Return, Size, and Age of Steelhead at the Besadny Anadromous Fisheries Facility, 2002

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ABSTRACT

An annual steelhead assessment project was begun in 1992 at the Besadny Anadromous Fisheries Facility (BAFF) to (1) assess the return of the three steelhead strains to BAFF, and (2) collect basic biological information on each strain.

Spring operations for 2002 began on April 3, and continued until April 23. During this time period a total of 376 steelhead were handled. The run consisted of 51 Chambers Creek strain steelhead (13.6% of the run), 61 Ganaraska (16.2%), 17 Skamania (4.5%), and 247 (65.7%) unclipped, misclipped or strays from other streams or states. The total number of fish handled during the spring of 2002 decreased from the 2001 total, and was the second smallest run since 1992.

Chambers Creek steelhead ranged in length from 440 mm to 860 mm, and had an average length of 716 mm. Weight ranged from 0.6 kg to 5.7 kg and averaged 3.45 kg. The average length and average weight for Chambers Creek steelhead in 2002 increased over 2001 levels and was near the five year average. Standard and trophy weight indices increased from 2001 levels.

Ganaraska steelhead ranged in length from 375 mm to 870 mm and averaged 662 mm in length. Weights ranged from 0.4 kg to 4.7 kg with an average weight of 2.82 kg. Standard weight increased slightly from 2001 levels while trophy weight decreased slightly.

Skamania steelhead captured during spring migrations ranged in length from 586 mm to 788 mm and had a an average length of 718 mm.. Weight for these steelhead ranged from 1.6 kg to 4.3 kg with an average weight of 3.10 kg. All weight trend indices decreased from 2000 levels.

The summer/fall migration of steelhead was the worst on record. A total of 3 steelhead were collected, of which 1 had an identifiable Skamania clip.

All strains of steelhead continue to exhibit decreasing return to the weir. From 1993 to 1997, Chambers Creek have returned to the weir in larger numbers than have Ganaraska, but since 1998, Ganaraska have returned to the weir in greater number. Survival based on return per thousand stocked also indicates that generally Chambers Creek return at a higher rate than Ganaraska strain steelhead although this trend has reversed based on the return rates since the 1998 stocking of steelhead. Summer-run Skamania have had reduced run numbers since the 1995 peak and return rate has been close to zero since 1997.

INTRODUCTION

Wisconsin began its Lake Michigan rainbow/steelhead trout fishery in 1963 when rainbow trout were stocked in a Door County stream (Daly 1968). During the years following the original stocking, many changes in the fishery occurred including changes in the strains and age of fish stocked. Since 1988, Wisconsin has chose to stock three steelhead strains, Skamania, Chambers Creek, and Ganaraska for its Lake Michigan steelhead program. Although similar in appearance, each strain has unique characteristics that make each important to the overall steelhead program. We hoped that these strains would provide a good return to the creel and provide more fishing opportunities throughout the year for anglers in tributary streams.

To further enhance the steelhead fishery and continue the time series of biological information collected during earlier studies, an annual steelhead assessment project was initiated by Fisheries Management at the C.D. Besadny Anadromous Fishery Facility (BAFF) weir in 1992. The goals of this project are to (1) assess the return of the three steelhead strains to BAFF, (2) to collect basic biological information on each strain, and in past years (3) to floy tag adult fish to determine: handling mortalities from the spawning operation, angler return rate and movement of these fish in the Kewaunee River and in Lake Michigan. This report summarizes the data collected during the 2002 migratory runs of steelhead at BAFF.

METHODS

BAFF operations begin during early spring when ice on the Kewaunee River starts to break up and continues until ice up during early winter (Baumgartner 1995). Water is passed through the collection ponds and down the fish ladder, attracting migrating steelhead up the ladder and into the ponds. Ponds are sorted at least once a week and fish are passed upstream, spawned and passed, or held, depending on clip and ripeness. During spring migrations as fish proceed through the BAFF, the fish are checked for clips, sex and ripeness. Steelhead are measured to the nearest 1 mm and weighed to the nearest 0.01 kg. All fish receive a caudal fin clip to denote that data had been collected on that fish. Ripe fish with the appropriate strain fin clip are spawned, allowed to recover, and then passed upstream. Fish that are not ripe, but have the appropriate fin clip are returned to a holding pond. All other fish are measured, weighed, revived, and then passed upstream.

Late summer/early fall collection procedures differ from spring procedures because of warm water conditions, which may increase mortality of the handled steelhead. To maximize survival, fish are handled as little as possible. Steelhead are checked for fin clips, and sexed. Fish with target fin clips are sent to the Kettle Moraine Springs Fish Hatchery (KMSFH) and held until spawned. All other steelhead are passed upstream.

Data was analyzed using basic fishery statistics, such as average length and weight by sex and clip. A regression of length and weight for each strain was calculated. By using standard weight and trophy weight, which is the measure of the weight of a 660 mm

steelhead and the weight of the 95th percentile of steelhead respectively, we are able to track recent weight trends in the population. Handling mortality was estimated from the number of caudal fin clipped dead fish that were found in holding ponds, recovery tanks, and around the river release site. Catch numbers per day of weir operation were plotted to examine the timing of spring migratory runs.

RESULTS

Spring

Spring operations began on April 3, and continued until April 23. During this time period a total of 376 steelhead were handled (Table 1). The run consisted of 51 Chambers Creek strain steelhead (13.6% of the run), 61 Ganaraska (16.2%), 2 Skamania (4.5%), and 247 (65.7%) unclipped, misclipped or strays from other streams or states. The total number of fish handled during the spring of 2002 decreased from the 2001 total, and was the second smallest run since 1992.

Chambers Creek strain

Processing of Chambers Creek fish began on April 3, peaked on April 11, and decreased substantially thereafter (Table 2). Length of Chambers Creek steelhead ranged from 440 mm to 860 mm, with an average length of 716 mm (Table 1). Weight ranged from 0.6 kg to 5.7 kg and averaged 3.45 kg. The average length and average weight for Chambers Creek steelhead in 2002 increased from 2001 levels.

Males comprised 43.1% of the run and averaged 700 mm in length and 3.19 kg in weight (Table 3). Two different Chambers Creek fin clips were observed for male fish, with the left maxillary (LM) the most common. With the use of fin clips, returning fish can be assigned to age classes. Males returned at ages 2 and 4 (Table 4). Age 4 was the most common, and averaged 756 mm in length and 3.73 kg in weight. With 18 of the 22 returning males age 4, the 2002 run was essentially a run of a single age class of male fish.

Females comprised 56.9% of the run, averaged 728 mm in length and 3.10 kg in weight, and were represented by three different fin clips (Table 3). The most common clip was LM. Females returned at ages 4, 5 and 6 (Table 4). Age 4 females returned in the greatest number, and averaged 720 mm in length and 3.54 kg in weight. Similar to male Chambers Creek steelhead most of the returning females were age 4 (25 of 29).

Handling mortality was 5.9% for Chambers Creek during the spring run (Table 5). This was much greater than the average handling mortality for Chambers Creek steelhead of 1.6% since 1995.

Ganaraska strain

Ganaraska processing began on April 3, peaked on April 11 and ended on the last day of BAFF operation (Table 2). Lengths ranged from 375 mm to 870 mm and averaged 662 mm. Weights ranged from 0.4 kg to 4.7 kg with an average of 2.82 kg (Table 1).

Males comprised 31.1% of the run, and had an average length of 603 mm and weight of 2.21 kg (Table 3). A total of three different fin clips were observed for Ganaraska males, with the adipose, right ventral (ARV) clip the most common. Based on fin clip, ages 2 through 4 returned during the spring migration (Table 4). Age 4 fish were the most common, with substantially fewer age 2 and age 3 fish captured. Age 3 males averaged 689 mm in length and 2.91 kg in weight.

Females comprised 68.9% of the run and averaged 689 mm in length and 3.10 kg in weight (Table 3). A total of three clips were detected for female Ganaraska, with the ARV clip the most common. The majority of returning females were age 4 and had an average length of 686 mm and average weight of 3.02 kg (Table 4). The return of female Ganaraska was dominated by age 4 fish (36 of 42) with only a few younger fish represented in the sample.

Handling mortality was 4.9% for Ganaraska during the spring run (Table 5). This mortality rate was higher than the seven year average of 0.8% for Ganaraska.

Skamania strain

Skamania processing began on April 3, peaked on that date and ended on the last day of BAFF operation (Table 2). Lengths ranged from 586 mm to 788 mm and averaged 718 mm. Weights ranged from 1.6 kg to 4.3 kg and averaged of 3.10 kg (Table 1).

Males comprised 52.9% of the run, and had an average length of 725 mm and weight of 3.14 kg (Table 3). A total of two different fin clips were observed for Skamania males, with the right maxillary clip (RM) the most common. Based on fin clip, ages 3 and 4 returned during the spring migration (Table 4). Age 4 fish were the most common, with substantially fewer age 3 fish captured. Age 4 males averaged 742 mm in length and 3.14 kg in weight.

Females comprised 47.1% of the run and averaged 710 mm in length and 3.06 kg in weight (Table 3). Only the RM fin clip was detected for female Skamania, which indicated only age 4 females returned.

Handling mortality was 0.0% for Skamania for the sixth consecutive spring run (Table 5).

Non-broodstock steelhead

The final component of the spring run was those steelhead not used for broodstock collection. Although the majority of these fish were Chambers Creek, Ganaraska, or

Skamania strain steelhead, they were not clipped, misclipped, or were study fish from another stream. Clipped or nonclipped fish from other states were also part of this category. Members of this group were collected during each day of operation (Table 2), and were the largest single component of the spring run (Table 1).

Handling mortality for this group of steelhead was 1.2% which was slightly greater than the seven year average of 0.9% (Table 5).

Summer/Fall

The summer/fall migration of steelhead was the lowest return on record for BAFF (Table 2). The 2002 summer/fall run was just 0.6% of the peak run in 1995. A total of 3 steelhead were collected, of which 1 had identifiable Skamania clips (Table 6). All summer/fall steelhead were passed upstream.

DISCUSSION

Since 1992, we have been monitoring trends of several factors associated with the annual steelhead spawning migrations up the Kewaunee River to BAFF. They include abundance and run timing for each strain, length and weight, return rate, and handling mortality.

Timing and Abundance of the Run

Spring

The past five springs, 1998 through 2002, steelhead runs at BAFF have been markedly different in timing and abundance as compared to previous years (Hogler and Surendonk 1997, 1998, 1999, 2000, 2001 and 2002). Spring migratory runs before 1997 had been predictable with large numbers of Chambers Creek returning to the weir with the onset of operations and then slowly declining in number through the end of April. As the Chambers Creek run dwindled in number, Ganaraska numbers increased rapidly, peaked in mid-April, and declined through early May.

However, since 1998, unusually mild winters brought early runoff and ice free river conditions and when combined with the lack of snow in the basin, water levels during normal migration times have been very low. Instead of the typical pulses of steelhead, the fish that have returned, move in for a short period of time and then leave the Kewaunee River.

The decreasing trend in run abundance observed since 1992 has continued. The total number of steelhead handled at BAFF during the 2002 spring run decreased about 10% from the spring 2001 run, and was well below the peak run of 1992 and below the seven

year average run size of 1208. This year's run total was just 11.2% of the 1992 run (Figure 1).

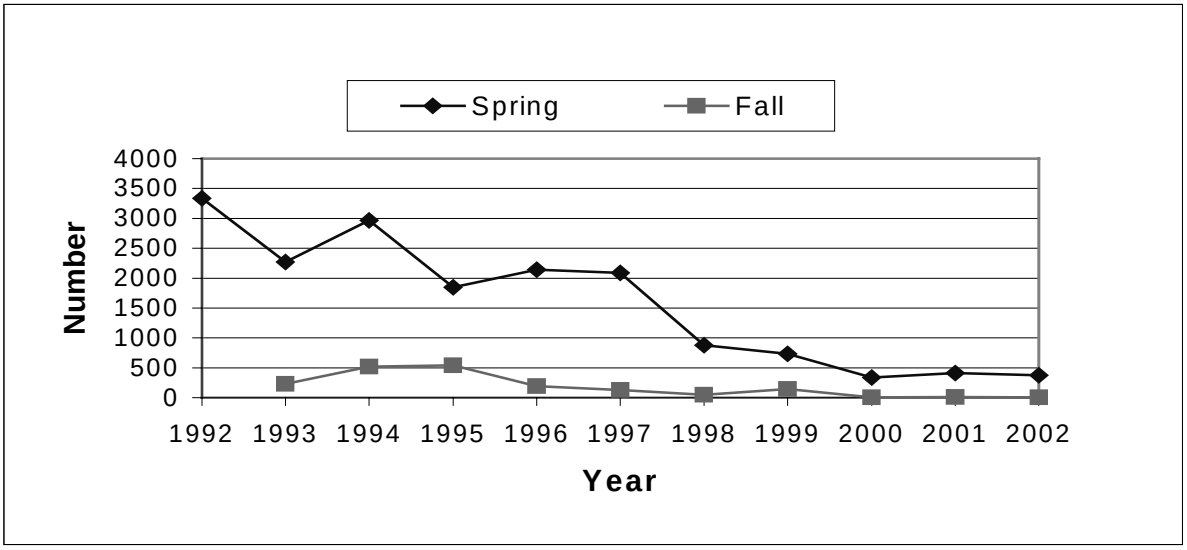

Figure 1. Steelhead return to BAFF during spring and fall runs, 1992-2002.

The 2002 Chambers Creek run was similar to the 2001 run while the 2002 Ganaraska run was less than half of what was seen in 2001 (Table 1). The 2002 Skamania run was larger than the number seen in the 2001 spring run.

The decrease in run abundance over time may be the result of unusual weather conditions, increased mortality of stocked smolts or adults, or a combination of reasons. Stocking number continues to remain relatively stable for Chambers Creek and Ganaraska, although Skamania numbers have varied from year to year (Figure 2). Size at stocking has been consistent since 1992. Unfavorable weather may explain some of the decline observed the past three springs. Early ice-out and quickly dropping flows may have caused steelhead to attempt to spawn in lower sections of the Kewaunee River or drop back into Lake Michigan and reabsorb their eggs instead of continuing to migrate upstream.

Mortality of smolts may also play an important role in the low return number seen the past three springs. Low flow in the Kewaunee River after stocking smolts above BAFF may have trapped fish in the upper river increasing smolt mortality and ultimately reducing the number of adults returning to the river. Very low flows over the past several years have resulted in smolts being stocked below BAFF. The increased number of Age 4 fish that returned this spring may be an indication of the benefits of lower river stocking during periods of low water which was begun in the spring of 1998 and fully implemented in 1999.

Lakewide angler harvest of adult fish may also affect the number of returning spawners to BAFF. The steelhead harvest since the early 1990's has averaged just over 92,800 fish

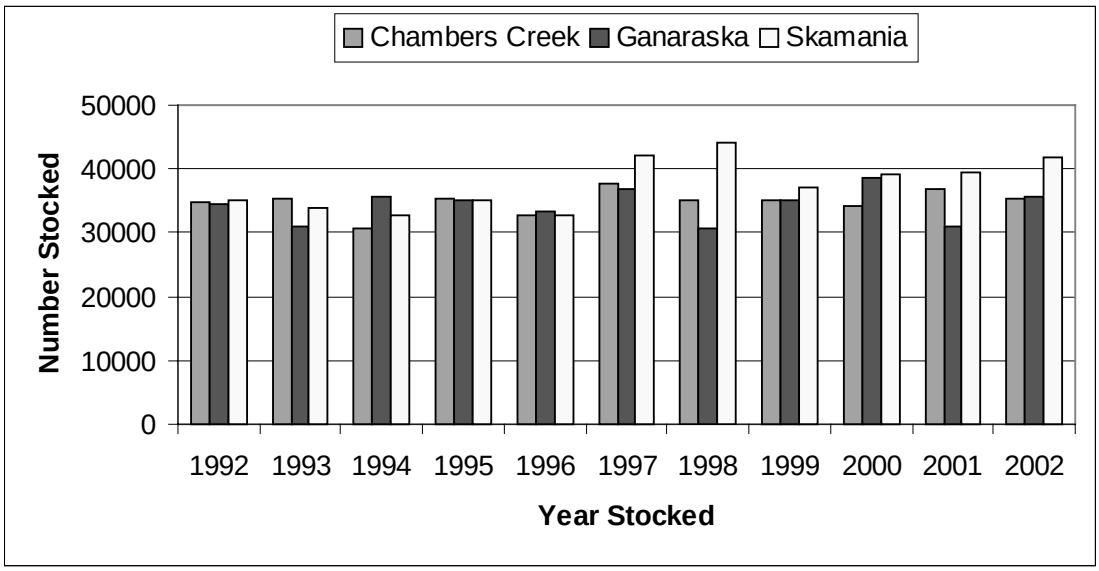

Figure 2. Stocking number by strain for steelhead stocked into the Kewaunee River from 1992 through 2002.

(Kubisiak 2002). However, harvest during 1994, 1995 and 1998 exceeded 110,000 steelhead. High lakewide harvest in these years may have reduced the number of adult fish available to return to the weir.

Since 1992, much of the decline in run number has been in clipped broodstock fish, which have declined 90%. During the same time period non-broodstock fish have declined 60%. Clearly it appears the decline is related to broodstock fish stocked into the Kewaunee River. However, it is unclear what is causing the decline in return for broodstock fish. Since angling mortality should be equal on broodstock and non-broodstock fish, and water levels have the same impact on both, it is likely related to river conditions (flow and water quality) and stocking location (predators) or to the health of the fish.

Fall

The number of steelhead handled at BAFF (3) in the summer/fall of 2002 was substantially lower than the 540 fish captured in 1995 and indicates a near complete collapse of this component of the steelhead fishery in the Kewaunee River (Figure 1). Low flow, despite late spring and summer rainfall and low lake water level have severely limited the run, although other factors such as lake harvest (Skamania return at the oldest age to spawn thereby remaining in Lake Michigan longer than other strains and available to harvest for a longer period of time) and stocking concerns must have also impacted the return of these steelhead.

Strain Performance

Chambers Creek

Average length and weight of Chambers Creek steelhead increased in 2002 over 2001 levels (Table 1). The increase may be an artifact due to the small number of fish returning or that most of the returning fish were age 4 in 2002 rather than the age 3 fish that returned in 2001. Standard and trophy weight indices in 2002 increased slightly 2001 levels (Figure 3). However, since 1993, the three weight trend indices have varied little for Chambers Creek steelhead.

Return rates from an individual year of stocking can also be evaluated by the use of fin clips. Since the majority of Chambers Creek fish generally return at age 4, we would expect to see the highest return rate of a year class occur three years after fish were stocked. In 2002, 4-year-old Chambers Creek steelhead stocked in 1999 returned at a much lower rate than 4-year-old fish stocked in 1995, but returned at the highest rate observed since Chambers Creek stocked in 1996 (Table 7). Chambers Creek stocked in 1998 had the lowest observed return rate at 2.6 per 10,000 stocked.

The reason(s) for these substantially lower return rates are unknown. Certainly low water has hurt return number but can't explain the entire decline in run number. Other potential reasons for the decline include poor imprinting to the river by smolts, predation on newly stocked steelhead by birds and other fish, entrapment behind the dam at BAFF under low flow conditions, poor river water quality, high harvest on adult fish by anglers on Lake Michigan and unhealthy fish from the hatchery. If returns continue to decline, each of these potential reasons must be examined to determine the cause of the decline.

Because of concerns about fish being trapped upstream of BAFF during low water level and flow years, steelhead stocking was shifted from an upriver location in 1998 to a lower river location in 1999. This may be the reason for the increased number of age 4 Chambers Creek steelhead observed this spring, but it is too early to determine if this trend will continue in future spring runs for this age class.

Ganaraska

Ganaraska strain steelhead have had more variation in yearly average length and weight than Chambers Creek strain fish. After a slow increase in average length and weight in the late 1990's, length and weight declined in 2001 and but has rebounded in 2002 (Table 1). Standard weight increased from 2001 to 2002 while trophy weight decreased during the same time period (Figure 2). Long-term trends for each of the three weight indices however indicate that Ganaraska weights have been relatively stable since 1993.

The return rate of Ganaraska strain steelhead, which declined for fish stocked in 1995 through 1998, has increased for 1999 stocked fish (Table 7). Similar to the Chambers Creek strain, Ganaraska stocked in 1998 have performed poorly, with improvements in return noted for those Ganaraska stocked in 1999. Overall return rate indicates that fish stocked in 1993 returned at a higher rate than those stocked in later years. Reasons for the decline are unknown, but the potential possibilities are similar to those discussed for Chambers Creek.

Skamania

Skamania have been a small, but consistent portion of the spring run until 2001 when their abundance dropped substantially. Average length and weight decreased in 2002 from 2001 levels, but should be viewed cautiously because of the small sample size. Standard weight in 2002 was similar to standard weight in 2000. Trophy weight for Skamania this spring decreased from the 2000 level (Table 1). Standard weight has remained constant since 1992 while trophy weight has declined (Figure 3). Since this strain normally migrates upriver in late summer and fall, return rates during the spring are expected to be low (Table 7).

The number of Skamania collected during the fall run has varied greatly. High lake harvest and poor river conditions may be responsible for the variation in run number and run timing.

Summary of all strains

All strains of steelhead continue to exhibit decreasing return to the weir. Of the spring running strains since 1993, Chambers Creek has returned in greatest number despite a sharp decline in number during the past three spring migrations. Survival based on return per thousand stocked also indicates Chambers Creek, in general, return at a higher rate than does Ganaraska strain steelhead although this trend may be reversing based on the return rates of the last four springs. Summer run Skamania have had reduced run numbers since the 1995 peak. The return rate of Skamania is the lowest of the three strains of steelhead and may be the result of longer lake exposure to angler harvest or from poorer river conditions encountered during fall migrations.

Skamania continue to be the largest steelhead followed by Chambers Creek and Ganaraska. Mixed results from the three weight trends may indicate forage problems on Lake Michigan or that younger (smaller) fish are more common during spawning runs because of the reduced return rate for fish stocked in 1995-1998. However, decreasing return number may influence the trends of each weight index if smaller fish (younger in age) continue to dominate the run.

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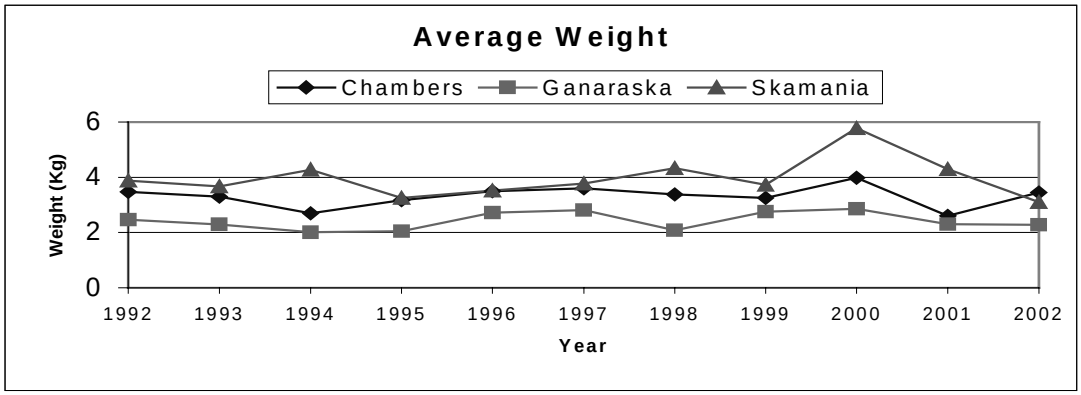

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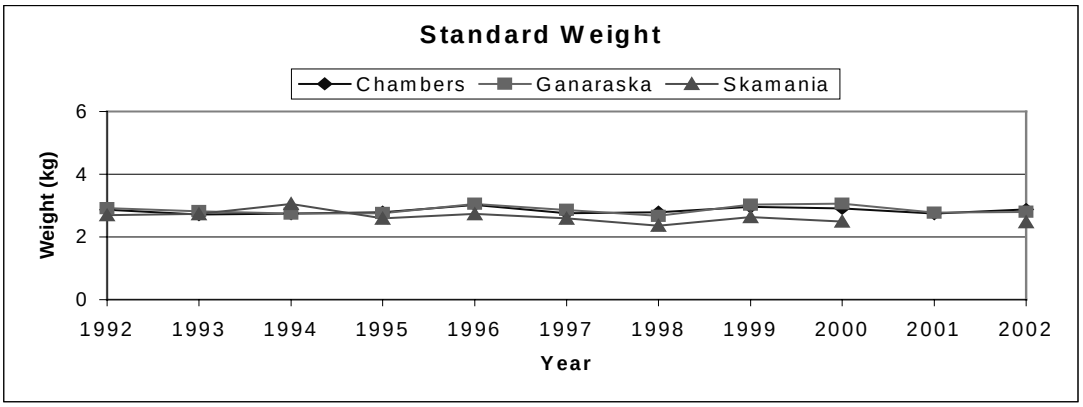

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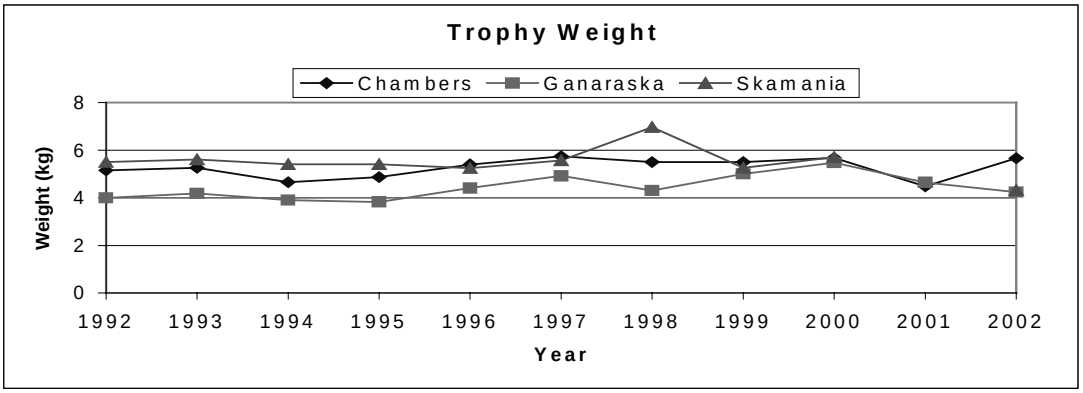

Figure 3. Weights trends for steelhead during spring migrations at BAFF, 1992-2002: (A) Average weight for each strain for that year, (B) Standard weight is based on the projected weight of a 660 mm steelhead, (C) Trophy weight for each strain based on the 95th. Percentile of weighed steelhead.

Handling Mortality

Spring

Handling mortality was 2.4% (9 of 376 fish handled) during the spring 2002 run (Table 5). The increase in handling mortality in 2002 reversed the trend of declining mortality seen since 1995. The reason for the increase in handling mortality is unknown but low water conditions in the river may have resulted in fish in poorer condition reaching BAFF and the stress of spawning was too great to survive given their poor condition.

Summer/Fall

Mortality caused by handling and holding steelhead during warm summer months is generally a problem. Skamania that returned in 2002 were in poor condition due to warm water and low river conditions.

SUMMARY

The 2002 spring run total was the second poorest spring run since BAFF went online in 1991. Early warmth and runoff were followed by low flow that reduced steelhead movement upstream into BAFF. These unusual conditions may be among the causes of the decline observed in steelhead return number since 1992. However, the marked reduction in return rate of several year classes that have been stocked since 1997 may be due to other reasons than poor flow or low water on the Kewaunee River.

Changes in average, standard and trophy weights may be due to a larger percentage of the run being younger (smaller) fish returning to the weir. Why older fish are absent from the return is unknown at this time and may be related to fish health, stocking location or predation.

The small increase in number of age 4 Chambers Creek and Ganaraska strain steelhead this spring may be the result of downstream (below BAFF) stocking of smolts since 1998. If this increase continues, return numbers should improve over the next two to three years, assuming all other variables remain the same.

Gamete collections for all three strains of steelhead were spotty from BAFF in 2002, but should not impact the total number of steelhead stocked in 2003 because of the contribution of gametes from the Root River Steelhead Facility.

Summer/fall runs of steelhead were also affected by weather. Although there was abundant late spring and summer rain, river flow did not increase enough to trigger steelhead runs into the river, making 2002 a very poor year for Skamania.

We will begin to evaluate the magnitude of the smolt out-migration from the Kewaunee River in 2003 and several years thereafter. However, the results may not yield any answers for the reasons for the decline in return number to BAFF for several more years.

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Table 1. Summary of steelhead length and weight data collected during spring migratory runs at BAFF, on the Kewaunee River, 1996-2002.

Year	Strain	Number	Run %	Average Length (mm)	Length Range (mm)	Average Weight (kg)	Weight Range (kg)	Standard Weight (kg)*	Trophy Weight (kg)**
1996	Chambers	731	34.1	699	390-950	3.49	0.6-8.2	3.02	5.40
	Ganaraska	414	19.3	630	341-865	2.72	0.4-6.1	3.05	4.41
	Skamania	175	8.2	734	436-907	3.52	0.8-6.9	2.73	5.25
	Other	824	38.4	--	--	--	--	--	--
	Total	**2,144**							
1997	Chambers	610	29.2	721	471-915	3.60	1.1-7.3	2.76	5.74
	Ganaraska	364	17.4	657	365-812	2.82	0.5-7.4	2.86	4.92
	Skamania	288	13.8	757	420-934	3.77	0.7-6.6	2.59	5.57
	Other	829	39.6	--	--	--	--	--	--
	Total	**2,091**							
1998	Chambers	236	26.9	706	394-900	3.38	0.6-6.9	2.79	5.50
	Ganaraska	241	27.5	593	270-795	2.09	0.5-5.1	2.67	4.31
	Skamania	74	8.4	795	540-953	4.33	1.7-7.4	2.36	6.97
	Other	325	37.1	--	--	--	--	--	--
	Total	**876**							
1999	Chambers	220	30.1	683	386-890	3.25	0.7-7.0	2.96	5.51
	Ganaraska	237	32.4	633	269-815	2.76	0.3-6.2	3.03	5.01
	Skamania	23	3.1	759	571-903	3.73	1.9-5.7	2.64	5.27
	Other	252	34.4	--	--	--	--	--	--
	Total	**732**							
2000	Chambers	69	20.3	750	475-865	3.98	0.9-5.8	2.91	5.67
	Ganaraska	84	24.7	637	370-832	2.87	0.4-5.7	3.06	5.48
	Skamania	40	11.8	761	635-894	5.78	1.4-5.8	2.49	5.71
	Other	147	43.2	--	--	--	--	--	--
	Total	**340**							
2001	Chambers	66	16.0	650	549-809	2.61	1.4-4.8	2.74	4.49
	Ganaraska	136	33.0	621	421-830	2.31	0.6-5.3	2.77	4.65
	Skamania	2	0.4	756	711-800	4.30	3.7-4.8	--	--
	Other	209	50.6	--	--	--	--	--	--
	Total	**413**							
2002	Chambers	51	13.6	716	440-860	3.45	0.6-5.7	2.88	5.66
	Ganaraska	61	16.2	662	375-870	2.82	0.4-4.7	2.80	4.25
	Skamania	17	4.5	718	586-788	3.10	1.6-4.3	2.48	4.32
	Other	247	65.7	--	--	--	--	--	--
	Total	**376**							

* Standard weight is a prediction based on a 660.4-mm steelhead.

** Trophy weight is based on the 95 percentile of weighed steelhead.

Table 2. Daily totals during 2002 operations at BAFF, by strain of steelhead.

Spring Run Steelhead

Date	Chambers Creek	Ganaraska	Skamania	Other	Day Total
April 3	14	7	8	100	129
April 11	24	35	8	115	182
April 16	9	9	0	22	40
April 23	4	10	1	10	25
Total	51	61	17	247	376

Summer/Fall Run Steelhead

Date	Chambers Creek	Ganaraska	Skamania	Other	Day Total
September 26			1		1
October 1					
October 4					
October 8				1	1
October 9					
October 15				1	1
October 24					
November 5					
Total			1	2	3

Table 3. Average length, weight and run number by strain, clip, and sex during the spring spawning run at BAFF, 2002.

	Male			Female		
Strain and Clip	**Average Length(mm)**	**Average Weight(kg)**	**Run Number**	**Average Length(mm)**	**Average Weight(kg)**	**Run Number**
Chambers Creek						
Left Maxillary, Left Ventral (LMLV)			0	752	3.91	3
Adipose, Left Maxillary (ALM)	445	0.76	4	860	5.72	1
Left Maxillary (LM)	756	3.73	18	720	3.54	25
Chambers Creek combined average	**700**	**3.19**	**22**	**728**	**3.65**	**29**
Ganaraska						
Adipose, Left Ventral (ALV)	407	0.62	5	723	3.82	5
Adipose, Right Ventral (ARV)	689	2.91	12	686	3.02	36
Both Ventral (BV)	575	2.01	2	600	2.04	1
Ganaraska combined average	**603**	**2.21**	**19**	**689**	**3.10**	**42**
Skamania						
Adipose, Right Maxillary (ARM)			0			0
Right Maxillary (RM)	742	3.34	8	710	3.06	8
Right Maxillary, Right Ventral (RMRV)	586	1.56	1			0
Skamania combined average	**725**	**3.14**	**9**	**710**	**3.06**	**8**

Table 4. The age distribution, length, and weight of returning clipped Chambers Creek and Ganaraska strain steelhead by sex for the Kewaunee River spring 2002.

Chambers Creek

Age (Male)	2	3	4	5	6	Age (Female)	2	3	4	5	6
Measured	4	0	18	0	0	Measured	0	0	25	1	3
Average Length (mm)	445		756			Average Length (mm)			720	860	752
Range (mm)	440-450		647-855			Range			665-788	--	740-760
Average Weight (kg)	0.76		3.73			Average Weight (kg)			3.54	5.72	3.91
Range (kg)	0.62-0.84		2.70-5.60			Range (kg)			2.82-4.76	--	3.70-4.52

Ganaraska

Age (Male)	2	3	4	5	6	Age (Female)	2	3	4	5	6
Measured	5	2	12	0	0	Measured	0	1	36	5	0
Average Length (mm)	407	575	689			Average Length (mm)		600	686	723	
Range (mm)	375-446	560-590	410-870			Range		--	615-760	690-772	
Average Weight (kg)	0.62	2.01	2.91			Average Weight (kg)		2.04	3.02	3.82	
Range (kg)	0.42-0.80	1.76-2.26	0.74-3.88			Range (kg)		--	154-418	312-466	

Skamania

Age (Male)	2	3	4	5	6	Age (Female)	2	3	4	5	6
Measured	0	1	8	0	0	Measured	0	0	8	0	0
Average Length (mm)		586	742			Average Length (mm)			710		
Range (mm)		--	612-788			Range			666-780		
Average Weight (kg)		1.56	3.34			Average Weight (kg)			3.06		
Range (kg)		--	1.88-4.32			Range (kg)			2.30-3.90		

Table 5. Handling mortality by strain at BAFF during spring operations for the years 1996-2002.

Year	Strain	Number	Number Dead	Percent Mortality
1996	Chambers	731	**41**	**5.6**
	Ganaraska	414	7	1.7
	Skamania	175	3	1.7
	Other	824	7	0.9
	Total	**2,144**	**58**	**2.7**
1997	Chambers	610	4	0.6
	Ganaraska	364	7	1.8
	Skamania	288	0	0.0
	Other	829	5	0.6
	Total	**2,091**	**16**	**0.7**
1998	Chambers	236	5	2.1
	Ganaraska	241	1	0.4
	Skamania	74	0	0.0
	Other	325	4	1.2
	Total	**876**	**10**	**1.1**
1999	Chambers	220	1	0.5
	Ganaraska	237	1	0.4
	Skamania	23	0	0.0
	Other	252	0	0.0
	Total	**732**	**2**	**0.3**
2000	Chambers	69	0	0.0
	Ganaraska	84	0	0.0
	Skamania	40	0	0.0
	Other	147	0	0.0
	Total	**340**	**0**	**0.0**
2001	Chambers	66	1	1.5
	Ganaraska	136	1	0.7
	Skamania	2	0	0.0
	Other	209	0	0.0
	Total	**413**	**2**	**0.5**
2002	Chambers	51	3	5.9
	Ganaraska	61	3	4.9
	Skamania	17	0	0.0
	Other	247	3	1.2
	Total	**376**	**9**	**2.4**

Table 6. Steelhead fin clip patterns detected at BAFF during fall migrations, 1996-2002.

Strain and fin clip	1996	1997	1998	1999	2000	2001	2002
Skamania							
Adipose, Right Maxillary (ARM)	97	57	8	8	3		
Right Maxillary (RM)	63	53	20	76	1	8	1
Right Maxillary,Right Ventral (RMRV)				8	1		
Right Maxillary,Left Pectoral (RMLP)				1			
Right Pectoral, Left Ventral (RPLV)	1		2				
Left Maxillary, Left Ventral (LMLV)	2						
Total Skamania	**163**	**110**	**30**	**93**	**5**	**8**	**1**
Chambers Creek							
Left Maxillary (LM)	4	1		1			
Left Maxillary, Left Ventral (LMLV)	1						
Adipose, Left Maxillary (ALM)							
Total Chambers Creek	**5**	**1**		**1**			
Ganaraska							
Adipose, Right Ventral (ARV)							
Adipose, Left Ventral (ALV)							
Both Ventral (BV)							
Total Ganaraska							
Unknown							
No Clips	20	17	15	30	2	5	2
Both Maxillary (LMRM)	1						
Adipose (?), Right Ventral (A?RV)	4						
Adipose (A)		1		1			
Other		2	1	20			
Total Unknown	**25**	**20**	**16**	**51**	**2**	**5**	**2**
Total Fall Steelhead Run	**193**	**131**	**46**	**145**	**7**	**13**	**3**

Table 7. Return rates (number per thousand stocked) of steelhead to the Kewaunee River during spring migrations by strain, 1996-2002.

Chambers Creek

	Year Stocked						
Return Year	1995	1996	1997	1998	1999	2000	2001
1996	1.10	--	--	--	--	--	--
1997	5.49	0.00	--	--	--	--	--
1998	4.99	0.85	0.11	--	--	--	--
1999	0.48	5.26	0.80	0.03	--	--	--
2000	0.08	1.16	0.93	0.11	0.09	--	--
2001	0.00	0.18	0.11	0.09	1.51	0.00	--
2002	0.00	0.00	0.09	0.03	1.23	0.00	0.05
Total	12.14	7.45	2.04	0.26	2.83	0.00	0.05

Ganaraska

	Year Stocked						
Return Year	1995	1996	1997	1998	1999	2000	2001
1996	0.94	--	--	--	--	--	--
1997	4.18	0.30	--	--	--	--	--
1998	2.67	3.57	0.35	--	--	--	--
1999	0.74	4.17	1.68	0.16	--	--	--
2000	0.14	0.57	0.57	0.58	0.51	--	--
2001	0.00	0.12	0.19	0.52	3.08	0.08	--
2002	0.00	0.00	0.00	0.16	0.13	0.08	0.16
Total	8.67	8.73	2.79	1.42	3.72	0.16	0.16

Skamania

	Year Stocked						
Return Year	1995	1996	1997	1998	1999	2000	2001
1996	0.00	--	--	--	--	--	--
1997	0.03	0.03	--	--	--	--	--
1998	0.68	0.06	0.00	--	--	--	--
1999	0.37	0.30	0.00	0.00	--	--	--
2000	0.14	1.03	0.00	0.00	0.12	--	--
2001	0.00	0.00	0.00	0.02	0.03	0.00	--
2002	0.00	0.00	0.00	0.00	0.43	0.03	0.00
Total	1.22	1.42	0.00	0.02	0.58	0.03	0.00