# Water Quality Education/ Non-Point Source Management: A Step Forward in the Antidegradation Process

Idaho Water Resources Research Institute
University of Idaho
Moscow, Idaho

*Sponsor*

Division of Environmental Quality
Idaho Department of Health and Welfare
Boise, Idaho

# WATER QUALITY EDUCATION/NON-POINT SOURCE MANAGEMENT: A STEP FORWARD IN THE ANTIDEGRADATION PROCESS

AUGUST 6-7, 1990
UNIVERSITY OF IDAHO
BOISE CENTER
800 PARK BOULEVARD
BOISE, IDAHO

AUGUST 21-22, 1990
HOLIDAY INN
414 WEST APPLEWAY
BAY 2
COEUR D'ALENE, IDAHO

AUGUST 23-24, 1990
UNIVERSITY OF IDAHO
STUDENT UNION BUILDING
APPALOOSA ROOM
MOSCOW, IDAHO

## *PURPOSE*

Differing levels of knowledge and the varying backgrounds of non-technical people create obstacles in making antidegradation and other water quality programs operate efficiently. A more informed base for individuals who will be participating in working groups called for in the Antidegradation Agreement, will be accomplished by a workshop on water quality basics.

Individuals will be involved in examining watersheds, identifying problems and prescribing solutions. In addition, participants will familiarize themselves with terminology, non-point control strategies, fish habitat requirements, the law and regulations, and other aspects of water quality protection. The workshop will properly prepare the working groups for their responsibilities before they begin the watershed work required in the Agreement.

## *INSTRUCTORS*

**Mr. Bill Clark** is a Senior Surface Water Quality Analyst at the Division of Environmental Quality, Idaho Department of Health and Welfare, Boise, Idaho

**Dr. C. Michael Falter** is a Professor in the Fish and Wildlife Resources Department at the University of Idaho

**Mr. Joe Hinson** is Executive Vice President at the Intermountain Forest Industry Association, Coeur d'Alene, Idaho

**Mr. Bill Love** is Chief of the Bureau of Private Forestry at the Idaho Department of Lands, Coeur d'Alene, Idaho

**Dr. Dennis L. Scarnecchia** is an Associate Professor in the Fish and Wildlife Resources at the University of Idaho

**Dr. Fred Watts** is a Professor in the Civil Engineering Department at the University of Idaho

**Mr. Will Whelan** is the Policy Analyst at the Idaho Conservation League, Boise, Idaho

# COURSE OUTLINE

## Day 1

| | |
|---|---|
| 8:00 am | Introduction |
| 8:05 am | Stream Hydrology and Sediment Transportation |
| *9:45 am* | *Break* |
| 10:00 am | Water Quality/Stream Ecology on Forested Watersheds |
| 11:30 am | Habitat Quality for Stream Fishes on Forested Lands |
| *12:00 pm* | *Lunch* |
| 1:00 pm | Habitat Quality for Stream Fishes on Forested Lands |
| 2:45 pm | Field Trips<br>Boise, Moore's Creek<br>Coeur d'Alene, Wolf Lodge Creek<br>Moscow, Hatter Creek Drainage |

## Day 2

| | |
|---|---|
| 8:00 am | Forest Industry Perspective |
| 8:30 am | Idaho Conservation League Perspective |
| 9:00 am | Water Quality Standards, Issues and Background |
| *9:45 am* | *Break* |
| 10:00 am | Water Quality Standards, Issues and Background |
| 11:00 am | Idaho Forest Practices Act (Development and Implementation of BMP's by Local Working Groups) |
| *12:00 pm* | *Lunch* |
| 1:00 pm | Idaho Forest Practices Act (Development and Implementation of BMP's by Local Working Groups) |
| 2:00 pm | Questions and Answers |

## TABLE OF CONTENTS

# Stream Hydrology and Sediment Transport

DR. F.J. WATTS
Department of Civil Engineering
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# Stream Hydrology and Sediment Transport

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Department of Civil Engineering
University of Idaho

**Hydrology treats the waters of the earth, their occurrence, their reaction with their environment, and their chemical and physical properties reaction with their environment**

## Surface Runoff

- Precipitation
- Interception (plants - trees)
- Depression storage
- Infiltration
- Surface runoff

# Factors Which Effect Amount of Precipitation

- **Elevation**
- **Aspect**
- **General location with respect to prevailing winds and large bodies of water**

**Ninety percent (90%) of precipitation that falls on continental areas returns to the seas**

## The Chief Concern

- Overland flow
- Rill and gully flow
- Flow in streams

## Stream Definitions

**Class I (Idaho Forest Practices Act)**

**Class II (Idaho Forest Practices Act)**

**The major concerns about a timber harvest development are:**

## Impacts

- **Prime fishing stream**
- **Water quality in headwater stream**
- **Temperature**
- **Sediment**
- **Chemical (fuels)**
- **Debris in stream crossings**

- What is the existing water runoff sediment - yield condition

- How will it change (temporarily)

- What is the length of time before revegetation

# Considerations

- What type of hydrologic events can we expect and when do they occur

- Violent convective summer rainstorms

- Winter rain-on-snow events

## Some generalized concepts about precipitation, runoff, production of sediment, and sediment transport

**Water is the driving mechanism for erosion and sediment yield**

**Excess rainfall = precipitation - intercepted volume - depression storage - infiltration**

**Intercepted volume is a function of tree density and ground cover - if these are removed, runoff from small to medium events increases**

**Depression storage may be 1/4" - 1/2" of precipitation**

- **may not change much with harvest**

**Infiltration can change drastically with removal of surface cover, plant and roots, equipment packing, etc.**

**Sedimentʼ yield is a function of:**

- **Dislodgement of sediment particles by**

  **raindrop - splash**

  **flowing water**

- **Sediment transported as**

  **suspended sediment (fine material)**

  **bed load - rolling, sliding, jumping along bed**

**Soil detachment by raindrop impact depends on:**

- **size of raindrop and the number of them - high density rainfall has most impact**

- **amount of soil detached is proportional to the intensity of rainfall (inches/hr) squared**

- **after a thick layer of water builds up, the energy of the raindrop is absorbed by the layer of water and no soil is detached**

- **a good tree and ground cover intercepts falling raindrops; therefore only a small amount of soil is detached by falling drops**

**Soil detached by flowing water**

**The amount of sediment is approximately proportional to:**

**Slope to the 1.5 power**

**Flow depth to the 1.5 power**

**Overland flow**

**Rill**

**Channel flow**

**Other major source of sediment:**

- **Downcutting**
- **Sloughing of material from bank**
- **Transport downstream by flow**
- **Soil stability problem**

**Soil type is very important:**

- **Erodibility varies from soil to soil**

**Soil Erodibility increases with**

- **increase in % of fine sand and silt**
- **decrease in organic moisture**
- **decrease in permeability (more runoff)**

**Soil cover very important**

**Sediment yield increase with flow length (the reason for water barring of forest roads)**

**Amount of sediment that is transported from the site is either:**

- **Supply limited**
- **Transport limited**

**Rivers and creeks are giant conveyors of water and sediment**

**The bed may be very "active", i.e., substantial bed load movement**

**The material that you see in the stream bed at a cross-section**

**This year may not be the same material that was there last year**

**Sediment movement in the downstream direction always lags the water flow (the reason we see large sediment deltas or bars along the channel)**

**The concept of surface "Armoring" - road surface, ruts, rills, channels**

**Review of best management practices and their relationship to sediment yield**

- Location of landings, skid trails, fire trails
- Stable flat areas - clear small surface, minimize slides

- Water barring
- Cross drainage
- Outslope
- Inslope
- Seeding - gravel, bank protection

**Shape and stabilize for proper drainage during wet season**

**Buffer strips along streams:**

- **Temperature control**
- **"Filter" for overhead and small channel flow**
- **Cross timbers in gullies may serve as sediment trap**

**Tracked or wheel skidding should not be conducted on geologically unstable saturated or easily compacted soils**

# Deposit waste materials in geologically stable area

# Minimize road width

## Minimize cut and fill near stream crossings

**Conduct regular preventative maintenance:**

- **Minimize ruts**
- **Cut in water bars during wet season when roads are closed**
- **Sidecast waste such that it doesn't get into streams**
- **Maintain culverts and ditches**

# Water Quality/Stream Ecology on Forested Watersheds

DR. C. M. FALTER
Department of Fish and Wildlife Resources
University of Idaho

# *Water Quality / Stream Ecology*

**Summer 1990**

C. Michael Falter, Limnologist
Dept. of Fish & Wildlife Resources
College of Forestry, Wildlife & Range Resources
University of Idaho

*Objectives* for this portion:

1. To understand the concept of water quality

2. To explore the basic components of a stream system

3. To understand the principal physical, chemical, and biological controlling factors in the stream environment (whether natural or human-caused)

4. To relate water quality and physical aspects of the stream channel to stream organisms and production.

5. To relate forest BMP's to stream channels and their biological responses.

## SECTION CONTENT

An aquatic environment = Water + Container + Organisms

Water.....
* Water quantity
* Seasonality of water quantity
* The sediment "load" of water
* Water quality
* Water "Richness"

Container.....
* The stream channel
* Substrate
* Stream banks
* Sediment sources

Organisms......
* Bacteria
* Algae
* Benthic Invertebrates
* Functional groupings
* Factors controlling stream communities
  - Temperature
  - Dissolved oxygen
  - Nutrients
  - Sediments
  - Toxicity
* Seasonality

Riparian communities

Logging Impacts on stream systems

Links between Best Management Practices, Water Quality, and Stream Ecology

Some common *terminology* of water quality and stream ecology.......

ATTACHED ALGAE: The community of single- and colonial-celled algae (simple plants) which comprises the slimy film attached to all underwater surfaces exposed to sunlight strong enough for photosynthesis (Attached algae = Periphyton).

AUTOTROPHIC: Production generated from photosynthesis within a stream or lake.

BACTERIA: Single- and colonial-celled organisms responsible for much of the heterotrophic degradation (decomposition) of dead plants and animals in streams. Fungi also account for much of the decomposition in streams.

BEDLOAD: The total of all particulate solids (sand, silt, gravel, or soil and rock fragments) too heavy to be carried in the water column but pushed or bounced downstream on or adjacent to the stream bottom.

BENTHOS: The community of animals living in, on, or within, the stream (or lake) bottom substrates. Comprised of aquatic insect larvae and adults, crustaceans, snails, clams, roundworms, and free-living flatworms.

BIOTA: All life (plants and animals) in a stream.

DECOMPOSITION: Breakdown of dead plants and animals to simpler organic compounds and eventually to $CO_2$ and simple inorganic nutrients; Effected by bacteria and fungi.

DETRITUS: Non-living organic residues in the aquatic environment.

DISSOLVED LOAD: The total of all solids dissolved in stream waters (includes dissolved inorganic ions, organic solutes, and soluble breakdown products from decomposition.

EMBEDDEDNESS (COBBLE EMBEDDEDNESS): The amount of fine sediment that is deposited in the interstices (spaces) between larger stream substrate particles.

EMERGENCE: In Insects.....The time of changeover from the aquatic environment to aerial existence.

FLOODPLAIN: Area adjacent to the channel that is occasionally submerged under water. Usually the floodplain is a low gradient area well covered by various types of riparian vegetation.

FUNGI: Single- and colonial-celled organisms responsible for the initial degradation of woody material in streams......often a preparatory step for bacterial decomposition.

HETEROTROPHIC: Production based on organic material transported into the stream from the watershed.

HYDROGRAPH: The graph of stream flow discharge (Q, expressed as cubic feet per second or cubic meters per second) on the vertical axis against month of the year on the horizontal axis.

HYDROLOGIC MODIFICATION: A category of nonpoint source pollution including, but not limited to, channelization, dredging, dam construction, flow regulation or modification, removal of riparian vegetation, and streambank modification or destabilization.

In Fish.........The swimming up of fish larvae or fry from within the gravels to the water column.

LENTIC: Refers to the lake environment.

LOADING: The quantity of a substance entering a receiving stream, usually expressed in pounds (or kilograms) per day or tons per year. Loading is calculated with flow (discharge) and concentration data.

LOTIC: (= Washed). Refers to the stream environment.

NONPOINT SOURCE POLLUTION: Impairment of beneficial uses caused by sediment, nutrients, organic, and toxic substances, and bacteria originating from land-use activities and/or from the atmosphere, which are carried to streams by runoff. NPS cannot usually be traced to a specific, identifiable point of entrance to water.

NUTRIENTS: The (mostly) inorganic and organic dissolved solids required by algae and rooted plants for photosynthesis and growth.

OXYGEN SAG: A decline in dissolved oxygen below saturation, with distance downstream, usually below a source of organic loading or very high biomass.

pH The symbol for the acid - base balance in water.

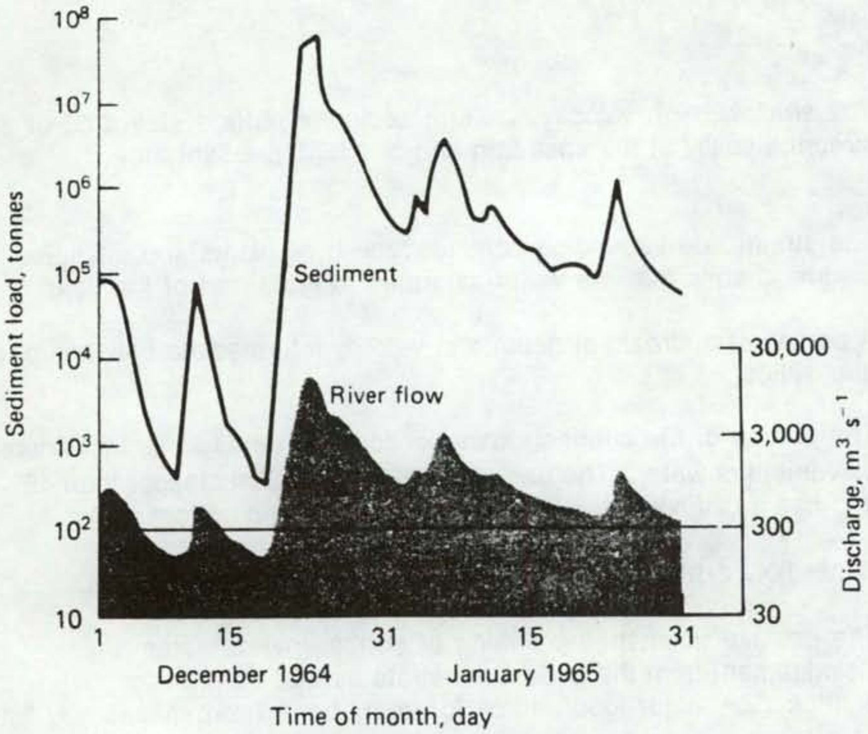
POCKET WATER The alcoves or small pools behind boulders, rubble, or logs. They form small, shallow microhabitats for organisms from the faster waters surrounding the pocket.

POINT SOURCE POLLUTION: Water contamination resulting from discharges into receiving waters from sewers and other identifiable point sources. Common point sources of pollution are the discharges from industrial and municipal sewage plants.

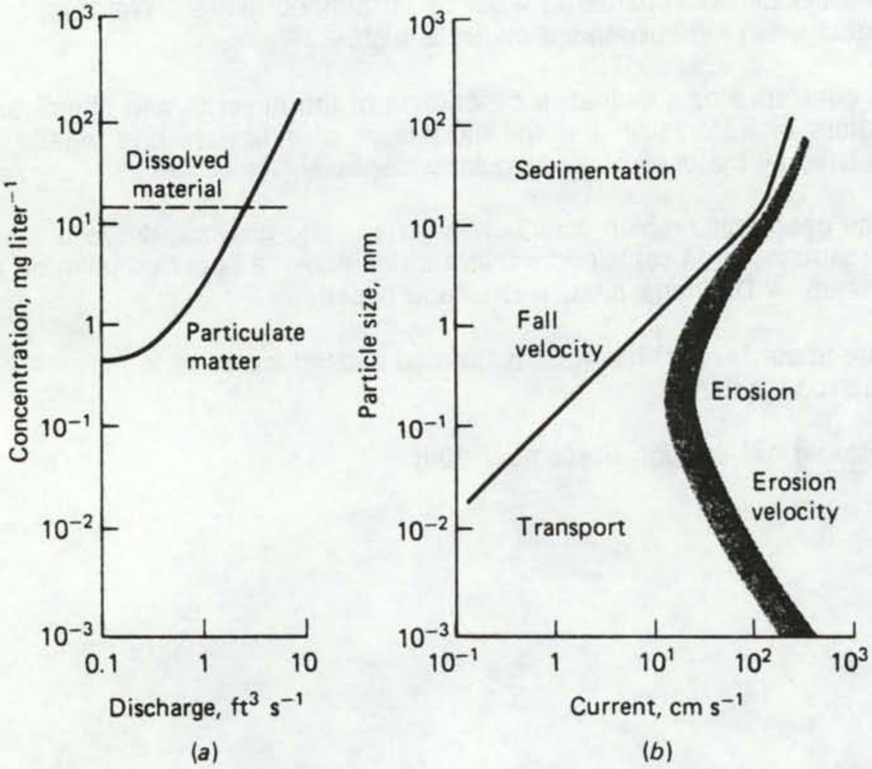
POWER (of a stream): The energy of a stream for erosion and transport of solids, provided by the flowing water; Proportional to water flow volume.

PRODUCTION: New plant or animal material (biomass) per unit time.

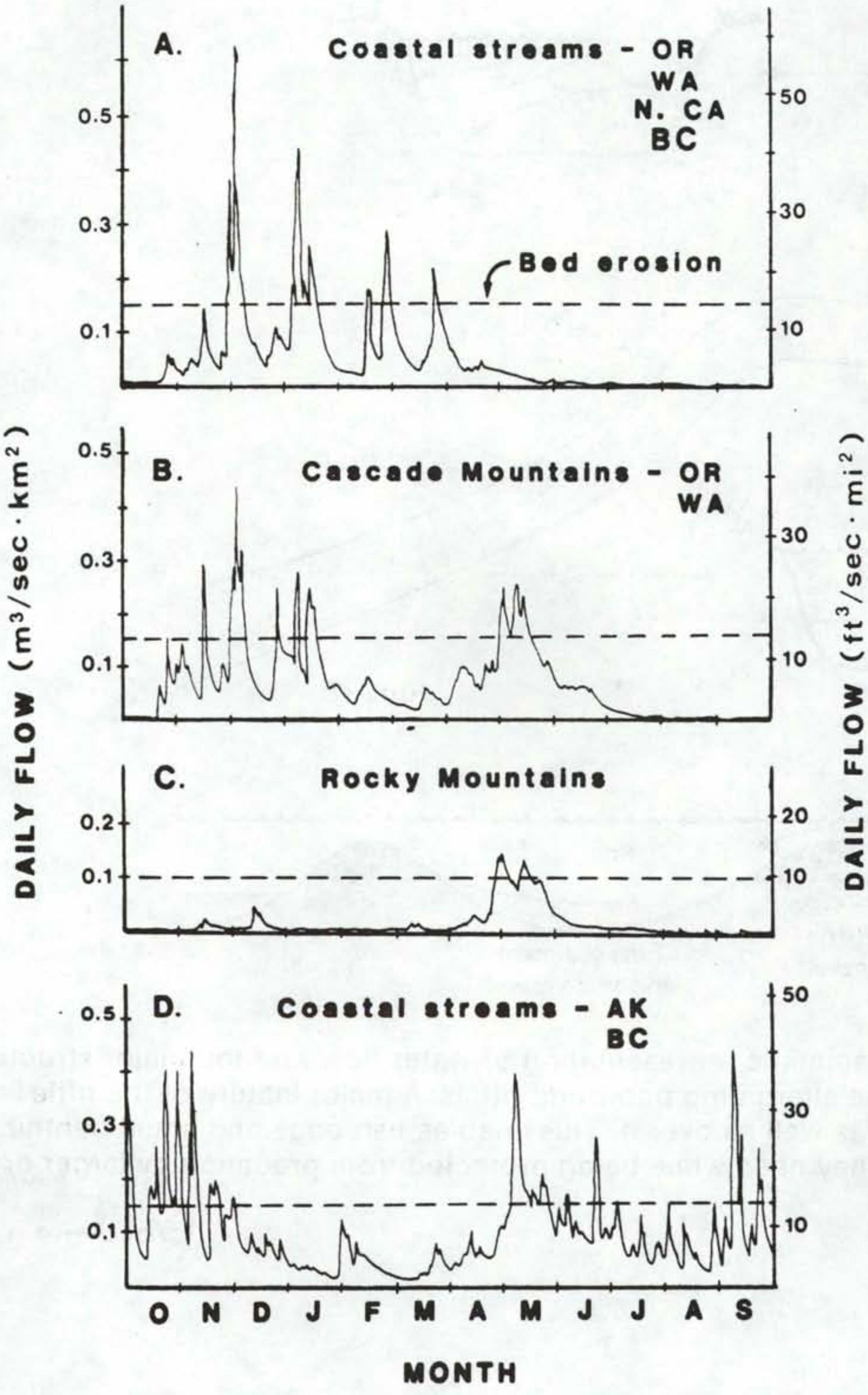
| | |
|---|---|
| RIFFLE: | The shallow, high velocity, uniform sediment particle size area of a stream, usually at the upstream end of a high gradient area. |
| RIPARIAN: | The streamside vegetation community with its plants and animals unique to soils that are water-saturated at least part of the year. |
| RUN: | A portion of a stream of depth and velocity intermediate between pools and riffles. |
| STREAM BANKS | The portion of the channel cross section that tends to restrict lateral movement of water. The bank often has a gradient steeper than 45° and has a distinct break in slope from the stream bottom. |
| STREAM DISCHARGE: | Water flow expressed as volume per unit time, eg. cfs or cms. |
| STREAM DRIFT: | The passive downstream drifting of bottom invertebrates after dislodgement from the bottom substrate as well as organic detritus......A major food source for many benthic organisms and fish. |
| SUBSTRATE: | Bottom materials..........<br>Fines = Substrate particles < 0.25 in. (< 6.25 mm).<br>Gravels = Substrate particles 0.08-3.0 in. (2-76 mm).<br>Cobbles = Substrate particles 3-10 in..<br>Boulders = Substrate particles > 24 in. |
| TURBIDITY: | The cloudiness imparted to water by suspended matter; Water is turbid when the suspended matter is high. |
| WATER QUALITY: | A qualitative or quantitative description of the physical and chemical nature of water, with the specific picture of indicators and criteria defined by the uses of a particular water body. |
| WATERSHED: | The geographic region contributing surface and groundwater to a stream; the area contained within a divide above a specified point on a stream (= Drainage area; = Drainage basin). |
| WATER TABLE: | The upper level of the water-saturated subsurface zone in the soil/rock column. |
| WATER YEAR: | October 1st through September 30th. |



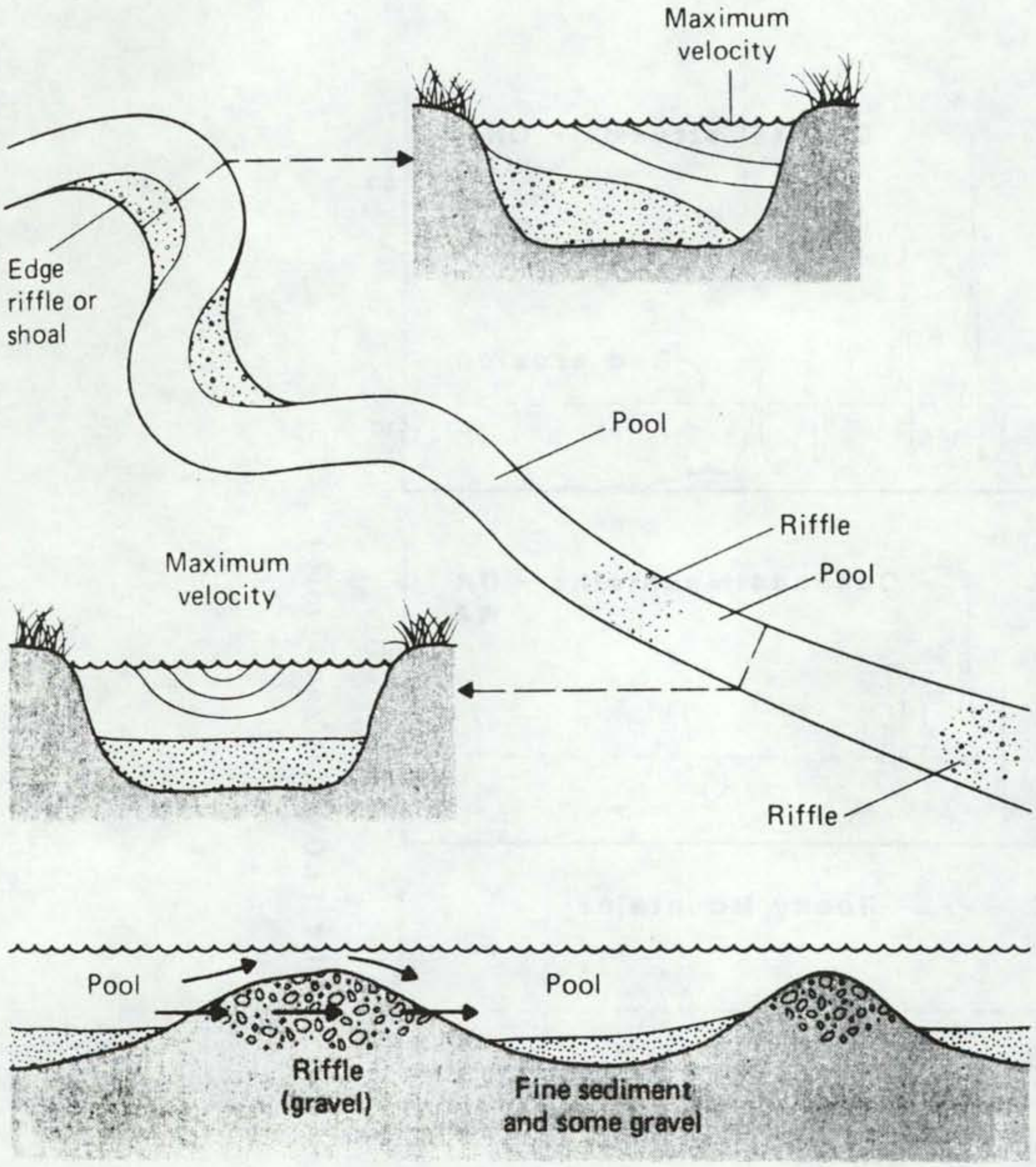

Relationship between river discharge and sediment load for the Eel River, northern California. Note that most sediment is carried in a few days of peak river flows. This river, like the Yellow River in China, carries much more sediment than most rivers, partially due to natural erosion at the headwaters. The general effect is similar in most rivers. (*Redrawn from Waananen et al., 1970; and Beaumont, 1975.*)




General illustration of the relationship between discharge, current, and the concentrations and transport of soluble and particulate materials. (*a*) A small stream in a heavily wooded part of northeastern United States in which most particulate matter is carried only at the highest discharges. This is shown in detail for another stream in Fig. 16-9. (*Modified from Likens et al., 1977.*) (*b*) A general figure for all flowing waters, showing erosion and deposition of a uniform material such as a sandy bank. Note that the size of the particle, as well as water current, controls how easily it will be eroded. (*Modified from Morisawa, 1968.*)

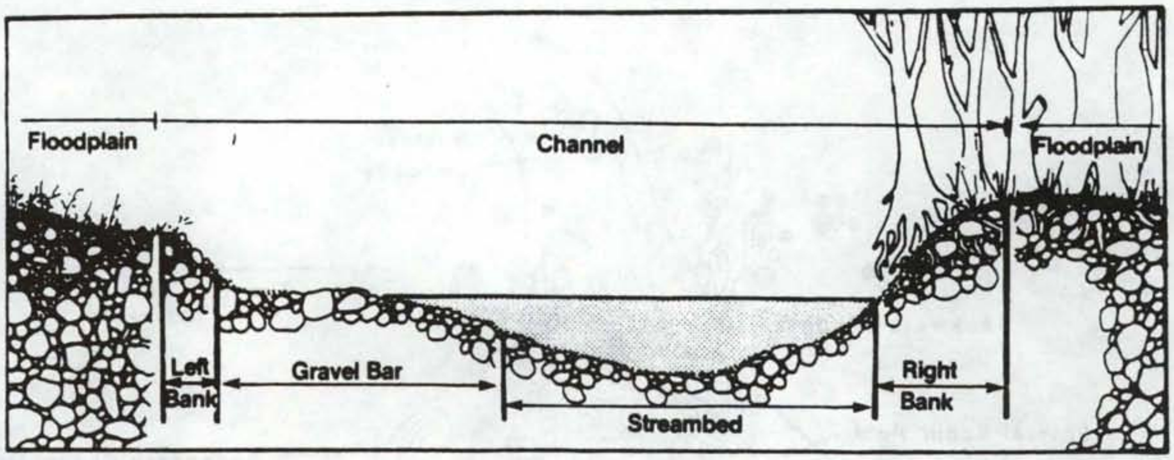



Representative hydrographs for western watersheds. Hydrograph A is typical of coastal British Columbia from the 49th parallel to Prince Rupert, and hydrograph D is typical of northern interior British Columbia.

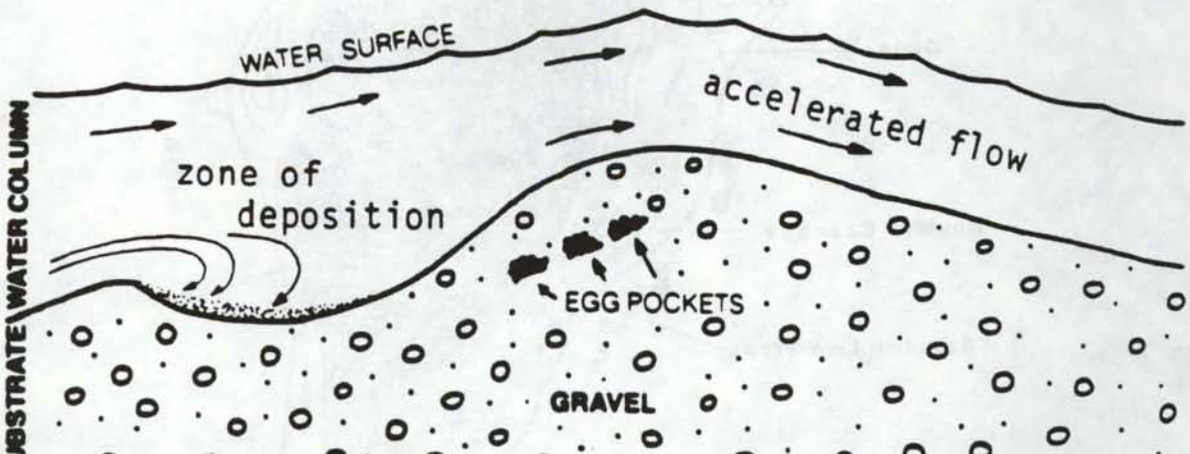



Diagrammatic representation of water flow and the major structural components of a stream. Note the alternating pools and riffles. A major feature of the riffle is that water flows through the gravel as well as over it. This enables fish eggs and small benthic invertebrates to obtain the oxygen they need while being protected from predation by larger organisms such as fish.

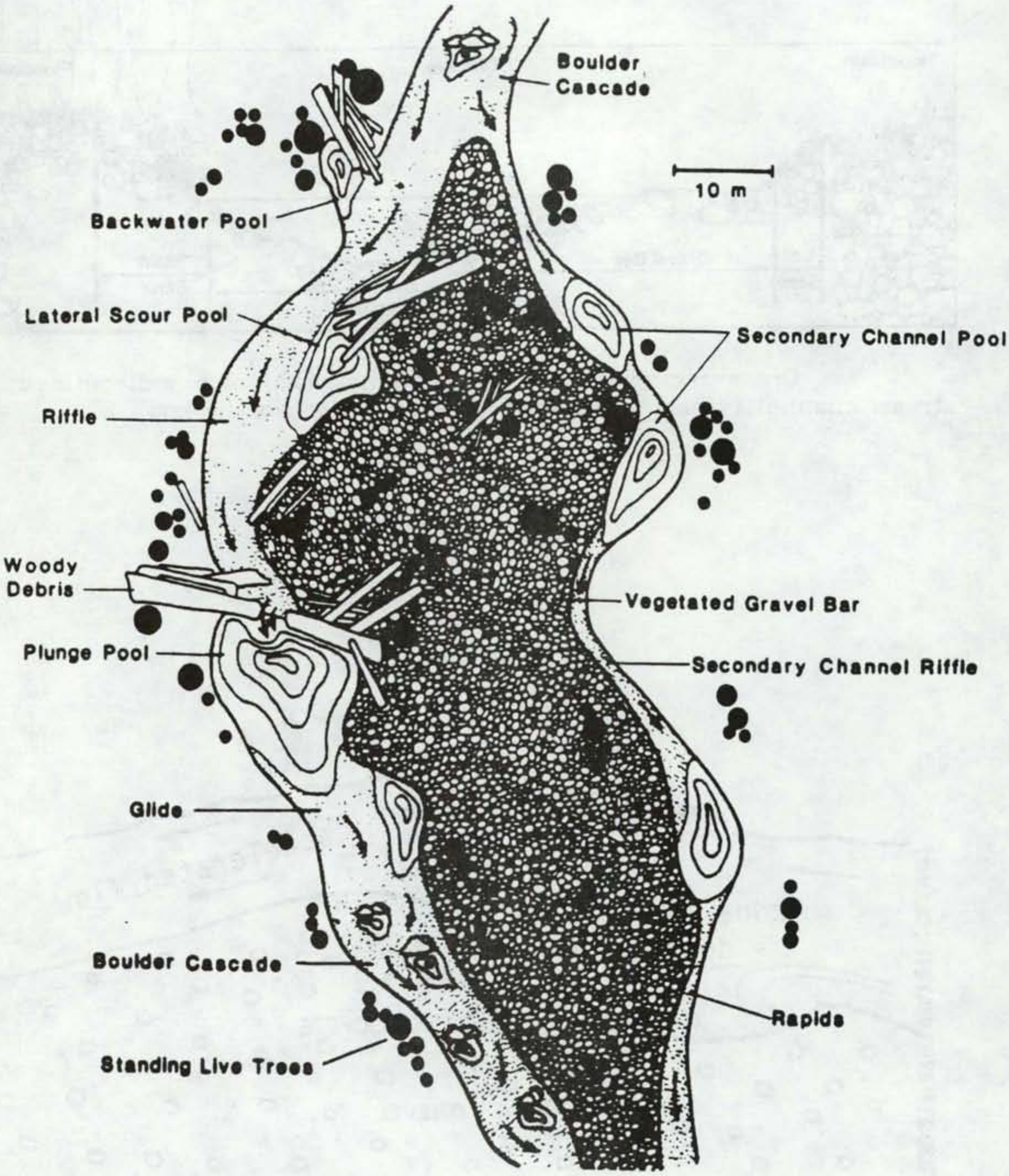
Goldman + Horne 1983




Cross-sectional view (from downstream) of a well-defined stream channel typical of streams of the Pacific Northwest.




Topographic features of salmonid redds resist deposition of fine sediment in the area where embryos are incubating.




Channel unit map of microhabitats in a stream reach in a fourth-order stream, western Washington (from Bisson et al. 1982).

# *WHAT'S REALLY IN SURFACE WATER?*

## THE DISSOLVED AND SUSPENDED LOAD OF STREAM WATER

***.......A GENUINE POT POURRI, so think about this when you next hear the term "Water Quality."***

1. Inorganic salts.....$Na^+$, $K^+$, $SO_4^=$, $Mg^{++}$, etc.
2. Organic solutes.......
   - carbohydrates
   - fatty acids & oils
   - alcohols & aliphatics
   - ring compounds, phenols, benzenes, etc.
   - amino acids & proteins
   - acids, sugars, & vitamins
   - complex organic compounds
   - metals
3. Colloidal.......
   - clays
   - $S^o$
4. Gases.........
   - Oxygen, nitrogen, argon
   - Carbon dioxide
   - Methane, ammonia
5. Particulates (Seston)..........
   - silts and clays
   - detritus (organic residues)
   - bacteria and algae
   - zooplankton and aquatic insects
   - eggs and larvae of worms, insects, and fish
   - fecal matter
   - dust (airfall)

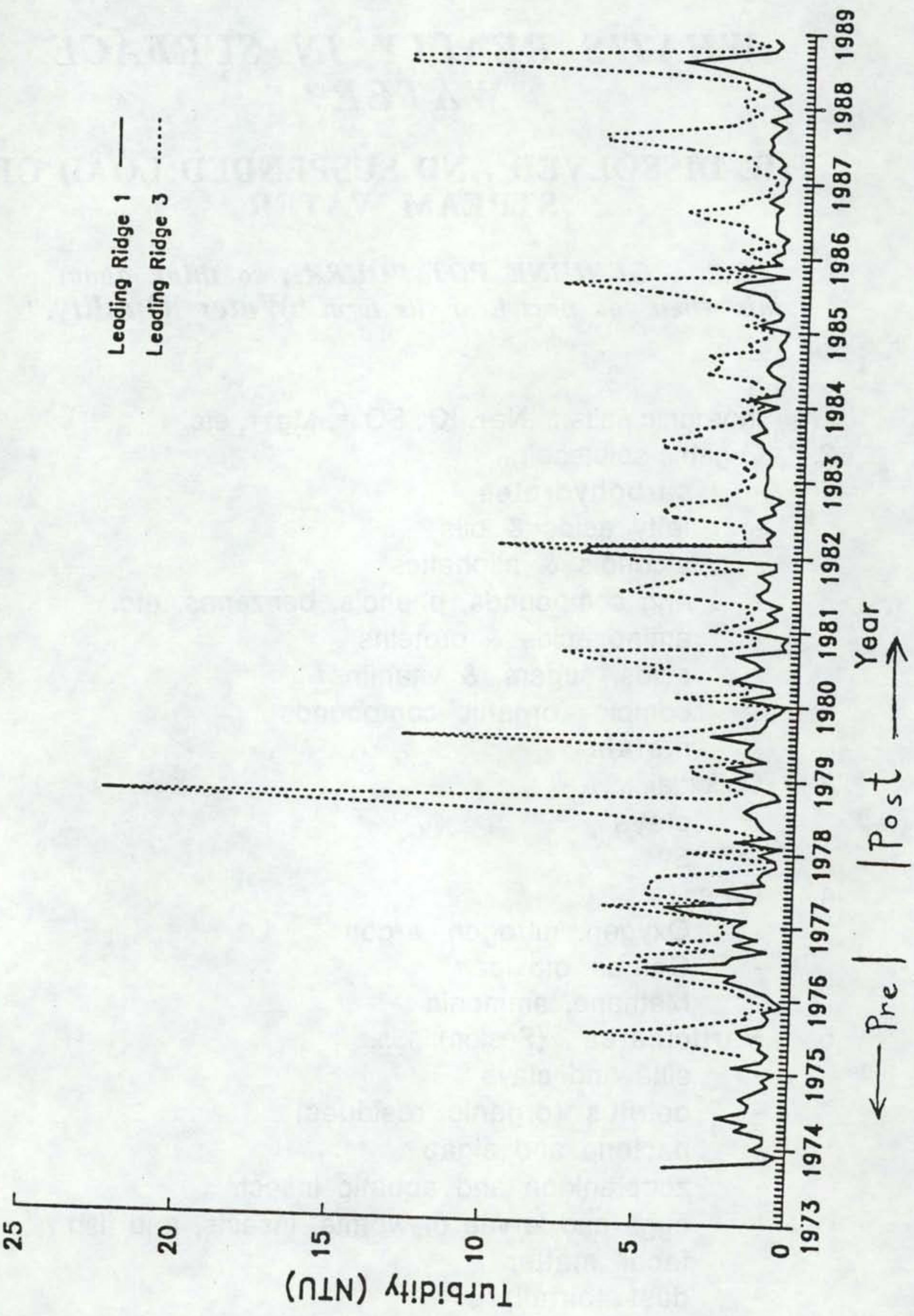



**Figure 1.** Trends in Stream Turbidity (NTU's) for the Control (LR1) and Harvested (LR3) Watersheds Before (1973-1976), During (October, 1976–May, 1977) and After Harvesting.

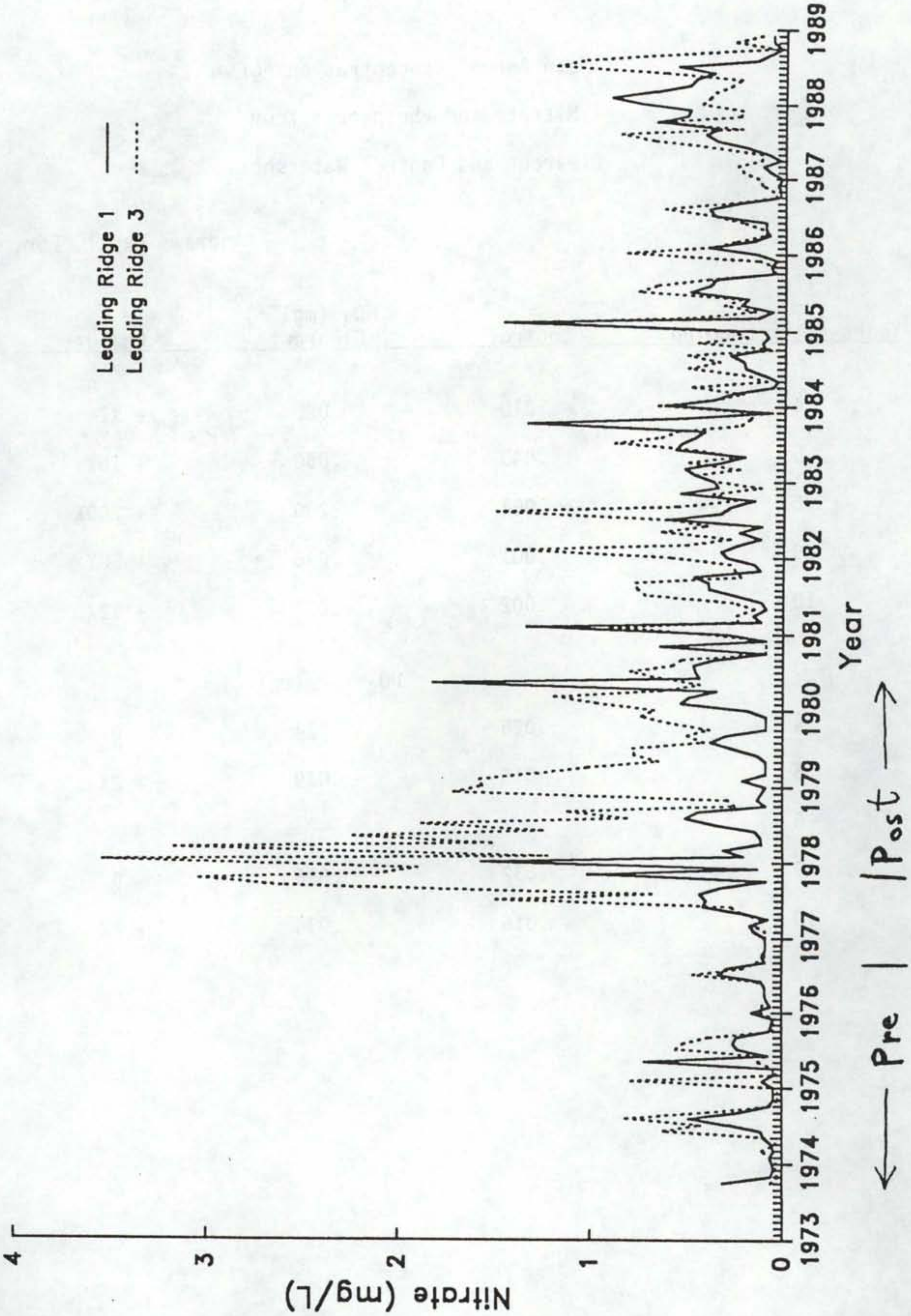



Figure 3. Trends in Stream Water Nitrate Concentrations for the Control (LR1) and Harvested (LR3) Watersheds Before (1973-1976), During (October, 1976–May, 1977) and After Harvesting.

Mean Annual Concentrations of

Nitrate and Phosphorus from

Clearcut and Control Watersheds

Andrews Exptl. For. 1974

| Years After Logging | Control | $NO_3$ ($mgl^{-1}$) Clearcut | Change |
|---|---|---|---|
| 4 | .010 | .020 | + X2 |
| 5 | .003 | .050 | + 16X |
| 6 | .001 | .200 | + 200X |
| 9 | <.001 | .046 | + 50X |
| 10 | .002 | .023 | + 12X |
| | | $PO_4 \cdot P$ ($mgl^{-1}$) | |
| 4 | .026 | .024 | 0 |
| 5 | .016 | .039 | + 2X |
| 6 | - | - | - |
| 9 | .032 | .036 | 0 |
| 10 | .016 | .034 | + 2X |

Impact of Forest Fertilization (urea)

on Upland Streams

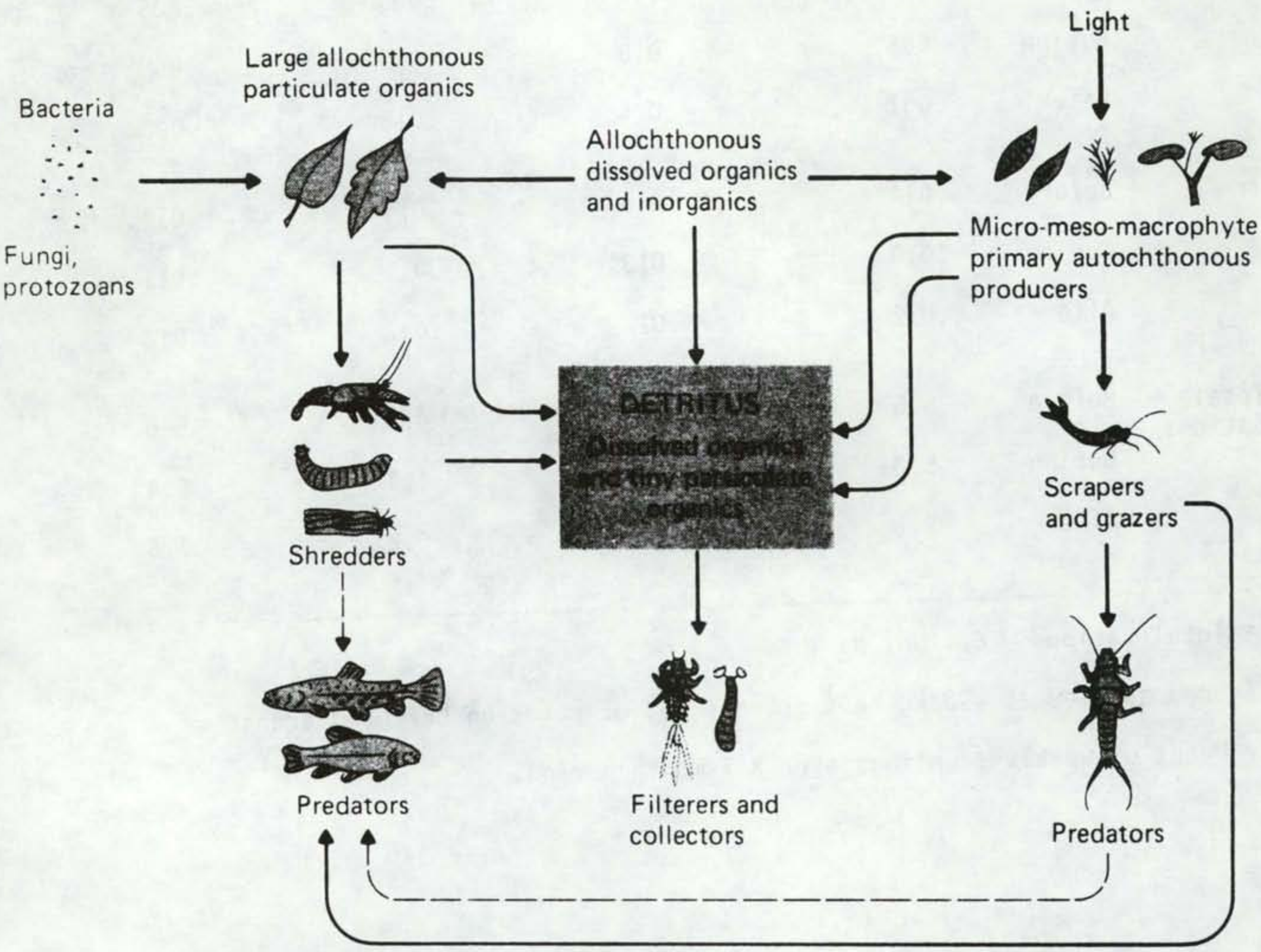
Stay, et al. 1979

| | | Control | Unbuffered+ | 30 m Buffer | 45 m Buffer |
|---|---|---|---|---|---|
| $NO_3$ | Before | .006 $mgl^{-1}$ | .012 | .005 | .005 |
| | During | .005 | .018 | .009 | .008 |
| | After | .007 | .024 | .015 | .008 |
| TP | Before | .014 | .010 | .011 | .012 |
| | During | .010 | .013 | .011 | .011 |
| | After** | .012 | .012 | .012 | .012 |
| Total* Cations | Before | 5.6 | 5.0 | 4.3 | 5.6 |
| | During | 5.2 | 4.3 | 4.4 | 5.4 |
| | After | 7.1 | 6.3 | 6.2 | 7.5 |

* Total cations = Ca, Mg, Na + K.

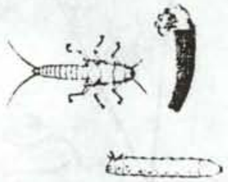
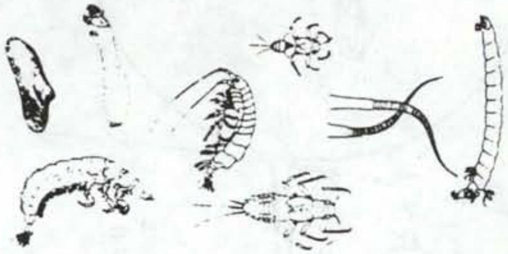
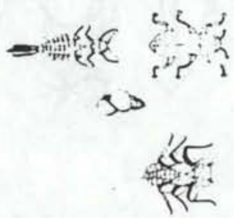
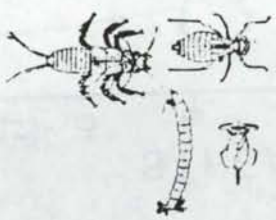
+ Urea applied at ~90 kg $ha^{-1}$ or only 40% of rates on buffered areas.

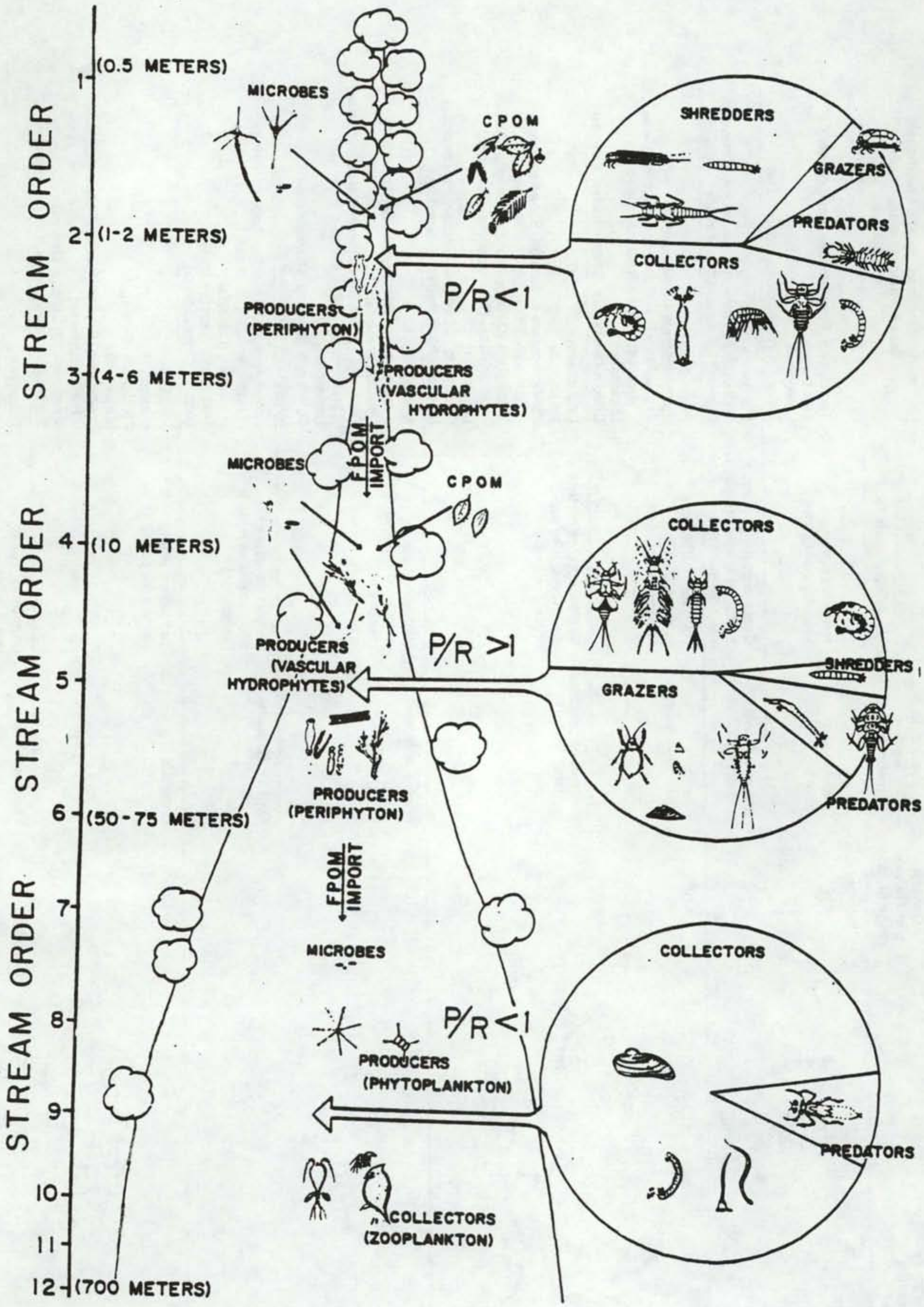
** Means of weekly samplings over a 7-month period.

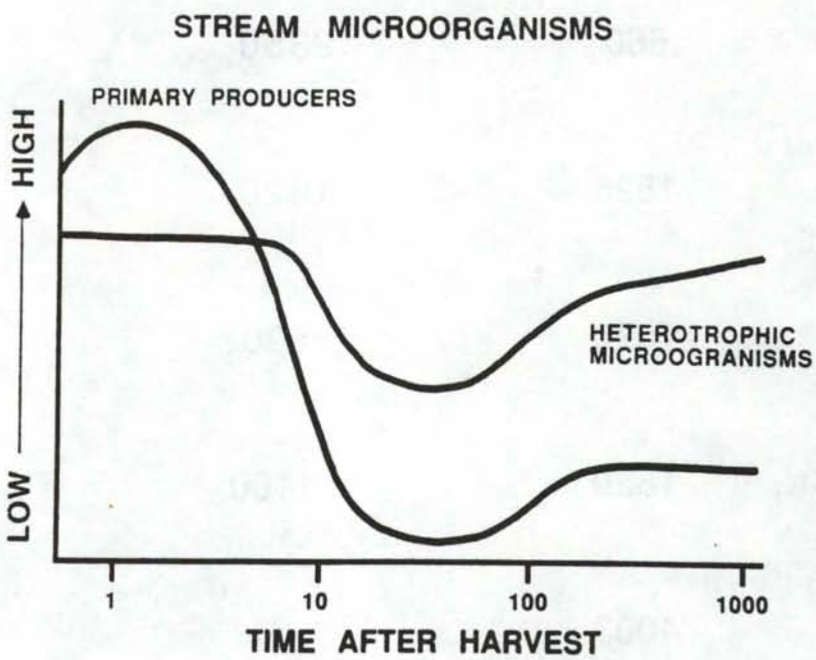



Diagrammatic representation of the functional roles of benthic invertebrates in streams. The crucial role of detritus is shown by its position at the center of the diagram. Fish, larger stoneflies, and some other carnivores are almost the only organisms not directly involved with detritus. The detritus pool contains fungi, bacteria, and small protozoans which continually convert the rather inedible cellulose and lignin of detritus into food by using nitrogen and phosphorus dissolved in the water. For further details of the functional roles of the organisms see Table 11-8. (*Modified from Cummins, 1974.*)

A general classification system for aquatic invertebrate trophic categories (after Cummins 1973)

| General category based on feeding mechanism | General particle size range of food | Subdivision based on feeding mechanisms | Subdivision based on dominant food | North American aquatic invertebrate taxa containing predominant examples |
|---|---|---|---|---|
| | *Microns* | | | |
| **SHREDDERS**  | >$10^3$ | Chewers and miners | Herbivores, living vascular plant tissue | Trichoptera (Phryganeidae, Leptoceridae)<br>Lepidoptera<br>Coleoptera (Chrysomelidae)<br>Diptera (Chironomidae, Ephydridae) |
| | | Chewers, miners, and gougers | Detritivores (large particle detritivores): decomposing vascular plant tissue; wood | Plecoptera (Filipalpia)<br>Trichoptera (Limnephilidae, Lepidostomatidae)<br>Diptera (Tipuiidae, Chironomidae) |
| **COLLECTORS**  | <$10^3$ | Filter or suspension feeders | Herbivore-detritivores: living algal cells, decomposing organic matter | Pelecypoda<br>Ephemeroptera (Siphlonuridae)<br>Trichoptera (Philopotamidae, Psychomylidae, Hydropsychidae, Brachycentridae)<br>Lepidoptera<br>Diptera (Simuliidae, Chironomidae, Culicidae) |
| | | Sediment or deposit (surface) feeders | Detritivores (fine particle detritivores): decomposing organic matter | Oligochaeta<br>Amphipoda<br>Ephemeroptera (Caenidae, Ephemeridae, Ephemerellidae, Leptophlebiidae)<br>Trichoptera (Glossosomatidae, Helicopsychidae, Molannidae, Odontoceridae, Goerinae)<br>Lepidoptera<br>Coleoptera (Corixidae, Elmidae, Psephenidae)<br>Diptera (Chironomidae, Tabanidae) |
| **SCRAPERS**  | <$10^3$ | Mineral scrapers | Herbivores: algae and associated material (periphyton) | Gastropoda<br>Ephemeroptera (Heptageniidae, Baetidae, Ephemerellidae)<br>Trichoptera (Glossosomatidae, Helicopsychidae, Molannidae, Odontoceridae, Goerinae)<br>Lepidoptera<br>Coleoptera (Elmidae, Psephenidae)<br>Diptera (Chironomidae) |
| | | Organic scrapers | Herbivores: algae and associated material (periphyton) | Ephemeroptera (Caenidae, Leptophlebiidae, Heptageniidae, Baetidae)<br>Hemiptera (Corixidae)<br>Trichoptera (Leptoceridae)<br>Diptera (Chironomidae) |
| **PREDATORS**  | >$10^3$ | Engulfers | Carnivores: whole animals (or parts) | Hirudinea<br>Odonata<br>Plecoptera (Setipalpia)<br>Megaloptera<br>Trichoptera (Rhyacophillidae, Polycentropidae, Hydropsychidae)<br>Coleoptera (Dytiscidae, Gyrinnidae)<br>Diptera (Ceratopogonidae, Chironomidae) |
| | | Piercers | Carnivores: cell and tissue fluids | Turbellaria<br>Hemiptera (Belastomatidae, Nepidae, Notonectidae, Naucoridae)<br>Diptera (Rhagionidae) |


STREAM ORDER
STREAM ORDER
STREAM ORDER
1 (0.5 METERS)
2 (1-2 METERS)
3 (4-6 METERS)
4 (10 METERS)
5
6 (50-75 METERS)
7
8
9
10
11
12 (700 METERS)
MICROBES
CPOM
SHREDDERS
GRAZERS
PREDATORS
COLLECTORS
P/R<1
PRODUCERS (PERIPHYTON)
PRODUCERS (VASCULAR HYDROPHYTES)
FPOM IMPORT
MICROBES
CPOM
COLLECTORS
P/R >1
PRODUCERS (VASCULAR HYDROPHYTES)
SHREDDERS
GRAZERS
PREDATORS
PRODUCERS (PERIPHYTON)
FPOM IMPORT
MICROBES
COLLECTORS
P/R<1
PRODUCERS (PHYTOPLANKTON)
PREDATORS
COLLECTORS (ZOOPLANKTON)

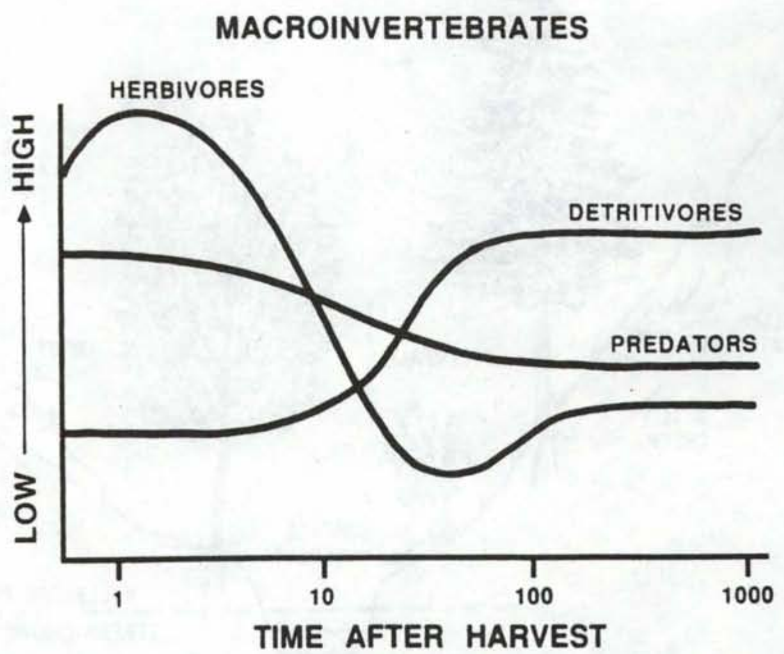



Temporal patterns of relative abundances of aquatic primary producers and heterotrophic microorganisms in streams after timber harvest (time is expressed as years on a logarithmic scale).

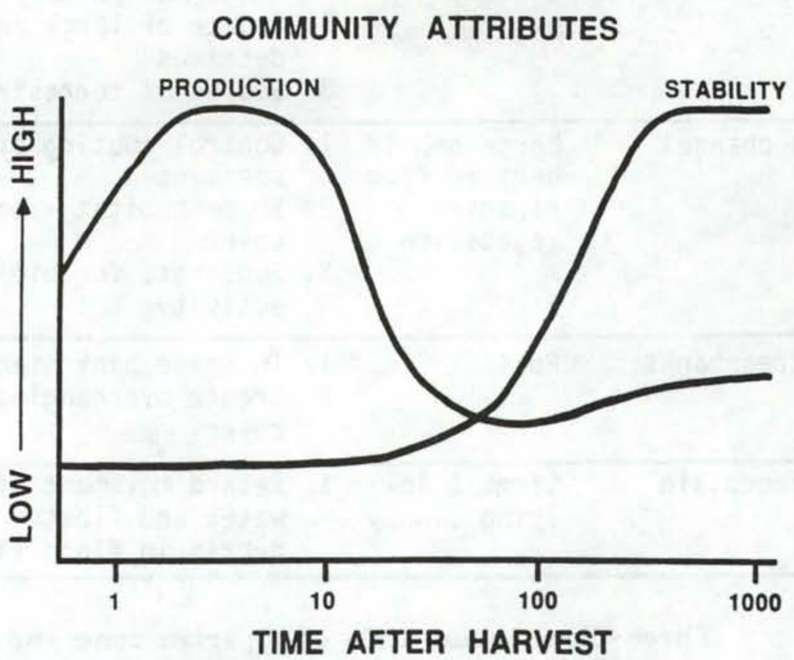
# ENERGY SOURCES IN VARIOUS LOTIC SYSTEMS

MINSHALL 1978

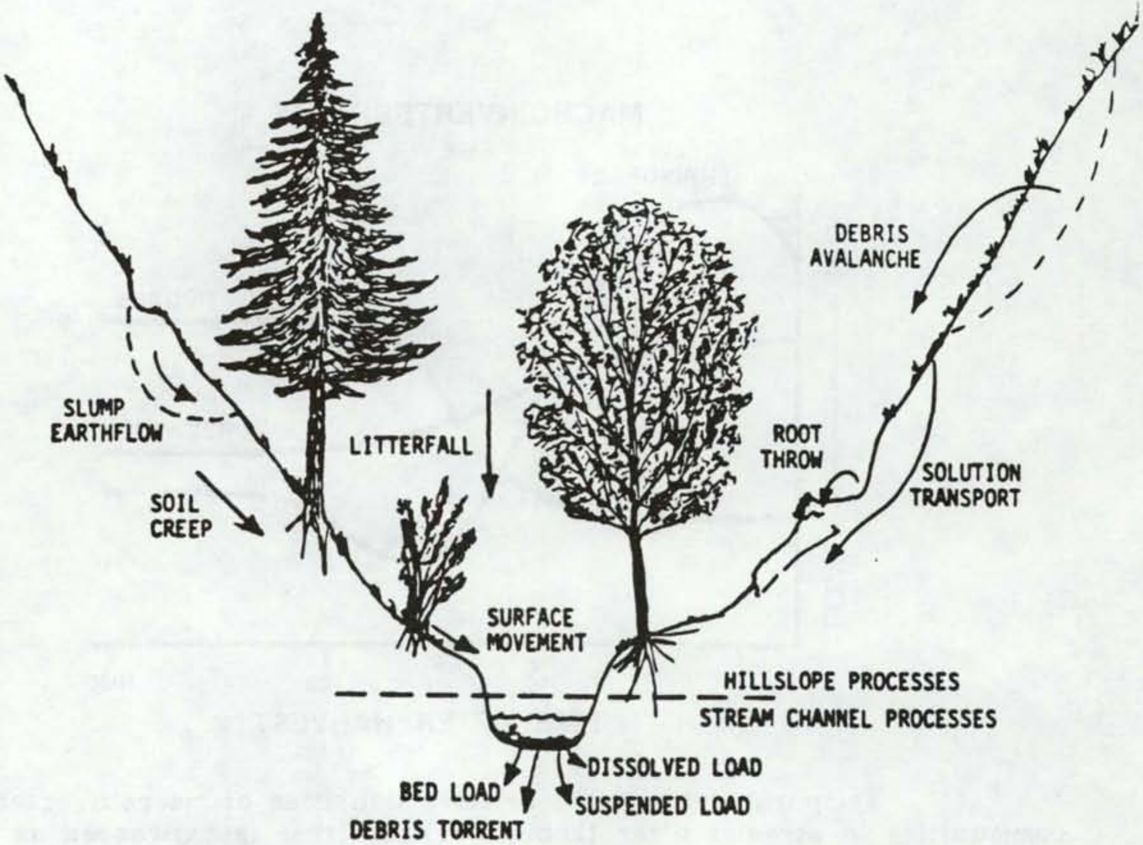
| Stream | Endogenous | Exogenous | End/Exo |
|---|---|---|---|
| Bear Brook, New Hampshire | 5 $Kcm^{-2}\ y^{-1}$ | 2260 | 0.002 |
| Root Spring Maryland | 660 | 2350 | 0.280 |
| Fort River, Massachusetts | 1525 | 1920 | 0.794 |
| Cone Spring, Iowa | 1070 | 630 | 1.700 |
| Rattlesnake Cr., Washington | 1820 | 1100 | 1.650 |
| Deep Creek, Idaho | 4003 | 24 | 166.80 |
| Silver Spring, Florida | 8830 | 490 | 18.00 |




Temporal patterns of relative densities of macroinvertebrate communities in streams after timber harvest (time is expressed as years on a logarithmic scale).




Temporal responses of the total production and stability of aquatic communities in streams after timber harvest (time is expressed as years on a logarithmic scale).

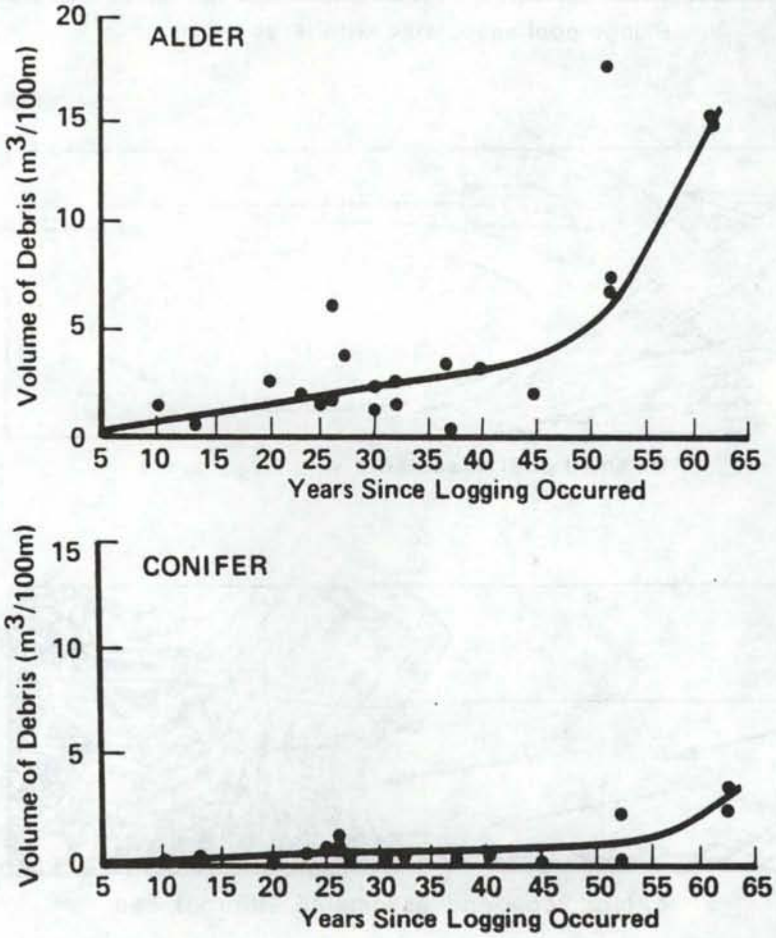



RIPARIAN VEGETATION

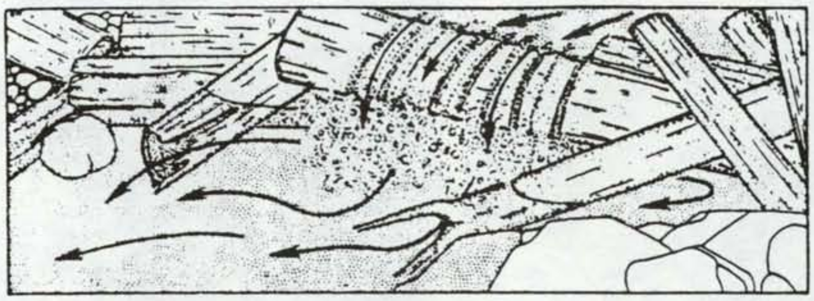
| SITE | COMPONENT | FUNCTION |
|---|---|---|
| Above ground-above channel | Canopy & stems | 1. Shade - controls temperature & in-stream primary production<br>2. Source of large and fine plant detritus<br>3. Source of terrestrial insects |
| In channel | Large debris derived from riparian vegetation | 1. Control routing of water and sediment<br>2. Shape habitat - pools, riffles, cover<br>3. Substrate for biological activity |
| Streambanks | Roots | 1. Increase bank stability<br>2. Create overhanging banks - cover |
| Floodplain | Stems & low lying canopy | 1. Retard movement of sediment, water and floated organic debris in flood flows |

Three-dimensional scale of riparian zone and functions of riparian vegetation as they relate to aquatic ecosystems in the Pacific Northwest (from Walters et al. 1980).

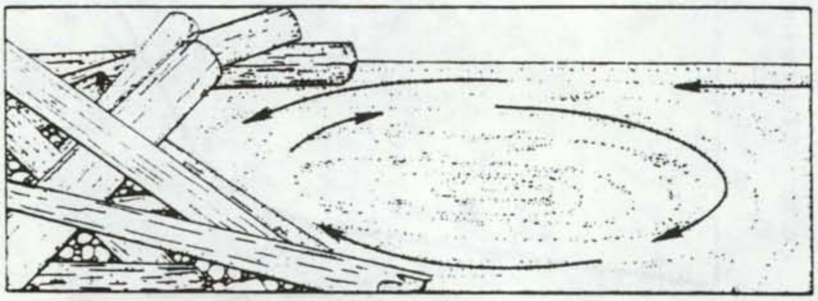
BISSON ET AL.



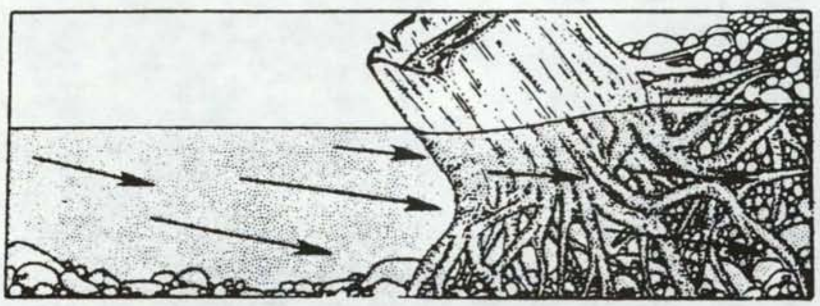

Inputs of red alder and conifer debris to small streams in second-growth forests in western Washington (from Grette 1985).



Plunge pool associated with large debris.



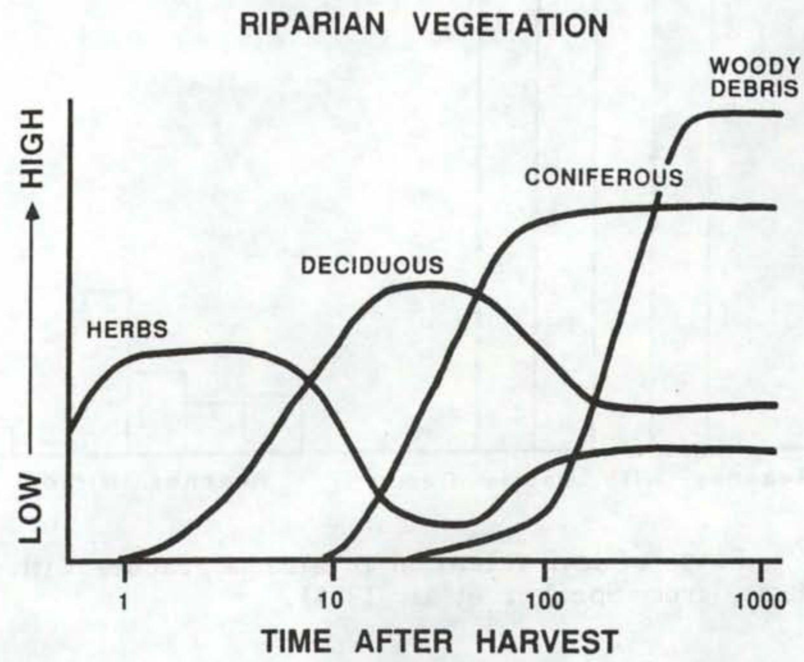
Dammed pool associated with large debris.



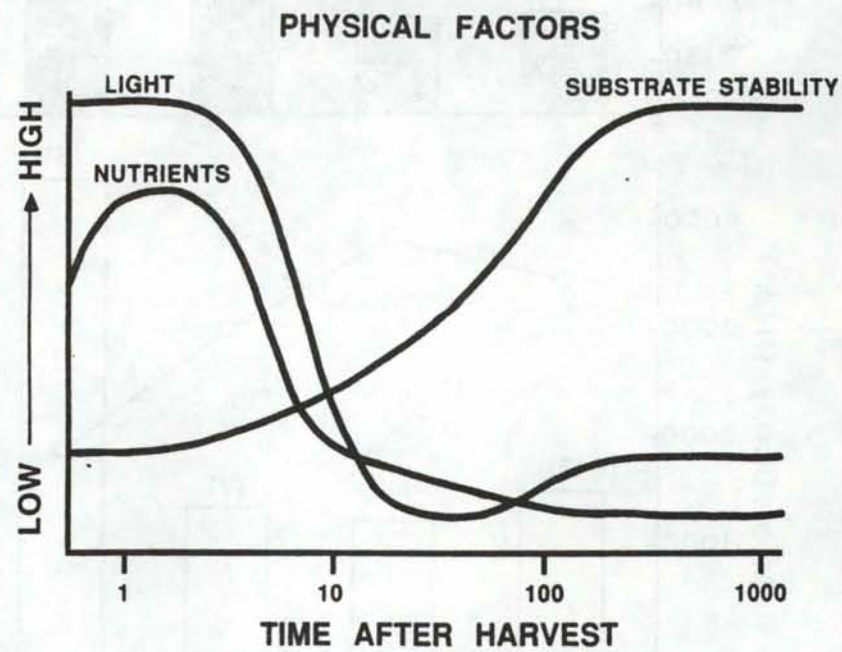
Lateral scour pool associated with root wad.

Lateral scour pool associated with large debris.

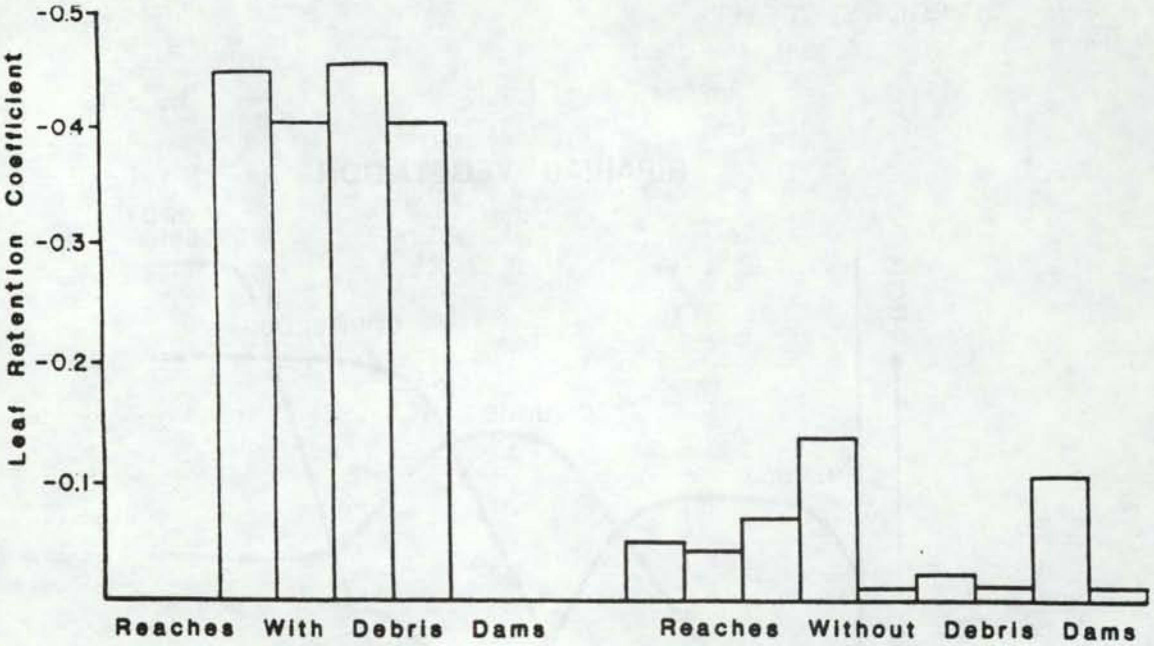
Examples of salmonid rearing pools formed around large woody debris (from Bisson et al. 1982).



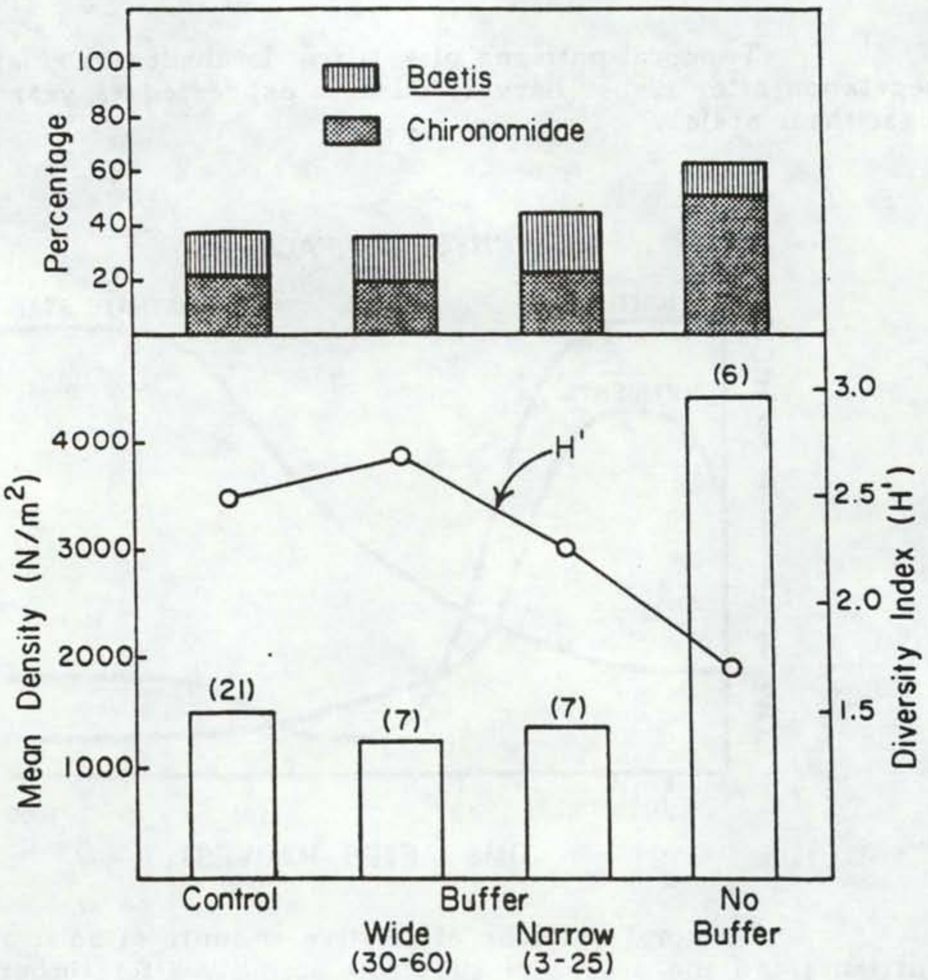

Temporal patterns of relative dominance of riparian vegetation after timber harvest (time is expressed as years on a logarithmic scale).



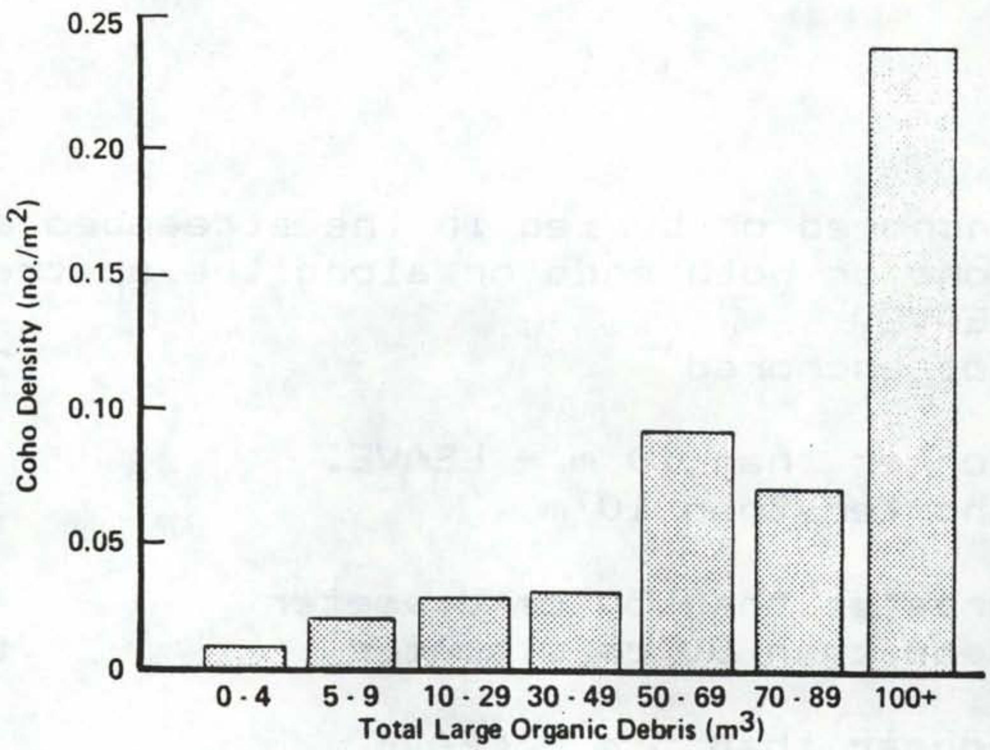

Temporal patterns of relative amounts of solar radiation and nutrients and the degree of substrate stability after timber harvest (time is expressed as years on a logarithmic scale).

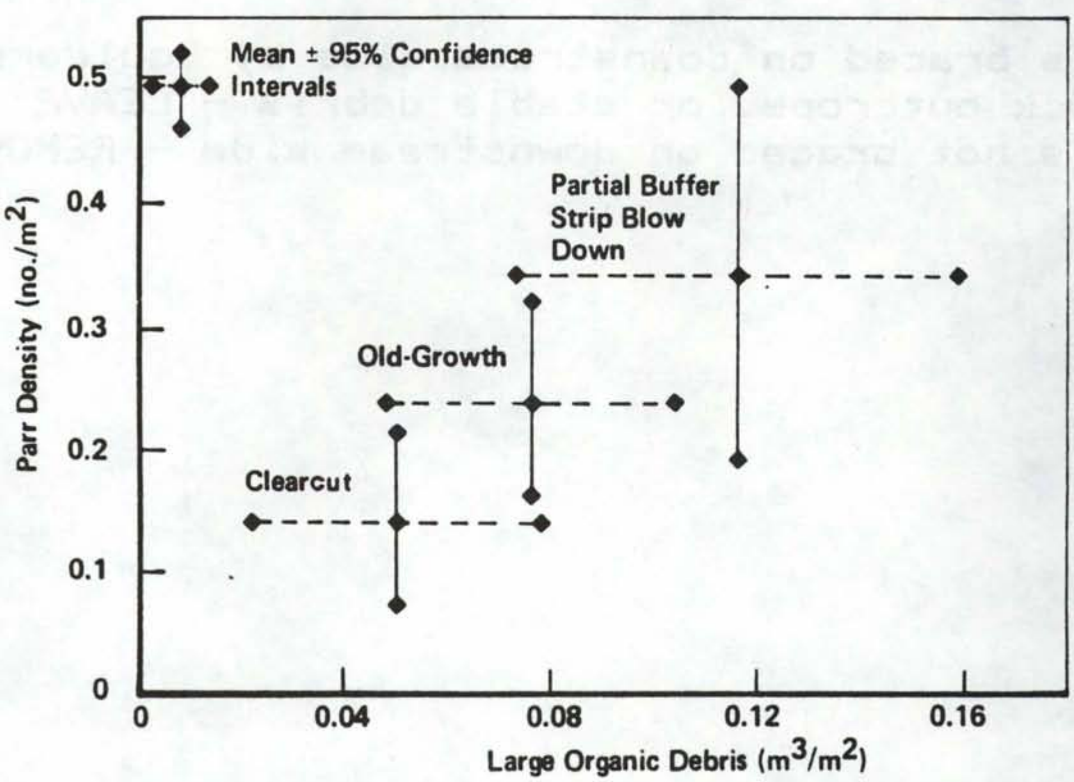



Rates of leaf retention in stream reaches with and without debris dams (from Speaker et al. 1984).




Mean densities and diversity indices of macroinvertebrate communities in streams with and without buffer strips in northern California (from Newbold et al. 1980). Percentages of Baetis and Chironomidae of total invertebrate populations are illustrated in upper histogram.



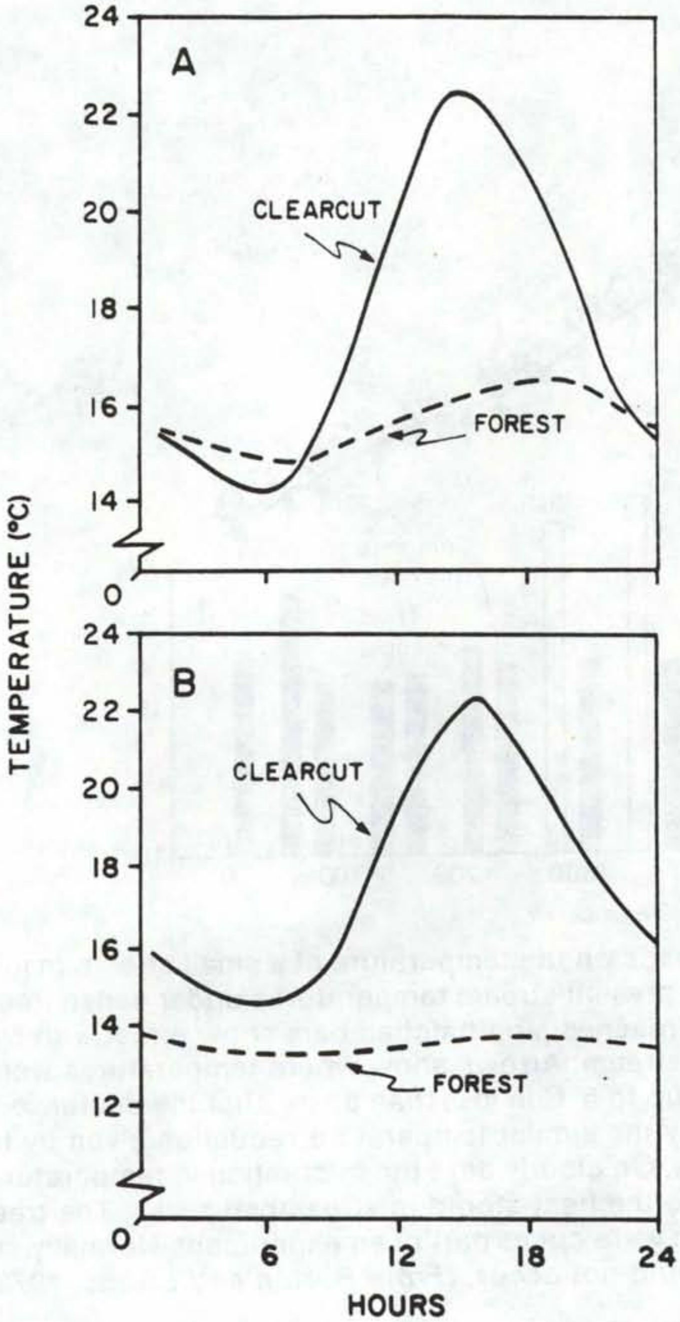




Examples of the relationship between woody debris abundance and juvenile coho salmon populations during winter in southeastern Alaska. In the lower graph the buffer strip sites had experienced partial blow down and actually had more debris than the old-growth sites (from Murphy et al. 1985).

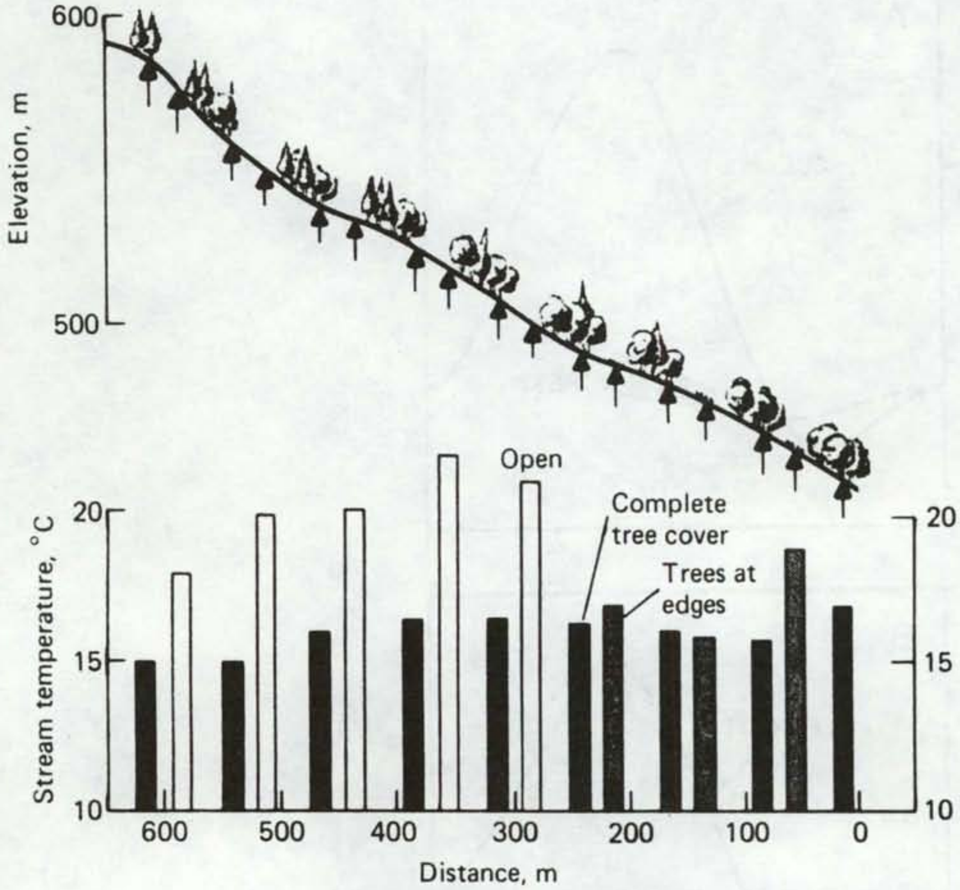
# STREAM DEBRIS STABILITY KEY

Bilby 1984

| | | |
|---|---|---|
| 1 | Debris anchored or buried in the streambed or bank at one or both ends or along the upstream face - LEAVE. | |
| | Debris not anchored | 2 |
| 2 | Debris longer than 10 m - LEAVE. | |
| | Debris shorter than 10 m | 3 |
| 3 | Debris greater than 50 cm diameter | 4 |
| | Debris less than 50 cm diameter | 5 |
| 4 | Debris longer than 5 m - LEAVE | |
| | Debris shorter than 5 m | 5 |
| 5 | Debris braced on downstream side by boulders, bedrock outcrops, or stable debris - LEAVE | |
| | Debris not braced on downstream side - REMOVE | |




Summertime stream temperatures during clear weather in (A) West Virginia (from Lee 1980), and (B) Coast Range of Oregon (from Brown and Krygier 1967).




Effects of shade on the temperature of a small stream in midsummer at midday on a sunny day. Black bars represent stream temperatures under dense tree cover, open bars show temperature in unshaded reaches, and hatched bars show effect with trees in a strip only 10 m wide on each side of the stream. Arrows show where temperatures were taken. Note the rapid increase and decrease of up to 5° C in less than 50 m. That the decrease is due to the immediate shading effect is shown by the similar temperature reduction given by full forest and the small buffer strip only 10 m wide. On cloudy days the fluctuation in temperature was reduced to 1.5°C. The effect is mostly due to the heat stored in streambed rocks. The trees by this stream in the Hubbard Brook ecosystem were cut as part of an experiment. Normally such a regular pattern of shade and open water would not occur. (*From Burton and Likens, 1973.*)

# *SUMMARY OF RIPARIAN ZONE EFFECTS ON STREAM HABITATS*

- Flow recovery through:
  - increased stream channel capacity
  - raised water table
  - slower runoff
- Temperature control:
  - summer cooling
  - winter warming
- Streambed aggradation
- Decreased turbidity, nutrients, and pesticides of stream water
- Increased terrestrial/aquatic "edge" provides enhanced food supply to stream.
- Sediment filtered before entering stream
- Increased bank storage of sediments and decreased bank erosion
- Increased channel length
- Physical structure of stream enhanced for fish habitat

# *Indicators of Satisfactory Riparian Health*

* Efficient channel shape with narrow width; conveys mean annual peak flow events (<2.33 year recurrence) with minimal bank erosion.

* Narrow deep, stable channels.

* Stream power < critical power.

* Expanded channel length with high sinuosity.

* Flows > mean annual peak spread over floodplain, dissipating energy, filtering sediment, and capturing sediment

* Confined channels with stepped drops; Non-confined channels with well-developed meanders.

* Stable channel with aggrading floodplain.

# WHAT CONSTITUTES A QUALITY STREAM?

Binns 1982 HQI

| Attribute | Rating | Characteristics |
| --- | --- | --- |
| Annual Streamflow Variability | 0 | Intermittent Stream<br>ASFV>500 |
| | 4 | Little or no fluctuation<br>ASFV<15 |
| Temperature | 0 | Low range < $6^{o}$ C<br>High > 26.5 |
| | 4 | Low range 12.5-18.5<br>High 12.5-18.5 |
| Nitrate | 0 | Low < 0.01 mg1-1<br>High > 2.0 |
| | 4 | 0.15 - 0.25 |
| Velocity | 0 | Low range < 0.25 fps<br>High >4.0 |
| | 4 | 1.5 - 2.5 |
| Fish Food Abundance | 0 | < 25 org $ft^{-2}$ |
| | 4 | > 500 org $ft.^{-2}$ |
| Fish Food Density | 0 | < 0.8 |
| | 4 | > 4.0 |
| Cover | 0 | < 10% |
| | 4 | > 55% |
| Bank Stability | 0 | 75 - 100% Eroding |
| | 4 | 0 - 9% |

## *BMP'S EMPLOYED ON A PENNSYLVANIA COMMERCIAL CLEARCUT TO CONTROL NONPOINT POLLUTION DURING AND AFTER HARVEST*

Lynch & Corbett 1990

* A protective buffer strip 100' wide on each side of perennial streams. Some selective logging in the strips permitted.
* 110 A of the 257 A WS were harvested, in 4 sequential blocks. All work had to be completed in a block before moving on to the next.
* Weekly inspections by a forester; More frequent during wet periods.
* No skidding through perennial streams.
* Main skid trails and roads constructed prior to harvest and allowed to settle. Lesser trails constructed by logger after approval.
* All logging roads and trails properly retired (incl. removal of culverts, installation of water bars and other drainage devices, grading to pre-logging conditions, and gating).
* No harvest during excessively wet periods (forester-approved).
* Trails and roads normally fertilized and seeded but this not done since stream chemistry monitored.
* Log landings > 300' from perennial and intermittent streams.
* Performance bond set at 25% of value of the timber.

## *MAJOR IMPACTS OF TIMBER HARVEST ON RIDGE/VALLEY LANDS OF PENNSYLVANIA WITH IMPLEMENTATION OF BMP'S*

Lynch & Corbett 1990

* BMP's controlled the "normal" turbidity (roads, skidding, stream crossings, etc.) increases.

* Turbidity did increase from:
a) Debris dams forcing channel changes and scouring,
b) Increased water flow filling and eroding intermittent channels

* Turbidity increases continued sporadically through the 9-year post-logging period.

* Wider buffer strips recommended to keep blowdowns out of streams.

* Mean water temperatures increased 2-3$^{o}$ F in the spring and *ca.* 1$^{o}$ F in the summer, primarily because of debris pools and warming of the bare-banked, newly filled intermittent channel.

* Daily fluctuations of water temperature also increased *ca.* 1.5 - 2.0$^{o}$ F.

* Concentrations of nitrate, sulfate, potassium, and other macronutrients sporadically increased for at least up to 9 years after harvesting.

* Although concentrations sometimes tripled, the losses from the WS were deemed "small and insignificant."

* Recommended changes in BMP's were:
a) Increase buffer width on perennial streams to 150'
b) Better water control devices on roads
c) Reduced size of clearcuts
d) Faster revegetation

# Habitat Quality for Stream Fishes on Forested Lands

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Department of Fish and Wildlife Resources
University of Idaho

# LECTURE OUTLINE

LECTURE OUTLINE -- HABITAT QUALITY FOR STREAM FISHES ON FORESTED LANDS

I. Introduction

1. Throughout the Pacific Northwest, Canada, and Alaska, some of the most economically important timbered areas are drained by rivers and streams that serve as valuable spawning and rearing sites for salmon, trout, and charr (Figure 1).

2. Small streams in particular may not be given effective protection during road building, felling and yarding operations; the effects on small streams can be transmitted downstream.

3. Logging operations directly and indirectly affect the physical environment of streams for fishes, and indirectly affect the biological and ecological components.

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II. Objectives

1. Provide an overview of fish and fish habitat on Idaho's forested lands, including:

a. overview of the fishery resources in Idaho affected by logging practices
b. life histories of salmonids
c. basic ecology and population dynamics of salmonids
d. habitat requirements of salmonid resources
e. fish habitat models and their use in predicting standing crop of fish and effects of habitat change.

2. Identify and discuss the important effects of logging, road building, and related activities on stream fishes and their habitats.

3. Discuss effects of the habitat changes on the different life history stages of salmonid fishes (egg, alevins, fry, smolts, adults).

4. Discuss some easily implemented monitoring techniques.

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III. Forests and Coldwater Resources

1. Coldwater streams: streams with water temperatures not exceeding about 70 F (20 C) for any but brief periods.

2. Other typical characteristics of coldwater streams:

--in areas that are geologically young
--V-shaped valleys
--generally low discharge
--moderate velocities

--turbulent flow
--generally shallow
--rubble/gravel substrate
--clear water
--extensive shading and cover
--few fish species: mostly salmon, trout, charr (Salmonidae) and sculpins (Cottidae)
--few predatory fish
--most competition among fish occurs within a species (intraspecific)

3. Forests and the Idaho batholith

a. Forests cover about 40% of the state (Figure 2).

b. Most forested lands in Idaho are associated with the Idaho batholith, a 16,000 square mile area extending throughout much of the central part of the state (Figure 3). Soils produced have coarse sand textures, poor cohesion, with low silt and clay components. Topography is typically steep, unstable slopes separated by narrow valleys.

c. The slopes are susceptible to erosion from logging, road building, fire, or other events. Fine sediments are released in these events that are often harmful to fish.

4. Fish resources in the area (Figure 4).

a. Important fish species include:

--Chinook salmon (Oncorhynchus tshawytscha)
--Steelhead trout (Salmo gairdneri)
--Cutthroat trout (Salmo clarki)
--Dolly Varden (Salvelinus malma)
--Brook charr (Salvelinus fontinalis)
--Mountain whitefish (Prosopium williamsoni)
--Several species of sculpins (Cottus sp.)

b. Chinook salmon and steelhead trout are both anadromous, spending part of their life growing rapidly at sea but returning to freshwater streams to spawn.

c. Construction of mainstem Columbia and Snake river dams (and resulting obstacles to both upstream and downstream migrations) has greatly reduced both species in Idaho. The problem has worsened considerably since three mainstem Snake and one mainstem Columbia River Dams were built from 1968 to 1975.

e. Salmonids in the streams typically feed on aquatic invertebrates; larger salmon and trout also will eat smaller fish. In Idaho, the Clearwater and Salmon river drainages are especially important for the salmonids.

f. Sculpins are small, flattened fishes well-suited to avoid fast currents by digging down in the gravel and lying at the water-substrate interface. Provide food for salmonids.

g. Species composition changes as one moves downstream in association with changing physical characteristics of a stream (Figure 5).

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IV. Life history of salmonids

1. Generalized life cycle (Figure 6).

2. Salmon adults spawn over clean gravel and cobble substrates that are well permeated by moving water.

3. Female digs next or <u>redd</u> (Figure 7). Males compete for the rights to spawn with each female.

4. Eggs deposited amid the gravel in late fall or winter amid gravel in such a manner that well-oxygenated water continually bathes incubating eggs (Figure 8). The timing of hatching of eggs is dependent upon water temperature.

5. Fry begin to feed on other small invertebrates as the yolk sac is depleted, about when stream productivity (including food supply) is rapidly increasing.

6. Anadromous species may spend from 6 months to three years in stream feeding. Critical periods for survival often occur in late summer and during winter.

7. Young fish from anadromous species or populations turn silvery-colored, undergo physiological changes, and migrate to sea, where they may spend 1 to 4 years and migrate long distances (Figure 9) before returning to spawn in their natal streams. Resident species and populations may remain entire life in stream or river of origin.

8. The life history varies with the species of salmonid, and, sometimes, with the <u>stock</u>. Each stock is a reproductively isolated group of fish. One, two, or many stocks may constitute a <u>run</u>.

9. Much of the life history of salmon is recorded on their scales, which are often useful in age determination and stock identification (Figure 10).

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V. Ecology, population dynamics, and habitat requirements of the Salmonids.

1. Basic ecological definitions

a. <u>Habitat</u> is defined as the place where a species (e.g. cutthroat trout) normally lives, or the place where you would go to find it occurring naturally. For example, a habitat of cutthroat trout is "coldwater streams".

b. <u>Environment</u> - the surroundings of the fish, including both <u>abiotic</u> parts (water temperature, current, substrate) and the <u>biotic</u> parts (competitive or predatory organisms, diseases).

c. <u>Ecological niche</u> is defined as all the components of the environment with which the fish interacts, including not only the physical space occupied by the fish but its functional role in the system.

d. Niche is more inclusive than habitat. Habitat is much like an organism's address, whereas niche is its occupation as well as how it interacts with others.

e. Example: cutthroat trout and sculpins may occupy the same habitat, but have different niches.

2. Carrying capacity and population dynamics

a. Each coldwater stream habitat can only support so many individuals of a given fish population (salmon or trout) because of the limited necessary resources for the species within that habitat. That number is often called the carrying capacity Figure 11a). The carrying capacity is not fixed, but rises and falls as habitat conditions change.

b. If enough adult salmon escape the fishery (escapement) to spawn in a stream so that as many young salmon are produced as the stream as the habitat (space, food supply) will support at a particular time, the stream is at carrying capacity and may be said to be fully seeded. A lot of management is directed at increasing carrying capacities.

c. Because salmon and trout often exhibit territorial defense of space in streams, or hierarchical social interactions among individuals fish, it is often true that a stream will produce just so many smolts no matter how many eggs hatch above a certain minimum (Figure 11b). The available habitat at some period in the life cycle (e.g., low summer flows or overwintering) may serve as a bottleneck.

d. A stock-recruitment curve describes the relation between the size of the spawning stock and the number of progeny produced (Figure 12). Several forms of the curve are widely used (e.g., Figure 13).

3. Aspects of salmonid habitat (Figure 14)

a. The habitat components are grouped into: a) flow characteristics, b) water quality, c) physical habitat, and d) energy (including food supply).

b. Flow characteristics include discharge, water velocity, depth, wetted area, and amount of turbulence. Higher flows usually provide more habitat, all else equal (Figure 15)

c. Coldwater streams are typically a sequence of riffles and pools (Figure 16). Pool:riffle ratio of about 1:1 is often considered optimal.

d. Different species of salmonids, as well as different ages and sizes of the same species, will use habitat of different depth and velocity characteristics. For example, young coho salmon strongly prefer pool areas of streams, whereas young-of-the-year steelhead and cutthroat trout prefer riffles (Figure 17).

e. In winter, individuals of both species move into pools and down into the substrate. Winter habitat may be limiting in many streams.

f. From results of field studies, biologists have constructed curves that indicate preferences of particular species for various factors such as depth and velocities. A utilization factor of 1 indicates optimal habitat. In Figure 18, the young coho salmon are shown to prefer deeper, slower water than young steelhead and cutthroat trout.

g. In natural streams, temperature preferences for salmonids are in the range of 45 to 59 F, with the zone of tolerance from 32 to 68 F (Figure 19).

h. During the summer period especially, flow, oxygen and temperature interact such that optimal conditions for trout and salmon occur at intermediate levels of all three (Figure 20).

i. Substrate: a critical habitat component used in spawning, incubation of eggs, emergence of fry, and by fingerlings and adult resident fish. Salmonids also use the gravel interstices as refuges from the current. Substrate is also important areas for production of invertebrates, insects for example, that are the main source of salmonid food.

k. Imbeddedness of substrate is a measure of the degree to which the larger particles (such as boulders, rubble, and gravel) are surrounded and covered by finer sediment. As the percentage of imbeddedness increases to high values, spawning, incubation of eggs, and survival of young salmon can be impaired.

l. Cover -- large rocks, trees, shrubs in or just above stream, and undercuts in the banks of the stream. Cover is difficult to quantify, but much effort is expended on it because it is such an important component of salmonid habitat. Cover tends to be better in streams with stable banks.

m. Shading/canopy -- There is an optimum amount of shading for a stream (at an intermediate level), for maximum potential trout production (Figure 21). Beyond this, the stream may actually be less productive for trout.

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VI. Fish habitat models and their uses in predicting standing crop

1. Fishery researchers and managers have developed models to explain why trout and salmon standing crops were higher in some streams than others, to predict how productive for salmonids a stream would be expected to be based on its habitat features, and to predict effects of habitat alterations on fish standing crop.

2. The major assumption in these models: the fish population is limited by habitat rather than fishing mortality, competition, or predation. Need to be adapted to local or regional conditions appropriately.

3. One such model -- Binns and Eiserman (1979) developed the idea of the Habitat Quality Index, HQI, as a quasi-quantitative method of rating the suitability of a stream for potential trout standing crop in Wyoming streams.

4. They rated trout habitat based on 11 physical, chemical, and biological characteristics (Figure 22a), and developed standard methods for measurement. The rating system was from 0 (worst) to 4 (best). They developed and tested two models on some other streams and found that the trout habitat quality index

scores developed for the streams were closely related to the actual standing crop in the stream (Their Figure 22b). The best HQI model explained over 95% of the variation in standing crop.

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VII. Effects of logging operations on salmonids, with emphasis on the Idaho studies.

1. History of long-term studies.

a. Long-term studies -- At least four major studies have been conducted in the western U.S. and Canada on the effects of logging on fish populations. One in Alaska, one in Oregon (Alsea River), one in British Columbia (Carnation Creek), and one in Washington (Clearwater River) (Figure 23).

b. Significant work has been conducted in Idaho on effects of logging, work that, while shorter term than the above studies, provides some valuable information especially applicable to the Idaho Batholith.

2. Review of one long-term study -- Alsea Watershed Study

a. Three small tributaries of the Alsea River studies for 15 years (1959-73).

b. A cooperative study of Oregon State University, Oregon State Game commission, Forest Service, U.S. Geological Survey, logging companies, and others.

c. Investigated both short-term and long term effects.

d. Three tributaries: Needle Branch (clear cut), no buffer strips; Deer Creek (clear cut, but in patches, and with buffer strips; Flynn Creek (unlogged, served as control; Figure 24)

e. Approach:

-- Measured physical and chemical characteristics (water temperature, dissolved oxygen, precipitation, sunlight, streamflows, erosion rates, gravel composition, sediment permeability, stream area)

-- Built traps to capture upstream-migrating adults and downstream-migrating smolts; tagged and released fish.

-- estimated population sizes in sections; age and growth of fish in sections, biomass estimates

-- studied fry emergence from gravel

f. Main results -- habitat

-- Stream temperature about same on Flynn, altered slightly on Deer, but major change on Needle Branch (clear-cut): maximum temperature went from 16.1 C to 26.1 C, which was too high for salmonids. Average monthly means much higher than before logging (Figure 25). Effects of temperature per se highly dependent on local situation.

-- Daily fluctuations on Needle Branch increased greatly (Figure 26)

-- Pre-logging D. O. comparable on all three, but intragravel D. O. in Needle Creek dropped more than 2 mg/l. Temperature rise contributed, but the major factor was sediment.

-- Sediment load-- increases in both Deer Creek and Needle Branch, but a 200% increase on Needle was the larger. Associated with road slumps. Sediment load in Needle Creek dropped in subsequent years, but did not go as low as pre-logging values.

-- A distinct drop in permeability of gravel in Needle Creek, but not in the others (Figure 27).

g. Main results -- fish

-- Little change detected in juvenile coho salmon abundance following logging, but significant declines in the numbers of resident cutthroat trout (Effects were long-term; Figures 28-30).

-- Enough "background" environmental variation existed in this and other natural field studies that was (and generally is) difficult to get clear results. Too little replication (if any) and many uncontrolled fluctuations. Artificial stream channels are much more controlled but less natural; a tradeoff.

3. Research in Idaho on effects of logging on fish populations.

a. Research has emphasized three areas: effects on

-- fish embryo survival
-- summer carrying (rearing) capacity
-- winter carrying capacity

b. Much emphasis placed on the importance of fine sediments (sediments less than 6.4 mm diameter) on these three life stages. Sediments also affect the other life stages.

c. Effects of sediment on eggs, hatching, and emergence from the gravel

-- McCuddin (1977) tested the ability of chinook and steelhead embryos and fry to emerge on troughs with various gravel-sand mixtures simulating spawning areas.

-- Tested concentrations and compositions of sediment commonly found in the Idaho Batholith.

-- He used 40 test troughs, 5 levels of sediment, and 8 replicates per treatment; 0,20,30,40,50% embedded. He also measured dissolved oxygen in each trough.

-- Results -- In troughs with no sediment, more than 90% of chinook eggs survived to the swim-up stage; 55% of the steelhead survived.

-- In each group of eggs, survival declined with increasing amounts of fine sediment (less than 12 cm) in the substrate (Figure 31).

-- Mortality rates for both species increased as the proportion of sediment less than 6 mm approached 25%

-- Found no relation between the amount of fine sediment in the substrate and the weight, total length, or time of emergence of the fry.

His conclusions:

-- The ability of chinook and steelhead embryos to survive and emerge from the substrate decreased sharply when sediment less than 6.4 mm diameter constituted more than 20-25% of the substrate.

-- He recommended that sediment in gravel beds be limited to 25% by volume of sediment. Less than 6.4 mm diameter.

d. Effects of increased sediment on juvenile salmonids and rearing environment (Summer and winter carrying capacity).

-- Robert Klamt (1976) investigated the effects of coarse granitic sediment on abundance, distribution, growth, and behavior. Little work done beforehand on effects of granitic sediment on rearing capacity of the stream for juvenile salmon and steelhead.

-- We discuss two parts of his study:

1). He added sediment to artificial stream channels and assess effects on fish density, fish food habits, fish behavior, growth and fatness (condition) of fish, and insect (food) supply.

2). He added sediment to a natural stream channel and investigate the same factors.

-- For (1), he used 4 artificial stream channels 21 m long, 1.2 m wide, and 0.6 m deep. A mixture of riffle areas and pools with a zig-zag pattern of rocks to provide some cover (Figure 32).

-- He stocked them with fish to full seeding. Added sediment in fall and spring to assess effects on summer and winter carrying capacities. Trapped fish leaving the lower end of the streams, and fish were prevented from leaving through the upper end.

-- He set up different sediment levels (1/3, 1/2, fully imbedded i.e. with material less than 6.4 mm diameter; Figure 33), and looked at effects on different ages of hatchery-reared and wild steelhead. Fish were also observable through plexiglass panels in the sides of the channel.

-- For (2), he used Knapp Creek, a small stream contained natural populations of steelhead and chinook. 165 m study section. Located fish via snorkeling. Measured water depths, and velocities along transects to get information on water volume, fish densities, depth contours, and habitat preferences. Sediment added in three steps. Also assessed amount of sediment before, during, and after adding sediment to selected reaches (Figure 34) with use of core samples and surface classification.

-- Results -- Artificial channels -- summer carrying capacity

-- Main effects of increased sediment were less habitat for fish and insects, less depth of pools, and a filling in of interstices amid both riffles and pool boulders.

-- As percentage of fine sediment increased, fewer fish remained in the channels. Age 1 wild steelhead: 1/3 imbedded-- only 86% as many as with no imbedding; 2/3 imbedded -- only 40% as many; fully imbedded -- only 11% as many (Figure 35). Similar, somewhat less strong results for age 0 fish.

-- Similar results for chinook (Figure 35). For age 0 wild fish, only 3% as many fish in fully imbedded channel as in unimbedded channel (Figure 36).

-- Behavior changed. Hierarchical behavior at 2/3 or fully imbedded, but territorial when sediment was not a problem.

-- Mechanism for lower numbers: age 0 steelhead used riffles (their preference) at 1/3 imbedded, but as imbeddedness increased, they moved into pools. There were no interstices in riffles for them, fewer insects for food, so less chance to feed and grow, hence, lower carrying capacity.

-- Longer-term test (35 days): fish density in both sedimented and unsedimented channels decreased (as expected, since the carrying capacity for fish will decrease as they grow), but the density of fish in the fully sedimented channels stabilized at only 12% of the density in the unsedimented channel. Growth rates of fish in unsedimented channels were also higher (Figure 37).

-- Results -- artificial channels -- winter tests

-- As had been found in other studies on salmonid behavior in winter, fish sought out spaces (interstices) in the substrate as water temperatures dropped to about 5 degrees C.

-- Such interstices were fewer in sedimented channels.

-- Age 0 hatchery steelhead--1/2 embedded--16% as many fish as controls<br>fully embedded--9% as many fish as controls<br>-- Age I,II wild cutthroat--fully imbedded--6% as many fish as controls (Figure 38)

-- Interpretation: difficult surviving winter anyway, and it is even worse when sedimentation is severe, especially for larger, older fish.

-- Results: Knapp Creek -- addition of sediment

-- As sediment was added, much washed into pools, reducing their volume and increasing their water velocities (Figure 39).

-- As more and more sediment was added, the amount of cover for fish decreased, as did fish densities (Figure 40). The volume of the upper test pool was decreased to 48% of original, and fish decreased to 29% of original number. Density of fish/square meter was 39% of original. A year later, total fish densities in the study area were about 50% of the pre-sediment condition of 1974 (Figure 41).

-- Results were consistent with artificial stream studies.

-- Klamt's conclusions (2)

-- Sediment added into streams decreases fish abundance in proportion to the reduction in the area deeper than 0.30 m and/or the reduction in the available cover for fish.
-- Winter holding capacity is affected more than the summer carrying capacity, due to filling in the interstices of the substrate, because the salmon use the interstices as preferred habitat in winter.

4. Summary and overview of effects of logging on the fish

a. In general, there is a positive relation between the percentage of stream banks that is stable, with intact riparian vegetation, and how productive the system in for fish production (Figure 42). Light-limited systems may benefit from an open canopy, but other side effects of vegetation removal (such as increased erosion and sedimentation) are usually worse than any gains from more light.

b. Channel morphology changes after clearing of riparian zone, already discussed, often result in a shallower, wider channel (Figure 43) with less-well-defined pools and riffles and less and poorer habitat for fishes.

c. Logging along streams is accompanied by an increase in sediment over natural levels, resulting in higher imbeddedness of the substrate (Figure 44), reduction in velocity of water flow in the gravel (lower permeability).

d. Lower water velocities in sediments can concentrate toxic metabolites

e. Higher sedimentation can crush eggs as gravel shifts; perhaps more abrasive with fine sediments.

f. The combination of high imbeddedness and low oxygen in more heavily sedimented streams can result in reduced egg survival, poorer rates of emergence from the gravel, as well as weaker, slower-growing fry upon emergence. Emergence can be physically blocked by the filling in of voids in gravel beds. Percent emergence of salmonids has been shown in many studies to drop substantially with increasing percentages of fine sediment in the substrate (Figure 45).

g. As the substrate becomes more embedded, fish carrying capacity declines for the summer rearing period for steelhead, chinook, and cutthroat trout declines (Figure 46). Causes are:

-- Reduced food -- fine sediments can smother aquatic fish food organisms, and eliminate some desirable organisms such as stoneflies and mayflies that are readily eaten by salmonids.

-- Reduced space for invertebrates -- imbeddedness reduces living space for food organisms; less food for trout; fewer and smaller trout

-- Reduced shelter (Cover) and quality space for fish; undercut banks eliminated; sediments fill in pools, reducing pool depth, resulting in fewer fish.

h. Increased sediment also decreases winter carrying capacity (Figure 47), because pools are filled in, because both pools and interstices in gravel (used a lot in winter) are filled in, and both areas are important to salmonids in winter.

i. Following logging, sediment yields may stay abnormally high over baseline levels, and degradation in fish habitat will continue after peak sediment yields have been delivered (Figure 48).

j. Population regulation in many of these Batholith streams may not occur at spawning, egg hatching, or emergence of fry unless escapements are especially low. Summer rearing or winter holding habitat in a stream may be more important than embryo survival in regulating fish abundance in most years, especially for species that have long freshwater residency periods. It is here that sediment would exert especially harmful effects on the productivity of the salmonid stock. Such an effect would show up as a lower stock-recruitment curve (Figure 49).

k. In some cases, if buffer strips are adequate, a buffered stream (with riparian vegetation protected) may become more productive for salmonids than either an old growth stream or a clearcut stream (Figure 50).

l. Some woody debris provides cover for salmonids, and thus natural levels of it are desirable even in logged streams. Too much debris bad: fish runs blocked, channel flows seriously disrupted. Too little also bad; poor habitat for fish.

m. Culverts associated with road building can block fish migrations. Both anadromous and resident fish commonly migrate. Culverts must be designed with consideration for fish passage (Figure 51).

5. Some general recommendations

a. Leave buffer strips; sediment problems start with disruption of riparian vegetation.

b. Design roads to minimize sediment transport into streams
   a. build as far from stream as possible
   b. use natural saddles and benches where possible
   c. avoid areas with unstable soils
   d. make sure stream is not blocked at crossings
   e. culverts should be passable to fish
   f. avoid road building at seasons of typically high precipitation

c. No felling into or across the stream or on immediate bank

d. No logs yarded across or through streams

e. <u>Excess</u> logging debris removed after logging (but leave some cover)

f. Better communication /consultation between industry and fishery managers.

g. Know the idiosyncrasies of each site and recommend accordingly.

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VIII. Some basic monitoring methods (Refer to Figures 52-54 and to Pages )

1. Streambank vegetative stability rating system

2. Streambank soil alteration rating system

3. Embeddedness rating for substrate

4. How to do a general stream survey

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# GLOSSARY OF FISHERY TERMS

## GLOSSARY OF FISHERY TERMS

| | |
|---|---|
| Alevin - | stage of fish from hatching of egg to end of dependence on yolk sac as a primary source of nutrition. |
| Anadromous species - | Fish, such as salmon, which are born in fresh water, migrate to ocean waters, and return to fresh waters to spawn. |
| Artificial stream channels - | constructed channels made by a researcher to simulate, as closely as possible, the actions and habitat conditions of a natural channel. |
| Biomass - | The weight of a fish stock or defined portion of a stock. |
| Brood year - | The year in which the eggs were spawned. |
| Carrying capacity - | The concept that the environnment can support only a finite quantity of a species, or combinations of a species, during any part of their life cycle. |
| Catch or harvest - | Physical possession of fish in a fishery that are either retained or released. |
| Cover - | Any aspect of the physical environment in a stream that will provide a fish with escape from current or predators. Cover can include rocks, logs and brush, deep, turbulent water, and undercuts in the stream bank. |
| Ecological - | Pertaining to the branch of biology that deals with the relations between living organisms and their environment. |
| Emigration - | movement, often downstream, of salmon or trout fry or fingerlings. |
| Empirical - | relying on or based upon experiment, observation, and practical experience (as opposed to threatened) |

| | |
|---|---|
| Escapement - | The number of salmon that avoid fisheries and return to spawn. |
| Fingerling - | a vague term referring to finger-sized salmon or trout prior to becoming smolts. The term parr is sometimes used. |
| Fish density - | refers to the number of fish per area ($m^2$) or per volume, $m^3$ of stream (as defined). |
| Fishery - | The act of or place for commerical and recreational fishing, often with reference to a particular season, species, or group of species. Fish + habitat + people = fishery. |
| Fry - | Stage from independence of yolk sac as primary source of nutrition to dispersal from the redd. |
| Habitat Quality Index (HQI) - | a quasi-quantitative method for rating the suitability of a stream for potential trout standing crop. |
| Idaho batholith - | geological region of central Idaho (approximately 16,000 $mi^2$) of intrusive, granitic rock. Most forest fisheries interactions in Idaho occur in streams within this region. |
| Imbeddedness - | The filling in of interstices between gravel and cobble with finer sediment. |
| Interstices - | spaces between rocks, gravel or sand grains. |
| Maximum sustained yield (MSY) - | The largest average sustainable catch that can be taken from a fish stock under existing environmental conditions. |
| Natural mortality - | Deaths of fish from all causes except fishing by man. |
| Optimum yield (OY) - | The best catch level of fish constrained by blending biological, political, economic, sociological, nationalistic, and idealistic points of view in harvest management regulations. |

| | |
|---|---|
| Policy - | A specific decision or set of decisions with related actions. |
| Recruitment - | The number of new fish added to a population at some specific life-history stage. |
| Redd - | Spawning nest of salmon dug in gravel. |
| Rehabilitation - | Short-term management techniques that restore fish stocks decimated or destroyed by natural or man-made events. |
| Riparian zone - | The area adjacent to and influenced by the stream. The vegetation associated with the riparian zone affects the physical make-up of the stream as well as the fish in it. |
| Salmonid - | A family of fishes (Salmonidae) that includes both resident and anadromous forms of salmon, trout, charr and related species. |
| Sediment - | Finely-grained material that settles to the bottom of a stream. |
| Smolt - | A juvenile salmon or trout that is migrating to the sea. |
| Spawning Run - | A number of stocks grouped together on the basis of similarity in migration times. |
| Steelhead - | anadromous rainbow trout. |
| Stock - | Fish spawning in a particular area at a particular time which do not, to any substantial degree, interbreed with any group spawning in a different area, or at the same place in a different season. Fish of the same species in adjacent rivers might be managed as a single stock, even if they do interbreed. |
| Stock-recruitment curve - | The relation between the number of salmon or trout allowed to spawn and the number of progeny produced. |

Swim-up fry - an alevin just as it emerges from the gravel and moves into the open water column.

# FIGURES FROM

# SLIDE PRESENTATION

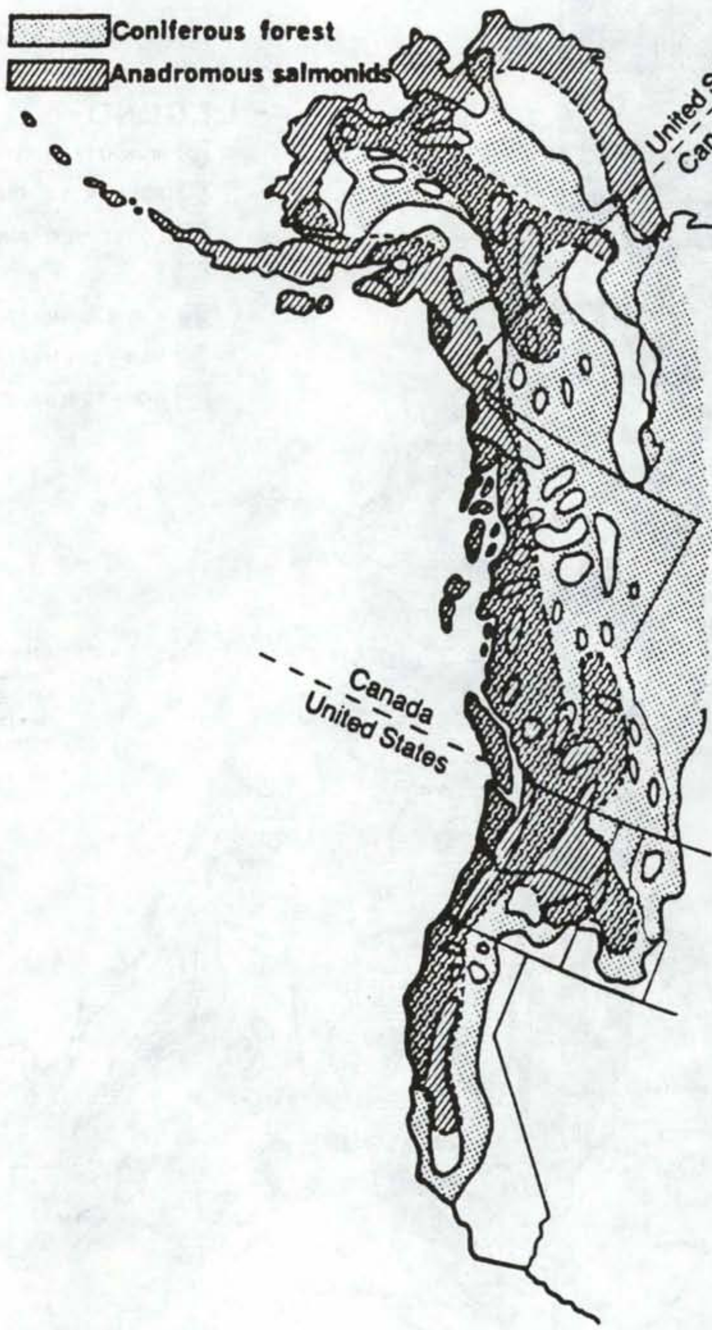



Figure 1. Distribution of anadromous salmonids and coniferous forests in western North America (from Everest and Harr 1982).

Source Everest in Salo and Cundy (1987)

# FOREST TYPES IN THE STATE OF IDAHO

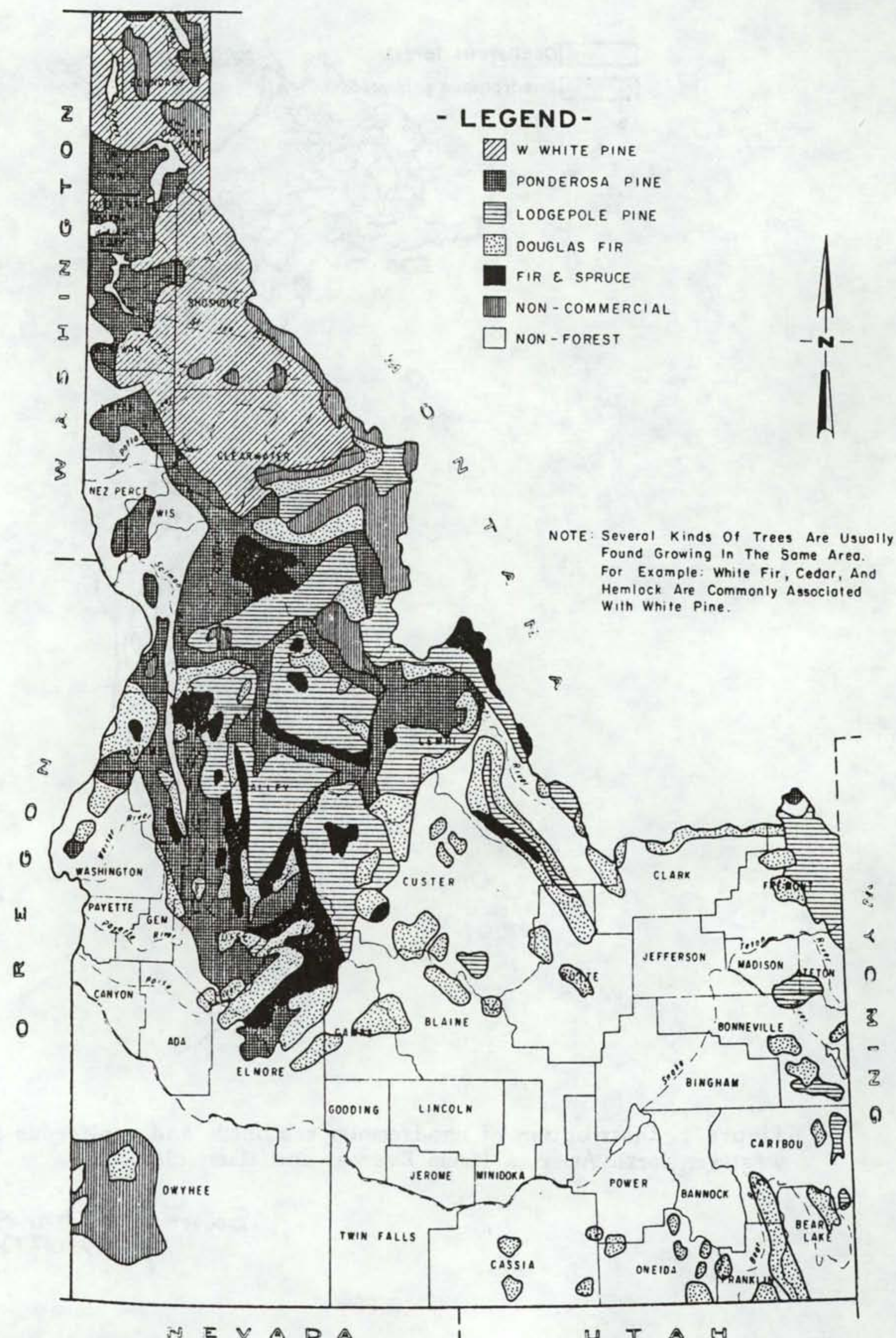



Figure 2

Source: U.S. EPA (1979)

FIGURE 2-1

# THE IDAHO BATHOLITH

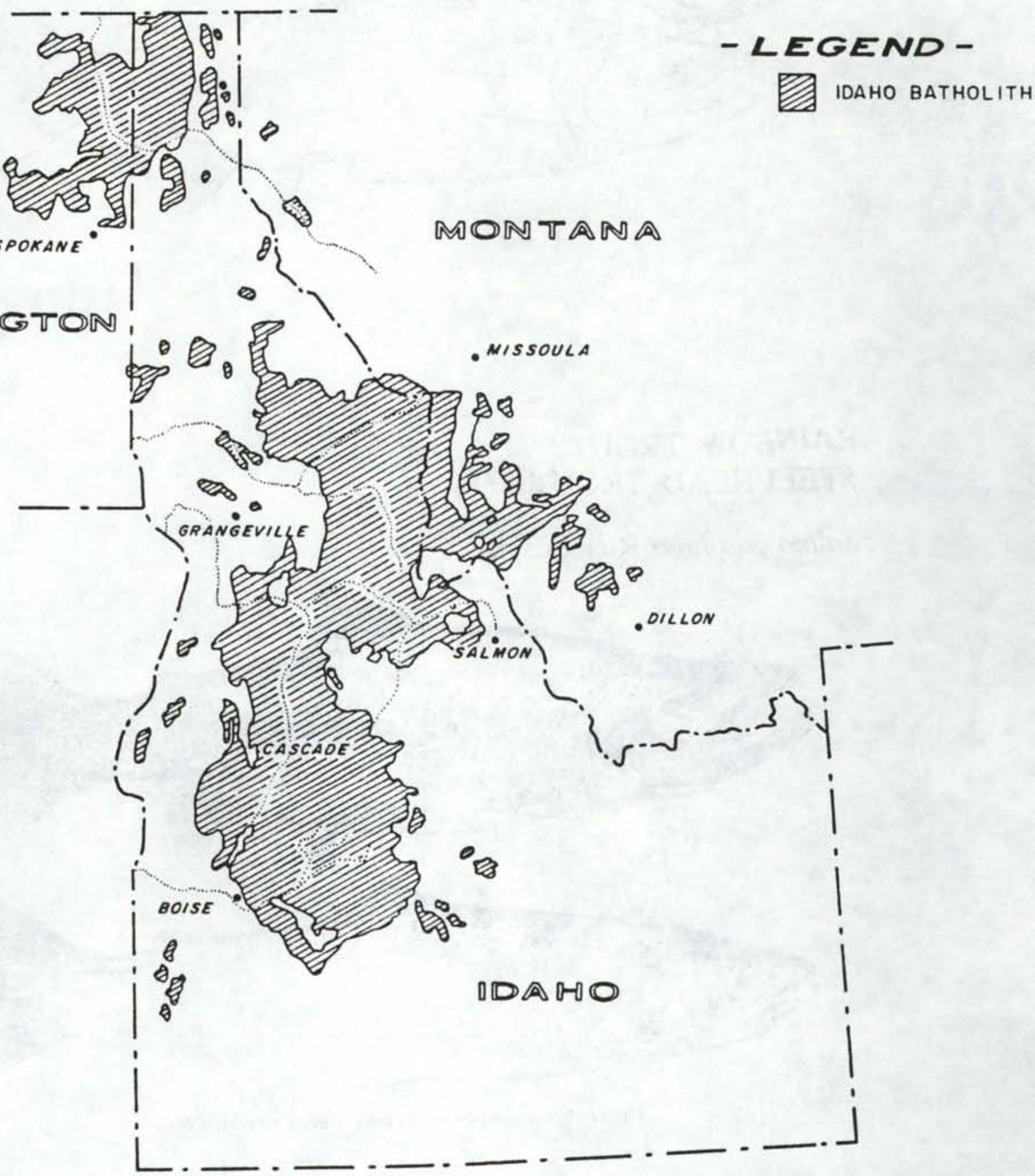
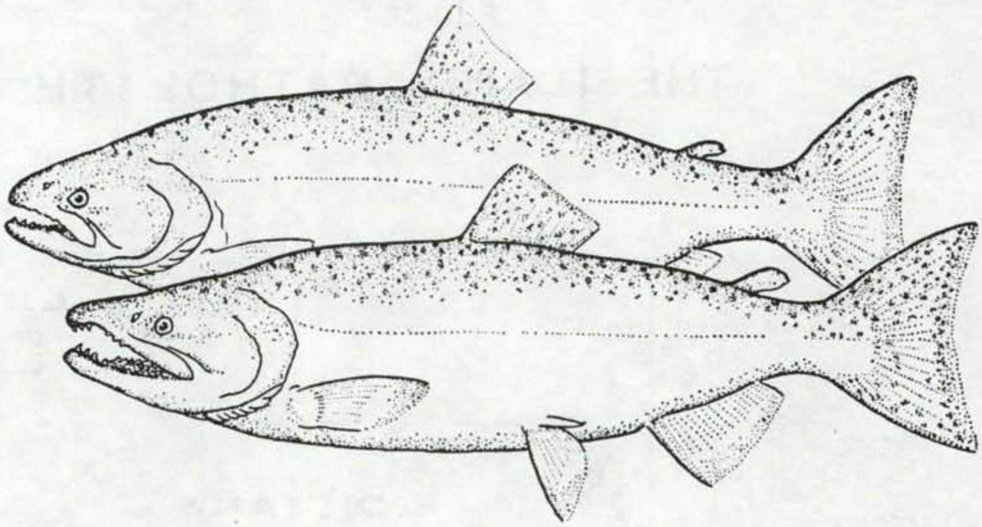



Figure 3

Source U.S. EPA (1979)

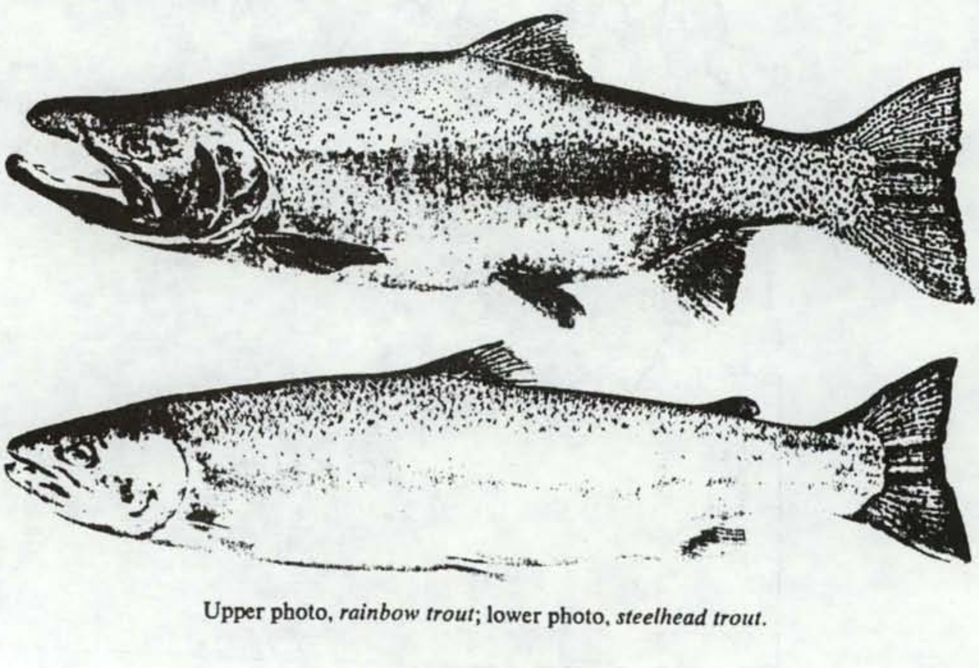
CHINOOK SALMON

*Oncorhynchus tshawytscha* (Walbaum)



RAINBOW TROUT,
STEELHEAD TROUT

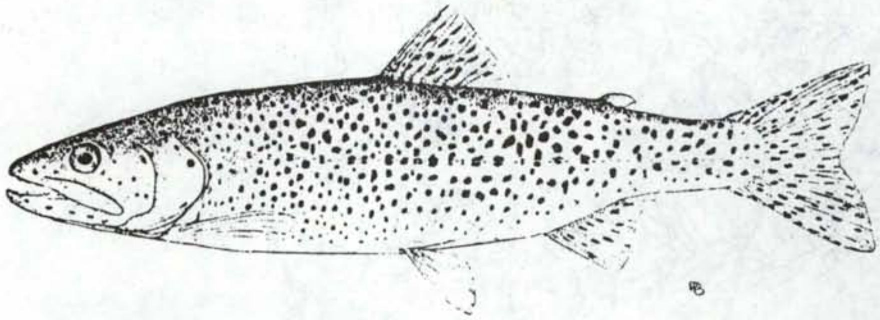
*Salmo gairdneri* Richardson



Upper photo, *rainbow trout*; lower photo, *steelhead trout*.

CUTTHROAT TROUT

*Salmo clarki* Richardson



DOLLY VARDEN

*Salvelinus malma* (Walbaum)

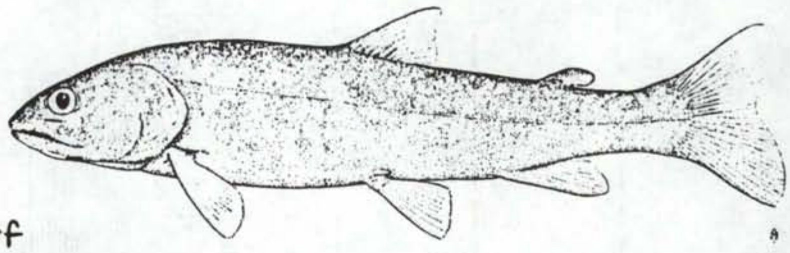
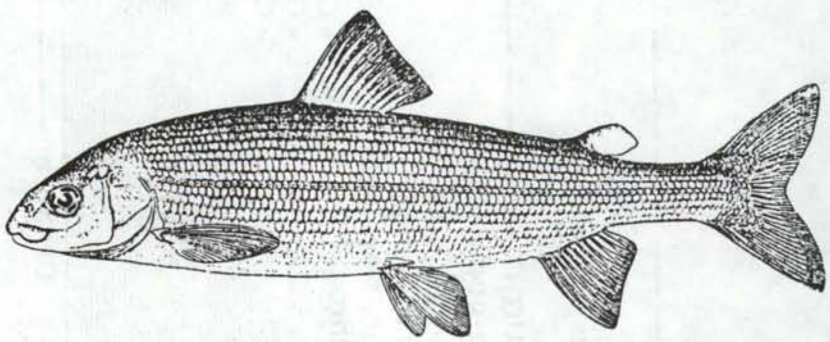


Figure 4a-f

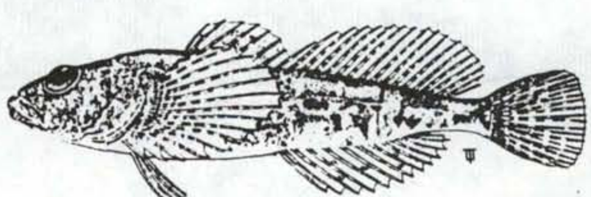
MOUNTAIN WHITEFISH

*Prosopium williamsoni* (Girard)



MOTTLED SCULPIN

*Cottus bairdi* Girard



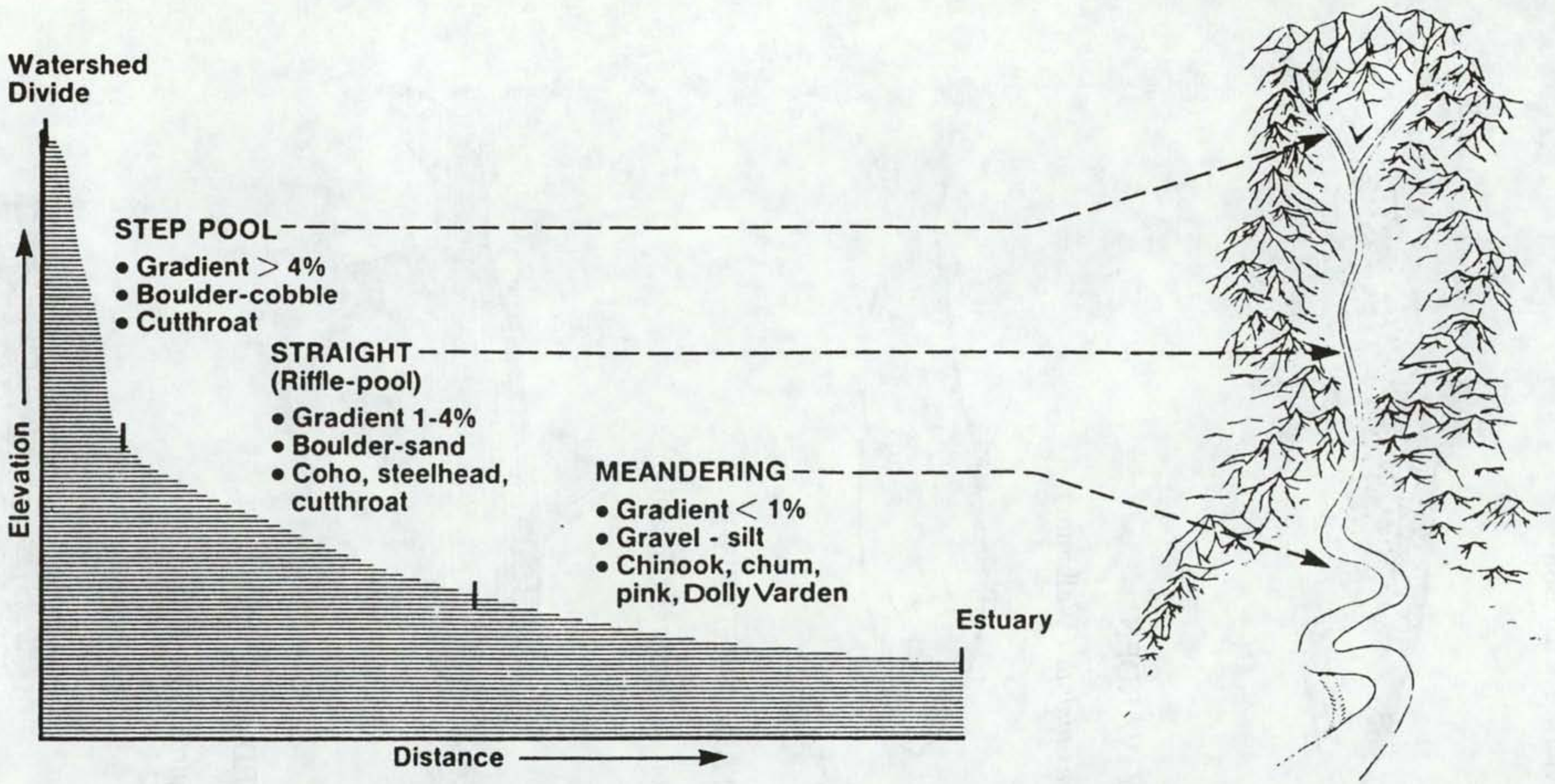



Figure 5. Patterns of channel morphology and fish use of watersheds.

Source : Sullivan et al. in Salo and Cundy (1987)

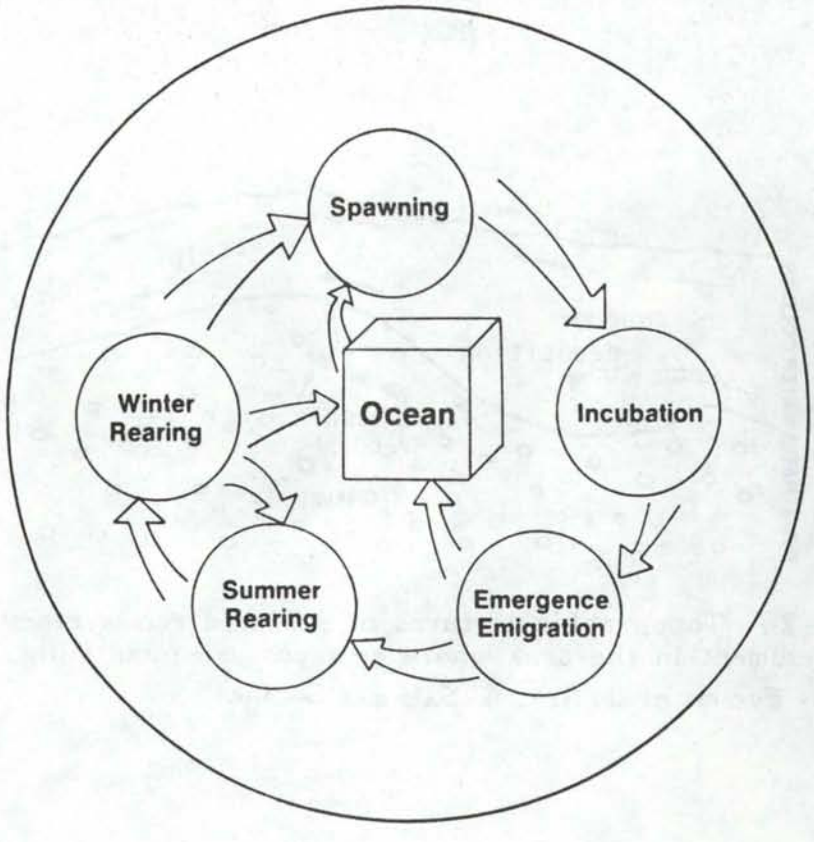



Figure 6. Generalized life cycle of salmonids.
Source Sullivan et al. in Salo and Cundy (1987)

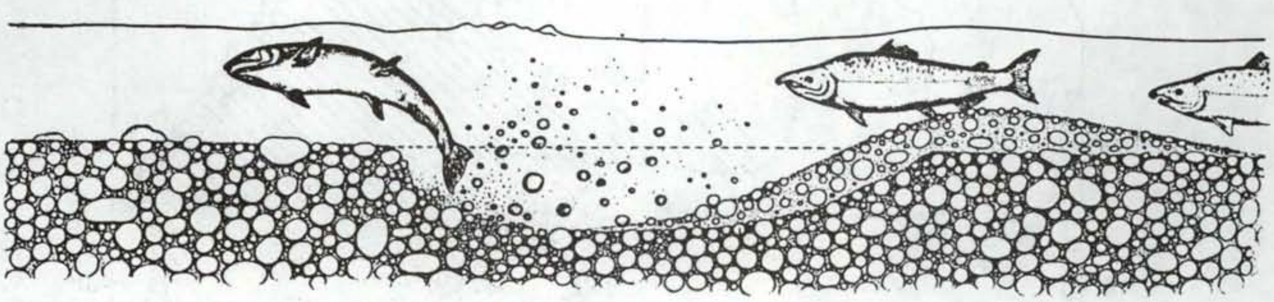



FIGURE 7.—Redd making. Female digging.

From Burner (1951)

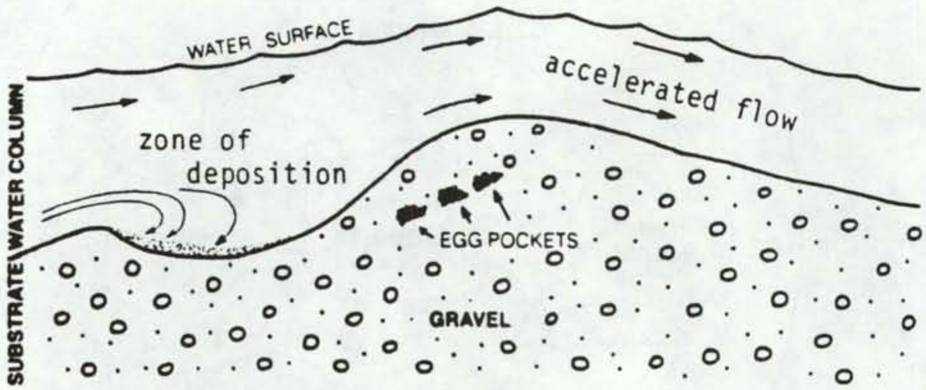
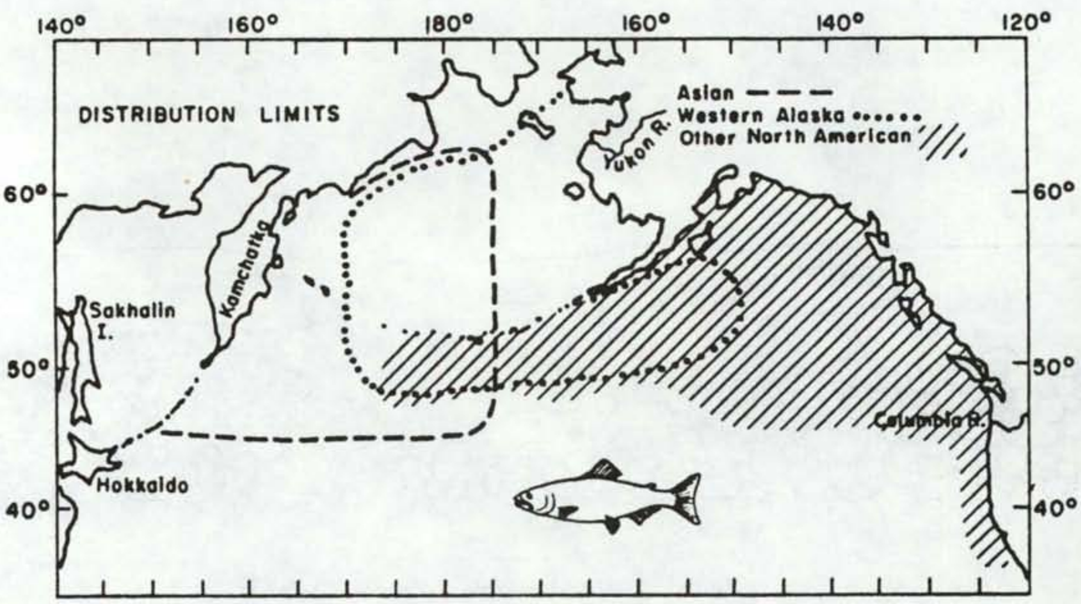



Figure 8. Topographic features of salmonid redds resist deposition of fine sediment in the area where embryos are incubating.
Source: Everest et al (1987) in Salo and Cundy




OCEAN DISTRIBUTION OF CHINOOK SALMON

Figure 9 SOURCE: SALMON INDUSTRIES OF THE U.S.

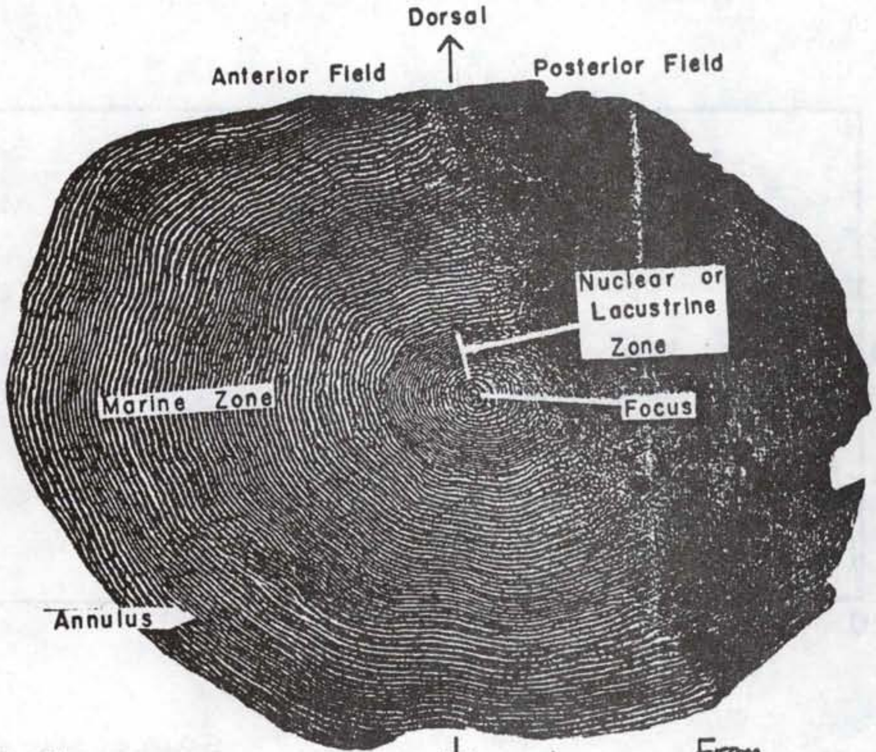



Figure 10

From Clutter and Whitesell

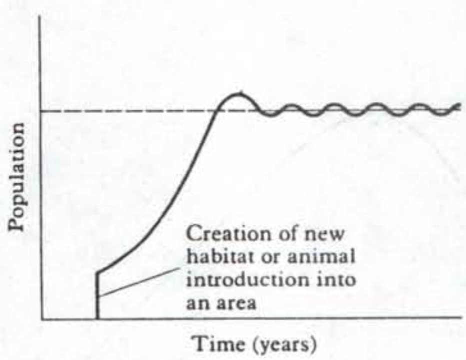



FIGURE 11 a

The change in a population over time is shown. Equilibrium, *E*, sometimes conceived as carrying capacity, is reached and exceeded before feedback mechanisms can bring the population under control.

From: Giles (1978)

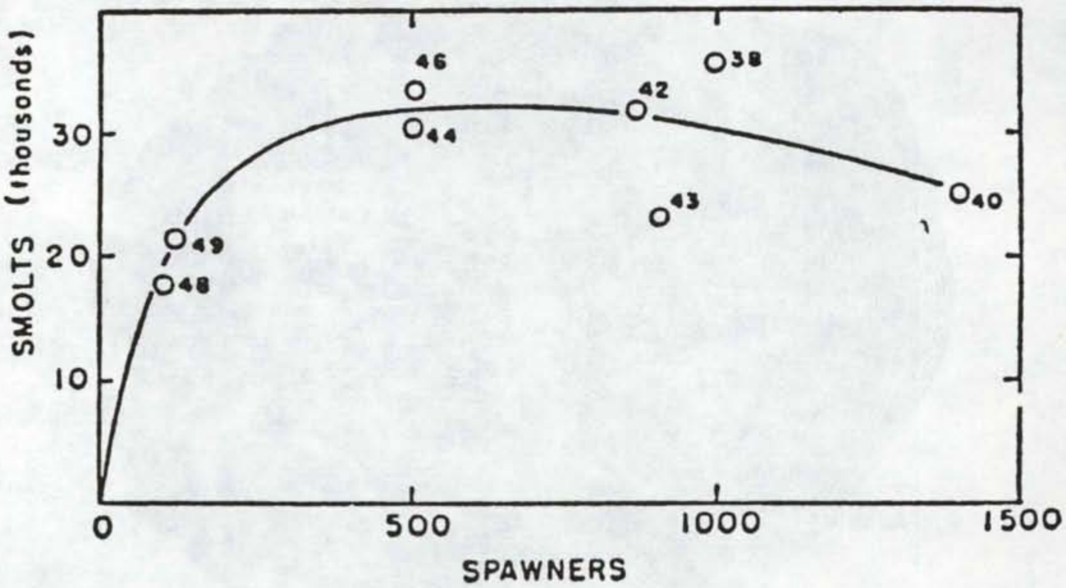



Figure 11b

SOURCE: SALO AND BAYLIFF (1958)

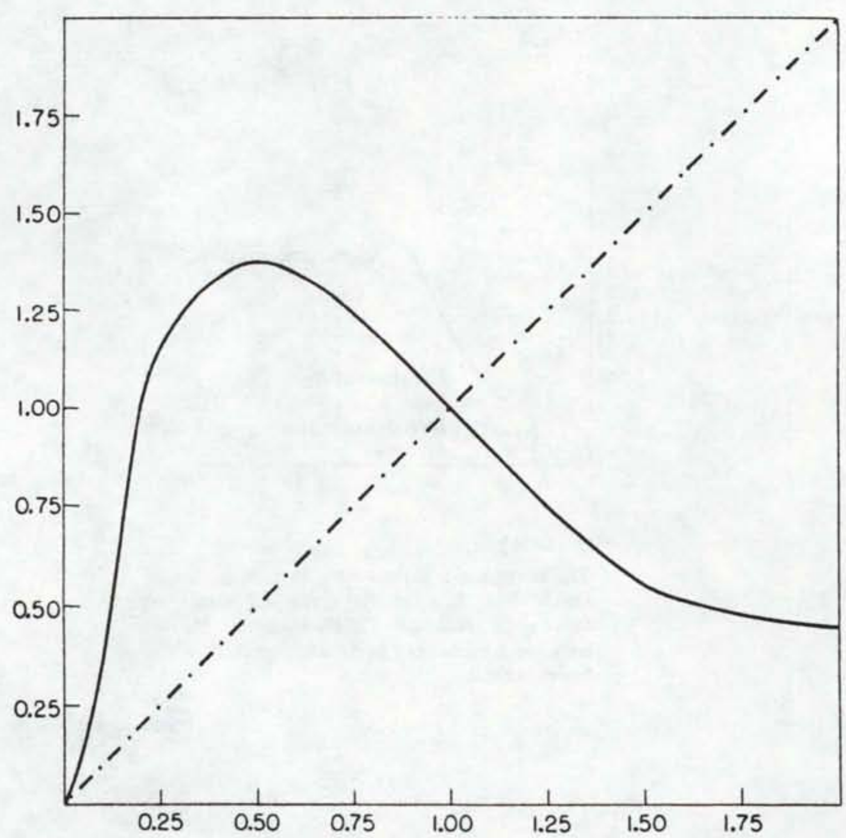



FIGURE 12 - Reproduction curve combining the effects of compensation and depensation in successive life-history stages.

Source: Ward and Larkin (1964)

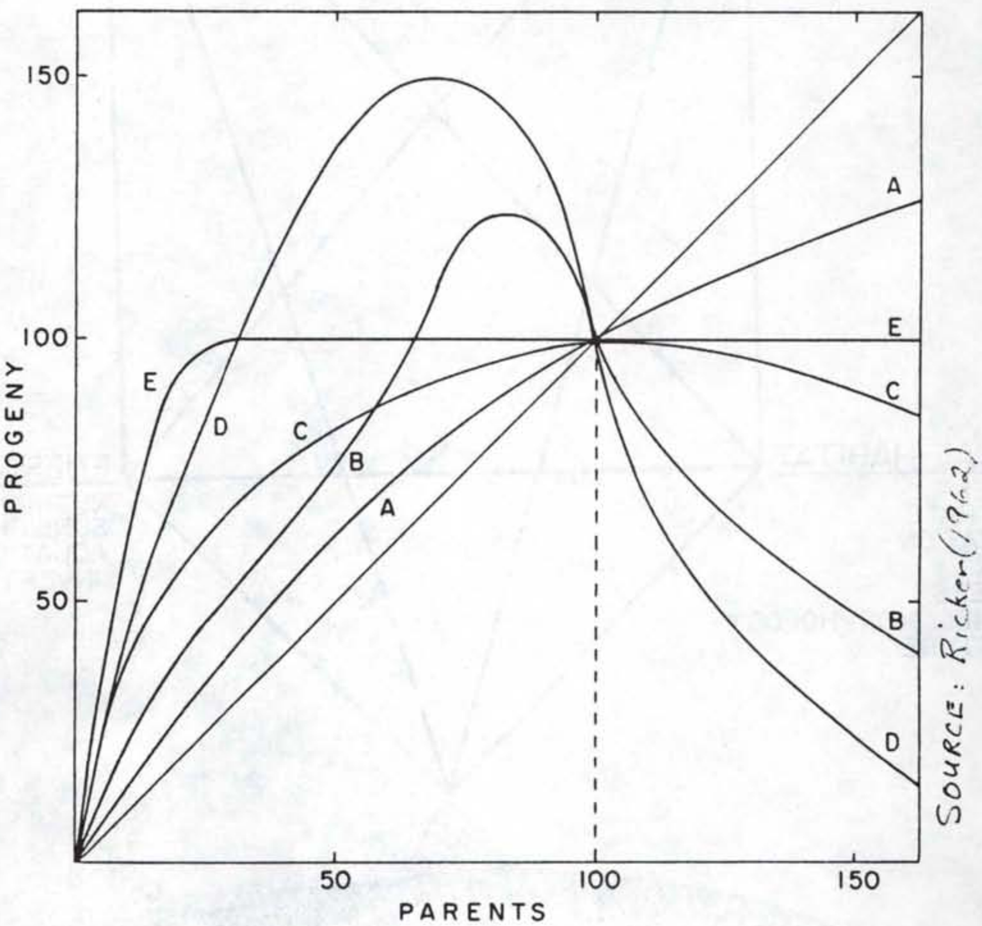
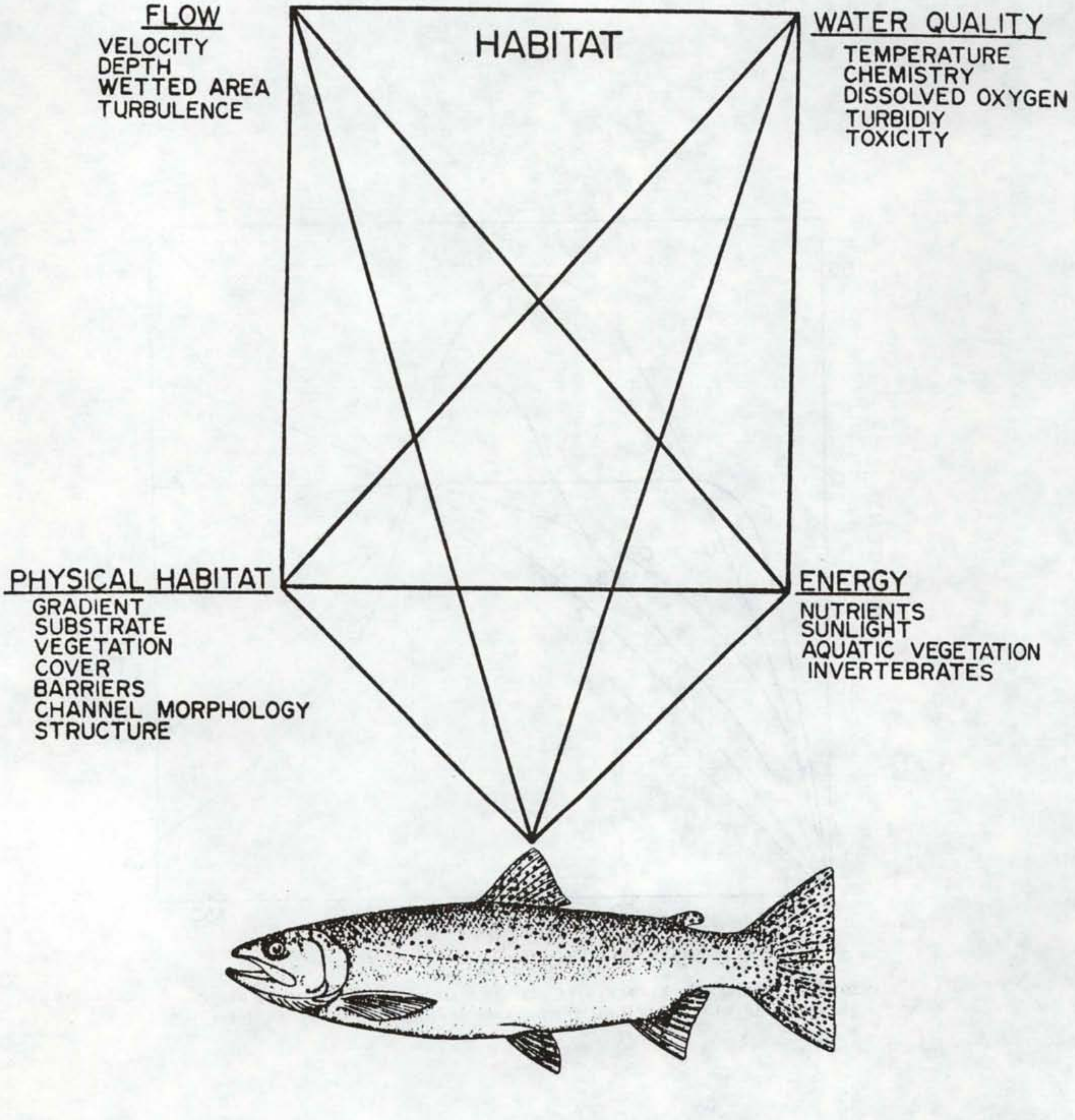



FIGURE 13

SOME POSSIBLE REPRODUCTION CURVES. ALL ARE SCALED SO THAT 100 IS THE ABUNDANCE OF SPAWNERS WHICH ON THE AVERAGE REPRODUCES ITS OWN NUMBERS.




Bottom et al. (1985)

Fig. 14. Interactions of major factors controlling salmonid production in fresh water.

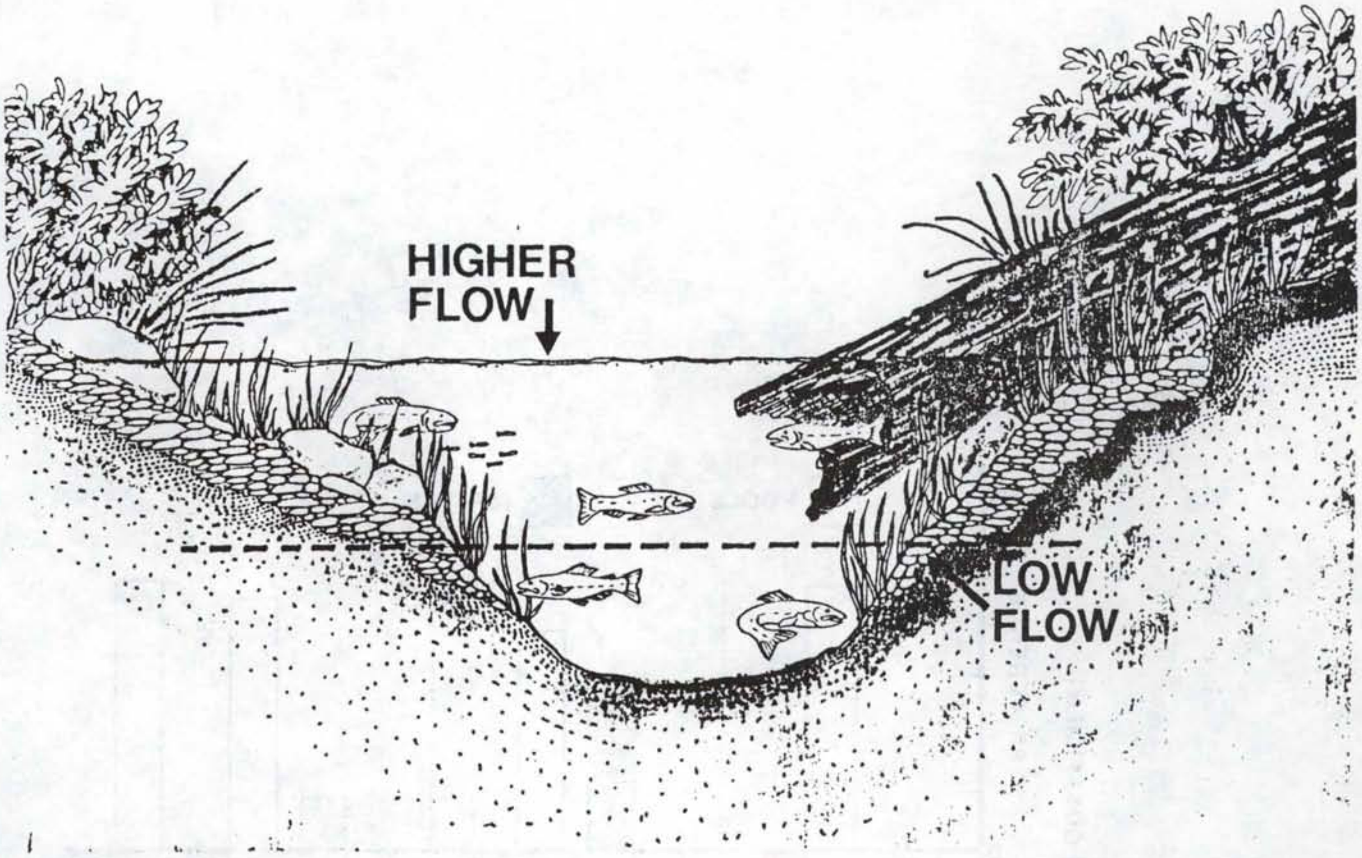



Fig. 15. Less habitat is available to salmonids and other stream organisms as flows decrease. Bottom et al. (1985)

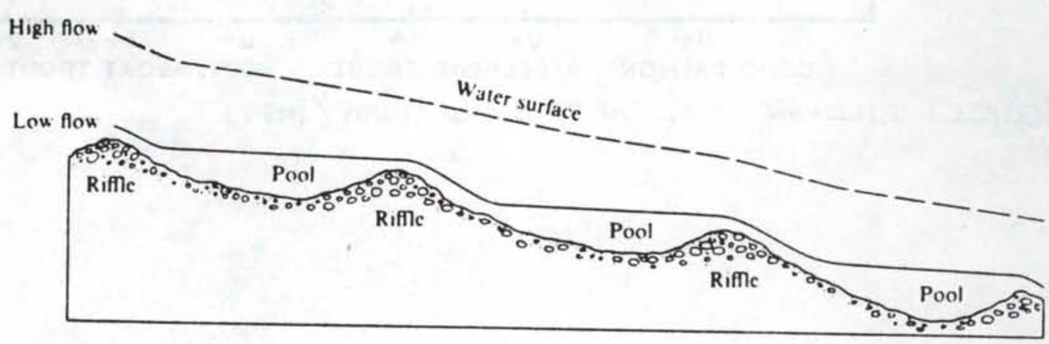
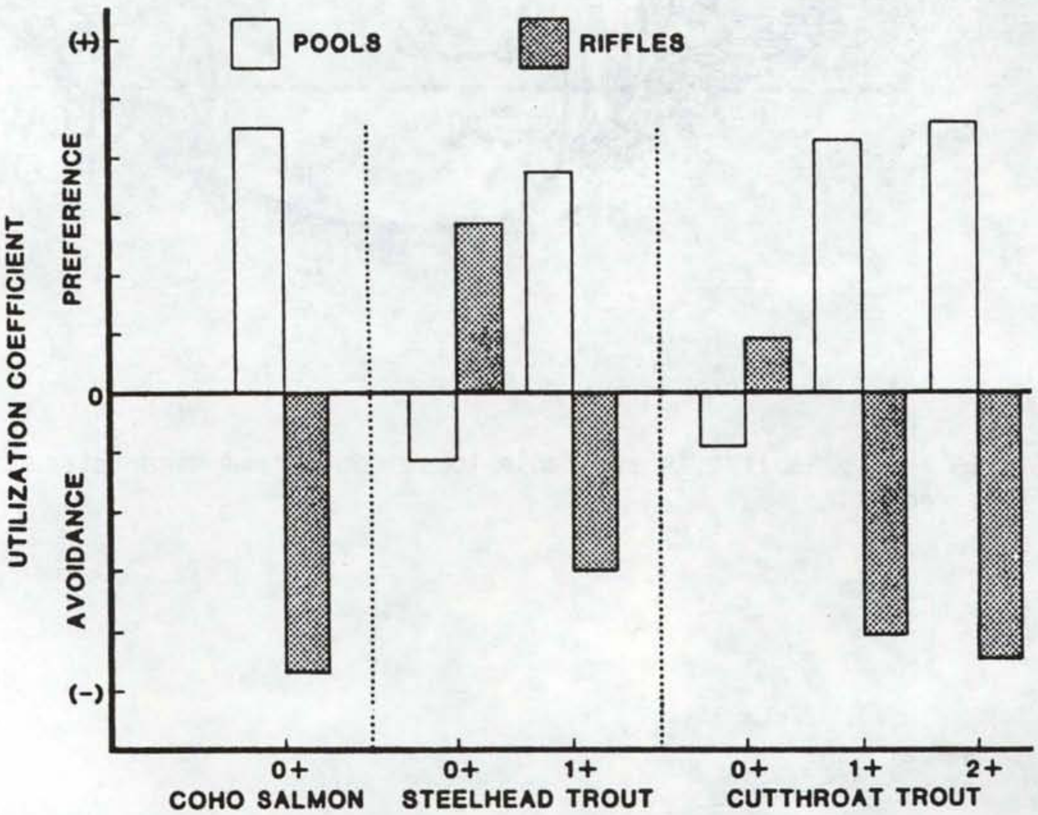



**Figure 16 Channel topography and water depth characteristics of a riffle-pool sequence at high and low flows (from Dunne and Leopold 1978).**

From Sullivan et al. in Salo and Cundy (1987)

Figure 17




SOURCE: SULLIVAN ET AL. IN SALO AND CUNDY (1987)

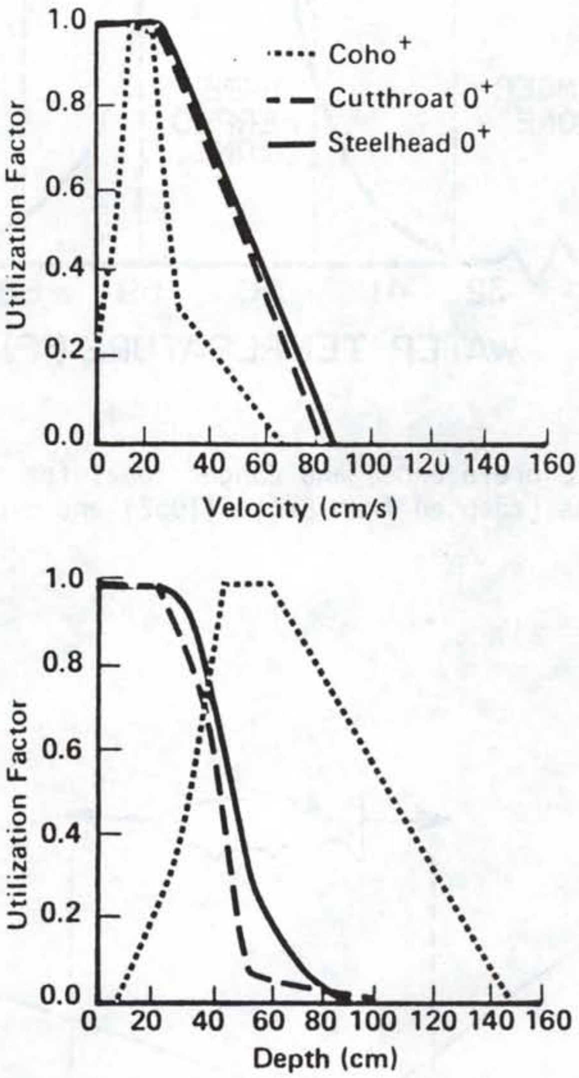



Figure 18. Utilization factor, an index of preference, of salmonid populations in relation to velocity and depth. The data shown were collected for several species of salmonid fry in streams in Washington by the Washington State Department of Game, Olympia, for use in the Instream Flow Incremental Method model developed by the U.S. Fish and Wildlife Service. (See Bovee and Cochnauer 1977 and Bovee 1982 for a description of the IFIM methodology and the utilization factor.)
SOURCE: SULLIVAN ET AL. IN SALO AND CUNDY (1987)

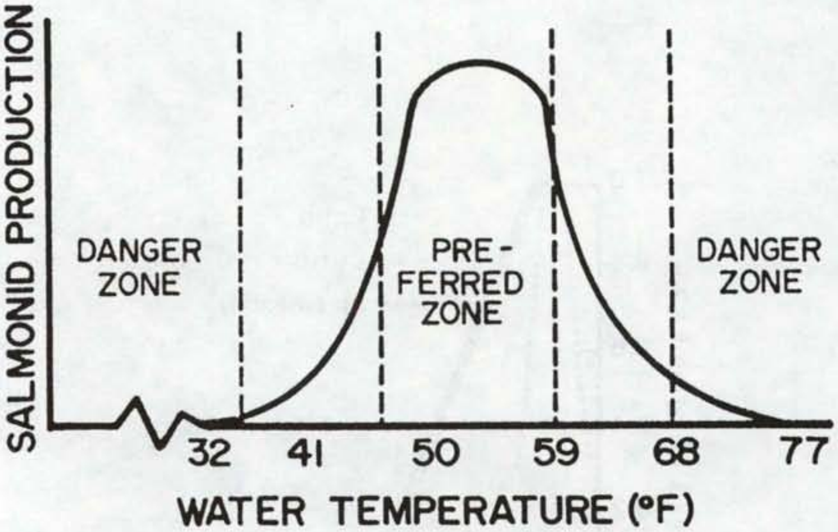



Fig. 19 Temperature preferences and danger zones for rearing and incubating anadromous salmonids [adapted from Brett (1952) and Everest et al. (1982)].

Bottom et al. (1985)

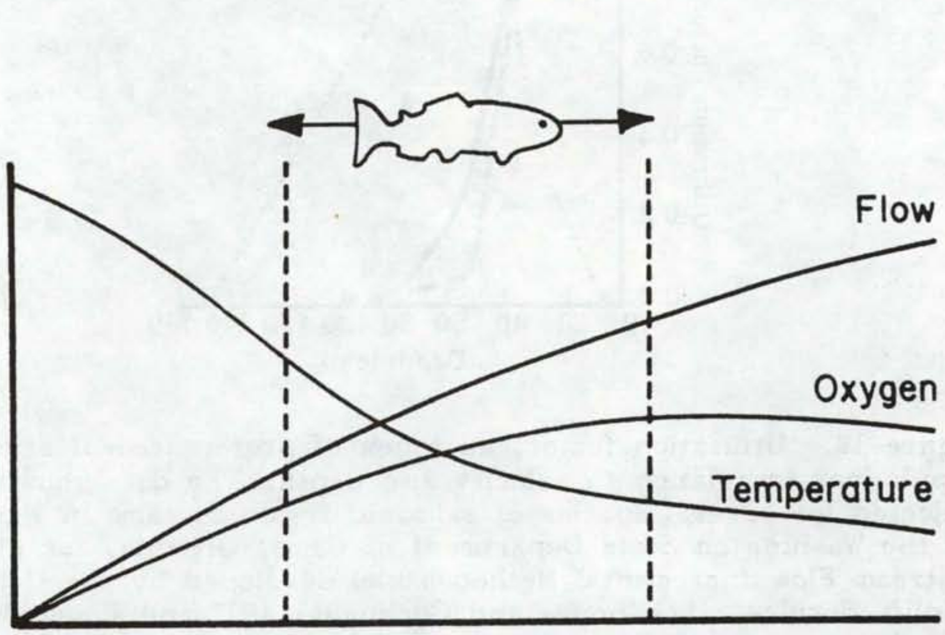



Fig. 20. Relationship of flow to summer water temperature and dissolved oxygen. (The range for optimum salmonid production is indicated by dashed lines.)

Bottom et al. (1985)

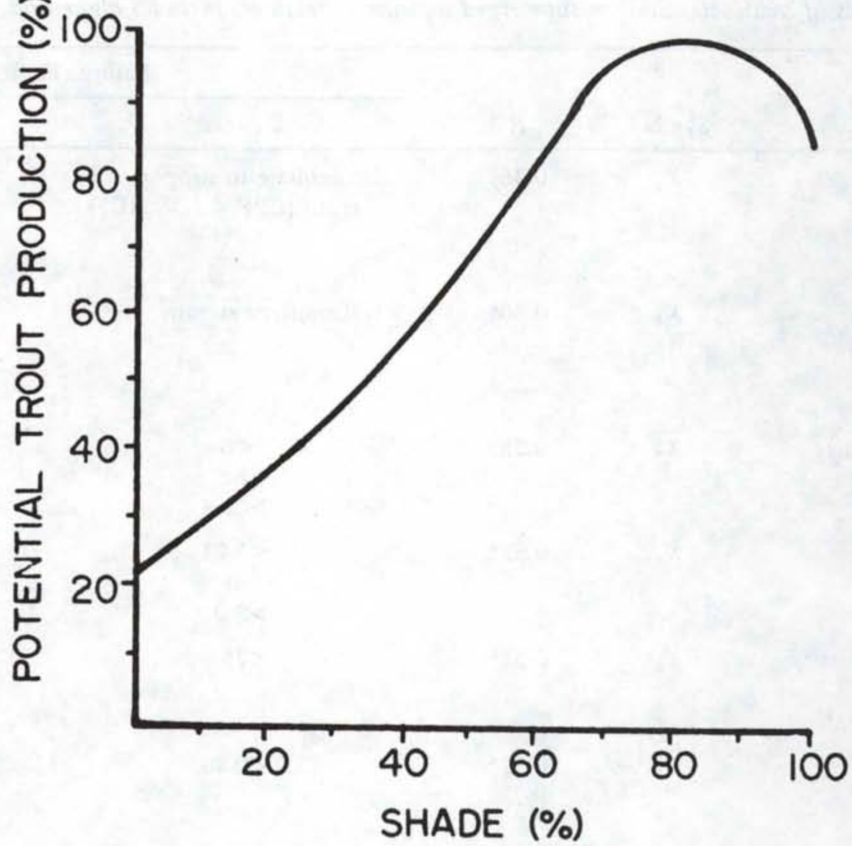



Fig. 21. Trout production in relation to surface shading of small streams (Riparian Habitat Committee 1979).

Bottom et al. (1985)

Figure 22a

.—*Stream habitat attributes used in the Habitat Quality Index, the characteristics used to rate them, and their multiple regression correlation coefficients* (R) *from a multiple regression analysis of their relationship to trout standing crop.* R *values followed by an asterisk (*) are significantly different from zero at the* $\alpha = 0.95$ *level* ($R = 0.378$ *from Table A-30a, Dixon and Massey 1969). ADF = average daily flow for the water year, obtained from gauging station records, if available; CPF = average daily flow during August and the first half of September only, from gauging station records, if available; SAV = submerged aquatic vegetation, includes algae and moss growing on rocks.*

| Attribute | Symbol | *R* | Rating characteristics | |
|---|---|---|---|---|
| | | | 0 (worst) | 1 |
| Late summer stream flow | $X_1$ | 0.36 | Inadequate to support trout (CPF < 10% ADF) | Very limited: potential for trout support is sporadic (CPF 10–15% ADF) |
| Annual stream flow variation | $X_2$ | 0.80* | Intermittent stream | Extreme fluctuation, but seldom dry; base flow very limited |
| Maximum summer stream temperature (C) | $X_3$ | 0.28 | <6 or >26.4 | 6–8 or 24.2–26.3 |
| Nitrate nitrogen (mg/liter) | $X_4$ | 0.69* | <0.01 or >2.0 | 0.01–0.04 or 0.91–2.0 |
| Fish food abundance (number/0.1 $m^2$) | $X_5$ | 0.57* | <25 | 26–99 |
| Fish food diversity ($D_s$)[a] | $X_6$ | 0.57* | <0.80 | 0.80–1.19 |
| Cover (%)[b] | $X_7$ | 0.55* | <10 | 10–25 |
| Eroding banks (%)[c] | $X_8$ | 0.45* | 75–100 | 50–74 |
| Substrate | $X_9$ | 0.44* | SAV lacking | Little SAV |
| Water velocity ($m^3$/second)[d] | $X_{10}$ | 0.38* | <8 or >122 | 8–15.4 or 106.6–122 |
| Stream width (m) | $X_{11}$ | 0.38* | <0.6 or >46 | 0.6–2.0 or 23–46 |

Source: Binns and Eiserman 1979

Figure 22a
—*Continued.*

| Attribute | Rating characteristics | | |
|---|---|---|---|
| | 2 | 3 | 4 (best) |
| Late summer stream flow | Limited; CPF may severely limit trout stock every few years (CPF 16–25% ADF) | Moderate; CPF may occasionally limit trout numbers (CPF 26–55% ADF) | Completely adequate; CPF very seldom limiting to trout (CPF > 55% ADF) |
| Annual stream flow variation | Moderate fluctuation, but never dry; base flow occupies up to two-thirds of channel | Small fluctuation; base flow stable, occupies most of channel | Little or no fluctuation |
| Maximum summer stream temperature (C) | 8.1–10.3 or 21.5–24.1 | 10.4–12.5 or 18.7–21.4 | 12.6–18.6 |
| Nitrate nitrogen (mg liter) | 0.05–0.09 or 0.51–0.90 | 0.10–0.14 or 0.26–0.50 | 0.15–0.25 |
| Fish food abundance (number/0.1 m²) | 100–249 | 250–500 | >500 |
| Fish food diversity ($D_s$)[a] | 1.20–1.89 | 1.90–3.99 | >4.0 |
| Cover (%)[b] | 26–40 | 41–55 | >55 |
| Eroding banks (%)[c] | 25–49 | 10–24 | 0–9 |
| Substrate | Occasional patches of SAV | Frequent patches of SAV | Well developed and abundant SAV |
| Water velocity (m³/second)[d] | 15.5–30.3 or 91.4–106.5 | 30.4–45.5 or 76.1–91.3 | 45.6–76 |
| Stream width (m) | 2.1–3.5 or 15.1–22.9 | 3.6–5.3 or 6.7–15 | 5.4–6.6 |

[a] For the purpose of the Habitat Quality Index, Diversity Score ($D_s$) is defined as follows: $D_s$ = antilog$_{10}\bar{D}$, where $D$ is calculated for each taxon from the formula: $D = P_i \log_{10} P_i$. When $P_i$ is defined as $1/N$, and $N$ is the number of organisms, then the formula reduces to $D = \log_{10} N$, as discussed in Watt (1968). $\bar{D}$ is the mean of all the $D$ values for the sample.

[b] % cover = total amount of cover (m²)/total area in study section (m²).

[c] % eroding banks = total length (m) of eroding stream banks (both sides) in section/total length (m) (one side) of study section.

[d] Time-of-travel water velocity, determined with fluorescent dye. Velocity = thalweg length/time required for dye to traverse section.

Figure 22b

BINNS AND EISERMAN (1979)

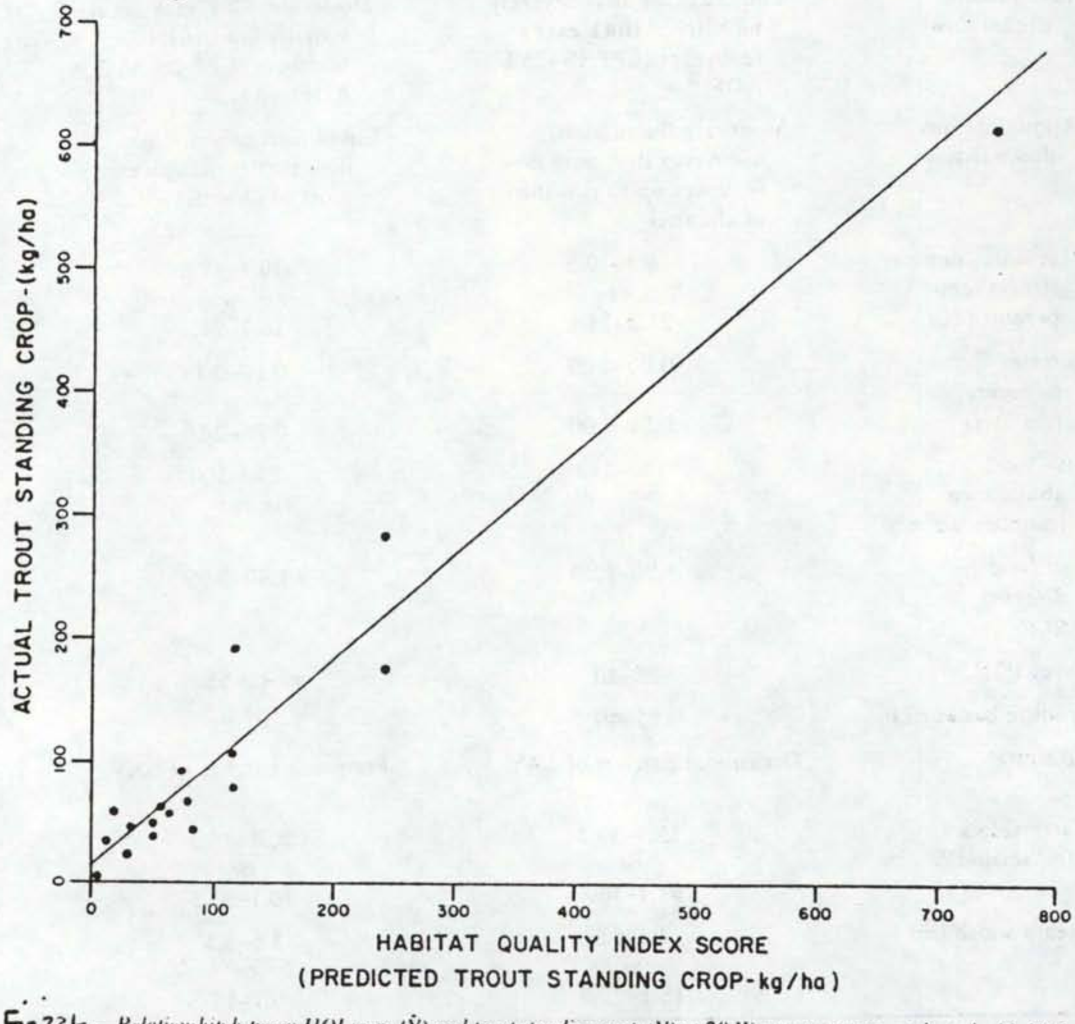



Fig 22b.—*Relationship between HQI score* ($\hat{Y}$) *and trout standing crop* (Y) *at 20 Wyoming streams evaluated with HQI Model I in 1975. The multiple correlation coefficient,* $R = 0.977$ *for the linear relationship:* $Y = 11.983 + 0.846(\hat{Y})$.

Figure 23

Calendar of events in the evolution of the four case studies.

| | Alaska | Alsea | Clearwater | Carnation Creek |
| --- | --- | --- | --- | --- |
| 1940s | A development of awareness in southeastern Alaska | | | |
| 1950s | Spawning and incubation requirements of chum and pink salmon (Hollis)<br><br>Development of research tools | Planning by interdisciplinary approach | | |
| 1960s | Emphasis shifts to "rearing" populations | Background study of three watersheds<br><br>Logging in 1966<br><br>Study of three treatments<br><br>Postlogging monitoring | | |
| 1970s | Independent research projects in various parts of the state | Physical studies<br>Biological studies<br>Initiation of processes concepts | Studies of landslide effects, intensive sedimentation studies | Intensive research on three treatments of a small watershed |
| 1980s | Cooperation among agencies<br>Formation of interdisciplinary working groups<br>Management oriented studies | Notable information dissemination | Sediment budget concept<br><br>Effects on underseeded populations in a large watershed<br><br>Enhancement of wall-based channels | Temperature processes and interrelated biological effects<br><br>Integrated case histories leading to the advancement of study of processes that may be transferred to other watersheds |

Source: Salo in Salo and Cundy (1987)

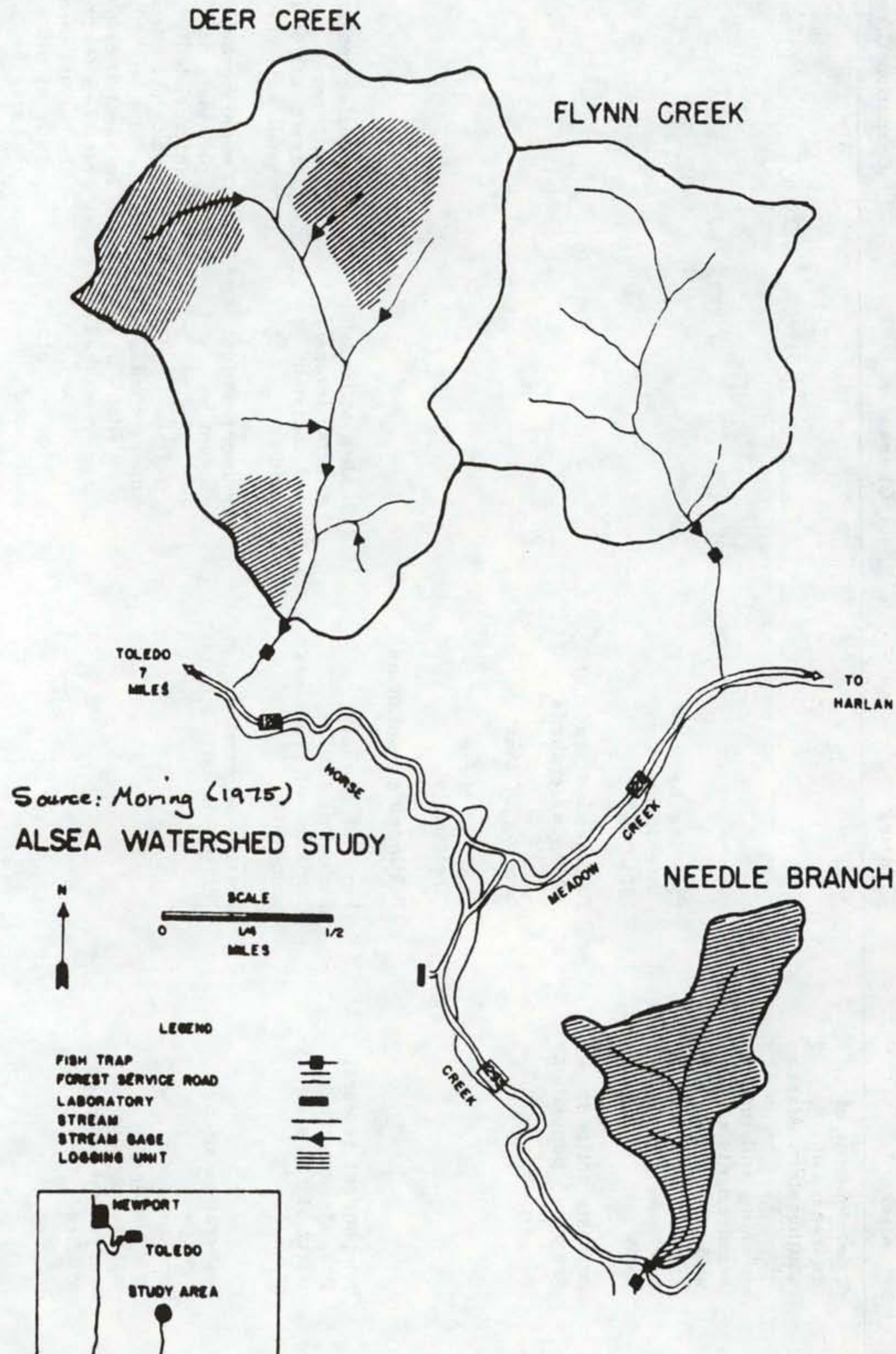



Figure 24 Map of the Study Watersheds. The approximate lengths of the streams accessible to anadromous salmonids are: Deer Creek –2324m, Flynn Creek–1433m, Needle Branch–966m.

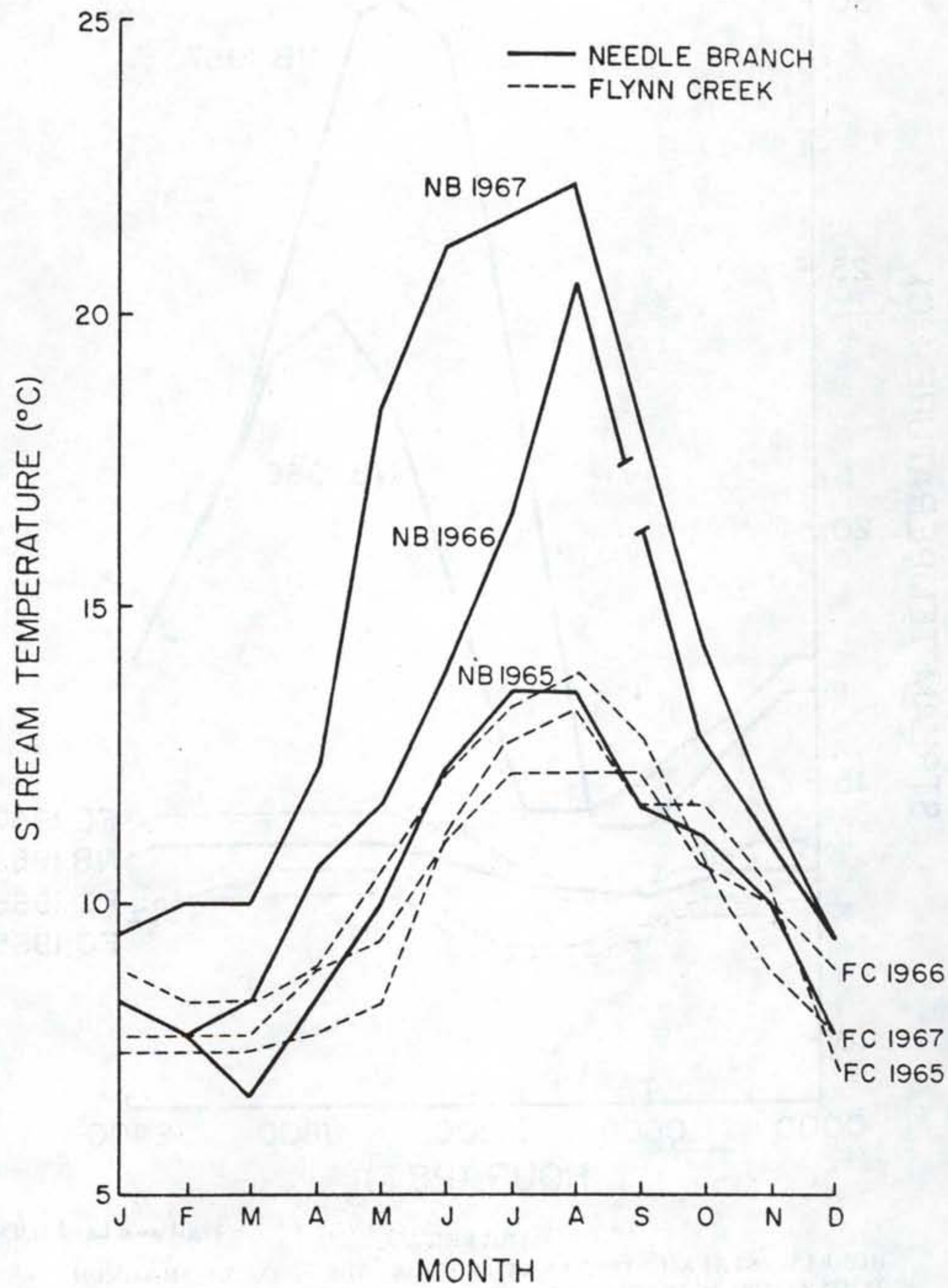



FIGURE 25

AVERAGE MONTHLY MAXIMUM STREAM TEMPERATURE AT THE POINT OF HIGHEST TEMPERATURE IN THE CLEARCUT (NEEDLE BRANCH) AND CONTROL (FLYNN CREEK) WATERSHEDS BEFORE LOGGING (1965), DURING LOGGING (1966), AND AFTER LOGGING (1967). DATA FROM SCHOOL OF FORESTRY, OREGON STATE UNIVERSITY. From Hall and Lantz (1969)

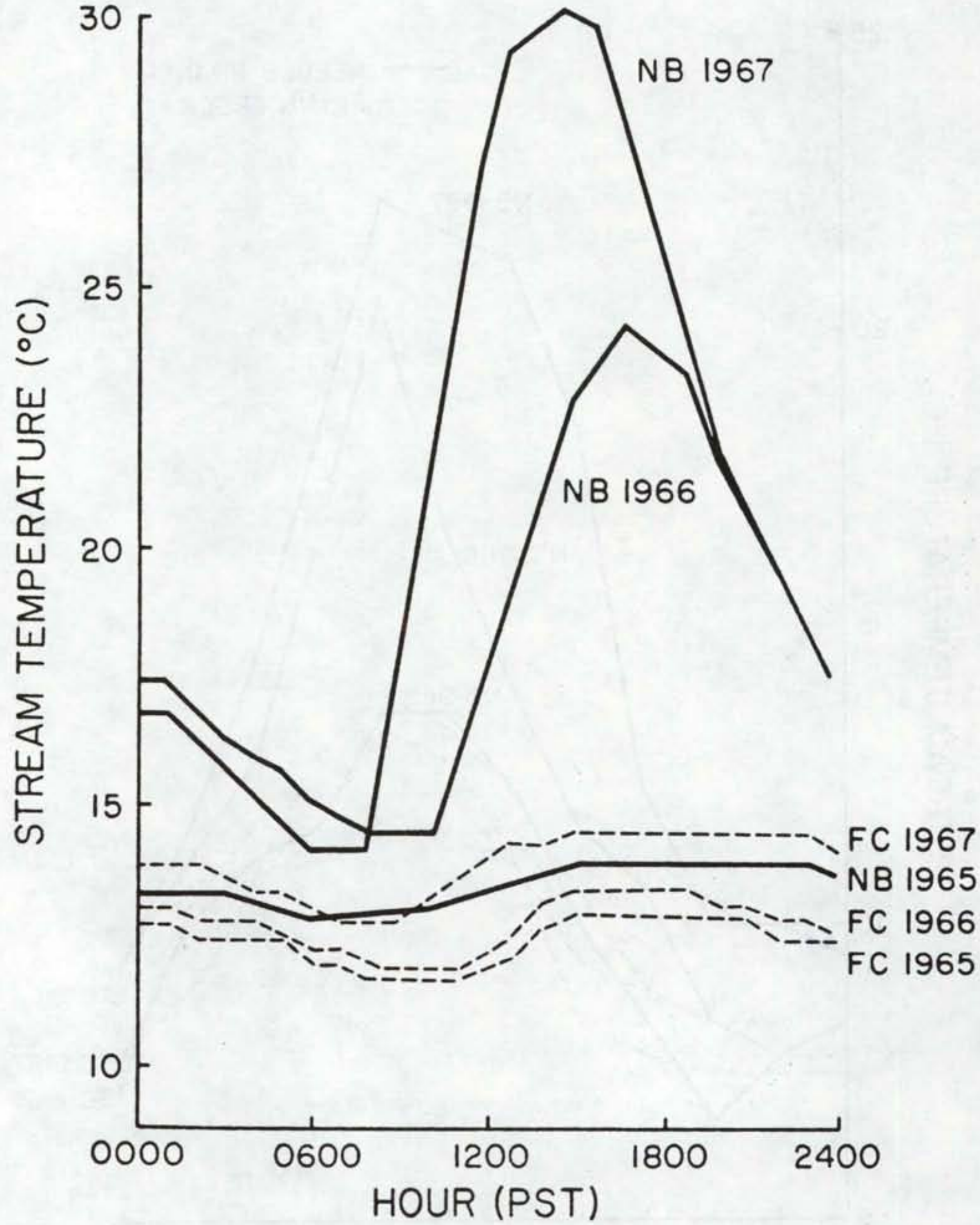



FIGURE 26

Hall and Lantz (1969)

HOURLY STREAM TEMPERATURES ON THE DAY OF MAXIMUM TEMPERATURE IN THE CLEARCUT (NEEDLE BRANCH) AND CONTROL (FLYNN CREEK) WATERSHEDS. VALUES SHOWN ARE FOR ONE DAY IN AUGUST BEFORE LOGGING (1965), DURING LOGGING (1966), AND AFTER LOGGING (1967). DATA FROM SCHOOL OF FORESTRY, OREGON STATE UNIVERSITY.

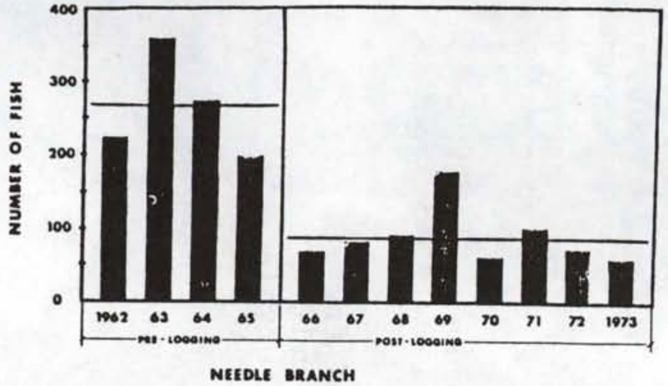



Figure 28. Estimated population numbers of cutthroat trout in Needle Branch, 1962-1973. Logging occurred in 1966.

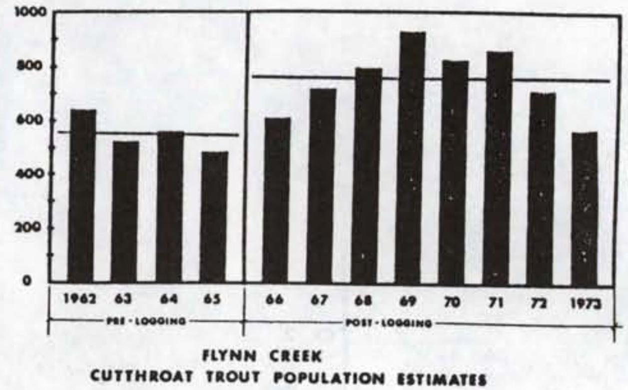



Figure 30 Estimated population numbers of cutthroat trout in Flynn Creek, 1962-1973. Logging occurred in 1966.

SOURCE MORING AND LANTZ (1975)

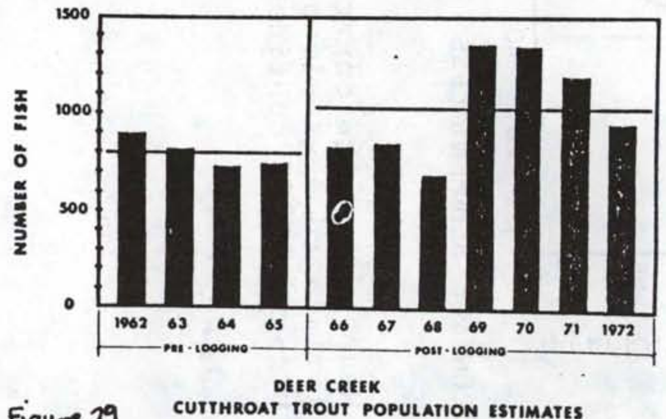
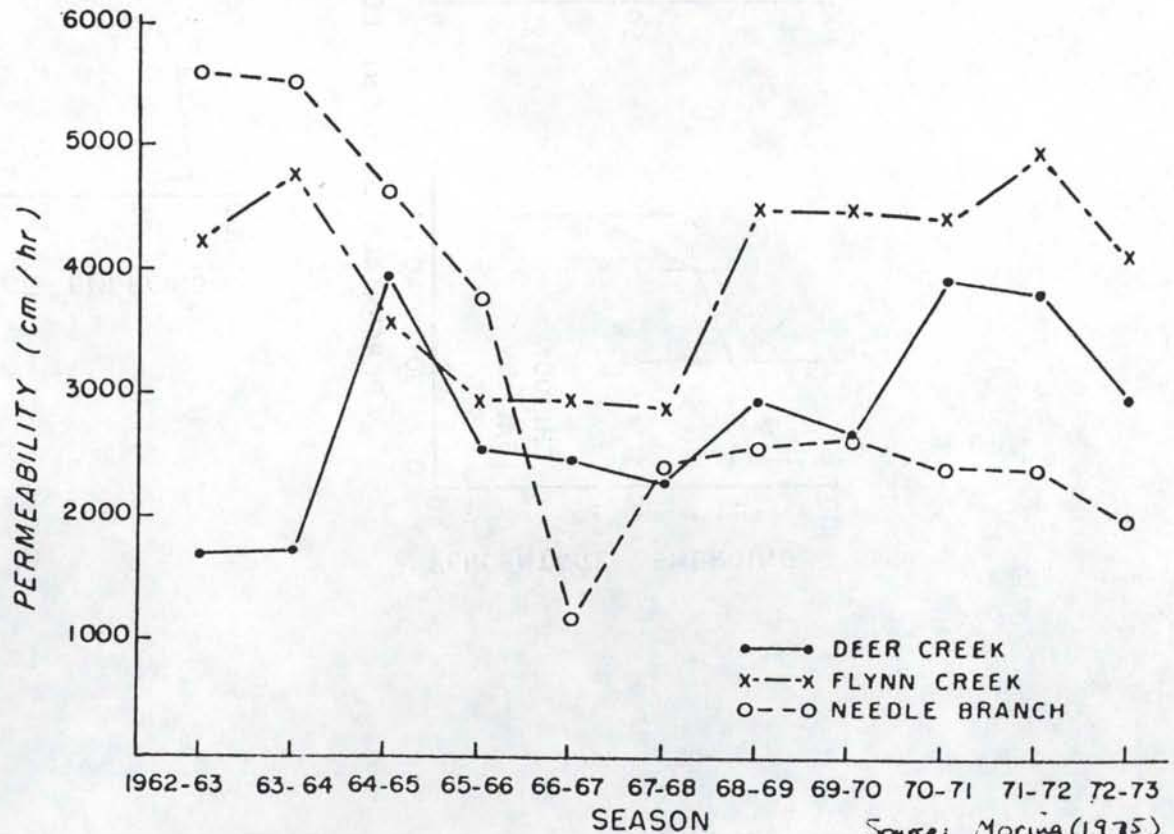



Figure 29. Estimated population numbers of cutthroat trout in Deer Creek, 1962-1972. Logging occurred in 1966.




Source: Moring (1975)

Figure 27. Average gravel permeability valves for the three study streams, 1962-1973.

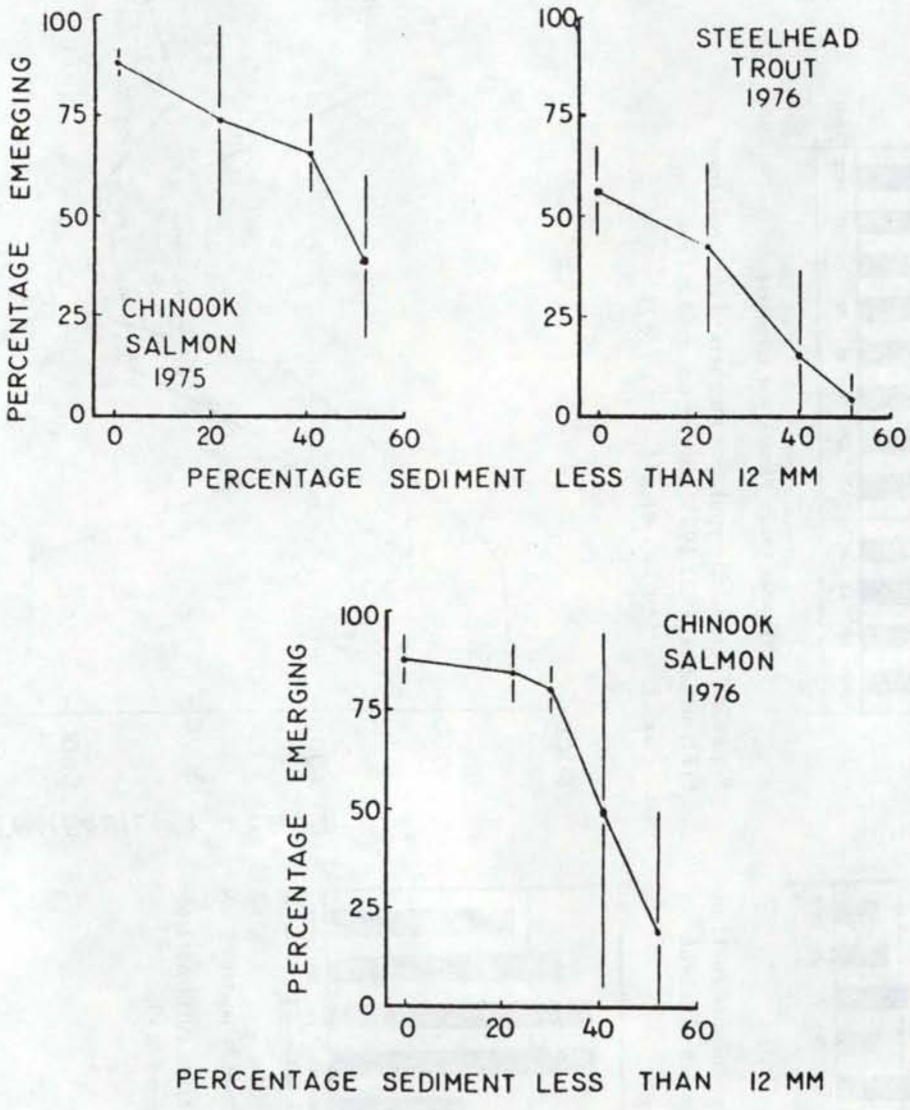



Figure 31. Mean percentage emergence of fry from newly fertilized eggs placed in sand-gravel mixtures with .95 confidence intervals

Source: McCuddin (1977)

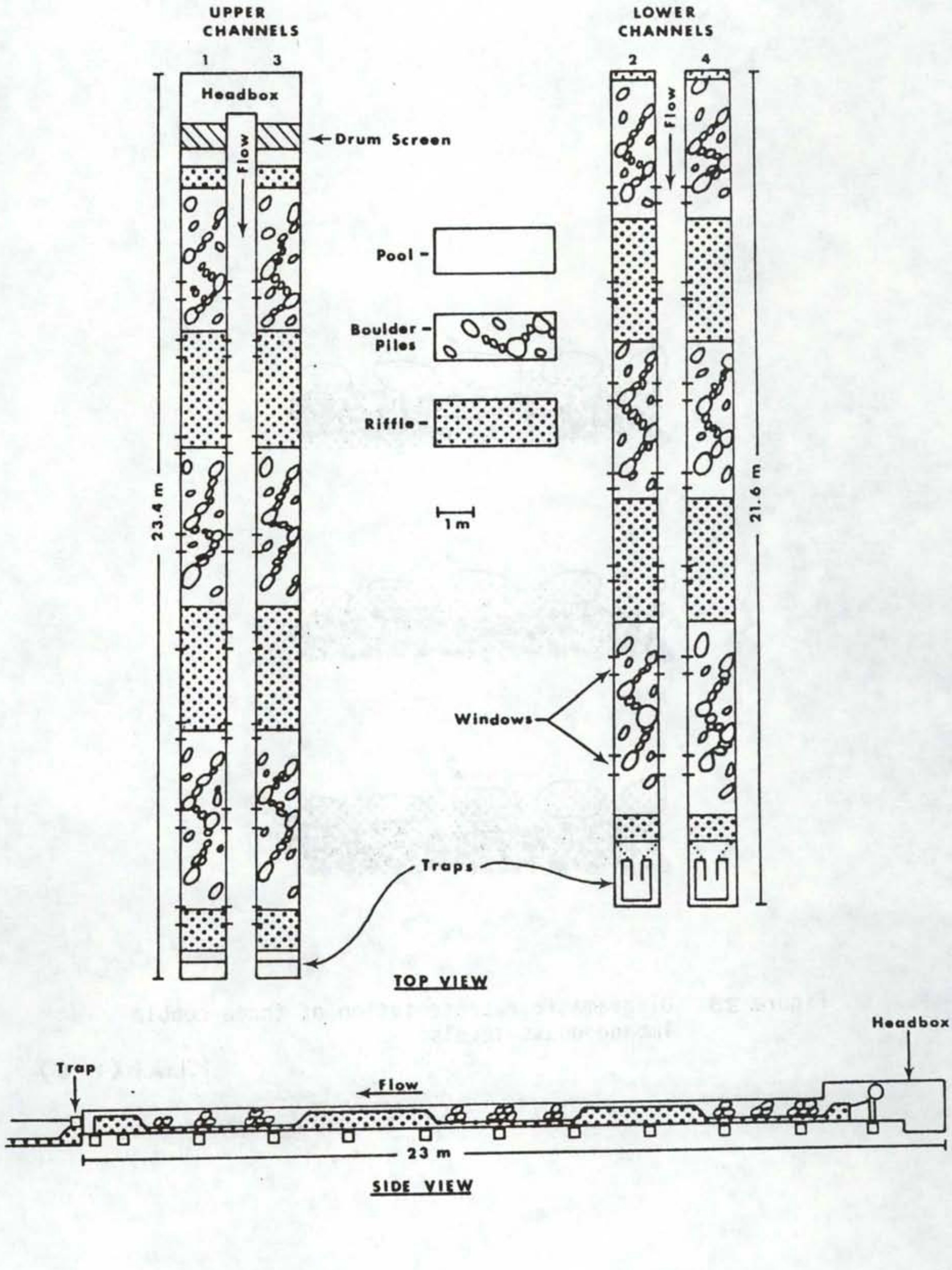



Figure 32 Artificial stream channels used in summer and winter holding capacity tests in 1974 and 1975.

Source: Klamt (1976)

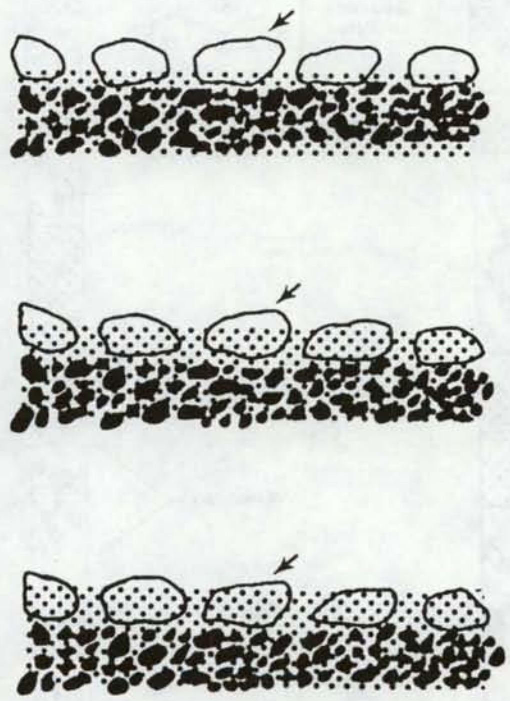


Figure 33 Diagramatic representation of three cobble imbeddedness levels.

Klamt (1976)

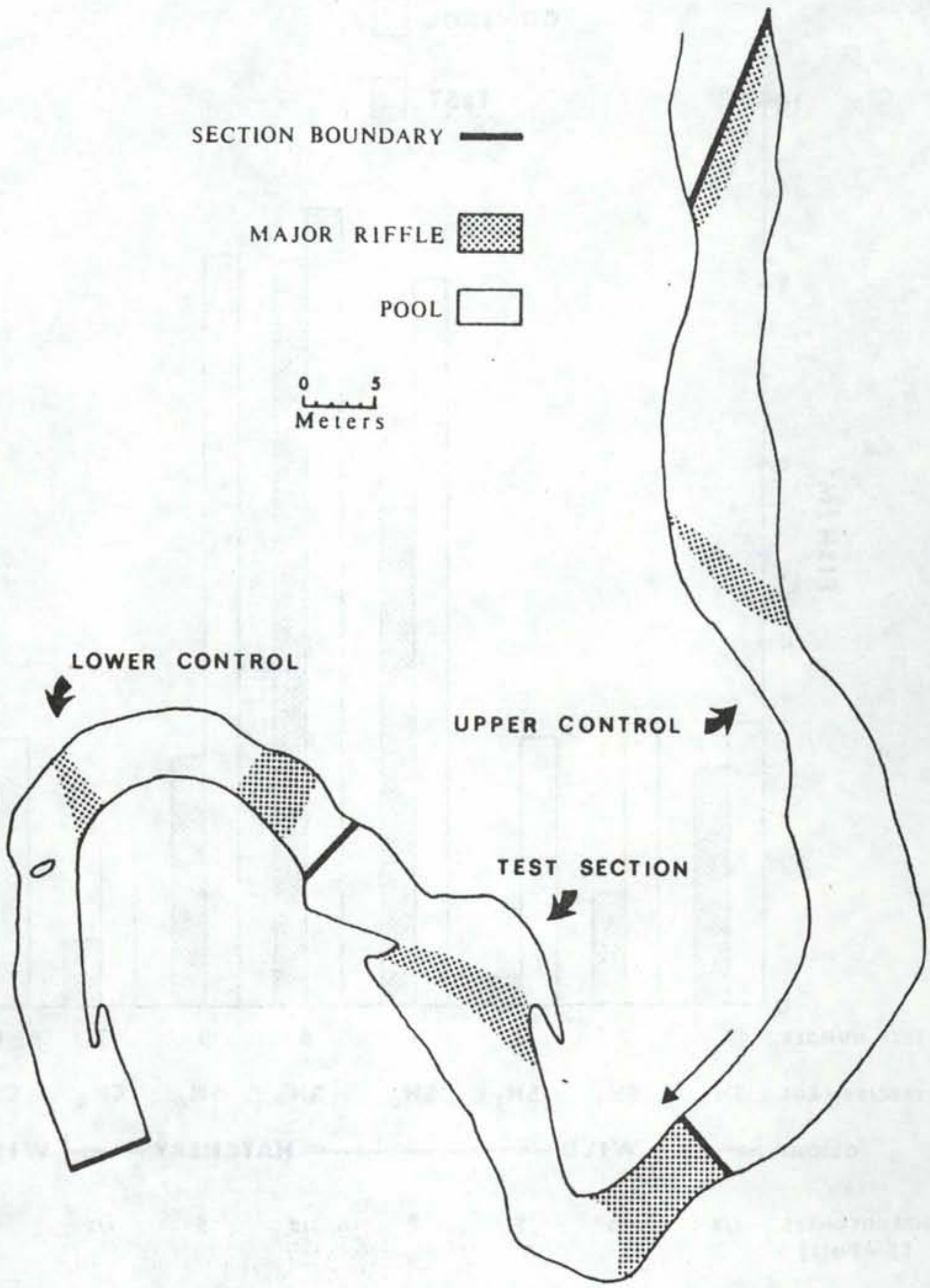



Figure 34 The Knapp Creek study area where we introduced coarse granitic sediment into the test section in 1974.

Klamt (1976)

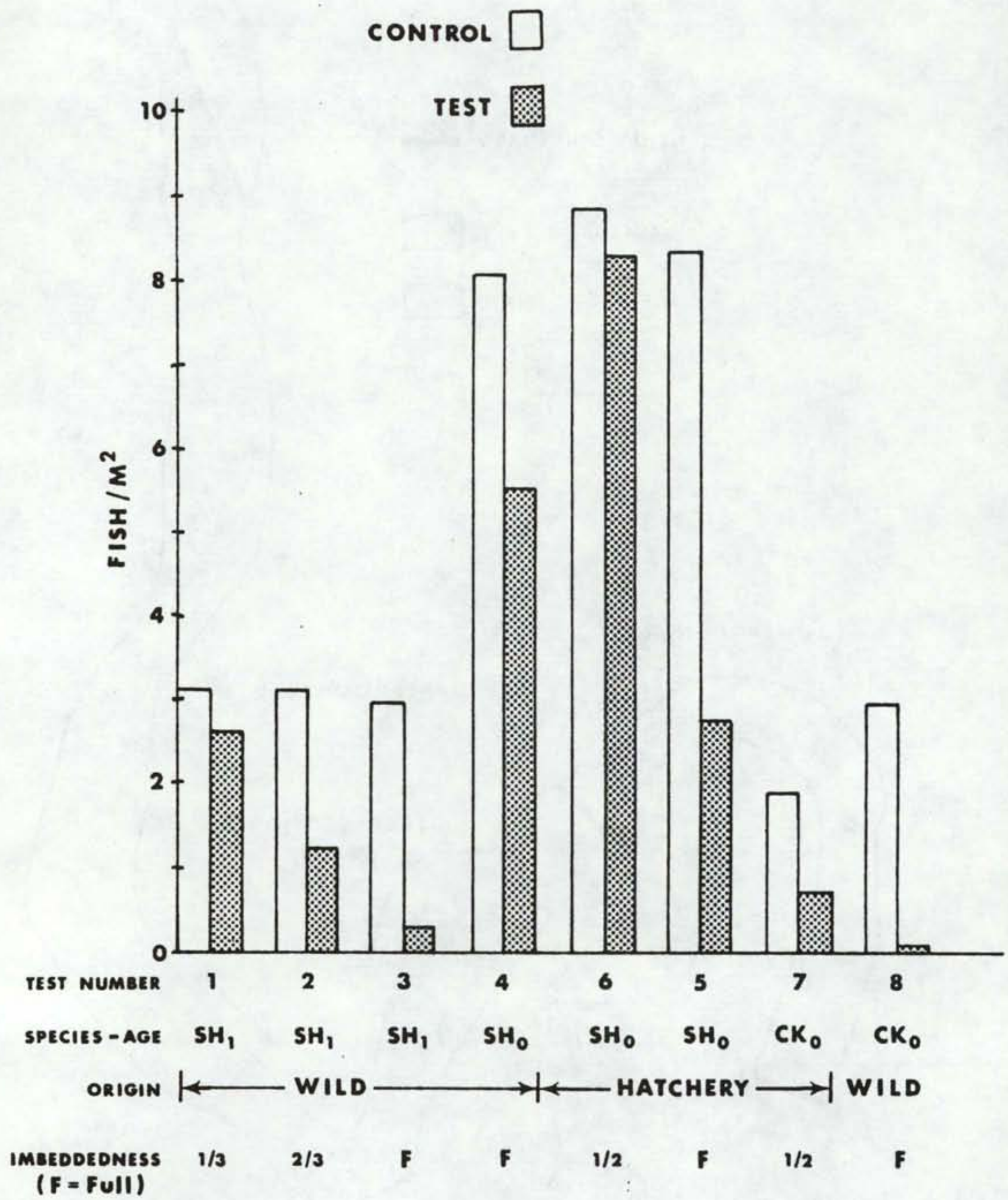



Figure 35 Densities of fish remaining after five days in the artificial stream channels during the summer tests of 1974 and 1975. (control = no sediment, test = sedimented; $SH_1$ = age I steelhead, $CK_0$ = age 0 chinook; 1/3 imbeddedness = boulders in pools 1/3 imbedded with sediment.)

From Klamt (1976)

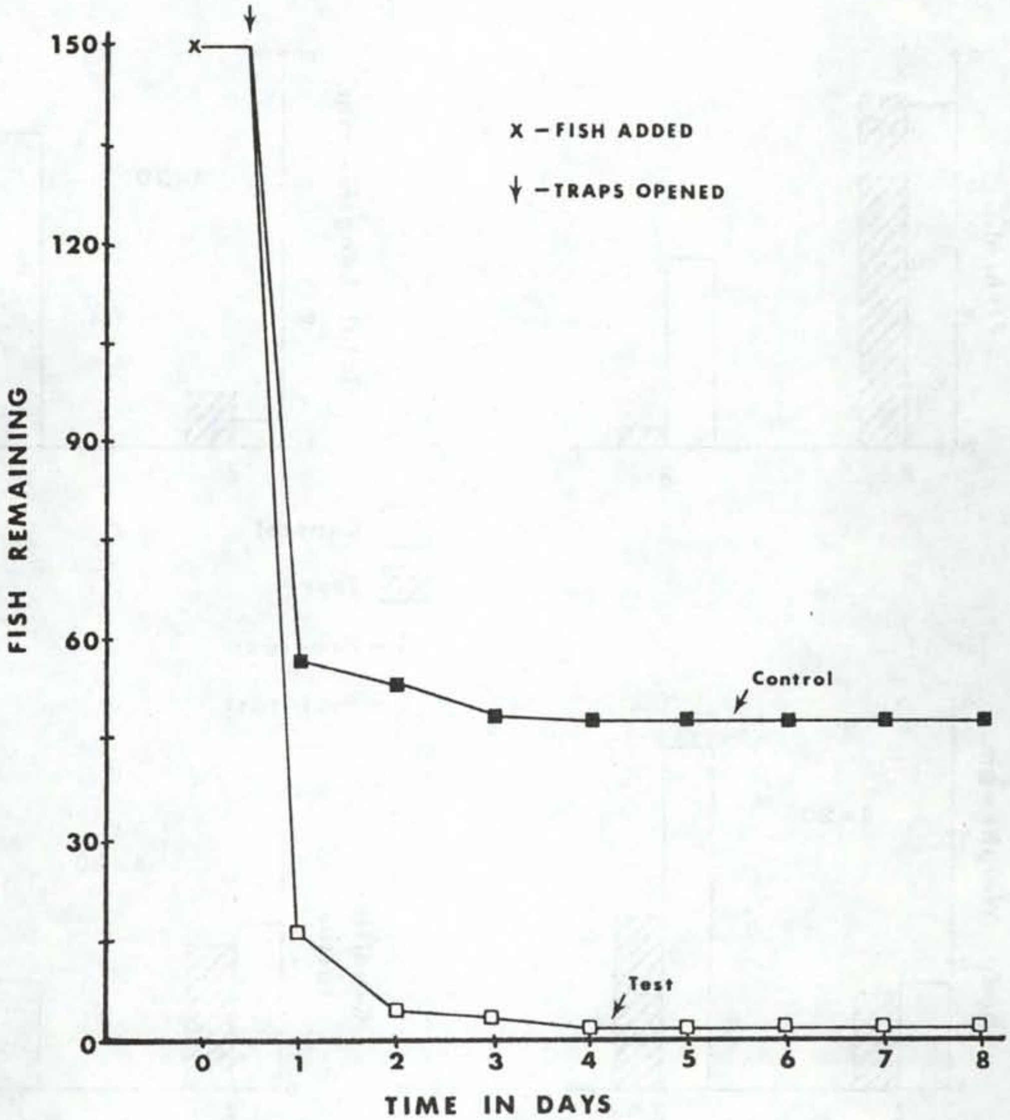



Figure 36 Changes in fish numbers with time in the artificial stream channels. Data is for test 8, wild age 0 chinook (test = fully imbedded with sediment, control = no sediment).

Klamt (1976)

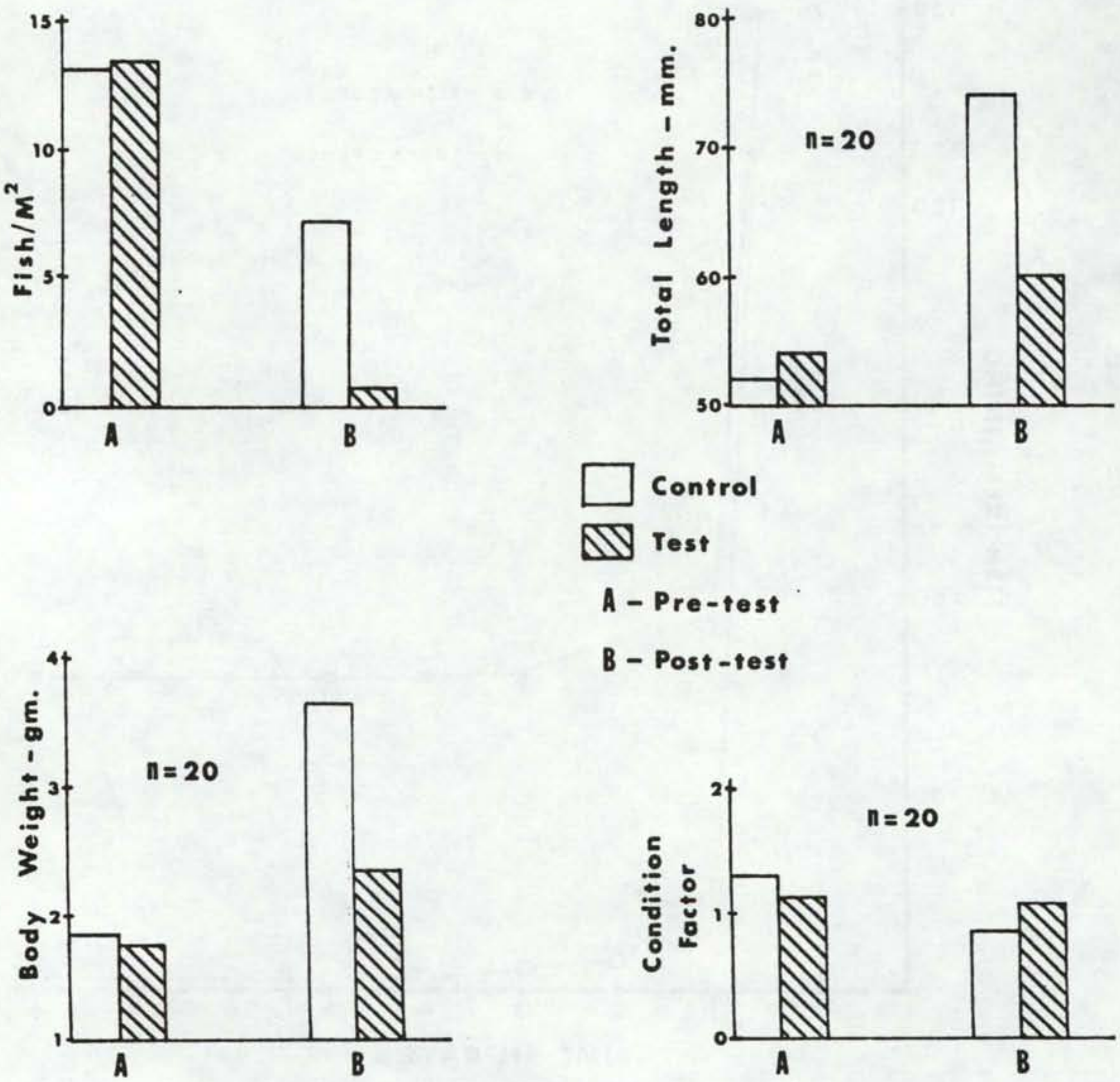



Figure 37 Results of the 35-day test in the Hayden Creek stream channels using age 0, hatchery steelhead trout at full imbeddedness, 1975. (control = no sediment, test = sediment.)

From Klamt (1976)

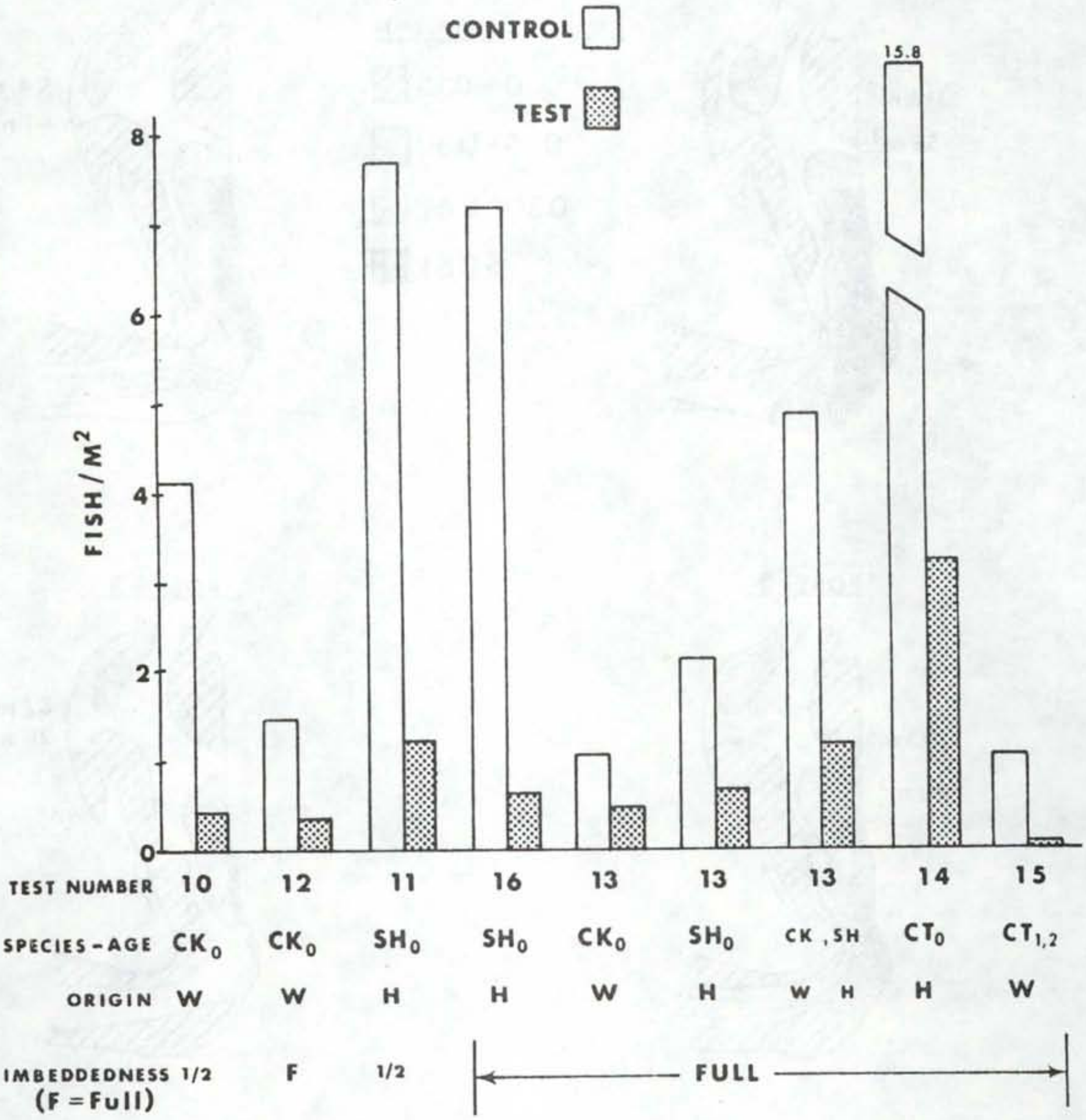



Figure 38. Densities of fish remaining after five days in the artificial stream channels during the winter tests of 1975. (control = no sediment, test = sediment; W = wild, H = hatchery; 1/2 imbeddedness = boulders in pools 1/2 imbedded with sediment; $CK_0$ = age 0 chinook, $SH_0$ = age 0 steelhead, CT = cutthroat trout).

Klamt (1976)

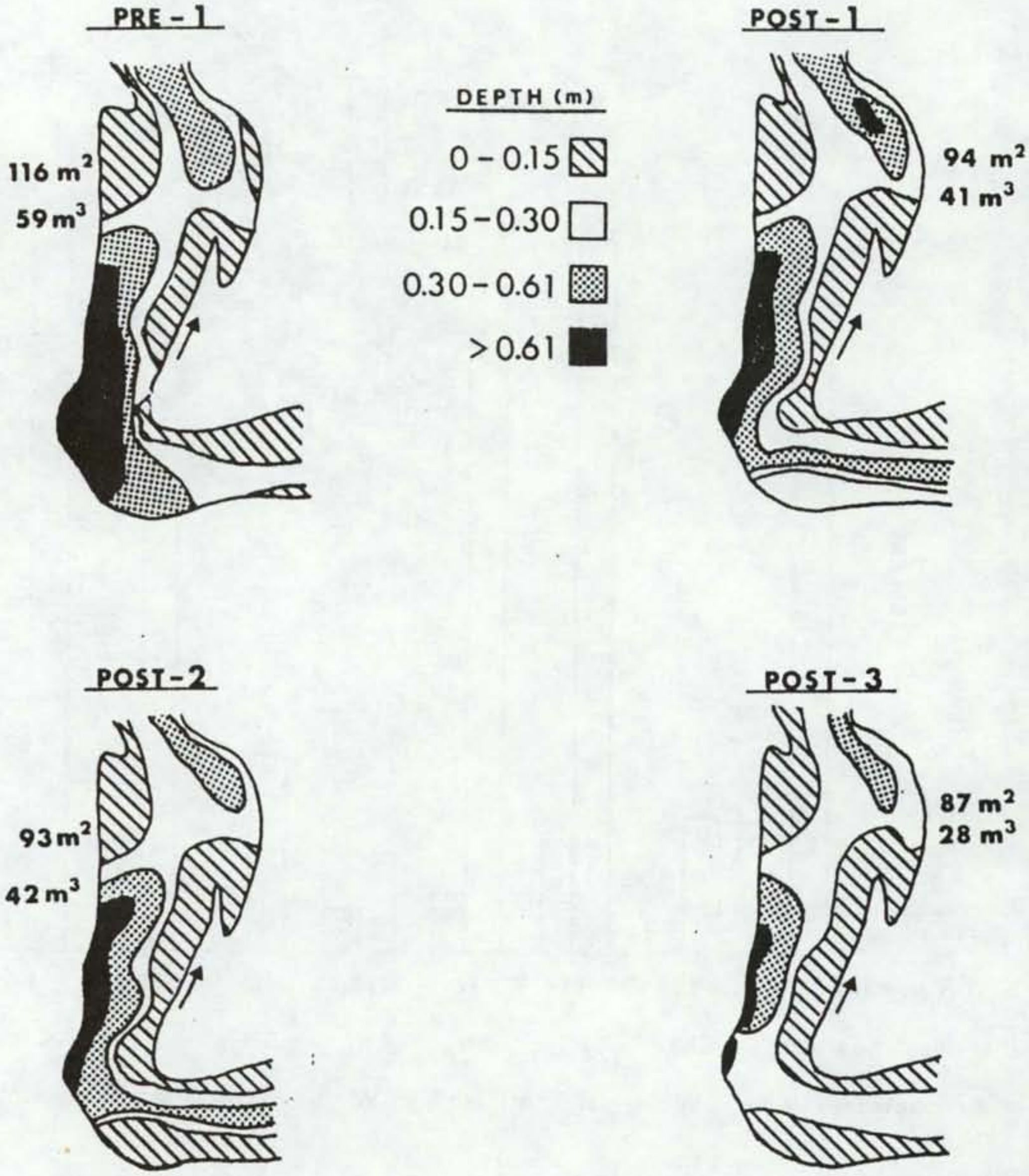



Figure 39. Depth contours in the Knapp Creek test section during the sediment additions of 1974. Pool areas and volumes deeper than 0.15 m for the upstream pool appear next to each figure. (pre-1 = before first sediment addition (8/1), post-1 = after first (8/3), post-2 = after second (8/9), and post-3 = after third sediment addition (8/13/74)).

Klamt (1976)

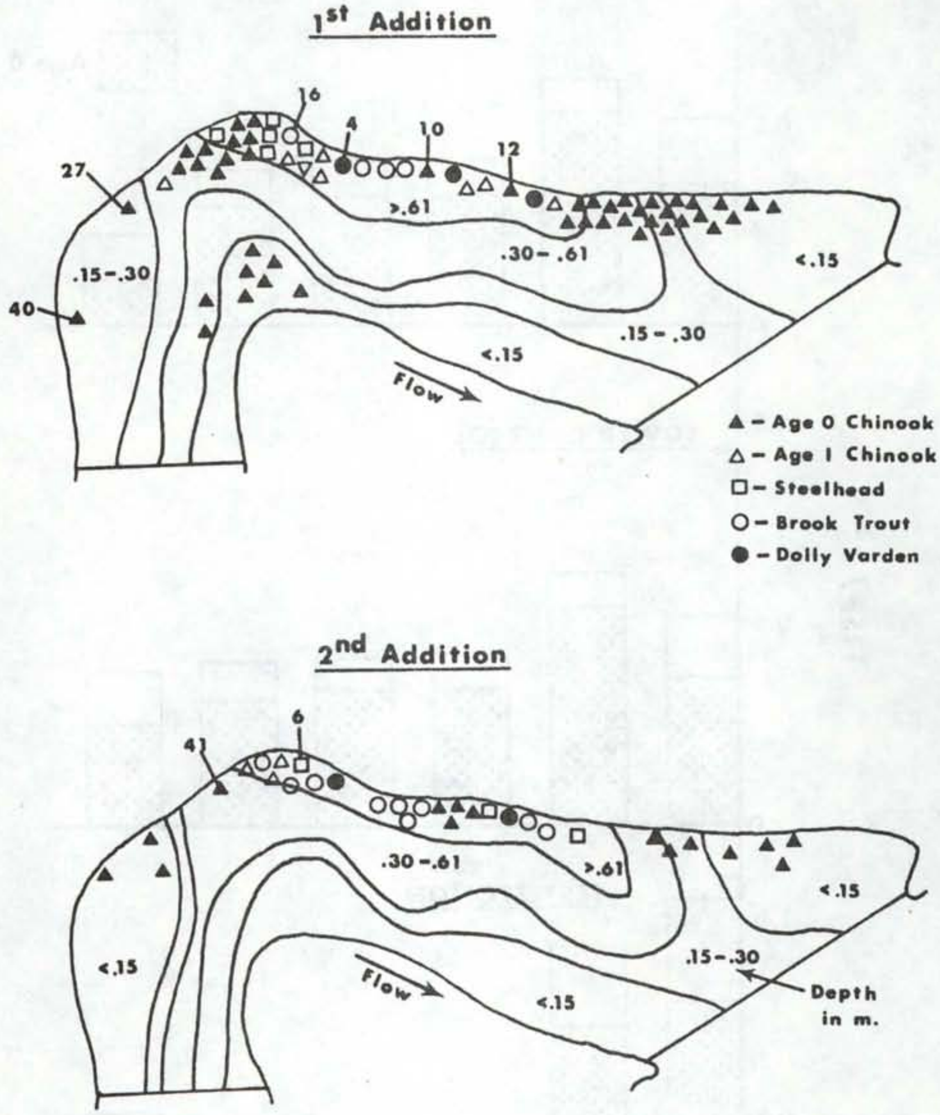



Figure 40. The distributions of fish in the upper test pool of the Knapp Creek test section after the first and second additions of sediment into the pool.

Klamt (1976)

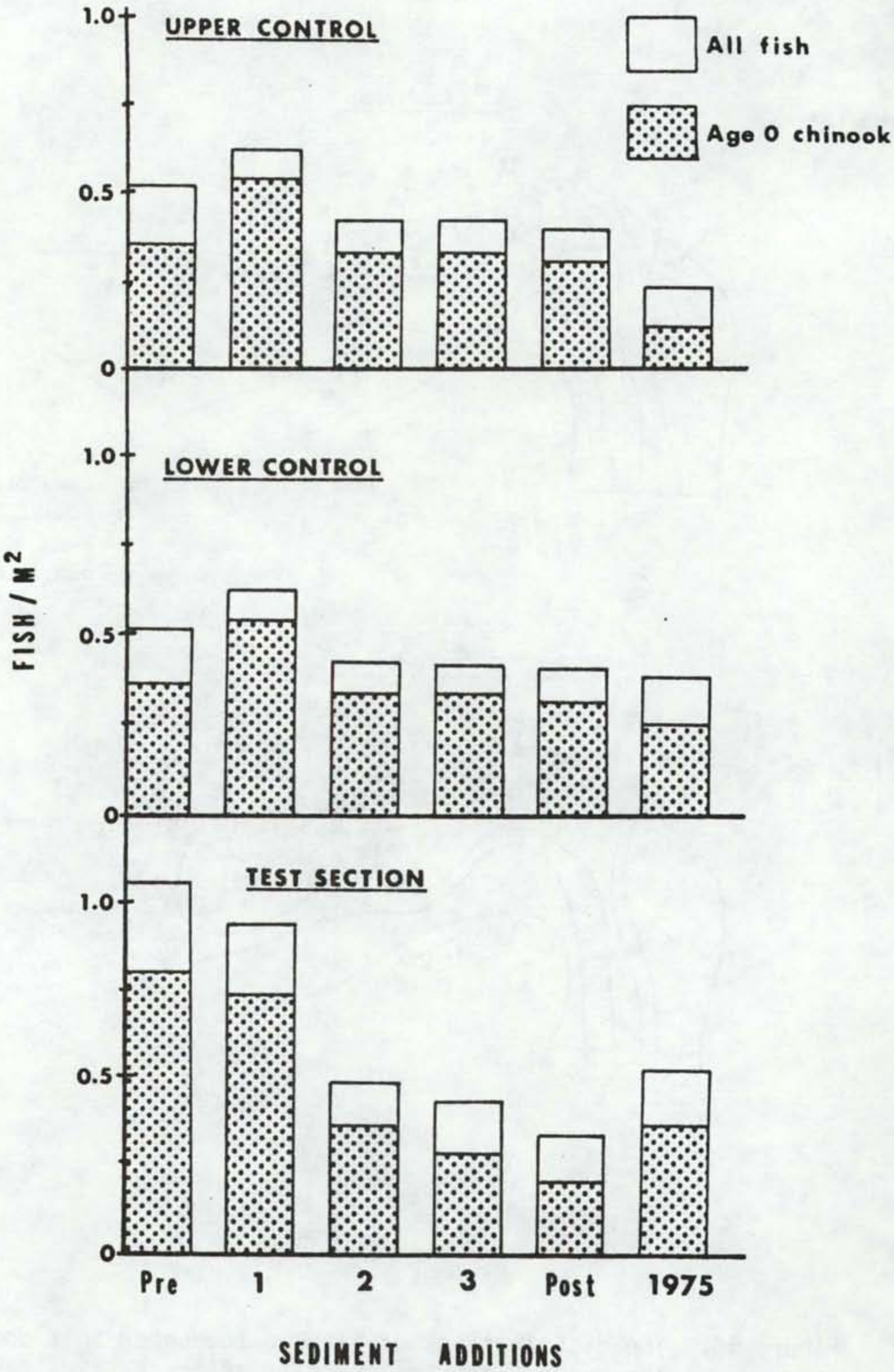



Figure 41 Total fish and age 0 chinook densities in the control (unsedimented) and test (sedimented) sections of Knapp Creek prior to the first addition (8/1/74), one day after the first (8/3), 4 days after the second (8/9), and 3 and 13 days after the third addition of sediment (8/13 & 8/23) and a year later on 8/15/75.



Klamt (1976)

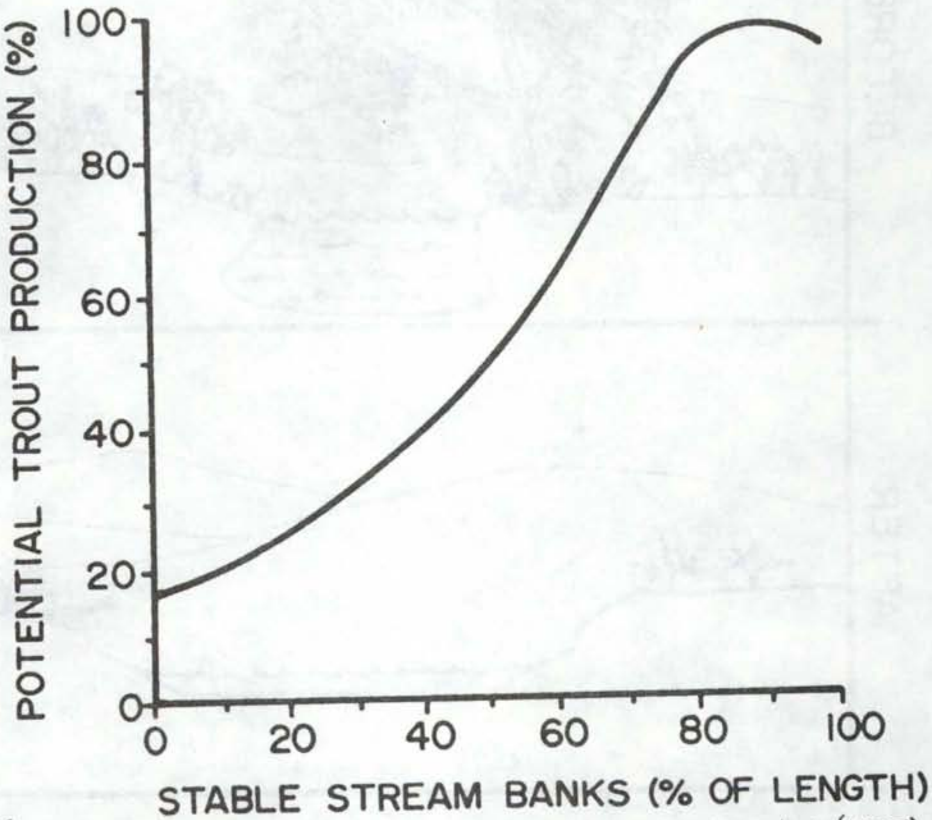



Figure 42

SOURCE: Bolton et al. (1985)

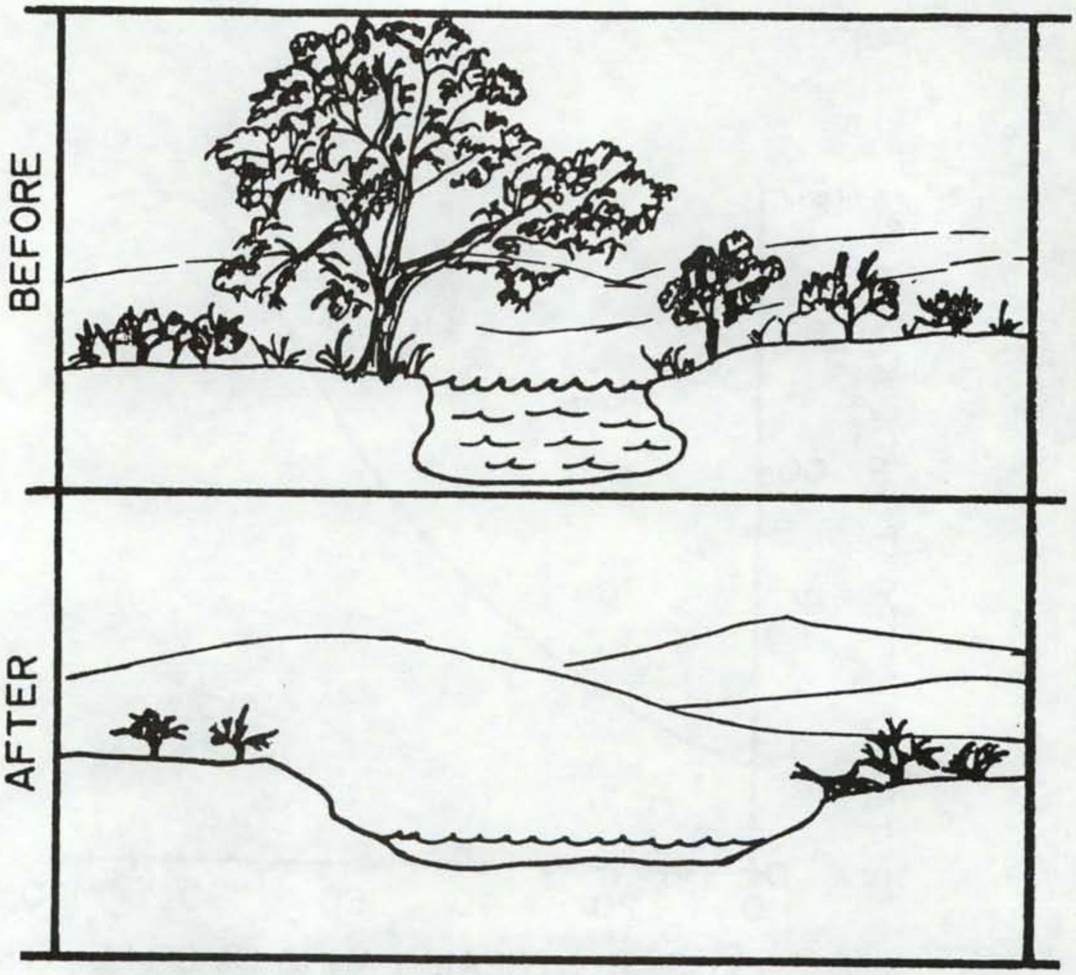



Fig. 43. Changes in cross-sectional channel profile due to riparian degradation.

Bottom et al. (1985)

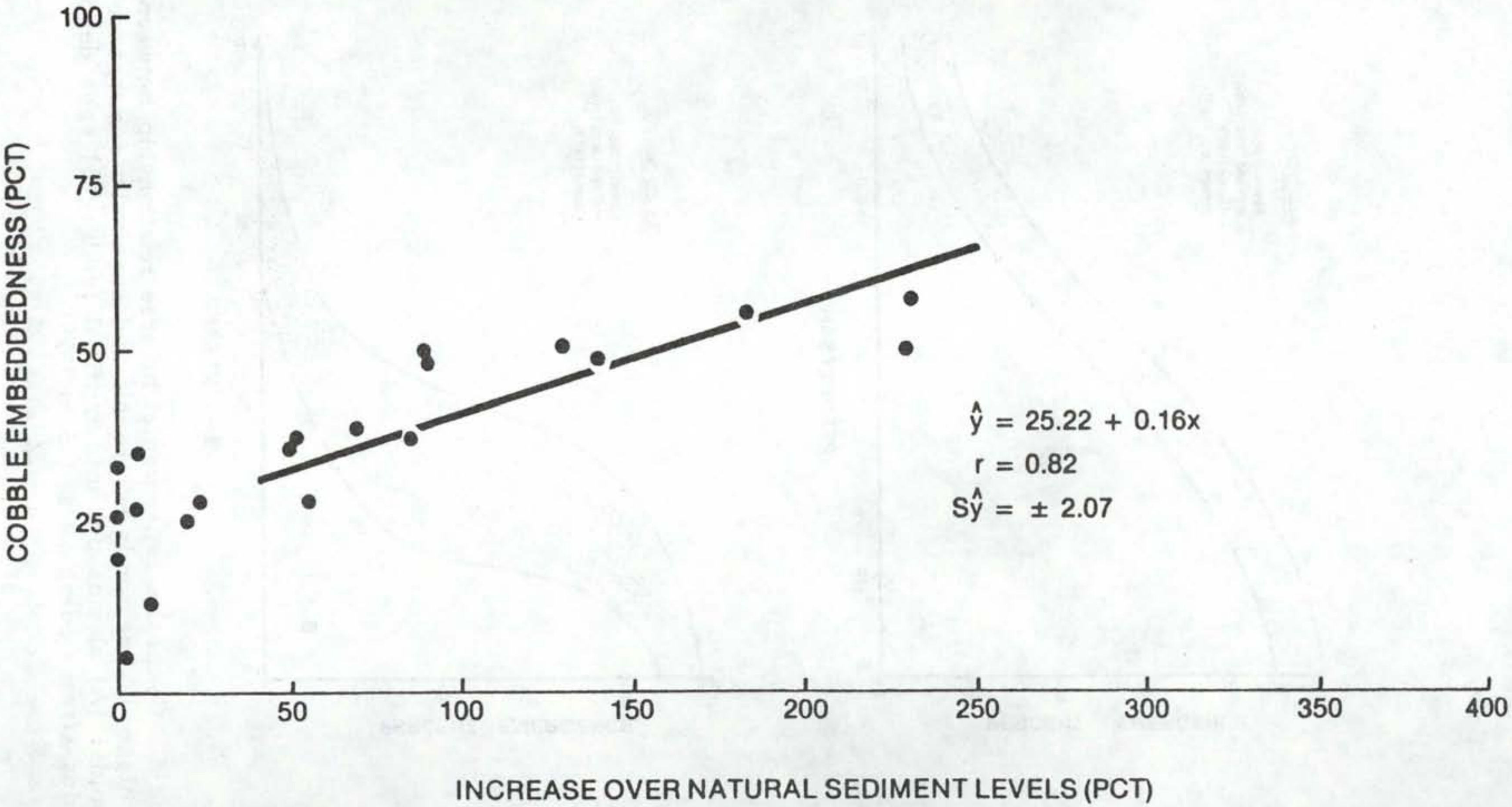



FIGURE 44. Sediment-substrate embeddedness response curve for "C" channels from Clearwater and Nez Perce National Forests' data. Stowell et al. (1983)

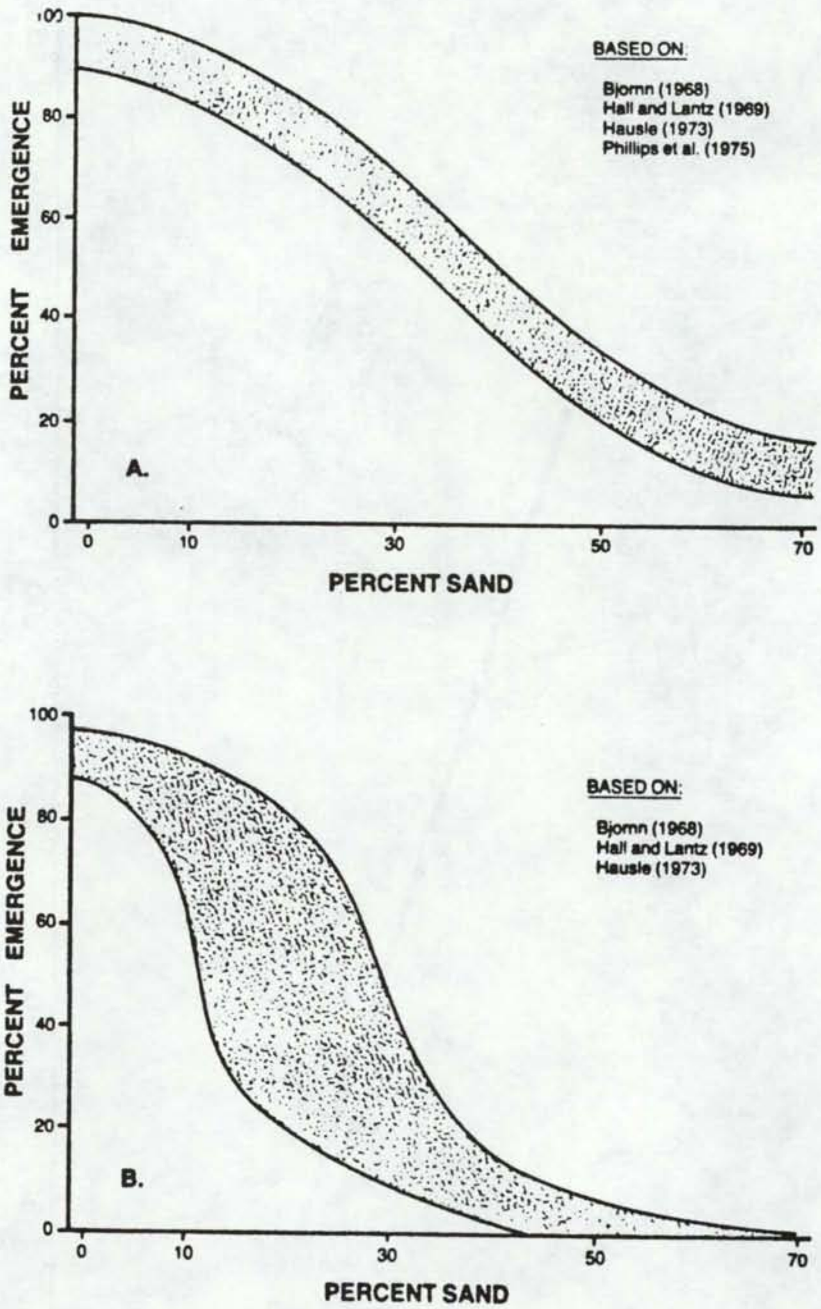



Figure 45. Composite experimental inverse relationship between percentage of fine sands in gravels and survival-to-emergence of salmonids: (A) alevins put into artificial redds; (B) eggs deposited in redds (from Cederholm and Salo 1979).

Source: Everest et al. in Salo and Cundy (1987)

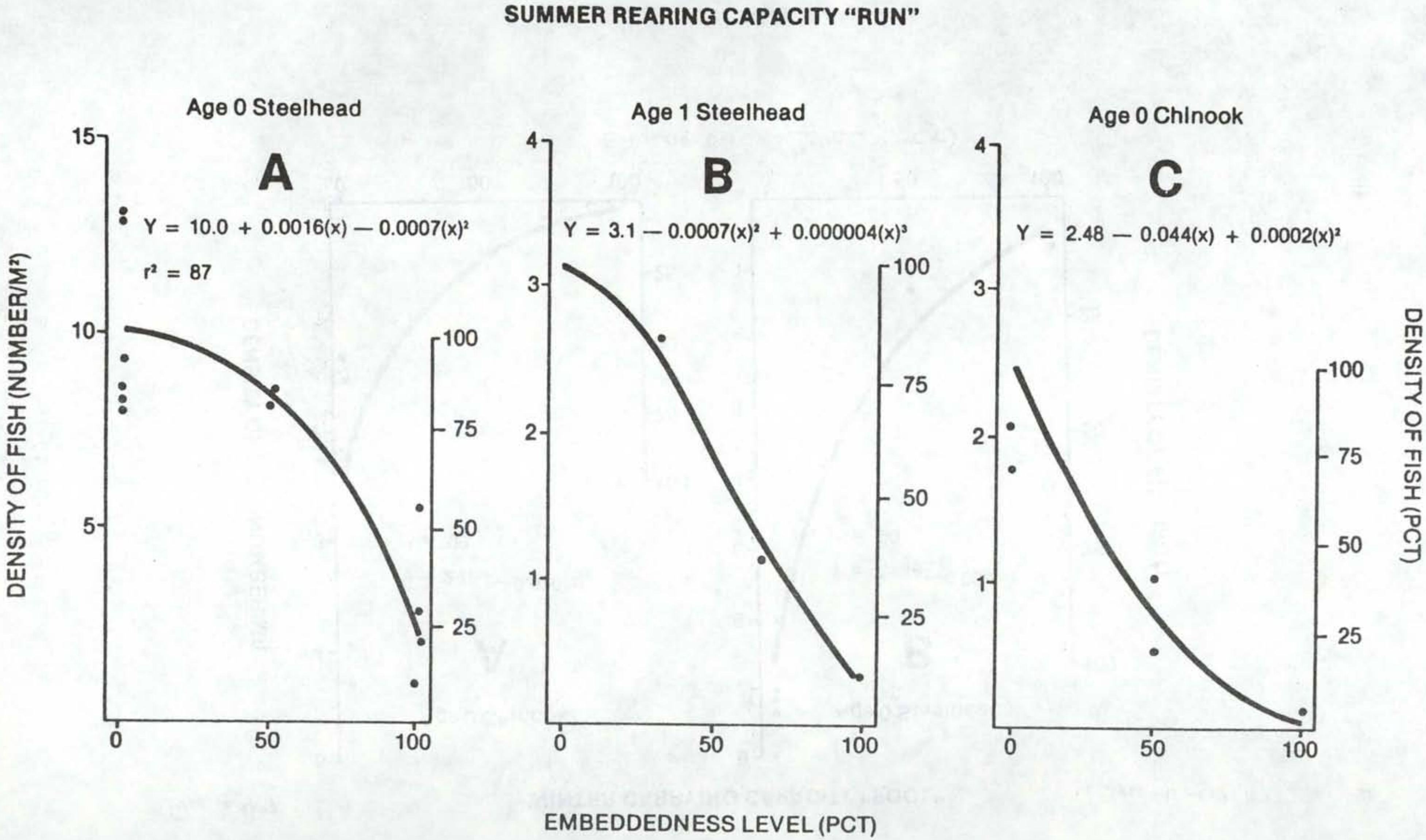
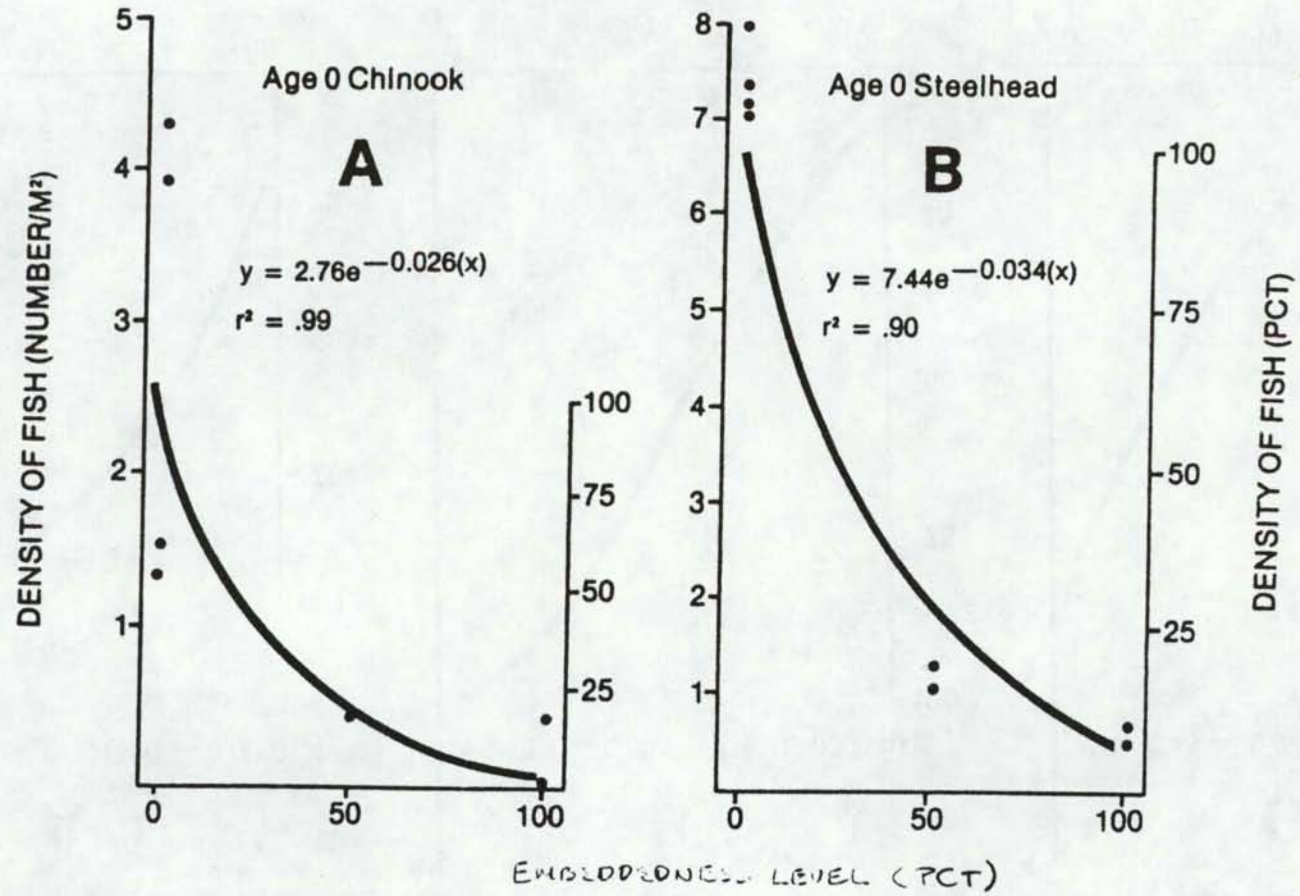



FIGURE 46. Relationship between summer rearing capacity (density of fish in numbers of fish /m² and as a percentage) and substrate embeddedness in runs for age 0 and 1 steelhead trout and age 0 chinook salmon (Bjornn et. al. 1977). From Stowell et al (1983)

Figure 47

**WINTER CARRYING CAPACITY "POOL"**

(Stowell et al. 1983)



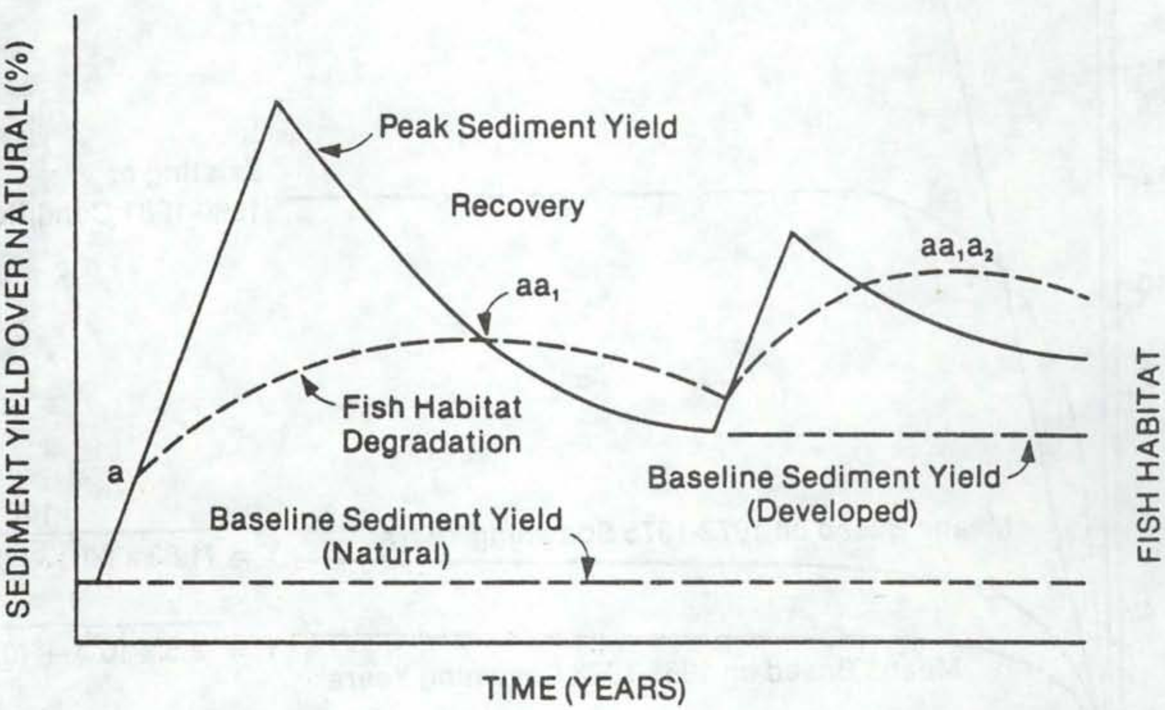



FIGURE 48. Graphic illustration of sediment yields and fish habitat response to sediment producing activities over a short time frame. See text for explanation.

SOURCE: STOWELL ET AL. (1983)

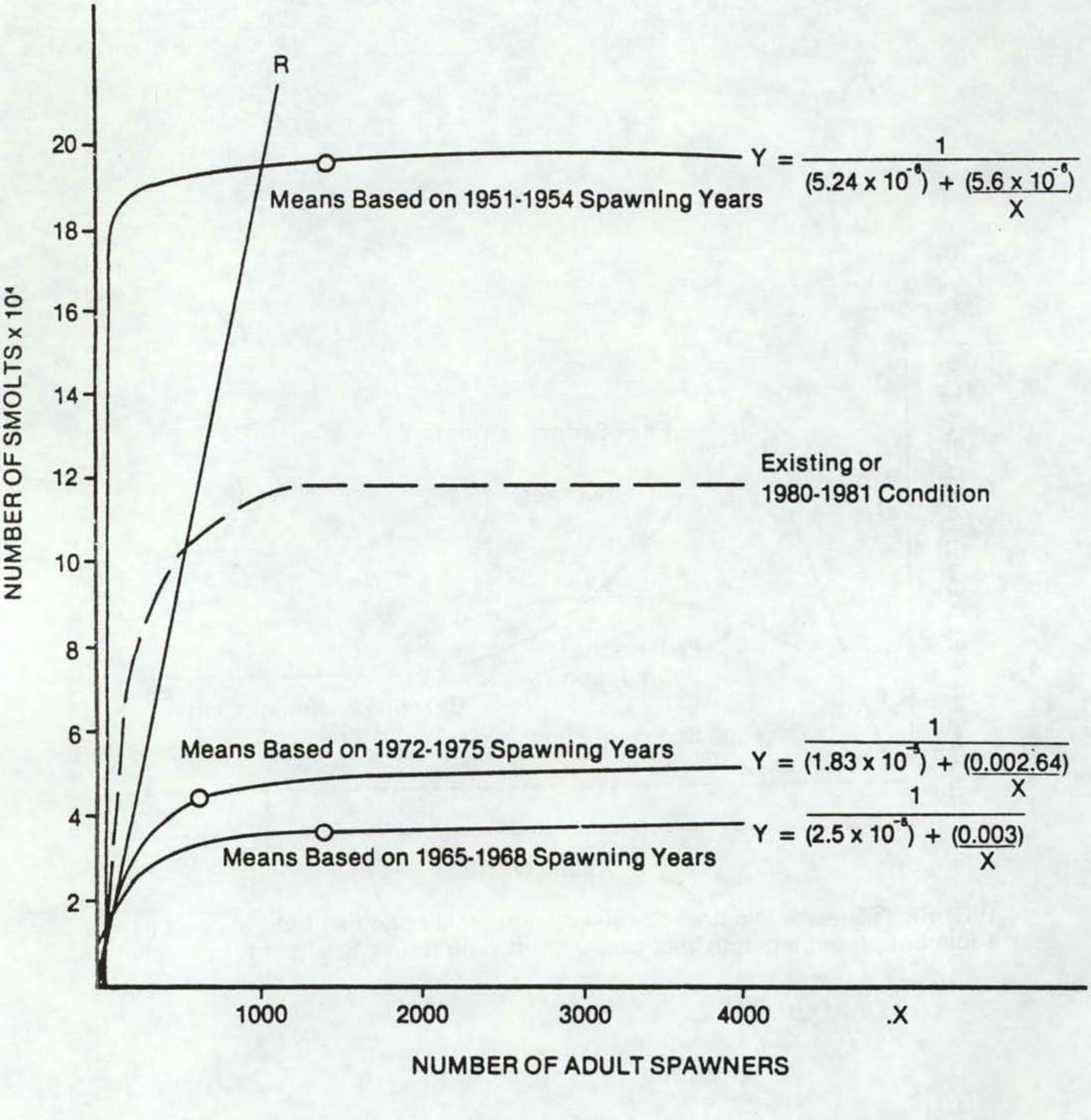



FIGURE 49. Existing reproduction curve (1980-81) for the South Fork Salmon River summer chinook relative to natural potential (1951-54) and following the 1964-65 storm (1965-68). The replacement line (R) is for 0.005 smolt to adult survival. Each curve is considered fixed for the quantity of sediment produced by land disturbing activities during corresponding years. STOWELL ETAL. (1983)

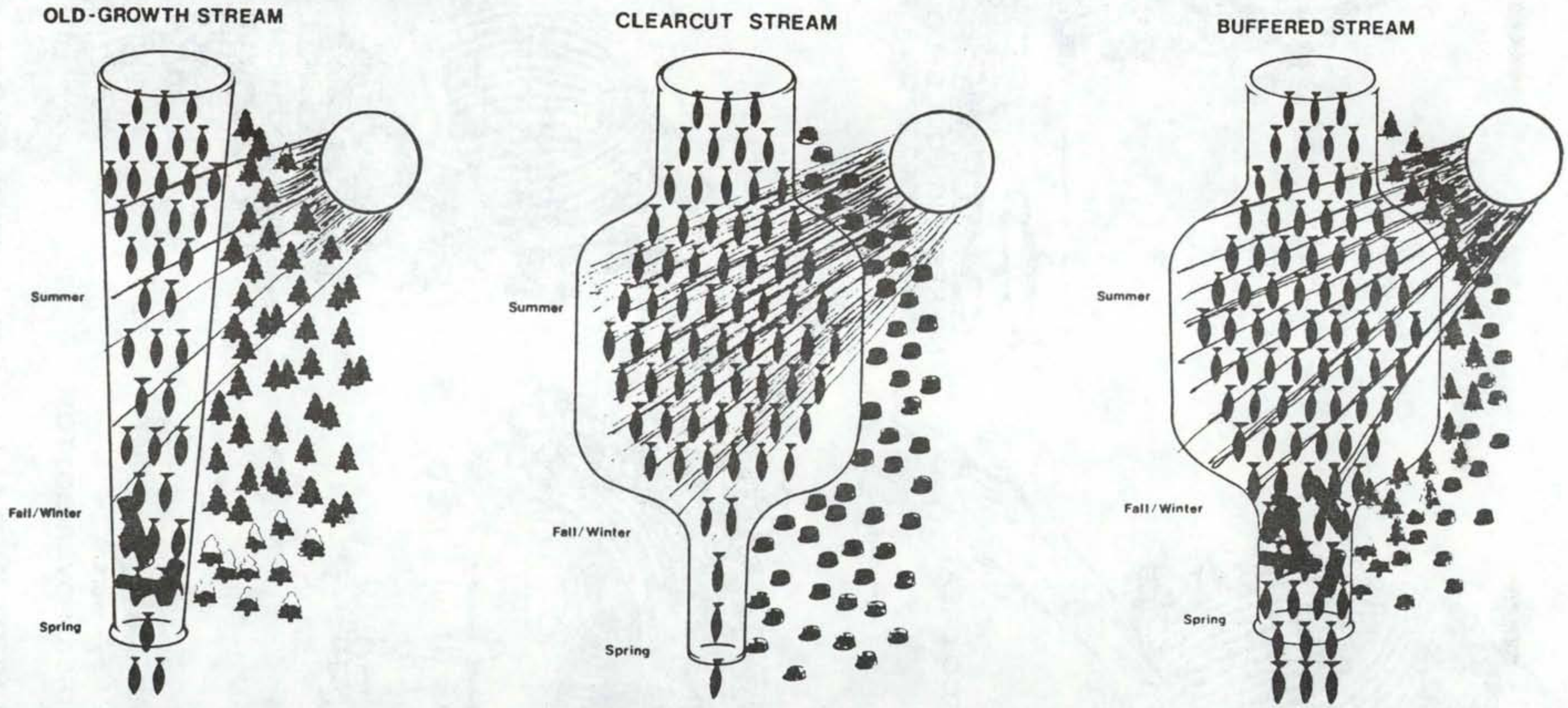



Figure 50. Relationships between clearcut, buffered, and old-growth stream coho salmon productivity (Koski et al. 1984).

Source: Gibbons et al. in Salo and Cundy (1987)

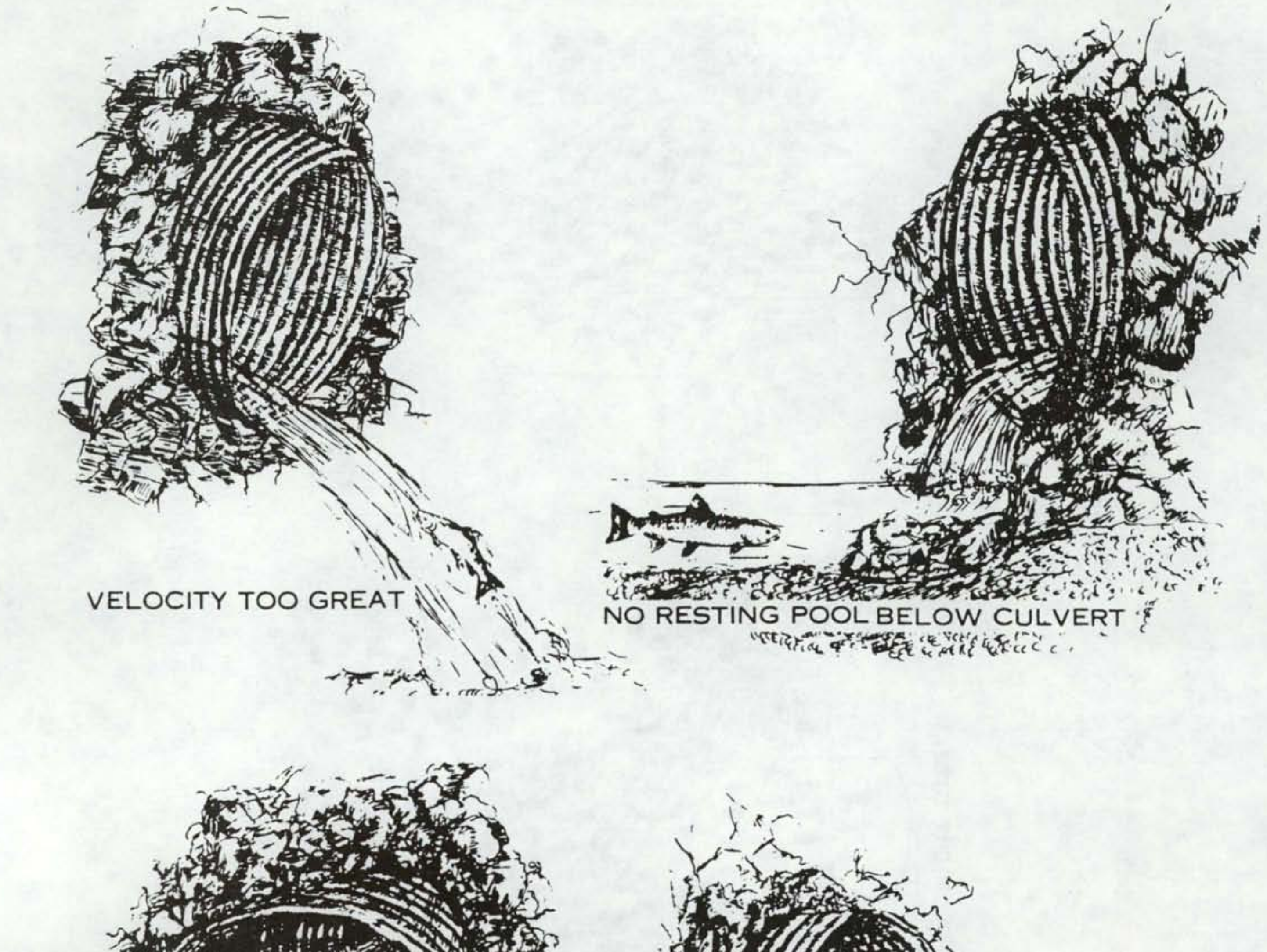



FIGURE 54 CULVERT INSTALLATIONS WHICH BLOCK FISH PASSAGE.



Figure 51

Fig 53. — Streambank soil alteration rating

| Rating | Description |
|---|---|
| *Percent* | |
| 0 | Streambanks are stable and are not being altered by water flows or animals. |
| 1 to 25 | Streambanks are stable, but are being lightly altered along the transect line. Less than 25 percent of the streambank is receiving any kind of stress and if stress is being received, it is very light. Less than 25 percent of the streambank is false, broken down, or eroding. |
| 26 to 50 | Streambanks are receiving only moderate alteration along the transect line. At least 50 percent of the streambank is in a natural stable condition. Less than 50 percent of the streambank is false, broken down, or eroding. False banks are rated as altered. Alteration is rated as natural, artificial, or a combination of the two. |
| 51 to 75 | Streambanks have received major alteration along the transect line. Less than 50 percent of the streambank is in a stable condition. Over 50 percent of the streambank is false, broken down, or eroding. A false bank that may have gained some stability and cover is still rated as altered. Alteration is rated as natural, artificial, or a combination of the two. |
| 76 to 100 | Streambanks along the transect line are severely altered. Less than 25 percent of the streambank is in a stable condition. Over 75 percent of the streambank is false,[1] broken down, or eroding. A past damaged bank, now classified as a false bank, that has gained some stability and cover is still rated as altered. Alteration is rated as natural, artificial, or a combination of the two. |

[1]False banks are those banks which have been cut back by cattle and are no longer immediately adjacent to the stream. They can become stabilized by vegetation, but base flows are usually too far removed from the stream to provide fish cover.

Source: Platts et al. (1983)



Fig 52. — Streambank vegetative stability rating

| Rating | Description |
|---|---|
| 4 (Excellent) | Over 80 percent of the streambank surfaces are covered by vegetation in vigorous condition or by boulders and rubble. If the streambank is not covered by vegetation, it is protected by materials that do not allow bank erosion. |
| 3 (Good) | Fifty to 79 percent of the streambank surfaces are covered by vegetation or by gravel or larger material. Those areas not covered by vegetation are protected by materials that allow only minor erosion. |
| 2 (Fair) | Twenty-five to 49 percent of the streambank surfaces are covered by vegetation or by gravel or larger material. Those areas not covered by vegetation are covered by materials that give limited protection. |
| 1 (Poor) | Less than 25 percent of the streambank surfaces are covered by vegetation or by gravel or larger material. That area not covered by vegetation provides little or no control over erosion and the banks are usually eroded each year by high water flows. |

Fig 54 — Embeddedness rating for channel materials (gravel, rubble, and boulder)

| Rating | Rating description |
|---|---|
| 5 | Gravel, rubble, and boulder particles have less than 5 percent of their surface covered by fine sediment. |
| 4 | Gravel, rubble, and boulder particles have between 5 to 25 percent of their surface covered by fine sediment. |
| 3 | Gravel, rubble, and boulder particles have between 25 and 50 percent of their surface covered by fine sediment. |
| 2 | Gravel, rubble, and boulder particles have between 50 and 75 percent of their surface covered by fine sediment. |
| 1 | Gravel, rubble, and boulder particles have over 75 percent of their surface covered by fine sediment. |

STEP

# SALMON TROUT ENHANCEMENT PROGRAM

**Oregon Department of Fish and Wildlife**

# HOW TO DO A GENERAL STREAM SURVEY

## INTRODUCTION

The general stream survey is designed to obtain basic information about stream habitat. The information collected will help fish biologists and Salmon and Trout Enhancement Program (STEP) volunteers to improve these fish populations. Citizen volunteers, with some training by Oregon Department of Fish and Wildlife personnel, can undertake a survey as a STEP project.

As with other types of surveys, some training is required and certain procedures must be followed.

1. The volunteer must submit a project proposal for approval by the ODFW staff. Your local STEP biologist will supply you with the form.
2. Contact landowners along the stream for permission to cross their property.
3. Training conducted by the ODFW is required. This includes classroom instructions and field trip experiences.
4. A "Volunteer Partial Liability Release Form" must be submitted. STEP biologists will supply and explain the form.

## GEAR AND EQUIPMENT

The following items will be used in making the survey:

1. Map—large scale (preferably 4"/mile) of the stream being surveyed. Copies made from Bureau of Land Management, U.S. Forest Service, or U.S. Geological Survey maps are best. Mark the stream off in quarter-mile sections.
2. Recording materials—Pencils, survey form, (ODFW will provide).
3. Clothes—Waders or hip boots (non-slip soles of felt, outdoor carpet or similar material is advised), raingear if weather is wet, warm clothes in cold periods.
4. Equipment—Polarized glasses, thermometer, watch with second hand, sturdy walking stick (marked off in 10ths of foot), small one-man seine (provided by ODFW), knapsack for lunch and other extras. Optional equipment may include camera, compass and tape measure.

## TIME COMMITMENT

The general survey has two parts, each requiring different amounts of time to complete. Part A, less detailed than the second, will take an average of one day to cover three miles of stream if access is not too difficult. Part B, done in conjunction with the first part, is more complicated and requires additional time. Therefore, under typical conditions, a surveyor can only average about two miles/day.

In some cases, the STEP biologist may request that you complete only certain portions of the survey for a specific purpose. In such instances, the time needed will vary.

The process can be speeded up by working in pairs. Leap-frogging and shuttling a vehicle saves walk-back time. It is always a good idea to work in pairs as a safety measure, especially in rough, inaccessible terrain where accidental injury could occur.

## SURVEY FORM

The General Stream Survey form is shown near the end of the brochure. Part A is less detailed than Part B, but still requires some careful observation and recording. While much of the information required is self-explanatory, some is covered in the instructions. In addition, the training you receive from ODFW personnel will help you complete the form.

Your STEP biologist will instruct you as to which parts of the survey need to be done.

## Survey Data:

### PART A

**Survey Section:** Record beginning and end of section on each form sheet by stream mile to nearest quarter mile. Sections recorded are usually a quarter-mile long and use a single page of the survey form. However, if a longer section of stream is virtually the same throughout with no major changes, a single page may be used for more than a quarter-mile. Also note common landmarks at the beginning and end of the section, such as tributary mouths, bridges or other crossings, a nearby house, etc.

**Stream Width:** Record average width (feet) for section as wetted surface on date of survey, and as it would be during normal high flows (as indicated by high water line on stream banks).

**Temperatures:** Record air and water temperatures and time taken.

**Flow:** Record average width of stream in feet, and average depth (measure across channel at least three places) in feet and tenths. Measure velocity by putting float in stream (stick, fishing bobber) and timing travel over measured distance (at least 20 feet) in seconds. Repeat at least three times and calculate average. Check whether bottom type is rough (gravel, cobbles, boulders) or smooth (sand, silt, bedrock). Cubic feet per second (CFS) is calculated as follows:
(Average width × average depth × velocity feet/second water travels) × 0.8 (for rough bottom) or 0.9 (for smooth bottom) = cubic feet/second (1 cfs = approximately 450 gallons/minute).

You are not required to do this calculation, but may if you wish.

**Substrate:** This factor indicates the stream bottom type. Record the estimated percentage of each type shown; boulders are greater than three feet in size, cobble is between six inches and three feet, and so on as indicated.

**Percentage Pools:** Knowledge of this factor helps to understand the quality of rearing conditions in a stream. Estimate what percentage of the stream's surface area is quiet, slack water where fish can rest out of the current and where enough depth offers some cover. Making this judgement is difficult, but field training by ODFW personnel will help you learn to recognize good pool area.

**Percentage of Shade:** Shading of the water surface helps keep waters cool. Estimate the percentage of water surface in the section shaded during the hours of 10 AM to 3 PM. Streamside vegetation is also important as it harbors insect life that contributes to fish food supply.

**Streamside Cover Type:** Indicate the relative abundance of each type of cover present in the riparian zone (adjacent to the stream).

**Erosion Points:** Note locations where you feel erosion is contributing to silt loads in the creek, is threatening stream stability or endangering an adjacent road. Give the location by river mile as closely as possible and mark on the map. Volunteer enhancement projects may correct the problem.

**Barriers:** Note the type, height, and location of each barrier observed. Although all such conditions may not prevent fish passage, if you feel there is a problem, record the site and mark on the map. It will be evaluated later by ODFW personnel to determine if correction is needed.

**Instream Structure (Woody Debris):** The presence of woody debris in the stream is important to fish habitat. It helps stabilize the streambed, traps gravels, creates pools and resting areas, affords hiding places, and fosters insect production. Record by checking the appropriate space to indicate the relative abundance of each type.

### PART B

**Valley Profile:** Check the space that best describes the shape of stream valley. The stream section may have more than one type of shape. If the overall profile changes, it may warrant starting a new section with another form page.

**Channel Profile:** Make the same judgement as above for the actual stream channel noting undercut banks and braided or split channels. Usually a stream section will have a combination of types. Check all that are observed. If possible, note the percentage of each type in the section.

**Pollution Sources:** Check appropriate space. If "other" is checked, describe in space at end for comments.

**Gradient:** This is a judgement factor, not easily measured. If the percentage of pool area in the section is 30 or less, the gradient is usually steep; if between 30 and 70%, it would be moderate; if over 70%, then classify it as flat. Reference to a topography map will also be helpful.

**Surrounding Land Use:** Record by checking appropriate box (or boxes, if mixed land-use exists) in the area. A significant change in adjacent land use is often a good place to break the stream section and start a new form page.

**Water Clarity:** This item indicates turbidity levels or the visibility in the water. Check appropriate box. (< means less than, > means greater than).

**Relative Fish Abundance:** This item is very difficult and requires good ability to identify species. Juvenile fish are difficult to identify when in hand, harder yet when seen in the water. It is sometimes impossible to distinguish between juvenile steelhead and cutthroat. Part of the training you receive will emphasize fish identification. The illustrations at the back of the brochure will also guide you.

Estimates of the relative abundance requires close observation. Polarized glasses improve visibility significantly. With experience, you'll soon be able to identify species and make estimates of the numbers present in a sample section of stream. Pick typical locations in the section to make the observations, and try to make two or three observations in each quarter-mile section and record the average.

**Additional Comments:** Record any remarks you may have to further explain parts of the survey where necessary. You may want to note unusual conditions or problems observed, or suggestions for habitat improvement. You could record here the need for further studies on particular conditions if warranted. Contact the local STEP biologist or district fish biologist if you have questions or need assistance.

## GENERAL STREAM SURVEY

**PART A.**

Stream ________ River System ________

County ________ Surveyors ________

Date ________ Stream mouth location: TWP____ R____ Sec____

**Survey Data:**

Survey Section: River mile___ to River mile___ Total length___ miles

Landmarks: Starting point________ Ending point________

Stream width________ Ft. today________ Ft. at high water line.

Air temp.______ °F Water temp.______ °F

Flow: Avg. width______ ft. Avg. depth______ ft.

Feet/sec. velocity______ Time of day ______ am ______ pm

Bottom type: Rough (0.8)________ Smooth (0.9)________

Calculate CFS (W × D × V × bottom factor) = ________

Substrate type, by percentage:

________% ________% ________%
Boulder (3'+) Cobble (6"−3') Gravel (1"−6")

________% ________%
Sand (1"−) Bedrock

Percentage of section in pools:

| 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |

Percentage of section shaded:

| 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |

Streamside cover type:

| Type | Abundant | Moderate | Sparse |
|---|---|---|---|
| Conifer Trees | | | |
| Deciduous Trees | | | |
| Grass and/or shrubs | | | |

Erosion Points: Severe______ Loc. Rm______: Moderate______

Loc. Rm________: Slight________ Loc. Rm________

Barriers:

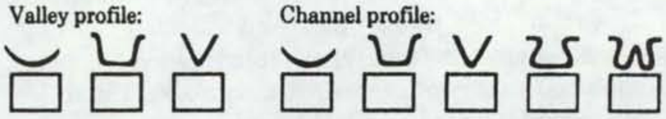
| Type | Height (ft.) | Location (rm) |
|---|---|---|
| Dam | | |
| Falls | | |
| Culvert | | |
| Log Jam | | |

Instream Structure (woody debris):

| Type | Abundant | Moderate | Sparse | None |
|---|---|---|---|---|
| Logs | | | | |
| Root Wads | | | | |
| Limbs | | | | |
| Brush | | | | |

**PART B.**

Valley profile: Channel profile:



Pollution Sources: Silt________ Sewage________ Industrial________

Animal waste________ Irrigation return________ Other________

Gradient: Flat________ Moderate________ Steep________

Surrounding land use: Forest________ Agric.________ Range________

Suburban________

Water Clarity: Less than 1'________ Between 1' and 3'________

Over 3'________

Water Withdrawal: Location, Rm________ Type: Ditch________

Size________ Pump________ Size________ Screened? Yes________

No________ Unknown________

Relative Fish Abundance:

| | SIZE | NUMBER/100 FEET | | | METHOD OF OBSERVATION | |
|---|---|---|---|---|---|---|
| Species | (inches) | 0.5 | 6-50 | 50+ | Visual | In Hand |
| Chinook | | | | | | |
| Coho | | | | | | |
| Steelhead | | | | | | |
| Rainbow | | | | | | |
| Cutthroat | | | | | | |
| Other | | | | | | |
| | | | | | | |
| | | | | | | |

Additional Comments: ________________

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# Water Quality Standards, Issues and Background

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WATER QUALITY MONITORING QUIZ

Please answer the following multiple choice questions to self-test your knowledge of monitoring-related laws, policy, and procedure. Choose only one answer per question (in some cases the best answer).

1. The Clean Water Act and its amendments are the overiding mandate for monitoring nonpoint sources of pollution on Federal lands. For this purpose, who implements the Act?

   A. The EPA
   B. The lead federal NPS management agency
   C. The States
   D. All of the above

2. The Clean Water Act was amended in 1987 with significantly greater emphasis on nonpoint source controls. According to EPA's interpretation of the Act, the primary mechanism for acheiving goals of nonpoint source control is:

   A. Application of Best Management Practices
   B. Monitoring water quality
   C. Develope standards and criteria for beneficial uses of water
   D. Combine all of the above in a feedback loop concept

3. The Clean Water Act requires monitoring the effectiveness of BMPs. The ultimate purpose is to:

   A. Verify that BMPs were implemented
   B. Verify that BMPs were properly designed
   C. Determine if pollutants are being delivered to a stream
   D. Determine if beneficial uses of water are protected
   E. Verify attainment of State water quality standards

4. Based on requirements of the Clean Water Act, at a minimum monitoring will be required:

   A. On projects within water quality limited segments
   B. On projects which have a potential to impact the beneficial uses of water
   C. On all projects regardless of location or potential impact

5. The Act directs States to develop water quality standards governing the control of nonpoint sources. The federal agency:

   A. Is not subject to such standards because of federal sovereign immunity
   B. Complies with State Standards through memorandums of understanding with the States
   C. Must fully comply with State Standards as required by the Clean Water Act.

6. The Act directs States to develop a nonpoint source program to address needed nonpoint source controls. The Federal or State agency:

   A. Provided input to the program but is not required to comply
   B. Will cooperate with where mutually beneficial
   C. Must be consistent with State Water Quality Programs in all aspects as directed by the Clean Water Act.

7. The Clean Water Act requires the application of Best Management Practices to control nonpoint sources of pollution. Those BMPs approved by States through their water quality standards are:

   A. Minimum performance standards for everyone
   B. Required on State and private lands but implemented through MOU on Federal lands
   C. Not binding on the Federal agencies

8. A clearly stated goal of the Clean Water Act is:

   A. Prevent further degradation of the Nations waters
   B. Provide for protection and propagation of fish and wildlife and provide for recreation
   C. Restore and maintain the Nations waters to acheive the maximum number of beneficial uses

9. The most significant pollutant in Idaho is:

   A. Bacteria
   B. Sediment
   C. Toxic chemicals
   D. Nutrients

10. The most sensitive and wide-spread beneficial use of waters in Idaho is:

    A. Water contact recreation
    B. Cold water biota including salmonid spawning
    C. Agricultural water supply
    D. Domestic water supply

11. Effective water quality monitoring programs key in on the minimum objectives of the Clean Water Act and therefore:

    A. Fully incorporate the feedback loop concept - that is they are centered around monitoring the effectiveness of BMPs
    B. Provide a mechanism to modify BMPs not found effective
    C. Address criteria and standards for the beneficial uses of water in the State water quality standards
    D. All of the above

12. Fully integrated monitoring programs:

    A. Coordinate data collection between agencies and specialists to avoid duplication and maximize available resources
    B. Provide timely data storage which provides opportunities for data sharing
    C. Provide standards for timely reporting and feedback to management and other interested agencies and individuals
    D. Consider cumulative effects among all landowners
    E. All of the above

13. Who is best qualified to assess BMP effectiveness:

    A. The Hydrologist or Water Quality Analyst
    B. The Fishery Biologist
    C. The project administrator
    D. The contractor or permittee
    E. Depends on the BMP
    F. Combination of A, B, and C

14. The feedback loop concept of nonpoint source management has been incorporated into:

    A. The Forest Services' National NPS strategy
    B. The Forest Services' Soil and Water Conservation Practices Handbook
    C. State Water Quality Standards (some States)
    D. BLM national policy
    E. All of the above

15. Which of the following is considered implementation monitoring

    A. Cobble embeddedness
    B. Tributary sediment accumulation monitoring
    C. Riparian evaluation
    D. Audits of project compliance

16. Pollutant source and transport monitoring

   A. Is point source monitoring
   B. Is monitoring that directly ties the impacts instream to nonpoint source pollution activities where the BMPs are located
   C. Is always conducted instream to assess physical, chemical, and biological parameters

17. Beneficial use monitoring:

   A. Determines current status of beneficial uses
   B. Detects trends in impairment or enhancement of the uses
   C. Predicts potential condition of the uses (or use attainability)
   D. All of the above

18. Which of the following is an example of beneficial use monitoring?

   A. Measuring intergravel dissolved oxygen to assess survival of incubating salmonid eggs
   B. Measuring suspended and bedload sediment and discharge
   C. Measuring streambank stability
   D. Measuring riparian vegetation stubble height

19. Which of the following makes a monitoring plan most defensible?

   A. In compliance with the Land Use Plan
   B. In compliance with State water quality standards
   C. In compliance with agency manuals
   D. In compliance with EPA handbook, Chapter 2 (EPA policy)

20. Best results from riparian assesments occur when:

   A. ID teams are formed and members work alone in their area of expertise
   B. ID teams are formed and members work together
   C. ID teams meet in the office but conduct field work separately
   D. ID teams are formed to conduct level 1 but not needed for levels 2 and 3.

## CLEAN WATER ACT GOALS

The objective of this Act is to restore and maintain the chemical, physical, and biological integrity of the nation's waters.

... an interim goal of water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water ...

# Idaho
# Water Quality Standards

# &

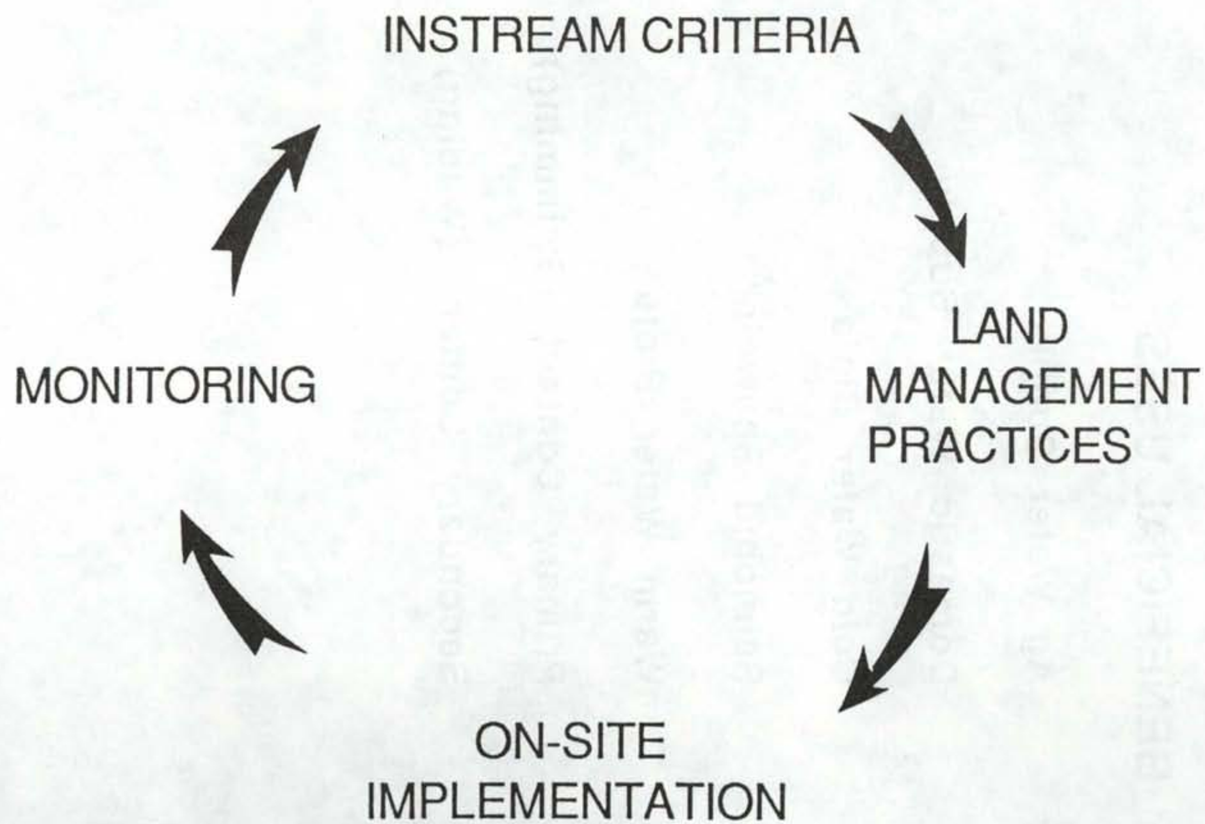
## Wastewater Treatment Requirements

Idaho Department of Health & Welfare

Division of Environment

January 1985

# THE FEEDBACK LOOP



## BENEFICIAL USES

Ag Water Supply

Domestic Water Supply

Cold Water Biota

Salmonid Spawning

Warm Water Biota

Primary Contact (Swimming)

Secondary Contact (Wading)

# Integrating Fish Habitat Into State Water Quality Standards

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It is exciting to note that State and Federal water quality agencies are questioning the use of point source concepts that no longer serve the overwhelming water quality impacts of nonpoint source pollution. This requires a different mind set—focusing on areas that are not traditionally regarded as our domain. Indeed it means rethinking what the term "water quality" means. It can no longer refer simply to a cubitainer of water shipped off to the lab if we are to do our job in protecting and restoring beneficial uses.

Since we are being futuristic, let's start out by symbolically giving the EPA Gold Book a drop-kick into the nearest muddy river. ~~Those standards and criteria apply to the Pacific Northwest and the northern Rocky Mountain ecoregion.~~ In Idaho the nonpoint sources of major importance are historical and current logging, mining, and grazing. Road construction associated with these activities is the most significant source of sediment to streams.

Much of Idaho's national forest lands occur in a geologic formation called the Idaho Batholith. When road construction exposes the parent material to weathering, it rapidly decomposes to large, sand-sized particles. This decomposed granite easily erodes and is transported to stream courses as bedload sediment. This is "clean" sediment that affects all the life stages of the valuable fishery in Idaho. The restoration of Chinook salmon and steelhead trout runs in the Columbia Basin has been described as the most comprehensive conservation effort in the United States. This concern for the fishery resource is international in scope and includes commercial fishermen from three States and Canada, sport fishermen in four States, and four treaty Indian tribes that use the fish for commercial, subsistence, and religious purposes.

## Desired Future Condition

The first case study is based on a proposal in progress between the Columbia River Intertribal Fish Commission and the United States Forest Service (USFS) to settle appeals on national forest management plans. It is based on describing the desired future condition (DFC) in forest plans required by the National Forest Management Act. The DFC describes measurable aquatic habitat characteristics that represent predisturbance or unmanaged habitat condition. Since nonpoint source activities, primarily logging and road building, affect fisheries habitat in many ways in addition to sediment impacts, DFC includes elements to describe the optimum habitat condition.

Draft land management plans used narrative fuzzy statements to describe DFC, which provides "maximum management flexibility" to the Forest Service but little assurance to the public that the fishery will be adequately protected. The Indian tribes are flexing their considerable legal muscle with the Forest Service to specify quantitative stream quality goals.

DFC is being developed for salmonids in the Pacific Northwest based on species and channel type. Table 1 represents the DFC for steelhead parr in "A" channel types. Other tables, not included here, show DFC for Chinook salmon and cutthroat trout in types A, B, and C channels. This procedure recognizes habitat preferences for key indicator species, a giant step toward site-specific criterion.

The first element in the table is density of parr at full seeding. Fish density is the end product. The DFC is based on empirical data collected in this channel type that is derived from direct counts in the habitat, for example, by snorkeling or electrofishing. The next two parameters are measures of bedload sediment in fish habitat. Cobble embeddedness is directed at measuring the effect of bedload sediment on winter-rearing habitat. Fish seek shelter in the interstices of cobble and boulders to avoid the lethal winter conditions of the water column. Fines by depth is a measure of the sand deposited in fish spawning gravel. The sand reduces flow through the gravel, restricting the supply of oxygen to the eggs and developing fry. In addition, fish that do hatch may become entombed by the excess sediment.

Pool/riffle ratio provides a diversity of habitat for all life stage requirements. Optimum ratios produce more fish in a stream. Temperature is a well understood water quality criteria. Management in the

Table 1.—Desired future condition of steelhead parr rearing habitat in "A" channel type. "A" channels are characterized by a steep gradient and a boulder substrate. This table is taken from a proposal developed by a Columbia River Intertribal Fish Commission/U.S. Forest Service working group.

| DFC (%) | DENSITY PER 100 m$^2$ | COBBLE EMBEDDEDNESS (%) | FINES BY DEPTH (%) | POOL RIFFLE RATIO | SUMMER TEMP (C) |
|---|---|---|---|---|---|
| 100 | 30 | <20 | <19 | 50:50 | 10-15 |
| 90 | 27 | 22-25 | 20-22 | 45:55 | 16-17 |
| 80 | 24 | 25-30 | 22-24 | 40:60 | 16-17 |
| 70 | 21 | 30-35 | 24-26 | 30:70 | 18-19 |
| 60 | 18 | 35-40 | 26-28 | 20:80 | <20 |

| DFC (%) | ACTING/ POTENTIAL DEBRIS (pcs/100m) | POOL QUALITY INDEX | IN-STREAM COVER | BANK COVER | BANK STABILITY |
|---|---|---|---|---|---|
| 100 | 50-60/120 | 5 | 5 | 5 | 2.0 |
| 90 | 45/90 | 4 | 4 | 4 | 1.8 |
| 80 | 40/80 | 3 | 3 | 3 | 1.5 |
| 70 | 35/70 | 2 | 2 | 2 | 1.0 |
| 60 | 30/60 | 1 | 1 | 1 | 0.5 |

riparian area can influence both summer maximum and winter minimum temperatures. Large woody debris or large organic debris is recognized as one of the most important habitat components in forested areas of the Pacific Northwest. This element is being addressed in State Forest Practice Rules and Regulations. Oregon and Washington have recently adopted leave tree requirements for riparian areas, and Idaho is in the process of adopting leave tree requirements in the Forest Practices Act. Acting debris is based on actual counts of woody debris in "unmanaged" riparian areas.

The remaining elements are standard habitat quality descriptors that are readily recognized. Pool quality rating is an index of length, width, depth, and cover. In-stream cover is an important security feature for fish. Fish will not use habitat that doesn't have in-stream cover such as logs, rough water, boulders, shade, and so forth. Bank cover is an essential habitat element. Undercut banks and vegetation within 10 to 15 feet of the water provide cover for fish. Bank stability relates both to sediment supply and bank cover. Stable banks are an indicator of high quality habitat and watershed health.

## State Water Quality Standards

The issues are basically the same for sediment criteria in Idaho Water Quality Standards. However, we are far from the 21st century in Idaho and not ready yet to incorporate a variety of habitat parameters. The Water Quality Bureau has worked with a technical advisory committee to develop the following sediment-related criteria:

- **Salmonid Spawning Criterion:** Nonpoint source activities may not cause intergravel dissolved oxygen in spawning gravels to decline below a weekly average of 90 percent of saturation or 6 milligrams per liter, whichever is greater.

This criterion is based on a comprehensive review of the literature (Chapman and McLeod, 1987) completed under contract with EPA. The review found deficiencies with the connection between many sediment parameters such as fines by depth and fish impacts. The literature, however, strongly supports a minimum dissolved oxygen concentration for successful incubation of salmonid eggs. This criterion basically shifts the emphasis of the existing Idaho oxygen criteria to the sensitive life stages of fish in the intergravel environment, which requires different monitoring techniques. We have been testing the use of an intergravel oxygen pipe installed in the spawning gravel. Water is pumped via a peristaltic pump across a dissolved oxygen probe. Whether this procedure can adequately simulate flow characteristics of a natural redd (fish spawning nest) is a key question that should be researched.

- **Cold Water Biota—Turbidity Criterion:** In surface waters supporting or capable of supporting salmonid fisheries, turbidity, as the result of nonpoint source activities, may not exceed background turbidity measured at comparable discharge by 50 NTU instantaneously or 25 NTU (standard unit for turbidity) for 10 days.

Many States have a turbidity criterion; however, we were unable to validate the low criteria numbers used in these standards and also found that most States do not really apply them. These criteria are based on a recent literature review by Lloyd (1987). The proposed turbidity criterion is based on protection of sight-feeding for salmonid species. The 25 NTU for 10 days is based on literature documenting the chronic effect of reduced growth at these turbidity levels.

■ **Cold Water Biota—Percent Embeddedness Criterion:** No statistically demonstrable increase, at the 95 percent confidence interval, in natural baseline percent embeddedness as the result of nonpoint source activities shall be permissible in salmonid rearing habitats.

The importance of interstitial spaces in streambed cobble and gravel as overwintering habitat is well supported. This habitat is considered the "bottleneck" in survival of salmonids in the Rocky Mountains. However, there is considerable disagreement regarding the adequacy of the measurement technique. The Division cooperated this past summer with the USFS Intermountain Research Station to work out the bugs in this technique related to random sampling and precision. An important aspect of this criterion is that it establishes a process of arriving at a number based on comparison to natural conditions, rather than trying to establish a statewide numeric criteria. We think that this will be a more sensible approach to establishing site-specific criteria.

■ **Domestic Water Supply Criterion—Turbidity:** The watersheds listed are designated as small public water supplies, which have 25-500 users for over 60 days per year: . . . [in the criterion] Nonpoint source activities in the listed watersheds may not increase turbidity at the public water supply intake(s):

a) by more than 5 NTU above natural background at comparable discharge when background turbidity is 50 NTU or less; or

b) by more than 10 percent above natural background at comparable discharge, not to exceed 25 NTU when turbidity is greater than 50 NTU.

The last sediment criterion relates to protection of domestic water supplies. Many surface public water supply systems in Idaho have very high clarity and utilize minimal treatment. Increased turbidity from nonpoint source activities in the watershed increases treatment cost. To make this criterion workable, we have restricted it to small public systems dependent on small watersheds. Small communities lack the economy of scale to bear the burden of increased treatment costs. By limiting the criterion to small drainages, we increase the likelihood of establishing cause and effect with a nonpoint source activity.

Now it's time to retrieve the Gold Book from the river, that is if we can see it, because these nonpoint standards cannot replace existing standards but rather will complement existing water quality criteria.

## References

Chapman, D.W. and K.P. McLeod. 1987. Development for criteria for fine sediment in the Northern Rockies ecoregion. EPA 910/9-87-162. U.S. Environ. Prot. Agency, Washington, DC.

Lloyd, D.S. 1987. Turbidity as a water quality standard for salmonid habitats in Alaska. N. Am. J. Fish. Manage. 7(1):34-45.

# Water Quality Standards for the 21st Century

## Proceedings of a National Conference

March 1-3, 1989
Dallas, Texas

U.S. Environmental Protection Agency
Office of Water
Washington, D.C.

1989

EPA

# BEST MANAGEMENT PRACTICES

for

# ROAD ACTIVITIES

Volume I:

location

construction

maintenance

design

Prepared by:
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August 1982

# BEST MANAGEMENT PRACTICES

# for

# ROAD ACTIVITIES

## Volume II:

## BMP catalogue

Prepared by:
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August 1982

**§ 131.12 Antidegradation policy.**

(a) The State shall develop and adopt a statewide antidegradation policy and identify the methods for implementing such policy pursuant to this subpart. The antidegradation policy and implementation methods shall, at a minimum, be consistent with the following:

(1) Existing instream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected.

(2) Where the quality of the waters exceed levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water, that quality shall be maintained and protected unless the State finds, after full satisfaction of the intergovernmental coordination and public participation provisions of the State's continuing planning process, that allowing lower water quality is necessary to accommodate important economic or social development in the area in which the waters are located. In allowing such degradation or lower water quality, the State shall assure water quality adequate to protect existing uses fully. Further, the State shall assure that there shall be achieved the highest statutory and regulatory requirements for all new and existing point sources and all cost-effective and reasonable best management practices for nonpoint source control.

(3) Where high quality waters constitute an outstanding National resource, such as waters of National and State parks and wildlife refuges and waters of exceptional recreational or ecological significance, that water quality shall be maintained and protected.

(4) In those cases where potential water quality impairment associated with a thermal discharge is involved, the antidegradation policy and implementing method shall be consistent with section 316 of the Act.

FINAL AGREEMENT

TO IMPLEMENT AN ANTIDEGRADATION POLICY FOR

THE STATE OF IDAHO

August 18, 1988

## ANTIDEGRADATION NEGOTIATIONS

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## FINAL AGREEMENT

### I. Introduction

This is a final agreement to establish an antidegradation implementation plan for Idaho. This agreement, when implemented through appropriate statutes, regulations, interagency agreements, and agency policies, is intended to satisfy the antidegradation requirements of the federal Clean Water Act. Implementation of this agreement is intended to: (1) maintain and protect the water quality of outstanding resource waters in the state of Idaho from nonpoint sources of pollution; (2) maintain or improve the quality of impacted waters; and (3) fully protect existing beneficial uses. Implementation of this policy is based upon a cooperative state, federal, tribal, industry and public participation process to identify and achieve the goals of the antidegradation policy, including such additional measures that may be necessary to achieve these goals.

This agreement will be examined and evaluated after three years to see if the purposes, programs, and goals are being effectively implemented.

### II. Public Participation

A. Basin Area Meetings. The principal process for facilitating public discussion of nonpoint sources and water quality is a series of six Basin Area Meetings (BAM). The six basin areas will be identical to the six areas identified in the Idaho Water Quality Standards produced by the Idaho Department of Health & Welfare, Division of Environmental Quality (DEQ). Each BAM will focus on water quality and any activity that may impact water quality in that area. The purposes of each BAM are to:

1. facilitate discussion of the current status of water quality, and fish habitat, and trends in their condition;

2. identify and discuss current and future activities (i.e. timber, mining, agriculture, recreational or other) in the area and water quality impacts likely to result;

3. consider the propriety and efficacy of water quality monitoring in the area;

4. discuss social and economic considerations associated with commercial activities in the area; and

5. identify stream segments of concern, that is, stream segments where the public has expressed a significant interest in that stream segment and its management.

B. <u>Basin Area Meeting (BAM) Process</u>. The Governor or his designee will chair each Basin Area Meeting, which will be "sponsored" jointly by appropriate state and federal agencies (i.e. Idaho: Water Resources, Lands, Health & Welfare, Fish & Game; U.S.: USFS, BLM), Tribes, private industry and the public. Basin Area Meetings will occur biennially. Health & Welfare, DEQ will be the lead agency with the following Basin Area Meeting responsibilities:

1. issue public notice of each of the six Basin Area Meetings;

2. in cooperation with resource agencies, Tribes and user groups, produce a Basin Summary Report in advance of the six meetings to include:

   a. a statement of the purposes of that Basin Area Meeting; and

   b. background information on each of the six basins relating to water quality, fisheries, monitoring and commercial activity. The information presented should be in sufficient detail to facilitate an informed discussion of these issues;

3. invite and encourage participation by all user and interest groups in the Basin Area Meeting process.

C. <u>Basin Area Meeting and Review.</u> At each Basin Area Meeting, the Division of Environmental Quality will make a general presentation on the area with assistance as appropriate from other resource agencies. The presentation will highlight and, if appropriate, expand upon the Basin Summary Report. Public comment will be accepted, and written comments will be received for a specified period of time after the BAM.

As soon as possible following the BAM, DEQ will produce a draft report for review by a working committee of the sponsoring groups. The draft report will synthesize and summarize oral and written comments received, and will propose a list of stream segments of concern about water quality. Any stream segment, regardless of water quality, may be identified as a stream segment of concern. The working committee will discuss the report and attempt to reach consensus on identifying stream segments of concern. If the working committee fails to agree, the Governor will identify stream segments of concern. After consensus of the working committee or, a decision by the Governor, DEQ will formulate and issue a final report with input from the working committee.

III. <u>Designation of Outstanding Resource Waters</u>

A. Except for conducting short-term or temporary activities which do not alter the essential character or special uses of a segment, allocation of water rights, or operation of water diversions or impoundments, the water quality for outstanding national resource waters shall be maintained and protected.

B. The Board of Health & Welfare will give due consideration to any request for a hearing on a segment to be designated as an outstanding resource water at its regular scheduled meeting.

C. The Board of Health & Welfare will decide whether or not a hearing is necessary.

D. Based on the public hearing record, if any, or if no hearing is held, on the basis of the record before the Board, the Board of Health and Welfare will decide whether or not to recommend said outstanding resource waters to the Legislature for their approval.

E. The Board of Health & Welfare will give special consideration to holding hearings for and to recommending, for designation by the Legislature, waters which constitute an outstanding national resource, such as waters of National and State Parks and Wildlife Refuges and waters of exceptional recreational or ecological significance.

F. The Legislature shall decide whether to designate any such ORW's through the passage of a bill.

G. If designated by the Legislature then such outstanding resource water shall be listed in the Water Quality Standards and, if appropriate, in the state water plan.

H. The above process for designating outstanding resource waters shall be enacted into regulation by the Division of Environmental Quality, Department of Health & Welfare or the Idaho State Legislature as appropriate.

IV. <u>Coordinated Monitoring Program</u>

A. The parties to this agreement recognize the need for a coordinated monitoring program to insure that Idaho's water resources are protected from degradation. Full implementation of this agreement would require that existing monitoring efforts by state, federal, tribal, and private interests be reviewed in order to insure that they are compatible and can be utilized in the creation of a complete statewide water quality data system. This coordinated monitoring system will provide current and ongoing data on trends, status of beneficial uses and BMP effectiveness in meeting water quality standards and protecting existing beneficial uses.

B. The Idaho Department of Health and Welfare shall have the lead responsibility in developing this coordinated system. In addition, memos of understanding will be required between various state, federal, tribal, and private entities.

C. The parties recognize that there are numerous existing monitoring efforts that can contribute to this program. However, they all agree that additional investments will be required. All of the participants to this agreement are committed to work with the appropriate agencies and entities to determine those additional requirements and to obtain necessary funding to implement many essential aspects of this agreement.

D. The parties recommend that a representative oversight committee be established to assist in the development of this program and to insure its timely implementation. This committee will insure that this monitoring meets the needs of the state of Idaho and the affected groups.

E. For monitoring activities on federal lands, in stream segments of concern, the appropriate federal land manager shall develop and implement a monitoring program that will identify the impacts, if any, of activities on federal lands, including, but not limited to, timber sales, road construction and allotment management plans on fish habitat and water quality. This program shall be sufficiently intensive to evaluate the effectiveness of the BMP's and other mitigation measures implemented in these activities to reduce or eliminate nonpoint source pollution to achieve water quality standards and protect existing beneficial uses.

Monitoring in areas of special concern shall be significantly more intensive than the normal program of monitoring agency actions set forth in the plans developed pursuant to federal statutes and regulations.

To the maximum extent feasible, the monitoring program shall seek to collect activity-specific data; as the purpose of this is to identify the environmental effects of individual activities and to assure that water quality standards are met and beneficial uses fully protected. This plan will be developed in consultation with interested agencies, tribes, and user groups.

V. <u>Mining</u>

Following are the provisions of the antidegradation implementation plan for the mining industry. These provisions will be formalized in regulations as appropriate or other actions which do not otherwise alter the authority of either the Department of Lands or the Land Board.

A. The Department of Lands will be the lead agency implementing the antidegradation policy for surface mining and dredge and placer mining.

B. The Department of Lands will submit copies of information required by Idaho Code Section 47-1506, Idaho Surface Mining Act, and Idaho Code Section 47-1317, Idaho Dredge and Placer Mining Act, to the Departments of Water Resources, Fish and Game and DEQ for all proposed surface (except sand and gravel) and dredge and placer mining operations. The three agencies will review and comment on the proposed operations within sufficient time for the Department of Lands to use their input in evaluating the proposed operation in accordance with Idaho Code Section 47-1507.

Information submitted by an operator to the Department of Lands regarding a proposed surface mining or dredge and placer mining operation shall identify foreseeable site-specific nonpoint sources of water quality impacts and the measures to be used to control such impacts.

C. The operator must insure that such best management practices are utilized that will achieve the level of water quality necessary to protect existing beneficial uses from nonpoint sources of pollution. These measures shall be among the first things to be constructed in order to protect water quality.

D. The Department of Lands will require BMP's designed to achieve Idaho's water quality standards and protect existing beneficial uses. If standards are not met or existing beneficial uses not protected, such BMP's will be modified or improved to meet the water quality standards and protect beneficial uses unless such water quality standards are adjusted pursuant to law.

E. When the Department of Lands determines, after consultation with Water Resources, Fish and Game and DEQ, and affected tribes that a proposed surface mining or dredge and placer mining operation can reasonably be expected to significantly degrade adjacent surface waters:

1. such potential significant degradation will be described in the public hearing notice;

2. the operator will describe the measures that will be taken to protect surface water quality; and

3. a public hearing will be conducted at which the measures to protect water quality from nonpoint water pollution will be discussed. Such hearing shall be conducted within the statutory time period for review of the reclamation plans for proposed surface mining and dredge and placer mining operations. A hearing record shall be considered by the Department of Lands when reviewing reclamation plans.

F. Nothing in this agreement shall prohibit or change the authority of the State Board of Land Commissioners from rejecting a proposed surface mining reclamation plan or dredge and placer mining permit application when development of the project would not protect existing beneficial uses or can reasonably be expected to violate Idaho water quality standards.

G. Nothing herein shall prohibit the State Board of Land Commissioners, Department of Health and Welfare, or the Attorney General, from seeking injunctive relief as provided in Idaho Code Section 39-108 to prevent or stop imminent and substantial danger to the public health or environment including situations where water quality criteria are not being met, or beneficial uses are being impaired. This provision reflects the current authority in IDAPA 16.01.2300.04, Idaho Water Quality Standards.

H. When there is a reasonable potential for nonpoint source pollution, the Department of Lands will be provided with baseline pre-project surface water monitoring information and ongoing monitoring data during the life of the project by the operator.

I. The antidegradation negotiating committee urges the Water Resources Department to thoroughly review, evaluate and improve its regulation of recreational dredging activities. The Water Resources Department should engage in this exercise with the cooperation of other resource agencies that may have overlapping jurisdiction or interest. The antidegradation negotiating committee further urges the Idaho Department of Lands in cooperation with the Department of Transportation to thoroughly review, evaluate and improve its regulation of sand and gravel pits.

VI. <u>Agriculture</u>

Following are the provisions of the antidegradation implementation plan for agriculture, including crop production and grazing. These provisions will be formalized in rule and regulation as appropriate.

A. The Soil Conservation Commission will be the lead agency for coordinating implementation of the antidegradation policy through the soil conservation districts.

B. The Soil Conservation Districts in consultation with the Soil Conservation Commission will design or adopt BMP's that meet Idaho's water quality standards and protect beneficial uses. If the Division of Environmental Quality determines that the standards are not met or beneficial uses are not protected, such BMP's will be modified or improved by the Soil Conservation Districts to meet the water quality standards and protect beneficial uses.

C. The six Basin Area Meetings (BAM's) will be a primary method used to collect public input and to identify stream segments of concern to the public. (See II, A, 1-5.)

D. The soil conservation districts will use the information collected at the Basin Area Meetings (BAM's) in development of the five-year plan for that district. Management of water quality in stream segments of concern should be addressed in the plan.

   1. Public notice shall be given regarding water quality aspects of the five-year plan.

   2. Each five-year plan will include:

      a. A list of stream segments of concern in the management district;

      b. A description of water quality in stream segments of concern;

      c. A list of impacted waters in district as described by DEQ water quality assessment report.

   3. Soil conservation projects and range projects are appropriate for both impacted waters and for stream segments of concern.

   4. It is appropriate for the Soil Conservation Districts to prioritize projects for both soil conservation and range rehabilitation or protection.

   5. The plan should include BMP's appropriate for the Soil Conservation Districts.

   6. The five-year plan may be modified or amended during the interim period if necessary based on public input.

E. The proper incentives to encourage participation in the programs are the cost share provisions for soil conservation programs and the use of low interest loans through the Resource Conservation and Rangeland Development Loan Account for rangeland projects. Seeking matching funds for habitat improvements on rangeland should be pursued. Use of the loan account and matching funds will be promoted by Soil Conservation Commission.

F. Educating farmers and ranchers of the benefits of soil conservation and proper rangeland use is an important part of the programs.

G. Water quality monitoring programs will be coordinated by DEQ to assist the Soil Conservation Districts in planning and implementation of projects.

H. It is appropriate for rangeland projects to be conducted by the permittee on his private, state or federal lands where he manages grazing.

I. The Soil Conservation Commission is an appropriate agency to provide the technical assistance for rangeland projects and will require up to three new positions to carry out this task.

## VII. Timber

Following are the provisions of the antidegradation implementation plan for the timber industry. These provisions will be formalized in rules and regulations as appropriate.

All forest practices in Idaho are currently subject to regulation through the Forest Practices Act. This act mandates the Best Management Practices (BMP's) which are the primary operational means to protect water quality from nonpoint source pollution associated with forest management activities.

Forestry BMP's should be rigorously enforced, periodically reviewed and improved when water quality monitoring shows the need. This cycle of BMP enforcement-water quality monitoring-BMP improvement constitutes a "feedback loop" for forestry BMP's. As noted in Idaho's Forest Practices Water Quality Management Plan, adherence to the feedback loop is the primary mechanism for assuring compliance with

Idaho water quality standards and the requirements of the federal Clean Water Act with its various amendments.

All landowners and timber operators must adhere to the requirements of the Forest Practices Act. It represents existing requirements for water quality protection. The forest management portion of this agreement, however, is designed to assure even higher levels of water quality protection when water quality parameters, fishery values, or on-the-ground operating conditions call for actions in excess of those normally required.

A. Best Management Practices (BMP's) and the state Forest Practices Act (FPA) are regulations with which all must comply. The state of Idaho must ensure rigorous enforcement and compliance with these BMP requirements.

B. The Idaho Department of Lands will require BMP's that meet Idaho's water quality standards and protect beneficial uses. If standards are not met or beneficial uses not protected, such BMP's will be modified or improved to meet water quality standards and protect beneficial uses.

C. The six Basin Area Meetings will provide the means to identify stream segments with particular water quality or fishery concerns. Identification of these areas will serve as a notice to private landowners and public land managing agencies that additional measures will be necessary to protect or enhance water quality or fishery objectives. These measures will exceed the normal Forest Practices Act requirements.

D. When stream segments of concern have been identified, the Idaho Department of Lands, in cooperation with the Departments of Fish and Game plus Health and Welfare, and affected landowners, will convene a local working committee. The local working committee shall include appropriate governmental agencies, representatives of the affected landowners, and representatives of tribal governments, environmental, and fish and wildlife groups which seek to be represented. This committee will:

   1. Discuss watershed goals specific to the stream segments of concern, including long term water quality and fishery objectives;

2. Review, as appropriate to the discussion and at the option of the involved landowners, their management plans and objectives; and

3. Identify those on-the-ground actions necessary to achieve water quality and fishery objectives.

E. The Department of Lands, in consultation with the local working committee, shall develop site-specific BMP's for timber operations in the area.

1. It is expected that individual landowners/ operators will enter into agreements with IDOL adopting specific BMP's to be used in the watershed.

2. Such agreements will be in writing transmitted from the landowner to the Department of Lands and/or other appropriate resource agencies, and will be reflected in secondary contractual agreements between the landowner and operator(s).

F. For landowners bordering stream segments of concern who refuse to enter into such agreements and where those owners' activities could significantly impact water quality in stream segments of concern, then the Land Board shall impose mandatory site-specific BMP's as follows:

There will be established a ten-day notification requirement on all lands bordering stream segments of concern for immediately pending timber harvests. If there is no agreement to employ modified BMP's during this ten-day period, IDOL shall not accept notification nor issue a slash burning permit nor otherwise allow the operation to proceed unless an emergency rule making process establishes specific BMP's.

If the timber sale is not pending, a petition shall be submitted by the Forest Practices Advisory Committee to recommend site-specific BMP's for Land Board approval.

G. In order to implement this agreement, the parties recommend amendments to the Forest Practices Act to give the Department of Lands authority to:

1. Require a ten-day notification period prior to the commencement of any forest practice within the stream segments of concern;

2. Develop, impose and enforce BMP's specific to given geographical areas through both emergency and normal rule making procedures; and

3. Withhold the completion of a forest practices notification (i.e., granting of a "slash number") in the absence of a written agreement specifying that the landowner will abide by the BMP's prescribed for his operation in the stream segments of concern.

H. If, through the concurrence of the directors of Lands, Fish and Game, and the Department of Health and Welfare, it is determined that, notwithstanding a landowners agreement to comply with BMP's which exceed those required by the Forest Practices Act, beneficial uses will not be fully protected, then such activity shall be deemed an imminent or substantial threat as provided in Idaho Code 39.108 (Environmental Protection and Health Act).

I. The Forest Practices Act makes clear that forestry BMP's are to be developed and recommended to the Department of Lands by the Forest Practices Act Advisory Committee. In order to assure that this committee is balanced and has the necessary expertise to properly evaluate land management, fishery, and water quality concerns, the parties to this agreement recommend amending the act to include a fisheries biologist as a voting member of the committee.

The foregoing agreement was reached August 18, 1988, by representatives of The Wilderness Society, Idaho Conservation League, Idaho Sportsman's Coalition, Nez Perce Tribe, Idaho Mining Association, Idaho Farm Bureau, and Intermountain Forest Industry Association.

# IMPLEMENTING IDAHO'S ANTIDEGRADATION POLICY

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In August 1988 an Antidegradation Agreement for Idaho was finalized (Office of the Governor 1988). This landmark agreement was reached after months of negotiations between agricultural, timber, and mining interests, Indian tribes and the conservation community. The key provisions of the agreement are: Basin Area Meetings (BAMs) will be held biennially across the state to discuss water quality and to allow citizens to nominate stream segments of concern; establishment of a coordinated monitoring program; and a process for designating outstanding resource waters.

The Basin Area Meetings held in Boise, McCall, Soda Springs, Idaho Falls, Twin Falls, Challis, Lewiston, and Coeur d'Alene in July, 1989, were quite successful, with approximately 800 people attending. The meetings had an information fair type of format with participants displaying information on water quality monitoring and water quality status and nonpoint source activities scheduled for the next two years. The agencies, industries, and conservation groups sponsoring the meetings answered many questions and provided other information useful to the public for the stream segment of concern nomination process. A video of the slide/tape program presented at the BAMs is available on loan from IDHW-DEQ.

Nearly 3,500 individual stream segment nomination forms were received by DEQ from the combined efforts of the BAMs and the mail-in campaign. The Governor has selected a Water Quality Advisory Working Committee which is currently prioritizing the list of stream segments nominated. The stream segments selected at the end of this process will receive priority for water quality monitoring by the appropriate agencies or groups, and may have special best management practices (more stringent than normally required by law) applied to nonpoint source activities in the particular watershed.

The water quality monitoring program plan is being developed by an eight member technical advisory committee to maximize water quality data collection efforts in Idaho. Some key aspects of the program are to eliminate duplication of monitoring effort and develop a shared common database. These aspects of the program will require cooperation by all involved with water quality monitoring in Idaho. The monitoring program is addressing trends in major river basins, beneficial use support status, and best management practice effectiveness. It is a technical based document listing appropriate parameters and protocols for all to use as a monitoring guide in Idaho.

Draft sediment criteria have been produced to facilitate instream monitoring of BMP effectiveness for protection of beneficial uses. The criteria are currently being tested for validity. They include turbidity, intergravel dissolved oxygen, and cobble embeddedness. Monitoring programs for agriculture are subdivided into irrigated cropland, dryland agriculture, and rangeland/riparian. Pollution abatement from irrigated cropland and associated water quality monitoring has a long history in the State of Idaho and has hence been easier to define in the monitoring plan.

An important aspect of the monitoring provision of the Agreement is that of coordination and sharing of data. Agencies, industries, and other groups will need to approach Antidegradation in a spirit of cooperation. A draft monitoring program plan has been produced, is undergoing revision, and should be ready for use in the spring.

Outstanding resource waters (ORW) will be waters that cannot be lowered in quality as a result of a nonpoint source activity. Only the legislature can designate an ORW based on recommendations from the Board of Health and Welfare. No ORWs have been submitted for consideration by the Legislature this year.

In October the Division of Environmental Quality was invited to the National Symposium on Water Quality Assessment in Fort Collins, Colorado. At the request of the U.S. Environmental Protection Agency, presentations were given on Idaho's antidegradation process and progress and on the research and development of sediment standards necessary for implementing nonpoint source pollution controls. Feedback from an audience of peers across the nation show Idaho to be leading the country in implementing antidegradation requirements for nonpoint source activities.

This agreement marks a new era for water quality awareness and protection in the State of Idaho.

## ACKNOWLEDGMENTS

Susan Martin reviewed and made helpful suggestions on this paper.

## LITERATURE CITED

Office of the Governor. 1988. Antidegradation policy--implementation, water quality advisory working committee, and assignment of functions to state agencies. Executive Order No. 88-23, ID Executive Dept. 3 pp.

# Idaho's Antidegradation Program: A Model

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It is a distinct pleasure to appear before you today on behalf of the Northwest Renewable Resources Center of Seattle to discuss antidegradation, that thing few people can spell and fewer can describe. I will blow my horn loud and long for the Center later in my presentation because it was principally responsible for the successful negotiation of an Idaho Antidegradation Agreement. The agreement is a simple one, a good one, and one that may serve as a model for other States that are yet undecided about the form of their antidegradation program. I hope our experience in Idaho, and the negotiating approach of the Center, will also be instructive for regulators, both State and Federal. I note from the Draft Framework for the Water Quality Standards Program that one goal for the 1988-1990 triennium is completion of the States' antidegradation programs. For those States that haven't resolved this issue, I extend my heartiest best wishes.

Let me briefly explain how I came to be involved in Idaho's antidegradation issue, and what I do for a living, then we'll get on with it. I had been practicing law in Seattle since 1982 in the areas of general municipal, environmental, natural resource, and utilities law when Governor Cecil Andrus called in the spring of 1987 and asked for my help on a couple of projects. He didn't mention the antidegradation project; that was added later. We solved the problem, and I returned to Seattle in mid-1988, where I am now vice president of Washington Waste Systems, a disposal company for nonhazardous wastes and a subsidiary of Chicago-based Waste Management, Inc.

## Antidegradation: History of the Idaho Dispute

In my mind, antidegradation is one of the most ambiguous and divisive issues posed under the Clean Water Act. In Idaho, timber, mining, and agriculture industries and conservation groups and the tribes were at each other's throats for nearly five years over this issue. Industry thought the law required nothing new, that Idaho's feedback loop (which I will discuss later) and the continuing planning process for natural resources satisfied antidegradation requirements. Conservationists took quite a different view. They argued that antidegradation required a process of prior approval of commercial activity project by project — a prospect that sent industry people running for their shotguns. State and Federal agencies didn't help matters; their interpretations of the law can fairly be described as inconsistent.

So we had a mess. Lawyers sifted through all of this and salivated. With ambiguous statutory language, inconsistent guidance from governmental agencies, and a general dearth of case law on the subject, attorneys could argue just about anything. And politicians, ever searching for that hallowed middle ground, ran from the issue like a cat from a bath. Everyone was confused and angry. No one understood antidegradation. No one could explain it or define it, no one could envision how it might work on the ground.

Let me give you a brief chronology of events in Idaho so you have an appreciation for the context in which we forged a solution. For all intents and purposes, the controversy began in 1983 with the Environmental Protection Agency's (EPA's) adoption of regulations that required States to develop antidegradation policies and implementation plans. Boiling it down to its essence, antidegradation requires a program to fully protect existing beneficial uses in high quality waters. High quality waters, of course, being those waters whose quality exceeds the minimum necessary to support beneficial uses — the famous "fishable-swimmable" standard.

In 1985, EPA informed Idaho that its water quality standards did not satisfy antidegradation requirements for pollution from nonpoint sources. EPA imposed a deadline of May 1986 for compliance, a deadline that slipped several times.

In early 1986, the Idaho Legislature passed HB 711, an industry-backed measure opposed by environmentalists. Then-Governor John Evans vetoed it and directed State resource agencies to form an interagency team on nonpoint source pollution. The so-called Nonpoint Source Team, or NPSI, was comprised of industry, tribal, environmental, and resource agency representatives. NPSI's major accomplishment was formulation of the feedback loop, which, simply put, is a program establishing and evaluating the efficacy of best management practices (BMPs) in meeting water quality standards. Antidegradation, however, remained unresolved.

In early 1987, the legislature asked NPSI to produce an antidegradation proposal for its consideration during the 1988 session. NPSI did its level best and moved toward a stream classification system to implement antidegradation, but, pardon the expression, the waters became muddy. From August 19, 1987, with EPA's rewrite of SAM-32, through the end of the year, Idaho received no fewer than eight separate, formal communications from EPA explaining what antidegradation required. The number of informal communications was untold. It is fair to say these communications were not internally consistent.

Now, before you rush to the conclusion that I am insulting our host today by suggesting that Idaho's problem was all EPA's fault, let me hasten to point out that conservationists and industry were looking for a reason to disagree so they would not have to compromise. EPA handed them a reason. All it took was a hint of ambiguity. Let me also hasten to point out that there were plenty of inconsistent interpretations of the law among State agencies as well.

So, industry retreated to its position that the BMP feedback loop and the continuing resource planning process were good enough to satisfy antidegradation. Conservationists likewise retreated to their position that antidegradation required site-by-site prior approval of commercial activities. NPSI collapsed after 18 months of work amid bitterness and resentment. Industry promised to write its own bill and push it through the legislature, while conservationists promised to sue, whether or not the industry bill passed.

Into this dismal state of affairs on a spirited white stallion rode Governor Cecil D. Andrus. Together with State Senator Laird Noh, the moderate chair of Idaho's Senate Natural Resources Committee, Governor Andrus convened a smaller negotiating group, with me as mediator, to give consensus one more chance. The Governor and State Senator Noh agreed that having a Federal judge decide how Idahoans would use Idaho water was not a happy prospect. Invited to the table were seven parties representing timber, mining, agriculture, the Nez Perce Tribe, the Wilderness Society, sportsmen, and the Idaho Conservation League.

In preparing this presentation, I reviewed my notes of our first meeting in October, 1987. I cannot overemphasize the bitter, suspicious, and downright hostile feelings among the negotiators. They squirmed in their chairs; they avoided eye contact with their adversaries. One industry negotiator said, "What are we negotiating? No one knows for sure what antidegradation is. We're just going to write a bill and take it to the legislature." A conservationist replied, "Consensus is a joke. We'll negotiate in good faith, but industry will just string us along like they did in NPSI, and they'll do an end run in the legislature. We're going to court!" Sound familiar?

Nevertheless, with healthy doses of handholding, cajoling, scolding, and encouragement, we began to make progress. We covered some of the same ground as NPSI and identified some common objectives. The ember of compromise began to flicker. Negotiations carried over into 1988 when the legislature came to town. But time ran out. Industry had drafted HB 652, which spooked the conservationists. And conservationists moved for summary judgment in the suit they had filed the previous fall and that spooked industry. Talks ended.

Everyone had thrown in the towel, save Governor Andrus. He didn't think HB 652 would protect the water, and he didn't want a Federal judge making natural resource policy in Idaho. So, we huddled and devised a strategy. We negotiated a six-month stay of the conservationists' lawsuit in exchange for a veto of the bill and reconvened negotiations. The veto was sustained by one vote in the senate in the face of tremendous pressure from industry.

This was, and this is an understatement, the vilest of shotgun weddings as far as industry was concerned. Obviously, the veto precluded me from continuing as mediator, so I called the Northwest Renewable Resources Center. I was aware of the Center's record of resolving natural resource disputes in Washington, and I thought they could help. I explained to the Center's Jim Waldo and Frank Gaffney that the lawsuit was on hold, that both sides would draft regulations reflecting their respective positions on antidegradation, and if either side left the table the Governor would direct adoption of the other side's regulations (hardly a subtle incentive to stay at the table and talk), and that industry was madder than wet hornets. Undaunted, Waldo and Gaffney accepted the challenge. We received a generous grant, for which we are grateful, from the Northwest Area Foundation in Minnesota to fund negotiations, participants and the Governor chipped in some money, and we went back to work.

## The Idaho Agreement

Let me describe for you the highlights of the Idaho Antidegradation Agreement. Then I want to close by emphasizing why negotiation is far preferable to litigation of natural resource disputes.

As I noted in my introductory remarks, antidegradation essentially requires a program to fully protect beneficial uses in high quality waters and to find some economic and social justification if the quality of those waters is to be lowered. Idaho's program accomplishes these goals with beautiful simplicity and by utilizing to the fullest extent possible existing regulations and processes.

At its heart, the agreement establishes six biennial Basin Area Meetings. The purposes of the Basin Area Meetings are five:

- To assess current water conditions, fish habitat, and trends in water quality;
- To identify and discuss current and projected commercial activity in the basin;
- To consider the propriety and efficacy of water quality monitoring in the basin;
- To discuss social and economic considerations associated with commercial activities; and
- To identify stream segments of particular concern.

The Idaho Division of Environmental Quality (IDEQ) will produce a Basin Area Summary Report for each Basin Area Meeting. After the meeting, IDEQ will produce a draft final report for review by a working committee comprised of appropriate State and Federal resource agencies and interest groups. The working committee will identify stream segments of concern, or the Governor will select them if the committee cannot agree. Among other things, the final report will discuss the social and economic justification for permitting the lowering of the quality of high quality waters.

The agreement also establishes a monitoring program to be coordinated between State and Federal resource agencies and tribes. Another working committee with similar representation is established to oversee development and implementation of this monitoring program.

There are separate and specific provisions for each of the three major industries: mining, agriculture, and timber. I won't go into the details except to note a few important provisions for timber that are, in my view, new and substantial and terribly important in their bearing on sedimentation of streams and fish habitat. On lands adjacent to stream segments of concern, landowners and operators must employ BMPs that exceed those generally prescribed in the Idaho Forest Practices Act. On these lands, the Idaho Department of Lands (IDOL), IDEQ, and the Idaho Department of Fish & Game will convene a local working committee comprised of interest groups and stakeholders. The committee will discuss watershed goals, including fishery objectives; review, at the option of the landowner, management plans; and identify, with IDOL, site-specific BMPs for the area. Landowners/operators are expected to enter into written agreements with IDOL adopting BMPs for timber operations. In addition, a 10-day notice requirement is established for all logging operations. If a landowner/operator files his 10-day project notice but refuses to enter into a written BMP agreement, IDOL will not issue a slash permit and the proposed logging operation may not proceed.

I cannot overstate the significance of these timber provisions. When negotiations began, timber interests would accept new regulations for private lands only over their dead bodies. Their agreement to these provisions is a tribute to their willingness to open their minds, check their guns at the door, and genuinely pursue consensus. The timber industry deserves credit and respect for their movement on this issue.

That's generally how it will work in Idaho. Industry, conservationists, and tribes are walking shoulder to shoulder, carrying this agreement to the legislature for ratification. That alliance is turning some heads in the Capitol, I can tell you. The agreement has been translated into appropriate statutes and regulations. Governor Andrus has included about $250,000 in his executive budget to initiate the monitoring program. Memoranda of Understanding will be drafted and executed with Federal agencies, principally the Bureau of Land Management and the U.S. Forest Service.

For Idaho, the Antidegradation Agreement heralds the dawning of a new era of cooperation on natural resource matters. The enthusiasm was reflected in a newspaper column by Rod Gramer appearing in the Boise Statesman that hails the agreement as a model of problemsolving that ought to be applied to crack other tough nuts like wilderness, forest plans, and even issues not related to natural resources. The spirit is infectious. It's been a long time coming, and it feels great. And the spirit should be nurtured under the agreement because it establishes a Basin Area Meeting working committee, a monitoring working committee, and a stream segment working committee. These working committees will cement the new relationships that have been struck between industry, tribes, and environmentalists. If the committees don't work together, the Idaho program will fail. I remain confident the user groups will build on the achievement the Antidegradation Agreement represents.

## The Northwest Renewable Resources Center

This infectious disease of cooperation actually blew into Idaho from across the Cascade Mountains in Washington where its carrier, the Northwest Renewable Resources Center, is building an impressive record in natural resource dispute resolution. The Center was born in 1984 from the vision of Seattle attorney Jim Waldo. Waldo had witnessed and participated in years of divisive litigation in which industry, tribes, and environmentalists had beat each other's brains out over fish and logging. Battles were won and lost, but the war raged on. There was no final victor, only increasing numbers of vanquished. Waldo thought there had to be a better way, and he was right. He convinced others to drop their guns, take a deep breath, and just talk. Cooperation now flourishes.

The Center's first project was to help the State of Washington devise a fisheries management plan following the controversial Boldt Decision, in which a Federal judge found, and the U.S. Supreme Court agreed, that certain tribes held treaty rights to half the harvestable salmon and steelhead returning to traditional tribal fishing grounds. The impact of the Center's work was dramatic. In 1983, more than 60 lawsuits existed between the State of Washington and tribes over fish. In 1984, there were none. In 1985 there were six, but the number of lawsuits hasn't reached double digits since the Center became involved.

In 1986, the Center came up to bat again on another major issue. The Washington Forest Practices Board was about to adopt new regulations affecting logging along streams with important fish habitat, and none of the stakeholders much liked them. The Center convened a meeting of 45 individuals involved in the issue and assessed the prospects for a negotiated settlement. One year later, the Timber/Fish/Wildlife Agreement was born. This agreement essentially rewrote forest practices in Washington from top to bottom. At the back of this text is a copy of the ground rules for the Timber/Fish/Wildlife Agreement negotiations. I urge you to read them carefully; they're a road map for reaching consensus through negotiation.

Jim Waldo and Frank Gaffney wanted to be here today to meet you all. But I'll deliver their message, to which I subscribe wholeheartedly, as succinctly as I can. Adversarial confrontation is the method of least preference for settling natural resource disputes. We simply are not at our best in adversarial relationships before courts, regulators, and legislatures. We spend too much time creating paper trails and advancing hardline rhetoric in an effort to sway opinion our way. Too often, regulators, and especially legislatures, make decisions based on the caliber of the bullet fired rather than on the accuracy of the aim, so interest groups spend precious resources buying more and bigger bullets. Courts aren't much better because their decisions generally resolve the battle, but not the overlying war. Soon, the means take on more importance than the end. We live for the fight, not the natural resource. Suddenly, we have begun talking at one another instead of with one another. We certainly have stopped listening. We've lost our view of the big picture. And our actions are determined solely by what we think our adversaries' reaction will be, not by what is best for the resource.

This is the sort of mindset Idaho user groups had been in for years. The will of natural resource industries usually prevailed in the Republican-controlled legislature in Idaho. Industry therefore preferred the legislative forum to solve its problems and thought it generally unnecessary to deal directly with environmentalists or tribes on natural resource issues primarily under State jurisdiction. Conversely, environmentalists turned to the courts as their favorite forum. Thus the two sides were locked in an adversarial relationship. Their posturing, their rhetoric, their public relations, their political communications were all geared to confront and combat their black-hearted adversaries. They rarely talked, and they rarely listened to each other's real concerns.

Waldo, Gaffney, and I spent months trying to penetrate this mindset. The real break came in a closed-door, no-holds-barred exchange between Waldo and Gaffney and the board of directors of the timber industry association in the early summer of 1988. What industry really wanted was certainty—certainty that they could go about their business without the prospect of a lawsuit on every project claiming violations of water quality standards. Waldo and Gaffney succeeded in convincing the board that a negotiated agreement could give them that certainty. It was possible because during negotiations the environmentalists had backed off their hard position that antidegradation required project-by-project prior approval. Instead, what environmentalists really wanted was a comprehensive watershed planning process in which they had a meaningful role. Industry had heard this new position stated at the table, but I guess they weren't really listening, or they didn't believe it. But when they heard it out of Waldo's mouth instead of an environmentalist's mouth, they got the message. This marked the first time industry and environmentalists had departed from their traditional mindsets and really listened to what the other side actually wanted out of an antidegradation program.

It was almost a religious experience. Industry realized it could negotiate a deal without having to accept a new and rigid permit process. Environmentalists noticed the industry's more constructive behavior at the table and began to realize they could negotiate a deal that included a meaningful role for themselves in watershed planning without fearing industry would dump the deal and go back to the legislature with another bill. There was new energy at the table. They actually listened to each other's concerns. They had opened their minds to a new approach. You know now how it all turned out.

I've tried to tell you the war story of Idaho, outline the Idaho agreement, and I've even lectured at you a little bit (for which I apologize) about the wonders of negotiation over litigation. I'll resist the urge to close with soaring rhetoric about how we must carefully husband our resources and work together to manage the growing pressure on our environment. You all know that or you wouldn't be here today. I just want you to understand how we solved the antidegradation challenge in Idaho in the hope that our experience and the Center's expertise may help you resolve the issue in your States.

Winston Churchill once commented about the apparent "wishy-washyness" of American democracy and foreign policy: "In the end, Americans will always do the right thing, after exhausting all other alternatives." I submit that in environmental policy, we have exhausted all other alternatives. It is time to do the right thing. The right thing is to pursue cooperation and consensus.

## A Better Future in Our Woods and Streams — *Ground Rules for Timber/Fish/Wildlife Agreement Negotiations*

*As Promulgated by the Northwest Renewable Resources Center, Seattle, Washington*

Each of the participants in these discussions agrees to the following ground rules:

1. We will attempt to develop a system which provides:
   a. minimum guarantees for everyone,
   b. incentives which maintain and enhance timber, fisheries and wildlife resources, and
   c. future flexibility, accountability, better management, compliance with regulations and resource goals.
2. All participants in the negotiation bring with them the legitimate purposes and goals of their organizations. All parties recognize the legitimacy of the goals of others and assume that their own goals will also be respected. These negotiations will try as much as possible to maximize attainment of all the goals of all the parties.
3. This effort will receive priority attention, staffing and time commitments.
4. The same priority will be given to solving the problems of others as you would give to solving your own.
5. A commitment is made to listen carefully: ask questions to understand and make statements to explain or educate.
6. All issues identified by any party must be addressed by the whole group.
7. Needs, problems and opportunities, not positions will be stated — positive candor is a little used but effective tool.
8. A commitment is made to attempt to reach consensus on a plan.
9. A commitment is made to be an advocate for an agreed-upon plan.
10. Participants will protect each other and the process politically with their constituencies and the general public.
11. Weapons of war are to be left at home (or at least checked at the door).
12. Anyone may leave the process and disavow the above ground rules, but only after telling the entire group why and seeing if the problem(s) can be addressed by the group.
13. All communications with news media concerning these discussions will be by agreement of the group. Everyone will be mindful of the impacts their public and private statements will have on the climate for this effort.
14. No participant will attribute suggestions, comments or ideas of another participant to the news media or non-participants.
15. In the event this effort is unsuccessful, participants are free to pursue their interests in other dispute resolution forums without prejudice.
16. Participants are free to, and in fact are encouraged to, seek the best advice from people who are not in the room.
17. All of the individuals who are participants accept the responsibility to keep their friends and associates informed on the progress of the discussions.
18. Participants agree to check rumors with facilitation team prior to acting.

# Water Quality Standards for the 21st Century

## Proceedings of a National Conference

March 1-3, 1989
Dallas, Texas

U.S. Environmental Protection Agency
Office of Water
Washington, D.C.

1989

EPA

# WATER QUALITY
# ADVISORY WORKING COMMITTEE
# DESIGNATED STREAM SEGMENTS OF CONCERN

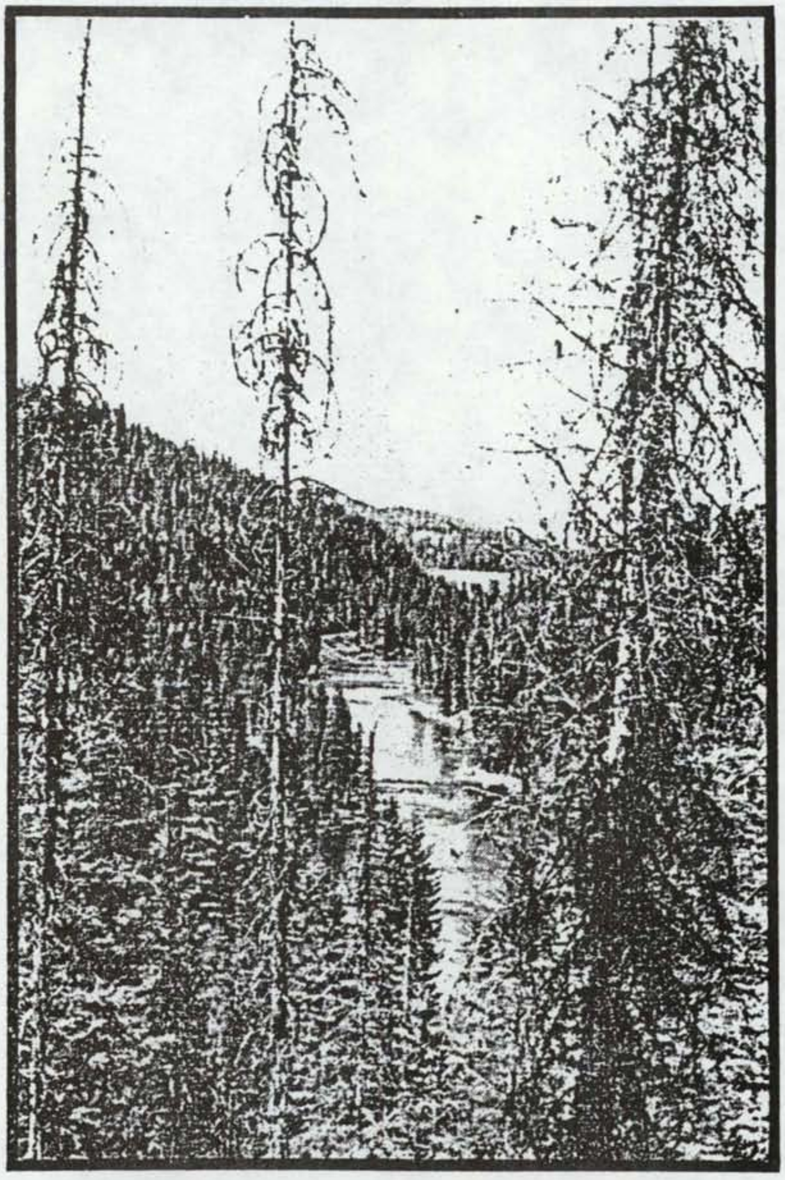
Prepared by
A. Kenneth Dunn, P.E.
Committee Chairman

February 16, 1990

Division of Environmental Quality

Water Quality Bureau

# Idaho
# Water Quality Status Report and Nonpoint Source Assessment 1988



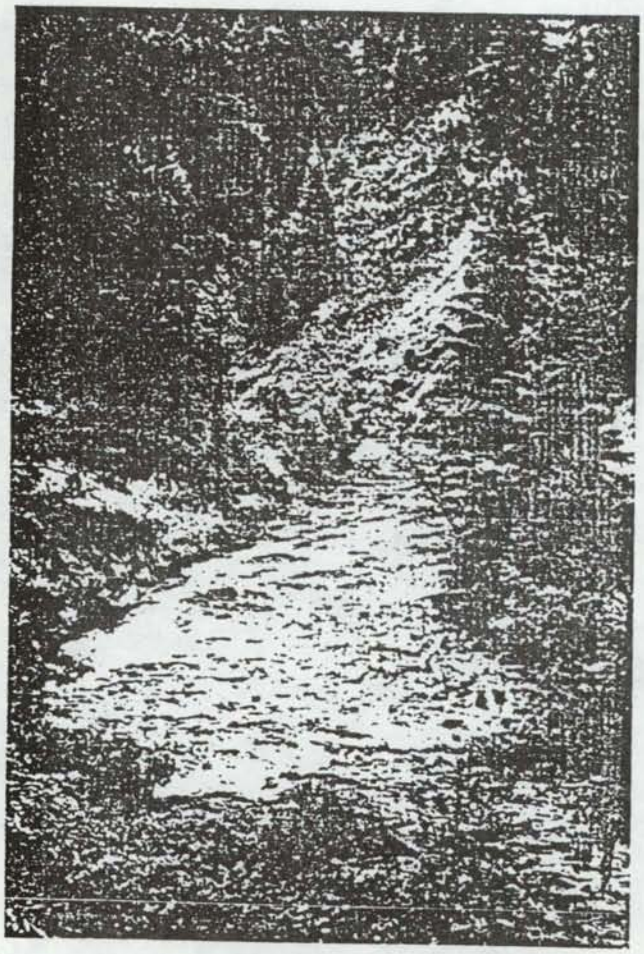
Idaho
Department of Health and Welfare

WATER QUALITY BUREAU REPORT

# TECHNICAL REVIEW OF SEDIMENT CRITERIA

Idaho Department of Health & Welfare
Division of Environmental Quality
Water Quality Bureau
450 W. State Street
Boise, ID 83720

1989

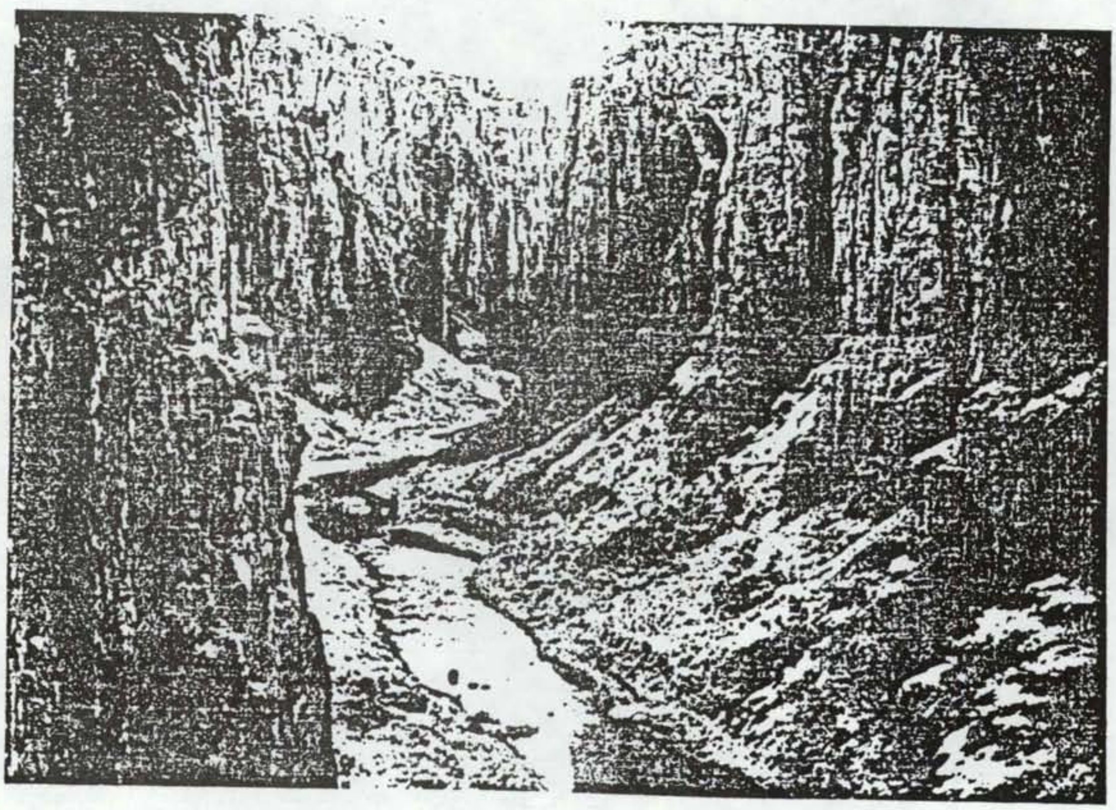


# Coordinated Nonpoint Source Water Quality Monitoring Program For Idaho

William H. Clark

Idaho Department of Health & Welfare
Division of Environmental Quality
450 West State Street
Boise, Idaho 83720

In cooperation with the Nonpoint Source Monitoring Technical Advisory Committee



January 31, 1990

## MONITORING PLAN CHECKLIST

**Antidegradation policy**

- ☐ "The monitoring program shall seek to collect activity-specific data".
- ☐ "Monitoring in areas of special concern shall be significantly more intensive than the normal program of monitoring agency actions."

**State water quality standards**

- ☐ Fully incorporates the feedback loop process; i.e. monitoring to evaluate BMP effectiveness.
- ☐ A mechanism to modify BMPs that are found to be ineffective.
- ☐ Address criteria and beneficial uses in the state water quality standards.

**Integrating monitoring programs**

- ☐ Coordinate data collection with other entities to avoid duplication and maximize available resources.
- ☐ Provide for data storage that maximizes opportunities for data sharing with others.
- ☐ Outlines the mechanism for sharing the results of data analysis, i.e. reporting.
- ☐ Are monitoring sites representative across land ownership under study?

**Quality Assurance/Quality Control**

- ☐ Field and laboratory protocols are state-of-the-art as suggested in Appendix H.
- ☐ As a minimum, compatible data, is entered into a common database within one year of collection.
- ☐ As a minimum, data reports, are available within eighteen months of data collection.
- ☐ Data analysis methods are fully referenced.

**Trend monitoring**

- ☐ Is compatible with statewide trend monitoring network.
- ☐ Water quality trends are reported annually.

**Beneficial use monitoring**

- ☐ Site selection is based upon a combination of land uses, stream and land types, and the existing uses of water.
- ☐ Parameter selection is oriented to the most sensitive beneficial use.
- ☐ Addresses: current status, change, and use attainability of existing beneficial uses.

**BMP effectiveness monitoring**

- ☐ Applies on-site, pollutant source and transport (PST), and in-stream beneficial use assessments in combination to determine the effects of nonpoint source activities on water quality.
- ☐ Prioritization for BMP effectiveness monitoring is based on the most sensitive land types, the significant NPS activities, BMPs that have not been adequately evaluated, stream segments of concern, waters with beneficial use impairment, or areas of increasing development.
- ☐ In-stream parameter selection is based on the most sensitive beneficial use or PST parameters appropriate to the BMPs being addressed.
- ☐ Reference sample sites are used to assess in-stream effects relative to baseline conditions.

**Agriculture**

- ☐ A Coordinated Resource Management planning approach will identify sources, impacts, responsibilities, funding sources, and priorities.
- ☐ Dryland agriculture, focus is on bioassessment and habitat assessment protocols.
- ☐ Irrigated agriculture, focus is on nutrients, suspended sediment, and bacteria.
- ☐ Grazing/riparian agriculture, focus is on streamside vegetation, streambanks, instream habitat, grazing intensity, bioassessment, nutrients and temperature.

**Forestry**

- ☐ Focus is on biological beneficial use impacts from sediment, temperature, & LOD.
- ☐ BMP effectiveness monitoring includes on-site implementation, PST, and beneficial use assessments, fully coordinated between IDHW, USFS, BLM, & IDL.

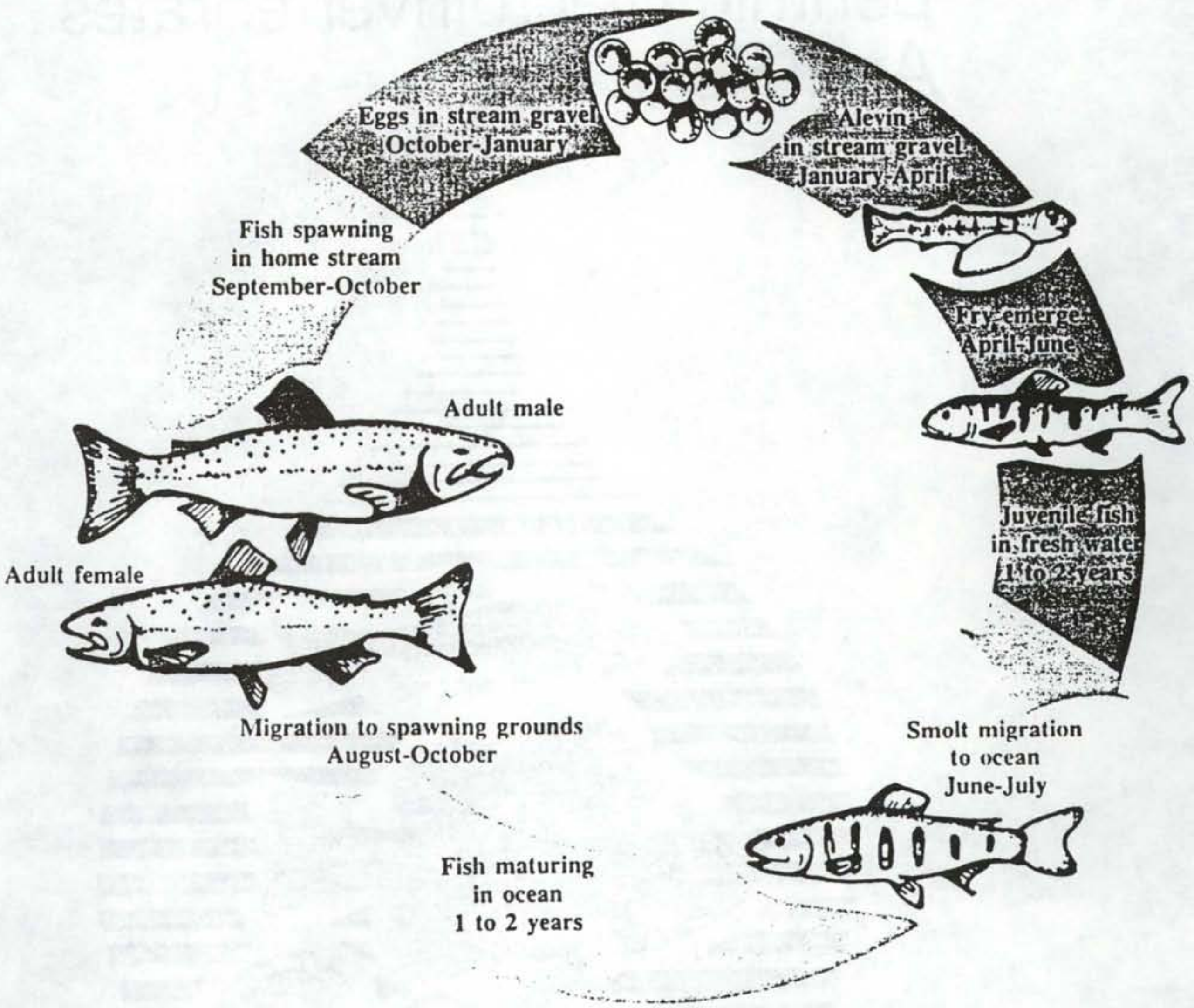
**Mining**

- ☐ Focus is on heavy metals, toxics, sediment, channel stability, biological beneficial use impacts, dissolved constituents, temperature, and pH.
- ☐ BMP effectiveness monitoring includes on-site implementation, PST, and beneficial use assessments, coordinated between operators, IDL, IDHW, IDFG, USFS, and BLM.

**Plan revisions**

- ☐ Please contact IDHW-DEQ, Statehouse, Boise, Idaho 83720 with any comments or corrections for future revisions of the NPS water quality monitoring plan.

# PROTOCOLS FOR ASSESSMENT OF DISSOLVED OXYGEN FINE SEDIMENT AND SALMONID EMBRYO SURVIVAL IN AN ARTIFICIAL REDD




Idaho Department of Health and Welfare
Division of Environmental Quality
Water Quality Bureau
1410 N. Hilton
Boise, ID 83706-1253

United States
Environmental Protection
Agency

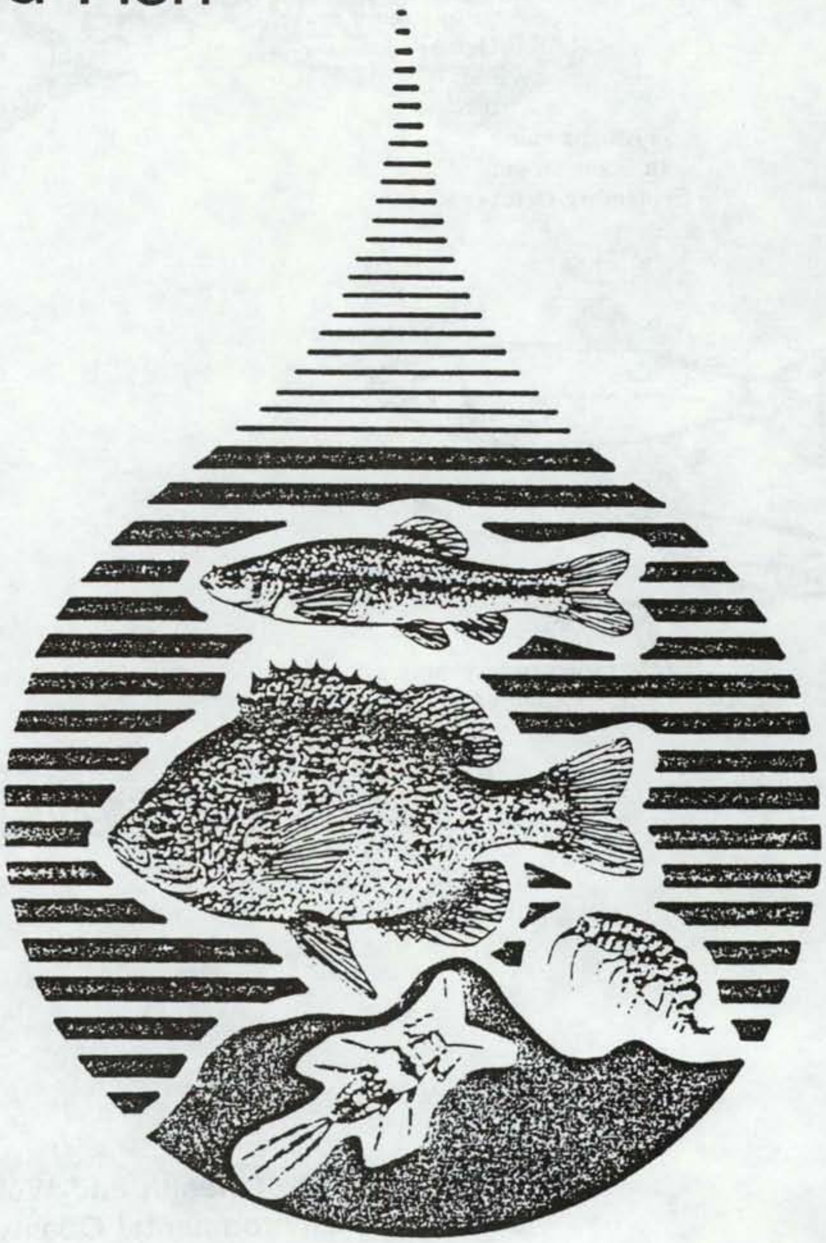
Office of
Water
(WH-553)

EPA/444/4-89-001
May 1989

EPA

# Rapid Bioassessment Protocols For Use In Streams And Rivers

## Benthic Macroinvertebrates And Fish



# Estimating Total Fish Abundance and Total Habitat Area in Small Streams Based on Visual Estimation Methods

David G. Hankin

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and Gordon H. Reeves

*USDA Forest Service, Pacific Northwest Experiment Station, Corvallis, OR 97331, USA*

Hankin, D. G., and G. H. Reeves. 1988. Estimating total fish abundance and total habitat area in small streams based on visual estimation methods. Can. J. Fish. Aquat. Sci. 45: 834–844.

We present sampling designs for estimating total areas of habitat types and total fish numbers in small streams. Designs are applied independently within strata constructed on the basis of habitat unit type and stream reach. Visual methods for estimating habitat areas and fish numbers are used to increase sample sizes and thereby reduce errors of estimation. Visual estimates of area are made for all habitat units, and visual estimates of fish numbers are made for systematic samples of units within given habitat types. Use of systematic sampling circumvents the requirement for a preexisting map of habitat unit locations and simplifies selection of units. We adjust for possible proportional bias of visual estimation methods by calibrating visual estimates against more accurate estimates made in subsamples of those units for which visual estimates are made. In a test application of these sampling designs, correlations between visual estimates and more accurate estimates were generally high, $r > 0.90$. Calculated 95% confidence bounds on errors of estimation were 13 and 16% for total areas of pools and riffles, respectively, and were 17 and 22% for total numbers of 1+ steelhead trout (*Salmo gairdneri*) and juvenile coho salmon (*Oncorhynchus kisutch*), respectively. Our methods appear to offer a cost-effective alternative to more traditional methods for estimating fish abundance in small streams. In addition, visual estimation surveys can produce detailed maps of the areas and locations of all stream habitat units.

Les auteurs présentent des protocoles d'échantillonnage pour l'estimation de la superficie totale de types d'habitats et du nombre total de poissons de petits cours d'eau. Les protocoles sont appliqués indépendamment à l'intérieur de strates déterminées à partir du type unitaire des habitats et de la section des cours d'eau. Des méthodes visuelles d'estimation de la superficie des habitats et du nombre de poissons sont utilisées afin d'accroître la taille des échantillons et, ainsi, de réduire les erreurs d'estimation. Des estimations visuelles de superficie sont réalisées pour toutes les unités d'habitat et d'autres portent sur le nombre de poissons se trouvant dans des échantillons systématiques d'unités au sein de types d'habitats donnés. L'échantillonnage systématique permet de contourner la nécessité de disposer d'une carte précisant les emplacements des unités d'habitat et de simplifier leur choix. Les biais proportionnels éventuels des méthodes d'estimation visuelle sont corrigés par étalonnage à partir d'estimations plus exactes obtenues de sous-échantillons des unités ayant fait l'objet d'estimations visuelles. Les auteurs ont obtenu, au cours d'un essai de mise en application de ces protocoles, des corrélations entre les résultats d'estimations visuelles et ceux d'estimations plus exactes qui s'avéraient généralement élevées ($r > 0,90$). Les limites de confiance à 95 % calculées des erreurs d'estimation étaient de 13 et 16 % pour, respectivement, les superficies totales des fosses et des hauts-fonds et de 17 et 22 % pour le nombre total de truites arc-en-ciel (*Salmo gairdneri*) 1+ et de juvéniles de saumons cohos *Oncorhynchus kisutch*). Les méthodes présentées semblent constituer une solution de remplacement rentable aux méthodes plus classiques d'estimation de l'abondance des poissons dans les petits cours d'eau. De plus, les inventaires par estimations visuelles permettent de produire des cartes détaillées des zones étudiées et des emplacements de toutes les unités d'habitat d'un cours d'eau.

*Received May 20, 1987*
*Accepted January 6, 1988*
*(J9293)*

*Reçu le 20 mai 1987*
*Accepté le 6 janvier 1988*

Hankin (1984) showed that typical surveys for estimation of fish abundance in small streams are two-stage sampling designs. Errors of estimation arise from two sources: (a) extrapolation from a small number of sampled stream sections to an entire stream and (b) estimation of fish numbers within sampled sections. Hankin (1984) recommended that sampled sections should be made equivalent to natural habitat units and that independent samples should be drawn from within strata constructed on the basis of habitat unit type and location. He then proposed several alternative two-stage sampling designs and compared their performances in several plausible settings.

The most important conclusion of Hankin's research was that errors of estimation of fish numbers *within* selected units (second stage errors) are likely to be small compared with errors that arise due to variation in fish numbers or densities *between*

United States
Department of
Agriculture

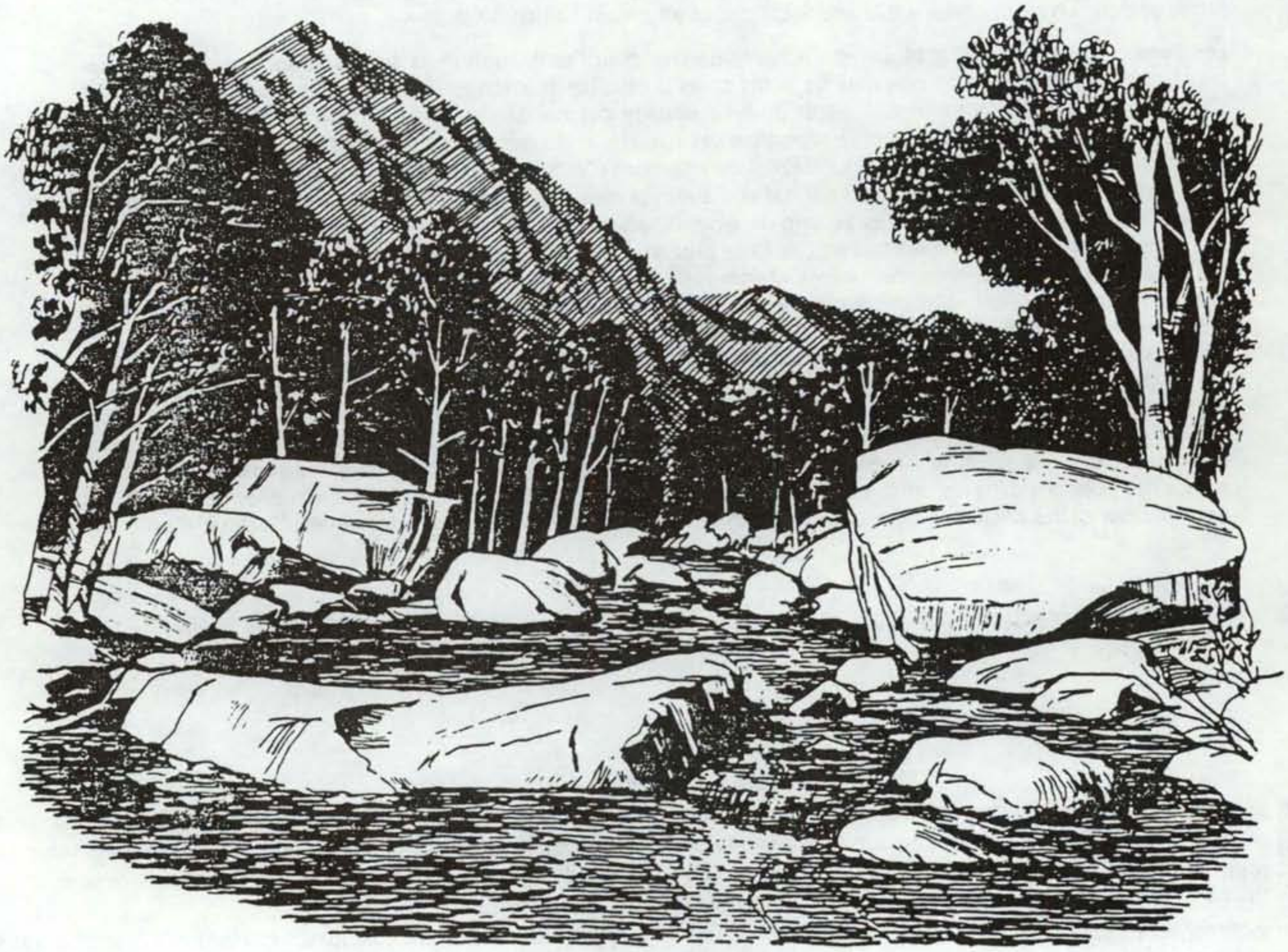
Forest
Service

Intermountain
Region

Ogden, Utah

# Integrated Riparian Evaluation Guide

## Intermountain Region
## May 1990



# PROPOSED COBBLE EMBEDDEDNESS SAMPLING PROCEDURE

JUNE 1989

by

Jack Skille, Idaho Department of Health and Welfare, Division of Environmental Quality

Jack King, USDA Forest Service, Intermountain Research Station

## PROTOCOLS FOR THE THALWEG PROFILE TECHNIQUE

### INTRODUCTION

Change in channel bed elevation is a useful indicator of the overall channel adjustments created by increasing sediment load. Evidence for the degradation of pool/riffle morphology from stream channel aggradation has been documented (Lisle, 1982). Thalweg profile surveys can be used to measure bed elevations and monitor changes in bed morhpology.

The ability to detect pool/riffle contrasts within the channel and the diminishments of habitat diversity over periods of increasing aggradation provides a means of measuring beneficial use impairment in streams used for rearing salmonids. The thalweg profile technique provides a sensitive measure of pool quality and pool/riffle composition within the stream channel.

### PROCEDURE

Reach identification:

A reach of stream, preferably representative of a longer section of stream is chosen for the profile measurements. The stream reach length is equal to, at minimum, 20 times the full channel width.

Reaches are intended to represent single geomorphic stream types as classified according to Rosgen, 1987. Single geomorphic stream types represented by the study reach may be further subdivided as influenced by any of the following:

- channelization
- riparian vegetation removal
- diversion and flow control
- any development activity affecting the morphology of the channel

Profile survey:

A rod and level survey is conducted on the longitudinal profile of the stream bed. The survey follow several steps:

1 Locate the leveling instrument in fixed position (as with a tripod) at any position in the stream (often near mid-channel)

2 Select a location at random between 0 and 20 feet downstream of the instrument.

3 At the selected location, read the elevation of the

# Idaho Forest Practices Act (Development and Implementation of BMP's by Local Working Groups)

MR. BILL LOVE
Bureau of Private Forestry
Idaho Department of Lands

# Idaho Forest Practices Act Development and Implementation of BMPs by Local Working Groups

[illegible]
Bureau of Private Forestry
Idaho Department of Lands

# RULES AND REGULATIONS PERTAINING TO THE IDAHO FOREST PRACTICES ACT TITLE 38, CHAPTER 13, IDAHO CODE

IDAHO DEPARTMENT OF LANDS
BOISE, IDAHO

April, 1990

TABLE OF CONTENTS

## RULE I. GENERAL DEFINITIONS.

Unless otherwise required by context as used in these regulations:

a. **"Act"** means the Idaho Forest Practices Act, Idaho Code, title 38, chapter 13.

b. **"Acceptable Tree Species"** means any of the species normally marketable in the region, including Christmas trees, which are suitable for the specific site requiring reforestation.

c. **"Additional Hazard"** means the debris, slashings, and forest fuel resulting from a forest practice.

d. **"Average DBH"** means average diameter in inches of trees cut or to be cut, measured at 4.5 feet above mean ground level on standing trees. All trees to be cut that do not have a measurable DBH will fall in the one inch class.

e. **"Board"** means the Idaho State Board of Land Commissioners or its designee.

f. **"Buffer Strip"** means a protective area adjacent to an area requiring special attention or protection.

g. **"Chemicals"** means substances applied to forest lands or timber to accomplish specific purposes and includes pesticides, rodenticides, plant growth regulators, fungicides, fertilizers, desiccants, fire retardants (other than water), salt, and other materials that may present hazards to the environment.

h. **"Constructed Skid Trail"** is a skid trail created by the deliberate cut and/or fill action of a dozer or skidder blade resulting in a road-type configuration.

i. **"Commercial Products"** means salable forest products of sufficient value to cover cost of harvest and transportation to available markets.

j. **"Condition of Adjoining Area"** means those fuel conditions in adjoining areas that relate to spread of fire and to economic values of the adjoining area.

<u>k</u>. **"Contaminate"** means to introduce into the atmosphere, soil, or water sufficient quantities of substances that are injurious to public health, safety, or welfare or to domestic, commercial, industrial, agriculture or recreational uses or to livestock, wildlife, fish or other aquatic life.

<u>l</u>. **"Cross-ditch"** means a diversion ditch and/or hump in a trail or road for the purpose of carrying surface water runoff into the vegetation duff, ditch, or other dispersion area so that it does not gain the volume and velocity which causes soil movement and erosion.

<u>m</u>. **"Cull"** means nonmerchantable, alive, standing trees of greater height than twenty (20) feet.

<u>n</u>. **"Department"** means the Idaho Department of Lands.

<u>o</u>. **"Deterioration Rate"** means rate of natural decomposition and compaction which decreases the hazard and varies by site.

<u>p</u>. **"Director"** means the Director of the Idaho Department of Lands or his designee.

<u>q</u>. **"Emergency Forest Practice"** means a forest practice initiated during or immediately after a fire, flood, windthrow, earthquake, or other catastrophic event to minimize damage to forest lands, timber, or public resources.

<u>r</u>. **"Fertilizers"** means any substance or any combination or mixture of substances used principally as a source of plant food or soil amendment.

<u>s</u>. **"Fire Trail"** means access routes that are located and constructed in a manner to be either useful in fire control efforts or deterring the fire spread in the hazard area.

<u>t</u>. **"Forest Land"** means state and private land growing forest tree species which are, or could be at maturity, capable of furnishing raw material used in the manufacture of lumber or other forest products. The term includes state and private land from which forest tree species have been removed but have not yet been restocked. It does not include land affirmatively converted to uses other than the growing of forest tree species.

<u>u</u>. **"Forest Practice"** means:

<u>i</u>. the harvesting of forest tree species;

ii. road construction associated with harvesting of forest tree species;

iii. reforestation;

iv. use of chemicals or fertilizers for the purpose of growing or managing forest tree species; or

v. the management of slashings resulting from harvest, management or improvement of forest tree species. "Forest Practice" shall not include preparatory work such as tree marking, surveying, and road flagging or removal or harvesting of incidental vegetation from forest lands; such as berries, ferns, greenery, mistletoe, herbs, mushrooms, or other products which cannot normally be expected to result in damage to forest soils, timber, or public resources.

v. **"Forest Regions"** means two regions of forest land: one being north of the Salmon River and one being south of the Salmon River.

w. **"Fuel Quantity"** means the diameter, the number of stems and the predominate species to be cut or already cut, and the size of the continuous thinning block all of which determine quantity of fuel per unit of area.

x. **"Harvesting"** means a commercial activity related to the cutting or removal of forest tree species to be used as a forest product. A commercial activity does not include the cutting or removal of forest tree species by a person for his own personal use.

y. **"Hazard"** means any vegetative residue resulting from a forest practice which constitutes fuel.

z. **"Hazard Offset"** means improvements or a combination of practices which reduces the spread of fire and increases the ability to control fires.

aa. **"Hazard Points"** means the number of points assigned to certain hazardous conditions on an operating area, to actions designed to modify conditions on the same area or to actions by the operator, timber owner or landowner to offset the hazardous conditions on the same area.

bb. **"Hazard Reduction"** means the burning or physical reduction of logging slash by treatment in some manner which will reduce the risk from fire after treatment.

cc. **"Herbicide"** means any substance or mixture of substances intended to prevent, destroy, repel, or mitigate any weed including algae and other aquatic weeds.

dd. **"Insecticide"** means any substance or mixture of substances intended to prevent, destroy, repel, or mitigate any insect, other arthropod, or mollusk.

ee. **"Landowner"** means a person, partnership, corporation, or association of whatever nature that holds an ownership interest in forest lands, including the state.

ff. **"Large Organic Debris (LOD)"** means live or dead trees and parts or pieces of trees that are large enough or long enough or sufficiently buried in the stream bank or bed to be stable during high flows. Pieces longer than the channel width or longer than 20 feet are considered stable. LOD creates diverse fish habitat and stable stream channels by reducing water velocity, trapping stream gravel and allowing scour pools and side channels to form.

gg. **"Merchantable Material"** means that portion of forest tree species suitable for the manufacture of commercial products which can be merchandised under normal market conditions.

hh. **"Merchantable Stand of Timber"** means a stand of trees that will yield logs and/or fiber:

i. suitable in size and quality for the production of lumber, plywood, pulp, or other forest products,

ii. of sufficient value at least to cover all costs of harvest and transportation to available markets.

ii. **"Mixed Forest Type"** means those forest areas in Idaho where the climate and site are naturally suited primarily for the growing of commercial species other than ponderosa pine. For purposes of this definition "primarily" means forest areas containing less than 25 percent by volume of ponderosa pine.

jj. **"Operator"** means a person who conducts or is required to conduct a forest practice.

kk. **"Operating Area"** means that area where a forest practice is taking place or will take place.

ll. **"Ordinary High Water Mark"** means that mark on all water courses, which will be found by examining the beds and banks and ascertaining where the presence and action of waters are so common and usual, and so long continued in all ordinary years as to mark upon the soil a character distinct from that of the abutting upland, in respect to vegetation, as that condition exists on the effective date of this chapter, or as it may naturally change thereafter.

mm. **"Partial Cutting"** means the well distributed removal of a portion of the merchantable volume in a stand of timber. This includes seed tree, shelterwood, or individual tree selection harvesting techniques.

nn. **"Ponderosa Pine Type"** means those forest areas in Idaho where the climate and site are naturally suited primarily for the growing of commercial quality ponderosa pine. For purposes of this definition, "primarily" means forest areas containing at least 25 percent ponderosa pine by volume.

oo. **"Present Condition of Area"** means the amount or degree of hazard present before a thinning operation commences.

pp. **"Public Resource"** means water, fish, and wildlife, and in addition means capital improvements of the state or its political subdivisions.

qq. **"Reforestation"** means the establishment of an adequately stocked stand of trees of species acceptable to the department to replace the ones removed by a harvesting or a catastrophic event on commercial forest land.

rr. **"Relief Culvert"** means a structure to relieve surface runoff from roadside ditches to prevent excessive buildup in volume and velocity.

ss. **"Rodenticide"** means any substance or mixture of substances intended to prevent, destroy, repel, or mitigate rodents or any other vertebrate animal which the Director of the State Department of Agriculture may declare by regulation to be a pest.

tt. **"Rules"** means rules adopted by the board pursuant to Idaho Code Section 38-1304.

<u>uu</u>. **"Slash"** means any vegetative residue three inches and under in diameter resulting from a forest practice and/or the clearing of land.

<u>vv</u>. **"Site"** means an area considered as to its ecological factors with reference to capacity to produce forest vegetation; the combination of biotic, climatic, and soil conditions of an area.

<u>ww</u>. **"Site Factor"** means a combination of percent of average ground slope and predominate aspect of the forest practice area which relate to rate of fire spread.

<u>xx</u>. **"Size of Thinning Block"** means acres of continuous fuel creating an additional hazard within a forest practice area. Distance between the perimeter of thinning blocks containing continuous fuel must be a minimum of six (6) chains apart to qualify as more than one block.

<u>yy</u>. **"Snags"** means dead, standing trees twenty (20) feet and greater in height.

<u>zz</u>. **"Soil Erosion"** means movement of soils resulting from forest practices.

<u>aaa</u>. **"Soil Stabilization"** means the minimizing of soil movement.

<u>bbb</u>. **"State"** means the state of Idaho or other political subdivision thereof.

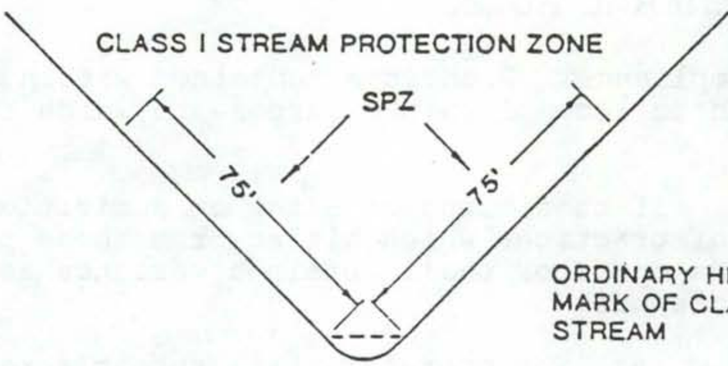
<u>ccc</u>. **"Stream"** means a natural water course of perceptible extent with definite beds and banks which confines and conducts continuously or intermittently flowing water. Definite beds are defined as having a sandy or rocky bottom which results from the scouring action of water flow.

<u>i</u>. Class I streams are used for domestic water supply or are important for the spawning, rearing or migration of fish. Such waters shall be considered to be Class I upstream from the point of domestic diversion for a minimum of 1,320 feet.

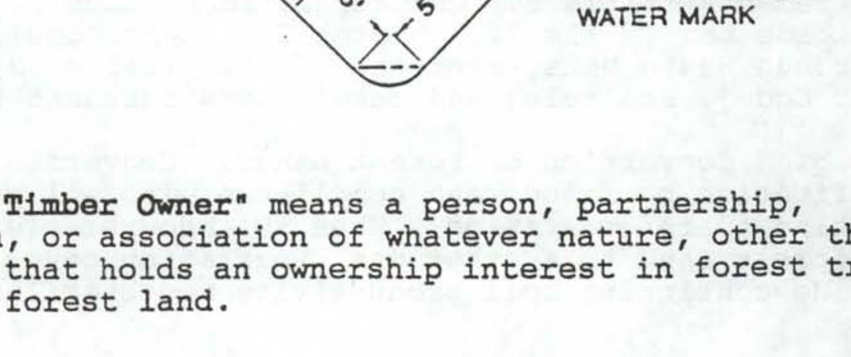
<u>ii</u>. Class II streams are usually headwater streams or minor drainages that are used by only a few, if any, fish for spawning or rearing. Their principle value lies in their influence on water quality or quantity downstream in Class I streams.

iii. Class I Stream Protection Zone means the area encompassed by a slope distance of 75 feet on each side of the ordinary highwater marks. (Figure 1.)

*Figure 1.*




iv. Class II Stream Protection Zone means the area encompassed by a minimum slope distance of five (5) feet on each side of the ordinary highwater marks. (Figure 2.)




ddd. **"Timber Owner"** means a person, partnership, corporation, or association of whatever nature, other than the landowner, that holds an ownership interest in forest tree species on forest land.

eee. **"Time of Year of Forest Practice"** means those combinations of months during which time the forest practice is taking place. Points assigned are: October through December - 2 points; August through September - 4 points; January through April - 7 points; May through July - 10 points.

## RULE 2. GENERAL RULES

a. **Compliance.** Practices contained within a rule shall be complied with to accomplish the purpose to which the rule is related.

i. If conditions of sites or activities require the application of practices which differ from those prescribed by the rules, the operator shall obtain a variance according to the following procedure:

(a) The operator shall submit a request for variance to the department in writing. The request shall include a description of the site and particular conditions which necessitate a variance, and a description of proposed practices which, if applied, will result in a violation of the rules.

(b) Within 14 days the department shall evaluate the request and notify the operator in writing of the determination to allow or disallow the variance request.

(c) All practices authorized under this procedure shall provide for equivalent or better results over the long term than the rules which are superseded to insure site productivity, water quality and fish and wildlife habitat. A variance can be applied only at approved sites.

ii. Practices shall also be in compliance with the Stream Channel Alteration Act (title 42, chapter 38, Idaho Code), Idaho Water Quality Standards and Waste Water Treatment Requirements (title 39, chapter 1, Idaho Code), the Idaho Pesticide Law (title 22, chapter 34, Idaho Code), and the Hazardous Waste Management Act of 1983 (title 39, chapter 44, Idaho Code), and rules and regulations pursuant thereto.

b. **Conversion of Forest Lands.** Conversions require a notification be filed, and compliance with all rules except those relating to reforestation. When a landowner elects to convert his forest land to another use, vegetation cover sufficient to provide continuing soil productivity and stabilization shall be established within one (1) year of completion of the forest practice on disturbed areas larger than one (1) acre, except that the director may grant an extension of time if weather or other conditions interfere. The determination by the director as to whether or not conversion has been accomplished shall be governed by:

i. the presence or absence of improvements necessary for use of land for its intended purpose,

ii. evidence of actual use of the land for the intended purpose.

c. **Annual Review and Consultation.** The director shall, at least once each year, meet with other state agencies and the Forest Practices Advisory Committee and review recommendations for amendments to rules, new rules, or repeal of rules. He shall then report to the board a summary of such meeting or meetings, together with recommendations for amendments to rules, new rules, or repeal of rules.

d. **Consultation.** The director shall consult with other state agencies and departments concerned with the management of forest environment where expertise from such agencies or departments is desirable or necessary.

The Idaho Water Quality Standards and Wastewater Treatment Requirements (Title 39, Chapter 1, Idaho Code) reference the Forest Practice Rules as approved best management practices and describe a procedure of modifying the practices based on monitoring and surveillance. The director shall review petitions from Idaho Department of Health and Welfare for changes or additions to the rules according to Administrative Procedures Act (Title 67, Chapter 52, Idaho Code) and make recommendations for modification to the Board of Land Commissioners.

e. **Notification of Forest Practice.**

i. Before commencing a forest practice or a conversion of forest lands the department shall be notified as required in subsection ii. of this section. The notice shall be given by the operator. However, the timber owner or landowner satisfies the responsibility of the operator under this subsection. When more than one forest practice is to be conducted in relation to harvesting of forest tree species, one notice including each forest practice to be conducted shall be filed with the department.

ii. The notification required by subsection i. of this section shall be on forms prescribed and provided by the department and shall include the name and address of the operator, timber owner, and landowner; the legal description of the area in which the forest practice is to be conducted; and other information the department considers necessary for the administration of the rules adopted by the board under Idaho Code Section 38-1304. Promptly upon receipt of the notice but not more than 15 days from receipt of the notice, the department shall mail a copy of the notice to whichever of the operator, timber owner, or landowner that did not submit the notification. The department shall make available to the operator, timber owner, and landowner a copy of the rules.

iii. An operator, timber owner, or landowner, whichever filed the original notification, shall notify the department of any subsequent change in the information contained in the notice within 30 days of the change. Promptly upon receipt of notice of change, but not to exceed 15 days from receipt of notice, the department shall mail a copy of the notice to whichever of the operator, timber owner, or landowner that did not submit the notice of change.

iv. The notification is valid for a period not to exceed two years from the date of original notification. At the expiration of the two-year period, if the forest practice is continuing, the notice shall be renewed annually using the same procedures provided for in this section.

v. If the notice required by subsection i. of this section indicates that, at the expiration of two-years from the date of notice, the forest practice will be continuing, the operator, timber owner, or landowner, at least 30 days prior to the expiration date of the two-year period, shall notify the department and obtain a renewal of the notification. Promptly upon receipt of the request for renewal, but not to exceed 15 days, the department shall mail a copy of the renewed notice to the operator, timber owner, or landowner that did not submit the request for renewal.

**f. Types of Operations for which Notification shall be Required.** The notification required shall be valid for two years from date of notice and shall be required for the following types of forest practices:

i. The harvesting of forest crops including felling, bucking, yarding, decking, loading, and hauling; road construction or improvement, including installation or improvement of bridges, culverts, or structures which convey stream flows within the area described.

ii. Road construction or reconstruction of existing roads including installation or replacement of bridges, culverts, or structures which convey streams not within operation areas associated with harvesting of forest tree species.

iii. Reforestation

iv. Application of insecticides, herbicides, rodenticides, and fertilizer for the purpose of growing or managing forest tree species.

v. Pre-commercial thinning.

vi. A woodlot management plan prepared by a forest practice advisor of the department or approved by the board of supervisors of a soil conservation district shall constitute a notification of a forest practice when filed with the department, provided it contains the information required in Rule 2.e.ii.

vii. Clearing forest land for conversion to non-forest use.

**g. Types of Operation for which Notice will not be Required.**

i. Routine road maintenance, recreational uses, grazing by domestic livestock, cone picking, culture and harvest of Christmas trees on lands used solely for the production of Christmas trees, or harvesting of other minor forest products.

ii. Non-commercial cutting and removal of forest tree species by a person for his own personal use.

iii. Clearing forest land for conversion to surface mining or dredge and placer mining operations under a reclamation plan or dredge mining permit.

**h. Emergency Forest Practices.** No prior notification shall be required for emergency forest practices necessitated by and commenced during or immediately after a fire, flood, windthrow, earthquake, or other catastrophic event. Within 48 hours after commencement of such practice, the operator, timber owner, or landowner shall notify the director with an explanation of why emergency action was necessary. Such emergency forest practices are subject to the rules herein, except that the operator, timber owner, or landowner may take any reasonable action to minimize damage to forest lands, timber, or public resource from the direct or indirect effects of the catastrophic event.

**i. Duty of Purchaser.** The initial purchaser of forest tree species which have been harvested from forest lands shall, before making such purchase or contract to purchase or accepting delivery of the same, receive and keep on file a copy of the notice required by Section 38-1306 of the Act relating to the harvesting practice for which the forest tree species are being acquired by the initial purchaser. Such notice shall be available for inspection upon request by the department at all reasonable times.

**j. Leakage or Accidental Spillage of Petroleum Products.** Petroleum product storage containers with capacities of more than 200 gallons, stationary or mobile, will be located no closer than 100 feet from stream, water course or area of open water. Dikes, berms or embankments will be constructed to contain the volume of petroleum products stored within the tanks. Diked areas will be sufficiently impervious and of adequate capacity to contain spilled petroleum products. In the event any leakage or spillage enters any stream, water course or area of open water, the operator will immediately notify the director.

i. Transferring Petroleum Products: During fueling operations or petroleum product transfer to other containers, there shall be a person attending such operations at all times.

ii. Equipment used for transportation or storage of petroleum products shall be maintained in a leakproof condition. If the Forest Practice Advisor determines there is evidence of petroleum product leakage or spillage he/she shall have the authority to suspend the further use of such equipment until the deficiency has been corrected.

**k. State Divided into Regions.** For the purpose of administering this Act, the State is divided into two forest regions: one being north of the Salmon River and one south of the Salmon River.

**l. Regions Divided into Forest Types.** For the purpose of further refining the on-the-ground administration of the Act, the forest regions are divided into two broad forest types, i.e., Ponderosa Pine type and Mixed Species type.

## RULE 3. TIMBER HARVESTING

**a. Purpose.** Harvesting of forest tree species is a part of forest management by which wood for human use is obtained and by which forests are established and tended. It is recognized that during harvesting operations there will be a temporary disturbance to the forest environment. It is the purpose of these rules to establish minimum standards for forest practices that will maintain the productivity of the forest land and minimize soil and debris entering streams and protect wildlife and fish habitat.

**b. Quality of Residual Stocking.** On any operation, trees which are left for future harvest shall be of sufficient vigor and acceptable species to assure continuous growing and harvesting of forest tree species and shall be adequately protected from damage resulting from harvest operations to enhance their survival and growth. This may be accomplished by locating roads and landings and by conducting felling, bucking, yarding, and decking operations so as to minimize damage to or loss of residual trees. When stands have a high percentage of unacceptable growing stock, consider stand conversion rather than intermediate cuttings.

**c. Soil Protection.** Select for each harvesting operation the logging method and type of equipment adapted to the given slope, landscape and soil properties in order to minimize soil erosion.

i. Tracked or wheel skidding shall not be conducted on geologically unstable, saturated, or easily compacted soils. On slopes exceeding 45 percent gradient and which are immediately adjacent to a class I or II stream, tractor or wheel skidding shall not be conducted unless the operation can be done without causing accelerated erosion. Where slopes in the area to be logged exceed 45 percent gradient the operator, landowner or timber owner shall notify the department of these steep slopes upon filing the notification as provided for in rule 2.e.

ii. Limit the grade of constructed skid trails on geologically unstable, saturated, or highly erodible or easily compacted soils to a maximum of 30 percent.

iii. In accordance with appropriate silvicultural prescriptions, skid trails shall be kept to the minimum feasible width and number. Tractors used for skidding shall be limited to the size appropriate for the job.

iv. Uphill cable yarding is preferred. Where downhill yarding is used, reasonable care shall be taken to lift the leading end of the log to minimize downhill movement of slash and soils.

d. **Location of Landings, Skid Trails, and Fire Trails.** Locate landings, skid trails, and fire trails on stable areas to prevent the risk of material entering streams.

i. All new or reconstructed landings, skid trails, and fire trails shall be located on stable areas outside the appropriate stream protection zones. Locate fire and skid trails where sidecasting is held to a minimum.

ii. Minimize the size of a landing to that necessary for safe economical operation.

iii. To prevent landslides, fill material used in landing construction shall be free of loose stumps and excessive accumulations of slash. On slopes where sidecasting is necessary, landings shall be stabilized by use of seeding, compaction, riprapping, benching, mulching or other suitable means.

e. **Drainage Systems.** For each landing, skid trail or fire trail a drainage system shall be provided and maintained that will control the dispersal of surface water in order to prevent sediment from damaging Class I streams.

i. Stabilize skid trails and fire trails whenever they are subject to erosion, by water barring, cross draining, outsloping, scarifying, seeding or other suitable means. This work shall be kept current to prevent erosion prior to fall and spring runoff.

ii. Reshape landings as needed to facilitate drainage prior to fall and spring runoff. Stabilize all landings by establishing ground cover or by some other means within one year after harvesting is completed.

**f. Treatment of Waste Materials.** All debris, overburden, and other waste material associated with harvesting shall be left or placed in such a manner as to prevent their entry by erosion, highwater, or other means into streams.

i. Wherever possible trees shall be felled, bucked, and limbed in such a manner that the tree or any part thereof will fall away from any Class I streams. Continuously remove slash that enters Class I streams as a result of harvesting operations. Continuously remove other debris that enters Class I streams as a result of harvesting operations whenever there is a potential for stream blockage or if the stream has the ability for transporting such debris. Place removed material five (5) feet slope distance above the ordinary high water mark.

ii. Remove slash and other debris that enters Class II streams whenever there is a potential for stream blockage or if the stream has the ability for transporting the debris immediately following skidding and place removed material above the ordinary high water mark or otherwise treat as prescribed by the department. No formal variance is required.

iii. Deposit waste material from construction or maintenance of landings and skid and fire trails in geologically stable locations outside of the appropriate Stream Protection Zone.

iv. Waste resulting from logging operations, such as crankcase oil, filters, grease and oil containers, shall not be placed inside Class I or Class II Stream Protection Zones.

**g. Stream Protection.** During and after forest practice operations, stream beds and streamside vegetation shall be protected to leave them in the most natural condition as possible to maintain water quality and aquatic habitat.

i. Tracked or wheel skidding in or through streams shall not be permitted. When streams must be crossed, adequate temporary structures to carry stream flow shall be installed. Cross the stream at right angles to its channel if at all possible. (Construction of hydraulic structures in stream channels is regulated by the Stream Channel Protection Act - title 42, chapter 38, Idaho Code). Remove all temporary crossings immediately after use and, where applicable, water bar the ends of the skid trails.

ii. When cable yarding is necessary, across or inside the Stream Protection Zones it shall be done in such a manner as to minimize stream bank vegetation and channel disturbance.

iii. Provide the large organic debris (LOD), shading, soil stabilization, wildlife cover and water filtering effects of vegetation along Class I streams.

(a) Leave hardwood trees, shrubs, grasses, and rocks wherever they afford shade over a stream or maintain the integrity of the soil near a stream.

(b) Leave 75 percent of the current shade over the stream.

(c) Carefully log the mature timber from the Stream Protection Zone in such a way that shading and filtering effects are not destroyed.

(d) Standing trees, including conifers, hardwoods and snags will be left within 50 feet of the ordinary high water mark on each side of all Class I streams in the following minimum numbers per 1000 feet of stream:

Minimum Standing Trees per 1000 Feet Required (each side)

| | Stream Width | | |
|---|---|---|---|
| Tree Diameter (DBH) | Over 20′ | 10′ - 20′ | Under 10′ |
| 0 - 7.9" | 200 | 200 | 200 |
| 8 - 11.9" | 42 | 42 | 42 |
| 12 - 19.9" | 21 | 21 | -- |
| 20"+ | 4 | -- | -- |

(e) Snags will be counted as standing trees in each diameter class if snag height exceeds 1.5 times the distance between the snag and the stream's ordinary high water mark. Not more than 50 percent of any class may consist of snags.

(f) As an alternative to the standing tree and shade requirements, the operator may notify the department that a site specific riparian management prescription is requested. The department and operator may jointly develop a plan upon consideration of stream characteristics and the need for large organic debris, stream shading and wildlife cover which will meet the objective of these rules.

(g) Where the opposite side of the stream does not currently meet the minimum standing tree requirements of the table, the department and the operator should consider a site specific riparian prescription that meets the large organic debris needs of the stream.

(h) Stream width shall be measured as average between ordinary high water marks.

iv. Provide soil stabilization and water filtering effects along Class II streams by leaving undisturbed soils in widths sufficient to prevent washing of sediment into Class I streams. In no case shall this width be less than 5 feet slope distance above the ordinary high water mark on each side of the stream.

**h. Maintenance of Productivity and Related Values.** Harvesting practices will first be designed to assure the continuous growing and harvesting of forest tree species by suitable economic means and also to protect soil, air, water, and wildlife resources.

i. Where major scenic attractions, highways, recreation areas or other high-use areas are located within or traverse forest land, give special consideration to scenic values by prompt cleanup and regeneration.

ii. Give special consideration to preserving any critical wildlife or aquatic habitat. Wherever practical, preserve fruit, nut, and berry producing trees and shrubs.

iii. When conducting operations along lakes, bogs, swamps, wet meadows, springs, seeps, or other sources where the presence of water is indicated, protect soil and vegetation from disturbance which would cause adverse affects on water quality, quantity and wildlife and aquatic habitat. Consider leaving buffer strips.

iv. Whenever practical, as determined by the department, plan clear cutting operations so that adequate wildlife escape cover is available within one-quarter (1/4) mile.

## RULE 4. ROAD CONSTRUCTION AND MAINTENANCE

a. **Purpose.** Provide standards and guidelines for road construction and maintenance that will maintain forest productivity, water quality, and fish and wildlife habitat.

b. **Road Specifications and Plans.** Road specifications and plans shall be consistent with good safety practices. Plan each road to the minimum use standards adapted to the terrain and soil materials to minimize disturbances and damage to forest productivity, water quality, and wildlife habitat.

i. Plan transportation networks to minimize road construction within stream protection zones. Design to leave or reestablish areas of vegetation between roads and streams.

ii. Roads shall be planned no wider than necessary to safely accommodate the anticipated use. Minimize cut and fill volumes by designing the road alignment to fit the natural terrain features as closely as possible. Use as much of the excavated material as practical in fill sections. Plan minimum cuts and fills particularly near stream channels.

iii. Design embankments and waste so that excavated material may be disposed of on geologically stable sites.

iv. Plan roads to drain naturally by out-sloping or in-sloping with cross-drainage and by grade changes where possible. Plan dips, water bars, and/or cross-drainage on roads when necessary.

v. Relief culverts and roadside ditches shall be planned whenever reliance upon natural drainage would not protect the running surface, excavation or embankment.
Design culvert installations to prevent erosion of the fill. Plan drainage structures to achieve minimum direct discharge of sediment into streams.

vi. Plan stream crossings to be minimum in number and in compliance with the minimum standards for stream channel alterations under the provisions of title 42, chapter 38, Idaho Code. Plan all culvert installation on Class I streams to provide for fish passage.

vii. If reuse of existing roads would violate other rules, the operator shall obtain a variance according to Rule 2.a. Consider reuse of existing roads when reuse or reconstruction would result in the least long-run impact on site productivity, water quality, and fish and wildlife habitat.

c. **Road Construction.** Place debris, overburden, and other materials associated with road construction in such a manner as to prevent entry into streams. Deposit excess material and slash on stable locations outside the Stream Protection Zones.

i. Roads shall be constructed in compliance with the planning guidelines of Rule 4.b.

ii. Clear drainage ways of all debris generated during construction and/or maintenance which potentially interferes with drainage or water quality.

iii. Where exposed material (excavation, embankment, borrow pits, waste piles, etc.) is potentially erodible, and where sediments would enter streams, stabilize prior to fall or spring runoff by seeding, compacting, riprapping, benching, mulching or other suitable means.

iv. In the construction of road fills near streams, compact the material to reduce the entry of water, minimize erosion, and settling of fill material. Minimize the amount of snow, ice, or frozen soil buried in embankment. No significant amount of woody material shall be incorporated into fills. Slash and debris may be windrowed along the toe of the fill, but must meet the requirements of Rule 4.d.iii.

v. Construct stream crossings in compliance with minimum standards for stream channel alterations under the provisions of title 42, chapter 38, Idaho Code. Roads shall not be constructed in stream channels. Roads that constrict upon a stream channel shall be constructed in compliance with minimum standards for stream channel alterations under provisions of title 42, chapter 38, Idaho Code.

vi. During and following operations on out-sloped roads, retain out-slope drainage and remove berms on the outside edge except those intentionally constructed for protection of road grade fills.

vii. Provide for drainage of quarries to prevent sediment from entering streams.

viii. Construct cross drains and relief culverts to minimize erosion of embankments. Minimize the time between construction and installation of erosion control devices. Use riprap, vegetative matter, downspouts and similar devices to minimize erosion of the fill. Install drainage structures or cross drain uncompleted roads which are subject to erosion prior to fall or spring runoff. Install relief culverts with a minimum grade of 1 percent.

ix. Earthwork shall be postponed during wet periods if, as a result, erodible material would enter streams.

x. In rippable materials, roads shall be constructed with no overhanging banks and any trees that present a potential hazard to traffic shall be felled concurrently with the construction operation.

d. **Road Maintenance.** Conduct regular preventive maintenance operations to avoid deterioration of the roadway surface and minimize disturbance and damage to forest productivity, water quality, and fish and wildlife habitat.

i. Sidecast all debris or slide material associated with road maintenance in a manner to prevent their entry into streams.

ii. Repair and stabilize slumps, slides, and other erosion features causing stream sedimentation.

iii. Active roads. An active road is a forest road being used for hauling forest products, rock and other road building materials. The following maintenance shall be conducted on such roads.

(a) Culverts and ditches shall be kept functional.

(b) During and upon completion of seasonal operations, the road surface shall be crowned, out-sloped, in-sloped or water barred, and berms removed from the outside edge except those intentionally constructed for protection of fills.

(c) The road surface shall be maintained as necessary to minimize erosion of the subgrade and to provide proper drainage.

(d) If road oil or other surface stabilizing materials are used, apply them in such a manner as to prevent their entry into streams.

iv. Inactive Roads. An inactive road is a forest road no longer used for commercial hauling but maintained for access (e.g., for fire control, forest management activities, recreational use, and occasional or incidental use for minor forest products harvesting). The following maintenance shall be conducted on inactive roads.

(a) Following termination of active use, ditches and culverts shall be cleared and the road surface shall be crowned, out-sloped or in-sloped, water barred or otherwise left in a condition to minimize erosion. Drainage structures will be maintained thereafter as needed.

(b) The roads may be permanently or seasonally blocked to vehicular traffic.

v. Abandoned Roads. An abandoned road is not intended to be used again. No subsequent maintenance of an abandoned road is required after the following procedures are completed:

(a) The road is left in a condition suitable to control erosion by out-sloping, water barring, seeding, or other suitable methods.

(b) Ditches are cleaned.

(c) The road is blocked to vehicular traffic.

(d) The department may require the removal of bridges and culverts except where the owner elects to maintain the drainage structures as needed.

## RULE 5. REFORESTATION

**a. Purpose.** The purpose of these rules is to provide for reforestation that will maintain a continuous growing and harvesting of forest tree species by describing the conditions under which reforestation will be required, specifying the minimum number of trees per acre, the maximum period of time allowed after harvesting for establishment of forest tree species, and providing erosion preventative measures on soils which have become exposed as a result of harvesting. However, when forest land is converted to another use, vegetative cover sufficient to provide continuing soil productivity and stabilization shall be established within one (1) year of completion of the forest practice on disturbed areas larger than one (1) acre, except that the director may grant an extension of time if weather or other conditions interfere.

b. **Reforestation** is required on all non-exempted forest land within five growing seasons after a forest harvesting practice reduces the stocking of acceptable tree species below the levels described in Rule 5.c.

c. **Stocking** will be deemed acceptable immediately following harvest if the following number per acre of trees by average size of acceptable species are reasonably well-spaced over the area affected by forest harvesting. (Tables 1 & 2)

**Table 1**

**ACCEPTABLE MINIMUM STOCKING - PONDEROSA PINE TYPE**

| Average Size Class DBH (1) - Inches | Average Number Trees Per Acre | Average Spacing In Feet |
|---|---|---|
| 2.9 and less | 150 | 17 x 17 |
| 3.0 to 4.9 | 105 | 21 x 21 |
| 5.0 to 7.9 | 55 | 30 x 30 |
| 8.0 to 10.9 | 30 | 38 x 38 |
| 11.0 and greater | 20 | 47 x 47 |

(1) DBH = Average Diameter (outside of the bark) of a tree 4.5 feet above mean ground level.

**Table 2**

**ACCEPTABLE MINIMUM STOCKING - MIXED FOREST TYPE**

| Average Size Class DBH - Inches | Average Number Trees Per Acre | Average Spacing In Feet |
|---|---|---|
| 2.9 and less | 200 | 15 x 15 |
| 3.0 to 4.9 | 110 | 20 x 20 |
| 5.0 to 7.9 | 60 | 27 x 27 |
| 8.0 to 10.9 | 35 | 35 x 35 |
| 11.0 and greater | 20 | 47 x 47 |

**d. Supplemental Reforestation** (seeding and/or planting) may be required if after three growing seasons from the date of harvest operations an inspection by the department determines the stocking levels do not meet the standards in Rule 5.c. Supplemental reforestation will not be required unless it is economically feasible under existing site conditions. If required, seeding and/or planting shall be completed before the end of the fifth growing season following the time of harvest, except that the director shall grant an extension of time if suitable seeds or seedlings are not available or if weather or other conditions interfere.

**e. Classes.** The following classes of land will be exempted from reforestation requirements.

i. Non-commercial forest land, i.e., land having a site quality incapable of economically growing a commercial quality stand of trees of acceptable species.

ii. Land on which the owner has stated his intention to convert to another use. This may include land converted to roads used in a forest practice.

iii. Ownerships of ten acres or less in one contiguous tract.

iv. Forest practice on larger ownerships which will affect a total of ten acres or less during a period of five consecutive years.

f. **On lands exempted** under Rule 5.e.i., iii. and iv. where reforestation is not being planned, some form of vegetative cover shall be established within one year on disturbed areas larger than one acre sufficient to provide continuing soil productivity and stabilization.

## RULE 6. USE OF CHEMICALS

a. **Purpose.** Chemicals perform an important function in the growing and harvesting of forest tree species. The purpose of these rules is to regulate handling, storage and application of chemicals in such a way that the public health and aquatic and terrestrial habitats will not be endangered by contamination of streams or other bodies of water. In addition, the application of chemical pesticides is regulated by Rules and Regulations of the Idaho Pesticide Law (title 22, chapter 34, Idaho Code).

b. **Licensing.** Any person acting as a commercial applicator or operator, limited applicator, or private applicator applying restricted-use pesticides, shall comply with the licensing requirements of the Idaho Pesticide Law Rules and Regulations. This requirement does not pertain to individuals applying non-restricted pesticides on their own property.

c. **Maintenance of Equipment**

i. Equipment used for transportation, storage or application of chemicals shall be maintained in leakproof condition. If, in the director's judgment, there is evidence of chemical leakage, he shall have the authority to suspend the further use of such equipment until the deficiency has been corrected.

ii. The storage of chemical pesticide shall also be conducted in accordance with the requirements of the Idaho Pesticide Law Regulations.

d. **Mixing.**

i. When water is used in mixing chemicals:

(a) Provide an air gap or reservoir between the water source and the mixing tank.

(b) Use uncontaminated tanks, pumps, hoses and screens.

ii. Mixing and landing areas:

(a) Mix chemicals and clean tanks and equipment only where spills will not enter any water source or streams.

(b) Landing areas shall be located where spilled chemicals will not enter any water source or stream.

**e. Aerial Application.**

i. Leave at least one swath width (minimum 100 feet) untreated on each side of all Class I streams, flowing Class II streams and other areas of open water. When applying pelletized fertilizer, leave a minimum of 50 feet untreated on each side of all Class I streams, flowing Class II streams, and other areas of open water.

ii. Use a bucket or spray device capable of immediate shutoff.

iii. Shut off chemical application during turns and over open water.

iv. Aerial application of chemical pesticides shall also be conducted according to the Idaho Pesticide Law Rules and Regulations.

**f. Ground Application with Power Equipment.**

i. Leave at least 25 feet untreated on each side of all Class I streams, flowing Class II streams and areas of open water.

ii. When applying fertilizer, leave at least 10 feet untreated on each side of all streams and areas of open water.

**g. Hand Application.**

i. Apply only to specific targets; such as, a stump, burrow, bait, or trap.

ii. Keep chemicals out of all water sources or streams.

**h. Limitations on Applications.**

i. Chemicals shall be applied in accordance with all limitations and instructions printed on the container registration labels and others established by regulation of the director.

ii. Do not exceed intended or allowable dosages.

iii. Prevent direct entry of chemicals into any water source or stream.

**i. Daily Records of Chemical Applications.**

i. When insecticide or herbicide sprays are applied on forest land, the operator shall maintain a daily record of spray operations which includes:

(a) Date and time of day of application.

(b) Name and address of owner of property treated.

(c) Purpose of the application (control of vegetation, control of Douglas-fir tussock moth, etc.).

(d) Contractor's name and pilot's name when applied aerially. Contractor's name and/or applicator's name for ground application.

(e) Location of project (section, township, range and county).

(f) Air temperature (hourly).

(g) Wind velocity and direction (hourly).

(h) Insecticides and herbicides used including name, mixture, application rate, carrier used and total amounts applied.

ii. Whenever rodenticides or fertilizers are applied, the operator shall maintain a daily record of such application which includes a, b, d, and e above and the name of the chemical and application rate.

iii. The records required in i and ii above shall be kept for three years.

<u>iv</u>. The records required in i and ii above shall not be required for ground application on less than 20 acres.

<u>j</u>. **Container Disposal.** Chemical containers shall be (1) removed from the forest and disposed of in a manner approved by the director in accordance with applicable local, state and federal regulations, or (2) removed and cleaned for reuse in a manner consistent with applicable regulations of a state or local health department.

<u>k</u>. **Spills** shall be reported and appropriate cleanup action taken in accordance with applicable state and federal laws and rules and regulations.

<u>i</u>. All potentially damaging chemical accidents and spills shall be reported immediately to the director.

<u>ii</u>. If chemical is spilled, appropriate procedures shall be taken immediately to contain or neutralize it.

<u>iii</u>. It is the applicator's responsibility to collect, remove, and dispose of the spilled material in a manner approved by the director.

<u>l</u>. **Applicator's Responsibility to Report Contamination.** Whenever chemicals are applied to forest land, it is the responsibility of the applicator to report suspected chemical contamination of streams or other bodies of water immediately to the director.

## RULE 7. SLASHING MANAGEMENT

<u>a</u>. **Purpose.** To provide for management of slashing and fire hazard resulting from harvesting, forest management, or improvement of forest tree species, or defoliation caused by chemical applications in that manner necessary to protect reproduction and residual stands, reduce risk from fire, insects and disease or optimize the conditions for future regeneration of forest tree species and to maintain air and water quality, fish and wildlife habitat.

b. **Fuels and debris** resulting from a forest practice involving removal of a commercial product shall be managed as set forth in the Idaho Forestry Act, Idaho Code, title 38, chapters 1 and 4, and the rules and regulations pertaining to forest fire protection.

c. **Fuels and debris** resulting from a forest practice where no commercial product is removed shall be managed in a manner as hereinafter designated under authority of the Idaho Forest Practices Act, title 38, chapter 13, Idaho Code.

i. Within ten (10) days or a time mutually agreed upon following receipt by the department of the "Notification of Forest Practice" as provided in Rule 2.e., the department shall make a determination of the potential fire hazard and hazard reduction and/or hazard offsets, if any, needed to reduce, abate or offset the fire hazard. Such determination shall be based on a point system found in Rule 7.c.v.

ii. The operator, timber owner and landowner shall be notified in writing of the determination made in paragraph i. above (on forms provided by the department) and of the hazard reductions and/or hazard offsets, if any, that must be accomplished by the operator, timber owner or landowner. The notification shall specify a reasonable time period not to exceed twelve (12) months from the date the forest practice commenced in which to complete the hazard reduction and shall specify the number of succeeding years that on site improvements or extra protection must be provided.

iii. A release of all obligations under Rule 7.c. shall be granted in writing on forms provided by the department when the hazard reduction and/or hazard offsets have been accomplished. When hazard offsets are to be accomplished during succeeding years, the release shall be conditioned upon the completion of the required hazard offsets. Notification of release shall be mailed to the operator, timber owner and landowner within seven days of the inspection by the department. Inspections by the department shall be made within ten days of notification by the operator, timber owner or landowner unless otherwise mutually agreed upon.

iv. If the department determines upon inspection that the hazard reduction and/or hazard offsets have not been accomplished within the time limit specified in Rule 7.c.ii., extensions of time, each not to exceed three months, may be granted if the director determines that a diligent effort has been made and that conditions beyond the control of the party performing the hazard reduction and/or hazard offsets prevented completion. If an extension is not granted the department shall proceed as required in Section 38-1307, Idaho Code (Idaho Forest Practices Act).

v. For the purpose of determining the potential fire hazard and the appropriate hazard reduction and/or hazard offsets, a point system using the following rating guides will be used by the department. A value of 80 points or less for any individual forest practice under Rule 7.c., as determined by the department, will be sufficient to release the operator, timber owner and landowner of all further obligations under Rule 7.c. Total points of the proposed forest practice will be determined from Tables I and II. If the total points are greater than 80, modification of the thinning practice to reduce points may be made as determined by Tables I and II, slash hazard offsets may be scheduled to reduce points as determined by Table III or a combination of these options may be used to reduce the hazards to a point total of 80 or less. Consideration will be given to the operator's, timber owner's and landowner's preference in selecting the options to reduce the points to 80 or less.

**Table I**

**HAZARD POINTS**

**Hazard Points for Ponderosa Pine, Western Red Cedar or Western Hemlock**

| Ave. | Thinned Stems Per Acre | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DBH | 250 | 500 | 750 | 1000 | 1250 | 1500 | 1750 | 2000 | 2500 | 3000 | 4000 |
| 1 | 1 | 2 | 3 | 3 | 4 | 5 | 6 | 7 | 9 | 10 | 16 |
| 2 | 3 | 6 | 9 | 13 | 16 | 22 | 25 | 30 | 36 | 42 | 51 |
| 3 | 7 | 16 | 25 | 32 | 38 | 46 | 51 | 52 | 56 | 59 | |
| 4 | 9 | 22 | 32 | 40 | 50 | 52 | 54 | 56 | 60 | | |
| 5 | 13 | 28 | 40 | 51 | 54 | 56 | 59 | 60 | | | |
| 6 | 19 | 36 | 51 | 54 | 58 | 60 | 60 | | | | |

**Hazard Points for Douglas Fir, Grand Fir or Engelmann Spruce**

| Ave. | Thinned Stems Per Acre | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DBH | 250 | 500 | 750 | 1000 | 1250 | 1500 | 1750 | 2000 | 2500 | 3000 | 4000 |
| 1 | 1 | 2 | 3 | 4 | 6 | 7 | 8 | 9 | 13 | 16 | 22 |
| 2 | 4 | 7 | 13 | 16 | 22 | 28 | 32 | 36 | 42 | 50 | 54 |
| 3 | 8 | 19 | 28 | 36 | 44 | 51 | 53 | 54 | 58 | 60 | |
| 4 | 10 | 25 | 36 | 46 | 51 | 54 | 57 | 59 | 60 | | |
| 5 | 16 | 32 | 46 | 52 | 56 | 59 | 60 | 60 | | | |
| 6 | 22 | 40 | 52 | 56 | 60 | 60 | 60 | | | | |

**Hazard Points for Western Larch, Lodgepole Pine or Western White Pine**

| Ave. | Thinned Stems Per Acre | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DBH | 250 | 500 | 750 | 1000 | 1250 | 1500 | 1750 | 2000 | 2500 | 3000 | 4000 |
| 1 | 1 | 2 | 2 | 3 | 4 | 4 | 5 | 6 | 8 | 9 | 13 |
| 2 | 3 | 6 | 8 | 11 | 16 | 19 | 22 | 28 | 32 | 38 | 48 |
| 3 | 6 | 16 | 25 | 32 | 38 | 46 | 51 | 52 | 56 | 59 | |
| 4 | 8 | 16 | 28 | 36 | 44 | 50 | 52 | 54 | 58 | | |
| 5 | 9 | 22 | 32 | 42 | 50 | 53 | 55 | 57 | | | |
| 6 | 13 | 28 | 40 | 50 | 53 | 56 | 59 | | | | |

Table II

**HAZARD POINTS WORKSHEET**

| **HAZARD CHARACTERISTICS** | **HAZARD POINTS** |
|---|---|

Fuel Quantity

Hazard points from Slash Hazard Table I 1/ ________
Record number of trees/acre to be cut ______
Average D.B.H. ________
Predominant species ________

Size of thinning block

| Points | 0 - 15 | 16 - 30 | 31 - 45 | 46 - 60 | 1/ |
|---|---|---|---|---|---|
| Acres | 20 | 20 - 40 | 40 - 80 | 80 | |

________

Site Factor

Record Slope ______ % Aspect ________
Determine points from table below 1/

| ASPECT | PERCENT SLOPE | | | |
|---|---|---|---|---|
| | 0 - 19 | 20 - 39 | 40 - 59 | 60 |
| E or NE | 0 | 5 | 10 | 20 |
| E or NW | 0 | 5 | 10 | 30 |
| W or SE | 0 | 10 | 30 | 40 |
| S or SW | 0 | 20 | 40 | 60 |

1/ Max. 60 points

Other Factors

Condition of operating area before forest practice commences 0-20 points ________

Condition of adjoining area 0-20 points ________

Presence of snags and culls 0-5 points ________

Deterioration rate of slash 0-5 points ________

Time of year forest practice operation 0-10 points ________

- - - - - - - - - - - - - - - - - - -

October thru December - 2 points
August thru September - 4 points
January thru April - 7 points
May thru July - 10 points

- - - - - - -

TOTAL FOREST PRACTICE AREA POINTS ________
(Max. 240 pts.)

Table III

**HAZARD OFFSETS**

| OFFSETS | HAZARD POINT DEDUCTIONS |
| --- | --- |
| Physical Changes to the Hazard[1] | |
| ***Disposal*** by burning or removal. | 0 - 160 |
| ***Modification*** by reducing depth through crushing, chipping or lopping. | 0 - 60 |
| On Site Improvements | |
| ***Condition of main access road*** to forest practice area should allow movement of heavy trucks without difficulty. | 0 - 5 |
| ***Access control*** to forest practice area provided by closure to public traffic. | 0 - 5 |
| ***Availability of water*** for tankers within one mile of forest practice area or within three miles for helicopter bucket use. Water supply to be sufficient to supply at least 50,000 gallons. | 0 - 15 |
| ***Buffer zones*** of unthinned areas at least two chains in width between roadways and thinned areas. | 0 - 10 |
| ***Fuel breaks*** with slash hazard removal around and/or through forest practice area, located so as to provide optimum fire control effect and of two to four chains in width. | 0 - 25 |
| ***Fire trails*** with fuel removed to expose mineral soil to a width of 12 feet. Maximum points allowed if combined with a fuel break. | 0 - 15 |
| Extra Protection | |
| ***Increased attack capability*** such as retardant availability, increased attack manpower and equipment. Must be in addition to regular forces normally available during the fire season. | 0 - 40 |
| ***Fire detection and prevention*** increased beyond that normally available for lands in the fire protection district. | 0 - 15 |
| ***Initial attack time*** based on proximity of forest practice area to initial attack forces. | 0 - 5 |
| ***Landowner protection plan*** which would provide extra fire protection on a voluntary basis such as extra equipment and/or manpower. | 0 - 5 |

[1] Points will be proportional to the amount of hazard disposed of or modified

# NOTES