Harvest, Age, and Size at Age of Chinook and Coho Salmon at Strawberry Creek Weir and Besadny Anadromous Fisheries Facility Fall 1999

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ABSTRACT

In the fall of 1999, the harvest of live chinook salmon *Oncorhynchus tshawytscha* at the Strawberry Creek Weir (SCW) dropped to less than 1,000 fish and only 0.6 million chinook eggs were collected. Another 1,000 dead salmon were collected or observed in Strawberry Creek or near the mouth of Strawberry Creek along the Sturgeon Bay shoreline. This was the lowest live fish harvest since the 1970's when harvest records for Strawberry Creek were first kept. The low return was the direct result of very low flow conditions in Strawberry Creek (estimated at approximately 100 GPM) exacerbated by the lowest Lake Michigan level in decades (Figure 1).

Figure 1.-Dead female chinook salmon in Strawberry Creek, fall 1999. As a result of very low flow conditions during the fall of 1999, hundreds of adult salmon were stranded and died attempting to ascend Strawberry Creek.

During the fall of 1999 age 1+ precocious males dominated the live chinook harvest because older, larger chinook had difficulty moving up Strawberry Creek and entering the pond. The extreme conditions also impacted the sex ratio of chinook captured at SCW. The sex ratio of the 1999 live fish harvest was 81 percent male and 19 percent female. The sex ratio of the dead fish collected and observed in 1999 was 57 percent male and 43 percent female.

The age composition of the entire chinook harvest at SCW consisted of 43 percent age 1+, 37 percent age 2+, 19 percent age 3+, and one percent age 4+ salmon. The age composition of chinook returning to Strawberry Creek in the fall of 1999 was heavily influenced by low flow conditions in Strawberry Creek. Most of the older, larger chinook were unable to ascend Strawberry Creek and enter the pond.

The average and trophy weights of chinook salmon returning to SCW in the fall of 1999 were down from the weights observed in the previous year. The decrease in average weight and trophy weight was heavily influenced by the extreme conditions that occurred at Strawberry Creek during the fall of 1999.

Size at age 1+ and age 2+ for coded wire tag (CWT) chinook salmon at SCW was up in the fall of 1999. Age 1+ fish (all males) were the largest (length and weight) since these statistics have been kept (1983). Average length of age 1+ males was up 98 mm and average weight was up 1.0 kg from the 1998 averages. The average size of age 2+ CWT salmon harvested at SCW also increased over 1998 averages. Movement of the larger, older age 3+ and age 4+ chinook was hampered by the extreme low flow and low water level conditions and as a result they were not collected in sufficient numbers to allow accurate size at age determination.

A total of 342 adipose clipped chinook were recovered at SCW during the fall of 1999. Low flow and low water levels affected the number of adipose clipped fish returning to SCW. 1,000 plus CWT chinook were expected at SCW in the fall of 1999 had conditions been normal.

Chinook treated with thiamine returned to SCW at nearly the same rate as chinook that had not been treated with thiamine. Although non treated chinook were generally slightly larger (length and weight) at age than treated chinook, the size difference was negligible.

A total of 5,798 chinook salmon were captured at Besadny Anadromous Fisheries Facility (BAFF) in the fall of 1999. This is the most chinook captured at BAFF since record keeping began in 1990. Approximately 3.3 million eggs were harvested at BAFF in the fall of 1999.

A total of 496 adipose clipped chinook were harvested at BAFF in 1999. Of these, 291 (all age 1+ precocious males) were from Kewaunee River releases, 179 were strays from SCW, and three were strays from the Michigan Department of Natural Resources Swan Creek stocking on Lake Huron. The 179 CWT strays from SCW represent a higher than usual number of strays from SCW and was likely the result of the low flow, low water level conditions at SCW.

During the fall of 1999, a total of 1,638 coho were captured at BAFF. The coho return in the fall of 1999 was 20 percent below the ten year average (1990-1999). Approximately 1.315 million coho eggs were collected at the BAFF during fall 1999 and transported to Kettle Moraine Springs Fish Hatchery for hatching and rearing. Another 0.130 million coho eggs were collected at Kettle Moraine Fish Hatchery from coho originally captured at BAFF but transported to the hatchery for ripening and spawning.

Coho captured at BAFF in the fall of 1999 were larger (mean length and weight) than coho captured at BAFF in recent years. Age 1+ males captured at BAFF in the fall of 1999 averaged 478.4 mm and 1.1 kg. Age 2+ males averaged 812.5 mm and 5.1 kg while age 2+ females averaged 776.8 mm and 4.9 kg. This increase in size at age for coho harvested at BAFF mirrors that seen in chinook salmon harvested at SCW.

INTRODUCTION

STRAWBERRY CREEK

The Wisconsin Department of Natural Resources (WDNR) chinook salmon *Oncorhynchus tshawytscha* program began in the spring of 1969 when approximately 65,000 fingerlings were stocked in Strawberry Creek, Door County. Each year thereafter, an average of 200,000 fingerlings have been released at this Door County site (Figure 2). A fish trap or weir was constructed on Strawberry Creek, and chinook eggs have been collected from sexually mature fish that returned to Strawberry Creek since the fall of 1972. Chinook salmon returning to Strawberry Creek Weir (SCW) have provided eggs for Wisconsin's Great Lakes stocking program and for other state and federal stocking programs. In addition detailed biological information regarding the spawning run has been collected since the late 1970's. Biological data obtained at SCW each fall during the harvest provides important information on chinook age, growth, movement, relative survival, various chinook studies, and comparisons of various disease treatment techniques.

Chinook spawning at the weir begins with the careful examination of each male and female salmon. Only fish with no gross signs of disease are selected for spawning. Compressed air is injected into the body cavity of the female salmon to expel the eggs. The body cavity of each female salmon is then carefully inspected by hatchery personnel for clinical signs of disease. Eggs from female salmon with no clinical signs of disease are then drained of ovarian fluid, fertilized, and water hardened. Since the fall of 1994 chinook eggs have been water hardened in a thiamine enriched solution. Chinook eggs harvested at SCW are transferred to WDNR hatcheries for hatching and rearing. In spring, chinook fingerlings from Wild Rose Fish Hatchery are stocked into SCW pond and held for a period of six to eight weeks. While in the pond they receive two or more daily feedings. During this time, the fish imprint to the stream water flowing through the pond. Upon release the fingerlings, which over the years have averaged approximately 90 mm in length, gradually leave SCW pond. Over the next two week period they make their way down Strawberry Creek (about ½ mile) to the Sturgeon Bay ship canal and eventually into Lake Michigan.

In late August and early September mature chinook begin to return to SCW. The salmon swim up Strawberry Creek, through a weir, and into a pond. Actual harvest and egg collection begins in late September and continues for about four to six weeks. The run usually peaks in mid October.

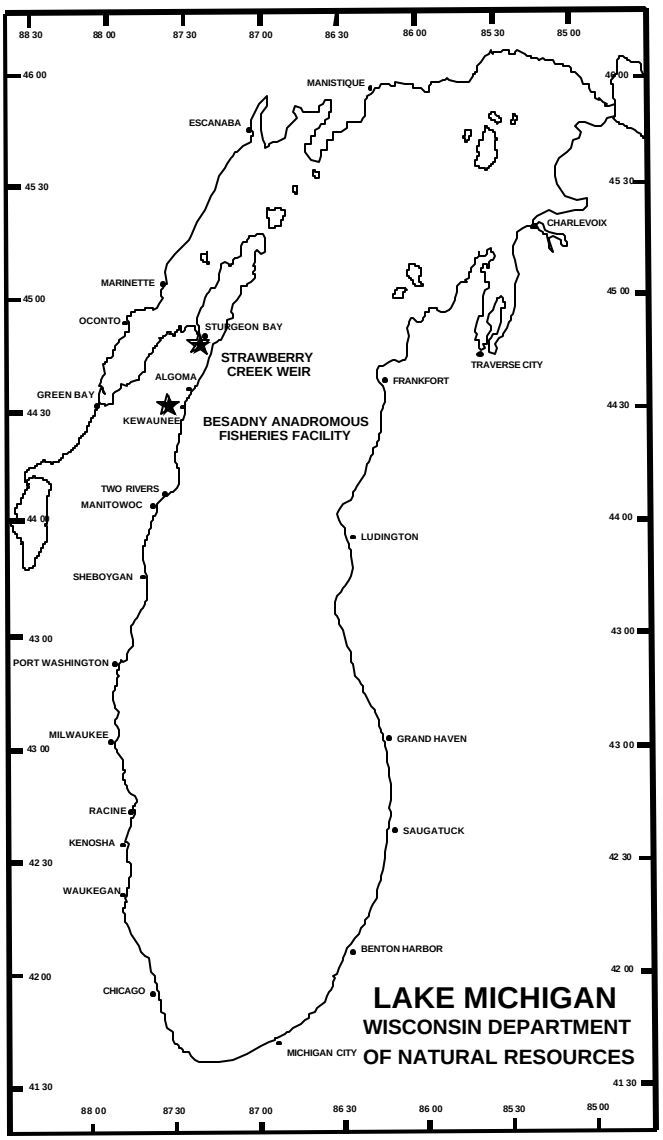

Figure 2.-Location of the Wisconsin Department of Natural Resources Strawberry Creek Weir, Door County, and the Besadny Anadromous Fisheries Facility, Kewaunee County.

SCW was one of four original release sites when coded wire tag (CWT) studies began in 1982. The primary objective of the first CWT study was to determine the movement patterns and growth of CWT chinook. From 1982 to 1984, 20,000 CWT chinook fingerlings were released annually from SCW. The first return of CWT salmon to SCW pond occurred in 1983 and has continued yearly. Since 1985, we have continued to tag a portion of the fingerlings released from SCW pond to monitor the growth of known age salmon and to conduct various treatment experiments. Since 1985, an age length key composed of known aged CWT fish has been used to estimate the age composition of the entire harvest. Prior to this time, a length frequency distribution was used to estimate the age composition of the fall run.

KEWAUNEE RIVER

Egg taking operations for chinook and coho salmon *Oncorhynchus kisutch* were conducted for the first time in fall 1990 at a new anadromous fish facility on the Kewaunee River, Kewaunee County (Figure 2). This facility, later named the Besadny Anadromous Fisheries Facility (BAFF), is one of the two WDNR primary egg collection stations for coho and rainbow trout (steelhead) *Oncorhynchus mykiss*. BAFF also functions as a backup for chinook egg collection.

Previously chinook and occasionally coho were imprinted in a rearing pond and released several miles down river from the new facility. The pond has been renovated and is still used for rearing chinook and coho for release to the Kewaunee River. Additionally, some coho and chinook are released directly into the Kewaunee River. Prior to 1990, very little biological information was collected on the fall runs of chinook and coho from the Kewaunee River. Now that BAFF is operational, chinook and coho runs are sampled annually. Current studies include age, growth, rate of return, comparisons of strain evaluations, comparisons of rearing techniques, and comparisons of disease treatment techniques, on both chinook and coho salmon. CWTs have also been used intermittently at BAFF for various chinook and coho salmon studies.

The life history of coho is similar to that described above for chinook. Coho are released directly into the lake or stream as yearlings in spring or as young of the year fingerlings in late summer to mid fall. Mature fish home back to the release site to spawn in late fall. Whereas most chinook mature as age 2+ or age 3+, most coho mature and return at age 2+.

METHODS

At the time of stocking or transfer to a rearing pond, and again at the time of release from the rearing pond, subsamples of fingerlings were individually measured to the nearest mm, and weighed (10 fingerlings at a time) to the nearest gram. At the time of harvest, all live chinook at SCW and a sample of chinook and coho at BAFF were measured to the nearest millimeter. Weights on all CWT salmon and approximately half of the remaining salmon were measured to the nearest .02 kilogram with an electronic digital scale. Sex was visually determined for all fish and finclips were noted. The heads of all adipose-clipped salmon (probable CWT) were collected, marked with a sequentially numbered jaw tag, and frozen for future examination. In the lab, the presence of a microtag in each head was confirmed with the use of a metal detector. All CWTs were retrieved by dissection and decoded with a compound microscope. The binary code on each CWT identifies year of stocking, the agency that stocked the fish, the location of stocking, and the treatment group of each fish. Known age CWT chinook returning to SCW in 1999 were used to develop a length at age key for aging non-CWT chinook returning in 1999.

Trends in size and condition of chinook salmon harvested at SCW have been examined each year since 1974. Annual sample sizes have ranged from 171 fish to 4,246 fish. Only fish for which both total length and round weight were recorded were used in calculations. Three measures of estimated weight were calculated and analyzed for each year. They include: 1) average weight; 2) trophy weight (weight of the 95^{th} percentile of the weight distribution); and 3) standard weight (predicted weight of a 30 inch chinook developed from a length-weight regression model). We used the same standard length of 30 inches for chinook salmon as calculated by Hansen (1986), who conducted a similar study on sport harvested chinook for the years 1969-1984. Statistical procedures were also the same as those used by Hansen.

RESULTS AND DISCUSSION

STRAWBERRY CREEK CHINOOK

GENERAL HARVEST

The fall of 1999 was very atypical and all observations and results must be considered in the context of the extreme conditions experienced. The harvest of live chinook salmon *Oncorhynchus tshawytscha* at the Strawberry Creek Weir (SCW) dropped to 998 fish and only 0.6 million chinook eggs were collected (Table 1). Another 936 dead salmon were collected or observed in Strawberry Creek or near the mouth of Strawberry Creek along the Sturgeon Bay shoreline. This was the lowest live fish harvest since the 1970's when detailed harvest records for Strawberry Creek were first kept (Table 2). The low return was the direct result of very low flow conditions in Strawberry Creek (estimated at approximately 100 GPM) exacerbated by the lowest Lake Michigan levels in decades (Figure 3).

Figure 3.-Strawberry Creek, fall 1999. Very low flow conditions and low Lake Michigan levels made it impossible for most adult chinook salmon to reach the Strawberry Creek Weir. Hundreds of salmon were stranded in the creek and died. Many others never even made it into the creek and died in Sturgeon Bay.

The summer of 1999 was particularly hot and dry (El Nino). In September of 1999, Strawberry Creek was warm, the flow was very low, and because of low Lake Michigan levels, the Strawberry Creek channel between Sturgeon Bay and the Strawberry Creek pond was essentially a ¼ mile long mud flat with a trickle of water (Figure 3). During the fall of 1999 age 1+ precocious males dominated the live chinook harvest because older, larger chinook had difficulty moving up Strawberry Creek and entering the pond. One moderate rain event on September 27th temporarily increased the flow in Strawberry Creek slightly, and for several days a few older larger chinook managed to reach the Strawberry Creek pond. Nearly no additional rain was received in the Sturgeon Bay area during the remainder of September or throughout October. Typically, chinook begin to enter SCW by mid September and by the end of September, enough chinook have entered SCW that one or more harvests have been made to reduce the number of chinook (mostly males) in the pond.

The sex ratio of the 1999 live fish harvest was 81 percent male and 19 percent female. The sex ratio of the dead fish collected and observed in 1999 was 57 percent male and 43 percent female. The overall sex ratio of the entire run (live and dead) was 70 percent male and 30 percent female. Only 0.6 million chinook salmon eggs, of the 3.5 million hatchery quota, were harvested at SCW during the 1999 spawning run.

Although salmon less than 800 mm were cleared for sale for human consumption, and a request for bids was announced, no bids were received. All of the salmon carcasses from SCW and BAFF were disposed of through a local contractor who agreed to take all of the salmon carcasses at no cost on the condition that all carcasses would be turned into liquid fish fertilizer. In the past the WDNR has had to transport the salmon carcasses to a landfill and pay to for their disposal. Eggs unsuitable for hatchery production were sold under contract to a private company for use in bait production.

The age composition of the entire chinook harvest at SCW consisted of 43 percent age 1+, 37 percent age 2+, 19 percent age 3+, and one percent age 4+ salmon (Table 3). The age composition of chinook returning to Strawberry Creek in the fall of 1999 was heavily influenced by low flow conditions in Strawberry Creek. Most of the older, larger chinook were unable to negotiate Strawberry Creek and enter the pond.

TRENDS IN SIZE AND CONDITION OF CHINOOK SALMON, 1974 - 1999

The average and trophy weights of chinook salmon returning to SCW in the fall of 1999 were down from the weights observed in the previous year (Table 4; Figure 4). The decrease in average weight and trophy weight was heavily influenced by the extreme conditions that occurred at Strawberry Creek during the fall of 1999. Most of the older, larger chinook were unable to reach the SCW and their absence from the harvest skewed the samples to younger, smaller fish. Standard weight was unchanged from 1998 but is within 0.1 pound of the lowest standard weight documented since this characteristic was first described for the SCW chinook in 1974. Average, trophy and standard weights have all gradually declined since the early 1990s.

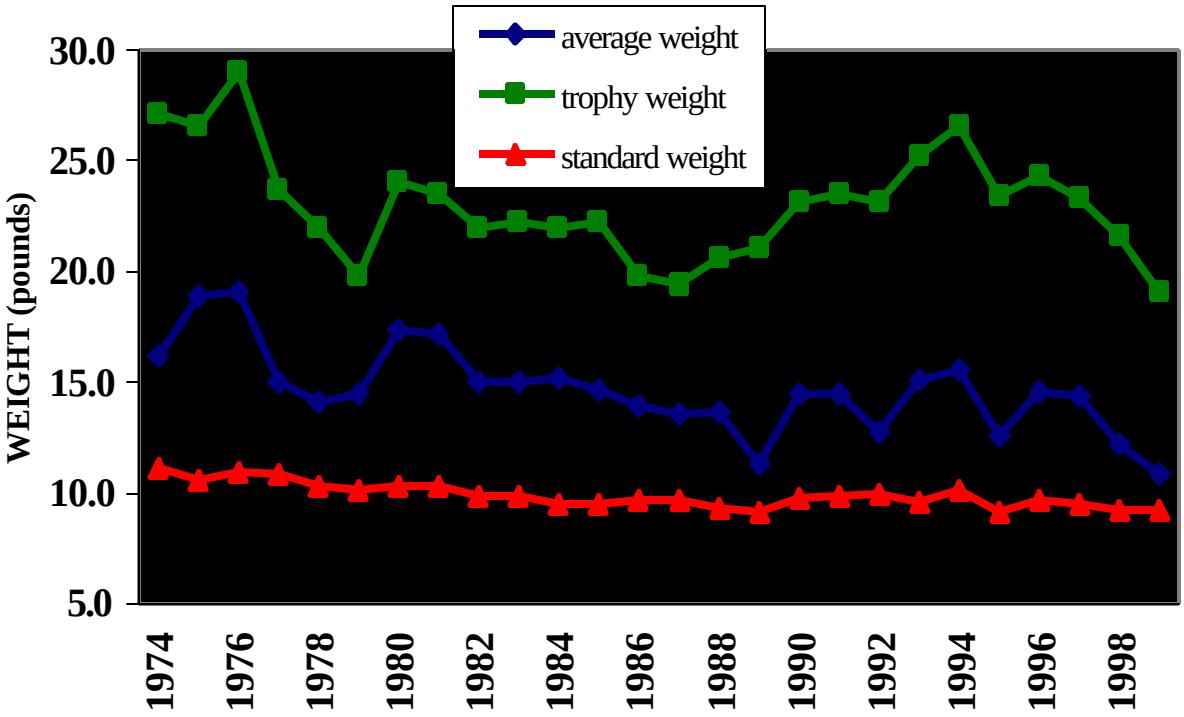

Figure 4.-Average, trophy, and standard weight for chinook salmon harvested at Strawberry Creek, Door County, 1974-1999.

CWT CHINOOK SALMON IN THE HARVEST

A total of 342 adipose clipped chinook were recovered at SCW during the fall of 1999 (Table 2). Low flow and low water levels no doubt affected the number of adipose clipped fish returning to SCW. Based on ongoing studies and the number of CWT chinook stocked at SCW, over 1,000 CWT's were anticipated. A total of 322 (94.2%) CWTs were successfully extracted from the adipose clipped fish, seven (2.0%) tags were lost during extraction, and 13 (3.8%) of the adipose clipped chinook did not have a CWT. All of the recovered CWTs were from chinook released from SCW. For the third consecutive year there was not a single stray from other CWT release sites.

AGE COMPOSITION AND SEX RATIO OF SCW CWT CHINOOK SALMON

Four age classes of CWT chinook were recovered at SCW in 1999 (Table 5, Figure 5). Age 1+ returns (all precocious males) accounted for 55 percent of the CWT harvest. Age 2+ chinook, accounted for 28 percent of the harvest (82 % male, 18 % female). The age 3+ CWT chinook made up 16 percent of the return (32% male, 68 % female) and age 4+ salmon (1 male, 2 female) accounted for one percent of the total CWT harvest.

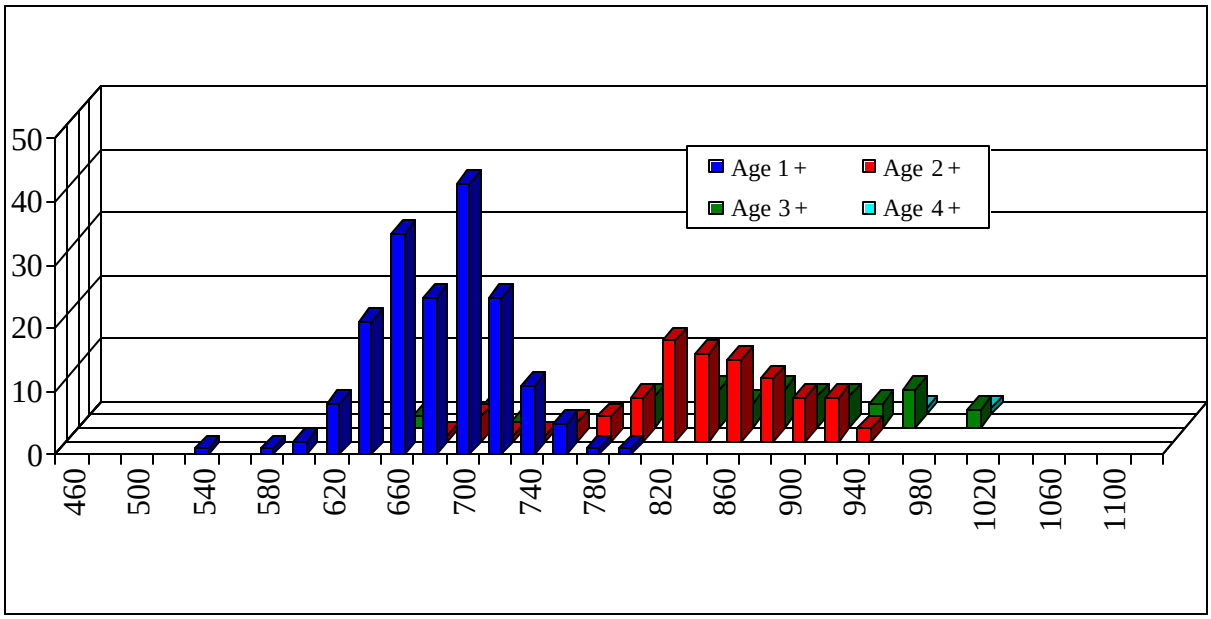

Figure 5.-Length frequency distribution of known age 1+, age 2+, age 3+, and age 4+ CWT chinook salmon harvested at Strawberry Creek Weir, Door County, during the fall spawning run, 1999.

SIZE AT AGE OF CWT SALMON

Size at age of CWT chinook salmon at SCW in the fall of 1999 was up from 1998 (Figures 6, 7, 8, and 9, Appendix A and B). Age 1+ fish (all males) were the largest (length and weight) since these statistics have been kept (1983). Average length of age 1+ males was up 98 mm and average weight was up 1.0 kg from the 1998 averages. There was negligible difference in size between the single paired family (SPF) and standard production age 1+ groups. The average size of age 2+ CWT males harvested at SCW also increased over 1998 averages. In the fall of 1998, Age 2+ males were the smallest since length and weight statistics of SCW, CWT, chinook have been calculated. In the fall of 1999 the average length of age 2+ males increased by 77 mm and average weight increased by 1.4 kg. Age 2+ females were also larger in the fall of 1999. Average length for age 2+ females increased by 30 mm and average weight increased by 0.2 kg. As a direct result of the low flow in Strawberry Creek and the low Lake Michigan levels, not enough of the older, larger age 3+ and age 4+ salmon were harvested at SCW to calculate a meaningful average.

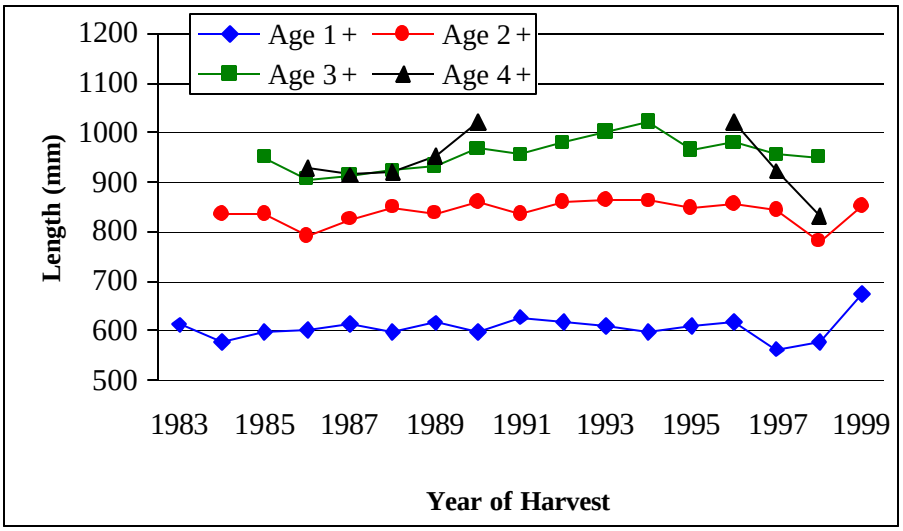

Figure 6.-Mean length of CWT male chinook salmon by age class and year of return to Strawberry Creek Weir, 1983-1999.

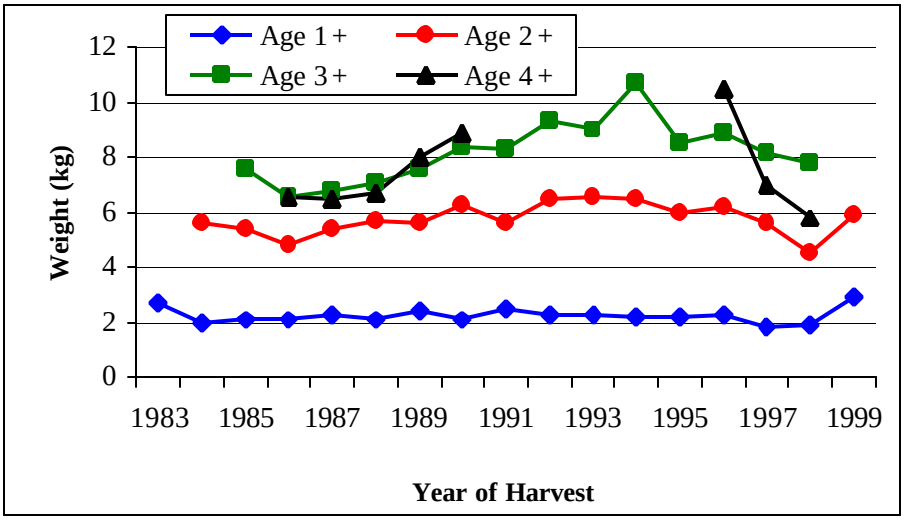

Figure 7.-Mean weight of CWT male chinook salmon by age class and year of return to Strawberry Creek Weir, 1983-1999.

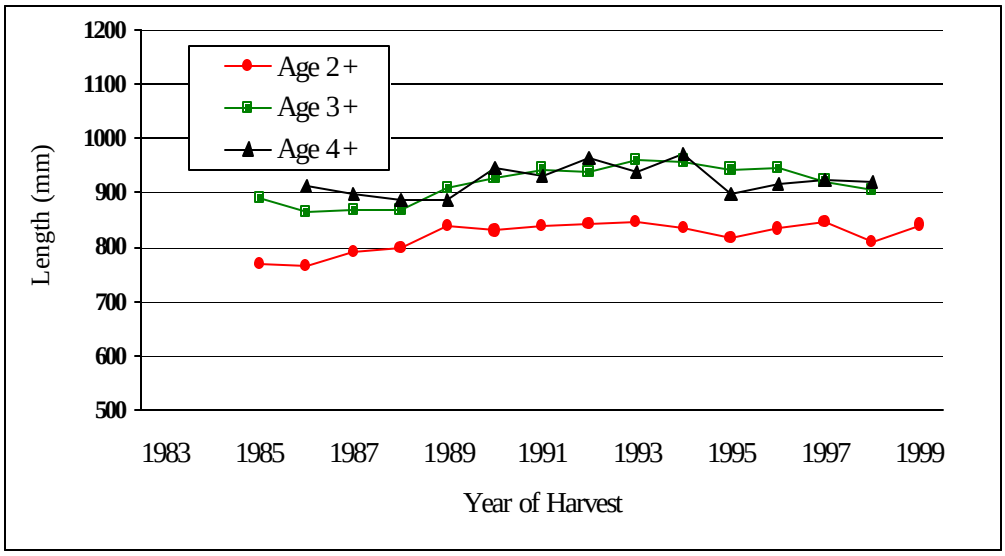

Figure 8.-Mean length of CWT female chinook salmon by age class and year of return to Strawberry Creek Weir, 1983-1999.

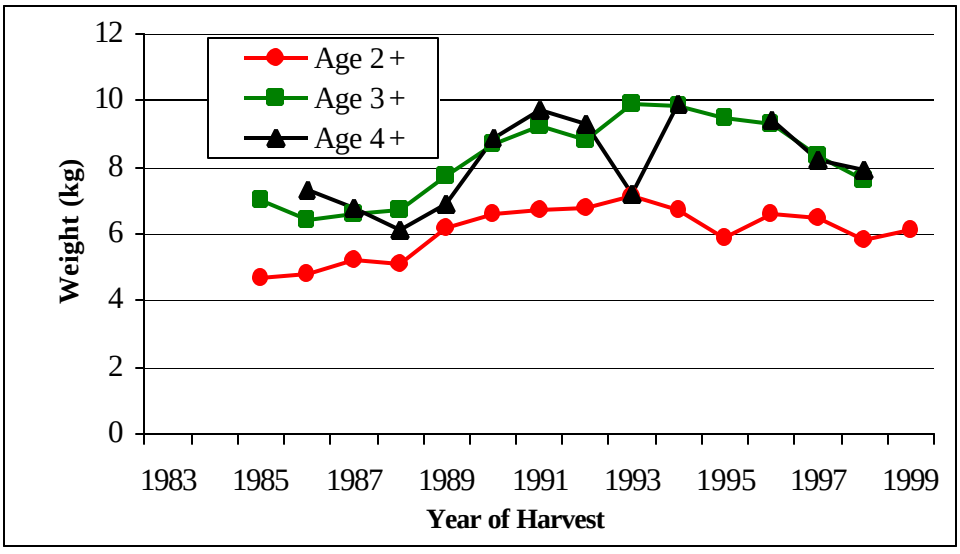

Figure 9.-Mean weight of CWT female chinook salmon by age class and year of return to Strawberry Creek Weir, 1983-1999.

RATE OF RETURN, YEAR CLASS STRENGTH AND SURVIVAL OF CWT SALMON

The rate of return for each of the CWT year classes of chinook salmon stocked at SCW has varied widely from 1982 to present (Table 6; Figure 10). Cumulative return has varied from a low of 0.75 percent for the 1985 year class to a high of 3.24 percent for the 1994 year class. Not only has cumulative year class return rate varied but so has the relative return rate by age within a year class. For the year classes 1982 through 1985, age 3+ chinook were typically 50 percent or more of the cumulative return of that year class. From 1986 through present, with the exception of the 1993 year class, age 3+ chinook have contributed less than 50 percent to the cumulative return rate of any year class. This apparent change in rate of return is associated with the BKD outbreak of 1988 and 1989.

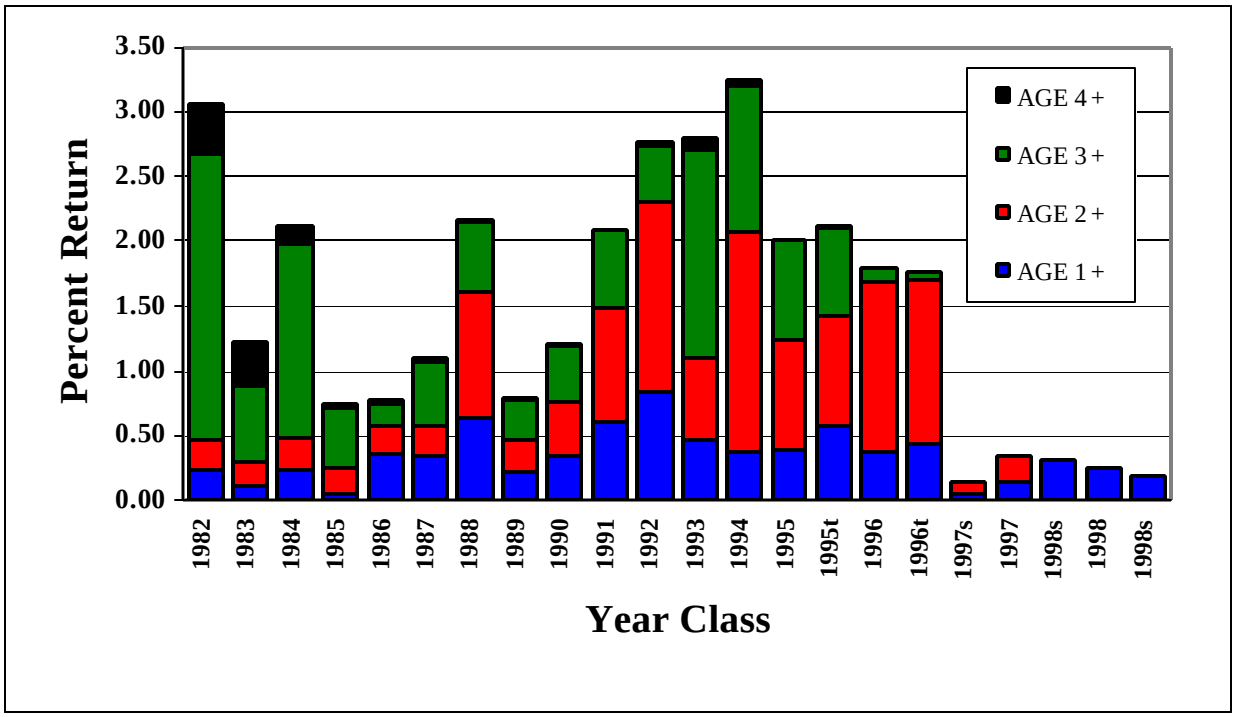

Figure 10.-Cumulative rate of return for the 1982-1998 year classes of CWT chinook salmon stocked at Strawberry Creek Weir, Door County (by year class), age 1+ through age 4+. Year classes identified with a "t" were treated with thiamine as eggs. Year classes identified with a "s" are part of an age at maturity study and were from known age parental stock. Return of the 1998 year class at age 1+, the 1997 year class at age 2+, and the 1996 year class at age 3+ were all heavily influenced by low flow and low water levels in Strawberry Creek.

During the fall of 1999, the return of all year classes, especially the older, larger cohorts were affected by the low flow of Strawberry Creek and the low level of Lake Michigan. No direct comparisons should be drawn between recovery rates observed in the fall of 1999 and any other fall. Comparisons between various same aged cohorts returning in 1999 is likely still valid. Return of the 1995 and 1996 year classes at age 4+ and 3+ were both very low. Both the 1995

and 1996 year classes had CWT cohorts that were part of the thiamine study. Thiamine treated and non treated fish were recovered at similar rates in 1999 and throughout their recovery history. The 1997 year class, recovered at age 2+ in the fall of 1999 and at age 1+ in the fall of 1998, was part of the single paired family, age of maturity, study. The 1998 year class recovered at age 1+ in the fall of 1999 was also part of the age of maturity study.

The estimated number of chinook by age (CWT and non-CWT) returning to SCW is detailed in Table 7. The total percent return is based on the number of chinook fingerlings stocked for each year class. The 1999 SCW harvest was heavily impacted by the water conditions at Strawberry Creek. No direct comparisons should be made between recovery rates in 1999 and other years.

CHINOOK SALMON STUDIES AT SCW

THIAMINE STUDY

Wisconsin and other Great Lakes States have been experiencing problems with a condition known as Early Mortality Syndrome (EMS), especially during the past decade. Researchers believe EMS may be related to the level of thiamine available to developing salmonid eggs. Thiamine treatments during salmon egg water hardening have been shown to reduce EMS in the early life stages, at least until the fish are stocked. A WDNR study was designed to evaluate the possible latent impact of thiamine egg treatment on chinook salmon, post stocking. As part of this chinook study an estimated 25,500 CWT thiamine treated fingerlings and 22,500 CWT non-treated fingerlings from the 1995 year class were stocked at SCW in the spring of 1995 (Table 8). Additionally, an estimated 24,500 CWT thiamine treated fingerlings and 26,000 CWT non-treated fingerlings from the 1996 year class were stocked in the spring of 1996 (Table 8).

The 1995 year class was recovered at SCW as age 1+ in the fall of 1996, as age 2+ in the fall of 1997, as age 3+ in the fall of 1998, and as age 4+ in the fall of 1999. The 1996 year class was recovered at SCW as age 1+ in the fall of 1997, as age 2+ in the fall of 1998, and as age 3+ in the fall of 1999.

Through the fall of 1999 with returns from the 1995 year class as age 1+, 2+, 3+, and 4+, there appears to be very little difference in the recovery rates of chinook that were treated with thiamine versus chinook that were not treated (Table 6, Figure 10). Cumulative return rates for the 1995 year class through age 4+ were 2.12 percent for thiamine treated chinook versus 2.00 percent for chinook not treated with thiamine. Similarly, there is very little difference between returns of treated and non-treated chinook from the 1996 year class through the fall of 1999, as age 1+, 2+, and 3+. Treated chinook from the 1996 year class returned at a cumulative rate of 1.76 percent and non-treated chinook returned at a cumulative rate of 1.80 percent.

As discussed above, the treatment of salmonid eggs with thiamine during the water hardening stage has been documented to improve survival of young salmonids through hatching and yolk sac absorption (Hornung et al. 1995) resulting in improved survival to stocking. This study was designed to evaluate if there was any possible latent impact of the thiamine treatment post stocking. In this study if the thiamine treated chinook were recovered at a higher or even similar rate to the non-treated chinook, thiamine treatment would be considered positive because it had already contributed to a higher percentage of chinook surviving to stocking. No additional substantive returns are expected. Chinook treated with thiamine returned to SCW at nearly the same rate as chinook that had not been treated with thiamine. Although non-treated chinook

were generally slightly larger (length and weight) at age than treated chinook, the size difference was negligible (Appendix A and B).

AGE AT MATURITY STUDY

Throughout the 1970's and up to 1988, age 1+ and age 2+ chinook made up less than half of the total salmon harvested at the SCW. Age 3+ fish provided the majority of the returns and supplied most of the eggs needed for production quotas. From 1989 to the present, however, returns have shifted rather dramatically from primarily age 3+ chinook to predominately age 2+ and age 1+ salmon. The shift in age of fish returning to SCW is believed to have been caused by higher mortality rates of larger, older aged chinook during the BKD epizootic. Since 1989 a higher proportion of age 2+ chinook have been used for spawning purposes at SCW. Age of maturity has been demonstrated to be an inheritable trait in chinook salmon (Hankin et al. 1993). By using younger aged salmon for spawning over the past few years, we may have genetically altered the run of fish at SCW to favor sexual maturity at a younger age.

To evaluate the effect of age of the parent on the age of sexual maturity of their offspring, a separate single paired family (SPF) CWT study was initiated in 1996. For this experiment eggs were obtained from paired spawnings of known age 3+ males and females in the fall of 1996. Age was verified by CWT when possible, or from vertebrae aging of non-CWT fish. The eggs from known age 3+ parents were raised to fingerling size and marked with CWTs prior to being stocked at SCW. One lot of standard production fish from unaged parents was also marked with CWTs and released from SCW. At stocking, the two lots of fingerlings were similar in mean length and weight, 93.4 mm, 9.2 g (age 3+ parents) and 93.0 mm, 9.2 g (unaged parents). SPF eggs were also collected in the fall of 1997. During fall 1997 spawning operations at SCW, known aged 3+ males were paired with known aged 3+ females and known aged 2+ females. The 3+ male, 3+ female eggs were held separate from the 3+male 2+ female eggs through the fingerling stage. Then before stocking at SCW in the spring of 1998 both of these lots were marked with CWTs. A third lot of standard production fingerlings from unaged parental stock was also marked with CWTs and stocked at SCW in the spring of 1998. At stocking the three lots of CWT fingerlings were all similar in length and weight. The standard production CWT fingerlings averaged 83.7 mm and 4.7 g. The CWT fingerlings from age 3+ males and age 2+ females averaged 83.3 mm and weighed 4.7 g. The CWT fingerlings from age 3+ males and age 3+ females averaged 85.5 mm and weighed 5.1 g. All three groups of CWT chinook fingerlings were raised in the SCW pond along with approximately 140,000 standard production chinook until May 13, 1998 when the SCW pond screens were removed, and they were released from the pond. At release the CWT fingerlings averaged 91.8 mm and 5.8 g, and the standard production fingerlings averaged 89.1 mm and 5.5 g.

In the fall of 1998, rate of return for both the standard production CWT fingerlings and the SPF (age 3+ parents) CWT fingerlings, from the 1997 year class, was low when compared to recent years (Table 6 Figure 10). At age 1+ (all precocious males) chinook that were the product of standard production techniques returned to SCW at a rate of 0.14 percent and chinook that were the progeny of known age 3+ parents returned at a rate of 0.06 percent.

In the fall of 1999 two CWT lots from the 1997 year class returned at age 2+ and three CWT lots from the 1998 year class returned at age 1+ (all precocious males). In 1999, the low stream flow and low lake level dramatically influenced the return of chinook to SCW. However, there is no reason to believe that any of the treatment groups within a year class were better suited to deal

with these harsh conditions. The 1997 year class (SPF and standard production) returned at a much lower rate than anticipated (Table 6 Figure 10). Whereas in recent years (1993-1998) age 2+ CWT fish have been returning at a rate ranging from 0.6 to 1.3, in 1999, age 2+ CWT fish were recovered at a rate ranging from 0.08 (SPF from age 3+ parents) to 0.20 (standard production). Standard production fish from this same year class also returned at a higher rate than the SPF fish as age 1+ in 1998. The 1998 year class of CWT fish returned at a relatively normal rate in the fall of 1999. Apparently the younger, smaller chinook were able to better negotiate the low flow, low water level than the older larger fish. The 1998 year class SPF chinook from age 3+ parents returned at a higher rate (0.31) than the Standard production fish (0.25), and the SPF fish from age 3+ males and age 2+ females (0.19).

REARING OF CHINOOK FINGERLINGS

In the spring of 1999 an estimated 211,700 chinook fingerlings were released from the SCW in excellent condition (Table 8). The total number released included an estimated 137,000 unmarked standard production fingerlings, 24,900 standard production A-CWT fingerlings, 25,000 RV A-CWT fingerlings, 8,300 A-CWT fingerlings with a pink photonic mark, 8,300 A-CWT fingerlings with a green photonic mark, and 8,200 A-CWT fingerlings with an orange photonic mark. All of the photonic marked fingerlings were marked with the same CWT lot number.

BESADNY ANADROMOUS FISHERIES FACILITY

CHINOOK

GENERAL HARVEST

A total of 5,798 chinook salmon were captured at BAFF in the fall of 1999 (Table 9). This is the most chinook captured at BAFF since record keeping began in 1990 (Table 10). Of the 5,798 chinook captured, 3,189 (55 percent) were released live upriver. Approximately 3.3 million eggs were harvested at BAFF in the fall of 1999. Adipose clipped salmon (CWT) and chinook needed for disease analysis were also harvested and sacrificed. An additional 452 dead chinook were removed from BAFF during the 1999 fall run. Eggs that were unsuitable for hatchery purposes or obtained from the dead and sacrificed fish were sold, along with the surplus eggs from SCW, under contract to a bait company.

A total of 496 adipose clipped chinook were harvested at BAFF in 1999 (Table 11). Of these, 291 (all age 1+ precocious males) were from Kewaunee River releases, 179 were strays from SCW, and three were strays from the Michigan Department of Natural Resources Swan Creek stocking on Lake Huron. Additionally, six CWTs were lost during extraction, and 17 of the chinook with an apparent adipose fin clip did not have a CWT. The 179 CWT strays from SCW represent a higher than usual number of strays from SCW and was most likely the result of the low flow, low water level conditions at SCW.

As many of the chinook as possible, not harvested for egg production or sacrificed for health studies or CWT extraction, are passed live upstream with as little handling as possible for the sport fishery. Other than detailed information collected on all CWT chinook captured at BAFF,

limited biological information is collected from the non-CWT chinook returning to BAFF. Detailed biological information is collected from chinook returning to SCW each fall and chinook returning to BAFF are believed to have similar biological characteristics.

CHINOOK SALMON STUDIES AT BAFF

STOCKING TECHNIQUE STUDY

The 291 age 1+ CWT chinook, captured at BAFF in the fall of 1999, were part of a chinook salmon stocking technique study. This current study was designed as a follow up to an earlier study, conducted in the late 1980's (Peeters and Toneys, 1995), that compared recovery rates of chinook fingerlings stocked into and released from rearing ponds, stocked into Lake Michigan tributaries, and stocked directly into Lake Michigan. In this earlier study, pond stocked fingerlings were recovered at a higher rate than river stocked fingerlings, which were recovered at a higher rate than fingerlings stocked directly into Lake Michigan. Also, as part of this earlier study one lot of the CWT marked fingerlings destined to be stocked directly into Lake Michigan was diverted to a harbor site because of a pounding surf on the day of stocking. This unplanned, unreplicated stocking of chinook fingerlings into a harbor was recovered at a higher rate than the pooled rates of any of the other stocking techniques.

In the present study, chinook fingerlings were stocked in the Kewaunee River at four locations of varying distance from Lake Michigan. Chinook fingerlings were stocked in the Kewaunee River Harbor, Near BAFF approximately four miles upstream from Lake Michigan, at Clydes Hill Road approximately nine miles upstream from Lake Michigan, and Hwy. 54 approximately 15 miles upstream from Lake Michigan.

Recovery rates of the four lots of 1998 year class chinook salmon, at age 1+, in the stocking technique study ranged from 0.14 percent for the harbor stocked fish to 0.41 percent for the lot stocked approximately nine miles upstream from Lake Michigan (Table 13).

COHO

GENERAL HARVEST

During the fall of 1999, a total of 1,638 coho were captured at BAFF (Table 14). The coho return to the BAFF over the last ten years has ranged from a low of 717 in 1994 to a high of 3,887 in 1990 (Table 15). The coho return in the fall of 1999 was 20 percent below the ten year average (1990-1999). From late September through mid October coho entering BAFF were processed on a regular basis with precocious males being passed upriver as quickly as possible when first handled. Adult coho captured through mid October were generally not ready for spawning and were sorted back to the holding ponds with as little handling as possible. In mid October when coho spawning began all fish that had been sorted back to the ponds and those that had just entered the facility were harvested and spawned. Numbers of coho harvested on specific dates in Table 14 are not indicative of the dates of the coho run because of the practice of sorting adults back to the holding pond. Harvested fish were sexed, checked for fin clips, measured and most of them were weighed. Approximately 58 percent of the coho captured during the fall of 1999 were utilized for spawning or sacrificed health testing purposes. Live coho released upriver for the sport fishery, made up 33 percent of the run, and dead coho collected during the season (9 percent), made up the remainder of the run.

WDNR personnel collected approximately 1.315 million coho eggs at the BAFF over a two week period during fall 1999 (Table 14). Coho eggs collected at BAFF in the fall of 1999 were transported to Kettle Moraine Springs Fish Hatchery for hatching and rearing. Another 0.130 million coho eggs were collected at Kettle Moraine Fish Hatchery from coho originally captured at BAFF but transported to the hatchery for ripening and spawning. Coho eggs not suitable for hatchery production were sold under contract to a bait dealer along with surplus chinook eggs. No adipose clipped coho were collected at BAFF in fall 1999. All CWT coho stocked in the Kewaunee River system in recent years have matured and cycled through the fishery.

Coho returning to BAFF in the fall of 1999 were age 1+ precocious males from the 1998 year class (stocked as fingerlings in the fall of 1998 or as yearlings in the spring of 1999) or age 2+ fish from the 1997 year class (stocked as fingerlings in the fall of 1997 or as yearlings in the spring of 1998) (Table 16). Currently, there are no coho studies in the Kewaunee River system and as a result none of the coho from the 1997 or 1998 year classes were marked with an identifying mark. As a result, coho recovery rate for the 1997 and 1998 year classes (Table 17 Figure 11) is necessarily based on the cumulative recovery of coho stocked as fingerlings and as yearlings. Coho returning to the BAFF were aged by length frequency. Cumulative recovery rate for the 1997 year class was 0.544 percent. Cumulative (two year) recovery rates of coho has ranged from a high of 4.261 percent, for one lot of coho (1994 year class) stocked in the Kewaunee River as part of an erythromycin study, to a low of 0.036 percent, for one lot of coho (1993 year class) stocked as hyper accelerated coho fingerlings. With no identifying fin clips, there is no easy way to differentiate the recovered coho from the 1997 or 1998 year class as to either fingerling or yearling stocked fish. The 1998 year class (all precocious males) was recovered at a rate of 0.035 percent.

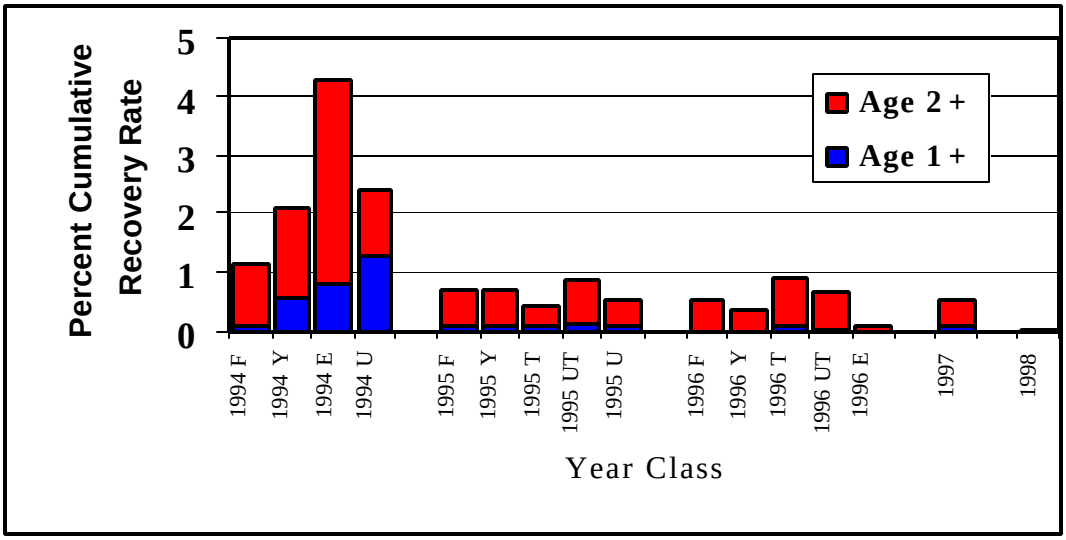

Figure 11.-Coho salmon cumulative recovery rate of return to the Besadny Anadromous Fisheries Facility, Kewaunee County. For year classes 1994, 1995, and 1996, letter designations F (fingerlings), Y (yearlings), E (erythromycin treated), T (thiamine treated), and UT (not treated with thiamine) designate specific marked lots of coho stocked in the Kewaunee for various studies. The 1994U and 1995U lots were unmarked yearlings stocked in the Kewaunee and aged by length frequency. The 1997 and 1998 lots were a combination of unmarked fingerlings and yearlings from the respective year classes and were aged by length frequency.

Coho captured at BAFF (age 1+ males and age 2+ males and females) in the fall of 1999 were larger (mean length and weight) than coho captured at BAFF in recent years (Table 18, Figure 12 and 13). Age 1+ males captured at BAFF in the fall of 1999 averaged 478.4 mm and 1.1 kg. Age 2+ males averaged 812.5 mm and 5.1 kg while age 2+ females averaged 776.8 mm and 4.9 kg. This increase in size at age for coho harvested at BAFF mirrors that seen in chinook salmon harvested at SCW.

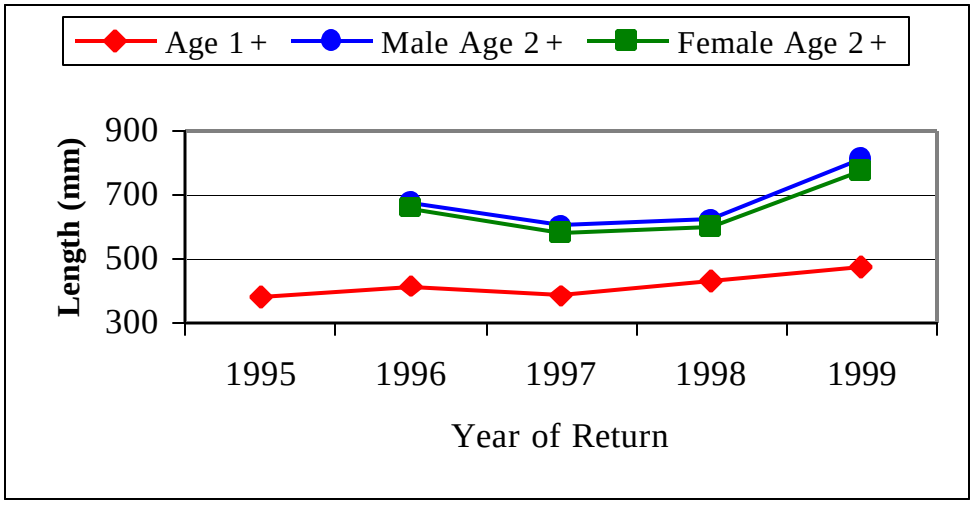

Figure 12.-Mean length of coho salmon by age class and year of return to the Besadny Anadromous Fisheries Facility, 1995-1999.

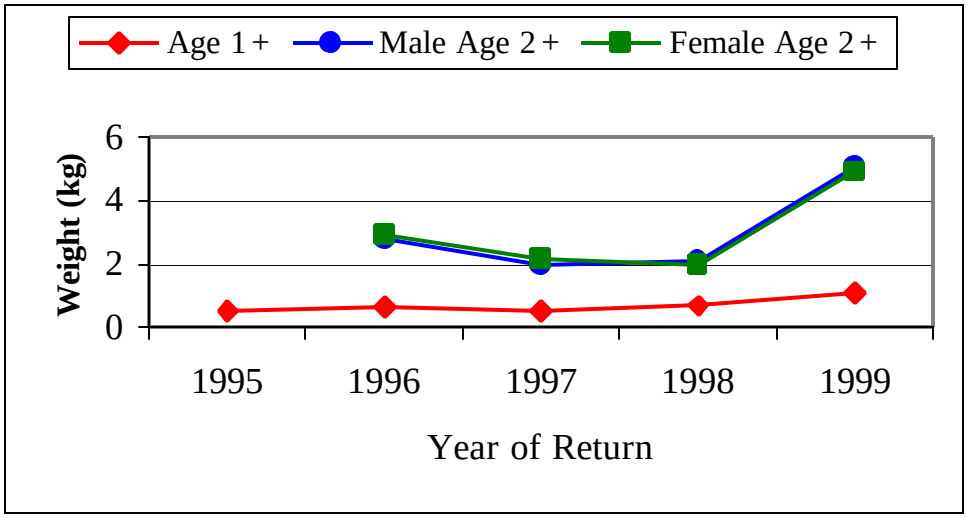

Figure 13.-Mean weight of coho salmon by age class and year of return to the Besadny Anadromous Fisheries Facility, 1995-1999.

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Table 1.-Daily summary of chinook salmon harvest and spawning operations at the Wisconsin Department of Natural Resources spawning facility at Strawberry Creek, Door County, during the fall of 1999.

DATE	LIVE FISH		NUMBER DEAD FISH	TOTAL NUMBER	NUMBER ADIPOSE CLIPPED	POUNDS[1] OF FISH	NUMBER[2] EGGS HARVESTED	WDNR HATCHERY DESTINATION
	MALE	FEMALE						
SEPT 27			35[3]	35		382	-	
SEPT 28			3[3]	3		33	-	
SEPT 30			61[3]	61		665	-	
OCT 1	354	129	40[3]	523	153	5,265	514,000	WILD ROSE
OCT 12	220	38	43[3]	301	97	3,281	119,000	WILD ROSE
OCT 22	239	18	229[3]	486	92	5,297	-	
OCT 25			525[4]	525		5,723	-	
TOTALS	813	185	936[5]	1,934	342[5]	20,646	633,000	

[1]Weights estimated using the average weight per fish for the entire harvest (1999 average weight was 10.9 pounds). Average weight was skewed by a disproportionately high number of age 1+ precocious males. Older, larger chinook were unable to negotiate Strawberry Creek and enter the pond.

[2]Number of chinook salmon eggs harvested by WDNR for hatchery production.

[3]Dead chinook from pond or in creek near the pond/road. These fish were picked up and disposed of.

[4]Dead chinook in Strawberry Creek and on Sturgeon Bay shoreline near the mouth of Strawberry Creek. These fish were counted and not picked up. Weight estimate for these fish is an underestimate because they included many of the larger fish that had been unable to negotiate Strawberry Creek and enter the pond.

[5]An additional 193 of the dead chinook that were removed or counted had an adipose fin clip but were not kept for CWT extraction because of the advanced stage of decay.

Table 2.-Yearly summary of the chinook salmon harvest and spawning operations at the Wisconsin Department of Natural resources spawning facility at Strawberry Creek, Door County, 1981-1999.

HARVEST YEAR	TOTAL NUMBER LIVE & DEAD	NUMBER ADIPOSE CLIPPED	TOTAL[1] WEIGHT (POUNDS)	HATCHERY[2] EGG PRODUCTION
1981	4,314		74,209	9,786,000
1982	3,963		60,206	7,728,000
1983	3,852	48	66,091	6,954,000
1984	5,208	64	76,905	7,652,000
1985	5,601	582	90,860	7,058,000
1986	4,392	322	53,700	5,052,000
1987	7,624	701	99,100	4,929,000
1988	3,477	408	43,645	3,997,000
1989	1,845	301	20,849	1,350,000
1990	3,016	501	47,091	2,378,000
1991	3,009	377	43,630	1,649,000
1992	4,009	382	51,878	1,677,100
1993	4,377	582	66,094	2,156,666
1994	4,051	733	63,195	3,426,026
1995	2,381	408	30,001	2,221,446
1996	6,653	1,187	97,135	4,299,086
1997	4,850	969	69,840	4,060,944
1998	5,035	1,092	61,427	3,489,114
1999	1,934	342[3]	20,646[4]	633,000
AVERAGE	4,189		59,816	4,236,652

[1] Annual average weight per fish used to estimate total weight (1999 average weight was 10.9 pounds,). Average weight in 1999 was heavily skewed by the fact that many of the larger, older chinook did not reach the pond due to low flow conditions in Strawberry Creek.
[2] Chinook salmon eggs harvested for hatchery production, does not include eggs sold for bait.
[3] An additional 193 dead chinook with an adipose fin clip were observed in Strawberry Creek but were not collected because of the advanced stage of decomposition.
[4] Total weight of harvested chinook was heavily influenced by low water flow in Strawberry Creek, which prevented many chinook especially older, larger individuals from reaching the pond.

Table 3.-Estimated age composition of chinook salmon (sexes combined) harvested at the Strawberry Creek Weir, fall 1985-1999, based on a length at age key developed from known aged CWT chinook salmon returning to Strawberry Creek.

YEAR OF RETURN	PERCENT AGE COMPOSITION					TOTAL NUMBER RETURNED
	AGE 1+	AGE 2+	AGE 3+	AGE 4+	AGE 5+	
1985	7 %	7 %	86 %			5,126
1986	5 %	15 %	47 %	33 %		3,810
1987	9 %	16 %	61 %	14 %	<1 %	6,804
1988	13 %	15 %	64 %	7 %	<1 %	3,031
1989	48 %	18 %	27 %	7 %		1,594
1990	13 %	64 %	21 %	2 %	<1 %	3,016
1991	31 %	25 %	43 %	1 %		1,958
1992	39 %	36 %	24 %	1 %		3,586
1993	16 %	55 %	28 %	1 %		3,964
1994	16 %	53 %	30 %	1 %		3,808
1995	25 %	46 %	29 %			2,292
1996	14 %	47 %	38 %	1 %		6,200
1997	14 %	41 %	42 %	3 %		4,325
1998	7 %	60 %	32 %	1 %		4,943
1999[1]	43 %	37 %	19 %	1 %		842

[1] Age composition of chinook returning to Strawberry Creek in the fall of 1999 was heavily influenced by low flow conditions in Strawberry Creek. Most of the older, larger chinook were unable to negotiate Strawberry Creek and enter the pond.

Table 4.-Average, trophy, and standard weights, in pounds, of chinook salmon harvested at the Strawberry Creek Weir, Door County, 1974-1999.

Year Of Return	Sample Size	Average Weight[1]	Trophy Weight[2] (95th%)	Standard Weight[3]
1974	171	16.2	27.1	11.1
1975	1,237	18.9	26.6	10.6
1976	344	19.1	29.0	11.0
1977	610	15.0	23.7	10.9
1978	750	14.1	22.0	10.3
1979	865	14.5	19.8	10.1
1980	1,640	17.4	24.0	10.3
1981	2,251	17.2	23.5	10.3
1982	2,725	15.0	22.0	9.9
1983	2,977	15.0	22.2	9.9
1984	4,014	15.2	22.0	9.5
1985	3,341	14.7	22.2	9.5
1986	2,036	13.9	19.8	9.7
1987	2,693	13.6	19.4	9.7
1988	1,326	13.7	20.6	9.3
1989	609	11.3	21.1	9.1
1990	1,194	14.5	23.1	9.8
1991	955	14.5	23.5	9.9
1992	1,546	12.8	23.1	10.0
1993	1,941	15.1	25.2	9.6
1994	3,756	15.6	26.6	10.1
1995	1,946	12.6	23.4	9.1
1996	4,246	14.6	24.3	9.7
1997	4,182	14.4	23.3	9.5
1998	4,032	12.2	21.6	9.2
1999[4]	843	10.9	19.1	9.2

[1] Average weight of all chinook salmon weighed in a season during harvest operations at Strawberry Creek.
[2] Trophy weight is defined as the weight of a chinook salmon at the 95th percentile in a distribution of all chinook weights collected during a harvest season at Strawberry Creek.
[3] Standard weight is defined as the predicted weight of a 30 inch chinook salmon using a length/weight regression of all fish weighed during a harvest season at Strawberry Creek.
[4] Average weight, and trophy weight of chinook returning to Strawberry Creek in the fall of 1999 was heavily influenced by low flow conditions in Strawberry Creek. Most of the older, larger chinook were unable to negotiate Strawberry Creek and enter the pond.

Table 5.-Age composition by sex and year of return of CWT chinook salmon released from and recaptured in Strawberry Creek Weir, Door County, 1983-1999.

YEAR OF RETURN	PERCENT AGE COMPOSITION										TOTAL NUMBER RETURNED
	NUMBER OF MALES				NUMBER OF FEMALES						
	AGE 1+		AGE 2+		AGE 3+		AGE 4+		AGE 5+		
	M	F	M	F	M	F	M	F	M	F	
1983	100%										48
	48	0									
1984	33%		67%								64
	21	0	43	0							
1985	9%		7%		84%						525
	47	0	34	3	229	212					
1986	9%		18%		43%		30%				267
	24	0	37	10	57	59	21	58			
1987	16%		19%		53%		12%		<1%		569
	91	0	84	22	142	160	21	48	0	1	
1988	14%		15%		63%		7%		<1%		368
	51	1	42	14	106	125	12	14	1	2	
1989	64%		14%		17%		5%				249
	159	0	28	6	12	31	6	7			
1990	14%		64%		19%		2%		<1%		381
	54	0	205	40	38	35	5	3	1		
1991	30%		22%		47%		1%				285
	85	0	53	9	39	95		4			
1992	45%		32%		23%		<1%				344
	153	1	75	34	31	47		3			
1993	42%		39%		19%		<1%				572
	240	0	163	59	34	74		2			
1994	18%		60%		21%		1%				709
	127	0	332	96	42	109		3			
1995	25%		43%		31%						389
	98	0	141	28	24	98					
1996	21%		39%		39%		<1%				1,124
	240	0	345	94	148	286	1	10			
1997	22%		44%		32%		2%				931
	205	0	364	44	124		5	18			
1998	6%		61%		32%		1%				1,068
	63	0	621	29	164		3	8			
1999[1]	55%		28%		16%		1%				322
	179	0	74	16	16	34	1	2			

[1] Age composition of chinook returning to Strawberry Creek in the fall of 1999 was heavily influenced by low flow conditions in Strawberry Creek. Most of the older, larger chinook were unable to negotiate Strawberry Creek and enter the pond.

Table 6.-Return rate of CWT chinook salmon at age and by year class to the Strawberry Creek Weir, Door County, for year classes 1982 through 1998. Return of the 1994, 1995, 1996, 1997, and 1998 year classes of chinook in fall 1999 was heavily influenced by low flow in Strawberry Creek and low Lake Michigan levels. No comparisons should be made between the return rates of the various year classes captured in the fall of 1999 and other years.

YEAR CLASS	AGE AT RETURN					CUMULATIVE RETURN BY YEAR CLASS
	AGE 1+	AGE 2+	AGE 3+	AGE 4+	AGE 5+	
1982	0.24	0.22	2.21	0.39	0.01	3.07
1983	0.11	0.19	0.58	0.35	0.02	1.25
1984	0.24	0.24	1.51	0.13	0.00	2.12
1985	0.05	0.21	0.46	0.03	<0.01	0.75
1986	0.36	0.22	0.17	0.03	0.00	0.78
1987	0.35	0.23	0.49	0.03	0.00	1.10
1988	0.64	0.98	0.53	0.01	0.00	2.16
1989	0.22	0.25	0.31	0.01	0.00	0.79
1990	0.34	0.43	0.43	0.01	0.00	1.21
1991	0.61	0.88	0.60	0.00	0.00	2.09
1992	0.83	1.48	0.42	0.04	0.00	2.77
1993	0.47	0.63	1.61	0.09	0.00	2.80
1994	0.38	1.69	1.13	0.04	0.00	3.24
1995[1]	0.40	0.84	0.76	0.00		2.00
1995[2]	0.58	0.85	0.68	0.01		2.12
1996[1]	0.38	1.30	0.12			1.80
1996[2]	0.43	1.27	0.06			1.76
1997[2,3]	0.06	0.08				0.14
1997[2,4]	0.14	0.20				0.34
1998[2,3]	0.31					0.31
1998[2,4]	0.25					0.25
1998[2,5]	0.19					0.19

[1] CWT chinook from eggs that were not treated with thiamine during water hardening.
[2] CWT chinook from eggs that were treated with thiamine during water hardening.
[3] Single paired family CWT chinook (from eggs that were collected from known age 3+ parents).
[4] Standard production CWT chinook.
[5] Single paired family CWT chinook (from eggs that were collected from known age 3+ male and age 2+ female parents).

Table 7.-Estimated number of chinook salmon by age returning to Strawberry Creek, Door County, and percent return by year class for ages 1+ through 4+ for the 1982 – 1998 year classes. For the years 1982 through 1990, rate of return is based on the number of fingerlings stocked into the pond at Strawberry Creek and does not account for subsequent mortalities. For the years 1991 through present the number stocked reflects the number believed to have been successfully released from the pond. This table includes CWT and non-CWT chinook based on a length at age key developed from known aged, CWT chinook returning to Strawberry Creek each harvest year. Return of the 1995, 1996, 1997, and 1998 year classes of chinook in fall 1999 was heavily influenced by low flow in Strawberry Creek and low Lake Michigan levels. No comparisons should be made between the return rates of the various year classes captured in the fall of 1999 and other years.

YEAR CLASS	AGE AT RETURN				TOTAL NUMBER RETURNED	NUMBER STOCKED (1,000'S)	TOTAL PERCENT RETURN
	1+	2+	3+	4+			
1982	362	539	3,281	1,257	5,439	250.0	2.2
1983	490	359	1,791	890	3,530	350.0	1.0
1984	359	572	4,271	212	5,414	350.0	1.5
1985	191	1,027	1,940	112	3,270	339.5	1.0
1986	616	455	430	60	1,561	300.0	0.5
1987	394	287	633	20	1,334	275.0	0.5
1988	765	1,930	842	35	3,572	225.2	1.6
1989	392	490	861	40	1,783	250.2	0.7
1990	607	1,291	1,110	17	3,025	250.0	1.2
1991	1,399	2,180	1,160	0	4,739	220.0[1]	2.2[2]
1992	634	2,032	672	50	3,388	125.0[1]	2.7[2]
1993	599	1,051	2,360	127	4,137	130.0[1]	3.2[2]
1994	569	2,923	1,796	47	5,335	157.0[1]	3.4[2]
1995	867	1,784	1,610	6	4,267	213.0[1]	2.0[2]
1996	618	2,949	162		3,729	210.5[1]	1.8[2,3]
1997	337	313			650	211.6[1]	0.3[2,4]
1998	361				361	211.7[1]	0.2[2,5]

[1] Corrected for the number of chinook salmon actually believed to have been successfully released from the Strawberry creek pond.
[2] Percent based on the number of chinook fingerlings successfully released, not the number stocked into the Strawberry Creek pond.
[3] Percent return based on age 1+ through age 3+.
[4] Percent return based on age 1+ through age 2+.
[5] Percent return based on age 1+.

Table 8.-Summary of chinook salmon stocking densities and average size of CWT and non-CWT chinook fingerlings when stocked into and released from the pond at the Strawberry Creek Weir, Door County, 1982-1998.

YEAR CLASS	CWT CHINOOK STOCKED AT STRWABERRY CREEK						NON-CWT CHINOOK STOCKED AT STRAWBERRY CREEK					
	NUMBER CWT'S STOCKED	SAMPLE TIME	AVERAGE LENGTH (mm)	SAMPLE SIZE	AVERAGE WEIGHT (G)	DATE	NUMBER NON-CWT'S STOCKED	SAMPLE TIME	AVERAGE LENGTH (mm)	SAMPLE SIZE	AVERAGE WEIGHT (g)	DATE
1982	20,000											
1983	20,000	Stocking	81.6		6.7	5/02/83						
1984	20,000	Stocking	83.6		4.9	4/30/84	330,000	Stocking	74.7	124		4/20/84
		Release	93.7	20	7.2	6/4/84		Release	89.1	105	5.5	6/4/84
1985	50,000	Stocking	83.7	50	5.5	4/29/85	289,500	Stocking	75.7	50	3.4	4/16/85
		Release	92.4	52	7.2	5/28/85		Release	92.4	155	7.2	5/28/85
1986	25,000	Stocking	79.0	62	4.3	4/23/86	184,000	Stocking	67.9	50	2.5	4/14/86
	15,000[1]	Stocking	79.5	48	3.9	5/1/86	91,000	Stocking	73.5	85	3.9	4/23/86
		Release	95.7[2]	92	7.7	5/28/86		Release	93.9	145	7.3	5/28/86
1987	15,000	Stocking	81.0	60	4.6	4/27/87	260,000	Stocking	65.3	58	2.6	4/9/87
	25,000[1]	Stocking	91.1	80	6.6	5/14/87		Release	84.5	70	5.8	5/22/87
		Release	94.0[2]	61	6.6	5/22/87						
1988	25,150	Stocking	91.7	50	4.4	5/10/88	200,000	Stocking	65.5	110	1.9	4/6-7/88
	25,300[1]	Stocking	85.3	60	5.0	5/3/88		Release	78.5	80	4.7	5/23/88
		Release	87.8[2]	70	5.2	5/23/88						
1989	25,241	Stocking	77.1	80	3.5	4/24/89	115,550	Stocking	67.9	70	2.5	4/6/89
		Release	83.4	50	4.5	5/19/89	109,450	Stocking	71.2	50	2.6	4/24/89
								Release	75.7	50	3.4	5/19/89
1990[3]	25,100	Stocking	69.6	60	2.9	4/18/90	133,497	Stocking	61.2	50	2.1	4/5/90
		Release	95.9	44	8.6	5/29/90	91,403	Stocking	68.7	50	2.8	4/18/90
								Release	91.2	50	7.6	5/29/90
1991[4]	25,200	Stocking	72.8	50	3.0	4/11/91	139,600	Stocking	71.1	50	2.9	4/2/91
		Release	88.4	50	5.6	5/24/91	85,200	Stocking				4/11/91
								Release	91.3	50	6.1	5/24/91
1992[5]	28,850	Stocking	81.7	50	4.6	5/6/92	170,000	Stocking	62.6	50	1.9	3/26/92
		Release	97.4	63	8.5	5/29/92	11,150	Stocking				5/6/92
								Release	85.3	99	5.6	5/29/92
1993[6]	27,024	Stocking	75.3	50	3.3	4/21/93	100,000	Stocking	73.1	50	3.2	4/8/93
		Release	95.8	34	7.1	6/4/93	71,450	Stocking	75.8	50	4.4	4/21/93
								Release	94.0	50	6.9	6/4/93

Table 8.-Continued

YEAR CLASS	CWT CHINOOK STOCKED AT STRWABERRY CREEK						NON-CWT CHINOOK STOCKED AT STRAWBERRY CREEK					
	NUMBER CWT'S STOCKED	SAMPLE TIME	AVERAGE LENGTH (mm)	SAMPLE SIZE	AVERAGE WEIGHT (G)	DATE	NUMBER NON-CWT'S STOCKED	SAMPLE TIME	AVERAGE LENGTH (mm)	SAMPLE SIZE	AVERAGE WEIGHT (g)	DATE
1994[7]	26,450	Stocking	80.1	60	4.9	4/22/94	131,432	Stocking	77.8	50	4.3	4/14/94
		Release	85.8	40	6.1	5/17/94		Release	85.5	50	6.3	5/17/94
1995[8,9]	22,646	Stocking	80.9	50	4.7	5/1/95	115,364	Stocking	71.5	50	3.5	4/21/95
		Release	96.3	47	8.1	5/25/95	50,027	Stocking	73.5	60	3.6	5/1/95
	25,697	Stocking	78.6	50	4.5	5/1/95		Release	90.6	50	7.9	5/25/95
		Release	96.2	77	8.3	5/25/95						
1996[10]	26,270	Stocking	87.1	87	5.8	5/13/96	100,460	Stocking	84.8	50	5.8	5/2/96
		Release	91.2	19	7.2	5/31/96	60,000	Stocking	82.6	50	4.8	5/13/96
	24,600	Stocking	88.1	78	6.3	5/17/96		Release	90.0	112	7.3	5/31/96
		Release	92.7	19	7.9	5/31/96						
1997[11,12]	25,850	Stocking	85.1	50	5.6	4/23/97	71,917	Stocking				5/5/97
		Release	93.0	30	9.2	5/30/97	71,534	Stocking	86.4	100	5.3	5/6/97
	42,491	Stocking	88.5	50	6.2	4/23/97		Release	96.6	50	7.7	5/30/97
		Release	93.4	70	9.2	5/30/97						
1998[11,13]	25,619	Stocking	83.7	50	4.7	4/20/98	70,780	Stocking	75.5	50	3.1	4/21/98
	22,785	Stocking	83.3	50	4.7	4/20/98	70,000	Stocking				4/22/98
	22,697	Stocking	85.5	50	5.1	4/20/98		Release	89.1	100	5.5	5/13/98
		Release	91.8	30	5.8	5/13/98						
1999[14]	8,313[15]	Stocking	85.4	18	4.8	5/3/99	80,090	Stocking	81.8	50	5.3	4/30/99
	8,317[16]	Stocking	86.6	14	4.8	5/3/99	57,073	Stocking	81.6	50	4.3	5/4/99
	8,233[17]	Stocking	85.5	17	4.8	5/3/99		Release				5/17/99
	25,051[18]	Stocking	85.9	50	5.0	5/3/99						
	24,943[19]	Stocking	82.6	50	4.3	5/3/99						
		Release				5/17/99						

[1] Fingerlings treated with methyltestosterone in an attempt to sterilize them (stocked in 1986-88).
[2] Includes regular and sterile CWT chinook salmon.
[3] First year that a moist pellet diet was fed to chinook fingerlings while in the pond.
[4] In 1991 an estimated 220,000 chinook were released from the Strawberry Creek pond (includes CWT and non-CWT combined).
[5] In 1992 an estimated 125,000 chinook were released from the Strawberry Creek pond (includes CWT and non-CWT combined) losses due to escapement and bird predation.
[6] In 1993 an estimated 130,000 chinook were released from the Strawberry Creek pond (includes CWT and non-CWT combined) losses due to escapement and gill disease.
[7] In 1994 an estimated 157,000 chinook (131,000 standard production and 26,000 CWT) were released from the Strawberry Creek pond.

Table 8.-Continued

[8] Beginning in the fall of 1994 all chinook eggs (other than thiamine study control eggs) were water hardened in thiamine to reduce EMS
[9] In 1995 an estimated 213,000 chinook (165,000 standard production, 25,000 CWT treated and 22,500 CWT non treated) were released from the Strawberry Creek pond.
[10] In 1996 an estimated 210,000 chinook (160,000 standard production, 24,500 CWT treated and 26,000 CWT non treated) were released from the Strawberry Creek pond.
[11] In the fall of 1996 and 1997 a limited number of known age chinook were spawned as single paired families (SPF) to produce fingerlings from known aged parents.
[12] In 1997 an estimated 211,600 chinook (143,000 standard production, 25,800 regular CWT and 42,400 SPF CWT) were released from the Strawberry Creek pond.
[13] In 1998 an estimated 210,500 chinook (140,000 standard production, 25,500 regular CWT and 45,000 SPF CWT) were released from the Strawberry Creek pond.
[14] In 1999 an estimated 211,700 chinook (137,000 standard production, 24,900 regular A-CWT, 25,000 RV A-CWT, 8,300 A-CWT pink photonic, 8,300 A-CWT green photonic, and 8,200 A-CWT orange photonic) were released from the SCW pond.
[15] Fingerlings with a CWT (and an adipose fin clip as per standard procedure) and a pink photonic mark in the anal fin.
[16] Fingerlings with a CWT (and an adipose fin clip as per standard procedure) and a green photonic mark in the anal fin.
[17] Fingerlings with a CWT (and an adipose fin clip as per standard procedure) and an orange photonic mark in the anal fin.
[18] Fingerlings with a CWT (and an adipose fin clip as per standard procedure) and a RV fin clip.
[19] Fingerlings with a CWT (and an adipose fin clip as per standard procedure).

Table 9.-Daily summary of chinook salmon harvest at the Wisconsin Department of Natural Resources Besadny Anadromous Fisheries Facility on the Kewaunee River, Kewaunee County, during the fall of 1999.

DATE	FISH HARVESTED		NUMBER DEAD FISH	FISH PASSED UPSTREAM	TOTAL NUMBER FISH	NUMBER ADIPOSE CLIPPED	EGGS HARVESTED
	MALE	FEMALE					
SEPT 30	12	1		62	75	13	
OCT 4	179	135	18	110	442	61	480,000
OCT 6	266	245	2	151	664	76	1,113,000
OCT 11	157	141	498	102	898	55	744,635
OCT 12	105	72		284	461	45	342,000
OCT 14	73	7		792	872	80	
OCT 18	96	89	4	136	325	28	352,836
OCT 19	2			44	46	1	
OCT 21	63	10	20	739	832	73	
OCT 26	67	57	12	267	403	30	258,875
NOV 3	20		65	391	476	20	
NOV 11	6		8	111	125	6	
NOV 18			7		7		
SEPT/NOV			172		172	8	
TOTALS	1,046	757	806	3,189	5,798	496	3,291,346

Table 10.-Yearly summary of chinook salmon harvest and spawning operations at the Wisconsin Department of Natural Resources Besadny Anadromous Fisheries Facility on the Kewaunee River, Kewaunee County, 1990-1999.

HARVEST YEAR	CHINOOK HARVESTED	PASSED UPRIVER	DEAD FISH	TOTAL CHINOOK	ADIPOSE CLIPPED	EGGS HARVESTED
1990	1,307	1,797		3,104	214	1,081,000
1991	2,390	966		3,356	21	1,880,000
1992	2,254	995	625	3,874	120	2,148,000
1993	2,180	726	354	3,260	241	880,000
1994	813	847	62	1,722	452	471,000
1995	1,182	1,362	77	2,621	738	1,360,000
1996	952	2,029	212	3,193	633	616,080
1997	144	1,139	235	1,518	148	
1998	695	2,858	452	4,005	67	1,155,080
1999	1,803	3,189	806	5,798	496	3,291,346
AVERAGE	1,372	1,591	340	3,245		1,408,140

Table 11.-Summary of 496 adipose clipped chinook salmon harvested at the Besadny Anadromous Fisheries Facility, fall 1999. In addition to the 473 CWTs listed below, six tags were lost during extraction and 17 of the adipose clipped chinook had no tag detected. The chinook released in the Kewaunee River were part of a chinook fingerling stocking evaluation. The chinook released at all other sites were strays to the Kewaunee River.

YEAR CLASS	LOCATION OF RELEASE	AGE AT CAPTURE	STOCKING AGENCY	NUMBER HARVESTED
1998	Kewaunee River (Harbor)[6]	1+	WIS DNR	35
	Kewaunee River (BAFF)[7]		WIS DNR	94
	Kewaunee River (Clyde's)[8]		WIS DNR	105
	Kewaunee River (Hwy. 54)[9]		WIS DNR	57
	Strawberry Creek, WI[5]		WIS DNR	21
	Strawberry Creek, WI[4]		WIS DNR	9
	Strawberry Creek, WI[3]		WIS DNR	17
	Swan Creek, Lake Huron		MICH DNR	3
1997	Strawberry Creek, WI[5]	2+	WIS DNR	39
	Strawberry Creek, WI[3]		WIS DNR	42
1996	Strawberry Creek, WI[2]	3+	WIS DNR	25
	Strawberry Creek, WI[1]		WIS DNR	25
1994	Strawberry Creek, WI[5]	5+	WIS DNR	1

[1] Fingerlings from eggs which were treated with thiamine (thiamine study conducted at Strawberry Creek).
[2] Fingerlings from eggs which were not treated with thiamine (thiamine study conducted at Strawberry Creek).
[3] Fingerlings from known age 3+ males and females (age at maturity study conducted at Strawberry Creek).
[4] Fingerlings from known age 3+ males and age 2+ females (age at maturity study conducted at Strawberry Creek).
[5] Regular production CWT fingerlings (controls) stocked at Strawberry Creek.
[6] Stocking technique study chinook fingerlings stocked in the Kewaunee Harbor near the mouth of the Kewaunee River.
[7] Stocking technique study chinook fingerlings stocked in the Kewaunee River near the BAFF approximately four miles upstream from Lake Michigan.
[8] Stocking technique study chinook fingerlings stocked in the Kewaunee River at Clyde's Hill Road crossing approximately nine miles upstream from Lake Michigan.
[9] Stocking technique study chinook fingerlings stocked in the Kewaunee River at Hwy. 54 crossing approximately 15 miles upstream from Lake Michigan.

Table 12.-Summary of chinook salmon stocking densities, strain, and average size of CWT and non-CWT salmon fingerlings at stocking into the Kewaunee River 1984-1999. All fish sampled at release.

YEAR CLASS	CWT CHINOOK STOCKED IN KEWAUNEE RIVER						NON-CWT CHINOOK STOCKED IN KEWAUNEE RIVER					
	NUMBER CWT'S STOCKED	STRAIN	AVERAGE LENGTH (mm)	SAMPLE SIZE	AVERAGE WEIGHT (G)	DATE	NUMBER NON-CWT'S STOCKED	STRAIN	AVERAGE LENGTH (mm)	SAMPLE SIZE	AVERAGE WEIGHT (g)	DATE
1984							250,000	L. Mich.				
1985							311,500	L. Mich.				
1986	20,000[1]	L. Mich.	78.5	50	4.5	4/22/86	190,000	L. Mich.	79.0		4.5	5/28/86
	20,000[2]	L. Mich.	78.7	50	4.7	4/22/86						
	20,000[3]	L. Mich.	83.3	50	4.8	4/22/86						
1987	20,000[1]	L. Mich.	77.3	50	4.2	4/29/87	190,000	L. Mich.	63.8		2.5	5/21/87
	20,000[2]	L. Mich.	78.1	50	4.4	4/29/87						
	20,000[3]	L. Mich.	79.3	50	4.5	4/29/87						
1988							200,000	L. Mich.	90.7		7.4	5/23/88
1989							180,000	L. Mich.				5/23/89
1990							133,497	L. Mich.				5/1&9/90
1991	20,255	L. Mich.	75.1	100	3.3	5/9/91	120,852	L. Ont.	83.3	100	5.0	5/9/91
	20,306	L. Ont.	84.2	100	4.6	5/9/91						
1992	22,345	L. Mich.	83.6	50	5.3	5/4/92	70,748	L. Ont.			4.9[8]	5/11/92
	21,920	L. Ont.	86.6	50	5.9	5/4/92						
1993	21,643	L. Mich.	80.4	50	4.6	5/5/93	50,000	L. Ont.			3.8[8]	5/14/93
	21,898	L. Ont.	81.5	50	4.9	5/5/93						
1994	16,905	L. Mich.	77.7	50	4.5	5/2/94	70,118	L. Ont.			4.9[8]	5/9/94
	22,875	L. Ont.	75.4	60	3.5	5/2/94						
1995							97,867	L. Mich.			6.7[8]	5/16/95
1996							105,468	L. Mich.			4.5[8]	5/22/96
1997							108,606	L. Mich.			5.8[8]	5/15/97
1998	25,443[4]	L. Mich.	80.4	50	4.7	5/1/98	20,000	L. Mich.			4.3[8]	4/12/98
	25,533[5]	L. Mich.	79.2	50	4.2	5/1/98						
	25,529[6]	L. Mich.	77.8	50	4.0	5/1/98						
	25,586[7]	L. Mich.	80.6	50	4.2	5/1/98						
1999	22,037[4]	L. Mich.	86.4	52	5.0	5/17/99	15,300	L. Mich.			5.9[8]	5/7/99
	24,473[5]	L. Mich.	89.8	52	5.8	5/17/99						
	24,515[6]	L. Mich.	86.6	50	5.2	5/17/99						
	24,354[7]	L. Mich.	88.6	50	5.4	5/17/99						

Table 12. Continued

[1] Chinook fingerlings stocked as part of a stocking technique study (stocked into and released from a rearing pond approximately three miles upstream from Lake Michigan).
[2] Chinook fingerlings stocked as part of a stocking technique study (stocked directly into the Kewaunee River approximately nine miles upstream from Lake Michigan).
[3] Chinook fingerlings stocked as part of a stocking technique study (stocked directly into Lake Michigan near the mouth of the Kewaunee River).
[4] Chinook fingerlings stocked as part of a stocking technique study (stocked into the Kewaunee Harbor near Lake Michigan).
[5] Chinook fingerlings stocked as part of a stocking technique study (stocked into the Kewaunee River near BAFF approximately four miles upstream from Lake Michigan).
[6] Chinook fingerlings stocked as part of a stocking technique study (stocked into the Kewaunee River at Clyde's Hill Road crossing approximately nine miles upstream from Lake Michigan).
[7] Chinook fingerlings stocked as part of a stocking technique study (stocked into the Kewaunee River at Hwy. 54 crossing approximately 15 miles upstream from Lake Michigan).
[8] Estimated from hatchery weight count at stocking.

Table 13.-Chinook salmon stocking technique study rate of return, at age, to the Besadny Anadromous Fisheries Facility. Rate of return expressed as a percent of the number of chinook stocked in the Kewaunee River that were actually recovered at the Besadny Anadromous Fisheries Facility through the fall of 1999. The percent return is followed by the actual number of fish recovered in parentheses.

Year Class	STOCKING LOCATION	AGE AT RETURN				CUMULATIVE Rate of Return
		1+	2+	3+	4+	
1998	HARBOR	0.14 (35)				0.14
	BAFF	0.37 (94)				0.37
	CLYDE'S	0.41 (105)				0.41
	HWY 54	0.22 (57)				0.22
1999	HARBOR					
	BAFF					
	CLYDE'S					
	HWY 54					

Table 14.-Summary of coho salmon harvest at the Wisconsin Department of Natural Resources Besadny Anadromous Fisheries Facility on the Kewaunee River, Kewaunee County, during the fall of 1999.

Harvest Date	Fish Harvested		Number Dead Fish	Fish Passed Upstream	Total Number Fish	Eggs Harvested	Destination Of Eggs
	Male	Female					
Oct 4			2	43	45		
Oct 6				24	24		
Oct 11	9	21		11	41		
Oct 12				37	37		
Oct 14				56	56		
Oct 18	64	125	13	8	210	298,909	Kettle Moraine
Oct 19	120	271		9	400	639,562	Kettle Moraine
Oct 21			1	45	46		
Oct 26	26	107	8	1	142	262,952	Kettle Moraine
Nov 3	28	38	12	151	229	114,000	Ontario
Nov 11			7	151	158		
Nov 18			8		8		
Sept/Nov	75*	75*	92		242	130,000*	Kettle Moraine
Totals	322	637	143	536	1,638	1,445,423	

* Mature but not ripe coho that were collected at the Besadny Anadromous Fisheries facility and transferred to the Kettle Moraine Fish Hatchery where they were held until ripe and then spawned.

Table 15.-Yearly summary of coho salmon harvest and spawning operations at the Wisconsin Department of Natural Resources Besadny Anadromous Fisheries Facility on the Kewaunee River, Kewaunee County, 1990-1999.

YEAR OF HARVEST	COHO[1] HARVESTED	PASSED UPRIVER	DEAD FISH	TOTAL COHO	ADIPOSE CLIPPED	EGGS HARVESTED
1990	2,074	1,813		3,887		1,374,000
1991	853	287		1,140		790,000
1992	362	596		958		163,000
1993	1,215	130	47	1,392		529,000
1994	464	156	97	717		350,000
1995	698	2,744	325	3,767		535,000
1996	632	989	1,762[2]	3,383	55	644,000
1997	773	337	52	1,162	251	524,000
1998	847	1,518	67	2,432	299	607,898
1999	959	536	143	1,638		1,445,423
AVERAGE	888	910		2,048		696,232

[1] Includes fish which were used for egg collection and those that were collected for disease and contaminant analysis.

[2] In 1996 it was decided that 1,514 coho (BV clip) that had been exposed to Infectious Pancreatic Necrosis as fingerlings should not be used for egg harvest, and that they should not be passed upstream. These fish were captured alive but were sacrificed and disposed of along with the dead fish.

Table 16.-Coho salmon stocking history of the Kewaunee River, Kewaunee County, 1987-1999.

YEAR STOCKED	NUMBER STOCKED	AGE AT STOCKING (YEAR CLASS)	CLIP	SOURCE OF EGGS	STUDY
1987	126,429	Fingerling (87)	LV	Lake Michigan	Accelerated
	50,400	Yearling (86)	NC		Standard Production
1988	51,040	Yearling (87)	NC	Lake Michigan	Standard Production
	119,502	Fingerling (88)	ARV		Accelerated
	86,700	Fingerling (88)	NC		Standard Production
1989	146,680	Fingerling (89)	LP	Lake Michigan	Age & Growth
	71,000	Fingerling (89)	NC		Standard Production
1990	72,555	Fingerling (90)	ALV	Lake Superior	Strain Evaluation
	875	Fingerling (90)	NC		Standard Production
	94,390	Fingerling (90)	RP	Lake Michigan	Strain Evaluation
1991	59,010	Fingerling (91)	LP	Lake Michigan	Strain Evaluation
	52,608	Fingerling (91)	LV	Lake Ontario	Strain Evaluation
	7,058	Fingerling (91)	NC		Standard Production
	42,550	Fingerling (91)	BV	Lake Michigan	Control/Erythromycin
1992	62,131	Fingerling (92)	RP	Lake Michigan	Strain/Disease Evaluation
	45,000	Fingerling (92)	NC	Lake Michigan	Standard Production
	40,490	Fingerling (92)	BV	Lake Michigan	Control/Erythromycin
	59,975	Fingerling (92)	RV	Lake Ontario	Control/Erythromycin
1993	None stocked (the entire 1993 year class was stocked as yearlings in 1994)				
1994	57,587	Yearling (93)	NC	Lake Michigan	Standard Production
	10,710	Yearling (93)	NC	Lake Ontario	Standard Production
	60,822	Fingerling (94)	LMLP	Lake Michigan	Fingerling/Yearling
	130,516	Fingerling (94)	LP	Lake Michigan	Hyper Accelerated
1995	28,846	Yearling (94)	NC	Lake Michigan	Standard Production
	5,280	Yearling (94)	NC	Lake Ontario	Standard Production
	32,154	Yearling (94)	BV	Lake Michigan	Control/Erythromycin
	59,400	Yearling (94)	LMRP	Lake Michigan	Fingerling/Yearling
	54,808	Fingerling (95)	LMLV	Lake Michigan	Fingerling/Yearling
1996	29,718	Yearling (95)	NC	Lake Michigan	Standard Production
	20,595	Yearling (95)	A	Lake Michigan	Treatment/Thiamine
	19,083	Yearling (95)	A	Lake Michigan	Control/Thiamine
	49,878	Yearling (95)	LMRV	Lake Michigan	Fingerling/Yearling
	66,486	Fingerling (96)	LM	Lake Michigan	Fingerling/Yearling
1997	40,950	Yearling (96)	BV	Lake Michigan	Control/Erythromycin
	18,800	Yearling (96)	A	Lake Michigan	Treatment/Thiamine
	20,220	Yearling (96)	A	Lake Michigan	Control/Thiamine
	62,886	Yearling (96)	RM	Lake Michigan	Fingerling/Yearling
	50,155	Fingerling (97)	NC	Lake Michigan	Standard Production
1998	126,619	Yearling (97)	NC	Lake Michigan	Standard Production
	50,024	Fingerling (98)	NC	Lake Michigan	Standard Production
1999	127,771	Yearling (98)	NC	Lake Michigan	Standard Production

Table 17.-Estimated rate of recovery of coho salmon at the Besadny Anadromous Fisheries Facility, through fall 1999. Unclipped (NC) fish were aged by length frequency distribution.

Year Class	Year Stocked (season)	Stocking Technique	Number Stocked	Clip	%Recovery Rate (number)		Cumulative Recovery Rate
					1+	2+	
1993	1994 (spring)	Production Yearlings	68,297	NC	0.271	3.480	3.751
					(185)	(2,377)	(2,562)
1994	1994 (spring)	Hyper Accelerated	130,516	LP	0.026	0.010	0.036
					(34)	(13)	(47)
1994	1994 (fall)	F/Y Study Fingerlings	60,822	LMLP	0.120	1.010	1.130
					(73)	(614)	(687)
1994	1995 (spring)	F/Y Study Yearlings	59,400	LMRP	0.557	1.552	2.109
					(331)	(922)	(1,253)
1994	1995 (spring)	Erythromycin Study	32,154	BV	0.809	3.452	4.261
					(260)	(1,110)	(1,370)
1994	1995 (spring)	Production Yearlings	34,126	NC	1.301	1.102	2.403
					(444)	(376)	(820)
1995	1995 (fall)	F/Y Study Fingerlings	54,808	LMLV	0.100	0.604	0.704
					(55)	(331)	(386)
1995	1996 (spring)	Thiamine Study/treated	20,595	A/CWT	0.112	0.340	0.452
					(23)	(70)	(93)
1995	1996 (spring)	Thiamine Study/controls	19,083	A/CWT	0.152	0.713	0.865
					(29)	(136)	(165)
1995	1996 (spring)	F/Y Study Yearlings	49,878	LMRV	0.088	0.640	0.728
					(44)	(319)	(363)
1995	1996 (spring)	Production Yearlings	29,718	NC	0.087	0.451	0.538
					(26)	(134)	(160)
1996	1996 (fall)	F/Y Study Fingerlings	66,486	LM	0.024	0.484	0.508
					(16)	(322)	(338)
1996	1997 (spring)	F/Y Study Yearlings	62,886	RM	0.021	0.382	0.402
					(13)	(240)	(253)
1996	1997 (spring)	Thiamine Study/treated	18,800	A/CWT	0.096	0.803	0.899
					(18)	(151)	(169)
1996	1997 (spring)	Thiamine Study/controls	20,220	A/CWT	0.049	0.613	0.663
					(10)	(124)	(134)
1996	1997 (spring)	Erythromycin Controls	40,950	BV	0.002	0.103	0.105
					(1)	(42)	(43)
1997	1997/fall 1998/spring	Production Fing/year	50,155 126,619	NC	0.110	0.434	0.544
					(194)	(768)	(962)
1998	1998/fall 1999/spring	Production Fing/year	50,024 127,771	NC	0.035		0.035
					(63)		(63)

Table 18.-Mean length and weight of various groups of coho stocked in the Kewaunee River, Kewaunee County, as fingerlings and yearlings and captured at the Besadny Anadromous Fisheries Facility through fall 1999.

Year class Study group Fin clip		Age at return (Year of return)			
		Age 1+		Age 2+	
		Male	Female	Male	Female
1994 hyper accelerated fingerlings fingerling/yearling study LP	Length mm (SD) Range Sample size	526.4 (73.6) 373-660 24	536.0 (47.1) 479-583 4	675.0 (50.9) 622-754 5	654.8 (24.4) 620-685 8
	Weight kg (SD) Range Sample size	1.7 (0.7) 0.9-2.7 9	1.4 (0.5) 1.0-1.9 3	2.0 - 1	2.8 - 1
1994 accelerated fingerlings fingerling/yearling study LMLP	Length mm (SD) Range Sample size	369.1 (24.1) 319-439 56	- - -	672.7 (58.7) 439-788 249	648.4 (40.1) 506-785 365
	Weight kg (SD) Range Sample size	0.5 (0.1) 0.3-0.8 32	- - -	2.7 (0.8) 0.9-4.2 87	2.7 (0.5) 1.5-3.8 90
1994 yearlings fingerling/yearling study LMRP	Length mm (SD) Range Sample size	360.1 (21.5) 285-417 202	- - -	658.6 (57.1) 416-854 363	644.4 (40.8) 383-759 559
	Weight kg (SD) Range Sample size	0.5 (0.1) 0.2-0.7 81	- - -	2.4 (0.7) 0.6-4.4 138	2.6 (0.6) 1.2-4.6 201
1994 erythromycin study controls not treated BV	Length mm (SD) Range Sample size	381.4 (23.5) 325-442 203	- - -	683.7 (62.4) 449-795 427	670.0 (39.3) 484-792 683
	Weight kg (SD) Range Sample size	0.5 (0.1) 0.2-0.9 62	- - -	2.9 (0.8) 0.7-5.0 185	3.1 (0.6) 0.9-5.1 238
1994 yearlings standard production NC	Length mm (SD) Range Sample size	426.6 (43.7) 333-518 424	482.4 (29.6) 433-517 12	702.3 (62.4) 527-885 155	680.6 (41.6) 554-770 221
	Weight kg (SD) Range Sample size	0.7 (0.2) 0.4-1.2 101	1.0 (0.2) 0.8-1.3 7	3.1 (0.9) 1.5-5.7 64	3.2 (0.6) 1.7-4.9 64

Table 18.-Continued.

Year class Study group Fin clip		Age at return (Year of return)			
		Age 1+		Age 2+	
		Male	Female	Male	Female
1995 accelerated fingerlings fingerling/yearling study LMLV	Length mm (SD) Range Sample size	397.1 (33.8) 321-480 52	421.7 (37.6) 392-464 3	591.4 (58.6) 460-742 172	562.3 (47.3) 461-674 159
	Weight kg (SD) Range Sample size	0.6 (0.2) 0.3-0.9 36	0.52 - 1	1.84 (0.6) 0.7-3.8 169	1.74 (0.5) 0.9-3.2 151
1995 yearlings fingerling/yearling study LMRV	Length mm (SD) Range Sample size	430.3 (41.3) 338-516 42	443.5 (41.7) 414-473 2	602.3 (57.8) 480-733 139	576.1 (49.8) 466-698 180
	Weight kg (SD) Range Sample size	0.7 (0.2) 0.4-1.0 18	- - -	1.9 (0.6) 1.0-4.3 133	1.9 (0.6) 0.8-3.8 165
1995 yearlings standard production NC	Length mm (SD) Range Sample size	438.6 (42.6) 346-508 23	510.1 (5.0) 505-515 3	605.8 (69.7) 466-740 60	584.4 (47.7) 470-673 74
	Weight kg (SD) Range Sample size	0.8 (0.2) 0.5-101 9	1.2 - 1	2.0 (0.8) 0.8-4.0 59	3.0 (0.5) 0.9-3.3 73
1995 yearlings thiamine study treated A/CWT 31-17-13	Length mm (SD) Range Sample size	409.2 (38.1) 335-481 23	- - -	609.9 (72.7) 495-763 39	597.1 (51.4) 474-703 31
	Weight kg (SD) Range Sample size	0.6 (0.2) 0.2-0.9 20	- - -	2.0 (0.8) 0.9-4.2 39	2.1 (0.6) 1.0-3.6 31
1995 yearlings thiamine study not treated A/CWT 31-17-14	Length mm (SD) Range Sample size	413.7 (39.6) 302-484 29	- - -	618.4 (64.9) 479-780 68	584.5 (54.5) 477-711 68
	Weight kg (SD) Range Sample size	0.7 (0.2) 0.2-1.1 26	- - -	2.1 (0.8) 0.7-4.3 66	2.0 (0.6) 0.9-3.3 64

Table 18.-Continued.

Year class Study group Fin clip		Age at return (Year of return)			
		Age 1+		Age 2+	
		Male	Female	Male	Female
1996 accelerated fingerlings fingerling/yearling study LM	Length mm (SD) Range Sample size	368.7 (22.7) 331-410 16	- - -	597.6 (73.3) 405-785 149	581.9 (46.4) 487-728 173
	Weight kg (SD) Range Sample size	0.5 (0.1) 0.3-0.8 15	- - -	1.9 (0.8) 0.6-4.7 135	1.8 (0.5) 0.9-3.8 169
1996 yearlings fingerling/yearling study RM	Length mm (SD) Range Sample size	405.2 (26.1) 366-440 13	- - -	623.4 (86.9) 357-777 124	608.6 (50.4) 498-743 116
	Weight kg (SD) Range Sample size	0.6 (0.1) 0.4-0.8 13	- - -	2.2 (0.9) 0.7-4.2 112	2.1 (0.6) 0.9-4.0 114
1996 yearlings thiamine study treated A/CWT 36-17-17	Length mm (SD) Range Sample size	399.9 (19.4) 364-430 10	- - -	648.9 (72.9) 445-772 75	611.1 (54.8) 510-725 76
	Weight kg (SD) Range Sample size	0.6 (0.1) 0.4-0.8 10	- - -	2.4 (0.9) 0.7-4.4 72	2.1 (0.6) 1.0-3.6 75
1996 yearlings thiamine study not treated A/CWT 36-17-18	Length mm (SD) Range Sample size	380.2 (18.2) 333-409 18	- - -	639.3 (59.9) 529-752 59	617.8 (56.4) 480-738 65
	Weight kg (SD) Range Sample size	0.5 (0.1) 0.3-0.7 18	- - -	2.2 (0.7) 1.1-4.0 57	2.2 (0.7) 1.0-4.0 61
1996 erythromycin study not treated BV	Length mm (SD) Range Sample size	380 - 1	- - -	614.6 (64.0) 510-722 20	580.2 (55.1) 509-700 22
	Weight kg (SD) Range Sample size	0.5 - 1	- - -	1.9 (0.6) 0.9-2.9 20	1.8 (0.5) 1.1-2.9 19
1997 fingerlings/ yearlings standard production NC	Length mm (SD) Range Sample size	431.8 (28.2) 340-506 163	468.4 (30.3) 400-510 31	812.5 (59.4) 570-918 236	776.8 (37.7) 575-857 532
	Weight kg (SD) Range Sample size	0.7 (6.1) 0.4-1.2 159	1.0 (0.2) 0.6-1.3 30	5.1 (1.2) 1.7-7.9 236	4.9 (0.8) 2.0-6.8 532
1998 fingerlings/ yearlings standard production NC	Length mm (SD) Range Sample size	478.4 (40.6) 345-556 63	- - -		
	Weight kg (SD) Range Sample size	1.1 (0.3) 0.4-1.8 63	- - -		

Appendix A.-Average length (mm) by age, sex, and year of return of CWT chinook salmon released from and recaptured at Strawberry Creek, 1983-1999.

YEAR OF RETURN	SEX		AGE				
			1+	2+	3+	4+	5+
1983	M	L (sd)	611 (35.2)	-	-	-	-
		Range	493-866	-	-	-	-
		n	48	-	-	-	-
	F	L (sd)	-	-	-	-	-
		Range	-	-	-	-	-
		n	-	-	-	-	-
1984	M	L (sd)	576 (29.6)	836 (42.1)	-	-	-
		Range	512-586	703-911	-	-	-
		n	21	43	-	-	-
	F	L (sd)	-	-	-	-	-
		Range	-	-	-	-	-
		n	-	-	-	-	-
1985	M	L (sd)	596.8 (32.9)	835.9 (36.9)	950.1 (52.4)	-	-
		Range	535-656	758-910	810-1,119	-	-
		n	47	34	229	-	-
	F	L (sd)	-	766.7 (18.9)	890.7 (46.2)	-	-
		Range	-	745-780	745-1,019	-	-
		n	-	3	212	-	-
1986	M	L (sd)	600.4 (31.9)	788.7 (50.3)	904.8 (45.5)	927 (42.9)	-
		Range	543-680	679-864	792-997	838-1,030	-
		n	24	37	57	21	-
	F	L (sd)	-	764.7 (58.0)	863.6 (40.2)	911.6 (44.7)	-
		Range	-	675-850	753-947	830-1,048	-
		n	-	10	59	58	-
1987	M	L (sd)	612.6 (35.3)	825.4 (45.4)	913.8 (51.0)	915 (106.6)	-
		Range	533-709	654-918	745-1,040	620-1,122	-
		n	91	84	142	21	-
	F	L (sd)	-	790.4 (36.2)	866.5 (41.7)	897 (38.7)	990
		Range	-	734-867	722-963	782-980	-
		n	-	22	160	48	1
1988	M	L (sd)	596.5 (28.4)	849.5 (62.1)	921.8 (61.5)	920.2 (74.3)	862.0
		Range	537-661	643-937	642-1,027	780-1,045	-
		n	51	42	106	12	1
	F	L (sd)	538	796.5 (43.0)	869.0 (44.0)	886.6 (51.2)	862.5 (24.8)
		Range	-	703-851	668-970	786-993	845-880
		n	1	14	125	14	2
1989	M	L (sd)	616.1 (37.1)	837.0 (49.9)	931.4 (74.6)	952.2 (74.9)	-
		Range	542-813	742-932	772-1,032	812-1,018	-
		n	159	28	12	6	-
	F	L (sd)	-	837.5 (40.3)	908.7 (55.2)	888 (114.2)	-
		Range	-	780-902	792-1,015	673-1,011	-
		n	-	6	31	7	-
1990	M	L (sd)	595.9 (31.6)	858.9 (51.9)	965.6 (57.1)	1,020 (56.8)	630
		Range	516-688	702-1,000	814-1,110	953-1,090	-
		n	54	205	38	5	1
	F	L (sd)	-	830.0 (47.8)	926.7 (42.9)	944.0 (12.1)	-
		Range	-	650-947	822-1,050	933-957	-
		n	-	40	35	3	-

1991	M	L (sd)	626.6 (29.1)	836.1 (42.1)	954.2 (76.5)	-	-
		Range	560-693	703-930	735-1,070	-	-
		n	85	53	39	-	-
	F	L (sd)	-	838.3 (29.6)	943.0 (46.7)	929.5 (89.0)	-
		Range	-	805-900	800-1,030	825-1,023	-
		n	-	9	95	4	-
1992	M	L (sd)	616.7 (35.6)	860.1 (71.4)	979.1 (71.0)	-	-
		Range	523-711	582-980	793-1,103	-	-
		n	153	75	31	-	-
	F	L (sd)	629.0	842.9 (47.8)	938.0 (49.4)	965.3 (92.8)	-
		Range	-	662-920	800-1,060	877-1,062	-
		n	1	34	47	3	-
1993	M	L (sd)	609.7 (43.0)	864.9 (59.7)	1,001 (60.3)	-	-
		Range	459-745	646-983	841-1,090	-	-
		n	240	163	34	-	-
	F	L (sd)	-	847.0 (40.6)	958.6 (51.6)	937.5 (46)	-
		Range	-	746-936	810-1,054	905-970	-
		n	-	59	74	2	-
1994	M	L (sd)	598.4 (37.1)	861.5(60.0)	1,020 (73.8)	-	-
		Range	501-687	611-1,007	805-1,140	-	-
		n	127	332	42	-	-
	F	L (sd)	-	834.7 (53.2)	958.2 (49.7)	972.3 (63.8)	-
		Range	-	695-1,016	836-1,057	933-1,046	-
		n	-	96	109	3	-
1995	M	L (sd)	609.8 (40.2)	848.1 (67.3)	965.3 (73.6)	-	-
		Range	508-700	614-988	738-1,073	-	-
		n	98	141	24	-	-
	F	L (sd)	-	816.8 (35.5)	943.1 (50.9)	897 (38.7)	-
		Range	-	749-877	810-1,038	782-980	-
		n	-	28	98	48	-
1996	M	L (sd)	616.5 (28.2)	856.2 (56.9)	979.3 (67.6)	1,022.0	-
		Range	553-693	617-972	731-1,120	-	-
		n	91	345	148	1	-
	F	L (sd)	-	833.4 (44.4)	943.8 (49.7)	916 (130.6)	-
		Range	-	700-940	769-1,065	661-1,079	-
		n	-	94	286	10	-
1996[1]	M	L (sd)	607.0 (33.9)	-	-	-	-
		Range	514-691	-	-	-	-
		n	149	-	-	-	-
	F	L (sd)	-	-	-	-	-
		Range	-	-	-	-	-
		n	-	-	-	-	-
1997	M	L (sd)	563.4 (36.8)	842.9 (76.4)	954.4 (68.3)	922 (154.9)	-
		Range	476-666	536-981	653-1,092	757-1,076	-
		n	100	166	124	5	-
	F	L (sd)	-	844.8 (49.5)	920.9 (45.2)	923.8 (79.4)	-
		Range	-	660-899	781-1,040	688-1,042	-
		n	-	24	171	18	-
1997[1]	M	L (sd)	561.2 (36.9)	831.5 (57.2)	-	-	-
		Range	473-661	687-943	-	-	-
		n	105	198	-	-	-
	F	L (sd)	-	808.1 (40.6)	-	-	-
		Range	-	707-856	-	-	-
		n	-	20	-	-	-

1998	M	L (sd)	-	780.9 (71.5)	949.5 (87.8)	831 (220.5)	-
		Range	-	557-943	700-1,107	627-1,065	-
		n	-	320	88	3	-
	F	L (sd)	-	810.4 (40.0)	904.0 (69.2)	919.8 (92.2)	-
		Range	-	736-892	625-1,019	713-1,012	-
		n	-	18	83	8	-
1998[1]	M	L (sd)	577.8 (41.5)	766.2 (74.0)	950.1 (73.4)	-	-
		Range	510-642	503-930	642-1,090	-	-
		n	37	301	76	-	-
	F	L (sd)	-	810.3 (25.8)	903.3 (69.0)	-	-
		Range	-	767-842	662-1,037	-	-
		n	-	11	97	-	-
1998[2]	M	L (sd)	574.3 (44.4)	-	-	-	-
		Range	487-674	-	-	-	-
		n	26	-	-	-	-
	F	L (sd)	-	-	-	-	-
		Range	-	-	-	-	-
		n	-	-	-	-	-
1999	M	L (sd)	-	-	886.5 (101.2)	-	-
		Range	-	-	666-1,015	-	-
		n	-	-	13	-	-
	F	L (sd)	-	-	870.1 (73.6)	-	-
		Range	-	-	669-965	-	-
		n	-	-	20	-	-
1999[1]	M	L (sd)	672.5 (36.2)	844.3(65.9)	820.0(105.8)	855.0	-
		Range	575-746	696-938	719-930	-	-
		n	65	44	3	1	-
	F	L (sd)	-	832.4(24.2)	899.9(82.9)	989(36.8)	-
		Range	-	776-860	708-1,000	963-1,015	-
		n	-	10	14	2	-
1999[2]	M	L (sd)	672.8(40.0)	857.1(55.3)	-	-	-
		Range	536-797	717-952	-	-	-
		n	71	30	-	-	-
	F	L (sd)	-	847.5(36.3)	-	-	-
		Range	-	795-897	-	-	-
		n	-	6	-	-	-
1999[3]	M	L (sd)	676.2 (38.2)	-	-	-	-
		Range	596-760	-	-	-	-
		n	43	-	-	-	-
	F	L (sd)	-	-	-	-	-
		Range	-	-	-	-	-
		n	-	-	-	-	-

[1] Thiamine treated salmon
[2] Single paired family age 3+ male and age 3+ female
[3] Single paired family age 3+ male and age 2+ female

Appendix B.-Average weight (kg) by age, sex, and year of return of CWT chinook salmon released from and recaptured at Strawberry Creek, 1983-1998.

YEAR OF RETURN	SEX		AGE				
			1+	2+	3+	4+	5+
1983	M	W (sd)	2.7 (0.5)	-	-	-	-
		Range	1.5-3.6	-	-	-	-
		n	48	-	-	-	-
	F	W (sd)	-	-	-	-	-
		Range	-	-	-	-	-
		n	-	-	-	-	-
1984	M	W (sd)	2.0 (0.3)	5.6 (1.1)	-	-	-
		Range	1.3-2.5	2.4-7.8	-	-	-
		n	20	43	-	-	-
	F	W (sd)	-	-	-	-	-
		Range	-	-	-	-	-
		n	-	-	-	-	-
1985	M	W (sd)	2.1 (0.5)	5.4 (1.0)	7.6 (1.7)	-	-
		Range	1.1-3.6	4.4-6.2	3.1-12.2	-	-
		n	46	29	205	-	-
	F	W (sd)	-	4.7 (0.8)	7.0 (1.5)	-	-
		Range	-	4.1-5.3	2.9-11.5	-	-
		n	-	2	180	-	-
1986	M	W (sd)	2.1 (0.3)	4.8 (1.0)	6.6 (1.1)	6.6 (1.2)	-
		Range	1.4-2.7	3.0-6.5	4.0-9.3	5.1-10.1	-
		n	24	37	57	21	-
	F	W (sd)	-	4.8 (1.0)	6.4 (1.1)	7.3 (1.4)	-
		Range	-	3.5-6.3	3.7-8.9	4.9-11.5	-
		n	-	10	59	58	-
1987	M	W (sd)	2.3 (0.4)	5.4 (1.0)	6.8 (1.3)	6.5 (2.3)	-
		Range	1.6-3.5	2.5-7.3	3.4-10.2	2.7-12.5	-
		n	90	82	142	21	-
	F	W (sd)	-	5.2 (0.9)	6.6 (1.1)	6.8 (1.1)	5.1
		range	-	3.6-7.2	3.7-9.6	4.3-9.2	-
		n	-	22	160	48	1
1988	M	W (sd)	2.1 (0.3)	5.7 (1.3)	7.1 (1.4)	6.7 (1.5)	5.5
		Range	1.3-3.1	2.5-8.3	2.9-9.7	4.9-9.5	-
		n	50	41	94	10	1
	F	W (sd)	1.8	5.1 (1.0)	6.7 (1.3)	6.1 (1.3)	5.4 (0.1)
		Range	-	3.4-6.4	3.4-11.3	3.9-8.9	5.4-5.5
		n	1	13	111	12	2
1989	M	W (sd)	2.4 (0.5)	5.6 (1.1)	7.6 (1.9)	8.0 (1.7)	-
		range	1.5-5.7	3.9-8.1	4.1-10.5	4.9-9.6	-
		n	153	28	10	6	-
	F	W (sd)	-	6.2 (1.0)	7.7 (1.6)	6.9 (2.6)	-
		Range	-	5.5-8.0	4.5-11.4	3.4-10.0	-
		n	-	6	27	5	-
1990	M	W (sd)	2.1 (0.3)	6.3 (1.2)	8.4 (1.8)	8.9 (1.9)	2.6
		range	1.4-2.8	3.1-10.4	4.4-14.7	7.5-11.6	-
		n	54	199	35	4	1
	F	W (sd)	-	6.6 (1.0)	8.7 (1.4)	8.9 (1.8)	-
		range	-	4.2-9.6	5.8-11.9	6.9-10.3	-
		n	-	39	31	3	-

1991	M	W (sd)	2.5 (0.4)	5.6 (1.1)	8.3 (1.9)	-	-
		range	1.9-3.5	3.2-8.6	3.6-10.6	-	-
		n	49	40	22	-	-
	F	W (sd)	-	6.7 (1.0)	9.2 (1.6)	9.7 (1.9)	-
		range	-	5.4-8.5	5.6-11.9	7.6-11.4	-
		n	-	9	64	3	-
1992	M	W (sd)	2.3 (0.5)	6.5 (1.4)	9.3 (2.7)	-	-
		range	1.1-3.9	3.0-9.9	4.7-16.7	-	-
		n	112	50	20	-	-
	F	W (sd)	2.4	6.8 (1.2)	8.8 (1.8)	9.3 (2.6)	-
		range	-	3.1-8.4	5.4-13.6	6.7-11.8	-
		n	1	27	34	3	-
1993	M	W (sd)	2.3 (0.6)	6.6 (1.6)	9.0 (2.1)	-	-
		range	0.7-4.5	2.0-10.3	5.4-13.0	-	-
		n	198	85	18	-	-
	F	W (sd)	-	7.1 (1.2)	9.9 (1.4)	7.2	-
		range	-	4.5-9.9	6.2-12.9	-	-
		n	-	31	61	1	-
1994	M	W (sd)	2.2 (0.5)	6.5 (1.5)	10.7 (2.3)	-	-
		range	1.2-3.3	2.1-10.3	5.4-14.9	-	-
		n	123	323	34	-	-
	F	W (sd)	-	6.7 (1.3)	9.8 (1.7)	9.9 (2.0)	-
		range	-	3.9-10.9	6.2-13.2	8.3-12.2	-
		n	-	92	98	3	-
1995	M	W (sd)	2.2 (0.5)	6.0 (1.5)	8.5 (2.1)	-	-
		range	1.2-3.8	2.2-9.4	3.5-11.9	-	-
		n	95	115	23	-	-
	F	W (sd)	-	5.9 (1.0)	9.5 (1.8)	-	-
		range	-	4.1-8.0	5.6-13.1	-	-
		n	-	23	79	-	-
1996	M	W (sd)	2.3 (0.4)	6.2 (1.3)	8.9 (2.2)	10.5	-
		range	1.6-3.3	2.3-9.4	3.3-15.9	-	-
		n	84	288	109	1	-
	F	W (sd)	-	6.6 (1.1)	9.3 (1.7)	9.4 (3.2)	-
		range	-	4.0-9.5	5.1-14.3	4.1-13.7	-
		n	-	77	226	6	-
1996[1]	M	W (sd)	2.2 (0.5)	-	-	-	-
		range	1.2-3.3	-	-	-	-
		n	123	-	-	-	-
	F	W (sd)	-	-	-	-	-
		range	-	-	-	-	-
		n	-	-	-	-	-
1997	M	W (sd)	1.8 (0.4)	5.7 (1.6)	8.2 (1.9)	7.0 (3.7)	-
		range	1.1-3.1	2.4-10.2	2.8-12.7	3.5-10.5	-
		n	93	162	111	4	-
	F	W (sd)	-	6.5 (1.1)	8.3 (1.5)	8.2 (2.0)	-
		range	-	3.2-8.6	5.1-14.1	3.4-13.1	-
		n	-	24	167	18	-
1997[1]	M	W (sd)	1.8 (0.4)	5.5 (1.3)	-	-	-
		range	0.9-3.1	2.5-9.1	-	-	-
		n	99	191	-	-	-
	F	W (sd)	-	5.8 (1.0)	-	-	-
		range	-	3.7-7.4	-	-	-
		n	-	19	-	-	-

1998	M	W (sd)	-	4.6 (1.3)	7.7 (2.1)	5.8 (3.9)	-
		range	-	1.3-8.4	3.3-12.1	2.6-10.2	-
		n	-	320	86	3	-
	F	W (sd)	-	5.8 (0.9)	7.6 (1.6)	7.9 (2.5)	-
		range	-	4.1-7.4	2.7-10.6	3.4-11.5	-
		n	-	18	82	8	-
1998[1]	M	W (sd)	1.9 (0.5)	4.4 (1.3)	7.9 (1.9)	-	-
		range	1.1-2.7	1.2-8.2	2.6-12.3	-	-
		n	37	301	74	-	-
	F	W (sd)	-	5.9 (0.6)	7.7 (1.7)	-	-
		range	-	5.2-7.1	2.8-10.9	-	-
		n	-	11	97	-	-
1998[2]	M	W (sd)	1.9 (0.5)	-	-	-	-
		range	1.2-3.3	-	-	-	-
		n	26	-	-	-	-
	F	W (sd)	-	-	-	-	-
		range	-	-	-	-	-
		n	-	-	-	-	-
1999	M	W (sd)	-	-	6.0 (1.8)	-	-
		range	-	-	2.6-12.3	-	-
		n	-	-	12	-	-
	F	W (sd)	-	-	7.0 (1.5)	-	-
		range	-	-	4.0-10.0	-	-
		n	-	-	19	-	-
1999[1]	M	W (sd)	2.9 (0.6)	5.8 (1.5)	4.6 (2.0)	4.4	-
		range	1.7-4.9	2.9-8.6	2.8-6.9	-	-
		n	65	41	3	1	-
	F	W (sd)	-	6.2 (0.6)	7.9 (2.1)	9.3	-
		range	-	5.0-6.9	3.8-10.7	-	-
		n	-	10	13	1	-
1999[2]	M	W (sd)	2.9 (0.6)	6.0 (1.5)	-	-	-
		range	1.7-4.7	2.9-8.9	-	-	-
		n	71	27	-	-	-
	F	W (sd)	-	5.9 (0.8)	-	-	-
		range	-	4.9-6.7	-	-	-
		n	-	4	-	-	-
1999[3]	M	W (sd)	2.8 (0.5)	-	-	-	-
		range	1.8-4.0	-	-	-	-
		n	43	-	-	-	-
	F	W (sd)	-	-	-	-	-
		range	-	-	-	-	-
		n	-	-	-	-	-

[1] Thiamine treated salmon
[2] Single paired family age 3+ male and age 3+ female
[3] Single paired family age 3+ male and age 2+ female

Appendix C.-Average length (mm) by age, sex, and year of return of CWT chinook salmon stocked as part of the stocking technique study in the Kewaunee River and recaptured at the BAFF on the Kewaunee River, Kewaunee County, 1999.

YEAR OF RETURN	SEX		AGE LENGTH AT AGE				
			1+	2+	3+	4+	5+
1999[1]	M	L (sd)	660.8(35.9)	-	-	-	-
		range	562-730	-	-	-	-
		n	35	-	-	-	-
	F	L (sd)	-	-	-	-	-
		range	-	-	-	-	-
		n	-	-	-	-	-
1999[2]	M	L (sd)	664.1(31.9)	-	-	-	-
		range	595-740	-	-	-	-
		n	94	-	-	-	-
	F	L (sd)	-	-	-	-	-
		Range	-	-	-	-	-
		n	-	-	-	-	-
1999[3]	M	L (sd)	668.3(36.4)	-	-	-	-
		range	520-782	-	-	-	-
		n	105	-	-	-	-
	F	L (sd)	-	-	-	-	-
		range	-	-	-	-	-
		n	-	-	-	-	-
1999[4]	M	L (sd)	677.9(31.6)	-	-	-	-
		range	604-743	-	-	-	-
		n	57	-	-	-	-
	F	L (sd)	-	-	-	-	-
		range	-	-	-	-	-
		n	-	-	-	-	-

[1] Stocking technique study chinook fingerlings stocked in the Kewaunee Harbor near the mouth of the Kewaunee River.
[2] Stocking technique study chinook fingerlings stocked in the Kewaunee River near the BAFF approximately four miles upstream from Lake Michigan.
[3] Stocking technique study chinook fingerlings stocked in the Kewaunee River at Clyde's Hill Road crossing approximately nine miles upstream from Lake Michigan.
[4] Stocking technique study chinook fingerlings stocked in the Kewaunee River at Hwy. 54 crossing approximately 15 miles upstream from Lake Michigan.

Appendix D.-Average weight (kg) by age, sex, and year of return of CWT chinook salmon stocked as part of the stocking technique study in the Kewaunee River and recaptured at the BAFF on the Kewaunee River, Kewaunee County, 1999.

YEAR OF RETURN	SEX		AGE WEIGHT AT AGE				
			1+	2+	3+	4+	5+
1999[1]	M	W (sd)	2.9 (0.5)	-	-	-	-
		range	1.7-3.7	-	-	-	-
		n	33	-	-	-	-
	F	W (sd)	-	-	-	-	-
		range	-	-	-	-	-
		n	-	-	-	-	-
1999[2]	M	W (sd)	2.8 (0.5)	-	-	-	-
		range	1.6-4.1	-	-	-	-
		n	86	-	-	-	-
	F	W (sd)	-	-	-	-	-
		range	-	-	-	-	-
		n	-	-	-	-	-
1999[3]	M	W (sd)	2.9 (0.5)	-	-	-	-
		range	1.3-4.4	-	-	-	-
		n	99	-	-	-	-
	F	W (sd)	-	-	-	-	-
		range	-	-	-	-	-
		n	-	-	-	-	-
1999[4]	M	W (sd)	3.0 (0.5)	-	-	-	-
		range	2.0-4.1	-	-	-	-
		n	53	-	-	-	-
	F	W (sd)	-	-	-	-	-
		range	-	-	-	-	-
		n	-	-	-	-	-

[1] Stocking technique study chinook fingerlings stocked in the Kewaunee Harbor near the mouth of the Kewaunee River.
[2] Stocking technique study chinook fingerlings stocked in the Kewaunee River near the BAFF approximately four miles upstream from Lake Michigan.
[3] Stocking technique study chinook fingerlings stocked in the Kewaunee River at Clyde's Hill Road crossing approximately nine miles upstream from Lake Michigan.
[4] Stocking technique study chinook fingerlings stocked in the Kewaunee River at Hwy. 54 crossing approximately 15 miles upstream from Lake Michigan.