Brief Handbook on determining spawning areas and salmon numbers in the spawning rivers of the Sakhalin Oblast

In undertaking work pursuant to the documentation of the salmon spawning rivers, one of the main tasks facing the Ichthyological Service river research workers is determination of the quantities, quality, distribution, and condition of the salmon spawning sites on the rivers being studied, the density of the salmon at the spawning sites, and the numbers of fish entering these rivers to spawn.

The goals and purposes of this research, as well as the scope of the work involved, have been quite thoroughly described in the Program for Expeditionary Research of the Fisheries Waters of the Sakhalin Oblast, approved by the Director of SakhalinRybVod Federal State Enterprise on August 1, 2003, under number 20-163.

In keeping with the instructions on safety of personnel, this river research program will be carried out by teams of no fewer than three persons working together.

The Hydrometeorological Service has established the following approximate norms for hydrographic reconnaissance in order to facilitate the calculation of the amount of time that will be required to research the river, using the length of the rivers as a basis: for rivers up to 50 km in length, 10 km per day; for rivers up to 100 km in length – 6 km per day; and for rivers over 100 km in length – 4 km per day.

It is self-evident that these norms consider not just the time required for movement, but more the time needed for conducting the research work.

During the research, workers will need to have with them a detailed copy (on tracing paper) of a 1:100,000-scale map.

Under this scheme, the river is to be divided into three sections, the borders between which must be selected from among the tributaries that are over 3 km in length. It is preferred that the length of the sections be no greater than 4-5 km, and that the tributaries that serve as boundaries between the sections be named.

Determination of the area of the spawning sites and the numbers of salmon begins at the uppermost portion of the river.

The time frame for river research for purposes of determining the area of the spawning sites is best selected to coincide with the period of summer low water. However, for a more accurate determination of the numbers of spawning sites, the rivers should obviously be studied during mass spawning in years with the highest numbers of humpback salmon, when the fish will be using the spawning sites to the maximum degree.

We suggest considering the spawning sites for humpback to be those sections of the river bottom that are covered with pebbles of various sizes and mixed with boulders or not, having a depth of from 10 to 100 cm and a water current speed over the spawning sites of from 0.15 to 1.5 meters per second.

The spawning sites area should not include the following: pits, deep holes with slow current flow, sections of the river bottom covered with fine pebbles mixed with a great deal of gravel and sand, as well as those portions of the bottom represented by hard rock outcroppings. The spawning site area should also not include shallows (less than 10 cm in depth) adjacent to flat dunes or in riffles.

If the river has obstacles to the passage of salmon to the upper reaches that are of natural (rapids, waterfalls) or artificial (dams) origin, it is still necessary to identify the spawning sites above these obstacles, and in the river description or a separate document to present recommendations on the feasibility of removing them in order to allow the spawning sites in the upper reaches to be used.

The amount of work involved in removing these obstacles must be determined.

After the headwaters of the river have been reached and, in the opinion of the members of the team, spawning sites are no longer to be found or their share of the total number of spawning sites in the river as a whole has become insignificant, the leader of the team will reallocate responsibilities

among the members, indicating specifically who is to carry out what sort of observation, measurement or record, and in what order.

A list of the minimum information that must be obtained during the observation period is presented in Section 2 of the Program of Expeditionary Research.

We suggest that work in determining the amount of spawning area be organized as follows: begin by descending downstream, using a measuring pole made of aluminum pipes with a 100 cm gap between the legs, or using a 10-20 meter long measuring tape, measure the length of the river, and every 100-150 meters measure the width of the river from waterline to waterline.

Measurements may be entered into the daily field journal using the following table format:

Table #1

Item #	Section boundary	Section length	Av. width of section in meters	Area of water surface in square meters	Percentage of spawning area for section	Area of spawning sites for section in square meters	Predominant bottom type	spawning site condition
1.	From #9 left to Kholodniy creek	1000	10	10,000	50	5,000	Lg.med. Pebbles	Good
2.	From Kholodniy creek to #8 left	1700	12	20,400	75	15,300	Med.small Pebbles	Good

The first tributary is considered to be the one closest to the mouth of the river.

The area of the spawning sites for the river section can be calculated one of two ways:

1. In cases where the spawning sites are represented as separate sections (as at the edges of pits or riffles), then their areas are measured directly on the spot and are then added together later.
2. If the spawning sites are distributed over a large portion of the river channel and alternate with small-area non-spawning sections, then they are first estimated as the percentage of the river water's surface area that they represent, and their number is then calculated from that.

It is preferable during the research to determine the amount of spawning site area for sections of river whose length does not exceed 500-700 meters. This will greatly enhance the accuracy in determining the numbers of spawning sites.

In the description of the river, Table #1 must be placed together with the list of the river sections and their parameters that you noted on the schematic map before the field research began.

For the future, knowing the number of spawning areas on the various sections of the river will permit a more accurate determination to be made of the numbers of fish coming into the river to spawn, the amount of roe lain in the spawning mounds, and so on. This is needed both for calculation of damage to salmon reproduction inflicted by various organizations and enterprises both for individual sections of river and for the river basin as a whole.

All spawning tributaries must be subjected to detailed field study.

The spawning areas in the smaller tributaries may be estimated approximately, using as a guide the nearest tributary in the river basin to have been studied.

All numerical data needed for the documentation and description of the particular spawning river are calculated during subsequent office processing of the results of the field study. The two documents thus generated are produced in two copies, one of which is to be forwarded to SakhalinRybVod.

The numbers of salmon entering the rivers to spawn may be calculated using any one of three methods. We shall examine each of these individually.

1. The full count method is to be used in two cases:

   A) when the density of salmon at the spawning sites is low (up to 75 individuals/100 square meters), and their distribution throughout the spawning sites and river sections during the period of mass spawning is very uneven;

B) when the field study is carried out before the onset of spawning. Fish during this period continues to enter the river to spawn, and its movement upriver is rather intense.

The full-count methodology is quite simple and consists of the following:

As the team moves downriver, the members count all of the fish encountered that day in the river and its main spawning tributaries individually (by species).

In that case, the following are subject to counting: fish found at the spawning sites to be preparing to spawn or in the process of spawning; fish moving upstream towards the spawning sites; fish lingering in pits (if in large concentrations, or if the visibility in the pits does not extend to the bottom, the numbers may be estimated). Dead fish must also be counted, whether as a result of injury, post-spawning mortality, or being captured and left on the riverbank or channel by animals or poachers.

2. The selective counting method is to be used only in cases when the field study is being conducted during the period of mass spawning, when the density of salmon at the spawning sites is approaching the norm (200 individuals/100 square meters), or if the spawning sites are overfilled, with a generally even distribution of fish among the spawning sites and river sections.

The norm for the density at the humpback spawning sites is generally accepted as being 200 spawners with a 1:1 ratio of males to females, occupying 100 square meters of spawning site area.

In the Sakhalin Oblast, more males enter the rivers to spawn than females. For that reason, permission to fish in the river or river mouth area is extended to harvesters only if there are no fewer than 100 humpback females per 100 square meters of spawning area. That is why the determination of the ratio of humpback males to females among the spawning population in the rivers is such an important factor in the field study of these rivers.

The norm for chum density is considered to be 160 spawning individuals at the spawning areas, with a 1:1 ratio of males to females.

To use the selective count method, as the team moves up to the upper reaches of the river, it carries out its reconnaissance in order to determine the distribution and approximate numbers of the salmon in the river sections and spawning areas and to select section lines for establishing control plots.

Control plots are to be established in those spawning areas that have a fish distribution corresponding to the average for a section of river 1-2.5 km long. The control plots must be no less than 20 meters in length and have a water surface area of no less than 200 square meters.

The number of control plots to be established on a river varies depending chiefly on the river's length.

For rivers up to 50 km in length, control plots should be established every 1-1.5 km; for rivers over 50 km long, they should be established every 2-2.5 km.

The fish are counted in the control plots as follows: the observers approach the selected plot carefully, so as to avoid spooking the salmon, define its boundaries and count the fish. If the river channel is wide, counting is best done up to mid-channel. If possible, humpback males and females should be counted separately, but chum spawners are best counted together, since it is difficult to distinguish the males and females from each other in the water.

After the fish have been counted in the control plot, the team begins the process of measurement, entering the results in a table of the following format:

Table #2

Item #	Distance from mouth in km	Plot length	Width of water surface in meters	Area of water surface in square meters	Percentage of spawning area	Area of spawning sites in square meters	Females	Males	Total	Density, individuals per 100 sq.m.	Average current speed, m/sec.	Bottom type
1.	21	20	10	200	80	160	167	173	340	212	0.5-0.8	Large and medium pebbles

2.												
	ETC., Av.											

As the team descends downstream, it counts the fish it finds in pits that is still not ready to spawn, as well as the dead, spawned-out fish.

During subsequent office processing of the results of the field study, averages are calculated for all columns in Table #2, and the following method is used to calculate the numbers of fish that entered the river to spawn:

Let the area of the spawning sites in the river basin equal 10,000 square meters, with an average density of humpback salmon at the spawning sites of 200 individuals per 100 square meters. The total number of fish in the river based on the data from Table #2 would then be:

$$X = \frac{200 \times 10{,}000}{100} = 20{,}000 \text{ individuals}$$

To this figure are added the fish that were found in pits on the day the field study was conducted (using our example above, this would be 1,500 individuals) and the number of dead, spawned-out individuals (for example, 2,500 individuals). Thus, the total number of fish entering the river to spawn would be 24,000, and the density of fish at the spawning site would be 240 individuals per 100 square meters.

Immediately upon completion of the field study, a report is compiled that indicates the date the river was studied, its total spawning area and the method that was used to count the salmon, with detailed calculations. If the calculation was based on the selective method, then Table #2 is appended.

In cases of overcrowding of the spawning areas, or if there is a danger of fish mortality due to unfavorable conditions, recommendations are made on the advisability of permitting a harvest of the fish in the river or at the mouth of the river, as well as on the time frame and methods to be used for the harvest in the river.

The report is to be forwarded to SakhalinRybVod at the earliest possible opportunity.

3. The method of counting salmon spawning mounds is the least accurate, and therefore should be used only to give an approximate estimate of the number of spawned-out salmon.

The number of salmon spawning mounds using either the full-count or the selective-count methods presented in the present handbook.

The total number of fish is determined by multiplying the number of spawning mounds by 2, i.e., taking into consideration the 1:1 ratio of males to females.

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