The caddisfly (Trichoptera) *Synagapetus dubitans* McLachlan, 1879

A study on its identification with information on habitat and known distribution in the North Yorkshire area of Great Britain from 2010 to 2019

By Stuart M Crofts

Contents

Acknowledgments

You do not work on a project for the best part of ten years without the help of a lot of other people and I would like to start by thanking the many landowners and private estates that have allowed me free access to their lands and search for caddisflies. Then there are the other esteemed entomologists that have helped and encouraged me along the way. In particular I would like to thank Dr Peter Wiberg-Larsen and Dr Peter Barnard for helping to confirm the identification of initial samples. Dr Johann Waringer and Aki Rinne for the extra literature to help kick start my hunt for information. Dr Ian Wallace, Craig Macadam and Richard Chadd for their valued support and ideas on how to progress further studies on the habits and distribution of the species in Britain. Last, but not least, my good friend Andrew Dixon who has helped with some of the surveys but more importantly for listening to some of my crazy ideas, philosophies, and all the daft questions without laughing.

The caddisfly (Trichoptera) *Synagapetus dubitans* McLachlan, 1879

A study on its identification with information on habitat and known distribution in the North Yorkshire area of Great Britain from 2010 to 2019

Background

Synagapetus dubitans is a caddisfly (Trichoptera) species from the family Glossosomatidae and part of the genus Synagapetus. The species had been recorded in a number of central European countries including France, Switzerland, Belgium and Italy but not from Britain. However, on the 4th of September 2010, I collected a single adult male from a small calcareous spring stream flowing through a wood near Masham in the county of North Yorkshire. On a return trip, on the 28th of October, I found a female at almost exactly the same place. Since those initial findings of 2010 and through until the end of 2019 I have continued to study this insect species to try and learn more of its distribution here in Yorkshire, the habitat where it is found and its identification. On the question of identification I wanted to understand the larval stage (except the tiny very early instar stages which are still unknown to me), the pupa stage and the adult stage (both males and females).

This report is a summary of the things I have found and some questions that have arisen. But, it is very important to stress that this is not a peer-reviewed study or report. These are my own findings and deductions and I am sure other people might have other, perhaps more scholarly views, on some of them. In short this is the work of an amateur and not a professor. Nonetheless, I do hope it is of interest and may even stimulate more study and research on this fascinating little caddisfly.

Stuart M Crofts
Penistone, January 2021

Introduction

The finding of this caddisfly was a total surprise, not at all planned and just plain lucky! It started as just another day doing my work as a Fly-Fishing Guide. I met my clients in the wonderful market town of Masham, within the county of North Yorkshire, on a fine September day in 2010. We were to be fishing the nearby River Ure for trout and grayling. While doing this kind of work I always have a small folding sweep net in my pocket to catch insects. I do this for two reasons; one is to show my clients the wonder of insects. And two, to catch adult caddisflies for the Adult Caddisfly Occurrence Scheme that I coordinate here in the UK. During the afternoon I happened to be walking past a tiny woodland stream and I ran my small pocket net through the plants alongside, just to see what was there. The net immediately caught in a brier and tangled! After a few minutes of carefully untangling the delicate mesh from the evil brier I noticed two small adult caddisflies still miraculously in the bottom of the net. I recognised one of the caddis as *Crunoecia irrorata,* a common species in small streams in that area. The other I just assumed to be another common species called *Agapetus fuscipes*. However, you never take these things for granted so I popped them into a collecting tube for proper investigation on my return home.

Back at home the *Crunoecia irrorata* was soon confirmed and added to my records. But, as I checked the suspected *Agapetus fuscipes* down the microscope my hands started to shake as it dawned on me that it was not *Agapetus fuscipes* at all and I was actually looking at something I had never seen before. For the identification of caddisflies I work from many different identification keys and back in 2010 I was still using the great work of T. T. Macan, The Key to British Trichoptera, Scientific Publication No.28 from the Freshwater Biological Association. This was published in the early 1970`s and wonderfully illustrated by Joan Worthington, so it is not just a practical working key but also a work of art. It was, and still is, a fantastic book. To cover other species that had been discovered in the UK since the early 1970`s I was also using the Atlas of European Trichoptera by Hans Malicky and it was with this that I was able to identify my odd looking caddisfly as a male *Synagapetus dubitans.* However, it was always going to be questioned. Maybe it was a freak and just blown in from Europe? But a few weeks later, during October, I found another similar looking caddisfly while looking at the same site with Dr Ian Wallace. Dr Wallace is the National Trichoptera Recorder for Great Britain and through which all caddisfly data is passed and scrutinised. This second finding was found to be a female and within a few feet of where the first capture had occurred. This was great confirmation and of course very exciting.

Following on from this, and after more consultations with Dr Wallace, I decided to spend as much time as possible during 2011 doing more research. With the aim to collect more information on the species and to try and locate other sites where it could be found. But a year is never enough, and I ended up chasing it around for the best part of ten years.

Habitat – general

Gaining some understanding of the habitat where I first found *Synagapetus dubitans* in 2010 was to me vitally important to looking for it in other places. The spring where I first found the species is unusual, it is a calcium rich spring that emerges from the base of a sandstone crag on a steep slope of mixed woodland near the market town of Masham. As the spring flows down the slope towards the River Ure various mosses are growing in association with it. Around these mosses tufa is continuously being deposited from the enriched spring water, something that has been going on for a very long time by the look of the deposits that have become a major feature of the landscape in the area around the spring.

On checking the geological survey maps it appeared that this area is part of a fault that probably helped create the nearby Hackfall gorge. In addition, for the water of the spring to be so enriched with calcium it was likely to be coming through ancient marine deposits. The two main candidates for this could be the Ure Shell Bed and the Cayton Gill Shell Bed that are both in the geology of that area. It therefore followed that looking for similar springs around Hackfall would be a logical start and then expand the search by looking for similar geological situations where other analogous springs could be found. I now had a plan; I had a good idea of what I was looking for and a list of potential sites to check for *Synagapetus dubitans* during 2011.

The plan started to work and following the successes of 2011 by finding new sites with *Synagapetus dubitans* present I was enthused to spend the next few years looking for yet more places farther afield. I targeted many of these sites by methodically looking for clues in the landscape from Ordnance Survey maps and then overlaying those with the geological survey maps. It is time consuming work but also rewarding when you get to a new site and find everything is exactly what you are looking for. Even when I failed to find any *Synagapetus dubitans* it gave me the confidence that I was looking in the right type of place and the more times you do this the more inspired you become to continue the search.

A huge concern with this project from the very start was the realisation of how delicate these tufa depositing springs actually are. At the moment the only protection these wonderful ecosystems appear to have is their remoteness. The site where I found the first two adult samples is less than 30 yards long and would clearly be sensitive to any disturbance or a pollution incident. This became patently obvious when in 2012 I found out that some major forestry work was going to take place in the area and that a track for the huge forestry machines would be going straight through the area of the spring that I had found the first *Synagapetus dubitans*. I immediately contacted the landowner (who thankfully I know well) and he arranged for a site meeting between myself and the forestry contractors to work out a plan to protect the springs. This was a success and a catastrophe was avoided.

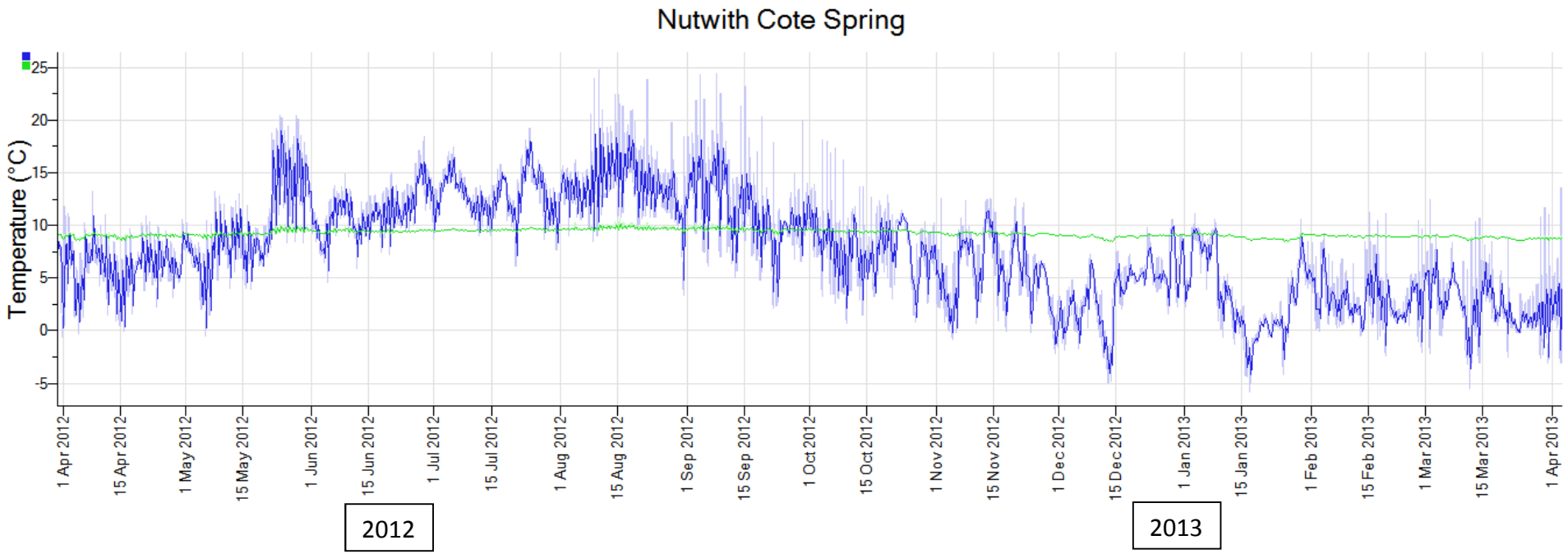
Habitat - water temperature

As I started finding more sites with *Synagapetus dubitans* present it was obvious that the springs and small streams where I was seeing them were all rather similar. Most looked to be visually depositing calcium type deposits (albeit in varying degrees), the flows always appeared stable no matter what the weather and there was never any signs of major flooding or spate events. The riparian vegetation always appeared lush and in many places there was a rich mix of succulent mosses both in, and alongside, the watercourse. But, there was something else; I also noticed that the water temperatures appeared quite stable.

To test my water temperature assumptions I managed to acquire three “Tinytag” data loggers, these are a very smart bit of technology that look like chunky bright yellow bath plugs. These can be programmed to take temperatures as often as you like and the data is stored on a memory chip. This data can then be easily downloaded onto a standard laptop. After getting permission from the landowner where I found the very first adult *Synagapetus dubitans* I set one of the data loggers in the water at the very top of the spring where it first appears from underground, the next was positioned ten meters downstream and the third set to record air temperature about a metre above the water course and out of direct sunlight. All were synchronized to operate together and programed to take a temperature reading once every thirty minutes for a full year. All I had to do now was wait. One year later I went back and the three data loggers were retrieved and the data transferred to my laptop. So what were the findings?

I found the results fascinating, each of the data loggers took over 17,500 readings during that one year period. So, starting with the data logger from the top of the spring, the place the water first appears; the average temperature was 9.3°C with a maximum of 9.5°C and a minimum of 9.2°C. I think everyone would agree that is a pretty stable temperature range over a twelve month period. The second data logger was positioned ten metres downstream from where the spring first emerges, clearly the water temperature here would be affected by the ever-changing air temperature. It would get pushed up as the air temperature increased and pushed down as the air temperature dropped. Again all very interesting; the average temperature was 9.2°C with a maximum of 10.7°C and a minimum of 8.0°C. Finally the air temperature logger; this recorded an average temperature of 7.6°C with a maximum of 24.8°C and a minimum of -5.9°C over the twelve month period.

Along with the statistics above I think the best way to see the stability of the water temperature of where I first found *Synagapetus dubitans* is to look at the chart on the following page. This shows the air temperature and the water temperature (ten metres down from where the spring appears) on the same chart. Clearly I am not suggesting that the only place you are ever going to find *Synagapetus dubitans* is where you have these tight temperature ranges but I do feel it is interesting to show them here.



The graph above shows the air temperature (blue trace) and the temperature of spring water 10 metres downstream of the point it emerges from the ground (green trace). The data was recorded over a full year (April 2012 to April 2013) with readings taken every 30 minutes.

Habitat – the mysteries

After the early findings of *Synagapetus dubitans*, and the successes of finding it at nearby sites, I started to spread the search based on what I had learnt. As a result, I soon found new populations in the area around Ampleforth. This was great news because not only was this on a completely different river system to the locations around Masham but it was over twenty miles to the east. Moreover, between these two areas there was no landscape connectivity that would suggest to me any natural route for such a specialist species to have crossed. My mind started to race, perhaps *Synagapetus dubitans* is quite a common species albeit in these rather uncommon habitats of small calcareous springs and streams?

I knew from years of traveling around Britain looking for other caddisfly species, and my life as a madcap fly-fisherman, that there were other areas of small calcareous streams and now was the time to start searching them. Derbyshire and parts of Cumbria immediately sprang to mind. Then there would be the areas of which I had little or no knowledge such as the south east and south west of England, Scotland and Wales - the list was starting to get very long!

The obvious starting point, and an area I knew well, was that part of Derbyshire around the River Wye, River Derwent and River Dove catchments. There was also Cumbria where my very good friend Andrew Dixon lived. He is an incredibly diligent amateur entomologist and a very proficient fly-fisherman too. His main area of study is on the River Eden catchment and I can think of no other person who knows more about that neck of the woods than Andrew. However, despite prolonged and detailed searches in both these areas we could not find any evidence of *Synagapetus* at all. Neither of us would be arrogant enough to say that just because we could not find it then it is not there. But, if it was common and widespread, in the calcareous springs and streams of those areas, then surely we would have come across it at least once. Nonetheless, there is good news because in the past three or four years *Synagapetus dubitans* has been found by others at some locations further south, I do not have the details here but they can be found on our UK National Recording database (at the time of writing this is the NBN Atlas and can easily be found with any website search engine).

Many questions still remain, for example, where else in Great Britain is *Synagapetus dubitans* hiding and just waiting to be discovered? Why, even when habitat conditions appear perfect, is *Synagapetus dubitans* apparently absent in so many places? And are there any other *Synagapetus* species, which are found in Europe, still to be found here in Britain?

Others that are far better qualified than I may have some of the answers but, at the end of the day, it will always be down to people to get outside to go in search of the truth. That is the joy in the study of nature, and it is always nature that writes the rules.

Collecting and recording sample locations

It made sense to me from the very start that I needed to document and standardise the methods used to catch and collect samples for analysis. Here are the methods I used:

1. Larvae and pupae collecting

Collecting typical cased caddis from the Glossosomatidae family is a relatively easy task as they are easy to find in small springs and streams whenever they are present. Those that can be picked off the stones and other structures easily are the active larvae. When those same cases are stuck down and reluctant to come from their chosen location the insect will have entered its immobile pupa stage.

2. Adult caddisfly collecting with a sweep net

For this job I use a standard triangular folding type sweep net (frame size 450mm x 400mm x 450mm) and work through the vegetation close to the springs and streams. The samples caught are then simply collected from the net with a pooter. The main problems with sweep netting for the adults are associated with weather conditions. If it is wet or windy the adults are often in shelter and therefore not picked up by the net. In addition, when it is raining, trying to judge what is a small wet caddisfly in the bottom of the net along with dozens of other small wet insects is never an easy task and often totally unworkable.

3. Adult caddisfly collecting with a light trap

During this study I used a battery powered lantern (like you would use for camping) with a 7w U-type energy saving lamp. The lantern is positioned in the middle of a two metre square white sheet so that any caddisflies coming close to the light can be easily seen and caught. Light trapping is always interesting but the lights can, and often do, bring in caddis from quite far away. Subsequently, light trapping has its good points and its bad points, just like any other sampling method. In common with sweep netting samples that come to the light are simply collected with a pooter. Interestingly, I have never attracted any *Synagapetus dubitans* using this system even when I knew I was in areas that the insects lived. I have no idea why.

Recording locations: Whatever method of collection used the locations of the sampling sites were noted by using a Garmin GPS. This recorded an accurate ten digit location (using the UK National Grid Reference system) but you will find, on the actual records, some of these are only logged to six digits. This was simply the result of having the batteries run out in the GPS, so the location then had to be worked out the good old fashioned way, with a map! All the locations can be found in the Appendix along with all details of the collected samples.

Rearing larvae to the adult stage

At the start of the project one of the questions I had in my head was could there be a way to look for what may be a very rare caddisfly without endangering a localised population? In my own mind I felt happy that collecting adult caddisflies, at any single location, on just a few days in any one year, would have a minimal effect simply because the numbers taken were always very low. But I did worry that in some of the tiny and often short spring streams it would be quite easy to over collect larvae. This was because they are so much easier to pick up and you always needed to take away a good number of samples since most would inevitably turn out to be the common and widespread *Agapetus fuscipes.* That problem arises because wherever *Synagapetus dubitans* is present there is always *Agapetus fuscipes* present too and there was no method, that I was aware of, to tell the two species apart in the field. So what could be done? Was there another way to search for evidence that *Synagapetus dubitans* was potentially around?

I recognised the two species could theoretically be split by the shape of the fronto-clypeus which I had seen when looking at the larval identification features. I was also aware that this structure could be found inside the cocoon of many similar caddis after metamorphosis was complete and the adult caddisfly had left. The cocoon itself is found inside the pupal case which was originally the mobile larval case that had been secured to the substrate just prior to the insect entering the pupa stage. The problem was that I was not confident in my thoughts and I needed a way to be sure. I decided that the only way to prove the hypothesis was to rear larvae through to the adult stage and then check the fronto-clypeus in a known cocoon against the identification of a known adult – genius! But of course, I still had the problem that the larvae of *Agapetus fuscipes* and *Synagapetus dubitans* could not be split while alive and they all lived together – so not so genius, I was back at square one.

I needed a cunning plan, and I found one. It started by going out and collecting a number of live mature larvae (hopefully close to pupation) from a site that I knew had a good population of *Synagapetus dubitans* and which I also knew would include some *Agapetus fuscipes.* These were taken home to one of my rearing tanks and checked every couple of days (I have a number of these in the cellar of my home, basically they are just small homemade aquariums with air and flow pumps along with a controllable lighting system). Whenever one of the active larvae was found to have secured its case, indicating the start of the pupa stage, I would remove it and place it in another tank that had at its base an ice cube mould. You know the ones I mean, a small plastic tray made of square box sections that you fill with water and put into your deep freeze for your summer evening gin and tonics. With this method I could keep each of the individual pupa in its own *cell*. Plus, this also allowed me to place the pupa in the individual cells in the order that they were starting this final stage before the adults emerged. Now all I had to do was wait for the adults to appear. Whenever an adult emerged it would find its way to a netted area over the top of

the tank making it very easy to see and collect. Whenever an adult was collected the pupal cases were individually checked and when the relevant empty cocoon was found it was then kept with the adult sample for analysis. The only flaw with the plan would be if two adults appeared at the same time but thankfully this never happened. It was great fun to do and reminded me of being a child and watching jam-jars of frog spawn turn into tadpoles and eventually into small frogs which would often end up hopping around the kitchen which, on refection, did not really impress my mum very much at all.

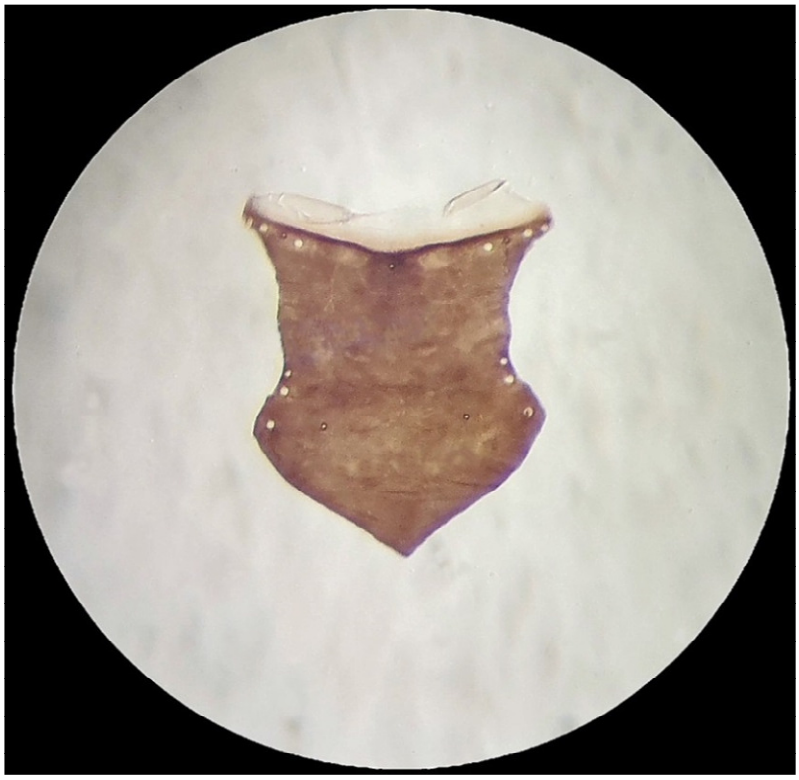
So, getting back to the caddis; the next part was relatively easy in that all I had to do was identify the adult caddis and then locate and evaluate the fronto-clypeus inside the empty cocoon. It soon became clear to my eye that there was a difference between the *Agapetus fuscipes* and *Synagapetus dubitans* in the shape of the fronto-clypeus found inside these cocoons. Now I did have a method of checking new sites for evidence of the presence of *Synagapetus dubitans* without taking away live larvae. All I had to do was to collect pupal cases that were firmly fixed to structures on the stream bed. This is easy to do and when any mobile larvae are picked up in error they can simply be released.

I found the best time of year to do this was in the winter months when most of the fixed pupae cases will be vacated. Yes, some will have live overwintering pupa inside, but I never found these in large numbers during the colder months of the year (for example late December, January and early February) and if some were collected they could still be analysed so nothing went to waste. Another advantage with sampling empty pupae cases is that they probably last several years after the adults have left meaning the numbers game, for finding vacated cases, is even more in your favour. Of course, on the negative side, some of the cases will be totally empty or the cocoon is so badly damaged that the fronto-clypeus will have been lost but that is all part of the game and is not a real issue. Yet another advantage of sampling *winter* pupa cases is that when you are ready for a break, and find a quiet local pub for your lunch, it will almost certainly have a good log fire burning to warm your hands and feet. And, of course in a Yorkshire pub the beer will be good too.

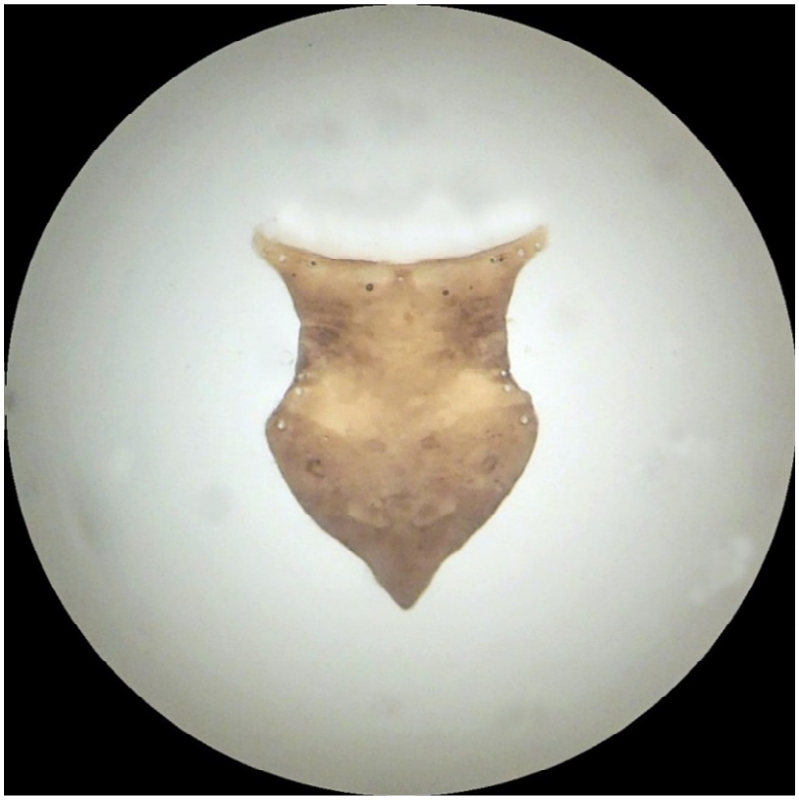
Let me stress at this point that I have never used this evidence alone for my records of *Synagapetus dubitans* being present on any individual site. But it has given me a lot of confidence to go back to a site, and look for the adults during the warmer months of the year, if I have previously found fronto-clypeus inside empty cocoons that I believed to be from *Synagapetus dubitans.*

On the page following you will see images of the fronto-clypeus of *Synagapetus dubitans* and *Agapetus fuscipes* that have been found inside empty cocoons and matched directly to adult caddis reared from larvae in my home rearing tanks. Can you see the difference between the two? Whatever your answer, there are more details on looking at the fronto-clypeus in the section of this report covering the identification of the larvae.

Synagapetus dubitans



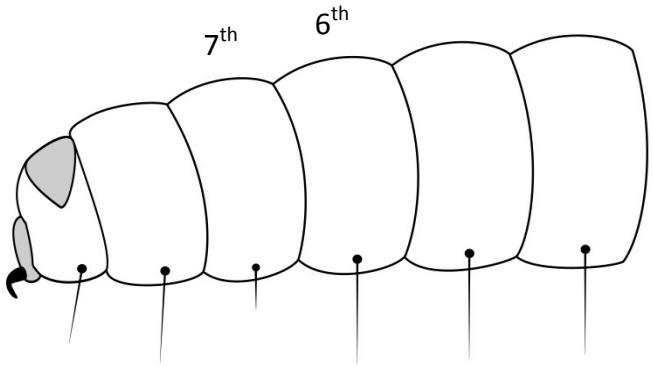
Agapetus fuscipes



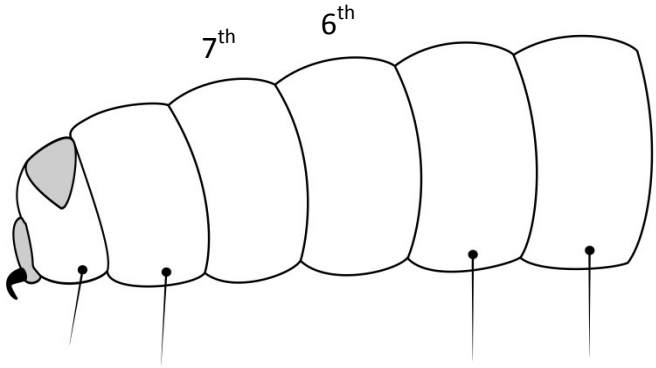
Identification of *Synagapetus dubitans* in the larval stage

Because *Synagapetus dubitans* was unknown in Britain until 2010 then it will be absent from all identification keys to British caddisflies published before that year. However, please do not despair because in 2012 a new Freshwater Biological Association book; Guide to Freshwater Invertebrates (Scientific Publication No. 68) was published which means that *Synagapetus dubitans* gets a mention. You cannot identify the actual species from this but you can very quickly put it into the same group as our other three native *Agapetus* (part of the subfamily of Agapetinae) and that is very helpful. The only guide to the identification of the species *Synagapetus dubitans* (at the larval stage) I was able to find in 2010 came from a 1993 study by Thomas Pitsch. He uses an interesting method of confirming each species by showing various morphological features on a type of comparative chart. This was a method I had not come across before but I could clearly see its virtues. From these charts I personally found that the easiest feature to split *Synagapetus dubitans* from our native *Agapetus* species was with regard to the abdominal ventral setae. Looking at the illustrations below you will see with *Synagapetus dubitans* the setae is relatively long on the 6th abdominal segment while on the 7th the setae is much shorter (Note: on actual larvae the setae are in pairs, one on the ventral left and one on the ventral right). With all our native *Agapetus* species these ventral setae are absent on both 6th and 7th segments.

Synagapetus dubitans



UK *Agapetus* species



Thomas Pitsch also noted some differences in the fronto-clypeus of *Synagapetus dubitans* and *Agapetus fuscipes.* I have found this useful not just for the larvae but also when looking at this structure when it is left behind in empty cocoons (see the section on rearing larvae to the adult stage). Looking at the images below you can see I have marked the angle "A" (in white) on the fronto-clypeus. The top image is *Synagapetus dubitans* where the angle is just over 90º. The bottom image is *Agapetus fuscipes* where the angle is just less than 90º.

Larval case

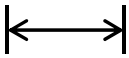
The larval case of *Synagapetus dubitans* is the typical dome case design that you see with other Glossosomatidae. However, during the study I have been unable to find a method to split those of *Synagapetus dubitans* and those of *Agapetus fuscipes* while live in the field. Nonetheless, Thomas Pitsch has on his charts two types of case made by *Synagapetus dubitans*. This intrigued me and suggested that one of the case types is a normal dome type but the other has a dome with a skirt all the way around its base made from tiny sand grains and silk. I never came across these until I started searching sites in winter and then I did indeed find some cases with the curious, and very distinct, skirt. The problem with these is that they are finely made and tend to collapse when the case is removed from the water. Also, for the same reason, I unfortunately never managed to get a photograph of one either because by the time I got them home I found they had disintegrated during transit. Nevertheless, it is something that needs to be noted. But, in general, when you find the *Synagapetus dubitans* and *Agapetus fuscipes* together the cases all look very similar. In addition, and probably as a result of the stable water temperatures, they also tend to be found in a wide range of sizes. The images below show a typical mix.

Pupal case

I believe that the pupal case, where metamorphosis to the adult stage takes place, is the same portable case the larva was living in during its last phase of growth. The main change being that the stones on the underside of the case are removed by the larva and the case is then secured to the substrate, or some other feature, of the stream bed. In addition, while going through metamorphosis, the insect will be inside a protective cocoon. When metamorphosis is complete the mobile *'pharate adult'* firstly cuts its way out of the cocoon (leaving just a small exit slit) using cutting jaws that are on the outside of the pharate membrane. It then cuts away some of the silk threads from inside the pupal case (sometimes releasing one or more of the small stones) to make a gap just large enough to allow its escape. It can now actively swim to the stream margin where it crawls from the water onto the land and the pharate membrane can be shed. Finally, it can pump up its wings, and fly away, to start the final part of its lifecycle as a fully adult caddisfly. I have witnessed this emergence phase many times with the *Agapetus* species and strongly suspect the same will happen with the *Synagapetus dubitans.* I can say this with some confidence because I have found the discarded pharate membranes in my rearing tanks, on the dry stones placed specially for them to leave the water, which I have then been able to positively link with freshly emerged *Synagapetus dubitans* adults.

The image below shows a pupal case that was removed from a stone at one of my sample sites. When viewed from the underside there is the almost fully developed pharate adult clearly visible through the cocoon (the species was not confirmed at the time but it is one of the Glossosomatidae).

1 mm scale line



Identification of *Synagapetus dubitans* in the adult stage

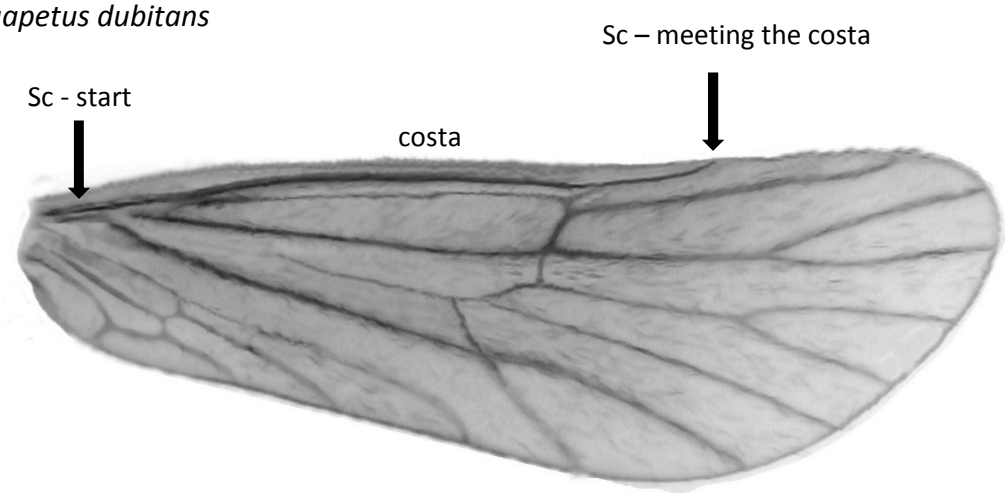
All the first samples of *Synagapetus dubitans* that I collected were identified by using the Atlas of European Trichoptera by Hans Malicky from 2004 but I was still curious to learn more. After some searching I soon found out that Martin E. Mosely had written about the species in 1935. I then found out that it was McLachlan who had separated the genus of *Synagapetus* from the *Agapetus* back in 1879. The more I looked the more I learnt, in fact I was flabbergasted at how much was known about *Synagapetus dubitans* yet it had taken until 2010 to find it here in Britain. In 2012 a new identification guide to the adult caddisflies was published; The Adult Trichoptera (caddisflies) *of Britain and Ireland* by Peter Barnard and Emma Ross and thankfully there was just time to include *Synagapetus dubitans* before it went to print. So, now there is a book where this species can be identified at the adult stage without delving into the European key sets. Consequently it would be very easy for me to leave the subject of the adult identification at this point and move onto other aspects of this report. But, that would be a shame because I believe the reader might want to know a little more and therefore I have decided to use some extra space here to provide additional information and illustrations to help with the identification of the adults.

I would like to begin with a characteristic found by McLachlan in 1879 which was in relation to the subcosta vein of the hind wings. Now looking at the wing venation of caddisflies I have always found to be a bit of a dark art. There are several reasons for this that include; hairs on the wings that can make the veins hard to see, some of the veins are dark and bold while others are lighter and more difficult to distinguish, and due to natural variation, vein positions can vary to some degree and therefore don't always match the illustrations seen in books. Mosley, in his 1935 paper on *Synagapetus dubitans,* gives what I believe is a lovely description of the McLachlan characteristic which splits the genera of *Synagapetus* from *Agapetus* and I have quoted this at the bottom of the page. Can I suggest while reading this you also refer to the next page that gives illustrations of both *Synagapetus* and *Agapetus* hind wings and the veins mentioned in this quote. Also at this point I want to make it clear that the images of the hind wings you will be seeing are not drawings but photographs of wings from known species. The reason they are in "grey-scale" and not full colour is down to a trick that I use allowing you to see both the naturally dark veins and the light finer veins on the same image. Often this would be hard to see and simply would not come out with standard photographic imaging. I told you it was a dark art!

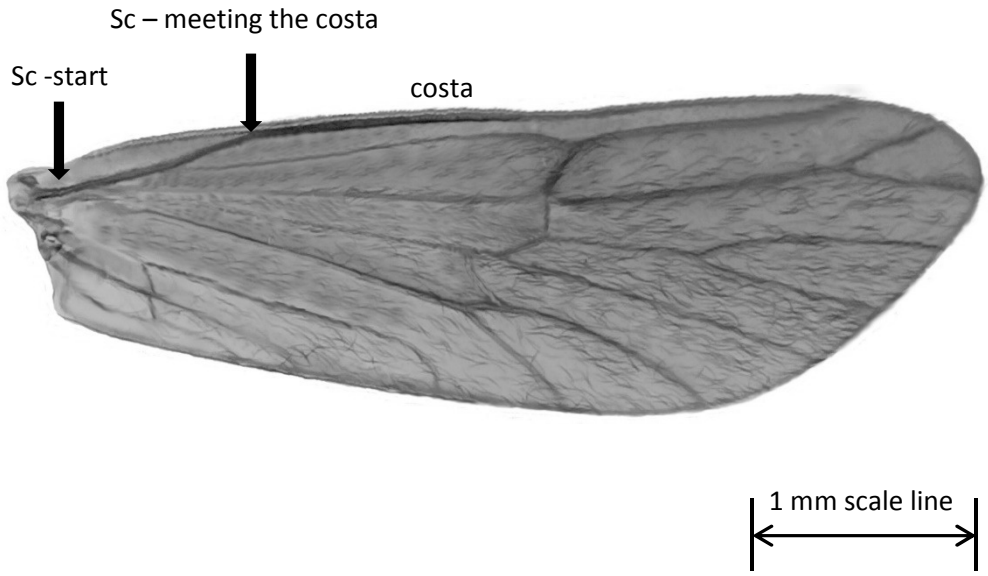
Here is what Mosley said (a direct quote from; The genus *Synagapetus* by Martin E. Mosley, Annals and Magazine of Natural History, Series 10, volume xvi, p. 304, August 1935.) with regard just to the subcosta of the hind wing in *Synagapetus*; "…..*in the posterior wing the subcosta commences as in Agapetus, then becomes nearly confluent with the costa and afterwards recedes, ending in the costal margin beyond the middle….".* I like this description and is what I have seen on the samples I have collected.

You can see below the hind wings of a *Synagapetus dubitans* and *Agapetus fuscipes.* In both cases the start of the subcosta (Sc) and the point where it meets the costa are marked with arrows. The costa is also named but in effect is the top front margin of the wing. Some keys say, and illustrate, that with *Agapetus* the subcosta of the hind wing is short. But, I am more inclined to once again use some of Mosley's words, this time from his classic book, The British Caddis Flies (1939) where he says; *"…subcosta rudimentary, distinct near the base but soon merging into the costa".* I believe this to be a better description of what I am seeing. With the subcosta of *Synagapetus* you can see the slight gap between it and the costa, just as McLachlan found and what Mosely describes in the words on the bottom of the previous page - as a reminder, the pertinent part is; "…***nearly confluent*** *with the costa…").*

Synagapetus dubitans

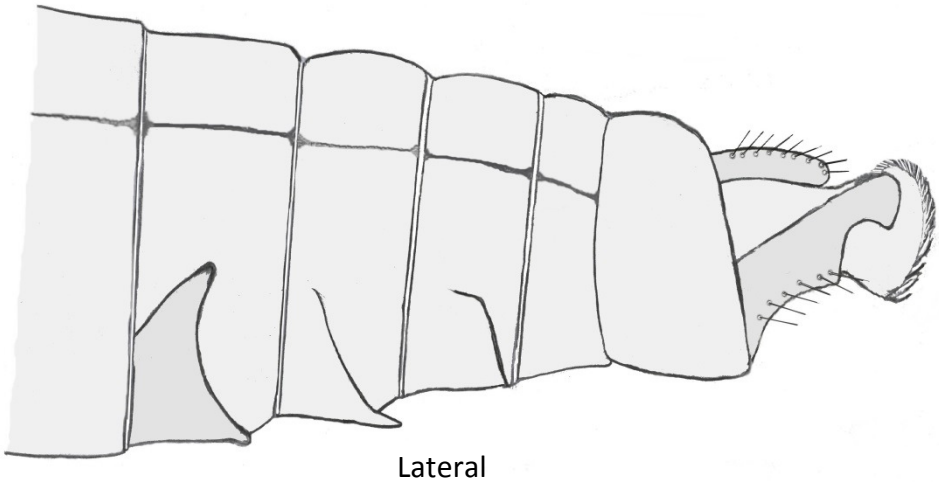


Agapetus fuscipes

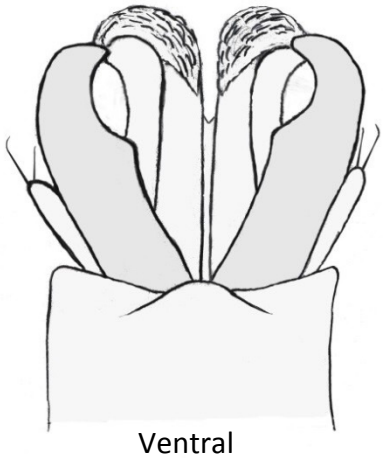


Synagapetus dubitans – Males

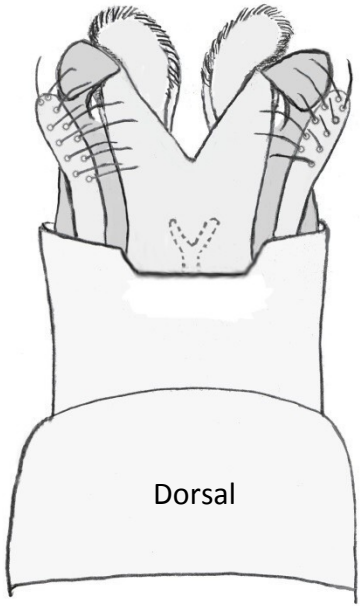
If you prefer to identify adult caddisflies without worrying too much about wing venation then of course that is not a problem. To get to the family level identification you can use Caddisfly Adults (Trichoptera) of Britain and Ireland – Family level keys and introductory guide. This is a Freshwater Biological Association publication (Scientific Publication No. 70) that I wrote and had published in 2019. Once at family level you can work through the genitalia images of that family in the Peter Barnard & Emma Ross guide that I mentioned earlier. However, if you are still not sure and think you have a male *Synagapetus dubitans,* I have included below my original illustrations that I did in 2010 that hopefully will help, and I have added some detailed photographs on the following page too.



Lateral

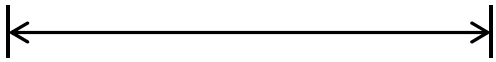


Ventral



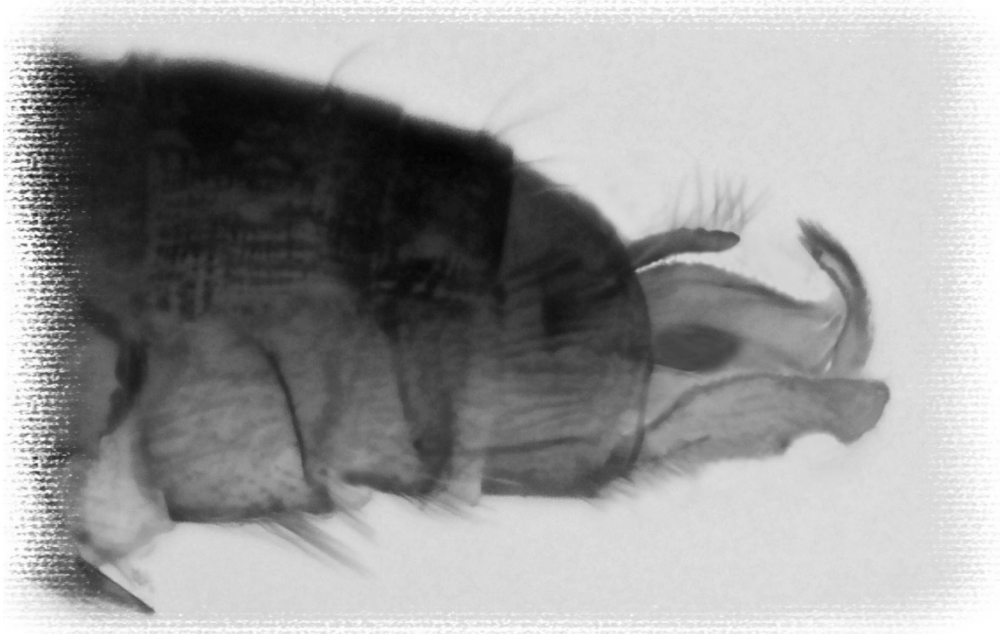
Dorsal

1 mm scale line



Synagapetus dubitans – Males

Below are some more images that you may find useful. It is also interesting to note that some keys reference a couple of spines that are buried in the complex of the male genitalia. I have found these challenging to locate in fresh specimens. However, because the entire structure of the male genitalia is so distinctive looking for such fine detail should be unnecessary for a positive identification of this species.

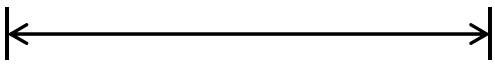


Lateral

Ventral

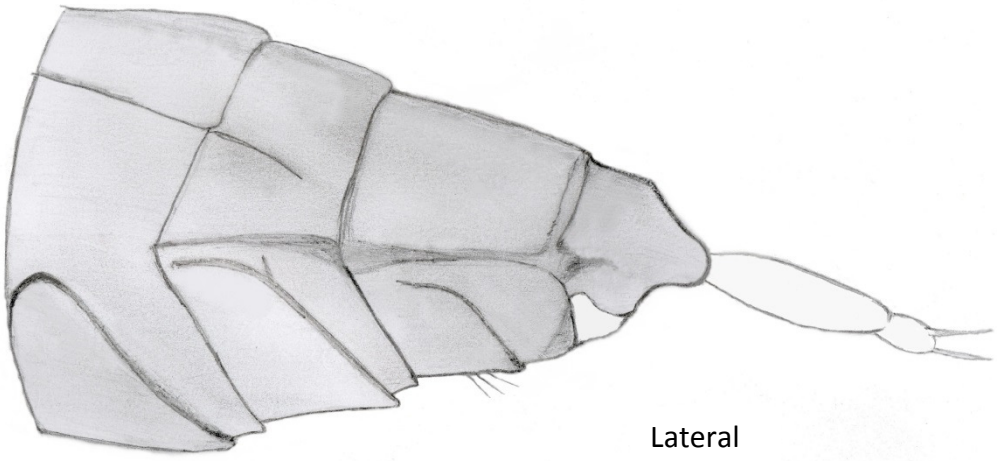
Dorsal

1 mm scale line

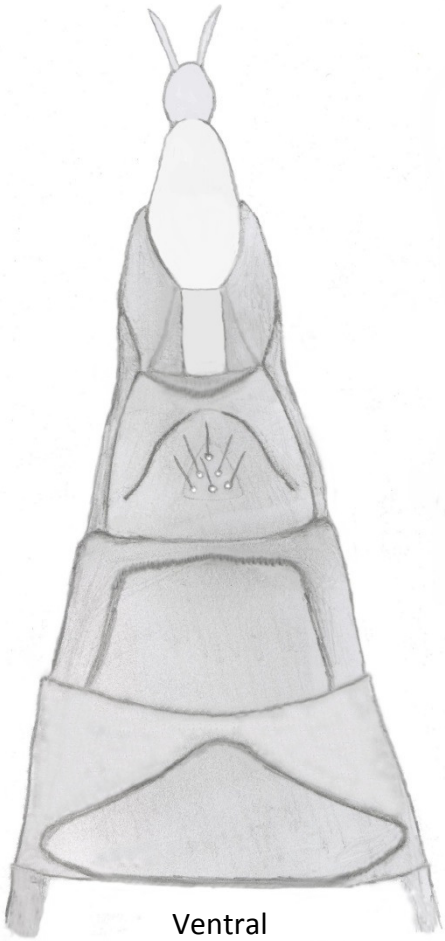


Synagapetus dubitans – Females

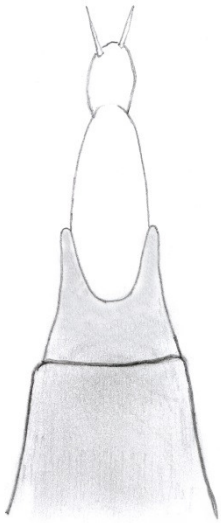
As with males the females are quite distinct and hopefully my simple illustrations below would quickly confirm any suspected sample you may want to check (again you should firstly confirm that you are looking at a caddisfly from the family Glossosomatidae).



Lateral

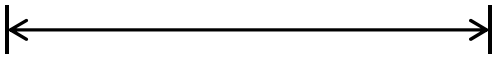


Ventral



Dorsal

1 mm scale line



Photograph of habitats – typical springs where *Synagapetus dubitans* has been found

Photographs of habitats – typical streams where *Synagapetus dubitans* has been found (note that the lower example is noticeably depositing more calcium than the upper example)

Appendix

Synagapetus dubitans records 2010 to 2019 (collecting and identifications by Stuart Crofts)

Location	NGR	Date	Samples taken	Larvae (L) Adult (A)	Males	Females
Nutwith Cote, woodland spring, N. Yorks	SE2338978291	04 September 2010	1	A	1	0
Nutwith Cote, woodland spring, N. Yorks	SE2338978291	28 October 2010	1	A	0	1
Nutwith Cote, woodland spring, N. Yorks	SE233782	14 May 2011	20	L	Not applicable	
Hackfall Alum spring, N. Yorks	SE2336876976	20 May 2011	2	L	Not applicable	
Hackfall Alum spring, N. Yorks	SE2337476977	20 May 2011	9	L	Not applicable	
Hackfall, woodland spring, N. Yorks	SE2352977349	20 May 2011	5	L	Not applicable	
Hackfall, woodland spring, N. Yorks	SE2345877378	20 May 2011	11	L	Not applicable	
Hackfall, woodland spring, N. Yorks	SE2340777208	20 May 2011	5	L	Not applicable	
Hackfall, woodland spring, N. Yorks	SE2336677247	20 May 2011	9	L	Not applicable	
Nutwith Cote, woodland spring, N. Yorks	SE2342378165	20 May 2011	1	L	Not applicable	
Nutwith Cote, woodland spring, N. Yorks	SE2337678294	20 May 2011	6	L	Not applicable	
Nutwith Cote, woodland spring, N. Yorks	SE2338778265	20 May 2011	5	L	Not applicable	
Nutwith Cote, woodland spring, N. Yorks	SE2337778281	20 May 2011	6	L	Not applicable	
Mickley Barras spring, Mickley, N Yorks	SE2450976882	27 May 2011	6	L	Not applicable	
Triple Springs, Mickley Wood, N. Yorks	SE2463476737	27 May 2011	11	L	Not applicable	
Grass Keld, near Rievaulx, N. Yorks	SE5557784696	05 July 2011	1	A	0	1
Woodland spring near Rievaulx, N. Yorks	SE5767485263	05 July 2011	2	L	Not applicable	
Nutwith Cote, woodland spring, N. Yorks	SE233782	01 August 2011	4	A	4	0
Hackfall, woodland spring, N. Yorks	SE2341477195	01 August 2011	1	A	1	0
Nutwith Cote, woodland spring, N. Yorks	SE234783	28 March 2012	2	L	Not applicable	
Mirefalls, Ashberry Wood, N. Yorks	SE5675184592	16 April 2012	6	L	Not applicable	
Mirefalls, Ashberry Wood, N. Yorks	SE5613885485	16 April 2012	3	L	Not applicable	
Mirefalls, Ashberry Wood, N. Yorks	SE5672184549	16 April 2012	4	L	Not applicable	
Small sping in Mickley Barras, N. Yorks	SE2461876744	01 June 2012	7	L	Not applicable	
Nutwith Cote, woodland spring, N. Yorks	SE2338078272	04 August 2012	3	A	1	2
Hackfall stream, Hackfall, N. Yorks	SE2341177196	08 August 2012	2	A	1	1
Small spring, Ashberry Pastures, N. Yorks	SE5676984595	09 August 2012	1	A	0	1
Spring flowing into Grass Keld, N. Yorks	SE5558384626	09 August 2012	1	A	0	1
Nutwith Cote, woodland spring, N. Yorks	SE2338478278	20 January 2013	1	L	Not applicable	
Beck at Ampleforth, N. Yorks	SE5793478692	14 February 2013	10	L	Not applicable	
Limperdale Gill, Yowlass Wood, N. Yorks	SE5316086899	14 February 2013	12	L	Not applicable	
Sledhill Gill, Yowlass Wood, N. Yorks	SE5312386925	14 February 2013	4	L	Not applicable	
Woodland spring near Rievaulx, N. Yorks	SE5767585272	14 February 2013	6	L	Not applicable	
Alum Spring, Hackfall, N. Yorks	SE2337576966	26 April 2013	1	L	Not applicable	
Grass Keld stream, Nr. Rievaulx, N. Yorks	SE5559284650	26 April 2013	2	L	Not applicable	
Hackfall stream, Hackfall, N. Yorks	SE2342377201	26 April 2013	6	L	Not applicable	
Limperdale Gill, Yowlass Wood, N. Yorks	SE5310186878	26 April 2013	9	L	Not applicable	
Small spring, Ashberry Pastures, N. Yorks	SE5676984593	26 April 2013	4	L	Not applicable	
Spring flowing into Grass Keld, N. Yorks	SE5558184620	26 April 2013	2	L	Not applicable	
Spring in Ashberry Pastures, N. Yorks	SE5669384556	26 April 2013	1	L	Not applicable	
Small spring, Ashberry Pastures, N. Yorks	SE5676984593	23 May 2013	1	A	0	1
Small spring, Ashberry Pastures, N. Yorks	SE5676984593	01 June 2013	1	A	1	0
Springs just north of Ebberston, N. Yorks	SE8994083301	12 January 2014	5	L	Not applicable	
Small stream, Ampleforth, N. Yorks	SE579788	30 June 2016	1	A	0	1
Burtis Beck, Nr. Wass, North Yorks	SE5656778833	03 August 2016	7	A	5	2
Shallowdale Beck, Nr. Wass, N. Yorks	SE5671479891	03 August 2016	1	A	0	1
Small stream, Ampleforth, N. Yorks	SE5792078821	03 August 2016	7	A	1	6
Hackfall, woodland stream, N. Yorks	SE2336177236	20 June 2019	2	A	2	0
		Total samples	218			

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