

2004 Interim Evaluations of Pen-Reared Steelhead and Chinook Salmon

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Several cooperative pen-rearing projects for chinook salmon and steelhead have been conducted annually in New York since 1998. Evaluations of chinook salmon pen-reared at Oak Orchard Creek and the Lower Niagara River are ongoing. An evaluation of steelhead reared at Oswego is nearly complete, while another at Niagara River began in 2004. This report summarizes relative performance of pen-reared fish to date. Indicators of performance include the relative contribution of pen-reared and traditionally stocked fish to the sport fishery and/or hatchery run, as well as relative rates of adult fish homing to their respective stocking sites.

Methods

Steelhead

The steelhead evaluation at Lower Niagara River began in 2004 with the stocking of 7,800 adipose marked, coded wire tagged (23-16-14) fish into net pens. The control group (7,500) was stocked directly into the river and also had adipose fin clips and coded wire tags (23-16-13). Paired plantings will continue through 2006. Fish will be collected at Lower Niagara River through cooperating anglers, at the Salmon River Hatchery, and through the Lake Ontario Fishing Boat Census. This study duplicates that conducted at Oswego.

Chinook Salmon

A four year (1999-2002) marking study is being

conducted to evaluate the relative performance of chinook salmon stocked at Oak Orchard Creek and Lower Niagara River. Three lots of 40,000 fin clipped fish were stocked at Oak Orchard in 1999 and 2001 and Lower Niagara River in 2000 and 2002. Each year, one lot consisted of fish raised at Salmon River Hatchery and stocked directly into the stream. A second lot was raised at Caledonia Hatchery and also stocked directly into the stream, and the third lot was Salmon River fish stocked into net pens. The fish stocked into the pens were reared for an additional period of approximately 2-3 weeks and then released. Returns have been monitored annually at both stocking sites since 2001 and at the Salmon River Hatchery since 2000.

Other fin clipped chinook in the system are fish stocked at the Black River on the eastern end of the lake. These fish are part of an experiment to determine the effects of morpholine imprinting and subsequent returns to the stocking site (McCullough 2005). A listing of all chinook finclips is provided in Table 1.

For the 2001 data collections, ages were assigned to fish from the pen experiments on the basis of length frequency. Since all returns were from age-1 and age-2 fish, all fish <28.5 in (725mm) were assigned age-1 (2000 year class (yc)) and larger fish were assigned age-2 (1999 yc). Ages were interpreted

from scales for the 2002 through 2004 samples fish.
because of the overlap in size of age-2 and older

Table 1. NYSDEC fin clips for chinook salmon by yearclass, stocking site, hatchery (CD-Caledonia, SR-Salmon River), and stocking method (DIR-direct, PEN-pen reared, MORP-morpholine, CONT-control).

Yearclass	Stocking Site	Hatchery-Method	Fin Clip				
			LV	RV	LP	RP	AD
2002	L Niagara R	CD-DIR				X	
2002	L Niagara R	SR-DIR	X				
2002	L Niagara R	SR-PEN		X			
2001	Oak Orchard Ck	CD-DIR				X	
2001	Oak Orchard Ck	SR-DIR	X				
2001	Oak Orchard Ck	SR-PEN		X			
2000	L Niagara R	CD-DIR				X	
2000	L Niagara R	SR-DIR	X				
2000	L Niagara R	SR-PEN		X			
1999	Oak Orchard Ck	CD-DIR		X			
1999	Oak Orchard Ck	SR-DIR			X		
1999	Oak Orchard Ck	SR-PEN				X	
1999	Black River	SR-MORP					X
1999	Black River	SR-CONT	X				
1998	Black River	SR-MORP					X
1998	Black River	SR-CONT	X				

Chi square tests were done to evaluate departures from expected return ratios of 1:1:1 to the return sites. Chi square tests of association were also done to compare distributions of returns from each year class to the different monitoring sites for the three stocking methods to evaluate homing. All chi square tests in this report were done with SAS release 8.0 (SAS Institute 1999).

Results and Discussion

Steelhead

No additional tags were collected from the Oswego steelhead evaluation in 2004, completing that evaluation. To date, pen reared fish returned better than direct stocked fish by a ratio of nearly 7:1

(Bishop et al. 2004). The first returns of marked steelhead to the Niagara River are expected in fall 2005/spring 2006, when yearlings stocked in 2004 begin to return.

Chinook Salmon

Substantive returns have been recorded from all year classes stocked at Oak Orchard and Lower Niagara River. The 2001 year class, which was the final stocking of the evaluation at Oak Orchard, returned at age-3 in 2004, effectively completing that evaluation. Returns from both year classes stocked at Oak Orchard revealed that pen reared fish returned to the stocking site best (Table 2). Direct stocked Caledonia fish returned better than direct stocked Salmon River fish from the 1999 stocking,

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but the opposite was true, to a lesser degree, for the 2001 stocking.

Returns to the stocking site at Niagara River are

showing a very different pattern. Returns from both stockings reveal that the direct stocked fish from Salmon River are returning best, followed by the pen reared fish, and direct stocked fish from

Table 2. Chi square tests for 1:1:1 return ratios of chinook salmon stocked from the Caledonia Hatchery (direct /CD), the Salmon River Hatchery (direct /SR), and Salmon River Hatchery fish reared in net pens (pen /SR) at Oak Orchard and the Lower Niagara River 1999-2002.

Yearclass	Stocking Location	Return Location	Year Returned	Method / Hatchery			chi square	p			
				direct /CD	direct /SR	pen /SR					
2002	Niagara R	Niagara R	2003	10	18	18	2.8	0.24			
			2004	14	32	20	7.7	0.02			
			All	24	50	38	9.1	0.01			
		Oak Orchard	2003	1	0	0	-	-			
			2004	2	8	4	4.0	0.13			
			All	3	8	4	2.3	0.24			
2001	Oak Orchard	Niagara R	2002	1	2	0	-	-			
			2003	12	8	8	1.2	0.56			
			2004	3	4	8	2.8	0.24			
			All	16	14	16	0.2	0.91			
		Oak Orchard	2002	1	0	1	-	-			
			2003	8	3	32	33.9	< 0.01			
			2004	5	18	45	37.1	< 0.01			
			All	14	21	78	66.1	< 0.01			
			2000	Niagara R	Niagara R	2001	6	35	16	23.1	< 0.01
						2002	46	52	52	0.5	0.78
2003	90	115				113	3.7	0.15			
2004	0	1				0	-	-			
All	142	203			181	11.0	< 0.01				
Oak Orchard	2001	1			1	1	-	-			
	2002	3	3	2	0.3	0.88					
	2003	4	6	12	4.8	0.09					
	2004	1	0	0	-	-					
	All	9	10	15	1.8	0.40					
1999	Oak Orchard	Niagara R	2001	4	9	4	3.0	0.23			
			2002	5	2	7	2.7	0.25			
			2003	2	0	1	-	-			
			All	11	11	12	0.6	0.96			
		Oak Orchard	2001	20	4	27	16.5	< 0.01			
			2002	18	9	31	12.8	< 0.01			
			2003	0	2	0	-	-			
			All	38	15	58	25.3	< 0.01			

Caledonia are returning the poorest. Age-3

returns from the 2002 stocking will be monitored

in 2005.

Straying of these fish to the Salmon River does not appear to be a problem. Returns from the stocked lots to Salmon River Hatchery have been negligible. To date, only two study fish have been collected at the Salmon River Hatchery, one fish from the 2000 yc Niagara River pen stocking, and one from the 1999 yc Oak Orchard, Salmon River direct stocking. No marked fish were sampled in 2003 or 2004.

There is sufficient straying between the stocking sites for evaluation (Table 2). The chi-square tests of association for returns to the monitoring sites revealed that there were no differences ($p > 0.45$) in the distribution of returns from the different stocking methods for either of the Niagara River stockings (i.e., there was no effect of stocking method on the relative amount of straying).

For both Oak Orchard stockings, however, there were significant differences ($p < 0.05$) in the distribution of returns from the different stocking methods to the monitoring sites. For the 1999 yc, relatively higher numbers of direct stocked Salmon River fish strayed to the Niagara River. For the 2001 yc, relatively higher numbers of direct stocked Caledonia fish strayed to the Niagara River. For both year classes, and especially the 2001 yc, the tendency for relatively fewer of the pen reared fish to stray suggests a relatively strong homing influence for the fish pen reared at Oak Orchard.

One somewhat surprising result of the monitoring efforts is the relatively high numbers of unmarked chinook observed in the samples. This has been the case every year at both sites. For example, 77.4% of all chinook stocked at Oak Orchard in 2001 were fin clipped. In 2004, we observed 1,782 chinook salmon at the stocking site and only 68 (3.8%) of those were marked fish from that stocking. Similarly, in 2004 at Lower Niagara River, we observed 66 marked fish (8% of the

sample) from the 2002 stocking. Sixty-five percent of that stocking had fin clips.

We did not age the unmarked fish in the samples but years of returns at Salmon River Hatchery and returns of marked fish in this study show strong contributions from age-2 and 3 chinook in any given spawning run. As a result, in any sampling year at either site, approximately half of the sample was from a year class that had a high percentage of the stocking that was fin clipped. Consequently, we would have expected to see a higher percentage of fin clipped fish in the samples.

Reasons for the relatively low numbers of fin clipped fish in the samples are not known. Perhaps these sites attract a relatively large number of strays which would be unmarked. Straying of marked fish between sites in this study suggest that this may be true. Another potential source of unmarked fish could be wild fish. Finally, it is possible that fin clipped fish simply do not survive as well as unmarked fish.

Despite whatever may be causing the relative scarcity of marked fish in our samples, we feel that the returns of marked fish in our study is providing a fair assessment of the relative performance of the stocked lots. If the pen reared fish were returning the most fish at both sites, one could argue that the extended period of post-clipping recovery afforded by the time in the pens was a factor. This argument fails, however, when one considers that the direct stocked fish from Salmon River have returned the most fish to Lower Niagara River.

References

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