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On taxonomic status of two species of orchids (Orchidaceae) from Turkmenistan

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Summary. The orchid genera *Epipactis* Zinn and *Ophrys* L. are well-known by their complicated taxonomy and extensive debates over species richness within them. These genera are represented in Turkmenistan by two species each. Two of them, namely *E. turcomanica* K. P. Popov et Neshat. and *O. kopetdagensis* K. P. Popov et Neshat., were hitherto accepted as species endemic to Turkmenistan. In the present paper, these taxa are synonymized with broadly distributed *E. persica* (Soó) Hausskn. ex Nannf. and *O. oestrifera* M. Bieb., respectively. Thus, the genus *Epipactis* is represented in Turkmenistan by *E. persica* and *E. veratrifolia* Boiss. et Hohen., and the genus *Ophrys* is represented by *O. mammosa* Desf. and *O. oestrifera*. There are no species of orchids endemic to Turkmenistan.

О таксономическом статусе двух видов орхидных (Orchidaceae) из Туркменистана

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Ключевые слова: новые находки, синонимия, Средняя Азия, таксономия, *Epipactis*, *Ophrys*.

Аннотация. Орхидеи родов *Epipactis* Zinn и *Ophrys* L. хорошо известны благодаря запутанной таксономии и бурным дебатам в отношении их видового богатства. Эти роды представлены в Туркменистане двумя видами каждый. *Epipactis turcomanica* K. P. Popov et Neshat. и *Ophrys kopetdagensis* K. P. Popov et Neshat. до настоящего времени считались эндемиками Туркменистана. В данной работе эти таксоны сведены в синонимы к широко распространенным *E. persica* (Soó) Hausskn. ex Nannf. и *O. oestrifera* M. Bieb., соответственно. Таким образом, род *Epipactis* представлен в Туркменистане *E. persica* и *E. veratrifolia* Boiss. et Hohen., а род *Ophrys* – *O. mammosa* Desf. и *O. oestrifera*. Эндемики Туркменистана среди орхидей отсутствуют.

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Introduction

The orchid family (Orchidaceae) is the second largest plant family in the world after Asteraceae (Christenhusz, Byng, 2016). Most species of orchids are threatened plants due to their complex life history strategies, threats from overcollection and habitat loss, as well as climate change (Pillon, Chase, 2006; Fay, Chase, 2009; Swarts, Dixon, 2009; Efimov, 2012; Fay, 2018). Some groups of orchids are still poorly studied taxonomically even in the temperate climatic zone. Particularly, this is true for the genera *Epipactis* Zinn and *Ophrys* L., which are currently being studied phylogenetically (Breitkopf et al., 2015; Bateman et al., 2018; Zhou, Jin, 2018; Sramkó et al., 2019).

Many species of *Epipactis* in the section *Epipactis* s. str. are described and then synonymized with other already known species; particularly, this is true for some facultatively cross-pollinating taxa. For example, *E. kartliana* Kreutz et Van Domm. recently described from Georgia (Kreutz, 2019) looks morphologically almost like *E. kuenkeleana* (Akhalk., H. Baumann, R. Lorenz et Mosul.) P. Delforge, which, in turn, has been already synonymized with *E. condensata* Boiss. ex D. P. Young (Fateryga, Fateryga, 2018). R. M. Bateman (2020) states that there are just 12 "bona fide" species of *Epipactis* in the section *Epipactis* s. str. among the 65 putative species recognized by P. Delforge (2016), although only 27 of them have been studied molecularly (Sramkó et al., 2019). It is evidently that further studies are required, since several taxa, which are well-recognized morphologically (e. g., *E. condensata* or *E. tangutica* Schltr.), were not included to their analysis.

Modern estimation of the species richness of the genus *Ophrys* varies from 9 macrospecies based on the results of molecular analysis (Bateman et al., 2018) to more than 350 microspecies based on minute morphological differences (Delforge, 2016; Baguette et al., 2019). Such a proliferation of species is merely the sort of irrational splitting. Although much more than 9 species can be recognized on the base of traditional morphology, the number of taxa well-distinguishable by this way is much less than 350. Some intermediate points of view between those of "lumpers" and "splitters" are also possible (Véla et al., 2015; Fateryga et al., 2018a).

The genera *Epipactis* and *Ophrys* are represented in Turkmenistan by two species each (Nikitin, Geldikhanov, 1988). Of them, *E. veratrifolia* Boiss. et Hohen. belongs to the section *Arthrochilium* Irmisch; this species is not problematic. *Ophrys transhyrcana* Czerniak. accepted by some authors as a full species (Vlasenko, 2011; Delforge, 2016) is currently treated as a synonym of *O. sphegodes* subsp. *mammosa* (Desf.) Soó ex E. Nelson (World Flora Online, 2020), which is, however, often accepted as a full species, i. e., *O. mammosa* Desf. (Fateryga et al., 2018a; Efimov, 2020). Two remaining taxa were described by K. P. Popov and G. Yu. Neshataeva (1982): *E. turcomanica* K. P. Popov et Neshat. and *O. kopetdagensis* K. P. Popov et Neshat.; both are currently accepted as full species endemic to Turkmenistan (Govaerts et al., 2005–2020; World Flora Online, 2020).

Epipactis turcomanica described from Ajdere Gorge in Southwestern Kopet Dag Mountains was hitherto known just by the protologue. It was, however, included to the Red Data Book of Turkmenistan (Vlasenko, 2011) as a critically endangered and narrow endemic species. The species was described on the base of plants in fruit (Popov, Neshataeva, 1982). The authors of the protologue compared their new species with *E. atrorubens* (Hoffm.) Besser and *E. tangutica*: both had strongly pubescent rachis, while *E. turcomanica* had rather glabrous one (Popov, Neshataeva, 1982). At the same time, they did not denote any differences of their new species from taxa in the *E. phyllanthes* G. E. Sm. species group, which contained species with either glabrous or subglabrous rachis (Delforge, 2016; Fateryga, Fateryga, 2018). A similar situation is true for *O. kopetdagensis* as well. It was described from Pordere Gorge, also in Southwestern Kopet Dag Mountains. The authors (Popov, Neshataeva, 1982) compared it with *O. transhyrcana* from the *O. mammosa* species group (merged into *O. sphegodes* Mill. group in Bateman et al., 2018), while their new species actually belonged to the *O. oestrifera* M. Bieb. species group (merged into *Ophrys fuciflora* (F. W. Schmidt) Moench group in Bateman et al., 2018). For a long time *O. kopetdagensis* was known just by the protologue until its rediscovery in the type locality in 2015 (Pavlenko et al., 2015).

The purpose of the present study is to clarify the taxonomic statuses of both *E. turcomanica* and *O. kopetdagensis* according to the species concept proposed in the previous papers (Fateryga, Fateryga, 2018; Fateryga et al., 2018a). It was possible due to a rediscovery of *E. turcomanica* by the second author and Ch. Tagiev in Pordere Gorge in 2019 (Fig. 1A–B). Living plants were studied in the field and voucher specimens were

collected and preserved in the research herbarium of A. V. Pavlenko (Serdar, Turkmenistan). Specimens of *O. kopetdagensis* previously recorded there (Pavlenko et al., 2015) were also studied in the field and on the base of the preserved material. Type specimens of *E. turcomanica* and *O. kopetdagensis* were studied in LE.

As the result, *E. turcomanica* and *O. kopetdagensis* were found being conspecific with *E. persica* (Soó) Hausskn. ex Nannf. and *O. oestrifera*, respectively. Nomenclature of these two species and proposed new synonymies are present below, along with taxonomic notes and other relevant data.

Species account

Epipactis persica (Soó) Hausskn. ex Nannf. 1946, Bot. Not. 1946(1): 21. ≡ *Helleborine persica* Soó, 1927, Repert. Spec. Nov. Regni Veg. 24: 36. ≡ *Epipactis microphylla* subsp. *persica* (Soó) Hautz. 1976, Verh. Zool.-Bot. Ges. Wien, 115: 42. ≡ *Epipactis helleborine* subsp. *persica* (Soó) H. Sund. 1980, Europ. Medit. Orchid. ed. 3: 41, nom. inval.

Lectotypus (Hautzinger, 1976, Verh. Zool.-Bot. Ges. Wien, 115: 42): Iran: "In dit. urb. Sultanabad. 1898. Th. Strauss s. n." (JE: JE00007753!).

= *Epipactis turcomanica* K. P. Popov et Neshat. 1982, Izv. Akad. Nauk Turkmensk. S. S. R., Ser. Biol. Nauk, 1982, 4: 16.

Holotypus: Turkmenistan: "Ю. Туркмения, юго-западный Копетдаг, ущелье Ай-Дере, на берегу в среднем течении р. Айдеринка. Un., чрезвычайно редко! [Southern Turkmenistan, Southwestern Kopet Dag, Ajdere Gorge, at a bank in the middle reaches of Ajderinka River. Un., very rarely!]. 19 VII 1980. K. P. Popov s. n." (LE: LE00050987!) (Fig. 2A).

= *Epipactis helleborine* subsp. *transcaucasica* A. P. Khokhr. 1991, Byull. Moskovsk. Obshch. Isp. Prir., Otd. Biol. 96, 4: 107.

Holotypus: Georgia: "Adzharia, distr. Kedensis, opp. pagus Zhemna, pineto-quercetum siccum, schistosum. 5 VI 1990. A. P. Khokhrjakov, P. A. Khokhrjakov, S. Czitanava s. n." (MW: MW0591780!).

= *Epipactis taurica* Fateryga et Kreutz, 2012, J. Eur. Orch. 44(1): 201. ≡ *Epipactis persica* subsp. *taurica* (Fateryga et Kreutz) Fateryga et Kreutz, 2014, J. Eur. Orch. 46(2): 413.

Holotypus: Russia: "Крым, окр. Ялты, Ялтинский заповедник, склоны горы Лопата, сосняк коротконожковый [Crimea, vicinity of Yalta, Yalta Reserve, slopes of Mt Lopata, pine forest with *Brachypodium*]. 9 VII 2011. A. V. Fateryga s. n." (CSAU!).

Specimens examined: Turkmenistan: "Ю.-З. Копетдаг, ущ. Пордере, в тени *Salix* [Southwestern Kopet Dag, Pordere Gorge, 38°20′N, 57°03′E, ca. 1300 m a. s. l., under a *Salix* shade]. 28 VI 2019. Ch. Tagiev s. n." (herbarium of A. V. Pavlenko: PAV00002) (Fig. 2B).

Distribution: Balkans, Crimea, Caucasus, Western Asia (except south of the Arabian Peninsula), Middle Asia (Turkmenistan, Tajikistan), and Southern Asia (Afghanistan, Pakistan).

Notes: The holotype of *E. turcomanica* has been already labeled as *E. persica* by D. Rückbrodt and U. Rückbrodt (Fig. 2A). Indeed, it perfectly fits the diagnosis of *E. persica*: the plant is rather small, with few leaves and flowers, and the rachis of inflorescence is glabrous. Although these characters are diagnostic for the whole *E. phyllanthes* species group, *E. persica* is the only species in this group distributed so far east (Delforge, 2016). Some doubts in the proposed synonymy, however, remained until the plants were rediscovered and studied in the field (Fig. 1A–B). Study of the living plants in flower revealed that they had epichile rather equal in length and width, and distinctly present but inefficient viscidim, i. e., the characters of *E. persica* (Fateryga et al., 2018b). One more character is a short but distinctly present pedicel.

It was recently stated that the *E. phyllanthes* species group consisted of a single "bona fide" species (Sramkó et al., 2019; Bateman, 2020), although just three microspecies in this group were studied molecularly: *E. exilis* P. Delforge, *E. persica*, and *E. phyllanthes* s. str. (Sramkó et al., 2019). Indeed, the differences between *E. exilis* and *E. persica* are not clear (cf. Fateryga et al., 2018b) and this is possibly true for other taxa as well. On the other hand, there are some species, which are well-recognized morphologically, e. g., *E. euxina* Fateryga, Popovich et Kreutz from the North Caucasus or the species from Crete known as *E. cretica* Kalop. et Robatsch, nom. inval. To better ascertain the phylogenetic relationships within the *E. phyllanthes* species group and to clarify the number of species in this group, such taxa should be also included in further molecular studies. Until this is done, *E. persica* can be also treated as a full species, not a synonym of *E. phyllanthes* (these two taxa are allopatric and, therefore, merit at least the subspecies rank).

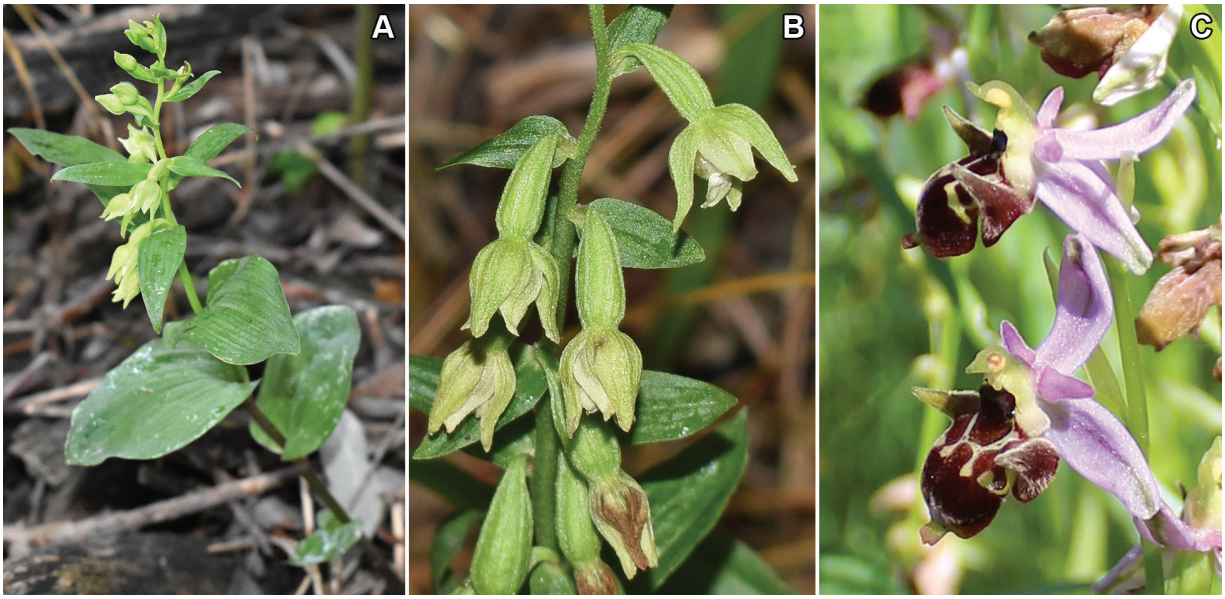

Fig. 1. *Epipactis persica* (Soó) Hausskn. ex Nannf. (A–B) and *Ophrys oestrifera* M. Bieb. (C) from Pordere Gorge, Turkmenistan: A – flowering plant; B–C – part of an inflorescence. Photos by Ch. Tagiev (A–B) and A. V. Pavlenko (C).

Fig. 2. Holotype of *Epipactis turcomanica* K. P. Popov et Neshat. (LE: LE00050987) (A) and a modern gathering from Pordere Gorge, Turkmenistan (herbarium of A. V. Pavlenko: PAV00002) (B).

Ophrys oestrifera M. Bieb. 1808, Fl. Taur.-Caucas. 2: 369. ≡ *Orchis oestrifera* (M. Bieb.) M. Bieb. 1819, Fl. Taur.-Caucas. 3: 605. ≡ *Ophrys scolopax* var. *oestrifera* (M. Bieb.) Rchb. f. in Rchb. 1851, Icon. Fl. Germ. Helv. (H. G. L. Reichenbach), 13/14: 99. ≡ *Ophrys scolopax* subsp. *oestrifera*

(M. Bieb.) Soó, 1970 (publ. 1971), Acta Bot. Acad. Sci. Hung. 16(3/4): 386.

Lectotypus (Averyanov, 1994, Bot. Zhurn. (St. Petersburg), 79, 10: 124): Russia: "Taur. mer. 1807. Ch. Steven s. n." (LE!).

= *Ophrys bremifera* Steven in M. Bieb. 1808, Fl. Taur.-Caucas. 2: 370; 1809, Mém. Soc. Imp. Naturalistes Moscou, 2: 174. ≡ *Ophrys oestrifera* subsp. *bremifera* (Steven) K. Richt. 1890, Pl. Eur. 1: 264. ≡ *Ophrys oestrifera* f. *bremifera* (Steven) Soó, 1928, Bot. Arch. 23: 32. ≡ *Ophrys scolopax* subsp. *bremifera* (Steven) Biel, 1999, Ber. Arbeitskreis. Heimische Orchid. 16(1): 54.

Lectotypus (Averyanov, 1994, Bot. Zhurn. (St. Petersburg), 79, 10: 124): Georgia: "Ex Iberia. 1808. Ch. Steven s. n." (LE!).

= *Ophrys cornuta* Steven in M. Bieb. 1808, Fl. Taur.-Caucas. 2: 370; 1809, Mém. Soc. Imp. Naturalistes Moscou, 2: 175. ≡ *Ophrys bicornis* var. *cornuta* (Steven) Nyman, 1882, Consp. Fl. Eur.: 698. ≡ *Ophrys oestrifera* subsp. *cornuta* (Steven) K. Richt. 1890, Pl. Eur. 1: 264. ≡ *Ophrys arachnites* var. *cornuta* (Steven) Fiori et Paol. in Fiori., Bég. et Paol. 1896, Fl. Italia [Fiori, Béguinot et Paoletti], 1: 236. ≡ *Ophrys scolopax* subsp. *cornuta* (Steven) E. G. Camus in E. G. Camus, Bergon et A. Camus, 1908, Monogr. Orchid.: 270. ≡ *Ophrys holoserica* subsp. *cornuta* (Steven) H. Sund. 1975, Taxon, 24(5/6): 625. ≡ *Ophrys fuciflora* subsp. *cornuta* (Steven) H. Sund. 1980, Europ. Medit. Orchid. ed. 3: 39.

Lectotypus (Kreutz, 2019, Ber. Arbeitskreis. Heimische Orchid. 36(1): 156): Illustration in Steven, 1809, Mém. Soc. Imp. Naturalistes Moscou, 2: Tab. XI, Fig. 3 [based on a specimen collected in Georgia].

= *Ophrys kopetdagensis* K. P. Popov et Neshat. 1982, Izv. Akad. Nauk Turkmensk. S. S. R., Ser. Biol. Nauk, 1982, 4: 17.

Holotypus: Turkmenistan: "Юго-Западный Копетдаг, ущелье Пордере, на берегу ручья, 1200 м над ур. м. Редко [Southwestern Kopet Dag, Pordere Gorge, at a stream bank, 1200 m a. s. l. Rarely]. 25 V 1981. K. P. Popov s. n." (LE: LE01079804!).

= *Ophrys oestrifera* subsp. *abchasica* Kümpel, 1988, Ber. Arbeitskreis. Heimische Orchid. 5(1/2): 25. ≡ *Ophrys abchasica* (Kümpel) P. Delforge in P. Delforge, Devillers-Tersch. et Devillers, 1991, Naturalistes Belges, 72(3): 100.

Holotypus: Russia: "Sotschi, Msymta-Tal. 17 V 1979. H. Kümpel s. n." (JE: JE00014373!).

Specimens examined: Turkmenistan: "Ю.-З. Копетдаг, ущ. Пордере (верховья) [Southwestern Kopet Dag, Pordere Gorge (upper reaches), 38°15′N, 57°02′E, ca. 1200 m a. s. l.]. 1 V 2019. A. V. Pavlenko s. n." (herbarium of A. V. Pavlenko: PAV00021).

Distribution: Balkans, Crimea, Caucasus, Western Asia (except south of the Arabian Peninsula), and Middle Asia (Turkmenistan).

Notes: The studied material (Fig. 1C) well corresponds to specimens of *O. oestrifera* from the type locality (Crimea). No differences in flower morphology were revealed, even the shape of the appendage of the lip was tridentate like in plants from the Crimea and unlike in those from the environs of Sochi (Fateryga et al., 2018a). No differences of *O. kopetdagensis* from *O. oestrifera* were reported previously as well (Popov, Neshataeva, 1982; Pavlenko et al., 2015). Therefore, a new synonymy is proposed here. The species should be included to the next edition of the Red Data Book of Turkmenistan (Pavlenko et al., 2015) under the name *O. oestrifera*.

The taxonomic status of *O. oestrifera* was justified in one of the previous papers (Fateryga et al., 2018a). Those who accept species of the genus *Ophrys* in the broader sense may treat it as *O. scolopax* subsp. *cornuta*. The synonymy of *O. oestrifera* with *O. apifera* Huds. (Govaerts et al., 2005–2020; Devey et al., 2008; World Flora Online, 2020) is incorrect and based on a mistake (cf. Bateman et al., 2018; Fateryga et al., 2018a).

Conclusions

The genus *Epipactis* is represented in Turkmenistan by *E. persica* and *E. veratrifolia*, the genus *Ophrys* is represented by *O. mammosa* and *O. oestrifera*. There are no species of orchids endemic to Turkmenistan.

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