Painter 1979b

JSA

State of California
DEPARTMENT OF FISH AND GAME

Anadromous Fish Conservation Act

Project AFS-17
American Shad Study

FINAL REPORT
JOB NUMBER 4
YOUNG AMERICAN SHAD ECOLOGY

ABSTRACT

Beach seines were used to identify American shad (Alosa sapidissima) nursery areas in the Sacramento River system and in the Sacramento-San Joaquin Delta during 1976, 1977 and 1978. This information will be used in the development of a shad management plan and as baseline data for future comparisons.

Shad nursery areas in the Sacramento River and in the Sacramento-San Joaquin Delta during the study period were located in the: 1) Sacramento River from Meridian to the Delta Cross-Channel, 2) Mokelumne River from in the vicinity of the Delta Cross-Channel to the San Joaquin River, and 3) Feather River from Yuba City to Nicolaus. We found no nursery areas in the Yuba and American Rivers, or in the San Joaquin River Delta. Specific boundaries of nursery areas and abundance in the nursery areas varied with the volumne of annual runoff.

Information on spawning (eggs and larvae) was not collected because of project cutbacks.

BACKGROUND

The ecological requirements of young American shad (Alosa sapidissima) studied in the Sacramento River system and in the Sacramento-San Joaquin Delta during 1976, 1977 and 1978. Shad became abundant in these regions soon after their introduction in 1871 and are presently a prized sport fish. The future for shad in the Sacramento River system, however, is unclear because of the present emphasis on water development (Peripheral Canal): as a result, the California Department of Fish and Game began a shad study in 1975[1/]. The purpose of the study was to 1) define the status of the present fishery, and 2) develop a management plan for future use. As part of the overall project, the ecology of young shad was studied and this paper presents the results of a beach seine survey defining nursery areas. We were unable to collect additional information on spawning (spawning locations, egg and larval abundance, water temperatures, water flows, and salinity) because the project was discontinued early in 1979.

PROCEDURES

Between 1976 and 1978 we sampled young-of-the-year American shad in the Sacramento River system (Figure 1) and in the Sacramento-San Joaquin Delta (Figure 2) from the first week in July through about the last week in September. Stations along the Sacramento, Feather, Yuba, American and Mokelumne Rivers were usually sampled once each week, and stations in the San Joaquin River Delta were sampled irregularly. Beach seines were used to make samples.

Beach seines were used to make samples. Typically, samples were made in moving water in areas accessible with a seine, i.e., sand or mud covered beaches.

1/ Some funds for this study were provided under Federal Anadromous Fish Conservation Act.

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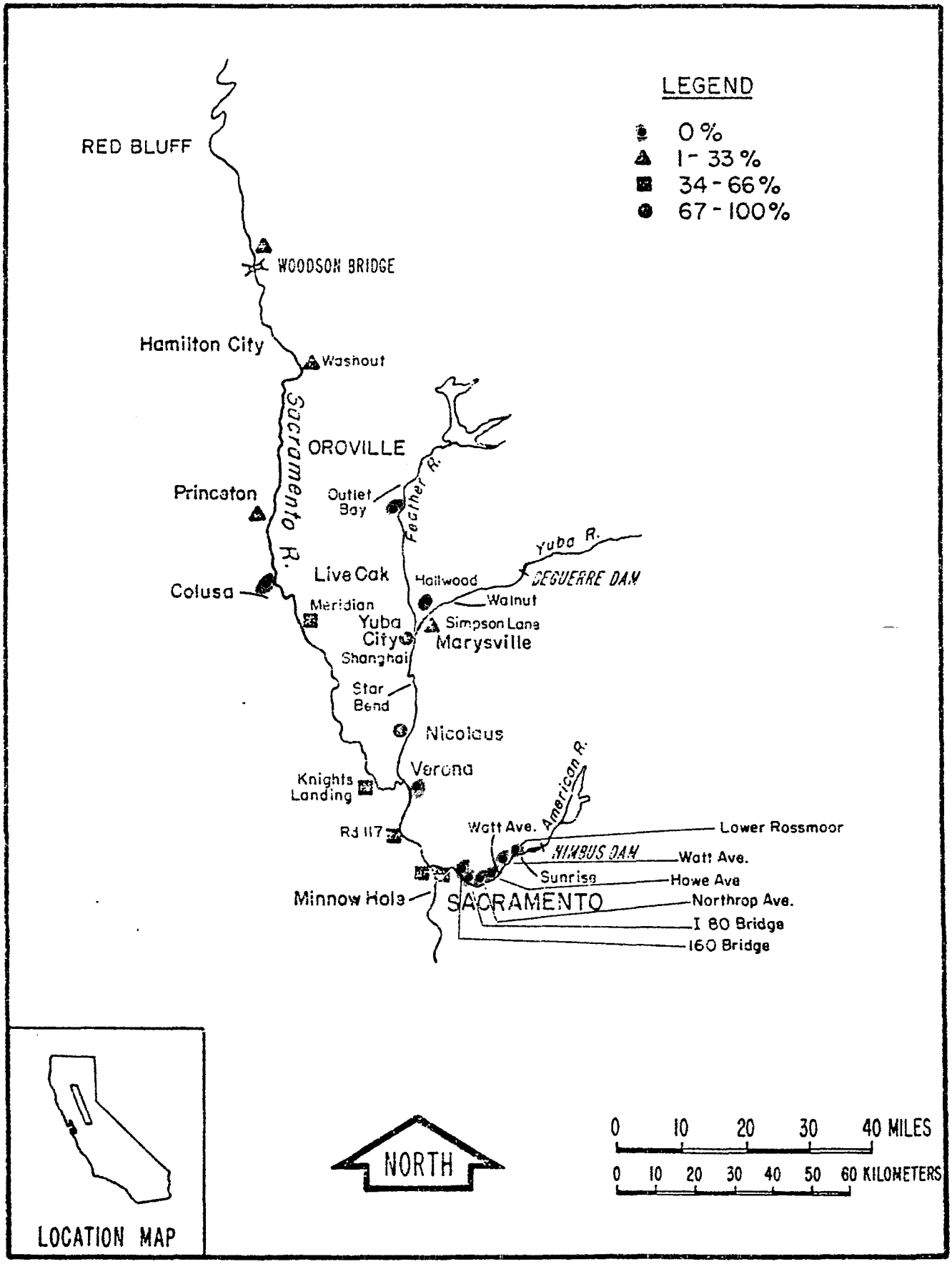

Figure 1. Sacramento River system showing sample sites and percentage of sample days in which shad were captured, 1976-78.

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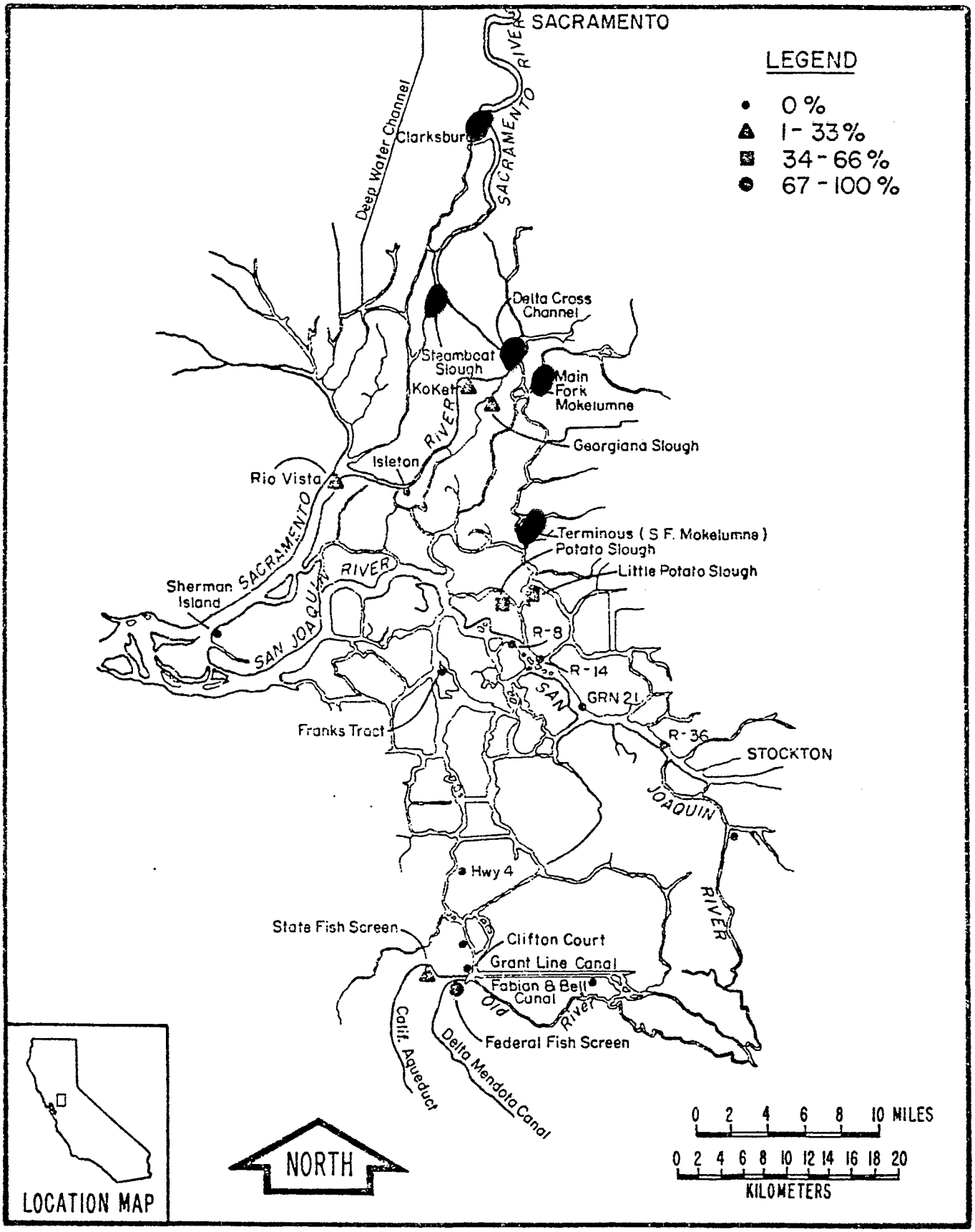

Figure 2. Sacramento-San Joaquin Delta, showing sample sites and percentage of sample days in which shad were captured, 1976-78.

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When the mean shad length was equal to or less than 50 mm (2 in.) FL, a seine 15.24 m long and 2.44 m deep made of 6.4 mm diameter mesh bobbinet (50 ft x 8 ft x .25 in.) was used. After which, a seine 22.9 m long, 1.83 m deep made of 9.5 mm diameter bobbinet (75 ft x 6 ft x .37 in.) was used. Usually two seine hauls per sample day were made at each site. Because of water clarity, night samples were made in the American, Yuba and Feather Rivers, and in the Sacramento River upstream of Verona. All other areas were sampled during daylight hours.

During the summer of 1976 we also collected shad periodically at the Federal fish screen on the Delta-Mendota Canal, and at the State fish screen on the California Aqueduct. These shad were collected during the normal fish salvage operation of the screens (U. S. Department of Interior, 1957).

FINDINGS[2/]

In the Sacramento River, shad were not common at sample sites above Meridian (Figure 1) or at sites below the Delta Cross-Channel (Figure 2). In contrast, shad young were commonly found at sites between these locations, with abundance highest downstream of Sacramento City.

Young shad were common at all sample sites in the Mokelumne River: Main Fork, South Fork, Little Potatoe Slough and Potato Slough. These locations correspond to Delta regions in Sacramento River where similar concentrations of shad were found (Figure 2).

In the Feather River, no young shad were taken at sample sites upstream of Yuba City, however, they were common at all sample sites downstream of Yuba City (Figure 1).

2/ Seine sites, year, dates, mean catches per seine haul, and mean sizes (FL) by river are in Appendix I, Tables 1, 2 and 3.

Young shad were not common in the Yuba and American Rivers, or in the San Joaquin River Delta. In the American and Yuba Rivers, shad were occasionally found near the mouth (Figure 1). In the San Joaquin River Delta, young shad were found only at the Federal and State fish screens at the head of the Delta-Mendota Canal and the California Aqueduct respectively (Figure 2).

ANALYSIS

American shad eggs and larvae begin appearing in the Sacramento River system from around the middle of April to the first week in July when mean temperatures during this period range from 12-22°C (50-71°F) (Lee Miller, pers. comm.[3/]). Young-of-the-year shad begin showing up in June (Stevens, 1966 and Whitesel, 1973) and they continue residence in their freshwater nursery until around November; apparently water temperatures in the vicinity of 15.5°C (60°F) triggers the exodus of shad from their freshwater nursery (Sykes and Lehman, 1957; Chittenden, 1967; Watson, 1970; and Meinz, pers. comm.[4/]).

Shad nursery areas in the Sacramento River and in the Sacramento-San Joaquin Delta during 1976, 1977 and 1978 were located in the: 1) Sacramento River from Meridian to the Delta Cross Channel, 2) Mokelumne River from in the vicinity of the Delta Cross Channel to the San Joaquin River, and 3) Feather River from Yuba City to Nicolaus. We found no shad nursery areas in the American and Yuba Rivers, or in the San Joaquin River Delta (Figures 1 and 2). The upstream boundary of young shad in the Sacramento River was effected by water flows. In 1977 spring and summer flows were low (Table 1) and young shad were frequently

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collected upstream of Meridian; in contrast, 1976 and 1978 flows were higher and no shad were collected upstream of Meridian. Young shad abundance seems also related to spring runoff, i.e., during this three-year study, runoff and catch per effort was highest in 1978. This abundance-runoff relationship is also supported by data collected in the bay-delta midwater trawl survey (Lee Miller, pers. comm.).

Table 1. Mean monthly flows (cfs) in the Sacramento River 1/4 mile downstream of the American River

Year	May	June	July	Aug.	Sept.
1975	30,260	23,710	18,280	19,500	20,380
1976	10,910	10,930	12,080	13,350	12,510
1977	7,597	6,865	8,248	7,687	6,838
1978	25,190	12,660	14,300	15,970	17,930

RECOMMENDATIONS

Without knowing more about spawning locations, and the egg and larval phase of the shad life cycle; we can only recommend that the shad ecology study be continued. Presently, we have been able to determine 1) why spawning shad enter a particular tributary (Painter, 1979), and 2) where young shad nursery, but we still do not understand the relationship between specific rivers and their nurseries which is important due to water development in the Delta region. For example, it is conceivable that the nursery for the upper Sacramento River (fish spawning above the Feather River) lies between Meridian and Sacramento, that the nursery for the Feather and Yuba Rivers lies between Nicolaus and Yuba City, and that the nursery for the American River is in the Delta downstream of Sacramento City. If this is true, shad eggs and larvae would be particularly bulnerable to Delta water diversions on years when high flows in the American River attract

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a large portion of the spawning shad. That is, eggs and larvae from spawning shad in the American River would drift into Delta nursery areas and become subject to water diversions.

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APPENDIX

Appendix Table 1a. Catches and Lengths of Young-of-the-year American Shad Taken Weekly in the Main Sacramento River, July-September, 1976

Location (River Mile)[1/]	I 7/4-10	II 7/11-17	III 7/18-24	IV 7/25-31	V 8/1-7	VI 8/8-14	VII 8/15-21	VIII 8/22-28	IX 8/29-9/4	X 9/5-11	XI 9/12-18
Woodson Bridge (RM 276)	0[2/] –	0 –	0 –	0 –	0 –	0 –	0 –	0.5 –			0 –
Princeton (RM 219)	0 –	0 –	0 –	0 –	0 –	0 –	0 –	0 –			0 –
Meridian (RM 188)				0 –	0 –	0 –	1 35.5	0 –			0 –
Near Mouth American R. (RM 110)	4 30.0		16 32.4	5.5 45.3	2 45.3	18.5 54.3	6.0 53.8	7.0 64.2	17.5 62.3		43 72.6
Clarksburg (RM 92)	0 –		1 –	1 21.3	5.5 71.6	4 51.8	0.5 67.5	0.5 81.0	0 –		
Steamboat Sl. (RM 74)	4 25.4		0 –	4 49.6	1.3 64.5	8.3 53.8	1 63.0	15 61.0	9 72.5		5 79.3
Delta Cross Ch. (RM 77)	0 –		3 19.0	10 35.5	1.5 31.3	10 47.8	3.7 42.5	1.3 50.5	2 46.5		
Georgiana Sl. (RM 74)	0 –		0 –	0 –	0.5 –	0 –	0 –	0 –	0.5 –		
Koket Beach (RM 72)	0 –		0 –	0 –	0.5 –	8 59.6	0.8 49.7	2.8 59.0	0 –		
Rio Vista (RM 65)	5.7 24.8		1 –	0 –	0 –	0 –	0.8 51.3	0 –	1.5 51.7		0 –
Sherman Island (RM 56)				0 –	0 –	0 –					

1/ Miles from Golden Gate Bridge.
2/ Mean number shad per seine haul / Mean FL (mm)

atches and Lengths of Young-of-the-year American Shad Taken Weekly in the Main Sacramento River, July-November, 1977

V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XIX	XX
8/1-7	8-15	16-22	23-29	30-9/4	5-11	12-18	19-25	26-10/2	3-9	10-16	17-23	24-30	31-11/6	7-13	14-20
1	0	0	0	0	0	0	0	0	0.5	0	0				
55.0	-	-	-	-	-	-	-	-	-	-	-				
0	0.5	0	0.5	0	0	0	0.5	0	0	0	0				
-	-	-	-	-	-	-	-	-	-	-	-				
0	0	0.5	0	1	0	0.5	0	0	0	0	0.5				
-	-	-	-	95.5	-	-	-	-	-	-	-				
5	8	5	2	0	0	0	0	0	0.5	1.5	0	0			
64.0	64.4	62.0	44.5	-	-	-	-	-	-	106.7	-	-			
	3	8	14	11	5.5	6	2.5	4.5	0	0	0				
	64.6	64.4	74.4	73.1	74.8	61.8	64.2	72.9	-	-	-				
	0	0					0	1	0						
	-	-					-	94.0	-						
	27	4					0	6	0		0				
	60.7	63.3					-	80.7	-		-				
	1	2		4	0		0	0	1.5		0		0	0	0
	57.5	71.5		66.3	-		-	-	74.7		-		-	-	-
	0		0.5	1.5	0		0	0.5			0		0	.5	0
	-		-	71.7	-		-	-			-		-	96	0
	0		0	1	0		1	0			0				
	-		-	78.0	-		83.0	-			-				
	0		0	0	0		0	0			0		0	0	0
	-		-	-	-		-	-			-		-	-	-

Appendix Table 1c. Catches and Lengths of Young-of-the year American Shad Taken in the Main Stem Sacramento River, 1978.

Location (River Mile)[1/]	I 7/17-23	II 24-30	III 31-8/6	IV 7-13	V 14-20	VI 21-27	VII 28-9/3	VIII 4-10
Woodson Bridge (RM 276)	0[2/] –		0 –		0 –		0 –	
Washout (RM 255)	0 –		0 –		0 –		0 –	
Princeton (RM 219)	0 –		0 –		0 –		1 110.0	
Colusa (RM 205)	0 –		0 –		0 –		0 –	Sampling discontinued due to budget cuts.
Verona (RM 130)	0 –		0 –					
Road 117 (RM 126)	0 –		0 –					
Near Mouth American R. (RM 110)	1 21.5	0 –	0 –	0 –			8 53.3	
Steamboat Sl. (RM 74)	0.5 25.0	0 –		7 49.2			2 60.0	
Delta Cross Ch. (RM 77)	104 37.7	29 41.1		9 42.9			No beach	
Koket Resort (RM 72)	0 –	0 –		0 –			0 –	
Isleton (RM 68)	0 –	0 –		0 –			0 –	
Rio Vista (RM 65)	20 36.2	0 –		0 –			0 –	

1/ Miles from Golden Gate Bridge.
2/ Mean number shad per seine haul / Mean FL (mm)

Appendix Table 2a. Catches and Lengths of Young-of-the-year American Shad Taken Weekly in the Mokelumne River and San Joaquin River Delta, July-September, 1976

Location (River Mile)[1/]	I 7/4-10	II 7/11-17	III 7/18-24	IV 7/25-31	V 8/1-7	VI 8/8-14	VII 8/15-21	VIII 8/22-28	IX 8/29-9/4	X 9/5-11	XI 9/12-18
Mokelumne River											
Main Fork (RM 83)	28[2/] / 42.1		4.7 / 45.6	0.7 / 47.5	7 / 42.2	12.3 / 54.1	14.9 / 53.6	4.9 / 55.4	7.3 / 68.1		1.5 / 70.6
South Fork (RM 79)			1.5 / 53.0	2 / 39.5	2 / 46.0	4 / 58.1					
San Joaquin River											
San Joaquin R. above Stockton (RM 92)		2 / 27.5	0 / -		0 / -	0 / -					
Grantline Canal (RM 89)		0 / -	0 / -	0 / -	0 / -	0 / -					
Federal Fish Screen[3/] at Italian Sl. (RM 83)		0 / -		14 / 69.3		11 / 70.1	2 / 83.5				
Byron Screen[4/] (RM 82)		12 / 23.1		0 / -		0 / -	0 / -				
Franks Track (RM 68)		0 / -									
Old R. at Hwy. 4 (RM 80)				1 / 27.0	0 / -	0 / -					

1/ Miles from Golden Gate Bridge.

2/ Mean number shad per seine haul / Mean FL (mm)

3/ Shad collected in the salvage operation at the fish screen on the Delta-Mendota Canal.

4/ Shad collected in the salvage operation at the fish screen on the California Aqueduct.

es and Lengths of Young-of-the-year American Shad Taken Weekly in the American River, Mokelumne River, and San Joaquin River Delta, 1977

V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XIX	XX
8/1-7	8-15	16-22	23-29	30-9/4	5-11	12-18	19-25	26-10/2	3-9	10-16	17-23	24-30	31-11/6	7-13	14-20
American River															
	1 51.0										0 -				
	0 -										0 -				
	0 -										0 -				
	0 -										0 -				
	0 -										0 -				
Mokelumne River															
	1 39.0		0 -	0 -	1 74.0		0 -	6 74.0			0 -		2 81.0	0.5 87.0	0.5 -
	0 -		2 56.0	3 63.9	0 -	2.5 60.8	0 -	0 -		0 -	2 72.8			0 -	0 -
				1 -						0 -					
				0 -		0 -									
San Joaquin River															
0 -			0 -			0 -				0 -					
0 -						0 -				0 -					
0 -			0 -			0 -				0 -					
0 -						0 -				0 -					

Appendix Table 2c. Catches and Lengths of Young-of-the-year American Shad Taken in the American River, Mokelumne River, and San Joaquin River Delta, 1978

Location (River Mile)[1]	I 7/17-23	II 24-30	III 31-8/6	IV 7-13	V 14-20	VI 21-27	VII 28-9/3	VIII 4-10
American River								
Mouth (RM 110)	0[2] / -	31 / 41.9		16 / 49.1				
16th Bridge (RM 112)	0 / -	0 / -		0 / -				
I80 Bridge (RM 114)	0 / -	0 / -		0 / -				
Northrop (RM 115)	0 / -	0 / -		0 / -				
Mokelumne River								
Main Fork (RM 83)	10 / 38.3	0 / -		17 / 44.8			1 / 60.0	Sampling discontinued due to budget cuts.
South Fork (RM 79)	7 / 61.2	7 / 49.2		14 / 50.1			15 / 59.8	
Little Potato Sl. (RM 76)					2 / 48.8			
Potato Sl. (RM 76)	9 / 38.7				1.5 / 38.3			
San Joaquin River								
Franks Track (RM 68)	0 / -				0 / -			
Bouy R-8 (RM 76)	0 / -				0 / -			
Bouy R-14 (RM 78)	0 / -				0 / -			
Bouy Grn-21 (RM 82)	0 / -				0 / -			
Bouy R-36 (RM 86)	0 / -				0 / -			

[1] River miles from Golden Gate Bridge.
[2] Mean number shad per seine haul / Mean FL (mm)

Appendix Table 3a. Catches and Lengths of Young-of-the-year American Shad Taken Weekly in the Feather and Yuba River, July-September, 1976

Location (River Mile)	I 7/4-10	II 7/11-17	III 7/18-24	IV 7/25-31	V 8/1-7	VI 8/8-14	VII 8/15-21	VIII 8/22-28	IX 8/29-9/4	X 9/5-11	XI 9/12-18
Feather River[1/]											
Below Thermalito (RM 56.0)	0[2/] —	0 —	0 —	0 —	0 —	0 —	0 —	0 —			0 —
Yuba City (RM 26.0)	2 / 46.5	1 / —	2.5 / 57.3	9 / 59.4	9 / 64.7	15 / 69.4	5 / 71.9	4 / 79.9			13 / 86.4
Nicolaus (RM 8.2)	8 / 39.8	1.5 / 49.0	1.7 / 69.6	12 / 68.9	7.5 / 70.1	3 / 74.7	7.5 / 75.1	14.5 / 80.0			22.5 / 89.8
Yuba River[3/]											
Hallwood Beach (RM 6.5)	0 —	0 —	0 —	0 —	0 —	0 —	0 —	0 —			0 —
Simpson Beach (RM 11.0)	0 —	0 —	2 / 68.8	3 / 62.0	0 —	6.5 / 68.3	1.5 / 67.0	3.5 / 67.1			3.5 / 76.9

1/ Miles from confluence of Sacramento and Feather Rivers.

2/ Mean number shad per seine haul / Mean FL (mm)

3/ Miles from confluence of Feather and Yuba Rivers.

Appendix Table 3b. Catches and Lengths of Young-of-the-year American Shad Taken Weekly in the Feather and Yuba Rivers, July-October, 1970

Location (River Mile)	I 7/1-10	II 11-17	III 18-24	IV 25-31	V 8/1-7	VI 8-15	VII 16-22	VIII 23-29	IX 30-9/4	X 5-11	XI 12-18	XII 19-25	XIII 26-10/2	XIV 3-9	XV 10-16	XVI 17-23	XVII 24-30
Feather River[1]																	
Below Thermalito (RM 56.0)		0[2]	0	0	0	0	0	0			0			0			
		–	–	–	–	–	–	–			–			–			
Yuba City (RM 26.0)	0	3	6.5	20	19.5	19	4.5	37	13	12.5	9	2	6	15.5	3	1	0
	–	58.5	52.7	62.0	63.8	65.7	68.4	72.7	75.5	80.6	81.4	81.8	90.7	98.8	103.2	113.0	–
Nicolaus (RM 8.2)	0	3	3	6	4	7	4	4	0.5	3	0	0.5	0	0	0	0	0
	–	60.3	64.8	58.7	65.6	73.6	73.6	78.0	–	87.5	–	–	–	–	–	–	–
Yuba River[3]																	
Hallwood Bch. (RM 6.5)						0					0			0			
						–					–			–			
Simpson Bridge (RM 11.0)	3	1	0	1	0	0	0.5	0	0	0	0	0	0	0	0	0	0
	37.0	–	–	50.0	–	–	–	–	–	–	–	–	–	–	–	–	–

1/ Miles from confluence of Sacramento and Feather Rivers.

2/ Mean number shad per seine haul / Mean FL (mm)

3/ Miles from confluence of Feather and Yuba Rivers.

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Appendix Table 3c. Catches and Lengths of Young-of-the-year American Shad Taken in the Feather and Yuba Rivers, 1978

Location (River Mile)	I 7/17-23	II 24-30	III 31-8/6	IV 7-13	V 14-20	VI 21-27	VII 28-9/3	VIII 4-10	
				Feather River[1/]					
Yuba City (RM 26.0)	2.0[2/] / 51.5		3.5 / 58.3		11.5 / 78.0		37.5 / 82.6		
Nicolaus (RM 8.2)	0 / -		1.5 / 58.0		0 / -		2 / 75.5		
				Yuba River[3/]					
Hallwood Avenue (RM 6.5)	0 / -		0 / -		0 / -		0 / -		Sampling discontinued due to budget cuts.
Simpson Bridge (RM 11.0)	0 / -		0 / -		0 / -		0 / -		

1/ Miles from confluence of Sacramento and Feather Rivers.

2/ Mean number shad per seine haul / Mean FL (mm)

3/ Miles from confluence of Feather and Yuba Rivers.

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