

Pearl bordered fritillary survey

Murrayton South East Cornwall 2002

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**Supported by English Nature
and The Cornwall fritillaries
Action Group**

Wild Landscapes



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Pearl bordered fritillary survey and report; Murrayton, South East Cornwall 2002

The work was funded by English Nature and formed part of a Cornwall wide survey of Pearl bordered fritillary (PBF) run by the Cornwall Fritillaries Action Group. This report sums up survey work based on one colony in Southeast Cornwall.

INTRODUCTION

The survey aims to establish the distribution, size and status of the Murrayton PBF colony. With a view to establishing the key priorities for the conservation of this species in Cornwall.

The survey was carried out from 9 April 2002 to 2 June. The Survey was carried out by Patrick Saunders with additional help from Phil Harris, Tim Dingle, Adrian Spalding and with additional work and kind help by Lee slaughter, Derek Worton and Louise Martin

SUMMARY

The survey work draws on the following conclusions

1. The colony is medium sized metapopulation.

Although the highest number recorded on any day at this site were 46 individuals a further 8-35 (as an estimate based on the survey work) could be added to this making the possible population this year 54-83. The metapopulation is composed of several distinct populations mostly based around seven areas of suitable habitat and microclimates along sheltered areas of the coastal cliffs.

2. The habitat used by the PBF is very different to the other known colonies in Cornwall,

which are mostly bracken-dominated habitats. Whereas the Murrayton colony seems to be based round Ivy *Hedera helix* / Woodsage *Teucrium scorodonia* / Wild strawberry *Fragaria vesca* dominated areas with abundant patches of bare clitter. These areas generally have a small component of Bracken *Pteridium* (typically between 0-10%). These are situated near areas of coastal *Prunus spinosa* / *Ligustrum vulgare* / *Rubus Fruct.* / *Pteridium* scrub and Sycamore *Acer plat.* woodland with an understory dominated by Ivy *Hedera helix*. This woodland has an open structure in places with flower rich paths and natural clearings with abundant Bluebell *Hyacinthoides non-scriptus*, Lesser celandine *Ranunculus ficaria* and Red campion *Silene dioica*. It is thought that the woodland is of more importance in inclement weather and for roosting although it has not been disproved that the woodland habitats are oviposition habitats.

3. All observed oviposition occurred in the south or west facing *Hedera helix* / *Teucrium scorodonia* / *Fragaria vesca* dominated areas with abundant patches of bare clitter. Although it is possible that oviposition occurred in adjacent *Prunus spinosa* / *Ligustrum vulgare* / *Rubus Fruct.* / *Pteridium* Scrub (visibility in scrub is difficult). Random quadrats on site 4B in oviposition habitat yielded on average less than 4% *Viola* cover 21 % leaf litter 5% bracken litter and 35% Clitter

4. The colony depends largely on natural un-managed features and is probably largely secure from management or lack of management threats. But depends on suitable landslippages being created at the same time, as old landslippages become more scrubbed over and unsuitable.

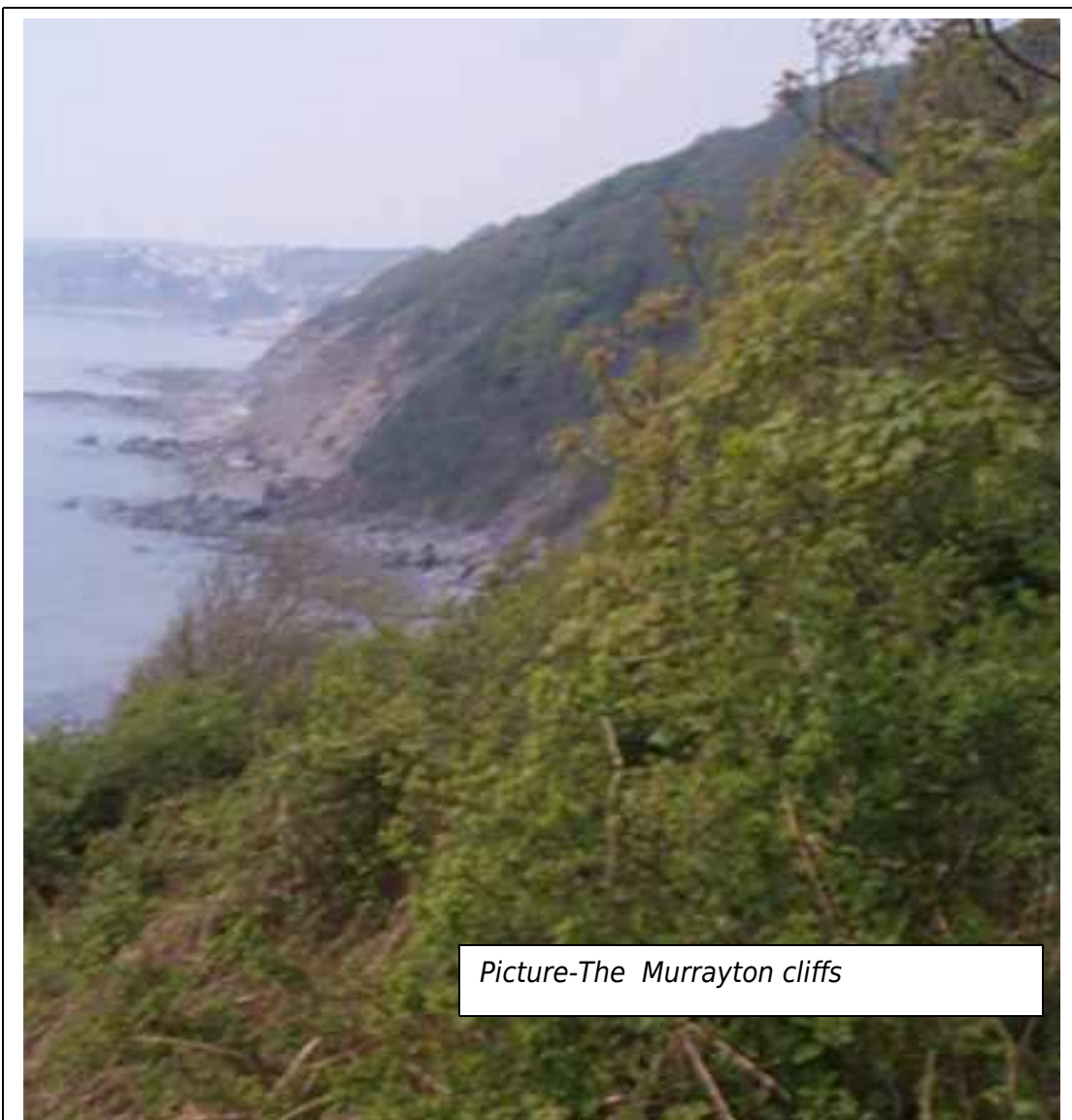
More research is necessary to confirm the effects of the existing light grazing with feral goats on the site, which in some case (2A) is proving very beneficial, but in others (1b) probably not.

5. Peripheral areas, with past records or within flight distance are probably presently unsuitable for colony expansion. Although some areas could become suitable with management and in some areas natural regeneration of scrub woodland may make expansion possible in the future.

6. The colony is geographically isolated from any other PBF populations and further work is necessary to confirm if the size of colony is large enough to prevent extinction through factors such as genetic isolation, extreme weather in any year or other factors, which can adversely affect populations of this type.

7. The Site is obviously important for a variety of invertebrates and wildlife in general. Dingy Skipper *Erynnis tages* and Hairy Birdfoot trefoil *Lotus subbiflorus* were recorded alongside PBF. The site has past records of Grizzled skipper *Pyrgus malvae* although none were recorded on this survey. The site is likely to have other BAP invertebrates and surveys of other groups are necessary.

8. As the site is of such conservation importance and as the Murrayton colony may not survive long term in Isolation. A crucial priority should be afforded not just to ensuring that the Murrayton colony should be conserved but also to expand into suitably managed areas peripheral to the site



Picture-The Murrayton cliffs

The Site

The Murrayton site consists of predominately south facing coastal cliffs with a mosaic of different semi natural habitats (See fig. 1). There is little management of the coastal cliff areas apart from light grazing by semi feral goats/rabbits and deer. The coast path is strimmed once a year (usually in July). Some areas of the site have recent clearings in existing woodland. The site is surrounded by permanent pasture in various states of improvement.

Two private landowners, the National Trust and the Monkey Sanctuary Trust own the site

Methodology

The survey was based initially on personal knowledge of the site through previous visits between 1990-2001 in combination with habitat maps provided by The Environmental Records Centre for Cornwall and the Isles of Scilly. Initial survey work consisted of covering as much of the area as possible to identify and map possible areas utilised by PBF.

From April 18 the whole site was checked for presence of PBF within timed counts.

Both the recorder movements and as the butterflies movements were recorded on a site map and a record sheet. As the season progressed areas unused by PBF were eliminated and the counts focussed on areas of the site with more obvious use by the butterfly. Thermometer readings were taken consisting of a min/max thermometer on a stake at 0.2m height facing north at SX288544 (4a).

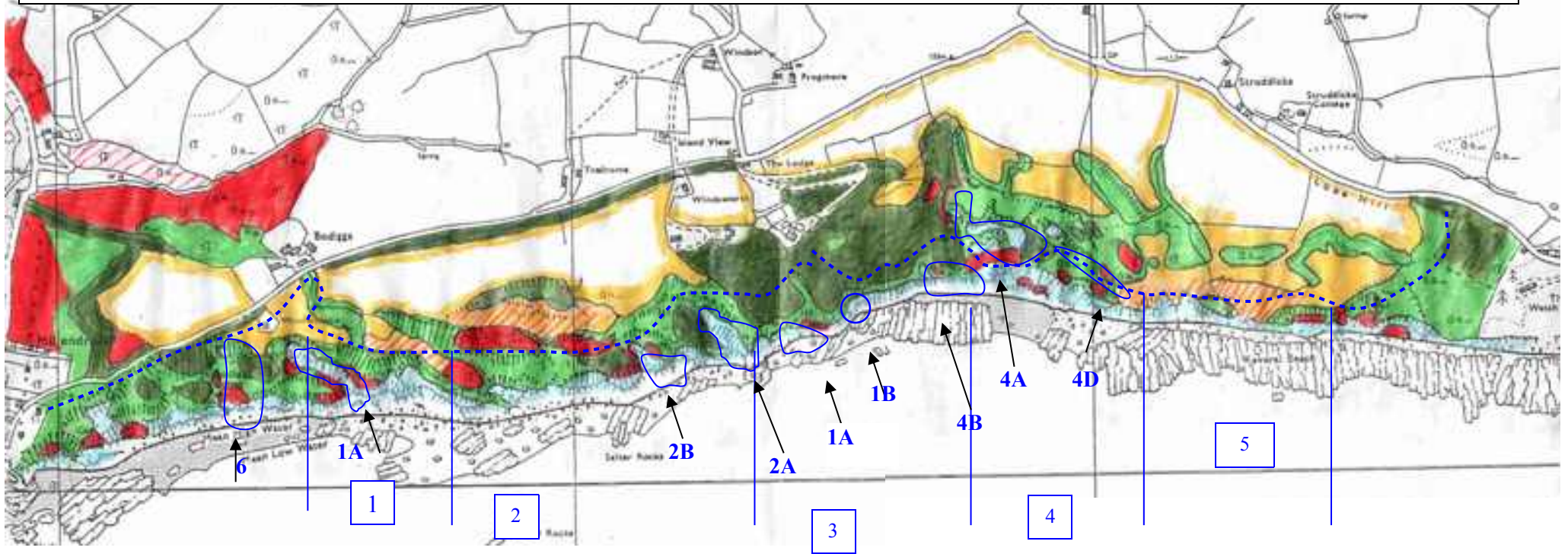
Limitations of the methodology and data

As much of the site was very inaccessible it was impossible to count the entire colony in any session. Most of the inaccessible areas consisted of either dense blackthorn scrub or near vertical cliffs and as such it is unlikely to have consisted of much suitable habitat. Some areas required walks along feral goat tracks along the cliff or a crawl through thick blackthorn to gain access. This combined with patchy weather leaves obvious limits of the data.

Again because of the terrain, counting was difficult and counts are rough estimates of numbers seen in discrete compartments. Some of the areas in particular 4p 4a 4b 4c 4d were close together is it possible that some of the numbers in this area consist of twice counted individuals. Although some attempt was made to avoid this.

As result of the limitations it is thought that the key habitat areas have not been missed but population numbers are estimates and some smaller breeding areas may exist

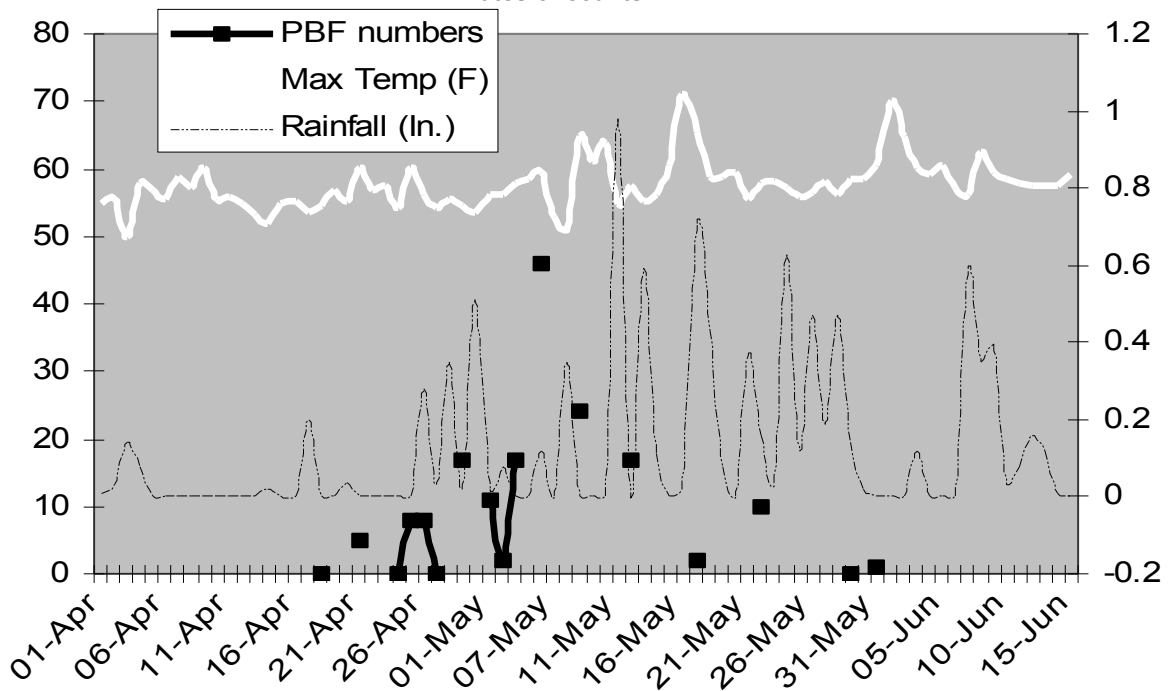
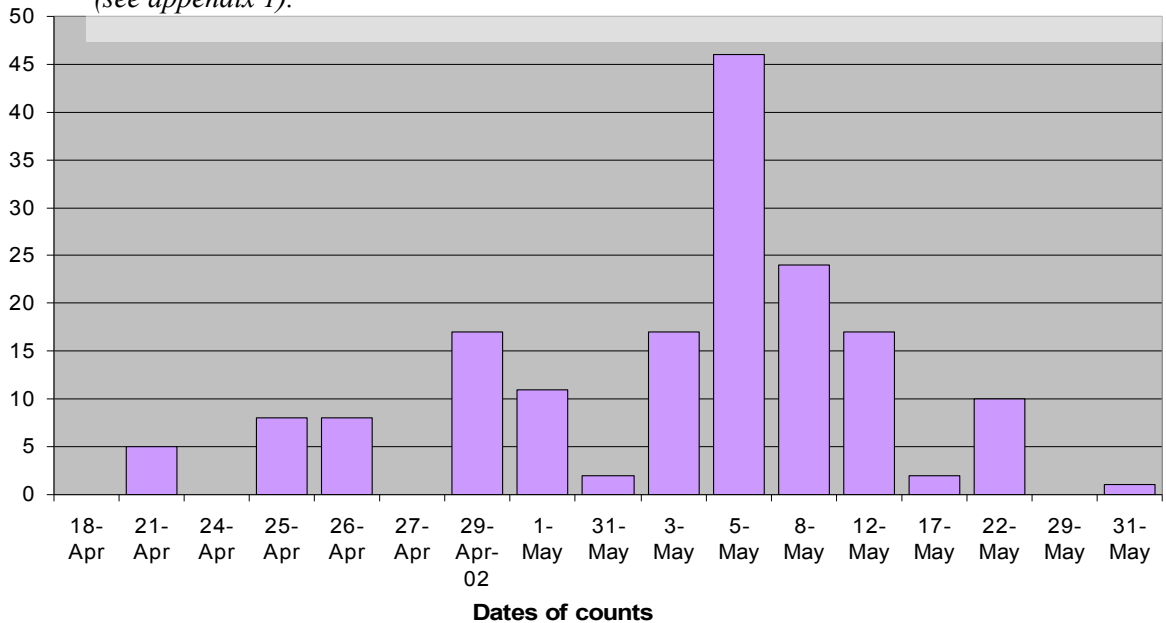
Map of site and compartments Murrayton SX2854 Fig.1



Summary of Field data Flight and dates and numbers

The flight period lasted for six weeks. Starting on the 21 April and ending on the 31 May. The butterflies flew about 9 days earlier than any of the other PBF colonies in Cornwall (*P.Harris 02*), but coincided with the first date in Devon at Ashclyst Forest nr.Exeter (*Pers. comm. N.Bowles 02*) (which perhaps suprisingly was one sighting from an inland woodland). Throughout the survey no Small Pearl-Bordered Fritillaries were seen although PBF were repeatedly netted to confirm identification. Dingy skipper was seen flying alongside PBF. Throughout the period patchy weather made counting difficult. The month before the first sighting was warm and very dry for March carrying on with some good days in April. The weather appeared to deteriorate after the first date with occasional good days (See graph). With rain and winds occurring intermittently in May and early June.

Fig 2. Graph showing total numbers recorded per day throughout the survey period. (see appendix 1).



Graph recording rain and max temp recorded at Plymouth (Mountbatten St.) and PBF numbers recorded at site throughout period

A combination of patchy weather and difficult terrain meant it was impossible to cover the entire site in any one day. For these reasons the peak number of 46 is likely to be an underestimate and excludes much of the site during peak emergence. (See *Appendix 1. For count data*) Based on highest numbers recorded from all the compartments and some guesswork (based on experience of site) 8-25 could be added to this total. This does not include small numbers which may be in the inaccessible areas, although it is thought unlikely that these are anything other than scattered individuals as the remaining unsurveyed areas are probably either too small or too exposed to support any other large colonies. But it is likely that in good weather these areas allow for expansion of the population.

Derek Worton had 17 PBF on the 4 May on a timed count from the coast path area. On the 5 May I met some naturalists from Devon who estimated 17 again, on the same day I saw 46 off the path. Derek Worton estimated 38 on the path in 1997. This indicates numbers rising well above 100 in this year (based on a similar proportion of the colony being inaccessible in 1997 as to in the present survey).

Data and comparison from compartments

Determination of compartments was a visually based on past visits and initial observations of the PBF. The fritillaries were commonly observed in close proximity to each other flying up and down the open areas of these compartments. 2a seemed to be the strongest colony followed by 4b, then 3a, then 4a and 4p. Numbers 1,2,3,4,5, were areas of a transect crossing most of the site.

A survey of PBF on Dartmoor (*D. Green 98*) indicated widespread dispersal of PBF between sites. There were little signs of dispersion of PBF from the key compartments at Murrayton apart from occasional individuals in woodland surrounding the compartments in transect area 3. Regular sightings of singletons occur in the Monkey sanctuary grounds (SX285544). But there were few sightings of butterflies outside the compartments on the transect areas. Although there was some seemingly suitable habitat above the coast path at SX278542 and along the coast path itself (transect 1,2,) no PBF were seen here. It is important to note some compartments were not visited until the second week of flight (*See appendix 1. For data*).

All the areas utilised as oviposition sites had a predominately south or south west aspect. These areas commonly have a mosaic of habitats including coastal scrub; more open bare ground and sycamore woodland. The vegetation structure and aspect of the key areas support a variety of different microclimates that appeared to be used differently in varying weather conditions.

The data seems to indicate a degree of difference in first/ last dates and peak emergence between the compartments. It is not known how much movement there is between these small populations. A mark and release survey could resolve this question.

Description of Key compartments

2A-

2a		SX282542	
Average num. seen	7.2	Highest count	14
Slope	50 deg.	Elevation	20-90M
Aspect	S	Oviposition	yes



Description of Area

2a is the largest compartment and has the highest numbers recorded of any of the compartments.

At the top of this compartment there is Ivy *Hedera helix* / Woodsage *Teucrium scorodonia* with abundant clitter and with abundant Red valerian *Centranthus ruber*. There is also a quite diverse flora including Germander speedwells *Veronica chamaedrys*, Trailing St. Johns wort *Hypericum humifusum*. Towards the middle, the slopes are dominated by windpruned *Prunus spinosa* 1m high with abundant *Viola/Pteridium* interspersed with clitter. Closer to sea level there is bare clitter landslippages with patchy coastal Ivy *Hedera* / Woodsage *Teucrium*/ Strawberry *Fragaria*/ Stonecrop *Sedum*. The area is connected to a small area of Sycamore woodland to the west and protected by cliffs to the East and North. There are signs of light feral goat grazing which appear to be keeping the *Prunus* scrub low and open with tracks which seems beneficial.

Butterflies used all the sheltered open slopes. In inclement weather (29 April), individuals were observed flitting low in-between the *Prunus* scrub. On 5 May the butterflies were observed towards the middle of the area commonly feeding on Red Valerian *Centranthus ruber*. Whereas on quite a hot day (12 May) numbers of them were within 10m of sea level on bare ground, which is where oviposition and mating was observed.

4B

4B		SX287543	
Average num. seen	4.1	Highest count	12
Slope	30-60DEG.	Elevation	20-60M
Aspect	SW	Oviposition	yes

Description of Area

Consists of a shillet scar 8m wide running south east to sea cliffs. To the south end, the scar is very exposed with large areas of bare ground surrounded by *Hedera* and patches of low (0.5m) *Prunus/Ligustrum/Rubus* scrub with occasion *Pteridium*. The scar is protected on the North and East by both the topography and Scrub/Sycamore woodland. To the NW the scar narrows to about 2m wide and becomes surrounded by Sycamore woodland and the bare ground is fringed by *Rubus* scrub. The scar is very close to 4P. *Viola riviniana* occur in small numbers but are consistent throughout (See *Random Quadrats Appendix 3*).



Left-The sheltered west end of 4b

The butterflies were commonly observed moving up and down the scar with males appearing to have separate territories within this area.

At about 5.35 on 1 May a butterfly was observed possibly roosting in 0.4m high *Rubus* in the more sheltered woodland edges.



Left-Exposed South end of 4B

On a hot day (5 May) the butterflies were observed quite low down at an elevation of about 20m on the south end of 4b which is where oviposition took place.

3A-

3a		Sx284543	
Average num. seen	3.8	Highest count	10
Slope	30-60	Elevation	10-50m
Aspect	S.e.	Oviposition	yes

Description of Area

The Vegetation of this area consists of soft cliffs with “islands” of disturbed grassland/Stone crop *Sedum*/ Hairy birdsfoot trefoil *Lotus subbiflorus* and *Teucrium*/*Hedera* vegetation also with islands of *Prunus*/*Ligustrum*/*Pteridium* scrub. Extensive bare clitter landslips break up the vegetation mosaics. There is abundant *Viola* throughout the slope. Higher up there is a clitter scar running east - west which is sheltered to the north by Sycamore woodland and to the south by *Prunus*/*Ligustrum*/*Rubus*/*Pteridium* scrub. It has *Teucrium*/*Hedera*/*Fragaria* between the bare scar and the scrub.

On the 3 May there was a strong wind and numbers were seen just in the sheltered scar. Whereas on the 5 May the weather was hotter, the numbers were higher and dispersed more widely using the more exposed but south facing soft cliffs which is where the oviposition was observed. Dingy skipper was observed here, interacting quite aggressively with PBF.

4A-

4a		SX287544	
Average num. seen	2.1	Highest count	6
Slope	45-60 DEG.	Elevation	40-90M
Aspect	SE-SW	Oviposition	Yes

Description of Area

Main area consists of a large clearing with a south westerly aspect. 10m wide patches of clutter are surrounded by patches of *Hedera / Sedum* and fringed by rank Tall (2m) *Prunus / Pteridium* scrub. The *Prunus* forms a barrier to the south and parts of the west. The area is protected to west and east by Sycamore woodland and to North by tall scree cliffs. Towards the northwest the area (where oviposition was witnessed) consists of a smaller scar 2m wide more sheltered by Sycamore with a westerly aspect. From this area PBF were seen flying into the woodland at SX286545. Although this woodland has some open areas with Bracken *Pteridium* mosaics and a flower rich ride no PBF were actually seen, and the Bracken scrub seems too neglected to be suitable. There were some signs of deer activity throughout 4a but this currently seems to have negligible impact.



Picture- 4A Top end where oviposition took

4P-

4P		SX286544-SX289543	
Average num. seen	2.9	Highest count	6
Slope	30-60	Elevation	50-70
Aspect	SW.-W.	Oviposition	No (but seen by D.Worton97)

Description of Area

This consists of a section of the Coast path. The west end of 4P is a woodland ride under Sycamore woodland with abundant Bluebell *Hyacinthoides non-scriptus*, Lesser celandine *Ranunculus ficara*, Ramsons *Allium triquetrum* and Red campion *Silene dioica*. Slightly further down the path becomes open but sheltered by *Prunus* / *Pteridium scrub*. Here the path has a grass fringe grading into *Hedera* dominated vegetation with abundant *Viola* and leaf litter. This area is connected to both 4a and 4d



PICTURE- The woodland ride area is utilised by fritillaries nectaring. During the main flight period the woodland was very open and sunny. Towards the beginning of the season (25 April) males were seen regularly patrolling the path and the area is probably mostly of significance for meeting females and nectaring. Mating was witnessed further down the path. Derek Worton (*D.Worton 97*) witnessed oviposition in this area although no oviposition was viewed in the present survey. In the last week of May most of the nectar plants finished flowering and the leaf canopy closed up simultaneously with the end of the PBF flight season.

1A

1A		SX274542	
Average num. seen	2	Highest count	3
Slope	45-60 DEG.	Elevation	40 -90M
Aspect	S	Oviposition	yes

Description of Area

A large exposed scar running in a south east direction from the cliffs to the sea. It consists of a very open area of bare clitter with *Hedera helix* mosaics. It has denser *Prunus/Pteridium* stands round the edges with light ash/sycamore woods and thick *Prunus* scrub to the NW. It is more open on the SE although the topography of the cliffs protects it from the north and east. The area has heavy goat runs and erosion. The Sycamore woodland connects with suitable habitat at Boddigga cliffs (6). This woodland area is lightly grazed by feral goats and has an open structure with patchy areas of abundant woodland herbs including abundant Bluebell *Hyacinthoides non-scriptus* and *Viola*.

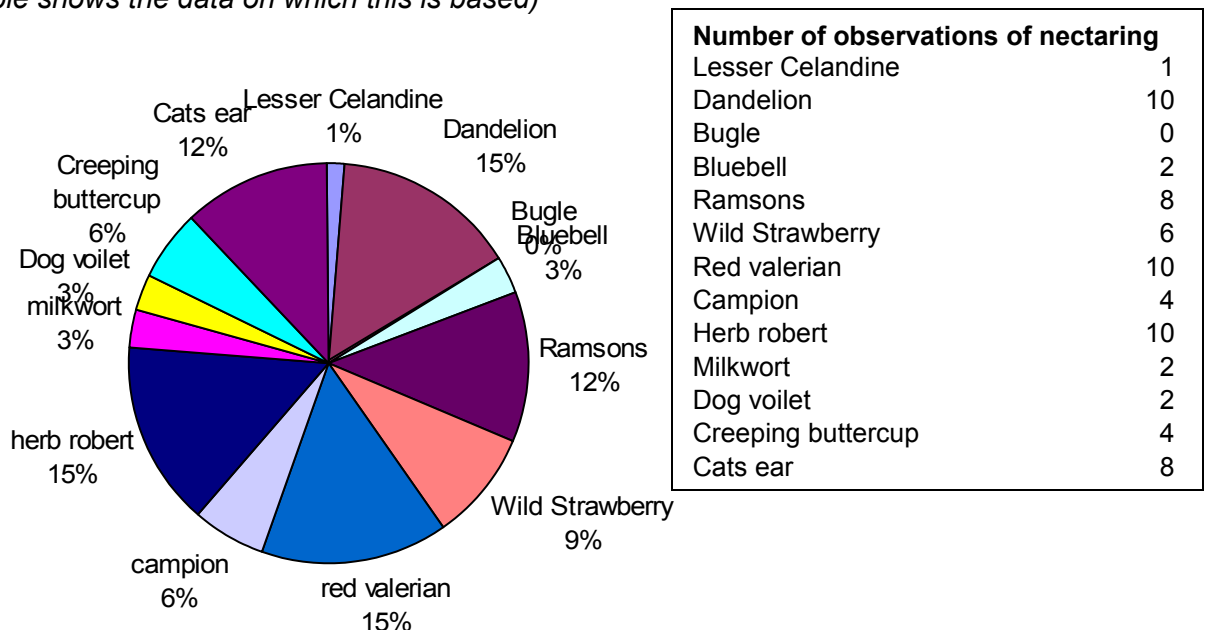
1a and 6 were not visited during peak flight period. Although both are exposed, there are numerous small sheltered areas with suitable vegetation and abundant *Viola* both on the west of the 1a slope and running along the south edge of the cliffs to Boddigga. In 6 Boddigga, there is a small bare clearing at SX273542 and a small area at SX273541 with patchy bracken where Fritillaries were seen. Both of these areas probably support a colony more numerous than the numbers seen.

Other sites of interest

3b is a small suitable area where two individuals were seen. 2b is quite exposed but superficially similar to 1a. Although 2b was visited twice in suitable conditions surprisingly only one PBF was seen. 4d is at the east end of the coast path at SX289544 and has small areas of suitable habitat. All the area below 4p and 4d has small areas of suitable cliff, although it is thought that the majority of individuals, if occurring here, would probably have been counted via 4p and 4d.

Summary of Foraging data fig 3.

Pie chart showing the relative proportion of nectarings observed during the survey- (the table shows the data on which this is based)



Oviposition and mating data

Five ovipositions were witnessed and seven matings. The ovipositions all occurred on or a couple of days after the peak emergence. (See below)

DATE	4/18	4/22	4/24	4/25	4/26	4/27	4/29	5/1	5/31	5/3	5/5	5/8	5/12	5/17	5/22	5/29	5/31	Total
Mating										2		1	3		1			7
Oviposition											1	2	2					5

A few unsuccessful matings were observed - eg. "on the 12 May a female was observed basking on bare clitter. She was gently flapping her wings with her tail pointed up when a male approached and hovered above as she flapped her wings more excitedly. The two flew together briefly then both settled on clitter a couple of feet apart."

A successful mating was observed at 13.55 on the 22 May by a worn looking female and a fresh looking male. Initially the male flew round the female whilst the female flicked her abdomen up and down. Initially, they paired with the male at a 3O'clock position to the female. Then for about 25 minutes they stayed still, abdomen to abdomen, facing opposite directions. The female broke contact then fed on Herb robert *Geranium robertium* repeatedly. She then flew towards the clitter slopes at 4a. Throughout the mating (which lasted 35 minutes), another male was present but showed no interest in mating.

Probable Ovipositions witnessed

5 May	4b	Oviposition on Dead ivy/ Wood speedwell <i>Veronica Montana</i>
8 May	1a	Oviposition on Green Ivy <i>Hedera Helix</i>
8 May	4a	Oviposition on Stonecrop <i>Sedum anglicum</i>
12 May	3a	Oviposition on Woodsage <i>Teucrium scorodonia</i>
12 May	2a	Oviposition on unknown

In most cases, ovipositing was very brief and because of the terrain difficult to place. The butterfly was usually witnessed briefly landing and curling its abdomen under a leaf and /or briefly flicking its abdomen. (With a duration of 3-7 seconds (Taylor, M. (1990)). All ovipositing witnessed at Murrayton seemed to be on living plants. Although it is common for PBF to lay eggs on dead vegetation in the vicinity of *Viola* (Taylor, M. 1990).

The ovipositions observed were marked on a map and later re-found. 1m Quadrats were placed over the approximate oviposition point. (Appendix 3.). Other quadrats were randomly placed close to the oviposition point to enable NVC Classification.

All the oviposition quadrats were in short vegetation. They were all west, south or south west facing, occurring between 20-85m altitude. All egg laying quadrats had some type of thin litter layer either bracken or leaf litter

Summary of oviposition quadrats see Appendix .

Av. Litter depth	0.4cm
Av. Veg. height	10cm
Av. Dead bracken cover	6.8%
Av. Other leaf litter	13.6%
Av. Clitter	23%

On Site 4B 30 1m quadrats were randomly placed in an area used by PBF. (Appendix 4.) Random quadrats on site 4b (Appendix 3.) indicate typically less than 4% *Viola* cover 21 % leaf litter 5% bracken litter 35 % Clitter

In all the quadrat studies the bare ground component was higher and the Bracken component lower than a similar study at Wyre forest (Taylor, M. 1990).



Picture. 4B Oviposition substrate *Hedera helix* dominated with light bracken litter and abundant bare clitter

Summary of habitat requirements

Historically the butterfly was widespread in coppiced woodland in South East Cornwall (Frost, Madge 91). The coppice conditions produced a sheltered microclimate with leaf litter and abundant *Viola* suitable for PBF (T. Bereton 97). The landslippages at Murrayton in some ways arrest the development of the vegetation producing almost a retarded coppice clearing.

It is important that areas utilised by PBF have a diverse structure providing suitable conditions both for adults and larvae. The adults require sheltered warm areas for flight. The more open areas of woodland and sheltered areas of cliff provide this habitat. They also require sheltered scrub or woodland margins peripheral to flight areas to provide roosting sites.

It is likely that the vegetation structure for nectar resources is of less importance than the vegetation structure necessary for egg / larval development. Although the provision of flower rich sheltered areas are likely to be important socially as meeting places for males and females. These are met at Murrayton both in the woodland and on sheltered flower rich areas of cliff.

Viola was abundant throughout the site in a variety of vegetation types. Other factors in the vegetation structure seem more important for providing suitable conditions for larvae and egg development rather than purely *Viola* abundance.

The habitat requirements in Dartmoor are exclusively where Bracken is at least co-dominant with the ground flora and undegraded bracken litter exists in 'islands' in conjunction with bare ground (*D.Green 98*). Similarly to Dartmoor and Wyre forest (*Taylor 90*) the litter at Murrayton is on islands bisected or surrounding bare ground. The Murrayton site may be more dependant on leaf litter than bracken. It is possible that the free draining cliffs retard leaf litter decomposition making it as suitable as bracken for protection of larvae. Although small (5-10%) proportions of bracken were present in all the compartments.

The clitter levels at Murrayton were very high averaging 35% on site 4b which seemed more than other sites in Cornwall (*P.Harris 02 per comm.*) The oviposition seemed to occur at the edges between bare clitter and the *Hedera* scrub probably giving the larvae a choice of microclimates in changing weather conditions. The clitter's structure has numerous air spaces and like bracken absorbs and stores heat. The thermometer readings on 18 April reached 32 degrees centigrade when the thermometer was put on the ground. The clitter gets to baking temperatures when hit by direct sun and stores this heat for a long time. These are good conditions for early larval development with the heat of the clitter being offset by the protection of green plants probably Ivy *Hedera helix* on particularly on warm days. Reflected heat from the clitter is probably important for adults to warm up for flight or other activity. On numerous occasions the adults were observed basking on bare clitter with their wings touching the substrate. It is likely that these disturbed cliff conditions provide a turn over of violets with fresh young leaves suitable for PBF larvae.

Further survey work necessary

Ongoing population monitoring work should be carried out on the site, ideally visiting all the main compartments during peak flight period, though this is very time consuming and may prove impossible for volunteers. Another option would be a timed count on the coast path to get a rough proportion of the site population.

Using the data so far the proportion of the population in view from on the coast path is about 25% (this being a very rough estimate). Therefore monitoring on the coast path only will exclude counts of most of the colony and assumes the general population is rising at the same rate as the individuals which use the coast path. Since many of the compartments are quite different this could obviously lead to very unaccurate counts.

Ongoing comparison of the compartments would probably be useful as it is suggested that the compartments may have slightly different flight times.

Boddiga cliff area needs further survey work to establish the peak numbers of this population. Other peripheral sites should be occasionally checked for possible PBF expansion. The Millendreath area SX269542 and SX273541. The East Looe cliffs SX2653 and possibly Keval woods SX2955.

A mark and recapture study would probably be the most reliable way ongoing monitoring of the population with different colours for the different compartments. This could also lead to more reliable population indices allowing for easier surveying of only a proportion of the population in the future.

Some sort of simple monitoring of grazing may be needed to monitor potential changes in Deer/ Feral goat grazing levels

Table of surrounding past records and their present status

SX2454 Polzion wood, Looe	Probably Extinct colony (Coniferized)		D.Worton 1982
SX2656 Morval	Probably Extinct colony (Over mature broadleaves)	field visit 25/4/02	P.Saunders 2002
SX2754 Boddiga	Still present	see main doc	P.Saunders 2002
SX2854 Murrayton	Still present	see main doc	P.Saunders 2002
SX4351 Maker menadew brake	Possibly never present confusion with Small pbf	field visit 21/4/02 +	P.Saunders 2002
SX2958 Colvase wood	Probably Extinct colony(Not suitable broadleaved management and coniferization)	Map search and drive through 10/5/02 Note south end not searched	P.Saunders 2002
SX3058 Hessenford woods	Probably Extinct colony(Not suitable broadleaved management and coniferization)	Map search and drive through 10/5/02	P.Saunders 2002
SX3057 Hessenford woods	Probably Extinct colony (Not suitable broadleaved management and coniferization)	Map search and drive through 10/5/02	P.Saunders 2002
SX3054 Seaton	Not present	field visit 10/5/02	
SX2955 Keveral bank	Probably Extinct colony (coniferization)	field visit 20/4/02 +3/5/02	P.Saunders 2002
SX2956 Bokenver wood Great Treveria wood	Probably Extinct colony (coniferization)	field visit 20/4/02 +3/5/02	P.Saunders 2002
SX2957 ???	Probably Extinct colony May represent stray or a habitat no longer there	Map search and drive through 20/4/02 +3/5/02	P.Saunders 2002
SX3952 Tregantle fort	Possibly never present confusion with Small pbf	Map search only	P.Saunders 2002
SX3454 Battern cliffs	Unknown possible confusion with small pbf	field visit 18/5/02	P.Saunders 2002
SX3354 St Germans hut	Unknown possible confusion with small pbf	field visit 18/5/02	P.Saunders 2002
SX3254 Eglalooze cliffs	Unknown possible confusion with small pbf	field visit 22/4/02	P.Saunders 2002
OTHERS WITHOUT PAST RECORDS BUT SUITABLE HABITAT			
SX269542 and SX273541 Millendreath Valley	Not here but may be suitable in future (Rank bracken)	field visit 22/4/02	P.Saunders 2002
SX269549 Millendreath area	Not here possibly suitable (Negelected bracken ?)	field visit 22/4/02	P.Saunders 2002
SX2757 Bindown	Not seen habitat may be suitable but too small area	field visit 10/5/02	P.Saunders 2002
SX2653 East Looe cliffs	Not seen some suitable habitat may become better with woodland regeneration	Field visit 5/02	D.worton 2002
SX25253 West Looe Downs	Not seen habitat very suitable but prob too small	Field visit 5/02	P.Saunders 2002
SX317547 Downderry Trewall	Not visited in flight season but small but good habitat	Field visit 8/02	P.Saunders 2002

Summary of conservation priorities

The previous table sums up work outside the Murrayton site carried out as part of the PBF survey. It is likely that there is some confusion with Small Pearl Bordered Fritillary on some sites, but undoubtedly there has been a quite a drastic decline of PBF in Cornwall. (See *other report?*) For this reason it is important to conserve the Murrayton colonies.

The Murrayton colony may not be large enough to survive long term in isolation. There is certainly scope to strengthen the population both at Murrayton and to manage areas for expansion or possibly reintroduction to managed sites.

In studies on Dartmoor (*D.Green 98*) individuals were found to move up to 4.6km and the individual female found to move this distance was observed ovipositing. Thus it is appropriate to consider expansion to other suitable sites within this distance.

Management recommendations

On many areas of the Murrayton site any practical management would be difficult and expensive because of the difficulty of access and terrain. But in some areas some element may be practical. In some areas the soil is very thin so scrub regeneration is fairly slow, this would make it practical to scrub cut small compartments periodically without follow up grazing. Because the PBF seems abundant in suitable small clearings, it may be fairly inexpensive to protect the colony with minimal cost and disruption to landowners.

6 Boddiga cliffs SX274542 Is a good area to target management. The area has a degree of light grazing by feral goats / possibly deer and has suitable neglected *Pteridium* and *Prunus* stands. Management here could concentrate on clearing thick south facing *Prunus* scrub and neglected Bracken to allow goats to follow through and keep the site open long term. Any management should aim to protect the isolation of the site and not encourage walkers through this area, as this would detract deer and goats from natural management of the area. The area has a great deal of sycamore /ash regeneration this must not be cleared as the woodland is essential for the colony's protection.

4a In particular the Blackthorn scrub on the North side of 4p is expanding and becoming dense. Small-scale scrub clearance particularly east west would be beneficial. In this same area there are other small areas for possible scrub clearance.

3 woods SX286544 Consists of neglected *Rubus*/*Pteridium* clearing within woodland is an area to target scrub clearance (and ideally some sort of grazing).

3 woods clearings are being created on the Monkey Sanctuary land, which may benefit PBF. As a result of the survey work management will target areas close to 3A with the aim of extending the 3A area slightly

Struddicks SX290534 the west side has some small areas that could be managed for PBF. In general the site is too exposed for PBF. But if the scrub is cut in smaller compartments than is done currently and more woodland regeneration is allowed the site may become suitable. (Although this may contradict with other requirements). The cliff area round SX29543 has potential for PBF apart from lack of shelter. Small

areas of Sycamore regeneration could be allowed in this area in particular to West and North.

Keval Bank SX299557 There are small patches of suitable habitat along rides and scrub surrounding the new sewage works. The area in the past sustained a large colony. (*D. Worton per com.*) There is great scope here for creating larger clearings and widening existing rides. To make it more attractive for stray PBF's. High priority should be given to sustaining at least a small colony in this area. Any colony here would allow easy expansion to the Seaton valley and other areas should they become available such as temporary forest clearings. The area is approximately 1.8 km from the Murrayton PBF colony so within flight distance for reestablishment. It may be possible to manage wide rides for PBF without compromising forest operations. The area above the sewage works is currently broad-leaved planted woodland/scrub which is probably of little economic value. Management could be targeted in this region.

Millendreath slope Up until about 2001 was neglected bracken. On recent field visit (10/5/02) no *Viola* were observed and the habitat was unsuitable. The site has been recently cleared and now has pony grazing and large areas of disturbed ground this may create suitable habitat in the future and there is scope for this quite large west-facing slope. Currently there is not the diversity of broad-leaved herbs and suitable woodland necessary but this may change. The top end SX273541 is owned by a different landowner but similarly has recently been cleared for horses this looks even better and could be very promising in the future. There seemed to be no other suitable areas in the valley apart from a small area of south west facing neglected bracken at SX269547.

Conclusion

The Millendreath Valley and Seaton valley areas should be targeted as management zones where suitable west or south facing slopes exist. The species and its requirement should be publicised and promoted locally to suitable cliff top and woodland landowners /site managers. The landowners/site managers of such areas should be advised (and positively encouraged) on suitable funding and suitable management techniques.

Through publicity and local media, interest has been generated in this species and as some of the areas in the vicinity are part of a country park and the South West coast path, there is great scope to conserve the species as part of the natural beauty and tourist attractions of the area.

The Murrayton site is owned by a variety of landowners and is sustained on a landscape scale rather than a site scale. This means partnership between site owners and conservation bodies is essential for conservation of the species.

A crucial priority should be afforded not just to ensuring that the Murrayton colony should survive but also to expansion into suitably managed areas peripheral to the site.

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DATE	18-Apr	21-Apr	24-Apr	25-Apr	26-Apr	27-Apr	29-Apr	1-May	31-May	3-May	5-May	8-May	12-May	17-May	22-May	29-May	31-May
MEAN Temp.	20		18	28	26	17	22	24	30		28	22		15	22	22	28
MAX TEMP	32		30	28	30	28	26	24		31	32	30		33	27	27	28
min temp	5		5	7	9	6	6	5			5	6		4	8	6	9
windspeed	4		2	22 to 3	3 to 4	4 to 5		1-5	2	0	0	0	1	0	5-6	3-5	0
winddirection					nw		sw-w	west				s		S		w	
weather			sea mist humid warm	hot with patchy cloud towards beginning	sunny with patchy cloud and rain spells hot towards end of walk	bright in morning but cloudy almost rain	hot and sunny but with strong wind and patchy cloud with some rain partic to start and end		variable patches of sun then then clouding over		hot bright sun no cloud	warm humid and irregularly bright	warm and bright	patchy sun mostly cloudy rain morning		patchy sun feeling warm no other butterflies does it feel stormy	
1	0		0		0			0				0					
1a								1				3					
2	0	2	0		0		1	0				0					
2a							8				14		9		4		1
2b									0			1					0
3	0		0		0	0		1			1	1					
3a							5			5	10	1	4	2	0		0
3b									2								
4	0	3	0			0											
4a				4	2					2	1	6			2	0	0
4b				2			2	3		8	12	6				0	0
4d				0	2		1				2					0	0
4p				2	3			2		2	6	6	4		4	0	0
5	0				1			1									
6 (bodigga)								3									
total	0	5	0	8	8	0	17	11	2	17	46	24	17	2	10	0	1

APPENDIX 1. all field count data

APPENDIX 2. Oviposition data

	1a poss ovi	3a	4b low			4b Top			4a				4p mati ng	
	70m	20m	25m	1	2	3	1	2	3	1	2	3	4	60m
Altitude														
Aspect	s	s	sw	sw	sw	w	w	w	sw	sw	sw	sw	sw	s
Slope	45	30	65	65	65	40	40	40	45	45	45	45	45	60
Litter depth cm	0	0.4	0.2	0.4	0.4	1	0.4	0.4	0.5	0.5	0.5	0.5	0.5	5
Av. Veg hieght cm	30	35	5-20	20	10	5-30	5	5	10	10	10	10	10	20
Dead bracken cover	10	8	10	4	0	5	0	0	10	15	15	5	0	
Other leaf litter	4	0	15	20	5	10	5	20	40	30	10	5	20	
Clitter	40	15	25	4	70	30	10		0	5	50	5	4	
<i>Hypericum perforatum</i>														
<i>Ligustrum vulgare</i>	10		20	60	5	0			0					30
<i>Lonicera periclymenum</i>	0		0			25			0	4				0
<i>Anthoxanthum odoratum</i>	0		0			0			4					0
<i>Polygala vulgaris</i>	4		0			0			0					0
<i>Polypodium vulgare sens. lat.</i>	0	4	0	5	10	0			0		5			0
<i>Potentilla erecta</i>	4		0			0			0					0
<i>Prunus spinosa</i>	0	10	5	5		0	0		0					0
<i>Pteridium aquilinum</i>	4	10	0			0	4		0	5				0
<i>Asplenium trichomanes</i>	0		4	4		4	4		0					0
<i>Rubia peregrina</i>	10	5	10	15	10	15	20	20	0					0
<i>Rubus fruticosus agg.</i>	4	5	4	10	5	10	10	5	0	4	4	5	5	5
<i>Rumex acetosa</i>	0		0	4		4	5	4	4	4	5	5	10	
<i>Asplenium adiantum-nigrum</i>	20		10	5	5	10	4		15		4	10	0	
<i>Sedum anglicum</i>	0		4	4	4	4	5	5	4	10	10	20	25	
<i>Silene uniflora</i>	0		0			15	5	30	10	4		25	0	
<i>Teucrium scorodonia</i>	10	40	4	20	4	10	40	40	20	20	15	30	0	
<i>Umbilicus rupestris</i>	0		4	4		0			0					30
<i>Veronica chamaedrys</i>	0		0			0			0					0
<i>Veronica officinalis</i>	0		20	5	4	0			0					0
<i>Vicia hirsuta</i>	4		4	4		4			0					0
<i>Viola riviniana</i>	5	4	5	4		5	4	4	5	4	4	4	4	0
<i>Blechnum spicant</i>	0		4			0			0					0
<i>Centranthus ruber</i>	0		0			0			0			4	0	
<i>Dryopteris filix-mas agg.</i>	0	5	0	4		0			0					5
<i>Fragaria vesca</i>	0		10	4	5	10	20	50	15					0
<i>Galium mollugo</i>	0		0			0			0					0
<i>Hedera helix</i>	60	30	60	70	30	5	50	40	90	90	70	90	90	
<i>Holcus sp.</i>	0	4	0			0			0					0
<i>Brome sp. ?</i>	0		0			4			0					0
<i>Fescue sp. ?</i>	0		0			0			4					0
<i>Bryophytes*</i>	4	8	80	60	30	60	90	80	5	10	5	60	10	
<i>Lichens</i>	0	8	4	10		5	5	5	30	10	20	10	30	
<i>Jasione montana</i>											4			
										10				
<i>Geranium robertum</i>													4	
<i>Unidentified grass</i>													4	

*Bryophytes noted at site include *Pseudoscleropodium purum*, *Homothecium lutescens*, *Campylopus introflexus* and *Hypnum cupressiforme* (E.V. Watson British mosses and liverworts 3rd edition 1990)

Appendix 3. 4B Random quadrat data

	4b	4b	4b	4b	4b	4b	4b	4b	4b	4b	4b	4b	4b	4b	4b	4b	4b	4b	4b	4b	4b	4b	Average	
clitter	0	30	30	40	0	0	30	0	10	70	90	99	99	80	90	40	0	60	60	5	4	70	0	35.9
viola	4	0	0	4	0	4	0	0	4	4	4	0	0	0	0	4	4	4	4	4	0	4	4	2.6
bracken litter	10	15	0	10	5	10	0	0	20	30	10	0	20	5	0	0	0	0	0	0	0	10	0	5.2
leaf litter	60	40	20	10	40	40	10	60	10	5	0	0	0	10	0	20	20	10	20	20	40	10	30	21.7
mainly low Hedera helix / Teucrium scorodonia	1	1	1				1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Mainly Ligustrum vulgare / Prunus spinosa scrub with Rubus Fruct.and occasional Pteridium Under story of Hedera helix / Teucrium scorodonia				1				1	1	1										1				1