Best Practices

for Recreational Stocking of Trout in Alberta

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Alberta

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A typical aquaculture pond.

Introduction

The information laid out in this document is to be used as a general guideline for private pond stocking in Alberta, including pond selection, fingerling selection, and problems that may arise in stocked ponds. These ponds are licensed under a recreational fish culture license with the Alberta government and must meet certain qualifications. More information about licensing fees and associated costs can be found here. This document is an amalgamation of information provided by other provinces, the Canadian Food Inspection Agency (CFIA), Department of Fisheries and Oceans (DFO), local non-profits, and research into how to best serve those who would like to farm trout.

Recreational licences allow the holder to keep Category 1 cultured fish, as specified, in the water body named on the licence. The licence is intended for the recreational, non-commercial use of the applicant. Fish cannot be sold under authority of this licence, except where they can be bartered or sold at local markets. Of note, only the waterbody specified on the license will be allowed to be stocked under this license. Latitudinal and longitudinal coordinates will be

required when applying for the license. This document will go into more detail outlining the requirements of recreational licenses in further sections, as well as outlining other licences that are available for commercial fish production. Recreational fish culture in Alberta is based on stocking free-roaming fish into small lakes, ponds, or dugouts. It is appealing to many farmers and landowners because there is no feeding required, associated costs are relatively low, and no special skills are necessary. Oftentimes, because of the harsh Alberta winters, trout are unable to overwinter, leaving the pond available to be stocked with new fish in the spring. Allowing trout to exploit natural food sources and grow to a harvestable size throughout the spring and summer gives the pond owner a great investment and many fishing opportunities throughout the growing season. Recreational fish culture systems depend largely on natural food, which may be supplemented by fertilization and/or use of formulated feed to complement natural food. These types of operations are typically characterized as being low cost, low output facilities that raise fish for personal use but may include bartering or selling a small part of the produce dead to neighbors and in local markets. Movement of live fish is not allowed.

All trout that are available for purchase through commercial fish farms are triploids and are unable to reproduce. Triploid fish are sterile and do not develop sexual organs. Because they do not put their energy into spawning, they can grow to be larger sooner, making them an ideal candidate for stocking into a trout pond for harvest.

The fish primarily stocked into recreational ponds in Alberta are rainbow trout (*Oncorhynchus mykiss*). This species is able to grow rapidly within the span of several months and provide ample recreational opportunities throughout their growing cycle. Stocking fingerlings in the spring that are 10-12.5 cm can oftentimes grow to over 450g by the fall. Other trout species may also be available for stocking into your pond. Contacting the hatchery you are planning on purchasing fingerlings from will give you a better idea of the types of trout and other species that may be available.

Legal Aspects

This guideline aims to support the development of recreational rainbow trout aquaculture and mitigate risks to wild species found in Alberta. For current policy information, please contact aquaculture@gov.ab.ca. You are responsible for knowing the current laws and policies around recreational fish stocking. Additional information, if viewing this document in print, is available in the addendum. Click through hyperlinks can be accessed in the “Additional Links” section of this document and used to access pertinent information if viewing digitally.

For the purpose of this document and associated documentation, a pond or dugout is defined as the following: a man-made or natural pool of water that is a closed system for holding rainbow trout, that is not connected to a natural watercourse, or from which fish cannot escape into native waters if the pond overflows. Water levels in recreational ponds will fluctuate depending on the supply of water and the outlets from these waters may become intermittent. In those cases where an outlet has established "direct flow" to another fish-bearing body of water the flow should have a fish barrier installed as per the Alberta Aquaculture Water Treatment Guidelines – please refer to the fish barriers section of this document for further details. All fish stocked into recreational facilities where fish are not held in "contained waters" must be sterile (triploid).

New fish culture sites must be approved by the regulator and an on-site inspection may be required before a license will be issued. The water body location must be reviewed to ensure it is situated entirely on privately-owned land and is isolated from other waters at all times of the year or has proper barriers in place to ensure that stocking fish will not adversely affect the receiving waters or native fish populations. A recreational licence can be issued to cover any number of waterbodies on any contiguous 640 acres of land, but each site must be identified using latitudinal and longitudinal coordinates. Each building and waterbody must be identified on the licence and only the licensed waterbodies can be stocked. Please see the Application for Recreational Fish Culture for more information.

Licences cannot be transferred if a property is sold or transferred to a family member. A new license will be required to stock fish the following year. If there are any changes in your mailing address, structural changes to the pond, stocking status, or phone number, you will need to reach out to aquaculture@gov.ab.ca to provide updated information. A Recreational Fish Culture Licence allows holders on privately owned land to keep live sterile (triploid) Category 1 species of fish as specified on the licence. All fish must be dead before being removed from the licensed premises. This licence is for the recreational, non-commercial use of the fish (live or dead) and live fish cannot be sold or transferred to another individual under the authority of this licence. Be advised that using water for the culture of fish may require a licence under the Water Act. It is the responsibility of the applicant to ensure biological, engineering, land and water use permits have been obtained.

For more information, contact Alberta Environment, Water Approvals at one of the following locations:

- Calgary (403) 297-6582
- Edmonton (780) 427-5296
- Lethbridge (403) 382-4254
- Peace River (780) 624-6167

- Red Deer (403) 340-7052
- Stony Plain (780) 963-6131

Site Selection

A typical site for trout stocking.

Any waterbody that you are considering stocking with trout on your property should be evaluated in the summer and winter before stocking would occur. This ensures that you are familiar with the waterbody and understand the ebb and flow of life within it. The following are general criteria that should be met when selecting a pond to stock. It is recommended that your pond is located outside of a floodplain and does not have connectivity to native waters due to the

potential for disease to spread from wild fish species to your stocked trout and vice versa. This also prevents your stocked fish from potentially escaping in flood events.

When initially assessing or building a dugout, no fish should be stocked into the waterbody for at least three years. This will give aquatic plants and shore vegetation time to establish. These plants will in turn attract aquatic insects, which will be food for the trout. Additionally, the aquatic vegetation will provide sun and predator protection for your fish, as well as pumping oxygen into the water. Stocking a dugout before its ready can result in fish dying very rapidly due to a lack of oxygen, predation, disease, or exposure.

It is recommended that all waterbodies that are being stocked with trout on private property have no inlet or outlet. If this is unavoidable, a fish screen needs to be placed on the inlet and/or outlet and well maintained. There will be more information about the installation and maintenance of a fish screen later in this guide. Having a standalone waterbody or screening a section of a waterbody prevents predatory fish from entering the pond as well as preventing newly stocked fingerlings from escaping the pond. Moreover, it is advised that waterbodies that contain minnows be avoided, as they will compete with your stocked fingerlings for food. They may also carry parasites and diseases which can affect your stocked fish.

All in all, stocking your chosen waterbody with trout should be well thought out and requires various considerations about the site before proceeding. The following outlines the most common recommendations to consider when selecting a site for stocking.

Oxygen

All fish require dissolved oxygen in order to respire. Trout require cooler temperatures to maintain steady growth and health levels, and cooler water can hold more oxygen. In the summer months, trout can survive for a limited time in levels as low as 3 parts per million (ppm). All levels should be above 5 ppm to make sure they are able to survive in the pond. Natural features such as aquatic plants, wind and wave action can provide oxygen to a pond. Oxygen levels can also be increased in low oxygen ponds by installing aerators. Oxygen may become limited in a pond when temperatures start to rise, as warmer water holds less oxygen, and fish may move to lower depths to find cooler waters. Deeper waters may not have as much available oxygen, however, for a number of biological and physical reasons. When ponds become too warm, they can experience ‘summerkill’, an issue that will be discussed in the troubleshooting section.

Depth

Another key aspect of a successful trout pond is the depth. As stated in the previous section, deeper ponds are able to hold more oxygen and allow healthier ecosystems to establish.

Shallow ponds are not advised for use in trout farming, as the oxygen levels may become too low to maintain a healthy, thriving population. Severe weather in both summer and winter can cause fish die offs in ponds that are too shallow. The minimum recommended depth for trout ponds is 3.66m or 12ft. However, sufficient depth does not guarantee survival over winter. Winterkills have been reported in well established, fertile ponds up to 7.5m (25 ft.) deep.

Temperature

Optimum water temperatures for rainbow trout growth are between 13-18°C. At temperatures above 21°C trout growth is reduced considerably, and the fish start to show signs of stress. Rainbow trout can survive in water with temperatures over 24°C for very short periods of time. Rapid fluctuations in temperature can often result in mortality as well. Smaller bodies of water will fluctuate much more than larger waterbodies.

An easy way to test the water temperature in your pond is as follows: attached capped bottles filled with pond water every few feet on a rope. Suspend them from a float anchored near the centre of the pond and check them daily or weekly with a regular thermometer as they come to the surface. The best time to check the temperature is at midday, since this is when daily temperatures are at their highest. Similar temperatures at the surface and at the bottom of the pond indicates that there is good circulation occurring in the pond. If there is a 3°C+ temperature difference between the surface and the bottom of the pond, the water may not be circulating correctly. This may indicate that there are pockets of oxygen-depleted water in the pond. As a rule, the temperature should remain below 22°C at one metre below the surface throughout the summer months.

Food

Allowing ponds to establish a functioning ecosystem is imperative to healthy trout survival. As mentioned previously, the most important food for trout is freshwater shrimp and insect larvae. Minnows can also supply a fair amount of a trout's diet, but they may also carry diseases and parasites that can affect your stocked trout. Trout that largely feed on minnows, such as stickleback, may have flesh that is very light in colour.

If trout are stocked into a pond that is not well established, the fish will have to be fed with manufactured trout feed. This feed is usually available from large feed supply outlets. Information should be available at these supply outlets about how much and how often to feed the fish. Fed fish get used to rising to the surface to feed, which can lead to them being easy prey for piscivorous (fish eating) birds. If you plan to hand feed the trout in your pond, you must be careful to not overfeed the fish. The uneaten food will accumulate on the bottom of the pond and begin to

decompose, taking away available oxygen from the fish. Supplemental feeding will increase the growth rate of trout slightly, but it is quite cost intensive for the amount of growth that occurs.

Aquatic Vegetation

Giving aquatic vegetation time to establish within the waterbody you are considering stocking will attract insects and other beneficial species to the pond and provide protection for the trout while they grow larger. Aquatic vegetation is also an important source of oxygen for your fish. However, excessive growth of pondweeds and algae should be avoided, as an overabundance of vegetation can cause summerkill if there's rapid die off. Excessively weedy ponds make it difficult to net out or fish for trout.

Water Quality

While most waterbodies in Alberta are sufficient for trout farming, some areas have highly alkaline water (pH more than 9.0). These waterbodies are not recommended for trout farming, as highly alkaline water can damage trout fins, stunt their growth, and cause ammonia build up in the water. If you see chalky or white rings along the shorelines of your pond, it is often indicative of alkaline water. A general indicator of a suitable waterbody for stocking is the presence of cattails and bulrushes along the shoreline. pH test strips are readily available at many large supply stores if you are unsure of your water acidity.

Trout require clear water for healthy growth and overall health. Trout are also visual hunters, and if the water is turbid (cloudy), they will be unable to hunt successfully. Newly constructed ponds and those fed by drainage water are oftentimes turbid and clouded by fine clay particles suspended in the water column. Turbidity also prevents sunlight from penetrating the water column, thus reducing photosynthesis and oxygen production in the waterbody. Stabilizing the shoreline with rocks and gravel can also prevent soil erosion along the edge, decreasing turbidity after a storm or runoff event.

It is also recommended that livestock do not have access to trout stocked ponds. Cattle will defecate at the edge of ponds or in water, depositing waste that can lead to algal blooms in warmer temperatures. Ponds should also not be located downhill from runoff on agricultural or pastoral areas, as groundwater and runoff can accumulate fertilizers (nitrates and phosphates), animal feces, herbicides, and pesticides that will end up in the pond, and eventually in the food chain, from bioaccumulation.

For more information about restoring and preserving riparian areas on farmland, please visit Cows and Fish. Their non-profit works to promote healthy landscapes by fostering riparian stewardship. They are able to provide technical assistance on riparian management and health

assessment as well as offer information to landowners and communities to make informed decisions.

Aquatic Invasive Species (AIS) and Fish Disease

Next to habitat loss, invasive species are the largest threat to biodiversity worldwide. The *Fisheries* (Alberta) *Act* makes it illegal to import, transport, sell, and possess certain species in Alberta. It is mandatory to report the presence of any prohibited AIS listed in the Fisheries (Alberta) Act if found. This allows for early detection and a rapid response. AIS can be reported by using EDDMaps Alberta (available in the App Store), emailing the Aquatic Invasive Species team at aep.ais@gov.ab.ca, or by calling the Aquatic Invasive Species Hotline at 1-855-336-BOAT (2628).

The Federal Fisheries Act has specific Aquatic Invasive Species legislation that came into effect in June 2015. This includes prohibiting the import, possession, and transport of zebra and quagga mussles, as well as four species of Asian Carp (silver, black, bighead, and grass) in Canada, with the exception of Ontario and Quebec where the mussels are already present. Additionally, it prohibits the release of all non-native aquatic species (including goldfish) into natural/public waters and enables the Minister of Environment and Parks to authorize the deposit of deleterious substances (such as pesticides) or fishing measures to control AIS.

On August 23, 2016, testing conducted in Alberta by the CFIA confirmed the presence of whirling disease in Johnson Lake in Banff National Park. Whirling disease is caused by *Myxobolus cerebralis*, a microscopic parasite that affects salmonid fish such as trout, salmon and whitefish. The parasite has a complex lifecycle that requires a salmonid fish and an aquatic-worm, *Tubifex tubifex*, as hosts. Species such as rainbow trout, cutthroat trout and whitefish are particularly susceptible to whirling disease. The severity of whirling disease depends largely on the age and size of the salmonid host. Young fish are most vulnerable, with mortality rates reaching up to 90%. The CFIA or Alberta Environment and Parks work to ensure that the disease is not persisting within Alberta hatcheries and test all facilities that are currently allowed to sell fish within Alberta annually. If you suspect that you have caught a diseased fish while fishing from public or private waters, please report it immediately to the Aquatic Invasive Species Hotline number listed above. More information about whirling disease can be found on the Alberta Environment and Parks website here.

Furthermore, if you plan to plant different types of foliage along the shoreline, please make sure to plant native species to protect Alberta's habitats. Native species attract beneficial insects to the pond and protect downstream habitats. Non-native, invasive, and noxious plants can distribute downstream into wild habitats and out compete native species. Many greenhouses around Alberta grow native species. The Grow Me Instead initiative by the Alberta Invasive

Species Council showcases several alternatives that work both near water and in your garden. If you believe you have found an invasive species on your property, please contact the Alberta Invasive Species hotline number with pictures and information about where it was found. Additionally, trout should not be stocked with koi fish or goldfish in the same pond, as fish from the pet trade can become invasive to new areas and may carry diseases that can affect trout species.

The Alberta Invasive Species Pocket Guide is available online and is a great resource for trout farmers, outdoorsmen/women, and landowners. The guide outlines invasive flora and fauna that are known to Alberta, as well as addressing several diseases, including whirling disease.

Trout Stocking Procedures and Best Practices

Fish may be purchased from commercial hatcheries within Alberta that are licensed to sell trout for pond stocking. A list of all current hatcheries can be found here. A recreational fish culture licence does not cover the import of live fish into Alberta. You will require an aquatic animal import licence to import or transport live fish or eggs into the province. Fingerlings are often ordered months before stocking time to allow the hatchery to grow them to an appropriate releasing size.

In order to grow the trout you order to table size in a five to six month growing season, it is advised that fingerlings of 10-15 cm (4-6 in) be ordered. Smaller fingerlings are less expensive, but are also less likely to reach a suitable table size before being harvested. If you are planning on stocking a large number of fingerlings into a large body of water, it is more economical to stock 6-7.5 cm fingerlings. If you are stocking your dugout for leisurely fishing over the summer months, many trout farmers prefer to order 20+ cm fish. Fish can be priced by weight or per fish.

Because of the demands of trout on the pond that they are stocked into, the number of fish that are stocked into the pond will influence the size and amount of fish produced. If you stock too many fingerlings into a waterbody, it may result in poor growth and poor survival rates. Too few fish may not utilize the pond fully.

In the first year of stocking, it is advised that low stocking rates be employed. This will help you to assess the suitability of the pond for trout farming. No more than 50 to 100 fingerlings per acre or 125-250 per hectare or, if measuring by weight, 4-5 kg per hectare of water (Ontario Ministry of Natural Resources, 2002). In the next year, if stocking is successful, higher stocking rates can be used. Because of the natural variability of fertility in ponds across Alberta, the optimal stocking rate can vary greatly from pond to pond. Dugouts should not be stocked at a rate

higher than 500-750 fish per hectare (200-300 trout per acre). For example, the standard size of a farm dugout, which is around 1/6 of an acre (0.07 hectares) or 60 by 120 ft. (18 by 36 m), should be able to support 50 to 100 fish. This ensures that the fish will not be overly stressed or competing too much in the pond. If you have very productive waters, higher rates of stocking may be possible. It is advised that you up your stocking rate slowly over the years until the correct balance is achieved.

Trout caught as a result of good stocking and best management practices.

Fish should be stocked shortly after the ice comes off the pond, as there should be enough available O_2 to support them. This will maximize your growing season. Fish ordered from hatcheries are generally delivered by trucks with distribution tanks (in the case of large order) or in bags or aqua cubes filled with O_2 saturated water. The fingerlings should be taken to the pond as soon as possible to reduce loss. Additionally, the containers should be kept out of direct sunlight and kept cool.

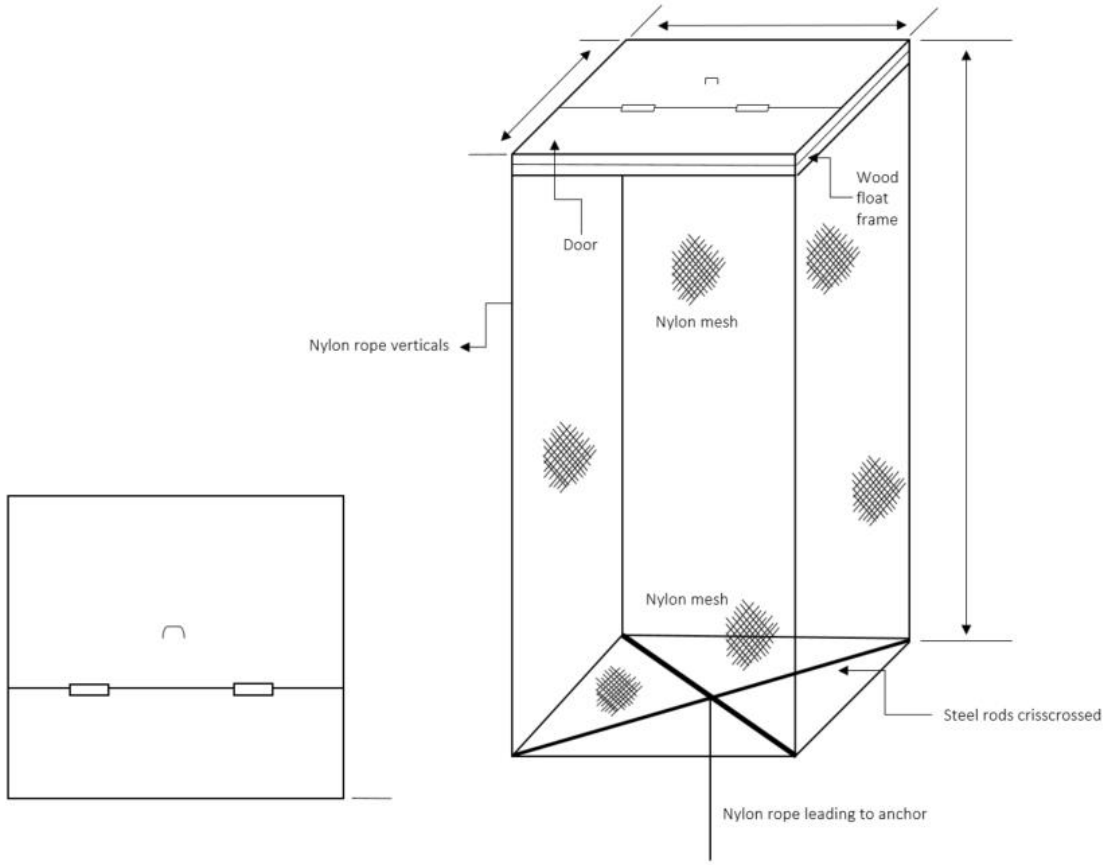
To avoid any losses to your trout order, the fish should be tempered to adjust to the difference in water temperature and water chemistry. The container that they are in should be placed in the water for at least 1.5 hours to equalize the temperatures. Pond water should also be gradually poured into the containers to allow the fish to adjust to the chemistry of the water. The larger the difference in water temperature between the container and your pond, the longer it will

take for the fish to acclimatize. Any oxygen-filled containers should not be opened until it is time to temper the fingerlings.

After tempering, the fish can be poured from their containers directly into the pond. The fish should be monitored for half an hour or so to ensure they are moving away from the shoreline and are not becoming entangled in aquatic or shore vegetation. Any weakened fingerlings in shallow water are prone to predation by dytiscid beetles (aka diving beetles) and giant water bugs. Stressed fingerlings cannot differentiate between good water and toxic water, and may sink to the bottom and perish.

While at the hatchery, fingerlings become accustomed to being fed on the surface of the water and will spend time at the top of the pond searching for food. This also makes them vulnerable to predation by birds. Scattering their distribution throughout the pond by stocking along multiple areas in open water or stocking close to dusk can help alleviate some of this. The fish will eventually adjust to life in the pond and will spend more time deeper in the water and hiding in the weeds.

Mortality relating to stress after stocking is common. As previously stated, the fingerlings in hatcheries are fed and do not know how to forage for food. They can also be in crowded tanks for long periods of time during transportation. Caging the fingerlings has been shown to be an effective tool for initial stocking to reduce overall mortality within the first few weeks. There is usually a smaller mortality rate in the cages and the fingerlings are in great condition after two weeks of confinement in the cage. Additionally, cages made with a plywood top will attract invertebrates for the trout to feed on, giving them the chance to begin to feed on the natural food supply in the pond. This also gives them the chance to grow slightly larger before being released into the pond, making it more difficult to be predated upon by water beetles.



Fingerling Trout Cage

Cages can be constructed of a wood frame and nylon mesh. These materials are non-toxic, non-corrosive, and light weight. Once ordered, the netting can be used again and again, and can be a quality investment for several years. Using plywood as a door helps with flotation and will attract aquatic insects to the underside of the lid. Attaching pool noodles to the top of the cage will also aid in flotation. Additionally, having a solid lid provides shade for the fish while they are contained. The cage must be anchored to the bottom by a weight and an appropriate length. If the cage floats freely around the pond, it can become tangled in weeds and be pulled under the water or washed up onto shore. It is critical that the depth of the nylon mesh portion is adjusted accordingly for the depth of your pond, as there may be pockets of anoxic water near the bottom that the fish should not be exposed to. For a depth of 11 ft (3.4 m), a 6ft (1.8 m) nylon mesh cage is recommended. Mesh for constructing these cages may be available from fingerling suppliers in the province. See the appendix at the end of this best practices guide for more information. The

appropriate stocking density for caged fingerlings is approximately 2 lbs of fingerlings per cubic foot of cage volume. Fingerlings stocked at this density can be held up to three weeks without any ill effects.

Troubleshooting Common Problems in Trout Farming

High Water Temperatures

As previously stated, warmer water holds less oxygen than cooler water. During the summer months, summerkills can occur in any waterbody, but because water temperatures fluctuate more closely with air temperatures in smaller bodies of water, small farm dugouts are much more affected. The most obvious sign of stress in fish is shown when they float to the surface of the pond and gasp for air. Inactivity, sluggishness, disorientation, and swimming in slow circles, or spiraling in the water can also be signs of stress in fish. A less observable habit that fish will display when stressed is diving to the deepest, coolest parts of the waterbody in hopes of finding a cooler area with more dissolved oxygen.

Summerkills do not happen all at once, and it is common to see one or two fish dead or dying before the problem is noticed. Carcasses can sink to the bottom or drift ashore and be eaten by birds, so it is possible to have a large or complete kill without noticing the impact on the pond. Failure to observe any dead fish in the pond does not mean that a summerkill has not occurred.

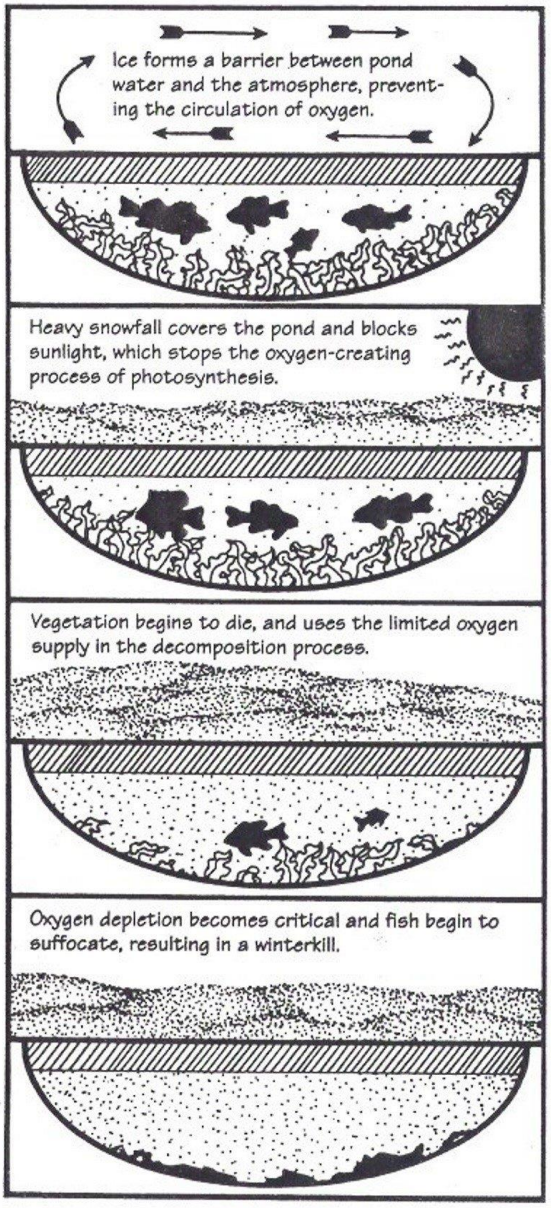
If the temperature is predicted to be warm without any wind, it is advisable that an aerator be turned on to allow the fish some reprieve. However, aerators will not completely alleviate the issue in the warmest conditions. Planting shrubs and other water tolerant trees along the banks of your pond can provide shade to the pond in the summer months. See the appendix for a list of native species that do well along shorelines. Monitoring the temperature of the water using the guide in the “Temperature” section is also recommended.

Depleted Oxygen Levels and Algal Blooms

While having aquatic vegetation at the bottom of your pond allows the fish to hide and provides oxygen, a careful balance must be maintained. During summer months, the rapid explosion of growth and then sudden collapse of algae, such as blue-green algae (*Aphanizomenon* sp.) can cause the rapid die off of fish in a pond. As these filament-like algae grow, they take up much of the nutrient supply in the water. This is the “blooming” phase. After they hit their peak, they rapidly die. This rapid die off, which usually happens in July or August,

then creates a mass of dead algae settling on the bottom of the pond. This decaying matter then begins to eat up the available oxygen resulting in a pond collapse. Rapid die-off of other algae species or of other aquatic vegetation can result in the same effect.

If blue-green algae is noted on a pond, do not allow any humans or animals to have access to the waterbody. Blue-green algae produces something called a cyanotoxin. This toxin can bioaccumulate in the liver and other organs of fish, as well as cause harm to humans and other animals. If water containing blue-green algae is consumed, it can cause headaches, fever, diarrhea, abdominal pain, nausea and vomiting. Swimming in water containing the toxin can irritate the skin and eyes. Eating fish from water contaminated by the bacteria or using products with blue-green algae has not been proven to cause these effects, as the levels of the toxin in the flesh are too low to cause illness. Correctly gutted fish are unlikely to cause health hazards in humans, however you should avoid consumption of any organs, including the skin. Organs or whole fish should not be fed to pets. Additionally, blue-green algae can kill animals within half an hour of exposure and after the toxin has been ingested. Additional details on Blue-green algae can be found here, or by contacting Alberta Health.



The biggest way to prevent algal blooms on a pond is to prevent nutrients from entering the waterbody. A primary source of excess nutrients in water bodies are cattle and livestock manure. Cattle and other livestock should have limited access to the pond. Additionally, fertilizers on cropland or lawns that are near the pond should be limited, as this can contribute to nutrient loading in the pond. By having a large (~100 ft) fringe of vegetation cover around the pond, you can create a nutrient filter that will uptake most of the available nutrients from runoff and fertilizers.

Algaecides can provide a short-term solution to the problem if all else fails. Copper sulphate (bluestone) is recommended. It is available at most hardware stores or farm suppliers. Copper sulphate is the most effective if a pond is treated early in the season, before the algae can hit the “bloom” phase. The waterbody can be treated according to the directions on the container. Caution is advised, however. Concentrations should not be exceeded, as copper sulphate is toxic to trout and their food organisms at higher concentrations. More is not better and will not work any faster. If the algae has begun to clump together and form mats on the surface, it is too late for a general overall treatment of the pond. This is what is known as the “bloom” phase. Spot treatments on a quarter of the pond at a time over three to four days may gradually lower the algae density and prevent a summer kill. Trying to treat the algae with copper sulphate while it is in bloom may cause a summerkill by depleting the oxygen in the water rapidly. Algaecides cannot be used in waterbodies where there is an outlet to a stream or native body of water without a permit from Alberta Environment and Parks, as it can have unintended effects downstream. For more information on receiving a permit, please contact the Provincial Pesticides Approvals and Registrations Specialist, Tanya.Rushcall@gov.ab.ca.

Generally, it is recommended that algaecides be avoided after a bloom has occurred. Aerating the water vigorously by installing a bubbler or irrigation pump can help to add oxygen to the water. Waterfall features also help to aerate the water while cooling it, which may help to break up some of the algae.

During daylight hours, plants will continue the process of photosynthesis, producing oxygen in the pond. However, at night this process stops while all life in the pond continues to respire. If there is no wind during the night, the rate of oxygen loss may exceed the uptake. This means that the oxygen level will reach its lowest point just before dawn. Oftentimes, this type of summerkill happens in dugouts that have experienced a period of hot, calm weather. This will likely affect all fish, and they will be seen at the surface gasping for air. Running the aerator at night during hot, sunny periods will help to cool the water and drive oxygen into the pond, preventing this. If you see fish washing ashore that have their gills flared, this is indicative of suffocation by a lack of dissolved oxygen.

Winterkill and Springkill

Winterkill refers to a die-off of a large number of fish in a waterbody. It can occur both in natural systems as well as in stocked ponds. When ice and snow cover a body of water, sunlight can no longer penetrate deep enough to allow aquatic plants to continue photosynthesis. The oxygen provided to the pond by the plants is no longer produced when this happens. Fish and other organisms will continue to respire in the water, and dead plants and organisms will continue to decay. Both of these processes will continue to lower the oxygen level in the water, until there is no longer enough for the fish, and they die.

Winterkill can be prevented by maintaining aeration in the pond throughout the winter. This may be done by using mechanical aeration systems, as discussed previously. If aeration is maintained on a waterbody throughout the winter, the ice may not be thick enough to support a person, especially near the aeration. If you want to test for potential winterkill during the winter, it is best to avoid this area.

Winterkill also depends largely on the fertility of the pond and the amount of organic material that may sit rotting at the bottom of the pond through the winter. Because of this, some newly excavated dugouts as shallow as 4-5m do not experience a winterkill. If you are interested in raising fish for angling, waterbodies that winterkill should be avoided. Deep, infertile gravel pits are better suited for this avenue.

To test whether or not your pond has experienced a winterkill, you can drill a hole in the ice in late winter. Late February through mid-March is the best time to do so, as the oxygen will be at its lowest level. If you smell something similar to rotten eggs, that means that hydrogen sulphide has built up and has likely killed most of –if not all- of the fish. This is not foolproof, however. The lack of a rotten egg smell does not necessarily mean that all of the fish made it over the winter.

The desirability of winterkill is dependent on how a landowner intends to use a pond. Winterkill may be desirable by farmers who wish to stock in the spring, as the death of the larger fish ensures that they cannot eat the newly stocked fish. It can also allow for the natural food chain to replenish, to ensure that there is food in the pond for newly stocked fish. Freshwater shrimp, (*Gammarus lacustris*), is an important food for stocked trout. They can survive over the winter and develop robust populations if predation from trout is removed. Fish culturists raising fish for angling may prefer that their fish overwinter to allow them to grow to a larger size. In this case, aeration and depth are important considerations.

Maintaining oxygen levels in ponds throughout the winter will also prevent “springkill”. Springkill can occur when the ice comes off the pond and the water mixes for the first time. This will stir up toxic oxygen depleted water throughout the waterbody. The amount of water in this toxic layer may be large enough to “poison” the entire pond in the beginning of spring.

Predation Control

Many different species of birds prey on fish in waterbodies across Alberta. Piscivorous birds such as gulls, loons, terns, mergansers, cormorants, kingfishers, herons, pelicans, and bitterns are present during the summer months in the province. These birds, and animals like mink and otters, will make a quick meal of newly stocked fish if given the chance. Stocking the fish into cages gives them time to adjust to predation pressure. While these birds can cause a fair

amount of damage to a trout pond, a federal statute called the Migratory Bird Convention Act prohibits the killing of all migratory birds. Mink predation control is also limited as, minks can only be killed under certain quotas and with a Trapper's License.

Because of these different laws and regulations, other non-lethal means of control must be considered to discourage the predators. Generally, pond owners tend to use tactics to either frighten the animals away or exclude them from a pond. When trying to control predatory birds, it is best to take action early in the spring so that they do not set up nests near the pond and do not realize they can utilize the pond as a food source.

One of the easiest methods to protect your fish is to use pond dye. Blue dye darkens the water so that birds flying overhead cannot see any of the fish in the pond. This will slow predation from diving birds, but may not be effective for fish swimming along the edge of the waterbody, as the dye will be less effective around the rim of the pond. Blue dye can also help to keep the pond cooler and prevent algae from growing. Blue dyes prevent algae from growing in the pond by blocking the amount of sunlight that is able to penetrate the surface of the water. This can cause problems if you have beneficial plants in your pond. Too little sunlight penetrating the surface will stop photosynthesis and collapse the food web your fish rely on. It is imperative that dosing directions are followed very closely.

Birds can sometimes be frightened away from waterbodies with the use of a scare cannon. These emit a loud boom at certain intervals that can be randomized so that birds do not get used to the noise. These cannons are often a pricey investment and are not suitable for pond owners who have close neighbors or livestock that may be easily frightened by the noise. Sometimes scarecrows, streamers, and reflectors are used to deter birds from landing on a pond or taking up residence near a pond. Reflectors that are suspended from a rope stretched across a pond are sometimes effective, but make it difficult to fish on a pond or launch a boat. If you are considering using reflectors, aluminum pie plates and tin can lids are a low cost option.

Some birds will get used to these scare tactics and may need to be physically excluded from the pond to achieve effective control. Great blue herons are the most common predator of trout in stocked ponds. The easiest way to deter them is to have steep drop-offs at most of the edges around the pond. Because these steep drop-offs prevent them from standing on the bank to hunt, they will be unable to feed successfully and will likely leave the area in search of better success. It is recommended that there is a 35cm difference between the top of the bank and the water surface. If you are unable to make the bank any steeper for fear of ruining your own fishing opportunities, perimeter fencing can be an effective control for herons. Strands of twine attached to post at a height of 20 and 35 cm prevents wading birds from entering the water to feed. This non-invasive deterrent can be very effective if installed in the spring.

Another option for deterring wading and diving birds is installing overhead lines across the pond. Spaced about 30 cm apart and about 20-30 cm above the water level and extending across the pond entirely, these can be an effective deterrent for gulls, terns, herons, pelicans, cormorants, loons, and grebes. It is recommended that twine be used as a visual deterrent as well. Using monofilament fishing line or similar wire can be invisible from the air and tangle the birds up if they do attempt to land on the pond. The Migratory Bird Convention Act prohibits the incidental take (killing or harming) of migratory birds, their nests, and their eggs, so it is best to use something that they will be able to see from the air. Attaching reflectors to these lines is also advised. The biggest downfall to the overhead lines is the inability to fish with a rod or in a boat while the lines are up.

Poor Flavour

During the summer months, as bacteria begin to decompose organic matter at the bottom of a pond, some trout can develop a muddy, unpleasant taste due to a chemical compound called geosmin. Trout are not the only species to develop this flavour, but it can become a problem for those who are trying to harvest their fish during summer months. As fish move through a body of water and respire, they also take up geosmin, which deposits in their muscle and skin. Waterbodies that have heavy particulate matter suspended in the water, including clays or loam, tend to produce fish that have a muddy flavour more often. These sediment types act like a sponge and absorb geosmin, which is then pulled into the trout's body as it breathes. Taking care to not stir up any of the sediment in the bottom of your pond or allowing overland, turbid flow to enter your pond is the best way to prevent poor flavour in your trout.

Pond owners and anglers report that you can often smell that a fish will be muddy tasting while you are cleaning it. It is recommended that a taste test of trout from your pond is conducted on one or two fish before performing a large harvest. Delaying harvest into the fall will help to alleviate this problem, as the poor, muddy flavour tends to dissipate as water temperatures cool.

Oxygen Depletion Over Winter

As the pond is covered with a layer of ice and snow, photosynthesis begins to stop and wind will no longer aerate the pond. Because decomposition will still be occurring, it is imperative to add oxygen into the water to allow the fish a better chance to survive overwinter. Aerators are the easiest solution to this problem.

The most common method of aerating a pond is using the diffused air or bubbler system. A compressor forces air through a perforated plastic pipe near the bottom of the pond and oxygen is transferred as rising bubbles. The best diffusion rates come from smaller bubble size. This method is very efficient, but the holes may occasionally clog if the pipe system is not used for

long periods. One solution is to suspend the line about 30 cm above the bottom of the pond so that there is less detritus build up when it is not running. Any compressor used for this purpose should be the oil-less variety, as an oil coating can form on the bubbles and cause problems with diffusing oxygen into the pond as well as affecting the fish by coating their gills with oil. Be sure to install an air check valve to prevent water from freezing in the line during the winter.

Spray aerators work by propelling water upwards or outwards through slots in a tube. Water forms a fine spray which absorbs oxygen before returning to the pond. Some of these units can be mounted to floats, which are easily moved when not in use. The downside of this type of aerator is that they do not raise oxygen levels quickly on large bodies of water. They are very suitable for regular aeration on smaller dugouts. This type of aerator is the most efficient in terms of oxygen transferred for energy consumed. The ideal size of dugout for this type of aerator is 0.2 hectares in size and is suitable for both winter and summer use.

If electrical power is being used to power an aerator, a ground fault interrupt (GFI) breaker should always be used in case there is an electrical leak from the line. A breaker will trip and shut down the line if there are any problems, and it will protect you and your fish from electrocution. Always disconnect the power from an aerator before doing any work on the water.

Windmill aerators have paddles, which stir the water surface to mix oxygen into the water and circulate the surface of the pond. Constant, predictable wind is required for their operations, although some do come with generators to allow their use with no wind. These are difficult to use in the winter, as ice can form on the paddles when the weather is calm. This adds weight to the paddles and will stop them from spinning reliably.

Sustained aeration throughout the winter is not required to overwinter fish. Aeration for six to eight hours twice per week is usually sufficient in dugouts. Larger ponds, however, will require more aeration. Monitoring the oxygen levels in your pond during the winter will help to determine the frequency and length of aeration to overwinter your fish. Electronic testing equipment is available, but chemical methods are less expensive and generally adequate for most use.

Harvesting

The growth rate of trout in Alberta ponds and dugouts is highly variable. Rates depend on a number of factors, including what size the trout were when initially stocked, stocking rates, length of the growing season, variability between strains, and pond fertility. Growth rates in dugouts are considerably slower than in large water bodies.

Fish from recreational licences cannot be sold, bartered or traded. If you are interested in a commercial aquaculture licence, see the appendix of this document.

Fish Barriers

The use of a fish barrier is required on the inflow and outflow of private ponds that have waters flowing through them. Barriers can prevent the introduction of native species to a pond, minimize the potential for the introduction of disease or competitive species to the pond, prevent the escapement of your stocked fish into native waters, and impact our endangered/threatened native fish species.

Fish barriers are required to be inspected at least every 5 years by Government of Alberta staff. Any barriers that are blown out by flood events should be fixed immediately if fish are in the pond. If fish are not present, the barrier should be repaired before fish are stocked into the pond.

The Department of Fisheries and Oceans (DFO) has a reference on fish barriers that can be found here. For those reading a printed copy, a link can be found in the resource section at the end of this booklet. It is required that any screen material that is used on a fish barrier is corrosion resistant and sufficiently durable to maintain a smooth uniform surface with long-term use (i.e. expanded metal, perforated aluminum or stainless steel). Material such as chicken wire and plastic mesh are not suitable, as they are difficult to clean, easily damaged and unable to withstand winter conditions.

If native waters are flowing through your pond, there is potential that minnows, such as stickleback, dace, and shiners will be present. Having minnows in your pond presents other issues, as previously discussed. Mesh that limits the movement of fry-sized fish should be used to prevent these fish from entering or escaping your pond.

It is recommended when pumping water from one waterbody to another that the DFO's "Freshwater Intake End-of-Pipe Fish Screen Guidelines, 1995" be used. A link to this reference is available at the end of this document. The primary objective of DFO's document is to provide detailed information about how to construct a fish barrier. A summary of the information is as follows:

- The screen material shall be corrosion and UV light resistant and sufficiently durable to withstand heavy flow into or out of the waterbody
- If biological justification cannot be provided to demonstrate the absence of fry sized fish in the vicinity of a fish culture facility screen, fry will be assumed to be present and the following criteria apply for screen material:
    - Perforated Plate – screen openings shall not exceed 2.38 mm.
    - Profile bar screen – screen opening shall not exceed 1.75 mm.
    - Woven wire screen openings shall not exceed 2.38 mm in the narrow direction (example: 6-14 mesh)
    - Screen material shall provide a minimum of 27% open area (National Marine Fisheries Service, 1996).
- If biological justification can be provided to demonstrate the absence of fry sized fish in the vicinity of the screen the following criteria apply for screen material:

    - Perforated plate opening shall not exceed 10 mm (Alberta Agriculture, 1999).
    - Profile bar screen shall not exceed 10 mm in the narrow direction.
    - Woven wire screen opening shall not exceed 10 mm in the narrow direction.
    - Screen material shall provide a minimum of 40% open area.
- Large mesh screens should use 16 gauge thickness screening or greater; small mesh screens should use 20 gauge thickness screening or greater (New Brunswick Department of Natural Resources, 2016).
- The total submerged screen area (square metres) required is calculated by dividing the maximum flow (litres per second/1000) by the allowable approach velocity (metres per second).
    - Approach velocity is defined as the water velocity component perpendicular to and approximately three inches in front of the screen.
    - The approach velocity for fry (< 6.0 cm) shall not exceed 0.12 metres per second.
    - The approach velocity for fingerlings (>6.0 cm) shall not exceed 0.24 metres per second (National Marine Fisheries Service, 1996).
- Screens must attach or fit snugly so that spaces larger than the clear opening in the mesh do not occur.
- If required structural features shall be provided to protect the integrity of the fish screens from erosion and/or large debris (i.e. trash rack, shoring base and sides of screens with rock or concrete).

Recommended Screen Openings for Trout

Fish Length		Fish Weight		Required Screen Spacing	
mm	inches	grams	ounces	mm	inches
51	2	1.5	.05	5	3/16
76	3	5	.17	10	3/8
127	5	28	1	13	1/2
203	8	114	4	19	3/4
305	12	284	10	25	1
381	15	681	24	35	1 3/8

Trout larger than the above sizes will be confined using screen with the corresponding spacing. When using expanded metal mesh, check the widest opening (inside measurement) prior to purchase. Expanded metal mesh is diamond-shaped, and openings may be larger than

advertised. Use of this chart for fish species other than trout is not appropriate, since many fish are shaped differently.

As previously stated, the Federal Fisheries Act prohibits the release of all non-native aquatic species (including goldfish and koi fish) into natural/public waters. It is imperative that your waterbody is properly screened at all times to prevent the escapement of stocked fish into native waters.

Types of Barriers for Passive Inflow/Outflow[1]

- **Culvert-type barrier:**
  - Simple and inexpensive to build.
  - Consider using a minimum 30 cm (12 inch) pipe or culvert made of steel or polyethylene.
  - Cut the screen 20 cm (8 inches) larger than the pipe diameter.
  - Remove a V-wedge from the screen perimeter every 4 inches. This will allow the screen to bend back and meld over the culvert/pipe.
  - Secure the screen to the pipe with a metal clamp or coupling band. Galvanized bolts should be used to stop corrosion.
  - Screens should be placed on the upstream and downstream end of the pipes.
  - Consider using a larger trash screen around your culvert to prevent larger debris from clogging or damaging the culvert screen.

Culvert Type Screens

- **Farm ditch screen:**
    - Can be used for water flows of less than 3,400 litres per minute.
    - Screen needs to be securely fastened and of sufficient height and width to contain all waters.
    - Similar to flat plate diagonal screen.


Farm Ditch Screens: Grates mounted on steel posts welded to 10' screw piles. Screens should be embedded in the ground or by rocks along the bottom and wired to the posts with no openings along the bottom and/or sides.

- **Rock screen/gabion filter:**

    - Effective for very slow water movement (less than 1,700 litres per minute).
    - Use varying sized rock from 100 to 200 mm in diameter.
    - Encase all rock in wire mesh or chain link.
    - Gabion should be at least 2 meters wide, 3 meters long and above the high water mark.
    - Water cannot be allowed to flow over or around the gabion.

Rock Screen

Appendix

Additional Links

An Identification Guide to Alberta Aquatic Plants: https://open.alberta.ca/publications/2007633

Aquatic Plants of Alberta: https://d3n8a8pro7vhmx.cloudfront.net/lswc/pages/21/attachments/original/1487109804/ALMS-Aquatic-Plant-Book-1st-Edition-Nov-2016.pdf?1487109804

Fish Culture License Information: https://www.alberta.ca/fish-culture-licence.aspx

Quality Farm Dugouts: https://open.alberta.ca/publications/9781460123508

Alberta Aquaculture Water Treatment Guidelines: https://www.alberta.ca/water-quality-guidelines.aspx

Water Act Forms: https://www.alberta.ca/water-act-forms.aspx

Cows and Fish: http://cowsandfish.org/

EDDMaps Alberta: https://www.eddmaps.org/alberta/

Fisheries (Alberta) Act: http://www.qp.alberta.ca/documents/Acts/F16.pdf

Whirling Disease Information: https://www.alberta.ca/whirling-disease.aspx

Alberta Invasive Species Pocket Guide: https://open.alberta.ca/publications/9781460140758

Trapper's License Information: http://albertaregulations.ca/trappingregs/licensing.html

DFO's Fish Barrier Resource: https://www.dfo-mpo.gc.ca/pnw-ppe/codes/screen-ecran-eng.html

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New Brunswick Rainbow Trout Aquaculture Policy. New Brunswick Department of Natural Resources, 2016.

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