OCCURRENCE OF TIGER BEETLES (CICINDELIDAE : COLEOPTERA) IN CHILLA WILDLIFE SANCTUARY, RAJAJI NATIONAL PARK, UTTARAKHAND

MANISH BHARDWAJ, VINAY K. BHARGAV AND V.P. UNIYAL

Wildlife Institute of India,
Chandrabani, Dehra Dun (Uttarakhand).

Introduction

The Tiger beetles (family Cicindelidae) are members of the sub-order Adephaga within the order Coleoptera. Tiger beetles so named because not only they are predatory insects, but their colouration pattern merges with the background for a perfect camouflage. There are over 2,600 species of Tiger beetles worldwide (Sinu *et ah,* 2006), 220 in India (with 114 or 51.8% endemics). Most adult Tiger beetles are characterized by large, prominent compound eyes and eleven-segmented, filiform antennae. The antennae are inserted on the frons above the clypeus and below the eyes, and the labrum is as wide as the clypeus. The head, at the eyes, is wider than the pronotum (in most common genera of cicindelids). The tarsi are five-segmented. The larvae of the Tiger beetles are highly predaceous, but are grub-like and do not hunt freely going around but stay in a special burrow in the ground, waiting for prey passing around.

The techniques for collecting adult Tiger beetles vary by genus. Some are diurnal, while a few others are primarily nocturnal. The best time for collection is on warm (greater then 30°C), sunny days. The preferred habitats are variable and include riverine sandy areas, riverside forests, paths and trails, roadsides and agricultural fields. Pearson and Cassola (1992) have proposed the use of Tiger beetles (Cicindelidae) as a good indicator group for identifying area for biodiversity conservation. On a much small geographical scale, cicindelids are particularly useful as 'fast indicators' of biotope quality relative to disturbance (Clark and Samways, 1992).

The Indian sub-continent has one of the most diverse Tiger beetles fauna of the world. Pajni and Bedi (1973) and Pajni *et al.* (1984) studied the Cicindelid fauna of Punjab State. Pearson and Ghorpade (1987, 1989) studied the Tiger beetles of Siliguri-Darjeeling area and geographical distribution and ecological history of Tiger beetles of the Indian sub-continent. Singh (1991) studied some Cicindelidae fauna of India with reference to external genitalia, while Uniyal and Mathur (2000) studied the altitudinal distribution of Tiger beetles in the Great Himalayan National Park conservation area of Western Himalayas. Sinu *et ah* (2006) studied the feeding fauna and foraging habits of Tiger beetles found in agro-ecosystems in the Western Ghats. Uniyal and Bhargav (2007) studied the Tiger beetle fauna of Himachal Pradesh. Uniyal *et al.* (2007) studied the role of Tiger beetles as ecological

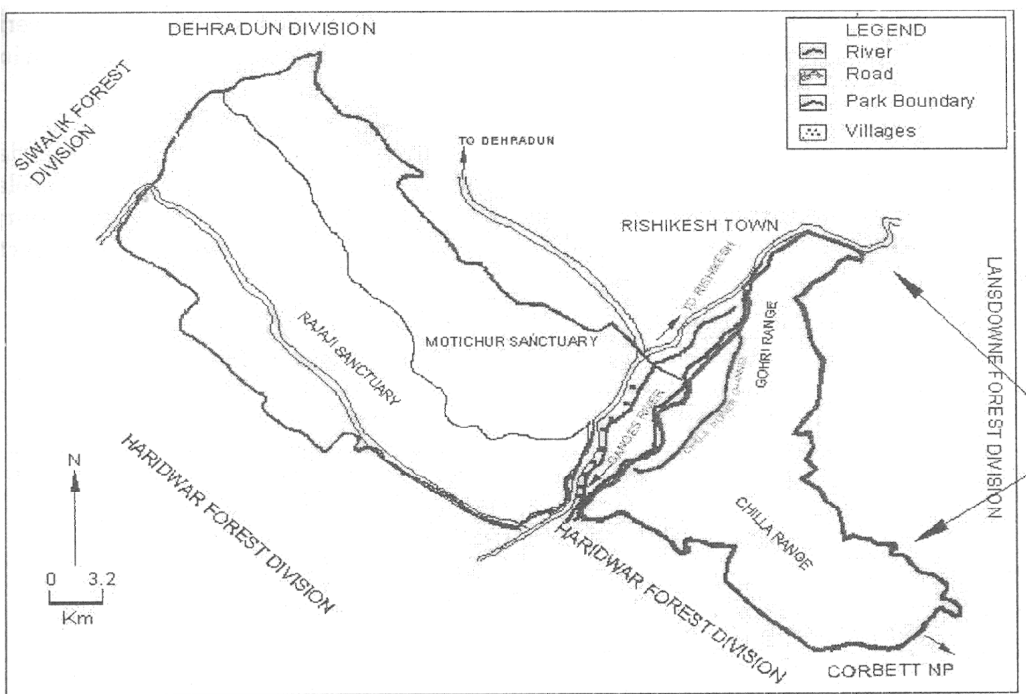
indicators in Shivalik of Himachal Pradesh and Uttarakhand. The present study was conducted to document the species diversity and habitat preference of Tiger beetles in Chilla Wildlife Sanctuary of Rajaji National Park..

Study Area

The sampling was conducted in Chilla WLS (148 km^2) part of Rajaji National Park (820 km^2) (Fig. 1). It is situated at the Shivalik foothills falling in Haridwar, Pauri-Garhwal District of Uttarakhand. The sanctuary is thickly foliated predominantly by the Sal *(Shorea robusta)* mixed forest and a number of other forest types which includes the western Gangetic moist and northern dry deciduous and khair-sissoo forests. Major tree species are *Shorea robusta, Mallotus philippensis, Ehretia laevis, Tectona grandis* and *Haplophragma adenophyllum.*

Topography, drainage and climate : The altitude varies from 400 m to 1,000 m with steep southern slopes and is drained by numerous rivers and streams running north to south, most of which remain dry in late winter and summer. These monsoon river beds are called as 'raus'. The sanctuary is bounded by the Ganges on the west, the range is drained by Gasiram and Khara raus on the southern boundary, Amgadi, Ghara and Mundal raus through the middle and Mitawali and Luni near the eastern boundary. Rainfall ranges from 1,300 to 1,900 mm per year with most of it during the monsoon (July - October) and sporadic rains through the year. With

Fig. 1



Chilla Wildlife Sanctuary (Rajaji National Park), Uttarakhand.

temperatures ranging from 20°C to 45°C (Harihar, 2005).

Methods

The study area was classified into five different habitat types for sampling of Tiger beetles. Riverine forest (Raus), Grassland, Sal mix forest, Hilly forest and Human habitations outside the sanctuary area. Sampling was conducted in month of January to July 2007. Twenty one transects were laid in different habitat types of the study area. Sweeping were done on the line transects across homogenous habitat types, on sighting of Tiger beetles. This method permitted the collection of some arboreal species that occurred in the lower canopy and ground living species, most of which are diurnal. It was quite difficult to sample nocturnal species due to presence of elephant and tigers in the sanctuary. Larvae of Tiger beetles were collected directly from their subterranean habitat by manual picking.

Results

Twelve species of Tiger beetles were documented in five different habitat types and riverine habitat was found to be most rich (Fig. 2) and was characterised by eight species (Table 1). Taxonomic details and specific habitat features of all recorded species have been discussed in the paper.

Taxonomic Identification of Tiger beetles

Fowler (1912), Acciavatti and Pearson (1989) were used to make preliminary identifications of Tiger beetle specimens. Their identifications were confirmed by comparing with voucher specimens available at the Deptt. of Zoology, Punjab University, Chandigarh using Singh (1991) and Pajni and Bedi (1973).

1. *Calomera plumigera* (Horn)

Habitat specific characters: Largest amongst all species recorded and was found predominantly in the riverine habitat often in aggregations (Plate 1).

Diagnostic characters :

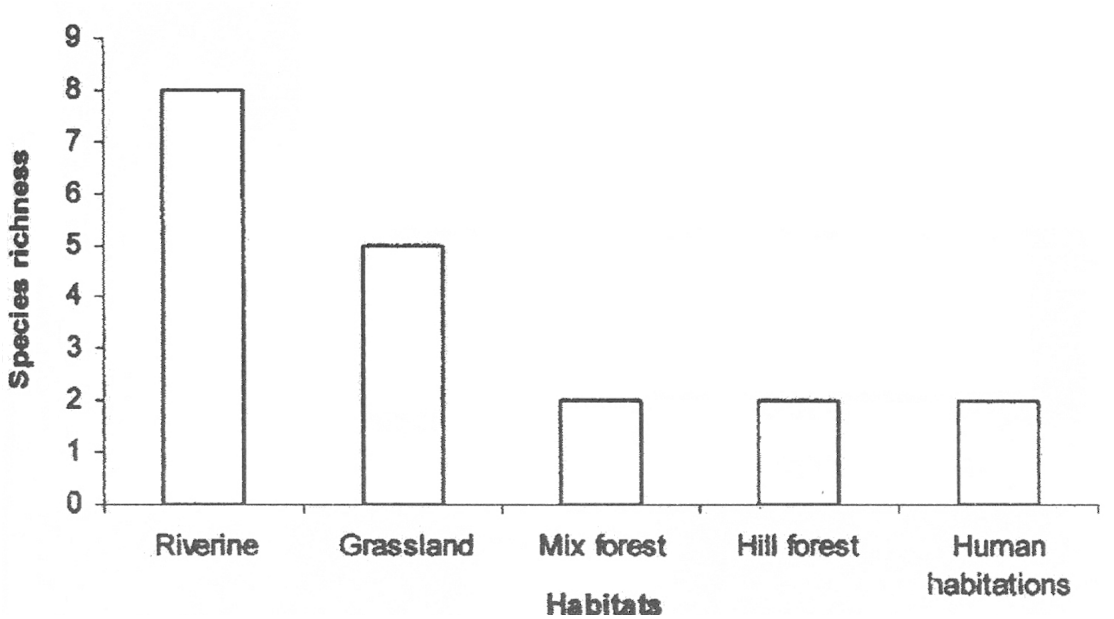
(i) Length 12.5-16 mm; head is dark greenish and coppery, antennae black with four basal joints with purple reflection. Pronotum is contracted

Table 1

Species of Tiger beetles recorded in Chilla Wildlife Sanctuary, Rajaji National Park

Habitats	Species Recorded
Riverine (raus)	*Calomera chloris, Calomera angulata, Lophyra parvimaculata, Calomera plumigera, Cicindela multiguttata, Cylindera venosa, Cicindela vigintiguttata, Myriochila undulata*
Grassland Mixed	*Cicindela fastidiosa, Jansenia chloropleura*
Forest Hilly Area	*Cosmodela intermedia, Calochroa bicolor*
Human Habitation	*Cicindela fastidiosa, Cosmodela intermedia*
	Calomera chloris, Calomera angulata, Calomera plumigera, Cicindela fastidiosa, Cosmodela intermedia,

Fig. 2



Species richness of Tiger beetles across habitats

before the base with greenish central line and green punctures.

(ii) Elytra are much broader than pronotum dark brown or olive green with elaborate or white testaceous markings. White colour extends from the shoulders to the apex, with an interruption before the apical lunate patch; there is a transverse extension towards suture, a large inverted V- or S-shaped patch at middle extending backwards.

(iii) Legs are greenish and coppery with reddish trochanters.

2. *Calomera angulata* (Fabricius)

Habitat specific characters: Most predominant of all species recorded in any habitat, often in dense aggregations (Plate 1).

Diagnostic characters

(i) Length 10.5-14 mm; head dull coppery, brilliant bright and greenish, broad and flat between eyes, glabrous, very finely striated longitudinally between eyes. Pronotum with colour similar to that of head, slightly rounded near apex, narrowed towards base, with impressions strongly marked, central line slightly marked. The margins of the elytra in the female are sometimes irregular and sinuate.

(ii) Elytra with colour similar to head and pronotum, with greenish punctures and white markings, slightly widened in middle. White colour extends from the shoulders to the apex, with an interruption before the apical lunate patch; there is a transverse extension towards suture, a large inverted V- or S-shaped patch at middle extending backwards.

(iii) Legs are greenish sometimes with coppery reflection.

Plate 1

Calomera plumigera

Calomera angulata

Cicindela multiguttata

Cosmodela intermedia

Cicindela vigintiguttata

Calomera chloris

3. ***Cicindela multiguttata*** **(Dejean)**

Habitat specific characters: Species of intermediate occurrence in riverine area (Plate 1).

Diagnostic characters

(i) Length 12-14 mm; head and pronotum brilliantly coloured with different shades of green and blue; white setae extend across the entire anterior margin and scattered over the pronotum.

(ii) Elytra greenish black, weakly pitted, each elytron with seven variable spots.

4. ***Cosmodela intermedia*** **(Chaudoir)**

Habitat specific characters: Most common species recorded both as juveniles and adults near human habitation, mixed forest and hilly areas (Plate 1).

Diagnostic characters

(i) Length 14-15 mm; head greenish, coppery in middle, with two purple blue stripes in front of eyes, slightly raised in middle between eyes, glabrous; antennae with four basal segments greenish black and deep blue.

(ii) Pronotum reddish coppery, with margins and impressions green and blue, with sides slightly rounded, narrowed towards base, with well marked impressions. Elytra much broader than the pronotum, with the sides being slightly rounded shoulders sub-rectangular, greenish and coppery. Each elytron has a white spot at the shoulder, and four others on each elytron.

(iii) Underside shining green and blue, legs blue and black and trochanters are dark brownish-grey, femora metallic, tibiae and tarsi dark; genae with few white hairs.

5. ***Cicindela vigintiguttata*** **(Herbst)**

Habitat specific characters: Least common species in the riverine area (Plate 1).

Diagnostic characters (i) 12-15 mm, Dull coloured species, with head and pronotum dark brown, setae on lateral margins of pronotum short and sparse, (ii) Elytra are greenish black, each elytron with ten short, dull white spots.

6. ***Calomera chloris*** **(Hope)**

Habitat specific characters: Only species recorded during winter in the riverine habitat (Plate 1).

Diagnostic characters

(i) Length 11.5-12 mm; head is greenish with coppery and bluish reflection, broad slightly raised in middle between eyes, surface is finely striated; antennae with four basal segments green with coppery reflection, rest black. Pronotum green, with the sides and depressions blue or violaceous, slightly transverse.

(ii) Elytra green to bluish green with blue punctures, much broader than pronotum, dull, granulose, at the margin about the middle there are two white spots joined by a thin line, before the apex a more or less comma-shaped spot.

(iii) Legs metallic, underside green and violaceous, with the whole of the sides of the abdomen, the episterna and the genae thickly clothed with long white coarse pubescence.

7. ***Lophyra parvimaculata*** **(Fowler)**

Habitat specific characters: Species of intermediate occurrence in riverine area (Plate 2).

Diagnostic characters

(i) Length 15-16 mm; head is dark green with bluish coppery reflection in the middle. Pronotum is setose on lateral sides.

Plate 2

Lophyra parvimaculata

Calochroa bicolor

Jansenia chloropleura

Myriochila undulata

Cylindera venosa

Cicindela fastidiosa

(ii) Elytra are dull greenish, long and the markings on each elytron include three spots along mid-sutural line roughly in middle. Humeral lunule is pale white coloured, extends and becomes broad towards centre. Middle band is short, inclined while apical lunules are separate spots without any connections.

8. ***Calochroa bicolor*** **(Fabricius)**

Habitat specific characters: Mostly recorded in high canopy cover of mixed forest areas (Plate 2).

Diagnostic characters

(i) Length 15-17 mm; head is coppery and dark green, flat between eyes, front parts green, finely and rugosely sculptured; broad between the eyes; antennae metallic black with four basal segments greenish. Pronotum as long as head without the labrum with colour and sculpture similar to that of head, sides convex and narrow base.

(ii) Elytra dark greenish, cyaneous or bluish with very fine sculpture, almost smooth and with two large yellow spots. Underside of the parts violaceous or partly green, abdomen dark, with the apex and the side margins reddish.

iii. Legs metallic, episterna of metasterna bare with a tuft of white hairs at inner posterior corner.

9. *Jansenia chloropleura* (Chaudoir)

Habitat specific characters: Recorded mostly as juveniles in the grassland habitat (Plate 2).

Diagnostic characters

(i.) Length 10-12 mm; head is predominantly coppery, with greenish reflection in front, green laterally behind the eyes, rather long, somewhat excavate and strongly striate between the eyes. Pronotum is bright coppery, green and blue laterally, strongly rounded at base, constricted near apex and base.

(ii) Elytra are dull coppery red or olivaceous with brilliant blue or green margins and suture, and with two white spots on each, just touching the marginal colour, one at middle and other at apex, surface with small moderately deep punctures.

(iii) Legs are black, with coppery and greenish reflection, trochanters are red, and underside is brilliant green or deep blue with very little pubescence.

10. ***Cylindera (Eugrapha) venosa*** **(Kollar)**

Habitat specific characters: Species mostly recorded near the edges of grassland-riverine interace (Plate 2).

Diagnostic characters

(i) Length 8-9 mm; head greenish and coppery, broad and slightly raised between eyes, with a small depression on each side of raised area. Antennae with four basal segments greenish, rest black. Pronotum greenish and coppery, transverse with sides straight and parallel, its surface are with transverse striations along central line and almost smooth at other places, laterally covered with long white setae.

(ii) Elytra slightly rounded at sides with shoulders slightly rounded, surface shallowly punctate with few basal punctures setigerous. Each elytron green and coppery with white maculation, which comprise of a complete white marginal line extending from shoulders to apex formed by fusion of a complete humeral and apical lunules and middle band.

(iii) Abdominal sternites green, densely setose with glabrous areas in middle. Legs green with anterior and hind trochanters partially reddish.

11. ***Myriochila (Myriochila) undulata*** **(Dejean)**

Habitat specific characters: Species mostly recorded near the edges of grassland-riverine interface (Plate 2).

Diagnostic characters

(i) Length 10-11 mm; head is small, dull coppery with the apex and basolateral portions being bluish green and coppery, feebly striated between the eyes and with no setae; antennae with the first segment metallic rest are dull brown coloured. Pronotum is more or less with parallel sides and lateral margins with setae the lateral sides of apex are bluish green while rest of the pronotum is dull coppery coloured

(ii) Elytra are uniformly pitted expanded towards the base, the antero-lateral margins being **bluish** green while the rest of the elytra are dull coppery coloured.

(iii) Legs are 'with greenish tro-chanters, metallic, setose while rests of the segments are brownish, tarsi brown ending in two claws.

12. *Cicindela fastidiosa* (Dejean)

Habitat specific characters: Species of intermediate occurrence in human habitation area (Plate 2).

Diagnostic characters

(i) Length 8-10 mm. Dorsal ground colour dull green with a mixture of blue on head and pronotum with several row of whitish setae.

(ii) Elytra with lunulate maculation and numerous bluish punctures.

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SUMMARY

Tiger beetles (Cicindelidae) are proposed as a good indicator group for identifying area for biodiversity monitoring. The present study documenting twelve species of Tiger beetles in five different habitat types in Chilla Wildlife Sanctuary of Rajaji National Park. Riverine habitat was found to be appropriate habitat for eight Tiger beetle species.

Key words: Tiger beetles, Cicindelidae, Biodiversity indicator, Chilla WLS, Rajaji NP, Uttarakhand.

चिल्ला वन्यप्राणि अभयारण्य, राजाजी राष्ट्रीय उपवन, उत्तराखण्ड में व्याघ्र भृंगों (व्याघ्रभृंग वंश : कंचुक पक्षा) की प्राप्ति

मनीष भारद्वाज, विनय के० भार्गव व वी०पी० उनियाल

सारांश

व्याघ्रभृगों (व्याघ्रभृंग वंश) को जैव विविधता की जांच पड़ताल करते रहने के लिए अच्छे संसूचक वर्ग के

रूप में प्रस्तावित किया गया है। प्रस्तुत अध्ययन में राजाजी राष्ट्रीय उपवन के चिल्ला वन्यप्राणि अभयारण्य के पांच विभिन्न प्राकृतावास प्ररूपों में मिलती व्याघ्रभृंगों की बारह जातियों को प्रलेखित किया गया है। इनमें से आठ व्याघ्रभृंग जातियों के लिए नदीय प्राकृतावास उपयुक्त रहता पाया गया है।

References

Acciavati, R.E. and D.L. Pearson (1989). The Tiger beetle genus *Cicindela* (Coleoptera, Insecta) from the Indian Sub-continent. *Annals Carnegie Museum,* 58:77-353.

Fowler, W.W. (1912). *The Fauna of British India, including Ceylon and Burma, Coleoptera: General introduction and Cicindelidae and Paussidae.* Taylor and Francis, London.

Glark, T.E. and M.J. Samways (1992). Dragonflies and damselflies. *Gustos,* 21 : 29-30.

Harihar, A. (2005). Population, Food Habits and Prey Densities of Tiger in Chilla Range, Rajaji National Park, Uttaranchal, India. *M.Sc. Thesis.* Wildlife Institute of India, Dehra Dun.

Pajni, H.R. and S.S. Bedi (1973). Preliminary survey of the Cicindelid fauna of Chandigarh, Punjab, India. *Cicindela,* 5(3) : 41-56.

Pajni, H.R., A. Kumar and D.L. Pearson (1984). Corrections and additions to the Tiger beetle fauna (Coleoptera: Cicindelidae) of the Chandigarh area of North-western India. *Cicindela,* 16(3/4) : 21.

Pearson, D.L. and F. Cassola (1992). World-wide species richness patterns of Tiger beetles (Coleoptera; Cicindelidae): indicator taxon for biodiversity and conservation studies. *Conservation Biology,* 6 (3): 376-391.

Pearson, D.L. and K. Ghorpade (1987). Tiger beetles (Coleoptera: Cicindelidae) of the Siliguri-Darjeeling area in India. *Coleman,* 4: 1-22.

Pearson, D.L. and K. Ghorpade (1989). Geographical distribution and ecological history of Tiger beetles (Coleoptera: Cicindelidae): of the Indian sub-continent. *J. Biogeography,* 16 : 333-344.

Singh, N. (1991). Taxonomic studies on some Indian Cicindelidae with special reference to external genitalia (Coleoptera: Insecta). *D.Phil. Thesis,* Faculty of Science, Punjab-University, Chandigarh.

Sinu, P.A., M. Nasser and P.D. Rajan (2006). Feeding fauna and foraging habits of Tiger beetles found in agro-ecosystems in Western Ghats, India. *Biotropica,* 38: 500-507.

Uniyal, V.P. and V. Bhargav (2007). *Tiger Beetles* -A *Field study in the Shivaliks of Himachal Pradesh.* Wildlife Institute of India, Dehra Dun.

Uniyal, V.P. and P.K. Mathur (2000). Altitudinal Distribution of Tiger Beetles (Cicindelidae: Coleoptera) in Great Himalayan National Park Conservation Area, Western Himalaya. *Indian Forester,* **126** (10): 1141-1143.

Uniyal, V.P., K. Sivakumar, R. Padmawathe, S. Kittur, V. Bhargav, M. Bhardwaj and R. Dobhal (2007). Ecological Study of Tiger Beetles (Cicindelidae) as Indicator for Biodiversity Monitoring in the Shivalik Landscape. *DST Project Completion Report.* Wildlife Institute of India, Dehra Dun.