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CHANGE OF EDITORSHIP

With this issue, Leo Shapovalov, Senior Fishery Biologist and Assistant Chief of the Inland Fisheries Branch, assumes the duties of Editor-in-Chief of *California Fish and Game*. This is his second assignment to this important post; he served previously from mid-1954 to mid-1958.

Mr. Shapovalov's assumption of the editorship follows the department's long-standing policy of rotating the editorial direction of our journal between staff members representing Marine Resources, Inland Fisheries, and Game Management.

Since his undergraduate days at Stanford University, where he deliberated between majors in English literature and biology, Mr. Shapovalov has been a staunch advocate of clear and concise writing. Throughout his more than 34 years of service with our department he has served as an outstanding authority on matters of word usage, style, and punctuation in both popular and scientific articles. In addition to his talents for inspiring and guiding others, he has authored more than 20 articles in our journal, *Science*, *Copeia*, *American Fisheries Society Transactions*, and others; coauthored 12 more; has written 68 administrative reports and coauthored 7 more; and has prepared a large number and variety of popular and semi-scientific articles. His definitive classic on steelhead trout and silver salmon won The Wildlife Society's award in 1954–55 as the most outstanding publication in wildlife ecology and management.

He served on The Wildlife Society's Fisheries Award Committee in 1965 and is again a member this year.

Mr. Shapovalov will be assisted in his duties by four associate editors: Robert F. Elwell for Inland Fisheries, Carol M. Ferrel for Game Management, Herbert W. Frey for Marine Resources, and Donald H. Fry, Jr. for Salmon and Steelhead.

To Mr. John E. Fitch we express our thanks for so ably performing the duties of Editor-in-Chief during the past 4 years.—*Walter T. Shannon, Director, California Department of Fish and Game.*

Calif. Fish and Game, 52(3): 133–150. 1966.

AGE, LENGTH COMPOSITION, AND CATCH LOCALITIES OF SARDINE LANDINGS ON THE PACIFIC COAST OF THE UNITED STATES AND MEXICO IN 1963–64[1]

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California landings of Pacific sardines, *Sardinops caeruleus* (Girard), during the 1963–64 season amounted to only 2,032 tons, the poorest catch in the history of the fishery. Baja California landings totaled 6,880 tons. Interseason landings for California and Baja California were 1,435 and 11,235 tons, respectively.

Lack of fish in central California caused purse seiners to shift operations to southern California shortly after the opening of the season.

Sardine landings in central California consisted primarily of large, 4- and 5-year-old fish. Southern California landings were dominated by large fish, 4 and 5 years old, with significant quantities of 1- and 2-year-olds at the end of the season. Three-, 4- and 5-year-old fish made up most of the Baja California landings from north of Punta San Pablo. Sardines were taken close to shore in central California, between Monterey and Point Lopez. Southern California catches were made primarily off the City of San Pedro and Santa Catalina and San Nicholas Islands. Baja California catches were made in three distinct areas: (i) Ensenada south to Punta Soledad, (ii) Cedros Island vicinity, Punta Santa Rosalia south to Punta San Pablo, and (iii) Magdalena Bay.

INTRODUCTION

Each year, since 1941, the California Department of Fish and Game and the U.S. Bureau of Commercial Fisheries have cooperated in the sampling (Figure 1) and age determination of sardine landings. During these years, basic data have been contributed concerning the dynamics of the sardine fishery, commencing with the period of peak abundance in the early 1940's and extending to the low population levels of the 1950's and 1960's.

This report, the 18th of the series, summarizes the length and age composition of the 1963–64 period landings. A discussion of the fishery, economic factors affecting it, and yield per area of the California fishing grounds are also included.

Numerous people are involved in the sampling and scale-reading program. A special acknowledgment is made to Anita E. Daugherty, who retired from the California Department of Fish and Game in early 1964. Miss Daugherty was associated with sardine research for 23 years and made significant contributions to the scale-reading program. The assistance of Robert S. Wolf, U.S. Bureau of Commercial Fisheries, and Harold Hyatt, California Department of Fish and Game, is also gratefully acknowledged. William W. Hatton, California Academy of

[1] Submitted for publication September 1965.

Sciences, did the sampling and contact work with the industry in Baja California. Gertrude Cutler worked on many of the tables and Robert Michaud drew the figures. Appreciation is also extended to the cannery personnel and fishing boat skippers who cooperated with our waterfront representatives.

THE FISHERY

Sardines have declined drastically in numbers and importance over the years, but are still heavily exploited in conjunction with the fishery for jack mackerel (*Trachurus symmetricus*) and Pacific mackerel (*Scomber diego*). Historically, the mackerel fishery in California is a year-around venture, while sardine fishing for the canneries is seasonal. In recent years, the industry in Baja California has taken on added significance by processing a greater portion of the total sardine catch.

The 1963–64 fishing period extended from March 2, 1963, through March 1, 1964. The period consists of an interseason and a season, so age and length data are summarized on this basis. In central California (Point Arguello north), the interseason extended from March 2 through July 31, and the season from August 1 through March 1. In southern California, the season began on September 1, thus extending the interseason in this area through August 31. The season closed for both areas at midnight on March 1, but landings were allowed on March 2.

Landings during the season, sometimes referred to as the cannery season, include both cannery and market deliveries. Market deliveries, used primarily as bait in the San Francisco region striped bass sport fishery, bring a considerably higher price than do sardines sold at the canneries. The special pack privilege was used by one southern California processor during the 1963 interseason. This privilege was designed to

FIGURE 1—Department waterfront representative, Robert Michaud, sampling from a mixed load of mackerel and sardines. *Photograph by Richard Wood, June 1965.*

give canners an opportunity to develop special packs in small cans for competition with imported "sardines". Thus, the southern California interseason landings consisted of both market and cannery deliveries.

For the second consecutive year, California seasonal landings dropped to an all-time low. Central California landings amounted to only 943 tons; southern California landings were only slightly higher at 1,089 tons. Interseason landings for central and southern California were 78 and 1,357 tons respectively, bringing the statewide total to 3,467 tons for the 1963–64 period.

In Baja California, cannery processing is allowed throughout the year, but age and length composition of the 1963–64 landings are summarized on the same interseason and season basis as in southern California. Interseason and season landings were 11,235 and 6,880 tons respectively.

Central California

The season opened on August 1 after all segments of the industry agreed to $60 per ton for sardines and $47.50 for mixed sardines and mackerel. During the last 4 days of the first dark (Table 1), only 107 tons were landed. The second dark, lunar period 542, resulted in the highest catch of the season with 430 tons (Table 9). The majority of this came from Monterey Bay, with the remainder taken off Point Lopez

TABLE 1

Calendar Dates of Lunar Months During 1963–64 Period

Lunar month	Lunar period	Dates
"February"	536*	February 9–March 10
"March"	537	March 11–April 9
"April"	538	April 10–May 8
"May"	539	May 9–June 6
"June"	540	June 7–July 5
"July"	541	July 6–August 4
"August"	542	August 5–September 2
"September"	543	September 3–October 2
"October"	544	October 3–October 31
"November"	545	November 1–November 30
"December"	546	December 1–December 30
"January"	547	December 31–January 28
"February"	548	January 29–February 27
"March"	549†	February 28–March 28

* 1963–64 period began March 2. Lunar months numbered serially since "November" 1919.
† 1963–64 period ended March 1.

and San Simeon. The balance of the season was unproductive, with fishermen choosing to remain in port rather than fight bad weather and roam far from home searching for fish. The season ended on March 1 with a total of 943 tons landed, the lowest since the prolonged failure of 1952–58.

During the season, only two plants packed sardines in central California: one at Monterey and one at Moss Landing. A San Francisco plant ceased operations and moved to Oxnard shortly before the season.

Central California fleet operations were unstable, with only five large (60 feet or over) and two small purse seiners operating during the first part of the season. Operations were shifted to southern California in "September" and "October" due to lack of fish. Thirteen lampara boats operated sporadically throughout the season.

Southern California

The season opened on September 1, but the full-moon period kept boats in port until the evening of September 8. Vessel operators commenced fishing at the price per ton of the previous season, which was in effect in central California. As expected, fishing was poor and only a few small loads of pure sardines were landed. Landings during the first lunar period, "September", amounted to only 127 tons (Table 9). "October" was only slightly better with 483 tons. Succeeding lunar periods resulted in smaller catches, reaching a low of 17 tons in "February". On the last day of the season, March 1, 136 tons were taken from the vicinity of San Nicolas Island. The season catch of 1,089 tons was the smallest in the history of the southern California sardine fishery.

Boat limits, in effect at some canneries, and weather did not materially hold down the catch. Negotiations over the price of mackerel tied the fleet up during January and February.

One cannery processed sardines at Oxnard and five in the Los Angeles area.

Altogether, 70 boats operated in southern California during the season with 34 large purse seiners (60 feet or over) and 29 small purse seiners and lampara boats fishing exclusively in the area. Five large and two small purse seiners from central California entered the southern California fishery shortly after the season opened.

Baja California

Season landings in the Ensenada, Cedros Island, and Puerto Adolfo Lopez Mateos areas amounted to 6,880 tons, and interseason landings to 11,235 tons; the total was about the same as for the 1962–63 period.

Five canneries operated in the Ensenada area, one on Cedros Island, and one at Puerto Adolfo Lopez Mateos. The price to fishermen for sardines varied between $32 and $42 per ton. Economic demand was good and all fish were utilized by the canneries.

Weather conditions were generally favorable throughout the 1963–64 period except off Cedros Island, where poor spring weather reduced landings.

The bulk of sardine catches off northern and central Baja California were made within easy sailing distances from Ensenada and Cedros Island canneries. Substantial tonnages taken in the Cedros Island area were shipped in refrigerated vessels to Ensenada for processing. A thriving fishery for sardines was conducted off southern Baja California. Most of the fish were taken from Magdalena Bay and processed at Puerto Adolfo Lopez Mateos.

AGE AND LENGTH COMPOSITION

Methods of estimating numbers of sardines landed by region and year-class are discussed by Felin and Phillips (1948, p. 11).

During the season 650 fish were measured in central California, 900 in southern California, 850 in northern Baja California, and 650 in

TABLE 2

Length Composition of Year-classes in Sardine Samples from the Central California Commercial Catch, 1963–64 Season

Standard length (mm)	Year-class							Totals	
	1962	1961	1960	1959	1958	1957	1956	Aged	Measured
150									
152									
154									
156									
158		1						1	1
160									1
162									1
164		2	1					3	6
166									2
168		1						1	2
170									3
172		1						1	3
174		1						1	6
176		1						1	2
178									
180									1
182									
184									1
186									2
188									1
190									
192									1
194									
196									2
198									
200									
202									3
204									
206	--	--	1		--			1	2
208		1	--	1	--			2	4
210		--	--	--	--			--	1
212		--	--	--	--			--	3
214		1	--	--	--	--	--	1	3
216		--	--	--	--	--	--	--	3
218	--	--	--	--	--	--	--	--	4
220	--	--	--	--	--	--	--	--	5
222	--	--	--	--	--	--	--	--	3
224	--	--	--	--	--	--	--	--	1
226	--	--	1	--	--	--	--	1	3
228	--	--	--	--	--	--	--	--	3
230	--	--	--	--	1	1	--	2	6
232	--	--	--	--	1	--	--	1	9
234	--	--	--	--	1	--	--	1	15
236	--	--	--	1	4	2	--	7	23
238	--	--	1	--	1	--	--	2	17

TABLE 2 Continued

Length Composition of Year-classes in Sardine Samples from the Central California Commercial Catch, 1963–64 Season—Continued

Standard length (mm)	Year-class							Totals	
	1962	1961	1960	1959	1958	1957	1956	Aged	Meas-ured
240			1	3	2			6	23
242				1	1	2		4	33
244			1	1	8	1		14	49
246			2	4	6	1	1	14	54
248				3	3	3	2	11	64
250				3	6			9	55
252			1	1	1	1		4	46
254				2	8			10	47
256				1	5	2		8	35
258				1	3	1		5	28
260				1	3		1	5	24
262				3	2		1	6	21
264					1			1	11
266				1	1	1		3	4
268					1			1	3
270									4
272									4
274									
276									1
278									--
280									1
Totals		9	9	30	59	15	5	127	650
Mean lengths		178	229	218	249	247	253	243	243

TABLE 3

Length Composition of Year-classes in Sardine Samples from the Southern California Commercial Catch, 1963–64 Season

Standard length (mm)	Year-class							Totals	
	1962	1961	1960	1959	1958	1957	1956	Aged	Meas-ured
168			--	--		--		--	2
170	--	1	--	--		--	--	1	7
172	1	--	--	--	--		--	1	6
174		--	--		--		--	--	7
176	1	1	--	--	--	--	--	2	6
178	1	--	--	--	--	--	--	1	6
180	--	1	--	--	--	--	--	1	3
182	--	1	--	--	--	--	--	1	7
184	--	2	--	--	--	--	--	2	3
186	--	1	--	--	--	--	--	1	3
188	--	--	--	--	--	--	--	--	--
190	--	--	--	--	--	--	--	--	--
192	--	--	--	--	--	--	--	--	1
194	--	--	--	--	--	--	--	--	--
196	--	--	--	--	--	--	--	--	1

TABLE 3—Continued

Length Composition of Year-classes in Sardine Samples from the Southern California Commercial Catch, 1963–64 Season—Continued

Standard length (mm)	Year-class							Totals	
	1962	1961	1960	1959	1958	1957	1956	Aged	Meas-ured
198									3
200		1						1	7
202									1
204			1					1	6
206									8
208			1					1	5
210		1						1	6
212			1					1	5
214				1				1	6
216									5
218									4
220				1				1	3
222				3	1			4	6
224				1	1	1		3	14
226			1	2	1			4	18
228			2		2			4	25
230			1	2	1			4	26
232			2	9	2	1		14	58
234			2	6	2			10	59
236				7	8	2		17	66
238			1	6	3	1	1	12	76
240			2	9	2	1		14	71
242			1	5	5	2		13	68
244				5	1			9	68
246			4	6	5			15	47
248			1	2	3	1	1	8	52
250			1	2	3	5		11	52
252				2	2			4	28
254				2	1	1		4	19
256									14
258					1			1	14
260					1			1	5
262				1				1	4
264									
266									4
268									--
270									1
Totals	3	9	21	72	48	15	2	170	900
Mean lengths	175	186	234	238	241	243	243	235	235

central Baja California (Tables 2–5). The average weights[2] of sardines taken from these areas were: central California 0.4476 pounds, southern California 0.3120 pounds, northern Baja California (Ense-

[2] Determined by dividing total seasonal catch in pounds by total estimated number of sardines.

TABLE 4

Length Composition of Year-classes in Sardine Samples from the Northern Baja California Commercial Catch, 1963–64 Season

Standard length (mm)	Year-class							Totals	
	1962	1961	1960	1959	1958	1957	1956	Aged	Measured
184									1
186									4
188									
190									
192			1		1			2	8
194			3					3	13
196			1	2				3	12
198			1	1				2	22
200			2	1		1		4	19
202					1			1	22
204				1	2			3	27
206			2	3				5	33
208				1	2			3	27
210				2		2	2	6	34
212			1	2	1			4	27
214			1	3	1			5	42
216			2	3	2		1	8	35
218				4	2			6	55
220			2	6	4	2		14	53
222			1	2	4			7	52
224			1	3	1	1		6	43
226			1	7	4			12	55
228			1	5	4	1		11	46
230				6	3	1		10	38
232			3	6	3			12	62
234			1	4	3			8	40
236				4	1			5	21
238			1	2	4			7	17
240				2				2	12
242				3	1			4	12
244									5
246				1				1	2
248									1
250									1
252									2
254									
256									
258					1			1	1
Totals			25	74	45	8	3	155	850
Mean lengths			214	224	224	218	212	222	219

nada) 0.3389 pounds, and central Baja California (Cedros Island) 0.2233 pounds.

In central California, sardines sampled ranged from 158 mm to 280 mm SL with a mean of 243 mm. The 1958 year-class (5-year-olds) dominated the central California catch, comprising 50 percent of the

TABLE 5

Length Composition of Year-classes in Sardine Samples from the Central Baja California Commercial Catch, 1963–64 Season

Standard length (mm)	Year-class						Totals	
	1962	1961	1960	1959	1958	1957	Aged	Measured
160								3
162								2
164								
166								3
168								1
170		1		1			2	6
172		1	2				3	12
174				4			4	22
176			1				1	18
178				1			1	18
180		1	4	2	1		8	27
182			4	3	1		8	44
184		1	3	3			7	54
186			9	3		1	13	51
188			8	10	1		19	75
190		1	6	6	3		16	67
192			5	6	1		12	69
194			5	7	2		14	67
196			3	2	2	1	8	38
198			3	5			8	37
200			3	1			4	16
202				1			1	7
204								5
206					1		1	4
208								4
210								
Totals		5	56	55	12	2	130	650
Mean lengths		179	188	189	192	191	188	188

numbers landed (Table 9, Figure 2). This year-class dominated the landings of the previous season as 4-year-olds. Since the 1961–62 season, central California landings have consisted primarily of large fish, 4, 5, and 6 years old. Two-year-olds have not contributed significantly to the fishery since the 1958–59 season, the year of sardine resurgence in central California.

Lengths of sardines sampled in southern California ranged from 168 to 270 mm with a mean of 235 mm. The 1958 and 1959 year-classes were dominant and contributed over 50 percent of the numbers caught (Table 9, Figure 2). The 1961 and 1962 year-classes, on the strength of catches from San Nicolas Island on the last day of the season, accounted for 28 percent of the landings.

Sardine fishing for Baja California canneries is not restricted to any one time of the year. For comparative purposes, the data have been

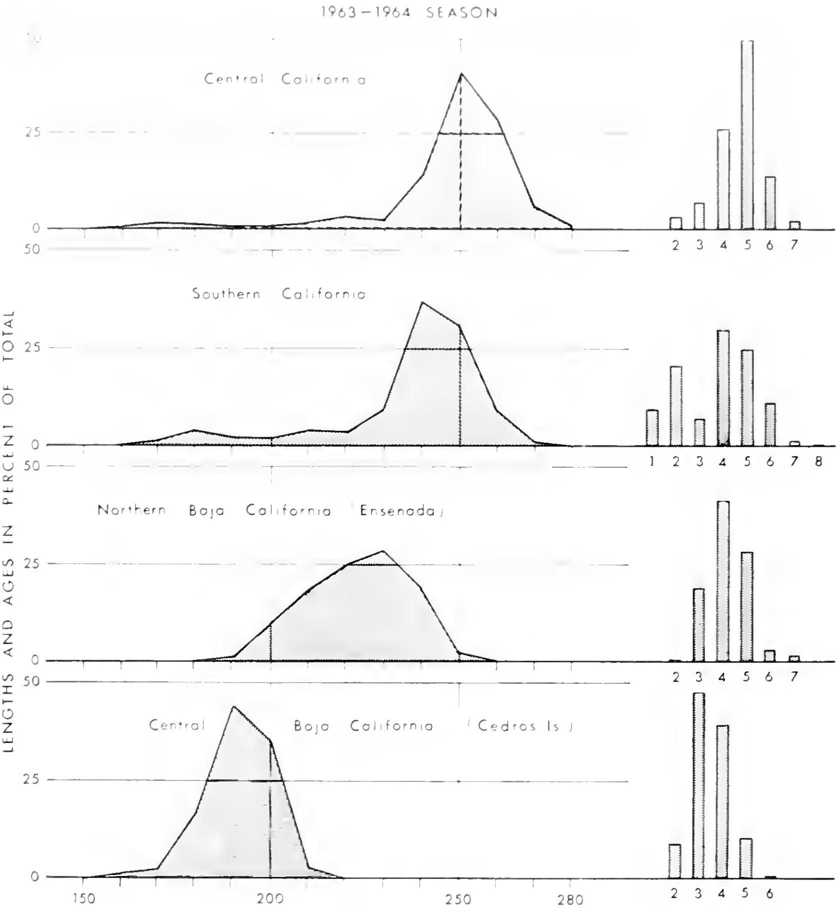

FIGURE 2—Length and age composition of 1963–64 sardine catch. Lengths are plotted by 10mm intervals and by perceniage of total numbers sampled. Ages plotted by percentage of estimated numbers landed.

summarized on the same basis as those for southern California. During the 1963–64 season, sardines sampled from Baja California were smaller than those from central and southern California (Figure 2). Historically, sardines from Baja California are much smaller per given age and investigators have allied this with serological differences to substantiate the subpopulation theory (Vrooman, 1964).

The lengths of sardines in northern Baja California samples ranged from 184 to 258 mm with a mean of 219 mm. Fish from central Baja California were considerably smaller, ranging from 160 to 208 mm with a mean of 188 mm (Tables 4 and 5). The 1958 and 1959 year-classes (ages 5 and 4) were major contributors to the catch in northern Baja California (Figure 2). In central Baja California, the 1959 and 1960 year-classes were dominant.

TABLE 6

Length Composition of Year-classes in Sardine Samples from the Southern California Interseason Catch, 1963 (April and May)

Standard length (mm)	Year-class							Totals	
	1962	1961	1960	1959	1958	1957	1956	Aged	Measured
210									1
212									
214									
216									1
218				1				1	2
220									3
222									1
224									[illegible]
226									3
228									1
230				2	1			3	9
232					1			1	11
234									8
236			1	2	3	1		7	13
238				1	1			2	9
240				1				1	11
242			1		1			2	10
244				3	1		1	5	14
246				1	3		1	5	11
248									1
250									2
252									3
254					1			1	2
256									1
258									
260					1	1		2	2
262									
264									1
Totals			2	11	13	2	2	30	129
Mean lengths			239	237	242	248	245	241	238

Interseason landings in central California were negligible and adequate samples were not obtained. Southern California interseason landings were sampled during April and May. Fish varied between 210 and 264 mm and consisted primarily of the 1958 and 1959 year-classes (Table 6). These year-classes also dominated catches during the season.

Sardines sampled from northern Baja California interseason catches ranged in length from 156 to 246 mm with a mean of 213 mm (Table 7). Central Baja California sardines ranged in length from 136 to 204 mm and averaged 180 mm (Table 8). In northern and central Baja California the 1959 and 1960 year-classes were dominant, contributing 81 percent of the total numbers landed (Table 10).

TABLE 7

Length Composition of Year-classes in Sardine Samples from the Northern Baja California Inter-season Catch, 1963

Standard length mm	Year-class						Totals	
	1962	1961	1960	1959	1958	1957	Aged	Meas-ured
156								2
158								1
160								3
162								2
164								
166								
168	1						1	2
170								
172		1					1	2
174								6
176								6
178		1					1	2
180								3
182		1					1	1
184								1
186								3
188								4
190	1			1			2	11
192								12
194		1	1		1		3	19
196			2	1			3	17
198	1		1			1	3	27
200			3	4	1		8	40
202			3	2	1		6	41
204			2	3	2	1	8	63
206			4	2	3	1	10	48
208		1	3	5	1		10	63
210			1	6	2		12	78
212			8	5	3		16	55
214			5	7	1		13	92
216			9	7	3	1	20	70
218			6	8	4		18	70
220			5	7	3		15	70
222			5	7			12	74
224			3	7	3		13	60
226			1	7	2		10	38
228			5	1	3		12	40
230			4	1	2		7	34
232			2	5	2		9	26
234				2	1		3	17
236					1		1	11
238				1	3	1	5	12
240				2			2	8
242			1	1			2	3
244								2
246								1
248								
250								
Totals	3	5	77	95	42	5	227	1,143
Mean lengths	185	187	215	218	219	212	216	213

TABLE 8

Length Composition of Year-classes in Sardine Samples from Central Baja California Interseason Catch, 1963

Standard length (mm)	Year-class						Totals	
	1962	1961	1960	1959	1958	1957	Aged	Measured
136								1
138								1
140								
142								1
144								1
146								1
148								2
150								
152								9
154								8
156								5
158		1	1				2	19
160			2				2	12
162								4
164			1				1	9
166			1				1	13
168			3				3	20
170			2	3			5	23
172		1	4	2			7	49
174			2	5	2		9	54
176			5	8	2	1	16	69
178			9	12	3		21	103
180		2	8	4	4		18	91
182		1	13	3			17	86
184		5	13	4	1		23	112
186		1	4	6	1	1	13	68
188		1	5	2	2		10	51
190		1	4	2			7	43
192			6	4	2		12	43
194		1	2	1			1	16
196			1	3	1	1	6	12
198			4	1			5	18
200								2
202								2
204								3
Totals		14	90	60	18	3	185	953
Mean lengths		182	182	182	182	186	182	180

TABLE 9

Age and Year-class Composition of the Sardine Catch in the 1963–64 Season

	Catch		Number of fish in thousands by age and year-class							
	Tons	Number	1 1962	2 1961	3 1960	4 1959	5 1958	6 1957	7 1956	8 1955
Central California										
"July"*	107	476				67	409			
"August"	430	1,780		53	214	623	730	160		
"September"	167	884		62	53	141	407	177	14	
"October"	9	41		12	5	4	18	2		
"November"	Trace									
"December"	37	202	-	-	16	11	85	48	12	
"January"	44	187			11	7	79	64	26	
"February"	149	640				173	365	102		
Total Central California	**943**	**4,210**		**127**	**299**	**1,056**	**2,093**	**553**	**82**	
Percent		100.00		3.02	7.10	25.08	49.71	13.14	1.95	
Southern California										
"September"	127	688		14	191	287	165	20	9	2
"October"	483	2,599		104	208	987	738	520	42	
"November"	185	928	--	-	6	353	439	105	25	
"December"	101	577	-	--	--	277	254	46		
"January"†	40	229		--	25	89	106	9		
"February"	17	94	-		21	28	45			
"March"‡	136	1,868	635	1,233						
Total Southern California	**1,089**	**6,983**	**635**	**1,351**	**451**	**2,021**	**1,747**	**700**	**76**	**2**
Percent	--	100.00	9.09	19.35	6.46	28.94	25.02	10.02	1.09	0.03
Total California	2,032	11,193	635	1,478	750	3,077	3,840	1,253	158	2
Percent	--	100.00	5.67	13.20	6.70	27.49	34.31	11.20	1.41	0.02
Baja California§										
"September"	957	6,950	--	--	1,736	3,554	1,316	239	105	
"October"	931	6,607	-	435	1,686	2,875	1,277	197	137	
"November"	1,166	8,367	--	660	3,249	3,749	532	113	64	
"December"	1,034	7,872	--	128	2,707	3,504	1,321	212		
"January"	884	7,323	--	76	3,732	2,104	1,411			
"February"	357	2,865	--	37	1,453	814	561			
"March"										
Total Baja California	**5,329**	**39,984**	--	**1,336**	**14,563**	**16,600**	**6,418**	**761**	**306**	
Percent	--	100.00	--	3.34	36.42	41.52	16.05	1.90	0.77	

* August 1–4
† No samples, Dec. and Feb. sampling used.
‡ Feb. 28–March 2 landings
§ Includes Cedros Island and Ensenada only—1,551 tons from southern Baja cannery not sampled.

TABLE 10

Age and Year-class Composition of the Sardine Catch in the 1963 Baja California Interseason

	Catch		Numbers of fish in thousands by age and year-class						
	Tons	Number	1 1962	2 1961	3 1960	4 1959	5 1958	6 1957	7 1956
Baja California*									
"February"†	204	1,776	1	290	957	334	112	82	
"March"	872	7,160	4	957	3,836	1,514	543	306	
"April"	963	7,430	--	1,134	3,722	1,893	645	36	
"May"	1,070	8,416	76	305	3,350	3,611	987	87	
"June"	1,573	11,358	--	393	4,014	6,090	861		
"July"	1,159	10,060	32	1,053	5,224	2,510	1,097	144	
"August"‡	870	6,281	--	--	1,892	3,739	457	193	
Total	**6,711**	**52,481**	**113**	**4,132**	**22,995**	**19,691**	**4,702**	**848**	
Percent	--	100.00	0.22	7.87	43.82	37.52	8.96	1.62	

* Includes Cedros Island and Ensenada only—4,524 tons from southern Baja California cannery not sampled.
† March 3–10, no samples, "March" used.
‡ September 1–2, no fish landed

Catch Localities

Areas of catch are important to the fisheries scientist interested in the relationships of the fish to its environment. The population dynamicist is interested in major shifts of catch areas that may be related to en-

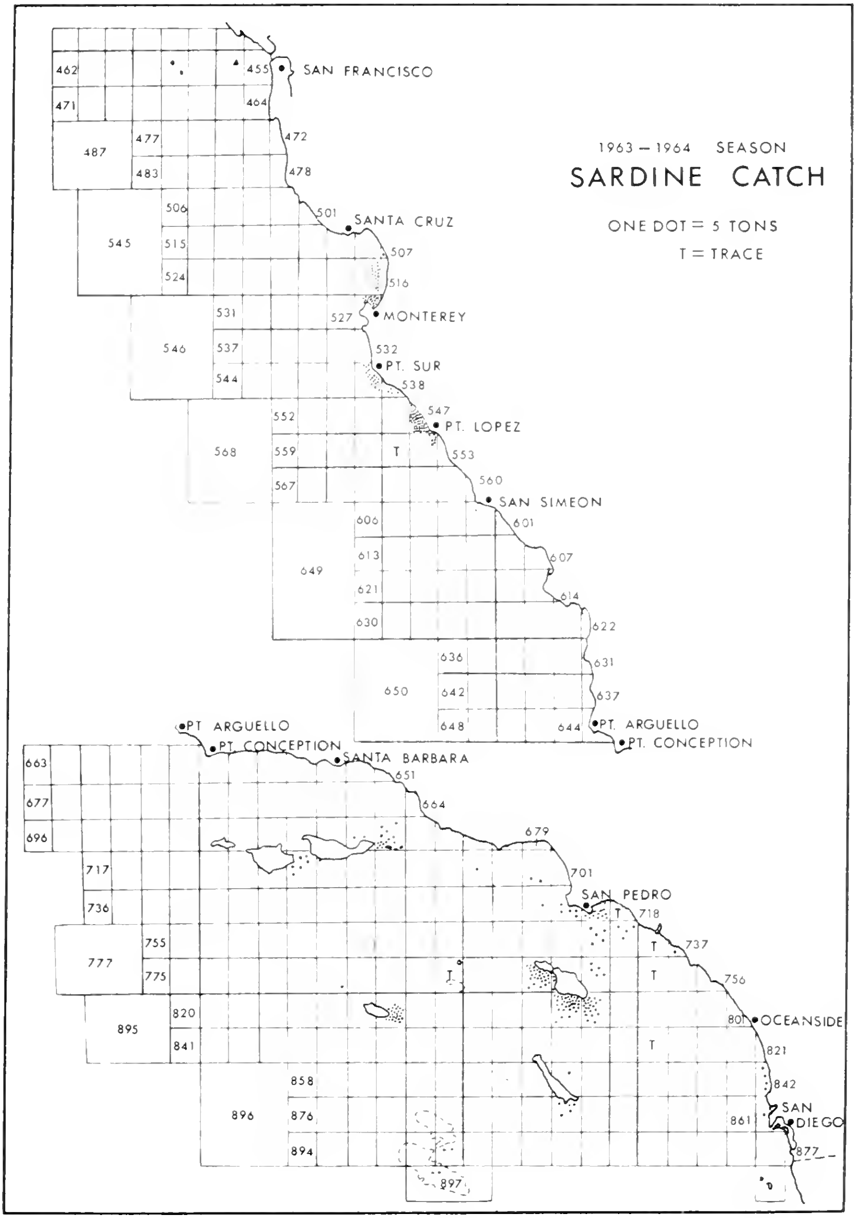

FIGURE 3—Sardine catch origins 1963–64 season. Dots are placed in approximate locations, relative to land masses where fish are known to have been taken.

vironmental changes resulting in displacement of subpopulations into areas of different fishing pressure. Past reports on yield per area (California State Fisheries Laboratory, 1930; Clark, 1937 a, b; Pinkas, 1951; Clothier and Greenhood, 1956) covered the fishery during its inception, rapid expansion, and decline in the early 1950's.

The data for this report are derived from the California pink ticket system, which has been well documented (California Bureau of Marine Fisheries, 1952) and consists of fish receipts (pink) filled in by the dealer at the time he purchases fish from the fishermen. The tickets list the variety of fish, pounds landed, and block area of catch. Block areas are 10 minutes of latitude by 10 minutes of longitude (Figure 3). At times, dealers do not enter the catch areas, but during the sardine season "checkers" are employed by the Department to interview the vessel captain at time of unloading and insure that all data concerning each catch are on a special checker's ticket. The system is also supplemented by scientific personnel who interview the vessel captains when sampling sardine catches (Figure 4).

The 1963–64 season catch localities off California consisted of three major areas: the central California coast from Monterey Bay to Point Lopez; the southern California coastal area off San Pedro; and the offshore islands of southern California (Figure 3). The catch origins correspond quite well to an early analysis by Clark (1937), in which most fish were taken within 3–5 miles of shore and in areas shallower than 500 fathoms.

To examine major shifts in areas of catch, tonnages for individual blocks have been grouped into general fishing areas (Table 11). Season and interseason tonnages were computed, and the tonnage of each gen-

FIGURE 4—Vessel personnel being interviewed on the activities of their vessel during the previous night of fishing. *Photograph by Richard Wood, June 1965.*

TABLE 11

Sardine Catch by General Fishing Areas for 1963–1964 Period

General areas	Block numbers	Interseason*		Season†		Total	
		Pounds	Percent	Pounds	Percent	Pounds	Percent
Point Arena	401-421	--	0.0	--	0.0		0.0
Bodega Head	422-445	--	0.0	--	0.0	--	0.0
San Francisco	446-471		0.0		0.0	--	0.0
Pigeon Point	472-506		0.0		0.0	--	0.0
Monterey	507-531	71,819	2.5	668,938	16.5	740,757	10.7
Point Sur	532-552		0.0	843,725	20.8	843,725	12.2
Piedras Blancas	553-606		0.0	123,420	3.0	123,420	1.8
Point Buchon	607-630		0.0		0.0	--	0.0
Point Sal	631-648		0.0		0.0	--	0.0
Santa Barbara	651-657, 665-671		0.0	--	0.0		0.0
Port Hueneme	664, 680-683, 703-706, 722-725	62,600	2.2	5,950	0.1	68,550	1.0
Santa Cruz Island	684-690, 707-713, 726-732	9,600	0.3	246,800	6.1	256,400	3.7
Point Vicente	679, 701, 702, 718-721, 737-742	1,138,985	39.7	296,317	7.3	1,435,332	20.7
Oceanside	756-758, 801-804, 821-825		0.0	470	T	470	T
Santa Catalina Island	759-762, 805-808	193,400	6.8	893,696	22.0	1,087,096	15.7
Santa Barbara Island	743-745, 763-765, 809-811		0.0	2,900	T	2,900	T
San Nicolas Island	746-749, 766-769, 812-815, 833-836		0.0	264,050	6.5	264,050	3.8
San Diego	842-846, 860-864, 877-882		0.0	50,707	1.3	50,707	0.7
San Clemente Island	826-832, 847-852, 865-869	6,550	0.2	60,450	1.5	67,000	1.0
Tanner & Cortes Banks	853-855, 870-873, 888-891, 897	110,000	3.8	32,200	0.8	142,200	2.0
Totals		1,592,954	55.5	3,489,653	85.9	5,082,607	73.3
Pounds of unknown origin not included above		1,276,215	44.5	574,515	14.1	1,850,730	26.7
Total catch		2,869,169	100.0	4,064,168	100.0	6,933,337	100.0

* Interseason—North of Pt. Arguello March 2–July 31
—South of Pt. Arguello March 2–August 31
† Season —North of Pt. Arguello August 1–March 1
—South of Pt. Arguello September 1–March 1

eral fishing area expressed as a percentage of the total for that time period. These general areas are the same groupings used in past yield-per-area reports (Pinkas, 1951) and provide a standard for comparing area of catch.

Catch localities for the 1963–64 season were similar to the 1962–63 season. In 1963–64, 16 percent of the seasonal catch was taken in Monterey Bay (Table 11) and only 2 percent in 1962–63. Santa Catalina Island contributed 22 percent of the total catch in the 1963–64 season. Compared to past years, this represents a significant change in the relative contribution of the Santa Catalina Island area to the total catch. This change resulted from the opening of the southeastern portion of the island, blocks 806 and 807, to roundhaul and purse-seine nets on September 23, 1963. Seiners concentrated on this area shortly after the opening and approximately 200 tons of sardines were taken.

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SKILFISH, *ERILEPIS ZONIFER* (LOCKINGTON), IN CALIFORNIAN AND PACIFIC NORTHWEST WATERS[1]

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A young skilfish 453 mm TL was trawled off Monterey Bay in December 1963. This north Pacific species attains a length of 6 feet and a weight of 200 pounds. Young fish are taken mainly in the epipelagic zone, usually far from shore, while large individuals are taken at greater depths. Skilfish apparently represent a latent resource awaiting discovery of major concentrations.

INTRODUCTION

A young skilfish, 17.8 inches long and weighing 3.6 pounds (Table 1), was taken in an otter trawl towed on the bottom in 95 fathoms southwest of Pt. Santa Cruz, Monterey Bay on December 4, 1963. Salvatore Tringali, owner of the Monterey Fish Company, discovered this unusual fish in a catch of rockfish (*Sebastodes* spp.) unloaded from the trawler *El Salvatore*. The specimen is deposited in the California Academy of Sciences fish collection (No. 27084).

Previously, only three specimens of *Erilepis zonifer* have been reported from California. The first, an 11.75-inch fish, was described as a new species (Lockington, 1880). It was found in August 1879 at a San Francisco market, in a catch of fish from Monterey Bay. The other two were reported as "fat-priest fish" by Jordan (1918) who saw them at a San Francisco market. He gave no lengths or weights, but partook of the flesh of one and pronounced it delicious.

SYNONOMY

Lockington (1880) described this species as *Myriolepis zonifer*, but Gill (1894) pointed out that the generic name *Myriolepis* was already in use for fossil fishes, and proposed *Erilepis* in its stead.

Not until 1900, 20 years after its description, was a second specimen noted. In that year, D. S. Jordan and J. O. Snyder found a 6-foot stuffed *Erilepis* in the Imperial Museum of Tokyo which they mistook for a giant sea bass. In fact, they described a 55-inch specimen caught in the Sagami Sea as *Ebisus sagamius*, and placed it in the family Serranidae (Jordan and Snyder, 1901). Later, Jordan (1917) recognized *Ebisus* as the uniformly-colored adult of the skilfish. Originally the skilfish was placed in a separate family, Erilepidae, but recent taxonomic practice has been to include *Erilepis* with *Anoplopoma* (sablefish) in the family Anoplopomatidae.

Numerous common names have been applied to skilfish, including: giant skilfish, giant seabass, marine monk, and priestfish, in North America; and *aburabozu* (fat-priest), and *aburainagi* (fat-bass), in Japan.

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[1] Submitted for publication February 1966.

DISPARITY

In earlier years, an occasional large skilfish may have been dressed and unintentionally marketed as a sablefish. Bell and Gharrett (1945) state that the captain of the halibut vessel *Forward* reported weighing out a blackcod (sablefish) at 126 pounds, head and entrails removed, that was caught off southeastern Alaska in 1916. This would represent a whole fish weighing about 189 pounds (assuming a weight loss of approximately one-third, which normally occurs when sablefish are dressed and beheaded. This adjusted weight (189 pounds) is acceptable for the skilfish, which attains a round weight of 200 pounds, but it is much too large for a sablefish.

Past surveys indicate that a sablefish of 50 pounds is near-maximum size. Swan (1885) notes: "Instances are not uncommon of black cod being taken measuring 50 inches and weighing 30 pounds, but the average is much less than this last. But it is the admitted rule that the deeper the water the larger the fish." Johnston (1917) reports the

TABLE 1

Measurements and Meristic Counts of a Young Skilfish, *Erilepis Zonifer*, Caught off Monterey Bay, December 4, 1963

	mm	Percent of standard length
Total length (ant. tip of jaws to tip of caudal fin)	453.0	--
Standard length (tip of upper jaw to end vertebral column)	382.0	--
Greatest vertical body depth	120.5	31.5
Greatest lateral body thickness	71.0	18.6
Length of head (tip of upper jaw to end of opercular flap)	114.5	30.0
Least interorbital width (top of head at mid-orbits)	48.5	12.7
Length of snout (median tip upper jaw to anterior rim orbit)	37.0	9.7
Horizontal width of orbital cavity	20.0	5.2
Vertical height of orbital cavity	15.5	4.1
Length of upper jaw (median tip to end of maxillary)	46.1	12.1
Width of suborbital bone, between orbit and maxillary	13.0	3.4
Least dorso-ventral height of caudal peduncle	36.0	9.4
Length of base of first dorsal fin	98.5	25.8
Length of base of second dorsal fin	100.0	26.2
Length of base of anal fin, including spines	63.2	16.5
Width of pectoral fin base	31.5	8.3
Longest pectoral fin ray (from line bet. insertions to tip)	88.5	23.2
Longest ventral fin ray	56.0	14.7
Longest anal fin ray	51.0	13.4
Longest dorsal fin spine	42.0	11.0
Longest dorsal fin ray	49.5	13.0
Interspace between first and second dorsal fins	10.0	2.6
Distance from posterior of anus to origin of anal fin	7.5	2.0
Counts		
First dorsal fin	XIII	
Second dorsal fin	I, 17	
Anal fin	II, 12	
Ventral fin	I, 5	
Pectoral fin	18 rays, each side	
Number of rakers on first gill arch	22 (6+16)	
Number of pores in lateral line	133	

capture of 40- to 50-pound sablefish off Umatilla Lightship in 1915. Clemens and Wilby (1946) mention that large individuals, 3 feet long and 40 pounds in weight, have been captured on North Pacific halibut banks. Coastwise sea surveys during the past decade have failed to yield sablefish weighing over 40 pounds (Pacific Marine Fish. Comm., 1954; Alverson, Pruter, and Ronholt, 1964). The largest authenticated sablefish from Pacific waters was a 56-pounder caught in 1930 off Fort Bragg, California (Capt. G. L. Larson, pers. comm.).

A readily observed difference between skilfish and sablefish is that in skilfish the first (spinous) dorsal fin is set in a shallow groove, and the space between the first and second dorsal fins is less than the width of the orbit. In sablefish there is no dorsal fin groove and the dorsal interspace is several times the width of the orbit.

DISTRIBUTION

Skilfish have been taken occasionally from Monterey Bay northward into the Gulf of Alaska, along the North American coast, and off the Kurile and Japanese islands, along the Asiatic coast. They have not been reported in Puget Sound,[2] nor in the Bering Sea.

In the past decade, intensified research fishing, particularly for salmon in North Pacific waters, has resulted in many incidental captures of skilfish. Neave (1959) reported 14 individuals taken in surface gill nets set well off the Canadian coast in July 1956, and May, June, and August 1958. Larkins (1961) reported 145 specimens taken in surface gill nets set overnight during May through September, 1955-1961, in waters off the Pacific Northwest and in the Gulf of Alaska; none was taken in nets set in the Bering Sea.

Young skilfish apparently lead an epipelagic existence. Andriashev (1955) reported that in August 1951 five young skilfish 3.6 to 7.0 inches long were caught at the surface from the Russian whaling ship *Blyuval* 85 miles east of the Kurile Islands. Another immature fish 21.5 inches long was caught in August 1953, by a crew member using a baited hook fished at the surface about 260 miles off the northern Kuriles; the surface water temperature was 8.7 C (47.7 F) at that time. In December 1965, the Vancouver Public Aquarium received three small, live skilfish, 10 to 12 inches long, that had been caught at the surface 900 miles west of Victoria the previous month. Crew members of the weathership *Stonetown* who had caught these three fish said that juvenile skilfish are apparently curious because they "poke their heads out of the water around the ship and can be dip-netted by long handled nets" (Hewlett, 1966).

Early in May 1965, the California Academy of Sciences, San Francisco, placed on display two live young skilfish contributed by the Fishery Research Institute, University of Washington, Seattle. One fish was 16 and the other 20 inches long when caught at the surface, April 20, 1965, on longline gear set for salmon, 1,100 miles off the southern Oregon coast.[3] The surface temperature was 10.3° C (50.5° F) at the place of capture (Lillian Dempster, pers. comm.).

[2] Andriashev (1955) inadvertently lists skilfish from Puget Sound, citing Kincaid (1919). Kincaid, in noting a distinction between skilfish and resident sablefish, states: "No specimens have been taken within the limits of Puget Sound, but a number of examples have been captured on the neighboring Canadian shore."

[3] One of these fish was still alive at Steinhart Aquarium on April 14, 1966.

Neither Neave (1959) nor Larkins (1964) listed the lengths or weights of skilfish taken in surface gill nets in eastern Pacific waters; however, Larkins noted that the net mesh sizes varied from 2.0 to 5.5 inches, stretched. This would indicate retention of subordinate sizes of skilfish. In the 17.8-inch specimen from Monterey (Figure 1), the greatest vertical body depth is 4.75 inches, and the greatest lateral body thickness is 2.80 inches. This fish, like those reported by Neave (1959) and Larkins (1964), could have been caught near the surface. An otter trawl has no closing device and fishes while being set and retrieved, as well as on the bottom.

Information concerning the depths at which large skilfish were caught off Japan is lacking, but there are a few records for eastern Pacific waters. These indicate that individuals 44 to 70 inches long, and weighing up to 175 pounds, have been caught on or near the bottom in 150 to 240 fathoms on baited halibut lines (Thompson, 1916, 1917; Clemens and Wilby, 1946, 1961).

COLOR

The body of young skilfish is dark-gray or blue-black, conspicuously blotched with white or light-gray (Figure 1). In large individuals, the whitish blotches are obscured, and the body is uniformly blackish above, and lighter below. The whitish blotches apparently are retained until a fish reaches at least 35 inches. Newman (1963) reported upon a skilfish exhibited at the Vancouver (British Columbia) Public Aquarium from July 1956 to September 1963, when it died. During this period, it grew in length from 12 to 35 inches, but retained its pattern of white and light-gray marks for the entire 7 years.

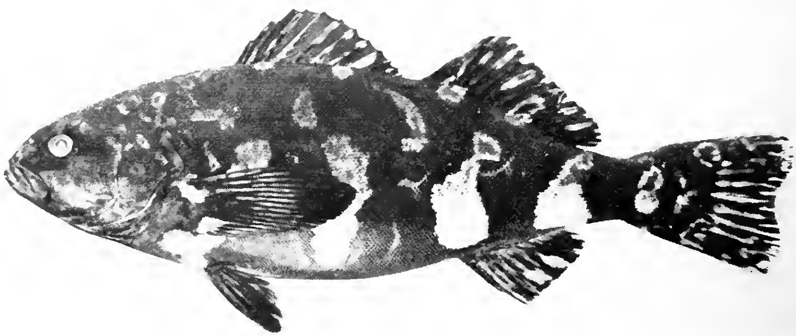

FIGURE 1—A young skilfish, *Erilepsis zonifer*, 17.8 inches long taken off Monterey Bay, December 4, 1963. *Photograph by J. B. Phillips.*

LATENT RESOURCE

Andriashev (1955) notes that the Soviet fisheries industry is interested in finding commercial concentrations of this large, fat fish, both in surface and bathypelagic waters of the northwestern Pacific area. Apparently, skilfish are not common on grounds traditionally fished along the North American coast. A few large individuals have been taken on halibut gear, but none with dragnet gear, except for the recent Monterey Bay specimen.

Alverson et al. (1964) made no mention of skilfish catches in bottom trawling operations by the U.S. Bureau of Commercial Fisheries in northeastern Pacific waters during 1940–1962. They evaluated over 1,700 drags that were made from Oregon northward into the Bering and Chukchi Seas. Depths to 300 fathoms, and in some cases to 600 fathoms, were sampled. By contrast, sablefish were taken in all depths from Oregon to the Bering Sea. The capture of many young skilfish in gill nets set at the surface several hundred miles from shore in North Pacific waters, could signify a bathypelagic habitat for the larger fish. If such is the case, harvesting could be accomplished with mid-water trawls, which recently have been used to capture commercial quantities of Pacific hake, *Merluccius productus*.

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RESULTS OF THE 1961 TO 1965 PISMO CLAM CENSUSES[1]

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California Department of Fish and Game

Data for the Department's annual Pismo clam census are analyzed and brought up to date for the years 1961 to 1965. Two of the 5 years, 1964 and 1965, were characterized by good recruitment at the three Pismo locations sampled, but recruitment at Morro Bay was almost lacking. Although recruitment during 1961, 1962, and 1963 was poor at all locations on both beaches, the censuses of the past 10 years revealed an improved situation over the previous 10 except at Morro Bay.

An annual census of the Pismo clam has been taken by the Department of Fish and Game at three locations on Pismo Beach since 1923 and at Morro Bay since 1949. Censuses prior to 1960 have been reported by Baxter (1961, 1962) and Fitch (1950, 1952, 1954, 1955). The present paper brings census data up-to-date through 1965.

The regular sections at LeGrande, Oceano, Pismo, and Morro (Baxter, 1961) were sampled in each of the 5 years 1961 through 1965. Baxter (1961) describes the census methods, gives a history of the regulations governing the utilization of the resource, and presents maps of the census locations.

Recruitment was very good in 1964 at the three Pismo Beach localities and quite good in 1965. The size of the 1964 year-class far exceeded any since 1957; the last outstanding set occurred in 1946. During 1961, 1962, and 1963 recruitment was poor. Essentially no recruitment has occurred at Morro Bay since 1944. During the 1965 census, however, a few clams-of-the-year were washed out underfoot as the offshore end of the section was flooded by incoming waves, giving evidence of a better set at Morro Bay than any since 1952.

As has been true for many years, very few large clams were dug in the 6-inch-wide sections. Practically no clams older than 5 years were found. Only a few clams have attained the legal size of 4½ inches before this age. All sections combined yielded only three legals in both 1961 and 1962, seven in 1963, and two in both 1964 and 1965. The 4½-inch size limit, however, allows ample time for reproduction; most Pismo clams have reproduced four or five times before reaching this size.

To obtain good clamming it is now necessary to dig in waist-deep water during the better minus (below −1 foot) tides of the year.

LE GRANDE SECTION

This section is about 5 miles south of the Pismo Beach pier in an area which was a clam refuge from 1929 to 1949 (Fitch, 1952). It is the least productive of the three Pismo Beach sampling locations.

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TABLE 1

Number of Clams by Year-Class Taken in the Le Grande Section 1961–1965

Year-class	Census year 1961	1962	1963	1964	1965
1955+	1*	0	0	0	0
1956	0	0	0	0	0
1957	0	1	0	0	0
1958	3	1	0	1	0
1959	7	1	2	0	0
1960	7	6	5	7	1
1961	1	1	1	1	2
1962		2	6	2	0
1963			4	8	14
1964				71	41
1965				--	40
Total	**19**	**18**	**21**	**90**	**98**

* 1945 year-class

Only one age zero clam was dug in 1961, two in 1962, and four in 1963 (Table 1). In 1964, a fair set occurred, indicated by the 71 zeros in the section; this was followed by 40 zeros in 1965. The latter 2 years had the best recruitment in this area since 1946.

OCEANO SECTION

The Oceano section was closed to digging from 1949 until 1955. A good set in 1964, indicated by the 200 zeros taken in the section, ap-

TABLE 2

Number of Clams by Year-Class Taken in the Oceano Section 1961–1965

Year-class	Census year 1961	1962	1963	1964	1965
1955+	0	1*	1*	0	0
1956	0	0	0	0	0
1957	6	2	0	0	0
1958	11	7	2	0	0
1959	13	11	5	1	0
1960	8	5	6	1	0
1961	6	18	21	6	1
1962		36	13	16	15
1963			14	25	25
1964				200	141
1965		--			75
Total	**44**	**80**	**62**	**249**	**257**

* 1946 year-class

parently survived quite well because 141 1-year-olds were found in 1965. The set was fair in 1965, when 75 zero clams were taken, somewhat better than any year since 1957, except 1964. During 1961, 1962, and 1963 recruitment was poor (Table 2).

Two legal-sized clams were dug in both 1962 and 1963, but none in the other 3 years. Poor survival of the record 1957 set (Baxter, 1961) is demonstrated by the fact that only one legal clam from this year-class was dug during the 5 years 1961 to 1965.

PISMO SECTION

This section, just north of the Pismo Beach pier, is in an area never closed to digging. Relatively good sets which occurred here in 1964 and 1965 were the best since 1959. Survival of the 1964 year-class has been good; the section yielded 111 clams as zeros in 1965, and 97 were taken as 1-year-olds (Table 3). The 1963 year-class was stronger here than at Le Grande or Oceano.

TABLE 3

Number of Clams by Year-Class Taken in the Pismo Section 1961–1965

Year-class	Census year 1961	1962	1963	1964	1965
1955+	1*	0	1†	1	0
1956	0	0	0	0	0
1957	3	3	0	0	0
1958	13	15	4	1	0
1959	18	10	9	5	0
1960	10	5	1	1	1
1961	4	12	11	10	0
1962		33	6	27	21
1963			64	20	34
1964				111	97
1965					126
Total	**49**	**78**	**96**	**179**	**282**

* 1952 year-class
† 1945 year-class

MORRO SECTION

Except for evidence of weak recruitment in 1965 (previously noted), few clams have set in the Morro area since 1959, and there have been no sets of real consequence since 1944 (Table 4). The situation here is extremely serious. Clams in this area need at least 7 years to reach legal size, so even if a good set occurs in 1966, clammers would not find digging very productive until after 1972. In the meantime a few legal clams still can be dug in waist-deep water during most extreme low tides (–1.0 foot or lower).

TABLE 4

Number of Clams by Year-Class Taken in the Morro Section 1961–1965

Year-class	Census year 1961	1962	1963	1964	1965
1955 +	1*	2†	0	0	0
1956	0	0	0	0	0
1957	0	0	0	0	0
1958	1	0	0	0	0
1959	2	2	1	0	0
1960	0	0	1	0	0
1961	0	0	0	0	0
1962		0	0	1	1
1963			0	0	0
1964				0	0
1965					1
Total	4	4	5	1	2

* 1942 year-class
† 1942 and 1951 year-classes

DISCUSSION

Two good years of recruitment at Pismo Beach since 1961, coupled with 3 good years during the preceding 5, have produced a greatly improved situation over that which existed during the 1946 to 1956 period. Provided there is a good survival of these year-classes during the next few years, there should be a steady increase in the take of legal clams.

Survival of these 1964 and 1965 year-class clams will depend to a large degree on whether the clamming public reburies the undersized clams they turn out in search of legals.

At Morro Bay, only the fortunate circumstance of several years of good recruitment and survival can restore the resource. With each passing year, such a revival appears more and more unlikely.

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ADDITION OF ADULT ANGLERFISH, *CHAENOPHRYNE PARVICONUS* REGAN AND TREWAVAS (PISCES: ONEIRODIDAE), TO THE EASTERN SUBARCTIC PACIFIC OCEAN[1]

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Data on variation are presented for two anglerfish that were trawled in deep water off the Columbia River in 1963 and 1964, and the escae of two closely allied species are discussed briefly.

Although the primary distribution of ceratioids appears confined to warm parts of the oceans, Bertelsen (1951) showed that adults of some species occasionally appear in subarctic and subantarctic regions. Adults of *Ceratias*, *Himantolophus*, *Cryptosaras*, and *Oneirodes* have been recorded from northern latitudes in both the Atlantic and Pacific; *Oneirodes* have been recorded as far north as the Gulf of Alaska in the eastern north Pacific.

Two fully-developed unattached females of *Chaenophryne parviconus* Regan and Trewavas were taken during daylight, offshore near the Columbia River effluence, during 1963 and 1964 cooperative bottom trawling studies by the Bureau of Commercial Fisheries and the Atomic Energy Commission. These specimens represent the first records of *Chaenophryne* in subarctic waters. Incidental captures of bathypelagic organisms have not been unusual during these investigations; Greenwood (1959) described the gear utilized.

The largest specimen, 82.8 mm TL (68.7 + 14.1) was taken from a 400-fathom station, September 2, 1964, at lat. 45° 50′N., long. 124° 51′W. The other, 48.3 mm TL (39.2 + 9.1) came from a 275-fathom station, August 27, 1963, at lat. 46° 00′N., long. 124° 49′W. The larger of these establishes a record size for this genus; the previous record was a 55 mm (41 + 14) *C. longiceps* Regan 1926 [= *C. melanorhabdus* Regan and Trewavas 1932; = *C. parviconus*, Beebe and Crane 1947] from the Gulf of Panama (Bertelsen, 1951).

Both specimens from off the Columbia River were deposited in the Fish Museum, University of Washington; the larger was catalogued as UW 18208 (Figure 1, left) and the other, as UW 17442 (Figure 1, right). Counts and measurements were taken from the left side of the specimen whenever possible, after Hubbs and Lagler (1958). Measurements were made with dial calipers to the nearest 0.1 mm and meristic data were supplemented with the aid of radiographs.

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DISCUSSION

The following discussion of variations in *C. parviconus* is based primarily on information acquired from the new records.

Bertelsen's (1951) diagnosis of *Chaenophryne* adequately isolates members of the *C. draco*-group (except for *C. draco* Beebe) on the basis of escal components. Although UW 18208 has a more specialized esca than UW 17442, the two new specimens intensify the relationship between *C. parviconus* and *C. draco*. The esca of UW 18208 is similar to that of the above-mentioned 55 mm specimen except that the anterior filament bundles are replaced by variable-length, tapered, cylindrical appendages with an accompanying reduction in the number of filaments arising from the anterior wing of the posterior appendage (Figure 1, left). Although UW 17442 is a well-developed female, there are no fringes or filaments on the esca (Figure 1, right). The 23 mm holotype of *C. draco* has no fringes or filaments on the esca, but has distinct short cylindrical appendages laterally extending from the base of the distal papilla (Bertelsen, 1951). Both UW 18208 and UW 17442 have iridescent basal swellings antero-lateral to the distal papilla; posteriorly these swellings give rise to the tapered cylindrical appendages (Figure 1). Beebe and Crane (1947) and Bertelsen (1951) suggest that these swellings, which were seen on most of their specimens, represent the precursors to filament formation. After examining the two Columbia River fish, I concur with Bertelsen (1951) that the cylindrical extensions of the anterior basal-lateral swellings with terminal luminescent patches shown by *C. macractis* Regan and Trewavas 1932 [=*C. parviconus*] and possibly by *C. draco* may represent an advancement over the rudimentary swollen state of this escal area preliminary to formation of filament bundles or appendages. Of course, this does not preclude that anterior cylindrical appendages could have been regenerated from filament bundles.

Although Bertelsen (1951) has shown various ontogenetic stages of escal development, the absence or presence of a number of filaments does not appear directly connected with growth as shown by the two new records. Beebe and Crane (1947) note that fringe lengths of the posterior bulb appendages vary regardless of age.

Morphometrically the Columbia River specimens exhibit maximum divergence in the width of the gill opening, length of anal base, length of longest gill filament, relative lengths of the esca, and tip of the subcutaneous appendage (Table 1, Figure 1). Most measurements, however, must be considered with caution because of the morphometric inaccuracy resulting from the gelatinous globular specimens. The increase in gill filament length and resultant filament surface could accommodate the increased oxygen requirements for the larger specimen. The tip of the subcutaneous appendage and escal length differences may reflect allometric growth or the effects of preservation. Meristic differences are limited to dentition (Table 2), one of the most variable ceratioid characters (Bertelsen, 1951; P. J. Struhsaker, *in litt.*).

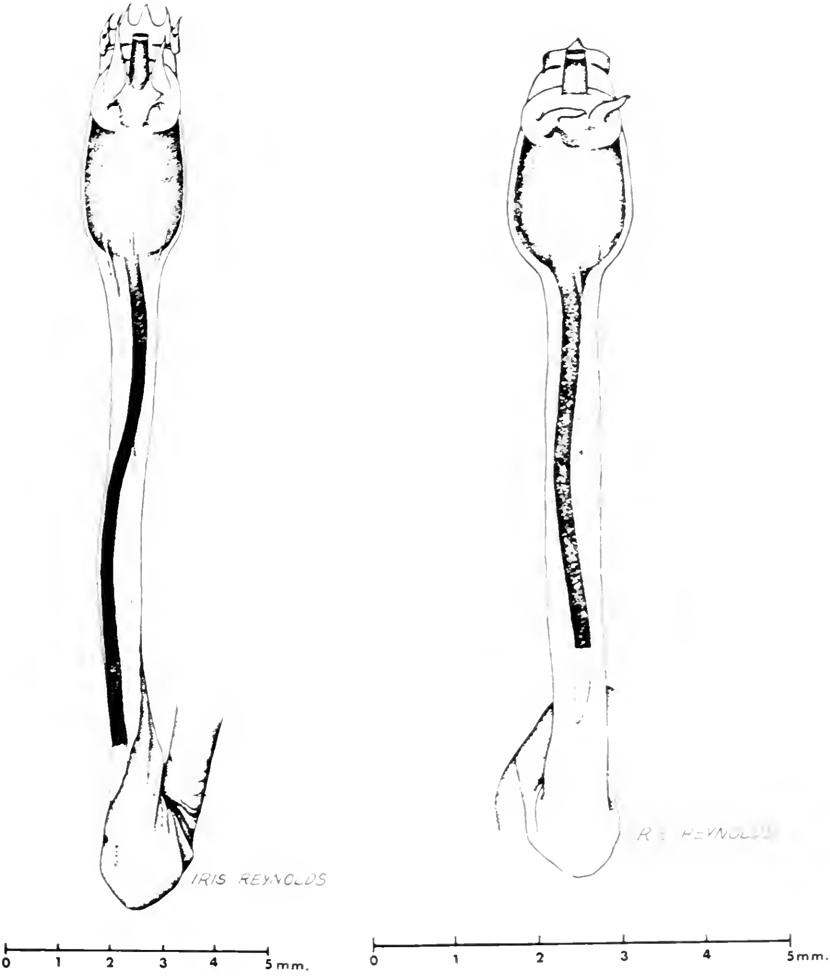

FIGURE 1—Frontal views of illicium of UW 18208 (left) with part of pigmented dermal layer removed, demonstrating extent of subcutaneous appendage, and UW 17442 (right).

DISTRIBUTION

C. parviconus has been recorded from below lat. 37° N. in the northeastern Atlantic Ocean and from below lat. 13° S. from the Indian and South Pacific Oceans. The most northerly previous record in the north Pacific is the Gulf of Panama (Bertelsen, 1951). The two new records extend the range of *C. parviconus* northward to a point offshore from Tillamook Head, Oregon, in the eastern subarctic Pacific Ocean. These northerly subarctic records suggest that this species also occurs in adjacent California waters.

Morphologically inferred as passive swimmers, anglerfishes must drift within major oceanic current systems. Dodimead, Favorite, and Hirano (1963) discuss the physical features of the variable subsurface *California Undercurrent* as a northerly flowing water mass penetrating the

TABLE 1

Measurements of Body Parts (mm) and Proportions in Standard Length from C. *parviconus*, UW 17442 and UW 18208

Items	UW 17442		UW 18208	
Total length	48.3		82.0	
Standard length	39.2		67.9	
Head length (to post. edge of articular	22.2	1.8	40.0	1.7
Maximum body depth	22.6	1.7	41.0	1.7
Maximum body width	18.0	2.2	39.6	1.7
Least depth, caudal peduncle	4.7	8.3	8.3	8.2
Predorsal length	33.3	1.2	58.5	1.2
Preanal length	32.8	1.2	57.6	1.2
Prepectoral length	27.7	1.4	47.5	1.4
Length of caudal	9.1	4.3	14.1	4.8
Width of gill opening	6.0	6.5	9.0	7.5
Length of dorsal base	5.0	7.8	8.0	8.5
Length of anal base	3.2	12.3	5.0	13.6
Width of pectoral base	3.0	13.1	5.2	13.1
Length of snout	13.0*	3.0	22.3	3.0
Interorbital width	12.3	3.2	26.0	2.6
Eye diameter (cornea)	1.1	35.6	1.9	35.7
Length of joined portion of first gill arch	5.8	6.8	11.0	6.2
Length of lower arm of first arch	13.0	3.0	22.0	3.1
Length of longest filament (second arch)	3.4	11.5	7.6	8.9
Length of illicium	10.3	3.8	16.3	4.2
Length of esca (from tip of distal papilla to base of oval body blackened portion)	3.0	13.1	4.2	16.2
Length of subcutaneous appendage	5.0	7.8	9.3	7.3
Length of white tip of subcutaneous appendage	0.7†	56.0	1.0	67.9

* Taken from right side
† Poorly preserved

TABLE 2

Counts of Body Parts from C. *parviconus*, UW 17442 and UW 18208

Items	UW 17442	UW 18208
Dorsal	7	7
Anal	5	5
Pectoral	17	17
Caudal	9	9
Branchiostegals	2 + 4	2 + 4
Dentition:		
Premaxillary	ca. 12	15
Mandible	ca. 13	16
Vomer	3	2
Upper pharyngeal teeth		
2nd arch	ca. 6	ca. 6
3rd arch	ca. 8	ca. 12
Total vertebrae (including urostyle)		19
Trunk vertebrae		10

subarctic region from the eastern tropical Pacific Ocean. Assuming the Oregon specimens were members of a species complex extending along the western North American continent, this undercurrent could provide the physical continuum for such passive swimmers.

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EXPERIMENTAL BROWN TROUT MANAGEMENT IN LOWER SARDINE LAKE, CALIFORNIA[1]

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Seven years were spent studying various sizes and strains of planted brown and rainbow trout in this high elevation, oligotrophic lake. All fingerlings tested produced very low angling returns. Domesticated strains of catchable-sized browns equalled the best strains of domesticated rainbows in returns to anglers. Both rainbows and browns produced better angling returns when stocked early in the season than when stocked late in the fall. All stocked trout grew slowly, and very few grew larger than 11 inches even after 4 or more years in the lake.

INTRODUCTION

From 1954 through 1960, Lower Sardine Lake was experimentally managed with various strains of brown trout, *Salmo trutta*, and rainbow trout, *Salmo gairdnerii*. The work was aimed at determining the potential of brown trout management on waters of this type.

Lower Sardine Lake lies in a glaciated granitic basin at an elevation of 5,968 feet in the Lakes Basin Recreation Area of Sierra County (Figure 1). It is 48 surface acres in extent, has a volume of 1,390 acre-feet, a maximum depth of 76 feet, and a mean depth of 38 feet. Summer surface temperatures reach 72° F. The lake is usually icebound from December until May.

Secchi disk readings average 38 feet during plankton maxima. Higher aquatic plants are scarce. Total hardness averages 14 ppm.

Rainbows spawn with limited success in one small tributary while browns spawn, also with limited success, over the stream's submerged alluvial fan. Meager fall flows prevent brown trout spawning in the stream proper.

Tahoe suckers, *Catostomus tahoensis*, are the only rough fish present.

Dense vegetation and rugged terrain limit shore angling somewhat. Rental boats are available.

The lake has a single access road, making it ideal for creel census work.

Brown trout were introduced in unknown numbers before 1927. Rainbows or eastern brook trout, *Salvelinus fontinalis*, were stocked annually from 1930 through 1948. About 25,000 fingerling brook trout were stocked annually for the 6 years preceding the study.

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[2] Currently with U.S. Fish and Wildlife Service, Maryville, Tennessee.

FIGURE 1—Lower Sardine Lake. *Photograph by Hallett D. Boles.*

METHODS

Experimental trout were fin-clipped for identification and stocked by truck. They were tranquilized with sodium amytal en route and were, with the exception of one group, in good condition when released. That group (the November 4, 1959, rainbow plant) suffered an 18 percent planting mortality.

The plants were evaluated by an 85- to 100-percent complete creel census. Data for uncensused days were estimated by the method of Best and Boles (1956).

RESULTS AND DISCUSSION

Fingerling Returns and Natural Reproduction

In 1954, 1955, and 1956, 10,000 fingerling browns from (i) wild Convict Lake parents; (ii) Convict Lake stock domesticated one generation at Mt. Whitney Hatchery; (iii) long-domesticated Massachusetts strain; were stocked in Lower Sardine Lake. The fish averaged

3.2, 9.4, and 10.1 per ounce, respectively, and eventually were recaught as follows:

Wild Convict Lake (BN-C)	1.6 percent
One generation domesticated (BN-W)	1.2 percent
Long-domesticated Massachusetts (BN-Mass.)	2.7 percent

They had been stocked in June, July, and August, which should have given them the greatest chance of survival according to work on similar lakes (Wales and Borgeson, 1961; Boles, Meyer, and Borgeson, 1964; Boles and Borgeson, 1965). The poor overall return showed that little could be achieved by continuing to plant fingerling brown trout in Lower Sardine Lake.

A measure of the success of fingerling brook trout plants was gained from the first year's creel census data. Despite six previous successive annual plants of 25,000 brook fingerlings, only 38 were caught in 1954. Thus, the returns from these plants averaged less than 0.2 percent. Annually for 25 years prior to this study more than $500 worth of fingerling trout were stocked in this water. Expand this to the many similar waters in California and the potential of these simple findings on fingerling survival becomes apparent.

The possible reasons for poor fingerling returns will be discussed under "Competition and Predation".

The 1954 census data showed that naturally-produced rainbows and browns comprised 44 and 47 percent, respectively, of the catch of unmarked trout (which totaled 412 fish). Natural reproduction was providing a yield of about 3 pounds of 8- to 12-inch trout per surface acre.

Returns from Catchable- and Subcatchable-Sized Trout

In contrast to the poor survival of fingerlings, catchable-sized trout gave consistently high returns (Table 1).

Four strains of brown trout were compared at catchable size (the three tested as fingerlings plus a domesticated strain from New Jersey, BN-N.J.). Late in the study, three lots of catchable-sized rainbows of domesticated stock were planted. These were the spring-spawning Mt. Whitney (RT-W) and the fall-spawning Mt. Shasta (RT-S) strains.

The results of the rainbow plants agreed in principle with what is now generally accepted as fact, namely, that higher returns are realized from spring or early summer plants of "catchables" than from fall plants. Seventy-five percent of the May 7, 1959, plant of Mt. Whitney catchables were caught, compared with 36 percent of a November 4, 1959, plant of the same strain, and 50 percent of Mt. Shasta catchables planted on September 1, 1960 (Table 1). The small size (10 per pound) and poor condition (18 percent planting mortality) of the November 4 Mt. Whitney plant undoubtedly contributed to its poor showing. Annual survival is so low for domesticated rainbow catchables that even though this study was terminated after 1960 the figures can be considered ultimate returns (annual survival of the May 7 Mt. Whitney plant was only 0.03, Table 2).

The annual survival of brown trout ranged from 0.33 to 0.80, and reflected the degree of domestication of the strains tested. The survival of Mt. Whitney browns (only 1 or 2 generations removed from the

TABLE 1

Annual and Cumulative Percentage Returns from Planted Groups of Catchable- and Subcatchable-sized Trout, Lower Sardine Lake, California

Planting date	Species	Number stocked	Number per pound	Year caught: 1	2	3	4	5	6	7	Cumulative total
5/20/54	BN-C	3,000	7.2	8.8	18.8	12.8	5.6	2.9	3.3	2.0	51.2
7/6/55	BN-Mass.	5,000	4.4	50.6	18.9	1.9	0.5	0.6	0.2	-	72.7
5/15/56	BN-N.J.	815	5.6	56.0	18.3	4.2	1.1	1.1			81.0
4/27/57	BN-W	1,315	5.3	33.2	15.4	7.8	1.6				61.0
5/10/58	BN-Mass.	2,227	3.2	59.0	13.8	3.2					76.0
5/10/58	BN-W	1,173	6.8	39.1	12.3	5.0	-				56.4
5/8/59	BN-Mass.	1,998	3.0	43.1	20.0						63.1
5/8/59	BN-W	2,006	4.3	22.0	15.1	--					37.1
5/8/59	BN-C	2,002	6.5	12.8	10.9						23.7
5/8/59	RT-W	2,013	5.4	73.4	2.0						75.4
11/1/59	RT-W*	10,072	10.0	36.2		--					36.2
9/1/60	RT-S	9,936	7.0	19.5							19.5

* Post-season plant; catch occurred in 1960.

TABLE 2

Percentage Return and Annual Survival of Test Plants of Catchable-sized Trout, Lower Sardine Lake, California *

Species	Percentage return	Annual survival
BN-N.J.	81	.33
BN-Mass.	75	.36
BN-W	61	.48
BN-C	54	.61†
RT-W	75	.03
RT-W‡ (Fall plant)	36	
RT-S (Sept. plant)	50	

* Means used where appropriate.
† Because of incomplete first-year vulnerability of BN-C and low angling effort in 1955, the 1955 returns were not used to calculate survival.
‡ This group suffered an 18 percent planting mortality.

wild) fell between that of the highly-domesticated eastern strains and the wild Convict Lake fish (Table 2). As one might expect, the domesticated strains, being more vulnerable to angling, gave higher returns than either the Convict Lake or Mt. Whitney strains. Domesticated browns equalled the spring plant of domesticated rainbows in this respect (75–81 percent returns, Table 1). Their slower rate of return, moreover, could be used to advantage over rainbows in waters more heavily fished than Lower Sardine.

About one-third of the returns from the New Jersey and Massachusetts strains were caught 2 or more years after stocking. On many waters, this would mean a substantial gain in weight returned, but in Lower Sardine the gain was not impressive because of the small maximum size reached (few fish grew larger than 11 inches). The potential advantage over California's rainbow catchables is there, however, and should be tested in more fertile waters. Such plants might serve the dual purpose of providing immediate "put-and-take" angling as well as larger carryover trout.

Because of the growth pattern in Lower Sardine Lake, a comparison of *weight* harvested from test plants was not made. Fish stocked at four per pound, for example, could not match the percentage weight gains of those stocked at six per pound even though an equal or greater *percentage* of the former were taken 2 or more years after planting. The percentage of a plant caught as carryovers is, in this case, a more reliable index of its potential for high yields from fertile waters.

With the exception of the first plant of Convict Lake browns, about 25 percent of each plant of catchable-sized brown trout was caught 2 or more years after planting, so the data do not clearly indicate that any of the brown trout strains tested were superior in providing carryovers. Because of higher first-year returns and lower production costs, the domesticated strains appear better-suited for maintenance stocking than browns of wild parentage.

Compared with the eastern strains, the wild Convict Lake browns and nearly-wild Mt. Whitney fish grew slowly and unevenly in the hatchery. Hatchery survival was also less (partly, at least, because of differential cannibalism). Mt. Whitney and Massachusetts strains were marked as 12-per-ounce fingerlings and reared together to catchable size. At planting time, 29 percent of the Mt. Whitney fish remained and averaged 6.9 per pound. The hatchery survival of Massachusetts fish was 56 percent and they were twice as large (3.2 per pound). Thus, hatchery trout survived best in the hatchery but wild trout survived best in the wild. This oft-observed relationship is significant to the fishery manager. Domesticated trout and wild trout are both valuable, but like wild and domesticated turkeys, they are *different* animals and should be recognized as such.

Many workers have observed that the faster growing fish of a group are more vulnerable to angling than the rest. To measure this, small and large members of the 1957 plant of Mt. Whitney browns were tagged before planting. Of 250 trout 8.5 to 9.5 inches long, 29 percent were caught in 4 months compared to only 13 percent of a similar-sized lot of 6.5- to 7.5-inch fish. This agrees in principle with the findings of Butler and Borgeson (1965). It appears that trout stocked for put-and-take angling should be at least 8 inches long or longer to assure maximum angling benefits per pound stocked.

Growth and Condition

Few trout grew larger than 11 inches in Sardine Lake. Of 10,024 marked brown trout measured during this study, 447 exceeded 10.9 inches, 52 exceeded 11.9, and only 2 were larger than 13.9. These two were between 19.0 and 20.0 inches. Growth after 9 inches was very slow. For example, the mean length of Mt. Whitney strain browns stocked as fingerlings in 1955 was 6.6 inches in 1956, and 8.7, 9.6, 9.9, and 9.9 inches in the 4 subsequent years. This typifies the growth for all plants. The 1954 plant of Convict Lake catchables reached an average size of 10.9 inches after 7 years in the lake.

The growth picture is even darker than these figures indicate, since condition became progressively poorer as length increased. The condition factor of wild Sardine Lake browns and rainbows fell steadily from 40 for each species at 5.0 to 5.9 inches to 30 and 34, respectively, for 11.0- to 11.9-inch fish. This trend, evidenced by all test plants, is believed to reflect a gradual approach to the ceiling placed on growth by food availability. The rare fish that made the transition from an invertebrate diet to fish, exhibited renewed good growth and condition. Age apparently was of little importance in determining which browns became piscivorous. In 1961, trout weighing 5.0 to 7.5 pounds were recovered (by gill net) from the 1959 plant of Massachusetts strain.

Angling Effort and Success

As a result of stepped-up catchable trout stocking, catch increased from 1,400 trout in 1957 to 10,500 in 1960 (almost eight-fold). Effort during this period only doubled to 10,500 angling hours, so catch per hour climbed from 0.28 to 1.00 trout (Table 3). This weak response of angling effort to increased stocking indicates a relatively low demand for catchable trout at this water. Until this demand grows, the catchable trout allotment for Lower Sardine Lake should be set at a level that will limit total catch to about 3,000 trout.

A catch of this magnitude will support about 2,000 angling days per year (Table 3). The additional fish required to raise this effort by 1,500 angling days at Lower Sardine Lake would support over 4,000 days if stocked in lakes having a high demand (Butler and Borgeson, 1965).

TABLE 3

Angling Effort and Success at Lower Sardine Lake, 1954–1960

Year	Total fish caught	Total angler days	Successful angler days	Total hours fished	Average catch per successful angler day	Average catch per angler hour
1954	760	--	252	--	3.02	--
1955	3,680	--	939	--	3.87	--
1956	2,550		915	--	2.79	--
1957	1,412	1,425	597	5,020	2.37	0.28
1958	2,725	1,735	974	7,732	3.57	0.35
1959	4,330	2,066	1,359	7,227	3.19	0.60
1960	10,535	3,326	2,269	10,548	4.64	1.00

Competition and Predation

Periodic gill netting in Lower Sardine Lake revealed an abundance of Tahoe suckers less than 13 inches long and a few large (18-27 inches) brown trout. Six of the latter, caught shortly after a plant of catchables, contained 12 trout, half of which had just been stocked. Small browns are not noted for eating fish but, in our experience, they are not above it if the opportunity arises. Four browns, 6.2 to 10.5 inches long, netted in a small pond below Lower Sardine Lake each contained a small Tahoe sucker. The pond's suckers were lethargic from an infestation of *Ichthyopthirius* sp. at the time. Newly-planted trout fingerlings might also present smaller browns with an unusual opportunity. It is tempting because of, (i) the poor survival of fingerlings yet reasonably good growth up to 8 inches, (ii) good catchable trout survival, (iii) and evidence of brown trout predation, to conclude that predation was the cause of poor fingerling survival; however, the diet of suckers is known to overlap that of trout (Bigelow, 1923; Nelson, 1955; Macphee, 1960). A limited study of 10 juveniles and 15 adults from Lower Sardine substantiated this. Nine, 1- to 2-inch juveniles contained microcrustaceans and 8, 3, and 2 contained rotifers, insects, and annelids, respectively. The 15, 4- to 9-inch adults contained mainly aquatic insects with some microcrustaceans, algae, and detritus.

When Lower Sardine was treated with rotenone to eradicate suckers in November 1963, suckers accounted for over 70 percent of the fish recovered by sportsmen and department employees. Since the sportsmen selected only trout, and since large numbers of suckers were observed on the bottom in deep water, this figure is believed minimal. Because there is evidence of both predation and competition, no firm conclusions can be made from our data on the true fate of stocked fingerlings. Perhaps future studies will be strengthened by these findings and in turn will help to interpret them.

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TOXAPHENE TREATMENT OF BIG BEAR LAKE, CALIFORNIA[1]

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Big Bear Lake was treated in 1960 to eradicate an abundant population of goldfish, *Carassius auratus*, and an ectoparasitic copepod, *Lernaea carassii*. The treatment followed two unsuccessful rotenone applications. Some goldfish survived the toxaphene treatment but their numbers were drastically reduced.

INTRODUCTION

Big Bear Lake, San Bernardino County, was treated with toxaphene in September 1960 to eradicate goldfish, *Carrassius auratus*, and the ectoparasitic copepod, *Lernaea carassii*. Two rotenone treatments, the last one in 1959, had failed to eliminate goldfish, and a more potent chemical was considered necessary. Toxaphene was chosen after a lengthy literature review. It is an insecticide patented by the Hercules Powder Company, Wilmington, Delaware. The chemical used at the lake was prepared by the Pacific Guano Company, Berkeley, California. One formulation used 60 percent toxaphene as the active ingredient, and the other 80 percent. The remainder in each formulation consisted of an inert ingredient and a petroleum carrier. Toxaphene was applied at rates calculated to result in predetermined ratios, and all concentrations are expressed as parts per million (ppm) actual toxaphene.

The lake's fish population consisted of about 99 percent goldfish, with small percentages of black crappie, *Pomoxis nigromaculatus*, brown bullheads, *Ictalurus nebulosus*, and a few hatchery-reared rainbow trout, *Salmo gairdnerii*. The goldfish competed with trout for food and were a nuisance to anglers.

Lernaea were endemic in the goldfish population but had not been a problem until after the 1959 rotenone treatment. When that treatment failed, the goldfish population suddenly exploded, allowing *Lernaea* to spread rapidly through the trout population in epizootic proportions.

The California Department of Public Health recommended that if toxaphene were used, public fishing should not be allowed until 50 percent of trout held in live-cars in the lake lived at least 20 days. This criterion was adopted and used to determine when the lake could be restocked. A control station was established at Green Valley Lake, a smaller but similar nearby reservoir. It was operated from May 19 through July 5, 1961, without significant mortalities in control fish.

DESCRIPTION OF AREA

Big Bear Lake is a reservoir about 100 miles east of the City of Los Angeles. It is in mountainous terrain of the San Bernardino

[1] Submitted for publication November 1964.
[2] Now with Federal Water Pollution Control Administration, Klamath Falls, Oregon.

National Forest at 6,670 feet elevation. The surrounding mountain tops range from 1- to 2-thousand feet above the lake. The watershed totals 36 square miles. Streams within the watershed are intermittent. The reservoir is wasp-shaped when full, with the upper shallow area separated from the deeper lower area by the "narrows". It has a surface area of 2,600 acres and a capacity of 72,400 acre-feet at spillway elevation; however, for the past 20 years its volume before the irrigation season has ranged from one-quarter to two-thirds its capacity because of drought conditions in southern California.

The fishery is popular, attracting anglers from Los Angeles and other southern cities. It depends entirely upon planted rainbow trout. At the time of the toxaphene treatment, the reservoir's surface area was 1,200 acres and its volume 4,800 acre-feet. The maximum depth was 32 feet, at the dam. The mean depth of the shallow reservoir above the narrows was 2.5 feet, and the mean depth of the reservoir between the narrows and the dam was 5 feet. The surface water temperature was 52 to 60° F. during the treatment period. The pH was 9.2; conductivity was 223 micromhos/cm at 23° C. Total dissolved solids (104 ppm) showed the lake was of the hard water series (Table 1). Zooplankton was abundant in the lake during the summer before treatment. It consisted of 95 to 99 percent *Cyclops* and *Daphnia*. Other plankton constituents were green algae (*Ulothrix*), protozoans (*Monas*), and unidentified rotifers. The limit of visibility using a Secchi disk was 18 inches at the time of treatment.

TABLE 1

Water Chemistry of Big Bear Lake, September 6, 1960

Ionic constituents	Amounts (ppm)*
Calcium	30
Magnesium	7
Sodium	14
Potassium	4
Carbonate	45
Bicarbonate	37
Sulphate	30
Chloride	7
Total Hardness	**104**

* Water analyzed by San Bernardino County Flood Control District, San Bernardino.

METHODS

Because of different physical characteristics in the upper and lower parts of the lake, an earth dike about 15 feet wide was placed across the narrows a few days before treatment. An airplane was used to treat the upper lake at 0.05 ppm on September 7, 0.05 ppm on September 16, and 0.10 ppm on September 26 (Table 2).

The lower lake was treated by airplane on September 13 and 28, giving a concentration of 0.03 ppm. Additional toxaphene was applied by boat in the lower lake from 30-gallon steel drums pressurized with

TABLE 2

Dates and Application Rates of Toxaphene Used in Big Bear Lake

Date	Treated area	Concentration ppm	Application method	Water temperature °F	Remarks
September 7, 1960	Upper Lake	0.05	Airplane	58	Small goldfish dying in 2 hours
September 13, 1960	Lower Lake	0.03	Airplane	54	Small goldfish dying in 2 hours Brown bullhead in distress
September 16, 1960	Upper Lake	0.05	Airplane	56	Small goldfish dying in 2 hours Many large goldfish seen
September 26, 1960	Upper Lake	0.10	Airplane	60	Small goldfish dying in 2 hours Many large goldfish seen
September 28, 1960	Lower Lake	0.10	Boat	52	Small goldfish dying in 3 hours Many large goldfish seen

compressed air. The airplane simply sprayed toxaphene on the surface, while the boat pumped it below the surface.

The lake tributaries were dry at the time of treatment. Several ornamental fish ponds within a mile of the lake were treated with liquid rotenone exceeding 10 ppm to eliminate populations of goldfish.

The water, fish, and plankton collected throughout the detoxifying period were in most cases analyzed by the California Department of Public Health, but the U.S. Fish and Wildlife Service Pesticide Laboratory, Denver, Colorado, and two private laboratories assisted with the analysis. Methods of the California Department of Public Health were used to establish guidelines for measuring the toxaphene in the lake.

RESULTS

A few shore birds and waterfowl, mostly coots, *Fulica americana*, died during the treatment. The coots were killed by eating fish killed by toxaphene or by being directly exposed to the toxaphene when it was sprayed by the airplane. Concentrations of toxaphene ranging from 10 to 1,200 ppm were found in birds, as reported by the Department of Fish and Game Disease Laboratory.

Fish Mortality

A monitoring program was started immediately after the first phase of the treatment to determine when the lake could be restocked. Dead and dying fish were seen 2 hours after the first treatment of both the upper and lower lake. Fish were seen in distress from 2 to 3 days following each phase of the treatment. Gill netting, rotenone cove sampling, and beach seining located live goldfish in large numbers a week after the first treatment. Most of the surviving goldfish were gold-colored adults 3 to 7 inches FL.

An estimated 95 percent of the goldfish in the lake, and all other fishes were eliminated. All fish life was eliminated in the small pools in the vicinity of the lake. No estimate was made of the total fish kill,

TABLE 3

Toxaphene Residue Found in Big Bear Lake Fish After Treatment

Date collected 1960–1961	Kind of fish	Condition of fish	Toxaphene residue (ppm)		Days since lake was last treated	Days exposed in live-cars
October 4 and 5	Brown bullhead	Fair	Flesh	6	5	—
			Fat and flesh*	18		
October 4 and 5	Brown bullhead	Fair	Flesh	3	5	—
			Fat and flesh	21		
October 4 and 5	Goldfish	Good	Flesh	3	5	—
			Fat and flesh	20		
October 19	Goldfish (composite)	Good	Flesh	60	21	—
			Fat	120		
			Liver	11		
November 21	Goldfish	Good	Fat	225	54	—
January 20	Goldfish, black	Good	Flesh	73	114	
			Fat	250		
January 20	Goldfish, red	Good	Flesh	45	114	
			Fat	208		
March 9	Goldfish, green	Good	Flesh	73	162	
			Oil	185		
March 9	Goldfish, red	Good	Flesh	49	162	
			Oil	260		
March 9	Goldfish, red	Good	Flesh	60	162	
			Oil	90		
March 9	Goldfish, red	Good	Flesh	75	162	
			Oil	137		
March 14	Trout (composite)	Dead	Flesh	16	167	4
			Oil	72		
April 3	Trout (composite)	Fair	Flesh	10	187	4
April 3	Trout (composite)	Fair	Flesh	4	187	4
April 8	Trout (composite)	Fair	Flesh	2	192	4

* Fat and flesh combined in sample

but the receding water in the reservoir left a beach about 10 to 20 feet wide around the perimeter of the lake, depending on the slope of the shore, almost paved with goldfish. The toxaphene killed all insects feeding on this enormous mass of putrefying protein; thus, the goldfish bodies were quickly sun-dried and except for smell did not become a public health problem. Attempts were made to bury the remains, but the job proved too big. Samples of goldfish were collected, frozen, and analyzed for toxaphene residue throughout the study period (Table 3).

The live goldfish collected appeared to be in good condition before they were sacrificed for analysis. They contained within their body tissues concentrations of toxaphene previously thought to be lethal.

Water Samples

Water samples were collected in 5-gallon glass carboys from different surface locations around the lake after each phase of treatment, and intermittently for 38 days after treatment. Although the toxaphene apparently disappeared shortly after it was put in, we later discovered that it was quickly absorbed within the lake biota. The toxaphene residue decreased throughout the 10-month detoxification period. Apparent increases of toxaphene residue indicated a natural cycling in the ecosystem (Table 4); this was consistent with results of similar work with toxaphene to eradicate fishes in Canada (Stringer and McMynn, 1960) and in New Mexico (Kallman, Cope, and Navarre, 1962). We concluded that analysis of lake water was not a reliable index of toxicity to fish life.

TABLE 4

Toxaphene Residue Found In Organisms Other Than Fish at Big Bear Lake (Lower Lake)

Date material collected	Type of organism	Toxaphene residue (ppm)	Days since lake was last treated	Laboratory that analyzed material*
October 4, 1960	Plankton	1.1	5	3
October 19, 1960	Plankton	50	21	1
January 20, 1961	Plankton	73	114	2
January 20, 1961	Plankton	97	114	2
March 1, 1961	Zooplankton	1.6 ± 0.5	154	2
March 1, 1961	Sessile algae	1.4 ± 0.4	154	2
March 7, 1961	Sessile algae	23	160	2
March 7, 1961	Plankton	50	160	2
April 10, 1961	Sessile algae	13	194	2
April 10, 1961	Sessile algae	17	194	2
April 10, 1961	Plankton	20	194	2
April 10, 1961	Plankton	30	194	2
April 20, 1961	Plankton	16	204	2
April 20, 1961	Sessile algae	12	204	2
April 20, 1961	Bottom mud	16	204	2
April 29, 1961	Bottom mud	18	213	2
May 11, 1961	Plankton	17	225	2
June 13, 1961	Plankton	19	227	2
June 20, 1961	Plankton	10	258	1
June 20, 1961	Plankton	12	258	1
June 26, 1961	Plankton	12	264	2
June 26, 1961	Plankton	0	264	1
June 26, 1961	Plankton	19	264	2
June 26, 1961	Plankton	trace	264	4
June 27, 1961	Plankton	2	265	5
June 27, 1961	Plankton	2	265	5
June 27, 1961	Plankton	2	265	5

* Laboratories that analyzed material:
1. Terminal Testing Laboratories, Los Angeles, California.
2. Department of Public Health Laboratory, Los Angeles, California.
3. Department of Public Health Laboratory, Berkeley, California.
4. U.S. Fish and Wildlife Service Pesticide Laboratory, Denver, Colorado.
5. Luckey Laboratories, San Bernardino, California.

Plankton Samples

Macro-plankton samples were collected during the entire post-treatment period. They were obtained by towing a conical 1/32-inch stretched mesh nylon cloth net, 3 feet in diameter and about 8 feet long. The plankton samples were put in plastic bags, frozen, and sent to laboratories for analysis. The most abundant plankters were cladocerans.

Starting in January and throughout the remaining part of the bioassay program, large concentrations of Cladocera were observed in the limnetic section (open water) and windward littoral areas. These invertebrates appeared healthy in the lake's environment, while trout died. This phenomenon was also observed in British Columbia (Stringer and McMynn, 1960).

The public demand to re-establish the Big Bear Lake fishery as soon as possible after the chemical treatment prompted an experiment to speed up the detoxification by controlling the plankton. The plankton contained high concentrations of toxaphene; therefore, we assumed that if the plankton were reduced by copper sulphate, the toxicity of the lake would also be reduced. Two copper sulphate treatments were carried out in April and June. Live-car observations on trout survival time after the copper sulphate treatment indicated that the toxicity was reduced by controlling the plankton.

Bioassays

Hatchery-reared rainbow trout were used to evaluate the detoxification of Big Bear Lake. These bioassays furnished immediate data on effects of toxaphene poisoning on trout, and were necessary to measure survival times as required by the Public Health criterion. A few live-car tests were run in November 1960 and January 1961. The trout died within 12 hours. An intensive bioassay monitoring program was started in March 1961, 6 months after the treatment. Live-car stations were established at docks along the shore, and in the center of the lake at the surface and also a few feet below it.

The bioassay program was confined to the lower area of Big Bear Lake because the upper area had dried up. The toxaphene residue in goldfish and confined trout slowly declined as the habitat improved (Table 5). To protect the confined trout from mechanical damage, live-cars were covered with fish netting in lieu of wire netting and some cars were made semibuoyant to stay just below the surface.

Ten months after treatment, detoxification had proceeded sufficiently to allow trout to be restocked and the lake opened to fishing.

TABLE 5

Toxaphene Residue Found in Big Bear Lake Fish After Treatment

Date collected 1960–1961	Kind of fish	Condition of fish	Toxaphene residue (ppm)*	Days since lake was last treated	Days exposed in live-cars
April 9	Trout (composite)	Fair	Flesh 4	193	5
April 9	Trout (composite)	Fair	Flesh 5	193	5
April 10	Trout (composite)	Fair	Flesh 14	194	6
April 10	Trout (composite)	Fair	Flesh 14	194	6
April 10	Trout (composite)	Fair	Flesh 11	194	8
			Oil 50		
April 12	Trout (composite)	Fair	Flesh 10	196	8
			Oil 27		
April 13	Trout (composite)	Fair	Flesh 9	197	9
			Oil 55		
April 29	Goldfish (composite)	Good	Flesh 25	213	--
May 8	2 trout	Fair	Flesh 8	222	6
May 15	5 trout	Fair	Flesh 10	229	10
May 19	3 trout	Fair	Flesh 11	233	11
May 23	1 trout	Fair	Flesh 6	237	11
May 23	3 trout	Fair	Flesh 10	237	8
May 23	9 trout	Fair	Flesh 9	237	4
June 5	1 trout	Dead (fresh)	Flesh 12	250	11
June 5	3 trout	Dead (fresh)	Flesh 2	250	11
June 5	2 trout	Fair	Flesh 10	250	11
June 5	2 trout	Fair	Flesh 17	250	11
June 13	3 trout	Fair	Flesh 12	258	8
June 13	2 trout	Fair	Flesh 16	258	19
June 13	2 trout	Fair	Flesh 7	258	19
June 28	10 trout	Fair	Flesh 0.1	273	12
June 28	10 trout	Fair	Flesh 3	273	15

* All samples analyzed by Department of Public Health Laboratory, Los Angeles.

DISCUSSION AND CONCLUSIONS

Southern California had one of its driest winters during the post-treatment period, and there was no inflow into Big Bear Lake. The precipitation for the 1960 61 winter was only 2.76 inches; that for a normal winter is 37.66 inches. Under these conditions the lake lost rather than gained water. The toxaphene program was postulated on the idea that winter runoff would dilute the treated water by more than half and reduce the toxic period. This did not occur. As a result, the lake remained toxic much longer than had been estimated.

When numbers of apparently healthy goldfish were located in October, a month after treatment, the treatment was considered incomplete. No explanation was found for gold-colored goldfish being more hardy to toxaphene than green-colored ones.

The toxaphene treatment at Big Bear Lake failed to destroy goldfish because too small a quantity of toxaphene was used at the late date selected for application.

Toxaphene was found to be a potent chemical that should be used to control rough fish only after safer chemicals and methods have been ruled out. It detoxifies slowly and contaminates the biota of a lake or reservoir for an unknown period. Based on results of this program, we recommend against its use as a fish toxicant anywhere in California.

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Calif. Fish and Game, 52(3): 180-184. 1966.

SEROLOGICAL EVIDENCE FOR INBREEDING OF LAHONTAN CUTTHROAT TROUT, *SALMO CLARKII HENSHAWI*, IN SUMMIT LAKE, NEVADA[1]

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Tests with isoimmune sera of rainbow trout, *Salmo gairdnerii*, have demonstrated blood types in Lahontan cutthroat trout. The more uniform reactivity in cutthroat trout from Summit Lake than in those from Catnip Reservoir indicated a greater degree of genetic homogeneity that may have resulted from inbreeding in the Summit Lake population. Blood typing techniques are applicable to trout breeding and management practices.

INTRODUCTION

The effects of civilization and indiscriminate stocking have drastically reduced the numbers of pure Lahontan cutthroat trout, once a major inland subspecies. Through historical research and meristic evidence, Behnke (1960) concluded that the Lahontan cutthroat trout of Heenan Lake, California (the major source for propagation in California and Nevada), although superficially a typical Lahontan fish, likely contains some rainbow trout genes. Summit Lake, Nevada, contains what Behnke considers a pure type of Lahontan cutthroat trout. The Summit Lake cutthroat population is therefore a brood stock of ichthyological and fish-cultural importance. In recent years, fry survival from matings among Summit Lake cutthroat trout has been poor; however, in outbreedings of Summit Lake fish with other cutthroat varieties, fry survival has been excellent. This difference led biologists to suspect that the Summit Lake strain might be inbred to a dangerous extent.

The work described here was an attempt to investigate, through blood-grouping techniques, the possibility of inbreeding. Research among higher vertebrates has shown that blood groups may reflect individual variations of a single locus, and that these blood groups usually are resistant to environmental influences (Race and Sanger, 1962). Similar advantages have been demonstrated in blood groups of fish where such data have been available (Cushing, 1964). Bingham (1963) presented evidence for strain-specific blood-group antigens of cutthroat trout using antisera from rainbow trout immunized with tissue preparations of cutthroat trout. Ridgway (1962a, 1962b, 1964) demonstrated the existence of numerous blood groups in rainbow trout and Pacific salmon (*Oncorhynchus* spp.) by using rainbow trout isoimmune sera. Calaprice and Cushing (1964) examined the antigenic diversity among a number of species and strains of California trouts by using a variety

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of normal and immune sera. They concluded that this diversity formed recognizable markers which could be used to advantage in a number of studies relating to the biology and management of California trouts. Sanders and Wright (1962) also demonstrated the existence of blood groups in several trout species, and pointed out their potential usefulness for management and biological studies.

MATERIALS AND METHODS

Selected isoimmune sera of rainbow trout were used in this study because of their ability to detect individual variations in various salmonid species. Ridgway (1962b) presented evidence that antibody specificities of isoimmune sera of rainbow trout are under simple genetic control. We have accumulated additional evidence (unpublished) supporting these observations. Since inbreeding leads to a greater proportion of homozygous individuals in a population, a more uniform reaction may be anticipated when red blood cells from an inbred population are tested with these reagents; this uniformity reflects the genetic homogeneity of the inbred group.

Red blood cells were tested from 19 fish from Summit Lake and 20 fish from Catnip Reservoir, which had been stocked in years past with cutthroat trout from Heenan Lake. Anesthetized adult fish were bled by cardiac puncture. The cells were placed in a citrate solution and kept on ice 4 days between collection and testing. Serological tests were made by the capillary-tube agglutination method of Chown and Lewis (1946).

RESULTS

Of 40 reagents screened for reactivity with the cutthroat trout cells, 24 either did not react with any of the cells or reacted very weakly with cells from a few individuals. Six of the reagents reacted with all cells tested. The remaining 10 reagents reacted variably with cells from different trout. Of these 10 reagents, 6 were pools of numerous bleedings of individual isoimmunized rainbow trout. These reagents had been absorbed with selected rainbow trout cells so that most antibodies in a given reagent were of a single specificity. The remaining four reagents were single bleedings of isoimmunized rainbow trout which had not been absorbed, so that multiple antibody specificities may have been present (Ridgway, 1962b).

The cells from the Summit Lake cutthroat trout reacted much more uniformly with a given reagent than did the cells of fish from Catnip Reservoir. Seven of the 10 reagents reacted with cells of either all or none of the Summit Lake trout. Only 1 of 19 fish differed in qualitative reaction from the remainder with each of the other three reagents. The reactive strengths of the cells of Summit Lake cutthroat trout were also uniform. The reactive uniformity of the Catnip Reservoir trout cells, both qualitatively and quantitatively, was less for each reagent (Table 1).

The results of our research (Table 1) support the hypothesis of inbreeding in Summit Lake cutthroat trout. The high or low frequency of reaction with a given reagent indicates a high or low frequency of the gene determining the presence of the component which that reagent detects. Where reactions occur, the uniformity of reactive strengths

TABLE 1

Reactions of Red Blood Cells of 20 Cutthroat Trout from Catnip Reservoir and Summit Lake with 10 Rainbow Trout Isoimmune Reagents *

Catnip Reservoir

Reagent	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Number positive	Percentage positive
260	2	1	0	0	0	2	1	0	0	2	2	1	0	0	0	0	0	0	0	0	7	35
269	2	2	0	0	2	2	0	1	1	2	0	1	1	0	0	2	1	2	0	t	13	65
297	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
304	1	1	0	0	0	2	1	0	0	2	2	1	0	0	0	0	0	0	0	0	7	35
306	0	0	1	1	1	0	t	0	1	1	0	0	0	1	0	0	0	0	0	0	7	35
316	2	2	t	2	0	2	2	t	0	1	1	1	1	t	t	0	1	0	0	0	14	70
393	0	t	1	1	1	2	1	1	0	t	t	t	1	1	1	2	0	0	t	t	16	80
412	0	1	0	2	0	2	0	1	t	2	t	t	t	0	0	t	0	0	t	t	12	60
417	t	1	0	1	0	2	0	1	t	2	0	1	1	0	t	t	1	t	1	t	15	75
507	2	3	1	2	1	2	1	2	2	2	0	2	0	2	2	2	t	1	1	1	18	90

Summit Lake

Reagent	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19†	20	Number positive	Percentage positive
260	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0		0	1	5
269	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2		2	19	100
297	1	1	1	1	1	t	1	t	t	1	1	1	1	1	1	1	t	1		0	18	94
304	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0
306	2	2	2	2	2	2	2	2	2	2	1	2	2	2	2	2	1	2		2	19	100
316	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2		2	19	100
393	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1		2	19	100
412	1	1	1	1	t	1	1	1	t	1	1	1	1	1	1	1	1	1		1	19	100
417	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2		2	19	100
507	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0		0	1	5

* Numbers in body of table indicate strength of reaction: 3—very strong; 2—strong; 1—distinct; t—weak; 0—no reaction.
† Sample hemolyzed

suggests possible homozygous conditions through the absence of detectable dosage effects. The Catnip Reservoir data reflect a mixture of genotypes with intermediate reactive frequencies and considerable quantitative fluctuations among individual fish with most reagents that produced reactions.

Chi-square tests were made between the two groups to compare the frequency of reactions of the 10 reagents used (Table 1). Seven of the tests were significant at the 1-percent level and the remaining three were significant at the 5-percent level. Reagents 297 and 507 were particularly discriminating for the two groups.

DISCUSSION

The reagents and techniques used in this work could be applied usefully to similar problems. Indications of inbreeding of brood stock could be detected and remedial measures taken before excessive losses of progeny developed. The differences in frequencies of reaction between the two groups tested may have additional implications for management. Relative survival of fry or degree of interbreeding might be estimated in areas where both Heenan Lake and Summit Lake fish have been planted.

An extension of blood-group testing for inbreeding in hatcheries could be the development of "blood lines" where different lots of fish are bred for particular blood-group patterns. Blood groups have proved highly valuable in identification and registration of various domestic animals (Stormont, 1958). By selecting for given blood types in breeding programs, hatcheries might identify individuals from various strains by reactive patterns of red blood cells. Selection only for antigens of red blood cells theoretically should have a minimal effect on survival. The reactions of isoimmune reagents of many of the rainbow trout with most salmonid species indicate that reagents can be produced in the more hardy species for blood-grouping work throughout the family.

This study demonstrates a further example of the rapidly expanding use of serological methods in fishery research during the past 15 years. We are continuing our research into the various specificities of the isoimmune sera of rainbow trout and their genetic interrelationships. We hope that the results presented here will lead to further application of serological methods to fishery problems.

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FIRST COOPERATIVE SURVEY OF THE CALIFORNIA CONDOR[1]

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A California Condor Survey Committee was formed on July 21, 1965 to determine the feasibility of a condor survey and to conduct, analyze, and report the results of such a survey. An experimental 2-day survey was conducted on October 16 and 17, 1965. Forty-eight sightings were reported by 16 of the 69 observation stations manned on October 16, 1965. Fifty-eight sightings were reported by 16 of the 63 observation stations manned on October 17, 1965. These sightings, by an evaluation of the reports, were reduced to a population index of 33 and 38 individual birds, respectively, for the 2-day survey. In the opinion of the authors and committee members, the count of 38 condors made on October 17, 1965, was the more reliable population index. No attempt was made to project the index figure to estimate the total condor population. Observations of young condors were of particular importance as an indicator of continuing nesting success. The annual survey will be continued to determine trends in the condor population.

INTRODUCTION

The California condor (*Gymnogyps californianus*) has aroused the scientific and aesthetic interest of man since the first sighting was recorded in 1602 by Fr. Antonio de la Ascension at Monterey Bay, Monterey County, California. In the 1800's condors were reported as far north as the Columbia River in Washington and as far south as 200 miles into Baja California. The present-day range extends north into San Benito and Fresno counties, California, and south into Ventura and Los Angeles counties, California (Figure 1).

In 1953 the condor population was estimated by Koford (1953) at 60 birds. A follow-up report was published by Miller, McMillan, and McMillan (1965), and the findings indicated a population of about 40 birds. This apparent decrease in birds brought into focus the need for more information about this rare and endangered species. Interest and concern for the condor is felt nationwide.

The California Department of Fish and Game, recognizing the need for information for better management of the species, invited interested agencies and individuals to meet July 21, 1965, to discuss condor management problems. Participants agreed unanimously at this meeting that an annual condor survey should be conducted to obtain data on trends in population. A California Condor Survey Committee was

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[2] Prepared for and with approval of the Condor Survey Committee: Chairman, Alden H. Miller, Professor of Vertebrate Zoology, University of California. Following the untimely death of Dr. Miller just prior to the condor survey, Ben Glading, Chief of Game Management Branch, California Department of Fish and Game, acted as chairman. Committee members are Ian McMillan, rancher and conservationist; A. Starker Leopold, Professor of Zoology, University of California; William P. Dasmann, U.S. Forest Service; John E. Chattin, U.S. Fish and Wildlife Service; John C. Borneman, National Audubon Society; and Robert D. Mallette, California Department of Fish and Game.

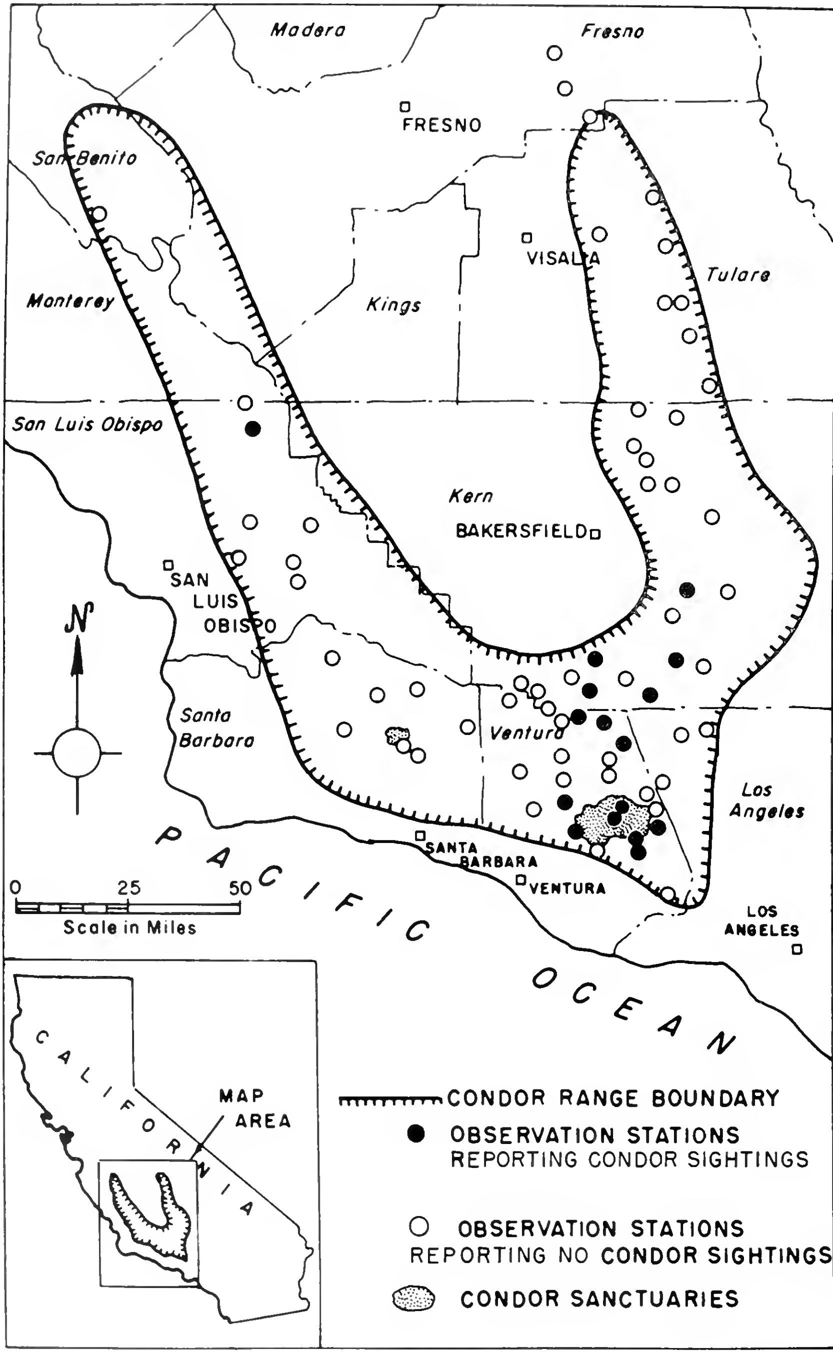

FIGURE 1—Location of condor survey observation stations manned on October 16, 1965, in relation to the range of the California condor. *Drawing by Cliffa Corson.*

formed from representatives of the participating agencies and individuals. This committee undertook to determine the most feasible survey method, conduct such a survey, evaluate the survey findings, and report on the results. Objectives of the annual survey are to: (i) establish periodic condor population counts which will provide an index to the population; (ii) gain an indication of nesting success based on the age classification of birds observed; (iii) obtain more information on the distribution of condors; (iv) foster public awareness of the precarious status and problems related to the protection of the species; and (v) gain other knowledge on condors and raptors as incidentally provided by such surveys.

METHODS

Pre-Survey

Seventy observation stations were selected by Alden H. Miller. These were selected because of their vantage points in areas commonly frequented by condors (Appendix A). Wherever possible, fire lookout stations of the U. S. Forest Service, California Division of Forestry, and county fire departments were utilized as observation posts. They were generally manned during the survey by their respective agency personnel. Other stations were manned by the U. S. Fish and Wildlife Service, California Department of Fish and Game, National Audubon Society, and private citizens. The Cuyama Valley and Antelope Valley areas were manned by roving patrols.

Two training sessions of 4 days each were held prior to the survey for Forest Service, Fish and Wildlife Service, and Department of Fish and Game personnel. The first session on September 27–30, 1965, was to train observer-instructors. The second session on October 4–7, 1965, was for training condor observers who would man stations during the 2-day survey period. John C. Borneman, Condor Warden for the National Audubon Society, conducted the training sessions, assisted by observer instructors trained in the first session.

The two training sessions were similar and were designed to acquaint the instructors and observers with the biology of the condor and comparative flight characteristics of condors, golden eagles, turkey vultures, and other raptors. A film, slides, and diagrams were used as training aids. Two days were spent in the field, observing condors and other raptors, while acquainting instructors and observers with some of the condor range topography. Additional training sessions were conducted by instructors for National Audubon Society and Forest Service personnel.

Each observer was provided with a set of survey instructions and report forms (Appendix B). Observers were instructed to record the time any condor observations were made, direction in which birds were flying, and comments pertinent in the evaluation of the reports. This aided in following movements of condors if they passed near other stations. Observers were asked to report any irregularities in the plumage of condors and determine the age classification by plumage characteristics when possible. This was intended to stimulate accuracy in observations as well as to aid in evaluating reports. Other raptors were recorded to obtain a population index and encourage observers to be more conscious of those raptors which may be confused with condors.

Survey Procedures

The condor survey was conducted the weekend of October 16 and 17, 1965. A 2-day period was selected to reduce the chances of both days being a loss due to bad weather, to determine the possibility of combining the 2 days into one survey, and if possible to compare the results of one day with the other. The committee chose October for the survey because road access to remote observation sites was generally assured at this time of year. The Forest Service reported that ordinarily in southern California fewer large fires occur during October than in September, November, or December. It was expected that the Forest Service could provide greater participation during an October condor survey with less interference from fire suppression activities. A somewhat better distribution of condors might occur in January, and consideration was given to having the census at that time; however, considering all other factors, October was selected. The committee also thought that participation would be better during a weekend census for National Audubon Society members, other agencies, and interested people.

Communications with many of the observation stations were maintained during the survey by using a short-wave radio and telephone network in two major condor concentration areas of Ventura and Kern counties. In these areas the observers used radio-equipped vehicles provided by the Department of Fish and Game, Fish and Wildlife Service, and Forest Service. Additional communications were maintained between the Forest Service coordinator and Forest Service lookout stations by phone and/or radio.

Observers in key locations were contacted by radio or phone at the close of each survey day to obtain preliminary survey results. This information was relayed to the central survey coordinator for evaluation and distribution to interested agencies and the press.

Observers were equipped with binoculars of 7× magnification or more, and many were also equipped with 20× spotting scopes. All observation stations were manned from 8 AM to 6 PM, Pacific Daylight Saving Time, for the 2-day period. Observers were encouraged to submit comments to assist the committee in improving survey procedures. At the close of the 2-day survey period, all observers forwarded completed report forms to the Condor Survey Committee for evaluation.

Survey Evaluation

A subcommittee was appointed to evaluate the results of the survey and arrive at an accurate condor population index for use as a base figure for comparison with future surveys.

A condor "sighting" is defined as a reported observation for each condor identified by the observers. Since one condor could be "sighted" several times, duplicate sightings could and did occur.

In a general evaluation of the reports, the committee determined that the 2-day survey was in effect two separate surveys. There was no way to determine duplication of sightings from one day to another. Condor sightings were analyzed for each day of the survey in chronological order. Observer comments and notes on the reports played an important part in the evaluation of the results. When an observer reported a number of condor sightings and his comments indicated that in the observer's judgment duplication had occurred, the Evaluation Subcommittee generally accepted that judgment.

Duplication of condors sighted from one or more stations was determined by evaluating the reports for each condor sighting. Criteria for ruling out duplications were based on: time of observations, direction of flight, grouping of birds of known age and plumage characteristics, distance between stations, normal condor flight patterns, and resting and roosting locations. The following example is a typical case of how duplicate sightings were eliminated (Appendix D):

> On October 17, 1965, an adult condor (observation No. 35) was first sighted at 2:46 PM from the observation Station 19 on Reyes Peak, Ventura County. This bird was soaring from east to west up the Sespe Canyon. It passed within an estimated 300 yards of the observer, which allowed good classification of its age. Station 14 at West Big Pine Mountain lookout in Santa Barbara County, approximately 20 air miles in a westerly direction from Station 19, reported an adult condor at 3:22 PM. It was first classified at a distance of 1½ miles, moving in a westerly direction. No other condor activity was reported in this area after the 3:22 PM sighting at Station 14. Thus we assumed the condor leaving Station 19 was the same bird observed at Station 14 approximately 35 minutes later. The average flight speed of a condor is estimated by Koford (1953) at 30 miles per hour.

WEATHER

A number of Forest Service lookout stations in the survey area recorded daily weather information during the survey period, and five of these were used as condor survey stations (Table 1).

The weather on October 16, 1965, was generally cold and windy throughout the census area. The temperature stayed in the high 40's and low 50's throughout most of the day. Wind velocities were 15–25 miles per hour all day.

Winds diminished on October 17, 1965, and temperatures reached a high of 80° F. at one condor survey station.

RESULTS

On the first day of the survey, 69 stations were manned by 98 observers (Figure 1 and Appendix A). Forty-eight condor sightings were reported from 16 stations (Appendix C). An evaluation of these sightings indicated that 33 individual birds were seen. The age classification of these birds was: 1 juvenile, 2 juveniles or immatures, 2 immatures, 3 sub-adults, 22 adults, and 3 unknown. Other raptors reported during the survey included an estimated 485 birds of 12 species (Table 2).

On the second day of the survey, 63 stations were manned by 91 observers (Figure 2 and Appendix A). Fifty-eight condor sightings were reported from 16 stations (Appendix D). An evaluation of these sightings indicated that 38 individual birds were seen. The age classification of these birds was: 2 juveniles, 1 immature, 6 sub-adults, 17 adults, and 12 unknown. Observers classified 233 raptors of 13 other species (Table 2).

TABLE 1

U.S. Forest Service Lookout Stations (Which Were Also Condor Survey Stations) Reporting Weather Information Readings Were Taken 2:00 p.m. October 16 and 17, 1965

Lookout station	County	October 16				October 17			
		Average wind velocity in miles per hour	Direction of wind	Temperature	Relative humidity	Average wind velocity in miles per hour	Direction of wind	Temperature	Relative humidity
Thorn Point	Ventura	12	NW	41	28	4	NW	56	21
Nordhoff	Ventura	8	NW	55	25	8	S	60	25
McPherson	Santa Barbara	18	NE	43	29	1	N	59	18
Figueroa	Santa Barbara	16	SW	64	22	8	SW	71	23
High Mountain	San Luis Obispo	18	NE	57	30	8	SW	69	18

TABLE 2

Raptors Reported During Condor Survey
October 16–17, 1965

Species	Date reported Oct. 16	Date reported Oct. 17
Turkey vulture (*Cathartes aura*)	300	72
Golden eagle (*Aquila chrysaetos*)	16	48
Bald eagle (*Haliaeetus leucocephalus*)	1	1
Goshawk (*Accipiter gentilis*)	1	3
Sharp-shinned hawk (*A. striatus*)	3	5
Cooper's hawk (*A. cooperii*)	17	12
Red-tailed hawk (*Buteo jamaicensis*)	89	61
Swainson's hawk (*B. swainsoni*)	7	8
Rough-legged hawk (*B. lagopus*)	1	
Pigeon hawk (*Falco columbarius*)		1
Sparrow hawk (*F. sparverius*)	9	10
Miscellaneous hawks	10	10
Barn owl (*Tyto alba*)		1
Pygmy owl (*Glaucidium gnoma*)	1	1
Total	185	233

DISCUSSION

No attempt is made to estimate the total condor population from the population index. A number of variables occur which prevent us from projecting this index to a number representing the total population. Chief among these is the fact that the condor range includes some extremely rugged terrain, which makes it difficult to detect and count all condors moving through or roosting in the area (Figure 3).

It is imperative that a survey method which will provide data that are comparable from year to year be used. Assuming that the judgment factor in eliminating duplication is similar and that the intensiveness of survey effort is roughly the same, we can expect a reasonably good population index which will be comparable from one year to the next.

The distribution of condors during the survey period was as expected for this time of year. Birds were concentrated in the lower portion of their range (Figures 1 and 2). If the distribution of birds remains similar in future years, a number of stations may be eliminated.

The presence of young condors observed during the survey is of particular interest because it is indicative of some nesting success for years represented by age classes. The age classes are difficult to distinguish unless birds are observed at close range. Birds in a transition phase from one age class to another present an added difficulty. Data from subsequent annual surveys will clarify the significance of such observations.

Based on weather conditions during the 2-day survey, the largest of the two survey counts, October 17, 1965, was in the opinion of the authors and committee members the more reliable of the two population

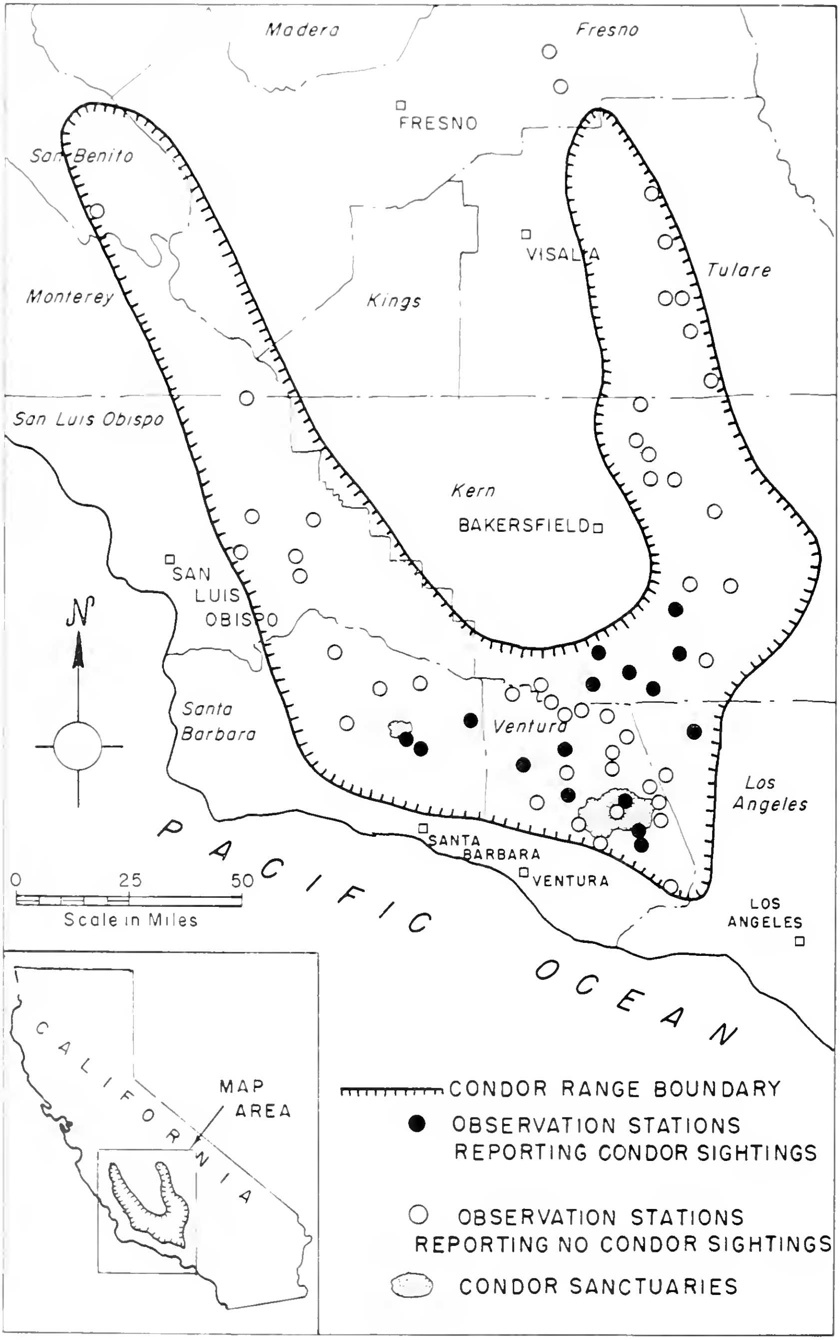

FIGURE 2—Location of condor survey observation stations manned on October 17, 1965, in relation to the range of the California condor. *Drawing by Cliffa Corson.*

FIGURE 3—Condor observer manning station along one of the major condor flyways, October, 1965, Ventura County. *Photograph by W. C. Dillinger, Department of Fish and Game.*

indices. Condor soaring conditions were better on this day, and activity was thought to be more nearly normal.

Condor sightings were reported by interested people who were not part of the survey team. These observations were not included in the survey evaluation, since the purpose of this count is to establish an index for the condor population and not to make a total count. However, these reports further stress the possibility that some condors were not seen and reported by survey observers.

The survey method of Koford (1953) was used by Miller et al. (1965). This method simply consists of getting acquainted with people who are considered reliable condor observers, watching condors with them, verifying their estimates and soundness of observations, evaluating simultaneous reports of separate groups of birds, and evaluating many assembled reports of single or small groups of birds.

The survey method and results used by the Condor Survey Committee, a planned simultaneous count, are not comparable to those of Koford and Miller. The Koford method and results were designed to estimate the total condor population, while results of the Condor Survey Committee survey constitute a condor population index. However, the figures gathered on the October 16 and 17, 1965, survey were not inconsistent with the recent National Audubon Society survey by Miller et al. (1965).

Recommendations

Seven suggestions for improving subsequent condor surveys are:

1) To maintain interest and enthusiasm of participants at a higher level, training sessions for observer-instructors and/or squad leaders

should be different from the sessions conducted for observers. Observer-instructor and or squad leader training programs should be slanted toward a team leader role.

2) Improved observer training on reporting condor and raptor sightings is needed. More detailed observer comments are needed for for evaluating condor sightings. Other raptor sightings require additional observer comments for evaluation.

3) Annual condor surveys should be conducted during the middle of the week. A weekend survey is often in conflict with opening dates of hunting seasons and more intensive public use in the survey area. Many volunteer observers were not able to devote the weekend to the survey because of other responsibilities.

4) Observation stations in key locations should be manned by teams of two observers. This would provide some relief from constantly scanning a large expanse of area and should improve area coverage.

5) Supervision for all observers is needed. A squad system, eight observers per squad, should be put into effect. Districts for supervision would be decided on the basis of the area and not by agency jurisdiction. The squad leader would be responsible for:

a) distributing materials, equipment and supplies;
b) manning the observation stations at the proper time;
c) communicating between stations and survey headquarters;
d) reporting results daily and submitting survey report forms to survey headquarters.

6) A rapid reporting system is needed to report pertinent information daily to survey headquarters. A complete and accurate daily survey evaluation is needed for prompt release of information to the press and interested agencies. It is important to maintain control over survey information to prevent premature or inaccurate releases.

7) The mid-October annual survey should be continued.

ACKNOWLEDGMENTS

The Condor Survey Committee wishes to thank all the people who participated in the condor survey; without them this survey could not have been possible. Appendix E lists the names which the committee could obtain from survey reports. The cooperation from the National Audubon Society, U. S. Forest Service, U. S. Fish and Wildlife Service, California Department of Fish and Game, California Division of Forestry, and interested ranchers and conservationists is greatly appreciated. Information provided freely from knowledge and experience by Alden H. Miller, Ian McMillan, and Eben McMillan, to select only a few from many who contributed so generously, is especially appreciated.

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APPENDIX A

Condor Survey Observation Stations October 16 and 17, 1965

(Stations were manned both dates unless noted otherwise. Those marked with asterisk observed condors)

San Benito County

1. 1 mile south of Bitterwater Store on the Maggini Ranch.

San Luis Obispo County

2. Cholame Flat near San Luis Obispo-Monterey county line.
*3. Eben McMillan Ranch, in the Palo Prieto area (Sat. only).
4. 1 mile east of the La Panza Ranch hdqrs. at San Juan Creek road crossing.
5. Beartrap Canyon on the La Panza Ranch.
6. La Panza Ranch, 2 miles south of Beartrap Canyon.
7. Black Mtn. Lookout.
8. High Mtn. Lookout.

Santa Barbara County

9. Miranda Pine Mtn., northwest end of Sierra Madre Ridge.
10. McPherson Peak.
*11. Cuyama Peak Lookout.
12. Figueroa Mtn.
*13. Sisquoc Sanctuary area, 2 miles east of the South Fork Guard Station and 200 yards up slope from Sisquoc Canyon Trail across the canyon from Sisquoc Falls.
*14. West Big Pine Lookout.
14a. Cuyama Valley and Foothill Road.

Ventura County

*15. Frazier Mtn. Lookout.
*16. Maxey Ranch in Hungry Valley, 5 miles southwest of Gorman.
17. Alamo Mtn. Summit Road.
*18. Mutah Road near San Guillermo Mtn.
*19. Reyes Peak.
20. Thorn Point Lookout.
*21. Head of Agua Blanca Canyon on trail about 1 mile north of Bucksnort Camp.
21a. McDonald Peak.
*22. Squaw Flat Road near Squaw Flat.
*23. Hopper Mtn.
*23a. Hopper Mtn.
*24. Domerguis Ranch in Reasoner Canyon area on ridge west of ranch headquarters at head of Dominguez Canyon.
24a. Reasoner Canyon.
25. Lower Agua Blanca Creek at Hollister Cabin Camp.
26. San Cayetano Peak and Pine Canyon where San Cayetano Road crosses saddle midway down ridge leading east from peak to Sespe Creek.
*27. Hines Peak area at end of road in saddle on northwest side of peak.
*28. Santa Paula Canyon on trail 1 mile north of Cross Camp.
29. Nordhoff Peak.
30. Strathearn Ranch in Simi Valley.

Los Angeles County

31. Whitaker Peak Lookout.
*32. West Liebre Lookout.
32a. Antelope Valley (Sat. only).

Fresno County

33. Delilah Lookout, 5 miles north of Dunlap.
33a. Fence Meadow Lookout.
33b. Stony Flat, 2 miles north of Pinehurst (Sat. only).

Tulare County

34. Milk Ranch Lookout.
35. Blue Ridge Lookout.
36. Solo Peak, 8 miles southeast of Springville.
36a. Solo Peak near Rogers Camp.
37. Mule Peak.
38. Tobias Peak.
38a. Lindcove area on the Mehrten Ranch (Sat. only).

Kern County

39. Blue Mtn. Lookout, 5 miles northeast of Woody.
40. Farnsworth Ranch, 2 miles south of Glennville (Sat. only).
41. Dead Ox Ridge about 4 miles south of Woody.
42. Round Mtn., 3 miles northeast of Granite Station.
43. Rattlesnake Ridge on the John Rofer Ranch, 4 miles west of Oak Flat Lookout.
44. Oak Flat Lookout.
45. Breckenridge Mtn.
46. Tollgate Lookout.
*47. White Wolf Corrals.
*48. Commanche Pt., 4 miles southeast of Arvin on Tejon Ranch.
*49. Two miles east of Grapevine Station and 4 miles southeast of Wheeler Ridge on Tejon Ranch ostrich farm.
*50. 2 miles east of Fort Tejon at Tejon Ranch airline beacon.
50a. Lopez Flats on Tejon Ranch.
*51. Ridge Overlook about ½ mile south of old Tejon Ranch buildings on Tejon Ranch.
*52. Pleito Hills overlooking Wheeler Ridge and Salt Creek on San Emigdio Ranch.
53. Near mouth of Pleito Canyon on San Emigdio Ranch. (Deleted as an observation station.)
54. Ridge to the west of big flat at head of Pleitito Canyon on San Emigdio Ranch (Sat. only).
*55. Tecuya Ridge, 2 miles north of Lake of Woods in Cuddy Valley.
*56. Mt. Pinos, east end of summit.
57. Mt. Pinos, west end of summit.
58. Mt. Abel (Cerro Noroest) on southwest side (Sun. only).
59. Brush Mtn., 4 miles north of Mt. Abel.
60. Santiago Canyon on Snedden Ranch (Sat. only).
61. Apache Potrero on Snedden Ranch.

APPENDIX B

California Condor Survey Form

Observation Station | County

Weather

Observer | Date

	Condors observed								
Exact time	Age uncertain	Juvenile	Immature	Subadult	Adult	Distance from observer	Flight direction	Other raptors observed	Remarks

APPENDIX C

Summary of Condor Survey Reports, October 16, 1965

Condor number	Age classification	Observation station	Sighting number	Reported time and duration of observation	Reported distance from observer	Reported direction of flight	Remarks
1	Adult	23	1	0936–0941	¼ mile	Circling east to N.E.	Seven sightings were believed to be the same bird as it moved northeast from Sespe Wildlife Area in the survey area.
		23A	2	0941	2 miles	East	
		24	3	0945–0950	1½ miles	Northwest	
		24	4	0955–0957	4 miles	Circling north	
		22	5	1010–1050	2–3 miles	Circling east over Whiteacre Pk.	
		16	6	1240–1250	700 yds.	South to north	
		50	7	1525	200 ft.	Southeast to north	
2	Adult	23A	8	1015–1026	¾ mile	West to Sespe Canyon; north to Alamo Mt.; and east over Cobblestone Mt.	Bird sighted three times from three stations.
		23	9	1037–1043	1½ miles	East to west over Whiteacre Pk.	
		22	10	1115–1120	2 miles	From Whiteacre Pk. north	
3	Adult	16	11	1025	500 yds.	South to north	Bird sighted twice by two stations.
		50	12	1158	150 ft.	Northerly	
4	Juvenile	17	13	1027–1109	300 yds.	Circling south	Sighted once and traveling with condor 5.
5	Adult	47	14	1027–1109	300 yds.	Circling south	Sighted once and traveling with condor 4.
6	Adult	16	15	1045–1100	800 yds.	South to northwest	Sighted once.
7	Unknown	27	16	1105	1½ miles	Northeast	Sighted once.
8	Adult	51	17	1107	½ mile	Circling southwest	Bird sighted twice from two stations and traveling with condor 9.
		50	18	1500	175 ft.	Northeast to west	
9	Adult	51	19	1107	½ mile	Circling southwest	Bird sighted twice from two stations and traveling with condor 8.
		50	20	1500	500 ft.	Northeast to west	
10	Immature	16	21	1115	1 mile	South to north	Sighted once.
11	Adult	16	22	1130–1135	500 yds.	South to rorth	Sighted once.
12	Adult	16	23	1135–1140	300 yds.	South to north	Sighted once.

13	Adult	16	24	1135 1140	300 yds.	South to [illegible]	Sighted once.
14	Sub-adult	16	25	1150 1200	800 yds.	Circling south of station	Sighted once.
15	Sub-adult	23A 21	26 27	1603 1608 1730 1733	1/2 mile 4 miles	Southeast to north Southeast circling	Bird sighted twice by two stations.
16	Unknown	53	28	1200	1/2 mile	Northwest	Sighted once and traveling with condor 17.
17	Adult	56	29	1200	1/4 mile	Northwest	Sighted once and traveling with condor 16.
18	Adult	16	30	1211 1235	800 yds.	South to northwest	Sighted once and traveling with condor 19.
19	Adult	16	31	1211 1235	800 yds.	South to northwest	Sighted once and traveling with condor 18.
20	Juvenile or immature	3	32	1305	1 mile	West to north	Sighted once and traveling with condor 21.
21	Juvenile or immature	3	33	1305	1 mile	West to north	Sighted once and traveling with condor 20.
22	Sub-adult	52	34	1305	200 yds.	Northeast	Sighted once.
23	Adult	16	35	1305 1315	900 yds.	South to north	Sighted once and traveling with condor 24.
24	Adult	16	36	1305 1315	900 yds.	South to north	Sighted once and traveling with condor 23.
25	Adult	28	37	1316	1 mile	Feeding west of station	Sighted once and feeding with condor 26.
26	Adult	28	38	1316	1 mile	Feeding west of station	Sighted once and feeding with condor 25.
27	Unknown	22	39	1330 1545	2 miles	Resting on Whiteacre Pk.	Sighted once.
28	Adult	23A	40	1346	1/4 mile	Circling southeast	Sighted once.
29	Adult	16 15	41 42	1505 1515 1557	800 yds. 4 miles	South to north Circling east	Bird sighted twice by two stations.
30	Immature	55	43	1610	1,000 ft.	North to south	Sighted once.
31	Adult	23 23A	44 45	1618 1627 1634 1635	300 ft. 1/2 mile	South to north East	Bird sighted twice.
32	Adult	23 23A	46 47	1643 1656 1702 1721	1,200 ft. 300 yds.	Southwest Southeast to northwest	Bird sighted twice.
33	Adult	23A	48	1658	1/2 mile	East	Sighted once.

APPENDIX D

Summary of Condor Survey Reports, October 17, 1965

Condor number	Age classification	Observation station	Sighting number	Reported time and duration of observation	Reported distance from observer	Reported direction of flight	Remarks
1	Adult	51	1	0855	¼ mile	North	Sighted once and traveling with condor 2
2	Adult	51	2	0856	¼ mile	North	Sighted once and traveling with condor 1
3	Unknown	51 51	3 4	0900 0919	1½ miles 1½ miles	Circling south Circling	Bird sighted twice by the same station.
4	Adult	51 51 50 50	5 6 7 8	0906 0919 1247–1249 1101	1½ miles 1½ miles 1 mile ¼ mile	Circling south Circling Circling north of station and feeding Left feeding site and moved north	Bird sighted four times by two stations. Part of group moving in to feed and back out to roost. Seven other birds believed to be in this group. Condors 5, 6, 7, 8, 9, 10, and 11.
5	Adult	51 51 50 50	9 10 11 12	0900 0919 1247–1249 1130	1½ miles 1½ miles 1 mile 300 ft.	Circling south Circling Circling north of station and feeding East	Bird sighted four times by two stations. Part of group moving in to feed and back out to roost. Seven other birds believed to be in this group. Condors 4, 6, 7, 8, 9, 10, and 11.
6	Juvenile	51 51 50	13 14 15	0900 0919 1247–1249	1½ miles 1½ miles 1 mile	Circling south Circling Circling north of station and feeding	Bird sighted three times by two stations. Part of group moving in to feed and back out to roost. Seven other birds believed to be in this group. Condors 1, 5, 7, 8, 9, 10, and 11.
7	Adult	51 50	16 17	0919 1247–1249	1½ miles 1 mile	Circling south Circling north of station and feeding	Bird sighted two times by two stations. Part of group moving in to feed and back out to roost. Seven other birds believed to be in this group. Condors 1, 5, 6, 8, 9, 10, and 11.
8	Unknown	51 50	18 19	0919 1247–1249	1½ miles 1 mile	Circling south Circling north of station and feeding	Bird sighted two times by two stations. Part of group moving in to feed and back out to roost. Seven other birds believed to be in this group. Condors 4, 5, 6, 7, 9, 10, and 11.

9	Unknown	51 50	20 21	0919 1217 1249	1½ miles 1 mile	Circling south Circling north of station and feeding	Bird sighted two times by two stations. Part of group moving in to feed and back out to roost. Seven other birds believed to be in this group. Condors 1, 5, 6, 7, 8, 10, and 11.
10	Unknown	51 50	22 23	0919 1247 1249	1½ miles 1 mile	Circling south Circling north of station and feeding	Bird sighted two times by two stations. Part of group moving in to feed and back out to roost. Seven other birds believed to be in this group. Condors 1, 5, 6, 7, 8, 9, and 11.
11	Adult	51 50 50	24 25 26	0926 1247 1249 1401	¾ mile 1 mile ¼ mile	Circling north Circling north of station and feeding Northeast	Bird sighted three times by two stations. Part of group moving in to feed and back out to roost. Seven other birds believed to be in this group. Condors 1, 5, 6, 7, 8, 9, and 10.
12	Unknown	44	27	0945	2 miles	West	Sighted once.
13	Unknown	21	28	1000 1043	4 miles	Southeast circling and roosting	Sighted once.
14	Unknown	21	29	1015 1100	4 miles	Southeast perched	Sighted once
15	Unknown	55	30	1021 1036	Unknown	South to north	Sighted once.
16	Adult	52	31	1040	300 yds.	East	Sighted once and traveling with condor 17.
17	Adult	52	32	1040	300 yds.	East	Sighted once and traveling with condor 16.
18	Unknown	21	33	1055 1109	4 miles	Perched southeast	Sighted once
19	Adult	23	34	1101 1110	300 ft.	Circling north	Sighted once
20	Unknown	23A	35	1103	2 3 miles	Circling north over Hopper Mtn.	Sighted once.
21	Sub-adult	18 44	36 37	1104 1115	2 miles + 1½ 2 miles	Northwest East to west to S.W.	Bird sighted twice
22	Adult	19 19	38 39	1140 1450	600 yds. 500 yds.	West to east East to west	Bird sighted twice by the same station.
23	Adult	49 50	40 41	1201 1222	500 yds. ½ mile	Southeast West	Bird sighted twice.

APPENDIX D

Summary of Condor Survey Reports, October 17, 1965—Continued

Condor number	Age classification	Observation station	Sighting number	Reported time and duration of observation	Reported distance from observer	Reported direction of flight	R[illegible]
24	Immature	50 50	42 43	1206 1231	300 yds. ¼ mile	Circling west West to southeast	Bird sighted [illegible]
25	Adult	50	44	1245	300 ft.	North	Sighted once [illegible]
26	Adult	50	45	1247	1 mile +	Circling north	Sighted once [illegible] condor 25.
27	Adult	13	46	1255–1304	150 ft.	Circling over Sisquoc Falls	Sighted once.
28	Unknown	13	47	1340–1341	2 miles	Circling to the east	Sighted once.
29	Sub-adult	27	48	1340–1350	150 yds.	North to south	Sighted once and traveling with condors 30, 31 and 32.
30	Sub-adult	27	49	1343–1350	150 yds.	North to south	Sighted once and traveling with condors 29, 31 and 32.
31	Sub-adult	27	50	1343–1350	150 yds.	North to south	Sighted once and traveling with condors 29, 30 and 32.
32	Sub-adult	27	51	1343–1350	150 yds.	North to south	Sighted once and traveling with condors 29, 30 and 31.
33	Adult	48	52	1345	¼ mile	North	Sighted once.
34	Sub-adult	55	53	1420–1422	1,000 ft.	North to south	Sighted once.
35	Adult	19 14	54 55	1446 1522–1524	300 yds. 1½ miles	East to west West	Bird sighted twice.
36	Adult	19	56	1500–1510	600 yds.	West to east	Sighted once.
37	Juvenile	32	57	1635	½–1 mile	North to southwest	Sighted once.
38	Unknown	23	58	1638	2 miles	West	Sighted once.

APPENDIX E

Observers Participating in Condor Survey October 16 and 17, 1965

A. Warren Ahlstrom, Sacramento, Calif.
Minnie Barkley, Woodlake, Calif.
Tony Barton, Miramonte, Calif.
Mr. & Mrs. Harold Baxter, Arcadia, Calif.
Grant H. Birmingham, Fresno, Calif.
Mr. & Mrs. Robert Blackstone, Los Angeles, Calif.
John Blake, San Luis Obispo, Calif.
John C. Borneman, Ventura, Calif.
Joe Burnett, Tulare, Calif.
Mr. & Mrs. Herbert Clarke, Glendale, Calif.
Eugene Cofer, Bakersfield, Calif.
G. B. Coigny, Miramonte, Calif.
Fred L. Cook, Sacramento, Calif.
Leslie Cook, Carpinteria, Calif.
Ray Dalen, Santa Barbara, Calif.
Merritt S. Dunlap, Glendale, Calif.
Gene Durney, Solvang, Calif.
Robert Easton, Santa Barbara, Calif.
A. W. Elder, Pasadena, Calif.
Evalyn Farnesworth, Porterville, Calif.
James Fazio, Newhall, Calif.
John Feazelle, Frazier Park, Calif.
Reno Ferreri, San Luis Obispo, Calif.
Robert G. Fischer, Taft, Calif.
Leon Fisher, Ojai, Calif.
Robert L. Fordice, Orcutt, Calif.
George Franklin, Porterville, Calif.
Gene L. Gerdes, Monterey, Calif.
Ken Gouff, Ojai, Calif.
Walter Charles Graves, Bakersfield, Calif.
James Greenhill, Ojai, Calif.
Charles G. Hansen, Las Vegas, Nevada
T. L. Hansen, New Cuyama, Calif.
Charles Harper
William J. Harvey, Santa Barbara, Calif.
Harry Hayden, Santa Maria, Calif.
Thomas Hoots, Frazier Park, Calif.
Betty Hudson, New Cuyama, Calif.
James W. Huffman, Manhattan Beach, Calif.
Thomas Ingersoll, Frazier Park, Calif.
Norval J. Jeffries, Yucca Valley, Calif.
Betty Jenner, Los Angeles, Calif.
Laura Lou Jenner, Los Angeles, Calif.
Roger A. Johnson, Frazier Park, Calif.
Ed Jones, Fresno, Calif.
Lenard Jordan, New Cuyama, Calif.
Dale B. King, Sr., Piru, Calif.
Richard Kramer, San Juan Capistrano, Calif.
Holger S. Larsen, Pasadena, Calif.
Tamsen Lilly, San Luis Obispo, Calif.
John A. Lorenzana, Santa Barbara, Calif.
John Maggini, King City, Calif.
Robert D. Mallette, Sacramento, Calif.
Mr. & Mrs. Vernon Mangold and Stefanie Mangold, Los Angeles, Calif.
William W. McGuire, Ojai, Calif.
Greg McMillan, Cholame, Calif.
Ralph W. Mehrten, Exeter, Calif.
Yulan D. Miller, Ojai, Calif.
James G. Mills, Santa Barbara, Calif.
Mr. & Mrs. Frank E. Mires, Springville, Calif.
Gary Morgan, Ojai, Calif.
Guy Noel, Fillmore, Calif.
Riley D. Patterson, Bakersfield, Calif.
Eugene F. Percy, Fillmore, Calif.
Donald S. Pine, King City, Calif.
Harry Plisco, Frazier Park, Calif.
Ron E. Powell, Bishop, Calif.
John Reed, Bakersfield, Calif.
Alice G. Rieman, Glennville, Calif.
John F. Rofer, Bakersfield, Calif.
Marshall L. Schultz, Frazier Park, Calif.
Hal Seyden, Miramonte, Calif.
C. R. Shepard, Sacramento, Calif.
Paul Shields, Fresno, Calif.
Arnold Small, Los Angeles, Calif.
Richard Smith, Santa Barbara, Calif.
Gary Snow, Bakersfield, Calif.
Kenneth Stager, Los Angeles, Calif.
Norman Stevens, Santa Barbara, Calif.
Carl C. Tegen, Palmdale, Calif.
Ronald A. Thompson, Riverside, Calif.
William H. Thomson, San Francisco, Calif.
Wesley P. Turner, Santa Barbara, Calif.
Hazel Upham, Frazier Park, Calif.
Sanford R. Wilbur, Willows, Calif.
Mr. & Mrs. Jim Ben Williams, Bakersfield, Calif.
Lawrence C. Wills, Fresno, Calif.
Mr. & Mrs. Russell Wilson, No. Hollywood, Calif.
Francis A. Winter, Pasadena, Calif.
Marie Woodmansee, Ojai, Calif.

NOTES

A POSSIBLE RECORD-SIZED BONITO SHARK, *ISURUS OXYRINCHUS* RAFINESQUE, FROM SOUTHERN CALIFORNIA

On July 4, 1965, Jerry Cherzaney, a commercial fisherman, caught an 11-foot long (3366 mm TL) bonito shark at Eagle Rock Cove, off the west end of Santa Catalina Island, California (Figure 1). It had been caught in 3 fathoms of water with a 6-inch mesh gill net, and when brought to the surface, it was found rolled up in the net and was dead. The carcass, after being hauled aboard, was taken to Pierpoint Landing, Long Beach, where it was frozen and exhibited the following weekend. John E. Fitch, California Department of Fish and Game, helped make the necessary arrangements with J. E. McClintock, General Manager of the Landing, who generously donated this unusual specimen to the Los Angeles County Museum of Natural History for study and dissection. Charles Grover, Marineland of the Pacific, put the facilities of the Marineland laboratory at our disposal and furnished transportation to move the specimen. Grover, Dennis Yeomans, and Stephanie Howells aided in measuring and dissecting the shark, which was an adult female (Table 1).

J. A. F. Garrick (pers. commun.) has told me that his studies have convinced him there are only two valid species of *Isurus*, and *Isurus glaucus* is not one of these. Proportional differences such as used by Bigelow and Schroeder (1948) to separate *Isurus oxyrinchus* from *Isurus glaucus* are not of specific significance. Garrick plans to discuss this point at some length in a forthcoming paper. In my researches, I have failed to find any discernable differences between Atlantic and Pacific bonito sharks, so I consider *glaucus* a synonym of *oxyrinchus*.

The shark weighed 850 pounds on the Marineland scales. The greater part of the body cavity was filled by the liver. The stomach contents weighed approximately 10 pounds, and consisted of the remains of three carcharinid sharks, probably blue sharks, *Prionace glauca* (Linnaeus). The vertebral centra of these sharks were intact and attached to one another, although the chondrocrania were almost completely digested. The vertebrae in each case had been severed in the area just below the second dorsal fin. From vertebral sizes and the lengths of these remains, I estimated that the blue sharks had measured between 4 and 5 feet when alive.

The uterus of the bonito shark was empty and flaccid. One large egg, 2 inches in diameter, was found in one ovary. Blood and mucus in the uterus would indicate that this female had just given birth to young, or had aborted them on capture.

FIGURE 1—Jerry Cherzaney and the 11-foot bonito shark, *Isurus oxyrinchus,* taken off Santa Catalina Island, California. *Photograph courtesy of Pierpoint Landing, Long Beach.*

Although a number of teeth had been removed by spectators before the Museum obtained the shark, the following dental formula (as defined by Applegate, 1965) was noted:

P3	L7	I1	A2	A2	I1	L7	P3
P3	L7		A3	A3		L7	P3

TABLE 1

Measurements of Body Parts and Proportions in Length Without Caudal (parts per mille) of 11-Foot *Isurus oxyrhinchus* from Santa Catalina Island, California

	Measurement (mm)	Proportion
Total length	3366	1.187
Length without caudal (to pit)	2835	---
Trunk width over pectoral origins	512	.181
Mouth width	270	.095
Mouth length (lower jaw)	190	.067
Eye diameter, horizontal	43	.015
vertical	45	.016
Preoral length	142	.050
Prenarial length	128	.045
Preorbital length	227	.080
Internarial distance (least)	130	.046
Length 1st gill slit	350	.123
2nd gill slit	320	.113
3rd gill slit	310	.109
4th gill slit	300	.106
5th gill slit	300	.106
1st dorsal fin height (perpendicular)	320	.113
overall length	380	.134
length base	320	.113
length posterior margin	50	.018
2nd dorsal fin height	58	.020
overall length	96	.034
length base	38	.013
length posterior margin	58	.020
Anal fin height	64	.023
overall length	99	.035
length base	35	.012
height posterior margin	58	.020
Pectoral fin anterior margin	850	.300
posterior margin	560	.198
length base	35	.012
Pelvic fin overall length	260	.092
length anterior margin	140	.049
length distal margin	210	.074
length base	150	.053
Caudal fin length dorsal lobe	635	.224
length ventral lobe	515	.182
dorsal tip to notch	65	.023
depth notch	155	.055
Tip of snout to 1st dorsal origin	1338	.472
2nd dorsal origin	2434	.859
anal origin	2611	.921
lower caudal origin	2830	.998
Distance between bases 1st and 2nd dorsals	883	.312
2nd dorsal and caudal	275	.097
pectoral and pelvic	935	.329
pelvic and anal	390	.138
anal and caudal	235	.083

The outermost tooth row shows a great deal of wear, which may indicate a slowing of tooth replacement with age. The teeth are much smaller than those of the fossil *Isurus* from Miocene rocks of California, apparently indicating that the fossil members of this genus attained much larger sizes than anything alive today. Lengths of selected teeth, measured at right angles from the center of a line across the ends of the roots to the tip of the tooth, are:

2nd upper left anterior: 38.4 mm
1st upper left intermediate: 16.5 mm
1st upper left lateral: 22.8 mm
2nd lower left anterior: 52.0 mm
3rd lower left anterior: 30.6 mm

Bigelow and Schroeder (1948:128) reported that the mako or bonito shark reaches a length of 4 meters (13 feet), although this is evidently based on hearsay evidence. A specimen said to have been 12 feet long was estimated from jaw size, a highly questionable procedure. The largest authentic record they listed is an *Isurus* taken off St. Petersburg, Florida, measuring 10 feet, 6 inches. The weight of this fish was said to have been 1,009 pounds, a most remarkable figure since it was 5½ inches shorter than the present shark, yet weighed over 150 pounds more. Recorded weights at different lengths from other sources are more in keeping with our specimen: 135 pounds at 6 feet; 230 pounds at 7 feet, 8 inches; and 300 pounds at 8 feet. Thus, the Santa Catalina Island bonito shark apparently constitutes a world's record in length and perhaps weight if, as appears to be the case, the 1,009 pounds cited for the St. Petersburg, Florida, mako are not accurate. It is certainly much larger than is usually recorded for this species (7 or 8 feet) off southern California (Roedel, 1953:15).

Since it was not possible to save this specimen in its entirety, the jaws, vertebral column, fins, and chondrocranium were removed and deposited in the Vertebrate Paleontology reference collection of Recent fish skeletal material at the Los Angeles County Museum of Natural History under VPF1059.

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—*Shelton P. Applegate, Los Angeles County Museum of Natural History, January 1966.*

THE UNICORNFISH, *EUMECICHTHYS FISKI* (GÜNTHER), IN THE EASTERN TROPICAL PACIFIC

A 27-inch unicornfish (620 mm SL, 682 mm TL) weighing 1 ounce (28 g) was caught November 13, 1965, in a purse seine set made for yellowfin tuna, *Thunnus albacares*, off the northeast tip of Clarion Island, Revillagigedos, Mexico. George Fukuzaki, owner and skipper of the purse seiner *Beverly Lynn*, recognized it as different from the usual ribbonfish (Trachipteridae) taken by purse seining in the eastern Pacific, and made certain it was saved. The only previous *Eumecichthys fiski* from our waters was a badly mangled specimen spit up by a yellowfin tuna that was caught southwest of Acapulco, Mexico, at lat. 15°16′N., long. 99°80′W. sometime prior to April 1960. The 1960 unicornfish was called to my attention by Frank Alverson, then with the Inter-American Tropical Tuna Commission, who found it while studying yellowfin tuna food habits.

Eumecichthys fiski (Figure 1) is of such unique shape that a list of proportional measurements would be superfluous; however, meristic counts, color notes, and a few notes on its distribution and biology should be helpful to future workers. Walters and Fitch (1960), in reviewing the family Lophotidae, presented characters and a key for distinguishing *Eumecichthys* from *Lophotus*, the only other genus in the family. The Clarion Island specimen (deposited in the UCLA fish collection as W65-46) has 5+305 dorsal, 13 pectoral (each side), 8 anal, and 12 caudal rays. Only one (the second) of the five rays making up the pennant is produced; the other rays are either much-reduced in length, or are no longer than succeeding dorsal fin rays (Figure 2). There are no pelvic fins and no sign of a pelvic girdle in the X-ray which was taken for me by Robert J. Lavenberg, Los Angeles County Museum of Natural History. All fin rays except the pectorals were counted from the X-ray with the aid of a binocular microscope at six magnifications. It was difficult to determine which vertebra contained the anteriormost haemal spine, even with the microscope, but it seemed to be the 57th. This gave a vertebral formula of 56+101=157 (precaudal, caudal, and total).

The dorsal and caudal fins were crimson when the fish was first caught, and remained quite red while frozen, but faded completely upon preservation in formalin. The silver-colored body was banded with about 40 dark, subvertical bars, most prominent dorsally (Figure 1). The ventral portions of these dusky bands were quite indistinct, even when the fish was fresh, so-much-so that the ventral half of every other band appeared to be lacking except upon very close scrutiny.

King and Ikehara (1956) did not give information regarding maturity of the 590 mm SL specimen they reported from Hawaii, but the slightly larger Clarion Island individual was a female with at least two sizes of eggs in her ovaries. The largest of these were transparent and ranged from 1.5 to 2.0 mm in diameter. These large eggs were not loose enough to be spawned by exerting pressure along the sides of the fish, but by their size and transparency the spawning season must have been close when the fish was captured.

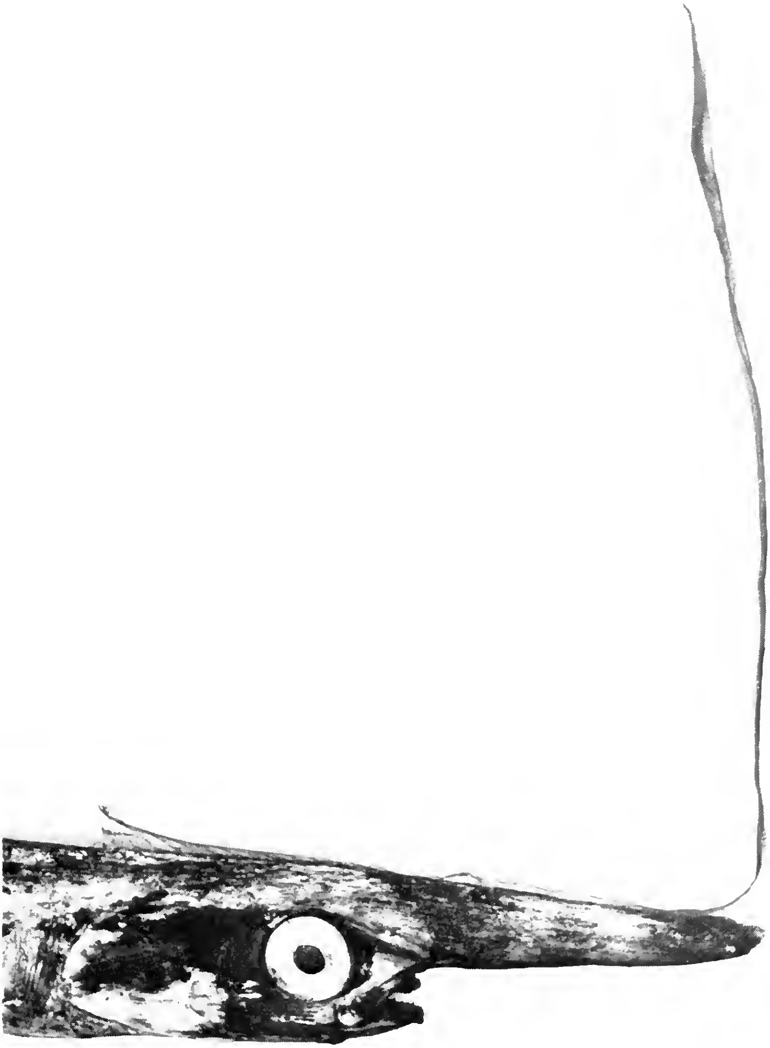

FIGURE 1—Clarion Island unicornfish, 620 mm SL, 682 mm TL, 28g. *Photograph by Jack W. Schott.*

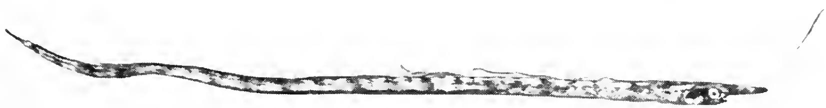

FIGURE 2—Head and anterior trunk of Clarion Island unicornfish. Only one ray (broken at its base) extends for the full length of the pennant. *Photograph by Jack W. Schott.*

Several unicornfish from Japanese waters have ranged upwards to 88 cm in length, but the largest reported in the literature seems to be the "50-inch" type specimen from South Africa.

The otoliths (sagittae) of the Clarion Island fish were examined for an indication of its age, but no growth rings or annuli could be observed on these tiny structures (0.6 by 0.3 mm).

The stomach of this fish was empty.

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Walters, Vladimir, and John E. Fitch. 1960. The families and genera of the lampridiform (allotriognath) suborder Trachipteroidei. Calif. Fish and Game, 46(4): 441–451.

—*John E. Fitch, Marine Resources Operations, California Department of Fish and Game, January 1966.*

NEW RECORDS OF *CATAETYX RUBRIROSTRIS* GILBERT FROM THE NORTHEASTERN PACIFIC OCEAN

The deep-sea ophidioid *Cataetyx rubrirostris* has been recorded from hauls made with non-closing gear fished from 161 to 510 fathoms off southern California from southwest of South Coronado Island north to the Santa Barbara channel (Gilbert 1890; 1895; 1915; Townsend, 1901; U. S. Bureau of Fisheries, 1906). Mead, Bertelsen, and Cohen (1964) give recent southern California records of young specimens from pelagic surveys in the Santa Catalina Basin.

Three specimens taken in open, bottom-sampling gear off the northern Oregon coast extend the northern limit of this species to the eastern subarctic Pacific region (as defined by Dodimead, Favorite, and Hirano, 1963). One is a female 91.5 mm SL from 368 to 370 fathoms at lat. 44° 23'N., long. 124° 56'W., taken August 8, 1961, by the Department of Oceanography, Oregon State University. The second, a male 105.5 mm SL from 325 fathoms at lat. 45° 57'N., long. 124° 48'W., was caught January 24, 1963, by the Bureau of Commercial Fisheries, Exploratory Fishing and Gear Research Base, Seattle, Washington, in cooperation with the U.S. Atomic Energy Commission (Figure 1). A third specimen about 80 mm SL, taken by the Oregon State University oceanography program, was lost before we could examine it but was identified as *C. rubrirostris* by a former student, Don Day, who recorded it from 350 to 400 fathoms, at lat. 44° 16'N., long. 125° 00'W., December 10–11, 1961. The male specimen (UW 16743) is in the fish museum, University of Washington, and the female (uncatalogued) is at the Oregon State University, Department of Fisheries and Wildlife.

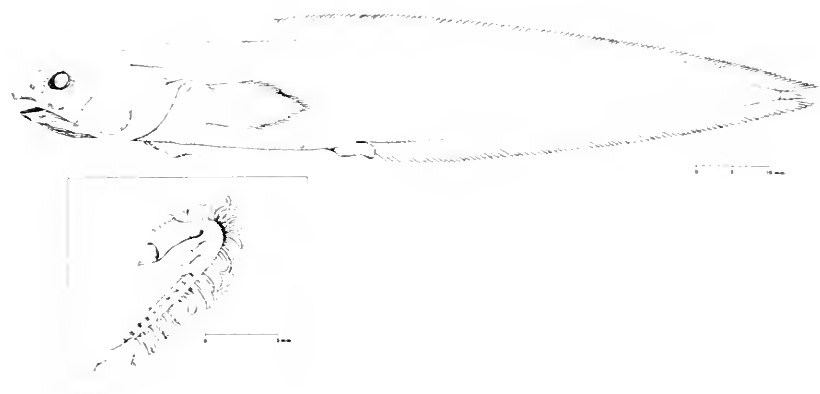

FIGURE 1—Drawing of *Cataetyx rubrirostris* Gilbert (UW 16743) showing cephalic sensory pore system and first gill arch (inset) removed from the left side of the specimen. *Illustration by Iris Reynolds.*

DESCRIPTION

Morphology of potential taxonomic usefulness is described, supplementary to Gilbert's (1890) original description based on a series of four specimens (largest 114.3 mm SL).

Measurements and counts (Table 1) were taken from the left side whenever possible, and follow Hubbs and Lagler (1958). Measurements were made with dial calipers (to the nearest 0.1 mm), and some meristic data were taken from radiographs. The scales are deciduous, and because they left undefinable pockets where they were missing, counts could not be made.

Most external morphology is illustrated in Figure 1, which emphasizes the cephalic papillae and premaxillary and preopercular-mandibular sensory series of seven pores each. A single pore at the apex of the articular notch is adjacent to the second anteriormost pore in the preopercular-mandibular series. There are four gill arches, with a restricted slit behind the last; the three developed gill rakers are short and triangular, the longest equal to about one-half of orbital width; rudi-

TABLE 1

Measurements (in mm) and Counts of Northern Oregon *Cataetyx rubrirostris*

Measurements	*U.W. 16743*	*O.S.U.*
Standard length	105.5	91.5
Depth at anal origin	11.2	11.1
Head length (to end of opercular flap)	24.4	20.2
Postorbital head length	15.0	13.2
Length of upper jaw	10.1	8.2
Length of lower jaw	5.9	5.7
Snout	4.2	4.0
Bony interorbital	2.7	1.9
Eye	4.5	3.2
Distance between anterior and posterior nostril	3.4	2.5
Greatest width of premaxillary tooth band	.7	.5
Length of premaxillary tooth band	6.9	6.0
Greatest width of mandibular tooth band	.3	.3
Length of mandibular tooth band	6.5	6.0
Greatest width of vomerine tooth band	.4	.4
Length of vomerine tooth band	1.7	1.5
Greatest width of palatine tooth band	.5	.4
Length of palatine tooth band	5.6	4.0
Snout to dorsal origin	32.5	25.3
Snout to pelvic origin	17.2	15.3
Snout to anal origin	47.7	36.9
Pelvic origin to anal origin	31.2	22.5
Length of dorsal-anal overlap	17.2	12.0
Length of longest pelvic filament	–	8.9
Length of pectoral fin	13.5	11.0
Cleithrum spine length (tip to angle formed by cleithrum with ventral edge of spine)	1.6	1.1
Length of caudal fin	–	8.1
Length of longest dorsal ray	6.7	6.0
Greatest height of fleshy membrane on dorsal base	2.2	2.4
Snout to anus	43.3	35.2
Anus to caudal base	62.1	45.7
Opercular spine length (measured from tip of spine to angle formed by posterior edge of opercle with ventral surface of spine)	3.5	2.5
Counts		
Dorsal rays	102	109
Anal rays	76	82
Caudal rays	4–4	5–4
Pectoral rays	25	25
Pelvic filaments	1	1
Vertebrae (urostyle counted as last vertebrate)	62	60
Developed gill rakers	3	3
Branchiostegal rays	8	8

mentary gill rakers appear as small rounded protrusions (Figure 1). The longest gill filament is equal to about $\frac{3}{4}$ of orbital width; pseudobranchiae are absent. Pyloric caeca are not evident. Color in alcohol: head and body cream-colored, overlain by silvery iridescence; buccal and branchial cavities lined with black, visible externally; occipital region translucent, exposing central nervous system from exterior; black peritoneum showing through translucent abdominal tissue; stomach unpigmented; intestine covered by darkly-pigmented epithelium; anal orifice with black emargination; pectoral fins dusky; pelvics and anal fin unpigmented; dorsal and caudal fins with dusky margins.

VARIATION

Our specimens basically agree with Gilbert's description, with the following exceptions: a greater number of pectoral rays (25 instead of 23), fewer caudal rays (8 to 9 instead of 12), bony interorbital width 9.0 to 10.6 instead of 7 in head (Gilbert's measurement may be of fleshy instead of bony interorbital). Gilbert states that the eye equals the snout, whereas in one of our specimens the eye is larger than the snout, and in the other it is smaller (Table 1).

ACKNOWLEDGMENTS

We are indebted to Don Day, U.S. Bureau of Commercial Fisheries, Biological Laboratory at Seattle, for catch data and identification of the misplaced specimen. Carl E. Bond, Oregon State University, loaned us the female specimen. Daniel M. Cohen, U.S. Bureau of Commercial Fisheries, Ichthyological Laboratory, Washington, D.C., and J. D. McPhail, College of Fisheries, University of Washington, reviewed the manuscript.

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—Richard B. Grinols, U.S. Bureau of Commercial Fisheries, Exploratory Fishing and Gear Research Base, Seattle, Washington, 98102, and David W. Greenfield, Department of Biological Sciences, California State College at Fullerton, Fullerton, California, 92631. February 1966.

A MARINE CATFISH, *BAGRE PANAMENSIS* (GILL), ADDED TO THE FAUNA OF CALIFORNIA, AND OTHER ANOMALOUS FISH OCCURRENCES OFF SOUTHERN CALIFORNIA IN 1965

A marine catfish was caught in a bait net 1½ to 2 miles off the mouth of the Santa Ana River on November 3, 1965, by Richard Soukup, skipper of the boat *Elinore C*. This fish, 245 mm SL (310 mm TL), has been deposited in the fish collection of the Los Angeles County Museum of Natural History (LACM 6883-1). It appeared healthy when captured (it weighed 250 g), and its stomach contained the remains of two, 5-inch anchovies, *Engraulis mordax*. The closest previous record of *B. panamensis* to California is Magdalena Bay, Baja California, where it and another marine catfish, *Netuma platypogon*, are present in considerable abundance.

Although the marine catfishes on the Pacific coast are an extremely difficult group to work with, and badly in need of a critical review, only 2 of the 26 Pacific coast species belong to the genus *Bagre*, characterized by having only one pair of barbels on the lower jaw. *B. pinnimaculatus*, the other species, has a long, flat filament extending from the dorsal spine; it ranges from about Mazatlan to northern Peru.

Twelve species of marine catfishes in five genera have been reported from Mexican waters (Meek and Hildebrand, 1923; Hildebrand, 1946;

TABLE 1

Anomalous Occurrences of Marine Fishes off Southern California During 1965 as Reported to California State Fisheries Laboratory

Species	Number of specimens	Date of capture	Locality of capture	Remarks
Southern Species				
Pseudopriacanthus serrula	1	early Feb.	Horseshoe Kelp	Rare off Calif.
Katsuwonus pelamis	1	June 4	Corona del Mar	3 months earlier than usual
Hermosilla azurea	1	mid June	Oxnard	
Strongylura exilis	1	Sept. 27	Carpinteria	
Strongylura exilis	1	late Sept.	Newport Beach	
Bagre panamensis	1	Nov. 3	Off Santa Ana R.	First Calif. record
Strongylura exilis	1	Nov. 8	Los Angeles Harbor	
Pseudopriacanthus serrula	1	end Nov.	Malibu	
Albula vulpes	1	Nov. 28	Sunset Beach	
Albula vulpes	1	Nov. 29	Los Angeles Harbor	
Northern Species				
Acipenser medirostris	1	Jan. 14	Ventura	
Reinhardtius hippoglossoides	1	Feb. 10	Ventura	Reported by Schott, 1966
Alosa sapidissima	1	Apr. 17	Los Angeles Harbor	
Alosa sapidissima	2	July 19	Los Angeles Harbor	
Alosa sapidissima	3	Sept. 27	Carpinteria	
Oncorhynchus spp.	many	June-Sept.	Los Angeles-Orange Counties	
Roccus saxatilis	many	Oct.-Dec.	Los Angeles-Orange Counties	
Alosa sapidissima	1	Nov. 1	Los Angeles Harbor	
Pelagic Species				
Brama japonica	1	June 2	lat. 29° 29′ N., long. 129° 23′ W.	South of usual range
Lampris regius	several	Aug.-Sept.	San Diego-Morro Bay	
Lophotus sp.	1	Sept. 20	Tanner Bank	Fewer than 10 Calif. records
Assurger anzac	1	Oct. 25	Torrance Beach	Third Calif. record
Lagocephalus lagocephalus	1	Dec. 16	Newport Harbor	Fewer than 10 Calif. records

Berdegue, 1956; and others), but only the two noted above are known to occur on the outer coast of Baja California (Magdalena Bay). Thus, the range for *B. panamensis* was extended northward approximately 650 linear miles by the capture of the 12-inch specimen off the Santa Ana River.

In order to check the plausibility of such a northward migration, I examined reports of anomalous occurrences of marine fishes during 1965 on file at California State Fisheries Laboratory (Table 1). Based upon these occurrences alone, it would appear that ocean temperatures fluctuated widely off southern California during 1965, often within the same month. When water temperatures were cold, shad, salmon, and striped bass moved in from the north, but the southern and pelagic species could have arrived only by taking advantage of northerly-moving currents of warm water. A few southern species, such as *Hermosilla azurea*, apparently have established populations along much of the southern California coastline, but individuals are known to migrate beyond the usual limits of their range when temperatures are suitable. The occurrence of *Bagre panamensis* off southern California apparently resulted from an intrusion of warm water which originated somewhere in the vicinity of Magdalena Bay, Baja California.

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—*John E. Fitch, Marine Resources Operations, California Department of Fish and Game, January 1966.*

FISHES AND OTHER MARINE ORGANISMS TAKEN DURING DEEP TRAWLING OFF SANTA CATALINA ISLAND, MARCH 3–4, 1962

Attempts by a private concern to retrieve with an otter trawl a valuable piece of electronic (seismic) equipment that broke loose and sank in several hundred fathoms of water outside Santa Catalina Island, California, afforded an excellent opportunity to examine the fishes and other organisms that were captured. The equipment was lost where it is

TABLE 1

List of Organisms from Deep Trawling off Santa Catalina Island, California March 3 & 4, 1962

	Tow 1 (315–340 fm)	Tow 2 (285–360 fm)	Tow 3 (294–315 fm)	Tow 5 (240–310 fm)
Fishes				
Scyliorhinidae				
Parmaturus xaniurus	1	1	4	8 + 36
Apristurus brunneus	1	2	1	2
Rajidae				
Raja rhina	3	--	1	2
Coryphaenoididae				
Nezumia stelgidolepis	14	7	10	68
Merlucciidae				
Merluccius productus	--	1	2	--
Scorpaenidae				
Sebastolobus alascanus	30	32	18	97
Sebastodes diploproa	--	--	2	
Anoplopomatidae				
Anoplopoma fimbria	10	11	23	32
Liparidae				
Careproctus melanurus	--	--	1	1
Pleuronectidae				
Embassichthys bathybius	--	--	--	2
Microstomus pacificus		--	--	8
Invertebrates				
Porifera		X	--	--
Coelenterata	X	X	X	X
Echinodermata	X	X	X	X
Mollusca				
Bathybembyx bairdi	--	--	--	70
Tectibranchs	--	--	--	2
Crustacea				
Chionoectes tanneri	10	30–40	30–40	40–50
Chorilia longipes	--	2	--	--

illegal to possess or operate a trawl net, so special permission had to be obtained from the Fish and Game Commission to conduct the search. A limitation of the permit called for a Department of Fish and Game representative to be aboard during all trawling operations.

Biologist William L. Craig, California State Fisheries Laboratory, was assigned the task of overseeing the search, conducted March 3 and 4, 1962, from the trawler *Christine*, skippered by Harry Barrington. Five tows were made in 240 to 360 fathoms (439–658m), but on one of these (tow 4) the net became snagged and the catch was lost; the electronic equipment was not recovered. All trawling was on the windward (offshore) side of Santa Catalina Island, 2.5 to 3.25 miles offshore between Ribbon Rock and Catalina Head at approximate lat. 33°23′N., long. 118°34′W. Most of the catch was retained for processing at California State Fisheries Laboratory, where the fishes were identified, measured, and weighed before being discarded or saved. The invertebrates were sent to various specialists, primarily at the Allan Hancock Foundation (AHF), University of Southern California, in the hope that identifications would be forthcoming at an early date.

The four successful tows yielded 11 species of fishes belonging to eight families (Table 1). Only five of the fish species (Pacific hake, shortspine channel rockfish, splitnose rockfish, sablefish, and Dover sole) might be considered of commercial importance (marketable for food), but none of these seemed to be present in commercial quantities—at least none was taken in commercial quantities.

A species-by-species account follows:

Parmaturus xaniurus—filetail cat shark

Forty-six cat sharks were taken in tow 5, but only 10 of these were saved: 8 filetails and 2 browns. Seven of the eight filetails were females, as were all six filetails taken in the other three successful tows. The male filetail was 385 mm TL; the 13 females ranged from 330 to 505 mm TL, but most were larger than 460 mm. The 14 specimens that were saved were deposited in the UCLA fish collection.

Apristurus brunneus—brown cat shark

Five of the six brown cat sharks saved were males, 384 to 555 mm TL; the single female was 515 mm TL. All were deposited in the UCLA fish collection.

Raja rhina—longnose skate

The three longnose skates for which sexes were noted were males, 550 to 765 mm TL; the three unsexed specimens were 530 to 567 mm TL. All six skates were deposited in the Scripps Institution of Oceanography (SIO) collection.

Nezumia stelgidolepis—California rattail (Figure 1)

Only the shortspine channel rockfish was more abundant than the California rattail in the trawling area. The 99 *N. stelgidolepis* taken in the four tows were relatively small for rattails, being 240 to 390 mm SL. Most were deposited in the SIO collection.

FIGURE 1—California rattail, *Nezumia stelgidolepis*, 310 mm SL, from 240 to 310 fathoms, Santa Catalina Island, California. *Photograph by Jack W. Schott.*

Merluccius productus—Pacific hake

The six hake ranged from 247 to 495 mm SL (273 to 543 mm TL); all were discarded.

Sebastolobus alascanus—shortspine channel rockfish

Shortspine channel rockfish were the most abundant fish captured, the best tow yielding 97 of the 177 caught. Although they varied greatly in size (100 to 430 mm SL; 125 to 536 mm TL), most were 200 to 300 mm SL. The largest individual, a spent female 536 mm TL, weighed 2045 g. Most of these rockfish were discarded.

Sebastodes diploproa—splitnose rockfish

Only two splitnose rockfish were taken, but both were fair-sized adults (273 and 295 mm SL; 332 and 357 mm TL).

Anoplopoma fimbria—sablefish

Sablefish were the third most abundant fish taken, but none of the 76 was exceptionally large (395 to 538 mm SL; 460 to 628 mm TL).

Careproctus melanurus—pink snailfish

Two good-sized, adult pink snailfish (230 and 245 mm TL) were taken, but were not saved.

Embassichthys bathybius—deepsea sole

Both deepsea sole were caught in tow 5, the most productive haul. They were 345 and 442 mm SL (395 and 510 mm TL), and the largest, a female, weighed 1430 g. Since they represented a new southern distribution record for the species, the smaller of the two was deposited in the UCLA fish collection.

Microstomus pacificus—Dover sole

The eight Dover sole taken in these operations also came from tow 5. All were of a marketable size (265 to 340 mm SL; 315 to 400 TL), but none was exceptionally large.

Porifera—sponges

Two sponges, representing two species, were taken in tow 2; both were sent to the AHF for identification and curating.

Coelenterata—sea anemones, gorgonians, sea pens

Coelenterates were not abundant in the trawling area, but the few sea anemones, gorgonians, and sea pens that came up in the net were saved and sent to the AHF collection.

Echinodermata—sea cucumbers, starfish, sea urchins

Sea cucumbers were abundant in all hauls, as were some of the starfishes and sea urchins. Samples of all were saved and sent to the AHF collections. One of the starfishes was new to science (Fred Ziesenhenne, pers. commun.).

Mollusca—snails, tectibranchs

Tow 5 yielded 70 fairly large, thin-shelled, greenish snails identified as *Bathybembyx bairdi* by A. Myra Keen, Stanford University. These snails seldom are captured at depths shallower than 250 fathoms (457 m); they are not uncommon between about Newport Beach and Eureka. The only other mollusks netted were two unidentified sea slugs or tectibranchs that were sent to the AHF collections.

Crustacea—crabs

Every tow yielded fair numbers of large Tanner crabs, *Chionoectes tanneri* (Figure 2). Although they were fairly large, there did not seem to be much edible flesh in the legs or body, so they probably do not represent a very choice latent resource. Two smaller crabs in tow 2 were identified as *Chorilia longipes* by John S. Garth, Allan Hancock Foundation.

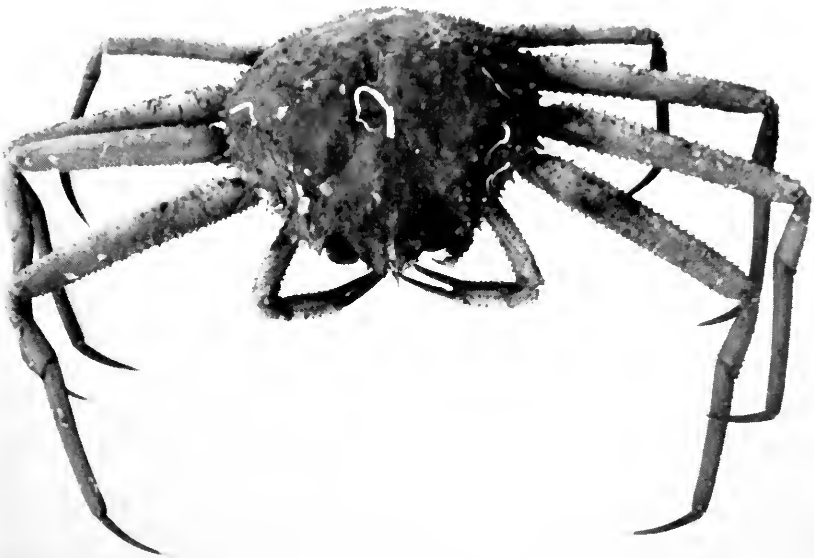

FIGURE 2—Tanner crab, *Chionectes tanneri*, trawled in 340 fathoms, Santa Catalina Island, California. *Photograph by Jack W. Schott.*

—*John E. Fitch, Marine Resources Operations, California Department of Fish and Game, January 1966.*

THE FINAL INTRODUCTION OF THE OPOSSUM SHRIMP (*MYSIS RELICTA* LOVEN) INTO CALIFORNIA AND NEVADA

The final introduction of the freshwater opossum shrimp into California and Nevada was made in September 1965. This and earlier introductions (Linn and Frantz, 1965) totaled 442,000 shrimp (Table 1). These introductions were made to improve the food supply for trout (Linn and Frantz, 1965).

TABLE 1

Summary of Introductions of *Mysis relicta* into California and Nevada in 1963, 1964, and 1965

Lake	Location	Surface area (acres)	Maximum depth (feet)	Total number shrimp planted
Lake Tahoe	California and Nevada	123,300	1,645	333,000
Fallen Leaf Lake	El Dorado County, California	1,410	1,100	30,000
Lower Echo Lake	El Dorado County, California	338	150	27,000
Donner Lake	Nevada County, California	960	200	26,000
Huntington Lake	Fresno County, California	1,441	150	20,000
Blue Lake	Humboldt County, Nevada	11	48	4,000
Island Lake	Elko County, Nevada	$7\frac{1}{2}$	22	2,000
Total				442,000

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Linn, Jack D., and Ted C. Frantz. 1965. Introduction of the opossum shrimp (*Mysis relicta* Loven) into California and Nevada. Calif. Fish and Game. 51(1): 48–51.

—*Jack A. Hanson, Inland Fisheries Branch, California Department of Fish and Game, November 1965.*

BOOK REVIEWS

McClane's Standard Fishing Encyclopedia and International Angling Guide

Edited by A. J. McClane; Holt, Rinehart and Winston, Inc., Great Neck, New York, 1965; 1057 p., illustrated; $23.95.

This volume is an outstanding example of the various angling encyclopedias that have appeared on the market in recent years. Though expensive, it exemplifies quality from the colorful binding throughout all its six pounds.

As the versatile fishing editor for *Field and Stream*, A. J. McClane is eminently qualified to undertake this compilation. He has used his experience and training wisely, both as a major contributor and to select 141 angling experts and fishery scientists as collaborators. The list of scientific contributors does not include anyone from the Pacific coast but this area has not been slighted and the species have been reported upon accurately by qualified authorities. The contributor's initials follow each entry, which allows an opportunity to evaluate the source of any statement.

All entries appear alphabetically, as in a popular world encyclopedia. Thus, the user turns directly to his subject, eliminating the added step of consulting an index. One might experience difficulty locating a particular subject if the crossreferencing was not so thorough. For example, our grunion's description is listed under "C" for California grunion and not under "G."

Angling information and life histories for over 1,000 species of fishes are included and most of these are illustrated. General information about where to fish, with what type of gear and what one might expect to catch is given for each of the 50 states and other important angling areas throughout the world. Fishing techniques such as casting are described thoroughly both verbally and through the generous use of illustrations. There are equally detailed sections on such subjects as: gear construction, boat selection, preserving the catch, as well as fresh and salt water biology. Most impressive of all is the extensive, up-to-date bibliography arranged by subject and by area. A few words borrowed from the flyleaf best describe the overall content. "There are 1,072 pages, more than 1,200 main entries, and over 5,000 secondary entries—nearly a million words—over 700 handsome illustrations—."

Individual users will no doubt discover pet omissions, for it would be virtually impossible to include all the vernacular from so vast a field. However, if one masters all the contents any omissions will seem minor.

This book represents a fine piece of workmanship deserving a prominent place in every serious anglers' library. It should prove valuable as a ready reference for the fishery biologist as well.—*William L. Craig.*

The California Deserts (Fourth Edition)

By Edmund C. Jaeger; Stanford Univ. Press, Stanford, Calif., 1965; x + 208 p., illustrated; $4.95.

With the exception of two added chapters, a few new photographs, and some slight alterations in the text, this fourth edition is the same delightful book that many of us have been enjoying for more than 30 years. Scientific names and the bibliography have been kept up-to-date, and Dr. Jaeger has made it a point to inform the reader of the changes that man has wrought upon the face of the desert (few for the best).

Chapters entitled "The aborigines of the desert" and "The preservation of deserts" add greatly to one's reading pleasure. A sketch map with shaded areas showing the "home territories" of the various Indian tribes would have helped those who are not familiar with all the localities mentioned, but its absence does not detract from the chapter in any way.

I was surprised to see that the section on fishes failed to mention the changes in the Salton Sea fauna that were brought about by the Department of Fish and Game over a decade ago. Nor was the publication on this subject (edited by Boyd W. Walker) listed among the references. Failure to include information from this publication has resulted in the inclusion of the "humpbacked sucker . . . and the Colorado River trout" among the Salton Sea's fish fauna.

It would be nice if a future edition would include mention of the herds of "wild" burros which now inhabit many desert areas under full protection of the law, and which are blamed by many for the perilous decline of the bighorn sheep populations in these areas. Regardless of these few omissions, this is still one of the finest and most pleasurable volumes on the California deserts that is available. Anyone who hasn't read the book or doesn't own a copy should make a resolution to rectify the oversight immediately. *John E. Fitch.*

Fish as Food, Vol. 3: Processing, Part I

Edited by Georg Borgstrom; Academic Press Inc., New York, 1965; xiv + 489 p., illustrated: $17.50.

This is not a book for the idle reader, but it should be of great value as a reference for fish processors and technologists.

Authors from major fishing nations contributed chapters describing methods of processing eight major types of fish products: dried, smoked, salted, marinated and Asian fermented seafood, fish sausage, fish solubles, and fish meal. Gene[illegible]lly, the descriptions mention the methods used with particular species, hist[illegible] contemporarily. Theoretical aspects are dealt with extensively in most [illegible] Most important is the stress given to quality control.

One chapter summarizes the history and trends of the commercial [illegible] major fish-producing countries of the world. The major species, types [illegible] and the size of the fishery (numbers of boats, fishermen, processo[illegible] reported for each country. This paper also lists the relative amount[illegible] duced for domestic use and export.

My one complaint concerns the list of the world's common food fish [illegible] strom states that "This list comprises the most important economi[illegible] species of the world's ocean and major fresh-water fishes." The list [illegible] fish, *Alepisaurus ferox*, and lanternfish, *Diaphus coeruleus*, but omits all of the important rockfishes (*Sebastodes* spp.) of the eastern Pacific. In fact, the only eastern Pacific rockfishes listed are the blue rockfish, *Sebastodes mystinus* (incorrectly listed as *Sebatosomus mystinus*), and the rosy rockfish, *Sebastodes rosaceus* (listed by the incorrect generic name *Sebastomus*). Neither of these is of significant commercial importance.

I am impressed with the amount of information in this book; it would be a valuable addition to the library of biologists interested in fish processing.—*Daniel W. Gotshall.*

Fisheries Year Book and Directory 1965–66

Edited by Harry F. Tysser; British-Continental Trade Press Ltd., London, 1965; 471 p., illustrated: £2.

This book provides an international reference and directory of fishing and fish processing industries for 1965–66. Data are incorporated from the *World Fisheries Year-Book*, *North Atlantic Fisheries Year-Book*, and *Herring Exporter's Manual.*

The opening section on world catch analysis presents fishery statistics for 31 countries. A 1964 record catch of 50 million metric tons was produced, with Germany and Japan the only countries reporting lower catches than their previous 1963 high.

Additional reference chapters summarize developments in the fish meal and oil trade, and industrial achievements in freezing, storage, transport, and merchandising. A survey of new fishing vessels and equipment, and a list of new fishing vessels completed or on order indicates an optimistic attitude toward future fisheries expansion, except in the United States, which listed only 2 of the 534.

Other aids to industry are the listings of organizations and trade associations, trade journals, and a monthly fish supply calendar. One section presents common names of fishes in eight languages, with corresponding scientific names.

In the world directory section, an index of more than 5,000 firms includes exporters, producers, trawler owners, importers, wholesalers, and canners. Dealers in machinery and equipment for processing and packing are also listed by national origin. Although approximately 150 advertisers are listed, none is from the United States.

It was alarming to see the United States, which is the fifth ranked fishing nation, so poorly represented throughout the book. Editor Tysser did not indicate the qualifications for representation in the yearbook-directory, so the poor United State representation may be due to a lack of data, a lack of interest by American firms or failure of the editors to contact American firms.—*J. Gary Smith.*

The Fisheries: Problems in Resource Management

Edited by James A. Crutchfield; Univ. Washington Press, Seattle, 1965; xvi + 1316 p.; illustrated; $5.

The Common Wealth in Ocean Fisheries

By Francis T. Christy, Jr. and Anthony Scott; The Johns Hopkins Press, Baltimore, Md., 1966; xiii + 281 p.; $6.

Our traditional approach to the utilization of the world's sea fisheries has been through the eyes of the fisheries scientist, with little regard for such contributions as might be made by the economist, the sociologist, or the lawyer. Optimum (or maximum) sustainable yield in terms of tons of fish delivered was, and remains, the goal of most administrations concerned with management of the living marine resources. This concept, indeed, is the foundation of the recently implemented Geneva Convention on Fishing and Conservation of the Living Resources of the High Seas.

Over the years however, those most deeply concerned with ocean fisheries have ...o recognize the need for an interdisciplinary approach to management, if ...on is to be truly rational.

...alifornia Department of Fish and Game, for example, has recently, in its ...a Fish and Wildlife Plan", recommended a sociological principle of ...nt—in essence the view that when the stock of a given species or species- ...s insufficient to fill both recreational and commercial demands, priority ... given to satisfying the reasonable demands of the sport fishery. Very ...ecommendations have been made by a University of California planning "California and the Use of the Ocean", and by at least one major Cali- ...ing firm.

... books toward which this review is directed exemplify this broadened concep. or resource management, and are in fact edited in the one instance and co-authored in the other by two of the leading exponents of an economic approach to fisheries management, James Crutchfield and Francis Christy.

The first of these books in time is Crutchfield's. It presents a series of lectures given at the University of Washington under the auspices of the Graduate School of Public Affairs as one of a series of interdiscplinary public policy seminars. Two of the seven lectures concern conservation, three economics, and two law. The fisheries biologist will find Crutchfield's examination of economic objectives, and Robert Fletcher's consideration of law and limited entry, particularly interesting, for economic-based management with limited entry as a tool are now matters of considerable debate. Crutchfield believes that limiting entry is a "vital first step" if the fisheries are to be managed with the intent of producing maximum economic profit as well as maximum physical yield.

Fletcher, professor of law at the University of Washington, believes that in federal court, at least, limited entry would be deemed constitutional. He is less certain of how state courts would rule, but he feels it probable that they too would rule favorably.

In other chapters, Royce and Bevan of the Fisheries Research Institute review conservation practices and regulations (Bevan's description of logging regulations based on the assumption that the timber industry operated under the same ground rules as fisheries brings home the point). Marion Marts, professor of geography, considers the place of fisheries in the total economy of the Northwest, Richard Van Cleve discusses the principle of abstention, and Ralph Johnson, professor of law, high seas fisheries and international law.

Francis Christy, senior author of "The Common Wealth in Ocean Fisheries", is a research associate for Resources of the Future and presently a member of California's Governor's Advisory Commission on Ocean Resources. He has specialized in the economics of resource use since college; his doctoral dissertation concerned the common property aspects of oystering in Maryland. Anthony Scott is professor of economics at the University of British Columbia.

This is a thoughtful and detailed discussion of worldwide fishery problems. Its initial concern is with characteristics of common property resources. Chapters on demand, productivity, the extent of the resource, the fishing process, supply, and future demand follow. They may prove a bit tedious to the more casual reader, but they are well worth the attention of the serious student.

Christy and Scott get to the nub of the situation in the final third of the book which covers international law, fisheries treaties, the objecives of fisheries management, and finally a consideration of what can be done best to utilize marine resources in the future.

They point out that scientists generally want to maximize the catch (viz., the Geneva Convention, where their viewpoint prevailed), whereas economists would rather maximize the "rent" or economic gain. The optimum sustainable yield concept is not necessarily the "best" for all countries, for it is conceivable that deliberate overexploitation to gain capital for other enterprises might be in some nation's interest. Their thesis is that the "rent" can be maximized, despite the great differences among nations in their wage-price structures, through international arrangements.

Rational exploitation can be attained in several ways: by extension of the rights of the coastal states; by management through national quotas; by internationalizing marine resources under a central authority(ies). But fundamentally, both administrative and economic efficiency require limited entry. Slowly-instituted "internationalization", recognizing national rights to an equity in the net proceeds from the fisheries, perhaps comes closest to "the maximization of international welfare". This presumably would put administration and harvesting itself under the control of regional international bodies.

Many of these ideas, as well as those in Crutchfield's book, have already been the subject of extensive debate; others are sure to be. There is a great deal of danger in trying to comment on such theories (of which these represent only a sampling) in the limits of a review, where paraphrase and out-of-context semi-quotes cannot begin to express the philosophies involved. My purpose is to emphasize the importance of the subject and hopefully to draw those concerned into an in-depth study of the intricate relationships of economics and biology, law and sociology, man and fish. To that end, I commend these volumes.—*Philip M. Roedel.*

History of the Sierra Nevada

By Francis P. Farquhar; Univ. California Press, Berkeley, 1965; xiv + 262 p., illustrated; $10.

One does not have to read very far into the first chapter before he realizes that this book was written by a man who knows, understands, and loves the Sierra Nevada. This and his ability to write well have resulted in a remarkably lucid and interesting volume.

Although this "history deals with human experiences in the Sierra Nevada from the time the Spaniards first saw it in the latter part of the eighteenth century to the present", it would not have been complete without some mention of the topography, flora, and fauna. Unfortunately, the brevity with which these subjects were treated (two pages for trees and flowers; one and one-half pages for mammals; one-half page each for birds and trout; and one tiny paragraph for insects, amphibians, and reptiles combined) left me with a feeling that I had been slighted just a bit. After all, many of the "human experiences" that have occurred in the Sierra Nevada were prompted by a quest for knowledge of the flora and fauna. I do feel that the happy grasshoppers one sees everywhere above timberline in the summer sun and the ever-present mosquitoes, at least, could have been mentioned along with the butterflies. Then too, a few amphibians are endemic to the area, and some snakes are rare and/or beautiful.

Actually, each of the 21 chapters is a complete story in itself, so that the book can be opened to any one of these and read for pleasure, for enlightenment, or for both. Notes and references at the end of each chapter offer additional background information on a particular subject, or document a given statement.

The frontispiece, a painting, is in color but the remaining 49 illustrations are in black-and-white. These illustrations, whether painting, sketch, or photograph, represent a well-balanced selection covering the *History of the Sierra Nevada.*—*John E. Fitch.*

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