

SURVEY OF POPULATION AND THREATS OF A CITES LISTED BUTTERFLY *Troides aeacus aeacus* (Felder and Felder, 1860) IN CENTRAL NEPAL

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ABSTRACT

The population of *Troides aeacus aeacus* is declining due to habitat threats in many parts of central Nepal. The population survey was done by direct observation with a random walk in the morning sun from 8 a.m. to 12 p.m., considering its appropriate months of appearance. There was no issue with counting repetition since this species appeared in single or double individuals at each locality of this survey. This work, which covered an elevation range of 550 to 2000 m, was carried out in central Nepal between May and July of 2017 and April, May, and September of 2018. A total count of 56 individuals of this butterfly was recorded in this survey, which covered adjoining districts like Bhaktapur, Lalitpur, Kathmandu, Makwanpur, and Nuwakot.

The observed small population and distribution gaps of this butterfly in a few locations were primarily caused by habitat loss, the absence of sufficient plants that provide nectar for adults and food for larvae, and tourism activity, which was particularly noticeable in Nagarkot (Bhaktapur) and Chitlang (Makwanpur). In addition, the impact was seen primarily as a result of road construction, forest fires, and small landslides in some of its habitat areas in Makwanpur and Chandragiri.

Keywords: decline, distribution, districts, elevation, habitat, individual, observation

INTRODUCTION

The country's declining populations of *T. a. aeacus* can be linked to habitat shrinkage resulting from land modification for urban planning and agricultural intensification. The monsoonal flood and massive landslides severely damaged its habitats in Sindhupalchok, Kavrepalanchok, and Nuwakot, though data from the first two districts are excluded due to insufficient research made in these areas.

This butterfly has only one subspecies *aeacus* in Nepal out of 16 subspecies in the world (Ohya, 2001). With wingspan measurements of 104- 140 mm, *T. a. aeacus* is a little smaller than its allied species *Troides helena cerberus* (Felder, 1865) which is also found in Nepal (Smith, 1989). This butterfly is distributed widely from 333m to 2030m of elevation in Nepal (Smith, 1989).

Forewings are black with white-bordered veins, while hind wings are golden yellow with distinct black veins and sub-marginal black spots. The lower half of the female's hind wing is dusted grey. It prefers open areas of the forest and flies higher up encircling tree tops (Khanal & Smith, 1997). In central Nepal, it mainly inhabits lowland and midland forests though a rare record has been made at 3,000 m of elevation (Igarashi, 1966). This butterfly has extended its range from northern India and Nepal into Southeast Asia, the Malayan peninsula to Taiwan, and is placed under the Least Concern Status of IUCN (Böhm *et al.*, 2018).

Being a large species, it prefers open or thin areas of the forest that provides enough space for its flight (Hill *et al.*, 2001). Since butterflies can access the nutrients in the moist, sandy soil along stream sides so open space near streams supports more species than closed natural forests (Lien, 2011).

This butterfly has distribution gaps in some pockets where the larval and nectar plants are scarce or absent. Only two species, *T. aeacus* and *T. helena*, are found in Nepal out of the 19 *Troides* species recognized in the world by Ohya (2001). According to the most recent IUCN Redlist amendment version of threatened species, this species' range has been estimated to be greater

than 8 million km², and from the available point localities, the area of occupancy could be at least 580 km² or much larger (Böhm *et al.*, 2018).

Six generations of *T. aeacus* were studied annually in Guangzhou city which revealed that this butterfly lived for 9 to 14 days in captivity (Caiyx *et al.*, 2003). The main host plant of this butterfly is *Aristolochia* species. In Bifeng Valley (China), it is distributed from 820 to 1,680 m of elevation (with high egg-laying observation within a range from 1,200 to 1,500 m) (Li *et al.*, 2010). The floral diversity observed here was rich along forested paths and forest edges with a canopy cover below 80%. The host plants are rarely found when forest canopy cover exceeds 90% (Li *et al.*, 2010).



Fig. 1 Map of study area.

Three species of Nepalese butterflies have been placed under CITES Appendix II which include *Troides aeacus*, *T. helena* and *Teinopalpus imperialis*. The last species is a rare and endangered species distributed in Kathmandu, Lalitpur, Bhaktapur, and Kaski districts of west Nepal.

Information on its status was unknown so far, so it was an essential task to document the current population of *T. a. aeacus* in some pockets of Bhaktapur, Kathmandu, Lalitpur, Nuwakot, and Makwanpur (Chitlang), where road networking and its expansion are taking place at the expense of pristine forest. The goal of this work was to conduct a population survey of this species including its threats, which has not been done before.

MATERIALS AND METHODS

Butterflies do have their own preferences for habitat selection. *T. a. aeacus* prefers habitats with both its larval and nectar plants, such as the edge and open parts of forests. These are the potential resources needed for the habitat of this butterfly, which has been spotted in some places where this butterfly was recorded in Kathmandu, Bhaktapur, Nuwakot, Lalitpur, and Makwanpur districts in central Nepal.

The population survey of *T. a. aeacus* was carried out in 2017 and 2018 considering its appropriate months of May to July in 2017 and April, May, and September in 2018. The survey

was conducted from 9 am to 12 pm by direct observation, with random walks and opportunistic sightings (Murugesan *et al.*, 2013). Smith (1989) was consulted to identify the sighted species in the field. The different elevation habitats visited in this study ranged from 550 to 2000 m.

The major threats noticed were the increasing pressures of humans on its ecosystem, mostly in the Godavari, Nagarkot, and Chitlang areas. The habitat shrinkage due to tourism promotion activities in Nagarkot is putting this butterfly at risk. The tourism inflow, road expansion, physical construction, and light landslides in the monsoon period are notable threats in some parts of the Chandragiri-Chitlang belt. Some impacts observed in Phulchoki were the forest fires that occurred in the past and destroyed many eggs, larvae, and pupa of this butterfly. Unsustainable harvesting of forest resources is the next impact, including long-operated marble mining, which is closed now.

The study sites below 1000 m of elevation represented *Shorea robusta* in the majority besides the occurrence of *Magnifera indica*, *Schima wallichii*, *Pinus roxburghii* and *Albizia* sp. The districts of Kathmandu, Lalitpur, Makwanpur, Bhaktapur, and Nuwakot accommodated vegetation like *Schima-Castanopsis*, *Pinus roxburghii* and *Alnus nepalensis*. *Quercus glauca*, *Quercus semicarpifolia*, *Berberis asiatica*, *Prunus cerasoides*, *Albizia julibrissin*, and *Rhododendron arboreum* are other species noted above 1500 m in Lalitpur and Kathmandu districts. Identification of plants was done by consulting Polunin & Stainton (1997) and with experts' help.

RESULTS AND DISCUSSIONS

This survey revealed the sightings of less than 10 individuals of this butterfly in two of the five districts, which reflected its population decline under the impact of land modification and habitat

shrinkage in these parts. The highest population record made in this survey was of 20 individuals observed in open areas of the Godavari and Phulchoki forests, while Nuwakot and Makwanpur (Chitlang) forests revealed 14 and 10 individuals, respectively. Bhaktapur District represented

the lowest population record of 3 individuals, and Chandragiri (Kathmandu) with 9 individuals only (Fig. 2).

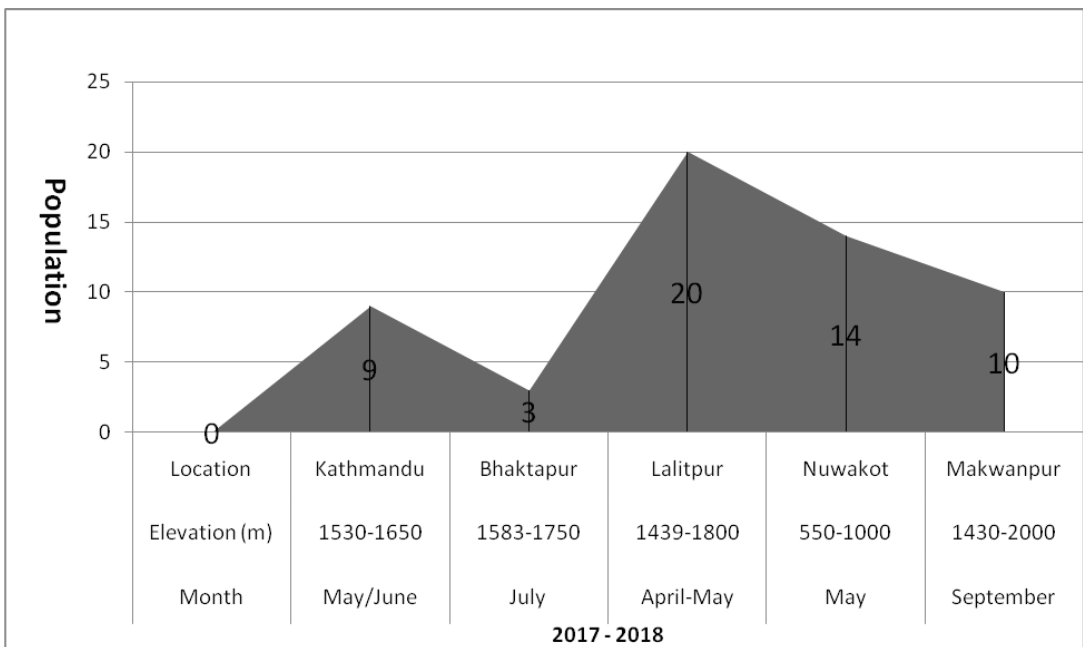


Fig. 2. Population status of *T. a. aeacus* in five districts of central Nepal.

Due to its large size, this butterfly prefers thin forests where it can find enough space to fly over open terrain and around tall trees. According to D'Abrera (1975), the distribution of *Troides* spp. requires a significantly wider range that extends to the Oriental Region and northern Australia. Nagypal (2008) examined the geographic range of this genus from China in the north to Indonesia in the south, and from India in the west to New Guinea in the east.

Li *et al.* (2010) found that habitat degradation is a severe threat to the population of this butterfly, which results due to destruction of forests for reclamation, grazing, mine exploitation, cutting of firewood, herbicide application, and sometimes even certain types of afforestation that

do not include larval host plants. This study also agrees with deforestation and habitat loss as the prime factors that put this butterfly under threat.

The population of this butterfly is still high in southern Taiwan (Hsieh *et al.*, 2010), although its larval plant, *Aristolochia zollingeriana*, is declining to an endangered state (Lu & Chiou, 1997; Hsieh *et al.*, 2010). No information on threats to *Aristolochia* spp. has been known yet in Nepal,

although ongoing and random deforestation may have an impact on this plant and eventually on *T.a. aeacus*.

As per Böhm *et al.* (2018), the species is very common in continental Thailand (Kimura *et al.*, 2011). This species occurs at a low population in all the mountain forests, which are now under pressure from humans. This species in less disturbed parts of the Godavari-Phulchoki forest

displays a better population than in other mountain forests of central Nepal (Khanal *et al.*, 2013).

The meta-population study of this butterfly revealed an increase in species diversity, which was followed by both larval and nectar plants, while its population was seen to decline with the denser canopy of its forest habitat (Böhm *et al.*, 2018). This provided evidence in support of the current study because its population in Nepal was observed at the edges and open spaces of forests.

The population density in southern Taiwan peaks from March to April and September to October (Haugum & Low, 1985, Wu *et al.*, 2010). A study conducted in the Kameng Potected area of Aruanchal Pradesh, India, revealed that it is common during the pre- and post-monsoon seasons at elevations ranging from 120 to 1,200 m asl (Sodhi & Kunte, 2016). The high abundance of this butterfly moderately correlates with the wet season as per the study conducted in Assam, India by Barua *et al.* (2010). The peak diversity period for butterflies in Nepal is also in July and August, being the wet and warmer months of the year. The genus was considered to display less strong sexual dimorphism than Ornithoptera (D'Abrera, 1975), and use *Aristolochia* spp. as their main food plant (Parsons, 1996).

Khanal (2013) calculated the population density of *T. a. aeacus* in different locations of central Nepal. This revealed its density of 1.80 percent in Kathmandu's Shivapuri

Mountain at an elevation of 1400 meters. Likewise, 1.75 percent was found at 1500 meters in Godavari-Phulchoki in Lalitpur, 4.34 percent at 1360 meters in Suryabinayak in Bhaktapur, and 0.92 percent at 2000 meters in the Panch Pokhari region of Sindhupalchok District. The Chandragiri Mountain in Kathmandu, where a similar study was carried out in 2011, revealed its highest density of 10.24%. However, the ongoing process of landscape modification has shrunk their habitat in some areas where less density was recorded. The recent study made in Godavari (Lalitpur) in 2017 and 2018 represented 20 individuals over the previous record of 10 individuals at 1500m (Khanal, 2013). Likewise, this study recorded 9 individuals of this butterfly compared to 2 individuals of the previous record made in Shivapuri Nagarjun National Park, Kathmandu (Khanal, 2013).

The Nepal Red Data Book includes 142 species of Nepalese butterflies into various threat categories, including both *T. a. aeacus* and *T. h. cerberus* (DNPWC, 1995). The increased growth of nectar and host plants and clearing of forest cover in selected areas may help to conserve these species effectively (Li *et al.*, 2010). This butterfly is highly specific to host plants which limit its population size, and its loss may have significant impacts on the species or subpopulations (Böhm *et al.*, 2018). The larval host and nectar plants both are equally important to maintain a good population of this butterfly besides large areas in the forest where this butterfly can fly freely around tall trees.

Human activities, primarily related to road networking, settlements, and agriculture extension at the expense of the pristine forest, including unsustainable harvesting of forest resources for livelihood and trade, are a threat to the low population of *T. a. aeacus* in the mountain forests of the Kathmandu valley (Böhm *et al.*, 2018). This study also showed that less disturbed Godavari and Phulchoki forest still accommodated a slightly better population of this species than the other districts where this study was conducted. The species housed inside the boundary of the Shivapuri Nagarjun National Park have been protected well though the flow of visiting tourists is moderate in this park.

Due to their high trade value, all the *Troides* species are included in CITES Appendix II, which prohibits the illegal collection of this butterfly for trade (Collins & Morris, 1985). No record on its trade has been known yet in Nepal. Slone *et al.* (1997) mentioned that no information is available on the benefits of ranching to the population size or extinction probability in the wild. Schütz (2000) stated that the increased availability of planted *Aristolochia* spp. in exposed areas has been thought to attract a high proportion of females to lay their eggs there, resulting in a population increase.

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Plate 1. Male *Troides aeacus aeacus*



Plate 2. Female *Troides aeacus aeacus*