APPENDIX N.

PERMITS, AGREEMENTS, AND ENVIRONMENTAL DOCUMENTS

Each instream fish habitat restoration project requires some type of permit, although the number and type of permits necessary will depend on the type of project being considered. One or more of the following permits may be required:

- **Access Agreement**. This agreement is necessary to not only do the development work, but to enter onto property other than your own to do preliminary survey work. This agreement must be reached between the project sponsor and the property owner or manager (examples 1 and 2).

- **Streambed Alteration Agreement**. This agreement, issued by the Department of Fish and Game, is necessary to perform any physical manipulation of the stream, including vegetation, within the high water mark. (Fish and Game Code, Sections (1601/1603)

- **U.S. Army Corps of Engineers 404 Permit**. This permit, required pursuant to the Clean Water Act, may or may not be needed, but if the project proposes removal or placement of any materials in the stream area, or if the project area is a wetland, then the project proponent must apply to the Corps of Engineers to determine if a permit is necessary.

- **U.S. Army Corps of Engineers Section 10 Permit**. This permit, required pursuant to the Harbors and Rivers Act, is to be obtained for any construction between high water marks of navigatable rivers.

- **Section 401 of the Clean Water Act**. Section 401 of the Clean Water Act requires that the California Regional Water Quality Control Board determine consistency between proposed projects, California water quality laws, and certain sections of the Clean Water Act. The California Regional Water Quality Control Board has established specific procedures for implementing this section. The project proponent may be required to submit a "Request for Certification" form to the California Regional Water Quality Control Board.

- **Department of Fish and Game Trapping and Rearing Permit**. If your restoration project is for to rearing fish, then a trapping and rearing permit must be obtained from the Department before any fish may be handled. This permit process requires the applicant to submit and have approved a five-year management plan before the permit will be issued (Appendix B). Contact the local DFG district fishery biologist.

- **County and State Right-of-Way permits**. If your project is near any roads it could require agreements or permits with county and state public works departments. In addition, many counties have ordinances against working within a riparian corridor along a stream area. This usually falls under the county planning department.

- **State Lands Commission**. State Lands Commission is a permitting agency responsible for riverbed lands owned in fee by the State as sovereign lands, subject to the public trust for water-related commerce, navigation, fisheries, recreation, open space, and habitat. Project proponents should contact the State Lands Commission to determine if the project falls under Commission jurisdiction.

- **California Environmental Quality Act (CEQA)**. Anytime an individual or a group (including public agencies), contracts with the Department of Fish and Game for fish habitat restoration projects, an environmental review is necessary. Individuals or groups conducting habitat restoration projects in a volunteer capacity may also need to have an environmental review of proposed projects, and should discuss proposed projects with the DFG district fishery biologist during the planning stages.

- **National Environmental Policy Act (NEPA).** This applies to projects which are carried out, financed, or approved in whole or part by federal agencies.

- **National Marine Fisheries Service (NMFS)**. Written authorization must be obtained for any activities that may impact a federally listed species.

California Environmental Quality Act (CEQA)

Anytime an individual or group enters into a contract with the Department of Fish and Game, or the Wildlife Conservation Board, an environmental review of the project is necessary. A "project" is defined as any action which may result in a physical change in the environment. This is the case in any fish habitat restoration project.

POLICY

California Department of Fish and Game (DFG) policy requires that consideration of potential environmental impacts of all actions is of highest priority, and that DFG shall involve affected Federal, State, and local agencies, private organizations, and members of the public to the fullest extent practicable in the environmental assessment process.

PROCESS

Fish and Game personnel will conduct an internal informal consultation with appropriate staff to determine CEQA documentation needed for its projects based on interpretation of the CEQA statutes and guidelines. Projects may be found to be categorically exempt. If this is the level of documentation necessary then a categorical exemption will be prepared, circulated within the Department, and then filed in the Governor's Office of Planning and Research, State Clearinghouse. If projects do not qualify for this exemption, then it is raised to the next level of environmental review, Negative Declaration. If a Negative Declaration is not sufficient then an Environmental Impact Report (EIR) must be prepared.

CATEGORICAL EXEMPTION

Categorically exempt projects are those which fall within one of many classes which have been determined by the Secretary for Resources not to have significant adverse environmental effects. An environmental checklist (example 3) and initial study is used to determine if the project is categorically exempt.

NEGATIVE DECLARATION

A negative declaration consists of an initial study, environmental checklist and a formal finding that the project will not have a significant adverse effect. The document contains: 1) description and title of the project; 2) location of the project with accompanying maps; 3) proposed finding that the project will not have significant adverse effect on the environment; 4) copy of the initial study documenting reasons to support the finding; and 5) mitigation measures, if any, included in the project to avoid potentially significant negative effects.

ENVIRONMENTAL IMPACT REPORT

An Environmental Impact Report is an informational document that must be considered by each affected agency prior to its approval or disapproval of a project. Environmental Impact Reports provide agencies and the public with detailed information about the environmental effects of proposed projects; lists ways in which the significant effects of such a project might be minimized; and indicates alternatives to projects. This level of review is time consuming and expensive and would reduce the cost effectiveness of most fish habitat restoration projects.

EXAMPLE
(RIPARIAN AREA MANAGEMENT PLAN AGREEMENT)
ACME STUMP GRUBBERS
P.O. Box 456
Halfway Hill, CA 95677

RIPARIAN AREA MANAGEMENT PLAN AGREEMENT

I. PURPOSE

The following agreement details the requirements of both the landowner and the Acme Stump Grubbers regarding a livestock exclusion, riparian vegetation restoration project on the real property controlled by the landowner named below. Said property is located approximately two miles upstream of the mouth of Trickle Creek, tributary to Ample Creek (see map attached to proposal).

I, _____, hereinafter called "Landowner", am aware that a riparian vegetation restoration project has been submitted to the California Department of Fish and Game for funding consideration. I understand the objectives of the project as proposed in the Trickle Creek Stream Restoration Project #1. The project has been explained to me by Acme Stump Grubbers. I support the goals of the project.

For the purpose of this agreement, riparian area shall be defined as the area, including the necessary fence(s), between the fence(s) and the middle of the stream channel. This specifically includes the stream bank and associated vegetation within this area.

I understand the purpose of the livestock exclusion fence detailed in the proposal mentioned above is to exclude livestock from the riparian zone on my property. The fence will allow mature riparian vegetation to become reestablished. A mature riparian community will provide increased stream bank stability, shade and cover for fish and wildlife. The project can only be successful if the fence is maintained long enough for the riparian community to become reestablished.

II. REQUIREMENTS

Acme Stump Grubbers agrees to:

1. Contingent on receiving funding from the California Department of Fish and Game, provide monies for purchase of materials and supplies to construct livestock exclusion fencing on landowners real property as described in proposal.

2. Provide labor necessary for initial installation of livestock exclusion fencing on landowner's real property.

3. Provide technical assistance during the contract life for management of the riparian area.

Landowner agrees to:

1. Maintain livestock exclusion fence(s) for a period of 10 years from the last date of execution shown below. Maintenance will include repair of fences to a level that will effectively exclude livestock from the livestock exclusion project area. Maintenance will not include damage that exceeds 50 percent of the fence due to natural disaster.

2. Totally exclude livestock from the project area until newly planted trees become well-established. If controlled, limited grazing is essential, landowner will submit a written plan, to the California Department of Fish and Game for approval, that will detail how the limited grazing will not cause damage to desirable vegetation or stream banks within the project area.

3. Once it has been established by the California Department of Fish and Game that limited grazing within the project area is acceptable, grazing will be limited to an amount that will not cause damage to the newly planted trees or stream banks. Generally acceptable limits will be to remove 50 percent of the current year growth of grasses and forbs. Livestock shall be removed before they begin to browse on woody plants. Newly planted trees damaged by browsing will be replaced at landowners expense.

III. DURATION OF NOTICE

The term of this agreement shall be _____ months for work performance, and 10 years for maintenance, inspection, and monitoring purposes from the last date of execution shown below. This is provided that Acme Stump Grubbers or the California Department of Fish and Game shall give Landowner reasonable actual notice prior to each needed access. Reasonable and actual notice may be given by mail, in person, or by telephone.

This agreement can be amended only by prior written agreement of both parties executing this permit.

IV. LIABILITIES

Reasonable precautions will be exercised by Acme Stump Grubbers to avoid damage to persons and property.

Acme Stump Grubbers agrees to indemnify and hold harmless the landowner and agrees to pay for reasonable damages proximately caused by reason of the uses authorized by this permit, except those caused by the gross negligence or intentional conduct of the landowner.

Date _____

_____
Landowner Signature

Date _____

_____
Chuck E. Chainsaw
Acme Stump Grubbers

EXAMPLE
(LANDOWNER AGREEMENTCCOOPERATIVE FISH REARING PROJECTS)
Dry Creek Salmon Enhancement Project
P.O. Box 123, Pine Valley, CA 95678
Access/Entry Agreement

I. PURPOSE

The following agreement details requirements of both the landowner and the Dry Creek Salmon Enhancement Project regarding establishment of a fishery enhancement project on real property controlled by the landowner named below. Said property is located four and one half miles from the mouth of Dry Creek, tributary to Muddy River (See map attached to proposal).

I, _____, hereinafter referred to as "Landowner", am aware that a fish rearing facility and trapping sites are located on Dry Creek, tributary to Muddy River, located on Big Trees Lumber Company property. The project has been explained to me by the Dry Creek Salmon Enhancement Project. I support the goals of the project.

II. ACCESS PERMISSION

Landowner hereby grants Dry Creek Salmon Enhancement Project and California Department of Fish and Game representatives permission to enter onto real property owned by the Landowner to perform pre-project evaluation; and, if an agreement for the project is entered into between the Dry Creek Salmon Enhancement Project and the California Department of Fish and Game, Landowner grants permission to perform the fishery enhancement work, to conduct field inspections, and to monitor project for needed maintenance or equipment removal for the life of the project. Access shall be limited to those portions of landowner=s real property where actual fishery enhancement work is to be performed and those additional portions of real property which must be traversed to gain access to the work site.

III. DURATION OF NOTICE

The term of this agreement shall commence upon signing of this Agreement and terminate on _____. This Agreement may be terminated by either party at any time, without cause, upon sixty (60) days written notice to the other party.

IV. LIABILITIES

Reasonable precautions will be exercised by Dry Creek Salmon Enhancement Project to avoid damage to persons and property.

Dry Creek Salmon Enhancement Project agrees to indemnify and hold harmless the landowner and agrees to pay for reasonable damages proximately caused by reason of the uses authorized by this permit, except those caused by the gross negligence or intentional conduct of the landowner.

Date _____ _____
Landowner Signature

Date _____ _____
Bob R. Float
Dry Creek Salmon Enhancement Project

ENVIRONMENTAL CHECKLIST FORM

PROJECT LOCATION: _____ City _____ County

PROJECT ADDRESS: _____

_____

PROJECT DESCRIPTION: _____

_____

_____

ENVIRONMENTAL IMPACTS:

(CEQA requires that an explanation of all "yes" and "maybe" answers be provided along with this checklist, including a discussion of ways to mitigate the significant effects identified. You may attach separate sheets with the explanations.)

		Yes	**Maybe**	**No**
I.	EARTH. *Will the proposal result in:*			
a.	Unstable earth conditions or changes in geological substructures?	_____	_____	_____
b.	Disruptions, displacements, compaction or overcovering of the soil?	_____	_____	_____
c.	Change in topography or ground surface relief features?	_____	_____	_____
d.	The destruction, covering or modification of any unique geologicor physical features?	_____	_____	_____
e.	Any increase in wind or water erosion of soils, either on or off the site?	_____	_____	_____

	Yes	Maybe	No
f. Changes in deposition or erosion of beachsands, or changes in siltation, deposition or erosion which may modify the channel of a river or stream or the bed of the ocean or any bay, inlet or lake?	_____	_____	_____
g. Exposure of people or property to geologic hazards, such as earthquakes, landslides, mudslides, ground failure, or similar hazards?	_____	_____	_____
II. WATER. *Will the proposal result in:*			
a. Substantial changes in currents, or the course of direction of water movements, in either marine or freshwaters?	_____	_____	_____
b. Changes in absorption rates, drainage patterns, or the rate and amount of surface runoff?	_____	_____	_____
c. Changes in the amount of surface water in any water body?	_____	_____	_____
d. Discharge into surface waters, or in any alteration of surface water quality, including, but not limited to, temperature, dissolved oxygen, petroleum products or turbidity?	_____	_____	_____
e. Change in the quantity of ground waters, either through direct additions or withdrawals, or through interception of an aquifer by cuts or excavations?	_____	_____	_____
f. Substantial reduction in the amount of water otherwise available for public water supplies?	_____	_____	_____
g. Exposure of people or property to water related hazards such as flooding or tidal waves?	_____	_____	_____

	Yes	Maybe	No
III. PLANT LIFE. *Will the proposal result in:*			
a. Change in the diversity of species, or number of any species, including upland, riparian and aquatic plants?	_____	_____	_____
b. Reduction of the numbers of any unique, rare, or endangered species of plants?	_____	_____	_____
c. Introduction of new species of plants into an area, or in a barrier to the normal replenishment of existing species?	_____	_____	_____
d. Reduction in acreage of any agricultural crop?	_____	_____	_____
IV. ANIMAL LIFE. *Will the proposal result in:*			
a. Change in the diversity of species, or numbers of any species of animals (birds; land animals, including reptiles; fish and shellfish; benthic organisms or insects)?	_____	_____	_____
b. Reduction of the numbers of any unique, rare, or endangered species or animals?	_____	_____	_____
c. Introduction of new species of animals into an area, or result in a barrier to the migration or movement of animals?	_____	_____	_____
d. Deterioration to existing fish or wildlife habitat?	_____	_____	_____
e. Result in activities during sensitive life stages, i.e. nesting, spawning, incubation, fry emergence, etc.	_____	_____	_____
V. NOISE.			
a. Will the proposal result in increases in existing noise levels?	_____	_____	_____

	Yes	Maybe	No
VI. LAND USE.			
a. Will the proposal result in substantial alteration of, or conflict with, the present or planned land use of an area, i.e. mining or timber harvest?	_____	_____	_____
VII. NATURAL RESOURCES.			
a. Will the proposal result in an increase in the rate of use of any natural resources?	_____	_____	_____
VIII. RISK OF UPSET. *Will the proposal involve:*			
a. A risk of an explosion or the release of hazardous substances (including, but not limited to oil, pesticides or chemicals) in the event of an accident or upset conditions?	_____	_____	_____
b. Possible interference with an emergency response plan or an emergency evacuation plan?	_____	_____	_____
IX. TRANSPORTATION/CIRCULATION. *Will the proposal result in:*			
a. Generation of substantial additional vehicular movement?	_____	_____	_____
b. Substantial impact upon existing transportation systems?	_____	_____	_____
X. PUBLIC SERVICES. *Will the proposal have an effect upon, or result in a need for new or altered governmental services in any of the following areas:*			
a. Parks or other recreational facilities?	_____	_____	_____
b. Maintenance of public facilities, including roads?	_____	_____	_____

	Yes	Maybe	No
XI. HUMAN HEALTH.			
a. Will the proposal result in exposure of people to potential health hazards?	_____	_____	_____
XII. AESTHETICS. *Will the proposal result in:*			
a. The obstruction of any scenic vista or view open to the public?	_____	_____	_____
b. The creation of an aesthetically offensive site open to public view?	_____	_____	_____
XIII. RECREATION.			
a. Will the proposal impact upon the quality or quantity of existing recreational opportunities including boating or kayaking?	_____	_____	_____
XIV. CULTURAL RESOURCES. *Will the proposal:*			
a. Result in the alteration of or the destruction of a prehistoric or historic archaeological site?	_____	_____	_____
b. Result in adverse physical or aesthetic effects to a prehistoric or historic building, structure, or object?	_____	_____	_____
c. Have the potential to cause a physical change which would affect unique ethnic cultural values?	_____	_____	_____
d. Restrict existing religious or sacred uses within the potential impact area?	_____	_____	_____

	Yes	Maybe	No
XV. MANDATORY FINDINGS OF SIGNIFICANCE.			
a. **Potential to degrade:** Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community,reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?	_____	_____	_____
b. **Short-term:** Does the project have the potential to achieve short-term, to the disadvantage of long-term, environmental goals? (A short-term impact on the environment is one which occurs in a relatively brief, definitive period of time. Long-term impacts will endure well into the future.)	_____	_____	_____
c. **Cumulative:** Does the project have impacts which are individually limited, but cumulatively considerable? (A project may impact on two or more separate resources where the impact on each resource is relatively small, but where the effect on the total of those impacts on the environment is significant.)	_____	_____	_____
d. **Substantial adverse:** Does the project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly?	_____	_____	_____

XVI. DISCUSSION OF ENVIRONMENTAL EVALUATION. (If more room is needed attach explanations to checklist.)

XVII. DISCUSSION OF LAND USE IMPACTS. (If more room is needed attach explanations to checklist.)

(Note: This is only a suggested form pursuant to CEQA Guidelines, Section 15063(d). Public agencies are free to devise their own format for initial studies. However, the DETERMINATION is an essential component of this form.)

APPENDIX O.

TEN PERCENT SAMPLING PROTOCOL FOR HABITAT TYPING INVENTORY SURVEYS

Since 1990 numerous anadromous salmonid streams in California have been inventoried for fish habitat utilizing fish habitat typing methods described by Flosi and Reynolds (1994). Habitat typing involves the identification, description, and measurement of distinct fish habitats within the wetted channel. Surveyors usually begin at the mouth of a stream and proceed upstream. They identify each fish habitat type and record up to 35 individual measurements or observations for each habitat type unit. Typically, this method is applicable in first through fourth order streams with an average wetted width of less than 75 feet. These streams can usually be waded. A team of two experienced surveyors are able to complete about one-half mile of stream (or about 100 habitat units) per day. The primary use of fish habitat typing data by the Department of Fish and Game, and others, is to identify and prioritize streams or stream reaches in need of restoration. The resulting stream descriptions are considered a general "basin level" view for planning purposes and not a rigorous "project level" view that describes site specific details. For example, a stream might reveal a lower than expected frequency of pools throughout the survey area, which indicates a potential restoration opportunity of deploying pool-forming structures.

Past practice has been to determine and record all characteristics of each habitat unit as called for on the Habitat Inventory Data Form. However, experience in analyzing over 200 stream habitat inventory data sets has indicated that adequate stream descriptive detail for “basin level” planning can be accomplished with a sampling level of about 10 percent. Possible strategies for subsampling habitat type units in streams or stream reaches at about a 10 percent level included:

1) a systematic sample with a random start of every tenth unit,
2) a systematic sample stratified by habitat type, where each habitat type was sampled at a pre-determined interval,
3) a 10% random sample of all habitat units,
4) a random sample within every 10 consecutive habitat units.

Each proposed sampling strategy has some drawbacks. The systematic random sample with a random start was perceived to be too non-random, except for the start. Both complete and systematic random sampling of habitat types requires prior knowledge of the population of habitat types available and is impractical for field application. A random sample of all habitat units is perhaps statistically the most sound, but might not reflect land use or ownership differences if a particular random sample allowed for no samples in some areas. Because of the desire to have samples selected throughout the entire stream reach, to avoid possible sampling gaps in some watershed ownership parcels, the stratified sampling method (strategy No. 4) was selected as the preferred sampling strategy. This sampling strategy was modified by adding to the randomly selected habitat type set, a sample set that included the first occurrence of each habitat type. This modification ensured that all habitat types were represented at least once in the entire sample.

RECOMMENDATIONS

1. Segment the stream into sub-reaches consisting of 10 consecutive habitat units. The Habitat Inventory Data Form contains spaces for 10 habitat units per page. Habitat unit numbers begin at the downstream end of the survey and continue sequentially upstream to the end of the survey area.

2. Obtain a random number table or a 10-sided die.

3. Randomly select a number from one through ten by tossing a die or using the random number table.

4. The number selected is the first randomly sampled habitat unit within the first 10 habitat units. Mark this habitat unit on Form 1 of the Habitat Inventory Data Form. Now, randomly select another number from one to ten. This is the habitat unit to randomly sample in the second set of 10 habitat units. If the number is "3", select the 3rd habitat unit on Form 2, or habitat unit No. 13. Mark this number on Form 2 of the Habitat Inventory Data Form. Continue selecting random numbers and marking forms to indicate random habitat units until you have enough forms for the day.

   Hint: use a felt tipped marking pen to highlight the entire column of the randomly selected unit.

5. Begin the survey at the downstream end of a stream, reach or stream channel type change.

6. The actual survey involves:
   a. Walk and measure the entire stream length.
      1). Identify every habitat unit by type.
      2). Measure the length of each unit.

   b. Record all measurements and observations (complete sample) for each first-time encounter of each habitat type found in a stream channel type reach.

   c. Record all measurements and observations (complete sample) for every randomly selected habitat unit number.

   Optimizing pool habitat is a high priority for restoration projects. To enable these survey data to function as a crude monitoring tool of pool scour and deposition dynamics, including relative quality of spawning substrate in pool tail crests, the following parameters are recommended for each pool habitat:

d. Measure maximum depth, pool tail crest depth and pool tail embeddedness in all pool habitat types.

Another high priority restoration prescription is improvement of riparian canopy density. To enable graphic display and analysis of canopy densities linearly along a stream reach, the following is recommended:

e. Determine canopy density in at least every third habitat unit.

Refer to following example:

EXAMPLE HABITAT INVENTORY SURVEY PROCEDURE FOR MODIFIED 10 PERCENT RANDOM SAMPLE

Random numbers: 6, 3, 4, 9, 4, 3, 8, 5, 2, 7, 6, 6, 1

Habitat unit No.	Habitat type	Action
1	LGR	Complete sample, first occurrence
2	RUN	Complete sample, first occurrence
3	MCP	Complete sample, first occurrence
4	LGR	Length and habitat type only
5	RUN	Length and habitat type only
6 Random	LSL	Complete sample, random selection
7	GLD	Complete sample, first occurrence
8	LGR	Length and habitat type only
9	LSR	Complete sample, first occurrence
10	RUN	Length and habitat type only
11	LGR	Length and habitat type only
12	MCP	Length, habitat type, max depth, pool tail depth and embeddedness, canopy
13 Random	RUN	Complete sample, random selection
14	LGR	Length and habitat type only
15	CRP	Complete sample, first occurrence
16	POW	Complete sample, first occurrence
17	RUN	Length and habitat type only
18	LSL	Length, habitat type, max depth, pool tail depth and embeddedness
19	LGR	Length and habitat type only Canopy
20	GLD	Length and habitat type only
21	PLP	Complete sample, first occurrence
22	LGR	Length and habitat type only
23	LSR	Length, habitat type, max depth, pool tail depth and embeddedness
24 Random	LGR	Complete sample, random selection
25	RUN	Length and habitat type only

Habitat unit No.	Habitat type	Action
26	GLD	Length and habitat type only
27	LSBo	Complete sample, first occurrence
28	SRN	Complete sample, first occurrence
29	LSR	Length, habitat type, max depth, pool tail depth and embeddedness
30	LGR	Length and habitat type only
-----Stream channel type changes to A3 - defines a NEW reach		
31	LSB	Complete sample. first occurrence
32	HGR	Complete sample, first occurrence
33	POW	Complete sample, first occurrence
34	PLP	Complete sample, first occurrence
35	LGR	Complete sample, first occurrence
36	RUN	Complete sample, first occurrence
37	LSB	Length, habitat type, maximum depth, pool tail depth and embeddedness
38	HGR	Length and habitat type only
39 Random	CCP	Complete sample, random selection
40	LGR	Length and habitat type only

APPENDIX P.

CALIFORNIA SALMONID FISHES

Anadromous Species

Taxonomy. Since recent taxonomic changes have included steelhead and cutthroat within the genus *Onchorhynchus*, there are now four species of salmon found in California streams in significant numbers. They are chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*Oncorhynchus kisutch*), steelhead trout (*Oncorhynchus mykiss*), and coast cutthroat (*Oncorhynchus clarkii*). These species are generally found along the west coast of the North American continent from the Bering Sea to central California, with coast cutthroat range and population numbers more limited than the others towards the south. Typically, the fish farther north grow slower and remain longer in fresh water as juveniles before migrating to the ocean and beginning their rapid growth phase in salt water. Specifics of the life cycles of these fish vary from place to place depending on climate, food supply, and other critical factors.

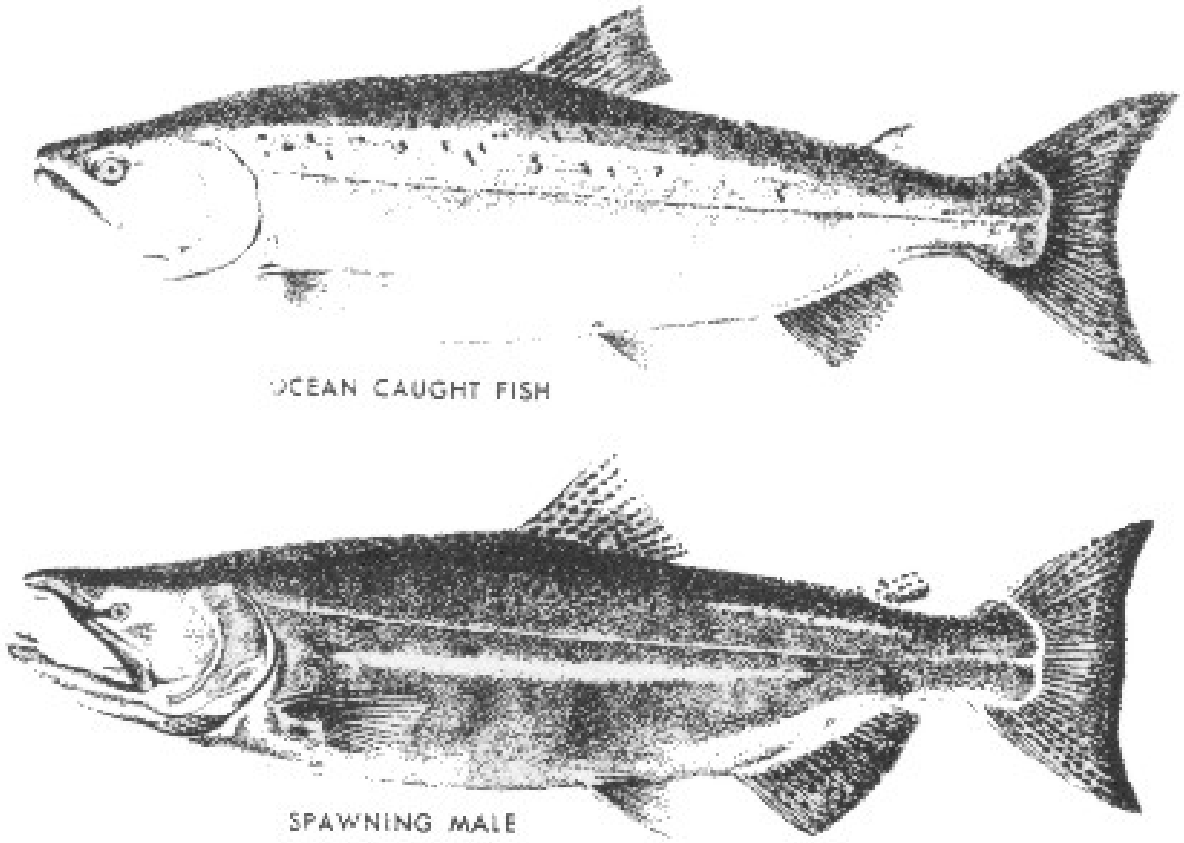
Races. The term "race", as used here, describes temporal occurrence of upstream migrating adults within a river system, and is not meant to imply any genetic distinction between different "races" of the same species. Races of anadromous salmonids are presently identified according to the time of year the adult fish first enter fresh water, although some are identified by their geographic range. Therefore, a spring-run steelhead, sometimes called a "summer steelhead" because it is seen in fresh water during the summer, is a steelhead trout that usually begins its upstream migration in the springtime. In California there are spring-, fall-, and winter-run steelhead trout; spring-, fall-, late-fall-, and winter-run chinook salmon; and fall- and winter-run coho salmon. Information on coast cutthroat trout is inadequate to say much more than that they are variable.

Chinook salmon that enter coastal streams in early winter have a shorter freshwater journey and spawn much earlier than Sacramento River winter-run chinook. Coastal "winter-run" chinook that spawn almost immediately after entering fresh water are more properly classed as late fall-run, whereas the Sacramento River winter-run spawning does not begin until April or May. Sacramento River winter-run chinook spawn in June, July, and August. Almost all north coast salmon spawning occurs from mid-November through February. Steelhead spawning seasons begin a little later and run into April.

There are flow timing differences between streams, and all streams do not support the same species or races of salmonids. For example, timing for the adult run of salmon and steelhead in the Klamath River system is typically earlier than for the Eel or Smith Rivers. Many coastal streams (including the Eel and Smith Rivers) do not have sufficient flows to allow adult migration until rains have increased discharge in November and December. In such streams, low flows control upstream migration timing and, therefore, spawning cycles.

Adult Life Histories

Chinook Salmon



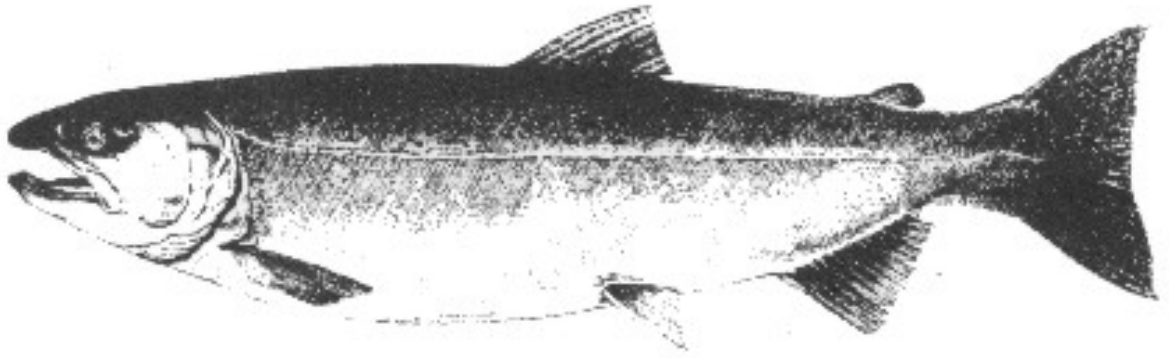
Chinook salmon runs are categorized by the time of year during which they enter the river systems on their spawning migration. In California's coastal rivers there are two clearly identified runs, or races, of chinook salmon. They are fall-run and spring-run. Fall-run chinook leave ocean waters and begin to enter the river systems in late August and September, and then proceed upstream if water temperatures are cool enough and if flow is adequate to allow their passage (Table P-1). If conditions in the river are not suitable, fall-run chinook remain in the ocean or in the lower river sections until early season storms raise stream flow and provide cooler water. Spawning usually occurs from October through January. Spring-run chinook enter river systems during the spring runoff period, remain in fresh water through the summer months, and begin spawning the following fall a little earlier than the fall-run fish. Spring-run spawning is usually completed from the end of September to mid-October. These fish have been designated as a species of special concern in California. In rivers that have both spring-and fall-run chinook, the spawning periods may overlap for several weeks. California also has late-fall-run and winter-run chinook, but they have only been formally identified in the Sacramento River system. The Sacramento River winter-run chinook salmon has been designated by the State of California and the United States Government as endangered.

Chinook salmon are riffle spawners and typically construct redd (nest) sites near the head of riffles in gravel 6 inches (15 cm) or less in diameter. During courtship, the female may dig several false redds before actually spawning, and communal or multiple redds are common under crowded conditions. As the female releases her eggs into the redd an attending male or males fertilize them. Upon completion of the spawning act, the female covers the eggs with 8-14 inches (20-36 cm) of gravel.

Chinook salmon die after spawning. During the period between spawning and death, the female may remain near or over the redd which may discourage excavation by other salmon that are seeking suitable places to spawn.

Eggs develop in gravel for about eight weeks (50-60 days) before hatching, depending on water temperatures (Table P-1). After absorption of the yolk sac, young salmon emerge from the gravel and begin actively foraging. Passive downstream movement of young chinook salmon begins shortly after emergence. Downstream movement is nearly complete by late June, at which time river flows are decreasing. At this time young chinook salmon are 3-5 inches (8-13 cm) long, and most are actively moving downstream. Most juveniles enter the ocean as fingerlings in the spring and early summer, but some may remain in streams or estuaries and enter the ocean as yearlings in the fall.

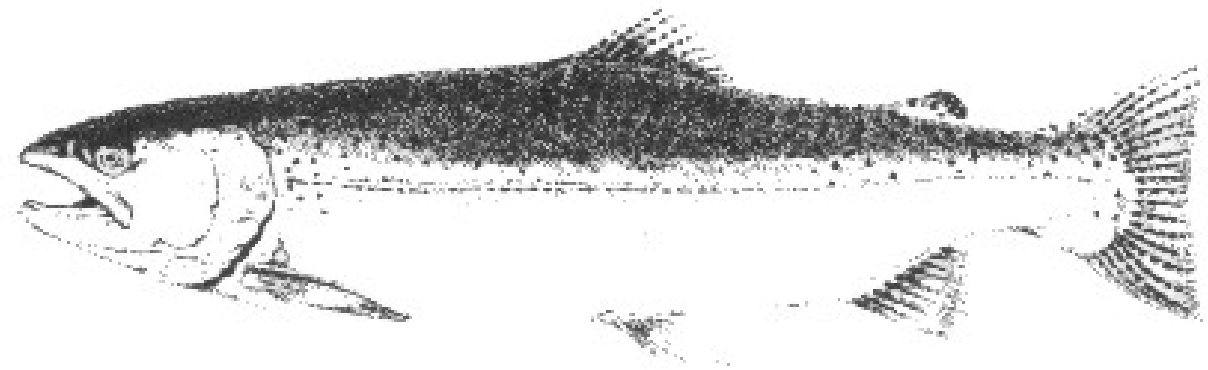
Coho Salmon



The spawning migration of coho salmon is similar to that of chinook salmon but starts later in the season. Like chinook, coho salmon are riffle spawners and their courtship and spawning are similar. Although there is some overlap of spawning habitats, coho salmon typically utilize smaller streams and gravel than do chinook.

Egg development is like that of chinook salmon, but after emergence, many coho salmon do not leave the river nursery area. Instead, coho salmon may remain a year or more before smolting (undergoing the changes necessary to enter saltwater) and entering the ocean. Yearling coho salmon enter the ocean during the spring when they are 5-6 inches long. In the smaller coastal streams, most coho enter the ocean during their first year as 1-3 inch fish.

Steelhead Trout

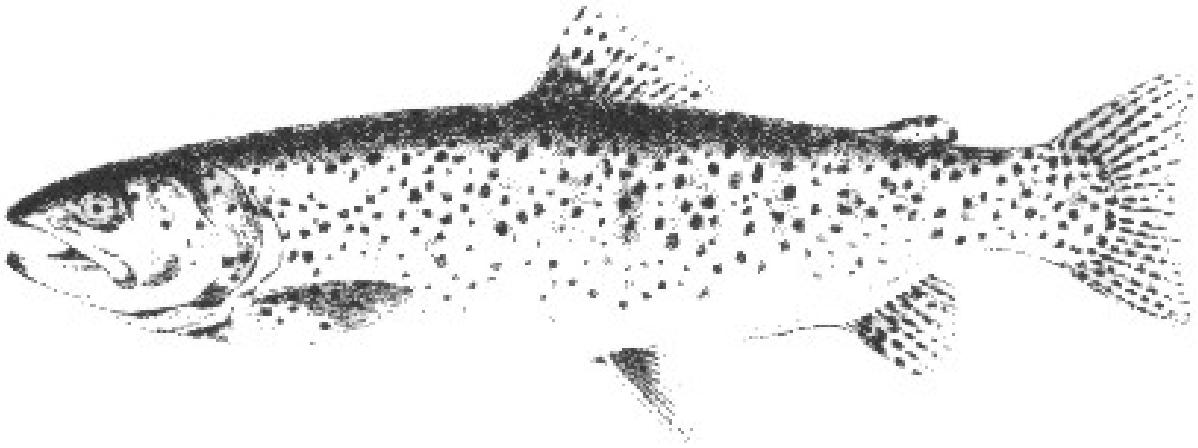


Adult steelhead enter river systems during most months of the year. Those entering during late summer through October are called fall-run steelhead, those entering during November through April are called winter-run steelhead, and those entering during May and June are called spring-run steelhead. In California, the Eel and Klamath-Trinity river systems have fall runs of predominately two-year-old steelhead returning from only two to four months in the ocean. These fish, called "half-pounders," range from 12 to 16 inches in length and do not mature to spawn during this migration.

Fall- and winter-run steelhead spawn a few weeks to a few months after they enter fresh water. Spring-run steelhead (descriptively named "summer steelhead") remain in the freshwater environment through the summer and spawn the following winter. Steelhead usually spawn in smaller tributary streams than salmon, and utilize smaller gravel. Spawning takes place from December to May. Egg development rate is temperature dependent and usually requires about 31 days at 50^{E} Fahrenheit (Table P-1).

Unlike chinook and coho, up to 50 percent of adult steelhead survive to spawn in more than one season. First-time spawners are usually three or four years old and will have spent one or two years in fresh water and one or two years in the ocean. Most steelhead enter the ocean after spending two years in freshwater.

Coastal Cutthroat Trout



Coastal cutthroat trout are found in coastal streams from the lower Van Duzen River north, within approximately 25 miles from the coast. Their upstream migration usually occurs in the late fall or early winter and, typically, spawning takes place in small streams. Coast cutthroat may not venture far in the ocean and often return to fresh water after one year or less in salt water.

Juveniles rear for two or more years in fresh water before migrating to the sea, and some fish live out their lives as freshwater residents. Reproducing populations of these fish are frequently found in small coastal streams above barriers to steelhead upstream migration. There is a valid concern that when steelhead trout are provided access to these areas, they may eliminate or partially replace the coast cutthroat trout through competition for food and living space.

Juvenile Life Histories

The rate at which salmon and trout eggs mature and hatch is controlled by their environment. Generally, if the water is above 50E Fahrenheit, oxygen supply is adequate, and silt and algae are not excessive, then the eggs develop and hatch at an optimum rate. However, if water temperature gets much above 58E Fahrenheit, the eggs will not mature (Table P-1). Various races of salmonids have evolved to spawn at the most opportune times and locations available within their home streams that will provide their eggs with the best chance for survival.

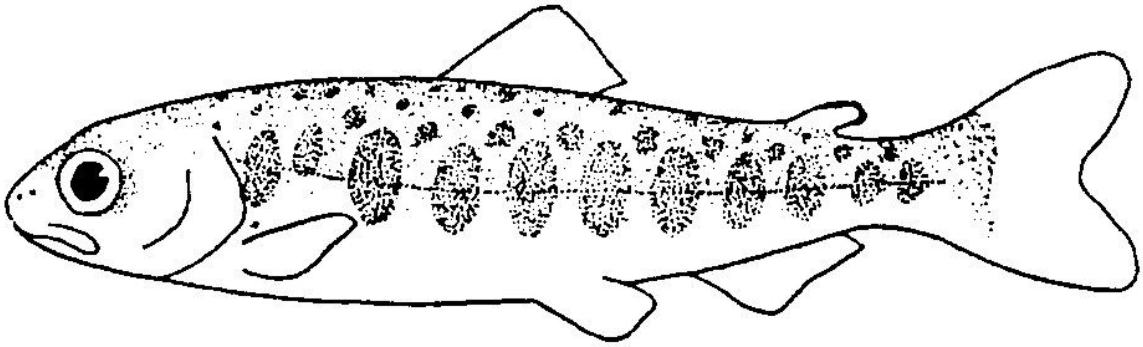
Chinook salmon juveniles may take up temporary residence in their natal environment (the surroundings where they emerged from the gravel) or they may begin to passively be carried downstream while they are feeding, and seek escape cover when threatened. Although in more northerly streams, coho typically leave fresh water as 1- or 2-year-olds, out-migration as first-year juveniles appears to be common for California coho. Juvenile coho numbers in coastal streams are observed to diminish rapidly during the spring months, and coho have been monitored moving downstream through lower stream reaches. This departure is often related to low flows and elevated water temperatures. Because adult coho return to the streams in greater numbers than could be accounted for by out migrating 1- or 2-year olds, 0-age fish apparently contribute significantly to California populations.

Juvenile salmon and steelhead have different habitat preferences in a stream. Chinook and coho

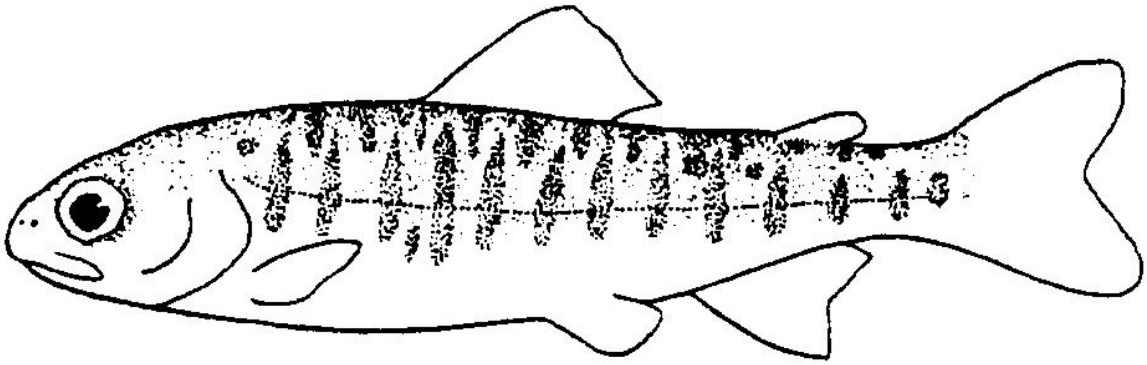
prefer pool environments, and steelhead tend to select glides and riffles. This does not mean that they will not be seen together, and their preferred feeding or resting habitat is not necessarily the habitat they will be found in when disturbed. Generally, as fish grow older and larger they require larger habitat. Therefore, if they rear for one or more years in fresh water, they will need adequate space and water quality.

Juvenile Salmonids

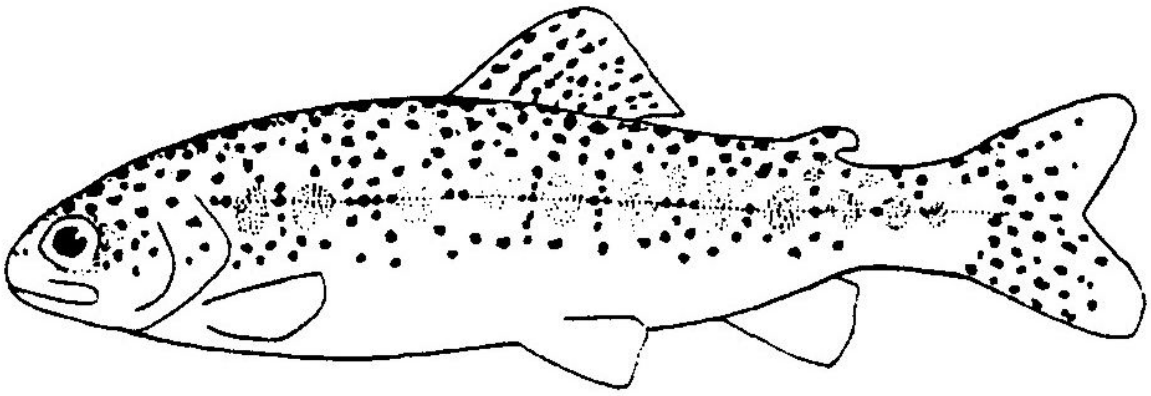
Chinook Salmon



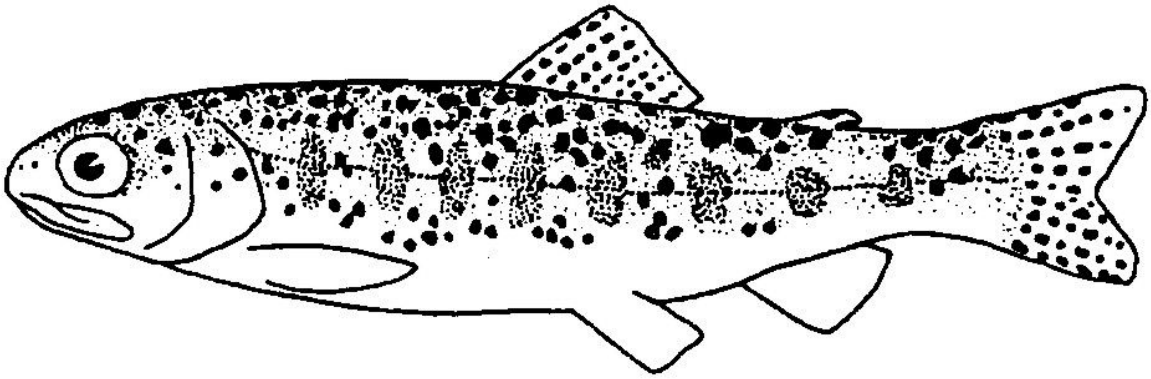
Coho Salmon



Steelhead Trout



Coastal Cutthroat Trout



Resident Species

In addition to four anadromous salmonids, there are ten species or subspecies of native resident trout, and three species of non-native resident trout in California. Coastal rainbow trout, *(Oncorhynchus mykiss irideus)*, is the most widespread and popular resident trout in California. This is the resident or non-anadromous form of steelhead trout. Eagle Lake rainbow trout, *(Oncorhynchus mykiss aquilarum)*, are a highly specialized form of rainbow, capable of surviving in highly alkaline waters. They provide a popular, hatchery supported sport fishery in Eagle Lake. The three subspecies of golden trout include: 1) Volcano Creek (S. F. Kern River) golden trout, *(Oncorhynchus mykiss aquabonita);* 2) Little Kern River golden trout, *(O. m. whitei);* and 3) Kern River rainbow trout, *(O. m. gilberti).* Although the native ranges of these species were confined to the Kern River drainage, golden trout have been transplanted in many suitable waters throughout the state. Resident forms of cutthroat trout include Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*), and Paiute cutthroat trout (*O. c. seleniris*). Lahontan cutthroat trout are the most widespread and the more popular sport fish of the two. California is also home to three remnant populations of redband trout, a close relative of the coastal rainbow. Although the taxonomic status of the redbands is presently unclear, California currently recognizes three subspecies, McCloud River redband trout (*Oncorhynchus mykiss* subspecies.), Goose Lake redband trout (*O. c.* subspecies), and Warner Lakes redband trout (*O. c.* subspecies). One native species of char, the

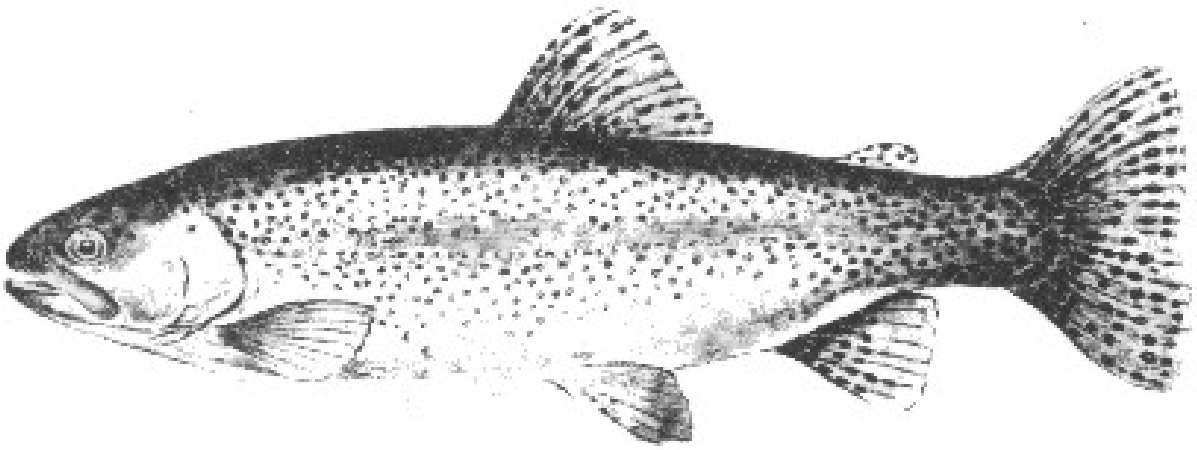
bull trout (*Salvelinus confluentus*) is now extinct in California.

Two of the most popular and easily recognized trout in California are non-natives, the brown trout (*Salmo trutta*) and the brook trout (*Salvelinus fontinalis*). A third non-native trout, the lake trout (*Salvelinus namaycush*), is locally popular in Lake Tahoe. All three of these species have established self-sustaining populations in many waters throughout the state.

Finally, a landlocked form of sockeye salmon, the Kokanee (*Oncorhynchus nerka*), is planted in several reservoirs throughout northern and central California and provides a popular fishery for the trout angler.

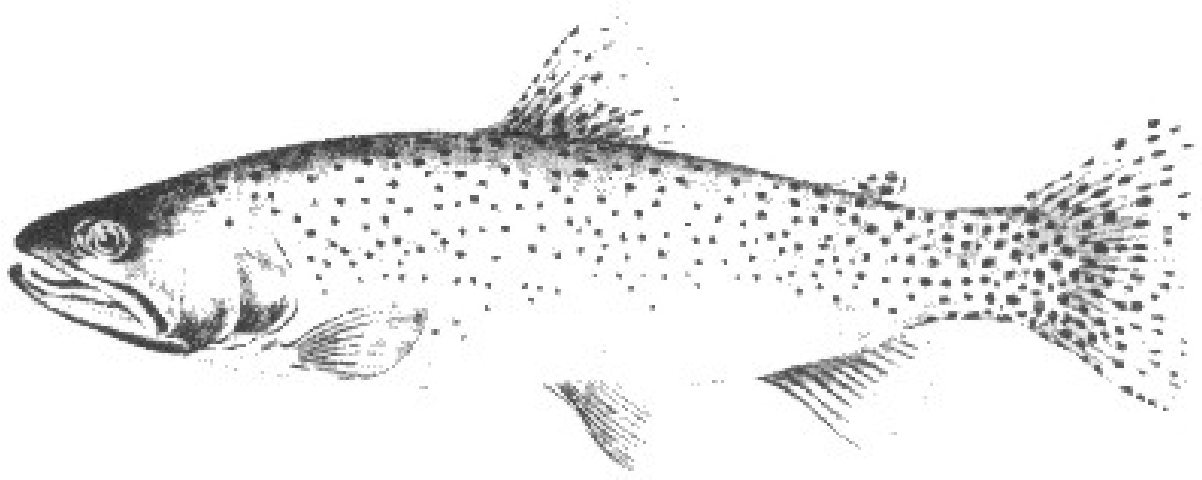
Resident salmonid adults spawn in fine gravel under conditions similar to those used by anadromous salmonids. Brook trout and Kokanee are capable of spawning in both streams and lake margins. Juvenile resident salmonids frequently rear and live out their life span in the immediate vicinity of their birthplace. Others may move downstream to larger streams or, like Kokanee, migrate to a lake environment.

Rainbow Trout



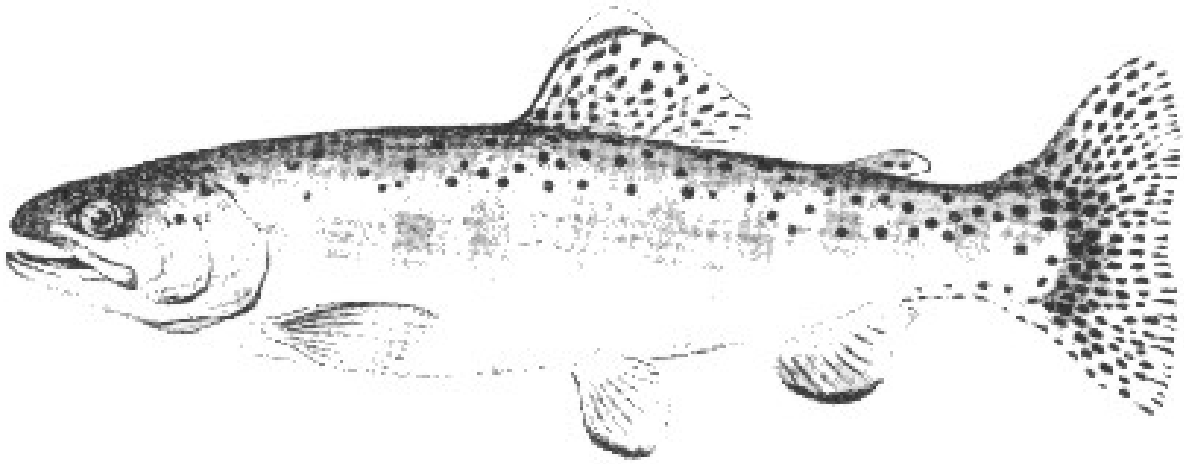
Rainbow trout are native and, partly as a result of being the fish most commonly raised and planted from the hatchery system, are widely distributed throughout California streams. They normally spawn in the spring in cold streams (50^{E}-58^{E} Fahrenheit) and rarely attain the size of steelhead (anadromous rainbow trout).

Lahontan Cutthroat Trout



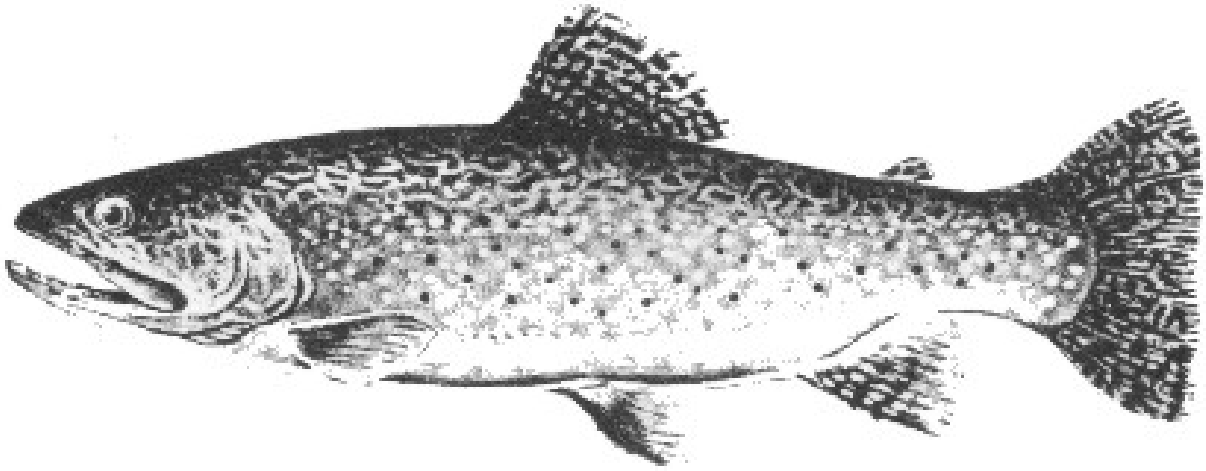
Lahontan cutthroat trout are native to the Truckee, Walker, and Carson River drainages on the east side of the Sierra Nevada in California. Their close relative in California, the Paiute cutthroat trout has a more restricted distribution on the east side of the Sierra Nevada range. These fish are a federally designated threatened species. Resident cutthroat trout are cold water spring spawners. The range of Lahontan cutthroat trout has been expanded by hatchery programs, but is generally limited to higher elevation streams and lakes.

Golden Trout



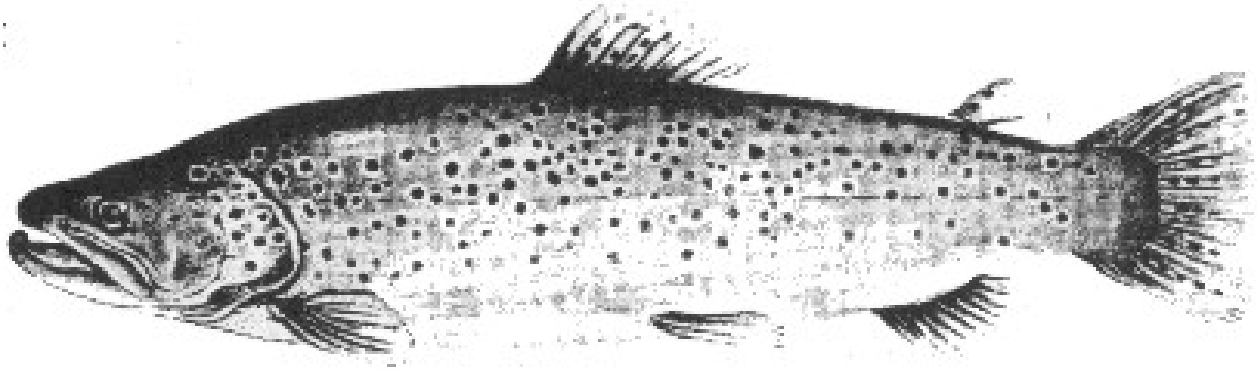
Found native to a few high-elevation streams in the Kern River drainage, this species has been successfully introduced to several other drainages. They are adapted to small, high-elevation waters and provide a specialized recreational opportunity. Spawning occurs in the spring as water temperatures increase in the small high mountain streams. The Little Kern golden trout is a federally threatened species, and the Volcano Creek golden trout is a species of special concern.

Brook Trout



Brook trout, not native to California, have been planted throughout most of the state's trout waters. It is a prolific fall spawner in high-mountain lakes, reservoirs, and streams. Overabundance and stunting have been a recurrent problem in many areas, and hatchery production and planting of brook trout is limited to a few waters where recreational harvest or natural kills control the population.

Brown Trout



Brown trout, another non-native fish, are widely scattered throughout California as a result of experimental and management planting in most of the state's inland trout waters. They are abundant in only a few areas, and tend to tolerate warmer water (55^{E}- 60^{E} Fahrenheit) than rainbow trout. Large brown trout are particularly picivorous and aggressive, and in warmer waters, tend to out compete other trout species. Spawning occurs in fall and early winter.

Table P-1. Temperature requirements, degrees Fahrenheit, for various life stages of salmon and steelhead (Reisner and Bjornn, 1979).

Species	Adult migration	Spawning	Incubation	Juvenile rearing
Chinook				
Fall	51 - 67	42 - 57	41 - 58	45 - 58
Spring	38 - 56	42 - 57	41 - 58	57 - 67
Coho	45 - 60	40 - 49	40 - 56	53 - 58
Steehead	-	39 - 49	-	45 - 58

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Reiser, D.W., T.C. Bjornn. 1979. Habitat requirements of anadromous salmonids. Pages 1-54 *in* W.R. Meehan, ed. Influence of forest and range management on anadromous fish habitat in western America. Pacific N.W. Forest and Range Experiment Station. USDA Forest Service, Portland. General Technical Report, PNW-96.

APPENDIX Q.

GLOSSARY

Acronyms and Abbreviations:

A_{FP}	-	Flood-Prone Area
BLM	-	U.S. Bureau of Land Management
BY	-	Brood Year
CALTRANS	-	California Department of Transportation
CCC	-	California Conservation Corps
CDF	-	California Department of Forestry
cfs	-	Cubic feet per second
CEQA	-	California Environmental Quality Act
CESA	-	California Endangered Species Act
CMP	-	Corrugated Metal Pipe
CPOM	-	Course Particulate Organic Matter
CWT	-	Coded-Wire Tag
d_{bkf}	-	Bankfull Depth
DO	-	Dissolved Oxygen
DOC	-	Dissolved Organic Carbon
DOD	-	Department of Defense
DOM	-	Dissolved Organic Matter
DFG	-	Department of Fish and Game
DWR	-	Department of Water Resources
ELP	-	Environmental License Plate
EPA	-	Environmental Protection Agency
ESA	-	Endangered Species Act of 1973 (Federal)
ESD	-	Environmental Services Division, DFG
FPOM	-	Fine Particulate Organic Matter
FL	-	Fork Length
FY	-	Fiscal Year
GIS	-	Geographic Information System
GPS	-	Global Positioning System
HSA	-	Hydrologic Sub Area
IFD	-	Inland Fisheries Division, DFG
IFIM	-	Instream Flow Incremental Methodology
LDA	-	Log Debris Accumulation
LOD	-	Large Organic Debris
LWD	-	Large Woody Debris
NDDB	-	Natural Diversity Database
NEPA	-	National Environmental Policy Act
NHD	-	Natural Heritage Division, DFG
NMFS	-	National Marine Fisheries Service

NOAA	-	National Oceanic and Atmospheric Administration
Q_{bkf}	-	Bankfull Discharge
RRIF	-	Renewable Resources Investment Fund
SB	-	Senate Bill
SCS	-	Soil Conservation Services
SWD	-	Small Woody Debris
TDS	-	Total Dissolved Solids
USBR	-	U.S. Bureau of Reclamation
USCOE	-	U.S. Army Corps of Engineers
USDA	-	U.S. Department of Agriculture
USFS	-	U.S. Forest Service
USFWS	-	U.S. Fish and Wildlife Service
USGS	-	U.S. Geological Survey
W_{bkf}	-	Bankfull Width
W_{FP}	-	Flood-Prone Width
WLPZ	-	Watercourse and Lake Protection Zone
WUA	-	Weighted Usable Area
YOY	-	Young-of-Year

Abstraction: a) The long-term to permanent removal of surface flow from the channel; b) A simple type of stream capture.

Accretion: a) A process of accumulation by flowing water, whether of silt, sand, pebbles, etc.; b) Channel-flow; the gradual increase in the flow of a stream due to influent seepage.

Aggradation: The geologic process by which stream beds, floodplains, and the bottoms of other water bodies are raised in elevation by the deposition of material eroded and transported from other areas. It is the opposite of degradation.

Alkalinity: A measure of the power of a solution to neutralize hydrogen ions (H^+) usually expressed as mg/l $CaCO_3$.

Alluvial stream: Named after the silts, clays, sands, and gravels of river origin that compose their bed, banks, and floodplains, alluvial streams are characterized by a distinctive S-shaped channel pattern that is free to shift slowly (meander) in the valley. Repeated bank cavings do not widen the channel as they do in erodible bed streams. Alluvial streams have their bed materials conveyed from upstream, and they tend to be large.

Alluvium: A general term for all deposits resulting directly or indirectly from the sediment transport of streams, thus including the sediments laid down in riverbeds, floodplains, lakes, fans and estuaries.

Anchor ice: Ice formed below the surface of a stream, on the stream bed or upon a submerged body or structure.

Apparent velocity: The rate of flow of subsurface water through the substrate, expressed as the volume of water flowing per unit of time through a unit area (of solids plus voids). Also called interstitial velocity.

Armoring: a) The formation of an erosion-resistant layer of relatively large particles on the surface of the stream bed which resists degradation by water currents, resulting from removal of finer particles by erosion; b) The application of various materials to protect stream banks from erosion.

Attribute: See Habitat component.

Bank: See Stream bank.

Bank storage: Infiltration of water into stream bank material during periods of high flow.

Bankfull discharge: The discharge corresponding to the stage at which the flood plain of a particular stream reach begins to be flooded. The point at which bank overflow begins.

Bankfull stage: Corresponds to the discharge at which channel maintenance is most effective, that is, the discharge at which moving sediment, forming or removing bars, forming or changing bends and meanders, and generally doing work that results in the average morphologic characteristics of channels. The bankfull stage is the most effective or is the dominate channel-forming flow, and has a recurrence interval of 1.5 years. (Dunne & Leopold, 1978).

Bar: a) A ridge-like accumulation of sand, gravel, or other alluvium material formed in the channel, along the banks, or at the mouth of a stream where a decrease in velocity induces deposition; b) An alluvial deposit of sand, gravel, or other material, at the mouth of the stream or at any point in the stream itself which obstructs flow and induces depositions. Chamberlain (1980) gives a description of bar types as follows:

braiding - pattern of river bars with numerous interconnected small channels.

diamond/braiding - multiple diamond-shaped interconnected mid-channel bars characteristic of braided rivers.

dunes - wave-like bed form common in relatively active sand bed channels.

islands - bars or land segments within the stream channel that are relatively stable, usually vegetated, and normally surrounded by water.

junction bar - a bar formed at the junction of two streams, usually because sediment transported by a tributary is deposited in the slower-moving water of the main stream.

lee bar - a bar caused by eddies and lower current velocities and formed in the lee of large immovable objects such as boulders or logs.

mid-channel bar - bar found in the mid-channel zone, not extending completely across the channel.

point bar - bar found on the island of meander bends.

side bar - bar located at the side of a river channel, usually associated with the inside of slight curves.

transverse bar - bar that extends diagonally across the full width of the active stream channel.

Basin: See Drainage area.

Beaded Stream: A stream consisting of a series of small pools or lakes connected by short stream segments; eg., a stream commonly found in a region of paternoster lakes or an area underlain by permafrost.

Bedload: Sediment moving on or near the stream bed and frequently in contact with it.

Bedload discharge: The quantity of bed load passing a given point in a unit of time, expressed as dry weight.

Bed roughness: A measure of the irregularity of stream bed materials as they contribute to resistance to flow. Commonly measured in terms of Manning's roughness coefficient.

Benthos: Organisms living on or within a stream's substrate.

Berm: A levee, shelf, ledge or bench along a stream bank that may extend laterally into the channel to partially obstruct the flow, or parallel to the flow to contain the flow within its stream banks. May be natural or man-made.

Biomass: a) The weight of a taxon or taxa per unit of stream surface; b) Amount of substance in a population, expressed in material units, such as living or wet weight, dry weight, ash-free weight, nitrogen content, etc.; also called standing crop.

Bog: A wetland comprised of in-situ accumulations of poorly to moderately decomposed peat that are derived chiefly from sphagnum mosses. The water is acidic.

Bole: See large organic debris.

Boulder: Stream substrate particle larger than 256 mm (10 inches) in diameter. See Substrate particle size table.

Braided: A stream that divides into a interlacing or tangled network of several branching and reunited channels separated from each other by branch islands or channel bars.

Buffer strip: Vegetation strip left intact along a stream or lake after logging.

Canopy: The overhead branches and leaves of stream-side vegetation.

Canopy cover: The vegetation that projects over the stream. Can arbitrarily be divided into two levels: **Crown cover** is more than three feet (1 m) above the water surface. **Overhang cover** is less than three feet (1 m) above the water surface.

Canopy density: The percentage of the stream covered by the canopy of plants, sometimes expressed by species.

Carrying capacity: The maximum average number or biomass of organisms or a given species that can be sustained on a long term basis under a given flow regime by a stream or stream reach.

Catchment area: See Drainage area.

Channel: A natural or artificial waterway of perceptible extent that periodically or continuously contains moving water. It has a definite bed and banks which serve to confine the water.

Channelization: Straightening of a stream or the dredging of a new channel to which the stream is diverted.

Channel pattern: The configuration of a stream as seen from above. Described in terms of its relative curvature, it includes:

straight: Very little curvature within the reach.

sinuous: Slight curvature within a belt of less than approximately two channel widths.

irregular: No repeatable pattern.

irregular meander: A repeated pattern vaguely present in the channel plan. The angle between the channel and the general valley trend is less than 90 degrees.

regular meander: Characterized by a clearly repeated pattern.

tortuous meander: A more or less repeated pattern characterized by angles greater than 90 degrees.

Channel stability: A measure of the resistance of a stream to erosion that determines how well a stream will adjust to and recover from changes in flow or sediment transport.

Channel width: The horizontal distance along a transect line from bank to bank at the high water marks, measured at right angles to the direction of flow. Multiple channel widths are summed to represent total channel width.

Checkdam: A small dam designed to retard the flow of water and sediment in a channel, used especially for controlling soil erosion. Also used in channels to divert intragravel water toward surface water for interchange of dissolved gases.

Climatic year: A continuous 12-month period during which a complete annual cycle occurs. The USGS uses the period October 1 to September 30 in the publication of its records of streamflow. Also called a water year.

Cobble: Stream substrate particles between 64 and 256 mm (2.5 and 10 inches) in diameter. Syn: Rubble. See Substrate particle size table.

Colluvium: A general term for loose deposits of soil and rock moved by gravity; e.g. talus.

Community indicators: See Biological indices.

Competence: The maximum size of particle that a stream can carry. This is governed by water velocity.

Conductivity: A measure of the ability of a solution to carry an electrical current dependent on the total concentration of ionized substances dissolved in the water.

Consumptive use of water: Occurs when water is taken from a stream and not returned.

Cover: Anything that provides protection from predators or ameliorates adverse conditions of streamflow and/or seasonal changes in metabolic costs. May be instream cover, turbulence, and/or overhead cover, and may be for the purpose of escape, feeding, hiding, or resting.

Cross-sectional area: The area of a stream, channel, or waterway opening, usually taken perpendicular to the stream centerline.

Debris: Material scattered about or accumulated by either natural processes or human influences.

Debris jam: Log jam. Accumulation of logs and other organic debris.

Debris loading: The quantity of debris located within a specific reach of stream channel, due to natural processes or human activities.

Degradation: The geologic process by which stream beds and flood plains are lowered in elevation by the removal of material. It is the opposite of aggradation.

Dendric: Channel pattern of streams with tributaries that branch to form a tree-like pattern.

Density: Number of individuals per unit area/unit volume.

Deposition: The settlement or accumulation of material out of the water column and onto the stream bed. Occurs when the energy of flowing water is unable to support the load of suspended sediment.

Depth: The vertical distance from the water surface to the stream bed.

Detritus: a) A non-dissolved product of disintegration or wearing away. Pertains to organic or inorganic matter; b) A collective term for loose rock or mineral matter that is worn off or removed directly by mechanical means; especially fragmental material such as sand, silt, and clay, moved from place of origin.

Discharge: Volume of water flowing in a given stream at a given place and within a given period of time, usually expressed as cubic meters per second (m^3/sec), or cubic feet per second (cfs).

Dissolved oxygen: The concentration of oxygen dissolved in water, expressed in mg/l or as percent saturation, where saturation is the maximum amount of oxygen that can theoretically be dissolved in water at a give altitude and temperature.

Diversion: A temporal removal of surface flow from the channel.

Diversity index: The relationship of the number of taxa (richness) to the number of individuals per taxon (abundance) for a given community. See Habitat quality index.

Dominant discharge: The cycle of rising and falling flows in the vicinity of bankfull flows, sustained over a long enough period that it alters a natural channel by dislodging, transporting, and distributing bed materials.

Drainage area: Total land area draining to any point in a stream, as measured on a map, aerial photo or other horizontal plane. Also called catchment area, watershed, and basin.

Drainage density: The relative density of natural drainage channels in a given area, expressed as r miles (or kilometers) of stream channel per square mile (or square kilometer) of drainage area. Syn: stream density.

Drift: a) Voluntary or accidental dislodgement of aquatic invertebrates from the stream bottom into the water column where they move or float with the current; b) Any detrital material transported in the water current.

Eddy: A circular current of water, sometimes quite strong, diverging from an initially flowing contrary to the main current. It is usually formed at a point at which the flow passes some obstruction or on the inside of river bends. Often forms backwater pools or pocket water in riffles.

Embeddedness: The degree that larger particles (boulders, rubble, or gravel) are surrounded or covered by fine sediment. Usually measured in classes according to percentage of coverage of larger particles by fine sediments.

Ephemeral stream: See Stream, Ephemeral.

Fall: a) A free fall or precipitous descent of water. The plural, falls, may apply to a single waterfall or to a series of waterfalls; b) A very fast white water cascade.

Fen: Peat land fed by relatively fast moving, nutrient-rich water. Water usually neutral to basic and rich in calcium. The peat is mainly made up of decaying sedges and rushes.

Fill: a) The localized deposition of material eroded and transported from other areas, resulting in a change in bed elevation. This is the opposite of scour; b) The deliberate placement of (generally) inorganic materials in a stream, usually along the bank.

Fine sediment: The fine grained particles in stream banks and substrate. These are defined by diameter, varying downward from 0.24 inch (6 mm).

Fish depth: See Fish elevation.

Fish elevation: The elevation of a fish above the stream bed measured at the tip of the fish's snout. See Focal point.

Fish habitat: The aquatic environment and the immediately surrounding terrestrial environment that, combined, afford the necessary biological and physical support systems required by fish species during various life history stages.

Flood: Any flow that exceeds the bankfull capacity of a stream or channel and flows out of the floodplain; greater than bankfull discharge.

Flood level: The elevation of the water surface of a stream during a particular flood.

Floodplain: Any flat, or nearly flat lowland that boarders a stream and is covered by its waters at flood stage. Also floodplain, flood-plain.

Flood recurrence interval: See Recurrence interval.

Flow: a) The movement of a stream of water and/or other mobile substances from place to place; b) The movement of water, and the moving water itself; c) The volume of water passing a given point per unit of time. Syn: Discharge.

> **base flow:** The portion of the stream discharge that is derived from natural storage i.e., groundwater outflow and the draining of large lakes and swamps or other source outside the net rainfall that creates surface runoff; discharge sustained in a stream channel, not as a result of direct runoff and without the effects of regulation, diversion, or other works of man. Also called sustaining, normal, ordinary of groundwater flow.

duration flow: A curve which expresses the relation of all the units of some item such as head, flow, etc., arranged in order of magnitude along the ordinate, and time, frequently expressed in percentage, along the abscissa. A graphical representation of the number of times given quantities are equaled or exceeded during certain periods of record.

enhancement flow: An improvement of flow that provides improvement over natural conditions for the aquatic, terrestrial, and other recreation resources. See improvement flow.

flushing flow: That discharge (natural or human-caused) of sufficient magnitude and duration to scour and remove fines from the stream bed gravel to maintain intragravel permeability.

improvement flow: That discharge which will improve upon existing aquatic organisms and/or related recreational activity by correcting for water quality deterioration and/or utilization pressures. See enhancement flow.

index flow: The discharge at the time of measurement.

instantaneous flow: That discharge measured by any instant in time, applied to any recommended flow term when modified by the appropriate adjective.

instream flow: Streamflow regime required to satisfy a mixture of conjunctive demands being placed on water while it is in the stream.

instream flow requirements: That amount of water flowing through a stream course needed to sustain instream values at an acceptable level.

interstitial flow: See intergravel flow.

intergravel flow: That portion of the surface water that infiltrates the stream bed and moves through the substrate pores.

laminar flow: The type of flow in a stream of water in which each particle moves in a direction parallel to every particle.

least flow: Negotiated lowest flow in a regulated stream that will sustain an aquatic population at agreed upon levels. The flow may vary seasonally. See **minimum flow.**

low flow: The lowest discharge recorded over a specified period of time. Also called minimum flow.

mean flow: The average discharge at a given stream location, usually expressed in (m^3/sec or cfs), computed for the period of record by dividing the total volume of flow by the number of days, months, or years in the specified period.

minimum flow: a) The lowest discharge recorded over a period of time (preferred definition); b) Negotiated lowest flow in a regulated stream that will sustain an aquatic population at agreed upon levels. This flow may vary seasonally. (This recently developed definition is in conflict with definition (a); to avoid confusion (a) should not be used. A suggested alternative is to apply this definition to the term **least flow.**

modified flow: The discharge at a given point in a stream resulting from the combined effects of all upstream and at-site operations, diversions, return flows, and consumptive uses.

natural flow: The flow as it occurs under natural unregulated conditions at a given stream location.

optimum flow: The discharge regime that allows for the maximum expression of the carrying capacity of any specified use of the stream. Any flow above or below this flow becomes limiting to the use under consideration.

peak flow: The highest discharge recorded over a period if time. Often thought of in terms of spring snow melt, summer, fall or winter rainy season flow. Also called maximum flow.

regime: a) The condition of a stream with respect to the rate of its average flow as measured by the volume of water passing different cross sections in a specified period of time. In this unspecialized sense, the term is incorrectly used as a synonym of regime; b) The existence in a stream channel of a balance or grade between erosion and deposition over a period of years.

regulated flow: The flow in a stream that has been subjected to regulation by reservoirs, diversions, or other works of man.

return flow: That portion of the water previously diverted form a stream, and subsequently returned to that stream, or to another body of ground or surface water.

seven day/Q 10 (7 day/ 10): That low flow which has occurred for seven consecutive days within a ten year period. A specific critical low flow.

subsurface flow: That portion (part or all) of the water that infiltrates the stream bed in moves horizontally through and below it. It may or may not return to the stream channel at some point downstream.

survival flow: That instantaneous discharge required to prevent death of an aquatic organism in a stream during specified short periods of time (e.g., 7 days) of extremely low flow.

turbulent flow: That type of flow in which any particle of water may move in any direction with respect to any other particle.

uniform flow: A flow in which the velocities are the same in both magnitude and direction from point to point. Uniform flow is possible only in a channel of constant cross section and gradient.

Fluvial: Pertaining to streams or produced by stream action.

Focal point: the location, and the conditions at that location, occupied by an organism. Microhabitat measurements are thus focal point measurements.

Frazil ice: Fine spicules of ice formed in water too turbulent for the formation of sheet ice. Frazil forms in supercooled water when the air temperature is far below freezing (most often below -8^{E} Centigrade or 18^{E} Fahrenheit).

Fredle index: An index of the quality of spawning gravel obtained by dividing geometric mean diameter of particle size by the sorting coefficient.

Freshet: A rapid temporary rise in the stream discharge and level caused by heavy rains or rapid melting of snow and ice.

Gabion: A wire basket filled with stones, used to stabilize banks. Not recommended for habitat enhancement.

Geometric mean diameter (d_g): A measure of the central tendency of particle size composition of substrate materials sometimes used as an index of the quality of spawning gravels. Also referred to as D50 size.

Graded stream: A geomorphic term used for streams that have apparently achieved, throughout long reaches, a state of practical equilibrium between the rate of sediment transport and the rate of sediment supply. Such a stream is in regimen. Syn: a mature stream.

Gradient: a) The general slope, or rate of the change in vertical elevation per unit of horizontal distance, of the water surface of a flowing stream; b) The rate of change of any characteristic per unit of length.

Gravel: Substrate particle size between 2 and 64 mm (0.08 and 2.5 inches) in diameter. See Substrate particle size table.

Habitat: The place where a population lives and its surroundings, both living and nonliving; includes the provision of life requirements such as food and shelter.

Habitat component: A single element (velocity, depth, cover, etc.) of the habitat or environment in which a fish or other aquatic species or population may live or occur. Syn: Attribute.

Habitat type: A land or aquatic unit, consisting of an aggregation of habitats having equivalent structure, function, and responses to disturbance.

Hardness: The total concentration of calcium and magnesium ions expressed as mg/l calcium carbonate. Syn: Total hardness.

Humus: Partially decomposed organic material found in soil and water.

Hydraulic control point: The top of an obstruction to which stream flow must rise before passing over, or a point in the stream where the flow is constricted.

Hydraulic gradient: a) The slope of the water surface; b) The drop in pressure head per length in the direction of stream flow.

Hydraulic radius: The cross-sectional area of a stream divided by the wetted perimeter.

Hydraulics: Refers to water, or other liquids, in motion and their action.

Hydrograph: A graph showing, for a given point on a stream, the discharge, stage, velocity, or other property of water with respect to time.

Incident light: Visible light reaching the water surface.

Indicator organisms: Organisms that respond predictably to various environmental changes, and whose presence, or abundance, are used as indicators of environmental conditions. See Water quality indicators.

Instream cover: Areas of shelter in a stream channel that provide aquatic organisms protection from predators or competitors and/or a place in which to rest and conserve energy due to a reduction in the force of the current.

Instream flow requirements: See Flow, instream flow requirements.

Intermittent stream: See Stream.

Interrupted stream: See Stream.

Interstitial velocity: See Apparent velocity.

Kinetic energy: The energy of a body or a system with respect to the motion of the body or of the particles in the system.

Large woody debris: A large piece of relatively stable woody material having a diameter greater than 30 cm (12 inches) and a length greater than 2 m (6 feet) that intrudes into the stream channel. Syn: LOD, large organic debris, log. Specific types of large woody debris include:

affixed logs: Single logs or groups of logs that are firmly embedded, lodged or rooted in a stream channel.

bole - Term referring to the stem or trunk of the tree.

large bole - 10 m (33 feet) or more in length; often in the stream for extended periods.

small bole - less than 10 m (33 feet), usually sections of bole; seldom stable, usually move downstream on high flows.

deadheads: Logs that are not embedded, lodged, or rooted in the stream channel, but are submerged and close to the surface.

digger log: Log anchored to the stream banks and/or channel bottom in such a way that a scour pool is formed.

free logs: Logs or group of logs that are not embedded, lodged or rooted in the stream channel.

root wad: The root mass of the tree. Syn: butt ends.

snag: a) A standing dead tree; b) Sometimes a submerged fallen tree in large streams. The top of the tree is exposed or only slightly submerged.

sweeper log: Fallen tree whose bole or branches form an obstruction to floating objects.

Types of large organic debris accumulation:

clumps: Accumulations of debris at irregularly spaced intervals along the channel margin, not forming major impediments to flow.

jams: Large accumulations of debris partially or completely blocking the stream channel, creating major obstructions to flow.

scattered: Single pieces of debris at irregularly spaced intervals along the channel.

Least flow: Negotiated lowest flow in a regulated stream that will sustain an aquatic population at agreed upon levels. See Flow, minimum.

Macroinvertebrate: An invertebrate animal (without backbone) large enough to be seen without magnification.

Mainstem: The principal, largest, or dominating stream or channel of any given area or drainage system.

Manning's "n": An empirical coefficient for computing stream bottom roughness used in determining water velocity in stream discharge calculations.

Marsh: A water-saturated, poorly drained wetland area, periodically or permanently inundated to a depth of up to 2 m (6 feet), that supports an extensive cover of emergent, non-woody vegetation, essentially without peat-like accumulations.

Microhabitat: That specific combination of habitat elements in the locations selected by organisms for specific purposes and/or events. Express the more specific and functional aspects of habitat and cover. Separated from adjoining microhabitats by distinctive physical characteristics such as velocity, depth, cover, etc.

Moveable bed: A stream bed made up of materials readily transportable by the streamflow.

Normal high water: A water level attained commonly during runoff season. Distinguished from extreme high water.

Off channel pond: A pond, not a part of the active channel, but connected to the main stream by a short channel. Generally in old flood terraces, but called wall-based channel ponds when located near the base of a valley wall.

Organic debris: Debris consisting of plant or animal material.

Organic materials:

coarse particulate organic matter (CPOM): Organic material having at least a dimension ranging from 0.04 to 3.9 inch (1 mm to 10 cm) 0.04 to 3.9 in). Technically includes both living and dead material, but often used more specifically to detritus.

dissolved organic matter (DOM) or Dissolved organic carbon (DOC): Organic material having a least dimension smaller than 0.45 micron (Passes through a 0.45 micron filter).

fine particulate organic matter (FPOM): Organic material having a least dimension ranging from 0.45 micron to 0.04 inch (1 mm).

Orientation: An organism's position relative to the direction of stream flow.

Overbank storage: Flow of water out of the stream channel and onto the valley floor floodplain during flood flows.

Overhead cover: Material (organic or inorganic) that provides protection to fish or other aquatic animals from above; generally includes material overhanging the stream less than a particular distance above the water surface. Values less than 0.5 m (1.5 feet) and less than 1 m (3 feet) have been used.

Percent fines: Percentage of fine sediments in substrate samples, expressed as a percentage by weight or volume less than some specified diameter. See Fine sediment.

Perennial stream: See stream.

Periphyton: Algae and associated microorganisms growing attached on any submerged surface.

Permeability: A measure of the rate of which water can pass through a given substrate. Depends upon composition and degree of compaction of the substrate (usually gravel). The apparent velocity per unit of hydraulic gradient. Units: cm/hr.

pH: A measure of the hydrogen-ion activity in a solution, expressed as the negative $\log_{10}$ of hydrogen ion concentration on a scale of 0 (highly acidic) to 14 (highly basic) with a pH of 7 being neutral.

Ponding: An increase in water surface elevation upstream of a blockage or an obstruction.

Pool feature: The condition or object that characterizes a pool's formation. These include: logs, trees, roots, stumps, brush, debris, channel meanders, sediment, culverts, bridges or other manmade objects, beaver dams, or tunnels.

Pool-riffle ratio: The ratio of the surface area or length of pools to the surface area or length of riffles in a given stream reach, frequently expressed as the relative percentage of each category.

Production: a) The process of producing organic material; b) The quantity of organic material produced.

Productivity: a) Rate of new tissue formation or energy utilization by one or more organisms; b) Capacity or ability of an environmental unit to produce organic material; c) The ability of a population to recruit new members by reproduction.

Profile: A graphical presentation of elevation vs distance, as in channel cross sections and longitudinal sections. In open channel hydraulics, it is a plot of water surface elevation against channel distance.

Reach: a) Any specified length of stream; b) A relatively homogeneous section of a stream having a repetitious sequence of physical characteristics and habitat types; c) A regime of hydraulic units whose overall profile is different from another reach.

representative reach: A length of stream which represents a large section of the stream with respect to area, depth, discharge, and slope.

specific reach: A length of channel uniform with respect to selected habitat characteristics or elements (discharge, depth, area, slope, population of hydraulic units), fish species composition, water quality, and type and condition of bank cover.

Recurrence interval: Expected or observed time intervals between hydrological events of a particular magnitude described by stochastic or probabilistic models (log-log plots).

Regime: See Flow, regime.

Revetment: See Riprap.

Rill: One of the first and smallest channels formed by surface runoff.

Riparian: Pertaining to anything connected with or immediately adjacent to the banks of a stream or other body of water.

Riparian vegetation: Vegetation growing on or near the banks of a stream or other body of water on soils that exhibit some wetness characteristics during some portion of the growing season.

Riparian vegetation erosion control rating: A system for ranking the relative effectiveness of riparian vegetation for controlling bank erosion (Platts et al. 1983).

Riparian area: The area between a stream or other body of water and the adjacent upland identified by soil characteristics and distinctive vegetation. It includes wetlands and those portions of floodplains and valley bottoms that support riparian vegetation.

Riprap: A layer of large, durable materials (usually rock) used to protect a stream bank from erosion. May also refer to the materials themselves. Syn: revetment.

Rock-fill dam: A dam composed of large, broken, and loosely placed or pervious rocks with either an impervious core or upstream facing or surface layer.

Roughness coefficient: See Manning's "n".

Rubble: Stream substrate particles between 64 and 256 mm (2.5 and 10 inches) in diameter. Syn: cobble.

Scour: The localized removal of material from the stream bed by flowing water. This is the opposite of fill.

Sediment: Fragmental material that originates from weathering of rocks and decomposition of organic material that is transported by, suspended in, and eventually deposited by water or air, or is accumulated in beds by other natural phenomena.

Sediment discharge: The mass or volume of sediment (usually mass) passing a stream transect in a unit of time. The term may be qualified, for example, as suspended-sediment discharge, bedload discharge, or total-sediment discharge, usually expressed as tons per day.

Sediment load: The portion of the total sediment load that moves in suspension, free from contact with the stream bed, and is made up of particles having such density or grain size as to permit movement disassociated from the stream bed. Density and grain size vary according to the amount of turbulence. Only unusually swift streams are turbulent enough to lift particles larger than medium-sized sand from their beds. See Bedload.

Seep: An area of minor ground water outflow onto the land surface or into a stream channel. Flows are too small to be a spring.

Sinuosity: a) The ratio of channel length between two points on a channel to the straight line distance between the same two points; b) The ratio of channel length to down valley length. Channels with sinuosities of 1.5 or more are called "meandering".

Slack water: A quiet part of, or a still body of water in, a stream; e.g., on the inside of a bend, where the current is slight.

Slough: a) Low, swampy ground or overflow channels where water flows sluggishly for considerable distances; b) Side channel slough formed by channelization; c) A sluggish channel of water, such as a side channel of a stream, in which water flows slowly through low, swampy ground, or a section of an abandoned stream channel containing water most or all of the year, but with flow only at high water, and occurring in a floodplain or delta; d) A marsh tract lying in a shallow, undrained depression on a piece of dry ground; e) A term used for a creek or sluggish body of water in a bottom-land.

Solar radiation: Electromagnetic energy from the sun in all wavelengths.

arc of the sun: The distance the sun travels on any given day in degrees from when it first strikes the water until it leaves the water. The arc of the sun on August 1st is used as a standard.

direct solar radiation: Radiation that reaches the water surface in an unobstructed straight line.

reflected solar radiation: Radiation that does not penetrate the water surface, but is redirected away from that surface.

total solar radiation: The sum of direct, reflected and refracted radiation reaching any one point.

Sorting coefficient: A measure of the distribution or variability of particle sizes in the substrate. The usual measure, computed as d75/d25 is equivalent to the standard deviation of the log transformed frequency curve, hence a measure of dispersion of particle sizes. A substrate with a large sorting coefficient is termed "well sorted". The terms d75 and d25 are those diameters for which 75 percent and 25 percent of the cumulative size-frequency distributions are larger.

Specific reach: See Reach.

Spring creek: A stream that derives most of its flow from ground water, with relatively constant flow and temperature.

Stability rating: An index of the resistance or susceptibility of the stream channel and banks to erosion (Platts et al. 1983).

Stage: The elevation of a water surface above or below an established datum or reference.

Standing crop: The abundance, total weight or energy content of organisms existing in an area at a given time. See Biomass.

Standing stock: The number of organisms (usually fish) present in an area at a particular time. Smaller sizes not susceptible to capture may sometimes be excluded.

Stream: (includes creeks and rivers): A stream is a body of water that flows at least periodically or intermittently through a bed or channel having banks and supports fish or other aquatic life. This includes watercourses having a surface or subsurface flow that supports or has supported riparian vegetation. Streams in natural channels may be classified as follows:

a) Relation to time:

ephemeral: One that flows briefly only in a direct response to precipitation in the immediate locality and whose channel is at all times above the water table.

intermittent or seasonal: One in contact with the ground water table that flows only at certain times of the year as when the ground water table is high and/or when it receives water from springs or from some surface source such as melting snow in mountainous areas. It ceases to flow above the stream bed when losses from evaporation or seepage exceed the available streamflow.

perennial: One that flows continuously throughout the year. Syn: Permanent streams.

b) Relation to space:

continuous: One that does not have interruptions in space.

interrupted: One that contains alternating reaches that are either perennial, intermittent, or ephemeral.

c) Relation to ground water:

insulated: A stream or reach of a stream that neither contributes to nor receives water from the zone of saturation. It is separated from the zones of saturation by an impermeable bed.

gaining: A stream or reach of stream that receives water from the zone of saturation.

losing: A stream or reach of stream that contributes water to the zone of saturation.

perched: Either a losing stream or a insulated stream that is separated from the underlying ground water by a zone of aeration.

d) Other:

incised: A stream that has, through degradation, cut its channel into the bed of the valley.

Stream bank: The portion of the channel cross section that restricts lateral movement of water at normal water levels. The bank often has a gradient steeper than 45 degrees and exhibits a distinct

break in slope from the stream bottom. An obvious change in substrate may be a reliable delineation of the bank.

lower bank: The periodically submerged portion of the channel cross section from the normal high water line to the water's edge during the summer flow period.

upper bank: That portion of the topographic cross section from the break in the general slope of the surrounding land to the normal high water line.

Stream capacity: Total volume of water that a stream can carry within the normal high water channel. Also called stream bottom.

Stream classification: Various systems of grouping or identifying streams possessing similar features according to geomorphic structure (e.g., gradient), water source (e.g., spring creek), associated biota (e.g., trout zone) or other characteristics. A hierarchical classification.

Stream corridor: A stream corridor is usually defined by geomorphic formation, with the corridor occupying the continuous low profile of the valley. The corridor contains a perennial, intermittent, or ephemeral stream and adjacent vegetative fringe.

Stream density: Kilometers of stream per square kilometer or area. Syn: Drainage density.

Stream/estuary ecotone: An area near the stream mouth extending from the upper limit of tidal influence seaward to the lower limit of marsh vegetation. Its size depends on stream gradient and range of tidal heights.

Stream flow: See Flow (a).

Stream/forest ecotone: An area of the stream directly influenced by riparian vegetation, including the stream bank and upland area adjacent to the stream. Its size depends on the stream width, type of vegetation, and the physical characteristics of the adjoining uplands.

Stream frequency: The number of streams per square kilometer of area.

Stream order: The designations (1, 2, 3, etc.) of the relative position of stream segments in a drainage basin network: The smallest, unbranched, perennial tributaries, terminating at an outer point, are designated order 1; the junction of two first-order streams producers a stream segment of order 2; the junction of two second-order streams produces a stream segment of order 3, etc. Use of small-scale maps (<2 in/mile) may cause smaller steams to be overlooked, leading to gross errors in designation. Ideally, designations should be determined on the ground or from large-scale air photos.

Stream pattern: See Channel pattern.

Stream power: The rate of doing work, or a measure of the energy available for moving rock, sediment particles, or woody or other debris in the stream channel, as determined by discharge, water surface slope, and the specific weight of water.

Stream reach: A portion of a stream that is relatively homogeneous based on geomorphology, stream flow, geology, and sinuosity. It is frequently bounded by significant tributaries, diversions, reservoirs, etc. It also may be thought of as a series of short reaches with common morphology.

Stream shore water depth: The water depth at the stream shoreline or at the edge of a bank overhanging the shoreline. This depth could be greater than 0 if the bank is undercut.

Stream width: See wetted width.

Structure: a) Any object, usually large, in the stream channel that controls water movement; b) The diversity of physical habitat within a stream; c) When applied to a biological community, the organization of taxa into various functional or trophic groups.

Substrate: The mineral and/or organic material that forms the bed of the stream.

Suspended sediment: See Suspended load.

Swamp: Tree or tall shrub dominated wetlands that are characterized by periodic flooding and nearly permanent subsurface water flow through mixtures of mineral sediments and organic materials, essentially without peat-like accumulation.

Swimming speed: Swimming speeds of stream fish vary from essentially zero to over 19.7 feet per second (six meters per second), depending upon species, size and activity. Three categories of performance are generally recognized.

> **cruising speed:** The speed that a fish can maintain for an extended period of time without fatigue. This implies a lack of stress, and is the maximum speed traveled by undisturbed individuals.
>
> **sustained (prolonged) speed:** The speed that a fish can maintain for a prolonged period, but which ultimately results in fatigue. At this speed the fish is under some degree of stress.
>
> **burst (darting) speed:** The speed that a fish can maintain for a very short time, generally 5-10 seconds, without gross variation in performance. Burst speed would be employed for feeding or escape, and represents maximum swimming speed.

Thalweg: The line connecting the lowest or deepest points along a stream bed.

Torrent: A temporary flow condition in streams created by heavy rainfall or rapid snow melt; characterized by near bankfull discharge, sizable increase in velocity, standing waves, and loss of the typical stepped profile and hydraulic diversity of habitat.

Total dissolved solids (TDS): A measure of inorganic and organic materials dissolved in water (passing through a 0.45 micron filter); often referred to as Filterable Residue (FR) and expressed as mg/l FR. Sometimes considered similar to conductivity as and indicator of potential production in habitat quality indices.

Total suspended solids: The organic and inorganic material left on a standard glass fiber filter

(0.45 micron) after a water sample is filtered through it; often referred to as Non-Filterable Residue (NFR).

Trash collector dam: A fence-like structure or grillwork of heavy wire, metal or logs placed across a stream to intercept and hold debris flowing downstream, creating a dam or blockage. Used to protect bridge crossings, create pools, and store gravel for spawning habitat. Syn: Debris catcher, grizzly.

Tributary: A stream feeding, joining, or flowing into a larger stream. Syn: Feeder stream, side stream. Tributary types based on watershed geomorphology include:

lower valley wall tributaries: Characterized by moderately steep gradients and occur at the slope break between the valley wall and valley floor.

terrace tributaries: Results from spring networks on valley floor, and from tributaries draining valley side slopes and continuing across terraces to the main stream.

upper valley wall tributaries: Possess very steep gradients, high velocities, and flow over a stepped profile of alternating pools and cascades.

upper valley wall tributaries: Run along the base of the valley wall, parallel to the main stream channel.

wall based tributaries: Run along the base of the valley wall, parallel to the main stream channel.

Turbidity: a) Relative water clarity; b) A measurement of the extent to which light passing through water is reduced due to suspended materials. Measured by several non-equivalent standards (e.g., Nephelometric Turbidity Units, NTU; Formazin Turbidity Units, FTU; Jackson Turbidity Units, JTU).

Turbulence: The motion of water where local velocities fluctuate and the direction of flow changes abruptly and frequently at any particular location, resulting in disruption of laminar flow. It causes surface disturbance and uneven surface level, and often masks subsurface areas because air bubbles are entrained in the water.

Undercut bank: A bank that has had its base cut away by the water action along man-made and natural overhangs in the stream.

Vegetative fish cover: Vegetation materials such as algal mats and organic debris capable of providing protection for fish and other aquatic organisms.

Velocity: The time rate of motion; the distance traveled divided by the time required to travel that distance.

critical velocity: a) The maximum swimming speed that a fish can sustain over a specified distance or length of time, or the maximum water velocity against which a fish can sustain a

position over a specified length of time; b) The velocity in a channel at which flow changes from laminar to turbulent; c) Velocity through which a fish will not swim, creating a velocity barrier.

fish velocity or focal point velocity: Represents the velocity at the location occupied by a fish, measured at the fish's snout. Syn: Snout velocity, facing velocity.

mean column velocity: The average velocity of the water measured on an imaginary vertical line at any point in a stream. A measurement at 60 percent of the depth, measured from the surface, closely approximates the average velocity for the water column. In water greater than 76 cm (30 in) in depth, the average of measurements made at 20 percent and 80 percent of the depth approximates the mean column velocity.

mean cross sectional velocity: Represents the mean velocity of water flowing in a channel at a given cross-section. It is equal to the discharge divided by the cross-section area of the cross section.

profile: A curve representing the velocity of flow along a given line.

swimming velocity: See Swimming speed.

thalweg velocity: The mean column velocity at the thalweg.

V-notch: a) Narrow, steep-sided ravine or valley with V-shaped cross-section whose bottom usually contains a watercourse; b) A type of weir containing a V-shaped notch used for gauging discharge in small streams.

Wash load: The load that because of its fine size has such a small settling velocity that it would be held in suspension. It is essentially synonymous with suspended load.

Water width: See Wetted width.

Water year: See Climatic year

Water yield: The total outflow from all or part of a drainage basin through either surface channels or subsurface aquifers within a given time (e.g., one year).

Watershed: See Drainage area.

Weighted Usable Area (WUA): a) An index of the capacity of a stream reach to support the species and life stage being considered, expressed as actual area or percentage of habitat area predicted to be available per unit length of stream at a given flow; b) The total surface area having a certain combination of hydraulic and substrate conditions, multiplied by the composite probability of use by fish for the combination of conditions at a given flow.

Weir: a) A notch or depression in a levee, dam, embankment, or other barrier across or bordering a stream, through which the flow of water is measured or regulated; b) A barrier constructed across a stream to divert fish into a trap; c) A dam (usually small) in a stream to raise the water level or divert its flow.

Wetland: An area subjected to periodic inundation, usually with soil and vegetative characteristics that separate it from adjoining non-inundated areas.

Wetted perimeter: The length of the wetted contact between a stream of flowing water and the stream bottom in a vertical plane at right angles to the direction of flow.

Wetted width: The width of the water surface measured at right angles to the direction of flow and at a specific discharge. Widths of multiple channels are summed to represent total wetted width.

White water: Occurs where flows are sufficiently fast and turbulent to entrain air bubbles in the water.

Woody Debris: See Large woody debris.

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