IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

DIVERSITY OF SCARABAEID BEETLES FROM PANHALA TEHSIL OF KOLHAPUR DISTRICT, MAHARASHTRA, INDIA.

A. R. Bhusnar, Pravina Zende and Komal Bhosale

Department of Zoology, Yashwnatrao Chavan Warana Mahavidyalaya, Warananagar.

Abstract

The order Coleoptera is known for its high species diversity, with over 400,000 different species belonging to class insecta. Within this order, family Scarabaeid, plays a crucial role in agriculture ecosystem by consuming and burying dung, thus aiding in nutrient recycling and maintaining soil structure. In this study, we collected Scarabaeid beetles from various regions in Panhala tehsil at 15-day intervals. Later carefully examined the collected specimens using lenses and a compound microscope and documented their taxonomical features through photography. Total identified 15 species of Scarabaeid beetles within the Panhala Tehsil area. While these beetles have significant ecological importance, some species have been identified as significant agricultural pests. These particular beetles pose a threat to crops, emphasizing the delicate balance between their beneficial role in the ecosystem and their potentially negative impact on farming activities.

Key words- Coleopetra, Scarabaeid, Beetle, Dung.

Introduction

The Western Ghats is considered one of the major biodiversity hotspots in India. Due to its importance, several researchers have conducted studies on the biodiversity of different animals, especially birds, reptiles, amphibians, and insects. The Insect order Coleoptera is the most abundant among all organisms, with over 400,000 species. The super-family Scarabaeoidea is a large and widespread group that makes up nearly 10 percent of all beetles in the world (Fincher *et. al.*, 2009). Scarabaeidae belonging to superfamily Scarabaeoidea of Order Coleoptera. The family includes 33,504 species globally, out of which about 2,211 species are reported from India.(Chandra *et.al.*, 2018) The family Scarabaeidae, are diverse in size but can be recognized by their oval bodies, a five segmented tarsi, lamellate antennae, and a front tibiae that is scalloped. They are usually found feeding on dung, plants, or flowers.

Scarabid beetles reported from many habitats, including desert, farmland, forest, and grasslands. They do not prefer extremely cold or dry weather. They are found on all continents except Antarctica. The beetles mostly feed on the microorganism rich liquid component of mammalian dung and use the more fibrous material to brood their larvae (Halffter & Edmonds, 1982; Halffter & Matthews, 1966).They eat the dung of herbivores, omnivores,

and other organic matter. Those that eat dung do not need to eat or drink anything else, because the dung provides all the necessary nutrients.

Most Scarabid beetles rely on their highly sensitive sense of smell to search for food. Some smaller species simply attach themselves to dung. Upon capturing the dung, they roll it, maneuvering in a straight line despite encountering obstacles. The Scarabid beetle undergoes complete metamorphosis. Its larvae reside within brood balls fashioned from dung crafted by their parents. Throughout the larval stage, the beetle sustains itself by consuming the surrounding dung.

Scarabid beetles play a remarkable role in agriculture by burying and consuming dung, thereby enhancing nutrient recycling and soil structure. Additionally, they contribute to safeguarding livestock, such as cattle, by eliminating dung that could otherwise serve as a habitat for pests like flies. Scarab beetles play their roles scavengers and bury dung pats into the soil. Larvae may consume 175 per cent to 530 per cent of their dry body weight in dung each day. These beetles are the nature's way of recycling carbonand minerals back into the soil to be further broken down into humus for plants. (Fincher,1997).

Materials and Methods

Scarabid beetles were collected from various regions of Panhala Tehsil at 15-day intervals. Specimens were observed for taxonomical features using lenses and a compound microscope, and subsequently photographed. The commonly found species were preserved for further study, while the rare species of Scarabid beetles were released in the same locations they were collected from. Species were identified by using following researcher's literature. Andresen, E. (2005), Arrow, G.J. (1931)., Balthasar, V. (1963), Cambefort, Y. & P. Walter (1991), Chown, S.L. (2001)... Gardner,et al. (2008), Gaston, et al.(2004). Kakkar, N. & S.K. Gupta (2010). Krikken, J. & J. Huijbregts (2007), Latha,et. al. (2011), Orris, J.B. (2005). Pawara., et al (2014)., Raupp et al (2010)., Sabu, T.K. (2011), Yahner, R.H. (1988).

Study area:

The latitude and longitude coordinates of Kolhapur are 16.691307, 74.244865. The climate in Kolhapur is a combination of coastal and inland elements that are common in Maharashtra. The temperature ranges between 10 and 35 °C (50 and 95 °F). In comparison to neighboring inland cities, summer in Kolhapur is relatively cooler but more humid. The maximum temperatures rarely go above 35 °C (95 °F) and typically range between 33 and 35 °C (91 and 95 °F). During this season, the lows are around 24 to 26 °C (75 to 79 °F). The district receives a significant amount of rainfall from June to September due to its proximity to the Western Ghats. Winter in Kolhapur occurs from November to February.

Consolidated map of India- Maharashtra- Kolhapur-Panhala

Results

1) *Anomala marginata* (Coleoptera- Scarabaeidae)

The total body length ranges from 8.0 to 13.0 millimeters. The body shape is ovate, typically with females being wider than males. The coloration varies from tan to black, with tan specimens often exhibiting black markings of different sizes and placements. The front tibia features two external teeth, with the apical tooth being long and curved; it tends to be longer in females compared to males. The basal tooth is evident in both male and female specimens. The front claw is bifurcate, and in females, the claws are less robust than those of males. The hind tibia possesses a simple inner margin that is not significantly enlarged in the middle. The grub is C-shaped, cylindrical, whitish in color, and lacks a humpbacked appearance. The maxilla exhibits a fusion of galea and lacinia, with the lacinia bearing two unci and anteriorly projecting maxillary teeth. The dorsoexterior region of the mandible is bare, and the crest of the labrum is not notably rugose. The haptomerum of the epipharynx features a transverse row of three prominent unci; it does not have a conspicuous, transverse, curved row of stout setae. The last antennal segment possesses a single sensory spot. The posterior frontal setae consist of two single setae.The dorsa of abdominal segments 7–9 are fairly uniformly covered with numerous medium-sized setae, each carrying a caudal transverse row of 5 or 6 very long setae. The septula are oblong, while the palidia are monostichous, slightly diverging, and each set with 11–15 pali. The anal slit is slightly curved and transverse

.

2) *Aphodius versutus* (Coleoptera- Scarabaeidae)

The described beetle is approximately 7-9mm in size, presenting a two-toned appearance with a black head and pronotum, complemented by red-brown wing coverings. Its activity persists throughout the year, peaking in late spring and early autumn. Notably, it features a black triangular scutellum, with males distinguished by a distinct indentation at the front of the pronotum, setting them apart from females. Both genders exhibit distinctive yellow patches on the sides of the pronotum. This species, originally from Europe, has now proliferated across North America. In Alberta, it stands out as one of the more colorful species due to its characteristic reddish elytra and a black pronotum adorned with reddish patches on each side. Egg laying occurs directly in dung, where larvae develop. Pupation takes place in the soil beneath the dung pat. Interestingly, this species does not seem to be attracted to light sources. The developmental cycle, from egg to emergence of a new adult from the dung pat, typically averages around 67 days at 22°C for beetles reared in dung from cattle fed alfalfa cubes.

3) *Onitis caffer* (Coleoptera- Scarabaeidae)

Onitis caffer is a stout, black beetle measuring 15-20mm, with an abdomen slightly longer than the pronotum. A distinct depression marks the rear of the pronotum. The male possesses a serrated ridge on the hind femur, a unique feature distinguishing it from other Onitis males, which typically have a single or double spur on the hind leg instead of serrations.Distinctly impressed striae, or grooves, adorn the wing covers (elytra). Both strains of Onitis caffer exhibit activity from autumn to early to mid-winter. In the South West, they might resume activity in the spring. Flight typically occurs at dusk and dawn. The species constructs nests composed of several short sausages, each containing 1-4 eggs, buried up to one meter below the dung pad. The development period from egg to adult spans between 10-12 months. Onitis caffer emerges and begins breeding in autumn for both strains, with breeding continuing through winter and spring, given suitable temperatures. In the field, Onitis caffer requires ten to twelve months from ovipositor to adult emergence. However, some individuals may undergo facultative larval diapause, induced in early summer, delaying their emergence until autumn one or two years later.

4) *Holotrichia fissa* (Coleoptera- Scarabaeidae)

Holotrichia fissa is a moderately sized beetle devoid of horns or spines. During winter, adult beetles burrow into the soil. Upon the first rainfall of the year, they emerge, mating ensues, and the female then buries the eggs. Within 7-10 days, the eggs hatch, giving rise to larvae that feed on grass and sugarcane roots. After two months, the larvae reach full maturity and enter the pupal stage. As autumn arrives, the beetles retreat underground. This species follows a singular annual generation cycle. While in the larval stage, these beetles frequently consume sugarcane roots, leading to the plant's desiccation and demise from water absorption issues. Various control methods exist, including periodic flooding of sugarcane fields to eliminate and displace the insects when underground, field pesticide spraying, manual removal of infested plants, early planting of sugarcane to expedite plant maturation, and the use of traps to capture and exterminate young larvae.

5) *Holotrichia reynaudi* (Coleoptera- Scarabaeidae)

The total body length ranges from 13.0 to 17.8 millimeters (0.51 to 0.70 inches). The body is cylindrical, somewhat elongated, and reddish-brown in color. The antennae consist of 10 segments, with a 3-segmented club. In males, the club is approximately the same size as segments 1-7, whereas in females, the club is noticeably shorter than segments 1-7. The clypeus is reflexed and sinuate, while the head lacks a ridge at the base of the frons. The pronotum doesn't exhibit a constriction near the apical angle and lacks distinct fovea at each side of the anterior margin in both males and females. The elytra are smooth without prominent setae.The grub is C-shaped, cylindrical, whitish, and lacks a humpbacked appearance. The maxilla has the galea and lacinia fused. The mandible's basolateral region contains nine setae, while the dorsoexterior region has fewer than three setae. The epipharynx haptomerum contains 11 heli, and the proplegmatia features 7-10 proplegmata. The last antennal segment possesses a single large, oblong, dorsal sensory spot. The respiratory plates of spiracles are not constricted, and the raster consists of closely set palidia.

6) *Adoretus testaceus* (Coleoptera- Scarabaeidae)

The adult beetle boasts large, dark eyes and a reddish chestnut body, typically measuring 12-14mm in length. The male, albeit smaller, exhibits a broader, convex body with a shiny underside. Its scutellum is short, and its lamellate antennae, brownish in hue, consist of ten segments, with the last three antennomeres expanded into a plate-like structure. The pronotum appears darker, less densely punctate in the mid-region, while the clypeus and frons are notably darker. Both the labrum and labium are hairy. Acute teeth on the tibia of the first leg pair aid in burrowing in sand. The elytra, brownish with a metallic sheen, are sclerotized and punctate, adorned with fine bristles, as are the pronotum and head. The female, possessing a broader and more convex body, lays eggs in the soil typically during the early monsoon season, spanning May to August. Eggs hatch within 8 to 14 days in the soil, giving rise to larvae that commence feeding on roots approximately a week after hatching. During drought periods, larvae move deeper into the soil, resurfacing during wet periods. Pupation concludes before the onset of the next monsoon, with adults emerging after rainy showers. The beetle's lifecycle usually spans three months.

7) *Maladera insanabilis* (Coleoptera- Scarabaeidae)

The small oblong-shaped beetles exhibit a body length ranging from 7 to 11mm. Their body coloration varies from brown, reddish brown to orange, possessing an iridescent sheen. Notably, their elytra lack setae and scales. The antennae consist of ten segments and a three-segmented club. The clypeus showcases an apex that appears rounded to subquadrate and is heavily upturned, while the labrum is indistinct and fused to the apical margin of the clypeus.

These beetles' behavior involves females depositing eggs in soil between July and October, with a preference for shady, moist, overgrown, and weedy areas. Upon hatching, the larvae burrow to a depth of 15–30 cm (5.9-11.8 in) and initiate feeding on plant roots. They typically spend the winter in the second or third larval instar, resuming feeding around mid-April. The larval stage spans roughly ten months, followed by a pupation period lasting 14 days. Adult emergence typically begins in July, potentially earlier in warmer climates. Adults can live for more

than 100 days, with an average lifespan closer to 30 days. They are nocturnal and fly only when temperatures exceed 16°C (70°F), remaining inactive during the day near or on host plants.

8) *Adoretus hirsutus* (Coleoptera- Scarabaeidae)

Adult beetles are medium-sized, light, reddish-brown, and approximately 13-14 mm long. Their pronotum features a narrow band of light yellow setae, and the underside of the thorax has similarly colored setae. The tip of the abdomen protrudes beyond the wing covers, which have longitudinal grooves. Larvae are white-colored and C-shaped with a yellow-brown head and six jointed legs. The raster has two distinct rows of small spines that diverge outward at the tip of the abdomen. Female chafers lay 20-40 milky-white eggs over their lifespan. The European chafer has a one-year life cycle.The imago, or adult beetle, stage is quite short, lasting 1–2 weeks. The adults emerge from the ground in late spring and mate in large swarms, usually on low trees and shrubs. The beetles are most active on warm, clear nights when the temperature is above 19 °C (66 °F). They emerge at about 8:30 pm, mate throughout the night, and return to the soil by daybreak. Beetles may return to the trees to remate several times over the mating period. Late in the period, the adult carcasses may litter the ground beneath trees used for swarming.

9) *Phyllophaga hirtivetris* (Coleoptera- Scarabaeidae)

The beetle is a shiny black, oval-shaped insect, measuring 12-15 mm in length. It exhibits a reddish-brown underside and a glossy black dorsal surface. Known for its potential to cause damage to lawns, turf, and various crops, especially during the summer, this species poses a threat to plant life. Adult beetles primarily feed on plant stems near the soil surface.The eggs of the shiny black beetle are initially white, oval-shaped, and approximately 1.8 mm long upon oviposition. As they progress through development, the eggs increase in size and roundness. Typically laid individually at a depth of 1 to 5 cm in the soil, each female beetle deposits between 12 to 20 eggs. Under field conditions, these eggs hatch after an incubation period of roughly 20 days.Larvae of this species pass through three distinct instars. Creamy-white in color, they feature a brown head capsule and hind segments. The smooth-textured head capsule measures 1.5 mm, 2.4 mm, and 4.0 mm during the first, second, and third instars, respectively. Once fully developed, the third instar larvae reach a length of approximately 25 mm. These larvae are visible to the naked eye during their growth stages.

10) *Holotrichia sp*. (Coleoptera- Scarabaeidae)

This species measures between 10.0 and 12.0 millimeters in total body length, displaying an elongated oval shape and a brownish hue adorned with numerous distinct cream-white setae, although some may be absent in older or worn specimens. The front tibia is characterized by three teeth along its lateral margin, which may exhibit signs of wear in mature individuals. In females, the last sternite features a rounded posterior apex, while

in males, it appears weakly quadrate. The larvae, resembling a whitish C shape, are found feeding on various plants of economic importance. This species poses a significant biosecurity risk due to its documented feeding habits across a broad spectrum of economically valuable plant species. Moreover, its close relation to species known for invasive tendencies raises concern. Adult feeding can result in substantial damage, leading to considerable reductions in fruit crop yields.

Attraction to light sources during nocturnal hours suggests a likelihood of drawn interest towards well-lit ports and airports. Consequently, there exists a potential for hitchhiking via marine or air cargo. Furthermore, there's a plausible scenario wherein adults or larvae could be inadvertently transported through the movement of nursery plants.

.

11) *Canthidium chimalapense* (Coleoptera- Scarabaeidae)

The head exhibits a Clypeus with a red hue, rugosely punctate, possessing a bidentate apex and a centrally U-shaped median emargination. The frons displays a green-red hue, finely punctate with sparse micropunctures, slightly convex, devoid of carinae, and adorned with three conical tubercles. The genae, with a red hue, are rugosely punctate, while the antennae present a yellow coloration. Moving to the pronotum, its surface showcases a green hue, finely and uniformly punctate, accompanied by sparse micropunctures. The lateral fovea appears conspicuous and simple, while the posterior margin displays sparse punctures. The elytra exhibit distinctly impressed striae adorned with evenly spaced, coarse punctures. Measurements record a length of 5.1 mm, pronotal width of 3.5 mm, and elytral width of 3.7 mm. The dorsum displays shagreen texture, presenting a metallic black appearance with a green-red hue. In females, distinctions from males include a shorter pygidium, a broader medial segment in the last abdominal segment, and a protibial apical spur that is spiniform. The legs on the protibia feature three teeth on the external border, with the inner apical margin producing an acute, obtusely triangular projection that slightly bends downwards. Additionally, the apical spur of the protibia extends into an obtusely rectangular projection that bends downwards

12) *Cyclocephala lurida* (Coleoptera-Scarabaeidae)

The brown beetle, recognized as the southern masked chafer, possesses a black head and attains an adult length ranging from 10 to 14 mm (0.4-0.6 inches). While the adult beetle itself is harmless, its subterranean eggs pose a threat. The developing larvae, often termed white grubs, subsist by feeding on grass roots and, particularly in dry conditions, have the potential to decimate turf. Emanating from the soil shortly after sunset during June and July, these beetles linger on the ground's surface or ascend grass blades. Simultaneously, the males emerge, engaging in zigzag mating flights at low altitudes. Typically, these beetles mate post-midnight, presumably utilizing a shared pheromone for communication. The larvae of the southern masked chafer, growing to about 2.5 cm (1 inch) in length, are commonly referred to as white grubs. These beetles usually foster a single generation annually, with adults displaying activity for a brief span of a few weeks. However, a soil-dwelling bacterium, known as milky spore (Paenibacillus popilliae), induces a developmental delay in the larvae. Researchers

observed these infected larvae on the soil's surface. It is believed that the capacity to emit pheromones, identified in larvae of both genders, persists in adult females but diminishes in adult males.

13) *Oryctes rhinoceros* (Coleoptera-Scarabaeidae)

The Asiatic rhinoceros beetle, commonly known as the coconut rhinoceros beetle, is a sizable species measuring an average length of about 31-40mm. These beetles display a dark brown to black coloration with a shiny dorsal surface. Their distinguishing feature includes a prominent horn on the head, notably longer in males than in females. Additionally, males possess a rounded, glossy terminal abdominal segment, while females have a relatively hairier 'tail'. On the thoracic ridge, there are two tubercles. Adult females lay yellowish-white oval eggs, approximately 3 mm in diameter. The larval stage progresses through three instars before transitioning into a pupa. Initially yellowish-white, the larvae reach lengths of 60-100 mm by the third instar, sporting a dark brown cranium. Eggs hatch into larvae in approximately 11 days, starting to feed on surrounding organic matter. Over eleven to 15 weeks, these larvae grow significantly—up to 16 times larger—ceasing their feeding behavior before entering a six-week immobile pupal stage (Hickley 1973). Once emerged, adults seek out new trees, feed, and engage in mating activities, often mating shortly after their initial feeding. Adults primarily spend their time consuming fresh leaves. Adult females have a lifespan of up to nine months, during which they can lay up to 100 eggs. Consequently, adult progeny may coexist with the mother, creating a population structure of overlapping generations.

14) *Onitis philomon* (Coleoptera-Scarabaeidae)

The beetles are black in color, although the shading can differ among species. Their size ranges from 0.4 to 1.4 inches (1 to 4 cm), and the structure of their bodies varies from rough to smooth. The larvae are brown to darkish green, possessing slender, rigid bodies that emit a faint sparkle. Some species' larvae are commonly referred to as false wireworms. The pupa appears dull yellowish-white and measures around 2 cm. The elytra exhibit prominent strial punctures, often of considerable size. Pinacate beetles, also known as stink beetles, belong to the darkling beetles genus Eleodes and are endemic to the Sonoran Desert. Larvae of darkling beetles (Coleoptera, Tenebrionidae) are collectively known as false wireworms. While larvae from various species within the Eleodes genus are recognized as agricultural pests, there has been limited research connecting larvae to adults of the same species. Only a few species have been fully characterized in their larval state. Morphological traits from late-stage larvae were examined and coded, generating a matrix within the server-based content management system, mx. This morphology matrix was utilized to craft descriptions of larval species, reconstruct a phylogeny, and develop a key encompassing the species outlined in the matrix.

15) *Holotrichia serrate* (Coleoptera-Scarabaeidae)

Holotrichia serrata, commonly known as the sugarcane white grub or cockchafer grub, is a species of dung beetle found in India. Adult female beetles lay almost round, white eggs. The first and second instars are translucent, appearing whitish-yellow and characterized by a 'C' shape. The third instar exhibits a dirty white color, typically measuring around 34-39 mm in length. The distinctively marked brownish-orange head comprises robust mandibles, accompanied by long, brown, slender antennae.The instar period spans 60-70 days, followed by a brief pre-pupal stage lasting two days. Pupation occurs within an earthen chamber, wherein the third instar burrows deep into the soil, constructing a small earthen cell. The pupal stage spans 13-19 days, after which beetles emerge within 3-4 days. Adult beetles are brown, with an average length of about 23-25 mm, and can survive for 12-26 days in captivity.The grub stage is deemed a significant pest in sugarcane cultivation. Management strategies include cultural, mechanical, biological, chemical, and integrated methods. As part of the biological approach, grubs can be controlled by utilizing the parasitoid fungus Metarhizium anisopliae.

Conclusion

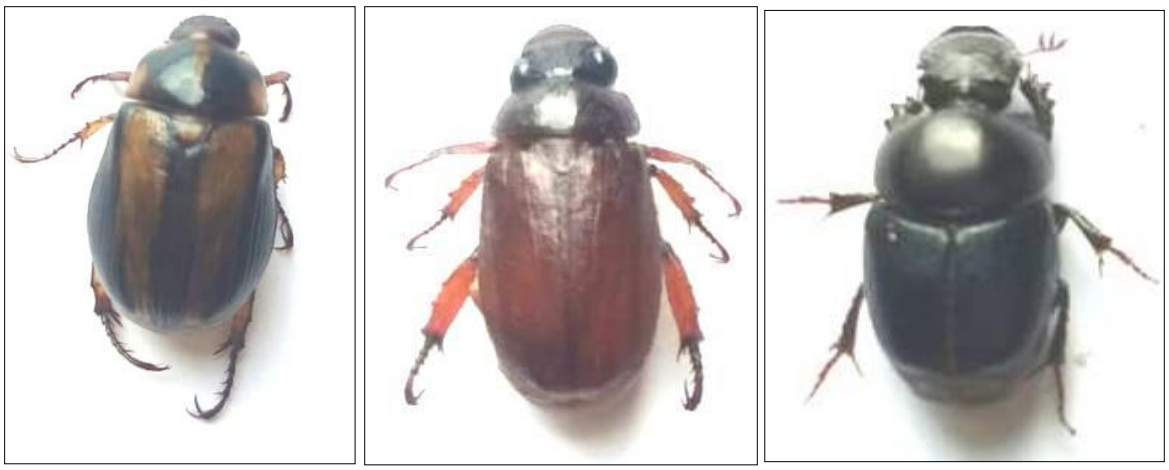
A total of 15 species of Scarabid beetles have been documented within the Panhala tehsil. These species showcase a remarkable adaptation to the climatic conditions prevalent in the area. Their significance lies in their pivotal role within the ecosystem, particularly in nutrient recycling. These beetles actively contribute to the enhancement of soil fertility and the augmentation of nutrient levels.

However, despite their ecological importance, certain species among them have been identified as significant agricultural pests. These particular beetles pose a threat to agricultural crops, highlighting a delicate balance between their beneficial role in the ecosystem and their potential negative impact on farming activities.

Acknowledgement

Authors are thankful to Yashwnatrao Chavan Warana mahavidyalaya, Warananagar for providing facilities.

Diversity of Scarabid beetles from Panhala Tehasil



1) Anomala marginata *2) Aphodius versutus* *3) Onitis caffer*



4) Holotrichia fissa Br. *5) Holotrichia reynaudi* *6) Adoretus testaceus*



7)Maladera insanabilis *8) Adoretus hirsutus* *9) Phyllophaga hirtivetris*

Diversity of Scarabid beetles from Panhala Tehasil



10) Holotrichia sp. *11) Canthidium chimalapense* *12) Cyclocephala lurida*

13) Oryctes rhinoceros **14) Onitis philomon** ***15) Holotrichia serrata***

REFERENCES

Andresen, E. (2005). Effects of season and vegetation type on community organization of dung beetles in a tropical dry forest. Biotropica 37: 291- 300

Arrow, GJ (1931) The Fauna of British India including Ceylon and Burma, Col .Lamella III (Caprinae), Taylor and Francis, London, 428pp.

Balthasar, V. (1963) Monographie der Scarabaeidae and Aphodiidae der Palacarktischen and Orientalisches Region (Coleoptera: Lamellicornia).Verlag der Tschechoslowakischen Akademie der Wissenschaften, Prague, Volume I 391 pp: Volume II 627pp.

Cambefort, Y. & P. Walter (1991) Dung beetles in Tropical Forests in Africa, 198-210, In: Hanski, L. & Y. Cambefort (eds). Dung Beetle Ecology Princeton University Press Princeton, New Jersey.

Chandra, K., Gupta, D., Uniyal, V.P., Bharadwaj, M., & Sanyal, A.K. (2012). Studies on scarabaeid beetles (Coleoptera) of Govind wildlife sanctuary, Garhwal, Uttarakhand, India. Biological Forum-An International Journal 4, 48–54.

Chows, SL. (2001) Physiological variation in insects: hierarchical levels and implications Journal of Insect Physiology47: 649-660

Fincher, T. 1997. Forage: Dung Beetles. AG News and Views. copyright 1997, The ecology:pattern and process. Kikkawa,J. and D.J. Anderson, Blackell Scientific Publication, Melbourne.

Fincher GT, Monson WG, Burton GW et al. Effect of Zoologicheskii Zhurnal. 2009; 88(2):247-249.

Gardner, TA, MMI Hemadez 1 Barlow & CA Peres(2008a) Understanding the biodiversity consequences of habitat change The value of secundary and plantation forests for neotropical dung bertles Journal of Applied Ecology 45: 883-893

Gaston, KJ. RM. Smith, K. Thompson & P.H.Warren (2004) Gardens and wildlife the BUGS project. BrWild 16:1-9.

Kakkar, N. & S.K. Gupta (2010) Diversity and seasonal fluctuations in dung beetle (Coleopters) community in Kurukshetra, India. Entomological Research275: 189-192.

Krikken, J. & J. Huijbregts (2007) Taxonomic diversity of the genus Ochicanthon in Sundaland (Coleoptera: Scarabaeidae Scarabaeinae) Tijdschrift voor Entomologie 150: 421-479

Latha, M. G. Cuccodoro, T.K. Sabu & K.V Vinod (2011) Taxonomy of the dung beetlegenus Ochicanthon Vaz-de-Mello (Coleoptera: Scanbacidae: Scanbarinar) of Indian subcontinent with notes on distribution pattern ahhhhightlessness. Zootaxa 2745: 1-29

Halffter, G. & Matthews, E. G. 1966. The natural history of dung beetles of the subfamily Scarabaeinae (Coleoptera, Scarabaeidae). Folia Entomologica Mexicana, 12–14: 1–312.

Halffter, G. & Edmonds, W. D. 1982. The nesting behavior of dung beetles (Scarabaeinae)- an ecological and evolutive approach. Instituto de Ecologia. Mexico, D. F. 1–176.

Orris, J.B. (2005) Megastat version 10.0. Butler University, College of Business Administration, 4600 Sunset Ave, Indianapolis Distributed McGraw-Hill. Available online: http://www.mbbe.com/uppor

Pawara K. H., Patel N.G. Pawara J.V., Gavit, PJ and Ishi S.5 (2014) beetles of jalgaon district of maharashtra, india. Biolife journal 2320-4257.pp 970-972

Rupp, M.J. P.M. Shrewsbury & DA Herms (2010) Ecology of herbivorous arthropods in urban landscapes. The Annual Review of Entomology 55: 19-38

Sabu, T.K. (2011) Guild Structure, Taxonomic Diversity and Biosystematics of Dung Beetles (Coleopters Scarabacinae) in the Agriculture and Forest Habitata of South Westem Journal of Threatened Taxa www.threatenedtaxa.org | July 2012|4(7): 2685-2692

Yahner, R. (1988) Changes in wildlife communities near edges. Conservation Biology2: 333-339.