

## THE UNUSUAL BEHAVIOUR OF PARAGYMNOMERUS SPIRICORNIS (SPINOLA) (HYMENOPTERA: EUMENIDAE)

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### Abstract

Experiments with marked *Paragymnomerus spiricornis* (Spinola) nests (Nos. 1—109) and wasps (53 specimens) proved that contrary to our earlier knowledge 14 wasps entered into 2—3—4 strange nests, in four nests two wasps were observation at the same time. By revealing these most of our earlier ethological observations become unreliable and call for further experiments carried out with similar marking systems.

For many decades specimens of *Paragymnomerus* (= *Odynerus*) *spiricornis* (SPINOLA) have been nestling at the same site. Several contributions appeared on the ecological-ethological conditions of this population (MÓCZÁR, 1939—1962), on certain details of behaviour (GIRAUD, 1863; MÓCZÁR, 1939; 1960a; 1961a; b; 1972; 1973). Reference was also made to the fact that two specimens of the same species have been found at the entrance of the nest where they (i. e. not the parasite and its host) fought (MÓCZÁR, 1960b). The following examination was carried in order to elucidate the details of intrusion into strange nests of this solitary wasp grouping into populations.

### Method

Between the 21st of June, 1971 and the 16th of August, 1971 on the loess wall at the foot of Csúcshegy in the southern parts of the Tihany Peninsula for 17 days seriatim all those funnels were marked with different colours in which active wasp was perceived. As a control beside the funnels we placed tiny flags numbered from 1 to 109 marked also with the same colour of paint (Fig. 1). Between the 28th of June and the 6th of July, 1971 we marked the females frequenting 53 funnels according to differently coloured dot and line combinations grouped into tens which marks also appeared on the funnels. The marking of the observed females is important as it had already been pointed out by LINSLEY et al. (1952) and MICHENER et al. (1955). The numbering of wasps was made on ice-cooled specimens (MÓCZÁR, 1960). The phases of activity of wasps visiting the marked funnels were recorded on tape-recorders between the 26th of June and 8th of July by Dr. L. GALLÉ, Mrs. Dr. B. HAJÁSZ, Miss M. KÁLMÁN and the author in groups of two for 19 hours a day (8<sup>h</sup>—18<sup>h</sup>). Thus we obtained a huge amount of data from 109 funnels, which totalled 1849 phases of activity upon which fairly reliable inferences may be drawn.

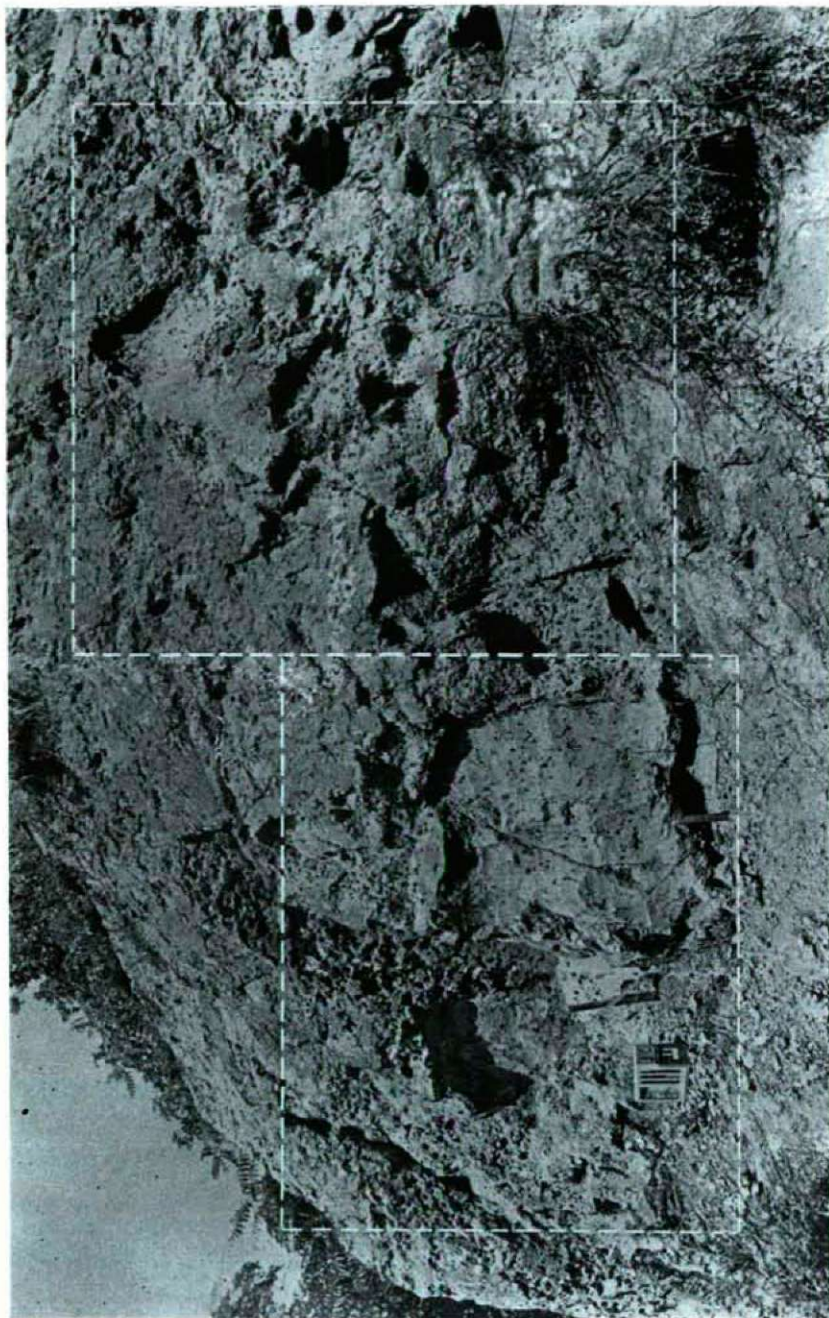


Fig. 1. The Tihany loess wall. Drawing 2 illustrate the turrets at the encircled parts.

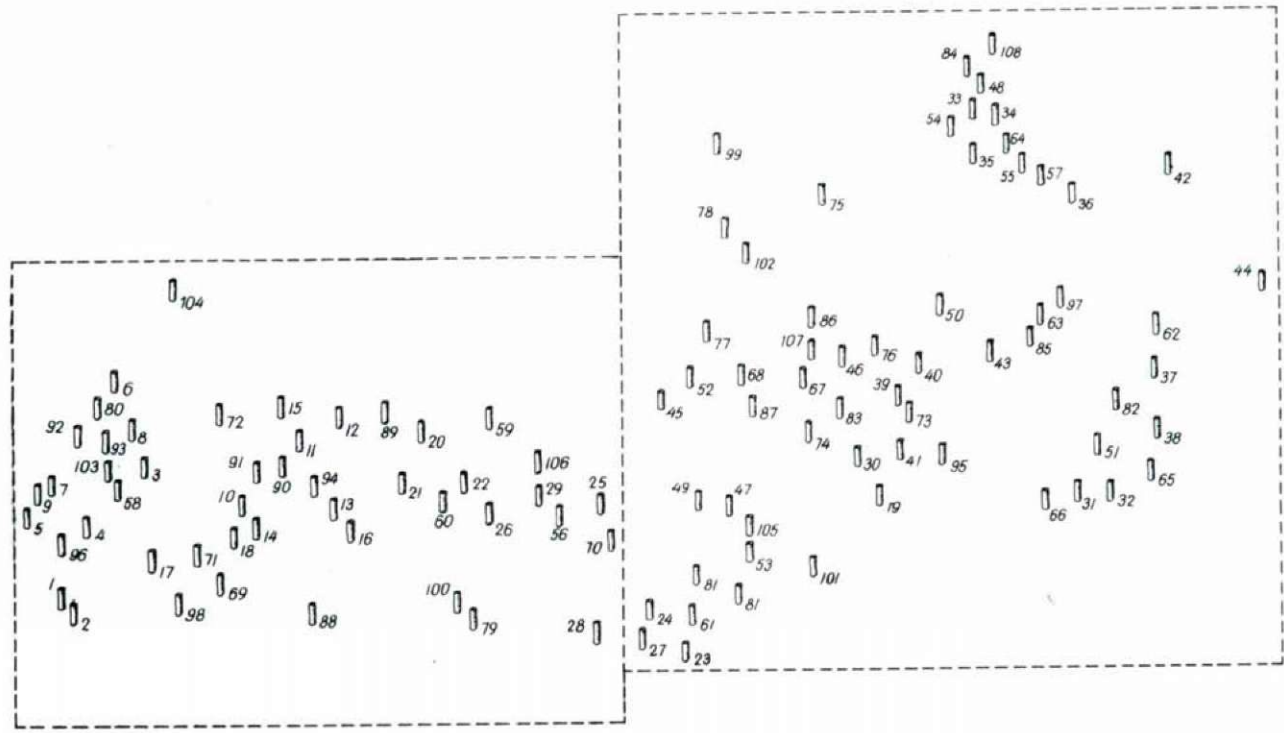


Fig. 2. The numbered turrets on two details of the loess wall.



Extract from the log-book of some nests:

Nests Nos. 3, 60, 84 and 95.

28th June: nest No. 3 was marked.

4th July, 14<sup>00</sup>: the captured wasp, taken from the nest, was marked according No. 3 then was replaced on its funnel. A white on its back also indicated that the wasp found active on the 21st of June.

5th July, 11<sup>40</sup>: Wasp No. 3 was building funnel No. 60, which was only one centimetre high, thus its second nest under our observation must have been started only today.

11<sup>40</sup>—13<sup>33</sup>: the same wasp observed in 14 occasions while it built nest No. 60, and brought out debris from inside.

13<sup>34</sup>: one (it was not possible to identify whether it was a marked or unmarked specimen) wasp was active in nest No. 95.

13<sup>46</sup>: wasp No. 3 was erecting the funnel No. 84.

13<sup>47</sup>—16<sup>57</sup>: wasp No. 3 was observed in 29 occasions while it erected the funnel No. 84 or entered, 6th July, 10<sup>44</sup>—13<sup>03</sup>: in 4 occasions we noticed wasp No. 3. to enter funnel No. 84.

14<sup>08</sup>: activity was observed in nest No. 95. 7th July, 11<sup>46</sup>: wasp No. 3 entered the ready funnel marked No. 95.

11<sup>46</sup>—16<sup>12</sup>: the wasp was captured to control marking and afterwards in 19 occasions we observed it to be active in funnel No. 95. While marking the funnel was damaged and cracked at the upper edge, but after some hesitation the wasp resumed the building of the funnel.

23rd July, 15<sup>00</sup>—15<sup>52</sup>: in 7 occasions we observed wasp No. 3 to enter nest No. 95.

28th July, 10<sup>03</sup>—15<sup>10</sup>: in 19 occasions we observed wasp No. 3 to repair funnel No. 95, finally the wasp partly demolished the funnel and blocked up the entrance.

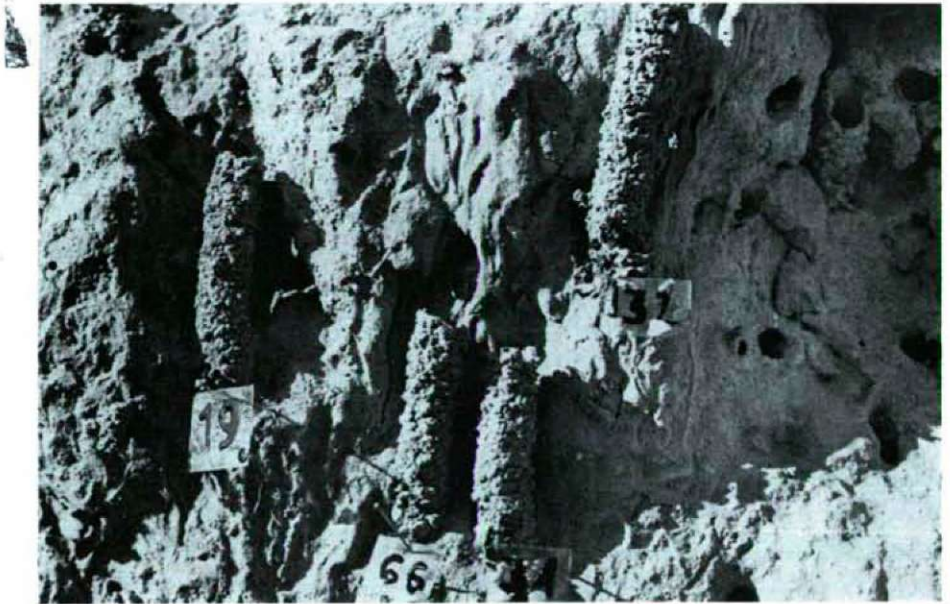


Fig. 3. Right upper detail of the loess wall with some turrets and flags.

Wasp. No. 3 was observed for 38 days on the loess wall and its activity was continuously recorded for 7 days. Surprisingly the wasp was active in four funnels: Nos. 3, 60, 84 and 95. For 6 days its work was intensely watched: on the 4th it spent a short time in nest No. 3, on the 5th two hours in nest No. 60, during a whole

afternoon and the following forenoon it spent its time in nest No. 84, while in three different days it was building the funnel to nest No. 95, or only flew in or out. In other words, the wasp has not completed a single cradle between the 4th and 7th of July, nor has it brought sawfly larvae in it, but it entered even strange nests where it actively worked for a prolonged time (7th—28th July). Out of these nests the wasp only built the one marked No. 60 for certain, its visits, on the other hand, included those nests which had already been marked, i.e. those with funnels being strange to it. On the 5th—6th the number of the wasp was left unobserved though actively worked in nest No. 95, it is most likely that it was wasp No. 3.

#### Nest No. 39.

28th June, 14<sup>10</sup>: a wasp began to build a nest and to raise its funnel.

15<sup>00</sup>: the base of the funnel was marked.

29th June, 16<sup>00</sup>: the funnel is finished the upper wet part is dry.

3rd July, 13<sup>10</sup>: the above funnel was numbered, the wasp captured from it has borne two white flecks which indicate that it had already brought sawfly larvae on the 21st of June. This time mark No. 39 (yellow, the reverse of No. 1) was painted on its back.

15<sup>07</sup>—17<sup>10</sup>: it was observed several times to fly in and out.

17<sup>15</sup>: it entered the funnel, but immediately it returned onto and edge turning round backed into the nest, probably for spending the night in.

4th July, 14<sup>06</sup>: it flew in.

17<sup>30</sup>: it went in then came out again to turn around and backed into the funnel.

18<sup>52</sup>: again it went into the funnel.

5th July, 15<sup>45</sup>—17<sup>49</sup>: several times it flew into the funnel.

6th July, 13<sup>37</sup>: the funnel was raised by 1 cm, the wasp entered the opening.

13<sup>39</sup>—17<sup>30</sup>: the wasp was rearing the funnel in 15 occasions. In the meanwhile at 13<sup>49</sup> and 14<sup>10</sup> a much smaller *Odontodynerus d. deflendus* (SAUND.) stole mud globules from the funnel to fortify its own funnel.

7th July, 10<sup>30</sup>: the wasp brought a yellow sawfly larva into the nest.

10<sup>59</sup>—11<sup>05</sup>: it flew in, but 20 sec. later it returned with the yellow sawfly larva and settled on the vegetation of the loess wall and finally it dropped the larva.

11<sup>10</sup>—11<sup>11</sup>: twice it entered the funnel, then it circled above the funnel.

11<sup>12</sup>: another, this time a green sawfly larva was brought out of the funnel.

11<sup>13</sup>—58: 12-times it flew in and out of its nest meanwhile it circled above it, and flew off on shorter or longer distances.

12<sup>05</sup>: flew in, soon after it left the funnel, another wasp entered it (!), thus, two wasps were active in one nest.

12<sup>06</sup>—07: re-entered its nest.

12<sup>08</sup>: it flew in, the former also soon entered the nest (now two wasps were in the nest).

12<sup>09</sup>: both wasps came out, then soon both re-entered separately the nest.

12<sup>12</sup>: one of the wasps captured from the nest has borne the number 53, after release it circled above the funnel, it could not enter the funnel because a glass vial blocked up the entrance.

12<sup>50</sup>: the other wasp was also captured, it was marked No. 39, i.e. the original inhabitant.

12<sup>55</sup>: wasp No. 39 flew in but soon returned.

13<sup>17</sup>: wasp No. 39 flew into its nest, then returned and crawled into it backwards.

13<sup>29</sup>—34: wasp No. 39 resumed building its funnel.

15<sup>02</sup>—15: wasp No. 39 flew in and out several times.

23rd July, 12<sup>12</sup>: wasp No. 39 transported two sawfly larvae into its nest.

14<sup>55</sup>—56: the wasp was active in the nest.

Wasp No. 39 was observed for 33 days on the loess wall, and for 8 days its activity was recorded. According to the above, the wasp marked in nest No. 39 on the 21st June and even on the 23rd July brought sawfly larvae into the nest marked No. 39. Between 3rd and 6th July, on the 7th July in the forenoon was active alone in the nest, but between 12<sup>05</sup>—12 wasp No. 53 also entered the nest. Another extraordinary phenomenon was that wasp No. 39 brought out three sawfly larvae (7th July) from its nest, probably because before (in 10<sup>20</sup>—59) a strange wasp intruded

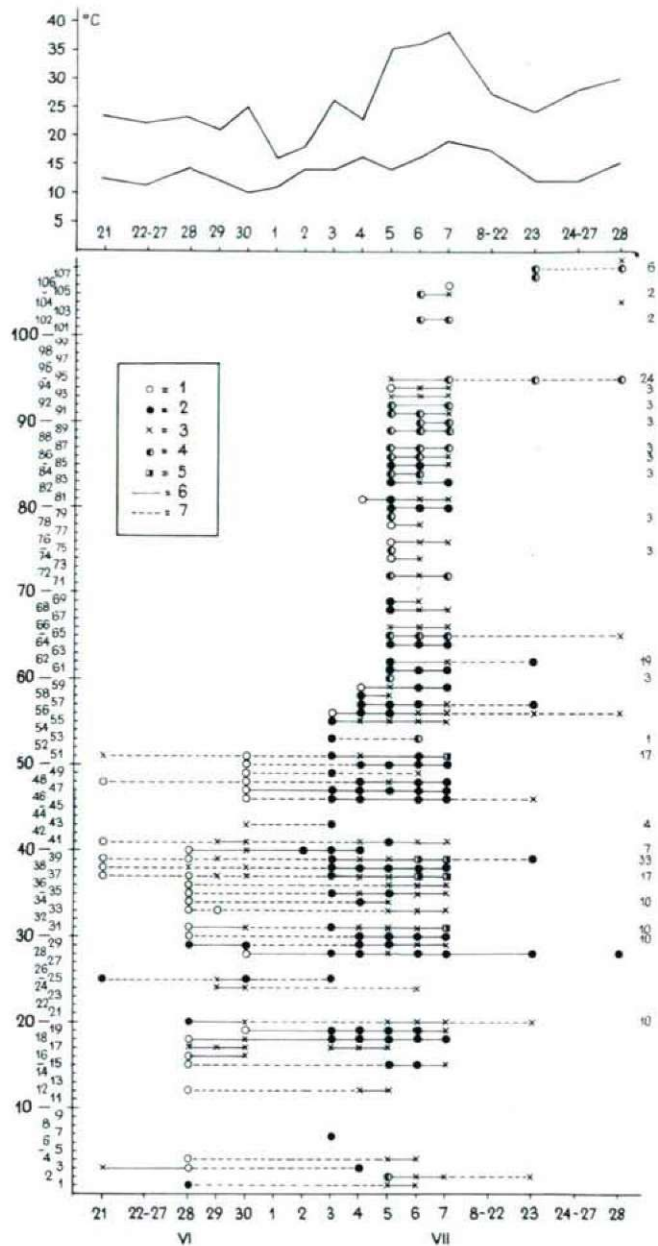


Fig. 4. Daily single activity observed in the numbered turrets. (Sign 1—5 see p. 170).



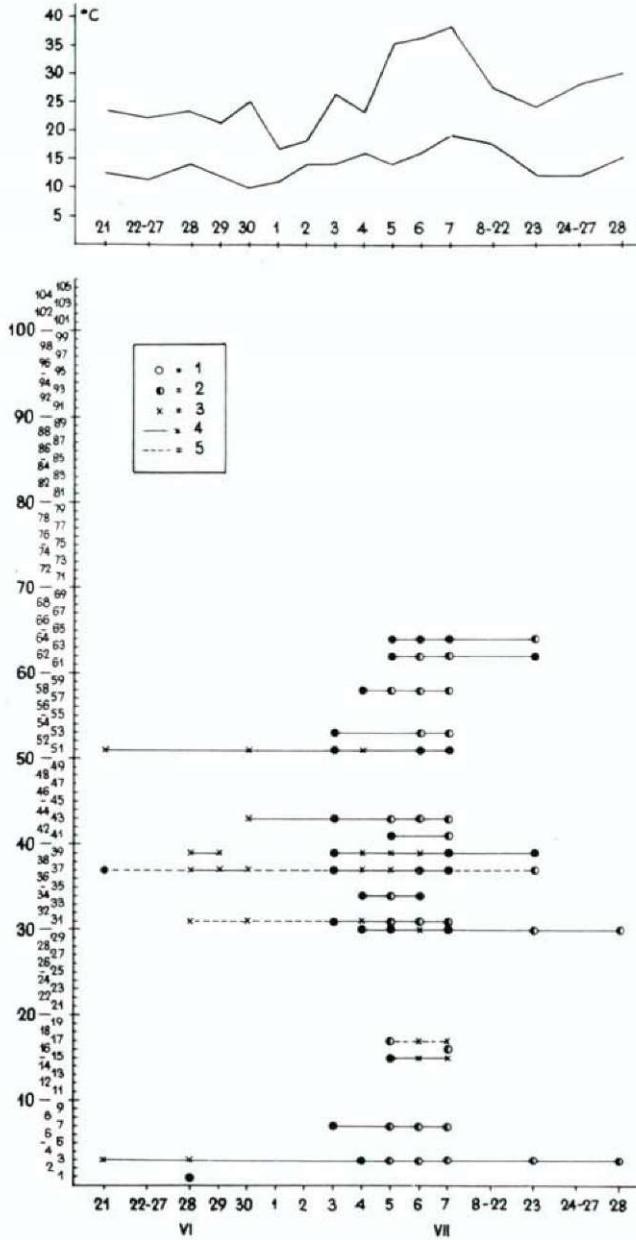


Fig. 5. Observed activity of the marked wasps. (Sign 1—5 see p. 170).

the nest, which was unobserved by us. Subsequent to our observing the entrance of the strange wasp it did not throw out sawfly larvae from its nest because there was no open cradle within, and it is proved by the fact, that it soon started to dig another cradle after this incident (and raised the funnel). Only one point does not support this theory, i.e. at 13<sup>17</sup> the wasp crawled inside the funnel backwards which generally mean ovipositing, of course, not every backward entrance means oviposition (cf. MÓCZÁR, 1973). There was no apparent reaction as to the stolen mud globules performed by *Odontodynerus d. deflendus* (SAUND.).

#### Summary to the observed nests Nos. 2, 17 and 72.

Wasp No. 17 was observed for 10 days on the loess wall, its activity was recorded in detail for 8 days. Owing to the fact that the wasp was first observed in the funnel, then in nest No. 2, it was obvious that it deserted nest No. 17 and favoured rather nest marked No. 2 (5th—23rd July), but the same wasp soon captured in nest No. 72 (5th July), and later though no identification was made most probably we observed the same wasp in nest No. 72 on the 6th and 7th July. Since because nest No. 2 was also visited, it is probable that wasp No. 17 tended two nests for three days (5th—7th July), or because we observed wasp No. 16 in nest No. 72 on the 7th July, this might have been that visitor the day before whose number remained unobserved. (Mark No. 17 cannot be mistaken for any other and the wasp was captured in two nests with only one minute difference in between).

#### Nests Nos. 7, 79 and 90.

Wasp No. 7 was observed in 5 days, and recorded for 3 days. The wasp was in nest No. 79 (5th July) the next day it was working in the nest with a funnel No. 90, here it most likely intruded as a stranger, on the second day it even brought a sawfly larva. In other words, the wasp was active at least in three nests at the same time.

#### Nests Nos. 30 and 108.

Wasp No. 30 was observed in 31 days and recorded for 6 days. After 16 days the wasp built a nest No. 108, and 5 days subsequent to this it was building another one. Its behaviour is normal.

#### Nest No. 31 (partly wasp No. 43).

The wasp of nest No. 31 was observed for 10 days and recorded in 7. For 9 days it worked alone, built its nest and brought sawfly larvae into it. In the afternoon of 7th July wasp No. 43 was also active in the nest together with No. 31, then the latter continued to work alone. The wasps did not fight with each other.

#### Nests No. 34 and 86.

Wasp No. 34 observed in 10 days and recorded for 4 days. It left its former nest on the 4th, on the 5th July in the afternoon it began to build another one (No. 86) into which brought a sawfly larvae, continued its activity there until noon next day. Early in the afternoon it returned to its former nest (No. 34) and worked there. Interestingly enough a wasp appeared in nest No. 86. On the 7th July for some two hours the wasp returned into its nest No. 34, in the afternoon in nest No. 86 again a wasp was present but we were unable to ascertain its number. On the 5th July at 13<sup>49</sup> a wasp entered nest No. 34, it remains an open question whether it was wasp No. 34 or not? In any way its behaviour is not normal.



## Nest Nos. 41 and 91.

The wasp of nest No. 41 was observed in 17 days and recorded in detail for 3 days. On the 5th July at noon the wasp was active in nest No. 41, in the afternoon it was captured in nest No. 91. Although on the 6th the number of the wasp was not controlled it is most likely that it stayed in nest No. 91, because on the 7th for certain we observed wasp No. 41 in nest No. 91, furthermore, a strange twice fought with it fiercely.

## Nests Nos. 43, 75, 87 and partly No. 31.

Wasp No. 43 was observed in 8 days on the loess wall and recorded in detail for 5 days. The wasp was active in 4 nests, in two nests for 1 and 1/2 day, respectively, in nest No. 87 for 2 1/2 days. Nest No. 75 was only visited for very short periods of time, so under no condition could it build a cradle therein, in other words, it deserted its nest and started to build a new one, but before it had completed even one cradle, at least in two occasions intruded nest No. 31.

## Nest No. 51.

Wasp No. 51 was observed in 17 days and recorded for 5 days. Its activity was normal until 16<sup>16</sup> on the 7th of July, but between 16<sup>19</sup> and 16<sup>26</sup>, though no reference number is given in the log-book as to the wasp one must have been the owner of the nest, two wasps were in the nest, then it disappeared from our sight. No fight is recorded in the diary. The wasp apparently did not react to the stolen mud globules performed by an *Odontodynerus*.

## Nests Nos. 53 and 105.

Wasp No. 53 was observed in 5 days and recorded in 3 days. The wasp was marked on the 3rd but then it disappeared. In the afternoon of the 6th July we observed it as it started to build nest No. 105. An hour later disappeared again. The following day at noon wasp No. 53 was captured in nest No. 39 where it spent 4 minutes, 5 minutes later it began to build a third nest. Thus, wasp No. 53 did not even build one cradle let alone bringing a sawfly larva into it, but it started to build a new nest, meanwhile it intruded a strange nest and spent 4 minutes with the owner (No. 39) of the nest.

## Nests Nos. 58 and 89.

Wasp No. 58 was observed on the loess wall in 4 days, and its activity was recorded for 3 days. During this time it provided two craddles with sawfly larvae, then it began to dig a new cradle. It is somewhat strange what made the wasp leave nest No. 58 at 13<sup>16</sup> on the 5th and work 24 minutes later (at 13<sup>40</sup>) in a strange nest.

## Nests Nos. 62. and 102.

Wasp No. 62 was observed in 19 days on the loess wall and recorded for 4 days. On the 5th it was active in nest No. 62, in the afternoon on the 6th it visited the ready nest No. 102 and continued to build it. But on the 23rd July it again returned to its original nest. In spite of this, it is difficult to assume that on the 6th at 17<sup>22</sup> and on the 7th at 17<sup>27</sup> a wasp carrying sawfly larva was No. 62, it is more likely that it was a strange wasp which took possession of the deserted nest. Wasp No. 62 was active in nest No. 102 then 16 days later we observed it again in its original nest.

Nests Nos. 64 and 107.

Wasp No. 64 was observed in 29 days and recorded for 4 days. Between the 5th and 7th of July it built nest No. 64, on the 23rd nest No. 107 and brought a sawfly larva into it. Its activity is normal.

The observed activity data are plotted on two graphs (Figs. 2 and 3). The horizontal axis on both show the days of observation, above the recorded minimum—maximum values of the weather. The vertical axis of Fig. 2 shows the numbered funnels, the same on the third figure displays the wasps marked with a combination of figures. The graph of Fig. 2 includes the partial data of a daily activity, in Fig. 3 the activity of marked wasps may be seen according to the following key: 1 — open circle — it was active in the funnel (flying in or out, erecting the funnel, bringing sawfly larvae), 2 — full circle — the wasp was active in its own nest (— the number of the wasp is identical with the number of the nest or funnel when it was captured), 3 — x — some real activity or the daily changing colour mark on the funnel, by which the series was conceived, 4 — half-full circle — the activity of a strange wasp (Fig. 1) or (Fig. 2) the wasp being active in a foreign nest, 5 — half-full square — activity of home or strange wasp observed only in one funnel, 6 — full line — continuous activity was observed for a number of days in one nest, 7 — broken line — on the respective days no observations were made, but wasp activity was probable.

#### The results of the observations

1. During this time 4 nests Nos. 31, 37\*, 39 and 51 were invaded by strange nests in which the owner was at home, 12 wasps were captured in strange nests. From the latter, 7 wasps (Nos. 30, 34, 40\*, 41, 58, 62 and 64) were active in 2 nests, 3 wasps (Nos. 7, 17 and 53) in 3 nests, 2 wasps (Nos. 3 and 43) in 4 nests.

2. In 3 wasps the second nest was built by the same wasp (nest No. 108 was built by wasp No. 30, nest No. 65 by wasp No. 40, nest No. 107 by wasp No. 64). Their activity is normal for no other wasp intruded their nests, and neither did they invade strange nests, the building of a second nest is normal, for during their lifetime one wasp generally builds several nests.

3. Only in two wasps could we prove that in the subsequent visiting of nests one was originally its own which it was building from the start (wasp No. 3 — nest No. 60, wasp No. 53 — nest No. 105). In further three wasps it is presumable that the nests are their own (wasp No. 34 — nest No. 86, wasp No. 40 — nest 108, wasp No. 64 — nest No. 107), all the other frequented nests were strange to the wasps.

4. Nests visited later in five occasions proved to be the meeting place of two wasps (nests Nos. 31, 37, 39, 41 and 51), i.e. they were inside at the same time (or a strange wasp intruded into the nest).

5. The meeting of strange wasps generally resulted in a prolonged fight, in only two occasions (nests Nos. 31 and 51) did we fail to observe any fight between the two wasps.

\* Note: Wasps Nos. 37 and 40 have been discussed in detail elsewhere (Móczár, 1973).



6. Two wasps (Nos. 17 and 34) were active in two nests at the same time.  
 7. Two wasps (Nos. 34 and 62) were working in other nests, but returned some days later into their original constructions.  
 8. There is no correlation between the frequency of changing nests and the duration of the observation. For example:

No. of visited funnels	No. of observation days	No. of recorded days	No. of marked wasps
4	38	7	3
4	8	5	43
3	5	3	7
1	33	8	39
1	17	5	51
1	10	7	31

9. Some of the wasps are rather inconstant in nature, i.e. before they have finished even one cradle, they start to dig another one, in other words, they entered a strange nest (e.g. wasp No. 53).

10. Wasp (No. 53) working for a prolonged time in its nest may enter for a short time a strange nest, or a wasp spending a longer period of time in its nest may witness the visit of a strange wasp (wasp No. 43 invaded the nest of wasp No. 31). A possible explanation to this is a disorder in orientation.

11. Permanent change of nests is a more frequent phenomenon (wasp No. 17 into nest No. 72, wasp No. 41 into nest 91, wasp No. 62 into nest No. 102, wasp No. 7 into nests Nos. 79 and 90). The explanation is possibly in some environmental effect (such as unsuitable medium), the long duration between nest building and ovipositing, etc.

12. One wasp (No. 43) was active in four nests (Nos. 75, 87 and 31). One wasp (No. 17) was also active in three nests, at least intruded them (Nos. 2 then 72).

13. A wasp may intrude several nests (wasp No. 3 into nests Nos. 60, 84 and 95) and may stay there for shorter or longer periods of time.

14. The wasp shows no reaction to the fact that an *Odontodynerus d. deflendus* (SAUND.) has stolen building material from its funnel.

### Summary

Between the 21 st of June and 16 th of July, 1971 we marked 109 *Paragymnomerus spiricornis* (SPINOLA) nests and 53 wasps with different combination of coloured marks, by this we were able to make 1849 recordings referring to behaviour. By our system of marking we could prove that 14 nests were invaded by strange wasps wherein they were building the nest or active in some manner. In four nests two wasps were together at the same time. At the meeting of strange wasps generally we observed a fight. The simultaneous activity of two wasps in one nest usually resulted in a return to their original nest after a few days. The above recordings clearly show that the activity of the wasps is by far not always in order and routine-like, as it has been suggested previously in literature, the conclusions



of which were founded on unmarked specimens of wasp. It is very likely that the situation will be different when conducting experiments with marked wasps. The system of activity of wasps quite frequently is upset. For some unknown reason the wasps perform activity which is sometimes the exact opposite what had been supposed in the sequence of nest building – oviposition – hoarding of food for the offspring – sealing the cradle. The above facts seem to support an earlier assumption (MÓCZÁR, 1960) which declared that wasps living in groups are more ready to accommodate themselves and quickly find the next step in activity in a strange nest, e. g. they continue to build the funnel, collecting larvae as food for the offspring, completing the nest, etc. And this seems to be an important link between solitary and social life. The enumerated irregular activities cannot be answered as yet, the motives are yet hidden, to find correct explanation to these irregularities and to their motivation are the most important tasks of the future.

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