

Redescription and Biology of an Endemic Chinese Butterfly: *Pieris kozlovi* (Alpheraky , 1897) (Lepidoptera: Pieridae)

Li Zhaohui^{1 2}

(1. Institute of Applied Ecology , Nanjing Xiaozhuang University , Nanjing 210017 , China)

(2. School of Life Sciences , Nanjing University , Nanjing 210093 , China)

Abstract: The endemic Chinese pierid butterfly , *Pieris kozlovi* (Alpheraky , 1897) , is redescribed and illustrated in detail based upon materials collected from the location of holotype in Qinghai autonomous region , northwestern of China. The grasses *Meconopsis* spp. of Papaveraceae , *Taraxacum* spp. of Compositae and *Thalictrum* spp. of Ranunculaceae are recorded as its main nectar source plants.

Key words: Pieridae , *Pieris kozlovi* , Lepidoptera , Qinghai , China

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中国特有蝶种——库茨粉蝶(鳞翅目:粉蝶科)再描述及生物学初报

李朝晖^{1 2}

(1. 南京晓庄学院应用生态研究所 ,江苏 南京 211171)

(2. 南京大学生命科学学院 ,江苏 南京 210093)

[摘要] 对采自模式标本产地的中国特有高海拔蝶种库茨粉蝶 *Pieris kozlovi* (Alpheraky , 1897) 进行详细地重新描述 ,并首次描述该蝶的蜜源植物及生境. 初步判定罂粟科多刺绿绒蒿、菊科蒲公英属、毛茛科唐松草属植物为该蝶主要蜜源植物.

[关键词] 粉蝶科 ,库茨粉蝶 ,鳞翅目 ,青海 ,中国

The pierid butterfly *Pieris kozlovi* was first reported by Alpheraky in 1897 as *Pieris dubernardi kozlovi* , the types are collected from the Nanshan of Qinghai in China. This speices had been mentioned in many literature and appeared in different genera. Huang^[5] regarded it as a absolute species , according to the differences of genitalia between *P. dubernardi* and put this species into the genus named *Sinopieris* that he set up in 1995. Wu^[9] regarded it as independent species according to the differences of genitalia to *P. dubernardi* and returned it into the genus *Pieris*. Kocman^[7] reported two subspecies of *P. kozlovi* , *Pieris kozlovi kozlovi* in Cayu of Tibet and Nanshan of Qinghai , *Pieris kozlovi lhamo* in southeast of Tibet^[1-7 9]. From the year of 2003 to 2004 , many specimens of this species were collected in the location of holotype. So we had a chance to re-describe the species in detail for determining its taxonomic status and adscription. Meanwhile , the nectar source plant and the habitat were reported here for the first time.

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Corresponding author: Li Zhaohui , PhD , professor , majored in biodiversity and systematics of anthropol. E-mail: lizhh6710@126.com

1 Morphological Characteristics (Terms Used Here After References 8 ~ 9)

Male (Fig. 1a) : FL (Forewing Length) (25.23 ± 1.09) mm ($n = 48$) . AL (Antenna Length) (13.64 ± 0.68) mm ($n = 48$) . Head: hairy , clothed with white or black hairs on vertex and frons; eye semi-spherical , yellow-brown; labial palpus hairy , cream-white scaled , porrect , pointed , projecting anteriorly , 3-segmented , each segment approximately equal in length , covered by black hairs and cream-white hairs; maxillary reduced , invisible; proboscis black , unscaled; antennae smooth , scaled , dark-brown; antennae black brown with buff scaling , last eight segments bulbous , tip of antenna yellow brown. Club abrupt. Thorax: clothed with cream-white hairs , mottled with black hairs. Legs with tibial spur formula 0-2-2 , covered by appressed cream-white scaling. Pretarsal claws laterally flattened , bifid. Foreleg: femurs and tibiae with long , yellow and white hairs. Midleg: trochanter and femurs with long hairs , white hairs longer than black ones. Black hairs present on outer surface of tibiae and white on inner surface. Elliptical scaling on femurs and scaling on tibiae serrated apically. Hindleg: trochanter and femurs with white and black hairs. All scaling on the hindlegs serrated apically. Forewing: 11 veins; costa nearly straight , curved near base , termen convex , apex rounded , dorsum nearly straight , curved interiorly at 1/3 nearly base. Discal cell elongated , more than half the length of forewing. Ground color of upperside creamy-white with black scaling near apex and along vein. Fringe black. R_{4+5} forked , covered with black scaling. Termen with black scaling , forming arrow-like patch , point inward along transverse vein , smaller from M_2 to Cu_2 . Black scaling also present on proximal end and distal end of discal cell , little on vein 2A distally. m_3 and cu_1 with black scaling , forming distinct , rounded patches. Underside patterns and coloration similar to those of upperside but with golden scaling , forming rounded pattern near apex and termen. Black scaling from m_3 to 2a forming a black band parallel to termen , attenuate towards dorsum. Hindwing: 9 separate veins , with outward-curving humeral vein near base of $Sc + R_1$. Fringe black. Upperside coloration similar to that of forewing , but with minute arrow-like , black patch along veins distally. r_2 , m_1 and m_3 with black scaling , forming small rounded patch. Discal cell distally with minute black patch. Ground color of underside pale yellow with extensive black scaling except submargin. Submarginal band expanded along all veins with pale yellow markings. Yellow scaling present on costa basally , linear-like patches in r_1 , r_2 , discal cell , m_2 and cu_2 basally. Abdomen: clothed with appressed black scaling but with yellow scaling ventrally. Female: (Fig. 1b) : FL (24.71 ± 1.52) mm ($n = 13$) . AL (13.46 ± 0.64) mm ($n = 13$) . External features , wing shape , and patterns of upperside basically identical to those of males , except the scope of black scaling enlarged. Forewing: cell m_2 nearly discal cell bearing extensive black scaling rather than faint in males. The scope of black scaling in cell m_3 expanded and cell cu_2 and cell 2a present black scaling forming circular patch. Submarginal band formed prominent , black band , attenuate towards dorsum. Hindwing: from r_1 to cu_2 present black scaling , forming arrow-like patches parallel to termen. Arrow-like , black patch along veins distally larger than that in male. Wing patterns of under-



Figs. 1 Digital habitus of *Pieris kozlovi* (Alpheraky 1897)

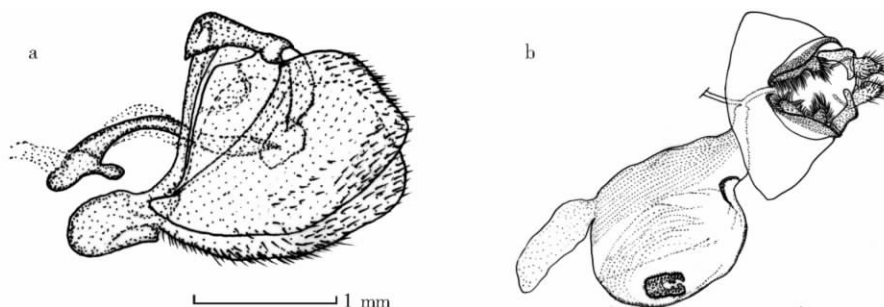
a. male , b. female (dorsal view on left and ventral view on right)

side as described for male except buff scaling increased, black scaling formed a eye patch at distal end of discal cell.

2 Genitalia

Male genitalia (Fig. 2a) : Sclerites of 9th segment forming a complete ring. Uncus wide and strong, approximately $0.80 \times$ length of tegumen, conjoined with latter along a narrow membranous, linear area. Dorsal surface of tegumen and uncus smooth, distinctly tapered, ending in a sharp point. Caudal end of uncus produced, downcurved. Saccus swollen, oval-like, approximately two thirds length of tegumen. Phallus cylindrical, slightly downcurved posteriorly, re-bent caudally; phallobase approximately $0.50 \times$ length of aedeagus. Penis curved with trochanter well developed. Coecum penis forming a pendent oval lobe bent toward aedeagus ventrad. Valve densely setose, large, lobe-like, valve with fovea.

Female genitalia (Fig. 2b) : Corpus bursae oval, with appendix bursae attached cephalically. Lateral $1/2$ of corpus bursae densely covered by minute pinules. Point of origin of ductus seminalis located at $1/3$ point of ductus bursae; oval signa present near distal end of corpus bursae, prominent, symmetric, medially constricted, covered with teeth; elongate signa present near proximal end of corpus bursae. A8 weakly sclerotized, with sternite reduced; apophyses anteriores short, conical. A9 + 10 with apophyses posterior forming short bar; papillae anales setose, ovate in shape. Lamella antevaginalis forming a pair of large folded oval sclerites by ostium bursae. Lamella postvaginalis forming sac-like folds bearing trichomes.



Figs. 2 Genitalia of *P. kozlovi kozlovi* (Alpheraky 1897)

a. Male, drawn from genitalic dissection LZHI008, a. lateral view of sclerites of 9 + 10 genitalic segments with right valve attached;

b. Female, drawn from genitalic dissection LZHI016 (scale bar = 1 mm)

Specimens examined 12 ♂ ♂ 4 ♀, 2003-VI-5; 18 ♂ ♂ 5 ♀, 2004-VI-21; 18 ♂ ♂ 4 ♀, 2004-VI-26.

Qinghai Province Hainan State: Xinghai County, Mt. Erlashan, southwest to Qinghai Lake; alt. 3 700 m, collected by W. B. ZHONG. Distribution: China: Qinghai (Nanshan), Tibet (Cayu). All the specimens deposited in Institute of Applied Ecology, Nanjing Xiaozhuang University. Dissection of genitalia was performed by removing the entire abdomen and placing in 10% KOH at room temperature for 24 h to dissolve the soft tissue, then transferring it to cellusolve for another 24 h for descaling, before placing it in 70% ethanol for dissection. The dissected parts were preserved in 70% ethanol.

3 Biology

Volitinism: univoltine; adult occurs during the early June to the early July of the year. Distribution: this species is endemic to Northwest of China (Qinghai, Tibet)^[9], occurs in the region of 3 700 m to 5 400 m elevation high. Host and honey association: From our observation in the field, the adults of this species often visit plants like *Meconopsis horridula* (Papaveraceae, Fig. 3), *Taraxacum* spp. (Compositae) and *Thalictrum* spp. (Ranunculaceae) as their nectar source. Further study on host plant should be made in the future.

Habitat and Behavior: Adults in this study are found in the habitats between 3 700 m and 3 900 m elevation (Fig. 4). Besides visiting flowers, sometimes they were observed staying on the new leaves of Crassulaceae

plants. But at most time , they hold rock surface to prevent blowing away by wind and do little other activity. This may be an adaptive habit to the strong windy habitats with high elevation.



Fig.3 One honey plant of *P. kozlovi*



Fig.4 Habitat of *P. kozlovi*

4 Remarks

According to the structure of genitalia , the speices was obviously different from *P. dubernardi* in despite of similarity of wing patch. We noticed that the genus *Sinopieris* was set up only by some “dubernardi group” speices sharing the similar location and wing patch pattern , and some differences among the genus *Aporia* and genus *Pontia*. There were no obvious differences in genitalia between *Sinopieris* and *Pieris*. Molecular research method should be necessary for determining the phylogeny status of this speices.

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