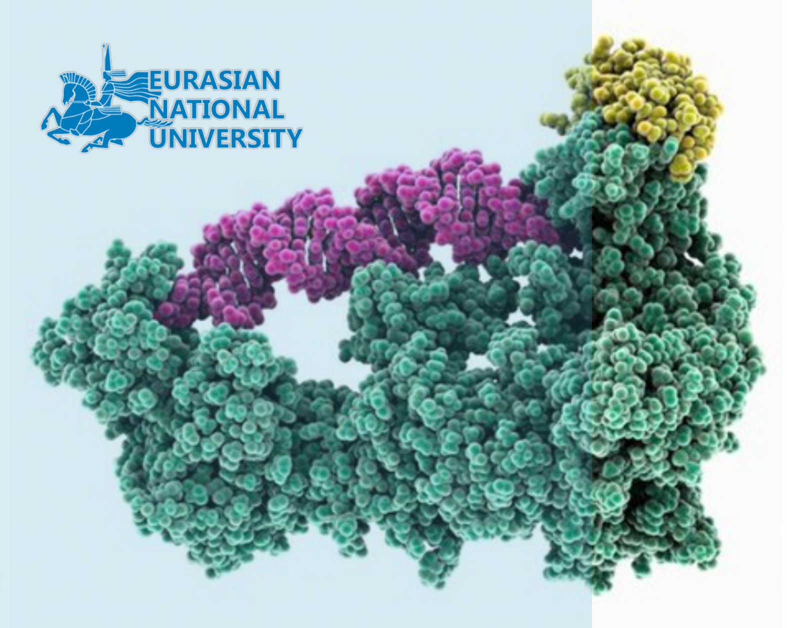
ҒЫЛЫМ ЖӘНЕ ЖОҒАРЫ БІЛІМ МИНИСТРЛІГІ
МИНИСТЕРСТВО НАУКИ И ВЫСШЕГО ОБРАЗОВАНИЯ



Л.Н. ГУМИЛЕВ АТЫНДАҒЫ
ЕУРАЗИЯ ҰЛТТЫҚ УНИВЕРСИТЕТІ

ЕВРАЗИЙСКИЙ НАЦИОНАЛЬНЫЙ
УНИВЕРСИТЕТ ИМЕНИ
Л.Н. ГУМИЛЕВА

"ОМАРОВ ОҚУЛАРЫ: XXI ҒАСЫРДЫҢ БИОЛОГИЯ ЖӘНЕ БИОТЕХНОЛОГИЯСЫ" АТТЫ ХАЛЫҚАРАЛЫҚ ҒЫЛЫМИ ФОРУМНЫҢ БАЯНДАМАЛАР ЖИНАҒЫ

СБОРНИК МАТЕРИАЛОВ МЕЖДУНАРОДНОГО НАУЧНОГО ФОРУМА "ОМАРОВСКИЕ ЧТЕНИЯ: БИОЛОГИЯ И БИОТЕХНОЛОГИЯ XXI ВЕКА"

АСТАНА, ҚАЗАҚСТАН
11 СӘУІР 2024 ЖЫЛ

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«Омаров оқулары: XXI ғасыр биология және биотехнологиясы» халықаралық ғылыми форумының баяндамалар жинағы. – Астана: Л.Н. Гумилев атындағы Еуразия ұлттық университеті, 2024. – 284 б., қазақша, орысша, ағылшынша.

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Жинақ «Омаров оқулары: XXI ғасыр биология және биотехнологиясы» атты халықаралық ғылыми форумына қатысушылардың баяндамаларымен құрастырылған. Бұл басылымда биология, биотехнология, молекулалық биология және генетиканың маңызды мәселелері қарастырылған. Жинақ ғылыми қызметкерлерге, PhD докоранттарға, магистранттарға, сәйкес мамандықтағы студенттерге арналған.

Сборник составлен по материалам, представленным участниками международного научного форума «Омаровские чтения: Биология и биотехнология XXI века». Издание освещает актуальные вопросы биологии, биотехнологии, молекулярной биологии и генетики. Сборник рассчитан на научных работников, PhD докторантов, магистрантов, студентов соответствующих специальностей.

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Сурет 3 $Na_2MoO_4*2H_2O$ әр түрлі концентарцияларында праймингтеудің сабақтың орта ұзындығына әсері.

Кесте-2 Сабақ ұзындығының нәтижелеріне молибденмен праймингтеу әсерінің бір факторлы дисперстік анализ арқылы саралауы

Дисперсионды анализ				
Вариация көзі	*SS*	*df*	*MS*	*P-дәрежесі*
Группа арасында	37,96317	6	6,327196	0,0000000000000000000000000000667
Группа ішінде	26,44415	167	0,158348	
Жалпы	64,40732	173		

Қорытынды

Тұқымдарды натрий молибдат жоғарғы концентрациялы ерітінділерімен өндеу жағымсыз әсер етеді. Бұл концентрациялар арпа өсімдігінде жақсы әсер көрсеткенімен, томат дәндеріне жағымсыз әсер етеді. Алынған нәтижелер *Solanum lycopersicum* «Никола» сортына молибденнің 100 мМ, 75 мМ, 50 мМ, 25 мМ және 10 мМ концентрацияларының негативті әсер ететінің көрсетті. Алдағы уақытта басқа төменгі концентрацияларда жұмыстар жүргізіледі. Бұл жұмыс Қазақстан Республикасы Жоғары білім және ғылым министрлігі қолдауымен жүргізілді, AP19680579.

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УДК 591.125

Effects of hypoxia on fish physiology

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Abstract: Oxygen is essential to sustain life for all fish and invertebrates. Hypoxia is an ever-increasing threat to aquatic systems. Dissolved oxygen (DO) in water bodies is essential for fish survival and plays a crucial role in fish growth, development, and physiological processes. Although fluctuations in its levels may be a natural phenomenon, hypoxia caused by eutrophication and organic pollution is now considered one of the most pressing and critical water pollution problems in the world, especially in densely populated regions. It stresses fish, causing them to exhibit fluency, inhibiting their growth and development, and causing tissue damage. Oxidative stress reduced immune function and altered metabolism have also been observed. Severe hypoxia can cause massive fish mortality, resulting in significant economic losses to the aquaculture industry. In response to hypoxia, fish exhibit a range of behavioral and physiological changes that represent self-protection mechanisms developed through long evolution. Knowledge of the aetiological factors, pathogenetic mechanisms, and risk factors allows the development of effective methods for the prevention and treatment of this pathological condition Therefore, the effects of low dissolved oxygen on fish are a major concern and are being actively studied. This article includes a review of information related to hypoxia and how it affects various characteristics of aquatic organisms.
Keywords: Hypoxia, Biochemistry Physiology, Dissolved oxygen, Respiratory system, Blood circulation, Metabolism, Energy balance, Anthropogenic influence

The definition of hypoxia often varies from study to study. Hypoxia is a term used to describe waters that have very low dissolved oxygen levels and thus are stressful to the habitat and life resources of lakes, estuaries, and coastal waters. Hypoxic waters contain oxygen concentrations of less than 2-3 ppm. Hypoxia can be caused by various factors including excess nutrients, primarily nitrogen and phosphorus, and stratification of the water body due to salinization or temperature gradients [1]. The moment of asphyxiation varies between animals, but generally, the effects begin to appear when oxygen levels fall below 2 mg O2/liter. For seawater, this represents only about 18% of air saturation. By comparison, air contains about 280 mg O2/liter. Anoxia is the complete absence of oxygen. The two main factors leading to the development of hypoxia, sometimes resulting in anoxia, are stratification of the water column, which isolates bottom water from exchange with oxygen-rich surface water, and decomposition of organic matter in bottom water, which reduces oxygen levels. Both conditions must be present for hypoxia to develop and persist [2]. Although minimum oxygen levels are set for water quality, they may not take into account all species or how oxygen levels affect the interactions between them. Different species and life stages have different oxygen needs, and these needs increase with increasing activity [3].

It is important to note that hypoxic (and oxygen-free) environments may have existed throughout geological time. but human degradation of the environment is increasing the occurrence of hypoxia as the influx of domestic waste and fertilizer runoff accelerates eutrophication and pollution of water bodies. Increasing hypoxia is now recognized as an environmental problem of global importance for fresh and coastal waters, which can lead to changes in species composition, population declines, mass mortality, and the creation of extensive "dead zones" [4]. Although the effects of low dissolved oxygen (DO) on fish have been studied for decades; it is only in the last few years that the study of the effects of hypoxia on fish has reached full bloom (Figure 1). A search conducted in the Web of Science database using the search words "hypoxia and fish" resulted in 859 published articles between 1965 and 2005. While this search is certainly not fully comprehensive, it does indicate publication trends. As shown in Figure 1, most of the published work on the effects of hypoxia on fish was conducted in the early 1990s, with the number of studies increasing since 2000.

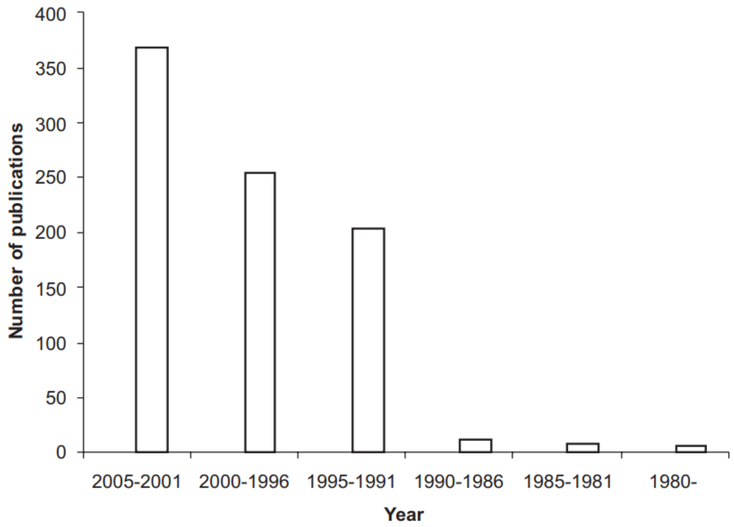

Figure 1. The number of papers published on the effects of low dissolved oxygen on fish from 1965 to 2005 [4].

The future status of hypoxia and its effects on fish will depend on a combination of climate change (primarily due to warming and changing wind, current, and precipitation patterns) and land use changes (primarily due to agricultural expansion and nutrient loading). If humans continue to modify and degrade coastal systems over the next 50 years as they have in previous years, population pressure is likely to be the primary driver of the spread of coastal dead zones, with climate change factors secondary. However, climate impacts will tend to make systems more susceptible to hypoxia development through direct effects on stratification, oxygen solubility, metabolism, and mineralization rates, especially in lakes and semi-enclosed coastal areas [5].

For fish, the presence of dissolved oxygen (DO) is one of the physicochemical factors that can limit habitat quality, distribution, growth, reproduction, and survival. However, the physical properties of water (high viscosity, low oxygen content) content at saturation) make it difficult for fish to absorb oxygen even at high levels of DO. In addition to these limitations imposed by the physical properties of water, there are many habitats in which dissolved oxygen is depressed. below saturation periodically or chronically. Hypoxia occurs naturally in habitats characterized by poor mixing or light limitation, such as heavily vegetated marshes, flooded forests, floodplain lakes and ponds, ephemeral puddles, springs, and deep waters of lakes; it is particularly prevalent in tropical waters where high temperatures increase organic matter decomposition and reduce oxygen tension and content [6]. Hypoxia can also occur regularly and predictably because of a lack of photosynthesis at night but occurs more unpredictably because of eutrophication, stagnant water, or ice cover. Although a naturally occurring phenomenon, the frequency, prevalence, and severity of hypoxic events have increased due to anthropogenic loading of organic and inorganic nutrients as well as widely discussed global warming. Hypoxia is also a widespread problem in aquaculture where planting densities are high, requiring large amounts of energy input for aeration. It is therefore not surprising that most studies linking hypoxia to growth and digestive performance have been conducted on commercially important species such as Atlantic cod, trout, and catfish [7].

The frequency and duration of hypoxic events vary by ecological system, time, and varying nutrient load or organic matter accumulation. Hypoxia varies from aperiodic events with periods of several years to decades between recurrences to a constant year-round function that can persist for years or centuries at the same rate. time. time. Dominant faunal responses vary with the type of hypoxia (figure 2).

Aperiodic hypoxia resulting from unusual climatic conditions causes the most dramatic mass mortality response among sedentary and sometimes motile fish species. For benthic invertebrates, this dramatic response is due to the large number of sensitive species that may have been present before the hypoxic event. Aperiodic hypoxic events have begun to be reported in many systems that currently experience seasonal outbreaks of hypoxia. Wind and tidal shifting periodically disrupt stratification and induce hypoxia in many systems, reducing the impact on sedentary fauna and at times providing an opportunity for mobile fauna to return. This form of periodic hypoxia, occurring a few too many times per year, is also common at the boundaries of seasonal and permanent dead zones as currents or wind upwelling cause hypoxic bottom waters to move. The form of periodic hypoxia with the most frequent recurrences is diurnal. cyclic hypoxia, which appears to be common in shallow water systems and is due to a balance between oxygen production during the day and respiration at night. Seasonal hypoxia, usually occurring in summer or early autumn, usually often causes benthic mortality with subsequent recolonization of benthos, and avoidance by mobile species with their return as oxygen concentrations increase. Persistent hypoxia and developing anoxia have the greatest impact on benthic fauna, destroying all habitat value. the bottom over long periods [8].

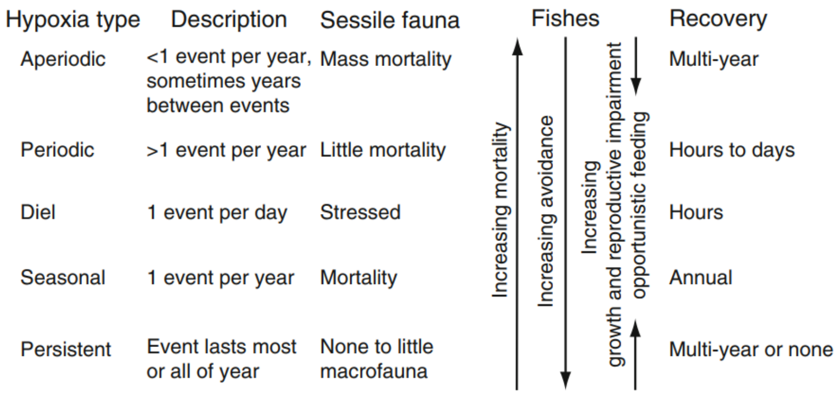

Figure 2. Types of hypoxias and generalized faunal response. Sessile fauna is primarily macrobenthos [8]. Arrows indicate the direction of increased impact on fish. Mortality in fishes is more likely from aperiodic hypoxia, with complete avoidance of persistent hypoxia. Physiological impairment and opportunistic feeding are greatest for periodic and diel hypoxia.

Generally speaking, all aquatic animals exposed to hypoxia face the same physiological challenges and therefore respond in the same way to both behavioral changes and physiological adaptations. Initial responses to hypoxia include attempts to maintain oxygen delivery through behavior or physiological adaptations. If oxygen levels cannot be increased, animals will attempt to conserve energy by minimizing energy output, followed by an increase in the energy efficiency of metabolic processes until eventually, they begin to obtain energy from anaerobic sources. When energy is conserved, other processes including reproduction and development can be affected, which can have long-term consequences for the population as a whole [9]. Aquatic surface respiration (ASR) and air breathing are bony fishes' two most pronounced behavioral responses to aquatic hypoxia. But the former behavior has not been described in the more plesiomorphic groups of fishes, the jawless, plastinoderms, or chondrichthyans. While air breathing is found in several primitive bony fishes and ancient cysteperids[10].

Fish range in size from milligrams to tons and many are regularly exposed to large fluctuations in ambient oxygen levels. For more than half a century there have been various, often divergent, claims about the effect of body size on the tolerance of fish to hypoxia, but the main conclusions can be emphasized:

1. Body size alone has little effect on the ability to absorb oxygen during hypoxic states, primarily because respiratory surface area corresponds to metabolic rate over a wide range of sizes. If size-related differences in oxygen uptake capacity are observed in a species, this probably reflects adaptation to a different lifestyle or habitat choice.

2. During times of severe hypoxia and anoxia, when fish have to rely on anaerobic ATP production (glycolysis) for survival, larger individuals have a distinct advantage over smaller individuals because smaller fish run out of glycogen or reach lethal levels of anaerobic end products (lactate) much more quickly due to higher specific metabolic mass.

3. Those fish species that have evolved under extreme conditions. Adaptations to hypoxia, including hemoglobin with exceptionally high oxygen affinity and an alternative anaerobic end product (ethanol), show that natural selection may be a much more powerful determinant of hypoxia tolerance than the scaling of physiological functions [11].

Maintaining oxygen delivery can be achieved by increasing water flow through the gills and increasing the diffusion capacity of the gills by increasing the number of perfused gills and plates. Fish can improve their oxygen transport capacity by increasing blood cell number, or the oxygen-binding capacity of hemoglobin. A second strategy for survival in hypoxia is to conserve energy expenditure through metabolic depression. This may be mediated by a decrease in overall metabolism, downregulation of protein synthesis, or downregulation and/or modification of certain regulatory enzymes in anaerobic and aerobic pathways. For example, the rate of ATP utilization can be regulated by more than an order of magnitude, and the metabolic rate is reduced by a factor of 5-20 in hypoxia. These biochemical adjustments allow the animal to enter a hypometabolic regime. Some fish can regulate energy production during anaerobiosis through covalent modification of certain glycolysis regulatory enzymes, such as phosphofructokinase [12].

To adapt to RK changes in the aquatic environment, fish may alter gill cell mass by total respiratory surface area and enhance antioxidant action to reduce AFC production [13]. In addition, there are numerous studies investigating species-specific tissue differences related to physiological mechanisms of response to hypoxia. For example, superoxide dismutase (SOD) activity in the gill tissue of *Leiostomus xanthurus* increased significantly after hypoxia for 12 h, but catalase (CAT) activity was unchanged [14]. SOD activity in gill tissues of *Cyphocharax abramoides* increased compared to the control group after 3 h of hypoxia; however, after short-term hypoxic stress of *Hemiscyllium* antioxidant enzymes, *ocellatum* did not differ significantly between exposure and control groups. groups [15]. Aerobic metabolism is dominant under hypoxic conditions as it produces more energy than anaerobic metabolism. However, some studies have shown that anaerobic oxidation can rapidly provide energy and reduce oxygen content and oxygen consumption in the hypoxic environment [16]. For example, after 10 h of extreme hypoxia, the lactate dehydrogenase (LDH) activity in the liver of Nile tilapia decreased slightly. Still, no significant change in LDH activity was observed in the liver of *Leiostomus xanthurus* after 12 h of hypoxia [17]. Hence, it is unclear which energy supply pattern is dominant in low-oxygen environments in fish. It is of great importance to study the mechanism of energy metabolism and the antioxidant mechanism of adaptation to hypoxia.

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"Kazbiorem-эм" биопрепаратынын жаздық бидайдың жоғары температуралық стрессіне әсері

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Аннотация: Ақмола облысының қара топырақты топырақтарында "KazBioRem-ЭМ" биопрепаратының көмегімен бидайдағы жоғары температуралық стрессті жұмсарту.