

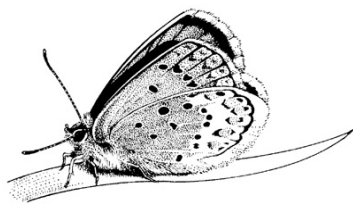
**The Silver-studded blue butterfly on the Sandlings 2009**

**Report to Butterfly Conservation (Suffolk Branch)**

**August 2009**

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## Summary

1. The silver-studded blue butterfly *Plebejus argus* is a nationally scarce species that occurs on lowland heathland. A small but significant population occurs on the Sandlings of coastal Suffolk, and this has been the subject of conservation efforts since the 1980s.
2. A detailed survey of the status of the species at several of its remaining sites in Suffolk was carried out in 2009, the first since 2003 and the second since 1994. Detailed surveys complement annual counts of the species by assessing actual population size and measuring flight areas. In addition, they assess site condition and management.
3. A slight decline in total flight area and population at the sites studied was apparent in 2009, caused primarily by changes at Martlesham Heath where old flight areas have been abandoned. Despite this, the population of *P. argus* should recover at this site following colonisation of recent burns and the occurrence of a large burn in 2009.
4. Healthy populations of *P. argus* occur on Lower Hollesley Common, where management is favouring established populations and encouraging the colonisation of new areas, and at Westleton Common, despite apparent die-back of heathers.
5. Small numbers of *P. argus* occurred at two sites: Purdis Heath, where it was numerous formerly, and at Wenhaston Blackheath. The former requires radical management to bring the site back into condition for *P. argus*. Recent management and a fire during August 2009 may encourage spread of the butterfly at the latter.
6. Specific recommendations are made for the management of each site, as the success of techniques varies. In general, the management of heather stands through cutting or forage harvesting appears to work well at sites on light, friable soils without a deep litter layer, but on sites where scrub or mature heather stands have established and soils are compact or encrusted with turf or moss, more destructive techniques are required to improve suitability for *P. argus*.
7. Data on the phenology of *P. argus* from all surveys since 1985 show that the peak population is usually present when males outnumber females by 2.6:1. The relationship between sex ratio and proportion of population present can be used to predict the peak population from estimates obtained at other stages of the flight period. This will be useful to conservationists and site managers when only single visits to assess populations of *P. argus* are possible.

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## 1. BACKGROUND

The last detailed survey of the population of the silver-studded blue butterfly *Plebejus argus* across the Sandlings was performed in 2003. Similar data was also collected in 1985/1986, 1990 and 1994. Since 2003, site managers and volunteers have monitored numbers of butterflies at the principal sites through annual counts. Although these counts provide good annual measures of site performance, they do not always account for varying flight periods, flight areas or survey effort.

Recent counts have indicated that numbers of butterflies may be falling at some colonies. To update previous population surveys and provide context to recent annual monitoring, a comprehensive survey of the status of *P. argus* on the Sandlings was undertaken in 2009.

The vegetation of most colonies is managed but their condition has not been assessed formally since the survey of 2003. An update is required to inform site management, particularly at sites where populations are thought to be failing and at sites where management is in the hands of non-specialist voluntary groups.

## 2. INTRODUCTION

### 2.1 Status in the UK

The silver-studded blue butterfly was formerly widespread in the UK but has declined markedly in the last century. It is included on the List of Priority Species and Habitats under the UK Biodiversity Action Plan and is classified as Nationally Scarce (JNCC 2008<sup>1</sup>). It is primarily a species of lowland heathland, and today it is common only on the heaths of southern England. Remnants of its former distribution occur in Cornwall, Wales, East Anglia and the Midlands.

### 2.2 Status in Suffolk

Populations are confined to the fragmented heathland of the Sandlings along the east coast. It used to be common in Breckland, west Suffolk, but was last recorded in the 1960s and to date no specific action to restore the butterfly to that area has occurred. The butterfly was probably common on the Sandlings in the nineteenth and early twentieth century when its heathland was contiguous and grazed, but by the 1960s large areas had been converted to forestry or agriculture, particularly between Woodbridge and Aldeburgh. Urban and industrial development, particularly east of Ipswich, has reduced the area more recently.

*Plebejus argus* occurs on the three primary areas of heathland that remain in the Sandlings: on the patches east of Ipswich, on the heaths of Sutton and Hollesley east of Woodbridge, and on the complex of heathland (and most extensive remaining in the county) around Westleton and Dunwich in the north. In the 1980s, the heaths east of Ipswich supported the majority of the Suffolk population and colonies elsewhere were generally small. By 2003, populations east of Ipswich were small and the majority of the population occurred around Westleton and Dunwich. Several populations have been established through introductions of the species.

### 2.3 Objectives

1. Assess the size of populations of *P. argus* at selected sites on the Sandlings;
2. Assess the condition of heathland at these sites;
3. Assess the suitability of one site for further establishments.

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<sup>1</sup> [www.ukbap.org.uk/NewPriorityList.aspx](http://www.ukbap.org.uk/NewPriorityList.aspx)

After discussion with the Sandlings Group, the extant sites included in the study were specified by Butterfly Conservation (Suffolk), and were those for which information on population status and site condition was deemed desirable, namely:  
Purdis Heath (where the population is now small);  
Martlesham Heath (where the flight area has been reduced considerably by scrub);  
Lower Hollesley (where there is an obligation for close monitoring as one site was a donor colony for a translocation in 2007);  
Westleton Common (thought to be in decline);  
Wenhaston Blackheath (a tiny population introduced in 1986 but where remedial management has occurred recently).

### 3. METHODS

#### 3.1 Population status

The assessment of the sizes of populations of *P. argus* on the Sandlings involved two stages:

1. recording the phenology of population size at two reference sites;
2. taking a relative measure of the populations at remaining sites.

The first stage was necessary as the best comparative measure of population size is when populations are at peak (and previous studies have used this method). Using the graph of the passage of the flight period at reference sites, estimates from remaining colonies can be converted to the projected peak of the flight period.

##### 3.1.1 Phenology

Adults were on the wing in the first week of June (R. Parker pers. comm.). Two colonies, Westleton Common and Lower Hollesley 'A', were visited every three days from mid June to early July 2009. In total, six recording visits were made to each colony.

At each visit, the density of adults and the extent of their flight area were recorded. The density of adults was recorded by using the same technique employed in previous surveys. The flight area was walked in a non-permanent zig-zag route, recording the numbers of male and female *P. argus* in an imaginary box 2m ahead of and either side of the route. The number of paces taken on the route was counted and each pace was assumed to be one metre. In most cases, flight area was the same or similar to the survey of 2003 when areas were calculated using GIS. Differences were measured in the field.

Density and flight area were converted to a simple index:

$$\text{Relative population size} = \text{Density} \times \text{Flight area}$$

where density of butterflies is represented per 100m ( $(n \text{ butterflies} / \text{distance of route}) \times 100$ ), distance of route is in metres and flight area is in hectares.

The peak of the flight period at each reference site was the date on which the maximum population index was recorded.

##### 3.1.2 Population sizes

One or more visits were made to remaining colonies plus several additional colonies (small sites at Lower Hollesley and Westleton). During these visits, a relative index of population size was measured using the same method for reference sites. The dates on which colonies were visited, and the sex ratios of males to females, were compared to the relevant graphs of the flight period at the reference colonies (fig. 1). The population index at each colony was adjusted to the estimated peak of the flight period at the reference colonies (the index was multiplied by the proportion of the

peak reference population present on the relevant date). Most colonies were visited during or close to the peak of the flight period at the reference colonies so little adjustment was necessary.

The population index provides comparison of the relative strengths of the populations studied in 2009, and also direct comparison with identical measures from previous surveys in 1985-2003. It can be converted to estimates of the actual numbers present using a formula derived from previous studies on the Sandlings:

$$\text{Actual population} = (\text{Population index} + 3.19) / 0.02$$

but this formula was derived in 1990 when colony populations on the Sandlings were larger and as such it exaggerates numbers from small indices (it can be seen that the minimum population size is 159 butterflies). Estimates of actual populations in 2009 are shown, but these are subject to large error where small populations occur and are presented for interest only.

### **3.2 Site condition**

General notes on vegetation structure and composition were made during visits to record populations of *P. argus*, but dedicated visits to measure these were made during the late stages of the flight period in 2009. The height and percentage composition of vegetation were measured in quadrats across the flight areas of *P. argus*. Visits were also made to assess the suitability of one site (Snape Warren) for a potential establishment.

#### 4. *P. ARGUS* IN 2009

##### 4.1 Status

###### 4.1.1 Phenology

Adults were on the wing in the first week of June, early by historical standards, but similar to recent years, and large numbers of males were present during the first recording visits to the reference colonies on 15<sup>th</sup> and 16<sup>th</sup> June, especially Westleton Common. Populations at both reference sites peaked on the 25<sup>th</sup>-27<sup>th</sup> June 2009 (fig. 1) and in general about 75% of the peak population was present on the 23<sup>rd</sup> and 29<sup>th</sup> June and about half on the 17<sup>th</sup> June and 1<sup>st</sup> July. The exception was Wenhaston Blackheath, where adults were late emerging – they were only recorded on July 9<sup>th</sup> and not seen during two earlier visits (greater numbers were seen in late July, R. Parker pers. comm.).

There was a drop in the density of adults at the reference colonies between the 19<sup>th</sup> and 24<sup>th</sup> June (this was noticed at other sites, D. Mason pers. comm.)<sup>2</sup>. The ratios of males to females increased slightly or remained the same during this period (fig. 2), suggesting a slowdown in the emergence of females, and this may have delayed the peak of the flight period. Sex ratios were identical (2.8 males to one female) at the flight period peaks of the reference sites, and very similar at remaining colonies when close to or at peak (2.5-3.6).

###### 4.1.2 Populations & flight areas

In descending order, the largest sites recorded in 2009 were Westleton Common (about 36% of the recorded population), Lower Hollesley B (30%), Martlesham Heath (13%) and Lower Hollesley A (12%). Remaining sites supported 4% or less. An estimated peak population of about 5600 adults was recorded at the sites studied in 2009 (Table 1).

The total flight area of *P. argus* at these sites was 3.34ha. Flight areas were small (mean 0.37±0.14ha), and five of the nine sites were smaller than 0.25ha. The colonies at Westleton and Lower Hollesley together represent the majority of the flight area (77%) available to *P. argus* at the sites studied in 2009.

Table 1: The populations and flight areas recorded at the sites studied in 2009. The population at Wenhaston Blackheath emerged much later than other colonies and its peak was unknown.

Site	Date of maximum index	Index	% of peak	Peak index	Population estimate*	Flight area ha
Purdis Heath	29 <sup>th</sup> June	0.4	90	0.4	181	0.13
Martlesham Heath	24 <sup>th</sup> June	9.6	90	10.6	690	0.50
Lower Hollesley A	27 <sup>th</sup> June	9.7	100	9.7	645	0.33
Lower Hollesley B	27 <sup>th</sup> June	24.5	100	24.5	1385	0.72
Lower Hollesley C	27 <sup>th</sup> June	3.7	100	3.7	345	0.14
Upper Hollesley MOD <sup>†</sup>	27 <sup>th</sup> June	1.4	100	1.4	230	0.06
Westleton Common	25 <sup>th</sup> June	29.0	100	29.0	1610	1.31
Westleton football pitch	28 <sup>th</sup> June	0.9	90	1.0	209	0.09
Wenhaston Blackheath <sup>†</sup>	9 <sup>th</sup> July	0.3	-	0.3	175	0.06

\* see methods

<sup>†</sup> see site section

<sup>2</sup> This coincided with a few days of cool and unsettled weather (generally the weather during the remainder of the flight period was warm and dry).

Fig. 1: The phenology of the 2009 flight period of *P. argus* from the two reference colonies, Lower Hollesley 'A' (solid circles) and Westleton Common (open circles). Curve fitted by eye. Dashed lines show that about 50% of the peak Sandlings population was present around the 17<sup>th</sup> June, 75% on the 23<sup>rd</sup> June, and that populations were at peak between the 25<sup>th</sup> and 27<sup>th</sup> June 2009.

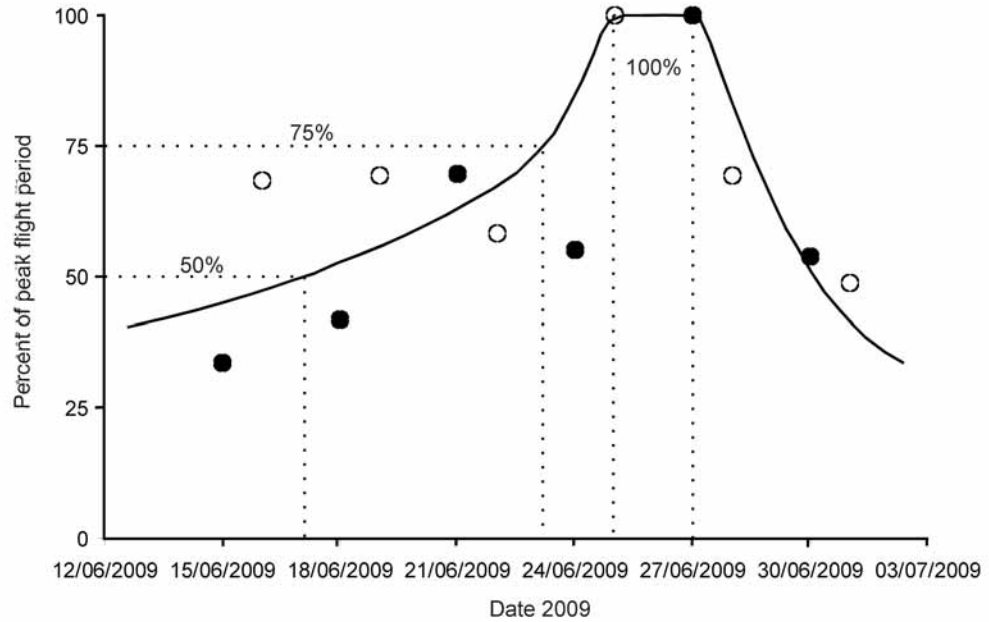
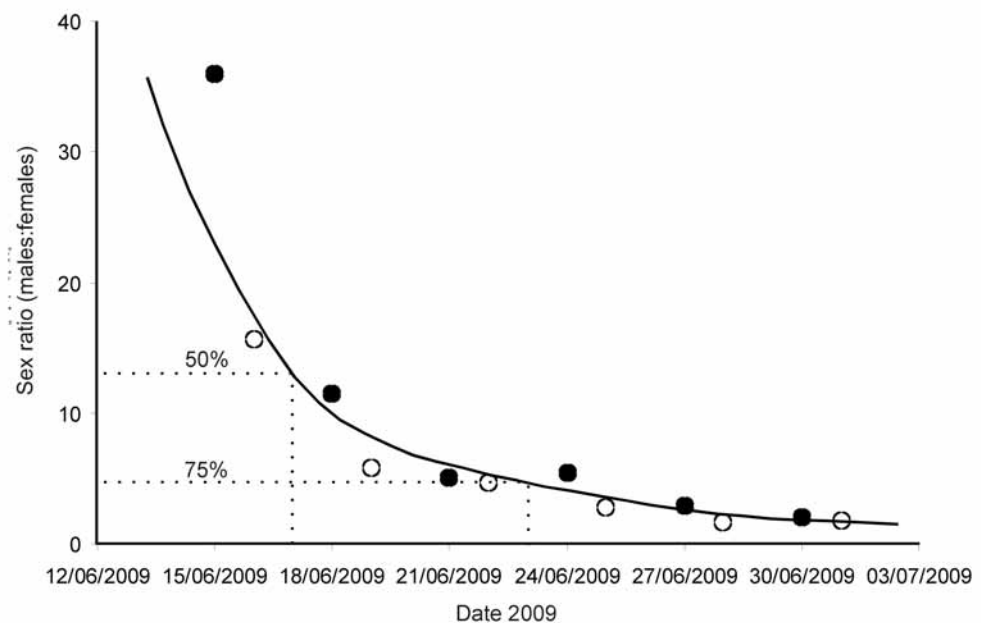


Fig. 2: The sex ratios (males: females) recorded at the reference sites, Lower Hollesley 'A' (solid circles) and Westleton Common (open circles). Curve fitted by eye. Males outnumbered females by 2.8:1 at both sites at the peak of the flight period, by 5:1 when about 75% of the population was present before peak and by 14:1 when 50% was present before peak.





## 4.2 Site accounts

### 4.2.1 Purdis

#### Flight area & population

The butterfly was absent from the south-east part of the heath where it flew in 2003 (fig. 3) and it was almost wholly restricted to the small patch of shorter heathland along the northern edge that has supported the majority of the population since the 1990s. In 2009, butterflies only flew over about 0.08ha of this and only four males were recorded on the first transect undertaken on 24<sup>th</sup> June, and five males and two females five days later (at a density of 3 per 100m). A few males were seen on a small flight patch (about 0.04ha) to the south (TM 21094262) during the first visit on 24<sup>th</sup> June, but none subsequently.

The population estimate of about 180 adults is subject to large error, but does reflect the small population that the site supports. Both this and the flight area are the smallest ever recorded from Purdis.

#### Condition

The vegetation of the main flight area is a stand of mature heathers (photo 1), mainly *Calluna vulgaris* (85%), bordered either side by strips of shorter building heathers and a cut area to the south. The overall structure is open and favourable for *P. argus*, but there is little *Erica cinerea* in the mature stand (<1%) and *C. vulgaris* is rather tall (mean height 65±10.5cm). *Erica cinerea* is more abundant in the adjacent strips (15-20%).

The temporary flight area to the south (photo 2) is recent birch clearance, and composed primarily of pioneer *C. vulgaris* (ca. 50%), among bare ground and encrusting mosses, plus some invasive willowherb and regenerating birch. Butterflies flew around the fringe of this patch where it bordered mature *C. vulgaris*.

The former flight area (TM 21244256) is now tall scrub, especially gorse (photo 3). Just to the west of this are several strips that have been foraged recently, with good covers of short heathers and a high proportion of *E. cinerea* but *P. argus* was not seen to use these in 2009.

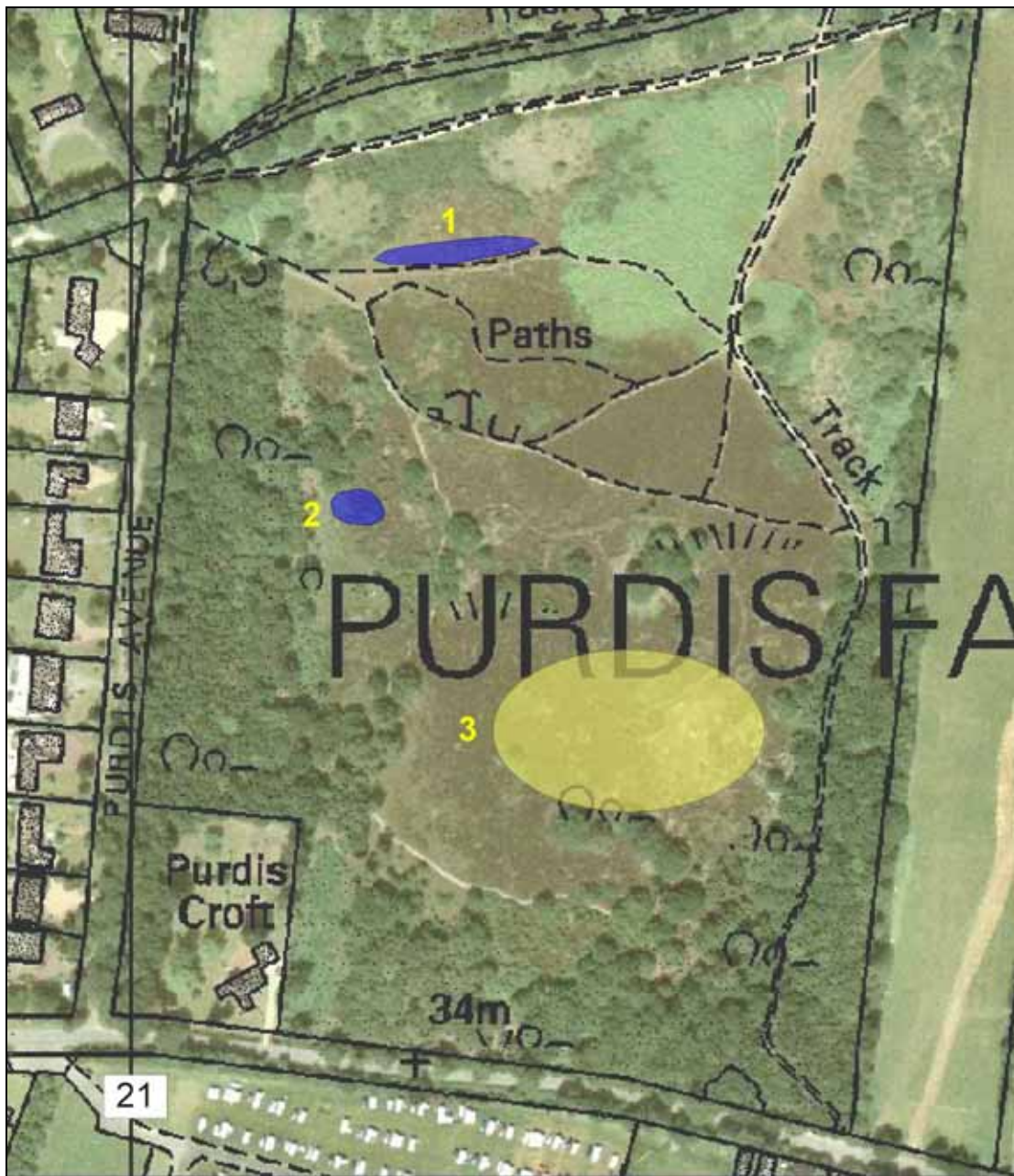
Much of the remainder of the heath is scrub covered or is mature or degenerate *C. vulgaris*.

#### Management

Current management of the heather stands, although on a small-scale, is beneficial for *P. argus*. The recent management of strips in the old flight area (fig. 3), although seemingly not occupied in 2009, has produced good habitat and further similar management in this part of the heath, as well as immediately around the current flight area, should be pursued. The soil of both areas is compacted or encrusted and any management that loosens or removes this will be of benefit.

The main part of the heath (between areas 1 and 3, fig. 3) has not been used by *P. argus* since the 1980s following a large burn. More radical management aimed at reducing the organic layer is required if there is intent to bring it back into a condition suitable for *P. argus*.

Fig. 3: Map and aerial of Purdis Heath, showing: 1) the primary flight area in 2009; 2) a temporary flight area; and 3) former flight area of 2003 where recent management has created good conditions and where further management would be beneficial for *P. argus*.



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Photo 1: Purdis Heath  
The primary flight area in 2009, looking east



Photo 2: Purdis Heath  
The recently managed area (area 2) where a few male butterflies were flying in 2009



Photo 3: Purdis Heath  
Area 3, a former flight area now overgrown, suitable managed strips are to the west (left) of this



#### 4.2.2 Martlesham Heath

##### Flight area & population

Apart from a few butterflies seen north of the fence in compartments 2, 5 and 6 (fig. 4, compartment 2 is very isolated now), the flight area is now almost wholly confined to the southern part of the heath around the runway. Nearly all of the population occurs on the accidental burn across compartments 8 and 11 that occurred in the summer of 2003 (this represents 68% of the flight area and supports 91% of the population at Martlesham). Butterflies occurred at high densities here (maxima of 19 and 30 per 100m in compartments 8 and 11 resp.). Without this burn it seems doubtful that *P. argus* would survive much longer at Martlesham, especially given the large burn that took place in spring 2009 that encompassed part of the remaining former flight area.

Elsewhere, flight patches were small (all  $\leq 0.05$ ha) and butterflies were usually at low density ( $< 3$  per 100m): a small fringe on the western edge of compartment 7 that escaped the burn in 2009 (0.04ha; a maximum of five butterflies seen); parts of compartment 5 (a maximum of 6 over 0.05ha); a small part of compartment 6 that escaped the 2009 burn (9 butterflies over 0.02ha); and a fringe of compartment 2 (five butterflies, no females seen, over 0.05ha). No butterflies were seen in compartments 3 and 9 where good numbers occurred in 2003.

##### Condition

The fragments of heathland north of the fence that are still occupied by *P. argus* are generally too mature, grassy or becoming scrub dominated as per the remainder of this part of the heath. Compartment 2 at the northern end of the heath (TM 23964520) is composed of tall, mature/degenerate *C. vulgaris* to 80cm and acid grassland, most of which is unsuitable for *P. argus*. There is a fringe of shorter vegetation that includes *E. cinerea*, bordering a previous burn to the south and this is where most *P. argus* occurred in 2009.

No butterflies were seen in compartment 3 (TM 23794491). The eastern part of this patch has grassed over, but the structure and composition of the western half is still suitable for *P. argus*, with favourable components of *E. cinerea* (10-20%), *C. vulgaris* (30-40%) and bare ground (30-40%). The soil was notably compact however, and no black *Lasius* ants or their nests were found.

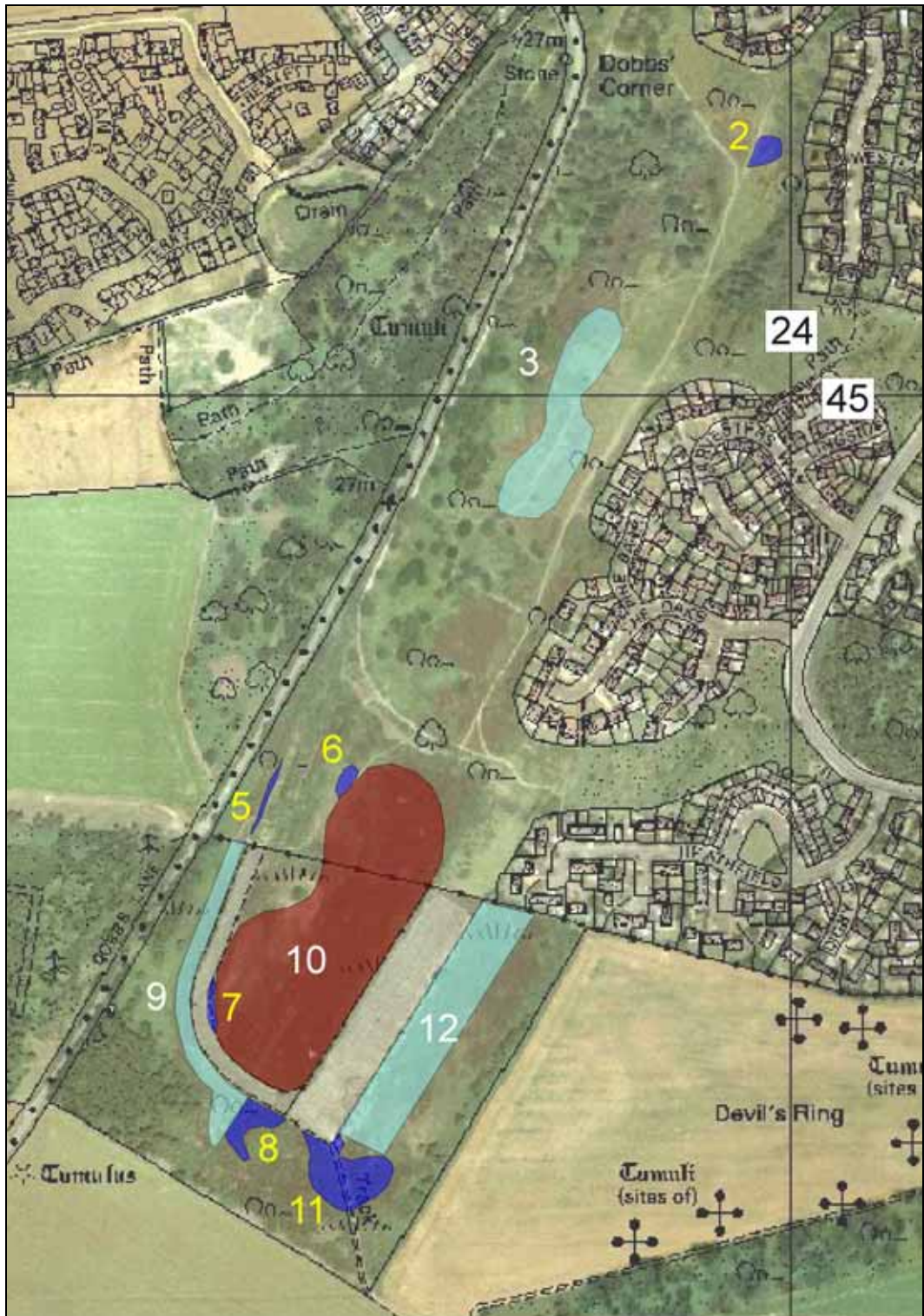
Gorse and tall *C. vulgaris* are now the dominant features of compartment 5 and the patch is barely suitable for *P. argus* although there is still an *E. cinerea* component and space between the tussocks, suggesting that it is likely to respond well to management.

South of the fence, the heathers of the former flight areas in compartments 9 and 12 have become too mature or gorse covered and closed and no butterflies were seen in 2009 – the location of the small flight area recorded in the latter in 2003 could not be found owing to scrub. Compartments 8 and 11 are both in excellent condition and typical of the vegetation produced by recent summer fires: rich in short *E. cinerea* (mean cover  $38 \pm 6\%$ , mean vegetation height  $19 \pm 2.4$ cm) and large amounts of loose bare soil ( $21 \pm 6\%$ ).

##### Management

The burn of spring 2009 represents an excellent opportunity to ensure the future of *P. argus* at Martlesham Heath. The burn covered all of compartment 10 and most of compartments 6 and 7, representing an area of some 2.4ha. Regeneration of heathers was occurring in June 2009 in compartment 7 and the southern end of compartment 10. If the vegetation recovers suitably, *P. argus* should have by 2014 the largest flight area at Martlesham since the 1980s. Monitoring and perhaps

Fig. 4: Map and aerial of Martlesham Heath, showing the flight areas of 2009 (2, 5, 6, 7, 8 and 11, blue), locations of other compartments mentioned in the text (3, 9 and 12, pale blue) and the approximate extent of the burn in May 2009 (10, red).



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Photo 4: Martlesham Heath  
Compartment 2



Photo 5: Martlesham Heath  
Compartment 3



Photo 6: Martlesham Heath  
Looking north over compartment 5



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Photo 7: Martlesham Heath  
Looking north over compartment 11 (burn of  
compartment 10 in background)



Photo 8: Martlesham Heath  
Burn of spring 2009 looking north-east  
across compartment 10 towards 6



Photo 9: Martlesham Heath  
Regeneration of heathers in compartment 7



management will be necessary to ensure that bracken and gorse do not get away and dominate regenerating heathers. The organic litter layer was not entirely destroyed in some parts of the burn (towards the ridge bordering the compartments), and removal of this will benefit the regeneration of conditions of *P. argus*.

Burns are a regular, if infrequent, feature at Martlesham Heath and *P. argus* has persisted here principally because of these. All of the remaining flight areas north of the fence (areas 2, 3 and 5) are on fragments of burns that occurred in the 1980s and 1990s. Otherwise, Martlesham Heath has been little managed and the majority of the heath is now wholly unsuitable for *P. argus* being scrub or grassland. Some recent management north of the fence has removed areas of gorse and opened up part of the heath (at TM 23764482), but more radical management of most of the area north of the fence is required to bring it back into condition for *P. argus*. Localised cutting of heathers and gorse and scraping and removal of litter may create small areas, particularly around compartments 2 and 3, but larger-scale management is more likely to promote long-term suitability.

#### 4.2.3 Lower Hollesley colonies

##### Lower Hollesley A

##### Flight area & population

Both the population and flight area have changed little since 2003 – although adults were absent from an area to the south-west and at lower density in the western half than formerly (fig. 5). Adults were particularly abundant along the northern part of the firebreak, the northern part of the eastern half and in foraged areas in the same. Overall density at the site peaked at 29.4 adults per 100m. Concentrations of females were notable in the foraged areas and large numbers were seen egg-laying in these on pioneer *C. vulgaris* on 30<sup>th</sup> June.

##### Condition

The recent forage harvesting has created several strips in the eastern half (photo 10) and these have produced excellent conditions for *P. argus*, rich in short pioneer heathers (*E. cinerea* 15±3.9%, *C. vulgaris* 28±9.8%) with large amounts of bare ground (33±12%) (overall mean height 11±2.9cm). These are being kept open by high densities of rabbits, although encrusting mosses were evident (26±8.1%). The varied structure this management has produced among the remaining mature *E. cinerea* and *C. vulgaris* has enhanced its condition further.

The western half is predominantly tall mature closed heathers (bare ground 3±2%, mean vegetation height 68±9.6cm, photo 11) and of marginal condition for *P. argus*. The reasonable numbers that occurred here were probably a reflection of the high numbers along the neighbouring firebreak and the eastern half of the flight area. Butterflies occurred primarily around the fringes of this and became occasional 30m west of the firebreak – none were seen further than 40m west of this.

##### Management

Current management of the eastern half of the flight area is doing an excellent job of creating conditions for *P. argus* and this form of management seems particularly well-suited to this site, perhaps because of the very light soils. Further strips, especially through the mature *E. cinerea* in the western half of the flight area, should be similarly successful.

## Lower Hollesley B

### Flight area & population

The colony was the second largest recorded in 2009, with about 1400 adults present at the peak of the flight period (Table 1). High densities were present in 2003 and these were repeated in 2009, with 34.1 adults per 100m on 27<sup>th</sup> June. The overall flight area was also similar, concentrated in the middle of the site where heathers have colonised, but it has contracted slightly at the northern and southern extremes, where heathers have become more mature, and expanded to the east over regenerating heathers.

### Condition

The central part of the flight area (fig. 5), where heathers have colonised previous bare ground between the two former flight areas, is in excellent condition, and is composed of short pioneer heathers, short turf and bare ground. A similar area to the east of the flight area (photo 12), that was formerly bracken dominated, should produce extra flight area in a year or two.

The main body of the flight area is now quite mature *E. cinerea* (59±18.2%, mean vegetation height 45±5.7cm) but with good spacing between the bushes allowing a reasonable proportion of bare ground (13.4±5.6%) with little encrusting moss and where ant nests were evident. The extremities at the north and south (along the oak fringe) are perhaps over-mature (photo 13), and butterflies were at low densities on these areas.

### Management

A couple of small strips have been foraged and the soil disturbed around the edges of the flight area and further foraging, especially in the mature stands of *E. cinerea* along the southern edge close to the tree-line should be beneficial for *P. argus*. Outside the flight area, further to the south, heathers are degenerate and management of these areas could provide additional areas for *P. argus*.

### Other sites

#### Lower Hollesley C

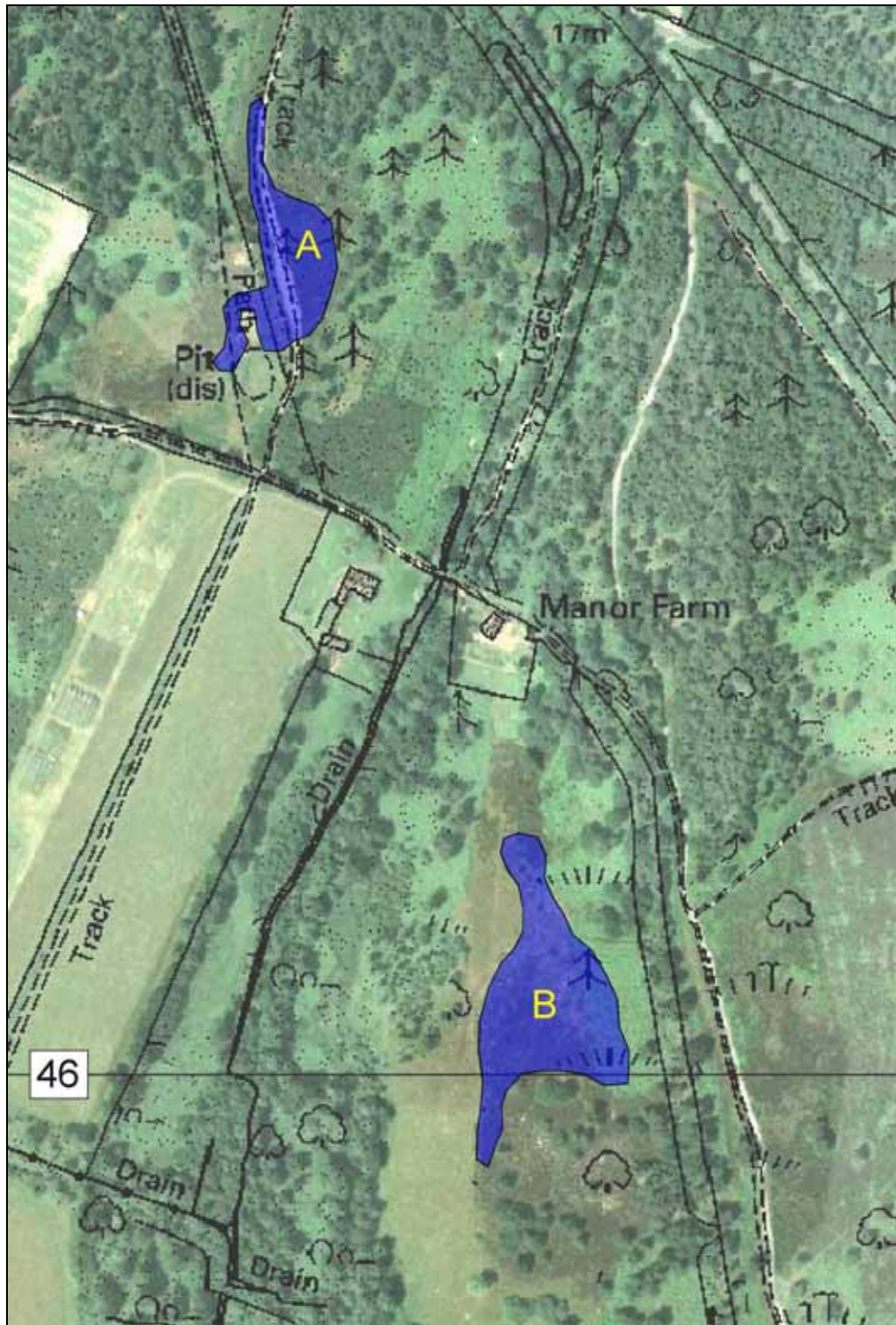
A small population (about 0.14ha flight area) has occurred for few years on part of a larger burn (D. Mason pers. comm.). The population was estimated at 350 adults in 2009. The flight area is a patch of recovering *E. cinerea* rich vegetation within a larger extent of *C. vulgaris* heathland, and the population should persist for many years at current or enhanced levels.

#### Upper Hollesley MOD

The small population in the trenches on this heath were still extant in 2009, although during both visits they were primarily confined to the southern and western trenches. The flight period here lagged well behind that of other sites and on the 27<sup>th</sup> June (the adjudged peak of the flight period), males outnumbered females by 8.3:1, suggesting that the flight period had some way to go (fig. 2) and that the peak population of 230 adults was an under-estimate (Table 2).



Fig. 5: Map and aerial of the flight areas at Lower Hollesley in 2009 (blue).



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Photo 10: Lower Hollesley A  
Recent management and favourable  
conditions for *P. argus*



Photo 11: Lower Hollesley A  
Dominant mature heathers of the western  
flight area



Photo 12: Lower Hollesley B  
Regeneration of heathers along the eastern  
edge of the flight area



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Photo 13: Lower Hollesley B  
Mature *E. cinerea* at the southern fringe of  
the flight area



Photo 14: Lower Hollesley B  
Degenerate heathers to the south of the  
flight area



Photo 15: Lower Hollesley C



#### 4.2.4 Westleton Common Common

##### Flight area & population

The colony was the largest recorded in 2009, with a peak population of about 1600 adults on the 25<sup>th</sup> June. The flight area was split into three for recording (fig. 6) and the primary concentrations of *P. argus* were usually in areas 1 and 2, and maximum densities of 27.7 and 19.9 adults per 100m were recorded in these areas respectively. Butterflies were generally at lower densities in area 3. The flight area was the same as 2003, with the exception of small expansions southwards in area 1 over heathers colonising the sand hill, and over a cleared area of gorse in area 2.

Particularly high densities occurred in the western part of area 1 (photo 16) and in the central part of the Common (the western areas of area 2). After the peak of the flight period, large numbers of females were recorded in the southern part of area 1 and areas of heather in the centre of the Common around the sandhill, and few in the main part of area 2 and in area 3.

##### Condition

Generally, the structure of the vegetation – open heathers among bare ground – and its composition – primarily *E. cinerea* – are still very good at Westleton Common. Mean covers of *E. cinerea* were 33.8±6.3%, 38±11.9% and 31±8.1% in areas 1, 2 and 3 respectively and mean heights 13.8±4.3cm, 22±5.8cm and 12±4.9cm. High numbers of ant nests are still characteristic of the site – especially under pioneer heather plants around the sandhill and in the centre of the site.

But there are two areas of concern:

1) substantial amounts of encrusting moss especially in areas 2 and 3 (mean covers of moss 52±15.6% and 64±10.8% respectively) that have reduced the bare ground component substantially compared with area 1 (areas 2 and 3: 3.2±1.9% and 8.2±3.3%; area 1 28.8±12.3%) (this is especially noticeable in the recently cleared areas of gorse in areas 1 and 2);

and 2) the condition of *E. cinerea*, as there was substantial die-back of plants, perhaps caused by excessively dry weather. The poor condition of *E. cinerea* was also noted in the 1994 survey, but it appears not to have any adverse effect on the status of *P. argus*.

##### Management

Several patches have been cleared of gorse, but these are generally encrusted with mosses and the surface needs breaking up or removal. The most affected patches occur in the main flight area of area 2, especially the eastern end (photo 17) and area 3. The heathers of area 2 (especially the main eastern area) are also quite mature and the cutting or foraging strips through this should promote young heather growth, if encrusting mosses are controlled.

#### Westleton Football Pitch

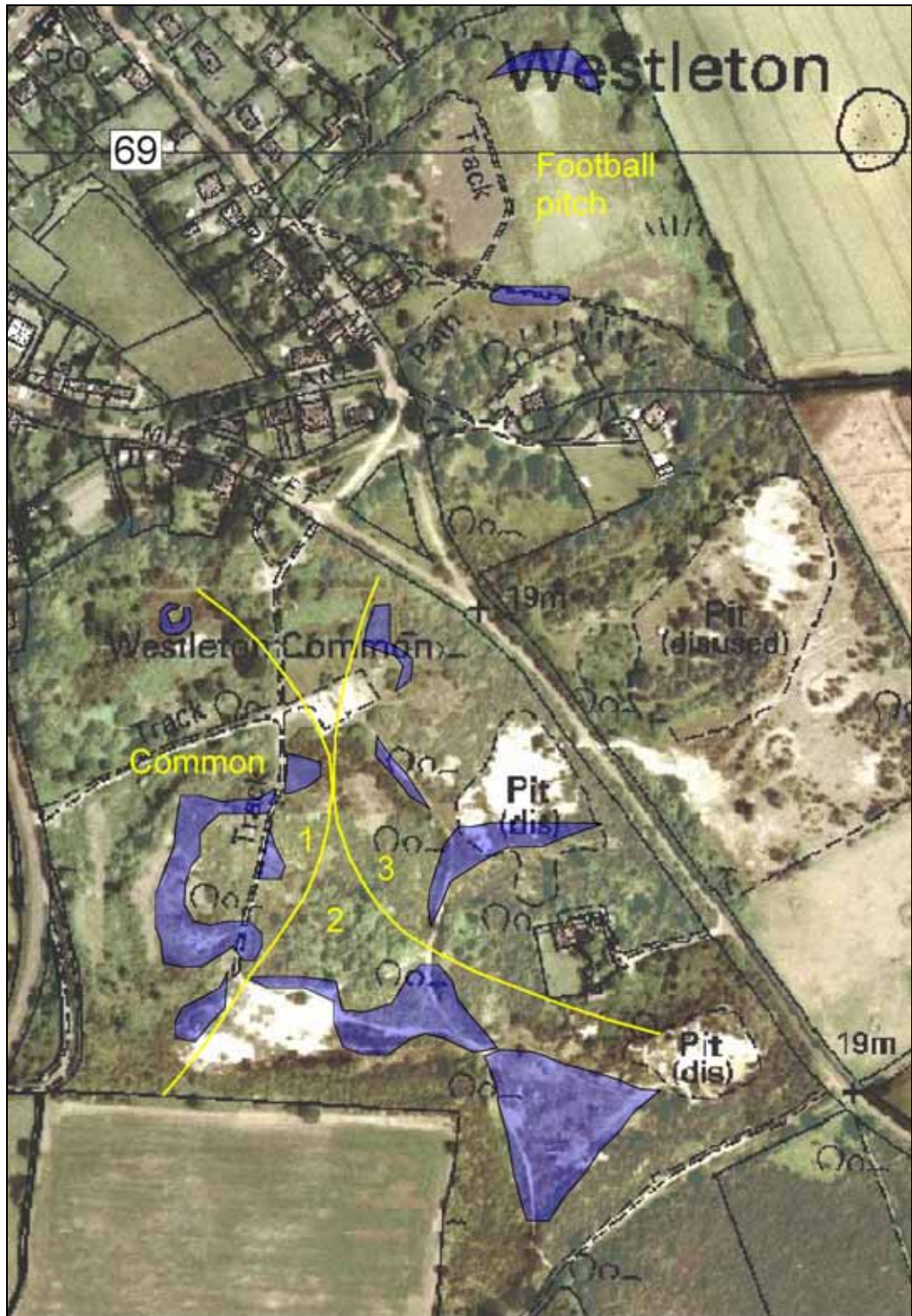
##### Flight area & population

This small population was almost entirely confined to the concentration of *E. cinerea* at the northern end of the site in 2009 (fig. 6). A few males were seen occasionally at the southern end, but no butterflies occurred in the central part of the site.

##### Condition

The vegetation structure of the site, with a high component of *E. cinerea* especially in the northern flight area, is in generally good condition, but the ground in the central and southern areas is generally encrusted with mosses or turf (photos 19 & 20). Few

Fig. 6: Map and aerial of the flight areas at Westleton Common (blue, divided into three zones) and on the football pitch 2009.



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Photo 16: Westleton Common  
Western part of flight area 1

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Photo 17: Westleton Common  
Eastern part of flight area 2

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Photo 18: Westleton Common  
Southern part of flight area 3

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Photo 19: Westleton Football Pitch  
Southern area



Photo 20: Westleton Football Pitch  
Main central part (the old pitch)



Photo 21: Westleton Football Pitch  
Northern fringe – principal area for *P. argus*

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ants were found in these parts.

#### Management

Any management for *P. argus* should concentrate on creating areas of bare and stripped sand between heather bushes. Some rides have been cut/foraged through the mature *C. vulgaris* and gorse to the west of the old pitch. These have produced good re-growth of pioneer heather, although *E. cinerea* seems scarce and the surface of the soil is compact and crusted.

#### 4.2.5 Wenhaston Blackheath

##### Flight area & population

The flight period lagged behind other sites in 2009 – no butterflies were seen during visits on 26<sup>th</sup> June, 1<sup>st</sup> and 3<sup>rd</sup> of July, but they were recorded during that of 9<sup>th</sup> July. The first sightings were made on 5<sup>th</sup> July (R. Parker pers. comm.). Both males and females were seen, suggesting that the flight period had been underway for a few days.

The population in 2009 was small, probably less than the 175 adults given by the conversion equation (see methods), and there have been changes in flight area. On 9<sup>th</sup> July they were absent from the main area in the centre of the heath, where adults have occurred more or less constantly since introduction in 1986. Instead, one male and two females were seen on a small patch at the base of the western slope (TM 41967487, a flight area of about 0.01ha), and two males and four females on a south-facing slope at the eastern end of the site (TM 42257490, a flight area of about 0.05ha, fig. 7). However, on 26<sup>th</sup> July, 62 butterflies were counted on these areas and parts of the former flight area, but mainly to the south of this on the slope (fig. 7, R. Parker pers. comm.).

##### Condition

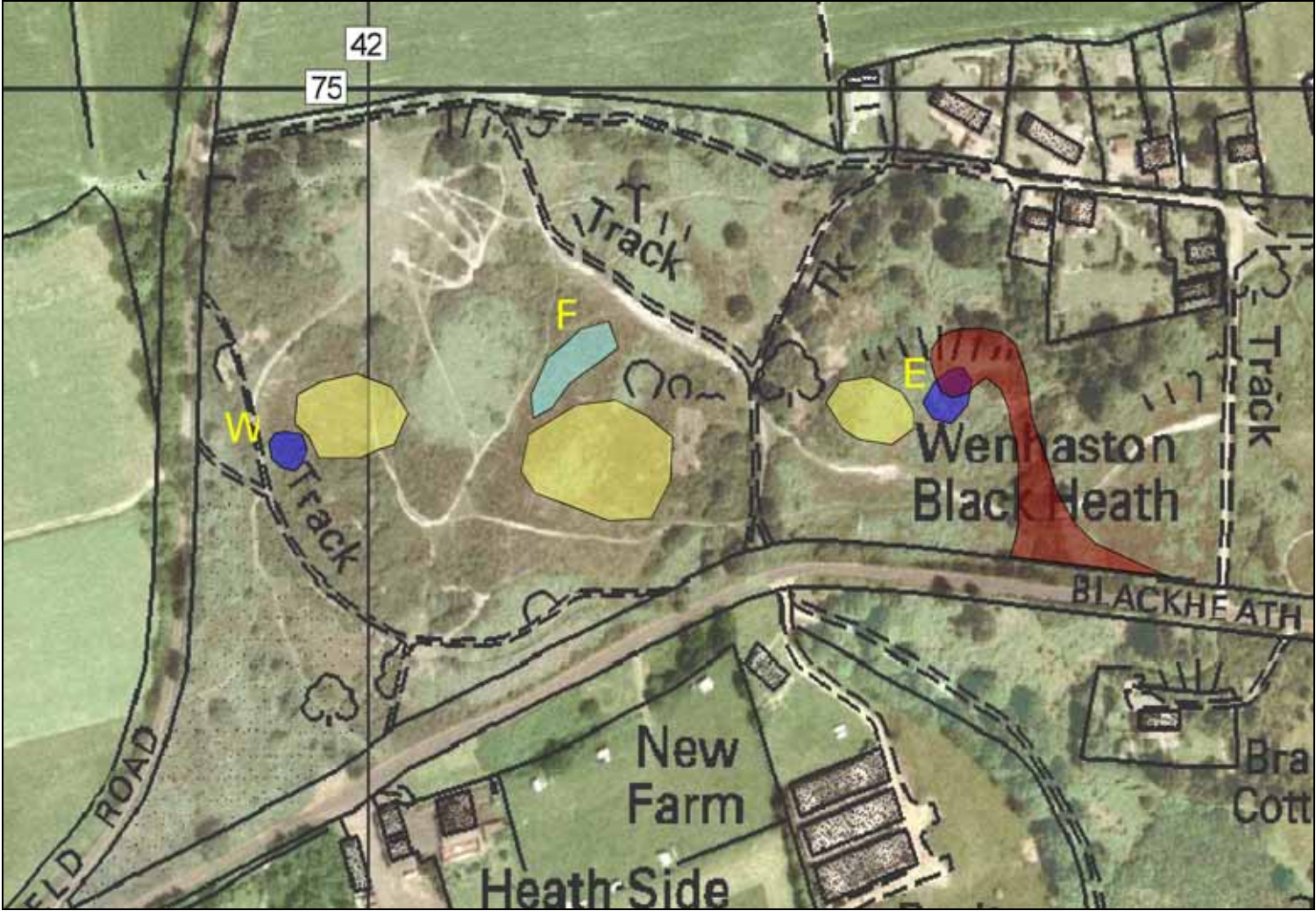
Generally, Blackheath is in very good condition, with a variety of management taking place that has produced a range of vegetation structure and composition, with good components of pioneer and building heathers. At the southern end of the main ridge of the site (TM 42077489), there is an area where management has produced patches of pioneer heathers and bare ground, highly suitable for *P. argus*, but where no ants were found. Similar vegetation occurs at the base of this slope to the east (TM 42107489), where strips have been cut through mature heathers producing suitable pioneer vegetation, although again no ants were found (butterflies were seen in this area on 26<sup>th</sup> July, R. Parker pers. comm.).

The old flight area at TM 42107493 has become quite mature and the canopy closed and grass-dominated (mean cover of grasses 61.3±18.8%, mean vegetation height 30±4.1cm, photo 22). Heathers, primarily *E. cinerea*, are still prominent (*E. cinerea* 36.3±14.9%), but there is little exposed ground between bushes, and where there is, it is generally moss covered.

The western flight area of 2009 (photo 23) occurred at the base of a slope that is in generally good condition for *P. argus* – a high proportion of *E. cinerea* (36.3±10.7%) in a mosaic with young gorse, short grass and a higher bare ground component (4±2.3%), and relatively short overall (mean vegetation height 16.3±4.3cm). A cut area around the slope has produced good growth of young *E. cinerea*.

The eastern flight area, on a slope of *E. cinerea* and *C. vulgaris* with high proportions of bare ground is adjacent to an area (TM 42187489) where the soil appears to have been stripped, exposing the sand. If this remains free of bracken invasion, this should expand the flight area for *P. argus* once heathers have established.

Fig. 7: Map and aerial of the flight areas at Wenhaston Blackheath in early July 2009 (blue: W western area, E eastern area). F is the original flight area (butterflies were seen in its locality in late July 2009). Areas of recent, favourable management are shown in yellow and the burn of August 2009 encompassed the area shown in red.



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Photo 22: Wenhaston Blackheath  
The original flight area on the central ridge



Photo 23: Wenhaston Blackheath  
Western flight area 2009



Photo 24: Wenhaston Blackheath  
Eastern flight area 2009



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Photo 25: Wenhaston Blackheath  
Southern slope below central ridge where  
butterflies occurred in late July



Photo 26: Wenhaston Blackheath  
Managed strip on southern slope



Photo 27: Wenhaston Blackheath  
The impact of the burn in late August on the  
eastern flight area (see photo 24).





## Management

A range of management beneficial to *P. argus* appears to be current at the site and this has produced suitable vegetation in several areas of the heath, especially on the southern slope of the main ridge below the old flight area. Similar management of the former flight area should be considered. But few ant nests were seen anywhere on the heath in 2009 (this appears to be a characteristic of the site, noted when it was being considered as an establishment site in 1986) and the soil is notably compact in most areas. Management specific for *P. argus* could focus on creating a looser soil surface between heather bushes that may encourage greater densities of ants.

A fire occurred on the heath in August 2009. This started by the roadside to the east of the heath and spread north, primarily through a stand of dense, mature gorse, but it clipped the northern half of the small eastern flight area of *P. argus* (fig. 7). Near the road, the fire was intense and it removed most of the litter layer. Towards the north of the gorse stand there is still quite a depth of litter that could be removed to improve the likelihood of recovery to heathland. On the flight area, the burn removed the more mature heathers at the top of the slope (see photos 24 and 27) and should provide excellent habitat for *P. argus* in a few years provided that bracken or gorse is not allowed to invade.

### 4.3 Establishment sites

Since the 2003 survey, there has been successful natural colonisation of a reversion field at RSPB Minsmere, and in 2007, a translocation to Blaxhall Common that has now survived for two seasons. Neither of these sites was included in the present survey, but one potential re-establishment site, Snape Warren, was assessed in 2009.

The most suitable conditions occur on the gentle southern slope above the River Alde (TM 40405740). Several patches occur that are heavily rabbit-grazed and have a good heather structure with proportions of *E. cinerea*, but all have high components of turf and little exposed soil. Little evidence of ant activity was found in any of the patches.

Two patches near the base of the slope, either side of the north-south footpath through the site, constitute about 0.13ha, where *C. vulgaris* is the dominant heather (40±13.8%) and *E. cinerea* is scattered (3.2±1.9%) (photo 25). Bushes are spaced widely and gaps are turf covered (58±13.2%), with small components of bramble, bracken and sorrel, and the only bare soil is found in rabbit scrapes (<1%).

Slightly more suitable vegetation occurs in a small patch (about 0.06ha) near the top of the slope on the eastern side of the path (photo 26). This is more mature as it blends into a stand of mature closed *C. vulgaris* and gorse that covers the plateau of the site. *E. cinerea* is more prominent (15±9.2%) and there is a higher proportion of bare ground (14±4.3%), again primarily caused by rabbit activity, but there is also a high turf component (64±7%).

The plateau, containing the bulk of the heathland of the site, is mature, closed, tall heather and gorse, dominated by *C. vulgaris* and is unsuitable (photo 27).

In its current condition, the site is not suitable for attempts to establish *P. argus*. Improvement could be made by addressing the crust of turf between heather bushes on the southern slope.

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Photo 28: Snape Warren  
Patch west of footpath, looking south to  
River Alde

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Photo 29: Snape Warren  
Patch near the top of the slope looking east



Photo 30: Snape Warren  
Typical habitat



## 5. DISCUSSION

### 5.1 Status

2009 was a good year for *P. argus* and densities were high at most sites. In particular, numbers at the Lower Hollesley colonies and at Westleton Common are healthy and relatively stable (Table 2). Large numbers were also recorded from sites that were not included in this survey (at Minsmere, R. Parker pers. comm.). With the exception of Wenhaston Blackheath and other small sites, such as the colony in the trenches on Upper Hollesley Common and on the old football pitch at Westleton, the flight period was advanced compared with early studies. Previous peaks have occurred usually in July (23<sup>rd</sup> July 1985; 11<sup>th</sup>-17<sup>th</sup> July 1986, probably 10<sup>th</sup>-19<sup>th</sup> July 1990; 8<sup>th</sup>-10<sup>th</sup> July 1994), but the most recent study was also a June peak (23<sup>rd</sup>-28<sup>th</sup> June 2003). Although females were still egg-laying at sites, adults were generally very worn at most sites by the second week of July in 2009.

Flight areas have contracted at most colonies since the last survey, only increasing slightly at Westleton Common where butterflies have spread over areas of regenerating heather. A total of 2.9ha was recorded in 2009, compared with 3.4ha in 2003 at the same sites and 15.2ha in 1985 – a decline of 81% since surveys began (Table 2 – a small part of this reduction is due to the introduction of GIS and its accuracy between the 1994 and 2003 surveys). The greatest loss of flight area was at Martlesham Heath where most of that used in 2003 was not occupied in 2009. Instead, the 2009 population was almost entirely concentrated on a six-year old burn. Most of the site is now very degraded for *P. argus*, and although a large burn in 2009 should ensure a healthy population in a few years, the flight area will still represent only about a third of that used in the 1980s even with this addition. Minor losses in flight area occurred at the Lower Hollesley colonies: areas of mature heather at both sites.

Table 2: Population indices and flight areas 1985-2009 for sites studied in 2009. Data are peaks with the exception of 1990.

	Population index					Flight area ha.				
	1985/6	1990	1994	2003	2009	1985/6	1990	1994	2003	2009
Purdis Heath	29.3	3.1	27.5	3.4	0.4	1.3	0.5	0.3	0.2	0.1
Martlesham Heath	133.0	30.9	37.0	16.2	10.6	12.5	5.4	6.2	0.8	0.5
Lower Hollesley A	14.4	4.5	7.4	8.5	9.7	0.7	0.7	0.7	0.4	0.3
Lower Hollesley B	16.4	1.7	3.0	41.3	24.5	0.7	1.1	0.3	0.8	0.7
Westleton Common	-	10.4	44.3	23.1	29.0		1.9	2.1	1.2	1.3
Total	193.1	50.6	119.2	92.5	74.2	15.2	9.6	9.5	3.4	2.9

Extremely small numbers were recorded at two of the sites included in the survey – Purdis Heath and Wenhaston Blackheath. Although *P. argus* is capable of persisting at very small population levels, and has done so at the latter site since introduction in 1986, the status of the former site must be regarded as critical. Numbers at Purdis Heath are at a historical low as is the available flight area (Table 2). Butterflies used to occur across the bulk of the heath after a fire in the early 1980s (when the site supported over 2000 adults), but the flight area contracted to a small corner in the 1990s where it has persisted. This patch is also an old (but more recent) burn, and an area that used to be disturbed by a tethered horse, but its recovering vegetation has now reached the limit of suitability for *P. argus*.

The flight period at Wenhaston Blackheath lagged well behind other sites, as it has done in recent years when few butterflies have been seen (only one in 2005, R. Parker pers. comm.). Only a few adults were recorded in this survey but 62 adults were seen in late July over a greater area (R. Parker pers. comm.). The peak at this site was therefore difficult to judge but it is unlikely that more than 100 adults occurred in total. It is encouraging, however, that the butterfly has colonised new patches and that active management at the site has produced some excellent habitat.

## 5.2 Management

The management of the colonies at Lower Hollesley has produced some excellent habitat. The forage harvesting employed at these colonies seems particularly suited to these sites and further opportunities exist in the mature heather stands to increase the flight areas. Similar management of the wider Common, plus occasional burns in recent years, has increased opportunities for colonisation. *P. argus* has expanded its range here and has been recorded at numerous patches, notably the burn at Lower Hollesley C (D. Mason pers. comm.). During the 2009 survey it was recorded at several locations between Lower Hollesley B and C, many of which were also noted in 2003.

Small amounts of management have taken place at remaining colonies, but these are of variable value to *P. argus*. Most opportunity for the improvement of conditions exists at Purdis and Martlesham Heaths, where large areas of the former flight areas are currently in poor condition (for *P. argus*).

Methods that produce good habitat vary site to site. Despite the success of forage harvesting at the Lower Hollesley colonies, similar management on Wenhaston Blackheath and the football pitch at Westleton has yet to be used by *P. argus*. Cutting gorse, mature areas of heather or areas of scrub invasion (as has been carried out at Purdis and Martlesham Heaths, Wenhaston Blackheath and Westleton Common) rarely produces suitable habitat. At most sites, the organic layer under mature vegetation is usually too deep or the soil is too compact (or turf or moss encrusted).

Even if apparently suitable vegetation does develop in managed areas, it appears that ants are not always present. It seems possible that compacted soils or encrusted surfaces may inhibit ant activity and the formation of nests and thus the presence of *P. argus* despite suitable vegetation. It is noticeable that where *P. argus* occurs in good numbers, ant activity or nests are especially obvious and appear as disturbances under and around heathers (e.g. at Lower Hollesley and Westleton Common, and where females were seen to concentrate late in the 2009 flight period). The soil is notably light and friable at these sites.

Burns are the best way to remove these impediments to the development of pioneer heathers and the best conditions for *P. argus*, but are no longer a deliberate management option at most sites. Manual stripping, disturbance or rotovation are possibilities – at most sites where succession has occurred some removal of material (moss, turf or organic litter) would appear to be essential.

Therefore, the priorities for management for *P. argus* are to increase the potential flight areas at Purdis Heath and Martlesham Heath, and to improve the ground conditions created by recent management at Wenhaston Blackheath and Westleton Common:

- 1) Purdis Heath – foraging/cutting of heathers and scrub in former flight areas accompanied by litter removal/soil disturbance.

- 2) Martlesham Heath – scrub and litter removal in former flight areas;
- 3) Wenhaston Blackheath – soil disturbance in areas managed recently;
- 4) Westleton Common – general moss stripping/removal and soil disturbance.

### 5.3 Monitoring

#### 5.3.1 Frequency

This survey is the fifth that has assessed the status of *P. argus* in detail since the first survey in 1985, but only the second since 1994. It is recommended that similar monitoring be performed every five years to provide context to annual monitoring at the colonies and an overview of status and site condition.

#### 5.3.2 Actual population size

Although the population index provides sufficient measure of relative change in status at sites on the Sandlings, it is informative and interesting to be able to convert these to absolute estimates of actual or absolute population size. The absolute estimates for 2009 were converted using an equation derived from a number of simultaneous measurements of actual population size (using mark-recapture techniques) and relative population size (using the transect method described in this study).

These measurements were made between 1985 and 1990 when most populations were greater at a number of sites (Lower Hollesley, Martlesham Heath, Purdis Heath and Westleton Common). Any such conversion equation is subject to error, and error is exaggerated at the extremes of scale, and as such it is no longer accurate for the smaller populations that are present at most sites on the Sandlings today. Estimates for those sites where populations are now very small (Purdis Heath, Wenhaston Blackheath etc) are likely to be gross over-estimates of population size (probably 2 or 3 times). It is recommended that a fresh calibration of population size versus transect data is made to provide more accurate estimates of actual population at the colonies.

#### 5.3.3 Relative population estimates

The method used to assess relative population size in the detailed surveys (population index) via transects has remained unchanged since 1985 and therefore these indices are directly comparable. No changes are necessary.

In between these surveys, and particularly since the survey of 2003, annual counts of butterflies have been performed by the RSPB at Minsmere, by the Martlesham Conservation Group at Martlesham Heath, by Suffolk Wildlife Trust Sandlings Project at Hollesley and by Butterfly Conservation members at most sites. In most cases these are single counts of the numbers of adults seen by a variable number of people passing through the flight area, with no measurement of survey effort (R. Parker pers. comm.), although some more detailed measurements have been taken at Minsmere (M. Kemp pers. comm.).

These counts of the number of butterflies seen at a site provide valuable information on broad changes in site status, but their comparative value from year to year would be improved if they could be extrapolated to an estimate of the numbers that would have been counted had it taken place on the peak day of the flight period.

The ratio of males to females through the flight period, and especially at its peak, has been one of the most consistent features of the surveys since 1985. In the 2009 survey, both reference colonies were at peak when males outnumbered females by 2.8:1. When all data that is available from 1985 to 2009 is plotted (fig. 8), populations peak at a mean of  $2.6 \pm 0.1$  males to one female ( $n=11$ ). Peaks in 1986 were 2.4:1 (Purdis) and 3.4:1 (Dunwich/Potbriggs); those of 1994 were 2.9:1 (Purdis), 3.4:1 (Westleton Common) and 2:1 (Lower Hollesley A); and in 2003 peaks were 2.6:1

(Westleton Common), 2.1:1 (Lower Hollesley A), 2.5:1 (Martlesham Heath) and 2.7:1 (Purdis).

About 75% of the population has usually emerged (before peak) if ratios are between 5 and 6:1 and about 50% at 10-15:1 (fig. 8), although earlier in the flight period the ratio of males to females is more variable, presumably depending on prevailing conditions influencing emergence (as was noted in 2009). Once the ratio drops to 2:1, populations are generally just past peak – and about 75% of the peak population remains at ratios of 1.5-1.75:1, and 50% at 1.5-1.25:1. At these times, care has to be taken in assessing sex ratios owing to the numbers of highly worn males that are present.

This relationship between sex ratio and the proportion of population present (Table 3) can be used to convert single counts to estimates of peak numbers and should be useful to site managers and conservationists. For example, 1126 males and 806 females were counted by the RSPB and Butterfly Conservation on a single day at Minsmere in 2009 (R. Parker pers. comm.). This ratio (1.4:1) indicates that the population was past peak, and Table 3 shows that the total can be doubled to approximate the numbers that would have been counted at the peak of the flight period. In fact, the count took place on the 1<sup>st</sup> July, a week or so past the known peak of the butterfly, so this estimate concurs.

Table 3: Corrections to derive peak population based on sex ratio of *P. argus*.

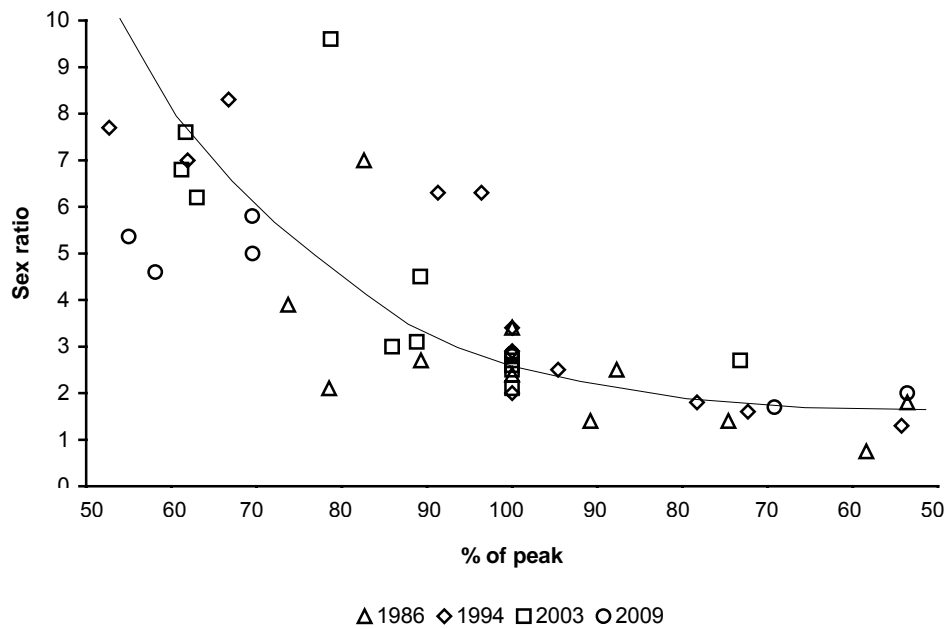
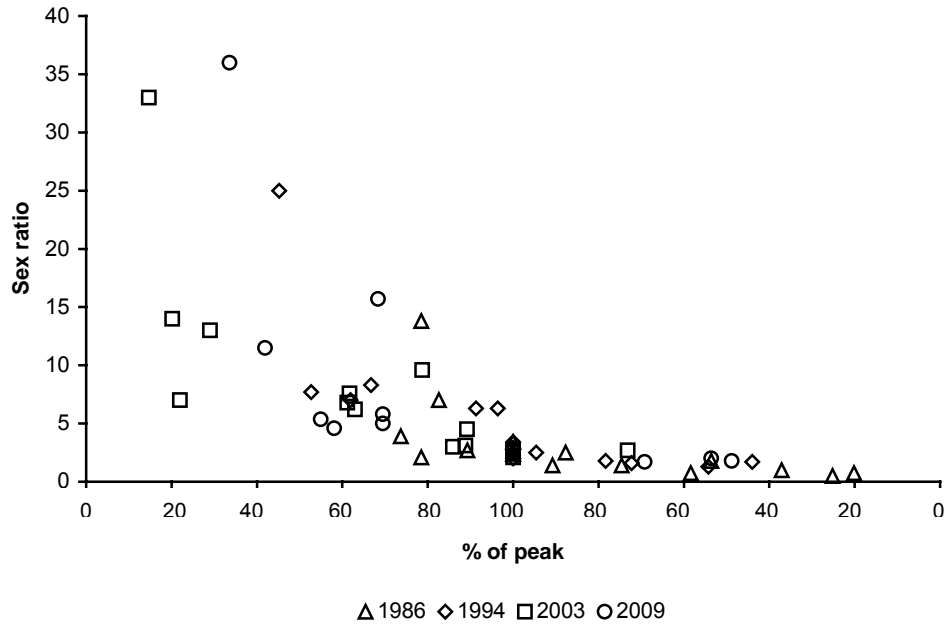
Sex ratio (males: females)	% of peak population
>15	<50
10-15	50
6-9	65
5	75
4	85
2.5-3	100
2	90
1.5-1.75	75
1.25-1.5	50
<1.25	<50

Monitoring the status of *P. argus* using a number of visits to gauge the peak of the flight period is still recommended for detailed surveys every five years and is the preferred option. But should time or resources be limited, the ability to convert estimates using sex ratios means that the cost of monitoring can be reduced if necessary.

## 6. Acknowledgements

Funding for this work was provided by the Biodiversity Fund of Suffolk County Council, Natural England, the Connect Fund and the Suffolk Branch of Butterfly Conservation. I am also grateful to Rob Parker (BC) for his determination in realising the work and to members of the Sandlings Group, especially David Mason (Sandlings Project, Suffolk Wildlife Trust) and Mel Kemp (RSPB) for information and general support.

Fig. 8: The ratio of males to females at *P. argus* colonies where the passage and peak of the flight period was measured in 1986, 1994, 2003 and 2009. Entire flight period (above) and detail around peak (below, curve fitted by eye).



## Appendices

Appendix 1: Transect data from *P. argus* colonies 2009. Peak data from the reference sites is highlighted.

Date	Males	Females	Sex ratio	Total	Transect length m.	Density n/100m	Flight area ha	% peak
<b>Lower Hollesley A</b>								
15/06/2009	36	1	36.0	37	372	9.9	0.30	33.6
18/06/2009	46	4	11.5	50	405	12.3	0.33	41.9
21/06/2009	70	14	5.0	84	410	20.5	0.33	69.5
24/06/2009	59	11	5.4	70	432	16.2	0.33	55.0
<b>27/06/2009</b>	<b>128</b>	<b>45</b>	<b>2.8</b>	<b>173</b>	<b>587</b>	<b>29.5</b>	<b>0.33</b>	<b>100.0</b>
30/06/2009	75	38	2.0	108	682	15.8	0.33	53.7
<b>Westleton Common</b>								
16/06/2009	173	11	15.7	184	1112	16.5	1.31	68.4
19/06/2009	179	31	5.8	210	1250	16.8	1.31	69.5
22/06/2009	139	30	4.6	169	1202	14.1	1.31	58.1
<b>25/06/2009</b>	<b>192</b>	<b>68</b>	<b>2.8</b>	<b>260</b>	<b>1075</b>	<b>24.2</b>	<b>1.31</b>	<b>100.0</b>
28/06/2009	128	76	1.7	204	1217	16.8	1.31	69.3
01/07/2009	101	57	1.8	157	1329	11.8	1.31	48.8
<b>Purdis Heath</b>								
24/06/2009	4	0	-	4	115	3.5	0.13	
29/06/2009	5	2	2.5	7	237	3.0	0.13	
<b>Martlesham Heath</b>								
24/06/2009	96	27	3.6	123	714	17.2	0.50	
29/06/2009	91	72	1.3	163	861	18.9	0.34	
<b>Lower Hollesley B</b>								
24/06/2009	87	12	7.3	99	500	19.8	0.72	
27/06/2009	114	36	3.2	150	440	34.1	0.72	
<b>Lower Hollesley C</b>								
24/06/2009	10	3	3.3	13	185	7.0	0.14	
27/06/2009	35	13	2.7	48	176	27.3	0.14	
<b>Upper Hollesley Common (MOD)</b>								
27/06/2009	25	3	8.3	28	117	23.9	0.06	
<b>Westleton Football Pitch</b>								
19/06/2009	10	0	-	10	92	10.9	0.05	
22/06/2009	7	0	-	7	123	5.7	0.05	
25/06/2009	9	0	-	9	132	6.8	0.05	
28/06/2009	14	3	4.7	17	178	9.6	0.09	
01/07/2009	8	2	4.0	10	120	8.3	0.05	
<b>Westleton Heath</b>								
22/06/2009	1	0	-	1			-	
<b>Wenhaston Blackheath</b>								
09/07/2009	5	4	1.3	9	166	5.4	0.06	



Appendix 2: Vegetation data from *P. argus* colonies 2009. E.cin is *E. cinerea*, C. vul *C. vulgaris*, BG bare ground, Rub *Rubus sp.*, Epi *Epilobium sp.*, Rum *Rumex sp.* and Pt *Pteridium aquilinum*.

Site/section	E. cin	C. vul	Grass	Moss	Lichen	BG	Ulex	Other	Height cm.
<b>Wenhaston Blackheath</b>									
West slope	40	0	60	5	0	1	5		15
West slope	50	0	35	15	0	0	0		25
West slope	5	0	70	35	0	10	5		5
West slope	50	0	40	0	0	5	5		20
								<b>Rub</b>	
Former flight area	30	5	80	0	0	0	5	0	30
Former flight area	15	0	80	0	0	0	0	10	30
Former flight area	80	0	5	0	0	10	5	0	40
Former flight area	20	0	80	0	0	0	5	0	20
<b>Westleton Common</b>									
Area 1	30	0	0	60	20	0	0		10
Area 1	50	0	5	20	10	25	0		5
Area 1	20	5	5	20	20	30	0		15
Area 1	35	0	0	10	0	60	0		25
Area 2	10	0	0	10	80	10	0		20
Area 2	75	0	0	20	15	0	0		30
Area 2	50	0	0	70	0	5	0		40
Area 2	15	0	5	90	5	0	0		10
Area 2	40	0	0	70	0	1	0		10
Area 3	20	0	0	80	0	10	0		5
Area 3	40	0	0	70	0	1	1		15
Area 3	40	0	10	50	0	5	1		30
Area 3	50	0	1	30	10	20	0		5
Area 3	5	0	0	90	0	5	0		5
<b>Purdis Heath</b>									
Flight area	0	50	0	45	0	5	0		30
Flight area	0	95	0	10	0	0	0		70
Flight area	0	100	0	0	0	0	0		95
Flight area	2	85	0	15	0	2	0		70
Flight area	0	95	2	5	0	0	2		60
<b>Martlesham Heath</b>									
								<b>Epi</b>	
Area 11	40	40	0	5	0	10	5		25
Area 11	35	25	0	10	0	30	0		25
Area 11	30	50	0	15	0	10	1		15
Area 11	60	30	0	15	0	15	1		15
Area 11	25	10	15	15	0	40	2		15

Site/section	E. cin	C. vul	Grass	Moss	Lichen	BG	Ulex	Other	Height cm.
<b>Lower Hollesley A</b>									
East managed	30	15	0	50	0	10	0		20
East managed	15	60	0	20	0	10	0		15
East managed	10	20	0	40	0	30	0		10
East managed	10	5	0	10	0	75	0		5
East managed	10	40	0	10	0	40	0		5
West unmanaged	20	60	0	5	10	5	0		80
West unmanaged	80	10	0	5	0	10	0		85
West unmanaged	90	0	0	5	5	0	0		40
West unmanaged	95	0	0	0	5	0	0		50
West unmanaged	10	85	0	5	5	0	0		85
<b>Lower Hollesley B</b>									
							<b>Rum</b>		
Mature area	60	0	0	20	0	20	0		30
Mature area	80	0	0	20	0	0	0		45
Mature area	70	0	0	10	0	15	5		40
Mature area	50	0	0	15	0	30	5		45
Mature area	95	0	0	3	0	2	0		65
<b>Snape Warren</b>									
							<b>Rum</b>	<b>Rub</b>	<b>Pt</b>
East of path	5	40	60	0	0	0	0	0	5
East of path	10	20	70	0	0	0	5	0	1
East of path	0	90	10	0	0	0	0	0	0
East of path	1	10	90	0	0	2	1	0	0
East of path	0	40	60	0	0	0	0	1	0
West of path	10	5	80	0	0	10	0	0	0
West of path	50	2	45	0	0	5	0	0	0
West of path	0	15	70	10	0	10	0	0	0
West of path	0	15	50	0	0	30	5	0	1
West of path	15	0	75	0	0	15	0	1	0