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その他（別言語等）のタイトル	コモリグモの子守行動について
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journal or publication title	Bulletin of Nippon Dental University. General education
volume	5
page range	143-151
year	1976-03-25
URL	http://doi.org/10.14983/00000143

Pulli-carrying Behaviour in Wolf Spiders (Lycosidae, Araneae)

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(Received October 31, 1975)

日本歯科大学紀要 第 5 号 1976年3月

BULLETIN OF NIPPON DENTAL UNIVERSITY, GENERAL EDUCATION

コモリグモの子守行動について

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概　　要

コモリグモ類（コモリグモ科，真正クモ目）は餌の捕獲に際して網を使用せず，地表を徘徊しながら狩猟する。また，これらは産卵後その卵嚢を糸疣に付着させて持ち歩き（着卵行動），出嚢した仔を背にのせて移動すること（子守行動）で著名である。具体的な方法は異なるが，卵嚢を持ち歩くことは他のクモ類にもしばしば認められる。しかし子守行動はこのクモだけに特有の行動であり，それゆえ数多くの文献によって紹介されてきた。それにもかかわらず，この行動がコモリグモの実際の生活にどんな点で重要なのか，さらには，コモリグモだけになぜそれが発達したのかといった問題についての論議は，常に推測の域を脱しなかった。おそらくそれはこの行動がすべてのコモリグモに共通で，しかも種ごとに相違する生活様式とかかわりなく，ほとんど同じ形でみられると考えられていたためではなかろうか。

筆者は1972年以来，埼玉県入間郡日高町に分布するコモリグモ類の生活の調査にあたってきたが，1973年の春，形態的には平凡だが，生態的に異常な特徴を有するコモリグモを発見した（このクモには現在正式な名称がない）。このクモは飼育観察により，子守行動を欠くことがわかった。そこで1974年と1975年にこのクモを含む8種のコモリグモについて産卵後の親と仔の行動を詳しく観察したところ，さらにもう1種のコモリグモが子守をしないことを見出した。また通常のコモリグモの間にも若干の差異を認めた。これらの結果とそれぞれの生活様式とを結びつけ，筆者は子守行動について現在次のように考えている。

クモ類には出嚢後の数日を密な集団をなして過ごすものが多い（まとい現象）。このようなクモ類はこの過程を経ずに生活を始めることができないらしい。環境条件の変動がたびたび起こる場所では，まといの維持が困難である。子守行動は母親の背上に形成される，特殊化したまといである。環境条件の不安定な場所に放浪生活者として適応してきた

一群のコモリグモは，まどい集団を背にのせて移動することにより，この期間の好適な条件を維持し，その終了時までまどい現象の継続を保証する。逆に安定したすみ場所に適応した他群のコモリグモでは，定住生活が可能となり，子守行動も痕跡的（ないし未発達）である。

なお，今後もこのような“異常種”がさらにみつかるものと思われる。着卵行動は今回取扱われた全種に認めることができた。

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Abstract.

The author found an abnormal wolf spider whose newly emerged spiderlings seldom climbed on the body of their mother. One more similar species was found by the subsequent investigation carried out in seven lycosid species. This paper reports and discusses the differences of the maternal care between the normal pulli-carrying lycosids and these abnormal lycosids.

Introduction

Wolf spiders (Lycosidae, Araneae) are ground-living hunters which generally don't depend on webs to catch their preys. It is well known that these mothers carry about with them not only their egg sac attached onto the spinneret (cocoon-carrying behaviour) but also their offspring on the back (pulli-carrying behaviour). Both are the behaviours peculiarly developed in lycosids, however, the cocoon-carrying behaviour occurs generally in other spiders apart from the actual means in each species, while the pulli-carrying behaviour is essentially unique in lycosid spiders. The pulli-carrying behaviour has attracted the attentions of many researchers for a long time, and there are a lot of descriptions to refer (Bristowe 1941, Gertsch 1949, Comstock 1965, Lavine 1966, Turnbull 1973 and so on). Nevertheless, any appropriate hypotheses have not been shown to explain the situations under which such a characteristic behaviour had developed only in wolf spiders.

The author has investigated various kinds of the behaviour of lycosids in the north-western suburbs of Tokyo since 1972, and unexpectedly found a lycosid spider (*Lycosa* sp.) lacking the pulli-carrying behaviour by a rearing observation in 1973. This means that the interspecific difference can be

seen in this behaviour of wolf spiders, or that a basis of the comparative study to construct some hypotheses for the necessity of this behaviour was given. Therefore, the differences of the maternal care between the normal pulli-carrying lycosids and the abnormal one were investigated to obtain more information on this subject from 1974 to 1975.

Materials and Methods

It is difficult to observe the details of the pulli-carrying behaviour in the natural habitats, so the spiders were reared in the laboratory for this purpose. Most females used to observe were collected in their cocoon-carrying stage and kept individually in small glass vials (3×12 or 1.5×10 cm) with soaked cotton plug. In the case of the lycosids to be hardly found because of their poor abundance or of their habits of behaviour, the females were collected frequently in more early stages and kept in terraria with supply of water and fruit flies (*Drosophila melanogaster*), and then they were transferred into the vials just after the oviposition. Then the daily changes of the distribution of newly emerged spiderlings in each vials were recorded. The room temperature, light intensity were not controled and widely ranged 12–39°C and 0–3,500 Lux respectively for the observation periods.

Eight species over four genera of wolf spiders were used for the observation. *Lycosa* sp.* is a small reddish, slow-moving and apparently featureless species, and it occurs in the dark litter stratum of well developed deciduous broad-leaved forests during the whole year. This lycosid has a short and clear breeding season in late spring when the forests begin to be thicken and darken. The all adult spiders die off simultaneously in early summer after the dispersion of new spiderlings. The females construct a particular silk room covered by fallen leaves without any entrances. They retreat into the room to oviposit in late spring, so they were collected from the forests in early spring and reared in the laboratory. This ovipositing room and the large white cocoon were made up also in the glass vial. They attach the cocoon to the spinnerets like other lycosids in despite of their sedentary life in this period.

* This lycosid became known to some Japanese arachnologists very recently, and its scientific name is not yet given. Every informations about this spider in this paper, including that described in this section, is the result from the author's investigations carried out in the field and the laboratory from 1973 to 1974.

Other lycosids collected and reared to compare with *Lycosa* sp. were the following seven species. *Pardosa T-insignita* wanders usually among the thin vegetations with bare patches and is more tolerable for dry environments. *Lycosa pseudoannulata*, *Pirata subpiraticus* and *Pirata procurvus* are dwelling in the litters or cracks in the damp areas or in its vicinity, and irresistible against the dryness extremly. Even the adults hardly survive for several hours in a glass tube sealed by a cork plug tightly. The latter two species are small lycosids and construct sheet webs in their early stages. *Pardosa laura* has many similarities with *P. T-insignita* in colouring, manner of walking etc. and has three different forms, which segregate their habitat each other although overlap to some extent, so it will be separated into three species in the near feature (Tanaka 1973 and 1975)*. In this paper, the one of them was dealt with. It occurs on the surface of sunny heaps of litter in bogs. These five species, especially *Pardosa T-insignita*, seem to spend their almost all time vagrantly without particular retreats (Fujii, 1974). The breeding seasons of these lycosids are extend from April to October because of the warm and rainy weather in these areas, therefore, the hibernating stages are greatly confused. They complete their life cycles within a year. *Arctosa ebicha* and *Lycosa coelestis*, which hunt on the grounds with rather dark thicket (Yaginuma, 1960), are large wolves and grow up to about 15 mm in the body length, but they are seldom seen probably for their poor abundance. *A. ebicha* is often collected from beneath stones or logs, and occasionally digs into the soil when it's reared. Both lycosids may require two years or more to mature. *A. ebicha* is considered to breed in late spring. In *L. coelestis*, the length of the breeding period is unknown eventhough the specimen collected by the author oviposited in September.

Results

The typical patterns of the daily change of newly emerged spiderlings' distribution within the vial in each species are illustrated in Fig. 1—8. In *Lycosa* sp. (Fig. 1) the youngs didn't climb on the body of their mother. They stayed for several hours on the surface of the cocoon, and then left by twos and threes to be scattered over the ovipositing room within 1—4 days (1.9 days on the average from 15 observations). The mother cast off

* Tanaka, H. 1973 and 1975: He reported it on the 8th and 10th general assemblage of Arachnological Society of East Asia.

her empty cocoon when the almost all spiderlings had finished their emergence. All spiderlings lodged with their mother in the same ovipositing room for one or two weeks, thereafter the true dispersion occurred. Though the cocoon was attached to spinneret of the mother, it was seldom carried out from the retreat, so, not only the pulli-carrying behaviour but also the cocoon-carrying behaviour cannot be seen virtually in *Lycosa* sp..

One more similar result was obtained in *Arctosa ebicha* (Fig. 2), but the length of the period from the beginning of emergence to the end of dispersal was about three times as long as that of *Lycosa* sp.. Besides, a few youngs were observed to ride on the back of their mother. The rising curve on the 5th to 6th day in Fig. 2 shows that some of the spiderlings already emerged or dispersed entered again into the cocoon.

The mothers of other six lycosid species carried about their own offsprig on the abdomen at least for two or three days. It was observed by the use of a binocular miroscope that the spiderlings held in the long and dense hairs of the mother with the whole legs and jaws, and seemed to use their spinnerets also, but those who couldn't so because of the late arrival clung to the legs of the earlier fellows. The all youngs emerged from the cocoon immediately began to move and cling onto their mother's abdomen, and finished it to the last individual within about ten hours, but in *Pardosa laura* this period was ofen extended to one or two days length (Fig. 5). The mothers took off the cocoon after when all youngs finished the riding, probably motivated not by the riding of youngs but by the emptied cocoon itself as well as in *Lycosa* sp. or *Arctosa ebicha*.

There were considerable differences in the durations of pulli-carrying periods both interspecifically and intraspecifically. Each duration was, to enumerate, 8 days in *Lycosa coelestis* (Fig. 3), 9 and 10 days in *L. pseudoannulata* (Fig. 4), 4—11 days (6.9 days, the mean from 7 observations) in *Pardosa laura* (Fig. 5), 3—9 days (5.6 days, the mean from 7 obs.) in *P. T-insignita* (Fig. 6), 5—7 days (6.3 days, the mean from 3 obs.) in *Pirata subpiraticus* (Fig. 7), and 3—4 days (3.8 days, the mean from 4 obs.) in *P. procurvus* (Fig. 8). In *Pardosa laura*, these durations seemed to be shorten on the hot summer days.

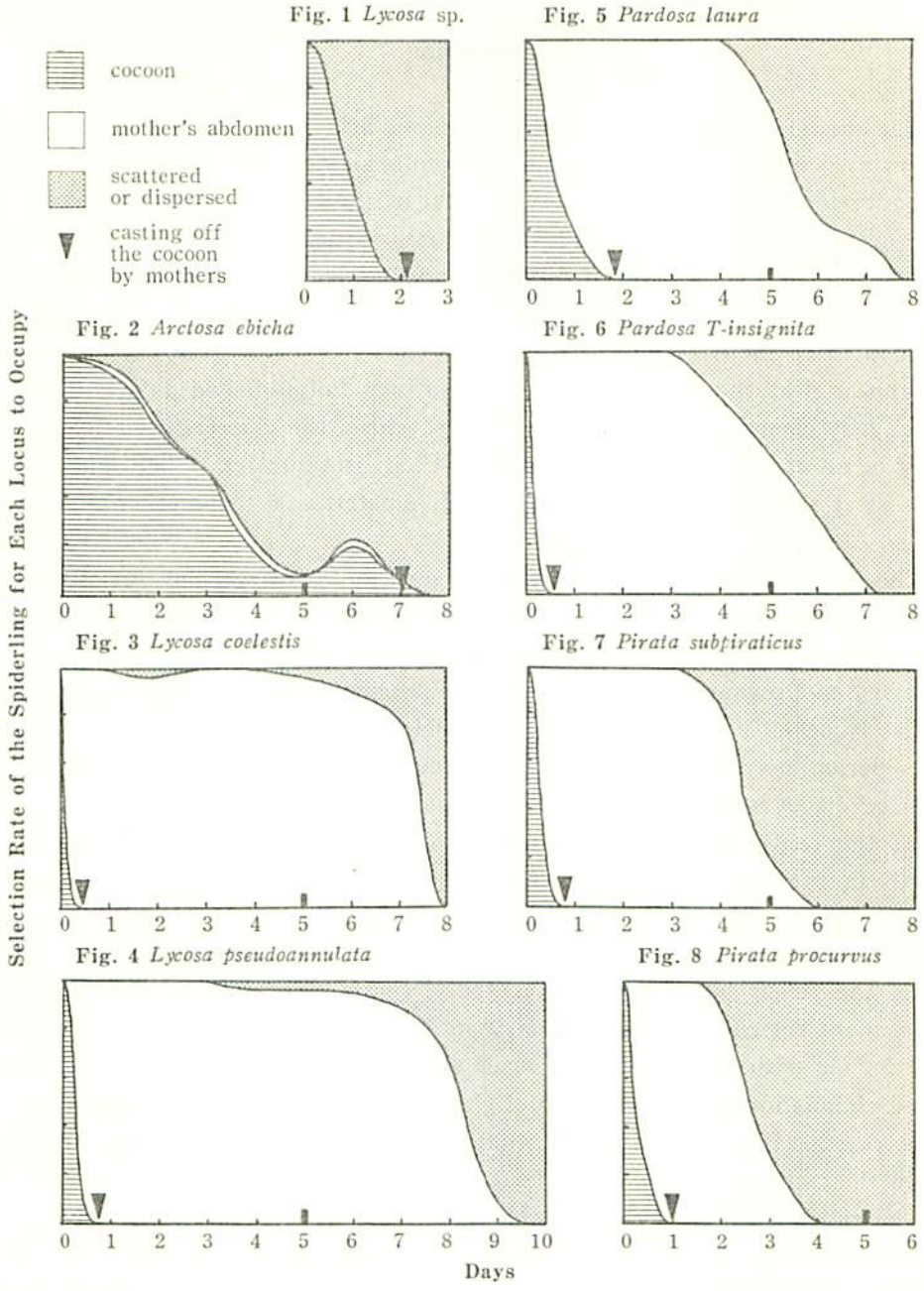

Fig. 1 *Lycosa* sp.

Fig. 2 *Arctosa ebicha*

Fig. 3 *Lycosa coelestis*

Fig. 4 *Lycosa pseudoannulata*

Fig. 5 *Pardosa laura*

Fig. 6 *Pardosa T-insignita*

Fig. 7 *Pirata subpiraticus*

Fig. 8 *Pirata procurvus*

Fig. 1—8: The daily changes of the distribution of the spiderlings in each vial. The typical examples in each lycosid species are illustrated to show the interspecific differences. The points of cocoon-casting off by each mother are also shown.

Discussion

The cluster formation by the newly emerged offspring can be seen generally in many species of Araneae, and the pulli-carrying behaviour may be its peculiar form developed in Lycosidae, that is, the cluster formation occurring on the mother's abdomen. During this investigation period the author observed that the spiderlings of *Pardosa T-insignita*, emerged from the artificially opened cocoons, aggregated to make up clusters of various size in a glass jar without both their mothers and egg sacs, then four days after, these clusters disappeared at the dispersal of the spiderlings (unpublished data). So, for the newly emerged spiderlings also in Lycosidae, the cluster formation itself may be an unavoidable process to begin their first hunting. The spiderlings just after the emergence must keep their cluster, and the mother must aid them.

The pulli-carrying behaviour was not seen in *Lycosa* sp. and *Arctosa ebicha* whose habitats are highly stable during their breeding seasons. Furthermore, these mothers have a proper retreat, such as the silk room or the barrow, to prevent the enemies from disturbing their youngs' cluster. In these lycosids, both the youngs and their mother may be able to spend this period movelessly under these circumstances. More similar lycosids will be discovered by careful investigations.

On the contrary, other species showed the pulli-carrying behaviour all dwell in the areas where the environmental conditions are very unstable. Those lycosids which live in the damp field, *Lycosa pseudoannlata*, every *Piratae* and *Pardosa laura* (the form dealt here) for example, should suffer from the floods and drought repeatedly, therefore, they cannot make any permanent retreat. In *Pardosa T-insignita* highly adapted for the dry habitat, the female with cocoon are also made to move continuously by the force of ants, cicindelids, wind, strong sunlights and other individuals of the same species etc. (Fujii, op. cit.). In these wolf spiders, the spiderlings cannot keep their cluster unbroken without aid of the mother.

The riding pulli took considerable time to leave from the mother (Fig. 3—8), so, the high mobility of the mothers may help the spiderlings to disperse over the wide area and to avoid the localized overpopulation of the youngs. The youngs are too fragile to disperse by ballooning, this behaviour may be profitable for these lycosids. According to the thorough experiment by Richiter (1970), aerial dispersal of lycosids (*Pardosae*) occurs generally in

the young instars, but not generally in adults and the spiderlings just after dismounting from the mothers. On the other hand, Hallander (1967) reported that the females moved very little in this period in both *Pardosa chelata* and *P. pullata*. The more detail observations with the instances in other animals, e. g. scorpions or pseudoscorpions, may be required for the more precise understanding the pulli-carrying behaviour in lycosids.

The every lycosid ovserved exhibited the behaviour of attaching the cocoon to spinnerets. This fact supports the Gertsch's suggestion (op. cit.) that this behaviour observed in sedentary lycosid can be regarded as a kind of their hystorical remnants, and the sedentary wolves were prbably developed from the primitive vagrant lycosid who had already learned to haul its cocoon about. To solve the problem whether the maternal care without the pulli-carrying behaviour is the secondary derivative from that of the normal lycosids or not, the morphological data must be obtained in addition to these ecological investigations.

Acknowledgements

I should like to thank Dr. J. Mishima and Dr. T. Saito of Zoological Institute, Tokyo Kyoiku University, for their reading the manuscript and valuable advices, and Dr. H. Tanaka, Dr. M. Yoshida, the members of Arachnological Society of East Asia, for their helpful discussions and kindly teaching informations about the materials. I also wish to express my gratitude to Prof. Dr. Komiya and other staff of Dept. of Biology, Nippon Dental University and Prof. Dr. Yaginuma of Biol. Laboratory, Ohtemon-Gakuin University, for their encouragement in this work.

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