

Update to the Status of *Lindeni Tetrphylla* (Vander Linden, 1825) (Odonata Gomphidae: *Lindenia* (De Haan, 1826)) in Uzbekistan, With Special Reference to the Khorezm Region

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Abstract: Considering that odontological studies have not been adequately conducted in the Khorezm oasis located in the north-western part of Uzbekistan, we presented the obtained results about the state of *Lindenia tetrphylla* (Vander Linden, 1825) for the last three years. Species *L. Tetrphylla* was included in the section “Endangered species” (LC- *Least concern ver 3.1*) of the International Red Book (IUCN). During our researches, this species was recorded in 3 regions of the oasis, as well as in one region of the Republic of Karakalpakstan. The species *L. Tetrphylla* was found mainly in the protected tugai biotope areas of the oasis.

Key words: population, phenology, imago, migration

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1. Introduction

Species *Lindenia tetrphylla* (Vander Linden, 1825) is the only species of *Lindenia* genus. The fair yellow, gray and dark gray forms of this species are common. The dark gray form of this species were observed in the “inkit” lake (Western Caucasus, Abkhazia, near the Pistun) and named as *Lindenia inkiti*. Whether *Lindenia inkiti* is actually a separate species is debatable and disputed, its distribution in Tajikistan, Uzbekistan and Tyanshan up to 1300 m altitude has been recorded (Belyshev, 1989). The main range of *Lindenia tetrphylla* is in the Mediterranean Sea and Central Asia, and from Pakistan to the Mediterranean Sea (eastern Spain) and Bulgaria (Gastarov, Beshkov, 2010). It was recorded for the first time in Dagestan in 1928 in the territory of the Russian Federation (Artobolevskiy G. V. 1929) and is a species endemic to the Mediterranean Sea - Central Asia (Borisov S.N., 2007, Surdo S., 2017, Rizervato et al., 2014). In North Africa, it is assessed as a rare and declining species (Boudot et al. 2009, 2013). Imago and larvae are found mainly in lakes with reeds, in confluences of big rivers (Schorr et al. 1998; Terzani F., 2002). The biology of *L. tetrphylla* is poorly understood, it is noted that it prefers areas with dense riparian vegetation, and its spores are found in water bodies with weak currents and rich aquatic vegetation (Rizervato et al., 2014b).

According to observations, the population was observed in a stable state every year in isolated, protected areas (Boudot & Kalkman, 2015). This species is distributed in semi-desert, desert areas, plains, and its larvae are found in saline water (Boudot et al., 2013). Larvae are slow-moving and occur in slow-flowing stagnant water bodies with dense aquatic vegetation (Hardersen & Leo, 2011; Surdo, 2017). The duration of the larval stage and their drought tolerance are unknown. Water pollution, reduction of natural landscapes, forests caused by the human factor are the reason for the reduction of the area of the species (Boudot, J.P., 2013). In Uzbekistan, Bartenev (1913) recorded it in Termiz and Bukhara (Schorr et al. 1998; Suhling & Müller 1996).

The species *L. Tetrphylla* is listed in the International Red Book (IUCN) – “Species in danger of extinction” (LC- *Least concern ver 3.1*) (Boudot, J.-P., Schneider, W. & Samraoui, B., 2013). For the odonata fauna of Italy and the Mediterranean Sea, this species has been assessed as “near threatened” (NT) (Rizervato, 2009, Rizervato et al., 2014). In our republic, large-scale reforms were carried out in the preservation of biodiversity, protection of natural areas, agricultural production, in this regard, special attention was paid to the preservation of the animal world, increasing the weight of bioresources, and

protection of cultivated plants from pests. Certain results were achieved on the basis of the programmatic measures implemented in these directions. However, not enough attention has been paid to fundamental research, including the composition of dragonfly (odonata) species, their bioecological characteristics, distribution in natural and agrocenoses, and scientific research on their importance. Taking into account the lack of odontological studies in the Khorezm oasis in the Republic of Uzbekistan, we have presented the results of the last three years in order to monitor the current state of dragonfly species and their biotopes in the oasis.

2. Material and Methods

Lindenia tetraphylla (Odonata Gomphidae: *Lindenia*) were sampled from 2020 to 2022 for two seasons, covering the entire period of the spring and summer from to along the south west edge of a riparian tugai forest fragment by the margins of the Amudarya River, in a landscape with the surrounding matrix composed by turanga (*Populus mutabilus*) and oleaster (*Elaeagnus angustifolia*) plantations, in the rural area in Cholish, of Urgench district (Fig. 1).

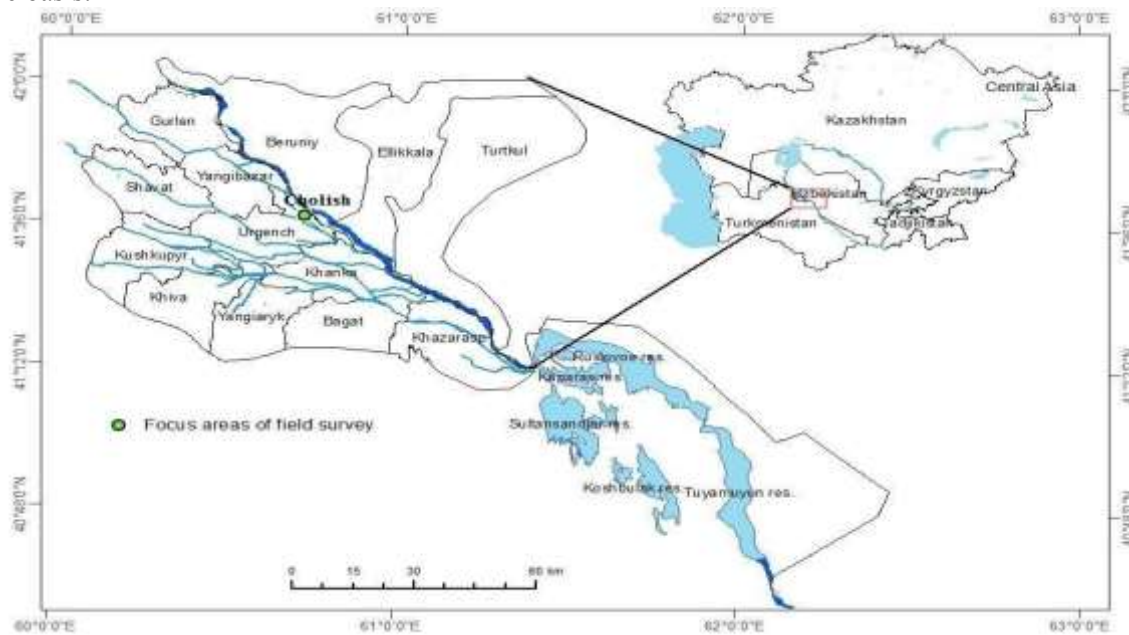


Fig.1. Map area of field survey, Uzbekistan, Khorezm region

Research methods and description of the site, where the materials were collected. Khorezm region is located in the north-western part of Uzbekistan, along the lower reaches of Amudarya at 60-61 degree longitude and 40-41 degree latitude. It is located at an altitude of 113 - 138 m above sea level. The climate is strictly continental. The average annual precipitation is 80-90 mm. The average temperature in January is 15 C, in July the average temperature is +30 C. The climate of the oasis is greatly influenced by the Kyzylkum and Karakum deserts (Abdullaev et al., 2020). Phenological analyzes were carried out mainly in spring and summer.

Loc: 1. Since the research area is close to the Amudarya coast, ponds and small water bodies are formed from the accumulation of underground water. This area belongs to the specially protected areas under the management of “National Park” of Khorezm Nature established by the Committee for

Ecology and Environmental Protection of the Republic of Uzbekistan. Any activity serving human needs is prohibited in these areas. During our observations in these areas, it was found out that turangil (desert poplar), oleaster and tamarix formed the main vegetation.

Loc: 2. Khiva is located 2.84 kilometers from the city center, in the northeastern part of the city. It is a recreation and fishing zone. It is surrounded by thick reeds. One side of the lake is near the main Khiva highway.

Loc: 3. It is located in Beruni and Amudarya districts of the Republic of Karakalpakstan. The reserve is located on the right bank of the river, at the foot of the Sultan Uwais Mountains. It was established in 1971. The area is 6462 hectares, of which 3975 hectares are covered with forests. The desert poplars cover the main part.

Loc: 4. District in Khorezm region. It borders Shavat district in the south, Urganch,

Yangibazar districts in the southeast, the Republic of Karakalpakstan in the north-east, and Turkmenistan in the south-west. The place of

research is Vazir village of Gurlan district. It is located in the northern part of Gurlan district and Amudarya flows from the north-east.

Table 1

Visited site (4)	(long//latt.)	2020	2021	2022
Location 1. Cholish, Urganch district	41°38'22.79"N, 60°41'21.43"E	0 (V.20) 1exx VI.16 5 – 8 (VI.28)	2 exx (V.22) 5+exx (VI.06) 10+exx (VI.17)	4 exx V.25, 4exx V.30, 12+exx (VI.18) (flying, mating)
Location 2. Govuk Lake, Khiva district	41°24'29.13"N, 60°22'42.41"E	1exx (hunting time) (VI.20)	2exx (mating) (V.29)	2 exx VI.18 5exx VII.01.
Location 3. Amudarya Biosphere Reserve	41°58'43.03"N 60°21'49.15"E	5 exx/ (flying) (VI.22)	4 exx/ (flying) (VI.09) 1ex (VII.20).	2 exx VI. 18. 2 exx (near river) , VI.22.
Location 4. Vazir village, Gurlan district	41°53'24.08"N 60°25'55.46"E	2exx (flying) VI.20	5 exx/ (flying) (VI.09) 2 exx (VII.18)	x

1 table. Information about the areas where the observations were made and the individuals encountered (observed species presented of number).

Phenological observations were made based on literature reviews (Kalkman, V.J., 2006, Boudot, J.-P., Schneider, W. & Samraoui, B., 2013) and personal observations. Observations have been made since the appearance of imagos. The research

sites were visited in 10-day-intervals, 3-4 times a month during the months of May-June-July (Borisov, 1982). The total number of all phenological observations was 20.



Figure 1. Species *L. tetraphylla*, Urganch district, Cholish. Tugai forest (photographed by the author, using the Nikon D 800 device, 18.VI.2022.)

3. Result and discussion

Observations were made in Khorezm oasis in 2020-2022. From the second half of May, *L. tetraphylla* began to fly actively. In early spring (March-April), we also observed species such as, *C. erythraea* (Morton, 1920), *O. albistylum* (Selys, 1848), *O. cancellatum* (Linnaeus, 1758) *O. brunneum* (Fonscolombe, 1837), *S. paedisca* (Brauer, 1877), *S. gobica* (Foerster, 1900), *I. elegans* (VanderLinden, 1820), which belong to the genera *Crocothemis*, *Orthetrum*, *Sympetma*, *Ischnura*. Researches were conducted in 3 sites of the region and one site of the Republic of Karakalpakstan.

Loc: 1. More than 10 visits were made to this area during the years 2020-2021-2022, and the species was recorded as follows - 16.VI.2020, 1♀♀. 28.VI.2020 5-8 (image). 22.V.2021, 2♂♂. 06.VI.2021 2♂♂, 3♀♀, 17.VI.2021, 10+ 25.V.2022, 4+ (imago, flying) 30.V.2022 5+(imago, flying), 18.VI .2022 12+ (flying, mating pairs) (table 1).

Since these lands are mainly the slopes of Amudarya, small ponds have formed from underground water. The water is warm and salty, rich in algae. But we could not find larvae of *L. tetraphylla*. In the process of hunting, we even witnessed them feeding on large species of wasps (*vespidae*). A species of *L. tetraphylla* flew to the

artificial light at night (16.VI.2020, 1♀♀.) Also European bee-eater (*Merops apiaster*) was observed to feed on *L. tetraphylla* (18.VI.2022)

Loc: 2. All sides of the lake surrounded by thick reed beds, rich in waterfowl. Here, during our visit, we observed imagos actively hunting and breeding. 20.VI.2020, 1♀♀ (hunting time). 29.V.2021 2♂♂♀♀ (mating time). 18.VI.2022, 2♂♂ (hunting time). 01.VII.2022 2♂♂, 3♀♀ (flying time, observed on the shore of the lake).

Loc: 3. We visited this area 4 times during 2020-2021, and we managed to record the species during 3 observations. The researched area is river banks and water basin surroundings. 22. VI. 2020 2♂♂, 2♀♀ (flying time), 22.VI.2021 1♀♀ (became known at night, artificial light). 18. VI. 2022. 2♀♀ (near river), 22.VI.2021. 1♂♂ (flying time). Also in this area, in the second half of June, it was noted that one male imago flew to an artificial light at night.

Loc: 4. The slopes of Amudarya are considered to be made up of groves. The number of visits to the area since early spring is 20. VI. 2020 2♂♂ (flying), 09.VI. 2021 2♂♂, 1♀♀ (hunting time, mating pairs). 18.VII.2021. 2♂♂ (flying time). According to the results of phenological observations, the species *L. tetraphylla* belongs to the group of spring-summer species, and its flight activity starts from the last ten days of May and ends at the end of July. By the middle of June, it actively hunts in the afternoon - at night (2 photos).



Figure 2. In the Amudarya Biosphere Reserve, *L. tetraphylla* (1♀♀) coming to artificial light at night (the author of the photo is Bekchanova M. 22.VI.2021, the photo was taken using the RED mi, note 9s device).

According to phenological analysis, this species was observed in the Khorezm oasis from the 3rd decade of May to the last ten days of July. (3

pictures). The period with the highest number of species corresponded to the second decade of June.

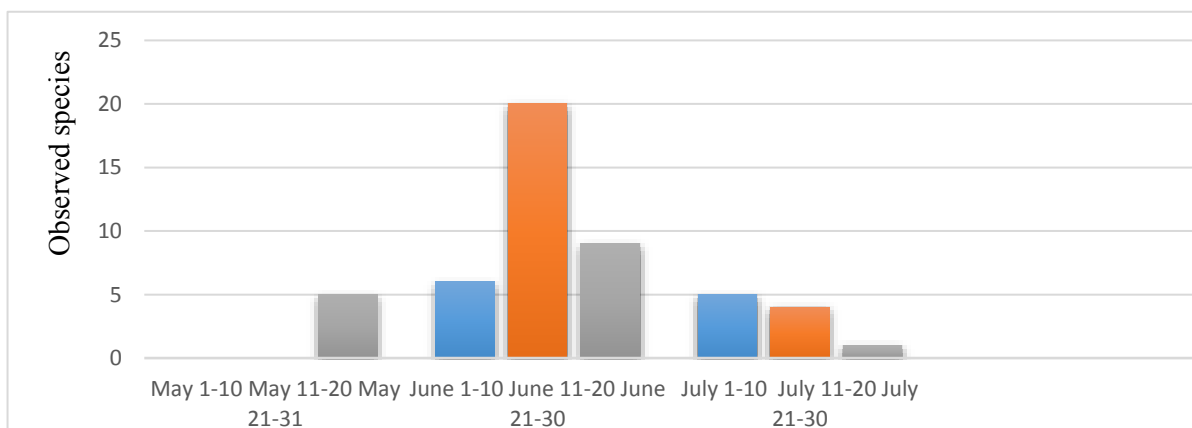


Figure 3 . Phenological analysis of the species *L. tetraphylla*

4. Discussion

According to the results of studies, we can see that populations of *L. tetraphylla* species are widely distributed throughout the orchards of the Khorezm oasis located in the north-western part of Uzbekistan. In the Fergana Valley of the Republic

of Uzbekistan, particularly, Andijan region (Ulughnor, Boz, Baliqchi, Izboskan, Pakhtaabad, Marhamat, Khojaabad, Kurgantepa districts, Andijan, Asaka and Khanabad cities), Fergana region (Kuva, Yozyovon districts, Fergana city), Namangan region (Namangan, Chortoq, Mingbulok), during 2017-2020, materials were

collected for the study of dragonflies scattered in large riverbeds and their surrounding channels, ditches and collectors. The species *L. tetraphylla* is not mentioned in the species composition of dragonflies in these research works (Zokirova, 2021.).

The Fergana Valley is located between the mountains in Central Asia, is one of the large mountain ranges (valleys) of Central Asia. It is surrounded by the Tianshan mountain range in the north and the Hisar Aloy mountain range in the south. It is mainly located in the Republic of Uzbekistan, partly in the territory of the Republics of Kyrgyzstan and Tajikistan. Its wide part is in the shape of a triangle, extending to the northern slopes of the Turkestan and Aloy ridges, to the east. It is surrounded by the Kurama and Chatkal ridges from the west, and the Fergana ridge from the northeast. In terms of climate and natural geographical structure, it differs sharply from the regions of the Khorezm oasis. Most studies have identified this species as a species adapted to living in plains and desert, semi-desert areas (Walker and Pittaway, 1987). The areas under our observation consist mainly of dark turangil and tugai forests. They were found mainly breeding and hunting. Exuviums were not found in our observations. According to the literature, it was mentioned that the *L. tetraphylla* species migrates to places several kilometers away from the water bodies where it was released. In some literature (Lohmann, 1992), *L. tetraphylla* species is mentioned as a river species, while in some literature, it is said that it is found on the shores of lakes. A number of studies have been conducted in Mediterranean lakes and in Southern Europe. According to this, it was mentioned that this species appeared in artificial reservoirs with concrete stone shores (Kalkman & Van Pelt, 2006) Belančić et al. (2008) described the habitat of the species as mostly natural in Croatia. In the Khorezm oasis, most of the populations are located in natural areas. We did not record *L. tetraphylla species*, although other species were found in areas close to residential areas, and in areas close to agro-landscape areas. If we conclude from this, cattle breeding, farming in the natural protected areas, and human exploitation of undeveloped lands can cause the reduction of the range of *Lindenia tetraphylla* species. Our future work is to monitor this species on a national scale.

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