Spawning Migrations of the Baikal Omul

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Abstract. This paper presents a complete list of spawning rivers of the Baikal omul. We specified the length of rivers, the location, and length of spawning grounds and plotted them on the topographic map. The study examines the ecological and biological significance of the spawning migrations of the Baikal omul. It reveals the features of spawning migration to latitudinal rivers. We show that the space and time structure of omul spawning is genetically determined. Baikal omul developed a peculiar mechanism of using even the most remote spawning grounds. This mechanism implies considering migration opportunities before entering the river and taking into account the river regime. Migration opportunities depend on the reproductive maturity of individual fish at the beginning of spawning migration. The research finds that the remoteness of the spawning grounds used by omul in the Selenga River correlates with the maturity of the female gonads at the moment of entering the river in a particular year. The water level influences the flow dynamics and changes the distribution of roe in the spawning grounds. The dynamics of entry into the Selenga River is also preserved when the spawning stock moves to the spawning grounds. Mass spawning of omul in entering the Selenga and Upper Angara Rivers allowed us to establish a pattern of spawning distribution between the spawning grounds, depending on the entry time.

Keywords: Baikal omul · Spawning migration · Spawning rivers · Spawning grounds · Ecological conditionality

1. Introduction
The migration of fish is considered an adaptation to the increase in the number of species. Due to its migrations – forage, wintering, and spawning – omul became a widespread species and the main fishing object on Lake Baikal. According to the classification of E. V. Burmakin and P. V. Tyurin [18], the Baikal omul belongs to “freshwater anadromous fish.” According to the categorization of V. V. Smirnov [23], it is represented by three morpho-ecological groups [MEG] (races) – pelagic, coastal, and benthic-deepwater. Summer feeding migrations of omul were discussed in detail [11, 23]. However, the spawning migrations have not been sufficiently studied due to the significant number of spawning rivers and short autumn in the region. When looking at the spawning migration of whitefishes, most researchers limit themselves to providing information on the dynamics of the entry of spawners into the river and considering biological indicators [7, 9, 15, 33]. Conclusions about the spawning migrations of the Baikal omul are made, in particular, based on the time and dynamics of the entry of spawners into the rivers and their biological parameters [1, 2, 11, 12, 14, 19, 21, 35]. Some conclusions on the peculiarities of spawning migration of omul in the Selenga River were made based on the distribution of the leading stock of roe in spawning grounds without considering the factors impeding its natural flow [6]. Noteworthy are the works on the field observations of the spawning
migration of omul in the river [13, 17, 22, 23, 26, 30].

The paper presents a complete list of spawning rivers of Lake Baikal and examines the patterns of omul entry along the main spawning rivers and the subsequent movement of spawners to spawning grounds. The length of potential spawning grounds in each river is established.

2. Materials and Methods
This work is based on field studies on spawning migrations of omul in the tributaries of Lake Baikal. Field studies included establishing the duration of omul entry into rivers, its intensity, the speed of movement along the river, the distribution of spawners of different access times over spawning grounds in the river basin, and the determination of the maximum travel range in each river. Most of the rivers were surveyed from 1996 to 2002. Detailed studies in the largest tributaries of Lake Baikal on the Selenga River in 1983–2018 and the Upper Angara River in 1999–2002 and 2016–2017 included the spawning of fish at different entry times (table 1). We clarified the lengths of spawning rivers, measured the length of spawning grounds in each river based on the field studies, and plotted it on a digital topographic map with a 1:50,000 scale. The remoteness of spawning grounds denotes the distance from the uppermost border of the developed spawning grounds to the river mouth or tributary. The spawning length is the total length of all spawning grounds developed by omul in the river from the mouth to the source.

We examined the uneven entry of the omul spawning stock into the river as its spatio-temporal structure, which can be expressed in relative and absolute values of the number of entering broodstock. The movement speed was monitored visually through net fishing and echo-sounding.

The preservation of this spatio-temporal structure during the movement of fish in the river was assessed using additional counting points, periodic net and echo-sounding surveys on long sections of the river, and the results of catching individuals marked at different periods of entry into the river. In the Angara River and its tributaries, we visually counted the marked producers going up the river. The marking was carried out in the lower reaches of the Selenga River, 27 km from the mouth. In the Upper Angara River, the marking was carried out at 43 km (the village of Verkhnyaya Zaimka) and upstream of the Okushanda river mouth (the Burkotovo area (123 km from the mouth)). The fish was marked with silk threads of different colors on the dorsal fins, according to the original express method developed by the authors in 1987. Observations showed that, in the conditions of Lake Baikal, the color of a silk thread lasted at least three years. Some of the results of marking on the Selenga River in 1995 and the marking technique itself were published in the monograph by A. V. Bazov [6]. The data on the number of marked omul producers are presented in table 1.

Table 1. Marking data for spawning omul.

| Year | River | Place | 1 period | 2 period |
|------|-------|-------|----------|----------|
|      |       |       | Red, pcs.| Green/Blue, pcs. |
| 1987 | Selenga | Mitroshino, 27 km | 1,733 | 383 |
| 1988 | Selenga | Mitroshino, 27 km | 2,289 |   |
| 1989 | Lake Baikal | Bumps, Selenga shallow water | 343 |   |
| 1990 | Selenga | Mitroshino, 27 km | 2,039 | 799 |
| 1994 | Selenga | Mitroshino, 27 km | 2,793 |   |
|      | Total |       | 9,197 | 1,182 |
| 1999 | Upper Angara | Verkhnyaya Zaimka 40 km | 2,030 | 928 |
| 2000 | Upper Angara | Burkotovo, 123 km | 2,315 | 2,047 |
| 2001 | Upper Angara | Burkotovo, 123 km | 3,341 | 437 |
| 2002 | Upper Angara | Burkotovo, 123 km | 5,171 |   |
|      | Total |       | 12,857 | 3,412 |

Source: Compiled by the authors.
3. Results

Table 2 shows a complete list of spawning rivers used by the Baikal omul with updated data on the length and location of spawning grounds. The topographic location of spawning grounds in the basin of each of the 22 rivers is shown in figure 1. The presented data indicate that the Selenga River occupies 47.2% of the spawning grounds, the Upper Angara River – 24.1%, and the Barguzin River – 8.7%.

The analysis of general patterns shows that the average date of omul entry depends on the length of the river \( (r = -0.75) \) and the distance to spawning grounds \( (r = -0.91) \). The length of the river determines the total length of spawning grounds \( (r = 0.8) \), their maximum distance from the mouth or the full length of spawning migration \( (r = 0.99) \), and the average speed of the omul \( (r = 0.6) \). The average travel speed depends on the distance of spawning grounds \( (r = 0.89) \) (table 3). On average, the speed of omul in the rivers flowing from south to north increases. The speed of omul in spawning migration in South Baikal was 1.2 km per day. In the Selenga River, this index was 5.5 km/day, in the rivers of middle Baikal – 6.4 km/day, in the rivers of Northern Baikal – 11.5 km/day. In rivers flowing latitudinally, the duration of spawning migration decreases. On average, it takes omul 0.87 days to travel 1 km in the southern rivers of Baikal, 0.13 days in the rivers of the middle part of Baikal, and 0.08 days in the rivers of Northern Baikal.

| River name | 1st order tributaries | River length, km | Maximum distance from the mouth, km | Spawning length, km |
|------------|-----------------------|------------------|------------------------------------|--------------------|
| Tyya       |                       | 120              | 26                                 | 16                 |
| Kichera    |                       | 126              | 72                                 | 35                 |
| Cold       |                       | 86               | 16                                 | 9                  |
| Upper Angara |                 | 438              | 373                                | 204                |
| Angarakan  |                       | 65               | 23                                 | 17                 |
| Yanchukan  |                       | 46               | 24                                 | 9                  |
| Yangchui   |                       | 87               | 32.6                               | 27                 |
| Churo      |                       | 124              | 30                                 | 25                 |
| Gonkuli    |                       | 82               | 45                                 | 10                 |
| Cotera     |                       | 244              | 150                                | 50                 |
| Svetlaya   |                       | 119              | 45.5                               | 15                 |
| Bolshoy Chivyrkuy |       | 39               | 21                                 | 10                 |
| Bezynmyanka |                      | 25               | 6.1                                | 5                  |
| Maly Chivyrkuy |                  | 34               | 24                                 | 14                 |
| Barguzin   |                       | 480              | 360                                | 125                |
| Ina        |                       | 152              | 82                                 | 17                 |
| Argada     |                       | 144              | 70                                 | 22                 |
| Garga      |                       | 251              | 32.6                               | 27                 |
| Turka      |                       | 272              | 61                                 | 35                 |
| River       | Average entry date | Spawning migration length (Lmax), km | Length of spawning grounds, km | Speed, km/day |
|-------------|---------------------|-------------------------------------|--------------------------------|--------------|
| Kika        | 107                 | 74                                  | 48                             |              |
| Selenga     | 1,429               | 580                                 | 570                            |              |
| Chikoy      | 769                 | 137.5                               | 132                            |              |
| Orkhon      | 1,125               | 49                                  | 37                             |              |
| Bolshaya Rechka | 77               | 54                                  | 32                             |              |
| Tolbuzikha  | 30                  | 15.5                                | 9.5                            |              |
| Abramikha   | 25                  | 22.5                                | 10.5                           |              |
|             |                     | 32                                  | 29                             | 14.5         |
| Snezhnaya   | 173                 | 21                                  | 18                             |              |
| Pankovka    | 37                  | 6                                   | 2.5                            |              |
| Hara-Murin  | 86                  | 11.6                                | 10.4                           |              |
| Utulik      | 86                  | 9                                   | 7.2                            |              |
| Malaya Kultuchnaya | 24          | 7.2                                 | 2.5                            |              |
| Bolshaya Polovinnaya | 44          | 3.5                                 | 2.7                            |              |
| Sarma       | 66                  | 6                                   | 5                              |              |
| Kuchelga    | 15                  | 11.6                                | 9                              |              |

Source: Compiled by the authors.

**Table 3.** The correlation dependence during spawning migration of the Baikal omul.

| Indicators                                   | Average entry date | Spawning migration length (Lmax), km | Length of spawning grounds, km | Speed, km/day |
|----------------------------------------------|--------------------|-------------------------------------|--------------------------------|--------------|
| River length                                 | r = -0.75          | r = -0.99                           | r = 0.8                        | r = 0.6       |
| The remoteness of spawning grounds           | r = -0.91          |                                    |                                | r = 0.89      |
| Length of spawning grounds                   |                    |                                    |                                | r = 0.6       |

Source: Compiled by the authors.

The research showed that in the Upper Angara River, omul spawns in many tributaries of the first order (table 2, figure 1). The dynamics of omul entry into this river is represented by three peak curves, i.e., three periods of the entry (figures 2 and 3).

We carried out mass marking to study the distribution of omul of different entry periods along spawning grounds in the Upper Angara River (table 4).
**Figure 1.** The location of omul spawning grounds in the river basins of Lake Baikal. Source: Compiled by the authors.

**Figure 2.** The dynamics of entry of omul into the Upper Angara River in 1964. Source: [23].

**Figure 3.** The dynamics of entry of omul into the Upper Angara River in 2017. Source: Compiled by the authors.
Table 4. The results of marking omul in the Upper Angara River.

| Year  | Place                  | 1, red specimen | 2, blue specimen | Visually taken into account going up, specimen |
|-------|------------------------|-----------------|------------------|-----------------------------------------------|
|       |                        | Place           | Place            | Place                                         |
| 1999  | 40 km from the mouth   | 2030 km         | 27.9 – 120 km    | 19                                            |
|       |                        |                 | 27.9 – 123 km    | 7                                             |
| 2000  | 121 km from the mouth  | 2315 km         | 26.09–27.09 km   | 13                                            |
|       |                        |                 | 27.9 – 240 km    | 17                                            |
|       |                        |                 | 28.9 – 289 km    | 9                                             |
|       |                        | 2047 km         | 2.10 – 345 km    | 5                                             |
|       |                        |                 | 7.10 – 370 km    | 3                                             |
| 2001  | 121 km from the mouth  | 3341 km         | 30.9–1.10 – 135 km | 23                                            |
|       |                        |                 | 2.10–3.10 – 270 km | 13                                            |
|       |                        |                 | 3.10–4.10 – 280 km | 5                                             |
| 2002  | 121 km from the mouth  | 5171 km         | 30.9–1.10 – 135 km | 19                                            |
|       |                        |                 | 2.10–3.10 – 280 km | 27                                            |
|       |                        |                 | 3.10–4.10 – 290 km | 12                                            |
|       |                        |                 | 2.10–4.10 – 290 km | 7                                             |
4.10 – 330 km  3
02.10 – 345 km  9
Total  16,269  12,857  3,412  256  66

Source: Compiled by the authors.

Omul of the first entry period spawns in the first-order tributaries of the Yanchuy, Yanchukan, Angarakan, the upper reaches of Kotera (after the bridge), and the Upper Angara River. Omul of the second-period spawns in the Okushanda River, lower spawning grounds of the Kotera River (before the bridge), Churo River, Gonkuli River, and the Upper Angara River from the floods of the village of Stary Uoyan to the Churo River. The remaining omul spawns on the spawning grounds of the Angara River from Mount Kiron (70 km from the mouth) and the lower areas of the spawning grounds of the Okushanda River.

The separation of omul spawning in the Selenga River, the largest tributary of Baikal, begins during feeding migrations in the second half of July. In the first decade of August, omul creates relatively dense clusters from the South (Slyudyanka region) to the Middle part (Akademicheskiy ridge region) of Baikal.

Every year, 5–7 days before entering the Selenga river, omul stops feeding and adapts to the conditions of the river water.

To ensure the planned harvest of roe in the Selenginsky experimental sturgeon-omul hatchery, every year, starting from 1981, an electric-fish-barrier device [EFBD] was switched on when the omul producers approached 115 km from the mouth. The use of the EFBD disrupted the natural course of spawning migration and prevented it in the most productive spawning grounds located near the city of Ulan-Ude. In 1995, it was decided to let the first entry omul pass. Therefore, the data before 1995 on the dynamics and speed of omul in Selenga is far from the natural patterns.

Mass marking in 1987 and subsequent years was aimed at studying the effect of EFBD on the spawning migration of omul in the Selenga River (table 5).

Table 5. The results of marking omul in the Selenga River.

| Date   | Place                  | Color | Qty | Returned labels |
|--------|------------------------|-------|-----|-----------------|
|        |                        |       |     | Km from the mouth | Date    | Color | Qty |
| 06.09–08.09, 1987 | Selenga River, Mitroshino (27 km) | Red   | 1,733 | 27 | 10.09.1987 | Red | 2 |
|        |                        |       |     | 30 | 13.09.1987 | Red | 1 |
|        |                        |       |     | 55 | 12.09.1987 | Red | 1 |
|        |                        |       |     | 75 | 16.09.1987 | Red | 3 |
|        |                        |       |     | 113 | 04.10–17.10.1987 | Red | 11 |
|        |                        |       |     | 175 | 14.10.1987 | Red | 1 |
| 15.09, 1987 |                        | Blue  | 383  | 55 | 21.09.1987 | Blue | 2 |
|        |                        |       |     | 101 | 07.10–10.10.1987 | Blue | 5 |
| 01.09–04.09, 1988 | Selenga River, Mitroshino (27 km) | Red   | 2,289 | 37 | 04.09.1988 | Red | 2 |
|        |                        |       |     | 40 | 08.09.1988 | Red | 3 |
|        |                        |       |     | 53 | 21.09.1988 | Red | 2 |
|        |                        |       |     | 75 | 24.09.1988 | Red | 3 |
| Date          | Catch Location                  | Colour | Catch No. |
|--------------|---------------------------------|--------|-----------|
| 07.09.1989   | Selenga River, Mitroshino (27 km) | Red    | 343       |
| 07.09.1989   |                                   |        |           |
| 113          | 27.09.1988                       | Red    | 3         |
| 115          | 29.09.1988                       | Red    | 5         |
| 115          | 30.09.1988                       | Red    | 59        |
| 185          | 11.10.1988                       | Red    | 1         |
| 36           | 09.09.1989                       | Red    | 1         |
| 45           | 11.06.1989                       | Red    | 2         |
| 55           | 13.09.1989                       | Red    | 1         |
| 67           | 15.09.1989                       | Red    | 2         |
| 101          | 03.10.1989                       | Red    | 1         |
| 101          | 06.10.1989                       | Red    | 2         |
| 115          | 14.10.1989                       | Red    | 1         |
| 115          | 16.10.1989                       | Red    | 7         |
| 115          | 18.10.1989                       | Red    | 3         |
| 198          | 18.10.1989                       | Red    | 1         |
| 26.08–29.08.1990 | Selenga River, Mitroshino (27 km) | Red    | 2,039     |
| 27           | 29.08.1990                       | Red    | 1         |
| 45           | 01.09.1990                       | Red    | 2         |
| 65           | 12.09.1990                       | Red    | 1         |
| 80           | 17.09.1990                       | Red    | 3         |
| 113          | 20.09.1990                       | Red    | 5         |
| 115          | 04.10.1990                       | Red    | 7         |
| 115          | 10.10.1990                       | Red    | 9         |
| 380          | 12.10.1990                       | Red    | 1         |
| 07.09–08.09.1990 |                                 | Blue   | 799       |
| 85           | 22.09.1990                       | Blue   | 2         |
| 113          | 03.10.1990                       | Blue   | 5         |
| 05-07.09.1994 | Selenga River, Mitroshino (27 km) | Red    | 2793      |
| 75           | 09.09.1994                       | Red    | 2         |
| 85           | 11.09.1994                       | Red    | 3         |
| 101          | 15.09.1994                       | Red    | 3         |
| 110          | 16.09.1994                       | Red    | 1         |
| 113          | 17.09.1994                       | Red    | 3         |
| 113          | 21.09.1994                       | Red    | 5         |
| 115          | 29.09.1994                       | Red    | 7         |
| 115          | 03.10.1994                       | Red    | 11        |
| 115          | 12.10.1994                       | Red    | 9         |

Source: Compiled by the authors.

Before 1995, the promotion of omul above 115 km was studied based on the insignificant part of fish stock that managed to pass the EFBD. Of the 191 specimens of the caught fish bearing the mark of the first entry period, 78% were caught in the EFBD zone, and only 2.1% were caught above the EFBD. Not a single specimen from the marked omul of the second period of entry was caught above the EFBD. Downstream of the EFBD, the first-entry and second-entry omul are intermixed, which does not happen naturally.
The duration of spawning migration depends on the time of entry and the onset of cold autumn weather. Figure 4 shows the data on the average travel speed of omul spawners in the Selenga River. Over the years, the travel speed had significant differences, with fluctuations from 2.7 to 10.3 km per day.

Figure 4. The data on the average omul speed in the Selenga River. Source: Compiled by the authors.

The information on omul speed in the Selenga River is shown in Figure 5.
Figure 5. The data on the dynamics of the speed of omul producers in the Selenga River. Source: Compiled by the authors.

In the left column of figure 5, there are graphs of the dynamics of omul advancement in those years when the potential speed range (Lmax) was below the long-term average (up to 270 km). On the right
of the figure, there are graphs when Lmax was higher than 300 km. Despite the annual differences in the advancement dynamics, there are general patterns, regardless of Lmax. The high speed of travel (up to 20 or more km/day) is mainly registered on the first day. A slowdown in travel speed in the area from 40 to 100 km from the mouth is observed. A sharp increase in speed is observed immediately before spawning grounds. In this section, the drop in the speed is especially pronounced in years when the water level in the river was higher. Since 2017, omul tended to enter the Selenga River via the northern channels of the delta (figure 5). Fish that start their spawning migration earlier have a greater potential range.

Observations established that during the spawning migration, omul separates into shoals and does not mix when moving up to the spawning grounds (figures 6 and 7). A stop in the migration course, if it happens, affects the entire length of the river. The research carried out under a unified program in 1997–2003 by ichthyologists of the Federal State Institution “Baikalrybvod” showed that the stops of the omul spawning migration occur synchronously in the Selenga, Bolshaya Rechka, Upper Angara, and Kichera Rivers, i.e., synchronously from South to North Baikal.

**Figure 6.** Data on the dynamics of the entry and isolated movement of omul during the spawning migration of 2002 – on the left, of 2003 – on the right. **Source:** Compiled by the authors.
4. Discussion

Baikal omul is a pronounced anadromous migrant. It uses 22 rivers for spawning. Due to the high distance of spawning grounds in the Selenga (580 km), Upper Angara (373 km), and Barguzin (360 km) Rivers, ovogenesis in omul happens in the river itself. When entering the Selenga River, omul females had the maturity index (MI) of gonads of 37% in 2002 and 65% in 2017, with an average value of 46.5%. They fully mature during the spawning migration. The maturation entirely depends on the energy accumulated during summer feeding because fish stop feeding a week before entering the river and do not feed until spawning. Nowadays, no one doubts that spawning migrations have a transport function. The delivery of roe to the most productive spawning grounds predetermines reproduction success [8, 31]. During anadromous migration, the fish undergoes complex physiological processes linked with the maturation of reproductive products [3, 4, 5]. These processes in the Baikal omul are not fully understood.

Most of the works devoted to spawning migrations focus on the biological and ecological sides of the process [7, 24, 27, 28, 29, 32, 34]. Our research shows that spawning migrations of omul are a functional activity that ensures favorable conditions for reproduction. The length of spawning rivers on Lake Baikal ranges from tens to hundreds of kilometers (table 2). This explains the high correlation between the length of the river and the time of entry ($r = -0.75$), the length of spawning migration $L_{max}$ (-0.99), the length of spawning grounds in the river ($r = -0.8$), and the fish speed ($r = 0.6$). The average speed directly depends on the distance to the spawning grounds ($r = 0.89$) (table 3). The autumn cold in the north of Baikal occurs earlier than in the south, and the main spawning of omul happens before and during the autumn ice drift, which limits the duration of spawning migration. Therefore, the speed of fish gets higher (tables 3, 4, 5).

The remoteness of the omul spawning grounds in the Selenga River is quite different [6, 26, 27, 36, 37]. Intrapopulation groups enter the Selenga River at different periods of spawning migration. They have different maturity of reproductive products, different migration potential, and spawn at different distances. Early spawners with high migration potential have more uniform dynamics of movement (figure 5) and a higher average speed from the entry to the beginning of the downstream movement (figure 4). Mass marking (table 6) and special studies carried out on the Selenga River showed that omul of different entry periods does not mix and spawns at different distances. This ecological mechanism, although it does not preclude panmixia, provides reproductive isolation.

A high level of water in the Selenga River at the beginning of the spawning migration significantly

![Figure 7](image-url)
reduces the speed of omul, especially in the area of 40 to 100 km from the mouth, i.e., before and at the beginning of the Khamar-Daban ridge (figure 5). In years when omul has a high migration potential and an increased travel speed (figure 4), individual shoals of its vanguard move away from each other along the river at an ever-greater distance. Thus, they cover more extensive areas of spawning grounds. Therefore, in the years with increased water, when there is a delay in movement rate, the density of the roe stock distributes close to the Gaussian distribution. In years with a low level of water, it distributes according to a log-normal distribution. The lower the migration rate during the entry, the less distance the fish cover, especially those of the first-entry period, with a smaller distance between the first and second periods. As a result of mass marking in the Upper Angara River (table 4), we established the distribution of omul in the basin. Spawners of the first period settle in the upper parts of the Upper Angara and Kotera Rivers and tributaries of the first order of the Yanchui, Yanchukan, and Angaran Rivers. Spawning grounds of the Angaran River are only used by omul in years with a high migration potential. The spawning grounds in the Angara River above the mouth of the Yangchuan and Angaran Rivers are only used by pelagic omul.

The study of the spawning migrations of the Baikal omul allowed us to identify the spawning grounds in the Upper Angara and Selenga Rivers, clarify the previously obtained data [23, 25, 26], and provide a complete map of the omul spawning locations in the rivers of the Lake Baikal (figure 1). The diversity, length, and remoteness of spawning grounds determines the structure of omul spawning shoals, especially the space and time organization, both interracially and intraracially (figures 2, 3, 6, and 7). The length of spawning grounds and their distance from the mouth form the spatio-temporal structure of spawning. The intrapopulation formation was done via settling certain areas of spawning grounds, taking into account their remoteness. The period of spawning migration increases, and the space and time structure of the spawning school becomes more complex with the increase of the distance from the mouth and the lengthening of the spawning grounds. The pre-spawning separation of omul happens during feeding migration in late July – early August in different regions of Lake Baikal. According to S. I. Krasnoshevich [11], the feeding area determines the remoteness of spawning grounds in the Selenga River.

The length of spawning migration determines the length of downstream migration of juvenile fish, providing conditions for their feeding. The feeding conditions determine the speed of development of juvenile fish, the range of fish, and the feeding opportunities in Lake Baikal. The feeding conditions contribute to the energy reserves of spawning fish, determine their potential travel range, and the length of spawning migration. The heterogeneity of pelagic omul is explained by the variety and length of spawning grounds in the Selenga River. The coastal spawning grounds are influenced by the isolation of the reproductive area and, to a lesser extent, by the length of the spawning grounds. Based on the theoretical assumptions [3, 4, 5, 24, 32], the biggest variance should be observed in the pelagic group, and the smallest – in the deepwater group.

5. Conclusion
The length and duration of omul spawning migration are determined by the river length, the distance of spawning grounds from the mouth, and their length.

The average date of the beginning of omul spawning migration is determined by the distance of the main spawning grounds from the mouth and the average speed of fish. The average speed of omul in the rivers of North Baikal is two times higher than in the rivers of South Baikal. A general pattern is – the more distant the spawning site, the higher the speed. The spatio-temporal structure of the omul spawning shoal corresponds to the spawning grounds in each river.
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