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Chapter 4

Transportation and Handling of Walleye Eggs, Fry, Fingerlings, and Broodstock

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Introduction

walleye have been propagated in North America since the late 1800s. Egg, fry and pond fingerling production programs arc widespread and well documented. Recent advances in culture techniques have enabled intensive production of large or advanced fingerlings. Culturists have shipped millions of walleye within and between many states in the continental United States. The New York State Department of Environmental Conservation (NYSDEC) Oneida Fish Cultural Station has shipped walleye eggs and fry to at least 17 states. This chapter describes practices used at the Oneida Fish Cultural Station in the handling and transportation of walleye broodstock, eggs, fry and fingerlings.

Capture and transporting broodstock

At the New York State Department of Environmental Conservation Oneida Fish Cultural Station, up to 40,000 adult walleyes arc handled and transported during spring netting operations. Adults arc captured with trap nets on a daily basis. After capture, they are placed in tubs, 48 x 32 x 18 in (122 x 81 x 46 cm), with about 40 gal (150 L) of water. As many as 150 adult walleyes that average 1–3 lbs (0.4–1.4 kg) arc held in a tub. They are transported by boat up to 1 mile (1.6 km) to the hatchery, where the sexes arc hand-sorted into separate holdmg tanks. The elapsed time from removal of walleye from nets to placement into hatchery holding tanks is generally around 30 min. Once sorted, the fish are routinely crowded, 500 fish/150 ft^3 (4.2 m^3), in tanks for up to 3 d or longer if water temperatures are low, –40°F (4.4°C). The seemingly "rough" handling for transportation and sorting is tolerated by adult fish with little mortality. The normal water temperature during the procedure is between 40 and 50°F (4.4 and 10.0°C). The stripping of adult walleye does not noticeably stress the fish. Walleyes arc handled using cotton gloves. The fish arc out of water less than one minute while being stripped before being returned to the stream. Normally, the post-release mortality associated with the entire netting and stripping operation is less than 20 fish.

Egg fertilization and water hardening

walleye eggs can be fertilized by either a wet or a dry method (Piper et al. 1982). Both produce acceptable results and preference of the culturist will probably determine the method used. Often, however, the dry method of fertilization is impractical in large field operations.

Following fertilization, eggs must be continuously stirred because of egg adhesiveness. Stirring can be accomplished with paint brushes (sized according to the volume being stirred), turkey feathers or other similar implements. To prevent having to stir eggs to the end of water hardening, most culturists treat the eggs to remove or coat the adhesive substance on the egg shell. The two most common agents are tannic acid and fullers earth, although other agents are effective (Colesante and Youmans 1983; Baker 1985; Krise et al. 1986). These agents arc generally applied to a mass of fertilized eggs at varying concentrations, stirred for a brief time, and then poured off. After rinsing, eggs are allowed to water harden with minimal care. If not treated, egg stirring must be done throughout the water hardening process, but this can contribute to egg mortality.

Egg treatments with tannic acid can affect the color of eggs. Walleye eggs are yellowish in color and become darker as they age. When treated with tannic acid, the eggs turn from yellow to a dark brown or black (usually within three days). Although this color change may alarm many fish culturists, the treatment does not seem to reduce viability of the eggs.

Egg incubation

Following water hardening (I–2 h depending on water temperature), eggs are generally placed in Downing style jars for incubation (Piper et al. 1982). Three qts (2.8 L) of water-hardened eggs are placed in each jar for optimum loading density. Water flow through the jar is initially set at 1.5 gpm (5.7 Lpm), but it is reduced after one day to 1.0 gpm (3.8 Lpm), and then increased again at hatching to 1.5 gpm (5.7 Lpm).

In large-scale operations using surface water supplies, eggs must be treated to control fungus and prevent egg mortality. A common treatment is a 1,667 ppm formalin concentration in a 15-minute flow through treatment every other day. Because formalin is not approved by the Food & Drug Administration (FDA) for treatment of walleye eggs, an Investigative New Animal Drug permit (INAD) is required. In the spring of 1994, hydrogen peroxide was tested on walleye eggs at concentrations of 250, 350, and 500 ppm active ingredient for 15 min every other day. Egg survival was similar to that achieved with formalin, however, hydrogen peroxide did not control egg clumping and clumps of dead eggs floated out of the jar and plugged the outlet during and shortly after treatment. Hydrogen peroxide is a chemical in the low regulatory priority class with the FDA, and an INAD is not required for its use.

During egg incubation, dead eggs become less dense than live eggs and move to the top of the egg mass in the jar. Dead eggs are periodically removed from jars using a small siphon. This process invariably results in the collection of live eggs as well. At the Oneida Fish Culture Station, we place the eggs siphoned from the hatching jars into a "hospital" jar where a second effort is made to separate live from dead eggs. Any eggs siphoned from a hospital jar are discarded. By the time eggs are eyed, the jars contain mostly live eggs. Routine, regular cleaning (removal of dead eggs) of jars minimizes egg clumping and fungal problems and facilitates movement of hatched fry out of the jars.

Shipping eggs

Million of eggs have been successfully shipped from the Oneida Fish Cultural Station over the years. We have used the "dry method' for the last 20 years to ship eggs. Eggs are transported in shipping boxes with perforated Styrofoam trays, cheese cloth and ice. Eggs can be successfully shipped any time after day 5, or about 90°F TU's (50°C TU's) of incubation. It is not necessary to wait until the eyed egg stage to ship walleye eggs. Prior to shipment, dead eggs are removed, water is decanted from the jar, and the eggs are poured into a tub. Styrofoam trays are covered with cheese cloth and they are floated in a tank. We add three quarts (2.8 L) of eggs to each Styrofoam tray, then wrap the wetted loose ends of the cheese cloth over the eggs. The trays of eggs are then placed in the shipping box previously lined with a plastic garbage bag so moisture doesn't damage the cardboard. Each box, 17 x 17 x 21.5 in (length x width x height) (43.2 x 43.2 x 54.6 cm), will receive 5 Styrofoam trays or a total of 15 qts (14 L) of walleye eggs. The top tray in the box has no eggs and is loaded with ice to help maintain temperatures. The bottom tray in the box is not perforated, receives no eggs and collects moisture from the trays above. The box is sealed with tape, and the eggs can be shipped. Shipment is normally by vehicle and/or air; eggs have survived 18 h trips with no apparent ill effects.

Other methods of shipment are possible. These include placing eggs in plastic bags with water and oxygen and transporting them in a cooler. However, it is best not to ship eggs that might hatch during shipment, because eggs hatching in route could create water quality problems within the bag.

Walleye fry

In most applications, walleye fry hatch and are carried (swim) out of an incubation jar into a holding tank. The fry are about 0.3 in (7.9 mm). They do not have an inflated swim bladder. Significant morphological and physiological changes occur as walleye are nourished through the yolk sac. The initiation of exogenous feeding occurs between 180 and 216°F TU's (100 and 120°C TU's) (Krise and Meade 1986). Fry in holding tanks are normally held at high densities. Because cannibalism can occur in first-feeding fry, one objective of fry stoclung programs should be to stock fry prior to first feedmg. The time window for transfer at the

Oneida Fish Cultural Station is normally 3–5 d after hatch. When stoclung, fry should be harvested from holding tanks and stocked daily whenever possible.

Enumerating fry

The most common method of enumerating walleye fry involves volumetric displacement (Piper et al. 1982). Fry capture from the holdmg tank is facilitated by first concentrating fry to specific areas of the holding tank. Because newly hatched fry are positively phototactic, they will concentrate where the light intensity is the greatest. As walleye age during yolk sac absorption, their displacement value changes (Colesante 1989). Accurate enumeration requires frequent sampling. Other methods of enumerating fry exist. For instance, an electronic counter is commonly used in research type applications (Kindschi and Barrows 1991) where accuracy is critical.

Transporting fry

Transportation of fry is accomplished by placing fry directly in a transportation tank or by placing fry in plastic shipping bags with water and pure oxygen. Transportation tanks are usually insulated fiberglass or wood tanks with covers, and aerators, agitators and/or bottled oxygen. The size of tanks vary, but generally are around 300 gal (1150 L); a single transport truck might carry 6 or more tanks (Carmichael and Tomasso 1988). Transportation of walleye fry requires that pure bottled oxygen be delivered to the water in the transportation tank. Agitators and aerators create excessive turbulence in the tank and can injure the delicate fry. Pure oxygen is usually delivered by air diffusers or rubber hose with fine holes in it. In New York, fry are loaded into tanks at a rate of one million fry per 50 gal (189 L) of water (5,291/L). Six hours of transportation time under these conditions has no adverse effect on fry. Fry are removed by draining or siphoning them from the tank to minimize handling. If fry are stocked from a boat, siphoning, draining or bailing out of the boat tank is desirable and minimizes the use of nets.

When stocking small numbers of fry, such as those destined for earthen culture ponds, plastic bags can be used. The use of plastic bag in shipping large numbers of fry at high density has been linked to mortality. (Colesante and Schiavone, 1980). Fry tend to settle in comers and in the bottom of the bag. Mortality can result even with adequate dissolved oxygen in the water.

NYSDEC guidelines for transporting and stocking fry:

Large stockings of more than 1 million fry:

Fry should be placed directly in truck compartments at a rate of 1 million per 50 gal (189 L) of water. Oxygen should be bubbled into the Compartment. The loadmg rate can be prorated for different capacity transportation tanks.

A. Fry should be siphoned into a live car on a boat, tempered as needed, and boat stocked in open water areas. Fry should be drained or siphoned from the live car into the lake.

B. If it is not possible to do (A), fry should be tempered on the transportation truck by adding water and siphoned directly into the lake. Consideration should be given to stocking in stream currents (inlets) in hopes of carrying fry to pelagic areas.

Stocking for less than 1 million fry within 3 h of the Oneida Fish Cultural Station.

A. Transportation should be as in 1A or 1B, if practical.

B. If not practical, fry can be transported by placing lots of 100,000 fry in a standard hatchery bag, 18 x 36 in (46 x 91 cm), with 2.6 gal (10L) of water and 1.3 gal (5 L) of oxygen. Bags should float freely in a hatchery tank compartment with at least 6 in (15.2 cm) of water. The truck should not stop for periods of longer than 15 min. Water in bags should be tempered by floating them in the receiving water only if absolutely necessary. It is preferable to release fry immediately into receiving water. Fry are released from the bag by opening it or cutting it with a knife and dumping the fry and water.

Stocking less than 1 million fry in excess of 3 h from the Oneida Fish Cultural Station.

A. Transport as in 1A or 1B if possible.

B. Otherwise, transport as in 2B, except 50,000 fry will be placed in each bag.

It is possible to transport fry freely in a truck compartment (as in 1) and float bags in the same compartment (as in 2B or 3B).

Small fingerlings

Handling and Transportation

Intensive culture of small (≥1in, ≥2.5cm) fingerlings is relatively new. At the Oneida Fish Cultural Station, brine shrimp-fed walleye with newly inflated swim bladders [day 8 of life) have been harvested from rectangular units, transported by truck and stocked. Fish were harvested by siphoning them into tubs; tubs with water and fish were poured into transport tanks with an oxygen life support system. Transportation was for 2 h, and fish were not stressed at the time of stocking.

Thirty day-old brine shrimp-fed walleyes (about 1 in, 2.5 cm, long), when raised at the Oneida Fish Cultural Station, are exceptionally sensitive to handling. When 30-day-old walleye come in contact with a net, many immediately go into shock and die. Generally by day 40, this sensitive period is over and normal handling of walleyes is possible.

Handling and transporting 1.2–2.0 in (3.2–5.1 cm) walleyes harvested from earthen ponds create a different set of problems. Many variables in a pond program can affect handling and transportation success, and fingerling survival. Among the variables are: inability to control water temperatures; the need to seine the fingerlings in many cases; contact of fingerlings with macrophytes, algae, crayfish, and aquatic insects in a concentrated situation as the pond drains; variation in condition factor of fingerlings due to problems associated with maintenance of food supply; deterioration of water quality as the pond drains. Culturists should concentrate on minimizing the effects of these variables on harvested walleyes. For example, ponds should be harvested on cool days and in the morning when possible. Algae and macrophytes, especially in the area of the kettle or catch basin, should be removed. Ponds should be harvested prior, during or immedately after zooplankton disappears to minimize deterioration of condition factor. Fish captured in the bag of a seine or corralled in a net should be removed in water with a bucket or with a hand net to minimize the contact of fish with the seine.

New York State Department of Environmental Conservation (Bureau of Fisheries) employs the following standard procedure for pond harvesting: remove fish from pond to truck with the least contact with nets as possible; drain fingerlings from truck to holding tank and hold overnight; gradually cool water to 65°F (18°C); remove tadpoles, crayfish and other undesirable organisms; next morning, remove dead fish and sample fish in holding tank; load transportation truck by displacement or weight and use aerators or oxygen for life support (depending upon fish size); temper water in tank at the stoclung site if the difference is 10°F(5.6°C) or more; drain or siphon fingerlings (if possible) to minimize netting at the stoclung site.

Effects of water temperature on transportation and handling

Some researchers have recommended 71.6°F (22°C) for the intensive culture of walleye fingerlings (Huh et al. 1976). However, fish culturists generally attempt to maintain rearing water temperatures at 68°F (20°C) or less, In doing this, culturists accept slightly slower fish growth to obtain greater survival, in part because bacterial levels (and potential Qseases) increase as water temperatures exceed 68°F (20°C) (Austin and Austin 1987).

The primary bacterium of concern in walleye culture is ***Flexibacter*** *columnaris* (Nickum 1978), a ubiquitous pathogen that can cause mass mortality of walleye in hatchery environments. The transmission of *columnaris* has been linked to routine mechanical injury (as from handling) in fingerling walleye (Hussain and Summerfelt 1991). This bacterium flourishes at water temperatures above 68°F (20°C) (Bullock 1986). Therefore, handling and transportation of walleye should occur below this temperature. When walleye must be handled at higher temperatures, such as during the harvest of pond fingerlings, extreme care must be exercised.

Advanced fingerlings

walleye raised intensively and fed formulated diets become tolerant to handling and transportation stress. Other than common sense, such as not handling sick fish and not handling them when water temperatures are excessive, these fish can be sampled weekly, inventoried, netted, and transported using the same methods used to handle salmonids.

Loading rates in transport tanks for pond-raised or intensively-raised walleye fingerlings are similar to trout (Piper et al. 1982). Three-quarters of a pound (340 g) of 5 in (12.7 cm) walleye fingerlings/gal (3.785 L) of transport water are commonly used in New York.

Usually, with larger fingerlings, mechanical aerators or agitators are used to generate acceptable life support conditions in insulated transport tanks. There should be no starvation period prior to shipping as this could promote nipping and cannibalism.

The use of chemicals in transport water has been examined (Piper et al. 1982; Leitritz and Lewis 1980; McCraren and Millard 1978). Salt is commonly used to alleviate stress during transport. With walleyes, however, care should be exercised. Significant losses of pond-raised fingerlings have occurred when they were shipped in moderately hard water with salt to a soft-water hatchery. Immediately upon siphoning from truck to hatchery water, the fish went into shock and died. Other shipments from that hatchery without salt in the transport water produced no mortality.

This chapter has highlighted methods associated with handling and transporting walleye. Even though walleye can be very sensitive to this type of stress, they can be successfully handled and transported in culture operations.

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Distribution of Walleye Fry and Fingerlings

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Introduction

Walleye fingerlings have been stocked by the Minnesota Department of Natural Resources (DNR) Fisheries Section since the 1930s. Prior to that, walleye stocking was accomplished exclusively with fry.

Fry stocking

Where suitable, fry stockmg is the most cost effective stocking method for maintaining lake populations. Each year, the DNR stocks about 250 lakes totaling over 300,000 acres (121,500 ha) with up to 250 million fry. Statewide, distribution costs (transportation and labor for stocking) average about $0.10/1,000 fry, for an annual cost of about $40,000.

Fry are distributed to stocking sites in 5-gal (18.9 L) plastic jugs (Figure 1) with oxygen (100,000 fry/jug); large plastic bags with oxygen (100,000 fry/bag); or 140-gal (530 L) fish distribution tanks with oxygen (>1 million fry/tank). Most fry are 12–48 h old when packaged for distribution. The 5-gal (18.9 L) plastic jugs have been used for at least 15 years and are the most popular container. The jugs are filled with 2.5–3 gal (9.5–11.4 L) of water and up to 100,000 fry (1 lb, 0.45 kg). The cap of each jug is fitted with an air valve so they can be filled with oxygen. Fry have been transported for up to 8 h using these containers. The jugs have rigid corners so fry are not crushed, and the jugs are much easier to load and handle than plastic bags.

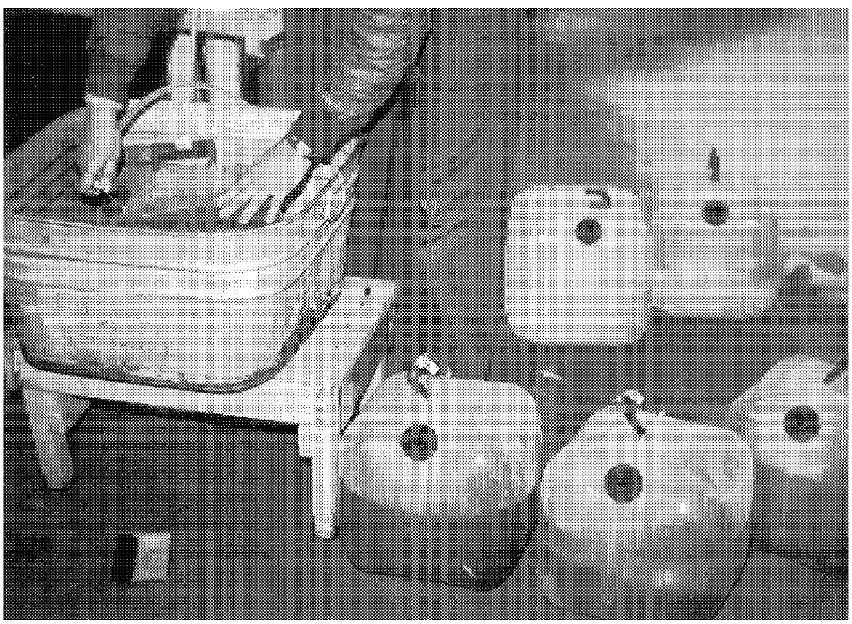


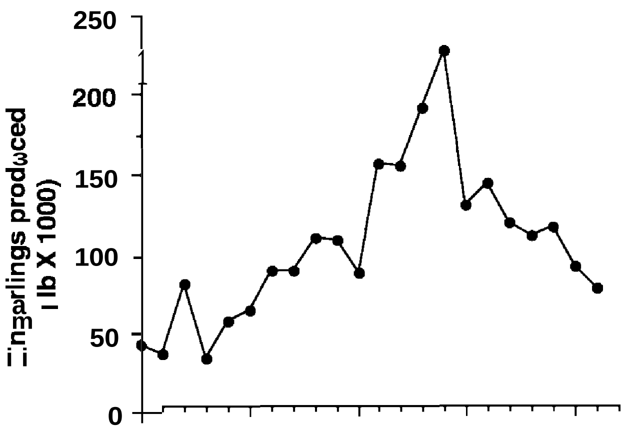
Figure 1. Plastic jugs (5-gal, 18.9-L) used by the Minnesota DNR for walleye fry distribution. The jugs are filled with 2.5-3 gal (9.5–11.4 L) of water and up to 100,000 fry (1 lb, 0.45 kg).

Lakes are generally stocked with 500–1,000 fry/littoral acre (1,236–2,472/ha), but experimental rates of up to 3,000 fry/acre (7,413/ha) may be used. Littoral acres are defined as all water less than 15 ft (4.6 m) deep. In lakes where fewer than 2 million fry are needed, the preferred stocking method involves hauling the fry in jugs and stocking them from a boat, well off shore, on the calm side of the lake. Larger lakes receiving several million fry are most often stocked from trucks; fry are hauled at low densities (–10,000 fry/gal, 2,642/L). Fry are released into the lake by draining the hauling tanks through a tube along the calm shore of the lake.

Fingerling stocking

Some waters, however, are not well suited to fry stocking, as survival is low and inconsistent. Walleye populations in these lakes are maintained by stochng fingerlings. In an average year, 300 lakes are stocked with fingerlings. In Minnesota, raising walleyes to fingerling size began in the late 1930s. Initially this was done in small (<20 acres, 7.3 ha) drainable or natural ponds. The ponds were harvested either by seining or by trapping at the outlet. By the late 1960s, natural pond use became more common; and by 1985, only 12 drainable ponds were in use statewide, comprising only 2% of the total production acreage. Through the 1980s, the size and number of natural ponds increased, use peaked in 1986 at 374 ponds with an average size of 58.6 acres (21.4 ha), for a total of 21,907 acres (7,992 ha). That year, a record of 5,647,430 walleye fingerlings weighing 197,450 lb (89,750 kg) were distributed to lakes throughout the state. The distribution cost of these fingerlings ranged from $0.20–$0.50/lb ($0.44 to $1 .10/ kg), depending on the productivity of the pond.

The impacts of fingerling stochng on fish community structure continue to be evaluated by fishery research and management personnel. All stocking proposals must be described in a lake management plan before being approved at the regional and at the state levels. **As** a result of these guidelines, the number of fingerlings requested by management personnel has decreased (Figure 2). It is estimated that only 250 production ponds (as opposed to 374 ponds in 1986) will be needed each year to fill all fingerling requests. From information gained through these studies, new stochng strategies are being developed that should eliminate stoclungs that are unproductive or harmful. New fish stocking guidelines require that the number of fingerlings and the frequency at which they are stocked must be compatible with the fish community structure and must meet the realistic goals of the management plan for each lake.



Pond production of fingerlings

Production ponds are generally stocked with 5,000 fry/ acre (12,355/ha) from a boat. An average fall survival from all 250 ponds (averaging 50 acres, 20.25 ha) of 5% will provide an adequate supply of 4–6-in (100–150-mm) fingerlings (averaging 25 fish/lb, 55/kg,) to meet the statewide stocking quotas. MNDNR walleye fingerling production has averaged 3.1 million fingerlings per year since 1980. **A** host of climatic conditions are the most important determining factors in having a good production year in our natural ponds.

Harvest methods

The ideal water temperature for harvesting fingerlings is 50–60°F (10.0–15.6°C). Most of the fingerlings are captured from the production ponds with trap nets with 3/8 in (1 cm) mesh. Heavy duty welded aluminum jon boats (the welded aluminum floors in these boats are easy to keep clean), equipped with at least 25 hp motors, are used to transport fish from the traps to the distribution trucks, Each boat is equipped with a 30-gal (1**13.6** L) fish holding tank. Aeration equipment is not used in the harvest boat, however, salt (1 cup) is added to the holding tank water to alleviate handling stress. Salt (0.5%) is added to hauling tanks to reduce stress, especially when bullheads are mixed in with the walleyes. Typically, water in the holding tank is changed each time fish are loaded from the harvest boat onto the distribution trucks.

Transportation procedures

A typical DNR fish hauling truck is a 1 ton expanded cab, 4-wheel drive pickup with a large horsepower V-8 engine and a twin 140-gal (530 L) compartment distribution tank (Figure 3). The distribution tanks are equipped with oxygen systems that include **a** regulator, flow meters, and 12 in (30.5 cm) micro-bubbler airstones. Some of the new tanks on larger trucks have built-in thermometers and oxygen probes. A trailer with a twin 200-gal (757 L) tank is often used in conjunction with this truck (Figure 4). The tanks are equipped with 6-in (15 cm) camlock drains, and camlock-equipped drain hoses are a part of each unit. Additional equip-

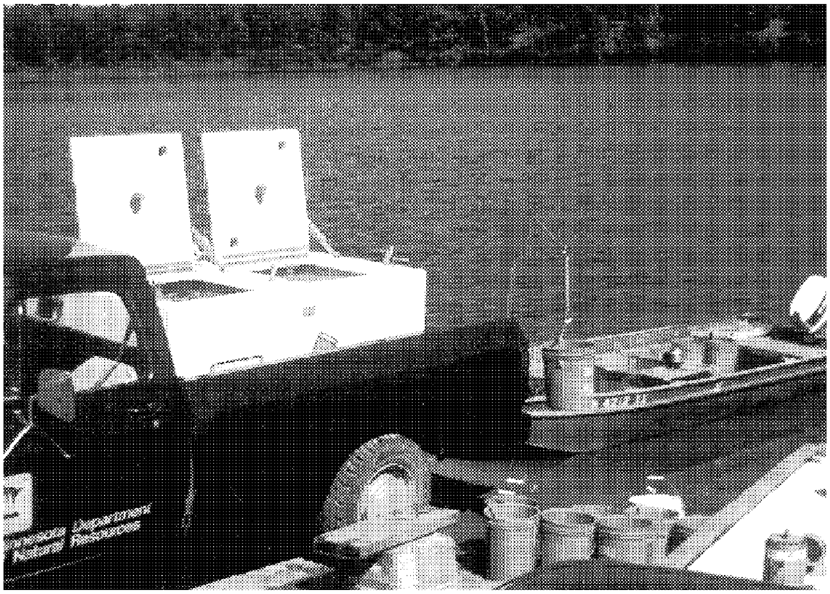


Figure 3. Typical DNR fish hauling truck with twin compartments (140-gal, 430-L).

a lot of sorting (e.g., crayfish, bullheads, salamanders, etc.) must be done. Typically, dip nets containing 20–30 lb (9.1–13.6 kg) of fingerlings are emptied into the distribution tanks. At water temperatures of 55" F (12.8°C) or less, loads of up to 1.5 lbs/gal (180 gal) are used. If the water temperature is greater than 55" F (12.8" *C)*, or the fish are small (> 30/lb, 66/kg) and the transportation time is greater than 2 h, then 1 lb/gal (120 g/L) is recommended.

With approximately 3 million fingerlings going to about 300 lakes, logistics and communication are critical. This huge statewide program is coordinated by the regional managers and the fish production coordinator in St. Paul. Weekly, and often daily, status reports are generated each fall so that fingerling distribution is equitable across the state. In Little Falls (central Minnesota), we generally grow fingerlings in six ponds with an average size of 200 acres (73 ha), however, waters from 20 (7.3 ha) to **600** acres (219 ha) have been used. Knowledge of the walleye's role in dfferent types of water and different fish communities is critical to successful management.

aerators in our distribution tanks was discontinued three years ago, and no problems have been experienced.

During the early **part** of the harvest season, the distribution trucks are filled with **a** mixture of well and lake water, but later in the season, only well water is used. About 125 gal (473 L) of water and 5 lb (2.3 kg) of salt (0.5%) are added to each tank. An anti-foam agent is recommended for long hauls.

In the past, fingerlings were enumerated while being transferred from the boats to the trucks by first filling **5-**gal (18.9 L) buckets with water until they weighed 20 lb (9.1 kg), adding the fish, and then re-weighing the bucket before dumping the **fish** into the hauling tanks. This year, weighing type dip nets were used to move the fingerlings from the boat directly to the scale then onto the truck. This method was faster, caused less congestion in the loadmg area, eliminated the unnecessary addition of water to the hauling tanks, and did not seem to cause more stress than the bucket method. The bucket method may still be necessary when

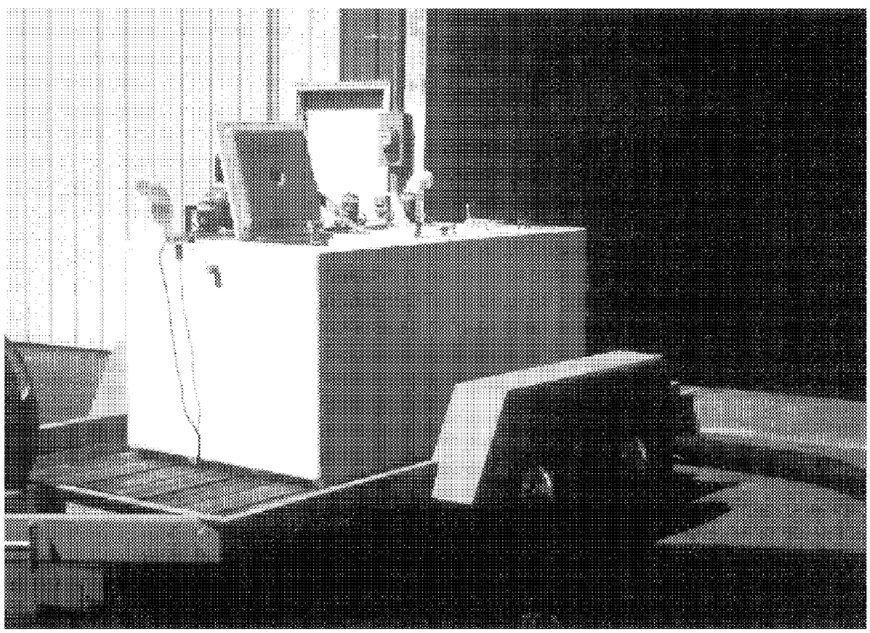


Figure 4. Trailer with twin (200-gal, 757-L) tanks that is used for distribution of fingerling walleye.