©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at
Atalanta (June 2001) **32**(1/2): 3-49, Würzburg, ISSN 0171-0079

A UK Perspective to Immigrant Lepidoptera in Europe: A Comparison of Migratory Species on the Continental Mainland with those of Great Britain and its County of Sussex

by
COLIN R. PRATT
received 10.I.2001

The purpose of this paper is to put on widely accessible record the species of Lepidoptera so far suspected of exhibiting the migratory instinct in Sussex and Great Britain, together with a comparison with European experience, and supplemental information on the historical background to recording, the countries of origin, numerical cycles and trends, colonisation, and the effects of natural global warming, so that both amateur and professional students of insect migration can compare research, experiences, and opinion, in their quest for knowledge.

Introduction

The county of Sussex is extensive, covering around 4,000 square kilometres. It encompasses many different habitats, each of which provide a home for a range of native butterflies and moths—but, being a maritime district on the south coast of England, the area is also ideally situated to receive boreal-flying insects migrating from the continent. The British Isles as a whole is also well located between 40 and 160 kilometres to the north of France on the European mainland. Even so, it has been said that these islands are only "on the fringe of the reception area for a wide range of species which come to them at irregular times from several directions in greatly varying numbers" (BRETHERTON, 1983). But the main disadvantage of such geographical positioning is that knowledge of the phenomenon of insect migration is largely restricted to the receipt of specimens, emigration to the south being a much less obvious phenomenon apparently restricted to just a few species.

The historical background

In Great Britain the recording of rare insects stretches back more than 150 years, although early on very few lepidoptera were suspected of being continental in origin. R. SOUTH was the first to propose that butterflies and moths might be arriving from the continent, in 1885 (SOUTH, 1885). C. G. BARRETT then made a number of incidental references to migration in his great work published during the 1890's and 1900's (BARRETT, 1893-1907), and J. W. TUTT added the first relevant collation of records (TUTT, 1902). After an inspirational personal experience of a butterfly migration in South America in 1916 (WILLIAMS, 1917), and after 14 more years of gathering a large number of references concerning such events from all over the world, C. B. WILLIAMS published his pioneering book on the subject in 1930 (WILLIAMS, 1930). After a lifetime of interest, he followed up this research with another book dedicated to the

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at

same subject in 1958, reissued in 1965 (WILLIAMS, 1965). The 1930 work stimulated others to action in Great Britain—one year later the Insect Migration Committee of the South-Eastern Union of Scientific Societies started to organise the collection of immigration records. In 1932 the first of an annual national collation appeared in "The Entomologist" magazine. The list was compiled by a hitherto unsung hero of entomological history, the mariner Captain TRISTRAM DANNREUTHER of Hastings in East Sussex. He continued these summaries every year in the Entomologist until 80 years old in 1953.
DANNREUTHER was succeeded by R. A. FRENCH of Rothamsted Experimental Station, who carried the torch until 1968, then the late R. F. BRETHERTON—the country's foremost modern authority on such matters—M. CHALMERS-HUNT, B. SKINNER, and M. S. PARSONS, up until the present day. A peerless and detailed modern review of all aspects of immigration to Great Britain was made by BRETHERTON in 1983 (1983).

Captain T. DANNREUTHER, in about the 1920's. Source: PRATT (1999).

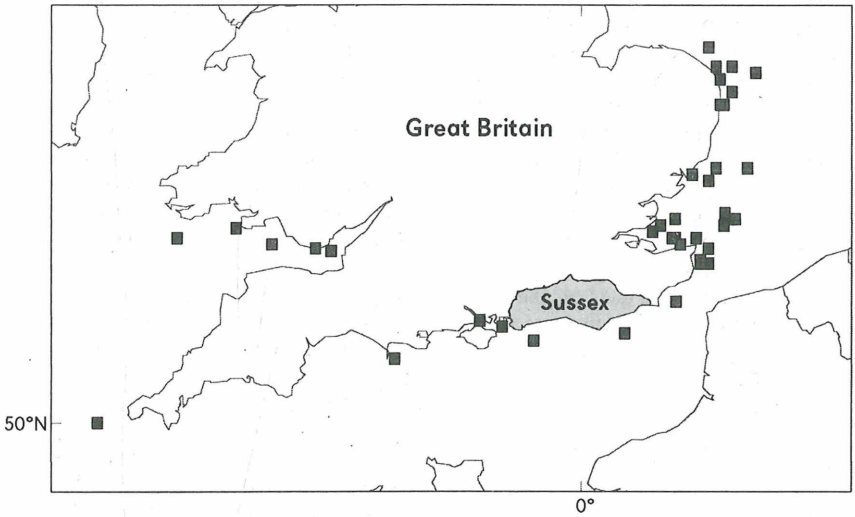
Light vessels

So far as recording the migration of night-flying insects is concerned, one of the most important practical benefits of being an island during the first half of the 20th century was that manned light vessels were situated several miles out to sea all around the coast, many being moored between mainland Europe and Britain. Vessels plying their trade off the coast of Sussex had been nocturnally alerted of the danger of rocks and shallows by the use of ship-borne lights since the 18th century—the "Ower's" light vessel was first moored seven miles off Selsey Bill in the west in 1788, the Royal Sovereign" being similarly positioned off Eastbourne in the east in 1875. In about 1900 the warning lights on these boats were powered by six two-wick burning oil-lamps, these then being quickly replaced by an arrangement of eight revolving 350 watt tungsten filament electric light bulbs powered by a diesel generator producing 100 volts of direct current (TRINITY HOUSE, pers. comm.). At this time a map of all of the country's light ships and lighthouses was published (BARTHOLOMEW, 1904).
A few seafarers on light-vessels were amateur entomologists, who relieved long hours of boredom by catching and identifying insects which sheltered on board or which came to the powerful warning light. Serving officers made a number of important discoveries, provided irrefutable evidence that particular butterflies and moths occurred several kilometres out to sea

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at

The Royal Sovereign light vessel moored off Sussex, when oil-lamp-powered in about 1905. Source: PRATT (1999).

in the English Channel, and added many new and surprising species to the list of suspected immigrants to the British Isles. Several different masters made entomological observations off Sussex during the 1930's and 1940's, including S. J. ROWE, F. J. MORGAN, and W. F. WILGRESS, but the most enthusiastic was S. G. SHARMAN who began in 1948. Their discoveries have recently been collated (PRATT, 1999), as were those mentioned earlier from ships moored off other parts of the country (WILLIAMS, COCKBILL, GIBBS & DOWNES, 1942). A few years later the Ower's was replaced by a light buoy. Then the Royal Sovereign dropped out of the entomological arena in 1960, and



The distribution of manned light vessels off Southern Britain, in 1927. Source: Compiled from data provided by TRINITY HOUSE, London.

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at
it too was supplanted in 1971—after all of those years of history, the last manned floating station off Sussex had been replaced by the more advanced technology of an automatic metal halide-sourced beacon. Since those years, powerfully-lit oil-rigs have been placed in some areas of the North Sea, but none are situated in the English Channel and maritime lepidopterists are rare.

Field experience in Great Britain

While field research into native species is always inspirational, the most exciting entomological events in coastal counties often concern the arrival of rare insects from the European mainland or unusually high levels of universal species from the same source. Varying numbers of immigrant Lepidoptera can sometimes be observed flying in across the English Channel and making landfall on the seashore, both by day and night. Unsurprisingly, warm southerly breezes are the most advantageous, especially those from the south-east. For example, after being watched flying up sea-facing chalk cliffs towards a mercury vapour light positioned at Eastbourne's Holywell for two hours on separate occasions in 1989 and 1996, hundreds of *N. comes* and thousands of *Autographa gamma* and *Noctua pronuba* were counted (Pratt, 1999). Such common immigrants provide an enormous boost to the local moth populations, and there is circumstantial evidence that the proportion of melanism within our *Agrotis segetum* (Pratt, 1999) and *Tethea ocularis octogesimea* (Chalmers-Hunt, 1960–81) are occasionally significantly altered for several years.

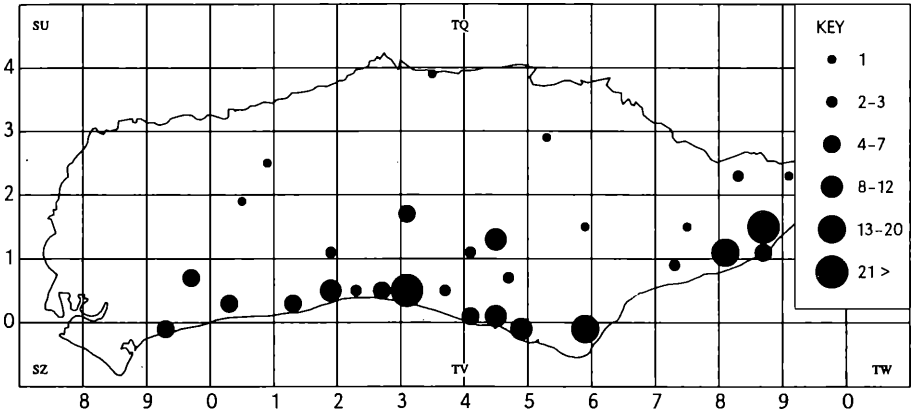
When migrating across water, normally exclusively nocturnal moths also fly by day (Bretherton, 1972) and even the butterflies *Cynthia cardui* and *Vanessa atalanta* are regularly caught in mercury vapour light-traps when pushing northwards by night—it was noticed many years ago that several different species regularly accompanied each other on these flights, and these were correlated, this suggesting a common origin (Williams, 1965). *A. gamma* sometimes swarms around coastal flowers by day and singletons of *Macroglossum stellatarum* fly at any time in any weather—day or night. Few immigrant butterflies stay longer than 24 hours on the coast, before dispersing inland in a relentless drive to the north. Moth species generally act similarly, although there are a few—such as *N. noctuella* (B. F. Skinner, pers. obs.) and *Eurois occulta* (Bretherton, 1983)—which sometimes show a disdain for further flight, and remain on the coastal strip. Examples of the most resolute species—such as *Hyles gallii, Spodoptera exigua, Macdunnoughia confusa*, and *Nymphalis antiopa*—regularly reach as far north as the Shetland Isles off the coast of Scotland, as in 1996 (Pennington, 1997). Most determined of all, after a flight of perhaps approaching 2,000 miles, *Cynthia cardui, Vanessa atalanta, Agrius convolvuli*, and *Autographa gamma*, sometimes overrun Iceland (Williams, 1930), at a latitude of 65 degrees north—and the first-mentioned butterfly occasionally even penetrates the Arctic Circle, in Finland (Williams, 1955).

Many of the main routes taken by migrating Lepidoptera across the European mainland have now been determined (Bretherton, 1983; Eitschberger, Reinhardt & Steiniger, 1991). In the UK an insect's first appearance is often in south-west England, with subsequent landfalls progressing eastwards over the following few days and nights. While sightings are therefore sometimes eventually made on a broad front of more than 300 miles of coastline, it has been

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at

known for many years that certain cross-land routes and localities are annually inexplicably peerlessly favourable for migrating insects (FORD, 1965)—more than 60 years ago that it was convincingly proposed that butterfly migration routes in Sussex "follow much the same lines as the spring-arriving birds" and that they "use river valleys as natural roads to guide them into the country behind the coast" (MACLEOD, 1939)—and it is true that some adventuring mobile natives are also thought to fly along railway-lines to colonise new sites (PRATT, 1999). Perhaps more inexplicably, throughout entomological history, *Daphnis nerii* has been far rarer in West Sussex when compared to the eastern vice-county. Similarly, so far as the commonplace butterflies are concerned, more *Colias croceus* are always to be seen to the east of Seaford in East Sussex than to the west.

After appearing in great waves, migrating insects are generally at their most dense along the south coast, just after arrival.



A. convolvuli - the numerical distribution of the 1991 migration in Sussex. Source: PRATT (1999).

News of the landfall of a continental rarity attracts a flock of collectors, recorders, and researchers, to particular places on the south-coast's seashore. The most favoured spots known for continental moths since the advent of the combinatory use of portable petrol-powered electricity generators and ultra-violet-emitting mercury vapour bulbs are land promontories at Dungeness in Kent—where up to 40 lights an evening can sometimes be seen—Portland Bill in Dorset, and at the Lizard peninsula in Cornwall. At its closest point in Kent, England and the continent are separated by less than 30 miles of sea, yet more European moths occur 110 miles away from those shores at Walberton (Arundel) in Sussex than in almost any other place in the whole of Britain—and the site is a simple domestic garden situated seven miles inland. Walberton is positioned to the north-west of one of the few gaps in the western coast's suburban sodium street-lights and domestic tungsten lights, and it could be that nocturnal insects are avoiding the all-night glow and funneling through the gap, but this particular phenomenon remains to be definitively explained.

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at

The species

Supplemental continental species often show up well amongst the comparatively impoverished native UK fauna, as do foreign specimens if they are of a different colour form as in *Eurois occulta* and *Semiothisa brunneata*, are of a monogoneutic race as *Pieris rapae*, or are of the unusually large dark ab. *cataleuca* Rob. of *P. brassicae* (Bretherton, 1983). But, so far as the continental mainland is concerned, many of the same species are permanently well established and movements of outsiders therefore much less obvious, and so suspected immigrants fewer.

So far as the maritime islands of Britain are concerned, in this work immigrant species of butterflies and moths are identified as those which first take flight abroad and make a natural landfall here without the aid of man (whether their flight is purposeful or not, and whether already a resident or not)—so a species whose history suggests that they seem more likely to have been either accidentally or purposefully introduced have been excluded. In the following table it has been assumed that authors of the reference books quoted believe each lepidopteron to be non-migratory unless a specific statement has been made to the contrary.

The Macro-Lepidoptera

Rhopalocera – the butterflies

Butterfly species	**European status** As listed in Eitschberger, Reinhardt & Steiniger (1991)	**British status** As listed in Bretherton (1983) and/or Emmet & Heath (1989)	**Sussex status** As listed in Pratt (1999)
Parnassius apollo Linn.	Non-migratory	Rare immigrant	Never detected
Papilio machaon gorganus Fruh.	Suspected immigrant	Immigrant	Rare episodic immigrant
Iphiclides podalirius Linn.	Possible immigrant	Possible occasional immigrant	Very rare suspected immigrant
Leptidea sinapis Linn.	Non-migratory [although some suspect otherwise (Lempke, 1950)]	Non-migratory	Non-migratory [although range changes are historically frequent]
Colias hyale Linn.	Occasional immigrant	Scarce immigrant [with a return flight (Williams, 1951 & 1965)]	Very rare immigrant
Colias alfacariensis Berg.	Suspected immigrant	Rare immigrant	Very rare immigrant
Colias croceus Geof.	Occasional immigrant	Regular immigrant [with a return flight (Grant, 1936; Williams, 1951 & 1965)]	Regular immigrant
Colias erate Esp.	Occasional immigrant	Never detected	Never detected
Colotis evagore Klug	Occasional immigrant	Never detected	Never detected
Catopsilia florella Fabr.	Occasional immigrant	Never detected	Never detected
Gonepteryx rhamni Linn.	Occasional immigrant	Mobile resident	Non-migratory

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at

Butterfly species	European status As listed in Eitschberger, Reinhardt & Steiniger (1991)	British status As listed in Bretherton (1983) and/or Emmet & Heath (1989)	Sussex status As listed in Pratt (1999)
Gonepteryx cleopatra Linn.	Suspected immigrant	Non-migratory	Very rare suspected immigrant
Aporia crataegi Linn.	Occasional immigrant	Non-migratory [although some suspect otherwise (Bretherton, 1951; Pratt, 1999)]	Suspected very rare immigrant
Pieris brassicae Linn.	Occasional immigrant	Regular immigrant [with a return flight (Williams, 1965)]	Regular immigrant
Pieris rapae Linn.	Occasional immigrant	Regular immigrant [with a return flight (Williams, 1965)]	Regular immigrant
Pieris napi Linn.	Occasional immigrant	Non-migratory [although some disagree (Ford, 1945)]	Episodic immigrant
Pontia daplidice Linn.	Occasional immigrant	Very scarce immigrant [with a return flight (Williams, 1965)]	Very rare immigrant
Pontia edusa Fabr.	Occasional immigrant	Never detected	Never detected
Pontia chlorodice Hbn.	Occasional immigrant	Never detected	Never detected
Euchloe simplonia Frey.	Non-migratory	Extremely rare possible immigrant	Never detected
Lycaena phlaeas Linn.	Occasional immigrant	Non-migratory	Non-migratory
Lycaena tityrus Poda	Non-migratory	Very rare immigrant	Extremely rare immigrant
Lampides boeticus Linn.	Occasional immigrant	Rare immigrant [with a return flight (Williams, 1965)]	Very rare immigrant
Leptotes pirithous Linn.	Occasional immigrant	Extremely rare immigrant	Never detected
Everes argiades Pall.	Occasional immigrant	Very scarce immigrant	Very rare immigrant
Lysandra coridon Poda	Non-migratory [although some suspect otherwise (Lempke, 1950)]	Non-migratory	Mobile native
Cyaniris semiargus Rott.	Non-migratory	Probable immigrant	Very rare immigrant
Plebicula amanda Schn.	Native coloniser	Never detected	Never detected
Vanessa atalanta Linn.	Immigrant, with a return flight	Immigrant [with a return flight (Grant, 1936; Williams, 1951 & 1965)]	Regular immigrant
Vanessa indica Herb.	Non-migratory	Extremely rare suspected immigrant	Never detected
Cynthia cardui Linn.	Immigrant, with a return flight	Immigrant, with a return flight	Annual immigrant
Cynthia virginiensis Drury	Occasional immigrant	Scarce immigrant	Very rare immigrant

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at

Butterfly species	**European status** As listed in Eitschberger, Reinhardt & Steiniger (1991)	**British status** As listed in Bretherton (1983) and/or Emmet & Heath (1989)	**Sussex status** As listed in Pratt (1999)
Aglais urticae Linn.	Occasional immigrant	Mobile resident [although some suspect otherwise (Williams, 1951 & 1965)]	Occasional immigrant
Libythea celtis Laich.	Immigrant, with a return flight	Never detected	Never detected
Polygonia c-album Linn.	Native coloniser	Native coloniser	Native coloniser
Nymphalis polychloros Linn.	Suspected immigrant	Suspected immigrant	Suspected immigrant
Nymphalis xanthomelas D. & S.	Suspected immigrant	Suspected very rare immigrant	Never detected
Nymphalis antiopa Linn.	Suspected immigrant	Regular immigrant	Episodic immigrant
Inachis io Linn.	Occasional immigrant	Mobile resident	Suspected occasional immigrant
Araschnia levana Linn.	Non-migratory	Suspected very rare immigrant	Never detected
Argynnis lathonia Linn.	Occasional immigrant	Scarce episodic immigrant [with a return flight (Williams, 1965)]	Rare occasional immigrant
Argynnis pandora D & S.	Non-migratory	Suspected extremely rare immigrant	Never detected
Lasiommata megera Linn.	Non-migratory	Non-migratory	Non-migratory [although a single circumstantial record does exist]
Hipparchia semele Linn.	Suspected immigrant	Non-migratory	Non-migratory
Arethusana arethusa D. & S.	Non-migratory	Suspected extremely rare immigrant	Never detected
Maniola jurtina Linn.	Non-migratory	Non-migratory	Non-migratory [although a few circumstantial records do exist]
Coenonympha pamphilus Linn.	Non-migratory	Non-migratory [although some suspect otherwise (Beirne, 1947)]	Non-migratory
Danaus plexippus Linn.	Occasional immigrant, with a return flight	Immigrant [with a return flight (Williams, 1951 & 1965)]	Scarce episodic immigrant
Danaus chrysippus Linn.	Occasional immigrant	Never detected	Never detected

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at

Macro-moth species	European status As listed in Eitschberger, Reinhardt & Steiniger (1991)	British status As listed in Bretherton (1983) and/or Skinner (1984 & 1998)	Sussex status As listed in Pratt (1999)
Zeuzera pyrina Linn.	Non-migratory	Non-migratory	Non-migratory [although a few circumstantial records do exist]
Malacosoma neustria Linn.	Non-migratory	Non-migratory [although some suspect otherwise (Beirne, 1947)]	Non-migratory
Philudoria potatoria Linn.	Non-migratory	Non-migratory	Non-migratory [although one circumstantial record does exist]
Gastropacha quercifolia Linn.	Non-migratory	Non-migratory [although some suspect otherwise (Beirne, 1947)]	Non-migratory
Dendrolimus pini Linn.	Non-migratory	Suspected very rare immigrant	Never detected
Saturnia pyri D. & S.	Non-migratory	Possible very rare immigrant	Never detected
Drepana curvatula Bork.	Non-migratory	Suspected rare immigrant	Very rare immigrant
Tethea ocularis octogesima Hbn.	Non-migratory	Suspected immigrant	Non-migratory
Aplasta ononaria Fues.	Non-migratory [although some suspect otherwise (Lempke, 1950)]	Suspected immigrant	Very rare suspected immigrant
Thalera fimbrialis Scop.	Non-migratory	Immigrant	Very rare immigrant
Cyclophora puppillaria Hbn.	Occasional immigrant	Immigrant	Scarce immigrant
Scopula nigropunctata Hufn.	Non-migratory	Suspected immigrant	Rare suspected immigrant
Scopula ornata Scop.	Non-migratory	Non-migratory	Suspected immigrant
Scopula rubiginata Hufn.	Non-migratory	Suspected immigrant	Very rare suspected immigrant
Scopula imitaria Hbn.	Non-migratory	Non-migratory [although some suspect otherwise (Beirne, 1947)]	Non-migratory
Idaea vulpinaria atrosignaria Lemp.	Non-migratory	Non-migratory	Suspected occasional immigrant
Idaea emarginata Linn.	Non-migratory	Non-migratory [although some suspect otherwise (Beirne, 1947)]	Non-migratory
Idaea aversata Linn.	Non-migratory	Non-migratory [although some suspect otherwise (Beirne, 1947)]	Non-migratory
Idaea degeneraria Hbn.	Non-migratory	Non-migratory	Suspected immigrant
Rhodometra sacraria Linn.	Occasional immigrant	Immigrant	Episodic immigrant

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at

Macro-moth species	European status As listed in Eitschberger, Reinhardt & Steiniger (1991)	British status As listed in Bretherton (1983) and/or Skinner (1984 & 1998)	Sussex status As listed in Pratt (1999)
Orthonama obstipata Fabr.	Occasional immigrant	Immigrant	Episodic immigrant
Xanthorhoe biriviata Bork.	Non-migratory	Non-migratory [although some suspect otherwise (Agassiz, 1996)]	Suspected rare immigrant
Xanthorhoe montonata montonata D. & S.	Non-migratory	Non-migratory [although some suspect otherwise (Beirne, 1947)]	Non-migratory
Xanthorhoe fluctuata Linn.	Non-migratory	Non-migratory	Non-migratory [although a single circumstantial record does exist]
Scotopteryx peribolata Hbn.	Non-migratory	Suspected immigrant	Suspected very rare immigrant (pers. obs.)
Scotopteryx luridata plumbaria Fabr.	Non-migratory	Non-migratory	Suspected occasional rare immigrant
Camptogramma bilineata bilineata Linn.	Non-migratory	Non-migratory [although some suspect otherwise (Beirne, 1947)]	Non-migratory
Lampropteryx otregiata Metc.	Non-migratory	Non-migratory	Possible very rare immigrant
Thera cupressata Gey.	Non-migratory	Suspected immigrant	Immigrant
Spargania luctuata D.&S.	Non-migratory	Suspected immigrant	Suspected immigrant
Rheumaptera cervinalis Scop.	Non-migratory	Non-migratory	Suspected immigrant
Euphyia biangulata Haw.	Non-migratory	Non-migratory	Suspected occasional immigrant
Eupithecia abietaria Goeze	Non-migratory	Status uncertain	Possible immigrant
Eupithecia centaureata D. & S.	Non-migratory	Non-migratory [although some suspect otherwise (Beirne, 1947)]	Non-migratory
Eupithecia intricata arceuthata Frey.	Non-migratory	Non-migratory	Possible immigrant
Eupithecia phoeniciata Ramb.	Non-migratory	Non-migratory [although some suspect otherwise (Agassiz, 1996)]	Suspected occasional immigrant
Eupithecia ultimaria Boisd.	Non-migratory	Suspected immigrant	Suspected occasional immigrant
Eupithecia sinosaria Ever.	Non-migratory	Suspected very rare immigrant	Never detected
Eupithecia lariciata Frey.	Non-migratory	Non-migratory [although some suspect otherwise (Barrett, 1893–1907)]	Non-migratory
Aplocera praeformata Scop.	Non-migratory	Suspected very rare immigrant	Never detected

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at

Macro-moth species	European status As listed in Eitschberger, Reinhardt & Steiniger (1991)	British status As listed in Bretherton (1983) and/or Skinner (1984 & 1998)	Sussex status As listed in Pratt (1999)
Abraxas grossulariata Linn.	Non-migratory	Non-migratory [although some suspect otherwise (Beirne, 1947)]	Non-migratory [although a single circumstantial record does exist]
Abraxas sylvata Scop.	Non-migratory	Suspected occasional immigrant	Suspected occasional immigrant
Stegania trimaculata De Vill.	Non-migratory	Suspected very rare immigrant	Never detected
Semiothisa signaria Hbn.	Non-migratory	Status unknown	Suspected occasional immigrant
Semiothisa clathrata clathrata Linn.	Non-migratory	Non-migratory	Suspected occasional immigrant
Semiothisa brunneata Thunb.	Non-migratory	Suspected immigrant	Never detected
Cepphis advenaria Hbn.	Non-migratory	Non-migratory	Suspected occasional immigrant
Opisthograptis luteolata Linn.	Non-migratory	Non-migratory [although some suspect otherwise (Beirne, 1947)]	Non-migratory
Ennomos autumnaria Wern.	Non-migratory	Suspected immigrant	Suspected occasional immigrant
Annomos alniaria Linn.	Non-migratory	Non-migratory [although some suspect otherwise (Beirne, 1947)]	Non-migratory
Selenia dentaria Fabr.	Non-migratory	Non-migratory [although some suspect otherwise (Beirne, 1947)]	Non-migratory
Selenia lunularia Hbn.	Non-migratory	Non-migratory	Suspected occasional immigrant
Crocallis dardoinaria Donz.	Non-migratory	Suspected very rare immigrant	Never detected
Ourapteryx sambucaria Linn.	Non-migratory	Non-migratory [although some suspect otherwise (Beirne, 1947)]	Non-migratory
Lycia hirtaria Cl.	Non-migratory	Non-migratory [although some suspect otherwise (Beirne, 1947)]	Non-migratory
Peribatodes secundaria Esp.	Non-migratory	Suspected immigrant	Suspected rare immigrant
Perobatodes ilicaria Gey.	Non-migratory	Suspected very rare immigrant	Never detected
Cabera exanthemata Scop.	Non-migratory	Non-migratory [although some suspect otherwise (Beirne, 1947)]	Non-migratory [although a single circumstantial record does exist]
Lomographa temerata D. & S.	Non-migratory	Suspected immigrant	Suspected occasional immigrant

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at

Macro-moth species	European status As listed in Eitschberger, Reinhardt & Steiniger (1991)	British status As listed in Bretherton (1983) and/or Skinner (1984 & 1998)	Sussex status As listed in Pratt (1999)
Hylaea fasciaria Linn.	Non-migratory	Suspected immigrant	Possible occasional immigrant
Siona lineata Scop.	Non-migratory	Non-migratory	Suspected rare immigrant
Aspitates gilvaria gilvaria D. & S.	Non-migratory	Non-migratory	Suspected occasional immigrant
Agrius convolvuli Linn.	Immigrant, with a return flight	Immigrant	Immigrant
Acherontia atropos Linn.	Immigrant, with a return flight	Immigrant	Immigrant
Sphinx ligustri Linn.	Non-migratory	Occasional immigrant	Possible occasional immigrant
Sphinx drupiferarum Smith	Non-migratory	Possible very rare immigrant	Never detected
Hyloicus pinastri Linn.	Suspected immigrant	Non-migratory	Episodic immigrant
Mimas tiliae Linn.	Non-migratory	Non-migratory	Suspected occasional immigrant
Smerinthus ocellata Linn.	Non-migratory	Non-migratory	Non-migratory [although a single circumstantial record does exist]
Proserpinus proserpina Pall.	Non-migratory	Suspected very rare immigrant	Very rare immigrant
Macroglossum stellatarum Linn.	Occasional immigrant	Immigrant [with a return flight (Williams, 1965)]	Immigrant
Daphnis nerii Linn.	Occasional immigrant	Immigrant	Rare immigrant
Hyles euphorbiae Linn.	Occasional immigrant	Very rare immigrant	Rare immigrant
Hyles gallii Rott.	Occasional immigrant	Immigrant	Episodic immigrant
Hyles nicaea de Prun.	Non-migratory	Uncertain [not listed in Skinner (1984 & 1998) but probable immigrant in Bretherton (1983)]	Never detected
Hyles lineata livornica Esp.	Occasional immigrant	Immigrant	Episodic immigrant
Hippotion celerio Linn.	Occasional immigrant	Immigrant	Rare immigrant
Notodonta torva Linn.	Non-migratory	Very rare immigrant	Suspected very rare immigrant (pers. obs.)
Tritophia tritophus D. & S.	Non-migratory	Very rare immigrant	Never detected
Harpyia milhauseri Fabr.	Non-migratory	Very rare immigrant	Suspected very rare immigrant
Ptilodon capucina Linn.	Non-migratory	Non-migratory [although some suspect otherwise (Beirne, 1947)]	Non-migratory
Gluphisia crenata Esp.	Non-migratory	Possible very rare immigrant	Never detected
Clostera anachoreta D. & S.	Non-migratory	Suspected immigrant	Suspected immigrant (pers. obs.)

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at

Macro-moth species	European status As listed in Eitschberger, Reinhardt & Steiniger (1991)	British status As listed in Bretherton (1983) and/or Skinner (1984 & 1998)	Sussex status As listed in Pratt (1999)
Thaumetopoea processionea Linn.	Non-migratory	Suspected very rare immigrant	Never detected
Euproctis chrysorrhoea Linn.	Non-migratory	Non-migratory [although some suspect otherwise (Barrett, 1896–1907)]	Non-migratory [although a single circumstantial record does exist]
Euproctis similis Fues.	Non-migratory	Non-migratory	Suspected occasional immigrant
Leucoma salicis Linn.	Non-migratory	Immigrant	Non-migratory [although some suspect otherwise (Adkin, 1930)]
Arctornis l-nigrum Müll.	Non-migratory	Suspected immigrant	Suspected immigrant
Lymantria dispar Linn.	Non-migratory	Probable immigrant	Suspected rare immigrant
Setina irrorella Linn.	Non-migratory	Non-migratory	Suspected occasional immigrant
Atolmis rubricollis Linn.	Non-migratory	Non-migratory	Suspected immigrant
Pelosia muscerda Hufn.	Non-migratory	Possible immigrant	Possible immigrant
E. griseola Hbn.	Non-migratory	Non-migratory [although some disagree (Brown, 1996a)]	Non-migratory
Eilema caniola Hbn.	Non-migratory	Possible immigrant	Suspected immigrant
Eilema pygmaeola pygmaeola Doub.	Non-migratory	Suspected immigrant	Possible immigrant
Eilema deplana Esp.	Non-migratory	Non-migratory [although some disagree (Brown, 1996a)]	Non-migratory
Lithosia quadra Linn.	Non-migratory [although some suspect otherwise (Lempke, 1950)]	Immigrant	Immigrant
Coscinia cribraria arenaria Lemp.	Non-migratory	Non-migratory [although some suspect otherwise (Bretherton, 1983)]	Never detected
Utethesa pulchella Linn.	Occasional immigrant	Immigrant	Immigrant
Utetheisa bella Linn.	Non-migratory	Suspected very rare immigrant	Never detected
Arctia caja Linn.	Non-migratory	Non-migratory	Suspected occasional immigrant
Arctia purpurea Linn.	Non-migratory	Not listed	Possible very rare immigrant
Spilosoma lubricipeda Linn.	Non-migratory	Non-migratory [although some suspect otherwise (Beirne, 1947)]	Non-migratory
Spilosoma luteum Hufn.	Non-migratory	Non-migratory [although some suspect otherwise (Beirne, 1947)]	Non-migratory

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at

Macro-moth species	European status As listed in Eitschberger, Reinhardt & Steiniger (1991)	British status As listed in Bretherton (1983) and/or Skinner (1984 & 1998)	Sussex status As listed in Pratt (1999)
Euplagia quadripunctaria Poda	Immigrant, with a return flight	Occasional immigrant	Suspected occasional immigrant
Callimorpha dominula Linn.	Non-migratory	Non-migratory	Suspected occasional immigrant
Tyria jacobaeae Linn.	Non-migratory	Non-migratory [although some suspect otherwise (Beirne, 1947)]	Non-migratory [although a single circumstantial record does exist]
Syntomis phegea Linn.	Non-migratory	Uncertain [not listed in Skinner (1984 & 1998) but probable immigrant in Bretherton (1983)]	Never detected
Meganola albula D. & S.	Non-migratory	Non-migratory [although some suspect otherwise (Bretherton, 1983)]	Possible occasional immigrant
Nola aerugula Hbn.	Non-migratory	Immigrant	Immigrant
Euxoa tritici Linn.	Non-migratory	Non-migratory [although some suspect otherwise (Beirne, 1947)]	Non-migratory
Euxoa cursoria Hufn.	Non-migratory	Suspected occasional immigrant	Never detected
Agrotis segetum D. & S.	Suspected immigrant	Immigrant	Immigrant
Agrotis exclamationis Linn.	Suspected immigrant	Non-migratory [although some suspect otherwise (Beirne, 1947)]	Non-migratory
Agrotis trux lunigera Steph.	Non-migratory	Non-migratory	Possible immigrant
Agrotis ipsilon Hufn.	Immigrant, with a return flight	Immigrant [with a return flight (Williams, 1965)]	Immigrant
Agrotis crassa Hbn.	Non-migratory	Uncertain [listed as non-migratory in Skinner (1984 & 1998) and scarce immigrant in Bretherton (1983)]	Never detected
Scotia spinifera Hbn.	Occasional immigrant	Never detected	Never detected
Actinotia polyodon Cl.	Immigrant	Scarce immigrant	Rare immigrant
Chloantha hyperici D. & S.	Non-migratory	Suspected very rare immigrant	Never detected
Ochropleura praecox Linn.	Non-migratory	Non-migratory [although some suspect otherwise (Tunmore, 1998b)]	Suspected immigrant
Ochropleura fennica Tausch.	Non-migratory	Rare immigrant	Never detected
Ochropleura flammatra D. & S.	Non-migratory	Very rare immigrant	Never detected

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at

Macro-moth species	European status As listed in Eitschberger, Reinhardt & Steiniger (1991)	British status As listed in Bretherton (1983) and/or Skinner (1984 & 1998)	Sussex status As listed in Pratt (1999)
Ochropleura plecta Linn.	Non-migratory	Non-migratory [although some suspect otherwise (Cooper, 1936)]	Non-migratory
Ochropleura leucogaster Frey.	Occasional immigrant	Suspected immigrant	Suspected immigrant (pers. obs.)
Rhyacia simulans Hufn.	Non-migratory	Possible immigrant	Non-migratory
Rhyacia lucipeta D. & S.	Possible immigrant	Probable extremely rare immigrant	Suspected extremely rare immigrant
Noctua pronuba Linn.	Occasional immigrant	Immigrant	Immigrant
Noctua orbona Hufn.	Non-migratory	Non-migratory	Possible immigrant
Noctua comes Hubn.	Non-migratory	Non-migratory	Episodic immigrant
Noctua fimbriata Schr.	Occasional immigrant	Non-migratory	Non-migratory
Spaelotis ravida D. & S.	Non-migratory [although some suspect otherwise (Lempke, 1950)]	Possible immigrant	Suspected occasional immigrant
Peridroma saucia Hbn.	Occasional immigrant	Immigrant	Immigrant
Diarsia rubi View.	Non-migratory	Non-migratory [although some suspect otherwise (Beirne, 1947)]	Non-migratory
Xestia c-nigrum Linn.	Suspected immigrant	Probable immigrant	Suspected episodic immigrant
Xestia xanthographa D. & S.	Non-migratory	Non-migratory [although some suspect otherwise (Beirne, 1947)]	Non-migratory
Xestia agathina agathina Dup.	Non-migratory	Non-migratory	Suspected occasional immigrant
Eurois occulta Linn.	Non-migratory	Immigrant	Immigrant
Mesogona acetosellae D. & S.	Non-migratory	Very rare immigrant	Extremely rare immigrant
Discestra trifolii Hufn.	Non-migratory	Suspected immigrant	Non-migratory
Polia bombycina Hufn.	Non-migratory	Non-migratory	Suspected immigrant
Mamestra brassicae Linn.	Possible immigrant	Non-migratory	Suspected occasional immigrant
Lacanobia contigua D. & S.	Non-migratory	Non-migratory	Suspected occasional immigrant
Lacanobia blenna D. & S.	Non-migratory	Possible rare immigrant	Suspected very rare immigrant
Hecatera dysodea D. & S.	Non-migratory	Non-migratory	Suspected occasional immigrant
Hadena rivularis Fabr.	Non-migratory	Non-migratory [although some suspect otherwise (Beirne, 1947)]	Non-migratory
Hadena compta D. & S.	Non-migratory	Possible immigrant	Possible immigrant

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at

Macro-moth species	European status As listed in Eitschberger, Reinhardt & Steiniger (1991)	British status As listed in Bretherton (1983) and/or Skinner (1984 & 1998)	Sussex status As listed in Pratt (1999)
Hadena bicruris Hufn.	Non-migratory	Non-migratory [although some suspect otherwise (Beirne, 1947)]	Non-migratory
Brithys crini pancratii Cyr.	Non-migratory	Possible immigrant	Never detected
Egira conspicillaris Linn.	Non-migratory	Possible immigrant	Uncertain
Orthosia miniosa D. & S.	Non-migratory	Non-migratory [although some suspect otherwise (Tunmore, 1999)]	Possible immigrant
Mythimna albipuncta D. & S.	Suspected immigrant	Immigrant	Immigrant
Mythimna vitellina Hbn.	Occasional immigrant	Immigrant	Immigrant
Mythimna pallens Linn.	Non-migratory	Non-migratory	Non-migratory [although a single circumstantial record does exist]
Mythimna favicolor Barr.	Non-migratory	Non-migratory	Possible immigrant
Mythimna litoralis Curt.	Suspected immigrant	Non-migratory	Non-migratory
Mythimna l-album Linn.	Suspected immigrant	Immigrant	Immigrant
Mythimna unipuncta Haw.	Occasional immigrant	Immigrant	Immigrant
Mythimna loreyi Dup.	Occasional immigrant	Immigrant	Immigrant
Senta flammea Curt.	Non-migratory	Suspected immigrant	Suspected immigrant
Cucullia absinthii Linn.	Possible immigrant	Non-migratory	Suspected occasional immigrant
Cucullia artemisiae Hufn.	Non-migratory	Suspected immigrant	Never detected
Cucullia asteris D. & S.	Non-migratory	Non-migratory	Suspected occasional immigrant
Cucullia gnaphalii occidentalis Bour.	Non-migratory	Non-migratory	Possible very rare immigrant
Cucullia scrophulariae D. & S.	Non-migratory	Suspected very rare immigrant	Never detected
Calophasia lunula Hufn.	Non-migratory	Suspected immigrant	Suspected immigrant
Calophasia platyptera Esp.	Non-migratory	Suspected very rare immigrant	Suspected extremely rare immigrant
Aporophyla australis pascuea H. & W.	Non-migratory	Non-migratory [although some suspect otherwise (Beirne, 1947)]	Non-migratory
Lithomoia solidaginis Hbn.	Non-migratory	Immigrant	Suspected very rare immigrant
Lithophane furcifera furcifera Hufn.	Non-migratory	Suspected immigrant	Suspected very rare immigrant
Lithophane lamda Fabr.	Non-migratory	Possible immigrant	Suspected very rare immigrant

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at

Macro-moth species	European status As listed in EITSCHBERGER, REINHARDT & STEINIGER (1991)	British status As listed in BRETHERTON (1983) and/or SKINNER (1984 & 1998)	Sussex status As listed in PRATT (1999)
Lithophane leautieri hesperica BOUR.	Non-migratory	Suspected immigrant	Occasional immigrant
Xylena vetusta HBN.	Non-migratory	Immigrant	Suspected episodic immigrant
Xylena exsoleta LINN.	Non-migratory [although some suspect otherwise (LEMPKE, 1950)]	Suspected immigrant	Suspected occasional immigrant
Dichonia aprilina LINN.	Non-migratory	Suspected occasional immigrant	Non-migratory
Blepharita solieri BOISD.	Non-migratory	Suspected very rare immigrant	Never detected
Trigonophora flammea ESP.	Non-migratory	Immigrant	Immigrant
Polymixis gemmea TREIT.	Non-migratory	Suspected very rare immigrant	Never detected
Antitype chi LINN.	Non-migratory	Non-migratory	Suspected very rare immigrant
Conistra erythrocephala D. & S.	Non-migratory	Suspected immigrant	Suspected occasional immigrant
Agrochola haematidea DUP.	Non-migratory	Non-migratory	Possible occasional immigrant
Omphaloscelis lunosa HAW.	Native coloniser	Non-migratory [although some suspect otherwise (BEIRNE, 1947)]	Non-migratory [although a single circumstantial record does exist]
Xanthia gilvago D. & S.	Non-migratory	Non-migratory [although some suspect otherwise (BEIRNE, 1947)]	Non-migratory
Acronicta strigosa D. & S.	Non-migratory	Non-migratory	Suspected very rare immigrant
Acronicta auricoma D. & S.	Non-migratory	Suspected immigrant	Suspected occasional immigrant
Simyra albovenosa GOEZE	Non-migratory	Non-migratory	Suspected immigrant
Cryphia algae FABR.	Non-migratory	Immigrant	Suspected rare immigrant
Cryphia raptricula D. & S.	Non-migratory	Suspected immigrant	Suspected very rare immigrant
Amphipyra pyramidea LINN.	Possible immigrant	Non-migratory	Non-migratory
Amphipyra berbera svenssoni FLET.	Possible immigrant	Non-migratory	Non-migratory
Amphipyra tragopoginis CL.	Non-migratory	Non-migratory [although some suspect otherwise (BEIRNE, 1947)]	Non-migratory [although a single circumstantial record does exist]
Phlogophora meticulosa LINN.	Occasional immigrant	Immigrant	Immigrant

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at

Macro-moth species	European status As listed in Eitschberger, Reinhardt & Steiniger (1991)	British status As listed in Bretherton (1983) and/or Skinner (1984 & 1998)	Sussex status As listed in Pratt (1999)
Pseudenargia ulicis Staud.	Non-migratory	Suspected very rare immigrant	Never detected
Callopistria juventina Stoll	Non-migratory	Suspected very rare immigrant	Suspected very rare immigrant
Enargia paleacea Esp.	Non-migratory	Immigrant	Suspected immigrant
Cosmia trapezina Linn.	Non-migratory	Non-migratory [although some suspect otherwise (Beirne, 1947)]	Non-migratory
Apamea monoglypha Hufn.	Non-migratory	Non-migratory	Suspected episodic immigrant
Apamea lateritia Hufn.	Non-migratory	Suspected rare immigrant	Never detected
Oligia spp.	Non-migratory	Non-migratory [although some suspect otherwise (Beirne, 1947)]	Non-migratory
Mesapamea secalis Linn. and *M. didyma* Esp.	Non-migratory	Non-migratory [although some suspect otherwise (Beirne, 1947)]	Non-migratory
Photedes extrema Hbn.	Non-migratory	Possible immigrant	Suspected very rare immigrant
Photedes fluxa Hbn.	Non-migratory	Possible occasional immigrant	Possible occasional immigrant
Photedes pygmina Haw.	Non-migratory	Non-migratory [although some suspect otherwise (Beirne, 1947)]	Non-migratory
Luperina testacea D. & S.	Non-migratory	Non-migratory [although some suspect otherwise (Beirne, 1947)]	Non-migratory
Luperina dumerilii Dup.	Non-migratory	Immigrant	Very rare immigrant
Luperina zollikoferi Frey.	Occasional immigrant	Immigrant	Very rare immigrant
Celaena leucostigma leucostigma Hbn.	Occasional immigrant	Suspected immigrant	Possible occasional immigrant
Archanara dissoluta Treit.	Non-migratory	Non-migratory [although some suspect otherwise (Beirne, 1947)]	Non-migratory
Rhizedra lutosa Hbn.	Non-migratory	Non-migratory [although some suspect otherwise (Williams et al, 1942; Beirne, 1947)]	Non-migratory
Sedina buettneri Her.	Non-migratory	Non-migratory	Suspected very rare immigrant
Arenostola phragmitidis Hbn.	Non-migratory	Non-migratory [although some suspect otherwise (Beirne, 1947)]	Non-migratory
Oria musculosa Hbn.	Non-migratory.	Suspected immigrant	Possible occasional immigrant
Hoplodrina blanda D. & S.	Possible immigrant	Non-migratory	Non-migratory

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at

Macro-moth species	European status As listed in Eitschberger, Reinhardt & Steiniger (1991)	British status As listed in Bretherton (1983) and/or Skinner (1984 & 1998)	Sussex status As listed in Pratt (1999)
Haplodrina superstes Ochs.	Non-migratory	Suspected very rare immigrant	Never detected
Hoplodrina ambigua D. & S.	Non-migratory	Suspected immigrant	Suspected immigrant
Spodoptera exigua Hbn.	Occasional immigrant	Immigrant	Immigrant
Spodoptera cilium Guen.	Non-migratory	Very rare immigrant	Never detected
Spodoptera littoralis Boisd.	Non-migratory	Suspected immigrant	Non-migratory [suspected rare import]
Caradrina flavirena Guen.	Non-migratory	Suspected very rare immigrant	Never detected
Earias insulana Boisd.	Non-migratory	Suspected very rare immigrant	Never detected
Nycteola asiatica Krul.	Occasional immigrant	Never detected	Never detected
Charadra deridens Guen.	Non-migratory	Possible very rare immigrant	Never detected
Raphia frater Grote	Non-migratory	Possible very rare immigrant	Never detected
Chrysodeixis chalcites Esp.	Occasional immigrant	Rare immigrant	Very rare immigrant
Chrysodeixis acuta Walk.	Non-migratory	Rare immigrant	Never detected
Ctenoplusia limbirena Guen.	Non-migratory	Rare immigrant	Never detected
Ctenoplusia accentifera Lef.	Non-migratory	Suspected very rare immigrant	Never detected
Trichoplusia ni Hbn.	Occasional immigrant	Episodic immigrant	Scarce immigrant
Diachrysia orichalcea Fabr.	Non-migratory	Rare immigrant	Very rare immigrant
Diachrysia chryson Esp.	Non-migratory	Non-migratory	Possible very rare immigrant
Macdunnoughia confusa Step.	Occasional immigrant	Rare immigrant	Very rare immigrant
Polychrysia moneta Fabr.	Non-migratory	Uncertain [listed as non-migratory in Skinner (1984 & 1998) and as a probable immigrant in Bretherton (1983) and Agassiz (1996)]	Suspected occasional immigrant
Autographa gamma Linn.	Immigrant, with a return flight	Immigrant [with a return flight (Fisher, 1938)]	Immigrant
Autographa bractea D. & S.	Native coloniser	Suspected immigrant	Never detected
Autographa biloba Steph.	Non-migratory	Suspected very rare immigrant	Never detected

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at

Macro-moth species	European status As listed in Eitschberger, Reinhardt & Steiniger (1991)	British status As listed in Bretherton (1983) and/or Skinner (1984 & 1998)	Sussex status As listed in Pratt (1999)
Syngrapha interrogationis Linn.	Suspected immigrant	Immigrant	Very rare suspected immigrant (pers. obs.)
Syngrapha circumflexa Linn.	Non-migratory	Suspected very rare immigrant	Never detected
Catocala fraxini Linn.	Suspected immigrant	Generally a scarce immigrant	Rare immigrant
Catocala nupta Linn.	Non-migratory	Non-migratory	Suspected episodic immigrant
Catocala electa View.	Suspected immigrant	Suspected rare immigrant	Suspected very rare immigrant
Catocala promissa D. & S.	Non-migratory	Non-migratory	Suspected occasional immigrant
Catocala sponsa Linn.	Suspected immigrant	Non-migratory	Suspected occasional immigrant
Catocala nymphagoga Esp.	Non-migratory	Suspected very rare immigrant	Never detected
Minucia lunaris D. & S.	Non-migratory	Scarce immigrant	Rare immigrant
Clytie illunaris Hbn.	Occasional immigrant	Possible very rare immigrant	Never detected
Dysgonia algira Linn.	Non-migratory	Suspected very rare immigrant	Never detected
Ophiusa tirhaca Cram.	Occasional immigrant	Never detected	Never detected
Grammodes bifasciata Pet.	Occasional immigrant	Never detected	Never detected
Grammodes stolida Fabr.	Occasional immigrant	Suspected very rare immigrant	Very rare immigrant
Catephia alchymista D. & S.	Non-migratory [although some suspect otherwise (Lempke, 1950)]	Scarce immigrant	Very rare immigrant
Tyta luctuosa D. & S.	Occasional immigrant	Uncertain [listed as non-migratory in Skinner (1984 & 1998) and as a scarce immigrant in Bretherton (1983)]	Possible occasional immigrant
Tathorhynchus exsiccata Led.	Non-migratory	Very rare immigrant	Very rare immigrant
Scoliopteryx libatrix Linn.	Non-migratory	Non-migratory [although some suspect otherwise (Beirne, 1947)]	Non-migratory
Anomis sabulifera Guen.	Non-migratory	Possible very rare immigrant	Never detected
Colobochyla salicalis D. & S.	Non-migratory	Possible rare immigrant	Non-migratory
Rivula sericealis Scop.	Non-migratory	Suspected immigrant	Suspected episodic immigrant

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at

Macro-moth species	European status As listed in Eitschberger, Reinhardt & Steiniger (1991)	British status As listed in Bretherton (1983) and/or Skinner (1984 & 1998)	Sussex status As listed in Pratt (1999)
Parascotia fuliginaria Linn.	Non-migratory	Suspected immigrant	Suspected scarce immigrant
Hypena crassalis Fabr.	Non-migratory	Non-migratory	Possible occasional immigrant
Hypena obsitalis Hbn.	Non-migratory	Suspected rare immigrant	Suspected very rare immigrant
Hypena obesalis Treit.	Non-migratory	Suspected very rare immigrant	Never detected
Herminia lunalis Scop.	Non-migratory	Suspected very rare immigrant	Never detected
Herminia tarsicrinalis Knoch	Non-migratory	Uncertain [listed as non-migratory in Skinner (1984 & 1998) and as a probable immigrant in Bretherton (1983)]	Never detected
Herminia zelleralis Wocke	Non-migratory	Suspected very rare immigrant	Never detected
Pechipogo plumigeralis Hbn.	Non-migratory	Suspected immigrant	Suspected very rare immigrant (pers. obs.)
Trisateles emortualis D. & S.	Non-migratory	Suspected scarce immigrant	Suspected occasional immigrant

Micro-moths

Pyralidae – the pyralid moths

Micro-moth species	European status As listed in Burmann (1973) and/or Eitschberger, Reinhardt & Steiniger (1991)	British status As listed in Bretherton (1983), and/or Goater (1986)	Sussex status As listed in Pratt (1999)
Euchromius ocellea Haw.	Uncertain [listed as an immigrant in Burmann (1973), and as non-migratory in Eitschberger, Reinhardt & Steiniger (1991)]	Occasional immigrant	Rare immigrant
Acigona cicatricella Hbn.	Non-migratory	Rare immigrant	Never detected
Chrysoteuchia culmella Linn.	Non-migratory	Episodic immigrant	Non-migratory
Crambus leucoschalis Hamp.	Non-migratory	Possible very rare immigrant	Never detected
Crambus perlella Scop.	Non-migratory	Non-migratory [although some suspect otherwise (Beirne, 1954)]	Suspected episodic immigrant
Agriphila selasella Hbn.	Non-migratory	Suspected immigrant	Non-migratory

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at

Micro-moth species	European status As listed in Burmann (1973) and/or Eitschberger, Reinhardt & Steiniger (1991)	British status As listed in Bretherton (1983), and/or Goater (1986)	Sussex status As listed in Pratt (1999)
Agriphila tristella Scop.	Non-migratory	Immigrant	Non-migratory
Agriphila latistria Haw.	Non-migratory	Non-migratory	Suspected immigrant
Catoptria osthelderi de Lat.	Non-migratory	Very rare immigrant	Never detected
Catoptria verellus Zinck.	Non-migratory	Possible immigrant	Very rare suspected immigrant
Chrysocrambus craterella Scop.	Non-migratory	Probable rare immigrant	Very rare suspected immigrant
Thisanotia chrysonuchella Scop.	Non-migratory	Non-migratory	Very rare suspected immigrant
Platytes alpinella Hbn.	Non-migratory	Non-migratory	Very rare suspected immigrant
Ancylolomia tentaculella Hbn.	Non-migratory	Suspected immigrant	Never detected
Eudonia angustea Curt.	Non-migratory	Non-migratory	Non-migratory [although a single circumstantial record does exist]
Evergestis limbata Linn.	Non-migratory	Not listed	Very rare suspected immigrant
Evergestis forficalis Linn.	Non-migratory	Immigrant	Non-migratory
Evergestis extimalis Scop.	Non-migratory	Irregular immigrant	Suspected episodic immigrant
Hellula undalis Fab.	Uncertain [listed as an immigrant in Burmann (1973), and as non-migratory in Eitschberger, Reinhardt & Steiniger (1991)]	Suspected immigrant	Suspected very rare immigrant
Margaritia sticticalis Linn.	Occasional immigrant	Scarce immigrant	Suspected scarce immigrant
Actenia brunnealis Treit.	Occasional immigrant	Not listed	Never detected
Uresiphita limbalis (*polygonalis*) D. & S.	Occasional immigrant	Very scarce immigrant	Suspected very rare immigrant
Sitochroa palealis D. & S.	Non-migratory	Immigrant	Suspected episodic immigrant
Sitochroa verticalis Linn.	Non-migratory	Immigrant	Suspected episodic immigrant
Paracorsia repandalis D. & S.	Non-migratory	Very rare immigrant	Never detected
Ostrinia nubilalis Hbn.	Occasional immigrant	Immigrant	Episodic immigrant
Eurrhypara hortulata Linn.	Non-migratory	Non-migratory [although some suspect otherwise (Beirne, 1954)]	Non-migratory

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at

Micro-moth species	European status As listed in Burmann (1973) and/or Eitschberger, Reinhardt & Steiniger (1991)	British status As listed in Bretherton (1983), and/or Goater (1986)	Sussex status As listed in Pratt (1999)
Phlyctaenia perlucidalis Hbn.	Non-migratory	Uncertain [listed as non-migratory in Goater (1986) and as a probable immigrant in Bretherton (1983) and Agassiz (1996)]	Suspected rare immigrant
Psammotis pulveralis Hbn.	Non-migratory	Scarce immigrant	Suspected rare immigrant
Udea fulvalis Hbn.	Non-migratory	Occasional immigrant	Never detected
Udea ferrugalis Hbn.	Immigrant, with a return flight	Immigrant	Common immigrant
Mecyna flavalis D. & S.	Non-migratory	Non-migratory	Suspected occasional immigrant
Nomophila noctuella D. & S.	Immigrant, with a return flight	Often abundant annual immigrant	Common immigrant
Nomophila neartica Mun.	Non-migratory	Possible very rare immigrant	Never detected
Dolicharthria punctalis D. & S.	Occasional immigrant	Non-migratory	Non-migratory
Antigastra catalaunalis Dup.	Non-migratory	Rare immigrant	Very rare suspected immigrant
Diasemia reticularis Linn.	Non-migratory	Scarce immigrant	Very rare suspected immigrant
Diasemiopsis ramburialis Dup.	Uncertain [listed as an immigrant in Burmann (1973), and as non-migratory in Eitschberger, Reinhardt & Steiniger (1991)]	Scarce immigrant	Very rare suspected immigrant
Hymenia recurvalis Fab.	Uncertain [listed as an immigrant in Burmann (1973), and as non-migratory in Eitschberger, Reinhardt & Steiniger (1991)]	Scarce immigrant	Very rare suspected immigrant
Palpita unionalis Hbn.	Immigrant, with a return flight	Uncommon immigrant	Episodic immigrant
Sceliodes laisalis Walk.	Non-migratory	Possible immigrant	Never detected
Orthopygia glaucinalis Linn.	Non-migratory	Possible occasional immigrant	Suspected episodic immigrant
Pyralis farinalis Linn.	Non-migratory	Non-migratory [although some suspect otherwise (Beirne, 1954)]	Very rare suspected immigrant
Pyla fusca Haw.	Non-migratory	Mobile resident	Suspected scarce immigrant

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at

Micro-moth species	European status As listed in Burmann (1973) and/or Eitschberger, Reinhardt & Steiniger (1991)	British status As listed in Bretherton (1983), and/or Goater (1986)	Sussex status As listed in Pratt (1999)
Etiella zinckenella Treit.	Uncertain [listed as an immigrant in Burmann (1973), and as non-migratory in Eitschberger, Reinhardt & Steiniger (1991)]	Never detected	Never detected
Oncocera semirubella Scop.	Non-migratory	Mobile resident	Suspected scarce immigrant
Dioryctria abietella D. & S.	Occasional immigrant	Irregular immigrant	Suspected episodic immigrant
Dioryctria schuetzeella Fuchs	Non-migratory	Suspected immigrant	Suspected very rare immigrant (pers. obs.)
Nephopterix angustella Hbn.	Non-migratory	Non-migratory	Suspected occasional immigrant
Acrobasis tumidana D. & S.	Non-migratory	Non-migratory	Suspected scarce immigrant
Ancylosis oblitella Zell.	Non-migratory	Extremely scarce immigrant	Suspected episodic immigrant
Aporodes floralis Hbn.	Occasional immigrant	Never detected	Never detected
Ancylodes pallens Rag.	Non-migratory	First record in 1999 (Davey, 2000b)	Never detected

Pterophoridae – the plume moths

Micro-moth species	European status As listed in Gielis (1996)	British status As listed in Bretherton (1983), and/or as opined by G. Hart (pers. obs.)	Sussex status As listed in Pratt (1999)
Agdistis bennetii Curt.	Immigrant	Mobile resident	Non-migratory
Cnaemidophorus rhododactyla D. & S.	Non-migratory	Suspected immigrant	Suspected immigrant
Crombrugghia laetus Zell.	Non-migratory	Suspected immigrant	Suspected immigrant

Cochylidae and Tortricidae – the tortricoid moths

Micro-moth species	European status As listed in Burmann (1973), and/or Eitschberger, Reinhardt & Steiniger (1991)	British status As listed in Bradley, Tremewan, & Smith (1973–9)	Sussex status As opined by C. R. Pratt and J. T. Radford (pers. obs.)
Eugnosta lathoniana Hbn.	Non-migratory	"probably adventitious"	Never detected
Tortrix viridana Linn.	Non-migratory	Non-migratory	Occasional immigrant

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at

Micro-moth species	European status As listed in BURMANN (1973), and/or EITSCHBERGER, REINHARDT & STEINIGER (1991)	British status As listed in BRADLEY, TREMEWAN, & SMITH (1973–9)	Sussex status As opined by C. R. PRATT and J. T. RADFORD (pers. obs.)
Crocidosema plebejana ZELL.	Non-migratory	Non-migratory	Occasional immigrant
Zeiraphera ratzeburgiana RATZ.	Occasional immigrant	Non-migratory	Non-migratory
Zeiraphera rufimitrana H.-S.	Occasional immigrant	Non-migratory	Non-migratory
Zeiraphera isertana FABR.	Occasional immigrant	Non-migratory	Non-migratory
Zeiraphera griseana HBN.	Occasional immigrant	Never detected	Never detected
Zeiraphera diniana GUEN.	Occasional immigrant	Non-migratory	Non-migratory
Cydia amplana HBN.	Non-migratory	First record in 1996 (DAVEY, 1997)	Never detected

The remainder of the micro-moths

Micro-moth species	European status As listed in BURMANN (1973), and/or EITSCHBERGER, REINHARDT & STEINIGER (1991)	British status As determined by C. R. PRATT and J. T. RADFORD (pers. obs.)	Sussex status As opined by C. R. PRATT and J. T. RADFORD (pers. obs.)
Yponomeuta padellus LINN.	Occasional immigrant	Occasional immigrant [*Yponomeuta* spec.]	Occasional immigrant [*Yponomeuta* spec.]
Plutella xylostella LINN.	Occasional immigrant	Regular immigrant	Regular immigrant
Tebenna micalis MANN	Non-migratory	Rare immigrant	Never detected

The additional species

In the above list there are 52 moth species that have not previously been specifically associated with the migratory phenomenon. Aside from the first good immigrant records of *Cydia amplana* and *Ancylodes pallens* in Dorset in south-west England in 1996 (DAVEY, 1997) and 1999 respectively (DAVEY, 2000b), and that of *Tebenna micalis* elsewhere at various times and places (DAVEY, 1999), all of the new additions here are sourced from events that took place in the county of Sussex, the details of which were published in 1999 (PRATT, 1999). In nomenclatural order, a characteristic distinctly episodic and thin history accounts for *Scopula ornata* SCOP., *Idaea degeneraria* HBN., *Xanthorhoe biriviata* BORK., *Lampropteryx otregiata* MET., *Rheumaptera cervinalis* SCOP., *Euphyia biangulata* HAW., *Selenia lunularia* HBN., *Siona lineata* SCOP., *Aspitates gilvaria* D. & S., *Setina irrorella* LINN., *Callimorpha dominula* LINN., *Noctua orbona* HUFN., *Polia bombycina* HUFN., *Hecatera dysodea* D. & S., *Photedes fluxa* HBN., *Agriphila latistria* HAW., *Thisanotia chrysonuchella* SCOP., *Platytes alpinella* HBN., *Nephopterix angustella* HBN., and *Cnaemidophorus rhododactyla* D. & S.. Some specific occurrences, often comparatively recent and at mercury vapour light, strongly suggest immigration, the species concerned being *Semiothisa clathrata* LINN., *Atolmis rubricollis* LINN., *Arctia purpurea* LINN., *Ochropleura praecox* LINN., *Noctua comes* HBN., *Xestia agathina* DUP., *Cucullia asteris* D. & S.,

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at
Cucullia gnaphalii Hbn., *Apamea monoglypha* Hufn., *Catocala nupta* Linn., *Catocala promissa* D. & S., *Catocala sponsa* Linn., *Mecyna flavalis* D. & S., *Acrobasis tumidana* D. & S., and *Tortrix viridana* Linn., this being especially noticeable for some usually strictly heather-loving insects such as *Scotopteryx luridata* Hufn., *Cepphis advenaria* Hbn., *Agrochola haematidea* Dup., *Lacanobia contigua* D. & S., and *Hypena crassalis* Fab.—while other events more weakly suggest immigration or perhaps native mobility, such as *Mimas tiliae* Linn., *Euproctis similis* Fues., *Arctia caja* Linn., *Agrotis trux* Hbn., *Orthosia miniosa* D. & S., *Mythimna favicolor* Barr., and *Diachrysia chryson* Esp. Finally, colonising species whose original founders may well have been continental immigrants include such moths as *Idaea vulpinaria* H.-S., *Eupithecia intricata* Zett., and *Eupithecia phoeniceata* Ramb. A few of these listings could be placed in more than one category.

The source of immigrants to Great Britain

The country of origin of different immigrant Lepidoptera is of great interest and importance, and has always been subject to speculation. While the very late Victorian collectors were the first to suspect that immigrants from the continent were supplementing the British population, and to tentatively propose specific sources, several more decades were to pass before research had progressed to the point where it could be said of the commonplace *Pieris brassicae* that there was "good reason to believe that before setting out to cross the North Sea" towards the British Isles the butterfly "had already in many cases flown from north Germany, from southern Scandinavia, or from islands in the Baltic", and that the much scarcer *Vanessa antiopa* had also originated from Scandinavia (Williams, 1930, 1939, 1955).

The first illustrative meteorological back-track map which plotted time against global position was produced by C. B. Williams in 1958, for *Cynthia cardui* (Williams, 1965). Further pioneering research in this field was performed during the 1960's, this mainly concerning *Spodoptera exigua* (Hurst, 1964; Mikkola & Salmensuu, 1965; Hurst, 1969; French & Hurst, 1969; Mikkola, 1970). Much more has recently been made of the technique for a wide range of butterflies and moths (Brown, 1996a; Davey, 1997a, 1998, 2000b; Brown, 1997a), and specifically for migrations of *Nymphalis antiopa* (Tunmore, 1996), *Danaus plexippus* (Nelson, 1996; Davey, 2000a), *Tritophia tritophus* (Davey, 1997b), *Ochropleura leucogaster* (Davey, 1996), *Chrysodeixis acuta* (Brown, 1996b), and *Eublemma parva, E. ostrina*, and *Tebenna micalis* (Davey, 1999). The work has yielded much new and stimulating information, although it's limitations and complete accuracy have been questioned (Bretherton, 1972)—especially as immigrant Lepidoptera are known to exhibit an independent directional flight which compensates for a non-aligned wind-flow (Williams, 1949, 1965) and even often fly into the wind (Williams, 1930). Illuminating and interesting as these researches are, definitive future advances will most likely come from the field use of radar and laboratory work into genes.

Many butterflies and moths seem to have several different source countries, which vary according to season and/or from year to year, but individual migratory waves are often composed of a number of different immigrant species from a common origin. While the derivation of specimens is not known in many cases, in nomenclatural order, the following associations (of varying degrees of certainty) have been made with migrant Lepidoptera arriving in the

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at

British Isles. Those source districts marked with an asterix (*) have been determined and supported by meteorological back-tracking, although their mention is sometimes one of several possibilities.

Butterflies

P. apollo – France (EMMET & HEATH, 1989).

P. machaon gorganus – Central America (FORD, 1945), northern France, Belgium (EMMET & HEATH, 1989).

A. crataegi – France (BRETHERTON, 1951).

P. brassicae – Holland, Belgium, Germany (WILLIAMS, 1930, 1939), southern Scandinavia, and the Baltic Islands (WILLIAMS, 1949, 1955).

P. rapae – Holland, Belgium, Germany (WILLIAMS, 1930).

P. daplidice – "the Mediterranean littoral, in the sheltered Swiss valleys" (ADKIN, 1928), central and southern Europe (FORD, 1945, NEWMAN, 1965), Spain, North Africa (EMMET & HEATH, 1989).

C. hyale – the Riviera, North Africa (FROHAWK, 1924, 1934), and southern France (NEWMAN, 1959).

C. croceus – the Mediterranean (FROHAWK, 1924, 1934; ADKIN, 1928), southern Europe, North Africa (ADKIN, 1928).

L. boeticus – the west coast of Europe (SOUTH, 1921), and central and southern France (EMMET & HEATH, 1989).

E. argiades – Brittany (TUTT, 1905–14), France (NEWMAN, 1959).

V. atalanta – southern Europe (FROHAWK, 1924, 1934), the Mediterranean (NEWMAN, 1959; BAKER, 1972), the Low Countries, northern France (BAKER, 1972), Spain (EMMET & HEATH, 1989), North Africa* (EMMET & HEATH, 1989; BROWN, 1996a; DAVEY, 1998), and the Canary Islands* (BROWN, 1996a; DAVEY, 1998).

C. cardui – North Africa* (BARRETT, 1893–1907; ADKIN, 1920; FROHAWK, 1924, 1934; NEWMAN, 1959; HEATH, POLLARD, & THOMAS, 1984; EMMET & HEATH, 1989; DAVEY, 1997, 1998), the Riviera (FROHAWK, 1924, 1934), south of the Sahara, Nigeria, Sudan (WILLIAMS, 1930), southern and south-eastern Europe (FROHAWK, 1934; HEATH, POLLARD, & THOMAS, 1984), "arid areas on the edges of the Great North African Desert" (WILLIAMS, 1955), "the mouth of the Mediterranean"* (WILLIAMS, 1965), the Mediterranean (BAKER, 1972), Spain, central and eastern Europe (HEATH, POLLARD, & THOMAS, 1984), Morocco* (DAVEY, 1996), the Atlas Mountains* (DAVEY,

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at
1997a, 2000b), the Canary Islands* (DAVEY, 1998, 2000b), and the western Sahara* (DAVEY, 2000b).

A. urticae Holland*, Belgium*, north-east France*, and north-west Germany* (TUNMORE, 1998a).

N. antiopa – Norway (BARRETT, 1893–1907; FROHAWK, 1924, 1934), eastern Scandinavia (WILLIAMS, 1930; FROHAWK, 1934; FORD, 1945), central and north Europe (WILLIAMS, 1965), Fennoscandia, western Europe (EMMET & HEATH, 1989), Poland*, the Baltic States* (TUNMORE, 1996), France*, and western Germany* (DAVEY, 1997a).

A. lathonia – the French coast opposite Dover (FROHAWK, 1934), central and southern Europe (FORD, 1945), Poland*, the Baltic States* (TUNMORE, 1996), France*, and western Germany* (DAVEY, 1997a).

D. plexippus – North America (BARRETT, 1893–1907; FROHAWK, 1924, 1934), the east coast of North America* (WILLIAMS, 1930; DAVEY, 1996, 2000a), the Canary Isles* (NICHOLSON, 1935; BROWN, 1996a), New Jersey*, southern North America*, Azores* (NELSON, 1996).

Macro-moths

D. pini – France* and Germany* (DAVEY, 1997a).

A. ononaria – France* and western Germany* (DAVEY, 1997a).

C. puppillaria – North Africa* and the Canary Islands* (BROWN, 1996a).

S. nigropunctata – France* and western Germany* (DAVEY, 1997a).

R. sacraria – north-west Spain* (FRENCH & HURST, 1969), North Africa* (FRENCH & HURST, 1969; BROWN, 1996a), and the Canary Islands* (BROWN, 1996a).

O. obstipata – the Mediterranean (FORD, 1965), Iberia* (BROWN, 1996b; DAVEY, 1997), the Canary Islands* (BROWN, 1996a), the Algerian Atlas Mountains* (DAVEY, 1997a), North Africa* (BROWN, 1996a; DAVEY, 1997a).

X. biriviata – Europe (AGASSIZ, 1996).

S. luctuata – Europe (AGASSIZ, 1996).

E. phoeniceata – southern Europe (AGASSIZ, 1996).

A. sylvata – western France* (DAVEY, 1997a).

S. brunneata – Denmark, central Germany, and the Ardennes (BRETHERTON, 1972).

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at

P. secundaria – Europe (AGASSIZ, 1996).

A. convolvuli – the Mediterranean (FORD, 1965), "Africa and the near East" (NEWMAN, 1965), North Africa*, the Canary Islands* (BROWN, 1996a), and northern Iberia* (BROWN, 1996b).

A. atropos – North Africa, Europe (NEWMAN, 1965).

M. stellatarum – North Africa* (WILLIAMS, 1930; BROWN, 1996a; DAVEY, 1997), southern France (FORD, 1965), the Canary Islands* (BROWN, 1996a), the Atlas Mountains*, Iberia* (DAVEY, 1997a, 2000b), and the western Sahara* (DAVEY, 2000b).

D. nerii – southern Europe (TUTT, 1905–14; NEWMAN, 1965).

H. gallii – northern Europe (EMMET & HEATH, 1979), France*, and western Germany* (DAVEY, 1997a).

H. lineata livornica – "southern littoral of the Mediterranean" (TUTT, 1905–14), North Africa* (TUTT, 1905–14; GRANT, 1937; NEWMAN, 1965; DAVEY, 1997a, 1998), "Quite a number emerging in the desert just to the west of Tunisia in Algeria during the second world war" (R. M. CRASKE, pers. comm.), Algeria (NEWMAN, 1965), "a mass exodus in Morocco"* (DAVEY, 1996), the Atlas Mountains*, Iberia* (DAVEY, 1997a, 2000b), and the western Sahara* (DAVEY, 2000b).

H. celerio – North Africa (NEWMAN, 1965), the Azores (JOHNSON, 1977), northern Mauritania*, and southern Morocco* (BROWN, 1996c).

T. tritophus – western Germany* (DAVEY, 1997b).

T. processionea – northern Europe* and western Germany* (DAVEY, 1997a).

L. dispar – eastern Europe (EMMET & HEATH, 1979), northern Europe*, and western Iberia* (DAVEY, 1997a).

E. pygmaeola – France* and western Germany* (DAVEY, 1997a).

L. quadra – North Africa* and the Canary Islands* (BROWN, 1996a).

U. pulchella – the Mediterranean (FORD, 1965), the Azores, north coast of Spain, north-west Spain (JOHNSON, 1977), North Africa*, the Canary Islands* (BROWN, 1996a), and southern Europe (MARCINIAK & PRZBYLOWICZ, 2000).

U. bella – North America (EMMET & HEATH, 1979).

A. ipsilon – North Africa* (EMMET & HEATH, 1979; BROWN, 1996a; DAVEY, 1998), the Canary Islands* (BROWN, 1996a), Iberia*, the Atlas Mountains*, and the western Sahara* (DAVEY, 2000b).

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at

A. crassa – France* and western Germany* (Davey, 1997a).

A. polyodon – northern Europe* (Davey, 1997a).

O. fennica – Finland (Emmet & Heath, 1979).

O. leucogaster – North Africa*, the Canary Islands* (Brown, 1996a), northern Iberia*, and Brittany* (Brown, 1996b; Davey, 1996).

R. lucipeta – north-west Spain, Morocco (Emmet & Heath, 1979).

P. saucia – North Africa* (Brown, 1996a; Davey, 1998), and the Canary Islands* (Brown, 1996a).

E. occulta – Belgium, southern and central Norway (Ford, 1965), Scandinavia* (Ford, 1965; Davey, 1997), Germany, Holland (Bretherton, 1972), Germany* (Bretherton, 1972; Davey, 1997), Denmark* (Emmet & Heath, 1979; Davey, 1997), Poland* (Davey, 1997a).

H. compta – central Europe (Agassiz, 1996).

O. miniosa – western France (Tunmore, 1999).

E. conspicillaris – northern France, Belgium (Emmet & Heath, 1979).

M. albipuncta – the Algerian Atlas Mountains*, Iberia* (Davey, 1997a), North Africa* (Brown, 1996a; Davey, 1997a), and the Canary Islands* (Brown, 1996a).

M. vitellina – North Africa* and the Canary Islands* (Brown, 1996a).

M. unipuncta – north-west Spain* (Davey, 1998) and western France (Tunmore, 1999).

M. loreyi – North Africa* and the Canary Islands* (Brown, 1996a).

L. solidaginis – Germany (French, 1955).

L. leautieri – southern Europe (Agassiz, 1996).

T. flammea – northern Iberia* (Brown, 1996b).

C. erythrocephala – north-west Africa* and the Canary Islands* (Davey, 1998).

A. auricoma – western France* (Davey, 1997a).

C. algae – western France* (Davey, 1997a).

A. strigosa – France* and western Germany* (Davey, 1997a).

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at

C. raptricula – western France* (DAVEY, 1997a).

T. atriplis – western France* (DAVEY, 1997a).

E. paleacea – Holland (BRETHERTON, 1972), Denmark* (BRETHERTON, 1972; DAVEY, 1997), southern Scandinavia*, Poland*, and north Germany* (DAVEY, 1997a).

A. lateritia – northern Europe (EMMET & HEATH, 1983), southern Scandinavia*, Poland*, north Germany*, and Denmark* (DAVEY, 1997a).

N. zollikoferi – Ukraine, Ural Mountains (EMMET & HEATH, 1983).

S. exigua – Morocco*, north-west Spain*, Madeira*, central France* (HURST, 1969), North Africa* (FRENCH & HURST, 1969; BROWN, 1996a; DAVEY, 1997, 1998), the Algerian Atlas Mountains*, Iberia* (DAVEY, 1997a), and the Canary Islands* (BROWN, 1996a; DAVEY, 1998).

S. cilium – North Africa* and the Canary Islands* (BROWN, 1996a).

C. flavirena – south-west Europe (EMMET & HEATH, 1983).

H. armigera north-west Spain* (FRENCH & HURST, 1969), North Africa* (FRENCH & HURST, 1969; BROWN, 1996a; DAVEY, 1997, 1998), the Atlas Mountains*, Iberia* (DAVEY, 1997a, 2000b), the Canary Islands* (BROWN, 1996a; DAVEY, 1998), and the western Sahara* (DAVEY, 2000b).

H. peltigera – north-west Spain* (FRENCH & HURST, 1969), North Africa* (FRENCH & HURST, 1969; DAVEY, 1997), the Algerian Atlas Mountains*, and Iberia* (DAVEY, 1997a).

H. nubigera – south-east Russia, Asia (EMMET & HEATH, 1983), Iberia*, the Atlas Mountains*, and the western Sahara* (DAVEY, 2000b).

E. ostrina – North Africa* (BROWN, 1996a; DAVEY, 1999), and the Canary Islands* (BROWN, 1996a).

E. parva – north-west Spain* (FRENCH & HURST, 1969), North Africa* (FRENCH & HURST, 1969; BROWN, 1996a; DAVEY, 1999), and the Canary Islands* (BROWN, 1996a).

D. bankiana – France* and western Germany* (DAVEY, 1997a).

A. lucida – northern Europe* and western Iberia* (DAVEY, 1997a).

C. chalcites – northern Mauritania* and southern Morocco* (BROWN, 1996c).

C. acuta – North Africa* and the Canary Islands* (BROWN, 1996a, 1996b).

C. limbirena – Madeira (EMMET & HEATH, 1983).

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at

T. ni – the northern Mediterranean (FORD, 1965), north-west Spain* (FRENCH & HURST, 1969; DAVEY, 1997a), North Africa* (FRENCH & HURST, 1969; BROWN, 1996a; DAVEY, 1997a), the Canary Islands* (BROWN, 1996a), the Algerian Atlas Mountains*, and Iberia* (DAVEY, 1997a).

M. confusa – southern Scandinavia*, Poland*, north Germany*, and Denmark* (DAVEY, 1997a).

P. moneta – central and southern Europe (AGASSIZ, 1996).

A. gamma – North Africa* (WILLIAMS, 1930; BROWN, 1996a; DAVEY, 1997, 1998), the Mediterranean (WILLIAMS, 1955), southern Europe (FORD, 1965), the Canary Islands* (EMMET & HEATH, 1983; BROWN, 1996a; DAVEY, 1998), the Algerian Atlas Mountains*, and Iberia* (DAVEY, 1997a).

A. biloba – Boston* and south Virginia* in North America (HURST, 1969).

S. interrogationis – Denmark, north Germany, Holland, Scandinavia (BRETHERTON, 1972), Denmark*, north Germany* (BRETHERTON, 1972; DAVEY, 1997), southern Scandinavia*, and Poland* (DAVEY, 1997a).

C. fraxini – Denmark, Finland, and northern France (EMMET & HEATH, 1983).

C. alchymista – northern France, Belgium (EMMET & HEATH, 1983).

T. exsiccata – North Africa (EMMET & HEATH, 1983).

R. sericealis – Scandinavia (EMMET & HEATH, 1983).

P. fuliginaria – Europe (AGASSIZ, 1996).

P. plumigeralis – France* and western Germany* (DAVEY, 1997a).

H. obsitalis – the Mediterranean (FORD, 1965), France*, and western German* (DAVEY, 1997a).

Micro-moths

E. ocellea – northern Europe*, western Iberia* (DAVEY, 1997a), North Africa* (BROWN, 1996a; DAVEY, 1998), and the Canary Islands* (BROWN, 1996a).

C. leucoschalis – "The drier parts of southern Africa" (GOATER, 1986).

A. tentaculella – southern Europe (GOATER, 1986).

H. undalis – North Africa*, the Canary Islands* (BROWN, 1996a), northern Mauritania*, and southern Morocco* (BROWN, 1996c).

M. sticticalis – northern Europe* and western Iberia* (DAVEY, 1997a).

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at

U. polygonalis – North Africa*, the Canary Islands* (Brown, 1996a), and northern Iberia* (Brown, 1996b).

P. repandalis – southern Europe (Goater, 1986).

P. perlucidalis – Europe (Agassiz, 1996).

U. ferrugalis – North Africa*, the Canary Islands* (Brown, 1996a; Davey, 1998), Iberia*, the Atlas Mountains*, and the western Sahara* (Davey, 2000b).

N. noctuella – Egypt (Williams, 1930), central Sahara (Johnson, 1977), North Africa* (Johnson, 1977; Brown, 1996a; Davey, 1998), and the Canary Islands* (Brown, 1996a; Davey, 1998).

N. neartica – North America (Goater, 1986).

H. recurvalis – North Africa* and the Canary Islands* (Brown, 1996a).

P. unionalis – North Africa*, the Canary Islands* (Brown, 1996a), France*, and Germany* (Davey, 1997a).

L. vagans – South America, West Indies (Tutt, 1893).

S. laisalis – Africa (Goater, 1986).

D. schuetzeella – central Europe (Agassiz, 1996).

A. tumidana – northern Europe*, France*, and Germany* (Davey, 1997a).

A. pallens – Iberia*, the Atlas Mountains*, and the western Sahara* (Davey, 2000b).

Cydia amplana – northern Europe*, France*, and western Germany* (Davey, 1997a).

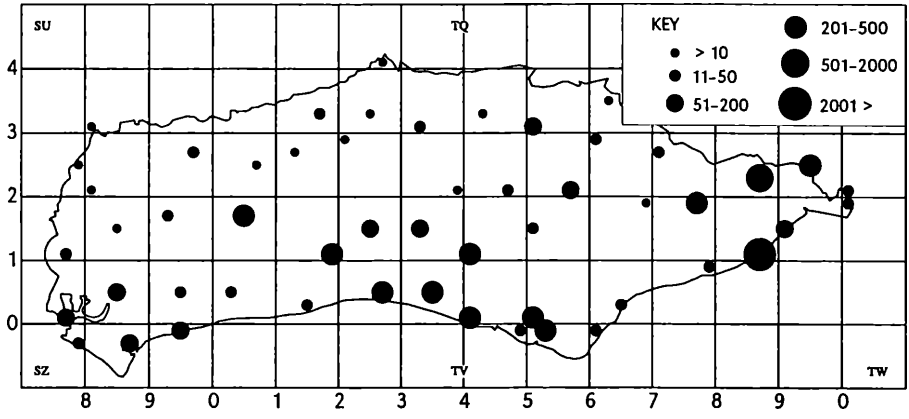
P. xylostella – east of the Baltic Sea (Hurst, 1969), western Baltic, and Russia (Johnson, 1977).

T. micalis – north-west Africa* (Davey, 1999).

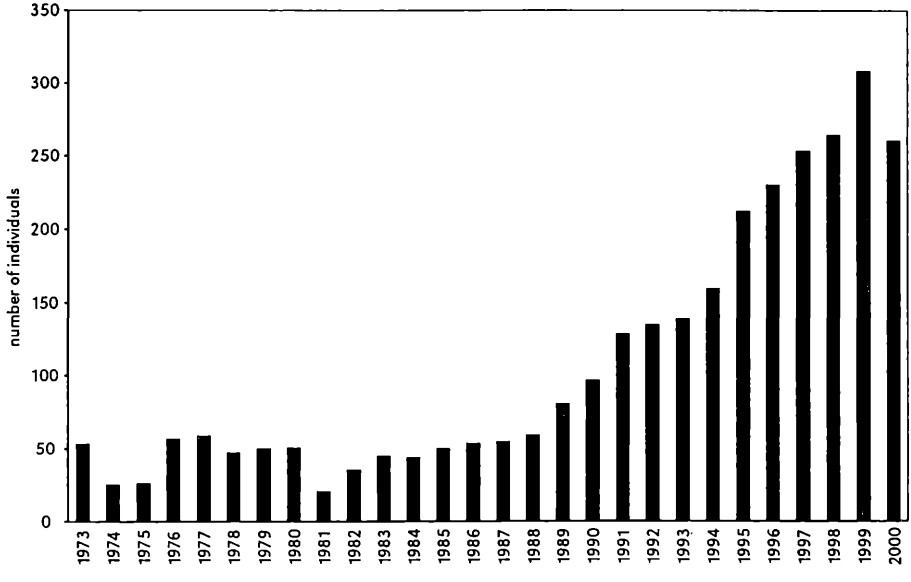
Numerical trends and cycles

An enormous amount of nonsense has been written by modern-day conservationists about insect numbers. So long as entomological records have been made, the numbers of butterflies and moths have varied—often violently—and a few species have naturally become extinct as the environment altered. These events have doubtless been taking place since Lepidoptera separated from other insects, amongst immigrants as well as native species. Some 19th century enthusiasts believed that there were finite cyclic periods of abundance for particular

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at

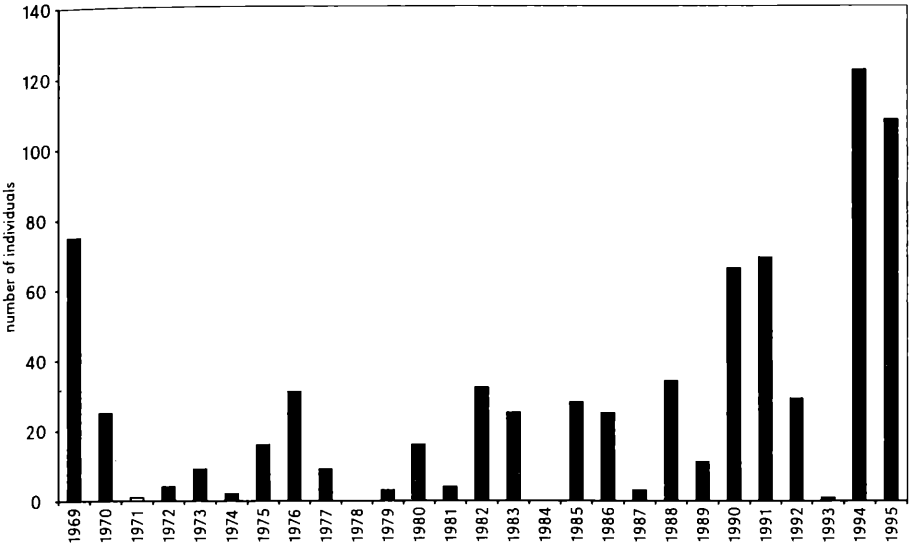


C. cardui - the maximum density of distribution in Sussex during 1996 (the highest number of *C. cardui* recorded in any area sized up to half a hectare, in each ten kilometre square. Source: PRATT, 1999).



A five year running average of the annual number of *V. atalanta* at Peacehaven, Sussex, 1973-2000 (calculated from annual totals obtained by an addition of the daily number of the known different individuals in a small garden, this usually being the highest number feeding at any one time from about 10 square yards of buddleja and valerian blooms). Source: PRATT (1999), with additions.

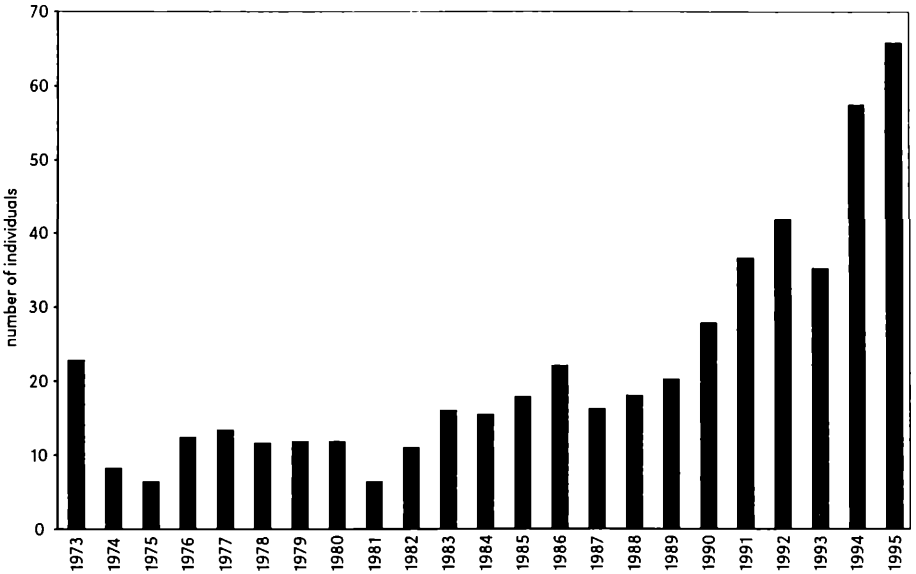
©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at



The annual number of *C. cardui* at Peacehaven, Sussex, 1969 to 1995 (calculated from annual totals obtained by an addition of the daily number of known different individuals in a small garden, this usually being the highest number feeding at any on time from about 10 square yards of buddleja and valerian blooms). Source: C. R. Pratt.

species. For example, with regard to *C. croceus*, it was said that "The older observers, believing in a hard-and-fast line, summarised that period as triennial, quadrennial, quinquennial, or septennial, each period being defended according to the immediate, though limited, experience of the individual" During the 1870's it was reported that the "septennial theory still lingers, probably owing more to its association with that mystical number than any actual experience" But in 1878 these beliefs were finally crushed—"our knowledge of *Colias* will warrant us in considering them all as arbitrary and unsupported by facts" (Fitch, 1878). A similar proposal was put forward for *C. hyale*, one collector suggesting that "you may safely state that it only appears every seven years (perhaps one or two may be seen in the interim)" This Delphic collector also provided evidence, tellingly published retrospectively, that "I have, ever since I took them near Brighton in 1835, foretold that it would be taken in 1842, which turns out to be true" (Desvignes, 1842). Strangely enough, decades later, unusually high numbers were seen in 1868 and these were followed seven years later by another upsurge. After the idea had been ridiculed with *croceus*, not surprisingly, the entire principle was discredited. After another century of Sussex records it can be said with some certainty that there have been no further significant agreements between these two butterflies and the cyclic theory—but during the modern era there *have* been species which exhibit a consistent trend, and others which even show signs of regular numerical pulses.

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at

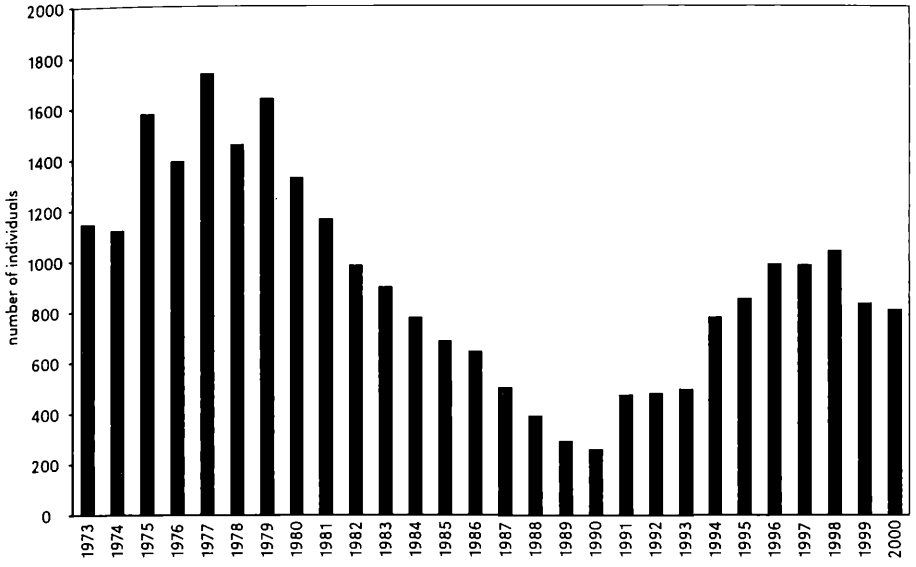


The five year running average of the annual number of *C. cardui* at Peacehaven, Sussex, 1973 to 1995 (calculated from annual totals obtained by an addition of the daily number of known different individuals in a small garden, this usually being the highest number feeding at any on time from about 10 square yards of buddleja and valerian blooms). Source: PRATT (1999), with additions).

As a density of distribution map illustrates, one of the most exciting entomological events during living memory took place in 1996, when several great waves of *Cynthia cardui*—each major influx being estimated as exceeding 10 million butterflies in Sussex alone—were the grandest in the county (and probably in Great Britain as a whole) since 1906 (PRATT, 1999).

It is still thought by most observers that this influx was an abrupt explosion in numbers—and so it was—but an examination of the previous 28 year-long sequence of records made at Peacehaven show that on average the butterfly had gradually been increasing in strength since a nadir during the late 1970's. For the modern era, apart from a hiccup in 1993, unprecedented levels had been recorded from 1990 to 1996 inclusive—and, compared to the 1970's, levels more than tripled in 1994 and 1995. It was during all of these years that the momentous events of 1996 were evidently first seeded, so it was not quite the very sudden outbreak believed. Furthermore, during recent decades *Cynthia cardui* has shown signs of a six or seven year cycle, as a regular succession of comparatively high numbers peaked in 1969, 1976, 1982, 1988, and 1994. This cycle was only broken by the historic events of 1996—although this could be explained by the arrival of specimens from a fresh source. The unusual disappearance of a deleterious factor could also explain the break in sequence, although the very presence of an identifiable cycle suggests that there is generally only one major influence on the numbers suc-

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at



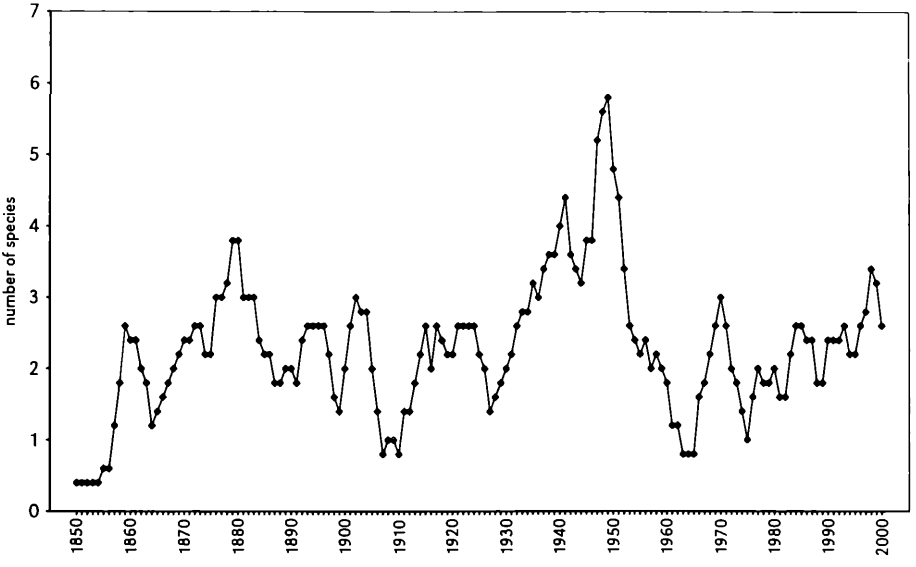
A five year running average of the annual number of nocturnal *P. gamma* at Peacehaven, Sussex, 1973 to 2000 (calculated from nightly totals trapped in a 250 watt mercury vapour light). Source: PRATT (1999), with additions.

cessfully attaining adulthood. There is now good evidence that, over time, the incidence of some other commonplace immigrant species also have a discernible trend. E. g., amongst the butterflies, on average, the levels of *Vanessa atalanta* arriving on the shores of Sussex in southern England have been gradually increasing since about 1987. Similarly, amongst the moths, there has been some signs of a numerical cycle in the arrivals of *Autographa gamma, Scotia ipsilon*, and *Peridroma saucia*, to parts of southern Britain (PRATT, 1999).

The successful immigrants

Most European insect immigrations made in a northerly direction are attempts to increase range or to ensure species survival, by searching out freshly available opportunities for colonisation. The successful establishment of continental insects new to Sussex and Great Britain is, aside from accidental or purposeful importations, initially completely dependent upon the events abroad which dictate the different species, and their numbers, which migrate—although some, such as *Heliothis peltigera*, come under continual severe environmental pressure even after a bridgehead has been well established (PRATT, 1981b). While there have been several extinctions of native British butterflies over the years, no such new arrivals have become permanently resident on these islands within entomologically historical times—but a number of moths have.

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at

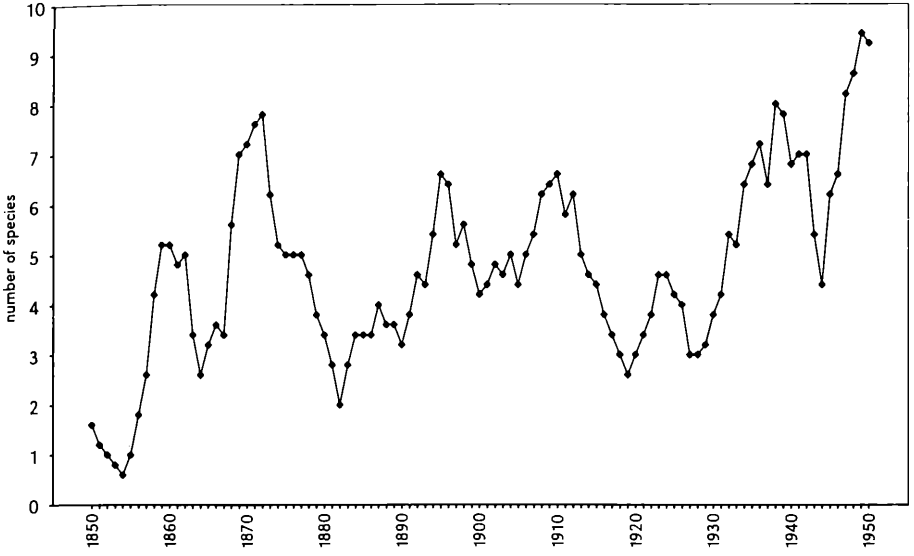


A five year running average of the annual number of episodic immigrant butterfly species detected in Sussex, 1850 to 2000 (this chart excludes *N. polychloros, C. cardui,* and *V. atalanta*). Source: PRATT (1999), with additions.

The number of different immigrant moths and new colonisers in the UK is currently at an all-time high. An accurate comparison over time of the number of different episodic continental immigrant species detected can be affected by several factors, the most serious of which are changes in the efficiency of the methods used for their detection and the varying number of detectors. While previously sugar was king for the early collectors of moths, since about 1950 the vast majority of such migrant records have been made at the vastly superior mercury vapour light, so strict numerical comparisons between these two great collecting epochs cannot be made. The number of entomological recorders in Sussex has also significantly varied—while the number of local butterfly observers has probably increased, those interested in moths is probably now at its lowest level for 150 years. Yet, even so, on average the number of different migrant moth species detected here has been higher than ever before since 1976, and since the mid 1990's they have been at a peak—which means that these particular comparisons are valid generalisations, and perhaps even understated.

Along with a sympathetic local environment, the increasing levels of different immigrant species arriving in Britain has resulted in a growth in the number of Sussex residents sourced from the continent since the middle of the 20th century. Such fresh faces currently total between 15 and 17 macro-moths. The highest number of historically episodic or rare immigrants ever to be detected in the county came in 1996, when 31 such insects were detected making local landfall.

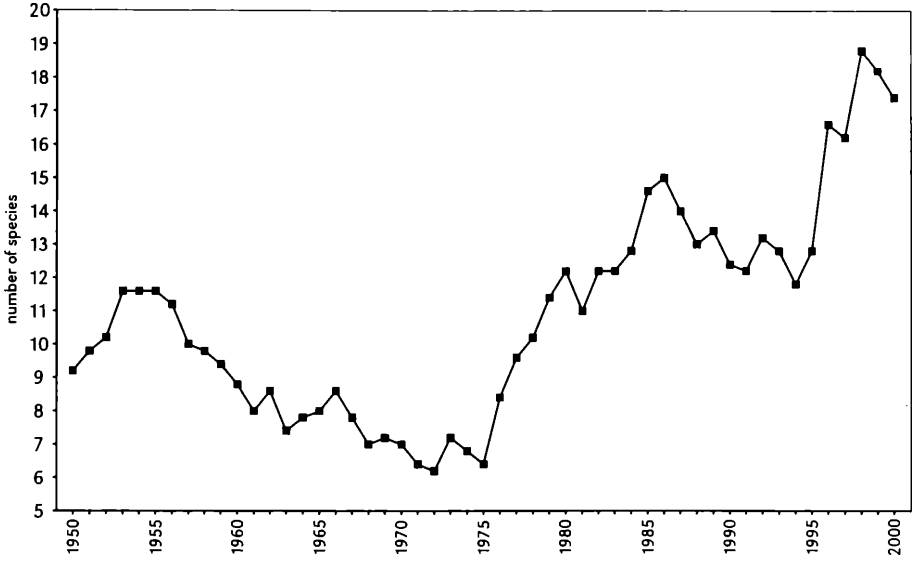
©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at



A five year running average of the annual number of episodic immigrant macro-moth species detected in Sussex, 1850 to 1950 (this chart includes all the macro-moths that are generally considered to be historically episodic immigrants, but excludes annually-seen species and suspected additions freshly promoted within this work). Source: Pratt (1999), plus additions.

There is a good proportional agreement between the average number of different immigrant species discovered in Sussex each year and those accomplishing residency between 1850 and 2000, except for between the 1930's and early 1940's inclusive—although workers researching the national picture obtained a different result (Agassiz, 1996). The rogue period is best accounted for by a time-lag in the discovery of the unprecedented number of new resident moths, before the widespread use of mercury vapour light and partially during wartime—although, even with no evidence of local climatic disadvantage, a unique mismatch in the suitability of our environment for the successful breeding of continental insects that existed at all other times cannot be eliminated. Whatever, it is still remarkable that the number of continental species which have become established in our county are so well related to the number of different migrants which have arrived from time to time over the past 150 years, and that Sussex is so proportionally receptive to these adventurers with only minor regard to the historical vagaries of our own local climate and general environment. This suggests that both facets are part of one phenomenon which encompasses both Britain and the continent, an influence which not only stimulates elevated levels of migrant species to cross the Channel but also dictates that our environment becomes more amenable, enabling an increasing number of lepidoptera to freshly successfully establish themselves.

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at

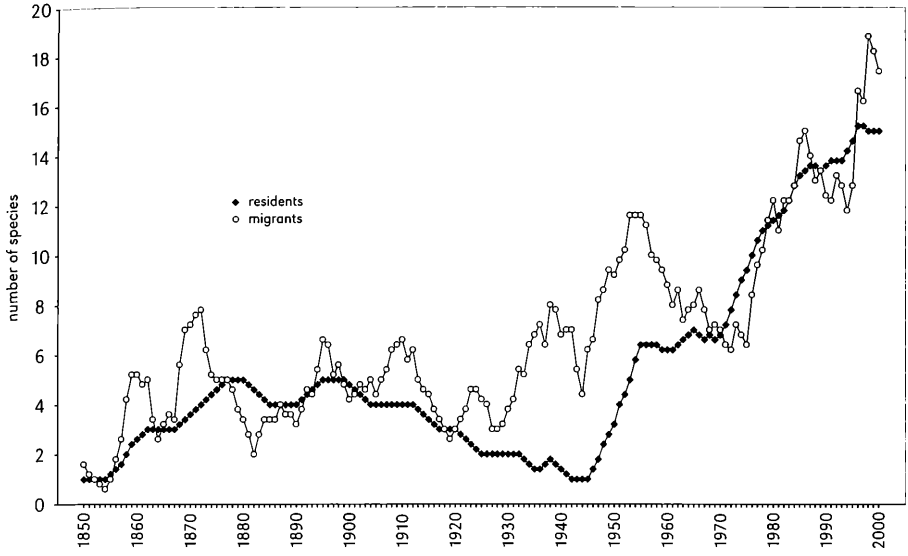


A five year running average of the annual number of episodic immigrant macro-moth species detected in Sussex, 1950 to 2000 (this chart includes all the macro-moths that are generally considered to be historically episodic immigrants, but excludes annually-seen species and suspected additions freshly promoted within this work). Source: PRATT (1999), plus additions.

The stimulus for change

As early as 1956 Baron CHARLES DE WORMS pointed out that "During the past twenty five years there appears to have been a distinct northward movement of a number of species of Lepidoptera, chiefly moths whose normal habitat is in the more southerly regions of Europe A similar and parallel movement of most of these species has been going on in other parts of Europe, notably in Denmark", Holland, and Belgium. This was "a definite movement to extend their range towards the north by some insects whose range just reaches the English Channel or the North Sea and by others of a more southern distribution" (DE WORMS, 1956, 1963a). DE WORMS also noticed that meteorological researchers had provided "very decided evidence of climatic amelioration round the North Atlantic since 1925. It has been shown by the retreat of the glaciers, the northward spread of warm Atlantic water and the increased growth of trees in Northern Scandinavia" (MANLEY, 1944). This was said to have afforded "ample evidence in support of the theory that this apparent movement towards the North of Lepidoptera and other creatures is most probably associated with the warming up of the climate in these more northerly latitudes of Europe, especially as some of the species of Lepidoptera are of distinctly Mediterranean origin and habitat" (DE WORMS, 1956). Now, more than forty years later, not

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at



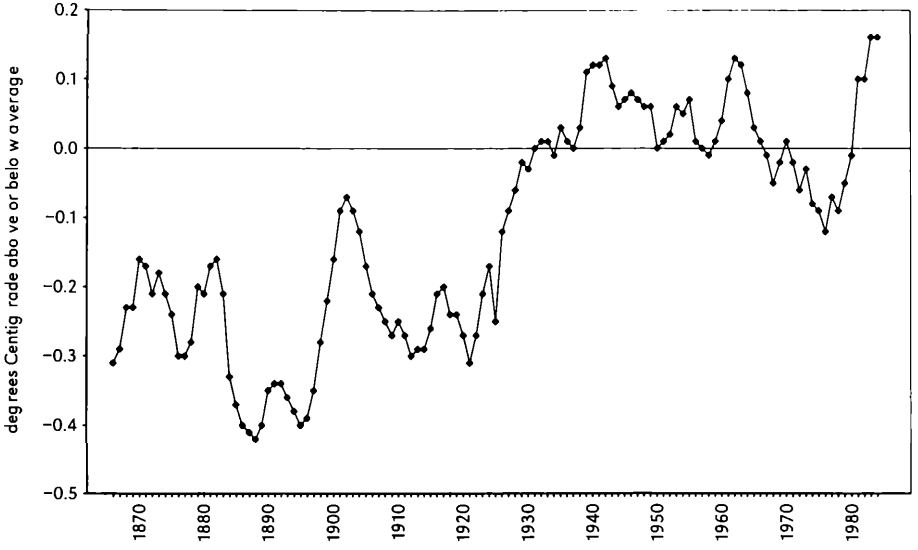
A comparison of the five year running averages of the annual number of freshly resident macro-moths and the annual number of episodic continental immigrant species detected in Sussex, 1850 to 2000. (This chart includes all the macro-moths that are generally considered to be historically episodic immigrants, but excludes annual species and suspected additions freshly promoted within this work. During the years in which a species becomes resident it is deleted from immigrant totals, unless there is an exceptionally good evidence for a cross-channel flight). Source: PRATT (1999), plus additions.

only can it be confirmed that these phenomena have continued almost unabated, and have even accelerated to dizzy new heights, but that the climatic changes have also been named—natural "global warming"

A comparison of a graph illustrating the timing of the number of different episodic species of lepidoptera arriving in England from abroad shows some agreement with trends in the northern hemiphere's temperature (European-wide data being untraceable). An examination of a graph of migrant butterflies shows mutual peaks during the early 1870's, in about 1880, early 1890's, early 1900's, and 1940's, and troughs during the late 1880's, in around 1910, mid 1960's, and mid 1970's. Migrant moths show harmony with peaks in about 1870, 1925, 1935 to 1940, 1955, and 1985, and with troughs in around 1920 and 1975.

There are many anomalies between the graphs of lepidopterous status change in Sussex and macro-temperature—this is hardly surprising, as it is unavoidably a comparison of events on a small portion of the south coast of England with that of the entire northern hemisphere of the

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at



A five year running average of annual temperature in the northern hemisphere, 1866 to 1984 (calculated from base data in JONES, WIGLEY & WIGLEY, 1986).

world—but the number of agreements are statistically beyond coincidence. It is therefore concluded that a significant proportion of the varying numbers of scarce migrant species arriving in Sussex are closely associated with both short-term sequences and long-term trends within the hemisphere's annual temperature. The disproportionate responses within these coincidences show that it is a *change* from an established norm of sometimes only a few years duration that causes modifications in range, and not necessarily absolute temperature values. This confirms that butterflies and moths are quickly adaptive, yet highly sensitive to climatic change.

The future

As our weather continually and simultaneously both creates and eliminates geographical areas of environmental advantage, altering the rates of insect colonisation and extinction, the future history of migrant and colonising species, and immigration as a whole, will also be largely dictated by climate. On the continent it is accepted that "The differences between the strengths of individual populations can be harmonized with climatic as well as ecological changes" (EITSCHBERGER, REINHARDT & STEINIGER, 1991) but UK conservationists rarely make this acknowledgment. A majority of the plans for preservation presuppose that alterations in habitat are exclusively responsible for range changes within insect species, and management

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at

tactics are often automatically fashioned from this basis. A recent detailed analysis of the 150 year-long status history of hundreds of native Sussex Lepidoptera dismissed this supposition for almost every species (PRATT, 1999), although it was readily agreed that habitat quality attenuates numerical levels—the only contrasting exclusions concerned those butterflies and moths associated with isolated and extremely specialised habitats, events such as the local demise of *Mellicta athalia* (PRATT, 1999) and *Scopula immorata* (PRATT, 1981a, 1988, 1999). Natural global warming and the ever changing climate have also been associated with the nationwide extinction of *Aporia crataegi* (PRATT, 1983, 1989), and serious fluctuations in the range of *Hydrelia sylvata* (PRATT, 2001), *Polygonia c-album* (PRATT, 1986–7; PRATT & EMMET, 1989), and *Hecatera dysodea* (PRATT, 1986), and even within that spectacular beetle *Lucanus cervus* (PRATT, 2000). However, despite investigation, some other similar disappearances from Great Britain, such as *Cucullia gnaphalii occidentalis* BOURS., remain mysterious (PRATT, 1992). Only when scientific research overrules political expediency can hitherto unrealised dead-ends be eliminated from detective inquiry, subsequent work focus on solving the true problems, and the genuine physical mechanisms of territorial alteration be determined.

Only a fraction of the whole is known about the migratory phenomenon. Forecasting such movements amongst the scarcer of these butterflies and moths remains completely impossible, but the first tentative steps have now been made towards quantitative predictions for a few of the annually common species. A decade ago ULF EITSCHBERGER made an international appeal for co-operation with research into the migration of insects (EITSCHBERGER, REINHARDT, & STEINIGER, 1991), and it will only be through such pan-European collaboration that our knowledge will expand and successful conservation efforts be maximised.

Acknowledgments

Thanks are due to ULF EITSCHBERGER for continually providing encouragement, and to COLIN WARTLY and JANE NICHOLSON of Trinity House (London) for their kind help in determining the latitude and longitude of historic British light vessels. I would also like to express my gratitude to W. WOLF and Dr. G. LEGG for their time-consuming assistance with the computerisation of this work.

References

ADKIN, R. (1920): Migrations of Lepidoptera in regard to the British Islands. – South Eastern Naturalist **25**: 41–48.

ADKIN, R. (1928): The butterflies of Eastbourne. – Transactions & Journal of the Eastbourne Natural History, Photographic & Literary Society **9**: 3–61.

ADKIN, R. (1930): The Moths of Eastbourne. Part 1. – Transactions & Journal of the Eastbourne Natural History, Photographic & Literary Society **10**: 3–97.

AGASSIZ, D. J. L. (1996): Invasions of Lepidoptera into the British Isles. – In EMMET, A. M., The Moths and Butterflies of Great Britain and Ireland **3**: 9–36.

BAKER, R. R. (1972): The geographical origin of the British spring individuals of the butterflies *Vanessa atalanta* (L.) and *V. cardui* (L.). – Journal of Entomology (A) **46**: 185–196.

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at

BARRETT, C. G. (1893-1907): The Lepidoptera of the British Islands, 8 volumes. - Lovell Reeve & Co., London.

BARTHOLOMEW, J. G. (1904): The Survey Gazetteer of the British Isles. - G. Newnes Ltd., London.

BEIRNE, B. P. (1947): The Origin and History of the British Macrolepidoptera. - Trans. Roy. Ent. Soc. Lond. **98**: 273-372.

BEIRNE, B. P. (1954): British Pyralid and Plume Moths. - F. Warne & Co., London.

BRADLEY, J. D., TREMEWAN, W. G., & A. SMITH (1973-9): British Tortricoid Moths, 2 volumes. - Ray Society, London.

BRETHERTON, R. F. (1951): Our lost butterflies and moths. - Entomologist's Gaz. **2**: 211-240.

BRETHERTON, R. F. (1972): Eastern immigrants and resident natives: a survey of some British Lepidoptera. - Proc. Trans. Brit. Ent. Nat. Hist. Soc. **5**: 95-119.

BRETHERTON, R. F. (1983): The Incidence of Migrant Lepidoptera in the British Isles. - In HEATH, J. & A. M. EMMET, The Moths and Butterflies of Great Britain and Ireland, **10**: 9-34. Harley Books, Colchester.

BROWN, D. (1996a): Cornish Migrant Expeditions, Autumn 1995. - Atropos, Issue **1**: 19-27.

BROWN, D. (1996b): A brief history of RADFORD's Flame Shoulder *Ochropleura leucogaster* (FREYER) in the British Isles. - Atropos, Issue **1**: 28-29.

BROWN, D. (1996c): A brief history of the Tunbridge Wells Gem *Chrysodeixis acuta* (WALKER) in Great Britain. - Atropos, Issue **1**: 32-36.

BURMANN, K. (1973): Wandernde Kleinschmetterlinge. - Atalanta **4**: 353-360 (in german).

CHALMERS-HUNT, J. M. (1960-81): The Butterflies and Moths of Kent. - T. Buncle, Arbroath. Contained in issues of the Entomologist's Rec. J. Var.

COOPER, B. A. (1936). Does *Graphiphora plecta* migrate? - Entomologist **69**: 242.

DAVEY, P. (1996). Weather conditions leading to occurrences of RADFORD's Flame Shoulder *Ochropleura leucogaster* (FREYER) in Britain. - Atropos, Issue **1**: 29-31.

DAVEY, P. (1997a): The 1996 Insect Immigration. - Atropos, Number **2**: 2-13.

DAVEY, P. (1997b): The historical status and potential sources of Three-Humped Prominent *Tritophia tritophus* (D. & S.) in the UK. - Atropos, Number **3**: 39-42.

DAVEY, P. (1998): The Winter Immigration of 1998. - Atropos, Number **5**: 7-12.

DAVEY, P. (1999): Instances of Purple Marbled *Eublemma ostrina* (HB.), Small Marbled *Eublemma parva* (HB.) and *Tebenna micalis* (MANN) in larval and adult stages in England during 1998. - Atropos, Number **6**: 15-17.

DAVEY, P. (2000a): Backtrack for the 1999 Monarch *Danaus plexippus* (LINN.) Influx. - Atropos, Number **9**: 17-18.

DAVEY, P. (2000b): The Winter Immigration of 1999 and Notes on *Ancylodes pallens* RAG. Atropos, Number **10**: 18-20.

DESVIGNES, T. (1842): Letter to W. COURTNEY. In NEWMAN, E., On the appearance of *Colias hyale*. - Entomologist **1**: 385-389.

EITSCHBERGER, U., REINHARDT, R., & H. STEINIGER (1991): Wanderfalter in Europa (Lepidoptera). - Atalanta **22**: 1-67.

EMMET, A. M. & J. HEATH [Eds.] (1989): The Moths and Butterflies of Great Britain and Ireland. Butterflies, volume 7, part 1. - Harley Books, Colchester.

EMMET, A. M. & J. HEATH [Eds.] (1991): The Moths and Butterflies of Great Britain and Ireland. Thyatiridae, volume 10. - Harley Books, Colchester.

FISHER, K. (1938): Migrations of the Silver-Y moth (*Plusia gamma*) in Great Britain. - J. Anim. Ecol. **7**: 230-247.

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at

FITCH, E. A. (1878): *Colias edusa*. - Entomologist **11**: 49-60.

FORD, E. B. (1945): Butterflies. New Naturalist, Collins, London.

FORD, E. B, (1967): Moths. -New Naturalist, Collins, London.

FRENCH, R. A. (1955): Migration records. 1954. - Entomologist **88**: 123-130.

FRENCH, R. A. & G. W. HURST (1969): Moth Immigrations in the British Isles in July 1968. - Ent. Gaz. **20**: 37-45.

FROHAWK, F. W. (1924): The Natural History of British Butterflies, **1-2**. - Hutchinson, London.

FROHAWK, F. W. (1934): The Complete Book of British Butterflies. - Ward, Lock Ltd., London.

GIELIS, C. (1996): Microlepidoptera of Europe, vol. **1**. Pterophoridae. - Apollo Books, Stenstrup.

GRANT, K. J. (1936): The collection and analysis of records of migrating insects, British Isles, 1931-1935. - Entomologist **69**: 125-131.

GRANT, K. J. (1937). An historical study of the migrations of *C. lineata lineata* FAB. and *C. lineata livornica* ESP. - Trans. R. ent. Soc. Lond. **86**: 345-357.

HEATH, J. & A. M. EMMET [Eds.] (1979): The Moths and Butterflies of Great Britain and Ireland. Sphingidae-Noctuidae, volume **9**. - Harley Books, Colchester.

HEATH, J. & A. M. EMMET [Eds.] (1983): The Moths and Butterflies of Great Britain and Ireland. Noctuidae (Cuculliinae to Hypeninae), volume **10**. - Harley Books, Colchester.

HEATH, J., POLLARD, E. & J. THOMAS (1984): Atlas of Butterflies in Britain and Ireland. - Viking, Penguin Books, Middlesex.

HURST, G. W. (1964): Meteorological aspects of the migrations to Britain of *Laphygma exigua* and certain other moths on specific occasions. - Agricult. Meteorol. **1**: 271-281.

HURST, G. W. (1969): Meteorological aspects of insect migrations. - Endeavor **28**: 77-81.

JOHNSON, C. G. (1977): Migration and Dispersal of Insects by Flight. - Methuen, London.

JONES, P. D., WIGLEY, T. M. L., & P. B. WRIGHT (1986): Global temperature variations between 1861 and 1984. - Nature **322**: 430-434.

LEMPKE, B. J. (1950): The Migrating Macrolepidoptera of Holland in Comparison with those of Great Britain. - Proc. S. Lond. Ent. Nat. Hist. Soc. **1948-9**: 148-158.

MACLEOD, H. G. (1939): A Naturalist in Sussex. - K. Saville, Hastings.

MANLEY, G. (1944): Lecture concerning climatic conditions in northern Europe. - Quarterly Journal of the Royal Meteorological Society **70**: 197.

MARCINIAK, B. & L. PRZBYLOWICZ (2000): A new record of *Uthetheisa pulchella* (LINNAEUS, 1758) from Poland. - Atalanta **31**: 75-76.

MIKKOLA, K. (1970): The Interpretation of Long-Range Migrations of *Spodoptera exigua* HB. (Lepidoptera: Noctuidae). - J. Anim. Ecol. **39**: 593-598.

MIKKOLA, K. & P. SALMENSUU (1965): Migration of *Laphygma exigua* HB. (Lep., Noctuidae) in Northwestern Europe in 1964. - Ann. Zool. Fenn. **2**: 124-139.

NELSON, J. (1996): The Monarch *Danaus plexippus* (L.) influx into Britain and Ireland in October 1995. - Atropos, Issue **1**: 5-10.

NEWMAN, L. H. (1959): Looking at Butterflies. - Collins, London.

NEWMAN, L. H. (1965): Hawk-moths of Great Britain and Europe. - Cassell, London.

NICHOLSON, C. (1935): *Danaus plexippus* L. In the British Isles. - Entomologist **68**: 245-251, 269-273.

PENNINGTON, M. (1997): Lepidoptera Immigration into Shetland during August 1996. Atropos, Number **2**: 17-24.

PRATT, C. R. (1981a): A History of the Butterflies and Moths of Sussex. - Booth Museum of Natural History, Borough of Brighton.

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at

PRATT, C. R. (1981b). The fate of *Heliothis peltigera* D. & S. in Sussex. Entomologist's Rec. J. Var. **93**: 137–141.

PRATT, C. R. (1983): A modern review of the demise of *Aporia crataegi* L.: the Black-veined White. – Entomologist's Rec. J. Var. **95**: 45–52, 161–166, 232–237.

PRATT, C. R. (1986): A modern review of the demise of *Hecatera dysodea* D. & S.: The Small Ranunculus. – Entomologist's Rec. J. Var. **98**: 70–78, 114–118, 154–158.

PRATT, C. R. (1986–7): A history and investigation into the fluctuations of *Polygonia c-album* L.: the Comma butterfly. – Entomologist's Rec. J. Var. **98**: 197–203, 244–250; **99**: 21–27, 69–80.

PRATT, C. R. (1988): The history and loss of the Lewes Wave, *Scopula immorata* L. (Lep.: Geometridae). – Entomologist's Rec. J. Var. **100**: 241–249.

PRATT, C. R. (1989): *Aporia crataegi* (Linnaeus). – In EMMET, A. M., & J. HEATH, The Moths and Butterflies of Great Britain and Ireland **7** (1): 99–103.

PRATT, C. R. (1992): An historical summary of *Cucullia gnaphalii occidentalis* BOUR. (Lep.: Noctuidae) in England – but is this the end? – Entomologist's Rec. J. Var. **104**: 9–17.

PRATT, C. R. (1999): A Revised History of the Butterflies and Moths of Sussex. – Booth Museum of Natural History, Brighton. CD-ROM.

PRATT, C. R. (2000): An Investigation into the Status History of the Stag Beetle *Lucanus cervus* LINNAEUS (Lucanidae) in Sussex. – Coleopterist **9**: 75–90.

PRATT, C. R. (2001): The Sussex Perspective to the National Biodiversity Action Plan for the Waved Carpet Moth (*Hydrelia sylvata* D. & S.). – Atropos, in press.

PRATT, C. R. & A. M. EMMET (1989): *Polygonia c-album* (LINNAEUS). – In EMMET, A. M. & J. HEATH, The Moths and Butterflies of Great Britain and Ireland **7** (1): 212–215.

SKINNER, B. (1984): Moths of the British Isles. – Viking, Middlesex.

SKINNER, B. (1998): Moths of the British Isles. – Viking, Middlesex. (Revised Edition).

SOUTH, R. (1885): Insect migration. – Entomologist's mon. Mag. **21**: 208–211.

SOUTH, R. (1921): The Butterflies of the British Isles. – Warne, London.

TUNMORE, M. (1996): The 1995 Camberwell Beauty *Nymphalis antiopa* (L.) Influx. – Atropos, Issue **1**: 2–5.

TUNMORE, M. (1998a): The 1997 Small Tortoishell *Aglais urticae* (LINN.) Influx. – Atropos, Number **4**: 6–10.

TUNMORE, M. (1998b): Portland Moth *Actebia praecox* (LINN.) – A Resident Reinforced by Immigration? – Atropos, Number **5**: 31–33.

TUNMORE, M. (1999): An Influx of Blossom Underwing *Orthosia miniosa* [D. & S.]) into the UK. – Atropos, Number **8**: 6–11.

TUTT, J. W. (1905–14): A Natural History of the British Butterflies, **1**–4. – E. Stock, London.

WILLIAMS, C. B. (1917): Some Notes on Butterfly Migration in British Guiana. – Trans. Ent. Soc. Lond. **1917**: 154–164.

WILLIAMS, C. B. (1930): The Migration of Butterflies. – Oliver & Boyd, Edinburgh and London.

WILLIAMS, C. B. (1939): The migrations of the Cabbage-White butterfly (*Pieris brassicae*). Proc. 7th Inter. Congr. Ent. Berlin **1**: 482–493.

WILLIAMS, C. B. (1949): Migration in Lepidoptera and the Problem of Orientation. – Proc. R. Ent. Soc. Lond. **13**: 70–84.

WILLIAMS, C. B. (1955): How far do insects travel? – Report of Rothamsted Experimental Station (1950–5): 173–180.

©Ges. zur Förderung d. Erforschung von Insektenwanderungen e.V. München, download unter www.zobodat.at

WILLIAMS, C. B. (1951): Seasonal changes in flight direction of migrant butterflies in the British Isles. – J. Anim. Ecol. **20**: 180–190.

WILLIAMS, C. B. (1965): Insect Migration. – Collins, London.

WILLIAMS, C. B., COCKBILL, G. F., GIBBS, M. E. & J. A. DOWNES (1942): Studies in the migration of Lepidoptera. – Trans. R. ent. Soc. Lond. **92**: 101–283.

DE WORMS, C. G. M. (1956): The northward movement of certain species of European Lepidoptera. – Proceedings of the 10th International Congress of Entomology **1**: 737–740.

DE WORMS, C. G. M. (1963): Recent additions to the British macrolepidoptera. – Entomologist's Gaz. **14**: 101–119.

address of the author

COLIN PRATT
5 View Road
Peacehaven
East Sussex
BN10 8DE
e-mail: colin.pratt@talk21.com

ZOBODAT - www.zobodat.at

Zoologisch-Botanische Datenbank/Zoological-Botanical Database

Digitale Literatur/Digital Literature

Zeitschrift/Journal: Atalanta

Jahr/Year: 2001

Band/Volume: 32

Autor(en)/Author(s): Pratt Colin R.

Artikel/Article: A UK Perspective to Immigrant Lepidoptera in Europe: A Comparison of Migratory Species on the Continental Mainland with those of Great Britain and its County of Sussex 3-49