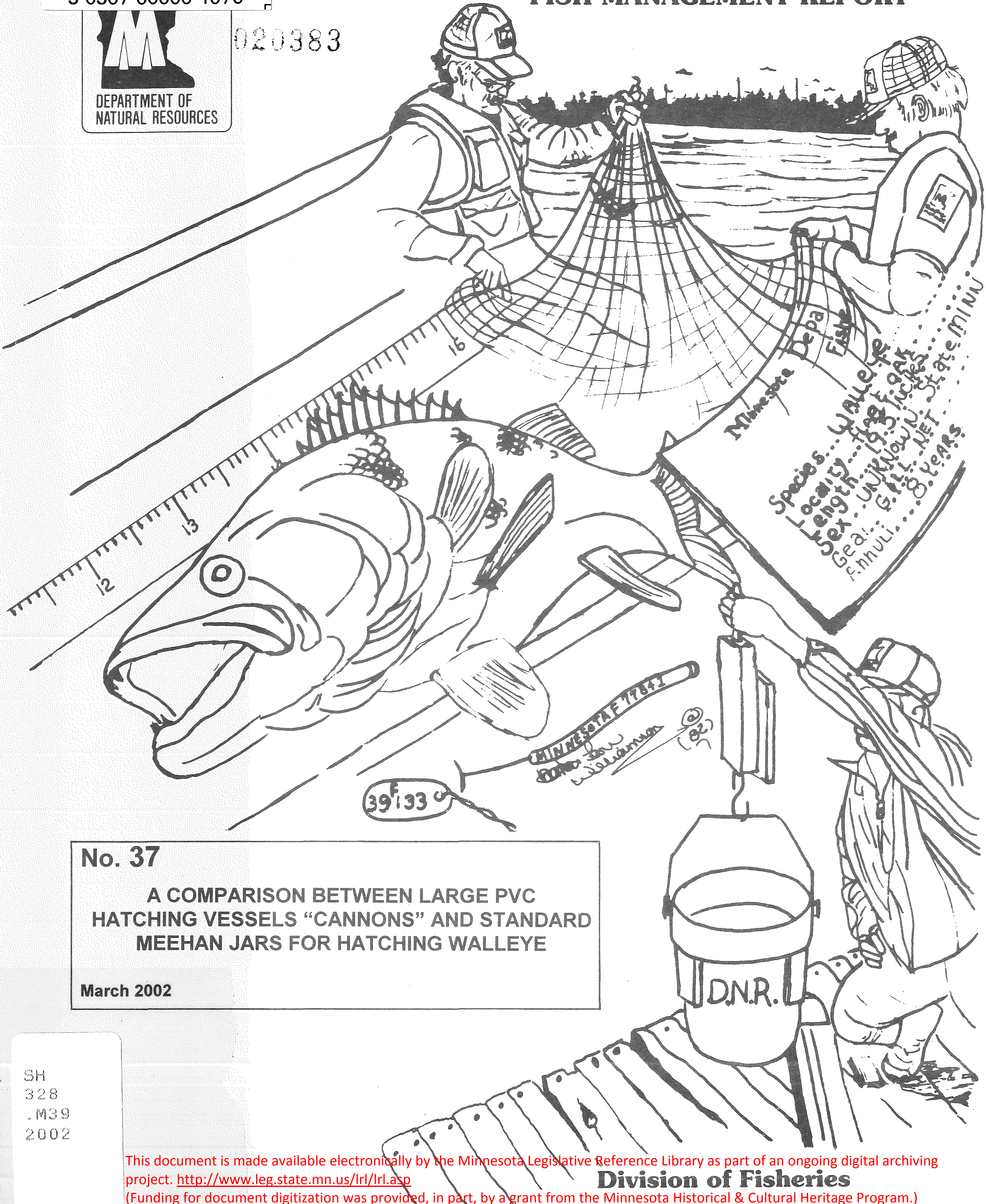
DEPARTMENT OF NATURAL RESOURCES

Division of Fisheries
FISH MANAGEMENT REPORT



No. 37

A COMPARISON BETWEEN LARGE PVC HATCHING VESSELS "CANNONS" AND STANDARD MEEHAN JARS FOR HATCHING WALLEYE

March 2002

Division of Fisheries

outlet tube was inserted near the top of the cannon 90 degrees from the inlet. Inside, at the bottom of each cannon, above the water inlet tube, a coarse floor stripping pad cut to size was secured by a beveled PVC keeper ring and screen. All PVC components were high pressure schedule 40. Inflow water was supplied to the cannons through flexible smooth tubing. Flow rates were adjusted to allow all the eggs to roll gently. Each cannon held 53 quarts of water, enough volume to incubate 20 quarts of eggs (Figure 2).

Standard Meehan jars used in this experiment are similar to those used throughout Minnesota DNR walleye hatcheries. These units hold 7 quarts of water and are constructed of clear plexiglass. Each unit is capable of hatching 3 quarts of walleye eggs. Inflow water enters through a tube at the bottom of the jar and exits out a lip at the top of the jar at a flow rate adjusted to gently roll the eggs. The Meehan jars were arranged in tiers on a battery (Figure 3). Water flowed from the upper level jars to lower level jars on the battery.

Cannon - Meehan jar comparison

Differences in walleye hatching success between cannons and Meehan jars were tested with 5 years (1995-1999) of side by side comparisons. Each year, we obtained walleye eggs from the MNDNR Pike River walleye egg take station in several lots (a lot was a single day's egg take consisting of a pool of fertilized gametes from several different fish). The number of lots and vessels used each year was determined by the availability of eggs, since a large lot size was needed in order to supply both a cannon(s) and Meehan jars. Each lot of walleye eggs was randomly divided into cannon and Meehan jar treatments. Eggs from a specific lot were measured with a one quart ladle and poured into each hatching vessel. Each cannon received 20 quarts of eggs and each Meehan jar received 3 quarts. All comparisons were conducted at the New London MNDNR Hatchery with both types of hatching vessels connected to the same water supply. Flow rates into the Meehan jars during the trials was usually less than 1 gpm and flow rates in the cannons varied from 1.1 to 3.5 gpm using a pressurized, overhead manifold water system from 1995 to 1997 and from 3.0 to 5.0 gpm using a gravity flow water system in 1998 and 1999. Water temperatures and dissolved oxygen were monitored throughout the incubation period at both the inflow and outflow with a YSI model 57 oxygen meter.

We siphoned off dead eggs and eggs with fungus (*Saprolegnia spp.*) daily. Siphoned eggs were placed in hospital jars separated by cannon and Meehan jar treatments. However, because the numbers of fry produced from these hospital jars were insignificant, these fish were not included in estimates of hatching success. The eggs were administered prophylactic treatments using a 1670 ppm flow-through formalin solution for 15 minutes. When infestations became problematic, the eggs were treated daily.

We measured hatching success using eyed egg volumes. Shortly before hatching, eyed eggs from 3 vessels in each lot were rated with a six inch Von Bayer trough. The mean of the 3 ratings was used as the eyed egg rate measurement for each vessel in a lot. Next, we stopped the flow to three Meehan jars to allow the eggs to settle and determine the volume of eggs from markings on the vessels. In cannons, we emptied the eyed eggs into a plastic tub, measured the volume, and returned the eggs to the cannon. The percent hatch in each vessel was determined from the following formula: Percent Hatch = 100* [(Volume of eyed eggs * Rate of eyed eggs)/(Volume of green eggs* Rate of green eggs).

Data Analyses

A total of 12 lots were used in the experiment ranging from a single lot in 1995 to five in 1998. Mean hatching success for each lot and treatment was calculated. To test for differences between mean hatching success in cannon vessels and Meehan jars, a paired t-test was used with year as an effect. The significance of among year variation in overall mean hatching rates was determined with an F-test. Similarly, an F-test was also used to determine the significance of among year variation between mean cannon vessel hatching rates and mean Meehan jar hatching rates. Finally, we used correlation analysis to identify associations between annual variation

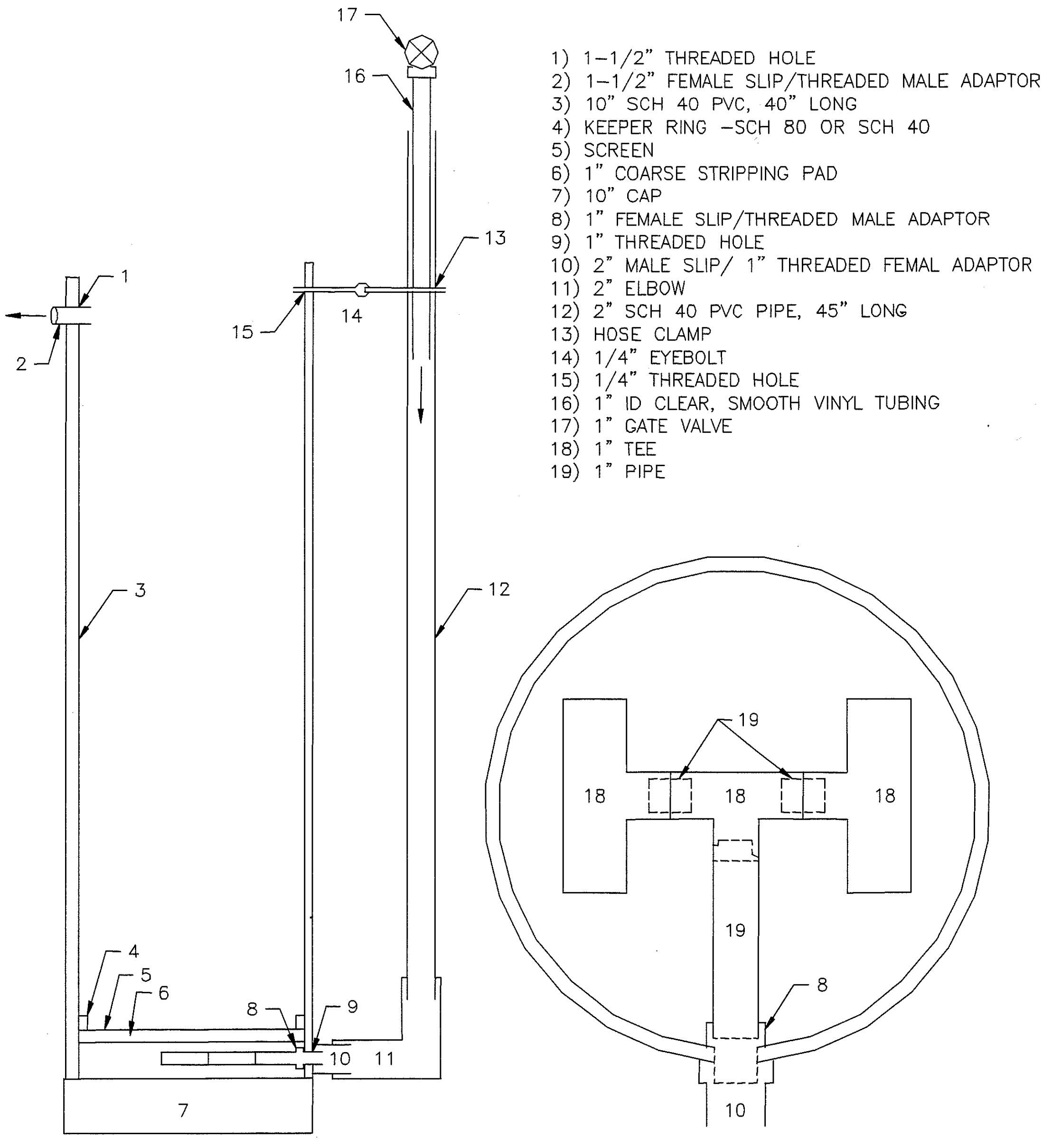


Figure 1. A schematic diagram of the cannon vessel, side and bottom views.

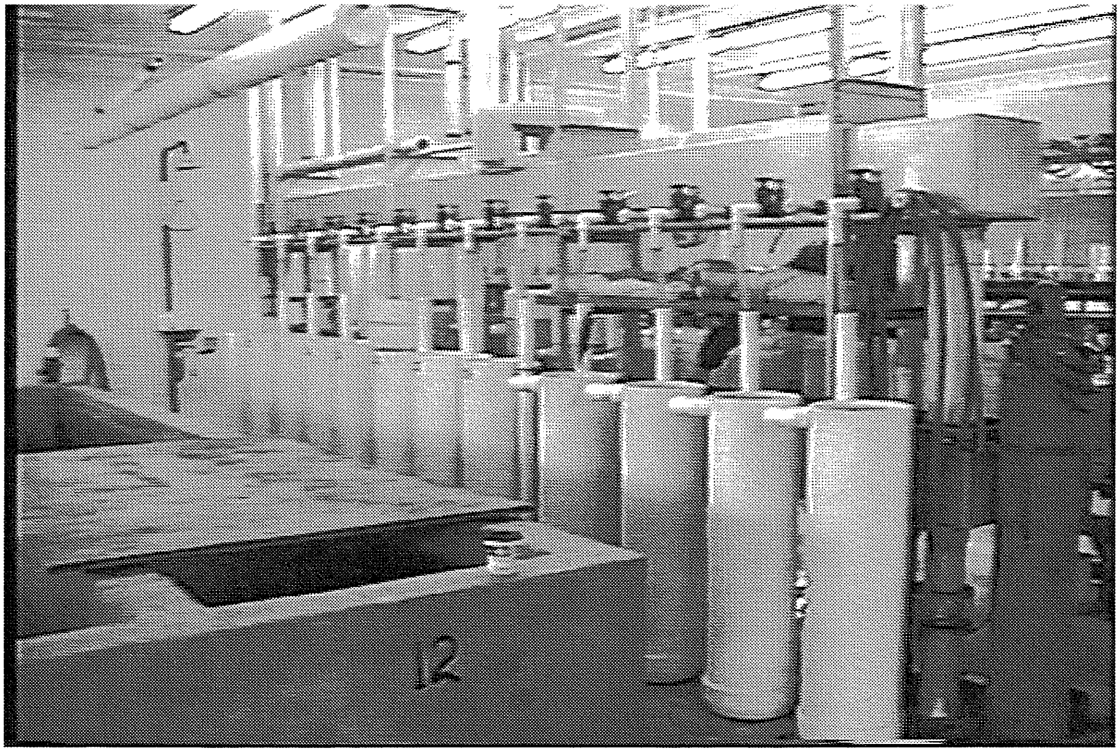


Figure 2. View of walleye egg hatching using the cannons.

Figure 3. View of walleye egg hatching using the Meehan jars on a two tier battery.

in hatching rates and both incubation period and water temperature. In all analyses, probability values < 0.05 were considered significant.

Results and Discussion

Cannons hatched walleye at a slightly higher rate than standard Meehan jars. Walleye hatching rates for each lot ranged from 55% to 79% for Meehan jars and from 64% to 90% for cannon vessels (Table 1). The overall mean hatching rate for cannon vessels was 79%, which was 8% higher than found with standard Meehan hatching jars (71%). The difference in hatching rates between the two treatments was statistically significant ($t = 3.157$, 11 d.f.; $P = 0.0091$). Mean differences between paired (cannon-Meehan jar) treatments were not significant among years (P=0.2140) even though a slightly lower hatch rate was observed for cannon vessels in 1997. Overall mean hatching rates varied significantly among years (P = 0.0044), but no correlations were observed linking variation in hatching success among years to either incubation period or water temperature variables (Table 2).

Walleye hatched one to two days earlier in cannons than in Meehan jars and this

Table 1. Mean (%) of walleye egg hatching, sample size (N) of Meehan jars and cannons, and standard deviation (S.D.) within lots (ID Number) subdivided into standard Meehan jar and experimental cannon vessel treatments at the New London State Fish Hatchery, 1995-1999.

Year	Lot[1] ID Number	Meehan jars N	Meehan jars Mean	Meehan jars S.D.	Cannons N	Cannons Mean	Cannons S.D.
1995	11	22	67.4	5.96	1	89.7	
1996	3	29	66.8	6.09	2	82.5	0.00
1996	4	25	68.6	8.89	2	79.8	0.34
1997	3	12	73.1	7.27	3	79.1	1.54
1997	4	23	71.5	3.46	3	63.7	3.12
1998	3	2	72.8	6.86	1	82.5	
1998	4	8	72.1	3.76	1	82.5	
1998	5	7	79.4	4.11	2	81.8	0.86
1998	8	8	79.2	2.44	2	84.3	0.86
1998	9	12	78.7	1.59	1	84.9	
1999	4	4	69.5	8.86	1	65.5	
1999	7	4	55.4	12.15	1	67.9	
Total			71.2			78.7	

[1] A lot was a single days egg take consisting of a pool of fertilized gametes from several different fish.

Table 2. Mean annual percent walleye hatching rate and mean difference in percent hatching rate between experimental cannon vessels and standard Meehan jars with corresponding water temperature FE(minimum, maximum, and average) and incubation periods (days).

Year	Number of lots	Mean difference in hatching rate between cannons and Meehan jars	Mean annual hatching rate	Water Temperature			Incubation[2] period
				Min.	Max.	Avg.	
1995	1	22.3	78.6	49	59	54	20
1996	2	13.5	74.4	52	68	57	15
1997	2	-0.9	71.8	51	61	56	19
1998	5	6.7	79.8	52	64	59	15
1999	2	4.3	64.6	47	62	54	16

[2] Eggs in cannons usually hatched 24 to 48 hours prior to those in Meehan jars.

could conceivably explain some of the improvements in hatching success. Harvey and Hood (1996) found that walleye hatching success improved with shorter incubation periods in a Pennsylvania hatchery. Factors that could have contributed to the earlier hatching in cannons include a softer, less abrasive roll and darker environment inside the cannons as opposed to the clear plexiglass Meehan jars. Interruptions of water flows into incubating jars and subsequent restoration of flow have also been implicated with initiating an earlier hatch (Harvey and Hood 1996). Although increases in water temperatures have been associated with shorter incubation periods (Malison and Held 1996, Thompson 1996), temperature differences between cannons and Meehan jars were negligible. Comparable dissolved oxygen levels were also observed in both the cannons and Meehan jars. Dissolved oxygen levels ranged from 6.7 to 11.7 ppm, and the difference between the influent and effluent concentrations never varied by more than 1.8 ppm. Minimum oxygen levels for optimal incubation of walleye eggs is generally considered to be between 5 and 6 ppm (Oseid and Smith 1971).

Hatchery operations were more efficient with cannons. Thirty-eight percent fewer fungus treatments were required for cannons than Meehan jars (Table 3) and cannons also required less chemical per quart of eggs than the jars. The cannons required 0.33 oz. of formalin per quart of eggs while the Meehan jars required 1.48 oz. of formalin per quart of eggs. Fewer personnel hours were needed to siphon and adjust water flows on the cannons than for the Meehan jars. For a similar volume of eggs, it took less than one-half the time to siphon eggs and one-seventh the time to adjust flows in the cannons versus Meehan jars. Also, more eggs can be hatched in a smaller area using less water with the cannons than with the Meehan jars. For example, 240 quarts of eggs (12 cannons) can be hatched in one-half the area of a 2 tiered, 50 jar per tier battery (300 quarts of eggs, 100 Meehan jars). Unlike Meehan jars, cannons can be stored away after use, thus allowing other hatchery operations to take place in the same area.

The use of cannons in MNDNR hatcheries would be beneficial. We found improvements over standard Meehan jars walleye hatching success and in reductions of labor and space requirements. To date, no other published information exists on walleye hatching success in cannons for comparison. However, MNDNR hatcheries in Brainerd, Ely, Glenwood, and Waterville have used cannons for hatching walleye and report similar hatching successes between cannons and Meehan jars.

Table 3. Number of fungal treatments administered to experimental cannon vessels and standard Meehan jars.

Year	Number of Treatments: Cannons	Number of Treatments: Meehan Jars	Percent Difference
1995	5	14	64
1996	4	7	43
1997	4	6	33
1998	5	6	16
1999	6	6	0

References

Harvey, J. E., and S. E. Hood. 1996. Collection and spawning of walleye broodfish and incubation of fertilized eggs. Pages 25-28 *in* R. C. Summerfelt, editor. Walleye culture manual. MCRAC Culture Series 101. North Central Regional Aquaculture Center Publications Office, Iowa State University, Ames.

Malison, J. E., and J. A. Held. 1996. Reproductive biology and spawning. Pages 11-18 *in* R.C. Summerfelt, editor. Walleye culture manual. MCRAC Culture Series 101. North Central Regional Aquaculture Center Publications Office, Iowa State University, Ames.

Oseid, D. M., and L. L. Smith Jr. 1971. Survival and hatching of walleye eggs at various dissolved oxygen levels. The Progressive Fish Culturist 33(2):81-85.

Thompson, D. 1996. Stripping, fertilizing, and incubating walleye eggs at a Minnesota hatchery. Pages 41-44 *in* R. C. Summerfelt, editor. Walleye culture manual. MCRAC Culture Series 101. North Central Regional Aquaculture Center Publications Office, Iowa State University, Ames.

Acknowledgments

Vince Jenniges and Graden West assisted in collecting data on the cannons and jars. Chuck Kernler (Crystal Springs Hatchery) and Dale Bast (Iron River National Fish Hatchery) supplied the cannon background information. Thanks also goes to the following MNDNR employees for comments about their experience with the cannons: Mike Caughey, Doug Thompson, Ryan Kessler, and Bruce Pitman. Tim Cross, Bruce Gilbertson, Huon Newburg, Don Pereira, and Shane Rustin provided editorial and statistical advice.

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