Both groups individually produced a prioritized list of issues and identified which issues they would like to see addressed in the FMZ 5 Fisheries Management Plan (see Appendix 9-1 and 9-2). In October and November of 2011, these were combined into one set of issues to be addressed in the Fisheries Management Plan (Table 1). Issues were prioritized into two groups – high priority which will be addressed in this current plan and medium priority which will be addressed in this plan if time permits and if not addressed as part of discussions about high priority issues.

Table 1. Summary of Fisheries Management Issues to be addressed in FMZ 5.

Priority	FMZ5 Management Plan Priorities
High	Managing for quality of walleye fishery.
High	Managing for sustainability of lake trout populations.
High	Management objective for smallmouth bass.
High	Management objective for northern pike with respect to current regulation.
High	Management objective for crappie.
Medium	Lack of guidelines and licensing for competitive fish tournaments
Medium	Concern with potential habitat impacts from development projects that reduce ability of lakes to support fish populations.
Medium	Ensuring appropriate socio-economic benefits and exploitation from non-resident day use anglers
Medium	Education of angling impacts and invasive species impacts on fish populations
Medium	Maintaining appropriate balance of access across FMZ 5 to address socio-economic and exploitation concerns.
District Fisheries Management Plan carry-over	Commercial fisheries – new opportunities and allocations

In addition to the issues identified during the issues and challenges exercise, a review of existing fisheries management direction found in District Fisheries Management Plan was conducted by MNR staff. The District Fisheries Management Plans will be replaced by the FMZ 5 Fisheries Management Plan and the purpose of the review was to identify management direction from these plans that needs to be carried forward into the new plan. This review identified direction around allocation of new commercial fisheries as direction that is currently being used and will continue to be needed in the future but had not been identified in the issues identification exercise (Table 1).

In addition to specific issues that would be addressed with specific objectives and actions in the plan, the advisory council and project team identified a number of concerns that while not specific to a specific issue, need to be considered in developing objectives, strategies and tactics for most if not all of the specific issues.

These broad issues include:

1. General fisheries management considerations:
    - There is a desire to be able to catch fish and eat fish.
    - Want to ensure there are fish for future generations (sustainability of populations at current levels or better).
    - Regulations need to be simple and easy to understand by anglers;
    - Some fisheries may be better managed by lake specific regulations.
    - Provincial scale regulations not always best.

2. Climate change
    - Need to understand how it will impact fish populations and how it affects our management response. One example is the appropriateness of the traditional season opening dates versus changes in spawning season with variable temperatures or changes in winter fishing from changes in ice conditions (eg. open water fishery in April becoming more common).
    - Need fish community synthesis of potential impacts.
    - Need a way to measure risks, define management response and put into planning process;
    - Corporately, MNR has no policy to address a response to climate change for fisheries management.
    - Climate changes can affect allocations and user expectations;
    - Is current monitoring program sufficient to track climate change?

3. Commercial fishing by First Nations
    - First Nations commercial fishing could influence how we manage fish populations and recreational fisheries.
    - First Nation Treaty/Aboriginal rights allow for subsistence harvest of fish.
    - In some cases, this may result in challenges with allocation of fisheries to other users to prevent exploitation issues.
    - Need to consider current and future First Nation harvest when making fish allocation decisions.

- We need to take FN commercial fishing into account by being more conservative in our management approach to recreational fisheries.
- The species that would be most affected by the management of commercial fisheries in the zone are whitefish.
- A management action might be to encourage First Nations to focus their use of the resources on tourism opportunities.

4. Angling ethics and potential impacts on exploitation
    - Anglers continue to act unethically (eg fishing during closed season, eat limit for shore lunch and continue to fish); these actions can impact sustainability of resource.
    - OMNR has fallen behind on education, especially in areas that are within the law (eg. catch and release fishing of deep water walleye); internal communication barriers affect ability to get information to the public.
    - Need to define conservation resource use/value
    - A related issue is ensuring that any tactics or regulations developed during the plan are well supported by science and data, their purpose explained to anglers so they understand the need and tactics are acceptable to anglers to address the issue.

5. Land use/development decisions
    - A number of existing land use and development decisions have occurred in the past that are beyond the scope of this project to change (eg. number of cottaging lakes or tourism development in zone.). However, these need to be considered when developing objectives. Conflicts between which groups requesting access to fishing opportunities may be higher in FMZ 5 than other Northwest Region zones because of the higher level of development and increased demand on a finite fisheries resource.

6. FMZ 5 lake characteristics
    - The inherent lake productivity, fish community, levels of development and access, etc. need to be considered when developing objectives and targets for fish species in the zone.

7. Review of the effectiveness of current management tactics and regulations at meeting FMZ 5 objectives.
    - We need to review our current regulations to determine if they are accomplishing the management objectives and to determine if there are opportunities for eliminating or reducing the number of exceptions to zone wide regulations.
    - Need to review current regulations in light of latest biological data see if they meet objectives for fisheries; e.g. Are current limits sustainable?
    - The challenge will be that there are no clear management objectives in some cases.

The specific issues that were chosen by the FMZ 5 Advisory Council and MNR Project Team which should be brought forward as items to be addressed through development of objectives, strategies, and actions/tactics listed in Table 1 are described below.

Description of Identified Issues

Issue: Managing for quality of walleye fishery.
Priority: High

Description

A concern exists about the level of walleye exploitation mainly from the perspective of maintaining an acceptable level of fishing quality.

Considerations

- Given the importance of walleye fishery to the residents and tourist industry, it is necessary to define an acceptable walleye population status for FMZ5.
- Generally, walleye is not considered a biological sustainability issue in FMZ 5, but a social/biological issue around maintaining acceptable level of angling quality.
- Specific concerns were expressed about over-harvest of large, mature walleye and possibility of requiring increased protection for this component of the population through new or changed regulations.
- Harvest of walleye for consumption is a primary consideration of resident anglers.
- Resident anglers may be less concerned about how fisheries compare across areas and more concerned about how angling quality is changing over time while non-resident anglers (and tourist industry) may be as concerned with how fishing quality in FMZ 5 compares to other areas.
- Harvesting by non-residents through the tourist industry is the largest component of walleye harvest. (Based on 2005 data 72% of fishing effort zone wide is generated by non-resident anglers)
- Non-residents are focused primarily on walleye with secondary interest in pike, and bass and limited interest in lake trout.
- It is MNR responsibility to manage the resource while it is the tourist industry who markets the opportunities.
- Walleye fishing in FMZ 5 has to be better for non-residents in Ontario than it is in their home states. Then the question becomes how far into Ontario are they prepared to drive which requires a level of quality in FMZ 5 that makes it worth stopping here versus the cost of traveling to areas with higher quality fisheries. The tourist industry wants to keep fishing quality reasonably good so that non-residents from the USA continue to come here but they don’t want too many restrictive regulations.
- Consumption of walleye for shore lunch remains important to non-resident anglers. Taking fish home appears to be important for at least some non-residents in FMZ 5 so restricting the possession limit might meet with some resistance. Conservation officers report a large proportion of tourism guests returning home with fish in possession.

- The tourism industry in FMZ 5 is marketing the diversity of fishing opportunities, high quality comfortable camps, family friendly experiences as things that counteract lower catch rates and presence of roads and possibly resident anglers on lakes.

Issue: Managing for sustainability of lake trout populations.
Priority: High

<u>Description</u>

There is a desire to manage to maintain healthy and harvestable lake trout populations. Management needs to consider angling effort (non-resident and resident) and non-angling impacts such as invasive species and climate change.

Considerations

- We remain concerned about lake trout because of their ecology, that FMZ 5 has the majority of the regions lake trout waters and a significant portion of the province's/world's populations, climate change is most likely to affect lake trout, they are more susceptible to species introductions and habitat impacts and they are easily over-exploited.
- Small lake trout lakes are particularly sensitive to over-exploitation and species introductions (eg. walleye, smallmouth bass).
- Day tripping by non-residents was the management issue that stimulated the current border waters regulation for lake trout. It appears currently that it addressed the problem.
- Exploitation, especially in winter, is more by residents.
- Winter angling effort for lake trout may be declining in some areas of the zones as anglers target other species (eg. Ice fishing for crappie in Kenora district).

Issue: Management objective for bass
Priority: High

<u>Description</u>

An issue was identified around what is the management objective for bass and are the current regulations achieving them? Are they to be managed as an invasive species or a naturalized species or both within the zone? Bass have been present in FMZ 5 for many decades and are not going away yet there still exists concerns about the spread of bass into new lakes and the potential for impacts on some native species.
There is a concern that current bass restrictions in spring may be increasing walleye harvest and regulations need to be considered for there impacts on all species, not just the targeted species.

Considerations

- Although smallmouth bass are most widespread in FMZ 5 “bass” management includes both smallmouth and largemouth bass as both species as managed in combination in current regulations.
- Smallmouth bass are a popular fish with the tourism industry, much of it based on a catch and release fishery and becoming more popular with residents.
- In past there was a combination of authorized and unauthorized introductions of bass; currently, expansion is due to unauthorized introductions or movement from previous introductions
- Bass are currently in every watershed and widespread across the zone.
- Still a need to emphasize that we shouldn’t be moving species around (e.g. concern about impact on lake trout populations, especially populations without cisco/whitefish prey)
- Research from the US suggests that largemouth bass/walleye interaction could be a looming problem
- There is an issue around enforcement of laws which make introductions illegal as it is often difficult to enforce them (need to catch violators in the act).
- There are questions around why are people illegally moving fish? A lot of the problem is people’s values system “I like/can make money off of bass”. How do we change people’s values.
- Some of the issue around illegal introduction may be that people don’t understand the impacts of introductions (see education issue).

Issue: Management objective for northern pike with respect to current regulation. Priority: High

<u>Description</u>

There are concerns and questions about whether the current northern pike regulation (i.e. no harvest of pike from 70-90cm) is meeting the management objective for pike and what this objective actually is? Does current regulation make sense or was the previous regulation (1 over 70cm) just as effective? Poor understanding of the rationale for this regulation and its acceptance has led to enforcement issues.

Considerations

- Concerns have been raised by both the tourist industry and resident anglers with the current pike regulation
- There is a feeling that the current pike regulation coupled with bass regulation (reduced limit of smaller fish in spring) has forced non-resident anglers to harvest more walleye, especially during May/June.
- There does not appear to be a sustainability or biological concern with pike. The current regulation appears to be more focused on addressing a social concern (i.e desire for large fish).

- Concerns raised with current regulation suggest that there is a desire to harvest pike in 70-90 cm range for consumption.
- Recognition that the current regulation appears to have increased the size of pike in some lakes however lake characteristics limit the number of lakes where this can occur (mainly larger, deeper lakes). Many lakes in the zone are biologically incapable of producing significant numbers of large pike.

Issue: Management objective for black crappie.
Priority: High

Description

There is an issue about the lack of a clear management objective for black crappie in FMZ 5. For some people, there is a concern that the harvest of crappie is too high and a desire to reduce harvest. Others are concerned about the spread of crappie into new waters and the potential impact on other species including the allowable harvest of walleye.

Considerations

- In past, there was a combination of authorized and unauthorized introductions of crappie; currently, expansion is due to unauthorized introductions or movement from previous introductions
- Crappie populations are still somewhat more confined to the west part of the zone but spreading (Atikokan and Dryden have recently had crappie populations appear)
- Black crappie are popular with both residents and tourism guests as a species harvested for consumption.
- The potential impact of crappie on native fish communities and in particular walleye populations is largest concern
- There is an issue around enforcement of laws which make introductions illegal as it is often difficult to enforce them (need to catch violators in the act).
- Some of the issue around illegal introduction may be that people don’t understand the impacts of introductions (see education issue).

Issue: Lack of guidelines and licensing for competitive angling tournaments.
Priority: Medium

Description

A need was identified that tournaments guidelines/policy be established and enforced through permitting for a number of reasons including to ensure tournaments properly care for fish (fish mortality concern). Permits would allow also limits to lake area fished resulting in reduced moving fish from one area of a lake to another; ability to control timing of tournaments and flexibility in developing zone wide regulations for species fished in tournaments.

Considerations

- Currently all competitive events on non-Specially Designated Waters in FMZ 5 are focused on bass.
- There is a management desire to limit number of events on lakes or timing of events to reduce fish mortality.
- Permitting/licensing could allow exceptions to potential new regulations. For example, if a 1 over size regulation for bass (much like the current walleye regulation) was implemented, specific tournaments could be exempted from out through their permit. There may be resistance to this type of regulation by tournament organizers without this ability to make exceptions.

Issue: Habitat impacts from development projects that reduce ability of lakes to support fish populations and maintain angling quality.
Priority: Medium

Description

Development projects such as hydroelectric dams, and mining, etc. can have impacts on the ability of habitat to support both populations and angling quality at acceptable levels. This results in a loss of value of lake from both tourism and recreation and there is a concern that fish habitat issues are largely ignored in approval process.
In particular, mining development was identified as a specific concern as this industry seems to have fewer controls on their activity than they should or than other industries such as forestry.

Considerations

- Types of development with fisheries concerns in FMZ5 include:
  - hydroelectric development
  - mining
  - roads and water crossings associated with forestry through both changes in access and exploitation as well as direct habitat impacts)

- cottage development

- Habitat impacts have potential to reduce sustainable level of exploitation.
- Some development (cottages, roads) can increase exploitation on populations above acceptable levels.
- May be more of a concern in FMZ 5 since we are managing closer to the sustainability line.
- Climate change is related to this concern at a larger scale in that widespread development that increases greenhouse gas production can have a similar affect of impacting fish habitat reducing productivity of some species.

Issue: Ensuring appropriate socio-economic benefits and exploitation from non-resident day use anglers
Priority: Medium

Description

Concern about access to FMZ 5 fishery from US based anglers both from an exploitation issue and a socio-economic issue (ensuring appropriate economic return from US based anglers/non-resident day use anglers). In part, this concern identifies the importance of the current regulations in place to address this issue.

Considerations

- Non-resident angling by US based day-trippers is still the major source of fishing effort on border lakes east (upstream) of Rainy Lake.
- The current border water regulations didn't eliminate the issue, just reduced the problem.
- The issue needs to be kept in mind if we are reviewing or considering changes to the current border waters regulations.

Issue: Education of public about angling impacts and invasive species impacts on fish populations.
Priority: Medium

Description

There is a concern about the current lack of public education on a number of issues but particularly the impact of invasive species on native ecosystems and impact of angling on fish populations.

Considerations

- Concern of invasive species includes introduction of fish species either accidentally such as by anglers dumping unused bait in lakes, or willfully such as intentional introduction of species into lakes by anglers or bait industry.
- There is also concern about the lack of general knowledge and potential impacts of other species such as zebra mussels or rusty crayfish.
- There is a need to understand how invasive species enter FMZ 5 waterbodies, effect of invasives on fish communities and impacts on yield and fish quality
- Concern over the potential for introductions of invasive spp. from US by anglers (boats/bait, etc)
- Angling concerns include a lack of knowledge by anglers about regulations (eg. shore lunch included in limit), impacts of catch and releases (eg culling fish held in livewells) and ethical considerations both within the law (e.g. catch release fishing in high mortality situations) and outside the law (e.g catch and release fishing during closed seasons for muskie).
- Questions were identified about the impacts of angling on fish survival including the effects of ingested plastic baits on fish.
- There is a feeling that OMNR is not paying enough attention to education.

Issue: Maintaining appropriate balance of access across FMZ 5 to address socio-economic and exploitation concerns.
Priority: Medium

Description

A concern was identified about balance between too much access causing exploitation issues on sensitive lakes and user conflicts (eg. outpost/road based anglers) and not enough access focusing effort on a few lakes causing fishing quality/exploitation concerns on those lakes.

Considerations

- There is a recognition that there needs to be a balance in access to prevent user conflicts and over exploitation of sensitive lakes on one hand while still providing access to fishing opportunities which also results in fishing pressure being more evenly distributed across the zone.
- The importance of protecting tourism facilities through road controls/removals was expressed.
- Other concerns identified as part of the access balance issue included the boat cache program, culvert removals, maintenance of access points, lake access during winter ("roadside parking").
- This is a large scale problem involving other land planning process (Forest Management Plans, Crown Land Use Policy Atlas, etc).

Issue: Commercial fisheries – new opportunities and allocations

Priority: District Fisheries Management Plan carry-over (High)

Description

Currently, much of the direction for the management of commercial fisheries including allowable gear, species and quota targets is found in the District Fisheries Management Plans (DFMP's) (see Table 5.2-3 for summary of DFMP direction). As these documents will be replaced by the FMZ 5 Fisheries Management Plan, OMNR fisheries managers felt it was important that this new plan contain commercial fisheries management direction and identified it as an issue to be addressed. This issue was not identified by the FMZ 5 Advisory Council and the development of management options will be primarily the responsibility of the OMNR FMZ 5 project team.

Acknowledgements

The work of the FMZ 5 background information document writing team is very much appreciated including Barry Corbett, Lisa Eddy, Brian Jackson, Darryl McLeod, Melissa Moseley, Lisa Solomon, John Vandenbroeck and Jill Van Walleghem. Thanks to Barb Elliott for the production of the maps. Thanks also to Melissa Rose and Darren Elder for providing the groundwork to start from.

Also, thanks to Mark Sobchuk and Kim Armstrong for providing advice and reviewing an earlier draft of this document and to Matt Myers, Jeff Wiume, Leo Heyens, Matthew Benson, Jeff Bonnema, Burt Hennesey, Kim Weedon and Greg Chapman for management support.

Literature Cited

Armstrong, K.B., P.D. MacMahon and L. Hunt. 1999. Fish harvest and angler characteristics in the resource based tourist industry. Ont. Min. Natur. Resour., Northwest Science and Technology, NWST Technical Report TR-121. 31p.

Aquatic Resources Management Advisory Committee (ARMAC). 2009. Fish habitat referral protocol for Ontario. Canada-Ontario Fisheries Advisory Board. 64 p.

Brown, T.G., Runciman B., Pollard, S., Grant, A.D.A., and Bradford, M.J. 2009. Biological synopsis of smallmouth bass **(***Micropterus dolomieu*). Can. Manuscr. Rep. Fish. Aquat. Sci. 2887: v + 50 p.

Browne, D.R. 2007. Freshwater Fish in Ontario's Boreal: Status, Conservation and Potential Impacts of Development. Wildlife Conservation Society Canada, Conservation Report 2. Toronto, Ontario, Canada. 100 pp.

Caplin, D. L. 1982. An experimental study of interactions between young-of-the-year northern pike (Esox lucius) and muskellunge (Esox masquinongy). M.Sc. Thesis. University of Wisconsin.

Madison, Wisconsin. Cano, T., and S. Parker. 2007. Characterization of Northwest Region Management Zones: Sport Fish Populations and Exploitation. Ontario Ministry of Natural Resources. Northwest Science and Information, Thunder Bay, Ontario. Technical Report TR-140. 63 p.

Carignan, R., D'Arcy, P. and S. Lamontagne. 2000. Comparative impacts of fire and forest harvesting on water quality in Boreal Shield lakes. Canadian Journal of Fisheries and Aquatic Sciences 57: 105-117.

Carignan R. and Steedman, R.J. 2000. Impacts of major watershed perturbations on aquatic ecosystems. Can. J. Fish. Aquat. Sci. 57 (Suppl. 2) 1-4.

Carl, L., Bernier, M.F., Christie, W., Deacon, L., Hulsman, P., Maraldo, D., Marshall, T., and P. Ryan. 1990. Fish community and environmental effects on lake trout. Lake Trout Synthesis, Ontario Ministry of Natural Resources, Toronto, Ontario.

Caron, D. 1994. Largemouth bass:A new resource for northwestern Ontario. Undergraduate thesis – School of Forestry. Lakehead University. 75p.

Casselman, J.M. 1995. Age, growth, and environmental requirements of pike. In: J.F. Craig, editor, Pike: biology and exploitation. Chapman and Hall, London. pp. 69-101.

Casselman, J. M., C. J. Robinson, and E. J. Crossman. 1999. Growth and ultimate length of muskellunge from Ontario waterbodies. North American Journal of Fisheries Management 19:271-290.

Casselman, J.M. 2002. Effects of Temperature, Global Extremes, and Climate Change on Year-Class Production of Warmwater, Coolwater, and Coldwater Fishes in the Great Lakes Basin. In: Fisheries in a Changing Climate. Nature A. McGinn, editor. American Fisheries Society Symposium 32: 39-60.

Clarke, K. D., T. C. Pratt, R. G. Randall, D. A. Scruton, and K. E. Smokorowski. 2008. Validation of the flow management pathway: Effects of altered flow on fish habitat and fishes downstream of a hydropower dam. Can. Tech. Rep. Fish. Aquat. Sci. 2784: vi + 111p.

Chapman, L. J., and W. C. Mackay. 1990. Ecological correlations of feeding flexibility in northern pike (Esox lucius). Journal of Freshwater Ecology 5:313–322.

Coker, G.A, C.B. Portt, and C.K. Minns. 2001. Morphological and Ecological Characteristics of Canadian Freshwater Fishes. *Can. MS Rpt. Fish. Aquat. Sci*. 2554: iv+89p

Corbett, B.W., L.A. Parsons and J.L. McNulty 2007. Practical Applications of Tournament Data for Fisheries Management in Bass research and management in Ontario II. Kerr, S. J. [ed.]. Ontario Ministry of Natural Resources. Peterborough, Ontario. 82 p. + appendices.

Crooke, J.C., and P.B. Hairsine. 2006. Sediment delivery in managed forests: a review. Environmental Reviews 14: 59-87.

Crossman, E.J. 1991. Introduced freshwater fishes: a review of the North American perspective with emphasis on Canada. Canadian Journal of Fisheries and Aquatic Sciences 48(Supplement 1): 46-57.

Crossman, E.J. 1976. Quetico Fishes. Life Sci. Misc. Pub., Royal Ontario Museum. 86p.

Curry, R. A., and K. J. Devito. 1996. Hydrology of brook trout (*Salvelius fontinalis*) spawning and incubation habitats; implication for forestry and land use development. Can. J. For. Res. 26:767-772.

Curry, R. A., Gehrels, J., Noakes, D. L. G. and R. Swainson. 1993. Effects of streamflow regulation on groundwater discharge through brook trout, *Salvelinus fontinalis*, spawning and incubation habitats. Hydrobiologia 277: 121-134.

DeHaan, P. W., S. V. Libants, r. F. Elliot and K. T. Scribner. 2006. Genetic population structure of remnant lake sturgeon populations in the upper Great Lakes basin. Transactions of the American Fisheries Society 135: 1478-1492.

Dockendorf, K. J., and M. S. Allen. 2005. Age-0 black crappie abundance and size in relation to zooplankton density, stock abundance, and water clarity in three Florida lakes. Transactions of the American Fisheries Society 134:172–183.

Dombeck, M. P., B. W. Menzel, and P. N. Hinz. 1986. Natural muskellunge reproduction in midwestern lakes. American Fisheries Society Special Publication 15:122-134.

Dunham, J. B., M. K. Young, R. E. Gresswell, and B. E. Rieman. 2003. Effects of fire on fish populations: landscape perspectives on persistence of native fishes and nonnative fish invasions. Forest Ecology and Management, v. 178, no. 1-2, p. 183-196.

Dunlop, E.S., and Shuter, B.S. 2006. Native and introduced populations of smallmouth bass differ in the concordance between climate and somatic growth. International Institute for Applied Systems Analysis Interim Report IR-06-031. 39 p.

Ellison, D. 1984. Trophic dynamics of a Nebraska black crappie and white crappie population. *North American Journal of Fisheries Management* 4: 355-364

Eschmeyer, P.H. 1950. The life history of the walleye (Stizosedion vitreum vitreum) in Michigan. Michigan Department of Conservation. Bulletin of the Institute of Fisheries Research No 3. 99p.

Evans, D.O., and C.C. Willox. 1991. Loss of exploited, indigenous populations of lake trout, *Salvelinus namaycush*, by stocking of nonnative stock. Canadian Journal of Fisheries and Aquatic Science 48:134-147.

Fayram, A. H., M. J. Hansen, T.J Ehlinger. 2005. Interactions between walleyes and four fish species with implications for walleye stocking. *North American Journal of Fisheries Management* 25:1321–1330

Gresswell, R. E. 1999. Fire and aquatic ecosystems in forested biomes of North America. Transactions of the American Fisheries Society 128:193-221.

Gibb, D. 1988. The 1987 angler survey of the Manitou Lakes System, Fort Frances and Dryden Districts. Ontario Ministry of Natural Resources, Fort Frances District Report Series No. 26. 43 p.

Gibson, R. J., R. L. Haedrich, and C. M. Wernerheim. 2005. Loss of fish habitat as a consequence of inappropriately constructed stream crossings. Fisheries: 30:10-17.

Green, D.M. 1994. Walleye introductions as a biomanipulation tool. P. 180. In Proceedings of the Annual Meeting of the American Fisheries Society, Halifax, Nova Scotia. (Abstract Only).

Gunn, J.M. and Pitblado, R. 2004. Lake trout, the boreal shield, and the factors that shape lake trout ecosystems. Pages 3 to 19 *In* Boreal Shield Watersheds, Lake Trout Ecosystems in a Changing Environment. Edited by J.M. Gunn, R.J. Steedman, and R.A. Ryder.

Haider, W and L. Hunt 1997. Remote tourism in Northern Ontario: patterns of supply and motivational segmentation of clients. Journal of Applied Recreation Research 1997 Vol. 22 No. 1 pp. 49-78

Hanson, D. A., J. R. Axon, J. M. Casselman, R. C. Haas, A. Schiavone, and M. R. Smith. 1986. Improving musky management: a review of management and research needs. American Fisheries Society Special Publication 15:335-341.

Harper, D. L., and J. T. Quigley. 2000. No net loss of fish habitat: an audit of forest road crossings of fish-bearing streams in British Columbia, 1996-1999. Canadian Technical Report of Fisheries and Aquatic Sciences 2319. 43 p.

HCA (Harry Cummings and Associates Inc.) 2009a. Kenora District Agricultural Economic Impact Study.

HCA (Harry Cummings and Associates Inc.). 2009b. Rainy River District Agricultural Economic Impact Study

Hartman, G.F. 2009. A biological synopsis of walleye (Sander vitreus). Can. Manuscr. Rep. Fish. Aquat. Sci. 2888: v + 48 p.

Harvey, B. 2009. A biological synopsis of northern pike (Esox lucius). Can. Manuscr. Rep. Fish. Aquat. Sci. 2885: v + 31 p.

Hartviksen, C and W. Momot. 1987. Fishes of the Thunder Bay Area of Ontario. Wildwood Publications. 282 p

He, X, and J. F. Kitchell. 1990. Direct and indirect effects of predation on a fish community: a whole lake experiment. Transactions of the American Fisheries Society 119:825–835.

Hicks, F. 1999. Manual of instructions, spring littoral index netting. Ontario Ministry of Natural Resources, Peterborough, Ontario. 37 p

Hinz, P. 2002. The History of Mining in the Kenora Area. Ont. Min. North. Dev. Min., Ontario Geological Survey. Kenora, Ontario. http://www.mndmf.gov.on.ca/mines/ogs/resgeol/offices/kenora_mining_history.pdf

Holm, E., N. E. Mandrak, and M. E. Burridge. 2009. The ROM field guide to freshwater fishes of Ontario. Royal Ontario Museum, Toronto, Ontario, Canada. 462p.

Hofmann, N. 2008. Gone fishing: A profile of recreational fishing in Canada. EnviroStats pages 7-13. Cat. No. 16-002-X.

Hogg, S.E., N.P. Lester and H. Ball. 2010a. 2005 Survey of Recreational Fishing in Canada: Results for Fisheries Management Zones in Ontario. Applied Research and Development Branch. Ontario Ministry of Natural Resources. 32 p + appendices.

Hogg, S.E., N.P. Lester and H. Ball. 2010b. The Effectiveness of the 2005 Survey of Recreational Fishing Survey to Deliver Spatially Explicit Estimates of Fishing Effort and Harvest: Analysis for Selected Ontario Lakes. Applied Research and Development Branch. Ontario Ministry of Natural Resources. 25 p + appendices.

Hrabik, T.R., and J. Magnuson. 1998. Predicting the effects of rainbow smelt on native fishes in small lakes: evidence from long-term research in two lakes. Can. J. Fish. Aquat. Sci. 56: 1364-1371.

Hrabik, T.R., Carey, M.P., and M.S. Webster. 2001. Interactions between young-of-the-year exotic rainbow smelt and native yellow perch in a northern temperate lake. Trans. Am. Fish. Soc. 130: 568-582.

Hunt, L.M. and N. Lester. 2009. The effect of forestry roads on access to remote fishing lakes in northern Ontario, Canada. North American Journal of Fisheries Management. 29:586-597.

Inskip, P. D. 1986. Negative associations between abundances of muskellunge and northern pike: evidence and possible explanations. American Fisheries Society Special Publication 15:135-150.

Jackson, B.W. 2011. Abbess SLIN report- Summary of 2000 and 2010 SLIN netting - Draft. OMNR Atikokan Area office. 13p.

Jackson, B.W. 2010a. Size based prey switching in walleye. OMNR Atikokan Area office. 17p.

Jackson, B.W. 2010b. Effect of temperature on early growth in bass. OMNR Atikokan Area office. 9p.

Jackson, B.W. 2010c. Sportfish community analysis of Atikokan Area lake trout lakes – draft. OMNR Atikokan Area office. 4p.

Jackson, B.W. 2007. Recent temperature and precipitation patterns in Atikokan Ontario. OMNR Atikokan Area office. 13p.

Jackson, B.W. 2005. Status of Smallmouth Bass in Atikokan Area - Summary of Nearshore Community Index Netting (NSCIN) surveys from 1997 to 2004. OMNR Atikokan Area office. 17p.

Jackson, D.A. 2002. Ecological effects of *Micropterus* introductions: the dark side of black bass. American fisheries Society Symposium 31: 221-232.

Jackson, D.A., and Mandrak, N.E. 2002. Changing fish biodiversity: Predicting the loss of cyprinid biodiversity due to global climate change. Fisheries in a Changing Climate, Am. Fish. Soc. Symp. 32: 89-98.

Jackson, D.A., Peres-Neto, P.R. and J.D. Olden. 2001. What controls who is where in freshwater fish communities – the roles of biotic, abiotic and spatial factors. Can. J. Fish. Aquat. Sci. 58: 157-1790.

Jacobson, P.C., H. G. Stefan and D. L. Pereira 2010. Coldwater fish oxythermal habitat in Minnesota lakes: influence of total phosphorus, July air temperature, and relative depth. Can. J. Fish. Aquat. Sci. 67: 2003-2013.

Janoscik, T. and N.P. Lester 2003. Use of Spring Littoral Index Netting (SLIN) to assess lake trout abundance.Aquatic Research Development Section, OMNR Peterborough.

Kaufman, S.D., E. Snucins, J.M. Gunn, and W. Selinger. 2009a. Impacts of road access on lake trout (*Salvelinus namaycush*) populations; regional scale effects of overexploitation and the introduction of smallmouth bass (*Micropterus dolomieu*). Can. J. Fish. Aquat. Sci. 66:212-223.

Kaufman, S.D., J.M. Gunn, and G.E. Morgan. 2009b. The role of ciscoes as prey in the trophy growth potential of walleyes. North American Journal of Fisheries Management 29:468–477, 2009

Keast, A. 1968. Feeding biology of the black crappie, *Pomoxis nigromaculatus*. Journal of the Fisheries Research Board of Canada 25 (2): 285-297.

Kelly, E.N., Schindler, D.W., St Louis, V.L., Donald, D.B. and K.E. Vlaclicka. 2006. Forest fire increases mercury accumulation by fishes via food web restructuring and increased mercury inputs. Proceedings of the National Academy of Sciences of the United States of America 103: 19380-19385.

Kempinger, J. J. 1988. Spawning and early life history of lake sturgeon in the Lake Winnebago system, Wisconsin. North American Journal of Fisheries Management 15: 102-114.

Kerr, S. J. and R. E. Grant. 1999. Ecological Impacts of Fish Introductions: Evaluating the Risk. Fish and Wildlife Branch, Ontario Ministry of Natural Resources, Peterborough, Ontario, 473 p.

Kiffney, P.M., Richardson, J.S., and J.P. Bull. 2003. Responses of periphyton and insects to experimental manipulation of riparian buffer width along forest streams. Journal of Applied Ecology. 40: 1060-1076.

Krishka, B.A., Cholmondeley, R.F., Dextrase, A.J., and P.J. Colby. 1996. Impacts of introductions and removals on Ontario percid communities. Percid Community Synthesis Introductions and Removals Working Group. Ontario Ministry of Natural Resources. Pp 111.

Langill, D.A., and P.J. Zamora. 2002. An audit of small culvert installations in Nova Scotia: habitat loss and habitat fragmentation. Can. Tech. Rep. Fish. Aquat. No 2422. 43p.

Lamontagne S, Carignan R, D'Arcy P, Prairie YT, Pare D. 2000. Element export in runoff from eastern Canadian boreal shield drainage basins following forest harvesting and wildfi res. . Can. J. Fish. Aquat. Sci. 57 (Suppl.2): 118-128.

Lester, N.P., A.J. Dextrase, R.S. Kushneriuk, M.R. Rawson, and P.A. Ryan. 2004 Light and temperature: key factors affecting walleye abundance and production. Transactions of the American Fisheries Society 133: 588-605

Lester, N.P., B.J. Shuter, R.S. Kushneriuk, and T.R. Marshall. 2000. Life history variation in Ontario walleye populations: implications for safe rates of fishing. Percid Community Synthesis. Population and Yield Characteristics Working Group. Ontario Ministry of Natural Resources. 34 p.

Lloyd, D. S., J. P. Koenings and J. D. LaPerriere. 1987. Effects of turbidity in fresh waters of Alaska. N. Am. J. Fish. Mgmt. 7:18:33.

Lofgren, B. M., F. H. Quinn, A. H. Clites, R. A. Assel, A. J. Eberhardt, and C. L. Luukkonen, 2002. Evaluation of potential impacts on Great Lakes water resources based on climate scenarios of two GCMs. J. Great Lakes Res., 28, 537- 554.

Luce, C. H. 2002. Hydrological processes and pathways affected by forest roads: What do we still need to learn? Hydrological Processes 16: 2901-2904.

MacRae, P.S.D. and D.A. Jackson. 2001. The influence of smallmouth bass (*Micropterus dolomieu*) predation and habitat complexity on the structure of littoral zone fish assemblages. Canadian Journal of Fisheries and Aquatic Sciences 58: 342-351.

Malette , M.D and G.E. Morgan 2005. Provincial summary of northern pike life history characteristics based on Ontario's Fall Walleye Index Netting (FWIN) program - 1993 to 2002. Ontario Ministry of Natural Resources. 22 pp. + appendices

Martin, C. W., J. W. Hornbeck. 2000. Impacts of intensive harvesting on hydrology and nutrient dynamics of northern hardwood forests. Can. J. For. Res. 57(Suppl. 2):19-29

McCauley, R. W., and J. M. Casselman. 1981. The final preferendum as an index of the temperature for optimum growth in fish. Pages 81–93 in K. Tiews, editor.

Aquaculture in heated effluents and recirculation systems, volume II, Proc. World Symp., Stavanger, Norway, May 28–30, 1980. Heenemann Verlagsgesellschaft, Berlin.

McEachern, P., Prepas, E.E., Gibson, J.J., and W.P. Dinsmore. 2000. Forest fire induced impacts on phosphorous, nitrogen, and chlorophyll a concentrations in boreal subarctic lakes of northern Alberta. Canadian Journal of Fisheries and Aquatic Sciences 57: 73-81.

McLeod, D.T. and C. Debruyne. 2009. Resident and seasonal distribution of lake sturgeon in the Namakan River, Ontario – preliminary report 2007-08. Ontario Ministry of Natural Resources, Fort Frances District Report Series No. 82. 89p.

McLeod, D.T. 1999. An assessment of sturgeon population in the Lower Seine River system, Ontario 1993-95. Ontario Ministry of Natural Resources, Fort Frances District Report Series No. 43. 28p.

McLeod, D.T. 1987. An analysis of winter roving and check station creel surveys, Fort Frances District, 1983. Ontario Ministry of Natural Resources, Fort Frances District Report Series No. 23. 34 p.

McMahon, T.E. and D.H. Bennett. 1996. Walleye and northern pike: Boost or bane to northeast fisheries? Fisheries 21(8): 6-13.

McNeil, O. C. 1992. A review of the life history, habitat requirements and past introductons of black crappie. Report prepared for the Ontario Ministry of Natural Resources, Midhurst District. Owen Sound, Ontario 36 p.

McRae, D.J., Duchesne, L.C., Freedman, B., Lynham, T.J., and S. Woodley. 2001. Comparisons between wildfire and forest harvesting and their implications in forest management. Environmental Reviews 9:223-260.

Mercado-Silva, N., Sass, G.G., Roth, B.M., Gilbert, S., and M.J. Vander Zanden. 2007. Impact of rainbow smelt (*Osmerus mordax*) invasion on walleye (*Sander vitreus*) recruitment in Wisconsin lakes. Can. J. Fish. Aquat. Sci. 64: 1543-1550.

Morgan, G.E., M.D. Malette, R.S. Kushneriak, S.E. Mann. 2003. Regional summaries of walleye life history characteristics based on Ontario's Fall Walleye Index Netting (FWIN) program - 1993 to 2001 Ontario Ministry of Natural Resources. 20 pp. + appendices.

Morgan, G.E. 2002. Manual of instruction - fall walleye index netting (FWIN): percid community synthesis diagnostics and sampling standards working group. Ontario Ministry of Natural Resources. 20 pp.

Mortsch L., H. Hengeveld, M. Lister, Lofgren B., Quinn F. H., Slivitzky M. and Wenger L.2000. Climate Change Impacts on the Hydrology of the Great Lakes - St.Lawrence System. Canadian Water Resources Journal, 153-179, Volume 25, Nb.2.

Mosindy, T. S. and J. Rusak 1991. An assessment of lake sturgeon populations in Lake of the Woods and the Rainy river, 1987-90. Lake of the Woods Fisheries Assessment Report 1991-01. Ontario Ministry of Natural Resources. Kenora, Ontario. 66 p.

Mosindy, T. 1998. Lake of the Woods bass fishery: a case history. 1998 Ont. Min. Natur. Resour., Northwest Sci. & Technol., Thunder Bay, Ont. NWST Tech. Rep. TR-115. 12pp.

Mosindy, T.1995. Black crappie introductions in the Lake of the Woods area. p. 17-18 In P. MacMahon [ed.]. Fish: To Stock or Not to Stock, Northwest Region Science and Technology Workshop Proceedings WP- 003, Ontario Ministry of Natural Resources, Thunder Bay.

National Research Council 1983. Changing Climate: Report of the Carbon Dioxide Assessment Committee, National Research Council, National Academy Press, Washington, D.C.

Neuswanger, D. 2009 Interactions between walleye and black bass in lakes: A literature review. Wisconsin Department of Natural Resources. 20p.

Northwestern Health Unit (NWHU), 2010. Sewage Permit Process: Backgrounder and Guide 2010. http://www.nwhu.on.ca/programs/env-health-sewage.php

Olden, J.D. and R.J. Naiman. 2009. Incorporating thermal regimes into environmental flows assessment: modifying dam operations to restore ecosystem integrity. Frehwater Biology 2009: 1 - 22.

Oliver, C.H., Desjardine, R.L., Goddard, C.I., Powell, M.J., Reitveld, H.J. and P.D. Waring. 1991. Lake trout in Ontario: Management strategies. Lake Trout Synthesis, Ontario Ministry of Natural Resources, Toronto, Ontario. 90 p.

Ontario Ministry of Environment, 2008. Map: Drinking Water Surveillance Program. http://www.ene.gov.on.ca/en/water/dwsp/DWSP_Map.pdf

Ontario Ministry of Environment, 2007. Lakeshore Capacity Assessment Handbook. . Queen's Printer for Ontario.

Ontario Ministry of Environment, 2005. Interpretation of TP and Secchi results. http://www.ene.gov.on.ca/en/water/lakepartner/docs/InterpretationTPSecchiResults.pdf

Ontario Ministry of Environment (MOE). 2009. Guide to Eating Ontario Sport Fish 2009-2010 Twenty-fifth Edition, Revised. Queen's Printer for Ontario. ISBN 978-1-4249-9219-5 281 p + appendices

Ontario Ministry of Northern Development and Mines (OMNDM). 1990. Mining Act. Queens Printer for Ontario. 203 pp

Ontario Ministry of Natural Resources. 2010a. Natural Resource Values Information System (NRVIS). Accessed September 7th, 2010.

Ontario Ministry of Natural Resources. 2010b. Renewable Energy Atlas. http://www.lio.ontario.ca/imf-ows/imf.jsp?site=renew_en

Ontario Ministry of Natural Resources (OMNR). 2010c. Manual of Instructions for Northwest Region Lake Temperature Monitoring Program Draft 1.2. Northwest Region, Ontario Ministry of Natural Resources. 20pp.

Ontario Ministry of Natural Resources (OMNR). 2009a. Site and Stand Guidelines, Ontario.

Ontario Ministry of Natural Resources (OMNR). 2009b. The lake sturgeon in Ontario. Fish and Wildlife Branch, Peterborough, Ontario. 48 p. + Appendices.

Ontario Ministry of Natural Resources (OMNR). 2009c. Fisheries Management Plan for Fisheries Management Zone 6. Ont. Min. Natur. Resour. Thunder Bay District, Thunder Bay, Ontario. 69p.

Ontario Ministry of Natural Resources (OMNR). 2008a. http://www.mnr.gov.on.ca/en/Business/Biodiversity/2ColumnSubPage/STEL02_167267.html. April 4 2008.

OMNR. 2008c. PL 3.03.07. Non-Resident Crown Land Camping- Northern Ontario.

OMNR. 2006a. Quetico Fisheries Stewardship Plan. Quetico Provincial Park. Ontario Ministry of Natural Resources. 51 p.

Ontario Ministry of Natural Resources (OMNR). Northwest Region. 2006b. An interim approach for reviewing remote outpost camp bed capacities. Ministry of Natural Resources.

Ontario Ministry of Natural Resources (OMNR). 2006c Inland Ontario Lakes Designated for Lake Trout Management. Ministry of Natural Resources.

Ontario Ministry of Natural Resources (OMNR). 2005a. A New Ecological Framework for Recreational Fisheries Management in Ontario. Fisheries Section, Fish and Wildlife Branch, Ministry of Natural Resources. 16 pp.

Ontario Ministry of Natural Resources (OMNR). 2005b. Our Sustainable Future. Ministry of Natural Resources.

Ontario Ministry of Natural Resources (OMNR). 2005c. Ontario's Biodiversity Strategy. Ministry of Natural Resources.

Ontario Ministry of Natural Resources (OMNR). 2005d. Science for Our Sustainable Future. Ministry of Natural Resources.

OMNR. 2005e. Quetico Background Information: Fisheries Stewardship Plan. Quetico Provincial Park. Ontario Ministry of Natural Resources. 37 p.

OMNR and MDNR. 2004. Ontario-Minnesota Boundary Waters Fisheries Atlas for Lake of the Woods, Rainy River, Rainy Lake, Namakan Lake and Sand Point Lake. Ontario Ministry of Natural Resources. Minnesota Department of Natural Resources. 95 p.

Ontario Ministry of Natural Resources (OMNR). 2003b. Northwest Region Fisheries Management Action Plan, Ministry of Natural Resources. 19pp.

OMNR 1999. Spring Littoral Index Netting. Muskoka Lakes Fisheries Assessment Unit update 1999-2. Ont. Min. of Nat. Res. 6p.

Ontario Ministry of Natural Resources (OMNR). 1998. Resource- Based Tourism Policy. Ministry of Natural Resources. 4p.

Ontario Ministry of Natural Resources (OMNR). 1997a. Fisheries Action Plan 1997 – 2000: Northwest Region. Ministry of Natural Resources. 6p.

Ontario Ministry of Natural Resources (OMNR). 1997b. Fisheries Management Needs Analysis: Northwest Region 1996. Ministry of Natural Resources. 64p.

Ontario Ministry of Natural Resources (OMNR). 1992a. Strategic Plan for Ontario's Fisheries SPOF II: An aquatic ecosystem approach to managing fisheries. Fisheries Section, Fish and Wildlife Branch, Ministry of Natural Resources. 22 pp.

Ontario Ministry of Natural Resources. 1992b. Ontario Provincial Parks: Planning and Management Policies, 1992 update. Peterborough, Ontario.

Ontario Ministry of Natural Resources (OMNR). 1989. Atikokan District Fisheries Management Plan 1988 – 2000. Atikokan OMNR, Queens Printer for Ontario.

Ontario Ministry of Natural Resources (OMNR). 1988. Dryden District Fisheries Management Plan 1987 – 2000. Dryden OMNR, Queens Printer for Ontario.

Ontario Ministry of Natural Resources (OMNR). 1988. Fort Frances District Fisheries Management Plan 1987-2000. Fort Frances OMNR, Queens Printer for Ontario.

Ontario Ministry of Natural Resources (OMNR). 1988. Ignace District Fisheries Management Plan 1987 – 2000. Ignace OMNR, Queens Printer for Ontario.

Ontario Ministry of Natural Resources (OMNR). 1988. Kenora Fisheries Management Plan 1987 – 2000. Kenora OMNR, Queens Printer for Ontario.

Ontario Ministry of Natural Resources (OMNR). 1983. Strategic Planning for Ontario Fisheries: The identification of overexploitation report of SPOF working group number 15. Fisheries Section, Fish and Wildlife Branch, Ministry of Natural Resources. 84 pp.

Ontario Ministry of Natural Resources (OMNR). 1982. Strategic Planning for Ontario Fisheries: Partitioning yields estimated from morphoedaphic index into individual species yields .Report of SPOF working group number 12. Fisheries Section, Fish and Wildlife Branch, Ministry of Natural Resources. 71 pp

Ontario Ministry of Natural Resources (OMNR). 1981. Manual of Instructions: Aquatic Habitat Inventory Surveys. Fisheries Branch, Ontario Ministry of Natural Resources. 166pp.

Pannel Forster Kerr, 2003. The economic impact of Tourism in Sunset Country, Ontario. PFK Consulting in association with the Canadian Tourism Research Institute. 86 p.

Peard, T. 2002. Freshwater Jellyfish! Indiana University of Pennsylvania, Indiana, PA 25 pp. http://www.jellyfish.iup.edu

Peruniak, S. 2000. Quetico Provincial Park — an illustrated history. Friends of Quetico Park, Atikokan, Ont.

Pierce, R.B., and C.M. Tomcko. 2005. Density and biomass of native northern pike populations in relation to basin-scale characteristics of north-central Minnesota lakes. Transactions of the American Fisheries Society 134:231-241.

Pierce, R.B. and C.M. Tomcko. 1998. Effects of discontinuing walleye stocking in fish populations in Lake Thirteen. Investigational Report 463, Minnesota Department of Natural Resources, St. Paul, Minnesota. 37 p.

Planas, D., Desrosiers, M., Groulx, S.R., Paquet, S., and R. Carignan. 2000. Pelagic and benthic algal responses in eastern Canadian Boreal Shield lakes following harvesting and wildfires. Canadian Journal of Fisheries and Aquatic Sciences 57:136-145.

Poehlman, T.N. 1996. Fluvial and sediment dynamics at the head of a subarctic estuary affected by human activity, Moose River, Moosonee. MSc thesis, University of Guelph, Canada

Poff, N.L., Allan, J.D., Bain, M.B., Karr, J.R., Prestegaard, K.L., Richter, B.D., Sparks, R.E., and J.C. Stromberg. 1997. The natural flow regime. Bioscience 47:769-784.

Porvari, P., Verta, M., Munthe, J. and M. Haapanen. 2003. Forestry practices increase mercury and methyl mercury output from boreal forest catchments. Environmental Science and Technology 37:2389-2393.

Post, J.R., M. Sullivan, S. Cox, N.P. Lester, C.J. Walters, E.A. Parkinson, A.J. Paul, L. Jackson, B.J. Shuter. 2002. Canada's recreational fisheries: The invisible collapse. Fisheries 27(1):6-17

Racey, G.D. 2004. Preparing for change: Climate change and resource management in Northwest Region. Ont. Min. Nat. Resour., Northwest Sci. and Info. NWSI Technical Workshop Report TWR-04. 27 pp

Radomski, P. J., and T. J. Goeman. 1995. The homogenizing of Minnesota lake fish assemblages. Fisheries 20:20–23.

Rashin, E.B., Clishe, C.J., Loch, A.T., and J.M. Bell. 2006. Effectiveness of timber harvest practices for controlling sediment related water quality impacts. Journal of the American Water Resources Association 42: 1307-1327.

Reid, L.M. 1993. Research and cumulative watershed effects. U.S. Department of Agriculture Forest Service, Pacific Southwest Research Station, Berkeley, Calif. General Technical Report PSW-GTR-141.

Rusak, J. A. and T. Mosindy. 1997. Seasonal movements of lake sturgeon in Lake of the Woods and the Rainy River, Ontario. Canadian Journal of Zoology 75(3):383-395.

Ryder, R.A. and S.R. Kerr. 1978. The adult walleye in the percid community – a niche definition on feeding behaviour and food specificity. *In* Selected coolwater fishes of North America. *Ed. by*: R. Kendall. Am. Fish. Soc. Special Publication, 11:39-51.

Ryder, R.A. 1965. A method for estimating the potential fish production of north-temperate lakes. Transactions of the American Fisheries Society, 94: 214-218.

Schiavone, A. 1983. The Black Lake fish community: 1931 to 1979. N.Y. Fish Game Journal. 30: 79-90.

Schiavone, A., 1985. Response of walleye populations to the introduction of the black crappie in the Indian River Lakes. N.Y. Fish Game Journal. 32: 114-140.

Schindler DW. 2001. The cumulative effects of climate warming and other human stresses on Canadian freshwaters in the new millennium. Can. J. Fish. Aquat. Sci. 58: 18-29

Schindler DW, Beaty KG, Fee EJ, Cruikshank DR, DeBruyn ER, Findlay DL, Linsey GA, Shearer JA, Stainton MP, Turner MA. 1990. Effects of climatic warming on lakes of the central Boreal forest. Science 250: 967-970 Schneider, K. N., R. M. Newman, V. Card, S. Weisberg, D. L. Pereira. 2010. Timing of walleye spawning as an indicator of climate change. Transactions of the American Fisheries Society. 139: 1198-1210

Scott, W. B. and E. J. Crossman. 1973. Freshwater fishes of Canada. Bulletin 184. Fisheries Research Board of Canada. Ottawa, Ontario. 966 p.

Serns, S.L. 1982. Influence of Various Factors on Density and Growth of Age-0 Walleyes in Escanaba Lake, Wisconsin, 1958-1980. Trans. Am. Fish. Soc. 111: 299–306.

Selinger, W., Lowman, D., Kaufman, S., and Malette, M. 2006. The status of lake trout populations in northeastern Ontario (2000–2005). Ontario Ministry of Natural Resources, Timmins, Ont.

Seyler, J. 1997. Adult lake sturgeon (*Acipenser fulvescens*) habitat use in the Groundhog River. Northeast Science and Technology Report Tr-035. Ontario Ministry of Natural Resources. Timmins, Ontario. 28 p.

Shuter, B.J., Minns, C.K., and N. Lester. 2002. Climate change, freshwater fish and fisheries: case studies from Ontario and their use in assessing potential impacts. Fisheries in a Changing Climate: American Fisheries Society Symposium. 32: 77-87.

Shuter, B.J., M.L. Jones, R.M. Korver and N.P. Lester. 1998. A general, life history based model for regional management of fish stocks: the inland lake trout (Salvelinus namaycush) fisheries of Ontario. Canadian Journal of Fisheries and Aquatic Sciences 55:2161-2177.

Shuter, B.J., MacLean, J. A., Fry, F.E.J., and Regier, H.A. 1980. Stochastic simulation of temperature effects on first-year survival of smallmouth bass. Trans. Am. Fish. Soc. 109: 1-34.

Siep, D.E. 1995. An evaluation of stocking walleye fingerlings in ten eastern Ontario lakes, 1984-93. Technical Report TR-007, Southern Region Science and Technology Transfer Unit, Ontario Ministry of Natural Resources, Brockville, Ontario. 83 p. + appendices.

Sims, R.A. and Baldwin, K.A. 1991. Landform features in Northwestern Ontario. For. Can., Ont. Region, Sault Ste. Marie, ON. COFRDA Rep. 3312, OMNR, Thunder Bay, ON. NWOFTDU Tech. Rep. 60. 63 p.

Snucins EJ, Gunn JM. 2000. Interannual variation in the thermal structure of clear and colored lakes. Limnol. Oceanogr. 45: 1639-1646

Sobchuk, M. 2010. Personal Communication. Regional Fisheries Specialist, Northwest Region, Ontario Ministry of Natural Resources. Thunder Bay, Ontario.

Steedman, R.J., C.J. Allen, R.L. France, and R.S. Kushneriuk. 2004. Land, water, and human activity on boreal watersheds. Pages 59 to 85 *In* Boreal Shield Watersheds, Lake Trout Ecosystems in a Changing Environment. Edited by J.M. Gunn, R.J. Steedman, and R.A. Ryder.

Steedman, R.J., Kushneriuk, R.S., and R.L. France. 2001. Littoral water temperature response to experimental shoreline logging around small boreal forest lakes. Canadian Journal of Fisheries and Aquatic Sciences 58: 1638-1647.

St-Onge, I. and Magnan , P. 2000. Impact of logging and natural fires on fish communities of Laurentian Shield lakes. Can. J. Fish. Aquat. Sci. 57 (Suppl. 2) 165-174.

Stirling, M.R. 1999. Manual of Instructions: Nearshore Community Index Netting (NSCIN). Ont. Ministry of Natural Resources Lake Simcoe Fisheries Assessment Unit.

Taillon, D. and D. McLeod. 2004. Effects of competitive fishing events on smallmouth bass (*Micropterus dolomieu*) – A literature review. Ontario Ministry of Natural Resources, Fort Frances District Report Series No. 55. 35 p.

Todd, T. N. 2003. Update COSEWIC status report on the shortjaw cisco, *Coregonus zenithicus* in Canada. US Geological Survey, Great Lakes Science Centre. Michigan, USA. 19 p.

Toman, E. M. 2004. Forest road hydrology: The influence of forest roads on stream flow at stream crossings. MSc. Thesis submitted to the Oregon State University. 78 p.

Vander Zanden, M.J., Casselman, J.M., and J.B. Rasmussen. 1999. Stable isotope evidence for the food web consequences of species invasions in lakes. Nature 401: 464-467.

Vander Zanden, M.J., Olden, J.D., Thorne, J.H., and N.E. Mandrak. 2004. Predicting occurrences and impacts of smallmouth bass introductions in north temperate lakes. Ecological Applications 14: 132-148.

Venturelli, P. A., N. P. Lester, T. R. Marshall, B. J. Shuter. 2010 Consistent patterns of maturity and density dependent growth among populations of walleye (Sander vitreus): application of the growing degree-day metric. Can. J. Fish. Aquat. Sci. 67: 1057–1067

Venturelli, P. A., and W. M. Tonn. 2005. Invertivory by northern pike, Esox lucius, regulates communities of littoral macroinvertebrates in small, boreal lakes. Journal of the North American Benthological Society 24:904– 918.

Vinson, M.R., 2001. Long-term dynamics of an invertebrate assemblage downstream from a large dam. Ecological Applications 11: 711 – 730.

Wemple, B. C., F. J. Swanson and, J. A. Jones. 2001. Forest roads and geomorphic process interations, Cascade Range, Oregon. Earth Sur. Process. Landforms 26: 191-204.

Wetzel, R.G. 1975. Limnology. W.B. Saunders Co., Philadelphia, Pa. 743 p. Williamson and Fitter 1996

Williamson, M. H. and Fitter, A. 1996. The characters of successful invaders. Biol. Conserv. 78: 163-170.

Wilson, C.C. and Mandrak, N.E. 2004. History and evolution of lake trout in Shield lakes: past and future challenges. Pages 21 to 35 *In* Boreal Shield Watersheds, Lake Trout Ecosystems in a Changing Environment. Edited by J.M. Gunn, R.J. Steedman, and R.A. Ryder.

Wepruk, R.L., W.R. Darby, D.T. McLeod, and B.W. Jackson. 1992. An analysis of fish stock data from Rainy Lake, Ontario, with management recommendations. Ontario Ministry of Natural Resources, Fort Frances District Report Series No. 41, Fort Frances, Ontario. 196 pp.

Wuellner, M. R. 2009. Exploring interactions between walleye and smallmouth bass in South Dakota waters. Doctoraldissertation. South Dakota State University, Brookings.

APPENDICES

Appendix 1. Acronyms and Definitions

ACOP (Annual Compliance Operating Plan) – the plan that identifies enforcement priorities for the upcoming year.

Age Frequency or Age Composition – The proportion of fish in each different age group or year class in a population or sample.

AHI (Aquatic Habitat Inventory) – A database of lake survey information for lakes surveyed from the sixties to the late eighties including physical data, water chemistry and species information

Annual Mortality (A) - The percentage of fish dying in one year due to both fishing and natural causes.

BAO (Bait Association of Ontario) – Provincial group representing bait industry in Ontario.

BsM (Broadscale Fish Community Monitoring) – a comprehensive fisheries assessment program that has been used in Ontario since 2008 to assess fish populations, habitats and angling effort. It is made up of gill netting with over night sets of both large mesh and small mesh nets, fish aging, water chemistry sampling, zooplankton sampling, contaminant sampling, and aerial angling effort surveys. It attempts to collect the status of the entire fish community, habitat quality information and an estimate of angling stress on the fish population. Contributes to sportfish contaminant monitoring in cooperation with MOE, and invasive species monitoring.

CEQ (Council on Environmental Quality) –Established by United States Congress to work on the development of environmental policies and initiatives. and environmental policy adviser to the President

CLUPA (Crown Land Use Policy Atlas) - OMNR document that directs land use decisions on Crown Land in Ontario. This direction was formerly provided in District Land Use Guidelines (DLUG's)

Commercial Fishery - A term related to the process of catching and marketing fish for sale. It refers to and includes fisheries resources, fishermen, and related businesses.

Commercial Sport Fishery - A term related to the whole process of marketing angling opportunities for the purpose of making income as well as the catch and harvest of fish through this industry. Also referred to as the tourism industry, it refers to and includes fisheries resources, anglers, and related businesses.

Condition - A measurement of the degree of plumpness of a fish or group of fish. For comparison between fish populations, the weight of a fish of a given length (e.g. 300 mm) is often used as an indicator of the population's condition.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada) – the scientific group that determines populations status of species in Canada for recommendation of protection under the federal Species at Risk Act.

COSSARO (Committee on the Status of Species at Risk in Ontario) - the scientific group that determines populations status of species in Ontario for protection under the provincial Endangered Species Act.

CUE (Catch per Unit Effort) – way of reporting catch of fish for a given amount of effort. In netting surveys, it is typically means the number of fish caught for each net set; in angling it usually means the number of fish caught in one hour of angling.

DFO (Department of Fisheries and Oceans) – the federal agency responsible for fisheries management in Canada. In Ontario, responsibility for management of fish populations has been passed to the province but DFO retains responsibility for fish habitat protection under the Fisheries Act. Also known as Fisheries and Oceans Canada.

DO (Dissolved Oxygen) – the amount of oxygen dissolved in water that fish rely on to live. The amount of dissolved oxygen required varies by species with species such as lake trout requiring relatively high levels (typically more than 4 mg/l). In recent times, it is usually measured by an electronic dissolved oxygen meter in milligrams of oxygen per litre of water.

DOC (Dissolved Organic Carbon) - this is organic material from decomposed plants and animals broken down into such a small size that it is "dissolved" into water. When water contacts highly organic soils such as found in lowland spruce swamps, this material can drain into rivers and lakes. DOC compounds often have natural acids associated with them which can influence pH levels and, because they tend to be yellow to black in color, streams and lakes with high DOC also appear to be dark and referred to as stained.

EA (Environmental Assessment) - The process by which projects proposed in Ontario that may have environmental impacts are assessed under the Environmental Assessment Act (EAA). The purpose of this act is to protect, conserve and wisely manage Ontario's environment. It sets out a planning and decision-making process to ensure the environmental effects of a project are evaluated and documented prior to decisions being made about proceeding to construction. In this process, environment is broadly defined to include the natural, social, cultural and economic environment.

Effort - The amount of time in hours spent in attempting to catch fish. To compare between lakes, it is often described as effort density or the amount of effort for the lake divided by the area of a lake to give the hrs/ha.

ELA (Experimental Lakes Area) – designated aquatics research area operated by DFO and Freshwater Institute, includes established research facility on Highwind Lake Road in Kenora/Dryden Districts

ESTN (End of Spring Trap Netting) – a fish population assessment method which uses overnight sets of trap nets in June to capture fish with a focus on walleye populations. The main advantage of this method is that it allows for release of most fish captured (useful for mark-recapture population estimates). The main disadvantage is it is more labour intensive; the limits on how deep nets can be placed (usually only 2-4m or 6'-12'); and the variability in catch makes it sometimes difficult to interpret results.

Fishery - All the activities involved in catching a species of fish or group of species and can involve harvesting fish for consumption

Fishing Mortality (F) - A measurement of the rate of removal of fish from a population by fishing. Usually reported as annual mortality or the percentage of fish dying in one year. The acceptable rates of fishing mortality may vary from species to species and between areas for a species.

FMP (Forest Management Plan) – The OMNR plan prepared by licence holder on the forest (usually the forest industry) that determines the sustainable level of harvest of trees from the forest and for the upcoming 10 years, where harvest will occur and where the access roads will be built.

FMP (Fisheries Management Plan) – The OMNR plan prepared in conjunction with an advisory council that defines fisheries management objectives and management actions to meet these objectives for a fisheries management zone or a specially designated water.

FMZ (Fisheries Management Zone) – one of twenty areas across Ontario that a similar in terms of fish community, environmental conditions and angling effort. A fisheries management plan will be prepared for each zone to direct the management of the fisheries within a zone.

Fork Length (FLEN) - The length of a fish as measured from the tip of its snout to the fork in the tail. Sometimes considered to be a more reliable measurement of fish length than total length (measured to the tip of the tail), especially for those species that prepare nests or redds during spawning which may cause wear and some loss of the end of their tail fins.

FQI (Fish Quality Index) – an indicator of fish quality based on size (length) categories by species. Also referred to as RSD (Relative Stock Density) or PSD (Proportional Stock Density). Size categories include: stock, preferred, memorable and trophy.

FWIN (Fall Walleye Index Netting) – a fish population assessment method which uses overnight sets of gill nets in Sept/Oct to capture fish with a special focus on walleye populations. The main advantage of this method is that it is very efficient in capture of walleye and has been found to be consistent in the relationship between catch and fish abundance. The main disadvantage is that it is focussed primarily on just one species and it kills most fish captured.

GDD (Growing Degree Days) - Growing degree days (GDD) are commonly used to determine the amount of heat accumulated in a year and, in fisheries in Ontario, always refer to Growing Degree Days>5^{o}C. It is calculated as the sum of the number of degrees by which the daily average temperature exceeds 5˚C for each day of the year (e.g. a day with an average temperature of 15˚C would count for 10 growing degree days>5˚C (15˚C -5 ˚C =10). The annual GDD value is calculated by adding together all the daily values for the year. These annual values can be summed for the life of a fish to determine what is known as the Cumulative Growing Degree Days (CGDD) or an estimate of the heat a fish has been exposed to over its life.

Growth - Usually used to mean a fish's increase in length with time and described by the average length of each age class of fish in a population. A mathematical formula that describes the increase in length of an individual fish with time may also be used. May also refer to the increase in numbers of fish in a population with time.

Harvest - The total number or weight of fish caught and kept from an area over a period of time. Note that that catch refers to all fish caught, including those released while harvest only refers to fish caught and killed.

HACCP (Hazard Analysis and Critical Control Point) – this is a method adopted from the food industry which is being used to prevent the spread of invasive species and diseases within Ontario through the movement of bait through identify high risk steps in their operation and taking measures to lower the risks at those points. Each bait fish operators must prepare Hazard Analysis and Critical Control Point (HACCP) plan to address the threat of invasive species associated with their operations.

Invasive Species (IS) – species not native to an ecosystem, also known as exotic or introduced species

Juvenile - A young fish or animal that has not reached sexual maturity.

Length Frequency or Length Composition – The proportion of fish by different lengths in a population or sample.

Length-at-Age Relationship – The average length of each age class of fish in a population. This relationship is often used to approximate the growth of fish in a population.

Length-Weight Relationship - Mathematical formula for the weight of a fish in terms of its length. This relationship is often referred to as the condition of a fish.

Mean - Another word for the average of a set of numbers. Simply add up the individual numbers and then divide by the number of items.

MDNR (Minnesota Department of Natural Resources) – agency responsible for fisheries management on US border lakes in FMZ 5 and shared fish stocks, through offices and staff in Baudette, International Falls and Tower, MN

MEI (Morphoedaphic Index) – One of the simplest and most common estimates of productive capacity in lakes which uses the amount of nutrients measured by total dissolved solids divided by the average depth to predict productive capacity for the entire fish community (MEI = TDS/average depth). Shallower lakes with more nutrients are considered to be more productive than deep lakes with less nutrients.

Mortality – In fisheries management, this term refers to the number of fish that die each year. Annual mortality is generally broken into natural mortality (i.e. the number that naturally die each year through predation, old age, etc). and fishing or harvest mortality (i.e. the number that are removed each year by fishermen). Can also be reported as instantaneous mortality (Z).

MSY (Maximum Sustainable Yield) - The largest average catch that can be taken continuously (sustained) from a population under ideal environmental conditions. This is sometimes used to determine a maximum limit of harvest when considering management goals.

NSCIN (Nearshore Community Index Netting)– a fish population assessment method which uses overnight sets of trap nets in August/September to capture fish often with a focus on smallmouth bass populations in northwest Ontario. The main advantage of this method is that it allows for release of most fish captured (useful for mark-recapture population estimates) and is more effective at capturing bass than gill nets. The main disadvantage is it is more labour intensive; there are limits on how deep nets can be placed (usually only 2-4 m or 6-12’); and the variability in catch makes it sometimes difficult to interpret results.

OFR's (Ontario Fishery Regulations) - the Ontario fishing regulations are developed by the OMNR under the federal Fisheries Act to manage recreational and commercial fisheries to ensure sustainable fish populations are maintained.

OMFC (Ontario-Minnesota Fisheries Committee) – cooperative fisheries management and data sharing for Namakan, Sand Point and Little Vermilion Lakes in FMZ 5, in addition to Lake of the Woods, Rainy River and Rainy Lake.

OMNR (Ontario Ministry of Natural Resources) – The branch of the Ontario government responsible for management of natural resources including fish, wildlife, forests and crown land.

Optimum Sustained Yield (OSY) - The harvest level for a species that achieves the greatest overall benefits, including economic, social, and biological considerations under the normal range of environmental conditions. Optimum sustained yield is different from maximum sustainable yield (MSY) in that MSY considers only the biology of the species under ideal conditions. Optimal sustained yield is always less than MSY.

Population - Fish of the same species inhabiting a specified area. It usually refers to a lake or, in the case of large, complex lakes, an identified portion of the lake.

PGT (Put-Grow-Take) – a form of fish stocking where small fish (either fry or yearlings) are stocked into a lake or stream with the intent that they grow to larger size and are caught by anglers. There is no intent to create a self-sustaining population with this approach.

Predator-Prey Relationship - The interaction between a species (predator) that consumes another species (prey). The stages of each species' life cycle and the degree of interaction are important factors.

Recreational Fishery - Harvesting fish for personal use, enjoyment and challenge. Recreational fishing does not include sale of catch or the sale of fishing opportunities. The term refers to and includes the fish resources, fishermen, and businesses providing needed goods and services such as tackle and bait.

Recruitment – In fisheries management, this term refers to the number of fish that enter a portion of a population (such as the spawning population) each year.

Relative Abundance - An index of fish population abundance used to compare fish populations from year to year. This does not measure the actual numbers of fish, but shows changes in the population over time.

SAR (Species at Risk) - These are species of plants, fish, mammals and birds that are at risk of disappearing due to a number of reasons which may include habitat loss, pollution, land use and resource management activities, as well as the

spread of invasive species. Species are determined to by at risk in Ontario by the Committee on the Status of Species at Risk in Ontario (COSSARO) and in Canada by COSEWIC (Committee on the Status of Endangered Wildlife in Canada). If a species is classified "at risk", they are added to the Species at Risk in Ontario (SARO) List in one of four categories, depending on the degree of risk. The four categories, or classes, of "at risk" are:
EXTIRPATED - a native species that no longer exists in the wild
ENDANGERED - a native species facing extinction or extirpation
THREATENED - a native species at risk of becoming endangered in Ontario
SPECIAL CONCERN - a native species that is sensitive to human activities or natural events which may cause it to become endangered or threatened

SARO (Species at Risk Ontario) – Species that are considered at risk in Ontario.

SDW (Specially Designated Water) – Waterbodies that because of their size, amount of effort or ecological, social or economic importance are considered to be important enough to be managed under individual lake management plans, and regulations. Criteria have been developed, and a list of SDW's for FMZ 5 is provided in Appendix 2-1.

SLIN (Spring Littoral Index Netting) - a fish population assessment method which uses short sets of small mesh gill nets in spring (May/early June) to capture fish with a special focus on lake trout populations. The intent is that the nets entangle fish rather than gill them allowing for release of most of the fish captured. The main advantage of this method is that it is relatively efficient in capture of lake trout and has been found to be consistent in the relationship between catch and fish abundance. The main disadvantage is that it is focussed primarily on just one species and has only a short period before lakes warm up that it can be done.

Socio-economics - A word used to identify the importance of factors other than biology in fishery management decisions. Includes things such as income derived from fisheries, angler attitudes and expectations, angling quality, etc.

SPIN (Summer Profundal Index Netting) - a fish population assessment method which uses short sets of small mesh gill nets set below the thermocline in summer (July/August)) to capture fish with a special focus on lake trout populations. The intent is that the nets entangle fish rather than gill them allowing for release of most of the fish captured. Except for the time of the year and location of sets, it is similar to SLIN. The main advantage of this method over SLIN is that there is a longer period when the netting can occur.

SPOF II (Strategic Plan for Ontario's Fisheries) - The 1992 document that sets provincial level strategic direction for fisheries management in Ontario. Notably, this plan promotes an ecosystem approach to fisheries management. This document is a follow-up to the original SPOF document produced in 1976.

TDS (Total Dissolved Solids) - a measure of all materials (including salts) which are dissolved in the water (mg/L). Usually determined by measuring how well water will pass an electrical current as more dissolved solids will pass electricity more easily. TDS has been found to be important in determining the overall productivity of lakes.

Thermocline - the narrow zone of rapid temperature change that separates the warm surface layer of water from the cold, deeper layer. During the summer, thise separates the coolwater habitat of the lake (known as the epilimnion) from the cold water habitat (known as the hypolimnion).

TOHA (Thermal Optical Habitat Area) – a model used to predict sustainable harvest levels of fish (in particular walleye) that includes the amount of available habitat area in a lake along with measures of lake productivity such as temperature and dissolved solids).

Total Length (TLEN) - The length of a fish as measured from the tip of the snout to the tip of the tail.

Under-utilized Species - A species of fish that has potential for additional harvest.

Winterkill – Winterkill is a form of fish mortality that is a result of oxygen levels in frozen lakes becoming too low to support fish. During winter, the lake is sealed off from the atmosphere and cannot be recharged with oxygenated air. Oxygen continues to be used in the lakes throughout the winter, especially for the decomposition of aquatic plants. Shallow lakes with excess amounts of aquatic vegetation and mucky bottoms are prone to this problem because they have limited amounts of oxygen stored in water to use and high rates of oxygen-consuming decomposition. Some fish species are very susceptible to winterkill while others (such as mudminnows) are adapted to surviving very low oxygen conditions.

Year Class – the fish spawned and hatched in a given year.

Yield - The production from a fishery in terms of numbers or weight.

Appendix 2-1. Specially Designated Waters (SDW's) and their associated waterbodies.

SDW name	Associated waterbodies	Area (ha) (Ontario waters only)
Lake of the Woods	Lake of the Woods	205,550
	Turtle Lake	180
	Obabikon Lake	1,685
	Rainy River	1,680
	Total Area	**209,095**
Shoal Lake	Shoal Lake	**24,800**
Rainy Lake	Rainy Lake	**72,120**
Winnipeg River system	Winnipeg River	8,425
	Eaglenest Lake	1,250
	Lost Lake	70
	Swan Lake	910
	Pistol Lake	575
	Tetu Lake	2,880
	Roughrock Lake	1,555
	Gun Lake	1,650
	Big Sand Lake	7,875
	Hidden Lake	
	Middle Lake	
	Muriel Lake	227
	Total Area	**25,190**
Wabigoon/Dinorwic system	Wabigoon Lake	10,385
	Mile Lake	165
	Trap Lake	260
	Paulson Lake	60
	Butler Lake	1135
	Larson Lake	180
	Olsen Lake	110
	Dinorwic Lake	5,090
	Minnehaha Lake	195
	Rock Lake	665
	Total Area	**18,245**
Eagle Lake	Eagle Lake	**31,825**

Appendix 2-2. Methodology for road density analysis within FMZ 5.

Purpose: Assessment of access to lakes within FMZ5 is evaluated using Road Density Analysis which classifies road density into low, medium and high.

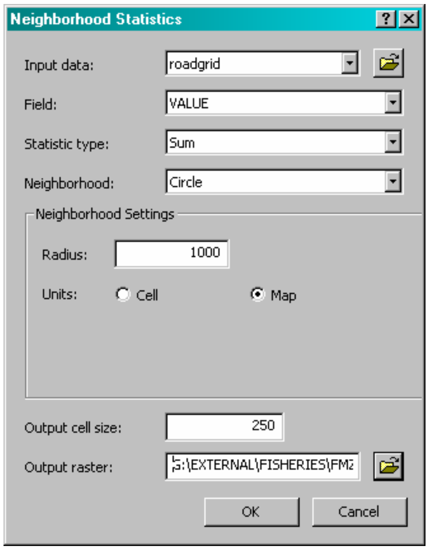
Data Source: NRVIS MNRRoagseg was the source data utilized. It was clipped to the FMZ5 boundary and named *RoadsFMZ5*. This new file contained roads within the administrative districts of Kenora, Dryden and Fort Frances.

Interpretation for Road Classification: a new attribute was added to define road classification into highways, primary, secondary and tertiary roads. Districts were at varying stages of updating the source MNRRoadseg file attributes which necessitated a variety of methods to define road classification.

Data Prep: An additional attribute was added to represent the weighting of roads utilized in the road density analysis process. Highways were assigned weighted value of highway-20, primary -15, secondary -10 and tertiary -5.

Spatial Analyst - Grid Analysis: *RoadsFMZ5Buff* (vector line file) was converted to rasterized (grid) @ 250mx250m cell size based on road classification (weight)

Spatial Analyst - Neighborhood Statistics were calculated on the raster image using weight as value field



Output = G:\EXTERNAL\FISHERIES\FMZ_5\8-GIS\Data\ROADS\roaddensity image file

Appendix 3-1. FWIN projects completed in FMZ 5 waterbodies (non-SDW).

Lake Name	District	Year (initial assessment)	Year (2nd assessment)
Agimak L.	Dryden	1995	
Amik L.	Dryden	2005	
Bar L.	Fort Frances	2000	
Barr L.	Fort Frances	2000	
Beak L.	Dryden	2000	
Bearpelt L.	Fort Frances	2000	
Beaverhouse L.	Fort Frances	1996	
Bending L.	Dryden	1997	
Bill L.	Fort Frances	2007	
Boffin L.	Fort Frances	2000	
Bradshaw L.	Fort Frances	2000	
Brewer L.	Fort Frances	1999	
Burditt L.	Fort Frances	1998	
Calm L.	Fort Frances	1998	2006
Chill L.	Fort Frances	2000	
Companion L.Upper	Fort Frances	2000	
Companion L.Lower	Fort Frances	2000	
Crooked Pine L.	Fort Frances	1998	2004
Cuttle L.	Fort Frances	1998	
Darby L.	Fort Frances	2000	
Despair, L.	Fort Frances	2000	
Dimple L.	Dryden	2000	
Dore L.	Dryden	1998	
Dovetail L.	Fort Frances	1996	2004
Drum L.	Dryden	2000	
Elbow L.	Fort Frances	1995	2003
Eltrut L.	Fort Frances	2000	2008
Factor L.	Fort Frances	2000	
Finlayson L.	Fort Frances	1997	2005
Footprint L.	Fort Frances	2000	
Husband L.	Fort Frances	2000	
Jac Saga L.	Dryden	2000	
Jackfish L.	Fort Frances	2000	
Jones L.	Fort Frances	2000	
Kaopskikamak L.	Fort Frances	2000	
Kawawiag L.	Fort Frances	2000	
Keckush L.	Fort Frances	2000	
Kenorain L.	Fort Frances	2000	2009
Kenozhe L.	Fort Frances	2000	
Kirk L.	Fort Frances	2000	
Lac la Croix	Fort Frances	1999	2003
Light L.	Fort Frances	2000	
Little Eva L.	Fort Frances	2006	
Little Eye L.	Fort Frances	2000	
Sandford L.	Fort Frances	2000	
Little Turtle L.	Fort Frances	2000	
Lower Marmion	Fort Frances	1996	2007
Mainville L.	Fort Frances	1998	
Manion L.	Fort Frances	2001	
Manomin L.	Fort Frances	2000	
Upper Marmion L.	Fort Frances	1994	2001
McAree L.	Fort Frances	1996	2007
Mercutio L.	Fort Frances	2000	
Minn L.	Fort Frances	1999	2008
Mount L.	Fort Frances	2000	
Namakan L.	Fort Frances	2004	2005
Niobe L.	Fort Frances	2000	2004
Old Man L.	Fort Frances	2000	
Otukamamoan L.	Fort Frances	1998	
Patricia L.	Fort Frances	2000	
Pekagoning L.	Fort Frances	1998	1999
Perch L.	Fort Frances	1998	2006
Pettit L.	Fort Frances	2000	
Pickwick L.	Fort Frances	1999	
Pipestone L.	Fort Frances	2000	
Pony L.	Fort Frances	2000	
Quetico L.	Fort Frances	1997	
Rawn Re.	Fort Frances	2000	
Richardson L.	Fort Frances	2000	
Robinson L.	Fort Frances	1999	
Rugby L.	Dryden	1997	
Sakwite L.	Fort Frances	2001	
Sand Point L.	Fort Frances	2000	2006
Sapawe L.	Fort Frances	2000	
Steep Rock L.	Fort Frances	1995	2002
Straw L.	Fort Frances	1999	
Sucan L.	Fort Frances	2000	
Surprise L.	Fort Frances	2000	
Twist L.	Fort Frances	2000	
Tyrell L.	Fort Frances	2000	
Union L.	Fort Frances	2000	
Vista L.	Fort Frances	2000	
Whalen L.	Fort Frances	2000	
White Otter L.	Fort Frances	2000	2007
Wolseley L.	Fort Frances	1997	

Appendix 3-2. SLIN projects completed in FMZ 5 waterbodies.

Lake Name	District	Year (initial assessment)	Year (2nd assessment)
Abbess	Fort Frances	2000	2010
Beaverhouse	Fort Frances	1997	
Clearwater	Fort Frances	1993	
Crook	Fort Frances	1997	
Crystal	Fort Frances	1993	2004
Dashwa	Fort Frances	1993	2006
Elbow	Fort Frances	1995	2009
Eva	Fort Frances	1994	2007
Grey Trout	Fort Frances	1999	
Islets	Dryden	2005	
Lac La Croix	Fort Frances	1997	
Lake #39	Fort Frances	1998	
Lilac	Fort Frances	1995	
McCauley	Fort Frances	1994	2008
Nym	Fort Frances	1993	2005
Quetico	Fort Frances	1998	
Robinson	Fort Frances	1999	
Rutter	Fort Frances	1998	
Secret	Fort Frances	1996	2009
Thompson	Fort Frances	1997	
Thunder	Dryden	2003	
Vickers	Fort Frances	1997	
Vista	Fort Frances	1997	

Appendix 3-3. NSCIN projects completed in FMZ 5 waterbodies.

Lake Name	District	Year (initial assessment)	Year (2nd assessment)
Abie	Fort Frances	2006	
Crooked Pine	Fort Frances	1998	2004
Crystal	Fort Frances	2001	2010
Eva	Fort Frances	2003	
Icy	Fort Frances	2006	
Kawene	Fort Frances	2002	
Lerome	Fort Frances	1998	2006
Nickleby	Fort Frances	2004	
Nym	Fort Frances	1999	2007
Pekagoning	Fort Frances	1999	
Plateau	Fort Frances	2000	2008
Pseudo	Fort Frances	1997	2005
Snow	Fort Frances	2006	

Appendix 3-4. List of lakes surveyed by Broad Scale Monitoring (BSM) 2010 in Fisheries Management Zone 5

Dryden	*Fort Frances*	*Kenora*
Augite	Abbess	Andy
Bending	Agnes	Atikwa
Daniels	Argo	Base
Dibble	Bad Vermilion	Big Island
Dore	Beaverhouse	Black
Edward	Bethune	Black Sturgeon Lakes
Godson	Blackstone	Blindfold
Gullwing	Bluffpoint	Blueberry
Horseshoe	Burditt	Caviar
Kawashegamuk (Long)	Burt	Cedartree
Kay	Calder	Cross
Lake WE66-23 (NL)	Calm	Cygnet
Little Gordon	Captain Tom	Dogpaw
Mountain	Cirrus	Dogtooth
Nixon (Aaron)	Clearwater West	Dryberry
Nora	Crooked Pine	Hawk (East Hawk)
Rugby	Crowrock	Kakagi
Stormy	Crystal	Longbow
Tadpole	Dovetail	Malachi
Thunder	Eltrut	NL
Wapageisi	Entwine	Old Man
Whitewater	Eva	Pelicanpouch
Windermere	Factor	Pickerel
Winnage (Buzzard)	Farley	Plum
	Finlayson	Populus
	Floodwaters	Porcus
	Grey Trout	Rowan
	Irene	Shrub
	Jackfish	Silver
	Jackfish (& West Jackfish)	Snook
	Jean	South Scot
	Kahshahpiwi	Whitefish
	Kaiashkons	
	Katimiagamak	
	Lawrence	
	Lilac	
	Little Kishkutena	
	Little Turtle	
	Loonhaunt	
	Louisa	
	Lower Manitou	
	Lower Marmion	
	Manion	
	McEwen	
	Mercutio	
	Minn	
	Mount	
	Nym	
	Off	
	Other Man	
	Otukamamoan	
	Perch	
	Pettit	
	Pickerel	
	Pipestone	
	Poohbah	
	Priam	
	Rawn Reservoir	
	Saganagons	
	Sandbeach	
	Sandford	
	Sarah	
	Schistose	
	Sheridan	
	This Man	
	Thompson	
	Turtle	
	Union	
	Upper Manitou	
	Upper Scotch	
	Vista	
	Wasaw	
	White Otter	
	Your	

Number of lakes assessed		
Dryden	***Fort Frances***	***Kenora***
24	**74**	**32**

Total number of lakes assessed

130

Appendix 5-1: Summary of recreational angling effort from the most recent open-water creel (angler) surveys completed on lakes within Fisheries Management Zone 5 since 1986 (adapted from Cano and Parker, 2007).

District	Lake	Year	Effort (hrs)	Effort (hrs/ha)	% Res	% Non-res	Survey Type
Fort Frances	Bad Vermilion	1988		8.7	11.3	88.7	roving
	Burditt	2003	30,450	21.6	3.6	90.1	roving
	Crooked Pine	1990	12,665	6.5	41.0	59.0	access
	Cuttle	1989	3,070	5.5	15.0	85.0	roving
	Dash	1987	1,470	5.3	0.0	100.0	roving
	Despair/Footprint/Jackfish	2003	56,900	16.1	9.9	90.1	roving
	Dovetail	1997	750	1.0	100.0	0.0	access
	Eltrut	1988	4,311	1.8	65.4	34.6	roving
	Eye	1997	7,200	6.0	34.0	66.0	access
	Finlayson	1989	13,790	9.4	7.0	93.0	roving
	Furlonge	1987	333	1.9	100.0	0.0	roving
	Kaiarskons	1987	8,845	4.1	3.1	96.9	roving
	Katimiagamak	1987	4,341	4.2	0.0	100.0	roving
	Kishkutena	1987	12,327	11.6	0.0	100.0	roving
	Lac La Croix	1996	46,200	7.7	1.0	99.0	roving, Ontario waters
	Little Turtle	1988	11,263	5.1	10.5	89.5	roving
	Loonhaunt	1987	6,743	3.3	3.9	96.1	roving
	Mainville	1989	7,286	8.4	31.0	69.0	roving
	Marmion (Upper)	1989	6,418	1.9	15.0	85.0	roving
	McAree	1996	10,043	12.1	1.0	99.0	roving
	Namakan	1998	18,784	3.6	0.5	99.5	roving, Ontario waters
	Obikoba	1989	3,354	8.0	30.0	70.0	roving
	Panorama	1987	890	1.8	0.0	100.0	roving
	Pickwick	1989	5,689	11.5	27.0	73.0	roving
	Pipestone/Schistose	2003	23,230	5.2	5.4	94.6	roving
	Quetico	1997	4,143	1.0	0.0	100.0	roving
	Sand Point	1998	16,465	9.2	1.0	99.0	roving, Ontario waters
	Scattergood	1986	1,997	7.1	75.0	25.0	access, August only LT season
	Seine River (Seine chain)	1989	39,425	10.9	31.0	69.0	roving
	Slender	1987	1,643	6.8	0.0	100.0	roving
	Sphene	1987	1,315	2.6	0.0	100.0	roving
	Thompson	1997	487	0.5	0.0	100.0	roving
	Tupman	1989	217	0.5	67.0	33.0	roving
	Weller	1989	4,696	9.4	83.0	17.0	roving
	Wolseley	1997	1,481	1.1	0.0	100.0	roving
	Yoke	1987	2,658	4.2	0.0	100.0	roving
	Rainy	2001/02	302,469	4.3	26.0	74.0	roving, Ontario waters
	Rainy River	1997	5,836	3.5	73.0	27.0	roving, spring, Ontario waters
Kenora	Lake of the Woods	2008	832,666	3.8	28.0	72.0	roving, Ontario waters
	Winnipeg River	2007	188,829	11.1	36.0	64.0	roving, Ontario waters
Dryden	Eagle	2010	136,339	4.9	9.5	90.5	roving
	Wabigoon	2009					roving, data not yet available
	Dinorwic	2009					roving, data not yet available
All Lakes							-
Average	**-**	**-**	**52,514**	**6.4**	**22.9**	**76.9**	**-**
Minimum	-	-	217	0.5	0.0	0.0	-
Maximum	-	-	832,666	21.6	100.0	100.0	-
Non-SDW Lakes							
Average	**-**	**-**	**10,597**	**6.3**	**21.5**	**78.4**	**-**
Minimum	-	-	217	0.5	0.0	0.0	-
Maximum	-	-	56,900	21.6	100.0	100.0	-

Appendix 5-2: Summary of catch per unit effort (CUE) (# fish caught/rod-hour) by species from the most recent open-water creel surveys completed on lakes within Fisheries Management Zone 5 since 1986.

District	Lake	Year	Walleye	N. Pike	SM Bass	Lake Trout	Muskie
Fort Frances	Bad Vermilion	1988	0.23	0.22	0.23	0.09	-
	Burditt	2003	0.17	0.33	0.57	-	0.02
	Crooked Pine	1990	0.07	0.42	0.41	-	-
	Cuttle	1989	0.40	1.64	-	-	-
	Dash	1987	-	0.04	-	-	-
	Despair/Footprint/Jackfish	2003	0.51	0.54	0.69	-	-
	Dovetail	1997	0.85	0.10	0.11	-	-
	Eltrut	1988	0.97	0.32	-	-	-
	Eye	1997	0.40	0.20	0.31	-	-
	Finlayson	1989	0.51	0.07	-	-	-
	Furlonge	1987	-	-	-	0.38	-
	Kaiarskons	1987	0.14	0.30	-	0.19	-
	Katimiagamak	1987	-	-	0.90	-	-
	Kishkutena	1987	-	-	1.61	-	0.04
	Lac La Croix	1996	0.70	0.24	0.40	0.08	-
	Little Turtle	1988	0.33	0.81	0.13	-	-
	Loonhaunt	1987	0.01	0.29	0.35	0.13	-
	Mainville	1989	0.59	1.78	-	-	-
	Marmion (Upper)	1995	0.86	0.42	-	-	-
	McAree	1996	0.77	0.14	0.60	-	-
	Namakan	1998	0.49	0.11	0.80	-	-
	Obikoba	1989	0.49	1.12	-	-	-
	Panorama	1987	-	0.23	-	-	-
	Pickwick	1989	0.46	0.43	-	-	-
	Pipestone/Schistose	2003	0.19	0.43	1.10	0.10	0.03
	Quetico	1997	0.08	0.10	0.39	0.03	-
	Sand Point	1998	0.26	0.24	0.57	-	-
	Scattergood	1986	-	-	-	0.53	-
	Seine River (Seine chain)	1989	0.54	0.37	0.33	-	-
	Slender	1987	-	0.08	1.50	0.10	0.04
	Sphene	1987	-	0.37	1.52	-	-
	Thompson	1997	-	-	-	-	-
	Tupman	1989	0.94	0.85	-	-	-
	Weller	1989	0.54	0.84	-	-	-
	Wolseley	1997	-	0.71	1.13	-	-
	Yoke	1987	-	-	1.15	-	-
	Rainy*	2001/02	0.87	0.65	0.59	-	0.04
	Rainy River*	1997	0.13	0.01	-	-	-
Kenora	Lake of the Woods*	2008	1.17	0.28	0.39	0.15	0.06
	Winnipeg River*	2007	0.92	0.68	0.84	-	0.04
Dryden	Eagle*	2010	1.24	0.52	0.24	0.16	0.09
	Wabigoon*	2009	-	-	-	-	-
	Dinorwic*	2009	-	-	-	-	-
All Lakes							
Average	**-**	**-**	**0.50**	**0.45**	**0.69**	**0.18**	**0.04**
Minimum	**-**	**-**	**0.01**	**0.01**	**0.11**	**0.03**	**0.02**
Maximum	**-**	**-**	**1.24**	**1.78**	**1.61**	**0.53**	**0.09**
Non-SDW Lakes							
Average			**0.46**	**0.46**	**0.70**	**0.18**	**0.03**
Minimum			**0.01**	**0.04**	**0.11**	**0.03**	**0.02**
Maximum			**0.97**	**1.78**	**1.61**	**0.53**	**0.04**

* denotes Specially Designated Water (SDW), and mean lake-wide values

Appendix 5-3: Summary of the 2010 competitive fishing events in FMZ 5 by administrative District and waterbody.

District	Event Name	Lake(s)	Fish Species	Type (Release or Kill)	Issues/Comments (sustainability, mortality, displacement, timing, etc)
Dryden	Dryden Walleye Masters	Wabigoon/Dinorwic*	Walleye	Catch & Release	Displacement, mortality, no fisheries assessment
	Agimak Lake Fishing Competition	Agimak	Walleye/Pike Bass/Perch	Catch & Release	Walleye mortality
	Dingwall Ford Bass Classic	Wabigoon/Dinorwic*	SM Bass	Catch & Release	Displacement
	Wabigoon Lake First Nation Derby	Dinorwic*	Walleye	Catch & Release	Mortality
	Vermilion Bay Winter Carnival Derby	Eagle*	Walleye	Catch & Release	Mortality
	Big Brother/Big Sisters Derby	Wabigoon*	Walleye	Catch & Release	Mortality
	Angler & Young Angler	Wabigoon*	Walleye	Catch & Release	Mortality
Fort Frances	Atikokan Bass Classic	Crowrock/Dashwa (1994-07) Marmion (2008-10)	SM Bass	Catch & Release	Trophy mgmt, off-site weigh-in
	Castin' for Cash	Despair/Footprint/ Jackfish	SM Bass	Catch & Release	Displacement, increased effort, timing (held before July 15th)
	Robert Ottertail Jr. Memorial Bass Tournament	Lac La Croix	SM Bass	Catch & Release	Lack of holding and live transport equipment
	Perch Lake Bass Challenge	Perch (and adjacent lakes on Seine River)	SM Bass	Catch & Release	
	Fort Frances Canadian Bass Championship	Rainy*	SM/LM Bass	Catch & Release	Displacement increased effort, hooking injury/mortality. Fisheries assessment value.
	Rainy River Walleye Classic	Rainy River*	Walleye	Catch & Release	Mortality
	Emo Walleye Classic	Rainy River*	Walleye	Catch & Release	Mortality, timing (held in June)
	Stratton Fish Derby	Rainy River*	Walleye/Pike	Kill	Mortality
	MEC Fish Derby	All Lakes	Lake Trout	Kill	Mortality, fishing quality, winter
Kenora	Shaw Kenora Bass International	Lake of the Woods*	SM/LM Bass	Catch & Release	Displacement, fisheries assessment value.
	Gary Roach Pro-Am	Winnipeg River*	Walleye	Catch & Release	Mortality
	Shoal Lake Bass Classic	Shoal*	SM/LM Bass	Catch & Release	Displacement, timing (held in early July)
	Morson Bass International	Lake of the Woods*	SM/LM Bass	Catch & Release	Displacement
	Minaki Walleye Classic	Winnipeg River*	Walleye	Catch & Release	Mortality, timing (held in July)
	Shoal Lake Last Chance	Shoal*	SM/LM Bass	Catch & Release	Displacement (held in mid-September)
	Bass'n For Bucks	Lake of the Woods*	SM/LM Bass	Catch & Release	Displacement. Fisheries assessment value.
	Whitefish Bay Bass Challenge	Caviar, Dogpaw, Flint	SM Bass	Catch & Release	Not aware of any (held mid-July)
	Lac-Lu Puff Fire Hall	Lac-Lu	SM Bass	Catch & Release	Not aware of any (held in mid-September)
	Angler & Young Angler (National)	Lake of the Woods*	Walleye	Catch, Record & Release	Not aware of any (new rules for CPR)
	Nestor Falls Winter Fish Derby	Lake of the Woods*	Crappie/ Walleye/Pike	?	Winter
	Morson Annual Live Release	Lake of the Woods*	Crappie/ Walleye/Pike	Catch & Release	Winter
	Keewatin Legion Family Fish Derby	Lake of the Woods*	Any	Catch & Release	Winter
	Kenora Bronzeback Classic	Lake of the Woods*	SM/LM Bass	Catch & Release	Displacement, mortality
	Crow Lake Classic	Crow	SM Bass	Catch & Release	
	Casey's Ice Fishing Derby	Lake of the Woods*	Any	Catch & Release	Winter
	Black Sturgeon Bass Tournament	Black Sturgeon	SM/LM Bass	Catch & Release	Displacement (held in mid-September)
	Paradise Cove Summer Walleye Classic	Winnipeg River*	Walleye	Catch & Release	Displacement, mortality
	Canadian Tire Fishing Derby	Lake of the Woods*	Any	?	Mortality. In association with LOWISA
	Crystal Harbour Ice Fishing Derby	Lake of the Woods*	Lake Trout	?	Winter
	Kenora Hospitality Alliance Fishing Derby	Any	All	?	Guests of local hotels/motels
	LOWS Annual Live Release	Lake of the Woods*	Any	Catch & Release	

*** denotes Specially Designated Water (SDW)**

Appendix 5.4 Lakes with commercial fisheries within FMZ 5

District	Water body	SDW	Non SDW
Kenora	Lake of the Woods	X	
	Shoal Lake	X	
	Winnipeg River	X	
	Dogpaw Lake		X
	Caviar Lake		X
	Cameron Lake		X
	Kakagi Lake		X
	Rowan Lake		X
	Black Sturgeon Lake		X
	Atikwa Lake		X
Dryden	Eagle Lake	X	
	Wabigoon Lake	X	
	Butler Lake (consider part of Wabigoon)	X	
	Cobble Lake		X
	Edward Lake		X
	Indian Lake		X
	Whitney Lake		X
	Long Lake (Kawaskegamuk)		X
	Stormy Lake		X
	Thunder Lake		X
	Gullwing Lake		X
Ft.Frances	Rainy Lake	X	
	Rainy River	X	
	Seine River		X
	Pettit Lake		X
	Mount Lake		X
	Lower Manitou Lake		X
	Esox Lake		X
	Upper Manitou Lake		X

Appendix 5.5 Restrictions placed on the harvest of bait fish for personal use with a recreational fishing licence (OMNR 2010)

Bait	Limit	Notes
Baitfish	120 Includes those caught or purchased. See list of permitted baitfish species.	Only resident anglers may capture baitfish, using the methods outlined below. One baitfish trap no more than 51 cm (20 in.) long and 31 cm (12.2 in.) wide can be used day or night. Baitfish traps must be clearly marked with the licence holder's name and address. One dip-net no more than 183 cm (6ft.) on each side if square, or 183 cm (6 ft.) across if circular, during daylight hours only (after sunrise and before sunset). Dip-nets and baitfish traps may not be used in Algonquin Park.
Leeches	120 Includes those caught and or purchased.	Only one leech trap no more than 45 cm (17.7 in.) in any dimension can be used day or night to capture leeches. Leech traps must be clearly marked with the licence holder's name and address.
Crayfish	36	Must be used in same water body where caught. May not be transported overland. May be captured by hand or using the methods outlined for Baitfish, above.
Frogs	12	Only northern leopard frogs may be captured or used as bait.

Appendix 6-1. List of lakes stocked since 2000 in Fisheries Management Zone 5.

Put-Grow -Take lakes

Lake name	District	Species stocked	size/age	Number stocked	Frequency
South Crook	Fort Frances	brook trout	yearlings	4000	annually
Bold Lake	Fort Frances	splake	yearlings	7000	every other year
Hoard Lake	Fort Frances	splake	yearlings	4000	every other year
Arpin Lake	Kenora	splake	yearlings	3000	sporadically
Arpin Lake	Kenora	rainbow	yearlings	3000	every other year
Howard Lake	Kenora	brook trout	yearlings	1400	every other year
Dixie Lake	Kenora	brook trout	yearlings	500	every other year
Dixie Lake	Kenora	splake	yearlings	2500	sporadically
Percy Lake	Kenora	brook trout	yearlings	500	every other year
Percy Lake	Kenora	splake	yearlings	4000	sporadically
Emerson	Kenora	brook trout	yearlings	1000	every other year
East Emerson	Kenora	brook trout	yearlings	1000	every other year
Tox Lake	Kenora	brook trout	yearlings	600	every other year
Emerald Lake	Dryden	brook trout	yearlings	840	every other year
Snowfall Lake	Dryden	rainbow trout	yearlings	4000	every other year
Little Clobber Lake	Dryden	splake	yearlings	2500	every other year
Anteater Lake	Dryden	brook trout	yearlings	6000	annually
George Lake	Dryden	splake	yearlings	6000	every other year
Dogtooth	Kenora	splake	yearlings		discontinued in 2001

Introduction stocking

Lake name	District	Species stocked	Year first stocked
Caribus	Fort Frances	walleye	2002
Fotheringham	Fort Frances	walleye	1991
Caldwell	Fort Frances	walleye	1993

Appendix 9-1. Fisheries Management Issues and Challenges – Advisory Council

Introduction

The FMZ 5 Advisory Council met to identify issues and challenges to fisheries management in FMZ 5 on August 31and Oct 5, 2011. The purpose was to identify issues that will be used as a basis for developing management objectives, strategies and actions in the FMZ 5 Fisheries Management Plan.

The objectives of the meeting were to

- develop a list of all fisheries issues, challenges and opportunities in the zone;
- summarize and describe issues including separating issues from symptoms of issues.
- Complete an initial prioritization of issues to identify which issues the council thought were important.
- Complete a second prioritization to determine which of these important issues were most appropriate to be addressed in this Fisheries Management Plan.

Eight members of the council were present at the August 31 meeting and contributed to identified issues and challenges through a process facilitated by an MNR staff member (Appendix 1). A similar exercise had been previously completed by the MNR project team. The priority issues and broader management considerations from the MNR exercise were shared with the Advisory Council part way through their issue identification exercise as a way of ensuring all critical issues were identified.

The meeting on August 31 identified a wide list of issues and concerns for fisheries management in the zone. These issues were ranked by what the Advisory Council felt the most important issues were affecting fisheries management in the zone. The council was directed to prioritize issues solely based on how important they felt they were without being concerned about how they could be addressed (see Appendix 2 for results). Note that following the meeting, two new issues were identified by MNR staff from comments that had previously been combined with other issues. These issues were not identified separately and were not available for consideration during the initial voting exercise.

The subsequent meeting on October 5, 2011 was attended by nine council members (Appendix 3) and provided the opportunity to review and confirm that all issues have been captured and add any that are missing. The issues were also re-ranked with the purpose of selecting those issues which were most suitable to be addressed in the 2013 Fisheries Management Plan which are shown in Table 1. There is a recognition that not all issues can be dealt with effectively within a Fisheries Management Plan or at least within the time frame of the first plan cycle and may be deferred to a subsequent plan. The issues are grouped by categories of exploitation, socio-economic, habitat, and biodiversity/invasive species.

A number of items that were considered important during the first round of voting were not selected as items to be addressed in this Fisheries Management Plan. These are identified in Table 2 along with decision rationale.

In addition to issues that would be addressed with specific objectives and actions in the plan, the advisory team identified a number of broad concerns that, while not specific to a individual issue, need to be considered in developing objectives, strategies and tactics. (Table 3).

The advice from the Council on issues and concerns was combined with similar direction from MNR staff to produce the list of issues that will be addressed in the FMZ 5 Fisheries Management Plan.

Table 1. Summary of Fisheries Management Issues/Challenges identified by FMZ 5 Advisory Council with priority voting results for which issues should be addressed in Plan.

Issue	Description	Final priority (priority for FMZ 5 plan) (# of votes Oct 5)
Sustainability of lake trout populations	Manage to maintain healthy and harvestable lake trout populations *See also angling regulation comments below(Table 3)*	11
Managing quality of walleye fishery	Concern about over harvest of mature spawning walleye and need for new or changed regulations such as protected slot size on walleye or close season earlier in response to earlier ice out. *See also angling regulation comments below(Table 3)*	8
Management objective for smallmouth bass	Are they invasive or naturalized or both within zone? - bass have been in zone for 100 years and are not going away. Are regs achieving objectives (what are objectives for bass?). Current bass restrictions in spring may be increasing walleye harvest. *See also angling regulation comments below(Table 3)*	5
Northern Pike Regulation/ Objectives	Are the current regulations (0 harvest from 70-90cm) meeting objective - what is objective? Does current regulation make sense? Poor acceptance leading to enforcement issues. Was the previous regulation (1 over 70cm) just as effective? *See also angling regulation comments below(Table 3)*	5
Exploitation of crappie	Concern that the harvest of crappie is too high - Limit too high, Close the season during spawning period	4

Access	Concern about balance between too much access causing exploitation issues on sensitive lakes and user conflicts (eg. outpost/road based anglers) and not enough access focusing effort on a few lakes. Comments ranged from concerns about loss of access to concerns that lakes in FMZ 5 are maybe too accessible resulting in reduced fish populations and importance of protecting tourism facilities through road controls/removals. Boat cache program, culvert removals/road closures, maintenance of access points, lake access during winter ("roadside parking") all part of access balance issue.	3
Lack of guidelines for competitive fish tournaments	Need tournaments guidelines established and enforced to ensure tournaments properly care for fish (fish mortality concern); permits would allow limits to lake area fished resulting in reduced mortality and moving fish from one area of a lake to another.	3
Fish habitat impacts	Impacts on fish habitat by development such as hydroelectric dams, mining, and climate change, etc. Mining developers seems to be able to do a lot more damage than they should or than other industries (eg. forestry). Concern that decisions that impact fisheries should not ignore MNR input e.g. mining claims being developed for real estate being controlled by Municipal Affairs; Loss of value of lake from both tourism and recreation; fisheries concerns largely ignored in process	2
Education of angling impacts on fish populations	Concern is about a lack of knowledge by anglers about regulations (eg shore lunch included in limit), impacts of catch and releases (eg release of walleye from deep water, culling fish held in livewells), invasive species, etc. Also, lack of ethical considerations by anglers, both within the law (e.g. catch release fishing in high mortality situations) and outside the law (e.g catch and release fishing during closed seasons for muskie). Science knowledge gaps identified include impacts of ingested plastic baits on fish.	1
Non-resident day use anglers	Concern about access to FMZ 5 fishery from US based anglers How do we ensure appropriate economic return from US based anglers/day use anglers; Would a guide requirement for non-res anglers work??	1

Water quality	Concerns with increase in algae; water less clear - decline in fish population as a result. Concerns with contaminant levels in game fish Development impact on water quality eg. mining, forestry, cottages	1
Non-resident harvest	What is the number of guests allowed at outpost camps per year? Non-residents harvest most of FMZ5 fish - how do we ensure we are getting the most economic benefit from this without depleting the resource?	1
Boat caches	Inconsistent application throughout the zone; no net benefit to MNR Exclusive use of lake by some/should be equal opportunity - possible permits for shorter period of time; Commercial vs. private - allocation between users, fairness Social economic issue about how it is administered	0
Illegal/unlicenced commercial fishing	Commercial activity with fish harvested by subsistence fishing. Illegal sale of from alternate/untargeted species from commercial fishing (non-quota species). Waste of untargeted species in commercial catch. How accurate are estimates of subsistence harvest and how does it impact allowable harvest by anglers.	0
Enforcement	Concern over apparent lack of enforcement, Lack of officers and dollars to support current officers, anglers over exploitation daily, Desire to legalize party fishing and registration of ice huts	0
Sturgeon angling regulations	There is good economic potential (see US side) for catch & release fishery that has been recently lost; Is there a biological reason why a catch and release fishery could not occur and why sturgeons classification under the ESA? *See also angling regulation comments below (Table 3)*	0
Invasive Species	Concern about impact of invasives on native species. Transfer through bait industry & anglers dumping unused bait in lakes, and willful transfer of species (eg. crappie, bass).	0

New regulations in parks	As new park management plans are developed (eg. Turtle R.-White Otter PP), should consistent regulations with rest of zone, regulations would be simpler; no need to restrict the regulations anymore; loss of fishing opportunities. No organic bait in Quetico Park a concern to anglers; what is biological justification? Lots of lake trout observed with undigested plastic in stomachs.	0
Musky regulations	Concern that size limits are too restrictive in some cases (muskie never get as big as minimum size); concern about impacts of catch and release muskie fishery on harvested northern pike populations.	0
Whitefish overharvest	Concern that exploitation, especially from commercial fishery, could impact whitefish populations	0
New technology	New technology (US website posting exact fishing locations from GPS units) increasing angling effort in good areas.	0
Tourist operations from private cabins	Private cabins are being used as commercial Tourist Operations general exploitation of fishery more effective enforcement; Exploitation issue (increased harvest from cabins beyond what would be expected from a private facility); Takes economic opportunities from licensed operators	
	Total votes (9 members present)	45

Table 2. Fisheries Management Issues/Challenges identified by FMZ 5 Advisory Council as important but not included in Fisheries Management Plan with rationale for non-inclusion.

Issue	Description	Rationale for not including in 2013 FMZ5 Plan
Boat caches	Inconsistent application throughout the zone; no net benefit to MNR. Exclusive use of lake by some/should be equal opportunity - possible permits for shorter period of time; Commercial vs private - allocation between users, fairness. Social economic issue about how it is adminsitered	Many of the concerns and questions with the boat cache program are related to MNR's current policy around the program. The advisory council felt that this issue was not most effectively dealt with through the FMP plan process but would be interested in providing advice to the MNR during the next regional boat cache review.
Unlicenced/illegal commercial fishing	Commercial activity with fish harvested by subsistance fishing. Illegal sale of from alternate/untargeted species from commercial fishing (non-quota species). Waste of untargetted species in commercial catch. How accurate are estimates of subsistance harvest and how does it impact allowable harvest by anglers.	This issue involved aspects of First Nation treaty and aboriginal rights which have been or will be decided by the courts. Since these decisions would have higher authority than the FMZ 5 Fisheries Management Plan, the Advisory Council felt that it limited ability to affect decisions around this issue.
Enforcement	Concern over apparent lack of enforcement, Lack of officers and dollars to support current officers, anglers illegally over harvest daily, Desire to legalize party fishing and registration of ice huts	This issue is essentially due to budget decisions by the government. Beyond identifying the concern, the Council felt there was little they could do to influence these decisions through the Fisheries Management Plan.
Sturgeon angling regulations	There is good economic potential (see US side of Rainy River) for catch & release fishery that has been recently lost; Is there a biological reason why a catch and release fishery could not occur and why sturgeons classification under the ESA? *See also angling regulation comments below*	This issue was seen as being more important on some of the Specially Designated Waters in the zone, especially Rainy River/Lake of the Woods. It was felt by the Council that it may be more properly addressed through the Individual Lake Management Plans for these waterbodies rather than through the zone plan.

Table 3 – Broad issues identified by the FMZ 5 Advisory Council to consider during FMZ 5 Fisheries Management Planning.

Issue	Description
First Nation Fishing	- First Nation Treaty/Aboriginal rights allow for subsistence harvest of fish. - In some cases, this may result in challenges with allocation of fisheries to other users to prevent exploitation issues. - Need to consider current and future First Nation harvest when making fish allocation decisions.
Angling Regulation considerations	- Regulations need to be simple and easy to understand by anglers; - Need to review current regulations in light of latest biological data see if they meet objectives for fisheries; e.g. Are current limits sustainable? What is purpose of "trophy slots" and should large fish be used for consumption? - Provincial scale regulations not always best.
General fisheries management concerns	- Desire to be able to catch fish and eat fish. - Want to ensure there are fish for future generations (sustainability of populations at current levels or better). - Some fisheries better managed by lake specific regulations. - Changing fishing pressure in winter from changes in ice conditions (eg. open water fishery in April becoming more common).

Appendix 9.1-1. Attendees of FMZ 5 Advisory Council Issues and Challenges identification meeting - August 31, 2011.

FMZ 5 Advisory Council Members

Tom Beck
Paul Blanchfield
Richard Boileau
Bob Burns
Roy DeCorte
Phil Haggberg
Al Ufland
Jeff Johnson (alternate for Ralph Hill)

MNR staff

Dan Taillon (facilitator)
Greg Chapman
Matt Myers
Jeff Wiume
Leo Heyens
Matthew Benson
Darryl Mcleod
Barry Corbett
Lisa Eddy
Brian Jackson
Patti Collett

Appendix 9.1-2 – Summary of Advisory Council initial voting results (August 31, 2011 meeting)

Issue	# of votes
Managing quality of walleye fishery	5
Boat caches	5
Illegal/unlicenced commercial fishing	4
Sustainability of lake trout populations	3
Access	3
Education of angling impacts on fish populations	3
Enforcement	3
Sturgeon angling regulations	2
Invasive Species	2
Management objective and regulations for smallmouth bass	2
Non-resident day use anglers	2
Fish habitat impacts	2
New regulations in parks	1
Northern Pike Regulation/Objectives	1
Water quality	1
Tourist operations from private cabins	1
Exploitation of crappie	0
Musky regulations	0
Lack of guidelines for competitive fish tournaments	0
Whitefish overharvest	0
	40 votes

Appendix 9.1-3. Attendees of FMZ 5 Advisory Council Issues and Challenges selection meeting – October 5, 2011.

FMZ 5 Advisory Council Members

Tom Beck
Paul Blanchfield
Richard Boileau
Bob Burns
Al Ufland
Ralph Hill
Jeremy Dickson
Lucas Adams
Paul Darling

MNR staff

Greg Chapman
Deb Weedon
Matthew Benson
Barry Corbett
Lisa Eddy
Brian Jackson
Patti Collett

Appendix 9-2. Fisheries Management Issues and Challenges – MNR Project Team

Introduction

The FMZ 5 Project team met two times (April 13, 2011 and June 22, 2011) to identify MNR issues and challenges to fisheries management in FMZ 5. The purpose of these meeting was to develop a prioritized list from an MNR view that would be combined with issues and challenges identified by the FMZ 5 advisory council to be used as a basis for developing management objectives, strategies and actions in the FMZ5 Fisheries Management Plan.

The meeting in April identified a broad list of issues and concerns for fisheries management in the zone (see appendix 1). The meeting on June 22 narrowed down this list to those issues that were more appropriate to be addressed in the 2013 Fisheries Management Plan. The following list represents these issues that MNR staff feels are highest priority for management action (Table 1).

In addition to specific issues that would be addressed with specific objectives and actions in the plan, the project team identified a number of concerns that while not specific to a specific issue, need to be considered in developing objectives, strategies and tactics for most if not all of the specific issues.

These broad issues include:

8. Climate change
    - ➢ Need to understand how it will impact fish populations and how does MNR respond;
    - ➢ Example is season opening dates versus changes in spawning season with variable temperatures.
    - ➢ Need community synthesis of potential impacts:
    - ➢ Need a way to measure risks, define management response and put into planning process;
    - ➢ Corporately, no policy to address climate change response:
    - ➢ Can affect allocations and user expectations;
    - ➢ Is current monitoring program sufficient to track climate change;
    - ➢ Quetico Park monitoring

9. Commercial fishing by First Nations
    - ➢ First Nations commercial fishing could influence how we manage fish populations and recreational fisheries.
    - ➢ We need to take FN commercial fishing into account by being more conservative in our management approach to recreational fisheries.
    - ➢ The species that would be most affected by the management of commercial fisheries in the zone are whitefish.
    - ➢ A management action might be to encourage First Nations to focus their use of the resources on tourism opportunities.

10. Angling ethics and potential impacts on exploitation

- Anglers continue to act unethically (eg fishing during closed season, eat limit for shore lunch and continue to fish); can impact sustainability
- Have fallen behind on education, especially in areas that are within the law (eg. catch and release fishing of deep water walleye);
- Need to define conservation resource use/value
- Internal communication barriers.
- A related issue is ensuring that any tactics or regulations developed during the plan are well supported by science and data, their purpose explained to anglers so they understand the need and tactics are acceptable to anglers to address the issue.

11. Land use/development decisions
    - A number of existing land use and development decisions have occurred in the past that are beyond the scope of this project to change (eg. number of cottaging lakes or tourism development in zone.). However, these need to be considered when developing objectives. Conflicts between which groups requesting access to fishing opportunities may be higher in FMZ 5 than other Northwest Region zones because of the higher level of development and increased demand on a finite fisheries resource.

12. FMZ 5 lake characteristics
    - The inherent lake productivity, fish community, etc need to be considered when developing objectives and targets for fish species in the zone.

13. Review of the effectiveness of current management tactics and regulations at meeting FMZ 5 objectives.
    - We need to review all of our current regulations to determine if they are accomplishing the management objectives and to determine if there are opportunities for streamlining.
    - We need to examine the current regulations for each species
    - The challenge will be that there are no clear management objectives in some cases.

The specific issues that MNR staff feel should be brought forward as items to be addressed through development of objectives, strategies, and actions/tactics are listed below (Table 1) and described below. The issues are grouped by categories of exploitation, development, habitat, biodiversity/invasives, changing environment. Issues were prioritized by asking each member of the project team to select their top 5 issues. Issues discussed but determined that they should not be addressed in this plan are presented in Appendix 2.

Table 1. Summary of Fisheries Management Issues/Challenges proposed by MNR Project Team to be addressed in FMZ 5 (by priority).

Issue Category	Issue/Management Challenge	Description	Priority
Exploitation	Walleye fishing quality	Walleye exploitation concern from the perspective of maintaining an acceptable level of fishing quality.	1
Biodiversity/Invasive /Introduced Species	Smallmouth bass/ black crappie management	What is the management objective for bass and crappie?	2
Development	Impacts of development on fish habitat and exploitation	Development has impacts on level of exploitation and habitat to support populations at acceptable levels.	2
Biodiversity/Invasive /Introduced Species	Introduction of invasive species	Potential for invasive species to reduce productivity of native species.	4
Exploitation/Changing Environment	Lake trout management	Lake trout population management needs to consider angling effort (non-resident and resident) and non-angling impacts such as invasive species and climate change.	5
Exploitation	Competitive fishing	Lack of policy/licensing of competitive events	6
Exploitation	US based non-resident use of fisheries.	Loss of economic opportunities due to US based non-resident use of shared fish stocks	7
Exploitation	Northern pike fisheries	Current regulation for pike fishery	7

Description of Identified Issues

Issue Category: Exploitation

2. Issue/Management Challenge: Walleye exploitation concern from the perspective of maintaining an acceptable level of fishing quality.

Considerations

- Primary focus of the FMZ 5 plan is the management of fish populations as part of recreational fisheries.
- Generally, not considered a biological sustainability issue here, we have a social issue around maintaining acceptable level of angling quality.
- In this case we may want to work with the user groups on the council to define what an acceptable level of fishing quality is for this zone. It was felt that this was necessary given the importance of walleye fishery to the tourist industry and resident anglers.
- MNR's role is to indicate that the majority of lakes in the zone have a fish abundance of X. In other words, MNR provides the resources while it is the tourist industry who markets the opportunities.

- Non-resident of the USA fishing effort on walleye
  - Harvesting by non-residents through the tourist industry is the largest component of harvest producing the walleye fishing quality concern. (Based on 2005 data 72% of fishing effort zone wide is generated by non-resident anglers)
  - Day tripping by non-residents is not really an issue at this time because of the border water regulations (see issue 6 below). We are not seeing an increase in US based day tripping.
  - Non-residents are focused primarily on walleye with secondary interest in pike, bass and limited interest in lake trout.
  - Walleye fishing in FMZ 5 has to be better for non-residents in Ontario than it is in their home states. Then the question becomes how far into Ontario are they prepared to drive which requires a level of quality in FMZ 5 that makes it worth stopping here versus the cost of traveling to areas with higher quality fisheries.
  - The tourist industry wants to keep fishing quality reasonably good so that non-residents from the USA continue to come here but they don't want too many restrictive regulations.
  - The tourist industry is looking at keeping fishing quality at the level necessary to keep non-residents traveling to FMZ 5 but not further north to FMZ 4.
  - Taking fish home appears to be important for non-residents in FMZ 5 so restricting the possession limit might meet with some resistance. Conservation officers report a large proportion of tourism guests returning home with fish in possession.
  - Consumption of walleye for shore lunch remains important to non-resident anglers.
  - The tourism industry in FMZ 5 is also highlighting the diversity of fishing opportunities (as being different than in other zones), high quality comfortable

camps, family friendly experiences as things that counteract lower catch rates and presence of roads and possibly resident anglers on lakes.
    - Monitoring could be done via voluntary angler surveys conducted in association with the tourist industry.

- Resident anglers may be less concerned about how fisheries compare across areas and more concerned about how angling quality is changing over time.
- Harvest of walleye for consumption is a primary consideration of resident anglers.

3. Issue/Management Challenge: Lake trout population management needs to consider angling effort (non-resident and resident) and non-angling impacts such as invasive species and climate change.

Considerations

- Day tripping by non-residents was the management issue that stimulated the current border waters regulation for lake trout.
- Appear to have dealt with the problem but we need to stay vigilant.
- We remain concerned about lake trout because of their ecology, that FMZ 5 has the majority of the regions lake trout waters and a significant portion of the province's/world's populations, climate change is most likely to affect lake trout, they are more susceptible to species introductions and they are easily over-exploited.
- Small lake trout lakes are particularly sensitive to over-exploitation and species introductions (eg. walleye, smallmouth bass).
- Exploitation, especially in winter, is more by residents (at least in FF District)

4. Issue/Management Challenge: Current management of pike fishery

Considerations

- TI and resident concern with the current pike regulation
- Current pike regulation coupled with bass regulation has forced non-resident anglers to harvest more walleye, especially during May/June.
- Not a biological concern – social concern (desire for large fish along with desire to harvest pike in 70-90cm range for consumption.)
- Recognition that the current regulation appears to have increased the size of pike in some lakes however lake characteristics limit the number of lakes where this can occur (mainly larger, deeper lakes). Many lakes in the zone are biologically incapable of producing significant numbers of large pike.

5. **Issue/Management Challenge: Lack of policy/licensing of competitive events**

Considerations

- currently all competitive events on non-SDW lakes in FMZ 5 are focused on bass.
- link to bass exploitation and management of bass populations through regulations
- seeing more First Nation sponsered events
- management desire to limit number of events on lakes or timing of events
- prevent/control US based events from taking ON fish
- could allow exceptions to potential new regulations (e.g. 1 over reg. for bass could be exempted for specific tournaments)

6. **Issue/Management Challenge: Loss of economic opportunities due to US based non-resident use of shared fish stocks**

Considerations

- Non-resident angling by US based day-trippers and shared management of lakes east (upstream) of Rainy
- The current border water regulations didn’t eliminate the issue, just reduced the problem.
- need to keep this in mind if we are looking at tweaking the current border waters regulations

Issue Category: Invasive/Introduced Species

1. Issue/Management Challenge: What is the management objective for bass and crappie?

Considerations

- In past there was a combination of authorized and unauthorized introductions of crappie and bass; currently, expansion is due to unauthorized introductions or movement from previous introductions
- bass are currently in every watershed and widespread, crappie still somewhat more confined to the west part of the zone but spreading (Atikokan and Dryden have recently had crappie appear)
- still need to emphasize that we shouldn't be moving species around (e.g. concern about lake trout, especially without pelagic forage)
- largemouth bass/walleye interaction could be a looming problem
- impact of crappie on indigenous fish communities/populations is largest concern
- sub-issue is enforcement (i.e. we have laws that make introductions illegal, how do we enforce them?).
- Why are people doing this? A lot of the problem is people's values system "I like/can make money off of bass". How do we changes peoples values.
- Some of the issue may be that people don't understand the impacts of introductions (education- possible management action)
- Smallmouth bass are a popular fish with the tourism industry, much of it based on a catch and release fishery and becoming more popular with residents.
- Black crappie are popular with both residents and tourism guests are a species harvested for consumption.

2. **Issue/Management Challenge: Potential for invasive species to reduce productivity of native species.**

Considerations

- OMNR are not paying enough attention to this.
- movement of baitfish/boats/planes, etc could be vectors for introduction
- we could be moving invasive species around as part of our monitoring efforts
- largest concern is introductions of invasive spp. from US by anglers (boats/bait, etc)

<u>Issue Category: Development</u>

1. **Issue/Management Challenge: Development has impacts on level of exploitation and habitat to support populations at acceptable levels.**

Considerations

- development with fisheries concerns in FMZ5 include:
    - cottage development
    - hydroelectric development
    - mining
    - roads and watercrossings (access/exploitation and habitat)
    - boat caches
- habitat impacts have potential to reduce sustainable level of exploitation.
- Some development (cottages, boat caches, roads) can increase exploitation on populations above acceptable levels.
- May be more of a concern in FMZ 5 since we are managing closer to the sustainability line.

Appendix 9.2-1. Summary of Initial Fisheries Issues from 2011 FMZ5 Project Team Issues/Challenges Identification meeting in Dryden (April 13, 2011)

Question was "What fisheries issues do you feel are most important or taking up most of your time to deal with?"

2011 FMZ 5 Project Team Issues Identification - 1st draft

Issue Category	Issue	# of votes	Description	Considerations and Needs
Changing Environment	Climate Change	7	Need to understand how it will impact fish populations and how does MNR respond; Example is season opening dates versus cahnges in spawning season with variable temperatures.	Need community synthesis of potential impacts: Need a way to measure risks, define management response and put into planning process; Corporately, no policy to address climate change Can affect allocations and user expectations; Is current monitoring program sufficient to track climate change; Quetico Park monitoring
Society Expectations and Conflicting Demands	User Conflicts	7	Allocations to resource user groups - residents, non-residents, tourism	Currently takes place on a lake by lake basis: 1970's allocation policy (SPOF); update required
Biodiversity/Invasive Species	Invasive Species	6	major failure by MNR to control - still rampant. Need stronger policy or regulation and effective proactive measures	Education not working Zebra mussels still a big threat Need to understand vectors, effect on fish communities and impacts on yeild and fish quality
Society Expectations and Conflicting Demands	Angler expectations versus MNR data	6	We need to define what anglers want/expect in terms of angling (fishing language) and translate into how we are monitroing the resource (BsM language)	Will be an issue in objectives and goals; Also an issue around expectations of anglers and ability of resource to meet these.
Society Expectations and Conflicting Demands	First Nation Negotiations	4	allocation of fisheries; FN opportunities both economic and capacity building;	viewpoints of rights - who owns fisheries? What to do with fully allocated fisheries? - buy room by reducing angling harvest No guidance from corporate MNR - policy vacuum
Fisheries Data Management	Defining healthy fish populations	4	Have lots of data but haven't defined "sustainability" limit using this data.	Data analysis needs to expand to include fish community; Doesn't refer to allowable yeilds Needs to be done (value in completing FWIN diagnostics) Is current project looking at BsM diagnostics going to be completed fast enough to be useful for first round of BsM analysis?
Exploitation?? Management/Planning??	Fish status differences within zones	4	How do we address lake/area in a zone that has a fishery problem? How do we deal with variable quality of fish populations within a zone?	Scale of management? How do we address idivdual lake problems within a zone management approach.

Exploitation?? Management/P lanning??	Border Water Area regulation	2	Planning challenge around fitting current regulation into rest of zone.	Non-resident presence in the zone; day use not staying at an Ontario resort Expolitation issue - major pressure on fishing with little economic benefit
?	Angler Ethics	1	Anglers continue to act unethically(eg fishing during closed season, eat limit for shore lucnh and continue to fish); can impact sustainability	Have fallen behind on education, especially in areas that are within the law (eg. catch and release fishing of deep water walleye); Need to define conservation resource use/value Internal communication barriers
Habitat	Cumulative effects of water crossings	1	Increasing numbers of water crossings being installed with few being removed - what is the impact on fish populations	"McColm projec"t died - phase 2 didn't happen; No maintenance occuring and not enough maintenance monitoring or compliance; Concerns around erosion and sedimentation impacts as well as fish passage; Stand & Site Guidelines say to consider cumulative effects - what are they??; No alignment of fisheries responsibility with fish population management
Habitat	Hydropwer development	1	Impacts of new waterpower developments on fish populations	ESA implications; Relationship and complexity of impacts; Lack of policy and guidance for collection of data at greenfield sites; May be identified as a concern in Zone plans: Impacts site specific
	Mn-Ont Shared stock management	1	Typically US based anglers harvest their share of fisheries resource and ours as well.	East of Rainy Lake in FMZ 5; More of a socio-economic issue than sustainability; Issue with sturgeon fishery
Biodiversity/Inv asive Species	Non-Authorized Species Introductions	0	Introduction of black crappies, largemouth and smallmouth bass into lakes	Some people don't understand impacts - more education on ecological impacts (monitor effectiveness of education?) Many anglers don't care about impacts- not an education issue but a value issue. Encourage people to go through EA process.
Development	Boat Cache	0	Administering program takes up a lot of staff time with no financial benefit to Crown	Question accuracy of harvest by boat estimates; Policy written and administered bydifferent people (lands lead on writing policy, fisheries lead in applying); Managing use or managing users? Is this a socio-economic or exploitation issue or both? Social issue to manage users; Few lakes left for commercial opportunities; policy doesn't allow for C/R commercial opportunities: Rules inconsistently appllied: Forces districts to decide between allocation to residents or tourism industry.
?	First Nation guiding	0	FN guides catching fish for clients and including as their catch	Not subsistence harvest but commercialization; need legal advice Is this a sustainability issue or an enforcement issue?
?	Sturgeon recovery plans	0	Federal and provincial sturgeon recovery plans potentially conflict; FMZ 5 has two different sturgeon designations	MNR SARB currently not participating with feds; need them involved.

Exploitation?	Winter fishing pressure	0	Trends in effort shifting from species to species (eg. Not fishing lake trout as much and targetting walleye more)	Need to be aware for zone management; May be a local or lake specific sustainability issue.
Exploitation?	Enforcement in Quetico PP	0	concern about illegal fishing activity in park along US border in summer and winter	Could be an exploitation issue and violation of park policy/regulation
Exploitation?	Baitfish	0	Sustainability of baitfish populations; Fair return to crown on resource use; Potential of species introductions	Lots of monitoring/reporting questions: No management of this resource: VHS introduction could be an issue
?	Management consistency between Zones and Zone/SDW's	0	Fisheries management decision (particularly regulation change) in one zone affects decisions in other zones	Awareness is a concern of councils; FMZ planning will involve reviewing decisins made in other zones.
Exploitation??	Effectiveness of existing regulations	0	Do we know how current regulations are affecting fish populations	Update Cano Parker report; Need to do review of exceptions to general regs as part of planning process.
Exploitation??	Competitive Fishing	0	Need ability to screen/review/approve proposals	Large number of events in zone; Sustainability concerns in places; Starting to see musky tournaments; Could deal with timing of events with a permit system; MNR refuses to regulate competitive events ("get a spine")
Changing Environment	Contamination	0	Concern about edibility of fish mainly from mercury	Questions about source - background, local or airbourne; Edibility is MOE jursidiction; Tackle Share program promotes use of lead tackle - human health concerns with lead, especially with kids.

Appendix 9.2-2. Issues discussed by FMZ 5 project team but not being proposed to be addressed in current Fisheries Management Plan process.

1. **Issue/Management Challenge: Non-resident Canadian (Manitoba) fishing effort on walleye**

    - Fishing effort is primarily generated by cottagers and day trippers.
    - This is primarily an issue for the Kenora District portion of FMZ 5.
    - Eight percent (8%) of fishing effort zone wide is attributable to non-resdient Canadians.
    - May be increased usage of tourist facilities by Manitoba residents.
    - issue probably focused mostly on SDW's (LOW and Win. R.) for day tripping)

It was agreed that this would not be pursued as a primary management issue in this plan as it is a relatively minor issue in a small area of the zone.

2. **Diagnostics Issue: Need to be able to describe population status from assessment data. Management risk is higher in FMZ 5 than other Zones in NW Region**

    - Desire for lots of year classes and to protect brood stock
    - Examine these within FMZ 5 context
    - Do a better job at explaining this.
    - Need to articulate this and what will happen if things start to slide.
    - Need to translate BsM assessment results into angler language.
    - MNR can provide information on abundance and size.

It was agreed that this would not be pursued as a primary management issue in this plan as this is more of an internal MNR issue that it being address by Science and District staff as part of the Broad-scale Monitoring project.

3. **Managing Individual lakes (Pipestone, Burditt, Despair)**

    - individual lake regs would not be considered unless there is a biological based conservation concern.
    - Could still manage lakes individually using non-reg actions
    - There is a large overdeveloped Tourist Industry on certain lakes (Burditt etc)
    - Not a sustainability concern
    - Overfishing/Fishing quality issue

It was agreed are we are not going to make these an SDW at this time and they would not addressed under individual lake regulations.

4. **Boat Cache Program (identified at April 22 session)**
    - Administration of program takes up significant staff time with no financial benefit to Crown.

It was agreed that this would not be pursued as a primary management issue in this plan as this is more of an internal MNR issue.

5. **First Nation Guiding (identified at April 22 session)**

- Potential exploitation issue with First Nation guides catching fish for clients and including as their catch.

This would not be pursued as a primary management issue in this plan as it is considered a relatively minor issue at this time.

6. Sturgeon Recovery Plans (identified at April 22 session)

- Federal and provincial sturgeon recovery plans potentially conflict; FMZ 5 has two different sturgeon status designations.

This would not be pursued as a primary management issue in this plan as this is more of an internal MNR/DFO issue.

7. Sustainability of Baitfish Populations (identified at April 22 session)

- Lack of consistent, reliable harvest data has led to questions about monitoring and management of baitfish.

This would not be pursued as a primary management issue in this plan as this isa relatively minor at this time and is more of an internal MNR issue.

8. Enforcement in Quetico Park (identified at April 22 session)

- Concern about illegal activity along border

It was agreed that this would not be pursued as a primary management issue in this plan as it is only an issue in a small area of the zone.

9. Management consistency between FMZ's (identified at April 22 session)

- Fisheries management decisions in one zone may affect management in other zones

Although it is considered important issue, at this time it is felt it can be addressed more appropriately as part of the functioning of FMZ team teams (eg. increased communication between zones) rather than through a specific objective.

10. Fish Contamination

- Concern about the edibility of fish contaminated by mercury.
- Some concerns about lead tackle (Tackle Share promotes use of lead tackle)

Human health issues and edibility of fish is MOE jurisdiction and will not be dealt with in this plan.