Sand Martin *Riparia* of the Kuznetsk-Salair Mountain Area (Kemerovo Area, Russia)

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**Abstract.** In view of the division of Sand Martin *Riparia riparia* sensu lato into two separate species: Sand Martin proper *R. Riparia* sensu strict and Pale Martin *R. diluta*, we conducted a series of studies aimed to clarify the species of the martins living in the Kuznetsk-Salair mountain region. Studies have shown that both species of martins are registered in the region; moreover, they can form mixed colonies and flocks together during feeding. After wintering, the proportion of returne d individuals to last year’s nesting sites can reach 90%. The same colony can be inhabited by different species of martins in different years. Preliminary studies of martins’ infection with viruses of feral herd infections gave a negative result.

1. Introduction

Today, in most faunal reports the sand martin *Riparia riparia* (Linnaeus, 1758) and the pale martin *Riparia diluta* (Sharpe et Wyatt, 1893) are considered as separate species [1, 2, 3, 4, 5, 6, 7] with a sympatry zone in the south of Siberia. In this regard there is a necessity to establish an up-to-date distribution of both species in the Kuznetsk-Salair mountain region, located in the center of overlapping ranges [8, 9]. In addition, in the 1980s scientists accumulated extensive material on the biology of the sand martin, which was largely depreciated due to the separation of the species. Using morphometric differences between species, we attempted to reconstruct the spatial distribution of the martins in the middle course of the river Tom in past years.

Of particular interest is the identification of martins’ species in wintering places. The pale martin winters mainly in Southeast Asia, while the wintering grounds of the sand martin are located in Africa [10, 11]. Given the fact that martins are highly likely to return to their nesting sites, both species can play a significant role in the circulation of feral herd infections [12].

2. Methodology

The study is based on the results of trapping of the sand martin within the Kuznetsk-Salair mountain region. Trapping was carried out during the feeding time at the biological station of KemSU Azhendarovo (54° 45’ N.; 87° 02’ E.) and at the territory of colonies along the banks of the river Tom in Krapivinsky district near the biological station (1983-1984; 2009–2018) and in the mouth of river Turala (2014–2016), in the Kemerovo district near the villages of Pugachi, Starochervo, Leningradsky (2010–2017), along the river Kiya near the village of Shestkovo (Chebulinsky district) (2015), as well as in Topkinsky district along the river Inya near the village of Katkovo (2013) (Figure 1). In total, 2670 sand martins of both species were captured.

Birds were trapped (and then ringed) with spider nets installed in front of the martins’ nests and in the places of their feeding. We measured the mass, lengths of the wing and the tail of all captured birds. Additionally, in some specimen we measured the length of the tarsometatarsus, the length of the beak (from the front edge of the nostrils to the end of the beak) and the height of the beak (at the level of the
front edge of the nostrils) with an accuracy of 0.1 mm [13]. To identify the distribution of species, we studied the zoological collections of the Zoology and Ecology Department of Kemerovo State University and the Zoological Museum of Tomsk University.

Brain and parenchymal organs were sampled in order to evaluate the infection of both species with Tick-borne encephalitis virus (TBEV) (*Flavivirus*), tick-borne borreliosis (*Borrelia burgdorferi sensulato*), human granulocytic anaplasmosis (*Anaplasma phagocytophilum*), human monocytic ehrlichiosis (*Ehrlichia chaffeensis*/*E. muris*), and West Nile virus (*Encephalitis nitioccidentalis*). The presence of RNA / DNA of infectious agents in biological material was analyzed by the method of polymerase chain reaction (PCR) with hybridization-fluorescence detection.

**Figure 1.** Detected colonies of sand martins *Riparia riparia* and pale martins *R. diluta* on the territory of Kemerovo region.

Legend: black circles – Sand Martin *Riparia riparia*, hollow circles – Pale Martin *R. diluta*
1. – surroundings of the Biological Station *Azhendarovo* and the mouth of the river Tural; 2. – surroundings of the village Starochevovo; 3. – surroundings of the villages Leningradka and Pugachi; 4. – surroundings of the village Katkovo; 5. – surroundings of the village Alaevko; 6. – surroundings of the village Shestakovo; ? – Nesting sites *Riparia sp.*

### 3. Results and discussion

Previously it was believed that only *R. riparia* (without identifying the subspecies) lived in the region [14, 15, 16, 17, 18]. Until the 1980s the sand martins were widespread nesting birds in the area. Today, *R. riparia* and *R. diluta* are common nesting species, reducing in numbers in the valley of the river Tom.

About 40 years ago, in the area of the biological station *Azhendarovo* there were several colonies with a total population of 13–14 thousand pairs, which were massively ringed from 1975 to 1984.

It should be noted that recently the nesting situation of sand martins has changed significantly. Extensive deforestation in 1979–1984 led to the increase of soil erosion and, as a result, to the silting of
rivers’ banks followed by overgrowth of willow on the brinks of the river Tom. Consequently, the majority of colonies disappeared and only individual fragments remained from former large colonies.

Since 2009, we have begun to register the sand martins in trappings on the territory of the biological station again, with both species in approximately equal proportions. In search of the colonies, we surveyed the adjacent area of the river Tom valley, but only two settlements were found with a total population of 300–500 pairs. Both settlements turned out to be recolonized: one was located on the bank of the river Tom opposite the biological station, and the second was on the left bank down the river Tom. Together they constitute a small fragment of the former large colony where the research was previously carried out. We found out that currently the left-bank colony is populated exclusively by \textit{R. diluta} while the right-bank colony turned out to be mixed (on the one hand it is mainly populated by \textit{R. diluta}, on the other by \textit{R. riparia}).

After trapping martins in the colonies the following year we found out that sometimes the same birds can colonize the colony for several years in a row. Thus, the colony can be populated by different species of martins in different years. On the contrary, trapping of martins shows that often the same birds can colonize the colony for several years in a row. Thus, in different years, the proportion of martins returning to their former nesting sites can range from 0% to 90%. In some cases, a mixed colony can be formed, as a rule, with compact nesting of one species or another.

Considerable morphological differentiation of species [19, 20] (see Table) allowed us to identify the species of Azhendarovskaya colony on the basis of records of previous years. Azhendarovskaya colony was the largest (up to 5 thousand inhabited holes) in the river Tom valley until the 1990s and, perhaps, the most thoroughly studied. We based our research on the wing measurements of the martins captured in this colony by V. B. Ilyashenko in the period of 1983–1984 (appr. 1000 specimens in total. 1).

| Table 1. Morphometric data measured on live birds in 2010–2018 |
|---------------------------------------------------------------|
| Sand Martin \textit{R. riparia}                               |
| | Adult | Young | All |
| | N | Limits | average | N | min – max | average | N | average |
| Mass | 608 | 10.7–19.0* | 14.2±0.1 | 175 | 10.9–15.8 | 13.0±0.1 | 822 | 13.9*±0.1 |
| Wing, mm | 634 | 99–115 | 107.6±0.1 | 180 | 94–110 | 102±0.2 | 864 | 106.4±0.1 |
| Tail, mm | 624 | 45–60 | 53.0±0.1 | 199 | 43–53 | 47.8±0.1 | 863 | 51.8±0.1 |
| Tarsometatarsus, mm | 278 | 9.3–11.6 | 10.4±0.03 | 7 | 9.7–11.2 | 10.4±0.2 | 288 | 10.4±0.03 |
| Beak, length, mm | 281 | 4.1–5.3 | 4.7±0.01 | 7 | 4.3–4.8 | 4.5±0.01 | 291 | 4.7±0.01 |
| Beak, height, mm | 281 | 1.9–2.6 | 2.3±0.01 | 7 | 1.9–2.3 | 2.0±0.01 | 291 | 2.2±0.01 |
| Pale Martinn \textit{R. diluta}                              |
| | Mass | 499 | 10.3–17.7* | 12.6±0.1 | 120 | 9.7–14.6 | 11.6±0.1 | 649 | 12.5*±0.04 |
| Wing, mm | 523 | 89–110 | 101.9±0.1 | 119 | 91–106 | 98.9±0.3 | 715 | 101.0±0.1 |
| Tail, mm | 519 | 40–56 | 48.9±0.1 | 118 | 41–50 | 45.3±0.2 | 665 | 48.2±0.1 |
| Tarsometatarsus, mm | 163 | 9.1–11.3 | 10.0±0.03 | 3 | 10.2–10.7 | 10.5±0.2 | 169 | 10.0±0.03 |
| Beak, length, mm | 164 | 3.8–5.0 | 4.4±0.02 | 3 | 4.1–4.6 | 4.4±0.2 | 170 | 4.4±0.02 |
| Beak, height, mm | 161 | 1.8–2.4 | 2.0±0.01 | 3 | 1.9–2.0 | 1.9±0.03 | 167 | 2.0±0.01 |

* - females before laying eggs were also included in calculations.

The analysis (Fig. 2) showed that the distribution of adult martins according to the length of the wing in 1983–1984 was almost identical to the same distribution for adults of \textit{R. diluta} in 2010–2018. A large size class, with a wing length of over 110 mm, which is characteristic for \textit{R. riparia}, was not found in the data for 1983–1984.
On the basis of the above analysis, it can be assumed that in previous years it was the colony of the pale martin *R. diluta* that was thoroughly studied. It is no coincidence that now we are capturing individuals only of this species on this territory. Nevertheless, the collection of the Zoology and Ecology Department of KemSU stores a small number of martins captured in the middle reaches of the river Tom. Among these specimens there are several individuals belonging to *R. riparia*. Unfortunately, there is no indication which particular colony they were captured in. Thus, in the period preceding the overgrowing of river banks, characterized by the maximum number of sand martins, both species lived in the area under study. However, while it is possible to state that Azhendarovskaya colony was formed by the pale martin *R. diluta*, nothing can be said about other colonies.

In general, the distribution of both species of martins in the region is still understudied. On the banks of all major rivers of Kemerovo region we are registering both species of martins. The analysis of our trappings shows that there are colonies inhabited exclusively by the pale martins *R. diluta* (near the villages of Katkovo, Pugachi, Starochervo, and Azhendarovo biological station), there are colonies inhabited exclusively by the sand martins *R. riparia* (near the village of Shestakovo on the river Kiya), and there are colonies inhabited by both species (near the village of Leningradsky and Azhendarovo biological station) (Fig. 1).

In addition to the above-mentioned areas the sand martins *Riparia sp.* were found nesting on the slopes of the Kuznetsk Alatau and Mountain Shoria, however, there are no trappings to clarify their species, except for the pale martin specimens found near the village of Alaevo, Yurginsky District, and kept in the funds of the Zoological Museum of Tomsk.

The presence of both species in approximately equal proportions near the biological station allowed us to analyze their ecological features, not only during nesting period, but also during autumn migrations.

According to the daily four-hour (2 hours in the morning and 2 hours in the evening) observations conducted by A. Belyankin and V. Ilyashenko in 1978, the maximum number of birds flies in late July - early August, then there is a gradual decline and the fly ends on September 3. Several birds were registered on September 27 and two birds were registered on October 4. Such late, after a long break, registrations of martins were observed in other years, usually characterized by a long and warm autumn. It can happen that in such years a part of the martins may undertake return feeding migrations to the nesting sites. In first and second ten days of September, the weather was warm and dry; insects seemed to be enough for feeding, all of that must have delayed the birds along the way.

In 2011 in mid-July young individuals of both species appeared over the territory of the biological
station, by the end of July martins were no longer registered (Fig. 3), and in early August they left the nesting sites. Before the beginning of their autumn migrations, sand martins had a rather long post-nesting period. It was characterized by intensive feeding movements and a massive gathering of birds in certain feeding and roosting places. A similar picture was observed in previous years.

There were no time differences in the appearance of young birds of both species both in the colonies and in the feeding stations (Fig. 4: 5).

**Figure 3.** The population dynamics of Sand and Pale Martins in 2011

**Figure 4.** Comparative dynamics of the population of adult and young Sand Martins *R. riparia* according to net captures in 2011
Both species of martins are migratory ones and may, theoretically, be involved in spreading of zooanthropoanous infections. On martins of both species we found ticks *Ixodes lividus* Koch, 1844, specific for the Riparia, which is considered as a possible carrier of a number of infections, including tick-borne encephalitis virus [12]. In order to assess the involvement of the pale martins *R. diluta* and the sand martins *R. riparia* in the functioning of natural focal diseases, we conducted an examination of the brain and parenchymal organs of 11 pale martins *R. diluta* and 10 sand martins *R. riparia* that belonged to different colonies in 2017. Samples were examined for the RNA of tick-borne encephalitis virus and West Nile virus, for the DNA of human granulocytic anaplasmosis and human monocytic ehrlichiosis. All samples were negative. This may indicate that the sand martins do not play a significant role as a natural reservoir for the infectious agents of these diseases.

4. Conclusions

Studies have shown that the sand martin *R. riparia* and the pale martin *R. diluta* inhabit the territory of the Kuznetsk-Salair mountainous region. The pale martin seems to be more widespread in the forest-steppe part of the Kuznetsk-Salair region, while the sand martin is found in its forests.

Most of the data on the sand martin from Krapivinsky District which is mentioned as *Riparia riparia* should be referred to as the pale martin. Despite all the research works, these species require further study: it is still unknown what species lives in the north-east of the region along the banks of the river Kiya, in the foothills of the Kuznetsk Alatau, Mountain Shoria and the Salair ridge.

The biology of both species in the region under study is similar and they can form mixed colonies and use the same feeding areas. We still do not know the time differences of the appearance of young birds in both species.

As a result of the transformation of the rivers’ banks, there was a shortage of nesting places. As a result, in different years, martins can either reuse last year's nesting places or completely change the nesting area.

Preliminary studies have shown that both species of martins are not significant natural reservoirs of tick-borne encephalitis virus, human granulocytic anaplasmosis, human monocytic ehrlichiosis and West Nile virus.
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