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Цей збірник наукових доповідей присвячень основним підсумкам виконання Стратегічного плану дій по реабілітації і охороні Чорного моря (1996-2000 рр.), підсумкового документа першого етапу виконання Міжнародної Чорноморської Екологічної Програми ООН. У цьому зв'язку надруковані матеріали відображають основні розділи Програми, а саме: швидке реагування при надзвичайних ситуаціях, моніторинг забруднення і стандарти якості навколишнього середовища, захист біологічної різноманітності, розробка загальної методології управління прибережною зоною моря, рибальство, освіта і громадська поінформованість в природоохоронній області. В статтях представлені результати раніше не надруковані результати наукових досліджень. Подані дані, їх інтерпретація і закінчення належать авторам повідомлень і ні в коєму разі не можуть бути приписані членам організаційного комітету, які склали даний збірник.
Збірник призначень для широкого кола спеціалістів у галузі біології і екології моря, океанографії, техногенної безпеки і охорони природи.

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Present issue is devoted to the main results of Strategic Action Plan for the Rehabilitation and Protection (SAPRP) of the Black Sea (1996-2000) implementation. The SAPRP is a resulting document of the Black Sea Environmental Program (GEF/UN/UNDP) first step. The published materials have been reflected by the main Program sections: emergency response, pollution monitoring and environmental quality standards, protection of biodiversity, integrated coastal zone management, fisheries, environmental education and public awareness. These papers are the results of scientific research haven't been unpublished earlier. The findings, interpretations and conclusions expressed in papers, are in own property of the authors and should not battributed in any manner to the members of organization committee, which prepared this issue.
The issue was design for specialists in the field of marine biology and ecology, oceanology, technogenic safety and environmental protection.

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MARINE AQUACULTURE: SEASONAL VARIATIONS IN THE BIOCHEMICAL COMPOSITION OF CULTIVATED MUSSELS IN THE NORTH-WESTERN BLACK SEA

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One of the overall aims of the Strategic Action Plan for the Rehabilitation and Protection of the Black Sea is to solve socio-economic issues which is to support livelihoods based on sustainable activities such as fishing, aquaculture and tourism to benefit the region in general in all Black Sea countries.

Marine aquaculture in the Black Sea region according to a report of a mission of international experts supported by the Black Sea Environmental Program (BSEP) is a relatively new development (Marine Aquaculture in the Black Sea Region, Current Status and Development Options, 1996), and rearing of the Mediterranean mussel *Mytilus galloprovincialis* L. is a perspective activity for all six coastal countries of the Black and Azov seas basin. Four main rivers such as the Danube, Dnepr, Dnestr and South Bug flow into the northwestern part of the Black Sea (NWBS) adjacent to Ukraine contributing to its high productivity (Mee, 1992). Mussels, as filter-feeding organisms, utilize the detritus, phytoplankton, microorganisms and dissolved organic matter in this highly trophic area. Taking advantage of this rich supply of primary production mussel culture after being subject to environmental impact assessments may turn into a suitable activity in this area. For evaluation of the quality of mussel production knowledge of the biochemical composition is important. The use of parameters of biochemical composition as lipid and glycogen content allows to monitor the physiological state of mussels in relation to season and abiotic factors.

Intensive experimental mussel farming in the late 1980s and early 1990s allowed to elaborate the biological and technological parameters for mussel cultivation in southern Ukraine mostly concentrated in the Crimean Black Sea area, and also along the Odessa coastal zone in the northwestern Black Sea

(Ivanov, 1980; Zolotarev, 1989; Zolotnitsky, Romanenko, 1998, 1999) According to Suprunovich (1994) the productivity of a mussel farm may read 100 tons of fresh mussels per hectare yielding 10-15 tons of highly nutritive meat per hectare. However, at present mussels are not cultivated on a commercial scale, but are reared by small groups selling small quantities to local markets.

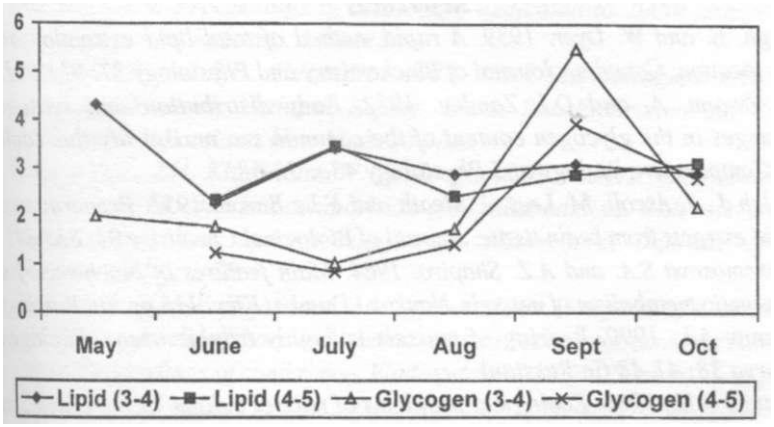
Conditions in the northwestern and Crimean shelves and in the Black Sea region as a whole have changed significantly as a result of anthropogenic factors. The change has been most marked in the shallow waters of the NWBS (Zaitsev, Alexandrov, 1998). Since the 1970s, hypoxia has been registered in the near bottom layers leading to extensive areas of mortality of benthos (Salsky, 1977). Consequently the oxygen regime is of great importance in selecting areas for aquaculture. In the NWBS coastal areas up to depths of 8 10 m have been recommended as favourable to mussel cultivation (Ivanov, 1990). Besides, the growth rate in cultivated Black Sea mussels according to diminishing rank, depends on: water temperature, age, feeding rate, body weight, food composition, productivity of phytoplankton, state of gonads, position in clusters (Valovaya, Kholodov, 1983).

For biochemical composition the lipid content was determined according to the method of Folch et al. (1951) modified by Bligh and Dyer (1957); glycogen according to the anthrone method (Seifter, 1950).

The annual life cycle of the Black Sea mussel, *Mytilus galloprovincialis* L., may be divided into 4 periods: the spring reproductive period (April-June), the summer period of general dormancy (July-August), the autumn reproductive period (September-December) and the winter period of inactivity (January-March). (Goromosova,Shapiro 1984).

Analysis of data studied shows that there is a close link of biochemical processes in the mussel with the reproductive period, and glycogen makes up the main energy reserve. Seasonal dynamics of glycogen content in mussels is closely related with reproduction. A seasonal trend in lipid and glycogen content has been noted in different age groups (3-4, 4-5 cm) of cultivated mussels in Odessa Bay NWBS in the early 1990s (Figure). Lipid values increased to a maximum in July with a low range of variation until the end of the period of study. The results show that the lipid values in spring - summer are higher than those of glycogen, but are inversely related. In this case, mobilization of energy reserves from glycogen occurs for gonad development. The inverse relationship between glycogen and lipid levels was noted by Zandee et al. (1980) for *Mytilus edulis* L. from a culture bed in the Dutch

Wadden Sea. Thompson et al. (1974) observed that lipid is synthesized and stored in the digestive gland during summer when carbohydrate content is low.



Seasonal changes in glycogen and lipid content in different age groups of cultivated mussels (the shell length in parentheses)

Beginning from August there is a steady rise in glycogen content reaching maximum values in September of 5.49 % and 3.93 % wet weight for 3 • 4 and 4 - 5 cm mussels, respectively. Evidently, the large amounts of glycogen which are stored in the mussel in autumn coincide with good food abundance (de Zwann and Zandee, 1972). In October the glycogen content declined to 2.2 % and 2.8 % wet weight respectively, almost to the same level as for lipid values (2.91 % and 3.14 % wet weight). The autumn reproductive period is similar to that in spring being characterised by intense gametogenesis and linear growth. These data illustrate the variation of lipid and glycogen content in relation to season and to physiological condition.

When comparing the biochemical composition of cultivated and wild mussels, it has been noted that the lipid glycogen, protein and amino acid content is higher in the former (Lisovskaya, 1990; Stepanyuk et al. 1990). The enhanced amounts for cultivated mussels are largely due to more favourable environmental conditions (temperature, oxygen levels and closer proximity to the euphotic zone) which influence the variations in mussels reared in upper levels in the water column in comparison to mussels inhabiting the seabed in more adverse conditions.

Similar trends in seasonal variations of biochemical composition were observed in mussels inhabiting shoreline reinforcement structures in the Odessa coastal area near Lanzheron beach in 1998.

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