COMPARISON OF A DIET OF THE MONTAGU`S HARRIER *CIRCUS PYGARGUS* L. DURING BREEDING SEASON IN TWO DISTINCT PLOTS IN THE WESTERN BELARUS

Dymitry Vintchevski, Aliaxandr Yasievitch

Abstract

The study of diet composition of the Montagu`s Harrier (*Circus pygargus* (L) in two distinct breeding populations in 1996 in Hrodna and Smarhon` districts in Western Belarus have found different occurence of small mammals: 72,6% (n=2034) for the population #1 and 85,0% (n=254) for the population #2. Main prey in both populations was represented by vole species *Microtus* spp.: 68,5% and 78,3% for populations #1 and #2 accordingly. Significant difference was found in share of birds, mainly ground-nesting Passerines (17,5% and 12,6% for the population #1 and #2 accordingly) and large grasshoppers *Tettigonia* sp. (6,4% and 0,4% accordingly). Other prey categories (mice, shrews, hares, eggs of birds, lizards, dragonflies, large beetles and frogs) did not form an important part of the diet of these populations. We believe that opportunistic hunting behavior of the Montagu's Harrier (which can easy switch on seasonally or locally abundant and accessible prey) is one of the reasons why the species did not form any subspecies throughout its wide range.

Key words: diet composition,. Montagu`s Harrier *Circus pygargus,* Western Belarus, Voles *Microtus* spp.

PORÓWNANIE SKŁADU POKARMU BŁOTNIAKA ŁĄKOWEGO *CIRCUS PYGARGUS* L. W SEZONIE LĘGOWYM NA DWÓCH ODLEGŁYCH POWIERZCHNIACH W ZACHODNIEJ BIAŁORUSI

Streszczenie

Badania składu pokarmu 2 odległych populacji lęgowych błotniaka łakowego *Circus pygargus* w 1996 r. w obwodzie Grodna i Smarhon w zachodniej Białorusi wykazały różny udział drobnych ssaków 72,6% (n=2034) w 1 populacji i 85,0% (n=254) w 2 populacji. Głównymi ofiarami w obydwu populacjach były różne gatunki norników *Microtus* spp.: 68,5% i 78,3% odpowiednio dla 1 i 2 populacji. Wykazano także dwie istotne statystycznie różnice między udziałem ptaków, głównie gniazdujących na ziemi *Passeriformes* (17,5% i 12,6% odpowiednio dla 1 i 2 populacji) i dużych pasikoników *Tettigonia* sp. (6,4% i 0,4% odpowiednio). Inne ofiary (myszy, ryjówki, zające, jaja ptaków, jaszczurki, ważki, duże chrząszcze i żaby) nie miały istotnego znaczenia w składzie pokarmu żadnej z populacji. Prawdopodobne przyczyny uzyskanych wyników przedyskutowano porównując dane z innych gatunków ptaków drapieżnych oraz innych populacji błotniaka łąkowego. Uważamy, że oportunistyczna strategia żerowania błotniaka łąkowego (który może łatwo zmieniać sezonowo i lokalnie dostępną zdobycz) jest jedną z przyczyn braku wytworzenia podgatunków w szerokim areale występowania.

Słowa kluczowe: błotniak łąkowy *Circus pygargus,* norniki *Microtus* spp., skład pokarmu, zachodnia Białoruś

Introduction

The most valuable data on raptors' diet should represent full breeding period, because only that approach allows to analyse the role of raptor species in ecosystem and its possible influence on number and structure of the potential prey species populations (Priklonsky and Krever 1985). But in this case direct methods (e.g. observations on nests or artificial limitation of food transfer to the nestlings), that often are easiest for implementation, are limited to a part of the breeding season – in the best cases for the part of incubation, full nestling and part of the post-fledging periods (Schipper 1973). So it is rather impossible to compare the data received by direct methods with data from pellets and prey remains (which are only known way to learn the diet of raptors during pre-incubation and most of the post-fledging periods). It is also possible, that the diet of adult birds are different from the diet of nestlings, so by direct observations on nests is not possible to determine the difference. Even as indirect methods of raptors` diet studies have some biases and shortcomings (review for general approach in Priklonsky and Krever (1985) and for Montagu`s Harrier in Sánchez-Zapata and Calvo (1998), they are still useful to obtain compatible data for the full breeding season (Osmalovskaia 1948, Simmons et al. 1991, Oro and Tiella 1995 and others).

We have studied different aspects of biology of Montagu`s Harrier during breeding seasons in 1993-2002 and 2005-2009 (Vintchevski et al. 1994; 2000; Vintchevski 2006a, 2006b; 2008, 2009).

In present paper we compare our data for the occurrence of each prey category in the diet of two breeding populations of Montagu`s Harrier in the same season, which were in a distance ca. 250 km far from each other.

Methods

Territory

We have investigated habitats suitable for harriers in Hrodna district around Hrodna city (ca. 350 thousand inhabitants (2001), the Western Belarus) at a total area ca. 150 km² (further the study plot #1) and in Smarhon` district around Smarhon` town (ca. 40 thousands inhabitants in 2001, Hrodna region) in the North-Western Belarus at a total area ca. 100 km² (further study plot #2) in 1996. Territories of both study plots consist mainly of arable farmlands that belong to the collective farms (`kolkhoses`). They are not specialised and cultivate grain, potatoes, technical cultures and perennial grasses as hay and pastures for the cattle. The size of fields can vary from 5 to more than 100 ha, but usually it is about 50 ha. Small forests (mainly coniferous) usually divide the several fields, but some (0.5-5 ha) are situated in the middle of the fields. Somewhere, especially in floodplains of small rivers and streams are drainage ditches. Human settlements are small. Every house has 0,5-1 ha of orchard and garden. Landscapes of both territories were rather similar except some rather small (up to 5 ha) sedge and transitory mires which were presented only at the study plot #1.

Studied populations

The harriers from the study plot #1 had exceptional breeding season in 1996 with late and cold spring. Only 9.0 % nests were situated at agricultural crops (1 nest in winter rye and 1 in

perennial grasses) and 31.8% of nests were found at an orchard in dry grass (left uncut from previous year) – totally 40.8% at farmland (n=22). For comparison for 10 years (1993-2002, n=196) the mean share of nests on arable farmland was 88.8%, and in 1994 (n= 13), 1999 (n= 18) and 2001 (n= 28) all nests were situated on arable farmland (Vintchevski 2006b). If we compare the data for 1996 with data for other 9 years (1993-95, 1997-2002), 94.3% of all nests (n=174) were situated in arable farmland. Unusually high was the share of harriers` nests in patches of ruderal vegetation on waste-land – 31.8% (n=22) in 1996, as for ten years (1993-2002) it was only 4.6%. Unusually high was also share of nests, which harriers placed in natural habitats (sedge mires and reedbeds) – 27.1% (n=22), as mean share for the same habitats for ten years of investigation was only 6.6%. The share of nests (86.4%), which were clumped in semi-colonies (from 4 to 8 nests) was rather normal for the study area (mean 83.1%, n= 195) during 10 years.

In 1996 at the study plot #2 we found 10 nests, all of them were built on arable farmland (in winter rye/wheat hybrid, winter rye and perennial grass). The share of nests, which were clumped in semi-colonies (from 2 to 4 nests) was 90%. We have not complete data from other years for comparison for this area.

Diet analyses

We have calculated the percentage occurrence (later on – share) of each prey category in the diet based mainly on indirect methods. Males and females of Montagu`s Harriers usually have quite permanent places (a stack of straw, patches without or with short vegetation, posts of fence nearby or inside nesting territories etc.), where they pluck the prey or rest. We visited and collected pellets and prey remains from such places during all breeding season (from 03.05 to 29.08) at least weekly or more often for each semi-colony or single nests in study plot 1 and once in May (19.05), 3 times in June and 3 times in July (the last time at 30.07) in study plot 2 and also from nests during nestling and the first part of the post-fledging periods.

Additionally, we also have used several direct observations of food-passes. When nestlings became about 2 weeks old, we checked content of the nestlings` crops *in situ* (Vintchevski 1996) during our visits to some nests. During each visit, an effort was made to remove all prey remains and to clean a nest.

To minimize the possibility of overcounting the number of each species or prey categories we used the same procedures during all breeding season. Our method of combining data is resembling a method described by Oro and Tiella (1995). Because when we found the same prey both in pellets and remains from the same site for same time we assumed it was from the same individual (if some quantities of prey`s parts do not show the bigger numbers of individuals).

Pellets and remains of prey from the same day, which were collected from one nest or pair of birds, were lumped and reconstructed by matching the bones, feathers, beaks and other parts of birds; fur, skull parts and other remains of mammals and so on for each prey group. For the interpretation of pellets content we have used a rule: minimum data about the prey in pellet = maximum data. It means, for example, that if we have found only one tooth of common vole in pellet, we interpreted it the same way as one eaten common vole by harriers = if we found a full skull and skeleton of the common vole. For the data from 1996 we have assumed, that all our direct observations and content of nestlings` crops were repeated in pellets and/or prey remains on both study plots.

Usually different parts of the same prey could be eaten by more than 1 nestling, to prevent overcounting of prey items, we have assumed that all pellets we collected during one visit to the nest was `one big pellet`. Remains and contents of nestlings` crops during second half of nestling period, that were collected during one visit, were lumped together with pellets and we used the same rule of reconstruction of prey individuals as was described before.

Pellets with feathers, gastrolits and/or pieces of insects (that we believed were from swallowed by harriers bird stomachs) we have counted as NCD bird's remains if it was not clear (on the base of feathers, beaks, size of some bones and rests of feet), that it was a Passerine bird. Only pieces of insects, which were found in pellets without feathers, were classified as the insects, which were eaten by harriers.

To identify teeth and/or skulls of the small mammals we have used keys and pictures in guides by Vinogradov and Gromov (1984), Siivonen (1979) and Sokolov (1977). To identify skulls or beaks of birds, we used guide by Brown et al. (1992). Feathers and feet of birds were identified by Dr. V. Gritchik by comparison with bird collection of the Zoological museum of the Belarusian State University in Minsk. Bird eggs and their shells were identified ourselves by comparison with pictures of eggs from the guide written by Nikiforov et al. (1989). Insects were identified by Aliaxandra Ryzhaja (Yanka Kupala Hrodna State University).

Diet categories

To have a possibility to compare the data between the study plots, we have divided all identified prey into 10 categories:

1. Not closer determined (later NCD) rodents;
2. *Microtus* spp. (It was impossible for us to divide *M. arvalis* and *M. rossiaemeriodionalis* on the base of teeth or other rests we had, but both species occurs in Belarus (Savicki et al. 2005), so when later we mention only *M. arvalis* it means that at least some of them could be *M. rossiaemeriodionalis*);
3. *Apodemus spp.* (including mainly *Apodemus agrarius*, and some *A.. sylvaticus/uralensis/flavicollis*);
4. Other mammals (juv. *Lepus europaeus* and *Sorex araneus/caecutiens*);
5. Birds: NCD birds and Passerines (incl. mainly *Alauda arvensis, Anthus pratensis*, then *Motacilla flava, M.alba, Saxicola rubetra, O.oenanthe, Emberiza calandra* and most probably other small, mainly ground-nesting species). For study plot 2 as a prey we could determine only *Alauda arvensis* and *Anthus pratensis,* but we could not excluded possibility of presence of other ground nesting birds;
6. Eggs of birds (incl. mainly eggs of *Alauda arvensis, Anthus pratensis* and *Perdix perdix* (only these for study plot 2), but also eggs of *Saxicola rubetra* and possibly other ground nesting birds);
7. *Lacerta spp.* (*Lacerta agilis* and possibly *L.vivipara*);
8. *Rana sp.* (NCD frogs);
9. *Tettigonia spp.* (mainly *Tettigonia viridissima/cantans,* possibly *Decticus* sp.);
10. Other insects: includes *Odonata* (*Sympetrum glareolum* and possibly others NCD middle-sized dragonflies), NCD *Acrididae* and *Coleoptera* (mainly *Nicrophorus vespillo* and possibly other *Nicrophorus* sp*.,* then *Geotrupes* sp.and possibly other big beetles).

For statistics analyses we have used Statistica 6.0 with the recommendations of Borovikov (2001).

Results

Finally we have determined 2034 prey items for harriers from study plot 1 and 254 prey items for study plot 2.

For both groups of harriers the main prey were small mammals (tab. 1) – 72.6% (n=2034) for the population 1 and 85.0% (n=254) for the population 2. The shares of them were different (p<0,0001, here and later we used Two-sided test for the differences between two proportions), but for both populations most common prey among small mammals were *Microtus spp.*: 68.5% (n=2034) for population 1 (at least 60.2% of all preys were *M. arvalis* and at least 1.8% – *M.oeconomus)* and 78.3% for population 2 (at least 68.9% of all preys were *M. arvalis,* at least 1.6%, were *M.oeconomus* and at least 0.4% – *M. agrestis*).

Table 1. Occurrence of different prey categories for Montagu`s Harriers in 1996 from two populations in the Western Belarus. For details, please, read the text

Tab. 1. Znaczenie różnych kategorii ofiar błotniaka łąkowego w 1996 roku dla populacji w zachodniej Białorusi. Szczegóły w tekście

Prey category	Importance for population 1 (%), n=2034	Importance for population 2 (%), n=254
NCD Rodents	3.7	6.7
Voles (Microtus spp.)	68.5	78.3
Mise	0.3	0
Other mammals	0.1	0
Birds	17.5	12.6
Eggs of birds	1.5	1.2
Lizards	0.9	0.8
Frogs	0.1	0
Large Grasshoppers Tettigonia spp.	6.4	0.4
Other insects	0.9	0

Mice (0,3%, n=2034), shrews and young hares (together 0,1%, n=2034) were quite rare as a prey in the diet of the group # 1 and were not found as prey for the group # 2.

Mammals were followed by birds in the diet of both populations and accounted for 17,5% of total prey items in the population # 1 and 12,6% in the population #2. The difference is significant (p=0,0499).

The share of bird eggs made only up to 1,5% of total prey items for the population # 1 and statistically was not different from share of the same prey category for the population # 2 – 1,2% (n=254).

The third in ranking of importance in numbers of prey for the population # 1 were large insects – 7,3% (n=2034). For the population # 2 they represented significantly much less, only 0,4% of all prey items (p<0,0001). Among insects large grasshoppers *Tettigonia spp.* were the most common taxon – 6,4% of all prey items, at the same time as large beetles, dragonflies and small grasshoppers *Acrididae* have compiled all together only 0,9%, n=2034.

One distinguish feature of harriers` diet in 2006 was comparatively low share of lizards for both populations: 0,9% and 0,8% of all prey items accordingly. For example, lizards were quite quantitavely important for harriers from the population # 1 in 1993-95, when the share was from 4,9 up to 6,8% of all prey.

Frogs as a prey of harriers was found only once (0,1%, n=2034) and only for population 1.

Discussion

As in many other studies of Montagu`s harrier diet (e.g. Underhill-Day 1993; Sánchez-Zapata and Calvo 1998 and others), we also observed many cases, when harriers hunted mainly on juvenile Passerines. Sánchez-Zapata and Calvo (1998) showed that many small nestlings were present seldom in pellets and remains, so we also believe that in our data the share of birds in diet of harriers is underestimated. But for both study plots we used the same methods, so the obtained data are comparable.

It is possible, that different efforts and especially data from the later season could affect the differences in occurence of some prey categories for harriers. That could mainly affect the share of grasshoppers (they become abundant after mid July), but still harriers from study plot #2 have caught only one grasshopper in the second half of July.

We believe that difference in the diet of Montagu`s Harriers that nest in different places could be linked with the features of their hunting ranges. Harriers are opptunistic. Even if some males, that provide most of food during breeding season, could have some preferences for the different prey (that was proved e.g. for Kazahstan (Khusainov 1963), harriers are not limited by one type of prey and hunt on the most abundant and accessible prey for the moment. Different hunting grounds (as well as different experience and quality of males) have different abundance of potential prey species, provide different accessibility of different species. The same was found for the Rough-legged Buzzard *(Buteo lagopus)* in Yamal peninsula, Russia (Osmalovskaia 1948).

The main prey categories varied widely between 19 studied groups in California for the Bald Eagle *Haliaeëtus leucocephalus* (Jackman et al. 1999) and several places in Washington for nesting populations of Goshawk *Accipiter gentilis* (Watson et al. 1998). Some positive correlation with numbers of some prey categories of the Common Kestrel *Falco tinnunculus* from two distinct populations were found in different habitats in Italy (Piatella et al. 1999). Surprisingly, no correlation was found between latitude and the proportion of invertebrates in the diet of Kestrels during breeding season, because breeding birds rely mainly on large prey to feed their young (Village 1990).

In a study of six widespread species of raptors in Palearctic clear difference in diet between subspecies of the same species was found (Pererva 1983). The author explains it as long-term adaptation of raptors for some prey categories, that are widely presented only in a limited breeding area and to be successful hunters, local populations of raptors have to use special techniques of hunting and in some cases have evolved even differences in features. It is reasonable in view of the relative changes in abundance of prey groups with latitude.

Montagu`s harrier is a monotypic species (Cramp and Simmons 1980). Arroyo (1995) could not find a clear link between composition of harriers' diet and geographical distribution of main prey species when analyzed different geographical populations of Montagu`s Harrier. So Montagu`s Harrier is a very universal opportunistic predator, whose different populations did not evolve on subspecies level throughout its widespread breeding range. It is difficult to imagine

that birds from so wide range can effectively mix which usually provides a background for accumulation of differences in morphology of different populations. We believe that in this case species `unity` is possible to explain rather by universal methods of hunting (and other) adaptations for open landscape. Specially because Montagu`s Harrier on the base of DNA comparison was recognized as a very ancient species and even an ancestor form for the whole group of six `marsh harriers` species (Wink 1998 in Simmons 2000).

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Dzmitry Vintchevski
Hrodna regional branch of APB-BirdLife Belarus
Harrier@tut.by

Aliaxandr Yasievitch
Hrodna regional branch of APB-BirdLife Belarus
Almar69@tut.by