

# Assessment of the Efficacy of Oral Vaccination of Wild Canids and Stray Dogs against Rabies in Azerbaijan

E. N. Hasanov, K. Y. Yusifova, M. A. Ali

**Abstract**—Rabies is a zoonotic disease that causes acute encephalitis in domestic and wild carnivores. The goal of this investigation was to analyze the data on oral vaccination of wild canids and stray dogs in Azerbaijan. Before the start of vaccination campaign conducted by the IDEA (International Dialogue for Environmental Action) Animal Care Center (IACC), all rabies cases in Azerbaijan for the period of 2017-2020 were analyzed. So, 30 regions for oral immunization with the Rabadrop vaccine were selected. In total, 95.9 thousand doses of baits were scattered in 30 regions, 970 (0.97%) remained intact. In addition, a campaign to sterilize and vaccinate stray dogs and cats undoubtedly had a positive impact on reducing the dynamics of rabies incidence. During the period 2017-2020, 2,339 dogs and 2,962 cats were sterilized and vaccinated under this program. It can be noted that the risk of rabies infection can be reduced through special preventive measures against disease reservoirs, which include oral immunization of wild and stray animals.

**Keywords**—Rabies, vaccination, oral immunization, wild canids, stray dogs, **vaccine**, disease reservoirs.

## I. INTRODUCTION

**R**ABIES is a deadly disease that causes acute encephalitis in domestic and wild carnivores. The disease is transmitted mainly by biting or close contact with the saliva of sick animals [1].

Azerbaijan, being at the crossroads of ancient cultures and civilizations, has always been a point of movement for transit of various agricultural crops, plants and animal breeds. Therefore, the prevention and control of diseases endemic to this region can be considered important. The rabies virus has a natural focus in Azerbaijan [2] and deserves the closest study and maintenance of the epidemiological surveillance service.

The veterinary aspect of rabies represents particular importance. The rabies virus is a very ancient zoonotic disease. A study of records made 2300 years ago in Babylon clearly confirms that rabies was widespread and recognized by society as a disease transmitted from dogs to bitten humans. At the same time, the epidemiological features of this dangerous disease were the same as today [3]. Rabies can cause high mortality if veterinary control is insufficient. As an example, we can note a recent case with the importation of rabies to the territory of the New World from Azerbaijan. Epidemiological

surveillance services of US initiated an investigation into the case of bites of 12 people by a dog imported from Azerbaijan [4]. Through this carelessness, Azerbaijan was included in the list of one hundred countries where the CDC (Centers for Disease Control and Prevention) banned for the import of dogs due to problems with rabies [5]. At the same time, the number of people bitten by dogs in the country is very high. During 2020, 35,548 animal bites were noted on the territory of the republic, of which 30,289 were caused by dogs [6].

The rabies virus belongs to the type of RNA viruses (Mononegavirales, Rhabdoviridae, Lyssavirus). Due to antigenic differences between rabies virus strains, at least four serotypes within the Lyssavirus genus were identified by the 1990s [7]. All of these diseases can cause morbidities that are identical in symptoms to rabies. Lagos bat virus, Duvenhage virus, European bat lyssavirus (EBLV1, EBLV 2), Australian bat Lyssavirus (ABLV), Mokola virus and Irkut virus have caused clinical cases amongst humans or domestic animals, and Ikoma virus has been found in the brain of African civet (*Civettictis civetta*) with neurological signs similar to those of rabies Shimoni bat virus (SHIBV), Aravan virus, Khujand virus, Bokeloh virus. The other relative virus, West Caucasian bat virus have only been found in bats, but may be pathogenic to other species. The list of lyssaviruses that can cause rabies-like symptoms is still being finalized [8], [9].

According to the World Health Organization and the World Organization for Animal Health, “rabies still kills tens of thousands of people each year”. The number of infected farm animals is in the hundreds of thousands. Meanwhile, half of the world's population lives in areas endemic for rabies. The risk of this disease is higher in Africa and Asia, where the mortality rate from rabies is 95% [10], [11].

Scientific and technological progress gives a new impetus to the prevention of this dangerous disease [12]. The oral vaccination of wild carnivores in nature is a key tool in rabies control programs [13]-[15]. The purpose of this activity is to stop the spread of the rabies virus and break its biological chain by adequately vaccinating vulnerable wildlife populations with oral vaccines.

Research and observation have shown that the red fox (*Vulpes vulpes*) is the main reservoir of the disease in the wild.

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The red fox is a medium-sized predatory mammal from the canines (Mammalia: Canidae). It is an adaptive species capable of living in a wide variety of habitats, including urban ones. The range of the common fox is very wide and covers most of Eurasia and Africa, in North America from the Arctic zone to the northern coast of the Gulf of Mexico. The intraspecific diversity of foxes in this vast area, especially in color, is so great that zoologists have identified about 40 subspecies [16].

In Azerbaijan, the common fox of two subspecies (*Vulpes vulpes alpherakyi* (Satunin, 1906) and *Vulpes vulpes alticola* Ognev, 1926) live in the Caucasus, including in the plains, forests, and mountainous regions of Azerbaijan, on the height above 3000 m sea level [17], [18].

Migration of wild animals in the world (including Azerbaijan) has significantly increased the risk of new outbreaks. The reason for this migration was the sharply accelerated pace of globalization and the widespread advance of man into the territories occupied by wildlife. Based on the above-mentioned facts, we set ourselves the goal of analyzing the data on oral vaccination of wild canids and stray dogs in Azerbaijan

## II. MATERIAL AND METHODS

Animal vaccination was carried out by the state veterinary service of the Agrarian Services Agency (Ministry of Agriculture of Azerbaijan) with the support of the Ministry of Ecology and Natural Resources and the IACC foundation. The preparation *Rabadrop* of the Czech company *Bioveta* was used for vaccination. This vaccine comes in the form of bait containing a blister with a suspension (vaccination strain with a stabilizing medium).

In appearance, the bait has a color ranging from brown-green to brown, a rounded shape and a hard consistency. The content of the blister is a suspension from orange to red-violet. Suspension contains attenuated rabies virus SAD Clone 1.8x106.0 TCID50 – 1.8x108.5 TCID50. The duration of immunity is at least 12 months [19].

Target animals for this vaccine are red foxes (*Vulpes vulpes*) and raccoon dogs (*Nyctereutes procyonoides*). Baits are recommended to be scattered either by hand or by aircraft, in areas where anti-rabies activities are carried out. The intake of single bait is sufficient to provide active immunization against rabies. The area to be vaccinated should be as large as possible (preferably over 5000 km<sup>2</sup>). Aerial distribution of baits by any suitable aircraft (such as aircraft, helicopter, drones, etc.) is preferred for open or sparsely populated areas; manual distribution — in areas with a high population. Aerial distribution of the vaccine is not advisable near bodies of water (lakes, rivers, reservoirs) or in an intensive populated area. It is recommended to vaccinate wild canids for several years with an interval of two years. At the same time, two years should pass from the last confirmed case of rabies in the region [20]. Vaccination is not recommended at ambient temperatures above +30 °C.

## III. RESULTS AND DISCUSSION

Before the start of the vaccination campaign in Azerbaijan, all rabies cases for 2017-2019 were carefully analyzed. Then, 30 regions for oral immunization with the above-mentioned preparation were selected. In total, 100,000 doses of *Rabadrop* vaccine in baits were scattered from February 4 to March 2, 2020. An example is the campaign proceeded at the Ismayilli region (Table I). From 3,510 scattered baits only 85 doses were not eaten (2.42%).

Vaccination was conducted amongst wild animals at 3-5 kilometers from the nearest settlement. The interval between the scattered baits was within 10-15 meters. Oral vaccination of dogs was carried out in cooperation with the district and city offices of the Agricultural Services Agency, workers of the regional veterinary services, forestry workers of the Ministry of Ecology and Natural Resources and local executive bodies.

TABLE I  
 RESULTS OF THE ORAL VACCINATION CAMPAIGN FOR WILD ANIMALS IN THE ISMAYILLI REGION OF AZERBAIJAN (APRIL 2020)

Localization of veterinary sites	Scattered	Not eaten
Ivanovka, 40°44'50"N48°01'59"E/ 40.74722° 48.03306°E	150	3
Goshakend, 40°42'46"N48°13'32"E	200	7
Gusendje, 40°44'13"N48°06'56"E	200	3
Golinchag, 40°49'17"N48°05'37"E/ 40.82139°N48.09361°E	200	4
Sulut, 40°46'01"N48°27'27"E/40.76694° N48. 45750°	200	8
Galagah, 40°43'01"N47°55'57"E/40.71694° N47.93250°E	160	4
Topchu, 40°52'41"N48°04'06"E/40.8780 6° N48.06833°	200	4
Lagidj, 40°51'11"N48°23'35"E/40.85306° N48.39306°E	150	2
Haftasov, 40°53'06"N48°24'21"E/ 40.88500° N48.40583°	150	5
Keyvendi, 40°41'29 "N48°18'57"E	200	4
Kelbend, 40°39'58"N48°07'47"E/ 40.66611°N48.12972°E	200	5
Sumagallu, 40°55'05"N48°02'42"E/ 40.918 06°N48.04500°	150	3
Akhan, 40°51'16"N48°25'19"E/40.85444° N48.42194°E	150	4
Gubakhalilli, 40°36'58"N48°07'27"E /40.61611°N48.12417°E	150	3
Tezekend, 40°44'46"N48°16'16"E/40.74611 °N48.27111°E	200	3
Kurdmashi, 40°40'33"N48°02'31"E/ 40.67583°N48.04194°	150	4
Tirdjan, 40°44'20"N48°20'01"E/40.73889° N48.33361°	150	3
Talistan, 40°48'00"N48°12'07"E	200	4
Gadjihetenli, 40°42'08"N47°54'13"E / 40.70222°N47.90361°E	150	4
Mican, 40°47'36"N48°07'53"E/40.79333° N48.13139°E	200	8

The results of the event were checked and documented in the prescribed form after 24 hours. During this period of time, most of the baits were eaten by wild canines and stray dogs. Thus, 95.9 thousand baits were scattered in 30 regions of the country, of which 970 (0.97%) remained intact.

Our study assessed the role of wild animals in the spread of rabies and the importance of oral vaccination. Over the past five

years, 22 cases rabies of have been registered in the human population. Within 2018-2020, 161 cases of animal infection were registered. From these cases, 49 were in cattle, 90 cases in dogs, 7 cases in wild animals (1 case in the wolf and 6 cases in the jackal) (see Fig. 1). Oral vaccination in the wild has been implemented at the endemic areas under a pilot project in 2015 and 2018. For the first time, oral vaccination with positive dynamics was done in 2015 in Absheron and the Sheki-Zakatala economic zones. As a result of oral vaccination in 2015, one case of rabies in dog in the Absheron Peninsula, and nine cases in the Sheki-Zagatala economic zone were registered.

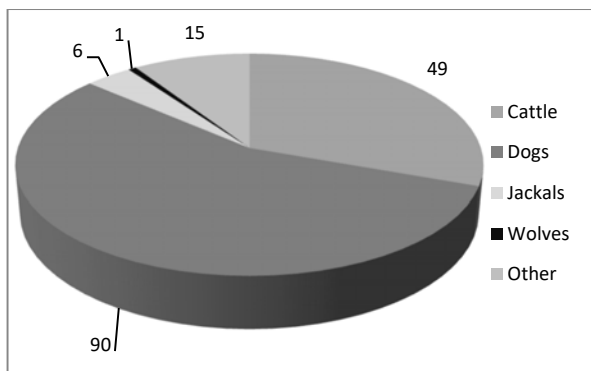


Fig. 1 Distribution of diseased animals by species, 2018-2020.

As a result of the pilot project, the coverage of the country with oral vaccination was expanded and oral vaccination was applied in 30 frontier and endemic regions. After the oral vaccination, the incidence of agricultural, domestic, and wild animals decreased. This trend is observed in human population too. So, if in 2018 and 2019 five cases of hydrophobia were registered, in 2020 only two people were infected with rabies [21].

Comparing the period from April 1 to September 10, 2020, it was found that the infection rate after oral vaccination was 5.5 times lower. As can be seen from Fig. 2, in the period from April 1 to September 10, 2017, 2018 and 2019, the incidence of rabies was at the same level (33, 34 and 32 cases). However, after oral vaccination of wild animals in February 2020, the incidence for this period (from April 1 to September 10) was only six cases.

It should be noted that two cases of rabies in cattle and one case of rabies in a stray dog were registered in the Gakh region, one case in a dog in the Neftchala region, one case in a stray dog in the Masalli region and one case of rabies in a stray dog in Agdash region. It should be noted that in the future it is desirable to give 48 hours to check the bait intake and mark the places where it is placed in order to determine the location of the bait. In addition, a campaign to sterilize and vaccinate stray dogs and cats had a positive impact on reducing the dynamics of rabies incidence. During the period of 2017-2020, 2,339 dogs and 2,962 cats were neutered and vaccinated under this program (Figs. 3 and 4).

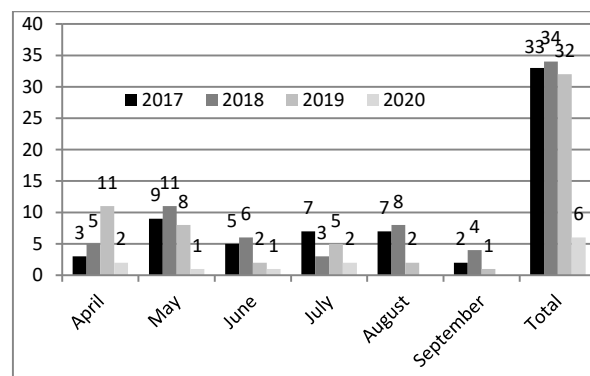


Fig. 2 Animal rabies incidence in 2017-2020

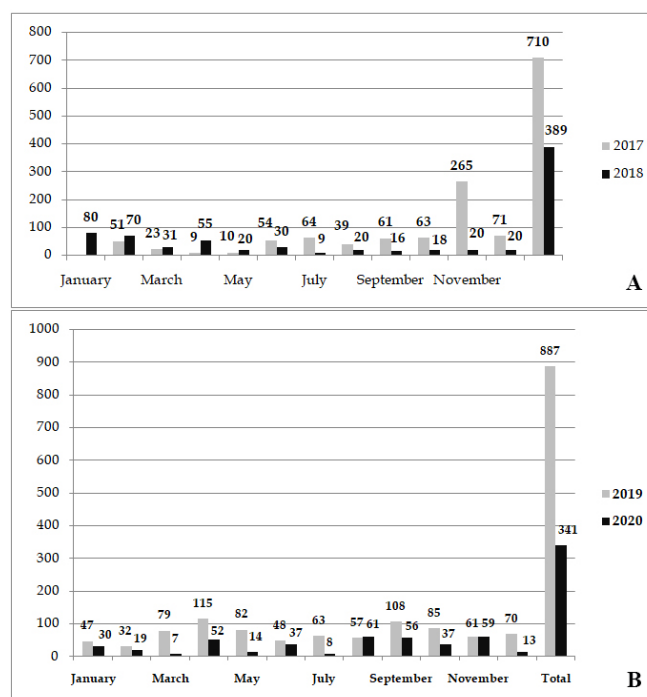


Fig. 3 Distribution of sterilized and vaccinated dogs by years and months in 2017-2018 (A) and 2019-2020 (B)

In the Mediterranean area, vaccination of wild animals has been practiced for a long time. Since 1998, vaccination of wild animals in Israel has been conducted regularly. At the same time, in 2003, two million RABOVAL V-RG® vaccine baits were scattered from airplanes and helicopters. In 2004 the rabies cases declined rapidly [13], [22]. In our investigation, the effect of vaccination of wild canines and stray dogs on declining of rabies cases was immediate and intense. The problem of the reasons for estimated duration of this effect remains contentious.

Summarizing our investigation, it can be noted that because of agrarian reforms in the country, the number of farm animals, the volume of agricultural enterprises, and the population in villages have increased. These processes have led to an intensification of interaction between the world of wildlife and farm animals. The risk of rabies infection can be reduced by specific preventive measures against disease reservoirs, which

include oral immunization of wild and stray animals.

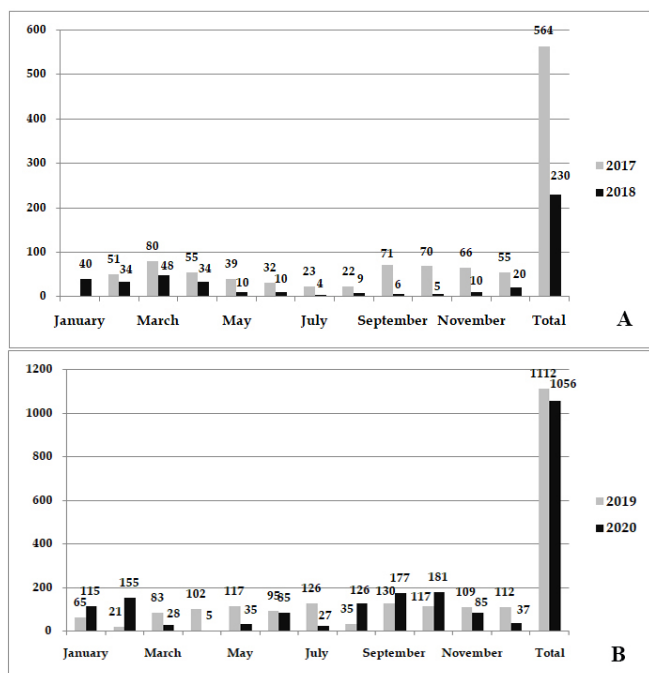


Fig. 4 Distribution of sterilized and vaccinated cats by years and months in 2017-2018 (A) and 2019-2020 (B).

#### IV. CONCLUSION

According to the results of the study, it should be noted that despite the preventive measures taken in Azerbaijan [21], [23], rabies continues to be registered. Infection of farm animals with wild animals remains a risk factor. Therefore, we recommend taking preventive measures against rabies by disrupting the natural circulation of the virus in wildlife and modified ecosystems.

As a result of the study, it is proposed to carry out a set of the following measures:

- Carrying out preventive vaccination of farm animals in the risk zone;
- Mandatory vaccination of all pets within a 3 km radius of rabies cases by expanding the existing preventive vaccination program;
- Oral vaccination carried out in endemic and border areas. This event must be implemented in accordance with the instructions of the manufacturer of the selected vaccines;
- Adopting National Action Plan on Rabies; and,
- Carrying out educational work among the population.

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