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### SUCCESSFUL TECHNIQUES FOR BREEDING THE SMALLER MICROLEPIDOPTERA

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#### INTRODUCTION

In considering a topic like this it might be best to give a bit of historical background to the subject.

I like to think that the father of microlepidopterology in the British Isles – if I can coin such a term, was Henry Tibbats Stainton who lived from 1822 to 1892. In the world of entomology, being well educated, fluent in German, French and Latin and of independent means, it gave him a unique insight into the study. His output of publications and editorships over his lifetime was prodigious and of special interest to the microlepidopterist was his monumental *Natural History of the Tineina* which appeared in thirteen volumes over an 18 year period (Stainton, 1855-1873). It is still very useful today.

Now, he was a contemporary of Philipp Christoff Zeller (1808 - 1883) who might be described as a “German” Stainton and who joined in the production of this natural history of the “Tineina” and indeed, he may well in the end have been the major author. Also involved in this work as a junior author was John William Douglas a contemporary and friend of Stainton. who was sufficiently expert in the Gelechiidae to qualify to assist. There were other collaborators too going as far afield as Austria where Heinrich Frey (1822 - 1890) contributed.

Stainton himself must have been a skilled breeder of microlepidoptera, since for instance, he was well aware of the difficulties attending the breeding of such a difficult species as the gelechiid *Monochroa arundinetella* (Stainton). Regrettably, he left little information about the methods he used, confining himself largely to descriptions and biology of species. He did however produce a small “*Entomologist's Companion*” (Stainton, 1852) and in it, devoted three brief, really uninformative paragraphs to the subject of breeding microlepidoptera.

Before I leave this fascinating person whose life is well documented by Salmon (2000), it is interesting to note that Stainton himself described some 110 species on the British List whose names still stand as well as a number of synonymised species in the literature. Zeller himself is responsible for some 160 species names on our list and Douglas himself, for about 40.

The next great microlepidopterist was Thomas de Grey, Lord Walsingham (1843 – 1919). He had the means and the fortune to garner a massive collection of microlepidoptera, which along with Zeller's collection which he purchased and other similar material containing many types was deposited in the British Museum of Natural History (BMNH). He bred many species for the first time, but did not

enlighten us about his methods. He did produce a rare pamphlet giving instructions about collecting micros, but regrettably had little to say about rearing methods, (Walsingham, 1872).

Tutt's Practical Hints first began to appear in 1901 and at last this offered some expertise with the problem of breeding the smaller moths (Tutt, 1901-1905), but after this Richard South's series of famous and standard books, so useful in my youth brought about a regrettable dichotomy in the British lepidoptera ...microlepidoptera and macrolepidoptera (South, 1907-1908). After this, interest in the former declined, but in 1949, an important ground breaking publication appeared. It was "A Guide to the Smaller British Lepidoptera" by L.T. Ford (1949). The format was somewhat akin to Scorer's (macrolepidoptera) *Log Book* (Scorer, 1913), sticking to key facts about an insect's phenology and biology. In its updated second edition, the *Guide* is now being reprinted by our Society to satisfy demand. Its editorship in the second edition was in the safe hands of Lt. Col. A.M. Emmet and the Society is now considering a completely new edition.

Members of the Amateur Entomologist's Society also have a useful publication to consult by Paul Sokoloff (1980). Colonel Emmet was also involved in another work of importance to this topic at this time which was a publication entitled "*Breeding Butterflies and Moths*". The author was Ekkehard Friedrich (1986) and was translated from the original German by Steven Whitbread and published by Harley Books in *The Moths and Butterflies of Great Britain and Ireland* (MBGBI) format. Colonel Emmet's contribution was to edit it.

Now, to the present day. It was Maitland Emmet (1976) who gave the best instruction on the subject of breeding endophytic microlepidoptera (i.e. those species developing internally in plants) in MBGBI Vol. 1. He, like me had initially been disappointed by the results from advice such as wrapping mines in tissue paper for pupation in plastic boxes. This is a guaranteed way to fail for many species since such paper is hygroscopic and desiccates the insects. (A bed of nylon is a better way for storing pupae in plastic boxes).

There is now no shortage of literature about microlepidoptera to give an idea about a species' biology so I can now get down to the "meat" of the subject. This is an attempt on my part to refine and update Maitland Emmet's techniques. Though my remarks are directed primarily at the endophytic superfamilies, especially the Nepticuloidea, they can be modified to apply to all the smaller moths or even the larger ones for that matter.

First, not the favourite pastime of an entomologist, is the necessity to go shopping to obtain the paraphernalia required to start the system. A first stop at the supermarket or other outlet should start at the dairy produce where scrutiny of the shelves should reveal 450g. Yoghurt pots with clear bodies, a removable label and a clear resealable top. The one I prefer to use is the "Yeo Valley" brand. Another brand is "Rachel's" though this one does not have clear sides. After enjoying the contents, the pot should be washed in warm water (but not cleaned in a dishwasher, because it will distort) and placed to one side with the clear top. One pot a week will produce over 50 pots in a year. A second stop should be made at the bread counter, where scrutiny of the bread wrappers will reveal that many are punctured with a myriad of small holes. After purchase of a suitable loaf the wrapper can be carefully opened at one end and then put to one side. Now the exciting bit; a visit to a lingerie department is required to obtain some tights (and of course make sure - if appropriate- you get hold of your partner's/wife's cast offs). I recommend the 15 denier black variety which gives them a reasonably good durability and when stretched over a pot, gives a good view inside. Visibility is far better with black than tan-coloured types the reason for this I know not.

The pots will now require preparing. The first act, should be to puncture the bottom with plenty of holes to secure good drainage. This can be done *en masse* using a heated skewer and stacking the inverted pot and pushing the skewer through. Next a sequence of fillers is necessary. First place two or three centimetres of pea gravel in the bottom, then three or four centimetres of moss peat mixed with a little sea or sharp sand to ensure satisfactory drainage. (Some people may have issues with the use of moss peat, but I have been using the same bag of Irish moss peat for many years). Next, sprinkle the surface with some of the pea gravel used for drainage to offer a pupating larva a choice of substrates. The pot is now ready for use except for one important ingredient, which is denatured sphagnum moss. This can be obtained by gathering a bag of sphagnum, tying it in a plastic bag and putting it on one side for a month or two in a dark place.

When the time comes to use a pot, some of the denatured sphagnum can be then placed in the pot after wetting it and squeezing out excess moisture. (It may already be wet in the storage bag). If they are leaf miners, then the moisture in the sphagnum will keep the larvae in the leaves viable until pupation or evacuation of the mine. It is important not to pack the sphagnum down too tightly. If this is done, then over a long period, especially during the winter, the material will coalesce to form a solid cake and hinder eclosion. It is then a matter of snapping the clear plastic lid over the pot (Figs 1 & 2) and writing upon the side of the pot, the identity of its contents. Inscriptions using a garden marker pen will not deteriorate over the winter if one is used.

For usage, the leaves containing larvae are placed in the pot over the damp sphagnum and kept somewhere at a reasonably constant temperature to minimise condensation of moisture on the sides of the container. There is the odd important exception: Some Nepticulidae particularly the *Fagus* feeders, require the detritus that occurs under beech trees to pupate satisfactorily, substituting this material in the pot for the moss peat. I have also found that *Crataegus* feeders benefit from use of detritus under their trees. The leaves can be checked daily and removed when the larva has vacated the mine. It is important to remember to examine the leaves upon removal in case any larvae have pupated on the host plant. This is a common occurrence with the *aurella* group of Nepticulidae. Almost all “neps.” will descend to pupate, but importantly, *Rosa* feeders will often go upwards, and pupate up on the lid or on the leaf they have recently vacated.

After removal of the leaves from the pot, it is a good idea to preserve a sample for future reference. They can be placed in photograph albums or the first day cover books sold by philatelist dealers.

Should the pot not be big enough to accommodate large leaves or even larger species, then recourse can be made to larger pots obtainable at garden centres. Stewart plastics make a good one. These are 170mm diameter (6.5”) and can be adequately sealed with sheet glass cut to 7”) with the glass resting on top. It is of course possible to use even larger plastic tubs with a larger sheet of glass to cover.

#### OVERWINTERING AND EMERGENCE.

We have the pots, we have the pupated or cocooned larvae, so now the question of their subsequent treatment has to be considered. The first action should be to consult an appropriate publication on life histories to give a clue as to whether the occupant is going to overwinter or not. If not going overwinter, then simply placing the pots outside with a degree of shelter should be alright. Otherwise it will be necessary to get the pots in as natural a condition as possible for the coming diapause. The first step is to remove the plastic snap-on lid, envelop the top of the pot with a cut off toe from a nylon stocking or tights and secure if necessary with an elastic band. (The rest of the tights of course can be used for pulling over larger tubs.) The pot should then be placed out in the open in a north facing

situation, for example in my case, I place on shelving under a hedge (Fig. 3). Emmet (1988) recommended burying the pots up to their necks in the ground, but this is not necessary and causes the pots to become messy and stained and the contents difficult to observe.

When spring is imminent, for example, early April in the south of England, the pots need to be dried out a bit, so they should be removed from their winter position and placed under shelter away from the rain to start drying out (Fig. 4). After a fortnight or so, it should be possible to remove the nylon and replace with the clear plastic snap-on lids which have been put to one side and await emergence. Some will stubbornly develop moisture on their walls all the time, so in that case it is necessary to use a hot pin to punch a few tiny holes in the lid to aid ventilation or revert back to the nylon toe.

The Nepticulidae usually emerge fairly early in the morning and slowly progress up the sides of the pot as they dry their wings and start to become very active in the mid afternoon. They will normally run round the rim of the pot and are easily seen (Fig.5). Note the cocoon in this picture is atypically at the top of the pot.

#### FORCING SPECIES

It is not a good idea to force emergence of the Nepticulidae or the Heliozelidae, but it is alright to do so with the Eriocranioidea and the Gracillarioidea. Generally, I tend not to force species of other families unless they are double brooded. If one has emerged, then it is generally safe to bring the pot into the warmth.

Returning to the Heliozelidae, they are a very difficult group to breed and it is probably best to leave them as long as possible before picking the mines, preferably just before they are about to make a case. For example, *Heliozela resplendella* (Stainton) on alder needs to be picked almost as it begins to cut its case for success and then treated like a nepticulid. This group make a case to overwinter in and for preference like to attach this to a twig or cut stem, so something like this should be added to the pot.

Examples of some specialised problems.

#### CASE FEEDERS

It is essential that the case-bearing Coleophoridae be given as much open air as possible, particularly if they are being overwintered and require ideally, a very large tub with the foodplant in a pot of water in the middle and preferably with the plant touching the nylon cover to enable the larvae to make what I can only describe as choices for fixing for overwintering. They should not be disturbed in the spring since they normally hibernate as larvae and frequently move around again in the spring. It is not uncommon for coleophorid larvae to go over for another year and I have a record of *Coleophora tricolor* Walsingham that feeds initially on basil thyme *Calamintha acinos* going over for a third year. For this species, it may well be a strategy for coping with a foodplant that is fickle in its appearance.

The same does not seem to apply to the case-bearing Tineidae which are happy in any environment and flourish satisfactorily in plastic boxes.

## GALLS

Breeding species such as the momphid *Mompha bradleyi* Riedl which forms a larval gall on great willowherb *Epilobium hirsutum* can cause difficulties and these can be overcome by recourse to the perforated bread wrapper mentioned earlier (Fig.6). The galled plants can be placed in water with a suitable stopping at the necks of the cut stems and the perforations in the wrapper will give just about the right atmosphere for the moths to complete their life cycle without the plant dying or mould killing the pupae. Similarly, larvae of the tortricid *Acleris lorquinana* (Duponchel) on purple-loosestrife *Lythrum salicaria* can be easily bred using this method which is notorious for quickly growing mouldy. Another gall feeder, *Cydia milleniana* (Adamczewski) has a special problem which applies to all larvae which feed on woody stems. They require as much air circulation around them as possible so they should be kept in the tops of the tubs as shown (Fig. 7) and fully exposed to "a' the airts - o - heaven" as PBM Allan used to say in his highly readable book (Allan, 1943) which is well worth referring to for breeding the macrolepidoptera, particularly his method of overwintering pupae.

## WOOD AND FUNGUS FEEDERS AND BIRDS' NESTS

These species will do very well in washing-up bowls with nylon tights pulled over. If they have been under shelter for a long period then the nylon can be replaced by a glass lid. With regard to birds' nests, they look innocent enough until late autumn when the fleas which have pupated in the nest material start to appear. If they are not required for study, then they are best disposed of by picking a cool day when they are torpid and brushing them out...somewhere away from your property otherwise, you may be a victim of casual feeding. This will have to be repeated a few times through the winter until spring.

## LARVAE MAKING COCCONS IN WOOD

Larvae such as the tortricid *Pammene gallicana* (Guenée) have the problem that they will chew through the nylon. These are best kept in a very large tub plus overlying large glass lid with the usual substrate and with the addition of a cut down inverted yoghurt pot which can sit in the middle so that the plant, in a container the other way up, can be removed with minimal disturbance. The sides of the tub can then be packed with some rotten wood or virgin cork which is sold by florists and is excellent for the purpose (Fig.8). The oversized tub will minimise the mould problem and the glass sheet can be moved over if the larvae start chewing through the enclosing nylon. It is also a good idea not to dry these tubs or pots out too much, but to leave them in a shady place exposed to moisture so that any cocoons do not become too dry and hardened making it difficult for the imagines to emerge.

## DISPOSAL OF THE POTS

All the materials I have mentioned should be disposed of after use in the pots. The detritophagous oecophorids *Endrosis sarcitrella* (L.) and *Hoffmanophila pseudopretella* (Stainton) show great ingenuity in invading the pots and tubs and interfering with the contents. The pots themselves can be washed and re-used. If virgin cork has been used as a pupating medium, it can be sterilised by heating and also re-used repeatedly.

## OTHER ORDERS

Though the title is directed exclusively at Lepidoptera with the emphasis on microlepidoptera it is worth mentioning that species in other Orders have similar lifestyles and the same techniques can be applied for successfully breeding them. For example, the larval mines of agromyzid flies are frequently seen in the same situations as those of microlepidoptera and would be very suitable for this kind of treatment. In the RES Series, *Handbooks for the Identification of British Insects: Agromyzidae*, (Spencer, 1972), brief reference is made to breeding methods and I think they would be ideal subjects.

#### CONCLUSIONS

I hope that this paper has provided some ideas on the techniques for successfully breeding the smaller Lepidoptera, using easily available modern materials, not only for records, but for obtaining a more complete understanding of the life histories of these fascinating creatures. Using the techniques that I have described, there is no reason why if the larvae are viable that breeding results approaching 100% cannot be obtained.

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