

Diversity of some forest-dwelling passerine birds in the Himalayas (Aves: Passeriformes)

DIETER THOMAS TIETZE, Dresden; JOCHEN MARTENS, Mainz & YUE-HUA SUN, Beijing

Summary

The Himalayas and adjacent West China represent a diversity hotspot for (passerine) birds. Diversity is achieved by a multitude of sympatric congeneric species on the one hand and by closely related allopatric relatively young taxa living in contiguous areas along the Himalayas and in West China on the other hand. The genus *Certhia* (treecreepers), with comparatively few species, demonstrates that a specialized physical adaptation may limit interspecific differentiation so that differences in song come forward more prominently. More sophisticated morphometric analyses reveal that sympatric species actually differ in external body dimensions depending on the amount of vertical overlap between their distributional areas. Subspecies of biological species are geographically separated, but their morphological differentiation may have progressed to a much lesser extent: Almost inseparable are the subspecies of the Pale-rumped Warbler (*Phylloscopus chloronotus*), the Himalayan representative of the Pallas's warbler complex (*Phylloscopus [proregulus]*). The subspecies of Hodgson's Treecreeper (*Certhia hodgsoni*), the Himalayan species within the Eurasian treecreeper complex (*Certhia [familiaris]*), differ morphologically more clearly, by coloration and bill size. The Himalayan subspecies of the Coal Tit (*Parus ater*) are even so distinct that the "Spot-winged Tit" (*Parus (ater) melanolophus*) is still mostly treated as a separate species. Our studies show, for these passerines, the degree to which morphological differences coincide with the differentiation of the mitochondrial cytochrome-*b* gene and territorial song. In the first two taxa sets, we find obvious "breaks" only in West China or between the Sino-Himalayas and northern Eurasia. Taxonomic treatment of allopatric taxa differs; species level was often reached and former subspecies upgraded.

Zusammenfassung

Der Himalaya und das angrenzende West-China stellen für (Sing-)Vögel ein Mannigfaltigkeitszentrum dar. Diversität kommt einerseits durch eine Vielzahl sympatrischer Arten einer Gattung und andererseits durch nah verwandte allopatrische relativ junge Taxa zu Stande, die ein zusammenhängendes Areal entlang des Himalaya und im West-China bewohnen. Das Beispiel der vergleichsweise artenarmen Gattung *Certhia* (Baumläufer) zeigt, dass eine spezialisierte körperliche Anpassung zwischenartliche Differenzierung einschränken kann, so dass gesangliche Unterschiede deutlicher hervortreten. Durch genauere biometrische Analysen wird aber erkennbar, dass zwei Arten um so stärker morphologisch verschieden sein müssen, je weiter ihre vertikale Ausbreitung überlappt. Unterarten biologischer Arten sind geographisch getrennt, aber ihre morphologische Differenzierung kann weniger weit fortgeschritten sein: Morphologisch fast nicht unterscheidbar sind die Unterarten des Fahlbürzel-Laubsängers (*Phylloscopus chloronotus*), der himalayenischen Art aus dem Goldhähnchen-Laubsänger-Komplex (*Phylloscopus [proregulus]*). Die Unterarten des Kaschmirbaumläufers (*Certhia hodgsoni*), der himalayenischen Art aus dem Waldbaumläufer-Komplex (*Certhia [familiaris]*), unterscheiden sich morphologisch deutlicher voneinander, hinsichtlich Färbung und Schnabellänge. Die himalayenischen Unterarten der Tannenmeise (*Parus ater*) sind gar morphologisch so stark verschieden, dass die „Schwarzschofpfmeise“ (*Parus (ater) melanolophus*) immer noch meist als eigene Art geführt wird. Unsere Studien zeigen für diese Singvogelformen, in wie weit diese morphologischen Unterschiede mit der Differenzierung des mitochondrialen Cytochrom-*b*-Gens und des Reviergesangs einhergehen. In den ersten beiden Beispielen finden wir stärkere „Brüche“ erst in West-China bzw. zwischen Sinohimalaya und Nordeurasien; das Artniveau wurde oft erreicht und bisherige Unterarten in Artrang erhoben.

Key words: Aves, passerine birds, Himalayas, China, taiga belt, interspecific differentiation, intraspecific differentiation

1. Introduction

The Sino-Himalayan region is an important diversity hotspot for birds in Eurasia. At least 608 species breed in the Himalayas alone (MARTENS & ECK 1995). Here we summarize a few examples of inter- and intraspecific differentiation related to morphology, vocalizations and genetic markers of a few passerine birds studied by us within recent years.

2. Interspecific differentiation in treecreepers (genus *Certhia*)

Four out of the nine species recognized (TIETZE et al. 2006) are distributed in the Himalayas and this area represents the general spot for this genus. Probably in order to avoid competition there is a trend towards a vertical segregation of the species (MARTENS 1981). *Certhia discolor* ranges from 2000 m a.s.l. upwards, followed by *C. nipalensis*, *C. himalayana* and *C. hodgsoni*, the latter even reaching timber line above 4000 m a.s.l. (MARTENS & ECK 1995). Treecreepers are highly specialized for life on tree bark: The upper side is camouflaged, the tail feathers are stiffened as in woodpeckers, they have quite a long and curved bill for gleaning and probing and their hind claw is adapted to the

bark of the preferred trees (HARRAP & QUINN 1996). These synapomorphies may limit interspecific differentiation as regards the external appearance.

Therefore differences in territorial song – important for reproductive isolation – are very prominent. *Certhia discolor* males utter long trills of downstrokes at low frequency, *C. nipalensis* males short trills of steep upstrokes at high frequency, and *C. himalayana* trills alternate up- and downstrokes whereas *C. hodgsoni* songs are "motif" verses starting with "sreeh" elements and continuing with a number of different elements (MARTENS 1981, TIETZE et al. 2008).

Nevertheless, a morphological discrimination of the four Himalayan species is possible (TIETZE & MARTENS 2009): Tail and bill measurements are most important to separate them from each other, but also wing and claw measurements influenced the multivariate analyses. Moreover, we found the following correlation in pairwise comparisons: the more the area of two species overlap vertically, the more morphometric features differ significantly between them. Even sexes differ in bill length, indicating that resources of the tree-bark habitat are limited and are best exploited by the adequately and differently shaped tool.

3. Intraspecific differentiation in some Himalayan passerine bird species

Subspecies, the local representatives of biological species, live in allopatry or parapatry. Their morphological differentiation generally progressed to a much lesser extent: The characters may be slight and individual specimens almost indistinguishable, clearly diagnosable or so different that one is tempted to treat them as different species.

The following examples share a common distributional pattern: On the one hand there is a huge northern (Eur-) Asian area in the taiga belt of Siberia and on the other hand a considerably smaller area comprising the Himalayas and the western Chinese mountains. The latter area is named the Sino-Himalayan area. These species inhabit the taiga forests in the north and, correspondingly, the high-altitude coniferous forests in the Himalayas and West China.

3.1. Pallas's Warbler complex (*Phylloscopus [proregulus]*)

Phylloscopus chloronotus is the Himalayan species within the *P. proregulus* complex (MARTENS et al. 2004). Its two subspecies are morphologically almost indistinguishable. There is merely a clinal change from *P. c. simlaensis* in the west, which has a "lighter" mantle, to *P. c. chloronotus* in the east with a "darker" mantle.

Since only a few song recordings are available, it is unknown whether vocal differences exist along the Himalayan chain. Further east in China the song of the allospecies *P. forresti* differs markedly, as holds true for the taiga belt allospecies, *P. proregulus*. But also the inborn calls discriminate the four representatives of the *P. proregulus* complex. Thus communication between at least two of these taxa fails (ALSTRÖM & OLSSON 1990) despite the relatively low genetic distances between these monophyletic units (MARTENS et al. 2004).

3.2. Eurasian Treecreeper complex (*Certhia [familiaris]*)

Certhia hodgsoni is the Himalayan representative within the *C. familiaris* complex (TIETZE et al. 2006). Its two Himalayan subspecies are morphologically markedly distinct: Nominate *hodgsoni* (western Himalayas to Afghanistan) is lighter and smaller and has a longer bill, but a shorter hind claw than *C. h. mandellii* (central and eastern Himalayas) (MARTENS & ECK 1995, TIETZE & MARTENS 2009).

Territorial songs of these two subspecies are quite similar – compared to each other and to those of western Chinese *C. h. khamensis*. Differences are obvious between the songs of the latter and those of parapatric *C. familiaris* s.str. populations in northern West China (MARTENS et al. 2002, TIETZE et al. 2008). This break is corroborated by molecular-systematic findings (TIETZE et al. 2006). In contrast, all three Sino-Himalayan well-defined subspecies are represented by their own genetic lineages, whereas there is almost no sub-structuring of the *C. familiaris* s.str. lineage, which ranges from Japan to West Europe and comprises a multitude of subspecies. While morphological differences between the northern subspecies are not backed by mitochondrial differentiation, song types are well differentiated within a common basic pattern (TIETZE et al. 2006, 2008).

3.3. Coal Tit (*Parus ater*)

In this species more than 20 subspecies are currently recognized (DICKINSON 2003). This is due to the fact that several types of coloration patterns exist and that south-eastern populations have a crest (HARRAP & QUINN 1996). *Parus (ater) melanolophus* is even so distinct in terms of pattern and coloration that it is mostly treated as a separate species (DICKINSON 2003, RASMUSSEN & ANDERTON 2005, GOSLER & CLEMENT 2007, but see MARTENS et al. 2006, PÄCKERT & MARTENS 2008), although it is evident and has long been known that it interbreeds with neighboring *Parus ater martensi* (DIESELHORST & MARTENS 1972). It simply represents one of the well differentiated genetic lineages within *Parus ater* (MARTENS et al. 2006). We refrain from upgrading these genetic lineages to species rank, because there are hybrids in the Himalayas and two further morphologically extremely similar lineages are present in central Europe without any hint of limited interbreeding.

The songs of representatives of all lineages including *melanolophus* are more or less uniform throughout the species' range (THIELCKE 1973, MARTENS 1993). Admittedly, this aspect is quite difficult to judge, because the variation within a single male and within a given population is high and may camouflage possible differences between populations. Plumage characteristics of eastern Himalayan and western Chinese *P. a. aemodius* are similar, but the latter belongs to another marked genetic lineage and it was separated as *P. a. eckodedicatus* (MARTENS et al. 2006).

4. Discussion

In mountainous areas of the Sino-Himalayan region there is a common pattern of passerine bird distribution, suggesting a common history of the species concerned. Similarities in distributional taxa patterns are even more pronounced where further area parts north of the Chinese deserts in the Siberian taiga forests are concerned. These populations are quite distinct and include well-differentiated subspecies (*Parus ater*) or allospecies of a common superspecies (*Phylloscopus [proregulus]*, *Certhia [familiaris]*). Quite obviously, these differentiations have their origin in a kind of fragmentation during the Pleistocene or even earlier in the late Pliocene (PÄCKERT et al. 2009; this volume) and may have acted slightly differently on the three taxa treated here. But in all cases the Sino-Himalayan area comprises three mitochondrial genetic lineages and an additional one in the northern taiga zone. The latter is separated from the Sino-Himalayan area block by a present gap caused by the deserts of Mongolia (Table 1). There are hints that this East Asian distributional pattern, exemplified here by three taxa complexes, is widely represented and that a multitude of additional bird species adhere to it.

Table 1: Specific and subspecific subunits of the passerine species complexes discussed in this talk

Species complex	Himalayas	W China
<i>Phylloscopus proregulus</i>	2 indiscernible subspecies	2 allospecies
<i>Certhia familiaris</i>	2 distinct subspecies	1 subspecific genetic lineage, 1 allospecies
<i>Parus ater</i>	3 subspecies in 2 genetic lineages	1 genetic lineage

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References

- ALSTRÖM, P. & U. OLSSON (1990): Taxonomy of the *Phylloscopus proregulus* complex. - Bulletin of the British Ornithologists’ Club **110**: 38-43.
- DICKINSON, E.C. (ed.) (2003): The Howard & Moore Complete Checklist of the Birds of the World. - London, Christopher Helm, 3. ed., 1039 pp.
- DIESSELHORST, G. & J. MARTENS (1972): Hybriden von *Parus melanolphus* und *P. ater* im Nepal-Himalaya. - Journal für Ornithologie **113**: 374-390.
- GOSLER, A. & P. CLEMENT (2007): Family Paridae (Tits and Chickadees). - In: CHRISTIE, D. A.; A. ELLIOTT & J. DEL HOYO (ed.): Handbook of the Birds of the World. Volume 12. Picathartes to Tits and Chickadees. - Barcelona, Lynx Edicions, 816 pp.
- HARRAP, S. & D. QUINN (1996): Tits, Nuthatches & Treecreepers. - London, A & C Black, 464 pp.
- MARTENS, J. (1981): Lautäußerungen der Baumläufer des Himalaya und zur akustischen Evolution in der Gattung *Certhia*. - Behaviour **77**: 287-318.
- (1993): Lautäußerungen von Singvögeln und die Entstehung neuer Arten. - Forschungsmagazin Univ. Mainz **9**: 34-44.
- MARTENS, J. & S. ECK (1995): Towards an Ornithology of the Himalayas. Systematics, ecology and vocalizations of Nepal birds. - Bonn, Zoologisches Forschungsinstitut und Museum Alexander Koenig, 445 pp.
- MARTENS, J.; S. ECK & Y.-H. SUN (2002): *Certhia tianquanensis* Li, a treecreeper with relict distribution in Sichuan, China. - Journal für Ornithologie **143**: 440-456.
- MARTENS, J.; D.T. TJETZE & Y.-H. SUN (2006): Molecular phylogeny of *Parus (Periparus)*, a palearctic radiation of titmice. - Zoologische Abhandlungen (Dresden) **55**: 9-26.
- MARTENS, J.; D.T. TJETZE, S. ECK & M. VEITH (2004): Radiation and species limits in the Asian Pallas’s warbler complex (*Phylloscopus proregulus* s.l.). - Journal of Ornithology **145**: 206-222.
- PÄCKERT, M. & J. MARTENS (2008): Taxonomic pitfalls in tits – comments on the Paridae chapter of the Handbook of the Birds of the World. - The Ibis **150**: 829-831.
- PÄCKERT, M.; J. MARTENS, Y.-H. SUN & D.T. TJETZE (2009): Phylogeography and the evolutionary time-scale of passerine radiations in the Sino-Himalayan region (Aves: Passeriformes). - in: HARTMANN, M. & J. WEIPERT (eds.): Biodiversität und Naturlausstattung im Himalaya, III. p.: 71-80, Verein der Freunde & Förderer des Naturkundemuseums Erfurt e.V., Erfurt.
- RASMUSSEN, P.C. & J.C. ANDERTON (2005): Birds of South Asia. The Ripley Guide. 2 vol. - Washington, D.C., & Barcelona, Smithsonian Institution & Lynx Edicions, 378, 683 pp.
- THIELCKE, G. (1973): Uniformierung des Gesangs der Tannenmeise (*Parus ater*) durch Lernen. - Journal für Ornithologie **114**: 443-454.
- TJETZE, D.T. & J. MARTENS (2009): Morphometric characterisation of treecreepers (genus *Certhia*). - Journal of Ornithology. **150**: 431-457.
- TJETZE, D.T.; J. MARTENS & Y.-H. SUN (2006): Molecular phylogeny of treecreepers (*Certhia*) detects hidden diversity. - The Ibis **148**: 477-488.
- TJETZE, D. T.; J. MARTENS, Y.-H. SUN & M. PÄCKERT (2008): Evolutionary history of treecreeper vocalisations (Aves: *Certhia*). - Organisms, diversity & evolution **8**: 305-324.

Authors addresses:

Dr. Dieter Thomas Tietze
Museum für Tierkunde
Königsbrücker Landstraße 159
D-01109 Dresden
Germany
E-Mail: mail@dieterthomastietze.de

Prof. Dr. Jochen Martens
Institut für Zoologie
Johannes Gutenberg-Universität
D-55099 Mainz
Germany

Prof. Yue-Hua Sun
Institute of Zoology
Chinese Academy of Sciences
100080 Beijing
China

