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M.M. Radomska, PhD
(National Aviation University, Ukraine)

The perspectives of setting long term biomonitoring programs at Ukrainian airports

The need for and preconditions to the development of the long term control of the environment status in an airport impact area was considered. The possible indicators were analyzed and recommended for the organization of such survey were developed.

Long-term Biomonitoring.

Biomonitoring stands for the observing living organisms' reaction to evaluate the status of environment they live in. It is often called bioindication and relies on the choice of sensitive species, able to reflect some changes in environment condition. Provided that instrumental analysis of environment components quality is a costly process, biomonitoring is able to give answers to the questions about real situation and enables reaction to the potential negative trends observed.

Long-term programs of biomonitoring started to set up in the second half of the XX century. The most well-known examples come from the USA, Canada, Japan and European Union.

Thus, the Forest Inventory and Analysis (FIA) Program of the U.S. Department of Agriculture, Forest Service (USFS) has been around since 1990, and operates a wide system of survey plots, covering all federal forests of the USA. It is able to provide valuable insights into the extent of negative environmental effects propagation from air pollution, originally coming from industrial facilities; as well as to demonstrate slow, but unavoidable pace of community composition modifications due to climate changes [1].

Another example of long term biomonitoring survey is the European Grassland Butterfly Indicator, collected from 16 European countries, which shows that there has been a 39% decline of grassland butterflies since 1990 [2]. The long term series of data about the Europe butterflies populations are also from the United Kingdom, the Netherlands, and Belgium, with the UK monitoring program being the oldest (starting from 1976) [3]. Finland has already seen almost complete varnishing of some species on a long term scale, mostly attributed to habitat degradations [4].

The accumulated experience is already large enough to demonstrate major and minor issues and drawbacks in the organization of such work. Even though it is a valuable source of information, long term programs often fail due to multiple reasons, including imperfect planning and inability to sustain work for decades [5, 6].

At the same time, all the well known long term biomonitoring programs are based on protected areas or territories out of regular anthropogenic pressure and as such reflect the global trends, in particular those related to climate changes. But such continuous research would be of great help for controlling and managing impacts of industrial facilities, in particular, airports and airfields.

Airports as sources of pressures on the environment.

Airports impose a variety of negative impacts on the environment, which must be controlled and mitigated to a possible extent. The factors perceived by living organisms in the airport impact area include, first of all, air pollution from aircrafts, ground equipment and facilities, as well as heating plants and road transport, attracted to the area. Soil and ground water pollution are also the case, since they can rise from both sedimentation of air contaminants and leakage of spills of petrochemicals and other working liquids. Physical pollution is a rising concern everywhere, and especially at airports as they operate powerful sources of noise and electro-magnetic fields. Noise is a factor of influence for animals, as well as electromagnetic pollution. The newest data show that plants are sensitive to certain ranges of electromagnetic radiation as well, but consistent evidence and dependencies are still to be obtained [7].

Additionally, aircraft emissions either as greenhouse gases contributors of precursors of cirrus clouds formation have potential to cause modifications of local climate patterns. This might have implications for the composition of plant communities more intensive, than for animals, since the latter ones are able to avoiding adaptation reactions and more flexible in terms of location.

Biomonitoring for airports.

The research works based on biomonitoring and bioindication surveys at airports are not very numerous yet present. Thus, the most widely accepted method is biomonitoring using lichens, since it is the easiest approach, which is well established and already formalized [8, 9]. Another possibility is transplant methodology using moss bags, used to measure trace elements presence, for example, at the airport "Nikola Tesla" (Belgrade, Serbia) and Capodichino Civil Airport (Naples, Italy) [10, 11]. Vascular plants are also involved in reported surveys of air quality around airports [12], including long terms survey programs. In particular, some German airports employ long term programs of air quality observations using grassy plants, like kale and grassy plants – Bremen, Munich, Berlin, etc. [13].

Animal bioindicators are also an option for airports, as studies shows. Thus, honeybee has also used at Frankfurt Airport in Germany since 2006 and are tested as an air quality control system in Canada [14]. Ornithological surveys are also possible basis for biomonitoring, when diversity, abundance and accumulation of pollutants are options for analysis [15]. However, there are always issues with animals as bioindicators, since they do not provide clear links to the contaminating sources.

Considering all options presented above, it is possible to recommend the long term environment survey program for civil airports in Ukraine, which will provide in time warning signals about the status of environment at early levels of degradation. The most suitable indicators are lichens, grassy plants by the German methodology, and birds. Airports are able to avoid typical problems with long term biomonitoring programs, like inability to provide consistency on a long term scale, since they have enough staff to run such research with the necessary scrutiny and scope.

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