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Relationship between vegetation structure and abundance of Great-spotted Woodpeckers *(Dendrocopos major)* in a mosaic habitat

Gábor Ónodi[1] & Tibor Csörgő[2]

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Abstract This study was made in a postglacial relic bog in the Ócsa Protected Landscape Area in Hungary. Secondary succession of vegetation began after peat extraction and a grove-like forest evolved. Among the eight woodpecker species that occur in this area, the Great-spotted Woodpecker is the most abundant with the largest amount of data, it is for this reason we chose this species to study. The aims of this work were to detect changes in the abundance of the study species in relation to forest succession; to examine the seasonal patterns of these changes in abundance, and to identify any relationship between the height of the trees near the nets and the number of captured birds. We used the data from 1411 mist-netted Great-spotted Woodpeckers (1984–2010), which were captured at the Ócsa Bird Ringing Station (120 standard mist nets). The assessment of forest succession rates were based on aerial photos (1979–2010). We measured the height of the vegetation, at 12 points, near each 12 m long net. Population growth of Great-spotted Woodpeckers was significantly correlated with the rate of afforestation. The majority of birds occurred only during the dispersal period. The pattern of the captures correlated well with the vegetation structure, not just with height, but also with vegetation quality as well.

Keywords: forest fragmentation, arboreal vegetation characteristics, succession, habitat preference, population dynamics

Összefoglalás Vizsgálatainkat az Ócsai Tájvédelmi Körzet területén végeztük, egy posztglaciális reliktum lápszegélyen. A terület beerdősülése a tőzegbányászat befejeztével kezdődött el. Mára mozaikos, kis facsoportokból álló ligetes fás vegetáció alakult ki. A munka során az Ócsai Madárvártán 1984-2010-ig, 120 db függőnyhálóval befogott és meggyűrűzött nagy fakopáncsok adatait dolgoztuk fel. A nyolc eddig megjelent harkályfaj közül a nagy fakopáncs a leggyakoribb, erről a fajról gyűlt össze eddig a legtöbb adat, ezért lett ez a vizsgált faj. A következő kérdésekre kerestünk választ: az erdősülés üteme mentén hogyan változott a vizsgált faj éves egyedszáma? Milyen az egyedszámok szezonális mintázata? Korrelál-e a fogásszám a hálók melletti fák magasságával? A vizsgálati periódusban 1411 fogási adat gyűlt össze a vizsgált fajról. A szukcesszió ütemét 1979, 1992, 2000, 2005 és 2010-ben készült légifotók alapján becsültük meg. A vegetáció magasságát a 12 m-es hálók mentén, a háló mindkét oldalától 5 és 10 m-re, 4 m-es szakaszokban mértük meg. Az évenkénti egyedszám pozitívan korrelált az erdősülés ütemével. A legtöbb madár a júliustól októberig tartó diszperziós időszakban jelent meg, és csak rövid ideig tartózkodott a területen, mivel a revírek a rezidens egyedek által már telítettek voltak. A fogásszámok pozitívan korreláltak a vegetáció magasságával, de a vegetáció számos más jellemzője is befolyásolta az egyedek élőhely preferenciáját, pl. preferált fafajok, illetve táplálékban bővelkedő holtfák jelenléte.

Kulcsszavak: erdő fragmentáció, fásszárú vegetáció jellemzői, szekunder szukcesszió, élőhely-preferencia, populációdinamika

[1] *Institute of Wildlife Management and Vertebrate Zoology, University of West Hungary, 9400 Sopron, Ady Endre utca 5., Hungary, e-mail: onodi.gabor@emk.nyme.hu*
[2] *Department of Anatomy, Cell- and Developmental Biology, Eötvös Loránd University, 1117 Budapest, Pázmány Péter sétány 1/c, Hungary, e-mail: csorgo@elte.hu*

Introduction

This study was carried out at the perimeter of a postglacial relic bog. This area is at the stage of early successional forest, such habitats are very important, because of their high biodiversity, complex food webs and ecosystem processes. Numerous opportunist and specialist species can settle there (Swanson *et al.* 2011). This area also has importance to species, because these kinds of habitats can be green corridors or stepping stones for them in a fragmented forest landscape, a common situation in Hungary.

These habitats are not preferred by most of the European woodpecker species, they are present, though at lower densities. The Great-spotted Woodpecker can reach higher densities than the other European woodpecker species can (Gorman 2004). Nine of the ten European woodpecker species live in Hungary (Gorman 2004). So far (1983–2010), eight woodpecker species have been recorded in the study area. Among them, the Great-spotted Woodpecker is the most common and most abundant. According to our ringing data, this is the only species with more than one breeding pair per year, and the other species don't breed yearly. The Great-spotted Woodpecker is a generalist species, and can inhabit various wooded habitats (Török in Csörgő *et al.* 2009). They can nest in closed or fragmented forests, and even in urban parks and orchards (Gorman 2004). As an opportunist, this species could be the first woodpecker species, to settle in an early stage succession forest. They help the other cavity-nester species, to settle (Carlson *et al.* 1998, del Hoyo 2002).

The number of birds occurring in an area varies seasonally (del Hoyo 2002). Every year, in summer, full-fledged young woodpeckers leave their parents' territory and disperse to occupy new territories (Kesler & Walters 2012). During this period, the density of woodpeckers can increase rapidly. They can cross tens of kilometres, to reach the appropriate woodlot, forest patch or closed forest (Howe 1984, Török in Csörgő *et al.* 2009). These dispersal movements finish in late autumn, and so the density of birds is stable in the other seasons.

During the study period from 1983 to 2010, succession was undisturbed, and the extent of the area, covered by arboreal vegetation increased steadily. The trees became older, providing better food sources for the Great-spotted Woodpeckers (del Hoyo 2002, Gorman 2004).

In this study, we examined through ringing records, if there are any seasonal patterns in the number of the Great-spotted Woodpeckers in the area. We also study if there is a relationship between the number of birds and the extent of tree coverage, and finally, we would like to determine, if there is a relationship between the height of the trees and the number of capturing occasions. Our aims were to examine the seasonal patterns of the species' abundances, to detect the changes in the abundance of the study species in relation to afforestation and to identify any relationship between the height of the trees near the nets and the number of captured birds in the five wooded blocks.

Material and methods

This research was carried out in Hungary, near Budapest (Ócsa, E 47^{o} 29' N 19^{o} 20') at the perimeter of a post-glacial relic bog in Ócsa Landscape Protection Area, which is the part of Duna-Ipoly National Park. There was intensive peat extraction in the area. In 1978, this area became protected, and that

Species	GSW	LSW	MSW	SW	GW	BW
All catches	1411	438	101	57	164	38
Ringed specimens	523	182	33	46	70	24
Recoveries	888	256	68	11	94	14
Recovered specimens	254	84	23	4	46	9

Table 1. The number of captures of each species in the study period
1. táblázat A különböző fajok fogási adatai a vizsgálati periódusban

extraction ceased. After this, secondary succession of wooded vegetation began. The size of the study area was approximately 30 hectares, of which tree coverage recently reached 20 hectares.

The canopy level is most provided by poplar (*Populus* spp.) and willow (*Salix* spp.) trees. There are also some other tree species, like Hungarian Narrow-leaved Ash *(Fraxinus angustifolia* ssp. *pannonica)*, Walnut *(Juglans regia)* and Hackberry *(Celtis occidentalis)*. In the shrub layer the most common species are Elder *(Sambucus nigra)*, Blackberry *(Rubus fruticosus)* and young specimens of willow species.

We used the data from woodpeckers caught using mist nets at the Ócsa Bird Ringing Station between 1983 and 2010. There are 120 standard Japanese-type mist nets in this area which are situated in standard net blocks according to the various vegetation types. Each mist net is 12 m long, 2.5 m high with 5 shelves. With this method, one can only catch woodpeckers that fly low through the area, but according to their foraging behaviour, it is common for birds to land on lower regions of trees and to climb upwards.

We assessed tree coverage by counting squares, which were covered by at least 50% by woody vegetation, on a grid of 10 m by 10 m. These were mapped on aerial photographs (which could be obtained from the years of 1979, 1992, 2000 and 2005) from the Institute of Geodesy, Cartography and Remote Sensing in Hungary and from Google Maps (2010). We studied and graphed the correspondence between number of caught specimens and the vegetation succession tendency. We fitted various lines on the points of the results, with GraphPad InStat (www.graphpad.com) and MS Excel (www.microsoft.com).

The mist nets are situated in standard net blocks representing various vegetation types. The first block is a willow-poplar woodlot next to a reedbed (6 nets). The second is also a willow-poplar woodlot, but with a numerous Elder bushes in the shrub layer (10 nets). The third is a willow-poplar-ash woodlot surrounded by reeds. There are young willow trees, Elders and Blackberries in the shrub layer (15 nets). The fourth is lining between bushes of Elder with Common Hop *(Humulus lupulus)* on them. At the end of the line, there are some large poplar and willow trees (10 nets). The fifth is on the bank of a channel. There are numerous large Hungarian Narrow-leaved Ashes all along the nets. There are some shorter willow, poplar and Walnut trees as well. There are Elders and Blackberries in the shrub layer (10 nets). We determined the specific location of the successful catches with the precision of 12 m, according to the standard numbered nets.

We measured the height of trees on transects lines running parallel with the nets,

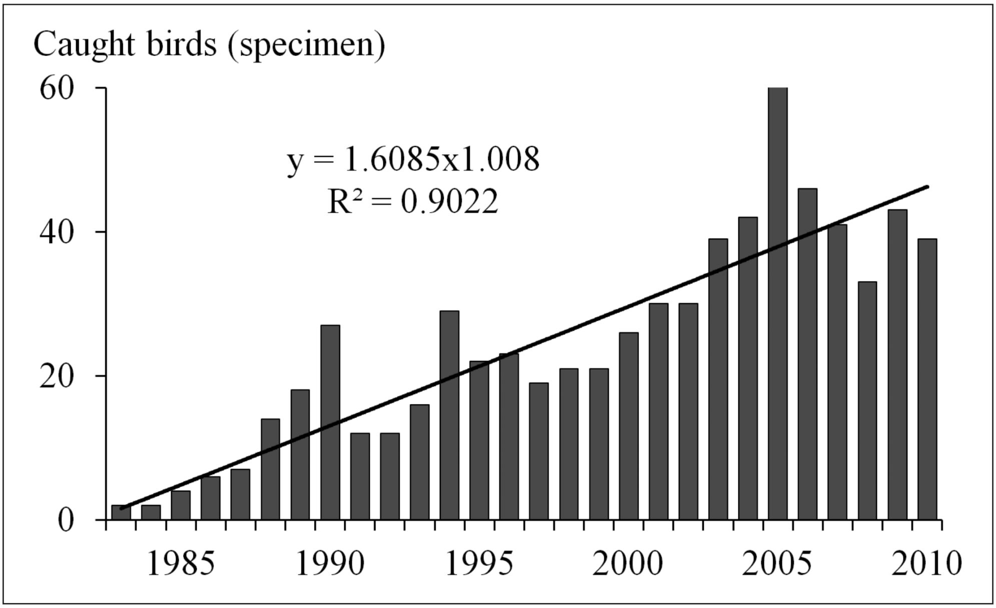

Figure 1. Yearly distribution of the number of caught Great-spotted Woodpeckers (fitted with the line of the best 'R2' value)

1. ábra A vizsgált faj egyedszámainak évenkénti eloszlása (a legjobb „R2" értékű illesztésekkel)

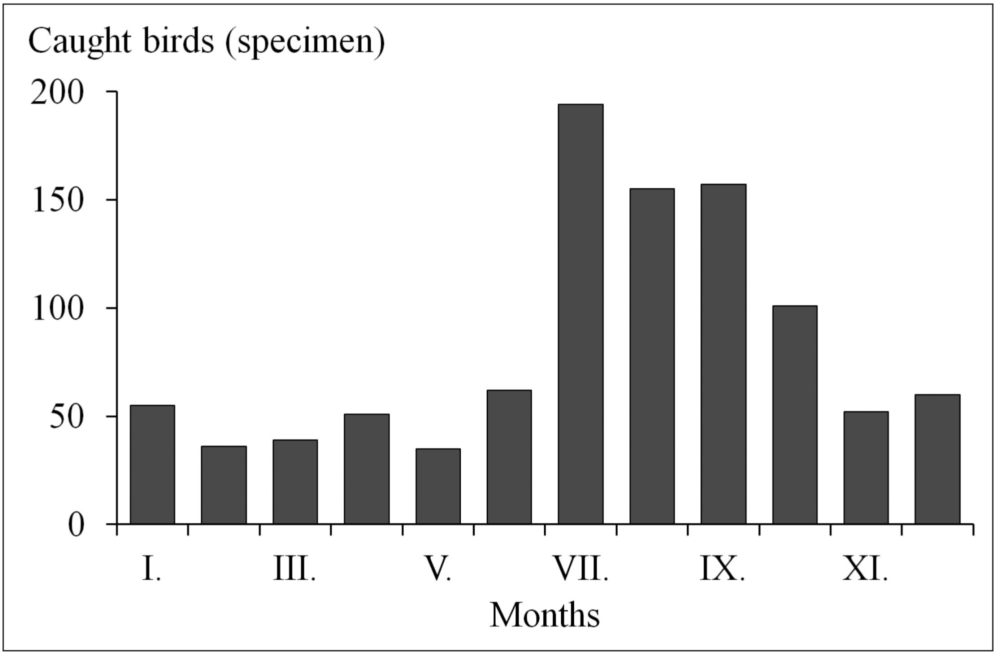

Figure 2. Monthly distribution of the number of captured woodpeckers

2. ábra A vizsgált faj egyedszámainak hónapok szerinti eloszlása at 5 and 10 m distance on both sides of the net. Measurements were made in three, 4 m long sections in each transect, resulting 12 records per net. The mean value of these 12 records gave the value of the vegetation profile. We made the measures with the Christen height meter. With this method, we measured the vegetation profile on the whole study area, because the nets were placed in the only small woodlots that are present in the study area. We determined six height categories (<5 m, 5-9.9 m, 10-14.9 m, 15-19.9 m, 20-24.9 m, >24.9 m) from the raw data in order to plot how frequent each height category was in the area.

We studied and plotted the relationship between vegetation profile and number of catches in the 5 net blocks. We fitted various lines with GraphPad InStat (www.graphpad.com) and MS Excel (www.microsoft.com).

Results

The study species increased in occurrence in the study period *(Figure 1)*. The majority of birds were captured from July to October, annually, with a peak in July. During the rest of the year, the number of birds caught was generally equal, with a moderate peak in March *(Figure 2)*.

Most of the birds caught had no or very few recoveries, although there were some birds which were caught more than 5 times or even more than 10 times *(Figure 3)*.

Tree coverage increased exponentially throughout the study period *(Figure 4)*. The abundance of the study species correlated positively with the increasing tree coverage *(Figure 5)*.

Almost half of the study area is covered by vegetation, shorter than 5 m, the higher vegetation categories are represented less and less *(Figure 6)*. Among all fitted lines, the logarithmic one appeared to be the best *(Figure 7)*.

Discussion

The studied area is fragmented, there are just small woodlots in this grove-like habitat, that makes a fragmented forest landscape. In the Ócsa Protected Landscape area these patches could be several hundred metres from each other. The study area is covers 30 ha of the total. So far, 8 woodpecker species of the 9 present in Hungary have already been recorded. The frequency of occurence of each species are different, because of their varied environmental needs. The study species increased in number in the time period. This species is a generalist which can attain high numbers even in fragmented landscapes (del Hoyo 2002, Török in Csörgő *et al*. 2009).

The majority of Great-spotted Woodpeckers were caught between July and October. This is the dispersal period of fully-fledged juveniles, when they look for foraging sites or try to occupy territories (Gorman 2004). The highest number of birds was caught in July. This activity decreases by October and so it is suspected that nearly all of these young birds abandon the area. The young birds fledge in June, in this month, their movements are mainly near the nesting cavity. Numbers of birds caught outside the dispersal period were generally even. It appears that this habitat can't support any more resident birds outside the breeding and dispersal periods, only the resident birds are present (del Hoyo 2002).

The strong relationship between the number of catches and the values of vegetation profile could be due to that there can be more prey in the taller, older and more

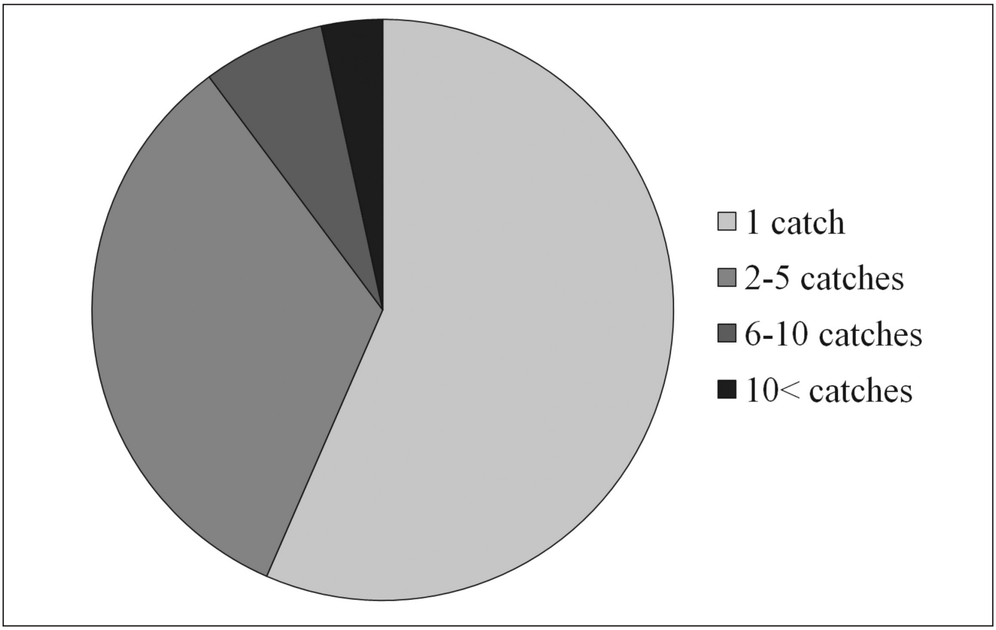

Figure 3. Distribution of the woodpeckers according to the number of catches
3. ábra A vizsgált faj egyedeinek fogásszám szerinti eloszlása

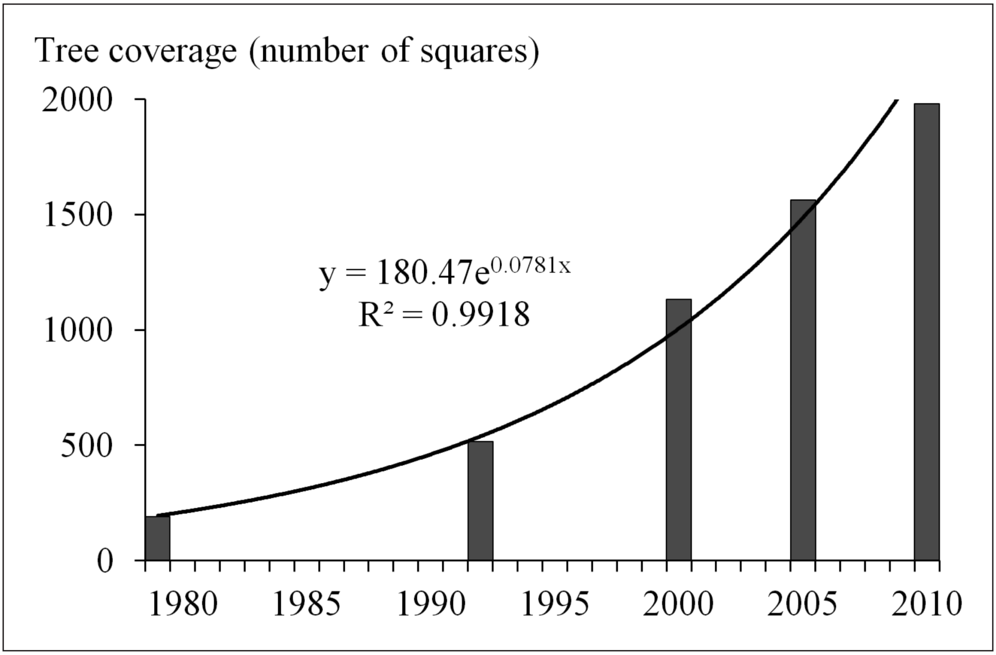

Figure 4. The tendency of tree coverage (fitted with the line of the best 'R2' value)
4. ábra A szukcesszió üteme a vizsgálati periódusban (a legjobb „R2" értékű illesztéssel)

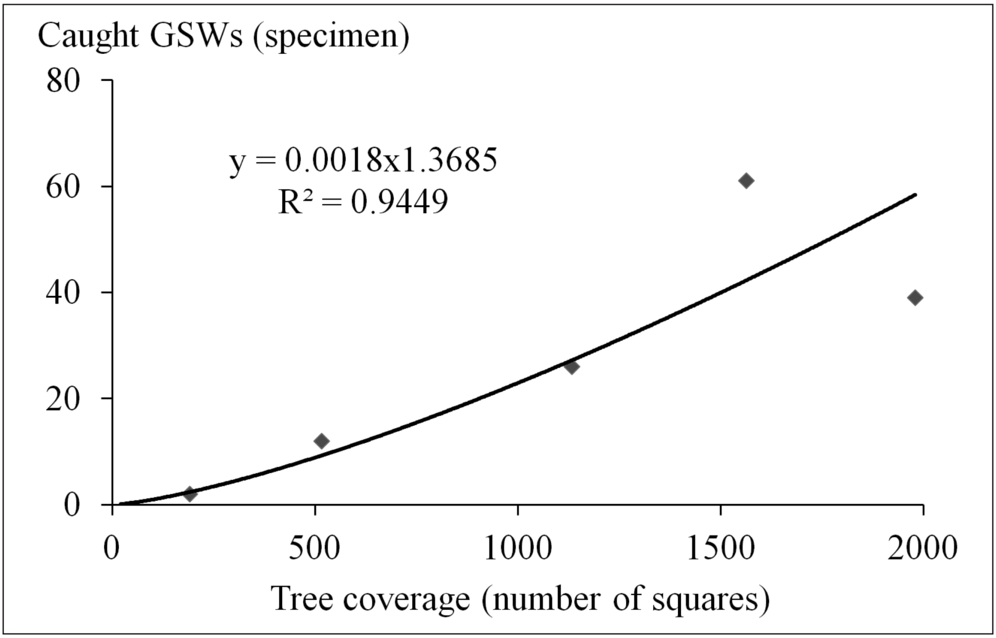

Figure 5. The relationship between tree coverage and numbers of the captured woodpeckers (fitted with the line of the best 'R2' value)

5. ábra A borítottság és az egyedszám összefüggései a vizsgált fajnál (a legjobb „R2" értékű illesztésekkel)

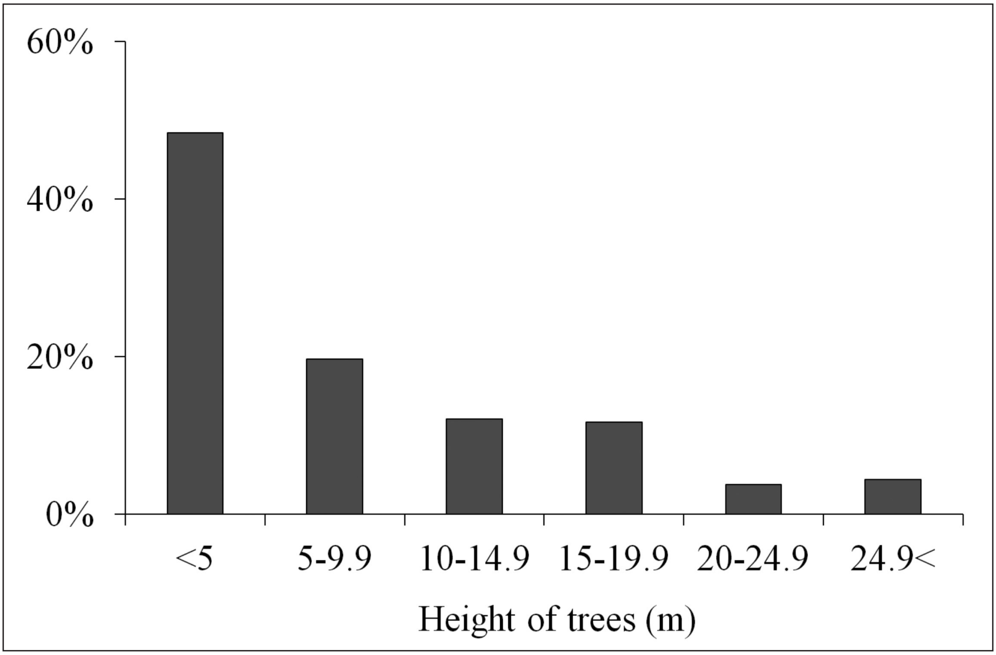

Figure 6. Percentage distribution of vegetation height according to the twelve sampling points per each net

6. ábra A vegetáció magasság szerinti eloszlása a vizsgált területen

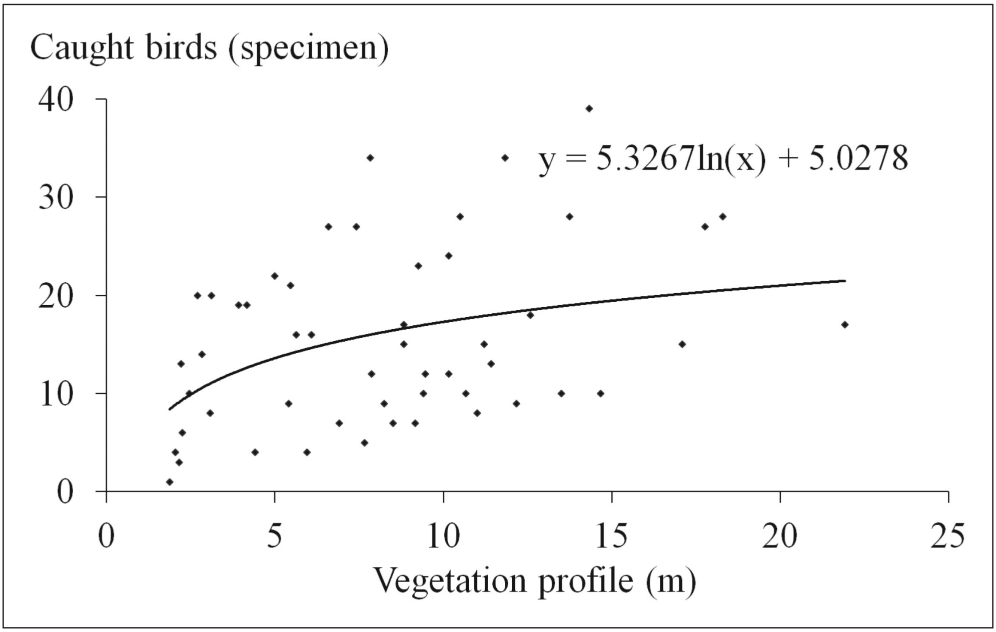

Figure 7. The relationship between vegetation profile and number of captured woodpeckers in each studied net block

7. ábra A vegetációs profil és a fogott példányszám korrelációja az összes hálóállás adataira

decayed trees (del Hoyo 2002, Gorman 2004). In the other hand woodpeckers prefer to move in the cover of trees to minimize the chance of encounter with predators such as Goshawk *(Accipiter gentilis)*, so the more dense the vegetation is, the safer it may be to forage there (Gorman 2004). According to our earlier studies, this is how the Great-spotted Woodpeckers mostly forage in this area. They look for their prey between branches, in the upper regions of trees (Ónodi & Csörgő 2012a, 2012c).

There were numerous cases when we've found extremely high capture rates in areas with low vegetation profile value. This may be due to the following characteristics of the habitat: there could be at least one specially preferred tree species, a decaying or dead tree with massive amount of prey, which could be a very important foraging site. There could be barkless, well-resonating branches too, on which the resident birds show their territorial drumming behaviour. There were nets, which showed extremely high capture rates despite the fact that the value of vegetation profile was low. This could be because the above-mentioned reasons. Above the net, in the woodlot, there live the highest trees in the study area (about 30 m high). Despite that, the vegetation profile value is low, because on the other side of the net there are just bushes, which decreased the value of the profile. There is a Walnut tree at a particular net, with low profile value. The study species prefers the nuts, so this could be the reason why we've found extremely high number of catches despite the very low vegetation (Cramp 1985, Székely 1987).

There were numerous nets without these mentioned preferable features, where we caught not surprisingly very few birds throughout the study period.

The prey species initially found their ecological needs in the quick-growing poplar and willow species, and so their populations have increased with the aging of the woodlots. Walnut trees occurred which are so preferred by the study species. Although the height of the vegetation has grown in the study period, the variation between the height of different vegetation types haven't changed so much. The present tallest trees were also the tallest ones at the start of the study. The shorter trees were in the shrub layer, so the nets under taller trees caught more birds than nets under shorter trees during the whole study period. The trees which are preferred nowadays, were preferred in the past too because there were more insects in the larger trees than in the younger, and, shorter ones. There could be some unpredictable circumstances, wood diseases, heart rot etc. which could make trees decay, to become important foraging or drumming objects. This could be some of the reasons for the pattern of catches changing throughout these years at nets under shorter trees (Gorman 2004, Ónodi & Csörgő 2012b).

As tree coverage increased over the years of the study, increasing numbers of woodpeckers came to the area during the dispersal period, from July to October. Most Great-spotted Woodpeckers left in autumn without being re-caught. Only a few birds spend the whole year as residents in the area. If the tendency of succession continues and edge effect decreases, no doubt more individuals will appear during dispersal periods, and more resident birds and even more nesting pairs of the sedentary species will probably occur (McWethy *et al*. 2009, Ónodi & Csörgő 2011, 2012b).

Numerous authors have studied the role of Picids in forest bird communities (Mannan *et al*. 1980, del Hoyo 2002, Gorman 2011), including how the changes in wooded habitats could affect the woodpeckers and their secondary cavity-nester species, or other bird species (Drapeau *et al*. 2000, Conner *et al*. 2002, Machmer 2002, Fink *et al*. 2006, Moore & Conroy 2006, Herrando *et al*. 2009, Franz *et al*. 2010, MacGregor-Fors *et al*. 2010). Conservation management of numerous forests influenced positively the density of secondary cavity-nesters (Zarnowitz & Manuwal 1985, Reed 1990, Wilson *et al*. 1995, Plentovich *et al*. 1998). For a couple of decades, numerous nest boxes were placed in the study area and the secondary cavity nesters mostly nest in them. These nest boxes were placed there to aid the settlement of these species. In some habitats the study species is a serious nest predator for hole-nester bird species, and some species avoid using the cavities of the Great-spotted Woodpecker (Wesolowski 2007). In spite of this, the arboreal vegetation of this area is still young, so this habitat hasn't got many tree hollows that usually occur in decaying trees. For this reason the cavities made by the study species could be the main choice for secondary cavity-nesters.

If the tendency of succession continues and edge effect decreases, no doubt more woodpeckers will excavate more cavities and more secondary cavity nester species will settle.

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Behavioural responses to handling stress in the Great Tit: within-individual consistency and the effect of age, sex and body condition

Gábor Markó[1, 2, 3*], Manuel Azcárate[4, 5], Gergely Hegyi[3], Gábor Herceg[3], Miklós Laczi[3], Gergely Nagy[3], Juan Carlos Señar[6], János Török[3], László Zsolt Garamszegi[4]

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Abstract In birds, individuals may show different behavioural and physiological responses when handling, and such variation may be related to individual differences in antipredator strategies. We performed a pilot study in both breeding and wintering populations of the Great Tit *(Parus major)*, and we characterised three typical behavioural traits during a standard ringing procedure in captured birds. We assessed between-individual variations in breath rate, pecking rate and the number of distress calls displayed in response to handling, and also calculated the within-individual variation of these traits by repeated behavioural measurements. We found that these behaviours were consistently displayed within individuals (with repeatability varying between 0.44 and 0.82), and there was also some modest correlation between them (e.g. breath rate covaried with the number of distress calls). Furthermore, using multivariate linear models assessing a role of some potential predictors we found that a considerable amount of between-individual variation can be explained by sex and age differences and also by variation in body condition. However, the magnitude and direction of these relationships was inconsistent across seasons. Our results are in line with previous findings that several consistent behavioural traits measured during human handling could reflect individual specific antipredator strategy, but some confounding effects cannot be ruled out. Hence, our preliminary results require careful interpretation, and further studies are needed to assess the exact magnitude by which different behavioural traits are inter-related.

Keywords: acute stress response, animal personality, coping style, repeatability

Összefoglalás A madarak az emberi jelenlétre adott egyedi viselkedései és fiziológiai válaszai tükrözik a ragadozók elleni stratégiákban megnyilvánuló egyedi különbségeket. Elővizsgálatunkban egy természetes populációiból származó költő és telelő széncinege *(Parus major)* egyedeket fogtunk meg és vizsgáltunk a gyűrűzéseink alkalmával. A morfológiai bélyegek lemérésén túl, három jellegzetes viselkedést is dokumentáltunk: a légzési rátát, a csípési rátát és a leadott vészjelzések számát. A madarak viselkedésének ismételt mérése lehetővé tette, hogy a viselkedési bélyegeknek kiszámoljuk az egyeden belüli varianciáját. Eredményül azt kaptuk, hogy ezek a viselkedési bélyegek konzisztens egyeden belüli mintázatot mutatnak (a repetabilitás 0,44 és 0,82 között változva), valamint a vizsgált egyedeknél mért viselkedési bélyegek mérsékelt módon korrelálnak egymással (pl.: légzési ráta együtt mozog a leadott vészjelzések számával). Többváltozós lineáris modellek segítségével kimutattuk, hogy az egyedek között fennálló viselkedési változatosságot számos lehetséges változó közül az ivar, az életkor valamint a kondíció magyarázza a legnagyobb mértékben, bár mind a feltárt kapcsolatok erőssége, mind pedig azok iránya szezonfüggő mintázatot mutatott (tavaszi költés, ill. téli kóborlás). Eddigi eredményeink alapján elmondható, hogy az emberi kezelésekre konzisztens egyedre jellemző válaszokat kaptunk néhány viselkedési bélyegben. Ezen bélyegek együttesen tükrözhetik az egyedre jellemző ragadozó ellen mutatott egyedi viselkedési különbségeket is, bár ez utóbbi kapcsolatot eddig még nem vizsgáltuk. Jelen munkában bemutatott előzetes eredményeket az összefüggések további tisztázásáig fenntartásokkal kell kezelnünk.

Kulcsszavak: akut stresszválasz, állati személyiség, repetabilitás

G. Markó, M. Azcárate, G. Hegyi, G. Herceg, M. Laczi, G. Nagy,
J. C. Señar, J. Török & L. Zs. Garamszegi

[1] *Ecology Research Group, Hungarian Academy of Sciences, Hungarian Natural History Museum, Eötvös Loránd University, 1117 Budapest, Pázmány Péter sétány 1/c, Hungary, e-mail: magvacska@gmail.com*
[2] *Department of Plant Pathology, Corvinus University of Budapest, 1118 Budapest, Ménesi út 44., Hungary*
[3] *Behavioral Ecology Group, Department of Systematic Zoology and Ecology, Eötvös Loránd University, 1117 Budapest, Pázmány Péter sétány 1/c, Hungary*
[4] *Department of Evolutionary Ecology, Estación Biológica de Doñana-CSIC, c/Americo Vespucio, s/n 41092 Seville, Spain, e-mail: laszlo.garamszegi@ebd.csic.es*
[5] *University of Cordoba, Medina Azahara Avenue, 5 14071 Cordoba, Spain*
[6] *Behavioural & Evolutionary Ecology Associate Research Unit, CSIC, Museu de Ciències Naturals de Barcelona, Passeig Picasso s/n, Barcelona 08003, Spain*

Introduction

Individuals apply consistent behavioural and physiological responses to cope with environmental challenges, and adaptation at both levels includes several traits and their complex interactions. At the behavioural level, the consistent individual strategy is manifested as behavioural correlations and the involved traits usually form behavioural syndromes (Bell 2007). At the physiological level, consistency becomes transparent in the associations between the components of stress machinery, which ultimately define individual coping styles along the reactive and proactive axes (Koolhaas *et al.* 1999). Behavioural syndromes and coping styles are not independent of each other, because both have evolved for the same or similar function and it is likely that a mechanistic link exists between the two levels (i.e. hormone levels determine behavioural activity) (Coppens *et al.* 2010, Koolhaas *et al.* 2010). Recognizing the importance of consistent individual responses that are integrated within complex physiological and behavioural processes, it has been proposed that individual strategies become expressed in several levels (from physiology to life history) (Buchanan 2000, Réale *et al.* 2010). Given that most of the environmental challenges are non-predictable in nature, a range of individual strategies are maintained within the wild populations of animals.

One of the most important environmental stimuli to which each individual has to react somehow is the appearance of life-threatening predators. Individuals of many species develop several forms of antipredatior strategies, in which they apply morphological, physiological or behavioural means to reduce the chances of being predated (Sih *et al.* 2003, Bell 2005, Liker & Bókony 2009). These defence mechanisms are expressed in two different contexts, first to avoid the incidence of being captured and then to increase the probabilities of escape if already caught (Laiolo *et al.* 2004, Laiolo *et al.* 2009). Selection acting in one context does not necessarily have consequences for selection acting in the other. Importantly, consistent individual responses might be prevalent in both contexts, resulting in that different individuals apply different behavioural and physiological strategies when a predator threatens or catches them. Some choose to freeze in this situation, while others rather attempt to fight (Eilam 2005). The freezer strategy can be beneficial if it deceivingly suggests to the predator that the prey is of low quality (e.g. unhealthy or dead). On the contrary, fighting can be advantageous if it incurs injury costs to the predator. As with other non-predictable environmental changes, an individual cannot foresee what type of predator attack it suffers during its life, thus no only one advantageous escape behaviour is selected for. Hence, one can observe an entire distribution of freezing and fighting strategies in natural prey populations.

The combined physiological and behavioural reaction to a capture event often results in the increase in hearth and breath rates, the production of distress calls and intense fighting behaviour (e.g. pecking, biting, kicking, wriggling). Elevated hearth and breath rates can generally reflect the incurred levels of fear as perceived by any prey in risky contexts (Axelrod & Reisine 1984, Carere & van Oers 2004, Deviche *et al.* 2010). Therefore, such traits could be good indicators of acute stress response in both freezer and fighter individuals. Accordingly, it has been shown in different taxa, such as in the Three-spined Stickleback *(Gasterosteus aculeatus)* (Bell *et al.* 2010) and in Great Tit *Parus major* (Carere & van Oers 2004, Torné-Noguera *et al.* in press), that the presence of predator or handling by human positively affects respiratory rate. However, active vocalization and attempting to struggle with the predator should be typical in individuals that apply fighter strategy (Brodie 1978, Perrone 1980). In an experimental study on several species caught by mist-net, the potential functions of distress calls were tested in a predatory context (Conover 1994). In most of the species investigated, distress call was only emitted when captured by human observers.

Distress calls of birds may have evolved to function as a reliable pursuit deterrent trait of individuals that can be used in both the within- and between-species context (Laiolo *et al.* 2004). This vocal signal could also serve as startling the predators to loose its grip and to make it possible for the prey to escape, warning conspecifics about the danger or calling for help (Woodland *et al.* 1980, Högstedt 1983). Moreover, intense pecking behaviour of bird preys can not only affect the energy and time investment of the predator, but could also increase their accidental injuries from the pugnacious fight responses of preys with active escape behaviour. Human presence or the effect of temporary handling during the standard ringing and measuring protocols could also generate acute stress response or escape behaviour in birds (Møller 2008, Fucikova *et al.* 2009). Therefore, in addition to breath rate, the amount of distress calls and pecking rate during the human manipulation of birds have been widely used as standard measure of the degree by which individuals respond behaviourally and psychologically to a capture by predator (e.g. see: Romero 2004).

In this correlative paper, we report a pilot study on free living Great Tit, in which we aimed at establishing the behavioural ecological roles of escape behaviour. We captured individuals during breeding and wintering with different ecological and social contexts, and estimated breath rate, the number of distress calls and pecking rate upon handling. Most of the individuals were measured more than once within the same capture session, while others were recaptured in another sampling day, thus we could determine the repeatability of traits. We predicted that if consistent behavioural responses to handling stress exist, we would detect significant repeatability for each trait. Furthermore, such consistency may be manifested in the form of correlation between traits reflecting a similar phenomenon, thus we also predicted relationship between the behavioural variables. However breath rate may have another meaning than distress call or pecking rate, as the former reflect the levels of the experienced acute stress, while the latter signify the willingness to fight against the predator. Accordingly, we also expected weaker relationships for breath rate than for the other two traits. We also investigated sex, age and body condition in relation to the assessed behavioural responses. We hypothesized that these traits could be potentially important determinants of how individuals respond to a capture event, as these predictors likely describe inter-individual variation in experience, life history and physiology. Previous studies (e.g. Laiolo *et al.* 2009) showed that sex, age, and condition differences can affect antipredator behavioural responses, which might potentially reflect the degree of stress-susceptibility. Finally, we also predicted that estimates of antipredator and acute stress responses would vary between different ecological contexts as experienced during the favourable breeding and the harsh wintering seasons. The possible reason could be that both periods may require dissimilar individual energetic investment, but underlying ecological and social contexts are also different.

Materials and Methods

Study site and capturing protocol

Capturing protocols and behavioural tests were carried out in our study plots where a nest-box network had been established for the long-term ecological monitoring of hole-nest breeding passerines in the Pilis Mountains, nearby Pilisszentlászló, Hungary (47°43′N, 19°01′E). During the breeding season, the artificial nest-boxes ('B' type: Lambrechts *et al.* 2010) are occupied mainly by the non-migratory Great Tit and the migratory Collared Flycatcher *(Ficedula albicollis)*. Breeding birds were caught by conventional nets-box traps when they feed their young at the 8th-12th days after hatching. During winter, a vagrant population (not identical with the breeding population) is present in our field sites. In this season, we provide sunflower seeds at two feeding stations, around which we regularly perform capturing protocols using mist-nets. Wintering birds were tested between November and December in 2012, while breeding birds were measured between May and June in 2013. Both conventional nets-box traps and mist-nests were checked regularly within 15-25 minutes. Upon capture, we recorded catch date, catch time, time spent in the bird bag between capture and handling, and time of behavioural tests.

Behavioural tests

We performed measurements on escape behaviour within 5 min after capture. We have characterised 3 simple behavioural variables that are known to reflect individual stress response and/or fighting ability (Carere & van Oers 2004, Fucikova *et al.* 2009, Laiolo *et al.* 2009). First, breath rate (BR) was used to estimate the degree of acute physiological stress experienced during handling (Carere & van Oers 2004, Torné-Noguera *et al.* in press). We counted the number of respiratory movements within a given time (winter: 60 sec, spring: 15 sec), while holding the wings fixed and also ensuring reduced disturbance by visual and sound cues. Given that we used different timeframes for the two periods, we brought winter BR data into the scale of 15 sec by dividing the number of breaths by 4. Second, following BR measurements, we estimated pecking rate (PR) and distress calls (DC) by counting the number of pecks and calls that were emitted during the next 15 sec of handling (Fucikova *et al.* 2009, Laiolo *et al.* 2009). PR refers to the number of pecks against a straight finger positioned at 2-3 cm from the beak of the focal bird while holding by their legs. DC was simply the number of vocalized distress or alarm calls that we observed during the same PR trial. DC was only measured during spring, thus information on this trait is unavailable for the wintering period. Most birds (spring: N=27; winter N=11) were assayed 2 or 3 times at the same capturing session (45 ± 23 SD min apart) that allowed calculating within individual repeatability. The recapture rate of measured individuals within the same season was very low. Altogether 4 birds were recaptured in another day during winter, and we could obtain multiple measurements for 1 individual only during spring.

Morphological traits

Morphological measurements were carried out after the behavioural tests by a standardized protocol as follows. Body mass was measured with a Pesola spring balance (to the nearest 0.1 g) and tarsus length to reflect body size by using a sliding calliper (to the nearest 0.1 mm). Sex and age (first-year or older) were determined according to the typical plumage coloration (Svensson 2002). Individuals were then labelled by numbered rings and released. None of the birds died during the manipulations by hand.

To describe individual body condition, we calculated index of scaled body mass (SBM) based on the allometric relationship between body mass (BM) and tarsus length (TL) following Peig and Green (2009, 2010). This approach relies on the following formula:

$$SMB_i = BM_i \times \left(\frac{TL_0}{TL_i}\right)^{B_{SMA}}$$

where BM_i stands for body mass of individual *i*, TL_0 is the population mean of tarsus length (20.16 mm in our sample), TL_i is the tarsus length of individual *i*, while B_{SMA} is the slope of a regression line that originates from a reduced major axis regression between body mass and tarsus length after the log-transformation of data and exclusion of obvious outliers (1.735 in our sample). SMB index was standardized across seasons by using z-transformed values that bring the data into a common scale with 0 mean and unit variance.

Statistical analyses

Prior to analyses, all variables were checked for normality, and statistical transformations were applied if appropriate.

Repeatability was calculated as the ratio of between-individual variance and total variance. Such variance components were obtained from a Generalised Linear Mixed Model that included individual identity as a random factor (Nakagawa & Schielzeth 2010). To control for seasonal effects and also for the fact that some birds with multiple measurements were assayed in different days while others within the same capturing session, we also added season and date as covariates. To determine the statistical significance of the estimated repeatabilities, we performed a permutation test, in which we randomly shuffled the data and examined the probability of finding the true repeatability values within the distribution of permuted values reflecting random chances. To determine the confidence intervals around estimates, we applied a parametric bootstrap, in which data were simulated based on the estimated model parameters, and then the same model was fitted again to estimate repeatability. This procedure was

Season	Sex	BR Mean ± SE, n	PR Mean ± SE, n	DC Mean ± SE, n
Spring	Female	29.00 ± 0.99, 14	3.93 ± 0.90, 14	1.79 ± 0.98, 14
	Male	26.44 ± 1.06, 16	5.69 ± 1.63, 16	5.81 ± 1.72, 16
	Total	27.63 ± 0.75, 30	4.87 ± 0.97, 30	3.93 ± 1.08, 30
Winter	Female	37.42 ± 1.34, 6	8.54 ± 2.41, 6	
	Male	35.26 ± 1.15, 24	1.95 ± 0.46, 24	
	Unidentified	35.92 ± 1.88, 3	0.67 ± 0.42, 3	
	Total	35.71 ± 0.88, 33	3.03 ± 0.70, 33	
Repeatability		r = 0.502 (0.291/0.667), P < 0.001	r = 0.448 (0.222/0.643), P = 0.002	r = 0.842 (0.728/0.912), P < 0.001

Table 1. Descriptive statistics and repeatability (r) of three behavioural traits measured in response to handling by human in Great Tit during the wintering and breeding seasons. The repeatability of BR and PR were calculated from both spring and winter samplings, while data for the calculations of DC repeatability obtained from only spring sampling. The significance of repeatability estimates was determined by random permutation. In brackets, the 95% confidence intervals are given (lower bound/upper bound) that were calculated by parametric bootstrap (see materials and methods). In each trait, we provide the season and sex specific means ± standard errors with their sample sizes (n)

1. táblázat A táblázat a széncinegék humán kezelésre adott viselkedési bélyegeinek leíró statisztikáját és repetabilitását (r) mutatja be a költési és a téli időszakban. Míg a vészjelzések repetabilitásának kiszámolásához csak tavaszi adatok álltak a rendelkezésünkre, addig a légzési és csípési ráta repetabilitás értékének meghatározásához mindkét időszak mintavételéből származó adatokat fel tudtuk használni. A repetabilitás szignifikancia szintjét random permutációval határoztuk meg. A zárójelben feltüntetett 95%-os konfidencia intervallum alsó és felső határértékeit parametrikus bootstrap módszerrel számoltuk ki (ld. Anyag és módszer). Minden viselkedési bélyegnél megadtuk a szezononon belüli, ivaronkénti várható értéket és feltüntettük a standard hibával és a hozzájuk tartozó elemszámmal (n)

	Breath rate	**Pecking rate**	**Distress call**
Breath rate	–	Rspring = 0.137, N = 30 P= 0.464	Rspring = –0.394, N = 30 P= 0.028
Pecking rate	Rwinter = 0.322, N = 32 P = 0.052	–	Rspring = 0.215, N = 30 P= 0.244

Table 2. Correlations (R) of three behavioural traits measured in response to handling by human in Great Tit during the wintering and breeding seasons. Correlations are given as Spearman rank correlations with their sample size (N) and their significance level (P)

2. táblázat A táblázat a széncinegék humán kezelésre adott viselkedési bélyegeinek egymással alkotott korrelációit (R) mutatja be a költési és a téli időszakban. A korrelációk értékeit Spearman-féle rang korrelációval számoltuk ki, amelyek mellett a táblázatban feltüntettük a minta méretét (N) és a szignifikancia szintjét (P) is

	Winter						**Spring**								
Predictor variables	BR			PR			BR			PR			DC		
	F	df	P	F	df	P	F	df	P	F	df	P	F	df	P
Sex	0.104	1, 22	0.750	2.981	1,21	0.084	**4.601**	**1, 23**	**0.043**	**8.441**	**1,24**	**0.004**	**16.72**	**1,21**	**<0.001**
SBM	**5.181**	**1, 22**	**0.032**	**11.88**	**1,21**	**<0.001**	0.001	1, 23	0.974	2.636	1,24	0.104	**12.43**	**1,21**	**<0.001**
Age	0.681	2, 22	0.517	**6.881**	**1,21**	**0.032**	0.597	1, 23	0.448	**7.115**	**1,24**	**0.008**	0.485	1,21	0.486
Date of capture	0.913	1, 22	0.350	0.052	1,21	0.820	0.749	1, 23	0.396	2.193	1,24	0.139	**4.707**	**1,21**	**0.030**

Table 3. The effects of predictor variables (Sex, SBM/body condition, Age and Date of capture) on three behavioural traits displayed in response to handling in Great Tit during the wintering and breeding seasons. Effects originate from Generalized Linear Models with the corresponding behavioural traits as predictors. Significant statistical outputs highlighted in bold

3. táblázat A táblázatban a széncinegék humán kezelésre adott viselkedési válaszait mutatják be a különböző magyarázó változók (ivar, testi kondíció, életkor és megfogás dátuma) függvényében a költési és a téli időszakban. A mért változók hatásait az egyes viselkedési bélyegeknél Általánosított Lineáris Modell segítségével külön-külön számoltuk ki. A szignifikáns összefüggéseket félkövér betűtípussal emeltük ki repeated 1000 times and the range of simulated repeatabilities was used to describe confidence range (5% and 95% quantile).

To check for the association between behavioural traits, we carried out Spearman's rank correlations. Generalised Linear Models were used to investigate the effect of the considered predictors on the behavioural response variables. Sex, age, SBM and date of capturing were entered in these models as predictors. Due to the limitation of sample sizes we did not consider interactions between variables *(Table 1)*. The model for BR fulfilled criteria for Gaussian distribution, while for models on PR and DC we used Poisson distribution. For transparency, and to avoid the confounding effects of different scales used for some variables, statistical models were run separately for each seasons.

All statistical analyses were performed in the *R* statistical environment (version 2.12.2) (2012).

Results

Repeatability and correlation of behavioural traits

We found that each behavioural trait, BR, PR and DC, showed repeatability of intermediate to high magnitude (*sensu* Cohen 1988) that could be statistically differentiated from zero *(Table 1)*.

When assessing the correlation between traits (summarized in *Table 2*), we detected that more stressed individuals performed significantly less alarm calls in the breeding season. A positive, but only marginally significant relationship was found between BR and PR during winter indicating that individuals under higher stress levels picked more frequently than the calmer individuals as revealed by their lower BR. On the contrary, this association was not detectable for birds tested in the breeding season even at a more permissive significance criterion ($\alpha = 0.1$). We did not find significant relationship between the DC and PR during the breeding period.

Predictors of escape behaviour

The outputs from the statistical models designed to test the effects of the considered predictor variables are given in *Table 3.* The general patterns emerging in most of these models were that behavioural traits showed variation between sexes and along body condition (SBM). BR and PR showed a sex-dependent pattern among seasons: in both traits, females displayed a significantly higher rate than males in spring, while these relationships were not detectable in winter *(Figure 1)*. In contrast, DC was significantly higher in males comparing to females in spring. For DC, we only had data for the breeding season, during which we detected differences between sexes: males fought more than females, contrary to the relationships of the previous measurements *(Figure 1)*. SBM was a significant predictor of BR and PR in winter and DC in spring *(Figure 2)*. Furthermore, age was related significantly to PR in the spring sample only indicating that juveniles maintaining higher pecking activity against the investigator's finger than adults *(Figure 3)*.

Discussion

We investigated both the within- and between-individual co-variations of three simple behavioural traits, which were hy-

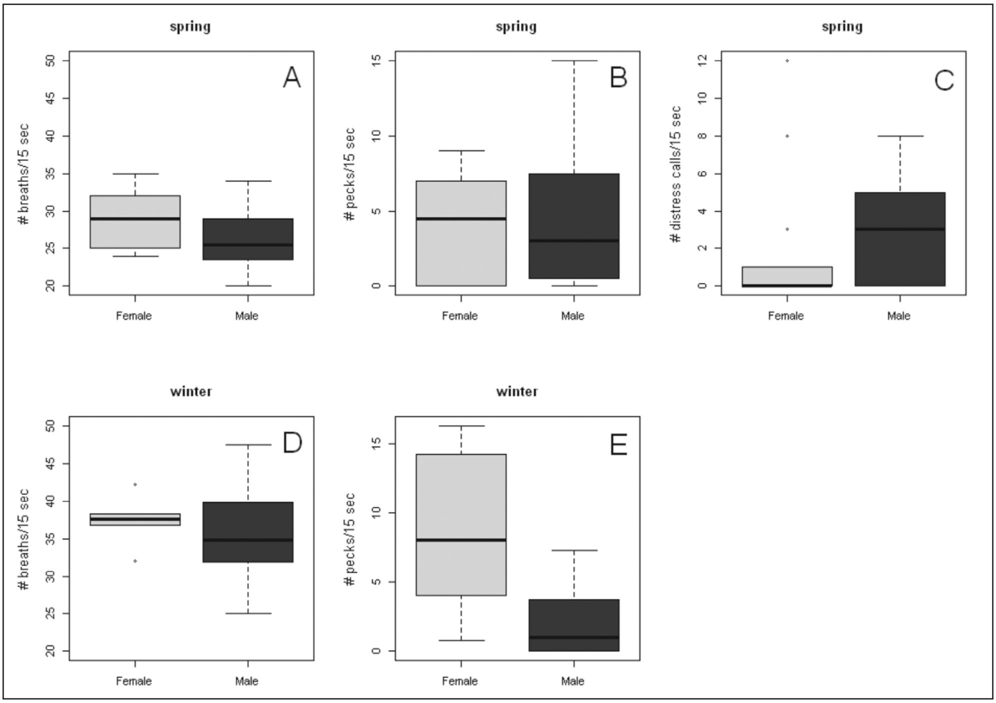

Figure 1. The significant relationships between sex (females: light grey, males: dark grey) and three behavioural traits measured in response to handling by human in Great Tit (see Table 3 for statistics). The Whisker box shows the most important information about the measured groups (data range: dashed Whiskers, interquartile range: square, median: black line). A: number of breaths per 15sec (spring); B: number of peaks per 15sec (spring); C: number of distress calls per 15sec (spring); D: number of breaths per 15sec (winter); E: number of peaks per 15sec (winter)

1. ábra A Whiskers diagramok az ivar (tojó: világosszürke, hím: sötétszürke) és a széncinegék humán kezelésére adott, három viselkedési bélyegei közötti szignifikáns kapcsolatát mutatja be (a statisztikáért lásd 3. táblázatot), ahol leolvasható a teljes adattartomány (szaggatott vonal), az interkvartilis tartomány (téglalap) és a medián (vízszintes vastag vonal). A: légzések száma 15sec alatt (tavasz); B: csípések száma 15sec alatt (tavasz); C: vészjelzések száma 15sec alatt (tavasz); D: légzések száma 15sec alatt (tél); E: csípések száma 15sec alatt (tél)

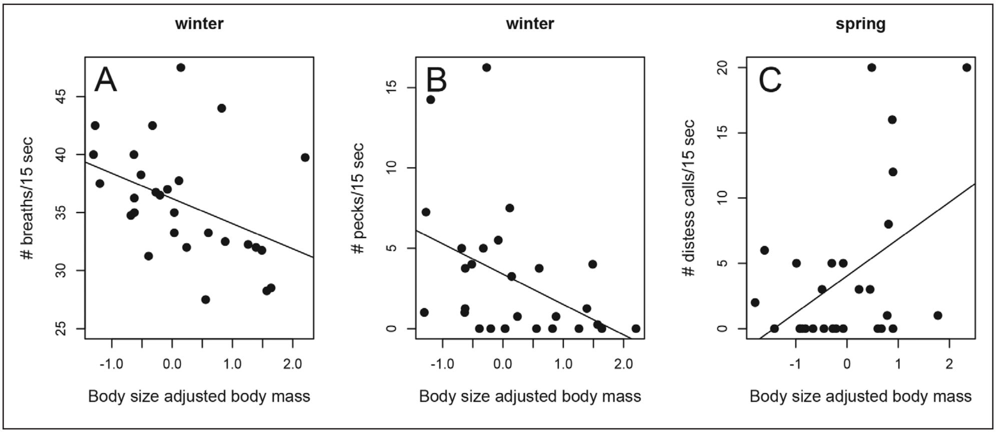

Figure 2. The significant relationships between body condition (body size corrected body mass) and three behavioural traits measured in response to handling by human in Great Tit (see Table 3 for statistics). A: number of breaths per 15sec (winter); B: number of peaks per 15sec (winter); C: number of distress calls per 15sec (spring)

2. ábra Az ábra a kondíció (testméretre korrigált testtömeg) és a széncinegék humán kezelésre adott, három viselkedési bélyegei közötti szignifikáns kapcsolatát mutatja be (a statisztikáért lásd 3. táblázatot). A: légzések száma 15sec alatt (tél); B: csípések száma 15sec alatt (tél); C: vészjelzések száma 15sec alatt (tavasz)

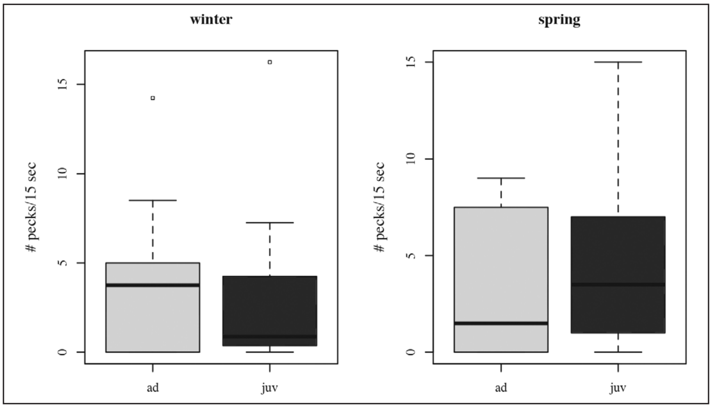

Figure 3. The significant relationships between age (adult: light grey, juvenile: dark grey) and pecking rate of Great Tit in response to handling by human in spring and winter (see Table 3 for statistics). The Whisker box shows the most important information about the measured groups (data range: dashed Whiskers, interquartile range: square, median: black line). A: number of peaks per 15sec (winter); B: number of peaks per 15sec (spring)

3. ábra Széncinegék életkora (felnőtt: világosszürke, fiatal: sötétszürke) és humán kezelésre adott tavaszi és téli csípési rátájának szignifikáns kapcsolata a téli és a tavaszi időszakban (a statisztikáért lásd 3. táblázatot), ahol leolvasható a teljes adattartomány (szaggatott vonal), az interkvartilis tartomány (téglalap) és a medián (vízszintes vastag vonal). A: csípések száma 15sec alatt (tél); B: csípések száma 15sec alatt (tavasz) pothesised to reflect the behavioural and physiological components of antipredator defence in free-living Great Tit. We found evidence for consistent within-individual variation of the same traits and also for the correlation of different behavioural traits. Furthermore, we also assessed the effect of the most important predictors that could potentially affect the between-individual variance of traits. The corresponding analyses revealed that sexes differ in the expression of most of the investigated traits, while body condition is also an important predictor. The detected patterns of these measurements showed slight variations between the sampled seasons.

We found that the significance and magnitude of repeatabilities are in line with patterns that are typical for behavioural and physiological traits (Bell *et al.* 2009). Repeatability significantly larger than zero implies that individuals systematically differ in the level of trait expression thus they display BR, DC and PR in an individual-specific manner. That is, some of them consistently respond to predation event with elevated respiration rate and fighting activity, while others respond with smaller activity. Whether the existence of such axis reflects individual differences in how they differ in responding to predation along the freeze and fight scale requires further investigation. Importantly, despite their significance, the modest repeatabilities suggest that a considerable within-individual variation exist in these traits, which could allow individuals to adjust their response with some flexibility depending on the environment (Bell *et al.* 2009, Coppens *et al.* 2010).

The correlations between behavioural traits measured in the same predatory context may indicate that individual antipredator strategies are manifested in a multi-trait dimension. In particular, if an individual has a high BR has an apparently reduced DC in spring (although, we could not know anything about winter due to the lack of available DC data from this season). Furthermore, BR tended to positively correlate with PR in the winter sample. Therefore, the covariance structure is sensitive to the period considered, which may suggest a weak, if any, role for the existence of strict physiological constraints that would force behavioural syndromes (Bell 2005). In addition, the fact that there was not an overwhelming relationship between all traits implies that some of the variation in these behaviours occurs independently of each other, thus they not necessarily reflect the same thing. On the other hand, the correlated components may be explained by the existence of behavioural syndromes (Bell 2007, Sih *et al.* 2012).

We detected that the expression of most traits occurs in a sex-dependent way. However, the direction of these relationships varied considerably across traits and seasons. In spring, sex-dependence was observed for all physiological and behavioural variables contrary to the winter sample when such differences were not detectable. Hence, it is difficult to conclude anything about a generally applicable sex-specific adaptive response to predators. At least, our results are in line with a previous finding suggesting that the behavioural response to predictable environmental challenges may differ between males and females (Laiolo *et al.* 2009, Bókony *et al.* 2012). Such differences may arise because the cost/benefit balance of different behavioural responses can vary from one sex to the other, as females generally invest more efforts into the reproduction than males. In addition, such sex-dependence may be more emphasized during the breeding season than during winter when the environmental challenges occur in a more balanced manner, which may explain our findings with respect to seasonal differences.

Body condition also emerged as a considerable predictor of some traits (Laiolo *et al.* 2009, Peig & Green 2009, 2010). For example, birds in better condition had lower BR and PR during winter *(Figure 2)*. Therefore, we could obtain some evidence for that, individuals accumulating more fat during winter experience less acute stress response and demonstrate less fighting upon handling. Furthermore, the direction of the relationship seems to be the opposite in more favourable conditions, as during breeding better body condition allows more active behavioural responses against predators (Laiolo *et al.* 2004, Atwell *et al.* 2012). Breeding individuals in better body condition could emit more alarm calls *(Figure 2)*, which might reflect that only individuals in better condition could elevate considerably their chances of escaping a predator. These patterns may signify that the prevailing ecological conditions have a strong effect on the determination of the acute stress responses and the escape behaviour, which are mediated through potentially different constraints mechanisms.

In general, we refrain ourselves from making strong conclusions from this pilot study that is based on correlative data and limited sample sizes. However, our results add to the growing literature on consistent behaviours and its complex interplay with physiological stress that help individuals to cope with the unpredictable environments in which they live (Coppens *et al.* 2010). The findings also suggest that the measured variables can be used as proxies of the stress response of birds only with great care, i.e. when several confounders that mediate within-individual variation are held constant. This pilot study may be useful for designing more targeted experiments in similar topics in the future.

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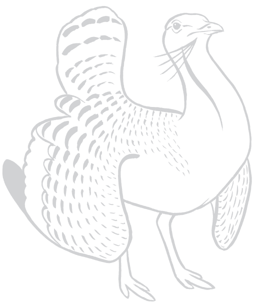

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Habitat preference of Common Sandpipers *(Actitis hypoleucos)* along the River Rába, Hungary

Tamás Hammer[1], András Liker[1, 2], István Szentirmai[3]

Tamás Hammer, András Liker, István Szentirmai 2013. Habitat preference of Common Sandpipers *(Actitis hypoleucos)* along the River Rába, Hungary. – Ornis Hungarica 21(1): 26–35.

Abstract We investigated habitat preference of Common Sandpipers as part of a monitoring program in the Őrség National Park, Hungary. Field observations were conducted during the summers between 2008 and 2012 along a 47-km long section of the River Rába. During the observations we recorded the number and location of birds on the river bank. We divided the studied area into 1 km long sections and measured the proportion of the visually distinguishable habitat types (water, low gravel and sand bank, vegetation and degraded area) from a digitalized map. Furthermore, we recorded the number of the low banks and the number of bends of the river within each section, as well as the sections' distance from the closest hydroelectric power plants and human settlements. In 2012 we also performed a detailed habitat mapping, recording the proportion of the vegetation types along the river bank and the number of fishing spots, embankment strengthenings and gravel banks. We tested the correlations between these habitat variables and number of birds present in the river sections. Our results show that Common Sandpipers were observed more frequently in locations which have (1) larger number and area of low gravel and sand banks, (2) less dense vegetation, and (3) lower proportion of degraded habitats. These findings can be taken into account in the conservation management of River Rába.

Keywords: wetlands, shorebird, territory, gravel bank, conservation

Összefoglalás Az Őrségi Nemzeti Park monitoring programja keretében a Rábán előforduló billegetőcankók élőhely választását vizsgáltuk. Az állományfelmérés 2008–2012 nyarán történt a Rába 47 km-es szakaszán. Ennek során rögzítettük a folyó partvonala mentén megfigyelt egyedek számát és előfordulási helyét. A folyót 1 km-es szakaszokra osztottuk fel, majd a szemmel jól lehatárolható élőhelytípusok (folyó, zátony, vegetáció, degradált terület) arányát minden egyes szakasz esetében légi felvételekről mértük. Ezen felül felmértük a szakaszokban található zátonyok számát, a kanyarok számát, valamint a szakaszok távolságát a folyóra telepített vízierőművektől és a folyó mentén található településektől. 2012-ben egy részletes terepi élőhely-térképezést is végeztünk, amely során a folyó mentén található növénytípusok előfordulási gyakoriságát, valamint a horgászhelyek és partfalerősítések számát jegyeztük fel. Teszteltük az egyes környezeti változók és a madarak előfordulási helye és egyedszáma közötti korrelációk erősségét. Az elemzések eredményei alapján a madarak nagyobb számban fordulnak elő (1) a nagyobb számú és területű zátonyokkal rendelkező, (2) növénytakaróval kevésbé sűrűn benőtt, és (3) a kevesebb degradált élőhelyet magában foglaló folyószakaszokon. A vizsgálat eredményei felhasználhatók a Rába jövőbeni természetvédelmi kezeléséhez.

Kulcsszavak: vizes élőhely, partimadár, territórium, kavicspad, természetvédelem

[1] Ornithology Research Group, Department of Limnology, University of Pannonia, 8200 Veszprém, Wartha Vince utca 1., Hungary, e-mail: hammer.t88@gmail.com
[2] Department of Animal and Plant Sciences, University of Sheffield, Sheffield S10 2TN, UK, e-mail: andras.liker@gmail.com
[3] Őrség National Park Directorate, 9941 Őriszentpéter, Siskaszer 26/a, Hungary, e-mail: i.szentirmai@gmail.com

Introduction

Wetlands and their wildlife are among the most threatened ecosystems in Europe and also worldwide (Wetlands International, www.wetlands.org). They are endangered by several factors such as agricultural drainage, regulation of water flows, infrastructural developments, industrial and communal pollution and climate change. Since approximately 50% of wetlands disappeared in the last century, these habitats are one of the main targets of nature conservation (Ward *et al*. 1999).

The Common Sandpiper *(Actitis hypoleucos)* is a typical species of the avifauna of Hungarian wetlands, especially rivers and fishponds, particularly in the River Rába and Szigetköz (Hadarics 2012). Although it is still common and widespread all over Europe, it is subject to the same threats as other wetland species and therefore deserves attention (Dougall *et al*. 2010, BirdLife International 2013). Due to its seemingly stable population, very few studies investigated the species and we know little about its habitat preferences in Hungary (but see Barbácsy 1977). For this reason we have chosen to investigate the habitat use of the Common Sandpiper on the River Rába, where a high proportion of its Hungarian population is thought to breed (Haraszthy 2000). The estimated Hungarian breeding population is 150–180 pairs (Hadarics & Zalai 2008).

In general, habitat choice of birds is primarily influenced by the availability of food (McCollin 1998), suitable nesting sites, and the presence of potential predators (Martin 1993). According to previous studies, the Common Sandpiper prefers stone, gravel, rocky, muddy or sandbanks along rivers during the breeding season (del Hoyo *et al*. 1996, Snow & Perrins 1998). While adult birds often feed on grasslands in the river valleys, older chicks exclusively feed in shingly areas of the river (Yalden 1986). Size of territories along the river banks was 100-300 m and it decreased with shingle width in Britain (Holland *et al*. 1982b, Jones 1983, Yalden 1986). According to some studies, the elevation of these gravel banks relative to water level determined whether they were suitable for the nesting (Yalden 1986, Ürmösi-Incze 2005). It was also shown in previous studies that Common Sandpipers are sensitive to habitat deterioration and human disturbance (Vickery 1991, Yalden & Holland 1993).

The objective of the present study was to collect data on the habitat use of Common Sandpipers, and contribute to the conservation of this wetland species in its Hungarian stronghold, the River Rába. We surveyed the distribution of individuals along the river and compared stretches that were used by the birds (i.e. where we observed sandpipers during the census) with those that were not used. We were primarily interested in how the amount of gravel or sand banks, the vegetation of the shore and potential anthropogenic effects of the stretches relate to the abundance of Common Sandpipers.

Materials and methods

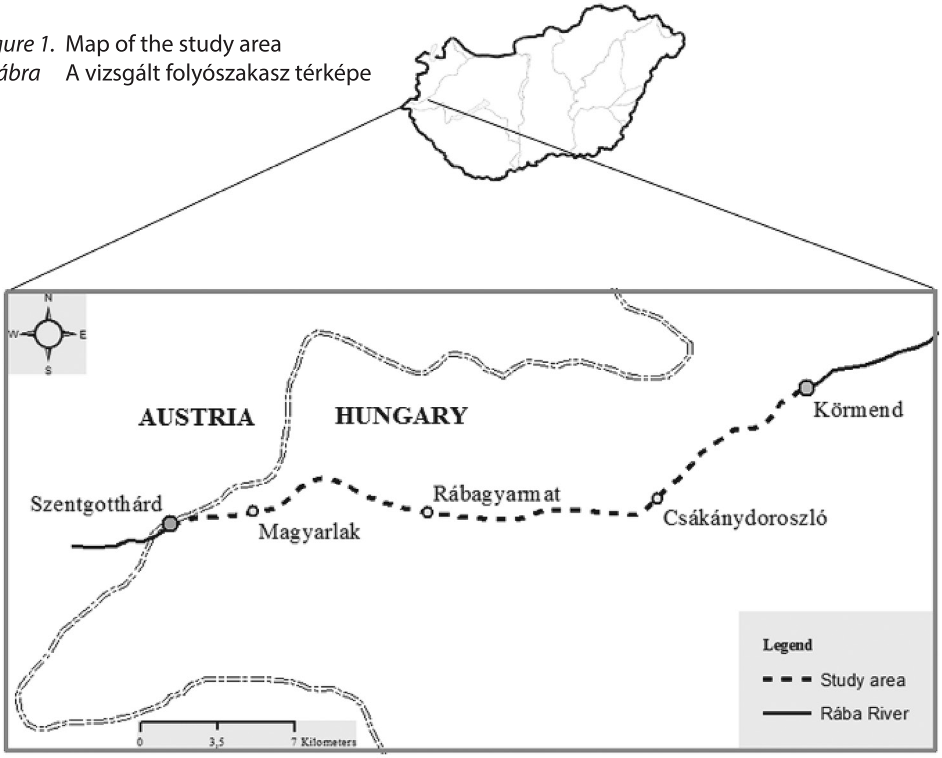
Study site and species

The River Rába is among the few water flows in Hungary that have not been the subject of water regulations in the last centuries and is still freely meandering in its valley for more than 100 km (Tardy 2007). The river valley currently has a mixture of natural and altered habitats. Large sections of the river bank are relatively undisturbed and have natural vegetation, e.g. soft-wood forests and bushes, sedge meadows, and sparsely vegetated gravel or sand banks. Increasing areas of these habitats have been occupied by invasive plant species during last few decades, of which the Japanese Knotweed *(Fallopia japonica)* and the Himalayan Balsam *(Impatiens glandulifera)* have the largest abundance. Other parts of the river's valley have been transformed to agricultural fields or used for recreation (e.g. camps for tourists). The river valley provides habitat and breeding site for several bird species of both national and European community interest, such as the White-tailed Eagle *(Haliaeetus albicilla)*, the Black Stork *(Ciconia nigra)*, the Bee-eater *(Merops apiaster)*, the Little Ringed Plover *(Charadrius dubius)* and the Common Sandpiper (Tardy 2007).

Common Sandpipers arrive in Hungary during the second half of April, start to breed in late April and early May, and finish the rearing of the broods by the end of June (Haraszthy 2000). The breeding can be prolonged due to the loss of first clutches, when birds may attempt a second breeding. Although the number of Common Sandpipers currently breeding along the River Rába is not known, their breeding is repeatedly verified by the presence of nests and chick rearing families (Barbácsy 1977, T. Hammer personal observations).

We investigated Common Sandpipers' habitat preference in two ways. First, we recorded the number of individuals and their locations along the 47 km section of River Rába, between the towns Szentgotthárd and Körmend *(Figure 1)*. Then we tested the correlations between the abundance of birds and specific habitat variables (see below) measured from aerial orthophotos of the study area. Second, in 2012 we conducted a detailed habitat mapping of the areas used by the sandpipers and compared the habitat characteristics of these areas to a set of randomly chosen sample areas along the river that were not used by the birds.

Figure 1. Map of the study area
1. ábra A vizsgált folyószakasz térképe



Bird censuses

We counted the number of Common Sandpipers during brief census periods (1-3 days each year) in late spring or early summer, that presumably coincided with the breeding season of the local breeding population, although late migrants and non-breeding birds could also have been included in the counts. We counted the birds from the water that allowed a good visual survey of the river banks where most of the birds stayed. During the census we moved slowly along the river by canoes and recorded the location of each Common Sandpiper using a Garmin Legend HCx GPS recorder, with an approximate accuracy of ± 5 m. If an individual moved away in the direction of river's flow after its first observation, we followed it until it flew back in the opposite direction of the census (which typically occured ca. 100-200 m from the place of first observation). Thus we only recorded a bird as a new individual when the previously recorded sandpiper was seen to turn back.

Measuring habitat variables from aerial photos

The first set of habitat variables were measured from aerial orthophotos (color depth: 24 bit, 0.5 metre/pixel). First we divided the studied river area into 1 km long sections *(Figure 2)*. For each section we analysed a 100 m wide area, that extended 50 m on both sides from the midstream of the river (i.e. the total analysed area of each section was 100 × 1000 m, *Figure 2*). We chose to measure habitat variables within 50 m from the midstream because Common Sandpipers usually stay and nest near the riverside (Yalden 1986). Since the river bed is usually 15-20 m wide, the 50 m wide zones typically included 30-40 m wide areas of the river bank at both sides of the river.

For each section, we measured the following habitat variables that we could clearly recognize on the orthophotos: (1) water area: the area of the river surface, (2) low bank area: the extent of gravel and sand islands and peninsulas along the shore, (3) vegetation area: vegetated areas with only moderate human impacts (mostly shrubby or woody vegetation), (4) degraded area: intensively used areas, e.g. agricultural fields and built-up areas. We delineated the border lines of these habitat types on the photos using ArcGis 10.1.1 (ESRI 2012), then measured the total area of each habitat type within each section *(Figure 2)*. Finally we calculated the proportion of each habitat type within the sections by dividing the area of each habitat type by the total area of the sections.

In addition, we determined (5) the number of discontinuous low banks and (6) the number bends of the river bed (with angles larger than 45°). (7) We also measured the sections' distance from the nearest hydroelectric power plant in the flow direction. (8) To charactarize potential anthropogenic effects we divided the sections into two groups: (i) the border of the nearest town or village was closer than 500 m to the border of the section, or (ii) it was farther than 500 m (we obtained identical results using a 1000 m threshold distance; results not showed). Finally, as an additional measure of the state of the sections' vegetation (i.e. natural *versus* degraded), we used habitat mapping data (according to the General National Habitat Mapping System, Bölöni *et al.* 2011) available for the study area from 2010-2011. This data set categorizes the larger vegetation patches on a five-point scale according to their composition (naturalness index, Németh & Seregélyes 1989). Using this data set we measured the proportion of (9) the least

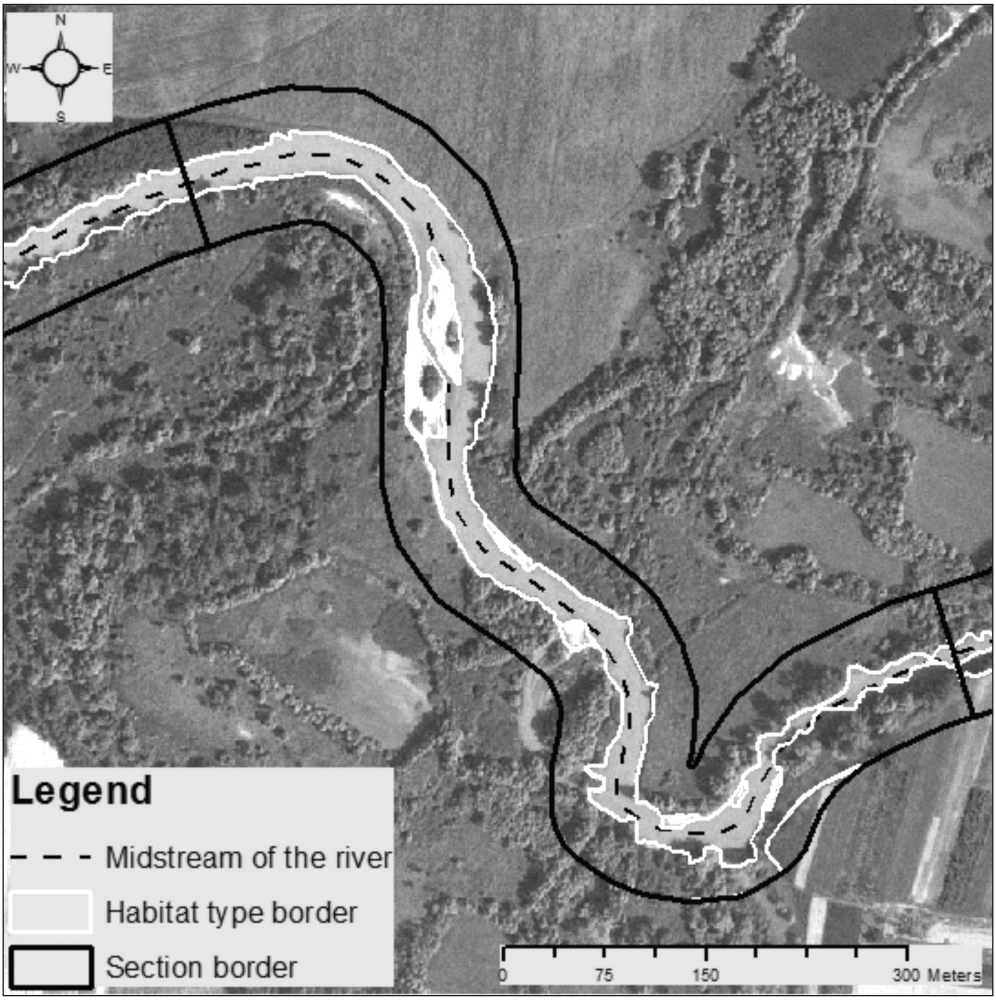


Figure 2. An example of the 1 km sections used in the analysis as a sampling unit
2. ábra Példa az 1 km-es szakaszokról, amelyeket az elemzésekben mintavételi egységként használtunk

natural habitats (naturalness score 1) and (10) the most natural habitats available in the study area (naturalness score 4) for each section.

Habitat mapping

A detailed habitat mapping was conducted in pre-selected parts of the study area on 23 and 24 June 2012. For this purpose, we divided the studied river area into 100 m long ‘small sections’ and categorized these sections into two groups on the basis of the previous occurance of Common Sandpipers: (i) sections used and (ii) not used by the birds as inferred from the census. From these two groups we chose randomly 20-20 small sections, that were visited and a habitat map was created for in the field, recording the following variables: the areas covered by (1) the invasive Japanese Knotweed, (2) by the invasive Himalayan Balsam, (3) by woods, (4) shrubs and (5) other non-invasive vegetation. Furthermore, we recorded the (6) number of fishing spots (used by local anglers), (7) number of gravel and sand banks, and the (8) number of embankment strengthenings (stone walls attached to the side of the river bank).

Statistical analysis

For the first set of analyses (correlations between bird abundance and habitat variables measured from aerial photos) we calculated the average sandpiper number for each 1 km long section, which was the average of the five counts recorded during the five yearly censuses. First we tested whether this measure of bird abundance was related to the ten habitat variables by using bivariate Spearman rank correlations (for continuous habitat variables) and Mann-Whitney U test (for comparing bird numbers between sections with and without a settlement within 500 m). Then we used a general linear model to conduct a multi-predictor analysis of the census data. The initial model included all ten habitat variables as predictors, and then the non-significant variables were removed from the model by backward stepwise selection, i.e. in each iteration we removed the predictor variable with the largest P value, until only the significant ($P < 0.05$) predictors remained in the model.

In the second set of analyses, we compared the eight habitat variables measured by habitat mapping between small sections used versus not used by Common Sandpipers, using Mann-Whitney U test. All statistical analyses were performed in the R statistical environment (R.2.14.1.). All statistical tests were two-tailed.

Results

The Common Sandpipers' number was highly variable among years and also between the river sections within a year *(Table 1)*.

In the first set of analyses (based on bird census data), bivariate correlations showed that the abundance of Common Sandpipers was related to three habitat variables: their abundance increased significantly with the water area of sections, and also with the number and area of low gravel and sand banks *(Table 2)*.

The result of the multi-predictor linear modell partially corroborated these findings. First, as in the bivariate analyses, sandpiper abundance significantly increased with the area of the low gravel and sand banks *(Table 3)*. Furthermore, bird abundance significantly decreased with increasing vegetation area and with increasing area of the most degraded habitats (naturalness score 1; *Table 3*).

Year	Date of counting	Total number	Average (± SE) number per 1-km river section	Minimum and maximum number per 1-km river section
2008	5 – 7 May	85	1.81 ±1.042	0 – 6
2009	10 – 12 May	22	0.47 ± 0.59	0 – 3
2010	29 June	11	0.23 ± 0.45	0 – 5
2011	17 – 18 May	25	0.53 ± 0.79	0 – 3
2012	24 – 25 May	9	0.19 ± 0.53	0 – 2

Table 1. The number of Common Sandpipers observed during yearly censuses along the River Rába, between Szentgotthárd and Körmend

1. táblázat A Rába Szentgotthárd és Körmend közötti szakaszán megfigyelt billegetőcankók száma a vizsgálat éveiben

Habitat variable	Test statistics	P	n
Water area	0.396	0.006	47
Area of low banks	0.356	0.014	47
Number of low banks	0.409	0.004	47
Vegetation area	–0.181	0.224	47
Degraded area	0.054	0.715	47
Numbers of river bed’s bends	0.212	0.151	47
Proximity to hydroelectric plant	0.002	0.987	47
Proximity to human settlement*	273	0.517	47
Proportion of least natural habitats (naturalness score 1)	–0.014	0.934	35
Proportion of most natural habitats (naturalness score 4)	0.228	0.186	35

Table 2. Bivariate analyses of the relationships between the average number of Common Sandpipers and ten habitat variables, measured in 1km sections of River Rába. Table shows Spearman correlation coefficients and associated P values, except for proximity to human settlement (binary variable, marked by *) where Mann-Whitney U-test was used. Sample size is different between analyses because habitat naturalness data were not available for 12 sections

2. táblázat A Rába 1 km-es szakaszain regisztrált átlagos billegetőcankó szám és a tíz élőhelyváltozó közötti kapcsolat elemzése egyszerű korrelációkkal. A táblázat a Spearman rang-korrelációs koefficienseket és a tesztekhez tartozó P értékeket mutatja, az emberi települések közelsége kivétel (bináris változó, *-al jelölt) amelynek hatását Mann-Whitney U-teszttel vizsgáltuk. A mintaszámok (n) különböznek az elemzésekben, mivel az élőhelyek természetességéről 12 folyószakasz esetében nem volt adatunk

In the second set of analyses, habitat mapping data also showed that the number of the low gravel banks was significantly higher in those 100 m long sections which were used by the sandpipers, than in the unused sections *(Table 4)*. There were no differences between the two groups of areas in other habitat variables, i.e. in the areas covered by invasive vegetation and by other vegetation types, and in the numbers of fishing spots and embankment strengthenings *(Table 4)*.

Discussion

In this study we found that the abundance of Common Sandpipers on River Rába is related to the number and total area of low gravel and sand banks, i.e. the birds prefer river sections where a large area of low banks are available. The effect of this habitat variable was confirmed by all three types of our analysis. This preference may be explained by the fact that gravel and sand banks are the main feeding habitats of the species where they can feed on macro-invertebrates (Holland *et al.* 1982b). Our results therefore confirm the findings of several previous, larger-scale studies showing that the width of shingly banks is positively related to the number of nesting Common Sandpipers (Yalden 1986). Diet analyses showed that majority of the species’ food items are taken from the ground surface and therefore they prefer open habitats against densely vegetated ones for feeding (del Hoyo *et al.* 1996, Snow & Perrins 1998). The im-

Habitat variables	Slope	t	P
Area of low banks	0.171	2.678	0.011
Vegetation area	–0.023	–2.261	0.031
Proportion of least natural habitats (naturalness score 1)	–5.471	–2.392	0.023

Table 3. Results of the multi-predictor analysis of the relationship between average number of Common Sandpipers in 1 km long river sections and habitat variables (predictors). Table shows the final linear model, including only siginficant predictors of bird number (n= 35 sections)

3. táblázat Az átlagos billegetőcankó szám és az élőhelyváltozók (független változók) közötti kapcsolat többváltozós elemzésének eredményei. A táblázatban a végső modell szerepel, melyben csak azok a független változók szerepelnek, amelyek szignifikáns kapcsolatban állnak a madarak számával (n= 35 folyószakasz adata)

Habitat variables	U	P
Area of invasive Japanese Knotweed	233	0.117
Area of invasive Himalayan Balsam	159	0.524
Wooded area	125	0.108
Shrub area	152.5	0.428
Area of other non-invasive vegetation	190.5	0.765
Number of low banks	105	0.006
Numbers of fishing spots	180	1.0
Numbers of embankment strengthenings	162.5	0.504

Table 4. Results of the analyses of habitat map data, collected in 2012. Habitat variables were compared between 100 m long areas used by Common Sandpipers (n= 20) and randomly selected controll areas (not used by the birds, n= 20) by Mann-Whitney U-test

4. táblázat 2012-ben végzett élőhely-térképezés eredményei. Az élőhelyváltozókat a billegetőcankók által használt (n=20) és random kiválasztott, madarak által nem használt 100 m-es szakaszok (n=20) között hasonlítottuk össze (Mann-Whitney U-teszt)

portance of gravel and sand banks is also underlined by the fact that older chicks exclusively feed in this habitat (Yalden 1986), and territory size decreases with the area of these habitats (Jones 1983).

The effect of some other variables on the abundance of Common Sandpipers was less consistent among the analyses. The water area was positively related while the vegetation area was negatively related to the abundance of sandpipers in one of the correlative analyses (either in the bivariate or in the multi-predictor tests, respectively). We suspect that the wider the river, the larger the area of low banks and consequently the smaller area is covered by vegetation. The river builds low banks where it becomes wider and slows down. This explanation is also supported by the strong negative relationship between the proportion of water area and vegetation area ($r = –0.574$; $P < 0.001$).

Furthermore, some of the analyses also showed that the proportion of deteriorated habitats (naturalness score 1) is negatively related to the presence of Common Sandpipers. These areas are dominated by Himalayan Balsam that provides no suitable habitat for the species. However, the presence of alien plants may not be the sole reason for this relationship, because in the habitat mapping data we did not find differences in the abundance of two alien plants between areas used and not used by sandpipers.

We found no relationship between the abundance of Common Sandpipers and the proximity of the river sections to hydroelectric power plants. This is in contrast with a study conducted on the river Danube in the Szigetköz area, where the abundance of Common Sandpiper increased near dams, probably due to the low water level that created suitable feeding habitats for these birds (Báldi *et al.* 1998). We suspect that two contrasting effects of dams on Common Sandpipers' abundance may cancel out each other in our analysis. On the one hand, the water level is artificially elevated above the dams and therefore low banks are not available here for the Sandpipers. On the other hand, the river stretches just below the dams are suitable habitats due to low water level (see also Báldi *et al.* 1998). Since Sandpipers can occasionally move between the two sides of the dam, this may cause more frequent occurrence of birds on both sides of the dam than in sections further away of dams.

Similarly, there was no relationship between the distance of settlements and the presence of sandpipers. However, this result does not mean that these birds are not susceptible to anthropogenic effects (see Vickery 1991, Yalden & Holland 1993), rather we believe that human disturbance does not necessarily increase towards the settlements. There are many types of human activities, such as fishing, water tourism, and agricultural works that occur all along the river, and these can potentially mask the effect of the proximity to settlements.

Our results on the habitat use of Common Sandpipers have two important implications for the conservation of this bird species. First, since low gravel and sand banks seem to be the most important habitat element for Common Sandpipers, River Rába should be allowed to continue its destroying and building work whereby it creates these open habitats (Arlettaz *et al*. 2011). Regulations by cutting through river banks or stabilizing banks by stone or concrete embankments can reduce suitable habitats in a great extent. Second, the deterioration of natural habitats through, for example, the spread of alien plant species and intensive agriculture next to the river reduces suitable feeding places for Common Sandpipers. Therefore conservation management should find the way to control these detrimental processes.

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Intraspecific kleptoparasitism in flock-fishing Great Crested Grebes *(Podiceps cristatus)* and Great Cormorants *(Phalacrocorax carbo)* – a cost to participants?

HANS KÄLLANDER

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Abstract Intraspecific kleptoparasitism was studied in flock-fishing Great Crested Grebes *Podiceps cristatus* during May and June 2011 and in Great Cormorants *Phalacrocorax carbo* during September 2011 and August 2012 at Lake Krankesjön, South Sweden, for a total of c.11 h for grebes and c.6 h for cormorants. Only attempts to steal large fish (relative to a bird's gape) were recorded, because small fish mostly did not elicit kleptoparasitic attempts and those seen appeared never to be successful. Attempts to steal large fish were rare, 0.14 h^{-1} $grebe^{-1}$ (N = 96) and 0.39 h^{-1} $cormorant^{-1}$ (N = 163). In both species, the host lost its fish in about 20% of cases. Based on the observed low parasitism and success rates, it is concluded that kleptoparasitism was a minor cost of participating in flock-fishing.

Keywords: Great Crested Grebes, Great Cormorants, flock-fishing, intraspecific kleptoparasitism, success rate

Összefoglalás A megszerzett táplálék fajtárs által történő eltulajdonításának (kleptoparazitizmus) gyakoriságát vizsgálták a dél-svédországi Krankesjön-tavon a búbos vöcsöknél *(Podiceps cristatus)* 2011 májusa és júniusa között, valamint a kárókatonánál *(Phalacrocorax carbo)* 2011 szeptembere és 2012 augusztusa között. Az összesen 11 órás (búbos vöcsök), illetve 6 órás (nagy kárókatona) megfigyelési periódus alatt csak a szájnyílásnál nagyobb méretű halak eltulajdonítására irányuló viselkedések számát regisztrálták. A fajtárstól történt tápláléklopási probálkozások egy egyedre eső száma alacsony volt: a búbos vöcsöknél 0,14 h^{-1} (N = 96), a kárókatonánál 0,39 h^{-1} (N = 163) próbálkozás óránként. Mindkét fajnál a lopási kísérletek kb. 20%-ában a potyázók sikeresek voltak, és elvették fajtársuktól annak zsákmányát. Az adatok azt mutatják, hogy a kleptoparazitikus viselkedés ritkasága és a sikeres eltulajdonítás alacsony rátája miatt mindkét fajnál kicsi a társas halászatban résztvevő egyedek költsége.

Kulcsszavak: búbos vöcsök, nagy kárókatona, csoportos halászat, intraspecifikus kleptoparazitizmus, potyázási ráta

Hans Källander, Department of Biology (Ecology), Ecology Building, Lund University, SE-223 62 Lund, Sweden, e-mail: hans.kallander@telia.com

Introduction

Intraspecific kleptoparasitism in birds appears to be less common than interspecific kleptoparasitism or at least has attracted much less interest. It does occur in some colony-breeding species, such as terns and auks (Shealer *et al*. 2005, Lavers & Jones 2007), and in groups of Bald Eagles *Haliaeetus leucocephalus* (Hansen 1986, Bennetts *et al.* 1990), Cattle Egrets *Bubulcus ibis* (Garrido *et al.* 2002) and gulls *Larus* spp. (Bertelotti & Yorio 2000, Galván 2003). It can also be seen in flock-fishing Common Mergansers *Mergus merganser* (Källander 2006) and Great Cormorants *Phalacrocorax carbo* (Lekuona & Campos 2001, Mahendiran *et al.* 2010), and one would expect it to occur also in several other situations where birds feed in close association with each other.

Flock-fishing, especially in species feeding on schooling prey, is likely to result in higher individual capture rates than solitary fishing as suggested by its common occurrence among deep-diving piscivores, such as penguins, cormorants, mergansers, and others. That flock feeding increases individual capture rate has been shown experimentally for Black-headed Gulls *Chroicocephalus ridibundus* plunge-diving for fish (Götmark *et al*. 1986). Also in a predatory species of fish, individual success was higher when foraging in groups than solitarily (Major 1978). However, flock-fishing also presents opportunities for intraspecific kleptoparasitism, which could thus constitute a potential cost of this feeding method. The aim of the present study was to determine the frequency of intraspecific kleptoparasitism in flock-fishing Great Crested Grebes and Great Cormorants to see whether it would constitute a significant cost of flock-fishing. In addition, observations on the evasive behaviours of the hosts are presented.

Methods

The species

Great Crested Grebes usually fish solitarily (Bauer & Glutz 1966, Cramp 1977, Fjeldså 2004), but in certain rare conditions they have been found to form fishing flocks. Thus, at Lake Krankesjön, South Sweden (c. 55° 42’ N, 13° 28’ E), flock-fishing is a regular phenomenon in Great Crested Grebes during the breeding season and involves birds during incubation recesses (Källander 2008, 2011). Flock-fishing usually ceases in early July but may sometimes continue until early autumn, when both adults and young of various age participate. The fishing flocks, which mostly contain anything from 15 up to a hundred grebes, roam widely across the c. 3 km^2 lake, both on the open water and along the its reed-fringed *Phragmites australis* margins. Particularly during periods of intense diving activity, probably indicative of the presence of a fish shoal, the flocks become very dense. In these situations, attempts at intraspecific kleptoparasitism sometimes occur.

Great Cormorants may fish in flocks numbering from a few individuals to many thousands (van Eerden & Voslamber 1995) in both limnic and marine habitats (Brown *et al*. 1982, Sellin 1986, Grémillet *et al*. 1998). At Lake Krankesjön, flock-fishing occurs predominantly during late summer – early autumn. Birds leave the night roost in the morning for a first fishing session. They then return to the roosting trees but fly out to fish again later during the day. During September 2011, numbers were usually around 30 to 80, but in August and September 2012 more than 200 cormorants were present.

Data collection

In 2011, data on the frequency of attempted kleptoparasitism in Great Crested Grebe flocks were collected at Lake Krankesjön during May – June. Fishing flocks engaged in at least moderately active diving were measured with a stopwatch during periods lasting 2 min 48 s – 44 min, for a total of slightly more than 11 h. Moderate diving was defined as roughly half of the individuals being under water at any one moment, while during intense diving often fewer than 20% of the birds were simultaneously present on the surface. Cormorants were monitored continuously using the same method for 2 min 35 s – 40 min, for a total of 6 h 10 min during September 2011 and August 2012.

Additional data on kleptoparasites' success rate were collected during all years 2007–2012. Most observations of both Great Crested Grebes and Great Cormorants were made from either of two bird observation towers, one on the southern and another on the eastern shore of the lake, using a Carl Zeiss® Diascope 85 T*FL with a 20–60x ocular. Distances were often long, which means that attempts to steal small, quickly swallowed fish mostly could not be seen. However, data below on parasitism frequency refer to cases where a grebe or cormorant had captured a large fish (relative to its gape size) that took long to swallow. Because both species foraged in dense, coordinated flocks, it is unlikely that any such kleptoparasitic attempt was missed.

To deal with the problem of zero observations during some observation periods, the number of 'grebe hours' and 'cormorant hours' was calculated, i.e. the duration of each observation period times the number of birds in the flock. These numbers were then summed for each species over all observation spells and the total number of recorded kleptoparasitic attempts was related to these figures.

Results

Great Crested Grebe

Kleptoparasitic attempts were rare. Overall only 0.138 attempts h^{-1} $grebe^{-1}$ were recorded (N = 96 kleptoparasitic attempts involving large fish). Also the kleptoparasites' success rate was low. In 93 out of 119 kleptoparasitic attacks recorded, the bird that had captured the fish also managed to swallow it (80%), and in only five cases (4%) the fish was with certainty lost to a kleptoparasite. However, in as many as 21 cases (16%) there was uncertainty about who eventually got the fish. To these data should be added 35 instances when a grebe with a large fish left the flock either before being attacked, or at least without being pursued, and swallowed its fish without being harassed. On four occasions large fish were simply dropped after a grebe had spent considerable time unsuccessfully trying to swallow it. In no case were (the few) attacks on birds with small fish successful.

A few kleptoparasitic attacks were very fierce; on one occasion the parasite even climbed the back of the fleeing victim (as frequently seen in flock-fishing Common Mergansers and Great Cormorants, pers. obs.). Often a bird was attacked by several grebes, either simultaneously or in succession. Once the fight over a big Roach *Rutilus rutilus* lasted for at least five minutes after which the host gave up its attempts at swallowing it and dropped the fish which then wandered between several grebes until finally ignored.

Grebes used essentially two methods to evade attacks from kleptoparasites, to rush (or 'flight-rush', a combination of running and flying) or to dive, but true flights of up to 50 m were observed three times. Flight-rushes were from 5 – 6 m up to c.40 m long. Also the kleptoparasite sometimes flight-rushed after the host but more often it dived and shortly afterwards surfaced close to the host which then made a new attempt to escape.

Great Cormorant

Kleptoparasitic attempts were relatively rare with a mean of 0.386 attempts h^{-1} cormorant^{-1} (N = 163 attempts). Cormorants that had captured a large fish occasionally flew outside the flock to swallow it without being harassed. Mostly, however, cormorants surfacing with a large fish were instantly attacked by one or more conspecifics and sometimes a long fight over the fish ensued. Out of 123 kleptoparasitic attempts, the attacked cormorant managed to swallow its fish in 92 (75%), in four the fish was with certainty lost to a kleptoparasite. However, in as many as 24 instances the outcome could not be ascertained (in the remaining three cases the fish presumably escaped). The success of kleptoparasites was also estimated for small and medium-sized fish (roughly 6 – 12 cm). Such attempts were very common when a flock was diving intensively, apparently following a shoal of young Roach. In 264 such attempts, a cormorant just once lost the fish (which probably escaped).

Discussion

The risk of losing a large fish to a conspecific kleptoparasite was low on a per bird basis among both Great Crested Grebes and Great Cormorants at Lake Krankesjön. Provided each individual suffered an equal risk of being attacked (observations indicate that juvenile cormorants may be more likely to lose fish (Lekuona & Campos 2003, J. Bruun pers. comm.), this risk would amount to only one attack per individual and seven hours of active fishing in the Great Crested Grebe and about one attack per two and a half hours in the Great Cormorant. Considering that only about 20% of kleptoparastic attempts were successful, a grebe would only risk losing its fish once every 35 hours of fishing and a cormorant once every 12 hours (at most, because in 35 instances in the grebe and several in the cormorants, a bird with a big fish left the flock and ingested it unattacked). The conclusion, therefore, is that intra-specific kleptoparasitism probably is a very minor cost of engaging in flock-fishing.

Both grebes and cormorants surfacing with small and quickly swallowed fish sometimes made a short forward leap, apparently to avoid being attacked, or they simply turned the back towards potential kleptoparasites. However, grebes with small fish were usually not attacked. In cormorants, when attacks on birds with small fish occurred, they were very brief and none was successful. This contrasts with the results of Lekuona and Campos (2001), who found that nearly half of the fish lost to kleptoparasites in Great Cormorants were less than 14 cm long and 4% were less than 8 cm. This difference between the two studies is intriguing. One possibility could be that the species of fish taken in their study were more difficult to swallow (because of spines or body form), but the data they present on handling times do not support this explanation. At Lake Krankesjön, the main identified prey of both species was Roach, although Common Bream *Abramis brama* was occasionally taken by cormorants.

As shown in several studies, a host's risk of being kleptoparasitized increases with prey size and/or prey handling time (e.g. Brockmann & Barnard 1979, Ratcliffe *et al*. 1997). However, a large prey is also more valuable to the host than a small prey and therefore worth defending more strongly, which may explain the low success rate of the kleptoparasites found here. With the low success rate of kleptoparasites observed in the present study, one may ask why intraspecific kleptoparasitism occurs among these piscivorous species. The likely answer may be that the cost of an attempt is relatively low to the parasite compared with the potential gain from securing a large prey, especially considering the low rate at which such prey were captured.

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Distribution and phenological data of some bird species of Uganda

Attila Bankovics[1], János Török[2], Gábor Michl[2], Péter Péczely[3] & Tibor Csörgő[4]

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Abstract During a twenty five days trip in Uganda a brief faunistic survey of birds, mammals and reptiles was performed. Altogether 380 bird species were observed in six National Parks and some other protected areas in the summer of 2012. From these 64 bird species are discussed here selected according the following criteria: rarity, occurrence in a new habitat or geographic area, and emergence of novel breeding phenological data of certain species. Our new records of House Sparrow *(Passer domesticus)* along the Kazinga Channel (between Lake Edward and Lake George) are outside the current distribution range of the species. The House sparrow expanded its area about 800 km toward west from their first record in Nairobi in 1992. Our new records on White-tailed Ant-thrush *(Neocossyphus poensis),* Red-tailed Ant-thrush *(Neocossyphus rufus),* Papyrus Yellow Warbler *(Chloropeta gracilirostris),* Shelley's Rufous Sparrow *(Passer shelley)* and Streaky Seedeater *(Serinus striolatus)* also require the correction of distribution maps of this species in Uganda. In addition we give some remarks on the breeding phenology of Mountain Wagtail *(Motacilla clara)*, Cassin's Grey Flycatcher *(Muscicapa cassini)* and Northern Red Bishop *(Euplectes franciscanus)*. Our recent observational data of African Skimmer *(Rynchops flavirostris)* may have importance for the Bonn Convention. These observations might be important from conservation and ecotouristic point of views.

Keywords: ecotourism, conservation, global conventions, rainforest, savannah

Összefoglalás 2012. július 11. és augusztus 4.-e között 25 napot töltöttünk el Ugandában madarak, hüllők és emlősök megfigyelésével. Utunk során hat nemzeti parkot és számos egyéb védett területet kerestünk fel, összesen 380 madárfajt észleltünk. Közülük 64 fajt válogattunk ki, melyek előfordulási és viselkedési adatainak közzététele érdeklődésre tarthat számot különféle szempontok, mint a természetvédelem, ökoturizmus, költésbiológia alapján, vagy az elterjedési területük változása miatt. A házi veréb *(Passer domesticus)* kelet-afrikai terjeszkedése során mintegy 10 éve érte el Ugandát, ezért a Kazinga-csatorna melletti megfigyelés jelentős új adatnak számít. További új előfordulási adatok a fehérfarkú hangyarigó *(Neocossyphus poensis)*, a vörösfarkú hangyarigó *(Neocossyphus rufus)*, a papirusz poszáta *(Chloropeta gracilirostris)*, a nílusi veréb *(Passer shelley)*, a csíkos csicsörke *(Serinus striolatus)* vonatkozásában születtek. Költésbiológiai adatokat közlünk a pataki billegető *(Motacilla clara)*, a cassin-légykapó *(Muscicapa cassini)* és a tűzhátú szövőmadár *(Euplectes franciscanus)* vonatkozásában. A részleges vonuló afrikai ollóscsőrűmadár *(Rynchops flavirostris)* előfordulási adata érdekes lehet a Bonni Egyezmény szempontjából.

Kulcsszavak: ökoturizmus, természetvédelem, globális egyezmények, esőerdő, szavanna

[1] *Bird Collection, Hungarian Natural History Museum, 1088 Budapest, Baross utca 13., Hungary, e-mail:* attila.bankovics@gmail.com
[2] *Department of Systematic Zoology and Ecology, Eötvös Loránd University, 1117 Budapest, Pázmány Péter sétány 1/c, Hungary*
[3] *2230 Gyömrő, Köztársaság utca 27., Hungary*
[4] *Department of Anatomy, Cell- and Developmental Biology, Eötvös Loránd University, 1117 Budapest, Pázmány Péter sétány 1/c, Hungary, e-mail: csorgo@elte.hu*

Introduction

There is a contradiction between the development of economy in African countries and the conservation of wildlife outside protected areas in general. As a consequence of fast human population growth more and more natural areas are occupied by proliferating human settlements and have to be converted into agricultural lands. As a result of these changes, the ancient free areas for wildlife habitats are shrinking continuously. The fragmentation of natural lands led to habitat loss and population decline of many African bird species (Dranzoa 1998). Some articles even deal with the collapse of avifauna in certain forest fragments (Beier *et al.* 2002).

These problems are especially severe in smaller countries with high density of human population like Uganda, where there is a great demand to enlarge the size of different plantations (tea, banana, sugarcane etc.) in the proximity of rainforests. Unfortunately, there is also a forestry practice to change natural forests into tree plantations, and as a consequence very strange landscapes with artificial conifer 'forests' are created (the neighborhood of Budongo Forest). The results of deforestation and these unsustainable silvicultural practices also lead to loss of the biological diversity (Dranzoa 1998).

The aim of this paper is double. First, we would like to draw attention to the new occurrences of some bird species including an interesting record for Uganda avifauna. Second, we present some interesting breeding phenological data of some bird species.

Materials and methods

We spent 25 days with birding in Uganda visiting some national parks, nature reserves and other protected areas between 11 July and 4 August 2012. In this paper we discuss the occurrence data of 64 bird species belonging to 33 families.

The 64 birds were selected according the following criteria:

a) The species was found outside its known distribution area published in different field-guides. That means unpublished occurrences. We have to mention, that in some cases our local guides has already known about these occurrences. These information are important to update the distribution borders of these species.
b) Our records give or confirm phenological data of certain species regarding its breeding biology, behaviour, moulting or its migration.
c) The record of certain species might have interest for global conservation agreements like Ramsar Convention or AEWA (African – Eurasian Waterbird Agreement) under the Bonn Convention.
d) The species may be interesting for ecotourism and hence is important for the economy of Uganda. Our paper gives data on the occurrence, habitats, habitat use and detectability of these target species.
e) It is worth to publish the data just because of the rarity of the species or subspecies.

Visited areas

We would like to give a short description of the visited areas from geographical and conservation point of view. The introduction follows the chronology of the trip.

Entebbe Botanical Garden – Old establishment inside the town at the shore of Lake Victoria.

Banana Village – Small bungalow hostel or camping with a wide well-wooded yard in Kidepo near Entebbe.

Mabamba Bay Papyrus Swamp – Large swampy area near Entebbe along the coast of Lake Victoria. It is an Important Bird Area (IBA) with 9 IBA trigger species and belong to the Ramsar sites of Uganda (http://www.ramsar.org/cda/en/ramsar-documents-texts/main/ramsar/1-31-38_4000_0__).

Mpanga Forest – Hardwood rainforest near Mpigi west from Lake Victoria. Established in 1963. Area: 453 ha.

Mabira Forest – Hardwood rainforest between Kampala and Jinja. Well known ecotourist attraction and lots of visitors come here every year. It is an Important Bird Area with 82 IBA trigger species (http://www.birdlife.org/datazone/sitefactsheet.php?id=7052).

Victoria Nile in Jinja – This is the source of the White Nile. We visited the first few kilometer of the river.

Lake Mburo National Park – Important wildlife refuge protecting the southern savannah of the country. Its area: 370 km^2. The wetlands are partly Ramsar sites and an Important Bird Area, with 12 trigger species (http://www.birdlife.org/datazone/sitefactsheet.php?id=7051).

Queen Elisabeth National Park – With its area of 2056 km^2 it is one of the largest NP's in Uganda. Besides the large open savannah, it has a wide diversity of other ecosystems.

Kazinga Channel Wide natural channel connecting Lake George with Lake Edward in West-Uganda.

Fort Portal area with the Rujuna Hill Top Guesthouse.

Semuliki National Park – This park was established in 1993. It is situated north of the Ruwenzori Mountains and south of Lake Albert along the Semuliki River. Actually, it is part of the famous Ituri Rainforest ecosystems of DR Congo along the eastern bank of the Semuliki River. Its size is 220 km^2.

Ruwenzori National Park (area around) – This park was established in 1991. It is situated in the Bundibugyo, the Kabarole and the Kasese districts. Its area is 996 km^2, of which 70% exceeds an altitude of 2500 m. The park is 120 km long and 48 km wide. We visited two small parts of that huge area, first the Slope near the Semuliki National Park in the Bundibugyo district and secondly, the Foothills in Kasese district.

Semliki Wildlife Reserve – This savannah and wooded savannah region is situated in the Southern Lowland of Lake Albert, with an area some 540 km^2.

Kibale Forest National Park – It is a medium-altitude moist evergreen tropical forest (Langdale-Brown *et al.* 1964). Located South-east of Fort Portal. Area: 766 km^2. Its area consists in 77% of different type of forests. The remaining 23% of the area is covered by plantations, exotic conifers, grasslands and swamps. It is an Important Bird Area with, 120 IBA trigger species (http://www.birdlife.org/datazone/sitefactsheet.php?id=7046).

Bigodi Wetland Sanctuary – It is located along the Kamwenge road at the vicinity of Kibale Forest NP. The sanctuary itself is part of the larger Magombe papyrus swamp. The management of the sanctuary is recruited from the local community. They get economic benefit from their natural resources. The community-based conservation of certain areas is a widespread phenomenon in other parts of Africa as well (Sekercioglu & Riley 2005).

Nyakasura Crater Lakes near Fort Portal – Among the several lakes we visited only the 370 m deep Kigere Lake, and we made observations on the hillsides pastures on the way and around the Amabere Caves near the Information Center.

Budongo Forest – This famous birding site is a semi-deciduous moist tropical rain forest situated north-west of Masindi. Its average altitude is 1100 m, and the size is 428 km^2. The average annual rainfall is 1500 mm. Controlled extraction of timber began in the 1930s. Measures of forest structure showed that more than 50 years is required for the forest to recover to pre-logging levels (Plumptre 1996).

Murchison Falls National Park – It is the first and oldest national park of Uganda, and it is also the largest conservation area of the country. Its size is 3840 km^2. It is situated along the Victoria Nile and it is a part of the Western Rift Valley with Lake Albert and Albert Nile. The wetlands are partly Ramsar sites and an Important Bird Area with 47 trigger species (http://www.birdlife.org/datazone/sitefactsheet.php?id=7060).

Results and Discussion

Altogether 380 bird species were observed during the trip from the total of 1073 species of Uganda. In this paper we discuss the data of only 64 species belonging to 33 families.

Twenty-two families with 35 species belong to the Non-Passeres orders, while 11 families with 29 species are Passeres (Passeriformes). The Murchison Falls National Park, Kibale National Park, Lake Mburo National Park, Mabira Forest Reserve, and the Mabamba Bay Papyrus Swamp as IBAs involve 174 IBA trigger species altogether, of which 67 bird species were observed during our birding trip.

Species accounts:

PODICIPEDIDAE

Little Grebe – *Tachybaptus ruficollis capensis* (Salvadori, 1884)

One specimen was observed near Fort Portal at the Crater Lakes in the Nyakasura area on 27 July 2012. The bird was on the water edge of the 370 meter deep Kigere Lake.

Great Crested Grebe – *Podiceps cristatus infuscatus* (Linnaeus, 1758)

This is a rare and declining sedentary species in Africa (del Hoyo e*t al*. 1992). Two families were observed on the Lake Kigere, which belong to the Crater Lakes in the Nyakasura area near Fort Portal, on 27. July 2012. Beside these families there were other 3+1 adults some hundred meters apart in the same lake. Both breeding pairs were close to each other, and they occupied the south-eastern part of the lake. They seem to avoid the deep (370 m) central part of the Kigere Lake.

Breeding biology and phenology observations: One pair had 2 youngs still with striped heads, but they were well feathered and rather large size. Nearly as big as theirs parents. Both parents were feeding their youngs. The second family has had 5 smaller youngs, which were downy and striped headed as well, but their feathers just started to grown. At first they were together, and a few minutes later they divided into two groups. One adult led and fed two chicks, while the other parent led and fed the remaining three.

ARDEIDAE

Little Bittern – *Ixobrychus minutus payesii* (Hartlaub, 1858)

One specimen was observed in Lake Mburo NP on 18 July 2012. The bird was flying along the edge of the papyrus stand in the large marshy area. Another one was seen at the shore of Lake Albert on 31 July 2012.

Common Squacco Heron – *Ardeola ralloides* (Scopoli, 1769)

One immature specimen was observed in the Lake Mburo National Park on 18 July 2012. Another immature was recorded in the Murchison Falls National Park on 31 July 2012. The bird was searching for food on the edge of Lake Albert at the neighborhood of a roosting place of Hippopotamus *(Hippopotamus amphibius)* near some 220 roosting Cattle Egret *(Bubulcus ibis)*.

Rufous-bellied Heron – *Ardeola rufiventris* (Sundevall, 1851)

It was recorded only at a single locality during our trip. There were 3 specimens observed in the Lake Mburo National Park on 18 July 2012. The three scattered birds were looking for food at the edge of the large marshy area of the park.

Purple Heron – *Ardea purpurea purpurea* Linnaeus, 1766

This widespread species has an African breeding population in the middle of the southern half of the African Continent. Its nesting range reaches Lake Victoria area from the south (del Hoyo *et al.* 1992). We observed at least four individuals in the Mabamba Papyrus Swamp along the shore of Lake Victoria. All four birds were alone, searching for food mainly on the edge of the papyrus stand. They were rather tame, only flew up in front of us, when the approaching (boat) canoe was about 20 meters from them. They might be an interesting species for photographers and hence important for ecotourism. One was seen also at the bank of Victoria Nile, near the dam in Jinja on 14 July 2012.

BALAENICIPITIDAE

Shoebill – *Balaeniceps rex* Gould, 1850

Its population has declined rapidly in the last decades. Not persecuted by the local peoples but nevertheless severely threatened. Its total world population was estimated not more than 1500 individuals (Brown *et al.* 1982). Although later del Hoyo *et al.* (1992) estimated its population to be 11000 individuals, based on a more precise estimation in 1986. In Uganda its population was estimated less than 600 individuals in 1977 (del Hoyo *et al.* 1992). It occurs very sporadically, therefore every record might be important for the history of the species in this country. We observed two individuals in the Mabamba Papyrus Swamp on 12 July 2012, and another one in the Lake Mburo National Park on 18 July 2012. This latter bird was searching for food also in a large papyrus swamp with open waters.

CICONIIDAE

Abdim's Stork – *Ciconia abdimii* M. H. K. Lichtenstein, 1823

We saw this species only once. Two individuals were observed in the Murchison Falls National Park on 2 August 2012. The 2 birds joined to a small group of other waterbirds like one Marabou Stork *(Leptoptilus crumeniferus)*, 10 White-faced Whistling Ducks *(Dendrocygna viduata)*, 1 Grey Heron *(Ardea cinerea)* standing near the bank of the Victoria Nile a few hundred meters from the Ferry.

Woolly-necked Stork – *Ciconia episcopus microscelis* G. R. Gray, 1848

This African subspecies need more attention, because it is important for the Bonn Convention (http://www.cms.int/documents/convtxt/cms_convtxt.htm). It is listed in Appendix II. of the CMS (Conservation of Migratory Species). That is why every record might have importance. We saw it only once. One specimen was seen flying over the papyrus swamp in Lake Mburo National Park on 18 July 2012.

ACCIPITRIDAE

Lappet-faced Vulture – *Torgos tracheliotus tracheliotus* (J. R. Forster, 1791)

This species was observed only twice. Two birds were seen sitting among some 20 African White-backed Vulture *(Gyps africanus)* in the canopy of a large tree at the edge of a wooded savannah area in the Lake Mburo National Park on 18 July 2012. Second time we found one bird soaring above the savannah area in the Murchison Falls National Park on 2 August 2012.

Great Sparrowhawk – *Accipiter melanoleucus melanoleucus* A. Smith, 1830

Also known as Black Sparrowhawk. We observed one adult female specimen between the Kibale Forest NP near the Bigodi Wetland on 24 July 2012. The bird was flying over abandoned gardens and fallow areas between small woods and tree-groups at the height of the trees.

PHASIANIDAE

Nahan's Francolin – *Francolinus nahani* Dubois, 1905

In three spots of the Budongo Forest were heard its characteristic voice in the early morning hours on 29 July 2012. All of the habitats, where it was heard were mature forests with dense understorey vegetation along the Royal Mile. According to the literature, as well as our observation, it prefers the dense understorey, shy and very difficult to see them (Madge & McGowan 2002, Sande *et al.* 2009).

SAROTHRURIDAE

White-spotted Flufftail – *Sarothrura pulchra centralis* Neumann, 1908

The detectability of this species is rather high. Its presence was easy to detect, because just after entering its territory, it started calling immediately. It was observed in the Mpanga Forest, on 13 July, in Mabira Forest on 15 and 16 July, in Semuliki NP on 21 July and in Bigodi Wetland on 27 July 2012. All birds preferred the wettest part of the mature rainforest. They appeared usually along small rivers or swampy areas of the forests. In the Bigodi Wetland it occurred in the border of the wet forest and the papyrus swamp.

OTIDIDAE

Denham's Bustard – *Neotis denhami denhami* (Children, 1826)

Declining species all over its range in West- and Central-Africa due to hunting and habitat loss but still common in north Uganda (del Hoyo *et al.* 1996). We were lucky to found it in two places in the Murchison Falls National Park, which area is nearly the easternmost distribution of the nominate race. Both observed birds were alone, searching for food in semi-open savannah vegetation and in light woodland. The first bird in semi-open savannah area was accompanied with one or two Carmine Bee-eater *(Merops nubicus)*. The bee-eater(s) followed the walking bustard flying above it one meter higher or hovering above sometimes. The second one was feeding in grassy area 400 meter distance from the shore of Lake Albert, and did not pay attention to an immature African Fish-eagle *(Haliaeetus vocifer)* sitting nearby (some 50 meters) on the top of a low shrub.

Black-bellied Bustard – *Lissotis melanogaster melanogaster* (Rüppel, 1835)

It was observed twice. One female individual was recorded in Lake Mburo National Park in light wooded habitat on 18 July 2012. The bird was searching for food in the tall grass among shrubs in late afternoon. One male was in display flight in the grassy savannah area with only a few scattered shrubs on the Lake Albert side of the Murchison Falls National Park on 2 August 2012.

CHARADRIIDAE

Black-headed Lapwing – *Vanellus tectus tectus* (Boddaert, 1783)

It was seen only once. The first 5 specimens of a small group observed (3 adults and 2 in juvenile plumage) in the short grassy area along the bank of Lake Albert in the Murchison Falls NP. These birds were resting during the observation between 11.30 and 11.50 am. A few hundred meters away we watched another 2+2 adults resting in the same habitat.

SCOLOPACIDAE

Common Greenshank – *Tringa nebularia* (Gunnerus, 1767)

During our trip only one specimen was seen. This bird was on its feeding ground in one of the swampy areas in the Lake Mburo National Park on 18 July 2012.

Common Sandpiper – *Actitis hypoleucos* (Linneaus, 1758)

Three times were seen on its early summer migration. One of them was on the Victoria Nile near the dam in Jinja, on 14 July 2012. We found another one along the steep bank of a small river near the gate of the Lake Mburo NP on 19 July 2012. We observed three (1+2) on the bank of the Lake Albert on 31 July 2012. One of these birds was resting on the back of a Hippopotamus from a group of some 25 animals among Cattle Egrets *(Bubulcus ibis)*, one African Jacana *(Actophilornis africanus)* and some Yellow-billed Oxpeckers *(Buphagus africanus)*.

STERNIDAE

White-winged Tern – *Chlidonias leucopterus* (Temminck, 1815)

Two data are given on its early summer migration in Africa. 1) It was observed a group of 29 birds flying above the Mabamba Papyrus Swamp along the Lake Victoria near Entebbe on 12 July 2012. All the birds have already been uniformly in their winter plumage. 2) Three birds were recorded flying alone (also all in winter plumage) just a few kilometers under the famous Murchison Falls on the Victoria Nile on 31 July 2012. They were in feeding flight 0-2 meters above the surface of the river.

RYNCHOPIDAE

African Skimmer – *Rynchops flavirostris* Vieillot, 1816

We found this declining intra-african migrant on the Victoria Nile inside the Murchison Falls NP on 31 July and 2 August 2012. Scattered small groups were in rhythmic feeding flight half a meter or less above the water surface of the river. Other time of the day about 150 individuals in were sitting a compact group (resting) on the sandy ground on the mouth of a right side tributary of Victoria Nile. Another group of 120 birds was seen sitting and resting on the edge of the water of Victoria Nile on 2 August 2012. All the data are important for the Bonn Convention, where the species – as the only skimmer from the three species in the world – is listed in Appendix II. of the convention because of its vulnerability. Actually, it is a partial migrant within its range. Their movements are dependent on local rains, the requirement of smooth surface water to feed and exposed sandbanks to rest (Harrison 1983).

COLUMBIDAE

Afep Pigeon – *Columba unicincta* Cassin, 1860

We observed it in the Mpanga Forest in the Mpigi region westwards from Entebbe on 13 July 2012. During the 4-hour observation along a 4 km trip its characteristic voice was heard at 3 places. One freshly moulted tail-feather was found in the same place, showing that the species is in moulting period that time in July. We heard it again in the Budongo Forest on 29 July 2012.

PSITTACIDAE

Meyer's Parrot – *Poicephalus meyeri saturatus* (Sharpe, 1901)

First we saw it in the Lake Mburo National Park on 19 July 2012. One immature bird was flying in the canopy of a low savannah tree near the northern border of the national park. Another was flying nearby that bird giving its high call ʿclí-clí'. Last we saw this species on the way returning back from Masindi to Entebbe on 3 August 2012. That time several birds were flying along the road some 20 km before we approached the junction of the main road of Kampala to Sudan.

Grey Parrot – *Psittacus erithacus erithacus* Linnaeus, 1758

This west-african species was rather common in most of the visited rainforests, like Mpanga, Mabira and the Budongo Forest. It was present even inside Entebbe. One individual was seen in the Entebbe Botanical Garden on 11 July 2012. In the Mpanga Forest on 13 July 2012 there were several scattered individuals, 8 birds together were the largest group. All the observed birds were moving or sitting in the high canopy level. They were often giving their simple whistling voice. It was seen also in Dangala area near the Information Center of Mabira Forest on 14 July 2012. The two birds were flying over a ruderal area and village outside the forest.

Red-headed Lovebird – *Agapornis pullarius ugandae* Neumann, 1908

We observed one specimen in the savannah area of Lake Mburo National Park on 19 July 2012. Two specimens were recorded in the Murchison Falls National Park on 31 July 2012. Two birds were seen at the edge of riverine forest along the Victoria Nile some 10 km under the Murchison Falls area.

CUCULIDAE

Red-chested Cuckoo – *Cuculus solitarius* Stephens, 1815

One adult male was seen in the Mabira Forest on 16 July 2012. The bird was flying inside the forest in the mid-canopy, and was sitting for a few minutes on a horizontal branch in a gap at one of the forest clearings.

Black Cuckoo – *Cuculus clamosus* Latham, 1802

This rarely seen bird species was observed only once. One individual in wholly black plumage was flying low (3 meters above the ground) in an open shrubby-grassy savannah area outside of the northern border of Lake Mburo National Park on 20 July 2012.

Dusky Long-tailed Cuckoo – *Cercococcyx mechowi* Cabanis, 1882

We heard *only in one place* the characteristic voice of that species in the Mpanga Forest during the four hours observation time on 13 July 2012 along the 3-kilometer long transect on the 'Basic Lane' in the forest.

TYTONIDAE

Barn Owl – *Tyto alba affinis* (Blyth, 1862)

We found a territory some 10 km south from the town Fort Portal just around our small hotel called Rujuna Hill Top Guesthouse. We heard them every night (also watched it few times) between 21 and 27 July 2012.

CAPRIMULGIDAE

Pennant-winged Nightjar – *Macrodypteryx vexillarius* (Gould, 1838)

Actually, no living specimens of that species were observed in the wild. We found only two dead birds probably hit by cars on the forest road inside the Murchison Falls National Park. Both individuals were found in early morning on 1 August 2012. At first the female, then about one kilometer away the male was found in breeding plumage on the same road. The dead birds were fresh, probably hit during the previous night.

APODIDAE

Scarce Swift – *Schoutedenapus myoptilus chapini* (Prigogine, 1957)

It was only observed once. Six individuals were seen in aerial hunting above a gallery forest along a small river in the Semliki Wildlife Reserve on 22 July 2012. They were in the same activity during the half an hour observation.

TROGONIDAE

Narina Trogon – *Apaloderma narina narina* (Stephens, 1815)

This is a target species for ecotourism. We could not see, but heard its characteristic voice several times. It was heard at two places in Mpanga Forest on 13 July 2012 along a 3-kilometer long transect of the mature forest. One was heard in Semliki Wildlife Reserve in savannah woods along the small Waassa River on 23 July 2012. It was heard also in the Budongo Forest on 29 July 2012.

ALCEDINIDAE

African Dwarf Kingfisher – *Ispidina (=Ceyx) lecontei* (Cassin, 1856)

It is also a target species, because it is a rarity for East Africa occurring only in a few places inside Uganda. We have recorded it in three localities. 1: One was seen in the

Entebbe Botanical Garden on 11 July 2012. 2: Another single specimen was recorded in the Mabira Forest on 15 July 2012. This bird was sitting motionless for long period among the twigs 3 meters high of a small tree along the forest path. The bird was rather tame, easy to observe. That is the moister part of the Mabira Forest east from the Kampala – Jinja road. 3: We have found a pair, as well. These two birds were moving in the 2-6 meters strata of the forest edge on the foothills of the Ruwenzori Mountains just in front of the Information Center of the Semuliki National Park.

MEROPIDAE

Swallow-tailed Bee-eater – *Merops hirundineus heuglini* (Neumann, 1906)

During our trip we found quite a few bee-eater species. Altogether 8 species were seen. Some of them were common, but we observed only one occasion the Swallow-tailed Bee-eater. Three young or immature birds were seen in the savannah area of the Murchison Falls National Park on 2 August 2012. All three birds were sitting close together on the lateral twigs of a shrub some 7 meters high above the ground.

Olive or **Madagascar Bee-eater** – *Merops superciliosus superciliosus* Linnaeus, 1766

It is a migrant mainly from Madagascar. We have got only one record. This bird was observed in Entebbe Botanical Garden near the shore of Lake Victoria on 11 July 2012. The bird was sitting on the top of a dry tree outstanding among the trees of a young forest patch.

BUCEROTIDAE

Black-casqued Wattled Hornbill – *Ceratogymna atrata* (Temminck, 1835)

Observed once in the Semuliki National Park on 21 July 2012. At least two pairs of that species were sitting close together in the canopy of an app. 30-meters high Natalian Mahogany *(Trichilia emetica)* tree standing alone among other mature forest trees. The birds were feeding on the 3-lobed rounded fruits. One pair of Piping Hornbill *(Bycanistes fistulator)* and a few Red-tailed Monkeys *(Cercopithecus ascanius)* also were part of this feeding community.

MOTACILLIDAE

Mountain Wagtail – *Motacilla clara chapini* Amadon, 1954

One pair was observed in the Kibale Forest National Park at the bridge of the road to Bigodi Wetland in the small river of the border of Kammengwe district on 26 July 2012. The birds were in a process of making their nests. Both were collecting nest material mostly green moss from the surface of big stones at the edge of the riverbed. The nest under construction (not seen the exact place) was some 15 meters away in the higher weed vegetation still inside the riverbed but close to the riverbank.

PYCNONOTIDAE

Toro Olive Greenbul – *Phyllastrephus hypochloris* (Jackson, 1906)

It was recorded in two localities. Firstly, along the three kilometer long ‘Basic Lane’ in the Mpanga Forest where 3 individual were observed in three different places on 13 July 2012. Secondly, we saw one specimen on 21 July 2012 on the northern base of the Ruwenzori Mountains in the Semuliki National Park.

Xavier's Greenbul – *Phyllastrephus xavieri* (Oustalet, 1892)

One individual was observed in the Mabira Forest on 16 July 2012. The bird habitat was the shrub strata under a 35-meter-tall mature forest. The bird was moving and searching for food in the 6-10 meter zone in the forest interior.

White-throated Greenbul – *Phyllastrephus albigularis albigularis* (Sharpe, 1881)

We found it only in one locality, namely in the Mpanga Forest on 13 July 2012. Only one specimen was observed along the 3-kilometer long 'Basic Lane', which splits the forest.

Yellow-throated Greenbul – *Chlorocichla flavicollis flavigula* (Cabanis, 1880)

We found it only in one locality, on the foothills of the Ruwenzori Mountains in the old mining village, Kilembe near Kasese on 22 July 2012. The two birds were skulking in one of the isolated bushes in the ruderal area of the small, old miner town.

Red-tailed Bristlebill – *Bleda syndactylus woosnami* Ogilvie-Grant, 1907

This species was found at several localities. We found it in two places in the Mpanga Forest on 13 July 2012. One individual was heard in the Bigodi Wetland near Kibale Forest National Park on 24 July 2012.

Green-tailed Bristlebill – *Bleda eximius ugandae* van Someren, 1915

One specimen was seen in the Mabira Forest on 16 July 2012. The habitat was mature forest, where the bird was in the forest interior moving on the 4-10 meters strata on smaller trees. Second time we found it in two places in the Budongo Forest on 30 July 2012. We made a transect counting along the public road crossing the forest, from the information centre to the southern edge of the forest. Along this 4-kilometer road we observed 1 + 1 individual both in mature forest. One joined to a mixed pycnonotid group feeding in the canopy on the same berries. This group consisted of mostly Little Greenbul *(Andropadus virens)* and Yellow-whiskered Greenbul *(Andropadus latirostris)*. The second Green-tailed Bristlebill one kilometer away was also in the forest interior under 35 meters high trees on liana tangles in the 3-15 meter level above the ground.

TURDIDAE

White-tailed Ant-thrush – *Neocossyphus poensis praepectoralis* Jackson, 1906

Although its distribution map shown in Keith *et al.* (1992) reaches the western bank of Lake Victoria in Uganda, the text of the same source restricted it only in West-Uganda. It was found in a new locality of its distribution not mentioned by Stevenson and Fanshawe (2011) in 'Birds of East Africa' either. Namely, it was recorded in the Mpanga Forest near Mpigi a few kilometers west from Lake Victoria on 13 July, 2012. Four individuals were recorded scattered along the 'Basic Lane'. They were first identified by our guide, *Nanyombi Prossy*, who knew exactly the voice of that species. All the individuals preferred the deeper wet part of the forest with moderately dense understorey, where they were moving on the ground and the shrubs in the 0-2 meter zone. We observed this species later again in its known distribution area, namely in the Bigodi Wetland near the Kibale Forest National Park in West Uganda on 24 July 2012. One specimen was singing in a deep ditch with original vegetation just under a slope with cocoa and coffee plantation. The population of this species here in the latter habitat suffered a severe habitat loss. If we consider the paper of Hulme *et al.* (2013), this species here in Bigodi Wetland is belonging to the 'losers'. Our other guide, *James Katangole,* was helping us when he identified the voice of White-tailed Ant-thrush.

Red-tailed Ant-thrush – *Neocossyphus rufus* ssp.*(?)* Neumann, 1908

One specimen was seen in the Mabira Forest on 14 July 2012. The bird was searching for food in the edge of small gaps in a mature part of the forest. Its activity was restricted in a strata of 1-6 meters above the forest floor. Its distribution map in the 'Birds of East-Africa' (Stevenson & Fanshawe 2011) did not show that area for that species. The Lake Victoria area is not mentioned concerning that species. Thus, according to this record, the Mabira Forest is a new locality of the Red-tailed Ant Thrush in Uganda. But it raised a question. Possibly the observed bird belong to the *N. r. gabunensis* subspecies, which is distributed in West-Uganda, or might belong to the nominate race *(N. r. rufus)*, which is living also not far from this new locality in Kenya and also in the Tanzanian side of the border in disjunct areas?

Common Stonechat – *Saxicola torquatus axillaris* (Shelley, 1884)

One pair was observed on a hilly pasture land near Fort Portal at the Crater Lakes in 27 July 2012. The behaviour of the birds has shown the characteristics of pre-breeding period.

SYLVIIDAE

Papyrus Yellow Warbler – *Chloropeta gracilirostris gracilirostris* Ogilvie-Grant, 1906

This rare and vulnerable species is known in West-Uganda from the Lake Edward and the Lake George areas. One specimen singing in the Mabamba Bay Papyrus Swamp was observed during a bird-safari on 12 July 2012. The distribution map of Birds of East Africa (Stevenson & Fanshawe 2011) does not show that area for that bird species. The Mabamba Bay Papyrus Swamp is an Important Bird Area (IBA) along the northern shores of Lake Victoria west of Entebbe. The habitat of the observed specimen of Papyrus Yellow Warbler was the inner fringe of the papyrus stand just on the edge of the wide-open water patch in the middle of the swamp. The bird was flying up from the papyrus stem some 3-4 meters away, gave an aerial singing and flew back to its place on the papyrus stem. It seemed to us that the local field ornithologists and conservationists have already known about the occurrence of that species in the Mabamba Swamp. This bird belongs to the 49 East-African species red-listed by BirdLife in 2000 (Stevenson & Fanshave 2011). It also occurs in Kenya along the shore of Lake Victoria at Kadenge, where Britton (1978) placed it among the species which not numerous, but found regularly. He recorded it from the total of 15 observation days in 15 months 9 times, and he caught 6 individuals by mistnets.

Grey Longbill – *Macrosphenus concolor* (Hartlaub, 1857)

It is relatively a widespread species inside of its disjunct area, but the detectability is very low. One specimen in Mabira Forest was observed, on 16 July 2012.

Green-backed Eremomela – *Eremomela canescens canescens* Antinori, 1864

A small group of three birds was recorded in the Semliki Wildlife Reserve on 26 July 2012. They were grey-headed, white-throated, but generally yellowish green birds. They were feeding on low scattered trees at a height of 4-7 meters in the savannah habitat of the reserve.

There is a taxonomical confusion about the 'form' of that species we observed in the Semliki Wildlife Reserve. According to Stevenson and Fanshave (2011) we can identify it as '*Eremomela pusilla*', which is a West-African species of that genus according to Dickinson (2003) and del Hoyo *et al.* (2006). It means that the latter authors not merge the observed 'form' *(E. canescens canescens)* into the '*Eremomela pusilla*' they separated the two species. Here, we follow the latter idea treating the 'form' separated as it is indicated by the title.

Black-faced Rufous Warbler – *Bathmocercus rufus vulpinus* Reichenow, 1895

The detectability of this species is not bad, because of its distinctive voice, but to actually to see it is not easy because of its hiding behaviour in the dense bushy habitat. We observed it only once at the vicinity of the waterfall on the small Ruwenzori river at the Amabere Caves near Fort Portal on 27 July 2012. At first one specimen gave its nice whistling voice in a damp narrow valley with dense secondary bush surrounded with wooded pastures. A few minutes later we heard another specimen in a distance of two hundred meters.

CISTICOLIDAE

Carruther's Cisticola – *Cisticola carruthersi* Ogilvie Grant, 1909

One specimen was singing along the shore of the Lake Albert near a roosting place of a group of 36 Hyppopotamus in the Victoria Nile delta on 2 August, 2012. The bird was sitting and singing sometimes in the top of the scattered reedstems. We heard another three songs of that species in some half hectare of that kind of habitat.

Red-winged Grey Warbler – *Drymocichla incana* Hartlaub, 1861

Two specimens were observed in the Murchison Falls NP along the Victoria Nile near the place of the Ferry on 1 August 2012. The birds were moving and searching for food in a higher stratum (5-9 meters) of the canopy of a secondary bush on the slope of a small hill. The birds were cocked the tail and one of them had given his high-pitched song.

Grey-capped Warbler – *Eminia lepida* Hartlaub, 1881

Although this species has a wide range in southern half of Uganda, we found it only at one locality. One specimen was observed along the shore of Lake Victoria (inside the Entebbe Botanical Garden) in the shrub among scattered trees on 11 July 2012.

MUSCICAPIDAE

Cassin's Grey Flycatcher – *Muscicapa cassini* Heine, 1859

It is mentioned here, because of new observations on its breeding phenology. One pair was searching for food, catching small flying insects along the small river, at the bridge (the border of Kammengwe district) in Kibale Forest National Park, some twenty kilometers from the town Fort Portal on 25 July 2012. Their nest was built on the edge of a big stone lying in the water near the edge of the river just about 40 cm above the water-surface. It has already contained one egg, but still not incubated. For time to time one of the birds was sitting in the nest for a few minutes.

MALACONOTIDAE

Black-headed Gonolek – *Laniarius erythrogaster* (Cretzschmar, 1829)

It is a target species for ecotourism and birdwatchers. We found it in several localities. It is a spectacular, rather common and relatively tame bird, therefore easy to watch it. We observed two individuals in the Entebbe Botanical Garden on 11 July 2012 and found it at least four places in a habitat of with scattered shrubs along the shore of the Mabamba Papyrus Swamp on 12 July 2012. It was recorded even in urban habitats. We were watching one adult (might be two) and at least one young in post-juvenile molting condition, an open-air garden restaurant on 4 August 2012. The adult(s) came from the hedge landed on tables or on the floor and feed the young frequently in the bush. They came one by one several times during the afternoon hours.

Papyrus Gonolek – *Laniarius mufumbiri* Ogilvie-Grant, 1911

It is a 'restricted habitat' species closely associated with Papyrus *(Cyperus papyrus)* and belongs to the papyrus endemics of Lake Victoria area (del Hoyo *et al.* 2009). Skulking in its habits in the dense vegetation it was very difficult to see. We heard the short song of that species in one place of the Mabamba Papyrus Swamp on 12 July 2012. This shy bird has a special habitat, using the old papyrus stand fringed of the central greater open-water of the swamp. It is a target species of eco-tourism. That bird is rather common in the Kenyaen part of the Lake Victoria at Kadenge in the north-east (Britton 1978).

Northern Puffback – *Dryoscopus gambensis congicus* Sharpe, 1901

One was seen in the Entebbe Botanical Garden on 11 July 2012. The bird was moving in the canopy at 25 meters level of the old mature 28 m high trees. Another observation: also one individual was seen in the Queen Elisabeth National Park on 20 July 2012.

Bocage's Bush-shrike – *Malaconotus bocagei jacksoni* (Sharpe, 1901)

It was observed twice on 24 and 25 July 2012, on both occasions nearly the same place near the southern edge of the Kibale Forest. The birds – in both case only one specimen – was joined to a mixed feeding flock of song birds, searching for food on the shrubs and small trees along the red laterit road to Bigodi Wetland.

PASSERIDAE

Shelley's Rufous Sparrow – *Passer shelleyi* Sharpe, 1891

We saw this species only at a single locality. One male and a few meters away another two specimens were seen in the savannah area with scattered bush north of the Victoria Nile in the Murchison Falls NP on 1 August 2012. Fry and Keith (2004) also mentioned it from the Murchison Falls NP.

House Sparrow – *Passer domesticus* (Linnaeaus, 1758)

This species is not native in the area. It was introduced to East-Africa at Mombasa one hundred years ago but was spreading very slowly. It was first recorded in Nairobi only October 1992 (Zimmerman *et al.*

1996). The new field guide 'Birds of East Africa' (Stevenson & Fanshawe 2011) not mentioned that species in Uganda. The first record for Uganda came only recently, at the beginning of this century: on 21 November 2001 at Kibimba rice scheme, SE Uganda (Fry & Keith 2004). We found the House Sparrow at one locality, east of the Ruwenzori Mountains in the small village Rukoma, just on the northern bank of the Kazinga Channel on 20 July 2012. One adult female was searching for food on the ground in the main street of that village and a few hundred meters away there were another 5 specimen on the same street. By that occurrence the species made a big jump to the west. We did not found it in the eastern part of the country. We note, A. Bankovics observed one specimen at a fuel station near Lake Nakuru, in Kenya on 20 November 2005 (unpublished record). That area is also on the western front in its spreading.

PLOCEIDAE

Northern Red Bishop – *Euplectes franciscanus franciscanus* (Isert, 1789)

One nest was found with two incubated eggs in the shore of the Lake Albert in the Murchison Falls National Park on 2 August 2012. The cup-shaped nest was placed in dense 'reed' stand at 160 cm height from the ground. We found this species rather common in the marshy habitats along the shore of Lake Albert. Many other males of this species were in display these days in that area.

ESTRILDIDAE

White-breasted Negrofinch – *Nigrita fusconotus* Fraser, 1843

One specimen was seen in the Mabira Forest on 15 July 2012. Two individuals were observed in the Budongo Forest on 30 July 2012. The two birds – likely one breeding pair – were feeding together in a lateral branch, 8 meter above the road crossing through the forest. They were feeding like warblers searching for food on terminal shots and among leaves of the canopy. The White-breasted Negrofinch is a West-African species with two subspecies. In Uganda the nominate race occurs with the easternmost distribution of the species.

Grey-headed Oliveback – *Nesocharis capistrata* (Hartlaub, 1861)

One male was seen in the Murchison Falls NP savannah area on 2 August 2012. The bird joined a mixed estrildidae feeding flock, which consisted of mostly Bronze Mannikin *(Lonchura cucullata)* and African Firefinch *(Lagonosticta rubricata)*.

Red-headed Bluebill – *Spermophaga ruficapilla* (Shelley, 1888)

It is a rarely seen species, target for eco-tourism. We observed it in two localities. First we saw it in the Mabira Forest on 16 July 2012. That bird was moving in the shrub strata of a high primary rainforest interior. The other locality where we saw it was the Bigodi Wetland in West Uganda on 24 July 2012. That time first we saw a pair of that bird coming out from a dense bush. Than they were searching for food in a cleared area near the secondary bush vegetation. Some hundreds meter away that place we found another individual of that species in cocoa plantation.

FRINGILLIDAE

Streaky Seedeater – *Serinus striolatus striolatus* Rüppell, 1840

One specimen was observed North-west from Entebbe in the yard of the small hotel 'Banana Village' on 11 July 2012. The bird was sitting on the top of a high tree that dropped down all its leaves that part of the year. It was observed with a binocular and a scope. The bird was bigger than the commoner Black-throated Seedeater *(Serinus atrogularis)* with a heavier bill, and its throat patch was whitish. The 'Birds of East Africa' (Stevenson & Fanshawe 2011) not mentioned this are in its distribution. The nearest place where it is shown on the map of that book is north of the Lake Victoria along the Ugandan /Kenyan border some 150 kms away. Also, according to Fry and Keith (2004) it occurs in Uganda only in the Ruwenzori mountains along the western border of the country.

Conclusion

The ornithological importance of Uganda is due to confluence of some very different biomes, namely lowland and highland forests, savannahs and other grasslands, leading to the high diversity of the bird species in Uganda. In the present paper altogether 64 species belonging to 33 families are discussed from the 380 bird species recorded during the 25-days survey trip in Uganda. The most important species in the different selected groups are as follows:

Birds are often found in Africa even today outside their recently known range, that is why new distributional records are always important (Keith & Twomey 1968). One of the most important groups is those species, which were found in new localities not mentioned in the literature before. They are: *Neocossyphus poensis, Neocossyphus rufus, Chloropeta gracilirostris, Eremomela pusilla, Passer rufocinctus, Passer domesticus* and *Serinus striolatus*.

A larger part of the species is important because of ecotourism. Ecotourism especially important in the economy of Uganda and as a consequence important in nature conservation, as well. In order to find target species for tourists this paper shows the occurrences of some species mentioned above like *Ardea purpurea, Balaeniceps rex, Torgos tracheliotus, Sarothrura pulchra, Neotis denhami, Poicephalus meyeri, Psittacus erithacus, Agapornis pullaria, Macrodypteryx vexillarius, Apaloderma narina*.

Some species are mentioned simply because of their rareness or low detectability, like *Francolinus nahani, Accipiter melanogaster, Cuculus solitarius, Cuculus clamosus, Cercococcyx mechowi, Schoutedenapus myoptilus, Malaconotus bocagei* and *Nesocharis capistrata*. Some other species are mentioned because their races occurring in Africa are different from our European ones. These are *Tachybabtus ruficollis capensis, Ixobrychus minutus payesii, Tyto alba affinis*.

A few species were exposed because we got phenologycal data about their breeding biology. They are *Podiceps cristatus, Motacilla clara, Muscicapa cassini, Euplectes franciscanus*.

A few bird species were selected because of the data of its migration both intra-African one or palearctic. Both migration types have importance for the Convention of Migratory Species (Bonn Connvention) or the Ramsar Convention, the latter dealing with the waterfowl habitats. These migratory species mentioned in our list are: *Ardeola ralloides, Ardeola rufiventris, Ciconia abdimii, Ciconia episcopus, Vanellus tectus, Tringa nebularia, Actitis hypoleucos, Chlidonias leucopterus, Rynchops flavirostris, Merops hirundineus* and *Merops superciliosus*.

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