

Description of the technological process at the salmon hatchery

1. Management's main goals at the Gidrostroy JSC salmon hatcheries are as follows:

1. The salmon hatchery is to be viewed from the perspective of its usefulness to the river ecosystem.
2. Hatchery workers are to view their work primarily from the perspective of helping to reinforce the natural spawning grounds, rather than just in terms of the numbers of fish returned from the fish released from the salmon hatchery.
3. The salmon hatcheries must serve as a means of preserving the genetic fund of the population, conserving the environment and restoring populations that have been lost. The salmon hatchery system must be seen as one of the components of the ecosystem as a whole.

2. The concepts of salmon hatchery operation are as follows:

1. Conformity with legislation aimed at preserving the environment.
2. Structure of operations at the salmon hatchery based upon scientific developments.
3. Logistics – all funds and number of personnel must be adequate to meet the goals set for each individual salmon hatchery.

3. The main technological processes.

The main elements of control over salmon rearing at the salmon hatcheries are reflected in the salmon development schedules and models that they adopt. The most important documents that the specialists working at the salmon hatcheries must develop are the following:

- 1) Model of the time frames and dynamics of salmon spawning migration into the salmon hatchery's base river for purposes of reinforcing the stocks at the natural spawning grounds.
- 2) Schedule of egg incubations for the purpose of conserving the population's genetic fund (mandatory combination of natural and artificial salmon reproduction within the salmon hatchery's base water system).
- 3) Model of the temperature regimes of the hatchery process (with consideration of the particular conditions at each salmon hatchery).
- 4) Schedule of young salmon entering its free-swimming stage and the initiation of outside feeding within the optimum time frame.
- 5) Schedule for rearing the young salmon to its standard weight range.
- 6) Calculation of the consumption of granulated fish food (including by individual fractions).
- 7) Schedule for the time frames and durations of the release period of young salmon from the salmon hatchery with consideration of the hydrological and thermal conditions in the coastal waters.

3. Description of the main technological processes.

3.1. Production of good-quality spawner fish.

Under proper operations and an enlightened approach to conducting the activities of the hatchery, the population of salmon in the river basin will increase significantly. This will help to achieve the main goal of salmon enhancement: to obtain additional raw material for fish processing within the sphere of activity of the salmon hatchery. At the same time, however, it leads to a problem – how best to allow the spawner fish to pass through to the natural spawning grounds and yet arrange for the harvest of the excess spawners. This creates a need for the erection of fish gates at the river mouths that can also serve as fish retention barriers.

As experience has shown, the best results are obtained at the salmon hatcheries that combine natural and artificial reproduction. For this reason, hatchery workers undertake a number of measures during the period when the spawners are running to the spawning grounds aimed at allowing the

spawners through to the natural spawning grounds, maintaining daily control over the movement of the spawners upstream, observing the physiological spawning changes undergone by the spawner fish and the temperature and hydrological conditions in the river. In order to complete these tasks, a model is developed on the time frames and dynamics of the salmon spawning migration into the base river of the salmon hatchery with a goal of achieving the proper density of spawners at the spawning grounds. During the course of operations, the model is adjusted to correspond to the actual time frames of spawner arrival and their numbers.

The fundamental goal at this stage: to exclude stress induced by retaining spawners to maturity, including the avoidance of oxygen starvation.

3.2. Production of good-quality eggs.

Egg collection occurs at a special location – the salmon hatchery's egg collection station. Pink salmon eggs are collected during the period between September 12-14 through October 12-15; chum salmon eggs are collected between October 12 – 15 through November 10 – 14.

Egg collection is conducted in accordance with the egg incubation schedule, developed in consideration of the population's genetic structure (as well as the mandatory combination of natural and artificial salmon reproduction in the base waters of the salmon hatchery). Small lots of eggs are collected on a daily basis.

The main goals during egg collection are the following: to observe hatchery requirements during egg fertilization, washing, and transport to the incubator area of the hatchery.

3.3. Healthy eggs during incubation.

Before the hatchery cycle is begun, a model is developed for the temperature regime during the hatchery process that considers the particular conditions at each salmon hatchery (the availability of water sources with different temperature regimes and the anticipated time of onset of favorable conditions for the young salmon in coastal waters).

At this stage, particular attention is paid to the following:

1. maintaining the temperature and dissolved-gas regimes that enhance the development of the species (pink and chum salmon require water of differing temperature regimes);
2. conducting preventative measures to avoid the development of diseases in the eggs;
3. discarding dead eggs that degrade the conditions of egg incubation.

The average length of the incubation period is as follows:

For pink salmon: from mid-September to the end of January;

For chum salmon: from mid-October to mid-February.

3.4. Production of healthy free embryos and fry.

The following requirements must be carried out in order to produce healthy free embryos and fry:

1. timely (before the onset of the sensitive development stage) transfer and placement of the eggs to hatch from the incubators to the nursery channels;
2. optimum density of free embryos (considered per unit of area);
3. establishment of the optimum temperature and dissolved-gas regimes in the water (based on the model temperature regime for the hatchery process);
4. maintenance of the optimum rate of water flow;
5. creation of the conditions that most closely approximate the natural: observance of the total darkness regime in the nursery areas, provision of a rate of water flow through the artificial substrata that corresponds to the flow rate through the gravel nests in the river, etc..

The result is the production of healthy young salmon that have good morphological characteristics and «adequate swimming strength».

The length of the free embryo holding period is as follows:

For pink salmon: from mid-December to the end of April;

For chum salmon: from mid-January to the beginning of April.

3.5. Healthy young salmon.

Upon completion of the free embryo holding period, a schedule is developed for the onset of the free-swimming stage and initiation of outside feeding, which is the defining moment for the beginning of the rearing period for the young salmon. This schedule takes into account not only external conditions (the temperature of the water and trends for change through a particular season), but the rate of resorption of the yolk sac and particulars of the transfer of fry from the parent generation to outside feeding as well. The time chosen to transfer the fry to outside feeding is very important, since its delay or an earlier inception of the free-swimming stage of the fry could lead to a decrease in the quality of feeding operations of the fry (a significant portion of the fry might have a low body weight that would require extra food to overcome).

Thereupon a schedule is developed for the rearing of the fry that includes a model for fry release that considers the anticipated time for development of the necessary hydrological conditions in coastal waters. The goal of the salmon hatcheries is to rear the young salmon until the optimum conditions have developed in the coastal portion of the sea for it to pursue its at-sea feeding stage, rather than merely to grow the young fish to a certain weight range. For this reason, the resultant weight range of the young salmon as reflected in the rearing schedule will depend upon the number of rearing days that correspond to the anticipated dates for the release of the young fish.

The feeding ration is reflected in the calculation of the consumption of granulated food (including by fractions).

The main goals at this stage are as follows:

1. accurate determination of the date that feeding of the young salmon is to begin;
2. strict observance of recommendations to maintain optimum water exchange within the channels;
3. control over the oxygen content in the channels;
4. conducting preventative measures to avoid the development of diseases in the young salmon.

The length of the fry rearing period is as follows:

For pink salmon: from the end of April to the second twenty-day period in June;

For chum salmon: from the beginning of April to the end of June.

Timely release to sea.

The main goal of this stage is the release of fish to sea at a particular time, when the food base in coastal waters has had a chance to develop. In order to accomplish this goal, a schedule is developed of the time frame and duration of the release period of young salmon from the salmon hatchery based on the anticipated hydrological and thermal conditions in the coastal waters, which is then adjusted as needed to reflect actual conditions.

As a rule, young pink and chum salmon are released from the end of May through the end of June. The fish are released every day during evening hours in lots of from 1 to 3 million young fish at a time.