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Research Article

Studies on the taxonomy and distribution of Cetoniinae (Leach, 1815) from Sindh-Pakistan

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Abstract

Cetoniinae are the members of scarab beetles commonly known as flower scarabs, fruit, chafers, and beetle. The present study was conducted from 2021 to 2023 in different ecological zones of Sindh-Pakistan. A total of 77 specimens were collected and sorted out into family Scarabaeidae, subfamily Cetoniinae with 02 genera i-e: *Clinteria* (Burmeister, 1842) and *Protaetia* (Burmeister, 1842) and with 02 species i-e: *Clinteria klugi* (Hope, 1831) and *Protaetia aurichalcea* (Fabricius, 1775) respectively. Besides this, species description, geographical maps, ecological data, and digital images of studied species are illustrated in the present paper.
Keywords: Flower chafers, Species, Ecology, Scarabaeidae, Illustration

Introduction

Scarab beetles, which belong to the subfamily Cetoniinae, are the members of the group known as flower chafers. Many species are diurnal and visit flowers to collect pollen and nectar or to snack on the petals of the flowers. Certain species also consume fruits. Various names have been given to this group, including flower beetles, flower scarabs, and fruit and flower chafers. There are approximately 4,000 species, most of which have not yet been described (Šípek *et al*., 2016; Gunter *et al.,* 2016). At the moment, eleven tribes are recognized: the Cetoniini, the Cremastocheilini, the

Diplognathini, the Goliathini, the Gymnetini, the Phaedimini, the Schizorhinini, the Stenotarsiini, the Taenioderini, and the Xiphoscelidini. Trichiini and Valgini, two tribes that had previously existed, were promoted to the position of subfamily. The Gymnetini tribe is the largest of the American tribes, and the Goliathini tribe, primarily located in the rainforest regions of Africa, is home to the largest species (Bouchard *et al.,* 2011; Mckenna *et al.,* 2015).

Adult flower chafers are characteristically brightly colored beetles that are frequently metallic in appearance and have a form that is somewhat flattened. When viewed from above, the insertions of the antennae are visible, although the mandibles and labrum are concealed behind the clypeus. Instead of having a tight membrane edge, the elytra are truncated, which allows the pygidium to be exposed (Bacchus, 1974; Lawrence & Britton, 1991; Lawrence *et al.*,2011). There is a divergence of the abdomen spiracles, which results in several of them lying on the abdominal sternites, with at least one being exposed. The mid coxae are transverse or slightly oblique, but the fore coxae are conical and ventrally generated. The fore coxae are produced ventrally. When viewed from above, the mesothoracic epimera can be apparent. Each of the tarsi is armed with a pair of simple tarsal claws of a size that is subequal to one another (Moeseneder *et al.*,2019; McQuillan, 1985).

Adult cetoniines are herbivorous and can be found on flowers (from which they ingest nectar and pollen), tree sap, and rotted fruit. Generally speaking, larvae will dwell and feed in decomposing plant materials, which may include decomposing wood or soil. Cetoniine larvae will consume soft fruit in captivity (Potapov *et al.,* 2022). Several researchers (Donaldson *et al.*,1986; Donaldson *et al*., 1990; Ratcliffe & Deloya, 1992; Holm, 1994; Ratcliffe & Micó, 2001; Krell *et al.,* 2002; Orozco & Pardo-Locarno, 2004; Ranius *et al.*,2005; Smetana & Smith, 2006; Mico *et al.,* 2008; Şenyüz & Şahin, 2009; Audisio *et al.*,2009; Legrand & Foo, 2010; Mynhardt & Wenzel, 2010; Ratclifle, 2010; Mudge *et al.,* 2012; Šípek & Kral, 2012; Orozco, 2012; Touroult & Le Gall, 2013; Rodrigues *et al*., 2013; Fremlin, 2018; Mitchell *et al.,* 2020; Perissinotto, 2020; Asgari *et al.*,2021; Perissinotto & Clennell, 2021; Perissinotto, 2022; Hernández *et al.,* 2023) carried out significant work on the various aspects of Cetoniinae fauna of the world. Recently, Mahar *et al.* (2023) reported a Cetoniinae species i-e: *Heterorrhina saeedi,* Mahar *et al.,* 2023 from Sindh Pakistan. However, no data have been found for the genus *Clinteria* (Burmeister, 1842) and *Protaetia* (Burmeister, 1842). The present study provides a detailed description of these two genera with two

species. This study will definitely be helpful for future researchers dealing with the Cetoniinae fauna of this area.

Material and methods

Specimens were collected throughout the Sindh region in different areas. The specimens were obtained by traps and hand-picking methods from different habitats during 2021-2023. The normal temperature of Sindh is warm and humid in the summer. The specimens were carefully transported to the Entomology lab, Department of Zoology, Shah Abdul Latif University, Khairpur, and stored using standard entomological methods in an insect collection box after being killed by potassium cyanide (KCN) in killing bottles for advanced study. The specimens were identified by examining them using a binocular microscope, and excellent-quality digital images of the samples were captured using a camera. For the purpose of identification, dichotomous keys and published research were utilized (Shipley, 1910; Lawrence & Britton, 1991; Moeseneder *et al.,* 2019). The morphological characters were observed, and measurements of specimens were taken with a scale divider in mm. The data was analyzed in MS Excel.

Results

The present investigation studies the Subfamily Cetoniinae (Leach, 1815), which includes 02 genera and 02 species.

Taxa
Subfamily Cetoniinae (Leach, 1815)
Genus *Clinteria* (Burmeister, 1842)
Diagnosis: *Clinteria* is a Genus of the Scarabaeidae family, commonly known as the flower beetles or fruit chafers. *Clinteria* beetles are usually brightly colored and have flattened, oval-shaped bodies. They have large eyes and clubbed antennae. Their size ranges from 5 to 60 mm long, depending on the species. *Clinteria* beetles are found in many habitats, including tropical rainforests, woodlands, grasslands, and even deserts. They are distributed worldwide but are most diverse in the tropics. Most species of *Clinteria* have a one-year life cycle. Females lay their eggs in decomposing wood or soil, and the larvae develop through several instars before pupating.
Ecology: The adults feed mainly on nectar, pollen, and fruit juices and are important pollinators of many plant species. The larvae of most species feed on decomposing wood or soil, but some species are pests of crops such as sugarcane and banana. *Clinteria* beetles are often active during the day, and can be seen flying around flowers or resting on foliage. Males may engage in territorial behavior and fight for access to females.

Diagnostic characteristics *Clinteria klugi* (Hope, 1831)

Body coloration: Reddish color with canary yellow spots.

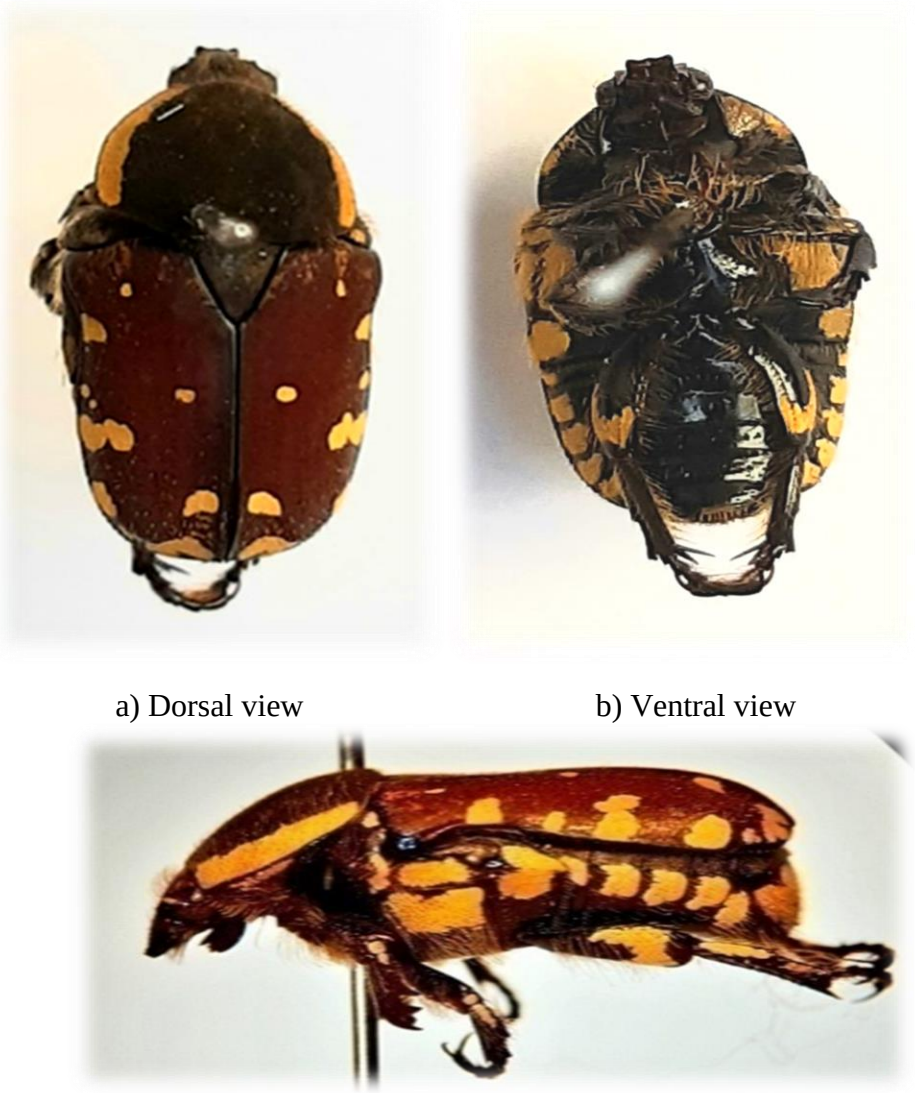
Head: Brownish with a strong metallic shine. Punctured densely on sides. The clypeus is arched downward. The antennal club is dark brown to black in color with a reddish stalk.

Thorax: The pronotum is dark to olive brown, with nearly none punctured. Sides with broad canary yellow. The sides' posterior half is a duller color than the border.

Abdomen: Scutellum is a dark brown in color and triangular in shape. Elytra are chestnut brown to reddish in color. Each elytron has five yellowish patches, two in the anterior and 3 in the posterior. The pygidium is reddish, transversally striated, with broad and yellowish patches.

Table 1. Morphometric measurement of *Clinteria klugi*

Body Parameters	Length (mm)				Width (mm)			
	Male (n=10)		Female (n=10)		Male (n=10)		Female (n=10)	
	Mean ± SD	Min-Max	Mean ± SD	Min-Max	Mean ± SD	Min-Max	Mean ± SD	Min-Max
Head	2.5 ± 0.5	2 – 3	4 ± 1	3 – 5	2.5 ± 0.5	2 – 3	3.5 ± 0.5	3 – 4
Thorax	6.16 ± 0.76	5.5 – 7	7 ± 1	6 – 8	5.5 ± 0.5	5 – 6	6.5 ± 0.5	6 – 7
Abdomen	11 ± 1	10 – 122	11 ± 1	10 – 12	9.5 ± 0.5	9 – 10	10.5 ± 0.5	10 – 11
Total length	14 ± 1	13 – 15	17 ± 1	16 – 18	----------	--------	----------	----------



a) Dorsal view b) Ventral view

c) Lateral view

Figure 1a. Dorsal, b.Ventral, and c.Lateral view of *Clinteria klugi*

Material Examined (*Clinteria klugi*)

Indus Delta

Badin: 7.iv.2021 1♂ (Mehtab A.M & Waheed A.P) same but 5.1.2022 1♂1♀ (Mehtab A.M & Waheed A.P). Hyderabad: 3.xi.2021, 1♀ (Mehtab A.M & Shaikh A.M) same but 2.ii.2022, 1♂1♀ (Mehtab A.M & Altaf A.M) same but 9.iii.2022, 1♂ (Mehtab A.M & Waheed A.P)

Southern Irrigated Plan

Dadu, 13.iv.2021, 2♂ (Mehtab A.M & Waheed A.P). Larkana, 18.iv.2021, 1♀ (Mehtab A.M & Waheed A.P). Jacobabad, 9.xi.2021, 2♂ (Mehtab A.M & Waheed A.P). Sukkur, 11.xi.2021, 1♀ (Mehtab A.M & Shaikh A.M). Shikarpur, 12.i.2022, 2♂ (Mehtab A.M & Shaikh A.M). Badin, 16.i.2022, 1♀ (Mehtab A.M & Altaf A.M). Tharparkar, 20.i.2022, 1♀ (Mehtab A.M & Waheed

A.P). Sanghar, 9.ii.2022, 1♂ (Mehtab A.M & Shaikh A.M). Khairpur, 13.ii.2022, 1♀ (Mehtab A.M & Waheed A.P). Shaheed Benazirabad, 16.iii.2022, 1♀ (Mehtab A.M & Waheed A.P). Hyderabad, 8.ii.2023, 1♀ (Mehtab A.M & Shaikh A.M)

Sandy Desert

Tharparkar, 21.iv.2021, 1♂ 2♀ (Mehtab A.M & Waheed A.P). Khairpur, 17.xi.2021, 1♀ (Mehtab A.M & Waheed A.P). Shaheed Benazirabad, 18.i.2022, 1♂1♀ (Mehtab A.M & Altaf A.M). Sanghar, 18.ii.2022, 1♀ (Mehtab A.M & Waheed A.P) same but 16.ii.2023, 1♂ (Mehtab A.M & Waheed A.P)

Dry western plateau

Karachi, 30.xi.2021, 1♀ (Mehtab A.M & Waheed A.P) same but 25.i.2022, 1♂ (Mehtab A.M & Waheed A.P). Dadu, 27.iv.2021, 1♂2♀ (Mehtab A.M & Waheed A.P) same but 29.iii.2022, 1♂ (Mehtab A.M & Waheed A.P).

Table 2. Distributional data and Ecological account of *Clinteria klugi*

S.no	Ecological Zones	Male	Female	No. of Specimen
1	Indus Delta	4	3	7
2	Southern irrigated plain	7	7	14
3	Sandy Desert	3	5	8
4	Dry western plateau	3	3	6
Total		**17**	**18**	**35**

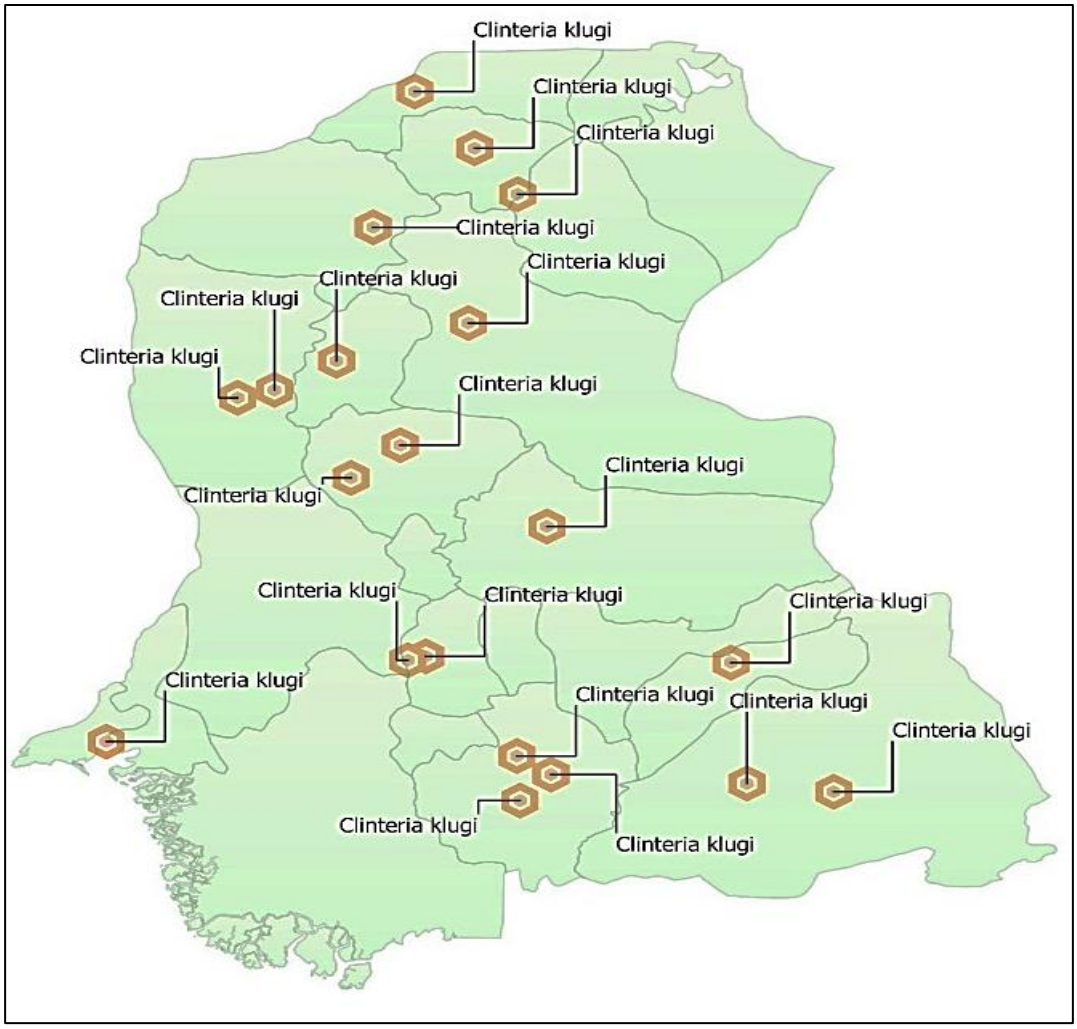


Figure 2. GIS Map of *Clinteria klugi*

Figure 3. Feeding habitat of *Clinteria kluge* feed on Brassica *(Brassica campestris)*, Sugarcane *(Saccharum officinarum)*, Banana *(Musa acuminata)*, and *Petunia* (*Petunia atkinsiana*).

Genus *Protaetia* (Burmeister, 1842)

Diagnosis: The genus *Protaetia* is a group of beetles in the family Scarabaeidae, commonly known as flower chafers. The genus contains over 200 species found worldwide, with the highest diversity in the tropics and subtropics. *Protaetia* species are generally medium to large-sized beetles, ranging in length from 10 to 35 millimeters. They are often brightly colored and have metallic sheens on their elytra (wing covers). The antennae are usually clubbed, and the tarsi (foot segments) have pads that allow the beetles to cling to surfaces. The larvae are C-shaped and white, with a brown head capsule.

Ecology: *Protaetia* beetles are primarily flower visitors, feeding on nectar and pollen. Some species are known to be important pollinators of various plants, while others may be pests of crops such as peach and apple trees. The larvae of some species feed on decaying plant matter, while others may be pests of agricultural crops.

Diagnostic characteristics *Protaetia aurichalcea* (Fabricius, 1775)

Body colouration: This short and broad beetle is lustrous and deep bronze in color with opaque white markings including a large irregular patch on the lateral sides of the pronotum.

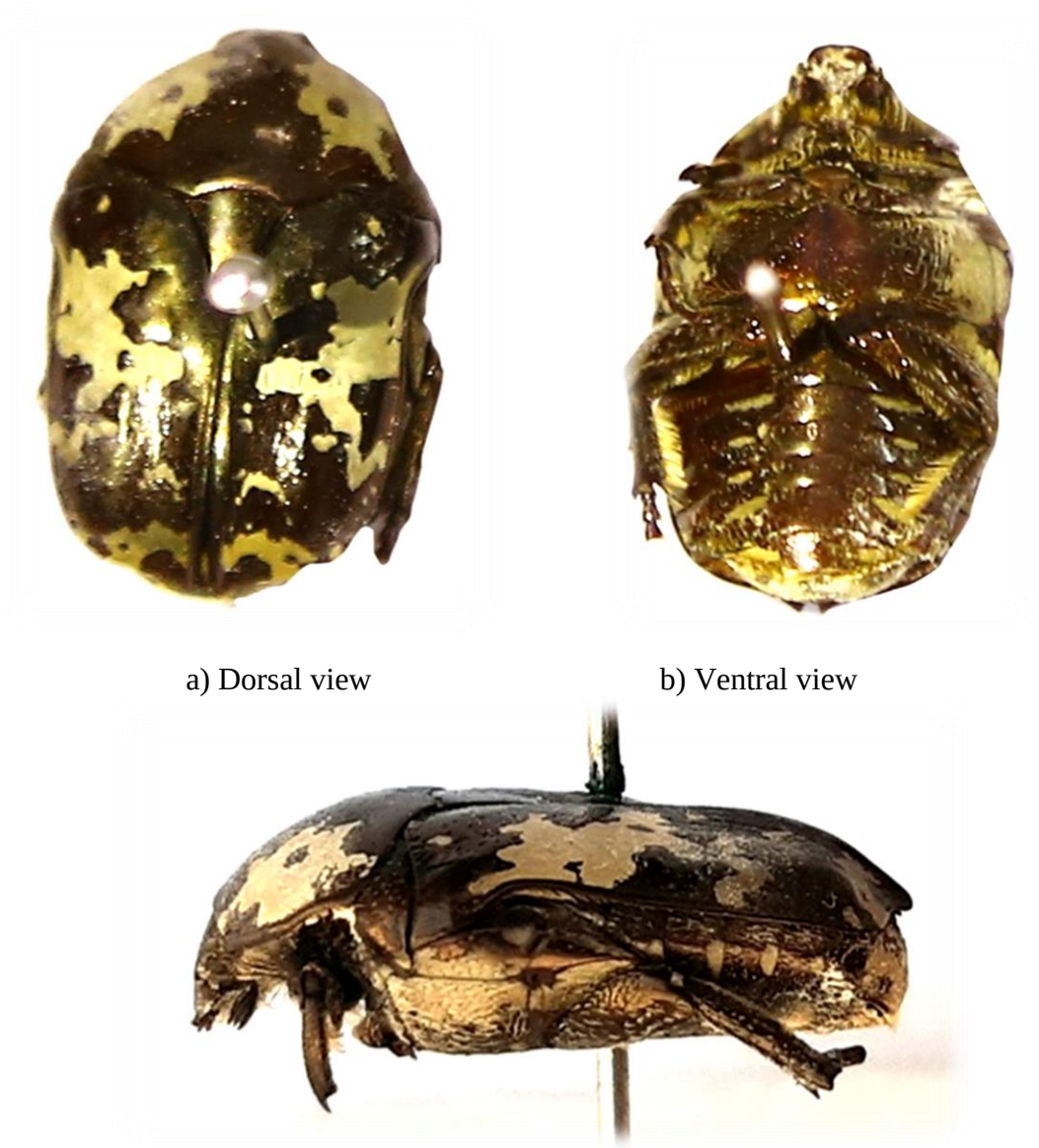
Head: Pronotum with basomedian lobe enlarged. Antennae 8 segmented

Thorax: Males have spines and apical elytral angles. Like other flower-beetles

Abdomen: Triangle-shaped Scutellum is present. Elytra is strongly punctured, and Elytral suture is clearly visible.

Table 3. Morphometric measurement of *Protaetia aurichalcea*

Body Parameters	Length (mm)				Width (mm)			
	Male (n=10)		Female (n=10)		Male (n=10)		Female (n=10)	
	Mean ± SD	Min-Max	Mean ± SD	Min-Max	Mean ± SD	Min-Max	Mean ± SD	Min-Max
Head	2 ± 0.5	1.5 – 2.5	2.5 ± 0.5	2 – 3	2.5 ± 0.5	2 – 3	2.5 ± 0.5	2 – 3
Thorax	7.5 ± 0.5	7 – 8	7.5 ± 0.5	7 – 8	9.5 ± 0.5	9 – 10	11 ± 1	10 – 12
Abdomen	13.5 ± 0.5	13 – 14	15 ± 1	14 – 16	11.5 ± 0.5	11 – 12	13 ± 1	12 – 14
Total length	19 ± 1	18 – 20	21 ± 1	20 – 22	---------	---------	---------	--------



a) Dorsal view b) Ventral view

c) Lateral view

Figure 4. a.Dorsal, b. Ventral, and c. Lateral view of *Protaetia aurichalcea*

Material Examined (*Protaetia aurichalcea*)

Indus Delta

Badin: 2.viii.2021 1♂1♀, (Mehtab A.M & [illegible] 4.iv.2022, 1♀ (Mehtab A.M & Waheed A.P), same but 8.xi.2022 1♂ (Mehtab A.M & Altaf A.M). Thatta: 8.viii.2022, 2♂1♀ (Mehtab A.M & Waheed A.P) Hyderabad: 7.iv.2021, 2♂2♀ (Mehtab A.M & Shaikh A.M) same but 1.xi.2021, 1♀ (Mehtab A.M & Altaf A.M) same but 6.ii.2023, 1♀ (Mehtab A.M & Waheed A.P).

Southern Irrigated Plan

Dadu, 14.viii.2021, 1♂ (Mehtab A.M & Waheed A.P). Larkana, 10.iv.2021, 1♂1♀ (Mehtab A.M & Waheed A.P). Jacobabad, 13.xi.2021, 2♀ (Mehtab A.M & Waheed A.P). Shikarpur, 9.iv.2022, 1♀ (Mehtab A.M & Shaikh A.M). Badin, 13.viii.2022, 1♂ (Mehtab A.M & Altaf A.M). Khairpur, 15.xi.2022, 1♂ (Mehtab A.M & Waheed A.P). Shaheed Benazirabad, 17.xi.2022, 1♀ (Mehtab A.M & Waheed A.P). Hyderabad 10.ii.2023, 1♀ (Mehtab A.M & Iltaf A.S)

Sandy Desert

Tharparkar, 22.viii.2021, 1♂1♀ (Mehtab A.M & Waheed A.P) same but 17.iv.2022 1♂1♀ (Mehtab A.M & Waheed A.P). Khairpur, 17.iv.2021, 1♂1♀ (Mehtab A.M & Waheed A.P) same but 20.viii.2022 1♂1♀ (Mehtab A.M & Altaf A.M). Shaheed Benazirabad, 27.xi.2021, 1♂1♀ (Mehtab A.M & Altaf A.M) same but 20.i.2023 1♀ (Mehtab A.M & Altaf A.M). Sanghar, 15.ii.2023, 1♂ (Mehtab A.M & Waheed A.P)

Dry western plateau

Karachi, 28.viii.2021, 2♂1♀ (Mehtab A.M & Waheed A.P) same but 29.xi.2022, 2♂ (Mehtab A.M & Waheed A.P). Dadu, 29.iv.2021, 1♀ (Mehtab A.M & Waheed A.P) same but 11.ii.2023, 1♀ (Mehtab A.M & Waheed A.P).

Table 4. Distributional data and Ecological account of *Protaetia aurichalcea*

S.no	Ecological Zones	Male	Female	No. of Specimen
1	Indus Delta	6	7	13
2	Southern irrigated plain	4	6	10
3	Sandy Desert	6	6	12
4	Dry western plateau	4	3	7
	Total	20	22	42

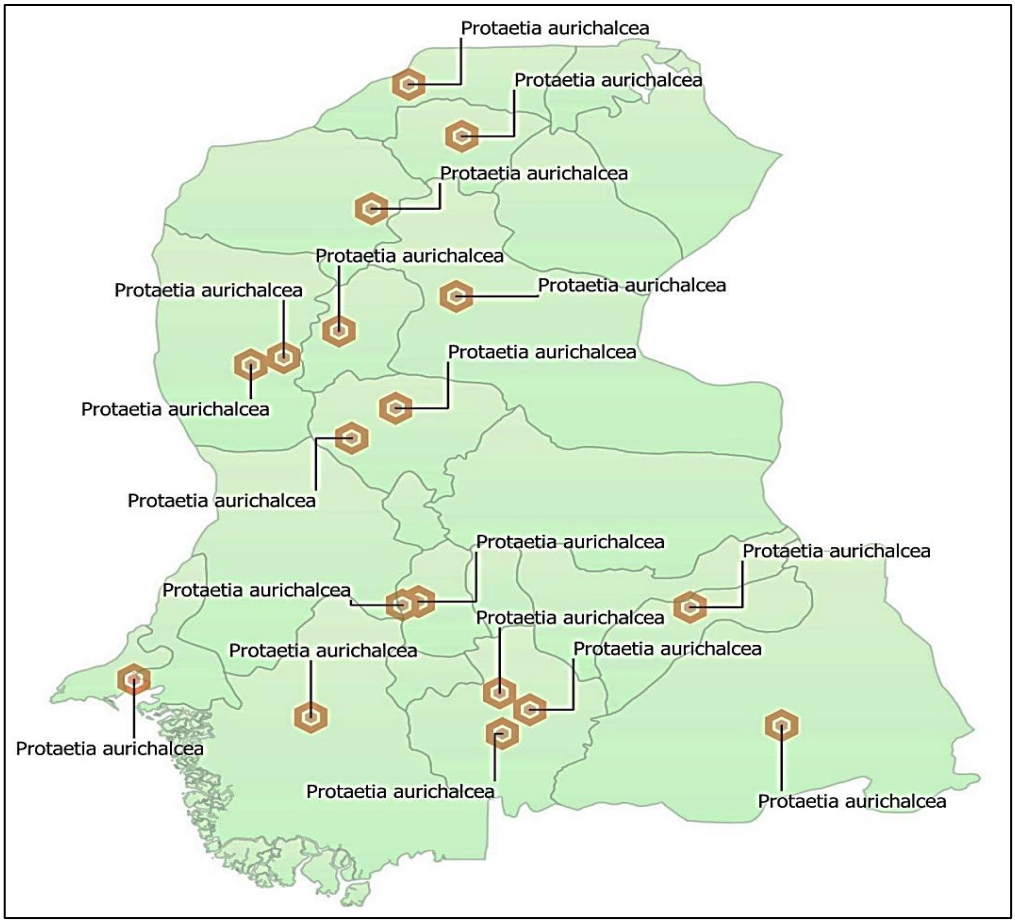


Figure 5. GIS Map of *Protaetia aurichalcea*

Figure 6. Feeding habitat of *Protaetia aurichalcea* feed on Banana (*Musa acuminata*), Brassica (*Brassica campestris*) Guava (*Psidium guajava*) and Strawberry (*Fragaria ananassa*).

Discussion

Beetles belong to the order Coleoptera of class Insecta. This order is the largest and most diverse order of organisms, constituting almost 25% of the described species of animals. Members of the subfamily Cetoniinae, commonly referred to as flower chafers, are scarab beetles. Many of the species that visit flowers during the day do so to gather pollen and nectar or to eat on the petals. Some species also devour fruits. Various names, such as flower beetles, flower scarabs, and fruit

and flower chafers have referred to this group. There exist around 4,000 species, with the majority of them still awaiting description (Šípek *et al*., 2016; Gunter *et al.*, 2016). The present study was conducted between 2021 and 2023 in several Sindh, Pakistan ecological zones. A total of 77 specimens were gathered and categorized into the Scarabaeidae family, specifically the Cetoniinae subfamily. The specimens belonged to two genera: *Clinteria* (Burmeister, 1842) and *Protaetia* (Burmeister, 1842). Within these genera, there were two species: *Clinteria klugi* (Hope, 1831) and *Protaetia aurichalcea* (Fabricius, 1775), respectively. Mahar *et al. (2023)* reported a new species of Cetoniinae, *Heterorrhina saeedi*, from Sindh, Pakistan. Panhwar *et al.* (2023) reported two species of scarab beetles of genus *Melolontha* Fabricius, 1775, from Sindh, Pakistan. Mahar *et al.* (2023) first time reported *Chiloloba acuta* (Wiedemann, 1823) from Sindh, Pakistan. Furthermore, our study provides a comprehensive account of the species, including regional maps, ecological data, and digital photographs of the studied species.

Conclusion

The present study concludes that two species of Flower chafer beetles, *Clinteria klugi* (Hope, 1831) and *Protaetia aurichalcea* (Fabricius, 1775), have been found. Besides, this study provides details about the habitat, geographical distribution of the species, and ecological perspective of Flower chafer beetles.

References

Asgari, M., Alderete, N. A., Lin, Z., Benavides, R., & Espinosa, H. D. (2021). A matter of size? Material, structural and mechanical strategies for size adaptation in the elytra of Cetoniinae beetles. *Acta Biomaterialia*, *122*, 236-248.

Audisio, P., Brustel, H., Carpaneto, G. M., Coletti, G., Mancini, E., Trizzino, M., ... & De Biase, A. (2009). Data on molecular taxonomy and genetic diversification of the European Hermit beetles, a species complex of endangered insects (Coleoptera: Scarabaeidae, Cetoniinae, Osmoderma). *Journal of Zoological Systematics and Evolutionary Research*, *47*(1), 88-95.

Bacchus, M.E. (1974). A catalogue of the type-specimens of the Cetoniinae (Coleoptera: Scarabaeidae) described by G.J. Arrow with a complete bibliography of his entomological works. *Bulletin of the British Museum (Natural History)* Entomol. **31**: 25-44

Bouchard, P., Bousquet, Y., Davies, A. E., Alonso-Zarazaga, M. A., Lawrence, J. F., Lyal, C. H., ... & Smith, A. B. (2011). Family-group names in Coleoptera (Insecta). *ZooKeys*, (88), 1-972.

Donaldson, J. M., McGovern, T. P., & Ladd Jr, T. L. (1986). Trapping techniques and attractants for Cetoniinae and Rutelinae (Coleoptera: Scarabaeidae). *Journal of Economic Entomology*, *79*(2), 374-377.

Donaldson, J. M., McGovern, T. P., & Ladd Jr, T. L. (1990). Floral attractants for Cetoniinae and rutelinae (Coleoptera: Scarabaeidae). *Journal of Economic Entomology*, *83*(4), 1298-1305.

Fremlin, M. A. R. I. A. (2018). The Rose Chafer Cetonia aurata L.(Coleoptera: Scarabaeidae: Cetoniinae) in Essex: distribution and some aspects of its ecology. *Essex Naturalist (New Series)*, *35*, 167-178.

Gunter, N. L., Weir, T. A., Slipinksi, A., Bocak, L., & Cameron, S. L. (2016). If dung beetles (Scarabaeidae: Scarabaeinae) arose in association with dinosaurs, did they also suffer a mass co-extinction at the K-Pg boundary?. *PLoS One*, *11*(5), e0153570.

Hernández, B., Rivera-Rodríguez, D. M., González-Leal, I., & Luna-Olea, F. M. (2023). Diversity of Cetoniinae1 Beetles in a Semiurban Area of Western Mexico. *Southwestern Entomologist*, *48*(4), 963-970.

Holm, E. (1994). On the genera of African Cetoniinae 1: the genus Pedinorrhina Kraatz and related taxa (Coleoptera: Scarabaeidae). *The Coleopterists' Bulletin*, 19-29.

Krell, F. T., Simon, U., & Zotz, G. (2002). Cetoniinae developing in a living stalk of Bromeliaceae (Coleoptera: Scarabaeidae: Cetoniinae: Gymnetini). *The Coleopterists Bulletin*, *56*(4), 533-539.

Lawrence, J. F., Ślipiski, A., Seago, A. E., Thayer, M. K., Newton, A. F., & Marvaldi, A. E. (2011). Phylogeny of the Coleoptera based on morphological characters of adults and larvae. In *Annales zoologici* (Vol. 61, No. 1, pp. 1-217). Museum and Institute of Zoology, Polish Academy of Sciences.

Lawrence, J.F. & Britton, E.B. (1991). Chapter 35. Coleoptera (Beetles). pp. 543-683 *in* Division of Entomology, CSIRO (ed.). *The Insects of Australia*. Ithaca, New York : Cornell University Press Vol. 2.

Legrand, J. P., & Foo, S. C. K. (2010). *Les Cetoniinae du Sabah*. Magellanes.

Mahar, M. A., Panhwar, W. A., & Shaikh, A. M. (2023). Identification Of *Heterorrhina Saeedi* Sp. Nov.(Scarabaeidae: Coleoptera) From Sindh Region, Pakistan. *Pakistan Journal of Biotechnology*, *20*(02), 243-248.

Mahar, M. A., Panhwar, W. A., Shaikh, A. M., Suhriani, S., & Ullah, S. (2023). The first report of Chiloloba acuta (Wiedemann, 1823) from Sindh, Pakistan. *Asian Journal of Science, Engineering and Technology (AJSET)*, *2*(1), 1-10.

Mckenna, D. D., Wild, A. L., Kanda, K., Bellamy, C. L., Beutel, R. G., Caterino, M. S., ... & Farrell, B. D. (2015). The beetle tree of life reveals that C oleoptera survived end-P ermian mass extinction to diversify during the C retaceous terrestrial revolution. *Systematic Entomology*, *40*(4), 835-880.

McQuillan, P.B. (1985). The identification of root-feeding cockchafer larvae (Coleoptera: Scarabaeidae) found in pastures in Tasmania. *Australian Journal of Zoology* **33**: 509-546

Mico, E., Moron, M. A., Šípek, P., & Galante, E. (2008). Larval morphology enhances phylogenetic reconstruction in Cetoniidae (Coleoptera: Scarabaeoidea) and allows the interpretation of the evolution of larval feeding habits. *Systematic Entomology*, *33*(1), 128-144.

Mitchell, A., Moeseneder, C. H., & Hutchinson, P. M. (2020). Hiding in plain sight: DNA barcoding suggests cryptic species in all 'well-known'Australian flower beetles (Scarabaeidae: Cetoniinae). *PeerJ*, *8*, e9348.

Moeseneder, C.H., Weir, T.A., Lemann, C. & Hutchinson, P.M. (2019). 34. Scarabaeidae: Cetoniinae Leach, 1815. pp.531-553 *in* Ślipiński, A. & Lawrence, J.F. *Australian Beetles. Archostemata, Myxophaga, Adephaga, Polyphaga (part)*. Australia : CSIRO Publishing Vol. 2 1, pp.784. [534] (key to the tribes, subtribes and genera)

Mudge, A. D., Orozco, J., Philips, T. K., & Antoine, P. (2012). The cetoniine fauna of the Upper Guinean forests and savannas of Ghana (Coleoptera: Scarabaeidae: Cetoniinae). *Terrestrial Arthropod Reviews*, *5*(2), 113-174.

Mynhardt, G., & Wenzel, J. W. (2010). Phylogenetic analysis of the myrmecophilous Cremastocheilus Knoch (Coleoptera, Scarabaeidae, Cetoniinae), based on external adult morphology. *ZooKeys*, *34*(2), 129-140.

Orozco, J. (2012). Monographic revision of the American genus Euphoria Burmeister, 1842 (Coleoptera: Scarabaeidae: Cetoniinae). *The Coleopterists Bulletin*, *66*(mo11), 1-182.

Orozco, J., & Pardo-Locarno, L. C. (2004). Description of immature stages of three species of American Cetoniinae (Coleoptera: Scarabaeidae: Cetoniinae). *Zootaxa*, *769*(1), 1-14.

Panhwar, W. A., & Shaikh, M. M. A. (2023). New record of genus Melolontha Fabricius 1775 (Melolonthinae: Scarabaeidae) from Sindh, Pakistan. *Pakistan Journal of Agricultural Research*, *36*(3), 285-289.

Perissinotto, R. (2020). Systematics and biology of the Ichnestomina, including new genera and species (Coleoptera: Scarabaeidae, Cetoniinae). *Fragm. Entomol*, *52*, 217-320.

Perissinotto, R. (2022). Review of the genera Elaphinis and Parelaphinis (Coleoptera: Scarabaeidae: Cetoniinae) with description of three new species from South Africa. *Acta Entomologica Musei Nationalis Pragae*, *62*(1), 35-55.

Perissinotto, R., & Clennell, L. (2021). Census of the fruit and flower chafers (Coleoptera, Scarabaeidae, Cetoniinae) of the Macau SAR, China. *ZooKeys*, *1026*, 17.

Potapov, A. M., Beaulieu, F., Birkhofer, K., Bluhm, S. L., Degtyarev, M. I., Devetter, M., ... & Scheu, S. (2022). Feeding habits and multifunctional classification of soil-associated consumers from protists to vertebrates. *Biological Reviews*, *97*(3), 1057-1117.

Ranius, T., Aguado, L. O., Antonsson, K., Audisio, P., Ballerio, A., Carpaneto, G. M., ... & Zach, P. (2005). Osmoderma eremita (Coleoptera, Scarabaeidae, Cetoniinae) in Europe. *Animal biodiversity and conservation*, *28*(1), 1-44.

Ratcliffe, B. C., & Deloya, A. C. (1992). The biogeography and phylogeny of Hologymnetis (Coleoptera: Scarabaeidae: Cetoniinae) with a revision of the genus. *The Coleopterists' Bulletin*, 161-202.

Ratcliffe, B. C., & Micó, E. (2001). A review of the Neotropical genus Neocorvicoana Ratcliffe and Micó, new genus (Coleoptera: Scarabaeidae: Cetoniinae: Gymnetini). *The Coleopterists Bulletin*, *55*(3), 279-296.

Ratclifle, B. C. (2010). A review of the Blaesiina (Coleoptera, Scarabaeidae, Cetoniinae, Gymnetini). *Current Advances in Scarabaeoidea Research*, *34*, 105.

Rodrigues, S. R., De Oliveira, J. L. N., Bagnara, C. A. C., & Puker, A. (2013). Cetoniinae (Coleoptera: Scarabaeidae) attracted to fruit-baited traps near Aquidauana, Mato Grosso do Sul, Brazil. *The Coleopterists Bulletin*, *67*(2), 119-122.

Şenyüz, Y., & Şahin, Y. (2009). Faunistic studies on Cetoniinae, Dynastinae, Melolonthinae, Rutelinae (Coleoptera: Scarabaeidae) Geotrupinae (Geotrupidae) of Kütahya province, Turkey. *Munis Entomology & Zoology*, *4*(2), 536-541.

Shipley, A. E.; Marshall, Guy A. K., eds. (1910). *The Fauna of British India*. London, Calcutta and Bombay: Taylor and Francis. p. 201.

Šípek, P., & Kral, D. (2012). Immature stages of the rose chafers (Coleoptera: Scarabaeidae: Cetoniinae): a historical overview. *Zootaxa*, *3323*(1), 1-26.

Šípek, P., Fabrizi, S., Eberle, J., & Ahrens, D. (2016). A molecular phylogeny of rose chafers (Coleoptera: Scarabaeidae: Cetoniinae) reveals a complex and concerted morphological evolution related to their flight mode. *Molecular Phylogenetics and Evolution*, *101*, 163-175.

Smetana, A., & Smith, A. B. (2006). Type species designations and other nomenclatural notes on Palaearctic Melolonthinae and Cetoniinae (Coleoptera: Scarabaeoidea: Scarabaeidae). *Zootaxa*, *1220*(1), 45-53.

Touroult, J., & Le Gall, P. (2013). Fruit feeding Cetoniinae community structure in an anthropogenic landscape in West Africa. *Journal of Insect Conservation*, *17*, 23-34.