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Chapter 3

DETERMINING THE EFFECT OF SOUND SYSTEMS ON CONTROLLING BIRD DAMAGES AT TRABZON INTERNATIONAL AIRPORT, TURKIYE

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INTRODUCTION

Most airports include extensive grasslands, scrubland, wetlands, and uninhabited areas. At many airports, the main areas used for birds are runways, taxiways and well-maintained short grasslands. Birds come to these areas to feed, rest, nest and roost (Eschenfelder, 2001; ATSB, 2002). Small birds may need a wide field of vision to detect predators, so they feel safer feeding in short grasslands (Devereux et al., 2004). The continuous cutting of grasslands means that the structure that hides insects and other invertebrates is destroyed, which can make prey easier to detect. It is also easier for birds to forage in short grasslands than in long grasslands (Butler and Gillings, 2004). Birds feeding on short grasslands may attract larger raptors to the site (Eschenfelder, 2001; ATSB, 2002). Places used as roosting or observation points for raptors are often aircraft hangars, runway markings, lights and trees. Another reason why airports are used by birds is that they can provide safety from larger predators, including humans (Wright, 1967). Birds can obtain water from drains and water channels, as well as from the standing water that forms at airports after rain. When it rains,insects may be forced to move from enclosed areas such as soil to hard surfaces such as runways, where they can feed more easily. Environments around airports, such as wetlands, dumps, scrubland and agricultural fields, can also contain resources that attract bird species (ATSB, 2002).

Flying species may be more likely to cause significant damage to aircraft in the event of a collision due to the potential for multiple collisions and ingestion by engines (Sodhi, 2002). Large migratory species have been observed to collide with aircraft more frequently than non- migratory species, especially since they often fly in large groups to conserve energy (Hummel, 1983; Weimerskirch et al., 2001). Migratory species may not be familiar with the dangers posed by aircraft and may be unable to detectapproaching aircraft (Sodhi, 2002). Some birds may be more likely to be involved in collisions due to fatigue after traveling long distances during migration (Sodhi, 2002).

Since the beginning of aviation, wild animal-aircraft collisions have caused 744 fatalities and 664 aircraft to become unusable. A total of 724 of the fatal collisions, 504 in civil aviation and 220 in military aviation, were caused by birds, while a total of 20, 9 in civil aviation and 11 in military aviation, were caused by mammals. Of the aircraft that became unusable, 166 in civil aviation and 421 in military aviation were caused by birds, while 70 in civil aviation and 7 in military aviation, 77 in total, were caused by mammals (URL-1, 2023). According to the International Civil Aviation Organization (ICAO), nearly 90% of bird-aircraft collisions occur during landing or take-off phases (ICAO, 2016). Since the power increases in the engines of aircraft can reach the highest values during the take-off andlanding phases, mass fatalities of lighter birds, especially at low altitudes, arehigh (Dukiya and Gahlot, 2013).

Despite the increasing number of studies on birds in Turkiye, scientific monitoring and data on birds and flight safety are still insufficient. The Eastern Black Sea Region has many different habitats for approximately 340 bird species identified to date (Kahraman et al., 2016). Başkaya (1994) conducted a study on migratory bird species in the Eastern Black Sea Region and Gülci (2011) investigated the effects of birds on flight safety at Trabzon International Airport (TIA). Sarı et al. (2022a) presented the first applied scientific study on bird damage at airports in Turkiye. In this study, a decrease of up to 85% in the number of domestic bird species, which negatively affect flight safety, was achieved by using trained dogs and adjusting the grass height according to migration seasons at TIA. Sarı et al. (2022b) conducted a study on bird species that threaten flight safety at TIA andtheir aviation risk values. In addition, Sarı and Mengen (2022) determined the control methods used on bird damages at TIA and conducted experiments using bioacoustic and ultrasonic sound systems.

In this study, the effectiveness of the methods applied in bird control at TIA and the responses of birds by testing various sound systems were investigated.

METHOD

Material

The surveys were conducted between August 13, 2021 and November 13,2022. During the field observations, two binoculars with 10x magnification, two telescopes with 20-60x magnification, and a digital camera with 125x optical magnification were used to collect remote information. Heinzel et al. (1995) "Birds of Turkey and Europe", Kiziroğlu, (2009) "Birds of Turkey Pocket Book" and Jonsson (2006) "Birds of Europe", were used to determine the species identification observed during field studies. After the areas used intensively by birds at the airport were identified, 5 cameratraps were placed in areas that would not threaten flight safety within the knowledge of the stuff of the airport. Images and video record of birds were tried to be obtained with cameratraps. Cameratraps are capable of taking infrared photos and videos. For recording the data obtained, 10 memory cards of different sizes were used according to the capacities of the devices. Although the energy needs of the cameratraps varied according to the model, they were provided with approximately 1000 batteries. While placing the cameratraps in the appropriate areas, 5 special wooden bars with a length of 50 cm and a thickness of 5 cm were prepared for the ground, and galvanized thin iron wire and pliers were used for fixing.

The golden jackal replica, which was made based on the original one-to-one measurements of the golden jackal (*Canis aureus*), one of the predators of Turkiye, was placed in the green areas of the airport that attract birds and the reactions of the animals were measured. The golden jackal replica was kept at

the airport during the study. The golden jackal replica creates the perception of a living creature with its three-dimensional design and movable tail. During the field studies in the areas where the golden jackal replica was placed, a remotecontrolled 38 cm high speaker with a sound power of 400-600 watts, which has a sound power of 400-600 watts and can last up to 5 hours of use, was placed and the reactions of the birds were measured again.

At the same time, along with the golden jackal replica, BirdXPeller®-PRO bird repellent, which has predatory bird sounds, can be programmed, emits sound waves over an area of 4 acres, and repels birds by emitting various distress calls and predatory sounds that confuse, scare or disorient birds, and Bird-K İmti 040 solar-powered multifunctional animal repellent device, which is effective in an area of 400 m^2 thanks to its ultrasonic signal and infrared flash light, were also placed in these areas. Bird-K Imti 040 was kept at the airport for the duration of the study.

A CTECHi 300 W portable power supply was used to meet the energy requirement during the activation of the BirdXPeller®PRO bird repellent device which was used when entering the field for field studies.

Determination of the Study Area

When the phases during which bird strikes occur are classified as acceleration, beginning of climb, climbing altitude, cruise, descent, maneuvering, beginning of approach, final approach and landing (FAA, 2010), the phases during which most bird strikes occur are 48% during climb, 30% during approach, 15% during flight, and 6% during landing (Maragakis, 2009; Gülci, 2011). Bird strikes are concentrated in the safe approach and climb area (ICAO, 2016; DGCA, 2017). For this reason, field studies were carried out in an area of approximately 3.5 km^2 within TIA and at most 1 km outside the airport (Figure 1).



Figure 1. *Study area (GoogleEarth, 2023)*

Installation of Devices in Study Areas

As a result of field observations, camera traps and devices were placed in 3 different areas determined to be used intensively by birds both during and outside the migration period.

After the first month of the study, the areas used intensively by birds were determined. Cameratraps were placed in these areas on September 13, 2021, which is the migration period, in the area shown as number 1 on the map to the east of the area known as the VOR road. This area is an area where especially gray heron species were found in groups of 60-80 during the study. The devices were kept in the area numbered 1 for about 3 months and after being used during the field studies, they were moved to the area named 1.1 critical area, which is the most intensively used by the birds, shown with the number2 on the map, on December 10, 2021. After being kept in area number 2 for 9months during the research, it was moved to area number 3 in critical area 1.1and followed here until the end of the research (Figure 2).

In these areas, the reactions of both migratory and resident species to the sound systems and the golden jackal replica were continuously monitored and recorded through direct observations and cameratraps. Cameratraps were used to monitor the presence of birds and their reactions to the golden jackal replica and the sound systems installed in the field. Bird-K Imti 040 was kept in the field continuously during the research period, staying in the line of sight of the cameratraps. BirdXPeller®PRO bird repellent was usually activated when the researchers arrived to the field, and sometimes it was left in the field without the practitioners in the field.

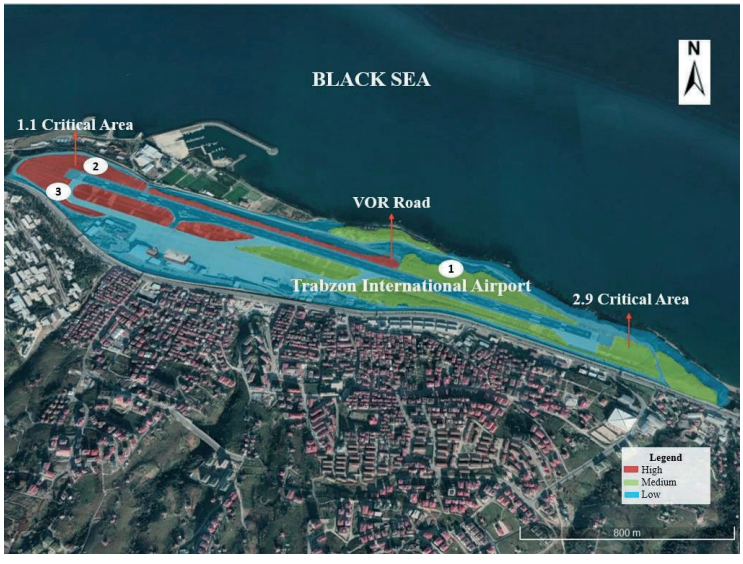


Figure 2. *Areas where cameratraps and sound systems were placed in the study area (GoogleEarth, 2023)*

RESULTS

Bird Control Methods Used at TIA in the Past and Present

One of the main methods used in the past to combat bird damage at TIA was the use of rifles, pistols and sound flares to scare birds away. Regular control of grass lengths, which is also used today, was also used in the past. Airport stuff, especially apron guards, were frequently used physically in the fight against birds. In addition, in the interviews with the managers of the airport, it was stated that an agreement was made with a company in the past years to install an ultrasonic sound system for testing purposes. It was stated that this ultrasonic sound system, which was quite expensive and tested, was ineffective on birds and that birds did not react to this system. Today, these and similar sound systems are not used in the vicinity of TIA due to the presence of residential neighborhoods.

Today, there is no comprehensive bird control methods either physically or systematically. Although weed control continues at TIA, the managers of the institution stated that the main purpose of this control is to protect against a possible fire hazard and that bird control is kept in the second priority. During the study period, it was observed that the weeds were mowed periodically in April, May, June, July, August, August, September and October by both tractors and airport teams. Otherwise, weed control is carried out taking into account the type and growth period of the weeds. In this struggle, 2 runway sweepers, 3 tractors, 7 motorized scythes, 1 drum type lawn mower, 1 garden type lawn mower and 1 weed collection vehicle are used.

Another method used at TIA today is the audible and visual physical control of birds by apron staff. In this method, apron guards try to drive away the birds on the runway and taxiways by driving vehicles and sounding sirens. In the grassland areas, apron officers try to ensure flight safety by getting out of their vehicles in a way that does not pose any risk, running over the flocks of birds in the grass and throwing foreign objects. It has been observed that when the bird density is very high, the fire trucks themselves and their sirens intervene with the birds several times a year. It was also observed that the apron attendants collect foreign objects on and near the runway with their hands. In particular, it was determined that gray carrion crows drop crusted food on the runway from a high distance in order tobreak it and then feed on it. These food residues left on the runway are also collected by the apron staff. During these physical struggles, it was determined that the apron staff had to exert considerable effort and difficulty.

Trials of Sound Systems for Bird Damage Control at TIA

Following the observations made inside the airport and outside the airport from the dominant points on the Karadeniz Technical University (KTU) Campus following the start of the study, cameratraps were first placed in the

area shown as number 1 on the map to the east of the area known as the VOR road during the migration period on September 13, 2021. This area offers temporary accommodation to many bird species, especially during migration periods, along with resident bird species. Among these species, one of the species that will adversely affect flight safety the most is the gray herons, which form groups of 60-80 in the area. Although the golden jackal replica and sound systems were used for about 3 months in area number 1, it was determined that they were not effective in any way, especially on large bird species from the beginning to the end. Again in the area number 1, Bird-K Imti 040 was kept in the field within the field of view of the cameratraps during the study, while the BirdXPeller Pro bird repellent was usually activated when the re- searchers arrived at the field and sometimes it was leftin the field without the practitioners by making the necessary adjustments andleaving it in the field of view of the cameratraps. All systems were tested individually in the field as well as in combination. During the study period, itwas determined that resident bird species did not use this area for a long timesince the grass lengths in the area number 1 were longer than the other areas and there were no trees near the area where birds could perch.

The areas where other resident bird species, especially gray carrioncrow, silver gull and rock pigeon, are seen most intensively at the airport are the green pasture areas in the area called "1.1 critical area" on the west sideof the runway. According to the observations made, it was determined that the trees located in the KTU Campus and in the north direction (the area where Trabzonspor facilities are located) are an important factor in the intensive use of this area. On the leafy tree species in these areas, especially resident species such as gray carrion crows stay in groups of 100-200 and constantly move between both directions. These low-height displacements and transitions pose a threat to airplane landings and take-offs. In this area, it was observed that rock pigeons use building roofs rather than tree branches for accommodation.

After the devices were tested during the field studies, they were moved to the 1.1 critical area, which is the most intensively used by birds, shown as number 2 on the map on December 10, 2021. During the study, all systems were kept in area number 2 for 9 months and then moved to area number 3 in critical area 1.1 and followed here until the end of the study.

Gray carrion crow, silver gull and rock pigeon, which pose the highest risk in terms of flight safety for TIA throughout the year and are among the resident bird species for the area, did not react to the stationary golden jackal replica in any way, while they reacted briefly to the sound systems. This short-term response was not in the form of flying away from the area, but in the form of short-term low-altitude flights over the devices for 10 to 40 minutes. During these short-term flights, it was even observed that the birds made attack-like peaks towards the systems used for bird control. It was determined that the

birds, which became accustomed to the systems in a short period of time, landed on nearby areas covered with short grass, on the sides of the runway or on the runway.



Figure 3. *Responses of birds to sound systems in the study area after the first 10 minutes*

It was determined that all the systems used for bird control (golden jackal replica, Bird-K Imti 040 general animal repellent, BirdXPeller Pro bird repellent and a loudspeaker with a golden jackal sound) gradually got used tothe systems after 10 minutes from the time they first started to work, and if the grasses were short, they landed near the devices, if not, they landed in suitable areas (Figure 3).

The golden jackal replica left at the airport during the study and the solar-powered multifunctional animal repellent Bird-K İmti 040 device, which is stated in the user manual to be effective in an area of 400 m^2 thanks to the

ultrasonic signal and flash light it emits, were observed that the birds got used to it in a short time and even landed on them without any discomfort (Figure 4).



Figure 4. *Acclimatization of birds to the methods used in the study area*

CONCLUSION AND COMMENTS

BirdXPeller®PRO bird repellent that has sounds of predatory birds was used in a study conducted by the University of South Africa on a pigeon population. It was found that there was a correlation between the number of pigeons observed at different time periods and the sound of BirdXPeller Pro bird repellent to pigeons. During the audible bird repellent trial, pigeons continued to disperse as if they were in a natural predator environment, moving away from the location during dawn and dusk counts. In contrast, when the pigeons did not see the presence of predatory birds causing them to fly away from buildings, they returned to their original locations (Harris et al., 2016). In a similar study, BirdXPeller®PRO bird repellent was used to repel pigeons from buildings. The sounds were played randomly so thatthe pigeons would not get used to the sounds. To measure the effect of the sounds, counts were made before and 10, 20 and 30 minutes after the sound was played. In this study, although there was no significant difference between the number of pigeons before and 30 minutes after the sound was played, there were differences in the number of pigeons between 0-30 minutes due to behavioral changes. In addition, since the pigeons did not have a warning call among themselves, the bioacoustics used to deter the pigeons were found to be insufficient (Harris et al., 2020). In this study, which was conducted by testing similar devices at TIA, it was observed that especially resident bird species got used to the systems in a short time and the effect of the systems was almost negligible.

Bioacoustic method, which is seen as a traditional method in Turkiye, is one of the most widely used methods in bird control. The use of this method alone causes the birds not to react in the long term as they get used to it after a while (Stenman, 1990). At TIA, the current bioacoustic control method

caused by apron guards during bird control is ineffective due to the fact that the sounds are not predatory or frightening.

Birds may give different results when confronted with ultrasonic sounds (Harris et al., 2020). It was observed that ultrasonic sounds were ineffective in scaring away birds at TIA. Bird species that were expected to leavethe area perched near the ultrasonic sound emitting devices, flew over them and even landed on them.

As a result of study conducted at airports around the world, it has been reported that leaving grasses at long (30-60 cm) lengths is effective in reducing the populations of dangerous bird species (geese, starlings, gulls) at airports (Hupf and Floyd, 1995), and that species such as ring-billed gulls, snow buntings, swallows and rock pigeons are more attracted to short grassland (5-10 cm) than long grassland (15-20 cm) (Potter, 1996). It has been observed that starlings, northern harriers and pigeons do not prefer tall grassland because tall grassland makes it difficult to see predators, be alert, foraging and social contact (Brough and Bridgman, 1980; Deacon and Rochard, 2000). When adjusting the height of the grassland, leaving it 25 cm and above may cause an increase in rodent and insect species, which may attract other predatory species to the site (Barras and Seamans, 2002; Clearyand Dolbeer, 2005). In this study, similar data were obtained and it was determined that the number of bird species was less dense in areas where grass height was 20-35 cm.

With this study carried out at TIA, it is aimed to determine the most appropriate control methods that can be used in Turkiye and the world airports against bird damage and to minimize the problem to the lowest levels. Within the scope of the studies, it has been clearly seen that especially resident bird species get used to the expensive sound systems preferred to increase flight safety and minimize economic losses at airports in a short time. In fact, it has been determined that they have no effect not only on resident birds but even on migratory birds. For this purpose, according to the results of the study, the measures that can be taken against bird damage at TIA are listed below.

- Assigning qualified stuff trained in their field at airports

- It was observed that apron guards are used in the fight against bird damage at TIA. Apron guards approach the birds with a vehicle and intervene by sounding the siren or getting out of the vehicle and running. Thisboth reflects on the enterprises as invisible expenses in economic terms and reduces the efficiency of the stuff. In developed airports that are successfulin combating wild animal-related damages in the world, teams of wildlife experts who have received training on the subject are among the permanent staff of airports. For this reason, it should be ensured that graduates of the “Wildlife Ecology and Management” department, which provides undergraduate education in Turkiye, are employed at the airport.

• Establishment of Wildlife control units

- In the airports of developed countries, there are bird control units where expert teams work full-time. Unfortunately, there are not yet any airports in Turkiye that have such units working directly in this way. Wildlife control units should be established as soon as possible, not only at TIA but also at allairports, especially within the body of General Directorate of State Airports Authority.

- Wildlife control units to be established should be staffed by wildlife experts (graduates of the "Wildlife Ecology and Management" department atthe undergraduate level) who have been trained in their field, and it should be ensured that the struggle is carried out by teams trained in this field. In Turkiye, apron guards or fire brigade units working at the airport are used in the fight against wild animal damage. However, the knowledge and experience of these stuff on wildlife, especially birds, is not sufficient. For example, birds are the most problematic wildlife class at airports. Knowing all kinds of information about birds (ecology, biology, migration periods, behavior, etc.) by the control team is essential for determining and implementing a successful control method.

• Continuous bird observations in all seasons of the year

- A total of 120 bird species were detected directly at TIA (Sarı et al., 2022a; Sarı et al., 2022b; Sarı and Mengen, 2022). However, considering that 340 bird species have been identified in the Eastern Black Sea Region to date, it is likely that the number of bird species identified in this study will increase with longer and continuous studies to be carried out in and around TIA. Continuous bird observations at the airport by wildlife experts trained in the field will also increase the success of the struggle. For this reason, bird observations should be made at the airport every day of the year.

• Use of trained dogs

- Although many different methods are used against bird strikes not onlyat TIA but also at airports in many countries around the world, the desired result cannot be achieved. Airport operators allocate high amounts of resources for these control methods. Birds, on the other hand, get used to almost all control methods applied in a short time and make the struggle unsuccessful. Therefore, alternative methods are constantly sought. In countries that minimize the problem in the fight against bird damage at airports, biological control methods are now used in addition to physical control. The most important of these methods is the use of trained dogs and predatory birds. The use of predatory birds is more difficult due to both the training of the bird and the lack of training stuff. For this reason, the use of dogs is more preferred.

- It has been found that the use of trained dogs is highly effective

evenin bird species such as silver gulls, gray carrion crows, storks and herons, which have limited response to sound systems and human intervention (Sarı et al., 2022a). Many countries in the Americas and Europe have employed trained predatory birds and dogs with trainers as permanent staff at airports. With this study conducted at TIA, it has once again been seen that almost all methods used against bird damage are ineffective. Therefore, in order to prevent further economic losses and, most importantly, mutual loss of life, trained dogs should be assigned to the airports of Turkiye on a permanent basis together with their trainers. For an area the size of TIA, 2 trained dogs shouldbe used together with wildlife experts.

• Regulation of grass lengths

- For TIA, except for migration periods, weed lengths should be kept between 20-35 cm and all weeds in the field should be reduced to the shortest length just before the start of the migration season (end of August - end of February). Weed control should be carried out continuously during migration periods. Instead of the existing grass species at the airport, spiny species that can be a food source for bird species and have a reducing effect on insect numbers should be selected, taking into account soil characteristics (Sarı et al., 2022a; 2022b).

• Plastic asparagus application

- Plastic asparagus, which is economically inexpensive and easy to apply and will not have a negative impact on electronic devices important for flightsafety, should be placed immediately on all structures used by birds during their temporary stay at TIA (electronic devices, building roofs within the campus, all electricity poles, wooden fences, lighting devices, plastic pontoons and antennas).

• Leaving suitable structures for natural predatory birds

- During the field studies, the hawk, which is a natural predator of small bird species, was seen in the airport at all seasons of the year. It has been determined that the hawk species has taken shelter in many structures in the area and poses a natural threat to other birds in the airport. For this reason, when plastic asparagus is applied, it would be appropriate not to apply this application on some fences and poles so that predatory birds such as falcons can land. In determining these structures, the opinion of experts who know the area and the requirements of the species should be taken into consideration.

• Felling of leafy, fruit-bearing trees and shrubs

- There are many coniferous and leafy tree species used by resident birds for accommodation and nesting at TIA. During the study, birds were detectedindividually on the tops, branches and interiors of coniferous species.

However, in leafy species, bird groups exceeding 100 were identified. Especially gray carrion crows were constantly seen on the leafy species in the airport in groupsof 100-200. In addition, fruity species such as cherries, figs and plums in the airport attract many bird species. Therefore, before the start of the vegetationperiod, the airport authorities should contact the relevant public institution (General Directorate of Forestry, Trabzon Regional Directorate) to cut all of these species within the scope of combating bird damage.

- Covering drainage channels

- During the study, it was observed that the birds formed large groups around the open drainage channels and all kinds of water accumulation areas in the airport. For this reason, it is necessary to cover the open drainage channels in the airport and to identify and level the pothole areas that cause water accumulation.

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