

# The Effects of Species Pools on the Community Reestablishment of Predatory Arthropods in Rice Fields<sup>\*</sup>

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**Abstract** The effects of species pool on community reestablishment were studied from a facet of predatory arthropod community. The results showed that the species pool was a resource of predators, which could contribute colonists to the rice field community during its reestablishing period. The distribution of the dominant predators, *Ummeliata insecticeps*, from species pool to rice field at the reestablishing period presented a step by step dynamic processes. In these processes, the field bund was not only an important component of species pool, but also a bridge for the predatory colonists from other sub-species-pools to pass through into rice field.

**Keywords** Predatory arthropods, species pool, community reestablishment, *Ummeliata insecticeps*

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Agroecosystem is a crop-dominated ecosystem, which includes two important components crop and non-crop habitats, and the arthropods in one are related to that in the other<sup>[1]</sup>. At the chemically constrained time, investigators noted that the pests in rice fields mainly immigrated from the field bunds and suggested that the vegetation on the bunds should be uprooted to prevent pest damages in rice fields<sup>[2]</sup>. On the other hand, the uncultivated areas can serve as species reservoirs or species pools for natural enemies that naturally colonize adjacent crops<sup>[3-6]</sup> rather than trophic bases for pests<sup>[2]</sup>. As their importance to the development of arthropod communities in rice fields, the arthropod communities in the non-rice habitats (such as rice field bunds, irrigation canals, grassy lands, nearby orchards and vegetable fields.) and the fallows or out-seasonal rice fields are conceptualized as species pools, which can contribute colonists to the developing communities in rice fields and can recruit emigrants from them as well<sup>[3, 6, 7]</sup>. The species pool can be divided into various sub-species-pools based on the different habitats. The process of the arthropod community reforming in a rice field is given a definition of community reestablishment so as to keep it distinct from the community succession in barren land, for the seasonal dynamics of the former are quite different from the developing regularities of the latter<sup>[6]</sup>. Thereby, the development of the arthropod community in rice field can be roughly divided into three stages as reestablishing stage, stable stage and collapsing stage, which may be closely related to the species pool. We have been studying the relationships between them in order to conserve natural enemies and to improve their effectiveness in controlling of

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pests in IPM program since 1993. This paper deals with one part of the relationships that pertains to the community reestablishment and the species pool from an aspect of predatory arthropod community.

## 1 Materials and methods

### 1.1 Study site and experimental design

This study was conducted in 1996, at IPM experimental station in Dasha, Sihui, Guangdong Province, where a 'Putting biocontrol first IPM program' has been practicing effectively since 1973. A plot of rice field ( $\approx 0.08 \text{ hm}^2$ ) with an irrigation canal flowing nearby was selected, of which one side was a 1 m wide bund close and parallel to the irrigation canal and the three other sides were contiguous to other rice fields with very narrow ridges ( $\approx 0.1 \text{ m}$  wide) between them. Grasses were allowed to grow and succeed naturally both on the rice field bund and on the irrigation canal banks since 1993. No pesticide was allowed to be sprayed in field and the other managements were carried out as convention from then on.

### 1.2 Spider-marking experiment

This experiment was conducted to verify the immigration of predators from the field bund to the rice field. On the day of transplanting, 50 wolfspider (*Pirata subpiraticus*) adults were collected from the bund of the experimental field, marked on the hind legs with a little white paint, and then were set free back to the bund after 4–5 hours indoor rest. Search activities were conducted row by row from the field bund side to the another side every day after rice transplanted.

### 1.3 Methods for sampling

Five sampling sites, each covered approximately  $1 \text{ m}^2$ , were taken at random both on the field bund and on the irrigation canal bank. The sampling sites in rice field were taken at rows in various distances (0.5, 3.5, 6.5, ..., 31.5 m) from the bund. At each sampling row 3 sampling sites, each covered 5 hills of rice, approximately  $1/6 \text{ m}^2$ , were taken from the center to the side end of the row. Thus, a total of 11 rows and 33 sampling sites were taken in the rice field. Sampling were carried out from 10:00 to 17:00 in a two day interval from April 13 to May 21, 1996 at the early rice season, and from August 6 to September 11, 1996 at the late rice season.

### 1.4 Data analyses

All data were analyzed using the following indices: ① Species richness ( $S$  = numbers of species); ② Shannon-Wiener's diversity index ( $H'$ ); ③ Hurlbert-DeBenedictis' evenness index ( $V'$ ); ④ average individual numbers per square meter ( $m$ ).

In addition, the spiders (*U. insecticeps*) individual numbers of the bund sampling sites in each sampling rice row were calculated as per  $1/6 \text{ m}^2$  means respectively to illustrate the dynamic processes of species colonization from species pool to rice field community.

## 2 Results and discussion

Of the 50 marked spiders that set free back to the bund three were found at the rice field. The first one was found at a distance of 1.5 m from the bund in the second day after rice transplanted, the second one at 2.2 m in the third day, and the third one at 3.7 m in the fourth day, respectively. The result indicated that the bund (non-rice habitat) served as a species pool, which was able to contribute colonists to the community reestablishment of predatory arthropods in rice fields.

Before early rice was transplanted, the predatory arthropod community was generally

damaged owing to the farming perturbations (e. g. , harvesting, flooding, plowing, etc. ). After rice was transplanted, the community was about to rebuild gradually. It was characterized by the increasing trends of its species richness ( $S$ ), diversity ( $H'$ ), evenness ( $V'$ ) and mean individual numbers ( $m$ ) (Fig. 1-a, c, e, g). At the mean time, though the individual numbers of predators,  $m$ , in species pool (bund and irrigation canal) did show an obvious going down trend (Fig. 1-g), the other indices,  $S$ ,  $H'$  and  $V'$ , did not present similarly (Fig. 1-a, c, e).

It was probably because ① the emigration of some, but not all, individuals of a few dominant species (such as *P. subpiraticus* and *U. insecticeps*) in species pool did not affect the species pool in the whole, so the indices did not change sharply; ② some predator immigrants from other sub-species-pools, like the nearby grassy lands or vegetable fields, compensated the above emigration.

During the community reestablishing period in late rice fields, the indices dynamics of community and species pool were similar in

general to that in early rice fields. However, some differences were still presented as follows: ① the increasing trends of indices curves advanced a bit, showing that the community reestablishing time was advanced; ② the indices levels of irrigation canal sub-species-pool were rather low, indicating that this sub-species-pool could hardly contribute predators to the community reestablishment in rice field (Fig. 1-b, d, f, h).

The spider, *U. insecticeps*, was one of dominant predatory arthropod species during the community reestablishing stage in early rice season. Among the sub-species-pools that comprised the species pool, the bund community was most closely related to the community reestablishment in rice field, for its nearest distance to rice field. Hence, we emphatically studied the colonization dynamics of *U. insecticeps* from field bund to rice field.

The dynamics of *U. insecticeps* colonizing rice field from species pool (bund) was a step by step process. The linyphiid, *U. insecticeps*, was first found in the field at a distance of 3.5 m from the bund at the 15th day after rice transplanted, then it occurred at the sites of 6.5, 12.5, 18.5, 30.5 m from the bund at the 17th, 19th, 23rd and the 25th days after rice transplanted, respectively, actually, it had spread over the whole field after 25th day. At the mean time, the population of *U. insecticeps* in species pool (bund) presented relevant decrease, which means that the colonists of *U. insecticeps* in rice field were from species pool (bund) during the community reestablishment stage (Fig. 2).

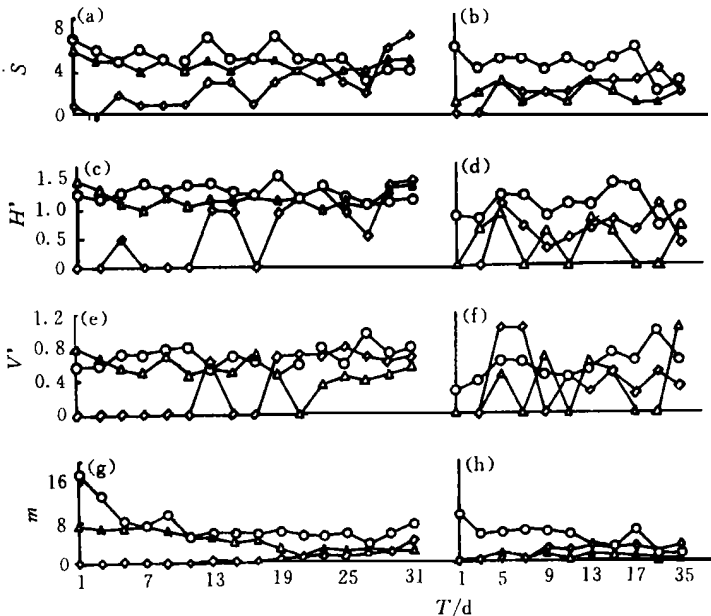


Fig. 1 Indices of predator species pool and its community in rice field at the early growing stage of early (left) and late (right) rice (Dasha 1996)

Since the rice field bund is close both to rice field and to other sub-species-pools (irrigation canals, grassy lands, etc.), the colonists from other sub-species-pools to rice field may pass through the field bund at first. So, not only was the bund an important component of the species pool, but could serve as a 'bridge' for the colonists migration as well. Therefore, the protection of vegetation on field bunds, especially during the early growing stage of rice, may be meritorious and beneficial. The relationships between sub-species-pools also deserve further researches in order to utilize its effectiveness for conserving natural enemies.

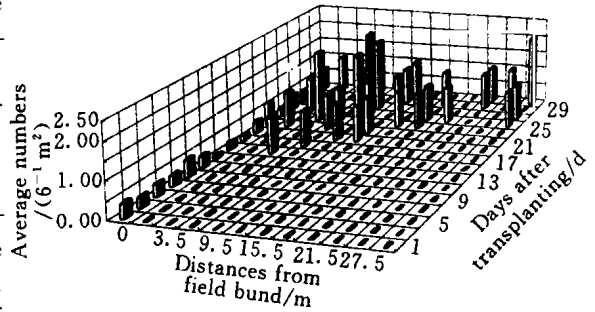


Fig. 2 The dynamic process of *U. insecticeps* colonizing in early rice field from field bund sub-species-pool after rice transplanted (Dasha 1996)

## References

- 1 Yu X, Hu C, Heong K L. The effects of non-crop habitats on crop pests and their natural enemies. Chinese Journal of Biological Control, 1996, 12 (3): 130~ 133
- 2 Wang G. The relationship between pests in field ridges and crops. Entomological Knowledge, 1958, 6 283~ 285
- 3 Liss W J, Gut L J, Westigard P H, et al. Perspectives on arthropod community structure, organization, and development in agricultural crops. Annual Reviews of Entomology, 1986, 31: 455
- 4 Kemp J C, Barrett G W. Spatial patterning: impact of uncultivated corridors on arthropod populations within soybean agroecosystems. Ecology, 1989, 70 (1): 114~ 128
- 5 Zhuang X. Studies on the relationship between the insect community and the grasses on the rice field ridges. Acta Ecologica Sinica, 1989, 9 (1): 35~ 40
- 6 Zhang G, Gu D, Zhang W. Species pools of predatory arthropod communities and community reestablishment in paddy fields. Chinese Journal of Biological Control, 1997, 13 (2): 65~ 68
- 7 Zhang W, Zhang G, Gu D. On some aspects of community ecology associated with the preservation and utilization of farmland natural enemies. Acta Phytolacica Sinica, 1996, 23 (4): 364

## 稻田捕食性节肢动物种库对其群落重建的作用

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**摘要** 在稻田生态系统中, 非稻田生境和休耕期间稻田生境中的节肢动物群落系统可以称为节肢动物群落的种库, 根据生境类型的不同, 可以将种库分为许多不同的亚种库, 如田埂亚种库、沟渠亚种库、菜地亚种库等等. 从捕食性天敌的角度研究了稻田节肢动物种库对其群落重建的作用. 结果表明在稻田天敌群落重建期间 (水稻移栽后 1 个月之内), 稻田的优势种天敌如食虫沟瘤蛛、水狼蛛等均来自种库, 它们由种库向稻田群落迁居的过程是一个循序渐进的动态过程. 其中, 田埂作为一个主要的亚种库为它们迁移入田起到了重要的“桥梁”作用.

**关键词** 捕食性节肢动物, 种库, 群落重建, 食虫沟瘤蛛 (*Ummeliata insecticeps*)

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