Biodiversity Perception and Value in UK Protected Areas

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This thesis is submitted in candidature for the degree of a Master of Science

Declaration

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Abstract

There is a wealth of literature on people's opinions, perceptions and economic valuations of particular species, but very few studies that focus on public opinion of biodiversity as a whole. In particular, the public's ability (or inability) to perceive species richness within protected areas (PA's) has received little attention.

This study is based on three data sets from a subset of six, eight and seventeen PA's within the UK. It investigates how accurately PA visitors can estimate the species richness of birds and butterflies in each PA. It also explores visitors' motivations for visiting particular PA's, and their economic valuation of biodiversity within PA's, using contingent valuation methods, and the travel cost method. Moreover, this study uses generalised linear models to explore variations in visitor patterns to PA's based on biodiversity related, and non-biodiversity related predictor variables. Visitors to the PA's sampled had an accurate perception of the numbers of bird and butterfly species, and were primarily visiting for biodiversity related reasons. Biodiversity was considered important regardless of the actual level of biodiversity within the PA. Initial exploration of visitor data indicated that the most important factor in influencing visitation across reserves during the breeding season was the presence of rare bird species. Furthermore, the amount that visitor's were willing to pay to visit PA's, the amount they spent, and their travel costs all increased logistically as biodiversity increased.

Although this study is based on only a few protected areas, and, therefore, cannot be used as a direct measure of the public's perception or valuation of biodiversity across the UK, it does indicate that visitors to the areas sampled have a fairly accurate perception of biodiversity, and consider biodiversity important when visiting reserves. Therefore, an increase in biodiversity within a PA could potentially justify an increase in entrance fee. Finally, the finding that that visitor spending, in both the PA and surrounding area, increased as biodiversity rose, could be an important discovery with regards to building additional support for biodiversity conservation from people and businesses local to PA's.

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CHAPTER ONE: INTRODUCTORY CHAPTER

1.1 Introduction to Thesis: The Perceived value of Biodiversity in the UK

This project explores the motivation of visitors to a small subsection of protected areas (PA's) in the UK that encourage visitation. It examines whether there is a connection between PA's biodiversity and visitor numbers, the accuracy of visitors' perceptions of biodiversity, and their economic valuation of biodiversity. This project also investigates whether reserves with greater biodiversity generate more revenue. These issues will be explored by analysing visitor numbers for 17 Royal Society for the Protection of Birds (RSPB) reserves in the UK. Additionally, visitor questionnaires have been conducted across 8 reserves (a mixture of RSPB and other reserves) across the UK. The main aims of this study are to establish:

- Why people visit reserves,
- Whether visitor numbers and the distance that people travel to visit reserves relate to its biodiversity,
- The accuracy of visitors' perceptions of biodiversity,
- Whether revenues generated by reserves is related to biodiversity,
- The value of PA visitor revenue to the local economy.

1.2 Literature Review: The Public Perception of Biodiversity

1.2.1 Introduction to protected areas

Protected areas, (PA's) operate under a range of objectives, regimes and authorities. Most share a common goal: the effective conservation of biodiversity (Emerton *et al.* 2006). The International Union for Conservation of Nature (IUCN) defines a PA as: "An area of land and/or

sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means." (Dudley 2008). This definition outlines the focus on biodiversity as well as the importance of management and cultural resources of PA's. One of the fundamental purposes of PA's is to maintain a selection of local biodiversity within their boundaries. This protects species from external processes which may threaten their existence (Margules & Pressey 2000). However, the primary focus and function of PA's can vary greatly. The ecological conditions within a PA determine its function (i.e. how it protects biodiversity) along with its management objectives and socioeconomic context (Munasinghe & McNeely 1994).

Biodiversity plays a vital part in regulating functions through the ecosystem services that it provides. Ecosystem services are defined as the benefits that people obtain from ecosystems (Millennium Ecosystem Assessment 2005). These include provisional services such as food, regulatory services that affect climate, floods, disease and more, cultural services such as aesthetic beauty and recreation and supporting services, such as soil formation and nutrient cycling. Although the human species tries to buffer itself from environmental change using culture and technology, we are still fundamentally dependent on the flow of ecosystem services. The cultural services that PA's provide to humans have long been recognised. The National Park Committee set out objectives for National Parks in 1931, which included "to improve means of access for pedestrians to areas of natural beauty" (Sheail 1975). More recently, the international treaty, "The Convention of Biological Diversity", (1992) required its signatory nations to promote public awareness of biodiversity through developing education programmes, which emphasize the importance of biodiversity (Booth *et al.* 2009).

It is important for organisations, such as the RSPB, to understand why people visit their reserves so they can cater for their visitors' needs. The challenge is to do this without compromising

biodiversity conservation. If visitors prefer reserves with greater biodiversity then satisfying public need and conserving biodiversity may not be a compromise. Moreover, it is essential to understand why people visit reserves, and to maximise revenue in order to make them economically viable. This is especially important during the current economic climate due to the cuts that have been made to environmental departments. This means that there is an even greater need for reserves to be privately or self financed and for reserve managers to be able to prove the economic benefits of reserves to all levels of government.

1.2.2 Historical Background of Protected Areas

Maintaining the intrinsic values of natural areas by setting them aside has occurred for millennia (Chape *et al.* 2005). Yellowstone National Park, USA, was the first National Park (NP), formally established in 1872 (McNeely 1994). National Parks are a subset of PA's that are protected because of their beautiful countryside, wildlife and cultural heritage (National Parks, Britain's Breathing Spaces 2012). The management of PA's and conservation science has developed enormously since the 1960s (Chape *et al.* 2005). The establishment of PA's dramatically increased in 1970, peaking between 1985-95 (West *et al*. 2006). It is now widely recognised that the aims and importance of PA's and NP's are far more extensive than their initial focus on species and habitat conservation (Chape *et al.* 2005). Additionally, the missions of PA's have also expanded. PA's in the developing world are now expected to directly contribute to issues which are not directly linked to biodiversity conservation, such as poverty reduction and national development (Naughton-Treves *et al.* 2005). Currently PA's have varying management objectives. These objectives include: scientific research; preservation of wilderness, species and ecosystems; maintenance of environmental services; protection of natural or cultural environments for tourism, recreation and education (Green & Paine, 1997).

This literature review will examine the public's knowledge and opinions of biodiversity, as well as their economic valuation of biodiversity. Additionally, it will provide further support for the importance of PA's in ecological conservation. Finally, it will summarize the importance of incorporating public valuation in PA management and highlight the relevance of this study and how it occupies a current gap in the literature. Specific points that will be covered include: an introduction to the Royal Society for the Protection of Birds, the importance of PA's, the public's understanding and valuation of biodiversity and methods of data collection used by other researchers. The section on environmental economics will discuss PA funding and how PA's are economically valued, for example using the cost valuation method and the travel cost method.

1.2.3 Introduction to the Royal Society for the Protection of Birds (RSPB)

The RSPB is one of the largest conservation organisations in Europe, and currently has over 1 million members. It is also the largest landholding conservation organisation in the UK (Garrod & Willis 1994), owning and managing over 200 nature reserves. Membership numbers are important for the RSPB, because a higher membership base increases their funding and influence. The work of the RSPB focuses on both species and habitats, although bird conservation is their primary concern. Because the RSPB's funding relies largely on membership, it is dependent on strong public relations and encouraging their members' interest in nature, as well as biodiversity conservation. Membership is on a sliding scale, where members pay as much or as little as they are willing for monthly membership. The suggested amount for adults is £3 per month. Because the RSPB is a charitable organisation that is primarily funded by membership, it is important for the RSPB to understand the needs and motivations of those members in order to maintain and increase membership.

1.2.4. The Importance of Protected Areas

Specific PA's are established for a variety of reasons, such as the preservation of a particular species, habitat, landscape or population. However, as an aggregate the role of PA's is to conserve specific biodiversity for the future (Gaston *et al.* 2006). There is an abundance of research on the importance of PA's in conserving biodiversity (Splash & Hanley 1995; Bruner *et al.* 2001; Rodrigues *et al*. 2004; Chape *et al.* 2005; Naughton-Treves *et al.* 2005). Some PA's focus on particular flagship species, such as the Komodo dragon (*Varanus komodoensis*) in the Komodo National Park, Indonesia (Walpole *et al.* 2001), or the African "Big Five" mammal species: lion *Panthera leo,* African elephant *Loxodonta africana*, cape buffalo, *Syncerus caffer*, leopard *Panthera pardus* and the black rhinoceros *Diceros bicornis* in the Kruger National Park, South Africa (Williams *et al.* 2000). Flagship species are charismatic megafauna used to attract visitors, and to promote conservation concerns to the public. Flagship species have a purely socioeconomic role: to raise public awareness, support and funds (Walpole & Leader-Williams 2002). The focus on prioritising conservation of flagship species has been criticised for being narrow and mammal-centric (Entwistle 2000). This has resulted in a public misconception that the role of mammals in biodiversity is disproportionately important (Snaddon *et al*. 2008). Walpole and Leader-Williams (2002) believe that PA's should exploit the public's affinity for large, charismatic animals in order to increase their funding pool and, thus, further conservation. The RSPB utilize flagship species to target and engage their market. For example, the RSPB website lists the "star species" that can be found at each of their reserves, as well as "seasonal highlights" (RSPB 2010). The star species at Minsmere are the pied avocet, *Recurvirostra avosetta*, bearded tit, *Panurus biarmicus*, bittern, *Botaurus stellaris*, marsh harrier, *Circus aeruginosus* and nightingale, *Luscinia megarhynchos*. Minsmere's seasonal highlights include avocets returning to breed and booming bitterns (RSPB, 2010).

Despite the recognition that conserving biodiversity is one of, if not the most important role of PA's, there have been very few studies that explicitly deal with how effectively they conserve biodiversity (Gaston *et al.* 2006). Chape *et al.* (2005) investigated the ability of PA's to monitor the success of biodiversity conservation initiatives. In order to fulfil this important role effectively, PA's must have a globally standardized monitoring methodology. Currently there are significant inaccuracies in the effective management of the global PA network due to discrepancies or a complete lack of PA monitoring (Gaston *et al.* 2006). Unlike many countries, the United Kingdom enforces a common standard for monitoring for sites of special scientific interest (SSSI), requiring the site condition of SSSI's to be documented every six years. Despite utilising this standard of monitoring there are still limitations, primarily maintaining consistency of monitoring over space and time and ensuring that assessment is standardised (Gaston *et al*. 2006). Furthermore, these measures only apply to SSSI's, and therefore are not required for other PA's.

Rodrigues *et al*. (2004) believe that the current global network of PA's are not effectively conserving species, demonstrating that the percentage of the area within a country designated as protected is a poor indicator of the additional conservation that the rest of the country requires to conserve biodiversity effectively. They argue that the regions that should expand their PA network with the greatest urgency are usually areas with high levels of endemism. Gaston *et al*. (2006) investigated the ecological effectiveness of protected areas in the UK. They found that there is currently a good understanding of the effectiveness of PA's in maintaining biodiversity within individual reserves, or reserve portfolios (collections/groups of PA's), while little is known of their effectiveness within whole PA networks.

The lack of published research into how effective PA's are at conserving biodiversity globally is due to a paucity, or complete absence of systematically collected data, particularly on species

abundance and biodiversity within PA's (Gaston *et al.* 2006). For example, data collected at separate reserves are often at different spatial resolutions. Therefore, although data can be analysed at each reserve, it cannot be used to make effective comparisons between reserves. Similar problems with a lack of standardisation off data collection are associated with several aspects of PA function, including visitor numbers. For example, the RSPB formerly had no standard approach for collecting visitor data. This led to the introduction, in some reserves, of standardised methods to record visitor data from April 2009 onwards; the intention being to expand these methods across all of their reserves (see Chapter two).

In addition to their primary role of conserving biodiversity, PA's are also important because of their cultural and social values (Munasinghe & McNeely 1994; Chape *et al.* 2005). Increasingly, society is relying on PA's as the means for people to see, understand and experience nature and have access to biodiversity (West *et al.* 2006); this is particularly the case in the developed world. It is important that people have access to natural landscapes because of the impacts that nature biodiversity (Ulrich 1984; Fuller *et al.* 2007) have on physiological and psychological wellbeing. Activity in the presence of nature, known as "green exercise", has been shown to lead to both short and long term health benefits over and above those accrued from exercise not in the presence of nature (Barton & Pretty 2010), including improvement in self-esteem and mood. The presence of water in green spaces can amplify these effects. Improved self esteem and mood are indicators of mental health, and mood is known to have a positive effect on the immune system and can delay the onset of certain diseases (Manuck *et al.* 2004).

Despite the evidence for health benefits of experiencing and exercising in green space, it remains hard to value health as an environmental service (Barton *et al.* 2009). Therefore, scientific findings have not led to a change in the planning of urban and natural environments, priorities for public health or social care (Barton & Pretty 2010). Additionally, while the beneficial effects

of exposure to nature have been widely recognised, little research has focused on the importance of green space "quality" (as measured by diversity) to achieving these effects (Fuller *et al.* 2007). Fuller *et al.* explored this, and concluded that within their study sites there were measurable positive associations between the species richness of the green spaces and the wellbeing of their visitors. The physical and psychological health benefits of biodiversity are relevant to the current study because participants' reasons for visiting nature reserves are being analysed. Respondents may consciously, or subconsciously, be visiting the nature reserve to experience the psychological or physical health benefits they receive from the green space, rather than to observe particular habitats or species.

As well as conserving biodiversity, there are also non-use and moral arguments for maintaining PA's, such as to conserve their cultural and aesthetical benefits for future generations (Munasinghe & McNeely 1994; Garrod & Willis 1997). Non-use values assess the fulfilment people get from a protected area without having any direct use of it. Non-use values include socioeconomic values such as the existence value: the satisfaction of knowing the resource exists, and bequest value: the satisfaction of knowing that the resource will be protected for future generations (Walsh *et al.* 1984). All of these values contribute to the total economic value, as illustrated in figure 1.2.4. However, some researchers, such as Munasinghe & McNeely (1994), believe that these socioeconomic benefits will always be supplementary and cannot replace the intrinsic natural value of species conservation for its own sake. Furthermore, Pearce and Warford (1993) reported that environmental degradation has the most important and immediate consequences on human health. These studies and the diagram of The Total Economic Valuation Framework (figure 1.2.3) demonstrate the importance of looking beyond just the market price when valuating environmental resources as the market price alone cannot represent the true social benefits of ecosystem services.

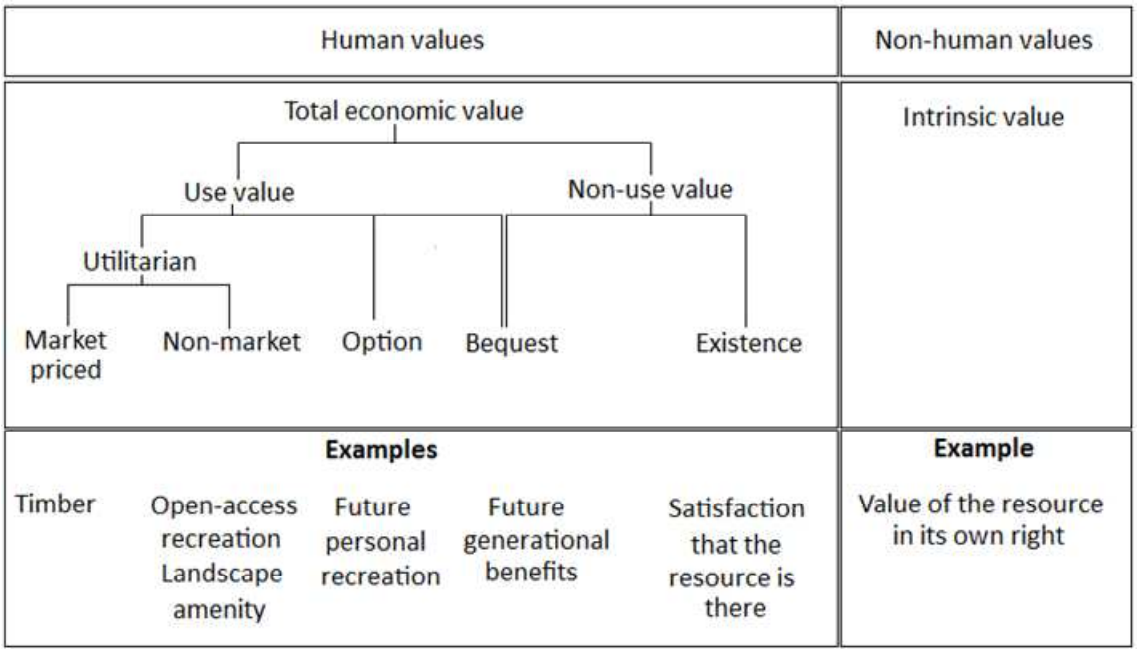


Figure 1.2.4 A diagram of the Total Economic Valuation framework (Bateman *et al*. 2003).

1.2.5 The Public's Understanding and Valuation of Biodiversity

According to Wilson's Biophilia Hypothesis humans have a need to associate with the natural environment, especially living biota (Kellert & Wilson 1993). Wilson believes that an affinity for nature is inherent, part of our evolutionary history. The studies reviewed in this section support this, they conclude that, although the public's knowledge of nature and biodiversity is often lacking, people still feel biodiversity conservation is important.

Numerous studies document the public's views and understanding of the definition of biodiversity. Hunter and Brehm (2003) found that thirty percent of surveyed respondents demonstrated a fairly "complete" understanding of biodiversity. Although several other participants could not provide a concise definition, they realised that biodiversity was related to ecological issues. Other surveys have found that only twenty six percent of respondents had heard of the term biodiversity, yet fifty two percent of these considered biodiversity protection

‘very important’ (DEFRA 2002). This supports the idea that although the public may not have a comprehensive understanding of the term biodiversity, they still value its conservation. Biodiversity is a relatively new ecological term (Hunter & Brehm 2003). Christie *et al.* (2006) identified eleven different concepts which ecologists commonly use to define biodiversity. Therefore it is understandable that the majority of the public do not yet fully comprehend the actual meaning of biodiversity.

It is apparent that some demographic groups have a greater knowledge of biodiversity than others. Splash & Hanley (1995) asked focus groups of students and the general public “What does the word ‘biodiversity’ suggest to you?” The most popular words used by students were: ‘species’, ‘different’, ‘biological’, ‘plants’ and ‘diversity’; by contrast, the most popular words used by the general public were: ‘don’t know’, ‘haven’t got a clue’ and ‘nothing’. Kellert (1985b) found that whilst the public has a vague knowledge of wildlife, most individuals’ knowledge of nature generally lacks scientific detail. Personal interviews were conducted with a random sample of 2455 Americans who were divided into twenty one demographic groups. During the interviews respondents were questioned about their knowledge and attitude towards animals. Participants were given a knowledge scale score (from 0-100) based on their answers to animal knowledge questions, which were laid out in a true or false format. Knowledge questions covered a variety of areas, including the biological characteristic of animals, taxonomy, superstition/folklore, domestic animals, endangered species and the interactions between humans and animals. Questions which might have given demographic groups such as hunters or birdwatchers an advantage were excluded. Bird watchers resulted as having the greatest wildlife knowledge, and, as a group scored 68.3 on a 1-100 scale (Kelert 1985b). The group “general public” had the poorest understanding of biodiversity, scoring 52.9 out of 100 as a group. However, both Kellert (1985b) and Splash and Hanley’s research (1995) is dated, and general knowledge of biodiversity may have improved since this time. This may be particularly true in

2010 and beyond, as 2010 was declared by the United Nations as the international year of biodiversity (CBD 2009). A sample of British school children showed that they had a sophisticated understanding of rainforest biodiversity (Snaddon *et al*. 2008): when asked to draw their "ideal rainforest", they incorporated several habitat features and a diverse array of animals. However, mammals, birds and reptiles were over represented, whereas insects, annelids and other taxa were under-represented.

Hunter and Ringer (2004) analysed whether an individual's concern for local species diversity was related to their knowledge of the species and environmental perspective. They scored individuals from 1-5 using 0.5 intervals based on their environmental perspective. At the top end of the scale (5) were "ecocentrics", who believe in the conservation of nature for its intrinsic benefits, and the bottom end of the scale (1) were "anthropocentrics", who believe in the conservation of nature for its benefits to humans. Ecocentric and anthropocentric individuals displayed no significant difference in their knowledge of local species, although ecocentric individuals placed greater priority on species' preservation (Hunter and Ringer 2004). Therefore, ecocentric individuals are more concerned with species' preservation than individuals with an anthropocentric perspective, regardless of their knowledge. Kahn (1999) studied children and parents from Houston, Texas, and their attitudes to nature. The majority of children had an anthropocentric view of nature; however, a few children (four percent) did show an ecocentric understanding of nature. Parents valued nature highly, with one hundred percent saying that it was important for people to live in harmony with nature and ninety five percent saying that parks and open spaces were important to their family. Social problems such as pollution, drugs and violence limited access to nature in this region. Parents were also very supportive of environmental education. Despite the drug problems in the area, environmental education was still ranked as a higher priority than drug education.

1.2.6. The Public's Ability to Identify Species

The lack of scientific detail in the public's understanding of wildlife is emphasized by studies that highlight the individuals' inability to distinguish between species. Many of these studies have been based in America. One study found that most Americans are familiar with and can identify hundreds of corporate logos, but that they can accurately name fewer than ten native plant species (Hawken 1993). Additionally, many high school students in Texas were unable to identify extinct or extant locally common mammals. Students were also ignorant about general relationships between urbanisation, habitat loss and species' decline (Adams 1987). UK based studies have similarly shown a lack of knowledge of common organisms. For example, a group of school children aged between four and eleven from ten primary schools in the UK were asked to identify ten types of common British wildlife and ten types of Pokemon (characters from a fictional card trading game) (Balmford & Taylor 2002). The Pokemon characters were largely identified better than common organisms such as badgers and oak trees by children aged 8 and above.

Although research has been conducted on the individuals' ability to identify species, there has been little research concerning their ability to quantify numbers of different species (species richness). One such study (Fuller *et al.* 2007) gave respondents five point scales to choose from:

- For plants: 1 = less than 10 types, 2 = 10-100 types, 3 = 100-300 types, 4 = more than 300 types.
- For birds: 1 = less than 5 types, 2 = 5-14 types, 3 = 15-30 types, 4 = more than 30 different types.
- For butterflies: 1 = less than 4 types, 2 = 4-10 types, 3 = 10-20 types, 4 = more than 20 different types.

Respondents assessed plant numbers with the most accuracy. Fuller *et al*. believed this was because they were visibly static components of the landscape, whereas birds and butterflies were mobile and hence might not be so easy to spot. However, estimating plant diversity involves approximating larger numbers than bird and butterfly diversity. “Numbers are often proposed to be represented spatially as lying along a mental number line” (Longo & Lourenco 2007). This could affect the accuracy of respondents estimation of species richness for taxa such as plants, which are likely to have a greater diversity than birds, butterflies or mammals. It has been established that when estimating numbers, as the magnitude of the number increases, individuals’ ability to discriminate between the two numbers decreases (Longo & Lourenco 2007). This is known as the numerical size effect and there are currently two proposed explanations for this. The first possible cause is that the mental number line is logarithmic, so as numbers increase they lie closer together (Dehaene & Mehler, 1992; Piazza *et al*. 2004). Opposing research supports a linear mental number line: as size increases the numbers become more variable and their representations increasingly overlap (Gallistel & Gelman 1992; Gallistel & Gelman 2000). Both theories maintain that lower numbers are estimated more accurately, therefore, according to the numerical side effect, in my study I would expect that taxa with a lower number of species present should be estimated with greater precision. The majority of study sites utilized in this study are RSPB reserves, which are frequented by birdwatchers. Therefore, I can also hypothesize that bird species may be estimated more accurately than mammals, butterflies and plants as some visitors are likely to have background knowledge of birds. Additional questions were included in the visitor questionnaire to establish the participant’s interest in birds and gauge the level of their prior knowledge.

1.2.7 Environmental Economics

Economic growth can be viewed as both the cause and cure of environmental problems (Hanley *et al.* 2001). The economic and environmental interests of an area are often conflicting, although many economists believe that economic growth provides the money required to conserve nature and lessen environmental problems (Adams *et al.* 2004). Biodiversity conservation can have a negative impact on economic growth, particularly in poverty stricken areas, as establishment of PA's prevents alternative, potentially profitable, land use options (Norton-Griffiths 1995). However, The Economics of Ecosystems and Biodiversity (TEEB) report, 2010, and also the UK National Ecosystem Assessment (UK NEA), 2011 both provide an up-to-date outline the economic benefits that can be generated from ecosystem services, advancing our understanding of their valuation. One aspect the TEEB report focused on was promoting entrepreneurial opportunities as a result of the public being increasing aware of the importance of conserving nature, thus choosing to buy greener products. This section explores the importance of valuating the environment economically and the economic benefits of biodiversity conservation.

The economic valuation of PA's is important because the benefits that society receives from them are often under-estimated, making the cost of protecting an area appear great in comparison (Dixon & Sherman 1991). The economy is made up of markets, where some, but not all, goods and services are assigned a price. The problem with environmental goods and services is that they are difficult to market, leading to market failure. This means that transactions in the economy under-provide these goods to society and fail to deliver the best outcome in terms of total social welfare. Therefore, is it critical that biodiversity and ecosystem services are economically valued so their public goods and services can be defined in the monetary language of the world's dominant economic and political models (TEEB Report 2010). The main remit of

environmental economics is to maximise welfare, and therefore the government should intervene to protect these goods for the benefit of society. However, in the current economic climate where the government are in general reducing intervention levels it is more important than ever that the conservation movement should seek to incorporate these goods into tangible markets, and maximise the private returns from the health, cultural and social benefits that people gain from the environment.

It is difficult to calculate the total economic value of a PA because there may be many contributing factors (outlined in Figure 1.2.4, page 9). For example, use and non-use values, and the revenue generated for the PA itself and for the local area must all be taken into account. Additionally, it is almost impossible to assign numerical figures to certain services, such as the value of ecosystem functions, including decomposition, nitrogen fixation, and the conversion of carbon dioxide into oxygen. Reducing Emissions from Deforestation and Forest Degradation (REDD) is a United Nations collaborative program which is trying to justify the conservation of forest habitat for these reasons. REDD+ (which go beyond deforestation, and also incorporate conservation and the sustainable management of forest habitats) is trying to calculate a financial value for the carbon stored in forests, and is offering incentives to reduce forest emissions (UN-REDD 2009). It has been predicted that the amount offered to countries to reduce their carbon emissions could reach US$30 billion (£18.67 billion) per year (UN-REDD 2009). As well as reducing carbon emissions this money could support development of impoverished areas, and conserve both biodiversity and ecosystem services.

It is also important to calculate the monetary worth of PA's for use in cost benefit analyses. If benefits of conservation regimes are assigned numerical values they can be compared directly with alternative options, such as different uses for the land, for example forestry or agriculture (Hanley *et al.* 2001). However, with the full benefits of PAs' continually being underestimated, it

is difficult to conduct an effective cost benefit analysis. (McNeely 1994). An example of a cost benefit analysis study is Kniivila *et al.* (2002), who analysed the costs and benefits of forest conservation against commercial timber production in Finland. At a regional level, the total market and non-market benefits of forest conservation exceeded the opportunity costs of timber production (Kniivila *et al.* 2002). However, at a local level the cost of conservation exceeded the benefits. This upholds the popular assumption that conservation benefits are largely seen on a regional and national scale, whereas the costs are seen locally (Kniivila *et al.* 2002). Cost-benefit approaches are utilized to determine the optimal balance between public funding and conservation, however few studies have simultaneously considered both the costs and benefits of conservation, particularly in regard to species diversity (Naidoo & Adamowicz 2005). When the value of ecosystem services has been estimated they can be used to justify public spending in PA's.

The UK National Ecosystem Assessment (UK NEA) 2011 was the first analysis of the UK natural environment in terms of the benefits that it provides to society and the nation's continuing prosperity. The project involved in over 500 experts, and culminated in the production of a detailed and lengthy report. In brief, the report details the current state of the UK's ecosystems, explores increasing pressures on ecosystem services, develops sustainable methods to mange ecosystems both presently and in the future, and speculates realistic future environmental scenarios. The main outcomes of the UK NEA include the concept that ecosystems, their services and the ways that people benefit from them are continually changing. Furthermore, the pressure on ecosystems will keep increasing along with the growth of the UK population, which is estimated to rise by 10 million in the next 20 years. Climate change is also likely to accelerate this pressure. Therefore, current actions and decisions will also have consequences on future ecosystems, and hence future human well-being. It is important that these actions are

understood, enabling decisions makers to make the best choices, not just for society now, but also for future generations.

Even though valuing natural resources economically is highly important, it does not capture their whole value. The UK NEA champions the holistic valuation of ecosystem goods. Rather than focusing monetary or social valuation of one particular good or service, the UK NEA takes into account the full range of monetary (market and non-market) and non-monetary values of ecosystem values to individuals and collectively to society. The UK NEA did not pioneer the idea of total economic valuation (discussed further on page 8 and 9); however it has championed the holistic valuation of ecosystem goods and services, arguing that due to the inherit complexity of nature the value of services should not be reduced to individual preferences and motivations alone. The UK NEA has also pioneered new methods of research into valuing aspects of ecosystem services, such as the affect that ecosystems have on health through exploring the relationships between subjective well-being and the natural world. For example, data on instantaneous measures of happiness (mappiness) were collected repeatedly from over 18,000 mobile phone users as part of the study. These were analysed in relation to respondents' location and activity. However, mappiness results were not used in isolation. In order to gain a holistic understanding of ecosystem valuation economic value, health value and shared social value were all incorporated into one to produce a valuation on human well-being.

The RSPB have published several studies on the economic influence on their reserves on surrounding communities (Rayment and Dickie 2001; Shiel *et al*. 2002; Molloy *et al*. 2011), and have found that they can provide significant economic input to the local economy. This effect is exaggerated when reserves are based in rural economies where job opportunities are often limited (Molloy *et al*. 2011). For example, reserves benefit local economies through direct employment, by supporting local suppliers and contractors and by the additionally business

reserves attract to the area through tourism (Rayment and Dickie 2001). Between 2002 and 2009 direct employment at RSPB reserves increased by 80%. Employees and volunteers also spend money in the locality of the reserve, and based on the conservative assumptions in Molloy *et al*.'s study, in 2009 an additionally 61 full time equivalent jobs where created in the UK based on local spend by reserve employees and volunteers. Molloy *et al*. calculated that, based on the assumptions of the study, RSPB reserves are responsible for a total spend of around £66 million per year within local economies.

Once financing is obtained for PA's, determining where funds should be spent is another problem. Millions of pounds have been put towards species' preservation; however, when deciding on resource allocation biological importance, uniqueness and risk are often overpowered by the charisma of megafauna (Garrod & Willis 1997). Additionally, the designation of most existing PA's have been based on the assumption that the environment will remain relatively constant, and contain the same assemblages of species (Graves & Reavey 1996). This assumption may be erroneous (Hole *et al*. 2009) and could mean that areas that are no longer biologically valuable are protected, at the expense of other areas of high biodiversity.

1.2.7.1 The Contingent Valuation Method and the Travel Cost Method

One method for determining the public's value of the environment is to use monetary values to determine how much they would be willing to pay towards nature conservation. Methods of doing this include the Contingent Valuation method (CVM), which includes measuring willingness to pay (WTP) and willingness to accept compensation (WTAC), and the travel cost method (TCM). There is extensive literature on these methods; concerning both their use and analysis. CVM involves directly surveying the public, using questionnaires to estimate the economic value (their WTP) of non-market goods, such as the presence of a particular species (White *et al.* 2001).

According to this method the more a person is willing to pay the more valuable the particular resource is to them (White & Lovett 1999). CVM has been criticised as it measures what people say they would do rather than their actual actions. Bateman and Willis (1999) argue that by asking a hypothetical question and you will receive a hypothetical response. In studies comparing actual WTP to hypothetical WTP (Champ 1997; Duffield 1992), hypothetical WTP was found to be twofold to tenfold higher than actual WTP. Other criticisms of CVM include its bias towards individuals with a high disposable income, who can afford to pay a greater amount than people with a lower disposable income regardless of how highly they value the resource. For example Macmillan *et al.* (1996) analysed WTP to prevent biodiversity loss by acid rain in Scotland. WTP increased with income and the primary reason why people were not willing to pay for the prevention of biodiversity loss was that they simply could not afford to. Bateman *et al*. (2006) found that WTP was also positively correlated with the socio-economic status of the respondents' area of residence. In some cases the use of CVM is not appropriate, for example, Kahn (1999) conducted semi-structured interviews with children and their parents associated with an elementary school in Houston, Texas, asking participants questions on their opinions of nature. The use of CVM in this situation could be considered unsuitable because young children are unlikely to completely comprehend the value of money. Additionally CVM questions may be insensitive in this area because of the widespread poverty.

Furthermore, CVM is not appropriate for absolute beliefs, where the individual believes that the environment has an unconditional right to be protected, irrespective of cost. The participant may value the resource as zero in protest (Hanley *et al.* 2001). There is also ethical unease about asking people to express environmental value as a monetary figure, due to disputes about methodology. Following the Exxon Valdez oil spill in 1989 where CVM was used to determine liability payment, the United States National Oceanic and Atmospheric Administration (NOAA) evaluated the use of CVM in determining non-use values. This led to several guidelines being

published about how studies using CVM should be conducted (Bateman & Willis 1999), which include always using face-to-face interviews instead of postal surveys and using dichotomous choice (DC) questions in interviews. DC questions involve stating a monetary amount and asking the respondent whether they would be willing to pay this amount or not. Most studies failed to mention the NOAA guidelines, let alone adhere to them. Some studies that mentioned them, such as Mungatana and Navrud's (1994), still did not use them. This is particularly true for postal surveys as "nearly all studies of individual species use mail questionnaires" (Loomis & White, 1996), despite the lack of evidence that postal surveys are capable of providing valid and reliable contingent value (CV) estimates (Herath 2004).

Previous research has found large, sometimes significant, discrepancies between WTP and WTAC (Loomis *et al.* 1998; Lienhoop & MacMillian 2007). WTAC is the minimum monetary amount an individual would be willing to accept to forgo the resource in question (Haneman 1991). This is due to "loss aversion", where people value what they already have more highly than what they could acquire (Christie *et al.* 2006). Because of this discrepancy, the NOAA advised that WTP should always be used. However, they did not explain this discrepancy, or why WTP is more reliable than WTAC. Despite the number of problems with CVM it is still regarded by some as an established technique (Herath 2004), and is widely used.

1.2.7.2 Examples of Willingness To Pay (WTP)

The majority of existing biodiversity valuation literature focuses on the value of a component biological resource, such as individual species, habitats or ecosystem function, rather than on biodiversity itself (Pearce 2001). Additionally, most of the studies have been based in America (Christie *et al.* 2006).

An example of using CVM on a single species is the Komodo dragon (*Varanus komodoensis*) in the Komodo National Park (KNP), Indonesia. In 1995-6 the KNP charged only a low entrance fee (US$ 0.87/£0.51) (Walpole *et al.* 2001). A WTP survey in 1995-6 showed the median visitor WTP was US$9.73/£6.17 and the mean WTP was US$11.70/£7.42. It was estimated that to maximise revenue the entrance fee should be US$13.54/£8.25 (Walpole *et al.* 2001). From 2006 onwards foreign visitors have had to pay US$15/£9.51 to visit the park for 1-3 days; the fee increasing as the stay lengthens (KNP 2009). Similar studies were completed by Naidoo and Adamowicz (2005) who used choice experiments on tourists visiting the Mabira Forest Reserve in Uganda. Their model looked at the bird species diversity attracting tourists and concluded that an entrance fee of US$47.00/£29.79 for international visitors would maximise tourist revenue. However, at the time of the study international visitors were charged <US$5.00/£3.17. Nadioo and Adamowicz argue that raising entrance fees would increase revenue whilst reducing tourist numbers, lessening the negative ecological and cultural impacts of tourists on the area. Some studies have also highlighted that terrestrial mammals generate a higher WTP value than other taxa, although Loomis and White, (1996) stated that WTP results for birds and marine mammals was significantly higher than that for land mammals and reptiles. Macmillan *et al.* (2002) used WTP to estimate the value of wild geese conservation in Scotland. They compared individual WTP to group based “Market Stall” (MS) estimates, where participants are given more time to discuss and consider their WTP. They found that the MS estimates were 3.5 times lower than the standard interview estimates. Although Macmillan *et al.* could not confirm that the MS estimations were more accurate; they referred to other studies where this had been the case (Champ et al. 1997; Duffield and Patterson 1992; Navrud and Veisten 1996). White *et al.* (1997; 2001) studied the influence of species characteristics on WTP, concluding that higher WTP is generated by flagship and charismatic species, even over species which are more threatened or which play more significant biological roles within the ecosystem.

CVM studies on habitats include that of Garrod and Willis (1994), who asked 227 members of the Northumberland Wildlife Trust (NWT) what habitats they thought were threatened and also which they preferred. They also asked how much participants would be willing to pay per year to protect habitats not currently protected by the NWT. The sum of respondents WTP was £2,404 annually to protect the Border Mires: peat bogs in Northumberland and Cumbria which are well known as important habitats and which support numerous rare fauna. However, individuals were willing to pay a total of £9,444 to protect Kielder Forest habitat, with the main aim to conserve red squirrels (*Sciurus vulgaris*). Other studies have shown the public are willing to pay for environmental problems that are not directly linked to charismatic species. For example, in Macmillian *et al.* (1996), WTP by the Scottish public for damage reduction from acid rain was assessed. Questionnaires with DC questions were sent to 2,720 Scottish households, and 1,820 responded. Forty seven percent of respondents were willing to pay the highest amount listed: a £396 annual fee. A further 30 questionnaires were sent out extending the bid price to £798, and eighteen percent were willing to pay this amount, leading to the conclusion that these individuals regarded biodiversity threatened by acid rain as an important concern.

1.2.7.3. The Travel Cost Method (TCM)

TCM differs from CVM because it makes use of actual, rather than hypothetical behaviour. TCM is based on the theory that the more time a person has spent travelling to a site the higher they value it. Time is interpreted as an indirect cost and is used to assess the value of a visit to a PA, as logically the visit must be more valuable than the distance travelled and the time it took to get there (Herath 2004). One of the most prevalent issues with TCM is calculating how much time is worth. The literature concerning the valuation of time is extensive. Values used include wage rate (McConnell and Strand 1981) as an opportunity cost. The majority of recent studies use a variation of wage rate, such as one third of the wage rate (Mendelson & Brown 1983; Chen *et al.*

2004; Gurluk & Rehber 2007) or a fraction of wage rage summed with the cost of petrol (Hesseln *et al.* 2003). Using one third of wage rate as a measure is based on a study by Nelson (1977). Nelson's study was based on commuting to work, and the costs and benefits of buying a cheaper house further away from the central business district, which held the majority of employment opportunities. Nelson concluded that commuting is valued between twenty five per cent and forty five per cent of gross wage rate, with thirty three percent being the best point estimate. However, a commute to work may not be equivalent to travelling to a PA. Mendelson and Brown linked the two in 1983, stating that commuting travel time provided a utility and trips to recreational sites also provide a utility. TCM is one of the oldest environmental valuation techniques (Hanley *et al.* 2001) and is broadly accepted and regarded as a successful non-market valuation technique (Smith 1993).

1.2.7.4 Examples of TCM

Several of Australia's National Parks have been valued using TCM, including Kakadu (Knapman & Stanley, 1991), Girraween (Beal, 1995b), Carnarvon Gorge (Beal 1995c) and Fraser Island (Fleming & Cook 2008). Flemming and Cook estimated that visitors spent between AUD$1,921/£1,186 and AUD$4,475/£2,763 in time per visit to Fraser Island in both time and travel costs. Only visitors from Australia were included in the survey; if international visitors had been included the total spend would have been much higher. However, it is likely that international visitors would have travelled to Australia to see a variety of tourist attractions, not just specifically Fraser Island.

Studies such as that of Navrud and Mungatana (1994) have utilised both TCM and CVM in order to compare results and compare the validity of the methods. Navrud and Mungatana concluded that it was difficult to decide which technique was preferable; therefore it was advisable to use

both. Using CVM and/or TCM is not always appropriate for determining people's values and perceptions of nature. If, for example, you are exploring physical and psychological benefits, putting a monetary value on physical and psychological health might not accurately reflect their worth. Fuller *et al.* (2007) used a five-point scale, asking respondents to rate statements on a scale from strongly disagree to strongly agree.

This study uses both the CVM and TCM, as well as other methods to determine how highly visitors value nature within PA's. Respondents were asked how much they would be willing to pay to visit a nature reserve equivalent to the one that they visited. Additionally, respondents were asked for their postcode to calculate the distance they have travelled. Distance was multiplied by a petrol cost to create a TCM value, which was then divided by the number of people in the party to establish a value per person. An opportunity cost, such as one third of a person's income, was not included in this study because a significant number of responds were either unaware of, or refused to disclose their annual household income.

1.2.7.5. Economic Valuation of Non-use Values

In addition to the benefits people receive from using reserves directly (e.g. by visiting them) they can also receive non-use benefits such as existence and bequest values. All of these benefits combined create the total economic value, illustrated earlier in Figure 1.2.4. Non-use values of PA's can be valued using CVM, but not TCM, because to assess non-use values respondents should not have visited the PA, and TCM requires respondents to have travelled to the site in question. In Colorado residents were asked to value wilderness areas according to their non-use values. From 218 respondents the mean WTP was US$32/£20.28 annually (Walsh *et al.* 1984), meaning that individuals still valued wilderness, despite not utilising the areas for their use

values, e.g. visitation. Walsh *et al.* (1984) state that the non-use values should be added to revenue generated by recreation use to determine the total economic value of a wildness area to society, because non-use value will increase the estimated value calculated by TCM.

Garrod and Willis (1997) looked at individual's WTP to improve the biodiversity of a 300,000ha area of coniferous forest within the Forestry Commission Estate in Britain. It was stressed to participants that because of its remote location they were unlikely to ever visit the area in question, and that increasing biodiversity would reduce timber production. Most people chose a compromise, which meant that biodiversity would be managed more effectively, but timber production would still continue at a reduced rate. Fewer respondents were willing to pay the most expensive option to conserve biodiversity at the highest level at the expense of stopping commercial timber production all together. The majority of respondents were also unwilling to pay to convert commercial woodland into a PA that they would never be likely to visit.

PA's need to use appropriate valuation techniques to provide estimates that can, in turn, be used to increase their management efficiency (Edwards 2008). This is particularly true with regard to entrance fees, which are often dramatically underestimated, as previously discussed. Therefore economic valuation is important not only to establish the economic worth of PA's, but also to ensure they are fulfilling their true economic potential. Unfortunately PA's often do not have the funding or resources to do this; within many PA's all types of monitoring and evaluation are a luxury (e.g. wildlife, visitor number and visitor feedback monitoring). Additionally monitoring and evaluation is often overlooked. Priority is given to day-to-day activities that PA mangers often perceive to be more important (Gaston *et al.* 2006). When WTP is being used to value an area, there is a trade-off between different charitable causes (Garrod & Willis 1997). If, for example, people pay extra taxation to improve biodiversity management within forest habitats they are

likely to be less capable of monetarily supporting other conservation organisations, such as the RSPB.

In spite of the importance of establishing how much the public values reserves, some conservationists believe that uninformed citizens cannot be asked to value the environment and that it should be left to the "experts" (Hanley *et al.* 2001). Some members of the general public are also of this opinion, as revealed in Christie *et al.* (2006), who explored the publics WTP towards two biodiversity conservation schemes, against an option which involved doing nothing. One respondent summed up this opinion, stating: "all I'm concerned about is that we protect our wildlife...I'm not really concerned about how this is achieved and to tell you the truth I don't really know how this might be best achieved...surely it is best to let the scientists decide what to do" (Christie *et al.* 2006). It is important to obtain public opinion and valuations of biodiversity and to ensure that public opinion is used and valued when it is relevant, particularly when investigating whether the public would be willing to pay towards biodiversity protection schemes.

1.2.7.6. Protected Area Funding

Conservation in the UK usually incurs a cost, because the Wildlife and Conservation Act 1981 requires land owners and tenants to be compensated for profits which will be foregone as a result of conserving wildlife (Garrod & Willis 1994). Funding of PA's has been fairly constant over the last 10-20 years, with an increase in funding being matched by PA expansion (Emerton *et al.* 2006). However, the current global economic crisis is leading to growing public sector budget constraints. When this is coupled with PA expansion it means that currently, and in the future, PA's are likely to be even more reliant on self-sustained funding through memberships and visitor charges. The amount of funding is not the only important factor to consider; it is also

imperative to ensure existing funds are being spent efficiently, that funding is timely, and that PA's are financially stable and sustainable (Emerton *et al.* 2006). Methods of achieving this include obtaining funding from multiple sources, managing PA's effectively, allowing for long-term planning and security, and identifying and targeting the broader market, i.e. people who may make use of the PA. Recording both demographic data of visitors and the opinions and perceptions of visitors is one way that PA's can assess their broader market, giving authorities in charge of PA's insight concerning what the public want and how much they are willing to pay for conservation. Unfortunately, many international governments require PA's to 'pay their own way', without recognising their important contributions to standards of living (McNeely 1994).

Britain has over 10,000 protected areas (Gaston *et al.* 2006). British PA's range from small, local areas to vast NP's, like the Cairngorms in Scotland and also include various types of PA, from NP's, to SSSI's, to marine nature reserves. Many of Britain's PA's do not protect any charismatic or nationally/internationally rare species, but they are still of vital importance to biodiversity and local ecosystems (Garrod & Willis 1994). The RSPB manages 200 PA's and the Royal Society for Nature Conservation (RSNC), which incorporates the national wildlife trusts, including Durham Wildlife Trust (DWT), manages 2,256. These reserves are primarily funded by subscriptions and donations rather than the central government (Garrod & Willis 1994). Although this study will incorporate several of the RSPB's flagship reserves, such as Minsmere and Leighton Moss, all of the reserves studied in this study are small in size, when considered on a global scale. It is important for the RSPB and DWT/RSNC to be aware of what is attracting people to their reserves, and whether visitor numbers would decline with biodiversity.

1.2.8 Conclusion

There are several important reasons for protecting areas of biodiversity. However, many academics believe that designating PA's is not enough to conserve global biodiversity (Soulé & Sanjayan 1998; Rodrigues *et al.* 2004). Currently it is hard to draw conclusions on how successful PA's are at conserving biodiversity because of the inconsistence or absence of wildlife monitoring; insufficient monitoring results from a lack of enforced guidelines, inadequate funding, and discrepancies in management priorities. For example some reserves prioritise public advertising over species counts. However, the RSPB, as a large and dedicated conservation organisation, document yearly targets, and publish how they are faring in meeting them.

Overall, there are many important reasons for people to interact with nature and experience biodiversity, and in the UK PA's can sometimes be the only access that people have to nature. Despite much of the British public having a limited understanding of biodiversity, the majority still value it highly, for its use and non-use values.

Ultimately, it is the public who are visiting the reserves, joining charitable organisations such as the RSPB, and generating the revenue. Therefore, it is important to pay attention to their opinions and incorporate them into management decisions when relevant. If public preference and biodiversity preservation diverge, such as when deciding what species to conserve, then the PA management must decide whether to prioritise popular and charismatic species at the expense of species which are less charismatic, but more biologically significant or under greater threat. Effective management of PA's relies on adequate funding, which is a challenge to obtain a climate where the government are making dramatic cuts. This results in pressure on PA's to be more economically self-reliant. Many PA's, both in Britain and abroad, require revenue from visitors and membership as their main funding source. Therefore, it is essential to understand

why people visit PA's, their understanding and value of biodiversity, and how biodiversity effects visitation. This knowledge could be used to enhance revenue, hopefully without compromising conservation objectives. In fact, if visitors prefer PA's with higher biodiversity it could be used to justify increased spending to enhance biodiversity within reserves.

Although the studies discussed have established the importance of biodiversity, public understanding and value of biodiversity, there is a lack of research on the public's (and PA visitors') perception of biodiversity. This study addresses the gap in the literature concerning how biodiversity and "perceived biodiversity" influence visitor numbers and therefore revenue, and which factors are most influential in influencing visitations. Such insight can be exploited by PA managers in order to maximise revenue, hence increasing profits which can be use to fund biodiversity conservation. A previous study that did incorporate public perception of biodiversity was Fuller *et al.* (2007). However, this study differs from the work of Fuller *et al*. in several ways, as Fuller *et al*. questioned visitors to public places in Sheffield, whereas I am questioning visitors to PA's. Additionally, this study also focuses on visitor's economic valuation of PA's, and how specific predictor variables influence visitor patterns, which is not covered in Fuller *et al*.'s study.

1.3 Aims

The aims of this study are:

- to explore the influence of a variety of biodiversity related and unrelated factors on visitor numbers, both across reserves during the breeding season, and monthly variation within reserves.
- to determine the level of accuracy with which visitors to PA's were able to estimate the species richness of different taxa (primarily birds and butterflies)
- to examine whether the public visit PA's principally for reasons related to biodiversity

- to assess, using willingness to pay and the travel cost method, the public's economic value of biodiversity at PA's across the UK.
- to determine the influence of biodiversity on visitor spending patterns within PA's and their environs.

1.4 Thesis plan

This thesis is divided into a further four chapters. Chapter two (page 39) explores whether predictor variables, such as breeding bird biodiversity, the presence of rare birds in reserves, and weather variables influence visitor numbers. This is examined both among PA's during the breeding season, and also inter-month variation at PA's. Chapter three (page 60) investigates the accuracy of visitors' perceptions of species richness of bird and butterflies in PA's. This chapter also examines people's motivations for visiting (particularly whether they are biodiversity related) and visitor's perceived importance of biodiversity. In chapter four (page 83) willingness to pay and the travel cost method are used to assess visitor valuation of biodiversity, and I explore which aspects of biodiversity have the strongest impact on these response variables. Visitor spending patterns are also analysed in chapter four. The conclusions from these data chapters are brought together and discussed in chapter five (page 104).

CHAPTER TWO: A STUDY OF THE INFLUENCE OF PREDICTOR VARIABLES ON SEASONAL AND MONTHLY VISITOR PATTERNS TO PROTECTED AREAS IN THE UK

2.1 Introduction

The primary aim of most PA's is to conserve biodiversity and maintain the survival of key species within their borders (Margules & Pressey, 2000; Emerton *et al.*, 2006). However, managers of a selection of PA's in the United Kingdom, which include the reserves that this study is based upon, also encourage visitation. It is therefore essential that a balance is found between conservation objectives and recreation objectives (Cessford & Thompson, 2002; Cessford & Muhar, 2003) for these reserves.

It is important for reserves to record visitor numbers and their distribution over space and time across PA's, in order to understand and manage the impact of visitors on PA's (Cessford & Muhar, 2003; Pettebone *et al*., 2010). In general, reasons for collecting visitor data vary between reserves. Reasons for monitoring visitor information include to justify funding requests, to direct planning, to guide management decisions and to identify problems within a PA, such as overuse by visitors (Muhar *et al*., 2002). Several techniques are frequently utilised for recording visitor numbers. These include: direct observations, such as manned counting stations and roaming observers; indirect observations, such as camera and satellite imagery; counting devices, such as turnstiles, and self-registration via registers or "guest books" (Muhar *et al*., 2002). The most suitable collection method depends on the desired use of the data and the resources available to the reserve. However, since the majority of PA's are short of funding, any monitoring of visitor numbers often has a low priority (Buckley, 2002; 2003), particularly when competing with other conservation objectives. This chapter analyses visitor centre data from RSPB reserves, in relation to factors such as locality, biodiversity and weather to

help explain variation in visitor numbers both within and among PA's. An understanding of such factors may enable managers to target certain periods and amenities for visitor centric development while prioritising conservation elsewhere.

If conservation organisations wish to increase visitor numbers to their reserves, then it is important for them to understand what attracts visitors. Previous studies have researched tourists' motivations for visiting reserves and natural areas (Barnes *et al*., 1999; Naidoo and Adamowicz, 2005; Van der Merwe & Saayman, 2008) These studies have found that biodiversity, unspoilt nature and landscape, and relaxation constitute the main reasons for people to visit reserves (see chapter three, section 3.4, for more details). This chapter investigates whether there are fundamental differences between reserves that attract high numbers of visitors and those that attract only a few, as well as examining variation over monthly time periods. Some factors that may influence visitor numbers cannot be altered by reserves, such as weather or the school holidays. However, it is still important to establish what the primary variables influencing visitor numbers are, so that reserve managers are aware of whether these variables can be managed or exploited to attract more visitors (for example, by focusing on special events during school holidays).

The effects of several potential explanatory variables on visitor patterns were examined in the analysis of this chapter. These include Reserve ID, the impacts of breeding bird diversity, range restricted species, threatened species, the number of days that rare birds were present in the reserve per month, monthly weather variables, distance to the nearest public transport link, the proportion of school holidays and the number of weekends per month.

Previous studies have shown the economic value of bird diversity (Nadioo & Adamowicz 2005). Losey and Vaughan (2006) estimated that Americans spent US$32.4 billion a year (£19.89 billion) on bird watching, based on a 1996 census, indicating the economic value of bird watching as a leisure activity.

There have been a number of studies that have investigated the public's economic valuation of restricted range species and endangered species, in general, or focusing on a particular species (Bowker and Stoll, 1988; Loomis & White 1996; Bell *et al*., 2003; Chambers and Whitehead, 2003; Christie *et al*., 2006; Richardson & Loomis, 2009). All of these examples reported that the public were willing to pay either an annual charge or lump sum to avoid the loss, reintroduce, or increase the population of the threatened or endangered species in question. Another type of species-focused conservation is flagship species conservation. Flagship species are popular or charismatic species, usually large mammals, which act as a symbol to stimulate conservation awareness and action (Entwistle & Dunstone, 2000). There has been a particular abundance of research on the influence of key and flagship species on conservation in areas that attract an large number of international nature tourists, such as Southern Africa (Williams *et al*., 2000; Kerley *et al*., 2003), Asia (Venkataraman *et al*., 2002; Nawaz *et al*., 2008) and North America (Simberloff, 1998).

Websites such as Birdguides and the services they offer highlight the attention that rare species receive from bird watchers. These services include "Bird News Anywhere", which provides subscribers with a variety of update services including a constantly updated list of all the rarest birds in the UK and Ireland. Therefore, this study investigates whether the presence of rare birds at a reserve had an impact on the number of visitors, or

whether the people who are interested in the presence of rare birds made up a negligible proportion of visitors.

Previous research has focused on the effect of metrological variables on visitation to PA's. Ploner and Brandenburg (2003) studied the influence of the weather (specifically temperature, precipitation, sunshine duration, vapour pressure and relative humidity) in nature conservation areas. They concluded that meteorological variables, particularly temperature, sunshine and precipitation, influenced the total number of visitors. Ploner and Brandenburg also studied the influence of the day of the week (whether it was a work day or not) and the season, on total visitor numbers and different visitor user groups to nature conservation areas. One of the variables that they concluded influenced the total number of visitors was the day of the week.

McNeely *et al*. (1992), stated that tourism is only likely to be a major source of revenue when protected areas fulfil certain criteria (Wilkie and Carpenter 1999). These criteria include "offers easy (short), comfortable and safe access", and "Is close to an international airport or major tourist centre". These studies were focused on international tourism, whereas I am investigating smaller scale tourism within the UK. Therefore, these two variables would be more relevant to my study if instead of investigating distance to an international airport, distance to the nearest public transport link was used.

The quality of facilities available at a site may also influence visitor numbers. However, from the visitor data available, there is no way of telling whether facilities were established at a particular site due to high visitor numbers, or whether visitor numbers to a site increased due to the high quality of facilities available. Also it would have been

difficult to quantify the different levels of facilities available at reserves. Therefore I have decided to exclude facilities from the analysis of this chapter.

The objectives of this chapter are to investigate which predictor variables influenced visitation to PA's, both over the breeding season, and monthly variation. Were the variables that positively influenced visitation biodiversity related? And are reserves able to use this information to actively encourage visitation?

2.2. Methods

In this chapter, two sets of monthly visitor data from RSPB reserves scattered across the United Kingdom were compared against several variables considered as potential predictors of visitor numbers. Three models were generated: one that focuses on visitors to reserve within the breeding season (April – August), and two that aim to explain inter-month visitor variation, both within and between reserves for a nine and nineteen month data set. One visitor data set spanned a nine month period at 17 sites, from April 2009 to December 2009 (see Table 2.2.1), and will hereafter be referred to as the "nine month data set". The second data set covered a nineteen month period, from April 2008 to October 2009 for 6 reserves, and will hereafter be referred to as the "nineteen month data set". The nine month data set was used to study the effects of predictor variables on visitor numbers across sites during the breeding season (April-August) because this set provided visitor data across the breeding season for 17 reserves. However, this analysis was not repeated for the nineteen month data set, as this data set only focused on six reserves, which was not a large enough sample size to draw any strong conclusions from. Additionally, I was interested in investigating the influence of breeding bird species on visitor patterns during the breeding season. In order to do this some of my analysis had to focus solely on the breeding season. The nine and nineteen month data set were used to

study monthly variation of visitors, both across and within sites. The reserves used in these analyses were selected because they had both accurate visitor and biodiversity data. Both visitor data sets were collected at staffed engagement points, where visitors were categorised into members and non members, and the term 'visitor numbers' refers to the sum of the two (R. George, Head of marketing insight and systems, RPSB, personal communication, 14/12/2009).

The predictor variables used in the breeding season analysis were Reserve ID, breeding bird diversity, range restricted species, Red, and Red and Amber listed species, a rare bird index, weather variables, distance to the nearest transport link, local population, the proportion of the month in the school holidays and the number of weekends in the month. UK birds are divided into three categories of conservation importance, Red, Amber and Green. Red listed species have the highest conservation priority, and require urgent action. Amber listed species are the next most threatened and Green listed occur regularly in the UK (RSPB, 2012). Breeding bird diversity data was supplied by the RSPB, and comprised of a total number of breeding bird species per reserve over a season, without month to month variation (See Appendix 2).

The influence of range restricted bird species was studied using a species score. This species score was based on the breeding bird species data provided by the RSPB. Restricted range species score was calculated for each reserve by focusing on breeding bird species presence in 10 km-grid cells covering the UK (excluding Ireland) (Gibbons, *et al*., 1993). A species was classified as range restricted if it was found in 350 or less of the 10 km cells across the UK (approximately one eighth of the cells). This method excluded a few species that may attract visitors, such as the barn owl (*Tyto alba*) and yellow wagtail (*Motacilla flava*), which have a wider range but are locally restricted. Additionally, this categorisation included some species that might not necessarily attract visitors, such as the ruddy duck (*Oxyura jamaicensis*). Despite these anomalies, this was

considered an appropriate method for defining restricted range species for the purpose of this research. Restricted range species scores were calculated for reserves by subtracting the number of cells that a bird was present from 350, and then summing the scores for each bird. Therefore, the restricted range species score increased along with the number of restricted range species and their rarity. See Appendix 5 for a list of range restricted species found in the sample sites and the number of 10km cells they are present in across the UK.

To assess the impact of threatened bird species on visitation, species from the breeding bird lists were categorised into Red and Red and Amber listed species. Each reserve was also given a score for Red and Red and Amber listed species. This score was allocated using a similar method as used for assigning a restricted range species score. However, instead of subtracting the number of cells that a restricted range bird species was found in from 350, the number of cells that a Red or Amber listed bird was present in was subtracted from 2800, which was the approximate total number of cells. The total amounts for Red listed, and Red and Amber listed species were summed to create a Red and Red and Amber listed species score for each reserve. See Appendix 5 for a list of Red and Amber listed species and their presence in reserves.

The number of days that rare birds were present in the reserve per month was also investigated in relation to visitor numbers. Rare bird days data were retrieved from the BirdGuides website (www.birdguides.com). The BirdGuides website divides rare birds into three categories: rare, very rare and mega rare, therefore I have also adopted this categorisation in my analysis. The categories of days where rare bird species were present were given scores: a score of 3 was assigned to mega rare days, 2 to very rare days and 1

to rare days. For each reserve I summed the rare bird scores over the month, and this figure is hereafter referred to as “rare bird index”. Using a rare bird index per month was chosen over using purely the number of rare species recorded at a reserve because the presence of a rare bird for several days may attract more visitors than a rare bird that was only briefly present. See Appendix 4 for summary data of rare bird days.

Monthly weather data for the PA’s in this analysis were extracted from the Met Office website (www.metoffice.gov.uk) for mean temperature, number of sunshine hours and rainfall. The Met Office monthly data is separated into nine regions: North Scotland, East Scotland, West Scotland, East England and North East England, North West England and North Wales, Midlands, East Anglia, South West England and South Wales, South East England and Central South England. The weather data from each region were associated with all the PA’s in that region. Unfortunately, some reserves were classed as being in the same region (see Table 2.2.1), meaning that in some cases the same weather data were used for multiple reserves.

Table 2.2.1. The Met Office website categorises UK monthly data for temperature, the number of sunshine hours and the amount of rainfall into nine regions. This table shows the seventeen reserves which make up the two data sets used in this chapter and the weather regions that they are located within. All reserves are included in the nine month data set, and those highlighted with an asterisk are also included in the nineteen month data set.

Reserve	Region
Arne	England, South West and Wales, South
Blacktoft Sands	England, East and North East
Conwy*	England, North West and Wales, North
Deane Valley	Midlands
Dungeness*	England, South East and Central South
Fairburn Ings	Midlands
Lake Vyrnwy*	England, North West and Wales, North
Mid Yare Valley	East Anglia
Minsmere*	East Anglia
Pulborogh Brooks	England, South East and Central South
Radipole lake	England, South West and Wales, South
Rainham Marshes	England, South East and Central South
Rye Meads	England, South East and Central South
Saltholme	England, East and North East
Titchwell Marsh	East Anglia
Vane Farm	Scotland, East
Ynys-hir*	England, North West and Wales, North

In order to interpret the influence of local population on visitation rates a 30 mile buffer was marked around each reserve, and population data from the 2001 census (Fouracre, D. Reserves GIS Officer, RSPB, personal communication, 04/04/10) was used to determine the population within the buffer. A 30 mile buffer was chosen so that reserves were within approximately 30 to 60 minutes commuting distance by car. This figure was included in the breeding season model. The distance of the nearest public transport link (either train or bus) was also included in the breeding season model. Neither the influence of local population or distance to nearest public transport link were included in the monthly variation model as neither of these variables have monthly variation.

The final factors included in both the breeding season and monthly visitor analysis were Reserve ID, the proportion of school holidays per month and the number of weekends in a

month. Each month scored between 0 and 1, based on the approximate proportion of the month in the school holidays. For example, one week of July and September usually fall within the summer holidays, meaning that these months were scored 0.25, whereas August was scored 1, as the whole month is in the summer holidays. Additionally, the number of weekends (either 4 or 5) was listed for each month, and a score of 4.5 was allocated if a month had four weekends and one extra Saturday or Sunday.

Therefore, the predictor variables included in the breeding bird analysis were Reserve ID, breeding bird diversity, restricted range score, Red listed score, Red and Amber listed score, mean number of rare bird days per month (April – August), mean of the mean monthly temperature (April – August), mean number of sunshine hours (April – August), mean amount of rainfall (April – August), local population and distance to the nearest transport link. Predictor variables were modelled against total visitor numbers, the number of members, and the number of non members in all of the analyses in this chapter, in order to see if there were any differences in predictor variables between these three categories. In the breeding season analysis, the natural log of total visitor, member and non member numbers were used, to normalise the data.

Monthly variations, within both the nine and nineteen month data sets, were also modelled in order to explore which variables had an impact on monthly levels of visitation. Again, total visitor numbers, members and non members were analysed separately. In both data sets the square root of the number of visitors was used, and the natural log of members and non members, to normalise the data. The predictor variables examined in this analysis were: the proportion of the month in the school holidays, number of weekends in the month, number of rare species days per month, mean number

of sunshine hours per month, mean monthly temperature and amount of rainfall per month. Variables such as breeding bird diversity, restricted range and threatened species scores, which did not have any monthly variation, were excluded.

All predictor variables had a *priori* support and so model selection techniques (Burnham and Anderson 2002) were used to determine which predictors, or combinations of predictors, best explained the response. A dummy variable was also included as a control in this analysis. Specifically General linear models using combinations of predictors were compared using The Akaike information criterion (AIC) (Whittingham *et al*. 2006). Models were retained for consideration if they had a delta AIC value equal to or less than 6 and were not a more complex version of the model of best fit (Richards 2008). If models fitted these outlines, but where lower than the null model, or contained the dummy variable then they were also rejected. This technique cannot be used to test hypotheses, and there have been criticisms on the use of this approach (Burnham & Anderson 2001; Anderson *et al*. 2001). However, this is an appropriate method to use for this study because of the large number of the predictor variables, and because this study is an introductory investigation.

2.3 Results

Analysis of the mean number of visitors between April and August 2009, from the nine month data set, using general linear models, indicated that the best model for visitors, members, and non members during the breeding season contained only Reserve ID. However, Reserve ID is only meaningful in the sense that it subsumed any effects of the other variables. This analysis was repeated, excluding Reserve ID as a predictor to investigate which variables acted as predictors once Reserve ID had been removed. There

was a single model that best explained visitor numbers during the breeding season. In this model, mean value of the rare bird index per month had a significant positive influence (fig. 2.3.1a). A summary of the accepted models for the breeding season analysis is shown in Table 2.3.1. For members, there was also only one model of best fit, in which the mean value of the rare bird index also had a significant positive influence (figure 2.3.1b). For non members the best fitting model was the null model, so the results were inconclusive. Therefore, the results of the breeding season analyses imply that visitors in general, and members, are influenced (or more likely that some are influenced) by the presence of rare species within a reserve.

Table 2.3.1. A summary of the coefficients, and their importance, found in the top models for visitor data during the breeding season (April – August) 2009. These models are plotted as lines of best fit in Figure 2.3.1. The delta AIC of the second model of best fit has not been included, because in each case one of the models either contained the dummy variable, or was the null model, meaning that it did not pass the acceptance criteria.

	Coefficients included in top model	Value of coefficients in top model	Coefficients included in second model of best fit	Coefficients in second model of best fit
Total visitors – breeding season	Rare Bird days	Rare: 0.078 (Intercept: 7.846)	Rare Bird days; Dummy variable	Not included because it contained the Dummy variable
Members – breeding season	Rare Bird Days	Rare: 0.086 (Intercept: 7.308)	Rare Bird days; Dummy Variable	Not included because it contained the Dummy variable.
Non members – Breeding season	Null model	Null model	N/A	Not included because it was lower than the null model.

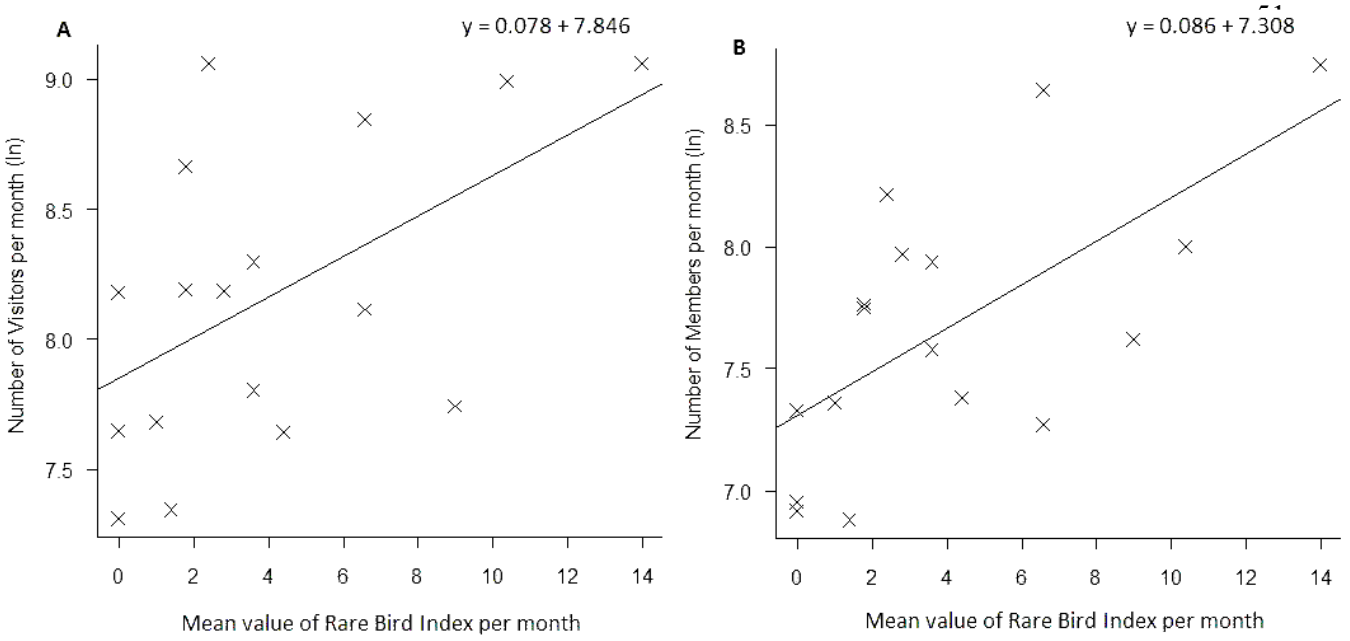


Figure 2.3.1. The association between the mean value of the rare bird index per month (see text for explanation) , during the breeding season (April – August) 2009, and A, the *mean number of visitors per month (ln)* (r^2 = 0.532; n=17; p=0.028), and B, the *mean number of members per month (ln)* (r^2 = 0.638; n=17; p=0.05), visiting during this period.

When monthly variation in visitor numbers for the nine month data set was examined for all visitors, there was a single model of best fit, which contained Reserve ID, mean monthly temperature (fig.2.3.2a) and the proportion of the month in the school holidays (fig. 2.3.2b). Similarly, for both members and non members there was only one model of best fit, which also contained Reserve ID, mean monthly temperature (fig.2.3.2c; 2.3.2e) and the proportion of the month in the school holidays (fig.2.3.2d; 2.3.2f). Increased temperature positively increased visitation at 0.01% significance for members, non members, and all visitors. Therefore, it appears that the impact of weather on variation in monthly visitation, in this analysis, was shown to be more important than the influence of the presence of rare bird species, which influenced visitation across reserves over the breeding season. A summary of the models of best fit for this analysis is shown in Table 2.3.2. Because the best fitting model had more than one predictor variable, the lines of best fit shown on figures 2.3.2b, d and f are not univariate lines of best fit, as all the predictor variables influenced the location of the intercept.

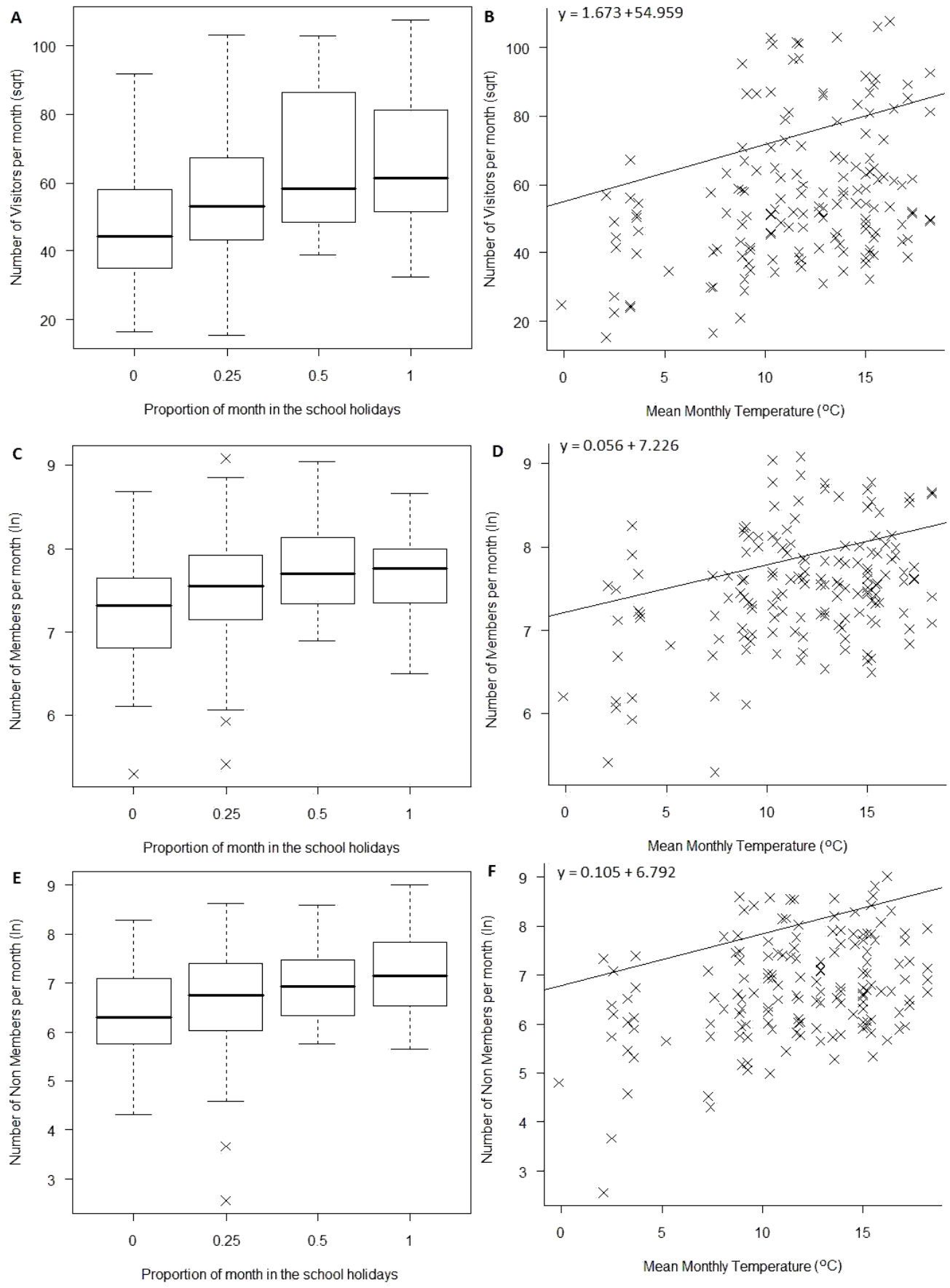


Figure 2.3.2. The association between the number of visitors per month (sqrt) and A, *the proportion of the month in the school holidays*, and B, *the mean monthly temperature* (r^2= 0.343; n=153; p<0.001); the number of members per months (ln) and C, *the proportion of the month in the school holidays*, and D, *the mean monthly temperature* (r^2 = 0.350; n= 153; p<0.001); and the number of non members per month (ln), and E, *the proportion of the month in the school holidays*, and F, *the mean monthly temperature* (r^2=0.373; n=153; p<0.001), between April 2008 and October 2009. The box and whisker diagrams represent the spread of visitors, members and non members over months where 0%, 25%, 50% and 100% of the month was in the school holidays.

Table 2.3.2. A summary of the coefficients, and their importance, found in the top models for monthly visitor data between April and December 2009. These models are plotted as lines of best fit in Figure 2.3.2b, d and f. The value of individual reserves have not been listed in the value of coefficients column, because all the reserves had some influence on visitor numbers in these models, and in essence Reserve ID simply subsumed all of the predictor variables.

	Coefficients included in top model	Value of coefficients in top model
Total visitors – monthly variation (nine month data set)	Proportion of month in the school holidays	25% of month in the school holidays: 9.093 50% of month in the school holidays: 19.201 100% of month in the school holidays: 8.739
	Reserve ID	Not included.
	Mean monthly temperature	Temperature: 1.6726; (Intercept 54.959)
Members – monthly variation (nine month data set)	Proportion of month in the school holidays	25% of month in the school holidays: 0.256 50% of month in the school holidays: 0.621 100% of month in the school holidays: 0.157
	Reserve ID	Not included.
	Mean monthly temperature	Temperature: 0.0565; (Intercept 7.226).
Non members – monthly variation (nine month data set)	Proportion of month in the school holidays	25% of month in the school holidays: 0.319 50% of month in the school holidays: 0.831 100% of month in the school holidays: 0.273
	Reserve ID	Not Included
	Mean Monthly Temperature	Temperature: 0.105; (Intercept 6.792).

The analysis of the nineteen month data set also focused on exploring the reasons for monthly variation in visitor numbers throughout the year. The results of this analysis for visitors generated two models of best fit. The first contained Reserve ID, mean monthly temperature (fig. 2.3.3a) and the value of the rare bird index per month (fig. 2.3.3b), and had a significantly positive impact on visitation. The second model of best fit was a simplified version of the first model, (delta AIC 1.9) and only included Reserve ID and mean monthly temperature as predictors (see Table 2.3.3 for a summary of all the models in this analysis). For members, two models that fitted the criteria were also generated. The first also had Reserve ID, mean monthly temperature (fig. 2.3.6a), and the value of the

rare bird index per month (fig. 2.3.6b). The second best fitting model (delta AIC 1.9) also only included mean monthly temperature (fig 2.3.6a) and Reserve ID as predictors. For non members there was only one accepted model of best fit, as the next best fitting model contained the dummy variable, and hence was rejected. The model of best fit for both total visitors and members contained Reserve ID and mean monthly temperature as significant predictors (fig 2.3.3). Therefore, these results indicate that, other than Reserve ID (which is meaningful only in the sense that it subsumes all of the differences between sites in a single variable), mean monthly temperature is the most important variable influencing monthly differences in visitation. The value of the rare bird index per month also had a significant positive impact for overall visitors and members, but not non members. This implies that members are also slightly influenced (or more likely that some members are influenced) by the presence of rare bird species in reserves.

Table 2.3.3. A summary of the coefficients, and their importance, found in the top models for monthly visitor data between April 2008 and October 2009. These models are plotted as lines of best fit in Figure 2.3.3.

	Coefficients included in top model	Value of coefficients in top model	Coefficients included in second model of best fit	Coefficients in second model of best fit	Delta AIC of second model of best fit
Total visitors – monthly variation (nineteen month data set)	Rare Bird Index	Rare Bird Index: 0.2690	Reserve ID	Dungeness: -31.660; Lake Vyrnwy: -30.150: Minsmere: 7.047; Titchwell Marsh: 1.054; Ynys-hir: -45.454;	1.9
	Reserve ID	Dungeness: -33.605; Lake Vyrnwy: -29.72; Minsmere: 4.421; Titchwell Marsh: -0.396; Ynys-hir: -45.057	Mean Monthly Temperature	Temperature 1.090 (Intercept 67.257)	
	Mean Monthly Temperature	Temperature 1.054 (Intercept 67.176)			
Members – monthly variation (nineteen month data set)	Rare Bird Index	Rare Bird Index: 0.009	Reserve ID	Dungeness: -0.955; Lake Vyrnwy: -1.288; Minsmere: 0.266; Titchwell Marsh: 0.138; Ynys-hir: -1.908;	1.9
	Reserve ID	Dungeness: -1.020; Lake Vyrnwy: -1.273; Minsmere: 0.182; Titchwell Marsh: 0.090; Ynys-hir: -1.894.			
	Mean Monthly Temperature	Temperature 0.0319 (Intercept 8.00)	Mean Monthly Temperature	Temperature 0.033 (Intercept 8.01).	
Non members – monthly variation (nineteen month data set)	Reserve ID;	Dungeness: -1.260; Lake Vyrnwy: -0.610; Minsmere: -0.245; Titchwell Marsh: -0.474; Ynys-hir: -1.510;	Dummy variable	Not included because it contained the dummy variable	N/A
	Mean monthly Temperature	Temperature 0.069; (Intercept: 6.766).			

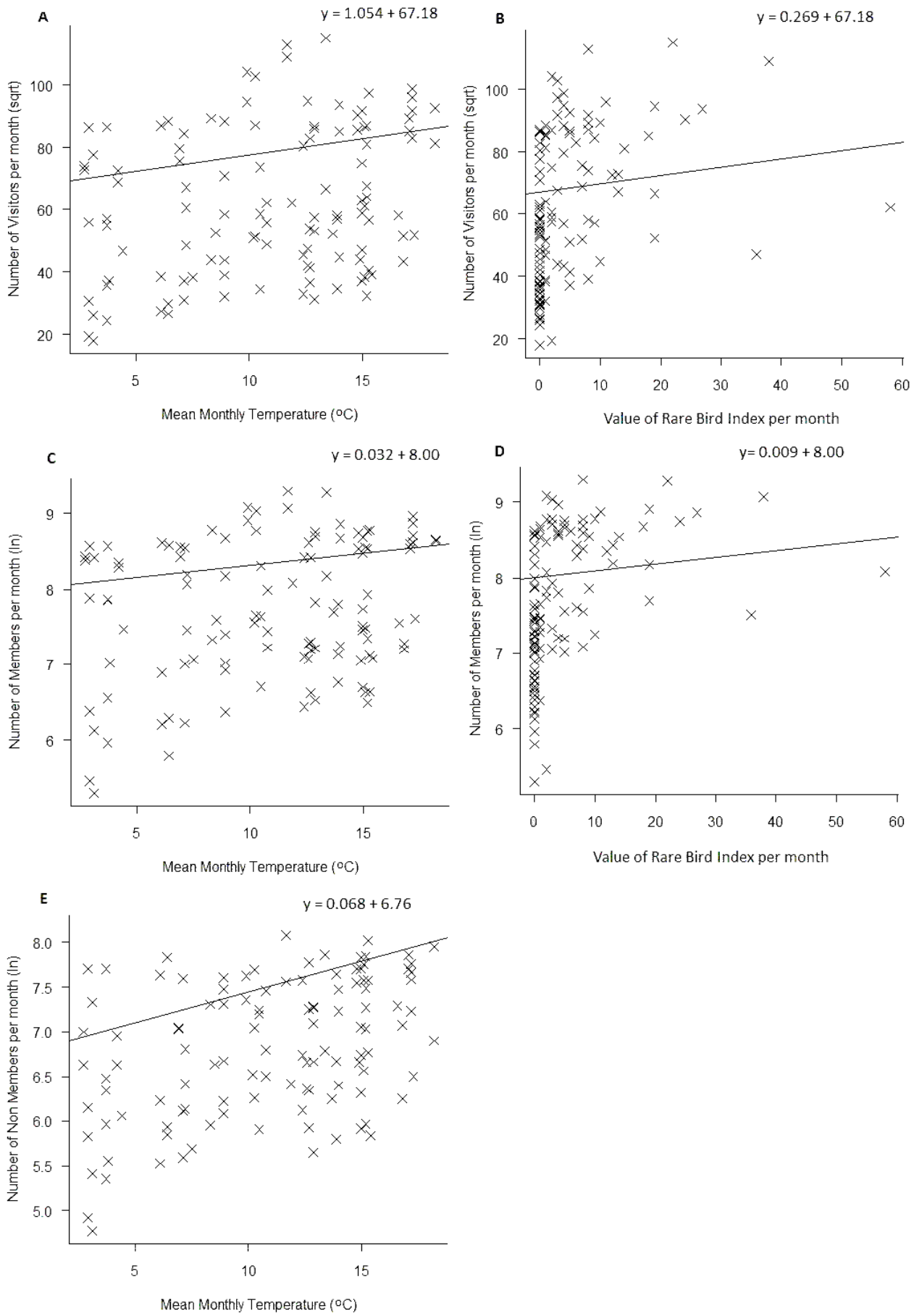


Figure 2.3.3 The association between the number of visitors per month (sqrt) and A, *the mean monthly temperature* (R2= 0.301; n=115; p=0.001), and B, *the value of the rare bird index per month* (r^2=0.317; n=115; p=0.001); The number of members per months (ln) and C, *the mean monthly temperature* (r^2=0.202; n=115; p=0.031), and D, *the value of the rare bird index per month* (r^2=0.375; n=115; p<0.001); and the number of non members per month (ln), and E, *the mean monthly temperature* (r^2=0.411; n=115; p<0.001, between April 2008 and October 2009.

2.4 Discussion

The analysis of the impacts of variables between reserves during the breeding season showed Reserve ID to be the most influential factor on reserve visitation. However, this is because Reserve ID subsumed all of the other factors in one variable. Once Reserve ID was removed, the mean value of the rare bird index per month was shown to have a significant positive impacted on overall visitor numbers and members. The results of the non member model for the breeding season were inconclusive. The value of the rare bird index was also shown to be important for the analysis comparing monthly variation in visitation for the nineteen month data set, but not the nine month data set, having a significant positive impact on the number of members and total visitors.

There is a large amount of literature on the publics' valuation of rare and threatened species (which ties rare species in with restricted-range and IUCN-threatened species). Rare and vagrant birds attract bird watchers. This is apparent by the huge market for services such as "Bird News Anywhere", provided by BirdGuides (www.birdguides.com), from which subscribers receive a variety of update services, including a constantly updated list of all the rarest birds in the UK and Ireland. Previous research has also shown that the public value rare and endangered species highly. This includes willingness to pay and travel cost method studies on species in protected areas that tourists will travel internationally to visit. For example, the Komodo dragon (*Varanus komodoensis*) in the Komodo National Park, Indonesia (Walpole *et al.* 2001); or primate tourism in the forests of Rwanda (Wilkie and Carpenter 1999). Additionally, willingness to pay studies indicate that residents value local rare or threatened species highly, as shown by White *et al*. (2001). The occurrence of vagrants in PA's in the UK, and their influence on visitation,

are likely to change in the future, as the ranges of birds shift as a result of climate change (Walther, *et al*. 2002; Opdam & Wascher, 2003).

For the monthly analysis, mean monthly temperature was shown to be an important predictor variable for both data sets. However, the numbers of sunshine hours per month, and amount of rainfall per month did not appear to influence visitor numbers. Previous research on the impact of weather variables on visitor patterns concluded that weather influences visitor numbers (Ploner and Brandenburg 2003). However, Ploner & Brandenburg (2003) reported that temperature, sunshine and precipitation all influenced the total number of visitors to nature conservation areas. For the nine month data set the proportion of the month in the school holidays also had slight positive influence on visitation, although this was not the case for the nineteen month analysis.

The presence of restricted range and threatened species did not appear to influence the number of visitors for either data set using either analysis method. However, an abundance of previous research has concluded that particular "key" species, such as restricted range and threatened species are important in attracting visitors to PA's (Walpole & Leader-Williams, 2002; Entwistle & Dunstone, 2000; Kerley *et al*., 2003; Lindsey *et al*., 2007). However, RSPB reserves do not attract the same level of high profile, international nature tourism as the reserves that were the focus of these studies, which could explain the contrast in results.

As mentioned in the methods section, the model selection technique utilised in this chapter is not suitable for hypothesis testing. Therefore, the results of this chapter are purely indicators of predictors that may be of greater importance than the other variables

that were explored. Additional, more thorough research would need to be conducted in order to draw stronger conclusions on this subject.

To conclude, the predictor variable that had the most important influence on levels of visitation between reserves (other than Reserve ID) was the mean number of rare bird days per month. The predictor variables that had the greatest impact on monthly variation in visitation was mean monthly temperature, the number of rare bird days per month, and the proportion of the month in the school holidays for the nine month data set. To maximise visitor numbers, reserves should ensure information on rare birds is widely broadcast. Additionally, reserves could focus on holding special events during school holidays, particularly when the weather is likely to be warm. Breeding bird diversity did not appear to impact on visitor numbers, although previous research has shown that single species, such as charismatic species or flagship species, often play a large role in attracting visitors to foreign PA's (Wilkie and Carpenter, 1999; Walpole *et al.* 2001). Reserves in the UK also use flagship species in order to promote conservation and to attract visitors, but at a much smaller scale. Therefore, alternate factors, such as weather, appear to be more important in attracting visitors to PA's within the UK.

CHAPTER 3: DETERMINANTS OF PROTECTED AREA VISITATION AND THE PUBLIC'S PERCEPTION OF BIODIVERSITY WITHIN UK PROTECTED AREAS

3.1 Introduction

Although the main aim of PA's is the effective conservation of biodiversity (Emerton *et al.* 2006), protecting biodiversity is not the sole purpose of PA's, as many governments require them to 'pay their own way' (McNeely 1994). In order to generate sufficient funds to ensure species protection, most classes of PA's encourage visitation. Therefore, it is important to understand peoples' motivation for visiting, so that PA's can be managed to cater for visitors' needs, as well as conserving biodiversity.

The benefits of nature based tourism to PA's are frequently assumed, but seldom quantified (Naidoo & Adamowicz 2005); the most often cited benefit being that biodiversity is the main reason why tourists visit protected areas. This study aims to investigate whether this is truly the case, or whether people are primarily visiting for alternate reasons, such as the quality of landscape or the teashop. Previous studies that have attempted to understand public perceptions of wildlife have collected data using a mixture of survey methods, ranging from postal surveys (Macmillan *et al.* 1996; Macmillan *et al.* 2002; Bateman *et al.* 2006) to semi-structured interviews (Kahn 1999) (see chapter one for a more information about these studies). Other researchers have used focus groups, either for preliminary research, such as to generate questions for questionnaires, or for their primary research. For example, Garrod & Willis (1997), who used focus groups to inform the design and conduct of their study on the non-use benefits of enhancing forest biodiversity. Previous work has studied the public's opinion of PA's using questionnaires; such as Dimitrakopoulos *et al*. (2010), who questioned 390 adults

living in Greece on their perception and awareness of Greek PA's. My study focuses on PA's within the UK. Britain has over 10,000 PA's (Gaston *et al.* 2006), which are primarily funded by subscriptions and donations rather than central government funding (Garrod & Willis 1994).

This research fills a gap in the literature by focusing on the publics' perception of biodiversity. This is an important topic as the majority of PA's in the UK are funded by membership and visitors, therefore it is important that PA managers understand how biodiversity affects motivation for visiting PA's. If the level of biodiversity does influence visitation it is also important to gauge whether this decision is a subconscious one, or if the public are aware of levels of biodiversity, and how this affects their decision to visit particular reserves. In order to answer the above this chapter focuses on three questions: How does the public's estimation of biodiversity compare to actual biodiversity? Do people visit biodiverse PA's because they are biodiverse? What other factors motivate visitation?

3.2 Methods

3.2.1 Background Information on the Study Sites

In order to collect visitor's estimations of biodiversity, as well as their opinions on the importance of biodiversity, a questionnaire (Appendix 1) was collected at eight reserves (five RSPB, two DWT and a country park). Previous studies have used questionnaires to assess public perception of wildlife, including Bremner and Park (2007), who used a questionnaire to question 248 members of the Scottish public on their opinion of invasive species management in Scotland. Contingent valuation method (CVM) surveys are

frequently conducted in economic valuation research, including the economic valuation of biodiversity (Splash, 2002) and particular species (Walpole *et al*. 2001). This is particularly true of willingness to pay (WTP) surveys, because of the non-market nature of biodiversity conservation (Naidoo & Adamowicz 2005). WTP studies are widely used despite a large proportion of respondents having no previous knowledge of the resource they are valuing (Kniivila 2006). Some ecologists believe that uninformed persons cannot be asked to value the environment (Hanley *et al.* 2001). Therefore, my study used a questionnaire that was conducted within PA's, once respondents had looked round. This ensured that they were familiar with the reserve, and were in a better position to value its worth and estimate species numbers.

The purpose of my questionnaire was to identify why individuals had chosen to visit the specific reserve, and also to assess their perception of the range of biodiversity within the reserve. Questions also aimed to determine the respondent's knowledge, experience and interest in nature reserves. Additional demographic questions were included to gain further insight into the type of individual, or group, who visited the reserve. The majority of the questions asked were closed, meaning that the respondent had to choose from a set of predetermined answers, although several questions included the option of "other, please specify". I used mostly closed questions in order to enable me to categorise the non-quantitative answers.

The reserves used as study sites were selected for their wide range in diversity of breeding birds, combined with their accessibility. Because I required the sample sites to have a wide range of breeding bird diversities, I was unable to use RSPB reserves for all of my

sites. There are few RSPB reserves with low bird diversity, the exception being coastal reserves. These often attract visitors for different reasons in comparison to terrestrial sites, namely congregations of key species of seabirds. Table 3.2.1 provides background information on each of the reserves visited, including the number of species of breeding birds and butterflies in each reserve, their entrance fees and additional facilities on site. The table also includes the number of questionnaires completed at each location. All study sites had basic facilities, such as toilets and car parking; however some reserves had additional facilities, such as a shop, which may have acted as an additional attractant for visitors. Rainton Meadows and Derwent Walk Country Park had the most basic facilities of all the reserves visited, as well as the lowest number of breeding bird species.

Table 3.2.1.
A summary of key infomation about the study sites, including the number of species of breeding birds, entrance fees and facilities available. *Butterfly species lists were not available for Rainton Meadows and Derwent Walk Country Park, therefore species lists for these reserves were estimated based on personal visits by my supervisor, Dr S G Willis, and additional available information.

Reserve	Minsmere	Leighton Moss	The Lodge	Rainham Marshes	Low Barns	Saltholme	Rainton Meadows	Derwent Walk Country Park
Abbreviation of name	MIN	LMS	LDG	RMA	LOW	SAL	RME	DCP
No. of questionnaires completed at each reserve	30	35	24	33	21	30	31	28
Number of species of breeding birds	114	82	66	58	55	55	51	35
Number of butterfly species	34	28	29	19	21	20	16*	20*
Tea shop	Yes	Yes	No	Yes	Yes, but basic	Yes	Yes, but basic	No
Additional Facilities available Car Parking	✓	✓	✓	✓	✓	✓	✓	✓
Coach Parking	✓	X	X	X	X	✓	X	X
Toilets, including disabled toilets and baby changing facilities	✓	✓	✓	✓	✓	✓	✓	✓
Visitor Centre	✓	✓	X	✓	✓	✓	✓	✓
Pushchair/ wheelchair friendly	✓	✓	✓	✓	✓	✓	✓	✓
Binocular Hire	✓	✓	✓	X	X	X	X	X
Large shop	✓	✓	X	X	X	✓	X	X
Medium Shop	X	X	✓	✓	X	X	X	X
Small Shop	X	X	X	X	✓	X	X	X
Picnic area	✓	✓	✓	✓	X	✓	X	✓
Guided walks	✓	✓	✓	✓	X	✓	X	X
Entrance fee at time of visit: Price for parking	Free	Free	£4	£1 optional donation	£2.50	£3	Free	Free
Price for adult non-members	£5	£4.50	Free	£2.50	Free	Free	Free	Free

Table 3.2.1 continued.

Reserve	Minsmere	Leighton Moss	The Lodge	Rainham Marshes	Low Barns	Saltholme	Rainton Meadows	Derwent Walk Country Park
Price for concessions non-members	£3	£3	Free	(no conc.)	Free	Free	Free	Free
Location	East Suffolk	Lancashire	Bedfordshire	Essex	County Durham	Tyneside	County Durham	Northumberland
Reserve Manager	Adam Rowlands	Robin Horner	Peter Bradley	Marc Fletcher (acting)	Craig Best	Dave Braithwaite	Mark Richardson	Stephen Rutherford (Senior Ranger)

3.2.2. Data collection methods and questionnaire design

My questionnaire consisted of 32 questions. These included specific questions that were tailored to extract desired information, and some additional questions that the RSPB requested I incorporate from their visitor survey. This resulted in a questionnaire, with a broad range of questions, some of which were not analysed.

Previous studies have used a pilot study to test questionnaires aimed at eliciting information from PA visitors or the wider public, prior to wider application (e.g. Garrod and Willis 1997). I conducted a pilot run of my questionnaire in the Durham University Botanic Gardens, in March 2010, to determine whether participants understood the questions and to gauge the time it took to complete a questionnaire. From this preliminary study I learned that respondents repeatedly misunderstood the format that should be used for their answers. For example, when left to complete the questionnaire unaided, individuals repeatedly ticked boxes when the question had requested that they should write a score in the box. Additionally, respondents were often inclined to leave questions blank if they perceived them as difficult, rather than answering them “incorrectly”. To ensure respondents completed questionnaires fully and in the correct format, questionnaires were conducted interactively with respondents; I read out the questions and filled in the responses. This approach was chosen over leaving questionnaires at reserves,

as approaching people directly was more likely to result in an increased response rate (Hansen & Hurwitz 2004). If questionnaires had been left to be filled out by respondents independently this may have produced biased results. Certain types of individuals are more likely to complete questionnaires (Moser 1993), which may result in a non-representative sample of visitors to the reserve. Moreover, by overseeing each questionnaire, questions could be clarified, if required, to ensure the answers were filled in correctly. Respondents were encouraged to answer all questions, particularly the difficult but important question asking them to estimate species numbers (question 17).

Questionnaires were conducted between May and early August, 2010, when the majority of breeding birds were most obvious to visitors. I aimed to collect a minimum of 30 questionnaires at each site, although this was not always possible (the number collected at each site is listed in Table 3.2.1). Because I conducted all of the questionnaires, interviewer bias was eliminated (Lincoln 2003). The fact that sampling was based on a set questionnaire format ensured consistency in the collection of results. Courtesy bias, which is when individuals alter their responses to provide an answer that they believe the interviewer wants to hear, could arise with a researcher questioning individuals. I attempted to overcome this by briefing each respondent prior to the questionnaire, informing them that I was carrying out research for Durham University and that I was interested in the participant's honest opinions. Because the subject of my questionnaire was not controversial, and the majority of the questions related to the experience of respondent's visit it was judged that the likelihood of answers being affected by my presence was low. The risk of such bias occurring was far outweighed by the benefit of ensuring that questionnaires were answered accurately and fully.

The questionnaires were conducted using convenience sampling (Anderson 2001). This involved asking individuals who crossed my path to fill out the questionnaire, rather than using a random stratified sampling technique. Convenience sampling has been criticised because data is only collected at a particular point, and the people questioned may not be representative of visitors overall (Anderson 2001). However, this method was chosen as it was the only feasible way of collecting sufficient data within the time available, particularly for reserves with low visitor numbers. Data was collected, if possible, at a point where the majority of visitors passed through.

3.2.3. Methods of Analysis of Questionnaire Data

The most relevant questions with regards to reasons for visitation and to elucidate visitor biodiversity knowledge were question 6, question 8 and question 17 (see Appendix 1). Throughout this chapter, data on breeding bird richness at each site has been used as a measure of site biodiversity, to which visitor responses could be compared. Breeding bird biodiversity was used because this was the most complete measure of biodiversity across all sites.

3.2.3.1 Visitor Motivations

Question 6 asked respondents to score how important nine motivation factors were to them when deciding to visit a nature reserve. The nine motivation factors were: proximity to home, good facilities, a well stocked teashop, a well stocked shop, a scenic landscape, a variety of wildlife which is easily viewable (*biodiversity*), the presence of particular key species (*rare and/or restricted species*) that are easily viewable, the quality of walks in the nature reserve and a relaxing atmosphere. Visitors graded each relevant factor on a five-point rating scale (from least (1) to most important (5)).

These results were analysed to understand the relationship between the perceived importance of biodiversity and actual biodiversity, and to investigate whether people visit biodiverse reserves for reasons related to biodiversity. The mean score of the factor "a variety of wildlife which is easily viewable", indexing biodiversity, was calculated for each reserve and was used as a measure of visitors' perceived importance of biodiversity. Using the mean scores for the importance of biodiversity in their raw form could be sensitive to the differences between the use of the 5 point rating scale among individual respondents. For example, some respondents may have used the whole scale, whereas others may have only used the top end of the scale. Therefore the data was z-transformed and the mean of the transformed data was regressed against breeding bird diversity.

To gain an understanding of why visitors chose to visit a particular nature reserve, question 8 of the questionnaire offered respondents nineteen potential reasons for visiting a site. Respondents were encouraged to select all reasons that applied to them. There was also an option of "Other, please specify". These data were summarised to assess the importance of each potential motivation and to calculate visitors "proportion of biodiversity motivation", i.e. what proportion of their motivation to visit was related to biodiversity. The nineteen motivations were categorised into biodiversity related, and non-biodiversity related. Biodiversity related motivations included: "there is lots of wildlife for me to view here", "I came to view a particular species", "there are uncommon/rare species here", and "a chance to see birds". Motivations unrelated to biodiversity included: "it is near to where I live/ where I am visiting", "it has good facilities", "I like the scenery", "I enjoy the walks this nature reserve has to offer", "I find it easy to relax in this particular nature reserve", "to meet friends/ relatives", "to see

historic buildings/ sites" and "to get some exercise/ fresh air". Seven of the initial nineteen (these options were of interest to RSPB and of peripheral interest to the current work) were excluded from this analysis as they could be interpreted as either biodiverse or non-biodiverse motivations. The ratio of biodiverse to non-biodiverse motivations were used to give each respondent a score between 0 (motivation was completely non-biodiversity related) and 1 (motivation was completely biodiversity related). This produced a continuous value for biodiversity motivation that was regressed against site biodiversity.

A 2 way ANOVA was conducted, with Reserve and Motivation Factor (the factors from question 6) as predictor variables and Score (the score individuals gave these motivation factors) as the response. If either Motivation Factor or Reserve are significantly related to Score then a Tukey *post-hoc* test will be used to clarify any significant differences in motivation factors between reserves.

3.2.3.2 Public Perception of Biodiversity

Respondents were asked to estimate how many different species of breeding birds, plants, mammals and butterflies occurred at a visited site (question 17 in the questionnaire). For butterflies, there was no data available directly for two of the reserves (Rainton Meadows and Derwent Walk Country Park). For these two reserves species lists were obtained based on personal visits by my supervisor, Dr S G Willis, and additional available information from the regional butterfly recorder (D. Wainwright, Northern England Regional Officer, Butterfly Conservation, personal communication 02/08/10). Estimated bird and butterfly data were logged to normalise the data. The mean visitor estimate of butterflies and birds per site was regressed against the known biodiversity (which was

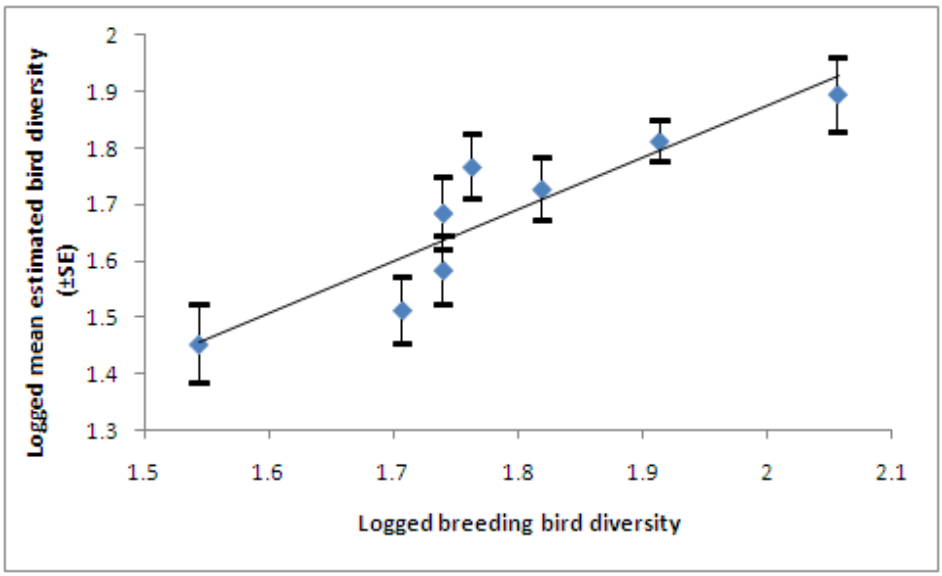
also logged for this analysis), rather than the individual visitor responses to avoid pseudo-replication. Due to a lack of recorded data at reserves I was unable to compare estimations of mammal and plant species biodiversity to actual biodiversity. However, estimations of bird, plant, mammal and butterfly diversity were plotted. The accuracy of individuals' perception of bird and butterfly species richness was calculated by dividing the estimation by the recorded value for diversity for each respondent. The accuracy of bird and butterfly estimations were correlated, to determine whether individuals' perceptions of bird and butterfly species richness are related. Additionally, the accuracy of bird species richness perception was correlated against the score each individual assigned to biodiversity in question 6. This will establish whether there is an association between people's accuracy of biodiversity perception, and how important biodiversity is in determining whether they visit a reserve.

The breeding bird diversity for RSPB reserve study sites were provided by the RSPB (see Appendix 2). For non RSPB reserves a website called BirdTrack was used (www.bto.org/volunteer-surveys/birdtrack). BirdTrack is run by the British Trust of Ornithology, which provides bird lists by locations, identified by reserve name or grid reference. An option available for bird lists was a list found in the breeding season, which BirdTrack defined as April to July. So this option was chosen to identify breeding birds. Subsequently I got hold of more accurate species lists for two of these three reserves, but at too late a stage to include in my thesis. The implications of this are discussed in section 3.4. Both the BirdTrack and alternative lists are shown in Appendix 3.

3.3 Results

Visitors to the eight study sites had a reasonably accurate perception of bird and butterfly diversity, as shown when estimated diversity was regressed against breeding bird diversity. The relationship between both logged breeding bird diversity and logged estimated bird diversity, and logged butterfly diversity and logged estimated butterfly diversity is significant: (r^2=0.835; n= 8; p =0.001), (fig. 3.3.1a) and (r^2=0.620; n= 8; p=0.02) (fig. 3.3.1b). Additionally, when individuals' accuracy of estimating bird species richness was correlated against their accuracy of butterfly species richness the association was highly significant (r^2=0.422; n=214; p<0.001). The accuracy of perception of bird diversity was also correlated against individuals' score of how important biodiversity was within nature reserves from question 4. There was not a significant correlation (r^2=-0.14; n=227; p=0.831). Therefore, individuals' with a more accurate perception of biodiversity did not regard biodiversity to be more important than individuals with a less accurate perception.

A



B

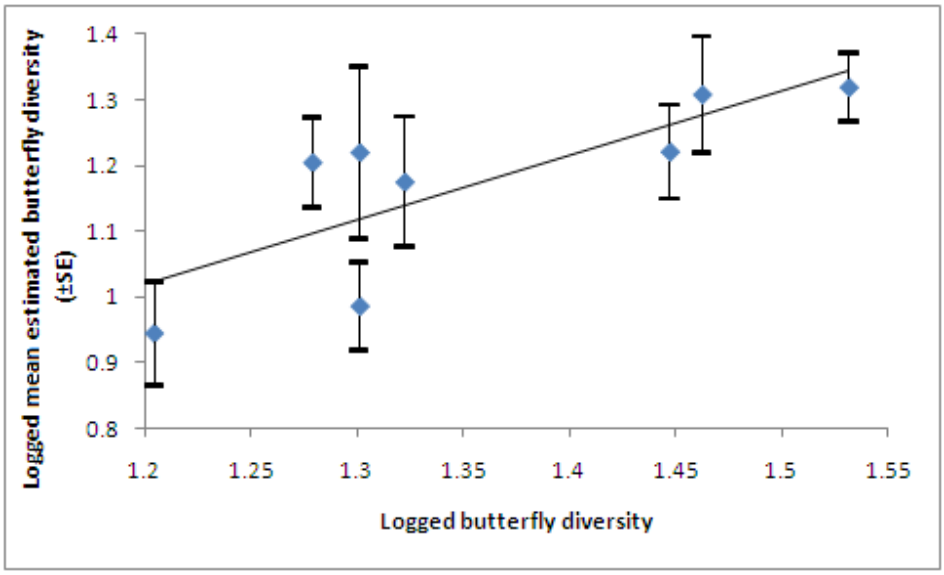


Figure 3.3.1. The realtionship between actual biodiversity and estimated biodiversity, for *A logged breeding bird diveristy*, and B *logged butterfly diversity*. The means and standard error bars are plotted, and a line of best fit included. Rainton Meadows and Derwent Walk Country Park were not able to produce a butterfly species lists; therefore species lists for these reserves have been estimated based on personal visits by my supervisor, Dr S. G. Willis, and additional available information.

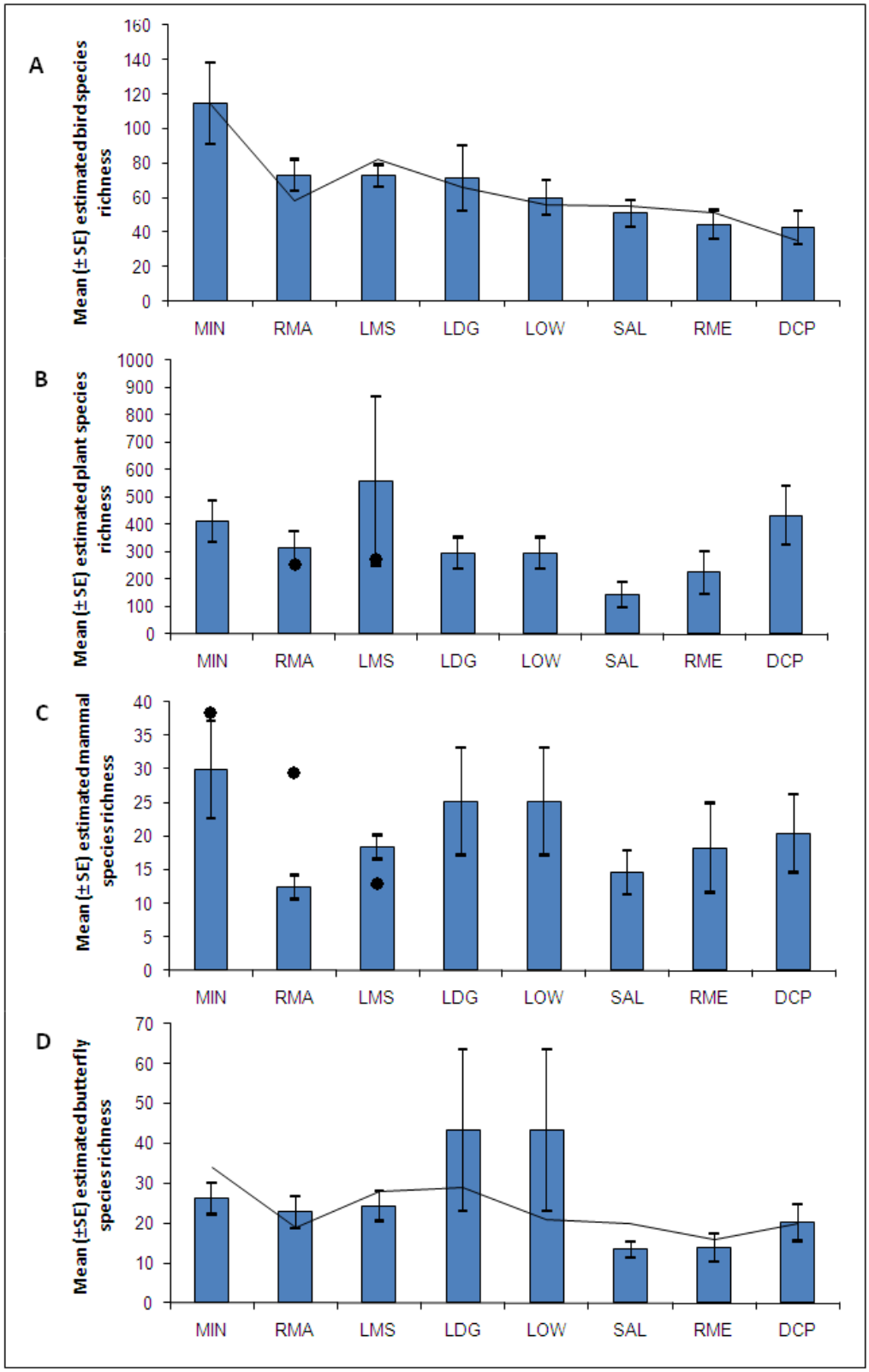


Figure 3.3.2. The estimated species richness for birds (A), plants (B), mammals (C) and butterflies (D). In graph D two outliers for Derwenthaguh Country Park (DCP) with estimations of 500 species and 1000 species have been excluded, because of their dramatic influence on the mean. Known species riches is indicated by a line for bird and butterfly taxa. Known single data points have been plotted for mammal and plant taxa. Rainton Meadows and Derwent Walk Country Park did not have butterfly species lists; therefore species lists for these reserves have been estimated based on personal visits by my supervisor, Dr S. G. Willis, and additional available information. Refer to table 3.2.1 for full reserve names.

Unfortunately, because of a lack of data, estimated plant and mammal species richness cannot be compared to actual species richness. For the two reserves (Leighton Moss and Rainham Marshses), where plant diversity was known, minus the standard error from the mean of estimated plant diversity was similar to actual plant diversity. Reserves that visitors perceived as having the highest bird diversity were not always perceived as having the highest plant, mammal and butterfly diversity (fig 3.3.2).

Out of the nine factors which could influence whether a respondent visited PA's (question 6), biodiversity was scored the highest, and shop and teashop were scored the lowest, respectively (fig 3.3.3).

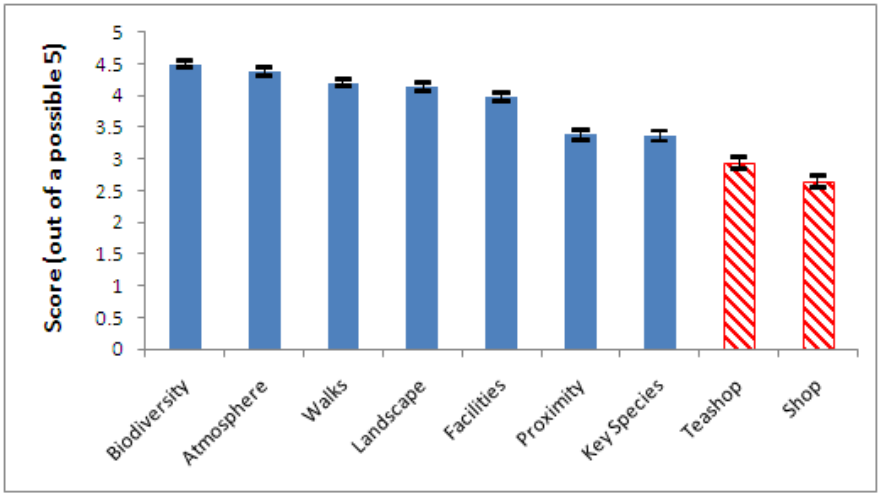


Figure 3.3.3. The motivation factors that influenced respondents' decision to visit a PA across, in score order, based on data from question 6. Means and standard error bars have been plotted. For teashop and shop, means and standard error have been calculated only using data from reserves which have these facilities (see Table 3.2.1.)
Motivation factors: Biodiversity = A variety of wildlife which is easily viewable; Atmosphere = A relaxing atmosphere; Walks = The quality of walks in the nature reserve; Landscape = A scenic landscape; Facilities = Good facilities, e.g. plentiful car parking and toilets; Proximity = Proximity to home; Key Species = The presence of particular key species which are easily viewable; Teashop = A well stocked teashop; Shop = a well stocked shop.

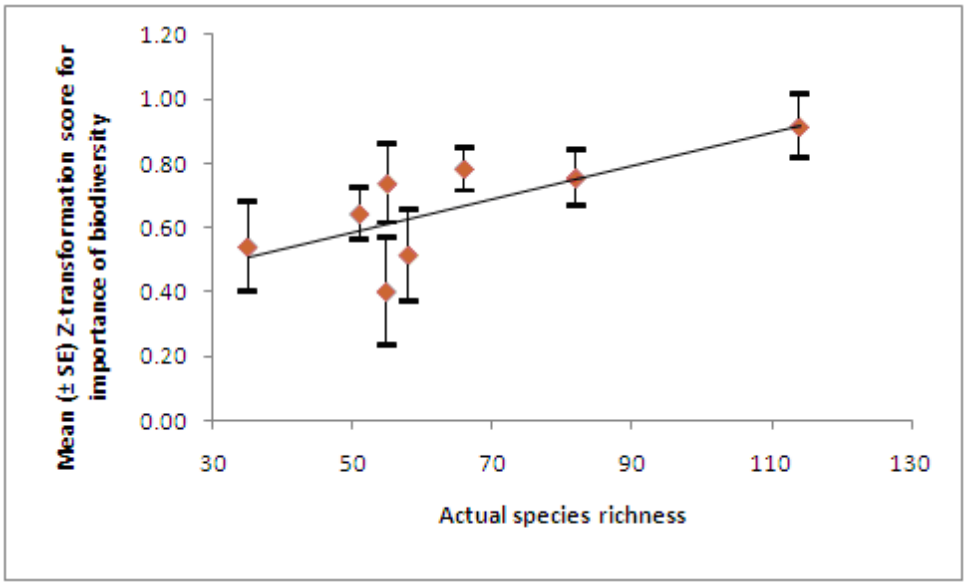


Figure 3.3.4. The relationship between the percieved importance of biodiversity and actual biodiversity. The data has been z-transformed, and shows a significant relationship (r^2=0.538, n=8, p=0.039).

There was a significant relationship between the mean Z-transformed score of biodiversity and actual species richness, as indexed by breeding bird diversity (fig 3.3.4). Therefore as biodiversity increases respondents assigned biodiversity a higher score. Additionally, the mean Z-transformed scores were always less than 0. This means that biodiversity was always above median importance among the factors listed in question 6.

The results of a 2 way ANOVA show that Reserve, Motivation Factor (factors from question 6) and their interaction are all significant: (Reserve F=6.740; n= 232; p<0.001; Motivation factor F=105.948; n= 232; p<0.001; Interaction F=2.351; n=232; p<0.001). Therefore, within any given reserve there were variations in how people valued factors, and for any given factor there were differences in how people valued those factors across the reserves. Most importantly, the significant interaction suggests that there was variation in visitors' valuation of factors among reserves. Although 'Reserve' was highly significant in the ANOVA, a Tukey *post-hoc* test revealed that Derwent Walk Country

Park is the only reserve where motivation factors, influencing visitation, differ significantly from any other study sites: (Minsmere, Leighton Moss, The Lodge and Saltholme p<0.001, Rainton Meadows p=0.001, Rainham Marshes p=0.011 and Low Barns p=0.015). Respondents at Derwent Walk Country Park generally assigned lower scores to factors than at other reserves.

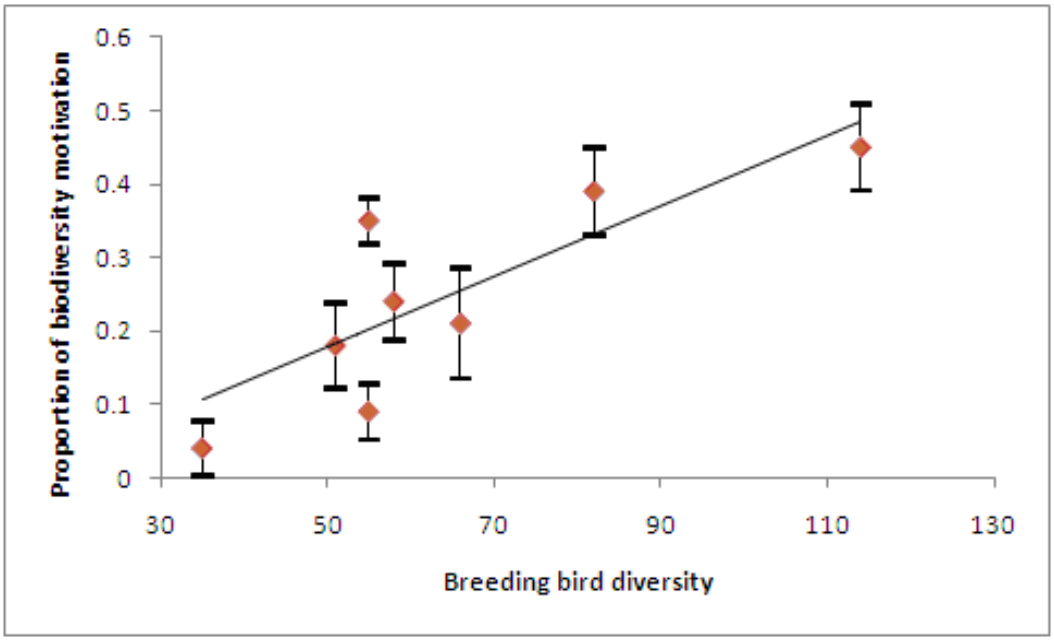


Figure. 3.3.5. The relationship between the proportion of biodiversity motivation (see text for explanation) and actual biodiversity, using means and standard error bars. The fitted line is significant (n=626, p<0.001).

The proportion of biodiversity motivation increased as biodiversity increased (fig 3.3.5). This shows that even though respondents from all the sample sites considered biodiversity as an important factor in determining their visit, visitors to reserves with higher biodiversity had the greatest biodiversity motivation for visiting.

3.4. Discussion

There has been very little research into motivations for visiting PA's in the UK. The majority of studies have focused on visitation to PA's in tropical regions, which have charismatic megafauna (Barnes *et al.* 1999; Naidoo and Adamowicz 2005). This study focuses on less charismatic species in temperate ecosystems. Additionally, there has been very little research into the public's perception of biodiversity, both in tropical and temperate regions.

This study indicated that there is a significant positive relationship between estimated breeding bird and butterfly diversity and actual breeding bird and butterfly diversity (fig. 3.3.1). This means that visitors questioned had a reasonably accurate perception of how many bird and butterfly species were present within the reserve they were visiting, and that the estimated results increased along with actual biodiversity. Fuller *et al.* (2007) conducted a similar study, where visitors to public green spaces in Sheffield were asked to estimate bird, plant, mammal and butterfly species richness. Fuller *et al.* did not find a significant relationship between estimated and actual bird species richness, but did find a significant relationship between estimated and actual plant species richness. They justified this finding as a result of plants being static elements of the landscape, whereas birds are mobile and sometimes less visible. Unfortunately the results from my study cannot be directly compared to Fuller *et al.*'s results, as I do not know actual species richness for mammals and plants. However, visitors to green spaces are less likely to be visiting specifically to see birds, unlike many visitors to RSPB and wildlife trust reserves, which made up seven of my eight study sites. Visitors to these reserves may have a greater knowledge of, and interest in birds and butterflies, and therefore have a more accurate perception of diversity. A potential extension to my study would be to conduct plant and

mammal surveys in the reserves, similar to Fuller *et al.* (2007). This would allow species richness estimations for all taxa to be compared to actual species richness.

Lindemann-Matties *et al*. (2010) investigated public perception of grassland biodiversity. They focussed on the aesthetic value of biodiversity, and whether species richness is aesthetically appreciated, as opposed to certain species, or nature as a whole. They found that the mean perception of species richness increased with true species richness, but was marginally overestimated at low species richness, and underestimated at higher levels. This suggests that people, in general, do not realise the full species richness of diverse grassland communities. Underestimation of bird or butterfly species richness was not apparent in the results of my study.

Determining the main reason why people visit a particular PA is not straight forward due to the multitude of aspects influencing visitors. A 2 way ANOVA revealed that there was variation in visitors' valuation of factors among reserves. My research indicates that people are visiting biodiverse reserves for biodiverse reasons. When the mean score assigned to each factor across all reserves was calculated, biodiversity was rated the highest (fig. 3.3.3), and the mean z-transformation of importance of diversity was significantly positively related to actual species richness (fig. 3.3.4). Moreover, the proportion of biodiversity motivation increased along with actual biodiversity (fig. 3.3.5). The mean importance of biodiversity was rated at least 4.1 out of 5 for all reserves, and for six of the eight reserves' biodiversity was the highest rated factor. The mean Z-transformed scores were always less than 0. This means that biodiversity was always above median importance among the factors listed in question 6.

From the results of this study biodiversity appeared to be considered the most important factor in determining whether respondents visited, across reserves, irrespective of the actual level. It is unsurprising that visitors' considered biodiversity important. The literature reviewed in chapter one concluded that although the public's knowledge of nature and biodiversity is often lacking, people still feel biodiversity conservation is important (DEFRA 2002). Previous studies have also reported strong public support for biodiversity conservation, such as Barnes *et al*. (1999), White *et al*. (1997) and Turpie (2003). Naidoo and Adamowicz (2005) also concluded that biodiversity was a main reason in determining which PA's tourists' hypothetically chose to visit in Uganda. They found that the number of bird species that visitors were told they were likely to see was a strong positive predictor of which park they chose to visit. Other studies have concluded that relaxation and landscape were important tourist motivations. Barnes *et al.* (1999) asked tourists to Namibia what had attracted them to the area. 26.8% of respondents (252 of 752) stated that they had visited for the "Unique, unspoiled nature/landscape" and 16.5% (161 out of 752) that "Wildlife/animals" had attracted them. However, both of these studies differ from my own because questionnaires were conducted in airports in Uganda and Namibia, rather than in PA's. Van der Merwe & Saayman (2008) questioned visitors in Kruger National Park, South Africa, on their reasons for visiting the park. The factor "to relax" was considered the most important reason. Uysal *et al.* (1994) compared the difference in motivations between Australians' who visited National Parks and natural areas in the USA, to those who did not. The factors that respondents rated were categorised into factor groupings. There was only one factor grouping that visitors to National Parks and natural areas found significantly more important, which was "Novelty". "Novelty" included factors such as "seeing and experiencing a foreign destination" and "escaping from the ordinary". Other motivations which were of greater

importance to park visitors, although there was not a significant difference, included "Escape" and "Relaxation/Hobbies". My study found "a relaxing atmosphere" to be the second most important factor in determining whether respondents visited reserves, followed by "the quality of walks" and "a scenic landscape".

The two factors that this analysis has revealed to be of the least importance in determining whether people visited reserves are a well stocked shop and a well stocked teashop (fig. 3.3.3). At all reserves, there were respondents who had visited for biodiverse reasons and, at sites where facilities were available, respondents who had visited primarily for the teashop and/or shop, irrespective of biodiversity. Although the RSPB and managers of the other reserves sampled aim to encourage visitation for biodiversity and key species, cafés and shops provide good sources of revenue. Reserves will still benefit from attracting visitors who are primarily interested in the teashop. Moreover, when accuracy of bird perception was correlated against the score that individuals assigned to the teashop there was not a significant association ($p=0.980$). Therefore, similar to biodiversity, the importance that respondents' assigned to the teashop was not associated with how accurate their perception of bird diversity was.

There are reasons to question the accuracy of the species lists obtained from the BirdTrack website. There may be omissions or inaccuracies in these lists as they are updated on an ad hoc basis by amateur bird watchers. Therefore, there is no guarantee that identifications are entirely accurate, and that additional breeding species were missed. However, I was able to obtain more accurate species lists for Low Barns and Derwent Walk Country Park at a date too late to include in this thesis. The species list for Low Barns was a list from the Durham Dales Ringing Group of all the birds that had been

ringed at Low Barns since 1995 (Best, C. Reserve Officer, Durham Wildlife Trust, personal communication, 24/06/11). The species list for Derwent Walk Country Park was from an ornithologist who used to work there (Westerburg, S. Geltsdale Site Manager, RSPB, personal communication, 16/06/11). These lists (shown in Appendix 3, alongside the BirdTrack lists) had a similar diversity to data obtained from the BirdTrack website. Breeding bird diversity, according to Birdrack, was 55 species for Low Barns, and 35 for Derwent Walk Country Park. According to the more accurate lists, breeding bird diversity was 55 for Low Barns, and 37 for Derwent Walk Country Park. This gives me confidence in the accuracy of the breeding bird data for non-RPSB reserves used in this study. However, it is a shame that more consistent reliable data was not available for all the reserves, and future work could verify the data to improve the quality of this analysis, and strength of these conclusions.

In conclusion, respondents had an accurate perception of bird and butterfly diversity. The main factor that determined whether people visited a particular reserve was biodiversity. The other most important factors were the quality of walks in the reserve and how easy visitors found it to relax. Other research has also concluded that these were important tourism motivations. Although respondents regarded good facilities as an important factor, a well stocked teashop and shop achieved comparatively low scores. However, people were also visiting reserves with lower biodiversity for biodiverse reasons, but to a lesser extent. It is encouraging to discover that, according to this research, visitors' considered biodiversity as the most important factor when deciding whether to visit a reserve. Chapter four will investigate whether an increase in biodiversity influenced respondents travel costs, the amount they were willing to pay to enter reserves, and the amount of money spent within the reserve and the local area. The influence that restricted

range and threatened species, and landscape had on visitation will also be further explored in chapter four.

CHAPTER 4: THE ECONOMIC SERVICES THAT PROTECTED AREAS BRING TO THE LOCAL ECONOMY, AND HOW THIS RELATES TO BIODIVERSITY

4.1 Introduction

Although the primary aim of most PA's is to conserve biodiversity and maintain the survival of key species within their borders (Margules & Pressey, 2000; Emerton *et al.*, 2006), it is also important to maximise the revenue generated by reserves, without causing a detrimental affect on conservation. The majority of PA's that allow visitation face the dilemma of promoting tourism, which generates revenue, while at the same time promoting effective conservation of species, habitats and biodiversity (Richard *et al*. 1995). The root of this problem is the reason why many PA's were originally established, often with a focus on nature or wildlife-based tourism, rather than a focus on biodiversity conservation (Leader-Williams *et al.,* 1990b; Entwistle *et al*., 2000). Maximising revenue does not necessarily involve increasing visitor numbers, which could conflict with the protection of biodiversity and species populations. Substantially increasing entrance fees can maximise revenue. Although overall visitor numbers may fall, revenue will be maximised if a sufficient number of people are willing to pay the higher amount (Wadapole *et al.*, 2001; Naidoo & Adamowicz, 2005).

Valuing PA's economically is important in order to measure the wide array of benefits that society receives from them, as these are often underestimated (Dixon & Sherman, 1991). These benefits include goods such as food and timber, and services such as nutrient cycling and waste assimilation. Ecosystem goods and services significantly influence human welfare, both directly and indirectly (Constanza, *et al*. 1997). Constanza *et al*. used a synthesis of published studies and original calculations to value the entire biosphere based on ecosystem services. They concluded that the value was in the range of

US$16-54 trillion (£9.8-33.2 trillion) a year. At the time of Constanza *et al*.'s study global GNP was around US$18 trillion (£11.1 trillion) per year, which puts this value into perspective (Constanza *et al*. 1987). The incredible economic value of these benefits, as well as the ecological value, can be used to justify the maintenance costs of PA's as well as conserving biodiversity within them. Additional studies support and develop Costanza *et al*.'s seminal although somewhat outdated research into the economic importance of ecosystem services; for example, the Economics of Ecosystems and Biodiversity (TEEB) Report, 2010. This report focuses on integrating business development and the protection of ecosystem services, arguing that economic development and environmental conservation can simultaneously thrive. The report highlights that consumers are becoming increasingly more concerned about the environmental impacts of their purchases, resulting in consumers favouring more ecological-certified goods and services. This creates opportunities for businesses and entrepreneurs to create new "biodiversity businesses" that take advantage of increasing environmental awareness, such as ecotourism, organic agriculture and sustainable forestry. Moreover, established businesses can also add value to their companies by focusing on environmental awareness, for example, by reducing input costs through improved efficiency. Furthermore, businesses can penetrate new markets and attract new customers through managing their company to reduce their carbon footprint, or through developing and marketing low impact technologies.

One of the aims of the current research is to discover whether a higher level of biodiversity within a PA increased the amount that visitors were willing to pay to visit, the travel costs that visitors paid, and how much people spent in the reserves, and the locality, during their stay. Calculating the monetary worth of PA's for cost benefit

analyses is also important (Dixon & Sherman, 1991), as assigning numerical values to the benefits of conservation regimes allows them to be directly compared with alternative land use options, such as forestry or agriculture (Hanley *et al.*, 2001). Willingness to pay (WTP) and the Travel Cost Method (TCM) have both been widely used as measures of how highly people value predictor variables, such as biodiversity and restricted range or threatened species (Garrod and Willis 1994; Walpole *et al.* 2001; Fleming & Cook 2008). To date, little research has focused on human preferences towards biodiversity, meaning that conservationists do not have a good understanding of which components of biodiversity appeal to people (Little *et al*., 2001; Stokes, 2007; Lindemann-Matties *et al*., 2010). However, due to the current rate at which global biodiversity is declining, this topic of research has never been more relevant. It is likely that many species will only survive if humans choose to assign funds towards their conservation (Stokes, 2007). Therefore, the preservation of biodiversity essentially depends on how highly humans value it (Edwards & Abivardi, 1998; Sanders *et al*., 2006).

In this study PA's were economically valued by estimating how biodiversity affects PA revenue and, additionally, the revenue they generate for the local economy. If the level of biodiversity within a reserve influences the visitor spend in the local area, this could encourage support from local businesses that rely on tourism, and in turn promote local support for protecting biodiversity within PA's.

It is important to understand how highly the public value PA's. All of the reserves covered in this study encourage public visitation. This is particularly true of organisations such as the RSPB, as the majority of their funding is generated through membership fees. It is thus important for the RSPB to take note of the opinions of their members as well as

other visitors who could be potential new members. The information that I collected from reserves can be used to generate a quantitative measure of how highly respondents valued reserves, as explained further in the methods section.

In chapter three, I concluded that visitors to the reserves I sampled had an accurate perception of bird and butterfly diversity, and that they were visiting reserves for biodiverse reasons. In this chapter the a range of attributes of nature reserves were analysed and assessed against how well each attribute explains various measures of respondents economic valuation of the reserve. The aim of this was to conclude which aspects of biodiversity generated a higher economic value from the valuation methods utilised, and therefore which elements of biodiversity visitors valued the most. This information could be used by PA managers to make informed decisions about which areas of biodiversity conservation should be prioritised, and to justify funding towards different areas of biodiversity conservation. Moreover, it could be used to gain the support of local people and businesses if increased biodiversity is likely to heighten tourism to the reserves in their area.

4.2 Methods

This chapter is also based on the data collected from my questionnaires, administered at eight reserves in the UK (see section 3.1 and 3.2 of chapter three for further information on my questionnaire and study sites, and Appendix 1. for the questionnaire). I utilised the contingent valuation method (CVM) in my questionnaire (Moran 1994; Cummings & Taylor 1999; Wiser 2007), specifically measuring visitors' willingness to pay (WTP). CVM involves directly surveying the public by using questionnaires to estimate the economic value (their WTP) of non-market goods, such as the presence of a particular species (White *et al.*, 2001). According to this method, the more a person is willing to

pay, the more they value the particular resource (White & Lovett, 1999). However, CVM is hypothetical, and data based on actual behaviour has a greater credibility in economic valuation (Richard *et al.*, 1995). Therefore, I have also used the travel cost method (TCM) to estimate the public's economic valuation of breeding bird diversity, and other predictor variables. TCM is based on the theory that the more time a person has spent travelling to a site, the higher they value it (Randall, 1994). Time, or an alternative travel cost, is interpreted as an indirect cost, which is used to assess the value of a visit to a PA. Logically, the visitor must perceive the value of the PA as being greater than the cost of travelling (Herath, 2004). I calculated travel cost by multiplying an estimated fuel cost per mile (13.39p), as quoted on the Automobile Association's website (www.theaa.com; accessed May 2011), by the number of miles respondents travelled to the reserve (generated by their postcode). Not all participants were willing to give their post code, despite reassurances that all information would be held confidential. However, the vast majority (229 out of 232) were willing to give at least the first section of their postcode, which provided a relatively accurate estimation of the distance travelled. This figure was divided by the number of people in the respondent's party, in order to generate TCM per person (hereafter referred to as TCM). Previous TCM studies focused on in my Literature Review (chapter one page 23) also determined TCM value using placing a value on time (such as one third of wage rate) and using time travelled as an opportunity cost (Mendelson & Brown 1983; Chen *et al.* 2004; Gurluk & Rehber 2007). I decided not to include an opportunity cost in this study, such as one third of a person's income, because a significant number of responds were either unaware of, or refused to disclose their annual household income. If an opportunity cost had been included in this study it may have influenced the results and therefore the conclusion. Navrud and Mungatana (1994) utilised both TCM and CVM in their study in order to compare results and compare the

validity of the methods. Navrud and Mungatana concluded that it was difficult to decide which technique was preferable; therefore it was advisable to use both. The arguments for and against using the different evaluation methods are discussed in more detail in my introductory chapter.

The specific questions from the questionnaire that this chapter focuses on are question 10, question 19 and question 22; with breeding bird diversity being used as a measure of biodiversity. Questionnaires were conducted between May and early August, when breeding birds were present. Question 19 asked respondents: "What do you think is an appropriate entrance fee per person to visit a PA equivalent to this particular nature reserve?" All respondents were asked to suggest an appropriate admission price for an adult non member. This question was open-ended, to provide a continuous data set and to ensure that respondents were completely free to choose any amount they felt appropriate. Because question 19 focuses on visitors WTP to visit, rather than their WTP to improve or keep the attributes of the reserve, it does not measure their WTP for the total economic value of the reserve. Therefore question 19 is directed at the marketing aspect of reserves, isolating the use-values within the total economic value framework. Not all of the reserves had the same policy for charging visitors; for example, Minsmere charged per adult, child or family whereas Saltholme charged per car. Because of this variation in pricing, it was not possible to compare WTP values with the actual admission charge for the reserves sampled.

Data from question 10 was also analysed in this chapter, asking respondents: "In total, approximately how much will your party spend in the local area today on: accommodation, entry fees, entertainment, fares and petrol, meals and drinks, gifts and

souvenirs and other." This data, in combination with site biodiversity data, was used to determine the effect of biodiversity on how much respondents spent on the day of their visit. An assumption has been made that local spend (money spent by respondents who lived within 10 miles of the reserve) is attributed to the reserve, and therefore would have been spent elsewhere in the absence of the reserve. However, as I interviewed each respondent personally I was able to omit local spend that was obviously not related to the reserve, such as money spent the same day on a weekly food shop, from the results. The estimated individual spend on the day was also multiplied by the number of nights visitors stayed in the locality to estimate the total spend over the duration of the trip, assuming that the amount respondents spent on the day represented an average for their visit. Both the money spent on the day and the calculated money spent throughout the total visit was divided by the number of people in the party, to generate an estimate of the mean spend per person in the party. Spend in the PA/region was also related to the landscape score visitors provided in the questionnaire (in question 18, respondents scored the quality of the landscape from 1-5: 1= very poor, 2= poor, 3= OK, 4= good and 5= excellent). Four response variables were used in the analysis of this chapter: respondents' WTP, TCM, money spent on the day of visit, and calculated money spent. For each response variable, linear, asymptotic and logistic fits for each predictor variable were compared to the null (Table 4.2.3). The predictor variables for these models were breeding bird diversity, restricted range species score (as defined in chapter two, section 2.2), the number of Red listed species, the number of Red and Amber listed species, Red listed species score, Red and Amber listed species score (as defined in chapter two, section 2.2) and landscape score. Initially each of the predictor and response variables were modelled separately. The mean values of money spent data were logged when represented graphically in order to normalise the data. Subsequently, all of the predictor and response variables were

modelled together to determine which predictor variable best fitted each response variable. Because some variables had an uneven distribution, the natural log of all variables was also modelled against each response variable in the combined analysis.

The log-likelihood (LL) of each model was calculated for the data assuming a gamma-distribution (see Richards (2008) for details). The Akaike information criterion (AIC) values for each model were calculated using equation (1)

$$\text{AIC}\ (M_x) = -2LL + 2K \qquad (1)$$

where M_x represented the model, LL log-likelihood, and K the number of parameters. Delta AIC values are used as a measure the accuracy of a model. For each response variable the models with a delta AIC of 0 was accepted as the best fitting model, and models with delta AIC values that are equal to or less than 6 (so long as they have fewer parameters than the best fitting model) were also accepted as fitting models. See Table 4.2.1 and figures 4.2.1 and 4.2.2 for further clarification about these models and their parameters.

Table 4.2.1 A summary of the mean relationship between variable x (one of the examined predictor variables, e.g. breeding bird diversity) and y (the response variable, e.g. mean willingness to pay) using four different models. β represents the different parameters (see fig. 4.2.1 and 4.2.2 for further

Model Name	Equation for the mean $\mu(x)$	Brief Description
M_1	β_0	Constant
M_2	$\beta_0 + \beta_1 x$	Linear
M_3	$\beta_0 + (\beta_2 - \beta_0)(1 - e^{-\alpha x})$	Asymptotic
M_4	$\dfrac{\beta_0 + (\beta_2 - \beta_0)e^{\alpha(x-\beta_1)}}{1 + e^{\alpha(x-\beta_1)}}$	Logistic

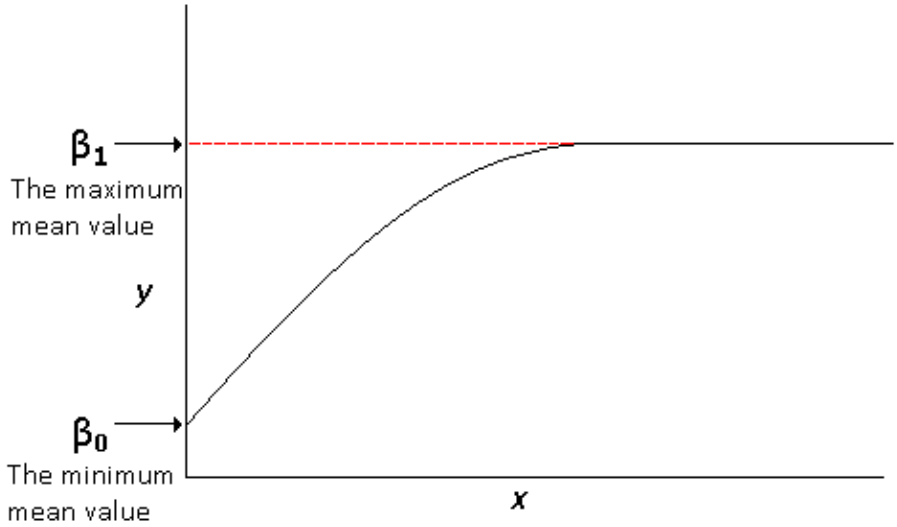


Figure 4.2.1 An asymptotic curve demonstrating the meaning of the β_0 and β_1 parameters. This corresponds to M_3 in Table 4.3.2. y is either biodiversity, willingness to pay or distance travelled to the reserve; and x is one of the examined predictors variables, for example breeding bird diversity.

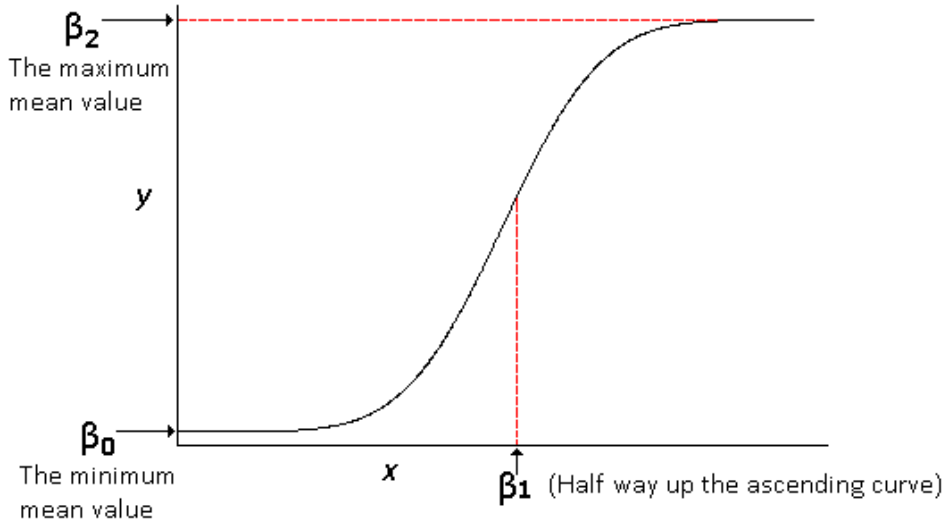
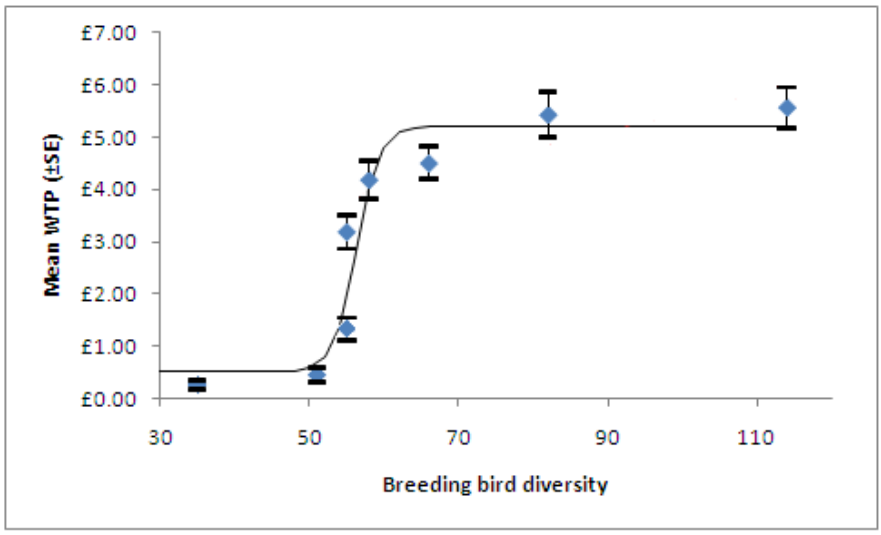


Figure 4.2.2 A logistic curve demonstrating the meaning of β_0, β_1 and β_2 parameters. This corresponds to M_4 in Table 4.3.2. y is either biodiversity, willingness to pay or distance travelled to the reserve; and x is one of the examined predictors variables, for example breeding bird diversity.

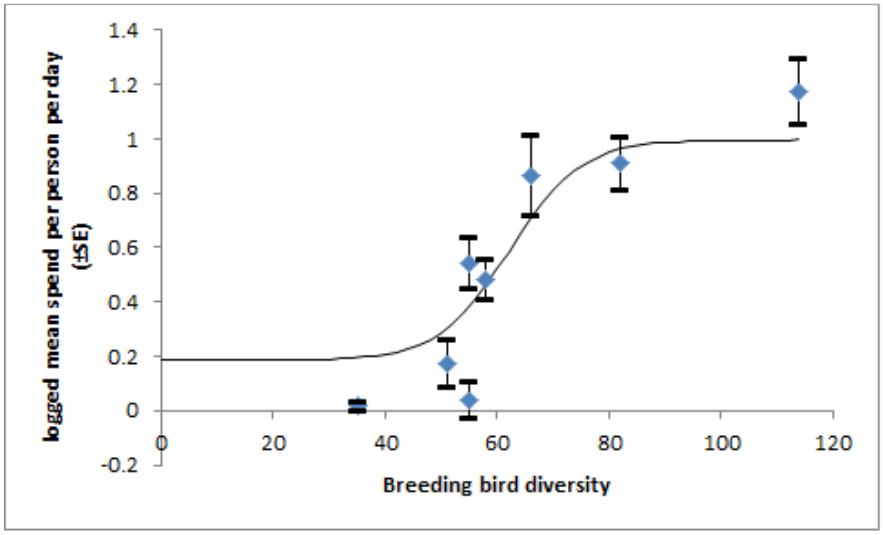
4.3 Results

There was a logistic relationship between breeding bird diversity and mean WTP (fig 4.2.1a). β_1 for breeding bird diversity was 57, meaning that the amount that visitors were willing to pay increased substantially beyond 57 bird species. β_2, the mean maximum amount that should be charged, according to the model of best fit, was £5.21, only £0.21 over the actual entrance fee. Breeding bird diversity also had a logistic relationship with logged mean money spent per person, per day (fig 4.3.1b), and the logged mean calculated spend over the total visit (fig 4.3.1c). In these analyses β_1 was 59 and 65 respectively. This shows that, for these reserves, the amount of money spent in reserves and the locality on the day increased at around 59 breeding bird species. This number was higher for calculated money spent over the total visit, implying that only reserves with higher breeding bird diversity had visitors who were staying in the location for multiple days.

A



B



C

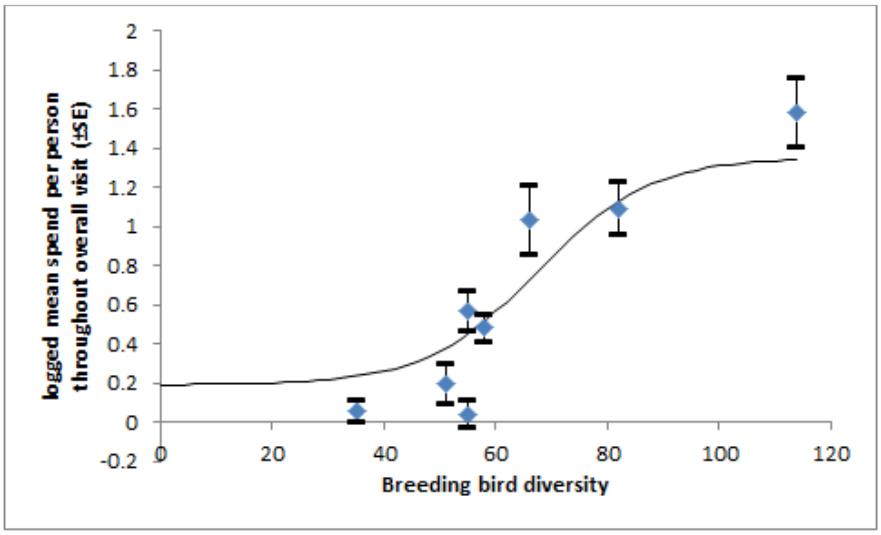


Figure 4.3.1. The relationship between breeding bird diversity and A, *mean willingness to pay (±SE)*, B, *logged mean spend per person (±SE)*, and C, *logged mean spend per person throughout the overall visit (±SE)*. All of the models of best fit for these results were logistic.

The best fitting models for each response of the combined analysis, where all predictor variables were modelled against respondents' WTP, TCM, money spent on the day of visit, and calculated money spent, are illustrated in figure 4.3.2. All of the models that fitted the acceptance criteria are shown in Table 4.3.1. From figure 4.3.2 and Table 4.3.1 it is apparent that the best fitting model for willingness to pay was the number of Red listed species. For the Travel Cost Method it was breeding bird diversity and for money spent, and calculated spend per person was the number of Red and Ambler listed species. All of the best fitting predictors were based on species richness rather than the rarity of birds, as indicated by the "species score" variables, although some of the species score predictors still met the acceptance criteria for fitting models (Table 4.3.1). None of the models that fitted the acceptance criteria were the null model, indicating that the response variable always increased as the predictor variables increased. For all of the models which compared number of species (breeding bird, Red or Red and Amber) to WTP, the logistic model had the lowest AIC value. This implies that respondents WTP increased dramatically once species number had exceeded a certain level (β_1).

Table 4.3.1. A summary of the combined AIC analysis. For each response variable, linear, asymptotic and logistic fits for each predictor are compared to the null. Only ΔAIC values that fit the acceptance criteria (less than 6, with equal or less parameters than the model of best fit) are displayed, and models of best fit are highlighted with an asterisk.

Model	**Response Variable**	**Predictor variable**	**K**	**AIC**	**ΔAIC**
Logistic	WTP	Number of Red listed species	5	-622.451	0.000*
Logistic	WTP	ln Number of Red listed species	5	-622.436	0.015
Logistic	TCM per person	Breeding bird diversity	5	-679.576	0.000*
Linear	TCM per person	Red listed species score	3	-677.753	1.823
Asymptotic	TCM per person	Red listed species score	4	-675.770	3.806
Logistic	TCM per person	ln Number of Red listed species	5	-675.727	3.849
Logistic	TCM per person	Red listed species score	5	-675.534	4.042
Logistic	TCM per person	ln Number of Red listed species	5	-674.846	4.729
Logistic	TCM per person	Red listed species score	5	-674.803	4.773
Logistic	Money spent per	Number of Red and Amber	5	-	0.000*

Table 4.3.1 continued.

	person	listed species		1707.988	
Linear	Money spent per person	Red and Amber listed species score	3	-1706.971	1.017
Logistic	Money spent per person	ln Number of Red and Amber listed species	5	-1706.182	1.806
Asymptotic	Money spent per person	Red and Amber listed species score	4	-1705.442	2.546
Linear	Money spent per person	Number of Red and Amber listed species	3	-1705.094	2.893
Logistic	Money spent per person	ln Red and Amber listed species score	5	-1703.204	4.784
Logistic	Money spent per person	Red and Amber listed species score	5	-1703.093	4.895
Asymptotic	Money spent per person	Number of Red and Amber listed species	4	-1702.878	5.110
Linear	Calculated money spent per person	Number of Red and Amber listed species	3	-2443.898	0.000*
Linear	Calculated money spent per person	Red and Amber listed species score	3	-2442.910	0.988

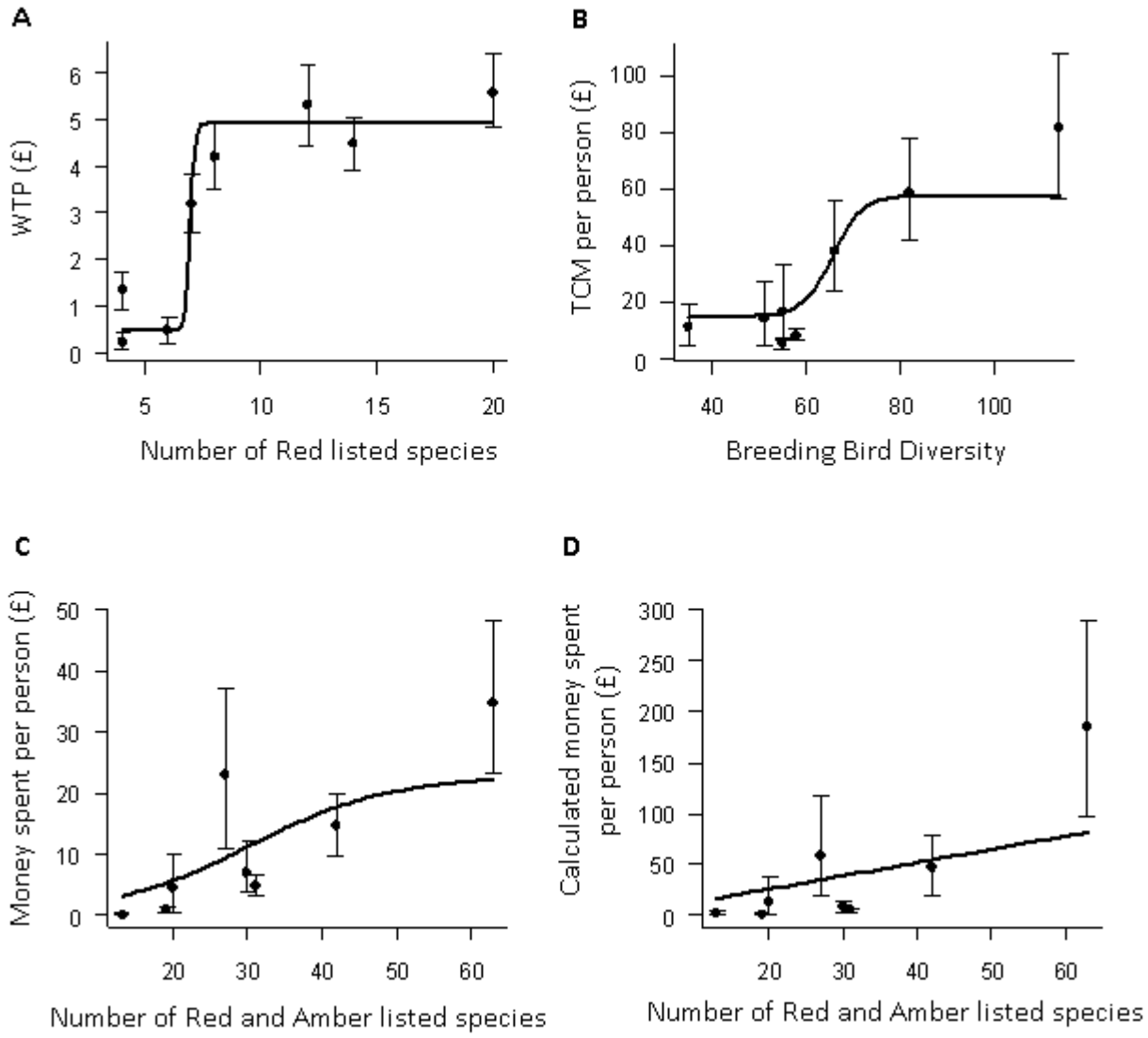


Figure 4.3.2. The models of best fit for the four combined response variables investigated: **A** *WTP*; **B** *TCM per person*; **C** *Money spent per person* and **D** *calculated money spent per person* (as defined in the methods section). Mean and the 95% bootstrapped confidence intervals of the mean are plotted for each reserve. AIC and ΔAIC values for these models of best fit are shown in Table 4.3.1.

β_2 for WTP (see fig 4.2.2) was £4.95, for TCM was £58.08, for money spent on the day of visit was £22.83, and the mean maximum estimate for calculated money spent was £81.80. Additionally, the model of best fit for calculated money spent per person is a linear relationship. This implies that the amount of calculated money spent has not reached its mean maximum threshold, and that if the number of Red and Amber listed species increased, that calculated money spent could rise. The β_2 values generated by the

models of best fit are significantly higher estimates than the β_0 values, the mean minimum that respondents spent where the predictor variable were 0. β_0 was £0.51 for WTP, £15.00 for TCM, £0.00 for money spent on the day of visit, and £0.01 total calculated money spent. From the table of parameter weights (Table 4.3.2) it is apparent that, of the predictors examined, numbers of Red and Amber listed species were usually the most informative, and their parameter weight was higher than breeding bird diversity. Landscape scores, and scores based on restricted range species were rather less compelling, as they had a parameter weight of 0, and therefore are not included in Table 4.3.2.

Table 4.3.2. A summary of parameter weights for all the predictor and response variables examined in the combined analysis. Predictor variables with a grand total of zero weighting on the parameters are not shown. These were restricted range species scores, and the perceived quality of landscape. The highest, and therefore most important, predictors for each response variable are highlighted with an asterisk.

Predictor variables	**WTP**	**TCM per person**	**Money spent per person**	**Calculated money spent per person**	**Grand Total**	**Percentage weighting**
Number of Red and Amber listed species	0.009	0.001	0.472*	0.435*	0.917	23
Red and Amber listed species score	0.009	0.000	0.348	0.359	0.716	18
Number of Red listed species	0.484*	0.059	0.001	0.014	0.558	14
ln Number of Red listed species	0.480	0.071	0.000	0.001	0.553	14
Breeding Bird Diversity	0.008	0.489*	0.000	0.000	0.498	12
Red listed species score	0.000	0.315	0.000	0.000	0.315	8
ln Number of Red and Amber listed species	0.000	0.000	0.146	0.146	0.292	7
ln Red and Amber listed	0.009	0.000	0.033	0.043	0.085	2

Table 4.3.2 continued.

species score						
ln Red listed species score	0.000	0.065	0.000	0.000	0.065	2
ln Breeding bird diversity	0.001	0.000	0.000	0.002	0.003	0
Grand Total	1.000	1.000	1.000	1.000	4.000	100

4.4 Discussion

In this chapter, four methods of establishing the economic value of biodiversity have been compared against several predictor variables to establish the economic value of biodiversity. Even though each individual relationship had different models of best fit, M_1, the null model, was not accepted as a model of best fit for any relationships. Therefore, in all cases the economic valuation rose as the different aspects of biodiversity studied increased. This is apparent by the large differences between the β_0 and β_2 values of the models of best fit, particularly for the money spent responses.

In the combined analysis, WTP showed a logistic relationship with the number of Red listed species (fig. 4.3.2a). Visitors were willing to pay a dramatically increased admission fee once the number of Red listed species had exceeded a threshold figure of approximately 7 species. Unfortunately, a comparison of WTP and actual entrance fee could not be made, as the reserves sampled used different methods for charging entrance fees. However, the mean maximum value generated for the model of best fit was £4.95, only £0.05 less than the reserve with the highest number of Red listed species charged for non member entrance. This implies that, at least at the top end of the scale, pricing appears to be appropriate. WTP, mean money spent on the day, and mean calculated money spent also had a logistic relationship with breeding bird diversity when modelled separately (fig 4.2.1). This research suggests that once biodiversity exceeds a certain threshold (about 57-59 breeding bird species), that visitors are willing to pay higher

entrance fees, and spend more money in the reserves and locality. These results cannot be assumed to represent all PA's in the UK, as a much larger study incorporating a far wider range of PA's would need to be conducted to come to any conclusions on a UK wide scale. However, it does show that the public's economic valuation of reserves increasing logistically along with biodiversity, and that reserve managers should aim to actively manage their bird diversity. If a larger study was conducted, and reached similar conclusions, these results could be used when appealing to funding bodies, to show that, in the long run, an increase in biodiversity is likely to lead to an overall increase in revenue.

A study by Mladenov *et al*. (2007) examined whether a decrease in biodiversity in the Okavango Delta, Botswana, would influence its economic valuation by the public. A total of 201 tourists who had recently visited the Delta were questioned. The mean WTP per person per annum was US$60 (£37.08), indicating that tourism could generate a large amount of funding that could be directed towards the management of the Delta. Only 29% of respondents stated that their WTP would not decrease if wildlife viewing was diminished. Therefore, Mladenov *et al*.'s study emphasised the importance of visible biodiversity in generating higher WTP figures, in a similar manner to this study. Mladenov *et al*.'s also found in their study that biodiversity positively influenced values generated by the TCM.

Respondent's valuation of the quality of the landscape did not appear to influence any of the four response variables. This indicates that landscape quality is not a primary factor for attracting visitation to PA's. By contrast, previous studies have concluded that the aesthetics of natural areas play a significant role in attracting tourism. For example, that

the scenic beauty of mountain ranges attracted tourists to mountainous landscapes (Beza, 2010). Weber *et al.* (2002) questioned residents in coastal areas of Croatia about their willingness to pay for local forest protection and regeneration programmes. The majority of locals questioned were willing to pay for forest protection (72% of 378 participants) and regeneration (71% of 101 participants), with the most frequently cited reasons being the "beauty of the surrounding area" and "it's preservation for future generations". However, the forests studied by Weber *et al*. may not have been specifically managed for their biodiversity, unlike the sample sites of this study, which could explain why the importance of landscape aesthetics prevailed. Other studies have concluded that the public value the conservation of nature over the conservation of scenic landscapes. An example is the study by Bienabe and Hearne (2006), who found that both Costa Rican residents and tourists were willing to pay more to support nature conservation than scenic beauty.

For the majority of reserves, the mean data points for biodiversity against money spent on the day, and money spent over their total stay were similar, as the majority of visitors to less biodiverse reserves were local, or were only visiting the area for a day. Therefore, spend on the day of visit was the same as their calculated spend. For the two reserves with the highest biodiversity, Minsmere and Leighton Moss, many of the respondents were staying in the area for longer than a day, and therefore spent considerably more on their overall visit. I was originally concerned about analysing visitors' total spend. More money could have been spent at reserves with higher biodiversity purely because these reserves presented more opportunities for spending, as many of them had larger shops and cafes. However, the amount spent in reserve shops and cafes is negligible when compared to accommodation expenses.

Visitors' total spend is a direct measure of the impact that visitors provide for businesses and residents in the locality of a PA. My results have indicated that a greater number of threatened species led to an increased spend, particularly for the total spend. If local businesses could be persuaded that heightening biodiversity would attract more visitors to the area, they may be more likely to support local biodiversity conservation schemes. Previous research conducted on local attitudes about PA's has primarily focused on less economically developed countries, such as Ecuador (Fiallo & Jacobson, 1995), Tanzania (Newmark *et al*., 1993), and India (Sekhar, 2003). Fiallo and Jacobson (1995) and Newmark *et al*. (1993) reported that the local people had a negative attitude towards PA's. This was because prevalent rural poverty meant that locals resented not having access to a PA's natural resources. However, Sekhar (2003) also found that there was a correlation between the benefits that local people received from conservation as a result of wildlife tourism and support for the existence of protected areas. Therefore, if businesses were made more aware of the potential profit they could gain from increasing biodiversity in local reserves, they may be more supportive of biodiversity conservation.

Previous studies have also indicated that charismatic species play a vital role in visitors WTP. For example, White *et al.* (1997; 2001) found that charismatic species such as the Otter (*Luta lutra*) generated significantly increased WTP values in comparison to common species, such as Brown hares (*Lepus europaeus*), which are considered less charismatic. This is relevant to my study because all four of the mammal species that White *et al.* compared were threatened, but the public were still willing to pay significantly more for species they considered charismatic. Unfortunately, in this chapter restricted range and threatened species scores were generated based on the number of restricted range and threatened species, and their range; therefore how charismatic a species was was not taken into account. However, Tisdell *et al.* (2006) found contrasting

results to White *et al*. (1997; 2001). Tisdell *et al*. explored how species conservation status and likability influenced the public's support for action to conserve said species. Their results concluded that respondents were willing to allocate more hypothetical funding towards the conservation of species in relation to how endangered they were, rather than their likability. However, the respondents to the survey had been briefed with information concerning how endangered each of the species they valued was, which could have influenced the results.

This study could be extended by modelling additional, non biodiversity related factors to response variables, for example proximity to other tourist attractions. Mcneely *et al*. (1992) stated that one of the factors likely to increase a PA's tourist potential is being close to other tourist attractions, such as beaches or cultural features. The exploration of additional variables would put this research into context, meaning that stronger conclusions could be made about the influence of biodiversity on the four response variables explored. Additionally, other aspects of biodiversity should be explored, such as a wider range of taxa, in order to gain a better understanding of how highly visitors to PA's value biodiversity within the UK.

In conclusion, as breeding bird diversity increased, WTP, TCM and money spent values, as generated by models of best fit, increased. This suggests that visitors value biodiversity not just on its diversity but also on its rarity, as reported in other studies (Tisdell *et al.* 2006). Respondents did not appear to be attracted to reserves solely because of a highly-rated landscape. In most cases, reserves with higher breeding bird diversity and higher restricted ranged and threatened species scores also have better facilities. Nonetheless, as the results of chapter three demonstrated, and the results of the current chapter reinforce,

visitors are willing to pay higher entrance fees and endure higher travel costs to visit biodiverse reserves for their biodiversity, rather than for non-biodiversity related reasons.

There appear to be thresholds above which respondents are willing to pay more to visit. Therefore, in order to generate maximum revenue, reserves should focus on increasing the biodiversity of bird species, particularly the number of threatened species, which would justify increasing entrance fees. This should be used as an argument to support the conservation of biodiversity, in addition to the other essential reasons, such as the vast impact that biodiversity has on the functioning of ecosystem services (Constanza, *et al*. 1997; Worm *et al.* 2006; Balvanera *et al.* 2001).

CHAPTER 5: THE CONCLUSIONS OF THIS STUDY AND THEIR IMPLICATION ON RESERVE MANAGEMENT AND BIODIVERSITY CONSERVATION POLICIES

5.1 Conclusion

Willingness-to-pay (WTP) and travel cost method (TCM) approaches can provide an economic valuation quantifying the public's value of a non-market good (White & Lovett 1999; Herath 2004). In this thesis I have used these methods to value different aspects of biodiversity (primarily focusing on bird biodiversity) through conducting questionnaires at eight PA's across the UK. Breeding bird species richness, the rarity of species and the presence of threatened species, were used as indicators of overall bird biodiversity. The conclusions reached were that WTP, TCM and the amount of money that people spent, in the reserve and locality, all had a logistic relationship with bird diversity. Out of the predictors tested, the best indicator for WTP was the number of Red listed species and that respondents' mean maximum WTP to visit a PA with the equivalent biodiversity to the most biodiverse reserve in this study was £4.95, only £0.05 less than the actual entrance fee for this reserve. The best indicator for TCM was breeding bird diversity and respondents' mean maximum travel costs were £58.08. The best indicator for money spent in the reserve and locality both on the day of visit, and throughout the overall visit, was the number of Red and Amber listed species. The mean maximum estimate for money spent on the day of visit was £22.83 and for the total visit £81.80. None of the models that fitted the selection criteria were the null model, indicating that an increase in all predictors tested led to an increase in the response variables.

The differences in results between WTP and TCM may have been due to the variation between the WTP and TCM techniques used in this study. The WTP method focused on exploring the marketing aspect of the PA's sampled, and therefore did not capture respondents' total economic valuation (TEV) of the PA's visited. Conversely, TCM generated an actual calculated cost, rather than a hypothetical cost, covering all aspects of TEV. However, the results for the TCM may have differed if time travelled had have been calculated as an opportunity cost in this study.

Mladenov *et al*. (2007) also concluded that higher biodiversity led to an increase in WTP and TCM values. Tisdell *et al.* (2006) reported that the public assigned a high economic value to threatened species. Analysis of visitor spending patterns in my study also supported these conclusions, as spending increased with biodiversity, specifically the number of threatened species within reserves. Sekhar (2003) found that there was a correlation between the benefits that local people received from wildlife tourism and their support for protected areas. Therefore, if businesses were made more aware of the economic benefits of increasing biodiversity in protected areas they may be more supportive of local conservation projects.

As well as investigating the economic value of biodiversity to PA visitors, this study also explored respondent's perceptions of biodiversity by asking then to estimate bird, butterfly, mammal and plant species richness. Results showed that respondents had an accurate perception of both bird and butterfly diversity. Unfortunately the accuracy of mammal and plant estimations could not be explored due to lack of data available from reserves. Fuller *et al*. found that visitors to public green spaces had an accurate perception on plant species richness, but did not find a significant relationship between actual and

estimated bird species richness. Lindemann-Matties *et al*. (2010) recorded that the mean perception of species richness increased with true species richness, but was marginally overestimated at low species richness, and underestimated at higher levels. In my study respondents demonstrated that they valued bird diversity more highly as species richness increased.

Chapter three also investigated respondent's motivations for visiting reserves, in order to establish whether biodiversity related factors were more important in attracting visitors. This research concluded that the main factor which determined whether people visited a particular reserve was its level of biodiversity. The quality of walks and how easily visitors found it to relax were also important contributory factors. Previous research has supported these findings (Barnes *et al.* 1999; Naidoo and Adamowicz 2005; Van der Merwe & Saayman 2008). Respondents regarded good facilities, such as car parking and toilets, as an important factor. However, a well stocked teashop and shop were found to be comparatively unimportant. This research also revealed that the majority of respondents were visiting for reasons related to biodiversity, irrespective of the level at the reserve.

Chapter two investigated the fundamental differences in factors that influence visitation and the relative magnitude of these effects. Monthly variations in visitor number were also explored. Seventeen reserves across the UK were investigated, only three of which overlapped with the PA's studied in chapters three and four. Conversely to the results reported in chapters three and four, biodiversity was not found to be an important factor in relation to visitor numbers. This may be because a larger number of reserves were included in the chapter two analyses, or because a narrower range of breeding bird diversities were explored than in chapters three and four. However, the presence of rare

bird species in reserves did appear to positively influence visitation across reserves during the breeding season, and monthly visitation for the nineteen month data set. Although the mean number of rare bird days was regarded as separate to biodiversity in this analysis, it still fell under the category of biodiversity related motivations for visiting (as employed in chapter three). The predictor variables that had the greatest impact on monthly variation in visitor numbers for the nine month data set were mean monthly temperature and the proportion of the month in the school holidays. The predictor variables that had the greatest impact on monthly variations for the eighteen month data set were mean monthly temperature and the presence of rare bird species. However, biodiversity was not explored as a factor in monthly variation because individual monthly lists of breeding birds were not available. In chapter three the influence of weather variables as a motivation for visiting reserves was not explored, and therefore this could be a potential extension of this study.

Globally biodiversity is declining at an unprecedented rate (Blaustein & Kiesecker 2002; Clausen and York 2008; Clausnitzer *et al*. 2009). There are multiple reasons for conserving biodiversity. These include the plethora of ecosystem goods, functions and services that a biodiverse ecosystem provides (Hector *et al*. 2001; Balvanera *et al*. 2006), the psychological benefits of biodiversity to humans (Ulrich, 1984), and the public's aesthetic appreciation of biodiversity (Lindemann-Matthies *et al*., 2010). Public perception and valuation may seem trivial reasons for biodiversity conservation when compared to the impact of biodiversity on crucial ecosystem services, such as waste decomposition, carbon sequestration and climate regulation. However, it is important to assess public support for biodiversity conservation. An awareness of public preference could be used to generate a more accurate forecast of their reaction to biodiversity

management measures (Fisher and van der Wal, 2007; Fisher and Young 2007). Moreover, public backing is essential, and can act as a catalyst for creating change in government policies. A recent example of this is the "Save Our Forests" campaign. This was led by a multitude of organisations, including 38 Degrees, The Woodland Trust, The National Trust, The World Wildlife Foundation and Greenpeace (38 Degrees, 2011). In 2010 the government announced the sale of a significant proportion of Britain's publicly owned national forests to the private sector in order to reduce the national deficit. These privatised forests could, for example, be felled, fenced off, or converted for recreational uses. Over half a million members of the public signed the petition against this policy, and on February 17th 2011 it was announced that the policy was to be revoked (38 Degrees, 2011).

It would be inappropriate to use the results of this study as a direct measure of the public's perception and valuation of biodiversity in all PA's in the UK, as only a small subsection of PA's that encourage visitation have been studied. Therefore a potential expansion of this research would be to repeat this study on a larger scale, and to also explore additional variables which could influence respondent's economic values, and hence putting this research into context. Furthermore, the majority of this study focused on bird diversity. In order to gain a better understanding of visitor's valuations of PAs other taxa should be also be economically valuated. Unfortunately this was not within the scope of this study due to limitations in time and access to reserves. However, this study *does* show, that for the reserves investigated:

- respondents had an accurate perception of bird and butterfly species;
- the primary motivation for visiting was biodiversity;
- respondents WTP, travel costs, and total spend increased as biodiversity increased;

- that initial exploration of visitor data indicated that the most important factor in influencing visitation across reserves during the breeding season was the presence of rare bird species, a factor related to biodiversity.

Results of this study indicate that, in general, the public have an accurate perception of species richness, and a high economic valuation of biodiversity. Therefore, managers of PA's that encourage visitation in the UK should focus on increasing biodiversity within their reserves in order to attract visitors and to justify an increase in entrance fees. Theoretically, PA managers could use the public's high valuation of biodiversity to justify funding for biodiversity conservation projects, although in reality this would require further research on a larger selection of PA's. However, this study focuses solely on questioning people who are already visiting PA's, and therefore must already value them in some capacity. It does not sample anyone from the UK tourism market who may have little or no interest in nature and biodiversity.

The UK nature tourism market is only a limited percentage of the whole tourism market, and reserves have to compete with each other for this business. However, as the public become more aware of biodiversity this market does have the potential to increase. Therefore, as well as endeavouring to increase biodiversity to encourage their current visitors to return, reserve managers should also make use of their non-biodiversity related aspects to try and attract the non-nature related UK tourism market. This could include advertising features such as their scenery and tea shops, which are also likely to be enjoyed and generate revenue from some of the people visiting for the biodiversity related reasons. This is of crucial importance in the current economic climate where the government are making funding cuts and public resources, such as PA's, have to be more

economically self-sustainable. Reserve managers could take advantage of the current recession by marketing trips to their reserves as a cheap family day out in comparison to other alternatives such as the cinema. As well as being cheaper, reserves have the added health benefits that many parents might be interested in if they were aware of them.

There is a multitude of evidence that nature and biodiversity has a positive influence on human welfare, as previously discussed. PA's should be used as tools to encourage public access to biodiversity and the benefits that biodiversity brings. When outlining policies about biodiversity conservation both the positive impact that biodiversity has on the economy and health need to be included. The marketing of biodiversity conservation no longer needs to be based solely on the ethical argument, but can focus on the multitude of evidence that biodiversity is beneficial to health, as well as playing a crucial role in maintaining ecosystem services and presenting business opportunities. Public awareness and attitude towards biodiversity conservation is heading in the right direction. It is now essential that the benefits and opportunities of biodiversity conservation are made common knowledge within businesses and, when appropriate, reserves should be run as businesses with a focus to increasing profit whilst simultaneously conserving biodiversity. An example of profitable biodiversity conservation is the expanding ecotourism market abroad. The primary focus of reserve mangers and policy makers should be to conserve biodiversity, make reserve profitable and to eliminate the assumption that biodiversity conservation has to be costly rather than profitable.

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Appendix 1: Questionnaire conducted at Study Sites

This research is being carried out by **Durham University**, in association with the **RSPB**. It is designed to explore why people visit nature reserves; consequently, we are interested in ***your*** opinions of this reserve. We would be very grateful if you could take time out of your visit to fill in this questionnaire.
Any information you provide us with will be anonymous and remain confidential.

Q1. Approximately, how long did/ will you be spending visiting this reserve today?

Less than 1 hour	☐	3-6 hours	☐
1-3 hours	☐	7 or more hours	☐

Q2. How often do you visit the following places....

	Never visited before	Weekly	Monthly	Quarterly	Biannually	Yearly	Less often
This particular nature reserve	☐	☐	☐	☐	☐	☐	☐
Other nature reserves	☐	☐	☐	☐	☐	☐	☐

Q3. Please score which of the following are most important to you when deciding whether to visit a nature reserve. *Please give a score of 1-5, with 1 being unimportant, 2 being of small importance, 3 being of average importance, 4 being important and 5 being very important.*

Proximity to home	☐
Good facilities , e.g. plentiful car parking, toilets	☐
A well stocked teashop	☐
A well stocked shop	☐
A scenic landscape	☐
A variety of wildlife which is easily viewable	☐
The presence of particular key species which are easily viewab	☐
The quality of walks in the nature reserve	☐
A relaxing atmosphere	☐

Q4. Please score the following statements concerning why nature reserves are important. *Please give a score of 1-5, with 1 being unimportant through to 5 being very important, as in Q2, and specify any other reasons you may have for visiting.*

To protect endangered species	☐
To protect a wide range of species	☐
To conserve high quality landscapes	☐
To preserve species for future generations	☐
To provide a place for recreational activities	☐
To provide a place for rest and relaxation	☐
To educate people about nature and ecological issue	☐

Other *(please specify)*.....

Q5. Why have you chosen to visit this particular nature reserve? *Please select all those that apply*

	Influenced my to visit	Main reason for visiting	decision
It is near to where I live/ where I am visiting	☐	☐	☐
It has good facilities	☐	☐	☐
I like the scenery	☐	☐	☐
There is lots of wildlife here for me to view	☐	☐	☐
I came to view a particular species	☐	☐	☐
There are a large number of uncommon/ rare species here	☐	☐	☐
I enjoy the walks this nature reserve has to offer	☐	☐	☐
I find it easy to relax in this particular nature reserve	☐	☐	☐
It was recommended by a friend/ guide book/ website	☐	☐	☐
To encourage children's interest in what is here	☐	☐	☐
To improve my own knowledge/ understanding of what is here	☐	☐	☐
To meet friends/ relatives	☐	☐	☐
A chance to see birds	☐	☐	☐
See historic buildings/ sites	☐	☐	☐
Get some exercise/ fresh air	☐	☐	☐
To attend a guided walk	☐	☐	☐
To take part in a specific event	☐	☐	☐
I have a general interest in what is here	☐	☐	☐
There's lots/a range of things to do here	☐	☐	☐

Other *(please specify)*.....

Q6. Which of the following applies to you?

I live within 10 miles of this reserve ☐

→ please proceed to Q10.

I have come from home on a day trip to visit the reserve ☐

→ please proceed to Q10.

I am holidaying in the area and staying near to the reserve ☐

→ please proceed to Q7.

I am holidaying elsewhere but made a day trip to visit the reserve ☐

→ please proceed to Q7.

Q7. What type of accommodation are you staying in?

Campsite☐ B&B☐ Hotel ☐ With friends or fami☐

Other *(please specify)*

.....

Q8. By the time you leave how many nights in total will you have stayed at your holiday location?

.....

Q9. Is this nature reserve the main reason for your visit to this area?

Yes ☐

No, I came to the area primarily for another reason, e.g. on holiday, to visit family (*please specify*)

.....
.....

Q10. In total, approximately how much will your party spend in the local area today on:

Accommodation..... Entry fees/ entertainment.....

Fares + Petrol..... Other.....

Meals + Drinks..... If other please specify what other is

Gifts + Souvenirs..... .....

Q11. What of the following have you done/do you plan on doing during your visit?
(Please select all that apply)

Bird watching ☐ Visiting a hide ☐

Following a marked walk/ track ☐ Visiting the shop ☐

Visiting the visitor centre and looking around the displays ☐ Visiting the teashop ☐

Look out for plants or other wildlife ☐ Walk the dog ☐

Take part in an organised walk/ children's activity/ planned event ☐

Other *(please specify)*

.....
.....

Q12. What has been the highlight of your visit so far?

.....
.....

Q13. Are there any species that you particularly wanted to see on your visit today?

.....
.....

Q14. Please estimate how many different species you think there are in this nature reserve. *Please specify for birds, plants, mammals and butterflies.*

Birds: .....

Plants: .....

Mammals: .....

Butterflies: .....

Q15. Would you be more likely to visit a nature reserve if it contained rare or restricted species?

Yes ☐ No ☐

Q16. If you answered "Yes" to Q15, how do you find out when/which rare species are present in nature reserves?

.....
.....

Q17. On a scale of 1-5 ***(1 not interested, 3 an average interest, 5 very interested)*** **how interested are you in the following when you visit a nature reserve?**

	1	2	3	4	5
Birds	☐	☐	☐	☐	☐
Butterflies	☐	☐	☐	☐	☐
Mammals	☐	☐	☐	☐	☐
Plants/Flowers	☐	☐	☐	☐	☐

Q18. Thinking about your visit today, please rate the reserve for each of the following...

	Very poor	Poor	OK	Good	Excellent	D/K
Quality of scenery	☐	☐	☐	☐	☐	☐
Standard of maintenance and upkeep	☐	☐	☐	☐	☐	☐
Friendliness and welcome of staff	☐	☐	☐	☐	☐	☐

Quality of facilities for families	☐	☐	☐	☐	☐	☐
Quality of facilities for visitors with disabiliti	☐	☐	☐	☐	☐	☐
Visit in terms of overall quality of experience	☐	☐	☐	☐	☐	☐

Q19. What do you think is an appropriate entrance fee per person to visit a PA equivalent to this particular nature reserve?

.....
.....

Q20. Relative to other nature reserves where do you think this reserve fits in terms of conservation value?
(Please tick a score from 1-5, 1 being of very low conservation vale, 3 being of an average conservation value and 5 being a very high conservation value)

1 ☐ **2** ☐ **3** ☐ **4** ☐ **5** ☐ First visit to a nature reserve ☐

Demographic questions Finally to help us understand why people visit RSPB reserves we would like to find out some more about you. Remember, any information you give us will remain anonymous and confidential.

Q21. How many people in your party today are:

Adults (aged 18+)____ Children (aged under 5)____Children (aged 5-10)____Children (aged 11-18)____

Q22. What is your postcode?
.....

Q23. Are you?
Male ☐ Female☐

Q24. Which age bracket do you fit into?
18-24☐ 25-34☐ 35-44☐ 45-54☐
55-64☐ 65+ ☐

Q25. How would you describe your current employment status?

Part time (less than 30 hours/week)	☐	Full time (more than 30 hours/week)	☐
Retired	☐	Unemployed	☐
In full time education	☐	Other *(please specify)*.....	

Q26. Which bracket does your estimated yearly household income lie in (before tax)

Less than £5,000 ☐ £5,001-£9,999 ☐ £10,000-£19,999 ☐

£20,000-£29,999 ☐ £30,000-£39,999 ☐ £40,000-£49,999 ☐

£50,000-£59,999 ☐ £60,000+ ☐ Decline to answer ☐

Q27. How many people live in your household?

Adults___ Children (under 18)___

Q28. Are you currently an RSPB member?

Yes ☐ No ☐

Q29. Are you a member of any other conservation organisations

Yes ☐ No ☐

If yes then please specify which.....

Thank you for taking the time to fill out this questionnaire. If you would like to be emailed a summary of the results please fill in your name and email address below. These details will not be passed on, and will only be used for the purpose stated.

Name.....

Email…….

Appendix 2: Breeding Bird Species Lists for RSPB Reserves

Reserve	Breeding Bird Species	Reserve	Breeding Bird Species
Arne	Barn owl	Minsmere	Arctic tern
Arne	Blackbird	Minsmere	Avocet
Arne	Blackcap	Minsmere	Barnacle goose
Arne	Blue tit	Minsmere	Bearded tit
Arne	Bullfinch	Minsmere	Bittern
Arne	Buzzard	Minsmere	Blackbird
Arne	Canada goose	Minsmere	Blackcap
Arne	Carrion crow	Minsmere	Black-headed gull
Arne	Chaffinch	Minsmere	Blue tit
Arne	Chiffchaff	Minsmere	Bullfinch
Arne	Coal tit	Minsmere	Canada goose
Arne	Coot	Minsmere	Carrion crow
Arne	Cuckoo	Minsmere	Cetti's warbler
Arne	Dartford warbler	Minsmere	Chaffinch
Arne	Dunnock	Minsmere	Chiffchaff
Arne	Gadwall	Minsmere	Coal tit
Arne	Garden warbler	Minsmere	Collared dove
Arne	Goldcrest	Minsmere	Common tern
Arne	Goldfinch	Minsmere	Coot
Arne	Great spotted woodpecker	Minsmere	Cuckoo
Arne	Great tit	Minsmere	Dartford warbler
Arne	Green woodpecker	Minsmere	Dunnock
Arne	Greenfinch	Minsmere	Firecrest
Arne	Hobby	Minsmere	Gadwall
Arne	House sparrow	Minsmere	Garden warbler
Arne	Jackdaw	Minsmere	Garganey
Arne	Jay	Minsmere	Goldcrest
Arne	Kestrel	Minsmere	Goldfinch
Arne	Lapwing	Minsmere	Grasshopper warbler
Arne	Lesser spotted woodpecker	Minsmere	Great crested grebe
Arne	Linnet	Minsmere	Great spotted woodpecker
Arne	Little grebe	Minsmere	Great tit
Arne	Little ringed plover	Minsmere	Green woodpecker
Arne	Long-tailed tit	Minsmere	Greenfinch
Arne	Magpie	Minsmere	Grey heron
Arne	Mallard	Minsmere	Grey partridge
Arne	Marsh tit	Minsmere	Greylag goose
Arne	Meadow pipit	Minsmere	Herring gull
Arne	Mistle thrush	Minsmere	Hobby
Arne	Moorhen	Minsmere	House sparrow
Arne	Mute swan	Minsmere	Jackdaw
Arne	Nightjar	Minsmere	Jay

Arne	Nuthatch
Arne	Pheasant
Arne	Pied wagtail
Arne	Pintail
Arne	Raven
Arne	Redshank
Arne	Reed bunting
Arne	Reed warbler
Arne	Ringed plover
Arne	Robin
Arne	Shelduck
Arne	Skylark
Arne	Song thrush
Arne	Sparrowhawk
Arne	Spotted flycatcher
Arne	Starling
Arne	Stock dove
Arne	Stonechat
Arne	Swallow
Arne	Tawny owl
Arne	Teal
Arne	Tree pipit
Arne	Treecreeper
Arne	Tufted duck
Arne	Water rail
Arne	Willow warbler
Arne	Woodlark
Arne	Woodpigeon
Arne	Wren
Blacktoft Sands	Avocet
Blacktoft Sands	Barn owl
Blacktoft Sands	Bearded tit
Blacktoft Sands	Bittern
Blacktoft Sands	Blackbird
Blacktoft Sands	Blackcap
Blacktoft Sands	Black-headed gull
Blacktoft Sands	Blue tit
Blacktoft Sands	Canada goose
Blacktoft Sands	Chaffinch
Blacktoft Sands	Chiffchaff
Blacktoft Sands	Collared dove
Blacktoft Sands	Coot
Blacktoft Sands	Corn bunting
Blacktoft Sands	Cuckoo
Blacktoft Sands	Dunnock
Blacktoft Sands	Gadwall
Minsmere	Kestrel
Minsmere	Kingfisher
Minsmere	Lapwing
Minsmere	Lesser black-backed gull
Minsmere	Lesser redpoll
Minsmere	Lesser spotted woodpecker
Minsmere	Lesser whitethroat
Minsmere	Linnet
Minsmere	Little grebe
Minsmere	Little owl
Minsmere	Little ringed plover
Minsmere	Little tern
Minsmere	Long-tailed tit
Minsmere	Magpie
Minsmere	Mallard
Minsmere	Marsh harrier
Minsmere	Marsh tit
Minsmere	Meadow pipit
Minsmere	Mediterranean gull
Minsmere	Mistle thrush
Minsmere	Moorhen
Minsmere	Mute swan
Minsmere	Nightingale
Minsmere	Nightjar
Minsmere	Nuthatch
Minsmere	Oystercatcher
Minsmere	Pheasant
Minsmere	Pied wagtail
Minsmere	Pochard
Minsmere	Quail
Minsmere	Red-legged partridge
Minsmere	Redshank
Minsmere	Redstart
Minsmere	Reed bunting
Minsmere	Reed warbler
Minsmere	Ringed plover
Minsmere	Robin
Minsmere	Rook
Minsmere	Ruddy duck
Minsmere	Sand martin
Minsmere	Sandwich tern
Minsmere	Sedge warbler
Minsmere	Shelduck
Minsmere	Shoveler
Minsmere	Siskin
Minsmere	Skylark

Blacktoft Sands	Goldfinch
Blacktoft Sands	Grasshopper warbler
Blacktoft Sands	Great crested grebe
Blacktoft Sands	Great tit
Blacktoft Sands	Greenfinch
Blacktoft Sands	Grey partridge
Blacktoft Sands	Greylag goose
Blacktoft Sands	Kestrel
Blacktoft Sands	Lapwing
Blacktoft Sands	Lesser whitethroat
Blacktoft Sands	Linnet
Blacktoft Sands	Little grebe
Blacktoft Sands	Long-tailed tit
Blacktoft Sands	Magpie
Blacktoft Sands	Mallard
Blacktoft Sands	Marsh harrier
Blacktoft Sands	Meadow pipit
Blacktoft Sands	Moorhen
Blacktoft Sands	Mute swan
Blacktoft Sands	Oystercatcher
Blacktoft Sands	Pheasant
Blacktoft Sands	Pied wagtail
Blacktoft Sands	Pochard
Blacktoft Sands	Redshank
Blacktoft Sands	Reed bunting
Blacktoft Sands	Reed warbler
Blacktoft Sands	Robin
Blacktoft Sands	Ruddy duck
Blacktoft Sands	Sedge warbler
Blacktoft Sands	Shelduck
Blacktoft Sands	Shoveler
Blacktoft Sands	Skylark
Blacktoft Sands	Song thrush
Blacktoft Sands	Stock dove
Blacktoft Sands	Tree sparrow
Blacktoft Sands	Tufted duck
Blacktoft Sands	Water rail
Blacktoft Sands	Whitethroat
Blacktoft Sands	Willow warbler
Blacktoft Sands	Woodpigeon
Blacktoft Sands	Wren
Blacktoft Sands	Yellow wagtail
Conwy	Blackbird
Conwy	Blackcap
Conwy	Blue tit
Conwy	Canada goose
Minsmere	Snipe
Minsmere	Song thrush
Minsmere	Sparrowhawk
Minsmere	Spotted crake
Minsmere	Spotted flycatcher
Minsmere	Starling
Minsmere	Stock dove
Minsmere	Stonechat
Minsmere	Stone-curlew
Minsmere	Swallow
Minsmere	Tawny owl
Minsmere	Teal
Minsmere	Tree pipit
Minsmere	Tree sparrow
Minsmere	Treecreeper
Minsmere	Tufted duck
Minsmere	Turtle dove
Minsmere	Water rail
Minsmere	Whitethroat
Minsmere	Willow warbler
Minsmere	Woodcock
Minsmere	Woodlark
Minsmere	Woodpigeon
Minsmere	Wren
Minsmere	Yellow wagtail
Minsmere	Yellowhammer
Pulborough Brooks	Barn owl
Pulborough Brooks	Blackbird
Pulborough Brooks	Blackcap
Pulborough Brooks	Blue tit
Pulborough Brooks	Bullfinch
Pulborough Brooks	Canada goose
Pulborough Brooks	Carrion crow
Pulborough Brooks	Chaffinch
Pulborough Brooks	Chiffchaff
Pulborough Brooks	Coal tit
Pulborough Brooks	Coot
Pulborough Brooks	Cuckoo
Pulborough Brooks	Dunnock
Pulborough Brooks	Gadwall
Pulborough Brooks	Garden warbler
Pulborough Brooks	Goldcrest
Pulborough Brooks	Goldfinch
Pulborough Brooks	Great spotted woodpecker
Pulborough Brooks	Great tit
Pulborough Brooks	Green woodpecker

Conwy	Carrion crow
Conwy	Chaffinch
Conwy	Chiffchaff
Conwy	Common sandpiper
Conwy	Coot
Conwy	Dunnock
Conwy	Gadwall
Conwy	Garden warbler
Conwy	Goldfinch
Conwy	Great crested grebe
Conwy	Great tit
Conwy	Greenfinch
Conwy	Greylag goose
Conwy	Herring gull
Conwy	House sparrow
Conwy	Kingfisher
Conwy	Lapwing
Conwy	Lesser black-backed gull
Conwy	Lesser whitethroat
Conwy	Little grebe
Conwy	Magpie
Conwy	Mallard
Conwy	Moorhen
Conwy	Mute swan
Conwy	Oystercatcher
Conwy	Pied wagtail
Conwy	Redshank
Conwy	Reed bunting
Conwy	Reed warbler
Conwy	Robin
Conwy	Ruddy duck
Conwy	Sedge warbler
Conwy	Shelduck
Conwy	Song thrush
Conwy	Teal
Conwy	Tufted duck
Conwy	Water rail
Conwy	Whitethroat
Conwy	Willow warbler
Conwy	Wren
Dearne Valley	Barn owl
Dearne Valley	Blackbird
Dearne Valley	Blackcap
Dearne Valley	Black-headed gull
Dearne Valley	Blue tit
Dearne Valley	Bullfinch
Pulborough Brooks	Greenfinch
Pulborough Brooks	Greylag goose
Pulborough Brooks	Jackdaw
Pulborough Brooks	Jay
Pulborough Brooks	Lapwing
Pulborough Brooks	Lesser whitethroat
Pulborough Brooks	Linnet
Pulborough Brooks	Little grebe
Pulborough Brooks	Little owl
Pulborough Brooks	Little ringed plover
Pulborough Brooks	Long-tailed tit
Pulborough Brooks	Magpie
Pulborough Brooks	Mallard
Pulborough Brooks	Mandarin
Pulborough Brooks	Marsh tit
Pulborough Brooks	Meadow pipit
Pulborough Brooks	Mistle thrush
Pulborough Brooks	Moorhen
Pulborough Brooks	Mute swan
Pulborough Brooks	Nightingale
Pulborough Brooks	Nightjar
Pulborough Brooks	Nuthatch
Pulborough Brooks	Pheasant
Pulborough Brooks	Pied wagtail
Pulborough Brooks	Quail
Pulborough Brooks	Redshank
Pulborough Brooks	Reed bunting
Pulborough Brooks	Reed warbler
Pulborough Brooks	Ringed plover
Pulborough Brooks	Robin
Pulborough Brooks	Rook
Pulborough Brooks	Sedge warbler
Pulborough Brooks	Shelduck
Pulborough Brooks	Skylark
Pulborough Brooks	Snipe
Pulborough Brooks	Song thrush
Pulborough Brooks	Sparrowhawk
Pulborough Brooks	Spotted flycatcher
Pulborough Brooks	Starling
Pulborough Brooks	Stock dove
Pulborough Brooks	Stonechat
Pulborough Brooks	Swallow
Pulborough Brooks	Tawny owl
Pulborough Brooks	Teal
Pulborough Brooks	Treecreeper
Pulborough Brooks	Tufted duck

Dearne Valley	Canada goose
Dearne Valley	Carrion crow
Dearne Valley	Chaffinch
Dearne Valley	Chiffchaff
Dearne Valley	Coal tit
Dearne Valley	Collared dove
Dearne Valley	Common tern
Dearne Valley	Coot
Dearne Valley	Cuckoo
Dearne Valley	Dunnock
Dearne Valley	Feral pigeon
Dearne Valley	Gadwall
Dearne Valley	Garden warbler
Dearne Valley	Garganey
Dearne Valley	Goldfinch
Dearne Valley	Grasshopper warbler
Dearne Valley	Great crested grebe
Dearne Valley	Great tit
Dearne Valley	Green woodpecker
Dearne Valley	Greenfinch
Dearne Valley	Grey partridge
Dearne Valley	Grey wagtail
Dearne Valley	Greylag goose
Dearne Valley	House sparrow
Dearne Valley	Jackdaw
Dearne Valley	Jay
Dearne Valley	Kestrel
Dearne Valley	Kingfisher
Dearne Valley	Lapwing
Dearne Valley	Lesser whitethroat
Dearne Valley	Linnet
Dearne Valley	Little grebe
Dearne Valley	Little owl
Dearne Valley	Little ringed plover
Dearne Valley	Long-eared owl
Dearne Valley	Long-tailed tit
Dearne Valley	Magpie
Dearne Valley	Mallard
Dearne Valley	Meadow pipit
Dearne Valley	Mistle thrush
Dearne Valley	Moorhen
Dearne Valley	Mute swan
Dearne Valley	Oystercatcher
Dearne Valley	Pheasant
Dearne Valley	Pied wagtail
Dearne Valley	Red-legged partridge
Pulborough Brooks	Water rail
Pulborough Brooks	Whitethroat
Pulborough Brooks	Willow warbler
Pulborough Brooks	Woodcock
Pulborough Brooks	Woodlark
Pulborough Brooks	Woodpigeon
Pulborough Brooks	Wren
Pulborough Brooks	Yellow wagtail
Pulborough Brooks	Yellowhammer
Radipole Lake	Bearded tit
Radipole Lake	Blackbird
Radipole Lake	Blackcap
Radipole Lake	Blue tit
Radipole Lake	Bullfinch
Radipole Lake	Canada goose
Radipole Lake	Carrion crow
Radipole Lake	Cetti's warbler
Radipole Lake	Chaffinch
Radipole Lake	Chiffchaff
Radipole Lake	Coal tit
Radipole Lake	Collared dove
Radipole Lake	Coot
Radipole Lake	Dunnock
Radipole Lake	Gadwall
Radipole Lake	Goldcrest
Radipole Lake	Goldfinch
Radipole Lake	Great crested grebe
Radipole Lake	Great spotted woodpecker
Radipole Lake	Great tit
Radipole Lake	Greenfinch
Radipole Lake	House sparrow
Radipole Lake	Kestrel
Radipole Lake	Lesser whitethroat
Radipole Lake	Little grebe
Radipole Lake	Long-tailed tit
Radipole Lake	Mallard
Radipole Lake	Moorhen
Radipole Lake	Mute swan
Radipole Lake	Pheasant
Radipole Lake	Pochard
Radipole Lake	Reed bunting
Radipole Lake	Reed warbler
Radipole Lake	Robin
Radipole Lake	Ruddy duck
Radipole Lake	Sedge warbler
Radipole Lake	Shelduck

Dearne Valley	Redshank
Dearne Valley	Reed bunting
Dearne Valley	Reed warbler
Dearne Valley	Ringed plover
Dearne Valley	Robin
Dearne Valley	Rook
Dearne Valley	Ruddy duck
Dearne Valley	Sand martin
Dearne Valley	Sedge warbler
Dearne Valley	Shoveler
Dearne Valley	Siskin
Dearne Valley	Skylark
Dearne Valley	Snipe
Dearne Valley	Song thrush
Dearne Valley	Sparrowhawk
Dearne Valley	Starling
Dearne Valley	Stock dove
Dearne Valley	Tawny owl
Dearne Valley	Teal
Dearne Valley	Tree sparrow
Dearne Valley	Tufted duck
Dearne Valley	Water rail
Dearne Valley	Whitethroat
Dearne Valley	Willow tit
Dearne Valley	Willow warbler
Dearne Valley	Woodpigeon
Dearne Valley	Wren
Dearne Valley	Yellowhammer
Fairburn Ings	Blackbird
Fairburn Ings	Blackcap
Fairburn Ings	Black-headed gull
Fairburn Ings	Blue tit
Fairburn Ings	Bullfinch
Fairburn Ings	Canada goose
Fairburn Ings	Carrion crow
Fairburn Ings	Chaffinch
Fairburn Ings	Chiffchaff
Fairburn Ings	Coal tit
Fairburn Ings	Collared dove
Fairburn Ings	Common tern
Fairburn Ings	Coot
Fairburn Ings	Cormorant
Fairburn Ings	Cuckoo
Fairburn Ings	Curlew
Fairburn Ings	Dunnock
Fairburn Ings	Gadwall
Radipole Lake	Shoveler
Radipole Lake	Song thrush
Radipole Lake	Sparrowhawk
Radipole Lake	Tufted duck
Radipole Lake	Water rail
Radipole Lake	Woodpigeon
Radipole Lake	Wren
Rainham Marshes	Avocet
Rainham Marshes	Barn owl
Rainham Marshes	Bearded tit
Rainham Marshes	Blackbird
Rainham Marshes	Blackcap
Rainham Marshes	Black-headed gull
Rainham Marshes	Blue tit
Rainham Marshes	Canada goose
Rainham Marshes	Carrion crow
Rainham Marshes	Cetti's warbler
Rainham Marshes	Chiffchaff
Rainham Marshes	Coot
Rainham Marshes	Cuckoo
Rainham Marshes	Feral pigeon
Rainham Marshes	Gadwall
Rainham Marshes	Garganey
Rainham Marshes	Grasshopper warbler
Rainham Marshes	Great crested grebe
Rainham Marshes	Great spotted woodpecker
Rainham Marshes	Green woodpecker
Rainham Marshes	Grey wagtail
Rainham Marshes	Greylag goose
Rainham Marshes	House sparrow
Rainham Marshes	Kestrel
Rainham Marshes	Lapwing
Rainham Marshes	Lesser whitethroat
Rainham Marshes	Linnet
Rainham Marshes	Little grebe
Rainham Marshes	Little ringed plover
Rainham Marshes	Magpie
Rainham Marshes	Mallard
Rainham Marshes	Meadow pipit
Rainham Marshes	Moorhen
Rainham Marshes	Mute swan
Rainham Marshes	Pied wagtail
Rainham Marshes	Pintail
Rainham Marshes	Pochard
Rainham Marshes	Redshank
Rainham Marshes	Reed bunting

Fairburn Ings	Garden warbler
Fairburn Ings	Goldfinch
Fairburn Ings	Grasshopper warbler
Fairburn Ings	Great crested grebe
Fairburn Ings	Great spotted woodpecker
Fairburn Ings	Great tit
Fairburn Ings	Green woodpecker
Fairburn Ings	Greenfinch
Fairburn Ings	Grey heron
Fairburn Ings	Grey partridge
Fairburn Ings	Grey wagtail
Fairburn Ings	Greylag goose
Fairburn Ings	House sparrow
Fairburn Ings	Kingfisher
Fairburn Ings	Lapwing
Fairburn Ings	Lesser whitethroat
Fairburn Ings	Linnet
Fairburn Ings	Little grebe
Fairburn Ings	Little owl
Fairburn Ings	Little ringed plover
Fairburn Ings	Long-eared owl
Fairburn Ings	Long-tailed tit
Fairburn Ings	Magpie
Fairburn Ings	Mallard
Fairburn Ings	Meadow pipit
Fairburn Ings	Mistle thrush
Fairburn Ings	Moorhen
Fairburn Ings	Mute swan
Fairburn Ings	Nuthatch
Fairburn Ings	Oystercatcher
Fairburn Ings	Pheasant
Fairburn Ings	Pied wagtail
Fairburn Ings	Pochard
Fairburn Ings	Red-legged partridge
Fairburn Ings	Redshank
Fairburn Ings	Reed bunting
Fairburn Ings	Reed warbler
Fairburn Ings	Ringed plover
Fairburn Ings	Robin
Fairburn Ings	Ruddy duck
Fairburn Ings	Sand martin
Fairburn Ings	Sedge warbler
Fairburn Ings	Shelduck
Fairburn Ings	Skylark
Fairburn Ings	Snipe
Rainham Marshes	Reed warbler
Rainham Marshes	Ringed plover
Rainham Marshes	Robin
Rainham Marshes	Sedge warbler
Rainham Marshes	Shelduck
Rainham Marshes	Short-eared owl
Rainham Marshes	Shoveler
Rainham Marshes	Skylark
Rainham Marshes	Snipe
Rainham Marshes	Song thrush
Rainham Marshes	Sparrowhawk
Rainham Marshes	Starling
Rainham Marshes	Stonechat
Rainham Marshes	Teal
Rainham Marshes	Tufted duck
Rainham Marshes	Water rail
Rainham Marshes	Whitethroat
Rainham Marshes	Wigeon
Rainham Marshes	Wren
Rye Meads	Blackbird
Rye Meads	Blackcap
Rye Meads	Black-headed gull
Rye Meads	Blue tit
Rye Meads	Bullfinch
Rye Meads	Canada goose
Rye Meads	Carrion crow
Rye Meads	Cetti's warbler
Rye Meads	Chaffinch
Rye Meads	Chiffchaff
Rye Meads	Collared dove
Rye Meads	Common tern
Rye Meads	Coot
Rye Meads	Cuckoo
Rye Meads	Dunnock
Rye Meads	Gadwall
Rye Meads	Garden warbler
Rye Meads	Goldcrest
Rye Meads	Great crested grebe
Rye Meads	Great spotted woodpecker
Rye Meads	Great tit
Rye Meads	Greenfinch
Rye Meads	Jay
Rye Meads	Kestrel
Rye Meads	Kingfisher
Rye Meads	Lapwing

Fairburn Ings	Song thrush
Fairburn Ings	Starling
Fairburn Ings	Swallow
Fairburn Ings	Tree sparrow
Fairburn Ings	Treecreeper
Fairburn Ings	Tufted duck
Fairburn Ings	Whitethroat
Fairburn Ings	Willow tit
Fairburn Ings	Willow warbler
Fairburn Ings	Woodpigeon
Fairburn Ings	Wren
Fairburn Ings	Yellow wagtail
Fairburn Ings	Yellowhammer
Lake Vyrnwy	Barn owl
Lake Vyrnwy	Black grouse
Lake Vyrnwy	Blackbird
Lake Vyrnwy	Blackcap
Lake Vyrnwy	Blue tit
Lake Vyrnwy	Bullfinch
Lake Vyrnwy	Buzzard
Lake Vyrnwy	Canada goose
Lake Vyrnwy	Carrion crow
Lake Vyrnwy	Chaffinch
Lake Vyrnwy	Chiffchaff
Lake Vyrnwy	Coal tit
Lake Vyrnwy	Collared dove
Lake Vyrnwy	Common sandpiper
Lake Vyrnwy	Crossbill
Lake Vyrnwy	Cuckoo
Lake Vyrnwy	Curlew
Lake Vyrnwy	Dipper
Lake Vyrnwy	Dunnock
Lake Vyrnwy	Firecrest
Lake Vyrnwy	Garden warbler
Lake Vyrnwy	Goldcrest
Lake Vyrnwy	Goldfinch
Lake Vyrnwy	Goosander
Lake Vyrnwy	Grasshopper warbler
Lake Vyrnwy	Great crested grebe
Lake Vyrnwy	Great spotted woodpecker
Lake Vyrnwy	Great tit
Lake Vyrnwy	Green woodpecker
Lake Vyrnwy	Greenfinch
Lake Vyrnwy	Grey heron
Lake Vyrnwy	Grey wagtail
Rye Meads	Lesser whitethroat
Rye Meads	Little grebe
Rye Meads	Long-tailed tit
Rye Meads	Magpie
Rye Meads	Mallard
Rye Meads	Moorhen
Rye Meads	Mute swan
Rye Meads	Pheasant
Rye Meads	Pochard
Rye Meads	Redshank
Rye Meads	Reed bunting
Rye Meads	Reed warbler
Rye Meads	Robin
Rye Meads	Ruddy duck
Rye Meads	Sedge warbler
Rye Meads	Shoveler
Rye Meads	Song thrush
Rye Meads	Starling
Rye Meads	Stock dove
Rye Meads	Treecreeper
Rye Meads	Tufted duck
Rye Meads	Turtle dove
Rye Meads	Water rail
Rye Meads	Whitethroat
Rye Meads	Willow warbler
Rye Meads	Woodpigeon
Rye Meads	Wren
Saltholme	Blackbird
Saltholme	Blackcap
Saltholme	Black-headed gull
Saltholme	Blue tit
Saltholme	Canada goose
Saltholme	Carrion crow
Saltholme	Chaffinch
Saltholme	Common tern
Saltholme	Coot
Saltholme	Cuckoo
Saltholme	Dunnock
Saltholme	Gadwall
Saltholme	Garganey
Saltholme	Goldfinch
Saltholme	Great crested grebe
Saltholme	Great tit
Saltholme	Grey partridge
Saltholme	Greylag goose

Lake Vyrnwy	Hen harrier
Lake Vyrnwy	House martin
Lake Vyrnwy	House sparrow
Lake Vyrnwy	Jackdaw
Lake Vyrnwy	Jay
Lake Vyrnwy	Kestrel
Lake Vyrnwy	Kingfisher
Lake Vyrnwy	Lesser redpoll
Lake Vyrnwy	Linnet
Lake Vyrnwy	Long-eared owl
Lake Vyrnwy	Long-tailed tit
Lake Vyrnwy	Magpie
Lake Vyrnwy	Mallard
Lake Vyrnwy	Marsh tit
Lake Vyrnwy	Meadow pipit
Lake Vyrnwy	Merlin
Lake Vyrnwy	Mistle thrush
Lake Vyrnwy	Nightjar
Lake Vyrnwy	Nuthatch
Lake Vyrnwy	Osprey
Lake Vyrnwy	Peregrine
Lake Vyrnwy	Pheasant
Lake Vyrnwy	Pied flycatcher
Lake Vyrnwy	Pied wagtail
Lake Vyrnwy	Quail
Lake Vyrnwy	Raven
Lake Vyrnwy	Red grouse
Lake Vyrnwy	Red-legged partridge
Lake Vyrnwy	Redstart
Lake Vyrnwy	Reed bunting
Lake Vyrnwy	Ring ouzel
Lake Vyrnwy	Robin
Lake Vyrnwy	Short-eared owl
Lake Vyrnwy	Siskin
Lake Vyrnwy	Skylark
Lake Vyrnwy	Snipe
Lake Vyrnwy	Song thrush
Lake Vyrnwy	Sparrowhawk
Lake Vyrnwy	Spotted flycatcher
Lake Vyrnwy	Starling
Lake Vyrnwy	Stock dove
Lake Vyrnwy	Stonechat
Lake Vyrnwy	Swallow
Lake Vyrnwy	Swift
Lake Vyrnwy	Tawny owl
Lake Vyrnwy	Teal
Saltholme	Kestrel
Saltholme	Lapwing
Saltholme	Lesser whitethroat
Saltholme	Linnet
Saltholme	Little grebe
Saltholme	Little ringed plover
Saltholme	Magpie
Saltholme	Mallard
Saltholme	Meadow pipit
Saltholme	Mistle thrush
Saltholme	Moorhen
Saltholme	Mute swan
Saltholme	Oystercatcher
Saltholme	Pheasant
Saltholme	Pied wagtail
Saltholme	Pochard
Saltholme	Redshank
Saltholme	Reed bunting
Saltholme	Reed warbler
Saltholme	Robin
Saltholme	Ruddy duck
Saltholme	Sedge warbler
Saltholme	Shelduck
Saltholme	Shoveler
Saltholme	Skylark
Saltholme	Snipe
Saltholme	Song thrush
Saltholme	Stock dove
Saltholme	Stonechat
Saltholme	Swallow
Saltholme	Teal
Saltholme	Tufted duck
Saltholme	Water rail
Saltholme	Whitethroat
Saltholme	Willow warbler
Saltholme	Wren
Saltholme	Yellow wagtail
Titchwell Marsh	Avocet
Titchwell Marsh	Bearded tit
Titchwell Marsh	Bittern
Titchwell Marsh	Blackbird
Titchwell Marsh	Blackcap
Titchwell Marsh	Black-headed gull
Titchwell Marsh	Blue tit
Titchwell Marsh	Bullfinch
Titchwell Marsh	Canada goose

Lake Vyrnwy	Tree pipit
Lake Vyrnwy	Treecreeper
Lake Vyrnwy	Wheatear
Lake Vyrnwy	Whinchat
Lake Vyrnwy	Whitethroat
Lake Vyrnwy	Willow tit
Lake Vyrnwy	Willow warbler
Lake Vyrnwy	Wood warbler
Lake Vyrnwy	Woodcock
Lake Vyrnwy	Woodpigeon
Lake Vyrnwy	Wren
Leighton Moss	Avocet
Leighton Moss	Bearded tit
Leighton Moss	Bittern
Leighton Moss	Blackbird
Leighton Moss	Blackcap
Leighton Moss	Black-headed gull
Leighton Moss	Blue tit
Leighton Moss	Bullfinch
Leighton Moss	Buzzard
Leighton Moss	Canada goose
Leighton Moss	Carrion crow
Leighton Moss	Chaffinch
Leighton Moss	Chiffchaff
Leighton Moss	Coal tit
Leighton Moss	Collared dove
Leighton Moss	Coot
Leighton Moss	Curlew
Leighton Moss	Dunlin
Leighton Moss	Dunnock
Leighton Moss	Gadwall
Leighton Moss	Garden warbler
Leighton Moss	Goldcrest
Leighton Moss	Goldfinch
Leighton Moss	Grasshopper warbler
Leighton Moss	Great black-backed gull
Leighton Moss	Great crested grebe
Leighton Moss	Great spotted woodpecker
Leighton Moss	Great tit
Leighton Moss	Green woodpecker
Leighton Moss	Greenfinch
Leighton Moss	Greylag goose
Leighton Moss	House sparrow
Leighton Moss	Jay
Leighton Moss	Kestrel

Titchwell Marsh	Carrion crow
Titchwell Marsh	Cetti's warbler
Titchwell Marsh	Chaffinch
Titchwell Marsh	Chiffchaff
Titchwell Marsh	Common tern
Titchwell Marsh	Coot
Titchwell Marsh	Curlew
Titchwell Marsh	Dunnock
Titchwell Marsh	Egyptian goose
Titchwell Marsh	Gadwall
Titchwell Marsh	Goldcrest
Titchwell Marsh	Great tit
Titchwell Marsh	Greenfinch
Titchwell Marsh	Greylag goose
Titchwell Marsh	Herring gull
Titchwell Marsh	Jay
Titchwell Marsh	Lesser whitethroat
Titchwell Marsh	Linnet
Titchwell Marsh	Little gull
Titchwell Marsh	Long-tailed tit
Titchwell Marsh	Magpie
Titchwell Marsh	Mallard
Titchwell Marsh	Marsh harrier
Titchwell Marsh	Meadow pipit
Titchwell Marsh	Moorhen
Titchwell Marsh	Mute swan
Titchwell Marsh	Oystercatcher
Titchwell Marsh	Pheasant
Titchwell Marsh	Pied wagtail
Titchwell Marsh	Pintail
Titchwell Marsh	Pochard
Titchwell Marsh	Redshank
Titchwell Marsh	Reed bunting
Titchwell Marsh	Reed warbler
Titchwell Marsh	Ringed plover
Titchwell Marsh	Robin
Titchwell Marsh	Ruddy duck
Titchwell Marsh	Sedge warbler
Titchwell Marsh	Shelduck
Titchwell Marsh	Shoveler
Titchwell Marsh	Skylark
Titchwell Marsh	Song thrush
Titchwell Marsh	Stock dove
Titchwell Marsh	Tawny owl
Titchwell Marsh	Teal

Leighton Moss	Kingfisher
Leighton Moss	Lapwing
Leighton Moss	Lesser whitethroat
Leighton Moss	Linnet
Leighton Moss	Little grebe
Leighton Moss	Long-tailed tit
Leighton Moss	Magpie
Leighton Moss	Mallard
Leighton Moss	Marsh harrier
Leighton Moss	Marsh tit
Leighton Moss	Meadow pipit
Leighton Moss	Mistle thrush
Leighton Moss	Moorhen
Leighton Moss	Mute swan
Leighton Moss	Nuthatch
Leighton Moss	Oystercatcher
Leighton Moss	Pheasant
Leighton Moss	Pied wagtail
Leighton Moss	Pochard
Leighton Moss	Redshank
Leighton Moss	Reed bunting
Leighton Moss	Reed warbler
Leighton Moss	Ringed plover
Leighton Moss	Robin
Leighton Moss	Ruddy duck
Leighton Moss	Sedge warbler
Leighton Moss	Shelduck
Leighton Moss	Shoveler
Leighton Moss	Skylark
Leighton Moss	Song thrush
Leighton Moss	Sparrowhawk
Leighton Moss	Spotted crake
Leighton Moss	Spotted flycatcher
Leighton Moss	Starling
Leighton Moss	Stonechat
Leighton Moss	Swallow
Leighton Moss	Tawny owl
Leighton Moss	Teal
Leighton Moss	Tree pipit
Leighton Moss	Treecreeper
Leighton Moss	Tufted duck
Leighton Moss	Water rail
Leighton Moss	Wheatear
Leighton Moss	Whitethroat
Leighton Moss	Willow warbler
Leighton Moss	Woodcock
Titchwell Marsh	Tufted duck
Titchwell Marsh	Turtle dove
Titchwell Marsh	Water rail
Titchwell Marsh	Whitethroat
Titchwell Marsh	Wigeon
Titchwell Marsh	Willow warbler
Titchwell Marsh	Woodpigeon
Titchwell Marsh	Wren
Vane Farm	Blackbird
Vane Farm	Blackcap
Vane Farm	Black-headed gull
Vane Farm	Blue tit
Vane Farm	Bullfinch
Vane Farm	Carrion crow
Vane Farm	Chaffinch
Vane Farm	Coal tit
Vane Farm	Coot
Vane Farm	Cuckoo
Vane Farm	Curlew
Vane Farm	Dunnock
Vane Farm	Gadwall
Vane Farm	Garden warbler
Vane Farm	Garganey
Vane Farm	Goldcrest
Vane Farm	Goldfinch
Vane Farm	Grasshopper warbler
Vane Farm	Great spotted woodpecker
Vane Farm	Great tit
Vane Farm	Greenfinch
Vane Farm	Greylag goose
Vane Farm	Jackdaw
Vane Farm	Kestrel
Vane Farm	Lapwing
Vane Farm	Linnet
Vane Farm	Long-tailed tit
Vane Farm	Magpie
Vane Farm	Mallard
Vane Farm	Meadow pipit
Vane Farm	Moorhen
Vane Farm	Mute swan
Vane Farm	Oystercatcher
Vane Farm	Pheasant
Vane Farm	Pied wagtail
Vane Farm	Pochard
Vane Farm	Red grouse
Vane Farm	Redshank

Leighton Moss	Woodpigeon
Leighton Moss	Wren
The Lodge	Blackbird
The Lodge	Blackcap
The Lodge	Blue tit
The Lodge	Bullfinch
The Lodge	Buzzard
The Lodge	Carrion crow
The Lodge	Chaffinch
The Lodge	Chiffchaff
The Lodge	Coal tit
The Lodge	Crossbill
The Lodge	Cuckoo
The Lodge	Dartford warbler
The Lodge	Dunnock
The Lodge	Firecrest
The Lodge	Garden warbler
The Lodge	Goldcrest
The Lodge	Goldfinch
The Lodge	Great spotted woodpecker
The Lodge	Great tit
The Lodge	Green woodpecker
The Lodge	Greenfinch
The Lodge	Grey partridge
The Lodge	Hobby
The Lodge	Jackdaw
The Lodge	Jay
The Lodge	Kestrel
The Lodge	Lesser redpoll
The Lodge	Lesser spotted woodpecker
The Lodge	Lesser whitethroat
The Lodge	Linnet
The Lodge	Little owl
The Lodge	Long-tailed tit
The Lodge	Magpie
The Lodge	Mallard
The Lodge	Marsh tit
The Lodge	Meadow pipit
The Lodge	Mistle thrush
The Lodge	Moorhen
The Lodge	Nightingale
The Lodge	Nightjar
The Lodge	Nuthatch
The Lodge	Pheasant
Vane Farm	Reed bunting
Vane Farm	Robin
Vane Farm	Sedge warbler
Vane Farm	Shelduck
Vane Farm	Shoveler
Vane Farm	Skylark
Vane Farm	Snipe
Vane Farm	Song thrush
Vane Farm	Spotted flycatcher
Vane Farm	Starling
Vane Farm	Stock dove
Vane Farm	Stonechat
Vane Farm	Swallow
Vane Farm	Tawny owl
Vane Farm	Teal
Vane Farm	Treecreeper
Vane Farm	Tufted duck
Vane Farm	Water rail
Vane Farm	Wheatear
Vane Farm	Whitethroat
Vane Farm	Wigeon
Vane Farm	Willow warbler
Vane Farm	Woodpigeon
Vane Farm	Wren
Vane Farm	Yellowhammer
Ynys-Hir	Barn owl
Ynys-Hir	Blackbird
Ynys-Hir	Blackcap
Ynys-Hir	Black-headed gull
Ynys-Hir	Blue tit
Ynys-Hir	Bullfinch
Ynys-Hir	Buzzard
Ynys-Hir	Canada goose
Ynys-Hir	Carrion crow
Ynys-Hir	Chaffinch
Ynys-Hir	Chiffchaff
Ynys-Hir	Coal tit
Ynys-Hir	Common sandpiper
Ynys-Hir	Coot
Ynys-Hir	Cuckoo
Ynys-Hir	Dipper
Ynys-Hir	Dunnock
Ynys-Hir	Garden warbler
Ynys-Hir	Garganey

The Lodge	Pied wagtail
The Lodge	Red-legged partridge
The Lodge	Robin
The Lodge	Rook
The Lodge	Siskin
The Lodge	Skylark
The Lodge	Song thrush
The Lodge	Sparrowhawk
The Lodge	Spotted flycatcher
The Lodge	Starling
The Lodge	Stock dove
The Lodge	Tawny owl
The Lodge	Tree pipit
The Lodge	Tree sparrow
The Lodge	Treecreeper
The Lodge	Turtle dove
The Lodge	Wheatear
The Lodge	Whitethroat
The Lodge	Willow warbler
The Lodge	Woodcock
The Lodge	Woodlark
The Lodge	Woodpigeon
The Lodge	Wren
The Lodge	Yellowhammer
Mid Yare Valley	Avocet
Mid Yare Valley	Barn owl
Mid Yare Valley	Bearded tit
Mid Yare Valley	Bittern
Mid Yare Valley	Blackbird
Mid Yare Valley	Blackcap
Mid Yare Valley	Black-headed gull
Mid Yare Valley	Blue tit
Mid Yare Valley	Bullfinch
Mid Yare Valley	Canada goose
Mid Yare Valley	Carrion crow
Mid Yare Valley	Cetti's warbler
Mid Yare Valley	Chaffinch
Mid Yare Valley	Chiffchaff
Mid Yare Valley	Coal tit
Mid Yare Valley	Collared dove
Mid Yare Valley	Coot
Mid Yare Valley	Cuckoo
Mid Yare Valley	Dunnock
Mid Yare Valley	Egyptian goose
Mid Yare Valley	Gadwall
Mid Yare Valley	Garden warbler
Ynys-Hir	Goldcrest
Ynys-Hir	Goldfinch
Ynys-Hir	Grasshopper warbler
Ynys-Hir	Great spotted woodpecker
Ynys-Hir	Great tit
Ynys-Hir	Greenfinch
Ynys-Hir	Grey heron
Ynys-Hir	Grey wagtail
Ynys-Hir	Jay
Ynys-Hir	Lapwing
Ynys-Hir	Lesser redpoll
Ynys-Hir	Lesser spotted woodpecker
Ynys-Hir	Linnet
Ynys-Hir	Little egret
Ynys-Hir	Little grebe
Ynys-Hir	Long-tailed tit
Ynys-Hir	Magpie
Ynys-Hir	Mallard
Ynys-Hir	Marsh tit
Ynys-Hir	Meadow pipit
Ynys-Hir	Mistle thrush
Ynys-Hir	Moorhen
Ynys-Hir	Nightjar
Ynys-Hir	Nuthatch
Ynys-Hir	Oystercatcher
Ynys-Hir	Pheasant
Ynys-Hir	Pied flycatcher
Ynys-Hir	Pied wagtail
Ynys-Hir	Raven
Ynys-Hir	Red kite
Ynys-Hir	Redshank
Ynys-Hir	Redstart
Ynys-Hir	Reed bunting
Ynys-Hir	Reed warbler
Ynys-Hir	Robin
Ynys-Hir	Sedge warbler
Ynys-Hir	Shelduck
Ynys-Hir	Siskin
Ynys-Hir	Skylark
Ynys-Hir	Snipe
Ynys-Hir	Song thrush
Ynys-Hir	Sparrowhawk
Ynys-Hir	Spotted flycatcher
Ynys-Hir	Stonechat
Ynys-Hir	Swallow
Ynys-Hir	Tawny owl

Mid Yare Valley	Garganey
Mid Yare Valley	Goldcrest
Mid Yare Valley	Goldfinch
Mid Yare Valley	Grasshopper warbler
Mid Yare Valley	Great crested grebe
Mid Yare Valley	Great spotted woodpecker
Mid Yare Valley	Great tit
Mid Yare Valley	Green woodpecker
Mid Yare Valley	Greenfinch
Mid Yare Valley	Grey heron
Mid Yare Valley	Greylag goose
Mid Yare Valley	House sparrow
Mid Yare Valley	Jackdaw
Mid Yare Valley	Jay
Mid Yare Valley	Kestrel
Mid Yare Valley	Kingfisher
Mid Yare Valley	Lapwing
Mid Yare Valley	Lesser spotted woodpecker
Mid Yare Valley	Lesser whitethroat
Mid Yare Valley	Linnet
Mid Yare Valley	Little grebe
Mid Yare Valley	Little ringed plover
Mid Yare Valley	Long-tailed tit
Mid Yare Valley	Magpie
Mid Yare Valley	Mallard
Mid Yare Valley	Marsh harrier
Mid Yare Valley	Marsh tit
Mid Yare Valley	Meadow pipit
Mid Yare Valley	Mistle thrush
Mid Yare Valley	Moorhen
Mid Yare Valley	Mute swan
Mid Yare Valley	Oystercatcher
Mid Yare Valley	Pheasant
Mid Yare Valley	Pied flycatcher
Mid Yare Valley	Pied wagtail
Mid Yare Valley	Pochard
Mid Yare Valley	Red-legged partridge
Mid Yare Valley	Redshank
Mid Yare Valley	Reed bunting
Mid Yare Valley	Reed warbler
Mid Yare Valley	Robin
Mid Yare Valley	Rook
Mid Yare Valley	Sedge warbler
Mid Yare Valley	Shelduck
Mid Yare Valley	Shoveler
Ynys-Hir	Teal
Ynys-Hir	Tree pipit
Ynys-Hir	Treecreeper
Ynys-Hir	Water rail
Ynys-Hir	Wheatear
Ynys-Hir	Whinchat
Ynys-Hir	Whitethroat
Ynys-Hir	Willow warbler
Ynys-Hir	Wood warbler
Ynys-Hir	Woodpigeon
Ynys-Hir	Wren
Ynys-Hir	Yellowhammer

Mid Yare Valley	Skylark
Mid Yare Valley	Snipe
Mid Yare Valley	Song thrush
Mid Yare Valley	Sparrowhawk
Mid Yare Valley	Spotted crake
Mid Yare Valley	Spotted flycatcher
Mid Yare Valley	Starling
Mid Yare Valley	Stock dove
Mid Yare Valley	Swallow
Mid Yare Valley	Tawny owl
Mid Yare Valley	Treecreeper
Mid Yare Valley	Tufted duck
Mid Yare Valley	Water rail
Mid Yare Valley	Whitethroat
Mid Yare Valley	Willow tit
Mid Yare Valley	Willow warbler
Mid Yare Valley	Woodcock
Mid Yare Valley	Woodpigeon
Mid Yare Valley	Wren
Mid Yare Valley	Yellow wagtail
Mid Yare Valley	Yellowhammer

Appendix 3: Breeding Bird Species Lists for non-RSPB Reserves

Breeding Bird Species Lists from the BirdTrack website (www.bto.org/volunteer-surveys/birdtrack).

Derwent Walk Country Park	Low Barns	Rainton Meadows
Blackbird	Blackbird	Blackbird
Blackcap	Blackcap	Blackcap
Blue tit	Black-headed gull	Black-headed gull
Bullfinch	Blue tit	Blue tit
Carrion crow	Bullfinch	Bullfinch
Chaffinch	Canada goose	Canada goose
Chiffchaff	Carrion crow	Carrion crow
Common turn	Chaffinch	Chaffinch
Coot	Chiffchaff	Chiffchaff
Cormorant	Coal tit	Coal tit
Cuckoo	Collard dove	Coot
Great spotted woodpecker	Common gull	Dipper
Great tit	Common sandpiper	Dunnock
Green woodpecker	Common tern	Goldfinch
Grey heron	Coot	Great spotted woodpecker
Herring gull	Cormorant	Great tit
House martin	Curlew	Greenfinch
Jackdaw	Dipper	Greylag goose
Kestrel	Dunnock	Herring gull
Little grebe	Goldcrest	Jackdaw
Magpie	Goldfinch	Jay
Mallard	Great spotted woodpecker	Kestrel
Moorhen	Great tit	Lapwing
Mute swan	Green finch	Lesser black-backed gull
Pheasant	Grey heron	Little grebe
Pied wagtail	Grey wagtail	Long tailed tit
Red kite	Greylag goose	Magpie
Robin	House sparrow	Mallard
Sand martin	Jackdaw	Mute swan
Song thrush	Kestrel	Nuthatch
Swallow	Little grebe	Oyster catcher
Swift	Long-tailed tit	Pheasant
Willow warbler	Magpie	Reed bunting
Wood pigeon	Mallard	Reed warbler
Wren	Moorhen	Ringed plover
	Mute swan	Robin
	Nuthatch	Sand martin
	Oyster catcher	Sedge warbler
	Pheasant	Shelduck
	Pied wagtail	Skylark
	Reed bunting	Song thrush

Reed warbler	Starling
Robin	Swallow
Sand martin	Tawny owl
Sedge warbler	Treecreeper
Song thrush	Tufted duck
Starling	Whtiethroat
Swallow	Willow warbler
Tawny owl	Wilow tit
Treecreeper	Woodpigeon
Tutfted duck	Wren
Willow tit	
Willow warbler	
Woodpigeon	
Wren	

Species lists provided by Stephen Westerburg (Derwent Walk Country Park) and Craig Best (Low Barns) – see chapter three.

Derwent Walk Country Park	**Low Barns**
Blackbird	Blackbird
Blackcap	Blackcap
Blue tit	Blue tit
Bullfinch	Brambling
Chaffinch	Bullfinch
Chiffchaff	Chaffinch
Common whitethroat	Chiffchaff
Coot	Coal tit
Dipper	Crow
Dunnock	Dunnock
Garden warbler	Garden warbler
Goldfinch	Goldcrest
Goosander	Golden oriole
Great tit	Goldfinch
Greenfinch	Grsshopper warbler
Grey partridge	Great tit
Grey wagtail	Greater spotted warbler
Kingfisher	Green woodpecker
Linnet	Greenfinch
Little grebe	Hawfinch
Long-tailed tit	Jay
Magpie	Kestrel
Mallard	Kingfisher
Meadow pipit	Lesser spotted woodpecker
Mistle thrush	Lesser whitethroat
Moorhen	Linnet
Mute swan	Long tailed tit
Pheasant	Magpie

Pied wagtail
Reed bunting
Robin
Sedge warbler
Song thrush
Treecreeper
Tufted duck
Willow warbler
Wood pigeon
Wren

Marsh tit
Nuthatch
Pied flycatcher
Redpoll
Redstart
Redwing
Reed bunting
Reed warbler
Robin
Sedge warbler
Siskin
Snipe
Song thrush
Sparrowhawk
Starling
Swallow
Tawny owl
Tree creeper
Whitethroat
Willow tit
Willow warbler
Wood pigeon
Wood warbler
Wren
Wryneck
Yellowhammer

Appendix 4: Rare Bird Days data for the nine and nineteen month data set

Rare Bird Days data for the nine month data set (April 09 – December 09)

Reserve	Month	Rare birds (worth 1)	Very rare birds (worth 2)	Extremely rare birds (worth 3)	Total rare bird index
Arne	Apr-09	1	0	0	1
Arne	May-09	1	4	0	9
Arne	Jun-09	1	0	0	1
Arne	Jul-09	1	0	0	1
Arne	Aug-09	0	0	0	0
Arne	Sep-09	0	0	0	0
Arne	Oct-09	6	3	0	12
Arne	Nov-09	6	1	0	8
Arne	Dec-09	6	0	0	6
Blacktoft Sands	Apr-09	11	0	0	11
Blacktoft Sands	May-09	5	1	0	7
Blacktoft Sands	Jun-09	3	0	0	3
Blacktoft Sands	Jul-09	11	0	0	11
Blacktoft Sands	Aug-09	13	0	0	13
Blacktoft Sands	Sep-09	8	4	2	22
Blacktoft Sands	Oct-09	8	1	2	16
Blacktoft Sands	Nov-09	3	1	0	5
Blacktoft Sands	Dec-09	1	2	0	5
Conwy	Apr-09	3	1	2	11
Conwy	May-09	0	2	0	4
Conwy	Jun-09	0	0	0	0
Conwy	Jul-09	0	0	1	3
Conwy	Aug-09	0	0	0	0
Conwy	Sep-09	0	0	0	0
Conwy	Oct-09	1	0	0	1
Conwy	Nov-09	4	0	0	4
Conwy	Dec-09	0	0	0	0
Dearne Valley	Apr-09	0	0	0	0
Dearne Valley	May-09	6	0	0	6
Dearne Valley	Jun-09	0	0	0	0
Dearne Valley	Jul-09	0	1	2	8
Dearne Valley	Aug-09	0	0	0	0
Dearne Valley	Sep-09	1	0	0	1
Dearne Valley	Oct-09	0	0	0	0
Dearne Valley	Nov-09	0	0	0	0
Dearne Valley	Dec-09	3	0	0	3
Dungeness	Apr-09	0	0	0	0
Dungeness	May-09	4	3	0	10
Dungeness	Jun-09	3	0	0	3
Dungeness	Jul-09	1	0	0	1
Dungeness	Aug-09	8	0	0	8
Dungeness	Sep-09	19	0	0	19
Dungeness	Oct-09	5	0	0	5

Dungeness	Nov-09	1	0	0	1
Dungeness	Dec-09	5	0	0	5
Fairburn Ings	Apr-09	0	0	0	0
Fairburn Ings	May-09	1	4	0	9
Fairburn Ings	Jun-09	0	0	0	0
Fairburn Ings	Jul-09	0	0	0	0
Fairburn Ings	Aug-09	0	0	0	0
Fairburn Ings	Sep-09	0	0	0	0
Fairburn Ings	Oct-09	0	0	0	0
Fairburn Ings	Nov-09	0	0	0	0
Fairburn Ings	Dec-09	0	0	0	0
Lake Vyrnwy	Apr-09	0	0	0	0
Lake Vyrnwy	May-09	0	0	0	0
Lake Vyrnwy	Jun-09	0	0	0	0
Lake Vyrnwy	Jul-09	0	0	0	0
Lake Vyrnwy	Aug-09	0	0	0	0
Lake Vyrnwy	Sep-09	0	0	0	0
Lake Vyrnwy	Oct-09	0	0	0	0
Lake Vyrnwy	Nov-09	0	0	0	0
Lake Vyrnwy	Dec-09	0	0	0	0
Mid Yar Valley	Apr-09	0	0	0	0
Mid Yar Valley	May-09	2	1	0	4
Mid Yar Valley	Jun-09	1	0	0	1
Mid Yar Valley	Jul-09	0	0	0	0
Mid Yar Valley	Aug-09	0	0	0	0
Mid Yar Valley	Sep-09	0	0	0	0
Mid Yar Valley	Oct-09	0	0	0	0
Mid Yar Valley	Nov-09	0	0	0	0
Mid Yar Valley	Dec-09	0	0	0	0
Minsmere	Apr-09	6	2	0	10
Minsmere	May-09	12	5	0	22
Minsmere	Jun-09	8	8	0	24
Minsmere	Jul-09	9	1	0	11
Minsmere	Aug-09	3	0	0	3
Minsmere	Sep-09	18	0	0	18
Minsmere	Oct-09	19	0	0	19
Minsmere	Nov-09	2	0	0	2
Minsmere	Dec-09	0	0	0	0
Pulborough Brooks	Apr-09	3	0	0	3
Pulborough Brooks	May-09	5	0	0	5
Pulborough Brooks	Jun-09	1	0	0	1
Pulborough Brooks	Jul-09	0	0	0	0
Pulborough Brooks	Aug-09	0	0	0	0
Pulborough Brooks	Sep-09	13	1	0	15
Pulborough Brooks	Oct-09	5	0	0	5
Pulborough Brooks	Nov-09	0	0	0	0
Pulborough Brooks	Dec-09	0	0	0	0
Radipole Lake	Apr-09	6	0	1	9

Radipole Lake	May-09	2	2	3	15
Radipole Lake	Jun-09	3	0	0	3
Radipole Lake	Jul-09	0	1	0	2
Radipole Lake	Aug-09	2	1	0	4
Radipole Lake	Sep-09	3	2	0	7
Radipole Lake	Oct-09	10	1	0	12
Radipole Lake	Nov-09	6	0	0	6
Radipole Lake	Dec-09	3	0	0	3
Rainham Marshes	Apr-09	5	0	0	5
Rainham Marshes	May-09	7	0	0	7
Rainham Marshes	Jun-09	3	0	0	3
Rainham Marshes	Jul-09	2	0	0	2
Rainham Marshes	Aug-09	1	0	0	1
Rainham Marshes	Sep-09	16	0	0	16
Rainham Marshes	Oct-09	11	1	0	13
Rainham Marshes	Nov-09	17	2	0	21
Rainham Marshes	Dec-09	8	6	0	20
Rye Meads	Apr-09	0	0	0	0
Rye Meads	May-09	0	0	0	0
Rye Meads	Jun-09	0	0	0	0
Rye Meads	Jul-09	0	0	0	0
Rye Meads	Aug-09	0	0	0	0
Rye Meads	Sep-09	0	0	0	0
Rye Meads	Oct-09	0	0	0	0
Rye Meads	Nov-09	0	0	0	0
Rye Meads	Dec-09	0	0	0	0
Saltholme	Apr-09	0	2	0	4
Saltholme	May-09	21	0	0	21
Saltholme	Jun-09	1	2	0	5
Saltholme	Jul-09	1	1	0	3
Saltholme	Aug-09	13	3	0	19
Saltholme	Sep-09	12	14	0	40
Saltholme	Oct-09	12	6	0	24
Saltholme	Nov-09	0	1	0	2
Saltholme	Dec-09	0	1	0	2
Titchwell Marsh	Apr-09	3	0	0	3
Titchwell Marsh	May-09	13	3	0	19
Titchwell Marsh	Jun-09	1	0	0	1
Titchwell Marsh	Jul-09	4	0	0	4
Titchwell Marsh	Aug-09	6	0	0	6
Titchwell Marsh	Sep-09	25	1	0	27
Titchwell Marsh	Oct-09	2	0	0	2
Titchwell Marsh	Nov-09	13	0	0	13
Titchwell Marsh	Dec-09	9	0	0	9
Vane Farm	Apr-09	1	3	0	7
Vane Farm	May-09	0	0	0	0
Vane Farm	Jun-09	0	0	0	0
Vane Farm	Jul-09	0	0	0	0

Vane Farm	Aug-09	0	0	0	0
Vane Farm	Sep-09	0	0	0	0
Vane Farm	Oct-09	0	0	0	0
Vane Farm	Nov-09	1	0	0	1
Vane Farm	Dec-09	0	0	0	0
Ynys-hir	Apr-09	0	0	0	0
Ynys-hir	May-09	0	0	0	0
Ynys-hir	Jun-09	0	0	0	0
Ynys-hir	Jul-09	0	0	0	0
Ynys-hir	Aug-09	0	0	0	0
Ynys-hir	Sep-09	8	0	0	8
Ynys-hir	Oct-09	1	0	0	1
Ynys-hir	Nov-09	0	0	0	0
Ynys-hir	Dec-09	0	0	0	0

Rare Bird Days data for the nineteen month data set (April 08 – October 09)

Reserve	Month	Rare bird days (worth 1)	Very rare bird days (worth 2)	Extremely rare bird days (worth 3)	Total rare bird index
Arne	Apr-08	1	0	0	1
Arne	May-08	1	4	0	9
Arne	Jun-08	1	0	0	1
Arne	Jul-08	1	0	0	1
Arne	Aug-08	0	0	0	0
Arne	Sep-08	0	0	0	0
Arne	Oct-08	6	3	0	12
Arne	Nov-08	6	1	0	8
Arne	Dec-08	6	0	0	6
Arne	Jan-09	6	0	0	6
Arne	Feb-09	2	0	0	2
Arne	Mar-09	4	0	0	4
Arne	Apr-09	0	0	0	0
Arne	May-09	0	0	0	0
Arne	Jun-09	0	0	0	0
Arne	Jul-09	0	0	0	0
Arne	Aug-09	0	0	0	0
Arne	Sep-09	0	0	0	0
Arne	Oct-09	1	0	0	1
Conwy	Apr-08	3	1	2	11
Conwy	May-08	0	2	0	4
Conwy	Jun-08	0	0	0	0
Conwy	Jul-08	0	0	1	3
Conwy	Aug-08	0	0	0	0
Conwy	Sep-08	0	0	0	0
Conwy	Oct-08	1	0	0	1
Conwy	Nov-08	4	0	0	4

Conwy	Dec-08	0	0	0	0
Conwy	Jan-09	0	0	0	0
Conwy	Feb-09	0	0	0	0
Conwy	Mar-09	0	0	0	0
Conwy	Apr-09	0	0	0	0
Conwy	May-09	0	0	0	0
Conwy	Jun-09	0	2	0	4
Conwy	Jul-09	0	1	0	2
Conwy	Aug-09	3	0	0	3
Conwy	Sep-09	2	0	0	2
Conwy	Oct-09	0	0	0	0
Dungeness	Apr-08	0	0	0	0
Dungeness	May-08	4	3	0	10
Dungeness	Jun-08	3	0	0	3
Dungeness	Jul-08	1	0	0	1
Dungeness	Aug-08	8	0	0	8
Dungeness	Sep-08	19	0	0	19
Dungeness	Oct-08	5	0	0	5
Dungeness	Nov-08	1	0	0	1
Dungeness	Dec-08	5	0	0	5
Dungeness	Jan-09	0	0	0	0
Dungeness	Feb-09	1	0	0	1
Dungeness	Mar-09	1	0	0	1
Dungeness	Apr-09	1	0	0	1
Dungeness	May-09	5	0	0	5
Dungeness	Jun-09	2	0	2	8
Dungeness	Jul-09	4	0	0	4
Dungeness	Aug-09	7	0	0	7
Dungeness	Sep-09	13	10	1	36
Dungeness	Oct-09	18	20	0	58
Fariburn Ings	Apr-08	10	0	0	10
Fariburn Ings	May-08	8	0	0	8
Fariburn Ings	Jun-08	2	2	0	6
Fariburn Ings	Jul-08	2	0	0	2
Fariburn Ings	Aug-08	12	0	0	12
Fariburn Ings	Sep-08	5	1	2	13
Fariburn Ings	Oct-08	1	0	0	1
Fariburn Ings	Nov-08	2	0	0	2
Fariburn Ings	Dec-08	5	0	0	5
Fariburn Ings	Jan-09	21	0	0	21
Fariburn Ings	Feb-09	18	0	0	18
Fariburn Ings	Mar-09	9	0	0	9
Fariburn Ings	Apr-09	0	0	0	0
Fariburn Ings	May-09	1	4	0	9

Fariburn Ings	Jun-09	0	0	0	0
Fariburn Ings	Jul-09	0	0	0	0
Fariburn Ings	Aug-09	0	0	0	0
Fariburn Ings	Sep-09	0	0	0	0
Fariburn Ings	Oct-09	0	0	0	0
Lake Vyrnwy	Apr-08	0	0	0	0
Lake Vyrnwy	May-08	0	0	0	0
Lake Vyrnwy	Jun-08	0	0	0	0
Lake Vyrnwy	Jul-08	0	0	0	0
Lake Vyrnwy	Aug-08	0	0	0	0
Lake Vyrnwy	Sep-08	0	0	0	0
Lake Vyrnwy	Oct-08	0	0	0	0
Lake Vyrnwy	Nov-08	0	0	0	0
Lake Vyrnwy	Dec-08	0	0	0	0
Lake Vyrnwy	Jan-09	0	0	0	0
Lake Vyrnwy	Feb-09	0	0	0	0
Lake Vyrnwy	Mar-09	0	0	0	0
Lake Vyrnwy	Apr-09	0	0	0	0
Lake Vyrnwy	May-09	0	0	0	0
Lake Vyrnwy	Jun-09	0	0	0	0
Lake Vyrnwy	Jul-09	0	0	0	0
Lake Vyrnwy	Aug-09	1	0	0	1
Lake Vyrnwy	Sep-09	0	0	0	0
Lake Vyrnwy	Oct-09	0	0	0	0
Minsmere	Apr-08	6	2	0	10
Minsmere	May-08	12	5	0	22
Minsmere	Jun-08	8	8	0	24
Minsmere	Jul-08	9	1	0	11
Minsmere	Aug-08	3	0	0	3
Minsmere	Sep-08	18	0	0	18
Minsmere	Oct-08	19	0	0	19
Minsmere	Nov-08	2	0	0	2
Minsmere	Dec-08	0	0	0	0
Minsmere	Jan-09	13	0	0	13
Minsmere	Feb-09	7	0	0	7
Minsmere	Mar-09	2	1	0	4
Minsmere	Apr-09	3	0	0	3
Minsmere	May-09	5	0	0	5
Minsmere	Jun-09	8	0	0	8
Minsmere	Jul-09	8	0	0	8
Minsmere	Aug-09	5	0	0	5
Minsmere	Sep-09	12	1	0	14
Minsmere	Oct-09	20	9	0	38
Ynys-hir	Apr-08	0	0	0	0

Ynys-hir	May-08	0	0	0	0
Ynys-hir	Jun-08	0	0	0	0
Ynys-hir	Jul-08	0	0	0	0
Ynys-hir	Aug-08	0	0	0	0
Ynys-hir	Sep-08	8	0	0	8
Ynys-hir	Oct-08	1	0	0	1
Ynys-hir	Nov-08	0	0	0	0
Ynys-hir	Dec-08	0	0	0	0
Ynys-hir	Jan-09	2	0	0	2
Ynys-hir	Feb-09	0	0	0	0
Ynys-hir	Mar-09	0	0	0	0
Ynys-hir	Apr-09	1	0	0	1
Ynys-hir	May-09	0	0	0	0
Ynys-hir	Jun-09	0	0	0	0
Ynys-hir	Jul-09	0	0	0	0
Ynys-hir	Aug-09	0	0	0	0
Ynys-hir	Sep-09	0	0	0	0
Ynys-hir	Oct-09	0	0	0	0

Appendix 5: The presence of range restricted and Red and Amber listed species in the UK

A table of the range restricted species found in the eight sample sites, shown with their presense in 10km-grid cells across the UK (explained in chapter two) and the reserves they are currently found in.

MIN = Minsmere; LMS = Leighton Moss; LDG = The Lodge; RMA = Rainham Marshes; LOW = Low Barns; SAL = Saltholme; RME = Rainton Meadows; DCP = Derwent Walk Country Park.

Range restricted species	All Records in the UK (excluding Ireland) (Gibbons *et al*., 1993).	Present in:
Mediterranean gull	7	MIN
Bittern	13	LMS; MIN
Spotted crake	26	LMS; MIN
Avocet	28	LMS; MIN; RMA
Barnacle goose	43	MIN
Sandwich tern	43	MIN
Dartford warbler	50	LDG; MIN
Stone-curlew	54	MIN
Bearded tit	60	LMS; MIN; RMA
Woodlark	73	LDG; MIN
Pintail	85	RMA
Red Kite	85	DCP
Cetti's warbler	86	MIN; RMA
Firecrest	99	LDG; MIN
Little tern	110	MIN
Marsh harrier	114	LMS; MIN
Garganey	136	MIN; RMA; SAL
Nightjar	274	LDG; MIN
Ruddy duck	292	LMS; MIN; SAL

A table of the ICUN Red and Amber listed species found in the eight sample sites, shown with their presence in 10km grid cells across the UK (explained in chapter two) and the reserves they were found in.

MIN = Minsmere; LMS = Leighton Moss; LDG = The Lodge; RMA = Rainham Marshes; LOW = Low Barns; SAL = Saltholme; RME = Rainton Meadows; DCP = Derwent Walk Country Park.

Species	ICUN classification	All Records in the UK (excluding Ireland) (Gibbons *et al*., 1993)	Present in:

Mediterranean gull	Amber	7	MIN
Bittern	Red	13	LMS; MIN
Spotted crake	Amber	26	LMS; MIN
Avocet	Amber	28	LMS; MIN; RMA
Barnacle goose	Amber	43	MIN
Sandwich tern	Amber	43	MIN
Stone-curlew	Amber	54	MIN
Bearded tit	Amber	60	LMS; MIN; RMA
Woodlark	Amber	73	LDG; MIN
Pintail	Amber	85	RMA
Red Kite	Amber	85	DCP
Firecrest	Amber	99	LDG; MIN
Little tern	Amber	110	MIN
Marsh harrier	Amber	114	LMS; MIN
Garganey	Amber	136	MIN; RMA; SAL
Nightjar	Red	274	LDG; MIN
Arctic tern	Amber	303	LOW; MIN
Gadwall	Amber	357	MIN; SAL
Wigeon	Amber	360	RMA
Common tern	Amber	426	LOW; MIN; SAL
Lesser black-backed gull	Amber	434	MIN; RMA
Nightingale	Amber	457	LDG; MIN
Great black-backed gull	Amber	486	LMS
Shoveler	Amber	500	LMS; MIN; RMA; SAL
Pochard	Amber	511	LMS; MIN; RMA, SAL
Common gull	Amber	557	LOW
Dunlin	Red	569	LMS
Black-headed gull	Amber	671	LOW; LMS; MIN; RMA; RME; SAL
Short-eared owl	Amber	679	RMA
Greylag goose	Amber	718	LOW; LMS; MIN; RMA; RME; SAL
Herring gull	Red	729	MIN; RME
Lesser spotted woodpecker	Red	790	LDG; MIN
Quail	Amber	804	MIN
Turtle dove	Red	940	LDG; MIN
Shelduck	Amber	959	LMS; MIN; RMA; RME; SAL
Ringed plover	Amber	1025	LMS; MIN; RMA
Yellow wagtail	Red	1047	MIN; SAL
Willow tit	Red	1100	LOW; RME; DCP
Barn owl	Amber	1110	RMA
Marsh tit	Red	1133	LOW; LMS; MIN
Teal	Amber	1147	LMS; MIN; RMA; SAL
Grasshopper warbler	Red	1189	DCP; LMS; MIN; RMA
Kingfisher	Amber	1224	LMS; MIN
Little grebe	Amber	1275	DCP; LOW; LMS; MIN; RMA; RME; SAL
Tree sparrow	Red	1346	LDG; MIN
Redshank	Amber	1473	LMS; MIN; RMA; SAL
Tufted duck	Amber	1484	DCP; LOW; LMS; MIN; RMA; RME; SAL

Tree pipit	Red	1524	LDG; LMS; MIN
Green woodpecker	Amber	1555	LDG; LMS; MIN; RMA
Sand martin	Amber	1559	DCP; LOW; MIN; RMA
Grey partridge	Red	1629	LDG; MIN; SAL
Oystercatcher	Amber	1702	LMS; MIN; RME; SAL
Wheatear	Amber	1738	LDG; LMS
Snipe	Amber	1806	MIN; RMA; SAL
Stock dove	Amber	1821	LDG; MIN; SAL
Curlew	Amber	1893	LOW; LMS
Bullfinch	Amber	2173	DCP; LDG; LOW; LMS; MIN; RME
Reed bunting	Amber	2188	LDG; LOW; LMS; MIN; RMA; RME; SAL
Yellowhammer	Red	2224	DCP; LDG; MIN
Linnet	Red	2268	LDG; LMS; MIN; RMA; SAL
Lapwing	Red	2340	LMS; MIN; RMA; RME; SAL
Spotted flycatcher	Red	2378	DCP; LDG; LMS; MIN
Mistle thrush	Amber	2397	LDG; LMS; MIN; SAL
Cuckoo	Red	2418	LDG; MIN; RMA; SAL
Kestrel	Amber	2481	DCP; LDG; LOW; LMS; MIN; RMA; SAL
Dunnock	Amber	2511	DCP; LDG; LOW; LMS; MIN; RME; SAL
House sparrow	Red	2525	LOW; LMS; MIN; RMA
Meadow pipit	Amber	2539	LDG; LMS; MIN; RMA; SAL
Mallard	Amber	2596	DCP; LDG; LOW; LMS; MIN; RMA; RME; SAL
Willow warbler	Amber	2602	LDG; LOW; LMS; MIN; RME; SAL
Song thrush	Red	2620	LDG; LOW; LMS; MIN; RMA; RME; SAL
Starling	Red	2620	LDG; LOW; LMS; MIN; RMA; RME
Swallow	Amber	2626	LMS; LOW; MIN; RME; SAL
Skylark	Red	2729	LDG; LMS; MIN; RMA; RME; SAL