UDC 551.583 : 574.21 (043.2)

THE OVERVIEW OF THE STATE-OF-ART IN CLIMATE CHANGES BIOINDICATION

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Keywords: bioindicator, climate change, phenophase shift, diversity, abundance.

Introduction. The major direction of research efforts in the field climate change are modeling of emission and temperature rise scenarios and prediction of potential effects. However, all these work is subject to considerable biases, since we lack analogues of such abrupt and significant climate changes in our geological history [1]. There fore it is necessary to collect evidences about the response of living systems to the current climate changes for the purpose of verifying and refining predictions made. Bioindication is traditionally used as a means for monitoring environment quality and can aid in providing necessary data about the changes taking place in nature due to modification of climate system parameters [2].

Methods and materials. The organisms suitable for biomonitoring of climate changes should posses a range of properties in order to separate other environmental pressures in the measured reactions of bioindicator organisms. The important prerequisites for selecting indicator organisms for tracing climate changes is a well-established taxonomy and ecology of e species, which enables reliable interpretation of the observed changes [3]. The easy and cost-effective approaches to study of indicator species are also important criteria. The results collected should be largely independent of sample size, have a response that reflects climate change, and be able to demonstrate trends or cycles [4]. The current applications and perspectives of the climate change bioindication were analyzed based on the published papers presenting research results and proposing new approaches.

Results. The main approaches to climate biomonitoring are based on tracing shifts in phenophases and mapping shifts in habitats or dispersal ranges of plants and animals.

Insects are good bioindicators of climate change, since they often have shortened life cycles and are present at all trophic levels [4, 5]. The beetles stand out as the most diversified group and therefore it is possible to choose those that are abundant in certain localities with endangered climate conditions. Cerambycidae, Eumolpinae, Lampyridae, and Phengodidae families are believed to be ideal bioindicators because of their heat tolerance, narrow elevational ranges, and abundance [5]. Honeybees are the second most mentioned biomonitor for climate changes, since they are widely distributed and monitored most easily as domestic animals [6].

Aquatic insects are also used as biomonitors of freshwater habitats and often exhibit noticeable changes in diversity and abundance in response to climate changes. There is a considerable research data set, listing traits of insects suitable for climate changes survey [7].

Butterflies are also monitored for the signs of the climate change effects. They are poikilothermic and are among the most well studied insects on the whole. There are clear evidences of phenological changes observed in butterflies due to climate changes [8].

The other well developed direction of research is phenophases of plants in particular fruit and decorative trees with well established blooming regularities [9]. The other important indicator is defoliation and propagation of diseases as a mark of suppressed immunity due to heat stress.

Biomonioring of climate changes is an important component of the system response to climate changes. It can provide valuable information about the adaptation of species to new conditions and failure to do so. Using this data it is possible to set up cost-effective research works in Ukraine.

References

1. Willis, K. J., Bailey, R. M., Bhagwat, S. A., & Birks, H. J. B. (2010). Biodiversity baselines, thresholds and resilience: testing predictions and assumptions using palaeoecological data. *Trends in ecology & evolution*, *25*(10), 583-591.

2. Taylor, K. (2021). Biomonitoring for environmental change; A review of current uses and limitations. *Air Quality and Climate Change*, *55*(4), 26.

3. Makiola, A., Compson, Z. G., ... & Bohan, D. A. (2020). Key questions for next-generation biomonitoring. *Frontiers in Environmental Science*, *7*, 197.

4. Chowdhury, S., Dubey, V. K., ... & Kumar, V. (2023). Insects as bioindicator: A hidden gem for environmental monitoring. *Frontiers in Environmental Science*, *11*.

5. Forister, M. L., Pelton, E. M., & Black, S. H. (2019). Declines in insect abundance and diversity: We know enough to act now. *Conservation Science and Practice*, *1*(8), e80.

6. Colares, C., Roza, A. S., ... & Macedo, M. V. (2021). Elevational specialization and the monitoring of the effects of climate change in insects: Beetles in a Brazilian rainforest mountain. *Ecological Indicators*, *120*, 106888.

7. Cunningham, M. M.,... & Guarna, M. M. (2022). Honey bees as biomonitors of environmental contaminants, pathogens, and climate change. *Ecological Indicators*, *134*, 108457.

8. Conti, L., Schmidt-Kloiber, A., Grenouillet, G., & Graf, W. (2014). A trait-based approach to assess the vulnerability of European aquatic insects to climate change. *Hydrobiologia*, *721*(1), 297-315.

9. Stefanescu, C., Peñuelas, J. and Filella, I. (2003), Effects of climatic change on the phenology of butterflies in the northwest Mediterranean Basin. Global Change Biology, 9: 1494-1506.