

Conference Paper

Exploration of Northern Commercial Fishing Area Resources and Sustainable Use Challenges and Ways to Resolve them

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Abstract

The present article is based on the review of the current patent, scientific and technical sources. It indicates the main challenges of fishing industry in the North-West Russia with the Murmansk Region taken as an example. The basic fishing techniques, being employed by the local fishing companies, are considered. The article defines the main challenges of the Northern commercial fishing area resources exploration and sustainable use. It substantiates the necessity to increase the share of fishing tools with better selectivity. It is concluded that the raw-materials supply crisis is likely to set in the fish processing industry. The article analyses the existing methods of processing applied to the underutilized fishing grounds. It reveals a correlation between the intensiveness of research applied to specific fishing grounds and the consumer demand availability and scope. It is concluded that predominantly research is made with regard to the use of underutilized species for production of dietary supplements and components which alter some food properties. The article substantiates the necessity to use the non-conventional hydrobiont species for food production, based on the consumer demand data. A study of the main standards has been performed with regard to regulation of the hydrobiont catching issues. The article reviews the underutilized species of the Northern commercial fishing area which are most prospective from the production and processing point of view. It concludes with the prospects of the proposed option for the fishing industry development and its probable impact on the development of coastal infrastructure and of the whole region.

Keywords: underutilized species of the Northern commercial fishing area, fishing challenges, the Murmansk Region fishing industry development prospect

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1. Introduction

With the aim to preserve the water bioresources, to control the catches and number of the hydrobionts, the total area of the Russian Federation and adjacent waters of the world ocean is legislatively divided into fishery zones -- commercial fishing areas, and the notion of a fishery water body has been introduced [1]. The legislation has established the rules for fishing and water bodies' use, which set strict requirements towards the legal entities exploiting the sea bio-resources. In spite of the efforts made

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to preserve the sea ecosystem, active exploitation of the sea bio-resources renders a significant impact on its state. The more abundant a fishery zone is, the more actively it is exploited, and the higher impact is laid on the bio-resources. Northern commercial fishing area is one of the largest commercial fishing areas, running second only after the Far East commercial fishing area in terms of the fish fauna varieties and catches.

The list of challenges related to the active fish catching in the Northern fishing area, is extensive:

- one of the peculiarities of catching method is the predominant use of the trawling technique, providing up to 90% of the annual withdrawal [2]. The bottom trawling affects the seabed condition in the trawling areas and renders serious impact on the fish fauna. [3, 4]. Low species and size selectivity is a grave disadvantage of the trawling technique. Longline fishing technique, offering higher selectivity in species and especially in size, is not much employed at present. Number of long-liners is 10-15 times as less as the number of trawlers [5];

- breaches of the fishing regulations. One of the most common breaches is overfishing, biomass withdrawal above the permitted scope caused by willful violation of the catch limitations, by incorrect calculations or, to a smaller extent -- by poaching. As per today, the fish and fish processing waste discards make about 10 % of the total catch globally [6], but in terms of fishing in the Northern area, the discards can significantly outnumber the mentioned figure. These breaches entail a substantial increase of impact towards the ecosystem, which is often excessive [7];

- increasing temperature of the world ocean waters, decreasing oxygen content and other sustainable changes of the climate render an unfavorable effect on the population number and size-and-weight characteristics and distribution of the most hydrobiont species [8], [9];

- annual large-scale outtake of the commercial fishing targeted species from their habitation area inevitably cause a decrease in their fishing stock, average size and number of fertile specimen [10];

Active fishing of one species and underutilization of the others entails gradual substitution of the targeted species with the unfished competitor hydrobionts and alterations of the existing stable food chains.

Given constantly rising demand and shrinking supply, deficit is inevitable. Even today it is noted that the supply of the aquatic organisms of high demand in the world market is significantly reduced. [11]. Therefore, without the supply base extension, the crisis in the industry is not a question of if but when.

2. Main Part

The main commercial fishing region of the Northern area is the commercial fishing water area of the Barents Sea, which comprises, apart from the sea itself, the North-East part of the Norwegian Sea and areas around the Bear Island and West Spitsbergen [1]. Currently, out of 220 species of fish and other aquatic organisms known to inhabit the commercial fishing area of the Barents Sea, [12], hardly one tenth can be assigned to the targeted fishing grounds. The most sought-after species are: cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*), halibut (*Hippoglossus*), herring (*Clupea*), northern shrimps (*Pandalus borealis*), and king crab (*Paralithodes camtschatica*). The following species can be caught mainly as surplus: Pollack (*Pollachius*), two species of perch, two species of sole, three species of catfish and polar cod (*Boreogadus saida*) [13]. Capelin and Icelandic scallop, used to be caught in meaningful quantities, have already become unavailable for the commercial fishing entities as their population has been significantly reduced. In accordance with the existing forecast, the scallop fishing ban is highly probable to be maintained throughout 2020, too [14]. The main reasons for the capelin and scallop population reduction can be defined as follows: climate changes, natural migration, fluctuations in the population number, diseases and human factor.

The ranges of many commercially relevant species go beyond the Northern commercial fishing area. In the case of further climate changes, commercial fishing impact aggravation and environmental deterioration, part of the biomass of these species can leave the areas available to the Russian fishers. The remaining 90% of aquatic organisms are not caught as targeted species or are not utilized by the fish processing enterprises if accidentally caught as a surplus. Presently it is not possible to precisely estimate the scope of withdrawal of the non-targeted species. Stringent regulations, banning the fish discards, protect the fish fauna, but if control is insufficient, the discards are carried on and the log-sheet data do not provide a full actual picture of the qualitative and quantitative characteristics of the species caught. Unreliable log-sheet data, both underestimating and overestimating the biomass outtake, render an unfavorable effect on the forecast and the permitted catches, based upon the forecast. Due to this, one may only guess how drastically the qualitative and quantitative composition changed in the commercial fishing industry over the past few decades [15].

Guided by non-objective catch data, fish processing companies have difficulties in assessment of the species with good prospects for processing with food production and other purposes. Without demand, the actual opportunities for catching of underutilized

species have not been explored and there are no large-scale scientific research activities going on to explore them. An indirect indication for exploration of these resources can be regular massive withdrawals, presented by some fishing companies in their log-sheet data [5].

Nowadays, the exploration of the underutilized fishing grounds in the Northern area is deprived for the industry's attention. Major fish processing enterprises of the region are not interested in exploration of the new fishing grounds. Necessity of large-scale funding, weak link between the enterprises and the science, conventional approach to the food production, poor state support of the enterprises taking part in the scientific research development are the roots of this situation. Fishing for 'conventional' water bio-resources remains a priority for the commercial fishing industry.

It is possible to note very few attempts to introduce in the market new products made of the underutilized fishing species, a variety of which is limited by frozen semi-finished food products. The demand for such products is limited due to unavailability of technological solutions for their further processing and to lack of standard for consuming food with their use. An example could be the frozen ray wings, available in the regional market to a limited extent.

Currently in Russia the new technologies, related to the hydroboints processing, are predominantly developed by scientific institutions and universities. In absence of the industry's demand for exploration of specific species of aquatic organisms, researchers target the species independently, guided by the state policy in the sphere of fishing industry. Aimed to preserve the aquatic life, a range of the catch scope regulations are developed on the national and international level. Total allowable catch (hereinafter - TAC) has been established by laws and regulations of the Russian Federation for certain targeted species: king crab, opilio crab, sea scallops [16]. For the most important targeted species, inhabiting the Russian and Norwegian waters, TAC and its distribution between the countries is settled in terms of the Interstate Fishing Committee meetings. TAC is not always consistent with the recommendations of the International Council for Exploration of the Sea (ICES), and often exceeds the recommended scope [17].

A recommended catch limit is established for the underutilized aquatic organisms. It is these data that are worth considering when selecting the species with prospects for commercial exploitation. The following species can be referred to the basic underutilized fishing grounds of the Northern commercial fishing area: Laminaria (recommended catch -- 17,497.0 tons); green sea urchin (recommended catch -- 5,995.0 tons); rays (recommended catch -- 3,800.0 tons); Fukus (recommended catch -- 2,499.0 tons); cucumaria (recommended catch -- 1,998.0 tons); torsk (recommended catch -- 1,000.0 tons); horse

mussel (recommended catch -- 990,0 tons); lumpfish (recommended catch -- 748,5 tons); sand lances (recommended catch -- 600,0 tons); dabber (dab) (recommended catch -- 575,0 tons); the recommended catch limit for other species of little use does not exceed 500.0 tons [18].

A range of conclusions can be drawn from the analysis of the existing patents as the documents indicative of the structure and areas of the ongoing research activities to the fullest possible extent. The most studied are the species, which are fished in the Northern commercial fishing area and demanded in Asian countries. This fact indicates a direct relationship between the demand for the ready-made product in the market and development of the raw materials processing technologies for its production.

At present the majority of projects are devoted to: brown algae (*Laminaria* and *Fucus*), *Cucumaria* and sea urchin. Several research works propose options for utilization of the lumpfish caviar [19, 20]. Mainly in the patents it is proposed to use the enumerated hydrobionts or their parts as functional or dietary supplements [21--27], ingredients altering some properties of food products [28--32, 32]. Only lumpfish caviar, sea urchin caviar and brown algae are considered as a standalone product or as a part of a complex product. There is no open-source publications of the patents and research findings aimed to provide scientific ground for processing of the lumpfish, torsk, horse mussel and sand lances flesh.

At the same time, according to the marketing research devoted to the food market, maximum growth of the consumers' interest is connected with the culinary food products [33]. However, a large portion of the published patents is not consistent with the existing consumer demand, but pursues only scientific targets, and this situation strongly reduces the opportunities for market development, does not give the required impulse for active exploration of the underutilized species of the Northern commercial fishing area.

3. Conclusion

The performed review of the relevant patent, scientific and technical sources shows that, in order to resolve the challenges of the Northern fishing area resources exploration and sustainable use, it is required to engage in active development of the processing technologies for the most widespread and underutilized species (such as rays, torsk) to produce food, for culinary food production. Development of such technologies will resolve the main challenge -- inclusion of the underutilized species into to the commercial fishing interests, at the expense of the emerging stable demand for them on

the part of the fish processing enterprises, with the consumer market situation taken into account. In its turn, the demand for these species of hydrobionts may substantially influence the fishing vessels fleet composition (increasing the share of long-liners), thus rendering a favourable effect on the sea life as a whole. The fishing industry development in the direction mentioned above may render substantial influence on development of the coastal areas on the Kola Peninsula, thus enabling to set up coastal fish farming and harvesting of such species as: clams (horse mussel, edible mussel and ocean quahog), lumpfish, polar cod and brown algae. Harvesting of all the enumerated species cannot be carried out without the corresponding coastal infrastructure which is not available for now.

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