



Odonata collected in southeast Kazakhstan in 2005–2015

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Abstract

Ten years of study on the Odonata of southeast Kazakhstan (63 stations) resulted in a list of 60 species. Almost all are typical of the west and center of the Palaearctic region. None are East Palaearctic. Regional (west-central Asian) endemics, adapted to adult life in a semi-arid environment occur sparsely. In spite of a deficit in precipitation, running freshwater is rather abundant. It takes the form of glacial melt-water, draining the Asian mountain chains, and some species have adjusted to spring fed-rivers, a typical Central Asian environment. *Cordulegaster coronata* is an example, though its generic taxonomic status is unsettled.

Ischnura aralensis has a unique range that extends from the south Ural to Lakes Aral and Balkhash, and possibly has crossed the Dzungarian gate. It is a lake species that spreads along rivers and may become abundant on lakes in hilly or mountainous environments.

We record a number of migrants like *Sympetrum fonscolombii* and *Pantala flavescens*, the latter a sub-cosmopolitan species. A substantial number of species reach the edge of their range in southeast Kazakhstan. On the other hand, the extensive irrigation works in central Asia have allowed a number of species to expand into areas that used to be dry and inaccessible. This form of faunal falsification will become more severe in the decades ahead.

Keywords: biogeography, Central Asia, *Cordulegaster coronata*, *Ischnura aralensis*, Odonata

Samenvatting

Tien jaar (2005–2015) van waarnemingen aan de libellen van Zuid-Oost Kazachstan (63 vindplaatsen) leverde een lijst van 60 soorten op. Bijna alle zijn typisch voor de west-centraal palaearctische zone. Regionale (west-centraal Aziatische) endemen zijn eerder schaars. Ondanks een deficit aan neerslag is zoet water redelijk overvloedig, dankzij het smeltwater van de centraal aziatische gebergten. Een paar soorten van stromend water hebben zich aan deze omstandigheden aangepast. *Cordulegaster coronata* is een voorbeeld, al is zijn taxonomisch statuut onzeker. *Ischnura aralensis* heeft een vrij unieke verspreiding, die zich uitstrekt van de zuidelijke Oeral tot de Aral en Balkhash meren en misschien de Dzungaarse doorgang naar China heeft benut. Het is een soort van meren maar die rivieren benut om zich te verspreiden. Zij kan lokaal algemeen worden in heuvelachtige gebieden binnen haar areal.

Wij vonden ook een aantal trekkende soorten, zoals *Sympetrum fonscolombii* en *Pantala flavescens*. Een opvallend aantal soorten bereikt de rand van zijn verspreidingsgebied in zuid-oost Kazachstan. Er is een belangrijke faunavervalsing aan de gang via het irrigatienetwerk van Centraal-Azië, dat soorten toelaat snel te expanderen in voorheen droge, ontoegankelijke gebieden. Dit verschijnsel zal zich in de komende decaden ongetwijfeld verder zetten.

Résumé

Dix années d'étude sur les odonates du sud-est du Kazakhstan (63 stations) ont permis de dresser une liste de 60 espèces. La plupart sont typiques de l'ouest et du centre de la région paléarctique, aucune n'est paléarctique orientale et les espèces endémiques régionales (Asie centrale occidentale), adaptées à la vie adulte dans un environnement semi-aride, sont peu nombreuses. Malgré un déficit de précipitations, l'eau douce courante provenant des chaînes de montagnes asiatiques est plutôt abondante. Certaines espèces se sont adaptées aux rivières alimentées par des sources, un environnement typique de l'Asie centrale, *Cordulegaster coronata* en est un exemple, bien que son statut taxonomique générique soit incertain. *Ischnura aralensis* a une aire de répartition unique qui s'étend du sud de l'Oural aux lacs Aral et Balkhash, et a peut-être franchi la porte de Dzungarian. Il s'agit d'une espèce lacustre qui se propage le long des rivières et peut devenir abondante sur les lacs dans les environnements vallonnés ou montagneux.

Nous enregistrons un certain nombre de migrants comme *Sympetrum fonscolombii* et *Pantala flavescens*, cette dernière étant une espèce sub-cosmopolite. De nombreuses espèces atteignent la limite de leur aire de répartition dans le sud-est du Kazakhstan. D'autre part, les vastes travaux d'irrigation en Asie centrale ont permis à un certain nombre d'espèces de se développer rapidement dans des zones auparavant sèches et inaccessibles, un processus qui devrait se poursuivre dans les décennies à venir.

Introduction

Southeast Kazakhstan is bounded to the north by a line passing through the Tarbagatai ridge and the southern Kazakh Uplands, north of Lake Balkhash (approximately 47° N), in the west by the eastern edge of the Moyinkum sandstone massif, in the middle by the Chu River (74° E), and in the south and east by Kyrgyzstan and China.

This relatively small area (ca. 300,000 km²) is diverse in natural conditions and landscapes. Vast low-lying areas, like the Balkhash-Alakol depression, drain water from the Northern Tien Shan, with altitudes of 4000–4600 m (the Ketmen, Dzungarskiy Alatau, Zailiyskiy Alatau, Kungei Ala-Too, Terskey Ala-Too ranges) and the Tarbagatay ridge. Alatau is the name for a mountain chain in the Central Asian Turkic language. The Balkhash-Alakol depression harbours the large Lake Balkhash (18,200 km²) and a number of smaller lakes, like Alakol (2650 km²), Sasykkol (736 km²) and others. Melting snow and glaciers in the highland feed a river network and a zone of irrigated agriculture. The largest rivers are Ayaguz, Ili, Chu, Aksu, Karatal, Lepsy, Tentek and Koksou. On the lowlands the climate is continental with low precipitation (135–200 mm per year) and the lakes fed by meltwater are endorheic. The summers are hot and dry and the winters are cold. In the foothills, as well as along rivers and canals in dry areas, irrigation canals serve as the main, and often only habitat for dragonfly larvae. Increasing salinities are a problem everywhere.

The earliest information on dragonflies of southeastern Kazakhstan was by HEYDEN (1889). His material, collected by A.I. Schrenck in 1840–43, was from the east Kyrgyz steppe in Dzungaria, and from between Lake Balkhash and the headwaters of the Chu River. It was identified by E. de Sélys Longchamps. In total, he recorded 16 species, plus 6 from the Kyrgyz steppe. Sadly, no precise collecting sites were given (HEYDEN, 1889). GRIGORIEV (1905) lists 6 species for the Balkhash region, and includes the description of *Sympetrum bergi* (= *S. tibiale*). Information on individual species in the region was first given by BARTENEV (1915, 1919, 1929), SHORYGIN (1926), and VALLE (1942).

BELYSHEV (1961) listed 34 species from southeast Kazakhstan. Later, in a general paper on the dragonfly fauna of Kazakhstan, 46 species were given for the south-east (again without localities) (BELYSHEV & SHEVCHENKO, 1971). KUMACHEV (1973) listed 27 species for the Ili River, still without specifying collecting sites. BRAGINA & HARITONOVA (1989) found 12 species in the Alma-Ata nature reserve. BELYSHEV *et al.* (1989), in his monograph on the fauna and ecology, summarized the distribution of all dragonflies of Central Asia.

At the end of last century, the study of southeast Kazakhstan intensified. REINHARDT (1995) cited 10 species from 4 spots on the shores of Lake Balkhash. REINHARDT & SEIDENBUSCH (1999) gave 19 species at 25 sites in the lower Ili River (below Kapchagai reservoir). The distribution of *Ischnura aralensis* (including 3 localities in southeast Kazakhstan) was discussed in an article by YANYBAEVA *et al.* (2006).

CHAPLINA (2004a) wrote a thesis on the dragonflies of Kazakhstan. As well, she published an article on the dragonfly fauna of the Alakol Nature Reserve (CHAPLINA, 2004b). Specific locations for dragonflies were not given. That paper, however, became the basis for a review of the dragonflies of Kazakhstan (CHAPLINA *et al.*, 2007). For southeast Kazakhstan, this article listed 13 species in 11 locations, but a large number of species were vaguely listed as “widespread” or “common in the south”.

Recently, data on the distribution of *Orthetrum cancellatum kraepelini*, including southeast Kazakhstan, were reviewed by VERSPUI & WASSCHER, 2020.

Since 2005, southeast Kazakhstan has been surveyed by one of us (SNB) but so far information on only few taxa was released. Among them are the genera *Sympetma* (BORISOV, 2005a), *Ophiogomphus reductus* (BORISOV, 2005b) and *Lindenia tetraphylla* (BORISOV, 2006a). Four species were recorded at a thermal spring in the “Altyn-Emel” Nature Park (BORISOV, 2009a). In articles devoted to Central Asian migratory dragonflies, data were provided on the distribution of *Sympetrum fonscolombii* (BORISOV, 2011a), *Anax ephippiger* BORISOV, 2011b), *Pantala flavescens* (BORISOV, 2012a) and *Anax parthenope* (BORISOV, 2012b).

Subsequent reviews on the dragonflies of Central Asia (BORISOV & HARITONOV, 2007, 2008) included southeast Kazakhstan. The locations of the species are shown on maps, but not enumerated in the text (BORISOV & HARITONOV, 2007, 2008). A separate article was dedicated to the Dzungarsky Alatau (KOSTERIN & BORISOV, 2010). All these articles, published in Russian, are difficult of access for many odonatologists.

Recent work was devoted to the distribution of *Coenagrion scitulum* (SCHRÖTER & BORISOV, 2012) and *Sympetrum tibiale* (DUMONT *et al.*, 2018).

Also, an atlas of West and Central Asia was published (BOUDOT *et al.*, 2021). It includes our data on southeast Kazakhstan. All locations are indicated by dots on maps but are not summed up in the text.

The purpose of the present study is to review all available information on the dragonfly fauna of Southeast Kazakhstan and to examine its affinities.

Material and methods

Material was collected by one of us (SNB) during 7 seasons, 2005–2009, 2012 and 2015. It includes data collected by O.E. Kosterin in 1993–1994 in the Dzungarsky Alatau (published by KOSTERIN & BORISOV, 2010). Material in the collections of the Zoological Institute of the Russian Academy of Sciences (St. Petersburg) (hereinafter ZIN), the Institute of Systematics and Ecology of Animals SB RAS (Novosibirsk) (hereinafter ISEA) and the Institute of Zoology of the Ministry of Education and Science of the Republic of Kazakhstan (Almaty) (hereinafter

IZRK) is also included. In some cases, locations are given based on photos of species. The coordinates of these localities were kindly communicated by the photographers, V.L. Kazenas and A.E. Gavrilov.

LIST OF ODONATA RECORDS

Locations, coordinates, altitude above sea level and date of collection are given for 60 species in 63 localities and shown on the map (Fig. 1) and captions below.

Loc. 1. North coast of Lake Balkhash, 50 km east of the town of Balkhash, 46°45'10'' N, 75°37'42'' E, 338 m., 09.V.2009, SNB.

Loc. 2. North coast of Lake Balkhash, 25 km west of the town of Balkhash, 46°46'20'' N, 74°38'48'' E, 338 m, 17–18.VI.2006, SNB.

Loc. 3. Northwest coast of Lake Balkhash, 5 km south of Saryshagan, 46°04'50'' N, 73°38'16'' E, 338 m, 18–19.VI.2006, SNB.

Loc. 4. Southwest coast of Lake Balkhash, Ulkan, 45°12'04'' N, 73°55'55'' E, 488 m, 2.VII.2016, photo of female *Sympetrum tibiale*, A.E. Gavrilov (pers. comm.).

Loc. 5. Mouth of the Ili River, Kuigan, 45°21'35'' N, 74°08'25'' E, 340 m, 17.VI.2005, SNB.

Loc. 6. Lower reaches of the Ili River, bridge along the Bola-Topar-Kuigan road, 45°24'45'' N, 74°25'18'' E, 345 m, 16, 18.VI.2005, SNB.

Loc. 7. Southwest tip of Lake Balkhash (salt Alakol' Lake), 44°50'50'' N, 74°11'31'' E, 338 m, 19.VI.2006, SNB.

Loc. 8. Bola-Topar village, Topar River, 45°03'00'' N, 74°37'10'' E, 354 m, 15.VI.2005, SNB.

Loc. 9. 35 km west of village of Bola-Topar, brackish water lakes along the road, 45°01'48'' N, 75°00'50'' E, 360 m, 15.VI.2005, SNB.

Loc. 10. Chu River, near village of Novotroitskoye, 43°56'13'' N, 73°35'17'' E, 410 m, 24.V.2009, SNB.

Loc. 11. Chu River, near village of Amangeldy, about 43°28' N, 73°51' E, 11.VII.2008, collector not known (IZRK).

Loc. 12. Chu River, near village of Aydarly, about 43°27' N, 73°53' E, 10.VII.2008, collector not known (IZRK).

Loc. 13. Zailiysky Alatau, Zhetyzhel ridge, Sulutor village, 43°14'39'' N, 75°12'06'' E, about 1500 m, 30.VII.2010, photo of *Cordulegaster coronata*, V.L. Kazenas (pers. comm.).

Loc. 14. South part of the sands of Taukum, Boroy tract, irrigation canal, about 44°14' N, 75°49' E, 22–23.VI.1988, leg. Toropov (ISEA).

Loc. 15. Village Bakbakty, 44°33'45'' N, 76°42'35'' E, 412 m, 10.VI.2005, SNB.

Loc. 16. Ili River near village of Kerbulak, 44°10'40'' N, 76°54'50'' E, 428 m, 24–25.VI.2006, SNB.

Loc. 17. Kurty River (bridge on Karaganda-Almaty highway), 43°53'57'' N, 76°19'37'' E, 514 m, 18.VI.2005, SNB.

Loc. 17a. Ibid, 19.VI.2006, SNB.

Loc. 18. Kapchagai city, dam, small ponds, 43°54'45'' N, 77°05'34'' E, 485 m, 25.VI.2006, SNB.

Loc. 18a. Ibid, 26.V.2008, SNB.

- Loc. 18b. Ili river, Iliisk (modern Kapchagai), 20, 27.VI.1952, 26.VI.1953, leg. P.A. Ler (ISEA).
- Loc. 18c. Ili river, Iliisk (modern Kapchagai), 27.VII., 18.VIII., 01.IX.1952, leg. P.A. Ler (ISEA).
- Loc. 19. Sorbulak Lake, 43°39'35'' N, 76°31'21'' E, 620 m, 18.VI.2005, SNB.
- Loc. 20. Lake Malyi Sorbulak and sewage canal, 43°37'31'' N, 76°45'47'' E, 639 m, 15.VI.2015, SNB.
- Loc. 20a. Ibid, 20.V.1983, leg. D. Kukashev (ISEA).
- Loc. 21. Kaskelen River, 40 km northwest of Almaty, 43°28'01'' N, 76°43'57'' E, 636 m, 15.VI.2015, SNB.
- Loc. 22. Shamalgan settlement, 50 km west of Almaty, 43°09'50'' N, 76°26'31'' E, 1010 m, 15.VIII.2008, SNB.
- Loc. 23. Pond and canal, 20 km west of Almaty, 43°16'39'' N, 76°32'06'' E, 770 m, 14.VI.2005, SNB.
- Loc. 24. Big Almaty Gorge, about 43°05' N, 76°57' E, 1800–1850 m, 30.V.2010, photo of *Cordulegaster coronata*, V.L. Kazenas (pers. comm.).
- Loc. 24a. Ibid, 19.VI.2009, photo of *Libellula depressa*, V.L. Kazenas (pers. comm.).
- Loc. 24b. Ibid, 20.VII.2009, photo of *Orthetrum brunneum*, V.L. Kazenas (pers. comm.).
- Loc. 25. Big Almaty Gorge, area of Almatinskoe Lake, 43°03' N, 76°59' E, 2200–2820 m, 28.VI.2006, SNB.
- Loc. 26. Almaty city, Lake Aerodrome and canal, 43°20'26'' N, 76°59'45'' E, 667 m, 21.VI.2005, SNB.
- Loc. 26a. Ibid, 19.V.2008, SNB.
- Loc. 26b. Almaty, 01.VIII.2002, leg. I.A. Chaplina (ISEA). (*Ophiogomphus reductus* mistakenly identified as *O. cecilia*).
- Loc. 26c. Almaty, 23.VII.1952, leg. P.A. Ler (ISEA).
- Loc. 26d. Almaty, Almatinka river, 'Priyutskaya colonija', approximately the centre of modern Almaty, 15-29.VII.1928, leg. Shnitnikov (ZIN).
- Loc. 26e. Almaty, garden of the Institute for Plant Protection, 43°10'96'' N, 77°03'02'' E, 1020 m, 19-25.VI.2005, SNB.
- Loc. 26f. Ibid, 17.V.2008, SNB.
- Loc. 26g. Ibid, 17.VI.2015, SNB.
- Loc. 26h. Valley of the Tymgada River, Alekseevka, Vernensky district of modern city of Almaty, 16.VI.1907, leg. Izdvetsky (ZIN).
- Loc. 27. Medeo, 10 km southeast of Almaty, 43°08'43'' N, 77°03'42'' E, 1825–2000 m, 21.VI.2006, SNB.
- Loc. 28. 50 km northwest of Almaty, Karashingil village, 43°38'32'' N, 77°34'45'' E, 532 m, 19.VI.2015, SNB.
- Loc. 29. Shelekinkskie fish ponds (near village of Shelek), 43°36' N, 78°15' E, 03.VIII.2002, leg. I.A. Chaplina (ISEA).

Loc. 30. Village Chilik (modern Shelek), 43°35'10'' N, 78°16'25'' E, 630 m, 22.VI.2005, SNB.

Loc. 30a. Ibid, 03.IX.1985, leg. A.Y. Haritonov (ISEA).

Loc. 31. Eastern outskirts of Zailiisky Alatau, Sogaty mountains, about 43°30' N, 78°33' E, 08.VI.2009, collector not known (IZRK).

Loc. 32. Borandasu village, cold spring, 43°40'10' N, 78°34'24'' E, 536 m, 02.VI.2015, SNB.

Loc. 33. Western spurs of Ketmen' ridge, Kegen river in vicinity of village of the same name, 43°01' N, 79°14' E, about 2000 m, 24.VII.1984, collector unknown (ISEA).

Loc. 34. Temerlik river (tributary of the Charyn river), 43°11'56'' N, 79°15'40'' E, 1050 m, 29-30.VI.2006, SNB.

Loc. 35. Thermal radon source Boguty, 43°45'57'' N, 79°04'53'' E, 637 m, 02.VI.2015, SNB.

Loc. 36. Charyn canyon (below the bridge, on road to Chundzhu), 43°31'19" N, 79°15'27" E., 743 m, 22.VI.2005, SNB.

Loc. 37. Charyn canyon, Ash grove, near Lesnaya Dacha, 43°36'05'' N, 79°20'22" E, 680-710 m, 07-11.VII.2009, leg. B. Zlatanov (IZRK).

Loc. 37a. Ibid, 24-26.VIII.2009, leg. B. Zlatanov (IZRK).

Loc. 38. Natural Park 'Altyn-Emel', Singing Dune, 43°51'53'' N, 78°34'02'' E, 600 m, 25.V.2008, collector not known (IZRK).

Loc. 38a. Ibid, 05.VI.2010, photo of *Selysiotthemis nigra* and *Ophiogomhus reductus*, V.L. Kazenas (pers. comm.).

Loc. 39. Natural Park 'Altyn-Emel', village of Chagan, 44°06'57'' N, 78°42'11'' E, 890 m, 21.IV.2012, SNB.

Loc. 40. Natural Park 'Altyn-Emel', radon source, 43°55'21'' N, 78°47'39'' E, 836 m, 13.V.2009, SNB.

Loc. 40a. Ibid, 23, 26.IV.2012, SNB.

Loc. 40b. Altyn-Emel Natural Park, Kalkan on bank of Ili River, 43°50'48'' N, 78°44'54'' E, 488 m, 23-30.04.2012, SNB.

Loc. 41. Bridge over Ili river on Chundzha - Koktal road, 43°58'12'' N, 79°36'17'' E, 503 m, 30.VI.2006, SNB.

Loc. 41a. Ibid, 12.V.2009, SNB. (*Calopteryx splendens* (larvae), *Stylurus ubadschii* (larvae)).

Loc. 42. Dzhungarskiy Alatau, lower part of gorge of Tyshkan river, 7-9 km north of village Sarybel, 44°28'59''-44°31'01'' N, 80°03'58'' E, 1700-1900 m, 22-23.VII.1994, leg. O.E. Kosterin.

Loc. 42a. Ibid, 03.VIII.1994. leg. O.E. Kosterin.

Loc. 43. Dzungarian Alatau, lower course of Kora River, 0-21 km northeast of city of Tekeli, 44°52'01''-44°58'59'' N, 78°52'59''-79°00' E, 1200-1600 m, 11-12.VIII.1994, leg. O.E. Kosterin.

Loc. 44. Dzungarian Alatau, gorge of Kora river in middle reaches, 21-35 km north-east of Tekeli, 44°58'59''-45°01'01'' N, 79°00'-79°12' E, 1600-2100 m, 10.VIII.1994, leg. O.E. Kosterin.

- Loc. 44a. Dzhungarskiy Alatau, lower course of Kora river, Kotloman, 20 km north-east of Tekeli town, 44°59'02'' N, 78°59'13'' E, 1596 m, 11.VIII.1994, leg. O.E. Kosterin.
- Loc. 45. Dzhungarskiy Alatau, valley of Kyzylagash river, 17–18 km southeast of village of Kopal, 45°01'59''–45°04'01'' N, 79°13'01''–79°13'01''–79°13'59'' E, 2050–2700 m, 04–06.VIII.1994, leg. O.E. Kosterin.
- Loc. 46. 50 km north of Taldykorgan city, 45°09' N, 78°44' E, 688 m, 1.VII.2006, SNB.
- Loc. 47. Dzungarskiy Alatau, Arasan (sanatorium), 45°15' N, 79°24' E, 996 m, 01.VII.2006, SNB.
- Loc. 48. Dzungarskiy Alatau, burial grounds Balasaz (Balasas), 45°04'52'' N, 79°14'53'' E, 1494 m, 01.VII.2006, SNB.
- Loc. 49. Dzungarskiy Alatau, dam south of village of Pokatilovka (now Yokiasha), 45°23'00'' N, 80°08'18'' E, 1600–1700 m, 06.VI.2007, leg. S. Titov.
- Loc. 50. Dzungarskiy Alatau, a pond 12 km west of village Lepsinsk, 45°27'47'' N, 80°28'08'' E, 1059 m, 31.V.2007, SNB.
- Loc. 51. Karatal River, 15 km north of village Ushtobe, 45°21'54'' N, 77°58'16'' E, 415 m, 22–26.V.2008, SNB.
- Loc. 52. Aksu river, Matai settlement, 45°52'34'' N, 78°44'16'' E, 402 m, 25.VI.2015, SNB.
- Loc. 53. Southeast coast of Lake Balkhash, 20 km northeast of Lepsy, Saxaul grove, 46°24'16'' N, 79°04'09'' E, 383 m, 25.VI.2015, SNB.
- Loc. 54. Southeast coast of Lake Balkhash, 46°48'27'' N, 79°08'14'' E, 340 m, 23–24.VI.2015, SNB.
- Loc. 54a. Southeast coast of Lake Balkhash, 46°43'59'' N, 79°12'43'' E, 340 m, 8–9.VI.2007, SNB.
- Loc. 55. East end of Lake Balkhash, delta of Ayaguz river, 46°41'10'' N, 79°13'50'' E, 342 m, 24.VI.2015, SNB.
- Loc. 56. Ayaguz river, 30 km north-west of Aktogay village, 47°12'18'' N, 79°32'15'' E, 400 m, 24–25.VI.2015, SNB.
- Loc. 57. West coast of Lake Sasykkol, 46°42'32'' N, 80°35'22'' E, 353 m, 02.VII.2006, SNB.
- Loc. 58. Alakolsky State Nature Reserve, natural boundary Baibala, 46°22'29'' N, 81°07'12'' E, 356 m, 08–09.VI.2015, SNB.
- Loc. 58a. Ibid, 14–16.VI.2002, leg. I.A. Chaplina (ISEA).
- Loc. 59. Neighbourhood of village Ucharal (Usharal), 46°11'' N, 80°53'' E, 375 m, 25.V.2007, SNB.
- Loc. 59a. Ibid, 18.VI.2002, leg. I.A. Chaplina (ISEA). (*Ophiogomphus reductus* identified as *O. serpentinus*).
- Loc. 59b. Ibid, 08.VI.2002, leg. I.A. Chaplina (ISEA).
- Loc. 59c. Ibid, 03.VI.2007, leg. unknown (IZRK).
- Loc. 59d. Ibid, 20–21.VIII.2008, leg. B. Zlatanov (IZRK).
- Loc. 60. Uyaly village (between lakes Kashkarkol' and Alakol'), 46°26'17'' N, 81°22'52'' E, 354 m, 12.VI.2015, SNB.

Loc. 60a. Southeast shore of Lake Kashkarkol', 46°21'40'' N, 81°19'09'' E, 352 m, 01–02.VII.2006, SNB.

Loc. 61. Northwest shore of Lake Alakol', Zayachia Guba, 46°19'25''N, 81°22'18''E, 349 m, 12.VI.2015, SNB.

Loc. 62. Maysk village (Chistopolskoe), canal, 46°09'35'' N, 81°07'20'' E, 397 m, 19.VI.2008, SNB.

Loc. 63. West shore of Lake Alakol', mouth of canal Mayskii, 46°01'58''N, 81°19'56''E, 349 m, 17.VI.2008, SNB.

Loc. 63a. West shore of Lake Alakol', Chernaya Kosa, 45°59'25''N, 81°30'25''E, 349 m, 16.VI.2008, SNB.

Loc. 63b. Neighborhood of Lake Alakol (exact location unknown), 10.VII.1987, leg. E.E. Gavrilova (ISEA).

Loc. 63c. Ibid, exact location unknown, 08.VI.2001, leg. I.A. Chaplina (ISEA).

Loc. 63d. Ibid, exact location unknown, 22.VI.2002, leg. I.A. Chaplina (ISEA).



Fig. 1. Locality map of dragonfly collecting localities in south-east Kazakhstan, with main mountain chains, lakes and rivers also indicated.

Results

ANNOTATED RECORDS OF SOUTHEAST KAZAKHSTAN ODONATA IN 2005–2015

Numbers for each species correspond to those in the list of locations and on the map (Fig. 1). Only those literature sources are cited in which a specific location is given. Taxonomic notes are given for individual species. ‘Larvae’ means that only larvae were found.

Zygoptera Sélys, 1854

Lestidae Calvert, 1901

1. *Lestes barbarus* (Fabricius, 1798)

LOCALITIES: 3, 6, 17, 19, 20 with green veins.

LITERATURE: BARTENEV (1929), BELYSHEV (1961), REINHARDT & SEIDENBUSCH (1999).

Common on the plains and in the foothills at up to 743 m asl (loc. 36). In Kyrgyzstan, widespread in the mountains (SCHRÖTER, 2010). Further south, in Central Asia, local and found only in the mountains (BORISOV & HARITONOV, 2007; BOUDOT *et al.*, 2021).

2. *Lestes dryas* Kirby, 1890

LOCALITIES: 3, 6, 17, 19, 23, 26, 26a, 48, 54, 60.

LITERATURE: BELYSHEV (1961), KOSTERIN & BORISOV (2010).

A temperate species, with boreo-montane distribution in Central Asia. In southeast Kazakhstan, local on the plains. Further south, restricted to the mountains (BORISOV & HARITONOV, 2007; SCHRÖTER, 2010), presumably as far as Afghanistan (BOUDOT *et al.*, 2021).

3. *Lestes macrostigma* (Eversmann, 1836)

LOCALITIES: 2, 3, 14, 17a, 19, 20, 52, 54, 54a, 55, 60, 60a, 61, 63a.

LITERATURE: BELYSHEV (1961), REINHARDT (1995), REINHARDT & SEIDENBUSCH (1999), CHAPLINA *et al.* (2007).

A brackish-water species widespread on the plains. In Central Asia, local and known from single finds (BORISOV & HARITONOV, 2007; SCHRÖTER, 2010; BOUDOT *et al.*, 2021).

4. *Lestes sponsa* (Hansemann, 1823)

LOCALITIES: 2, 33.

Known only from two sites, the plain off the north coast of Lake Balkhash (loc. 2) and in the south, the mountains (loc. 33). The nearest northern localities are in north-east Kazakhstan, in Temirtau on the Nura River (50°05'40'' N, 73°12'19'' E, 496 m) (BORISOV & KOSTERIN, 2014) and on the Ashysu River (60 km north of Ayaguz, 48°13'37'' N, 80°27'03'' E, 720 m).

In Central Asia, *L. sponsa* has a boreo-montane distribution. To the south, at approximately 44° N, only in the mountains. In Turkey, the South Caucasus and northwestern Iran, only at high altitudes (BOUDOT *et al.*, 2021). In Tajikistan, recorded at heights from 720 to 2800 m (BORISOV & HARITONOV, 2007). In north Kyrgyzstan, recorded in two places, but it was not stated whether they were on the plain or in the mountains (SCHRÖTER, 2010). In Afghanistan, a single find is Ishkashim, at an altitude of 2500 m (SCHMIDT, 1961).

5. *Lestes virens vestalis* Rambur, 1842

The taxonomic status of eastern *Lestes virens* is discussed by SCHRÖTER *et al.* (2015).

LOCALITIES: 19, 20, 26, 26d, 52, 55, 56, 57, 58, 62, 63.

LITERATURE: BELYSHEV (1961).

In Central Asia this species has a pronounced boreo-montane distribution. In southeast Kazakhstan, it is widespread on the plains, in high numbers in places like loc. 19, 20. In Tajikistan, widespread only in the mountains, at 1100–2100 m (BORISOV & HARITONOV, 2007). Two findings in Afghanistan, on the northern slope of the Hindu Kush, lie at an altitude of 2000 m (SCHMIDT, 1961).

6. *Sympecma fusca* (Vander Linden, 1820)

LOCALITIES: 16, 19, 22, 23, 25, 26, 26e, 27, 34, 41, 42, 42a, 43, 44, 45, 48.

LITERATURE: SHORYGIN (1926), BARTENEV (1929), VALLE (1942), BELYSHEV (1961), BORISOV (2005a), KOSTERIN & BORISOV (2010).

The West Palaearctic *S. fusca* is widespread in Central Asia and in southeast Kazakhstan. In Central Asia it has a peculiar annual cycle, similar to the two other *Sympecma* species. After emergence they have a short pre-imaginal development and a long (3–4 months) pre-reproductive period. In hot summers, individuals from the lowland populations fly to the mountains after emergence to estivate. They return to the foothill plains in autumn to overwinter as adults and breed the next spring (BORISOV, 2006b; BORISOV & HARITONOV, 2007; BOUDOT *et al.*, 2021).

Larval development has been reported only from the foothill plains (BORISOV, 2005a). In Kyrgyzstan, development was also noted in the mountains – up to 1800 m asl (SCHRÖTER, 2010). During estivation, imagoes ascend into the mountains. Common at the end of June in the vicinity of Lake Almaty at up to 2820 m (loc. 25) (BORISOV & HARITONOV, 2007).

7. *Sympecma gobica* Förster, 1900

LOCALITIES: 11, 12, 19, 20, 22, 26d, 26e, 26g, 36, 41, 42, 42a, 43, 48.

LITERATURE: SHORYGIN (1926), BARTENEV (1929), BELYSHEV (1961), BORISOV (2005a), KOSTERIN & BORISOV (2010).

Range: a rather narrow strip from the North Caucasus in the west to the Gobi Desert in the east and to northern Iran and Afghanistan in the south. This species develops mainly in arid and semi-arid regions, but during summer, it flies up the mountains to estivate (BORISOV & HARITONOV, 2007; BOUDOT *et al.* 2021).

In southeast Kazakhstan, *S. gobica* is near the northern limit of its range, but it is common and abundant here. Larval development was demonstrated on the foothill plains (BORISOV, 2005a). In the Dzungarskiy Alatau, dragonflies were recorded up to 1900 m asl during estivation (KOSTERIN & BORISOV, 2010); in Kyrgyzstan, huge estivating flocks gather at 1500–2000 m (SCHRÖTER, 2010). The maximum altitude at which these dragonflies have been recorded in the Tien Shan is 2500 m asl (BORISOV & HARITONOV, 2007).

8. *Sympecma paedisca* (Brauer, 1877)

LOCALITIES: 1, 15, 16, 17, 19, 22, 25, 26e, 37, 40b, 41, 42, 43, 48, 50, 51, 54, 55, 57, 59d.

LITERATURE: SHORYGIN (1926), BARTENEV (1929), BELYSHEV (1961), REINHARDT (1995), REINHARDT & SEIDENBUSCH (1999), BORISOV (2005a), KOSTERIN & BORISOV (2010).

A Eurasian temperate species, common in southeast Kazakhstan. The larvae develop on the foothill plains and in the mountains. Mass oviposition was observed at an altitude of 1059 m in the Dzungarsky Alatau (KOSTERIN & BORISOV (2010)). To the south, in Kyrgyzstan (floodplain of the Keke-Meren River), we observed emergence at an altitude of 1550 m (BORISOV & HARITONOV 2007). These dragonflies ascend to the mountains – up to 2800 m asl (loc. 25). BELYSHEV (1961) noted *S. paedisca* in July in the Zailiyskiy Alatau at an altitude of 2500 m.

Calopterygidae Sélys, 1850

9. *Calopteryx splendens* (Harris, 1782) s.l.

For taxonomic features of the group ‘*splendens*’ see DUMONT *et al.* (in press).

LOCALITIES: 5, 6 (two forms), 8 (two forms), 10 (larvae), 12, 15, 20, 21, 23, 26, 26a, 26d (two forms), 30, 34, 35, 36, 37, 41a (larvae), 51, 52 (two forms), 56, 59b, 62, 63.

LITERATURE: BELYSHEV (1961), REINHARDT & SEIDENBUSCH (1999).

Common and abundant on the lower zone of rivers, as well as on canals. At least two forms occur, one with the blue metallic male coloration and dark wing spot not reaching the top of the wings. This morph is traditionally identified as *C. splendens*. The female wing is spotless. The second form has androchromic (= wing spot resembling that of the male) females. Here, males wing spots are larger and reach the top of the wing or nearly so. Such dragonflies used to be identified as subspecies *Calopteryx s. intermedia* Sélys, 1887 (BORISOV & HARITONOV, 2007) but *C. s. ancilla* Sélys & Hagen has priority. Both forms may live together, and the size of the wing spot may vary, as well as the relative frequency of androchrome females. For example, dragonflies of both forms were abundant at the same time in the lower reaches of the Ili (loc. 8) and Aksu Rivers (loc. 52). However, recent data that include the study of molecular markers, suggest that there are indeed two species, *Calopteryx splendens* and *Calopteryx samarcandica*, that are closely related, without any structural differences, but can be defined in non-morphological ways. Their taxonomy is furthermore marred by the frequent occurrence of hybrids that may take any form, from typical *intermedia* (or *C. splendens ancilla*) to males lacking a wing spot altogether. The taxonomy and distribution of the *C. splendens* group is even more complex but cannot be explained here. For a treatment in detail, see DUMONT *et al.*, in press).

Coenagrionidae Kirby, 1890

10. *Coenagrion armatum* (Charpentier, 1840)

LOCALITY: 63a.

To date, no exact data on this species in southeast Kazakhstan exist. CHAPLINA *et al.* (2007) state that *C. armatum* is present only in northern regions. POPOVA (1951), using data from an unpublished manuscript by A.N. Bartenev, cites this species for ‘South Kazakhstan’. KRYLOVA (1969) cited *C. armatum* in her dissertation “Dragonflies of Kyrgyzstan” but again without locations. *C. armatum* was included in the list of dragonflies of Central Asia by BORISOV & HARITONOV (2007) but information on *C. armatum* in Kyrgyzstan was not provided until SCHRÖTER (2010).

We caught one male on the shore of Lake Alakol at an altitude of 349 m (Loc. 63a). The closest northern locations are in Northeast Kazakhstan, at a distance of more than 600 km: Temirtau Town, the Nura River (50°05’40’’ N, 73°12’19’’ E, 496 m) and Borly Lake (51°49’27’’ N, 77°56’46’’ E, 124 m) (BORISOV & KOSTERIN, 2014).

C. armatum is a temperate-boreal species distributed from northwestern Europe to Kamchatka Peninsula (BOUDOT & SAHLÉN, 2015). Locally (and only at altitudes), it is known from the Armenian Highlands, South Caucasus (ANANIAN & TAILLY, 2013; SCHRÖTER *et al.*, 2015; BOUDOT *et al.*, 2021) and from the Suusamyр valley in Kyrgyzstan (SCHRÖTER, 2010), a boreo-montane disjunction. It is interesting that the population in the Alakol depression is not mountainous.

11. *Coenagrion hastulatum* (Charpentier, 1825)

LOCALITY: 50.

LITERATURE: KOSTERIN & BORISOV (2010).

In southeast Kazakhstan, recorded only at one site in the Dzungarsky Alatau at an altitude of 1059 m asl. The nearest 'non-mountainous' localities are approximately 700 km to the north - in Pavlodar (52°56'38" N, 76°24'05" E, 97 m) and in Bayanaul Natural Park (50°44'47" N, 75°37'09" E, 558 m) (BORISOV & KOSTERIN, 2014). The range of *C. hastulatum* covers the temperate and boreal zones of Eurasia (BOUDOT *et al.*, 2015b). The Dzungarsky Alatau populations are probably isolated from the main range.

12. *Coenagrion lunulatum* (Charpentier, 1840)

LOCALITIES: 48, 50.

LITERATURE: KOSTERIN & BORISOV (2010).

Like the previous, *C. lunulatum*, was found only in the mountains of the Dzungarsky Alatau. The nearest sites are located 350–400 km to the north on the Ashysu River (48°13'37" N, 80°27'03" E, 720 m) (BORISOV & HARITONOV, 2007) and in the vicinity of Voznesenka (modern Birlik, 48°34' N, 83°47' E, 422 m) (CHAPLINA *et al.*, 2007).

This palaeartic temperate species (BOUDOT & NELSON, 2015b) has isolated colonies in the mountains of eastern Turkey, northwestern Iran, Armenia, Georgia, and Azerbaijan (BOUDOT *et al.*, 2021).

13. *Coenagrion puella* (Linnaeus, 1758)

For taxonomic notes see SCHRÖTER (2010).

LOCALITIES: 26, 27, 34, 36, 48, 50, 59, 59b.

LITERATURE: BELYSHEV (1961), KOSTERIN & BORISOV (2010).

Widespread in southeast Kazakhstan. Also recorded from Western Tien Shan in the area of the Chokpak pass at altitudes of 1090–1125 m asl. Confined to the foothills and low-mountainous strip along the northern slope of the Tien Shan and recorded here at a heights from 380 to 1825 m. Larval development in stagnant water. In the foothills, the species lives mainly in small rivers.

In Kyrgyzstan, *C. puella* was found only in two places in the north (SCHRÖTER, 2010), that is, in the northern foothills of the Tien Shan. In Central Asia, not recorded in the south (BOUDOT *et al.*, 2021).

14. *Coenagrion pulchellum* (Vander Linden, 1825)

For the subspecific status of melanic forms of *C. pulchellum* in the eastern part of the range, see BORISOV & HARITONOV (2007), SCHRÖTER (2010), BOUDOT & NELSON (2015a) and MALIKOVA & KOSTERIN (2019).

LOCALITIES: 3, 6, 18, 20, 54a, 57, 59, 59b, 63, 63a.

A temperate species, rare and local in south-east Kazakhstan, mainly around large lakes in the Balkhash-Alakol depression. In Central Asia, South Kazakhstan, *C. pulchellum* lives only in the mountains (BORISOV & HARITONOV, 2007).

15. *Coenagrion scitulum* (Rambur, 1842)

LOCALITY: 18.

LITERATURE: BORISOV & HARITONOV (2007), SCHRÖTER & BORISOV (2012).

Male and female were collected on a small lake near the dam of the Kapchagai reservoir (city of Kapchagai) on May 25, 2006. In 2008, at the same place and time of year (May 26), no specimens were found.

In Central Asia, distributed in the mountains of Tajikistan and Kyrgyzstan from 1100 to 2300 m (SCHRÖTER & BORISOV, 2012). The location in south-east Kazakhstan lies at an altitude of 485 m. This is the easternmost point of its range. Central Asian populations are isolated from the main range in Europe and Southwest Asia (BOUDOT *et al.*, 2021). The distance between the localities in northeastern Iran (SCHNEIDER & IKEMEYER, 2016) and Tajikistan (SCHRÖTER & BORISOV, 2012) is approximately 1000 km.

16. *Enallagma cyathigerum risi* Schmidt, 1961

For the subspecific status of *E. c. risi* see KOSTERIN (2004), KOSTERIN & ZAIKA (2010) and KALKMAN & KITANOVA (2015). SCHRÖTER (2010) and BOUDOT *et al.* (2021) claim it is a good species.

LOCALITIES: 1, 2, 3, 5, 6, 7, 8, 9, 15, 17, 18, 18a, 19, 20, 23, 27, 35, 38, 48, 50, 52, 54, 54a, 57, 58, 60, 60a, 61, 63a.

LITERATURE: BELYSHEV (1961), REINHARDT (1995), REINHARDT & SEIDENBUSCH (1999), KOSTERIN & BORISOV (2010).

One of the most abundant and widespread damselflies of southeast Kazakhstan. In the mountains it lives on stagnant waters, on the foothills it also inhabits small rivers and irrigation canals and aryk (an aryk is a rather narrow irrigation ditch, usually with aquatic vegetation and surrounding an irrigated piece of land. It probably is the most common habitat for dragonflies in modern Central Asia).

In Central Asia, *E. cyathigerum* shows a boreo-montane distribution. To the south, approximately 41° N, it lives exclusively in the mountains (BORISOV & HARITONOV, 2007).

17. *Erythromma najas najas* (Hansemann, 1823)

LOCALITIES: 6, 8, 20, 21, 26d, 50, 61, 62.

LITERATURE: REINHARDT (1995), REINHARDT & SEIDENBUSCH (1999), KOSTERIN & BORISOV (2010).

The range of this species covers temperate Europe and Asia. In the south-east of Kazakhstan it is distributed locally. The southern border of the range is here. The southernmost point of the range is the city of Almaty (loc. 26d). Here, it was collected by Shnitnikov (ZIN collection, St. Petersburg), in 1928.

18. *Erythromma viridulum* (Charpentier, 1840)

At present, the species is considered to be monotypic (KALKMAN & BOGDANOVIC, 2015).

LOCALITIES: 6, 9, 20, 35, 60, 60a.

LITERATURE: CHAPLINA *et al.* (2007).

In Central Asia, *E. viridulum* is represented by local populations, isolated from the main western part of the range (KALKMAN & BOGDANOVIC, 2015; BOUDOT *et al.*, 2021). In the south-east of Kazakhstan lies the eastern border of its range. It is quite rare and local.

19. *Ischnura aralensis* Haritonov, 1979

LOCALITIES: 54, 54a, 60a, 61, 63, 63a.

LITERATURE: REINHARDT (1995), REINHARDT & SEIDENBUSCH (1999).

REINHARDT (1995) cites *I. aralensis* from the western end of Lake Balkhash, REINHARDT & SEIDENBUSCH (1999) for the middle reaches of the Ili River (below the Kapchagai reservoir), and CHAPLINA (2004b) for the Alakol Nature Reserve. *I. aralensis* was known from three sites in southeast Kazakhstan (specifics not given). The present paper adds 6 more localities, mostly lakes like Balkhash, Kashkarkol and Alakol. Larvae live along the coastline.

The full range is peculiar and covers different climatic zones that include temperate latitudes, from the Southern Urals to northern Kazakhstan. It reappears in the arid region around Lake Aral, where the type locality is situated. It likely went extinct there by the recent salinization of the lower Amur and Syr Darja rivers. Further east, we document it from the Balkhash-Alakol depression. We expect it in flat, arid Western China close to the Dzungarskiy Alatau. It may well have crossed the Dzungarian gates.

20. *Ischnura elegans* (Vander Linden, 1820)

The current consensus is an absence of clear subspecies in *I. elegans* (SCHRÖTER *et al.*, 2015; SCHNEIDER *et al.*, 2018; KOSTERIN & AHMADI, 2018; MALIKOVA & KOSTERIN, 2019).

LOCALITIES: 1, 2, 3, 5, 6, 7, 8, 14, 15, 16, 17a, 18, 18a, 19, 20, 23, 26, 26a, 26d, 32, 34, 35, 39, 40, 40a, 40b, 41, 48, 51, 52, 54, 54a, 56, 57, 58, 59, 60, 60a, 61, 63.

LITERATURE: BELYSHEV (1961), REINHARDT (1995), REINHARDT & SEIDENBUSCH (1999), BORISOV (2009a), KOSTERIN & BORISOV (2010).

Ischnura elegans is one of the most abundant dragonflies of southeast Kazakhstan and of Central Asia (BOUDOT *et al.*, 2021). The larvae develop in stagnant water, canals and aryk. In Central Asia, artificial reservoirs of the irrigation system contribute to its dispersal and abundance (BORISOV & HARITONOV, 2007). Larvae have been found in reservoirs fed by thermal springs (loc. 35, 40, 40a).

21. *Ischnura fontaineae* Morton, 1905

LOCALITIES: 2, 3, 6, 7, 8, 17a, 19, 54a, 62.

LITERATURE: BELYSHEV (1961), REINHARDT & SEIDENBUSCH (1999).

In southeast Kazakhstan, *I. fontaineae* is at the northern and eastern limits of its range, and is not numerous. All localities lie in the Balkhash-Alakol depression, mainly around Lake Balkhash (BOUDOT *et al.*, 2021).

22. *Ischnura pumilio* (Charpentier, 1825)

LOCALITIES: 3, 7, 17a, 18, 18a, 19, 20, 23, 26d, 32, 34, 35, 37, 39, 40, 40a, 41, 50, 54, 58, 59, 60a, 61.

LITERATURE: BELYSHEV (1961), REINHARDT & SEIDENBUSCH (1999), BORISOV (2009a), KOSTERIN & BORISOV (2010).

Widespread in south-east Kazakhstan, as well as in other regions of Central Asia (BORISOV & HARITONOV, 2007; SCHRÖTER, 2010; BOUDOT *et al.*, 2021). Larvae have been found in reservoirs fed by thermal springs (loc. 35, 40, 40a).

Platycnemididae Jacobson & Bianchi, 1905

23. *Platycnemis pennipes* (Pallas, 1771)

LOCALITIES: 20, 21, 26, 26a, 26d, 56.

A local species, living along small rivers, irrigation canals and ponds fed by springs. We also noted it in the Western Tien Shan, practically along the full Karatau ridge. Thus, the South Kazakhstan part of the range extends to the foothills along the northern slope of the Tien Shan for more than 1000 km, isolated from the main range (BOUDOT *et al.*, 2015a). In north Kazakhstan, *P. pennipes* was not recorded south of 49° N (BORISOV & KOSTERIN, 2014), in the northeast it occurs not south of 48° N (CHAPLINA *et al.*, 2007). At the same time, it was abundant on the lower Ayaguz River (loc. 56), which flows in east Kazakhstan, in latitudinal direction. This river may connect the northern and southern populations of *P. pennipes* in Kazakhstan.

Aeshnidae Rambur, 1842

24. *Aeshna affinis* Vander Linden, 1820

LOCALITIES: 19, 20, 21, 26, 28, 35, 37, 51, 54, 55, 56, 63.

LITERATURE: VALLE (1942), BELYSHEV (1961).

This west Palaearctic species is quite common in southeast Kazakhstan. Further south, in Kyrgyzstan, mass appearance and migrations have been seen (SCHRÖTER, 2011). In the southern part of Central Asia, it is rare and local BORISOV & HARITONOV, 2008; BOUDOT *et al.*, 2021).

25. *Aeshna grandis* (Linnaeus, 1758)

LOCALITIES: 23, 26.

A north Euro-Siberian species cited for 'South Kazakhstan' by POPOVA (1951) after an unpublished manuscript of A.N. Bartenev. In June 2005, we found it on a pond 30 km west of Almaty (loc. 23; 770 m asl) and on a lake located inside the city (loc. 26; 667 m asl). The nearest northern locations are in North and East Kazakhstan: Bayanaul National Park, 50°48'32" N, 75°46'32" E, 440 m (BORISOV & KOSTERIN, 2014); Zyryanovsk, 49°43' N, 84°16' E (BELYSHEV, 1961); Kuludzhun River, 48°20' N, 83°26' E, 432 m (CHAPLINA *et al.*, 2007).

26. *Aeshna isoceles* (Müller, 1767)

Currently considered monotypic (KALKMAN *et al.*, 2015a).

LOCALITIES: 23, 26, 59.

LITERATURE: BELYSHEV (1961), REINHARDT & SEIDENBUSCH (1999), CHAPLINA *et al.* (2007).

In southeast Kazakhstan, located at the eastern border of the range. The most northeastern point of the range lies in east Kazakhstan, in the vicinity of Ust-Kamenogorsk (BORISOV & HARITONOV, 2008). In Central Asia, *Ae. isoceles* is rare and local (BOUDOT *et al.*, 2021). It is interesting that in May 2007 large numbers were seen in the vicinity of Ucharal, Alakol depression (loc. 59) (BORISOV & HARITONOV, 2008).

27. *Aeshna juncea* (Linnaeus, 1758)

BELEVICH (2005) synonymised all subspecies of *A. juncea* with the nominotypical ssp.

LOCALITIES: 27, 44a.

LITERATURE: KOSTERIN & BORISOV (2010).

This northern species has been recorded from the mountains only. Emergence occurred on 21 June on a small lake near Medeo at an altitude of 1825 m (loc. 27). Copulating pairs were observed on 11 August on a small lake in the Dzungarsky Alatau at an altitude of 1596 m (loc. 44a) (KOSTERIN & BORISOV, 2010). The nearest finding is in East Kazakhstan, on the Urukhayka River (48°46' N, 86°01' E), at an altitude of 1446 m (CHAPLINA *et al.*, 2007).

In Eurasia, *A. juncea* has a boreo-montane distribution with isolated foci in the southern mountains (BORISOV & HARITONOV, 2008; KALKMAN *et al.*, 2015b). Central Asia holds the maximum height at which larvae can develop in non-thermal water: Lake Song-Köl (3016 m) in Kyrgyzstan and Lake Kharikul (3120 m) in Tajikistan (BORISOV & HARITONOV, 2008; SCHRÖTER, 2012).

28. *Aeshna mixta* Latreille, 1805

LOCALITIES: 42, 43, 44, 44a, 45.

LITERATURE: BELYSHEV (1961), KOSTERIN & BORISOV (2010).

In south-east Kazakhstan, as well as in Central Asia as a whole, this species is not numerous yet widespread in the mountains and adjacent foothill plains. *Ae. mixta* in Central Asia has a pre-reproductive diapause and shows seasonal high-altitude migrations. Individuals from lowland populations fly to the mountains for 3–4 months and return to the plains in autumn for reproduction (BORISOV, 2006b; BORISOV & HARITONOV, 2008; SCHRÖTER, 2010; BOUDOT *et al.*, 2021). In south-east Kazakhstan, dragonflies were recorded in the Dzhungarskiy Alatau at altitudes of 1200–2100 m for estivation (KOSTERIN & BORISOV, 2010).

29. *Aeshna serrata* (Hagen, 1854)

LOCALITY: 63a.

LITERATURE: BORISOV & HARITONOV (2008).

There are only two records for this aeschnid. A female was in the collection of E.D. Gavrilova on Lake Alakol, southeast Kazakhstan (loc.63d; approximately 350–500 m asl). In north Kyrgyzstan, one male in the Alamedin canyon (at an altitude of c. 1500 m asl) (SCHRÖTER, 2010). At the same time, the nearest northern location is in Bayanaul in north-east Kazakhstan (50°48'32'' N, 75°46'32'' E, 440 m), at a distance of approximately 700 km (BORISOV & KOSTERIN, 2014).

30. *Anax ephippiger* (Burmeister, 1839)

LOCALITY: 20a.

A. ephippiger is a more or less obligatory migrant (DUMONT & DESMET, 1990; DUMONT, 2014; BORISOV, 2015), common in the southern regions of Central Asia (Tajikistan, Uzbekistan), but becoming rare in Kazakhstan. A single find is known from the southeast of the country. The northernmost locality, both in Kazakhstan and in the Asian part of the range, is Ust-Kamenogorsk (49°57' N, 82°43' E, 285 m asl) (CHAPLINA *et al.*, 2007; BORISOV, 2011b).

31. *Anax imperator* Leach, 1915

LOCALITIES: 23, 35, 39, 50.

LITERATURE: BELYSHEV (1961), CHAPLINA *et al.* (2007), KOSTERIN & BORISOV (2010).

Located at the eastern border of the range and local here. At all 4 locations, only one individual was recorded. In Central Asia, distributed locally and in small numbers only (BORISOV & HARITONOV, 2008).

32. *Anax parthenope* (Sélys, 1839)

At present, considered monotypic. The closely related *A. julius* Brauer, 1865 replaces it in the Eastern Palaearctic (KALKMAN & PROESS, 2015).

LOCALITIES: 1, 2, 3, 5, 6, 7, 8, 16, 18, 18a, 19, 20, 23, 28, 35, 38, 40a, 40b, 62, 63, 63a.

LITERATURE: BELYSHEV (1961), REINHARDT (1995), REINHARDT & SEIDENBUSCH (1999), BORISOV (2012b).

One of the most abundant species of south-east Kazakhstan and Central Asia (REINHARDT & SEIDENBUSCH, 1999; BORISOV & HARITONOV, 2008; BOUDOT *et al.*, 2021). Regular migrations and, at the same time, hibernation of larvae throughout the range suggest the existence within populations of two separate cohorts – ‘migratory’ and ‘stationary’ (BORISOV, 2012b, 2015). The same strategy is seen in south-east Kazakhstan as seen by the regular southward autumnal migrations at the Chokpak Pass in the Western Tien Shan (BORISOV, 2015).

Gomphidae Rambur, 1842**33. *Lindenia tetraphylla* (Vander Linden, 1825)**

LOCALITIES: 2, 5, 8, 54a.

LITERATURE: BORISOV (2006a).

Southeast Kazakhstan, holds the northern and eastern range boundaries of *L. tetraphylla*. It is rare and confined to Lake Balkhash (BOUDOT *et al.*, 2021).

34. *Onychogomphus flexuosus* (Schneider, 1845)

LOCALITIES: 11, 18b, 59b, 63c.

LITERATURE: BELYSHEV (1961), CHAPLINA *et al.* (2007).

Rare in south-east Kazakhstan where its northern and eastern boundaries are located (BOUDOT *et al.*, 2021).

35. *Ophiogomphus reductus* Calvert, 1898

LOCALITIES: 10, 16, 17, 23, 26, 26b, 26h, 28, 34, 35, 36, 37, 37a, 47, 56, 59a.

LITERATURE: BELYSHEV (1961), BORISOV (2005b), CHAPLINA *et al.* (2007), KOSTERIN & BORISOV (2010).

One of the most common rheophylic dragonflies of south-east Kazakhstan and even Central Asia (BOUDOT *et al.*, 2021). In the mountains, larvae are found in permanent small rivers, predominantly snowmelt or groundwater-fed. Numerous on rivers, canals, and aryk [small irrigation canals with near-standing water and often with abundant macrophytes]. Larval development in the Charyn River lasts 4 years (BORISOV, 2005b).

36. *Stylurus ubadschii* Schmidt, 1953

LOCALITIES: 10, 12, 16, 35, 41a, 52, 59d.

LITERATURE: BELYSHEV (1961), REINHARDT & SEIDENBUSCH (1999).

According to BOUDOT *et al.* (2021) *S. ubadschii* is known from 13 localities in south-east Kazakhstan. This rheophilic species is thus relatively rare in south-east Kazakhstan and lives here only on the plains. It has been noted on rivers and on canals and irrigation ditches. Unknown to the north of the Balkhash Basin.

Cordulegastridae Calvert, 1893

37. *Cordulegaster coronata* Morton, 1916

Formerly classified as a member of the *insignis* group, this Central Asian endemic is now regarded as a distinct species (SCHRÖTER, 2013). It is quite different from all congeneric species, and deserves to be restudied and perhaps re-assigned to a different genus.

LOCALITIES: 13, 24, 31.

This mountainous Central Asian species is rare in south-east Kazakhstan, where it reaches its northern and eastern range boundaries (BOUDOT *et al.*, 2021). We know *C. coronata* from this region only from photos provided by V.L. Kazenas (loc. 13, 24), and collection material (loc. 31).

Libellulidae Rambur, 1842

38. *Crocothemis erythraea chaldaeorum* Morton, 1920

For the subspecific status of *C. e. chaldaeorum* see BORISOV & HARITONOV (2008), KOSTERIN & AHMADI (2018).

LOCALITIES: 3, 6, 9, 18, 35, 54a.

LITERATURE: REINHARDT & SEIDENBUSCH (1999).

Rare, and found only on the plains. Lake Balkhash is the northern limit of the range of this dragonfly (BORISOV & HARITONOV, 2008; BOUDOT *et al.*, 2021).

39. *Crocothemis servilia* (Drury, 1770)

LOCALITIES: 23, 58a.

This South Asian species is widespread in Central Asia, yet in south-east Kazakhstan it is already rare. Adapted from BOUDOT *et al.* (2021), 4 locations are known. The find between lakes Sasykkol and Alakol (loc. 58a) is the northernmost point of the range of *C. servilia*.

40. *Leucorrhinia dubia* (Vander Linden, 1825)

For the taxonomic status of *L. dubia*, see MALIKOVA & KOSTERIN (2019).

LOCALITIES: 59, 62.

LITERATURE: KUKASHEV (1989), CHAPLINA *et al.* (2007).

So far only in the Alakol depression. This southern locality is isolated and located at considerable distance from the main range. Its nearest finding in northern Kazakhstan is at a distance of more than a thousand kilometers (Lake Aksuat, 53°39' N, 66°26' E) (CHAPLINA *et al.*, 2007). It is assumed that in Western Siberia the southern border of *L. dubia* is also located at about 50° N (BELYSHEV, 1973).

41. *Leucorrhinia pectoralis* (Charpentier, 1825)

LOCALITIES: 50, 58a, 59, 59c, 62.

LITERATURE: CHAPLINA *et al.* (2007), KOSTERIN & BORISOV (2010).

Recorded in the Alakol depression and in the Dzungarsky Alatau. As in the case of *L. dubia*, this location is isolated from the main range. The nearest northern finds lie in the north-east and east of Kazakhstan at a distance of 500–600 km: Sibinskie Lakes, 49°50' N, 82°00' E, 800 m (CHAPLINA *et al.*, 2007) and Bayanaul Natural Park, Lake Shelandykol, 50°44'47" N, 75°37'09" E, 558 m (BORISOV & KOSTERIN, 2014).

42. *Libellula depressa* Linnaeus, 1758

LOCALITIES: 24a, 26f, 27, 44a, 49, 50, 59.

LITERATURE: BARTENEV (1929), KOSTERIN & BORISOV (2010).

In Central Asia, *L. depressa* is local (BORISOV & HARITONOV, 2008; BOUDOT *et al.*, 2021). It is most common in the northern foothills and mountains of the Tien Shan at altitudes of 375–2000 m asl.

43. *Libellula quadrimaculata* Linnaeus, 1758

LOCALITIES: 1, 15, 26, 50, 55, 58, 59, 59b, 61, 63, 63a.

LITERATURE: GRIGORIEV (1905), BARTENEV (1929), BELYSHEV (1961), REINHARDT (1995), REINHARDT & SEIDENBUSCH (1999), KOSTERIN & BORISOV (2010).

A common species in Central Asia, including south-east Kazakhstan (BORISOV & HARITONOV, 2008; BOUDOT *et al.*, 2021).

44. *Orthetrum albistylum* (Sélys, 1848)

The eastern subspecies *O. a. speciosum* (Uhler, 1858) has no reliable diagnostic characters (SEEHAUSEN & FIEBIG, 2016; MALIKOVA & KOSTERIN, 2019). See also BORISOV (2016), BORISOV & BORISOV (2017).

LOCALITIES: 3, 6, 7, 8, 15, 16, 17, 18, 18a, 20, 21, 23, 26, 35, 52, 62, 63.

LITERATURE: GRIGORIEV (1905), BARTENEV (1929), BELYSHEV (1961), REINHARDT (1995), REINHARDT & SEIDENBUSCH (1999).

O. albistylum is common in Central Asia (BORISOV & HARITONOV, 2008; BOUDOT *et al.*, 2021). In south-east Kazakhstan, also widespread in the plains.

45. *Orthetrum coerulescens anceps* (Schneider, 1845)

For the subspecific status of *O. c. anceps* see KALKMAN & AMBRUS (2015).

LOCALITIES: 9, 15, 17, 26, 28, 29, 30, 40, 40a, 56.

LITERATURE: BELYSHEV (1961), BORISOV (2009a), CHAPLINA *et al.* (2007).

Widespread in Central Asia and common in south-east Kazakhstan.

46. *Orthetrum brunneum* (Fonscolombe, 1837)

LOCALITIES: 6, 12, 15, 16, 17, 17a, 20, 21, 23, 24b, 26, 27, 28, 30, 35, 36, 37, 39, 40, 40a, 56, 58, 59, 60, 62.

LITERATURE: BELYSHEV (1961), REINHARDT (1995), REINHARDT & SEIDENBUSCH (1999), BORISOV (2009a).

One of the most widespread and abundant species of Central Asia (BORISOV & HARITONOV, 2008; BOUDOT *et al.*, 2021). The larvae develop in stagnant and flowing water, canals and aryk [see the explanation above]. Also in thermal springs (loc. 35, 40, 40a).

47. *Orthetrum cancellatum* (Linnaeus, 1758)

LOCALITIES: 2, 3, 5, 6, 7, 9, 12, 17, 19, 20, 26, 54a, 55, 58, 61, 62, 63, 63a.

LITERATURE: GRIGORIEV (1905), REINHARDT & SEIDENBUSCH (1999), VERSPUI & WASSCHER (2020).

Orthetrum cancellatum is widespread in south-east Kazakhstan. Rare and local in the rest of Central Asia (BOUDOT *et al.*, 2021).

48. *Pantala flavescens* (Fabricius, 1798)

LOCALITIES: 15, 26e, 36.

LITERATURE: BORISOV (2012a).

A well-known migrant. Reaches its northern limit of distribution in South Kazakhstan (BORISOV, 2012a, 2015). A study of its migrations using stable isotope analysis (SIA) (HOBSON, 2019) revealed that these dragonflies migrate in spring from East Africa and/or the Arabian Peninsula to Middle Asia (including southeast Kazakhstan) for breeding. Their descendants, developed during summer, migrate back to the south. Also, it is supposed that some individuals migrate to Africa in a large circle through the southern part of Hindustan, crossing the Indian Ocean. The total length of the migration may exceed 14,000 km (BORISOV *et al.*, 2020a).

49. *Selysiothemis nigra* (Vander Linden, 1825)

LOCALITIES: 38, 38a.

LITERATURE: REINHARDT & SEIDENBUSCH (1999).

In southeast Kazakhstan, found only in two places: the Altyn-Emel Natural Park on the banks of the Kapchagai reservoir (loc. 38, 38a) and the Ili River (not far from the reservoir) (REINHARDT & SEIDENBUSCH, 1999). These are the most northern and eastern locations of this species in the Asian part of the range.

50. *Sympetrum arenicolor* Jödicke, 1994

LOCALITIES: 18c, 26c, 54a, 59b, 63d.

LITERATURE: BELYSHEV (1961).

According to BOUDOT *et al.* (2021), *S. arenicolor* has been recorded from 10 localities in south-east Kazakhstan. Common in most of Central Asia (BORISOV & HARITONOV, 2008; BOUDOT *et al.*, 2021). In south-east Kazakhstan, it is located at the northern and eastern borders of its range and is not numerous. It is characterized by delayed maturation and seasonal high-altitude migrations (BORISOV, 2006b, 2006c). Apparently, at the northern border of its range, *S. arenicolor* is characterized by the same strategy. This is evidenced by high-mountain records in the Zailiyskiy Alatau (1400–3000 m asl) (BELYSHEV, 1961), where animals fly during the period of estivation. In neighboring Kyrgyzstan, *S. arenicolor* was found up to an altitude of 2500 m asl and directional flights from plains to mountains were noted (SCHRÖTER, 2010). We also noted altitudinal migrations at the Chokpak Pass in the Western Tien Shan.

51. *Sympetrum danae* (Sulzer, 1776)

LOCALITIES: 44a, 48.

LITERATURE: KOSTERIN & BORISOV (2010).

A holarctic boreo-montane species, isolated in the southern mountains (KALKMAN *et al.*, 2015d, BOUDOT *et al.*, 2021). In Central Asia, disjunctions are pronounced. Currently, there are three known locations in the Tien Shan. Two of them are in south-east Kazakhstan, Dzungarsky Alatau (loc. 44a, 48), and one is in Kyrgyzstan, on the southern slopes of the Talasskii Alatau (Chyckan River, 2130 m asl) (BORISOV & HARITONOV, 2008). It is suggested that *S. danae* is “comparatively common in most of Kazakhstan, except in the south”, but specific locations are not given (CHAPLINA *et al.*, 2007). BELYSHEV (1973) says that the southern border of distribution of *S. danae* in Kazakhstan is at approximately 50° N. It is assumed that the gap in its range is not less than 500 km.

52. *Sympetrum depressiusculum* (Sélys, 1841)

LOCALITIES: 29, 41, 43, 59d.

LITERATURE: BARTENEV (1915), BELYSHEV (1961), KOSTERIN & BORISOV (2010).

In the region under study, local, and known only from single specimens.

In the eastern mountainous part of Central Asia, confined to a strip of foothills bordering the Tien Shan and Pamir-Alai. Occasionally, the species can become very numerous. It is abundant in rice paddies in the Gissar Valley and in the floodplain of the Zeravshan River in Tajikistan, as well as in the throat of the Fergana Valley in Uzbekistan (BORISOV & HARITONOV, 2008) and in the floodplain of the Chu River in north Kyrgyzstan (SCHRÖTER, 2010). The latter location is in close proximity to southeastern Kazakhstan.

The Central Asian part of the range is considered to be isolated from the European and Western Asian parts (KALKMAN & CONZE, 2015; BOUDOT *et al.*, 2021). Only a single find in the lower reaches of the Amu Darya River is known from collections more than a century old (BARTENEV, 1915). A gap in the range of this species is also noticeable in east Kazakhstan. The distance from the site in the Alakol depression (loc. 59d) to the southwestern coast of Lake Zaisan, where *S. depressiusculum* is numerous (BELYSHEV, 1961), is approximately 300 km.

53. *Sympetrum flaveolum* (Linnaeus, 1758)

LOCALITIES: 26, 26a, 26e, 27, 33, 53, 54a, 55, 59, 59c.

LITERATURE: BARTENEV, (1915), BELYSHEV (1961).

A temperate Eurasian species widespread in south-east Kazakhstan, but not numerous. It lives both in the plains and in the mountains. Here lies the southern border of the flat habitat of this boreo-montane species. Further south, in Central Asia, it is scarce and lives only in the mountains (BORISOV & HARITONOV, 2008). Already in neighboring Kyrgyzstan, this species is not found below 1400 m asl (SCHRÖTER, 2010).

54. *Sympetrum fonscolombii* (Sélys, 1840)

LOCALITIES: 2, 15, 16, 17, 17a, 22, 23, 26, 26e, 26g, 35, 48, 58a, 59b.

LITERATURE: GRIGORIEV (1905), BARTENEV (1915), BELYSHEV (1961), KOSTERIN & BORISOV (2010), BORISOV (2011a).

Common in the study area, showing seasonal latitudinal migrations. In spring and early summer it flies from the south to temperate latitudes for reproduction. In autumn, the second (summer) generation migrates back south (BORISOV, 2011a; BORISOV *et al.*, 2020b). In south-east Kazakhstan, immigrants (first generation) have been recorded after June 10 but they arrive much earlier. In south Kazakhstan (Chokpak pass, 500 km west of Almaty), the first immigrants were noted on April 29, and a mass arrival occurred on May 22. A stable isotope analysis was performed (HOBSON, 2019) to determine their probable origin. It included individuals from south-east Kazakhstan, and it was found that these dragonflies arrive in Kazakhstan in spring from South-West Asia, from regions located south, approximately at 36° N (BORISOV *et al.*, 2020b).

The development of a summer generation takes about two months. In early August, individuals of a second generation can be seen in south-east Kazakhstan. It is assumed that they migrate south in autumn, evidenced by massive migrations in September–October at the Chokpak Pass, South Kazakhstan (BORISOV, 2009b, 2011a). There are no data on overwintering larvae in Central Asia and in south-east Kazakhstan. Thus, this species, though common in south-east Kazakhstan, lives here only from June to late October.

55. *Sympetrum meridionale* (Sélys, 1841)

Localities: 2, 3, 5, 6, 8, 11, 14, 16, 17, 19, 20, 21, 26, 26e, 28, 29, 34, 36, 41, 46, 47, 48, 52, 53, 54, 55, 56, 57, 59d, 60a, 63.

Literature: BARTENEV (1919), BELYSHEV (1961), KOSTERIN & BORISOV (2010).

One of the most abundant and widespread dragonflies in south-east Kazakhstan.

In Central Asia, it has a pre-reproductive diapause (3–4 months) and seasonal high-altitude migrations (BORISOV, 2006b, 2009b). In south-east Kazakhstan, at least in some pre-reproductive populations, high-altitude migrations are characteristic. In the Zailiysky Alatau (outskirts of Almaty), at 1000–1600 m, the first individuals arriving from the plain are seen from 20 June onwards. In early July, these dragonflies are already common in the mountains. In the Dzungarsky Alatau, at 1500 m asl, accumulations have been observed during estivation in early July (KOSTERIN & BORISOV, 2010). At the same time, it remains unknown whether *S. meridionale* makes such migrations in areas far away from the mountains. For example, in the delta of the Ili River (loc. 5, 6, 8) on June 15–18, we observed accumulations of these dragonflies in a tugai forest, but they did not show migratory activity. The nearest forested mountains were at a distance of ca 200 km. We observed the same at the east end of Lake Balkhash (loc. 53). On June 25, large numbers took refuge in the shade of a saxaul grove. In this case, the nearest mountains were at about 100 km. It is likely that in these cases, dragonflies can spend a period of estivation on the plain. A prerequisite for this is the presence of shaded areas, like floodplain forests, groves or orchards. On hot days, dragonflies avoid direct sunlight, even in the mountains (BORISOV, 2006b, 2009b).

56. *Sympetrum pedemontanum* (Allioni, 1766)

LOCALITIES: 12, 37.

LITERATURE: BARTENEV (1915), VALLE (1942), BELYSHEV (1961), CHAPLINA *et al.* (2007).

In south-east Kazakhstan, known only from museum collections. BOUDOT *et al.* (2021) list 15 locations for the region. In Central Asia, distributed locally, mainly in mountainous and foothill regions. Not recorded South of Tajikistan (BORISOV & HARITONOV, 2008; BOUDOT *et al.*, 2021).

57. *Sympetrum sanguineum* (Müller, 1764)

LOCALITIES: 26, 28, 29, 30, 37, 37a, 52, 53, 55, 60a, 63.

LITERATURE: BARTENEV (1919), BELYSHEV (1961).

Common in the study region and found mainly on the plains. Further south, in Central Asia, confined to the mountains. In Tajikistan, only in the mountains (BORISOV & HARITONOV, 2008). The Central Asian *S. sanguineum* range seems isolated from the West Asian part (BOUDOT *et al.*, 2021). It is possible that, like *S. depressiusculum*, there is a gap in the range in east Kazakhstan. In south-east Kazakhstan, the most northern location lies at the east end of Lake Balkhash (loc. 55). The nearest location is at the east end of Lake Zaisan (CHAPLINA *et al.*, 2007), approximately 460 km north-east.

58. *Sympetrum striolatum pallidum* (Sélys, 1887)

LOCALITIES: 3, 5, 6, 8, 14, 16, 17, 18, 19, 20, 22, 37, 41, 42, 43, 44, 46, 54a, 57, 59d, 60a, 63a.

LITERATURE: BARTENEV (1919), CHAPLINA *et al.* (2007), KOSTERIN & BORISOV (2010).

One of the most abundant and widespread dragonflies, both in south-east Kazakhstan and in Central Asia (BORISOV & HARITONOV, 2008; BOUDOT *et al.*, 2021). In the eastern half of Kazakhstan, north of Lake Balkhash, this species has not been recorded. In the northwest, the

nominative subspecies is recorded (CHAPLINA *et al.*, 2007). In the Dzungarsky Alatau, individuals with characters transitional to the nominative subspecies are found (KOSTERIN & BORISOV, 2010).

In the mountains of southeast Kazakhstan, seasonal high-altitude migrations have been recorded. Individuals from lowland populations migrate to the mountains during the pre-reproductive period. In mid-summer, significant concentrations are noted in the Zailiysky Alatau and Dzungarsky Alatau at altitudes of 1000–1600 m asl. Immatures are observed in large numbers around Lake Balkhash in the middle of summer, which suggests estivation on the plains as well.

59. *Sympetrum tibiale* Ris, 1897

LOCALITIES: 2, 3, 4, 6, 7, 8, 30a, 54a, 55, 58, 60, 60a, 61, 63, 63a.

LITERATURE: GRIGORIEV (1905), BARTENEV (1915), DUMONT *et al.* (2018).

For distribution and ecology of *S. tibiale* see DUMONT *et al.* (2018). To these data, the present article adds only one location, off the east coast of Lake Balkhash (loc. 4).

60. *Sympetrum vulgatum decoloratum* (Sélys, 1884)

LOCALITIES: 22, 29, 42, 43, 44, 48, 57, 59d, 63, 63a.

LITERATURE: VALLE (1942), BELYSHEV (1961), CHAPLINA *et al.* (2007), KOSTERIN & BORISOV (2010).

Common and living both in the plains and in the mountains. Further south, in Central Asia, *S. v. decoloratum* occurs only in mountains (BORISOV & HARITONOV, 2008). Transitional forms between *S. v. decoloratum* and the nominative subspecies from the Zailiysky Alatau are mentioned by BELYSHEV (1961). In the population on the northern slope of the Dzungarsky Alatau, we noted individuals with color transitions from typical *vulgatum* to *decoloratum* (KOSTERIN & BORISOV, 2010).

SPECIES ERRONEOUSLY REPORTED FOR SOUTHEAST KAZAKHSTAN

***Ophiogomphus cecilia* (Fourcroy, 1785)**

CHAPLINA (2004b) indicated *Ophiogomphus serpentinus* (= *O. cecilia*) for the Alakol reserve, but *Ophiogomphus reductus*, which is common here, was ignored. In another article (CHAPLINA *et al.*, 2007), *O. cecilia* is reported for the Alakol Nature Reserve and the environs of the city of Almaty. In the collections of the Institute of Systematics and Ecology of Animals (Novosibirsk), we found only specimens of *Ophiogomphus reductus* from these places, collected and identified by Chaplina.

***Cordulegaster boltonii* Donovan, 1807 (= *C. annulatus* Latreille, 1805)**

There are two erroneous records of this species in south-east Kazakhstan. For the territory located between Lake Balkhash and the cities of Taldykorgon and Almaty, REINHARDT & SEIDENBUSCH (1999) give a list of 44 species. The evidence for this is a paper by KUMACHEV (1973), entitled "The role of dragonflies and wasps in the decline in the number of gnats in the Ili River basin." It mentions *C. boltonii* as a potential enemy of gnats. No data on the place of observation or capture are given. This is a misidentification of the species. The range of *C. boltonii* is limited to Europe (BOUDOT & HOLUŠA, 2015).

A similar misidentification was *Cordulegaster annulatus* (= *C. boltonii*) in the Almaty nature reserve (BRAGINA & HARITONOVA, 1989), taken from a student report. In an article on the

odonatofauna of the reserves of Central Asia (BORISOV & HARITONOV, 2001), only *C. coronata*, is confirmed.

***Somatochlora arctica* (Zetterstedt, 1840)**

In their article on Central Asia, an error occurred in the map of the distribution of this species (BORISOV & HARITONOV, 2008: 115, map 14), and *S. arctica* was falsely cited for southeast Kazakhstan and north Kyrgyzstan. The text (BORISOV & HARITONOV, 2008: 105), correctly reports a single find of this dragonfly in Central Asia.

BIOGEOGRAPHIC REMARKS

With 60 species, we believe we have reached a near complete inventory of the species living in East Kazakhstan. Among the species recorded, there are remarkably few East Palaearctic species. The vast majority is temperate to boreo-montane. This should not surprise us: most dragonflies in the study area deal, at least from time to time, with arid climates and cold winters, and, even more selective, with saline waters. Boreal species tend to be limited to mountains or to the north. Disjunctions are frequent. Brackish water tolerant species are rather numerous, such as most of the *Sympetrum*s, *Selysiotthemis*, and *Lestes macrostigma*. Of *Sympetrum* it is common to find three or four species together in summer, in the dry bush on the interfluvial lowlands. The migrations of these species and long adult life-span (by estivation) are remarkable. All three species of *Sympecma* show hibernation.

Although many species have extended ranges and occur as far as western Europe, a fair number have limited ranges and are more or less endemic. Ranging from Anatolia to Central Asia are, for example, *Onychogomphus flexuosus*, *Stylurus ubadschii*, and *Sympetrum arenicolor*. Conversely, reaching its limit of westward extent is *Ophiogomphus reductus*. Another interesting pattern is shown by the little-known *Sympetrum tibiale*, found from the northern foothills of the Caucasus to Kazakhstan. A most interesting species is *Ischnura aralensis*. Morphologically, it cannot be confused with any other *Ischnura* species. Its habitats are river valleys with freshwater lakes, and it may build enormous populations on such lakes. In Central Asia, many of these rivers are seasonal and dwindle or even dry out. Such rivers may reach an appreciable salinity when near-dry. In contrast, lakes connected to rivers draining the much wetter south Ural, flow west towards Europe and are of pure freshwater. How far west the species extends into European Russia remains to be determined.

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