Return, Size, and Age of Steelhead at the Besadny Anadromous Fisheries Facility, 2001

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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 2001 began on April 9, and continued until April 24. During this time period a total of 413 steelhead were handled. The run consisted of 66 Chambers Creek strain steelhead (16% of the run), 137 Ganaraska (33.2%), 2 Skamania (0.4%), and 208 (50.4%) unclipped, misclipped or strays from other streams or states. The total number of fish handled during the spring of 2001 increased from the 2000 total, but still was the second smallest run since 1992.

Length of Chambers Creek steelhead ranged from 549 mm to 809 mm, with an average length of 650 mm. Weight ranged from 1.4 kg to 4.8 kg and averaged 2.61 kg. The average length and average weight for Chambers Creek steelhead in 2001 was the shortest and lightest since 1995. Standard and trophy weight indices also decreased in 2001 from 2000 levels.

Lengths of Ganaraska steelhead ranged from 421 mm to 830 mm and averaged 631 mm. Weights ranged from 0.6 kg to 5.3 kg with an average weight of 2.46 kg. Standard and trophy weight indices also decreased in 2001 from 2000 levels.

The summer/fall migration of steelhead was the second worst on record. A total of 13 steelhead were collected, of which 8 had identifiable Skamania clips. Seven Skamania were sent to KMSFH to be held until ready for spawning.

All strains of steelhead continue to exhibit decreasing return to the weir. Of the spring run 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 that generally Chambers Creek return at a higher rate than does Ganaraska strain steelhead although this trend may be reversing based on the return rates of the last two 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.

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 year class failures.

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. Most recently, Wisconsin chose 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. It was 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 from the 2001 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 spawning building, 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 9, and continued until April 24. During this time period a total of 413 steelhead were handled (Table 1). The run consisted of 66 Chambers Creek strain steelhead (16% of the run), 137 Ganaraska (33.2%), 2 Skamania (0.4%), and 208 (50.4%) unclipped, misclipped or strays from other streams or states. The total number of fish handled during the spring of 2001 increased from the 2000 total, but still was the second smallest run since 1992.

Chambers Creek strain

Processing of Chambers Creek fish began on April 9, peaked on that date, and decreased substantially thereafter (Table 2). Length of Chambers Creek steelhead ranged from 549 mm to 809 mm, with an average length of 650 mm (Table 1). Weight ranged from 1.4 kg to 4.8 kg and averaged 2.61 kg. The average length and average weight for Chambers Creek steelhead in 2001 was the shortest and lightest since 1995.

Males comprised 51.5% of the run and averaged 641 mm in length and 2.37 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 3, 5 and 6 (Table 4). Age 3 was the most common, and averaged 632 mm in length and 2.25 kg in weight. With 32 of the 34 returning males age 3, the 2001 run was essentially a run of a single age class of fish.

Females comprised 48.5% of the run and averaged 658 mm in length and 286 kg in weight and were represented by three different fin clips (Table 3). The most common clip was LM. Females returned at ages 3 through 6 (Table 4). Age 3 females returned in the greatest

number followed by age 6 fish. Age 3 females averaged 616 mm in length and 2.36 kg in weight. Although not as skewed as the Chambers Creek male return, 66% of female fish (21 of 32) were from a single age class, age 3.

Handling mortality was 1.5% for Chambers Creek during the spring run (Table 5). This was slightly less than the average handling mortality for Chambers Creek steelhead of 1.6% since 1995. Uncrowded ponds and short holding time may have reduced the handling mortality rate.

Ganaraska strain

Ganaraska processing began on April 9, peaked on that date and ended on the last day of BAFF operation (Table 2). Lengths ranged from 421 mm to 830 mm and averaged 631 mm. Weights ranged from 0.6 kg to 5.3 kg with an average of 2.46 kg.

Males comprised 60.6% of the run, and had an average length of 621 mm and weight of 2.02 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 3 fish were the most common, with substantially fewer age 2 and age 4 fish captured. Age 3 males averaged 603 mm in length and 2.02 kg in weight.

Females comprised 39.4% of the run and averaged 647 mm in length and 2.70 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 3 and had an average length of 606 mm and average weight of 2.12 kg (Table 4). The return of female Ganaraska was a more typical return than was the male return, with older age classes represented in the sample.

Handling mortality was 0.7% for Ganaraska during the spring run (Table 5). This mortality rate was slightly less than the seven year average of 0.8% for Ganaraska. It is likely that uncrowded ponds and short holding time reduced the handling mortality rate.

Skamania strain

Only two Skamania were captured during the spring 2001 run (Table 1). The Skamania handled were 711 mm in length, weighing 3.7 kg and 800 mm in length and weighing 4.8 kg.

Both of the Skamania were female, with one being age 5 and one age 6 (Table 3).

For the fifth consecutive year, spring handling mortality was 0.0% for Skamania (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 0.5% which was less than the seven year average of 0.9% (Table 5).

Summer/Fall

The summer/fall migration of steelhead was the second lowest return on record for BAFF (Table 2). The 2001 summer/fall run was just 2.4 % of the peak run in 1995. A total of 13 steelhead were collected, of which 8 had identifiable Skamania clips (Table 6).

Seven of eight Skamania were sent to KMSFH to be held until ready for spawning. The other Skamania and the unclipped steelhead were returned to the Kewaunee River (Table 6).

DISCUSSION

Over the years 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 four springs, 1998 through 2001, steelhead runs at BAFF have been markedly different in timing compared to previous years (Hogler and Surendonk 1997, 1998, 1999, 2000, and 2001). Unusually mild winters brought early runoff and ice free river conditions, although water temperatures remained cold. These early favorable conditions were then followed by rapidly declining flow rates and cooler temperatures. These environmental conditions caused the spring run to begin two weeks late and end 2 weeks earlier than average spring runs (Figures 1, 2 and 3).

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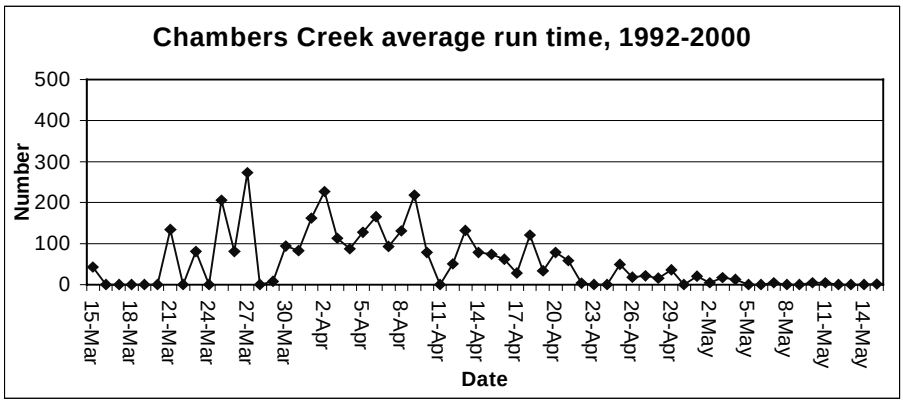

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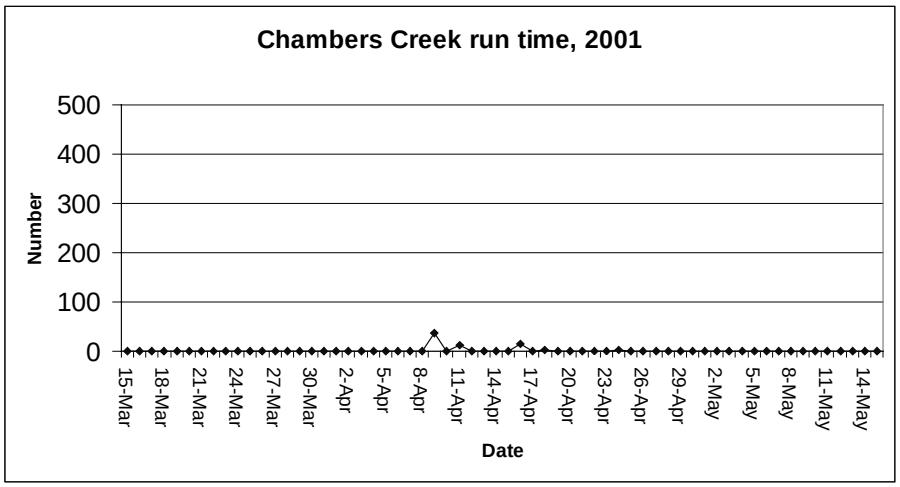
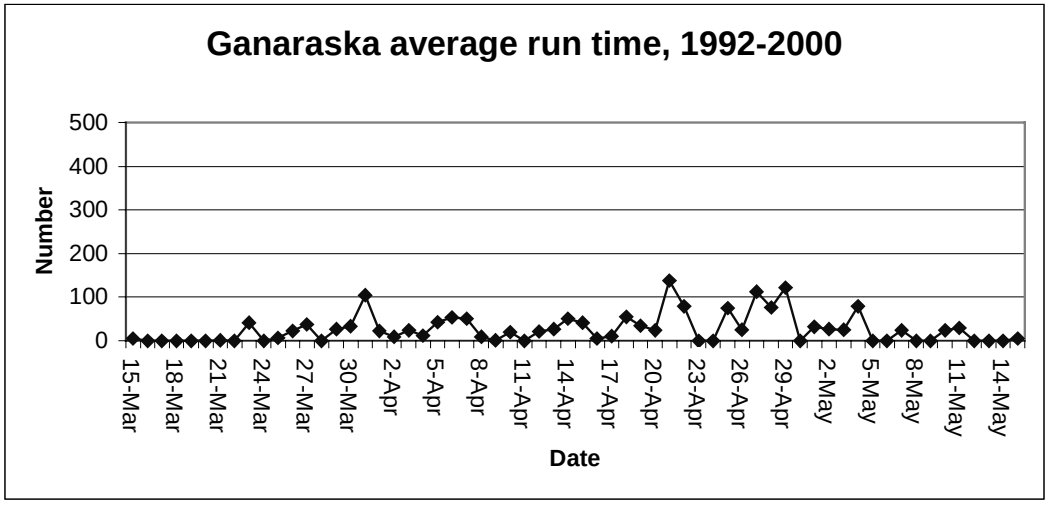


Figure 1. Spring run timing for Chambers Creek steelhead on the Kewaunee River: (A) Average run time, 1992 through 2000, (B) Run time, 2001.

A.



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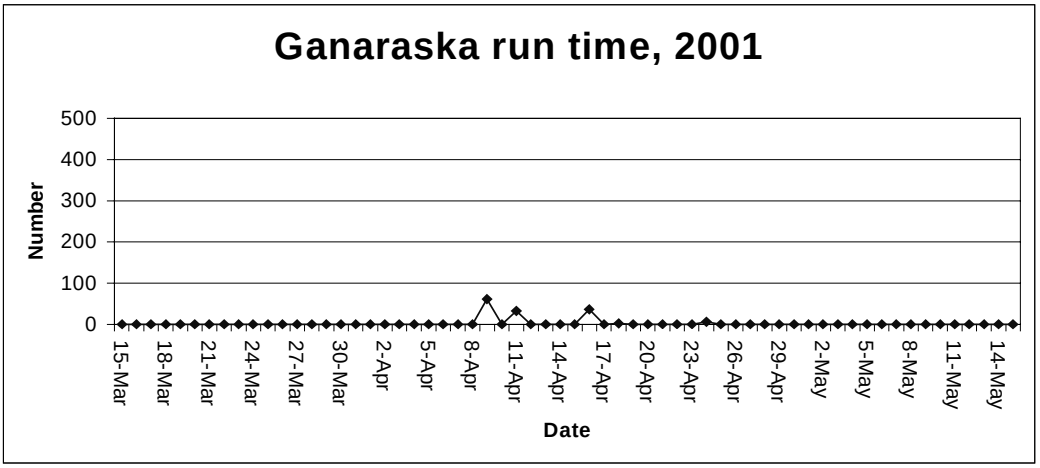
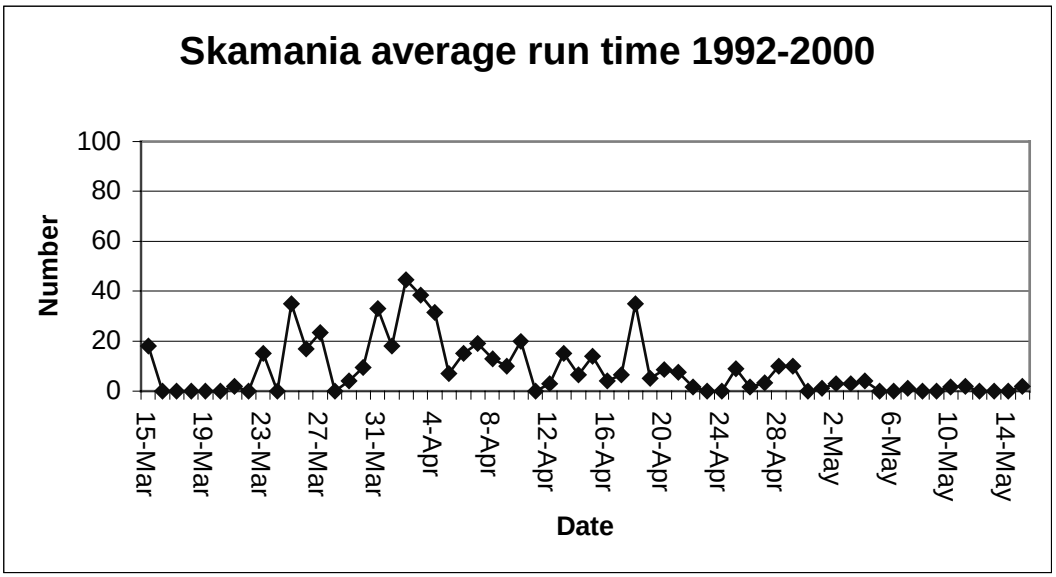


Figure 2. Spring run timing for Ganaraska steelhead on the Kewaunee River: (A) Average run time, 1992 through 2000, (B) Run time, 2001.

A.



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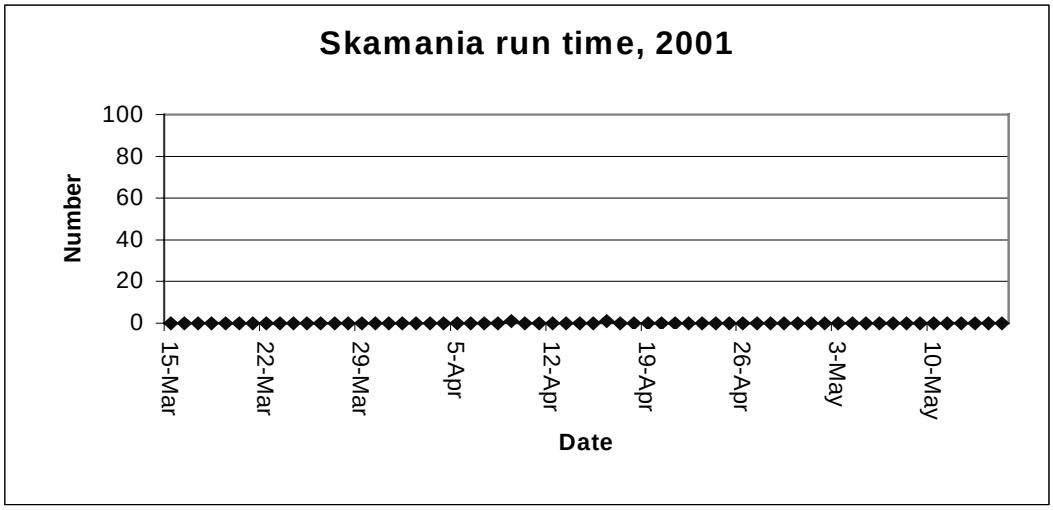

Figure 3. Spring run timing for Skamania steelhead on the Kewaunee River: (A) Average run time, 1992 through 2000, (B) Run time, 2001.

The last four spring runs have also been unusual with most of the fish returning early in the run and substantially lower numbers during the remainder of the migration.

The decreasing trend in run abundance observed since 1992 has continued. The total number of steelhead handled at BAFF during the 2001 spring run increased 20% over the

spring 2000 run, but still was well below the peak run of 1992 and below the seven year average run of 1208. This year's run total was just 12.3% of the 1992 run (Figure 4).

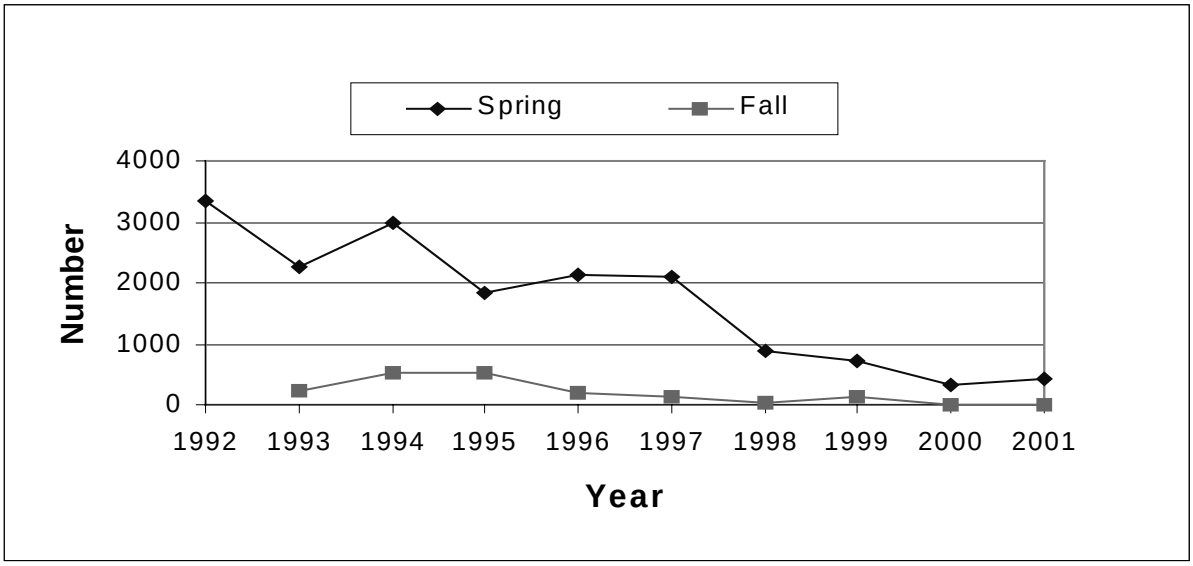

Figure 4. Steelhead return to BAFF during spring and fall runs, 1992-2001.

The 2001Chambers Creek run was similar to the 2000 run while the 2001 Ganaraska run was nearly double over what was seen in 2000 (Table 1). The 2001 Skamania run was substantially below the number seen in 2000.

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. 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 younger 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.

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 100,000 fish (Eggold 1999). Harvest during 1994, 1995 and 1998 have 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 84%. 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 eight steelhead handled at BAFF in the summer/fall of 2001 was substantially lower than the 540 fish captured in 1995 (Figure 4). Low flow, despite late spring and summer rainfall and low lake water level has severely limited the run.

Lake harvest of Skamania (which remain in Lake Michigan longer than other strains), and similar concerns to those for other brood strains may also explain the low return numbers for this strain since 1995.

Strain Performance

Chambers Creek

Average length and weight of Chambers Creek steelhead decreased in 2001 over 2000 levels (Table 1). The decrease may be due to the small number of fish returning or that most of the returning fish were from only one class (age 3). These age 3 fish are younger and smaller than fish from an average run when age 4 is the most common age of return. Standard and trophy weight indices decreased in 2001 from 2000 levels (Figure 5). 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 2001, 4-year-old Chambers Creek steelhead stocked in 1998 returned at a much lower rate than 4-year-old fish stocked in 1994 (Table 7). The return rate that was 10.57 fish per 1000 stocked for 1993 stocked fish returning in 1996 at age 4, has dropped to 0.09 fish/1000 stocked in 1998 (1997 year class) returning in 2001. For Chambers Creek steelhead

stocked in and since 1997 (1996 year class), return has been very poor (Table 8). The only exception are those Chambers Creek steelhead that were stocked in 1999 (1998 year class) and captured this spring.

The reason or reasons for these year class failures 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.

However, because of concerns about fish being trapped upstream of BAFF during low water level and flow years, steelhead have been stocked below BAFF since 1998. This may be the reason for the increased number of age 3 Chambers Creek steelhead observed this spring, but it is too early to determine if this trend will continue in future spring runs for this year class.

Ganaraska

Ganaraska strain steelhead have had more variation in yearly average length and weight than Chambers Creek strain fish. After an increase in average length and weight in 1999 and again in 2000, length and weight declined in 2001(Table 1). Standard and trophy weights also decreased in 2001 from 2000 levels (Figure 5). Long-term trends for each of the three weight indices however indicate that Ganaraska weights have been stable since 1993.

The return of Ganaraska strain steelhead has declined each spring since 1993 although not as severely as for Chambers Creek strain fish (Table 7). The return rate of four year old fish has dropped from 4.39 fish per 1000 stocked in 1997 (1993 year class) to 0.52 in 2001 (1997 year class). Similar to the Chambers Creek strain, Ganaraska stocked since 1997 have performed poorly with the exception of the 1998 year class. 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 during the spring run. Average length and weight decreased in 2001, but should be viewed cautiously because of the small sample size. Standard and trophy weight indices were not calculated for this spring because of the small number of Skamania that returned. However standard weight slightly decreased from 1992 to 2000 with trophy weight remaining fairly constant (Figure 5). Age of returning fish has

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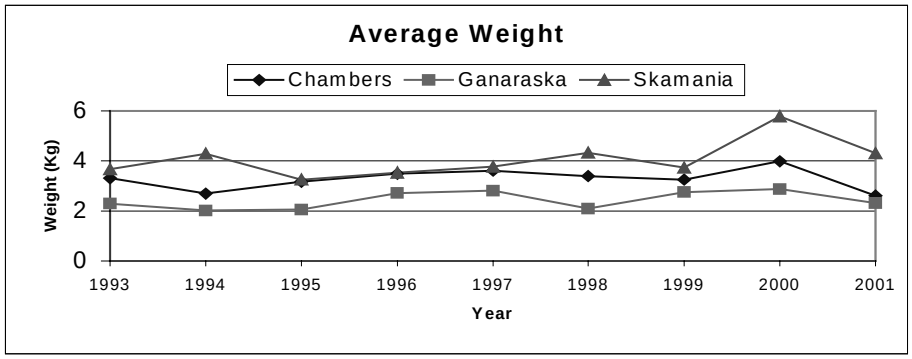

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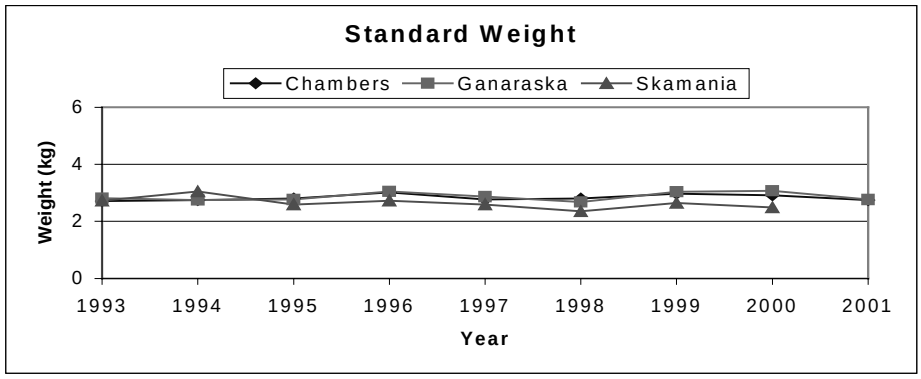

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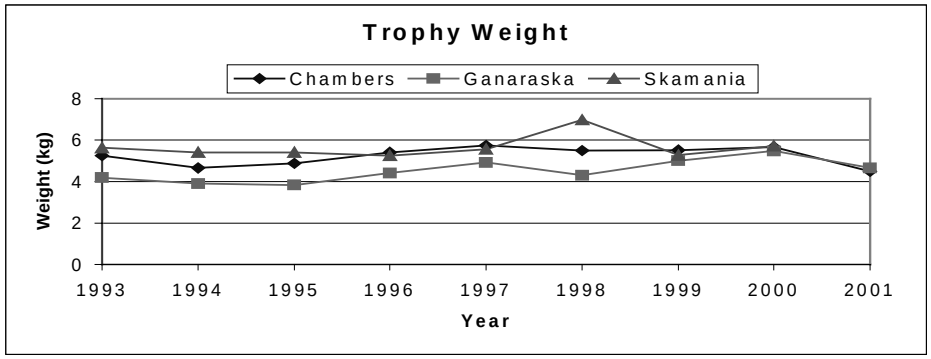

Figure 5. Weights trends for steelhead during spring migrations at BAFF, 1992-2001: (A) Average weight for each strain for that year, (B) Standard weight is based on the projected weight of a 660 mm steelhead, (C) Trophy weight for each strain based on the 95th. Percentile of weighed steelhead.

also been consistent, with mostly age 5 fish present in the run. Since this strain normally migrates upriver in late summer and fall, return rates during the spring are 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 of run number and run timing.

Summary of all strains

All strains of steelhead continue to exhibit decreasing returns 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 two 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 year class failures. However, decreasing return number may influence the trends of each weight index if smaller fish (younger in age) continue to dominate the run.

Handling Mortality

Spring

Handling mortality's as expressed by absolute number or by percentage was 0.5% (2 of 413 fish handled) during the spring 2001 run (Table 5). Uncrowded ponds and short holding times were likely responsible for the decline. Improved handling techniques by BAFF personnel and hatchery and management staff while fish were held in ponds, during collection of biological data, and spawning operations has led to decreases in handling mortality. Reaching a zero mortality rate may be difficult to achieve, but returning the healthiest possible steelhead to the Kewaunee River will always be a priority.

Summer/Fall

Mortality caused by handling and holding steelhead during warm summer months is generally a problem. Skamania that returned in 2001 were in poor condition due to warm water and low river conditions. Although no steelhead died in the ponds at BAFF, several adults that were sent to KMSFH died shortly after arriving.

SUMMARY

The 2001 spring run total increased over the run total of 2000 but still 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 apparent failure 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 due to younger (smaller) fish returning to the weir. Why younger fish are returning to the weir is unknown at this time and may be related to fish health, stocking location or predation.

The small increase in number of Age 3 Chambers Creek and Ganaraska strain steelhead this spring may be the result of downstream (below BAFF) stocking of smolts the past two springs. If this increase continues, return numbers should improve over the next two to three years, assuming all other variables remain the same.

Gamete collections from Chambers Creek and Ganaraska strain steelhead were spotty, but should result in near quota yearling stocking in 2002 for both strains.

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 2001 a very poor year for Skamania.

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Table 1. Summary of steelhead length and weight data collected during spring migratory runs at BAFF, on the Kewaunee River, 1995-2001.

Year	Strain	Number	Run %	Average Length (mm)	Length Range (mm)	Average Weight (kg)	Weight Range (kg)	Standard Weight (kg)*	Trophy Weight (kg)**
1995	Chambers	928	50.2	695	293-920	3.17	0.2-6.3	2.79	4.87
	Ganaraska	331	17.9	593	402-847	2.05	0.6-5.7	2.76	3.83
	Skamania	57	3.1	713	547-945	3.25	1.6-6.4	2.59	5.41
	Other	531	28.8	--	--	--	--	--	--
	Total	1,847							
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	631	421-830	2.46	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							

* 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 2001 operations at BAFF, by strain of steelhead including recaptured fish.

Spring

Date	Chambers Creek	Ganaraska	Skamania	Other	Day Total
April 9	37	61	1	114	213
April 11	11	32	0	36	79
April 16	14	35	1	45	95
April 18	2	2	0	5	9
April 24	2	6	0	9	17
Total	66	137	2	208	413

Summer/Fall

Date	Chambers Creek	Ganaraska	Skamania	Other	Day Total
August 17					
August 31			7	3	10
September 21					
September 26			1		1
October 1					
October 4			1	1	2
October 15					
October 17					
October 26					
November 5					
Total			9	4	13

Table 3. Average length, weight and run number by strain, clip, and sex during the spring spawning run at BAFF, 2001.

	Male			Female		
Strain and Clip	**Average Length (mm)**	**Average Weight (kg)**	**Run Number**	**Average Length (mm)**	**Average Weight (kg)**	**Run Number**
Chambers Creek	641	2.37	34	658	2.86	32
Left Maxillary, Left Ventral (LMLV)	804	4.88	1	767	3.97	3
Adipose, Left Maxillary (ALM)	--	--	--	70	3.29	3
Left Maxillary (LM)	636	2.29	33	642	2.68	27
Ganaraska	621	2.31	82	647	2.70	54
Adipose, Left Ventral (ALV)	668	2.97	6	679	3.24	10
Adipose, Right Ventral (ARV)	603	2.02	74	628	2.42	39
Both Ventral (BV)	438	0.81	2	738	3.78	5
Skamania	--	--	--	756	4.30	2
Adipose, Right Maxillary (ARM)	--	--	--	800	4.88	1
Right Maxillary (RM)	--	--	--	711	3.72	1

Table 4. The age distribution, length, and weight of returning clipped Chambers Creek and Ganaraska strain steelhead by sex for the Kewaunee River spring 2001.

Chambers Creek

Age (Male)	2	3	4	5	6	Age (Female)	2	3	4	5	6
Measured	0	32	0	1	1	Measured	0	21	3	3	5
Average Length (mm)		632		804	741	Average Length (mm)		616	701	767	747
Range (mm)		549-690				Range		555-616	655-748	742-791	716-809
Weighed	0	32	0	1	1	Weighed	0	21	3	3	5
Average Weight (kg)		2.25		4.88	3.56	Average Weight (kg)		2.36	3.29	3.97	4.06
Range (kg)		1.40-2.94				Range (kg)		1.42-3.16	2.84-4.02	3.24-4.52	3.56-4.66

Ganaraska

Age (Male)	2	3	4	5	6	Age (Female)	2	3	4	5	6
Measured	2	74	6	0		Measured	0	34	10	5	5
Average Length (mm)	438	603	668			Average Length (mm)		606	679	738	772
Range (mm)	421-455	496-691	589-786			Range		530-680	559-744	709-771	728-830
Weighed	2	74	6	0		Weighed	0	34	10	5	5
Average Weight (kg)	0.81	2.02	2.97			Average Weight (kg)		2.12	3.25	3.78	4.42
Range (kg)	0.68-0.94	1.14-3.00	1.92-4.30			Range (kg)		1.60-2.96	1.56-4.40	3.02-4.56	4.04-5.32

Table 5. Handling mortality by strain at BAFF during spring operations for the years 1994-2001.

Year	Strain	Number of fish handled	Number Dead	Percent Mortality
1995	Chambers	928	11	0.9
	Ganaraska	331	3	0.6
	Skamania	57	1	1.8
	Unknown	531	6	0.9
	Total	1,847	21	1.1
1996	Chambers	731	41	5.6
	Ganaraska	414	7	1.7
	Skamania	175	3	1.7
	Unknown	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
	Unknown	869	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
	Unknown	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
	Unknown	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
	Unknown	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
	Unknown	209	0	0.0
	Total	413	2	0.5

Table 6. Steelhead fin clip patterns detected at BAFF during fall migrations, 1994-1999.

Strain and fin clip	1994	1995	1996	1997	1998	1999	2000	2001
Skamania								
Adipose, Right Maxillary (ARM)	60	41	97	57	8	8	3	
Right Maxillary (RM)	325	356	63	53	20	76	1	8
Right Maxillary, Right Ventral (RMRV)						8	1	
Right Maxillary, Left Pectoral (RMLP)	2	6				1		
Right Pectoral, Left Ventral (RPLV)	1	2	1		2			
Right Pectoral (RP)		1						
Right Maxillary, Left Ventral (RMLV)			2					
Left Maxillary, Left Ventral (LMLV)							5	8
Total Skamania	388	406	163	110	30	93		
Chambers Creek								
Left Maxillary (LM)		1	4	1		1		
Left Ventral (LV)	2							
Adipose, Left Maxillary (ALM)		2	1					
Total Chambers Creek	2	3	5	1		1		
Ganaraska								
Adipose, Right Ventral (ARV)								
Adipose, Left Ventral (ALV)								
Left Ventral (LV)								
Left Ventral, Right Pectoral (LVRP)		1						
Total Ganaraska		1						
Unknown								
No Clips	131	130	20	17	15	30	2	5
Both Maxillary (LMRM)			1					
Adipose (?), Right Ventral (A?RV)			4					
Adipose (A)				1		1		
Other				2	1	20		
Total Unknown	131	130	25	20	16	51	2	5
Total Fall Steelhead Run	521	540	193	131	46	145	7	13

Table 7. Return rates (number per thousand stocked) of steelhead to the Kewaunee River during spring migrations by strain, 1994-2000.

Chambers Creek

	Year Stocked						
Return Year	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
1995	0.20	--	--	--	--	--	
1996	4.01	1.10	--	--	--	--	--
1997	10.33	5.49	0.00	--	--	--	--
1998	0.68	4.99	0.85	0.11	--	--	--
1999	0.00	0.48	5.26	0.80	0.03	--	--
2000	0.00	0.08	1.16	0.93	0.11	0.09	--
2001	0.00	0.00	0.18	0.11	0.09	1.51	0.00
Total	15.22	12.14	7.45	1.95	0.23	1.60	0.00

Ganaraska

	Year Stocked						
Return Year	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
1995	0.26	--	--	--	--	--	
1996	3.00	0.94	--	--	--	--	--
1997	4.39	4.18	0.30	--	--	--	--
1998	0.37	2.67	3.57	0.35	--	--	--
1999	0.14	0.74	4.17	1.68	0.16	--	--
2000	0.09	0.14	0.57	0.57	0.58	0.51	--
2001	0.00	0.00	0.12	0.19	0.52	3.08	0.08
Total	8.25	8.67	8.73	2.79	1.26	3.59	0.08

Table 7. Continued.

Skamania

	Year Stocked						
Return Year	1994	1995	1996	1997	1998	1999	2000
1995	0.00	--	--	--	--	--	--
1996	0.00	0.00	--	--	--	--	--
1997	2.84	0.03	0.03	--	--	--	--
1998	1.44	0.68	0.06	0.00	--	--	--
1999	0.00	0.37	0.30	0.00	0.00	--	--
2000	0.00	0.14	1.03	0.00	0.00	0.12	--
2001	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	4.28	1.22	1.42	0.00	0.00	0.12	0.00