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TROUT GROWTH IN CALIFORNIA STREAMS

by

William M. Snider

and

Alison Linden

Inland Fisheries Branch

Inland Fisheries

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William M. Snider<sup>2/</sup>

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Alison Linden<sup>3/</sup>

Back-calculated lengths at annulus formation are presented for stream-dwelling rainbow, brown, golden, Lahontan cutthroat, and Paiute cutthroat trout. The data are summarized by stream habitat type and geographical region. The majority of the data was collected as part of the Department of Fish and Game's wild trout and threatened trout management programs.

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<sup>2/</sup> Inland Fisheries Branch, Sacramento.

<sup>3/</sup> Current address, Department of Wildlife and Fishery Biology, University of California, Davis, CA 95616.



## INTRODUCTION

California's wild trout and threatened trout management programs have amassed a comprehensive collection of age and growth data about resident, stream-dwelling trout. The data have been combined with similar information from a variety of unpublished reports to provide this baseline reference on the age and growth of trout in California streams.

Trout fishery managers use age and growth data for various purposes, from the setting of angling regulations to the evaluation of the general health of a fishery. Derivation of such data is time consuming, however, which forces most stream managers to make empirical estimates. This reference can be used to refine such estimates.

## METHODS

The wild trout (D-J F-10-R) and threatened trout (D-J F-33-R) programs collected age and growth data concurrent with life history studies, stream surveys, and various management evaluations. Methods used to collect fish samples included electroshocking, gill netting, angling, and creel censusing. Scale samples were taken from a small (161 mm<sup>2</sup>, 1/4 in.<sup>2</sup>) area on the fish's left side, midway between the insertion of the dorsal fin and the lateral line (Miller 1966). The scales were mounted between two microscope slides and then read using a microfiche projector. Anterior scale radius and annuli radii were measured; fork lengths at annulus formation were back-calculated following Tesch (1968). A minimum of 30 samples was collected from each cohort per stream to obtain 80% confidence ( $\pm 10\%$ ) in the back-calculated estimates (Carlander 1956).

Age data were also obtained from various Department of Fish and Game reports and raw data on file, and two masters' theses (Seegrist 1965; Wong 1975). Lengths at annulus formation were not given in these sources, only the average length for each age group.

## RESULTS

The brown and rainbow trout data collected by the wild trout program represent growth within six distinct stream habitat types (Table 1) in four different geographic regions (Tables 2, 3, 4, and 5). The golden, Paiute cutthroat, and Lahontan cutthroat trout data (Table 6) collected by the threatened trout program represent growth in stream types common to their ranges. Age data for rainbow trout and Paiute cutthroat trout were obtained from various Department and non-Department sources (Table 7).

TABLE 1. Definition of Stream Habitat Types and Symbols Used to Describe the Study Streams.

Symbol	Description
A	Moderate to steep gradient, canyon terrain, 1.5-6.0 m (5-20 ft) wide, with cascades, short riffles and splash pools 0.5-2.5 m (1.5-8 ft) deep, fed by snowmelt.
B	Moderate to steep gradient, canyon terrain, over 6.0 m (20 ft) wide, with cascades, large pools 1.2-3 m (4-10 ft) deep, wide riffles, fed by snowmelt.
C	Low gradient, meadow/grassland terrain, 1.5-6.0 m (5-20 ft) wide, short runs, and undercut banks, shallow pools, spring fed.
D	Low gradient, meadow/grassland terrain, over 6.0 m (20 ft) wide and 1-3 m (3-10 ft) deep, large runs with abundant submergent vegetation, spring fed.
E	Low gradient, 1.5-6.0 m (5-20 ft) wide, with long runs 0.75-1.25 m (2-4 ft) deep, shallow riffles, sparse to heavily wooded terrain, fed by snowmelt.
F	Low gradient, over 6.0 m (20 ft) wide, with long runs 1.2-3 m (4-10 ft) deep, wide riffles, sparse to heavily wooded, fed by snowmelt.

TABLE 2. Length at Annulus Formation for Rainbow and Brown Trout Summarized by Stream Habitat Type for Four Geographic Regions of California.

Geographic region	Stream habitat type	Species	Average length at annulus formation				
			I mm (in.)	II mm (in.)	III mm (in.)	IV mm (in.)	V mm (in.)
West Slope Sierra Nevada	A	RT	76 (3.0)	140 (5.5)	192 (7.6)	235 (9.3)	-----
	B	RT	98 (3.9)	165 (6.5)	211 (8.3)	214 (8.4)	-----
	B	BN	105 (4.1)	163 (6.4)	210 (8.3)	246 (9.7)	-----
	C	RT	99 (3.9)	149 (5.9)	-----	-----	-----
	C	BN	92 (3.6)	171 (6.7)	244 (9.6)	315 (12.4)	-----
East Slope Sierra Nevada	B	RT	94 (3.7)	201 (7.9)	278 (10.9)	-----	-----
	B	BN	108 (4.3)	215 (8.5)	314 (12.4)	-----	-----
	D	BN	139 (5.5)	257 (10.1)	304 (12.0)	374 (14.7)	-----
	E	RT	82 (3.2)	160 (6.3)	-----	-----	-----
	E	BN	84 (3.3)	160 (6.3)	252 (9.9)	-----	-----
	F	BN	119 (4.7)	239 (9.4)	318 (12.5)	388 (15.3)	421 (16.6)
Upper Sacramento River Drainage	B	RT	98 (3.9)	211 (8.3)	299 (11.8)	274 (14.7)	429 (16.9)
	B	BN	94 (3.7)	187 (7.4)	279 (11.0)	344 (13.6)	407 (16.0)
	D	RT	144 (5.7)	255 (10.0)	328 (12.9)	403 (15.9)	479 (18.9)
	D	BN	140 (5.5)	258 (10.2)	341 (13.4)	389 (15.3)	455 (17.9)
Klamath River Basin	F	RT	92 (3.6)	192 (7.6)	284 (11.2)	-----	-----

TABLE 3. Fork Length at Annulus Formation for Rainbow and Brown Trout Inhabiting Streams of the West Slope Sierra Nevada.

Stream habitat type <sup>a/</sup>	Stream	Species	Collection		Average length at annulus formation				
			Method <sup>b/</sup>	Year	I	II	III	IV	V
					mm (in.)	mm (in.)	mm (in.)	mm (in.)	mm (in.)
A	Nelson Creek	RT	EF	1974	78 (3.1)	138 (5.4)	192 (7.6)	-----	-----
		RT	EF	1978	89 (3.5)	154 (6.4)	-----	-----	-----
		Average			83 (3.3)	146 (5.8)	192 (7.6)	-----	-----
A	N.F. American River	RT	EF	1974	76 (3.0)	140 (5.5)	190 (7.5)	230 (9.1)	-----
A	Rubicon River	RT	EF	1974	86 (3.4)	141 (5.5)	186 (7.3)	258 (9.1)	-----
		RT	EF	1975	76 (3.0)	137 (5.4)	192 (7.6)	244 (10.2)	305 (12.0)
		RT	EF	1978	94 (3.7)	165 (6.5)	226 (8.9)	-----	-----
		Average			85 (3.3)	148 (5.8)	201 (7.9)	251 (9.6)	305 (12.0)
A	N.F. Yuba River	RT	EF	1977	75 (3.0)	143 (5.6)	197 (7.8)	-----	-----
A	Clavey River	RT	EF	1975	61 (2.4)	124 (4.9)	181 (7.1)	225 (8.8)	-----
B	M.F. Feather River	RT	EF	1975	107 (4.2)	183 (7.2)	234 (9.2)	-----	-----
B	Merced River	RT	EF	1973	94 (3.7)	173 (6.7)	209 (8.2)	-----	-----
B	S.F. Kings River	RT	C	1975	95 (3.7)	155 (6.1)	206 (8.1)	214 (8.4)	-----
		RT	C	1978	94 (3.7)	147 (5.8)	196 (7.7)	213 (8.4)	-----
		Average			95 (3.7)	151 (6.0)	201 (7.9)	214 (8.4)	-----
B	S.F. Kings River	BN	C	1975	105 (4.1)	168 (6.6)	213 (8.4)	237 (9.3)	-----
		BN	C	1978	104 (4.1)	158 (6.2)	207 (8.1)	255 (10.0)	-----
		Average			105 (4.1)	163 (6.4)	210 (8.3)	244 (9.7)	-----
C	Yellow Creek	RT	EF	1974	99 (3.9)	149 (5.9)	-----	-----	-----
		BN	EF	1974	92 (3.6)	171 (6.7)	244 (9.6)	315 (12.4)	-----

<sup>a/</sup>See Table 1.

<sup>b/</sup>Collection methods: EF=electrofishing, A=angling, C=creel census, G=gill net.



TABLE 4. Fork Length at Annulus Formation for Rainbow and Brown Trout Inhabiting Streams of the East Slope Sierra Nevada.

Stream habitat type <sup>a/</sup>	Stream	Species	Collection		Average length at annulus formation				
			Method <sup>b/</sup>	Year	I	II	III	IV	V
					mm (in.)	mm (in.)	mm (in.)	mm (in.)	mm (in.)
B	Truckee River	RT	EF	1974	94 (3.7)	201 (7.9)	278 (10.9)	-----	-----
		BN	EF	1974	108 (4.3)	215 (8.5)	314 (12.4)	-----	-----
D	Owens River	BN	EF	1974	130 (5.1)	282 (11.1)	-----	-----	-----
		BN	EF	1977	122 (4.8)	241 (9.5)	-----	-----	-----
		BN	EF	1979	147 (5.8)	310 (12.2)	-----	-----	-----
		Average			133 (5.2)	278 (10.9)	-----	-----	-----
D	Hot Creek	BN	EF-C	1973	133 (5.2)	243 (9.6)	317 (17.5)	-----	-----
		BN	EF-C	1975	144 (5.7)	238 (9.4)	305 (12.0)	374 (14.7)	-----
		BN	EF	1979	157 (6.2)	227 (8.9)	291 (11.5)	-----	-----
		Average			144 (5.7)	236 (9.3)	304 (12.0)	374 (14.7)	-----
E	E.F. Carson River	RT	EF	1978	82 (3.2)	160 (6.3)	-----	-----	-----
		BN	EF	1978	84 (3.3)	160 (6.3)	252 (9.9)	-----	-----
F	E. Walker River	BN	EF-C	1974	104 (4.1)	228 (9.0)	308 (12.1)	399 (15.7)	438 (17.2)
		BN	EF-C	1975	115 (4.5)	245 (9.6)	327 (12.9)	398 (15.7)	446 (17.6)
		BN	EF-C	1976	121 (4.8)	240 (9.4)	320 (12.6)	366 (14.4)	398 (15.7)
		BN	EF	1979	138 (5.4)	243 (9.6)	-----	-----	-----
		Average			119 (4.7)	239 (9.4)	318 (12.5)	388 (15.3)	421 (16.6)

<sup>a/</sup>See Table 1.

<sup>b/</sup>See Table 3.

TABLE 5. Fork Length at Annulus Formation for Rainbow and Brown Trout in Streams of the Upper Sacramento and Klamath River Drainages.

Stream habitat type <sup>a/</sup>	Stream	Species	Collection		Average length at annulus formation				
			Method <sup>b/</sup>	Year	I	II	III	IV	V
					mm (in.)	mm (in.)	mm (in.)	mm (in.)	mm (in.)
B	Upper Sacramento River	RT	C	1978	102 (4.0)	208 (8.2)	305 (12.0)	373 (14.7)	-----
B	McCloud River	RT	A-C-G	1977	97 (3.8)	226 (8.9)	302 (11.9)	368 (14.5)	429 (16.9)
		RT	A-C-G	1978	94 (3.7)	198 (7.8)	290 (11.4)	381 (15.0)	429 (16.9)
		Average		96 (3.8)	212 (8.3)	296 (11.7)	375 (14.8)	429 (16.9)	
B	McCloud River	BN	A-C-G	1977	91 (3.6)	201 (7.9)	305 (12.0)	368 (14.5)	432 (17.0)
		BN	A-C-G	1978	97 (3.8)	173 (6.8)	254 (10.0)	320 (12.6)	381 (15.0)
		Average		94 (3.7)	187 (7.4)	279 (11.0)	344 (13.6)	407 (16.0)	
D	Hat Creek	RT	EF	1972	135 (5.3)	259 (10.2)	355 (13.2)	432 (17.0)	490 (19.3)
		RT	EF	1978	140 (5.5)	247 (9.7)	323 (12.7)	385 (15.2)	-----
		RT	EF	1979	131 (5.2)	255 (10.0)	320 (12.6)	-----	-----
		Average		135 (5.3)	254 (10.0)	326 (12.8)	408 (16.1)	490 (19.3)	
D	Hat Creek	BN	EF	1972	142 (5.6)	279 (11.0)	356 (14.0)	389 (15.3)	-----
		BN	EF	1978	138 (5.4)	237 (9.3)	326 (12.8)	388 (15.3)	455 (17.9)
		Average		140 (5.5)	258 (10.2)	341 (13.4)	389 (15.3)	455 (17.9)	
D	Fall River	RT	EF-C	1978	170 (6.7)	258 (10.2)	333 (13.1)	386 (15.2)	447 (17.6)
F	Upper Klamath River	RT	C	1978	92 (3.6)	192 (7.6)	284 (11.2)	-----	-----

<sup>a/</sup> See Table 1.

<sup>b/</sup> See Table 3.

TABLE 6. Fork Length at Annulus Formation for Golden, Paiute Cutthroat, and Lahontan Cutthroat Trout Inhabiting Streams of the Sierra Nevada.

Stream habitat type <sup>a/</sup>	Stream	Species	Collection		Average length at annulus formation				
			Method <sup>b/</sup>	Year	I	II	III	IV	
					mm (in.)	mm (in.)	mm (in.)	mm (in.)	
Little Kern River Drainage									
E	Fish Creek	GT	EF	1977	76 (3.0)	115 (4.5)	115 (6.1)	209 (8.2)	
E	Willow Creek	GT	EF	1977	79 (3.1)	113 (4.4)	146 (5.7)	183 (7.2)	
E	Soda Springs Creek	GT	EF	1977	82 (3.2)	108 (4.2)	138 (5.4)	-----	
					Average	79 (3.1)	112 (4.4)	146 (5.7)	196 (7.7)
East Fork Carson River Drainage									
C	Silver King Creek	PCT	EF	1956	107 (4.2)	163 (6.4)	-----	-----	
C		LCT	EF	1976	84 (3.3)	132 (5.2)	196 (7.7)	216 (8.5)	
E	Murray Canyon Creek	LCT	EF	1977	73 (2.9)	118 (4.6)	159 (6.3)	-----	
Kings River Drainage									
E	Cow Creek	LCT	EF	1975	75 (3.0)	110 (4.3)	158 (6.2)	-----	
East Walker River Drainage									
E	By-Day Creek	LCT	EF	1977	68 (2.7)	108 (4.3)	147 (5.8)	-----	

<sup>a/</sup> See Table 1.

<sup>b/</sup> See Table 3.

TABLE 7. Average Length of Trout Age Classes in a Variety of Streams in California.

Stream habitat type <sup>a/</sup>	Stream	Species	Collection period	Average length of age class				
				0 mm (in.)	I mm (in.)	II mm (in.)	III mm (in.)	IV mm (in.)
B	San Joaquin River <sup>b/</sup>	RT	Late summer	91 (3.6)	175 (6.9)	241 (9.4)	-----	-----
E	Sagehen Creek <sup>c/</sup> (Truckee River)	RT	Fall	46 (1.8)	112 (4.4)	158 (6.2)	198 (7.8)	236 (9.3)
A	Tiger Creek <sup>b/</sup> (Mokelumne River)	RT	Late summer	64 (2.5)	97 (3.8)	147 (5.8)	178 (7.0)	-----
A	South Fork Mokelumne River <sup>b/</sup>	RT	Late summer	69 (2.7)	114 (4.4)	145 (5.7)	178 (7.0)	-----
A	North Fork Stanislaus River <sup>b/</sup>	RT	Late summer	64 (2.5)	97 (3.8)	147 (5.8)	178 (7.0)	-----
A	North Shitrtail Creek <sup>b/</sup> (American River)	RT	Late summer	97 (3.8)	119 (4.7)	145 (5.7)	185 (7.3)	213 (8.4)
A	West Fork San Gabriel River <sup>d/</sup>	RT	<u>f/</u>		112 (4.4)	158 (6.2)	210 (8.3)	-----
E	Cottonwood Creek <sup>e/</sup>	PCT	<u>f/</u>		89 (3.5)	130 (5.1)	199 (7.8)	-----

<sup>a/</sup> See Table 1.

<sup>b/</sup> West slope Sierra Nevada.

<sup>c/</sup> East slope Sierra Nevada.

<sup>d/</sup> San Gabriel Mountains.

<sup>e/</sup> White Mountains.

<sup>f/</sup> Back-calculated length at annulus formation.

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