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OF EMERGENT CHUM SALMON
(*ONCORHYNCHUS KETA*) FRY AT
MAIN BAY HATCHERY, PRINCE WILLIAM
SOUND, ALASKA (1983)

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ABSTRACT

As part of on-going studies to evaluate hatchery culture of chum salmon *(Oncorhynchus keta)* at the Main Bay Hatchery, three groups of emergent fry (mean body weight = 0.33 g) were placed in saltwater rearing pens after 0, 7, and 14 days of in-hatchery freshwater rearing. Each group was reared for 30 days in seawater and growth data were collected periodically. A separate group of emergent chum fry were held in full strength seawater (salinity = 30 0/00) for 48 hours to test for initial mortality.

All groups exhibited a decrease in mean body weight after 24 hours in saltwater. Group A (0 days freshwater rearing) recovered initial weight loss at a slower rate than Groups B and C (7 and 14 days freshwater rearing respectively). Fry mortality for the 30-day rearing period was less than 0.5% per group for all groups. Mortality for the single lot of emergent fry held in full strength seawater was 3.0% after 48 hours.

At the Main Bay Hatchery, emergent chum fry can be transferred directly to seawater upon emergence, but because of losses in body weight, it is recommended that fry be reared in freshwater for a minimum of 2 weeks prior to release or rearing in seawater.

Key Words: Chum salmon fry, saltwater rearing, hatchery incubation, salinity tolerance, and osmoregulation.

INTRODUCTION

Chum salmon fry *(Oncorhynchus keta)* generally begin seaward migration soon after emergence from the spawning grounds but may spend extended periods of residence in freshwater or in

the inner estuary where distribution is influenced by food availability and diel fluctuations in salinity. Acclimation to full strength seawater is a transitional process with osmoregulatory changes occurring gradually over time. In a study of behavioral ecology of chum fry on Vancouver Island, British Columbia, Mason (1974) presented evidence showing that seaward migrating chum fry showed preferences for various salinities in estuaries.

In a hatchery situation, the transfer of emergent chum fry from freshwater to full-strength seawater may induce mortality or severe physiological stress that may affect growth. Dudiak (1979) reported high mortality (84%) of emergent chum fry that were transferred from hatchery incubators to rearing pens in seawater (salinity >20 0/00). In Japan, Iioka (1978) and Koganezawa et al. (1968) reported that their stocks of chum salmon experienced high mortality when transferred to saltwater at small sizes (body weight ≅ 0.35 g).

Main Bay Hatchery, a chum and pink salmon *(Oncorhynchus gorbuscha)* production facility located in northwestern Prince William Sound, was designed for an incubation capacity of approximately 65 million eggs. Modification of the hatchery incubation system has increased the facility production capacity to over 100 million chum salmon eggs. The potential exists to further increase the capacity to near 150 million eggs. The facility incorporates eight indoor raceways for freshwater rearing of up to 25 million chum fry at any one time.

Since completion of the hatchery in 1982, a chum salmon brood-stock development program has been in progress. A non-indigenous stock of early run (summer) chum salmon from Wells River was selected as a donor stock for the program.

Two years of above-average chum salmon escapements into Wells River has allowed the program to proceed ahead of previously scheduled annual egg-take goals. The first chum salmon returns to the facility are anticipated in 1985, and full production is expected to be reached in 1986.

To gain a better understanding of how an introduced chum salmon stock responds to hatchery cultivation, several experiments are being conducted at the Main Bay Hatchery. This applied research deals primarily with incubation techniques and post-emergence rearing. Information gained from this type of research will be valuable in determining egg and alevin development schedules, production rearing schedules, optimal size of fingerlings at release, and optimal release timing.

The aim of the work outlined in this report is to develop information on the adaptability of hatchery-incubated chum fry to seawater. More specifically, the project is designed to subject emergent and post-emergent chum fry to estuarine conditions in order to monitor osmoregulatory response and to gain information on fry growth in seawater. This information may be useful if a large-scale saltwater rearing program is developed at Main Bay or if a situation occurs where the freshwater rearing capacity of the facility is exceeded and emergent chum fry must be released directly into the bay.

MATERIALS AND METHODS

Immediately after emergence from incubation units, hatchery-incubated chum fry with an average individual body weight of 0.33 g were separated into three lots (250 fry per lot). A single lot, Group A, was placed in a 3.5-m^3 saltwater rearing pen. The two remaining lots, Groups B and C, were held and fed in a hatchery raceway for 7 and 14 days,

respectively, prior to transfer to 3.5-m^3 saltwater rearing pens.

All three lots were sampled for length and weight: prior to transfer to seawater; after 24 hours in seawater; after 2 weeks in seawater; and after 4 weeks in seawater. All groups were fed Alaska Dry Pellets at a rate of approximately 2% of body weight per day. Mortalities were enumerated on a daily basis and seawater temperatures and salinities were sampled daily at surface and at a depth of 1.2 m (bottom) in the rearing pens. Each group was released after 30 days of saltwater rearing. A single lot of 100 emergent fry was placed in a holding container and held in full strength seawater (salinity = 30 0/00); mortalities were enumerated after 48 hours, and the live fish were released.

RESULTS

Seawater Temperatures and Salinities

Water temperatures remained relatively stable during the 44 days the experiment was in progress. There was an increase of 0.4°C for both mean surface and subsurface temperatures (Table 1) during the experiment. The variation in surface salinities (2.0 0/00 to 22.0 0/00) was influenced primarily by tidal cycles and discharge from Main River. Subsurface salinities were more stable and varied from 13.0 0/00 to 30.0 0/00. The surface to subsurface variation allowed rearing fry to select less saline water.

Table 1. Seawater temperatures and salinities on surface and at 1.2-m depth in rearing pens which contained three groups of chum fry during seawater tolerance tests at Main Bay, 1983.

Test Group Time Period	Temperature (°C) Mean	S.D.	Range	Salinity (0/00) Mean	S.D.	Range
			Surface			
Group A 2/24 - 3/26	3.5	0.64	2.3-4.9	12.4	5.19	2.0-22.0
Group B 3/04 - 4/02	3.8	0.57	2.4-4.9	13.4	5.36	2.0-22.0
Group C 3/11 - 4/09	3.9	0.47	2.9-4.9	12.9	4.95	3.0-21.0
			1.5-m Depth			
Group A 2/24 - 3/26	3.7	0.54	2.4-4.7	24.9	3.78	13.0-30.0
Group B 3/04 - 4/02	3.9	0.48	2.8-4.8	26.0	2.47	19.0-30.0
Group C 3/11 - 4/09	4.1	0.42	3.2-4.9	25.2	3.27	14.0-30.0

Fry Mortality and Growth

Fry mortality was less than 0.5% per group during the 30-day saltwater rearing period for the three groups tested. Approximately 80% of the fry mortality in Group A occurred during the first 4 days of saltwater rearing. There were no apparent trends in fry mortality in Groups B and C during the rearing period. Overall mortality of saltwater-reared fry was comparable to mortality of fry reared in the hatchery raceways in 1983. For the single lot of emergent fry held in full strength seawater, mortality was 3.0% after 48 hours.

All three groups showed a decrease in mean body weight after 24 hours in saltwater (Table 2). Group A showed a decrease after 2 weeks of saltwater rearing but a slight increase after 30 days. Groups B and C showed an increase in mean body weight after 2 and 4 weeks of rearing in salt water.

DISCUSSION

The results of this study indicate that the transfer of hatchery-incubated chum fry into saltwater rearing pens immediately after emergence will not induce significant mortality but may result in a decrease in mean body weight. At temperatures less than 5.0°C, Group A did not regain the initial mean body weight (emergent weight) until close to 4 weeks of saltwater rearing. Groups B and C exhibited similar initial decreases in mean body weight but regained weight at a faster rate and had larger increases in total weight than Group A during similar 30-day rearing periods.

Table 2. Growth of three groups of chum salmon fry in saltwater rearing pens after 0, 7, and 14 days of freshwater rearing, Main Bay Hatchery, 1983.

Date	n	Mean (mm) Length	S.D.	Mean (g) Weight	S.D.	Cumulative (g) Weight Change	Sample Explanation
			Group A. 0 days of freshwater rearing				
2/24	150	35	1.2	0.33	0.04		Emergent fry.
2/25	50	35	1.2	0.27	0.04	-0.06	24 hrs. saltwater rearing
3/11	50	34	1.2	0.30	0.04	-0.03	2 weeks saltwater rearing
3/26	50	36	1.2	0.35	0.06	+0.02	4 weeks saltwater rearing
			Group B. 7 days of freshwater rearing				
2/24	150	35	1.2	0.33	0.04		Emergent fry.
3/03	50	34	1.6	0.33	0.05		7 days freshwater rearing
3/04	50	34	1.6	0.28	0.03	-0.05	24 hrs. saltwater rearing
3/18	50	35	1.2	0.34	0.04	+0.02	2 weeks saltwater rearing
4/02	50	37	1.9	0.40	0.08	+0.08	4 weeks saltwater rearing
			Group C. 14 days of freshwater rearing				
2/24	150	35	1.2	0.33	0.04		Emergent fry.
3/10	50	36	1.3	0.34	0.04		14 days freshwater rearing
3/11	50	36	1.3	0.32	0.04	-0.02	24 hrs. saltwater rearing
3/25	50	37	1.2	0.40	0.07	+0.05	2 weeks saltwater rearing
4/04	50	37	1.8	0.43	0.07	+0.09	4 weeks saltwater rearing

Faster growth rates of Groups B and C in saltwater could be related to two factors. First, freshwater rearing of emergent chum fry prior to transfer into seawater could increase osmoregulatory ability. This could result in less physiological stress and dehydration during the initial period of saltwater rearing. Second, fry in Groups B and C, having already developed feeding responses during in-hatchery rearing, would have a feeding advantage over Group A, which had no prior exposure to artificial feeding.

Based on the results of this study it is recommended that at the Main Bay Hatchery, emergent chum salmon fry be reared in freshwater a minimum of 14 days prior to transfer to seawater rearing pens or release into the bay. Presently underway are additional rearing studies to evaluate the optimal size of hatchery-reared chum fry before transfer to salt water.

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