Alberta Government

Northern Pike Recreational Fisheries Management Framework

Fisheries Management
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Disclaimer

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Photo Credit

Gordon Court, 2014, Alberta Environment and Parks

Preface

The following document summarizes the current information on the status, sustainability and management goals, objectives and regulations for Northern Pike in Alberta. This framework focuses on the management of the recreational utilization of Northern Pike and is presented in a non-technical manner. Readers are encouraged to review scientific literature and supporting Government of Alberta documents regarding the assessment and management of Northern Pike in Alberta.

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Introduction

The Government of Alberta is committed to the guiding principles, goals and priorities identified in the Fish Conservation and Management Strategy for Alberta (GoA 2014a). Conserving Alberta's fish biodiversity and sustainability is at the core of this commitment. Managing a sustainable harvest of fish for Alberta's Indigenous Peoples, as well as for the socially and economically valuable recreational fishery are the key benefits of this conservation goal (GoA 1982; GoA 2014a).

Managing the vitally important recreational fishery in Alberta demands an understanding of the complex interplay of biological requirements, habitat threats, and invasive species. As well, the divergent needs and desires of a diversity of stakeholders must be addressed. Effective management decisions must therefore be science-based, incorporating social and economic factors.

The following framework describes the strategic goals and tactical objectives for managing these complex recreational fisheries. The overarching goal for recreational fisheries management is to have Alberta's fisheries producing ecological, social and economic benefits for long-term sustainability and use.

Goals:

The goals of the Recreational Fisheries Management Framework (RFMO) are:

1. To provide an easily-understood series of recreational fisheries management objectives (RFMOs), designed to create and maintain a diversity of fisheries based on sound science, best available information, and stakeholder consultation.
2. To provide a clear set of recovery and restoration actions to allow fisheries to achieve their RFMOs.
3. To align a consistent set of sport fishing regulations and actions that effectively achieve their specified RFMO.
4. To provide an assessment and regulation-setting process for both actively and passively managed fisheries, with the object of managing Alberta's fisheries in the most cost-effective and sustainable manner consistent with achieving RFMOs.
5. To provide clearly stated and understood RFMOs that work reciprocally with indigenous fisheries objectives, habitat objectives, and ecosystem objectives as integral components of the broader Fisheries Management Objectives (FMO).

Overview of Alberta's Fisheries Management Objectives

In Alberta, Fisheries Management's primary concern is the sustainability of ecosystems. To ensure ecosystems remain intact, we will report on the various species and their habitats within a watershed. Fisheries management objectives will be focussed on individual fish populations but consideration for the fish community, and alignment of objectives within the watershed, is required for effective plans and healthy ecosystems.

For management purposes the extent of a fish population is defined by the watershed; for river fishes usually described by a river system which is reported as a Hydrological Unit Code (HUC), or a lake for lake fishes (GoA 2015a). Examples of managed fish populations would be the Bull Trout (*Salvelinus*

confluentus) in the Berland River (HUC 17010301), or the Walleyes (*Sander vitreus*) in Lac Ste. Anne. Each population is then assessed and assigned a score based on measured variables, such as adult abundance, habitat, harvest threats, and natural limitations. Typically, adult abundance is the key parameter used to assess current status which is compared against a desired status for that population. This desired status is determined based on the identified constraints of the fishery and stakeholder input into the type of fishery they desire within these constraints. Differences between the current and desired status trigger implementation of a management action. This process is outlined in the Fish Conservation and Management Strategy (FCMS) for Alberta (GoA 2014a) and is called the fisheries management cycle.

Why Update Alberta's Sport Fish Management Approach?

Historically, sport fish like Walleye and Northern Pike have been abundant and important fish in Alberta, utilized by Indigenous Peoples, recreational and commercial fishers (Nelson and Paetz 1992, Berry 1999, Zwikel 2012). There are few empirical datasets available to inform historic (pre-1940s) fish population status. However, information is available in summary from federal reports gathered on fishing activities in the inland provinces and territories from 1865 to 1940. This information indicates that in some lakes in Alberta, significant fishing pressure was already present in this era and required intensive management to prevent overfishing (DFO 1917). Examples of overharvest in this time period include the extirpation of Walleyes from Wabamun Lake and Lake Trout (*Salvelinus namaycush*) from Lesser Slave Lake. Pauly (1995) warns that capturing historical fish abundance and fishing pressure is important to prevent a shifting baseline from biasing management of fish populations to states below their achievable status and structure.

Alberta Fisheries Management has accounted for the change in baselines overtime in the Fish Sustainability Index (FSI) using a metric scoring the historic adult density (MacPherson *et al.* 2014). The FSI is a report card system that scores metrics which inform the sustainability of fish populations. Historic adult density is informed by a combination of empirical and anecdotal information. Empirical sources include early provincial commercial fishing data and angler surveys (MacPherson *et al.* 2014). Historical records, anecdotes, photographs, local environmental knowledge (LEK) and traditional environmental knowledge (TEK) were used to inform historic density scores. Specific LEK sources included accounts in historical National Park Warden journals and formal interviews of anglers who fished in the mid-1900s and recall angling experiences of older family members and friends.

Since 1940, Alberta's Fisheries have continued to be influenced by a series of threats including population growth, increased fishing pressure, land conversion, eutrophication and climate change. Beginning in 1993, stakeholders and government completed an extensive review of Walleye and Northern Pike management, which led to the development of Alberta's Walleye and Northern Pike management and recovery plans (Berry 1995; Berry 1999). As the current FSI indicates, these plans allowed for the recovery of some Walleye and Northern Pike populations; however, the majority remain in a high to very high sustainability risk category (MacPherson *et al*. 2014; GoA 2015b). The new Walleye and Northern Pike frameworks are intended to further recovery and maintenance of these populations, while reducing the complexity of sport fishing regulations. The new frameworks improve upon the foundation of the initial management and recovery plans by drawing clear connections between population statuses (FSI) associated with a desired fishery objectives (RFMO) managed with the appropriate regulations.

Risk and Resiliency: Why Manage Fish? How?

Alberta's fishes are especially vulnerable to overharvest when compared to other North American jurisdictions. Alberta has an estimated 800 fish bearing lakes, which is a relatively low number compared to other inland provinces in Canada (Table 1; Sullivan 2003). As a consequence of the scarcity of waterbodies, Alberta sustains disproportionately high levels of angling pressure. Zwickel (2012) reported that Alberta had an estimated 352,472 anglers including youths (n=75,582), seniors (n=24,860) and licenced anglers (n=252,030). Table 1 summarizes data from the Recreational Survey of Canada (DFO 2012) indicating that Alberta has nearly 100 times more angling pressure per waterbody than other provinces. The relatively low number of fish bearing waterbodies and high angling effort coupled with other factors such as the short growing season and higher catchability of sport fish makes fish populations more vulnerable to overexploitation in Alberta (Post *et al*. 2002; Mogensen *et al.* 2013).

Table 1. Comparison of lakes and licenced anglers in the inland provinces

Province	Number of Lakes	Licensed Anglers	Anglers per Lake
Alberta	800	252,031	315
Saskatchewan	100,000	194,599	2
Manitoba	110,000	170,501	2
Ontario	250,000	1,460,960	6

A key component to maintaining and recovering the biodiversity and sustainability of Alberta's fish populations is initiating management actions that support or promote resiliency in fish stocks. Resiliency is the capacity of an ecosystem or fishery to absorb disturbance without undergoing a fundamental change (Holling 1973; GoA 2014b; Angeler and Allen 2016). These changes may be to species abundance, composition, distribution, biological performance, genetic integrity or any combination thereof. The loss of resiliency in a fish population can occur at different scales (e.g. population vs watershed level). There are legal, biological and social consequences to reductions in resiliency. In Alberta, one of the tools used to monitor the resiliency of a fish population is the Fish Sustainability Index (FSI; Table 2; MacPherson *et al.* 2014). The FSI captures and reports on various metrics that inform population status, resiliency and risk (e.g. adult abundance, genetic integrity, natural and anthropogenic limitations, overharvest risk protection need; GoA 2015b). These thresholds are based on today's understanding of what is "high-density" with categories following the criteria developed by the International Union for Conservation of Nature (IUCN; MacPherson *et al.* 2014). As fisheries recover, that baseline will change, and our management will adapt with new and better information.

Undesirable change can come from a combination of risk factors, and these are taken into consideration when implementing management actions. The key risk factors for each species of Alberta fish are described, scored and reported in the FSI, as well as being quantitatively incorporated into species-based cumulative effects models (MacPherson *et al*. 2014). The species based cumulative effects models are integral to evaluating the current threats influencing a fish population and inform the achievable status (usually adult abundance) measured as an FSI score (Table 2).

Table 2. Northern Pike adult abundance Fish Sustainability Index scores and risks developed from index netting. Adult catch rate thresholds are based on five lightly exploited actively managed reference lakes used to establish the very low risk category (FSI 5). The other risk categories were then based on IUCN methodology used to establish sustainability category thresholds (MacPherson *et al*. 2014).

Adult Abundance FSI Score	Adult Index Netting Catch (fish/net-night)	Sustainability Risk Category
5	>21.8	Very Low Risk
4	15.3-21.8	Low Risk
3	10.9-15.2	Moderate Risk
2	4.4-10.8	High Risk
1	<4.4	Very High Risk
0	Extirpated	

These models inform what FMOs are available for a fish population, and identifies key threats that are limiting the population under broad categories of harvest (indigenous and recreational), habitat, and ecosystem integrity. FMOs are a composite of management objectives that are broken down into four categories: indigenous fisheries, recreational fisheries, fish habitat requirements, and ecosystem integrity (Figure 1). These categories are closely linked whereby the success in achieving any one objective is clearly dependant on achieving supporting objectives. For example, achieving healthy indigenous and recreational fisheries requires intact fish habitat, including effective protection against invasive species. FMOs link together the management processes and inform us about the necessary tools (e.g. fishing regulations, habitat mitigation, and species control) required for managing fisheries and habitat to meet the desired status. This framework deals specifically with the recreational fisheries management objective (RFMO) component of the broader FMO.

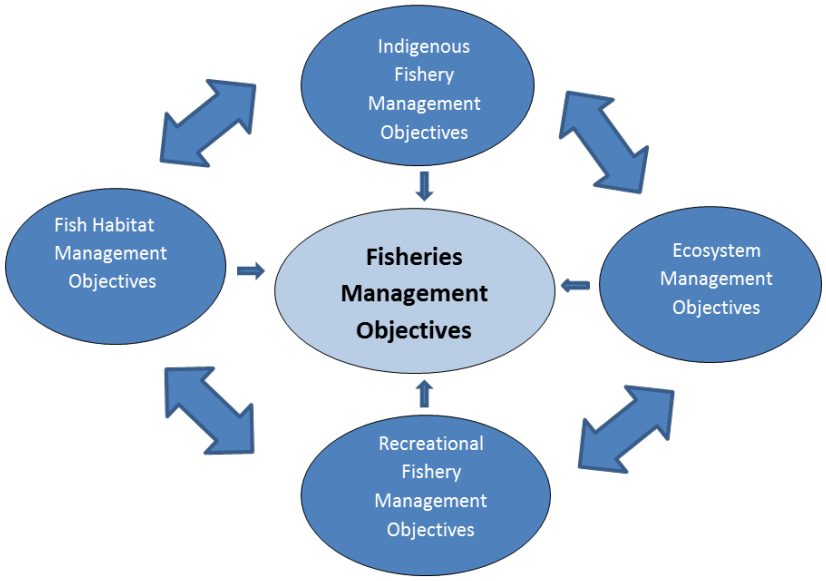

Figure 1. Diagram of the four categories of fisheries management objectives (FMOs) and interactions between objectives.

Active and Passive Management

In creating the FSI, cumulative effects models and RFMOs, the first step is collecting, analyzing and interpreting data. Despite the proportionately smaller number of waterbodies in Alberta relative to other provinces, it is not feasible for surveys to be conducted on every, or even most waterbodies in the province. Logistic constraints (e.g. survey timing, waterbody location, access), trade-offs (e.g. assessing popular, heavily used fisheries vs. remote, low-use fisheries), budget, and staff availability limit which waterbodies are surveyed. Alberta Fisheries Management addresses this problem by using the results from waterbodies that are intensively sampled to inform on the status of waterbodies not sampled. This dichotomous approach is active vs. passive management (e.g. surveys regularly completed, well studied vs. surveys completed infrequently or not done; Pereira and Hansen 2003; Sullivan 2003; Cochrane and Garcia 2009).

Sullivan (2003) identified that following a period of fisheries declines and collapses, Alberta began implementing more active and precautionary management in 1996 to address the failures of the previously indirect harvest controls (FAO 1996). Active and passive management follows the stepwise process of the fisheries management cycle outlined in the Fish Conservation and Management Strategy for Alberta (GoA 2014a): 1) Fishery Status Assessment, 2) Plan – Assess RFMO, identify options and set objectives, and 3) Allocate and Regulate – align sport fishing regulation with management action and desired objective. The key difference between active and passive management is determined by an assessment of the data from the waterbody: 1. is it up-to-date? and 2. what information exists? (Table 3). In Alberta, angler effort most often dictates how fisheries are managed. If angler effort or the threat of overharvest is moderate to high, the local fisheries manager will usually have collected specific data on that lake. Conversely, if the threat of overharvest is low or the fish population is limited (e.g. very high natural or anthropogenic limitations) the priority is lower for data collection. The primary consideration and trade-off is the increased management costs for higher levels of harvest.

Passive management in this context is not the fisheries management approach of the 1980s and 1990s described by Sullivan (2003), which lacked management objectives, population thresholds or standardized monitoring. Passive management will address the same RFMO's as actively managed lakes, however, because data collection is infrequent or absent, regulations must be more precautionary as information is extrapolated from well-studied to lesser-known systems or is collected less frequently. Cochrane and Garcia (2009) provided a definition for passive management as data-less management, where information from well understood systems is combined with traditional, local and non-fishery specific data to assess populations and inform management actions. Table 3 outlines the examples of passive data sets used to inform FSI scores and management actions. A precautionary approach allows allocation and use of the resource while reducing the potential of overharvest in these lesser-known systems. Accepting uncertainty and developing defensible, repeatable means of making management decisions using the best available information is imperative to avoid management paralysis, which can also lead to the decline, collapse or loss of these fish populations (Walters 1986).

Table 3. Examples of data sources used to determine management approach (active vs. passive) for fish populations.

Management Approach	Fish Population Data	Fishery Data
Active	Index netting, creel samples, population estimates, electrofishing	Angler surveys, indigenous netting surveys
Passive	Adjacent lakes, satellite watershed survey	Internet reports, historical comments, access maps

How Do We Prevent Overfishing?

In Alberta, regulating the sport fishery relies on managing the harvest of each angler, rather than restricting the number of anglers. This is referred to as open-access management. There are several common tools used to limit and focus angler harvest to manage inland recreational fisheries to meet a desired management objective. These different regulation types each have their own best uses, limitations and trade-offs.

Detailed descriptions of the different regulation types commonly used to manage recreational fisheries can be found in Paukert *et al.* (2001), Sullivan (2003), Arlinghaus *et al.* (2010) and Gwinn *et al.* (2015). Alberta generally uses two tools; minimum length limits, which are intended to retain adult fish and increase density of spawning fish and possession (bag) limit restrictions to limit harvest (Sullivan 2003). The size and bag limits in this framework are based on analysis of biological, catch and harvest data collected from standardized index netting and creel surveys. Evaluations of Gini coefficients from creel data at 10 Alberta lakes showed that the distribution of catch is often skewed with a small number of anglers catching the majority of the fish (Baccante 1995).Reducing the bag limit ranges achieves sportfishing regulation simplification with a minimal effect on harvest opportunity and potentially increase the distribution of harvest between anglers. Size limits are designed to conserve adult fish, maximize spawning potential and increase recruitment while providing harvest opportunity. Minimum length limits in the pike framework provide two to five years of spawning protection past the size at which 50% of females are mature. The regulations align with providing a specific recreational fishery objective; sustainable harvest (active and passive), quality harvest and old growth.

Alberta also uses a unique tool that bridges the gap between open access and limited access fisheries. The special harvest licence (SHL) was initially designed to assist in the management of walleye recreational fisheries in Alberta implemented at waterbodies where a sustainable surplus of fish was available but due to overwhelming angling pressure an open harvest regulation could not be used without causing a dramatic decline in the population. SHL enables biologists to more carefully manage the number and sizes of fish being harvested (Isermann and Paukert, 2010). This innovative licence allows anglers to harvest fish from specified lakes which are either in recovery and working towards meeting there RFMO or as a maintenance regulation for lakes that have met there RFMO but have high or very high overharvest risk profiles preventing the use of open harvest regulations. SHL licences are issued on a draw basis, using a lottery system where priority for at a waterbody can be built up over time. Priority is reset once an angler is successful acquiring a licence at a waterbody. This occurs on a waterbody by waterbody basis.

Recreational Fisheries Management Objectives

The focus of this framework is to provide a diversity of recreational angling opportunities across Alberta, as well as meeting the primary objectives of conserving biodiversity and providing for indigenous fishing rights and opportunities. The RFMO for most Alberta waterbodies is sustainable harvest, with three additional special types of fisheries proposed; old growth, quality, and liberal harvest. Selecting the specific objective for any individual population one must consider factors such as biological limitations (e.g. Can this lake produce big fish?), social acceptance (e.g. Do the majority of anglers agree with this objective?), geographical dispersion (e.g. Are there other liberal harvest fisheries nearby?), and legal issues (e.g. Is this population unique and must be protected under provincial and federal legislation?; Figure 2).

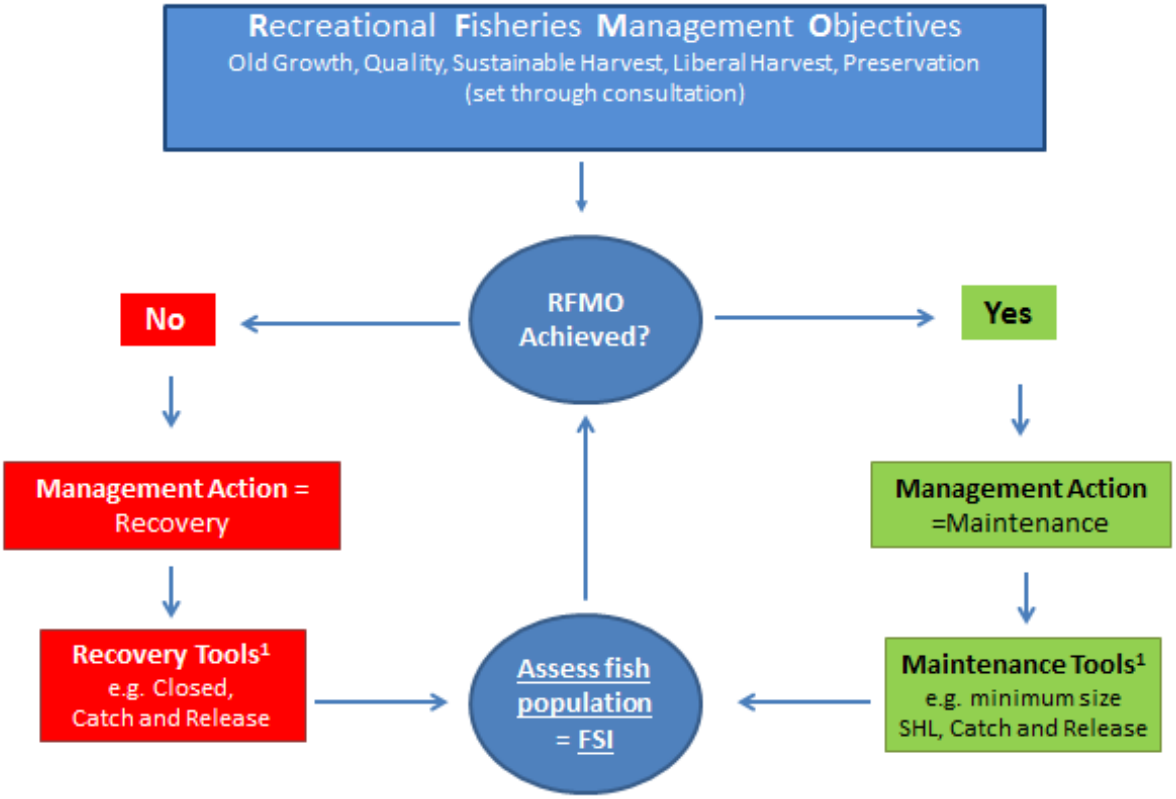

Figure 2. Conceptual diagram of the assessment, implementation and evaluation process for setting recreational fisheries management objectives at actively and passively managed waterbodies.
[1]Note passively managed fisheries will require more precautionary tools due to the lack of information.

The RFMOs and associated regulations must be reviewed and adjusted over time to account for changes that would impact the achievement of the desired RFMO. The various RFMOs are described below:

RFMO: Sustainable Harvest Fishery

The majority of waterbodies in Alberta will have a sustainable harvest fishery objective. This RFMO provides anglers with harvest opportunities, while maintaining a sustainable and resilient fish population. A basic requirement is that fish must live long enough to spawn 3 to 5 times in their life. These fish populations are characterized by an FSI abundance score of 3+, with low to moderate rates of mortality, a moderate range of fish sizes and ages with strong and consistent recruitment.

Potential regulations to achieve this objective include moderate to large minimum size limits, Special Harvest Licences (SHL), fishing season and gear restrictions.

RFMO: Old Growth Fishery

The objective of this RFMO is to provide opportunities to catch (but not necessarily keep) a memorable-sized fish, or a native fish species that is rarely available to Alberta anglers (e.g. Lake Sturgeon *Acipenser fulvescens*, or a 10 kg Northern Pike *Esox lucius*). For old growth fisheries in Alberta, this typically requires the fish population to be maintained in a near-unexploited status (e.g. FSI abundance score 4+), with low rates of mortality and a very wide range of fish sizes and ages. Because this RFMO requires low fishing effort, low mortality and restrictive regulations, it should only be implemented with public support on a small number of waterbodies.

Potential regulations to achieve this objective include catch-and-release, Special Harvest Licences (SHL), fishing season and gear restrictions or in rare cases, effort regulation (e.g., lake specific license for fishing). Effort regulation would be a relatively new management tool in Alberta and require public support prior to implementation.

RFMO: Quality Harvest Fishery

The objective of this RFMO is to provide anglers with the opportunity to catch, and occasionally keep, a memorable fish. For quality fisheries in Alberta, this typically requires the fish population to be maintained in a lightly exploited status (e.g. FSI abundance score 4+), with low rates of mortality and a wide range of fish sizes and ages. These restrictive harvest fisheries, which require low fishing effort, should only be implemented with public support on a small number of waterbodies.

Anglers' expectations should be in line with the opportunity to harvest a memorable fish every few trips. The necessity of keeping fishing mortality low with restrictive regulations means the regulations will need to be adjusted to the fishing effort, with more restrictions imposed as fishing effort is high and relaxed when effort is low. Potential regulations would include; catch-and-release, SHL, very large minimum size limits, gear and season restrictions.

RFMO: Liberal Harvest Fishery

The objective of this RFMO is to provide anglers fish for harvest with few restrictions. These fisheries are characterized by occasional high catch rates in an unusual year, but more typically would be represented by low to moderate catch rates on small fish. The fish population may not be managed to be sustainable with decline or extirpation not being a conservation concern. These considerations will depend on the fishery's specific characteristics identified in the FSI and RFMO.

Examples of liberal harvest fisheries include shallow natural lakes that repeatedly winter or summer kill, but have some natural recruitment or immigration, isolated lakes or reservoirs with a history of stocking non-native fish and limited recruitment. Harvest restrictions (e.g. bag limits) are needed for the equitable sharing of fish, rather than to produce a sustainable fish population.

Few natural Alberta lakes should be managed with this objective, as most lakes are managed for long-term sustainability. Public awareness and support for this objective must be strong, and anglers must understand the obvious trade-offs, specifically that the advantages of having liberal regulations will

result in poor fishing. Consultation with enforcement staff is necessary to avoid the obvious issues of lakes with restrictive regulations being adjacent to liberal harvest lakes.

In specific circumstances, put-grow-and-take stocking for native fish species may be considered to support this RFMO. This activity must be economically responsible and ecologically benign. These types of fisheries will only occur in a small number of locations around the province, as they are management intensive, requiring additional resources for monitoring and evaluation. These fisheries may not provide catch and harvest opportunities equivalent to naturally occurring fisheries. To create and evaluate these special opportunities, all provincial policies and processes regarding stocking of fish will be followed. This activity would cease if the fishery proves incapable of meeting the RFMO. Put-grow-and-take stocking for native species would be a relatively new management tool in Alberta and require public support prior to implementation.

Fisheries Conservation Objectives

There are two sets of special circumstances that are not addressed by the standard suite of RFMOs. These include preservation and experimental objectives.

RFMO: Preservation

The preservation RFMO is applied to fish populations that are self-sustaining at very low abundance (FSI 1) and/or have a very high risk to sustainability which means the population cannot support fishing harvest. These types of fisheries have unique characteristics, such as being naturally limited, the only population in a watershed, genetically distinct or has some unusual life history feature.

Stakeholder expectations should be in line with the high vulnerability of these populations. The necessity of keeping fishing mortality low with restrictive regulations means that if the population is small and the access to the waterbody is easy, a closure to fishing may be necessary. If the waterbody is very remote with very limited use, a less restrictive regulation such as catch and release may be implemented.

Few fish populations should require this management objective. Preservation RFMOs should only be considered for the protection of a fish population to meet the government's obligation to maintain biodiversity (GoA 2014a).

RFMO: Experimental Fishery

Science is the foundation for sound decision making to guide Alberta fisheries management (GoA 2014a). Functional management systems benefit from incorporating flexibility that allows for change based on testing the performance of the management actions and incorporating those results into the ongoing management approach (Cochrane and Garcia 2009). Experimental regulations should be used to test hypotheses that will lead to clearly defined benefits such as more efficient management practices, improved harvest, or increased conservation. These efforts should be focused on situations where an information gap exists between the existing management tools and the desired management objective. Experimental fisheries may have regulations ranging from restrictive to liberal, depending on the hypothesis being tested. The most efficient management system using this iterative learning process is called Active Adaptive Management (Walters 1986; Hilborn and Walters 1992). A rigorous application of Active Adaptive Management is the preferred experimental design used for Alberta's fisheries management (GoA 2014a).

Experimental fisheries will only be implemented after scientific and peer review of the research questions and study design. Experimental fisheries must have clearly defined and communicated time plans, and the fishery should revert to the appropriate RFMO when the experiment is completed. All Alberta fisheries protocols and processes must be followed, and stakeholders should be actively engaged to provide a clear understanding of the hypotheses tested and the implications of the results. If indigenous fishing is affected, proper consultation must be completed.

Tools for Recovery

Action is required when a fishery is not meeting the desired RFMO. The intent of a recovery action is to restore the population to achieve the RFMO. Recovery actions are meant to be short-term and distinct from the management actions used to maintain a population that has reached its RFMO. These actions include fishing restrictions and restoration measures:

Fishing Restrictions

Recovering collapsed or suppressed fish populations is necessary to achieve the assigned RFMO. Recovery from overfishing is often accomplished by fishing less. Regulations must therefore result in lower fishing mortality. These regulations could include fishing closures, catch-and-release, SHL with very low harvest, various gear and seasonal restrictions to reduce both catch and by-catch mortality.

Recovery of collapsed fisheries should be an interim step towards achieving an assigned RFMO. The estimated time-to-recovery has a social component. Fast recovery requires severe restrictions and slower recovery allows for more liberal regulations. Stakeholders need to be consulted and informed as to their expectations of recovery actions and the inherent trade-offs. Conservation needs and Indigenous rights have a higher precedence in legislation and policy.

Restoration Measures

Restoration, following extirpation or near extirpation of a population, necessitates stocking for recovery. This measure should be a final course of action, to be used only when all else has failed with the preference being on the maintenance and recovery of the native stock. Restoration of an extirpated or near extirpated fishery should be initiated by carefully planned stocking, using appropriate genetic sources with attention to avoid invasive species and pathogens. All Alberta fish stocking protocols and guidelines for reintroductions must be carefully followed. Because of the expense and value of the stocked fish, harvest and incidental mortality should be avoided until the stock has had sufficient time to establish.

Regulations on restoration fisheries must be very restrictive. Directed harvest should not occur until the successful recruitment and maturity of the introduced stock's offspring.

Regulations could include fishing closures, catch-and-release or in rare circumstances the use of SHL with very low harvest. Restoration programs must have a specific time plan. If successful spawning and recruitment of wild-born fish has not occurred by the specified time, a decision will be made to either repeat the restoration with an improved plan, or declare the plan a failure. The RFMO will be reassessed and updated.

Because of the intensive efforts and costs of restoration, waterbodies should not be overfished to the point where abundance reaches very high risk to sustainability (FSI score 1) or extirpation (FSI score 0). Selecting a fishery for restoration must involve consultation with stakeholders.

What is the Status of Alberta's Northern Pike?

The Northern Pike Recreational Management Framework is applicable for lakes and rivers within Alberta. Northern Pike are native to Alberta and are currently listed as 'Secure' within the province (GoA 2015a). Northern Pike and can be found in the waters of the Petitot, Hay, Peace, Slave, Athabasca, Beaver, North Saskatchewan, Battle, Red Deer, Bow, Oldman and South Saskatchewan river drainages (Nelson and Paetz 1992).

Northern pike populations have shown some recovery since the implementation of the management and recovery plan (Berry 1999). Mature Northern Pike are now living long enough to spawn several times before being eligible for harvest. Large, trophy sized pike, however, can still only be found at few waterbodies, mostly managed under highly restrictive regulations. Key limitation reported in the FSI continuing to influence Northern Pike populations include: fishing pressure, human population growth, climate change, growing land use, nutrient loading, and habitat limitation. One source of mortality affecting Northern Pike populations was recently removed with the provincial closure of the commercial gill-net fishery. This is a significant step towards the restoration of some collapsed Northern Pike populations across Alberta (Colby 2012). Continued efforts to mitigate or minimize the effects of other limiting factors are required to recover and maintain Northern Pike populations.

Sport Fishing Regulations and RFMOs for Northern Pike

To assign an effective RFMO to a particular fish population, the manager must carefully consider the specific situation of the fishery. These considerations include the indigenous fishing, recreational fishing, the uncertainty of the data sources (i.e., active or passive management), the threat of overharvest, the consequential acceptable level of risk, and typically include consultation with stakeholders.

The regulations shown in Tables 4 and 5 are intended to achieve the assigned RFMO and management action. The appropriate regulation is assigned based on an explicit assessment of local conditions, with a firm goal of maintaining the RFMO or recovering the fishery in a specified time to reach an RFMO. The management actions and trade-offs will be communicated to stakeholders as part of the RFMO.

Table 4. Recreational Fisheries Management Objectives, Regulations and categories for Northern Pike under Active and Passive Management. Note: all lengths are total lengths (TL) measured from the nose of the fish to a pinched tail.

	FSI Adult Abundance Score	Sport Regulations Active Management	Sport Regulations Passive Management
Province-wide RFMO			
Sustainable Harvest	**3+**	**2 pike> 63 cm[1,2]** **1 pike > 63cm or SHL**	**1 pike > 70 cm[1,3], or SHL**
Special Fisheries RFMOs			
Old Growth	**4+**	**C&R[1] or SHL**	**C&R**
Quality Harvest	**4+**	**2 pike> 75 cm[1,4]** **1 pike > 75cm or SHL**	**1 pike >75 cm[1,4], or SHL**
Liberal Harvest	**1+**	**1-3 pike, any size[1,5]**	**1-3 pike, any size[1,5]**
Conservation RFMOs			
Preservation	**1+**	**Closed[1], or C&R**	**Closed[1], or C&R**
Experimental	**0+**	**Study dependant**	**n/a**

[1] The primary regulation assigned base on the RFMO, FSI Score, and Active or Passive management approach. The alternate regulations are additional to the primary regulation and are implemented at the discretion of the fishery manager following all GoA processes, science and peer review.

[2] 63cm (TL) - 50% length-at-maturity for female Northern Pike plus 2 years of growth, providing 2-3 years of spawning potential before being vulnerable to harvest. This is a risky tool in that it provides limited protection to spawning adults. It is used on actively managed lakes where data is collected frequently enough to maximize sustainable allocation.

[3] 70cm (TL) – a precautionary tool for passively managed lakes with the goal of maintaining population sustainability while providing harvest opportunity, providing 4-5 years of spawning protection. Because it is applied in the absence of assessment data, it is not intended to achieve a social objective of larger fish.

[4] 75cm (TL) - 50% length-at-maturity for female Northern Pike plus 5 years of growth, providing 5-6 years of spawning potential before being vulnerable to harvest. Intended to provide an opportunity to grow larger fish while maintaining a harvest opportunity.

[5]The default bag limit is 3 fish per angler but 1 or 2 fish bag limits can be used for social reasons i.e. to distribute fish to more anglers. This regulation provides no protection of spawning potential before being vulnerable to harvest.

Table 5. Management actions for increasing adult abundance and improving FSI scores.

Recovery Actions	FSI Adult Abundance Score	Sport Regulations Active Management	Sport Regulations Passive Management
Fishing Restrictions	**1+**	**C&R[1], or SHL**	**C&R**
Restoration Measures	**0**	**C&R[1], Closed or SHL**	**n/a**

[1] The primary regulation assigned base on the RFMO, FSI Score, and Active or Passive management approach. The alternate regulations are additional to the primary regulation and are implemented at the discretion of the fishery manager following all GoA processes, science and peer review.

Seasonal Closure

Seasonal closures are used by many jurisdictions to protect spawning aggregations of fish. This has been a useful tool assisting in the recovery and maintenance of Alberta's sport fish populations. (Berry 1999; Paukert *et al.* 2001; Sullivan 2003; Arlinghaus *et al.* 2010). Seasonal closures will be selected based on Fish Management Zone, population status and the RFMO for the waterbody.

Bait and other Gear restrictions

Bait and the type of angling gear used influence the catchability of sportfish. Restrictions on the use of bait and varying types of angling gear (e.g. multiple treble hooks, single hooks, multiple hooks on a lure) have assisted in the recovery and maintenance of Alberta's sport fish by reducing harvest and catch and release mortality . Bait and gear restrictions are listed in the Alberta Guide to Sportfishing Regulations and will be selected based on Fish Management Zone, population status and the RFMO for the waterbody.

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