KLAMATH RIVER EDUCATIONAL PROGRAM

Grades 9-12
Fiscal Years 1992 & 1993

U.S. FISH AND WILDLIFE SERVICE
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FINAL REPORT

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Submitted by:
Diane Higgins, Coordinator
Klamath River Educational Program
4649 Aster Avenue
McKinleyville, CA 95521

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Abstract

The Klamath River Educational Program (KREP) is being developed for public schools as part of the Klamath River Basin Fisheries Restoration Program. The goals of the program are to increase awareness of and knowledge about salmon habitat requirements, habitat restoration, and harvest management. To help facilitate the inclusion of these topics in school curriculums, the KREP is providing teaching units, research materials, videos, slide shows and equipment to interested teachers. Training sessions for teachers are also provided. The program is being implemented in Del Norte, Humboldt, Trinity and Siskiyou Counties in California; and in the upper Klamath River Basin, in Oregon. At this time, curriculum has been developed for grades 4-12, and teachers of those grade levels have also been trained. This report covers the development of the 9-12th grade portion of the program, which took place during 1992 and 1993.

The 9-12th grade curriculum consists of units of study for biology, chemistry and social studies/geography courses, and of one lesson plan for an economics course. The biology unit involves students in an assessment of their watershed and field studies to gather information about the past and present state of the fisheries resource in their watershed. The chemistry unit focuses on the oxygen/carbon dioxide, nitrogen and phosphorus cycles in aquatic environments and on monitoring water quality in a stream or lake. The social studies/geography unit is about water use in California and how it impacts aquatic habitats and salmon. The economics lesson is based on a computer simulation about fish harvest. Two guides for infusing fisheries topics into biology and economics courses have also been prepared.

The KREP sponsored two week-long summer institutes for students. Participants traveled along the Klamath River and major tributaries. They visited watershed and river restoration sites, observed fish and their habitats by snorkeling, and talked to resource managers and people whose livelihoods depend on the fish. In the summer of 1992, a summer institute was conducted for ninth and tenth grade students from throughout the Klamath River Basin. Besides increasing their knowledge about fisheries issues, a major goal of the summer institute was to make students aware of career options in natural resources. In the summer of 1993, another summer institute was conducted as part of a special class offered at Eureka High School. These students are preparing a slide presentation about the Klamath River fisheries resource which they will present to students in other schools during the 1993-94 school year.

A two-day retreat for teachers provided an opportunity to exchange teaching strategies, ideas and experiences. Many of the teachers who have worked with the KREP are implementing watershed/fisheries programs in their schools. The KREP has provided technical support and advice to many of these teachers.

INTRODUCTION

In 1986, the U.S. Congress enacted the Klamath River Basin Fishery Resources Restoration Act (PL 99-552), setting in action a twenty year program for restoring the anadromous fish populations within the Klamath River Basin. The Act established the Klamath River Basin Fisheries Task Force (Task Force) to assist the Secretary of the Interior in formulating, coordinating and implementing the program. Recognizing the fundamental role education can play in bringing about change, the Task Force made education one of the Restoration Program goals. Funding has been provided for public information and education, and for education in public schools. Public information and education is being coordinated by the U.S. Fish and Wildlife Service staff in the Klamath River Fishery Resource Office. Education in public schools is being addressed through the Klamath River Educational Program (KREP), which is being developed under contract with the U.S.Fish and Wildlife Service.

The goal of the KREP is to have citizens within the Klamath River Basin who appreciate the value of the fishery, who know what constitutes healthy habitat and who understand that human activities are closely linked to the state of the fishery resource. To achieve this goal, the program is developing curriculum materials about the life history habitat needs and harvest management of the Klamath River anadromous fish, and is working with individual teachers or school districts that are using these materials.

Units of study have been developed for high school biology, chemistry and social studies classes. Two outlines were prepared that show teachers how fisheries and resource management topics can be infused into traditional courses in biology and economics. A matrix showing the articulation of fisheries concepts throughout grades K-12 was also developed. School districts may use this matrix to help them design science programs that include fisheries and resource management topics.

The KREP supports teachers in their efforts to implement the curriculum. Teachers call upon the KREP to help conduct field trips, set up study sites, and to help in the classroom. The KREP also operates a loaning library of resource materials such as videos, slide shows, field equipment and research materials. The KREP also sponsored a retreat where teachers shared their teaching strategies and experiences.

Two summer institutes were conducted for high school students. These were designed to increase students' awareness about fisheries issues and careers in natural resources.

The KREP worked closely with the Adopt-a-Watershed Program in Trinity County while developing the biology unit, which has been included as one of the units for that program. This type of coordination ensures that there is no duplication of efforts by the two programs.

METHODS AND MATERIALS

Curriculum Development

The first objective of the program was to develop curriculum for use in high schools. This was achieved by conducting several meetings with individual teachers, and with teams of teachers. At these meetings, we discussed which topics would be most appropriate for the various courses. We prepared outlines of potential lessons, and decided which ones needed to be pilot tested. Teachers taught those lessons during the 1992-93 school year and we then discussed the results. Several teachers submitted summaries of the units they had taught, and shared materials they had used. This information was used to design the final units for the KREP.

The biology unit was developed in cooperation with the Adopt-A-Watershed Program. We conducted three planning meetings at Hayfork High School, where we created lists of potential topics and lessons. Several of these lesson ideas were tested by the biology teacher at Hayfork High School. We decided that the unit should involve students in real scientific inquiries that would require field work, laboratory work and research. These inquiries would focus on the fish populations in a stream or river near the school and would illustrate the close connection between the state of the fishery and the condition of the watershed. With these general guidelines in mind, the contractor wrote a unit outline and refined these ideas with the director of Adopt-A-Watershed, Kim Stokely.

A draft unit was written by the contractor and was reviewed by a panel comprised of resource managers, fisheries biologists and educators, which was organized by Kim Stokely. Kim sent her edited copy of the unit along with comments from the review panel back to the contractor. The unit was revised according to their suggestions.

The biology unit requires a considerable amount of research. Since many students in the Klamath River Basin do not have access to the necessary scientific reports and other research materials, these were gathered by the contractor. Copies of these materials are available on loan from either the KREP library or the Adopt-A-Watershed library.

The social studies unit was designed after meetings with two teachers at Hayfork High School and several teachers at Eureka High School. The Hayfork teachers expressed concerns about adding anything new to civics and economics courses which they barely had time to teach. Although they acknowledged the importance and relevance of fisheries to their community, they seemed doubtful that they could teach an entire unit on resource management. The economics teacher at Eureka High School voiced the same concern, and said that a simulation activity would be the most useful type of lesson. With this advice, the contractor decided to develop

only one lesson for economics and to make geography the focus of the social studies unit.

Two meetings were held with a team of teachers at Eureka High School who teach at-risk students. The social studies teacher expressed an interest in teaching a geography unit about water. The contractor loaned him maps, videos, and materials from the Water Education Foundation. He taught a unit and discussed the results with the contractor at a follow-up meeting. Notes from his experience guided the development of the geography unit. After this unit was written, it was reviewed by the teacher and minor revisions were made. The contractor compiled most of the materials used for this unit, which include maps, videos, newsletters, Water Education Foundation materials, and books.

The geography unit addresses the topic of water use and its impact on salmon, steelhead and other fish populations. This is a topic of great concern in the Klamath River Basin. It is also a very sensitive topic. For this reason, the contractor decided to broaden the focus to include all of California. By doing this, teachers can avoid direct "finger pointing" at water users in their own community, while still teaching students about the issues and problems involved with water use. Also, since it encompasses the entire state, there is a clear rationale for teaching it: to study California's geography. One lesson of the unit does involve students in looking at water issues in their own region.

The chemistry unit was written by the contractor with advice from teachers from Eureka High School and Fortuna High School. As with the geography unit, a general approach was taken. The most obvious way to teach fisheries restoration topics in a chemistry course is through water quality. Agriculture, grazing and timber harvest are the land uses that most seriously affect water quality in the Klamath River Basin. By focusing on the biogeochemical cycles for nitrogen, phosphorus, oxygen and carbon, the unit allows students to learn about nutrient overloading caused by livestock and fertilizers and the effect this has on the oxygen cycle and aquatic ecosystems. Several readings about sources of water pollution in the Klamath River Basin are included in the unit. The unit also provides suggestions for water quality monitoring projects. Since several excellent books about how to conduct various water quality tests are available, instructions for these tests were not included in the unit. Teachers can purchase these books or borrow them from the KREP library.

After the units were written, the contractor worked with an artist to have illustrations made. A list of teachers who helped create the units is included in Appendix A of this report. Copies of the units and the economic lesson are included as Appendices J,K,L and M.

Correlations Between Biology and Economics Textbooks and Fisheries Resource Topics

The second objective of the KREP was to create a guide for integrating fisheries issues into traditional "textbook centered" courses in biology and economics. This was accomplished by reviewing textbooks and talking to several teachers It was apparent that nearly every publisher of biology textbooks includes essentially the same topics. Although the organization and emphasis may vary, the same basic concepts are taught in almost all biology courses. This fact simplified the task somewhat. Using one popular textbook as the guide, the contractor went through each section and wrote down fisheries related topics that the teacher could discuss with her/his class to reinforce a concept, or could assign to students as research projects. The *Guide For Infusing River/Fisheries Topics Into a High School Biology Course* is included as Appendix B.

The *Guide For Infusing River/Fisheries Topics Into a High School Economics Course* (Appendix C) was written after reviewing the California Department of Education *Model Curriculum Standards*, several books about teaching high school economics and about the economics of natural resources. The important economic concepts that are related to natural resource management were identified. For each of these concepts, a summary of facts, issues, different points of view, and leading questions that could be used to generate class discussions was written.

Summer Institute (Retreat) for Teachers

The third objective of the KREP was to provide an opportunity for teachers to share their experiences with implementing fisheries and natural resource education. This objective was met by holding two retreats for teachers. The contractor had originally planned to hold this retreat during the summer of 1993. However, a summer institute for high school students was conducted instead, which caused the teacher retreat to be postponed. Since many teachers leave town during the summer, it was difficult to organize the event for the summer. An attempt was made to conduct the retreat on September 4-5, but only three educators were able to attend. The focus was on river ecology, as we did direct dive observation of salmon in the Salmon River and took a raft trip down a section of the Klamath River. The second retreat was well attended. It was held on October 2-3. A list of educators in attendance at both retreats and a summary of the presentations and discussions at the October 2-3 retreat is included as Appendix D of this report.

Articulation of Fisheries Topics in a K-12 Science Program

One of the topics discussed at the retreat was how to articulate fisheries and resource management topics throughout grades K-12. These discussions helped to clarify the form this type of guide should take. The contractor reviewed the California Department of Education *Model Curriculum Standards*, the *Curriculum Frameworks for*

Science and *Essential Learnings in Environmental Education*, published by the North American Association for Environmental Education when designing the guide. If a school wants to design a program that includes fisheries topics, this guide will help them to fit these topics into their science matrix. *The Guide for Articulating Fisheries and Resource Management Topics in a K-12 Science Program* is included as Appendix E.

Promoting Use of the KREP by Schools

The fourth objective was to expand awareness and use of the Klamath River Educational Program. To do this, the contractor visited schools districts within the Klamath River Basin and met with administrators and/or teachers. A brochure describing the KREP and services it provides was also created. A copy of this brochure and a list of school districts visited is included in Appendix F.

Provide Technical Support for Teachers and Help Them Find Funding

The fifth objective of the KREP was to lend support to teachers. Teachers are often hampered by their lack of knowledge about field techniques and lack of equipment to conduct field studies. The KREP helps teachers overcome these potential barriers to implementing fisheries studies in several ways. It maintains a library of equipment for use in the field and in the classroom. Items such as water quality test kits, magnifying boxes, kick nets, thermometers, and a dissecting microscope are available on loan. The library also contains videos about salmon, river restoration, and water use, several slide shows, other curriculums, extensive materials for student research projects and books. This library is used frequently by teachers.

The KREP also provides technical assistance with field trips, with setting up experiments or study sites, with conducting classroom activities such as identifying aquatic insect samples, and giving slide presentations.

The contractor has also helped teachers identify sources of funding sources for implementing fisheries education programs, and prepared one proposal for several schools in the river basin. A list of teachers who received technical assistance is included in Appendix G.

Summer Institutes for Students

The sixth objective of the KREP was to provide extracurricular opportunities for high school students to learn about the Klamath River and its restoration. A summer institute was held from August 24-28, 1992. Students who were entering the 9th and 10th grades in the fall of 1992 were invited to attend. Announcements and a cover letter were sent to teachers in schools throughout the Klamath River Basin and in other areas of Siskiyou and Humboldt Counties. Approximately 45 applications were received, and 23 students attended.

The goals of the summer institute were to increase students' awareness and knowledge about the fish, their habitats and the problems they face, and the people who depend on them. Another goal was to increase their awareness about careers in natural resources. Teachers who received the announcements for the summer institute were asked to encourage students who were possibly at risk of dropping out of school to apply. Students met people who were employed in a variety of natural resource careers during the week.

The announcement, cover letter, agenda, and list of participants are included in Appendix H. The Appendix also includes letters that students sent to the Chairman of the Klamath River Restoration Program's Task Force, William Shake.

Another summer institute was conducted July 5-9, 1993, for students from Eureka High School. These were students who had taken advanced biology from Bill Schaser, who had attended a Klamath River Summer Institute for teachers in 1991. He involved his students in studies of the Klamath River restoration, and a special summer school class was taught for a group of students who wanted to continue these studies. The objective of the summer class was for students to compile a slide show which they will present at schools throughout the Klamath River Basin during the 1993-94 school year. The summer institute was conducted to give them an opportunity to see the river and its major tributaries and to talk to people who are working to restore the river and its fish populations. Students took pictures to include in their slide presentation, talked to many experts and dove into several tributaries of the Klamath to observe fish and aquatic habitats. The agenda for this summer institute and a sample of student notes are included as Appendix I of this report.

RESULTS AND DISCUSSION

The results of the 9-12th grade portion of the Klamath River Educational Program development are the three units for biology, chemistry and geography and an economics lesson; two in-depth trainings for high school students; continued networking and communication between teachers who are implementing the program and technical support for these teachers. The KREP is not only reaching teachers, it is reaching students and the community at large.

CONCLUSIONS

The Klamath River Educational Program is having a significant impact on the level of knowledge about the fishery resource in the river basin. Students and adults are both learning from the efforts of the program. A number of parents of the students who attended the summer institutes have indicated that they learned about the restoration of the river from their children. When the

curriculum is taught in the schools, students take the ideas home to their parents.

A number of other programs have been developed at schools where KREP participants teach. Teachers are taking their knowledge back to their colleagues and are facilitating programs such as the adoption of the Wildlife Refuge on the Little Shasta River, the adoption of Trout Creek by McCloud Elementary School and the restoration work done on the upper Little Shasta and Shovel Creek by students at Dorris School.

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APPENDIX A

List Teachers Who Helped Develop 9-12th Grade Curriculum

LIST OF TEACHERS WHO HELPED DEVELOP 9-12TH GRADE CURRICULUM

Alan Brainard, Biology, Hayfork High School

Jim Burger, General Science, Eureka High School

Paul Bressoud, Social Studies, Eureka High School

Kim Stokley, Adopt-A-Watershed, Hayfork

Pam Halstead, Biology and Chemistry, Fortuna High School

Mildred Roberson, Civics and Economics, Hayfork Highs School

Bill Schaser, Biology, Eureka High School

Lee Turner, Economics, Eureka High School

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APPENDIX B

A Guide for Infusing River/Fisheries Topics Into a High School Biology Course

A GUIDE FOR INFUSING RIVER/FISHERIES TOPICS INTO A HIGH SCHOOL BIOLOGY COURSE

This guide has been prepared for teachers who structure biology courses around textbooks, but would like to include discussions and/or lessons that relate to fisheries and rivers. When a biology course is taught in a traditional way, there is often little time available for teaching an entire unit about fish or river ecosystems. However, the biological concepts that are taught can often be illustrated and reinforced with examples from fisheries. Students who are interested in fishing or stream environments will be more motivated to learn, and all students will see how biology is applied when textbook learning is coupled with examples of how biological knowledge is used in the real world.

The Holt, Rinehart, Winston *Modern Biology* was used as a model textbook when this guide was designed. However, since most textbooks (and basic biology courses) include the same major topics, this guide can be used with any textbook. The order of the units may differ, but the content will be mostly the same. The unit topics are listed in the left column, and the related fisheries facts or concepts are in the right hand column. Some of the units are also broken into subtopics. The resources listed below include curriculum manuals and reference materials that may be used by the teacher or students to investigate the subjects covered in this outline.

In addition to these materials, the teacher might encourage students to use school and community libraries to find more resources. Many of the suggestions given in this outline would make good research projects, or present opportunities for experiments.

RESOURCES

Klamath River Studies Grades 4-6, Klamath River Educational Program, 1990.

Klamath River Studies Grades 7-8, Klamath River Educational Program, 1992.

Klamath River Studies Grades 9-12, Biology, Klamath River Educational Program, 1993.

Anadromous Salmonid Genetic Resources An Assessment and Plan for California, National Council on Gene Resources, 1984.

Freshwater Fishes of California, S. McGinnis, U.C. California Press, 1984.

Freshwater Ecology, W. Andrews, Ed., Prentice Hall, Inc. 1972.

Fundamentals of Aquatic Ecology, R.S.K. Barnes and K.H. Mann, Eds., Blackwell Scientific Publications, 1991.

Field Manual for Water Quality Monitoring, M.K. Mitchell and W.B. Stapp

Long Range Plan for the Klamath River Basin Conservation Area Fisheries Restoration Program, U.S. Fish and Wildlife Service, 1991.

Aquatic Insects of North America, Merritt and Cummin, Kendall Hunt Publishing, 1984.

Nature Scope, National Wildlife Federation (A variety of booklets covering topics such as marshes, wetlands, endangered species, amphibians,, and more.)

The Stream Scene, Oregon Department of Fish and Wildlife, 1990.

California's Salmon and Steelhead: Our Valuable Natural Heritage, D. Higgins, 1989.

THE CONTINUITY OF LIFE

Raise salmon, steelhead or trout in classroom aquariums. Remove several eggs each day and have students observe and draw changes.

Principles of Heredity
Genetic Material

Discuss genetic studies in the field of fisheries. How do fish biologists get and analyze the genetic materials?

Applied Genetics

Fish hatcheries should be concerned with applying the principles of genetics when breeding fish. Arrange to visit a hatchery and discuss genetic concerns with the manager. Let him or her know in advance that this is your area of interest

Evolution
(Organic Variation)

Trace the evolution of the various kinds of fish from their common ancestors.

A stock of salmon or steelhead is a population that returns to spawn at a specific time and place. Because they spawn at different times and different places, stocks of fish of the same species, (eg. fal;l, winter or spring chinook salmon) are essentially isolated breeding populations.

The various stocks of salmon and steelhead, have developed special behavioral and physical characteristics that distinguish them from one another. These characteristics are the result of evolution. They represent the fishes' adaptations to conditions in the particular stream where they live. Stocks of fish are the first step toward the evolution of new species.

Students could research stocks of salmon and steelhead that are recognized throughout northern California or the Pacific Northwest.

Issues to discuss:
Why is it important to protect the various stocks of salmon & steelhead?

Is it wise to move fish stocks into rivers where they did not evolve? How might this impact the viability of the native fish in that river? How well would the transplanted fish survive?

Discuss concepts of coevolution and parallel evolution.

A good example of coevolution among species is the niche partitioning that occurs among chinook, coho and steelhead that live in the same stream. These fish have all evolved in the same environment, but use it slightly differently in order to minimize competition for food and space. They use different areas for spawning

Evolution, continued

and often spawn at different times of the year. Steelhead rearing in the stream will often be found in riffle areas, while coho prefer areas near logs and pools. Chinook fry usually migrate to the estuary soon after swimming up from the gravel, which reduces competition with the other fish.

Parallel evolution is probably best illustrated in aquatic insects that have evolved different traits that allow them to cope with the same environmental conditions. For example, to move around in or on the water, some insects are adapted for swimming, with

Diversity of Life - Classification

How are the fishes classified? There are three classes of fish and many orders and families. Find out how varied these forms of life are and the many adaptations that have evolved in the various kinds of fish. See where salmon fit into the classification scheme. What are salmon's closest relative, and how much do they have in common with salmon?

The classification of species is not a static thing. The recent reclassification of the steelhead trout from the genus Salmo to genus Onchorynchus is an interesting example of how new information or reevaluation of existing information can lead scientists to change the classification scheme.

If there is a hatchery nearby, you might be able to get a trout or salmon (or both) to dissect. Have students find and verify the features used to distinguish between species such as: number of rays in the anal fin, size of gill rakers, color of gums, presence and location of teeth, and body coloring.

Use keys to classify aquatic insects at least to order, and to family or genus if possible. If you can collect samples for several different river basins, you'll probably find different species of mayflies, caddisflies, etc. The rate of evolution for insects is relatively fast, since the life cycle is short. Insects in different river systems often develop different reproductive organs. This means they are reproductively isolated from each other and thus are distinct species.

Discuss some of the more sophisticated concepts of species that are relevant to fisheries. Morphology is usually the basis for classification, but the fish's behavior may be equally important to survival. Behaviors such as time spent rearing in the stream or estuary, ocean migration routes, and the timing of spawning migration are a few behaviors that distinguish one stock of salmon from another. Other factors, like the time it takes the female fish's eggs to develop after entering fresh water, are probably directly related to the distance the fish must swim to get "home". These differences all occur among fish that are classified as the same species. To preserve genetic diversity represented in the stocks of fish, the Endangered Species Act has been applied to preserve endangered stocks, such as the winter run chinook in the Sacramento River.

Have students research the stocks of fish in the Klamath River Basin. Are any threatened or endangered? Were there runs of fish in the past that don't exist now?

MICROBIOLOGY

Viruses

IHN (infectious hematopoetic necrosis) is a virus that infects the livers of salmon and steelhead. It can be transmitted through the amniotic fluid. There are different strains of IHN, and some fish have been found to be resistant to certain strains. Scientists have discovered that some Idaho trout are resistant to the strain of IHN found in their local streams, which might suggest that over evolutionary time, fish can develop immunities to the virus. Unfortunately, widespread transplanting and moving of fish between hatcheries has spread strains of IHN, which has reached epidemic levels in some hatcheries. As with all viruses, there is no cure for IHN.

Bacteria

Testing various water samples for *Escherichia coli* would be a relevant activity for students. The presence of this bacteria indicates problems with runoff from grazing lands or cattle in the creeks, or with untreated sewage entering the stream. You could set up a one time experiment, or monitor over time, depending upon your interest and the extent of problems in your area. Often when there is *E. coli* present, there will be other related pollutants, such as phosphorous, heavy metals and solvents, or high biological oxygen demand associated with agricultural wastes. *E. coli* may increase during time of high runoff from the land. It may also become more concentrated in streams or lakes during times of low flow.

Bacterial Kidney Disease (BKD) affects a salmon's ability to adjust from fresh to salt water. Fish with this disease may look fine during their freshwater rearing stages. Hatchery practices, including transferring fish between river basins, have helped to spread this disease.

Infectious Diseases

Discuss infectious disease as it relates to the operation of hatcheries. Overcrowding increases stress and the probability that a disease will become epidemic. Non antiseptic practices may also contribute to the spread of disease. New diseases are sometimes introduced when fish are transferred between river basins.

Ask students if they think diseased hatchery fish should be destroyed or released into streams on the chance that they might survive. Destroying them would waste taxpayers' money, but releasing them could infect entire populations of native fish. What decision would they make?

Protozoa

Ceratomyxa shasta, a protozoa that flourishes in the Upper Klamath marshes, is deadly to most fish. Spores have been found in infected fish, but no one has found the adult phase. All native trout and steelhead in the Klamath Basin have been found to be resistant to this protozoa except for one population in a spring fed headwater stream that is above a waterfall. Ask students if they can suggest reasons for this.

Fungus

Fish have slime on their bodies to protect them from fungus. If anyone has seen spawning salmon, they may have noticed the spots of fungus that often are growing on the fishes' bodies. Their battle with boulders to get upstream and the sparring associated with spawning rubs the slime off and exposes areas to fungal infection.

Fungi are important in aquatic food webs. They break down leaves so insects can eat them.

Algae

Algae is the primary producer in streams. Fallen leaves from the riparian trees and algae comprise the major plant materials found in streams. You could scrape rocks in different locations (shady and sunny, swift and slow water) or at different times of the year. Compare and classify the algae you find.

Use a plankton net to collect zooplankton and planktonic alga. Sort them by size and type. Discuss the relationship between size, shape and surface area that is available for diffusion of nutrients into planktonic organisms. Calculate surface areas of various sized organisms.

Discuss the role of algae in the aquatic food web. How important is algae to salmonids?

Discuss how blooms of algae can indicate nutrient enrichment from fertilizers and/or grazing cattle.

Algae blooms in Upper Klamath Lake caused by nutrient enrichment from fertilizers have been responsible for massive fish kills. While the algae lives, the water is supersaturated with oxygen, but when it dies, the decaying process uses up oxygen, leaving water so oxygen depleted that fish and other organisms die.

Multicellular Plants

Multicellular plants are not common in cold, swift, freshwater streams where salmonids live. Algae are the most commonly found plants in these environments. Spring fed streams with even flow, or slow moving water in larger rivers may have abundant rooted aquatic plants. Challenge students to explain why this might be the case.

Plants found in lakes and marshes play an important role in the ecosystem. If there is a lake or marsh near you, collect some aquatic plants and have students use a key to identify them. Find out what animals depend on them for food or cover. What is their role in the ecosystem. For example, some marsh plants provide surfaces where bacteria grow. These bacteria break down "waste products" that are in the water, thus helping to purify the water.

PLANTS, continued

Study the plants in the riparian zone of your stream. Are the riparian plants different from those found upland? If so, why?

Discuss the role of riparian plants to the aquatic ecosystem. Roots are important for keeping stream banks stable. They can filter runoff from the land and during floods they catch soil particles. Trees and plants growing upland also keep the watershed stable and reduce erosion. Some trees, like alders, are nitrogen fixers. Terrestrial insects fall off trees into the water where they may be eaten by fish. Riparian plants are used by some species of aquatic insects during their adult, breeding stages. Trees provide shade to keep stream temperatures low, and roots and logs provide cover for fish.

Leaves from plants provide nutrients to the stream food web. The minerals and nutrients taken up through the plants' roots are released into the stream as they decay. The decaying leaves are eaten by insects and microscopic organisms.

Roots, trunks and stems that fall into the stream play an important role for fish. They make good cover, where fish can hide from predators or rest from currents. They also help shape the stream channel.

INVERTE-BRATES

Aquatic insects are important invertebrates in river ecosystems. There are also aquatic worms and snails. If you have the time to spend in class, and you want students to become familiar with classification of these animals, bring in samples from a stream lake or pond near you.

One method you might use is to take several buckets to the stream. Use a kick net to get samples of aquatic insects. Use a plankton net to collect floating organisms. Look along the margins of streams and on top of rocks for mollusks and worms. Take the buckets back to the classroom and have students work in small groups. Using microscopes, and/or magnifying glasses, students should sort all animals they find in the buckets, putting like organisms into the same group. If you have identification keys, students could attempt to identify the animals to order or family (or to genus or species when possible).

After samples have been sorted, students could count the number of groups to determine biodiversity, and count the number of individuals in each group to determine relative abundance. Ask students to design a possible food web, using the organisms in the sample. What are the roles of each type of organism (ie. which are consumers, first order predators, second order predators, etc.)

They could also classify insects as grazers, collectors, scrapers, and shredders. (You will need a powerful microscope to see the feeding parts.) Investigate relationships between adaptations and microenvironments where they live (pools, riffles, etc.)

For more information and ideas about how to use river organisms to teach about invertebrates, see the KREP curriculums and other

VERTEBRATES

Dissect fish during lab period. Fish might be obtained from a local hatchery or catch the fish yourself. (Keep fish refrigerated.) If you usually dissect frogs, you could make comparisons between fish and amphibians.

Use CD ROM discs or other computer programs designed for biology classes. Compare the fish you dissect with those shown on the computer program. How is each organism adapted to its environment.

Have students prepare slides of different kinds of cells. They can compare cells from heart, muscle, kidney, liver and brain tissues.

Students could list the various systems found in fish (circulatory, digestive, reproductive, etc.) Make diagrams and explain the parts, their individual functions, and the function of the system as a whole.

Study the physiological changes that allow anadromous fish to move from fresh to salt water, and then back. Why are these changes necessary ? (Discuss osmosis and salt concentrations)

Your study of fish morphology and physiology can be reviewed when you study human biology. How are fish similar to humans? How are they different. Are they more like humans, or like insects? Although fish may appear to be very different from us, many of their systems are similar to our own.

ECOLOGICAL RELATIONSHIPS

Aquatic ecosystems you could study include streams/rivers, estuaries, lakes and marshes. When studying ecosystems, try to include a field trip. Students will gain a better understanding of these systems if they can see the environments.

In the case of the Klamath River Basin, you could study the relationships between all these ecosystems. Marshes play an important role in purifying water and in regulating water supply (they release water during dry periods and hold it during wet periods)

Other possibilities for studying ecosystems include:
Links between watersheds and rivers, the role of riparian areas, changes in biota from headwaters to estuary, the roles of individual animals in ecosystems, the impacts of land uses on aquatic ecosystems, the impacts of dams to river systems.

Ecosystems, continued

You could compare the relative health of streams that are of the same size, gradient, etc. to see how they differ and how they are similar. Look at riparian zones, sample insects, look for frogs and salamanders, which are both indicators of water quality. Also, compare land uses in the watersheds of each stream.

Compare riparian zones of streams that have been impacted by floods with those that were not impacted.

The river continuum describes the changes in a river system from the headwater tributaries to the estuary. These ideas would reinforce the concepts of ecosystems.

There are several videos that could be shown to illustrate some concepts about aquatic ecosystems.

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APPENDIX C

A Guide for Infusing Natural Resource and Fisheries Topics Into a High School Economics Course

A GUIDE FOR INFUSING NATURAL RESOURCES AND FISHERIES TOPICS INTO A HIGH SCHOOL ECONOMICS COURSE

This outline was prepared to help teachers include classroom discussions about fisheries and watershed management in their economics courses. The guide lists some common economic concepts. Each concept is followed by information that could provide the basis of discussions that might increase participation and critical thinking by students. These are not intended to be lessons in themselves. They are provided only as suggestions for further investigations, debates or simply to encourage thought.

For lessons pertaining to these topics, refer to the *Klamath River Studies for High School Economics.* Also, the following books and articles may help you and your students understand the economics of natural resources.

For the Common Good, Redirecting the Economy Toward Community, the Environment, and a Sustainable Future, H. Daly and J. Cobb Jr., Beacon Press, 1989.

The Economic Imperative of Protecting Riverine Habitat in the Pacific Northwest, Oregon Rivers Council Research Report No. V, January 1992.

An Economic Evaluation of Anadromous Fishery Resources for the Siskiyou National Forest, F. Everest. USDA Forest Service, Siskiyou National Forest, Grants Pass, OR, 1975.

The Tragedy of the Commons, G. Hardin, **Science,** 162:1243-1248, 1968.

Pacific Salmon at the Crossroads: Stocks at Risk for California, Oregon, Idaho and Washington, W. Nehlsen, J.Williams and J. Lichatowich, **Fisheries**16(2):4-21, 1991.

Cadillac Desert, The American West and Its Disappearing Water, M. Reisner. Penguin Books, 1986.

Restoring the Balance, California Advisory Committee on Salmon and Steelhead Trout, 1988 Annual Report.

The Fisherman's Problem, Ecology and Law in the California Fisheries 1850-1980, A. McEvoy, Cambridge University Press, 1986.

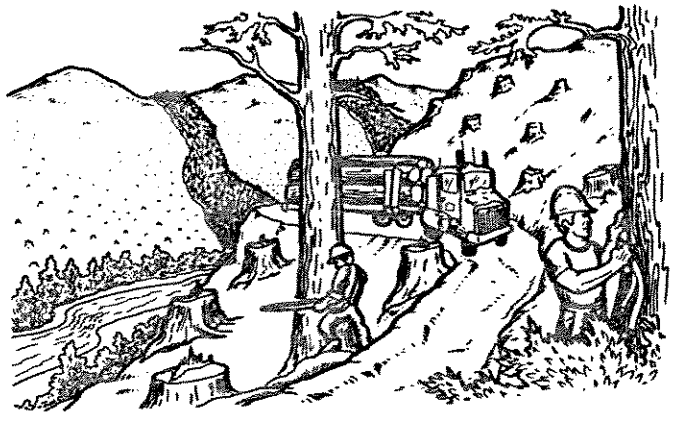
Unlimited Wants

The market economic system assumes that the desire for material goods is never satisfied, and that this fact requires that more and more natural resources (as well as human resources) are used to produce more goods and services. Is this a fundamental truth? Is it a basic human trait to always want more? Does the market economy itself give rise to this attitude? Are students aware of any society where people are satisfied with the material goods they have, or where acquisition of material goods is not the primary motivating factor? How does this economic model shape our views and attitudes towards the earth, natural resources, and our relationship to them? If desire for material goods and services is the main driving force, then are people in wealthy countries more satisfied with their lives than those in less developed countries? (Studies have shown that this is not the case. How would students explain this?)

If people were really by nature insatiable, why would aggressive advertising be necessary? Why are new gimmicks and novelty items advanced to replace last years "outdated" products. Wouldn't people simply buy these things naturally, on their own? What about desire for power and standing in one's community? Could these be viewed as equally compelling motivating factors? Do people ever look to nature, religion or family to give them a sense of fulfillment and contentment? Can (or do) these values equal material desires?

Self Interest

Another basic assumption of the market economy is that people are motivated primarily by self interest - the desire to make a profit. What impact could, or does, this have on the environment? Are people driven mainly by greed? Is it always true that as more people maximize individual profits, society at large benefits? Can students think of examples where this is not the case? Is there any evidence that people are willing to sacrifice some profit for the sake of cleaner air and water, for instance? Is it possible to have an economy that functions for the benefit of society and for the environment?



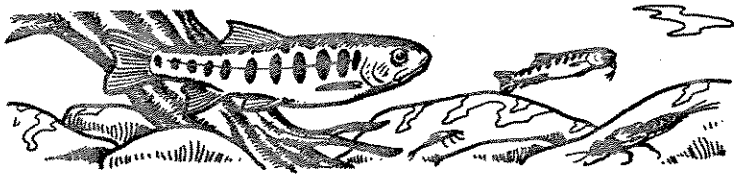
Economic Growth

The sustained increase of the nation's output is viewed as the most desirable condition in a market economy. Bigger is better, and people will always want more than they have now - this is the premise of economic growth. What are the consequences to natural resources and the environment of this view? Is it possible for our economy to experience unlimited growth given the finite nature of some natural resources? Is is possible to exhaust renewable resources, such as trees and salmon if growth it too great? What are the alternatives to unlimited growth? Is economic growth linked to population growth? Should either be limited?

Discuss the idea of the scale of economy. How could personal and societal choices change the ideas that unlimited growth is always best? Discuss carrying capacity as it relates to humans. Is it possible to run out of fresh water, land, and food?

Externalities

The costs that are external to a business or action are called externalities. A mill or factory that produces toxic waste that is dangerous to the environment and living creatures does not bear the cost of that burden. The cost is born by society - in the form of polluted water and air, and often in illness and death. Should industries bear these costs themselves? If so, how? When water is removed from streams to irrigate crops or for domestic use, the external cost is often the loss of aquatic ecosystems and the animals that live in them, including salmon. Should these costs be factored into the price of water? Is it fair to expect industries or communities to pay the real price of the water they use? Can a realistic price be put on that water? What information would be needed to price water according to the external costs of removing it from streams? Is it fair for society to bear all the external costs, so that agriculture can thrive? Does society benefit when agriculture thrives? Is it possible to find a balance between the health of aquatic ecosystems, peoples' desire for healthy ecosystems and salmon populations, and agricultural interests?



Government Regulations

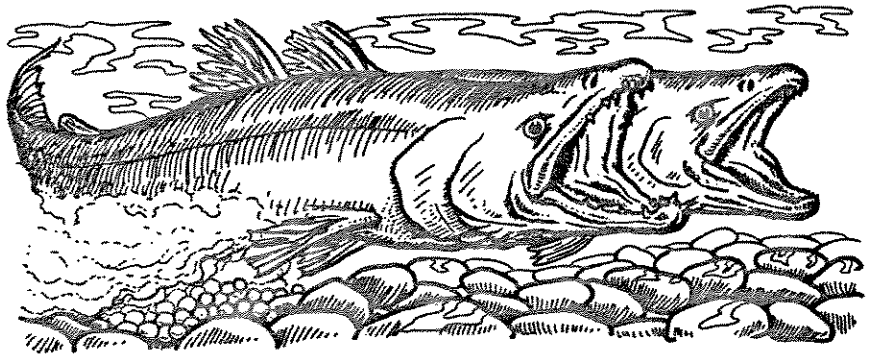
The government is involved in regulating many activities related to the use of natural resources. Commercial, sport and Native American ceremonial salmon fishing are all tightly regulated in the Klamath Management Zone and elsewhere. Government policies regulate the removal of water from rivers for agricultural, domestic and industrial purposes. Timber harvest is also regulated by a set of rules. While some people complain about over regulation, others feel that these activities are not controlled enough, or that rules are often not enforced. They point to massive soil erosion, dry creeks and stocks of salmon and steelhead on the verge of extinction as examples of the government's failure to protect natural resources.

Discuss the role of government in regulating activities of industries and individuals in order to minimize external costs and protect the public welfare. Are government regulations necessary? If left alone, would people make decisions based on public welfare, or on personal profit? If the premise of the market economy is personal profit, could those who operate their business in the best interest of society compete successfully? How much should the government regulate? Are existing rules followed? If not, what could be done to ensure compliance with regulations?

Public Trust Resources

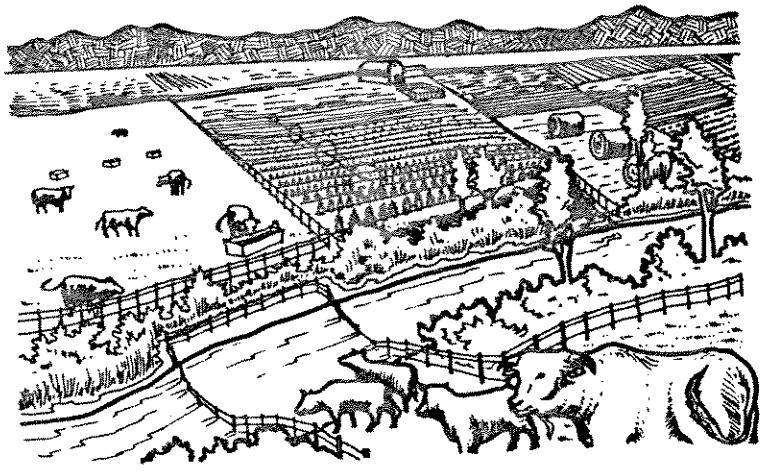
Water, air and wildlife (including fish) are all resources which, in theory, belong to everyone. Also, the trees and recreational opportunities provided on public lands, such as U.S. Forest Service land, belong to the public. Problems with managing these resources effectively stem partly from the fact that many agencies (both federal and state) are responsible for protecting them, and jurisdictions often overlap. Agencies do not always agree on how to best manage public resources, and political pressures exerted by special interest groups confuse things even more.

The salmon are an excellent example of a public trust resource that has been harmed by management practices on both public and private land. Agricultural interests have a very strong voice in politics, and they are able to shape policies to benefit themselves.



While it can be argued that cheap, unlimited water supplies help to keep food prices low, which benefits the public, it can also be argued that the severe impacts to salmon populations caused by water diversions have injured the public.

A 1983 court decision (see *Restoring the Balance*, p. 46) regarding Mono Lake dictated that public trust values must be considered when issuing permits to remove water from lakes or streams. This did not solve the problems for fish however, since the fishery resource has usually been greatly undervalued. Therefore, when these resources were considered, they did not factor into the equation in a realistic way. *The Economic Imperative of Protecting Riverine Habitat in the Pacific Northwest* contains estimates of the value of salmon to economies in the region. Use the charts that show the value per fish and the number of jobs created by the sport and commercial fishery to generate a discussion with your students. Ask students if they know anyone who has lost their job because of depleted salmon populations. Discuss the conflicts that exist between the timber, agricultural and fisheries interests. Are these conflicts necessary? Can they be resolved? How? What other public trust resources are undervalued?



Discuss the idea of the "tragedy of the commons", which says that resources that theoretically belong to everyone, but are under no one's direct control, tend to be over exploited. Can students think of examples? Is the market economic system responsible for this, or is it simply human nature? Are there other doctrines that could be followed to guide our use of public trust resources? (The Bible, or scientific knowledge for example.)

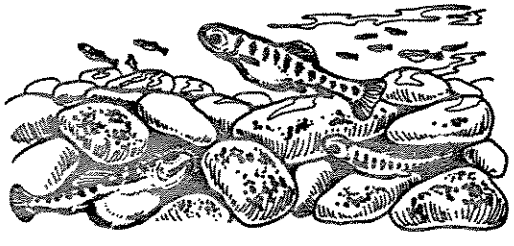
Private Ownership

Our legal and economic system is firmly rooted in the notion of private ownership. Our society is based on the concepts of individualism and freedom. When one person's freedom injures another person, or society, legal battles usually ensue. There is currently a heated debate about timber harvest practices on private land. Some argue that they are free to harvest their trees as they see fit, if they adhere to harvest rules. Others argue that harvest rules are inadequate to protect public trust resources, and that existing rules are sometimes not followed. Bring this debate to your class.

Clearcutting and logging roads often lead to extensive erosion during floods. When the soil washes into the stream, it degrades fish habitat and may cause fish populations to decline. Fish (and clean water) are public trust resources. Does a private land owner have a right to injure public trust resources? Does society have a right to regulate timber harvest activities, even if it means that profits may shrink and timber related jobs may be lost? Is it fair for the timber industry to profit at the expense of the fishing industry? Should future generations be considered when decisions about timber harvest are made? If soil is eroding, how might that effect the future productivity of the land? Who should decide whether current timber harvest rules are adequate for protecting stream habitats? What are some of the steps that should be taken to resolve these debates?

Natural Capital

Capital, as it is used in industry, refers to the accumulated goods of a business that are devoted to the production of other goods: the buildings, equipment, and other tangible possessions, as well as the working capital (money) required to meet payroll and restock products or buy new equipment are all considered capital. Usually, a business does not liquidate its capital, unless it is going out of business or re-tooling. If the business makes a profit, that money is often reinvested and the business will expand.

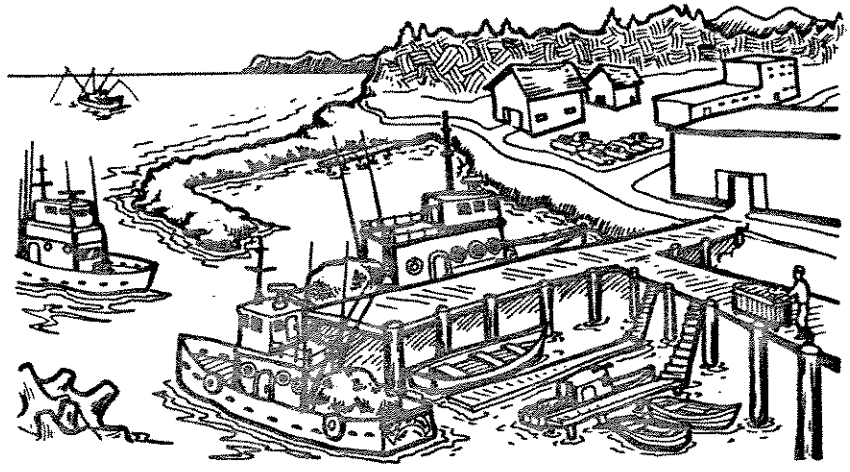


Industries that depend on natural resources, such as trees and salmon, are different from industries that manufacture products, but an analogy can be drawn. In the timber industry, the trees may be seen as part of the capital. Trees are renewable. When they are cut down, more will grow. As long as the rate of cutting does not exceed the rate of new growth, the industry can remain in a steady state. This is called sustainable harvest. But if the harvest level exceeds the rate at which trees are growing back to harvestable size, the industry is essentially spending its capital. This may eventually result in a situation where there are not enough trees to maintain business on the same level. The industry must either re-tool so it may extract another resource, or it must reduce its operations. This may result in lost jobs.

Discuss this situation with you students, as it relates to the harvest of old growth trees. It can be argued that environmentalists are responsible for the lack of old growth trees available for harvest, and for the impacts that are being felt by the timber industry. But if all the remaining old growth trees were taken in the next year or two, would the industry be better off? What are the trade-offs involved here? Is it reasonable to take the remaining old growth timber to make a profit today and then suffer the impacts to public trust resources? Salmon and owls are only the most widely recognized species affected when old growth is harvested. Is it good business practice to harvest trees at a rate that exceeds their growth rate?

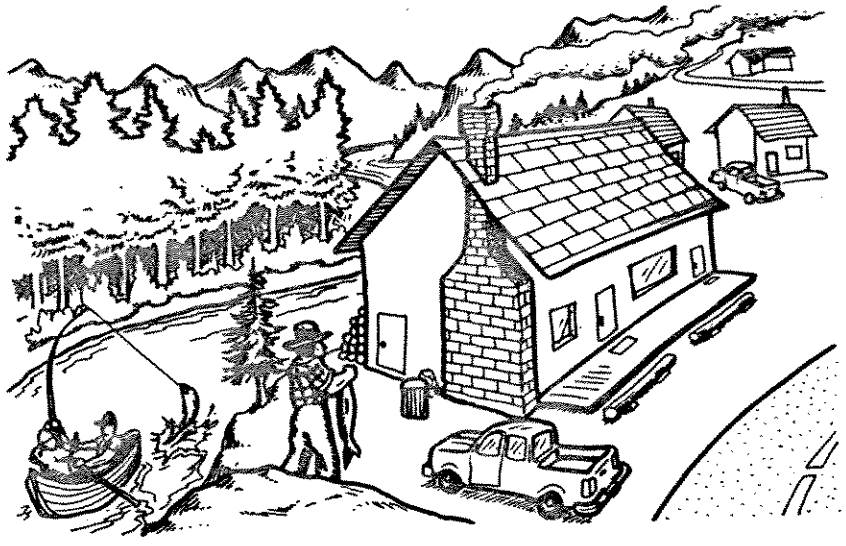
The same arguments can be applied to the fishing industry. Is it possible to over-fish salmon to the point where the population is not replenished at the same rate as it is harvested?

Is it fair to limit harvest of these fish, if regulations drive commercial fishermen out of business? What are the possible consequences of no harvest limits?



Opportunity Costs

When a resource is used for one purpose, often other possible uses are foregone. If a forest is designated as a national park, it can not be harvested. The choice to use the forest as habitat for wildlife and as a recreational area for humans is made at the cost of not harvesting the trees. When water is removed from a river for irrigation, the opportunity cost is the use of that water within the ecosystem. The ecosystem often suffers, but this is the cost of the decision. Discuss the concept of opportunity costs as it relates to natural resources. Often, the real economic value of natural resources is not recognized. In the case of the national park, the community will lose income from the harvest of trees. But the community may gain income from increased tourism and from a healthier fishery. Also, the non-monetary values of natural resources are usually overlooked completely in economic considerations. Should they be? Is money the only legitimate value to consider when decisions about resource uses are made?



Decision Making

When decisions are made regarding the best actions to take, the steps involve clearly identifying the problem, and then considering the costs, benefits and consequences of the decision. Do students feel that economic decisions are based on a full and clear understanding of the problems? Are important facts ever ignored or not recognized? When the costs and benefits of a particular action are considered, are they calculated accurately? Is it legitimate and logical to compare the benefits derived from a new industry that will produce toxic wastes with the cost of human lives that may be lost because of those toxins? How often are the real costs of externalities factored into the equation?

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APPENDIX D

Summer Institute for Teachers

SUMMER INSTITUTE FOR TEACHERS

Many of the teachers who attended Klamath River Summer Institutes have expressed a desire to share their experiences with implementing river and fisheries programs in their classrooms. To provide them with an opportunity to do this, two retreats were held. The first retreat was scheduled on (Labor Day weekend) and only a few teachers were able to attend. The second retreat was held on October 2-3, and was attended by 14 educators.

EDUCATORS WHO ATTENDED THE SEPTEMBER 4-5, 1993 RETREAT

Alan Eddy, 8th grade teacher and science mentor, Montague School
Dan Laney, Superintendent, Montague School
Stephanie Bennett, Big Lagoon Elementary School
Geoff Proust, Trinidad Elementary

On this retreat, we saw fish in the Salmon River, and took a raft trip down part of the Klamath River. It was a good opportunity to talk in depth with Alan and Dan, who have a model program at their school.

EDUCATORS WHO ATTENDED THE OCTOBER 2-3, 1993 RETREAT

Sally Burns, McCloud Elementary School
Dennis Cahill, Eureka High School
Alan Eddy, Montague School
Dan Laney, Montague School
Pam Halstead, Fortuna High School
Nina Gee, Hayfork Elementary School
Donna Scott, Hoopa Elementary School
Edna Watson, Junction School
Sue Terence, Forks of Salmon School
Dorothy Freudenberg, Sawyers Bar School
Sue Maurer, Siskiyou County Schools
David Van Scoyoc, Butte Valley High School
Valarie Van Scoyoc, Butte Valley High School
Patrick Higgins, Fisheries Biologist

SUMMARY OF OCTOBER RETREAT

The goal of the retreat was to provide a relaxed, informal environment where teachers could discuss their experiences and ideas. The retreat was held at Otter Bar Lodge, on the Salmon River. Teachers became acquainted, or re-acquainted, in the morning of October 2, and discussions continued throughout lunch. In the afternoon, we gathered as a group for a more structured share time. The following is a brief description of what each teacher had to show or tell.

Patrick Higgins and Diane Higgins started off with slides of the four KREP summer institutes and of various restoration projects or stream studies students have done.

Sally Burns shared photographs of the students from her school at their adopted Trout Creek. McCloud Elementary School has formed a partnership with the U.S. Forest Service and has helped with restoration work and building an interpretive trail along the creek. Students are also studying the ecology of the creek and watershed. Sally expressed the importance of having support from the administration for such projects.

Dennis Cahill discussed the changes that are occurring in science classes at Eureka High School. The physical and biological sciences are being merged into an integrated course. A discussion followed about how many opportunities this will provide for teaching about river ecology and fisheries. Some examples that came up were water quality and its impact on life in streams, land forms and how they relate to erosion, how erosion impacts stream habitats, stream morphology and how it relates to rock types, climate and the kinds of life found in the stream.

Alan Eddy and Dan Laney showed slides of their students at the Little Shasta River Wildlife Area, which their school has adopted. They had time- sequence pictures that showed the changes over the past three years. Alan talked about their experiences with rooting and planting willows. They planted 1,500 last year, and all but a few were eaten by muskrats. Now that the grass has come back, he thinks they will leave the willows alone, so they plan to plant again, only fewer trees.

Pam Halstead gave a multi-media presentation. She has developed a rap song to help her students learn the names of aquatic insects. She sang the song with a taped sound track. Pam's students have adopted Rohner Creek, in Fortuna. She had slides of students measuring stream flows, taking transects and sampling insects. She also gave out copies of a brochure

they helped produce about Fortuna's creeks. A discussion followed about how to deal with apathetic bureaucrats and parents who are suspicious of environmental education.

Susan Terence brought samples of student work, including beautifully illustrated books of poems about nature. She showed us an on-going list of observations about the natural world around them. She encourages students to make observations, and every day they add these to the list and discuss them. She and her students, have learned a great deal from this.

Dorothy Freudenberg discussed some things she has done with the computer, which started a discussion about the many opportunities for computer networking which still have not been realized. We talked about what can be done to overcome obstacles to setting up a river watch computer network.

Dave VanScoyoc showed a few slides and talked about the work his students did on upper Little Shasta River and Shovel Creek. Like Montague School, they planted many willows, but most died because of the drought. We talked about the techniques used at James Koch's nursery that high school students help to operate. He has had good success with rooting and transplanting trees.

Valarie VanScoyoc talked about her experiences with the fish rearing program. This led to a discussion about whether it is necessary or desirable for Siskiyou County Schools to require attendance at the training workshops even by teachers who have done the project in the past. We talked about new topics that could be addressed at these workshops.

Donna Scott talked about her experiences with teaching Hoopa children about their native fishery. We started talking about resources for teaching about Native Americans in the Klamath Basin. Later in the evening, several teachers went to Forks of Salmon School with Sue Terence to see her extensive collection of books on Native Americans.

Sue Maurer told teachers about the Eisenhower Grant that Siskiyou County Schools and College of the Siskiyous has received. They will be developing a program to get under-represented students into math and science careers. These careers will be in the field of natural resources. Sue described progress to date and discussed how schools could participate.

Louis Armon-Hoilan, who teaches biology at Arcata High School, could not attend the retreat, but he sent a video his students had made and copies of student reports from the last two years. His class has been responsible for taking Jolly Giant Creek out of a large, underground culvert which ran through school grounds, and bringing it back to the surface. They have restored a marsh area on the school grounds, as well. Students are conducting on-going studies and writing reports each year. This started another discussion about teaching styles and how to manage large projects such as this.

Discussions continued in small groups during dinner and into the evening. Teachers seemed very satisfied with the information they shared. Most commented that they had gotten ideas that they would take back to their classrooms. New relationships were developed which should help future efforts in the Siskiyou County program and possible computer networking programs.

On October 3, we took teachers to several sites on the Salmon River. Those who were hardy dove in to observe chinook salmon that were in pools.

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APPENDIX E

A List of Concepts and Fisheries/Resource Management Lessons To Use When Developing a Science Program Content Matrix

TABLE OF CONTENTS

INTRODUCTION

The California Science Framework has established a process for developing science programs. Part of this process involves creating a matrix which summarizes the important concepts and subconcepts to be taught at each grade level, and the themes that tie these concepts together.

This list of concepts and lessons was written to help educators decide which concepts about resource management and fisheries will best fit into their matrix, and to suggest lessons or units that could be used to help teach those concepts. The concepts are from the Essential Learnings in Environmental Education: A Database for Building Activities and Programs, which was published in 1990 by the North American Association for Environmental Education, P.O. Box 400, Troy, Ohio 45373.

The concepts are divided into categories, and each concept is preceded by a number 1, 2 or 3. These numbers indicate the learning level: 1 is basic and 3 is the most complex. The educator must decide at what grade level to introduce a particular concept, or sequence of concepts. While some level 1 concepts may be appropriate for primary grades, other level 1 concepts may be too abstract or complex for younger students.

Some of the concepts are closely related. A large number of concepts are listed to provide a variety of options. Each school staff will develop a matrix that is best suited to their overall educational goals, the needs of their students, the resources available, and the themes they choose. A matrix will not include all, or even most of the concepts included in this list, but only those that fit into the program best. These concepts may be used as the unifying, grade-level concepts or as subconcepts

The lessons and/or units listed after each concept are offered as possible methods for teaching the selected concepts. In some cases, these lessons may be adequate to teach a certain concept, but in most cases they should be used in conjunction with other lessons. For instance, to teach the concept of protective coloration, the suggested lessons about fish should be used with lessons about protective coloration in other animals (birds, mammals).

The lessons are from the following sources: California's Salmon and Steelhead: Our Valuable Natural Heritage, which is abbreviated here as **CS&S**; Klamath River Studies for Grades 4-6, and Klamath River Studies for Grades 7-8, abbreviated as **KRS 4-6** and **KRS 7-8**; and the Klamath River Studies for Grades **9-12**, which include the **Fisheries and Watersheds Unit** and the **Chemistry of Aquatic Environments Unit**. All materials are available from the Klamath River Educational Program.

GENERAL

ANIMALS

1 Animals include vertebrates (with backbones--fish, amphibians, reptiles, birds and mammals) and invertebrates (without backbones--such as snails, worms and insects.

CS&S: *ANIMAL CLASSES, CLASSIFYING FISHES*

1 Some animals are colored or can change color to blend visually with their background. This camouflage may serve as a means of protection from predators or a disguise during hunting.

CS&S: *GETTING INTO A FISH, BIG AS LIFE STEELHEAD,*
KRS 7-8: *FASHION A KLAMATH FISH, STREAM DIVERSITY PROTECTS SALMON*

1 Mobility in animals often helps them to escape unfavorable conditions. Many animals, including species of birds, insects, fish and mammals, migrate long distances to areas where conditions are more favorable for feeding and breeding.

CS&S: *CALIFORNIA'S SALMON AND STEELHEAD, SALMONID LIFE CYCLE, HOMING IN SNIFFIN' SALMON, WHY LIVE ANADROMOUSLY?*
KRS 4-6: *FOUR SPECIES OF SALMONIDS IN KLAMATH RIVER, ANADROMOUS FISH OF THE KLAMATH RIVER, LIFE CYCLE BULLETIN BOARD, THE NOSE KNOWS*
KRS 7-8: *COMPARING LIVES OF SALMON AND HUMANS*

BIOGEOCHEMICAL CYCLES

1 Biogeochemical cycles are the movement of elements between the biotic and abiotic components of the biosphere.

KRS 9 - 1 2: CHEMISTRY OF AQUATIC ENVIRONMENTS UNIT

2 Just six elements -- carbon, oxygen, nitrogen, hydrogen, phosphorus and sulfur -- make up 95% of the earth's biomass. Life depends on their efficient cycling through the biosphere.

KRS 9-12: CHEMISTRY OF AQUATIC ENVIRONMENTS UNIT

3 Some elements such as oxygen and nitrogen, cycle quickly and so are readily available for use by organisms. Others, such as phosphorous, are released from their immobile forms slowly depending on soil acidity and other factors. There elements are often limiting factors in plant growth.

KRS 9-12: CHEMISTRY OF AQUATIC ENVIRONMENTS UNIT

1 Nutrients are chemical elements or compounds essential for life. The most important of these are carbon, oxygen, hydrogen, nitrogen, potassium and phosphorous.

KRS 9-12: CHEMISTRY OF AQUATIC ENVIRONMENTS UNIT

2 Nutrients are cycled and recycled through food chains from plants to herbivores to carnivores. Finally, decomposer organisms break down dead plants and animals and release their nutrients to the soil or water body to be used again.

KRS 7-8: *AQUATIC FOOD PYRAMID AND ENERGY FLOW*
KRS 9-12: CHEMISTRY OF AQUATIC ENVIRONMENTS UNIT

2. Biological processes such as photosynthesis and respiration are part of biogeochemical cycling.

KRS 9-12: CHEMISTRY OF AQUATIC ENVIRONMENTS UNIT

2. Eutrophication occurs when nutrients (minerals and organic matter) accumulate in aquatic ecosystems, increasing plant growth and depleting oxygen levels. Sediment from erosion along with domestic and industrial sewage speed eutrophication.

KRS 9-12: CHEMISTRY OF AQUATIC ENVIRONMENTS UNIT

3. We have adversely changed the balance of some biogeochemical cycles.

KRS 9-12: CHEMISTRY OF AQUATIC ENVIRONMENTS UNIT

EVOLUTION

1 Where an organism can live and how well it can reproduce are limited by its heredity and environment.

KRS 4-6: *VARIATIONS IN HABITAT USE, INCUBATION PROJECT JOURNAL WRITING, SALMON LIFE STORY, SALMON SURVIVAL GAME, IS THIS GRAVEL GOOD FOR SPAWNING?*
KRS 7-8: *FASHION A KLAMATH FISH, STREAM DIVERSITY PROTECTS SALMON, LIMITING FACTORS*
KRS 9-12: FISHERIES & WATERSHEDS UNIT - *DIGGING DEEPER, PUTTING IT ALL TOGETHER*

2 A species is a distinct group of biological organisms capable of interbreeding yet isolated reproductively from all other organisms. Subspecies, or races sometimes occur when groups of the same species become isolated from one another.

KRS 4-6: *ANADROMOUS FISH OF THE KLAMATH RIVER, FOUR SPECIES OF SALMONIDS IN KLAMATH RIVER, FISH RUN CALENDAR*
KRS 7-8: *FISH RUNS OF THE KLAMATH- TRINITY RIVER*
KRS 9-12: FISHERIES AND WATERSHEDS UNIT

2 Organisms living in a particular environment show similar adaptive characteristics. For instance, many animals that live in water have gills that allow them to take oxygen from the water efficiently.

CS&S: *ANIMAL CLASSES, GETTING INTO A FISH*
KRS 4-6: *ANADROMOUS FISH OF THE KLAMATH RIVER, COMMON AQUATIC INSECTS OF THE KLAMATH RIVER*
KRS 7-8: *COMPARING LIVES OF SALMON AND HUMANS, COMPARING INSECTS IN DIFFERENT STREAMS*

2 Co-evolution is when two species evolve in response to each other's function and behavior.

KRS 4-6: *FISH RUN CALENDAR, VARIATIONS IN HABITAT USE, THE NOSE KNOWS*
KRS 7-8: *HOW SALMON & STEELHEAD SMOLTS USE THE KLAMATH RIVER ESTUARY*

ECOSYSTEMS

1 Ecosystem is defined as a community of organisms and their physical environment acting as an ecological unit. Ecosystems consists of interacting abiotic (nonliving) components (solar energy, water, air soil,

etc.) and biotic (living) components (plants, animals, etc.). The abiotic components link with the biotic components through energy flows and nutrient cycling.

CS&S: *THE RIVER ECOSYSTEM*
KRS 4-6: *INCUBATION PROJECT JOURNAL WRITING*
KRS 9-12: **FISHERIES AND WATERSHEDS UNIT**
KRS 9-12 **CHEMISTRY OF AQUATIC ENVIRONMENTS UNIT**

2 An ecosystem may be regarded as a machine fueled by energy and nutrients. Organisms decay, contributing nutrients to the soil which are then used by other organisms in the ecosystem. The energy use is almost always derived from the sun.

KRS 7-8: *AQUATIC FOOD PYRAMID AND ENERGY FLOW*
KRS 9-12: **CHEMISTRY OF AQUATIC ENVIRONMENTS UNIT**

2 The stability of an ecosystem may be disrupted by non-human or human factors. A large disturbance may alter or destroy an entire ecosystem.

CS&S: RIVER USES THAT THREATEN SALMON AND STEELHEAD
KRS 4-6: HARMFUL ACTIVITIES IN THE KLAMATH RIVER BASIN
KRS 9-12: **FISHERIES AND WATERSHEDS UNIT**
KRS 9-12: **CHEMISTRY OF AQUATIC ENVIRONMENTS UNIT**

3 Natural ecosystems (forests, lakes) are self-sustaining in that they function within the limits of available resources. Sustaining artificial ecosystems (cities, agricultural fields) requires external resources. For example, both cities and agricultural fields often require subsidies of water, nutrients and energy.

KRS 9-12: **FISHERIES AND WATERSHEDS UNIT**
KRS 9-12: **CHEMISTRY OF AQUATIC ENVIRONMENTS UNIT**

3 Each ecosystem has several fundamental characteristics that derive from the interactions of its components. In order to understand these characteristics the ecosystem must be understood in its entirety.

KRS 9-12: **FISHERIES AND WATERSHEDS UNIT**
KRS 9-12: **CHEMISTRY OF AQUATIC ENVIRONMENTS UNIT**

FOOD CHAINS AND WEBS

1 Food chains consist of producers, which make their own food, and consumers. Consumers can be herbivores, carnivores, omnivores or decomposers.

CS&S: *THE RIVER ECOSYSTEM*
KRS 7-8: *AQUATIC FOOD PYRAMID AND ENERGY FLOW*

2 Decomposers break down organic wastes and recycle their nutrients, but there are limits to their effectiveness. For example, untreated sewage and wastes dumped into a body of water can cause rapid growth in the population of aerobic decomposers, which may quickly deplete their supply of oxygen, so that they, and other organisms cannot continue to function.

KRS 9-12: **CHEMISTRY OF AQUATIC ENVIRONMENTS UNIT**

1 A trophic level consists of those organisms in a food chain that are the same number of steps away from the original source of energy. Green plants are grouped in the first trophic level, herbivores in the second level, and carnivores in the third, and so on.

KRS 7-8: *AQUATIC FOOD PYRAMID AND ENERGY FLOW*

2 Trophic levels may be organized into ecological pyramids with producers at the base and successive levels of consumers forming the higher layers. Pyramids can be based on numbers of organisms or amount of biomass at each level, energy flow, or other dynamics.

KRS 7-8: *AQUATIC FOOD PYRAMID AND ENERGY FLOW*

POPULATION

1 A population is a group a naturally-interbreeeding individuals of one species of plant or animal, living in a defined area and usually isolated to some degree from similar groups.

KRS 4-6: *ANADROMOUS FISH IN THE KLAMATH RIVER , FOUR SPECIES OF SALMONIDS IN KLAMATH RIVER, FISH RUN CALENDER, THE NOSE KNOWS*
KRS 7-8: *COMPARING INSECTS IN DIFFERENT STREAMS, FISH RUNS OF THE KLAMATH-TRINITY RIVER*

2 Populations are dynamic: they increase, decrease or stabilize depending on their interactions with other populations and with their environment.

KRS 7-8: *SALMON POPULATION TRENDS IN THE SHASTA RIVER, WHY FISH AND GAME LAWS, WHAT IS ESCAPEMENT?*
KRS 9-12: FISHERIES AND WATERSHEDS UNIT

1 A limiting factor is any factor of the environment which in excess or insufficient amounts diminishes a population or inhibits the growth or reproduction of an individual organism.

KRS 7-8: *LIMITING FACTORS, STREAM DIVERSITY PROTECTS SALMON*

1 The carrying capacity of an ecosystem is the maximum population of a given organism that the system can hold without being degraded. Carrying capacity is influenced by many variables, and can be altered by the management or mismanagement of resources.

KRS 7-8: *LIMITING FACTORS*

2 The carrying capacity of a system varies with environmental conditions. For example, drought will lower the carrying capacity of an ecosystem.

KRS 7-8: *LIMITING FACTORS, SEDIMENT EFFECTS ON SALMON EGGS, HOW SALMON AND STEELHEAD SMOLTS USE THE KLAMATH RIVER ESTUARY*

KRS 9-12: FISHERIES AND WATERSHEDS UNIT,
KRS 9-12: CHEMISTRY OF AQUATIC ENVIRONMENTS UNIT

2 Environmental barriers, whether natural (mountains, water falls) or artificial (roads, dams) influence the distribution and spread of populations.

CS&S: *RIVER USES THAT THREATEN SALMON AND STEELHEAD*
KRS 4-6: *SALMON LIFE STORY, HARMFUL ACTIVITIES IN THE KLAMATH RIVER, SALMON SURVIVAL GAME*
KRS 7-8: *FISH RUNS IN THE KLAMATH AND TRINITY RIVER BASINS*

1 Interactions among and between populations include territoriality, symbiosis, parasitism, predation and competition.

CS&S: *THE RIVER ECOSYSTEM, THE FISHING GAME, WILD FISH VS. HATCHERY FISH*
KRS 4-6: *VARIATIONS IN HABITAT USE, SALMON LIFE STORY*
KRS 7-8: *COMPARING INSECTS IN DIFFERENT STREAMS*

2 Territorial behavior is when an animal defends part of its habitat against other individuals or groups. It is usually associated with feeding and mating behaviors.

CS&S: *FISH BEHAVIOR, TROUT BREEDING AND SOME OF ITS PROBLEMS*
KRS 7-8: *HOW SALMON AND STEELHEAD SMOLTS USE THE KLAMATH RIVER ESTUARY*

2 Predation is the consumption of one animal by another. Predation is important to the stability of an ecosystem as it helps keep prey populations within the habitat's carrying capacity.

CS&S: *THE RIVER ECOSYSTEM, THE FISHING GAME*
KRS 4-6: *SALMON LIFE STORY, SALMON SURVIVAL GAME*

1 Competition results when two or more individuals or populations in a habitat struggle for the same resource.

CS&S: *FISH BEHAVIOR, TROUT BREEDING AND SOME OF ITS PROBLEMS*
KRS 4-6: *VARIATIONS IN HABITAT USE*
KRS 7-8: *HOW SALMON AND STEELHEAD SMOLTS USE THE KLAMATH RIVER ESTUARY, LIMITING FACTORS*

HABITAT AND NICHE

1 Habitat is the locality or particular type of environment naturally occupied by a species. For example, cold, fresh water streams are the salmon's habitat.

CS&S: *ENVIRONMENTAL NEEDS CHART, FIN RUMMY, POOLS AND RIFFLES*
KRS 4-6: *INCUBATION PROJECT JOURNAL WRITING, SALMON LIFE STORY*

2 Organisms are adapted to the particular abiotic and biotic conditions of their habitats.

CS&S: *GETTING INTO A FISH, POOLS AND RIFFLES*
KRS 4-6: *INCUBATION PROJECT JOURNAL WRITING, FISH TANK TEMPERATURE*

KRS 7-8: *COMPARING INSECTS IN DIFFERENT STREAMS, STREAM DIVERSITY PROTECTS SALMON*

2 A niche is the ecological role of a species in a community and the sum of its requirements of existence. Species which occupy well defined niches often exhibit highly specialized features.

CS&S: *POOLS AND RIFFLES*
KRS 4-6: *VARIATIONS IN HABITAT USE*
KRS 7-8: *COMPARING INSECTS IN DIFFERENT STREAMS, AQUATIC FOOD PYRAMID AND ENERGY FLOW*

3 Each species has a particular habitat and niche resulting from its unique adaptation to its environment. Understanding habitat and niche requirements helps us manage species.

CS&S: *POOLS AND RIFFLES*
KRS 4-6: *VARIATIONS IN HABITAT USE*
KRS 7-8: *COMPARING INSECTS IN DIFFERENT STREAMS*
KRS 9-12: **FISHERIES AND WATERSHEDS UNIT**

3 Diversity within a habitat leads to niche diversity.

CS&S: *POOLS AND RIFFLES*
KRS 4-6: *VARIATIONS IN HABITAT USE*
KRS 7-8: *COMPARING INSECTS IN DIFFERENT STREAMS, HOW SALMON AND STEELHEAD SMOLTS USE THE KLAMATH RIVER ESTUARY*
KRS 9-12: **FISHERIES AND WATERSHEDS UNIT**

3 Both plant and animal populations increase or decrease in response to the expansion or reduction of habitat. Humans are largely responsible for changing habitats. As a result some species have become extinct while others which thrive in human-altered environments have become abundant. Overall, the number of species (species diversity) has declined.

CS&S: *RIVER USES THAT THREATEN SALMON AND STEELHEAD, THREATS TO FISH*
KRS 4-6: *HARMFUL ACTIVITIES IN THE KLAMATH RIVER BASIN*
KRS 7-8: *COMPARING INSECTS IN DIFFERENT STREAMS, SALMON POPULATION TRENDS IN THE SHASTA RIVER*
KRS 9-12: **FISHERIES AND WATERSHEDS UNIT**
KRS 9-12: **CHEMISTRY OF AQUATIC ENVIRONMENTS UNIT**

NATURAL RESOURCES

MANAGEMENT AND CONSERVATION

1 We should not exhaust our resource capital, but try to live on the interest -- the renewable resources.

CS&S: *THE FISHING GAME*
KRS 7-8: *WHY FISH AND GAME LAWS?*

2 Studying and understanding resources is vital to managing and protecting them for future use.

KRS 7-8: *MEMORIES OF DAY AND FISH GONE BY, WHAT IS ESCAPEMENT, WHO'S WHO IN FISHERIES MANAGEMENT AND RESTORATION, WHO IS CATCHING KLAMATH FISH IN THE OCEAN?*
KRS 9-12: **FISHERIES AND WATERSHEDS UNIT**

2 Environmental management tactics should vary with the environment and the resources to be managed.

KRS 9-12: **FISHERIES AND WATERSHEDS UNIT**

2 Sound resource management depends on clear definitions of goals in both social and ecological terms. For example, wildlife conservation should consider human needs as well as the needs of wildlife.

KRS 4-6: *THE RESTORATION GAME, HARVEST MANAGEMENT ROLE PLAYING*
KRS 7-8: *WHY FISH AND GAME LAWS?*
KRS 9-12: **FISHERIES AND WATERSHEDS UNIT**

2 Effective conservation programs should involve the communities adjacent to the resource or affected by resource-use policy changes.

KRS 4-6: *THE RESTORATION GAME, HARVEST MANAGEMENT ROLE PLAYING*
KRS 7-8: *CAPPEL FISH DAM AND YUROK FISHERIES MANAGEMENT*
KRS 9-12: **FISHERIES AND WATERSHEDS UNIT**

2 Multiple-use management means management of a resource for the greatest possible good, for the longest time, with the least possible environmental damage. It means meeting many rather than single needs. For example, multiple-use management of wetlands may meet needs for

water storage, food production, flood control, wildlife habitat and recreation.

CS&S: *BEST MANAGEMENT PRACTICES*
KRS 4-6: *MAPPING RESOURCE USES OF THE KLAMATH RIVER BASIN, THE RESTORATION GAME*
KRS 9-12: **FISHERIES AND WATERSHEDS UNIT**
KRS 9-12: **CHEMISTRY OF AQUATIC ENVIRONMENTS UNIT**

1 Sustained yield means managing forestry, agriculture and other resources so that they produce continuously, unimpaired by periodic harvests.

CS&S: *THE FISHING GAME, BEST MANAGEMENT PRACTICES*
KRS 7-8: *WHY FISH AND GAME LAWS?*
KRS 9-12: **FISHERIES AND WATERSHEDS UNIT**

WATERSHEDS

1 A watershed is the land area that collects and channels water to a common outlet. Each lake, river and stream collects its water from the surrounding watershed.

CS&S: *NATURE'S SPONGE, HOW BIG IS YOUR WATERSHED, WATERSHED MODEL*
KRS 4-6: *THE KLAMATH RIVER WATERSHED, MAPPING RESOURCE USES OF THE KLAMATH RIVER BASIN*
KRS 9-12: **FISHERIES AND WATERSHEDS UNIT**

2 Lack of watershed management has resulted in accelerated erosion, loss of soil, and damage to stream and estuary environments.

KRS 4-6: *HARMFUL ACTIVITIES IN THE KLAMATH RIVER BASIN, RESTORING THE KLAMATH RIVER, THE RESTORATION GAME*
KRS 7-8: *MEMORIES OF DAYS AND FISH GONE BY*
KRS 9-12: **FISHERIES AND WATERSHEDS UNIT**
KRS 9-12 **CHEMISTRY OF AQUATIC ENVIRONMENTS UNIT**

3 Watershed planning requires a comprehensive plan for development and use of the water, soil and other resources in the watershed, even if divided by political boundaries. It should also consider the basic needs of the people living in that area.

CS&S: *BEST MANAGEMENT PRACTICES*
KRS 4-6: *THE RESTORATION GAME*
KRS 9-12: **FISHERIES AND WATERSHEDS UNIT**

LAND AND SOIL

2 Land use refers to the way in which we harness the potential resources of a given area. Categories of land use may be based on current use (e.g. agriculture, forestry, industry) or potential use (based on surveys of topography, soil type, etc.). Land-use planning is the use of this information to make decisions about long-term use of the land for maximum community benefit.

CS&S: *RIVER USES THAT THREATEN SALMON AND STEELHEAD, THREATS TO FISH, BEST MANAGEMENT PRACTICES*
KRS 4-6: *THE RESTORATION GAME*
KRS 9-12: **FISHERIES AND WATERSHEDS UNIT**

2 The most immediately profitable use of the land is not always the best use in terms of its long-term health and ecology.

CS&S: *RIVER USES THAT THREATEN SALMON AND STEELHEAD, THREATS TO FISH, BEST MANAGEMENT PRACTICES*
KRS 4-6: *HARMFUL ACTIVITIES IN THE KLAMATH RIVER BASIN, THE RESTORATION GAME*
KRS 9-12: **FISHERIES AND WATERSHEDS UNIT**
KRS 9-12: **CHEMISTRY OF AQUATIC ENVIRONMENTS UNIT**

3 The effects of land use tend to be cumulative. We therefore have an obligation to future generations to minimize our negative impact on the land.

KRS 4-6: *THE RESTORATION GAME*
KRS 9-12: **FISHERIES AND WATERSHEDS UNIT**
KRS 9-12: **CHEMISTRY OF AQUATIC ENVIRONMENTS UNIT**

2 Land is misused through deforestation, overgrazing, overcropping, intensive irrigation, and other forms of mismanagement and poor land-use practices. These can result in erosion, reduced groundwater recharge, deterioration of soil quality, salinization, lower crop yields, heavy siltation of surface waters and flooding of low-lying areas.

CS&S: *SAVE THAT SOIL, THREATS TO FISH, BEST MANAGEMENT PRACTICES*
KRS 4-6: *HARMFUL ACTIVITIES IN THE KLAMATH RIVER BASIN, THE RESTORATION GAME*
KRS 7-8: *PLANTING WILLOWS*
KRS 9-12: **FISHERIES AND WATERSHEDS UNIT**
KRS 9-12: **CHEMISTRY OF AQUATIC ENVIRONMENTS UNIT**

3 Severe soil erosion by wind or water has affected many areas. Soil erosion can be controlled through a variety of forestry and agricultural practices. Planting trees on slopes, and reducing agricultural soil are some examples.

CS&S: *SAVE THAT SOIL, THREATS TO FISH, BEST MANAGEMENT PRACTICES*
KRS 4-6: *HARMFUL ACTIVITIES IN THE KLAMATH RIVER BASIN, THE RESTORATION GAME*
KRS 7-8: *PLANTING WILLOWS*
KRS 9-12: **FISHERIES AND WATERSHEDS UNIT**
KRS 9-12: **CHEMISTRY OF AQUATIC ENVIRONMENTS UNIT**

2 Water quality and quantity in streams and aquifers depend to a large extent on forest cover. Where the cover is maintained, rainwater infiltrates the soil, streams are fed gradually by subsurface flows of relatively clean water, and aquifers are recharged by deep infiltration. Where forest cover is removed, especially on sloping land, more of the rainwater becomes surface runoff and streams are filled suddenly with silt-ladden water. Sedimentation of stream beds and more erratic stream flows increase the frequency and severity of floods.

CS&S: *SAVE THAT SOIL, THREATS TO FISH, BEST MANAGEMENT PRACTICES*
KRS 4-6: *HARMFUL ACTIVITIES IN THE KLAMATH RIVER BASIN, THE RESTORATION GAME*
KRS 7-8: *PLANTING WILLOWS*
KRS 9-12: **FISHERIES AND WATERSHEDS UNIT**
KRS 9-12: **CHEMISTRY OF AQUATIC ENVIRONMENTS UNIT**

FISH AND WILDLIFE

1 Wildlife refers to all animals and plants that are not domesticated. Wildlife is found everywhere: forests, parks, lakes, streams, school grounds, farms, cities and towns.

KRS 7-8: *WHY FISH AND GAME LAWS?*

3 To manage wildlife, it is necessary to manage the ecosystem, One species cannot be preserved in isolation; it depends on and is depended upon by the other species with which it interacts.

CS&S: *BEST MANAGEMENT PRACTICES*
KRS 4-6: *THE RESTORATION GAME*
KRS 9-12: **FISHERIES AND WATERSHEDS UNIT**
KRS 9-12: **CHEMISTRY OF AQUATIC ENVIRONMENTS UNIT**

2 Maintenance of productive habitats is one of the most effective tools for wildlife management.

CS&S: *BEST MANAGEMENT PRACTICES, WHAT'S WRONG?*
KRS 4-6: *THE RESTORATION GAME*
KRS 9-12: **FISHERIES AND WATERSHEDS UNIT**
KRS 9-12: **CHEMISTRY OF AQUATIC ENVIRONMENTS UNIT**

2 Regular monitoring of wildlife species and habitat is essential to ensure their conservation.

KRS 4-6: *THE RESTORATION GAME*
KRS 9-12: **FISHERIES AND WATERSHEDS UNIT**

3 Several wildlife management strategies should be incorporated into a comprehensive plan for management of a species. For example, hunting regulations on their own will not work to save a species whose habitat has been destroyed or seriously depleted.

KRS 4-6: *THE RESTORATION GAME*
KRS 7-8: *WHY FISH AND GAME LAWS?*
KRS 9-12: **FISHERIES AND WATERSHEDS UNIT**

3 Wildlife ownership is vested in the state. The government (at both federal and state levels) handles legislation, management and research related to wildlife. However, there is much concern and participation in wildlife conservation from individuals, local groups, and national and international organizations.

KRS 4-6: *CHANGES IN HARVEST OF KLAMATH RIVER FALL CHINOOK, HARVEST MANAGEMENT ROLE PLAYING, THE RESTORATION GAME*
KRS 7-8: *WHO'S WHO IN FISHERIES MANAGEMENT AND RESTORATION, WHY FISH AND GAME LAWS?, WHO'S CATCHING KLAMATH RIVER FISH IN THE OCEAN?*
KRS 9-12: **FISHERIES AND WATERSHEDS UNIT**

2 Fisheries resources are best preserved by protection of spawning and feeding habitats.

CS&S: *BEST MANAGEMENT PRACTICES, WHAT'S WRONG?, RESTORING HABITAT, WILD FISH VS. HATCHERY FISH*
KRS 4-6: *THE RESTORATION GAME*
KRS 9-12: **FISHERIES AND WATERSHEDS UNIT**
KRS 9-12: **CHEMISTRY OF AQUATIC ENVIRONMENTS UNIT**

POLLUTION

1 Pollution is any addition of an unwanted substance to or alteration of the environment that adversely affects human health or living systems.

KRS 9-12: FISHERIES AND WATERSHEDS UNIT
KRS 9-12: CHEMISTRY OF AQUATIC ENVIRONMENTS UNIT

2 Pollution may be nutrients, natural or artificial, which are not toxic in themselves but which may be harmful when introduced into the environment faster than they can be removed by natural processes.

CS&S: *SAVE THAT SOIL, RIVER USES THAT THREATEN SALMON AND STEELHEAD*
KRS 9-12: FISHERIES AND WATERSHEDS UNIT
KRS 9-12: CHEMISTRY OF AQUATIC ENVIRONMENTS UNIT

2 Water pollution comes from point and non-point sources. Point sources are pipe outlets and other direct and observable sources of pollution. Non-point sources include run-off of fertilizers, acid precipitation, and other large-scale "blanket" sources. These pollution sources are less easy to identify and control.

CS&S: *SAVE THAT SOIL, RIVER USES THAT THREATEN SALMON AND STEELHEAD*
KRS 9-12: FISHERIES AND WATERSHEDS UNIT
KRS 9-12: CHEMISTRY OF AQUATIC ENVIRONMENTS UNIT

2 Pollution of lakes, streams and rivers can often be traced to run-off from their watersheds. If the watersheds are deforested, there is likely to be heavy siltation. Watersheds in agricultural areas may contain residues of pesticides, fertilizers and other chemicals which leach into water bodies.

KRS 9-12: FISHERIES AND WATERSHEDS UNIT
KRS 9-12: CHEMISTRY OF AQUATIC ENVIRONMENTS UNIT

2 Stagnant waters (lakes reservoirs and ponds) are more easily polluted than flowing waters (rivers and streams) because the water is not renewed as quickly and pollutants can accumulate.

KRS 9-12: CHEMISTRY OF AQUATIC ENVIRONMENTS UNIT

3 Preventing pollution costs less financially and environmentally than cleaning up after it has occurred.

CS&S: *BEST MANAGEMENT PRACTICES*
KRS 4-6: *THE RESTORATION GAME*
KRS 9-12: **FISHERIES AND WATERSHEDS UNIT**

3 The most important factor in prevention and control of pollution is education and the resulting changes in people's values, attitudes and behavior.

KRS 4-6: *THE RESTORATION GAME, ADOPT- A- STREAM*
KRS 9-12: **FISHERIES AND WATERSHEDS UNIT**

HUMANS AND THE ENVIRONMENT

2 The occurrence of natural phenomena, such as floods and drought, and the magnitude of their effects have been accelerated by human activity.

KRS 4-6: *THE RESTORATION GAME*
KRS 9-12: **FISHERIES AND WATERSHEDS UNIT**

3 People are capable of reducing and reversing their negative impacts on the environment because they can think, plan and educate.

CS&S: *BEST MANAGEMENT PRACTICES, RESTORING HABITAT*
KRS 4-6: *THE RESTORATION GAME, RESTORING THE KLAMATH RIVER*
KRS 9-12: **FISHERIES AND WATERSHEDS UNIT**

2 Environmental issues can cause conflict between individuals with different values, or because of differences between the wants of the individual and the environmental priorities of the society.

KRS 4-6: *THE RESTORATION GAME, HARVEST MANAGEMENT ROLE PLAYING*
KRS 9-12: **FISHERIES AND WATERSHEDS UNIT**

DEGRADATION OF RESOURCE BASE

3 Water pollution, destruction of spawning areas, inadequate regulation of harvest, and intensive fishing methods have disrupted many aquatic ecosystems and contributed to a sharp decline in aquatic organisms. This has deprived many fishermen of their livelihood and people of the much needed food.

KRS 4-6: *HARVEST MANAGEMENT ROLE PLAYING, CHANGES IN HARVEST OF KLAMATH RIVER FALL CHINOOK, HARMFUL ACTIVITIES IN THE KLAMATH RIVER BASIN*

KRS 7-8:*SEDIMENT EFFECTS ON SALMON EGGS, MEMORIES OF DAYS AND FISH GONE BY, SALMON POPULATION TRENDS IN THE SHASTA RIVER*

KRS 9-12: FISHERIES AND WATERSHEDS UNIT

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APPENDIX F
KREP BROCHURE AND LIST OF SCHOOLS VISITED

KREP BROCHURE AND LIST OF SCHOOLS VISITED

Schools districts that were visited to distributute KREP curriculums and to promote their use include:

Klamath County School District -	Barbara Gridley, Curriculum Supervisor Mike Reeder, Science Teacher Mentor
Humboldt County Schools	Jan Rae Coates, Curriculum Coordinator
Del Norte County Schools	Mike Crowley, Superintendent of Instruction
Siskiyou County School	Sue Maurer, Curriculum Specialist for Natural Resources
Trinity County Schools	Kim Stokley, Director of Adopt-a-Watershed Program

In addition to visiting school districts, a brochure was prepared to inform educators and other interested people about the Klamath River Educational Program. A copy of the brochure is attached.

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APPENDIX G

Teachers Who Received Technical Assistance

LIST OF TEACHERS WHO RECEIVED TECHNICAL ASSISTANCE FROM THE KREP

The Klamath River Education Program provides technical assistance to teachers who are implementing fisheries/river education. The following is a list of teachers who received help during the 1991-1992 and 1992-1993 school years, and a brief description of the help given by Patrick Higgins (P.H.), Fisheries Biologist, and the contractor, Diane Higgins (D.H.).

Geoff Proust, Trinidad, 1992 and 1993 - slide presentations about restoration of the Klamath River (P.H.)

Stephanie Bennett, Big Lagoon School 1992- slide presentation about salmon and steelhead and their habitats, (P.H.).

Rebecca Leuck, Trinidad School, 1993 - slide presentation about restoration of the Klamath River (P.H.).

Pam Halstead, Fortuna High School, 1992- help with establishing study site and monitoring program (P.H.)

Alan Brainard, Hayfork High School, 3 times in 1992 - scoping of Hayfork Creek for potential study sites, help with field trip, participation in panel debate before school body (P.H.).

Mike Savarese, Mt. Shasta High School, 1992 - help with field trip to Bogus Creek (P.H.) and (D.H.).

Linda Hardy, Mt. Shasta High School, 1992 - slide presentation to all fourth graders on salmon and steelhead (P.H.).

Dave Sanders, Weitchpec School, 2 times in 1992 - help locate study sites, help conduct field trip (P.H.).

Bill Schaser, Eureka High School, 1993 - slide show about fish stocks at risk of extinction (P.H.).

Dave Van Scoyoc, Butte Valley School - 3 times in 1992 and 1993 - help with two field trips, help with classroom identification of aquatic insects (P.H.) and (D.H.).

Surie McNeil, Freshwater School, 1992 - help with classroom identification of aquatic insects (D.H.).

Shelly Slusser, Orleans School, 1992- help with tree and grass planting and mapping activity (D.H.)

Sue Maurer, Siskiyou County Schools, 1992 and 1993 - several meetings to discuss projects at Etna High School, potential for ROP projects and Eisenhower program

Roger Brandt, Redwood National Park, 1992 - met twice and several phone conversations to help him use KREP materials in his environmental education camp and public talks - gave slides, curriculum and information (P.H.) (D.H.)

Paula Yoon, Eureka High School, 1993 - Slide presentation about Klamath River Basin for summer school class (P.H.)

Paula Yoon, Eureka High School, 1993, Assistance with conducting five-day summer institute field trip. (P.H.) (D.H.)

The KREP also maintained an active library of videos, slide shows, field equipment and curriculum materials during both school years. It also helped teachers to buy two-way viewers (magnifying boxes) at wholesale price, and to locate other sources of field equipment.

Assistance With Finding Funding

A proposal was sent to Apple Computers in 1992 to get eight computers, a CD ROM, scanner, and three printers. The equipment was to be used as part of a river monitoring and networking program. The proposal was not funded.

Additional assistance was given to teachers in the Klamath Trinity Joint Unified School District, who wanted to submit a proposal to the Klamath River Task Force. The proposals they submitted were not funded.

Assistance was given to Paula Yoon in her attempts to get funding for the Eureka High School summer course on the Klamath River, which she taught. The contractor reviewed her proposal, wrote letters of support and spoke with some Task Force members about funding the field trip. She was awarded $500.

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APPENDIX H

SUMMER INSTITUTE FOR STUDENTS

Diane Higgins, Coordinator
4649 Aster Avenue
McKinleyville, CA 95521
(707) 839-4987

April 24, 1992

Dear Teachers & Parents,

This summer the Klamath River Educational Program will sponsor a summer institute for students. The purpose will be to increase awareness of the river's fish and other important resources within the Klamath River Basin, and to expose students to careers in natural resources. The institute will be modeled, in part, after the very popular summer institutes for teachers, which the K.R.E.P. has sponsored for the past two years.

During the five day institute, we will travel from the Shasta River through the Scott River Valley, and down the Salmon River to the Klamath. We will continue down the Klamath River, and will spend the final day at the estuary. Along the way, students will be involved in activities such as diving with wet suits, masks and snorkels to observe fish and habitats, conducting simple measurements of stream characteristics, visiting fisheries restoration projects and talking to a number of men and women who work in natural resource careers. We are hoping to provide a raft trip down part of the Klamath, too.

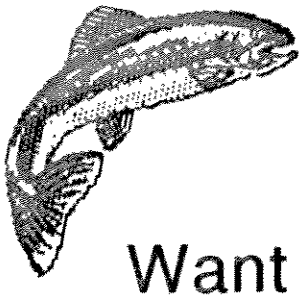
You can help by identifying students (boys and girls) in your school whom you feel would most benefit from this experience, and encouraging them to apply. Please do not confine your selections to students who excel academically. We are especially interested in reaching those who have potential but may be at risk of dropping out. We feel that the summer institute might give these kids a goal and a vision that will help motivate them to stay in school and pursue careers in natural resources.

Please copy the enclosed announcement, application and this letter (for parents) and give them to your students. I'll be out of town until May 11, but will be available to answer questions after that. Feel free to call me anytime. Thank you for your help.

Sincerely,

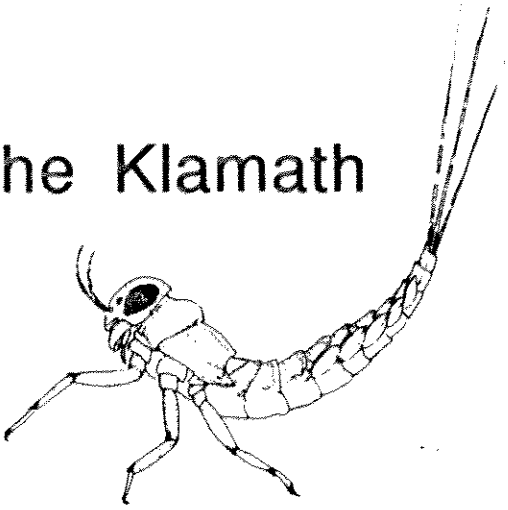
Diane Higgins

Encs.



Hey - What are ya doing this summer?

Want to take a trip down the Klamath River?

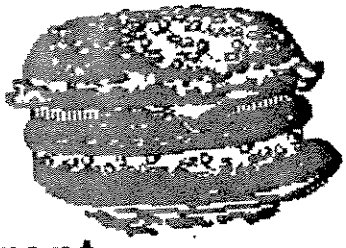


- Dive in the water to see fish and stream habitats

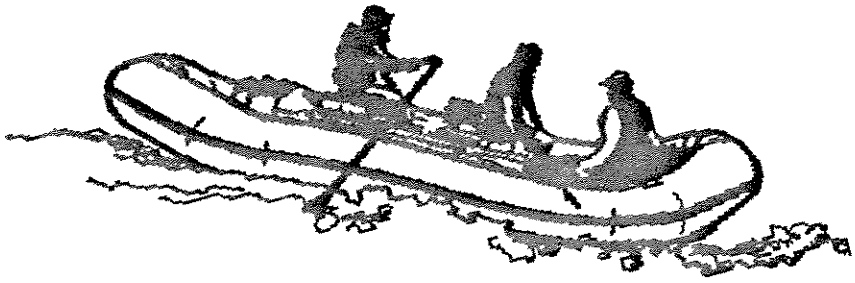
-See what it would be like to have a good paying job working outdoors, like:

Fish Biologist **Geologist** **Forester**

- Camp out and eat good food



- Take a raft trip to get a different view of the river



- Learn about stream biology, fish, geology, and how people depend on the land and water of the Klamath River Basin

WHAT: KLAMATH RIVER SUMMER INSTITUTE FOR KIDS

WHEN: AUGUST 24 - 28 (MONDAY - FRIDAY)

WHERE: ALONG THE KLAMATH RIVER AND ITS TRIBUTARIES

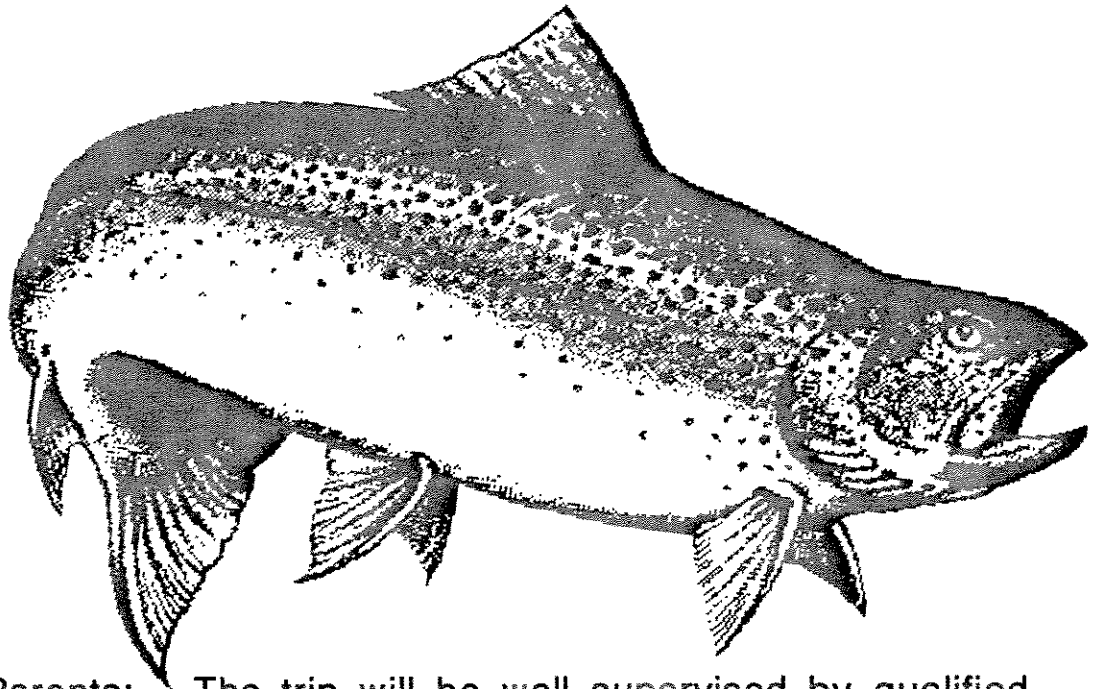
WHO: FOR STUDENTS WHO WILL BE ENTERING 9TH OR 10TH GRADE IN THE FALL

AND... ITS FREE

- FOOD, TRANSPORTATION AND CAMPING FEES WILL BE PROVIDED BY THE Klamath River Educational Program.

WHAT YOU MUST DO TO ATTEND:

GET PERMISSION FROM PARENT OR GUARDIAN
FILL OUT APPLICATION
MAIL IT BY JUNE 10 (SPACE IS LIMITED ON THIS TRIP)



Note to Parents: The trip will be well supervised by qualified people. Please call Diane Higgins, Program Coordinator for more details. (707) 839-4987

KLAMATH RIVER EDUCATIONAL PROGRAM
AGENDA - SUMMER INSTITUTE 1992

MONDAY

8:30 am	Coastal Departure: Leave Arcata Airport
8:30 - 12:30	Travel up Klamath River (Hwy 96) with pick up stops in Willow Creek, Hoopa, Orleans, and Happy Camp.
* * *	Travel connections for Etna, Fort Jones, Dunsmuir and Gazelle to be arranged this week with Dave Van Scoyoc, who'll drive from Dorris
12:30 - 2:30	Convene at Sarah Totten Campground. Lunch - Introductions - Goals of the trip - Words about safety - Responsibilities
2:30 - 3:00	Travel to Kelsey Creek
3:00 - 5:00	Greg DesLaurier, Fisheries Biologist, or Jay Power, Geologist, U.S. Forest Service, will show us the Kelsey Creek spawning channel and will help us learn to identify fish that live in the creek and river. - Dive in Scott River at convergence of Kelsey Creek. Observe fish and collect insect samples
5:00- Dark	Set up camp at Indian Scotty Campground - Eat Dinner Tricia Whitehouse, Fisheries Biologist, U.S. Fish and Wildlife Service will talk to us about her job and the Klamath River Restoration Program

TUESDAY

7:30 - 8:30	Eat breakfast and pack to leave
8:30- 10:00	Travel up the Scott River to Callahan. Stop to see mining tailings along the way.
10:00 - 4:00	Sue Maurer, Fisheries Technician, U.S. Forest Service, will guide us down the Salmon River and show us some work that is being done to restore the river and learn more about the salmon. We'll visit crews and see what they do. We will dive at several locations on the river to observe fish and river habitats. A soil scientist and a hydrologist will also talk to us about their work
4:00 - 5:00	Travel to Forks of Salmon School
5:00 - 7:00	Relax, explore, visit
7:00 - Dark	Dinner - Slide show about the Klamath River

WEDNESDAY

7:00 - 8:00	Breakfast - Pack to leave
8:00 - 9:00	Travel down Salmon River to the Klamath, and to Young's Ranch
9:00 - 4:00	Rafting trip down the Klamath River
4:00 - Dark	Return to Young's Ranch - A chance to shower!! - Shoot hoops, Play volleyball - Dinner - Group activities

THURSDAY

7:30 - 8:30	Breakfast - Pack to leave
8:30- 10:30	Travel down Klamath River, stopping at Ishi Pishi Falls
10:30 - 12:30	Soyka Dobush, Fisheries Biologist, U.S. Forest Service will explain the study she is doing at Camp Creek. We'll visit the Camp Creek salmon rearing facility and dive into Camp Creek briefly. - Sample the insects - Eat lunch
12:30-2:00	Travel to Hoopa, stopping at Bluff Creek and the convergence of the Klamath and Trinity Rivers
2:00 - 5:00	Noland Colegrove and Bill Wilkenson, Foresters for the Hoopa Tribe Danny Hagans, Earth Scientist, Pacific Watershed Associates We'll visit Pine Creek to see a restored landing and talk about forestry and geology, and how they are related.
5:00 - 8:30	Travel to Klamath Glen Resort, stopping for dinner
8:30 - Bedtime	Campfire

FRIDAY

8:00 - 9:00	Breakfast - Pack
9:00 - 10:00	Tom Weseloh, from California Dept. of Fish and Game will meet us at a dock on the estuary and tell us about the creel census he does and how Fish and Game use that data.
10:00-12:00	Mike Wallace, CDFG, will talk to us about the estuary system and how CDFG is sampling and counting young fish that are swimming out to the ocean. We'll drive up to the estuary lookout and talk about the recent change in the position of the river's mouth.
12:00 - 2:00	Lunch - Discussion of week's activities - Goodbyes
2:00 -	Drive home

PARTICIPANTS IN KREP SUMMER INSTITUTE 1992

COASTAL AREA

Jennie Carrera
10th Grade Fortuna High
2014 Cyupress Lane
Fortuna, CA 95540
707-725-4826

Jaime Carter
10th Grade Fortuna High
859 Crissy Way
Fortuna, CA 95540
707-725-2615

Tonia Stevens
10th Grade Fortuna High
220 Cherry Lane
Rio Dell, CA 95562
707-764-5769

Julia Everding
10th Grade Arcata High School
2711 Hilltop Ct.
Arcata, CA 95521
707-826-0605

Tawna Backman
10th Grade Arcata High School
2141 Sandra Ct.
Arcata, CA 95521
707-822-9274

PARTICIPANTS IN KREP SUMMER INSTITUTE 1992

MID RIVER REACHES

Leatrice Camez
9th Grade Hoopa High
P.O. Box 721
Hoopa, CA 95546
916-625-4128

Tammy Hunt
9th Grade Hoopa High

Hoopa, CA 95546
- -

Alisha Olmo
10th Grade Hoopa High School
Site 4 Box 15
Hoopa, CA 95546
- -

Sam Welch
9th Grade Hoopa High
P.O. Box 734
Hoopa, CA 95546
916-625-4025

Rose Gibbens
10th Grade Hoopa High
Site 4 Box 10
Hoopa, CA 95546
- -

Carlton Gibbens
9th Grade Hoopa High
Site 4 Box 10
Hoopa, CA 95546
- -

Kai Ferrara
9th Grade
Black Bear Ranch
Box 27
Forks of Salmon, CA 96031
- -

August Nunes
9th Grade

Forks of Salmon, CA 96031
916-462-4689

Jennifer Goodwin
9th Grade Happy Camp High
P.O. Box 466
Happy Camp, CA
916-493-2291

Jennifer Landrum
9th Grade Happy Camp High
P.O. Box 401
Happy Camp CA 96039
(916) 493-2344

Eric Wheeler
9th Grade Hoopa High
P.O. Box 32
Orleans, CA 95556
916-627-3457

PARTICIPANTS IN KREP SUMMER INSTITUTE 1992

UPPER RIVER AREAS

Sarah Dias
9th Grade Etna High School
15039 Quartz Valley Rd.
Fort Jones, CA 96032
916-468-2824

Bethany Gravelle
9th Grade Etna High School
P.O. Box 583
Etna, CA 96027
916-468-2969

Karen Casterline
10th Grade Yreka High
P.O. Box 92
Gazelle, CA 96034
916-435-2491

Gabe Moon
10th Grade Dunsmuir High
4324 Bransttetter
Dunsmuir, CA
916-235-2165

Michael Kerwin
9th Grade Butte Valley High
P.O. Box 195
Dorris, CA 96023
916-397-7361

Lisa Green
9th Grade Butte Valley High

Dorris, CA 96023
916-397-3981

Alisha R. Cline
Site 4 Box 15
Hoopa Ca
95546

August 25, 1992

Mr. William F. Shake, Chairman
Klamath River Basin Fisheries Task Force
US Fish and Wildlife Service
500 NE Multnomah St., Suite 1692
Portland. OR 97232

Dear Mr. Shake

In the month of August between the 17-21 I attended the Summer Institute sponsered by the Klamath River Educational Program. We spent a lot of time observing fish and other water habet in the creeks and rivers. I've learned a lot in the past week. We traveled to some of the main distributing head waters. We had lot of foaster and geologist talk to us about how important it is to have

rocks running into the creeks. We were told it is not good to damn creeks cause they can stop the fish from be able to come up the creek.

I think this trip has affected me a lot it makes me more aware of the fish and that they need to live also. I live on the Klamath River. After I got home from the trip I told my parents what I had learned they thought it was a good experience for me. Today we went to the creek we always swim at. My mom and sisters help to un damn the creek for the fish so they would have a better chance and easier time get over the damn.

I think the trip was a good idea and worth while doing. I also think if it could be done again it should. Thank you Task Force for making this trip possible.

Yours Truly,

Nisha Robin Cimo

David Van Scoyoc
P.O. Box 14
Dorris, CA 96023

August 28, 1992

Mr. William B. Shake, Chairman
Klamath River Basin Fisheries Task Force
U.S. Fish and Wildlife Service
500 N.E. Multnomah St., Suite 1692
Portland, Oregon 97232

Dear Mr. Shake,

I have been involved in the Klamath River Education Project for almost two years. I teach in the Butte Valley Middle School in Dorris, CA. This Summer Diane Higgins invited me to go along on the Summer Institute. This was truly a valuable experience for all the students as well as myself.

Diane arranged to have a number of professionals and technicians in many outdoor occupations visit with the kids every day. I believe this really opened some minds to the possibilities of future employment, as well as being informative.

The students experienced a thorough survey of the Klamath drainage. By the end of the week I saw kids asking very good questions about the resource. I'm sure a giant leap in their understanding of the problems took place during this time. They will carry a very high level of understanding back to their classrooms.

Another by-product of this experience was the friendships made between kids from all over north-western California. Also, a wide variety of backgrounds was represented. I'm certain many of them will correspond in the future.

This was a terrific experience. I'm very glad I was a part of it. I highly commend Diane and Pat Higgins both for their dedication and enthusiasm to make an adventure like this work. It was a beautiful and valuable thing to do for these kids.

Sincerely,

David Van Scoyoc

August 31, 1992

Dianne Higgins, Coordinator
Klamath River Task Force
4649 Aster Road
McKinleyville, CA 95521

Dear Task Force:

This summer I attended the Klamath River Educational Program. I thought it was a very educational camp. We learned about fish restoration in everything we did. We also had alot of fun at the same time.

Just about every day we went snorkling in different rivers. We studied each rivers habitat and which fish could live the best in them. We learned that some need real cool water to live in. We learned that in some rivers like the Klamath warm water fish are starting to do well.

We learned how anything from water pollution to careless logging can affect the runs of fish. We also thought of ways to prevent that damage. We saw a slide show about the Klamath River that showed how a logging road had slid into the river and blocked it off and made it silty. We also saw alot of other neat things in the slide show.

We talked to a lot of neat people including the Forest Service and the Fish and Game. They talked to us about what they were doing to help the fish. Some of them talked about their jobs and how they personally helped.

We went to Petersburg, a Forest service station in the Forks of Salmon, where I live. At Petersburg we did a thing with three highschool kids from Etna High, and Forest Service Lady. We broke up into four groups and did these four things in the river: Habitat Typing, Insect Collecting, Snorkling and, Fines in Pools.

We went rafting one day on the Klamath River and had a fun water fight. We also stopped to take a hike up this cold creek to look at a waterfall.

The last day we ended up at the ocean. We talked to two Fish and Game people. One talked about how many fish people are catching in the river and showed us how he surveyed them. And the other talked to us about the Estuary and its habitat and how it's always changing. Then we loaded up in the vans and went home.

I'd like to thank you for making that trip possible and I hope you continue to have it.

Very truly yours,

August Nunes

Rose Gibbens
Site 4 Box 10
Hoopa, Ca. 95546

Mr. William .F. Shake, Chairman
Klamath River Basin Fisheries Task Force
U.S. Fish and Wildlife Service
500 N.E. Multnomah St., Suite 1692
Portland, Or. 97232

Dear Mr. Shake,

Recently I attended a summer camp sponsored by the Klamath River Educational Program. While I was there I learned a lot about fish and the way they live. For example fish tend to lie under rocks and shaded areas to hide from predators. I also learned about how people abuse the fish and how they are becoming extinct.

We looked at different types of rivers and saw how logging and other disruptions have effected them. Foresters and Fisheries Biologists talked to us about situations with the rivers and how some are clearer and more cold than others.

This trip gave me a whole different outlook on the rivers and fish. If there is anything I can do to help restore the river, like planting trees I would like to be a part of it. I would like to thank you for funding this trip I hope that in the future people can learn as much as I have.

Yours Truly,
Rose Gibbens

Rd FORT JONES
CA 96032

August 25 1992

DEAR Mr. Shake,

This last week I went to a summer camp. It was sponsored by the Klamath River Educational Program.

We learned about the many problems concerning the steelhead, Salmon, and Chinook in the Klamath, Salmon, and Scott River area.

I live in Scott Valley and knew about the agricultural problems, but not about the erosion, and fishing problems. I also didn't know about the restoration work that was going on. We had hands on Experience to learn about the fish. We snorkled, learned how to identify each kind of fish, and learned about the other life in the river.

I'm so glad somebody is doing something to help the fish along their way. I hope we can increase the number of Reds and fish.

I think the trip was a great idea and definitely worth while. I hope that other kids get the chance to explore the beautiful world under water, through this program. Thank you so much.

Yours truly,

Sarah Dias

Dear Mr. Shake

I'm really glad that this trip was put on because it makes you realise how many fish that were loosing and it also lets you study the fish and learn about them. I think that they should outlaw letting people set nets at the mouth every year and catch fish as they enter the Klamath and then they go and sell them. On this trip we did lots of exiting things, like diving and looking at the fish and study their habitat. This trip has made me realise what is really happening to all of the fish. It really changed the way I looked at things. I thank you and the task force for making this trip possible

Sincerely

Carlita Dillon

Julie Everding
2711 Hilltop Ct.
Arcata, CA. 95521
August 21, 1992

Mr. William F. Shake, Chairman
Klamath River Basin Fisheries Task Force
U.S. Fish & Wildlife Service
500 N.E. Multnomah St., Suite 1692
Portland, OR 97232

Mr. Shake~

In a little less than 2 hours, I will be going home from a Summer Institute sponsored by the Klamath River Educational Program. Through a variety of activities planned by Diane Higgins I did more than just learn about the river and habbitats. I experienced the environment and problems of the Scott, Klamath, and Trinity rivers. We saw dried out creek beds, eroded hillsides, and algae filled ponds. I live close to all these rivers, but I had never seen so vividly the problems and struggles of the water. I heard bidogists, geologists, foresters, and other workes doing their part to help the rivers. We dove in creeks to murky and algae filled to see through. There was water too gross

to swim in. By the seccond day I was disgusted with what is happening with our [redacted] river tributains. Then, later during this week I saw waterfalls, and rivers, and deep swimming holes, hatcheries, even some Steelhead while diving. I saw what conservation and reconstruction can do to save our water and water systems. It was really amazing.

What I'd like you to understand, it that trips like this make a difference. It has completly changed my views on the importance of the rivers. Please continue to support educational programs like this. If it could change my mind, I'm sure it can help other people understand the importance of saving the rivers. Thank you for supporting this trip, and please continue to do this for other people.

Thank you,
Julie Everding

Dear Mr. Shake,

It's a few days after the Klamath Rive Educational trip and I find myself wishing to be back there. We did a lot of interesting and fun things.

I learned all about the fish in the Klamath river and the smaller creeks and rivers. I learned about the insects and where they live. We didn't spend all our time in the river, of corse. We traveled up into the hills to see how the forest effected the river, and the things in it. I found that spoting a salmon in the river (espesially the 3+ foot one) to be extreamly exciting. The people I met were great also. I liked the idea of meeting kids from other towns. The counceleŕs were fun too.

This trip has set things in my mind I hope never to forget. I was allways concerned about the rivers and it's inhabitants but now I seem more concerned. I want to help the rivers and most of all the fish in it.

This trip was a very good idea. Not only did I learn a great deal, but made a few friends along the way. Thank you very much for providing this for me and thee others. Some day I hope to be a counseler on this trip! Thanks again, Laura Bregman

KLAMATH RIVER EDUCATIONAL PROGRAM

GRADES 9-12
FINAL REPORT

APPENDIX I

1993 SUMMER INSTITUTE FOR EUREKA HIGH SCHOOL STUDENTS

HIGH SCHOOL STUDENTS' CONFERENCE
(1993 SUMMER INSTITUTE)

The purpose of this task was to support the efforts of a Eureka High School teacher, Bill Schaser, who attended the KREP Summer Institute in 1991 and was motivated to get his students involved in studying the river. Bill wanted his advanced placement biology students to have an opportunity to share what they learned about the Klamath River fisheries issues with other students. The KREP agreed to provide $500 to help fund this effort, which we originally thought would take the form of a one day conference.

Instead of this conference, a group of interested students took a special summer school course so they could study the river more and prepare a slide show which they will present to students in other schools. To help them prepare for this, the KREP used the $500 to help pay for a five-day summer institute which was conducted July 5-9, 1993.

The KREP made all the arrangements, and Patrick and Diane Higgins went on the trip to help facilitate. The $500 was used to purchase food, buy gas and pay camping fees. Additional funding for the Summer Institute was provided by grants from CAL Serve, the Pacific States Marine Fisheries Commission and the Klamath River Restoration Program.

The Summer Institute allowed students to see the river system they were studying and to talk to experts along the way. It gave them an opportunity to gain direct experience and make personal observations that greatly increased their understanding of the issues. They visited the major subbasins in the Klamath River system to see land uses that are affecting fish populations and had a chance to talk to knowledgeable people. Their presentation will benefit from this experience.

Some of the students took photographs during the trip which will be added to their slide presentation. They also collected a sample of decomposed granitic soil to show other students when they talk about erosion. The facilitators who spoke to them during the week have been good sources of information, and students have called several of them to check their facts and ask more questions.

A list of participants and the agenda for the trip is attached. One student's notes from the trip is also included as a sample of the notes that all students took.

PARTICIPANTS IN 1993 SUMMER INSTITUTE
FOR EUREKA HIGH SCHOOL STUDENTS

STUDENTS:

Mary Benzinger
Aaron Brown
Yasmon O'Brien
Mollie Hartman
Yuri Camesi
Leah Shikuma
Jeni McGregor
Aaron Brown
Jennifer Trotts
Wagma Komak
Moss Bitner
Young Yoon

ADULTS

Diane Higgins
Patrick Higgins
Paula Yoon
Bob Wunner

KLAMATH RIVER EDUCATIONAL PROGRAM
AGENDA for SUMMER INSTITUTE 1993

MONDAY July 5

9:00 am	Coastal Departure: Leave Eureka High School
9:00 - 1:00	Travel up Klamath River (Hwy 96) to Happy Camp
1:00 - 3:00	Go up Slater Ridge Road to see impact of forest fires to watershed, visit fire lookout station for a bird's eye view of Klamath River watershed. Ken Baldwin, Geologist, Klamath National Forest will be with us to discuss geology of Klamath River Basin. Eat lunch.
3:00 - 4:00	Travel to Kelsey Creek
4:00 - 5:00	See Kelsey Creek spawning channel - dive into Scott River at convergence with Kelsey Creek to observe fish, insects and habitats
5:00- Dark	Set up camp at Indian Scotty Campground - Eat Dinner

TUESDAY July 6

7:30 - 8:30	Eat breakfast and pack to leave
8:30- 9:30	Drive up Scott River to Ft. Jones. Stop to see impacts of sedimentation in Scott River
9:30-11:30	Tour Scott River to see restoration of riparian areas, irrigation practices and mining tailings. Sari Sommarstrom, Coordinator, Scott River Coordinated Resource Management Program (CRIMP) will guide.
11:30 - 1:00	Travel to Yreka - eat lunch.
1:00 - 4:30	Tour Shasta River Valley with Dave Webb, Coordinator of Shasta River CRIMP. Alan Eddy, teacher at Montague School will show us restoration work being done by his students.
4:30 - 5:00	Take showers at Yreka Community Pool
5:00 - 6:30	Travel to Trail Creek Campground
6:30 - Dark	Get set up - eat dinner (informal talk with Peter Brucher, Salmon River Restoration Council, about community participation in watershed & fisheries restoration

WEDNESDAY July 7

7:00 - 8:30	Breakfast - Pack to leave
8:30 - 12:00	Hike to Long Gulch Lake - swim (ha ha) & fish - hike back
12:00 - 1:00	Travel to East Fork of South Fork of Salmon River - eat lunch
1:00 - 3:30	Sue Maurer, Fisheries Technician, U.S. Forest Service, will guide us along forks of the Salmon River and show us some work that is being done to restore the river. Dive in to see spring chinook.
3:30 - 4:00	Travel to Matthew's Creek Campground, on the Salmon River
4:00 - 6:00	Relax, explore, eat dinner
6:00 - Dark	Dinner - Slide show about the Klamath River at Forks of Salmon Community Center - go back to campground

THURSDAY July 8

7:00 - 8:30	Breakfast - Pack to leave
8:30- 10:30	Travel down Salmon River, stopping at Butler Creek (not confirmed)
10:30 - 11:00	Travel to convergence of Salmon and Klamath Rivers.
11:00 - 12:30	Leaf Hillman, Karuk Tribe, will describe traditional Karuk fishing. See Ishi Pishi Falls. Eat Lunch
12:30 - 2:00	Visit the Camp Creek salmon rearing facility and dive into Camp Creek to observe fish & habitat. View in-stream structures Sample aquatic insects
2:00 -3:00	Travel to Hoopa, stopping at Bluff Creek and the convergence of the Klamath and Trinity Rivers
3:00 - 5:00	Presentation by Mike Orcutt, Fisheries Biologist for Hupa Tribe about water rights and Hupa fisheries
5:00 - 6:00	Swim at Tish Tang.
6:00 - Dark	Travel to cabin at Pecwan Eat dinner - sleep

FRIDAY July 9

7:00 - 8:30	Breakfast - Pack
8:30 - 10:30	Drive over Bald Hills Road and up to the Klamath River estuary.
10:30 -12:30	Mike Wallace, CDFG, will talk to us about the estuary system and how CDFG is sampling and counting young fish that are swimming out to the ocean. We'll drive up to the estuary lookout and talk about the recent change in the position of the river's mouth. Eat Lunch at overlook.
12:30 - 1:30	Ronnie Pierce, fisheries biologist, will talk to us about the Yurok fishery
1:30 - 2:30	Travel to Crescent City
2:30- 5:00	Talk with Dave Allen from the Del Norte Fishermen's Marketing Association, about the ocean commercial fishery. Visit fishing boats
5:00 - 7:00	Eat dinner - discuss week's activities. Depart for home.
9:00	Estimated time of return to Eureka.