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Review of genus *Spoladea* Guenée (Lepidoptera: Crambidae) from Indian Himalayas

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Abstract
The study is concerned with review of genus *Spoladea* Guenée and first record of its type species i.e., *Spoladea recurvalis* (Fabricius) from Ladakh region of Indian Himalayas. Its taxonomic account has been reviewed and updated. This genus is represented by only *Spoladea recurvalis* (Fabricius) from India.

Keywords: crambidae, ladakh, *Spoladea*, *recurvalis* and genitalia

Introduction
Guenée (1854) [9] established the genus *Spoladea* with *recurvalis* Fabricius as its type-species. Hübner (1825) synonymized this genus under *Hymenia* Hübner. Batra and Bhattacharjee (1960) [3], Bhattacharjee and Menon (1964) [4], Chaudhary and Kapil (1975) [6] and Babu *et al*. (2000) [2] followed this placement. Zeller (1852) [22] proposed a new genus i.e., *Zinckenia* for proper placement of *perspectalis* Hübner and also shifted *recurvalis* Fabricius under it. Hampson (1896, 1898) [10, 11] followed this nomenclature and discussed three species namely *Z. perspectalis* Hübner, *Z. fascialis* Cramer and *Z. alimenalis* Walker under it. Fletcher and Nye (1984) [7] recognized *Spoladea* Guenée as a valid genus. While compiling a checklist of Crambidae, Munroe (1995) [19] also included the present species under *Spoladea* Guenée. He remarked that this genus is represented in the Western Hemisphere by a single widespread species i.e., *recurvalis* (Fabricius). Aswal *et al*. (2005) [1], Zilli and Pavesi (2015) [23] and Chandra and Sambath (2013) [5] also discussed *recurvalis* Fabricius under *Spoladea* Guenée. While reporting its outbreak from Haryana, Kedar and Kumaranag (2013) [14] discussed it under *Spoladea* Guenée. Kumar *et al.* (2013) [16] dealt with six major pest species from North India and discussed *recurvalis* (Fabricius) under genus *Spoladea* Guenée. Presently, the genus *Spoladea* Guenée is represented by only two species namely *recurvalis* Fabricius (the type species) and *mimetica* Munroe (Nuss *et al*. 2016) [20] and the latter one restricted only to New Guinea. Landry (2016) [17] followed the same nomenclature. Husain *et al*. (2020) [13] termed *Spoladea recurvalis* (Fabricius) as an invasive species and reported it as a new record from Dehradun, Aligarh and Jamshedpur. They compiled notes on its systematics, distribution, host plants and biological control.
Ladakh is one of the loftiest (2550-5500mASL) inhabited regions of the world (Garrett, 1963) [8]. It lies towards north and east of the valley of Kashmir and Zoji-La pass (3528mASL) provides the vital link to Kashmir valley. Its short but warm summers enable some plants and animals along with a few species of insects to thrive successfully.

Material and Methods
The adult moths of genus *Spoladea* Fabricius were collected with the help of light trap from different sites mentioned in material examined column. The freshly collected specimens were killed, pinned and properly stretched on stretching boards. Finally, well stretched specimens were stored in duly fumigated air tight wooden boxes of insect cabinet after proper labeling information about date of collection, locality, altitude, name of collector and sex of the specimen etc. The permanent slides of forewings and hindwings were prepared to have clear picture of wing venation and the terminology proposed by Miller (1970) [18] was followed for naming different veins. The dissections were made to explore the male and female genitalic features and the terminology given by Klots (1970) [15] was followed.

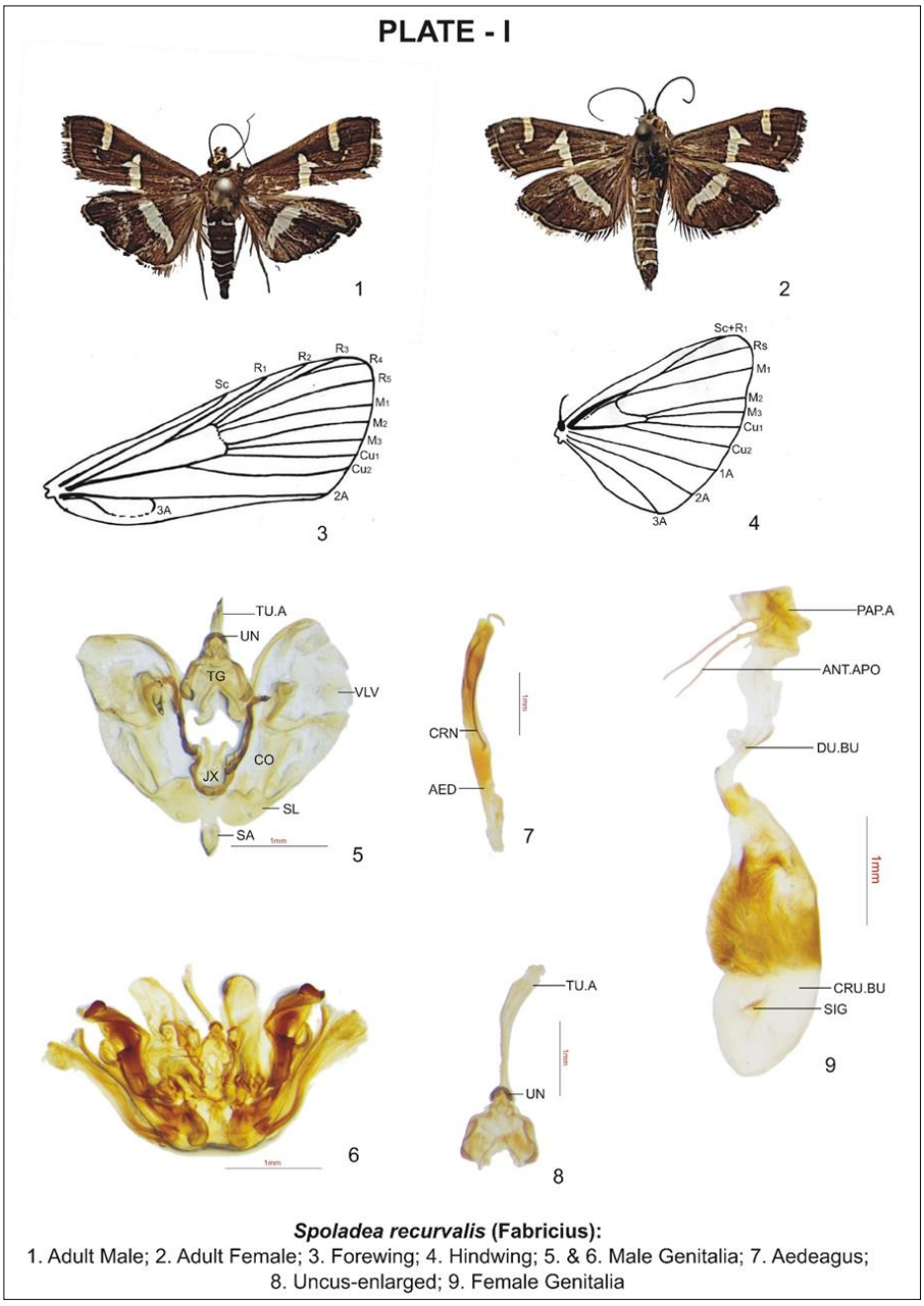
a. **Abbreviations:** 1A: First anal vein; 2A: Second anal vein; 3A: Third anal vein; AED: Aedeagus; ANT.APO: Anterior apophyses; CO: Costa; CRN: Cornuti; CRP.BU: Corpus bursae; CU1: First cubital vein; CU2: Second cubital vein; JX: Juxta; M1: First median vein; M2: Second median vein; M3: Third median vein; PAP.A: Papilla analis; R1: First radial vein; R2: Second radial vein; R3: Third radial vein; R4: Fourth radial vein; R5: Fifth radial vein; RS: Radial Sector; SA: Saccus; Sc: Subcosta; Sc+R1: Subcosta+First radial vein; SIG: Signum; TG: Tegumen; TU.A: Tuba analis; VLV: Valva.

Results
Genus *Spoladea* Guenée
Guenée, 1854 [9], *Hist. Nat. des Ins. Spec. Gén. Lépid.*, 8: 224;Fletcher and Nye, 1984, *Brit. Mus. Nat. Hist*., 5: 143; Kedar and Kumaranag, 2013, *J. Ent. Res.*, 37(2): 149-151; Kumar *et al*., 2013, *Mun. Ent. Zool*., 8(2): 862; Landry, 2016, *Rev. Sui. de Zoo.*, 123(2): 387; Husain *et al*., 2020, *J. Exp. Zool. India*,23(1): 593-598.

Type species
Phalaena recurvalis Fabricius, 1775.

Distribution
Worldwide.

Diagnosis
Smaller sized moths; head with frons rounded; labial palpi vertically ascending with second joint rounded, broadly scaled, third segment bent, very distinct and thin; maxillary palpi slender; antennae of male filiform, rather thick. Abdomen and legs long and slender, spurs long; entire wings rounded concolorous with common patterns with two-tone fringes, the upper ones narrow with obtuse apex, the lower ones very developed bearing a median white band; abdomen with anal valves surrounded by long, silky hairs forming an enlarged brush. Forewing with discal cell closed, about half the length of wing; anal veins present; Cu_1, M_3 and M_2 from posterior angle of cell; M_1 from upper angle of the cell; R_5 curved and approximated at base to R_{4+3}; R_2 opposed to R_{4+3}. Hindwing with discal cell closed, less than half the length of wing; veins 3A, 2A and 1A present; Cu_1, M_3 and M_2 from posterior angle of the cell, approximated at base. Male genitalia with uncus reduced, basally broadened; tegumen broader; valva leaf-like; costa narrowly inflated; aedeagus moderately long; vesica with a sclerotized cornuti. Female genitalia with corpus bursae oblong, broadened posteriorly, posterior half decorated with numerous well sclerotized setae; ductus bursae reduced; anterior apophysis longer than posterior apophysis.



Figs 1-9: *Spoladea recurvalis* (Fabricius)

***Spoladea recurvalis* (Fabricius)**
Phalaena recurvalis Fabricius, 1775, *Syst. Ent*., 644; Fabricius, 1794, *Ent. Syst*., 3(2): 237.
Spoladea recurvalis Fabricius: Guenée, 1854 [9], *Hist. Nat. des Ins. Spec. Gén. Lépid.*, 8: 225, pl. 8, fig. 5; Chandra and Sambath, 2013. *J. Thr. Taxa*, 5(1): 3567; Kumar *et al*., 2013, *Mun. Ent. Zool*., 8(2): 862; Zilli and Pavesi, 2015, *Phagea*, 43(3): 94; 704; Landry, 2016, *Rev. Sui. de Zoo.*, 123(2): 316, 327, 336 fig. 63, 341, 368 fig. 130, 387, 390 fig. 176; Husain *et al*., 2020, *J. Exp. Zool. India*,23(1): 593-598.
Zinckenia recurvalis, Zeller, 1853, *Lep. Micro. Caffr. Kongl. Vet. Akad. Handl*., 55; Lederer, 1863. *Pyral. Wien. Ent. Mon*., 7:437; Snellen, 1872. *Tijd. Voor Ent*., 1872: 95; Meyrick, 1884. *Tr. Ent. Soc. Lond.*, 1884:308.
Hymenia recurvalis, Walker, 1859. *Cat. Lep. Het. Brit. Mus*., 17: 396; Moore, 1884, *Lep. Cyl*., 3: 293; Mandal and Bhattacharya, 1980, *Rec. Zool. Surv. India*, 77: 302.
Phalaena fascialis Stoll in Cramer, 1782, *Pap. Exot*., 4: 236, pl. 398, fig. O; Stoll, 1791, *Pap. Exot*., 5, pl. 36, fig. 13.
Phalaena angustalis Fabricius, 1787, *Mant. Ins.*, 2: 222.
Hymenia diffascialis Hübner, 1826. *Verz. bck. Schmett*., 1826: 361.
Hydrocampa albifacialis Boisduval, 1834. *Faun. Ent. Madag. Lep*., 119, pl. 16, fig. 1.
Spoladea animalis Guenée, 1854 [9]. *Hist. nat. Ins., Spec. gen. Lepid*., 8; 226.
Zinckenia fascialis, Hampson, 1896. *Faun. Brit. India*, 4: 262; Mandal and Bhattacharya, 1980, *Rec. Zool. Surv. India*, 77: 303; Ahmad *et al.*, 2017, *Pak. J. Life Soc. Sc.*,15(2): 130.

Type Locality
India.

Diagnosis
Head with frons rounded dressed with white scales, medial area stalked with blackish brown scales; vertex covered with white scales, medially stalked with blackish-brown scales; labial palpi upturned, basal and second joints broad, scaled with white edged with black scales, third segment short, black, nearly naked; proboscis well developed; antennae long, filiform having blackish-brown scape; collar reddish-brown, mixed with pale-white scales behind eyes; tegula covered with rufous scales; abdomen rufous dorsally, zoned white with a wider band on first segment, pale-brown from underside; legs long, slender, foreleg with tibia and tarsi edged with brownish scales on edges, midleg clothed with yellowish scales having a pair of tibial spurs with inner one longer than the outer one, hindleg with two pairs of tibial spurs of almost the same length.

Wing Maculation
Forewing with ground colour umber-brown; a broad white median band edged in dark and not reaching the costal margin extending from anal margin and projecting a small streak on Cu_2; a postmedial white band extending upto vein M_2 followed by two small white dots on veins Cu_1 and M_3; fringe with rufous mixed with white patches; underside almost similar; basal costal margin white. Hindwing with ground colour umber-brown; costal area white upto middle of wing, broad, white medial band not reaching anal margin; fringe black mixed with white patches; dorsum ciliated; underside almost similar; anal margin white, fringed with long hairs.

Wing Venation
Forewing triangular with discal cell closed, about half the length of wing; vein 3A forming a loop curved forward and joining 2A+1A; the latter two veins fused from base of the wing reaching the margin; Cu_2 from three-fourth of the cell; Cu_1 well before lower angle of cell, M_3 from lower angle of cell; M_2 above lower angle of cell; M_1 from upper angle of the cell; R_5 free; R_{4+3} well stalked; R_2 from well before the common stalk of R_{4+3}; R_1 from just before three-fourth of cell; Sc from base of the wing not reaching the apex. Hindwing globular with discal cell closed, less than half the length of wing; veins 3A and 2A from base of the wing reaching tornus; 1A from base reaching margin; Cu_2 just beyond two-third of cell; Cu_1 well before lower angle of cell, M_3 from lower angle of cell; M_2 above lower angle of cell; M_1 from upper angle of cell; $Sc+R_1$ anastomosed with Rs after its origin from upper angle of cell and ends at costa near apex.

Wing Expanse
Male: 19-21mm; Female: 20-22mm.

Body Length
Male: 12-14mm; Female: 10-12mm.

Male Genitalia
Uncus quite reduced, dome-shaped, dorsally studded with prominent backwardly directed spines; tuba-analis prominent, quite long; tegumen broad, moderately sclerotized; vinculum narrow, heavily sclerotized, horse-shoe shaped, shorter than tegumen; saccus wanting; valva slipper shaped, broader towards distal end; costa inflated, heavily sclerotized, ending into inwardly directed projection near middle of valva; middle portion of valva setosed with fine setae; juxta long, narrow, “V” shaped; aedeagus moderately narrow and slender with a

sclerotized strap along one wall and the other one membranous; vesica with a long sclerotized plate representing cornutus; ductus ejaculatus entering directly from proximal end.

Female Genitalia
Corpus bursae oblong, rounded anteriorly, anterior half membranous, posterior half decorated with numerous rows of spines representing signum; one oblique sclerotization in anterior half; ductus bursae narrow, shorter than corpus bursae, sclerotized towards corpus bursae; anterior apophyses quite long, almost double the length of posterior one; posterior apophyses short and thin; papilla analis narrow, oblong, setosed with long setae.

Material Examined
Ladakh: Drass, 01.ix.2018- 4♂, 3♀ (Alt. 3300 M; Geo. Coord. 34.4269ºN, 75.7459ºE); Krishi Vigyan Kendra, Kargil, 10.ix.2018- 6♂, 4♀ (Alt. 2950 M; Geo. Coord. 34.5539ºN, 76.1349ºE); Horticulture Dept. Kurbathang, 15.ix.2018- 2♂, 3♀ (Alt. 2980 M; Geo. Coord. 34.4958ºN, 76.1017ºE); Pashkum, 03.ix.2018- 2♂, 1♀ (Alt. 3000 M; Geo. Coord. 34.5116ºN; 76.1929ºE).

Distribution
India: Andaman and Nicobar Islands, Assam, Delhi, Haryana, Himachal Pradesh, Jammu and Kashmir, Punjab, Uttarakhand, Uttar Pradesh; Africa; Australia; China; Malaysia; Myanmar; Nepal; N. & S. America; S. Europe; Thailand; Sri Lanka.

Discussion
Guenée (1854) [9] established the genus *Spoladea* Guenée on the basis of *recurvalis* Fabricius as its type species. This world-wide species is commonly known as beet webworm. Hübner (1825) and Zeller (1852) [22] formulated two new genera i.e., *Hymenia* and *Zinckenia* for placement of *perspectalis* Hübner. Later, *Zinckenia* Zeller got synonymized under *Hymenia* Hübner. During present studies, it has been observed that both type species namely *recurvalis* Fabricius and *perspectalis* Hübner are distinct. Shibuya (1929) [21] presented a key for both these genera and observed a short second joint of labial palpi in *Hymenia* Hübner and broad in *Spoladea* Guenée. Landry (2016) [17] also studied both these species and discussed a number of morphological distinctions including the general colouration which is dark-brown in *perspectalis* Hübner and somewhat paler-brown in *recurvalis* (Fabricius). Similarly, the white markings differ in forewings by thin median fascia from dorsum not touching the discocellular stigma in *perspectalis* Hübner while these markings are wider and touch the discocellular stigma in *recurvalis* (Fabricius). Moreover, hindwings marked by a thin fascia in *perspectalis* Hübner as compared to wider and evenly margined fascia of *recurvalis* Fabricius. During present study, the male and female genitalic features of *Spoladea recurvalis* (Fabricius) have also been examined in detail. The quite reduced, dome shaped uncus with distinct spines; long tuba-analis; heavily sclerotized horse-shoe shaped vinculum; wanting saccus; valva with inflated costa and sclerotized strap along one wall of aedeagus in male genitalia and well decorated posterior half of corpus bursae with numerous rows of spines in female genitalia further makes *Spoladea recurvalis* (Fabricius) distinct from *Hymenia perspectalis* Hübner. On the basis of relevant literature and present study, the placement of *recurvalis* Fabricius under genus *Spoladea* Guenée has been justified. The collection for this species from Drass, Kargil, Kurbathang and Pashkum is its first record from Ladakh region of Indian Himalayas. The covering of male genitalia with tufts of long hairs is its characteristic feature.

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