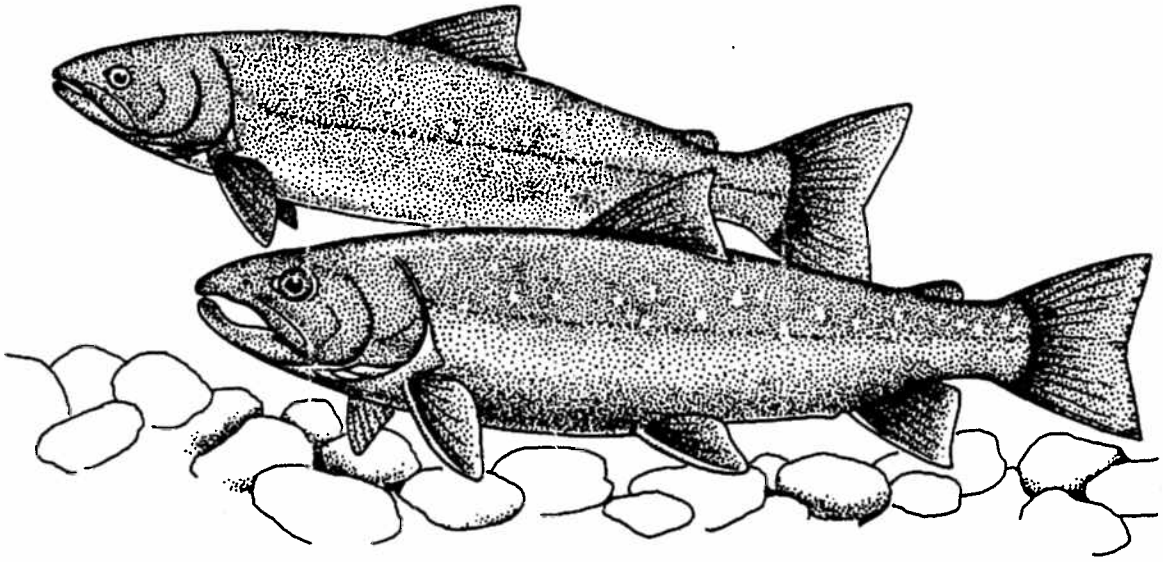
Montana Bull Trout

Redd Survey Manual



August 1997
Shelley Spalding
Reviewed by Tom Weaver
Montana Fish, Wildlife & Parks

Table of Contents

Introduction

A variety of survey techniques are used to measure bull trout populations. The type of method used is often dictated by the objectives of the survey. Survey objectives may include determining escapement, estimating total population numbers, or monitoring population trends. Work may focus on either the adult or juvenile segment of the population in question.

The purpose of this manual is to provide information for surveyors training to identify bull trout spawning sites or redds. It is important that consistent criteria be used in redd identification and recording. If collected consistently over a sufficient period of time, this type of information is useful in determining the status of various populations as well as for providing a basis to estimate current or anticipated spawner trends.

Species Identification

BULL TROUT

Dark bodies with light spots characterize char. Trout have light bodies with dark spots. Bull trout have a flattened head profile with a rounded frontal view head form. The upper jaw of the bull trout has a more pronounced downward curve. The beauty of these native char is seen in their coloration - olive green body, cream colored spots over the back with red or orange spots on the side. In lakes or large rivers, sub-audlts often appear silvery and close inspection is required to detect the spotting.

During spawning season, the colors on mature fish intensify and the male takes on a reddish color on the flanks and caudal fin. Both sexes exhibit a bright white leading edge on paired fins, which becomes more prominent during spawning.

The name "bull trout" was used by fishermen to describe the native char with a large, broad, stout head and extremely piscivorous nature. The size and shape of the bull trout's head, as well as its distinctive jaw and large mouth are characteristics well adapted to an apex predator. The record bull trout in Montana was caught in 1916, weighed 25 lb. 10 oz., and was 37 inches long.

Bull trout may have either resident or migratory life histories. Resident fish are smaller (usually less than 12 inches) and are found in headwaters or high elevation streams, where they spend their entire life. True resident populations are often separated from other populations due to a physical barrier such as a falls or thermal barrier. Many resident fish may be "remnants" of former migratory populations that have become fragmented due to dams or dewatering.

BROOK TROUT

Brook trout are not a native char in Montana, but were widely introduced around the turn of the century. They are similar in appearance to bull trout but are usually smaller, have vermiculations (wavy, worm-like lines) and black markings on the back and dorsal fin. Brook trout's red spots also have a bluish halo surrounding them.

BROWN TROUT

Brown trout are another fish introduced to Montana's waters. Brown trout have black or

brown spots with halos as well as red spots on their sides with light halos and spots on their dorsal fin.

Spawning

SITE OR HABITAT PREFERENCE

Bull trout have very specific spawning site requirements and tend to utilize only 15 to 25% of the habitat available to spawning adults.

From the work by Graham et al. (1982) and others, the following relationships between habitat variables and redd frequencies in streams available to bull trout were observed:

Higher stream order (3rd and 4th order) was associated with more redds
Lower stream gradient (less than 3%) was associated with more redds, with bull trout often spawning immediately downstream from low gradient-high gradient interfaces. Concentrations of redds were found in the upstream portion of low gradient reaches. However, bull trout in Washington have been found to spawn in 15% gradient.
Overhanging cover was associated with areas of frequent spawning use. Adults not actively engaged in spawning are often found near undercut banks, debris jams or deep pools.
Streambed composition is predominately **large gravel and finer material**. The predominate size of streambed material was from 16 to 50 mm (5/8 to 2 inches).
Water temperatures that initiate spawning are usually **9 degrees C. (49 degrees F.)** or lower.
Stream reaches with numerous **side channels** and **braided channel areas** also contained large numbers of bull trout redds.
Spring fed channels or other areas with continually **recharged by ground water** probably provide a more stable environment for embryos and may contain abundant redds.

AGE OF SPAWNERS AND SEASON OF SPAWNING

Fluvial (river dwelling) and adfluvial (lake dwelling) adult bull trout spawn and juveniles rear in tributary streams with juveniles migrating to lakes or larger rivers at ages 1 to 3. These migratory fish return to their natal streams to spawn beginning at ages 5 to 7. Bull trout spawning may occur from August to November with the majority of spawning occurring from late September to early October. Resident bull trout may spawn, rear and overwinter in the same locale.

Redds

DEFINITION

A redd is a nest or a disturbed area in the gravel that is constructed by the female spawning fish in order for her to bury the fertilized eggs (Fig. 1). Redds are visually identified by the presence of a pit or depression and associated tail area of disturbed gravel. With a recently constructed redd the gravel will have a "bright" or "cleaned" appearance (Fig. 2 and 3). A single redd may have more than one pit, but they are associated with a single tail. A single cleaned area may have more than one redd if each pit has a distinct tail (Fig. 4). In that case **each pit with a distinct tail is counted as a redd**. Occasionally the fish will make a "test" dig and this is recognized by a much smaller cleaned area than is observed for the redds and it often lacks a distinct pit and tail.

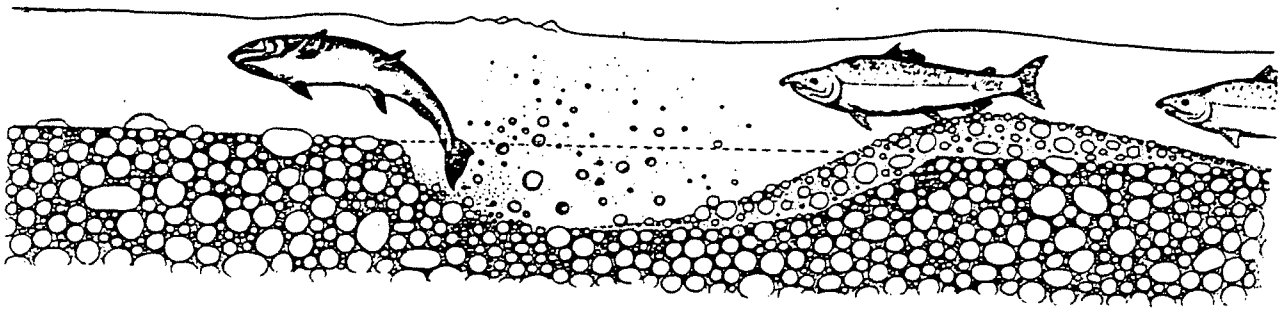


FIGURE 1.—Redd making. Female digging.
From Bruner 1951

CONSTRUCTION AND HYDRAULICS

The following description of salmon redd construction is from Bruner (1951):

"The female digs the redd as she turns on either side, at an angle of about 45 degrees to the current, head upstream, body arched, and makes a series of violent flexions with body and tail (Fig. 1). The tail strikes the gravel occasionally and the strong-boiling current created carries gravel and silt a short distance downstream. This material spreads out in a flat semicircle first; then as the digging proceeds, it collects onto a loose pile called a tailspill. With more digging the redd assumes a long oval shape....

At the beginning of the spawning stage, the nest is ready for the eggs. All loose gravel and fine material have been removed from the pit, or center of the redd, whose shape is such that any current in the bottom flows upstream (Fig. [5]), then upward and outward. Usually there remains in the pit large stones too heavy for the fish to move far, and the crevices between these rocks provide excellent lodgment for the eggs...."

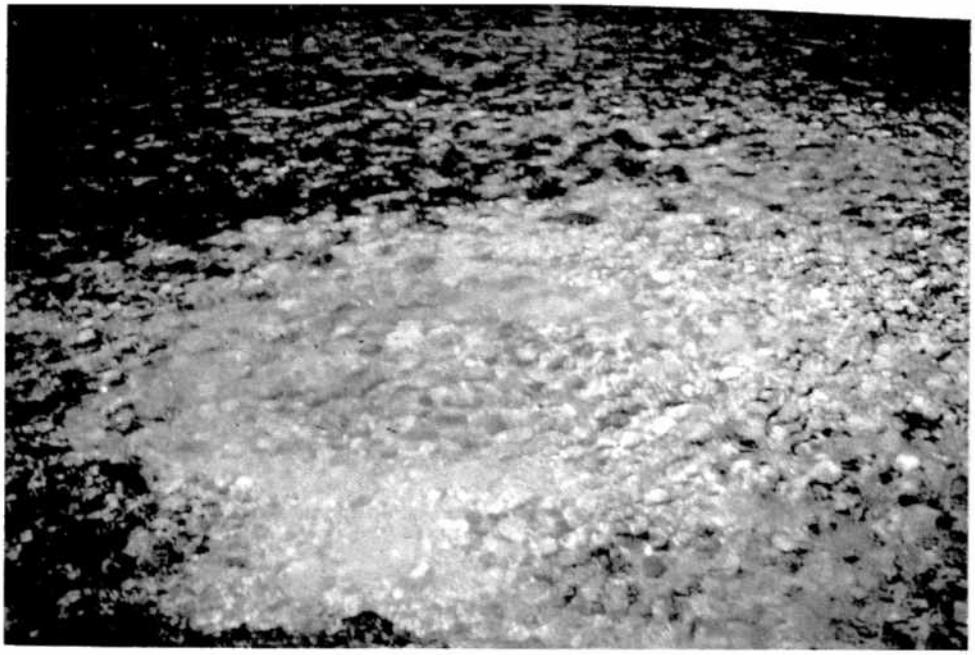


Figure 2
Recently constructed redd with characteristic cleaned or "bright" gravel
Photo courtesy Russ Thurow

Figure 3
Recently constructed redd close to cover
Photo courtesy Russ Thurow

Figure 4
Single cleaned area with two pits and tailouts
Photo courtesy Russ Thurow

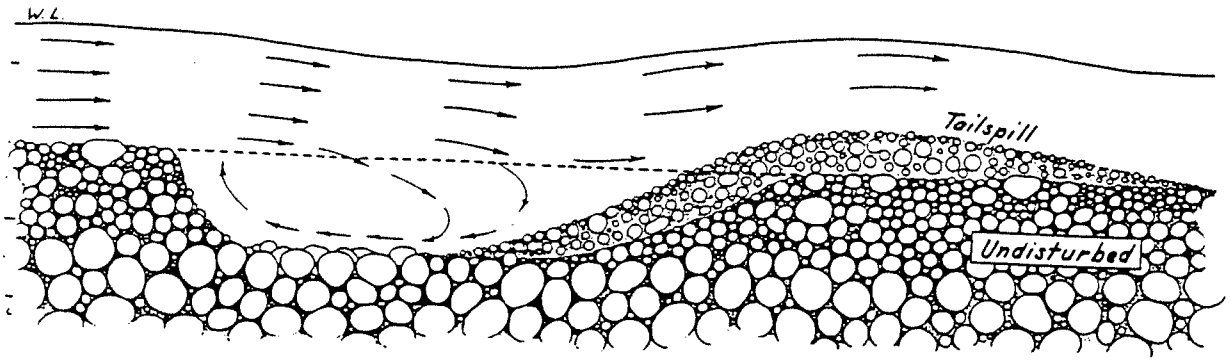


Figure 5. Typical currents in redd. From Bruner 1951

SIZE OF REDD

Visually identifying the redds of the large migratory bull trout presents little problem if done before they lose the cleaned or birght apprearance. These redds are large, usually 2-3 ft. by 5-6 ft. The redds of resident bull trout are smaller, 1.5 by 3 ft.

Survey Procedures

BASIN-WIDE COUNTS

During a basin-wide count all habitat which appears suitable for bull trout spawning (as described in "spawning site or habitat preference" section) is surveyed. From this basin-wide survey index areas can be identified for annual surveys. Basin wide counts can be done every 5-7 years.

INDEX AREAS

Areas in which redds are counted on a routine basis are called "index" areas. In some cases these index surveys continue to an upstream barrier. It is important to establish upper and lower limits of index areas. Through repeated annual index surveys we obtain valuable trend information to use in monitoring bull trout populations. Detection of trends will often require at least 10 years of monitoring index areas (Rieman and Meyers, in press).

SUPPLEMENTAL AREAS

Supplemental areas are areas where redd counts are not made on a routine basis. Index areas are often located in the areas where the most spawning is found and consequently redd numbers in index areas may be above average. The number of spawners in the index areas may be slower to respond to environmental variation because those fish spawning in less suitable habitat may move to the higher quality habitat if habitat becomes degraded in the stream (Rieman and McIntyre 1996). Other supplemental and selected suitable spawning areas in the watershed should be surveyed to better monitor metapopulation trends.

TIMING OF SURVEYS

Preliminary surveys should be done to determine the appropriate time for final redd counts.

Final counts are conducted when redds are completed but few adult fish are found on the redds. Timing is critical because as the redds age, they will lose their "cleaned" or "bright" appearance. If timing is optimal, identification of redds presents little problem.

IDENTIFICATION OF MIGRATORY AND RESIDENT BULL TROUT REDDS AND OTHER SALMONID REDDS (BROOK TROUT AND BROWN TROUT)

Migratory bull trout tend to have larger redds than brook trout or resident bull trout. Bull trout also tend to spawn earlier than brown trout or brook trout. To reduce confusion with these other salmonids, it is important to determine the optimal timing for bull trout redd surveys and to record the size of redds. While brook trout do not present much of a problem when the focus is on surveying migratory bull trout, where present brown trout can be a confusing factor.

RECORDING REDDS

Shepard and Graham (1983) used three classes of certainty for classification of redds: definite, probable, and possible. The possible class has been discontinued for current redd surveys.

1) Definite: No doubt. The area is definitely "cleaned" and a pit and tailspill are recognizable. Not in an area normally cleaned by stream hydraulics.
2) Probable: An area cleaned that may possibly be due to stream hydaulics but a pit and tailspill are recognizable, or an area that does not appear clean, but has a definite pit and tailspill.

Because the "probable" category has such a high degree of certainty, the definite and probable are counted together in the final number of redds for the survey.

SURVEY REACHES

Survey reaches are located on topographic maps. Observors should walk downstream unless glare, visibilty or logistics indicate otherwise. Survey reaches should try to capture the majority of hightest density spawning areas and at a minimum be 0.5 to 1.0 mile long.

OTHER INFORMATION AND CONSIDERATIONS

Reduce the chances for mortality of eggs by avoiding stepping on redds.

Notes should include test digs, numbers of live and dead bull trout, estimated lengths, gender, spawning activity and behavior, landmarks.

For surveying consistency, ideally the same surveyor would participate in all surveys in an area during a season and in subsequent years. However, this is may not be possible in most cases.

Annotated Bibliography

Annotated Bibliography

Redd surveys

Bonar, S.A., Divens, M. and B.Bolding. 1996. Methods for sampling the distribution and abundance of bull trout. *Draft.* Washington Department of Fish and Wildlife, Olympia, WA. *Review of existing survey methodologies, how to classify a redd, determining cumulative number of redds over the entire spawning season, abundance survey designs, calculating spawner escapement.*

Bruner, C.J. 1951. Characteristics of spawning nests of Columbia River salmon. Fishery Bulletin of the Fish and Wildlife Service, Vol. 52, Bulletin 61. *Although this is for salmon redds, it provides an excellent description with illustrations of criteria of a mature redd, measurement and methods, and redd size and interred space.*

Linth, J., R. Mosley, R. Brix. 1990. Washington coastal spawner survey manual. Washington Department of Fish and Wildlife, Olympia, WA. *Although designed for salmon redd surveys, provides usefrul information including defintions, procedures, instructions, field gear checklist, safety.*

McPhail, J.D. and J.S. Baxter. 1996. A review of bull trout (*Salvelinus confluentus)* life-history and habitat use in relation to compensation and improvement opportunities. Fisheries Management Report no. 104, British Columbia Ministry of Environment, Lands and Parks.
Pp. 5 - 8, spawning areas, habitat characterisitics, season and conditions, behavior, sex ratio, fecundity, and sexual dimorphism.

Montana Bull Trout Scientific Group. Effects of land management activities on habitat requirements of bull trout.

Rieman and McIntyre. 1996. Spatial and temproral variability in bull trout redd counts. North American Journal of Fisheries Management 16:132-141. *An analysis of bull trout redd counts with evidence of a stronger correlation in the number and year-to-year change in number of redds between streams that were closer together than between streams that were far apart.. Indications that monitoring only a few index populations may not clearly represent the dynamics of larger regional populations.*

Shepard, B.B., J.J. Fraley, T.M. Weaver, P. Graham. 1982. Flathead River fisheries study -1082. Environmental Protection Agency, Denver, Colorado. *Pp 46 - 58 describes objectives of redd surveys, consistency of location of bull trout redds in successive years, comparison of helicopter and ground surveys, factors important in triggering spawning activity, spawning site preference as related to depth, velocity and substrate.*

Shepard, B.B. and P.J. Graham. 1983. Fish Resource Monitoring Program for the Upper Flathead Basin. Flathead River Basin Environmental Study, EPA Contract No. R008224-01-4.
Pp 26 - 33 give a thorough description of redd survey procedures, including criteria for identifying

redds, timing of surveys, ground versus helicopter surveys.

Weaver, T. and J. Fraley. 1991. Fisheries habitat and fish populations. Flathead Basin Forest Practices Water Quality and Fisheries Cooperative Program, Flathead Basin Commission, Kalispell, MT. *pp 17 & 18 describe criteria for classifying redds, timing of surveys, and designation of redd locations.*