

Mon-21-022

Features of Ichthyofauna Biodiversity Monitoring in the Ukrainian Black Sea Area

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SUMMARY

Analysis of ichthyological studies in the Zmiinyi Island coastal waters in 2003-2020 has been done. Various methods of ichthyological material collecting have been discussed. Data and Methods. Standard methods of ichthyological studies. Visual observation using lightweight diving outfit. Results. It has been shown that due to their high selectivity, use of commercial fishing gears for ichthyofauna biodiversity monitoring could entail erroneous results – depauperation of species composition in the studied marine areas. The most precise information about fish species composition can be received through visual observation using diving outfit. Conclusions. Various commercial and non-commercial fishing gears in combination with visual underwater observation using lightweight diving outfit allow the most successful ichthyological monitoring in the difficult-to-reach areas characterized by complicated bottom configuration.



XV International Scientific Conference “Monitoring of Geological Processes and Ecological Condition of the Environment”

17–19 November 2021, Kyiv, Ukraine

Introduction

Monitoring of ichthyofauna biodiversity is one of the main points in the Descriptor D2 of Marine Strategy Framework Directive (MSFD, 2008) and implies a system of repeated targeted ichthyological observations. Its ultimate goal, like that of the environmental monitoring in general, is assessment and forecasting in order to develop recommendations and options of managerial decisions being necessary and sufficient to ensure management of aquatic biological resources state and environmental safety (Monitoring, 2015).

Successful study of marine ichthyofauna to monitor its state and develop scientifically grounded recommendations on organizing and regulating its use is only possible with establishing of regular integrated marine surveys. Currently, studies of ichthyofauna are being performed in the framework of marine communities and ecosystems research. Their main task is to obtain highly representative material (i.e. high degree of correspondence between sample indicators and the parameters of natural populations of the studied fish species) characterizing the state of the populations, processes of aggregations formation and migrations of the main Black Sea ichthyofauna species.

Typically, ichthyological studies include:

- study of the current fish species composition and their distribution in the studied area;
- determination of number and biomass of fish populations;
- analysis of fish populations intraspecific structure (length and weight, age and sex composition of populations);
- analysis of diet and assessment of state of the fish food base;
- study of biology and ecology of the fishes being indicators of the state of the environment;
- study of the main hydrological, hydrochemical, hydrobiological and ecological parameters.

Due to the very difficult socioeconomic situation, lack of basic funds for high-quality collection of the material, complex bureaucratic procedures for the preparation and obtaining of permits, imperfect environmental legislation, which often impede professional research, ichthyofauna biodiversity monitoring in Ukraine has a number of features that have to be taken into account when organizing and conducting the monitoring.

Data & Methods

Materials collected during complex surveys in the Zmiinyi Island coastal waters from 2003 to 2020 in the framework of the National Research Project implemented by Odesa National I.I. Mechnikov University (the ONU) with financial support of the Ministry of Education and Science of Ukraine and during implementation of the international projects EnviroGRIDS, PERSEUS, EMBLAS (phase I, II) have been used in the work.

Fish was caught both near the coastline and at the distance of 5.0 km from the island. Most of studies (about 90.0% of fishing) were carried out in the coastal waters. Under 'coastal waters' we understood the water area of the General-Zoological Protected Area of National Significance «Zmiinyi Island», the boundaries of which are lying at 0.5 km distance from the coastline (Fig. 1).

Fish was caught in accordance with the standard ichthyological methods (Romanenko, 2006; Pryakhin, 2008):

- gillnets and Nieman multi-mesh size nets (length 100.0 m, mesh size 16-100 mm, material – kapron, monofilament) at the depths 1.5-30 m, distance from water edge from 2.0 to 500.0 m. In case the nets were set on stony substrate they were placed under water between stones and boulders by divers. The nets were set at 1.00-3.00 p.m. and checked once a day;
- rectangular fish traps with an opening on each side (mesh size 0.8 cm);
- dual trap net (length 3.0 m, mesh size 0.8 cm).

Fishing time was from two to three days;

- flat-bottom fry net (diameter 1.5 m, mesh size 0.6 cm);
- big aquarium dip-net (diameter 0.5 m, mesh size 0.02 cm);
- hook and line gear using natural and artificial bites.

In such a way, we studied the island coastal area with total square of ca. 2.0 km².



To assess fish number in the period of studies near the island coast (depth 1.0 – 1.5 m) we have selected plots of stony substrate (boulders) with the area of ca. 1.0 m². In those areas observations and catching of fishes belonging to families Gobiidae, Blenniidae, Gobiesocidae, and Labridae were carried out from 12.00 to 3.00 p.m. in the days when the conditions were as follows: water transparency – not less than 2.0 m, waves – under force 1, no clouds.

Underwater observations, description of bottom relief and substrate in the areas of ichthyological material collecting were performed using diving outfit in accordance with the methodologies (Getman, 2007; Mochek, 1978; Halford, 1994).

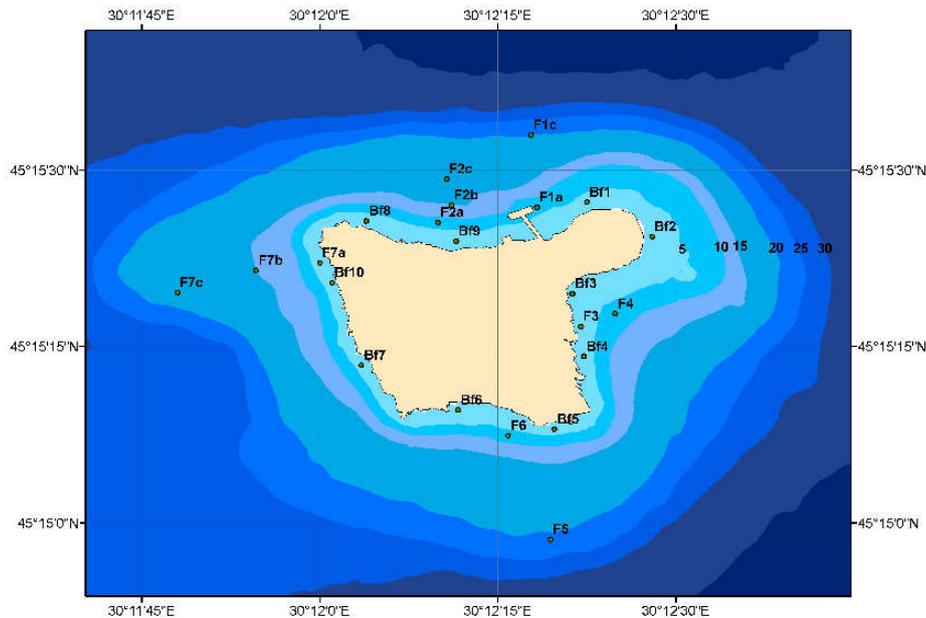


Figure 1 Schematic map of ichthyological stations location near the Zmiinyi Island (-5-.... -35- – isobaths with depth; F1 – F7 – ichthyological stations (depth from 5.0 to 30.0 m); Bf1 – Bf10 – coastal ichthyological stations (depth not more than 2.0 m).

Results

The north-western part of the Black Sea is notable for its highest productivity. There are the spawning and feeding grounds for more than half of the fish species registered in the entire Black Sea. The routes of winter and spring-summer migrations of many Black Sea commercial fish species are passing along the north-western coast (STECF, 2017). That part of the sea has a heterogeneous, in some places rather complex bottom topography. It is into this part of the sea that large European rivers flow, determining its special hydrology, primarily an unstable level of salinity and freshening of the surface water layer. Significant fish-kill phenomena are periodically noted there. That part of the sea suffers long storms in autumn and low temperatures in winter (STECF, 2017). Such conditions largely determine the peculiarities of ichthyological monitoring. They make it necessary to perform ichthyological studies in different seasons of the year using different fishing gears at different depths, substrates etc. The features of various fishing gears used for ichthyological research have been considered in more detail.

Ichthyological monitoring in modern Ukraine, due to unsatisfactory financing of ichthyological research, absence a research vessel and equipment, a complicated procedure for obtaining permits and other reasons is carried out, first of all, on commercial fishing vessels using commercial fishing gears: midwater trawls, beam-trawls, gill nets, dredges, pound nets, fyke nets etc. (Fig. 2). Selectivity of the gear used significantly complicates the ability to determine species composition accurately, as well as to make a correct assessment of biodiversity, abundance and distribution of ichthyofauna. This often



leads to serious mistakes, first of all, to the deliberate depauperation of species composition in the studied marine areas. The use of commercial fishing gears in the areas having complicated bottom topography leads to serious errors in assessing the qualitative and quantitative indicators of ichthyofauna. Catchability coefficient of gill nets, fyke nets etc. significantly reduces when they are worn out, damaged or set improperly.

Thus, for example, only 31.6% (24 species) out of the total (76) fish species registered in the Zmiinyi Island water area were found in trawl catches (Snigirov, 2012, 2020).



Figure 2 Commercial fishing gears and catches in the north-western part of the Black Sea.

The number of species in net catches was 2.5 times higher, however representing only 80.3% (61 species) of the ichthyofauna species composition. Thus, monitoring of ichthyofauna biodiversity using only commercial fishing gears, especially in the areas characterized by complex configuration of bottom relief, cannot be considered fully valid.

The most accurate information on fish species composition in the Zmiinyi Island coastal waters was collected via visual observations using light diving outfit. This method of sampling and observation, which is widely used in world practice, makes it possible perform ichthyological monitoring on rocky soils, vertical walls of hydraulic structures and in other hard-to-reach places the most successfully.

It should be noted that some fish species (11.8%) near the island were found due to use of various traps. Those were especially successful in shallow (up to 1-1.5 m depth) open areas, where use of other fishing gear and visual observations were not possible.



Shallow coastal areas (north-eastern side of the Zmiinyi Island) Traps of various configurations

Figure 3 Ichthyological traps for sampling from shallow areas.



Conclusion

Features of the studied area (depth, bottom topography, nature of the substrate etc.) should be taken into account when ichthyofauna biodiversity monitoring is organized and performed in the northwestern Black Sea. Various fishing gears should be used to collect ichthyological material the most effective way. Commercial fishing gears (midwater trawls, beam-trawls, gill nets, dredges, pound nets, fyke nets, etc.) do not provide accurate information on the fish fauna species composition due to their high selectivity. Visual observations using lightweight diving outfit allow the most successful ichthyological monitoring on rocky soils, vertical walls of hydraulic structures and in other hard-to-reach places.

Acknowledgements

The study was carried out in the framework of research activities funded by the Ministry of Education and Science of Ukraine with financial support from the EnviroGRIDS, PERSEUS, EMBLAS (phase I, II), BS4Fish GFCM (FAO) projects.

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