

## A REVIEW OF THE ODONATA OF KAZAKHSTAN

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The odonate fauna of Kazakhstan (86 spp.) is reviewed, using literature data, miscellaneous collections and the results of an expedition by the authors in July 2004. *Aeshna caerulea*, *A. subarctica*, *Somatochlora graeseri* (all from the S Altai mountains), *Macromia amphigena fraenata* (Sibinskie Lakes near Ust'-Kamenogorsk), *Calopteryx samarcandica*, *Coenagrion hylas* and *Anormogomphus kiritchenkoi* (all based on specimens in Zool. Inst. Russ. Acad. Sci., St. Petersburg) are first records for the country.

### INTRODUCTION

The first mention of Odonata from Kazakhstan was by SELYS & MacLACHLAN (1872), in a paper on the "Kirgiz steppe". At the beginning of the 20th century, GRIGORYEV (1906) provided data on 10 species from the Kazakh part of the south-western Altai, while BARENEV (1911) cited 15 species from Akmolinsk, Taldy-Kurgan and Western Kazakhstan. Fragmentary information on Odonata was occasionally provided by parasitologists and hydrobiologists e.g. DOGEL & BYKHOVSKY (1934), TYUTENKOVA (1956), and KLIMSHINA & KUKASHEV (1982, 1989), but for substantial work we had to wait for BELYSHEV (1961), who recorded 42 species from eastern Kazakhstan. In the 1971 review by BELYSHEV & SHEVCHENKO, the faunal list reached 73 species. Eight of these were not collected in Kazakhstan but near its borders. A decade later, BRAGINA & HARITONOVA (1989) cited 78 species. *Ischnura senegalensis* Rambur, 1842, was a misidentification, now deleted from the fauna of the former USSR (HARITONOV, 1988).

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In 1979, HARITONOV described *Ischnura aralensis*, from floodplain lakes of the lower Syr-Darja River. At the close of the 20<sup>th</sup> century, REINHARDT (1995, 1999), and REINHARDT & SEIDENBUSCH (1999), based on field studies by K. Reinhardt, documented the zone between Lake Balkhash and the Tien Shan mountains. REINHARDT & SEIDENBUSCH (1989) list 44 species inhabiting the area, 5 of which are doubtful.

The following material formed the backbone of the present paper:

- (1) The Ph.D. study of I.A. CHAPLINA (2004), from 2000 to 2004, mainly dealing with East-Kazakhstan and Alma-Ata district. Most of her material is in the collections of the Institute of Systematics and Ecology of Animals, Siberian Branch, Russian Academy of Sciences (ISEA SB RAS), Novosibirsk. Some material has been published (BERDIBAEVA & CHAPLINA, 1997; CHAPLINA, 1998, 2001, 2002, 2003).
- (2) The collections made by A. Yu. Haritonov in the 1970's – 1990's on the territories of Aktyubinsk, Kustanai, North-Kazakhstan, Kokchetav, Pavlodar, Tselinograd, East-Kazakhstan, Alma-Ata and Kyzyl-Orda districts. Most material is in the collections of ISEA SB RAS, Novosibirsk, with some specimens in the Zoological Museum of Chelyabinsk and at Kyzyl-Orda State Pedagogical University.
- (3) The collections of the Zoological Institute of the Russian Academy of Sciences (ZI RAS) at St-Petersburg, Moscow State University (MSU), Tomsk State University (TSU), Kurgan State University (KSU), and Chelyabinsk (CSPU) and Kyzyl-Orda (K-OSPU) State Pedagogical Universities.
- (4) A concerted exploration effort by the present authors in July 2004, in the framework of a NATO collaborative grant. The material collected was deposited at ISEA SB RAS, H. Dumont's personal collection (HJD) and the collection of the Royal Institute of Natural Sciences, Brussels (RINSB).

## THE COUNTRY OF KAZAKHSTAN

The Republic of Kazakhstan was the second largest of the former USSR. With an area of 271,700 km<sup>2</sup> it extends for almost 3000 km from West to East, from the Caspian Sea and the lower Volga to the Altai, and 1600 km from North to South, from the West Siberian Lowlands and spurs of the Urals to the Tien Shan ridges and Kyzyl Kum desert. Kazakhstan lies in the central and southern latitudes of the temperate zone; the south is almost subtropical. A peculiar feature is its location in the centre of Euro-Asian continent, with effects on its physical geography, hydrography, vegetation, and fauna. Kazakhstan covers four zones: forest-steppe, steppe, semi-desert and desert, beside mountain systems with all features inherent to high altitudes.

Total sunshine in Kazakhstan is high: the number of sunny days per year increases from 120 in the North to 260 in the South, and that of cloudy days decreases from 60 in the North to 10 in the Balkhash depression.

The plains receive little precipitation. In areas of forest-steppe, annual precipitation is 300–400 mm, but in the steppes it decreases to 250 mm and in semi-desert and desert areas to 200–100 mm. Areas with less than 100 mm occur in the Balkhash basin, south-western Priaral Kyzyl Kum, and the south of the Ust Urt. In the foothills and mountains, average precipitation reaches 400–1600 mm; over the western slopes of the Altai, it sometimes overshoots 1600 mm.

The transition between winter and spring is marked by a dramatic change in weather. Snow melts in the middle of April in the North, in March in the centre, and in February at the latitude of Kyzyl-Ordy. In the far South, snow does not fall every year. After snow melt, the temperature increases rapidly; in the northern part of the country, average daily temperature is above +10°C in the first decade

of May, and in the southern part in early April. This is when spring dragonflies hatch. Summer in North Kazakhstan starts in early June, and in mid May in the South. Favorable temperatures (above +10°C) for dragonflies to hatch vary from approximately 20°C in forest-steppe to 44°C in deserts. In mid summer (late June – early July), the number of dragonfly species reaches its peak. A decrease in daily temperature to +10°C signals autumn. This starts in early September in the North (the forest-steppe); in the centre, in mid September and in the southern deserts in the second half of October. First frosts occur in mid September in the forest-steppe and steppe and in early October in the desert. The frost-free period ranges from 105 days in the North, to 195 days in the South. With the onset of frosts the activity of dragonflies drastically decreases.

The abundance and diversity of regional dragonflies depends on available water. The number of rivers and streams longer than 10 km exceeds 7000. They mostly empty in the endorheic Caspian-Aral, Balkhash, or Tengiz lakes. Some tributaries of the Ob River, the Irtysh, Ishym and Tobol flow to the Arctic Ocean, however. The principal rivers are the Ural, Irtysh, Tchu, and Syr-Darya. The wet alpine regions of Kazakhstan, viz. the Altai, the Dzhungarian and Zailysk Alatau, are notable for their dense river system (0.2-0.4 km/km<sup>2</sup>). The largest rivers of Kazakhstan flow from those mountains. The flat country, in contrast, has a reduced river system: 0.13 and 0.022 km/km<sup>2</sup>, respectively, for the Uila and Nura basins. Here, temporary streams with a short spring flow are numerous. They either dry up or divide into numerous lakelets, fed with subsoil waters. There are no permanent rivers in the semi-deserts and deserts. The rivers flowing from the hilly steppe areas of Central Kazakhstan and from the low mountains of Mugodzhzar are mainly snow-fed. They are characterised by sharp, short floods. About 90-100% of their annual flow takes place during 10-15 spring days.

Kazakhstan has approximately 40000 lakes, both permanent and temporary, and more than 3000 ponds and reservoirs. The largest lakes are Balkhash, Zaisan, Alakol, Markakol, and Tengiz. They are mostly located in the forest-steppe and northern part of the steppes. Many are endorheic. Northern Kazakhstan has a lake district, with 11195 freshwater and 2513 saltwater lakes. In central Kazakhstan freshwater and slightly saltwater lakes occur mainly in the mountainous regions of Kokchetavsky, Bayanoulsky, Karkaralinsky and in the lower reaches of rivers. In semi-deserts and deserts, lakes are restricted to the lower reaches and deltas of rivers. Most lakes are at 100-350 m asl, often on loose quaternary or tertiary sediments. Lakes in the plains of Kazakhstan have simple outlines, flat bottoms, and their depth is usually only 1-3 metres. Lake level fluctuates drastically on an annual and long-term scale, and many dry up in summer and during arid spells. Long-term changes in water level are of a cyclical nature, the cycle lasting approximately 30 years.

Such extreme conditions affect odonates. Species able to endure drought in the egg stage inhabit drying-up waters (for example, *Sympetrum*); others, with a short development time, hatch before lakes fall dry (some *Coenagrionidae*).

Kazakhstan's continental climate causes strong heating in summer and long freezing in winter, with many lakes freezing to the bottom. In spring, lakes warm rapidly and in May temperatures rise to 10-15°C. In June-August, temperature reaches 17-22°C and peaks (28-33°C) are observed in late July – early August. In September, temperatures decline to 9-14°C, in October to 2-6°C, and at the end of October – November to 0°C. In autumn, dragonfly larvae leave the shore and aggregate in deeper places, where the water does not freeze.

#### LIST OF LOCALITIES

(Fig. 1)

- (1) Petropavlovsk City, Ishim River: 54° 28'N, 68° 50'E, 98 m asl
- (2) Ust'Uyskoe village, Tobol River: 54° 20'N, 64° 00' E, 80 m asl
- (3) Kuturkul' Lake (ZI RAS, Karavaev): 53° 36' N, 69° 30'E, 115 m asl
- (4) Ishim River: 53° 30'N, 66° 38'E, 170 m asl
- (5) Kyzyl-Dzhar Lake: 53° 28'N, 77° 24'E, 190 m asl

- (6) Kellervka village: 53° 19'N, 69° 20'E, 280 m asl
- (7) Kustanai City, Upper Tobol River: 53° 18'N, 63° 32'E, 162 m asl
- (8) Zhalandy Lake: 52° 53'N, 66° 40'E, 220 m asl
- (9) Pavlodar City, Irtysh River: 52° 40'N, 76° 55'E, 115 m asl
- (10) Tersakkan River (ZI RAS, Rudol'ph): 51° N, 57° E, 300 m asl
- (11) Kok-Dzhida village: 51° 54'N, 51° 22'E, 90 m asl
- (12) Large Aksuat Lake: 51° 33'N, 64° 40'E, 120 m asl
- (13) Ural'sk City, Ural River: 51° 32'N, 51° 30'E, 65 m asl
- (14) Derzhavinsk town: 51° 18'N, 66° 19'E, 290 m asl
- (15) Astana City, Ishim River: 51° 12'N, 71° 30'E, 260 m asl
- (16) Shabdar River: 51° 10'N, 70° 08'E, 270 m asl
- (17) Yanvartstevo village: 50° 42'N, 53° 55'E, 78 m asl
- (18) Semipalatinsk City: 50° 24'N, 80° 13'E, 202 m asl
- (19) Aktyubinsk City, Ilek River: 50° 22'N, 57° 03'E, 240 m asl
- (20) Shemonaikha town: 50° 20'N, 81° 57'E, 880 m asl
- (21) Tengiz Lake: 50° 15'N, 69° 10'E, 220 m asl
- (22) Shul'binsk village: 50° 13'N, 79° 45'E, 280 m asl
- (23) Dubygalinskoe Lake: 50° 10'N, 81° 30'E, 344 m asl
- (24) Tavricheskoe village: 50° 07'N, 82° 12'E, 875 m asl
- (25) Sarykopa Lake: 50° 04'N, 64° 00'E, 110 m asl
- (26) Ust'-Kamenogorsk City: 49° 57'N, 82° 43'E, 285 m asl
- (27) Sibinskie group of lakes: 49° 50'N, 82° 00'E, 800 m asl
- (28) Zyryanovsk City: 49° 44'N, 84° 18'E, 457 m asl
- (29) Serebryansk town: 49° 40'N, 83° 20'E, 460 m asl
- (30) New Bukhtarma village: 49° 23'N, 83° 50'E, 720 m asl
- (31) Katon-Karagay village, 49° 10'N, 85° 39'E, 1081 m asl
- (32) Temir town, 49° 08'N, 56° 28'E, 230 m asl
- (33) Khar'kin village, 49° 07'N, 52° 15'E, 46 m asl
- (34) Ural River, 49° 06'N, 51° 47'E, 24 m asl



Fig. 1. Localities in Kazakhstan from which dragonfly records have become available.

- (35) Yazovka village, 49° 00'N, 86° 00'E, 900 m asl
- (36) Urunkhayka River, 48° 46'N, 86° 01'E, 1446 m asl
- (37) Zaysan valley, Voznesenka village, 48° 34'N, 83° 47'E, 422 m asl
- (38) Tikhushka River, 48° 26'N, 85° 48'E, 1442 m asl
- (39) Cold valley, 48° 26'N, 85° 50'E, 2000 m asl
- (40) Terekty village, Chesh-Terek River, 48° 25'N, 85° 45'E, 508 m asl
- (41) Emba River, 48° 23'N, 57° 09'E, 112 m asl
- (42) Zaysan valley, Karatorgay village, 48° 23'N, 84° 28'E, 425 m asl
- (43) Kuludzhun River, 48° 20'N, 83° 26'E, 432 m asl
- (44) Zaysan valley, Tokyr River, 48° 09'N, 84° 58'E, 420 m asl
- (45) Ayaguz town, 48° 00'N, 80° 25'E, 510 m asl
- (46) Zaysan valley, Black Irtysh River, 47° 58'N, 85° 01'E, 416 m asl
- (47) Kok-Tas village, 47° 30'N, 65° 33'E, 510 m asl
- (48) Karatal village, 47° 30'N, 85° 18'E, 670 m asl
- (49) Zaysan City, 47° 28'N, 84° 55'E, 604 m asl
- (50) Dzhangil'-Tau village, 47° 20'N, 62° 10'E, 240 m asl
- (51) Lake Aral, Kamyshlybas village, 46° 10'N, 62° 00'E, 162 m asl
- (52) Uch-Aral town, 46° 08'N, 80° 50'E, 485 m asl
- (53) Alakol'skiyi Nature Reserve, Tentek River, 45° 32'N, 82° 08'E, 347 m asl
- (54) Alma-Ata district, Lake Balkhash, 45° 30'N, 74° 00'E, 342 m asl
- (55) Taldy-Kurgan district, Beskul' Lake, 45° 27'N, 78° 46'E, 590 m asl
- (56) Chinaz Lake, 45° 05'N, 67° 01'E, 103 m asl
- (57) Ili River, ~ 45° N, ~ 76° E, ~200 m asl
- (58) Kargaly-Kul' Lake, 44° 56'N, 69° 58'E, 300 m asl
- (59) Middle Syrdar'ya valley, Kzyl'-Orda district, Karasevo lake, 44° 50'N, 64° 55'E, 172 m asl
- (60) Aleksandrovski village, 44° 07'N, 51° 02'E, 20 m asl
- (61) Zhana-Dar'ya River, 44° 03'N, 65° 00'E, 100 m asl
- (62) Chirkili River, 44° 00'N, 65° 10'E, 100 m asl
- (63) Mangyshlak peninsula, ~ 44° N, 52° E, ~150 m asl
- (64) Ili town, 43° 58'N, 77° 10'E, 180 m asl
- (65) Dzhambul village, 43° 55'N, 66° 08'E, 100 m asl
- (66) Baytugay Lake, 43° 50'N, 66° 18'E, 100 m asl
- (67) Yany-Kurgan town, 43° 49'N, 67° 45'E, 120 m asl
- (68) Chilik town, 43° 40'N, 78° 07'E, 580 m asl
- (69) Ostashkino village, 43° 33'N, 78° 50'E, 620 m asl
- (70) Alma-Ata City, 43° 20'N, 77° 00'E, 800 m asl
- (71) Alekseevka village, 43° 15'N, 78° 05'E, 950 m asl
- (72) Dzhambul City, 43° 02'N, 71° 25'E, 400 m asl
- (73) Beshkek City, 43° 00'N, 74° 28'E, 650 m asl
- (74) Ustyurt Nature Reserve, 43° 00'N, 55° 00'E, 150 m asl
- (75) Syr-Darya River, 42° 55'N, 67° 23'E, 125 m asl
- (76) Kok-Kaynar village, 42° 40'N, 73° 50'E, 220 m asl
- (77) Charyn River, 42° 35'N, 80° 06'E, 600 m asl
- (78) Przhhevsk City, 42° 30'N, 78° 18'E, 1200 m asl
- (79) Chimkent City, 42° 20'N, 69° 36'E, 480 m asl
- (80) Aksu-Dzhabag State Nature Reserve, 42° 18'N, 70° 45'E, 1600 m asl
- (81) "Transcaspian district", ~42° N, 54° E, ~30 m asl
- (82) Sary-Agach village, Keles River, 41° 35'N, 69° 18'E, 950 m asl
- (83) Krasnovodsk City, 40° 02'N, 53° 15'E, 50 m asl

## ANNOTATED LIST OF SPECIES

In total, 86 ssp. have become known, with *Calopteryx samarcandica*, *Coenagrion hylas*, *Aeshna coerulea*, *A. subarctica*, *Anormogomphus kiritchenkoi*, *Somatochlora graeseri*, *Macromia amphigena fraenata* here reported for the first time. Species are listed hereunder by localities (in bold). Collectors are mentioned individually, except for the July 2004 expedition, in which all authors of the present paper were involved. If more than ten specimens were collected, "series" is used. The sex of specimens is mentioned if it was explicitly recorded. Some brief notes on distribution and phenology (with months in Latin numerals) are also given.

– *Calopteryx samarcandica* Bartenev, 1911. Syn. *C. maracandica* Bartenev, 1913; *C. unicolor* Bartenev, 1912

S Kazakhstan, "Yany-Kurgan, 21.06.1907": 6 ♂, 4 ♀ (collection ZI RAS); 79: 1 ♂, 12-VII-1923 (collection ZI RAS) (a male with uncoloured, "unicolor"-like, wings). A member of the *C. splendens*-complex, with specific status still uncertain.

– *Calopteryx splendens* (Harris, 1782)

Series. Common in most of Kazakhstan. July 2004 collection: 40, 46: series, 9/11-VII. Flight period V-VIII. Subspecific status undecided, but about half of the females were androchomic, and the wing bands of the males were wide, often reaching the wing tip, as in *Calopteryx splendens ancilla* Selys.

– *Calopteryx virgo* (Linnaeus, 1758)

Known from BELYSHEV & SHEVCHENKO, 1971, for SE Kazakhstan, locality and flight period unknown.

– *Lestes barbarus* (Fabricius, 1798)

Series. Common in most of Kazakhstan. July 2004 collection: 37: 2 ♂, 9-VII. Flight period VI-X.

– *Lestes dryas* Kirby, 1890

Series. Common in most of Kazakhstan. July 2004 collection: 37: 1 ♂, 1 ♀, 9-VII. Flight period VI-IX.

– *Lestes macrostigma* (Eversmann, 1836)

Series, 10: VII-1989; 64: VI-1952 (collection ZI RAS); 53: VI-2002 (Chaplina). All Kazakhstan, but local and sporadic. Flight period VI-IX.

– *Lestes sponsa* (Hanseman, 1823)

Series. One of the commonest dragonflies of Kazakhstan. July 2004 collection: 37: 3 ♂, 3 ♀, 9-VII; 44: 1 ♀, 9-VII; 43: 6 ♂, 5 ♀ ♀, 11-VII. Flight period VI-X.

– *Lestes virens marikovski* Belyshev

Series, widespread. July 2004 collection: 43: 5 ♂, 1 ♀, 11-VII. Flight period VI-X.

– *Sympetma fusca* (Vander Linden, 1820)

Series. Common everywhere except in the North. Flight period V-X.

– *Sympetma gobica* (Förster, 1900)

Series. Common in South Kazakhstan. Flight period IV-XI.

– *Sympetma paedisca* (Brauer, 1877)

Series. One of the common damselflies of Kazakhstan. July 2004 collection: 43: 1 ♂, 1 ♀, 11-VII; 44: 1 ♂, 9-VII; 46: 1 ♂, 1 ♀, 9-VII. Flight period IV-XI.

– *Coenagrion armatum* (Charpentier, 1840)

Series. Common in North Kazakhstan. Flight period V-VII.

– *Coenagrion ecornutum* (Selys, 1872)

BELYSHEV & SHEVCHENKO (1971) record this species from the Altai mountains, NE Kazakhstan, because it was collected at Loktevkа village in Russia, close to the northern border of Kazakhstan.

– *Coenagrion hastulatum* (Charpentier, 1825)

Series. Common in North Kazakhstan. July 2004 collection: 36: 5 ♂, 1 ♀, 9-VII. Flight period V-VII.

– *Coenagrion hylas* (Trybom, 1889)

35: 3 ♂, 6 ♀, 1-VII-1987 (leg. Kosterin). Only record for Kazakhstan.

– *Coenagrion johanssoni* (Wallengren, 1894). Syn. *C. concinnum* Johansen, 1859

17: 1 ♂, 15-VI-1984 (Haritonov); 10: 1 ♂, 25-VII-1989 (Kosterin). Only in North Kazakhstan, rare. Flight period VI-VII.

– *Coenagrion lunulatum* (Charpentier, 1840)

Series. Common in North Kazakhstan. July 2004 collection: 37: 1 ♀, 9-VII. Flight period V-VII.

– *Coenagrion puella* (Linnaeus, 1758)

Series. Common in most of Kazakhstan. July 2004 collection: 37: 1 ♂, 9-VII. Flight period VI-VII.

– *Coenagrion pulchellum* (Vander Linden, 1825)

Series. The most common *Coenagrion* of Kazakhstan. July 2004 collection: 37: 1 ♂, 9-VII; 42: 1 ♀, 9-VII; 43: 5 ♂, 1 ♀, 11-VII. Flight period V-VII.

– *Enallagma cyathigerum risi* Schmidt, 1961

Series. Common in most of Kazakhstan. July 2004 collection: series, 36, 37, 38, 40, 42, 43, 44, 46: 9-VII/11-VII. Flight period VI-VIII.

– *Erythromma najas* (Hansemann, 1823)

Series. Common in North Kazakhstan. July 2004 collection: 37: 1 ♀, 9-VII. Flight period V-VIII.

– *Erythromma viridulum* (Charpentier, 1840)

70, 77: 3 ♂, 3 ♀, 23-VII-1928; 81: 9 ♂, 5 ♀, 23-VI-1987 (collection ZI RAS); 53: 8 ♂, 4 ♀, 12/25-VI-2002 (Chaplina). South Kazakhstan, not common. Flight period V-VII.

– *Ischnura aralensis* Haritonov, 1979

Series. Known from several widely disjunct stations (see YANYBAEVA et al., 2006 for details and a distribution map). The populations along the Syr Darja, including the type locality, are probably extinct, because of salinisation and drying of the local lakes, a consequence of abstraction of water for irrigation. Flight period VI-VIII.

– *Ischnura elegans* (Vander Linden, 1820)

Series. One of the common species of Kazakhstan. July 2004 collection: series, 37, 40, 42, 43, 44, 46: 9-VII/11-VII. Flight period V-X.

– *Ischnura fountaineae* Morton, 1905. Syn. *I. bukharensis* Bartenev, 1913

Series. Common in South Kazakhstan. Flight period V-X.

– *Ischnura pumilio* (Charpentier, 1825)

Series. Common in South Kazakhstan. July 2004 collection: 40: 1 ♀, 11-VII. Flight period V-IX.

– *Nehalennia speciosa* (Charpentier, 1840)

73: 1 ♀, 15-VI-1978 (collection ZI RAS). Local, rare. No data about ecology and biology.

– *Platycnemis pennipes* (Pallas, 1771)

Series. Common in most of Kazakhstan. July 2004 collection: 40: 10 ♂, 2 ♀, 11-VII. Flight period V-VII.

– *Aeshna affinis* Vander Linden, 1820

Series. Common across Kazakhstan. Flight period VII-X.

– *Aeshna caerulea* (Ström, 1783). Syn. *Aeshna squamata* Müller, 1764

39: 2 ♂, 1 ♀, 10-VIII-2001 (Chaplina). First record from Kazakhstan. The specimen was collected at a small shallow marshy reservoir in the canyon “Cold valley” at Markokol’ State Nature Reserve (South Altai, 2000 m asl). Flight period VII-VIII.

— *Aeshna crenata* (Hagen, 1856)

2: 2 ♂, 1 ♀, 15-VII-1970 (Haritonov); 20: 1 ♀, 18-VI-2000 (Chaplina). Only in North Kazakhstan, local. Flight period VI-VIII.

— *Aeshna cyanea* (Müller, 1764)

REINHARDT & SEIDENBUSCH (1999) cite a larva from Balkhash lake. Exact flight period unknown.

— *Aeshna grandis* (Linnaeus, 1758)

Series, 9: VII-1984 (Haritonov); 13: VI-2002, 26, 31: VII-2001 (Chaplina); 43: VII-1957 (collection ZI RAS). Comparatively common in the North and in East Kazakhstan mountains. Flight period VI-X.

— *Aeshna juncea* (Linnaeus, 1758)

Series, 2, 4, 7: VII-1970; 1, 9: VI-1983 (Haritonov); 31: VII-2000, VIII-2001 (Chaplina). Comparatively common in the North and in East Kazakhstan mountains. July 2004 collection: 36: 5 ♂, 10-VII. Flight period VI-VIII.

— *Aeshna mixta* (Latreille, 1805). Syn. *A. coluberculus* Harris, 1782.

Series. Common across Kazakhstan. Flight period VII-IX.

— *Aeshna serrata* (Hagen, 1854)

2: 4 ♂, 2 ♀, 15-VII-1970; 4: 2 ♂ 10-VII-1981; 9: 1 ♂, 2 ♀, 22-VII-1989 (Haritonov). Comparatively common in North Kazakhstan. Flight period VI-IX.

— *Aeshna subarctica* Walker, 1908.

39: 2 ♂, 10-VIII-2001 (Chaplina). First record for Kazakhstan. The specimens were collected on small bogs in a canyon named "cold valley" at Markokol' State Nature Reserve (South Altai, 2000 m asl). Flight period VII-VIII.

— *Aeshna viridis* (Eversmann, 1836)

9: 2 ♀, 20-VI-1981 (Haritonov); 43: 2 ♂, 1 ♀, VII-1989. Only in North Kazakhstan, local. Flight period VI-VIII.

— *Anaciaeschna isoceles antehumeralis* Schmidt, 1950

26: 1 ♂, 16-VI-2001; 53: 10 ♂, 11 ♀, 9/19-VI-2002 (Chaplina); 79: 3 ♀, 19-V-1910 (collection ZI RAS). Only in South Kazakhstan, local. Flight period V-VII.

— *Anax imperator* Leach, 1815.

23, 27, 43: 2 ♂, 2 ♀, 1/18-VII-2000 (Chaplina); 70: 2 ♂, 2 ♀, 20-VI-1952; 47: 1 ♀, 20-IX-1954; 57: 2 ♀, 26-VI-1988 (collection ZI RAS). Widely distributed, but not abundant. Flight period VI-IX.

— *Anax parthenope* (Selys, 1839)

Series. Common in most of Kazakhstan, except in the North. Flight period V-IX.

— *Hemianax ephippiger* (Burmeister, 1839)

26: 1 ♂, 1 ♀, 19-V-2001 (Chaplina). South and East Kazakhstan, local. Flight period V-VII.

— *Anormogomphus kiritschenkoi* Bartenev, 1913

50: 1 ♂, 20 V 1874 (collection ZI RAS). Sole record for Kazakhstan!

— *Gomphus (Stylurus) flavipes* (Charpentier, 1825)

Series, 17: VI 1950 (collection ZI RAS); 61: VI-VIII 1976 (Haritonov). 2004 collection 46: 1 ♂, 1 ♀, 9-VII. Comparatively common in most of Kazakhstan. Flight period VI-VIII.

— *Gomphus vulgatissimus* (Linnaeus, 1758)

4: 3 ♂, 3 ♀, VI-1983, VII-1989 (Kosterin, Haritonov). North Kazakhstan, local, rare. Flight period VI-VII.

— *Lindenia tetraphylla* (Vander Linden, 1825)

62: 1 ♂, 1 ♀, VI-1974 (collection K-OSPU); 50, 75: 3 ♂, 2 ♀, VI-1937; 81: 13 ♂, 7 ♀, V/VII-1939 (collection ZI RAS). South Kazakhstan, local, rare. Flight period V-VIII.



– *Nihonogomphus ruptus* Selys, 1857. Syn. *Altaigomphus heterostylus* Bartenev, 1930.

Recorded by BELYSHEV & SHEVCHENKO (1971) as a possible inhabitant of the NE (the Altai Mountains), but no real records are currently available.

– *Onychogomphus flexuosus* (Schneider, 1845)

64: 1 ♂, 3 ♀, 20-VII-1952 (collection ZI RAS); 53: 1 ♀, 8-VI-2001 (Chaplina). S and SE Kazakhstan, local. Flight period VI-VIII.

– *Onychogomphus forcipatus* (Linnaeus, 1758)

10: 5 ♂, 4 ♀, 3/23-VII-1989 (Kosterin). N and W Kazakhstan, local. Flight period VII.

– *Ophiogomphus cecilia* (Fourcroy, 1785). Syn. *O. serpentinus* Charpentier, 1825

Series, 9: VI-1984 (Haritonov); 26, 27, 28: VII-2001 (Chaplina); 45: VI-1984 (Sergeev); 53, 70: VI/VIII-2002 (Chaplina). Comparatively common in most of Kazakhstan. Flight period VI-early IX.

– *Ophiogomphus reductus* Calvert, 1898.

57: 1 ♂, 1 ♀, VI-1952 (collection ZI RAS). South Kazakhstan, local. Flight period VI-VIII.

– *Cordulegaster boltonii* (Donovan, 1807)

Known only from the papers by BRAGINA & HARITONOVA (1989) and KUMACHEV, (1973) for SE Kazakhstan, but identification made by non-specialists. REINHARDT & SEIDENBUSCH (1999) record this species for Ili River valley, citing data by parasitologist KUMACHEV (1973).

– *Cordulegaster insignis* Schneider, 1845

80: 1 spec., 2-VI-1966 (collection ZI RAS). BELYSHEV & SHEVCHENKO (1971) recorded this species for South and South-East Kazakhstan, but exact locality and flight period unknown. The Kazakh subspecies remains to be determined.

– *Cordulia aenea* (Linnaeus, 1758)

Series, 2: VII-1970; 1, 4: VI-1983 (Haritonov); 26, 27: VI-2001 (Chaplina). Comparatively common in North Kazakhstan. Flight period V-VIII.

– *Epitheca bimaculata* (Charpentier, 1825)

26, 36: 2 ♂, 1 ♀, 25-V/6-VI-2000 (Chaplina). Local in N and N-E Kazakhstan. Flight period V-VII.

– *Somatochlora arctica* (Zetterstedt, 1840)

79: 1 ♀, 27-VI-1981 (collection ZI RAS). The only female specimen is preserved in the ZI RAS collection, collected from an “artificial irrigation system near Chayan village, Chimkent district”. This record was published by D. KUKASHEV (1989).

– *Somatochlora flavomaculata* (Vander Linden, 1825)

13: 1 ♂, (collection ZI RAS); BELYSHEV & SHEVCHENKO, 1971 cite it from West Kazakhstan, but exact locality and flight period unknown.

– *Somatochlora graeseri* Selys, 1887

36: 1 ♂, 8-VIII-2002 (Chaplina). The single male specimen was collected on the bank of a small pond near Markokol' lake (South Altai, about 1500 m asl). First record for Kazakhstan.

– *Somatochlora metallica* (Vander Linden, 1825)

Series, 2: VII-1970; 1, 4: VI-1983 (Haritonov); 26, 27, 31, 36: VI/VIII-2001 (Chaplina). July 2004 collection: 36: 1 ♂, 10-VII; 38: 11 ♂, 4 ♀, 9-VII. Comparatively common in North Kazakhstan. Flight period VI-IX.

In North-East Kazakhstan, in the South Altai mountains (about 1700 m asl) subspecies (or species?) *S. m. exuberata* Bartenev, 1911 occurs; elsewhere, the nominal subspecies is found.

– *Macromia amphigena fraenata* Martin, 1907. Syn. *Macromia sibirica* Djakov, 1926

27: 1 ♀, 24-VII-2002 (Chaplina). A single female, collected at the top of a granitic ridge near the Sibinskaya group of lakes (about 70 km south of Ust'-Kamenogorsk). First record from Kazakhstan.

– *Crocothemis erythraea* (Brullé, 1832)

Series, 59, 61, 62: VI/VII-1976 (Haritonov). Comparatively common in South Kazakhstan. Flight period VI-XI.

– *Leucorrhinia albifrons* (Burmeister, 1839)

Known only from the paper of BELY SHEV & SHEVCHENKO, 1971 for West Kazakhstan, exact locality and flight period unknown.

– *Leucorrhinia caudalis* (Charpentier, 1840)

Known only from the publication of BELY SHEV & SHEVCHENKO, 1971: West Kazakhstan, but exact locality and flight period unknown.

– *Leucorrhinia dubia* (Vander Linden, 1825)

53: Kukachev, 1989; 12: 1 ♂ (collection ZI RAS); 2: 1 ♂, 1 ♀, VI-1970 (collection CSPU). Rare, only N, local. Flight period V-VI.

– *Leucorrhinia pectoralis* (Charpentier, 1825)

Series, 4, 14, 19: VI-1981 (Haritonov); 26, 27: V-2001; 53: VI-2002 (Chaplina). Comparatively common in most of Kazakhstan, except the South. Flight period V-VII.

– *Leucorrhinia rubicunda* (Linnaeus, 1758)

Series. Common in North Kazakhstan, local in W and N-E. July 2004 collection: 36: 1 ♂, 1 ♀, 10-VII. Flight period V-VII.

– *Libellula depressa* Linnaeus, 1758

Series, 4, 14, 19: VI-1981 (Haritonov); 26, 34, 49: VI/VIII-2001 (Chaplina). All Kazakhstan, but local. Flight period V-VII.

– *Libellula quadrimaculata* Linnaeus, 1758.

Series. One of the most common dragonflies in Kazakhstan. July 2004 collection: 40: 1 ♂, 11-VII. Flight period V-VII.

– *Orthetrum albistylum* (Selys, 1842)

Series. Comparatively common in most of Kazakhstan, except in the North. July 2004 collection: 46: 2 ♂, 9-VII. Flight period V-VIII.

– *Orthetrum anceps* (Schneider, 1845)

61: 2 ♂, 1 ♀, VI-1976 (Haritonov); 68, 70: 16 ♂, 2 ♀, VII/VIII-2002 (Chaplina). Only in the South, local. Flight period VI-VIII.

– *Orthetrum brunneum* (B. de Fonscolombe, 1837)

Series. Common in most of Kazakhstan, except in the North. July 2004 collection: 40: 1 spec. 11-VII. Flight period V-VII.

– *Orthetrum cancellatum* (Linnaeus, 1758)

Series. Common in most of Kazakhstan, except in the North. July 2004 collection: 44: 1 ♂, 9-VII. Flight period V-VII.

– *Orthetrum sabina* (Drury, 1770)

62: 4 ♂, VI-1976 (Haritonov). Only in the South, rare. Flight period VI-VIII.

– *Pantala flavescens* (Fabricius, 1798)

59: 1 spec. VI-1976; 61: 3 spec. VI-1976; 62: 2 spec. VI-1976 (Haritonov). Only in the South, rare. Flight period VI-VII.

– *Selysiotthemis nigra* (Vander Linden, 1825)

61: 3 ♂, 2 ♀ (collection K-OSPU); 2 ♂, 5 ♀ (collection ZI RAS, West Kazakhstan, locality unknown). South Kazakhstan, locality unknown (BELY SHEV & SHEVCHENKO, 1971); East Kazakhstan (REINHARDT & SEIDENBUSCH, 1999). Mainly in South Kazakhstan, local. Flight period V-VIII.

– *Sympetrum danae* (Sulzer, 1776)

Series. Comparatively common in most of Kazakhstan, except in the South. Flight period VII-X.

– *Sympetrum depressiusculum* (Selys, 1841)

Series, 43, 48, 49: VII-2000 (Chaplina). Comparatively common in most of Kazakhstan, except in the North. July 2004 collection: 44: 1 ♂, 9-VII; 46: 1 ♂, 4 ♀, 9-VII. Flight period VII-X.

– *Sympetrum flaveolum* (Linnaeus, 1758)

Series. One of the most common dragonflies of Kazakhstan. July 2004 collection: 46: 1 ♂, 6 ♀, 9-VII; 36: 5 ♂, 4 ♀, 10-VII; 38: 2 ♂, 10-VII; 40: 1 ♂, 1 ♀, 11-VII. Flight period VI-X.

– *Sympetrum fonscolombii* (Selys 1840)

Series, 59, 61, 62: VII/VIII-1976 (Haritonov); 26: IX-2002 (Chaplina). Common in South Kazakhstan. Flight period VII-X.

– *Sympetrum meridionale* (Selys, 1841)

Series. Common in almost all Kazakhstan, rare in the North. July 2004 collection: 46: 3 ♂, 6 ♀, 9-VII. Flight period VI-X.

– *Sympetrum pedemontanum* (Müller, 1766)

Series, 53, 70: VIII-2001 (Chaplina); 58: 2 ♂, 2 ♀, VIII-1964 (collection K-OSPU). Comparatively common in most Kazakhstan. Flight period VI-X.

– *Sympetrum sanguineum* (Müller, 1764)

Series. Common across all Kazakhstan. July 2004 collection: 46: 2 ♂, 1 ♀, 9-VII. Flight period VI-X. In North-East Kazakhstan *S. s. sykinia* Belyshev, 1955; elsewhere, *S. s. sanguineum* Müller, 1764.

– *Sympetrum striolatum* (Charpentier, 1840)

Series, 19: VIII-1969 (Haritonov); 68, 70: VIII-2002 (Chaplina). Comparatively common in most of Kazakhstan except in the North. Flight period VI-XI.

In North-West Kazakhstan *S. s. striolatum* Charpentier, 1840; elsewhere, subspecies *S. s. pallidum* Selys.

– *Sympetrum tibiale* (Ris, 1897)

Series, 59, 61, 62: VII/IX-1976 (Haritonov); 49: VIII-2001 (Chaplina). Common in South Kazakhstan. Flight period VII-X.

– *Sympetrum v. vulgatum* (Linnaeus 1758)

Series. One of the most common dragonflies of Kazakhstan. July 2004 collection: 37: 1 ♀, 9-VII; 46: 1 ♀, 9-VII. Flight period VII-XI.

Two subspecies occur. In the North *S. v. vulgatum* Charpentier, 1840, in the South *S. v. flavum* Bartenev, 1915, with boundary at ~47° North.

– *Sympetrum v. decoloratum* (Selys, 1884)

Series, 70: VII/VIII-2002 (Chaplina); 61, 62: VIII-1963; 64, 75: VIII-1965 (collection K-OSPU); 57, 64: VIII-1953 (collection ZI RAS). Comparatively common in South Kazakhstan. Flight period VI-XI.

## ZOOGEOGRAPHICAL ANALYSIS

The research so far undertaken in Kazakhstan establishes the presence of 86 odonate species (44% of the former USSR fauna). Seven of these are first records. For others, our findings update and extend their range. *Somatochlora graeseri*, for example, known from Western Siberia and the Urals, was found near Lake Markokol in the mountains of the West. *Aeshna subarctica* and *A. caerulea*, also in Markokol nature reserve at an altitude of 2000 m, are circum-arctic and their

habitat in Kazakhstan is the southernmost of Central Eurasia, which makes it appropriate to consider their ranges not as simply arctic but boreo-montane. For *Ischnura aralensis*, Southern Kazakhstan is the *terra typica* and our populations in Western Kazakhstan extend its range considerably. The population at Dubagalinsky lake is the easternmost known. For more information on this Middle Asian species, see YANYBAEVA et al. (2006).

*Macromia amphigena* occurs in temperate rivers draining mountains (in Siberia mainly the Altai) from the Pacific Ocean to the Upper Ob river basin. Its habitat in the foothills of the Altai closes a gap between its occurrence in Bulgan, Mongolia (PETERS, 1985) and in the north-western Altai. Its extent in the Irtysh basin is thus likely wider than was hitherto believed, and it crosses the Dzhungarian gates to reach the end of its range in West Mongolia, facing the Gobi desert.

*Anormogomphus kiritschenkoi* was found in Southern Kazakhstan in the environs of Kazalinsk (near the Aral Sea). This record considerably pushes the range boundary of this species to the north.

The Odonata of Kazakhstan are clearly non-uniform, a fact explained by the vastness of the country and diversity of its nature and climate. In southern Kazakhstan, the species composition is like that of southern Siberia. In the West, including the European part of Kazakhstan, and in the Russian southern Ural, 3 species occur, *Brachytron pratense*, *Libellula fulva* and *Pyrrosoma nymphula*, that do not also live elsewhere in Kazakhstan. The fauna of the southern half of the country is similar to that of the Caucasus and Middle Asia, having in common about fifteen species that do not inhabit northern regions. The differences between the north and south is even more striking when not species, but dominant genera and species are compared.

Thus, the northern Kazakhstan fauna is marked by an abundance of *Aeshna*, *Leucorrhinia* and *Coenagrion* and the South by *Anax*, *Orthetrum*, and *Ischnura*. Between the "northern" and "southern" species a transition zone, approximately between 46° and 50° N, is found. Within this band we situate the southern boundary of 14 species, viz. *Leucorrhinia caudalis*, *L. albifrons*, *Epithea bimaculata*, *Cordulia aenea*, *Somatochlora flavomaculata*, *S. graeseri*, *Macromia amphigena*, *Onychogomphus forcipatus*, *Aeshna crenata*, *Coenagrion armatum*, *C. hastulatum*, *C. lunulatum*, *C. johanssoni*, *C. ecornutum*. Also within this band is the northern boundary of 26 southern species, viz. *Pantala flavescens*, *Crocothemis erythraea*, *Sympetrum decoloratum*, *S. depressiusculum*, *S. tibiale*, *S. fonscolombii*, *Orthetrum albistylum*, *O. anceps*, *O. brunneum*, *O. sabina*, *Selysiothemis nigra* (except for the isolated finding of a specimen in the southern Ural at 53° N, see YANYBAEVA et al., 2006), *Anax imperator*, *Hemianax ephippiger*, *Anaciaeschna isosceles*, *Cordulegaster boltonii*, *C. insignis*, *Lindenia tetrphylla*, *Onychogomphus flexuosus*, *Ophiogomphus reductus*, *Anormogomphus kiritschenkoi*, *Sympecma gobica*, *S. fusca*, *Erythromma viridulum*, *Ischnura fountaineae*, *Calopteryx virgo*, *C. samaracandica*.

Such data allow a refinement of the biogeographic divisions suggested by BELYSHEV & HARITONOV (1981), further specified for Eurasia by POPOVA (1999) and KETENCHIEV & HARITONOV (1999). Within Kazakhstan, the boundary between the Holarctic and Subholarctic (palaeosubtropical) areas of the boreal kingdom should now be drawn through the south Caspian lowlands, along the valleys of the Emba and Turgai rivers and through the southern slopes of the Kazakhstan hills to the south Altai mountains.

KETENCHIEV (2002) distinguished 3 subregions in the Subholarctic (Palaeotropical area): East Asia, central Asia and the Mediterranean, with the southern half of Kazakhstan part of the latter. However, the Mediterranean region, with its humid and warm climate suitable for 179 species in 54 genera and 10 families, is distinct from the more arid part of the Kazakh area under study. In this Subholarctic part of the Mediterranean only 72 species, 27 genera and 10 families occur. The approximate boundary between both areas is the Caspian Lake. Therefore, we identify South Kazakhstan and the Central Asian Republics of the former USSR as the Transcaspian province of the Mediterranean Subholarctic. BELYSHEV (1962, 1968) and HARITONOV (1976, 1975) expect a break in the ranges of *L. albifrons*, *L. caudalis*, *S. pedemontanum*, *S. sanguineum*, *A. mixta*, *A. affinis*, *E. bimaculata*, and *O. cecilia* between the Ural and Irtysh Rivers. Thus, Kazakhstan also lies at the junction of the Holarctic and Subholarctic (palaeotropical) regions of the Boreal kingdom. North Kazakhstan belongs to the European-Siberian subregion of the Holarctic, and the South to the Transcaspian province of the Mediterranean Subholarctic. The latter province can be further divided into West and East, with the Pleistocene Turgai the boundary between both. The Turgai valley, which was alternatively much more humid and drier than today across the Pleistocene, and thus functioned either as a corridor or as a barrier, continues south into the Turan depression that extends to the foothills of the Kopet Dag in Turkmenistan. This Turgai-Turan depression forms the transition between the western and eastern parts of the Transcaspian province.

Building on BELYSHEV (1968, 1974), the Odonata of Kazakhstan are seen to fall into three large groups. The first group is comprised of western species, with a European and partly Mediterranean distribution. These are *L. depressa*, *L. albifrons*, *L. dubia*, *L. pectoralis*, *L. rubicunda*, *L. caudalis*, *O. brunneum*, *O. cancellatum*, *S. sanguineum*, *S. meridionale*, *S. flavomaculata*, *A. mixta*, *A. affinis*, *A. grandis*, *A. cyanea*, *A. parthenope*, *A. isosceles*, *H. ephippiger*, *O. forcipatus*, *G. flavipes*, *G. vulgatissimus*, *C. splendens*, *L. macrostigma*, *L. barbarus*, *L. virens*, *S. fusca*, *C. hastulatum*, *C. pulchellum*, *C. puella*, *P. pennipes*, *N. speciosa*, *I. pumilio*, *I. elegans*, in all 33 species (38% of the regional fauna). These constitute the western fauna complex.

The second group is that of the eastern species (predominantly Siberian and even Transamurian): *O. albistylum*, *S. pedemontanum*, *S. depressiusculum*, *S. vulgatum*, *S. danae*, *E. bimaculata*, *S. metallica*, *S. arctica*, *S. graeseri*, *C. aenea*, *M.*

*amphigena*, *A. crenata*, *N. ruptus*, *O. cecilia*, *C. virgo*, *S. paedisca*, *C. johanssони*, *C. ecornutum*, *C. armatum*, *C. vernale*, in all 20 species (23% of the fauna).

The remaining 33 species cover vast, transpalaeartic ranges of which the origin cannot at present be ascertained.

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