

Fisheries Education as a Basis for the Formation of the Human Potential of the Fishing Industry of the Republic of Karelia

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ABSTRACT

The article presents materials on the state of the fisheries complex of the Republic of Karelia and the peculiarities of personnel training for this industry at Petrozavodsk State University. It was noted that in the process of developing aquaculture and increasing the production of fish products from 2001 to 2021, the system of training students was improved, educational programs of various levels were developed, allowing the production of in-demand specialists. As a result, the high importance of PetrSU in providing personnel for an actively developing industry in the region is shown. The article analyses educational programs of different levels. It is noted that modern educational technologies are used in the learning process, good material and the technical, scientific and practical base is used. The training of qualified personnel is of great importance is also a high level of practice-orientation of all programs and active participation in the training of enterprises of the fisheries complex. Thanks to this, the most important professional competencies necessary for graduates at the present stage are implemented when teaching students. This experience allows us to train high-level specialists and thus actively participate in developing the fisheries complex of the Republic of Karelia, forming its human potential.

Keywords: *Aquaculture, Fish farming, Fisheries complex, Educational programs, Practice-oriented bachelor's degree, Competencies.*

1. INTRODUCTION

In the conditions of an increase in the world's population and an increase in the population's need for animal products, aquaculture is becoming increasingly important as a source of protein for humans and animals, as well as as a method of reducing the pressure of industrial fishing on the state of natural ecosystems [1]. Thanks to the growth of global aquaculture, humanity receives an additional 80 million tons of products of aquatic origin, which makes it possible not to increase, and in some years even reduce the volume of catch from the world ocean [2]. In Russia, as well as in the world, there is an increase in the production of fish products, but it is not as fast as in other countries. The most critical factor in developing this area is the training of qualified personnel. Currently, the training of specialists in fish production is carried out in secondary and higher

educational institutions under the jurisdiction of the Ministry of Education and the Federal Agency for Fishery (Rosrybolovstvo). However, the number of graduates from these educational institutions is clearly insufficient to ensure the fisheries sector. One of the most active areas with the rapid growth of aquaculture is the North-Western region, including the Republic of Karelia, which already produces more than 30 thousand tons of fish.

Petrozavodsk State University has been training personnel for the fisheries complex of the Republic of Karelia and neighbouring regions for the past 20 years.

The work aims to assess the importance of fisheries education in the formation of the human potential of the fishing industry of the Republic of Karelia.

Purposes:

- to study the main stages of the formation of the system of fisheries education in the Republic of Karelia in connection with the active development of aquaculture in the region;

- to analyse the content and features of educational programs used to train specialists for the fisheries complex.

2. RESEARCH MATERIALS AND METHODS

The training of fish farmers based on zootechnical education began in 1995, at the same time as the appearance of the first commercial fish farming enterprises. In 2001, the first release of fish farmers took place; many of them are still working at the aquaculture enterprises of Karelia. Over the years, more than 20 graduates of students of different levels - specialists, bachelors, masters. Professional development courses are regularly held, scientific personnel are trained in postgraduate studies, several dissertations on the most pressing issues of fisheries have been defended. A total of 311 students were graduated during the period under consideration (Table 1).

To determine the role of fisheries education in the formation of human resources, methods of analysing educational programs and applied technologies in the training of specialists were used. To study the main stages of the development of aquaculture in the region and the formation of a system of fisheries education, official sources on the state of the fisheries complex, annual State reports on the state of the environment in the Republic of Karelia and statistical materials of Kareliastat from 2001 to 2021 were analysed. The assessment of employment and demand for graduates of PetrSU at the enterprises of the fisheries complex was carried out based on the results of individual surveys and as a result of studying the materials of the Ministry of Agriculture and Fisheries of the Republic of Karelia.

3. RESULTS AND DISCUSSION

One of the main indicators of the quality of a specialist is demand in the labour market, but the state of the industry has a significant influence on it. Figure 1 shows that from 2001 to 2008 in the Republic of Karelia, there was a steady increase in fish production and the number of fish farms. However, interest in the new degree program appeared somewhat later. Since 2001, 5-7 people have graduated annually, and only half of them got a job in their speciality at aquaculture enterprises. In subsequent years, since 2004, the competition for this degree program began to increase. The highest demand for fish farmers began to form in 2010, as during this period there was active development of commercial fish farming, large fish farming companies appeared, the industry switched to the use of industrial technologies. The most considerable graduation rate of fish farming students was noted in 2015 (22 graduates) due to the increase in fish production during this period (Fig.1). In the future, due to the intensification of production and the transition to modern methods of fish cultivation, the share of large enterprises with high production capacity (1000 tons of fish per year or more) will increase. Currently, this process continues, and large fish-breeding companies already produce more than 60% of all fish-breeding products in the Republic. In this regard, the need for qualified personnel is also increasing every year, and many enterprises in the fishing industry are experiencing a severe shortage of personnel. But, despite this, the number of applicants in all degree programs in the agricultural, engineering and, including in the fishing sector, is decreasing, which is one of the most acute problems in the region.

Nevertheless, it is worth noting that students' employment at the enterprises of the fisheries complex after graduation remains fairly stable throughout the studied period. The analysis of the results of graduates'

Table 1. Number of graduates during the period under consideration (2001-2021)

Level of training	Number, people
Specialists	109
Bachelors, full-time department	110
Bachelors, extramural department	31
Masters	6
Trainees of advanced training courses	55
Postgraduate students (with an academic degree)	7
Total	311

employment in the field of fisheries in the first years after training is presented in Figure 2.

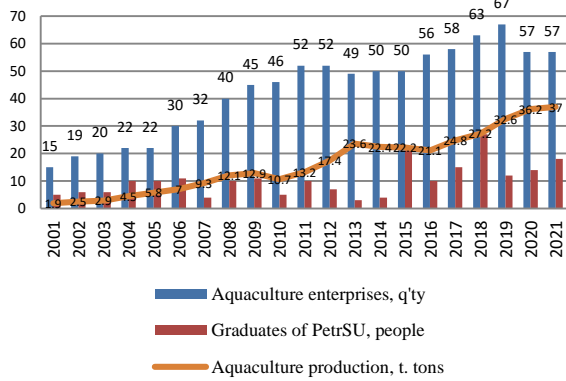


Figure 1 The aquaculture condition in the Republic of Karelia from 2001 to 2021.

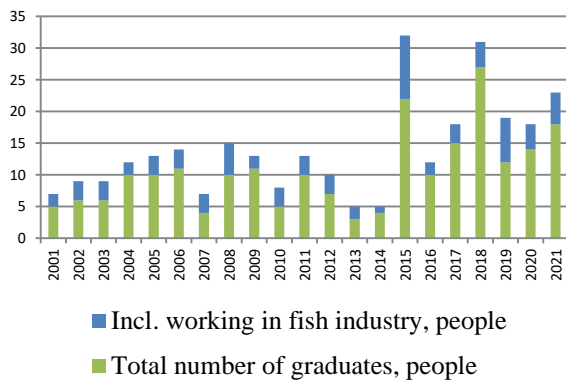


Figure 2 Statistics of graduates and employment of full-time students at aquaculture enterprises.

Figure 2 shows that the same trend has been maintained over all the years of training specialists, and the number of graduates working at aquaculture enterprises averages 20-30% of the total number of students annually. The most significant number of students employed after training at aquaculture enterprises was noted in 2015 and 2019 and amounted to 10 and 7 people, respectively, which is probably due to a good set of applicants and the active growth of the industry in these years.

Trainees of advanced training courses and students of the extramural department play a rather significant role in the organisation of fisheries education at PetrSU. It is worth noting that these programs have been developed and implemented for employees of the fisheries complex without interrupting their production. 31 students graduated from the extramural department during the period under consideration; 55 students improved their qualifications. All these graduates work at various enterprises of the fishing industry of the Republic of Karelia and neighbouring regions.

3.1. Review of PetrSU educational programs for training specialists in the field of aquaculture

Initially, the training of fish breeders was conducted within the framework of the speciality "Animal Science". For the training of students, an author's work program was developed, in accordance with which specialists of fish breeders were trained. During the training, students mastered the main block of general professional competencies in the field of genetics, breeding, animal husbandry, the basics of breeding and breeding work, and in the 4th-5th year, they studied the main profile disciplines of the specialisation "Fish farming" with a focus on cage trout farming. This level of training laid the foundations for staffing the actively developing fish farming industry in the Republic of Karelia. Graduates of the speciality today form the basis of personnel and are very much in demand in the labour market, and mainly occupy senior positions at many fish-breeding enterprises. Thanks to this, a high level of mentoring is maintained, active participation in the life of the university is carried out, internships are organised, students are employed after training, and scientific work is carried out aimed at improving the efficiency of fish farming in the farms of the region.

Since 2011, PetrSU has been recruiting students for bachelor's degree, and since 2015 – a master's degree in "Aquatic bioresources and aquaculture". Both degree programs produce training in the "Aquaculture" profile, and when developing these training programs, emphasis is placed on specialisation in cage fish farming (trout breeding). The structures of the curricula, and especially the availability and content of training and production practices, are planned to consider the peculiarities of regional production, as they were discussed and developed jointly with representatives of partner enterprises and the Association of Trout Breeders of Karelia. In connection with the transition to the standards of the new generation of Federal State Education Standards 3++ in 2019, the curricula of bachelor's and master's degrees were transformed. During their preparation and development of the educational program "Aquatic bioresources and aquaculture", emphasis was also placed on training specialists for their region, i.e. specialising in cage trout farming.

Following the needs of the labour market, specialists with technological and biological competencies in the field of aquaculture, as well as the basics of organisational and managerial work, are in demand at the aquaculture enterprises of the Republic of Karelia; therefore, production and technological and organisational and managerial activities of graduates were chosen for the implementation of educational programs. In the master's program, pedagogical and research activities are additionally mastered. Professional

competencies, respectively, are also consistent with the requirements of employers.

Due to the lack of specialists in commercial fish farming at the enterprises of the North-Western region, there is also a high shortage of technologists in the field of fish processing and evaluation of the quality of fish products. PetrSU has developed an educational bachelor's degree program, "Animal food products" with the profile "Technology of production of animal products" to train such specialists. According to this curriculum, the training of technologists is currently carried out only in the extramural department. Also, the extramural form of education is also provided the bachelor's degree program "Aquatic bioresources and aquaculture", specialists working at fish-breeding enterprises on the job are trained in this direction. Programs of additional professional education and retraining in various production and processing areas of fish products have also been developed and are being implemented. Due to the peculiarities of the modern period, they are organised both full-time and remotely. An international educational program on the basics of fish farming, "School of Fish Breeders", has been developed for students and schoolchildren, attended by employees of fish farming enterprises with extensive production experience. In general, it is worth noting that the organisation of the educational process in the fisheries sector at PetrSU complies with the principles of continuity of education, i.e. promotes flexibility and rapid dynamics associated with changing needs in the labour market [3-5].

3.2. Practice-oriented educational programs

It is known that increasing the competitiveness of technical education is impossible without integrating the educational process with science and production [6-7]. Due to this, practice-oriented educational programs are provided, which contributes to a high level of training, significant involvement of students in the field of professional activity and compliance of specialists graduated by the university with the requirements of employers. Also, the purpose of this interaction is the development and introduction of new technologies, processes and products into production, the execution of research commissioned by enterprises, scientific support of production processes and the implementation of research on their basis, including with the involvement of students and postgraduates. Thanks to this, several tasks are being solved to create a single educational space that unites the university and production. This contributes to more efficient use of the material and technical base of the University and fisheries enterprises, the implementation of joint research and production projects and the formation of close ties between the university and the economy of the region, which fully corresponds to the

basic principles of the "Concept of the development of practice-oriented vocational education in Russia".

A high level of practice-oriented training and compliance with the peculiarities of regional production of fish products are the basis for the preparation of bachelors and masters in the field of aquatic bioresources and aquaculture (profile "Aquaculture"). All students of this degree program undergo several types of practice during the training period. During the training practice, they study the basics of fish farming and visit various types of fish farming enterprises, get acquainted with fish growing technologies. This format of training practice gives the most complete picture of the state of the fishing industry, allows students to be interested from the first year of study and shows the possibilities of further activities of graduates.

During the production practices, students work as fish farmers at the enterprises of the North-Western region. The content of practices contributes to implementing basic professional competencies, which is vital for graduating competitive and in-demand specialists. Similar technology for training engineering personnel is often used in higher educational institutions in Finland (the so-called polytechnics), Denmark, Austria and other countries, including in some Russian engineering universities [6-9].

The production base of PetrSU allows conducting production practices also on the university's territory. Therefore, some students remain in the research centre for aquaculture of PetrSU: in the aquarium, recirculating aquaculture system or laboratories. This division of PetrSU was opened in 2019. This is a modern complex whose tasks in the educational process are very extensive: conducting practical and laboratory classes, introductory and academic practice, researching within the framework of research work, including involving students and schoolchildren, conducting advanced training courses and training seminars. Thanks to the use of aquarium and recirculating aquaculture system in the educational process, the main task is solved – teaching students all the technological methods of growing various aquaculture objects, the basics of water treatment, methods of laboratory analysis and expertise, which allows them to realise the most critical professional competencies for aquaculture specialists.

One of the most critical competencies of a modern specialist in any industrial field is the knowledge and application of digital technologies [10]. The application of digital competencies in current industrial production areas is especially relevant [11-12], including in aquaculture, the development of which is now tightly connected with the use of various innovative developments. Thanks to the use of modern methods of fish production in the recirculating aquaculture system, as well as the developments of the PetrSU Artificial Intelligence Centre, in the recirculating aquaculture

system, is conducting research and implementing an interdisciplinary project on the use of digital technologies for the identification of aquaculture objects, as well as on the development of automated control systems for the recirculating aquaculture system. Undergraduate students, graduates, postgraduates, employees of several institutes, and representatives of industries are involved in this work. Undoubtedly, such projects involving many people, departments of PetrSU and social partners correspond to the main goals of integration processes and contribute to ensuring that the level of personnel training meets the requirements of industrial customers [6]. Thanks to this, new, competitive technologies and products are being created that contribute to increasing labour productivity and the development of the digitalisation of aquaculture in the region.

For the educational process to have a minimum separation from production and form a holistic approach to forming graduates' competence in the educational process, the production base of partner enterprises is used when training aquaculture specialists. One of the most successful projects in the organisation of practice-oriented training is creating an educational and production base located in a large fish-breeding enterprise LLC "PARADE plus" in the waters of Lake Onega. The main task of this educational and production site is fully implemented, as it allows to conduct practices with maximum involvement of students in the production process, conduct research, and test new technologies and methods of growing fish in cages.

Qualified management is critical during industrial practice outside of PetrSU since students' interest in their future profession and prospects for further employment depend on it. Mentoring from the production plays a huge role in students' interest in realising their potential. Thanks to this, the training of future specialists in the basic technological techniques of growing various types of fish takes place and the transfer of personal, professional experience. Over many years of cooperation between PetrSU and enterprises, a certain interaction system has developed that promotes the release of fish breeders with good theoretical and practical training, who are in demand in the labour market of Karelia and neighbouring regions.

3.3. International educational activities relating to aquaculture

The internationalisation of higher education is an essential component of increasing the competitiveness of specialists and their demand in the international labour market [6]. Since the training of specialists in aquaculture relates to technical and biological areas, it is essential to raise the level of education in the educational process, including through international cooperation between educational institutions and production. There are many forms of international interaction (academic mobility,

export of educational services, joint grant activities, etc.) that educational organisations use [13-14]. All of them have a considerable impact on the quality of education and the competence of graduates, as they allow them to adopt foreign experience in the field of education, science and production, which is very important in the fisheries sector due to the high import dependence of domestic aquaculture.

Due to the peculiarities of the cross-border location of the Republic of Karelia, the most common form of international cooperation is academic exchange. It mainly relates to exchange programs, the organisation of joint international schools, and seminars, including multidisciplinary ones. The most interesting is the experience of conducting exchange practices for students at fish farming enterprises in Belarus, Finland, Norway, the organisation of which allows you to study the experience of aquaculture enterprises in different regions, get involved in joint research work based on partner universities, participate in collaborative research projects and gain experience with students and teachers from other countries. This undoubtedly contributes to the development of individual educational trajectories. Exchange programs with Nordland University (Norway), Savonia University of Applied Sciences (Finland), University of Eastern Finland, and other educational institutions of Northern Europe are most widely in demand.

Also, based on PetrSU, joint interdisciplinary seminars and schools in the field of agriculture and fisheries are held annually; the main partners are the University of Applied Sciences of Savonia and the Belarusian Agricultural Academy, as well as aquaculture enterprises of Karelia, which act as production sites for field seminars. Great support in this direction is provided by the Association of Trout Breeders of Karelia and the Ministry of Agriculture and Fisheries of the Republic of Karelia, whose representatives perform a coordinating function and contribute to the organisation of seminars, schools and conferences. Regular implementation of this area of international cooperation has a positive impact on participants' mobility from all sides. Along with educational workshops and scientific schools, including those with international participation, PetrSU actively cooperates with foreign industrial companies: Raisioaqua, Biomar, Skretting. Basically, cooperation with them is expressed in the regular holding of joint scientific and practical seminars, where the most pressing problems in aquaculture are discussed. Every year, representatives of science, education and production in fisheries meet at the venues of these events. This contributes to the acquisition of new knowledge, contacts, and, among other things, the employment of graduates-fish farmers.

4. CONCLUSIONS

As a result of the study, the high value of fish breeders produced by PetrSU is shown. Forming the basis of the personnel potential of the Republic, graduates of various levels work at almost all enterprises of the fisheries complex, which undoubtedly contributes to the high level of development of aquaculture in the region. Despite this, the number of graduates of fish farmers remains insufficient; there is a shortage of personnel at enterprises and a high demand for specialists, which is due to the low number of applicants and the low interest of schoolchildren in this profession.

The analysis of educational programs, the main degree programs and the features of the formation of students' professional competencies is carried out. It is noted that the high level of graduates' training and their demand in the labour market are due to the active development of the fishing industry in the region. Also, a well-organised educational process using a modern scientific and production base and high-quality, practical training at the enterprises of the fisheries complex has a significant impact on the formation of personnel.

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