A NEW SPECIES OF ANOPHELES HYRCANUS GROUP FROM NEI MONGOL AUTONOMOUS REGION (DIPTERA: CULICIDAE)

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ABSTRACT Morphology of *Anopheles* (*Anopheles*) *hailarensis*, a new species belonging to the *Anopheles hyrcanus* group, collected from Hailaer, Nei Mongol Autonomous Region, P. R. of China, is described in adult, pupal, larval and egg stages. It is closely related to *Anopheles sinensis* Wiedemann, 1828 and Anopheles heiheensis Ma, 1981[1]. Comparisons on adult morphology among above three species and egg morphology between the new species and *Anopheles sinensis* are made.

Key words: Diptera, Culicidae, *Anopheles hyrcanus* group, new species, Nei Mongol Autonomous Region

Hailar City is located in 119°44'E longitude, 49°13'N latitude, faunally belonging to Hulun Buir Plateau Subdivision, Mongolia-Xinjiang Division, Middle Asia Subregion, Palearctic Region. Mosquito fauna of Northeast China and adjacent region including Hailar has been reported (Chang, 1958[2]; Su, 1983[3,4], and Zhang, 1983[5]). A total of 66 species in 6 genera were recorded. Among them, 6 species belong to Genus Anopheles. A thorough study of the anopheline mosquitoes in Hailar conducted during 1993 to 1995 showed that one species is new which is described here as *An.* (*Ano.*) *hailarensis* sp. nov.

Materials and Methods

Mosquito collections were made from the cow sheds and breeding places in the surburbs of Hailar City during August 4—20, 1993. Each engorged female was isolated in a glass tube fitted with damp cotton and a piece of filter paper for oviposition. The eggs were reared to adults and ten broods of mosquitoes containing the eggs, the adults and the associated fourth instar larval and pupal exuviae were preserved for study using the method reported by Xu and Feng (1975)[6]. The pinned adult specimens and larval and pupal exuviae on microscope slides were examined under a steromicroscope or binocular microscope. Morphological terminology and numbering of larval and pupal setae follow Harbach and Knight (1980, 1981)[7,8]. And Lu (1974)[9] is followed for wing spot nomenclature.

Description

Adults have broad hindtarsal pale bands (hindtarsomeres 2—4 possess apical and basal pale bands). The wings have wide pale fringe spots. Remigium is mixture of pale and dark scales, humeral crossvein without scale, costa darkly scaled except subcostal and preapical pale spots and there is a distinct pale fringe spot at apex of V5.2. Males have a basal band on palpal segment 3, the aedeagus has 5—6 pairs of leaflets. The pupae have the trumpet darkly pigmented with a thin and paler rim and have a distinct pattern of dark spots on the

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Palearctic Region. Among 6 species within *An. hyrcanus* group recorded from the Palearctic Region in China, *An. hailarensis* sp. nov. is closely related to *An. sinensis* and *An. heiheensis*. Differential characteristics among the adults of above three species are shown in Table 3 and morphological comparison of the eggs between *An. hailarensis* sp. nov. and *An. sinensis* is given in Table 4. These data showed that obviously morphological differences exist among *An. hailarensis* sp. nov. and its sibling species, so it is proved to be a distinct species.

Table 4 Morpholgical comparison of the eggs between Anopheles hailarensis **sp nov and** Anopheles sinensis **Wiedemann, 1828**

Characteristics	*Anopheles hailarensis* sp. nov.	*Anopheles sinensis*
Length of egg (um)	679.3	611.1
Width of deck (um)	47	94.9
Width of deck/Width of egg (%)	20.5	50.2

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References

1 Ma SF. Studies on the *Anopheles* (A.) *sinensis* group of mosquitoes in China, including four now sibling species. Sinozoologia 1981; 1: 59
2 Chang SC. The races of *Anopheles maculipennis* and their distribution in the north eastern provinces of China. Acta Entomol Sinica 1958; 8: 266
3 Su L. Mosquitoes of Northeast China and adjacent region. J Bethune Med Univ 1983; 9(1): 1
4 Su L. The member of mosquito fauna and the regularities of their geographical distribution in northeast China. J Bethune Med Univ 1983; 9(3): 9
5 Zhang DC. Fauna distribution of mosquitoes in southwestern region of northeast China. J Bethune Med Univ 1983; 9(4): 45
6 Xu JJ, Feng LC. Studies on the Anopheles hyrcanus group of mosquitoes in China. Acta Entomol Sin 1975; 18(1): 77
7 Harbach RE, Knight KL. Taxonomists' glossary of mosquito anatomy. Marlton: Plexus Publishing Inc, 1980: 1-415
8 Harbach RE, Knight KL. Corrections and additions to Taxonomists' glossary of mosquito anatomy. Mosq Syst 1981. 13: 201
9 Lu BL. Handbook for identification of anopheline mosquitoes in China. Second edition. Beijing: Science Press 1974: 1
10 Reid JA. The *Anopheles hyrcanus* group in Southeast Asia (Diptera: Culicidae). Bull ent Res 1953; 44: 5
11 Lu BL, Zhao TY, Kang WM. *Anopheles hyrcanus* group and their vector competence in China. Acta Parasitol Med Entomol Sin 1993; 1: 55
12 Le XT. A new species of the *Genus Anopheles* (Diptera: Culicidae) from China. Sichuan Animal 1996: 15(1): 1

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内蒙古赫坎按蚊种团一新种(双翅目: 蚊科)

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提要　本文记述一种采自我国内蒙古自治区海拉尔市郊, 隶属于赫坎按坟种团的新种海拉尔按蚊[*Anopheles* (*Anopheles*) *hailarensis* sp. nov.]的成虫、蛹、幼虫和卵的形态特征。成虫与其近缘种中华按蚊(*Anopheles sinensis* Wiedemann, 1828)和黑河按蚊(*Anopheles heiheensis* Ma, 1981)的形态进行比较, 并与中华按蚊卵的形态作比较。

关键词　双翅目　蚊科　赫坎按蚊种团　新种　内蒙古自治区

wing case. The anterior tergal plates on abdominal segments II-V II of larvae are not uniformly pigmented. The pecten has 8-10 long teeth. The eggs have a widish deck, that is about 0. 21 of egg width.

Female (Figs. 1—4): Large size, wing length 4. 10—4. 99 mm, average 4. 5 mm (10 specimens measured). Head: Frontal area has long white seta-like scales. Vertex with pale erect scales on central area, dark brown erect scales laterally. Palpus is rather slender, with 4 distinct pale bands, no pale scale between the pale bands. Base of palpus is shaggy, with scattered pale scales dorsally. Antenna is slender, about 0. 75 length of palpus. There are some flattened pale scales on the pedicel and basal six segments of flagellomeres. Clypeus has a tuft of dark scales on each side. The edge of eye has a narrow pale line. Thorax: Scutal integument light brown, with dark brown median line extending from the frontal border back to prescutellar area, with paired dark lateral lines and indistinct dark eyespots. The pleura of thorax is grey, with a longitudinal dark line extending from front back to prealar area. There are several flattened pale scales on anterior pronotum and sternopleuron. Pleural setae: 4—7 propleural, 6—10 prealar, 5—6 uppersternopleural and 6—9 upper mesepimeral. Wing: With pale and dark scales contrast. Costa darkly scaled except subcostal and preapical pale spots, the subcostal pale spot is usually longer than the preapical spot. Humeral crossvein usually bare. There is a distinct sector pale spot on V1 besides subcostal and preapical pale spots, and the middle dark spot is deep black. Remigium is usually mixture of pale and dark scales. Base of V2 and the fork of V 2. 1 and V 2. 2 as well as the apexes of V 2. 1 and V 2. 2 with dark scales, the remainder parts are usually mixture of pale and dark scales. Base and apex of V3 with dark scales, mainly pale on middle portion, infrequently with scattered dark scales. V4 mainly dark scaled, the fork and apexes of V4. 1 and V4. 2 with dark scales, and usually have pale and dark dots on the middle portion. Basal dark mark on V5 is rather long, usually separated by its own length from the most basal dark spot on V6. V5. 1 with dark scales on its base and apex, there are two dark spots on the middle portion. V6 with two dark spots. Apical pale fringe spot extends from V2. 1 to V4. 1. There is an obvious pale fringe spot at the apex of V5. 2. Stem of halter pale, knob is covered densely with dark flattened scales. Leg: Coxae have distinct pale scales. Foreleg: Femur has dark scales dorsally and apically, with dirty yellow scales ventrally. Tibia dark doraslly, pale ventrally. Tarsomeres 1—3 with narrow apical pale bands approximately equal segment width, without basal pale band. Mid-leg: Femur and tarsomeres as on foreleg. Hindleg: Femur dark scaled dorsally and apically, with yellow scales ventrally except at apex; tarsomere 1 has apical pale band; tarsomeres 2—4 not only possess apical pale bands, but also have basal pale bands, forming three broad pale bands; tarsomere 5 usually has basal pale band. Abdomen: Integument dark brown dorsally, pale ventrally, with long golden setae, devoid of scales except median tuft of erect dark scales near caudal margin of sternum V II. Infrequently (4/10), there are a small number of flattened pale scales on sternum V I.

Male (Figs. 5—8): General markings are as that for the female. Head: Base of palpus is shaggy, inner side of segment 2 has a pale longitudinal line, base of segments 3—5 with narrow pale bands, segment 5 pale

scaled on dorsoapical 0. 50; with long hairs on the margin of segment 4. Leg: Essentially as in female except the pale bands of hindtarsomeres 2—4 may be slightly longer, the length of each pale band is about 2. 5—4. 0 times of segment width. Genitalia: Basimeres without pale scale, but have several dark scales and long setae laterally and dorsally. There are 2 parabasal spines, the inner spine is stout, arising from a marked prominence, the outer spine is straight, slender and longer than inner spine. Dorsal lobe of claspette is broad, with 4—5 spines which fuse to form club, ventral lobe of claspette with 2 long setae and several short hairs; mesal seta distinctly longer than lateral setae. Aedeagus is slightly longer, with 5—6 pairs of leaflets, the largest one usually has a basal tooth and several lateral teeth on one edge.

Pupa (Figs. 9—10): The pupal exuvia is generally darkly pigmented. Range, average and modal number of setal branches for pupae are presented in Table 1. Tip of antennal case pale, with distinct dark marks at each joint of flagellomeres. Leg case with some dark crossbars. Wing case with distinct round dark markings arrange along the wing veins of the developing adult. Trumpet: Darkly pigmented, with thin and paler rim. On the metathorax, dark markings exist at both sides. Paddle: Refractile border approximately 0. 72 of paddle length; 1-p is dark and strong, about 2 times of 2-p length.

Larva (Figs. 11—16): Integument is generally darkly pigmented. Range, average and modal number of setal branches for larvae are presented in Table 2. Head: Frantoclypeus has distinct dark pattern. Seta 3-C with 60 or more branches, it divides into 2- and 3 big branches, each big branch divides into several small branches and then each small branch divides into many fine hairs. 4-C is rather strong, 3—6 branches, usually 4 branches. 5-, 6-C 16—20 and 17—23 branches, respectively. 7-C 20—27 branches, average 23. 4 branches. 8-C 7—11 branches, average 9 branches. 9-C 5—9 branches, average 6. 6 branches. Branching number of 8-C is usually more than 9-C. The shaft of antenna has a number of minute spinous projections which are usually conspicuous on the internal surface. Antennal hair 1-A is strong, 3—6 branches, average 4. 9 branches. The mentum bears 7 teeth, a row of 3 teeth on each side of the median tooth. Thorax: Seta 1-P simple or occasionally (6/20) 2—4 branches on distal half; 2-P 8—13 branches, average 9. 7 branches; 4-M 4—5 branches, divided from an erect central stem; 3-T is an undeveloped palmate hair, with 8—20 unpigmented leaflets. Abdomen: Seta 1 with flattened unpigmented leaflets on segments I—II; well developed (palmate) and darkly pigmented leaflets on segments III-V II, each consisted of 16—26 leaflets. The leaflets are not uniformly pigmented, their shoulder areas are the darkest and their filaments are pale. The anterior tergal plates on segments II—V II are usually not uniformly pigmented, the anterior half is dark and the posterior half is pale, this characteristic may be useful for identification between the new species and *An. sinensis*. The anterior tergal plate of segment V III is not very long, but fairly broad, the index of its length/width is 0. 52—0. 60, avarage 0. 56; the pigmentation on the plate is not uniform too, both sides are dark, and the central area is pale. Pecten plate has 8—10 long teeth (frequently 9) and 12—15 short teeth. The lengths of long teeth are 105—132 μm, the lengths of short teeth are

21—26 μm, the length of the former is about 5 times of the latter.

Egg (Fig. 17): 10 eggs were examined. The egg is rather large, egg length 658.4—700.2 μm, average 679.3 μm; egg width including float 219.4—240.4 μm, average 229.9 μm. Deck exhibits shoe-like in shape, its anterior and posterior portions are obviously wider than its middle portion. The average deck widths of the anterior and posterior portions are 73.2 μm and 62.7 μm, respectively; while the deck widths of the middle portion are 36.6—57.5 μm, average 47.0 μm, and is about 0.21 of the egg width. Lengths of float are 365.8—407.6 μm, average 386.7 μm, being about 0.57 of the egg length. There are 22—30 ribs, average 25.5 ribs on the float.

Type data: Holotype: 1 female (SM 135-1) with associated its pupal and larval exuviae on microscope slides and 10 eggs.

Allotype: 1 male (SM-135-11) with associated its pupal and larval exuvie on microscope slides.

Paratypes: 50 females and 50 males with associated their pupal and larval exuviae on microscope slides.

All above mentioned holotype, allotype and paratypes were collected by the authors during August 4—20, 1993 from cowsheds in the suburbs of Hailar, and are deposited in the Institute of Parasitic Diseases, Chinese Academy of Preventive Medicine.

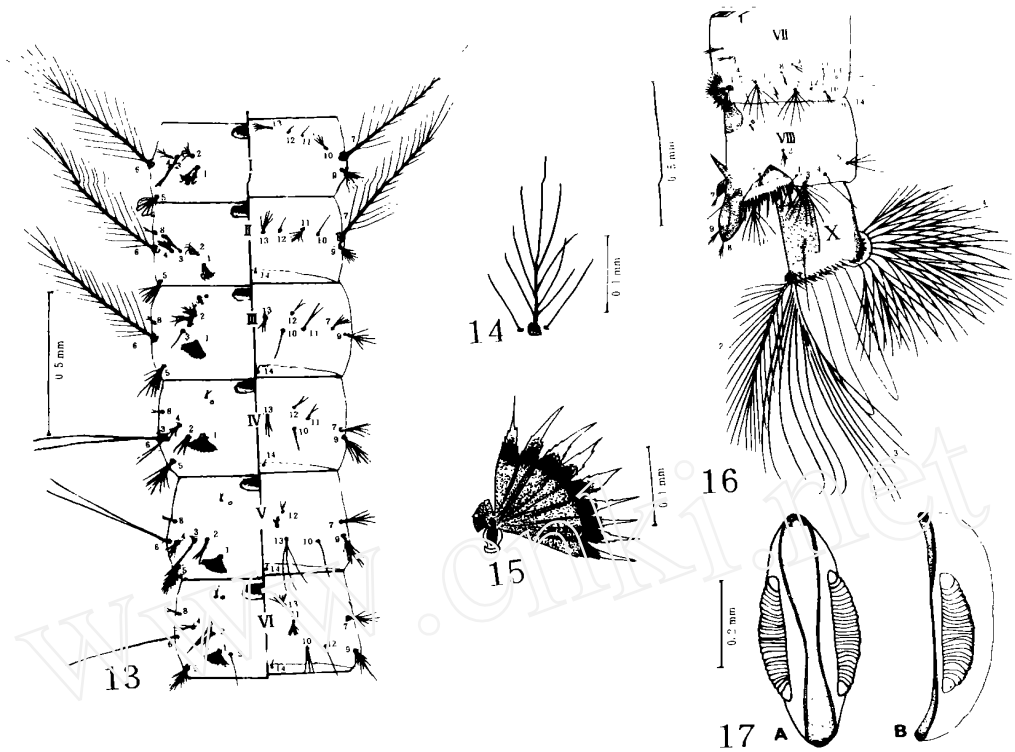
Other materials examined: 5 females and 2 males collected from Zalantun, Nei Mongol Autonomous Region, People's Republic of China (123°E longitude, 48°N latitute); 4 females collected from Yinbo, Democratic People's Republic of Korea (125°E longitude, 38°20'N latitute) and 3 females collected from Xinpu, Democratic People's Republic of Korea (128°E longitude, 40°N latitude).

Bionomics: Larvae have been encountered in fresh water ground pools near human dwellings and clean water pits with abundant aquatic plants on the wild pasture ground. In these breeding places, larvae of *An. hailarensis* sp. nov. coexist with larvae of *An. messeae* Falleroni, 1926, *Culex modestus* Ficalbi, 1889 and *Aedes dorsalis* (Meigen), 1830. The density of female *An. hailarensis* sp. nov. within the cowsheds in the evening was higher than *An. sinensis*, and lower than *An. messeae*. Among 284 females caught during the August, 1993, the percentages of *An. sinensis*, *An. hailarensis* sp. nov. and *An. messeae* were 8.8%, 14.4% and 76.8% respectively.

Discussion

The clypeus of female *An. hailarensis* sp nov. has a tuft of dark scales on each side, palpus with 4 distinct pale bands, sternum VII of abdominal segmen T has median tuft of erect dark scales and seta 3-C of the larval head has 60 or more branches. These characteristics coincide very well with the definition of the "*Anopheles hyrcanus* group" setted by Reid (1953)[10]. The fact demonstrates that An. hailarensis sp. nov. is one of the members of *An. hyrcanus* group.

In China, *An. hyrcanus* group is one of the most complicated and important sibling species groups. According to the reports of Lu et al (1993)[11] and Lei (1996)[12], there were 19 species of mosquitoes belonging to the *An. hyrcanus* group in China (some species remain to be further studied). This paper reports on another species. Most species of *An. hyrcanus* group distribute in the Oriental Region. Only a few species distribute in the Palearctic Region. *An. hailarensis* sp. nov. is restricted to the



Figs 1—8 Adult of Anopheles hailarensis **sp. nov. 1, 2 Wing of female; 3 Legs of female: A foreleg, B midleg, C hindleg; 4 Palpus of female; 5 Palpus of male; 6 Male genitalia; 7 Claspette; 8 Leaflets of aedeagus**
Figs 9—11 Pupa and larva of Anopheles hailarensis **sp. nov. 9 Pupal cephalothorax; 10 Pupal metanotum and abdomen; 11 Head of larva; 12 Mentum of larva.**
Figs 13—17 Larva and egg of Anopheles hailaerensis **sp. nov. 13 Abdominal segments** Ⅰ—Ⅵ **of larva; 14 Setae 1-3P of larva; 15 Falmate hair of abdominal segments** Ⅲ—Ⅶ **of larva; 16 Terminal segments of larval abdomen; 17 Egg**

Table 3 Differential characteristics among the adults of *Anopheles hailarensis* sp. nov, *Anopheles sinensis* and *Anopheles heiheensis*

Sex	Characteristics	*Anopheles sinensis* Wiedemann, 1828	*Anopheles hailarensis* sp. nov.	*Anopheles heiheensis* Ma, 1981*
Female	Wing: Remigium	Mixture of pale and dark scales	Mixture of pale and dark scales	Most part with white scales
	V5.2 pale frine spot	Presence	Presence	Absence
	Leg: Foreleg	Tarsomeres 1—3 only have narrow apical pale bands, no basal pale band.	Tarsomeres 1—3 only have narrow apical pale bands, no basal pale band.	Tarsomeres 1—2 have broad pale basal bands, each band as wide as two times of segment width. Tarsomere 3 has a narrow basal pale band approximately equal segment width.
	Midleg	Tarsomeres as on foreleg indicated above	Tarsomeres as on foreleg indicated above	Tarsomeres as on foreleg indicated above
	Hindleg	Tarsomeres 1—4 only have narrow apical pale bands, no basal band. Tarsomere 5 is dark thoroughly.	Tarsomere 1 has an apical pale band. Tarsomeres 2—4 not only possess apical pale bands, but also with basal pale bands, forming three broad pale bands. Tarsomere 5 has basal pale band.	Tarsomeres 1—4 have basal pale bands approximately as wide as two times of segment width, and tarsomeres 1—3 have apical pale bands, forming some broad pale bands. Tarsomere 5 is black thoroughly.
Male	Number of aedeagus leaflets (pair)	4—5	5—6	4—5

*According to the description of Ma (1981) p. 66—67 for *An. heiheensis*