

Electro-Acoustic Influence on Birds

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Abstract: *Results from the comparison of the effect of three devices influencing the hearing apparatus of the birds, are reported. The necessity for further thorough investigation of the physiology of hearing and development of specific equipment for registration of the influence of electro-acoustic signals and behavior analysis is outlined.*

Keywords: *Bioacoustics, electro-acoustics, ultrasound.*

1. Introduction

Very often the environment conditions put the human beings in a situation of defending themselves from unwilling co-existence with birds, rodents, insects and like, that cause damages on the agricultural products, buildings or monuments. Due to the changes in the ecological conditions, violation of the natural equilibrium and migration, the number of some bird species may increase significantly in some areas. Mainly this holds for pigeons, sparrows, starlings, crows. Significant concentrations of these birds may occur in the fields, in the vineyard areas or in the fruit and vegetable gardens [1]. The starlings concentration may be extremely huge and lasting, achieving more than 5000 birds per ha, while the flock may increase up to 60000. The enormous mass of birds sleeping in the trees breaks branches and covers the earth underneath with a thick layer of excrements [2]. When sleeping on roughs, terraces or cultural monuments, they cause damages and ruin them.

Another essential problem concerns birds near airport sites [3, 4] where they cause up to 1500 air crashes yearly.

A new danger is related to the birds during the last years – they happen to spread the dangerous virus of the influenza.

On the other hand the present day human society requires humanitarian behaviour to the living creatures, which excludes violation and killing. Thus, chasing away the birds from vital for the human activity places becomes a world problem. It could be solved using different signals that influence their senses. In this respect investigations are carried out in different countries.

The acoustic influence has appeared in the second half of the last century and now a significant experience was accumulated in different firms [5, 6, 7, 8]. According to the nature of the signals the acoustic equipment could be divided into two groups: bioacoustic and ultrasound.

2. Bioacoustic equipment

The most popular bioacoustic emitters are using shrieks of birds in case of danger. The action consists in repeated producing of amplified sounds “alarm” and “danger” that are specific for the birds being in a dangerous or disastrous situation. The ability of the birds to recognize such signals is of vital importance for them. This ability is probably inherited or may be learned from the parents. It is desirable this sound to belong to birds from the region where the equipment will be used. To avoid the effect of getting accustomed, the alteration of the generated signals is required. It is recommendable to change the signals every 1-4 weeks depending on the ornithological situation. This equipment operates at a long distance and could protect a large area. In [9] a device QB-4 of the firm BIRD-X is described consisting of 4 piezo-ceramic loud speakers positioned at 90° each relative to its neighbours and producing a sound of 20 kHz frequency, modulated between 20 and 30 kHz in a combined mode every 12 s.

The device BCUSTM [10] operates in a similar way. It consists of 6 loud speakers that produce sound in the range of 21-26 kHz with a few mode of sound generation.

3. Ultrasound equipment

The devices of this kind are considered universal and according to the publications, they influence all the bird species. However, this is a type of signals which spread badly in the atmosphere, depend on its parameters, reverberate well from solid surfaces, have a small radius of action and are not hearable. The two last properties make them very suitable for use in rooms or grounds. One of the reasons for the wide popularity of this class of equipment concerns the excellent hearing system of the birds. The frequency range, which is distinguishable from the birds, is quite large. The lower limit is about 40 Hz, while the upper one is 29 kHz [11]. However, for the majority of them, the upper limit does not exceed 20 kHz. Also, there is a conjecture that the birds could accept sounds not only by the ears, but also through the skull bones, the so called bone conduction.

4. Experimental results

Two groups of experiments have been carried out with different devices producing acoustic signals, including ultrasound. The experiments were organized in the Bulgarian Ornithological Center, where a feeding place was mounted. The place has been visited mainly by doves, starlings and sparrows.

The first tested device was X4-Life FALCON (Fig. 1). It belongs to the family of bio-acoustic devices.

The device switches on automatically when an object appears within the range of its activity and starts producing a mixture of annoying and frightening sounds of different birds for one minute. During the first experiments the birds have been frightened by the sounds and immediately flew away. After some time the birds were visiting the feeding place again and were staying cowardly. The dove was the first that adapted to the signals: during the first 7-8 experiments it was flying away immediately, but after the 10th experiment it was eating calmly, paying no attention to the screamer. Soon after that the other birds started eating without any anxiety.

The second device that was tested, is Attack Wave Pestrepeller of Conrad company, aimed at scaring away rodents by ultrasound of about 30 kHz (Fig. 2). No visible results have been registered with this device. Just a small trouble was noticed, may be due to the presence of an unknown object. However, as whole the frequency of the bird visits at the place diminished significantly. This may be related to the influence of the device on one hand, but may be related to the advancing period for nesting for the majority of them, as well.



Fig. 1. X4-Life FALCON



Fig. 2. Attack Wave Pestrepeller

The third device USE-3 was developed in the Institute of Information Technologies (Fig. 3).

It consists of three ultrasound emitters connected in parallel. They are fed with a monochrome ultrasound signal of different power and frequency of about 40 kHz. The power lever is changed via voltage changing. Except for the direct visual observation over the bird behavior the quantitative feature “duration of stay” was measured in seconds. This data was collected both in the case of absence of emission (a reference set) and in case of a working device (a test set). The two sets have been collected for the following hours of the day: 09-11 h, 11-14 h and 14-17 h, and at different voltage – 5, 10, 15 and 20 V. One and the same type of food

was used under almost similar weather conditions. The results from the experiments are shown in Table 1. Table 2 presents the average data for the day. In both tables N stands for the average number of the observed birds and median is the largest duration of the stay in seconds.

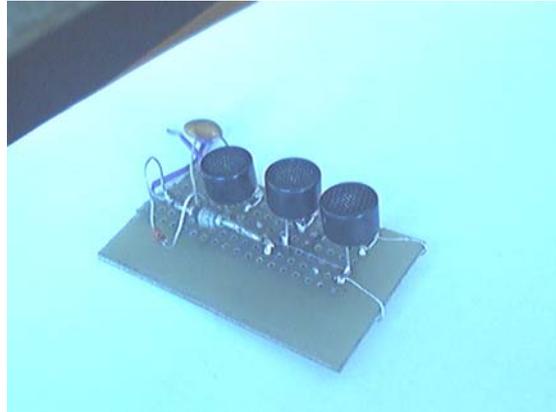


Fig. 3. USE-3

The largest number of birds was registered in the morning hours (09-11h) which correlates with their morning activity. The difference in the median was significant for the first two intervals, but this was not true for all the groups, when a detailed pair testing was performed, e.g. for the period 14-17h, maybe due to the small size of the sample.

Table 1

09-11:00 h	Number	Reference	5 V	10 V	15 V	20 V
	N	85	66	118	73	17
	Median (s)	8	8	7	6	6
$H_4 = 24.8$, $P < 0.0001$ (Kruskal-Wallis ANOVA) Significant difference according to Dunn ($P < 0.05$): reference – 5. 5-15 V						
11-14:00 h	Number	Reference	5 V	10 V	15 V	20 V
	N	59	25	97	5	15
	Median (s)	9	8	7	5	6
$H_4 = 17.2$, $P < 0.001$ (Kruskal-Wallis ANOVA) Significant difference according to Dunn ($P < 0.05$): reference – 15 V						
14-17:00 h	Number	Reference	5 V	10 V	15 V	20 V
	N	5	124	25	36	–
	Median (s)	7	6	5	5	–
$H_3 = 7.67$, $P > 0.05$ (Kruskal-Wallis ANOVA)						

When all the samples are combined, the distance between the medians is minimal (5-8 s) and when tested for significance (Dunn's method), the results are positive only for some of the groups (Table 1). Such combination of the data is possible because the differences in the activity of the birds for the three time periods are insignificant for almost all data groups. Only the difference at 10V is significant at $P < 0.05$. This leads to the following conclusion.

Table 2

	Reference	5 V	10 V	15 V	20 V
Total	151	216	240	212	32
Median (s)	8	7	6	5	6
$H_4 = 72.6, P < 0.0001$ (Kruskal-Wallis ANOVA)					
Significant difference according to Dunn ($P < 0.05$): reference – 15 V, 20 V, 10V, –5 V, 5-20 V, 10-15 V					

Despite the statistical significance of the differences of the data, concerning the duration of the birds stay in the feeding place at different voltage, we think that the device does not influence significantly the birds even when the distance between the place and the device is less than 0.5 m.

This conclusion is supported by the visual observation of the bird behaviour as well.

5. Conclusion

An experimental study is described in the paper about the influence of three different devices aimed at scaring away some birds. Two of them are available in the market; the other one is developed at the Institute of Information Technologies. The investigations were carried out using a specially prepared feeding place. The bio-acoustic device has shown a strong scaring effect at the beginning. However, this effect, if not supported by a real threat, was fading too fast – about 7-10 days. The second device has not shown any noticeable effect during the first 10 days, but the number of birds significantly decreased after that. There may be two explanations for this. The first one concerns the approaching of the nesting period. The second one is more promising. By analogy to the effect on the rodents we may assume that the ultrasound has had a repulsing influence on the birds and finally the majority of them refused to visit the feeding place after some period of inconvenience. The third device had no visible effect on the birds. However, it is possible to obtain a repulsing effect provided a continuous exercise is applied at frequencies, resonating with the hearing apparatus. Such an effect has been noticed when electromagnetic irradiation of 30 kHz was used for the protection of vines from starlings.

These preliminary results have shown that further investigation is required to obtain more reliable and practically useful results. The investigation has to be aimed at a deep physiological (and technical) analysis of the hearing apparatus of the

birds, on the one hand, and the development of specific equipment for investigation of the stimulus and reactions of the birds.

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