SHEFFIELD HALLAM UNIVERSITY

URBAN & REGIONAL ENVIRONMENT PROGRAMME

BSc (Hons) Environmental Management

L6 RESEARCH PROJECT

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Habitat Preferences of the Dartford Warbler on Alderney

by

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Abstract:

The Dartford warbler (*Sylvia undata*) is a small passerine warbler with the smallest worldwide breeding range of all UK birds. It is closely linked to the lowland heathland that it breeds on in the UK, but its preferred habitat is known to vary across the countries it breeds in.

Therefore, in order to increase the knowledge of its habitat preferences across its breeding range, a survey of the breeding Dartford warblers on the Channel Island of Alderney was carried out in the summer of 2007.

Once this survey had been completed and the locations of Dartford warbler territories noted, a vegetation survey was performed based on these findings. This second survey compared the vegetation where territories were found to where they weren't, in an attempt to establish its habitat preferences.

It was found that the presence of gorse is statistically significant as expected, and all territories contained a large amount of it. However, the almost total lack of heather was not expected. Previous studies from the south of England have found that heather is as important as gorse for Dartford warblers, but this was not found to be the case in Alderney. Several suggestions are made for this disparity.

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My **parents** and **everyone else** who offered me support and advice.

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Glossary

AWT – Alderney Wildlife Trust – http://www.alderneywildlife.org
BTO – British Trust for Ornithology – http://www.bto.org
The Giffoine – an area of western Alderney containing heathland
RBBP – Rare Breeding Birds Panel, a panel that compiles data on the UK's rarest breeding birds – http://www.rbbp.org.uk/
RSPB – Royal Society for the Protection of Birds – http://www.rspb.org.uk

Aims and Objectives

- to find what factors influence the locations of Dartford warbler territories, by studying:
  a) vegetation type
  b) vegetation height

- to statistically compare vegetation type and height data from Dartford warbler territories with those taken from control quadrats

- to propose a standard methodology for the survey of Dartford warblers to be used to compare different areas and years to detect changes in the population of Dartford warblers

Chapter 1.1: Introduction to the Channel Island of Alderney

Alderney is the northernmost island of the English Channel Islands, with an area of approximately 9 km^2 (900 ha) and a population of around 2,400 people (States of Alderney 2007). This gives it a population density of 267 people per square kilometre. For comparison, Sheffield's population density in 2001 was 1395/km², and the density of England as a whole at the same time was 377/km² (Office for National Statistics 2001). Alderney lies just 8 miles from mainland France (States of Alderney 2007).

The Giffoine is a large area of heathland covering the west of Alderney, and is one of the largest areas of heathland in the Channel Islands: the area surveyed is 139.65 ha (approximately 1.40km^2). It has been designated an RSPB “Important Bird Area”, partly due to its importance in sustaining Dartford warblers (Veron 1997).

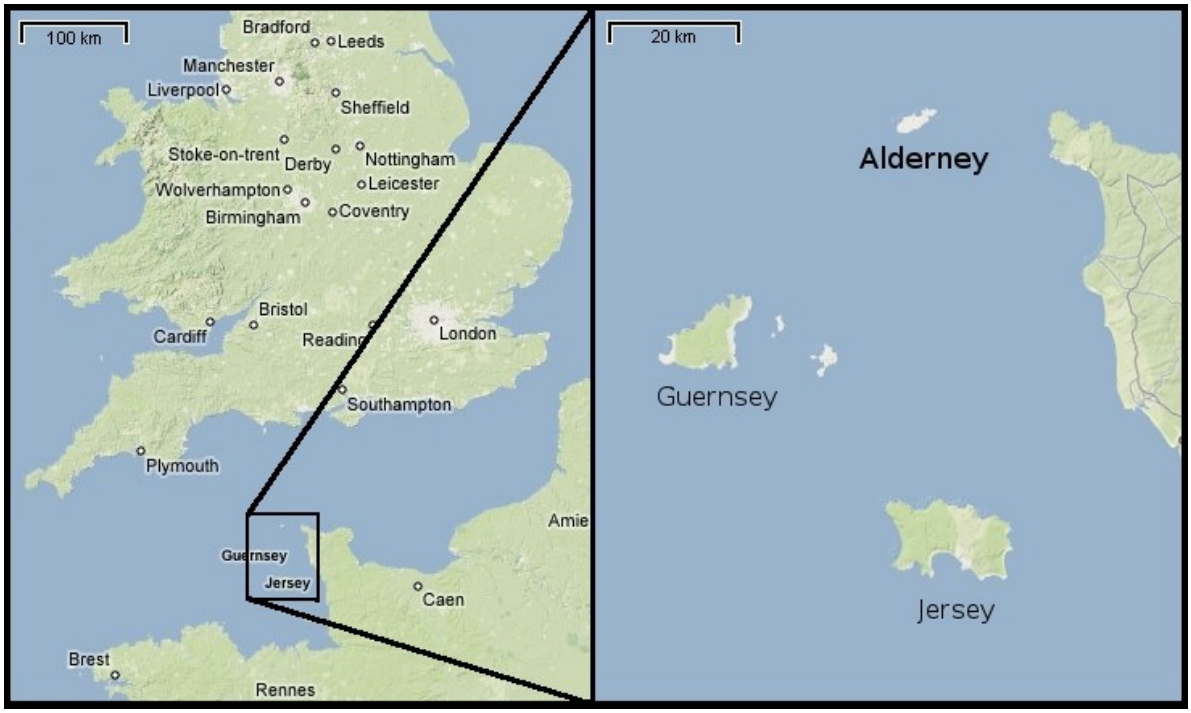
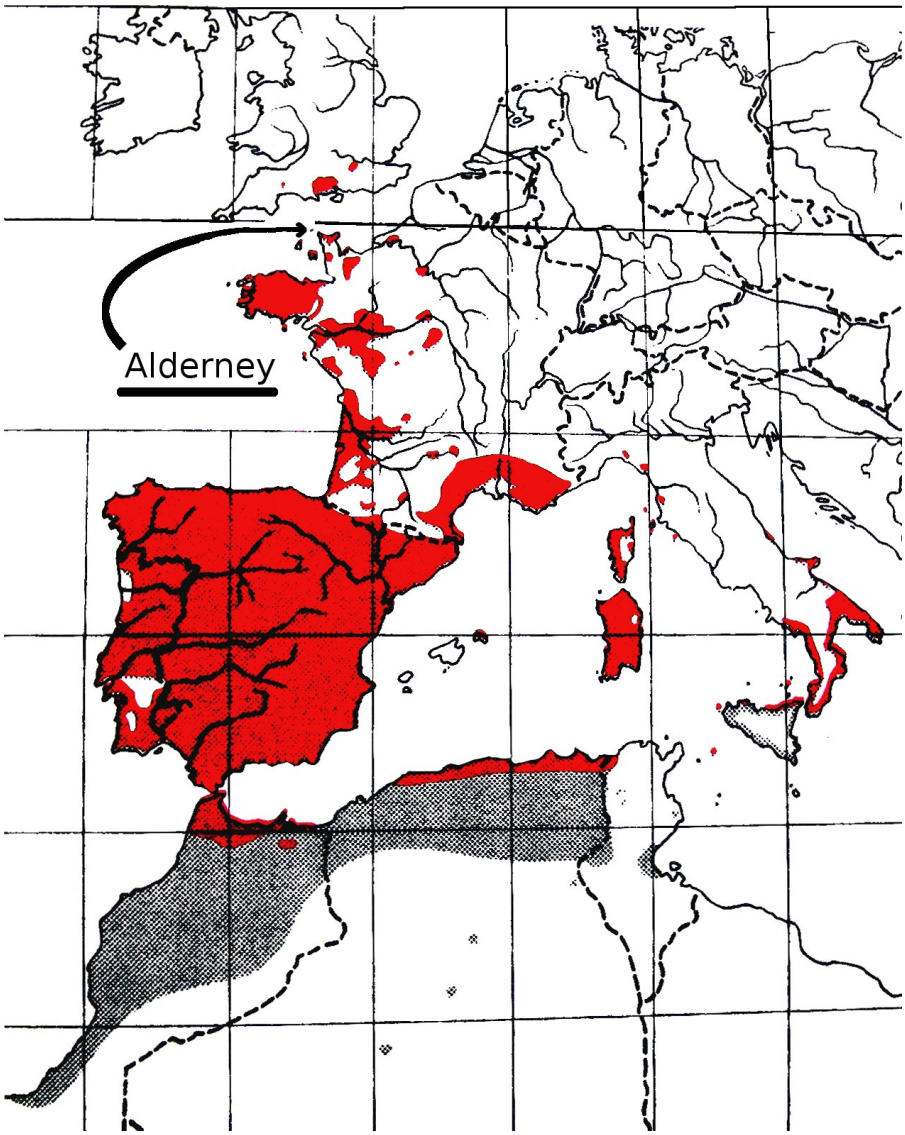


Figure 1.1: Location of the Channel Islands (left) and Alderney (right). Maps from maps.google.co.uk with compilation by the author.

Chapter 1.2: Introduction to the Dartford warbler

The Dartford warbler *Sylvia undata* is a small passerine warbler, no heavier than a wren (Cocker and Mabey 2005, p. 370). It is about 12 to 13 cm long, with a wingspan of 13 to 18 cm. About half of its length is made up of its tail, which it cocks whenever it is perched. The oldest ringed bird was 4 years old (Cramp et al. 1992). Dartford warblers are very territorial, tend to remain in their original territory, and are "site tenacious" (Bibby 1979b, p. 12). They are so closely linked to their territories that if adults disappear from their territories one year, it can be assumed they have died.

It is a resident of the southern UK, parts of France, Spain, Portugal, Italy, and it winters in northern Africa. It thus has the smallest world range of the UK's breeding birds (Cocker and Mabey 2005). The fourth national survey of Dartford warblers took place in 2004 and estimated 3,208 territories in the UK (Wotton 2007). 85 territories were found in the Channel Islands in 2006, mainly in Jersey (email from Simon Wotton, Dartford warbler national survey co-ordinator, RSPB, 25th January 2008. pers. comm.).



Key: **RED** = breeding distribution, **GREY** = winter distribution

Figure 1.2: European distribution of the Dartford warbler in 1992, from Cramp et al. (1992)

Figure 1.3 and **1.4**: Views of a male Dartford warbler

Photos courtesy of Mr. Vic Froome of La Société Guernesiaise, used with permission.

Dartford warblers in Alderney

Long (1981) noted that in 1951 the only Dartford warblers in the Channel Islands were breeding in Jersey and since then they have become established in Alderney and Guernsey. According to the bird records of the Alderney Society (Lawrence 1999), 15 pairs were found in an island-wide census in 1973. Bibby, writing in 1979(b), considered the territories in the Channel Islands to be “isolated outposts” only (p. 16).

The Alderney Society records that no breeding occurred from the winter of 1984-85 until a singing male was sighted in 1993. The next full census took place in 2005 by RSPB officer Paul St. Pierre (2006), who found 7 pairs. In 2006, a specific Dartford warbler survey was undertaken by members of the Alderney Wildlife Trust, who discovered 22 breeding pairs across the entire island, with 19 of these being on the Giffoine (email from Roland Gauvain, manager of the Alderney Wildlife Trust, 16th February 2008. pers. comm.). The present survey was conducted whilst the author was working for the Alderney Wildlife Trust, so had advice readily available, and is the first study of the habitat preferences of the Dartford warbler on Alderney. St. Pierre (2006) suspected that the Alderney population is 1% of the UK population and greater than 10% of the Channel Islands population.

Chapter 2: Literature review

The Dartford warbler in the UK almost exclusively breeds on lowland heathlands (Moore 1962, Bibby 1978, Webb and Haskins 1980), and is mainly concentrated in two locations in south England: Dorset and the New Forest in Hampshire (Westerhoff and Tubbs 1992). Its reliance on one type of habitat makes it vulnerable, particularly since areas of lowland heathland are rapidly diminishing (Webb and Haskins 1980, Webb 1990, and Rose et al. 2000). Moore, in his 1962 study of the Dorset heaths, considered the Dartford warbler an indicator species for heathland and defined it as being "virtually confined to heaths of study" (p. 371), the heaths of study being Dorset and west Hampshire. This dependence means it is very important to understand the nature and context of lowland heathland, so that the pressure the Dartford warbler is under can be properly understood and mitigated where possible. Therefore this literature review is divided in two, with the first part concerning lowland heathlands and the second part concerning Dartford warblers.

Chapter 2.1: Lowland heathland literature review

Webb and Haskins (1980) define lowland heathland as being found on acidic (pH 3.5 – 6.7) mineral soils with low levels of plant nutrients and stable humidity levels. They suggest the most important condition is the presence of a factor that prevents the natural succession to woodland that would otherwise occur with the other conditions alone. Historically, this role was filled by grazing (e.g. by cows or rabbits), and also by spontaneous heathland fires. Lowland heathland is a *plagioclimax community*, which means that ecological succession of the vegetation has been limited by human or animal activities (Webb and Hopkins 1984). This role can also be filled by factors such as wind.

The flora on lowland heathlands is typically composed of heathers (ling heather *Calluna vulgaris*, bell heather *Erica cinerea* or cross-leaved heather *E. tetralix*) and gorses (common gorse *Ulex europaeus*, western gorse *U. gallii*, or dwarf gorse *U.*

minor). Some common heathland indicator species include the nightjar *Caprimulgus europaeus*, the stone-curlew *Burhinus oedicnemus*, the silver studded blue butterfly *Plebeius argus* (English Nature 2002), and all six species of British reptile, including the sand lizard *Lacerta agilis* and the adder *Vipera berus* (Humphries and Shaughnessy 1987).

At one point in western Europe, lowland heathlands covered several million hectares, but there is now less than 10% of this total. At present, it can be found in Sweden, Denmark, northern Germany, the Netherlands, Belgium, northern France, and southern England (Webb and Haskins (1980). The UK accounts for 60,000 ha (20%) of world's lowland heathland (English Nature 2002).

Figure 2.1: Location of the UK's lowland heathlands (English Nature 2002)

Lowland heathland in Britain was once widespread where conditions suited it, but its extent has been restricted by human activities since the 18th century (Webb 1986). Heathland in Dorset first formed during the Bronze Age after forest clearance. In 1759, it covered about 40,000 ha (Webb and Haskins 1980) but in 1996 it covered only 7,373 ha (Rose et al. 2000). This is a decline of more than 80% and while the two figures will not be directly comparable, mainly due to different definitions, they give a good idea of the scale of the decline. See Figure 2.2 below to see maps of this decline.

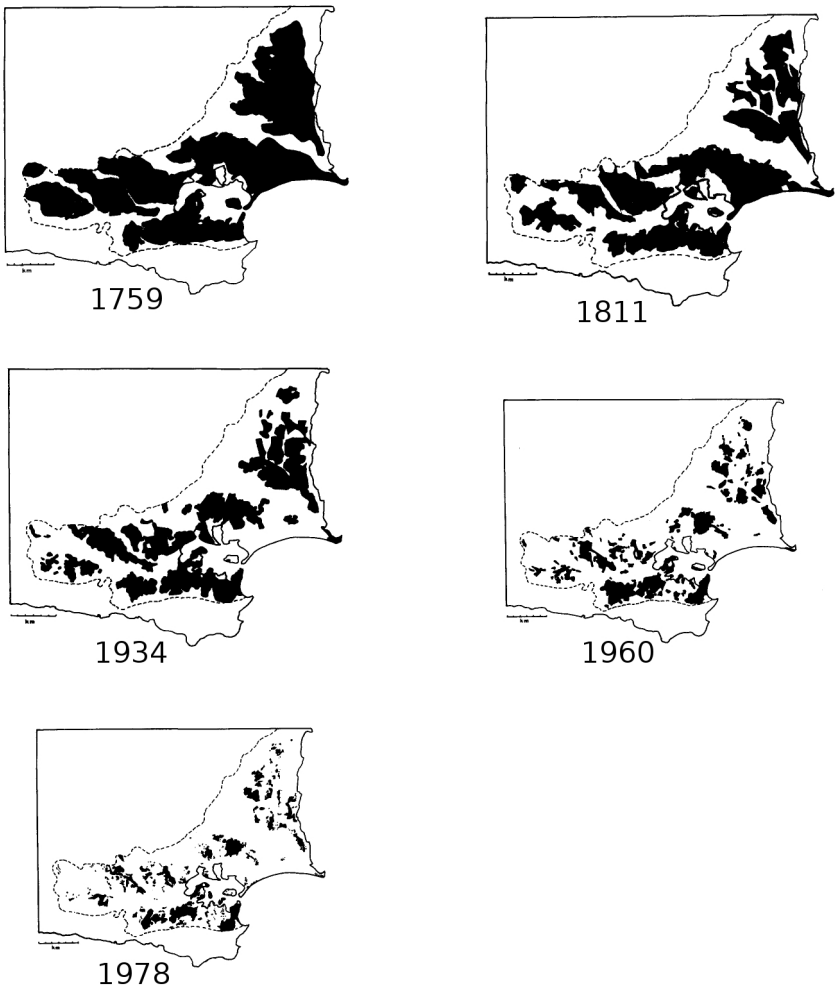


Figure 2.2: The decline of heathland in Dorset. From Webb and Haskins (1980).

There have been three detailed surveys of the Dorset heathlands, in 1978, 1987, and 1996, together making up the Dorset Heathland Survey (Webb and Haskins 1980, Webb 1990, and Rose et al. 2000 respectively). This Survey is one of the

only studies in the UK to look at vegetation change at a landscape level, rather than a local one (Rose et al. 2000).

These Surveys found two main causes of the decline. The first is the natural succession from heathland vegetation to scrub and woodland, and the second is the direct impact of human developments, including farming, forestry, and urban and industrial construction (Rose et al. 2000). The direct losses are relatively small compared to succession.

The loss of heathland to scrub and trees between the first two Dorset Heathland Surveys (1978 and 1987) was estimated at a rate of 15%, which was about the same as the rate between the second and third Surveys (1987 to 1996). While *Ulex* scrub is preferred by Dartford warblers, scrub of most other species and woodland are avoided (van den Berg et al. 2001). It is thought that conservation efforts made between Surveys only served to maintain this rate of loss (Rose et al. 2000), which would otherwise have been even greater.

When considering only the original area observed in 1978, the principal causes of heathland loss between 1978-1987 were conversion to agriculture (183 ha, 46% of the total loss) and the spread of urban development (148 ha, 37%) (Webb 1990). Previously, the main cause of loss was farmland and forestry, but now development has an equal impact. The use of heathlands for farming ceased when farmers' subsidies were stopped (Rose et al. 2000). Urban and industrial development is now restricted by planning and wildlife legislation and so must take heathland conservation into consideration when management policies for the land are being planned (Rose et al. 2000).

Traditionally, the method used for preventing succession is controlled burning, which has been used for millennia. It removes the rank vegetation that can compete with young gorse and heather and encourages seed generation. It will also remove fire-intolerant species, including successional species (English Nature 2003). Heather is able to survive this burning since it has underground stem bases

which survive the temperature increase. In fact, dormant heather seeds are stimulated to germinate by this temperature (Gimingham 1975). Grazing can be used to maintain existing heathland, but not to recover scrub invasion (Rose et al. 2000).

Gorse and heather are extremely inflammable (Humphries and Shaughnessy 1987) and so are prone to spontaneously catching fire in dry summers. They are both “fire-climax” plants and are among the first to regain dominance as they have less competition due to the loss of other vegetation (Gimingham 1975). Young gorse shoots are especially palatable to grazing animals, so this can prevent regrowth of gorse after a fire. Bibby (1978) estimated that about 200 ha, enough for 100 pairs of Dartford warblers, has been lost in the New Forest since 1960, from this cause alone.

However, this method of succession control is declining, and Moore (1962, p. 378) considers this “the most important ecological effect of the decline of rough grazing”. Rose et al. (2000) call for a reintroduction of controlled burning programmes, simply due to the inefficiency of other methods.

As the overall area of heathland diminishes, it breaks up and becomes fragmented, and as the number of these fragments increases, the mean sizes decrease (Rose et al. 2000). This means that the fragments are breaking up as well as the main heathlands. This trend of increasing heathland fragmentation is leading to Dartford warbler populations becoming isolated from each other (Catchpole and Phillips 1992). Van den Berg et al. (2001) suggest several reasons why isolation in this way is not good for Dartford warblers, including more human disturbance and scarcity of food. This isolation also causes higher extinction rates and lower rates of colonisation from heathland fauna and flora, as seen from previous studies.

There have been several suggestions and recommended methods to preserve and restore heathland and optimum Dartford warbler habitat.

According to Bibby (1978), the best way to preserve the preferred, non-“leggy”, gorse, is to locate all the known or likely Dartford warbler territories (approximately 2.5 ha each) on a site, then remove 1/15th of the gorse in each territory, each winter. Only the tallest and most open gorse bushes – least appropriate for Dartford warblers – would be selected. This process would only have to be done more than 10 years after the most recent fire on the site, as the leggy stage only takes place when gorse is 10 to 20 years old.

Moore (1962) observed that gorse grew where the soil had been disturbed by humans. Westerhoff and Tubbs (1991) suggested intentionally disturbing the heathland soil in appropriate places, in order to stimulate growth of gorse. They give the example of the New Forest, where they say there is 200 ha of old gorse (enough for 100 Dartford warbler territories) that would be a good place to start.

Chapter 2.2: Dartford warbler literature review

The Dartford warbler *Sylvia undata* was first recognised in Britain in 1773 by the ornithologist John Latham (1740-1837) after he was given a pair that had been shot on Bexley Heath, near Dartford in Kent (Cocker and Mabey 2005). In the early 19th century, the Dartford warbler's range extended from East Anglia and Kent to West Cornwall (Witherby et al. 1938 *in* Moore 1962). For most of the 20th century, its range was limited to Dorset and Hampshire, with a few pairs in Sussex (Westerhoff and Tubbs 1991). The most recent study found that the Dartford warbler is at its largest population since records began (3,208 pairs) and has extended its range to include Wales, north Norfolk, and even Derbyshire (Conway et al. 2006). See Figure 2.3, a map showing the extent of Dartford warblers in England and Wales.

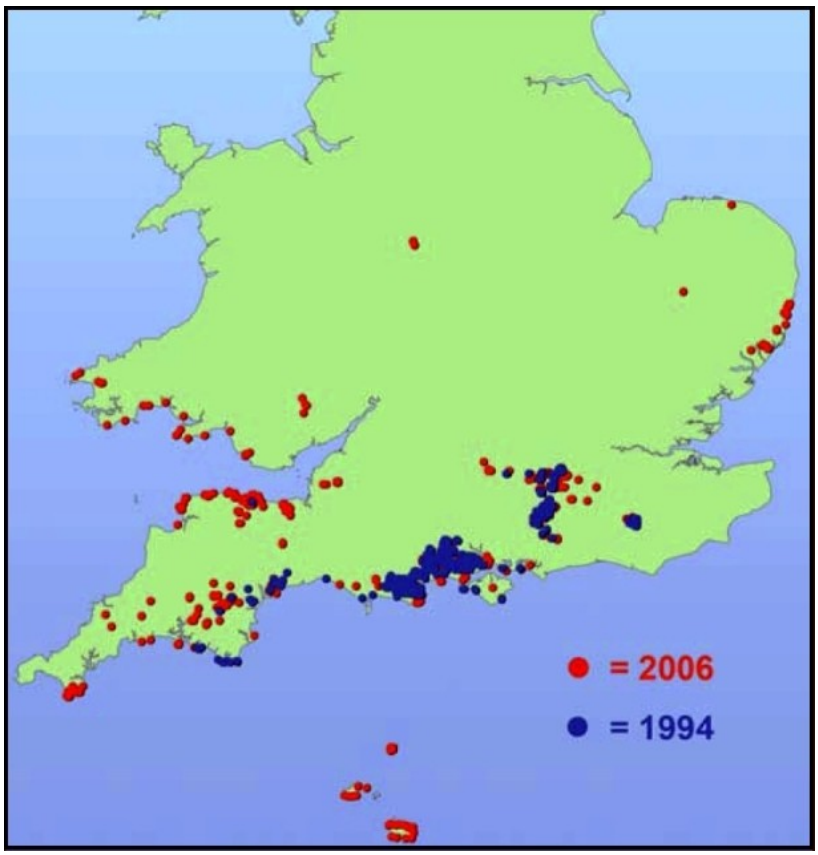


Figure 2.3: The extent of Dartford warblers in England and Wales in 2006, from Conway et al. (2006)

Although this looks encouraging, the larger trend across the EU is not as promising.

Criteria	Status	Definition
EU25* Population size	1,900,000 – 3,700,000	Number of individuals
% of global population in EU25	> 95%	
1970-1990 EU25 Breeding Population Trend	Large Decline	Population declined by ≥20% in ≥66% of the population ***or*** by ≥50% in ≥25% of the population
EU25 Threat Status	Depleted	Population does not meet the IUCN Red List Criteria and is not Rare or Declining in the EU, but has not yet recovered from moderate or large historical declines suffered during 1970–1990.

Table 2.1: Conservation status of the Dartford warbler in the EU, from Birdlife International (2004)

* EU25 = The countries in the EU as of 1st May 2004: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, United Kingdom.

The table shows that although the EU population is hundreds of times greater than that of the UK, there have been large declines amongst areas of the population between 1970 and 1990 that the warblers have not yet recovered from. The population trend between 1990 and 2000 is unknown. The vast majority of Dartford warblers breed in the EU (the rest are in north Africa), and any population crash here would have a great impact on the survival of the Dartford warbler.

In the UK, the British Trust for Ornithology (BTO) classifies the Dartford warbler as an Amber list species, which means it is a species of medium conservation concern (BTO 2007). Three criteria place it on this list. They are:

- Historical population decline during 1800–1995, but recovering; population size has more than doubled over last 25 years
- Species with unfavourable conservation status in Europe
- 50% of UK breeding population in 10 or fewer sites, but not rare breeders (rare breeders are classed as species with a five-year mean of 1–300 breeding pairs in UK)

(BTO 2007)

This shows a similar status to the rest of Europe: a decline in the recent past that the warbler's population still hasn't fully recovered from. It is also found in relatively few places, making those places more valuable in terms of preserving the species.

As well as Dorset (Bibby 1978, Catchpole and Phillips 1992, van den Berg 2001, Murison et al. 2007) and Hampshire (Westerhoff and Tubbs 1991), studies of the Dartford warblers' habitat have been done in France (Constant and Maheo 1970), Sardinia and Corsica (Cody and Walter 1976), Spain (Zamora et al. 1992) and North Africa (Cramp et al. 1992).

Dartford warblers are completely insectivorous and in England they are at the extreme north of their range, so are particularly vulnerable to cold winters (van den Berg et al. 2001). They can tolerate short periods of cold temperature (–10°C), but it is snowlie that poses the greatest threat to them as it prevents them foraging for insects (Westerhoff and Tubbs 1991). In the harsh winter of 1962/63, the UK's population crashed to just 11 pairs from 450 (Cocker and Mabey 2005) – a loss of 98% – after snow covered much of the New Forest for six weeks. Figure 2.4 shows how rapidly the population can fluctuate:

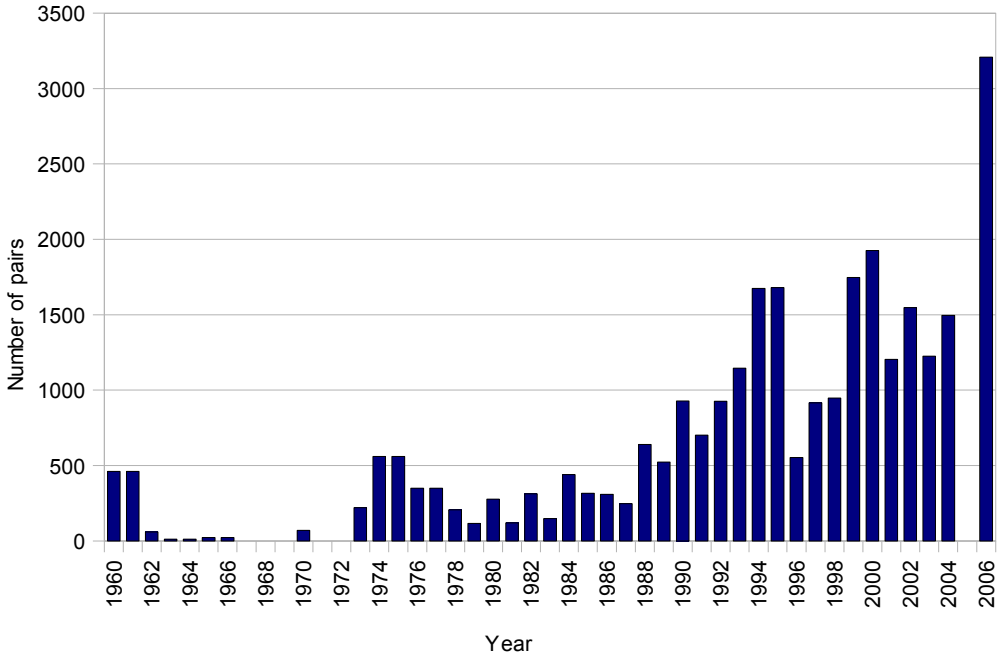


Figure 2.4: Estimated UK Dartford warbler population by year (estimated by the Rare Breeding Birds Panel to be the maximum number of Dartford warbler pairs)

The figures that this chart is based on can be found in Appendix H, although the figures for the years 1976, 1983, 1996-98 and 2000-02 are thought to be underestimates due to large areas of known Dartford warbler habitat not being surveyed. Nevertheless, Gibbons and Wotton (1996) consider monitoring by the RBBP to be successful. Note that no data was found for the years 1967-1969, 1971, 1972, and 2005. The 2005 RBBP data is likely to be published in the near future.

- Sources:
  - 1960-1961; 1970 from Bibby and Tubbs (1975)
  - 1962-1966 from Tubbs (1967)
  - 1973-2002 from the respective Rare Breeding Birds Panel (2007) reports
  - 2003 and 2004 from Holling and the RBBP (2007)
  - 2006 from Conway et al. (2006)

The population increase of more than 5000% in the 11 years after 1963 shows the Dartford warbler's high reproductive rate. Catchpole and Phillips (1992) found they could produce up to 6.62 young per pair per season. Bibby (1979a *in* Catchpole and Phillips 1992 (p. 214)) “established that nesting success in Dartford warblers

(70-80%) was considerably higher than estimates for other *Sylvia* warblers (35-45%)". Three broods per year were recorded by Bibby (1977 *in* Murison et al. 2007).

Bibby and Tubbs (1975) described the Dartford warbler as "the only exclusively characteristic bird of lowland heath in southern England" (p. 177), and Moore (1962) used the species as an indicator species in his study of the Dorset heaths, as they are "conspicuous, easily observed and known to occur over the heaths" (p. 370). Moore also applied all 5 of his "quasi-quantitative" (p. 385) criteria for selecting which rare species require special conservation efforts:

1. World distribution restricted (range is less than a fifth of the area of Europe)
2. Dorset population is an important part of the range in Britain (Dorset population is estimated at more than a fifth the British population)
3. Characteristic species of Dorset heathland (found on most heaths surrounding Poole harbour)
4. Known special scientific interest (object of special studies)
5. Known special interest to naturalists (recorded regularly in Natural History Society Annual Reports etc)

In 1988, Westerhoff and Tubbs (1991) surveyed the New Forest in Hampshire (thought to contain up to 75% of the UK's population at the time) and found that optimum Dartford warbler habitat was dry and humid heath, 30cm or taller, containing scattered gorse bushes. Dartford warblers also used denser gorse, 1-2m high with older heather at the edges and amongst the gorse itself. Old, open and "leggy" gorse was not suitable (Moore 1962). Westerhoff and Tubbs found 1830.6 ha of the optimum vegetation, which supported 406 territories (89% of the total 454 territories found).

Catchpole and Phillip's (1992) study compared 37 territories and found the following:

- the mean territory size was 2.13 ha (s.d. 0.61 ha)
- the mean area of heather was 1.45 ha (68.1%, s.d. = 0.65 ha)
- the mean area of gorse was 0.60 ha (28.2%, s.d. = 0.37 ha)
- the mean area remaining was 0.07 ha (3.3%, s.d. = 0.13 ha)

They also found that there was a strong correlation between the area of the territory and the area of heather but not with the area of gorse. Catchpole and Phillips suggested some likely reasons for this finding. The first is that Dartford warblers defend “super-territories” – areas that are larger than the warbler needs to supply food and shelter – in order to prevent rivals from using it instead. They also suggested that in areas with less gorse, a larger area is defended until there is enough gorse within the boundary.

Catchpole and Phillips also suggested that heather could be more important than has been previously understood. Bibby (1979a *in* Catchpole and Phillips 1992) found that Dartford warblers preferred to nest amongst heather, even where there was sufficient gorse for a nest. Previous studies have also found areas where Dartford warblers nested with no gorse, but no study found Dartford warblers nesting in gorse with no heather present at all.

Bibby (1979a *in* Catchpole and Phillips 1992) found that gorse contains a much greater biomass of invertebrates than heather, and even when gorse only accounted for 2% of cover, it accounted for 68% of all foraging – adults would fly over large areas of heather to reach gorse. Even if adult Dartford warblers don't nest amongst gorse as much as heather, it seems that they need to have gorse close by.

Van den Berg et al. (2001) found four statistically significant factors that increased the chance that an area of heathland contained a Dartford warbler territory. These

were: area of dry/humid heath, area of mature *U. europaeus*, area of bare soil, and the fragmentation index. The first three were all positively correlated, so that squares containing these were more likely to contain a Dartford warbler territory. The last factor, fragmentation index, was negatively correlated, so a greater fragmentation index meant the square was less likely to contain a Dartford warbler territory. A greater fragmentation index indicated that the square was further from other heathland squares.

The impact of the area of bare soil was important and unexpected, but van den Berg et al. (2001) suggested that these areas could provide a warm open habitat for invertebrates, and therefore food for Dartford warblers.

Knowledge of the habitat preferences of the Dartford warbler is important at a local level as well as a regional or global one, as the preferred habitat cannot be extrapolated throughout its range (van den Berg et al. 2001).

This means that studies like the one in Alderney are very important to help identify the ideal habitat for Dartford warblers wherever they are found. Without this knowledge, the ideal habitat cannot be monitored, preserved, restored, or protected. Conservation groups and management policies would not be able to deliberately target which type of habitat to save, and as the availability becomes more confined, it would affect the population in the long-term (van den Berg et al. 2001).

However, in years where the Dartford warbler did well, more nests in sub-optimal habitat were found, and these nests eventually produced fewer young (van den Berg et al. 2001). Therefore even a good year for the Dartford warbler population is not a good indicator for the health of the long-term population. Additionally, the exact effects of global warming on the Dartford warbler's idea habitat remain to be seen.

Chapter 3.1: Dartford warbler study methodology

This was the first half of the study, which had the aim of finding the number and location of Dartford warblers on the Giffoine. The area surveyed was about twice as large as the area defined by Veron (1997) as being the Giffoine, due to its likely suitability for Dartford warblers. To ensure the land was surveyed evenly, the entire area was divided into 3 approximately equal sections which were visited on separate occasions. These sections are named Giffoine A, Giffoine B and Giffoine C, and are shown in Figure 3.1 below:

Giffoine A area: 47.76 ha
Giffoine B area: 42.11 ha
Giffoine C area: 49.78 ha

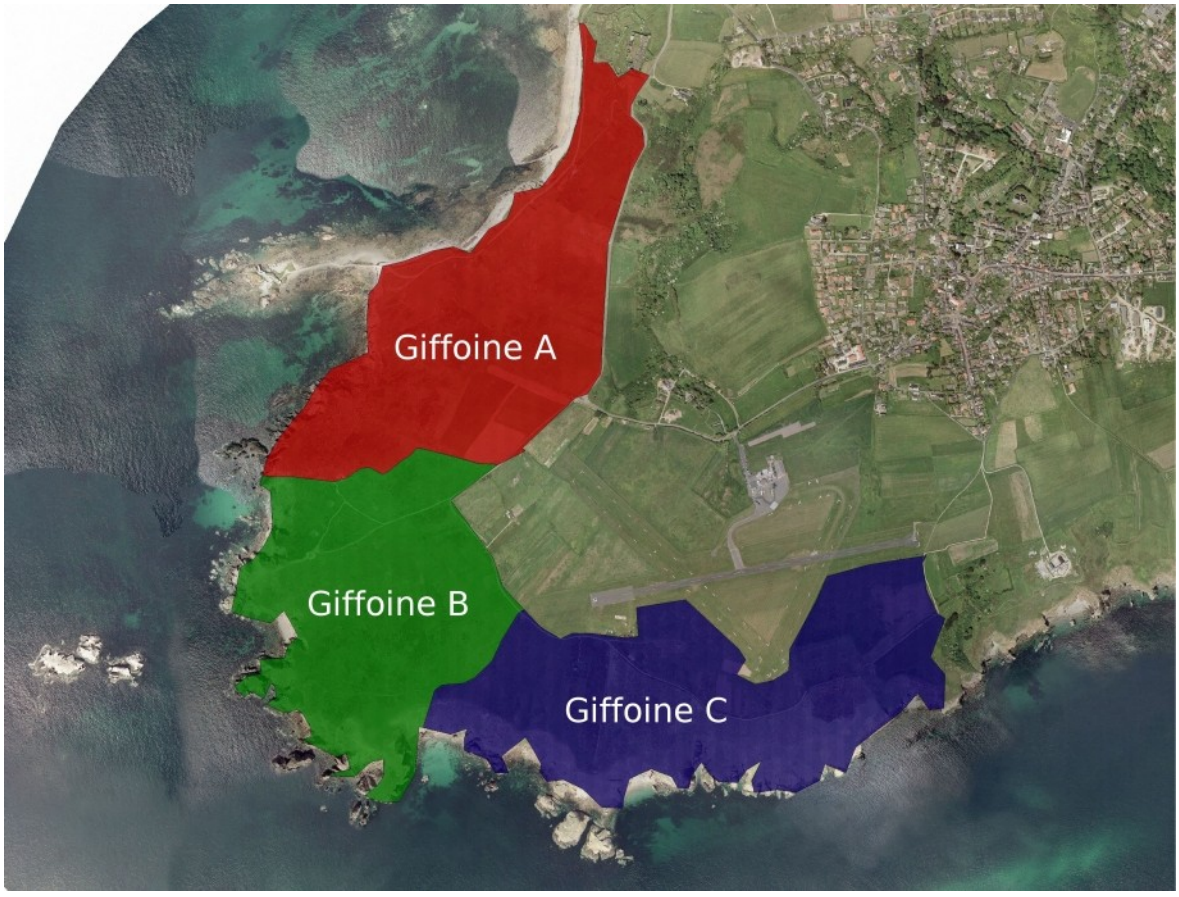


Figure 3.1: Survey areas on the Giffoine

Each section was visited on three separate occasions to map the locations of Dartford warblers, using recommendations from Gilbert, Gibbons and Evans (1998) and adapting the methodology of the BTO's Common Bird Census (Marchant 1983). The aim was to establish the number and range of Dartford warblers and their territories on the Giffoine. On average, the first three visits to a site will together find 94% of all Dartford warbler territories (Gibbons and Wotton 1996).

The author familiarised himself with Dartford warblers by looking at photographs, listening to recordings of Dartford warbler calls and song, and by observing them directly in the field with an experienced surveyor, so that he was confident of being able to identify a Dartford warbler by sight before any surveys took place. To class a Dartford warbler as singing, the author had to both hear and see it singing to confirm it. This was to avoid confusion with the similar-sounding Whitethroat *Sylvia communis*, and also to help plot the bird exactly on the map.

Each visit route aimed to cover the section as thoroughly as possible by using all available paths to maximise the observed area. It was suggested that Dartford warbler surveyors should attempt to get within 100m of all points in the survey area (Wotton 2006). When a Dartford warbler was sighted its position was noted on a map with scale 1:2500, with any extra information – such as if it was singing, whether there was a pair, or if its sex could be determined – noted where possible. Along with this information, the following was also noted: visit number, dates, start time and end time, time of sunrise, and weather conditions. See Appendix A for all this information.

Each visit was conducted in the morning, starting from about an hour after dawn where possible. It is easier to distinguish individual song at this time, as general song activity is more uniform in the period after the dawn chorus (Sutherland 2007, p. 315). Surveys were only done on fine, calm days, as Dartford warblers do not like to sing in cold, windy conditions (Gilbert, Gibbons and Evans 1998).

The low angle of the sun at that time in the morning can make visibility difficult, so surveys began towards the east of the survey area, meaning the author was walking away from the sun for the start of the survey. This made it easier to see birds, as the sun shone directly on them, which also made it harder for them to see and be disturbed by the presence of the author.

Further biases were reduced by completing each visit in one go, to reduce the variation in changing weather conditions, and by having a different starting point and route each time, where possible. This reduced the likelihood that the author would pass the same point at the same time of day. The author spent an equal amount of time examining both sides of the path walked, using a slow, steady pace throughout. The only exception to this was when a possible Dartford warbler was seen or heard, when the author stopped to confirm the species.

If a walker or dog-walker passed nearby, the author would temporarily wait on the spot to allow the birds to settle down again. This was an attempt to reduce the effects of disturbance on the study.

After a survey was completed, the path walked by the author and the locations of Dartford warblers were taken from the survey map and plotted onto a map of the Giffoine at the same scale on the GIS (geographic information system) PC software ArcView GIS 3.3. ArcView was developed by the Environmental Systems Research Institute (ESRI).

Chapter 3.2: Habitat study methodology

The study by van den Berg et al. (2001) was the first Dartford warbler habitat study to consider territory choice over the entire landscape, as “more precise information can be obtained by assessing the differences between selected habitats and those not occupied by the species” (p. 218). This fact has been an important influence on the design of the current study.

The habitat study was therefore divided in two, using a number of quadrats to study Dartford warbler areas, with an equal number of quadrats outside Dartford warbler territories. The aim was to collect data about the cover of various vegetation types and heights, and then perform statistical analyses on the data to compare the Dartford warbler areas to the areas where no Dartford warblers were found.

Each Dartford warbler territory was sampled at the exact location of the Dartford warbler, and again at 6m, 12m and 18m from this point at a random bearing. This gives four samples per Dartford warbler location. These distances were chosen as they were alternating rings twice the width of one quadrat, ensuring a wider spread. See Figure 3.2 for an example:

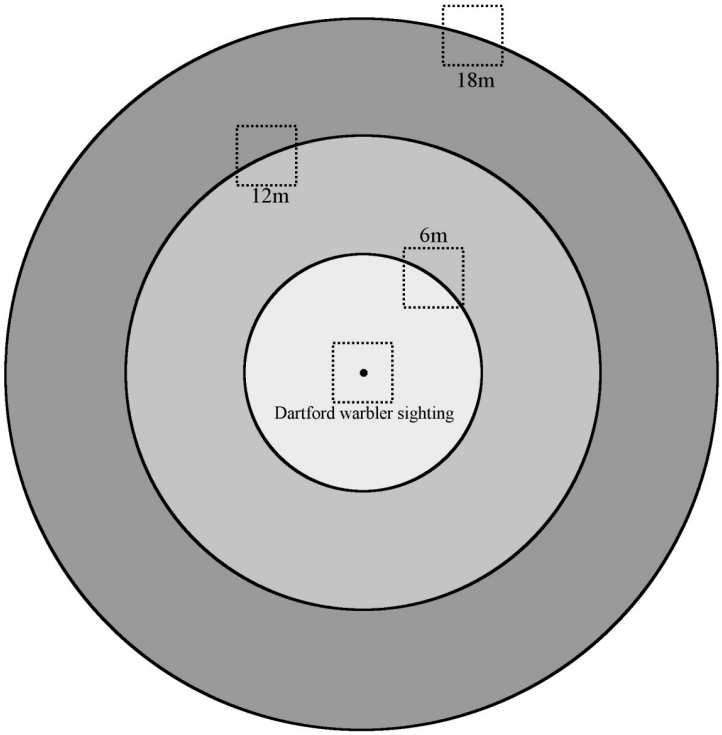


Figure 3.2: Sample quadrat allocation

If there were two or more sightings close together, without further information it was assumed that they were the same bird and a point central to both sightings was plotted. This was used as the location for sampling instead of all the individual sightings.

The locations for samples outside of Dartford warbler territories were randomly plotted with ArcView using a piece of software called a *plugin*. Plugins enable additional functionality within a program, and this one, “Random Points Generator” (Jenness 2005), allowed the placing of samples in such a way that they fell outside of all Dartford warbler territories but still within the Giffoine. The vegetation survey method was therefore a stratified random sampling strategy. Figure 3.3 shows where these quadrats were located.

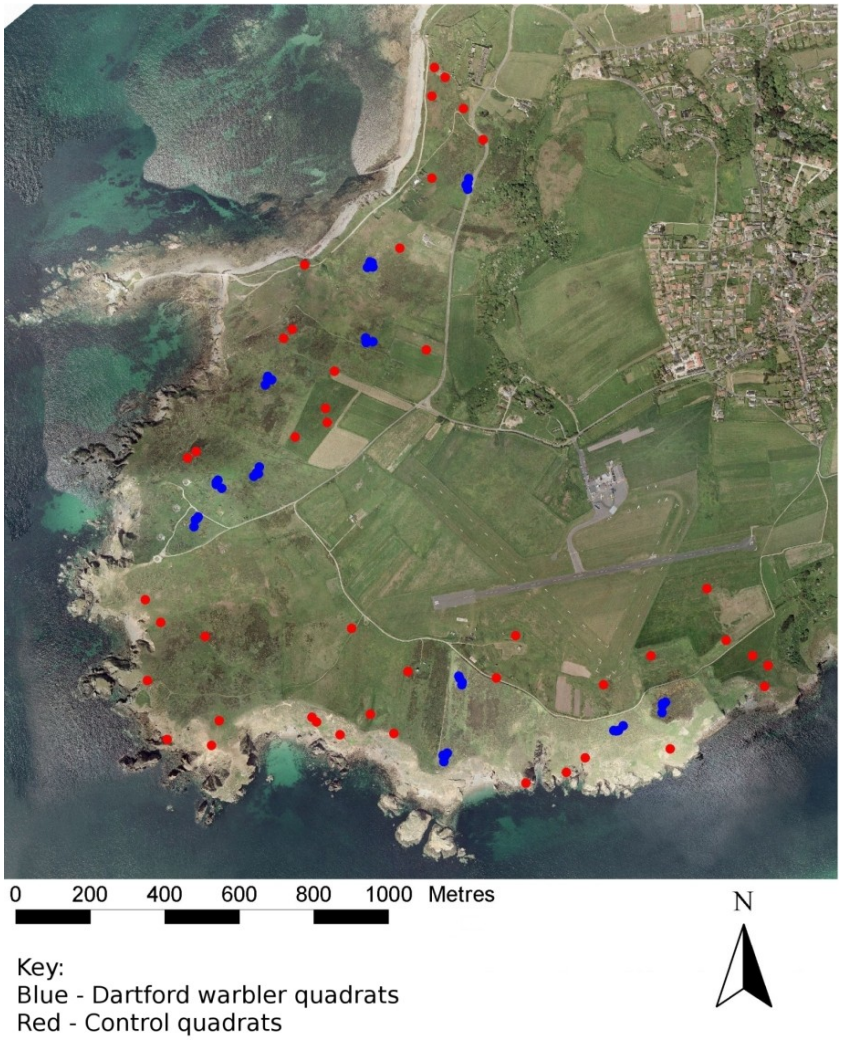


Figure 3.3: Quadrat distribution over the Giffoine

Each sample was taken using 3 x 3m quadrats (Murison et al 2007), built with a plastic post at each corner. To help judge these distances, a pair of wooden planks, measuring 3m in length, were attached with a pivot so that they could be placed over one post to measure the distance to the others. See Figure 3.4.

Figure 3.4: Example of quadrat with wooden guide

After conducting the Dartford warbler surveys, it was decided that three visits weren't enough to accurately define each territory boundary, so some assumptions were made to provide a rough estimate instead. Using Catchpole and Phillips' (1992) estimate of 2.13ha (21,300m^2) for the average area of a Dartford warbler territory, a circle with radius 82.3m (to give an approximate area of 2.13ha) was plotted on ArcView and centred over each Dartford warbler sighting. This was used to define land that contained a Dartford warbler territory and land that did not.

This method is not precise, as Dartford warblers are unlikely to be seen singing at the centre of their territories, which are also unlikely to be a perfect circle. And while it is also unlikely that all territories are the same size (Catchpole and Phillips' study found a range of 0.96 ha to 3.51 ha), most sightings were fairly well distributed, suggesting that territories should be roughly equal in size. While this method is far from perfect, it is probably the best way with a limited number of sightings. Dartford warblers are known to be highly sedentary (Bibby 1979b) and so will not travel far from their territories. It was also assumed that all Dartford warbler territories were found.

At each survey point, an estimate was made of the cover of the following seven vegetation types, as these seemed to be the dominant species on the Giffoine. The frequency notes are from Bonnard (2007).

- **gorse** – the only gorse species found in great numbers on Alderney is Common Gorse (*Ulex* europaeus) (abundant), from now on referred to only as gorse.
- **heather** – only heather (*Calluna vulgaris*) and bell heather (*Erica cinerea*) are found on Alderney, and are designated as locally frequent and locally common, respectively. They are both referred to simply as heather.
- **bracken** (*Pteridium aquilinum*) is noted as abundant on Alderney
- **bramble** (*Rubus spp.*) is noted as common or abundant
- **grass** species – recorded as grass with no further definition
- **other** species – any other species with significant cover in a quadrat
- **bare** ground – either soil or exposed rock

Additionally, an estimate of the cover of vegetation at certain heights was made. The four height bands used, taken from Murison et al. (2007) were:

- ≤ 20 cm
- 21 – 40 cm
- 41 – 60 cm
- > 60 cm

The estimates for cover were made using the Domin scale, below.

Domin score	Percentage cover	Median percentage
1	< 4% cover with few individuals	2%
2	< 4% cover with several individuals	2%
3	< 4% cover with many individuals	2%
4	4 – 10%	7%
5	11 – 25%	18%
6	26 – 33%	29.5%
7	34 – 50%	42%
8	51 – 75%	63%
9	76 – 90%	83%
10	91 – 100%	95.5%

Table 3.1: The Domin scale, taken from Sutherland (2007), p. 191.

The Domin scale is a good way of quantifying a visual estimate of the cover of vegetation. It is designed to be easy to make judgements on categories, due to its use of simple fractions. Although the Domin scale is a subjective estimate, a lone researcher can be confident that he is being consistent between estimates. Dartford warblers will also be subjective in their selections so any scale that is more specific will not reflect an increase in accuracy.

Once all quadrat locations had been assigned by ArcView, a table was printed with all their co-ordinates. This meant the actual position of the quadrats on the ground could be quickly located using a GPS receiver. The GPS receiver that was used in fact has an error of approximately 5 metres (email from Charles David, Joint Manager of the Guernsey Biological Record Centre, 16th June 2007. pers. comm.), but this error can be ignored due to its small size, and the fact the quadrats were randomly placed anyway. A sampling error occurring on a randomly placed point does not take away from the fact the position is still random (Sutherland 2006, p.20).

Chapter 4: Results

Dartford warbler survey

A total of 11 individual Dartford warbler territories were located, with 20 individuals sighted on separate occasions. Of these, 7 were singing males, 8 were pairs together, and 5 were calling individuals. Singing males and pairs were taken as evidence of breeding territories (Westerhoff and Tubbs 1991, van den Berg et al. 2001). These Dartford warbler surveys covered a total of approximately 48.8km, and took more than 35 hours. See Appendix A for full details of the Dartford warbler surveys.

Vegetation survey

The level of rejection was set at the 5% level of significance ($p = 0.05$), using the Mann-Whitney *U* test. The test use is non-parametric since a normal distribution cannot be assumed for these vegetation studies. A total of 792 m^2 was directly surveyed.

Statistical analysis

A *p* value calculates the probability of finding a result at least as extreme as the one found, given the null hypothesis is true. In this study, the null hypothesis was that Dartford warblers had no particular preference for territory on the Giffoine. Therefore, these *p* values refer to probability of an area of vegetation being found of at least the extent of the area actually found, assuming that Dartford warblers have no habitat preference at all and do not distinguish between vegetation heights or types.

The vegetation survey produced four sets of data:

A: The area covered by each vegetation type in the Dartford warbler quadrats	B: The area covered by each vegetation type in the control quadrats
C: The area covered by each height band in the Dartford warbler quadrats	D: The area covered by each height band in the control quadrats

See Appendices A-D for the full data set.

These charts show the total number of quadrats for each Domin score for each vegetation type and height. They also show where the data was taken from; either a Dartford warbler territory or a control quadrat.

Using stacked columns is the simplest way to show this large amount of data. As well as showing relative abundance of vegetation, the Domin score is also shown, allowing the comparison of relative cover too.

For example, a large amount of the gorse found in Dartford warbler quadrats actually made up the majority of those quadrats, i.e. covered more than 50% of them. This is shown by the yellow, orange and red sections in the first column of Figure 4.1.

On the other hand, of the gorse outside of Dartford warbler territories (the control quadrats), half contained a majority of gorse and the other half were a minority, as seen by the blues and purple sections in the second column of Figure 4.1.

A: Dartford warbler vegetation types

Dartford warblers had a preference for large amounts of gorse, with 33 of 44 quadrats, 75%, containing at least some gorse (Z = -4.437, n = 88, p < 0.001), while many quadrats also contained some bramble, with 21 of 44 quadrats, 47.7%, containing some (Z = -1.322, n = 88, p = 0.186).

B: Control quadrat vegetation types

The control (non-Dartford warbler) quadrats contained large amounts of grass, with 23 of 44 quadrats, 52.3%, containing at least some grass (Z = -2.856, n = 88, p = 0.004), but also some gorse (20/44, 45.5%). Even though there weren't a lot of quadrats containing other species (13/44, 29.5%) they were found to be statistically significant (Z = -2.532, n = 88, p = 0.011)

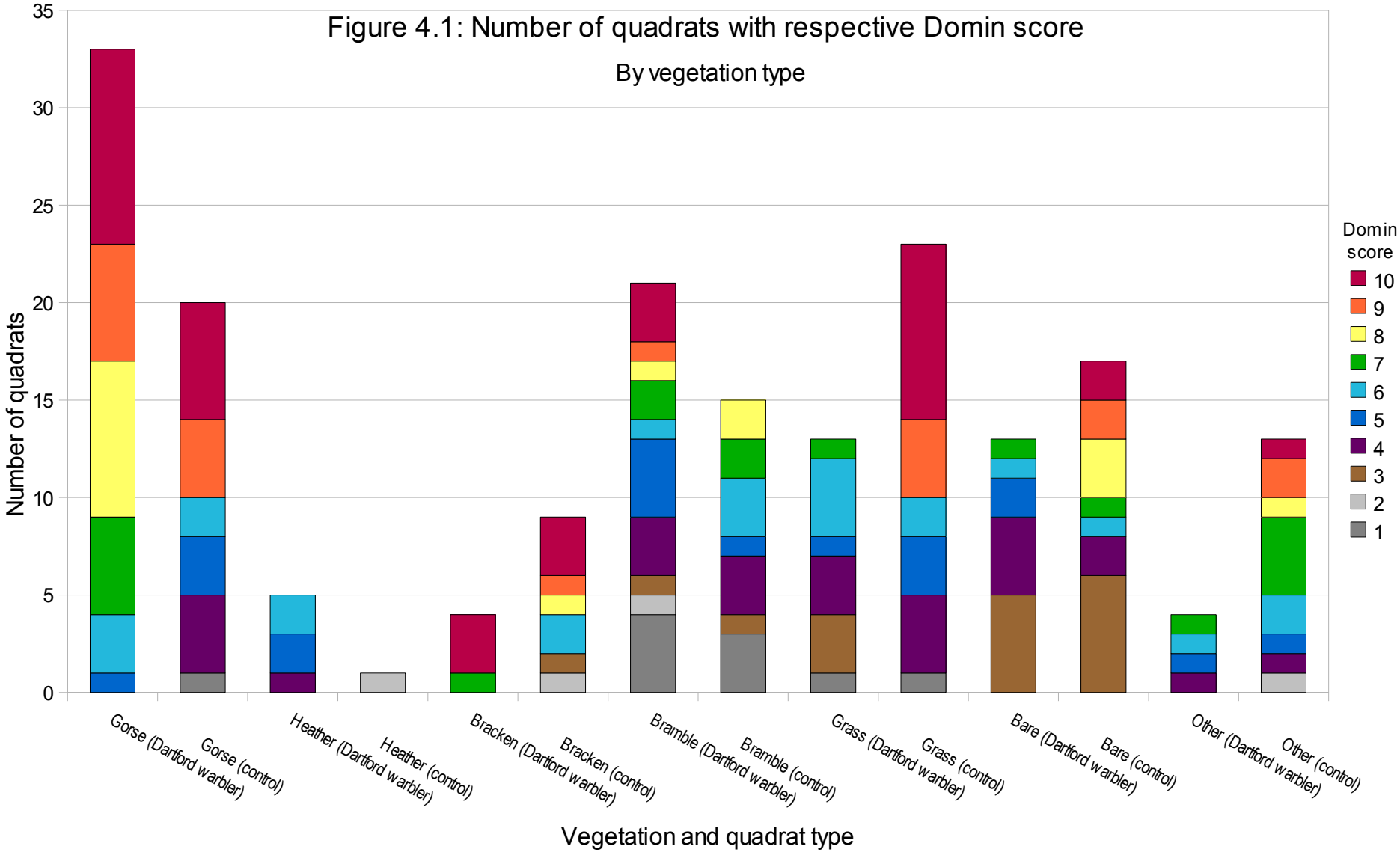


Figure 4.1: Number of quadrats with respective Domin score
By vegetation type
Number of quadrats
35
30
25
20
15
10
5
0
Gorse (Dartford warbler)
Gorse (control)
Heather (Dartford warbler)
Heather (control)
Bracken (Dartford warbler)
Bracken (control)
Bramble (Dartford warbler)
Bramble (control)
Grass (Dartford warbler)
Grass (control)
Bare (Dartford warbler)
Bare (control)
Other (Dartford warbler)
Other (control)
Vegetation and quadrat type
Domin score
10
9
8
7
6
5
4
3
2
1

C: Dartford warbler vegetation heights

Dartford warblers also had a clear preference for vegetation at least 60 cm in height, with 40 of 42, 95.2% containing some (Z = -4.940, n = 85, p < 0.001), with a small amount of their habitat containing vegetation 20 cm or shorter, with 17 of 42 quadrats, 40.5%, containing some (Z = -3.999, n = 85, p < 0.001).

D: Control quadrat vegetation heights

The majority of the control height measurements were ≤ 20cm (30/43, 69.8%) but also a number of > 60cm (17/43, 39.5%) were found. An equal number of quadrats with the height band of 21-40cm were found, but these were not found to be statistically significant, as the cover by 21-40cm vegetation was a lot less than the cover by > 60cm vegetation.

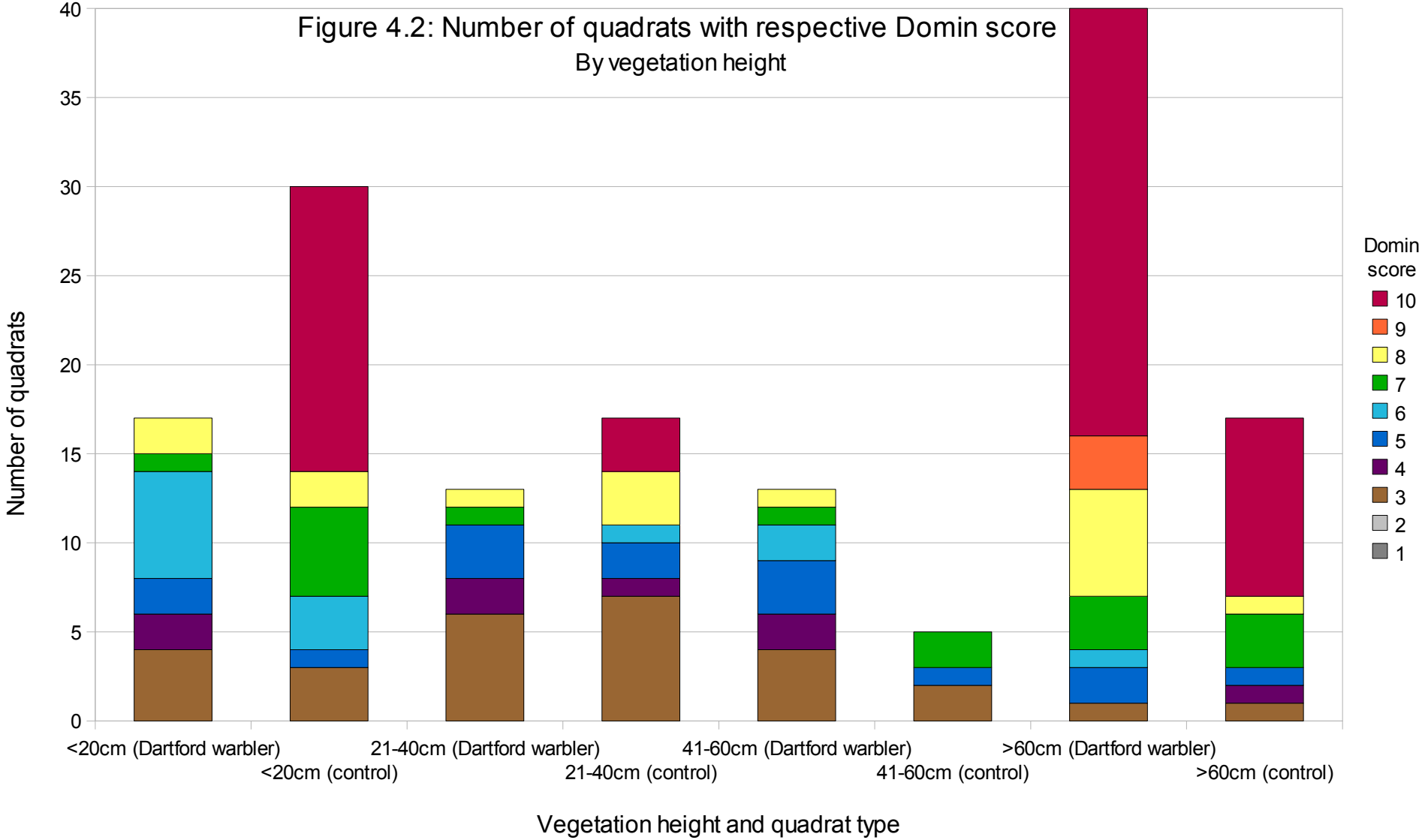


Figure 4.2: Number of quadrats with respective Domin score
By vegetation height
Number of quadrats
40
35
30
25
20
15
10
5
0
Domin score
10
9
8
7
6
5
4
3
2
1
<20cm (Dartford warbler)
<20cm (control)
21-40cm (Dartford warbler)
21-40cm (control)
41-60cm (Dartford warbler)
41-60cm (control)
>60cm (Dartford warbler)
>60cm (control)
Vegetation height and quadrat type

Showing only the number of quadrats that each category was found in is not the best way to show the trends, because the Domin scores from the quadrats must also be considered. These pie charts (Figures 4.3–4.6) give a better idea of how the actual areas of vegetation types and heights compare between Dartford warbler and control areas. They have been calculated by taking the median percentage cover of each Domin score (where the median value is taken between the maximum and minimum values; see Table 2.1: The Domin scale) and multiplying this by the number of quadrats found with that Domin score. The stacked charts illustrate the distribution of the Domin scores, whereas the pie charts illustrate the relationships between the total areas.

These median percentages show the proportional differences between Domin scores more clearly. For example, there are 21 percentage points between the median Domin scores of 7 (42%) and 8 (63%) compared to none between Domin scores 2 and 3 (2% for both). Three Domin scores of 6 would still give less than a Domin score of 10 (3 x 29.5% < 1 x 95%). These pie charts are an attempt to illustrate these differences in a more proportional way.

Figure 4.3: Pie Chart A - Percentage of total cover by vegetation type – Dartford warblers

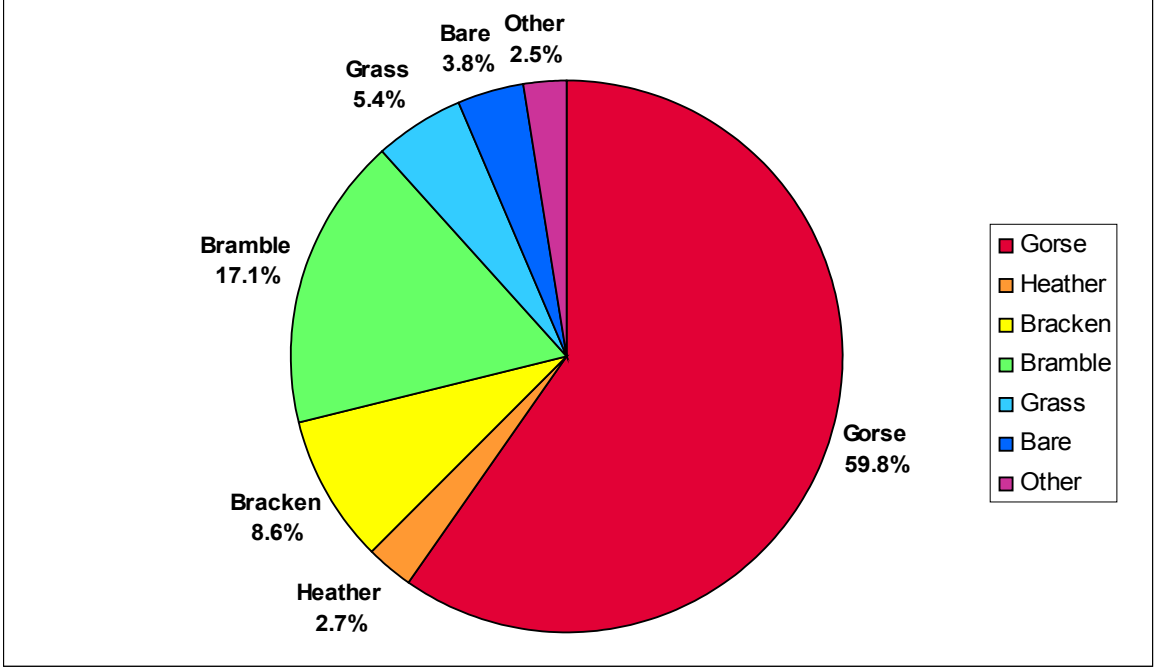
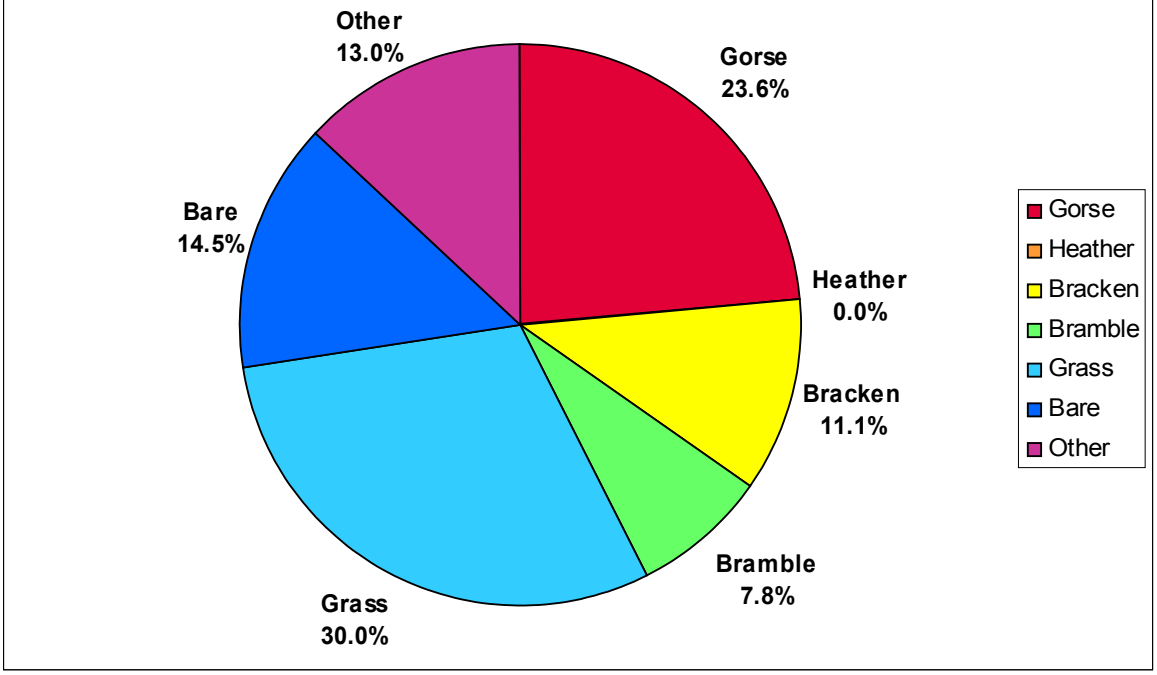


Figure 4.4: Pie Chart B - Percentage of total cover by vegetation type – control



Pie Chart A shows a clear preference for gorse (59.8%), with a bit of bramble (17.1%). All the other vegetation types contribute less than 10% each, and heather is all but absent.

Pie Chart B shows no clear preference amongst vegetation types, with grass (30.0%) and gorse (23.6%) being the majority, but also with large areas of bare ground (14.5%) and other vegetation types (13.0%). It shows the more general make-up of heathland vegetation when compared to the specific needs of the Dartford warbler.

By far the vast majority of Pie Chart C is taken up by vegetation of height greater than 60cm (79.0%), with a small amount of vegetation 20 cm or shorter (10.2%).

Pie Chart D is less clearly defined, with the ≤ 20cm vegetation taking up 51.8%, and also the > 60cm vegetation comprising 30.7% of the total area.

Figure 4.5: Pie Chart C - Percentage of total cover by vegetation height – Dartford warblers

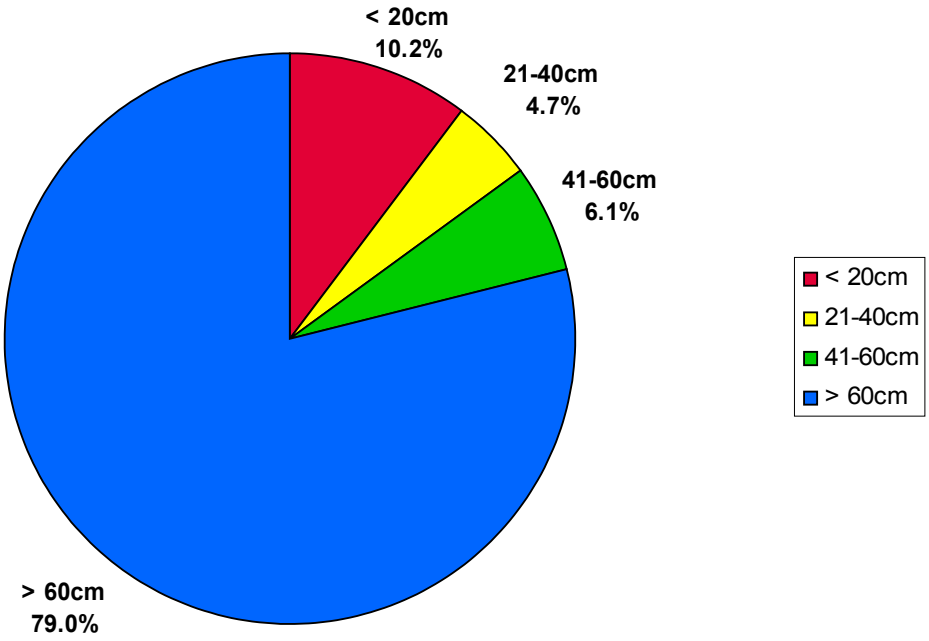
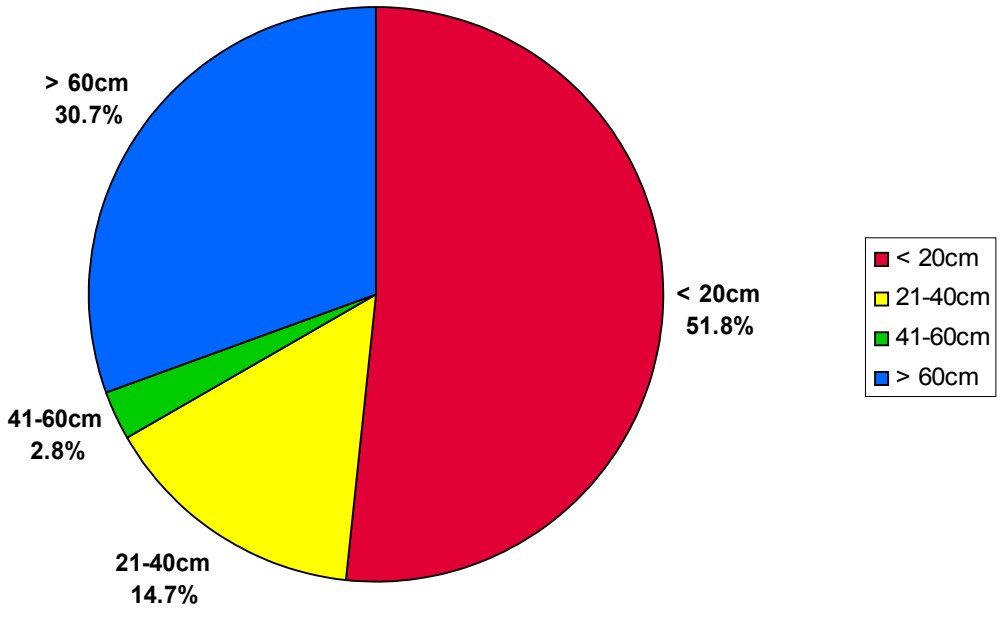


Figure 4.6: Pie Chart D - Percentage of total cover by vegetation height – controls



Vegetation types

There were more quadrats containing **gorse** than any other vegetation type, with most of it having a Domin score of 7 or greater. Three-quarters of all Dartford warbler quadrats contained at least some gorse. It was found to be statistically significant at $p < 0.001$. This dominance of gorse amongst Dartford warbler territory vegetation was also found in every other study into Dartford warblers and therefore was expected.

There was almost no **heather** at all, with only 6 quadrats out of the entire 88 surveyed containing any. It was not found to be statistically significant ($p = 0.084$). This was a very surprising result, since previous studies have shown it is as important to Dartford warblers as gorse. Compare the columns for gorse and heather in Figure 4.1. One explanation could be that Dartford warblers are using bramble as a replacement. The finding could be an artefact from the study and a survey covering more quadrats would find the amount of heather that could be expected. The heather could have been hidden under dense gorse, invisible to the observer but perfectly accessible to Dartford warblers. See the Discussion section for more on this issue.

Only four Dartford warbler quadrats were found to contain **bracken**, yet three had a Domin score of 10. This could be due to the thickness of the vegetation forcing an estimate from a distance, so that small patches of other vegetation could be missed, especially as the vegetation in the area was tall (> 60cm). For the control quadrats, three again contained a Domin score of 10, with the others containing various other scores. There are still few in number, and it is not statistically significant ($p = 0.851$) anyway.

There is a lot of **bramble**, which accounts for the second greatest number of quadrats in Dartford warbler territories, and third greatest overall. The Domin scores are well distributed within this amount. It was not statistically significant (***p* = 0.186**). However, it could still be important to discourage predators or human disturbance, and only found to be not statistically significant because of its abundance elsewhere on the Giffoine.

There was some **grass** scattered throughout the Dartford warbler quadrats, though none contained more than 50% of it. It was not essential to the selection of an area for a territory. In the control quadrats, on the other hand, grass is the vegetation type present in the greatest number of control quadrats, and the second greatest number overall. Grass covers half of the control quadrats by more than 75% (Domin scores ≥ 9), with the rest covering less than a third of their quadrats. There is a clear divide here as no quadrat contained grass between these two values ($6<x<9$). The difference between the Dartford warbler and control quadrats was statistically significant at ***p* = 0.004**.

The cover of **bare** ground in Dartford warbler quadrats was similar to the area for grass, but with slightly lower Domin scores – all were 7 or lower. The bare ground amongst control quadrats has quadrats with Domin scores 8-10. This difference is not statistically significant, ***p* = 0.229**. This scenario has two possible explanations. The first is that bare ground is simply not an important factor when a Dartford warbler selects a suitable place for its territory. The second possibility is that the control quadrats near cliffs that only contained bare rock are being countered by the bare soil contained within Dartford warbler territories for feeding, as found by van den Berg et al. (2001). It could also indicate the fact that several gorse bushes were “leggy” and so bare soil showed amongst gorse stands.

There were very few “**other**” species in Dartford warbler quadrats, as only 4 quadrats were found to contain any at all. The control quadrats contained a number of them, though no Domin score was dominant. This difference is found to be statistically significant at ***p* = 0.011**. Most of the vegetation classified as “other”

was ground ivy (mostly likely *Hedera hibernica,* Bonnard 2007), and would mostly have been ≤ 20cm. As ivy can spread and cover an area quickly, it would have been avoided by the Dartford warblers as it likely to out-compete gorse and heather. Not too much can be read into this category, as only a large cover of "other" species were counted and the rest was ignored.

Vegetation height

Vegetation at the **≤ 20cm** height band was found in about half the number of Dartford warbler quadrats when compared to control quadrats, and had much lower Domin scores too. This difference was statistically significant at ***p* < 0.001**. About half of the control quadrats had a Domin score of 10, whereas only 2 Dartford warbler quadrats had more than 50% of the area under 21cm.

More control quadrats contained the ≤ 20cm category than any other control quadrat, and the majority of these had a Domin score of 10.

The make-up of the **21-40cm** and **41-60cm** height bands is very similar within the Dartford warbler quadrats, but very different in the control ones. The 21-40cm category was not statistically significant, as ***p*** was only found to be **0.295**. There was very little 41-60cm vegetation amongst the control quadrats and the difference was statistically significant at ***p* = 0.034**.

Almost half of all Dartford warbler quadrats contained **> 60cm** vegetation, and most of those that did contained more than 50% of this height. More than half had a Domin score of 10. The difference was statistically significant at ***p* < 0.001**.

Chapter 5: Discussion

During the Dartford warbler survey, the author mainly stayed on the paths. This made passage through the Giffoine easier and quicker, and most importantly, quieter. Much of the vegetation on the Giffoine is tall and dense, making it extremely difficult to get through at all, let alone to walk through quietly. This density, as well as other obstacles such as steep hillsides and cliffs, prevented the author from getting within 100m of all points on the map, as recommended by Wotton (2006) in the methodology. When a large section of the study area was inaccessible, the area was carefully observed with binoculars from a distance instead. This is not as thorough as walking past but there are no other reasonable alternatives.

The avoidance of thick vegetation can bias the results, since Dartford warblers that have territory in thick areas of gorse are harder to locate, especially from a distance. Conversely, Dartford warblers with territories closer to paths will be more apparent to observers. Dartford warblers will therefore appear to favour less dense, more accessible vegetation when this may not in fact be the case. The attraction of Dartford warblers to vegetation taller than 60 cm would make it seem as though this is not the case.

One possible way to confirm or refute this is to identify potential territories by looking for areas of gorse and heather that are difficult to access, and then sit and observe the area with binoculars or a telescope for a fixed period of time (perhaps half an hour to an hour), waiting for a male to sit on top of a bush and sing. As with the main study, this would have to be done on a calm, sunny day, ideally just after dawn or before dusk, in order to maximise the chance of seeing a bird if it is there. This should only be done for large areas of impenetrable vegetation, and the observer should sit with his back to the sun to give the best view possible. A downside to this method is the long period of time needed to monitor all possible sites, so it would probably be best to do it with when more than one person is performing the surveys. If this type of observation is being performed a lot, it may

be better to conduct further path surveys too, to avoid one type of observation being used a lot more than the other.

The pie chart for vegetation areas in control quadrats (Figure 4.4 – Pie Chart B) shows what could reasonably be expected to see for a survey covering an area of this type. No one type is dominant (as gorse is in Figure 4.3 – Pie Chart A) and all types are represented fairly evenly. This suggests the survey is a fair representation of what is actually there. The only exception is heather:

Vegetation types

Heather

The relative lack of heather is probably the most interesting finding of this study: it was only found in 6 out of the total 88 quadrats, and even then it was never found to occupy more than one-third of the quadrat. The study found only two territories containing heather; nine were without.

There have been at least five previous studies (Bibby & Tubbs 1975, Robins & Bibby 1985, Westerhoff & Tubbs 1991, Catchpole and Phillips 1992, Murison et al. 2007) that found several Dartford warbler territories with no gorse, but none with no heather at all. Bibby (1979a *in* Catchpole and Phillips 1992) found that heather was preferred as a nesting site, to the exclusion of gorse. The following chart compares the relative abundance of gorse and heather on Catchpole and Phillip's study – the latest with quantitative data – with the present one:

Figure 5.1

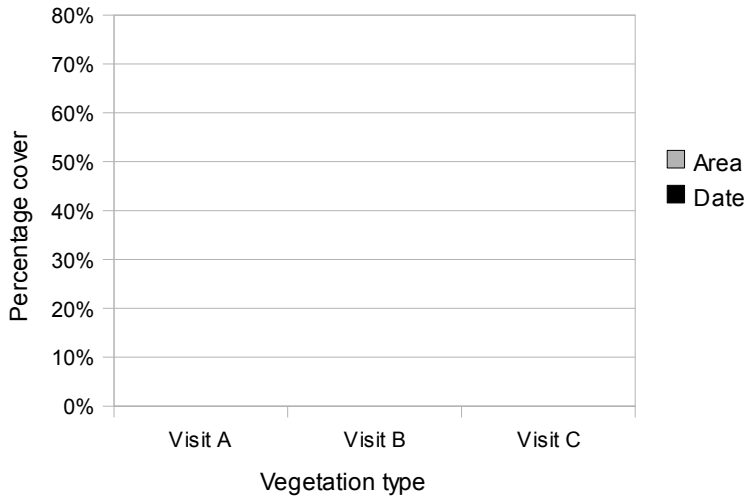


Figure 5.1: A comparison of the findings of Catchpole and Phillips (1992) and the present study

The figures from Catchpole and Phillips can be found in Chapter 2.2, the Dartford warbler section of the literature review. There are several possibilities for this unexpected difference:

The simplest explanation would be because not enough measurements from inside Dartford warbler territories were taken to be representative, and a redesigned study that fully understood the extent of each territory could be used to place quadrats more effectively to collect data. However, this explanation does not show why only heather was affected: all other vegetation types were found in much larger numbers (see Figure 4.3).

Another reason could be that the heather *was* present, but it was hidden amongst dense gorse. It would be invisible to the observer but perfectly accessible to Dartford warblers. This would happen most easily amongst quadrats that had to have a Domin score estimated from a distance, which are those most likely to be surrounded by dense vegetation, making the dwarf shrub layer of heather much harder to see. However, this is also unlikely since a lot of gorse would block the light getting down to the base layer and the heather would be out-competed.

Murison et al. (2007) discovered that heather territories are particularly vulnerable to disturbance, especially recreational disturbance, which can delay breeding by up to 6 weeks. This delay reduced the number of successful broods as well as the number of chicks fledged per brood. This effect was noticed for all types of territory (*U. europaeus* and *U. gallii* as well as heather), but the effect on heather territories was found to be the only statistically significant one.

Murison et al. (2007) also recorded dogs that were off the lead moving as far as 45m into heather, and noted that they were unable to do the same with *U. gallii*. They concluded that these dogs had the single greatest impact on productivity. This could mean that Dartford warblers have learnt to avoid heather as a nesting site, or at least when it was near a path. As mentioned previously, the author stayed close to paths to avoid disturbance, so the study would not reveal this trend if it was indeed the case. If it was, all that would be shown is the territory composition near to disturbance sources (paths), which would be more built up to provide shelter and protection. The open, heather-based territories would be further into areas of dense gorse and therefore inaccessible.

Dartford warblers that were disturbed whilst nest-building were observed by Murison et al. (2007) to cease construction and abandon all nest materials they were carrying. 70% of these observations were in heather territories. However, if Dartford warblers on the Giffoine were deliberately avoiding heather as a nesting site for this reason, then the Dartford warbler quadrats would surely contain less heather than the control quadrats, when in fact they contained more (Figure 4.1).

The reason for this could be the simple fact that a greater percentage of the area deemed to be Dartford warbler territory was sampled than the percentage of the area outside of these territories, the control quadrats:

1. Area of Dartford warbler territories = 11 x 2.13ha = **23.43ha**
2. Area outside of these (control area) = Total area surveyed – Dartford warbler territories = (47.76ha + 42.11ha + 49.78ha) – 23.43ha = **116.22ha**
3. Dartford warbler territories as a percentage of control area surveyed = $\frac{23.43}{116.22}$ = **20.16%**

The total Dartford warbler territory area is therefore about five times smaller than the entire area outside. As an equal area was surveyed from both of these areas, about five times as much, proportional to the area, was surveyed from within Dartford warbler territories as outside. Therefore, a lack of heather on the Giffoine as a whole is harder to see. In this case, five times as many quadrats should have been placed outside Dartford warbler territories to ensure an equal proportion of the landscape has been monitored. A study performed with the recommendations made in the Recommendations section may help to see if this reasoning is accurate.

Gorse

This study supports all previous findings that gorse is heavily used by Dartford warblers (e.g. Moore 1962, Bibby 1978, Westerhoff and Tubbs 1991). Twenty control quadrats also contained gorse, with ten containing more than 75%. This suggests that other factors are important to Dartford warblers as well as gorse cover. For example, if a seemingly perfect territory was located near a cliff edge, then rough sea winds could dissuade the bird from nesting there. However, it could also mean that some Dartford warblers were not found where they actually had territory (a Type II error). Whilst one or two territories could have been missed, it seems unlikely to have been a large or significant number since more grass was found in the control quadrats than gorse, leaving them relatively little room (see Figure 4.4 – Pie Chart B). No Dartford warblers were seen during the vegetation survey near the control quadrats.

Bramble

Perhaps the Dartford warblers on the Giffoine were using bramble instead of heather, which would explain the relatively large amount of bramble found in the study: after gorse it was the second most common vegetation type found in Dartford warbler territories.

However, the only mentions of Dartford warblers breeding in gorse and bramble are from the 1984 Dartford warbler survey, where Robins and Bibby (1985) found 5 sites in coastal Hampshire where Dartford warblers had territories amongst gorse and bramble, and also from Westerhoff and Tubbs (1991) where a few pairs, again on the Hampshire coast, did so. Dartford warblers have also been recorded as eating the fruits from bramble, i.e. blackberries. These observations (the first was from the mid 1980s) were the first confirmed records of this behaviour by Dartford warblers in Britain (Combridge and Christie 2002), and were seen at Pennington Marsh, and Warsash, both in Hampshire. Both took place near to the sea, so it could be that maritime conditions (e.g. higher salinity, higher wind speeds) are encouraging bramble growth or having a negative effect on the amount of heather available.

Dr. C.J. Cadbury, speaking personally to Bibby and Tubbs (1975), said that bramble may be acceptable to Dartford warblers as an alternative dwarf scrub in place of heather at sites in the Channel Islands, an idea backed up by Cramp et al. (1992). This fact could account for the “discrepancy” seen, with almost no heather found, and more bramble than expected (see Figure 4.3 – Pie Chart A).

Bare

Bare soil was not found to be statistically significant (p = 0.229), but this is interesting since several control quadrats were located near cliff edges and so contained a majority of bare rock. The high p value suggests there is not much difference between the two populations of data, which means that Dartford warbler territories contain a similarly important amount of bare soil.

Bare soil is suspected to be important to Dartford warblers, since one study estimated that Dartford warblers hunt here 20.1% of the time, and more than three times this amount (64.5%) whilst following Stonechats, perhaps due to the Stonechat indicating a good search area for insect prey (Zamora et al. 2002). In that study, they were seen to follow Stonechats 27.1% of the time, which is not insignificant, so it follows that bare soil is useful to have nearby. Stonechats are resident on Alderney (Alderney Wildlife Trust 2007).

Van den Berg et al. (2001) unexpectedly discovered that the area of bare ground inside a territory was an “important and ubiquitous” (p. 225) factor in territory selection. This suggests that the findings in the current study are related to the findings from van den Berg even though relatively little was found amongst Dartford warbler quadrats (approximately 3.8% by area). Even so, this figure was greater than the figure for heather, so further study is needed to fully understand the relationship Dartford warblers have with areas of bare ground.

Bracken and Grass

Catchpole and Phillips (1992) found small amounts of bracken or grass in 12 of 37 territories (32.4%). In the current study, bracken was found in only 2 of 11 (18.1%) territories, while grass was found in 8 of 11 (72.7%) territories. Bracken had a Domin score of 10 in 3 of the 4 territory quadrats it was found, while grass was found in small but not insignificant areas in several territory quadrats. Bracken was not found to be significant, probably due to its abundance over the Giffoine, but grass was. Large areas of grass will be unfavourable to a Dartford warbler since it offers no protection from predators and very few insects by itself. However, small amounts will be useful for similar reasons to the bare category (see above).

Vegetation height

The most obvious finding from the height survey is that Dartford warblers like tall (> 60 cm) vegetation to form the majority of their territory. Figure 4.5 (Pie Chart C) shows that on average, it actually makes up 79.0% of their territory.

This finding was not unexpected, as others, e.g. van den Berg (2001) have already recognised tall vegetation as being important. Gorse by itself provides a source of prey, protection from predators and shelter from the elements (Murison et al. 2007). A taller gorse bush will therefore provide more of these things and so will be more attractive to a Dartford warbler looking for a breeding territory.

There is also an amount of > 60cm vegetation in the control sample, with a lot of it having Domin score 10. The survey sheets show this is mostly gorse, with tall bracken found too.

The results from the height survey also show that while Dartford warblers did not have territories in large areas of short vegetation, they preferred to be among small patches of it, especially vegetation 20cm or shorter. This relates back to van den Berg et al. (2001) who said Dartford warblers need short and bare patches to feed in.

The overall trend for short vegetation is not as clear as it could be, since any quadrats containing bare rock or soil would be registered as being ≤ 20cm, when actually there was no vegetation there at all. This can misrepresent what is there and confuse the issue, especially the comparison of Dartford warbler and control quadrats. These areas should really have been recorded as a separate category, “absent”. In control quadrats, this would probably give the “absent” category a value somewhere between the 21-40cm and 41-60cm categories, leaving the ≤ 20cm category just over the > 60cm category.

Chapter 6: Recommendations for further study

It would seem that more confirmation of these unexpected results is needed before any definite management recommendations can be made to preserve the habitat. Although Gibbons and Wotton (1996) estimated that the first three visits to a site will find 94% of all Dartford warbler territories, this study only found 11 pairs when the year before 19 pairs were found. This could be due to the author's relative inexperience in surveying or it could reflect an actual change. More surveys are needed to determine this.

The surveys should be started in early April and continue until late June. They should be performed regularly, perhaps 3 a week when weather conditions suit, so that the entire Giffoine is surveyed regularly. The surveyor must be experienced with bird song – several times the author thought a Dartford warbler was singing and it turned out to be a Whitethroat. If the surveyor is good enough they could map Dartford warblers without needing visual confirmation too. This could extend the range that it would be possible to recognise and confirm a Dartford warbler, possibly increasing the number mapped.

More measurements need to be taken outside Dartford warbler territories to cover the same area proportionately as the area inside the territories.

The vegetation bandings were also a bit limited. For example, Dartford warblers could actually prefer vegetation taller than 1.5m, which in this study would still be recorded as > 60cm. However, with more bandings there is the risk of making it too specific. Therefore as the heights increase, they should become broader to reflect the difficulty of accurately measuring the height of lots of tall vegetation.

It is suspected by van den Berg et al. (2001) that Dartford warblers show “density-dependent habitat selection” (p. 218) and as the population is liable to fluctuate, this could influence the apparent habitat preference. Therefore these surveys

should be conducted regularly so as to include both high- and low-population years.

During research for this project, the author found that the majority of Dartford warbler research was in England, usually in Hampshire and Dorset. This could be a language issue, however, as the author is unlikely to encounter research in other languages. Nevertheless, any research that has been conducted in other countries should be collected and coordinated, and it should be established whether or not Dartford warbler habitat in other countries is under threat as it is in the UK, and recommendations made based on these findings. It is known that Dartford warbler habitat is not constant throughout its range (van den Berg et al. 2001) so the information from the UK cannot simply be extrapolated. Further studies are needed throughout the Dartford warblers' range to discover differences in its preferred habitat.

The results from Alderney suggest that the Dartford warblers' habitat preferences are similar to those in the UK, aside from heather which is the main difference. However, it cannot yet be determined if this difference really is there or if the survey design needed more data input, and so further studies are needed. The same methodology could be applied to the two other large Channel Islands, Guernsey and Jersey, to see how the preferences of their Dartford warblers differ. This link could be set up by the Alderney Wildlife Trust with its counterparts, La Société Guernesiaise and La Société Jersiaise.

Chapter 7: Conclusions

Dartford warblers are territorial and site tenacious, and therefore have a close relationship with the land they live on. They have a small breeding range, in fact the smallest world range of the UK's breeding birds, though they have expanded in the Channel Islands since the 1950s.

In Dorset, van den Berg found three vegetation type factors that Dartford warblers looked for in their territories. These were the areas of heather, gorse, and bare soil. In Alderney, gorse was found to be very significant, with the evidence of the need for small amounts of bare ground also being arguable. Heather was almost entirely absent which was unexpected. Bramble may be serving as an alternative to the heather, although the only mentions of this happening are from the 1980s on the Hampshire coast. Nevertheless, these maritime conditions may be contributing, and a specially designed study could establish whether or not they are. None of these suggestions are conclusive by themselves and so further study is recommended.

Dartford warblers also preferred large areas of vegetation that was taller than 60cm, with smaller amounts of vegetation that was shorter than 21cm. The heights between these values were not significant. This reflects the warblers' need for protection from predators and the elements for themselves and their nests, but also their need for short vegetation to hunt amongst.

References:

van den Berg, L.J.L. et al. (2001) *Territory selection by the Dartford warbler (*Sylvia undata*) in Dorset, England: the role of vegetation type, habitat fragmentation and population size*. Biological Conservation **101**, pp. 217–228.

Alderney Wildlife Trust (2007) *Alderney Bird List* [online]. Last accessed 1st April 2008 at: http://www.alderneywildlife.org/html/birdslist.php

Bibby, C.J. (1977) *Dartford Warblers in Britain*. PhD thesis, RSPB/Institute of Terrestrial Ecology.

Bibby, C.J. (1978) *Conservation of the Dartford warbler on English Lowland Heaths: a review*. Biological Conservation **13**, pp. 299–307.

Bibby, C.J. (1979a) *Breeding biology of the Dartford warbler* Sylvia undata *in England*. Ibis **121**, pp. 41–52.

Bibby, C.J. (1979b) *Mortality and Movements of Dartford warblers in England*. British Birds **72**, pp. 10–22.

Bibby, C.J. and Tubbs, C.R. (1975) *Status, habitats and conservation of the Dartford warbler in England*. British Birds **68**, pp. 177–195.

Birdlife International (2004) *Birds in the European Union: a status assessment* [online]. Last accessed 21st January 2008 at: http://www.birdlife.org/action/science/species/birds_in_europe/birds_in%20_the_eu.pdf

Bonnard, B. (2007) *The Wild Flowers of Alderney* [online]. Last accessed 27th December 2007 at: http://www.flora.org.gg/AldFlora02.pdf

BTO (2007) *Birds of Conservation Concern 2002-2007: Amber List Species* [online]. Last accessed 19th December 2007 at: http://www.bto.org/psob/amberlist.htm

Catchpole, C.K., and Phillips, J.F. (1992) *Territory quality and reproductive success in the Dartford warbler* Sylvia undata *in Dorset, England*. Biological Conservation **61**, pp. 209-215.

Cocker, M. and Mabey, R. (2005) *Birds Britannica*. London, Chatto & Windus.

Cody, M.L. and Walter, H. (1976) *Habitat Selection and Interspecific Interactions among Mediterranean Sylviid Warblers*. Oikos **27**, (2), pp. 210-238.

Combridge, P. and Christie, D.A. (2002) *Dartford Warbler eating fruit*. British Birds **95**, pp. 457–458.

Constant, P. and Maheo, R. (1970) *L'avifaune niches d'une lande xerophile be Bretagne*. Terre et Vie **117**, p. 346.

Conway, G. et al. (2006) *Moving with the times... 2006 Woodlark and Dartford Warbler Surveys*. BTO News **270**, pp. 12–13.

Cramp, S. et al. (1992) *Handbook of the Birds of Europe, the Middle East and North Africa: The Birds of the Western Palearctic*. *Volume VI: Warblers*, pp. 317–329. Oxford, Oxford University Press.

English Nature (2002) *Lowland heathland: a cultural and endangered landscape* [online]. Last accessed 11th of January 2008 at: http://www.english-nature.org.uk/pubs/publication/PDF/heathland.pdf

English Nature (2003) *The Scrub Management Handbook: Guidance on the management of scrub on nature conservation sites*. West Yorkshire, Forum for the Application of Conservation Techniques (FACT). Available online at: http://www.english-nature.org.uk/pubs/handbooks/upland.asp?id=8

Gibbons, D.W. and Wotton, S. (1996) *The Dartford warbler in the United Kingdom in 1994*. British Birds **89**, pp. 203–212.

Gilbert, G., Gibbons, D.W. and Evans, J. (1998) *Bird Monitoring Methods - A Manual of Techniques for Key UK Species*. Sandy, Royal Society for the Protection of Birds.

Gimingham, C.H. (1975) *An Introduction to Heathland Ecology*. Edinburgh, Oliver & Boyd.

Holling, M. and the Rare Breeding Birds Panel (2007) *Rare Breeding Birds in the United Kingdom in 2003 and 2004*. British Birds **100**, pp. 321-367.

Humphries, C.J. and Shaughnessy, E. (1987) *Gorse.* Aylesbury, Shire Natural History.

Jenness, J. (2005) *Random point generator extension for ArcView 3.x, v. 1.3*. Jenness Enterprises. Last accessed 22nd June 2007 at: http://www.jennessent.com/arcview/random_points.htm

Lawrence, N. (1999) *The Alderney Society Bird Records* [database]. Available on request from the Alderney Society Museum on (01481) 823222.

Long, R. (1981) *Review of Birds in the Channel Islands, 1951-1980*. British Birds **74**, pp. 327–344.

Marchant, J.H. (1983). *Common Birds Census instructions*. Tring, British Trust for Ornithology.

Moore, N.W. (1962) *The Heaths of Dorset and their Conservation*. The Journal of Ecology **50**, (2), pp. 369–391.

Murison, G. et al (2007) *Habitat type determines the effects of disturbance on the breeding productivity of the Dartford warbler* Sylvia undata. Ibis, **145**, pp. 16–26

Office for National Statistics (2001) *Neighbourhood Statistics: Sheffield Population Density* [online]. Last accessed 4th April 2008 at: http://neighbourhood.statistics.gov.uk/dissemination/LeadTableView.do?a=3&b=276794&c=sheffield&d=13&e=16&g=365736&i=1001x1003x1004&m=0&r=1&s=1207319909566&enc=1&dsFamilyId=789

Rare Breeding Birds Panel (2007) *Annual RBBP Reports* [online]. Last accessed on 1st April 2008 at: http://www.rbbp.org.uk/rbbp-reports.htm

Robins, M. and Bibby, C.J. (1985) *Dartford warblers in 1984 Britain*. British Birds, **78**, pp. 269–280.

Rose, R.J. et al. (2000) *Changes on the heathlands in Dorset, England, between 1987 and 1996*. Biological Conservation **93**, pp. 117–125.

St Pierre, P. (2006) *Alderney Breeding Bird Survey 2005*. Cornwall, RSPB.

States Of Alderney (2007) *Island Life* [online]. Last accessed on 26th June 2007 at http://www.alderney.net/index.php/pid/15

Sutherland, W.J. (ed.) (2006) *Ecological Census Techniques – A Handbook* (2nd edition) [online] Cambridge, Cambridge University Press. Book from Sheffield Hallam University Library Catalogue. Last accessed 13th June 2007 at: http://catalogue.shu.ac.uk/record=b1463605a

Tubbs, C.R. (1967) *Numbers of Dartford warblers in England during 1962-1966*. British Birds **60**, pp. 87-89.

Veron, P.K. (ed) (1997) *Important Sites for Birds in the Channel Islands*. Guernsey, La Société Guernesiaise.

Webb, N.R. (1986) *Heathlands*. Collins, London.

Webb, N.R. (1990) *Changes on the Heathlands of Dorset, England, between 1978 and 1987.* Biological Conservation **51**, pp. 273–286.

Webb, N.R. and Haskins, L.E. (1980) An Ecological Survey of Heathlands in the Poole Basin, Dorset, England in 1978. Biological Conservation **17**, pp. 281-296.

Webb, N.R. and Hopkins, P.J. (1984) *Invertebrate Diversity on Fragmented* Calluna *Heathland*. Journal of Applied Ecology **21**, pp. 921-933.

Westerhoff, D. and Tubbs, C.R. (1991) *Dartford Warblers* Sylvia undata*, Their Habitat and Conservation in the New Forest, Hampshire, England in 1988.* Biological Conservation **56**, pp 89-100.

Witherby, H.F. et al. (1938) *The Handbook of British Birds*. London.

Wotton, S. (2006) *Dartford Warbler survey instructions 2006*. Available from author

Wotton, S. (2007) *Heathland birds are doing well*. RSPB Birds, **21** (8), p. 17.

Zamora, R., Hodar, J.A., and Gomez, J.M. (1992) *Dartford warblers follow Stonechats while foraging*. Ornis Scandinavica **23**, pp. 167-174.

Bibliography

Hinton, P.R. et al. (2004) *SPSS Explained*. London, Routledge.

Kent, M. and Coker, P. (1992) *Vegetation Description and Analysis: A Practical Approach*. Chichester, John Wiley and Sons, 1999.

Moore, D.S. (2007) *The Basic Practice of Statistics* (4th ed.) New York, W.H. Freeman and Company.

Appendix A: Number of quadrats with Domin score in **Dartford warbler** quadrats – **vegetation types**

Domin	Gorse	Heather	Bracken	Bramble	Grass	Bare	Other
10	10	0	3	3	0	0	0
9	6	0	0	1	0	0	0
8	8	0	0	1	0	0	0
7	5	0	1	2	1	1	1
6	3	2	0	1	4	1	1
5	1	2	0	4	1	2	1
4	0	1	0	3	3	4	1
3	0	0	0	1	3	5	0
2	0	0	0	1	0	0	0
1	0	0	0	4	1	0	0

Appendix B: Number of quadrats with Domin score in **control** quadrats – **vegetation types**

Domin	Gorse	Heather	Bracken	Bramble	Grass	Bare	Other
10	6	0	3	0	9	2	1
9	4	0	1	0	4	2	2
8	0	0	1	2	0	3	1
7	0	0	0	2	0	1	4
6	2	0	2	3	2	1	2
5	3	0	0	1	3	0	1
4	4	0	0	3	4	2	1
3	0	0	1	1	0	6	0
2	0	1	1	0	0	0	1
1	1	0	0	3	1	0	0

Appendix C: Number of quadrats with Domin score in **Dartford warbler** quadrats – **height** bands

Domin	≤ 20cm	21-40cm	41-60cm	> 60cm
10	0	0	0	24
9	0	0	0	3
8	2	1	1	6
7	1	1	1	3
6	6	0	2	1
5	2	3	3	2
4	2	2	2	0
3	4	6	4	1

Appendix D: Number of quadrats with Domin score in **control** quadrats – **height** bands

Domin	≤ 20cm	21-40cm	41-60cm	> 60cm
10	16	3	0	10
9	0	0	0	0
8	2	3	0	1
7	5	0	2	3
6	3	1	0	0
5	1	2	1	1
4	0	1	0	1
3	3	7	2	1

Note: there are no Domin scores 1 or 2 in the height tables as the height and not the type was being recorded so the number of individuals is irrelevant. An estimate of < 4% was simply recorded as a score of 3.

Appendix E: Dartford warbler survey information

Visit	Area	Date	Start time	End time	Time of dawn	Conditions	Minutes taken	Distance walked (m)	Pairs	Singing individuals	Calling individuals
Visit A	Giffoine A	16th May 07	0655	1055	0526	15mph NW - Sunny/overcast	240	4815	1	1	3
Visit B	Giffoine B	22nd May 07	0728	1111	0519	6 mph N - Sunny	223	5017	-	1	-
Visit C	Giffoine C	23rd May 07	0703	1201	0518	8mph N - Sunny	298	5933	-	1	-
Visit D	Giffoine A	6th June 07	0620	0955	0506	16mph NE - Overcast and cold	215	6373	-	-	1
Visit E	Giffoine B	13th June 07	0630	0945	0503	7mph S - Sunny/overcast	195	4756	-	-	-
Visit F	Giffoine C	20th June 07	0711	1040	0501	18mph S - sunny	209	5967	1	-	-
Visit G	Giffoine A	21st June 07	0755	1230	0501	21mph S - sunny/overcast	275	6140	-	1	1
Visit H	Giffoine B	26th June 07	0715	1030	0502	23mph NW - overcast/sunny	195	4160	-	2	-
Visit I	Giffoine C	28th June 07	0720	1131	0503	17mph SW - sunny/overcast	251	5618	2	1	-

- Wind speed and direction were taken after completion of the survey from http://www.windfinder.com
- The distance walked was taken from ArcView by plotting the path taken during that survey

Appendix F: Mann-Whitney *U* test on vegetation type

	gorse	heather	bracken	bramble	grass	bare	other
Mann-Whitney *U*	456.000	877.500	952.500	827.000	663.500	846.500	759.000
Wilcoxon *W*	1446.000	1867.500	1942.500	1817.000	1653.500	1836.500	1749.000
Z	-4.437	-1.729	-.188	-1.322	-2.856	-1.202	-2.532
Asymp. Sig. (2-tailed) (*p*)	**0.001**	0.084	0.851	0.186	**0.004**	0.229	**0.011**

- **bold** indicates where $p < 0.05$

Appendix G: Mann-Whitney *U* test on vegetation height

	≤ 20 cm	21 - 40 cm	41 - 60 cm	> 60 cm
Mann-Whitney U	471.000	801.500	730.500	370.000
Wilcoxon W	1374.000	1704.500	1676.500	1316.000
Z	-3.999	-1.048	-2.124	-4.940
Asymp. Sig. (2-tailed) (*p*)	**0.001**	0.295	**0.034**	**0.001**

- **bold** indicates where $p < 0.05$

Appendix H: Dartford warbler population in the UK (sources in text)

Year	Total Dartford warbler pairs	**Year**	Total Dartford warbler pairs
1960	460	**1984**	440
1961	460	**1985**	316
1962	60	**1986**	308
1963	11	**1987**	247
1964	12	**1988**	639
1965	22	**1989**	522
1966	22	**1990**	928
1967	–	**1991**	701
1968	–	**1992**	926
1969	–	**1993**	1146
1970	70	**1994**	1675
1971	–	**1995**	1679
1972	–	**1996**	552
1973	220	**1997**	915
1974	560	**1998**	947
1975	560	**1999**	1747
1976	350	**2000**	1925
1977	350	**2001**	1203
1978	206	**2002**	1547
1979	116	**2003**	1225
1980	277	**2004**	1496
1981	119	**2005**	–
1982	312	**2006**	3208
1983	148		