N O T E

Survey for Natural Enemies of *Drosicha* sp. (Homoptera: Margarodidae) in Skardu, Pakistan[1]

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Drosicha sp. (Homoptera: Margarodidae) was first observed in Pakistan in Gilgit-Baltistan in 2005 when it was recorded damaging *Salix* spp. and other forest trees in hilly areas at 1,450- to 5,000-m elevations. The original source of the invasive pest remains as unknown (Mahmood 2013, CAB International Pakistan Center Ann. Rep. 23 p.). It has since become more widespread in Gilgit-Baltistan and is now a serious pest of forest trees and horticultural plants in Skardu, Pakistan, and adjoining areas. The primary tactic used to manage the pest has been insecticide sprays, but these have not effectively reduced the spread and occurrence of the pest. Herein, we report the results of surveys for natural enemies of *Drosicha* sp. that were conducted in 2017 in Skardu (Olding, Khargrong, Chumik, Tangus, Sundus, and Sumbul Town) and adjoining areas such as Baghicha, Pakistan, at lower elevations and approximately 40 km from Skardu.

In March 2017, we found only eggs in soils and in bark crevices of trees in Baghicha. This is apparently the overwintering stage of *Drosicha* sp. in this region. First-instar nymphs appeared in April as they hatched from eggs that had overwintered. These nymphs settled in aggregations on the main stems and offshoots of infested trees and plants where they fed and developed until reaching the adult stage in July to August. Males died after mating, and females dispersed from infested trees and plants in August. In September, only mature females were observed. At this time, they deposited eggs in fibrous pouches they placed in the soil or in crevices or cracks in the bark of stems and branches. The white-colored fibrous egg pouches were observed covering stems and branches of infested trees

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Table 1. Numbers of *Cryptochaetum grandicornis* reared from 50 colonies of *Drosicha* sp. on *Salix* spp. from different adjoining areas of Skardu, Pakistan, in 2017.

Month	Locations	Adult Flies Reared
May	Olding + Khargrong + Chumik	102
June	Sundus + Sumbul Town	55
July	Baghicha + Tangus	37
August	Chumik + Tangus+ Baghicha	90
September	Baghicha	32

during this period. Thus, *Drosicha* sp. appears to be univoltine in this region of Pakistan.

In our surveys of *Drosicha* sp. throughout the year, we identified two natural enemies attacking the pest. These were *Cryptochaetum* sp. nr. *grandicornis* Zetterstedt (Diptera: Cryptochetidae) and *Tetrastichus* sp. (Hymenoptera: Eulophidae). We also initiated releases of the predator *Sumnius renardi* Weise

Fig. 1. *Cryptochaetum* sp. adults on *Drosicha* sp. females.

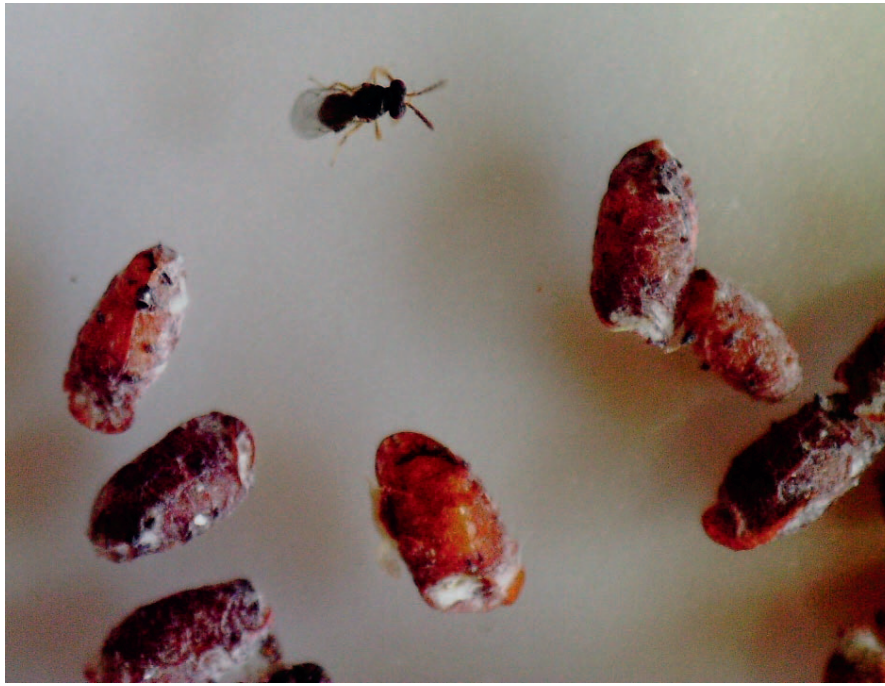

Fig. 2. *Tetrastichus* sp. adult among mealy bug mummies.

(Coleoptera: Coccinellidae), which occurs naturally in some areas of Pakistan, but not where *Drosicha* sp. has reached pest status.

This represents the first report of *C.* sp. nr. *grandicornis* associated with *Drosicha* sp. in Pakistan. This cryptochetid is found primarily in the Mediterranean basin, but similar cryptochetids have been reported from India (N. Wyatt, Natural History Museum, UK, pers. commun.). Adult flies were reared from aggregations of *Drosicha* sp. on *Salix* spp. in Olding, Khargrong, Sundus, and Chumik in Skardu and Baghicha (Table 1; Fig. 1). The phenology and biology of this natural enemy on *Drosicha* sp. is not clear. It appears that adult flies deposit their eggs on surfaces near aggregations of *Drosicha* sp. Larvae hatching from the eggs were observed feeding on various immature stages in the aggregations. Larvae pupated within these aggregations, and adults emerged singly from puparia. Further studies are needed to elucidate the phenology and the impact of this predatory activity.

Tetrastichus sp. wasps were reared from *Drosicha* sp. nymphs and adult females from May to September (Fig. 2). Parasitism was highest in August, approaching 70% of *Drosicha* sp. in the aggregations. Further observations can clear its biology and role in regulating the *Drosicha* sp. population.

Sumnius renardi has been reported from India and Pakistan, but its only known host is *Drosicha stebbingi* (Stebbing) (Rasheed et al. 1986, Proc. Pakistan Congr. Zool. Lahore, 22-24 December 1985: 137–142; Mahmood and Mohyuddin 1986, Bull. Directorate Publ., PARC, Islamabad, 11 p.; Commonwealth Inst. Biol. Contr. Pakistan Sta., Rawalpindi, Final Rep. 1959–69, 243 p.). Mahmood (2013) reported

it from Gilgit-Baltistan in Gilgit (1,459-m elevation) and other areas at 2,560 m. It has not been reported from Skardu (2,228 m) where the *Drosicha* sp. has become a serious threat to forest trees and other horticultural plantings.

We, therefore, initiated attempts to distribute this predator from Ghizer-Gahkuch, where it naturally occurs, into Skardu and adjoining areas, including Baghicha, where it has not been previously reported. Adults collected from Ghizer-Gahkuch were released on willow trees, *Salix wallichiana* Andersson, infested with *Drosicha* sp. in April 2017. Protection for the released adults was provided by placement of gunny bands or straps on the tree stems and branches. We observed adult mating and breeding immediately after the releases, with the predation of the *Drosicha* sp. nymphs. At least one generation was completed. The adults sought overwintering refugia under the bands or straps starting in September. We also provided shelter in the form of *Salix* twigs placed in trays. The beetles also congregated in these protected environments, completing its one generation therein. We are hopeful that the beetle will successfully survive and become established in this area.

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