

Habitat choice of *Cordulegaster vanbrinkae* in Iran (Odonata: Cordulegastridae)

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Abstract. The occurrence of *Cordulegaster vanbrinkae* was studied in Gilān and Māzandarān provinces in northern Iran in July 2014. Ten localities demonstrated the occurrence of *C. vanbrinkae* at elevations from 169 to 1,424 m a.s.l. Larvae were found at seven localities and oviposition was observed at two localities. A total of 65 males, five females, 95 larvae, and 32 exuviae were found. Habitats were classified into the following types: a) narrow, shallow streams in forests at middle and higher altitudes; b) boulder-stepped shaded forest streams; c) deep cut forest streams with gravel banks, drying to intermittent pools; and d) broader sunlit rivers.

Key words. Dragonfly, Anisoptera, faunistics, new records, habitat preference, bionomy, Alborz Mts.

Introduction

Cordulegaster vanbrinkae Lohmann, 1993 belongs to the so-called “*C. boltonii* group” where together with *C. heros* Theischinger, 1979 and *C. picta* Selys, 1854 it represents the eastern subgroup (VERSCHUREN 1989; BOUDOT 2001). *Cordulegaster vanbrinkae* is the darkest species of the genus, with the yellow dots on the abdomen reduced (LOHMANN 1993; ANANIAN & TAILLY 2012; SCHNEIDER et al. 2014). It was described based on one specimen collected 1971 north of the locality of Veysar near the town of Chalus, in the Alborz Mountains in northern Iran (LOHMANN 1993). Subsequently, *C. vanbrinkae* was recorded in 2010 in south-eastern Armenia in the surroundings of Verin Khotanan village (ANANIAN & TAILLY 2012) and then in 2013 at two localities in the Caspian region: One in south-eastern Azerbaijan in the surrounding of the Azfilial settlement (SKVORTSOV & SNEGOVAYA 2014) and another in the area surrounding the type locality in Iran (SCHNEIDER et al. 2014).

The range of this species is not known in detail. Present records suggest it is a South Caspian species, largely restricted to the Hyrcanian and neighbouring forests including its western end in warmer open environments (SKVORTSOV & SNEGOVAYA 2014). Hyrcanian forest is created by the following dominant tree species at lower elevations (A. Salehi and Y. Ahangaran pers. comm.): *Quercus castanifolia*, *Carpinus betulus*, *Parrotia persica*, *Acer velutinum*, and *Alnus subcordata*, often with an understorey of dense *Buxus hyrcanus*. *Fagus orientalis* and *Acer velutinum* with isolated *Ulmus scabra*, *Fraxinus excelsior*, *Tilia cordata*, and *T. dasystyla* dominate at higher elevations. The alluvia of broader streams typically have a dominant vegetation of *Alnus subcordata*.

There is no information on the features of the females, larvae or exuviae, and only few details about the ecology of the species are known. The IUCN Red List of Threatened Species classifies this species in the DD (Data deficient) category because of the paucity of information (BOUDOT 2006).

This article provides new information on the distribution of *C. vanbrinkae* in northern Iran and discusses some aspects of its ecology and behaviour, including habitat selection and the flight activity of adults.

Material and methods

Intensive investigations of aquatic habitats were performed during July 2014 (8–19- and 27-vii-2014). The habitats were selected in Māzandarān and Gilān provinces, which have large-scale expanses of Hyrcanian forest where *Cordulegaster vanbrinkae* may occur (Fig. 1). Forest streams and rivers were selected. The middle and lower reaches of the streams, especially sections with suitable features, were searched. Larvae were the focus of the search on 100 m sections containing suitable sediment, where they were caught by sluicing sediments. Bank vegetation, stones and rocks on the banks were searched for exuviae. Adults were caught or photographed for later determinations (Fig. 2). Two localities (Qaleh Rudkhan, Poonel – Shafarud) were observed from 8 a.m. to 4 p.m. IRDT (Iran Daylight Time; UTC + 4:30 h) to evaluate imaginal activity. Adults were determined on the basis of the characteristics reported in previous studies (LOHMANN 1993; ANANIAN & TAILLY 2012; SCHNEIDER et al. 2014).

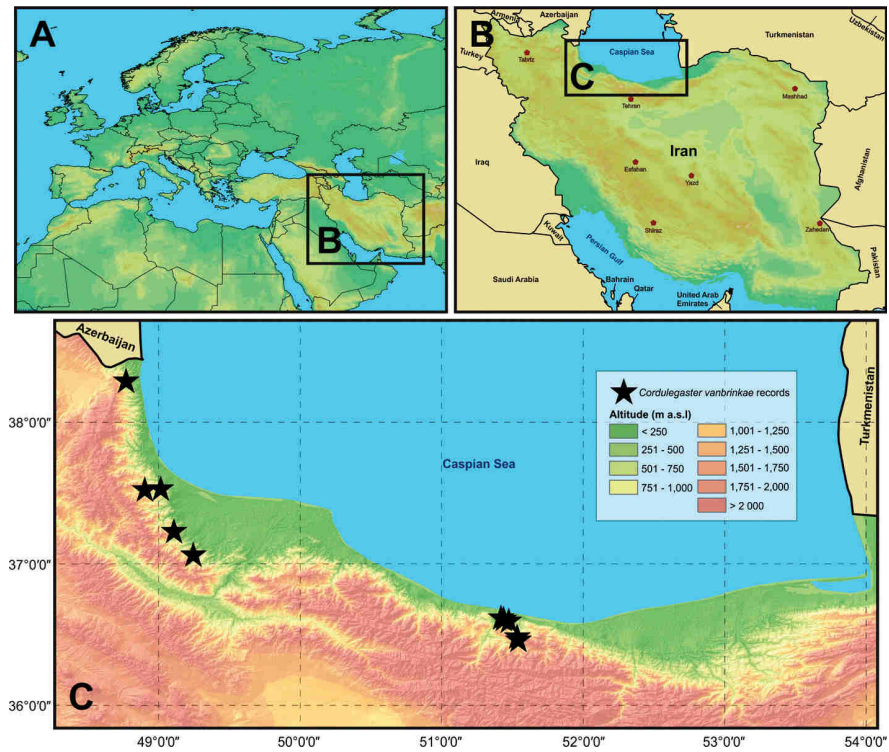


Figure 1. New localities with records of *Cordulegaster vanbrinkae* in northern Iran.

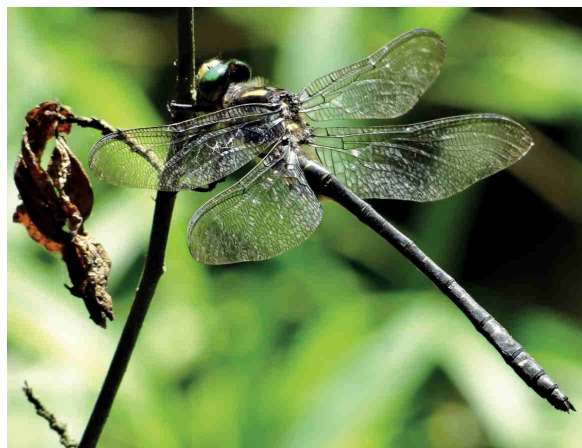


Figure 2. Male *Cordulegaster vanbrinkae* resting in sunspots at the Koshkesara – Khātir bon stream (site 8), Chālūs district, Māzandarān province, northern Iran (14-vii-2014). Photo: OH.

Table 1. List of sites where *Cordulegaster vanbrinkae* was found in northern Iran in July 2014. L – larvae; E – exuviae; I – male/female imagines.

Site	Province	District	Locality – local name	Coordinates N	Coordinates E	Elevation [m a.s.l.]	Date	Record of
1	Gīlān	Fūman	Qaleh Rudkhan	37°04' 01.46''	49°14' 46.00''	412	09-vii-2014 17-vii-2014	2L, 27E, 0/1 I 3L, 1E, 2/0 I
2	Gīlān	Tālesh	Ardeh – Derān	37°31' 40.52''	48°54' 12.85''	784	18-vii-2014	20L, 11/0 I
3	Gīlān	Tālesh	Poonel – Shafā Rūd	37°32' 01.44''	49°00' 57.88''	318	10-vii-2014 18-vii-2014	4L, 2E, 2/0 I 4/1 I
4	Gīlān	Sowme'eh Sara	Āliān	37°13' 58.97''	49°06' 33.13''	349	16-vii-2014	2L, 1E, 1/0 I
5	Gīlān	Astara	Lavandevīl – Laton waterfall	38°17' 44.28''	48°46' 14.48''	568	27-vii-2014	0/1 I
6	Māzandarān	Chālūs – Shoorab	Veysar – Talī Chāl Stream	36°27' 53.88''	51°32' 32.65''	1,427	13-vii-2014	42L, 1E, 35/0 I
7	Māzandarān	Chālūs – Jamand	Veysar – Lāroosar Stream	36°29' 18.07''	51°32' 02.55''	1,276	13-vii-2014	17L, 4/0 I
8	Māzandarān	Chālūs	Koshkesara – Khātibon stream	36°37' 20.68''	51°25' 13.52''	237	14-vii-2014	5L, 3/2 I (Fig. 2)
9	Māzandarān	Chālūs	Neyrang – Khalīl Rūd Stream	36°35' 59.54''	51°28' 31.98''	178	14-vii-2014	2/0 I
10	Māzandarān	Chālūs	Koshkesara – Khānikan Stream	36°36' 47.74''	51°26' 20.02''	169	14-vii-2014	1/0 I

The habitats of *C. vanbrinkae* were classified based on the characteristics of watercourses and their surroundings (e.g., width, slope, shading, and the presence of sediment).

Results

Cordulegaster vanbrinkae was found at 10 localities from 169 to 1,427 m a.s.l. (Tab. 1). Larvae were found at seven localities. A total of 65 males and five females as well as 95 larvae and 32 exuviae were found. Eleven males, three females, 43 larvae and 21 exuviae have been stored as voucher specimens in coll. O. Holuša.

Habitat description

The habitats were classified into the following four types:

- a. Narrow, shallow streams in forest at middle and higher elevations; depth 2–5 cm, width 20–120 cm, stream bed with a gentle slope without large boulders, frequent sand and muddy sediments, without large pools, and shaded by trees (Fig. 3). Numerous populations of larvae, often in groups, with several stadia, and adults showing intense flight activity were discovered in some places.
- b. Shaded stepped boulder streams at middle elevations; depth 10–150 cm, width 90–420 cm, stream bed with large boulders to rocks, often surrounded by a vertical wall of rock, frequent large pools in the bed with a depth of 140 cm, sediment only in large pools, with sand and gravel, and shaded by trees (Fig. 4). Populations were recorded at lower abundance, i.e. 1–4 larvae per 100 m section of the stream, and single sightings of imagines were recorded, but at some sites a great abundance of exuviae was found, which had probably been carried down from the higher parts of the stream when in spate.
- c. Deep cut forest streams at lower altitudes; depth 2–10 cm, width 3–4 m, stream bed with a very low slope, bed without large boulders, stream bed sandy and silty, stream dries up but eventually pools that are fed by water flow in the rubble and shaded by tree vegetation remain (Fig. 5). Only individual occurrences of larvae at low density were found in small residual pools in the dry stream bed. Females were also found at residual pools, sometimes ovipositing. Males were also observed in totally dry parts of the stream bed.
- d. Broader sunlit rivers at lower altitudes; depth 20–60 cm, width 4–10 m, stream bed with a lower slope and bottom sediments sandy and silty, lacking both in large boulders and large pools. Sediments only locally close to the banks, open, totally exposed to sunlight, without shading trees. Larvae were not found. Only single sightings of flying males were recorded.

Imaginal behaviour

The first individuals were detected on the wing at 09:00 h IRDT at an air temperature of 19°C in clear weather. Very intense flight activity was recorded at sites 2 and 6, where between 11:00 h and ca 16:00 h males were



Figure 3. The locality of Ardeh – Derān (site 2), Tālesh district, Gīlān province, northern Iran, where periodic patrolling flight of *Cordulegaster vanbrinkae* males was observed (18-vii-2014). Photo: OH.



Figure 4. The locality of Qaleh Rudkhan (site 1), Fūman district, Gīlān province, northern Iran, where there was a scarcity of larvae and adults of *Cordulegaster vanbrinkae* (09-vii-2014). Photo: OH.

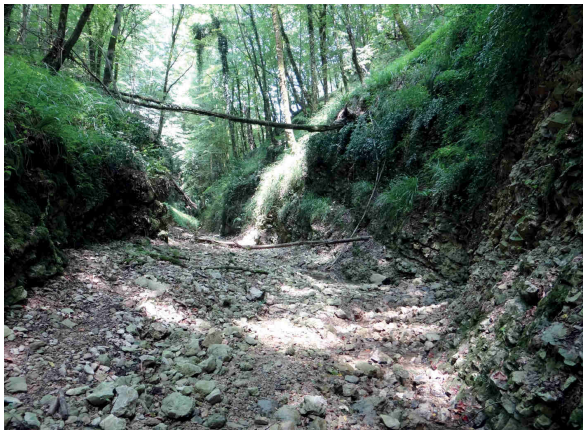


Figure 5. The locality of the Koshkesara – Khātibon stream, a dry creek bed with small pools of water (site 8), Chālūs district, Māzandarān province, northern Iran, where individual larvae of *Cordulegaster vanbrinkae* were found in residual pools (14-vii-2014). Photo: OH.

recorded every 10 to 20 minutes. Two flight activity patterns were found in males:

- a. Patrol flights along streams – direct flights of males along streams; in most cases, approximately 80 % of individuals flew upstream, 20 % downstream, rarely interrupted by stops or loops to the side, flying 20–40 cm above water for more than 50–70 m along the long sections of streams.
- b. Arrival flight at the side of the watercourse – sudden arrival flights from the surrounding forest to the streams, looping flights up the streams or pools, flying a few meters along streams, turning back and flying downstream and returning to vegetation, often drinking from the water surface.

Perching and basking by males in sunspots in the stream bed at heights of 1–3 m were observed infrequently (Fig. 2).

Sudden arrival flights to the watercourses from the surrounding vegetation were also recorded in females. They swirled above pools in the river bed and flew 2–4 m along the streams. Females attempted to select a site for oviposition, tending to choose sites with gravel and sand at the base of the banks. Females laid eggs in the same manner as other *Cordulegaster* species (15 penetrations in one locality and 12 in a second locality).

Orthetrum sabina (Drury, 1770) occurred at the observed sites in high densities, sometimes *en masse*. However, no contact between *C. vanbrinkae* and *O. sabina* or the single syntopic *Calopteryx splendens* (Harris, 1780) or *Aeshna* sp. present was noticed.

Discussion

Cordulegaster vanbrinkae is known from only a limited area and is the rarest species of its genus. It has currently been reported from 12 localities that are distributed almost over the entire belt from southern Armenia and south-eastern Azerbaijan to northern Iran. An extension of the species' range to some parts of eastern Georgia (i.e., the protected area of Vaslovani) is very uncertain and needs further investigation. The eastern border could be well in the promontory of forests in north-eastern Iran near the border with Turkmenistan (cf. SCHNEIDER et al. 2014), which would match both the south-eastern spur of the *Fagus orientalis* range (EUFORGEN 2014) and the range of the genus *Tilia* (YOUSEFZADEH et al. 2010).

SCHNEIDER et al. (2014) suggested that the species is restricted to elevations between 1,000 and 1,600 m a.s.l. Our records included sites from 196 to 1,427 m a.s.l. and published records include localities from 51 to 1,550 m a.s.l. Most likely, the majority of localities are located at middle elevations, probably around 1,000 m a.s.l. as most of the best habitats occur around this elevation.

The large number of exuviae found (sites 1, 2, 3, and 6) suggests that adults emerge mainly in the month of June and probably in late May at lower elevations, as observed in some central European species such as *Cordulegaster bidentata* (HOLUŠA 2007).

Two sites (9 and 10), in which the streambeds were wide and included larger gravel-sand areas open to sunlight, were visited by nomadic males and apparently did not support larvae. Such sunny places don't seem to be suitable for reproducing populations.

Habitat desiccation is an important factor for *Cordulegaster* species, as this limits the occurrence or causes the extinction of the species (BOUDOT 2001, 2010). Our findings suggest that some larvae, especially older instars, survive habitat desiccation by burying themselves in the moist substrate. This behaviour is also known from other Anisoptera such as *Libellula depressa* (KNAPP et al. 1983), *Trithemis arteriosa*, and *Orthetrum chrysostigma* (DUMONT 1982).

Based on existing knowledge (e.g., adults observed, exuviae, and emergence), it can be concluded that the flight period will be the same as in the related species *C. heros* and *C. picta*. Basing on the appearance of exuviae, the first emerged individuals can be estimated to occur at the beginning of June. Besides, as a juvenile individual was found on 14-vii-2014, it is likely that the flight period will reach the first half of August. This corresponds to the situation in Armenia, where no imago was found on the wing after mid-August (ANANIAN & TAILLY 2012). The peak of the flight period probably extends over July.

Current knowledge classifies this species as category DD (Data deficient) according to the IUCN Red List of Threatened Species (BOUDOT 2006). Some authors suggest that forests in the Alborz Mts. are vanishing because of extensive logging for agricultural purposes (KNAPP 2005). However, logging has stopped in several areas of protected regions, e.g., near Chālūs in the North Alborz Protected Area (Y. Ahangaran pers. comm.). Furthermore,

forestry is not a serious problem if a timber selection and extraction practices are designed to minimise impact on adjacent forests streams. However other factors such as pollution can affect odonate populations. Some sites are directly linked to human settlements and to the runoff of chemicals. However, the largest socio-economic problem is the use of forests for grazing cattle, which can significantly affect water chemistry because of their excrement and also cause habitat damage by tramping banks. All areas in the vicinity of settlements are under strong pressure of human activity.

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