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Fisheries Division

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GREAT LAKES COHO SALMON MORTALITIES 1973-1974

Harry Westers, Fisheries Biologist

SUMMARY

Only three hatcheries reported significant losses during the early hatchery life of the freshwater coho salmon. These befell Lake Erie as well as Lake Michigan salmon. The "pesticide syndrome" was present during these particular mortalities, but was otherwise not observed in this year's production of the first third generation freshwater cohos.

We could be observing the process of natural selection of salmon possessing a greater tolerance to DDT and PCB's.

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INTRODUCTION

This is the third annual report documenting the early hatchery performance of the Great Lakes coho salmon. It covers their life through approximately six weeks of feeding.

Unexplained and inconsistent, but at times and at certain hatcheries, significant losses prompted a coordinated reporting effort by those States engaged in a Great Lakes coho salmon rearing program.

The information was obtained by means of a questionnaire (Appendix A).

The following participants contributed information for this report:

I. Pennsylvania - Pennsylvania Fish Commission

A. Source of eggs:

1) Lake Erie - Walnut Creek
2) Lake Michigan - Platte River

B. Hatcheries involved:

1) Linesville Fish Cultural Station
2) Tionesta Hatchery
3) Walnut Creek Hatchery

II. Pennsylvania - Marine Protein Corporation

A. Source of eggs:

1) Lake Erie

B. Hatchery involved:

1) Mammoth Spring Hatchery, Arkansas

III. Ohio - Division of Wildlife

A. Source of eggs:

1) Lake Michigan - Platte River
2) Lake Erie - Walnut Creek

B. Hatchery involved:

1) Put-in-Bay Hatchery

IV. New York - Department of Environmental Conservation

A. Source of eggs:

1) Lake Michigan - Little Manistee River
2) Lake Erie - Walnut Creek

B. Hatchery involved:

1) Caladonia State Fish Hatchery

V. Minnesota - Department of Natural Resources

A. Source of eggs:

1) Lake Superior - French River

B. Hatchery involved:

1) French River Hatchery

VI. Michigan - Department of Natural Resources

A. Source of eggs:

1) Lake Michigan - Little Manistee River
2) Lake Michigan - Platte River
3) Lake Michigan - Thompson Creek
4) Lake Huron - Tawas River
5) Lake Superior - Anna River; Big Creek; Little Garlic; Cedar Creek
6) Lake Erie - Walnut Creek (Penn.)

B. Hatcheries involved:

1) Platte River Hatchery
2) Thompson Hatchery
3) Grayling Research Station

RETURNING ADULTS

Michigan reported a substantial migration into the Platte River of coho jacks by mid-September. Adult salmon appeared in early October, but large schools were absent. The fish displayed a continuous movement of small schools over several weeks. These entered readily into the maturation ponds without accumulating below the weir as occurred in previous years.

Tables I and II summarize the data from 1968 through 1973 for the Platte and Little Manistee Rivers.

Pennsylvania observed a normal behavior pattern and generally good condition of the adults. The average weight was 4.4 pounds with an average length of 24.5 inches. Incidence of lamprey scarring was 4.3 percent, tumors and related growths 12.4 percent. No infectious diseases were noticed.

Minnesota reported the capture of 3,218 adults from traps and seines set in the French River tributary to Lake Superior. These averaged 3.3 pounds and 21.2 inches. Virtually no lamprey scars were observed; but, all fish examined showed evidence of goiter. No other diseases were recorded.

EGG TAKE OPERATION

At the Platte River spawn taking facility in Michigan, the egg take operation was performed by means of the surgical technique. Two males were handstripped over each batch of eggs. Eggs were kept in ten gallon milk cans for water hardening under a continuous flow of well water.

The same method was applied at the Little Manistee spawn taking facility, but here the females were anesthetized with M.S. 222, while sperm was collected from the males via the Australian method and dispensed in aliquots of 3-4 ml. per female. Fresh sperm was collected every hour.

Pennsylvania also applied the surgical technique while Minnesota used handstripping of live fish.

EGG INCUBATION

Table III provides the data on egg incubation. It includes the data on four lots of eggs from Lakes Michigan, Superior, Huron and Erie incubated and hatched under identical conditions at the Grayling Fish Disease Research Laboratory. However, the Lake Erie eggs were incubated to the eyed stage in Pennsylvania and shipped as such to Michigan for final incubation and rearing.

TABLE I

REGION II LAKE MICHIGAN ANADROMOUS FISH DATA - FALL 1968 - 1973

PLATTE RIVER

Salmon Harvested	1968	1969	1970	1971	1972	1973**
% Return	22.3	11.4	13.7	11.2	5.9*	10.2
Coho III	110,050	43,330	149,815	87,095	23,277	41,594
Trout Passed						
% Mortality			4.9	12.3		
Rainbow	888(L)	587(L)	2,746(L)	715(L)	139(U)	215(U)
	247(U)	291(U)	245(U)	211(U)		
Brown	109	50	79(L)	22(L)	0	86(U)
			46(U)	105(U)		
Average Weight						
Coho III	9.0	8.8	8.2	8.7	No data available due to inadequate sample	
Rainbow	4.9	6.0	6.8(L)	7.6(L)		
			5.2(U)	5.3(U)		
Average Length						
Coho III					23.8(s)	
					27.4(n)	
% Lamprey Scarring						
Coho	3.5	2.7	0.5	1.0	0.0	0.01
Chinook					0.0	
Rainbow					0.0	

(L) Lower Weir
(U) Upper Weir
(s) September Sample
(n) November Sample
* Includes 20,565 fish passed upstream for egg taking purposes. The figures make allowance for an estimated 1,000 chinook and steelhead passed.
** 1973 run monitored thru November 20

Source: Region II Lake Michigan Anadromous Fish Report, Fall 1973. By B. R. Ylkanen, Michigan Department of Natural Resources

TABLE II

REGION II LAKE MICHIGAN ANADROMOUS FISH DATA - FALL 1968 - 1973

LITTLE MANISTEE RIVER

Salmon Harvested	1968	1969	1970	1971	1972	1973 (e)
% Return	14	15.6	15	10.7	2.3	7.9
Coho III	58,900	24,750	105,400	59,123	2,314	11,872
% Return	2.0	2.05	1.5	0.93	0.6	0.4
Chinook II	9,600	7,950	4,670	2,885	1,900	1,153
% Return		3.3	3.3	4.0	3.8(a)	2.5(c)
Chinook III		19,700	11,100	11,913	23,094	15,323
% Return			3.0	2.0		
Chinook IV			18,420	6,415		
Trout Passed						
% Mortality	1.9	1.9	1.2	1.3	1.3	1.4
Rainbow	1,297	2,987	7,322	7,523	3,515	1,899(d)
% Mortality			3.0			6.7
Brown	28	36	123	69	5	45
Average Weight						
Coho III	8.7	8.9	8.0	8.7	6.5	5.8
Chinook II	5.8	6.0	6.3	5.2	4.3	4.4
Chinook III		15.9	16.6	15.0	17.7(b)	17.8(b)
Chinook IV			23.0	22.7		
Rainbow	7.2	7.8	8.7	8.8	9.3	6.5
Average Length						
Coho III					26.3	24.5
Chinook II					22.6	22.4
Chinook III, IV, V					35.6	36.0
Rainbow					27.4	24.3
% Lamprey Scarring						
Coho	4.3	2.5	1.0	1.5	0.4	0.0
Chinook	0.0	4.7	4.0	2.8	0.0	0.7
Rainbow	6.0	0.9	2.0	0.0	0.0	0.0

(a) % return includes chinook ages III, IV, and V. These returns are based on only the 1969 and 1970 plants.
(b) Average weight is for chinook ages III, IV, and V.
(c) % return includes chinook ages III, IV, and V. These returns are based on only the 1970 and 1971 plants.
(d) Includes 1,478 rainbow transferred to the Big Manistee and Pine Rivers.
(e) 1973 biological data obtained from a sample of 300 chinook, 345 coho and 79 rainbow.

Source: Region II Lake Michigan Anadromous Fish Report, Fall 1973. By B. R. Ylkanen, Michigan Department of Natural Resources.

TABLE III

SUMMARY OF INCUBATION AND HATCHING OF GREAT LAKES COHO SALMON, 1973-1974

State	Egg Source	Hatchery	Type Incubator	Flow in # Eggs/ GPM	Incubation Temp. °F.	D.O.- ppm	Percent Expected Eye-up	Percent Actual Eye-up	Percent Hatch-off (from eyed eggs)
Michigan	Lk. Mich.	Platte	Heath	25,000	45°-51°			49-65 $\bar{x}$-58	
Michigan	Lk. Mich.	Thompson	Trough		45°			70.6	
Michigan	Lk. Mich.	Grayling	Jar	20,000	46°			44.08	94.5
Michigan	Lk. Sup.	Grayling	Jar	20,000	46°			23.0	85.2
Michigan	Lk. Huron	Grayling	Jar	20,000	46°			56.25	91.9
Michigan	Lk. Erie	Grayling	Jar	20,000	46°		60-70	in Penn 60+	83.0
Pennsylvania	Lk. Mich.	Tionesta	Jar	20,000	47°	10	60-70	65	99.0
Pennsylvania	Lk. Erie	Tionesta	Jar	20,000	47°	10	60-70	69	96.0
Pennsylvania	Lk. Erie	Linesville	Jar	17,000	50°	8-9		62.5	90.0+
Ohio	Lk. Mich.	Put-in-Bay	Trough	15-20,000	52°	7.0	67.0	26.2	70.0
Ohio	Lk. Erie	Put-in-Bay	Trough	15-20,000	52°	7.0	89.4	26.7	83.6
New York	Lk. Mich.	Caladonia	Heath & Baskets	20,000	46°-48°	9-11		31.4	90.0
New York	Lk. Erie	Caladonia	Heath	11,000	46°-48°	9-11	40	78.2	91.0
Minnesota	Lk. Sup.	French River	Baskets	5,000	33°-36°	10-12		87.5	96.2

FRY AND FINGERLING REARING

The losses during early rearing were very minimal at the Platte River Hatchery and lower than ever before. Less than an eight percent mortality occurred during the first months of rearing. The "pesticide syndrome" was not observed to any significant degree (less than three percent). At the Thompson Hatchery in Michigan, where the Alaskan strain salmon is reared, success was excellent too. The "pesticide syndrome" was absent and overall mortalities during the critical period were virtually zero.

The Tionesta Hatchery in Pennsylvania reports 1973-1974 as their best year to date. Both the Lake Michigan and Lake Erie salmon had very low losses and neither group displayed the characteristic symptoms. Those few fish that died turned black and/or became pinheads.

However, at the Linesville Hatchery in Pennsylvania, severe losses occurred in their Lake Erie cohos during swim-up and early feeding. The fish showed a disinterest in food and many displayed the "pesticide syndrome". Thyamine treatments were found to be very damaging to the gills. Losses continued at a level of one to two percent daily until the fingerlings were about 4 months old. The final survival after five months was 21.5 percent. Temperatures and dissolved oxygen levels were a favorable 50°F. and 8 and 9 ppm.

Ohio also experienced poor results. The symptoms described for both swim-up and feeding fry were: "slow spiral swimming, off feed, weak, float upside down against screen". Both their Lake Erie and Lake Michigan fish were affected. Losses recorded during these stages of development were 37.9 and 35.9 percent respectively. Rearing temperatures were 52°F., dissolved oxygen levels 7.0 to 9.0 ppm.

The Caladonia Hatchery in New York incubated and reared both Lake Erie and Lake Michigan cohos.

The Lake Erie cohos were retained in the incubator to the swim-up stage. Losses of the sac fry were 9.05 percent, swim-up fry 9.1 percent. After swim-up, these fish (31,000) were added to the Michigan salmon. The Lake Michigan cohos experienced a loss of 8.3 percent from hatch-off to feeding. "There were no noticeable gross symptoms for mortalities. The erratic spiraling of past years was not observed to any significant degree." Losses continued through February, March and April as follows: 5.9 percent, 7.4 percent and 6.7 percent and dropped to less than 4 percent in May and June. Again, no gross symptoms were observed throughout these periods. Temperatures ranged from 47.5°F. to 52.0°F. Their evaluation is summed up with these words: "At the present time (July 19, 1974) the Michigan strain coho at our station is our best fish with respect to size, vigor, and low percent mortalities".

The State of Minnesota disposed of their coho fry after hatch-off.

The eggs incubated at the Mammoth Spring Hatchery in Arkansas hatched 67 percent of the eyed eggs, and were retained in the incubator for 12 days as sac fry. During that period, 29 percent died. Daily temperatures during incubation and after hatching was 60°F. Losses as swim-up fry were 48 percent and a high of 69 percent during early feeding. Symptoms observed were described for swim-up fry as "darkening of color, pinheads, and slow spiraling" and for feeding fry: "slow spiraling, laying on bottom, loss of equilibrium, darkening of color, and pinhead". Dissolved oxygen levels were 8.4 ppm. The total losses by April 20, 1974, were 91,459 from 96,459 eyed eggs. During hatching itself, 20 percent of the fry emerged partly and then died.

DISCUSSION

The coho salmon returning as adults in the fall of 1973 were of the third freshwater generation. (Fig. 1)

In the 1972 coho salmon mortality report, I speculated that we may experience a further decline in the egg quality as we come to utilize successive generations of the Great Lakes coho salmon.

However, based on the results this year, we could be seeing a trend which indicates:

1) Equal or better egg quality.
2) A reduction in fry and fingerling mortalities during the transition period associated with the "pesticide syndrome".

What we may be observing, therefore, might be a natural selection of fish better adapted to the freshwater environment with its specific characteristics including the presence of DDT and PCB's.

Several studies (Degurse et.al. 1973; Johnson & Pecor, 1969) with the Great Lakes coho salmon were performed to demonstrate a direct correlation between pesticide and PCB levels in eggs and fish and the levels of mortalities. This research failed to prove that such a correlation exists, which too, may indicate the existence of a genetic differential to the susceptibility of these specific pollutants, resulting in a natural selection of the more resistent strains.

Yet when certain stresses are exerted on the "survivors" in the hatchery some of the young cohos may still succumb as a result of near threshold levels of these toxicants.

This is what we may be seeing with the salmon reared at the Put-in-Bay Hatchery in Ohio (water quality problem?), those reared in the Mammoth Spring Hatchery in Arkansas (too high temperature?) and those produced at the Linesville Hatchery in Pennsylvania (water quality problem?). Each of these hatcheries observed the typical "pesticide syndrome" in many of the dying cohos. These peculiar symptoms have, as yet, never been reported to occur in fry and fingerlings hatched from West Coast eggs or even from those of Lake Superior.

RECOMMENDATIONS

1) Continue with "natural selection" by means of using freshwater strains for artificial spawning and propagation.

2) Continue with the annual reporting as outlined in Appendix A.

REFERENCES

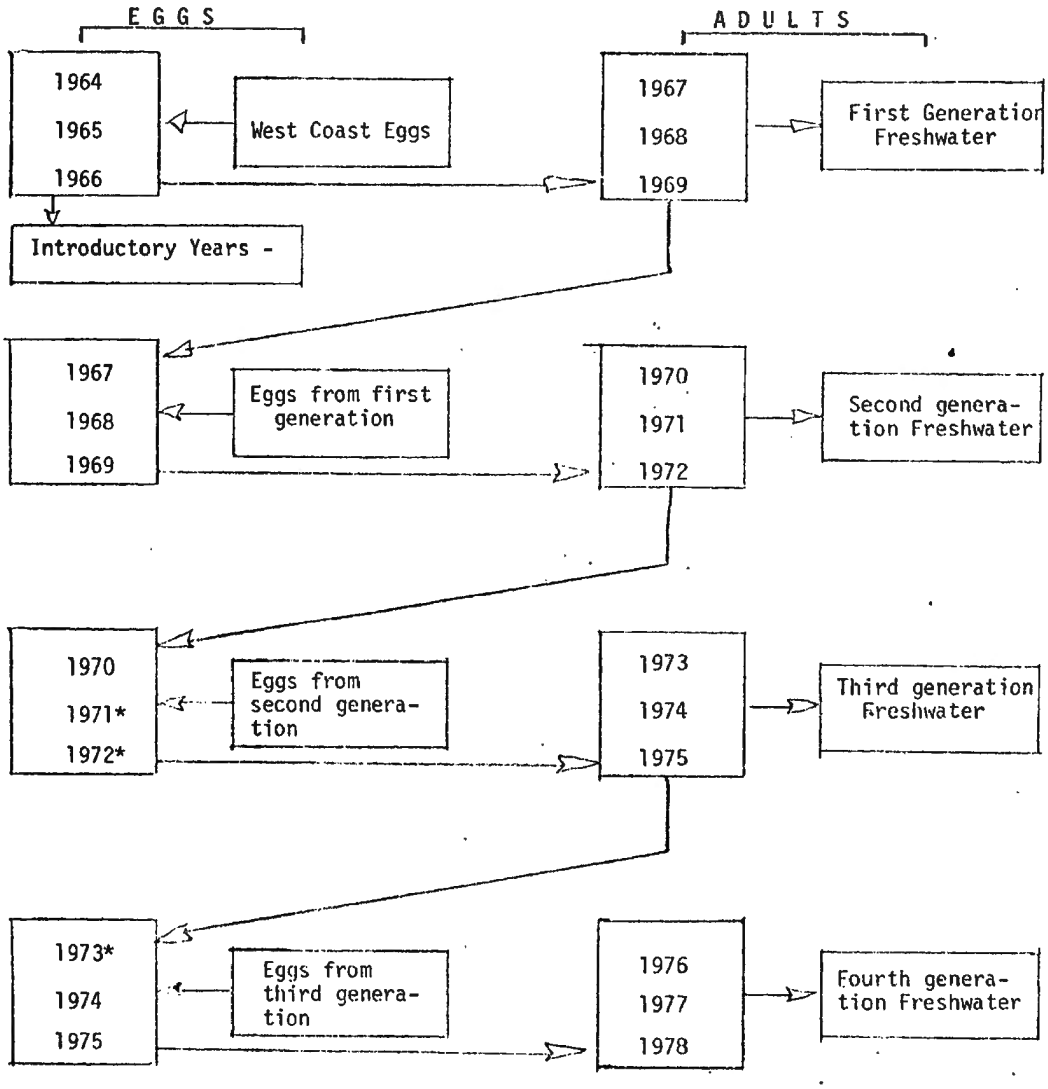
Degurse, Paul E. and David Crockett with H. R. Nielsen. 1973. Observations on Lake Michigan Coho Salmon (Oncorhyncus kisutch) Propagation Mortality in Wisconsin with an evaluation of the pesticide relationship. Wisconsin, Fish Management Report No. 62.

Johnson, Howard E. and Charles Pecor. 1969. Coho salmon mortality and DDT in Lake Michigan. Trans. 34th no. Amer. Wildl. & Nat. Res. Conf. Mar. 2-5 Washington, D.C. pp. 159-166.

FIGURE 1

GREAT LAKES COHO SALMON

FRESHWATER GENERATIONS



* Eggs were supplemented with West Coast eggs

1971 - one million
1972 - " "
1973 - two million

Smolts from these eggs are not stocked into the spawntaking streams; Little Manistee and Platte River.

APPENDIX A

Great Lakes Coho Salmon Records

I. Returning Adults

A. Fishing Success

1. Estimated Percent Return

B. Condition

1. Average Weight - Length
2. Lamprey Scars
3. Tumors/Growths
4. Diseases

C. Spawning Run

1. Daily River Water Temperature
2. Daily Air Temperature
3. Condition of Fish
4. Behavior of Fish

II. Egg Take Operation

A. Daily Water Temperature

B. Technique Used

C. Number of Eggs/Female

D. Egg Quality

1. Rejects (Reasons)
2. Size (No./oz.)
3. Color

III. Egg Incubation

A. Type Incubator

B. GPM Flow per Number of Eggs

C. D.O. Readings

D. Daily Temperature or High and Low and Average

E. Expected Eye-up

F. Actual Eye-up in Percent of Green Eggs

G. Other Information

IV. Fry and Fingerlings

A. Hatch-Off (Percent of Eyed Eggs)

B. Sac Fry

1. Losses (Percent of Sac Fry)
2. Daily Temperature

C. Swim-Up Fry

1. Losses During Yolk-sac Absorption (Percent of Fry)
2. Symptoms During Losses
3. Daily Temperature

D. Feeding Fry/Fingerlings

1. Percent Losses
2. Symptoms During Losses
3. Daily Temperature
4. D.O.
5. Termination of Losses

V. Any Additional Comments