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# INTERSPECIFIC AGRESSION OF THE PASSERINE BIRDS (AVES, PASSERIFORMES) ON WATERING PLACES IN WOOD-AND-STEPPE ZONE OF UKRAINE

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**Interspecific Agression of the Passerine Birds (Aves, Passeriformes) on Watering Places in Wood-and-Steppe Zone of Ukraine. Markova, A. O. —** Study of aggressive behavior of different species of birds in various places of the Wood-and-Steppe Zone of Ukraine with the methods of continuous logging and total surveillance revealed that aggression manifestation of birds in different territories are similar. Ratings of successive interactions among aggressive species in different areas are evaluated. According to the ratings, four types of birds position in the ranking were allocated and the species always holding to them in any area are established. The Blackbird is always dominating, whereas the Blue Tit and Treecreeper occupy a subordinate position. The Nuthatch, Greenfinch, Chaffinch, Marsh Tit, Great Tit, and Blackcap are characterized by active successful attack, but have low defense rating. These results can be used in analyzing the adaptation of certain bird species in communities and their success in competitive interactions in different areas.

Key words: aggressive behavior, agonistic interactions, Aves, Ukraine.

## Introduction

The causes and consequences of aggression among the animals are subjects of special attention in zoology. Behavior differences in various areas and their importance for biology, ecology and social relations of close and competitive species are actively studied. Animal aggression is widespread in intraspecific competition (Arnott, Elwood, 2009), but it's significance and effect on interspecific competition or other relations between closely related species are new and still poorly studied aspects (Tanner, Adler, 2009; Lehtonen et al., 2010).

Similar studies of some closely allied territorial passerine bird species (Panov, Ivanitskiy, 1975, 1979, Ryabitsev, 1977) showed that the number of interspecific contacts is much greater than intraspecific (Ivannitskiy, 1980, 1982). Over the past decades, was accumulated a significant amount of new data on the aggressive behavior of different groups of animals (Reichert, Gerhardt, 2014; Tanner, Adler, 2009), including for example the common chaffinch *Fringilla coelebs* Linnaeus, 1758 (Foltz et. al., 2015), collared flycatcher

*Ficedula albicollis* (Temminck, 1815) (Forsman et. al., 2007), great tit *Parus major* Linnaeus, 1758) (Forsman et. al., 2007; Grabowska-Zhang et. al., 2011), house finch *Haemorhous mexicanus* (Müller, 1776) (Hasegawa et. al, 2014) and others.

In this paper, the territorial, food or nesting behaviors of one or a few competitive species are considered. However, interspecific competition is an important factor regulating niche overlap in resource using by the related species and relative density of bird populations in forest communities (Umapathy, Kumar, 2000; Peiman, Robinson, 2010). Many different species are involved in such a process, and this raises the level of competition between individuals, as well as their aggressive behavior (Mikami, Kawata, 2004). Peiman & Robinson (2007) called it a "non-specific" aggression. This is quite common for animals, but it still gets less attention than the other forms of interspecific and intraspecific competition, so its mechanisms and effects are not clear (Grether et al., 2009, 2013; Peiman, Robinson, 2010). There are interesting studies of the interspecific hierarchy for a small number of family of closely allied species of birds (Grava et al., 2012; Sushma, Singh, 2006), but the interaction between several bird species of a particular community at the same time has not been ever considered.

This study aims to analyse the reaction of interspecific aggression in multi-species bird community on watering places (as neutral territories) and determine success ratings of an aggressive reaction as a result of direct aggressive interaction between them.

**Material and methods**

Observation data were collected by the author in the following sites.

1. **Kaniv Nature Reserve** (KNR) — May and June of 2010, 2012 and 2014 at the watering place in Mokry ravine (49.722 N, 31.532 E) near administrative building of KNR and has low human impact. Duration of observation: 324 h, with 15 280 interspecific and intraspecific contacts recorded.

2. **State Arboretum "Alexandria"** (Bila Tserkva, 49.812 N, 30.072 E) — June 2012 and 2015. The site is located in a mixed forest and has high anthropogenic influence. Duration of observations: 144 h, with 9315 interspecific and intraspecific contacts recorded.

3. Vakalivschyna (51.040 N, 34.932 E) — June 2015. Bird species diversity is similar to sites 1 and 2. The site has comparatively high human disturbance factor, but less than in the arboretum (site 2). Duration of observation: 81 h, with 9243 interspecific and intraspecific contacts recorded.

The conventional ethological methods of "total surveillance" and "continuous logging" (Altmann, 1974; Popov, Ilchenko, 2008) were used. Definition of interspecific and intraspecific interactions (meaning tolerant and intolerant (aggressive) interactions) follow Sushma, Singh (2006) and Panov, (1983).

For statistical analysis the software package "STATISTICA 7.0" was used. Similarities of birds communities were tested with Jaccard index. Absolutes data were tested for normality and correlations of performance were determined, by using parametric and nonparametric methods, correspondingly. Since all species interact with each other during the observation period, hierarchical claster analysis was conducted by Ward's method with Euclidean distances, as it fits better for grouping types by aggression activity. Nonparametric Wilcoxon Matched Pairs Test set accurate similarity aggressive behaviour in different areas. The calculation of the success rate of the aggression reaction was carried out according to the already tested scheme on the example of the Muscicapidae birds (Markova, 2016).

## Results

Twenty-one species of birds of the orders Passeriformes and Piciformes were equally often at the watering places, which is common for all studied territories:

*Dendrocopos major* (Linnaeus, 1758) — Great Spotted Woodpecker
*Dendrocopos medius* (Linnaeus, 1758) — Middle Spotted Woodpecker
*Dendrocopos minor* (Linnaeus, 1758) — Lesser Spotted Woodpecker
*Hippolais icterina* (Vieillot, 1817) — Icterine Warbler
*Sylvia atricapilla* (Linnaeus, 1758) — Blackcap
*Phylloscopus collybita* (Vieillot, 1817) — Chiffchaff
*Phylloscopus sibilatrix* (Bechstein, 1793) — Wood Warbler
*Muscicapa striata* (Pallas, 1764) — Spotted Flycatcher
*Ficedula albicollis* (Temminck, 1815) — Collared Flycatcher
*Erithacus rubecula* (Linnaeus, 1758) — Robin
*Turdus merula* Linnaeus, 1758 — Blackbird
*Turdus philomelos* C. L. Brehm, 1831 — Song Thrush
*Parus caeruleus* Linnaeus, 1758 — Blue Tit
*Parus palustris* Linnaeus, 1758 — Marsh Tit
*Parus major* Linnaeus, 1758 — Great Tit

*Sitta europaea* Linnaeus, 1758 — Nuthatch
*Certhia familiaris* Linnaeus, 1758 — Treecreeper
*Fringilla coelebs* Linnaeus, 1758 — Chaffinch
*Carduelis chloris* (Linnaeus, 1758) — Greenfinch
*Carduelis carduelis* (Linnaeus, 1758) — Goldfinch
*Coccothraustes coccothraustes* (Linnaeus, 1758) — Hawfinch

In addition, in KNR and Alexandria also often were observed:

*Ficedula parva* (Bechstein, 1794) — Red-breasted Flycatcher
*Ficedula hypoleuca* (Pallas, 1764) — Pied Flycatcher

In Vakalivschyna:

*Motacilla alba* L. 1758 — Pied Wagtail
*Aegithalos caudatus* (Linnaeus, 1758) — Long-tailed Tit

In Alexandria and Vakalivshchyna:

*Spinus spinus* (Linnaeus 1758) — Siskin

According to Jaccard index, all three biocenoses are similar in pairs: KNR and Alexandria — 96 %, Alexandria and Vakalivschyna — 85 %, KNR and Vakalivschyna — 81 %. Considering such a similarity, we suggested that the same species of birds in different areas perform the same roles in interspecies aggressive contacts, which can be estimated by the rate of success.

These birds were grouped by the intensity of expression of aggressive behavior (figs 1–3), where the most aggressive species are isolated in the most remote clusters, while the least aggressive are grouped together, and the position of these species was analyzed in different areas. The main active aggressors in experimental areas are:

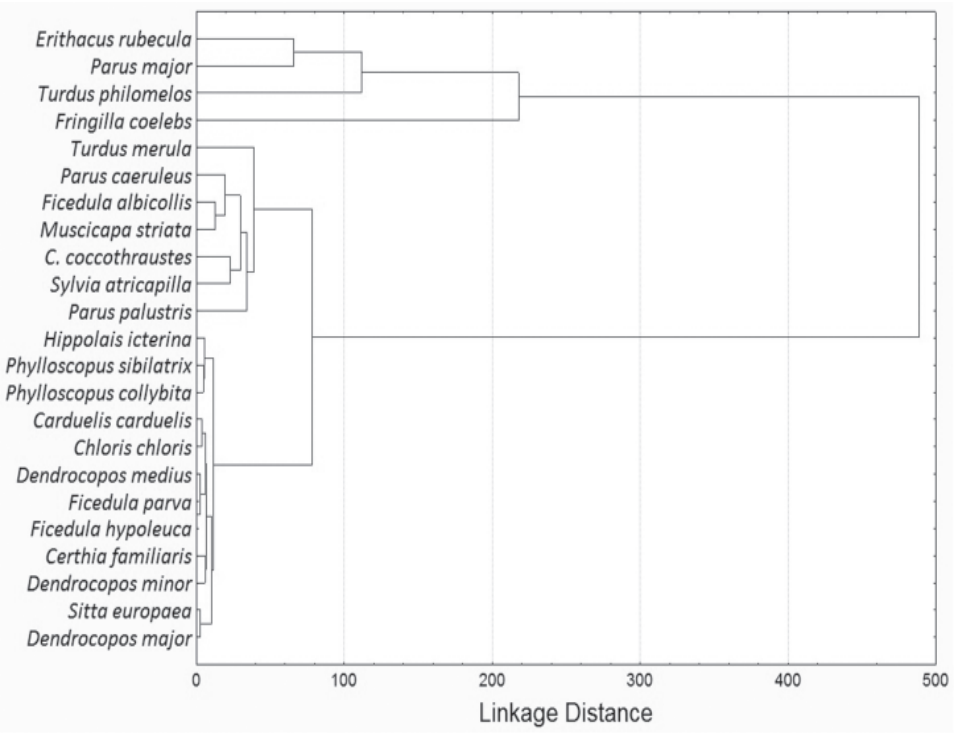


Fig. 1. Grouping of species distribution by demonstration of aggressive behavior at watering places in Kaniv Nature Reserve.

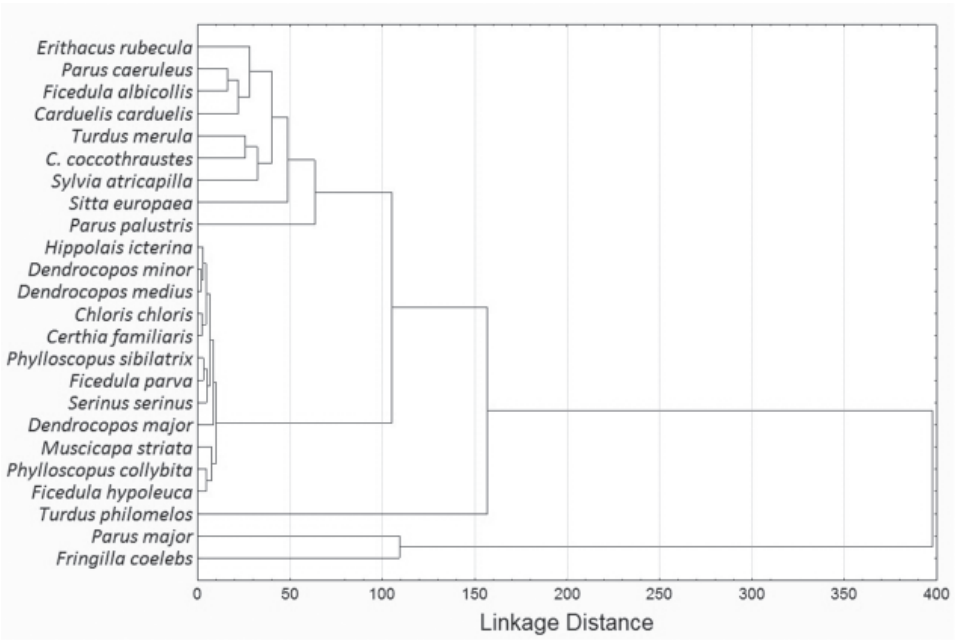


Fig. 2. Grouping of species distribution by demonstration of aggressive behavior at watering places in the State Arboretum "Alexandria".

*F. coelebs*, *Coc. coccothraustes, T. merula*, *T. philomelos*, *P. major, P. palustris, P. caeruleus*, *F. albicollis*. At the same time in KNR and "Alexandria" they also include *S. atricapilla* and *E. rubecula.* And in "Vakalivschyna" and "Alexandria" *S. europaea* and *C. carduelis*. Based on this distribution, we assume that the number of the last four species at the places is quite different, or they are sensitive to environment with high antropogenic impact that shows elevated levels of aggressive behavior.

Analysis of the rating of success of birds in defence and attack in interspecies conflicts in the study area nonparametric with Wilcoxon Matched Pairs Test revealed no significant differences (table. 1). That is, the results are considered typical for above-mentioned interspecies relationships of the birds, in the nesting period. It was shown that these birds almost identically respond aggressively to the same competitor species and almost the same number of times in similar circumstances (not only

**Table 1. The reliability of the similarity of demonstration of aggression by birds in different areas (Wilcoxos test)**

| Wilcoxon Matched Pairs Test. Marked tests are significant at p < .05000 | | | | |
|---|---|---|---|---|
| | N | T | Z | p-level |
| Kaniv, defense & Alexandria defense | 23 | 75.0000 | 1.916142 | 0.055348 |
| Kaniv, defense & Vakalivschina, defense | 21 | 106.0000 | 0.330198 | 0.741251 |
| Kaniv, attack & Alexandria, attack | 23 | 101.0000 | 1.125353 | 0.260440 |
| Kaniv, attack & Vakalivschina, attack | 21 | 99.5000 | 0.556122 | 0.578128 |
| Alexandria defense & Vakalivschina, defense | 22 | 79.0000 | 1.268654 | 0.204565 |
| Alexandria, attack & Kaniv, attack | 23 | 101.0000 | 1.125353 | 0.260440 |
| Alexandria, attack & Vakalivschina, attack | 22 | 73.0000 | 1.194645 | 0.232226 |
| Vakalivschina, defense & Kaniv, defense | 21 | 106.0000 | 0.330198 | 0.741251 |
| Vakalivschina, defense & Alexandria defense | 22 | 79.0000 | 1.268654 | 0.204565 |
| Vakalivschina, attack & Kaniv, attack | 21 | 99.5000 | 0.556122 | 0.578128 |
| Vakalivschina, attack & Alexandria, attack | 22 | 73.0000 | 1.194645 | 0.232226 |

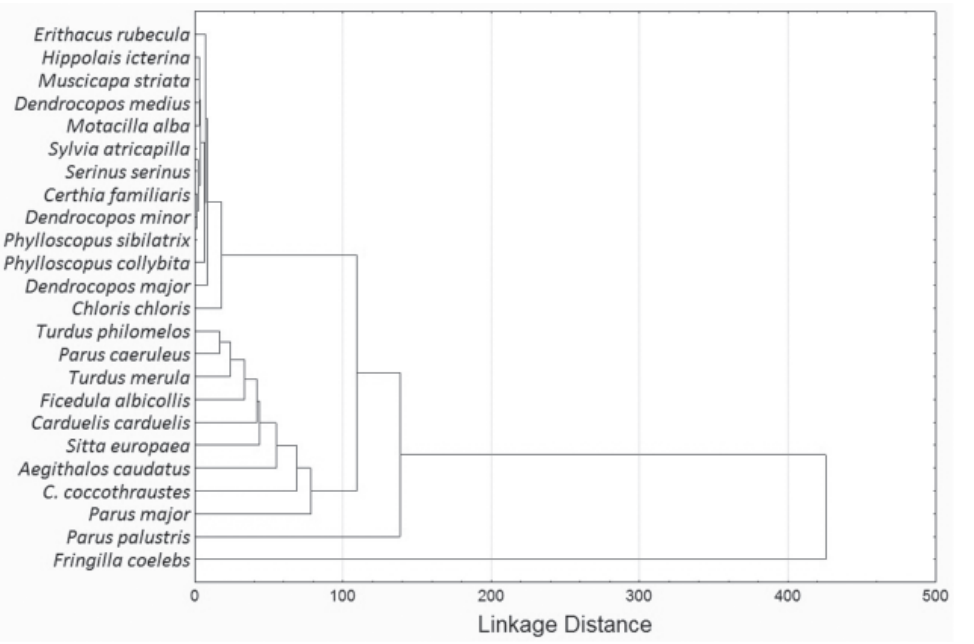


Fig. 3. Grouping of species distribution by demonstration of aggressive behavior at watering places in biological educational and research institution "Vakalivschyna".

the environment but also the condition of neighbor birds community). Thus, the hypothesis is confirmed.

The practical difference in rating of success of species in aggressive contacts in the defence of its territory (time on watering, personal space) and attack (figs 4–6),

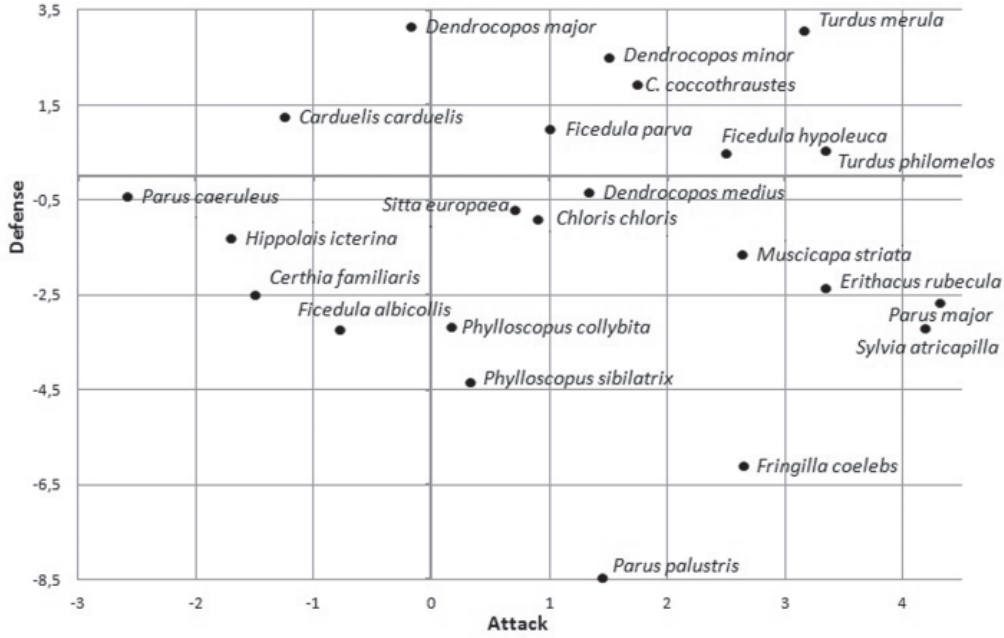


Fig. 4. Rating of success of attack and defense of birds in Kaniv Nature Reserve.

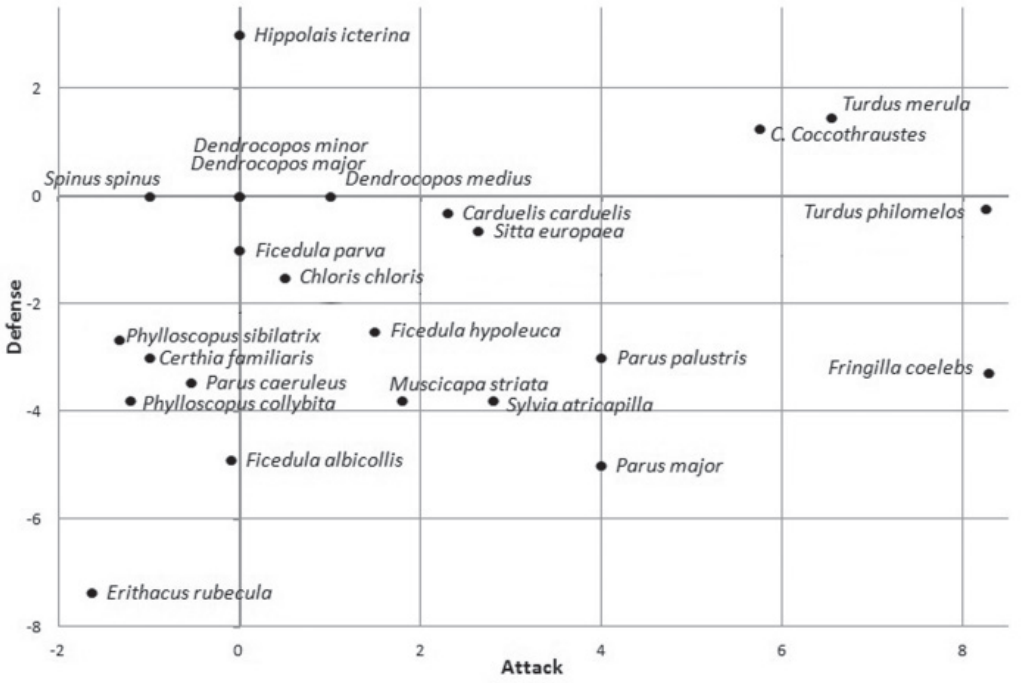


Fig. 5. Rating of success of attack and defense of birds State Arboretum "Alexandria".

indicating the lability of individual adaptation of species for existence under different conditions that depends on many factors (the availability of resources, competition, size

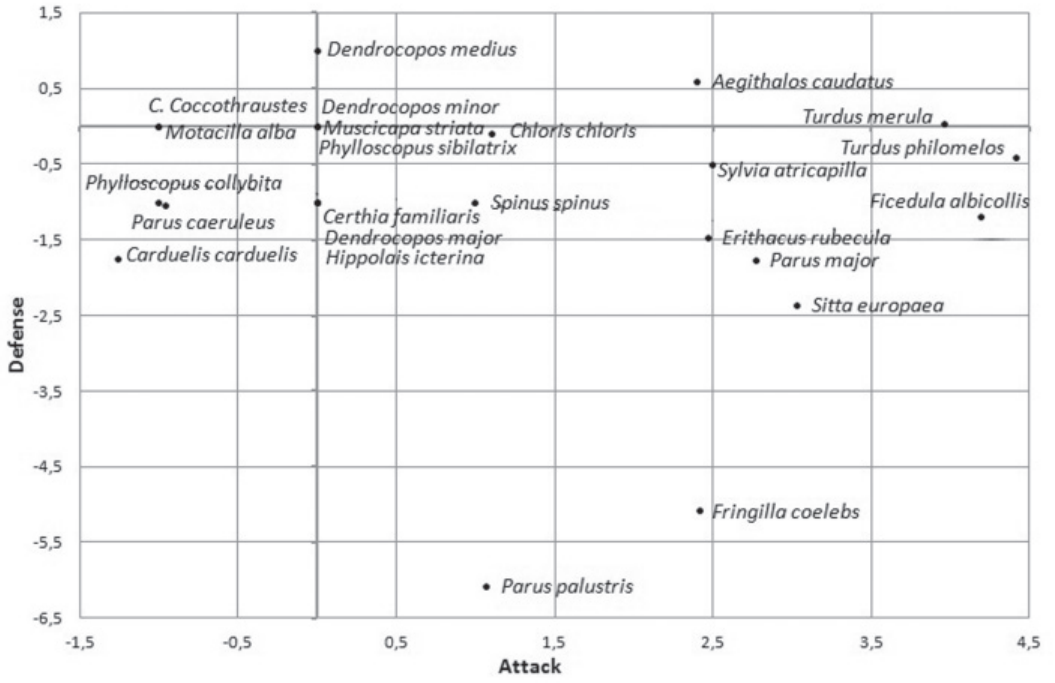


Fig. 6. Rating of success of attack and defense of birds in biological educational and research institution "Vakalivschyna".

**Table 2. Index of connection between the rating of success in aggressive behavior and general demonstration of aggression of birds on watering places**

| Rating | Kaniv | Alexandria | Vakalivschyna |
|---|---|---|---|
| | Sum of aggression | | |
| Defense | –0.17 | -0.06 | **–0.69** |
| Attack | **0.54** | **0.81** | 0.34 |
| Mean rating | 0.18 | **0.52** | –0.23 |

Note. Marked correlations are significant at $p < 0.05$, N = 21 (Casewise deletion of missing data)

and population density on the territory of their own species and others). In addition, this division rating indicates the most dominant or subordinate status in the form of interspecies relationships.

Most bird specie in KNR and Vakalivschyna had high success rating of attack. In Alexandria, most of birds have low success rating of territory defence.

According to the obtained result and the logic of the possible distribution of the variants of success, the species form four groups:

1. Successfully defending and attacking (an undisputed dominant in the area).
2. Well defending, but not successful in attack.
3. Poorly defending and attacking, (indisputable subordinates).
4. Successfully attacking but poorly defending.

*Turdus merula* belongs to the first group of species; it dominated on any territory. *Turdus philomelos, C. coccothraustes, F. albicollis, F. hypoleuca, D. minor* also dominated in KNR. *Aegithalos caudatus* and *D. medius* dominated in Vakalivschyna. *Coccothraustes coccothraustes* and *D. medius* dominated in Alexandria

In to the second group in the different areas were a different species. In Alexandria, such success of aggressive behavior is typical for *S. spinus*. In Vakalivschyna: *D. medius, Coc. coccothraustes*, and *M. alba*. In KNR: *C. carduelis* and *D. major*.

*Parus caeruleus* and *C. familiaris* belong to the third group of species and are subordinates in studied biocenoses. Despite their activity in aggressive behavior, it is obviously energetically inexpedient. In KNR, to this group also belong *F. albicollis* and *H. icterina*. In Vakalivschyna: *P. collybita, C. carduelis, D. minor, H. icterina*. In Alexandria: *E. rubecula, F. albicollis, F. parva, Ph. sibilatrix, Ph. collybita*.

To the forth group belong: *S. europaea, Ch. chloris, F. coelebs, P. palustris, P. major, S. atricapilla.* In addition, as it was described above, these species are the most aggressive. Most likely, the strategy of interspecies behavior directed at active fast attack, and they do not waste energy on defending the teritory. This category also includes: *D. medius, M. striata, E. rubecula, Ph. sibilatrix, Ph. collybita* in KNR, *T. philomelos, S. spinus, F. albicollis, E rubecula* in Vakalivschyna, and *T. philomelos, C. carduelis, M. striata, F. hypoleuca* in Alexandria.

There is a connection between common manifestation of aggressive behavior of species and rating of success of the same aggression (table 2). Thus, in KNR, connection of medium strength ($r = 0.543$; $p < 0.05$) aggression with the success of the attack, and in Vakalivschyna there is reverse significant correlation ($r = –0.697$; $p < 0.01$) between aggression and progress in the defence. At the same time, Alexandria is characterized by a strong correlation ($r = 0.818$; $p < 0.01$) between the attack and the average ($r = 0.520$; $p < 0.05$) with the mean rating of species.

## Discussion

The size of the individuals of a species is believed to be usually linked to positive correlation with the rank of interspecific hierarchy (Ivanitskiy, 1982). To test this hypothesis,

the length and weight of different species of birds based on the field key "Birds of Ukrainian fauna" (Fesenko, Bokotey, 2002) and the data obtained about on the mean and specifically for the rating of success for species attack and defence. Using nonparametric methods, correlation of species size parameters with the overall rating of success of aggressive behavior (attack + defense) in KNR (weight $r = 0.642$; $p < 0.01$ and size $r = 0.637$; $p < 0.01$) and in the Alexandria (weight $r = 0.642$; $p < 0.01$ and size $r = 0.546$; $p < 0.01$) was shown. In Vakalivschyna, no proofs of such connection were found.

Similar studies by Sushma and Singh (2006) claim that size parameters of species have a little effect on aggression, but the gender and age are important. The meta-analysis of the data from 81 scientific papers found that the correlations between the behavior in general are weak and varied in magnitude by themselves because of compared features (Garamszegi et al., 2013). They found out that different correlations is unlikely to occur because of differences in recurrence related to the measurement of different features, and they believe that the most frequently evaluated behavioral traits are not necessary form the same independent domains. Generally between behavioral acts there is a positive correlation of medium strength, as shown in our work above.

The dominance phenomenon was observed in nature (as in our study) and checked in aviaries and by analysis of mitochondrial DNA (Grava et. al., 2012). This all pairwise intraspecific and interspecific interactions were observed in winter feeders, while in our research we were observing at watering places in the breeding season, when watering is necessary and frequent seat of birds. At the same time Grava A. and collaborators determined the dominance of a small number of species using the Binomial and Fisher tests.

Sushma and Singh (2006) deeply analysed of interspecies hierarchy of four primate species of using $x^2$-test and behavior analysis during three different seasons and considering the overlapping of feed niches and other parameters. Meanwhile, in this study according to non-standard exiting data non-parametrical methods of analysis were also used, with an emphasis on overall distribution of dominance at every certain territory only by the reaction of aggression.

In this study, possible scenarios of aggressive behavior on the ground watering for natural and anthropogenically modified territories. It corresponds to the conclusions of Colléter and Brown (2011) and Dingemanse and de Goede, (2004) that the differences in participation of birds in social interactions are important for explaining differences in individual adaptive behavior of animals and are the part of evolutionary process.

Summarizing, the distribution of success of combined roles of birds in grouping shows the mechanisms of establishing of interspecies hierarchies and to make a decision of the competitive significance of the area and neighboring species. The dominant species always winning the conflict get more resources and effective influence on the structure of bird community. This is useful for analysis of condition of the certain bird species populations and their success in competitive interactions in protected areas and for explaining historical changes in different types of habitat, changes in species behavior, fodder, etc.

## Conclusion

We established that aggression manifestation of birds in different territories are similar. According to the ratings, four types of birds position in the ranking were allocated and the species always holding to them in any area are established. The *Turdus merula* is always dominating, whereas the *Parus caeruleus* and *Certhia familiaris* occupy a subordinate position. *Sitta europaea*, *Carduelis chloris*, *Fringilla coelebs*, *Parus palustris*, *Parus major*, and *Sylvia atricapilla* are characterized by active successful attack, but have low defense rating. These results can be used in analyzing

the adaptation of certain bird species in communities and their success in competitive interactions in different areas.

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