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## LAKE OAHE HOOKS AND LADDERS

### Lake Oahe Hooks and Ladders

A South Dakota version of the Project WILD Aquatic activity, *Hooks and Ladders*, that provides information on the Lake Oahe salmon population.

### Objectives and Method

Refer to *Hooks and Ladders*, found on page 69 in the 1987-1991 editions of the Project WILD Aquatic Guide, or page 76 in the 1992 edition.

### Background

The creation of the reservoir system on the Missouri River in the 1950's significantly altered the aquatic habitats in and near the river. The stretch of river that is Lake Oahe has become a cold water lake that layers or thermally stratifies each summer. The deeper cold water zone was not well used by native fish species. Fisheries biologists decided to introduce a new species that could tolerate the *limiting factors* created by the thermal stratification and add to our sport fishery.

During the 1970's South Dakota introduced kokanee salmon and lake trout in Lake Oahe. Neither introduction was successful. Simultaneously, North Dakota was running experiments in Lake Sakakawea, also a reservoir on the Missouri. Their work focused on a food

chain based on rainbow smelt, a fish species used as food by other species. The smelt reproduced, migrated downstream, and were abundant in Lake Oahe by 1977. Chinook salmon, introduced to feed on the smelt, appeared in Lake Oahe in 1979 and 1980. Because of the success of these two species and the state's commitment to providing quality sport fishing opportunities, South Dakota implemented its own chinook salmon program.

Chinook salmon are an *anadromous* species. However, there are some strains that live their entire life cycle in fresh water. One such strain, Lake Michigan chinooks, provided the eggs for South Dakota's initial efforts. Like their ocean dwelling relatives, these fish make an autumn spawning run up a fresh water stream just before the end of their lives. Stream water quality and clarity are important in successful spawning locations. Lake Oahe tributaries are turbid in the autumn, and so there was not a good location for Lake Oahe salmon to spawn. Thus, Whitlocks Bay Spawning and Imprinting Station was built. It is located on the eastern shore of Lake Oahe, 18 miles west of Gettysburg.

South Dakota first stocked its own chinooks in April 1982. In 1984, 175 adult fish returned to Whitlocks Station. In 1990, 1107 salmon returned, and approximately 787,000 eggs were

collected. The goal of the salmon program is to collect eggs and raise enough fish to stocking size to maintain the sport fishery in Lake Oahe.

A non-introduced population of chinook salmon would live their entire lives without human contact-unless they were caught by an angler! In South Dakota, the chinook's life cycle is intertwined with the work of fisheries biologists. At Whitlocks, eggs are removed from adult females between mid-September and the end of October every year. The precise timing depends on the weather and the water temperature. The fertilized eggs are incubated at fish hatcheries around South Dakota, and the individual fish, which live to a 3 to 6 inch size, are held until late April or early May. They are then returned to Whitlocks Station and kept in ponds during which time imprinting occurs. After release, the fish will spend 3-4 years maturing in Lake Oahe. Adults ready to complete the life cycle return to Whitlocks and swim up a fish ladder and into a holding pool created for them.

South Dakota salmon face a wide range of hazards that serve as *limiting factors* in the completion of their life cycle. *Limiting factors* are factors that reduce the population of living organisms. Eggs taken from adult fish were understandably few in number in the first years following the introduction. Also, a low success rate (< 50%) of egg hatching limited the population prior to 1991. Knowledge gained from research in the first years of the project has led to refined techniques that have resulted in higher hatching rates.

Another frequent cause of death for *smolts* is predation by larger fish such as pike. One of the ways biologists are overcoming this problem is to keep the young fish until they are larger. Originally, fish were stocked when they reached 3.5 inches in length. By keeping them at hatcheries until they reach 5.0 inches, twice as many smolts survive.

Once the salmon reach their second summer of life, the principal *limiting factors* change. Fishing harvest becomes the biggest pressure on the population. The number of rainbow smelt, the primary food for chinook, and the space in the deep water zone are additional *limiting factors* for 2-4 year old fish. Depleted oxygen levels in the water during the summer months is limiting, especially if the reservoir water levels are low. Fluctuating water levels in Lake Oahe caused by drought are a concern for all of the salmon population. People can soften this impact only through regulation of the water flows throughout the Missouri River reservoir system.

## Materials

This game requires: a large playing area (100'x50' minimum); 10-12 boundary markers; 2 cardboard boxes; 3"x 5" cards or fabric scraps for food tokens; 3-5 squares of fabric or cardboard; weights to hold the fabric down; ID tags or pinnies for the predators; a whistle for the teacher.

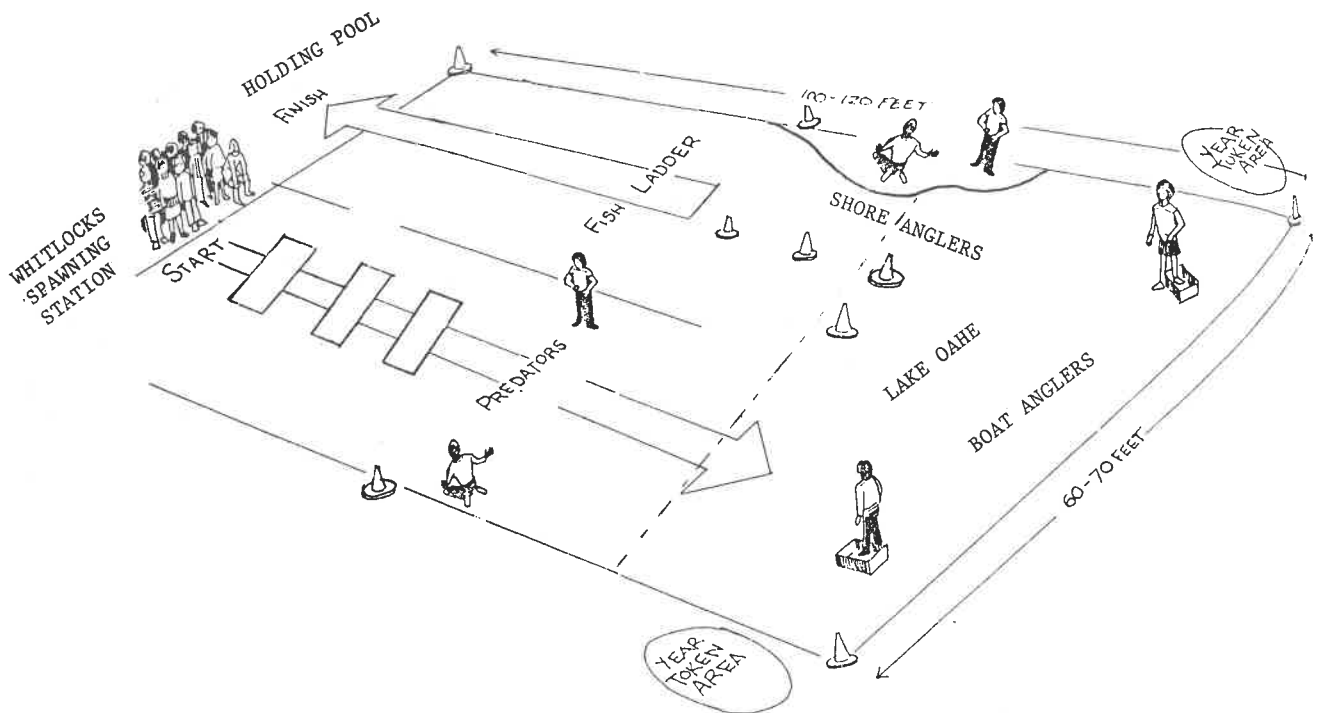
## Procedure

1. This is a very physically involving activity! Set up the playing field as shown in the diagram on the next page. Assign roles to each of the students: some will be salmon, others will be potential hazards to the salmon. Assign the roles as follows: **2 students** will be predators. At the beginning of the simulation, they will be pike stationed on the inbound path from the smolt holding area (the start) to Lake Oahe. After all the salmon have passed them, they will move to the other side of the playing field and become the shore anglers. **2 students** are anglers in boats in Lake Oahe. They are restricted to the Lake Oahe portion of the playing field and must keep one foot in a cardboard box. If they catch a salmon, they should leave their boat and take the salmon to the fish ladder. **All remaining students are salmon.**

Note: these figures are based on a class of 30. Make adjustments for your class size.

2. The salmon begin their journey as *smolts*. Remind them that they are in the 55-60 percent that have matured to this life stage! The first hazards they encounter are the pieces of fabric or cardboard. These simulate the stair steps

the fish must swim down as they leave the Station. The students are to leap-frog jump from one square to the next, until at the last square they run to avoid the pike. The number of squares used is dictated by the size of your playing area.



3. The next hazards the salmon encounter are the pike. If a pike catches a salmon, he or she must do so with 2 hands. The predator escorts the salmon over to the fish ladder area, thus effectively removing that predator from the playing field for a short while. This simulates the intermittent feeding by larger fish. The students who are the fish ladder kneel on the ground a body width apart.

should leave the boat and take the salmon to the top of the fish ladder.

4. Once past the pike, the salmon must avoid the boat anglers. Salmon must make four trips back and forth across Lake Oahe, and collect a food token from the sideline area during each pass. Only one token can be picked up at a time! If an angler catches a salmon with only one food token, he or she must let the fish go. Anglers can only "catch" fish who have 2-4 food tokens. A capture must be with both hands (like the pike). If an angler catches a fish, he or she

5. At some random point (the teacher's discretion), the whistle is blown loudly. Action freezes. It is announced that it is the middle of summer, and oxygen in the lake is depleting. Any salmon that has fewer than 3 food tokens is dead. These dead salmon come to the top of the fish ladder.

6. The simulation resumes with remaining salmon picking up food tokens, avoiding the anglers, and going to the place where they can start up the fish ladder. They must also avoid the grasp of the shore anglers. These people are restricted in the area from which they can work, but the funnel made of boundary markers is intentionally close to them so that they can reach out and tag salmon. A two-handed grab is not necessary, but the shore angler must

take the caught salmon to the top of the fish ladder.

7. Salmon who make it past the shore anglers "climb" the fish ladder by carefully stepping over the backs of their classmates. Those who make it to the holding pool at the top of the fish ladder are the successful breeders.

8. The activity ends when all the salmon are gone before the holding pool is reached-or when all the surviving salmon reach the holding pool.

9. Engage the students in a discussion. Explore such things as:

- \*the apparent survival/mortality ratio of salmon;
- \*students' feelings about the activity;
- \*the role of the predatory wildlife and the anglers;
- \*what the consequences would be if all the *smolts* that began the journey made it successfully;
- \*what seemed realistic about the simulation and what did not.

10. Ask the students to summarize what they have learned about the life cycle of Lake Oahe salmon and their *limiting factors*. Make sure the students have a clear, working definition of *limiting factors*. Encourage the students to make the generalization that all animals, not just salmon, are affected by *limiting factors*. Have them give examples.

## Extensions

1. Visit the Whitlocks Spawning and Imprinting Station. The Station is open from mid-September through the end of October, and again in mid-April through early May. Guided tours are available, and arrangements can be made by calling the South Dakota Game, Fish & Parks Department, 523 E. Capitol, Pierre, SD 57501 (605) 773-5535. During April, May, September and October call Whitlocks directly at 765-9411.

## Glossary

**Anadromous** - Anadromous species lay eggs in fresh water streams, migrate to the ocean where they live for most of their lives, and return to spawn in the freshwater stream where they hatched.

**Fry** - Juvenile fish that have absorbed their yolk sac but have not yet been imprinted.

**Imprinting** - A physiological process by which the smolts learn the odors of their home stream and later remember the smell to relocate that stream when they return to spawn.

**Limiting Factor** - Too much or too little of something in an ecosystem that restricts the growth, abundance or distribution of a population, ie. drought, lack of food, competition, etc.

**Smolt** - Young fish that have been imprinted. In South Dakota, chinook salmon are imprinted to Whitlocks Station.

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