SECTION VIII

GENETIC EFFECTS OF THE RELEASE OF CAPTIVE-BRED LEPIDOPTERA INTO THE WILD

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Entomologists have been releasing Lepidoptera - mainly butterflies - into the British countryside for well over a century. Unfortunately few examples were thoroughly documented, if at all, and it is only recently that any assessment has been made (Thomas 1989, Morris & Thomas 1989, Oates & Warren in press). There is even less information on the genetic effects of this, which were scarcely considered in the above reviews. However, a little information can be gleaned from research on *Panaxia dominula* and other moths, and, to a lesser extent, on the Meadow Brown butterfly, *Maniola jurtina*, and research on American butterflies. This paper will therefore define the likely scale of the problem and discuss the putative genetic effects. It also contains suggestions for research that might rectify this lack of information, and recommendations for those planning future introductions; the latter complement a voluntary code of practice for insect re-establishments, drawn up by the Joint Committee for the Conservation of British Insects (Appendix 1).

The scale of introductions

Although our brief is to consider captive bred organisms, I include examples where the released stock was simply caught and released elsewhere, usually in the adult stage.

Oates and Warren (in press) have made the only thorough review of butterfly introductions in Britain and none exists for moths. Excluding the accidental or deliberate release of single individuals, and the release of common mobile species such as the Peacock, *Inachis io*, which is widely sold at butterfly farms for release in gardens, they list over 1000 examples that involved species that live in predominantly closed populations and are locally or nationally scarce. These are considered to be the tip of a large iceburg. Reasonable documentation exists for about 300 examples, involving 28 British species and 5 from abroad. Of these, at least 78 examples, involving 34% of the British species, founded new populations that existed for 5 generations or more (some survive after 65 years), although monitoring has been poor in most cases; at a local level, there are at least 9 species for which the majority of current populations in a County are the offspring of introductions (Thomas 1989).

Most introductions have involved the release of 10-100 adult Lepidoptera, although much higher numbers may be involved: Project Papillon, that was cancelled at the 11th hour in the 1980s, would have involved the release of many thousand Peacock, Red Admiral and Speckled Woods in north London, having been bred in disused glasshouses in the Channel Isles. Although examples are known of successful introductions beinning with under 10 (even 2) adults, most that have been successful involved the release of over 50 individuals.

Documented introductions date from the periods shown in Fig 1. This requires some interpretation. 19th century examples were genuinely few, but much commoner than is implied by the figure, especially from c1850 onwards

when collecting became a popular pastime and entomologists began to breed stock, often releasing surplus in their neighbourhood. Introductions received a further fillip after 1925, when the Royal Entomological Society formed Britain's first insect conservation committee under the chairmanship of Lord Rothschild: its main recommendation was to "introduce as far as possible threatened species into new districts". This resulted in both more introductions and a tendancy for entomologists to be less secretive about this controversial practice. However by 1940 amateurs were being strongly discouraged from making introductions, and official disapproval continued until very recently. The practice is now being widely discussed within NCC, Local Naturalists Trusts, and the British Butterfly Conservation Society.

The effect of official disapproval over the last 50 years has been to drive the practice underground, and to ensure that many agreed guidelines are disregarded. There is little doubt that an increasing number of introductions has occurred, and that the 1980s has seen a dramatic increase (Oates & Warren in press). Very recently, the tide of opinion has again changed to favour introductions, mainly because it has become apparent that most local species of butterfly have poor powers of dispersal, and that many unoccupied habitats exist (perhaps temporarily) in British biotopes that are not being colonised by natural means. There is every indication that butterfly introductions will become a common conservation practice in the future (Thomas 1984, 1989, in press, Morris & Thomas 1989).

Reasons for introductions

Most butterfly examples are for conservation, usually to found new populations (or more often to re-establish extinct ones) or to boost existing populations thought to be weak. Common species such as the Peacock are released in gardens or schools for aesthetic or educational reasons. A few introductions were for ecological (though seldom genetic) research, and a few were gimics, such as the release by Samuel Jones & Co (paper makers) of many hundred of the company's logo, the Camberwell Beauty. Some collectors have also released aberrations, in the hope of increasing the proportion of these highly collectable individuals in their local populations. Genetic research on the Scarlet Tiger moth, *Panaxia dominula*, has involved the release of individuals containing known frequencies of a gene, both to found new populations and to disrupt existing populations; the persistance of this gene has then been monitored (Sheppard 1951, 1961, Ford 1971).

Many accidental introductions have also occurred, such as the release of 300 Camberwell Beauties in Avon in 1983 when a cat broke into a breeding cage. Escapes have become commonplace in the 1980s with the proliferation of Butterfly farms. This is not a problem for these exclusively involve single individuals of exotic species that are unable to survive British winters, even if their foodplant exists. The modern craze for photographing butterflies also results in many escapes, for it is common to chill the butterfly, and place it in a 'natural' setting for filming; the butterfly usually escapes when it has warmed up. However this again usually results in a single (often unfertilised) individual escaping.

Origin of stock, local races, and genetic implications

Nearly all known introductions have involved the release of British stock into other parts of Britain. This has aroused little concern among entomologists from the genetic viewpoint, so long as the Joint Committee's guidelines were adhered to. The reasoning was that the comparatively few mobile species that live in open populations are, by definition, unlikely to differ across their British ranges or possess local adaptations that might be altered, whereas it is known that most colonial species are sedentary (in many cases extremely so), and introductions should be made only to isolated unoccupied sites that are beyond the dispersal range of existing populations of the species; it was therefore assumed that no mixing of genotypes would occur, otherwise the introduction would not have been necessary in the first place (Morris & Thomas 1989). This view is perhaps too simplistic on ecological and behavioural grounds, and ignores the fact that a great many entomologists disregard the guidelines. The extent to which this occurs is hard to assess, but it is perceived as a considerable problem in the future and undoubtedly already exists (M Oates pers comm). For example, Marsh Fritillaries (*Euphydryas aurinia*) have regularly been released throughout Hampshire in suitable looking places during the last 20 years. There is now probably no 'pure' native population left; most have been supplemented by the addition of bred individuals whereas other populations were founded by introductions. These are of mixed genetic stock that has been kept in captivity for many years, periodically topped up with individuals from as near as Sussex and as far as Scotland, where a distinctive morphological form exists.

There is no evidence to say whether this has been harmful. It is generally assumed that Lepidoptera that have distinct races or subspecies that are well adapted to particular regions and local climates are potentially at risk. Unfortunately, this distinction is almost always based on morphological rather than ecological characteristics, even in the case of the few genetics studies that have been made. Appendix 2 lists the 9 species that display considerable regional variation in their wing markings within the British Isles; some, such as *Coenonympha tullia*, involve clines that have highly distinctive forms at either end of the range. It should be noted that many British butterfly species also show considerable variation in size and markings within populations, and that some taxonomists have raised many of these to sub-specific status; on the other hand most European taxonomists lump all the British subspecies of every species apart from the Mountain Ringlet, *Erebia epiphron*, as belonging to a single west European subspecies of each species.

Although a useful guide, Appendix 2 cannot be taken as a list of species that might possibly be harmed if mixed with genotypes taken from elsewhere in Britain. On the one hand there may be no true ecological distinction between populations that possess distinguishable wing patterns. For example Thomas (1985) demonstrated that the so-called *caernensis* and *argus* subspecies of the Silver-studded blue, *P.argus* (an Appendix 2 species), which breed respectively on limestone pavement and acid heaths, were in fact using an identical habitat within the two biotopes, and survived equally well when transfered to the other one. On the other hand, the lack of a distinctive wing pattern does not necessarily mean that the population in a particular region is not adapted to its locality in behavioural,

ecological, physiological or other ways. Three examples are given in Appendix 3.

The fact that local races of Lepidoptera may have evolved does not necessarily mean they will be harmed by mixing with other populations. The only known example of possible harm involves the Heath Fritillary *(Mellicta athalia)* in Abbots Wood, Surrey (M Oates pers comm). This has long had two centres of populations, in east Kent and the West Country. After its extinction in Abbots Wood, the butterfly was re-established using West Country stock, which fed on *Veronica chamaedryas*. However, after some years Kentish butterflies were added to the apparently thriving colony, which soon became extinct. It is sometimes claimed that these were genetically incompatible, for the foodplant in Kent is *Melampyrum pratense*. However most entomologists suspect that Abbots Wood became less suitable for the species, and research on foodplant choice in this species does not support the theory of incompatible local races (Warren 1977).

There are a few weak pointers that suggest that wild Lepidoptera populations, experiencing natural selection, are fairly robust when mixed with different genetic stock:

1) One of the *Heliconius* species, in S America, has different coloured patterns through its range. When these were mixed, there was selection against the hybrids, with the eventual result that one of the two genotypes was eliminated. However, the population survived (Mallet & Barton 1988?).

2) In north America, the butterfly *Euphydryas media* exists in closed populations, and has a wide (and different) range of foodplants in different localities. This is genetically determined, and crosses result in larvae that have intermediate preferences. They do appear, however, to adapt quite well when mixed in the wild, ending up in favour of one foodplant or another; they have also been able to adapt to alien introduced plants in some localitites, which support the largest known populations (Thomas et al 1987). Although it is impossible to say whether any other populations were unable to mix and instead became extinct (C D Thomas pers comm), the implication is that the mixing of ecologically distinct local races is not harmful because natural selection soon readjusts the population to its particular local habitat.

3) In Britain, The Scarlet Tiger moth *(Panaxia dominula)*, exists in local closed populations that contain balanced polymorphisms, but with very different percentages of the *medionigra* (and its hetereozygote *bimacula*) gene on different sites. This is believed to reflect differences in the fitness of this gene for certain slightly different habitats that support this moth. Sheppard (1951) introduced 4000 heterozygote eggs into a population where this was absent, from a population about 2 Km away where the gene was quite common and was bestowing a distinct advantage. The next year 25% of the moths were *bimaculata* as a result of the introduction, but there was apparently selection against this, for the percentage dropped to about 7% 8 years later, which was maintained in the population for at least two more years (Ford 1971). The point for this paper is that although the introduced gene was not eliminated, the population itself was not harmed. It should be noted, however, that the race of *P.dominula* that has evolved

in central Italy is so different from Western European races that they cannot mate in the wild, because their assembling scents have diverged. But this would not necessarily result in extinction if a population of one race were mixed with the other; the two populations would presumably be kept segregated on the site, and the one best adapted to it would probably survive.

4) Similar polymorphisms temporarily occur in some British butterfly populations, and collectors sometimes breed up and introduce these highly prized specimens to their local populations. Thus 500 examples of a blue female form (*semi-syngrapha*) of the Chalkhill blue (*Lysandra coridon*) were moved from Royston to populations at Princes Risborough. This apparently had no effect and did not persist. Similarly, many examples of a simple recessive of the Ringlet (*A.hyperantus* ab *synographa)* were released into Surrey populations in the 1950s by A E Collier. However, I was unable to find any 15 years later, although the Ringlet populations were still flourishing.

Conclusions

Although the data are few and anecdotal, it is concluded that native populations of Lepidoptera have not been genetically harmed by the release of captive bred individuals or by those from distant populations. Insects have a population structure wherebye many eggs are laid but few survive, and it appears that unsuitable genotypes are quickly eliminated or

suppressed. The problem should hardly arise if the Joint Committee's guidelines were adhered to, but conservationists should recognise that these will frequently be broken in practice.

It must be stressed, however, how little hard evidence exists on which to base the above conclusions. There is clearly a considerable need for more information on the ecological genetics of Lepidoptera, for despite the many studies on clines and boundary effects that masquerade under this name, extremely few studies have shown what this means to fitness in the wild, and how any harm is caused. Equally important is the need for better information on the dispersal of apparently sedentary species, for this will determine how much introduced populations mix.

The need for this information has become important because it is clear that introductions involving bred Lepidoptera will become much commoner in the future, and form a significant part of European conservation programmes (Thomas 1989, Morris & Thomas 1989, Oates & Warren in press). In the absence of this knowledge, it is strongly recommended that the Joint Committee guidelines (Appendix 1), as well as those of Oates & Warren are adhered to. In addition, it is suggested that no introductions of local races (Appendix 2) are made to diffferent regions, unless this is impossible because the species or race is extinct in the region. This applies even more to introductions from continental Europe, where populations of most species have been isolated from the British ones for about 7500 years (= 7500 or 15000 generations). Indeed this should only be permitted when an extinct species is being reintroduced, as has occurred

with the Large Copper *(Lycaena dispar)* and Large Blue *(Maculinea arion)* butterflies.

Appendix 1 See attached

Appendix 2 Species of butterfly that have morphologically distinct subspecies, races or clines in different parts of the UK.

Meadow Brown	*Maniola jurtina*
Large Heath	*Coenonympha tullia*
Grayling	*Hipparchia semele*
Mountain Ringlet	*Erebia epiphron*
Scotch Argus	*Erebia aethiops*
Marsh Fritillary	*Euphydryas aurinia*
Northern Brown Argus	*Aricia artaxerxes*
Silver-studded Blue	*Plebejus argus*
Common Blue	*Polyommatus icarus*
Small Copper	*Lycaena phlaeas*

Appendix 3. Examples of British butterfly species that have evolved races without distinct wing patterns but which are adapted to a particular region for ecological, behavioural or physiological reasons.

1) Swallowtail *(Papilio machaon)*: Wing patterns on British and European specimens are almost identical. However the species is common, widespread and mobile on the continent, is not confined to wetland, and has a wide range of Umbelliferous foodplants (Wiklund 1974, 1975): In Britain it is a

great rarity, now confined to the Norfolk Broads, where larvae feed solely on *Peucedanum palustre*, and is fairly sedentary. Continental specimens occasionally migrate to Britain and found populations which survive by eating wild carrot for a few years on southern downs. Most entomologists consider that these belong to distinct physiological subspecies, of which the European form is clearly unable to persist in Britain. However, among British (*britannicus*) Swallowtail populations, selection has favoured local forms suited to the isolation, dynamics and size of their breeding grounds. This occurred at the Wicken Fen in the 19th century and in the Broads early this century, when fragmentation of the habitat coincided, over about 30 years (=generations), with a change in mean body dimensions believed to favour more sedentary behaviour (Dempster et al 1976, Dempster in press).

Large Blue (*Maculinea arion*). This highly variable species has been split into scores of 'subspecies' based on spot patterns, but is generally lumped into three major European subspecies. However I have found that one of these, the Alpine form, is probably identical in behaviour and ecological requirements to northern populations of the lowland subspecies, whereas the latter occurs in two physiologically distinct forms, which effects adult emergance time by about a month and hence the foodplant on which egglaying occurs. This makes southern European specimens completely unsuitable for British conditions. Even in Britain, populations appear to have experianced the same morphological (and not wing pattern) changes found in the Swallowtail as sites became more isolated, with an encouraging example of a recovery of a large thorax in the late 19th century Cotswold populations when the habitat increased in area and extent (Dempster in press).

Meadow Brown (*Maniola jurtina*). The small black spots on the hindwing of this species are variable and were believed to be insignificant, although distinctive patterns predominate in different parts of the country. It is now known that these are linked to the larger eyespot on the tip of the forewing, and that variation in this is subject to different degrees of selection by predators, depending on the nature of the habitat (Brakefield 1984). Populations in open habitats, especially at high altitude, are seldom attacked by birds and have fewer, smaller spots. There is always much variation within populations, however, and it is assumed that natural selection would recify any imbalance created by an introduction.

Appendix 1

INSECT RE-ESTABLISHMENT — A CODE OF CONSERVATION PRACTICE

Joint Committee for the Conservation of British Insects

Introduction

The use of re-introductions and re-establishment of animals and plants, as part of projects aimed at re-creating habitats and communities, is widely accepted as constructive for the conservation of the countryside.

The Joint Committee for the Conservation of British Insects has been concerned at the lack of coordination, documentation or advice available on appropriate techniques for the re-establishment of insects. Accordingly, it has produced this code of conduct, which it hopes will have wide application. It has consulted with other conservation organisations and is currently pressing the Nature Conservancy Council to produce a nationally accepted policy with guide-lines for re-establishment and re-introduction.

This code of conduct has been agreed by the members of the Committee, representing the Royal Entomological Society, the British Butterfly Conservation Society, The British Entomological and Natural History Society, the Amateur Entomologist's Society, the British Museum (Natural History), the IUCN (SSC) Butterfly Specialist Group, and by observers of the Nature Conservancy Council, National Trust, Forestry Commission, Agricultural Development and Advisory Service and the Ministry of Defence on the Joint Committee.

1. Cautionary Foreword

Entomologists and conservationists are by no means agreed about the rôle establishment of invertebrates (see 'Definitions', 2. below) should play in the conservation of species and sites. Indeed, some insect conservationists believe that establishment of species may do more harm than good. Others are convinced that, under due safeguard, establishment of species has an increasingly important rôle in conservation. It is for these that this code is written. The Commmittee *recommends* that no specific proposal for insect re-establishment be condemned or approved without full discussion and consideration.

Any proposal to establish a population of insects must consider the objectives of doing so, together with the points for and against, including theoretical and practical ones. These cannot be set out fully in a code of practice, but the Committee is always willing to advise on particular cases.

However, the Committee believes that some ecological principles have been misunderstood in relation to establishment, and it urges that a thorough ecological assessment be made when considering the points for and against any establishment.

2. Definitions

Re-establishment means a deliberate release and encouragement of a species in an area where it formerly occurred but is now extinct. It is recommended that no species should be regarded as locally extinct unless it has not been seen there for at least five years.

Introduction means an attempt to establish a species in an area where it is not known to occur, or to have occurred.

Re-introduction means an attempt to establish a species in an area to which it has been introduced but where the introduction has been unsuccessful.

Reinforcement means an attempt to increase population size by releasing additional individuals into the population.

Translocation means the transfer of individuals from an endangered site to a protected or neutral one. Translocation is of less importance to insects than to longer-lived animals, such as mammals.

Establishment is a neutral term used to denote any attempt made artifically and intentionally to increase numbers of any insect species by the transfer of individuals.

3. Objectives

Objectives in establishing insect populations are many and varied. The three most important objectives are pest control, scientific research and wildlife conservation.

Biological, natural and integrated control are three types of pest management aimed at the establishment of insect populations. Biological control uses introductions, specifically. Establishments for pest control are not considered further in this code, though it may be helpful in planning them. Attention is drawn to the provisions of the Wildlife and Countryside Act 1981, which prohibit the introduction of alien species to the United Kingdom (Part I, Section 14).

Establishments of insect populations for scientific research are often temporary, being made to elucidate some principle of scientific theory or practice. In most of its provisions, this code is relevant to this type of establishment.

Establishments of insect populations for conservation are arguably acceptable in principle, but are affected by individual circumstances, by the aims of conservation, and by considerations of geographical scale. Establishments cannot replace biotope conservation, or ensure conservation of species over their natural range.

Establishment of insect populations for conservation should focus particularly on the re-establishment of nationally threatened species, but the establishment of a particular resource, such as an attractive butterfly, for the enhancement of human enjoyment can also be considered. Re-establishments are particularly important because of recent trends in land-use (see 4. below).

It is recommended that for any proposed re-establishment, its *objectives* are clearly formulated, in detail, and made freely available for examination by responsible organisations (e.g. NCC, this Committee, BRC, DBCS). The need for confidentiality in particularly sensitive cases is recognised.

4. Trends in wildlife conservation

Whilst it is not the purpose of this code to advocate the use of re-establishments for conservation, the trend over the last 30 years has at least shown that they must be increasingly considered.

In the past, wildlife in some areas has been able to survive only because agriculture and forestry have been relatively inefficient in maximising yields of crops and timber.

Intensification of agriculture (and, to a lesser degree, forestry) has destroyed wildlife habitats over a wide area, leaving nature reserves as the most important wildlife refugia.

Nature reserves are a series of isolated and fragmented areas. Virtually all need to be managed to preserve their wildlife interest, but some have lost species through the lack of appropriate management. Some species may be particularly vulnerable to extinction in small reserves.

Although local extinctions and recolonisations have been the usual pattern in nature, the isolation of nature reserves makes recolonisation uncertain and unreliable.

The rehabilitation of nature reserves, and their creation from disused or abandoned land, may suggest the intervention of Man to establish wildlife in them.

Contrary to a widely held belief, many successful re-establishments have been made over the last few decades.

5. Planning for re-establishment

Re-establishment for conservation may be species-orientated or site-orientated.

Species-orientated re-establishments are primarily aimed at endangered or vulnerable species whose very existence in the country is threatened by habitat destruction and change. Such species obviously merit particular attention. In some instances, it is appropriate also to consider introduction, in which case the risk of displacing other organisms should be considered.

Site-orientated re-establishments are usually aimed at enhancing the wildlife of a site (usually a nature reserve) by providing a showy, or otherwise valuable, species that was formerly present but has become extinct.

In practice, both site-orientated and species-orientated re-establishments are dependent on adequate preparation of the site, or sites, to receive the species selected.

There is little point in attempting to re-establish a species if its ecological requirements are not known or understood. It is recommended that every proposal for re-establishment states the detailed ecological needs of the species concerned and how they are to be met.

Although local extinctions may occur from a variety of events, a very common cause is simply lack of, or inappropriate, habitat management. Virtually no reserve (or other site) consists of 'climax' vegetation, and most are changing with time in the absence of management. It is recommended that no re-establishment be attempted unless the cause of extinction is well understood, and can be reversed. This is the counterpart to the paragraph above.

Before proceeding to prepare a site for re-establishment, it must be considered whether objections, theoretical and practical, have been given due weight. Is the proposed receiving site large enough? Will the re-established colony require constant reinforcement? Have genetic implications been fully thought out?

In the planning stage, an assessment of the impact of the proposed re-establishment on the receiving site should be prepared. Possible effects on other wildlife, especially species of conservation value, should be considered.

6. **Preparing the receiving site**

Permission to re-establish any species must be obtained from the owner-occupier of the designated site.

The adequacy of resources for the species on the receiving site should be determined, preferably through research.

The ecological conditions necessary for the re-established species must be imposed on the site before the re-establishment is attempted. Where continuous, regular or periodic management is required, this must be to an agreed, detailed plan, and the body attempting the re-establishment must be satisfied that management will proceed in accordance with the plan.

Re-establishment of any species, and the re-creation of its habitat, must be compatible with the objectives of management for the receiving site, and conform to the provisions of the management plan. Apparently incompatible objectives can often be achieved by suitable rotational management.

It is recommended that the attempted re-establishment be discussed fully with the site owner/occupier, and with the full reserve committee and scientific committee, as well as the warden, in the case of nature reserves.

It is important to consult NCC because an SSSI may be involved. There are implications under the Wildlife and Countryside Act, 1981, if this is the case.

7. **The source of stock for re-establishment**

An attempt at re-establishment must not weaken or harm the source population from which the stock is obtained. (Most colonies of insects, with a high rate of intrinsic natural increase, are able to withstand the removal of stock, if their habitat is in a satisfactory condition.)

Permission to take stock for re-establishment elsewhere must be obtained from the owner/ocupier of the source site. The provisions of the Wildlife and Countryside Act, 1981, must be complied with. Advice can be obtained from regional officers of the Nature Conservancy Council.

The community of which the species for re-establishment is a part must be considered, and reproduced as far as possible on the receiving site. Specific parasites should be introduced with the source stock, if possible, as these are inevitably rarer, and therefore in even greater need of conservation than their hosts. An exception should of course be made where the purpose of the establishment is biological control rather than species conservation.

Stock of an ecological type most similar to that formerly inhabiting the receiving site should be chosen. Usually this will mean a source close to the receiving site, but not to the exclusion of other factors. Stock from a similar biotope should be preferred to a geographically closer but dissimilar biotope.

Consideration should be given to breeding in captivity stock for later release. In this way, numbers may be increased with less damage to the source.

The stage (egg, larva, pupa, imago) for release depends on circumstances; there is no generally applicable rule. Species with sedentary adults may be released with the exception that eggs will be laid in the most appropriate sites. Active adult insects may leave the site before oviposition. Larger numbers of immature stages than adults should be used in re-establishment, to allow for mortality between release and reproduction.

Numbers of released insects must be adequate to achieve re-establishment. Small numbers are often ineffective.

Detailed records of the exact procedures used in the attempt at re-establishment should be kept.

8. **Monitoring re-establishments**

All attempts at re-establishment, whether successful or not, should be reported to the Biological Records Centre (ITE, Monks Wood), and to this Committee. Confidentiality, if required, is assured. Secretive attempts can confuse others and result in lost information.

A standard form for recording re-establishments has been produced by this Committee, is available *gratis* from the Biological Records Centre, and should be sent, when completed, to the Committee's Surveys Officer. The relevant addresses are at 10. below.

Detailed assessment of the success of any attempt at re-establishment should be made, with continual re-assessment at frequent and regular intervals. Such assessment should consider resources and other species.

In the case of butterfly re-establishments, success can be monitored using transect 'walks', undertaken during the adult flying period and compared with regional and national trends derived from the Butterfly Monitoring Scheme. Details may be obtained from this Committee or the organiser of the Scheme, Dr E. Pollard (ITE, Monks Wood Experimental Station).

As far as possible, re-establishments should be written up and published, so contributing to a common store of expertise.

9. Summary of main recommendations

1 Consult widely before deciding to attempt any re-establishment.

2 Every re-establishment should have a clear objective.

3 The ecology of the species to be re-established should be known.

4 Permission should be obtained to use both the receiving site and the source of material for re-establishment.

5 The receiving site should be appropriately managed.

6 Specific parasites should be included in re-establishment.

7 The numbers of insects released should be large enough to secure re-establishment.

8 Details of the release should be meticulously recorded.

9 The success of re-establishment should be continually assessed and adequately recorded.

10 All re-establishments should be reported to the Biological Records Centre and this Committee.

10. Useful addresses

Biological Records Centre, Monks Wood Experimental Station, Huntingdon, PE17 2LS.

Butterfly Monitoring Scheme, address as above.

JCCBI, c/o Royal Entomological Society of London, 41 Queen's Gate, London, SW7 5HU.

Nature Conservancy Council, Northminster House, Peterborough, PE1 1UA.

British Butterfly Conservation Society, Tudor House, Quorn, Loughborough, Leicestershire, LE12 8AD.

Amateur Entomologists' Society (Conservation Committee), 54 Cherry Way, Alton, Hampshire, GU34 2AX.

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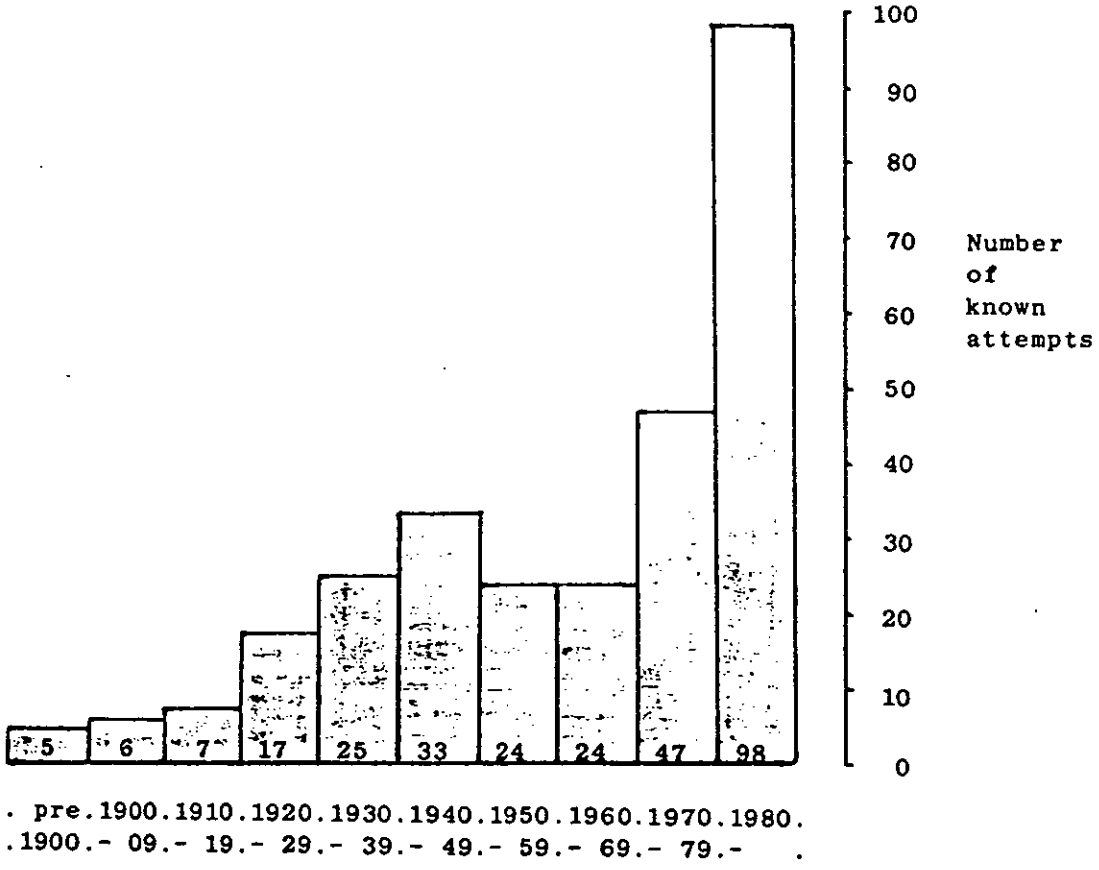
FIG. 1: HISTOGRAM SHOWING NUMBER OF KNOWN RELEASES DECADE BY DECADE.



Oates & Warren in press.