

**REPUBLIC OF AZERBAIJAN**

*On the rights of the manuscript*

**ABSTRACT**

of the dissertation for the degree of Doctor of Biological Sciences

**DISTRIBUTION, BIOLOGY AND PROTECTION OF  
SCAVENGER BIRDS (AEGYPIUS MONACHUS,  
GYPS FULVUS, NEOPHRON PERCNOPTERUS,  
GYPAETUS BARBATUS) IN AZERBAIJAN**

Speciality: 2401.01 – “Zoology”

Scientific area: Biology

Applicant: **Tahir Arshad oglu Karimov**

**Baku – 2021**

Dissertation was executed in the Laboratory of Vertebrates of Zoology Institute of Academy of Sciences of Azerbaijan Republic

**Scientific advisor:** Doctor of Biological Sciences  
**Qiyas Naghy Quliyev**

**Official opponents:** Doctor of Biological Sciences,  
Professor

**Janbakhish Ali Najafov**

Doctor of Biological Sciences,  
assistant professor

**Asif Abbas Manafov**

Doctor of Biological Sciences,  
assistant professor

**Vafa Farman Mammadova**

Doctor of Biological Sciences,  
professor

**Rauf Vahid Hajiyev**



Dissertation council BED 1.09 operating at the Zoology Institute of ANAS of High Attestation Commission under the President of Azerbaijan Republic.

**Chair of Dissertation council:** Doctor of Biological Sciences,  
assistant professor

**Elshad Ilyas Ahmadov**

**Scientific secretary of  
Dissertation council:**

Doctor of Phil of Biological  
Sciences, assistant professor

**Guler Aydin Huseynzade**

**Chair of Scientific Seminar:**

Doctor of Biological Sciences,  
prof., ANAS corresponding member

**Ilham Khayyam Alekberov**

## INTRODUCTION

**Significance of the topic and level of application.** One of the main tasks of faunistics, which is among the fundamental sections of ornithology and performs the function of a constant source of primary information for such areas as the history of avifauna, zoogeography, ecology, ethology and others, is the study of the current state of bird fauna in the context of global climate change and landscapes' anthropogenic transformation. This is of great importance in terms of biodiversity conservation, since the lack of necessary information about individual components of the ecosystem in poorly studied areas may cause perishing of some species. From this standpoint, certain species such as Griffon vulture (*G.fulvus*, Habl.,1783), Black vulture (*A.monachus*, L., 1766), Egyptian vulture (*N.percnopterus*, L.,1758) and Bearded vulture (*G.barbatus*, L., 1758) of the hawkish birds family (*Accipitridae*) from the order of *Falconiformes* that have their own diet niche (as necrophages) and possess reproductive, morphological, physiological, ethological adaptive characteristics, currently represent one of the ecological groups that may actually disappear from the common connections of natural systems.

Consuming corpses and having a weak potential for breeding these species respond very quickly to environmental changes and negative impacts of anthropogenic origin by changing adaptation characteristics and worsening of breeding as well as decreasing numbers.

Currently, with different protection statuses, these species are listed in the Red Book of the International Union for Conservation of Nature (IUCN). Practice shows that such a passive method of commitment for the protection of these species like Red Book inclusion in and various conventions cannot achieve stable development of these species in nature.

A working solution to this problem would be possible with a comprehensive study of biological and ethological features which allow an objective assessment of the current state of these species and also by designing and implementing biotechnological methods aimed at effective protection. The publications provided albeit fragmentary information on the status, registration, nesting and diet behavior of scavengers in the

territory of Azerbaijan. Proposals by G. Mustafayev (2003) “*study of birds as per zoo-geographical regions*”<sup>1</sup> and N. Sadigova (2008), “*Conducting ornithological zoning based on breeding birds*”<sup>2</sup> allow researching the ornitho-fauna problems within framework of zoogeographical areas in the times of increasing anthropogenic effects on landscapes. The National Strategic plan accepted for the years of 2017-2020 envisages “*sustainable development in the nature, study, preparation and introduction of protective measures that are scientifically targeted to rare, endangered as well as poorly researched species*”<sup>3</sup>. Our research that refers to the mentioned concept aims to design measures that ensure conditions for a stable development of populations by conducting an environmental assessment of these species.

Undoubtedly, the study of scavengers in the territory of Azerbaijan is of both national and international importance. Thus, the study of scavengers at the level of modern scientific requirements allows integrating preservation processes of these species on a global and nationwide scales.

**The purpose and objectives of the study.** The purpose of the research was to prepare methods that promote sustainable development in nature, and research the distribution, biological, ecological and ethological characteristics of Bearded, Black, Griffon and Egyptian vultures in Azerbaijan. To achieve our goals, the following issues were studied:

1. Determine the number and zoogeographical reproduction areas of the species under study,
2. Identify the landscape-biotope adaptation.
3. Study the species composition and dynamics of animals making up their diet base.

---

<sup>1</sup> Mustafaev, G.T. The relationship of vertebrates and humans / G.T. Mustafayev, - Baku: Elm, - 2012. - p.268

<sup>2</sup> Sadygova N.A. Complex ecological assessment of anthropogenic factors affecting birds in Azerbaijan:/Doctor of Biological Sciences. Dissertation thesis. / – Baku, 2008 – p 44.

<sup>3</sup> National Strategic plan for 2017-2020 on protection and sustainable usage of biodiversity in Azerbaijan Republic. // Decree of president of AR no. 2358 dated 03 October 2016 (Amendments and annexes dd.31 May 2018 – Baku,2018. – p.14

4. Recognize their “sanitary” role in the ecosystem.
5. Study the features of breeding.
6. Determine the origin, form and nature of biotic and abiotic factors affecting biotopes of nesting, populations and scavengers themselves.
7. Study the intrapopulation processes that regulate the dynamics of numbers.
8. Identify the rules and conditions for additional diet in natural conditions, taking into account the veterinary and sanitary standards, environmental and ethological characteristics.

**Research methods:** I personally collected materials in outdoor and lab conditions using the below methods for fulfilling the dissertation work.

1. Method of route – defined the nesting spots of species, logged their coordinates and studied geographical and natural conditions.

2. Breeding phenology of species with stationary observation method: that is, arrival of birds to nesting places, start of the mating and brooding as well as the study of diet spectrum and negative factors affecting birds and living habitat and outcomes were practically examined.

3. Statistical calculations were made in laboratory with SPSS software, graphics developed, photographs of species’ breeding biotopes on Google map obtained and a map showcasing their distribution in Azerbaijan was developed.

**Main provisions put for the defense:**

1. Zoogeographical areas of residence and breeding of Bearded, Black, Griffon and Egyptian vultures.

2. Patterns of distribution and adaptation in mountain landscapes in the territory of Azerbaijan.

3. Assessing their role of the “sanitary keepers” in the ecosystem.

4. Assessment and prediction of factors affecting their gene pool.

5. The study of intrapopulation processes that regulate the dynamics of numbers.

6. Preparation of biotechnical methods for stable development of

the species' populations in the nature within the territory of Azerbaijan.

**Scientific novelty of the research.** For the first time in Azerbaijan, on the basis of systematic long-term research work and a comprehensive study of bio-eco-ethological parameters, a system of ecological assessment of scavenger birds was worked out. New original data was collected about the places of zoogeographic distribution, landscape-biotope adaptation, nutritional conditions, population dynamics, features of breeding and factors limiting these species and also identifying the direction of development of their populations. This knowledge serves as a basis for implementation of a system for environmental monitoring of bird scavengers, rational management and preparation of national as well as international conservation programs.

**Theoretical and practical significance of the work.** This research work, in modern terms of intensive anthropogenic transformation of natural ecosystems enriches scientific knowledge of bio-cenotic relationships, population structures, intrapopulation processes that regulate the dynamics of numbers, the potential of breeding, the characteristics of scavengers' adaptation to environmental changes in the country. This, in its turn, ensures mutual tolerance of people with birds.

The thesis materials play a basic role in the preparation of protective concepts, forecasting the number and directions of development of scavenger populations in the territory of Azerbaijan. Scavenger birds as species that are especially sensitive to anthropogenic and environmental changes can be used as indicators in identifying the real state of biodiversity in ecosystems, characteristics of change dynamics, forecast on the direction of possible processes in terms of transformation.

Suggestions prepared by me about supplementary diet for scavengers in the nature was discussed and accepted by the Scientific Council of the Institute of Zoology (Protocol No. 10, 10 May 2016), which was practically implemented in the territory of the Turyanchay and Korchay State Natural Reserves with positive outcomes.

On the organized feeding sites, it is possible to catch individuals

for their relocation to safer and protected places, for banding, reintroduction as well as radio telemetry. Materials collected about ecology and ethology can be used for organizing ecotourism in their places of residence, environmental education, and also in teaching such subjects as ecology and zoology.

### **Approbation and application of the research.**

The main provisions of the research presented in the thesis were communicated and discussed at scientific seminars of the Institute of Zoology of ANAS, Society of Azerbaijan Zoologists and Ornithologists as well as national and international scientific conferences shown below:

- “Mountain Ecosystems and Their Components” International scientific conference,” (Russia, Nalchik).

- “Birds of the Caucasus: study, protection and rational usage”, International scientific conference (Stavropol, 2007).

- “Veterinary medicine and food safety: problems and prospects”, Materials of the international conference (Nakhchivan, 2014).

4- International Scientific and Practical Conference, "Modern Concepts of Scientific Research (Moscow, 2015)

- “Emergencies and Safe Life”, International Scientific and Practical Conference dedicated to the 10th anniversary of the Ministry of Emergency Situations (Baku, 2015).

- "Development of Science in the XX Century" (Kharkiv).

Based on the research materials 23 scientific articles (6 in journals of international level index) as well as 6 theses were published.

**Name of organization hosting the dissertation work:** “Dry vertebrae laboratory” at the Zoology Institute of Azerbaijan National Academy of Sciences.

**The structure and volume of the dissertation.** The dissertation consists of 405553 characters, introduction (10535 characters), 7 chapters (385710 characters), result (6642 characters), practical proposals (2666 characters), a list of 249 references in Azerbaijani, Russian and other languages and an annex. 27 tables, 39 pictures, 8 graphs are given in the dissertation.

## MAIN CONTENT OF THE DISSERTATION

### CHAPTER I. BRIEF OVERVIEW OF THE HISTORY OF SCAVENGER STUDIES IN AZERBAIJAN AND IN OTHER GEOGRAPHIC TERRITORIES

This chapter provides a brief overview of the bio-ecological characteristics, rehabilitation and effective conservation of bird populations in the territory of Azerbaijan and other aeriels since the 19th century.

### CHAPTER II. RESEARCH MATERIALS AND METHODS

The research covers the years of 2004 - 2016. The species under research: Griffon vulture (*G. fulvus*), Black vulture (*A. monachus*), Egyptian vulture (*N. percnopterus*), Bearded vulture (*G. barbatus*), their populations, nests and animal corpses representing their diet supply. During the journey and stationary observations as well as registrations we used the “*Methods for registering the number and geographical distribution of day and night birds of prey*” by V.Osmolovskaya (1952) <sup>4</sup>, “*Registering the birds of prey in mountains*” by A.Abuladze (1989) <sup>5</sup> and also “*Ornithological monitoring*” <sup>6</sup> prepared by us according to local conditions.

Primarily, the zoogeographical reproduction areas of these species, their natural and geographical conditions, number of breeding pairs, their arrival to nest spots, mating, brooding, periods of embryonal development, baby feeding in nests, nest leaving as well as nest productivity were studied (Table 1).

---

<sup>4</sup> Osmolovskaya, V.I., Formozov, A.N. Methods for accounting the abundance and geographic distribution of day and night birds of prey // In the collection of "Methods for accounting the abundance and geographic distribution of terrestrial vertebrates", – Moscow: – 1952, – p. 68-96.

<sup>5</sup> Abuladze, A.V. Accounting the birds of prey in the mountains. Methods of study and protection of birds of prey (Guidelines). – Moscow: Central Research Laboratory of Head Office of Hunting of the of the RSFSR 1989. – p. 4.

<sup>6</sup> Sultanov, E.H. Ornithological monitoring / E.H.Sultanov, T.A.Karimov, S.A.Isayev / – Baku: Khazar University, –2008, – p.16,



**Table 1. Materials of research, conducted in 2004-2016**

<b>Materials</b>	<b>No of expeditions</b>	<b>Work days</b>	<b>No of materials</b>	<b>Route travelled km</b>
Expeditions and observations outside stationary area:				
- nests revealed	66	277	145 nests	8640
- materials on the sanitary role of birds	8	41	62 corpses	310
- supplementary diet in nature	12	42	2400 kg food	378
Stationary observations:				
- study of the diet	29	75	1861 leftover feed collected around nests	474
- study of breeding features	32	80	70 nests	123
Study of nutritional factors	14	68	60	286
Total	160	583	4598	10211

To study the spectrum of the diet and its dynamics we used generally accepted methods including “*Guidelines for the study of bird nutrition by collecting and analyzing riddles* “ by Shilov (1973)<sup>7</sup> and

---

<sup>7</sup> Shilov, M.N., Warsaw, S.N. Guidelines for the study of bird nutrition by collecting and analyzing riddles // Materials of the 5th meeting of the Working Group on the Problem of "Researching the Species within the Range", – Vilnius: – 1973. – p. 112-115.

*Potapov's (1990) "Using riddles to study the nutrition of birds of prey"* <sup>8</sup> To this end, during May-July, the food remainders were gathered around the nests and from corpses consumed by birds. On the basis of the collected and identified materials, the dynamics and diet spectrum of each of the 4 species was determined.

The role of scavengers as 'orderlies' was studied in July - August of 2013 on the example of the Turyanchay reserve and adjacent territories. For this purpose, on the pastures that represent the diet territories of scavenger birds, animal dead bodies left around villages (torn by wolves, dead from diseases) and in river valleys (killed during floods and crossing the river), shot down on the Agdash – Gebele highway or abandoned by owners in landfills and hidden places were taken into account. The number of animals susceptible to various diseases was determined on the basis of samples taken from corpses by the Agdash Veterinary Authority.

In May-June of 2013-2014, within the borders of the Turyanchay reserve, feeding of these species was implemented on the basis of the instructions and rules prepared by us. Corpses of animals died for various reasons, waste of animals slaughtered in yards and sacred places (skin, guts, hooves, bones, etc.) were used as diet. We studied intraspecific and interspecific relations during this feeding in nature.

Supplementary diet's effect on birds and lack of food were determined on the basis of the biological parameters of populations. The number of breeding couples, emigrants and immigrants, the level of death of nestlings and nest productivity were studied as biological parameters in the colony. With the help of SPSS (T-test) computer software the correlation (linear relationship) between the dynamics of diet objects and breeding ability of the species, the impact of food and anthropogenic factors on the number of birds was studied.

Along with hiking we used various means of transportation (horses, cars, tractors) depending on the topography of the territories where the routes and nesting biotopes are located.

---

<sup>8</sup> Potapov, E.R. Using riddles to study the nutrition of birds of prey // Methods of studying and protecting birds of prey (Methodical recommendations) / Scientific. ed. S. G. Prikloonsky. Moscow: – 1990. – p. 103-115.

Observations were conducted with the help of YUKON 10x50 binoculars and Kova TSN-601, 20x60 telescope. Photos were taken using a SONY DSC N10 Digital Still Camera. During stationary observations and journeys along the route, some data was recorded on a portable Alsten x2 voice recorder which later was used in research work.

## **CHAPTER III. DISTRIBUTION, QUANTITY AND DYNAMICS OF THE NUMBER OF SCAVENGERS IN AZERBAIJAN**

### **3.1. Zoogeographical territories and distribution in Azerbaijan**

It was revealed that the Griffon, Black, Egyptian and Bearded vultures breed in the territory of Azerbaijan: 1. Mountain forests of the Eastern Caucasus (Greater Caucasus), 2. High mountains of the Greater Caucasus, 3. Gobustan, 4. Jeyranchol - Ajinohur; 5. Mountain forests of the Eastern Caucasus (Lesser Caucasus), 6. Mountain forests of Talysh, 7. Plain along the Araz River in Nakhchivan, 8. The zoogeographical territories of the highlands in the Lesser Caucasus.

It was found that the number of species and couples capable of breeding are more in the zoogeographical territory of Adjynokhur-Jeyranchol but less in the high mountains of the Greater Caucasus and in the mountainous zoo-geographic territory of Talysh [8, 22, 26] During the monitoring held in 2016, the number of breeding pairs these zoogeographical areas that are within 5 provinces in was as follows:

I. Great Caucasus region: 1. 31 pairs of Griffon vultures in the zoogeographical area of East Caucasus mountain forests were registered. 2. 1 pair of Bearded vultures in the high mountain zoogeographical area of Great Caucasus was registered. 3. 8 breeding pairs of Egyptian vultures were registered in the Gobustan zoogeographical area. 27.6% of scavengers in the country breed in this province.

II. Kur mountain ravine region: 4. 26 pairs of Egyptian vultures, 15 pairs of Griffon and 12 pairs of Black vulture breed in the Ajinohur - Jeyranchol area. This makes 36.6% of all birds.

III. Lesser Caucasus region: 5. 10 pairs of Egyptian vultures, 10 pairs of Griffon vulture and 3 pairs of Black vulture breed in the

mountainous forest zoogeographical area of East Caucasus. This makes 15.7% of all birds. According to the data of 1993, 6 pairs of Bearded vultures, 6 pairs of Egyptian vultures, 5 pairs of Griffon vulture and 9 pairs of Black vultures nested in the high mountain area of Lesser Caucasus included in this region. We didn't include the pairs' numbers in the overall quantity since no monitoring was held (area under occupation) in this area in 2016.

IV. Lankaran region: 6. 1 breeding pair of Black vultures was identified in the Talysh mountain-forest area. This makes 0.6% of all birds.

V. Mid-Araz region: 7. Breeding of 3 pairs of Bearded vultures, 12 pairs of Egyptian vultures and 5 pairs of Griffon vultures was found in the region of Nakhchivan Arazboyu area. Although Black vulture was logged in the area, it does not nest. 8. There are 5 pairs of Bearded vultures and 3 pairs of Egyptian vultures that breed in the high mountain zoo-geographical of Lesser Caucasus. We should note that 8 out of 9 pairs of Bearded vultures (i.e. 88.8 percent) in Azerbaijan territory settled in this region. 19.4% of all birds registered in this region breed in the Mid Araz region.

Breeding of Egyptian vultures in 5 zoogeographical areas was found out. 44.1% of Egyptian vultures registered in the country breed in Ajinohur-Djeyranchol, 20.4% in the Nakhchivan Arazboyu plain, 16.9% in the East Caucasus mountainous forest zoogeographical areas (Lesser Caucasus region), 13.6% in Gobustan and 5.0% in the high mountains of Lesser Caucasus.

Bearded vultures breed in 3 zoogeographical areas. 55.5% of these birds breed in the high mountains of Minor Caucasus, 33.3% in Nakhchivan Arazboyu plains, only 11% in the high mountains of Major Caucasus.

Black vultures breed in 3 zoogeographical areas. Their biggest population is located in the Ajinohur - Jeyranchol zoo-geographical area. That is, 75.0% of the 16 pairs of registered Black vultures in the country settle in that area, while 18.7% in the mountain forests of East Caucasus (Lesser Caucasus region) and 6.2% in the Talysh mountain forest zoogeographical area.

Griffon vultures breed in 5 zoogeographical areas in Azerbaijan. Their biggest population settled in the mountain forests of the East Caucasus (Great Caucasus region). 50.8% of the registered Griffon vultures in the country breed in the mountain forest area of East Caucasus. 24.6% of Griffon vultures breed in Ajinohur-Jeyranchol, while 16.4% in the East Caucasus (Lesser Caucasus region) and 8.2% in Nakhchivan Arazboyu plains zoo-geographical areas.

Identification of the breeding areas and coordinates of these species can play vital role in their monitoring as well as efficient protection in Azerbaijan territory.

### **3.2. Characteristics of adaptation to mountain landscapes**

Monitoring that we carried out in the nesting areas of these species gave us the opportunity to identify the environmental factors causing their adaptation to mountain landscapes.

It was found that the orography of the mountain landscape, petrophilia (bare rocks, stony places), mosaic, fauna of the zoogeographic region, food stocks and eco-ethological characteristics of birds in these territories have huge impact on distribution and the number of species' nesting sites. Vertical relief of the mountain landscapes' surface fragmented by rocks, stones, and rock-stone created special conditions for scavenger birds to settle in these biotopes forming a separate ecological group within the mountain avifauna. Bearded vulture, Egyptian vulture, and Griffon vulture nests were noted on the dome-shaped elevations of mountain ranges (Deresham, 1150 m; Aydashy, 776 m; Destedag, 672 m). Settlement of those species in mountain landscapes is primarily encouraged by the orography of the territory, petrophilia and the mosaic pattern of phytocoenosis. Factors including height of relief, exposure of slopes, location, rocky protrusions and piles of stones affecting the atmospheric processes form a microclimate inherent in valley gorges. During daylight, thermal air currents form in the gorges and valleys of mountain ranges which allow the scavengers to make floating flights in search of food. Only on some spring days when the air temperature drops to the point of dew in the Greater Caucasus and in the mountains of Talysh the flight of birds is obstructed by fog that rise along the slopes. This factor has a negative

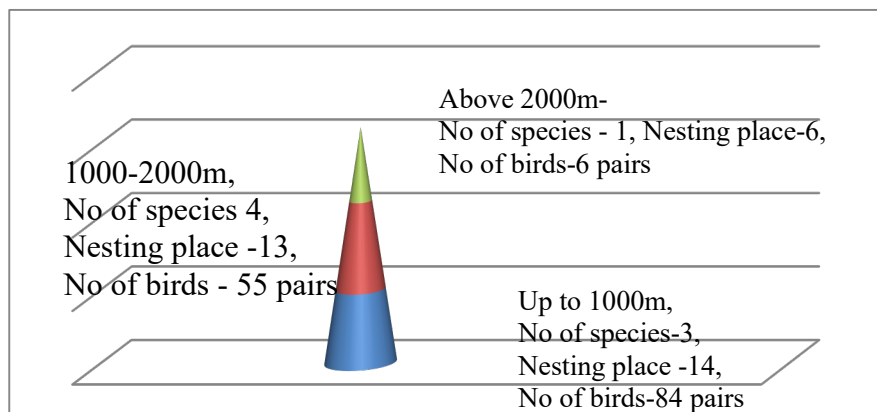
effect on daily activities, brooding and breeding of scavengers in the territory of Zagatala reserve as well as Gusar and Zuvand. Secondly, scavengers with their long wings (2-3 m) and large body weight (2-12 kg), have the opportunity to rise into the air from a fall by using rocks and ledges of stones as a springboard. Thirdly, the petrophilia of the mountainous landscape (bare rocks, stones, slopes with rock-stone fragments) make it possible to locate diet while flying in the sky (in such areas animals die more often and are easier to find). Fourthly, finding nests on steep cliffs at an altitude of 30-70 m protects birds and their babies from predatory mammals. Fifth, in the nest locations, namely in the valleys of the Turyanchay, Goychay, Garachay, Tahirchay, Ganjachay, Gilgilchay, Velvelechay, Kurmukchay and other rivers there take place grazing, grass cutting, forestry works and unplanned tourism. The location of the nests on the coastal cliffs at an altitude of 30-50 m significantly reduces the level of disturbance to the birds and protects against dangers during the above-mentioned activities. Sixth, these species build their nests in small caves and rock cracks with an entrance looking south, southeast, southwest, east and west.

In the northern territory, the use of caves looking to north is hampered by higher humidity, high density of vegetation, cold winds and heavy rainfall. On the contrary, birds and their babies are protected from winds and rains in the nests with access to the south that keeping them dry. Even Black vulture, a representative of the dendrophilic complex builds nests on juniper trees (*Juniper sp.*) that grow in petrophilic areas of dry climate.

Despite the fact that, historically these species are associated with the formation of the Caucasian mountain system, their nesting sites are not at the same height and located in different highlands, middle mountain and foothill areas according to the characteristics of tier compliance.

With gathering and comparison of data on the distribution of these species depending on altitudes, it can be said that the density and number of nesting sites decreases with increasing altitude. In contrast, the number and density of nesting sites increase at lower

altitudes, with an increase in the level of petrophilia. This is due to increased reaction of scavengers to the expansion of arid conditions (a zone of dry and warm climate) that provide habitat (Chart 1).



**Chart 1. The number of species and breeding pairs depending on altitude.**

The aggregate of collected material specifies and summarizes information about the breeding productivity of scavengers' descendants in Azerbaijan and their adaptation in rock biotopes as feeding areas, and also allows monitoring in these territories ensuring effective protective measures.

### **3.3. Quantitative dynamics**

In the territory of Azerbaijan, the total number of 4 species in 2004 was 171 breeding pairs, 145 pairs in 2016. In other words, the reduction rate for 13 years was 26 pairs or 15,3%. Reduction in numbers for the species were as follows (Table 2).

In 2004, 71 pairs of the Griffon vultures were noted in the country, but this number dropped to 61 pairs in 2016. Within 13 years, breeding couples became 14,1 % less.

Decrease was observed mainly in Talysh mountains and Zagalata region. The number of Egyptian vultures were 68 breeding pairs in 2004, but decreased to 59 pairs in 2016. This drop was by 13,3%.

**Table 2. The dynamics of the number of breeding pairs of scavengers in 2004-2016**

Species	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Griffon vulture	71	70	71	70	70	70	69	66	64	65	64	62	61
Egyptian vulture	68	70	68	69	70	70	71	68	66	64	60	60	59
Black vulture	22	18	20	19	21	19	17	18	16	18	19	18	16
Bearded vulture	10	11	10	9	8	10	9	10	8	9	10	9	9

The number of Black vultures in 2004 was 22 pairs, but in 2016 it dropped to 16. Within 13 years the reduction was 27,3%. The Bearded vultures were 10 pairs in 2004 while in 2016 it dropped to 9 pairs. The decrease was 10.0% [28]. This is due to the loss of nesting sites in the territory of Pırgulu and Babadag. As per our inspection, a breeding map was designed for 4 species of vultures in Azerbaijan (Figure 1).



**Figure 1. Map of cadastral nesting sites of scavengers in Azerbaijan.**



In Africa, where birds fly for wintering the negative factors such as “*deaths on power lines (Angelov 2012)*”<sup>9</sup> and “*illegal hunting, lack of food, poisoned traps*” (Arkumarev 2014)<sup>10</sup> seriously affects their numbers in Azerbaijan.

At present, the majority of breeding pairs of these species in Azerbaijan grow in Minor Caucasus. As in Azerbaijan territory, they are considered species with shrinking number in all their zones of their habitat.

It was revealed that during 13 years the level of shrinkage in the number of breeding pairs was not equal in all zoo-geographical areas. Decrease (16 pairs) in the zoo-geographical region of Major Caucasus made more than half of all reduction (26 pairs), that is 61.5%. 26.9% of this decrease took place in the East Caucasus mountain forests, 23.0% in the high mountains of Major Caucasus and 11.5% in Gobustan zoo-geographical area. This decrease was in 1 species (Griffon vultures – 7 pairs) in the East Caucasus mountain forest and in 1 species (Egyptian vulture – 3 pairs) in Gobustan area. In the high mountain area of Major Caucasus there was decrease in 3 species (Griffon vultures – 3 pairs; Egyptian vulture – 2 pairs; Bearded vulture – 1 pair). In general, the main reasons of decrease in breeding pairs’ numbers in the Major Caucasus region that encompasses 3 zoogeographical areas are as follows: reduction of wild and domestic animals that comprise the diet base and also enhancement of construction, planting as well as tourism activities near the birds’ nesting biotopes.

Decrease in the numbers was noticed in the Kur mountain ravine that border Major Caucasus region. The decrease was 15.3% in the Ajinohur-Jeyranchol zoogeographical area included in the mentioned region. This happened only to 1 species – Egyptian vulture (4 pairs) population. One species, that is Black vulture, breed in the mountain forests of Talysh zoogeographical area in the Lankaran region. The

---

<sup>9</sup> Angelov, L., Hashimi, I., Oppel, S. Persistent electrocution mortality of Egyptian vultures (*Neophron percnopterus*) over 28 years in East Africa // Bird Conservation International, – 2012. 23 (01), – p. 1-6.

<sup>10</sup> Arkumarev, V. Congregations of wintering Egyptian Vultures *Neophron percnopterus* in Afar, Ethiopia: present status and implications for conservation / Arkumarev, V., Dobrev, Y. Abebe [et al.] // Journal Ostrich, 85 (2), – 2014, – p. 139 -145.

decrease in this species' population made 23.0%. Although there were 3 nests of Egyptian vulture and 2 nests of Griffon vulture in this zoo-geographical area during 2005-2007, we did not observe these species nesting there in following years. Several factors affected the reduction of these species in this region. In past years, shrinkage of household economies, pastures and wild animal numbers as well as development of planted lands, construction works negatively affected scavengers' diet. Comparative analysis of materials showed that the numbers of species under study is stable in the Arazboyu plains of Mid Araz region and high mountains of Minor Caucasus. No decrease in these areas was noticed during the research period. Bearded vultures, Egyptian vultures and Griffon vulture that breed in these zoo-geographical areas do not leave their places permanently. Each year they nest in the same spots. It was found that pairs emigrating from population due to some reasons (i.e. erosion in rocks where nests located, landslides, loss of an individual in a pair, "density" in population) or individuals establishing a new pair usually nest in close areas. This was evidenced with existence of pairs nesting as groups or independently in the Nakhchivan AR. We recorded such small populations and groups breeding in Darydagh, Dastadagh, Bozdag, Shahbulag and Kotamdag (Ordubad district). It should be noted that locations of zoo-geographical areas that include the nesting places in National Parks, reserves and restricted zones as well as strict illegal hunting measures positively influence the number of wild animals, which in turn, means favorable diet conditions for scavengers. Another factor contributing to better trophic conditions is possibility of flying to neighboring Iran and Turkey for diet opportunities. Minimum level of dangers, favorable diet and nesting conditions allow steady development of population of 3 species in the zoo-geographical area in Nakhchivan AR.

3 species – Griffon vulture, Black vulture and Egyptian vulture breed in the mountain forest area of East Caucasus that relate to Gandja region of Minor Caucasus. Study of negative factors indicates that effect of anthropogenic factors in this area is low. Moreover, maintenance of tens thousands of cattle in summer pastures as well as grazing places of surrounding villages creates conditions for scavengers to locate diet.

Decrease in the populations of 4 species during 2004-2016 made 26 pairs. In other words, the total number of 4 species in our country decreased by 15.3% in 13 years.

## **CHAPTER IV. EVOLUTION OF SCAVENGING STRATEGY AND THE ATTRIBUTES OF TROPHIC RELATIONS IN AZERBAIJAN**

### **4.1. Evolution of the scavenging strategy**

Scientific data show that the diet forming strategy of cathartids, which are ancient ancestors of the species discussed, was associated with climate on the planet, changes in landscapes, and the rapid development of the megafauna during Holocene and Pliocene. The paleontological finds of scavenger remnants in the Binagadi lake and in the Azykh cave show that they lived in the territory of Azerbaijan already in the Pleistocene and their evolution proceeded in parallel with the processes occurring in Eurasia. About 12-8 thousand years ago the domestication of animals, 3 thousand-year-old customs of Zoroastrian burial and development of animal husbandry in the Middle Ages had a positive impact on the diet base of these species. Thus, their diet was made up not only of wild cloven-hoofed animals, but also of the corpses and offal of animals domesticated by humans. Starting from the Neolithic period new forms of connections began to form between man and these species.

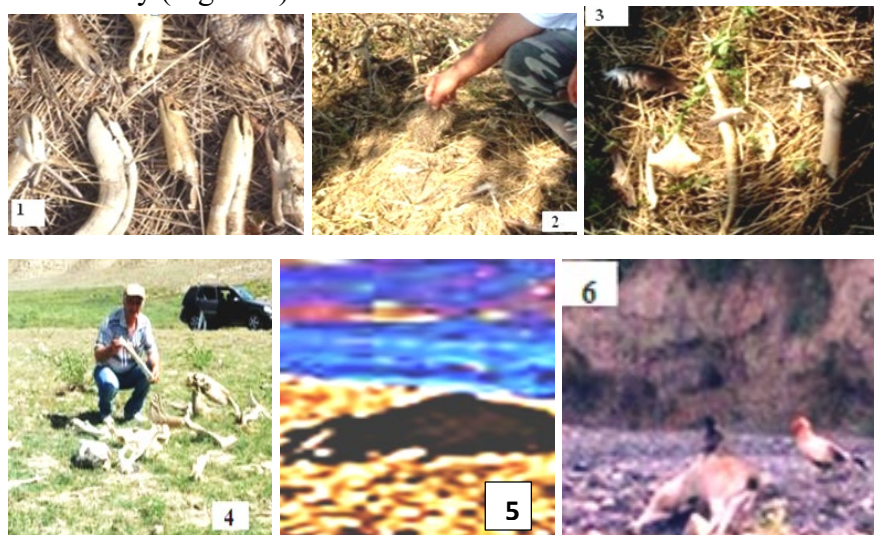
At subsequent stages of human development, a direct and detrimental negative influence of anthropogenic factors on the diet supply as well as planned destruction of predatory birds starting from the 19th century led to a decrease in the number throughout the area, and in some places even to complete extermination. These processes took place in the territory of Azerbaijan. That is why the question of studying the role of such environmental factors as diet supply, which has a huge impact on the evolution of these necrophagous birds, remains very relevant.

### **4.2. Spectrum and dynamics of the diet**

Currently, in Azerbaijan, wild and domestic animals' corpses make the diet base of scavenger birds.

In 2008-2012, the diet of these 4 species was represented by 37 species of wild animals (mammals – 24 species; birds – 6 species; reptiles – 3 species; amphibians – 1 species; fish – 1 species; insects – 2 species) and domestic animals belonging to 8 species (bull, cow, horse, donkey, pig, ram, goat, dog). Despite the fact that the corpses of wild animals from various groups and domestic animals of different species form the diet base, they are unevenly distributed in the diet of these 4 species. This is due to the following reasons.

1861 pieces of food were collected around the nests of 4 species during 2008-2012. 476 of those were picked around Griffon vulture nests, 467 around Black vultures', 456 around Bearded vulture and 462 around Egyptian vulture nests. Verification of collected residues showed that the size of the corpses affects the type and number of animals that make up the diet along with breeding process, number, mortality, ability of birds to eat corpses and migration of animals in the territory (Figure 2).

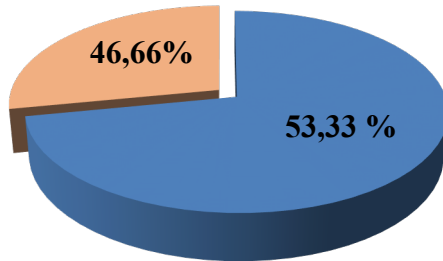


**Figure 2. 1-Remnants of grass-snakes around scavenger nests; 2-skin of a hare; 3-bones of various animals; 4-remnants of horse corpses; 5 -a buffalo died during river floods; 6 – cow corpse died after falling from rocks.**

It was revealed that these birds consume animal corpses of various sizes depending on behavioral characteristics, available diet reserves of areas and animals' migrations. Apart from these factors the diet ration spectrum is also influenced by household activities. As a result, the diet spectrum changes and birds become unable to use food objects.

We would like mention that feeding with the corpses of larger animals allows the birds to spend less time and energy in search of food while receiving the right amount of diet. In contrast to the Black vulture and Griffon vulture the diet of Bearded and Egyptian vultures includes remains of birds along with mammals. Hunting for amphibians, large beetles and grasshoppers was also noted.

Of the remnants noted by us "53.3% belonged to animals with weights of 100-300 kg, and 46.6% to animals with low weights. Comparison of animals with various weights in diet rations is given in the below chart (Chart 2).



Note: Blue- large and medium weighted animals;  
Red - small and low weighted animals

**Chart 2. The ratio of animals of various weights in the diet**

While the diet of Griffon and Black vulture made of corpses of 24 species with large and medium weight represented 98.8% and 99.9%, for diet of the Egyptian and Bearded vulture this figure was 62.74% and 89.47%. Such a difference in the behavior of these species while providing themselves with food and their selective attitude to it can be explained by the characteristics of hunting inherent to their

ancestors and preservation of diet characteristics. That is, Bearded and Egyptian vultures, in order to provide themselves with food, hunt smaller animals in addition to scavenging. Compared with these species, the Black and Griffon vultures with larger and greater masses prefer larger mass corpses in their trophic adventures. The selective attitude of the Bearded as well as Egyptian vultures aims to minimize the sharing of diet sources in the territory, interspecific and intraspecific competition for food in conditions of limited supply as well as time spent searching for and bringing to the nest large animal remains and thus satisfying physiological nutritional needs of babies and themselves. It was found that along with the factors listed above, anthropogenic factors also directly or indirectly influence the spectrum of birds' diet. That is, the influence of anthropogenic factors on the number of food sources in the territory does not allow birds to specialize in a specific source using it for long-term. These processes were studied in the territory of Turyanchay reserve and its border areas, where the influence of anthropogenic factors are quite strong and they represent the diet areas for these 4 species. The following conclusions were made. Despite the fact that the diet of the Bearded vultures that nest in the foothills of the Greater Caucasus is represented by corpses of wild and domestic animals living in the subalps and the Alps, the largest share of the diet are the Caucasian turs (*Capra cylindricornis*). This is due to the fact that it is possible to locate corpses of turs in this area ("*according to literary data, 10 - 12% of the turs are killed by wolves, 10 -15% of the young die from diseases*"<sup>11</sup>), and hunters leave part of corpses in the territory).

Also, the reason for the death of turs and other animals in winter months are lack of food, avalanches, and floods of the rivers during April - May. Their corpses persist for a long time in certain climatic conditions. Therefore, Bearded vulture prefers fresh corpse and rarely descends to areas with a warmer climate (below 500 m) for searches. In recent years, Bearded vulture's diet base has been affected by the

---

<sup>11</sup> Kuliev S.M., Askerov, E.K. The modern status of red-book species of carnivorous and herbivorous mammals of Azerbaijan // - Perm: Bulletin of Perm University, Biology, – 2012. Issue. 2, – p. 47-52.

expansion of farm operations and illegal hunting that lead to a decrease in tur numbers as well as a gradual reduction in its range. Thus, if in 2008 the diet included tur corpses with 50.0% share, in 2012 this figure dropped to 44%.

A gradual decrease of tur's share and other wild animals "*Capra aegagrus* - 800, *R. caucasica* - 630, *C. capreolus* - 1800, *C. elaphus* - 700, etc".<sup>12</sup> in the diet can certainly lead to diminishing of Bearded vulture population in Azerbaijan in the future.

Farm activities in the territory have caused a change in the diets of Griffon and Black vultures in 2008-2012 several times. For example, wolves (*C. lupus*) attacked sheep in the pastures (*O. aries*). As a result, during 2008-2009, the main part of the Griffon and Black vultures' diet was ram carcasses (Griffon vulture - 60.5%; Black vulture - 58.0%). In April-July of 2010 livestock owners killed jackals (*C. aureus*) (out of 110 individuals 60), foxes (*V. vulpes*) (out of 56 individuals 36) and wolves (n = 32) with bullets and traps while their corpses were thrown into landfills as well as unobservable territories, which again led to a change in the diet. The material collected in May-June of the same year from the remnants of food around the nests, was mainly consisted of the remains of those animals (Griffon vulture - 78.4%; Black griffon - 72.8%). In 2011 - 2012, 73.3% of all Griffon vulture diet of was made up by corpse remnants of illegally slaughtered horses (*Eguus caballus*). The share of horse corpses was 59.4% in the diet of the Black vultures.

In the diet of Griffon vultures, which prefers large and medium-sized animal corpses, the remnants of reptiles, amphibians and such small animals as mice were not found. In contrast to the Griffon vultures, we recorded that the Egyptian vultures search for food in the surrounding landfills, along the roads and consumes corpses of found animals and their remains. This adaptation of the Egyptian vultures to alternative sources is possible because they don't avoid human presence and can locate food on the Agdash - Gabala road passing

---

<sup>12</sup> Kuliev S.M., Askerov, E.K. The modern status of red-book species of carnivorous and herbivorous mammals of Azerbaijan // - Perm: Bulletin of Perm University, Biology, – 2012. Issue. 2, – p. 47-52.

through the territory of the reserve. During two months on this road we recorded 36 cases of vultures eating corpses of animals as victims of transport (15 foxes – *V. vulpes*; 2 hares – *L. caucasicus*; 4 hedgehogs – *E.concolor*; 3 turtles – *T.graeca*; 5 water snakes – *N.natrix*; 5 birds sp . etc.). We noted no other vultures feeding on landfills and along roads. The proportion of corpse remains of large and medium animals in the diet of Egyptian vultures (bull - *Bubalis b. bubalus*; goats- *Capra hircus*; donkeys - *Asinus africanus*; cows- *Bos.t .domesticus* ; wolves - *C. lupus*; dogs - *Canus famillaris*) was 3.38 % of the total. The remains of fox corpses were the largest - 43.25%. The share of the remaining animals was distributed as follows: hare - 10.5% (*L. caucasicus*); turtle - 9.3% (*T. graeca*); poultry sp. - 5.1%; raccoon- 5.0% (*Procyon lotor*); scheltopuzik-5.0% (*Pseudopus apodus*); snake - 3.42% (*N.natrix*); mouse sp., - 4.0; frog-0.21 (*B.variabilis*); fish thrown by river flood on the bank - sp. - 0.21%; large insects-0,008%.

The restriction of the diet supply and its spectrum in the Turyanchay reserve and the adjacent territories represented by 4 species were affected by the decrease in the number of corpses of 11 species of wild mammals (brown bear *Ursus arctos*; striped hyena *Hyaena hyaena*; the boar *Sus scrofa*; lynx - *L. lunx*; indian porcupine - *Hystrix indica*; badger - *Meles meles*; hare - *L.caucasicus*; wolf - *C.lupus*; Fox - *V.vulpes*; hedgehog - *E.concolor*; jackal - *C.aureus* ) ( $p < 0.5$ ) and pets ( $p < 0.01$ ).

Put together, the analysis of research materials showed that anthropogenic factors directly or indirectly affect the stability of the diet supply, its range, the ability of birds to use a specific diet object and thereby affect the emergence of new behavioral features of trophic relationships of scavengers.

*“It was found that individuals not engaged in breeding fly to Kalmykia, as well as to the Arabian Peninsula and Iranian territory to search f or food and because of unstable diet during reproduction period when their mortality increases”<sup>13</sup>.*

---

<sup>13</sup> Gavashelishvili, L. Where do Vultures Fly from Their Natal Areas in the Caucasus? Results of 10-Year-Long Radio-Satellite Tracking // Materials of the International conference "The Birds of Prey and Owls of Caucasus", – Abastumani; Tbilisi: – 26 - 29 October, 2011. – p.18-19.



### **4.3. Sanitary role in natural and anthropogenic landscapes**

The impact of these species on the sanitary-hygienic environment of ecosystems as a result of corpse consumption was studied using the example of the Turyanchay reserve and adjacent territories. In July-August, 62 animal corpses were logged on pastures, in river valleys and on the Agdash - Gabala road passing through the reserve's territory. Agdash Veterinary Department found out that 38 of all the studied corpses had a number of diseases (*rabies, pasteuriosis, toxoplasmosis, brucellosis, tuberculosis, etc.*) including parasite infection with echinococcus. In Turyanchay reserve located in 6 districts (Agdash, Goychay, Gabala, Sheki, Oguz, Yevlakh), and in the adjacent areas, 30-110 scavengers find corpses in a short time and within 1-3 hours they eat up them not allowing other animals (predators mammals, flies, etc.) to approach. Doing so, they prevent the possibility of animals' infection on pastures, on migration routes and hence, have a positive impact on the sanitary and hygienic conditions of anthropogenic ecosystems.

## **CHAPTER V. BREEDING ATTRIBUTES OF SCAVENGERS IN AZERBAIJAN**

These species possess features specific to them along with common biological and ethological characteristics of breeding. As the indicators characterizing the features of breeding by the 4 species, we studied arrivals of birds to nesting sites, mating, hatching of eggs, natural incubation time, mortality of babies during the embryonic and postembryonic periods, change of plumage, leaving nests and fertility of the nest.

### **5.1. Breeding characteristics of the Griffon Vulture**

During stationary observations in late February of 2009 and 2010, 20 and 22 vultures were marked at the nesting places, respectively. They mated 1-2 times a day and eggs began to hatch in the first half of March. By the time the eggs were incubated, the air temperature around the nest was + 9-14°C during the day, + 3-8 °C in the evening, humidity was 60-80%, wind speed was 5-7 m/s. 50.0-60.0% of the pairs brood and produce babies. Hatching of eggs was recorded

at the end of April and in the first days of May. The period of embryonic development was 52-54 days. In late June and early July, 65-69 days-old nestlings left their nests. In the eve of leaving nests the feather covers of young nestlings had formed. This enabled them to “exercise” flight movements and leave nests for separate living. In 2009, all 5 nestlings and in 2010, 5 of 6 left their nests. Nest productivity was 100% in 2009, while in 2010, it was 83.33%. Embryonal development period continued 52-54 days. No death cases were recorded in the embryonal development period. Only in the post-embryonal period there were cases of death due to diet shortage. This was due to a nestling not joining the colonial nestling “collective” and hence, weakened being left alone in the nest. One such death case was registered in 2009. In other words, parents did not steadily feed the nestling in the eve of leaving nests and within following couple days. This is, certainly, related to weaker parenting pairs at the end of breeding, leaving their nests and also, weak family group characteristics. A comparative analysis of the materials indicated to differences in our results with the outcomes obtained in other geographic territories. For example, in the Crimean Peninsula, located north of Azerbaijan in the North Caucasus, Griffon vulture mates earlier, in October-December and by the end of January and in the second 10 days of February, nestlings already begin to incubate. In Azerbaijan, mating occurs in February while hatching is in March. According to our findings, early nesting occurs so that the nestlings leaving the nests fall into more suitable temperature conditions. Because, late start of nesting of this species whose reproduction lasts 6 months could lead the inexperienced ones that leave their nests during cold autumn to dangers.

## **5.2. Breeding characteristics of the Black vultures**

Unlike other vultures, they nest on juniper tree. This is due to the fact that juniper has a healing effect on the nest by phytoncides it releases. That is, the diet remnants brought to a nest result in surge of various harmful invertebrates and micro-organisms. Those are the sources of diseases for nestlings and mature birds. We noticed that pairs “renovate” nests before brooding. Nests with a diameter of 1.5-2.0 m and depth of 20-30 cm are built with dry branches in a size of a

wrist. Soil and dry grass are put in the center of nests. They ensure normal heat and airflow and also enable drainage of rain waters.

In 2011, 15 vultures were spotted in the nesting places, while in 2012 they were 14. During the day, they mate 1-2 times and in the first 10 days of March begin to brood. When brooding starts the air temperature around the nests was +7-12°C at noon (+3-7°C at night), humidity was 70-80% and wind speed was 3-5 m/s. Like other scavengers their mating also took place around nests. Before brooding, male and female individuals fly in skies for couple minutes, descend to land near the nest and mate 1-2 times during the day. Dancing flights of the 4 scavenger birds are different. The idea here is to avoid emergence of inter-species hybrids. In 2011, 4 pairs of 15 griffons and in 2012, 4 pairs of 14 griffons bred. 44.5% of pairs in the population leave the nesting place for brooding. At the beginning of brooding period the air temperature was + 7-10° C with humidity of 60 –70% and wind speed of 2-7 m/s. Chickens mortality was 25.0%. Under natural conditions, the period of embryonic development is 54-56 days. Nest productivity in 2011-2012 amounted to 80-88,8%. The complete formation of the plumage allowed the nestlings to leave the nest at the age of 66-68 days. In 2011-2012, the egg and nestling losses in the 19 nests was 15.78%. Synchronous exit of nestlings from eggs allow leaving nests in groups during post-embryonal period and formation of population of same-age individuals.

### **5.3. Breeding characteristics of the Egyptian vultures**

They arrive to the territory of Azerbaijan in late March and early April. Mating occurs on the ground next to the nest at the end of March and in the first half of April. Egg hatching begins in the second half of April. They nest in small caves and cracks of rocky biotopes. In 2013, 11 pairs of 30 individuals, and in 2014, 14 pairs of 33 individuals hatched eggs. The number of individuals not participating in breeding was 21.2-26.6%. The number of individuals not partaking in breeding is relatively lower compared to other griffons. In 2013, 2 eggs were noted in 2 nests out of 11, and in 2014, 2 eggs in 3 nests out of 14. Hatching occurs in late May and in the first days of June. In 2013, 13 chickens came out of 13 eggs in 11 nests. 3 of those

perished within first 20 days. Most probably, the main reason was that the parents fed the second baby less often and hence, its weakening led to loss. Death of babies decreased in 2014. Only one of them died. The reason was supplementary diet for griffons by us in 2014. Nest productivity in 2013 was 76.9% and 94.12% in 2014. The mortality of chickens in the period of postembryonic development was 13.3%. Embryonic development lasted 40-42 days. Nestlings leave their nests in August at the age of 70-80 days, and fly out of the country until September 30<sup>th</sup>.

#### **5.4. Breeding characteristics of the Bearded vultures**

The reproduction cycle of this species begins the earliest of the rest. 2-3 times of mating a day is noted already in the second half of January. Egg hatching begins in the first 10 days of February. In 2015, 7 pairs out of 9 and in 2016, 6 pairs (that is, 77.7% and 66.6%) participated in breeding. Fetal development occurs within 55-60 days.

Hatching occurs in late March and the first week of April. The mortality of nestlings is 25.0% (2015) and 36.3% (2016). Nestling deaths were observed during post-embryonal period. Losses were recorded in those nests with two nestlings. 3 nestlings died in 2015. No chickens came out from 2 eggs. 4 chicken died in 2016. One of the eggs produced no chicken. Nestlings cared for 98-103 days, leave their nests in the first half of June. Weakened ones that their parents do not feed due to hunger reflex, are forced to leave the nest and search for food with adults. Nest productivity amounted to 75.0% (2015) and 63.6% (2016).

As seen from above materials, failed eggs in the Bearded vulture population during 2015-2016 (3 out of 23 eggs produced no chickens) and death cases in postembryonal period (7 out of 20 chickens died) were more compared to other griffons. Non-productive eggs can be explained with non-fermentation. Egg fermentation level is usually affected by birds' diet and climate conditions as well as placing eggs in nests in intervals (second egg). It should be noted that these materials allow not only determining the breeding potentials but also ornithological monitoring in nesting places.

It was found out that in Azerbaijan, Egyptian vulture, Griffon

vulture, Bearded vulture nest in rocks but Black vulture on trees.

Those nesting places cannot be limiting factors for these species in Azerbaijan. On the contrary, their use of several nests shows there are enough suitable nesting spots. Existence of suitable biotopes for breeding serves for protection of population by attracting young mature individuals to nesting spots in the area. Moreover, the use of several alternative nests protects the nest and nestlings from parasites.

## **CHAPTER VI. FACTORS AFFECTING THE DYNAMICS OF SCAVENGER NUMBERS IN AZERBAIJAN AND PROBLEMS OF THEIR PROTECTION**

Our monitoring outcomes showed that the spectrum of the factors negatively affecting scavengers are vast and impacting forms are different. For this reason, we divided classification of the limiting factors to 2 groups by basing on impact form of a concrete factor, its level and duration.

### **6.1. Factors affecting the gene pool**

It was found that the population structure of these species, the breeding potential, mortality, abundance, connection with habitat, mobility and migration are directly or indirectly affected by the 2 groups of factors. Factors of anthropogenic origin belong to one group while factors related to climatic conditions to the second. Choice of caves with suitable climatic conditions enabling normal temperature of egg laying and also 'brooding spots' allow these species to warm eggs during ambient temperature of + 7-14°C as well as cold times in February-March.

Daily activity of these birds is greatly affected by spring fogs in the territory of Babadag, Murovdag, Zagatala reserve and the Talysh Mountains. Despite the fact that this natural factor has an impact on the flight of birds and diet search, it does not affect the decline in the population size lasting very short. Because, such natural factors, which in no way can be avoided and eliminated, were pursued by scavenger birds throughout their evolution and affected daily activity of different individuals only in certain areas and times [18].

The data collected by us on the effects of anthropogenic factors

revealed their differences in origin, level of impact, form and duration of terms. Some of these impacts, such as catching birds and nestlings for the purpose of selling, keeping them in small zoos and village canteens, grazing cattle in their nesting grounds were easy to identify and eliminate because of their easy and quick revelation.

Laying of the Oguz-Baku water channel, mining stone on Mount Aydashy were temporary works and therefore, did result in low impact on the scavenger birds that nest in these territories.

It was recorded that some factors of anthropogenic origin of various forms and in different territories (shooting birds, destroying nests, killing birds in traps for predators, wounding birds in landfills, recreation, unplanned tourism, etc.) had a negative impact on their numbers.

Our statistical studies of the negative factors in 2004-2015 proved their impact on the drop in the number of scavenger birds:  $p < 0.0001$ . Our statistical calculations revealed an indirect effect of factors including expansion of the agricultural business, shrinkage in the area of land allocated for pasture ( $p < 0.0001$ ) and livestock farms ( $p < 0.0001$ ) as opposed to increase in the area allocated for crops ( $p < 0.0001$ ) on the decrease in the number of scavenger birds in 2004-2015. This impact was ( $p < 0.0001$ ) not only on reduction of birds themselves, but also on the animals that represent the diet base of scavengers (i.e. buffaloes, horses, camels, pigs, donkeys, mules) (Table 3).

All this has an indirect effect on drop in the number of animal corpses that provide the diet base of scavenger birds. This is evidenced by the presence of a correlation (linear relationship) between the number of wild and domestic animal corpses and the dynamics of scavengers' number.

In the Turyanchay reserve and nearby areas, which are places of diet and nesting for scavenging birds, there was a decrease in domestic animals ( $r = 0.862$ ,  $p < 0.01$ ) and 11 species of wild animals ( $r = 0.748-0.752$ ) in 2004-2012. These changes caused a decrease in the number of breeding couples and nestlings in the populations. Statistical studies revealed a correlation between a drop in diet supply and breeding couples in the populations of the Black and Griffon vultures (respectively:

$p < 0.01$  and  $p < 0.5$ ) as well as high co-efficiency of this indicator ( $r = 1.0$  and  $r = 0.654$ ). Moreover, a correlation was noted between the dynamics of diet objects and the productivity of Griffon vulture nests ( $r = 0.610$ ).

**Table 3. Factors affecting the decrease in the number of scavengers in 2004 - 2015**

Indicators	Average value	Standard deviation	Standard error	Assurance interval of variety, 95%		T-test	Degree of freedom	Level of statistical importance
				Bottom	Top			
Buffaloes	258842.	12748.96	23887.56	111419.1	206266.7	10.8	11	<0.0001
Pigs	11385.1	7498.433	2164.611	16149.44	6620.889	5.26	11	<0.0001
Donkeys	44119.0	3270.646	944.1542	46197.15	42041.01	46.7	11	<0.0001
Mules	65.75	14.08497	4.06598	56.80084	74.69916	16.1	11	<0.001
Planting area	1516484	155747.	44960.48	1615441.	1417526.	33.7	11	<0.001
No of house holds	2259.5	500.18136	158.1712	2617.3081	1901.591	14.2	9	<0.001
Total use of land	38752.6	12366.81	3910.731	47599.28	29905.91	-9.90	9	<0.001

A full analysis of all materials showed that limiting the amount of diet led to a type of unstable population dynamics (fluctuation) and as a consequence, to a drop in the total number in populations.

The below table provides materials about trophic conditions affecting breeding indicators (Table 4).

## **6.2. The influence of trophic conditions on biological parameters of populations**

The effect of intrapopulation mechanisms was studied in order to clarify the question of the influence of trophic conditions on the dynamics of numbers. These mechanisms were analyzed during the diet instability in the period of continuing fluctuations in the dynamics of abundance and during supplementary diet of scavengers.

It was found that in conditions of diet supply instability between the 3 groups participating in the breeding (1. Ones breeding, but not nesting every year, aged couples, 2. Steadily breeding middle-aged couples, 3. Young couples that have reached maturity) increases rivalry in consequence of which there is a decrease in the number of couples participating in breeding. This was due to emigration of some couples from the population. The reason for emigration is the reaction of some younger and relatively old couples to density in conditions of limited diet base manifested in the rejection of competition with couples representing the backbone of the population in favor of the population to which they belong. With changing trophic conditions breeding success is mainly determined by competition between groups. The purpose of such a strategy of reproduction is to provide a new generation in a given territory with a diet base in favor of the common interests of the population. Couples who refuse to take part in the breeding process in favor of the population are mainly couples whose nests are unevenly located on the periphery of the camp, only starting nesting and having weak social connections. Such structural changes in the population make it difficult to create pairs and form new populations. As a result, this becomes the reason for a drop in the rates of breeding and the quantitative indicator of these species. Supplementary diet resulted in restoration of the bonds of emigrants in the biotope and nesting in their colony. Thus, the intrapopulation mechanisms that regulate the dynamics of the number (the number of nestlings and breeding couples, the level of emigration and immigration, the “group effect”) under conditions of diet instability control the decrease in the number of individuals in the population, and under suitable trophic conditions ensure a normal growth of numbers. That is, the living conditions in the population through nervous and hormonal systems affect the physiological processes in birds’ body. The mutual exchange of information between individuals with the help of a complex signaling system directs the activities of all members of the population in the right direction. Depending on the diet conditions we noticed this process going in two directions.



**Table 4. Correlation between dynamics of diet base and breeding indicators (linear relation)**

Indicators	years	no of corpses	no of wild animals	Number of breeding couples			Number of nestlings		
				Egyptian vulture	Griffon vulture	Black vulture	Egyptian vulture	Griffon vulture	Black vulture
Years	1	0.862 <sup>1</sup>	0.748 <sup>2</sup>	0.135	0.902 <sup>1</sup>	0.902 <sup>1</sup>	0.725 <sup>2</sup>	-0.58	0.346
Number of corpses		1	0.752 <sup>2</sup>	0.398	0.887 <sup>1</sup>	0.887 <sup>1</sup>	0.415	0.602 <sup>2</sup>	0.434
Number of wild animals			1	0.370	0.814 <sup>1</sup>	0.814 <sup>1</sup>	0.529	0.681 <sup>2</sup>	0.248
Egyptian vulture (breeding couples)				1	0.654 <sup>2</sup>	0.254	0.023	0.461	0.398
Griffon vulture (breeding couples)					1	1.0 <sup>1</sup>	0.481	0.610 <sup>2</sup>	0.364
Black vulture (breeding couples)						1	0.481	0.610 <sup>2</sup>	0.364
Egyptian vulture (no of nestlings)							1	0.436	0.060
Griffon vulture (number of nestlings)								1	0.456

Note: <sup>1</sup> p <0.01; <sup>2</sup>p <0.5

It was found that during supplementary diet for birds in times of food shortage, the physiological processes are optimized, leading to an increase in the quality of life, which leads to a positive “group effect” and maintenance of homeostasis (the population’s ability to maintain the number of individuals at a certain level). Supplementary diet for these species positively affects the quantity dynamics by regulating emigration and immigration processes within population.

Supplementary diet in nature not only positively conditions of scavenger birds but also allows attracting them to less stressful zones, stimulating them to nest in more favorable places, lower perishing by eliminating flights to places with hazards and stabilizing relations with biotopes as well as sustainable development in the nature.

### **6.3. Supplementary diet in natural conditions**

The legal basis for the strategy in the protection of rare and endangered species in Azerbaijan are the main elements of the legislative framework (basics). Protection of these species on a legal basis is regulated and enforced under these laws.

The effectiveness of the basic elements of the strategy is implemented with the help of measures that constitute a facultative (additional) category of strategy. The biotechnical method prepared by us for feeding scavengers under natural conditions also serves to optimize and increase the effectiveness of the basic elements of this strategy.

These supplementary diet provisions also allow to clarify the number of birds in a particular area, assess and forecast populations’ status, study the ethological and ecological features, conduct photo shooting, catch them for surveys, and carry out introduction and reintroduction.

#### **These species to be provided with supplementary diet in the nature using the below rules in “feeding grounds”.**

Supplementary diet is to be provided by relevant National Park, State Natural Reserves and State Natural Protective Areas where birds nest. This shall be based on agreement and contract with local district veterinary and sanitary-epidemiology entities.

As a diet object the following items can be used: corpses of wild and domestic animals died of various reasons (diseases, traps, on roads

and rivers) as well as remnants of killed animals (i.e. head, legs, bones, skins, internals).

## **VII CHAPTER. DISCUSSION OF THE MATERIALS**

Decreasing of scavengers in Azerbaijan as well as in global scale is being observed. The main reason being the natural landscapes undergoing intense anthropogenic transformation and shrinkage of aerials and diet bases. The speed of adaptation of these species lags behind the ecological changes happening in natural ecosystems. Meanwhile adaptation to the ecological changes is possible with long-term evolution. Various negative impacts of anthropogenic origin resulted in gradual and ongoing decrease in eventual reduction in the numbers of these birds, which have weak breeding potentials (maturity reached at the age of 4-6, not nesting every year, produce 1-2 eggs, 2-3 months of brooding, nurture babies in nests for 3 months and etc.) and limited diet adaptations (not always diet includes corpses belonging to animals for these necrophage species).

As a result of changes in biological systems losses of these species is dangerous not only for ecosystem but also humans. Because, like other species, scavenger birds provide potential economical importance for people. That is, scavengers participate in the balance of natural systems by minimizing spreading danger of infections as natural "sanitation" and circulation of organic elements as consumers in the biological relations of ecosystems.

Azerbaijan's territory makes one of the main habitats of these birds. Study of these species is of special importance in our country especially in such increasing pace of direct and indirect anthropogenic and climate factors. It is worth noting that these species are registered in "Red Book" of Endangered Animals of Azerbaijan. However, "passive" measures like "Red Books" and conventions are not enough for achieving efficient protection in the nature for these rare and endangered birds.

Successful solution of the problem includes complex study of bio-ecological characteristics that enable objective assessment of modern situation of the populations of the species under research in their

habitats, audits and registration of breeding spots, sustainable monitoring, revealing natural and anthropogenic factors that impact the species, their nesting places, breeding features and diet as well as designing biotechnological methods aimed at their efficient protection. In Azerbaijan the following activities were required for solving those issues: study of natural and anthropogenic factors that affect birds' gene pool, biological and ecological parameters that quantity dynamics, nesting ecologies, adaptation to mountainous landscapes and trophic conditions and zoo-geographical areas of breeding of scavenger birds, their sanitary roles and preparing biotechnical methods that ensure their efficient protection in the nature.

We must note that emergence of biological species that are scavenger birds in Azerbaijan is linked to below factors. Paleontological materials confirm that evolution of scavengers and spreading in paleartic occurred due to extreme climatic and landscape changes on earth and also evolutionary processes in the phylogenetic development of large predator and herbivore mammals. Paleontological remnants found in Absheron and Azykh cave showed that spreading of scavenger birds in Azerbaijan territory occurred due to formation of the last landscape in the Caucasus mountain system in the third geological period and proceeding evolutions going in parallel with evolution taking place in Eurasia.

Although there are numerous factors ensuring the living of these species two of them play major role and decisively influenced placement of scavengers as well as their breeding. These are satisfactory trophic conditions in habitat and biotopes for breeding.

We identified that scavengers populate and breed in 8 zoogeographical areas located in mountainous landscapes in Azerbaijan. The initial historical reason for spreading of the species in mountainous landscape was due to formation of Caucasian mountain systems. That is, paleontologists explain settlement of these birds in mountain landscapes with their ancestors being of big sizes. This means these birds with 70-80 kg of weights and 6.5-7.0 meters long of wings would struggle run with 40 km/h speed while elevating and flapping wings. Therefore, in order to elevate to air they reached the mountainous areas

by using vertical rocks as well as sloppy hills as a “spring points”. In relation to following evolution period the modern-day scavengers, despite their less weight and sizes, kept those features of flying and adaptation to mountain acquired from their ancestors.

By conducting monitoring of the nesting places of the 4 species in the country we studied their settlement in rocky biotopes on mountain landscapes, breeding in mountainous climate and the regularities conditioning formation of petrophilicity. It was found that settlement and breeding of scavengers in mountain areas were influenced by complex factors: orography (range, elevation and exposition), petrophilicity (naked rocky places, stony areas), mosaicness (sparse greenery) of landscapes, fauna and diet reserves. All these greatly affected spreading of these species and their breeding.

During sunny times of day, the thermic airflow emerged from heated tones, rocks and debris in mountain hills and river valleys enabled the birds to swing in the air for locating food without consuming much energy (they must span vast areas to find diet). Complex orography, mosaicness, petrophilicity, mountain river floods and snow falls increase deaths of animals and hence, corpses. This also enables the birds to scan more areas for finding food. High altitudes influenced selection of nesting places in mountain landscapes. That is, as altitudes increase the number of nesting spots and density of birds decreases. In the mountain range of over 2000-meter-high in the Lesser and Major Caucasus we logged 6 nests of one species, the Bearded vulture. Our conclusion explained this due to the fact that they stay away from warm climate places, people and prefer corpses that decay slower on the high mountains of warmer climate. In Azerbaijan territory, the altitude interval between nesting places of scavengers is minimum 166 m (Egyptian vulture) and maximum 2574 m (Bearded vulture). Here, all 3 species live only in small caves and ravines on rocky biotopes. As for dendrophile Black vultures, they nest on juniper (*Juniper sp.*) trees of 2-3 m high that grow in petrophilic sloppy ravines and slopes. In general, there are enough useful nesting biotopes and they can't be considered a limiting factor for scavenger birds.

It was understood that only daily activity of these species was

affected by climatic aspects. Natural factors including clouds, rains and hot sunshine do not affect reduction in their numbers. Because these factors are not steady and short-living they do not influence birds' daily activity. That is, they re-start seeking food after cloudy, rainy and hot weather. Since these natural factors existed along their evolution, so they are resistant to their negative impacts.

It was determined that the main limiting factor was decreasing diet base and its instability. Because, the impact of anthropogenic factors on diet base and decrease of numbers occurred and is ongoing in indirect and direct ways. These are the factors affecting the 4 scavenger birds' diet conditions: larger wild animals decrease; pasture areas shrink (referring to corpses of perished animal); limited number of animals are kept in households; big horned animals are kept in closed complexes; veterinary and sanitary activities enhance and dead animals' numbers decrease due to utilization. This leads to limited opportunities for scavenger diet.

We noticed a correlation (linear relation) between dynamics of diet objects and some breeding indicators of scavengers (number of breeding pairs and nest productivity). Therefore, number of pairs in breeding in each population as well as nest productivity can be considered favorable indicator for determining the ecological role of a factor such as trophic condition.

The study of the spectrum and dynamics of diet rations of scavengers revealed instable diet base and changing of diet sources dependent on human economic activities. Gradual decrease of animals included in the birds' ration and instable diet sources deprived scavengers from possessing (or specializing) concrete food resources. During the 5 years of research of diet rations anthropogenic factors frequently changed them. That is, in 2008-2009, the main diet sources for Griffon vultures, Egyptian vultures and Black vultures were made of sheep killed by predator mammals, wolves, jackals and foxes killed by household animals' owners in 2010 and horse corpses illegally killed and disposed in hidden places 2011-2012. The share of Eastern Caucasus tur (*C.cylindricornis*) in the ration of Bearded vulture reduced from 52,6% to 44,1% due to reduction in their aerals and numbers. Reduction in other

even-toed ungulates may deprive the Bearded vultures of their traditional food sources in near future.

We found out that Bearded vulture and Egyptian vulture hunt small-sized animals, hence making use of alternative diet sources. In the condition of competition for food, hunting small animals is connected to efforts of feeding themselves and their babies. On the other hand, using additional diet sources ensures minimizing competition for food between and inside species during limited food availability. As a whole, Egyptian and Bearded vultures' "return" to the hunting ways of their ancestors can be connected to evolution in diet habits. This relates to the hunting instincts and reactions of their ancestors remaining in these two species that they use when necessary. The observed changes in diet habits of these two species can be assessed as phyletic form of evolution. That is, depending on trophic conditions Egyptian vulture's continuing evolution was also noted in other geographical territories.

Diet shortage and instability of rations force scavengers seek food in places far from their breeding territories. As a result, some individuals die on the route or never return.

At present, various methods are being utilized for protection of these decreasing species and their sustainable implementation. Presently, for the purpose of keeping gene pool of necrophage birds in Azerbaijan, there is no need for introduction, re-introduction (it is organized in Alp and Pyrenees mountains), proliferation in aviary and freezing of cells in liquid nitrogen.

Biotechnical method (supplementary diet in the nature) worked out by us also enable favorable bio-conservation of the birds' populations in Azerbaijan by including it in the protection program of these species as a natural trophy of the nesting biotopes during breeding period.

## **RESULT**

1. Egyptian vulture, Black vulture, Bearded vulture and Griffon vulture breed in the following zoogeographical areas: 1. Mountain forests of the Eastern Caucasus (Greater Caucasus), 2. Highlands of the Greater Caucasus, 3. Gobustan, 4. Jeyranchol-Ajinohur; 5. Mo-

- untain forests of the Eastern Caucasus (Lesser Caucasus), 6. Mountain forests of Talysh, 7. Plain along the Araz River in Nakhchivan, 8. Zoo-geographical territories of the high mountains of the Lesser Caucasus [8, 22, 26].
2. Adaptation of these species to the rock biotope is determined by complex factors including the orography of mountain landscapes, petrophilia, the mosaic pattern of microphytocenoses, climatic and trophic conditions. These species seek food by flying and scanning over wide areas using thermic flows emerged from heating of rocks, stones and their remnants during noon in the hills and slopes of Gadi, Aladash, Kamchi, Nihaldag, Alar division and Alazan-Ayrichay, Lahic pit, Murovdag of Lesser Caucasus, Shahdagh, Mikhtoken, Zengezur, Peshtasar of Talysh and Burovar mountain ranges that stretch 10-100 km in Great Caucasus accommodating the nesting biotopes [10, 26].
  3. Griffon vulture, Bearded vulture and Egyptian vultures nest in the small caves and cracks protected against dry and cold north winds and located in 30-70 m altitude as well as south-looking rocks of high petrophilia. Black vulture nests on juniper trees. Availability of nesting biotopes, 2-3 “brooding stains” on their breast and back sides during breeding period enabled these species to nest in groups and colonies in over 30 areas during February-March with air temperatures of +7-14 C [7, 26, 27, 28].
  4. Nesting biotopes of Bearded vultures are located at an altitude of 1216-2574 m, Black vultures - 363-1486 m, Griffon vultures - 182-1645 m, Egyptian vultures - 166-1849 m above sea level. It was found that 4.2% of 4 species breed in altitudes over 2000 m, 37.8% in 1000-2000 m, and 57.9% in below 1000 m. The reason for the number increasing in direction from high mountain areas to low altitudes is because these species prefer petrophilic areas with a dry climate. The distances between nests in breeding biotopes is 10-1000 m for Egyptian vulture, 10-2000 m for Griffon vulture, 500-2000 m for Black vulture and 5-20 km for Bearded vulture [26, 28].
  5. Monitoring in 2015-2016 revealed that Bearded vultures mated 2-3 times and brooded during the first week of February. The number



- of breeding pairs made 66.6-77.7%. Embryonic development occurred within 56-60 days. Nestlings hatched at the end of March and in the first 10 days of April. The mortality rate of chickens in the period of postembryonic development was 25.0-36.3%. Chickens are fed 1-3 times a day. They leave their nests in the first 10 days of July. Nest productivity amounted to 63.6-75.0% [26].
6. Monitoring of 2009-2010 revealed that Griffon vultures mated 1-2 times a day in February and brooded in 4-14th of March. Number of breeding pairs made 50.0-55.5%. Embryonic development occurred within 52-54 days. Hatching of eggs occurred during 27.04 - 04.05. The mortality rate of nestlings was 20.0% in the period of postembryonic development. Nestlings were fed 1-2 times a day. They left nests on the dates of 29.06 - 05.07. Nest productivity amounted to 83.33 - 100% [26].
  7. The monitoring of 2011 - 2012 revealed that Black vultures mated 1-2 times a day in February and brooded in 7-12th of March. Number of breeding pairs was 53.3-56.2%. Embryonic development occurred within 54-55 days. Nestlings hatched on the dates of 30.04-04.05. Nestlings are fed 1-2 times a day. The mortality rate of chicks in both the embryonic and postembryonic developmental period was 25.0%. Nestlings left nests on 04-07th of July. Nest productivity was 75.0% [26, 27].
  8. The monitoring of 2013-2014 found that Egyptian vultures, a species of migratory nesting, mated at the end of March and beginning of April 2-3 times during the day. Number of breeding pairs was 73.3-84.8%. Hatching of nestlings begins with laying of 1-2 eggs in early April. Embryonic development occurred within 40-42 days. Nestlings hatched on the dates of 28.05-02.06. Nestlings were fed 1-2 times a day. The mortality rate of nestlings in the period of postembryonic development was 13.33%. They left nest on 15th of August. Nest productivity amounted to 94.1% [26].
  9. During 2004-2016, the number of breeding pairs of all 4 species in Azerbaijan made 61-71 Griffon vultures, 59-70 Egyptian vulture, 16-22 Black vultures, 9-10 Bearded vultures. It was found that within 13 years the number of nesting pairs gradually decreased from 171 to

145 pairs or by 15.3%. The level of reduction by species was: Black vulture - 27.3%, Griffon vulture - 14.1%, Egyptian vulture - 13.3% and Bearded vulture - 10.0%. Nestlings' death levels by zoogeographical zones are as follows: Great Caucasus high mountains – 50.0%, Lesser Caucasus high mountains – 60.0%, Gobustan – 50%, Nakhchivan Arazboyu plains – 50.0%, Ajinohur-Jeyranchol – 32.5% and East Caucasus mountain-forrests – 26.9%. The total nest productivity for 4 species in Azerbaijan was 79.6% [21, 22, 26, 28].

10. According to the 1861 pieces of diet remnants collected during the five years of study the scavenger birds' ration was comprised of corpses of 37 wild and 8 domestic species. 53.33% of corpses belonged to large and medium weighted animals while 46.66% to small weighted. It was found out that intensive appropriation of natural landscapes by humans negatively affect the number of diet objects and diet spectrum of these bird. This is evidenced by the quantity of diet objects, shrinking of breeding pairs = 0.654-1.0,  $p < 0.01$ , and also decreasing nest productivity:  $r = 0.610 - 0.681$  and correlation between  $p < 0.5$ . Supplementary diet of birds in the nature increased the number of breeding pairs in the Egyptian vulture population from 65.4% to 76.9%, nest productivity from 0.7 to 0.8 individuals, in the Black vulture population, pairs from 56.2% to 64.7%, from 0.6 to 0.8 individuals, in the Griffon vulture population, pairs from 47.0% to 66.7% and from 0.6 to 0.8 individuals [14, 17, 19, 25, 26, 28].
11. It was found that the stable dynamics of the scavenger numbers and trophic abilities of the habitat are achieved proportionally. This allows regulation of emigration as well as immigration processes. That is, the intrapopulation mechanisms provide a reduction in individuals and the number of breeding pairs in the periods of limited diet supply but a steady increase in the number of individuals during increased diet supply. In other words, younger and older pairs reacting to "density" in conditions of limited diet supply, reject any "competition" with the pairs that make the population's backbone "for the sake" of the population to which they belong and immigrate. Supplementary diet for these species in the

nesting places created conditions for pairs that left their population to return to the previous biotopes and restore trophic relations with the area [14, 15, 18, 24, 26].

12. The collected materials showing the scavengers consuming the corpses of 38 domestic as well as wild animals as carriers of 10 diseases and left in uncontrolled territories during July-August prove that these species reduce the spread of disease sources and thereby have a healthy effect on the natural ecosystem [11, 12, 26, 29].

## **PRACTICAL RECOMMENDATIONS**

For stable development and working protection of these species in the territory of Azerbaijan we consider it useful to implement a number of practical proposals.

1. The following zoogeographical territories: the nesting biotopes in the high mountains of the Greater Caucasus (the, Ajinokhur - Jey-ranchol the Talysh mountain forests, Gobustan should be protected by special status of natural monuments due to the existing danger to the nests, birds, nestlings during breeding season (March-August). The biotope (rock, tree) birds announced as natural monuments should be under the supervision of local ecological entities, municipalities and schools from brooding till leaving nests. All these measures must prevent stress of brooding birds during breed period, shooting birds including their nests, picking up eggs and nestlings, cattle grazing in their areas, hunting of animals and birds as well as recreational activities.
2. In order to improve the diet conditions of these species in the territory of Azerbaijan, there is a need for supplementary feeding in the vicinity of nesting biotopes during breeding seasons. Because the demand of diet increases during the 3 months of baby feeding period. From this standpoint, the most suitable areas for nesting biotopes are Shahdag and Goygol national parks, the Turyanchay, Ilisu, Korchay, Shahbuz State Nature Reserves and the State Natural Preserves along the Araz. Supplementary diet should be implemented according to rules and terms of suggestions prepared by us consi-

dering bio eco-ethological characteristics of these species with participation of local veterinary, sanitary as well as ecological entities. In order to prevent gathering of rodents and pests in the area of supplementary diet its location should be renewed frequently. Corpse remnants must be utilized in the spots of supplementary diet. Diet to be provided only during 3 months of baby feeding in nests to prevent birds attaching to those spots demanding food from humans. Otherwise, birds would stop seeking diet leading to behavior changes and hunger.

3. Local ecology agencies, NGOs and school teachers (biology) should provide ecological and awareness in these districts where nesting biotopes are located: Sudur, Khashi, Guscu, Savalan, Gash, Dastafur, Chanakchy, Dize villages, Goychay river valley. During relevant events the roles of scavengers in bettering the hygienic and sanitary conditions in natural and anthropogenic ecosystems and also, their protection and observation of ecology laws should be explained to local residents.

## REFERENCES

1. Sultanov, E.H. Bird species included to international conventions from Azerbaijan ornithofauna / Elchin Sultanov, Tahir Karimov, Afdandil Musayev [et. al] // ANAS Works of Zoology Institute, – Baku: – 2006. Vol. 28, – p. 846-855.
2. Sultanov, E.H., Karimov, T.A., Mamadov, A.F. Griffon Vulture (*Gyps fulvus*) in Azerbaijan // Proceedings of the International Conference "Mountain Ecosystems and Their Components", – Nalchik: – 13-18 August, – 2007, part. 3, – p. 97-99.
3. Sultanov, E.H. Practices of organizing ornithological studies in reserves and national parks of Azerbaijan / Elchin Sultanov, Tahir Karimov, Arzu Mamadov [et al.] // Proceedings of the State Nature Reserve "Dagestan", Institute of Applied Ecology, Union of Bird Conservation of Russia, – Makhackala:–2007, – ed. 1, – p. 20-23.
4. Sultanov, E.H., Karimov, T.A., Isaev, Sh.A. Practices of studying and protecting key ornithological territories in Azerbaijan //

- Moscow: Journal of the South of Russia, –2007. №2, – p. 63-68.
5. Sultanov, E.H, Karimov, T.A., Isaev, Sh.A. Griffon vulture in Azerbaijan // Materials of a scientific and practical conference dedicated to the 25-year-old activity of the North Caucasian ornithological group, North Caucasian branch of the Menzbirovsky Ornithological Society “Birds of the Caucasus, study, conservation and rational use”, - Stavropol: October 10 -12 , -2007, -p.116-120.
  6. Karimov T.A., Talibov S.T. Modern aerals, nesting places and numbers of Lesser kestrel (*Falco naumanni*), Black (*Aegypius monachus*) and Griffon Vultures (*Gyps fulvus*) in Azerbaijan // - Baku: Works of Zoology Institute of Azerbaijan, - 2008, vol.1, -p.652-656.
  7. Karimov, T.A., Talibov, S.T. Black Vulture in Azerbaijan // –Baku: Works of Zoology Institute of Azerbaijan, –2010, vol.1, – p. 884-888.
  8. Karimov, T.A., Talibov, S.T., Abdullayev Q.A. Important ornithological areas of Garabagh region under occupation // – Baku: Works of Zoology Institute of Azerbaijan, – 2011, vol.3, – p. 150-155.
  9. Farzaliyev, V.Ş., Karimov, T.A. The Role of Ornitho-fauna in Ecological Analysis of Biocenosis in Turyanchay National Reserve // – Artvin: Artvin Çoruh University Forestry Faculty Journal, – 2013, vol. 14, (2), – p.310-320.
  10. Karimov, T.A. Current situation of Egyptian Vultures (*Neophron percnopterus*) // – Nakhchivan: News of ANAS Nakhchivan Section, Biology sciences series, – 2014, Vol. 10, №2, – p.191-196.
  11. Karimov, T.A. Roles of necrophage predator birds in natural and antropogenic ecosystems // Review of Research Journal, – 2014, 4, (2), – p. 1-3.(<http://ror.isrj.org/UploadedData/1164.pdf>).
  12. Karimov, T.A. About sanitary roles of scavenger birds in the nature // Materials of International conference on Veterinary Medicine and Food Safety: Problems and Perspectives”, – Nakhchivan: – 23-25 May, - 2014,- p. 58-61.
  13. Karimov, T.A. Study of the species composition and numbers during supplementary diet of scavengers. / T.A.Karimov, A.F. Mammadov, R.H. Hasanov [et. al.] // Works of Zoologists Union, – Baku: 2014. vol. 6, №2, – p. 61-65.

14. Karimov, T.A. Main limiting factors affecting biological parameters of necrophage birds // The Journal of V.N.Karazin Kharkiv National University, – 2015, № 1153, – p. 68-72. ([http://seriesbiology.univer.kharkov.ua/ukr/24\(2015\)/pdf/68.pdf](http://seriesbiology.univer.kharkov.ua/ukr/24(2015)/pdf/68.pdf)).
15. Karimov, T., Quliyev, Q.N. Impact of trophic conditions on biological parameters of griffon vultures in Azerbaijan // XIII International Scientific and Practical Conference "Modern Concept of Scientific Research", Moscow, – 29-30 April 2015, No. 4, - p. 35-38.
16. Karimov, T.A., Namazov, I. Methodical guidance on supplementary diet for scavengers in the nature. // – Baku: News of Pedagogical University. Section of Natural sciences, – 2015. № 1, – p. 451-453.
17. Karimov, T.A., Mammadov, A.F. Limiting factors of scavengers and their elimination // – Nakhchivan: News of ANAS Nakhchivan Section. Nature and technical sciences series, – 2015. Vol. 11, – №2, – p. 222-229.
18. Karimov, T.A. Elimination of negative factors affecting population of Griffon Vultures (*Gyps fulvus*) // – Baku: ANAS News, Biology and medical sciences series, – 2015. vol.70, №2, – p. 80-85.
19. Karimov, T.A., Quliyev, Q.N. About evolution phases of diet of necrophage predator birds // – Baku: Works of ANAS Zoology Institute, – 2015. vol. 33, № 1, – p. 78-85.
20. Mammadov, A.F., Karimov, T.A. Mutual connection of birds with electric lines (Nakhchivan AR area) // Materials of scientific conference dedicated to 10th anniversary of Ministry of Emergency “Emergencies and safe life”, – Baku: – 10-11 December, – 2015, – p. 344-346.
21. Karimov, T.A. Breeding indicators of scavenger birds in ornithogeographical areas in Azerbaijan // – Gandja: ANAS Gandja section – 2016, №3 (65), – p. 29-35.
22. Karimov, T.A., Mammadov, A.F. Ornithogeographical areas of scavenger birds in Azerbaijan // – Baku: Works of Zoology Institute, – 2016. vol. 34, №1, – p. 54-60.
23. Karimov, T., Guliyev, G. The current status of necrophage birds

- in Azerbaijan Republic // X International Conference "Development of Science in the XXI Century", - Kharkov: - February 14-15, - 2016, Part 4, - p. 90-93.
24. Karimov, T.A. Limiting Factors Affecting Reproductive and Demographic Indicators of Black Vulture (*Aegypius monachus*) // Journal Applied Environmental and Biological Science, – 2016. Vol. 6, – № 1, – p.17-22.
  25. Karimov, T., Guliyev, G. Diet composition of four vulture species in Azerbaijan // Journal Ardea,–2017, 105 (2), – p.163-168. (<https://doi.org/10.5253/arde.v105i2.a3>).
  26. Karimov, T.A. Distribution, biology and protection of scavenger birds of *Falconiformes* group // – Baku: Works of ANAS Zoology Institute, – 2017. Vol. 35, № 1, – p. 56-75.
  27. Karimov T.A. Breeding characteristics of Black Vultures (*Aegypius monachus*) in Azerbaijan // – Nakhchivan: Nakhchivan State University, Scientific Works, Natural and Scientific Works Series, – 2019. № 3 (100), – p.68-72.
  28. Karimov, T., Mammadov A. The status of vultures *Neophron percnopterus*, *Gypaetus barbatus*, *Gyps fulvus*, *Aegypius monachus* (*Accipitriformes*) in Azerbaijan // Ukrainian Journal of Ecology, – 2019, 9 (4), – p. 565-570. DOI: [10.15421 / 2019\\_791](https://doi.org/10.15421/2019_791)
  29. Karimov, T., Matsyura, A. The ecological role of *Accipitridae* vultures' terrestrial landscapes of Azerbaijan // Ukrainian Journal of Ecology, – 2020, 10 (1), – p. 90-94. DOI: [10.15421/2020\\_14](https://doi.org/10.15421/2020_14)

Defense of dissertation will be in the meeting of Dissertation council D.01.071 operating in the Zoology Institute of ANAS on the date of 11 November 2021 at the time of 14:00

Address: AZ1004, Republic of Azerbaijan, Baku city, Str. A.Abbaszadeh, 1128<sup>th</sup> side street, 504<sup>th</sup> block

Dissertation is accessible at the Institute of Zoology of ANAS Library

Electronic versions of dissertation and its abstract are available on the official website of the Institute of Zoology of ANAS

Abstract was sent to the required addresses on 05 October 2021.



Signed for publication: 20.09.2021

Paper format: 60x84 <sup>1</sup>/<sub>16</sub>

Volume: 71621

Circulation: 20