Return, Size, Age, and Movement of Steelhead at the Besadny Anadromous Fisheries Facility, 2000

Steve Hogler and Steve Surendonk

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, (2) collect basic biological information on each strain, and in past years (3) to floy tag adult fish to determine: handling mortality, angler return rate, and movement.

Spring 2000 operations began on March 14, and continued until April 17. During this time period a total of 340 steelhead were handled. The run consisted of 69 Chambers Creek strain steelhead, 84 Ganaraska, 40 Skamania, and 147 unclipped, misclipped or strays from other streams or states. The total number of fish handled during the spring of 2000 declined from the 1999 level, making the 2000 run the smallest in past eight years.

Chambers Creek steelhead ranged in length from 475 mm to 865 mm, with an average length of 750 mm. Weight ranged from 0.9 kg to 5.8 kg and averaged 3.98 kg. Standard weight decreased from 1999 levels, while average weight and trophy weight increased.

Ganaraska lengths ranged from 370 mm to 832 mm and averaged 637 mm. Weights ranged from 0.4 kg to 5.7 kg with an average of 2.87 kg. All three weight indices increased in 2000 over 1999 levels.

The summer/fall migration of steelhead was the worst on record. A total of 7 steelhead were collected, of which 5 had identifiable Skamania clips. All Skamania were sent to KMSFH to be held until ready for spawning, and all the other steelhead were passed upstream. The 2000 fall summer run was just 1.2% of the peak run in 1995.

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 Chambers Creek in general, return at a higher rate than does Ganaraska strain steelhead. 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 residence time or from poorer river conditions during fall migrations than during spring movements.

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 2000 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 March 14, and continued until April 17. During this time period a total of 340 steelhead were handled (Table 1). The run consisted of 69 Chambers Creek strain steelhead (20.3% of the run), 84 Ganaraska (24.7%), 40 Skamania (11.8%), and 147 (43.2%) unclipped, misclipped or strays from other streams or states. The total number of fish handled during the spring of 2000 substantially declined from the 1999 total, making the 2000 spring run the smallest in recent history.

Chambers Creek strain

Processing of Chambers Creek fish began on March 14, peaked on that date, and decreased substantially thereafter to end on the last day of BAFF spring operations (Table 2). Length of Chambers Creek steelhead ranged from 475 mm to 865 mm, with an average length of 750 mm (Table 1). Weight ranged from 0.9 kg to 5.8 kg and averaged 3.98 kg.

Males comprised 34.8% of the run and averaged 751 mm in length and 3.9 kg in weight (Table 3). A total of three 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 through 5 (Table 4). Age 5 was the most common, and averaged 798 mm in length and 4.36 kg in weight.

Females comprised 65.2% of the run and averaged 750 mm in length and 4.02 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 5 females returned in the greatest number followed by age 4 fish. Age 5 females averaged 758 mm in length and 4.23 kg in weight.

Handling mortality was 0.0% for Chambers Creek during the spring run (Table 5). This was a decrease from 1999 levels, and was lowest on record. Uncrowded ponds and short holding time may have reduced the handling mortality rate.

Ganaraska strain

Ganaraska processing began on March 14 peaked on March 29 and ended on the last day of BAFF operation (Table 2). Lengths ranged from 370 mm to 832 mm and averaged 637 mm. Weights ranged from 0.4 kg to 5.7 kg with an average of 2.87 kg.

Males comprised 39.3% of the run, and had an average length of 559 mm and weight of 1.99 kg (Table 3). A total of three different fin clips were observed, with the adipose, right ventral (ARV) clip the most common. Based on fin clip, ages 2 through 5 returned during the spring migration (Table 4). Age 2 fish were the most common, followed by age 4. Age 2 males averaged 417 mm in length and 0.68 kg in weight.

Females comprised 60.7% of the run and averaged 687 mm in length and 3.43 kg in weight (Table 3). A total of four clips were detected for female fish, with adipose, left ventral (ALV) the most common followed by the ARV clip. The majority of returning females were age 5 and had an average length of 724 mm and average weight of 3.88 kg (Table 4). Age 3 and 4 fish were also commonly caught.

Handling mortality was 0.0% for Ganaraska (Table 5). The mortality rate was the lowest observed for Ganaraska at BAFF. It is likely that uncrowded ponds and short holding time reduced the handling mortality rate.

Skamania strain

Although Skamania are a minor component of the spring run, 40 fish were collected early in the spring run (Table 2). Skamania ranged in length from 635 mm to 894 mm with an average length of 761 mm (Table 1). Weight ranged from 1.4 kg to 5.8 kg, with an average weight of 2.49 kg.

Males comprised 40.0% of the run, with an average length of 785 mm and weight of 3.83 kg (Table 3). Right maxillary (RM) was the most common clip observed. Age 2, 5 and 6 fish returned with age 5 males the most common (Table 4).

Females averaged 745 mm in length and 3.68 kg in weight (Table 3). Similar to males, the majority of females had a RM clip, with the remainder having an ARM clip (Table 4).

For the fourth consecutive spring handling mortality was 0.0% for Skamania (Table 5).

Non-broodstock steelhead

The final component of the spring run were 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 0.0% which was similar to the 1999 rate (Table 5).

Summer/Fall

The summer/fall migration of steelhead was the lowest return on record at BAFF (Table 2). The 2000 summer/fall run was just 1.2 % of the peak run in 1995. A total of 7 steelhead were collected, of which 5 had identifiable Skamania clips (Table 6).

All Skamania were sent to KMSFH to be held until ready for spawning.

The two non-Skamania strain steelhead captured, were unclipped and 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 three springs, 1998 through 2000, steelhead runs at BAFF have been markedly different in timing compared to previous years (Hogler and Surendonk 1997 and 1998). Unusually mild winters brought early runoff and ice free river conditions. Early favorable conditions were then followed by rapidly declining flow rates. These environmental conditions caused the spring run to begin and end approximately two to four weeks earlier than average spring runs (Figures 1, 2 and 3).

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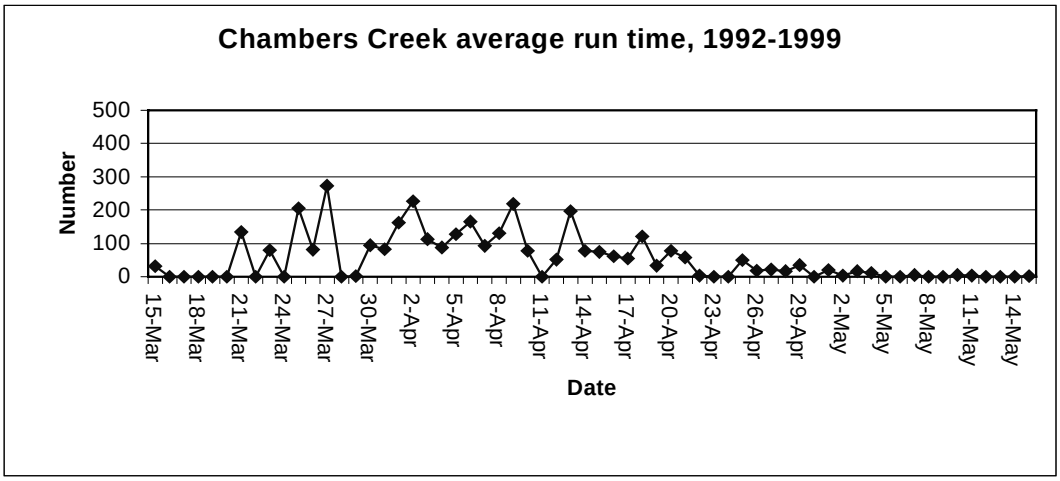

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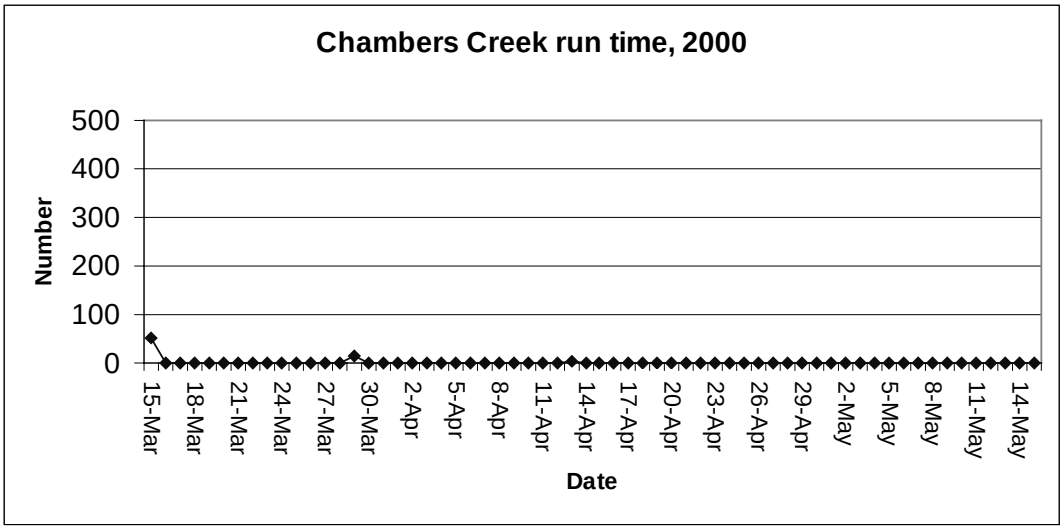
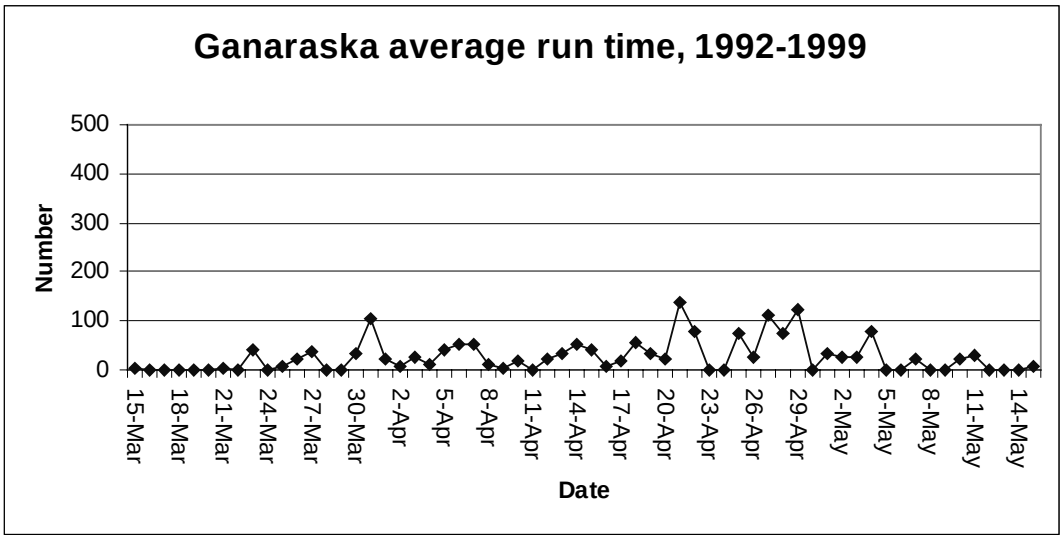


Figure 1. Spring run timing for Chambers Creek steelhead on the Kewaunee River: (A) Average run time, 1992 through 1999, (B) Run time, 2000.

A.



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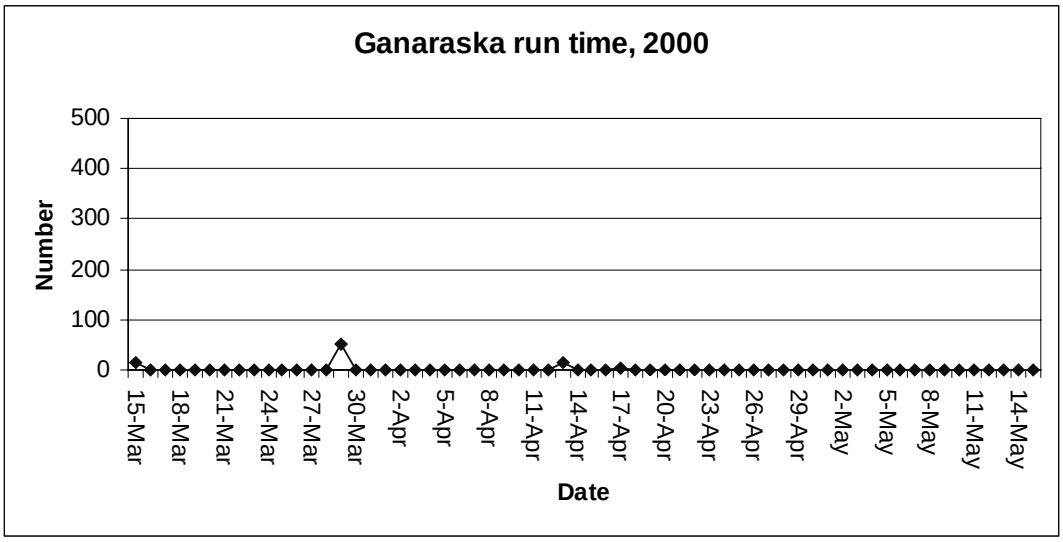

Figure 2. Spring run timing for Ganaraska steelhead on the Kewaunee River: (A) Average run time, 1992 through 1999, (B) Run time, 2000.

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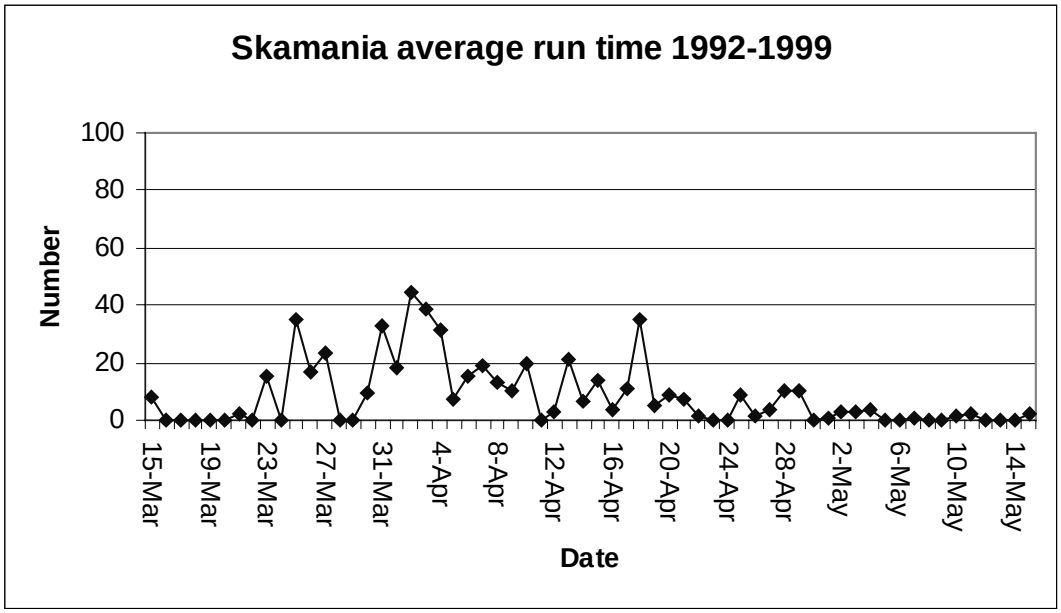

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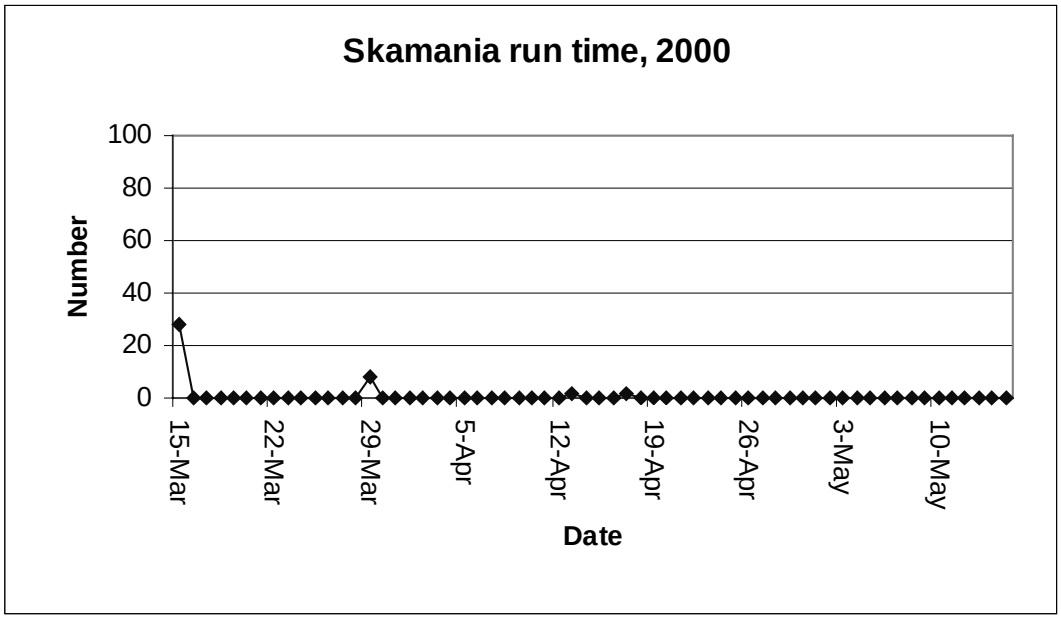

Figure 3. Spring run timing for Skamania steelhead on the Kewaunee River: (A) Average run time, 1992 through 1999, (B) Run time, 2000.

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

The total number of steelhead handled at BAFF during the 2000 spring run continued to decline sharply from the peak run in 1992. This year's run was less than 50% of last year's run and just 10.3% of the run in 1992 (Figure 4). Chambers Creek and Ganaraska strains were each down over 60% from 1999 levels, while non-broodstock fish declined 40% (Table 1). Skamania numbers nearly doubled although this should be viewed with caution because of the low return numbers seen in both years.

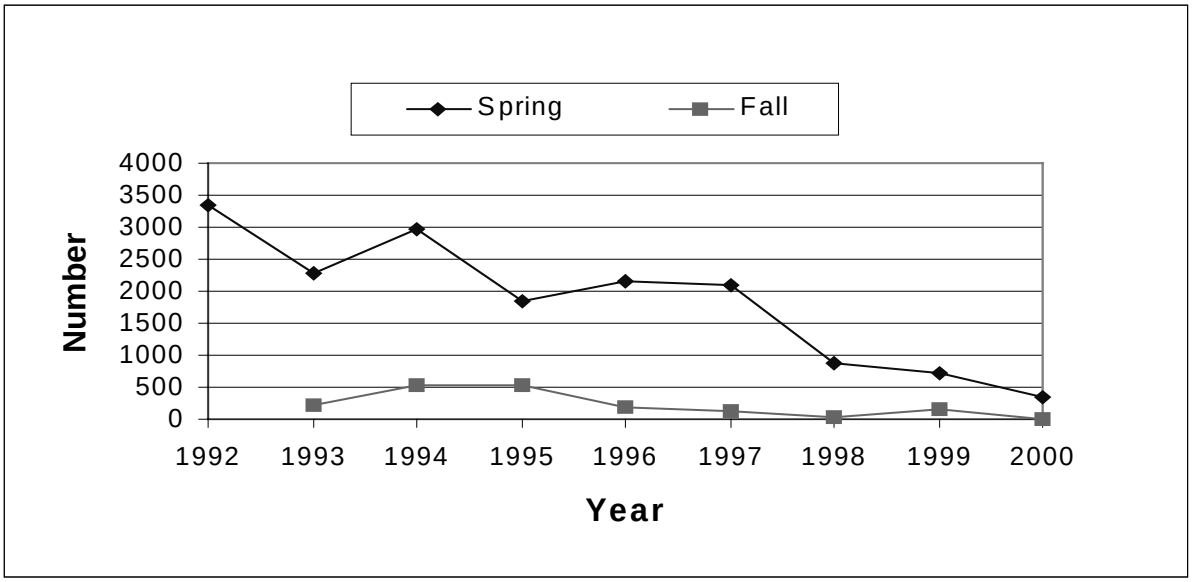

Figure 4. Steelhead return to BAFF during spring and fall runs, 1992-2000.

The decrease in run number 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 stabile 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 large Age 2 Ganaraska that returned this spring may be an indication of the benefits of lower river stocking during periods of low water.

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 that exceeded 110,000 steelhead. High harvest in these years may have reduced the number of adult fish available to return to the weir.

Fall

The seven steelhead handled at BAFF in the summer/fall of 2000 was a dramatic decrease from 145 in 1999 and substantially lower than the 540 fish captured in 1995 (Figure 4). Low flow, despite good summer and fall rainfall and low lake water level severely limited the run.

Lake harvest of Skamania (which remain in Lake Michigan longer than other strains), stocking location of smolts, and unfavorable river conditions may also affect return number.

Strain Performance

Chambers Creek

Average length and weight of Chambers Creek steelhead increased in 2000 over 1999 levels (Table 1). The increase may be due to the small number of fish returning or may be an indication of favorable forage conditions on Lake Michigan. Standard weight decreased from 1999 to 2000 while trophy weight increased (Figure 5). 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 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 2000, 4-year-old Chambers Creek steelhead stocked in 1997 returned at a much lower rate than 4-year-old fish stocked in 1996 (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 0.93 fish/1000 stocked in 1997 returning in 2000. High harvest numbers on Lake Michigan or low water may be reducing the fish available to return to spawn.

Ganaraska

Ganaraska strain steelhead have had more variation in yearly average length and weight than Chambers Creek strain fish. After a decline in average length and weight from 1997 to 1998, average length and weight increased in 1999 and again in 2000 (Table 1). Standard and trophy weights also increased in 2000 from 1999 levels (Figure 5). Long-term trends indicate a slow increase in all three weight trend indices.

Similar to Chambers Creek, each spring the return of Ganaraska fish stocked three years previous has declined each spring since 1993 (Table 7). Overall return rate indicates that fish stocked in 1993 returned at a higher rate than those stocked in later years. Increased harvest of adult fish and loss of smolts through predation and entrapment behind BAFF most likely has affected return rates.

Skamania

Skamania collected during the spring run have been a small, but consistent portion of the spring run. Average length and weight increased in 2000 from 1999 levels (Table 1). Standard weight decreased from 1999 levels while trophy weight increased (Figure 5). Average weight and trophy weight indices have shown the most variation among strains since 1993. This variation is likely due to the small number of captured fish each spring. Standard weight has slightly decreased since 1992. Ages of returning fish have also been consistent, with mostly age 5 fish present in the run (Table 4). 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.

We have tried to reverse the declining return trend by stocking all steelhead below the Besadny Weir. If return numbers continue to decline, additional measures such as reductions in steelhead bag limits or stocking a replacement strain for Skamania that makes the most of the current environmental conditions of Lake Michigan and tributary streams must be considered.

Summary of all strains

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 Chambers Creek in general, return at a higher rate than does Ganaraska strain steelhead. 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 residence time or from poorer river conditions during fall migrations than during spring movements. All strains are now stocked

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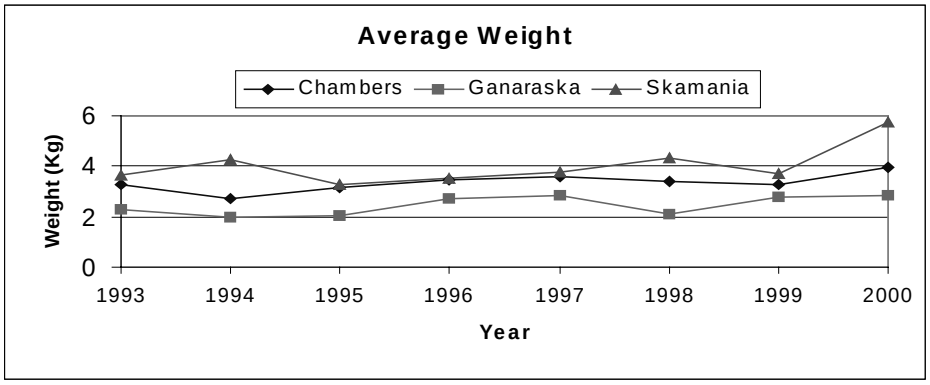

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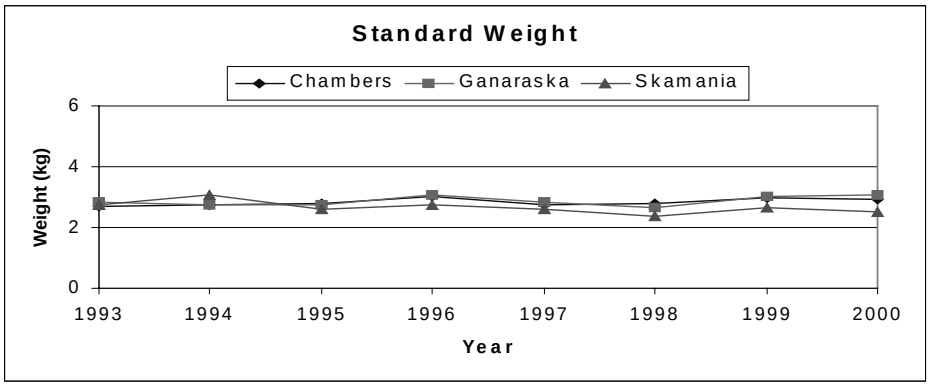

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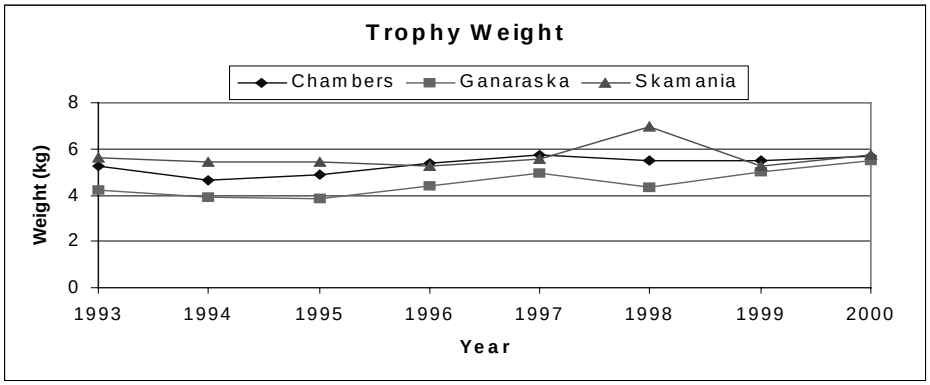

Figure 5. Weights trends for steelhead during spring migrations at BAFF, 1992-2000: (A) Average weight for each strain for that year, (B) Standard weight is based on the projected weight of a 660 mm steelhead, (C) Trophy weight for each strain based on the 95th. Percentile of weighed steelhead.

below the Besadny Weir in an attempt to improve return rates. Returns during the next several springs may indicate if the change in stocking location increases the run size.

Skamania continue to be the largest steelhead followed by Chambers Creek and Ganaraska. Mixed results from the three weight indices used to track trends in the population may indicate forage problems on Lake Michigan or that larger fish are being harvested at a high rate, making younger (smaller) fish more common during spawning runs. However, decreasing return number may influence the trend of each index.

Handling Mortality

Spring

Handling mortality's as expressed by absolute number or by percentage decreased to zero during the spring 2000 run (Table 5). Uncrowded ponds and short holding times were likely responsible for the decline. The 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. Maintaining zero mortality 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 2000 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 2000 spring run total was substantially less than run total of 1999 and the 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 the major causes of the decline observed in steelhead return number. However, increased harvest of adults or high smolt mortality may have also contributed to the decline.

Future changes in average, standard and trophy weights may signal forage problems or overharvest of steelhead in Lake Michigan. Currently two of three weight trends have increased from 1999 levels indicating favorable growth conditions on Lake Michigan.

The small increase in of Age 2 Ganaraska this spring may be the result of down stream (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 difficult, but should result in near quota yearling stocking in 2001 for both strains.

If the low water trend continues, it may be necessary to reevaluate stocking location and to be prepared to collect fish in either lower river sections or from harbors to ensure enough gametes are collected to provide for genetic diversity as well as the number needed for the stocking quota. Steelhead will continue to be stocked below the weir if return rates indicate improved returns. Summer/fall runs of steelhead were also affected by weather. Although there was abundant fall rain, river flow did not increase enough to trigger steelhead runs into the river making 2000 a very poor year for Skamania. With adult Skamania collection much lower than required, eggs from other sources will be needed for full quota stocking in 2002.

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Table 1. Summary of steelhead length and weight data collected during spring migratory runs at BAFF, on the Kewaunee River, 1994-2000.

Year	Strain	Number	Run %	Average Length (mm)	Length Range (mm)	Average Weight (kg)	Weight Range (kg)	Standard Weight (kg)*	Trophy Weight (kg)**
1994	Chambers	1,268	42.7	656	158-911	2.70	0.1-6.3	2.74	4.66
	Ganaraska	685	23.1	582	202-830	2.01	0.1-6.0	2.74	3.91
	Skamania	133	4.5	776	379-993	4.28	0.2-8.1	3.05	6.57
	Other	882	29.7	--	--	--	--	--	--
	Total	2,968							
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							

* 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 2000 operations at BAFF, by strain of steelhead including recaptured fish.

Spring

Date	Chambers Creek	Ganaraska	Skamania	Other	Day Total
March 14	52	13	28	85	178
March 29	14	53	8	43	118
April 13	2	13	2	13	30
April 17	1	5	2	6	14
Total	69	84	40	147	340

Summer/Fall

Date	Chambers Creek	Ganaraska	Skamania	Other	Day Total
September 26			5		5
October 4					
October 9				2	2
October 16					
October 18					
October 25					
November 1					
November 7					
November14					
Total	0	0	5	2	7

Table 3. Average length, weight and number by strain, clip, and sex during the spring spawning run at BAFF, 2000.

	Male			Female		
Strain and Clip	Average Length (mm)	Average Weight (kg)	Number	Average Length (mm)	Average Weight (kg)	Number
Chambers Creek	751	3.90	24	750	4.02	45
Left Maxillary, Left Ventral (LMLV)	784	4.46	8	724	3.53	13
Adipose, Left Maxillary (ALM)	763	3.57	2	772	4.16	5
Left Maxillary (LM)	730	3.62	14	758	4.23	27
Ganaraska	559	1.99	33	687	3.43	51
Adipose, Left Ventral (ALV)	630	2.30	4	665	3.01	19
Adipose, Right Ventral (ARV)	472	1.17	21	703	3.68	16
Left Ventral (LV)	--	--	--	723	3.58	3
Both Ventral (BV)	752	3.99	8	691	3.72	13
Skamania	785	3.83	16	745	3.68	24
Adipose, Right Maxillary (ARM)	767	3.76	2	818	4.61	3
Right Maxillary (RM)	788	3.84	14	735	3.55	21

Table 4. The age distribution, length, and weight of returning clipped steelhead by strain and sex for the Kewaunee River spring 2000.

Chambers Creek

Age (Male)	2	3	4	5	6	Age (Female)	2	3	4	5	6
Measured	3	2	8	11	0	Measured	0	2	13	27	3
Average Length (mm)	483	763	784	798		Average Length (mm)		724	724	758	803
Range (mm)	475-493	736-790	762-825	730-862		Range		710-738	688-865	686-821	780-840
Weighed	3	2	8	11	0	Weighed	0	2	13	27	3
Average Weight (kg)	0.93	3.57	4.46	4.36		Average Weight (kg)		2.88	3.53	4.23	5.01
Range (kg)	0.92-0.94	3.38-3.76	3.60-5.70	2.76-5.50		Range (kg)		2.76-3.00	3.10-4.56	3.16-5.30	4.50-5.82

Ganaraska

Age (Male)	2	3	4	5	Age (Female)	2	3	4	5	6	7
Measured	17	4	8	4	Measured	1	14	13	15	5	3
Average Length (mm)	417	630	752	704	Average Length (mm)	389	636	691	724	745	723
Range (mm)	370-463	573-676	637-820	664-761	Range		509-734	456-790	668-832	715-782	690-765
Weighed	17	4	8	4	Weighed	1	14	13	15	5	3
Average Weight (kg)	0.68	2.30	3.99	3.26	Average Weight (kg)	0.66	2.70	3.72	3.88	3.88	3.58
Range (kg)	0.42-	1.76-	2.46-	2.82-	Range		1.30-	2.78-	3.08-	3.56-	2.92-

	0.84	2.80	5.18	3.88	(kg)		3.36	5.58	5.70	4.38	4.04

Table 4 (cont.)

Skamania

Age (Male)	2	3	4	5	6	Age (Female)	2	3	4	5	6
Measured	1	0	0	13	2	Measured	0	0	0	21	0
Average Length (mm)	790			788	767	Average Length (mm)				735	818
Range (mm)				670-883	730-803	Range				635-805	776-894
Weighed	1.44	0	0	13	2	Weighed	0	0	0	21	3
Average Weight (kg)				4.02	3.76	Average Weight (kg)				3.55	4.61
Range (kg)				2.76-5.64	3.62-3.90	Range (kg)				2.32-5.50	3.52-5.78

Table 5. Handling mortality by strain at BAFF during spring operations for the years 1994-2000.

Year	Strain	Number of fish handled	Number Dead	Percent Mortality
1994	Chambers	1,268	24	1.9
	Ganaraska	685	10	1.5
	Skamania	133	2	1.5
	Unknown	882	8	0.9
	Total	2,968	44	1.5
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

Table 6. Steelhead fin clips detected at BAFF during fall migrations, 1994-2000.

Strain and fin clip	1994	1995	1996	1997	1998	1999	2000
Skamania							
Adipose, Right Maxillary (ARM)	60	41	97	57	8	8	3
Right Maxillary (RM)	325	356	63	53	20	76	1
Right Maxillary,Right Ventral (RMRV)						8	1
Right Maxillary,Left Pectoral (RMLP)						1	
Right Pectoral, Left Ventral (RPLV)	2	6					
Right Pectoral (RP)	1	2	1		2		
Right Maxillary, Left Ventral (RMLV)		1					
Left Maxillary, Left Ventral (LMLV)			2				5
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
Both Maxillary (LMRM)			1				
Adipose (?), Right Ventral (A?RV)			4				
Adipose (A)				1		1	
Other				2	1	20	2
Total Unknown	131	130	25	20	16	51	
Total Fall Steelhead Run	521	540	193	131	46	145	7

Table 7. Return rates (number per thousand stocked) of steelhead to the Kewaunee River during spring migrations by strain, 1993-1999.

Chambers Creek

Return Year	Year Stocked 1993	1994	1995	1996	1997	1998	1999
1994	0.40	--	--	--	--	--	--
1995	3.79	0.20	--	--	--	--	--
1996	10.57	4.01	1.10	--	--	--	--
1997	1.78	10.33	5.49	0.00	--	--	--
1998	0.00	0.68	4.99	0.85	0.11	--	--
1999	0.00	0.00	0.48	5.26	0.80	0.03	--
2000	0.00	0.00	0.08	1.16	0.93	0.11	0.09
Total	16.54	15.22	12.14	7.27	1.84	0.14	0.09

Ganaraska

Return Year	Year Stocked 1993	1994	1995	1996	1997	1998	1999
1994	1.77	--	--	--	--	--	--
1995	5.08	0.26	--	--	--	--	--
1996	7.37	3.00	0.94	--	--	--	--
1997	1.25	4.39	4.18	0.30	--	--	--
1998	0.00	0.37	2.67	3.57	0.35	--	--
1999	0.00	0.14	0.74	4.17	1.68	0.16	--
2000	0.00	0.09	0.14	0.57	0.57	0.58	0.51
Total	15.47	8.25	8.67	8.61	2.60	0.74	0.51

Table 7. (Cont.)

	Skamania Year Stocked						
Return Year	1993	1994	1995	1996	1997	1998	1999
1994	0.12	--	--	--	--	--	--
1995	0.06	0.00	--	--	--	--	--
1996	0.56	0.00	0.00	--	--	--	--
1997	4.71	2.84	0.03	0.03	--	--	--
1998	0.00	1.44	0.68	0.06	0.00	--	--
1999	0.00	0.00	0.37	0.30	0.00	0.00	--
2000	0.00	0.00	0.14	1.03	0.00	0.00	0.12
Total	5.45	4.28	1.22	1.42	0.00	0.00	0.12