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NOVATO CREEK FLOOD CONTROL PROJECT, MARIN COUNTY

FISHERY RESOURCES CONDITIONS FROM DIABLO AVENUE TO GRANT AVENUE

RECONNAISSANCE-LEVEL SURVEY

Prepared for

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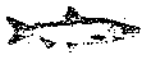

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A.A. RICH AND ASSOCIATES

I. SCOPE OF WORK

As part of the Novato Creek Flood Control Project, *A. A. Rich and Associates* assisted ESA, by providing a general overview of the fishery resources conditions within Novato Creek, in the project area (Diablo Avenue to Grant Avenue, Novato, Marin County). More specifically, the objectives were as follows:

- Determine fish habitat conditions;
- Identify fish species which inhabited or could inhabit the creek;
- Describe relevant fish life stage periodicities and life stage requisites; and,
- Provide recommendations for additional work, if warranted.

II. METHODOLOGY

To achieve the objectives, the following methodology was used:

(1) A one-day (April 18, 1996) field reconnaissance fish habitat survey (i.e., "habitat typing", according to Bisson et al., 1982, modified by Dr. Alice Rich for California streams), to identify fishery resources habitat conditions within the 4,400 foot section of Novato Creek between Grant Avenue and Diablo Avenue in the City of Novato;

(2) Non-quantitative spot-check" electrofishing, using a Smith-Root Type XII Electrofisher) at several sites (Table 1); and,

(3) Review of relevant information (i.e., previous studies, known information on fish life histories, water quality, streamflow, and water temperature data, etc.).

The results from the above were analyzed and discussed in the remainder of this report.

TABLE 1. ELECTROFISHING SITES WITHIN THE PROJECT AREA

General Local	Habitat Type
Novato Creek adjacent to the Pacific Bell building	One lateral scour pool associated with a short (2/3 meter) log
	One lateral scour pool associated with a cement wall
	One short (2 meters long) riffle
Lee Gerner Park near the foot bridge	One lateral scour pool associated with rip-rap, a chair, and shopping cart
Diablo Avenue-downstream side of culvert	One plunge pool associated with culvert under the street
	One lateral scour pool associated with bank cut

III. RESULTS AND DISCUSSION

A. RESULTS OF THE HABITAT SURVEY

The habitat within the project area consisted, primarily, of a series of lateral scour pools, with some low gradient riffles. Most of the lateral scour pools were associated with undercut banks, although there were several pools associated with cement walls, rip-rap and tree roots. The lateral scour pools ranged from lengths of 6-130 meters (m), widths of 1.5-5 m, and depths of 5 centimeters (cm) to over 1 m (rare), with average depths of about 15 cm. The low gradient riffles ranged from lengths of 1-20 m, widths of 0.5-2.5 m, and depths of 3-25 cm. There was ample cover, primarily from canopy and overhanging vegetation, with a few areas of turbulence and rocks, particularly within riffles. Water temperatures ranged from 11°C (morning) to 12°C (afternoon), well within acceptable ranges for steelhead and rainbow trout Substrate consisted primarily of sand and silt, although there were a few areas with small (i.e., pea-size) gravel, marginally suitable for salmonid spawning. Flow was estimated to be between 2-2.5 cubic feet per second (cfs) (USGS flow gage recorded a flow of 2.5 cfs the day before). Although, the creek was fairly clean of human debris, there were five shopping carts, one chair, and red brick which was tumbling down into the creek from a pile of bricks on someone's property near tree # 208.

Although Novato Creek within the project area is suitable for roaches and stickleback, the habitat appeared only marginally suitable for salmonids. Potential spawning areas were few and marginal and, summer water temperatures were presumed to be high, as streamflow would be very low during this time of year. Substrates consisted, primarily, of silt and sand, not the gravel-cobble habitat required by salmonids and salmonid food organisms. Few good salmonid rearing pools existed. One of the pool areas which would be more suitable for salmonids was a pool created by a tree (tree # 208). In addition, a brown alga covered all substrates, a condition one usually observes at the end of the summer, rather than during the spring, indicating that eutrophication was well underway early in the season. Although, there were a few riffles (which would provide oxygen and food for salmonids), the lack of gradient and low flows made these riffles difficult to distinguish from the pool habitats. The existing pools lacked structure (e.g., woody debris) and were very shallow, thus precluding use by larger fish of any species. In summary, Novato Creek within the project area consisted of poor salmonid habitat, a "trout ghetto", if you will. The fact that one small trout was collected in the cursory spot-check electrofishing effort suggested that more trout were present in Novato Creek, as this fish would have had to hatch in the creek. The location of other trout within Novato Creek is unknown.

B. FISHES WHICH INHABIT NOVATO CREEK WITHIN THE PROJECT AREA

1. *Previous Surveys and Observations*

The fish species which have been collected and/or observed in Novato Creek since Stafford Lake was drained in the 1980's include: rainbow/steelhead trout *(Oncorhynchus mykiss),* California roach (*Lavinia symmetricus),* Sacramento sucker *(Catostomus occidentalis),* common carp *(Cyprinus carpio),* goldfish *(Carassius auratus),* mosquitofish *(Gambusia affinis),* black crappie *(Pomoxis nigromaculata),* and threespine stickleback *(Gasterosteus aculeatus).* Some of these fish (e.g., black crappie, carp, sucker) originated in Stafford Lake. Although Stafford Lake has legally been stocked with only bluegill, largemouth bass, and redear sunfish, many other species end up inhabiting the lake, often as a result of "bait" fishing. Each year, the Kiwanis Club plants catchable trout for young anglers, at two sites in Novato Creek. Although, habitat is marginal for rainbow and steelhead trout, a few adult steelhead trout have been observed in Novato Creek in recent years. Although, black crappie probably do not normally inhabit Novato Creek, dozens of them were observed dead, near Diablo Avenue, in February 1996, by Liz Lewis, the County Naturalist. Three frozen specimens were keyed out by Dr. Alice Rich, and confirmed to be black crappie (Cox, 1996, 1987; Leidy, 1993).

2. *Results of April 18, 1996 Non-Quantitative Spot Check Electrofishing Survey*

Fish species collected during the spot-check electrofishing survey were: rainbow/steelhead trout, California roach, Sacramento sucker, carp, and threespine stickleback (Table 2). By far the most abundant species were the native roach and stickleback. The rainbow trout collected was too large (85 mm) to be a young-of-the-year fish (i.e., hatched this spring). It was concluded that this fish was hatched within Novato Creek last spring (1995) and had survived, although it was very thin and not particularly healthy looking. Although, this is the time of the parr-smolt transformation (i.e., anadromous fish change from fresh to saltwater animals and emigrate to sea), it is not known whether or not this fish was an emigrating steelhead or a resident rainbow trout. Due to its small size, the rainbow/steelhead trout could not have been a "catchable" planted by the Kiwanis Club. The carp and sucker were located in a rather shallow cement plunge pool at the downstream end of the culvert under Diablo Avenue, rather marginal habitat, at best, even for these two hardy species.

TABLE 2. RESULTS OF "SPOT CHECK" ELECTROFISHING WITHIN THE PROJECT AREA

General Local	Habitat Type	Fish Species Collected
Novato Creek adjacent to the Pacific Bell building	One lateral scour pool associated with a short (2/3 meter) log	Rainbow/Steelhead Trout (1 fish - 85 mm fork length) California roach (many) Threespine stickleback (many)
	One lateral scour pool associated with a cement wall	California roach (many) Threespine stickleback (many)
	One short (2 meters long) riffle	California roach (many) Threespine stickleback (many)
Lee Gerner Park near the foot bridge	One lateral scour pool associated with rip-rap, a chair, and shopping cart	California roach (many) Threespine stickleback (many)
Diablo Avenue-downstream side of culvert	One plunge pool associated with culvert under the street	Sacramento sucker (1) Carp (l)
	One lateral scour pool associated with bank cut	California roach (many) Threespine stickleback (many)

TABLE 3. LIFE STAGE REQUISITES OF STEELHEAD TROUT

LIFE STAGE	OPTIMAL WATER TEMPERATURE	DISSOLVED OXYGEN (mg/l)	PH	WATER DEPTH	WATER VELOCITY	TURBIDITY (mg/l)	SUBSTRATE SIZE
Immigration/Passage	7.8-11.2 °C 46.0-52.0 °F	≥ 7 at ≤ 15 °C ≥ 9 at > 15 °C	7-8	≥ 18 cm ≥ 7 in	0-4.2 m/s 0-13.7 ft/s	≤ 25	N/A
Spawning	7.8-11.2 °C 46.0-52.0 °F	≥ 7 at ≤ 15 °C ≥ 9 at > 15 °C	7-8	≥ 18 cm ≥ 7 in	0.2 -1.7 m/s 0.7-5.6 ft/s	≤ 25	1.3-10 cm 0.5-4.0 in
Incubation	7.8-11.2 °C 46.0-52.0 °F	≥ 7 at ≤ 15 °C ≥ 9 at > 15 °C	7-8	≥ 18 cm ≥ 7 in	0.2 -1.7 m/s 0.7-5.6 ft/s	≤ 25	1.3-19 cm 0.5-4.0 in
Fry Emergence	8.9-11.2 °C 48.0-52.0 °F	≥ 7 at ≤ 15 °C ≥ 9 at > 15 °C	7-8	fry: 8-[ ] cm 3-14 in juvenile: 25-50 cm 10-20 in	0.2 -1.7 m/s 0.7-5.6 ft/s	≤ 25	1.3-10 cm 0.5-4.0 in
Rearing	12.8-15.6 °C 55.0-60.1 °F	≥ 7 at ≤ 15 °C ≥ 9 at > 15 °C	7-8	18-67 cm 7-26 in	0.1-1.5 *m*/s 0.3-4.9 ft/s	≤ 25	6.3-30 cm 2.5-12 in
Smoltification/ Emigration	7-11.3 °C 44.6-52 °F	≥ 7 at ≤ 15 °C ≥ 9 at > 15 °C	7-8	18-67 cm 7-26 in	0.1-1.5 m/s 03-4.9 ft/s	≤ 25	6.3-30 cm 2.5-12 in

cm	=	centimeters	cm/s	=	centimeters per second	in	=	inches
ft	=	feet	ft/s	=	feet per second	≥	=	greater than or equal to
C	=	centigrade	>	=	greater than	≤	=	less than or equal to
F	=	fahrenheit	<	=	less than			

Sources: Rich, 1987; Folmar and Dickhoff, 1980; Phillips el al., 1975; Smith, 1973; Zaugg and Wagner, 1973; Zaugg et al., 1972; Dickson and Kramer, 1971; Doudoroff and Shumway, 1970; Orcutt et al., 1968; Shapovalov and Taft, 1954

TABLE 4. LIFE STAGE REQUISITES OF RAINBOW TROUT

LIFE STAGE	OPTIMAL WATER TEMPERATURE	DISSOLVED OXYGEN (mg/l)	PH	WATER DEPTH	WATER VELOCITY	TURBIDITY (mg/l)	SUBSTRATE SIZE
Spawning	12-18 °C 54-64 °F	≥ 7 at ≤ 15 °C ≥ 7 at ≤ 59 °F ≥ 9 at > 15 °C ≥ 9 at > 59 °F	6.5-8	> 18 cm > 7 in	≤ 1.2 m/s ≤ 4 ft/s	≤ 25	fish < 0.5 m long: 1.5-6 cm 0.6-2.4 in fish ≥ 0.5m long: 1.5-10 cm 0.6-4 in
Incubation	12-18 °C 54-64 °F	≥ 7 at ≤ 15 °C ≥ 7 at ≤ 59 °F ≥ 9 at > 15 °C ≥ 9 at > 59 °F	6.5-8	> 18 cm > 7 in	≤ 0.5-0.9 m/s ≤ 1.6-3 ft/s	≤ 25	0.3-10 cm 0.1-4 in
Fry Emergence	12-18 °C 54-64 °F	≥ 7 at ≤ 15 °C ≥ 7 at ≤ 59 °F ≥ 9 at > 15 °C ≥ 9 at > 59 °F	6.5-8	> 18 cm > 7 in	≤ 0.1-0. 3 m/s ≤ 0.3-1.0 ft/s	≤ 25	0.3-10 cm 0.1-4.0 in
Rearing	15-18 °C 59-64 °F		6.5-8	> 18 cm > 7 in	fry: ≤ 0.1-0.3 m/s ≤ 0.3-1.0 ft/s juvenile: ≤ 0.1-0.2 m/s ≤ 0.3-0.7 ft/s	≤ 25 m/s	.1.5-10 cm 0.6-4 in
Adult	15-18 °C 59-64 °F	≥ 7 at ≤ 15 °C ≥ 7 at ≤ 59 °F ≥ 9 at >15 °C ≥ 9 at > 59 °F	6.5-8	> 18 cm > 7 in	≤ 0.1-0.7 m/s ≤ 0.4-2.4 ft/s	≤ 25	1.5-10 cm 0.6-4 in

cm	= centimeters	cm/s	=	centimeters per second	in	=	inches
ft	= feet	ft/s	=	feet per second	≥	=	greater than or equal to
C	= centigrade	>	=	greater than	≤	=	less than or equal to
F	= fahrenheit	<	=	less than			

Sources: Rich. 1987; Horner and Bjornn, 1976; Smith, 1973; Hooper, 1973; Thompson, 1972; Doudoroff and Shumway, 1970; Orcutt et al., 1968

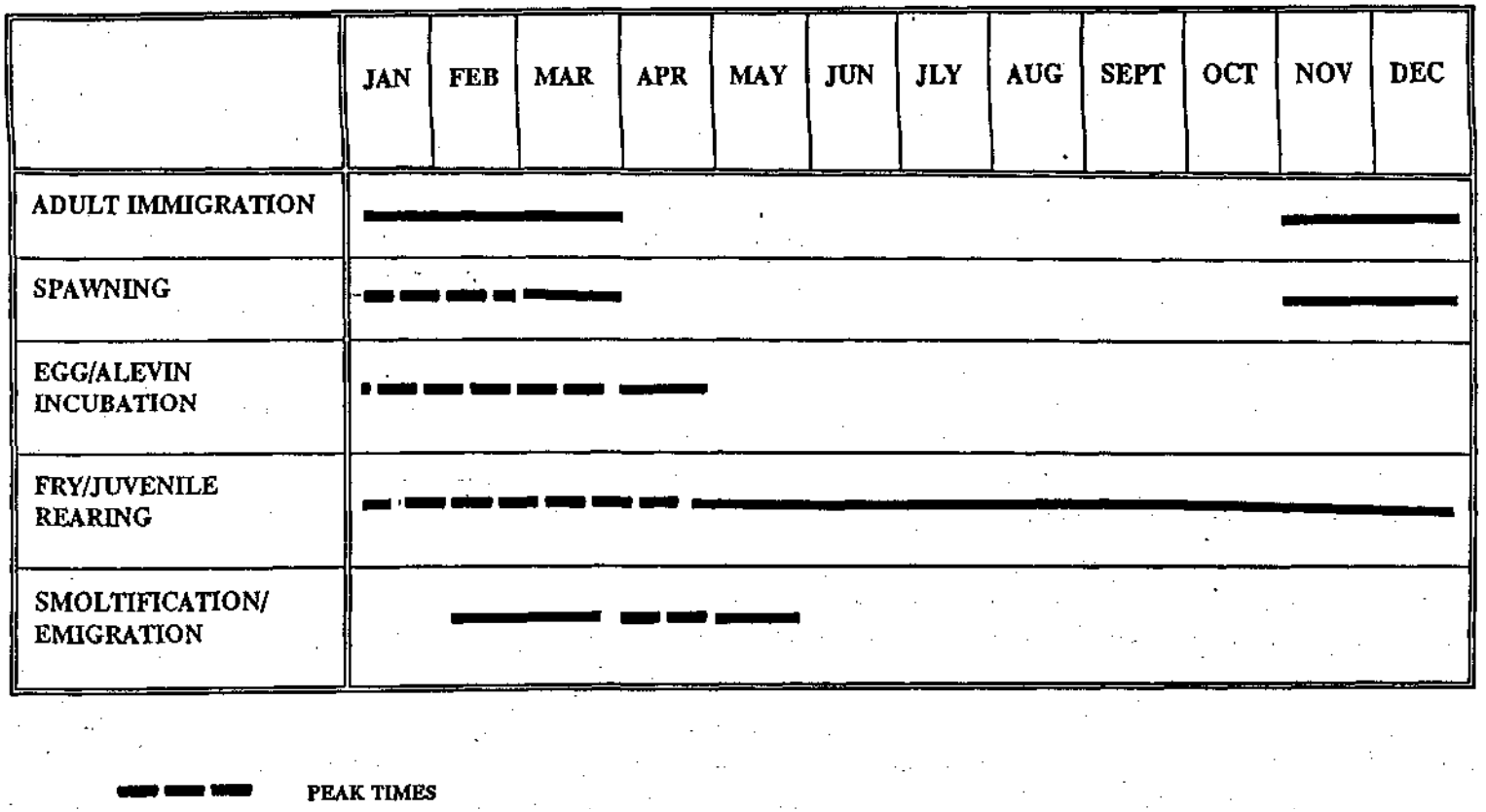

FIGURE 1. STEELHEAD TROUT LIFE STAGE PERIODICITIES

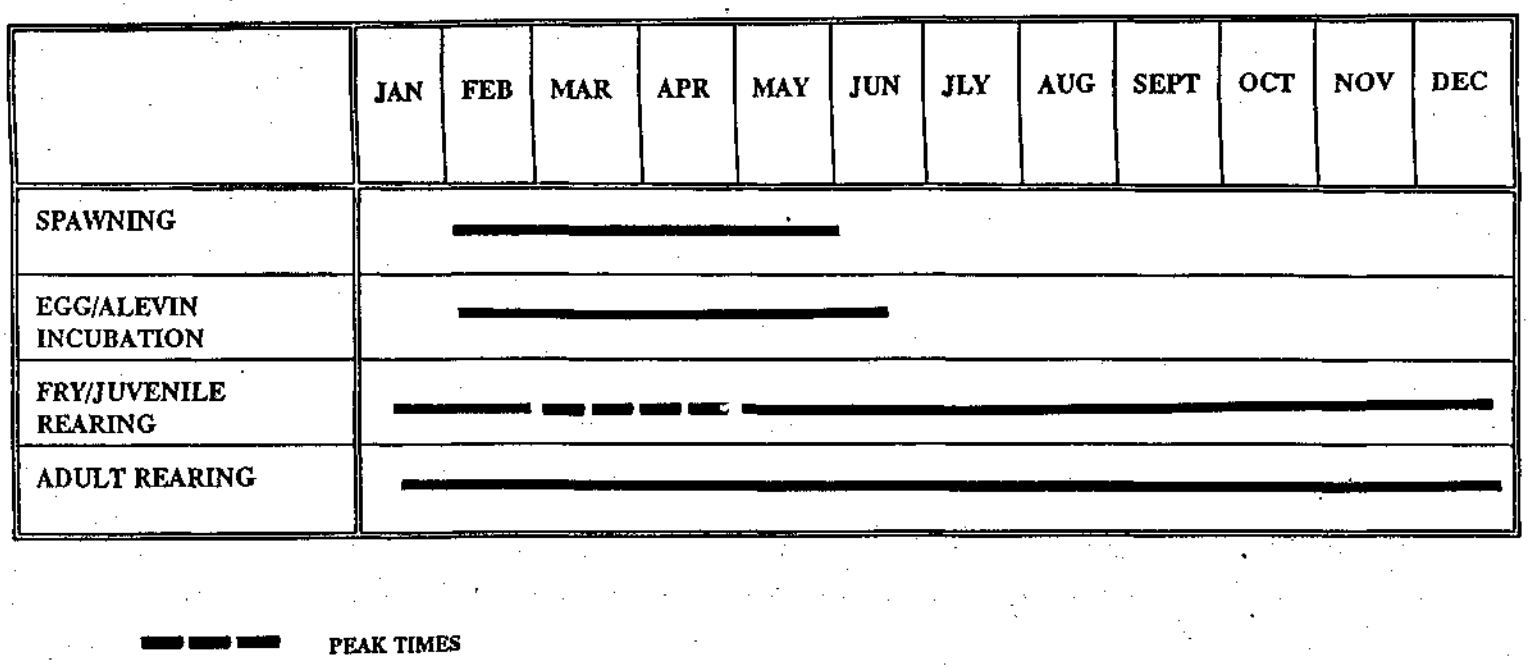

FIGURE 2. RAINBOW TROUT LIFE STAGE PERIODICITIES

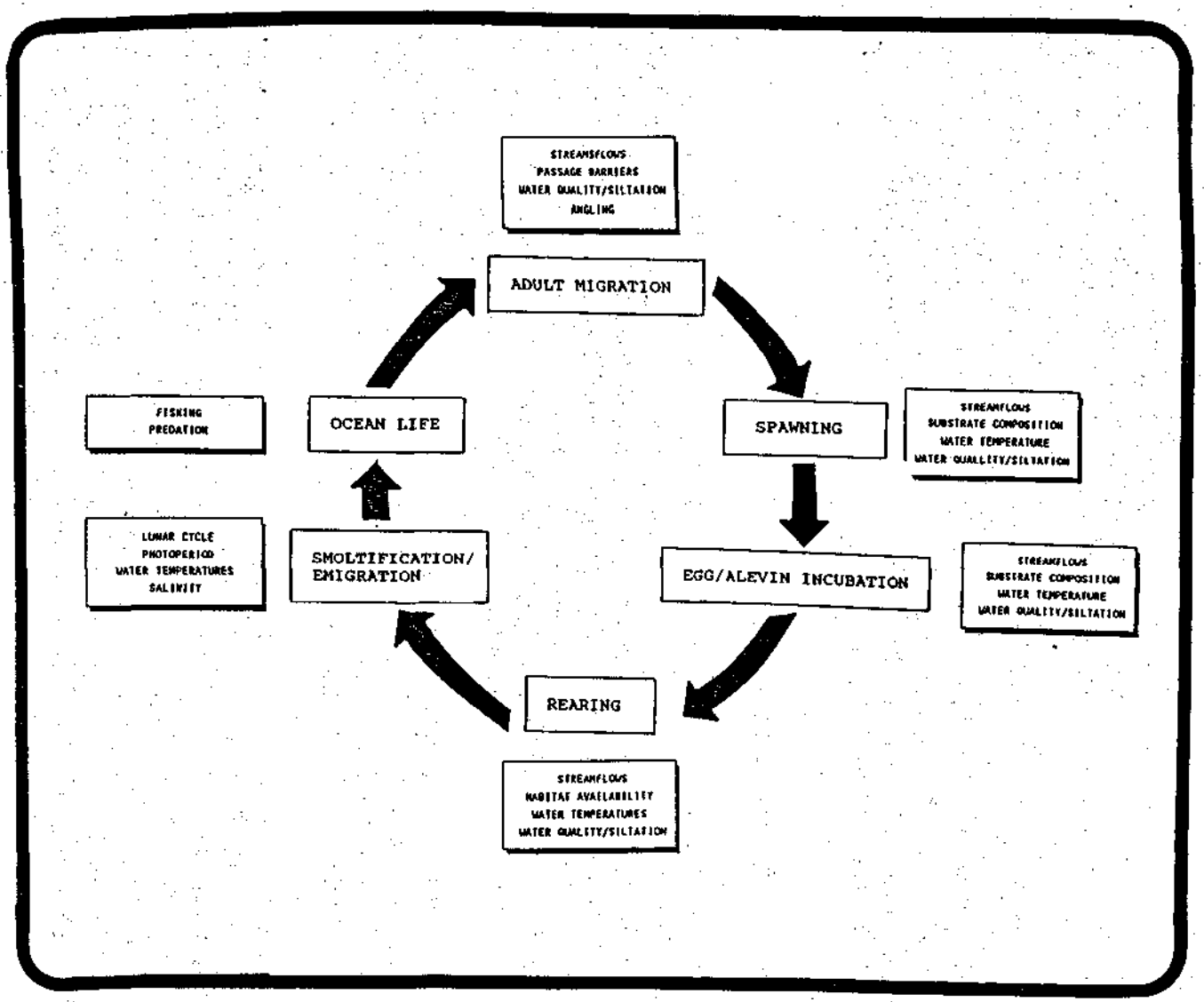

FIGURE 3. FACTORS WHICH AFFECT FISHERY RESOURCES

b. *California Roach*

California roach are one of the most abundant native fishes. One key to their survival appears to be their ability to survive where large native fishes cannot (e.g., 35°C; dissolved oxygen of 1-2 ppm). California roach usually inhabit small, intermittent, tributaries to larger streams. The main food type is filamentous algae, although they also eat aquatic insects, small crustaceans, and larval fishes. Although, few roach live longer than three years, the oldest roach on record is a five-year specimen from San Anselmo Creek, Marin County. Spawning occurs from March through June. The fish move up from pools into shallow, flowing areas where the substrate is covered with small (3-5 cm) gravel. They spawn in schools in crevices between rocks. The eggs are adhesive, sticking to rocks as they are deposited. The fish hatch in two to three days and the newly hatched fry remain in the crevices until they are large enough to swim actively around (Barnes, 1957; Fite, 1973; Greenfield and Deckert, 1973; Moyle, 1976).

c. *Threespine Stickleback*

There are two types of threespine stickleback: (1) Estuarine anadromous; and, (2) Freshwater resident. Both forms may exist in Novato Creek. Although, rarely living beyond one year, they are a hardy fish with a great ability to adapt, either to fresh or brackish water. Two adaptive features of the stickleback have enabled it to survive, despite its small (60-80 mm length) size. First, the dorsal fin has three spines which the fish can maneuver into an upright position, thus diminishing its delectability to predators. Second, it is extremely euryhaline (i.e., it can withstand wide variations in salinity concentrations).

Stickleback inhabit quiet water, in weedy pools and backwaters, or among emergent plants at the edges of creeks. Generally, they require cool water and are seldom found in waters warmer than 24°C. In addition, as they are visual feeders (as evidenced by their large eyes), they rarely occur in turbid water (Table 5).

Their life cycle is as follows. Spawning occurs in the spring and summer months. The breeding cycle lasts two or three months, during which an elaborate courtship ritual occurs. Once the eggs hatch (six to eight days at 18-20 °C), the fry remain in the nests for a couple of days. Once the fry begin to swim about, the male continues to guard them, grabbing wanderers in its mouth and spitting them back into the main school. Eventually, the fry become more active; the male has more difficulty in guarding them, and begins the spawning cycle again with another female, or joins a school of fish that have finished reproducing. The young fish join schools of similar sized fish.

TABLE 5. HABITAT REQUIREMENTS OF THE THREESPINE STICKLEBACK

	ESTUARINE	HABITAT	FRESHWATER	HABITAT
	Overwintering	Breeding	Overwintering	Breeding
Period of Occupation	September-April	May-August	September-February	March-August
Substrate	Sand	Sand, Mud	Fine gravel	Mud
Vegetation	Variable	Abundant	Sparse	sparse
Water Depth	More than 1 meter	Less than 1 meter	Less than 1-5 meters	Less than 0.5 meters
Water Current	Strong	Moderate	Moderate	Weak
Water Temperature	10-15 °C	18-22 °C	12-17 °C	18-22 °C
Salinity	Approximately 30 parts per thousand	0-1 parts per thousand	0 parts per thousand	0 parts per thousand

Source: Snyder and Dingle, 1989; Moyle, 1976

IV. CONCLUSIONS AND RECOMMENDATIONS

From the reconnaissance survey, the following conclusions were made, regarding Novato Creek, within the project area:

(1) Although, there are an assortment of fish species which have been observed and/or collected in Novato Creek, due to habitat conditions, probably only the rainbow/ steelhead trout, California roach, and threespine stickleback use Novato Creek to reproduce and grow;

(2) The suckers, mosquitofish, carp, and black crappie were introduced, either by escape from Stafford Lake or by introduction of unknown origin (e.g., bait from fishermen, aquariums, fish ponds);

(3) Native roach and stickleback appeared to be thriving within the project area;

(4) The area did not provide suitable salmonid (e.g., trout) habitat, due to a variety of factors, including the lack of spawning and rearing habitat;

(5) Although the creek was fairly free of trash, five shopping carts, one chair, and several tires were observed within the project area;

(6) Although, steelhead trout have been observed in Novato Creek, it is not known the extent of habitat use and population size of this species. The one salmonid collected could have been a rainbow or a steelhead trout. Steelhead trout would pass through the project area, both as adults (spawning immigration) and juveniles (parr-smolt transformation and emigration). The "spot-check" survey was not sufficient to determine the use of salmonids within or upstream of the project area. Therefore, the long-term impacts of dredging the channel are not known.

(7) To determine salmonid use and population size within Novato Creek, it is recommended that a more rigorous fishery resources survey be conducted in Novato Creek, both within and upstream of the project area;

(8) To determine the long-term impacts of the flood control project (i.e., dredging, deepening of channel, levee improvements, etc.) on salmonids, it is recommended that fishery resources surveys be conducted a year or more after the project; and,

(9) It is recommended that the volunteer creek clean-up include the removal of the trash in the creek.

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