

## WHAT IS *Falco altaicus* MENZBIER?

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**ABSTRACT.**—The systematics of the Altay falcon (*Falco altaicus/lorenzi*) remains enigmatic. First reported in 1811, it has been treated as a gyrfalcon (*F. rusticolus*), a saker (*F. cherrug*), and two separate species (*F. lorenzi* and *F. altaicus*). Of 53 “altaicus” specimens examined, at least two are misidentified gyrfalcons, many are typical sakers, but 34 (the core group) are considered to be the true Altay falcon type. Adults have red, brown, and gray color morphs. The red (backed) morph closely resembles some eastern sakers; the chocolate and gray morphs resemble respective gyrfalcon morphs. While the true affinities of the Altay falcon will be resolved by molecular genetics, the ecological, geographical, and morphological information suggest that the core group represents a gyrfalcon-saker cross that is being swamped through back crosses with the saker. The breeding range of the core group (i.e., the Altay and Sayan Mountains) is much smaller than previously reported.

**KEY WORDS:** *Altay falcon; Asia; Falco altaicus; gyrfalcon; saker; Siberia.*

¿Que es *Falco altaicus* Menzbier?

**RESUMEN.**—La sistemática de *Falco altaicus/lorenzi* se mantiene en el enigma. Reportado primero en 1811, y después fue tratado como *F. rusticolus*, como *F. cherrug*, y dos especies separadas (*F. lorenzi* y *F. altaicus*). De 53 especímenes de “altaicus”, al menos dos son *F. rusticolus* mal identificados, muchos son típicos *F. cherrug*, pero 34 (grupo principal) son considerados como verdaderos halcones Altay. Los adultos poseen fase de color rojo, café y gris. La fase de dorso rojo es bastante parecida a algunos *F. cherrug* del este; las fases chocolate y gris son parecidas a las respectivas fases de *F. rusticolus*. Mientras que las verdaderas afinidades del halcón Altay serán resueltas por la genética molecular, la información ecológica, geográfica y morfológica sugiere que el grupo principal representa híbridos de *F. rusticolus* y *F. cherrug*. El rango reproductivo del grupo principal (i.e., Montañas Altay y Sayan) es mucho más pequeño que el previamente reportado.

[Traducción de Ivan Lazo]

The existence of a gyrfalcon-like (*Falco rusticolus*) bird from southcentral Siberia and Central Asia is beyond dispute. Some museum specimens labeled Altay falcon (*F. altaicus* and *F. lorenzi*) are so unlike sakers (*F. cherrug*) that Menzbier (1891, 1901) and Sushkin (1938) assigned them separate species status. Dementiev (1951) and Brown and Amadon (1968:840, 843) presented body measurements for these birds that would categorize them as large gyrfalcons. However, the major problem in defining an *altaicus/lorenzi* taxon results from the existence of an almost uninterrupted continuum from the most gyrfalcon-like to the most saker-like specimens (Figs. 1–5). Recent works (Brown and Amadon 1968, Baumgart 1978, Cade 1982) have dismissed the *altaicus/lorenzi* problem by relegating the bird to either a subspecies or a color morph of the saker. Even Dementiev, who for so long argued that Altay falcons were closer to gyrfalcons than sakers, eventually concluded that both *altaicus* and *lorenzi* were synonymous with the saker (Dementiev and Shagdarsuren

1964). However, a few specimens labeled Altay falcon (mostly those originally labeled *lorenzi*) are indistinguishable from gray-morph gyrfalcons.

Several papers have treated Altay falcon systematics (Dementiev 1933a, 1947, 1951, Kots 1948, Vaurie 1961, Dementiev and Shagdarsuren 1964, Baumgart 1980, 1991). Dementiev (1933a) cited 53 publications in his monograph. Pfeffer (1987:23) and Walton et al. (1991) referred to the confusion surrounding the bird. Because of the misinformation and confusion in the literature, it is important to identify those specimens that are most likely to be useful in correctly defining *Falco altaicus* by means of molecular genetics.

**Historical Perspective.** The image of the Altay falcon was reportedly borne on the shields of the armies of Attila (Schenk 1935/38, Dementiev 1951: 141). Tamerlane, and even the sons of Genghis Khan, reportedly hunted swans with this falcon (Dementiev 1951:144). Such romantic notions are compelling, but how can we be certain that it was the Altay

falcon (rather than the saker or the gyrfalcon) that the Huns and Mongols retained for centuries in their cultural memory?

Initially mentioned in a scientific context by Pallas (1811), the first Altay falcon specimen was collected in 1840 (Fig. 1A), and the second in 1874. Based on the first specimen and a fledged juvenile collected in 1879, Menzbier (1891) described a new species, *Hierofalco altaicus*. Later, he examined three gyrfalcon-like birds collected in fall and winter in southern Siberia and thought them distinct enough that he named them *H. lorenzi* (Menzbier 1901). By the time he wrote his monograph on the large falcons of Russia, Menzbier (1916, in Dementiev 1933a: 137) had six *lorenzi* and ten *altaicus* specimens. Dementiev (1933a) used 34 specimens for his analysis.

**The Altay Falcon Confusion.** The Altay falcon reportedly inhabits high elevations of Central Asia from the Sayan and Altay Mountains in the north to the Tien Shan Mountains in the south and as far southwest as the Alexandrovski Mountains in Turkestan (Dementiev 1933b, Stephnyan 1990). Later authors reported it breeding east to Lake Baikal (Johnson 1956, in Dementiev 1960), and one of the *lorenzi* cotypes (Fig. 5C) was taken in late autumn near the southern end of the Ural Mountains.

Other areas of confusion are habitat preference and plumage. The Altay falcon reportedly prefers alpine tundra or tundra-like montane steppe, with the saker occupying lower elevations (Sushkin 1938). The original adult *lorenzi* specimens (Fig. 5C and D) and two birds from Sushkin's family (Fig. 4C, 4F) resemble adult gray gyrfalcons in plumage. Dementiev first wrote of only two forms, light and dark (1933a, 1951). Strangely however, in the "dark form" he included the *lorenzi* types (e.g., Fig. 4C, 4F) that are as light as his light or red form (Fig. 4B). Later, Dementiev and Gladkov (1951 [1966, 1:136]) more accurately described three adult forms: the chocolate, the red-backed, and the gray.

Polymorphism was further confused when Dementiev (1947, 1951) observed that the Altay falcon was polymorphic while the saker was not. Platt (1983), however, described four saker color morphs in Pakistani hawk markets, including a chocolate form, and Baumgart (1978) reported gray, brown, and rufous saker morphs breeding in central Mongolia.

Using the most unique Altay falcon specimens, I redefine the range of the Altay falcon, provide a more accurate estimate of the size of this falcon, compare

the ecological similarities between the Altay falcon and sympatric sakers, and consider the probable origins of the Altay falcon.

#### METHODS

Altay falcons (i.e., specimens labeled *lorenzi* or *altaicus*) were measured (wing chord and tail), aged, and photographed in the only two sizable collections (ZIAS, 26 specimens; and University of Moscow Zoological Museum [UMZM], 25 specimens), as were single skins from the British Museum (BM) and the American Museum of Natural History (AMNH). Hundreds of sakers and gyrfalcons were also compared with the Altay falcons. All specimens labeled Altay falcon, and a few *altaicus*-like sakers were assigned to one of 19 morphological classes.

#### RESULTS AND DISCUSSION

**The Lorenzi/Altaicus Link.** The link between *lorenzi* and *altaicus* was forged in 1914 when Sushkin (1915, in Dementiev 1933a) collected a family of what he thought were gyrfalcons in the Russian Altay Mountains. Both adults were shot and the five nestlings were taken into captivity (Sushkin 1938). The adult male and his five daughters (Fig. 4) eventually came into the collection of the Zoological Institute of the Academy of Sciences (ZIAS), St. Petersburg, Russia. The adult male (Fig. 4F) and one progeny (Fig. 4C) are unquestionably like some *lorenzi* cotypes from southwestern Siberia (Fig. 5C, 5D), while three progeny (Fig. 4A, 4D, 4E) are of the dark *altaicus* type, thus linking *lorenzi* and *altaicus*. If it were not for one of the progeny, I believe the Altay falcon would today be viewed as a disjunct relict subspecies of the gyrfalcon (i.e., *F. rusticolus altaicus*). The last bird, however, in adult plumage (Fig. 4B) is nearly identical to the red-backed morph of the saker, common in the Altay region.

**Differences between Altay Falcons and Sakers.** Brown and Amadon (1968:840, 843) reported that the Altay falcon had longer wings than even the gyrfalcon (males, 367 mm vs. 361 mm; females, 403 mm vs. 396 mm). These Altay falcon values, however, are likely simplified from Dementiev (1951: 21), whose comparisons, I believe, must be reexamined for two reasons. First, Dementiev included in his sample the *lorenzi* birds, some of which I claim to be wintering gyrfalcons. Second, Dementiev's (1933a) individual measurements for tail length exceeded mine 16 of 16 times and by an average of 18.5 mm. For wing length, his values were greater in 10 of 19 cases ( $\bar{x} = 9$  mm). Only a small portion of these differences could be accountable to specimen shrinkage or by the difference between chord vs.



Figure 1. Adult, brown morph Altay falcons, both from central Altay Mountains. Note extremely dark heads and tails. A: First (Nov. 1840) specimen collected (cotypic, ZIAS 75486, female). B: Male collected Dec. 1916 (ZIAS 127701).

flattened wing measurements. Both of these biases would exaggerate the size of the Altay falcon.

Sushkin (1915, *in* Dementiev 1933a:158) maintained that Altay falcons were more powerfully built than similar-sized sakers. Differences in relative build should be evident by comparing mass with linear measurements. However, only three weights are available for birds in the core Altay falcon subsample. Two females weighed 1050 g (juvenile, UMZM 58635, collected in September) and 990 g (second year, UMZM 58642, collected in May). A juvenile male (AMNH 648864, collected in July) weighed 805 g. These values are smaller than gyrfalcon values from Brown and Amadon (1968:843).

Altay falcons are reportedly gyrfalcon-like with

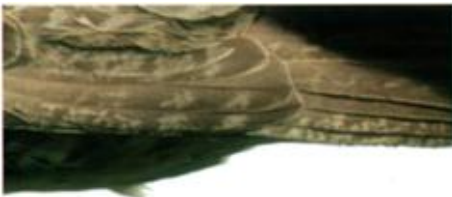


Figure 2. Dark flecking in light bars is considered a gyrfalcon trait, especially evident in adult gyrfalcons (above) and gray Altay falcons.

tarsi more than one-half feathered (Dementiev 1933a: 157). However, I detected extensive overlap between gyrfalcons, Altay falcons, and sakers for this trait.

The traits I believe best characterize the plumage of the three taxa are presented in Table 1. To this point, my discussion seems to undermine the hypothesis that the Altay falcon is a gyrfalcon. However, it is clear that the Altay falcon more closely resembles the gyrfalcon than the saker (Table 1).

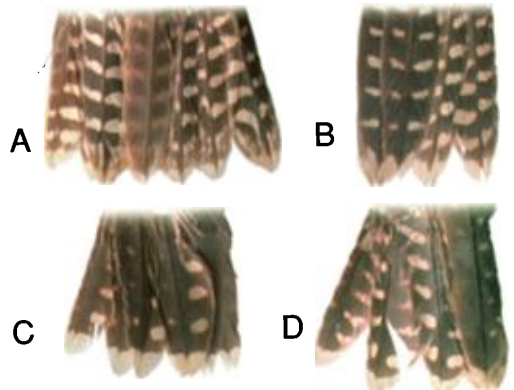


Figure 3. Unusual patterns in tail barring and spotting for juvenile gyrfalcons (A, B) and sakers (C, D).



Figure 4. Family of Altay falcons collected by Sushkin in June 1914 in the southwestern Altay Mountains. Adult male (F) was shot and five siblings were retained alive. Specimen E was sacrificed in autumn 1914 to document juvenile plumage. Other specimens were preserved as they died. A. ZIAS 127699, second year female, chocolate morph. B. ZIAS 127704, sixth year female, red (backed) morph. C. ZIAS 127703, sixth year female, gray morph. D. ZIAS 127702, fifth year female, brown morph. E. ZIAS 127698, juvenile (first year) female. F. ZIAS 127697, adult male, gray morph.



Figure 5. Four adult, gray morph, gyrfalcons. A and B are females from breeding areas in northern Siberia. C (ZIAS 75497) and D (ZIAS 75494) are cotypes of *F. lorentzi*. C is a female from near Kurgan just southeast of the Ural Mountains. D is a male from western Siberia.

Table 1. A comparison of color traits of adult gyrfalcons, sakers, and Altay falcons of equivalent general color saturation.

| TOPOGRAPHIC REGION                                     | GYRFALCON EXPRESSION <sup>a</sup> | ALTAY FALCON EXPRESSION <sup>a</sup> (ALLY) <sup>b</sup> | SAKER EXPRESSION <sup>a</sup>  |
|--|-----------------------------------|--|--|
| Head   | Slightly lighter                  | As dark as (A) <sup>c</sup>                              | Much lighter   |
| Malar stripe   | Light or diffuse                  | Light or diffuse (G) <sup>c</sup>                        | Dark but narrow  |
| Cheek  | Darker                            | As dark as (G) <sup>c</sup>                              | Lighter  |
| Superciliary line                                      | Ill-defined                       | Obscure or ill-defined (G) <sup>c,d</sup>                | Well-defined   |
| Dark flecking in light bars on primaries and rectrices | Pronounced and coarse             | Pronounced but fine (G, eastern S) <sup>c</sup>          | Rare (western) or seldom present but fine (eastern)                                      |
| Breast   | Heavily spotted                   | Heavily spotted (G) <sup>c</sup>                         | Lightly spotted  |
| Flank  | Heavily barred                    | Heavily barred (G) <sup>c</sup>                          | Bars mostly lacking (western) to prominent (eastern) but seldom as bold as in gyrfalcons |
| Under-tail coverts                                     | Heavily barred                    | Heavily barred (G) <sup>c</sup>                          | Lightly barred   |
| Tail pattern   | Barred                            | Barred (G and eastern S) <sup>c</sup>                    | Spotted (western) to barred (eastern)  |
| Tail darkness  | As dark as or slightly lighter    | Tail as dark as dorsal plumage (G) <sup>c</sup>          | Lighter  |

<sup>a</sup> Comparison is with general body color (e.g., head lighter than dorsum).

<sup>b</sup> Ally used here to indicate whether a particular Altay falcon trait is gyrfalcon-like (G), saker-like (S), or unique to the Altay falcon (A)

<sup>c</sup> Feature is well pronounced in most adult Altay falcons.

<sup>d</sup> Dementiev (1933a:158) said that in the Altay falcon the eye stripe is brighter than for sakers. Sushkin's juvenile (ZIAS 127698) seems to confirm this, but in most juvenile museum specimens, and probably in all adults, the eye stripe is less pronounced in Altay falcons than in sakers of comparable darkness.

An important element of the gyrfalcon plumage (Table 1) is dark flecking (Fig. 2) in the light bars on wing and tail. This flecking appears to always be evident in all gray and chocolate Altay falcon adults. Flecking is little evident in red-backed Altays, seldom evident in eastern sakers, and almost never evident in western sakers.

Head features (Table 1) also suggest gyrfalcon influence. Sakers have a clearly defined light superciliary line, a color saturated narrow malar stripe, and contrasting light and dark areas on the cheek. Adult Altay falcons, like adult gray gyrfalcons, have a more diffuse pattern of light and dark in these areas.

The red morphs of Altay falcons and sakers are most alike. Dementiev (1933a:158) proposed that, when compared to red sakers, red Altay falcons have more black and less red on mantle, more spots on breast, more gray on upper tail coverts and rump, darker tail, and a less distinct and shorter malar

stripe. By contrast, I see an uninterrupted continuum between the two forms, and the single red morph from the Sushkin family (Fig. 4B) has much less gray on the rump than many eastern sakers.

**Designating Key Specimens.** Using traits in Table 1, I divided museum specimens into 11 color classes for each age group and taxon (Fig. 6). Moltling birds revealed that adults of all three taxa are normally one-half or one full cell lighter in Fig. 6 than their corresponding juvenile plumage. Because gyrfalcons winter south to the Altay Mountains (Dementiev 1951), I classified those fall and winter specimens that appear identical to adult gyrfalcons, including Menzbier's (1901) *lorenzi* cotypes (ZIAS 75494 and 75497; Fig. 5), as gyrfalcons.

Red-backed and gray adults that exhibited dark flecking and other gyrfalcon or Altay falcon traits in Table 1, were classified Altay falcons as were all birds in the Sushkin family even though the red-backed female (Fig. 4B) is little different from some

| Color Code          | 1.0   | 1.5 | 2.0         | 2.5  | 3.0                              | 3.5  | 4.0   | 4.5  | 5.0   | 5.5                               | 6.0              |
|---------------------|-------|-----|-------------|--|----------------------------------|--|---|--|---|-----------------------------------|------------------|
| <b>GYRFALCON</b>    |       |     |             |  |                                  |  |   |  |   |                                   |                  |
| Adult               | White |     | Gray-white  |  | Gray                             |  | Dark Gray                                   |  | Dark Streaked, Barred                               |                                   | Black (Grayish)  |
|                     |       |     |             |  |                                  | 75494<br>75497                             |   |  |   |                                   |                  |
| Juvenile            | White |     | Brown-white |  | Light Brown                      |  | Brown                                       |  | Dark Brown  |                                   | Black (Brownish) |
|                     |       |     |             |  |                                  |  |   |  |   |                                   |                  |
| <b>ALTAY FALCON</b> |       |     |             |  |                                  |  |   |  |   |                                   |                  |
| Adult               |       |     |             | Red-backed   | Gray-brown                       |  | Dark Gray Brown                             |  | Dark Streaked, Barred                               |                                   | Black (Brownish) |
|                     |       |     |             | 127704   | 75493<br>127697<br>127703        |  | 75488<br>75489<br>95287<br>127699<br>127702 | 127701   | 19<br>75486<br>75491<br>95290                       |                                   |                  |
| Juvenile            |       |     |             |  |                                  |  | Brown                                       |  | Dark Brown  |                                   | Black (Brownish) |
|                     |       |     |             |  |                                  |  | 21545                                       | 21607<br>75485<br>75490<br>75498<br>75499<br>75501<br>127698 | 58642<br>75492<br>75495<br>75496<br>75502<br>648864 | 75487<br>75500<br>95293<br>127700 | 58635<br>95281   |
| <b>SAKER</b>        |       |     |             |  |                                  |  |   |  |   |                                   |                  |
| Adult               |       |     | Blond       | Red-backed   | Gray-brown                       |  | Brown                                       |  |   |                                   |                  |
|                     |       |     |             | 75530*<br>75570*<br>95286<br>95291<br>96907*<br>96958<br>96961*<br>97698*<br>168201* | 95292                            |  | 96939*                                      |  |   |                                   |                  |
| Juvenile            |       |     | Blond       | Blond, Streaked  |                                  | Brown                                      | Dark Brown                                  |  |   |                                   |                  |
|                     |       |     | 95280       | 58637<br>58638<br>58641<br>95284   | 58636<br>58639<br>58640<br>69447 | 95282<br>95283<br>95285<br>95289<br>96931* | 168208*                                     |  |   |                                   |                  |

Figure 6. A classification scheme for dividing 62 specimens (53 that bear an *altaicus* or *lorenzi* label and the nine sakers that most clearly display Altay falcon traits identified in Table 1) into gyrfalcon, Altay falcon and saker color classes. Specimens from ZIAS have prefixes 12, 16, and 75; those from UMZM bear prefixes 21, 58, 69, 95, 96, and 97; number 19 is from the BM; and 648864 is from the AMNH. Sakers marked \* never bore the *altaicus* or *lorenzi* label.

eastern sakers. Some Altay falcons (e.g., Fig. 1A), are as dark as the so-called black gyrfalcon (*F. r. obsoletus*) from Labrador (Dementiev 1951). I tentatively classified all dark-headed or dark-tailed, chocolate juveniles as Altay falcons, and dark spec-

imens with heads and tails lighter than their general color as sakers. The scheme in Fig. 6 is subjective, but useful in identifying the most important specimens for future molecular genetics work.

As Cade (1982:82) noted, some juvenile sakers

cannot be safely distinguished from some juvenile gyrfalcons. However, sakers tend to have round tail spots (Table 1) and tails lighter than their general body color, while gyrfalcon tails tend to be barred (Cade 1982:82, Baumgart 1980:20, 1991:36). For the extreme specimens in Fig. 3, the opposite appears true. Because of this overlap in tail pattern, the most taxonomically useful juvenile specimens are the darkest-headed and darkest-tailed birds because most of these molt into dark adults. Light-bellied juveniles were classed as sakers in Fig. 6.

In Table 2, the size of four age and sex classes are compared for specimens identified in Fig. 6 as most distinctly Altay falcon (i.e., core group). Deletion of unsexed birds left sample sizes so small that conclusions are tentative. Averages for Altay falcons in Table 2 do not support that it is a large gyrfalcon as suggested by Brown and Amadon (1968:843). Adults were within, albeit at the low end of, gyrfalcon ranges while juvenile Altay falcons averaged smaller than gyrfalcons. It should be noted that the largest sakers also have wing and tail lengths similar to gyrfalcons (Brown and Amadon 1968).

**Character Displacement.** Closely related taxa are usually most different ecologically and morphologically in their zone of sympatry. The literature advances the notion that the Altay falcon breeds at higher elevations than the saker (e.g., Sushkin 1938), but this assertion is not supported by the specimen data. For example, a fledgling (ZIAS 75487) Altay falcon was collected "near the city" of Krasnoyarsk (Dementiev 1933a:152) which is only 400 m in elevation. Another eyrie in southcentral Siberia was at 250 m elevation (Dementiev 1933a:154) while the supposedly lower-elevation saker breeds up to 3400 m (Brown and Amadon 1968:842) and probably even higher in Tibet (C.M. White pers. comm.).

Character displacement should also be evident in food habits. Interestingly, the distribution of both rock ptarmigan (*Lagopus mutus*) and willow ptarmigan (*L. lagopus*), important prey for the gyrfalcon worldwide (Johnson and Herter 1989:132), extend south into the Altay Mountains (Dementiev and Gladkov 1951 [1967, 4:46]). Unfortunately, few Altay falcon food habits data are available (Sushkin 1938:160), and there is anecdotal evidence from only a single eyrie in the Altay Mountains of ptarmigan being important prey (A. Sorokin pers. comm.).

If the Altay falcon and sympatric sakers do not hybridize, character displacement predicts that sakers from Central Asia should be morphologically

more different from Altay falcons than are distant populations of sakers. However, the reverse is true.

**Conclusions and Explanations for the Altay Falcon.** I earlier concluded that at least some of the *lorenzi* adults are gyrfalcons (e.g., Fig. 5C, 5D). I also concluded that some specimens labeled Altay falcon are sakers (Fig. 6). The simplest explanation of the remaining Altay falcon core group is that all are merely sakers, the darkest and grayest of which have been arbitrarily tagged Altay falcons because they fit the Altay falcon paradigm. This "saker morph" conclusion is generally accepted today (Cade 1982:80) without explaining the few misidentified specimens that are obviously wintering gyrfalcons. Also left unexplained is the remarkable similarity between some birds that breed in Central Asia (e.g., Fig. 4F) and the gray morph of the northern gyrfalcon (compare Fig. 4F with Fig. 5B, 5D). Such individuals, I believe, provide the key to the origin of the true Altay falcon. Simply put, Altay falcons in the core group exhibit strong gyrfalcon influence because they are hybrids.

Several lines of evidence support the hybrid hypothesis. From Table 1, the core Altay falcons appear to be more gyrfalcon-like than saker-like. Kots (1948) believed that some individual Altay falcons look like a conglomeration of gyrfalcon (patches of gray) and saker (brown) plumage. I dispute that some Altay falcon specimens look "patched together," but accept the hybrid concept. Dementiev (Dementiev and Shagdarsuren 1964) resisted Kots' hybrid hypothesis to the end. I submit that sakers and gyrfalcons constitute a superspecies with the Altay falcon a hybrid between the two. *Lorenzi* should be treated as synonymous with *rusticolus*.

There are three probable explanations for the infusion of gyrfalcon genes into Central Asia. First, a gyrfalcon deme may have been isolated south of a Pleistocene glacial sheet, an interpretation similar to that explaining the black gyrfalcon in the eastern Nearctic (Palmer 1988).

A second explanation is that during post-Pleistocene cold periods, limited gene flow occurred (and may still be occurring) between gyrfalcon populations to the north and the mountains of Central Asia. Until two centuries ago, gyrfalcons reportedly bred in the southern Ural Mountains and they today breed in southern Kamchatka Peninsula (Dementiev 1960, Ellis et al. 1992) at the same latitude as the northern Altay Mountains.

Third, falconry escapees may have provided much



Table 2. Measurements of a restricted sample<sup>a</sup> of Altay falcons in comparison with gyrfalcon and saker measurements.

| SPECIES   | AGE      | SEX | WING CHORD |             |       |      | TAIL LENGTH |             |       |      | SOURCE <sup>b</sup>  |
|-----------|----------|-----|------------|-------------|-------|------|-------------|-------------|-------|------|----------------------|
|           |          |     | N          | RANGE       | MEAN  | SD   | N           | RANGE       | MEAN  | SD   |                      |
| Altay     | Adult    | M   | 3          | 361.5-372.5 | 367.7 | 5.6  | 3           | 193.2-205.0 | 197.7 | 6.4  | Museum               |
| Altay     | Adult    | F   | 8          | 369.0-405.7 | 391.8 | 14.0 | 9           | 221.0-245.6 | 229.3 | 9.0  | Museum               |
| Altay     | Juvenile | M   | 3          | 355.0-363.0 | 358.0 | 4.4  | 4           | 186.0-205.0 | 196.0 | 7.9  | Museum               |
| Altay     | Juvenile | F   | 8          | 378.0-408.5 | 394.3 | 8.8  | 8           | 204.0-237.0 | 223.5 | 12.2 | Museum               |
| Altay     | Pooled   | M   | 6          | 355.0-372.5 | 362.9 |      | 7           | 186.0-205.0 | 196.7 |      | Museum               |
| Altay     | Pooled   | F   | 16         | 369.0-408.5 | 393.1 |      | 17          | 204.0-245.6 | 226.6 |      | Museum               |
| Altay     | Pooled   | M   |            | 348-377     |       |      |             | 197-220     |       |      | Dementiev<br>1951:21 |
| Altay     | Pooled   | F   |            | 385-415     |       |      |             | 218-242     |       |      | Brown and<br>Amadon  |
| Altay     | Pooled   | M   |            | 348-377     | 367.0 |      |             |             |       |      | 1968:840             |
| Altay     | Pooled   | F   |            | 385-415     | 403.0 |      |             |             |       |      | Brown and<br>Amadon  |
| Gyrfalcon | Pooled   | M   |            | 342-406     | 360.5 |      |             | 190-225     |       |      | 1968:843             |
| Gyrfalcon | Pooled   | F   |            | 370-425     | 396.0 |      |             | 235-265     |       |      | Brown and<br>Amadon  |
| Saker     | Pooled   | M   |            | 348-380     | 359.0 |      |             |             |       |      | 1968:840             |
| Saker     | Pooled   | F   |            | 386-411     | 402.0 |      |             |             |       |      |                      |

<sup>a</sup> Only Altay falcons so classified in Fig. 6 are included here. Saker measurements are for *F. c. mitripes*. Birds were excluded if sex was uncertain. Measurements were excluded if critical feathers were missing, growing or abraded.

<sup>b</sup> Museum refers to present study.

gyrfalcon influence in Central Asia. Marco Polo reported that Kublai Khan's hawking party (ca 1290 A.D.) included 10 000 falconers carrying a "vast number of gyrfalcons, peregrine falcons and sakers . . ." (Masefield 1908:96).

**Breeding Range.** The breeding range of the Altay falcon, based on my restricted sample (Fig. 6), is far different than that described in the recent literature (Vaurie 1965:210, Cade 1982). Considering only birds taken from May to August, the sample size drops to 11 birds at six locations, all but one in the Altay Mountains. The best records for determining breeding range are, of course, those involving adults and young taken at eyries. The Sushkin (1938) family (Fig. 4) is from the Kushconur River in the southwestern Russian Altay Mountains. Recently fledged juveniles are available from Krasnoyarsk (ZIAS 75487, 14 August 1928, just north of the Sayan Mountains in southcentral Siberia), Minusinsk (ZIAS 75492, July 1879, eastern Russian Altay Mountains), and Altay Mountains or Altay region (ZIAS 75485, August).

A final summer specimen (BM 19, 15–20 May 1874, Yarkand) is very important because its date and location in Chinese Turkestan south of the Tien Shan Mountains would greatly expand the redefined summering range. However, this bird may have been obtained from a falconer (as suggested by its specimen tag), or may have been purchased (as suggested by Vaurie 1965:210). Because of these uncertainties and its age (subadult), I exclude Yarkand from the Altay falcon's breeding range with the result that all remaining breeding records are for the Altay and Sayan Mountain region.

**The Final Solution.** Ultimately, molecular genetics will reveal Altay falcon affinities. Most valuable for DNA comparisons are specimens from the Sushkin family (Fig. 4) and the darkest and grayest adults in Fig. 6. Some live birds, with characteristics like those in the core Altay falcon group, are now available in captive colonies at Barnaul, Russia; Alma-Ata, Kazakhstan; and Oka Reserve, south of Moscow, Russia.

High quality DNA has been extracted from long-dead specimens (Leeton et al. 1993). Some saker and gyrfalcon DNA comparisons have already been made (Seibold et al. 1993). Using this technology, we should eventually know the magnitude, the source, and even the timing of the gyrfalcon influence toward deciding if the Khans, a gene-flow bridge, and/or the glaciers produced the Altay falcon.

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