

Vibrational courtship signals of *Zygiella x-notata* (Clerck) (Araneae: Araneidae)

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Summary

Behavioural observations suggest that intra-specific vibrational communication in web-spiders is intricate and complex. Unfortunately, the delicate structure of the spider web makes it virtually impossible to record vibrational signals accurately using conventional techniques which require contacting the web (e.g. with a recording stylus). We report here, for the first time, the male courtship signals of a web spider (*Zygiella x-notata*) as recorded with a laser Doppler vibrometer (LDV), a non-contact method of recording vibrations. Our behavioural observations and vibrational recordings showed that male *Zygiella* made two types of signals: a rhythmic “pulling” signal, made by the male immediately before copulating, and a “plucking” signal, also made immediately before copulating. Both types of signals seemed to be used to arouse the female to mate. A third signal, called “burping” (named because it sounds like someone releasing gas) was most likely also made by the male. It was heard as the male approached the female across her web, and seemed to inhibit a predatory attack from the female. With the LDV it is possible to examine accurately the information content of courtship signals and the relationship between this information and the mating strategies of web-spiders.

Introduction

For web-building spiders, the web is more than a means of capturing prey; it is an extension of the spider’s sensory system through which the spider receives most of the information about its environment (Foelix, 1992). This information is most often encoded and transmitted to the spider in the form of vibratory signals (Barth, 1985, 1986). For instance, when a fly becomes trapped in the web, it unintentionally notifies the spider of its presence by the vibratory signals it creates as it struggles to free itself.

However, vibratory signals from prey are only one type of signal transmitted through webs (Foelix, 1992; Barth, 1985, 1986; Krafft, 1982). The web also serves as the channel through which vibratory courtship signals are transmitted between web-spiders (Leborgne, 1984; Krafft, 1982; Robinson & Robinson, 1980). Because the web transmits both predatory and courtship signals, a spider must have the means of distinguishing between them (Foelix, 1992; Barth, 1985, 1986; Krafft, 1982): it would generally not be beneficial for a web-spider to react predaciously to a courtship signal, or to react amorously to a struggling fly. Clearly, the spider must have some way of distinguishing between these two different types of signals. Ideally, this method should be reliable (i.e. it must work close to 100% of the time),

robust (be unaffected by damage to the web or by adverse environmental conditions like high wind), and simple (so as not to put too great a computational strain on the spider’s simple nervous system). One suggested means by which female spiders distinguish between prey and conspecific signals is through the temporal patterning of the signals (Foelix, 1992; Leborgne, 1984; Robinson & Robinson, 1980). Male courtship vibratory signals typically occur at repetitive and regular intervals, whereas prey signals occur at sporadic and irregular intervals (Foelix, 1992; Krafft, 1982). If this difference in the temporal patterning of the signals is the key by which the female determines what is in its web, then this method meets all of the above listed criteria: it is simple (it does not require processing any information about the frequency of the signal), robust (would work equally well on a damaged or undamaged web), and reliable (relying on temporal patterning is almost fool-proof).

A male entering a web with the intent to mate must do more than avoid being eaten. Both the male and the female can be expected to behave in a way that would optimise the chances of their genes surviving into the next generation. Therefore, each individual can be expected to try to find the most suitable partner for its genes. Courtship signals may be a way of transmitting information about the fitness of the signaller to a potential mate. Courtship signals may therefore have two functions: preventing the male from being eaten, and providing information to a potential mate about the fitness of the signaller. Unfortunately, we know next to nothing about how the courtship vibrations of web-spiders serve either of these two functions, perhaps because it is difficult to record vibrational signals from webs accurately (Masters, 1984a, b; Barth, 1982). Most techniques for recording vibrations require either contacting the web with a recording stylus or placing in the web some other object (e.g. a magnet) whose displacements relative to an outside reference (e.g. a magnetic field) are then measured. Both of these techniques are, for many types of studies, inappropriate for recording from a spider web (Masters, 1984a, b; Masters & Markl, 1981; Masters *et al.*, 1986; Barth, 1982). There are two reasons for this. First, the web is an ultra-light structure; any recording technique that requires either contacting the web or putting something in the web would change its vibrational properties and thereby distort the signal being recorded (Masters *et al.*, 1986; Barth, 1982). Secondly, these types of methods require that the stylus or object in the web be moved by the vibrating web in order for the vibrations to be recorded. This means that the force of the web’s vibrations must be strong enough to overcome the resistance (i.e. inertia) of the stylus or recording object in order to be detected. Therefore, faint web-signals which are not strong enough to overcome the inertial resistance of the stylus or recording object will not be detected by these recording methods.

Laser Doppler vibrometry (LDV), a method of recording vibrations which uses the Doppler shift coming from laser light reflected off a vibrating object, is a non-contact method for recording signals (Buchhave, 1975). Because this technique does not require contact

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with the web, it does not distort the web vibrations being transmitted, and it is sensitive to amplitudes far below the threshold of other methods. Both of these advantages mean that LDV is the most accurate technique for recording web vibrations. LDV has been used before to measure web vibrations caused by prey entrapped in a web (Masters & Markl, 1981; Masters *et al.*, 1986; Masters, 1984a, b; Landolfi & Barth, 1996), but never to record courtship signals. This paper is the first that reports the courtship signals of a web-spider as recorded by LDV.

The web from which we chose to record is that of *Zygiella x-notata* (Clerck), a common orb-weaving spider in Europe. We chose *Zygiella* because its web has a geometry which makes it ideal for recording with LDV. *Zygiella* spins an ecribellate, vertically oriented orb (Fig. 1). Orb webs are essentially two-dimensional sheets of silk strung under high tension. Most orb-weaving spiders sit at the hub of their web waiting for prey. *Zygiella*, however, stays in a retreat off the web (Liesenfeld, 1956; Gerhardt, 1926). To monitor what occurs in the web, *Zygiella* attaches a signal line between its nest and the hub of the web, usually running the signal line through a sector of the orb free of silk (Fig. 1). When prey in the web is detected, *Zygiella* rushes down the signal thread to the hub and then to the prey (Liesenfeld, 1956; Gerhardt, 1926). Therefore, by focusing the LDV on this signal strand, one can eavesdrop on the same sensory channel the spider is using to monitor vibrations in its web.

In this study, we introduced a male *Zygiella* into a cage containing a virgin female *Zygiella* and her web. We then recorded the vibratory signals made by the male as he approached and mated with the female.

Methods

Females of *Zygiella* were caught on the University of Konstanz campus during April and May 1997 and kept in a controlled-environment laboratory (light-dark cycle, 12L:12D). Lights came on in the laboratory at 0800 h. Males were kindly provided by Dr Raymond Leborgne of the University of Nancy, France.

Female spiders were housed in cages measuring 30 × 30 × 30 cm. These were made of wood, with a removable perspex front and back. Six holes (diameter 10 mm), two on each side, were drilled through the middle of the sides and ceiling of each cage. These holes were used to drop prey into the cage when feeding the spider. When spiders were not being fed, these holes were plugged.

We only tested females which had built a complete web within the cage. Each test consisted of introducing a single male into a female's cage through the upper hole on the side of the cage opposite where the female had built its nest. Males were allowed to walk freely into the cage. Tests began when the male walked into the cage, and ended when either the male left the female's web after copulating or if the male failed to approach the female within 30 min after first contacting her web. We tested 3 separate pairs of males and females.

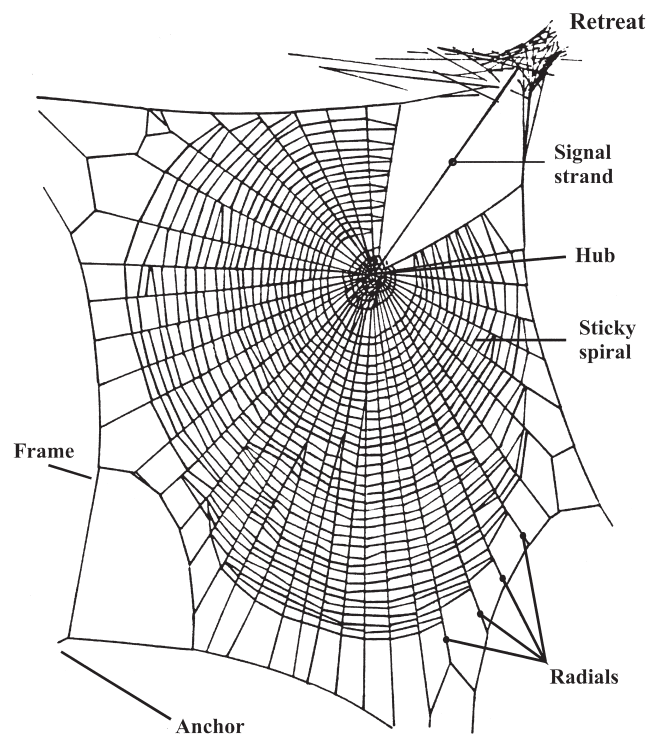


Fig. 1: Web of *Zygiella x-notata*, with the various components labelled (modified from Foelix, 1992).

We used a laser Doppler vibrometer (LDV) to measure web vibrations (Buchhave, 1975). Because the LDV measures the velocity of an object, not its displacement, the amplitudes in our results are presented as metres per second (peak to peak). [The abbreviation for metres per second (m/sec), a unit of velocity, should not be confused with the abbreviation for milliseconds (ms) a unit of time; both abbreviations are used in this paper.]

We also videotaped the spiders' behaviours. The vibrations measured by the laser were recorded simultaneously on DAT (digital/analogue tape) and on the soundtrack of the videotape. The DAT record was used for signal analysis, while the videotape soundtrack was used for synchronisation of the DAT with the video. In this way, we were able to correlate the behaviour of the spiders with their vibratory signals. A Cambridge Electronic Design (CED) A/D converter was used to translate the signal to a 586 computer, where it was sampled at 4,000 Hz and analysed using a Fast Fourier Transform (FFT) algorithm from a programme provided by CED. We measured a frequency range of between 0 and 2,000 Hz. The FFT finds the discrete spectrum of a signal, not a continuous spectrum; it therefore only finds the amplitudes of a spectrum at distinct frequency intervals (to calculate a continuous Fourier spectrum is computationally too difficult, and computer programs that calculate continuous spectra are not available). The frequency resolution of the algorithm provided by CED was 1.375 Hz; in other words, the algorithm calculated the amplitude of the signal at intervals of 1.375 Hz.

Temporal patterns to the signals (e.g. the duration of a signal and the time intervals between signals) were studied by examining the wave on a commercially available wave generating and analysis system ("Cool Edit"

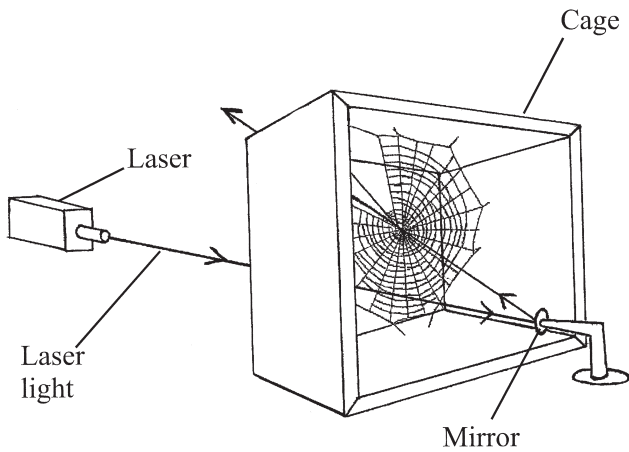


Fig. 2: The laser Doppler vibrometer set-up used to measure courtship vibrational signals in the web of *Zygiella*.

from Syntrillium Software, P.O. Box 62255, Phoenix, AZ 85082-2255, USA).

Stray ground-transmitted vibration was minimised by putting the cage containing the spider to be tested on a standard vibration-proof table. During the course of the study we found that, even within the course of a single recording session, there was a degree of variation in both the frequency and the amplitude of the signals produced. Therefore, we computed an “average spectrum” for each experiment. To do this, we first found the spectrum using the FFT algorithm for each signal recorded during an experiment. From these spectra, we then found the average amplitude of the signal at each frequency interval calculated by the FFT (i.e. every 1.375 Hz). From these average amplitudes, we constructed the average spectrum for the signals recorded during the experiment. Each spectrum presented in the results is an average spectrum, and the

number of signals (n) that went into each calculation is given alongside it.

Three basic types of web vibrations can be recorded from a web (Masters, 1984a): translational, or those which move within the plane of the web and perpendicular to the long axis of the silk; lateral, or those that move perpendicular (i.e. at 90°) to the plane of the web and also perpendicular to the long axis of the silk; and longitudinal, the compression waves that move along the long axis of the silk. Behavioural studies suggest that longitudinal vibrations are the most important type of vibration for the web-spider: they are transmitted through the web better than the other types of vibrations and the amplitude threshold needed for unleashing a spider’s predatory attack is lower for longitudinal vibrations than for the others (Klärner & Barth, 1982; Masters, 1984a, b). We therefore concentrated our study on longitudinal vibrations. Because all vibrations in the web are channelled to the retreat through the signal strand, we made all our recordings from the signal strand. To record the longitudinal vibrations of the signal strand, we positioned a mirror to reflect the light of the laser up at the hub of the web along a vector which was as near to parallel with the long axis of the signal strand as was possible (Fig. 2).

Results

Two of the males tested moved rapidly onto the web after being introduced into the cage. The third contacted the web, then retreated to the middle of the side of the cage opposite the female, and did not move from this position for the remainder of the test. In all three tests, when the male first contacted the web, the female quickly emerged from her retreat and assumed a posture

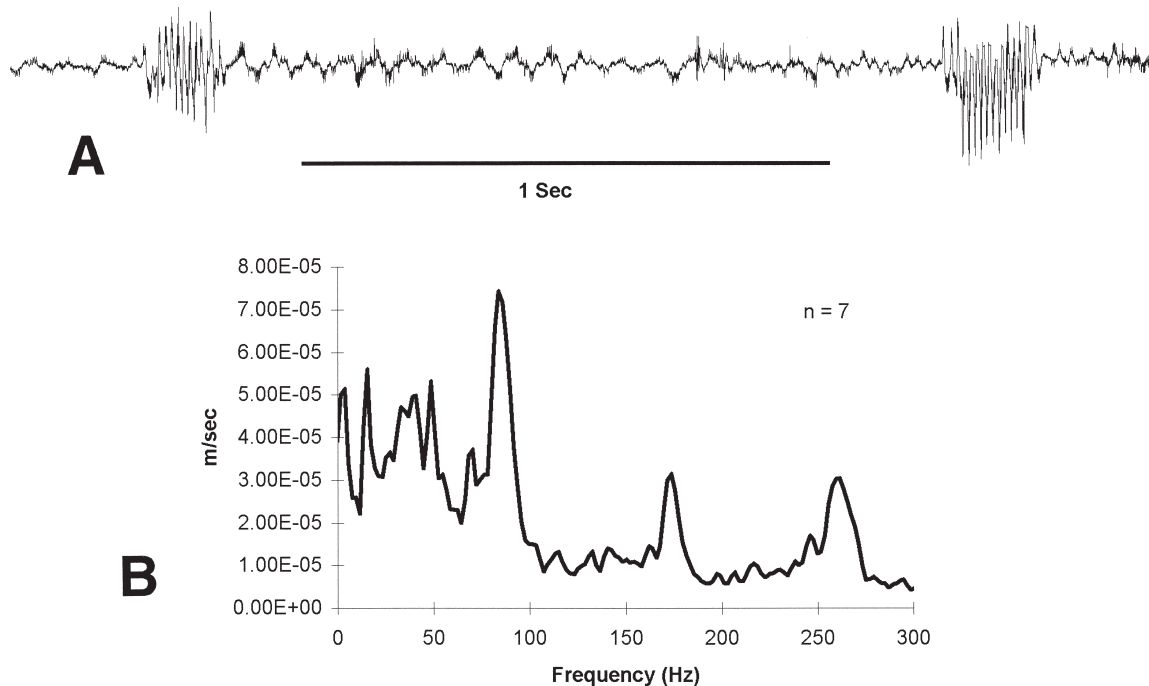


Fig. 3: **A** Waveform of *Zygiella*’s “burping” signal. **B** Average frequency spectrum of “burping” signal (n =number of signals recorded); “E” in numbers on the y-axis represents the logarithmic multiplier (i.e. $1.00\text{E}-05=1.0 \times 10^{-5}$); note harmonics at around 174 Hz and 261 Hz.

typical of when it first detects prey in its web (Liesenfeld, 1956; Tarsitano *et al.*, 2000).

Of the two males that entered the web, one ran immediately to the hub, then approached the female in her retreat along the signal strand. The second ran across the top of the web, at the junction between the upper support strands of the web and the top of the cage, until it reached the nest containing the female.

Both males paused occasionally while running towards the female. These pauses were momentary and occurred at irregular intervals. During pauses, a signal called “burping” (named for how the signal sounded on the LDV) was heard (Fig. 3). How the burping signal was generated could not be seen. The signal had an average duration of 196.8 ± 94.5 ms and its primary frequency was at 87 Hz but with harmonics at 174 Hz, 261 Hz, 348 Hz, and so on down to 696 Hz (the harmonics from 348 Hz to 696 Hz are not shown in Fig. 3).

On reaching the retreat, both males contacted the female by reaching up towards the female in her retreat with their first pair of legs. After contact, each male turned away from the female and attached a strand to the end of the retreat to which the signal strand was attached (Liesenfeld, 1956; Barth, 1982). The male then retreated 20–30 mm along the roof of the cage, trailing the strand it had attached to the signal strand behind it. The male then turned around to face the female. While retreating, the burping signal was heard again. During initial contact with the female and throughout the mating routine, both males were oriented with the dorsal side of their body pointed towards the bottom of the cage.

After turning to face the female, the male began signalling by either “pulling” or “plucking” on the courtship strand it had laid down while retreating from

the female. One male predominantly pulled, whereas the other predominantly plucked; only sporadically and very rarely did the pulling male pluck, and the plucking male pull.

Pulling consisted of the male grasping the courtship strand between its chelicerae and violently pulling on it, thereby rapidly running the strand between its chelicerae. Pulls occurred in bouts, the animal rapidly and repeatedly generating a series of pulls (Fig. 4). Sometimes a bout of pulls would be preceded by the male making a very large pull that shook the entire web, followed by a 2–3 s interval of silence before the next bout of pulling began. The number of pulls in a bout varied widely, ranging from 8–34 (mean = 17.3 ± 9.3 ; $n=11$ bouts). The duration of each signal generated by a pull was 127.7 ± 41.15 ms ($n=124$), and the time between each pull was 395.28 ± 95 ms ($n=113$). Females never pulled.

When plucking, the male held its legs close to its body. The signal was made by rapidly moving the first pair of legs anteriorly and posteriorly, each leg oscillating about 3–4 times per second. The duration of plucking was highly variable. The female also plucked, sometimes after the male began plucking, sometimes before. Unfortunately, we were not able to record the signals made by the plucking behaviour. This was most probably due to the position and weight of the male shifting the position of the signal strand from which the recordings were being made. This meant that the laser was no longer focused on the strand. Try as we might, we could not re-focus the laser and resume recording (adjusting the position of a web would have been impossible during an experiment without disturbing the animals).

Whether the male pulled or plucked, the female eventually left her retreat and approached the male, while oriented so that the underside of her abdomen was

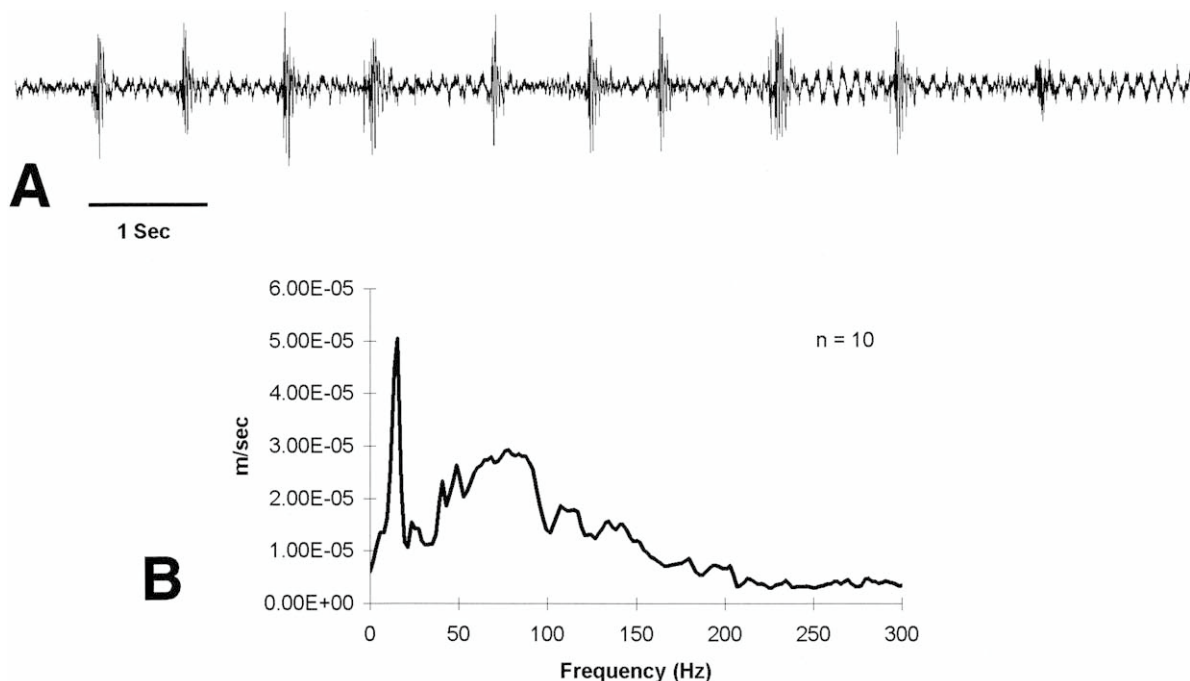


Fig. 4: **A** Waveform of *Zygiella*'s pre-copulatory pulling signal. **B** Average frequency spectrum of pulling signal (n =number of signals recorded); “E” in numbers on the y-axis represents the logarithmic multiplier (i.e. $1.00\text{E-}05=1.0 \times 10^{-5}$).

facing the male's palps. Copulation then took place. The copulatory behaviours were as described by Gerhardt (1926), Liesenfeld (1956) and Blanke (1984), and matched type 2 copulatory behaviour as described by Foelix (1992). Briefly summarised, the female and male, while mating, were both pointed towards the bottom of the cage (i.e. the anterior end of the cephalothorax was oriented downwards) with the female oriented so that the ventral side of her abdomen was directed towards the male's palps. Palps were inserted one at a time. Sometimes mating was preceded by the male repetitively lunging forward and momentarily touching the underside of the female's abdomen with the tip of his palp.

Upon dismounting, both males turned away from the female, walked 20–30 mm away along the top of the cage, then turned around again to face towards her retreat. Both females also turned around after mating and walked back into their retreat; they then turned around again to face outwards and placed one front leg on the signal strand. Eventually, the male would start signalling again, and a new copulation would ensue.

Although qualitatively similar, there were quantitative differences between the mating behaviours of the two males. Whereas the male which plucked almost always preceded each copulation with lunging, the male which pulled only rarely did so. Furthermore, the burping signal was often heard after the pulling male dismounted and retreated, whereas it was not heard when the plucking male dismounted and retreated (however, this difference could be an artefact: the same problem that prevented us from recording this male's plucking behaviour (see above) could have prevented us from recording other signals it made when dismounting).

These behavioural differences were also reflected in the length of time each male spent with a palp inserted. The total duration of courtship differed between the two spiders, the male which pulled courting for over 120 minutes before retreating from the female's web, whereas the male which plucked courted for only 35 minutes. Also, the total amount of time each male spent with a palp inserted was different, the male which pulled copulating for a total of 415 s (approximately 6% of the time), while the male which plucked copulated for only 151 s (approximately 7% of the time). Furthermore, the mean duration of each insertion was different for both males, the male which pulled inserting on average for 37.7 ± 17.7 s ($n=11$ insertions), whereas the male which plucked inserted on average for only 12.6 ± 2.5 s ($n=12$ insertions) (Mann–Whitney U-test, $n=23$, $U=3.97$, $p<0.001$). Finally, the average time between insertions was also significantly different between the two males, being 327 ± 284 s for the male which pulled, but only 119 ± 76 s for the male which plucked (Mann–Whitney U-test, $U=2.324$, $p<0.05$).

Discussion

The courtship behaviour of the *Zygiella* tested followed a basic pattern which was very similar to those observed by Gerhardt (1926) and Liesenfeld (1956).

Here we relate the spiders' behaviour to the vibratory signals being transmitted.

Both males entered the cage and found their way across the web to the female, one by running down to the hub and up along the signal strand, the other by running along the top of the web where it was anchored to the roof of the cage. The males paused occasionally while running towards the female, and burping sounds were heard during these pauses. No behaviour was seen to generate burping, and no earlier accounts of the mating of *Zygiella* mention any behaviours that could generate the burps (Liesenfeld, 1956; Gerhardt, 1926), but a large amount of circumstantial evidence suggests that it was generated by the male. First, burping was heard only when a male first entered a female's web and approached the female. Many different types of signals have been recorded in *Zygiella* webs with an LDV (Tarsitano *et al.*, 2000), and not once has a similar type of signal been recorded elsewhere, the burping signal being unusual in that it contains strong harmonics. Secondly, the burping signal coincided with the pauses made by the male while approaching the female, as if each male was pausing in order to burp. Thirdly, in all three tests, the immediate reaction by the female to the male contacting her web was to rush out of her retreat as if the male were prey. However, once the burping signal was made, the female halted her attack. The simplest interpretation of these results is that the burping signal was made by the male, and that this signal served to prevent the female from attacking the male as he approached the female across her web.

Once at the female's nest, the males' mating behaviours took on a cyclic pattern of (1) pre-copulatory signalling, (2) copulating, (3) dismounting, (4) retreating, and (5) repeating the cycle by beginning with the pre-copulatory signalling again. However, there were clear differences in the mating behaviour between the two spiders. One male predominantly used a "pulling" pre-copulatory signalling behaviour, the other a "plucking" behaviour. This difference in each male's signalling behaviour was reflected in other differences in their copulatory behaviour. The plucking male often lunged towards the female and touched the underside of her abdomen with his palps before copulating; the pulling male, however, only rarely did so. Also, although the plucking male copulated for shorter periods of time than the pulling male, the amount of time each male spent copulating as a proportion of the total courtship duration was approximately the same. The total amount of time the pulling male spent copulating was almost three times as long as that spent by the plucking male, and the mean duration of each insertion by the pulling male was about 3 times as long as that of the plucking male.

As mentioned in the introduction, a male entering a female's web with the intention of mating must first signal its presence to the female so as to avoid being mistaken for prey. It would seem that the male would be most at risk of being mistaken for prey while he is walking across the female's web towards her. It has been proposed that the regular rhythm of the male mating signal is a cue by which a female spider might determine

that a male conspecific, and not a prey item, has entered her web (Foelix, 1992; Robinson & Robinson, 1980). The only signal which we recorded which had such a rhythmic temporal pattern was the pulling signal. Yet the male only began generating the pulling signal after he had walked across the web; in other words, after he had passed through the most dangerous part of the courtship. Therefore, it seems unlikely that the principal function of the rhythmic pulling signal is to inhibit a predatory attack by the female.

The burping signal, if it was made by the male, is a more likely candidate for identifying the male and thereby inhibiting the female's attack. First, burping was heard when the males first entered the web and approached the female. In all three tests, the immediate reaction by the female to the male contacting the web was to rush out of her retreat as if the male were prey. However, the burping signal seemed to quieten the female. Another reason for supposing that the burping signal was the cue for the female not to attack was the uniqueness of its frequency spectrum. The burping signal had harmonics, and no other signal ever recorded in *Zygiella* webs has such a characteristic (Tarsitano *et al.*, 2000). Because of this unique characteristic, burping could serve to inform the female that what is now in its web is of special importance for the female and should not be attacked.

The rhythmic pulling signal, on the other hand, was used only immediately before mating took place, and the female responded to the pulling signal by emerging from her nest and mating with the male. The pulling behaviour may serve to persuade the female to mate with the courting male and may possibly contain information about the male's status (health, age, weight, etc.) that could influence the female's decision whether or not to mate with him. However, pulling was not the only pre-copulatory signalling behaviour seen. There was also plucking, which we were unable to record. Interestingly, whereas one male predominantly used pulling as its pre-copulatory signal, the other male used plucking. This difference in the type of pre-copulatory signal was reflected in other differences in their copulatory behaviours (as mentioned above). These differences were very pronounced and, while a sample size of two is certainly not large enough to draw any conclusions, the fact that such a large variation was seen after testing only two males suggests that there is considerable variation in the courtship behaviour of the species. Other spider species have large variations in their courtship signalling behaviours (Krafft, 1982; Robinson & Robinson, 1980), and this variation may play a part in their complex mating conditional strategies. However, what information is contained in a courtship signal and how this information, combined with other factors (such as whether a female is a virgin), influences the spiders' mating tactics, has not yet been explored. The most probable reason this has not been done is the lack of a means to examine a signal with enough accuracy to answer such questions. Although *Zygiella*'s courtship behaviours have been recorded before (Liesenfeld, 1956; Gerhardt, 1926), this

paper is the first study in which its courtship signals (or any other web-spider courtship signal) have been recorded using the ultra-sensitive laser Doppler vibrometer. Since the LDV allows one to record and analyse these signals with a high degree of accuracy, it should now be possible to develop a better understanding of the information content of web-spider vibratory courtship signals.

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***Clubiona pseudoneglecta* Wunderlich, 1994, a clubionid spider new to Britain (Araneae: Clubionidae)**

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Summary

The clubionid spider *Clubiona pseudoneglecta* Wunderlich, 1994 is described and illustrated as new to Britain. Comparative drawings of *C. neglecta* O. P.-Cambridge, 1862 are also provided.

Introduction

While checking records of spiders found in the Channel Islands for the revised check list of British spiders (Merrett & Murphy, 2000), I asked the collector if I could see a specimen of *Clubiona similis* L. Koch, which had been recorded from Jersey by Williams (1980), expecting that it would probably be *C. frisia* Wunderlich & Schütt, 1995. In fact the specimen, a female collected at St. Ouen's Pond on 15 June 1979, proved to be *C. pseudoneglecta* Wunderlich, 1994. Five further females from the same locality, collected on 12 September 1979 and recorded by Williams (1980) as *C. neglecta* O. P.-Cambridge, were also found to be *C. pseudoneglecta* (S. A. Williams, pers. comm.). I therefore decided to check specimens in my own collection which had been identified as *C. neglecta*, and found that I had four females of *C. pseudoneglecta* which had been collected on Tresco, Isles of Scilly, in July 1959. All my specimens from mainland Britain proved to be *C. neglecta*. Subsequently, John Murphy checked the specimens of "neglecta" in his collection, and found that all his British material was *neglecta* but that he had two females of *pseudoneglecta* from southern France and one male from northern Greece. Both sexes of *C. pseudoneglecta* have also been found among material from Sandwich, Kent, collected in 1975 and misidentified as *C. neglecta* (S. A. Williams, pers. comm.).

The species is described here as new to Britain, based mainly on the females from Scilly and on the male from Greece, which was virtually identical with the British male. Comparative drawings of *C. neglecta* are

provided from specimens from southern England. All measurements are in mm.

Description

***Clubiona pseudoneglecta* Wunderlich, 1994** (Figs. 1–3, 7–9)

Clubiona pseudoneglecta Wunderlich, 1994: 157, figs. 1–3 (descr. ♀); Roberts, 1998: 135, figs. (♀♂).

Material examined: GREAT BRITAIN: Isles of Scilly, Tresco, 4♀, July 1959, leg. & coll. P. Merrett; Kent, Sandwich, on sand at roots of grass, 2♀ 1♂, 24 June 1975, leg. & coll. S. A. Williams; Jersey, St. Ouen's Pond, 1♀, 15 June 1979 (sub *C. similis*), 5♀, 12 September 1979 (sub *C. neglecta*), leg. & coll. S. A. Williams. FRANCE: Lot-et-Garonne, Boudy, 150 m, scrub, oak woods, 2♀, 7 August 1985, leg. & coll. J. & F. Murphy 13161. GREECE: Halkidiki, Gerakina, reed beds and grubbing near hotel, 1♂, 19 April 1978, leg. & coll. J. & F. Murphy 3481.

Comparative material: *C. neglecta*: GREAT BRITAIN: Devon, Slapton, 1♀, 1974, coll. P. Merrett; Dorset, Durlston, limestone grassland, 1♂, June 1974, leg. & coll. P. Merrett; Cornwall, St. Just, 1♂, May 1961, leg. & coll. P. Merrett; Surrey, Warlingham, chalk grassland, 1♂, 23 June 1958, leg. & coll. P. Merrett.

Female: Total length 5.3–6.8. Carapace length 2.1–2.8, width 1.5–2.0. General appearance, coloration, and leg spination similar to *C. neglecta*. Chelicera length 0.9–1.35, ratio chelicera length/carapace length 0.43–0.5. Patella+tibia I length 1.75–2.6, ratio patella+tibia I length/carapace length 0.8–1.0. Epigyne and vulva (Figs. 1–2): close to *C. neglecta*, for differences see Diagnosis.

Male: Total length 5.3–5.5. Carapace length 2.4–2.5, width 1.7. General appearance, coloration, and leg spination similar to *C. neglecta*. Chelicera (Fig. 3): length 1.65–1.7, robust, with long fang, ratio chelicera length/carapace length 0.68–0.69. Legs long, patella+tibia I length 2.65–2.8, ratio patella+tibia I length/carapace length 1.10–1.12. Palp (Figs. 7–9): close to *C. neglecta*, for differences see Diagnosis. The palp of the Greek specimen was virtually identical to that from Sandwich.

Diagnosis: The structure of the epigyne and vulva is similar to that of *C. neglecta*, but there are a number of