

Superwarfarins and Mass Destruction of Wildlife.

Review

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Introduction

Agrocenoses are the artificial ecosystems created by man. They occupy about 10% of the land area, but have no physical boundaries, so the processes occurring inside them affect the biological diversity of adjacent territories, which are considered natural. Animals employ both cultivated fields and nearby areas. In addition, there is a water exchange between these parts and the natural territories and reservoirs adjacent to them. The current changes in the structure of agrocenoses in the southern regions of Russia increase the share of intensive processing fields in which agrochemical preparations are introduced. It means the increase in the proportion of fields in which rodenticide treatment is carried out and the plowing inconveniences contributes to the ingress of agrochemicals into reservoirs. Environmental pollution by chemicals used in agrotechnical activities is the biggest problem of preserving biological diversity and human food safety, although it is impossible to exclude their use. Chemical treatments are the basis of modern agriculture. They include the destruction of unwanted vegetation, stimulation of plant development, reduction of the number of animals recognized as undesirable producers of agricultural products.

The particular importance belongs to modern rodenticides-superwarfarins, designed to control the number of rodents that cause damage to agriculture, i.e. for the destruction of animals. They are advertised as harmless, but an analysis of the literature proves their danger not only to animals, but also to humans. For example, poisoning of more than 80 people was registered in 2019 in the Russian Federation and multiple cases are well known in different countries of all

continents. There are two forms of exposure to rodenticides: direct poisoning and transmission through food chains. Direct poisoning is targeted to rodents, but treatments are often carried out with gross violations of the rules of use, which, sometimes, can be detected. But also dangerous is the transmission of toxicants through the food chains- i.e., exposure to toxicants during transitions between trophic levels. The effect is out of control of agricultural producers, but its importance for maintaining biodiversity, hunting and the safety of the human population cannot be overestimated. We (Erofeyeva, et al. [1-4]) studied mass poisoning of wild animals based on transmission through food chains using rodenticides.

Rodenticides are the drugs for the destruction of rodents, the other animals they affect are called non-target objects. These include mammals, birds, reptiles and amphibians, fish and, of course, humans. Poisoning of non-target species is possible in all regions, but experience shows that their use poses the greatest threat in forest-steppe and steppe zones. Literature data indicate that animals of different species are not equally sensitive to superwarfarins. The death of dogs from relatively low doses was established, which excluded their use as indicators of danger to humans (we also observed poisoning and death of dogs after sniffing holes and soil sprinkled with poisoned grain in 2008 - 2011). According to recent data, the LD50 of some drugs in mammals varies by orders of magnitude: for wild boar it is 3 mg/kg, and for rats 150 mg/kg (Poche, et al. [5]).

There are many reports of the death of animals of non-target species after the use of rodenticides (e.g. Otis tarda in Crimea 2021), but only in few regions the facts were officially registered (Volgograd re-

gion 2019, Krasnodar Territory 2020, Rostov region 2022, Stavropol region 2022). In January 2020, at the route about 7 km in Krasnodar were collected carcasses of 3070 poisoned animals. The list includes *Lepus europaeus*, *Columba palumbus*, *Columba oenas*, *Pica pica*, *Garrulus glandarius*, *Buteo buteo*, *Buteo lagopus*, *Buteo rufinus*, *Falco tinnunculus*, *Asio flammeus*, *Asio otus*. Veterinary examinations of some samples in the state veterinary laboratory excluded infectious diseases as the cause of the death. The range of species of dead animals includes grain-eating hares and birds, omnivorous birds and mammals and birds of prey, i.e. consults consumers not only of the first, but also of the second order, which proves the transmission of toxicants through food chains. Comprehensive pathomorphological and toxicological studies proved the presence of bromadiolone in the tissues of birds. Its average values in birds are very small (0.005-0.05 mg/kg) and significantly lower than in a vole from the stomach of an owl (0.09 mg/kg). Pathomorphological changes were established in:

1. 8/8 – circulatory and hemostatic systems
2. 8/8 – respiratory system
3. 7/8 – bone tissue
4. 3/8 – digestive system
5. 2/8 – brain.

Vascular and respiratory system changes predominate, but the gastrointestinal tract has been reached in less than half of the birds. The autopsy results prove the possibility of poisoning animals precisely by inhaling and possibly licking off the poison particles – while the doses received are much lower than those when eating the bait. This effect is based on the stereotype of feeding behavior common to wild animals: both animals and birds do not eat everything in a row (as homogeneous food from a feeder), but touch, sort, choose the right parts. Of course, at the same time they repeatedly inhale drugs that have fallen on the ground, grain, grass and/or mice. Analysis of the results showed that the calculation of LD50 for wild animals should be verified according to intake of the toxicant through the respiratory

but not digestive system, which, unfortunately, is now accepted. The results of pathanatomic autopsies prove the possibility of poisoning animals precisely by inhaling and licking the toxicant – while the doses received by animals are much lower than those that can come from eating bait. We are convinced that the most important fact that has been established thanks to the autopsies of dead animals is the underestimation and insufficient knowledge of the routes of entry of the toxicant. Poisoning with superwarfarin was confirmed in birds of two trophic levels; the obtained data indicate that lethal doses for birds are significantly lower than those described for rodents. That could be due to both the routes of drug intake and the increased sensitivity of birds. Not only in the Russian Federation, but also around the world, the danger of anticoagulants for non-target species is closely related to the established practice of their use. This also means that widely available toxicants that are on the open market enter food and reach humans.

Poisoning with various doses of rodenticides and other agrochemicals transformed to be the factor of systemic impact on wildlife, became the factor of evolution. It is undoubtedly waiting for the complex research. Poisoning of predatory (flying and terrestrial) proves the possibility of toxicants entering the human body with food. The reaction of predators – death – means an unacceptable level of use, violation of regulations, or unsuitability of the drugs used.

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