MANAGEMENT NOTES

My Range Use Affects Salmon and Steelhead Production[1]

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Highlight

The Gover Ranch carries out a program of streambank manipulation and shore protection that maintains suitable spawning grounds for king salmon and steelhead. Estimated values are very high.

Although our Society is dedicated to promote advancement in the science and art of grazing land management, I want to discuss a topic that is becoming important to those of us who own and operate range land — The Preservation of Wildlife. To be more specific, I want to describe how we on the Gover Ranch stimulate salmon and steelhead production through the performance of sound range management practices.

We operate 14,000 acres of rangeland adjoining Battle Creek and the Sacramento River in Shasta County, California. This land is 100 air miles from the ocean; however, it is 200 miles as a fish swims.

What we do on our range lands affects a multitude of wildlife because it is the residence of hundreds of deer, birds of many kinds, and fronts on seven miles of trout and salmon streams.

I could spend a considerable amount of time telling you of the many popular and accepted practices we do to provide improved cover that benefit wildlife.

These include leaving 300 to 400-ft wide strips of brush along streams, piling brush to protect bird life, manipulating brush to provide browse for deer and similar practices. These, however, are accepted and well known to all of us. We have what we believe to be a unique situation because what we do for our ranch to provide streambank or shore protection on our streams has a direct effect on the salmon and steelhead production in the Sacramento River and its tributaries.

FIG. 1. Bulldozed gravel bed for salmon spawning on Battle Creek, Gover Ranch, Shasta County, California.

Battle Creek, a major tributary of the Sacramento River, runs through our ranch. It is an all-year cold running stream averaging in width from 50 to 75 ft with a minimum flow of approximately 400 sec/ft. It provides an excellent salmon and steelhead spawning area. However, in winter months it is subject to flash floods which erode the land and leave narrow channels running between mounds of compacted gravel in the stream. It builds up banks of gravel on the inside of "S" and "U" curves and washes away the banks on the outside. Because of this annual erosive action it is necessary for us to protect our lands adjoining Battle Creek to prevent the topsoil from being washed into the Pacific Ocean 200 miles away.

The problem we face is to protect our land and yet protect and improve the salmon and steelhead spawning grounds. Since the mounds of gravel and the compacted gravel in the stream are useless for spawning fish as well as useless in providing protection to our adjoining lands, it is necessary for us to take measures that will protect both the lands and the spawning grounds.

Now, you may ask, why are we so concerned about protecting the king salmon and steelhead when the actual business we are in is raising range livestock. Let me give you a description of these valuable fish, their habits and the benefits we derive through their protection.

The average weight at spawning time of the king salmon is 20 lb although some individuals exceed 50 lb and the record is over 100 lb. King salmon taken in the ocean are usually immature and average smaller than those in rivers.

King salmon spawn in cool or cold streams where there are gravel bottoms, preferably loose gravel. They prefer gravel in which most of the larger rocks are about 6 inches in diameter or a little smaller. The preferred spawning area is the lower end of a pool where the water is beginning to pick up speed, just above or within the edge of a riffle.

At spawning time a female selects a spot and digs a nest. She rolls on her side on the bottom and with a swimming or pumping motion moves the gravel downstream, and leaves a pit in which she deposits some eggs which are immediately fertilized by a waiting male. The female then moves upstream a short distance and resumes her digging, thus covering her previously deposited eggs and extending the nest farther upstream. More eggs are deposited and the process repeated until she is spawned out. After spawning, all Pacific salmon die, whether they are large or small, male or female. A few may last a week, or even two, but none lives to spawn again.

Eggs hatch in 50 or 60 days at California temperatures, and in the next three or four weeks the young wriggle up through the gravel to the water above. When newly hatched, the young have a large pink yolk which gives them a tadpole-like shape. They live off this yolk until it is absorbed and then start feeding on minute forms of life in the stream.

In California most young king

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salmon migrate to the ocean in the first few months. A small percentage wait in the stream until they are over a year old before this migration. These yearlings are seven to ten inches long and are often taken by trout fishermen.

In the ocean many king salmon stay relatively close to the mouth of the river in which they are spawned, but many others migrate long distances. Salmon from the Sacramento River move down California's coast in quantity to Monterey Bay and also as far north as the northern part of the State of Washington. A relatively smaller number go as far north as Vancouver Island, Canada. Of the salmon taken in the vicinity of the Golden Gate, over 90% are from the Sacramento-San Joaquin River System. Farther north the percentage drops off, but even in northern California, more than half of the king salmon taken in the commercial catch are Sacramento River fish.

When a salmon approaches maturity, it returns to the stream from which it migrated to the ocean. Relatively few salmon will ascend any other river system. "Straying" into the wrong tributary is somewhat more common and it has been demonstrated in the Central Valley of California that salmon which were bound for a certain tributary would ascend another if their home stream was not accessible to them.

The greater part of California king salmon mature when four years old; but many mature at three. Five-year olds are less common, sixes are rare, and sevens are almost unknown. Large numbers of precocious males mature at two years of age; these fish weigh about three pounds. Relatively few females mature at this size and age however.

Although somewhat similar in appearance, steelhead trout are considerably different from king salmon. Steelhead trout are known as the sea-going rainbow trout. In general most steelhead enter streams in the winter and spring, but in the Sacramento River the principal migration is during early fall and winter. Steelhead spawning resembles that of salmon, but the young fish spend a much longer time in the creek. Young steelhead usually remain in fresh water one or two seasons before migrating to the ocean; some remain three seasons, and a few for even longer.

After reaching salt water steelhead grow rapidly and usually return to spawn in their home streams after one or two seasons in salt water. Unlike salmon, steelhead do not necessarily die after spawning. The rigors of migration and spawning do cause a high mortality, but fish that have spawned two or three times are not at all uncommon. Because juvenile steelhead remain in the stream a long time, their habitat requirements differ from salmon. Spawning areas are usually the limiting factor in the fresh water requirement of king salmon, while nursery or rearing areas are generally limiting in steelhead protection.

Values

The average fall-run of king salmon in Battle Creek is estimated to be about 12,000. In the lower six miles of Battle Creek there are about 4.5 mi of stream that have excellent spawning habitat.

Let's examine the life cycle of 100 adult salmon that reach the spawning bed in Battle Creek. The California Department of Fish and Game, based on records over a period of years, estimate that 400 of the progeny of the 100 adult salmon live to reach maturity. Of this number 240 would be caught commercially, 60 by sport fishermen, and 100 would return to perpetuate the spawning cycle. It is interesting to see what happens when one puts a commercial benefit value on each of these fish. The net commercial benefit value is \$4.08/fish, which is determined by taking the average weight of 12 lb. times 34¢/lb. Sport salmon fish-value of a day's salmon fishing is \$1.80. It takes three days of ocean sports fishing to catch a salmon (3 x \$1.80 = \$5.40) and seven days for a river-caught fish (7 x \$1.80 = \$12.60). The composite sports value weighted on the basis of 69% being ocean caught and 31% being river caught is \$7.65.

Therefore, the value of the fisheries in Battle Creek for the average run of 12,000 spawners is estimated to be as follows:

Net Commercial: 28,800 @ \$4.08	\$117,504
Sport (both ocean and fresh water) 7,200 x \$7.65	55,080
Total annual value	\$172,584

Each spawner thus has an estimated value of \$14.28, and each acre of spawning habitat has a value of \$17,258/acre/year.

In the 4.5 mi of stream there are about 10 acres of salmon spawning habitat. At a reasonable interest rate of 5%, one acre has a capital value of \$345,160.

The value of one acre of gravel in Battle Creek may be estimated in another way; that is by figuring the cost of replacing one acre of natural spawning gravel by an artificial spawning channel. The 2.8-acre Comanch spawning channel in the Mokelumne River costs about \$750,000 or \$270,000/acre. Spawning channels in Canada, Oregon, and Washington have been estimated to cost from \$120,000 to \$470,000/acre. Streams such as the Fraser River with the spawning stream bed of 305 acres have produced a Sockeye salmon pack valued at as much as 50 million dollars at the cannery; this is about \$160,000/acre annually. At 5% interest this represents a capital value of \$3,200,000/acre.

Clearly, gravel made unsuitable for spawning or extracted from salmon rivers for other uses produces only a small fraction of the value produced when used for salmon production.

Management Practices

Battle Creek in the winter months is subject to flash floods which erode the land and leave mounds for compacted gravel in the stream. In the summer months we go in with bulldozers and push the gravel from the inside of the curves to the outside to increase the width of the channel by 100 to 150 ft. The gravel is left loose in a wide channel bottom. It is this area which creates ideal spawning beds for salmon and steelhead. In moving this gravel we exercise every reasonable precaution to prevent muddying or silting the creek.

Whenever possible, prior to the removal of materials from the channel bottom of the live stream a gravel barrier separating the stream channel from the removal area is constructed in such a location that it will prevent silt or mud from entering the stream. This barrier is kept intact as much as possible throughout the period of operation. Every precaution is taken to avoid siltation. Siltation caused by the rolling

effect of a dragline or bulldozer operation can suffocate downstream eggs and fry and also destroy organisms in the water necessary for fish survival.

We conduct our operation in such a manner that the fish will have free passage at all times. Only when absolutely necessary or when we are making the final crosscuts with the bulldozer, do we operate directly in the live-stream channel. We keep the removal of living vegetation to the minimum; however, when it cannot be avoided, exposed banks are revegetated by seeding grass or other good binding vegetative cover to reduce bank erosion and stream turbidity.

We also encourage the growth of overhanging trees and other vegetation along the banks, which supply the fish with considerable food from insects falling into the water. We schedule the necessary work in the stream beds to those periods of time when spawning fish are not present and when eggs are not incubating in the gravel. In general this is February through May for steelhead and October through February for king salmon. We have found that an irregular bottom is much better for fish production than a smooth bottom. Therefore, in excavating new channels no back-blading is done by the bulldozer in the final cuts across the channel. By not back-blading the bulldozer will leave ridges or berms a blade width apart. These berms create the riffles necessary for a good spawning bed.

In this work we have the close cooperation of the Department of Fish and Game of the State of California. Also the work we are doing is right along the lines of the U. S. Department of Agriculture's endeavor to encourage conservation measures which also have recreational and wildlife benefits. The California ASC State Committee encourages this very type of multiple land use practice through the Federal Agricultural Conservation Program.

I hope I have given you a little insight to the possibilities of preserving and improving, in one operation, our beef and fish supply of food for our tables while at the same time our fish supply for the sportsmen.