



Research Article



New records of Tropical Leather-leaf Slug *Laevicaulis alte* (Ferussac, 1822) from Dehra Dun (Uttarakhand) and Jamshedpur (Jharkhand), India

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ABSTRACT

Laevicaulis alte, the Tropical Leather-leaf Slug is an invasive African slug, that got introduced into India. Recently specimen was sighted at Dehra Dun (Uttarakhand) and Jamshedpur (Jharkhand), India which are new records from these areas. In the present communication, its systematic account, distribution, control measures, and other aspects have been dealt with.

Keywords: New records, *Laevicaulis alte*, Dehra Dun, Jamshedpur (India).

INTRODUCTION

Laevicaulis alte (Ferussac, 1822) (Mollusca: Gastropoda: Systellommatophora: Veronicellidae) the Tropical Leather-leaf Slug, a terrestrial gastropod mollusc, is native to Africa but has been introduced to southern Asia, Australia, and many Pacific Islands. It has spread as a serious invasive agri-horticultural slug pest in India and neighbouring countries (Raut & Mandal, 1984; Herbert & Kilburn, 2004) and can negatively affect the agriculture field, natural ecosystems, and human health. Forcart (1967) and Raheem et al. (2014) attributed its possible occurrence in India and elsewhere through the introduction of flowering plants from different countries as also inferred by others.

The slug has been studied in detail on various aspects (morphology, morphometry, anomaly, colour variation, systematics, Karyology, distribution, population dynamics, food & feeding, breeding, incidence on palm seedlings, control measures, nematode hosts, influence of temperature, diseases, intermediate host etc.) by a number of workers during the past (Rao & Ramdoss, 1953; Ray, 1961; Brar & Simwat, 1973; Kulkarni & Nagabhusam, 1973; Rao & Mitra, 1979; Godan, 1983; Rao et al., 1989; Muthumani et al., 1992; Rao et al., 1995; Panigarhi, 1997, 1998a-c, 1999a-c, 2000a-e; Kulkarni et al., 1998; Kumar et al., 1998; Raut & Mandal, 1984, 1986; Rao & Mitra, 1991; Mitra & Dey, 1992; Kumar et al., 1998; Raut & Panigrahi, 1988a,b, 1989, 1990, 1991a, b; Rao et al., 1997; Raut, 1999; Kumar & Ahmed, 2000; Mookherjee et al., 2000; Murugan & Chandran, 2001; Dey et al., 2003; Herbert &

Kilburn, 2004; Rao et al., 2004; Mitra et al., 2005; Kumari & Thakur, 2005; Patil & Tamale, 2005; Kalidas et al., 2006; Cowie et al., 2008; Cordova et al., 2010; Ramakrishna et al., 2010; Patil & Talmale, 2011, 2012; Brodie & Barker, 2012; South, 2012; Jayashankar et al., 2014; Raheem et al., 2014; Budha et al., 2015; Das & Parida, 2015; Selvi et al., 2015; Kim et al., 2018; Das, 2020; Sajan et al., 2021; wikipedia.org).

The species has been recorded from various states of India but no record is available from Jharkhand and Uttarakhand. Recently specimens of *Laevicaulis alte*, commonly known as Tropical Leather-leaf Slug, were found for the first time from Dehra Dun (Uttarakhand, India) and Jamshedpur (Jharkhand) and recorded here as new to these areas with a systematic account, distribution, control measures, and other aspects.

STUDY AREAS

1. Dehra Dun (Uttarakhand):

Location: Dehra Dun is located at co-ordinates 30.32° N 78.03° E. Hari Vihar, a subdivision of Vijay Park (alt. 648 m) which is a large residential area near Ballupur crossing, Chakrata road in the western part of Dehra Dun city, where the Tropical Leather-leaf Slug was found.

Flora: Vijay Park has a good green cover of Ashoka (*Saraca asoca*), Banana (*Musa* sp.), Blackboard tree (*Alstonia scholaris*), Bottle Brush (*Melaleuca flammea*), Cheeku (*Manikara zapota*), Christmas tree, or Cook Pine (*Araucaria columnaris*), Lemon (*Citrus limon*), Forest Fire (*Butea monosperma*), Guava (*Psidium guajava*), Gurhal (*Hibiscus rosa-sinensis*), Jamun (*Syzygium cumini*), Kachnar (*Bauhinia purpurea*), Litchi (*Litchi*

chinensis), Mango (*Mangifera indica*), Mouslari (*Mimusops elengi*), Neem (*Azadirachta indica*), Papaya (*Carica papaya*), Paper Mulberry (*Broussonetia papyrifera*), Palms (Arecaceae), Sago Palm (*Cycas revoluta*) and other ornamental trees. Here most of the residents maintain kitchen gardens vegetables and lawns with flower beds in their dwellings which attract these slugs for their food.

Climate: Humid subtropical, varying greatly from tropical to severe cold depending upon the altitude of the area. In the valley, summer temperatures can reach up to 44 °C for a few days, winter temperature drops below the freezing point and usually remain between 1.0 (or below freezing during severe cold conditions) and 20 °C with some foggy days. It receives an average annual rainfall of 2,073.3 mm, mostly during June-September with a maximum in July-August.

2. Jamshedpur (Jharkhand):

Location: Lat.22.80° N, Long. 86.20° E with 159 m elevations (av. 135 m) on Subernarekha and Kharkai rivers' confluence, with several lakes and Sitarampur reservoir, surrounded by Dalma Hills with dense forests in Chota Nagpur. The specimen dealt here was found in residential areas.

Climate: Subtropical with maximum temperature 47.7° C in May, minimum 3.9 ° C in December-January; average rainfall 316.5 mm in July; av. relative humidity 81% in August.

Flora around: Dry thorny type to semi-evergreen with *Butea monosperma* (Palash), *Gmelina arborea* (Gamhar), *Madhuca longifolia* (Mahua), *Shorea robusta* (Sal), Bamboos, shrubs, herbs and grasses, being the main vegetation.

Plants at collection site (St. Mile Road, Northern Town):

Arbi (*Colocasia esculenta*), Banana (*Musa* sp.), Bela (*Jasminum sambac*), Cardamom, Illaichi (*Elettaria cardemomum*), Cheeku (*Manikara zapota*), Chrysanthemum, Guldaodi (*Dendranthema grandiflora*), Custard Apple, Sharifa (*Annona squamosa*), Doob grass (*Cynodon dactylon*), Guava (*Psidium guajava*), Gurhal (*Hibiscus rosa-sinensis*), Jackfruit, Kathal (*Artocarpus heterophyllus*), Karipatta (*Murraya koenigii*), Lemon (*Citrus limon*), Lemongrass (*Cymbopogon* sp.), Lotus (*Nelumbo nucifera*), Mango (*Mangifera indica*), Marigold, Gainda (*Tegetes* sp.), Money plant (*Epipennum aureum*), Neem (*Azadirachta indica*), Papaya (*Carica papaya*), Rose, Gulab, (*Rosa rubiginosa*), Sadabahar (*Cantharanthus roseus*), Torai (*Luffa aegyptiaca*), Turmeric (*Curcuma longa*), Water lily (*Nymphaea* sp.) etc.

SYSTEMATIC ACCOUNT DISTRIBUTION AND OTHER ASPECTS

Laevicaulis alte (Ferussac, 1822)

Synonymy: *Vaginulus alte* Ferussac, 1822. *Tabl. Syst. Linaceae*: 14; Gude, 1914. *Faun. Brit. India*, Mollusca, 2: 282, fig. 153.

Eleutherocaulis alte, Ferussac, 1822; *Filicaulis alte*, Ferussac, 1822; *Meisenheimeria alte*, Holffman, 1925;

Vaginula maculosa Hasselt, 1830; *Vaginula maillardi* Fischer, 1871; *Laevicaulis maillardi*, Fischer, 1871; *Vaginula brevis* Fischer, 1871; *Vaginulus petersi* von Martens, 1879; *Veronicella petersi*, von Martens, 1879; *Vaginula frauenfeldi* Semper, 1885; *Filicaulis frauenfeldi*, Semper, 1885; *Vaginula elegans* Semper, 1885; *Vaginula leydigi* Simroth, 1889; *Vaginula bocagei* Simroth, 1893; *Veronicella willeyi* Collinge, 1900; *Vaginula leydigi* var. *celebensis* Simroth, 1918; *Vaginula leydigi* var. *keyana* Simroth, 1918.

Laevicaulis alte, Ray, 1961. *Treubia*, 25 (3): 275; Rao & Mitra, 1979. *Rec. Zool. Surv. India*, 75 (Part 1-4): 5, 10; Rao & Mitra, 1991. *Rec. Zool. Surv. India*, Occ. Paper No. 126: 36-37; Mitra & Dey, 1992. *State Fauna Series*, 3 (9): 49; Rao et al., 1995. *State Fauna Series*, 4 (8): 84, pl. 24, figs. 4, 5; Rao et al., 1997. *State Fauna Series*, 6: 111, 127-128, pl. 3, fig. 8; Kumar & Ahmed, 2000. *Rec. Zool. Surv. India*, 98 (Part-3): 67-68; Mookherjee et al., 2000. *State Fauna Series*, 7 (4): 324, 350; Dey et al., 2003. *State Fauna Series*, 9 (5): 132, 143; Rao et al., 2004. *State Fauna Series*, 10: 72 (Part-3), 103-104; Patil & Tamale, 2005. *Zoos' Print Journal*, 20 (6): 1913; Patil & Talmale, 2011. *State Fauna Series*, 15 (3): 3, 22; Patil & Talmale, 2012. *State Fauna Series*, 20 (Part-2): 252, 273; Raheem et al., 2014. *Tropical Natural History Supplement*, 4 (1-13): 55, fig. 31D; Budha et al., 2015. *Zookeys*, 492: 9; Sajan et al., 2021. *Journal of Threatened Taxa*, 13 (2): 17813.

Filicaulis (Eleutherocaulis) alte, Ramakrishna et al., 2010. *Rec. Zool. Surv. India*, Occ. Paper No. 306: 114-115; Mitra et al., 2005. *State Fauna Series*, 5 (Part-5): 225.

Common Names: Black Slug, Common Slug, Garden Slug, Leather-back Slug, Tropical Leather-leaf Slug

Sightings: 1 example; 41, Hari Vihar, Vijay Park, Chakrata Road, Dehra Dun, Uttarakhand, India; 27. viii, 2021; by 1st author (A.H.); 1 example, St. Mile Road, Northern Town, Jamshedpur, East Singhbhum district, Jharkhand, India; 30. viii, 2021; by 2nd author (H.J.H.).

Diagnostic Features: Robust and dark-coloured slug, without a shell; foot pale cream, very narrow, transversely grooved, separated from rest of body by a groove, 4-5 mm wide in adult and 1 mm wide in juvenile; a pair of eye-bearing tentacles protrude anteriorly from underneath mantle (when it's active), tentacles short, 2-3 mm in length and rarely extend beyond the tip of the mantle; an inferior pair of bilobed and inconspicuous tentacles; mantle leathery, slightly granulated, covering entire dorsum and overlapping head, dark brown to blackish, with a pinkish pale line on the central keel, running more or less on entire dorsum; ventral side broad, with broad hyponotum on either side of foot; respiratory orifice and anus ventral on the posterior side of the body.

Panigrahi (1998b; 2000b) observed abnormal development of ocular tentacles in some individuals and reported various colour variants in the species.

Jayashankar et al. (2014) and Das & Parida (2015) studied its morphometry in detail.



Figure 1. *Laevicaulis alte*, dorsal side (from Dehra Dun)



Figure 2. *Laevicaulis alte*, dorsal side (from Jamshedpur)



Figure 3. *Laevicaulis alte*, ventral side (from Jamshedpur)

Size: 35.5 mm in length, 15 mm in width (Rao & Mitra, 1979); 19.5-21.8 mm in length, 6.4-6.9 mm in diameter (Rao & Mitra, 1991); 25.8-63.0 mm in length, 10.25-22.75 mm in width (Mitra & Dey, 1992); 28.55-32.75 mm in length, 8.50-8.55 mm in width (Rao et al., 1995); 7-62 mm in length (Kumar & Ahmed, 2000); 18.7-21.5 mm in length, 5.80-6.75 mm in diameter (Mookherjee et al., 2000); 20.60-36.75 in length, 7.68-13.25 mm in width (Dey et al., 2003); 21.00-26.15 mm in length, 6.25-7.35 mm in width (Rao et al., 2004); length can be extended up to 120 mm (Herbert & Kilbum, 2004); 43.25 mm in length, 17.00 mm in width (Mitra et al., 2005); reaching up to 100 mm in length (Ramakrishna et al., 2010); 44-65 mm in length, 28-40 mm in circumference

(Das & Parida, 2015); 70-80 mm in length (wikipedia.org).

Distribution: Introduced/invaded in India as under.

Jharkhand:

East Singhbhum district: Jamshedpur (present new record).

Uttarakhand:

Dehra Dun district: Hari Vihar, Vijay Park, Western Doon Valley, Dehra Dun (present new record).

Rest of India: Andaman & Nicobar Islands, Andhra Pradesh (Medak dist.), Bihar, Delhi (Deer Park, IARI Campus, Kamla Nehru Ridge, Karkula Nursery, Lal Bagh, Lodhi Garden, Municipality Nursery, Qutub Minar area, Tughlaqabad and Yamuna Barrage), Gujarat, Karnataka (Bengaluru Urban dist.), Kerala, Madhya Pradesh (Jabalpur, Khargone and Sagar dists.), Maharashtra (Aurangabad and Pune dists.), Manipur (Imphal), Meghalaya (Nangpoh), Odisha (Prachi river belt, Cuttack dist.), Puducherry, Punjab, Rajasthan (Jaipur, Jodhpur and Udaipur dists.), Sikkim (Jorhang), Tamil Nadu, Tripura (West Tripura dist.), Uttar Pradesh (Noida), West Bengal (Bardhaman; Kalyani, Nadia; Alipur Garden, Kolkata; Sandeshkhali, North 24 Parganas; Basrhat and Port Canning, South 24 Parganas dists.) and Western Ghats (vicinity of Coimbatore and Tirunelveli).

Elsewhere:

1. Natural: Africa (western and eastern parts).
2. Introduced / Invaded: Australia, Borneo (Malaysian), China, Hong Kong, Indian Ocean Islands, Indonesia, Loyalty Island, Madagascar, Malaysia, Mauritius, Nepal, New Caledonia Island, Pacific Islands, Reunion Island, Samoa (American), Sri Lanka, Taiwan (Dongsha and Pratas Islands), USA (Hawaii) and other areas.

Habitat: Mostly in dry areas and at lower altitudes. Good summer rainfall and increased relative humidity provide a favourable environment for its growth and abundance (Brodie & Barker, 2012).

Adaptation: Adapted for living in dry conditions by its rounded shape, leathery dorsal surface and narrow foot which help in reducing evaporation.

Food and Feeding (in captivity): Feed on host plants as mentioned below under host plants. Being nocturnal, juveniles mostly come out for feeding at night and stay buried in soil during the daytime. However, larger individuals may be found active during the day (Rao et al., 1989; Raut & Panigrahi, 1990; Panigrahi, 1999a). They defoliate the host plants like caterpillars and other insects (Cowie et al., 2008; South, 2012).

Breeding: Protandric hermaphrodite (changing sex from male to a female). Breeds during the summer rainy season. After mating deposit 16-86 oval and translucent eggs in a string, measuring 6-8 mm, in a hole in soil or shallow pit and cover them with faecal pellets. Hatching takes place in about 7-21 days. New-borns measure around 7-8 mm in length. Juveniles grow from 5 mm to about 40 mm in length in seven months (Rao et al., 1989; Raut & Panigrahi, 1988a, b, 1998; Panigrahi, 1998c,

1999c, 2000a,c; Herbert & Kilburn, 2004; Das & Parida, 2015).

Population Dynamics: Panigrahi (1997) made studies on its populations. Kumari & Thakur (2005) studied its population dynamics and found maximum during summer rainy season with increased relative humidity, when population density reached its peak, thereafter it declined to lowest in winter.

Host Plants: *Malus domestica* (Apple), *Impatiens balsamina* (Balsam), *Phaseolus vulgaris* (Bean), *Brassica oleracea* (Cabbage), *Daucus carota* (Carrot), *Coriandrum sativum* (Coriander), *Cosmos* spp. (Cosmos), *Cucumis sativus* (Cucumber), *Dahlia* spp. (Dahlia), *Taraxacum* spp. (Dandelion), *Anethum graveolens* (Dill weed), *Cucurbita pepo* (Gourd), *Latuca sativa* (Lettuce), *Lilium* spp. (Lily), *Tagetes* spp. (Marigold), *Narcissus pseudonarcissus* (Narcissus), Palms (Arecaceae), *Portulaca oleracea* (Common Purslane), *Solanum lycopersicum* (Tomato), *Spinacia oleracea* (Spinach), *Nicotiana tabacum* (Tobacco), *Verbena officinalis* (Common Verbena) and some wild plants (Rao & Ramdoss, 1953; Brar & Simwat, 1973; Godan, 1983; Raut & Panigrahi, 1990; Rao & Mitra, 1991; Panigrahi, 1998a; Raut, 1999; Kalidas et al., 2006; wikipedia.org).

Diseases: Raut & Mandal (1986) and Raut & Panigrahi (1989) studied some of its diseases. Kumar et al. (1998) recorded *Fusarium* sp. fungal infection during its culture. Panigrahi (2000d) noted small non-malignant tumours on dorso-lateral parts of body which did not affect the normal activities of the slug.

Intermediate host for Nematode Parasite in Humans: It acts as an intermediate host of nematode parasite, *Angiostrongylus cantonensis*, the Rat Lung-worm, the most common cause of Eosinophilic meningitis in humans. It is caused primarily through ingestion of infected gastropods, the intermediate hosts of the parasite (Kim et al., 2018).

Control Measures: Being invasive, harmful to agriculture and ecosystems. Rao & Ramdoss (1953) did experiments on their control. Brar & Simwat (1973) controlled these by using certain chemicals. Kulkarni & Nagabhushanam (1973) and Godan (1983) also dealt with control measures. Rauth & Panigrahi (1991a) found the mite *Fuscuropoda marginata* helpful in controlling the pests. Muthumani et al. (1992) studied predatory behaviour in various anurans (*Hoplobatrachus tigerinus* = *Rana tigerina*, *Euphlyctis hexadactylus* = *Rana hexadactylus*, *Duttaphrynus melanostictus* = *Bufo melanostictus*), providing them different food items (earthworms, insects, slugs etc.) and found that predation efficiency of *Hoplobatrachus tigerinus* on slugs was highly significant as compared to other food items and could be potential slug pest controllers. Murugan & Chandran (2001) studied the effect of extract *Tephrosia purpurea*, the Wild Indigo (*Jangli Neel* or *Sarphonk*), injected into the slugs and found them dead on 10th day. Selvi et al. (2015) studied the molluscicidal effect of silica synthesized from rice husk ash coated with leaf

extracts from *Azadirachta indica* (*Neem*), *A. juss*, *Calotropis procera* (*Aak* or *Madar*), *Nicotiana tabacum* (Tobacco) and *Milletia pinnata* (*Karanj*; syn. *Pongamia pinnata*) applied both dust and slurry forms but dust form in higher concentration was found more effective. Das (2020) studied the impact of certain molluscicides in controlling in rural areas.

Raut & Panigrahi (1991b) and Panigrahi (1999b, 2000e) studied the factors influencing mortality in aestivating slugs and artificial aestivating homes in the controlling the slug, which may help to some extent.

Remarks: *Eleutherocaulis haroldi* (Dundee, 1980) (syn. *Laevicaulis haroldi* Dundee, 1980), the Caterpillar Slug, also native to South Africa (KwaZulu-Natal; Republic of South Africa), has some similarity to *Levacaulis alte* but differs from it in colouration (wheatish-brown above with irregular white bands spread across laterally giving a wrinkly appearance, while both ends with an aggregation of black patches, when fully hydrated loses wrinkly appearance, posterior and anterior ends of mantle blackish-brown, hyponotum creamy white with patchy white spots; foot beige), tentacles and foot. It has been recorded from Gujarat, Maharashtra, Rajasthan, Uttar Pradesh and West Bengal.

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