



Description of *Pneumolaelaps berlesei* (Hirschmann, 1969) and *Eulaelaps stabularis* (Koch, 1836) (Acari: Mesostigmata: Laelapidae) from Pakistan

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Abstract: The members of the family Laelapidae were poorly explored from Pakistan. *Pneumolaelaps berlesei* (Hirschmann, 1969) and *Eulaelaps stabularis* (Koch, 1836) from genera; *Pneumolaelaps* Berlese, 1920 and *Eulaelaps* Berlese, 1903 respectively, found cosmopolitan as manure-inhabiting mites and new records from Pakistan mite fauna. This manuscript includes the description of new records along with short notes on previously identified laelapids from Pakistan.

Keywords: *Pneumolaelaps*, *Eulaelaps*, *Androlaelaps*, *Cosmolaelaps*, *Laelaps*, *Laelaspis*, Pakistan mite fauna.

1. INTRODUCTION

The poultry and animal wastes are suitable places for free-living predators that feed on the nematodes, dipteran (eggs and larvae), and play an essential role in manure's biological ecosystem [1-3]. Many researchers previously explored the manure-inhabiting mesostigmatic fauna and their role in biological control of manure inhabiting arthropods [4-7]. Qayyoun and Khan [8] reported poultry manure-inhabiting mesostigmatic mites of Macrochelidae, Parasitidae, Laelapidae, Uropodid, and some others, from Punjab province, Pakistan. The family Laelapidae is poorly explored from Pakistan [9]. Allred [10-12] worked on exploring laelapids during 1969-1975 as a project of parasitic mites from small mammals. Allred [9-12] identified 14 species from Pakistan. Among the Laelapidae, the genus *Pneumolaelaps* Berlese is known for the association with Hymenoptera, especially bumblebees [1, 13-15]. While the genus *Eulaelaps* Berlese, commonly found in damp places, straw, and

soil [16]. Allred [10] reported the genus *Eulaelaps* Berlese and Qayyoun and Khan [8] reported genus *Pneumolaelaps* Berlese from Pakistan. An accurate and detailed morphological description of *Pneumolaelaps berlesei* (Hirschmann, 1969) and *Eulaelaps stabularis* (Koch, 1839) is necessary for the clarification of laelapids fauna of Pakistan.

2. MATERIAL AND METHODS

Poultry manure samples were collected from 6 different Punjab districts during 2014-15 (Table 1). Approximately more than 500 g of each sample was used for mite extraction. Mites were extracted using the Berlese funnels extraction method [17-21]. All mites specimens were preserved in 75% ethanol and Hoyer's medium used for mites mounted permanently on the slides. The mites specimens were identified under a phase-contrast microscope (**model name, company, country**) and pictures were saved at 40X for further illustration. The illustration of mites was made with the help

of Adobe Illustrator [22]. Setal nomenclature and legs chaetotaxy were followed that of Lindquist et al [23]. All the specimens were deposited in the acarological collection (University of Agriculture, Faisalabad). The collection of mites were done from different districts of Punjab province, Pakistan as given in table 1.

3. RESULTS AND DISCUSSION

3.1. GENUS *PNEUMOLAE LAP S* BERLESE

Pneumolaelaps Berlese, 1920.

Iphis bombicolens Canestrini 1885 (original designation)

***PNEUMOLAE LAP S BERLESEI* (Hirschmann, 1969)**

Hypoaspis berlese [24]

Description of Female ($N = 5$)

Idiosoma:

Idiosoma 618-638 μm long and 3341-376 μm wide. The width of the idiosoma was measured at the level of $r3$. The idiosoma of the descriptive specimen was 620 and 356 μm , long and wide, respectively. About 40 pairs of setae present on the dorsal idiosoma. The length of dorsal setae ranged from 33-43 μm with many reticulations on the dorsum. All dorsal setae were simple and needle-like with 5-6 pairs of pores (Fig. 1A).

Ventral Idiosoma:

Pre-sternal shields soft and membranous with few horizontal lines, divided into two portions. Pre-sternal shields 66 - 68 μm wide. Sternal shield 120 - 123 μm long and 105 - 109 μm wide. Sternal shield covered with reticulations and smooth area posteriorly. *St1* 69-73 μm long than other sternal setae. The genital shield looks like a flask with reticulation lines. These reticulations lines become dense and thin near the sternal shield. Genital shield ranged from 220-225 μm than wide 90(86-92 μm). The width of the genito-ventral shield is measured at the middle of coxa-IV. One pair of genito-ventral setae (*St5* = 54-57 μm) and one pair of the pore were presented. Five pairs of setae present around the pear-like anal shield. One pair of pre-anal and one post-anal seta present on the anal shield. Post-anal and pre-anal setae' lengths ranged from

54 to 57 μm and 22 to 23 μm respectively. The descriptive specimen's measurement is as follows; pre-sternal shield 67 μm in length, sternal shield 121 and 107 μm in length and width respectively, genito-ventral shield 222 and 90 μm in length and width respectively. The length of sternal setae of the descriptive specimen is 72 μm (*St1*), 55 μm for *St2*, *St3*, *St4*, and *St5* (Fig. 1B).

Peritreme:

Peritrematal shield (Fig. 1B) enlarged 350-354 μm , slighter thin at the stigmatic opening level, free from dorsal and exopodal platelets, approaching the margin of coxa-I. poststigmatal plate triangular, thinner than peritrematal plate with a pore. The descriptive specimen, peritrematal length was 351 μm .

Chelicerae:

The movable digit of chelicerae having two teeth and a fixed digit with three long teeth. The fixed digit without smaller teeth and with a pilus dentilis as shown in Fig. 1C.

Legs:

The genu for leg-IV with 10 setae, setae *av*, and *pv* presented. All legs with simple setae. The length of legs as leg-IV (120-135 μm); leg-III (89-97 μm); leg-II (89-97 μm) and leg-I (140-144 μm). The length of descriptive specimen legs as leg-IV (125 μm); leg-III (95 μm); leg-II (95 μm) and leg-I (143 μm) (Fig. 1D).

Male:

Unknown.

Distribution:

Worldwide.

Remarks:

In general appearance, the identified specimens were similar to previously described specimens except the smaller in size.

Specimen Examined:

All specimens were collected from poultry manure. One female found from JKFsd; three female found from KWFsd; two females identified from PUFsd; three females found from NKBkr-I; one female found from NKBkr-II; two females found from NKBkr-III; three females found from FPRjp;

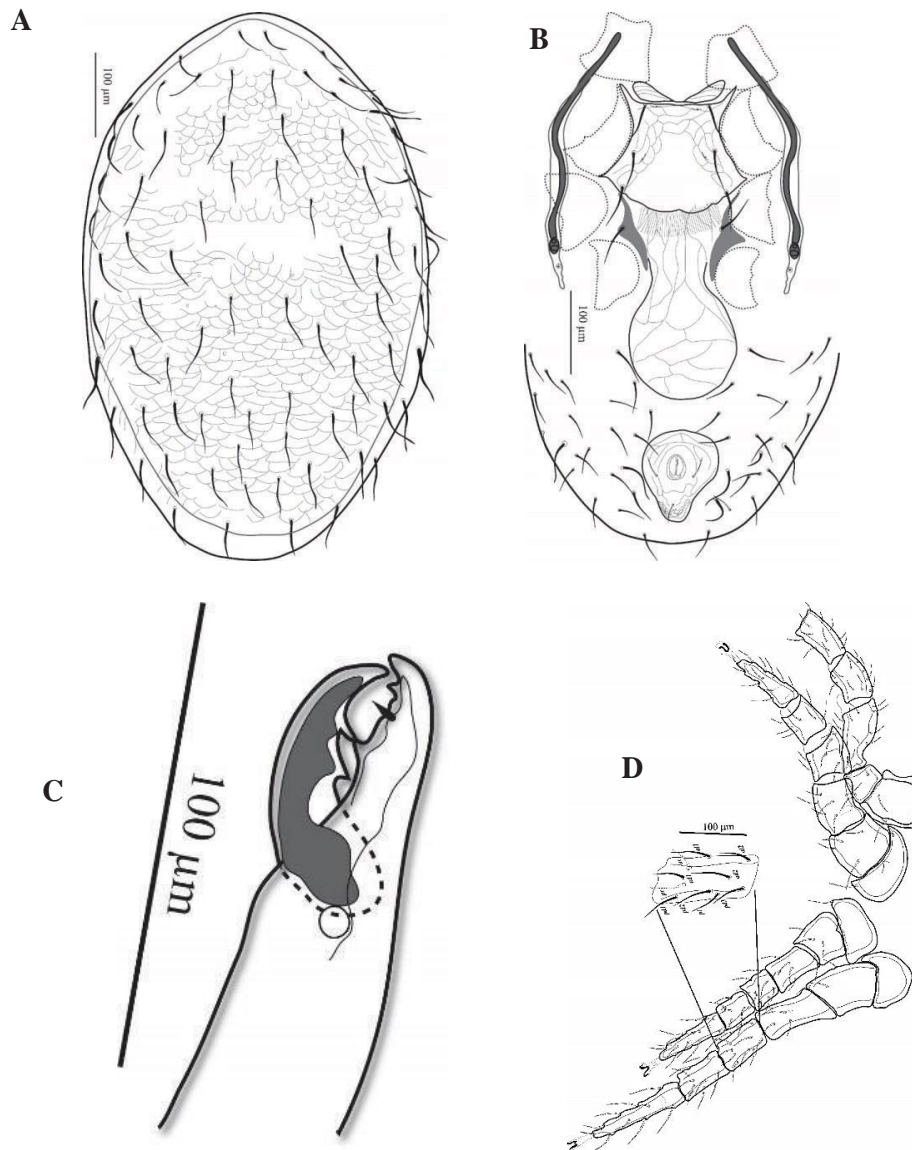


Fig. 1. *Pneumolaelaps berlesei* (Hirschmann, 1969): female; dorsal view (A) ventral view (B) Chelicera (C) legs (D).

one female found from RJP; three females found from KMRjp; two females found from EPLyh; one female found from KSLyh; two females found from LMLyh; two females found from KAMgh; one female found from MGH-I; two females found from MGH-II; three females found from KSRYk-I; one female found from KSRYk-II; four females from RYK (for abbreviations see Table 1).

3.2. GENUS *EULAE LAP S* BERLESE

Eulaelaps Berlese, [25]

Eulaelaps stabularis (Koch, 1839)

EULAE LAP S *STABULARIS* (Koch, 1839)

Gamasus stabularis (Koch, 1839)

Diagnostic Characters:

The dorsal shield entirely covered the idiosoma and hypertrichous. Pre-endopodal shields/plates are prominent. Meta-sternal setae are free, sternal shield with two pores and three pairs of sternal setae. Lateral incisions present on the genital shield anteriorly. Genito-ventral shield laterally approaching coxa-IV, wider posteriorly. Twenty pairs of opisthogastric setae present on the genito-ventral shield. Anal shield triangular in shape marginal concave anteriorly and with three setae.

Table 1. The list of sampling sites with abbreviations and coordinates (2014-15).

Abbreviation	Site name	Coordinate	Abbreviation	Site name	Coordinate
Faisalabad District			Layyah District		
JKFsd	Chak# 99RB, Jandiala Khalan	31°28'21" N, 73°20'20" E	EPLyh	Ehsanpur, Layyah	30°41'33" N, 70°1'19" E
KWFsd	Khurianwala	31°28'18" N, 73°14'55" E	KSLyh	Kot Sultan, Layyah	30°49'40.93" N, 70°55'27.7" E
PUFsd	Poultry farm, UAF	31°26'20" N, 73°04'32.79" E	LMLyh	Layyah mor, Layyah	30°53'59.64" N, 70°57'51.26" E
Bakhar District	Muzaffergarh Distrc				
NKBkr-I	Notak-I	31°26'60" N, 71°5'9" E	KAMgh	Kotaddu	30°22'03.46" N, 70°59'42.18" E
NKBkr-II	Notak-II	31°26'32.19" N, 70°59'40.50" E	MGH-I	Muzafergarh-I	30°09'51.61" N, 71°5'41.76" E
NKBkr-III	Notak-III	31°23'12.05" N, 71°3'29.21" E	MGH-II	Muzafergarh-II	29°57'58.83" N, 71°9'27.43" E
Rajanpur District			Rahim Yar Khan District		
FPRjp	Fazilpur	29°22'15" N, 70°31'24" E	KSRYk-I	Kot Samba-I	28°30'25.67" N, 70°30'16.61" E
RJP	Rajanpur	29°10'24.61" N, 70°24'36.65" E	KSRYk-II	Kot Samba-II	28°32'2.75" N, 70°31'26.14" E
KMRjp	Kotmithan	29°57'0.29" N, 70°15'29.52" E	RYK	Rahim Yar Khan	28°27'24.23" N, 70°21'21.15" E

The Gnathostomata is smaller than the body. The deutosternum having 4 to 7 rows of denticles with 10 or more denticles.

Description of Female ($N = 5$)

Dorsal Shield:

Dorsal shield length ranged from 618-638 μm and 41-376 μm wider at the level of $r3$. Dorsal shield oval in shape and having more than 40 pairs of dorsal setae. Dorsal setae simple and needle or spine-like with length ranged from 33-43 μm . Marginal dorsal setae spine or needle-like with 4 pairs of pore gland on the dorsum. The network of reticulation present on the dorsum. The descriptive specimen's dorsum length was 620 μm and 356 μm width with the length of dorsal setae 35 to 43 μm (Fig. 2A).

Ventrum:

The pre-sternal shield was membranous with a network of lines. Sternal shield length ranged from 142-147 μm and 178-191 μm wider. Six sternal setae present on the sternal shield. The sternal setae length ranged from 98 to 106 μm with $St1$ and $St4$ longer than others. The sternal setae length ranged as $St1$ 104 to 105 μm ; $St2$ and $St3$ 98 to 101 μm ; $St4$ 104 to 106 μm ; $St5$ 99 to 100 μm . genito-ventral shield longer 612 to 635 μm than 190 to 210 μm wider from the middle of coxa-IV. Genito-ventral shield with sternal setae, $St5$ anteriorly with a pair of pore and hypertrichus setae on the posterior side. Metapodal shield with networks of ornamentations presented near the coxa-IV. Anal shield wider than its length. One pair of pre-anal (73-75 μm) and post-anal (82-86 μm) setae present on the anal shield. The ventrum of the descriptive specimen was 187 μm in width and 145 μm longer. Sternal setae length of the descriptive specimen as follows: $St1$ 105 μm ; $St2$ 100 μm , $St3$ 100 μm ; $St4$ 105 μm ; $St5$ 100 μm . genito-ventral shield 625 μm longer than 200 μm wide as shown in figure 2B.

Peritreme:

Peritrematal shield (Fig. 2B) broader at the level of stigmatic opening, approaching the margin of coxa-I. Poststigmatal plate broader than peritrematal plate with a pore. Out layer of Peritreme with ornamentations.

Chelicerae:

Two teeth present on the movable digit of chelicerae

and three long teeth present on the fixed digit without small teeth.

Hypostome:

Hypostomal setae (4 pairs) present on hypostome with 9-10 rows of denticles with 6-7 denticles in each row. Sharp edge cornicles 61 (62-63 μm) present on the hypostome (Fig. 2C).

Legs:

All legs are simple and more extended. Legs length ranged from 956 to 1006 μm , 767 to 800 μm , 767 to 800 μm , and 1090 to 1144 μm for leg-IV, III, II, and I, respectively. The length of descriptive specimen 1000, 780, 780, and 1100 μm for leg-IV, III, II, and I, respectively. The length and width of leg segments were smaller in leg II and III compared to the first and fourth (Fig. 2D).

Male:

A dorsal shield covered the whole body. Tritisternum with base (42 μm), and laciniae (96 μm). holoventral shield covered the venter with more than 50 opisthogastric setae. Paranal and post-anal setae 52-57 μm long. Peritrematal characters are similar to females but not approaching coxa-I. Legs segments measurement was similar to Uchikawa and Rack [16].

Remarks:

The specimen identical to previously described *Eulaelaps stabularis* except smaller than Uchikawa and Rack [16] and Oudemans [26].

Ecological notes:

Distribution:

World wide.

Material Examined:

One female found from JKFsd; three female found from KWFsd; two females identified from PUFsd; three females found from NKBkr-I; one female found from NKBkr-II; three females found from KMRjp; two females found from EPLYh; one female found from KSLyh; two females found from LMLyh; two females found from KAMgh; one female found from MGH-I; two females found from MGH-II; three females found from KSRYk-I; one female found from KSRYk-II; four females found from RYK (for abbreviation see Table 1).

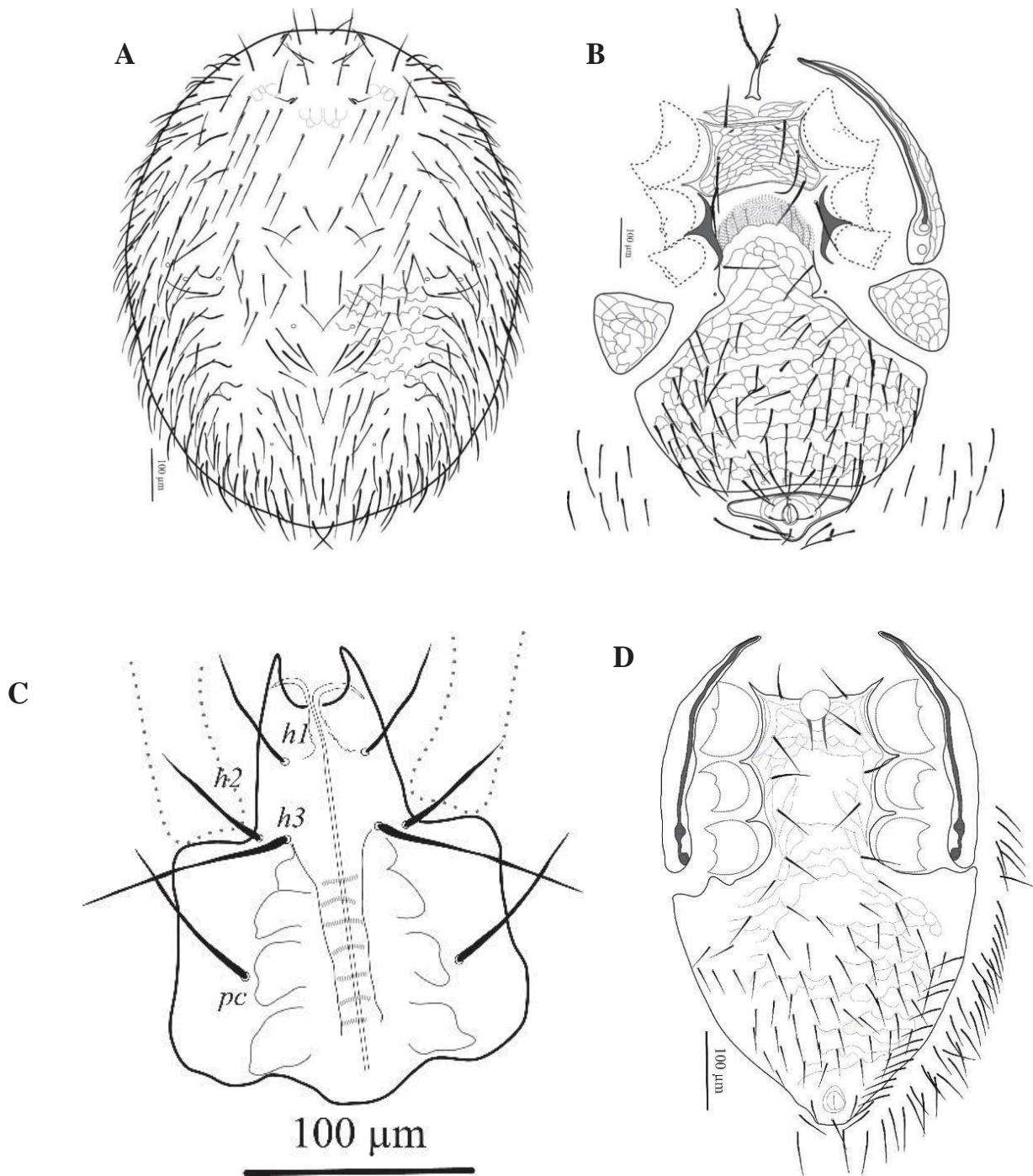


Fig. 2. Female, dorsal view (A) ventral view (B) Hypostome (C) Male, ventral view (D) of *Eulaelaps stabularis* (Koch, 1839)

4. NOTE on PREVIOUS WORK

The family Laelapidae is poorly explored from Pakistan [9]. Only 14 species were identified from Pakistan before by Allred [10-12]. He collected all

specimens from rodents as a parasitic mite while the addition of new records in this study was explored from poultry manure. Now, a total of sixteen mites from six genera are identified from Pakistan (Table 2).

Table 2. Previous mites (Acari: Mesostigmata: Laelapidae) from Pakistan.

S. No.	Species	Genus	Host	Distribution	Reference
1	<i>Androlaelaps abuncus</i>	<i>Androlaelaps</i> Berlese, 1903	<i>Tatera indica</i> (Rodentia: Muridae).	Pakistan	[10,12]
2	<i>Androlaelaps casalis</i>		Bird and rodent nests, in poultry litter etc.	Cosmopolitan	[9]
3	<i>Androlaelaps congoensis</i>		<i>Spermestes cucullatus</i> (Estrildidae)	Congo and Pakistan	[10]
4	<i>Androlaelaps marshalli</i>		<i>Arvicanthis abyssinicus rubescens</i> , <i>Tatera schinzi</i> (Rodentia: Muridae); <i>Saccostomus</i> sp. (Rodentia: Nesomyidae).	Somalia, Uganda, South Africa, Zimbabwe, and Pakistan.	[10]
5	<i>Androlaelaps longipes</i>		<i>Meriones tristami</i> , <i>M. erythrourus</i> , <i>M. tamariscinus</i> , <i>M. rex buryi</i> , <i>M. crassus</i> , <i>Rhombomys opimus</i> , <i>Citellus pygmaeus</i> (Rodentia: Muridae).	Armenia, Turkmenistan, Tajikistan, Russia, Yemen, Egypt, and Pakistan.	[10,12]
6	<i>Androlaelaps pakistanicus</i>	<i>Cosmolaelaps</i> Berlese, 1903	<i>Cricetulus migratorius</i> (Rodentia: Muridae).	Pakistan	[11]
7	<i>Androlaelaps zuluensis</i>		<i>Cricetulus migratorius</i> , <i>Aethiomys namaquensis</i> (Rodentia: Muridae).	South Africa and Pakistan	[10,12]
8	<i>Androlaelaps pavlovskii</i>		<i>Tamias sibiricus</i> , <i>Rattus norvegicus caraco</i> , <i>Apodemus agrarius</i> , <i>A. speciosus</i> , <i>Myodes rufocanus</i>	Siberia, Russian, China and Pakistan	[10,12]
9	<i>Cosmolaelaps vacuus</i>		<i>Camponotus herculeanus</i> , <i>Lasius flavus</i> , <i>L. fuliginosus</i> (Hymenoptera: Formicidae).	Austria, Italy, Ireland, Germany, China	[10,12]
10	<i>Laelaps algericus</i>		<i>Psammomys algiricus</i> , <i>P. obesus</i> , <i>Mus musculus</i> .	Africa, Europe, Siberia (Russia), China, Pakistan	[10]
11	<i>Laelaps jugalis</i>	<i>Laelaps</i> C.L. Koch, 1836	<i>Rattus rattus</i> (Rodentia: Muridae)	Pakistan	[10]
12	<i>Laelaps longisetosus</i>		<i>Cricetulus migratorius</i> (Rodentia: Muridae)	Pakistan	[10]
13	<i>Laelaps nuttalli</i>		<i>Mus rattus</i> , <i>Mus norvegicus</i> (Rodentia: Muridae)	Serbia (Russia), Pakistan	[10]
14	<i>Laelaspis patulus</i>	<i>Laelaspis</i> Berlese, 1903	<i>Apodemus flavicollis</i> (Rodentia: Muridae)	Pakistan, Iran	[10,12]

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