

BIANNUAL SPAWNING BEHAVIOR IN THREE STRAINS OF RAINBOW TROUT

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04/98

Introduction

Kincaid (1983) reported observing biannual spawning behavior in fall-spawning rainbow trout in 1976. Through selection the frequency of fish exhibiting biannual spawning behavior increased to 96.9, 86.5 and 93.0% of the fish spawning at 2.0, 2.5 and 3.0 years of age. Katsumi (1984) reported a strain of rainbow trout breeding twice a year in Japan with 62.3% and 95.2% of the fish ovulating in the summer and winter breeding seasons respectively. Parke and Burns (1995) reported twice per year spawning activity at two hatcheries in Alberta, Canada.

Six strains of rainbow trout at Ennis exhibit a primary spawn. Three of these strains also exhibit a secondary spawn about 6 months later. The percentage of fish exhibiting biannual spawning varies but is lower than that reported by either Katsumi or Kincaid. Biannual spawning at Ennis NFH, MT is discussed below.

Discussion

In the constant 54° F water temperature at Ennis NFH, rainbow trout normally mature and spawn for the first time at two years of age. Males are disposed of after first spawning. Most of the females maturing at 2 years old are kept and spawned again at three years of age. Occasionally some females are kept to four and five years of age.

MCCONAUGHY RAINBOW TROUT

About 85% of McConaughy strain RBT spawn as 2 year olds, and 99% as three year olds. Normal spawning time for McConaughy strain RBT is December, January and February.

MCD92

During December 1993 and January 1994 about 79% of lot MCD92 spawned for the first time. Average eyeup was 86%. On 6/29/94, at about age 2½, ovulation occurred again in 21% of these fish, but many of the females were overripe when spawned, and eyeup was only 47%. These biannual spawners were fin clipped for identification and returned to the original lot. From 12/6/94 to 2/14/95, all of them matured as 3 year olds. Average eyeup was 81%. These fin clipped fish were moved into a separate raceway. From 6/12 to 7/11/95 50% of them spawned again. Most of these fish were grossly over ripe which probably accounts for the average eyeup of 15%. Between 12/13/95 and 2/14/96 these same fish (93%) spawned again. Eyeup was 84%. It was confirmed by fin clipping that these fish spawned at age 2, 2½, 3, 3½, and 4 years of age!

MCD93

Two year old McConaughy strain rainbow trout were spawned for the first time in December 1994. Five months later in June 1995 a number of ripe females were noted during routine sample counting. These ripe fish were spawned and fin clipped

before mixing them back into the original lot. Fin clipped females (100%) spawned again as 3 year olds from 12/13/95 to 2/20/96. Percent eyeup was 85%. These fish were held and spawned again at age 3½, and 4 before being disposed of.

EAGLE LAKE RAINBOW TROUT

About 80% of Eagle Lake strain RBT spawn as 2 year olds, and 95% as three year olds. Normal spawning time for Eagle Lake strain RBT is December, January and February.

ELW92

This lot first spawned from 11/30/93 to 2/1/94. On 6/29/94, 7% of these fish spawned again. Eyeup was only 21%. Poor egg survival among the mid year spawners probably resulted from over ripe eggs. Biannual spawners were fin clipped and moved to a separate raceway for observation. Between 11/29/95 and 2/15/96, 100% of these fish spawned as 3 year olds, and eyeup was 83%. From 6/15 to 8/15/95, 82% of these fish spawned again at 3½ years of age. Eyeup was 50%. And finally, from 12/19/95 to 2/20/96, 85% of these fin clipped fish spawned for the 5th time at age 4. Eyeup was 79%.

ELW93

Two year old Eagle Lake rainbow trout spawned for the first time in December 1994. About 81% spawned and average eyeup was 87%. Five months later in June 1995 several ripe females were discovered during routine sample counting. From June until August 8, 17% of this age group had spawned again. Eyeup was 44%. These ripe fish were marked by fin clipping, and mixed back with the original lot. Ninety three percent spawned again from 12/19/95 to 2/20/96. Eyeup was 84%. These same fish were documented spawning for a 4th, and 5th time at 3½ and 4 years of age before being disposed of.

ERWIN STRAIN RAINBOW TROUT

The normal spawning season for the Erwin strain is July and August. However, from 1985 to 1997, Erwin strain rainbows were spawned over a 3 to 5 month period. Every year a number of these fish had overripe eggs at first sort. It was noted the percent of fish sorted with bad eggs did not increase significantly whether the fish were sorted in early May or in June. In other words, they were reaching final maturation sometime earlier than May 1.

ERD93

These fish spawned for the first time during the summer of 95 as 2 year olds. When this lot was sorted at 2½ years old on May 7, 1996, 114 fish out of 700 had overripe eggs (characterized by white, soft, broken, and bullseye eggs). The bad eggs were stripped out and those 114 fish were separated from the rest of the lot. Spawning records show that from 8/1 to 9/25, viable eggs were taken from 96 (84%) of these 114 fish. In October, the unspawned females in this lot were sorted and most of them had over ripe eggs.

ERD94

These fish spawned for the first time from 6/11 to 9/25/96 as two year old fish. On March 26, 1997, the lot was sorted for ripeness. Of 800 females, 195 (24%) contained overripe eggs which were stripped out. These 195 fish were held separately from the rest of the group. From 6/10 to 9/16/97, a total of 147 (89%) females spawned, and 20 fish were in stages of final maturation when the test was terminated on 9/16/97. Average eyeup was 76%. The original lot of ERD94 females were spawned during the same time period. Of those fish, 96% spawned and the average eyeup was 83%.

ERD95

On 12/30/97, during routine sample counting, ripe fish were detected in 2½ year old Erwin strain rainbow trout. On 12/31 the entire lot was sorted and 245 ripe females were separated from the lot. On 1/2/98 they were spawned. ERD96 males were used to fertilize the eggs (this was the first time Erwin strain males have been observed spermiating this time of year). There were 23 fish with normal appearing eggs and 222 fish with over ripe eggs. Egg survival to the eyed stage was 25%. These fish were moved to a separate raceway so their future spawning behavior could be examined in detail.

DISCUSSION:

What causes the biannual spawning behavior experienced at Ennis? Does genetics play a role or contribute to biannual spawning, and if so should they be used in future broodstock programs to avoid a loss of rare alleles, or should they not be used to avoid perpetuating this anomaly? Does a constant water temperature of 54° F contribute to biannual spawning? Is fish condition, general health or size a factor? Are hormones or other chemicals in the feed or water contributing to this behavior? Why do females exhibit biannual spawning and males usually do not? Is it harmful or beneficial and what effect will it have on future broodstock programs?

Table 1. Percent of Erwin Strain Rainbow Trout With Overripe Eggs

at First Sort.

Lot	Two-year old		Three-year old		Four-year old	
	Date	%Bad	Date	%Bad	Date	%Bad
ERD-83	6-17-85	7.4	6-16-86	16.9		
ERD-85	6-29-87	4.8	7-15-88	18.6		
ERD-87	6-28-89	7.3	6-18-90	28.0		
ERD-88	6-18-90	4.7	7-01-91	8.7		
ERD-89	6-24-91	4.0	5-04-92	10.0		
ERD-90	5-04-92	4.7	5-26-93	12.0	5-23-94	13.0
ERD-91	5-25-93	4.0	5-24-94	17.5		
ERD-92	5-23-94	4.7	5-15-95	12.5		
ERD-93	5-15-95	4.0	5-07-96	16.4		
ERD-94	5-07-96	2.0	3-26-97	24.0		
ERD-95			1-02-98	40.0		
Average		5.0		18.6		13.0

Table 2. Results of Biannual Spawning Activity of McConaughy and Eagle Lake Rainbow Trout at the Ennis National Fish Hatchery.

ALL BIENNIAL										
	TWO YEARS		2 ½ YEARS		THREE YEARS		3 ½ YEARS		FOUR YEARS	
LOT	%	%	%	%	%	%	%	%	%	
	SPAWN EYED		SPAWN EYED		SPAWN EYED		SPAWN EYED		SPAWN EYED	
MCD92 spawn dates	79	86	21	47	76 ^a	81	50	15	93	84
	12/1/93 to 2/1/94		6/29/94		12/6/94 to 2/14/95		6/12 to 7/11/95		12/13/95 to 2/14/96	
MCD93 spawn dates	80	90.4	36	46	100	85				
	12/6/94 to 3/1/95		6/14/95 to 8/8/95		12/13/95 to 2/20/96					
ELW92 spawn dates	83	80	7	21	100	83	82	50	85	79
	11/30/95 to 2/1/94		6/29/94		11/29/95 to 2/15/96		6/15 to 8/1/95		12/19/95 to 2/20/96	
ELW93 spawn dates	81	86.5	17	44	93	84	Exact Nos. not recorded		100	82
	11/15/94 to 2/15/95		6/15/95 to 8/08/95		12/19/95 to 2/20/96				12/30/96 to 3/20/97	

a. 100% ovulated but not all were spawned.

LITERATURE CITED

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