



Species Action Plan

PEARL-BORDERED FRITILLARY
Boloria euphrosyne

December 1995

Compiled by:
L. K. Barnett and M. S. Warren
Butterfly Conservation
Manor Yard
East Lulworth
Wareham
Dorset
BH20 4QP

Tel: 01929 400209

email: nbourn@butterfly-conservation.org

THIS PROJECT IS SUPPORTED BY



This species action plan is an unpublished working document produced by Butterfly Conservation to focus and co-ordinate the conservation of the Pearl-bordered Fritillary in the UK over the next five to ten years. It has been prepared under the *Action for Butterflies* project which is funded by WWF-UK, English Nature, the Countryside Council for Wales and Scottish Natural Heritage. The Action Plan was prepared in consultation with the following organisations in the hope that they will participate in the actions outlined: English Nature, Countryside Council for Wales, Scottish Natural Heritage, the National Trust, MAFF/ADAS, ITE, Forestry Authority, Forest Enterprise, The Wildlife Trust Forestry Unit, the Woodland Trust, the National Trust for Scotland, SOAFD, RSPB, the Scottish Wildlife Trust, the Royal Museum of Scotland, WOAD.

Acknowledgements

We are grateful to the following for their comments at the Pathfinder meeting and / or on subsequent drafts; Jeremy Thomas (ITE), David Sheppard & Rob Petley-Jones (English Nature), Adrian Fowles (Countryside Council for Wales), Dave Phillips (Scottish Natural Heritage), Matthew Oates (National Trust), Sue Clarke (Consultant), Fred Currie (Forestry Authority), Rod Leslie, Robin Kahn and Philip Chambers (Forest Enterprise), Mike Harrison (MAFF), Dave Smallshire (ADAS), Mark Shaw (Royal Museum of Scotland), Jim Cowie (WOAD), Richard Smithers (Woodland Trust), Tony Whitbread and Matthew Phillips (Wildlife Trust Forestry), Alastair Sommerville (Scottish Wildlife Trust), Stephen Moran (Inverness Museum), J. Hood (The Scottish Office), Rob Whitehead (BC Clwyd), Nigel Bourn & Paul Kirkland (Butterfly Conservation).

Butterfly Conservation (the British Butterfly Conservation Society) has an overriding objective to ensure a future for butterflies, moths and their habitats. In order to achieve this objective its aims are to:

- raise public awareness of the plight of our butterflies and moths and encourage public involvement in conservation.
- halt the decline of butterflies and moths and maintain or improve the present status of threatened species.
- improve the extent and suitability of key lepidoptera habitats and the environmental quality of the countryside as a whole for all lepidoptera species.
- work with and advise other conservation groups, local bodies and agencies on techniques of land management which favour butterflies and moths and related wildlife.
- acquire and manage habitats for butterflies and moths.
- encourage the research (both at amateur and professional levels) on butterflies and moths.
- support and encourage butterfly and moth conservation world-wide.

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Summary

- The Pearl-bordered Fritillary, *Boloria euphrosyne* has declined very rapidly during the present century, most notably in woodland in the last 50 years, and is now extinct in large parts of its former range (e.g. eastern England). The Pearl-Bordered Fritillary is a nationally scarce species and is listed under Schedule 5 of the Wildlife and Countryside Act for sale only.
- The current rate of loss of colonies in southern England is estimated at 39% per decade and losses are thought to be equally high throughout large parts of its range. A recent study suggests that the butterfly is holding its own in the Highlands of Scotland, but the distribution map is quite out of date. Accurate distribution data are required urgently to ensure appropriate conservation action for this species. Owing to its rapid decline a **high** priority is afforded to the conservation action in this plan to maintain and increase the number of Pearl-bordered Fritillary colonies in the UK.
- The butterfly breeds in three main habitat types; woodland clearings (usually in coppiced or recently-felled woodland in the south); well-drained grassland habitats either with scattered scrub or where Bracken is abundant in the west; and open deciduous woodland in the north. It is restricted to short, sparse vegetation with a very warm microclimate where the larvae feed on Violets. In coppiced woodland in southern England the Pearl-bordered Fritillary is probably a rather sedentary species. Thus in this type of habitat new patches of habitat must occur very close to existing populations if they are to be utilised. In regions where there are more extensive habitats the species may be more mobile and exist as metapopulations which breed over a network of habitats (e.g. grassland and open woodland habitat in Scotland). This may have been the case formerly in much of southern England.
- The main threats to the butterfly are the continuing changes in woodland management, especially the decline in coppicing and lack of continuity of sizeable fellings of broad-leaved woodland, both of which have reduced the frequency of canopy gaps; abandonment of well-drained grassland habitats (e.g. cessation of grazing and burning); and overgrazing in open woodland habitats. The fragmentation of existing and potential habitats is a current and future limiting factor for the Pearl-bordered Fritillary throughout all its habitats, especially in the woodlands of southern England.
- The immediate major objectives of the plan are to halt the rapid decline of the Pearl-bordered Fritillary in the UK, maintain viable networks of populations and conduct research on the ecology and distribution of the species to enable its effective conservation. A long term objective of the plan is to restore its 1950 range. The conservation of this species concentrates on large scale land management.
- The objectives of the Plan will be achieved by determining current core areas of distribution of the butterfly; improving and disseminating information on the habitat requirements of the species (especially in well-drained grassland or Bracken and open woodland habitats); encouraging the maintenance or introduction of sympathetic

grazing regimes in well-drained grassland/Bracken habitats; encouraging the maintenance/restoration of coppicing and active broad-leaved woodland management (including deer control where necessary) throughout the current and former range of the butterfly; identifying potential reintroduction sites, restoring the habitat and conducting re-introductions if necessary.

- The Action Plan covers the next ten years, will be monitored annually and reviewed in the year 2000 or earlier as the situation demands.

Part 1 Overview

1.1 PRIORITY STATEMENT

The Pearl-bordered Fritillary, *Boloria euphrosyne* was formerly widespread and locally abundant through much of Britain. It declined very rapidly during the present century, most notably in woodland during the last 50 years, and is now extinct in large parts of its former range (especially in eastern England). It does not appear to have declined as much in the Highlands of Scotland. Nationally its range has declined by 52% during the last 150 years, and by 38% during the c20 year period from 1940-69 to 1970-82 (Warren *et al.*, in prep). The current rate of loss of colonies in southern England is estimated at 39% per decade (Warren, 1993a) and is thought to be equally high elsewhere in its range. It is classed as a nationally scarce species in Britain (Nature Conservancy Council, 1989) and is listed as a priority species in Biodiversity: The UK Steering Group Report (DOE, 1995). **High** priority should therefore be afforded to conservation action to protect and increase the number of Pearl-bordered Fritillary colonies in the UK, but this should be reviewed when we have more complete distribution data.

1.2 BROAD OBJECTIVES

1. Halt rapid decline.
2. Maintain viable networks of populations throughout its current range.
3. Conduct research on the ecology and distribution of the species to enable its effective conservation.
4. Long term objective to restore its 1950 range.

1.3 LEGAL STATUS

The Pearl-bordered Fritillary is listed on Schedule 5 of the 1981 Wildlife and Countryside Act (for sale only).

Population	-size	Not known except for a few sites covered by butterfly monitoring transects.
	-trend, numbers	Total number of U.K. colonies is unknown; many colonies with post-1970 records in eastern Britain have since disappeared.
	-trend, range	Formerly widespread, major decline in the eastern England, current strongholds Highlands of Scotland and parts of SW, NW England. Nationally range has declined by 52% in the last 150 years, and 38% in the c20 year period from 1940-69 to 1970-82.
Knowledge of	-status	No up-to-date national data are available for this species. Identification of core areas of distribution required. A review of the status of this species in Scotland is currently taking place.
	-trends	Warren (1993a & b) found the rate of extinction to be 39% per decade in the 1980s on important sites in southern England; Clarke & Robertson (1993) found declines of 33% since 1970 in central-southern England. Several regional studies have shown continuing massive declines (e.g. Berks (100%), Bucks (95%), Oxfordshire (100%), Wilts, Hants and Dorset, Ceredigion, Carmarthen).
	-conservation	Fair ecological knowledge of practical management requirements in woodland. Research needed into ecology and appropriate management regimes in grassland, Bracken, Gorse and open woodland habitats.

Part 2 Biological Assessment

2.1 INTRODUCTION

The Pearl-bordered Fritillary, *Boloria euphrosyne* usually occurs in small colonies of up to a few hundred individuals. It is mainly found in dry, open deciduous woodlands that have a continuous history of coppice or underwood management, or extensive tracts of broad-leaved woodland of uneven age structure, where there are always areas which have recently been cleared and replanted. Numerous colonies in the west and north also breed in rough grassland, often where Bracken and/or gorse is abundant. Open deciduous woodland is used in Scotland.

2.2 ECOLOGY

Life Cycle

The butterfly is univoltine, rarely with a small second brood during August. It is one of the earliest of the Fritillaries to appear, flying in May and June. The adult is normally seen in sunny rides and open woodland areas where there are plenty of spring flowers like Bugle (*Ajuga reptans*), which they use as nectar sources. The food plants are Violets, a number of species of which are used. The most important food-plant throughout its range is Common Dog-Violet (*Viola riviniana*) but further north Marsh Violet (*V. palustris*) can be used, and other species such as Heath Dog-Violet *Viola canina* may be used in some habitats.

The males attempt to locate females by the strategy of “patrolling”. Large numbers can sometimes be found flying low over the vegetation within suitable breeding areas (those with abundant violets growing in short, sparse vegetation) and where females are emerging. The males carefully scan the ground vegetation, pausing to investigate briefly any reddish brown leaf or other object that could possibly be a conspecific female. In the early morning on suitable days, the males feed mainly before their patrolling begins but also intermittently later. A freshly emerged female rests low down on the vegetation until discovered by a patrolling male. If receptive, she will lead the male to a suitable platform for copulation, more often than not at some suitable height from the ground e.g. high in a Hazel tree. Pairing is of short duration, lasting 30-60 minutes.

The eggs may be laid on violets but more frequently are deposited on dead leaves or dead Bracken litter nearby. Young violet leaves are preferred, especially if they are growing in sunny open situations in a wood, e.g. in depressions surrounded by bare ground. On its cooler sites, there is a strong preference for a south-facing aspect (Thomas, Moy & Snazell, in press). In south-west England, Wales and Scotland breeding also occurs outside of woods, in Bracken dominated habitats or in well-drained grasslands where scrub succession is slow (e.g. Carboniferous Limestone around Morecambe Bay). The spiny black larvae feed intermittently on violet leaves

and, between feeds, leave the plants to bask openly on dead leaves (Warren, 1992). They often return to the same resting place. The larvae hibernate among dead leaf litter early in the fourth instar. They resume feeding in March or April, and pupate among low vegetation.

Little is known about predators or parasites of this species, nor the life stages in which mortalities affect the developmental stages. [Parasitism can be studied quite easily by taking a sample of larvae into captivity and returning them to the site as pupae. Dr Shaw of Edinburgh Museum is willing to identify any parasites found]. Shreeve (1990) found substantial egg predation by the wood ant, *Formica rufa* in woodland ride intersections at Bernwood Forest near Oxford, although the Pearl-bordered Fritillary population at Gait Barrows NNR continues to survive, even with a high density of wood ant colonies. There is also a suggestion that larvae are predated by Common Lizards (Emmet & Heath, 1990).

Habitat

The butterfly breeds in three main habitat types; 1) woodland clearings (usually in coppiced or recently-felled woodland); 2) well-drained grassland habitats either with scattered scrub and/or where Bracken is abundant and 3) open deciduous woodland (mainly in Scotland).

1) Woodland Clearings

The Pearl-bordered Fritillary is particularly associated with clearings within ancient woodland. Traditional coppice management where adjacent woodland plots are cut in succession produces the ideal conditions for the butterfly. It also occurs in clear-felled areas within high forests and can thrive, on a transitory basis, in commercially-managed woodland, provided clearings are created regularly.

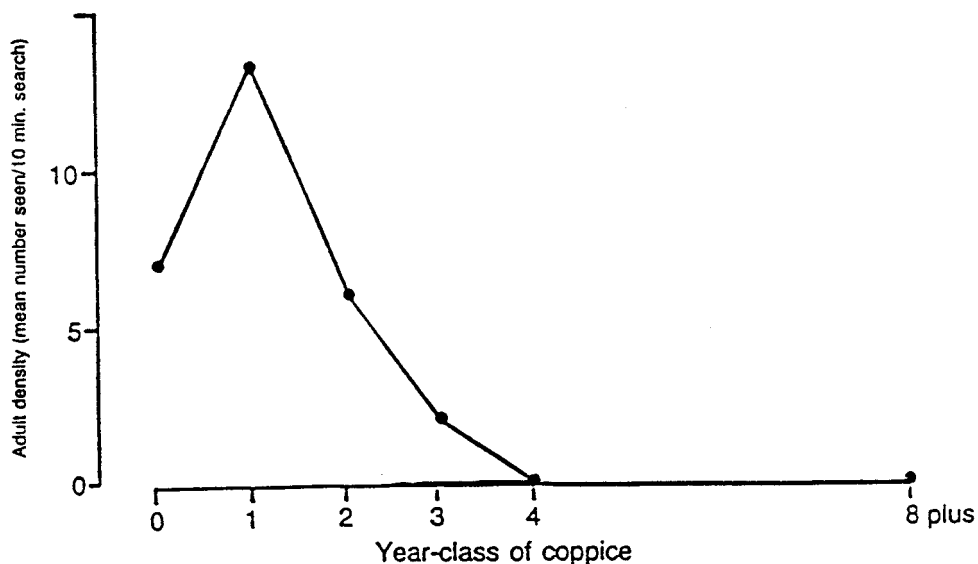
The butterfly lays its eggs on or near violets that grow in open situations, where at least 60% of direct sunlight reaches the plants. The preferred violets are those that are partly surrounded by bare earth, dry dead grass or other leaves, or leaf litter (Thomas, Snazell & Moy, in press). However in commercial plantations such areas are usually replanted with conifers and only produce ideal conditions for a few years. This period of suitability may be extended if succession is delayed e.g. by deer browsing and grazing, by annual cutting (or even spraying) of ground vegetation between the rows of young or crop failure. Colonies may persist for decades in some Christmas tree plantations where there is regular cropping. In extensive woodlands, clearing operations in other areas may allow colonies to move and survive for longer periods, perhaps indefinitely, provided there is good continuity of clearances and they are not too distant. The Pearl-bordered Fritillary is capable of dispersing along open sunny rides and tracks from sites that have begun to deteriorate and some individuals may occasionally fly over the canopy. In these ways new breeding areas can become established, though the butterfly's colonising ability is thought to be quite limited. It should also be noted that many woodland clearings are unsuitable for the butterfly i.e. those with a lack of violets such as clearings from broad-leaved woodland where

Dog's Mercury (*Mercurialis perennis*) or Bluebell (*Endymion non-scriptus*) dominate the ground flora. Competition from vigorous Brambles (*Rubus sp.*) and similarly fast-growing plants can also shorten the longevity of colonies in woodland clearings.

If a supply of continuous sunny flower-rich clearings is not available, the Pearl-bordered Fritillary is known to be able to maintain itself in extensive woodland systems at low density along the margins of broad woodland rides or wayleaves beneath powerlines, provided they receive a high percentage of sunshine and have an adequate supply of violets. This subsistence level existence is rare, and provides essentially only a short to medium term future.

There have been few studies of butterflies in actively coppiced woodland and these involve only a small number of species. This paucity of data is partly due to the rarity of actively coppiced woods where studies can be undertaken but also to the fact that the importance of coppicing to butterfly conservation has only recently been recognised. A preliminary study of one of the last commercially-managed hazel coppices in Hampshire (Warren & Thomas, 1992). They recorded large and rapid responses to coppicing, the greatest at about two years after coppice clearing (see figure A). Although the sample sizes were small, this and other population studies have shown that populations of the Pearl-bordered Fritillary peak under the most open conditions provided by coppice cycle, and there after decline rapidly (Warren & Thomas, 1992). The response of populations in the coppice cycle varies with the vigour of the regrowth; where regrowth is very vigorous a coppice plot will have a shorter life span for the Pearl-bordered Fritillary (e.g. Thomas, Snazell & Moy, in press).

Figure A **The response of Pearl-bordered Fritillary to the coppice cycle in vigorous Hazel coppice** (from Warren & Thomas, 1992).



The density of standard trees has a profound effect on ground-breeding butterflies, largely because of the shading of their food-plants. An analysis of the effects of standard density (ranging from 20-80 % cover) on the abundance of Pearl-bordered Fritillaries in hazel coppice showed that in general higher adult densities were found where the cover was 25% or less and densities declined significantly as the cover increased (Warren & Thomas, 1992). Details of how to manage coppiced woodland and woodland rides for butterflies and other wildlife are given by Fuller & Warren (1994), Warren & Fuller (1994) and in Appendix 4.

The preference of the butterfly for the early stage of coppice and woodland clearings appears to be due to their requirement for a particularly warm microclimate. This factor is most important for the developmental stages, which have limited mobility and require warmth, and in some cases direct sunlight, in order to develop successfully.

2) Well-drained Grassland/ Bracken/ Scrub Habitats

In West Dorset, Devon, Cornwall, the Carboniferous Limestone hills of south Cumbria and north Lancashire, and parts of Scotland, Wales and northern England, the Pearl-bordered Fritillary breeds in non-woodland habitats that can broadly be described as well-drained grassland, typically with either scattered scrub (often gorse and Blackthorn) or dense patches of Bracken. The requirements of the butterfly in these types of habitat are poorly known, although on the edge of Dartmoor it selects areas where violets are abundant in Bracken/grass mosaics (Warren & Oates, 1995). In a preliminary study, eggs were recorded in areas where there was a high violet cover (5-25%), sparse grass (0-50%) and high cover of dead litter (40-100%) (M.S. Warren & N.R. Baker, unpub. data). It seems likely that Pearl-bordered Fritillary larvae select areas with dead Bracken because these provide a very warm microclimate in the spring when larvae are developing. The species has similar requirements in this respect to the High-Brown Fritillary, though the latter is even more demanding (Warren, 1994). On the Morecambe Bay limestones, it breeds on high violet densities amongst slowly growing regenerating scrub, and even amongst open Blue Moor Grass (*Sesleria albicans*) turf.

On certain soils it seems that a moderate cover of Bracken can encourage plants such as Violets which are typical of the woodland ground flora. In the past, Bracken stands were kept in check by a combination of burning, trampling by grazing animals (notably cattle and horses) and the widespread practice of collecting dead Bracken for animal bedding. These traditional practices have ceased on most sites that have escaped agricultural improvement and few are now actively grazed, leading to the spread and total domination of Bracken. Once neglected, Bracken stands soon become unsuitable for Fritillaries, as violets and other herbs are eliminated by the dense shade and, especially litter build up. Current sites are maintained by cattle, sheep and pony grazing, and probably periodic burning, but far more research is needed to elucidate ideal management regimes (Warren & Oates, 1995). For example the degree to which rotational burning is a successful tool in the management of such habitats for the Pearl-bordered Fritillary appears to vary on different sites: On one

Dartmoor site, rotation burning of the Gorse (5-7 year cycle) combined with heavy winter and light summer grazing resulted in a ten fold increase in Pearl-bordered Fritillary numbers and a one hundred fold increase of violets (J. Thomas, pers. comm.). In contrast on a site in Clwyd there were significant losses of the butterfly when Bracken was burnt on rotation (R. Whitehead, pers. comm.). It appears that the impact of rotational burning in such habitats depends very much on the scale and frequency of burns, but it can undoubtedly be useful in maintaining a high violet density. Preliminary results suggest that burning c20% of a site area a year on rotation may be appropriate.

Certain well-drained grassland sites seem to deteriorate quite slowly after abandonment (e.g. the Morecambe Bay limestone grasslands and coastal grassland) and may remain suitable for many years. However these too will eventually becoming unsuitable unless an appropriate management regime is restored (M. Oates pers. comm.).

3) Open Deciduous Woodland

In Scotland, the Pearl-bordered Fritillary is associated with open and lightly grazed deciduous wood pasture. Very little is known about this type of habitat and the regimes needed to manage it. However, the few sites that have been studied in Scotland suggest that such habitats have a sparse canopy, are well drained and contain Bracken/grass mosaics. Much more research is needed on these habitat types.

2.3 DISTRIBUTION AND POPULATION

Distribution

The Pearl-bordered Fritillary occurs throughout the Palaearctic from western Europe across most of Asia, northern Spain and Italy, Sicily being its most southern location. It does not occur in America. The species is declining in parts of north western Europe, e.g. it is extinct in the Netherlands where it was formerly widespread (van Swaay 1990).

The Pearl-bordered Fritillary has undergone a major contraction of its range in the UK over the past 100 years. It was almost ubiquitous in English and Welsh woods in the middle of the nineteenth century, but the Victorian County Histories and other local lists refer to a decline as early as the end of the century. This decline began in the north-east of England (where the species was always more local) and in the east Midlands. Despite this Frohawk (1934), writing from Kent, could still describe this Fritillary as being “one of the commonest of our woodland butterflies.....occurs in almost all the larger woods and forests throughout England and Wales”. Today, this hardly applies to any county following an increasing rate of extinction in the 1950s - 80s. During this period the species was lost from much of the south-east and Anglia, making its disappearance from eastern England and south-east Scotland almost complete.

No national or regional trends of population abundance for the Pearl-bordered Fritillary have been produced by the Butterfly Monitoring Scheme, principally because of the presence of the species on so few sites in the scheme. A number of regional studies covering the south of England and Wales (see Appendix 3) have however revealed that many (if not all) former sites of the Pearl-bordered Fritillary have been lost. In addition Clarke and Robertson (1993) surveyed sites in Hampshire, Wiltshire and Dorset, known to have contained Pearl-bordered Fritillaries in 1970. The number of colonies had declined by 33% and the losses were most pronounced in woods with relatively few remaining areas of coppice, young conifers, rides or glades. The extinct colonies were also those in woodlands with the greatest proportion of mature conifers. In a review of the prime butterfly sites in central southern Britain, Warren (1993a) found that the rate of loss of the Pearl-bordered Fritillary was 39% per decade in the 1980s.

Most former localities of the Pearl-bordered Fritillary retain some woodland today and the species has declined not so much because of wholesale habitat destruction but through changing management. In the south and east, they have survived in woods where coppicing still continues (e.g. Blean Woods in Kent where the species survives in worked Chestnut coppice), or in large woodlands where there has been a continuous cycle of clearance and replanting. The Pearl-bordered Fritillary had a modest revival in the 1950s when lowland broad-leaved woods were extensively cleared and replanted, mainly with conifers, and the butterfly's rapid decline over subsequent decades has largely been due to these plantations maturing. This phase of planting has now ceased and the clearings that will be created on the second rotation of clearing will usually be of too poor a quality to support viable populations, with few or no food-plants compared with the initial clearance of broad-leaved woodland. Moreover, most colonies will already have died out by the second clear felling. The decline of the Pearl-bordered Fritillary and other woodland butterflies has been mirrored by a decline in numerous other warmth-loving and specialist insects, and their outlook is equally bleak (Warren, 1992).

The Pearl-bordered Fritillary is found in numerous sites in Scotland where it prefers the drier habitats of open, light Birch woodland. For a recent summary of distribution data for the Pearl-bordered Fritillary in Scotland see Appendix 2. It is found only in the west of Ireland, on the limestone outcrops of the Burren, Co. Clare (Heath, Pollard & Thomas, 1984). The species has tended to survive far better in western Britain, where it has always been less reliant on woodland and often breeds in more open habitats such as rough grassland or moorland edges. One of the current strongholds in England is also on Carboniferous Limestone, where it occurs around Morecambe Bay in well-drained grassland, scree and scrub habitats. The Pearl-bordered Fritillary has undoubtedly declined within these regions owing to changing woodland management and general habitat loss, but sufficient alternative habitats have survived, maintaining some of its former distribution. Open habitats have also suffered from changing management practices, again often through a combination of agricultural improvement on some sites and neglect on others (Warren, 1992).

Population

Good data is available only for coppiced woodland in southern England where research has shown that the Pearl-bordered Fritillary is a sedentary species. It forms closed colonies within discrete areas (Thomas 1984), and most individuals rarely move outside the habitat patch where they emerge. Thus new patches of short-lived habitat must occur very close to existing populations if they are to be utilised (Thomas, 1991; Thomas & Snazell, 1989; Thomas, Warren & Thomas, 1992). Current evidence suggest that new habitat patches probably have to be within a few hundred metres of an existing colony to ensure rapid colonisation.

In some regions with more extensive habitats however, the species may be more mobile and individuals are sometimes seen a few kilometres from their known breeding habitats. Experience with species of butterfly that exhibit similar behaviour (e.g. the High Brown Fritillary) suggests that where the Pearl-bordered Fritillary occurs in more open and unfragmented habitats it may exist as metapopulations* which breed over a network of habitats. In lowland woodland metapopulations may be confined within each woodland block, with little or no interchange between neighbouring blocks.

2.4 LIMITING FACTORS

Historical

Changes in woodland management (especially decline in coppicing) leading to fewer open habitats within woods and to an increase in distance of new clearings from occupied ones (thus reducing colonisation rates).

Loss and abandonment of well-drained grassland and Bracken/gorse habitats.

Current and Future Limiting Factors

Continuing changes in wood management, especially loss of open clearings and reduction in frequency of canopy gaps within modern high forest systems, resulting in an increased isolation of new clearings.

Continuing decline in the market for coppice produce (although this may have recently been reversed in some areas, e.g. Hampshire).

Abandonment of well-drained grassland/bracken habitats (e.g. cessation of grazing and burning).

Possible threat from Bracken eradication measures in some areas.

* A metapopulation is a collection of local populations, connected by occasional dispersal, in which there are local extinctions and colonisations (Gilpin & Hanski, 1991).

Overgrazing of open woodland habitats (e.g. the New Forest).

Fragmentation of existing habitats and potential habitats.

2.5 RESUME OF CONSERVATION TO DATE

The precise ecological requirements of the Pearl-bordered Fritillary were very poorly known until recent studies by Dr Jeremy Thomas and co-workers and Dr M.S. Warren (Warren & Thomas, 1992; Thomas, Snazell & Moy, in press). As with other butterflies their research revealed that the requirements of the adults were fairly broad and unlikely to be limiting, but those of the early stages were highly specific. The thermal requirements of the larval stage is an intrinsic reason for this observation: The larvae are black and bask in spring sunshine in order to develop satisfactorily. The research also showed the butterfly's association with early successional woodland stages and the need for regular management.

The national distribution map of the Pearl-bordered Fritillary of Heath *et al.* (1984) (Appendix 1) is now out-of-date: studies by Warren (1993a) and Clarke and Robertson (1993) have revealed massive declines of the butterfly in central southern Britain. Regional studies have shown similar results in Berkshire, Buckinghamshire, Oxfordshire (Shreeve, 1990), Ceredigion (Fowles, 1984) and Carmarthenshire (Morgan 1989). The location of all large and medium colonies, and the core regions of distribution thus remain to be identified, though it seems likely that the carboniferous limestone hills around Morecambe Bay constitute a secure stronghold. Other good areas include many west Highland loch sides.

Conservation management is being implemented on several nature reserves and SSSIs, though monitoring is patchy. At Bernwood Forest, box junctions were created to provide open clearings but these remained suitable for only a few years, after which they became too tall and grassy (Shreeve, 1990). There have been several recent attempts at re-introducing the species (e.g. Essex, Hants), all of which have so far failed (Oates and Warren, 1990). New conservation initiatives are being planned by Butterfly Conservation with both Forest Enterprise and The Forestry Authority, including the possible targeting of the new Woodland Improvement Grant towards coppice restoration. Butterfly Conservation is also running a Woodlands campaign aimed at conserving a number of declining butterflies, especially the pearl-bordered Fritillary. In Scotland, the species has been monitored as part of the Scottish Diurnal Lepidoptera Project funded by Scottish Natural Heritage in 1995. On a local level, the Hampshire Branch of Butterfly Conservation is studying the impact of Hampshire County Council's coppicing scheme on Pearl-bordered Fritillaries.

Although the conservation requirements (and appropriate management regimes) for the Pearl-bordered Fritillary in woodland habitat are relatively well known, more research is needed to identify appropriate management regimes in well-drained grassland/ Bracken/ gorse habitats and open woodland habitats. This is particularly important as the species is becoming increasingly reliant on the latter following the adverse changes in its traditional woodland habitats.

Part 3 Actions and Work Programme

This section has been divided into the standard headings Policy and Legislative; Site Safeguard and Acquisition; Land Management; Species Protection and Licensing; Advisory; International; Future Research and Monitoring; Communications and Publicity; Review. Actions are given a low, medium or high priority. The lead organisation(s) concerned for each action is/are named.

Notes

Definition of Colony Size: Large = > 1,000 adults; medium = 100-1,000 adults.

Area of search is defined in NCC (1989, figure 2, page 18).

For key to abbreviations see page 22.

3.1 POLICY AND LEGISLATIVE

**Lead
organisation(s)
concerned**

Action 1 PRIORITY: HIGH

Improve financial incentives for coppice restoration and active broad-leaved woodland management throughout range (especially measures that will increase the size and frequency of canopy gaps and clearings).

FA (+ LAs)

Action 2 PRIORITY: LOW

Prevent the destruction of coppice woodland by extending coverage of felling licenses to include small diameter timber.

FA

Action 3 PRIORITY: HIGH

Include habitat requirements of the Pearl-bordered Fritillary when drawing up or revising management prescriptions in ESAs and other agri-environment schemes (e.g. to promote appropriate Bracken and grazing management in regions where the species occurs).

**MAFF, CoCo,
EN, CCW,
SOAFD,
WOAD.**

Action 4 PRIORITY: MEDIUM

Review grant applications for Bracken control in regions where the Pearl-bordered Fritillary occurs in bracken habitat and refuse or amend control programmes on existing and potential sites.

**NPs, EN,
CCW,
SNH, FA**

3.2 SITE SAFEGUARD AND ACQUISITION

Action 5 PRIORITY: MEDIUM

Designate as SSSI three large or medium colonies per area of search (or as many as exist if less than three), where this will help improve habitat management. **EN, CCW, SNH**

Action 6 PRIORITY: HIGH

Encourage protection of all large/medium colonies through management agreements and/or reserve acquisition *etc.* **All**

3.3 LAND MANAGEMENT

Action 7 PRIORITY: HIGH

Incorporate needs for the Pearl-bordered Fritillary in management plans on all SSSIs with colonies. **EN, CCW, SNH**

Action 8 PRIORITY: HIGH

Maintain / restore coppicing and active broad-leaved management throughout range (especially measures that will increase the frequency of large canopy gaps near existing populations). **All**

Action 9 PRIORITY: HIGH

Encourage appropriate grazing regimes and scrub management on well-drained grassland/Bracken/gorse mosaics, and open woodland habitats in regions where the Pearl-bordered Fritillary survives. **All**

Action 10 PRIORITY: HIGH

Encourage management that will maintain some large populations or networks of populations across the butterfly's range. **All**

Action 11 PRIORITY: MEDIUM

Encourage restoration of suitable breeding habitat within former range , where there is potential for re-establishing viable networks of populations. **BC, EN, CCW**

3.4 SPECIES PROTECTION AND LICENSING

Action 12 PRIORITY: MEDIUM

Conduct strategic re-introductions of Pearl-bordered Fritillary (and any parasitoids that may be identified) into networks of suitably restored habitat. **BC etc.**

3.5 ADVISORY

Action 13 PRIORITY: HIGH

Advise conservation agencies and site owner/managers on practical habitat management for the Pearl-bordered Fritillary and how to incorporate this with other management priorities and interests. **BC, ITE, CCW, EN, SNH**

Action 14 PRIORITY: MEDIUM

Advise on habitat restoration techniques on potential and former sites. **BC, ITE etc.**

Action 15 PRIORITY: MEDIUM

Produce a brief, practical guide on habitat management for the Pearl-bordered Fritillary, incorporating this with management for other wildlife. **BC, EN, SNH, CCW**

3.6 INTERNATIONAL

Action 16 PRIORITY: MEDIUM

Make information about the Pearl-bordered Fritillary, its decline and conservation measures available to other countries especially Ireland and western European countries. **JNCC/BC**

3.7 FUTURE RESEARCH, SURVEY AND MONITORING

Action 17 PRIORITY: HIGH (URGENT)

Collate all recent records, update national distribution map and determine core regions of distribution. **BC, ITE, JNCC etc.**

Action 18 PRIORITY: HIGH

Identify location of all large/medium colonies.

**BC, SNH,
EN, CCW
*etc.***

Action 19 PRIORITY: HIGH

Conduct further research on habitat requirements, ecology and management techniques especially in well-drained grassland/Bracken/gorse habitats and open woodland.

All

Action 20 PRIORITY: HIGH

Establish monitoring on a range of sites representing each habitat type throughout the UK.

**BC, ITE,
SNH, EN,
CCW**

Action 21 PRIORITY: MEDIUM/HIGH

Collate transect data annually and calculate annual index to compare trends on individual sites.

BC, ITE *etc.*

Action 22 PRIORITY: MEDIUM

Identify potentially suitable, unoccupied habitats within 10-20 km of existing populations.

BC

Action 23 PRIORITY: LOW

Identify potentially suitable, unoccupied habitats in former range greater than 20 km from existing populations.

BC

Action 24 PRIORITY: HIGH

Investigate dispersal ability of the Pearl-bordered Fritillary, the effect of habitat loss and isolation of colonies on population viability.

**BC, EN,
CCW, SNH,
ITE**

Action 25 PRIORITY: MEDIUM

Conduct research on parasitoids and species associated with Pearl-bordered Fritillary habitats.

BC, ITE *etc.*

3.8 COMMUNICATIONS AND PUBLICITY

Action 26 PRIORITY: HIGH

Publicise this Action Plan, the decline of the Pearl-bordered Fritillary and the measures needed to conserve it. **All**

3.9 REVIEW

Action 27 PRIORITY: HIGH

Review this action plan annually and update in five years if necessary. **EN, CCW, SNH, BC**

Key to abbreviations

All = All organisations listed below
BC = Butterfly Conservation
CCW = Countryside Council for Wales
CoCo = Countryside Commission
EN = English Nature
FA = Forestry Authority
FE = Forestry Enterprise
ITE = Institute of Terrestrial Ecology
LAs = Local Authorities
JNCC = Joint Nature Conservation Committee
MAFF = Ministry of Food and Fisheries
NT = National Trust
SNH = Scottish Natural Heritage
SOAFD = Scottish Office Agriculture & Forestry Department
WOAD = Welsh Office Agricultural Department
WT = Woodland Trust
Wts = Wildlife Trusts

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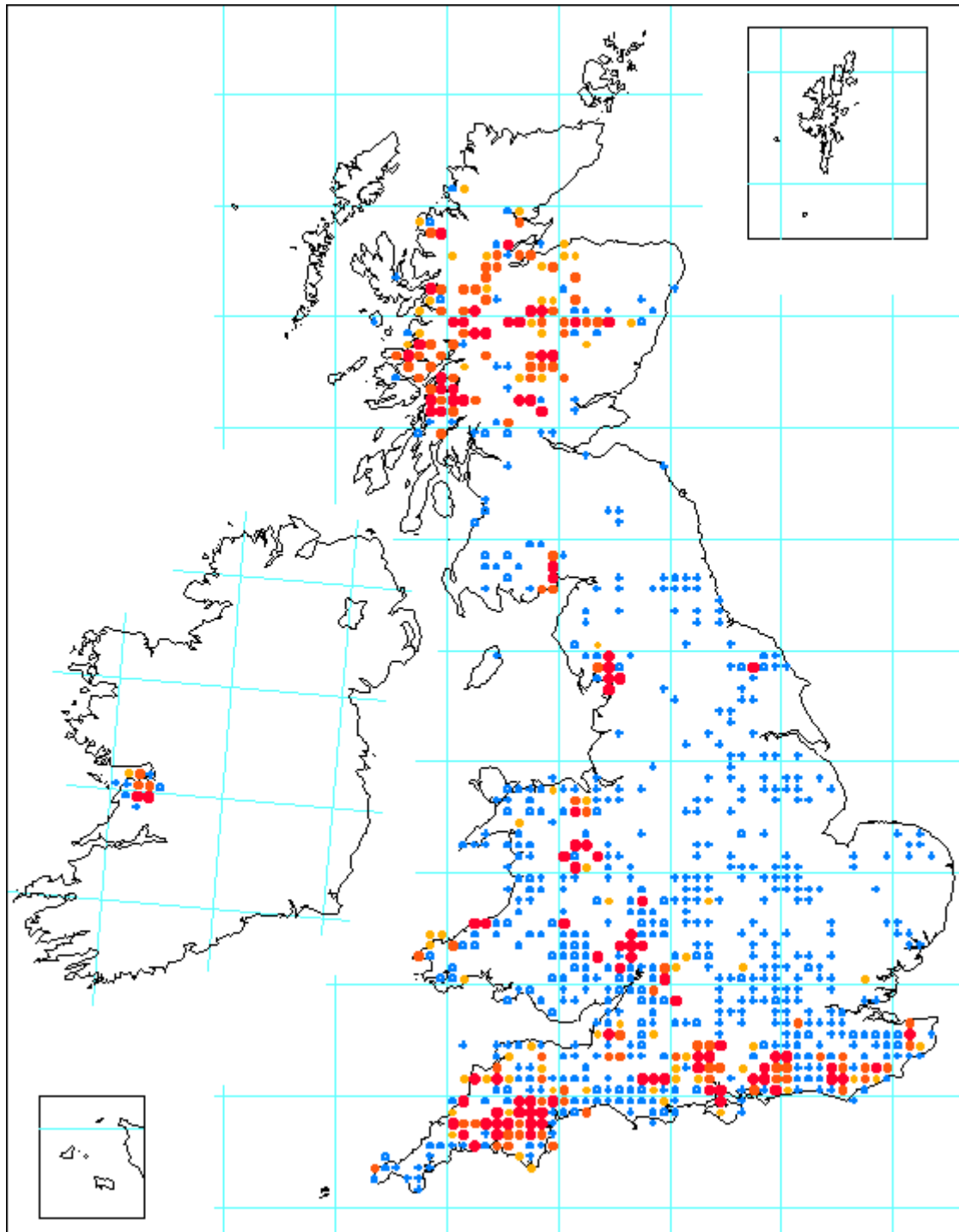
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Appendix 1 The distribution of the Pearl-bordered Fritillary.

Butterflies for the New Millennium project (2001).

Copyright of Butterfly Conservation/Biological Records Centre.

(Dark full spot all records from 1995-1999; open circles all records between 1970-1982; cross all pre 1970 records).



**Appendix 2 Summary of distribution data for the Pearl-bordered Fritillary
in Scotland (D. Barbour pers. comm.)**

Source*	Area	No. of 10 km squares with records from 1970 onwards **.
Highland Biological Recording Group	Highland region plus Isle of Mull	50
D Barbour - provisional maps	Grampian region	28
Dundee Museum	Dundee and Angus	4
Perth Museum	Perthshire including Kinross and part of Central region	14
Fife Nature	Fife	0
Lothians Biological Records Centre	Lothian region	0
MBGBI (1989)***	Strathclyde, excluding Mull, but includes part of the Central region	14
MBGBI	Dumfries & Galloway	12
MBGBI	Borders region	1****
Total		122 (definite)

* plus MBGBI (see ***) in each case

** Each 10-km square has been uniquely assigned to one area - that is , no duplication occurs at area borders.

*** MBGBI (1989) records for areas that are not covered by active schemes are taken direct from maps in Vol 7 (1) of Moths and butterflies of Great Britain and Ireland (Emmet and Heath, 1990).

**** may be doubtful - recorder not known.

Appendix 3 Regional surveys and atlases of the Pearl-bordered Fritillary.

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Appendix 4 Conservation requirements of the Pearl-bordered Fritillary

General Habitat Requirements

Newly cleared woodland or sunny glades with sparse vegetation and plentiful violets. Alternatively Bracken/well-drained grassland mosaics, incorporating frequent pockets of bare ground or sparse ground vegetation, often with scrub that is regularly cleared or burnt.

Coppice

Ensure a succession of flower-rich, sunny clearings where adults can feed and larvae can bask in sparse vegetation. Continuity of habitat is essential, and as the coppice re-grows there must be wide corridors for the species to move along to new, freshly cleared areas where conditions are suitable for breeding. The ideal is coppicing where adjacent woodland plots are cut in succession with open, sunny rides interlinking plots (further information in Fuller & Warren 1994). This allows the whole colony to move into each new patch of habitat as it arises. If standard trees are present, it is essential that their density is low (< 20% canopy cover); much abandoned coppice has far too high densities of standards for this species. N.B. Many clearings are unsuitable; e.g. those on damp ground, or those where the ground flora is dominated by plants such as Dog's Mercury, Bluebell and vigorous grasses such as Tufted Hair, which suppress violets.

Deer Control

When considering the maintenance and re-establishment of coppicing, deer control should aim at reducing deer populations to levels where habitat damage is not occurring or at worst is only very light. Too often deer control is seen as a way of managing the deer as a resource, and inevitably such a deer population will threaten butterfly habitat.

High Forest Woodland

Suitable conditions could be provided by ensuring there is a regular sequence of felling and replanting preferably with deciduous trees and a network of broad sunny rides and glades (for details see Warren & Fuller, 1994). Many colonies appear to breed in areas of Bracken and it may be essential to maintain a light or moderate cover of this plant to provide warm basking conditions for the larvae as well as good over wintering cover. Boundary banks and ditch edges are especially favoured and should be maintained as sheltered unshaded habitat.

Well-drained Grassland/Bracken/Gorse

Suitable breeding conditions are not well-known. Preliminary studies suggest that it requires a mosaic of Bracken & sparse grassland vegetation with abundant violets. The rate of succession in these habitats is generally slow, usually due to extensive stock grazing (especially by cattle) or deer browsing, or both (Warren & Oates, 1995), and possibly even occasional fires (though the latter should ideally cover only a small part of the breeding area). Further research is needed urgently into the species requirement and appropriate management regimes. Suitable breeding conditions may also be provided around the edges of scrub patches, notably gorse. Such populations are enhanced by cutting the scrub on a rotation of 5-10 years which should maintain abundant violets growing in short, sparse vegetation.

Open Deciduous Woodland (Scotland)

Suitable breeding conditions are not known in this habitat. Further research is urgently needed into the species' requirement and appropriate management regimes.