Northern Pike Fry Mortalities Attributed To P.C.B.'s - Polychlorinated Biphenyls

By: Ronald Waybrant, Aquatic Biologist,
Michigan Department of Natural Resources
Bureau of Water Management

Background

The Michigan Department of Natural Resources Fisheries Division collects from 12 to 14 million northern pike eggs each year from wild sources for its northern pike stocking program. Pike in spawning condition are trapped in southwestern Michigan streams and transported to the Wolf Lake Hatchery near Kalamazoo for spawning. Survival of the fertilized eggs to swim-up averages about 60%. Swim-up fry are then stocked in extensive rearing marshes adjacent to lakes or in chemically reclaimed waters.

Mortality

By April 10, 1974, more than 1 million fry had died at Wolf Lake and the mortalities were brought to the attention of the D.N.R.'s Toxic Materials and Bioassay Group. Nearly all fry were dying about 6 days after hatching at the swim-up stage.

The installation of new PVC pipe at the hatchery was first suspected as a source of phthalates or other vinyl chloride compounds which may have caused the mortality. The death of fry at swim-up is characteristic of mortalities caused by chlorinated hydrocarborn compounds and other lipid soluble toxicants. Water and fry samples were taken to check this possibility, while the plumbing at Wolf Lake was converted back to iron pipe on April 11, 1974.

Phthalate leaching from the new PVC pipe was ruled out as a cause of the mortality after water samples taken during plastic pipe use were analyzed, and pike fry reared with iron piping continued to die six days after hatching on April 18th.

Thirty-nine ppb phthalate were found in the water sample taken when PVC pipe was in use. Although somewhat elevated, the available 96 hour LC50's for phthalates range from 0.7 to 6.5 ppm, much higher than the observed level. An important consideration is that very hard PVC pipe was used which has less phthalate than softer plastics, and after adequate flushing little or no phthalate should leach from the pipe.

Analysis of the fry and eggs did indicate, however, that PCB levels were sufficient to cause fry mortalities. Total PCB levels in the fry were 1.65 ppm of Arochlor 1254 and 1.41 ppm of Arochlor 1248 in one sample and 0.44 ppm as 1254 and 1.21 ppm as 1248 in the other. The eggs contained 1.58 ppm as 1254 and 1.80 ppm as 1248. According to Jensen et.al. (1970), when PCB residues in groups of salmon eggs ranged from 0.4 to 1.9 ppm on a whole weight basis, mortalities ranged from 16 to 100 percent. Jensen et.al. (1970) suggested that 0.5 ppm PCB in whole salmon eggs may be near the threshold for mortality. This value may approximate the threshold level for other species, such as the northern pike.

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The swim-up stage of fry may be a susceptible stage for PCB poisoning as it is with DDT.

According to Cuerrier et. al. (1967), DDT related mortality tends to occur in the swim-up stage of fry development. This can be attributed to the fact that most of the DDT in the egg will remain with the oils, which are absorbed during the swim-up stage. Like DDT, PCB's are chlorinated hydrocarborns and are very lipid soluble.

Because the PCB levels found in the fry and eggs were high and fry died in the swim-up stage, the presence of PCB's are considered to be the likely cause of the northern pike fry mortalities experienced at the Wolf Lake Hatchery.

The source of PCB's did not appear to be in the hatchery water. The basic water supply was tested and found to be free of chlorinated hydrocarbons. Pesticides and PCB's were found, however, in the water samples from the third rearing trough. These may have originated from the fry which lost them to the water, particularly after they started dying. Since PCB's were not found in the water supply entering the troughs, the PCB's in the eggs and fry probably originated with the adult fish.

To test this hypothesis, adults were collected from Lake Macatawa near Holland. Six adults ranging in size from 17.4 to 34.7 inches were collected on two separate collection attempts, May 22 and 29, 1974. The following table lists the lengths and ages of these northern pike with the concentrations (ppm) of two PCB residues found in the flesh.

Northern Pike		Arochlor (ppm)		
Length (Inches)	Age Group	1254	1248	Total PCB
34.7	V	5.5	4.2	9.7
30.0	IV	1.5	1.7	3.2
29.5	III	1.6	1.3	2.9
26.0	III	3.8	2.6	6.4
23.0	II	1.1	0.6	1.7
17.4	---	0.43	0.53	0.96

As you will note, total PCB appeared to increase with the age and size of pike. This is probably significant in light of the tendency of most fish culturists to select the largest females for spawn taking.

Past (1972) PCB data of the Michigan Water Resources Commission (MWRC) on fish collected from the Black River above Lake Macatawa also corroborates the relatively high PCB concentrations noted in 1974. An 11-inch smallmouth bass contained 4.35 ppm PCB in a portion of edible flesh. This is well above what the MWRC considers background levels.

The discovery of relatively high PCB concentrations in brood stock collected from Lake Macatawa and associated fry mortalities indicates that alternative brood stock collection sites should be explored for 1975.

Jensen, S., M. Johansson, M. Olsson. (1970) "PCB-Indications of Effects on Salmon." PCB Conference. Stockholm, Sept. 29, 1970. (Swedish Salmon Research Institute). Rept. LFIMEDD 7/19/70

Cuerrier, J. P; J. A. Keigh, E. Stone, (1967) Problems with DDT in Fish Culture Operations. Naturaliste Can. 94;315-320

Report by: Ronald Waybrant, Ph.D.
Aquatic Biologist
Water Quality Appraisal Section

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