

Completeness of Seasonal Molting in Passerine Birds (Aves, Passeriformes) in Northwestern Siberia

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Abstract—This paper considers the variability of the completeness of seasonal molting in passerine birds of the forest tundra and tundra areas of Western Siberia. All variants of passerine birds of North Eurasia known for molting—from complete postjuvenile molting at hatching places to its absence and complete postjuvenile molting at wintering places or at migratory routes, from complete prebreeding molting at wintering places to its absence, and from complete postbreeding molting at nesting places to complete molting at wintering places or at migratory routes—are shown. The factors affecting the completeness of molting are discussed—the properties of adaptation to the subarctic region, length of the migratory route, and photoperiodic conditions during molting. The completeness of molting is most significantly affected by the duration of daylight.

Keywords: Subarctic region, Siberia, passerines, completeness, molting

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Molting occupies an important place in the annual cycle of birds. The feather is continuously being worn out, the area of the vane decreases, and the flying and heat-insulating qualities worsen with time and are restored again after molting. The specific features of molting depend on the origin of a species, its ecology, remoteness and location of wintering sites, and photoperiodic conditions during the molting period (Larionov, 1945; Noskov and Rymkevich, 1977, 1978; Stresemann and Stresemann, 1966, 1968; Bub, 1981; Jenni and Winkler, 1994). The completeness of molting, i.e., the number of replaced feathers in the process of regular plumage regeneration, is the main characteristic of this seasonal phenomenon. The modern information on the completeness of molting in individual passerine species of Eastern and Western Europe are expounded in two monographs (Rymkevich et al., 1990; Jenni and Winkler, 1994). They also present extensive bibliographies on molting in individual bird species, including its completeness. The variability of the completeness of postjuvenile molting in nature is considered in one article (Rymkevich and Bojarinova, 1996).

The factors influencing the completeness of molting were actively studied experimentally. For the most part, these were experiments aimed at determining the effect of photoperiodic conditions on the completeness, timing, and duration of postjuvenile molting in European representatives of the Sylviidae, Muscicapidae, Fringillidae, and Emberizidae families, which

were carried out with the participation or under the direction of P. Berthold, E. Gwinner, G.A. Noskov, and T.A. Rymkevich. The list of publications is large; a significant part of it is given in the monographs mentioned above.

Intraspecific differences in the completeness of molting often exist and are manifested at the level of geographical populations. For this reason, it is not desirable to extend the information on the completeness of molting in one part of the range to the whole range; it must be tied to a specific region. This is especially true for long-distance migrants (Stresemann and Stresemann, 1968). The author has been studying molting in passerine birds of the Lower Ob region and the Yamal Peninsula since 1976. The material has been accumulated for almost all passerine species of the forest tundra and tundra areas of Western Siberia, and part of it has been published (Ryzhanovskiy, 1997, 2009, 2013, 2014, 2014a). The purpose of this article is to demonstrate field materials on the completeness of molting in the birds of our region for a possible comparison with molting of the studied species in other parts of Siberia and the Far East, to expound the main results of the experimental research into the effect of photoperiodic conditions on the completeness of molting, and to discuss the relationship between the annual cycles of the completeness of molting with the length of migratory route and properties of birds adapting to the Subarctic region.

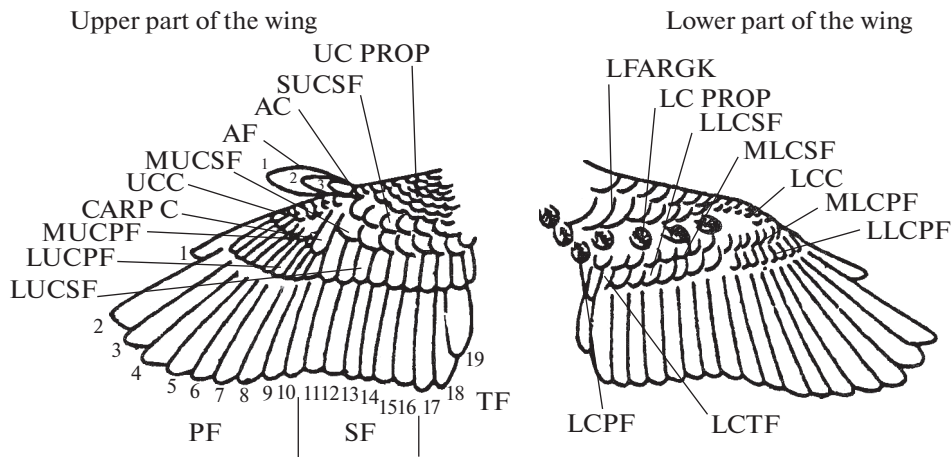


Fig. 1. Location of plumage areas on the wing and complete names of pterylae in the tables: PF is primary flight feathers, SF is secondary flight feathers, TF is tertiary flight feathers, UTC is upper tail coverts, LTC is lower tail coverts, LUCPF is large upper coverts of primary flight feathers, MUCPF is mean upper coverts of primary flight feathers, LUCSF is large upper coverts of secondary flight feathers, MUCSF is mean upper coverts of secondary flight feathers, UC PROP is upper coverts of the propatagial fold, CC is carpal coverts, AF is alula flight feathers, AL is alula coverts, UCC is upper carpal coverts, LCC is lower carpal coverts, LLCPF is large lower coverts of primary flight feathers, MLCPF is mean lower coverts of primary flight feathers, LLCSF is large lower coverts of secondary flight feathers, MLCSF is mean lower coverts of secondary flight feathers, LCSF is lower coverts of secondary flight feathers, and LCTF is lower coverts of tertiary flight feathers.

MATERIALS AND METHODS

We began to study molting in 1976 in the Polar Urals in the Sob River valley (66°50' N, 66°30' E). From the end of July to the middle of September, birds were caught in mist nets, and the state of plumage was described according to the methods of G.A. Noskov and T.A. Rymkevich (1977). In 1977, the studies were continued; in August, the authors of the methods worked at our station and provided substantial assistance in their further development and office processing of the materials (Rymkevich and Ryzhanovskiy, 1987). In 1978, we moved the study area to the left bank of the Ob River, to the region of the settlement of Oktyabrsky (the Oktyabrsky station, 66°40' N, 66°40' E), where, along with other works (counts, observations, and searches for nests), we described the molting of birds caught with mist nets and a large fishing trap. The irregular catching of birds with nets at this station continues. In one season we caught birds in the Southern Yamal (Khadyta post, 67° N, 67°30' E). The state of plumage in July–September was described in more than 8000 individuals.

Since 1986, in addition to describing the state of feathering in birds caught in nature, molting was studied experimentally. Adult birds, usually 4–8 species of the same species, were caught in spring, transferred to cage feeding, and kept in open-air cages until the end of molting in autumn or during the year, until spring–summer. Young birds were taken from nests at 10–12 days of age, artificially fed, and kept in cages under different photoperiodic conditions (short-day, natural, and long-day regimes) until autumn or summer of the following year. In 1990, we brought fledglings of

the white wagtail *Motacilla alba*, yellow wagtail *M. citreola*, common wheatear *Oenanthe oenanthe*, and snow bunting *Plectrophenax nivalis* from the Middle Yamal (70°40' N, 68°45' E). The minimum size of the experimental group in winter and in summer was 4–6 and 5–23 individuals of the same species, respectively, but the number of 1-year-old white wagtail individuals kept under different photoperiodic conditions in summer and in winter was 74 and 11, respectively, and the number of willow warbler individuals (*Phylloscopus trochilus*) was 40 and 8, respectively. To determine the completeness of molting more exactly, bird plumage was colored with an alcohol solution of rhodamine before molting began. In total, the experiments involved over 600 individuals of 28 species.

RESULTS

The pteresis of passerine birds was first described by Dwight (1900). In the domestic literature, the complete layout of plumage areas is given in the works (Noskov and Rymkevich, 1977; Rymkevich et al. 1990). The latter authors distinguished the following areas in the bird-feather coverage: 21 areas of upper and lower coverts on the wing pteryla, in addition to flight feathers; nine covert areas on the head pteryla, five covert areas on the ventral pteryla, three covert areas on the dorsal pteryla, tail feathers on the tail pteryla, and two areas of tail coverts, as well as shoulder, femoral, thigh, and anal pterylae. In this study, the head, ventral, and dorsal pterylae are considered without division into areas. The layout of the wing pteryla plumage areas is shown in the figure.

In the temperate and high latitudes of Eurasia, sedentary birds, nomadic birds, and near migrants have one molting, which is postjuvenile in the first year of life and postbreeding in the next years. Molting takes place in summer and early autumn. Migrants to low latitudes may also have one molting in the annual cycle, but more often they have two moltings: postjuvenile summer molting and prebreeding winter molting in the first year of life and postbreeding summer molting and prebreeding winter molting in subsequent years. The differences in molting are related to the photoperiodic reaction: summer molting responds to summer-day length reduction in the daily photocycle by accelerating the rate of fall and growth of feathers, whereas winter molting responds to an increase in day length (Noskov and Rymkevich, 1988; 2010). It is important to make allowance for the relationship between the completeness of molting and its duration—the greater number of feathers is replaced on individual pteryxae and, the more pteryxae participate in molting, the longer it lasts.

Postjuvenile molting should be distinguished from the completion of growth of juvenile attire. During the period of stay in the nest, nestlings pass the stage of the formation and growth of tail and flight feathers and part of the contour plumage of the head and central rows of body plumage, as well as part of upper and lower wing coverts. The formation of the second part of juvenile plumage (completion of growth) starts in different species in the postnesting period at the age of 14–40 days. In addition to the central rows of juvenile contour feathers, the peripheral rows also begin to grow; most of the lower and upper coverts of flight feathers, part of carpal coverts, coverts of proptagial folds (upper and lower), and part of upper coverts of flight feathers start to grow on the wing. The order of the completion of growth is almost the same in all species; the specific and individual differences are not significant and are not considered here.

Postjuvenile molting can be complete, partial, or absent. Complete postjuvenile molting is characteristic of the horned lark *Eremophila alpestris*, house sparrow *Passer domesticus*, and tree sparrow *P. montanus*; even the peripheral rows of coverts on body pteryxae and lower wing covers that have grown after fledglings leave nests are replaced; i.e., molting is actually complete. In the Subarctic region, where the period from hatching to the beginning of fighting away for wintering (the horned lark) or the onset of winter (house and tree sparrows) lasts 2–3 months, feathers grow in the nest and cease to grow at the age of 25–30 days. At the age of 30–45 days, all feathers or their greater part, including all tail and flight feathers, begin to fall out again with the subsequent growth of new feathers.

During the partial postjuvenile molting typical for most northern birds, tail and flight feathers, as well as part of the body and wing coverts, are not replaced (Table 1). In addition, there is a partial combination of

the second stage of the formation of juvenile plumage—the completion of the growth of nest attire (Rymkevich et al., 1990) and initial stages of molting. The peripheral rows on body pteryxae, as well as part of upper and lower wing coverts, complete their growth. In the Subarctic region, according to our data, completely formed feathers do not participate in postjuvenile molting, but in temperate latitudes some completely formed feathers can be involved in molting in a number of species (Stolbova, 1985).

None of the species listed in Table 1, except for the horned lark, house sparrow, and tree sparrow, have pteryxae with complete molting. Horned larks from second broods probably also have incomplete molting, since it takes place in August–September against the background of a reduction in day length. The examination of birds of other species with rhodamine-colored plumage, which had been fed in captivity and finished molting, showed that the nonreplaced feathers of the nest plumage were mosaically present on some areas of the head and body pteryxae that had participated in molting. As was mentioned above, the completely formed feathers were not replaced. The interspecific differences in the completeness of molting between the species with partial molting were, for the most part, related to the wing and tail. The wing can experience the replacements of tertiary flight feathers (all three (17–19th) or one–two) and a different number of coverts, varying from the replacement of part of the coverts of secondary flight feathers in the willow wabler to the replacement of all or almost all upper and lower coverts of flight feathers, except for large upper covers of primary flight feathers in the magpie *Pica Pica*, gray-headed chickadee *Parus cinctus*, common redpoll *Acanthis flammea*, Lapland bunting *Calcarius lapponicus*, and a number of other species (Table 1). On the tail pteryxa, central tail feathers can be replaced in some species (pipits and wagtails), or not only are tail feathers not replaced, like in all species in the case of partial molting, but neither are upper and lower tail coverts (the willow wabler).

The individual variability of the completeness is significant. The areas marked with the light circles participate in molting in not all individuals, and the black circles mark molting in all of them. For example, in the meadow pipit *Anthus pratensis*, all upper coverts of secondary flight feathers molted in all birds, which were caught at the middle stages of molting (the black circles), and large and mean coverts molted in part of the birds (the light circles).

Postjuvenile molting in the nesting part of the range was absent in the common rosefinch *Carpodacus erythrinus* and arctic wabler *Ph. borealis*; in 1997 in the Polar Urals, we caught young arctic wabblers with the least complete molting—the central rows of feathers on the ventral, dorsal, and shoulder pteryxae were replaced (Rymkevich and Ryzhanovskiy, 1987). However, in the previous (1976) and next years (hundreds

Table 2. Completeness of prebreeding molting in passerine birds of Northwestern Siberia according to experimental data

Species	Pterylae, areas of pterylae																												
	head	ventral	dorsal	shoulder	femoral	thigh	anal	tail	UTC	LTC	PF	SM	TM	LUCPF	MUCPF	LUCSF	MUCSF	LUCSF	UC	CC	AF	AC	UCC	LCC	LLCPF	MLCPF	LLCSF	MLCSF	LCTM
<i>Anthus pratensis</i>	•	•	•	•	•	•	•	○	•	•			○			•	•	•	•				○	○	?	?	?	?	?
<i>A. cervinus</i>	•	•	•	•	•	•	•	○	•	•			○			○	○	○	○				○	○	?	?	?	?	?
<i>Motacilla flava</i>	•	•	•	•	•	•	•	•	•	•			•			○	•	•	•	•			○	•	○	○	○	○	?
<i>M. alba</i>	•	•	•	•	•	•	•	○	•	•			○			•	•	•	•	•			•	•	?	?	?	?	?
<i>Phylloscopus trochilus</i>	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
<i>Ph. collybita</i>	•	•	•	•	•	•	•	•	○	○			○			•	•	•	•	•	•	•	•	•	•	•	•	•	•
<i>Ph. borealis</i>	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
<i>Luscinia svecica</i>	•	•	•	•	•	•	•	•	•	•																			
<i>Emberiza schoeniclus</i>	•																												
<i>E. pusilla</i>	•																												
<i>Calcarius lapponicus</i>	•																												
<i>Plectrophenax nivalis</i>	•																												

of birds were examined), we did not find molting in young arctic wabblers in the Polar Urals and in the Lower Ob floodplain. Judging from single catches, postjuvenile molting is also absent in the golden bunting *E. aureola*. Golden buntings of western populations that possibly include West Siberian golden buntings pass postjuvenile and postbreeding molting on the routes of autumn migration in China (Rymkevich et al., 1990).

Prebreeding molting is typical for a number of northern species that winter in the subtropics and tropics. It may have different completeness, varying from the replacement of almost all feathers on all pterylae to the replacement of some feathers on some pterylae. Table 2 presents the materials that were obtained during the winter caging of birds, primarily, 1-year-old individuals.

Molting in meadow pipits, red-throated pipits *A. cervinus*, yellow wagtails *M. flava*, and white wagtails is always incomplete. Molting involves the replacement of head and body coverts (possibly not all). The differences between species relate to the wing and tail pterylae. The greatest completeness among the caged 1-year-old birds was observed in the yellow wagtail: molting involved all tail feathers, all tertiary flight feathers, part of the upper covers of secondary flight feathers (proximal coverts) or all upper covers of secondary flight feathers, alula coverts, upper

coverts of the propatagial fold, carpal coverts, and a part of lower coverts of flight feathers. White wagtails replaced central tail feathers, all (17–19) or (18, 19, or 18) tertiary flight feathers, all small and mean upper coverts of secondary flight feathers, and all or only internal large upper coverts of secondary flight feathers. Meadow pipits replaced some of the upper coverts of secondary flight feathers or all of them, some lower coverts of flight feathers, and all tertiary flight feathers. Red-throated pipits replaced a significant part of head and body coverts, part of upper coverts of secondary flight feathers, and one to three tertiary flight feathers in the process of molting. Some pipits were observed to have molting of central tail feathers.

The complete or almost complete winter molting is typical for northern wabblers—the willow wabber and arctic wabber. At the end of April, caged 1-year-old individuals of all species with rhodamine-colored plumage had completely new flight and tail feathers, upper wing coverts, and a greater part of lower wing coverts (Table 2). Individual nonreplaced feathers (colored) remained on the head, breast, back, femur, and thigh. According to the position in the annual cycle with the photoperiodic reaction to increase in day length, this molting is prebreeding in both species. However, under the conditions of increase in day length, the Siberian chiffchaff *Ph. Collybita tristis* replaced head and body coverts, tertiary flight feath-

ers, and central tail feathers, having the same completeness of molting as the West European chiffchaff *Ph.c.collybita* (Handbook ..., 1992).

Prebreeding molting in 1-year-old individuals of the blue-throated wabler *Luscinia svecica* extended to all body pteryxae (ventral, dorsal, shoulder, femoral, thigh, anal, and tail pteryxae), but tail feathers were not replaced; only their coverts were replaced. The wing covert did not participate in molting. It is assumed (Ryzhanovskiy, 2014) that there is the second stage of molting that involves only feathers of the throat spot, predominately in the intermaxillary area, which were not replaced at the first stage, and coverts of the neck area that are adjacent to the spot, a part of which grew quite recently, less than a month earlier. Possibly, it is this stage (the chin, throat, and blue plastron on the breast) which was described as prebreeding molting by G. Witherby (1945). Bluestarts *Tarsiger cyanurus* do not molt during wintering.

Out of the northern representatives of the *Fringillidae* family, winter molting is characteristic of only the common rosefinch. According to the position in the annual cycle, molting in 1-year-old individuals and adult birds is postjuvenile in the former and postbreeding in the latter; i.e., it is controlled by reduction in day length (Noskov, 1978). In December, three of our caged birds replaced all contour body feathers, most of upper and lower wing coverts, all tail feathers, tertiary flight feathers (17–19), distal primary flight feathers (1–4), and some secondary flight feathers (11; 11, 12). The results agree with the experiments that were carried out by G.A. Noskov (1978)—rosefinches that molt in October–December have partial molting. However, birds that molt in January–April have complete molting.

During caging, we did not observe winter molting in northern buntings: reed bunting *Emberiza schoeniclus*, little bunting *E. pusilla*, Lapland bunting, and snow bunting, but in nature in the second half of winter these birds partially replace coverts of the head pteryxa (Witherby, 1945; Rymkevich et al., 1990). The photoperiodic regime of caging probably did not stimulate the implementation of molting in these birds.

According to the literature data (Rymkevich et al., 1990, Jenni and Winkler, 1994), among the species that are listed in Table 1, wintering does not involve prebreeding molting in the Siberian accentor *Prunella montanella*, common redstart *Phoenicurus phoenicurus*, and thrushes of the *Turdus* genus. Partial prebreeding molting of contour plumage and part of wing coverts is present in the yellow-headed wagtail and gray wagtail *M. cinerea*, lesser whitethroat *Sylvia curruca*, stonechat *Saxicola torquata*, and wheatear. Prebreeding molting is also absent in nonmigratory species, species that migrate within the taiga zone, and near migrants: all titmouses, finches, and crows.

Postbreeding molting that takes place at breeding areas is usually complete; i.e., all feathers on pteryxae

and down and downy feathers on the apteries fall out and grow again, so the table of completeness is not given for them. The exception is northern wablers—the arctic wabler, chiffchaff, and willow wabler. The first species replaces the contour plumage of the head and body, some upper wing coverts, tertiary flight feathers, central tail feathers, and sometimes all tail feathers. No molting of secondary flight feathers (12–16), small upper coverts of secondary flight feathers, or large and mean coverts of secondary flight feathers was observed in some willow wablers and chiffchaffs (Ryzhanovskiy, 1997). Among the latter, individuals of other species (blue-throated wabler, common redpoll) with incomplete molting of flight feathers were episodically caught in the season.

DISCUSSION

The passerine birds of Northwest Siberia have all variants of the completeness of molting that are known for molting in birds of Northern Eurasia (Rymkevich et al., 1990; Jenni and Winkler, 1994)—from complete postjuvenile molting at hatching places to its absence and complete or partial postjuvenile molting at wintering places or at migratory routes, from complete prebreeding molting at wintering places to its absence, and from complete postbreeding molting at nesting places to complete molting at wintering places or at migratory routes.

Among the species that were related by N.N. Daniilov (1966) to subarctic species, the maximal completeness is typical for the northern subspecies of the horned lark, but the same completeness is characteristic of the Balkan subspecies (Patzold, 1981) and other larks. The completeness of postjuvenile molting in the common redpoll, which is a subarctic species, and in the bramble finch *Fringilla montifringilla*, pine grosbeak *Pinicola enucleator*, and bullfinch *Pyrrhula pyrrhula* that penetrate into the subarctic region almost does not differ, particularly in case of large samples. However, among wagtails the maximal completeness is characteristic of the red-throated pipit, which is a subarctic species in comparison with the meadow pipit and tree pipit *A. trivialis*, yellow wagtail, yellow-headed wagtail, and white wagtail; among buntings the least completeness is also observed in subarctic species—the Lapland bunting and snow bunting, when compared with the little bunting and reed bunting. The reduction in the completeness of molting in subarctic species is quite understandable—the short summer in subarctic and arctic tundras requires the quick completion of molting, which is possible at a small number of shed feathers. Postbreeding molting is equally complete in all these species; there are no data on the greater or smaller completeness of prebreeding molting in the subarctic species when compared to the species that penetrate into the subarctic region.

The length of migratory route is considered a very important factor affecting all aspects of the molting

process (Rymkevich, 1983; Stresemann and Stresemann, 1966, 1968). The longer the migratory route is, the less time the bird can stay in the nesting area and the less time it can spend on molting. A pronounced relationship between the completeness of postjuvenile molting and length of migratory route is typical for wablers: the chiffchaff that migrates to North Africa and Southern Europe (3000–4000 km) replaces the contour plumage and some wing coverts (Table 1); the willow wabler migrating to Africa and yellow-browed wabler *Ph. Inornatus* migrating to India (5500–6500 km) replace only their contour plumage except for tail feather coverts, which molt only in some willow wablers. The arctic wabler migrating to Southeast Asia (6000–8000 km) from Eastern Europe and Western Siberia usually does not have postjuvenile molting and has partial postbreeding molting. Other wablers have complete or almost complete postbreeding molting. Meanwhile, willow wablers, chiffchaffs, and arctic wablers from the parts of the area that are closer to wintering places have a more complete postjuvenile molting: willow wablers and chiffchaffs in Western Siberia replaced a larger number of flight-feather coverts (Gwinner, 1969) than in our region; arctic wablers from Southeast Siberia and Yakutia have partial postjuvenile molting (Portenko, 1960; Bub, 1981) in its absence in Western Siberia.

The magpie *Pica Pica*, which is a sedentary species in forest tundra, replaces almost all upper and lower wing coverts, in contrast to the near migrant gray crown *Corvus cornix*, which replaces only small upper coverts and carpal coverts (Table 1). However, Lapland buntings and snow buntings that migrate to the snow-free zone (3000–4000 km) have a less complete postjuvenile molting than the little bunting that migrates to Southeast Asia; i.e., adaptation to the subarctic region in the Lapland bunting and snow bunting are dominant over migration distance. All northern thrushes, varying from the fieldfare *Turdus pilaris* to the bluestart that migrates to Southeast Asia, have similarly complete postjuvenile molting and equally complete postbreeding molting, but differ in prebreeding molting, from its absence in the bluestart to its significant completeness in the blue-throated wabler. Some distant migrants (rosefinch and golden bunting) transferred all types of molting to the late-autumn and winter periods upon maximal completeness. Thus, the dependence of the completeness of molting, mainly postjuvenile molting, on the migration distance is observed only in some species groups of the region.

It was experimentally established (Ryzhanovskiy, 1997; 2008) that, in the passerines of the subarctic region, like birds of temperate latitudes (Noskov, 1977; Noskov and Rymkevich, 1978, Rymkevich and Bojarinova, 1996), postjuvenile molting depends on the photoperiodic conditions in the molting region. In temperate latitudes, molting takes place against a background of a reduction in day length in July–Sep-

tember. Upon a shorter day photoperiod, birds from late broods may have a less complete postjuvenile molting in comparison with birds from early broods upon a long-day photoperiod, which was shown by G.A. Noskov (1977). The reduction in day length begins from the middle of July in the south of the subarctic region (with consideration for sunlight refraction) and in August in its north. Therefore, the initial stages of molting in forest tundra and a significant part of the molting process in tundra take place upon around-the-clock insolation or insolation with a similar duration. The experiment on the response of molting to a change in day length (Ryzhanovskiy, 2008) identified two species groups. The completeness of molting in the blue-throated wabler, little bunting, and reed bunting is uniquely positively related to day length; the birds responded by higher completeness to an increase in day length and by a lower completeness to a reduction in day length. Meanwhile, the meadow pipit and red-throated pipit, yellow-headed wagtail and yellow wagtail, willow wabler, fieldfare, red-winged thrush, common wheatear, and Lapland bunting responded in the experiment only to a reduction in day length by the decreased completeness of molting and did not respond by the increased completeness to the 24-h day of early August in the Northern Yamal. This means that in the first group the advancement to latitudes with a long polar day must be accompanied with an increase in completeness. Currently, the northern border of the range of these species passes through the subarctic tundras of the Middle Yamal. The possible further advancement of these birds to the Northern Yamal must be accompanied with an increased completeness and duration of molting. This delays the formation of the migratory state, which is not compatible with molting (Dol'nik, 1975), and the start of flying away under the conditions of the rapid onset of cold weather; i.e., this impedes the further expansion of the range. Birds of the second group did not increase the completeness and, accordingly, the duration of molting when adapting to subarctic tundras, in comparison with forest tundra; therefore, some of them (red-throated pipit, white wagtail, common wheatear, and Lapland bunting) nest in arctic tundras and others nest in northern subarctic tundras. Out of the second group, only the yellow wagtail is currently adapting to the southern subarctic tundras of the Yamal, having an early time (middle of August) of flying away.

Postbreeding molting in the individuals that started it late (that fed the second or repeated brood) may be incomplete due to the stoppage of the process in the case of a very short length of day, which we observed in willow wablers and common redpolls. It is known that incomplete postbreeding molting is noted in chaffinches *F. coelebs* (Noskov, 1977), which started it in the experiment from the middle of the process at a short-day photoperiod and did not replace the internal primary flight feathers. The light regime may also

affect the completeness of prebreeding molting. In particular, the experimental increase in day length in the second half of winter caused a growth in the number of molting feathers in the yellow wagtail (Kukish and Noskov, 1975).

CONCLUSIONS

During the year, each feather of a passerine bird must be replaced by a new one due to being gradually worn out. A number of species that gather food in dense shrubs (wablers) and migrate to the equator renew the entire plumage or part of it twice a year, before flying away to wintering places and before returning to the nesting region. Larks and sparrows completely renew the plumage every year, starting with the first summer–autumn. However, flight and tail feathers are completely replaced by the end of the first year of life, and contour feathering is also replaced completely once a year and partially twice a year. The variability of the completeness of molting in the passerine birds of Northwest Siberia is significant. The relationship with the conditions of the subarctic region is manifested in the reduced completeness in subarctic species in comparison with taxonomically close widespread species. The photoperiodic regime of the Trans-Polar region divides birds into species that respond with increased completeness to the polar day in the second part of summer in the north of the subarctic region and those that do not respond to it, i.e., the species that have photoperiodic and endogenous control of maximal completeness.

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