THE STATUS OF *DOLOMEDES PLANTARIUS* ON REDGRAVE AND LOPHAM FENS 1991

PAST HISTORY

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It was some years before a fall in the water table was noticed. In 1968 the Nature Conservancy wrote to the Water Authority complaining about water loss and at about the same time a group of us, with the warden, dug out some of the original Redgrave Fen pools with spades, in order to deepen them and allow sunlight to reach the water surface. Later on, many more pools were clearly becoming overgrown, as water levels fell, and a grant was obtained from the World Wildlife Fund in 1977 to construct the machine-dug pools later crossed by the Boardwalk. By the middle 1970s it was clear that the

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original pools formed by peat cuttings were all becoming overgrown due to low water levels in the late summer and that the raft spider was becoming very localised. To some extent this was ameliorated by the formation of new pools when bushes and their roots were removed, creating depressions, and by wet winters which filled up the holes. Nevertheless, from this point onwards it was becoming a losing battle against the falling water table and at that time there were no convincing data available to persuade the Water Authority that their borehole was to blame.

The three years 1974-1976 were all hot and dry in the summer and I remember looking for the spider in 1976 but failing to find it, and wondered whether it had then become extinct. However, in the following wet years it revived and from then on until the dry years of the late 1980s up to 1991 the numbers fluctuated in relation to the wetness or dryness of the weather, although the general trend appeared to be one of population contraction and decline in numbers. The extensive piezometer readings of the water table levels which were taken in the 1980s by the Suffolk Wildlife Trust, and the dramatic increase in water table when the borehole was switched off, eventually convinced the Water Authority that water extraction through the borehole was the reason why the fen was drying out.

AIMS, OBJECTIVES AND METHODS OF THE 1991 SURVEY

In late April 1991 the only pools with a reasonable depth of water were those in Middle Fen which had been dug by machine in 1986 and a number in Little Fen which had been dug in 1988. Nevertheless the pools were not full. The Boardwalk pools still retained some water but were becoming very overgrown and some were heavily stained by iron salts from the substrate. No *Dolomedes* have been found on these pools for several years. The observations made in 1990 indicated that a few *Dolomedes* still remained in Little and Middle Fens, and it was decided to select all the worthwhile pools for survey in 1991.

The selection of pools was entirely subjective, the criteria being: a good depth of water; the pool should not be shaded by tall vegetation around the side, but retain sufficient cover for *Dolomedes*, which tend to hunt along the margins of the water; the water should be clean and not stained by the oily secretions and other chemicals which are released by the breakdown of vegetation and which seep into the water from the substrate. These subjective criteria were based on previous experience with this species both in Britain and abroad, and also from the research of Pierre Bonnet (1930). Bonnet studied this species in France for many years and was convinced that good water quality was essential for it to breed successfully.

Twenty-nine pools were selected in Middle Fen and 28 in Little Fen. The other pools in these two parts of the

fen were rejected for various reasons, although we later found that water quality in some improved during the wet month of June. The rejected pools were examined from time to time in both Little and Middle Fens, although not on a regular basis, but no *Dolomedes* were recorded on them. Each of the selected pools was marked with a cane which was pushed through the peat to the sand underneath. The water level was marked on 19May so that we could trace the fall in level throughout the summer. Observations should have started a month earlier but the contract was not awarded until May.

From mid May to mid August the fen was visited two days each week and recordings made. The objectives were (1) to examine the margins and surface of the pools and record all the *Dolomedes* seen. Each spider location was plotted on a sketch map of the pool together with sex or immature stage. In some instances it was necessary to catch specimens with a net in order to assess whether they were adult or not. After a minute or two they were returned to where they were caught.

(2) to record the colour pattern of the spiders, that is whether they were banded or unbanded and any peculiarities about the pattern such as spots on the abdomen and darkness or lightness of the general background colour, which occurred in some instances..

(3) to assign immature specimens to the following size categories: juvenile, up to 5 mm body length; third-grown, 5-8 mm; half-grown, 8-12 mm; three-quarters grown, of if a male possibly adult, 12-15 mm; over 15 mm, adult, males were usually adult but females not usually until

20-22 mm. These estimates were made by eye.

(4) The fall in water table below the level of 19 May was recorded in centimetres.

(5) Notes were made on the clarity of the water, presence of oily film, debris and whether aquatic macrophytes were present. These plants are i*mportant as hiding places for Dolomedes.*

The weekly visits to the numbered pools meant that there was a certain degree of trampling around the edges. This was kept to a minimum.

WATER LEVELS

Middle Fen

In Middle Fen the water levels had fallen between 5 and 6 cm at the beginning of June, 16 days after the systematic recording began. June was a relatively wet month so that by 26 June the water levels were only 1-2 cm below that at the beginning of the month. By 3 July the fall in level was accelerating, being 7-8 cm below the original. On 10 July a further 2 cm had been lost and by 24 July the levels were down by 24-25 cm. By 5 August, when a flow of water from irrigation pipes was directed onto 18 of the 29 Middle Fen pools, the water table had fallen between 20 and 30 cm. On 21 August water levels were very variable as some pools received more irrigation water than others. Irrigated pools varied between 5 and 30 cm below the original level but those without irrigation water were reduced to muddy pools with exposed marginal areas. On 21 August, after 16 days of irrigation, the impression was that water loss exceeded the inflow.

Little Fen

As it is nearer to the borehole, the effect of water loss on Little Fen was greater and took place earlier. By the beginning of June the levels had fallen between 7 and 8 cm in those pools nearest to the borehole site. Pools nos. 1-11, furthest from the borehole site, showed a smaller fall, varying from 4 to 7 cm. Again the wet season in June helped to maintain the water levels at roughly 6 cm below the original. By 4 July, however, the level was falling quite rapidly and varied from 10 to 13

cm below the original. On 11 July Pools 1 and 2 of Little Fen had dried out. The remainder varied in water loss from 11 to 25 cm. By 25 July the situation was really quite bad in Little Fen. Pools 1 and 2 were still dry, Pool 3 had only 8 cm of water and the cane was fully exposed. The remainder of the pools had lost between 15 and 29 cm of water and the majority of them were dirty, oily, cloudy and looked in very poor condition. With only a few centimetres of water in the bottom of the pool, the exposed margins are bare with no cover for the raft spider, although to some extent the floating debris provides a certain amount of cover. On 5 August 26 out of the 28 pools (i.e. nos. 3-28) were receiving some irrigation water and there was a considerable improvement in water level. The water depth increased in a number of pools from a few centimetres to between 8 and 35 cm. This level was maintained on 21 August, although the two pools receiving no irrigation water were as dry as they had been earlier in the season. Nevertheless the general levels of the pools had fallen by about 6 cm compared with the levels recorded on 8 August.

The irrigation water in both Little and Middle Fens came too late to make any real difference because the breeding season was virtually over, the population of adult spiders being so few small, but it may have made some difference to the survival of juveniles up to the point when they went into hibernation in the autumn.

Redgrave Fen

Two visits were made to Redgrave Fen while conducting our survey but this area is now so overgrown

and difficult to walk through that no suitable pools were found. The original pools where I found the spider in 1956 and which were deepened in 1968 were completely dry and overgrown with thick vegetation. There is no firm record of *Dolomedes plantarius* being seen in Redgrave Fen since 1977.

Water chemistry

Water samples were taken by Mr Paul Dolman on 16 July and on 28 August and analysed for pH, dissolved oxygen, biological oxygen demand (BOD), soluble reactive phosphorus (SRP), and total phosphorus. On the second date he could not take samples in some of the pools because they were already dry, and in others there was so little water that contamination with organic matter falsified the results. A copy of his full report is attached as Appendix 1.

In addition to the pools in Little Fen and Middle Fen, Mr Dolman took water samples from Worby's Drain and from the River Waveney and the Boardwalk spider pits. There were no clear differences in water chemistry between Middle and Little Fens. However, a number of pools had very low pHs and this was illustrated in Middle Fen, where Pools 21-28 had an average pH of 3.8, whereas Pools 1-20 had an average pH of 6.31. Only one adult spider was recorded on the lower pH pools. On Little Fen there were six pools with a pH of 4 or lower but this did not appear to inhibit the spiders, as 5 of the 29 adults

were recorded on them. The irrigation water in August reduced the level of total phosphorus and increased the pH. The water quality of the River Waveney appears to be reasonable, although it deteriorates further downstream. The water chemistry of the spider pits along the Boardwalk did not differ significantly from the values found in Middle and Little Fens, so some other reason must be found for the absence of the spiders there. Worby's Drain, on the other hand, showed clear evidence of contamination by heavy inputs of phosphorus with a high BOD and low levels of dissolved oxygen.

In conclusion I think the sampling exercise was well worth while because it seems to indicate that, at least on this reserve, water quality is not necessarily the most important factor determining whether the raft spider will survive and breed successfully.

THE POPULATION

In assessing the population of *Dolomedes plantarius* on the reserve, we had no means of checking the efficiency of our method of searching. On approaching each pool we first looked carefully over the water surface using close-focussing binoculars and recording any specimens which we saw by this means. We then walked round the pool and carefully searched the marginal vegetation with the minimum of disturbance. We used a leaf-rake on which the tines had been straightened to hold back the vegetation so that we could see the water by the margins of the pool more clearly. The aquatic vegetation in the middle of the pool was also carefully disturbed in case raft spiders were hiding there. Adult spiders sometimes dive very quickly when disturbed before they can be seen. However, the slight sound of the spider diving is indication of its presence. It is less common for the smaller immature stages to dive although this may also happen. In cold weather, as for instance during May, the spiders tended to be immobile and no attempt was made to dive.

In assessing the total numbers we added together the highest number of adults and immatures recorded on each pool throughout the season and then summed the totals. **Little Fen recorded 14 adult females and 15 males and 24 immature stages. Middle Fen recorded 6 females and 6 males and 62 immature stages.** These figures assume that there was no interchange between the pools and therefore no double counting. Kennet (1985) marked over 200 raft spiders with paint and found that about 5% moved to

adjacent pools during the recording period. All those which moved were immature. The first three weekly surveys in May recorded only well-grown immature and subadult specimens. All these were assumed to have become adult, if they survived, and so have not been included in the population total, which includes only adults and the young which originated from the breeding of those adults.

In Middle Fen a total of 12 immature and subadult specimens were recorded in May and a total of 12 adults throughout the rest of the season. However, in Little Fen 17 immature and subadult specimens were recorded in May but later a total of 29 adults were seen. Of the 12 additions, 5 appeared on pools which already had a raft spider and 7 on pools for which no specimen had been recorded earlier in the year.It is possible that some of these 12 immature spiders were overlooked during the early pool surveys because of the very cold weather in May, which inhibited any activity. Some may also have originally been on unrecorded pools which held water during the early part of the season but which moved elsewhere as adults when the pools dried out.

Males mature first and on the 29 May one male was recorded in Middle Fen and one in Little Fen. By 6 June there were both adult males and females, though some of the females were still subadult. By 14 June the first juveniles of the year appeared in Middle Fen but juveniles were not seen in Little Fen until 26 June. By 21 August only 1 adult, a female with an egg-sac, was recorded in Middle Fen, and 2 females in Little Fen on

the same date, one with an egg-sac and the other without. This is a relatively short season, no doubt due to the fact that the population was so low. At the Pevensey Levels females with egg-sacs were still being recorded at the end of September, and Bonnet in southern France reported that the breeding season extends until well into October.

Totals of immature stages recorded on different dates

	Little Fen	Middle Fen
July 3/4	6	27
" 10/11	13	37
" 24/25	14	30
Aug. 7/8	15	44
" 21/22	7	40

Although there were fewer adults in Middle Fen compared with Little Fen, the number of juveniles recorded was considerably higher - a total of only 24 immatures in Little Fen and 62 in Middle Fen. The reason for this may be linked with the ability of Middle Fen to retain a good depth of water for a longer period than Little Fen. In addition the Middle Fen pools were generally deeper than those on Little Fen.

Low water levels or absence of water may affect the breeding population and young in different ways (see section on Habitat Requirements). The females may abandon

the egg-sac and there may be a higher mortality of young. Females are said to produce an average of 3 egg-sacs under optimum conditions (Bonnet 1930) but this might be reduced in unfavourable environments. Another possibility is that absence of water or poor-quality water, for example very low pH values, may reduce food availability resulting in poor survival of both adults and immature stages.

Of the 6 females recorded in Middle Fen only 3, and of the 14 females in Little Fen only 5, were seen with egg-sacs. However, females recorded without egg-sacs may have already reared one brood and be developing eggs for the next. We cannot make any estimate of the egg-sacs actually produced by the total number of adult females. Nevertheless, there seems no doubt that the breeding success in Little Fen was much inferior to that in Middle Fen.

Predators

We have no field data on the predators of the raft spider. Potential predators are shrews which are known to be very fond of spiders, frogs which are very common in the pools, and other spiders. The most likely candidate is *Pirata piscatorius*, the largest of the British *Pirata* species. This spider also lives on the water surface and although not as large as the raft spider may well prey on the young stages.

Colour varieties

Although the typical raft spider is brown with two white

or cream bands down the sides of the body, some specimens are entirely brown without any bands. We found a considerable difference between Little Fen and Middle Fen. Of the combined total of 53 adults and immature stages in Little Fen, 12 were recorded as unbanded - 22.6%. In Middle Fen, where a total of 74 adults and immature stages were recorded, only 3 were unbanded - 4.0%. Combining the totals of the pools in Little and Middle Fens (53+74=127), the mean proportion of unbanded spiders was 11.8%.

The unbanded colour morph of *Dolomedes plantarius* seems to be a characteristic of the species. It was recognised by Bonnet as a reliable method of distinguishing *Dolomedes plantarius* from *D. fimbriatus* - there is no record in the literature of specimens of the latter being seen without pale bands. There is some variation in *D. fimbriatus*, however, as Bonnet (1930) illustrates a specimen with pale bands on the cephalothorax but not on the abdomen. Pevensey Levels seems to have an even higher proportion of unbanded specimens than Little Fen but no extensive count has yet been made.

THE HABITAT REQUIREMENTS FOR *DOLOMEDES PLANTARIUS*

The raft spider is a sun-loving animal, even though it requires cover when hunting and to avoid predators. It is far more active on warm sunny days. It avoids pools which are shaded and this has been shown dramatically in the past when a series of pools in a bush-covered part of the fen were cleared of woody growth and in the following season *Dolomedes* soon colonised the area. Shading can also be produced by the vigorous growth of vegetation, particularly reed and some tall grasses which are able to invade the pools with shallow water or which have dried out.

Dolomedes needs to drink regularly and soon dies if deprived of water. Bonnet found that the spiders lived only 2-5 days if kept in a container without water. If given as much prey as they can eat the body juices are insufficient to sustain them and they survive only from 11 to 15 days, so that the presence of water throughout their life is essential. The same is true for the female's egg-sac, which she keeps moist and cool by frequently immersing it. Bonnet found that if females with egg-sacs were kept in containers without water they abandoned the eggs after two or three days and soon died. If they were kept in a muslin bag suspended over water in a container they still died after a few days because they were unable to drink although very close to the water surface. This emphasizes the need for the raft spider to have water available throughout the breeding season. The first young hatched in the early summer grow to a large

size by the autumn but do not become adult and there is no record of an adult raft spider overwintering to the following year. Young that are born late in the summer will still be quite small by the time they go into hibernation and may mature later in the following year. Bonnet claims that no *Dolomedes* live longer than 14-16 months. When the eggs are ready to hatch the female climbs up into the vegetation, perhaps only a few centimetres but sometimes as much as 30 or more cm, spins a dome-shaped nursery web in which the egg-sac is suspended. She stays with the eggs until they hatch and remains with the young for several days before returning to the water to feed and produce another egg-sac.

When the young hatch they cluster together in a tight bunch and may remain like this for only 3-4 days. However, the young of one egg-sac at Pevensey Levels which was recorded as hatching on 28 September remained in a tight bunch without dispersing for 25 days. When they did disperse they moved downwards to the water and not higher into the vegetation, as has sometimes been supposed in order to disperse aerially. **No nursery webs were found in 1991 on Redgrave/Lopham Fens**, although we searched for them frequently. This may be because the vegetation there has become very thick and they are impossible to find. At Pevensey Level, where the spider occurs in dykes and the marginal vegetation is sometimes quite low due to grazing and trampling, the nursery webs and egg-sacs or young could be found with great ease and provided a very useful method of assessing the abundance of the spider in different dyke systems.

CONCLUSIONS AND PROPOSALS FOR FUTURE MANAGEMENT

The population of the raft spider at Redgrave and Lopham Fens has contracted to the smallest area and the lowest numbers that have been previously recorded by systematic surveys. Its status is obviously considerably endangered and urgent measures are required to safeguard the population in the future. Although the second population at Pevensey Levels is flourishing, it seems likely that both the Redgrave/Lopham Fen and Pevensey Levels populations have been separated for a considerable period of time and we need to know whether there are differences between them. Perhaps an even more important point is that the raft spider at Redgrave/Lopham is an indicator of what has been happening to the once very rich flora and fauna there and that all the other wildlife characteristic of wetlands has declined as well as the raft spider.

Proposals for future management

(1) The water quality measurements gave inconclusive results but it is possible that some other factor, not measured, may influence the attractiveness of pools to the raft spider, especially whether it is able to breed successfully and the young to thrive.

Before the borehole was constructed spring water permeated through the surface peat so that there was a constant renewal of pool water. Today this does not happen during the summer because the water table is too low. Consequently pool water becomes stagnant as levels fall and plant decomposition products accumulate. An oily film forms on the surface and the water may become discoloured with the accumulation or iron hydroxides. The pH also falls; values of less than 3 were recorded in several pools.

The only solution to this problem is for the borehole to cease to function. This must be the main priority and is urgent not only for the raft spider but for many other plants and animals characteristic of this type of wetland.

(2) Although it appears that irrigation was originally intended to be made available only in the summer, I think it is essential to continue to supply water to the pools for as long as possible. Irrigation is not possible during frosty weather because the pipes are on the surface, as is the pump. In general, the pools fill up or partly fill in the winter as evapotranspiration is very

low. However, a dry winter could result in relatively low water levels in spring, as was the case in 1991. The wet June postponed serious water loss by a month but by the middle of July some pools had already lost standing water.

(3) The rapid fall in water levels throughout the summer has several undesirable side effects. The drier surface peat enables bushes to spread, placing additional burdens on the fen staff to remove them. Reed invades the shallow water of the pools and by shading and inhibiting the growth of aquatic macrophytes creates unfavourable conditions for the raft spider. The exposed pool margins provide no cover for the spider and when this effect is prolonged dense fen grasses as well as reed colonise these areas so that even if a satisfactory water level is restored the environment is still unsuitable.

This type of succession is probably responsible for the absence of the raft spider from the Boardwalk spider pits as well as elsewhere on the reserve. An annual winter programme of pool restoration is needed as follows:

(a) Clean the bottom of selected pools by removing reed rhizomes and accumulated plant debris. This should be done by hand so that desirable aquatics such as *Potamogeton* species are not completely removed. If some are left they will soon reolonise.

(b) Overgrown pool margins should have the vegetation selectively removed. This needs care as

adequate cover should be retained. It would also help to open up the pools to sunshine by cutting the ground surface vegetation around them to reduce the height to about half a metre. Trampling around the peat margin to the pools when the vegetation is thinned is probably an advantage in that it creates variation in the peat surface morphology just as grazing and trampling by cattle at Pevensey Levels appears to enhance the raft spider habitat.

(c) Pools treated as above should be the 57 which were surveyed in 1991. Further deepening of the pools is not possible as they are already close to the underlying sand.

(4) A programme of monitoring the spider population on the 1991 pools should be carried out each year until the borehole is removed and the previous water table is restored. Water loss, water quality and condition of the pools (vegetation change, etc.) should also be monitored. New pools will be required once the natural water table is restored because the original peat cuttings are so overgrown. This should be written into the programme at an early stage and monitoring of the populations continued.

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6 December 1991