

**A BEHAVIOURAL STUDY OF PREDATION BY  
SERRASTRUMA SERRULA SANTSCHI  
(FORMICIDAE, MYRMICINAE)**

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*SUMMARY*

A behavioural analysis of Collembola capturing can be based on a succession of phases : detection, localization, approach, antennating, attack, stinging, transport. The richest sequence is most frequent when prey and predator meet one another by chance. Detection, approach and antennating are absent in fortuitous meetings and when the prey is inert there is prolonged antennating followed directly by transport of the prey. The behaviour of the ant is adjusted to the situation. After an unsuccessful attack, the worker is excited and mandibles remain open as during approach. If it then meets a living Collembola it attack and stings directly. If it meet an inert prey there is no antennating but stinging is very frequent (92 %). The behaviour of an excited ant is badly adjusted to this last situation : an excited worker generally carries out the end of the sequence even if it is not necessary.

*RESUMEN*

**Estudio del comportamiento de predación de *Serrastruma serrula*  
Sautschi (Formicidae, Myrmicinae)**

El estudio de las secuencias de comportamiento durante la captura de *Folsomia candida* por las obreras proveedoras de *Serrastruma serrula* nos permite distinguir la sucesión

de las fases siguientes : detección ; localización ; marcha de aproximación ; palpación antenal ; ataque ; picadura ; transporte. Cuando presa y depredador se encuentran por azar, la secuencia mas rica es la más frecuente. Cuando la proveedora encuentra fortuitamente un Colembolo, la secuencia conductual es siempre rápida, pues no existen las fases de detección, aproximación y palpación. En presencia de una presa inerte, la palpación antenal es siempre de larga duración, la picadura no se ha observado más que excepcionalmente. Son adaptaciones a la situación. Cuando una proveedora está excitada por una fallida, conserva sus antenas dirigidas hacia adelante y sus mandíbulas abiertas. Si encuentra en ese momento una presa, la ataca directamente. Este comportamiento permitirá, eventualmente, encontrar la presa que ha huido y capturarla. Si se le da un Colembolo anes-tesiado con CO<sub>2</sub> a una proveedora excitada por una captura fallida, falta la palpación ; la picadura está presente en general. El comportamiento de la obrera se encuentra, pués, mal ajustado a la situación. Esto muestra que el fracaso excita a la obrera que tendrá, entonces, tendencia a desarrollar hasta el final la secuencia, incluso si no es necesario.

## INTRODUCTION

Brown and Wilson, in 1959, during their study on the evolution of Dacetini, showed that Collembola make up the essential part of the diet for the species which belong to the subtribe *Strumigeniti* and that there exist a fundamental difference between the predatory behavior of species with long mandibles and those with short mandibles. *Strumigenys*, with long mandibles, after a short approach period, strikes the prey, after which there may or may not be a stinging phase. *Trichoscapa*, with short mandibles, approaches slowly and strikes an appendage of the prey. Stinging is obligatory. Our study is of the genus *Serrastruma* whose mandibles are intermediate between the two cases just cited. The genus *Serrastruma* has been derived from the *Smithistruma* which has short mandibles (Brown, 1952). The sequential analysis exposed in this work was systematically conducted with the prey being the Collembola *Folsomia candida*.

## SEQUENTIAL ANALYSIS

Analysis of the behaviour phases during the capture of the Collembola *Folsomia candida* shows the following sequence : detection, localization, approach (with opening of mandibles), antennation, attack, lifting, stinging (fig. 1), transport. This is the whole sequence, but depending on the conditions one phase or another may or may not be present.

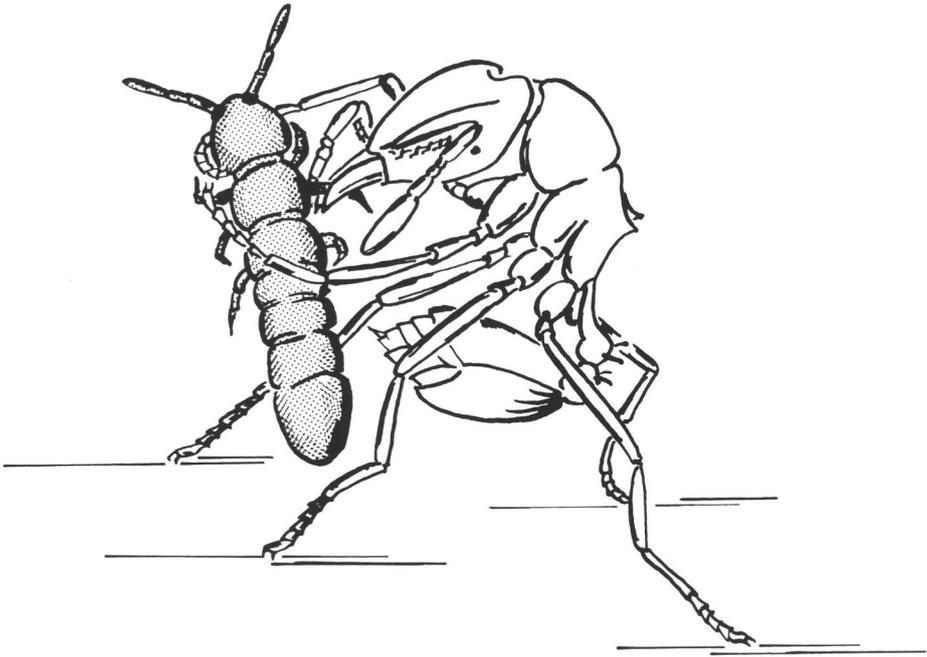


Fig. 1 — Stinging. The worker is standing on its mesal and hind legs between which the gaster is reflexed. It is preparing to sting the Collembola which is lifted up by a mesal leg. The forelegs of the ant seize the prey which is struggling.

Fig. 1 — Picadura. La obrera levanta al Colembolo por una pata, y manteniendo con sus patas anteriores la presa la cual forcejas, está a punto de picarla.

A study of the capture of *Folsomia* by the foraging workers *Serrastruma serrula* is shown in figure 2, where we can see that the prey can escape at different levels. The results are presented in Table I. We establish that the richest sequence is also the most frequent (50 %). It is followed by those alternatives where the closing of the mandibles and/or the raising of the prey are/is absent.

Rapid attack : in certain cases (16 %) antennating is absent. The whole sequence will be shorter, because this phase may be long (30 sec.).

Unexpected encounter : sometimes the prey and the predator are going in different directions and run into each other unknowingly. Thus there is neither detection nor approach. Because of this it seems that the worker becomes excited, since all the actions which follow are hurried. There is no antennating. The striking action is always present.

**Table I** – Sequential analysis of the predatory behavior of one hundred foraging workers capturing living *Folsomia*.

**Tabla I** – Análisis secuencial del comportamiento de predación de 10 obreras proveedoras capturando *Folsomia candida* vivos.

% of presence	Phases	Richest sequence	Variations as a function of the richest sequence					Quickly attacks			Unexpected encounter		Slow or inert prey		
			+	-	+	-	+	+	-	+	-	+	-	+	-
88 %	Detection	+	+	+	+	+	+	+	+	-	-	+	+	+	+
100 %	Localization	+	+	+	+	+	+	+	+	+	+	+	+	+	+
88 %	Approach	+	+	+	+	+	+	+	+	-	-	+	+	+	+
100 %	Opening of the mandibles	+	+	+	+	+	+	+	+	+	+	+	+	+	+
71 %	Antennating	+	+	+	+	-	-	-	-	-	-	-	+	+	+
	<b>Attack</b>														
78%	Stricking	+	-	+	-	+	-	+	-	+	+	-	-	-	+
79 %	Lifting of the prey	+	+	-	-	+	+	-	-	+	-	-	-	+	-
91 %	Stinging	+	+	+	+	+	+	+	+	+	+	-	-	-	-
	Percentage	50	7	2	4	10	2	3	1	9	3	1	6	1	1

Slow or inert prey : the last three phases are absent. After examining the condition of the prey during a long antennating period, the worker grasps it and takes it to the nest.

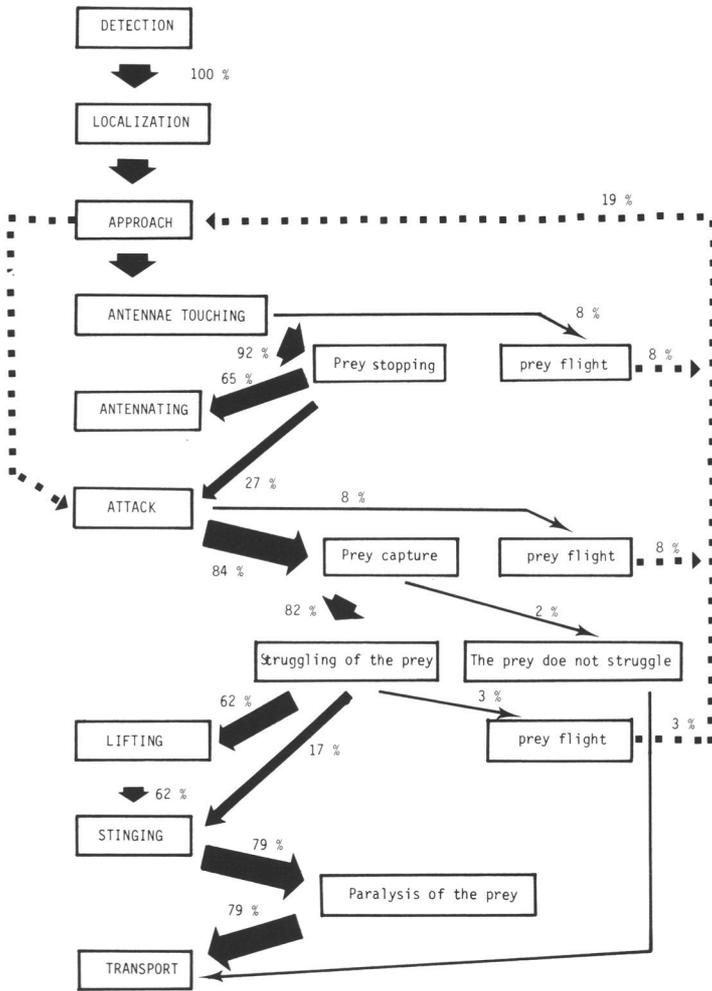


Fig. 2 — Schematic figure of the sequential analysis of predation behaviour of *Serrastruma serrula* ; the prey is the Collembola Isotomidae : *Folsomia candida*. Each arrow shows the passage between the different acts. Its thickness is approximately proportional to the percentage of observed cases.

Fig. 2 — Representación esquemática del análisis secuencial del comportamiento de predación de *Serrastruma serrula* capturando el Colembolo Isotomidae *Folsomia candida*. Cada flecha indica el paso de un acto dado al otro. Su espesor representa aproximadamente el porcentaje de casos observados.

## SEQUENTIAL ANALYSIS AFTER EXPERIMENTAL INTERVENTION

We carried out a series of sequential analyses after changing certain variables. The results are presented in Table II. The foraging worker encounters a *Collembola* anaesthetized by  $\text{CO}_2$ . The antennating is exceptionally long and stinging is absent. The foraging worker, excited by the escape of its prey, meets another one which is alive and active : the worker moves swiftly, antennae pointed forward, mandibles open. This posture may last 45 seconds. When this worker meets the prey it is in such a state that it attacks and stings immediately. There is no antennating. The actions of the worker are hurried.

**Table II** – Sequential analysis of the predatory behaviour of foraging workers, in three situations

**Tabla II** – Análisis secuencial del comportamiento de predación de las obreras proveedoras dentro de tres situaciones particulares.

Phases	Inert prey given to foraging workers			Foraging workers excited by the escape of prey				Workers excited by the escape of prey encounter inert prey				
Detection	+	+	+	-	-	-	-	+	+	+	+	+
Localization	+	+	+	-	-	-	-	+	+	+	+	+
Approach	+	+	+	+	+	+	+	+	+	+	+	+
Opening of the mandibles	+	+	+	+	+	+	+	+	+	+	+	+
Antennation	very long			-	-	-	-	-	-	-	-	-
Attack Striking	-	-	-	+	+	-	-	+	+	-	-	-
Lifting of the prey	-	+	+	+	-	+	-	+	-	+	-	-
Stinging	-	-	+	+	+	+	+	+	+	+	+	-
Number of observed cases	37/40	2/40	1/40	18/32	12/32	1/32	1/32	10/24	5/24	4/24	3/24	2/24
Percentage	92,5	5	2,5	56,25	37,5	3,125	3,125	41	21	17	13	8

The foraging worker, excited by the escape of its prey, meets an inert one (anaesthetized by  $\text{CO}_2$ ). For this experiment we excited the ant by presenting an anaesthetized *Collembola* on the tip of a fine paintbrush. The prey was removed before the ant could capture it and placed on the ground near the worker. As in the preceding cases, the worker, excited by the loss

of this prey, moves swiftly, antennae pointed forward, mandibles open. When it finds the prey that we placed near it, the ant attacks immediately. Antennating is never seen. Although in 8 % of the cases the prey is transported directly to the nest, we did not observe complete adjustment of the behavior of the ant to this situation. This result illustrates the excited state of the worker after a failure.

### CONCLUSION

Foraging workers of *Serrastruma serrula* can adapt their predatory behaviour in certain situations : unexpected encounter with the prey, which provokes a swift reaction ; detection of a dead or inert prey, which is followed by a long antennating period and then direct transport towards the nest (the phases which are not indispensable are absent). After a failure escape or loss of prey, attack is rapid and the stinging is carried out very early. The workers are adapted to the capture of Collembolans whose antipredatory tactics consists of immobility at contact with the predator. If the prey escapes, the ant has a second tactic which allows it to find and eventually capture prey. This second solution requires much more energy than the first.

It results in despecialization which will permit worker to capture other prey which systematically run away when the worker approaches. The worker in this excited state has a lot of difficulty in adjusting its behaviour when it encounters inert prey. In this case, the succession of actions leading to the typical capture (striking, raising, stinging) tends to be present, even though not necessary.

This compensating behaviour is important because it permits the *Serrastruma* to colonise areas where the population of collembolans decreases during certain seasons because its too dry. In this case the foraging workers capture other insects whose populations increase under dry conditions. This is observed under forest of Eucalyptus at the beginning of the dry season, where certain Psocids are abundant. Psocids do not freeze in front of *Serrastruma*.

### References

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