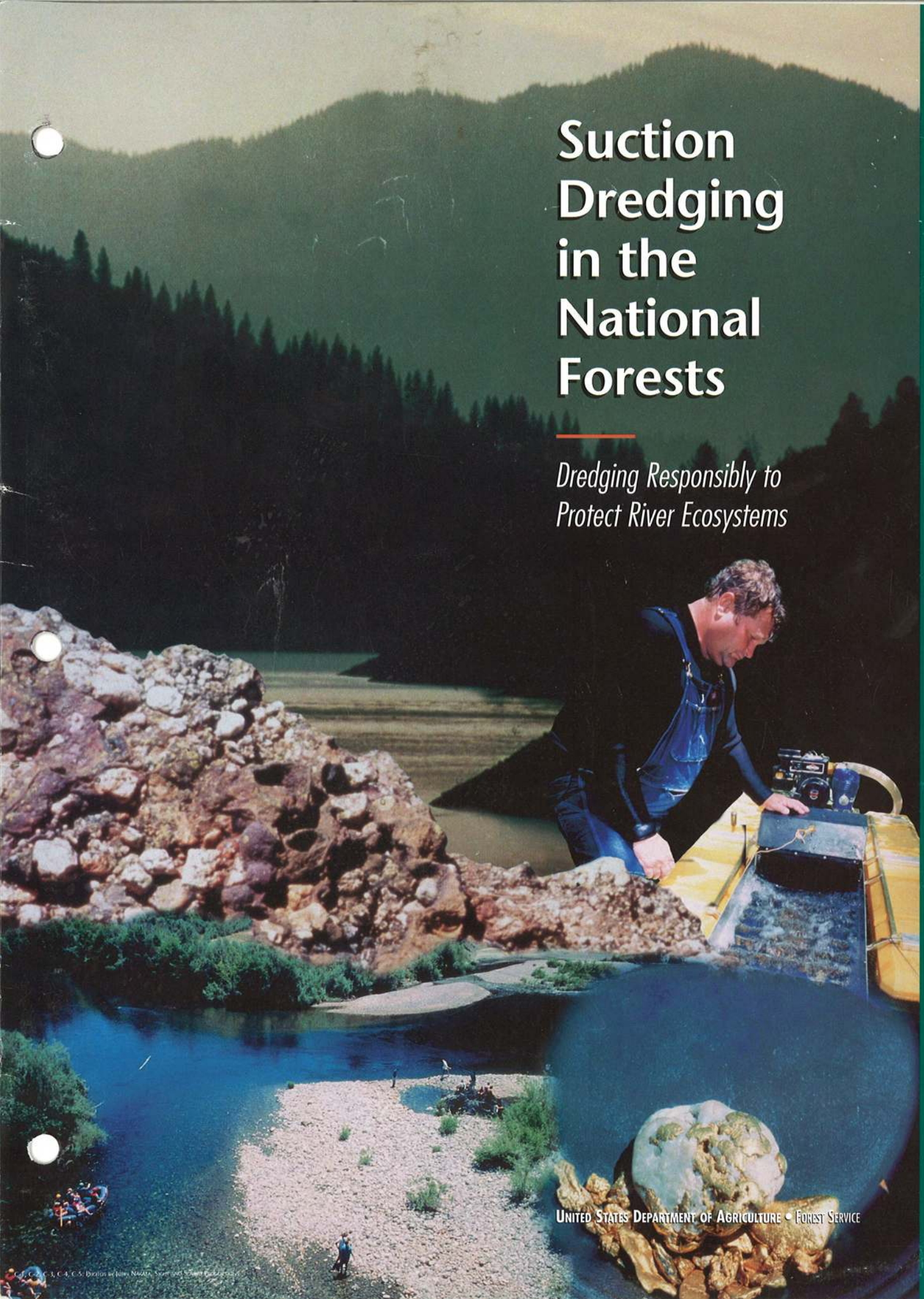
Suction Dredging in the National Forests

Dredging Responsibly to Protect River Ecosystems



United States Department of Agriculture • Forest Service

Front cover: panoramic landscape, gold-bearing conglomerate, suction dredger and sluice box, rafters on tributary, and pan with gold.

Welcome page: Forest Service shield and panoramic landscape.

Panoramic landscape: Photo by John Nakata, Sight and Sound Productions

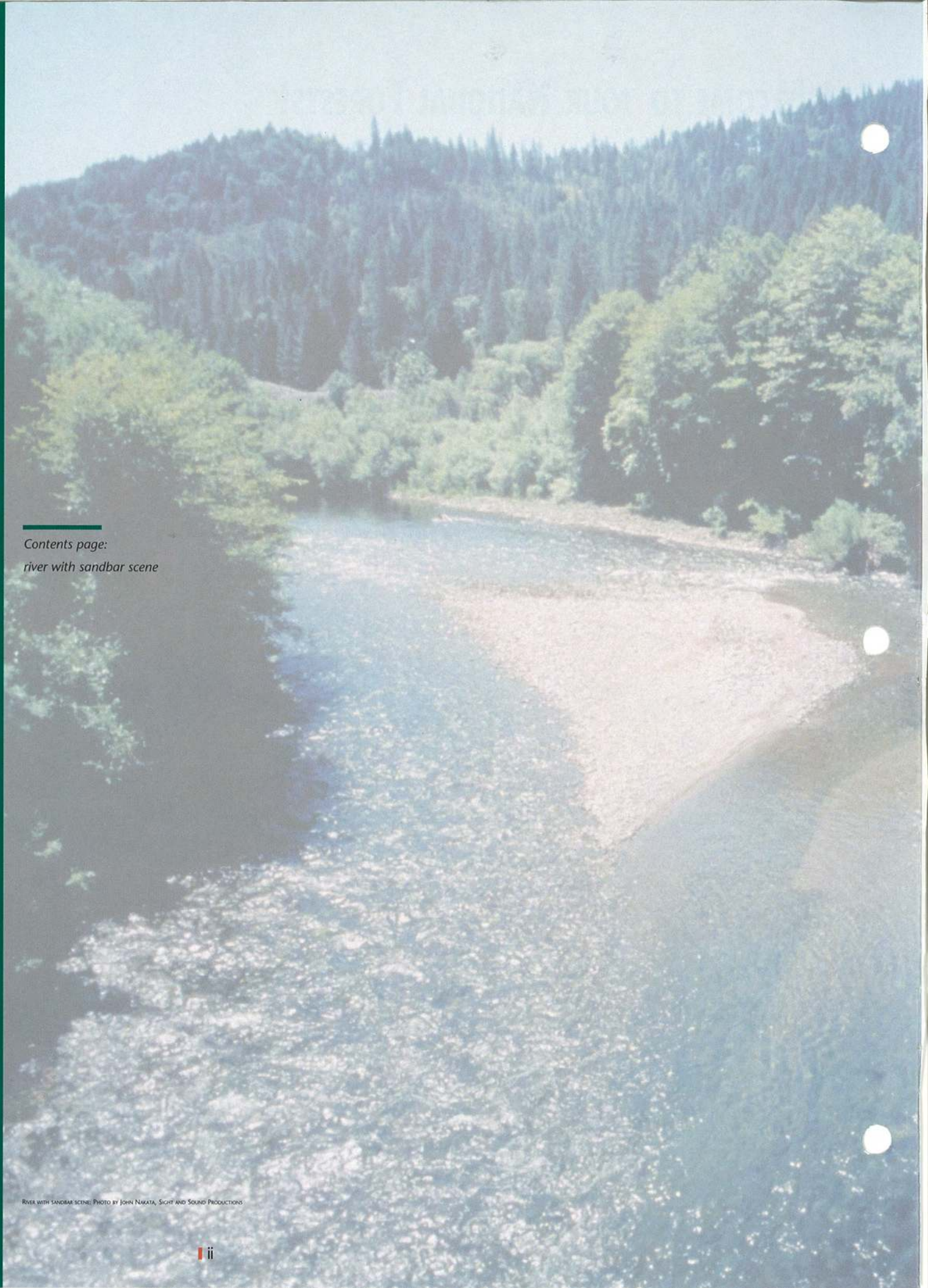
Welcome to your National Forests!

For millennia the allure of gold has kindled the adventurous spirit of miners, and many have sought their fortunes in its pursuit. In California alone, thousands of 49'ers arrived from all corners of the world after James Marshall found gold in a Sierra stream. Few people know that the California gold rush infused hundreds of millions of dollars in the national economy and fueled the eastern economic engines that settled the West. Over the past two centuries, miners have extracted gold from mountains and streams throughout the United States, changing the course of the Nation's future.

Today there is a new-found interest in gold mining. For individuals or small groups of miners, only a few methods of gold mining are economically feasible. One of these methods, a type of placer mining called suction dredging, removes gold from where it has lodged in the beds of running creeks and streams. This method is increasing in popularity in the national forests. This brochure is intended to increase readers' understanding of suction dredging; it is not intended to replace existing laws and regulations.

Mining today differs from that of yesteryear: while sharing many of the traditions of their forebears, today's miners must be aware of how their activities affect the streams and surrounding ecosystems, and of the need to understand and operate according to laws and regulations. These laws and regulations ensure continued use of national forests and protect resources such as clean water and fish populations. Indeed, all users of national forests must share in their stewardship as well as reap their benefits.

Please work with the United States Department of Agriculture (USDA) Forest Service to make sure that suction dredging is done in a manner consistent with current law and good natural resource management, in order to maintain our forest resources for future generations. Enjoy using your national forests—and good luck in your search for gold!



Contents page:
river with sandbar scene

River with sandbar scene; Photo by John Nakata, Sight and Sound Productions

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Shared Stewardship

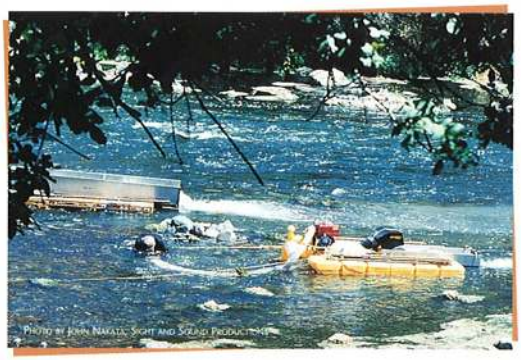
Though not as numerous as in the past, today's independent prospectors and miners are still walking our national forests, searching for the mother lode. They continue to be the on-the-ground eyes and ears of the mining industry. Their exploration plays a large role in the development of the mineral industry.

National Forest System lands are experiencing an ever-increasing demand from a growing and increasingly diverse population. There is demand for products, recreation, water, wildlife, and fish, and for an almost endless list of intangible, but desirable, goals.

It is the policy of the Federal Government to foster and encourage the orderly exploration and development of minerals to help assure our Nation's industrial, economic, and environmental needs. At the same time, the multiple-use doctrine recognizes the need to maintain our national forests for current and long-term benefits to people, while a host of other laws and regulations require that these multiple uses do not disrupt the natural ecosystem. It is every citizen's responsibility to help forge a way for these values and objectives to co-exist.

The challenge for today's gold dredger is to demonstrate a model of compatibility with other forest users, and sensitivity to the environment we all share. Like all users of the national forests, gold dredgers must practice responsibility and stewardship for our lands and streams.

Suction dredgers must recognize that the laws and regulations governing their activity vary from place to place. Please refer to the back pocket of this brochure for local information. ■



A suction dredger mines the river bottom for gold. Upstream is the sluice box from a large dredge.

Rafters pause to enjoy the ambiance of a picturesque tributary. On the gravel bar nearby, hikers exchange greetings with the rafters.

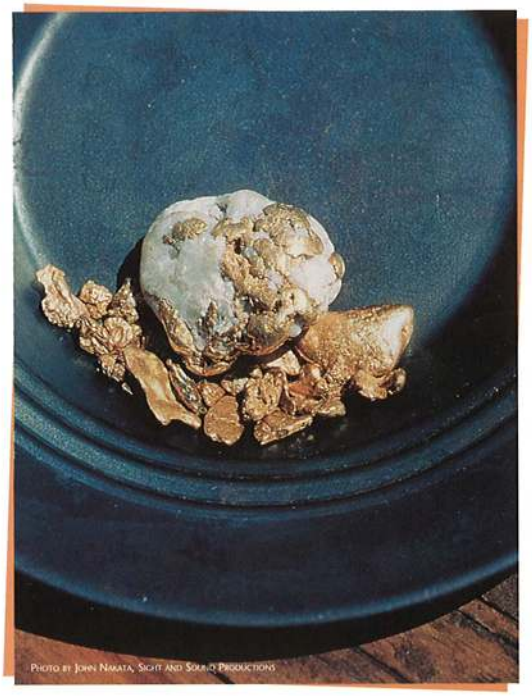
Placer Gold

Most gold originates in hard rock deposits, often within quartz veins. Through weathering, such as cycles of freezing and thawing, and erosion, such as that caused by flowing water, gold is separated from the rock. The gold flakes and nuggets released are transported downslope by gravity and running water, and are eventually deposited in streams.

Since gold is denser than the other streambed sediments, it tends to move downward to the contact between the gravels and the underlying bedrock, collecting at the bedrock surface and in the overlying few feet of gravels. During floods, when rushing waters transport gravels rapidly downstream, the gold moves more slowly, often lodging in cracks, crevices, and small holes in the bedrock surface.

Gold settles out where flowing water decreases in velocity—for example, at places where the stream gradient decreases, downstream of large boulders, or where the bed deepens into pools. ■

Gold-bearing pebble of vein quartz and assorted gold nuggets.



Working a small stream, a gold panner concentrates black sands and gold.

Suction Dredging

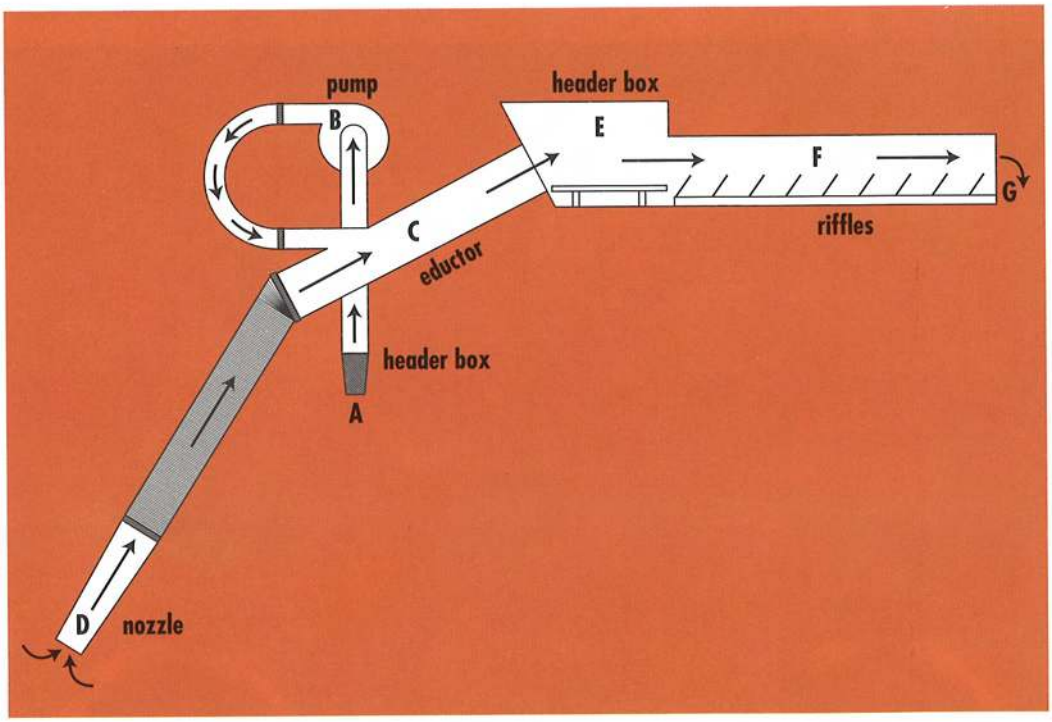
A suction dredger inspects his sluice box, removing cobbles that impede the flow of water.

Suction dredges are used within streams and rivers to remove the gravels overlying bedrock and to access gold. The gravels are deposited into a sluice box, a long container divided into sections by a series of slats called riffles. As water runs through the sluice box, heavy particles, including gold, are concentrated behind the riffles, and "cleaned" gravels exit from the final compartment to form tailings.

Dredges use high-pressure water pumps driven by gasoline-powered engines. The pump creates suction in a flexible intake pipe 2 to 12 inches in diameter. Suction dredges vacuum the streambed (which is composed of rock, gravel, and finer sediment) with water through the hose into the sluice box. Both the pump and the sluice box are usually mounted on a floating platform. Dredges are often positioned over the work area by securing the dredge to trees or rocks with ropes or cables.

Suction dredgers often use hookah (air supply) gear in order to dredge well below the surface of the water. The portion of stream bottom dredged ranges from a few small excavations to the entire wetted area in a section of the stream. Larger suction dredges have the capacity to excavate as much as several cubic yards of gravel from the river bottom, depending on the type of streambed material and the skill of the operator. ■

Glistening among the colored sands and pebbles from the river bottom, four gold nuggets reward the suction dredger.



Water is sucked through a screened intake (A) by water pump (B). The force of high pressure water into the eductor (C) creates a suction at nozzle (D). Water, sand, gravel, and gold are sucked through the nozzle into the headerbox (E), across the riffles (F)—where gold is trapped—and out the end of the dredge (G). Streambed material is not sucked through the water pump.

The health of fisheries is significant for several reasons. First, fisheries are a major source of food and income, contributing hundreds of millions of dollars to coastal economies, and constituting an essential source of income for many communities. For many Pacific Coast Native American tribes, salmon are an integral part of their culture. Recovery and protection of fisheries is an important goal for ecosystem managers on both the Atlantic and Pacific coasts.

Second, each fish species, and in many cases each population or stock of a species, has been honed by nature for survival within a specific environment. Genetic differentiation among fish species may allow us to produce unique compounds that could prove useful in the future, for example, in industry or medicine.

Of special concern to forestry managers are endangered and threatened species, and fish caught either commercially or for recreation. Many species of salmonid fishes fall into both of these categories.

SALMONIDS

UP-RIVER MIGRATION

Salmonid fishes, for example, salmon, trout, and char, are considered one of nature's most intriguing mysteries. Many of them, including most species of salmon, and some populations or stocks of steelhead, migrate from the stream where they hatched—their natal stream—to the ocean, where they spend as much as 80 percent of their life. Then, after years spent swimming in the ocean, these salmonids are able to find their way back to their natal waters to spawn. How they navigate their return to these exact locations is still incompletely understood.

The term used to describe this type of migration is "anadromous" (uh na' druh mus), derived from the Greek for "up running." On the Pacific Coast, anadromous salmonids occur from southern California north to Alaska and the Arctic Ocean; on the Atlantic Coast, from Connecticut to northern Newfoundland.

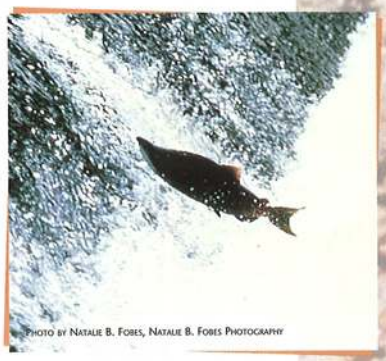


PHOTO BY NATALIE B. FOBES, NATALIE B. FOBES PHOTOGRAPHY

Salmon leap upstream in a bid to reach the stream or lake where they hatched years earlier.

Brightly colored sockeye salmon ready to spawn in their natal waters.

PHOTO BY NATALIE B. FOBES, NATALIE B. FOBES PHOTOGRAPHY

Suction Dredging and Fish

Coho eggs and alevins.

Most salmonids begin migrating upstream between April and October. Since spawning may not occur until fall, fish arriving in spring and summer stay in the river for a number of months. Spawning usually occurs between September and December. In between the time they migrate upstream and the time they spawn, anadromous salmonids live and feed in the river, staying cool in deep holes in the river bed, and often taking cover under large woody debris and overhanging banks.

Spawning usually occurs where sediment-free, coarse gravels are within a few feet of the water surface, often on shallow gravel bars. Female salmon deposit eggs in a nest called a "redd," which is an area in the gravel she loosens up. The velocity of the water running over a redd must be high enough to oxygenate the eggs.

Redd size varies with the species of salmonid, but can be as large as 18 inches deep and 6 feet across for larger fish. During spawning season, it is often visible as a lighter round or oval depression in the gravels. However, later on, while the eggs are still developing, or the youngest stages of the fish are present in the redd, the topmost gravels in the redd may wash away. This can make it difficult, if not impossible, to distinguish the redd from its surroundings.

The rate at which the eggs develop depends on the water temperature, but, generally, fry hatch from the eggs after 50-70 days. Each tiny fish is attached to the yolk sac from its egg. Over the next 35-45 days, the fry move through the gravel toward the surface, absorbing the yolk in route. Disturbance of a redd can kill developing eggs and fry.

When the fry reach the surface, they are free-swimming, and are termed "alevins." The length of time smolt remain in their natal river before entering the ocean depends on the species, and even the particular population. Populations that spend a longer period of time in streams and rivers are more sensitive to changes in the river. As anadromous salmonids swim downstream, they feed and grow on their way to the ocean. They will live in the ocean for a number of

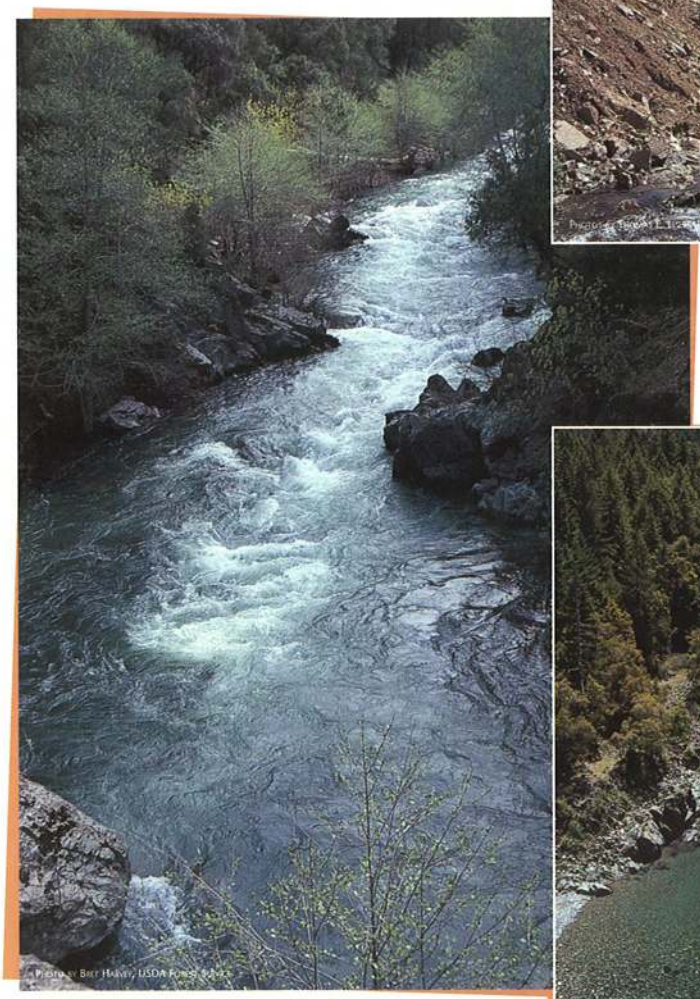
Sockeye salmon smolts.

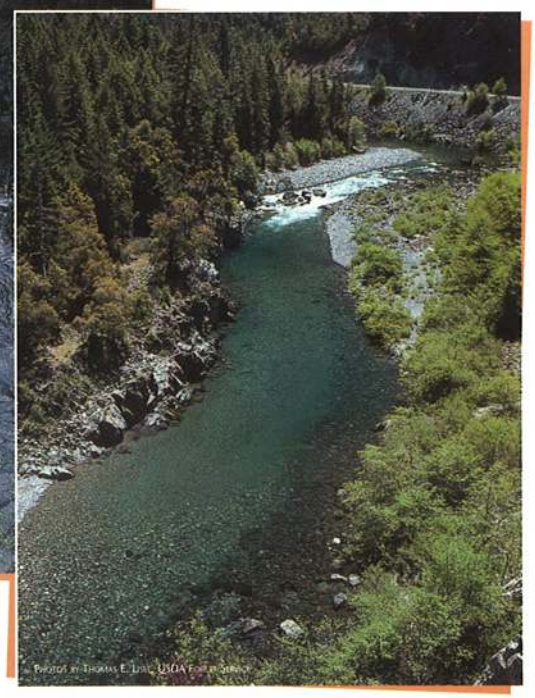
months or years, the time period depending on the species, population, and environmental conditions, before returning to their natal river or stream to spawn.

Management Strategy

Until recently, raising fish in hatcheries and barging them around barriers such as dams was the major strategy for reversing fisheries depletion. However, continued decline has focused fisheries management on a new approach, that of ecosystem and habitat restoration and protection. Managers are opting to minimize and repair disturbance of natural systems wherever possible.

For suction dredgers, this means that many streams and rivers are closed to dredging during the period that salmonids spawn, the eggs mature and hatch, and the fry move up through the gravels. Because of the wide variation between streams and between fish stocks (a population that reproduces independently from other populations), closures are determined on a local basis. Respecting these closures is the first step suction dredgers can take to help protect the fish. ■

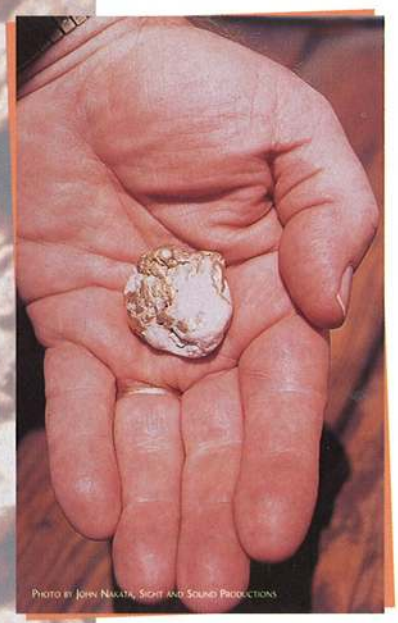




Each river bears its own signature, carving an individual path through unique terrain. Management decisions, such as those regulating suction dredging, are customized for local conditions.

Suction Dredging Checklist

The following Suction Dredging Checklist outlines precautions dredgers should take to help maintain healthy salmonid populations when streams are open for mining. One of the most important precautions is depositing loosened gravels in a manner so that salmonids will not use them for spawning, as these gravels may wash out before the fry are fully developed.



By carefully following good mining practices, the search for gold can go hand in hand with stewardship.

Introduction

Following laws and regulations related to suction dredging helps to protect river ecosystems. These statutes have been designed to preserve rivers and protect fish populations—for example, to prohibit dredging during the time that eggs and fry are present in the gravels. Since there is so much variation between rivers, many of the regulations, such as closures, must be determined on an individual basis. Rivers containing endangered species of fish or other aquatic animals may be closed year-round.

This section gives pointers for reducing the impacts of suction dredging on rivers and the plants and animals they contain. The checklist begins the same way suction dredging does: obtaining needed permits and transporting dredges and other equipment. Also covered are various activities associated with dredging including camping, securing dredges, and using gasoline engines, as well as dredging itself. The checklist was developed with the assistance of miners, scientists, and forest managers. It does not replace existing laws and regulations.

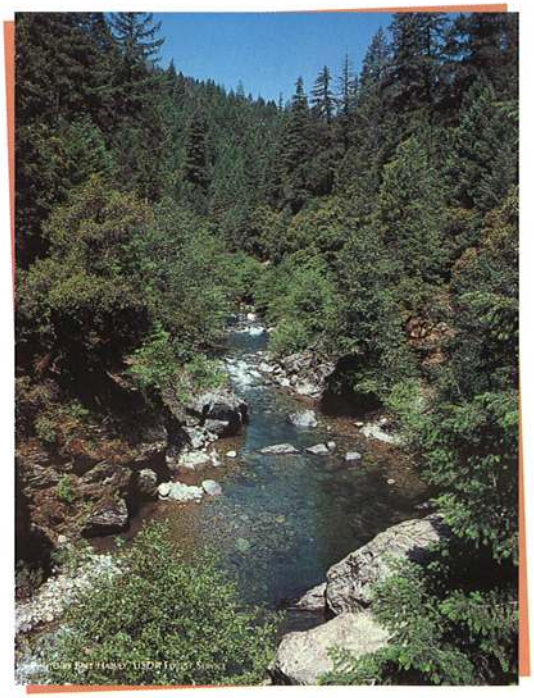
- Follow the law and create good will through mutual respect.
- Identify where and when mining is allowed or prohibited.
- Obtain needed permits.

Check with the local USDA Forest Service District Ranger for guidance on which laws and regulations apply to the specific lands. Recognize that different laws apply to different lands. For example, depending on the land status, the Acquired Lands Leasing Acts or the 1872 Mining Law may apply.

Review USDA Forest Service Surface Use Regulations for locatable minerals.

Review other rules and regulations that may cover, but are not limited to, the following: annual and seasonal stream closures, nozzle and hose diameters, engine horsepower and noise levels, winch use, operations in spawning areas, hydraulicking and bank mining, stream flow disturbance, damming, volume of material, restoration, woody debris, spill, and sanitary waste.

The riparian zone bordering a small stream has different vegetation than the surrounding forest. Usually dense and multistoried, this ribbon of riparian growth supports an abundance of wildlife.



If applicable, file a notice of intention (NOI) to operate with the District Ranger.

If required, submit a proposed plan of operations to the District Ranger.

Obtain permits and file notices and plans of operation with other Federal and State agencies as required.

Camping Near Rivers and Streams

Treading lightly

The land bordering rivers and streams, known as the riparian area, is vitally important to many species of wildlife. If possible, camp outside of the riparian area.

- Minimize camping impacts, such as trails and clearings.
- Avoid trampling vegetation.
- Do not use soaps or detergents in or near river or riparian areas.
- Dispose of garbage and human waste in a sanitary, self-contained way and remove it to an approved disposal site.
- Keep the campsite clean to avoid pollution and maintain a natural experience for other users.

Tents set up on sand, away from riparian vegetation.

Transporting and Storing Equipment

Heavy duty protection

Overhanging banks keep the edges of streams cool and are used for cover by fish. When portions of the streambank are damaged, erosion occurs and soil washes into the stream, silting in gravel beds and causing increased turbidity in the stream. The ribbon of land adjacent to streams, often a border of thick, multilayered vegetation, hosts numerous wildlife species. Keeping riparian areas undamaged preserves important wildlife habitat.

- Minimize impacts of bringing in and storing equipment.
- Avoid streambank damage.
- Avoid driving off-road through riparian areas.

Securing Dredges with Lines

Line up for safety

Lines securing dredges can be a safety hazard for rafters and boaters if the lines block passage. Another concern is injury to trees where equipment has been tied.

- Secure dredges carefully.
- Make sure cables and ropes don't block

Tie lines must be high enough to allow clear passage.

Suction Dredging Checklist

passage for boats and rafts; lines spanning the river should be at least 6 feet above the water surface.

- Flag lines to make them easy to see.
- When anchoring a cable to a tree, protect the trunk by wrapping it with an old inner tube, or by covering the cable with a piece of old hose.
- Make sure trees along the cable are not damaged.
- Remove all cables, ropes, and inner tubes when dredging is completed.

Using Gasoline Engines

Fuel for concern

Other stream users often express concerns about the gasoline engines on dredges, complaining, for example, about noise and fumes. An additional problem can be leakage of petroleum products from engines or storage containers.

- Install a muffler on engine to minimize noise.
- Prevent fuel and oil leaks into water or riparian areas, from the engine as well as from storage containers.
- Outfit the suction dredge with an oil pan.
- To prevent gasoline from entering the water, place a polypropylene pad around the gas tank when refueling. The pad absorbs petroleum products but repels water.
- In case of a leak, do not disperse oil or fuel with detergent. This makes spills harder to clean up and increases the damage to aquatic wildlife.

Leaving Boulders and Large Woody Debris

Best left alone

Large boulders and woody debris are important elements in the creation of fish habitat because large pools form adjacent to them. During periods of hot weather, the cooler deep sections of the pools are essential for fish survival. Fish use large woody debris for cover.

- Do not remove large boulders and large woody debris from the stream.

Suction dredge engines outfitted with mufflers.

Photo by Tracy Vallier, U.S. Geological Survey

Preserving Overhanging Banks

Watch out above

Destabilization of overhanging banks by undercutting often causes banks to collapse into the streams. This increases sediment in the water and decreases habitat for fish, which often seek cover under banks.

- Do not undermine overhanging banks with the suction dredge.
- Do not remove protruding boulders or woody debris from banks.
- Make sure gravel piles do not deflect high water against banks.

Placing Cobble and Tailing Piles Effectively Helps Protect and Preserve Salmon Spawning Grounds

Tell "tail" signs

Redd means STOP

When salmonids spawn, eggs hatch, and the fry move up through the gravels, streams and rivers are generally closed to suction dredging. This protects eggs and fry from being sucked through dredges or suffocated by tailings or sediment.

While seasonal closures protect eggs and fry from direct impacts, they may not alleviate a potential problem that occurs if salmonids spawn in gravels left by dredgers. If these gravels are loose, and wash down river during high waters, any redds contained within these gravels may be destroyed.

Cobble and tailing piles can obstruct passage for boaters and rafters. Another problem can be cobbles and tailings left on or near the bank. During dry periods, when the water level drops, the piles become exposed. Unlikely to be flushed away by high waters, these piles can remain for many years, particularly during periods of drought.

- Don't stack cobbles or deposit tailings on or near the bank.
- Distribute cobbles as broadly as possible in the channel.
- Periodically stop operations and pivot the back of the dredge to help spread tailings.
- Deposit tailings further from the dredge by extending the end of the sluice.
- Follow regulations concerning where and when suction dredging is permitted.
- Piles can be flattened using hydraulic force.

Dredging the streambank has exposed plant roots and washed silt into the stream. It has also destabilized the bank, which leads to further erosion.

A large salmon finds cover under a downed tree limb.

Dredged debris sometimes includes lead seams from old cans

Controlling Silt Discharge into Water

Get a clear idea

Depending upon site-specific conditions, silt can settle on and suffocate redds when dredging coincides with spawning or movement of fry through the gravels. This is one of the reasons dredging is seldom allowed during that time period. Large amounts of silt and fine sand can have a big impact, especially in small streams, which have less capacity for flushing.

- Look behind you. Evaluate your impacts and consider reasonable ways to minimize them.
- Do not dredge streambanks.

Toxic Materials and Rubbish in Streams

Take-out Menu

Suction dredgers can help restore streams by removing natural and introduced lead and mercury from the streambeds. Within a streambed, lead weights and shot are ground by the constantly moving sand, which removes small flakes of lead. The flakes oxidize easily, which releases the lead into the environment.

Lead recovered by suction dredgers can be recycled. In many cases, local mining organizations can act as central collection points.

Sometimes mercury is encountered on stream bottoms. Even in modest amounts, mercury can be quite toxic. Contact your local Forest Service office and appropriate State agency for information about proper disposal of materials you find in streams.

- Dispose of removed material safely and according to the law.
- Be careful when dredging in areas where sediments are likely to contain toxic substances, such as near discharge areas from towns and industrial sites.
- Discard refuse in an approved disposal area. ■

Glossary

Aggradation: Sediment deposition by a stream in order to establish or maintain uniformity of grade or slope; can occur in channels, point bars, and other parts of a stream.

Alevins: Juvenile salmonids that begin migrating downstream to the ocean after hatching.

Alluvial Deposits (Alluvium): Unconsolidated detrital material deposited by a stream or other body of running water in the bed of a stream, on its flood plain or delta, or as a cone or fan at the base of a mountain slope.

Anadromous: Refers to fishes that spend a large part of their lives in the oceans and return to fresh water to spawn. Examples include salmon, sturgeon, steelhead, and shad.

Biota: General term for all living organisms in an area; the flora and fauna considered as a unit.

Detritus: A collective term for fragmental rock and mineral material that is worn off or removed directly by mechanical means, as by disintegration or abrasion; loose boulders, cobbles, pebbles, sand, silt, and clay all are detritus.

Ecosystem: A unit in the general discipline of ecology consisting of the environment with its living elements and the factors that affect it.

Habitat: The environment of an organism or community of organisms, including all external factors and conditions that may influence it.

Placer: A surficial mineral deposit formed by mechanical concentration of mineral particles from weathered debris; generally applied to stream deposits from which valuable minerals and metals can be extracted.

Pool: A small, quiet, and rather deep reach of a stream, as between two rapids or where there is very little current; can also form upstream from coarse woody debris that blocks a stream channel.

Reach: A length or section of a stream channel that is approximately uniform with respect to discharge, depth, area, and slope.

Redd: Shallow parts of a stream where salmonids lay eggs; these nesting areas require just the right amounts of gravel to assure proper cover and water flow.

Riffle: A natural shallow area extending across a streambed over which the water flows swiftly and the water surface is broken in small waves by obstructions that are wholly or partly submerged.

Riparian: The area situated along the banks of a body of water; the term generally refers to a stream, including most of its floodplain.

Salmonid: A family of coldwater fishes including salmon, trout, and char. Many are anadromous.

Smolt: Refers to a juvenile salmonid, generally less than 2 years old, as it descends downstream to the sea.

Turbidity: The state, condition, or quality of opaqueness or reduced clarity of a fluid, due to the presence of suspended matter; a measure of the ability of suspended material to diminish the penetration of light through a liquid.

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Inside back cover: suction dredger and sluice box

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Suction dredger and sluice box: Photo by John Nakata, Sight and Sound Productions