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The present and future of an integrated database on oceanology of the Southern Scientific Research Institute of Marine Fisheries and Oceanography (YugNIRO, Kerch, Crimea, Ukraine)

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Abstract

A brief description of the Southern Scientific Research Institute of Marine Fisheries and Oceanography (YugNIRO) status and activities is presented. The state of archives dating from the middle of the 20th century is characterized, as well as measures for its safety storage, processing and future use are under consideration. Four principal datasets specified by their origin, means of QC, methods of analysis and data presentation, namely: environmental, ichthyological and hydrobiological, fisheries statistics, and references are described in short. A listing of 15 databases available at present, though accomplished to different levels of extent, is also given.

The value of the databases originates from the method of research: collection of the information on the state of the ecosystem was carried out simultaneously with oceanographic surveys, which were complemented with meteorological observations. This multipurpose nature of primary data collected offers a scope of opportunities for further research of the marine ecosystems. On the one hand, this opens a way to analyzing the situation in the synoptic spatial-temporal scale, i.e. to define the state of fish population and its behaviour in relation to the water structure peculiarities. This type of data obtained may serve as a ground for expanding knowledge of ecosystems' mechanism of functioning (scientific aspects), and for implementing operative regulation of fishery (closed seasons/areas, quota management, etc.) and scientific advice to improve the efficiency of fisheries fleet operations (short-term forecasts), administrative and commercial applications tailored to rational and sustainable use of MLR. Data obtained by standard methods in terms of repeated (through a number of years, in the same geographic regions) integrated surveys allow to access the long-term dynamics of the state of population of certain species against long-term fluctuations of the oceanographic and meteorological modes. Besides the science-related aspects, such data maintain applied information on changes in the overall stocks and estimations of the Total Allowable Catches in the different regions, as well as the development of middle- and long-term forecasts for fisheries about catches of particular commercial species in the future.

Keywords: Databases; Informational support; Marine living resources.

Introduction

YugNIRO, the Southern Scientific Research Institute of Marine Fisheries and Oceanography, formerly (till 1989) the Azov and the Black Seas Scientific Research Institute of Marine Fisheries and Oceanography (AzCherNIRO), is the principal governmental research institute

under the State Committee for Fisheries of Ukraine involved in integrated marine fisheries research. Its basic responsibility is to provide information support to fisheries on the current state and dynamics of marine living resources (MLR), marine environment, marine pollution, as well as to perform control over the fishing fleet activity, and to carry out data collection.

Such kinds of information are backgrounded by the studies on marine commercial fish populations in different areas of the World Ocean and of oceanological conditions defining the state of population and behaviour of commercial species, executed by the three departments: the World Ocean Fisheries Resources, the Azov and the Black Seas Marine Living Resources, and the Department of Fisheries Oceanology.

Archives

Since the time of the YugNIRO foundation, 80 years ago, the history of its intensive research of the World Ocean living resources has resulted in a solid database on a variety of subjects. This information defines the current state of commercial species and their natural environment. The database 'Cruises' includes records made by over 950 research, scouting, and multipurpose (research and fishing) ocean-going (to high seas and to EEZs of coastal countries) expeditions. It is also being planned to systematize the available material for the Black Sea expeditions.

Archives of the institute's expeditions are available since the late 1950s only, data collected earlier have not been saved. They cover primary research data from the Indian, Southern, Atlantic and Pacific Oceans, the Azov, the Black, the Mediterranean and the South-China Seas. Those are records on tens of thousands of fishing operations (hauls, tows, sets), on hundreds of thousands of biological analysis, and size frequency data of fishes, cephalopods, shellfishes, on over 70 thousand profiles of water temperature obtained by bathythermographs of different types and by about 50 thousand deepwater Nansen's bottle oceanographic stations, including temperature measurements, salinity data, information on dissolved oxygen and nutrients concentrations accompanied by meteorological data. In recent years the archives have been updated by data collected on commercial species at sampling sites scattered all over the Crimean Peninsula coastline.

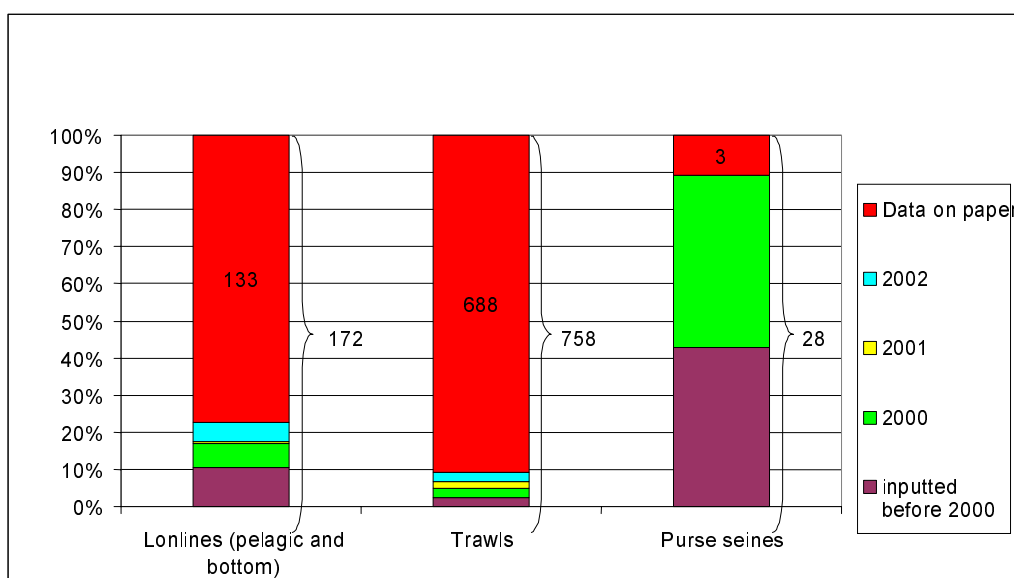
A substantial part of the above-mentioned unique materials is being stored in paper archives, that include logbooks of fishing vessels, records of ichthyologic, hydrobiological and oceanographic surveys started yet in the middle of the 20th century, and this by no means may provide the archives' security and efficient application. At present, the accumulated materials exist mostly in single copies of original cruises logbooks, records of biological analysis, and records of oceanographic and hydrometeorological observations. They are not guaranteed to be safe in case of natural cataclysms and anthropogenic disasters, nor are they protected against natural ageing of paper and other media.

The only feasible possibility for preservation and efficient use of the archive is its transfer into electronic media, creation and maintenance of an integrated database. To follow this objective, YugNIRO is digitizing the archived data and transferring the information into electronic media. This advancement has become partly possible, due to and within the framework of several projects conducted under the auspices of IOC of UNESCO, particularly the GODAR Project, World Data Center for Oceanography-Silver Spring, NMFS. However, unfortunately YugNIRO's own insufficient resources are inadequate, and thus they do not allow to provide the

necessary volume of work in due time; proper requirements for secure data storage can not always be observed; and the software support to data processing is not always updated accordingly.

The biggest advancement in turning archives into digital data has so far been made in the section of oceanographic and meteorological information, for this database has been formalised since the very origin of data collection. The state of digitizing of the fisheries archives is illustrated in Table I. Materials of biological and ichthyological surveys in some cases do not allow any kind of formalization. In particular, formalization of footnotes and extended comments made in cruises logbooks is not possible, while they present valuable information for researchers. Such information may be scanned and stored as digital images in ‘registers of field studies’, to be included in the final integrated electronic product.

Table I. World Ocean Cruises Archive (number of cruises)



Databases

We distinguish four principal datasets specified by their origin, means of quality control, and methods of analysis and data presentation:

- environmental data (physical and chemical parameters of water body (SD2, MBT, EBT, CTD), meteorological parameters (METEO), and data on marine pollution) obtained in YugNIRO cruises and integrated with WODB 98, WOCE Global Data 98, TOGA, COADS 2001, GOSTAplus);
- ichthyological and hydrobiological data collected by research/scouting cruises (data on haul/set operations, composition of catch by species, biological analyses, size frequencies, ichthyoplankton and zooplankton surveys, etc.);

- fisheries statistics (total catch/effort by time/area strata and by type of vessels/gears; daily radio reports database ('OCEAN'), fishing operation database ('RIF'), and fisheries logbooks database for some areas/fisheries);
- reference datasets (our original metadata on YugNIRO cruises, sampling methods and methodology, fishing vessels of Ukraine, and such well known and widely spread databases as ASFA, GEBCO 97 Digital Atlas, FAO FishStat, FishBase 98, FAO World Fisheries and Aquaculture Atlas, AGRIS).

Available at present, though accomplished to different levels of extent, are the following databases:

1. Data on oceanography and hydrometeorology (including original research records by YugNIRO, and information obtained on exchange basis through international scientific cooperation).
2. Data on research/scouting fishing.
3. Data on commercial purse-seine tuna fisheries collected by observers aboard fishing vessels.
4. Data from tuna purse-seine vessels' logbooks and logbooks records extracts.
5. Database of daily radio reports from the purse seine tuna fishing fleet.
6. Data on research and scouting long-line catches.
7. Data of daily reports by vessels of the several fishing companies from Soviet Corporation 'Yugryba' (a. Fishing operation database 1985-1988 (RIF)). Data on catch and effort (trawl sets, hours of trawling, sets positions) by types of vessels; b. Daily radio reports database 1993-1997 (OKEAN). Data on catch and effort (number of fishing days, noon position of vessels).
8. Zooplankton tows database.
9. Data on commercial invertebrates.
10. Data of statistical reports about catches by the Ukrainian fishing companies of fish and other MLR in the Azov-Black Sea basin.
11. Data of monthly reports on catches at sampling sites and during research expeditions by YugNIRO in the Azov and the Black Seas.
12. Data of daily observations at the sampling site 'Yurkino'.
13. Data on the structure and capacity of the fishing fleet of Ukraine (fishing vessels inventory).
14. Meteorological data of research expeditions by YugNIRO, 'Yugribpoisk' fishing company, and scientific observers from the ichthyological and fishing logbooks.
15. Data on the pollution of the Azov and the Black Seas water body and bottom sediments, and of tissues and organs of commercial species by contamination (heavy metals, components of oil and chlor-organic compounds – pesticides and polychlorinated).

Tables II and III demonstrate structures of 'SD2' Database (Nansen's Bottles Data from YugNIRO original cruises, 1950-2001) and 'OCEAN' Database (Daily radio reports 1993-1997).

Discussion

The above-described databases, in our opinion, present a substantial/essential part of the global knowledge about fishing resources in particular areas of the World Ocean and of the Azov and the Black Sea basin, also being a unique database in Ukraine.

Table II. 'SD2' (Nansen's Bottles Data from YugNIRO original cruises, 1950-2001) and 'OCEAN' Data Base (Daily radio reports 1993-1997)

Record 1

No	Parameter	Position	Length	Description
1.	File id	1	1	
2.	Form number	2-7	6	
3.	Record type	8	1	
4.	Count	9-10	2	number of records type 2 + 1
5.	Ship code	11-14	4	(from SHIPS.txt)
6.	Country code	15-16	2	
7.	Station number	17-21	5	
8.	Lat. (degr., min.)	22-25	4	DDMM
9.	Lat. Hemisphere	26	1	N or S
10.	Long. (degr., min.)	27-31	5	DDDDMM
11.	Long. Hemisphere	32	1	E or W
12.	Year	33-34	2	
13.	Month	35-36	2	
14.	Date	37-38	2	
15.	Start time of station	39-42	4	HHMM
16.	End time of station	43-46	4	HHMM
17.	Hour zone	47-48	2	
18.	Maximum depth	49-52	4	whole meters
19.	Cruise number	53-54	2	
20.	Start year of cruise	55-56	2	

Record 2

No	Parameter	Position	Length	Description
1.	File id	1	1	
2.	Form number	2-7	6	
3.	Record type	8	1	
4.	Line number	9-10	2	
5.	Time	11-14	4	HHMM
6.	Depth	15-18	4	whole meters
7.	T°C	19-22	4	degree to hundredths
8.	S‰	23-27	5	less to thousands
9.	Δ	28-31	4	less to hundredths
10.	O2 (mg-at/l)	32-34	3	whole
11.	O2 (%)	35-38	4	less to tenths
12.	PH (B)	39-41	3	less to hundredths
13.	Alk (mg-ekv/l)	42-44	3	less to hundredths
14.	PO4-P (mg-at/l)	45-47	3	less to hundredths
15.	P (total) (mg-at/l)	48-50	3	less to hundredths
16.	SIO3-SI (mg-at/l)	51-53	3	whole
17.	NO2-N (mg-at/l)	54-56	3	less to hundredths
18.	NO3-N (mg-at/l)	57-60	4	less to hundredths
19.	NH4-N (mg-at/l)	61-63	3	less to tenths

Table III. Structure of "OCEAN" Data Base (Daily radio reports 1993-1997)

No	Field Name	Type	Width	Dec	Remark
1.	DATA	Date	8		Date
2.	SUDNO	Character	4		Radio call
3.	RAJON	Character	4		Fishing area
4.	SHIROTA	Numeric	6		Latitude
5.	DOLGOTA	Numeric	7		Longitude
6.	ORUDIE	Character	4		Fishing gear
7.	K_TRAL	Numeric	2		Number of sets
8.	VR_TRAL	Numeric	3	1	Duration of set
9.	GLUBINA	Numeric	4		Depth (m)
10.	VID1	Character	3		Species code
11.	VILOV1	Numeric	4	1	Catch (kg)
12.	VID2	Character	3		Species code
13.	VILOV2	Numeric	4	1	Catch (kg)
14.	VID3	Character	3		Species code
15.	VILOV3	Numeric	4	1	Catch (kg)
16.	VID4	Character	3		Species code
17.	VILOV4	Numeric	4	1	Catch (kg)
18.	VID5	Character	3		Species code
19.	VILOV5	Numeric	4	1	Catch (kg)

The value of this database originated from the method of research: collection of the information on the state of the ecosystem (estimations of the stock abundance, food, localization/distribution of aggregations, and corresponding biological analysis) were carried out simultaneously with oceanographic surveys, which were complimented with meteorological observations. This multipurpose nature of primary data collected offers a scope of opportunities for further research of the marine ecosystems. On the one hand, this opens a way to analyzing the situation in the synoptic spatial-temporal scale, i.e. to define the state of fish population and its behaviour in relation to the water structure peculiarities. This type of data obtained may serve as a ground for expanding the knowledge on ecosystem functioning mechanism (scientific aspects), and for implementing operative regulation of fishery (closed seasons/areas, quota management, etc.) and scientific advise to improve efficiency of fisheries fleet operations (short-term forecasts), administrative and commercial applications tailored to rational and sustainable use of MLR. Data obtained by standard methods in terms of repeated (through a number of years, in the same geographic regions) integrated surveys allow to access the long-term dynamics of the state of population of certain species against long-term fluctuations of the oceanographic and meteorological modes. Besides the science-related aspects, such data maintain applied information on changes in the overall stocks and estimations of the Total Allowable Catches in the different regions, as well as the development of middle- and long-term forecasts for fisheries about catches of particular commercial species in the future.

The available databases and current YugNIRO monitoring activities are the principal basis for the fulfilments of Ukrainian obligations in the framework of international conventions, agreements and membership in the international organizations involved in fisheries regulations CCAMLR, NAFO, CITES, which means monitoring of the state of fisheries ecosystems in the

high seas areas of active Ukrainian fisheries, monitoring of the fishing fleet activity, and development of sound management advice on the use of fisheries resources, forecasts of resource state, as well as estimation of the Black Sea and the Sea of Azov species stocks (European sprat, European anchovy, grey mullets, sturgeons, flatfishes, etc.) for fisheries regulation and setting fishing quota by the State Committee of Fisheries of Ukraine.

Thus, when developing the database, we faced a rather serious problem of arranging different types of data, also with consideration of the data interrelationships. Volumes of information that differs by contents and by forms, suggest a very specific role of experts in charge of the final integrated product development, as well as a requirement to ensure the prospective users' access to different levels of adequate information presented in the most explicit way on the specific matters of the user's enquiry.

A possible solution to the problems stated above is the proposed design of the GIS-based integrated database. This is supposed to be a comprehensive Fisheries Science/Knowledge Database, which will contain both primary data, obtained from surveys, and analytical ones and descriptive information, as a result of investigations then compiled into aggregated descriptions of certain species, their biological specifications and features of behaviour determined by the water structure of the region. The system should harmonize all scientific and fisheries data that presently exist and will be assimilated in the future.

The main objectives of the current stage of the database development are:

- to provide adequate hardware to store, process and analyze scientific and fisheries data available;
- to develop and maintain an intranet which would have access to other communication networks;
- to develop and arrange a databank with a compulsory access to the global network;
- to provide data search and data transfers of archives by YugNIRO into digital formats (primarily of the information in danger of extinction because of its paper aging under effect of time);
- to integrate into the database those materials that have been collected in expeditions by other research institutions and other databases maintained as a result of a number of projects performed;
- to pursue quality control and information correction of data entered into the database;
- to maintain adequate software facilities for archiving, processing of integrated oceanological, biological and fisheries data, and distribution of final data and information;
- training of personnel.

The next step, in our opinion, should be done to provide links to other administration's fisheries management information systems such as vessel registrations details, licensing of fishing vessels, vessels surveillance, quota management, market prices, etc. Such vessels surveillance system, based on VMS as a part of a general system, is presently being created at the division of the State Committee of Fisheries.

Conclusion

On the basis of the above-said information it will be possible to develop guiding decisions regarding priorities and strategies of sustainable use and development of MLR, on ecological monitoring of certain regions of the World Ocean, coastal zone management and sustainable development improving health and productivity of aquaculture, effective MLR management through the provision of better information. The above-mentioned specific datasets and substantial experience of personnel would make a good background for provision of MLR-risk management solutions even in cases of uncertainty.

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