Emperor Season Without End: A Study of pre-hibernation *iris* larvae in the wild

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This is a provisional account of a detailed study of pre-hibernation iris larvae, carried out at a site in Wiltshire during the late summer and autumn of 2009. Much data has yet to be fully analysed and some aspects of factual presentation may consequently change. Field work will continue into the spring, and at least one further account will be written.

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The Emperor lives eternally in never ending cycles, by means of metamorphosis. He is with us always, if only we care to look; so our experience of him need not be restricted to five or six heady weeks in midsummer. There is magic to be found in the study of the immature stages, deep magic from beyond the dawn of time.

Although Emperor larvae are capable of sitting around doing nothing for days, possibly even weeks, on end, they are also capable of amazing things, and stretching the human mind in inconceivable ways. Thus, on 31st August 2009 I watched two wild (and dangerous) *iris* larvae fighting – one had invaded the other's seat leaf, and was promptly intercepted; they locked horns and tried to wrestle each other off the leaf, before the invader boldly turned his back and crawled away at speed. The event was deeply reminiscent of the familiar clash-and-chase behaviour of the adult males, and took place in a strong wind, *dignus vindice nodus.*

Two 2nd instar larvae fighting! The pink object is a larval location marker. Photo: Matthew Oates

Doings in a Wiltshire Wood

During the period late July to late October 2009, I spent a total of 90 hours searching for eggs and larvae in a Wiltshire wood, to use Heslop's gloriously vague phrase. The wood is in private ownership. I did something along these lines at the back end of the long hot summer of '76, but was a silly flibbertigibbet then. This year I did it properly, as a scientific exploration, though my commitment to Silliness remains. I am grateful to the Test Match Special team for keeping my sanity just about intact. All things, no matter how tedious, are possible if accompanied by the dulcet tones of TMS. I spent nearly all of three test matches searching sallows whilst listening diligently.

In all, I found 141 ova, larvae, unaccounted for egg case bases and vacant larval seat pads + adjacent feeding marks, largely by searching low branches from the ground. This represents a valid sample size, *quoad hoc*, especially by Emperor standards. The vast majority of the findings were of 2nd and 3rd instar larvae. A further 42 ova and larvae were found at other sites in five other counties.

The tally of 141 may not be that remarkable, for during the late 1960s Dr Roger Clarke of Horton cum Studley, Oxford, used to find getting on for 100 ova and young larvae annually, for captive rearing and subsequent release into Bernwood Forest. I do not think he ever found significantly more than 100 though. He was a subscriber to *Notes & Views*.

The following attributes were carefully recorded:-

1) Sallow type in terms of species, sub-species and hybrid as far as was possible, using the BSBI handbook (Meickle, 1984);

2) Sex of tree, where old flowers were still present;

3) Leaf colour, in a crude classification of Yellow-green, Mid-green, Dark-green and Blue-green;

4) Whether the leaf upper surface was matt and glossy, and the undersides pubescent or not;

5) Whether the leaf texture was soft or hard;

6) Height above ground;

7) Leaf size;

8) Position on the bush, in terms of outer and inner foliage, sub-canopy, back, front, side, and so on;

9) Degree of exposure to sun, as a percentage of Summer Shade.

10) Aspect (where *distinct*), and the presence of sheltering tall trees;

11) Approximate size of tree, and tree health and condition of foliage.

The sallow resource of the study site was found to consist mainly of Goat Willow *Salix caprea*, with smaller amounts of its hybrid with narrow-leaved sallow *S. x Reichardtii*, and of the common narrow-leaved sallow, Rusty Sallow *S. cinerea oleifolia.*

Within a large study area every single piece of reachable sallow was searched, irrespective of likelihood of it revealing ova or larvae. This is where TMS proved invaluable.

It is important to note, *qualis ab incepto processerit*, that I had already found some 250 ova and larvae over the years, though I took care not allow that to prejudice my searches. I knew that most ova are laid on sub-canopy sprays, beneath the main canopy umbrella, and that larvae are almost invariably found on leaf tips, particularly where the tip dips and curls down, allowing rain drops to gather, and that ova and larvae occur exclusively on the leaf upper surface.

Pre-hibernation 3rd instar larvae in rain drop in the leaf tip curl. Photo: Neil Hulme

Provisional Results

Data are in the process of proper analysis, with the intention of producing a scientific paper. Provisionally, then, although the odd ova or larva can be found in quite a range of situations it appears that there are clear selection preferences, at least within the context of the main study site.

1) The butterfly strongly prefers *S. caprea* over *S. cinerea oleifolia* and certainly over the broader-leaved hybrid *S. x Reichardtii.* These preferences have also been determined at other sites.

2) Leaf texture appears to be critical, with the butterfly strongly favouring leaves and leaf sprays that are soft, with matt upper surfaces and pubescent lower surfaces.

3) Such conditions are met on leaves that are Mid-green in colour, though I suspect that colour is only really an attribute of texture.

A Mid-green Soft Matt leaf, showing a 2nd instar larval seat pad and feeding marks. Note the lack of glossy shine. Photo: Matthew Oates.

4) These conditions of texture and colour occur in moderate to heavily shaded situations. The vast majority of ova and larvae were found where there was less than 2 hours of dappled sun per summer's day, often much less. Most were found where 80-90% summer shade was recorded. The most exposed larva received 60% summer shade. Many larvae were in deep shade, in situations similar to those favoured by the White Admiral. Shade could be cast by the host sallow tree or by trees to the south, or both.

5) Leaf sprays open to significant amounts of sun grow thick and coarse, and tend to be Dark-green or Blue-green in colour and have glossy upper surfaces. Leaves on the outer foliage of sallow bushes tend to have these characteristics, as do leaves high up on vigorous leader growths. Coarse leaves with serrated edges are unsuitable.

6) Medium size leaves are favoured by the larvae. The Empress can deposit on just about any size leaf, on sprays that meet the above criteria, but she favours whole medium sized leaves. Incidentally, and importantly, the data I hold on oviposition (egg laying) indicates that females fail to deposit an egg on about 40% of occasions when the abdomen is seen to bend down to touch a leaf. Such instances are of leaf situations being rejected.

7) Crucially, leaf texture and colour varies within a bush, linked to degree of exposure to sunlight. So, on bushes growing along south-facing ride or glade edges, ova and larvae were found only well inside the bush, usually at the very back. Again, the need for shade is paramount. The vast majority were found inside the bush, usually on rather thin sub-canopy sprays.

8) Ova and larvae were not found on bushes suffering from significant outbreaks of Sallow Mildew (white mould on leaf uppersides). Such bushes tend to have very dark leaves, usually Blue-green. A very small number of late autumn larvae were found on branches with light outbreaks of this mildew, but it would appear that the butterfly successfully avoids such trees.

9) Ova and larvae were found between 1.1m (4') to 3m (12'+) and beyond. A surprising number were around eye level. However, the study site was blessed with low boughs, unlike in many FC woods where ride-side sallows are periodically trimmed by flail-cutter.

10) Only one ova / larva was found on a small, young tree. They were, though, found on a diversity of positions on older trees, including on fresh leaders coming off main stems and trunks and older coppice regrowth. None was found on pollarded trees, anywhere (this aspect needs looking at closely, given the conservation fashion of pollarding sallows for Purple Emperor in FC woods and on nature reserves. More anon.) Trees in various states of health were

utilised, including those badly or even severely damaged by squirrels stripping bark.

Aspect was found to be rather an irrelevance, being obviated by the presence of tall trees to the south. However, it appears that females strongly prefer sheltered locations, selecting sheltered nooks and crannies and avoiding trees exposed to wind or buffeting by traffic. At the same time, they seem to favour prominent sallows.

It proved impossible to determine the sex of about 30% of utilised trees. At this stage, a preference for female trees is apparent, but it may well be that the bulk of the undetermined 30% is male. We shall find out next March, *quibus, quibus, quibus.*

The Pilgrims' Progress

In addition to being indelibly dull and scientific, and numbering larvae, each was also named after a poet of the English language. At times this proved disconcerting to one of poetic disposition, not least when Dylan Thomas was found dying on his seat leaf. Of course, Sylvia Plath was the first to disappear. As a friend of Coleridge, I am pleased to announce that Wordsworth – who treated Coleridge appallingly - was an early casualty. I chose not to name a larva after the current poet laureate.

By and large, Purple Emperor larvae are remarkably sedentary prior to hibernation. About a third fed close to their egg leaf, and most wandered less than a metre. However, it seems that once past the vulnerable first instar stage, some can be quite mobile. The mobility of young larvae needs to be assessed against leaf texture and colour, as it appears that deterioration in these characteristics – and leaves certainly change during the course of the autumn feeding season – may well be the main reason for larvae dispersing. Some 2nd and 3rd instar larvae definitely move up the tree. I have quite a lot of data on the disappearance (and sometimes reappearance) of 2nd and 3rd instar larvae, though I have yet to work out how analyse it.

Because of this dispersal factor it was not possible to determine mortality at all accurately, certainly beyond the first skin change. Over 50% of 1st instar larvae disappeared. I suspect some were washed off by heavy rain but have no evidence to substantiate this. Way into October I was finding vacant seat pads + adjacent feeding damage attributable to

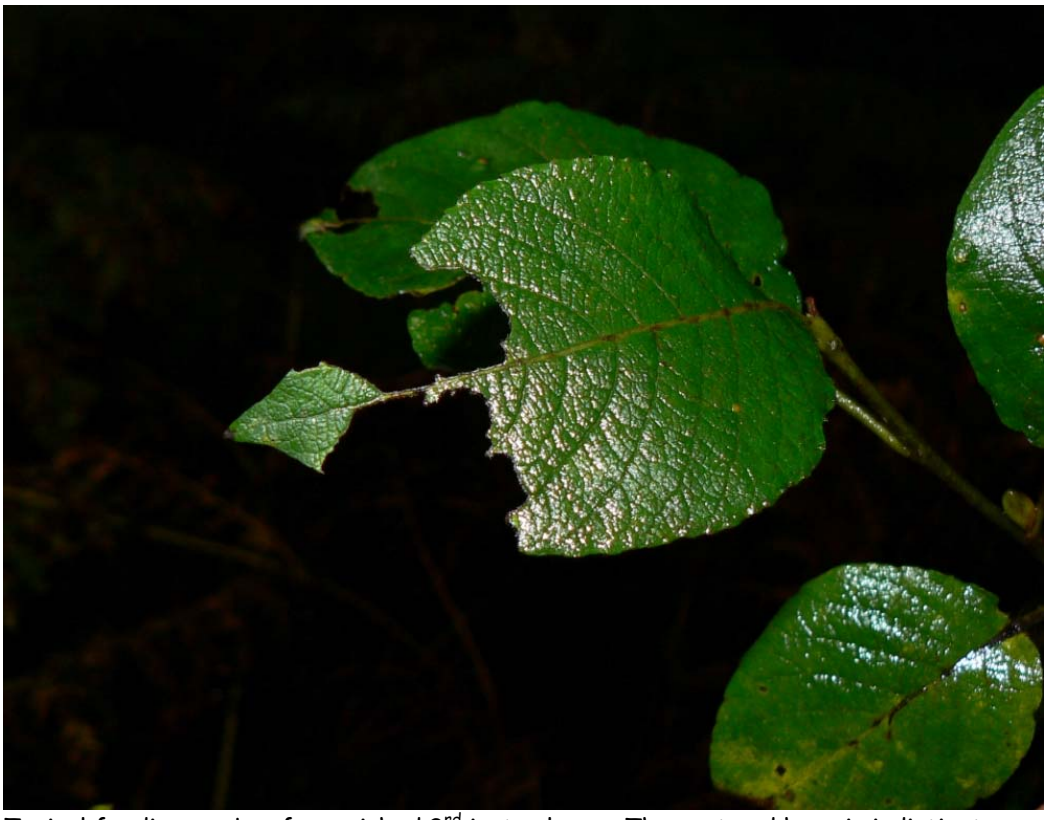
1st instar (or early 2nd instar) larvae, with no sign of any subsequent feeding, let alone a larva.

Incidentally, the larvae consume the bulk of the egg case but the base can remain on the leaf for weeks. I was finding the odd egg case base right through to late October. Three infertile eggs were found, along with two that appeared to have been sucked by bugs.

In 2009, at the study site, the first (1st instar) larva was noted on July 27th. Eggs were being laid up to at least August 3rd, and probably as late as the 7th. The first 2nd instar larvae were noted on August 10th. A late 1st instar larva was found on Aug 31st. I found it extremely difficult to tell late 2nd instar larvae from 3rd instar larvae, except immediately after the skin change, when the horns are freshly coloured. As Frohawk states, the larvae seem to eat the cast skin. It looks as though 3rd instar larvae were around from August 22nd.

Prior to hibernation, most larvae fed from 3 leaves, though a few sampled as many as five. On average, larvae changed seat-leaf three times.

Heslop claims that the best month in which to find *iris* larvae is October. This must be based on the distinctiveness of leaves supporting seat-pads and larval feeding marks during that month. However, all too often the associated larvae are nowhere to be seen, for a significant percentage of late 2nd instar and 3rd instar larvae vanish, seemingly without trace. Some seem to go up the tree but I am struggling to make sense out of this.



Typical feeding marks of a vanished 3rd instar larva. The seat pad here is indistinct. The shine results from flash. Photo: Neil Hulme.

Into Hibernation

In 2009 at the main study site, the first signs of larvae colouring up prior to hibernation were noted on October 11th, when two had coloured up well and four more were showing signs of colouring.

The first larva was found in hibernation on Oct 23rd (Byron), which may be rather on the early side. During the last two days of October I located 51 of my marked larvae, of which 12 were definitely in hibernation and another two or three seemed to be hibernating on withered leaves (sometimes larvae have an early hibernation spell on a withered leaf, which they attach to the stem by silk, though they almost invariably move off the leaf later). Nearly all were fully coloured-up.

Larva No 69 (Christina Rossetti), partly coloured-up on a fading feeding leaf. Photo: Neil Hulme.

By Remembrance Sunday (November 8th), approximately two-thirds of larvae I had managed to locate were in hibernation. However, by then about 50% of larvae had disappeared when well coloured up. Either they had undertaken seriously long journeys (>3m), or they had succumbed to predators, or had simply not been found (the situation will should become clearer once the leaves fall off).

At the end of October, a total of 42 sallow trees bearing larvae were inspected and classed in terms of timing of leaf fall into Early, Mainstream and Late Trees. This rough classification worked quite well, though of course a few trees fell between two camps. Of the 42, 14 were Late, 3 were Late-Mainstream, 16 were Mainstream, 2 were Mainstream-Early and 7 were Early. This may suggest that Early trees are generally avoided.

Moreover, hibernating larvae were found on 3 Early trees, 2 Early-Mainstream trees, 3 Mainstream trees, 1 Mainstream-Late tree and 3 Late trees. This small sample suggests no obvious link between the timing of hibernation and the timing of leaf fall.

I intend to check the timing of leaf-break on utilised trees next spring.

Interestingly, it looks as though larvae move much further on old dirty branches when seeking a hibernation site. Out of a sample of 21, larvae that had been feeding on sprays growing on clean stems found a hibernation site <·4m from their feeding spray, whilst larvae based on sprays growing off old, blackened, dirty and lichen-covered growth travelled >2m. The sample size here should, though, increase, so treat this finding as provisional. There may be something significant here.

I will attempt an account of hibernating larvae in due course.

Crucially, it must now be possible, as Heslop suggests, to develop the finding of early autumn larvae into a useful survey technique, applicable in woods where sallows are allowed to have low branches and where flail cutters are not used.

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Larva No 111 (Henry Vaughan) crawling off his leaf on his journey into hibernation. He has yet to be relocated. Photo: Matthew Oates.

What to look out for, a typical larva, erect on a seat leaf; larva No 8 (Samuel Taylor Coleridge). Photo: Matthew Oates.