Science and Research Information Report IR–07

A history of fish stocking in Algonquin Provincial Park

Ministry of Natural Resources and Forestry

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A history of fish stocking in Algonquin Provincial Park

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Cover photos: A selection of anglers and their catches on Cache Lake, Algonquin Park in the early 1900s. Early fish stocking efforts began on Cache Lake in part due to a growing interest in angling among the park's visitors. (Source: Algonquin Park Visitor Centre Archives).

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Summary

This report provides, for the first time, a summary of the historical record of fish stocking in Algonquin Provincial Park from its start in 1899 to current stocking efforts. The beginning of fish stocking in the late 19th and early 20th century coincided with major changes in outdoor activities and leisure that were occurring at the time in many areas of North America. Important factors such as the history of recreational fishing and the role of fish hatcheries in fulfilling both a demand and an ideal for outdoor activity are present in this history.

Algonquin Park was advertised as an angler's dream landscape — many fishing locations and numerous fish located in a remote but accessible natural setting. In reality, access for most anglers was limited to lakes near lodges and the early distribution of stocking reflects this limited movement. Angling likely occurred beyond the lodges and travel corridors but stocking did not. Railroad lines and their connections to lodges help define fish stocking distribution in the early 20th century.

Fish stocking began in 1899 with introductions of smallmouth bass then expanded mid-20th century along with expansion of access to the park interior. Landscape-scale fish stocking was questioned beginning at a time when natural ecosystems of Algonquin Park, including natural brook trout and lake trout populations, were recognized as defining features of park values as well as the park experience for visitors. The change was incorporated into the 1986–2000 Algonquin Park Fisheries Management Plan and was reinforced with the 1998 Park Management Plan. Current fish stocking focuses mostly in the Highway 60 corridor on small lakes with high visitor use and relative ease of access.

Stocking has continued from 1899 to present day. Lake trout were first stocked in 1911, brook trout in 1918, and splake in 1954. A minimum of 10,300,000 fish have been stocked in Algonquin Park in over a century. The peak number of fish stocked in a year was 905,000 in 1923. The peak number of lakes stocked in year was 126 lakes in 1959. The overall peak year for numbers of fish stocked and lakes receiving fish was 1962 with 255,610 fish distributed among 108 lakes.

Résumé

Une histoire d'empoissonnement dans le parc provincial Algonquin Ce rapport est le premier récit succinct de l'histoire de l'empoissonnement dans le parc provincial Algonguin, de ses débuts en 1899 à aujourd'hui. L'empoissonnement a commencé à la fin du 19e siècle et au début du 20e siècle. Il coïncide avec les changements importants que connaissent alors les activités et les loisirs de plein air dans de nombreuses régions d'Amérique du Nord. On retrouve dans cette histoire des facteurs comme la

pêche sportive et les alevinières qui ont joué un rôle important pour satisfaire la demande et le désir de mener une activité de plein air idéale.

Le parc provincial Algonguin était présenté aux pêcheurs sportifs comme l'endroit idéal où trouver un grand nombre d'endroits poissonneux et de poissons dans un environnement naturel, loin de la société, mais accessible. En réalité, la plupart des pêcheurs n'avaient accès qu'aux lacs situés près des gîtes, et selon la répartition des stocks de l'époque, leur déplacement était également limité. La pêche était probablement pratiquée aux alentours des gîtes et des corridors de déplacement, mais sans empoissonnement. Les voies ferrées et leurs raccordements aux gîtes ont permis de définir la répartition de l'empoissonnement au début du 20e siècle.

L'empoissonnement a commencé en 1899 par l'introduction de l'achigan à petite bouche et s'est poursuivi au milieu du 20e siècle avec l'expansion de l'accès à l'intérieur du parc. L'empoissonnement à l'échelle du paysage a été remis en question lorsque les écosystèmes naturels du parc provincial Algonguin, notamment les populations naturelles d'ombles de fontaine et de touladis, ont été reconnus comme des particularités propres au parc dont pouvaient profiter les visiteurs. Ce changement a été pris en compte dans le Plan de gestion des pêches du parc provincial Algonguin de 1986-2000 et renforcé avec le Plan de gestion du parc de1998. À l'heure actuelle, l'empoissonnement est concentré dans les petits lacs, principalement dans le corridor de l'autoroute 60, très fréquenté et relativement facile d'accès.

L'empoissonnement n'a pas cessé depuis 1899. Il a commencé par l'introduction du touladi en 1911, puis de l'omble de fontaine en 1018 et de la truite moulac en 1954. Au moins 10 300 000 poissons ont été ensemencés dans le parc provincial Algonguin en un siècle, dont une année record en 1923 avec 905 000 poissons. Le nombre record de lacs ensemencés dans le parc provincial Algonguin date de 1959, avec 126 lacs. Le nombre record combiné de poissons et de lacs date de 1962 avec 255 610 poissons répartis dans 108 lacs.

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Introduction

Algonquin Park has many histories. These historical perspectives include travel and resource harvesting by indigenous peoples for millennia, logging spanning from the mid-19th century to the present, and establishment of lodges and early tourism in the 20th century, to name only a few. Current recreational activities are almost as wide ranging as the visitors with the importance of outdoor activity and leisure the main focus of everyone's Algonquin Park experience. The park creates a deep, enduring appreciation of natural history among its visitors. This appreciation has been expressed by many Canadian artists who have captured Algonquin Park in their work for the past century.

Angling, or recreational fishing, has been an outdoor activity in Algonquin Park for as long as the park has existed. This park is renowned as a destination for providing fishing opportunities for brook trout and lake trout in the many lakes and rivers that help define this landscape. Fish *stocking* — the number or biomass of fish from hatchery or a donor population that are deposited in a lake or stream— has been part of the management of recreational fishing for almost as long. The purpose of this report is to summarize the fish stocking history of Algonquin Park from its beginnings in the context of the times.

Currently, angling opportunities in Algonquin Park are supported through natural reproduction in lakes with self-sustaining populations of fish and fish stocking in other lakes. Simply, *angler yield,* or the biomass of fish harvested by an angler expressed as kilograms per hectare, is based on natural production of fish in most park lakes. Fish stocking is focused on lakes largely near the Highway 60 corridor area for the purpose of providing fishing opportunities in lakes without self-sustaining fish populations and with high numbers of visitors. This aspect of fish stocking today is similar to the purpose of fish stocking in the past. Providing angling opportunities has been a consistent rationale for fish stocking in the park. What has changed over the decades has been angler access to the park interior, angler numbers, and resource planning related to fish stocking in Algonquin Park.

A history of fish stocking would be incomplete without considering changes in park management and response to demand for fishing. Early fish stocking efforts reflect a broader shift related to fish and fishing that was occurring in North America at the time. Resolving federal versus provincial jurisdictional control of fishing in Ontario was an important step and an impetus for fish stocking for anglers. This step, along with widespread interest in recreational fishing and hunting at the time, fuelled angler interest in Algonquin Park. The promotion of fishing in many popular magazines and books of the day was widespread and helped shape narratives of the Algonquin Park experience.

Understanding angler motivation for and satisfaction with fishing based on current research helps to provide context for the motivation in early years — assuming anglers'

interests in catching large fish, and lots of them, hasn't changed much in over a century. A key insight is the ability of anglers to respond to the effects of exploitation. Some anglers decide to move on when fishing in one lake declines while others are less motivated to move on. Access to other lakes and the mobility of anglers affects sustainability of recreational fisheries in any one particular lake.

Each fish stocking is accompanied by a measure of uncertainty about how many fish will survive to harvestable size. Young fish of a given species are introduced to a lake, or perhaps older life stages are transferred from one lake to another and the outcome is fish for anglers to catch. Just how that process works is better understood today. Despite better insight, it is wrong to assume a constant ratio of stocked fish to eventual fish of catchable size. Stocking can succeed or fail based on many factors including differences in productivity among lakes, survival among fish strains, climate from year to year, and the role of predators already present in many lakes. This report reflects a summary of best available data on fish stocking efforts from a variety of sources (see Appendix 1). Stocking success from the past century is not evaluated.

When fish stocking started in the late 19th century, interest in factors affecting stocking success was minimal. Fish stocking was seen as a way to provide angling opportunities by supplying fish in response to over exploitation and habitat loss. It matched a new view of angling with a desire to make amends for losses of natural fish. Fish stocking in Algonquin Park predates what is widely acknowledged as the beginning of animal ecology as a science — the publication of Charles Elton's book Animal Ecology in 1927 (Elton 1927). Elton's book described for the first time concepts such as food web, food chains, and the pyramid of numbers that so many now recognize as the basic structure of ecology. The pyramid places predators such as lake trout at the top and primary production organisms (i.e., photosynthesizers) at the bottom (Figure 1). In between are small herbivores, such as zooplankton, which are consumed by small fish that in turn are consumed by lake trout. Densities of predators are lower at the top of the pyramid than herbivores, which appear lower in the pyramid, because energy transfer from one level to another (trophic transfer) is inefficient and imperfect. Inefficiencies in energy transfer result because some of the food (energy) consumed at one level is used for maintenance of the organism at that level — so energy is not all transferred to the consumer at the next higher level. Thus, an ecosystem is structured as a pyramid. Such a concept would have been helpful in thinking about stocking success and why stocking results in fewer fish at the end than go into a lake at the start. Indeed, Elton and his writing were known to the fisheries science staff conducting research in Algonquin Park at the time, and he visited the Harkness Laboratory of Fisheries Research in 1938. Elton's book significantly influenced early thinking about the role of science and management in Algonquin Park.

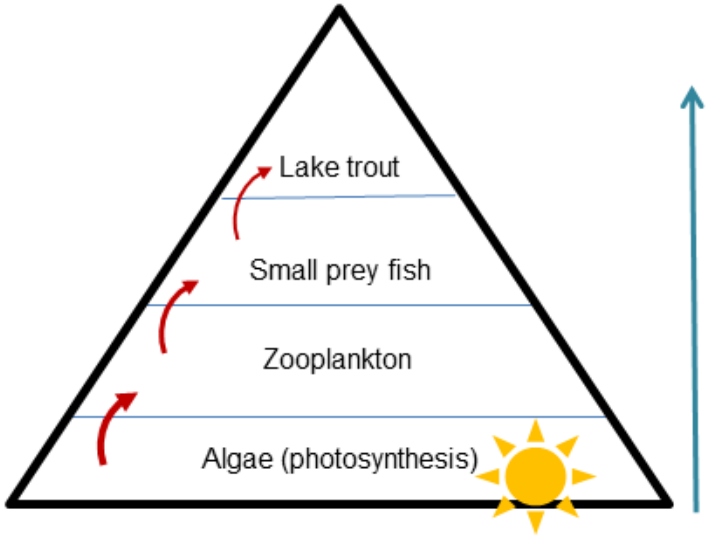


Figure 1. A simple Elton food pyramid or pyramid of numbers for a lake ecosystem with lake trout as the top predator. The vertical blue arrow represents the direction of energy flow. The base of the pyramid begins with the sun, where primary production based on photosynthesis converts light into biological material. In natural ecosystems, energy transferred from one level to the next is reduced, generating fewer organisms at each successive level. Not all energy is transferred up (red arrows) because all organisms use energy for growth, survival, and reproduction. Generally, about 10–14% of energy is transferred from one level to the next through prey/food consumption.

Later in his career, Elton published The Ecology of Invasions by Animals and Plants (Elton 1958), which is viewed as a foundational text on the study of effects of species introductions on food webs. The effects of stocking in Algonquin Park were documented by J.R. Dymond (1935; Appendix 3) in the first fisheries science report based on study in the park. It anticipates Elton's writing by over two decades. If fish stocking was seen as an experiment in both ecosystem ecology and animal invasions then decisions that occurred over a century ago may have been viewed differently at the time. But fish stocking preceded fisheries science as a discipline and the effort here is to avoid reading history backwards from the present.

Early stocking effort was a cultural and social response to fundamental changes that were occurring in the late 19th century. The history of conservation thinking in many ways started with early efforts to develop recreational angling by sportsmen based on concern about severe depletion of freshwater fish populations from harvesting for food and commercial value. A pattern of overharvest better understood today as the invisible collapse is evident in the commentary and actions of people early in Algonquin Park history. Fish stocking levels in the early decades were a response by park managers in light of the demand for fish — and a clientele with limited options for movement among

lakes. The narrative of fish stocking can be partitioned into periods of increasing access to the Algonquin Park landscape and finally a shift to a more organized and resource planning driven response. Although few detailed descriptions of fish stocking in the early decades exist, descriptions of activity and comments by the park's first superintendent, George Bartlett, reveal signals of overharvest.

This report is organized as follows: Overall stocking numbers, locations, and trends are presented showing that fish stocking in the park can be partitioned into three phases 1) the railroad and lodge era in the early decades through the 1930s, 2) decades following increased access to the park via the family car and development of Highway 60 from the 1940s through the 1970s, and 3) a stronger planning approach for allocating fish stocking among lakes beginning in the 1980s. Patterns of stocking are also summarized based on fish species. The historical background and a general insight into the elements of overfishing provide context for some of the early patterns of fish stocking in Algonquin Park. This historical perspective includes the development of a long-term fisheries science program in the park in response to increasing public access in the 1930s. Finally, a summary of fish stocking in aquatic ecosystems offers a perspective, based on research results, on effects beyond providing fishing opportunities and production of fish. A more modern view of fish stocking requires broader consideration of outcomes than in the past.

Fish stocking patterns in Algonquin Park

The spatial distribution of angling effort for over a century in Algonquin Park points to fish stocking decisions as a response to changing angler distribution. Specifically, early stocking was needed because of limited angler movement when early declines in fishing quality occurred. Stocking also fulfilled an ideal of angling that was central to this recreational activity. Increased angler movement and more widespread harvest occurred as park access changed in subsequent decades, but especially after completion of Highway 60. Stocking decisions appear to have been responses to problems stemming from overharvest along with limited angler movement in the first decades, or attempting to meet angler expectations following post-World War II changes in access that increased angler movement. Since the development of the Algonquin Provincial Park Master Plan in 1974 (OMNR 1974), a planning approach has been followed to assess locations for fish stocking in support of put-grow-take fisheries in lakes without self-sustaining lake trout or brook trout.

This summary is based on an extensive review of multiple data sources containing information on historical fish stocking in Algonquin Park (Appendix 1). Each data source was thoroughly examined for records of fish stocking events that occurred within the current park boundary. The resulting database contains detailed information for 4,412 stocking events distributed across 372 lakes and 23 river and stream locations. Ninety of these records (2%) do not list data on stocking quantity and 306 records (6.9%) do not include a confirmed stocking location.

Of the 4,412 stocking events, 14 were fertilized egg transfers and 314 were confirmed adult fish transfers. Fertilized lake trout and/or brook trout egg transfers were made to Lake of Two Rivers as well as Canoe, Delano, Mykiss, Hay, and Shirley Lakes between 1957 and 1988, inclusive. Adult transfers of hatchery and/or wild strain lake trout, brook trout, splake, bass, cisco, and Arctic grayling were made to several lakes between 1899 and 2004, inclusive.

Historical records show that since 1899 over 10.3 million fish have been stocked into Algonquin Park waters. Twelve different fish species have been released within the park boundary with 89% of the total fish stocked comprising brook trout, lake trout, and splake.

The long-term trend line

The long-term trend in annual fish stocking is shown in Figure 2. Numbers of fish stocked vary each year with some years showing peaks in stocking while other years indicate declines in numbers of fish stocked. Accounting for year-to-year differences in fish stocking can be difficult given the lack of detailed historical information on factors

such as hatchery production, decisions to allocate fish stocking to other regions of Ontario, or annual decisions by park management to increase or decrease stocking for any given lake. Despite the lack of information on decisions about what and where to stock fish in any given year, patterns in the long-term trend still help to partition fish stocking in Algonquin Park into historical periods.

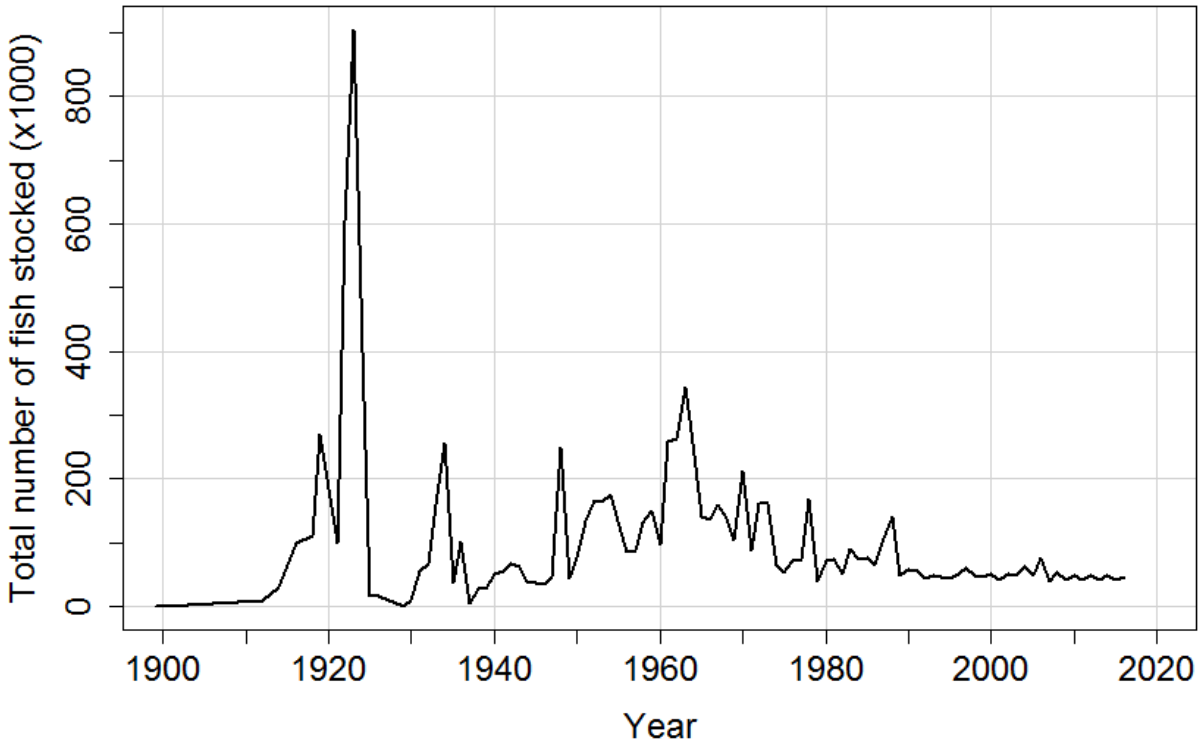


Figure 2. The total number of fish (in units of thousands) stocked per year in Algonquin Provincial Park from 1899 to 2016. The largest peak in stocking quantity is in the early 1920s — a time when lakes near Algonquin Park lodge and camp operations were likely experiencing high angling pressure from railway visitors. Increasing stocking numbers was likely a response by park managers to meet the demand of a growing angling community.

Three phases or historical periods of fish stocking can be described from Figure 2: 1) the railroad and lodge era; 2) the Highway 60 and increased access era, and 3) the park planning era. In the first phase, from 1899 to the 1930s (Figure 2), referred to as the railroad and lodge era, fish stocking was focused on providing fishing opportunities to lodge guests on few lakes. Lodges were served by railroad lines bringing guests and support. Access to areas of Algonquin Park not in the vicinity of lodges was limited. During this period, the peak year for fish stocking occurred with 905,000 fish (mostly lake trout) stocked in relatively few lakes. In the second phase, automobile access to the park increased beginning with completion of Highway 60. The highway allowed people who were not part of the lodge and railroad clientele to arrive and push further into the interior of the park. For purposes here, this period covers the 1940s through the

1970s (Figure 2). During that time, total numbers of fish stocked in the park increased and many more lakes were stocked each year. In the third phase, the trend in the numbers of fish stocked settles into a steady pattern beginning in the late 1980s and continuing to today (Figure 2). Park planning for fisheries management began with the Algonquin Provincial Park Master Plan (OMNR 1974) and the realization that past stocking practices were not sustainable with respect to native populations of lake trout and brook trout. In most cases, stocking success was not well evaluated. Each of these phases is addressed in more detail in subsequent sections.

The highest total number of fish stocked was in 1923, with 905,000 individual fish distributed into Algonquin Park waters (Table 1). The top three years of stocking occurred in the early 1920s (Table 1). The following top seven years in total fish stocked in the park corresponded to the period of increased access to the park interior. The peak stocking year in Algonquin Park was 1962 for both numbers of stocking events and number of lakes stocked (Table 2). During that year, 255,610 fish were stocked in 157 separate events across 108 known lake locations (Table 2). Table 2 shows that widespread stocking was common in the years following Highway 60 construction, which increased public access to the park. Stocking events in Table 2 refer to unique records of fish stocking based on different dates or different quantities of fish in a given year. Some lakes received more than one stocking event in a year.

Cache Lake received the highest total number of fish stocked at 1,289,084 individuals (Table 3), surpassing Canoe Lake which had the second highest total, by over 920,000 fish. The highest total number of stocking events has occurred in Ryan Lake (Table 4) with 85 events (i.e., unique stocking records) over a 53 year span (1963 to 2016). Note that Tables 2, 3, and 4 are based only on stocking events for which lake locations are known and in many instances individual lakes were stocked multiple times in the same year.

The distribution of fish stocking in Algonquin Park lakes was widespread. Figure 3 shows all lakes that have received at least one stocking event since 1899. The distribution of lakes receiving stocked fish in any given decade is less than the total illustrated in Figure 3. These numbers are explained in subsequent sections.

The total stream or river sites stocked with fish were far less than the total lakes stocked (Figure 4). Most stream stocking events appear to be aligned with historical railroad access.

Table 1. Top 10 list of years between 1899 and 2016 with the highest total number of fish stocked. The railroad and lodge era includes the major stocking years of 1919, 1922–1924, and 1934. The other years are in the Highway 60 and increased access era.

Year	Total number of fish stocked
1923	905,000
1922	605,000
1924	400,000
1963	344,554
1919[a]	270,200
1962	263,360
1961	258,895
1964	255,254
1934	255,000
1948	250,000

[a]All fish stocked into Cache Lake.

Table 2. Top 10 list of years between 1899 and 2016 with the highest number of stocking events and lakes stocked. Stocking events represent unique historical records of fish stocking based on either separate dates for stocking in a year or different quantities of fish stocked in a lake in a year. All top 10 years are during the Highway 60 and increased access era because of increased stocking in lakes across the park rather than concentrating on relatively few lakes as was the case during the railroad and lodge era.

Year	Number of stocking events	Number of known lakes stocked
1962	157	108
1963	156	87
1959	144	126
1958	136	117
1970	135	86
1967	125	89
1961	123	96
1972	119	105
1969	113	94
1956	112	79

Table 3. Top 10 list of Algonquin Park lakes with the highest total number of fish stocked since 1899.

Rank	Lake name	Total number of fish stocked
1	Cache Lake	1,289,084
2	Canoe Lake	361,147
3	Lake Opeongo	331,965
4	Source Lake	323,523
5	Ryan Lake	283,350
6	Billy Lake	263,747
7	Galeairy Lake	227,099
8	Smoke Lake	226,175
9	Lake of Two Rivers	204,689
10	Redrock Lake	195,366

Table 4. Top 10 list of Algonquin Park lakes with the highest total number of stocking events since 1899. Stocking events are unique historical records of stocking, some of which may represent more than one stocking event in an individual lake in the same year.

Rank	Lake name	Number of stocking events
1	Ryan Lake	85
2	Billy Lake	84
3	Cache Lake	80
4	Cauliflower Lake	71
5	Little Minnow Lake	64
6	Jake Lake	62
7	Peck Lake	51
8	Bluff Lake	50
9	Lake of Two Rivers	47
10	Myra Lake	47

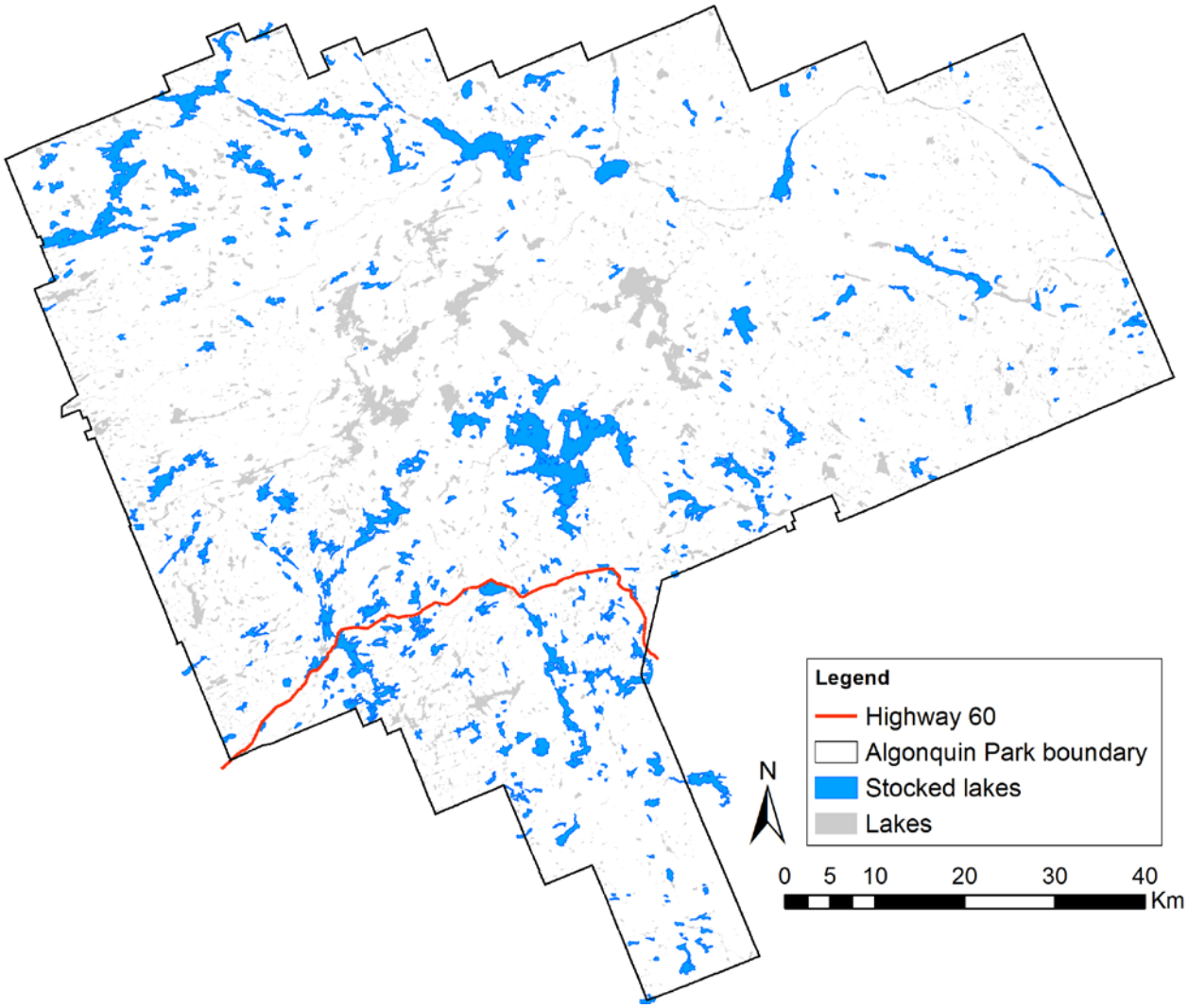


Figure 3. The distribution of all known fish stocking in Algonquin Provincial Park lakes from the start in 1899 through 2016. A total of 372 lakes have been stocked with one or more fish species. Fish stocking in lakes in any given year is less than the total number of lakes illustrated in this figure.

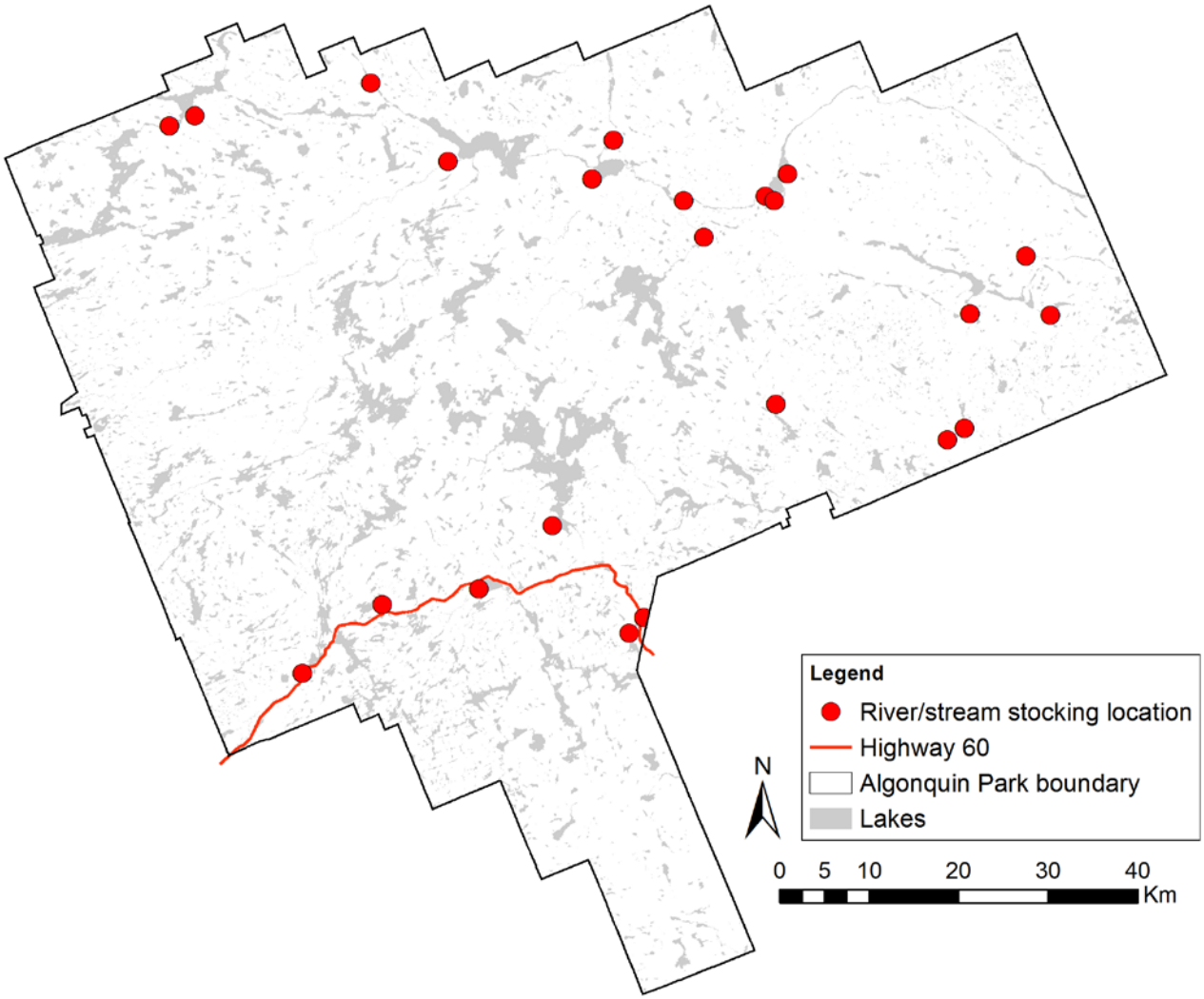


Figure 4. The approximate locations of river and stream stocking events in Algonquin Provincial Park. These locations are based on river and stream names as well as any associated geographic townships referenced by historical fish stocking records. A total of 122 river and stream stocking events occurred between 1930 and the early 1970s. Lake trout fingerlings were stocked in the south branch of the Madawaska River on four separate occasions in the late 1940s and early 1950s. Largemouth bass fingerlings were released in the Little Madawaska River in 1950. The remaining 117 river and stream stocking events relate to the release of various brook trout age classes.

Is there an average angler?

The average angler exists only in statistical summaries of catch and fishing effort data. As individuals, anglers exhibit a range of motivations and interests in angling and in being outdoors. The criteria used by one angler or group of anglers to judge success of an outdoor trip may differ from that of another depending on how they rank the importance of, for example, catch rate or fish size. A view of nature as something other than a commercial interest was part of the development of an angling ideal that began in the 19th century. The opening of Algonquin Park to public visitors provided an opportunity to satisfy that interest for those seeking an outdoor experience away from cities, towns, and settled landscapes.

Insight into the human dimensions of angling is important for addressing changing patterns of fish stocking in Algonquin Park. The human dimension of the angling experience is a multi-level phenomenon including the outdoor experience itself, characteristics of a single fishing trip such as enjoyment of the outdoors, a general sense of satisfaction with a season of fishing, and how focused anglers are on catching fish over other factors contributing to a satisfying outdoor experience (Hunt et al. 2013). In the 1974 park master plan (OMNR 1974), the outdoor experience of recreational angling was identified as critical. The important role of human dimensions is such that recreational fishing has been referred to as a social-ecological system — social because of the human dimensions driving angler choice and activity and ecological because angler success is controlled in part by lakes and rivers with their own inherent production patterns (Hunt et al. 2013). Social-ecological systems strongly imply a coupling of the two basic elements of recreational fishing or any other kind of harvesting activity.

The angling experience has three fundamental components that are common among many recreational fisheries (Arlinghaus 2006; Beardmore et al. 2015). The consistency of each component has been revealed by angler surveys and points to their generality across recreational fisheries in many countries. The three components are 1) **motivation** — a desired outcome by an angler or group before a fishing trip (Arlinghaus 2006), 2) **satisfaction** — difference between a desired outcome and the perceived fulfillment of the desired outcome (Arlinghaus 2006), and 3) **catch orientation or catch importance** — the focus on catching versus harvesting fish and the importance attached to the number and size of fish captured (Hunt et al. 2011, Beardmore et al. 2015). Catching large fish and more fish is a general finding in many studies of angler motivation and satisfaction — a feature of angling likely as important a century ago as today. Anglers often prefer high catch rates that stocking can provide vs a strict interest in catching wild fish (Arlinghaus et al. 2014). The premise of the summary presented in this report is that basic angler motivation and satisfaction has remained largely unchanged in over a century. What has changed is knowledge about components of the angling experience as described above and understanding of the attributes of

overfishing in recreational fishing. This results in deeper insight into how social-ecological systems fail, including the inability to detect a fishery in decline.

Anglers move among lakes, typically focusing their effort on a few or single lakes. Movement is a key feature of recreational fisheries (Hunt et al. 2011). If anglers can move among lakes then their activity links lakes based on the criteria they use to decide to move from one to the next. If anglers respond to yield then those ranking catch importance as high will likely move when yield declines. Travel, or more precisely the effort (time and cost) and willingness to travel, affects movement decisions. Acceptance of travel may increase if anglers have information about the potential status of other lakes. Anglers who are not focused on yield may opt to travel less and perhaps place greater importance on the local environment they prefer to visit. Many combinations of these factors can combine to produce a satisfying angling trip. The fundamental aspect of recreational fisheries is that they represent landscape fisheries, not simply a single lake fishery.

In a region with low angler numbers general fishing effort will be low. Anglers looking for high yield may move to other lakes, allowing the fish population in their regular lake to recover. In this case fisheries generally do not become threatened because at low angler numbers and high access to other lakes, an angler's response to declining yield is often movement to other lakes, reducing pressure. Anglers who are not as responsive to yield may remain on a lake continuing to harvest fish, which can lead to fisheries becoming threatened. These anglers are not necessarily responding to any strong signal from the fishery because they rank catch importance lower. Of course, if regulations allow harvest of many fish then any number of anglers could jeopardize the sustainability of a recreational fishery. Or if more anglers are expecting good catches of fish from the same set of lakes this too can result in declines in recreational fisheries.

With more anglers and greater fishing effort, catch importance declines as a mechanism governing movement decisions. In this case, overfishing can become a reality across a landscape of lakes, forcing anglers to move further to sustain desired catch levels. This is the scenario that explains walleye fisheries in northwestern Ontario (Hunt et al. 2011).

One other insight into fisheries sustainability is apparent and it is one that helps explain the so-called invisible collapse of recreational fisheries across Canada. The invisible collapse relates to the difficulty of detecting a declining fishery until it may be too late (Post et al. 2002). As with a landscape view of recreational fisheries the invisible collapse also involves movement. Anglers ranking catch importance as high will, through knowledge and experience, be able to locate fish in a lake and sustain their catch rates even as fish numbers decline. As numbers decline fish will be found only in preferred habitat or other locations and anglers can adjust their fishing location to track the shrinking distribution of fish. Ironically, the catchability of fish increases in this scenario, meaning that the loss of fish for each day of fishing increases because the remaining fish of catchable size are more easily located in their remaining habitat (Post

et al. 2002). Because of their skill, the angler experiences relatively constant catch rates through most of the decline. Recreational fisheries are susceptible to the invisible collapse. This effect is depensatory — once the decline in fish begins it can accelerate downwards because of the nature of the invisible collapse where catch rate appears good but each unit of fishing effort causes an accelerating reduction in numbers of fish (Post et al. 2002).

For walleye, or other species with larval stages in open water a decline in numbers can release prey fish that in turn increases prey fish numbers. This is a compensatory response because prey is now released or compensate for loss of predatory control by an increase in numbers. Overfishing potentially cultivates prey species to the point of dominating a new food web structure where the predatory species, such as walleye, can no longer dominate because of increased losses of their larval stages to abundant prey fish. This produces another mechanism of depensatory loss of a targeted game fish (Walters and Kitchell 2001).

Catch importance is illustrated in Figure 5. Both parties are demonstrating their high ranking of catch importance based on the number of harvested lake trout in each photo. Other visitors may have fished for shorter time periods, were satisfied with the experience of being in Algonquin Park, enjoyed the scenery, and were happy to have had an opportunity to fish for lake trout. For these people, their catch importance was low since for them the outdoor experience may have been a greater part of their angling satisfaction than the groups photographed in Figure 5. It's not clear that the parties in Figure 5 would have posed for a photo if only one lake trout had been captured. Both photos show anglers with a strong commitment to harvesting fish. If these photos serve as examples of harvest levels, then Algonquin Park lakes were under very high levels of angler fishing effort and depletion of fish in the early 1900s. Sustaining these harvest levels would have likely resulted in depensatory control of recreational fishing — the invisible collapse. In Figure 6, the advertisement by Grand Trunk Railway for travel to Algonquin Park points to the desirability of a natural landscape and abundant fish. This clearly addresses the motivation interests of anglers and one not so different than today.

Figure 5. Angler harvest from the early 1900s. Left: A catch of fish from Canoe Lake in 1916. Photos with long stringers of fish were common in the past. Right: Two anglers with a 1930 catch of 33 trout. Angler harvest is the number of fish kept by an angler expressed as a total for a fishing trip or daily harvest (Source: Algonquin Park Visitor Centre Archives).

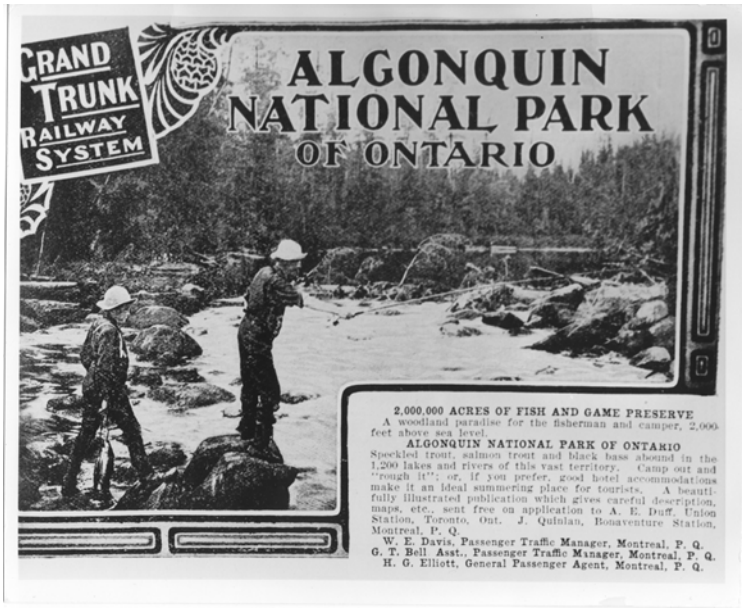


Figure 6. A 1911 advertisement by Grand Trunk Railway System for Algonquin Park emphasizing “a woodland paradise for the fisherman and camper 2,000 feet above sea level. Speckled trout, salmon trout [lake trout in modern naming] and black bass abound in the 1,200 lakes and rivers of this vast territory.” Black bass (a general name for smallmouth bass) abound due to stocking efforts over the previous decade. (Source: Algonquin Park Visitor Centre Archives).

Railroads, lodges, and the early decades of fish stocking in Algonquin Park

In keeping with the era, angling in Algonquin Park was widely promoted and drew notice. A quote from George Bartlett in his superintendent annual report of 1914 illustrates the high value placed on the new recreational fishery in the park, including a nod to celebrity status (Bartlett 1914):

> "Fishing during the past year has been good. Some fine specimens were taken: one fine salmon trout [lake trout] caught in Smoke Lake by Lady Conan Doyle has been mounted and sent to her home in England. Nearly all the prizes offered by sporting journals won this year were taken by fish from Algonquin Park. A number of fingerling bass were put into Cache Lake; they were in splendid condition when planted. I should like to see some more next year, also salmon and speckled trout, as it is important to keep the lakes near the hotels stocked, so that those who are not able to go far afield can have some sport."

Between 1899 and 1910, three lodges began operating in Algonquin Park on Cache Lake and Joe Lake. In the following decade several more lodges were established in these and more lakes, including Canoe Lake. For the first three decades of the 20th century, railways brought visitors to the lodges (Appendix 2). The concentration of fishing effort on these lakes, and the evidence for high catch importance (see Figure 5) indicates that overfishing may have been underway at that time. As will be shown, stocking was used to support angling at lakes with lodges for several decades.

Access to the interior of the park was available on early trail networks but did not match the portage system in operation today. Most visitors likely remained near the lodges and their neighbouring lakes, resulting in a lack of movement by anglers and likely signs of potential overfishing. Faced with lack of movement (likely associated with lodged-based guests), bringing fish to the new anglers in the form of smallmouth bass was the initial solution. Expanding fish stocking to include lake trout and brook trout occurred after 1910.

In his 1911 annual report, George Bartlett provided a clear image of the motivation and satisfaction of anglers in the park and the need for providing fishing opportunities for lodge guests (Bartlett 1911). The lack of movement to other lakes by many visitors points to possible problems encountered in sustaining fisheries close to where most of the visitors using the railway would have spent their leisure time:

> "Fishing was good during the past year, and general satisfaction was expressed by all visitors, who do not hesitate to pronounce the Park the best fishing grounds now to be found in America. I would, however, recommend

> stocking Cache, Cranberry [now Canisbay] and White [now Tanamakoon] Lakes, as these being within easy reach of the hotel provide sport for those who cannot reach more distant waters."

Bartlett's quote also speaks to the high expectations of fishing quality met by the park in the early years of the lodge era. The need to sustain a high level of satisfaction among anglers, as clearly stated, would reach its peak in the early 1920s, 10 to 20 years into the lodge era of Algonquin Park and when many seasons of heavy fishing demand were likely coming to bear on local lakes. Catch rates would have been maintained throughout any period of decline until dispensatory processes began to suddenly drive down yield. From 1922–1924, 1.9 million fish, mostly lake trout, were stocked in lakes with lodges — the single greatest peak in stocking numbers in the history of Algonquin Park.

Fish stocking from 1899 to 1940 indicates a clear pattern of stocking lakes near lodges (Figures 7 to 10). During these decades access for both recreational visitors at lodges and forestry was strongly connected with railways. Crotch Lake (Figure 7) is a stocking event associated with a forestry operation. The Canoe to Cache Lake corridor was routinely stocked with fish near lodge operations. Cache Lake in particular was heavily stocked during this period (Table 1 and 4) to such an extent that it tops the list of lakes for stocking numbers. This level of fish stocking was largely achieved in the 1920s.

In the 1930s (Figure 10), the completion of Highway 60 and railroad access coincided with the transition from an older, more traditional transportation mode for park access — railroads and lodge visitors — to a new mode — the family car — promising increased park visitation and access.

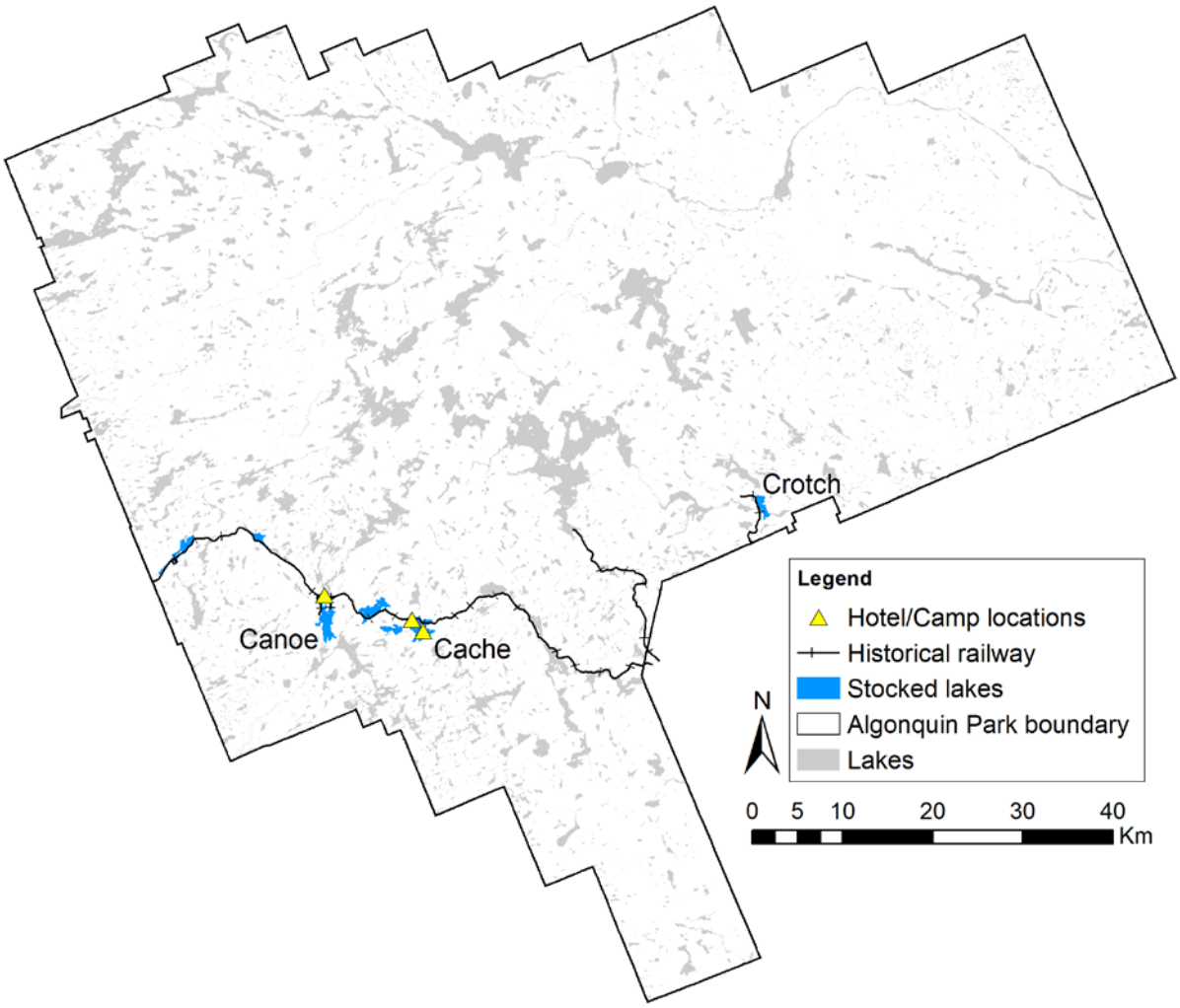


Figure 7. Algonquin Park lakes stocked with fish from 1899 to 1910, inclusive. Smallmouth bass transferred to Cache Lake was the first ever stocking event, which occurred in 1899. The rail line in the east served the Booth logging operation with Crotch Lake receiving smallmouth bass transfers as stocked fish. The stocked lakes align with lodge locations and are situated on rail lines transporting lodge guests. Two stocking events using Atlantic salmon occurred in 1908 and 1909.

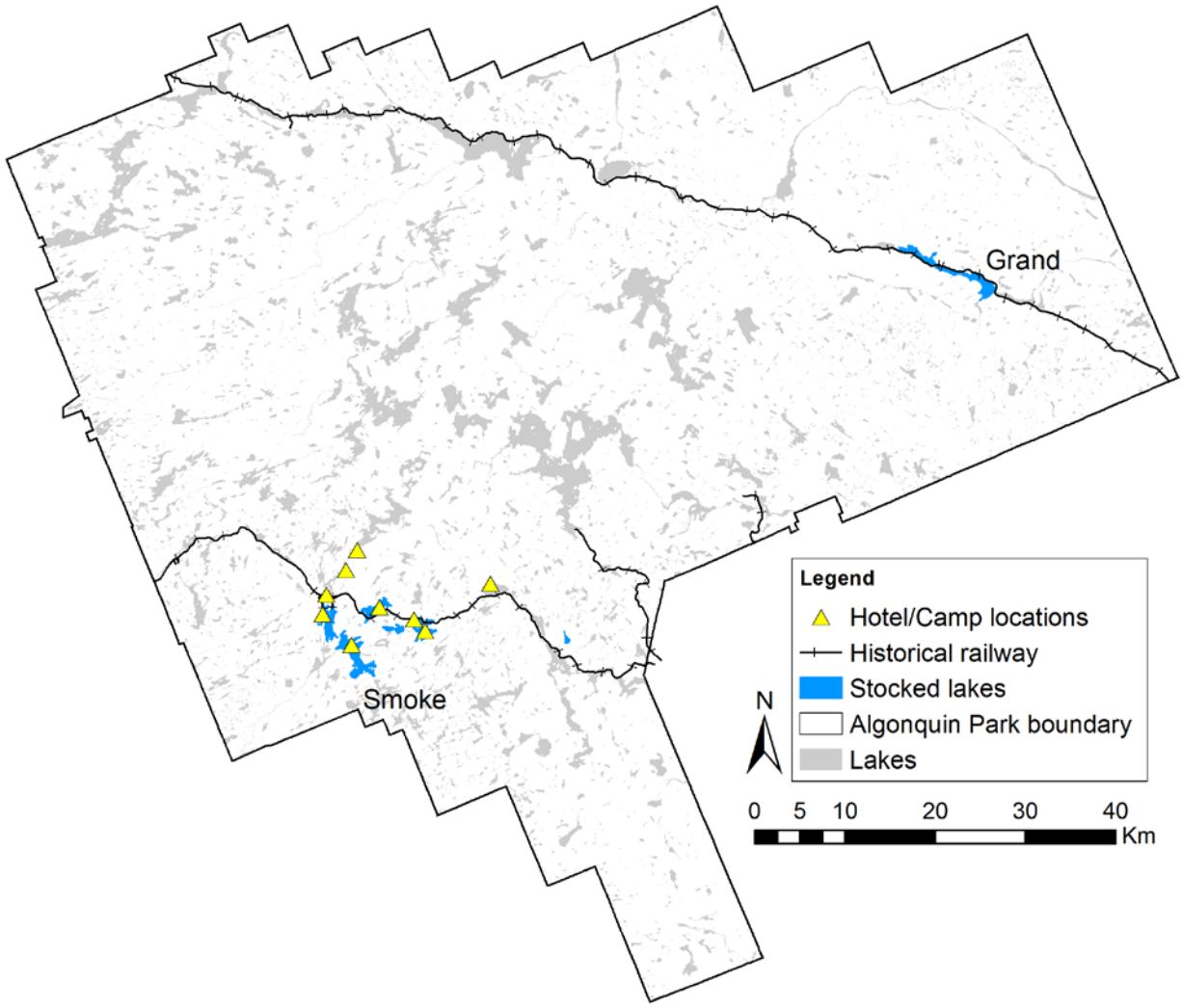


Figure 8. Algonquin Park lakes stocked with fish from 1911 to 1920, inclusive. Stocking in lakes with lodge guests continued with new stocking occurring in Grand Lake along the Canadian National Railroad in the northern area of the park. This was the first stocking event along that rail line.

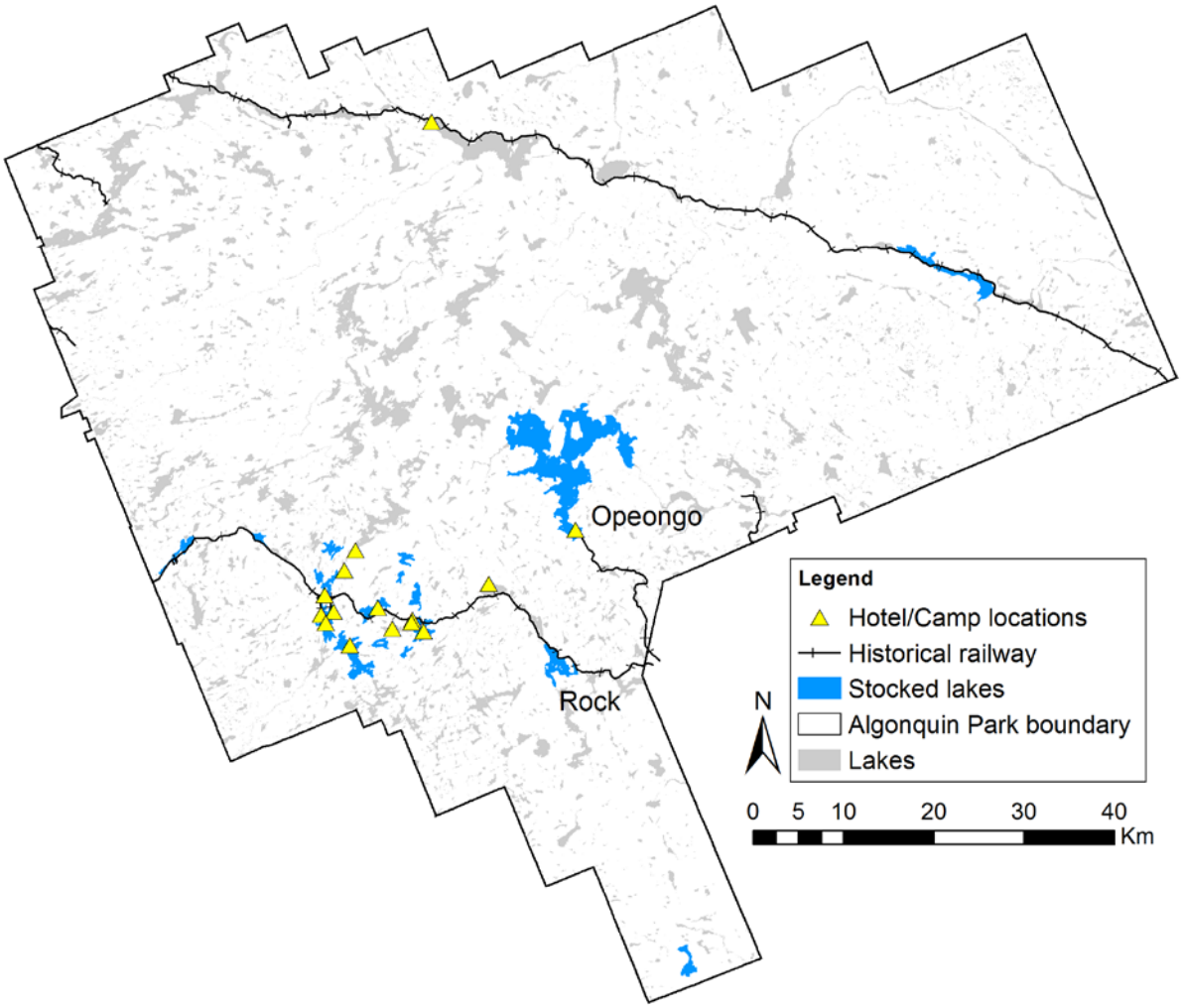


Figure 9. Algonquin Park lakes stocked with fish from 1921 to 1930, inclusive. Lodge numbers increased and stocking continued on lakes supporting lodge guests. The 1920s represented some of the most concentrated stocking of lake trout in Cache Lake.

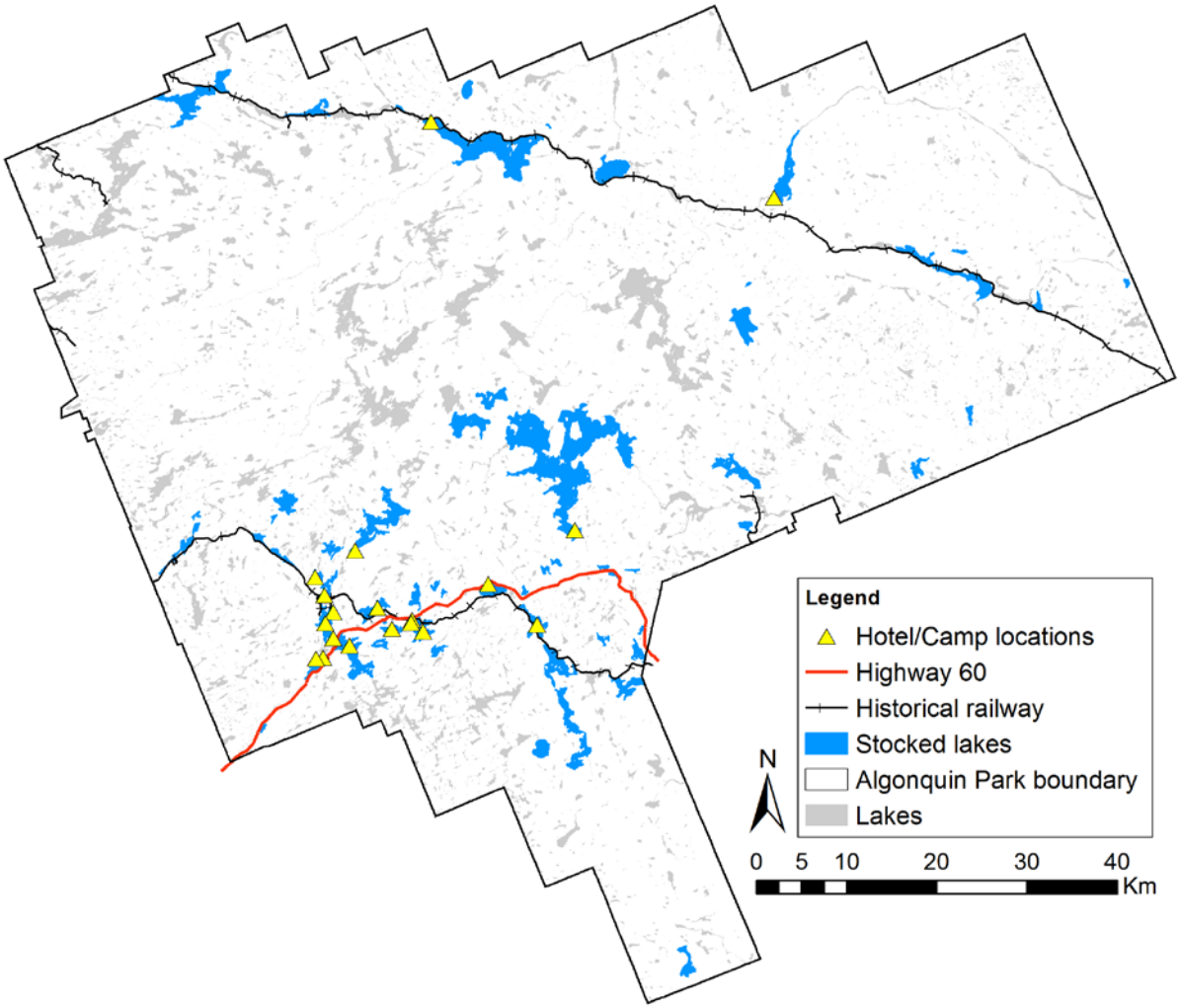


Figure 10. Algonquin Park lakes stocked with fish from 1931 to 1940, inclusive. Fish stocking expanded along the northern rail line and construction of the Highway 60 corridor began with completion of the road (1937) allowing stocking to be expanded into more lakes. Stocking continued in lakes with lodges.

The era of the family car and increased access

With the completion of Highway 60, patterns of fish stocking changed. This change in access concerned Frank MacDougall, park superintendent in the 1930s (Killan and Warecki 1998). MacDougall identified changing road access, and by implication changing clientele from the affluent lodge guest transported by railroad to middle class visitors using an automobile, as a new challenge for sustaining native fish populations in the park. In 1935, MacDougall concluded that the family car "changed the character of the park" (p. 141 in Killan and Warecki 1998). The expanding road network in Ontario was a general concern for newly minted angler groups such as the Ontario Federation of Anglers (Clark 1964).

The period following World War II saw some of the greatest increases in angling interest in the park as reflected in the long-term fishing effort trends in the Lake Opeongo creel survey (Figure 11). Following a dip during the war years, angling effort doubled from 5,000 hours of fishing on Lake Opeongo in 1945 to 10,000 hours by 1975, after which it tripled to nearly 30,000 angler hours in 2000. It has decreased somewhat since then.

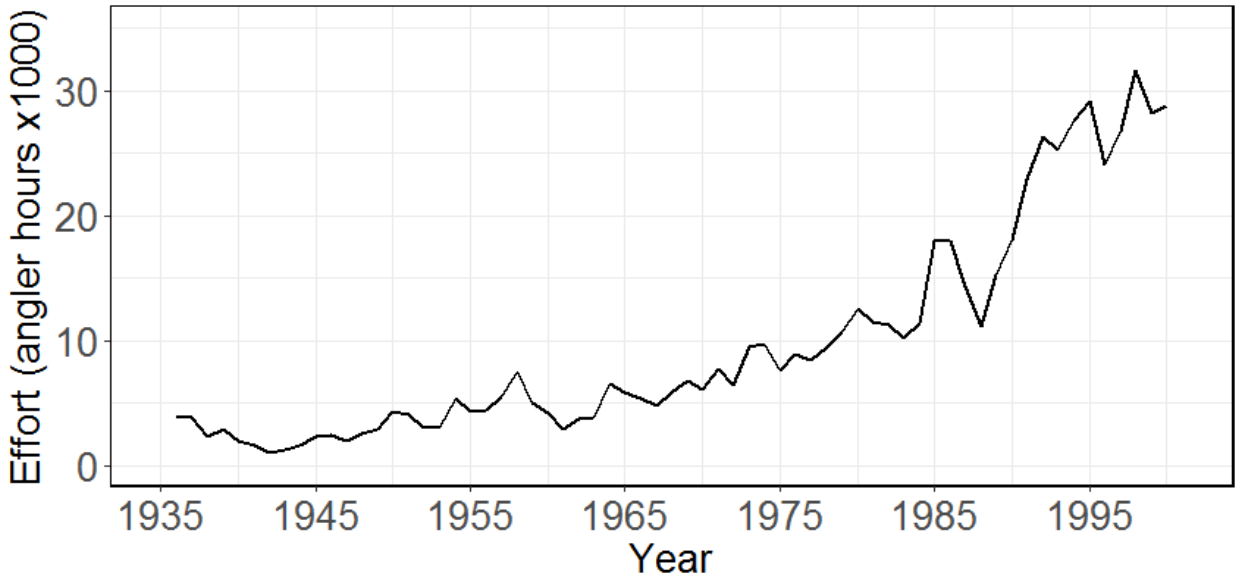


Figure 11. The trend in angler effort (hours spent fishing) for lake trout on Lake Opeongo, 1936–2000. A steady increase in angling effort (hours spent fishing) reflects an increase in the number of anglers from the beginning of Highway 60 construction to the year 2000. Values on vertical axis are in units of thousands.

In the decades of improved access following construction of Highway 60, stocking expanded to more areas of the park. Opening access to the interior of the park appeared to provide the movement element missing in the lodge era. With improved access came increased angling effort. In the decades following the Second World War,

the distribution of fish stocking was greatly expanded with lake numbers peaking in the 1950s and 1960s. During this period, the number of lakes stocked increased from 26 in 1950 to a peak of 126 in 1959.

In the 1940s (Figure 12) and 1950s (Figure 13), a pattern of stocking lakes well away from lodges and railroads had begun. Lakes traditionally recognized as lodge-based destinations continued to be stocked but the emphasis apparently shifted to lakes in the wider landscape of the park. Stocking by plane began in the 1950s.

In the 1960s (Figure 14), the number of lakes receiving fish stocking in the park reached its maximum (see Table 2). Over 100 lakes were stocked annually during this time. This period corresponds to the start of an accelerating trend in *angler effort* (the number of hours or days spent angling — angler effort can also be expressed based on the number of fishing rods such as rod-hours per hectare) on Lake Opeongo (Figure 11). The demand for back country fishing opportunities must have been high in the 1960s.

Fish stocking activities were reduced in the 1970s (Figure 15), with stocking in the northern half of Algonquin Park greatly reduced compared to the two previous decades. Lakes in the Highway 60 corridor continued to be stocked as they had been for several decades.

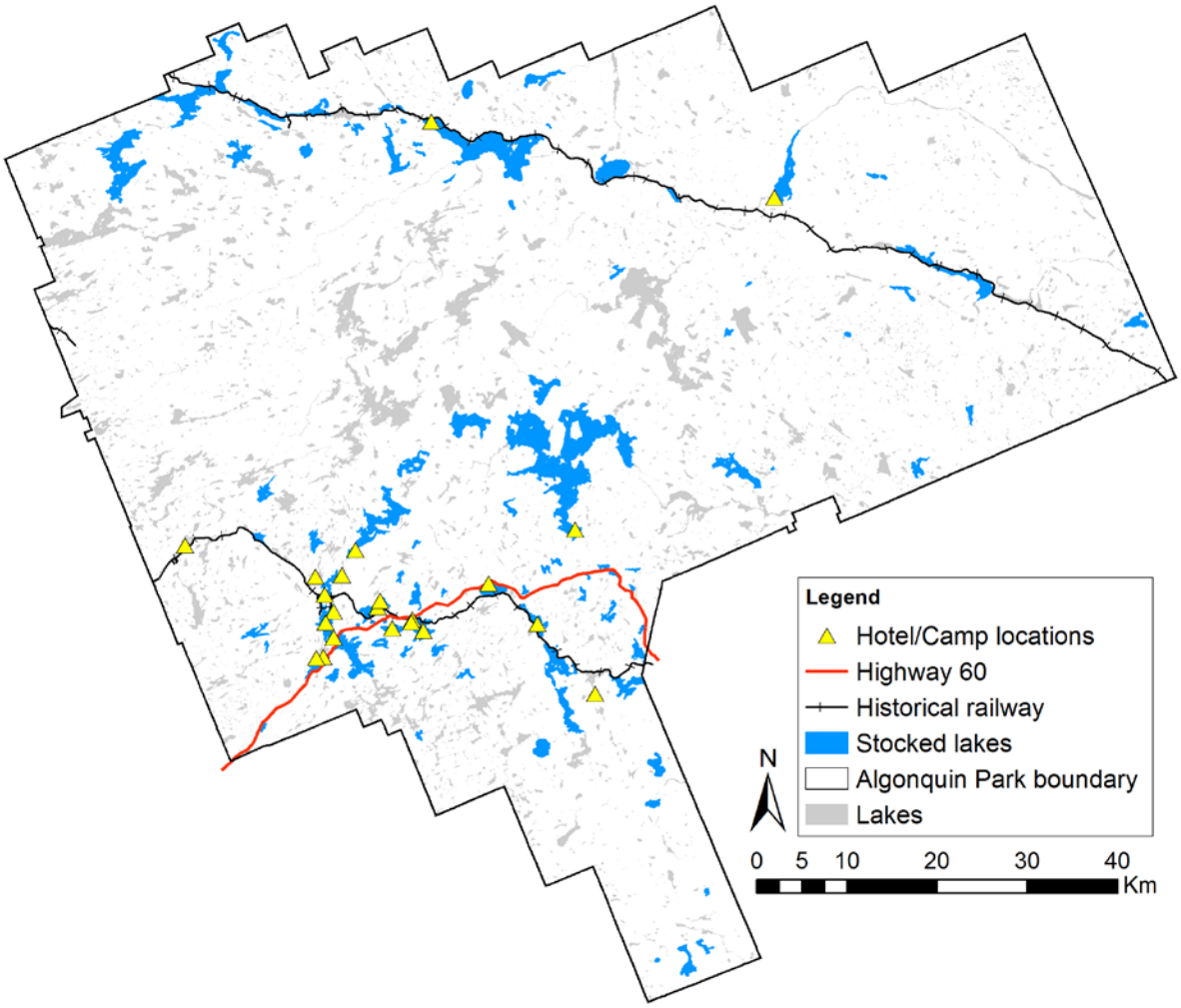


Figure 12. Algonquin Park lakes stocked with fish from 1941 to 1950, inclusive. Stocking expanded along the northern rail line in the park as well as beyond the Highway 60 corridor.

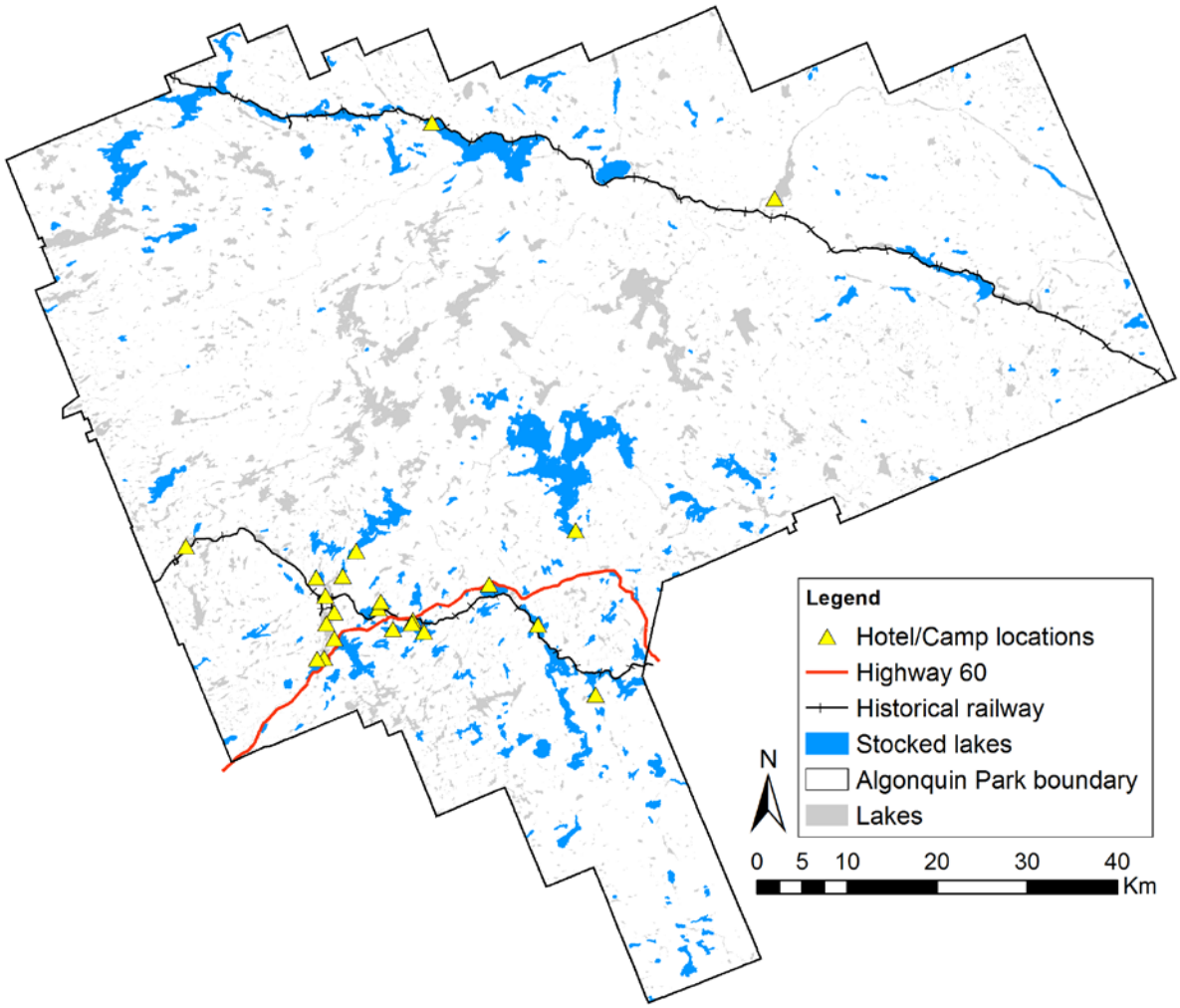


Figure 13. Algonquin Park lakes stocked with fish from 1951 to 1960, inclusive. Fish stocking expanded south of the highway and rail corridor as well as into more remote areas in the northern region of the park. Interior lakes began to be stocked using aircraft.

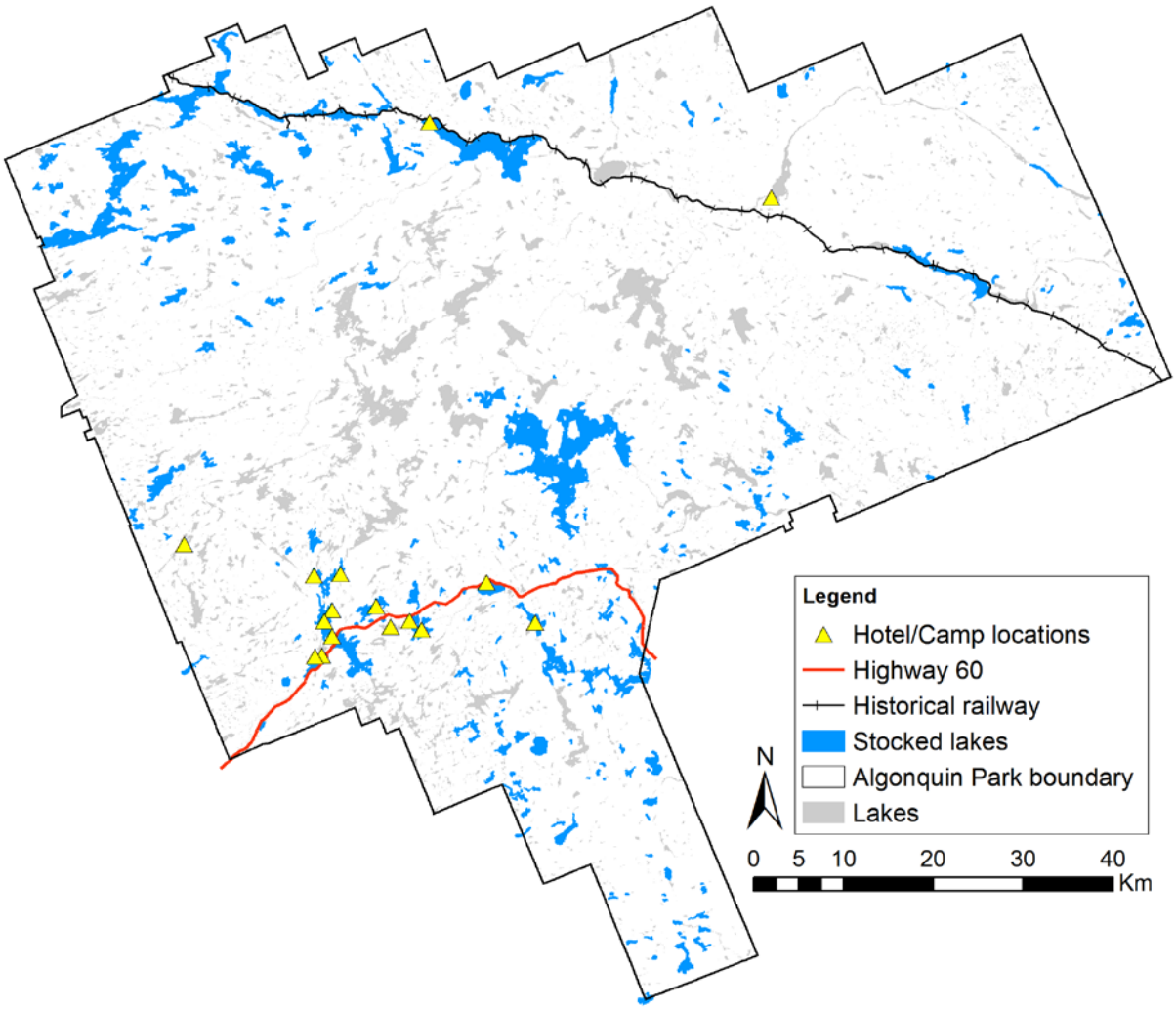


Figure 14. Algonquin Park lakes stocked with fish from 1961 to 1970, inclusive. This decade represents the height of fish stocking across the park's landscape, with the most lakes stocked with hatchery fish and the greatest spatial coverage in the park's history. Aircraft-based stocking was common. The southern rail line transporting park visitors was decommissioned leaving Highway 60 as the major access to the southern portion of the park.

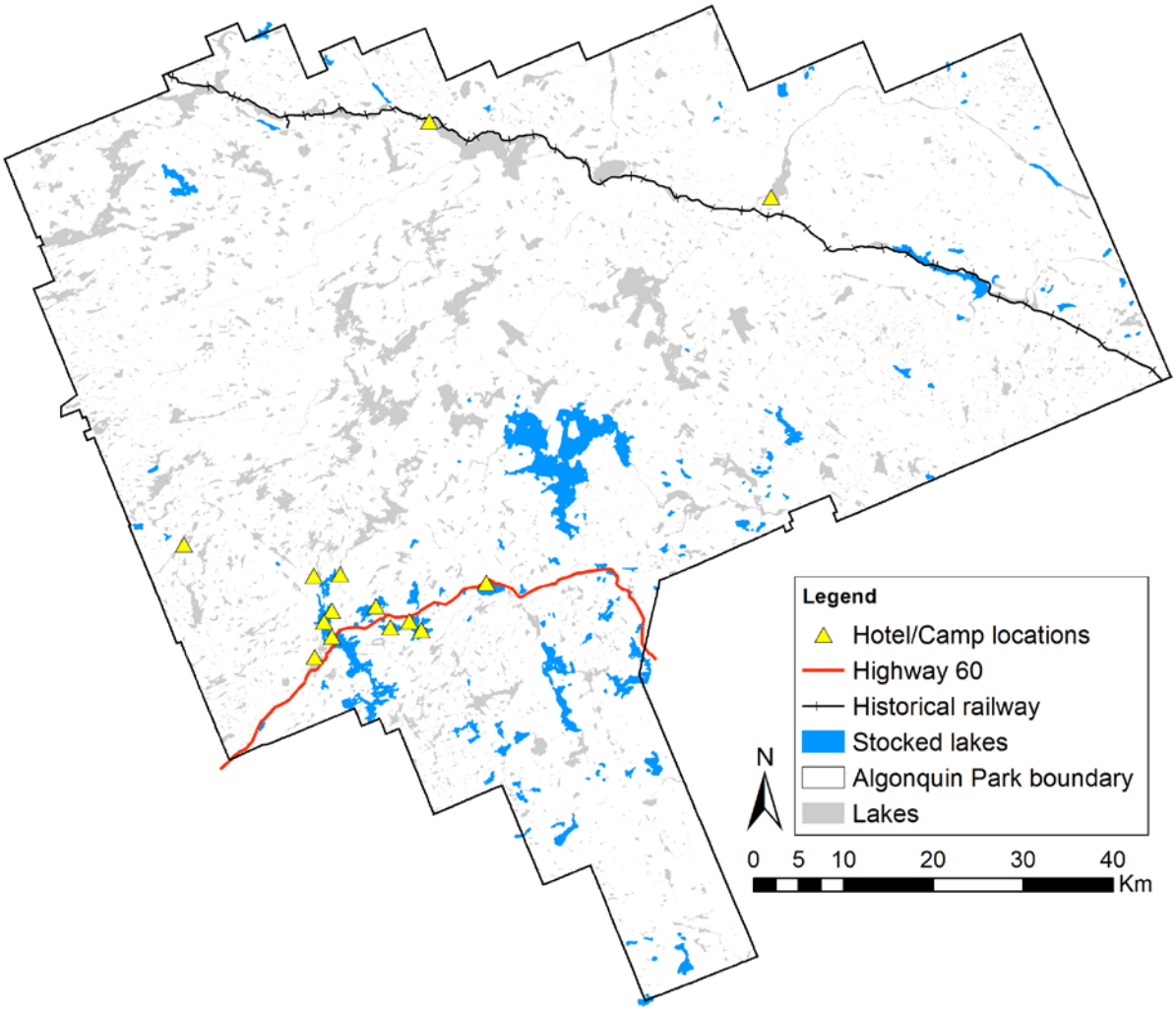


Figure 15. Algonquin Park lakes stocked with fish from 1971 to 1980, inclusive. Fish stocking was greatly reduced in the north but continued in the south.

The shift to planning-based fish stocking

Fish stocking in Algonquin Park started as a need to provide fishing opportunities and fish during the era of rail access to major lodges. Following increased access in the post-war decades, it expanded to a more landscape scale management effort that included the park's interior, and coincided with increases in population and demand for leisure and outdoor experiences. During these decades, stocking was spatially dispersed and likely represented a significant effort for park staff.

After several decades of landscape-scale stocking effort, consensus about a changing role for fish stocking in Algonquin Park was achieved by the 1980s. The Algonquin Provincial Park Master Plan (OMNR 1974) represented the beginning of this change in thinking by emphasizing the unique features of park brook trout and lake trout populations and the need for their conservation. This need was summarized in 1985 in the background report for a new fisheries management plan for the park (OMNR 1985). Despite decades of stocking lake trout, the background report said: "There is evidence that readily accessible lake trout fisheries particularly those in the Park Corridor are overexploited" (p.14). In addition, "Exploitation is the greatest single stress on fisheries in Algonquin Park District" (p.36). However, for lakes in the interior of the park, "Overexploitation is generally not a problem in the brook trout and lake trout lakes of the Park Interior" (p. 37).

The background report summarizes decades of fish stocking (OMNR 1985):

> "There has not been a rational, well-planned approach to stocking lakes in the District (Algonquin Park District). This problem has 3 components: 1) there has been no assessment before or after stocking, 2) there is a need to establish policies regarding stocking of species other than lake trout and brook trout (in particular splake and rainbow trout but also warmwater species such as walleye and largemouth bass), 3) there is no firm policy establishing the role(s) of stocking in the District. The present program is essentially put and take and there is uncertainty whether or not (and where) to attempt rehabilitation stocking, and whether stocking over natural populations (maintenance stocking) is desirable." (p. 37–38, OMNR 1985)

In 1988, the Algonquin Park District Fisheries Management Plan (OMNR 1988) was released to address the unique role of Algonquin Park in conserving native brook trout and lake trout populations. It also served to provide a more modern perspective on fisheries management in the park. Among several new strategies for fisheries management, one identified the need to "establish a highly effective fish stocking program" in Algonquin Park. Another strategy with fish stocking recommendations was "maintain native sport fish community structure in the Park interior but manage community structure in the Corridor". This perceived need likely reflected the

accumulated experience of resource managers after decades of sustaining stocking over many areas of the park. It effectively ended the landscape approach to stocking and brought a focus to specific requirements of stocking fish while at the same time conserving native populations of brook trout and lake trout.

In the Fisheries Management Plan (OMNR 1988), the following fish stocking tactics were recommended:

1. Stop stocking hatchery fish in lakes with difficult access (implement park-wide).
2. Reduce stocking of lake trout in favour of an increase in splake (sterile hybrid of lake trout and brook trout) (implement in corridor area).
3. Maintain recent levels of brook trout stocking (implement in corridor area).
4. Continue stocking assessment to develop effective lake rotation schedule for brook trout and splake by 1990 (implement in corridor area).
5. Stock in the park only in the corridor and other recreation zones (implement in corridor and recreation zones).
6. Stock in the interior only for rehabilitation or introductions with Algonquin stocks (implement in interior).
7. Cease stocking hatchery fish in lakes with self-sustaining trout populations (implement park-wide).

This list of tactics reflects recognition that past fish stocking policies for Algonquin Park were not meeting a more modern view of fisheries conservation and were not sustainable. Lakes with difficult access are also lakes with native self-sustaining populations of lake trout and brook trout. Maintaining levels of brook trout stocking points to the importance of this species for park anglers. Finally, stocking in the Highway 60 corridor was an acceptance of the need to provide fisheries closer to where most visitors access the park. This decision was in many ways fundamentally similar that of to the lodge era but with a more up-to-date perspective that included camp ground visitors and day trips.

Reviews of this kind reflect concerns about the direction and utility of resource management practices underway before the review period. It speaks to the accumulated experiences of park staff of the day on the role of fish stocking in the park. This was the first comprehensive review of fish stocking in Algonquin Park.

This comprehensive view was incorporated into the 1998 Algonquin Provincial Park Management Plan (Ontario Parks 1998). It recognizes basic differences between the interior of the park and the park's Highway 60 corridor area.

For the Highway 60 corridor, fish stocking became more focused in purpose:

1. In lakes with naturally reproducing lake trout and brook trout, replenishment will be by natural reproduction, eliminating supplementing populations with stocking.
2. For lakes without naturally reproducing populations, a stocking program relying heavily on splake (a hybrid between brook trout and lake trout) will continue on small lakes in the corridor.
3. Stocking programs will continue in lakes in the corridor development zone where native fish populations will not be affected, or within one portage of this zone.

For the park interior, fish stocking was more restricted than in the past:

1. Population replenishment will be by natural reproduction, thus reducing the need to supplement populations with fish stocking.
2. Hatchery-reared fish will be stocked only in development zones or within one portage of these zones.
3. Any trout stocking in the interior will be essentially for introduction, research, or rehabilitation only and will use native stocks (fish of wild Algonquin stock origin).
4. The introduction of new species of fish will be prohibited.
5. Warmwater (e.g., walleye) and non-native species will be impeded from further range extension where possible.

In the most recent development of policy for fish and fisheries, Ontario's Provincial Fish Strategy: Fish for the Future (OMNRF 2015), fish stocking is viewed as one of several fisheries management tools rather than a focus. In addition to the traditional role for put-grow-take fisheries in support of angling opportunities, fish stocking is placed in the context of fishery management objectives including restoring, recovering, and rehabilitating populations of fish — a more conservation-oriented approach to fish stocking. This shift is also reflected in several other Ontario Parks policy documents and in the province's Provincial Parks and Conservation Reserves Act, 2006 (Statutes of Ontario 2006).

The change in fish stocking patterns can be seen in the distribution of stocking from the 1980s (Figure 16), 1990s (Figure 17), and 2000s (Figure 18). Reducing the total number of stocked fish and lakes receiving fish has resulted in a more consistent trend in annual stocking numbers (see Figure 2).

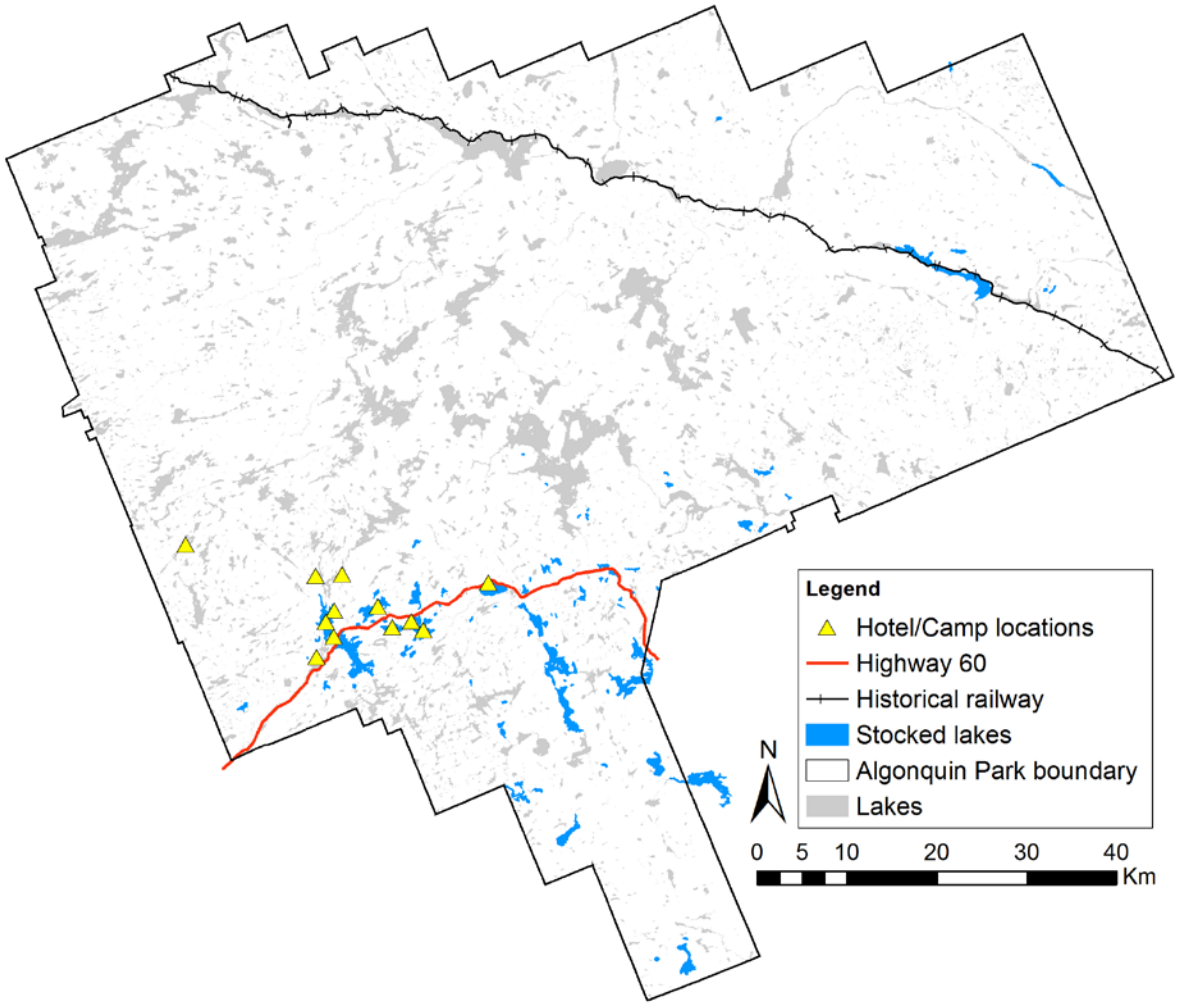


Figure 16. Algonquin Park lakes stocked with fish from 1981 to 1990, inclusive. After the Algonquin Park District fisheries management plan (OMNR 1988) was implemented, fish stocking was reduced and generally concentrated in the Highway 60 corridor.

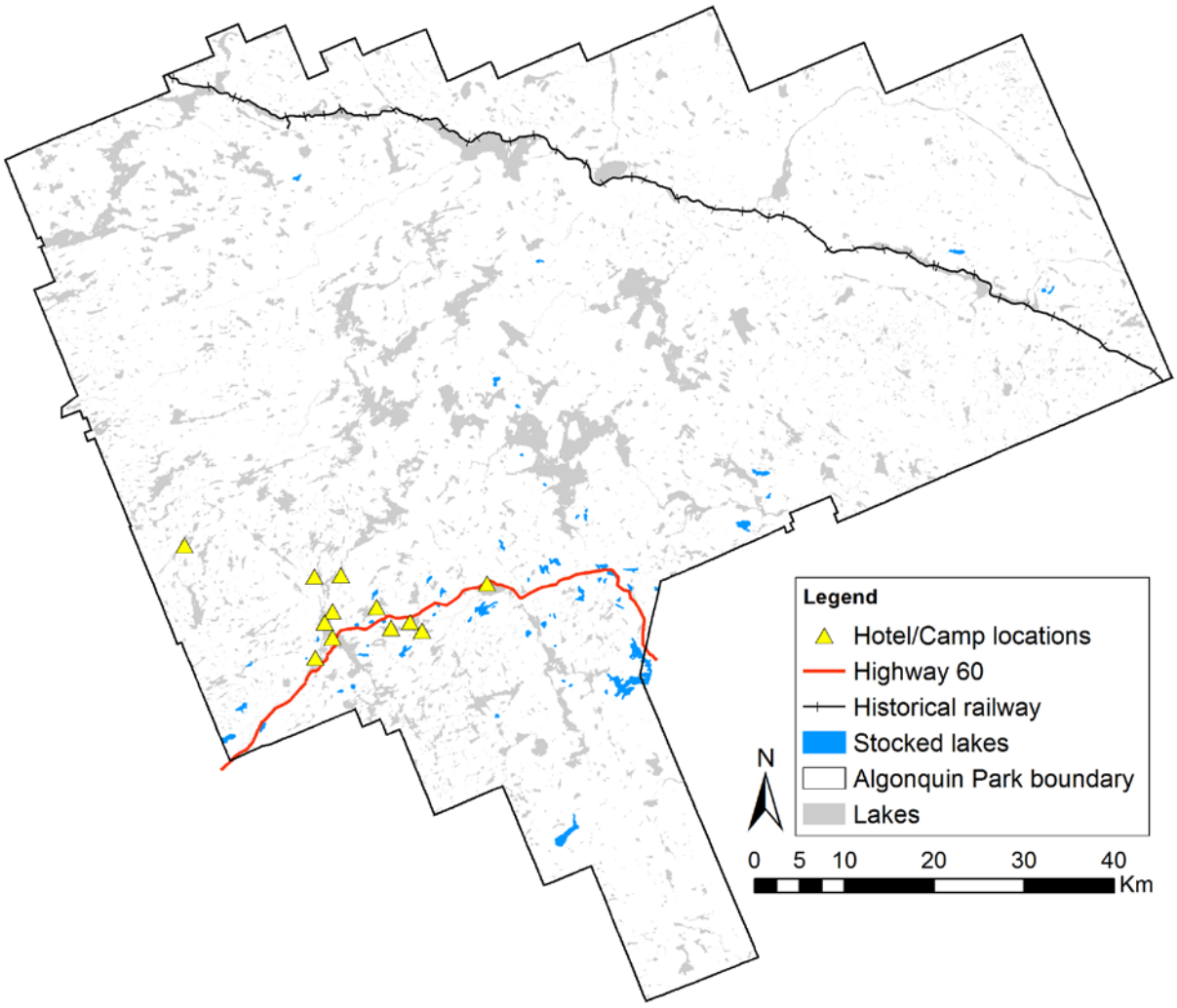


Figure 17. Algonquin Park lakes stocked with fish from 1991 to 2000, inclusive. Stocking was largely governed by the recommendations of the 1988 fisheries management plan for the park (OMNR 1988) and the 1998 Park Management Plan (Ontario Parks 1998). For first the first time since 1899, Cache Lake was not stocked.

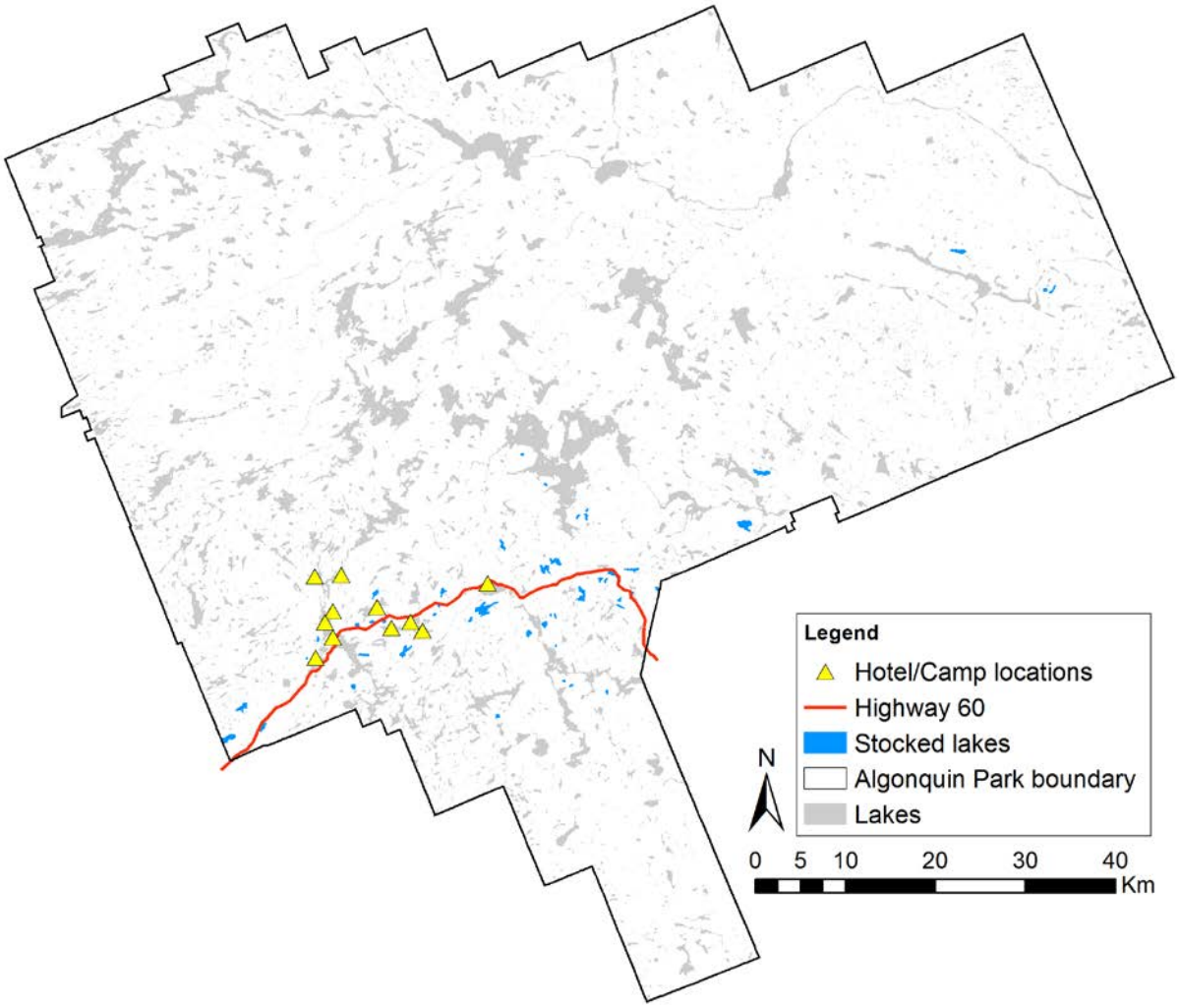


Figure 18. Fish stocking for put-grow-take fisheries in Algonquin Park lakes from 2001 to 2016, inclusive. Fish stocking is confined to lakes in areas of higher use by park visitors.

Fish stocking by species

Since the first fish were released in 1899, twelve fish species have been stocked in Algonquin Park. The first species to be released in the park was smallmouth bass. George Bartlett describes this event in his first superintendent report to the commissioner of Crown lands (Bartlett 1900):

> "Some 500 very fine black bass, from one to four pounds in weight, were brought from Parry Sound and put into Cache, White [Tanamakoon in modern naming] and Source Lakes. These were procured before the spawning season and successfully carried to their destination in a tank car supplied by the Canada Atlantic Railway, the General Manager, Mr. Chamberlain, as well as the other officials, taking a great interest in the experiment and doing all in their power to ensure its success."

Following the first introduction of 500 individuals to three lakes, 391,511 bass were stocked before 1965 (Figure 19). Most were smallmouth bass but occasionally largemouth bass were stocked as well. Most of the bass stocking occurred before 1920 during the railroad and lodge era of fish stocking.

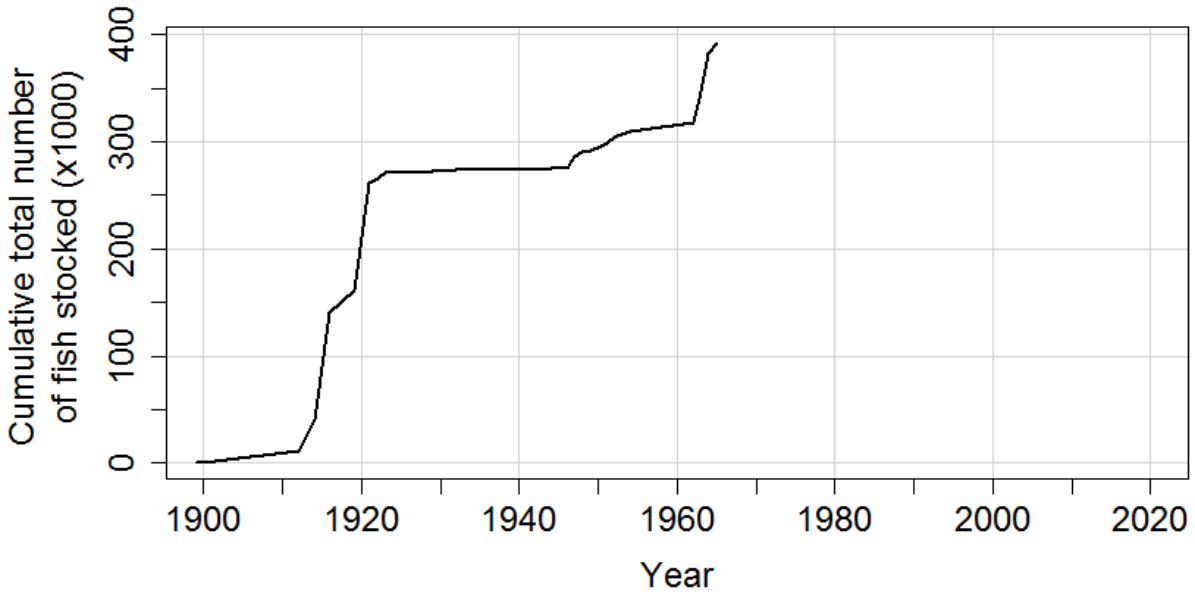


Figure 19. The cumulative number of bass (largemouth, smallmouth, and black bass) stocked in Algonquin Provincial Park. Values on the vertical axis are in units of thousands.

Smallmouth bass represents an interesting example of what can occur after fish stocking, including spread to other lakes and unauthorized stocking. Because most lakes in Algonquin Park do not represent the natural distribution of smallmouth bass, the occurrence of this species in lakes can stem from authorized releases of fish as well as unauthorized or unrecorded introductions. In addition to the initial introduction described by George Bartlett in 1899, smallmouth bass were introduced to an additional 21 known lakes (Figure 20). However, the distribution of smallmouth bass illustrated in Figure 20 does not represent the current extent of this species in the park. Historical records for bass stocking did not include stocking by staff associated with railroads or cases of apparent unauthorized stocking. Figure 21 summarizes these other possible stocking events as well as where smallmouth bass likely spread following stocking. Both unauthorized stocking and spread were based on known barriers to fish movement between lakes and downstream movement from stocked lakes. For example, Happy Isle Lake is a likely unrecorded or unauthorized introduction given a barrier to fish movement between Happy Isle and Lake Opeongo. Booth Lake, downstream of Lake Opeongo, is a likely example of a spread of smallmouth after stocking in Lake Opeongo.

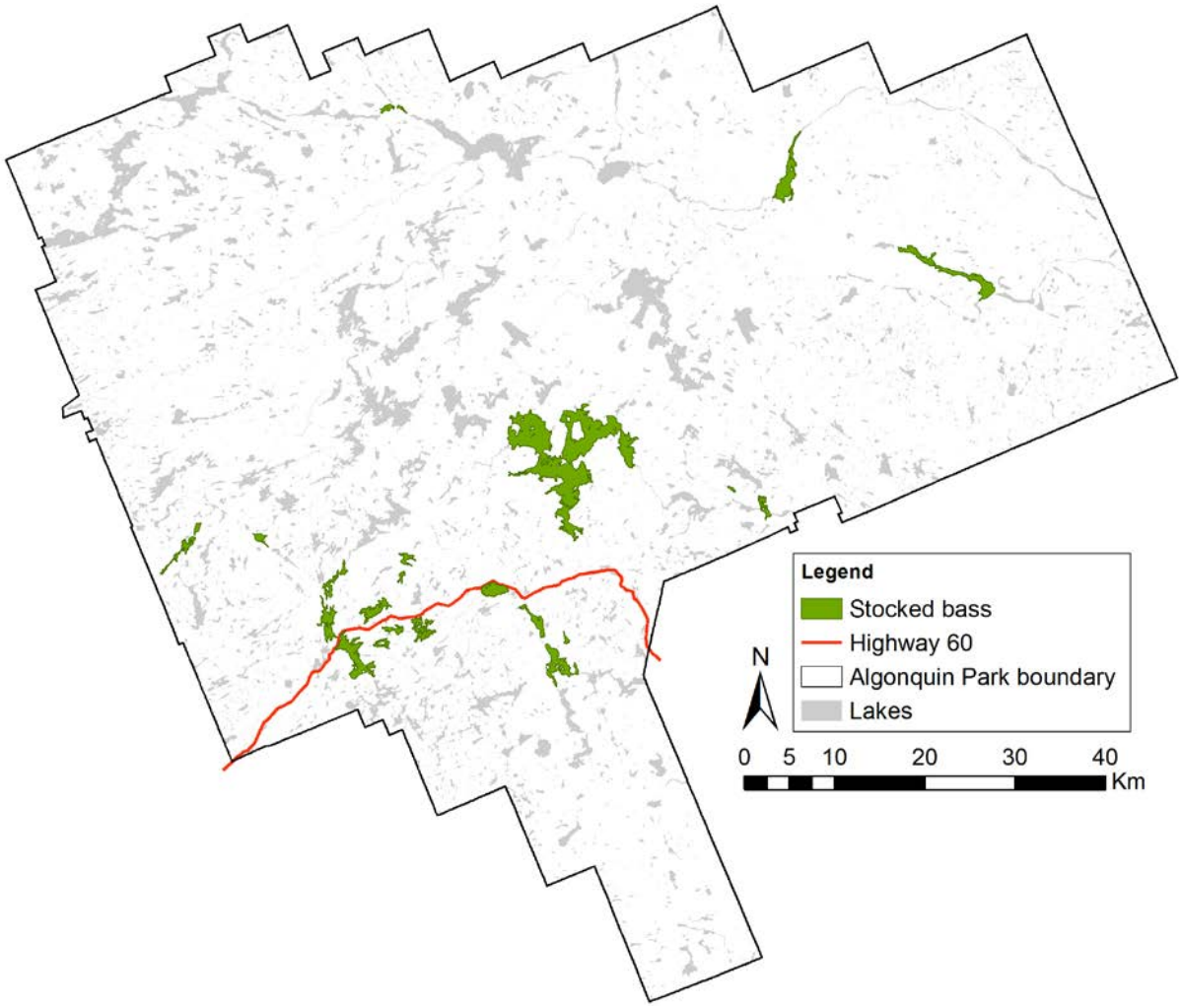


Figure 20. Lakes within the current Algonquin Park boundary that received stocked bass based on records of stocking events. See Figure 21 for a more complete stocking history. Bass was the first fish species to be stocked in Algonquin Park, beginning in 1899 with a total of 500 individuals released into Cache, Tanamakoon, and Source lakes. Following this initial stocking, bass were distributed in Algonquin Park until 1965 across 24 lakes.

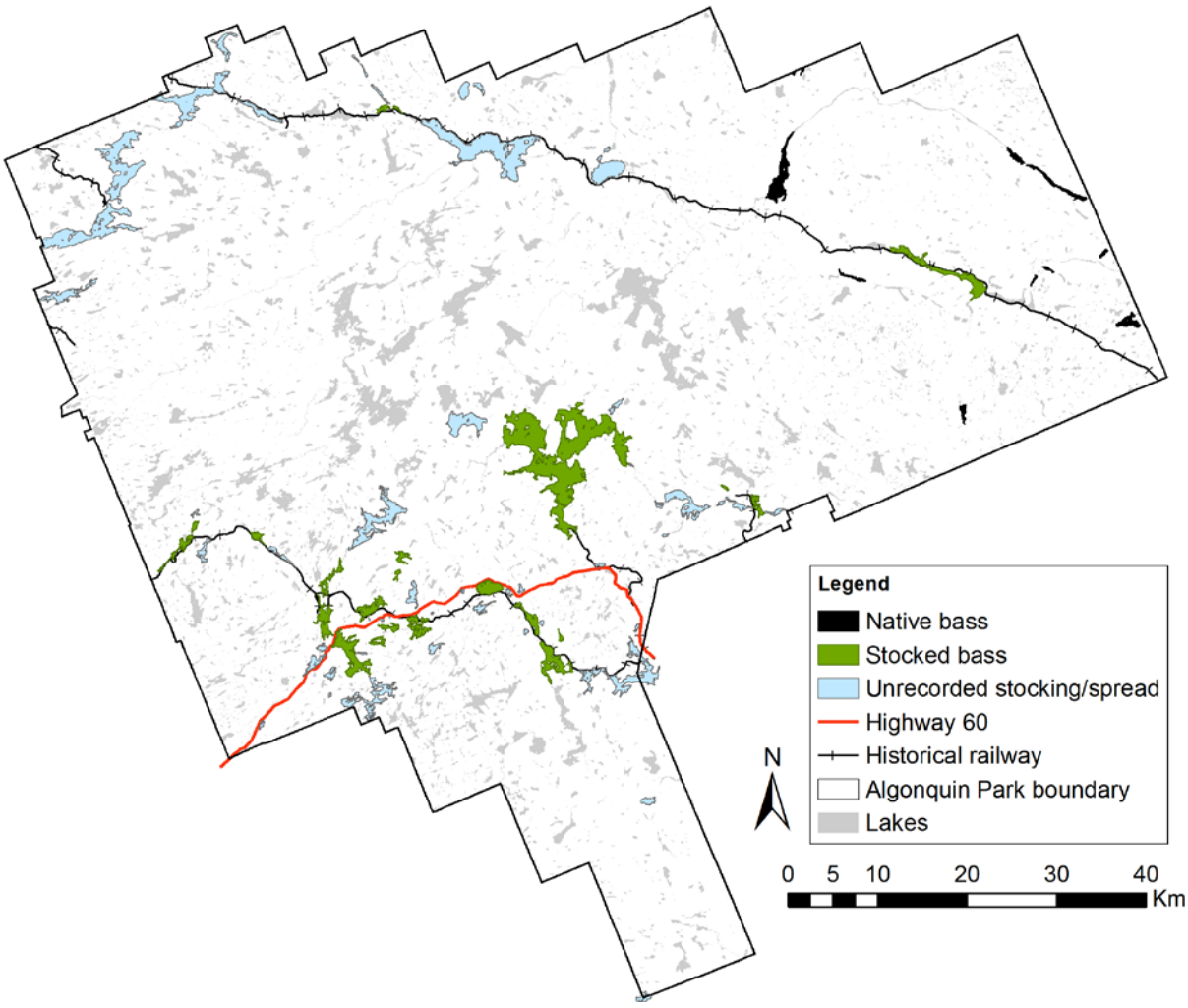


Figure 21. Smallmouth bass stocking in Algonquin Provincial Park included railway-based stocking, agency-based stocking, and unrecorded stocking. Unrecorded stocking events and spread from other stocked lakes are based on the position of barriers to fish movement. For lakes designated as unrecorded stocking, a barrier prevented natural movement so bass occupancy of these lakes required assistance. For lakes designated as a spread of stocked bass, bass occupancy is assumed to have occurred because of natural downstream movement including movement over barriers.

Stocking of lake trout, brook trout, and splake began more than a decade after smallmouth bass introductions. Lake trout stocking began in 1911 with quantities of fry distributed into several lakes near the former park headquarters at Cache Lake (Source, Canoe, Tanamakoon, Smoke and Cache lakes). It was argued that these waterbodies were “within easy reach of the hotel [Highland Inn]” and would “provide sport for those who cannot reach more distant waters” (Bartlett 1911). The early years of lake trout stocking resulted in the steepest increase in the total number of lake trout stocked in the park in a century, much like the pattern observed for smallmouth bass (Figure 22). Considering both species, it appears that stocking lake trout and smallmouth bass were viewed as an important fisheries management approach for maintaining angling opportunities for lodge guests during the railroad and lodge era. The sharp increase in stocking numbers for both species points to concerns about over-fishing and clear potential for the invisible collapse.

Since those early stocking events, lake trout stocking continued across 84 lakes (Figure 23) and 1 river in the park. A total of over 3.6 million lake trout have been stocked into Algonquin Park waters with the last event, a restoration stocking for a population thought to be extirpated, occurring in 2004.

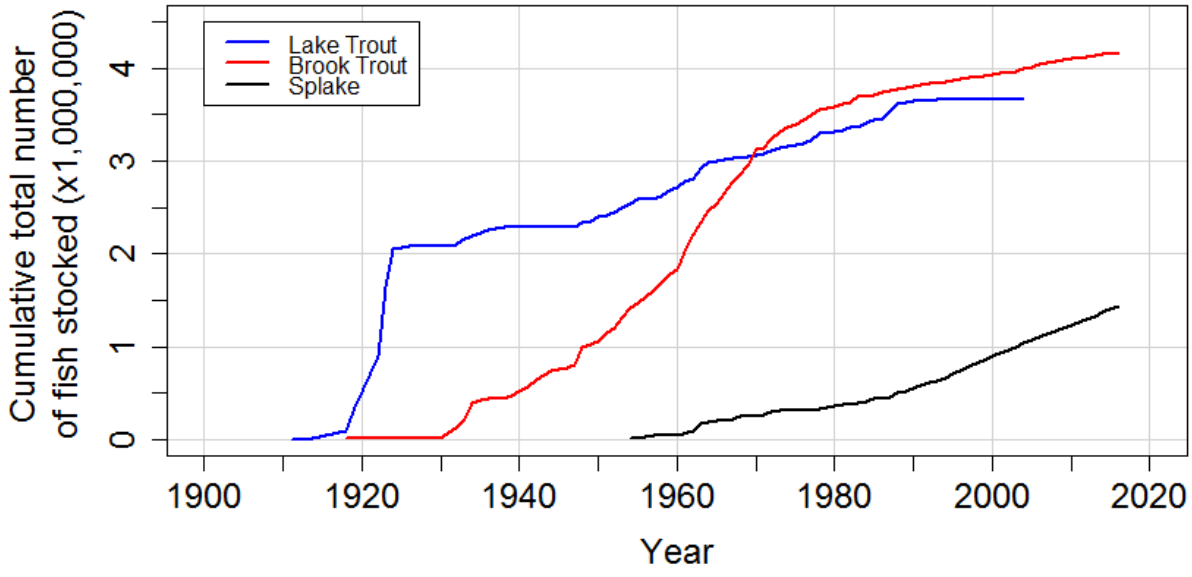


Figure 22. The cumulative total number of lake trout, brook trout, and splake (sterile hybrid of lake trout and brook trout) stocked in Algonquin Provincial Park from 1899 to 2016, inclusive. Values on the vertical axis are in units of millions. Brook trout surpassed lake trout by 520,179 individuals as the species with the highest total number stocked.

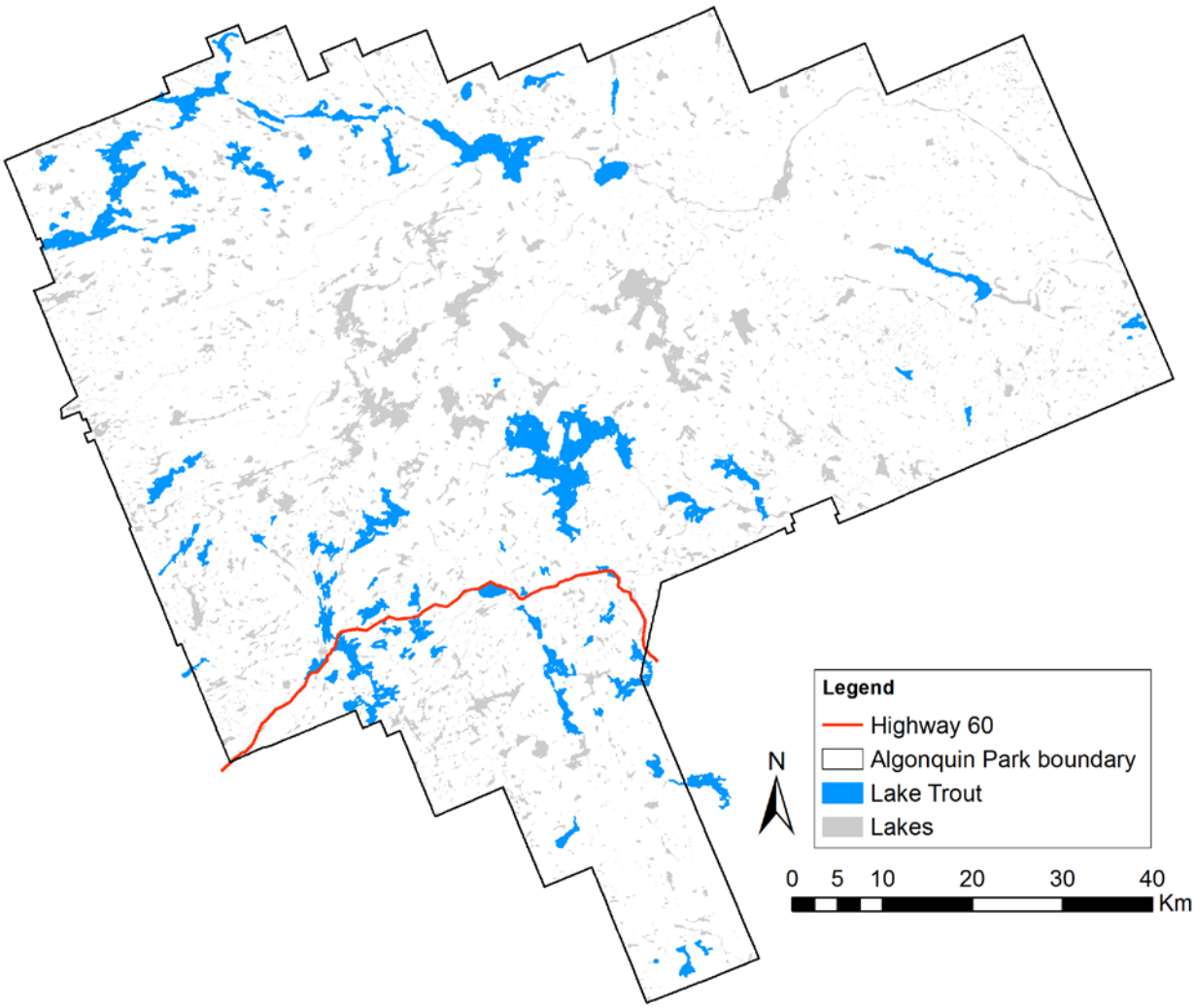


Figure 23. Lakes within the current Algonquin Park boundary that were stocked with lake trout. Lake trout stocking began in 1911 and continued until 2004 across a total of 84 lakes. Lake trout, commonly called salmon trout throughout the early 1900s, was a highly prized fish for new anglers visiting Algonquin Park during the peak hotel and lodge era. Fifty-seven percent of the total lake trout stocked in Algonquin Park was distributed in the 15 years between 1911 and 1926, corresponding to 2,080,000 individual fish.

Brook trout were stocked in Algonquin Park seven years after the first lake trout stocking. Unlike the trend for lake trout, brook trout stocking levels were steady for decades, with the stocking rate tapering off since the 1970s (Figure 22). Beginning with a 1918 stocking event of 10,000 individuals into Grand Lake, brook trout were distributed across 344 lakes (Figure 24) and 20 rivers and streams. Brook trout became the most widely distributed stocked fish in Algonquin Park with a total of over 4.1 million fish released within the park boundary. Brook trout continue to be stocked in several lakes, primarily along the Highway 60 corridor of the park, offering anglers a greater opportunity to catch one of these “speckled beauties”. Today, the Dickson Lake brook trout strain is stocked in the park.

Splake were first stocked in Algonquin Park in 1954 (Figure 22) and continue to be part of the put-grow-take fishery (Figure 18). In 1954 several thousand yearling splake were stocked into four lakes (Jack, Redrock, and Sproule Lakes as well as an unnamed lake in Canisbay Township) in the southern part of the park. Since then, over 1.4 million splake have been released into 70 lakes (Figure 25.) Today, stocking continues in several lakes along the Highway 60 corridor.

Several other species were stocked throughout the park from the early 1900s until the late 1980s including rainbow trout (Figure 26), brown trout, Atlantic and cherry salmon, Arctic char, and Arctic grayling (Figure 27 and Figure 28). None of these species are native to Ontario except Atlantic salmon whose native range is Lake Ontario until it was extirpated from that lake in the late 1800s. Since the inception of fish stocking in the late nineteenth century, introducing non-native game fish was a common practice. Stocking non-native species is now prohibited under several directives including management plans (OMNR1988), and environmental assessment processes including maintenance of ecological integrity as described in Ontario’s Provincial Parks and Conservation Reserves Act (Statutes of Ontario 2006). The lakes stocked with these non-native species occur largely along the railroad/Highway 60 corridor reflecting perhaps an interest in providing different angling opportunities in a busy area of the park. In searching historical records, few explanations are provided for choosing these species so it is likely their use reflects a trend at the time to stock a range of species without consideration as to their effects or the possible establishment of a non-native population.

Walleye and cisco, species native to parts of the park historically, were introduced to lakes in the railroad/Highway 60 corridor (Figures 27 and 28). Past walleye stocking did not establish viable populations, probably because the larval stages used for stocking were extremely vulnerable to predation. Cisco introductions did succeed in lakes such as Canoe and Smoke for the purpose of supplying prey for lake trout. Both lakes have natural populations of lake whitefish and, in other lakes in the park, this species serves as good prey for lake trout in the absence of cisco. Stocking records for each species are summarized in Table 5.

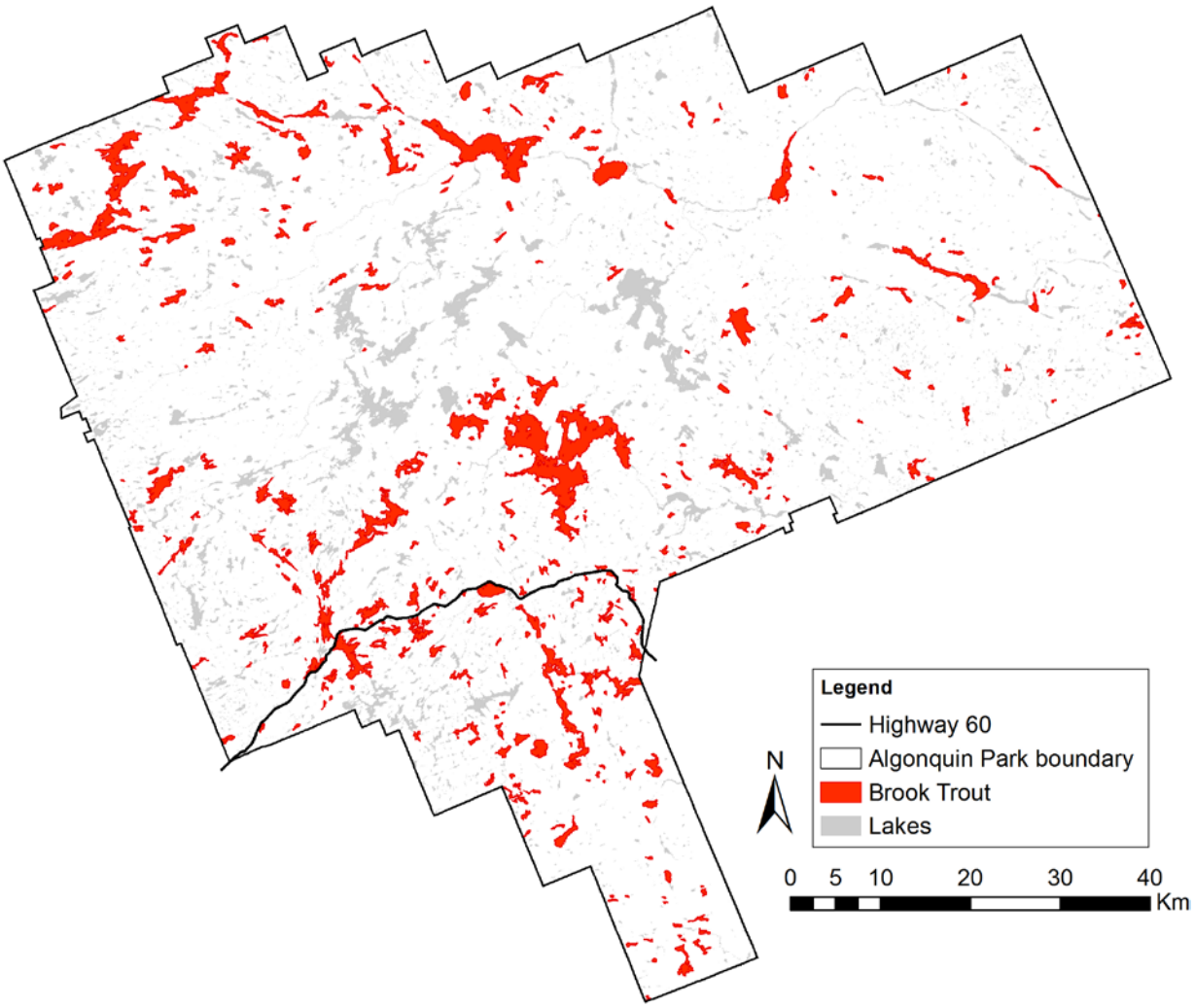


Figure 24. Lakes within the current Algonquin Park boundary where brook trout stocking occurred. From 1918 to 2016 inclusive, brook trout were distributed across 344 Algonquin Park lakes, making it the most widely distributed stocked fish in the park. The peak stocking year for brook trout was 1961 with 180,105 individuals released into Algonquin Park lakes. The decade between 1960 and 1970 accounts for 30% of the brook trout stocked in Algonquin Park, corresponding to 1,252,014 individual fish.

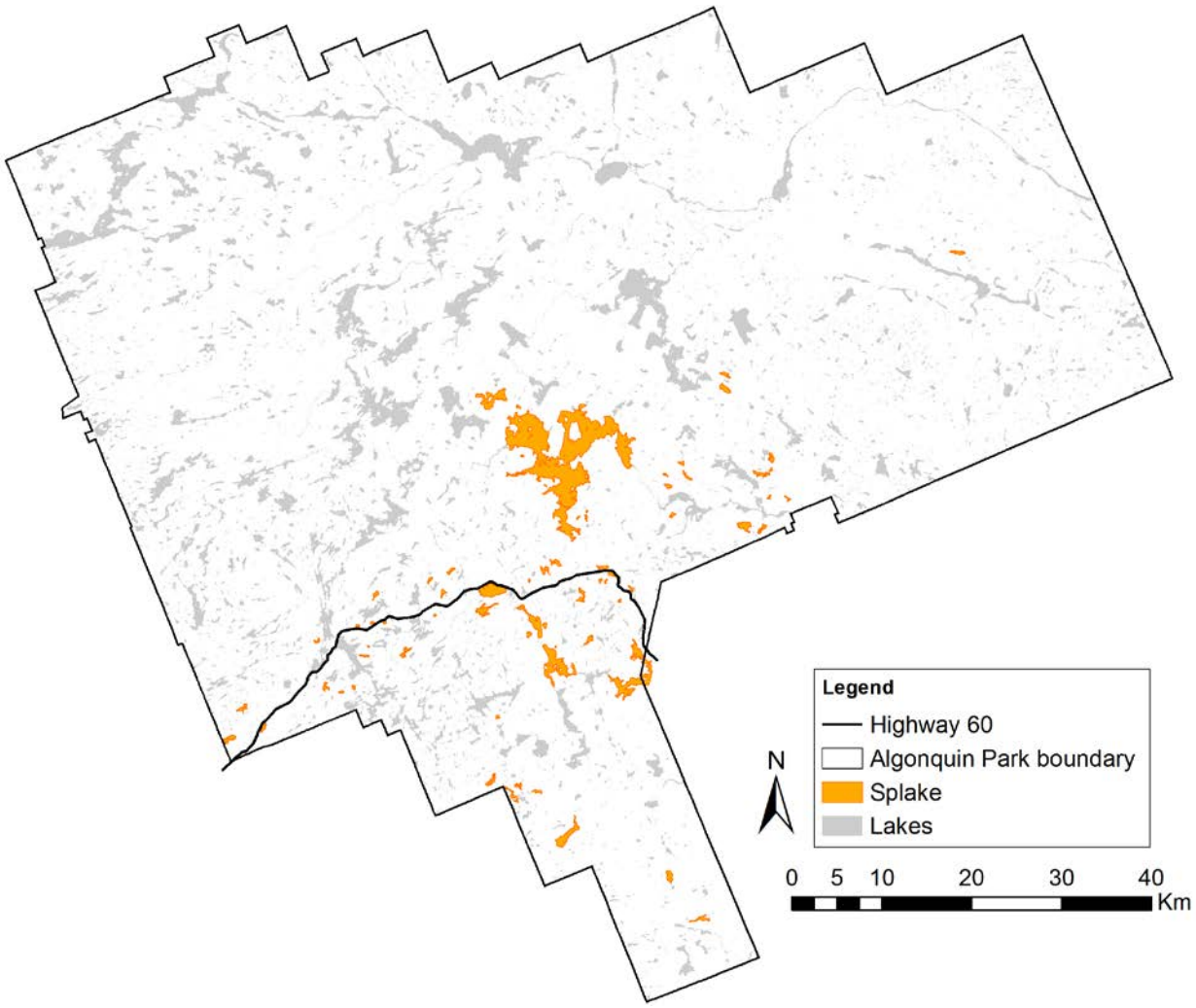


Figure 25. Lakes within the current Algonquin Park boundary where splake (sterile hybrid of lake trout and brook trout) stocking occurred. Splake stocking began in Algonquin Park in 1954 and continues today in lakes concentrated around the Highway 60 corridor. In the past 62 years, 70 lakes have received splake. The largest number of splake stocked in the park was in 1963 with 73,235 fish distributed across 18 lakes.

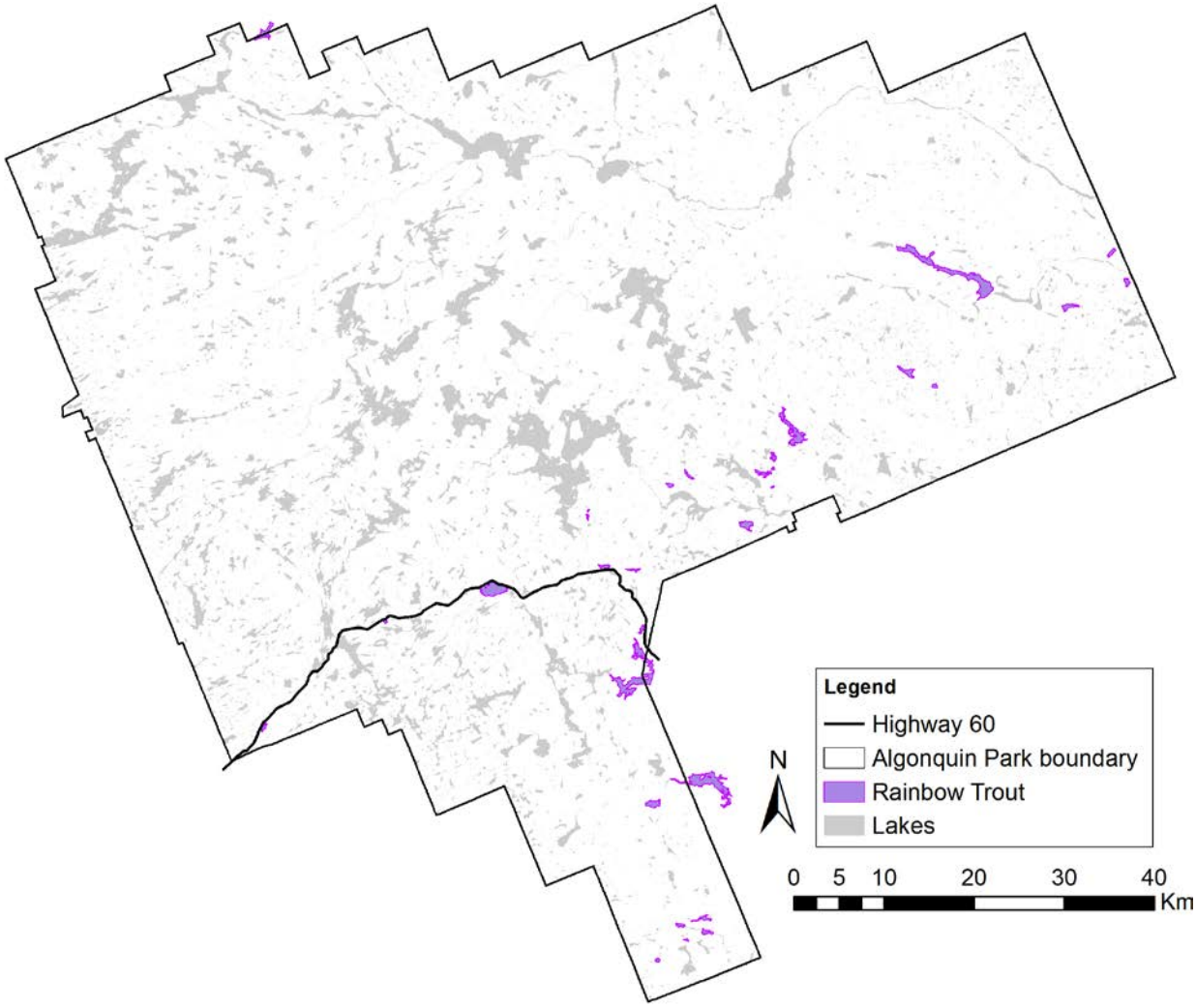


Figure 26. Lakes in the current Algonquin Park boundary that received stocked rainbow trout. From 1934 to 1989 inclusive, rainbow trout were distributed across 32 lakes. The peak year for number of rainbow trout stocked was 1973 with 40,000 individual fish released into Algonquin Park waters.

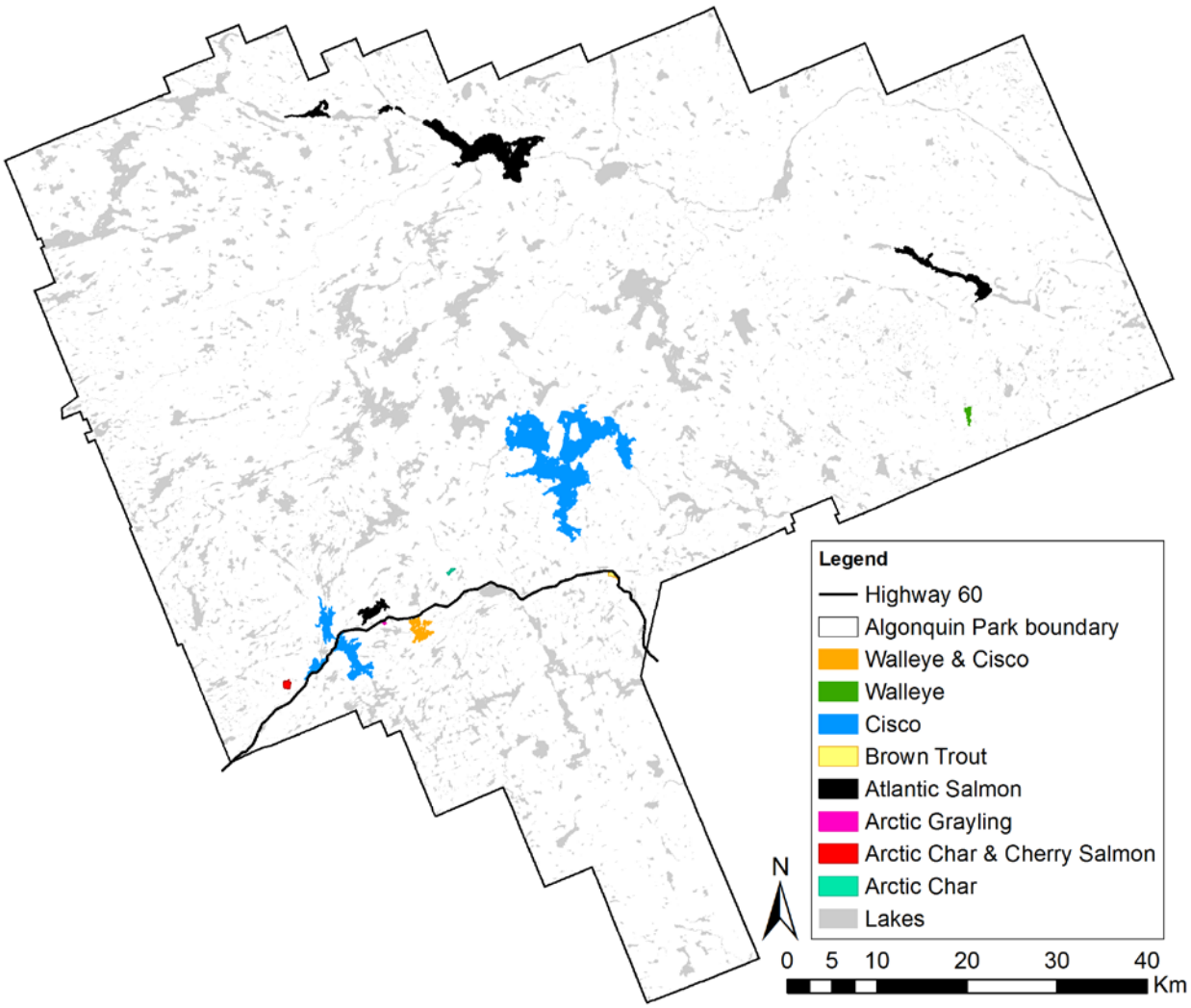


Figure 27. Lakes where atypical stocking events occurred in Algonquin Park from 1899 to 1969, inclusive. Seven species were released into 18 lakes. Brown trout were stocked into Brewer Lake in 1934 and 1942 and walleye larvae into Cache Lake in 1922 and 1923 as well as into Basin Lake in 1934. Cisco were stocked into Cache Lake in 1938; Lake Opeongo in 1940, 1947, and 1948; Tea and Canoe lakes in 1947; and Smoke Lake in 1947 and 1948. Atlantic salmon were reportedly stocked into Source Lake in 1908 and 1909, Grand Lake in 1948 as well as Cauchon, Laurel, Aura Lee, and Cedar lakes in 1952. Arctic grayling were stocked into Found Lake in 1960, cherry salmon into Westward Lake in 1966, and Arctic char into Westward Lake in 1955 and Kathlyn Lake in 1956. These stocking events represent the experimental approach to fish stocking in Algonquin Park between the early 1900s and the mid-1960s.

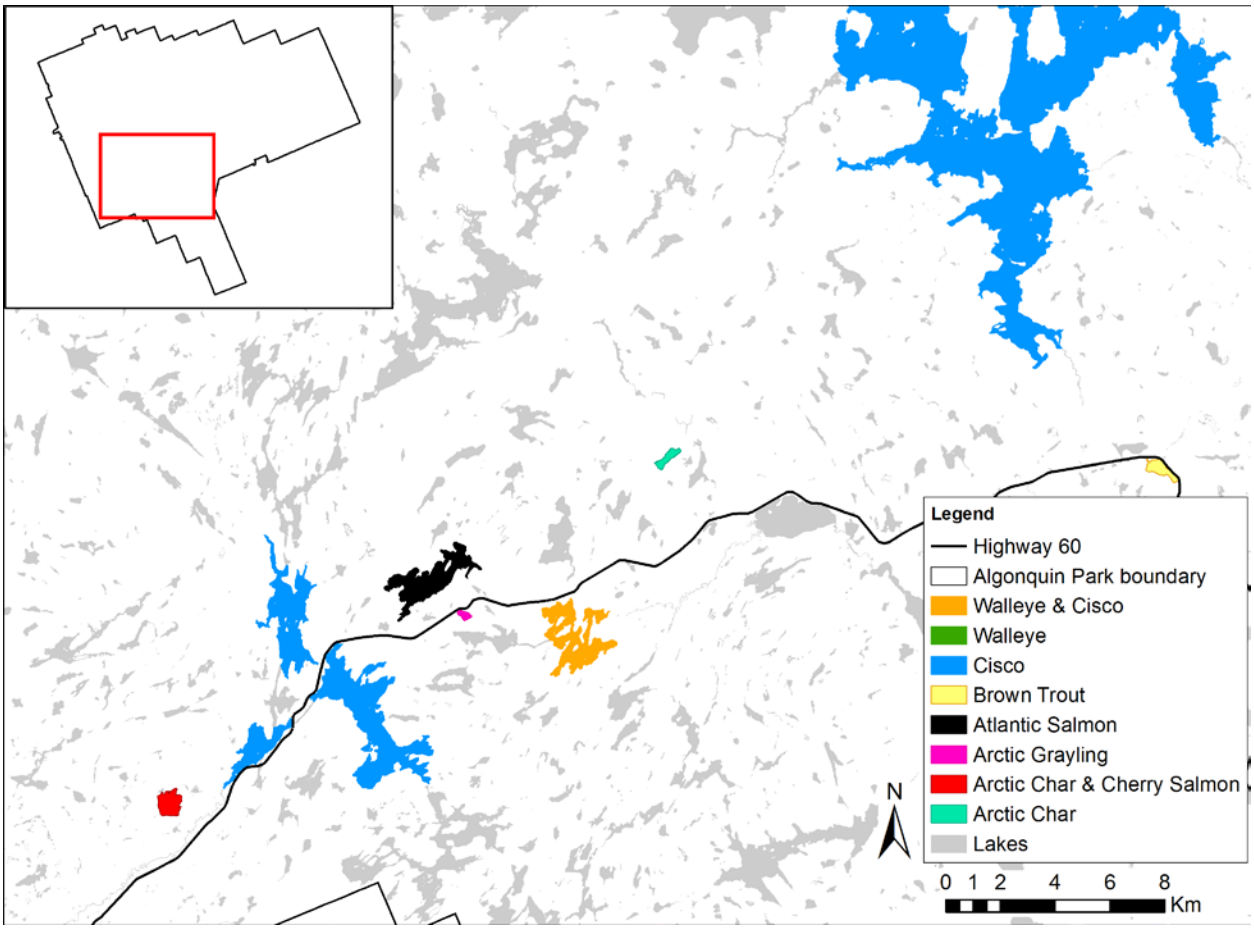


Figure 28. Lakes in which anomalous stocking events occurred near the Highway 60 corridor between 1899 and 1969, inclusive. Westward Lake received both cherry salmon and Arctic char while Cache Lake received both walleye and cisco. Cisco were stocked in several lakes with the intention that they would act as a new food source for lake trout populations and help sustain strong lake trout fisheries in areas experiencing high levels of angling pressure. Stocking non-native species of fish is no longer permitted.

Table 5. Total number of fish stocked per species in Algonquin Provincial Park from 1899 to 2016. These are conservative totals as several stocking records did not list quantities. Four historical records were not associated with a specific species; numbers from these records are listed in the table under Unknown.

Species	Common name	Species code	Number of lakes stocked	Number of rivers and streams stocked	Total number of fish stocked
Thymallus arcticus	Arctic grayling	111	1	0	200
Unknown	N/A	999	4	0	500
Coregonus artedi	Cisco	93	5	0	1,475
Oncorhynchus masou	Cherry salmon	N/A	1	0	5,500
Salmo trutta	Brown trout	78	1	0	10,000
Salvelinus alpinus	Arctic char	79	2	0	21,425
Salmo salar	Atlantic salmon	77	6	0	93,000
Sander vitreus	Walleye	334	2	0	225,000
Oncorhynchus mykiss	Rainbow trout	76	32	0	341,625
***Micropterus* sp.**	Bass (smallmouth, largemouth)	316, 317, 321	24	1	392,011
Salvelinus namaycush x Salvelinus fontinalis	Splake	82	70	0	1,435,714
Salvelinus namaycush	Lake trout	81	82	1	3,661,485
Salvelinus fontinalis	Brook trout	80	344	20	4,181,664
				Total number of fish stocked	**10,369,599**

Why stock fish in a natural landscape of lakes?

In Algonquin Park over 440 lake populations of brook trout and numerous stream and river populations occur in all fourth order watersheds of the park (Ridgway et al. 2017). The 188 populations of lake trout represent several different kinds of aquatic food webs. Of the total lake trout lakes, 162 are shared with brook trout. Given this diversity of native fish populations, why stock fish in Algonquin Park lakes? Because that is where the anglers are, is a brief answer and, in the case of visitors to Algonquin Park in the early decades of the 20th century, it's quite true. The longer answer to the question is found in the 19th century including a consideration of the origins of recreational angling in North America and the role of fish hatcheries at that time. The answer also includes the unique role of brook trout as a sentinel species in the 19th century.

Interest in recreational angling grew out of concern for the apparent depletion of native freshwater fish in areas of New England and eastern United States over many decades in the 1800s (Reiger 2001), and in Ontario over the same period (Knight 2007). Fish were harvested from lakes and rivers as food and for use in commercial trade by European settlers and their descendants. Growing cities and towns placed great demand on natural resources such as fish. No particular land ethic and view of nature accompanied this enterprise except the need to catch fish by whatever means and at times of the year when they were most available. Efficiency would have been a key element of harvesting. It was the era of commercial hunting for wildlife and waterfowl, a time when both fish and wildlife market harvesting paralleled one another (Reiger 2001). Habitat loss due to mill operations blocking access to streams and rivers, or pollution from industrial operations were also recognized as factors contributing to loss of fish populations.

An end to these practices came about because they came to be seen as distasteful or depraved as two examples of words used to describe those who valued wild nature. Individuals with wealth and position in society came to see nature in a different way largely associated with an ethic defined by fair play with respect to harvesting fish and wildlife. Angling was a class-based leisure activity in its early decades and leaders of this movement ensured its profile through articles in the first outdoor magazines and popular books. As noted by Reiger (p. 48–49; 2001) in several quotes from American Sportsman magazine:

> "It is not the mere killing of numbers, much less the mere killing at all; it is not in the value of the things killed, though it is not sportsmanship, but the butchery and wanton cruelty to kill animals which are valueless (as food) and out of season; it is not in the inevitable certainty of success — for certainty destroys the excitement, which is the soul of sport — but it is the vigor, science [meaning correct technique], and manhood displayed in the difficulties to be overcome, and in the pleasurable anxiety for success, and

> the uncertainty of it, and lastly in the true spirit, the style, the dash, the handsome way of doing what is to be done, and above all the unalterable love of fair play, the first thought of the genuine sportsman, that true sportsmanship exists." — Wilbur Parker, editor, American Sportsman 1872.

Other quotes in the same issue of American Sportsman point to the low view held by sportsmen of the day about commercial harvesting of fish or wildlife species. Species that could provide a match in every way for sportsmen based on what at the time was regarded as noble, uplifting. and fair play. From Reiger (p. 49, 2001), in the same issue of American Sportsman, a true sportsman…

> "makes no (financial) profit of his success, giving to his friends more than he retains, shoots invariably upon the wing and never takes a mean advantage of bird or man. It is his pride to kill what he does kill elegantly, scientifically (correct technique), and mercifully. Quantity is not his ambition; he never slays more than he can use; he never inflicts unnecessary pang or fires an (unnecessary) shot" (American Sportsman 1872).

> Continuing, Reiger (p. 49; 2001) indicates the repulsion to commercial hunting or fishing in freshwaters by sportsmen at the time. A sportsman never considers wildlife "as representing so much money value…. to be converted into it as soon as possible" (American Sportsman 1872).

This attitude, along with a developing sense of outdoor activity and leisure, was reflected in many magazines in the last decades of the 19th century. In addition to American Sportsman, the precursors of Field and Stream also began in this era. The overall effect was to render fashionable a new view of nature including fishing and hunting that was above mere commercial interest, known in the day as market hunters or pot hunters. The promotion of wild habitat as necessary for wild populations of fish and wildlife began in magazines of the 19th century. Technical and popular articles were mixed in each issue because popular outdoor magazines had become one of the main means of communicating among professional and public interests. Pressure on local governments was applied and the first regulations governing fishing and hunting came into place (Reiger 2001), regulations that often filled a void in the legislative environment.

In Ontario, the growth and popularity of angling by sportsmen followed a similar timeline as that in the United States, but the push for hatchery production of fish to support angling followed a particularly Canadian route. The interest in promoting angling in Ontario in mid-19th century were similar to those in the United States including a low opinion of the narrow interests of pothunters (fish for food or market) and the role of those in higher social strata in promoting the new view of anglers and hunters (Knight 2007). The loss of fish populations, especially near city areas from market forces, was also recognized. According to Knight (2007), such forces were recognized as

responsible for collapsing trout populations in local streams in the Toronto area. Magazines played a role in promoting this recognition and pleaded for action on behalf of the new angler.

The response to this interest was delayed by ongoing federal/provincial disputes on constitutional authority over fish and fishing. Initially, the federal government took authority in Ontario and concentrated almost exclusively on commercial fishing in the Great Lakes. Issues with overharvest were becoming apparent in the Great Lakes and fish hatchery production was seen as an important function for government action. This effort was led by Samuel Wilmot. As noted by Knight (p. 79; 2007), “it was Samuel Wilmot, a prominent resident of Newcastle, Ontario, who transformed fish culture in Canada from a hobby into a central state function.”

Samuel Wilmot was the earliest leader of fish hatchery production in Canada in the 19th century (Knight 2007). Working for the federal government, Wilmot viewed hatchery production as exclusively for commercial fishing in the Great Lakes — a public interest for him over what he perceived to be private interests of anglers of the day (Knight 2007). He resisted the interests of provincial fishery management and anglers until his retirement in the 1890s. His departure from the fisheries management regime in 1895, along with resolution of the constitutional debate to include both provinces and federal government, brought about change in the 1890s for fisheries management and administration in Ontario. In 1899, Ontario gained jurisdiction for fisheries and started its own fisheries administration. The first smallmouth bass transfer in Algonquin Park occurred in Cache Lake in 1899 as well. This marks the beginning of fish stocking in the park.

Wilmot’s resistance to fish stocking for anglers did not have widespread support. Federally, the Dominion Commissioner of Fisheries, Edward Prince, arranged with Ontario to transfer smallmouth bass from Lake of the Woods to other lakes in the region in 1895. He also endorsed smallmouth bass transfers in and around Algonquin Park. Interest in bass is captured in this quote on the idea of bass transfers in Algonquin Park:

> “From all the information I can get, there are no black or rock bass in any of the lakes in the Park. I think an effort should be made to introduce this gamey variety of fish into a few of the lakes at least.” — John Simpson, The Algonquin National Park of Ontario, 1896

Why did fish stocking in Algonquin Park begin with smallmouth bass transfers? Unlike trout or salmon, whose eggs and milt can be stripped and mixed for hatchery rearing, smallmouth bass cannot be reared this way. Smallmouth bass courtship is complex (Ridgway et. al. 1989), requires more than an hour to complete and may represent a species where courtship itself is needed to complete ovulation and gamete release — by activating hormonal pathways for release of eggs and milt. Pond rearing of bass is more efficient where males and females are allowed to complete spawning in semi-

natural conditions and young bass are then removed for stocking. Transferring young bass was outlined in detail by one of the most popular books on fish and fishing published in the late 19th century.

James Henshall was a medical doctor and avid angler living in Cincinnati, Ohio. In 1881, his book on The Book of Black Bass was published — or more precisely, The Book on Black Bass Comparing its Complete Scientific and Life History Together with a Practical Treatise on Angling and Fly Fishing and a Full Description of Tools, Tackles, and Implements. Henshall followed it in 1889 with a sequel entitled The Best Game Fish of America: More about the Black Bass. The books must have been popular because they continued to be printed for nearly a century after the first edition was published. In 1904, the books were combined and published as one book with many printings in following decades. In 1978, it was published as a replica edition. Following his success with the two books, Henshall also published magazine articles on bass fishing. In the tradition of the era, the books and magazine articles were a mix of natural history and guides to catching bass. Here again, the importance of popular writing in the promotion of the new angler experience is an important feature of Henshall's efforts. One feature of his first book was the chapter on practical steps and insights on moving bass from one site to another. As he described (p. 190), "Metal tanks, constructed of galvanized iron, heavy tin etc., though expensive are to be preferred…." He clearly describes and recommends the ease of completing the task of transferring bass from one site to another.

Interest in black bass (smallmouth bass and largemouth bass) was recognized before publication of Henshall's books. In 1865, the book Superior Fishing: The Striped Bass, Trout and Bass of the Northern States by R.B. Roosevelt was published where again the idea of the new angling experience was elaborated — fair play, noble aspirations etc. (Reiger 2001). From 1868 to 1880, ending one year before Henshall's black bass book, the state of New Hampshire transferred bass to 140 lakes in the state as part of an effort to expand fishing opportunities at the time (Noon 1999). Bass fishing in eastern North America was widely known and promoted. Henshall played the role of popularizer and promoter to a wider audience but the appreciation of the qualities of smallmouth bass resistance to capture fit nicely with higher ideals each new angler was expected to follow. Fisheries administration in many jurisdictions, including Ontario, would have been aware of the trend to promote bass as a fish for everyone's angling experience.

Besides popularity, was there an indication that Henshall's opinions and recommendations were accepted and respected? Did Henshall influence fisheries management at that time? Reviewing his obituary in the New York Times (April 5, 1925) clearly indicates his writing had great influence. He was elected President of the American Fisheries Society serving in 1891–1892. He served as the Chief of the Fisheries Department at the World's Fair in Chicago in 1893. Twice he received international awards for literary work on fish culture and fishing with the silver medal at

the 1900 Paris World's Fair followed by a gold medal at the 1904 St. Louis World's Fair. The purpose of World Fairs and expositions was to celebrate the past and especially the future, with millions of visitors attending each exposition. Construction of pavilions and displays for each exposition were of Olympic scale or greater. Recognition bestowed through positions and awards would have been very important and an acknowledgement of one's standing and forward vision. Henshall's publications and position in the discipline of fisheries management at the turn of the 19th century appeared to have met this high bar. The interest in transferring smallmouth bass in Ontario in the 1890s was clearly connected to Henshall's popularizing and the general level of interest in bass as a fish that can be moved to the new angler. Interest in bass transfers among lakes in Ontario is well portrayed in Figure 29 where a large crew of workers are offloading young bass from a rail car dedicated to the Department of Game and Fisheries near Kenora, Ontario.

Figure 29. Workers unloading bass from a rail car operated by Department of Game and Fisheries to stock Lake of the Woods, 1920 (Source: Kerr 2010). From a modest start in the late 1800s to the time of this photo, fish stocking had greatly expanded in Ontario. Note the metal tanks constructed of galvanized iron recommended by Henshall for transferring bass. Early fish stocking efforts were greatly facilitated by a partnership between the Ontario Department of Game and Fisheries and both the Grand Trunk and Canadian Pacific railways. Railway access to lodges in Algonquin Provincial Park aided in the distribution of game fish for several decades.

Conservation concerns for one fish species played an important role in the early awareness of the new angling experience — the loss of brook trout. In 1822, the Massachusetts legislature passed a law stating that brook trout could not be caught "in any other manner than with the ordinary hook and line" (Reiger 2001). This was likely

the first legislation protecting any game fish in the United States (Goodspeed 1939; cited in Reiger 2001). Further, in 1829, a writer described the loss of stream brook trout in some areas of Pennsylvania through netting as a “villainous practice” leading to extirpation or greatly reduced populations (Reiger 2001). In Ontario, loss of “speckled beauties” due to overfishing and land use practices that degraded stream habitat led Wilmot to describe the status of brook trout in the 1870s in southern Ontario as “exceedingly scarce” (Knight 2007). The loss of brook trout (and Atlantic salmon) from streams near towns and cities where they were once captured appears to be a general phenomenon pointing to overfishing and habitat loss, a consistent pattern in settled areas at the time (Reiger 2001). Brook trout was a species that served as an early sentinel for the degradation of fish habitat and overexploitation and was important in the coalescence of the new angler experience in the 19th century.

Stocking fish in Algonquin Park began with people visiting lodges and with an interest in the new angling experience. Fish stocking was associated with this trend in outdoor leisure. The interest of an economically privileged class to be in nature was in ascendance in North America and the park could fill that role. The idea of nature as leisure did not occur suddenly but over several decades when the losses of what was seen as a pristine nature were accumulating and many viewed a change in attitude as a necessary response. The desire to repair nature and provide opportunities for everyone to participate in recreational angling was behind the push for reducing the influence of market fishing. This desire also served to motivate followers of the new angling experience. Fish stocking was used to fulfill these needs. In Ontario, newly emerging from constitutional challenges on responsibility for fisheries, bass followed by lake trout and brook trout were used to address overfishing as well as bringing the new angling experience to people. In Algonquin Park, this initially meant bringing the experience to those staying at lodges — a change to a landscape once used exclusively for forestry operations to one now increasingly open to the public and their interests.

Fisheries science and Algonquin Park

In the mid-1930s, construction was finishing on Highway 60 and a new technology, the family car, promised to change park use for the foreseeable future. Even when only railway access was available, visitation and park use from that technology appeared to have contributed to overfishing, imposition of regulations, and very high levels of fish stocking in the lakes near lodges. Greater access and the family car could potentially disrupt lakes further. It was the beginning of a new era of leisure and no one could be certain if the wider public shared in a respectable view of angling. The automobile transformed Algonquin Park (Killan and Warecki 1998).

MacDougall anticipated the kinds of information and new approaches this pending change in park use would require. In late 1931 and continuing until 1934, he conceived of a plan that would recognize multi-use, including recreation, scenic, and scientific values, as a core feature of Algonquin Park (Killan and Warecki 1998). These elements were to be included in park management in addition to a more regulated forestry operation. It included mapping out a highway in southern Algonquin Park.

MacDougall's thinking about the need for conserving park areas and the importance of long-term scientific research as a step in park management were greatly influenced by John R. Dymond, a University of Toronto ichthyologist (i.e., one who studies fish) (Killan and Warecki 1998). Beginning in 1931, shortly after accepting the park superintendent position, Frank MacDougall collaborated with J.R. Dymond on the idea that a more modern perspective on park management included a better understanding of natural ecosystems and species. Dymond was familiar with Elton's important publication Animal Ecology and apparently visited Elton in Oxford in 1929 (Killan and Warecki 1998). It is believed Dymond tutored MacDougall on the new science of ecology as described by Elton. Through their collaboration, MacDougall came to appreciate the new and modern view of natural ecosystems and how they functioned based on Elton's intellectual breakthrough. Protected areas, nature reserves, and long-term ecological research came to be associated with new approaches in Algonquin Park management. For long-term research on fish and fisheries, Dymond suggested to MacDougall that the Ontario Fisheries Research Laboratory, based at the University of Toronto, be invited to establish a field station to undertake this work (Killan and Warecki 1998).

W.J.K. Harkness, director of the Ontario Fisheries Research Laboratory at the time, agreed to the opportunity provided by MacDougall. Harkness was familiar with the rising interests of anglers. In 1925, he and J.R. Dymond attended the founding meeting of the Toronto Anglers' Association that in several years would become a provincial-scale organization, the Federation of Ontario Anglers and Hunters. An eyewitness at the founding meeting captures their concern over the changes taking place in Ontario and reveals the challenge to the new angler experience (Dymond 1964):

> "It is my recollection of the meeting that the two of them (Harkness and Dymond) sat listening with acute attention to the proceedings as we sportsmen outlined the dire predicament in which, we, as anglers and hunters, found ourselves at that time. The great expansion of provincial highways inaugurated by the Farmers Government was already under way. The first waves of the tourist tide were rising. *We foresaw invasion and disaster for our precious wilderness* [italics added], including our various private hideaways and pet streams and lakes." — Gregory Clark 1964

The rapid expansion in size and interest by the Federation of Anglers (precursor to Anglers and Hunters) by 1928 led the Ontario Government to create a committee entitled Special Committee on the Game Fish Situation. The Committee toured the province in 1929–30 seeking input into the state of angling fisheries with W.J.K. Harkness serving as secretary to the Committee.

MacDougall likely understood the position enjoyed by Harkness and Dymond among anglers when he offered the invitation. He shared the general concern expressed in the above quote. The importance for MacDougall of having Harkness and Dymond involved in fisheries research is reflected in how the anglers themselves felt about their leadership (Dymond 1964):

> "With what I now realize to have been masterly composure, they (Harkness and Dymond) modified the ire characteristic of embattled sportsmen, and supplied to our aims and objects the impassioned and orderly procedures of the academic mind. In committee, they quietly phrased for us the elementary principles of conservation which became the policy of the federated association and so arrested public attention that the hunters of Ontario, organized as the Ontario Game Protective Association, asked to join with the anglers. Thus the Federation of Ontario Anglers and Hunters came into being — several thousand sportsmen enlisted, if not as conservationists, at least as a captive audience for the cause." — Gregory Clark 1964

J.R. Dymond supervised five biologists who conducted interviews and basic survey work in 1935 at Cache Lake as the first fisheries science initiative in Algonquin Park. His report is ahead of its time in recognizing the outcome of the food web experiment (stocking smallmouth bass) in Cache Lake that had taken place since 1899 (see Dymond 1935; Appendix 3). In his report he outlines his general conclusion: "the introduction of the bass [to Cache Lake] has upset the natural balance in the lake so that there is now insufficient food for the game fish found in the lake". The selection of Cache Lake likely reflected its position as a destination for lodge tourists and the recreational fishery that had been in place for at least 36 years. Selecting Cache Lake may also have reflected the heavy investment in stocking the lake that had occurred up to that time. Cache Lake was also being considered as the location for the new field station.

The Ontario Fisheries Research Laboratory was established on Lake Opeongo in 1936. Within weeks, Harkness had devised a plan to conduct scientific research addressing sustainability of fisheries and the use of stocking as a management tool to support fishery yields (see Appendix 3). In his plan, Harkness outlined several priority areas including 1) determining the "best fish for each waterbody" including questions around food limitation for fish production, 2) establishing a stocking policy for each lake and stream, 3) looking into the possibility of stocking prey fish to overcome questions of food limitation (as recommended by Dymond in 1935, Appendix 3), 4) developing a hatchery in Algonquin Park that was "integral to the plan", 5) determining stocking success by monitoring fisheries, 6) establishing a museum for the public for instructing on natural history and field science underway, and 7) maintaining a close connection between the field station and both the university and resource management agency. A stocking policy for each lake and stream was never developed nor was a hatchery built for producing young fish to support this policy. The elements of this plan point to the perceived need by Harkness, presumably reflecting what was viewed as important at the time. The need to meet angler demand for fish was an obvious priority. Again, fish stocking was viewed as a primary response in the management of the park's recreational fishing.

What did happen after 1936 was development of a centre for long-term research in fisheries science (Figure 30). Initial efforts included a fishery monitoring program on Lake Opeongo and many other lakes, research into the fundamental role of temperature and oxygen in defining fish habitat via physiological performance, and developing interest in fish and aquatic ecology in general. Fish stocking followed by the evaluation of fishery yield was one area of research that continued for decades in the park. Charles Elton visited the field station in 1938, likely as a return favour for the 1929 visit by J.R Dymond to Oxford (Killan and Warecki 1998).

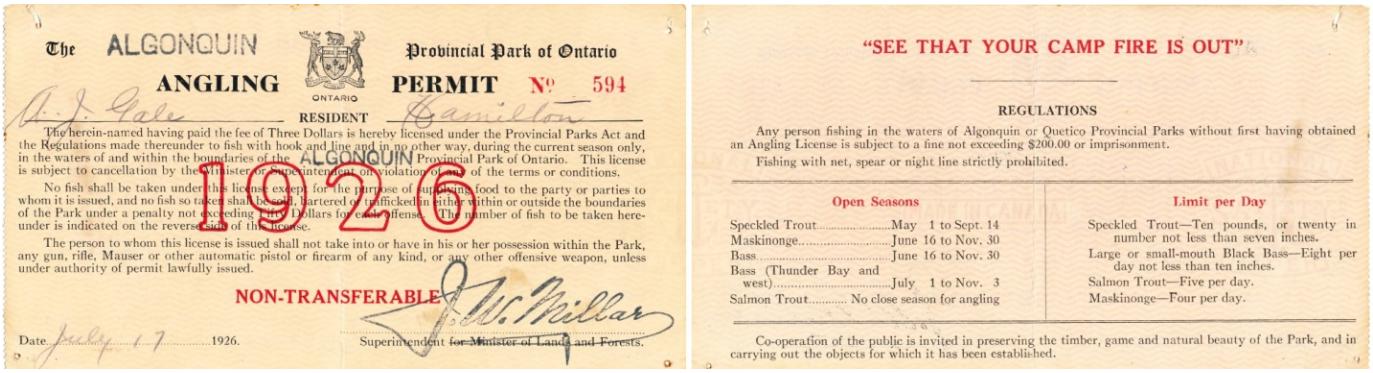
That most of Harkness's plan was not implemented did not limit research at the new field station on Lake Opeongo. After 1936, and continuing for nearly 20 years, most who established careers in fisheries science in Canada passed through the Ontario Fisheries Research Laboratory as students. It was deeply influential in developing a view that science and resource management were linked and that each could inform the other. The fishery monitoring program continues today on Lake Opeongo. The facility, now known as the Harkness Laboratory of Fisheries Research, continues to be the base for those conducting research into fish and aquatic ecology in the park.

Figure 30. The first field truck of the Ontario Fisheries Research Laboratory, located at Costello Lake (1937) where the crew was based. The station on Lake Opeongo was being built. Note the galvanized metal cans for transporting fish as recommended by Henshall in the 1880s. The individual holding the can is A.G. Huntsman. (Source: Algonquin Park Visitors Centre Archives)

Fishing regulations in Algonquin Park

The regulations governing harvest of fish in Algonquin Park have evolved, ranging from early catch limits of 30 brook trout to the more conservative limit of two individuals of the same species under the conservation category fishing license today (see Table 6). The generous limits for brook trout may have reflected its widespread distribution and short lifespan relative to lake trout. After the release of the fisheries management plan for the park (OMNR 1988), brook trout limits were reduced in 1989. Both lake trout and bass harvest limits have been reduced over the past century; however, prior to the mid–1930s, no closed season regulation existed for angling lake trout.

The 1926 Algonquin Park angling permit for 1926 (Figure 31) includes a list of regulations and season opening and closings for each species. This represents a significant change from the onset of fish stocking in 1899 when no regulations were in place.



The ALGONQUIN Provincial Park of Ontario

ANGLING PERMIT No 594

A. J. Gale RESIDENT Hamilton

The herein-named having paid the fee of Three Dollars is hereby licensed under the Provincial Parks Act and the Regulations made thereunder to fish with hook and line and in no other way, during the current season only, in the waters of and within the boundaries of the ALGONQUIN Provincial Park of Ontario. This license is subject to cancellation by the Minister or Superintendent on violation of any of the terms or conditions.

No fish shall be taken under this license except for the purpose of supplying food to the party or parties to whom it is issued, and no fish so taken shall be sold, bartered or trafficked in either within or outside the boundaries of the Park under a penalty not exceeding Five Dollars for each offense. The number of fish to be taken hereunder is indicated on the reverse side of this license.

The person to whom this license is issued shall not take into or have in his or her possession within the Park, any gun, rifle, Mauser or other automatic pistol or firearm of any kind, or any other offensive weapon, unless under authority of permit lawfully issued.

1926

NON-TRANSFERABLE

J. W. Millar

Date July 17 1926. Superintendent for Minister of Lands and Forests.

"SEE THAT YOUR CAMP FIRE IS OUT"

REGULATIONS

Any person fishing in the waters of Algonquin or Quetico Provincial Parks without first having obtained an Angling License is subject to a fine not exceeding $200.00 or imprisonment.

Fishing with net, spear or night line strictly prohibited.

Open Seasons		Limit per Day
Speckled Trout	May 1 to Sept. 14	Speckled Trout—Ten pounds, or twenty in number not less than seven inches.
Maskinonge	June 16 to Nov. 30	
Bass	June 16 to Nov. 30	Large or small-mouth Black Bass—Eight per day not less than ten inches.
Bass (Thunder Bay and west)	July 1 to Nov. 3	Salmon Trout—Five per day.
Salmon Trout	No close season for angling	Maskinonge—Four per day.

Co-operation of the public is invited in preserving the timber, game and natural beauty of the Park, and in carrying out the objects for which it has been established.

Figure 31. A 1926 Algonquin Park angling permit and associated regulations. (Source: Algonquin Park Visitors Centre Archives)

Few if any regulations existed in Algonquin Park before 1918 (Table 6). The current daily limit for lake trout and brook trout stands in stark contrast to some of the early stringers of abundant lake trout catches (Figure 5). High harvest limits for brook trout for several decades stands in contrast to the role of this species in the 19th century as a sentinel species highlighting overexploitation and habitat loss.

Table 6. Evolution of historical fish harvest regulations for Algonquin Provincial Park. This table represents highlights of regulations during each decade since the establishment of regulated harvest in the park. Fishing seasons and closures represent a separate category of regulation.

Year	Lake trout	Brook trout	Bass
1918	Five (5) per day	Aggregate of ten (10) lbs or thirty (30) in number per day	Eight (8) per day
1926	Five (5) per day	Aggregate of ten (10) lbs or twenty (20) in number per day; min. length of seven (7) inches	Eight (8) per day; min. length of ten (10) inches
1938	Five (5) per day	Aggregate of ten (10) lbs or twenty (20) in number per day; min. length of seven (7) inches	Six (6) per day; min. length of ten (10) inches
1946	Five (5) per day	Aggregate of ten (10) lbs or twenty (20) in number per day; min. length of seven (7) inches	Six (6) per day; min. length of ten (10) inches
1954	Five (5) per day	Aggregate of ten (10) lbs plus one (1) fish, or fifteen (15) in number per day, whichever is lesser; min. length of seven (7) inches	Six (6) per day; min. length of eleven (11) inches
1966	Three (3) per day	Aggregate of ten (10) lbs plus one (1) fish, or fifteen (15) in number per day, whichever is lesser	Six (6) per day
1975	Three (3) per day	Aggregate of ten (10) lbs plus one (1) fish, or fifteen (15) in number per day, whichever is lesser	Six (6) per day
1985	Three (3) per day	Seven (7) per day	Six (6) per day
1989[a]	Two (2) per day	Five (5) per day	Six (6) per day
1989[a]	Aggregate five (5) lake trout / brook trout	Aggregate 5 lake trout / brook trout	Six (6) per day
2005[a]	Sport license (S): Two (2) per day Conserv. license (C): One (1) per day	S: Five (5) per day C: Two (2) per day	S: Six (6) per day C: Two (2) per day
2017[a]	S: Two (2) per day C: One (1) per day	S: Five (5) per day C: Two (2) per day	S: Six (6) per day C: Two (2) per day

[a] Several lake-specific regulation exceptions in these years.

Aquatic ecosystems and fish stocking

With hindsight and research, we now know that fish stocking is a food web manipulation. Stocking success relies on the food web pyramid described by Charles Elton (Figure 1). Predators (e.g., lake trout, brook trout) are added to a lake in early life stages, survive to large sizes, and become predators. Natural fish populations and lake food webs can be affected in several ways by fish stocking.

Genetic integrity: Genetic integrity refers to the locally adapted genetic make-up of fish populations living in isolation. Each lake has a characteristic pattern of seasonal temperature (based on volume), habitat structure, and population size of a species to name a few distinguishing features of lake-based populations. The genetic structure of these populations, evolved over thousands of years of isolation, reflects their unique conditions. Stocking can introduce fish with substantial differences in their genetic structure from the receiving population. Domestication of hatchery fish and corresponding changes in genetic structure is always a risk with hatchery raised fish. When introduced to natural self-sustaining populations, the result is potentially a loss of genetic integrity of that population. This results in a loss of genetic diversity from one population to the next that leads to a homogenization of the genetic structure among what was a highly diverse set of populations. Genetic variation can increase (paradoxically) but this reflects only the introduction of new genes to what was a locally adapted population.

This phenomenon has been detected for lake trout and brook trout in Quebec (brook trout, Marie et al. 2010; lake trout, Valiquette et al. 2014). In the case of lake trout, stocking hatchery origin, domesticated strains resulted in a twofold decline in genetic differentiation among lake populations that were stocked vs those not stocked. Genetic mixing stemming from stocking was correlated with stocking intensity — more stocking led to more mixing. In some cases, mixing was short-lived while in others mixing persisted. Because lake trout are long lived it was possible for older, larger lake trout native to a particular lake to breed and effectively recover the genetic structure of the original population.

A similar pattern occurred with stocking of hatchery brook trout (Marie et al. 2010). More stocking led to more genetic mixing between native and hatchery fish in the population. Populations of brook trout in stocked lakes became more similar genetically and across stocked lakes the genetic structure became more homogenized as a result. Loss of locally adapted genetic structure occurred among brook trout populations in lakes. In Algonquin Park, Dickson Lake strain brook trout are used for stocking so that locally adapted genetic structure is present in stocked fish. For both lake trout and brook trout genetic mixing was not only detected at population (within lakes) and landscape scale (among lakes in a region), it was also occurring in individual fish as more members of a population were essentially hybrids of native and stocked fish.

Reliance on stocking for sustaining recreational fisheries can affect wild fish in lakes targeted by anglers (van Poorten et. al. 2011). Referred to as social-ecological systems, fish stocking is both a user-based management response (supplying fish for anglers = social) and a reliance on natural productivity (growing stocked fish in lakes = ecological). When stocking is a response or reward to ongoing expectations by anglers then this management activity can lead to the genetic replacement of wild fish with stocked fish (van Poorten et. al. 2011). Planning-based stocking that includes sustaining wild populations of brook trout and lake trout is therefore an important step in managing the broad effects of stocking on wild fish.

Stocking fish in lakes can affect aquatic food webs resulting in changes in lake productivity, loss of species, and disruption of food webs supporting native species (Knapp et. al. 2001; Eby et. al. 2006). Food web changes due to stocking can be partitioned into lakes with native fish predators such as lake trout and brook trout, and lakes without native fish.

Food web effects and natural fish populations: Stocking fish into lakes can change the structure of food webs — altering the established predator/prey linkages that exist among species within a lake. The stocking or introduction of bass into lakes is a case study in disruption of natural food webs (Jackson 2002). Dymond noted this effect in the first fisheries science report for Algonquin Park (Appendix 3).

Bass introductions into lakes lead to a loss of small fish species due to predation (MacRae and Jackson 2001). The loss of small fish species can accumulate when introductions are considered at landscape scales (Whittier and Kincaid 1999; Vander Zanden et. al. 2004). Loss of species is indicative of a change in the food web structure of lakes. Bass are able to successfully compete against lake trout for food in the inshore areas of lakes, come to dominate the food web of lakes, and as a result, force lake trout to forage offshore reducing their size because they have to work harder for less food (Vander Zanden et. al. 1999). Removal of bass allows lake trout to regain their food web structure demonstrating in reverse the food disruption stemming from bass introductions (Lepak et. al. 2006).

The whole process homogenizes the fish fauna of lakes and streams across large landscapes (Radomski and Goeman 1995; Rahel 2000). The result is a loss of species diversity in watersheds. The homogenization phenomenon is global and therefore an important contributing factor to the loss of regional species diversity (Toussaint et al. 2016). Five of the ten top global challenges facing freshwater fish conservation focus on species introductions and homogenization in whole or in part (Olden et al. 2010).

Introducing new predators to brook trout lakes severely reduces or extirpates the brook trout. Brook trout forage at more shallow depths than lake trout, making this species particularly vulnerable to predation effects due to the new predators in addition to food web disruption. Early life stages of brook trout occupy the shallow areas of lakes and render young brook trout at risk of predation from new predators (Biro et. al. 2008).

Food web effects in fishless lakes: Lakes without brook trout, lake trout, or fish of any kind, can be viewed as opportunities for stocking in so-called unoccupied food webs. Evidence from western North America following stocking of brook trout in lakes without a large fish predator provides a clearer picture of food web disruption that can follow from what appears to be a good idea initially.

Stocking of brook trout and other trout species in high-elevation lakes has altered their food webs. Stocking has increased cycling of phosphorus in lakes, an essential element in primary production at the base of food webs (Schindler et al. 2001). Changes in phosphorus cycling largely stemmed from disruption of lake-bottom sources due to predation by trout. Stocked fish mobilized phosphorus that was not previously accessible to the food web resulting in a stimulus for increased primary production (i.e., aquatic plants, algal growth).

Stocking also altered aquatic insect productivity leading to reduced prey for birds relying on this food during the period when rearing chicks (Epanchin et. al. 2010). Lakes with stocked trout had 98% fewer mayflies at the lake surface compared to lakes without stocking. The reduction in this food source for birds led to large differences in the numbers of birds foraging at stocked lakes versus fishless lakes with more birds located at fishless lakes.

Stocking of brook trout and other trout into fishless lakes has also reduced or extirpated local amphibian populations (Pilliod and Peterson 2001). As with bass removals, experimental removal of stocked trout increased abundance of a frog species previously reduced following stocking (Knapp et. al. 2007). Recovered populations of the species served as sources for the movement and establishment of new local populations.

Conclusion

Fish stocking in Algonquin Park has been a fisheries management approach for well over a century. Starting as a need to meet visitor interest in the lodge and railroad era, fish stocking became a response to a change in visitor access and movement at landscape scale. Beginning in the recent era of park planning, fish stocking became more focused on supporting a put-grow-take fishery in accessible areas. When viewed over this time span, fish stocking reflected resource management at the time and continues to play a role in the management of recreational fishing in Algonquin Park.

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Appendix 1. Data and information sources

Methods

Multiple sources were reviewed for records of fish stocking events in Algonquin Provincial Park (see Table A1.1). The location of each listed event was assessed and, once confirmed to be in the current park boundary, the stocking record was entered into a Microsoft Access database (described below).

Table A1.1. Algonquin Provincial Park fish stocking data sources.

Source	Data code	Date range	Description	Location
Algonquin District annual reports	ALGD_AR	1943 to 1953	Includes recommendations for expenditures equipment purchases, and improvements, fire prevention information, a fish and wildlife report as well as information on land transactions, prosecutions, personnel, timber management, operating permits, etc..	Algonquin Park Visitor Centre archives
Algonquin Park District Fisheries Management Plan (DFMP) Background Document	ALG_DFMP	1985	A compilation of information pertaining to the former Algonquin Park District's fishery resource, resource users, problems, issues, and management practices used to support the formulation and implementation of the Algonquin Park DFMP (1985).	MNRF Algonquin Zone data files
Algonquin Park District fish spawn transfer record	ALGD_FSTR	1987 to 1988	Includes a record of species, donor/recipient waterbodies, quantity of spawn, dates spawn was taken and placed, description of handling/transfer procedure, map of stocking site, and other related information.	Algonquin Park East Gate
Algonquin Park fish stocking lists	ALG_STK_LISTS	1973 to present	Ministry of Natural Resources and Forestry fish stocking program records for the former Algonquin Park District and Algonquin Provincial Park.	Algonquin Park Visitor Centre library and MNRF Algonquin Zone data files
Algonquin Park superintendent reports	ALG_SR	1893 to 1954	Annual reports written by former park superintendents to the Government of Ontario. Includes information on park personnel, finances, improvements, boundary maintenance and expansion, fishing, game, fire protection, stream control, logging, transportation, publicity, summer resort activities, communication, sanitation, pest control, regulations, aviation, budgeting, arrests and convictions, etc.	Algonquin Park Visitor Centre archives

Source	Data code	Date range	Description	Location
Algonquin Park Visitor Centre library files	ALG_ VCL	1800s to Present	Reprint collection containing a variety of documents relating to Algonquin Provincial Park, e.g., newspaper/magazine articles and advertisements, scientific journal articles, educational resources, etc.	Algonquin Park Visitor Centre library
Bancroft District fish stocking lists	BD_ STK_ LISTS	1993 to 1994	Stocking records for Bancroft District, Whitney Area.	Algonquin Park Visitor Centre library
Department of Lands and Forests fish distribution card files	DLF_ CARD_ FILES	1925 to 2001	Fish and Wildlife Division's paper record of fish distribution events within Algonquin Provincial Park. Includes date, species, age class, length, number of fish, request number, and event location information.	Algonquin Provincial Park East Gate office
FISHARC database	FISH ARC	1936 to 1973	The subset of stocking records from the provincial database that are listed within Nipissing and Haliburton counties and either lie within or intersect with the current boundary of Algonquin Provincial Park	OMNRF data files
Fish stocking into public waters records	MNR_ FSPW	1987 to 2001	Ontario Ministry of Natural Resources records of fish stocking events in public waters. Include details such as stocking date, transit method, purpose, location, species, age, quantity, etc.	Algonquin Provincial Park East Gate office
Harkness Laboratory of Fisheries Research archive files	HLFRA	1936 to Present	Research notes, reports, journal articles, Lake Opeongo Limnological Laboratory progress reports, and Harkness Laboratory of Fisheries Research Advisory Committee reports.	Harkness Laboratory of Fisheries Research and Trent University DNA building
Lake survey files	LSF		Include contour maps, netting survey results, temperature and dissolved oxygen profiles, aquatic resource project history, etc., for lakes within the former Algonquin Park District.	Algonquin Provincial Park East Gate office
Monthly record of hatchery transfers and shipments	MNR_ MRHTS	1976 to 1987	Ontario Ministry of Natural Resources records of hatchery fish transfers and shipments. Include fish lot data (e.g., species, age, quantity), transportation data (e.g., vehicle, trip number), and distribution data (e.g., water body, quantity).	Algonquin Provincial Park East Gate office

Source	Data code	Date range	Description	Location
Pembroke District annual reports	PD_AR	1954 to 1962	Include information similar to that found in the Algonquin District Annual Reports.	Algonquin Park Visitor Centre archives
Pembroke District fish stocking lists	PD_STK_LISTS	1958 to 1972	Department of Lands and Forests/Ministry of Natural Resources fish stocking program records for Pembroke District.	Algonquin Park Visitor Centre library

Stocking database

The Algonquin Provincial Park fish stocking database contains detailed records of current and historical stocking events within the current park boundary between 1899 and 2016, inclusive. Each record lists the following stocking event information, if available: location details (waterbody location identification code (LID), geographic township and county, waterbody name, and local names), date of event, fish species, quantity stocked, age class, average length, stock/genetic strain, stocking event purpose (e.g., research, re-introduction), hatchery information, transportation method, and data source. The database also contains a list of 261 fish stocking records with unconfirmed stocking locations that may or may not lie within the current park boundary (i.e., are related to geographic townships that are not fully within the park). These records have not been included in the analyses within this report.

Data assumptions

This report is based on the best available data relating to current and historical fish stocking within Algonquin Provincial Park. Due to the nature and historical range of the data, several assumptions were made about species as well as stocking quantities and locations:

- Early records listing salmon or true salmon were assumed to refer to stocking of Atlantic salmon, *Salmo salar*, while those listing salmon trout were assumed to refer to lake trout, *Salvelinus namaycush* (Scott and Crossman 1973).
- Where a total number of fish stocked was listed for a specific time period, the number was divided equally among each stocking year. For example, if a stocking record indicated that Brewer Lake received 8,740 brook trout from 1940–1944, the total of 8,740 was divided by 5, giving 1,748 fish each year.
- Where a total number of fish stocked was listed for several waterbodies in the same year, the number was divided equally among each waterbody. For example, if a stocking record indicated that 532 bass were stocked into Rainy, Brule, Canoe,

Source, and Cache Lakes in 1900, the total of 532 was divided by 5, indicating approximately 106 fish for each lake.

- Where a stocking record referenced a stocking density, the number of fish stocked per hectare was multiplied by the total lake area to determine the total number of fish stocked. For example, if a stocking record listed that Billy Lake was stocked at a density of 25 brook trout per hectare, this stocking density was multiplied by 96.9 hectares, giving a total of approximately 2,423 fish.
- Where an early stocking record (i.e., those originating between 1900–1925) referenced stocking event locations using language such as lakes near park headquarters or lakes near the highway, it was assumed the stocking record was referring to a select few lakes referenced in other stocking records from a similar time. These lakes included Cache, Source, Canoe, and Tanamakoon.
- Where a stocking record listed a historical waterbody name, several resources were used to determine the waterbody's current name and location including Algonquin Park Technical Bulletin No. 10 —Names Behind Algonquin, Jeff's Map of Algonquin Provincial Park Version 5.0 (June 2014), several historical maps of Algonquin Park, as well as personal recollections of individuals familiar with the park's history (see Table A6.1).
- Where a stocking record was listed in more than one source with discrepancies in total number of fish stocked, the number from the oldest/original source was used. For example, where a stocking event was listed in both the provincial FISHARC database as well as the Department of Lands and Forests fish distribution card files, the stocked quantity listed in the card file record was used. Likewise, where a stocking event was listed in both the Department of Lands and Forests fish distribution card files and an original historical source (e.g., report, article, etc.), the stocked quantity listedin the historical record was used. As much other information pertaining to the stocking record (i.e., age class, length, other notes) as possible was gathered from all sources.
- The Fish Stocking Information System (FSIS) was not used to summarize stocking after 2000 because stocking records that were reviewed for Algonquin Park are maintained by park staff separately so records were obtained directly from staff.

Limitations

While the database contains the best available data on fish stocking in Algonquin Provincial Park, it does not address fish stocking in areas outside the current park boundary. An abundance of waterbodies near the park have rich stocking histories, with several continuing to receive hatchery fish. Many of these lakes are in Algonquin Provincial Park watersheds. This interconnectedness presents the potential for historical and current stocking events in these waterbodies to influence fish communities within the park boundary. Additional work is needed to gather stocking information related to waterbodies outside the park and generate a more complete stocking story.

In many instances historical records listed waterbody names that could not be located in the park (see Appendix 3). Many of these records listed geographic township names in the park, allowing records to be associated with the current park boundary. Stocking information for records confirmed to be from within the park was included in the analyses. Those that listed geographic townships that are not fully within the park boundary were added to records in the database entitled Unconfirmed in Park and were excluded from analyses.

Appendix 2. Railways in Algonquin Park

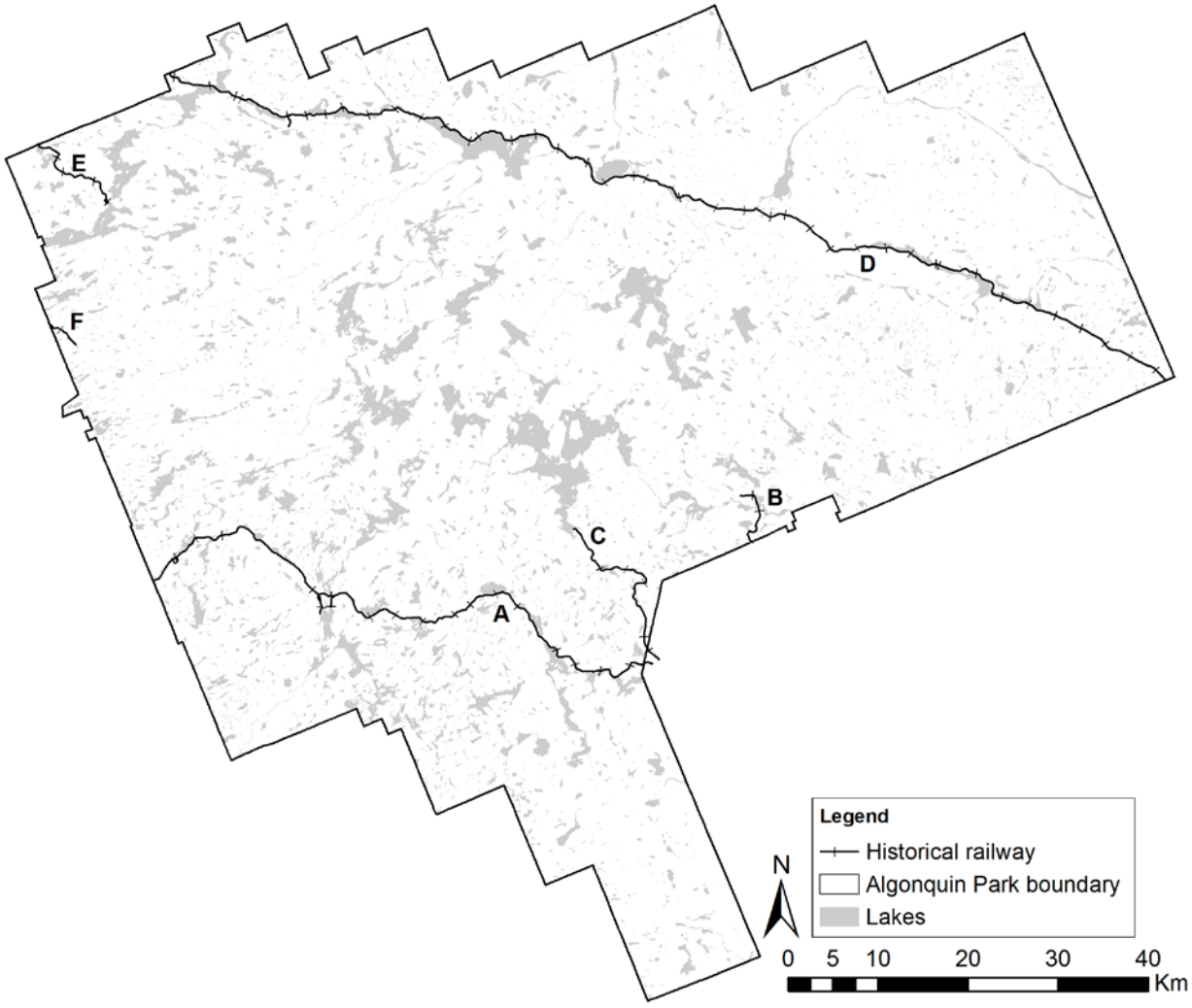


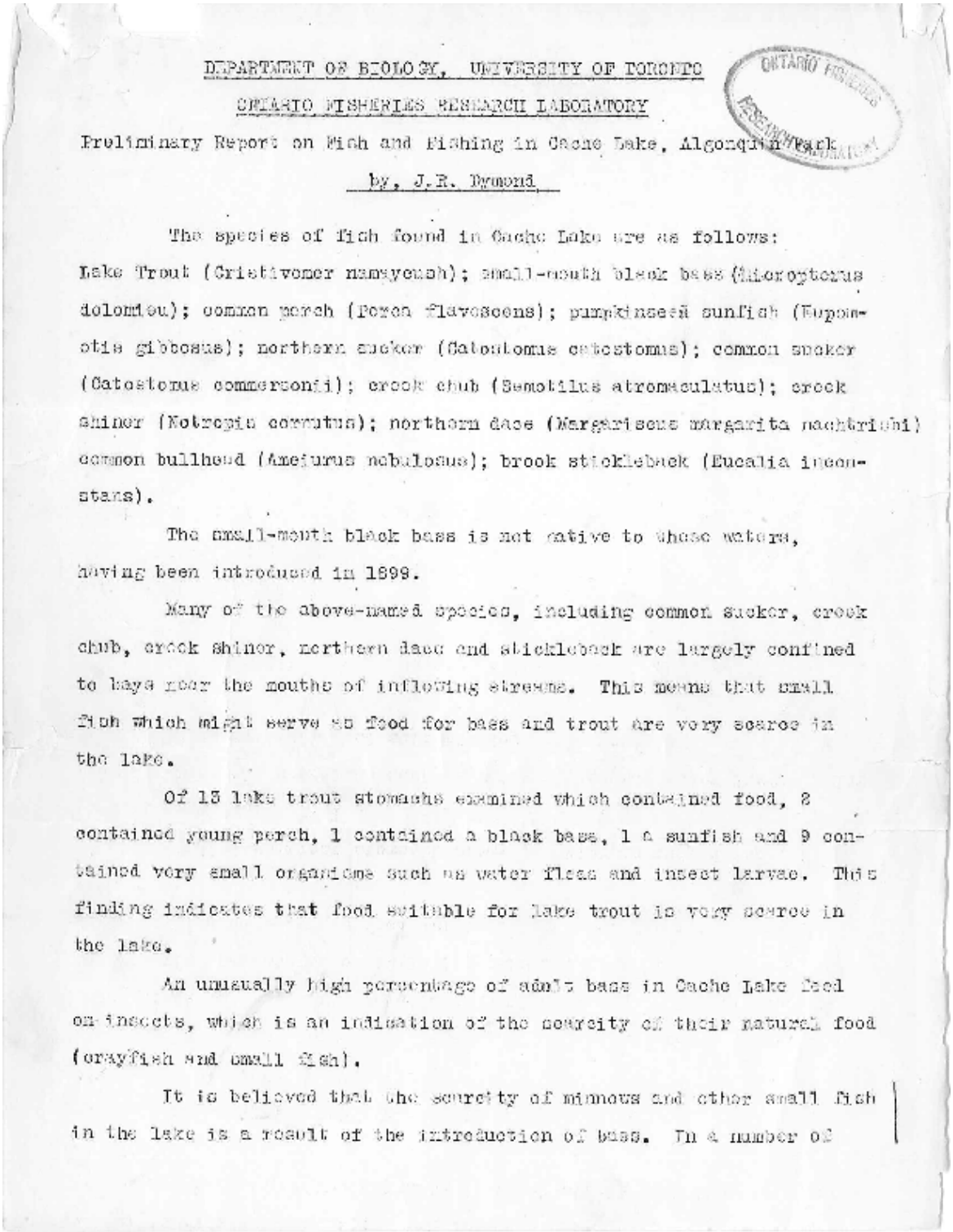
Figure A2.1. A map of railways that operated in Algonquin Provincial Park. Details about each railway are included in Table A2.1.

Table A2.1. Names of railways that operated within Algonquin Provincial Park. Map labels correspond to those in Figure A2.1. This information was gathered from multiple sources including Jeff's Map of Algonquin Provincial Park Version 5.0 (June 2014), and The Canadian National Railway's *(CNR)* "Algonquin Route" 1915–1995 (McKay 2003).

Map label	Name	Operating dates	Description
A	Ottawa, Arnprior, Parry Sound Railway	1895 to 1959	Canadian National Railway (CNR) Algonquin Subdivision ran through southern portion of the Park
B	Egan Estates Railway / Booth's Railway	1899 to 1930s	Ran from the Egan Estate Station (between Whitney and Madawaska) to north of Farm Lake
C	Whitney and Opeongo Railway	1902 to 1926	Ran from the town of Whitney to Lake Opeongo
D	Canadian National Railway	1915 to 1995	Alderdale and Beachburg subdivisions ran through northern portion of the Park
E	Fassett Lumber Company Railway	1924 to 1934	Ran from Fossmill Station on the northern CNR railway to North Tea Lake
F	Standard Chemical Company Railway	1925 to 1946	Ran from the town of South River to south of Craig Lake

Appendix 3. Historical correspondence

J.R. Dymond's report (1935) on fish and fishing in Cache Lake — the first fishery investigation in Algonquin Park.



DEPARTMENT OF BIOLOGY, UNIVERSITY OF TORONTO

ONTARIO FISHERIES RESEARCH LABORATORY

Preliminary Report on Fish and Fishing in Cache Lake, Algonquin Park

by, J.R. Dymond

The species of fish found in Cache Lake are as follows: Lake Trout (Cristivomer namaycush); small-mouth black bass (Micropterus dolomieu); common perch (Perca flavescens); pumpkinseed sunfish (Eupomotis gibbosus); northern sucker (Catostomus catostomus); common sucker (Catostomus commersonii); creek chub (Semotilus atromaculatus); creek shiner (Notropis cornutus); northern dace (Margariscus margarita nachtriebi) common bullhead (Ameiurus nebulosus); brook stickleback (Eucalia inconstans).

The small-mouth black bass is not native to these waters, having been introduced in 1899.

Many of the above-named species, including common sucker, creek chub, creek shiner, northern dace and stickleback are largely confined to bays near the mouths of inflowing streams. This means that small fish which might serve as food for bass and trout are very scarce in the lake.

Of 13 lake trout stomachs examined which contained food, 2 contained young perch, 1 contained a black bass, 1 a sunfish and 9 contained very small organisms such as water fleas and insect larvae. This finding indicates that food suitable for lake trout is very scarce in the lake.

An unusually high percentage of adult bass in Cache Lake feed on insects, which is an indication of the scarcity of their natural food (crayfish and small fish).

It is believed that the scarcity of minnows and other small fish in the lake is a result of the introduction of bass. In a number of

other lakes, e.g. Head Lake and Joe Lake, in which bass are not found, small fish are common. On the other hand, in Rain lake in which bass have been introduced, minnows are so scarce that it is necessary to go to neighbouring lakes to secure bait minnows. Minnows are said to have been common in Cache Lake 25 years ago. The introduction of bass may therefore be said to have upset the natural balance existing in the lake and that a new balance between the food supply (small fish, crayfish, etc.) which the lake is capable of maintaining, and the population of fish-eating fish (lake trout and bass) has not yet been re-established. It is probable that the establishment of the new balance in such a lake as Cache and other small and medium-sized lakes will mean the elimination of the trout.

The problem of increasing the number and size of lake trout and bass in the lake is therefore one of increasing the food supply of these species. The planting of more of these fish would only increase the competition for the already insufficient food supply.

It is suggested that perch is the most suitable species to introduce as food for bass, and ciscoes (lake herrings) as food for lake trout. These species should be introduced as fry as it is possible that conditions are unsuitable for the spawning and (or) hatching in Cache Lake. Perch already occur sparingly in the lake and the few young perch that are found appear to make a good growth during their first year. It is during their first year that they are eaten by bass.

If ciscoes are propagated for planting as food for lake trout, it is advisable to use the ones occuring naturally in lakes of Algonquin Park such as Opeongo.

If the time should come when it is necessary to propagate lake trout, the native trout should by all means be used as there can be little doubt that they are physiologically adapted to the conditions

obtaining in the lakes of this area.

Since bass tend to eliminate lake trout from small and medium-sized lakes, they should not be introduced into lakes in which it is desirable to retain trout fishing. Since trout are more easily propagated artificially than bass, it would seem desirable from the point of view of restocking to retain trout in as many waters as possible. On account of the upsetting effect on the natural balance in the waters, produced by the introduction of fish not native to them, careful consideration should be given before any further introductions of this kind are made.

In order to prevent so far as possible the accidental introduction of non-native species of fish into the waters of the Park, the Ontario fishery regulations respecting the liberation of live minnows should be given the widest possible publicity. Under these regulations it is unlawful to liberate live minnows and other small fishes to any waters excepting those from which they were originally taken. These regulations further specifically prohibit the use of live carp minnows as bait excepting in the waters from which they were originally taken. On account of the danger of introducing carp or other undesirable species into the waters of the Park, it would probably be advisable to prohibit the bringing of live bait minnows from outside into the Park.

As a basis for comparing the productivity of the lake for different periods, it is desirable that a record of the fish taken from the lake each year be compiled from the returns of individual anglers. There is at present disagreement as to whether the number of fish taken from the lake is less than it was ten years ago. In the absence of some means of arriving at a reliable estimate of the number of fish produced each year, it is impossible to judge satisfactorily the trend of fishing in the lake.

August, 1935.

W.J.K Harkness' early ideas on the role of the fisheries science program in Algonquin Park (June 1936). The proposed hatchery was never built.

A PLAN FOR BIOLOGICAL WORK TO BE CONDUCTED IN ALGONQUIN PARK

This programme includes four phases of which the first and most important is the study of the game fishes, which has as its objective the improvement of fishing in all Park waters.

Different species of fish are definitely limited to particular lakes and streams by the temperature and oxygen supply of the water, the depth of lakes and the rate of flow of streams. Fish are also definitely limited by the amount of food available in the lake or stream.

The first study will be to determine what species of fish are best suited to each body of water, and what amount of food is available to these particular species.

Following this a stocking policy will be established for each lake and stream. A definite number of game fish of a particular size will be introduced each year. In some cases, where food is scarce, instead of introducing game fish, smaller species on which game fish commonly feed will be introduced. This increase in food should result in an increased output of game fish.

It will be most advantageous to have a hatchery located at a key point in the Park in which to produce the game and food fish necessary for this stocking policy. The early construction of such a hatchery is an integral part of the plan.

It is important to follow the results from these plantings in order to ascertain the production from the different policies as they are put into practice. This will be done for certain key lakes and streams by maintaining a catch census. Knowing very definitely the results from a certain policy for some waters it will be possible to apply successfully

the same policy to other waters.

This method of checking the catch resulting from a known definite planting effort supplants the "hit and miss" method of introducing fry and places fish culture on a business like basis.

A second part of the plan, and one which will not in any way interfere with the fisheries work, will be a study of the birds and mammals of the Park. This will probably not be undertaken for some time.

The laboratory which we hope to establish in the Park will have a close connection with the University. This will make it possible to take our class in Biology consisting of from ten to fifteen students, into the Park and give them a field course covering two or three weeks, on the life in the Park. Here, they will find conditions more favourable for such a study than almost anywhere else in Ontario.

In the course of a year or two the programme should provide for the establishment of a museum, with an instructor in charge. This museum would include specimens native to the Park, aquaria containing the smaller fish and any literature on the natural history of the area.

People visiting here would be given an account of the animals found in the Park and the work being carried on by the laboratory and the Park.

In order to function to best advantage this laboratory

should be an integral part of the Park service and there must be the closest cooperation between the staff of the laboratory and the Park Superintendent.

The information obtained by the laboratory, the laboratory accommodation and staff should be at the service of the department of Lands and Forests and the department of Game and Fisheries as the chief function of this work is to increase the efficiency of these departments in their treatment of the biological natural resources of fish, birds and mammals.

June 9, 1936.

W. J. H. Harkness

Appendix 4. Waterbody names with unconfirmed locations

Table A4.1. Stocked waterbodies in Algonquin Provincial Park with unconfirmed geographic locations. The list includes rivers and streams with only geographic township identification. Some lake names were referenced in more than one township. Stocking events also took place at several other unnamed lakes in Canisbay, Sproule, and Master Townships (not included on this list).

County	Township	Waterbody name	County	Township	Waterbody name
Nipissing	Fitzgerald	Allen Lake	**Nipissing**	Edgar	Noon Lake
Nipissing	Canisbay	Amos Lake	**Nipissing**	Master	Number Two Lake
Nipissing	Sproule	Bailes Lake	**Nipissing**	Edgar	Park Lake
Nipissing	Lister, Sproule	Bates Lake	**Nipissing**	Deacon	Pine Lake
Nipissing	Master	Bear Lake	**Nipissing**	Deacon	Rainbow Lake
Nipissing	Sproule	Beaver Lake	**Haliburton**	Clyde	Sand Lake
Nipissing	Sproule	Belle Lake	**Nipissing**	Stratton	Sausage Lake
Nipissing	Pentland	Branch of Hales	**Nipissing**	Barron	Seldom Seen Lake
Unknown	Unknown	Brennan Lake	**Haliburton**	Bruton	Smith Lake
Nipissing	Preston	Bruce Lake	**Nipissing**	Guthrie	Spectacle Lake
Nipissing	Master	Buzzard Lake	**Nipissing**	Wilkes	Suzanne Lake
Nipissing	Preston	Carswell Lake	**Unknown**	Unknown	Trout Lake
Nipissing	Pentland	Caulon Lake	**Nipissing**	Edgar	Upper Cross Lake
Nipissing	Dickson	Chance Lake	**Nipissing**	Edgar	Upper Twin Lake
Unknown	Unknown	Clear Lake	**Nipissing**	Master	White Lake

County	Township	Waterbody name	County	Township	Waterbody name
Haliburton	Clyde	Connelly Lake	**Nipissing**	Wilkes	Amable Du Fond
Haliburton	Bruton	Coon Lake	**Nipissing**	Pentland	Maple Lake
Nipissing	Edgar	Cross Lake	**Nipissing**	Peck	Oxtongue River
Nipissing	Deacon, Sproule	Fish Lake	**Nipissing**	Peck	South Branch of Madawaska River
Nipissing	Stratton	Forbes Lake	**Nipissing**	Boyd	Hurdman Creek
Nipissing	Preston	Frog Lake	**Nipissing**	Lister	Nipissing River
Nipissing	Deacon	Gauthier Lake	**Nipissing**	Canisbay	Madawaska River
Nipissing	Deacon	Gun Lake	**Nipissing**	Sproule	Bab Creek
Nipissing	Deacon	Haskin Lake	**Nipissing**	Deacon	Little Madawaska River
Nipissing	Bronson	Hillendale Lake	**Nipissing**	Deacon	North River
Nipissing	Peck	Kelly Lake	**Nipissing**	Airy	Mud Creek
Nipissing	Lister	Lake South of Carl Wilson	**Nipissing**	Airy	Headstone Creek
Nipissing	Lister	Lake Nipissing	**Nipissing**	White	Crow River
Nipissing	White	Lake Travers Vicinity	**Nipissing**	White	White Partridge Creek
Haliburton	Clyde	Little Lake	**Nipissing**	White	Petawawa River
Nipissing	Bronson	Little McIntyre Lake	**Nipissing**	White	Travers Creek
Nipissing	Edgar	Lower Cross Lake	**Nipissing**	Clancy, Guthrie	Bonnechere River
Nipissing	Wilkes	Manitou Rapids	**Nipissing**	Edgar	Whitson Creek

County	Township	Waterbody name	County	Township	Waterbody name
Nipissing	Fitzgerald	McSourley Lake	**Nipissing**	Guthrie	Robitaille Creek
Nipissing	Deacon	Minnow Lake	**Nipissing**	Guthrie	Carcajou Creek
Haliburton	Bruton	Monrock Lake	**Nipissing**	Stratton	Forbes Creek
Nipissing	Master	Moose Lake	**Nipissing**	Master	Indian River

Appendix 5. Current and historical Algonquin Park lodging and camp operations

Table. A5.1. Names of main hotels, lodges, and camps that operated in Algonquin Park between 1899 and 2016.

Lake location	Name	Operating dates
Cache Lake	Northway Lodge	1906-present
Cache Lake	Highland Inn	1908-1956
Joe Lake	Hotel Algonquin	1908-1956
Little Joe Lake	Camp Ahmeek	1911-1922
Lake of Two Rivers	Camp Minnewawa	1911-1930
Canoe Lake	Mowat Lodge	1913-1930
Smoke Lake	Camp Nominigan	1913-1931
Burnt Island Lake	Camp Minnesing	1913-1956
Source Lake	Camp Pathfinder	1914-present
Canoe Lake	Camp Ahmek	1921-present
Cache Lake	Bartlett Lodge	1923-present
Canoe Lake	Camp Wapomeo	1924-present
Tanamakoon Lake	Camp Tanamakoon	1925-present
Cedar Lake	Kish-Kaduk Lodge	1927-1975
Lake Opeongo	Opeongo Lodge	1928-1956
Tepee Lake	Camp Arowhon	1931-present
Lake Travers	Turtle Club	1933-1973

Lake location	Name	Operating dates
Lake of Two Rivers	Killarney Lodge	1935-Present
Canoe Lake	Portage Store	1936-Present
Tea Lake	Musclow Lodge	1937-1970
Tea Lake	Camp Tamakwa	1937-Present
Whitefish Lake	Whitefish Lodge	1939-1965
Little Joe Lake	Arowhon Pines	1942-Present
Rain Lake	Rain Lake Camp (Lodge)	1944-1997
Source Lake	Glen Donald Lodge	1949-1958
Galeairy Lake	Forest Bay Boys Camp	1950-1952
Whitefish Lake	Camp Douglas	1951-1958
Cache Lake	Camp Wendigo	1965-Present

Appendix 6. Waterbody names identified by personal recollection

Table A6.1. Names of Algonquin Park waterbodies identified through personal recollection using geographic township, if available.

Township	Current name	Historical name
Bruton	Big Rock Lake	Rock Lake
Bruton	Billings Lake	Sand Lake
Clyde	Cauliflower Lake	Clear Lake
Hunter	Hanes Lake	Harold Lake
Bower	Happy Isle Lake	Green Lake
Clyde	Little Hay Lake	Birch Lake
Peck	Little Island Lake	Henry Lake
Sproule	Little Minnow Lake	Minnow Lake
Bruton	Lostwater Lake	Lost Lake
Bruton	Scorch Lake	Burnt Lake
Clancy	Spot Lake	Tin Can Lake
Osler	Tillie Lake	Raven Lake

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