Fishery Data Series No. 07-14

Stock Assessment of Rainbow Trout in the Upper Kenai River, Alaska, in 2001

by

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and

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April 2007

Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

Symbols and Abbreviations

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Measures (fisheries)

fork length	FL
mideye-to-fork	MEF
mideye-to-tail-fork	METF
standard length	SL
total length	TL

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$log_{2,}$ etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

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ABSTRACT

A multiple event capture-recapture study of rainbow trout *Oncorhynchus mykiss* in the upper Kenai River was conducted in 2001 as a result of concerns that mortality from catch-and-release fishing might be jeopardizing sustainability of the resource. The objectives of the study were to estimate the abundance and length composition of rainbow trout in the most heavily fished section of the upper Kenai River, from river mile 69.7-73.2. Estimated abundance of rainbow trout at least 200 mm FL in the study area was 8,553 (SE = 806) fish. The estimate included 6,698 rainbow trout at least 300 mm FL. The latter estimate was 2.7 times more rainbow trout than the 1986 population estimate of 2,520; therefore, we conclude that the fishery is sustainable in its current form. Rainbow trout ranged from 200 to 630 mm FL with 350 to 399 mm FL the most abundant (26.4%) length category.

Key words: rainbow trout, *Oncorhynchus mykiss*, abundance, CAPTURE, length, Kenai River, capture-recapture.

INTRODUCTION

The Kenai River drainage (Figure 1) is the most heavily utilized system for freshwater sport fishing in Alaska. Although many anglers participate in the river's salmon fisheries, the Kenai River drainage also supports a major rainbow trout *Oncorhynchus mykiss* fishery.

Rainbow trout catch records were first compiled for the Russian River in 1939. During 1940, an active rainbow trout sport fishery occurred as early as 1 April, with the first trout harvested on 6 April. An estimated 3,000-4,000 rainbow trout were harvested from the Russian River that year. Opinions of anglers from a 1951 survey indicated the Russian River rainbow trout harvest had declined by that year in both size and number. The general consensus was that the stream had been overfished (ADF&G memos, Soldotna).

Rainbow trout catch and harvest records were kept sporadically during the 1970s and early 1980s, and harvest was also estimated by the SWHS. In 1984, 15,680 rainbow trout were estimated caught in the drainage (Table 1). The annual catch remained relatively stable until the 1990s when it increased dramatically despite periodic gear and harvest restrictions. The mean catch for 1999-2001 was 105,974 (Howe et al. 2001d; Jennings et al. 2004; Walker et al. 2003). During the years of highest catch, directed participation in the rainbow trout fishery was highest in the upper river between Kenai and Skilak lakes where over half of the catch occurred. This section of the river has been managed as a trophy fishery since 1988 under the Cook Inlet and Copper River Basin Rainbow/Steelhead Trout Management Policy.

Lafferty (1989) evaluated the rainbow trout population in the section of the upper Kenai River from the ferry crossing (RM 73.7) to Jim's Landing (rm 69.4) in 1986 and 1987. Using a capture-recapture experiment, he estimated the abundance of rainbow trout ≥ 300 mm FL in the study area to be 3,472 rainbow trout (SE = 482) in 1987. A creel survey revealed that the exploitation rate was low and that catch-and-release of rainbow trout was a common practice. Based on these findings, Lafferty (1989) concluded that the rainbow trout population in the upper Kenai River was healthy.

Hayes and Hasbrouck (1996) also estimated the population in the Powerline (rm 72.9) to Jim's Landing section of the upper Kenai River in 1995. They estimated the abundance of rainbow trout at least 300 mm FL at 5,598 (SE = 735). The population in 1995 also had a more uniform distribution of fish among size classes and a greater proportion of fish in the 450-550 mm size range than observed in the 1986-1987 studies.

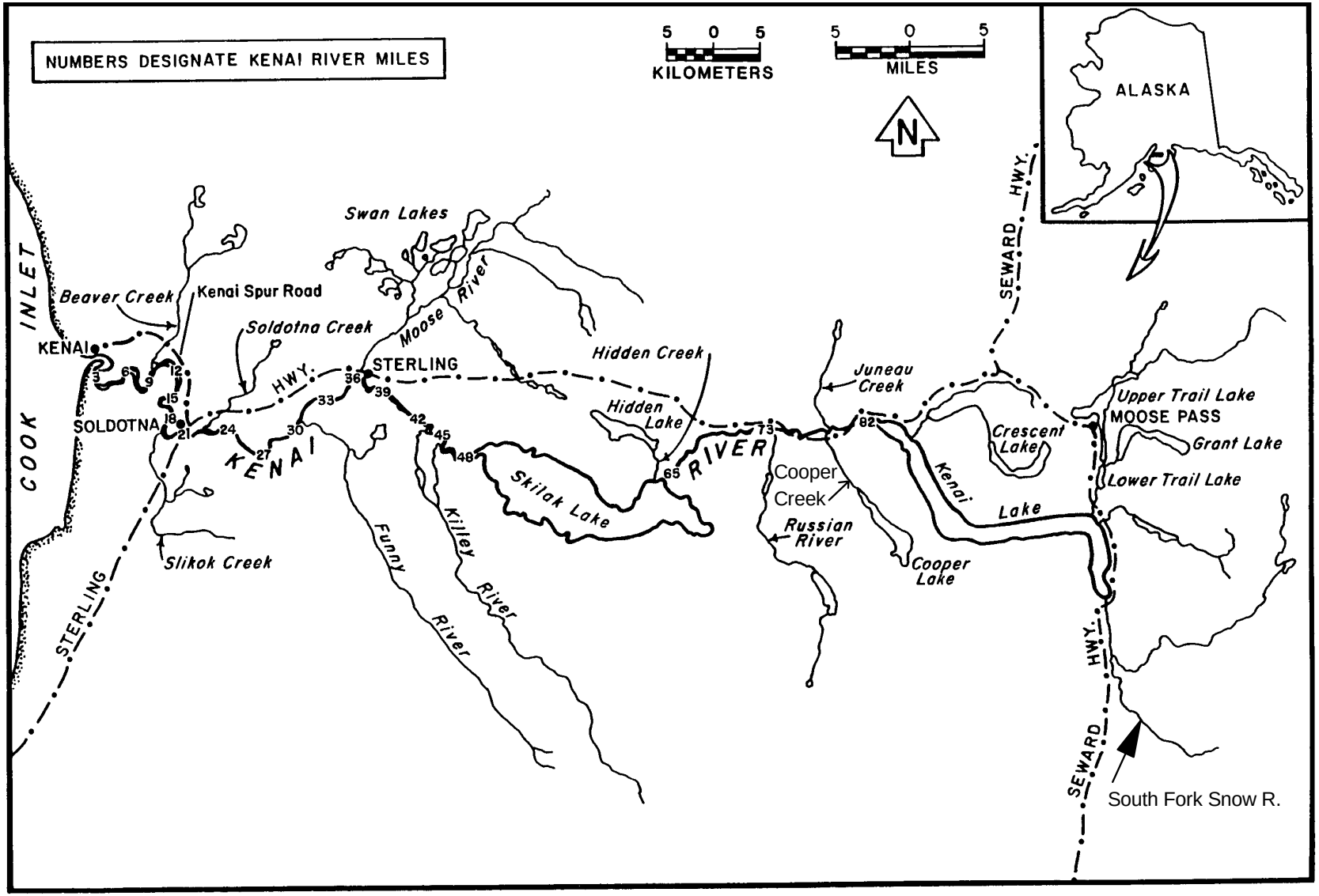

Figure 1.-Kenai River, Alaska and its major tributaries and lakes.

Table 1.-Number of Kenai River rainbow trout caught and retained by river section as determined by Statewide Harvest Survey, 1984-2001.

	Cook Inlet to Soldotna Bridge			Soldotna Bridge to Moose River			Moose River to Skilak Outlet			Skilak Inlet to Kenai Lake (Trophy Trout Area) a			Kenai River Total		
Year	Number Caught a	Number Retained	Percent Retained	Number Caught a	Number Retained	Percent Retained	Number Caught a	Number Retained	Percent Retained	Number Caught a	Number Retained	Percent Retained	Number Caught a	Number Retained	Percent Retained
1984[b]	3,460	710	20.5	2,910	1,250	43.0	5,110	580	11.4	4,200	930	22.1	15,680	3,470	22.1
1985[b]	3,400	880	25.9	2,650	850	32.1	5,410	1,500	27.7	3,520	710	20.2	14,980	3,940	26.3
1986	2,570	620	24.1	2,380	170	7.1	1,750	900	51.4	2,020	730	36.1	8,720	2,420	27.8
1987	2,220	520	23.4	3,450	670	19.4	6,430	630	9.8	3,870	360	9.3	15,970	2,180	13.7
1988	2,780	290	10.4	1,560	220	14.1	5,880	1,060	18.0	7,580	560	7.4	17,800	2,130	12.0
1989	2,020	480	23.8	2,230	350	15.7	6,470	830	12.8	6,870	250	3.6	17,590	1,910	10.9
1990	2,620	510	19.5	3,570	940	26.3	5,370	940	17.5	12,000	1,150	9.6	23,560	3,540	15.0
1991	3,670	520	14.2	3,840	1,120	29.2	7,930	940	11.9	18,110	740	4.1	33,550	3,320	9.9
1992	4,450	430	9.7	3,880	410	10.6	15,130	740	4.9	28,700	400	1.4	52,160	1,980	3.8
1993	6,190	1,150	18.6	5,560	580	10.4	12,650	650	5.1	37,780	190	0.5	62,150	2,570	4.1
1994	3,800	510	13.4	3,980	360	9.0	10,970	540	4.9	35,090	160	0.5	53,840	1,570	2.9
1995	4,520	620	13.7	4,090	440	10.8	13,070	780	6.0	33,480	310	0.9	55,160	2,150	3.9
1996	5,513	304	5.5	4,777	646	13.5	8,650	373	4.3	45,471	237	0.5	64,411	1,560	2.4
1997	7,411	739	10.0	6,641	539	8.1	20,047	632	3.2	61,053	-	-	95,152	1,910	2.0
1998	5,502	608	11.1	5,380	670	12.5	12,158	737	6.1	42,224	-	-	65,264	2,015	3.1
1999	11,415	1,516	13.3	8,325	695	8.3	32,050	1,573	4.9	50,189	-	-	101,979	3,784	3.7
2000	16,477	1,292	7.8	9,428	1,083	11.5	18,990	1,084	5.7	78,836	-	-	123,731	3,459	2.8
2001	11,216	987	8.8	7,473	868	11.6	22,392	567	2.5	51,130	-	-	92,211	2,422	2.6

Source: Statewide Harvest Survey (Howe et al. 1995, 1996, 2001 a-d; Jennings et al. 2004; Mills 1985-1994, Walker et al. 2003.

Note: Retention of rainbow trout not allowed beginning in 1997.

[a] Catch estimates for 1984-1989 are unpublished estimates from the Statewide Harvest Survey (M. Mills, Alaska Department of Fish and Game, Division of Sport Fish, Research and Technical Services, Anchorage).

[b] In 1984 and 1985, catch estimates were mistakenly reported as harvest in Mills 1985 and 1986. Numbers for harvest presented here are correct.

Both previous studies found that rainbow trout migration from winter to summer areas was complete by the end of June, providing a stable population in the study area for their respective capture-recapture experiments (Hayes and Hasbrouck 1996; Lafferty 1989). Our examination of the population in the springs of 1999-2001 (unpublished data) showed that spawning in the Upper Kenai River was essentially over by then as well.

This study was designed to reassess the stock status of the upper Kenai River rainbow trout resource in order to evaluate the effectiveness of the current management strategy. Results of this study were compared to those conducted in 1986-1987 and 1995. The objectives were:

1. Estimate the abundance of rainbow trout ≥ 200 mm in the upper Kenai River between the ferry crossing and Jim's Landing from July 1 through August 17.
2. Estimate the length composition of rainbow trout ≥ 200 mm in the upper Kenai River between the ferry crossing and Jim's Landing from July 1 through August 17.

METHODS

We captured rainbow trout in the upper Kenai River between rm 73.2 (the "Guardrail Hole") and rm 69.7 (Jim's Landing) from 1 July through 17 August. Two 3-5 person crews working from drift boats captured fish using hook-and-line gear and bait. Sampling was conducted 3 days per week for 7 weeks and each week represented a separate event. The study area was divided into three geographic sections: (1) rm 73.2 to 72.2 ("Guardrail Hole" to "Windy Point"); (2) rm 72.2 to 71.1 ("Windy Point" to the "57 Hole"); and (3) rm 71.0 to 69.7 ("Whirlpool Hole" to "Jim's Landing"). We attempted to duplicate the sampling sections from previous studies (Figure 2), although there were slight differences in the upstream boundary of all three studies. Each sampling section received equal fishing time during each event.

Upon capture, we restrained each fish in a tagging cradle (Larson 1995), and measured its fork length. We then marked rainbow trout ≥ 200 mm in length with an individually numbered Floy™ T-Anchor tag inserted on the left side between the basal rays of the dorsal fin. We also clipped the adipose fin as a secondary mark to assess tag loss. Tagged fish were released immediately and in proximity to their location of capture. We monitored any fish that did not actively swim away upon release until it regained mobility. If a fish did not recover from tagging, the tag was removed prior to final release. We did not mark rainbow trout with severe injuries or in poor condition.

We recorded capture and recapture data on field forms printed on Rite-in-the-Rain® paper. The tag number, geographic subsection, river mile and fish length were recorded for all rainbow trout.

ABUNDANCE

We used a capture-recapture model to estimate abundance. Hayes and Hasbrouck (1996) estimated the abundance in the study area to be 5,598 rainbow trout ≥300 mm in 1995. The sampling goal for this study was based on an assumed abundance of 7,500 fish ≥200 mm FL in the study area. This meant that during the 7 weeks of the study, we needed to capture 250 rainbow trout per week to estimate abundance within 25% of the true value 95% of the time. The assumptions necessary to estimate abundance with a closed population model are (Seber 1982):

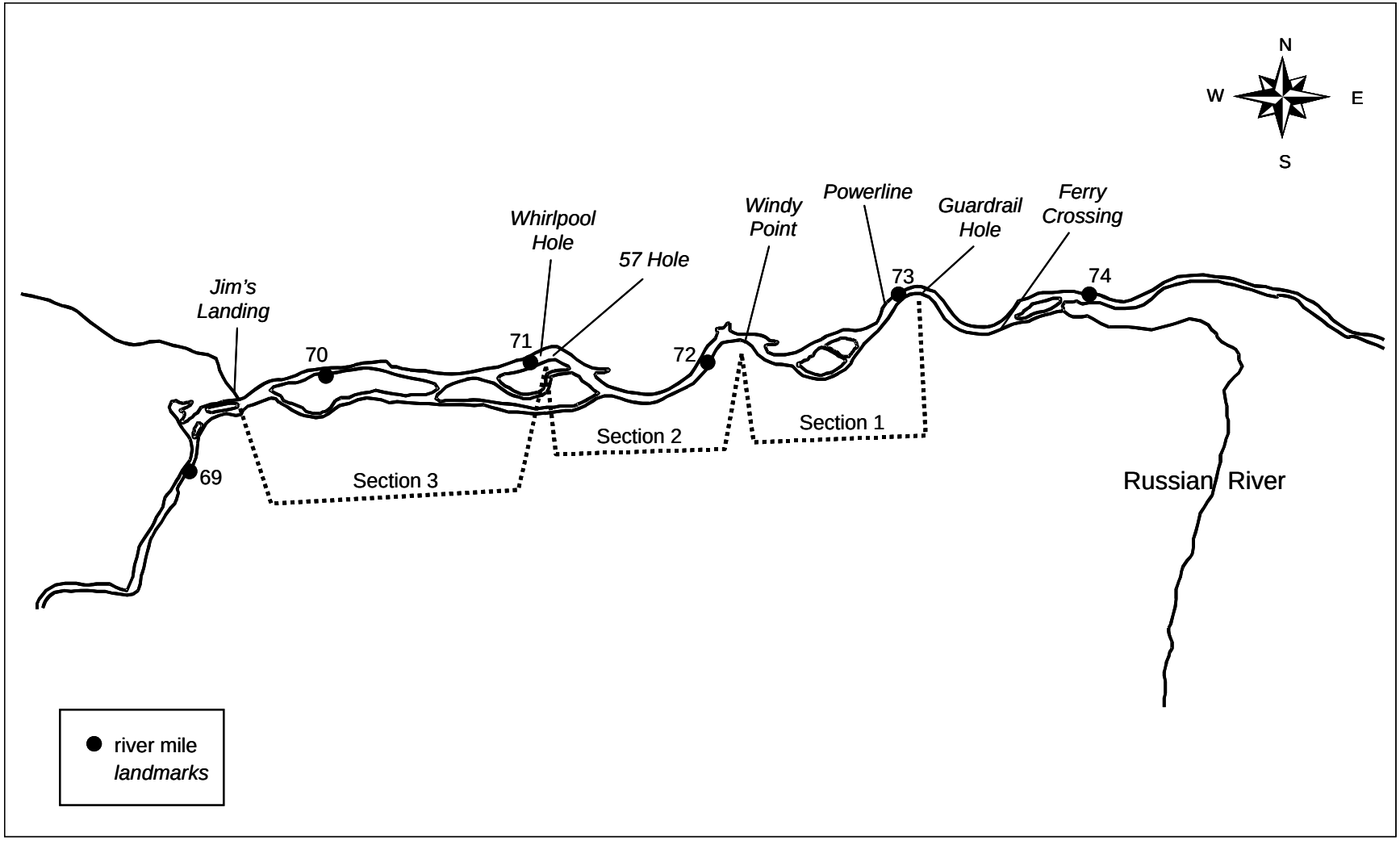

Figure 2.-Study area of the upper Kenai River, Alaska.

1. The population is closed with no additions or losses among capture events (through recruitment, death, immigration, or emigration);
2. All fish have an equal capture probability during all capture events or marked fish mix completely with unmarked fish after marking;
3. Marking does not affect capture probability in subsequent capture events;
4. Marks (tags) are not lost between events;
5. All marked fish recaptured during subsequent capture events are correctly identified and recorded.

We took several measures to minimize violation of the assumption of closure. We satisfied assumption 1 by conducting the fieldwork during the time interval when the population of rainbow trout had stabilized to feed for the summer and was most likely closed. We also assumed that natural mortality would be low during the summer. Additionally, by regulation there is no sport fish harvest. Hook-and-release mortality and emigration from the study reach may have occurred but we assumed that both would affect the marked and unmarked portion of the population equally. Immigration into the study area would also bias estimates of abundance. With no immigration the proportion of marked fish observed would increase over time as more fish were marked and released. If immigration occurred, the proportion of marked fish would remain constant or decline over time. A plot of the proportion of marked fish over time was used to determine if there was an increasing trend.

The assumption of equal probability of capture during all capture events involved looking at selectivity due to sampling location and fish length. We used a Chi-square analysis to test the assumption of equal probability of recapture among sampling locations and examined the contingency tables to detect mixing among sampling locations. We tested for differences in probability of capture due to size selectivity between time intervals using an Anderson-Darling test (Conover 1980). Also, a Chi-square test was used to test the assumption of equal probability of recapture among length categories.

The crew carefully handled and marked captured fish to minimize the possibility that marking affected the probability of capture in subsequent periods. We also assumed that marked fish would not become gear shy after marking. The adipose fin was clipped as a secondary mark to assess tag loss. Finally, tag numbers were carefully read and recorded to minimize problems of marked fish not being properly detected.

After evaluation of the assumptions, we estimated the rainbow trout abundance with the program CAPTURE (Otis et al. 1978). The proper estimator in CAPTURE was selected based on goodness-of-fit and likelihood ratio tests of models that allow probability of capture to remain the same (model M_o), or differ because of time (M_t), behavior (M_b), heterogeneity (M_h), or any possible combination of these three factors.

SIZE COMPOSITION

The proportion of rainbow trout in size class *j* and its variance were estimated as a binomial proportion (Cochran 1977) by:

$$\hat{p}_j = \frac{n_j}{n}, \tag{1}$$

$$Var(\hat{p}_j) = \frac{\hat{p}_j(1-\hat{p}_j)}{n-1}, \tag{2}$$

where:

n_j = the number of rainbow trout of size class *j*, and

n = the total number of rainbow trout sampled for size.

The abundance of rainbow trout by size class was estimated as a product of two random variables by:

$$\hat{N}_j = \hat{N}\,\hat{p}_j, \tag{3}$$

and its variance by (Goodman 1960):

$$Var(\hat{N}_j) = \hat{N}^2 Var(\hat{p}_j) + \hat{p}_j^2 Var(\hat{N}) - Var(\hat{p}_j)Var(\hat{N}). \tag{4}$$

RESULTS

We tagged 1,434 rainbow trout ≥200 mm in 2001 (Table 2). Of the tagged rainbow trout, 107 were recaptured once, and four were recaptured a second time. Catches within each river section were roughly equal, with the smallest proportion of the sample (0.279) obtained from Section 1 (Table 3).

ABUNDANCE

The proportion of recaptured fish followed an increasing trend through the experiment (Figure 3), supporting our assumption that the population was closed during the study. Overall, 18.7% of the recaptured fish were caught outside of the section in which they were tagged (Table 4). We used a Chi-square test to determine if the probability of recapture was equal among the three sampling sections and found no significant difference (χ^2 = 1.032, df = 2, P = 0.597) in the recapture history of rainbow trout among sampling sections (Table 3). These results indicate that the probability of recapture was the same among locations and there was sufficient mixing within the study area so that the abundance estimate did not need to be stratified by location.

There was no significant difference in the cumulative length distribution among all events (Anderson-Darling test; T_{akn} = 1.364, P = 0.10). Also, the probability of recapture was not significantly different among length categories (χ^2 = 7.24, P = 0.07, df = 3; Table 5). We concluded from these results that the abundance estimate did not need to be stratified by length.

Likelihood ratio and goodness-of-fit tests of the model selection procedure of CAPTURE (Otis et al. 1978) indicated that model M_t (Chao 1987), which allows the probability of capture to vary among capture occasions, fit the data best. Using model M_t, the abundance estimate of rainbow trout ≥ 200 mm was 8,553 (SE = 806). The 95% confidence interval about the estimate was 7,140 to 10,315 fish. The estimate included 6,167 rainbow trout ≥ 300 mm (SE = 625). The density of rainbow trout ≥ 200 mm in the study area during the study period was approximately 1,500 fish/km.

Table 2.-Capture history of upper Kenai River rainbow trout ≥ 200 mm, summer 2001.

	Event[a]							
Statistic	1	2	3	4	5	6	7	Total
Captured	149	230	224	246	230	275	191	1,545
New tags	149	225	208	228	208	248	168	1,434
Recaptures	0	5	16	18	22	27	23	111
At Large	0	149	374	582	810	1,018	1,266	1,434
Recap. Prop. at Large[b]		0.034	0.043	0.031	0.027	0.027	0.018	
Recap. Prop. during Event[c]		0.022	0.071	0.073	0.096	0.098	0.120	

[a] 1 = 2-8 July, 2 = 9-15 July, 3 = 16-22 July, 4 = 23-29 July, 5 = 30 July –5 August, 6 = 6-12 August, 7 = 13-19 August.

[b] Recapture proportion of rainbow trout at large.

[c] Recapture proportion of rainbow trout captured during event.

Table 3.-Recaptures of rainbow trout by river section in the upper Kenai River, summer 2001.

	Recaptured?			
River Section[a]	No	Yes	Total	Proportion of Total Captures
1	372	26	398	0.279
2	416	38	454	0.318
3	531	43	574	0.403
Total	1,319	107	1,426	

[a] Section 1 = rm 72.3-73.2; Section 2 = rm 71.1-72.2; Section 3 = rm 69.7-71.0.

Previous studies conducted in the same river reach also estimated the numbers of fish ≥ 300 mm (Table 6, Figure 4). Between 1987 and 1995, a period of 8 years, the estimated population of rainbow trout ≥ 300 mm increased by 61%, followed by an increase of 20% between 1995 and 2001. In addition, three of the studies, including this one, successfully estimated the numbers of fish 200 mm and longer. For that size grouping, the increase over 14 years (1987-2001) was approximately 73%.

SIZE COMPOSITION

Sixty percent of the rainbow trout ≥ 200 mm was from 300-449 mm (Table 7, Figure 5). When we compared the 2001 data for rainbow trout 300 mm and longer with surveys done in 1987 and 1995, rainbow trout from 300-450 mm made up 76%, 78%, and 68% of the total, respectively. Conversely, rainbow trout 500 mm and longer made up a smaller percentage of the total in 2001 than the two previous studies (Table 8).

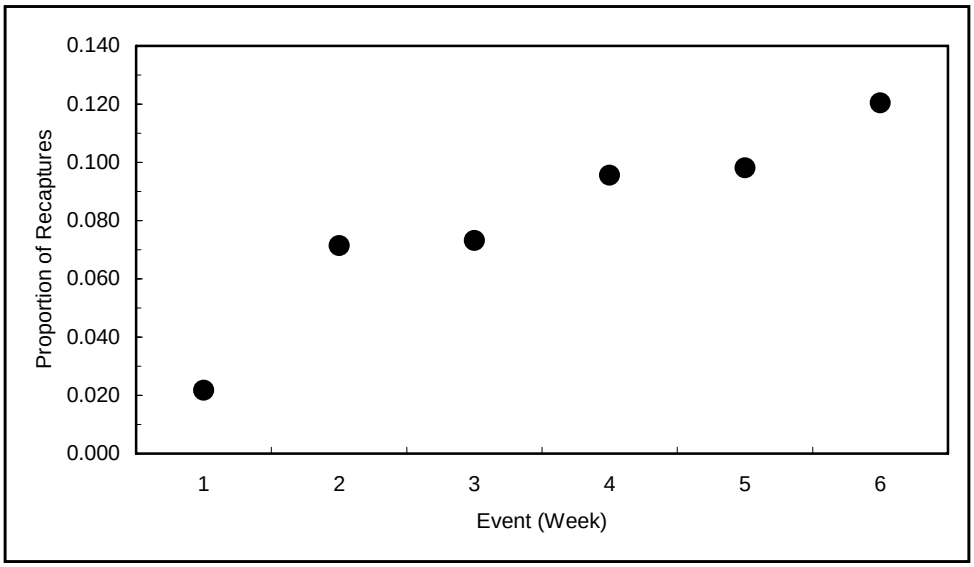

Figure 3.-Proportion of rainbow trout recaptured over time in the upper Kenai River study area, summer 2001.

Table 4.-Movement of rainbow trout between river sections of the upper Kenai River, summer 2001.

River Section of Capture[a]	River Section of Recapture[a] 1	2	3	Total Recaptures	Number Outside Original Capture Section	% Recaptures Outside Original Capture Section
1	17	6	3	26	9	34.6%
2	1	31	6	38	7	18.4%
3	0	4	39	43	4	9.3%
Total	18	41	48	107	20	18.7%

[a] Section 1 = rm 72.3-73.2; Section 2 = rm 71.1-72.2; Section 3 = rm 69.7-71.0.

In absolute numbers, there were as many or more rainbow trout in all size classes < 500 mm in 2001 than in previous studies (Figure 6). Numbers of rainbow trout ≥ 500 mm declined in 2001 from the previous estimate.

DISCUSSION

Although we fielded two crews with up to five fishers each for 3 days per week, we only collected 250 rainbow trout (the minimum sample size) in week 6. We suspect this was in part due to abnormally high water conditions prevalent throughout the study period (Figure 7; data from United States Geological Survey Website, Cooper Landing Gauging Station), although a concurrent radiotelemetry study indicated that virtually all of the upper Kenai River rainbow trout were in the river at the time of our study (Figure 8). Our study also occurred during the period known to be stable from a migratory perspective (Hayes and Hasbrouck 1996).

Table 5.-Numbers by length group of recaptured rainbow trout from the upper Kenai River, summer 2001.

Length Group (mm)	Recaptured? No	Yes	Total
200 - 299	296	15	311
300 - 399	538	46	584
400 - 499	402	42	444
500 - 599	90	4	94
Total	1,326	107	1,433

Table 6.-Abundance estimates of rainbow trout in the upper Kenai River study area.

	Number of Rainbow Trout	
Year	(≥200mm)	(≥300mm)
1986	3,640	2,520
1987	4,950	3,472
1995		5,598
2001	8,553	6,167

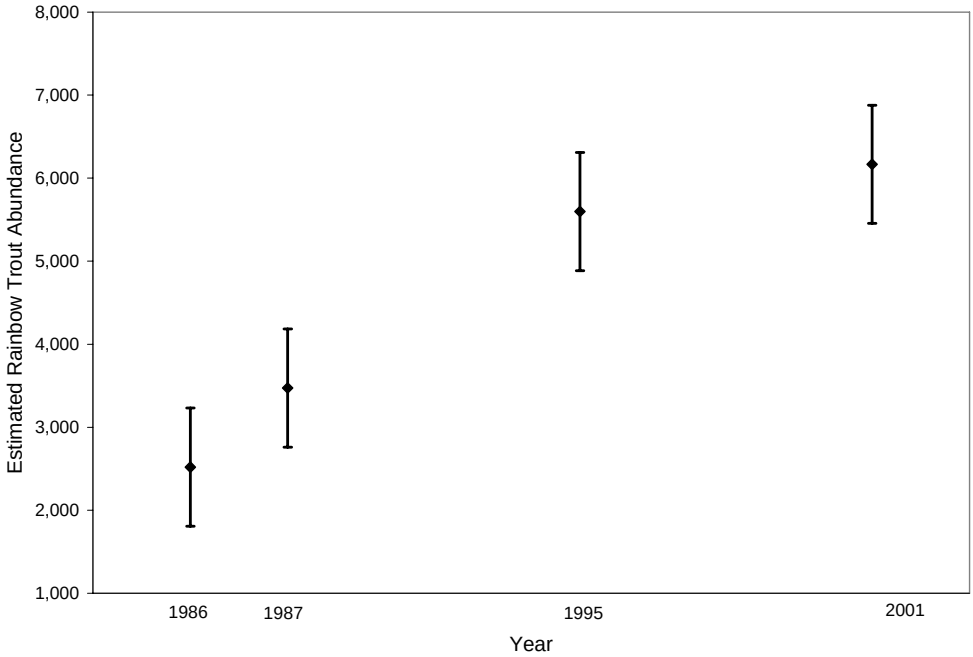

Figure 4.-Abundance estimates and 95% confidence intervals of rainbow trout in the upper Kenai River in 1986, 1987, 1995 and 2001.

Table 7.-Estimated abundance of rainbow trout in the upper Kenai River study area, summer 2001.

Length Group (mm)	Number Caught	Proportion Estimate	Proportion SE	Abundance Estimate	Abundance SE
200-249	95	0.07	0.007	570	78
250-299	214	0.15	0.009	1,284	145
300-349	288	0.20	0.011	1,729	186
350-399	295	0.21	0.011	1,771	190
400-449	268	0.19	0.010	1,609	175
450-499	172	0.12	0.009	1,032	122
500-549	77	0.05	0.006	462	67
550-599	16	0.01	0.003	96	25
Total	1,425	1.00		8,553	

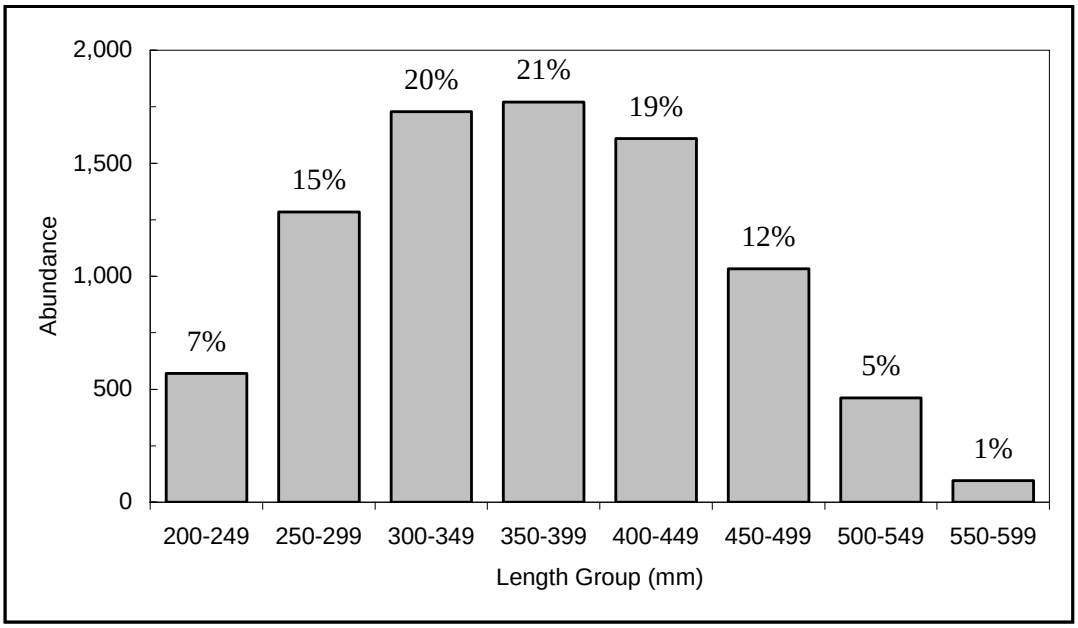

Figure 5.-Estimates of abundance by length group of rainbow trout in the upper Kenai River, summer 2001.

The water conditions also allowed us to sample many places in the river either not available to, or not used by rainbow trout under normal flow conditions. Rainbow trout are thought to exhibit a seasonal feeding strategy and not move far from their selected feeding area and hierarchy (Brink 1995; Brown and Mackay 1995; Eastman 1996; Lisac 1996). However, the rainbow trout in our study may have changed feeding stations in response to the atypical flow. This reshuffling of the feeding hierarchies may have resulted in tagged fish being recaptured outside the river section where originally tagged.

Table 8.-Estimated abundance of rainbow trout (≥ 300 mm) by year and length group in the upper Kenai River study area.

Length	Abundance				Percent of Total			
Group (mm)	1986	1987	1995	2001	1986	1987	1995	2001
300-349	821	697	1,449	1,729	33%	20%	26%	26%
350-399	801	1,009	1,277	1,771	32%	29%	23%	26%
400-449	444	1,009	1,070	1,609	18%	29%	19%	24%
450-499	158	368	1,050	1,032	6%	11%	19%	15%
500-549	143	212	539	462	6%	6%	10%	7%
550-599	112	117	146	96	4%	3%	3%	1%
>600	41	61	66	0	2%	2%	1%	0%

Sources: Hayes and Hasbrouck 1996; Lafferty 1989.

Despite the high water, we were able to distribute effort evenly within and between river sections and combine all recapture data to estimate the size of the population. The model selected accounted for the variation in recapture probability seen between time strata, and our results met our precision objective. The density of rainbow trout was within the range reported for other Alaska streams (Dunaway 1993; Wagner 1991).

Changes in the management strategy over the last decade are at least partly responsible for the increase in fish numbers. The average annual harvest from the upper Kenai River was about 450 rainbow trout in the decade prior to the 1997 decision to eliminate harvest completely. Although this may not seem like a lot of fish, all were above spawning size. Our data indicate that rainbow trout begin spawning at about 400-450 mm, and in the years when harvest of fish was allowed and the Department estimated the size of population (1987 and 1995), only half the rainbow trout population (approximately 1,800-2,900) was of spawning size. Essentially, a relatively high exploitation rate of spawners, added to a relatively high natural mortality rate, may have limited increase in the size of the population. Elimination of sport harvest mortality, coupled with increases in the escapement of sockeye salmon in the drainage in the 1990s, a critical component of their diet (Eastman 1996; Johnson and Ringler 1979; Piorkowski 1995), may have triggered the population increase measured in 2001.

Fish size has changed over time. There were more fish 300-500 mm in the population in 2001 than in any previous survey; however, we did not catch any fish over 600 mm. The latter might be an artifact of sampling since this size class has been less than 2% of the population in all of the previous studies. Anecdotal evidence from angler reports and photos confirms that there are fish larger than 600 mm caught in the fishery periodically. Higher numbers of fish in the smaller size classes with respect to the previous surveys suggests comparable increases in numbers in the larger size classes as these cohorts age.

We conclude from these data that the rainbow trout fishery is sustainable in its current form. Total abundance is up in comparison to historic estimates. Also, the size composition appears relatively stable in terms of the length frequency distribution, and is comparable to those of most Western Alaska rivers (Riffe 1994).

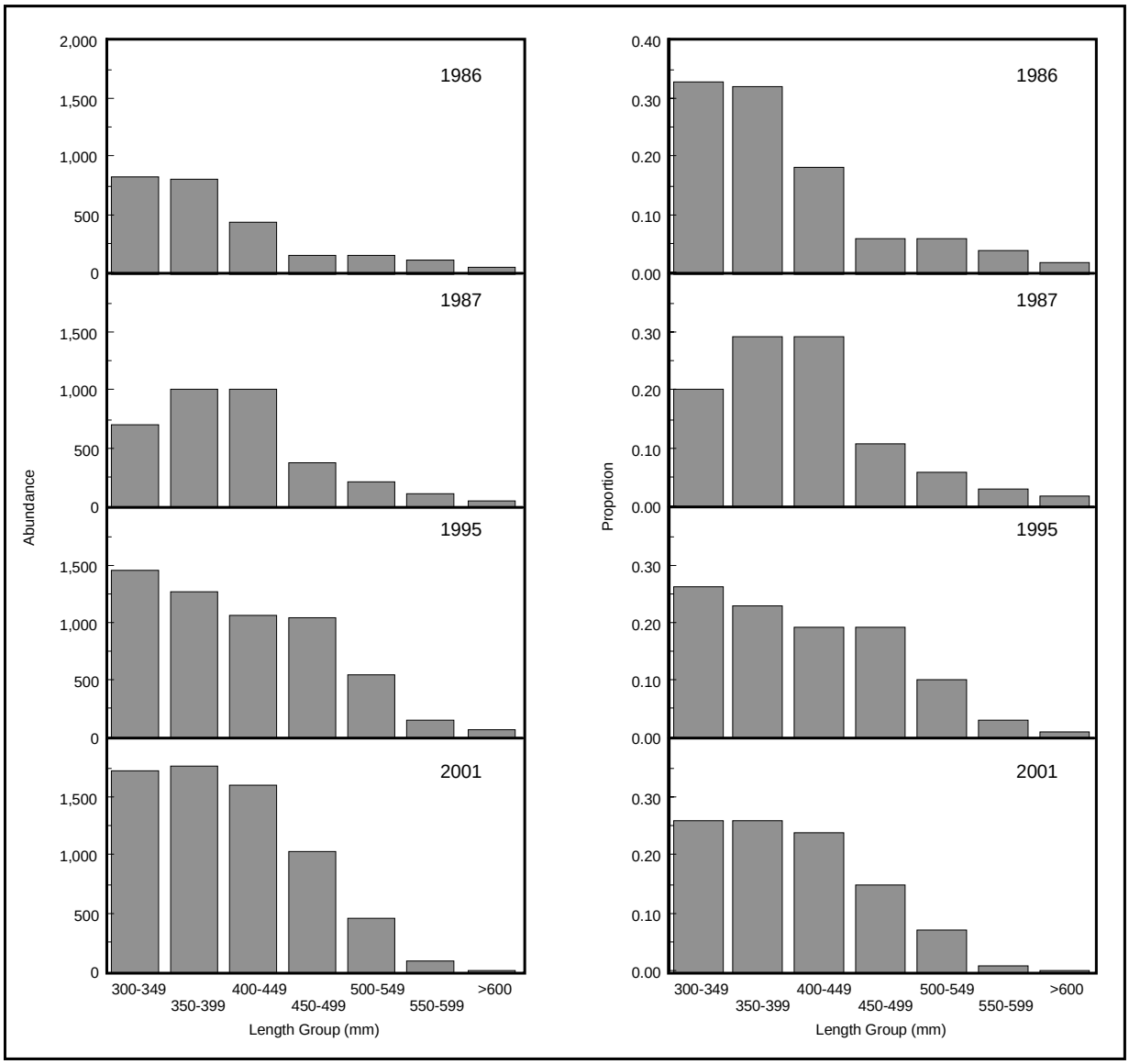

Figure 6.-Length distribution of rainbow trout in the upper Kenai River, 1986, 1987, 1995 and 2001.

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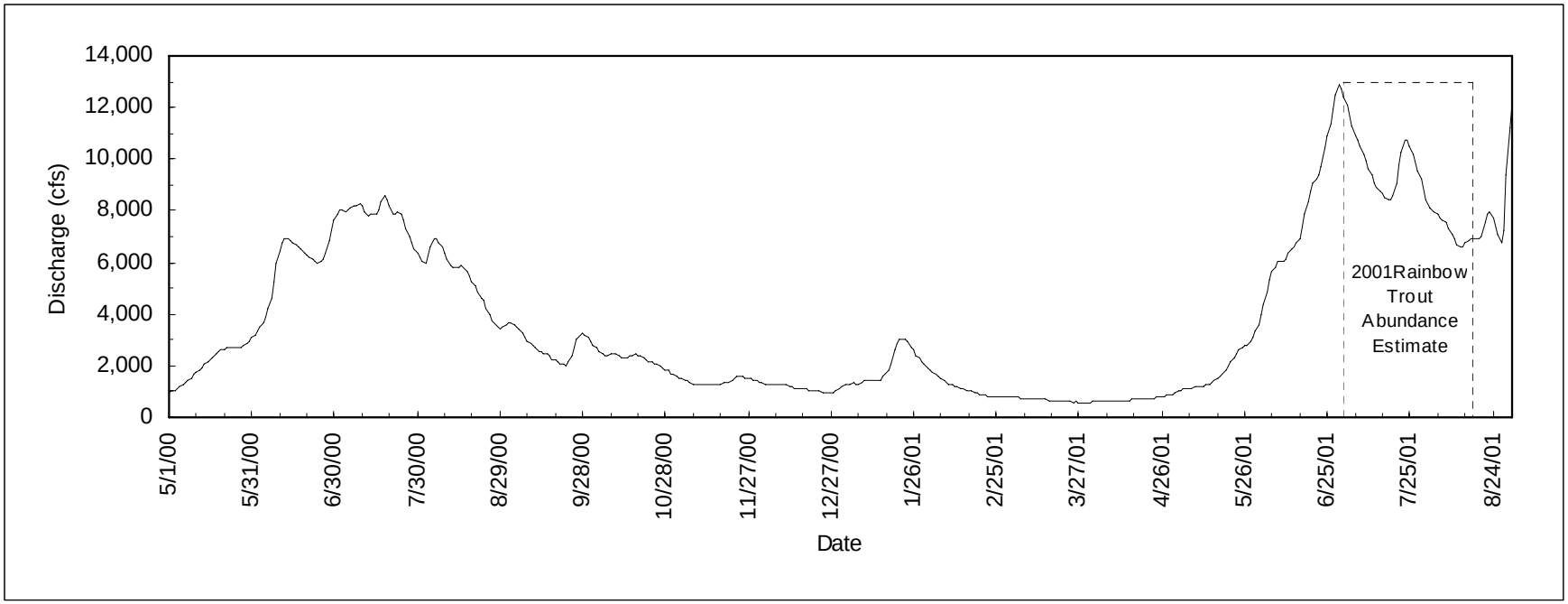

Source: http://nwis.waterdata.usgs.gov/nwis/discharge/?site_no=15258000

Figure 7.-Daily discharge at the upper Kenai River (at Cooper Creek, USGS site 15258000), May 2000 through August 2001.

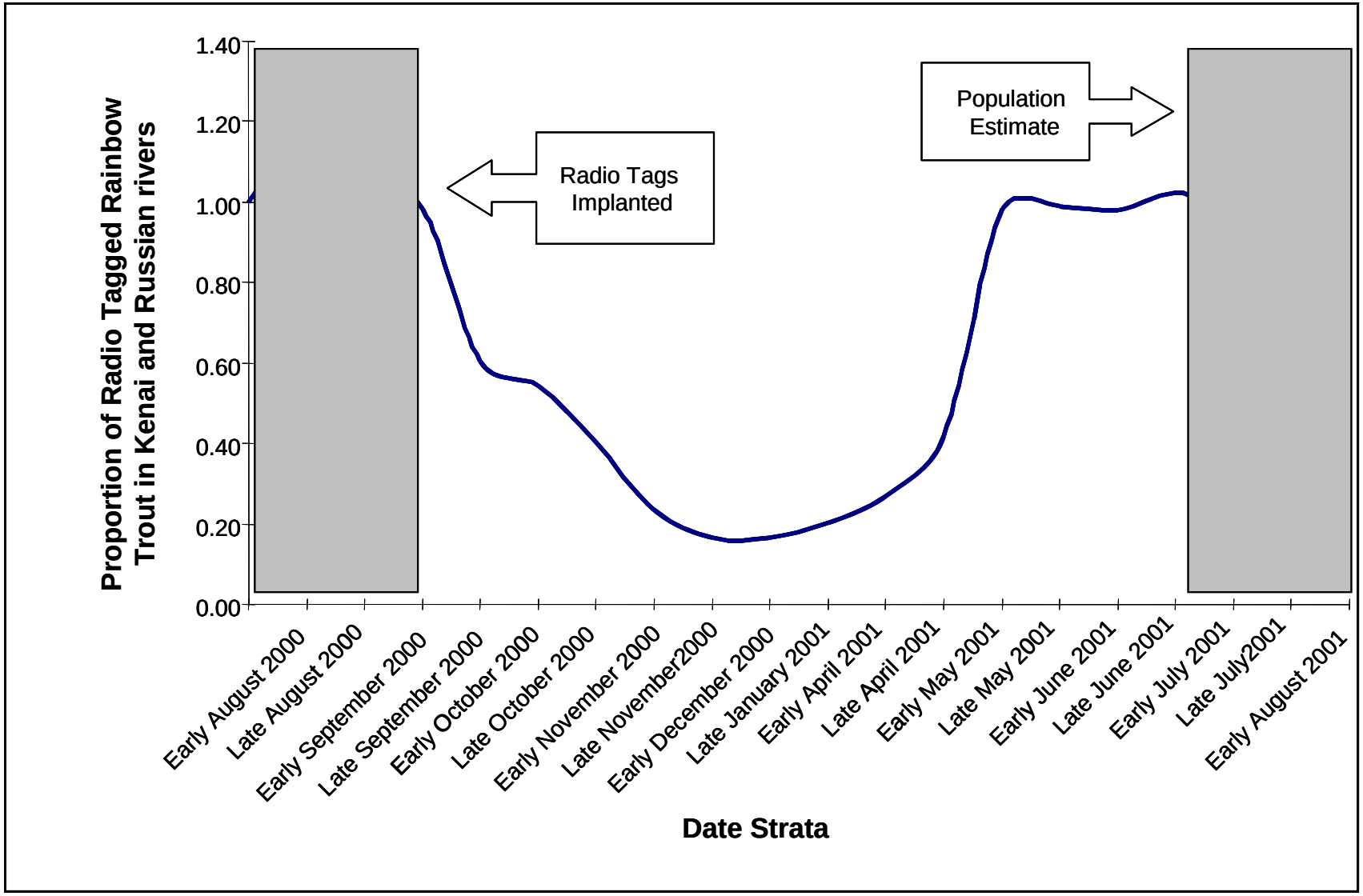

Figure 8.-Migratory timing of rainbow trout in the upper Kenai River, 2000-2001.

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