AN ASSESSMENT OF THE EFFECT ON OVER-WINTERING DUCKS OF RECREATION AT THE WRAYSBURY AND THORPE PARK PITS WITHIN THE SW LONDON WATERBODIES SPECIAL PROTECTION AREA

FINAL REPORT

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Contents

1. Summary

- This report summarises the first year of fieldwork at Wraysbury 1 and Wraysbury 2 Gravel Pits.

Distribution and numbers of key species: Wraysbury 1

- Wraysbury 1 held a peak count of 25 Gadwall (Jan/Feb), 12 Shoveler (Dec), 204 Tufted Duck (Dec) and 4 Smew (Feb) over the course of the winter 2001/2002.
- Tufted Duck and Gadwall numbers were generally higher midweek compared to weekend on Wraysbury 1. The mean number of Tufted Duck was significantly higher midweek versus weekends, but there was no significant difference in Gadwall numbers.
- On average over the winter, both Gadwall and Tufted Duck spent less than 10% of the day feeding on Wraysbury 1.
- There was no significant difference in the proportion of time birds spent feeding midweek compared to weekend for Gadwall or Tufted Duck on Wraysbury 1.

Distribution and numbers of key species: Wraysbury 2

- Wraysbury 2 held a peak count of 147 Gadwall, 50 Shoveler, 549 Tufted Duck and 12 Smew over the course of the winter 2001/2002.
- Over the whole site, weekend numbers of Tufted Duck were significantly higher than midweek numbers but there was no significant difference in Gadwall numbers between weekends and midweek days.
- Wraysbury 2 (North) held considerably higher numbers of Tufted Duck than the South section. Numbers on Wraysbury 2 (North) were higher at weekends compared to midweek, but on the South part of Wraysbury 2 numbers were lower at weekends compared to midweek.
- The overall increase in the numbers of Tufted Ducks at the weekend was largely the result of an influx of birds to the North section from outside of the site.
- Wraysbury 2 (North) was also favoured by Shoveler and Smew.
- Gadwall occurred predominantly on Wraysbury 2 (South).
- Shoveler numbers were generally low throughout the winter, however there was a daytime peak of 50 birds in February, and night-time counts by the WeBS counter revealed a flock of up to 260 birds on Wraysbury 2 (North) during February.

- Tufted Duck numbers generally increased throughout the day except on Wraysbury 2 (South) during weekends when numbers declined between 1100 and 1500 hrs coincident with sailing activity in the South. Gadwall numbers in the South showed a similar pattern of diurnal variation on weekends.
- A high proportion of the Gadwall in the South section was recorded feeding. In contrast most of the Tufted Duck on the whole site and in particular the North were roosting birds.
- Sector B in the North and sector G in the South appeared to function as refuges for Gadwall from the South sectors which experienced sailing (in particular from Sector E) at the weekend. However fewer birds were recorded feeding in sector B compared to the South sectors.
- Sectors I and J in the North were the main recipient of large influxes of Tufted Duck at weekends, with sector I in particular acting as an important refuge area. Some of these birds came from Wraysbury 2 (South), but a larger number were from outside the site.

Human recreation at Wraysbury I: distribution, extent and response by waterbirds

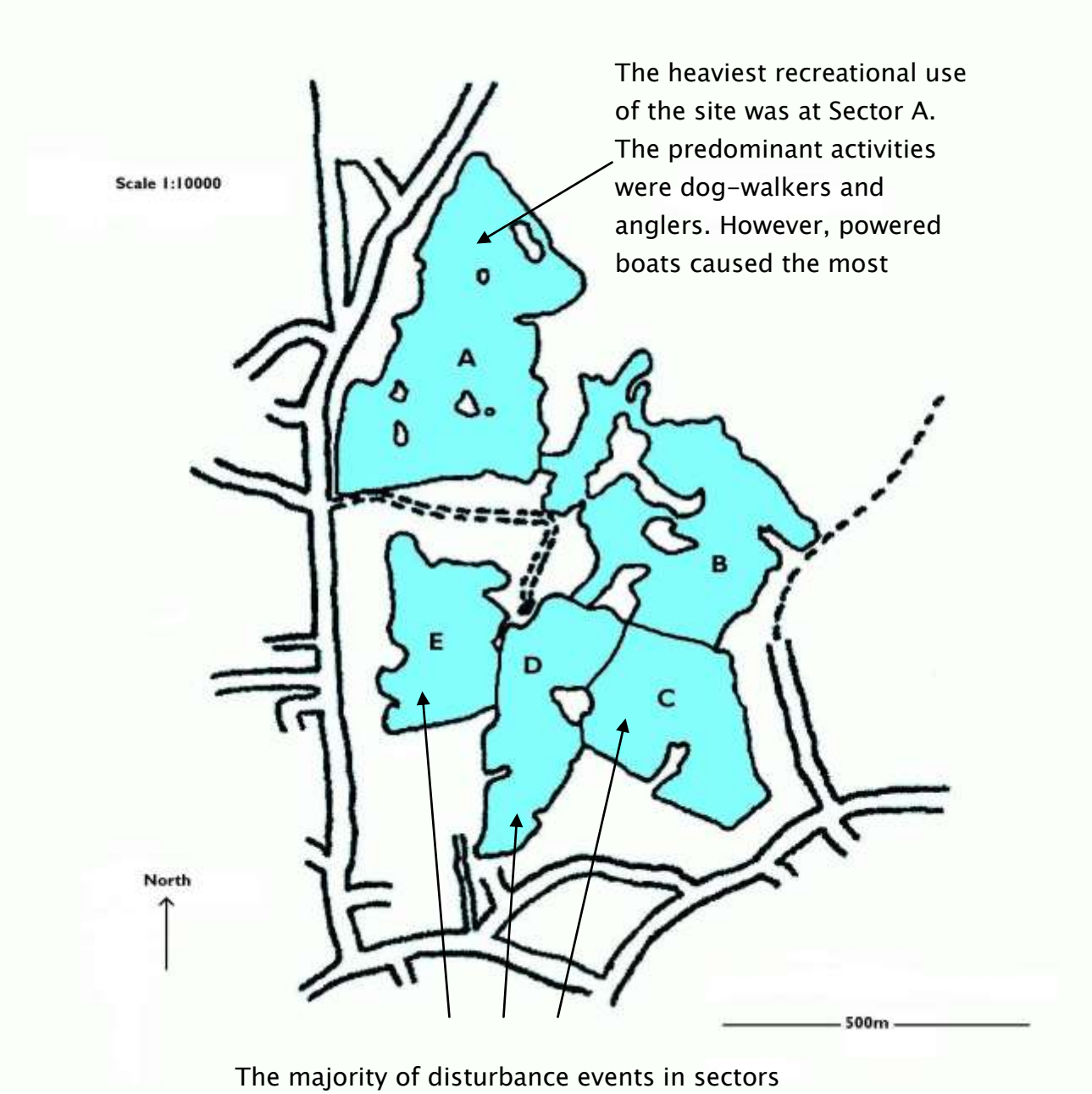
- A total of 82 human recreational events were recorded on Wraysbury 1 over the winter.
- 30.5% of recreational events resulted in a reaction by one or more of the key species.
- Recreational activity was actually higher midweek compared to weekends on Wraysbury 1. On average, there were 6.71 events per day midweek compared to 5.00 events/day at weekends.
- However, there were more events that resulted in a reaction by the key species at weekends compared to midweek – on average 1.14 'disturbing events' midweek compared to 2.43 at the weekend.
- Across all events resulting in a reaction, on average 25% of the birds on Wraysbury 1 left the site in response to the activity. More than 40% of birds, on average, did not respond at all.
- Dog-walkers were the most frequent recreational activity on the site, followed by sailing, powered boat use and angling.
- The recreational events most likely to cause a reaction by the key species were shooters, sailing and powered boat use (more than 80% of these activities resulted in a reaction).
- Cumulatively, over the winter, sailing and powered boat use resulted in disturbance to the greatest number of birds.

- In terms of individual events a shooter event and a quad bike event resulted in the largest number of birds being disturbed by a single event.
- Angling from the shore/island caused disturbance to the smallest number of individuals over the course of the winter.
- Only sailing, powered boat use and shooters caused birds to leave the site.
- Fewer birds were present on the site during disturbed scans compared to undisturbed scans, but the proportion of time spent feeding was not affected.

Human recreation at Wraysbury 2: distribution, extent and response by waterbirds

- Disturbance occurred in all sectors of Wraysbury 2 and there were no obvious refuge areas.
- Recreational activity was higher at the weekend compared to midweek – there were an average of 3.04 individuals/craft per 120 minute recording session on midweek days compared to 13.8 at the weekend. The difference between midweek and weekend levels was most pronounced in the South.
- Sectors A and J in the North and E in the South were the most heavily used. J and E had heaviest usage at weekends and A at both midweek and weekends.
- The North was used primarily by shore-based activities and the South by boat-based activities.
- Angling was the main recreational activity on the North and sectors A and J were the most frequently used by anglers. Sailing and powered boat activity occurred mainly in sector E of the South.
- Sailing and powered boat use at weekends, mainly between 1100 and 1500 hours resulted in the majority of birds leaving the South section of Wraysbury 2. In contrast angling and birdwatching on the North part of Wraysbury 2 were more likely to result in a redistribution of birds to adjacent sectors within the North.

An illustrated summary of data collected at Wraysbury 1



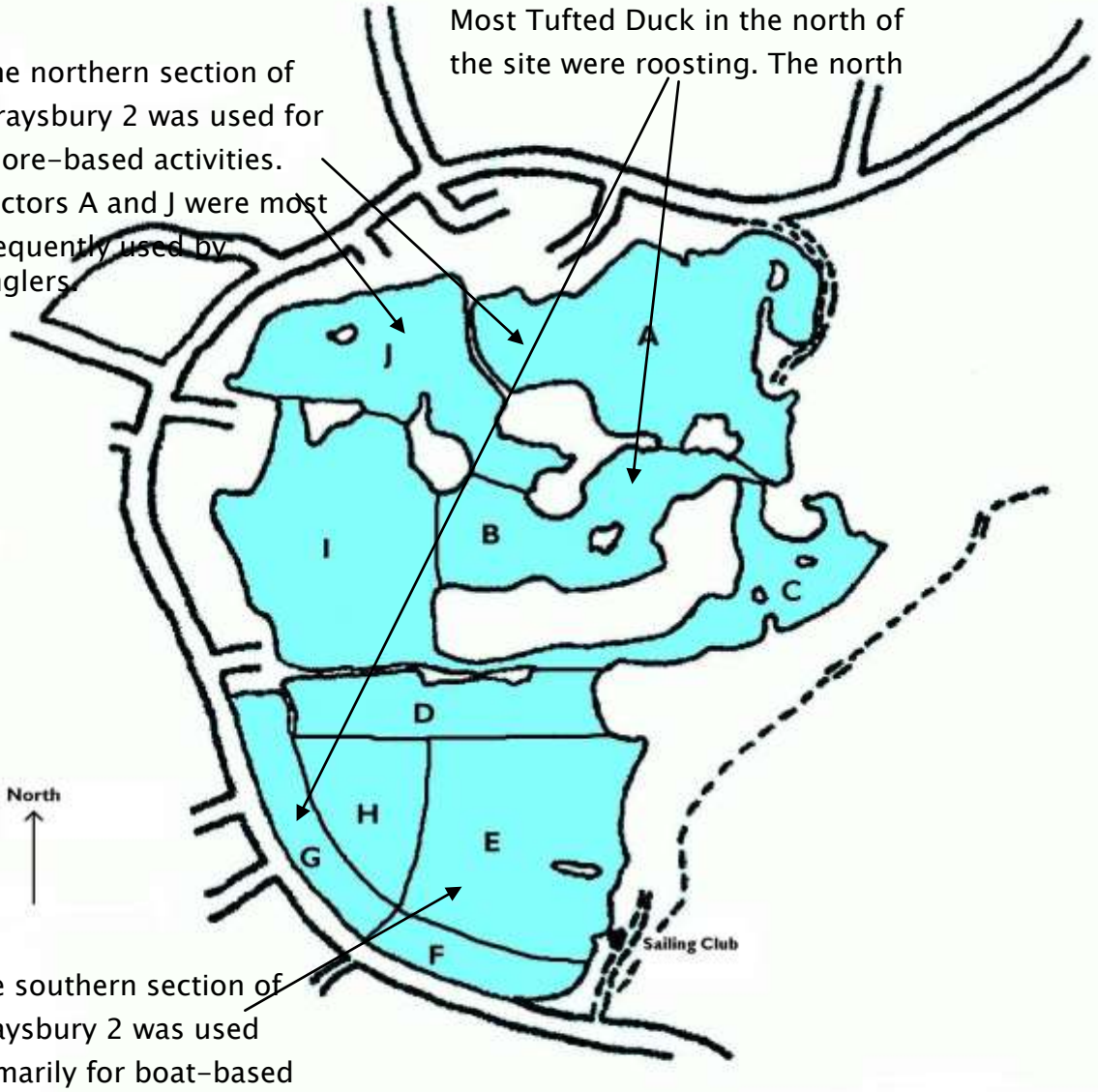
The heaviest recreational use of the site was at Sector A. The predominant activities were dog-walkers and anglers. However, powered boats caused the most

The majority of disturbance events in sectors C, D and E involved sailing or powered boats from the sailing club. Around 25% of birds present on the site flew off in response to a human activity causing disturbance. 34% reacted but remained on site and just over 40% did not react at all. Numbers of Tufted Duck and Gadwall were generally higher midweek than at weekends

An illustrated summary of data collected at Wraysbury 2 in 2002/01

Sectors B and G appeared to act as refuges for Gadwall at the weekend. Most Tufted Duck in the north of the site were roosting. The north

The northern section of Wraysbury 2 was used for shore-based activities. Sectors A and J were most frequently used by anglers.



The southern section of Wraysbury 2 was used primarily for boat-based activities. Section E was heavily used by sailing and powered boats from the sailing club.

Scale 1:10000

2. Introduction

2.1 Wetlands and waterbirds are under pressure from anthropogenic activities such as land claim, habitat destruction, pollution, hunting and recreation (Bell & Owen 1990; Ward 1990; Yalden 1992; Tucker & Heath 1994). It is generally agreed that disturbance, especially that caused by recreational activities, is a threat to waterbirds, particularly since many recreational activities may be increasing in intensity and distribution (e.g. Ward 1990; Cayford 1993). Disturbance has been defined as *any phenomenon which may cause a significant change in the dynamics of a population or the eco-ethological characteristics of populations of birds* (defined by the EU Commission, 4 September 1992, EU Journal No C 289/16).

2.2 It has been estimated that 23 waterbird Species of European Conservation Concern (SPECs) have suffered moderate or large scale declines in the past due, in part, to some form of disturbance (Tucker & Heath 1994). Furthermore, 29% of European sites classified as Important Bird Areas (IBAs) are threatened by the effects of disturbance (Heath & Evans 2000). Although many experimental studies have shown that disturbance, which can be equated to deterioration of habitat, can have a considerable effect on the numbers of individuals using a site, it is generally much less clear how populations of species respond to the stimuli (see Madsen *et al.* 1995 and Hill *et al.* 1997 for reviews).

2.3 Effective waterbird conservation requires the demonstration and minimisation of the effects and impacts of anthropogenic activity where there is a potential conflict between waterbird conservation and recreation interests.

A legislative framework for measuring the effects and impacts of disturbance

2.4 Nations are responsible for implementing various international agreements, directives and conventions which have been introduced to ensure that birds and their habitats are conserved effectively. Along the east Atlantic flyway, the EC Birds Directive 1979, the Ramsar Convention 1971 and the African-Eurasian Waterbird Agreement 1995 (AEWA) provide legislative requirements for disturbance measurement.

The EC Birds Directive

2.5 The European Community (EC) Directive on the Conservation of Wild Birds (Council Directive 79/409/EEC), provides a legal framework for the conservation of all naturally occurring bird species in Europe. Article 2 of the Directive requires the maintenance of populations of bird species *'at a level which corresponds in particular to ecological, scientific and cultural requirements, while taking account of economic and recreational requirements, or to adapt the populations of these species to that level.'*

2.6 Article 3 requires that Member States should *'take requisite measures to, maintain or re-establish a sufficient diversity and area of habitats for all the species of birds naturally occurring in Europe referred to in Article 1.'* Article 4 requires Member States to classify suitable territories in number and size as Special Protection Areas (SPAs). Article 4 specifies that steps should be taken *'to avoid pollution or deterioration of habitats or any disturbances affecting the birds insofar as these would be significant'* and that *'outside these protection areas, Member States shall also strive to avoid pollution or deterioration of habitats.'*

The Ramsar Convention on Wetlands of International Importance

2.7 The Ramsar Convention requires signatories to protect wetlands of international importance, to promote wetlands generally and to foster the wise

use of wetlands. At least one site in each country must be designated for inclusion in the Ramsar 'List'. With respect to the impacts of human activities, Article 3.1 specifically requires Signatories to *'formulate and implement their planning so as to promote the conservation of wetlands included in the List, and as far as possible the wise use of wetlands in their territory'* and, within Article 3.2, *'...arrange to be informed at the earliest possible time if the ecological character of any wetland and its territory in the List has changed, is changing or is likely to change as the result of technological developments, pollution or interference.'*

2.8 Signatories are also required to *'...encourage research and the exchange of data and publications regarding wetlands and their flora and fauna.'* However, the Convention text is no more specific than this regarding the measurement and monitoring of the effects and impacts of human disturbance.

AEWA

2.9 The AEWA 1995 requires that Parties should take co-ordinated measures to maintain migratory species in a favourable conservation status, or to restore them to such a status. This Agreement goes slightly further than the Birds Directive and Ramsar; Article III, 2 (e) requiring Signatories to *'...investigate the problems posed or are likely to be posed by human activities and attempt to implement remedial actions throughout flyways. Such information can only be collected by long-term schemes which monitor the effects of anthropogenic disturbance on waterbirds.'*

2.10 For those waterbird populations with particularly unfavourable conservation status, Section 2.1.1 (b) of the Agreement Action Plan requests that Signatories should *'...prohibit deliberate disturbance in so far as such disturbance would be significant for the conservation of the population concerned.'* Section 4 deals with the management of human activities and in

4.3.6 requests that '*In cases where human disturbance threatens the conservation status of waterbird populations listed in Table 1, Parties should endeavour to take measures to limit the level of threat. Appropriate measures might include,* inter alia*, the establishment of disturbance-free zones in protected areas where public access is not permitted.'*

2.11 Section 5 deals specifically with research and monitoring needs and in Part 6 states that Parties *'.....shall endeavour to undertake studies on the effects of.....disturbance on the carrying capacity of wetlands used by the populations listed in Table 1 and on the migration patterns of such populations.'*

2.12 In summary, if nations are to fulfil their commitments under these international legislation, it will be necessary to develop appropriate research which adequately measures:

- the causes, distribution and frequency of potentially disturbing activities nationwide.
- the 'effects' of human disturbance at site-level, especially at protected sites.
- the 'impacts' of human disturbance at the population level, i.e. what are the consequences of disturbance for the conservation status of individual waterbird populations.

A scientific basis for measuring the effects and impacts of recreational disturbance

2.13 The distribution and frequency of disturbance events has been measured in the UK by the Wetland Bird Survey (WeBS) (Robinson & Pollitt 2002). Between 1995/96 and 1998/99, volunteer counters recorded human activity and perceived waterbird disturbance during co-ordinated counts of waterbirds at wetland sites across the UK. Over 68% of counters recorded no disturbance at their site and only a small proportion of those (<2%) indicated very high levels. The frequency of disturbance peaked during the late summer. Just over 36% of

disturbance events were attributed to human activities. The most perceived disturbance was caused by people using motor-driven machines and shooters. Waterbirds at inland sites were more likely to be disturbed by motor-driven machines and unpowered boats than those at the coast. Improvements to the methods for collecting these data have been proposed and new techniques are being piloted in the Republic of Ireland (Robinson & Cranswick in press).

2.14 It is important to differentiate between the terms 'effects' and 'impacts' when used in the biological sense. An effect is an observed response, i.e. a movement of birds away from a site in response to some stimuli which may only be a temporary displacement. Furthermore, birds may be able to use alternative sites during periods of high disturbance at the original site without any negative effects on their energy budget. Impacts are of primary conservation importance because they imply a reduction in survival of individuals which may cause declines in population size. Impacts depend largely on whether alternative sites are available and the energetic costs of displacement (Gill *et al.* 1998).

2.15 Two approaches have been taken to assess the effects of disturbance on waterbirds. The first method involves recording the distribution of animals before and after disturbance incidents (e.g. Draulans & van Vessem 1985; Bélanger & Bédard 1989; Madsen 1998a). A problem associated with this method is that disruptions to waterbird distribution subsequent to a disturbance event may not have negative consequences because the new distribution pattern may only be temporary; animals returning to their original distribution at a later date to exploit the remaining resources (Owens 1977; Underhill *et al.* 1993). The alternative method is to relate the numbers of animals to the varying rates of disturbance across a number of sites or patches within sites (e.g. Tuite *et al.* 1984; Sutherland & Crockford 1992). However, to be able to interpret these data correctly, an assessment of the number of animals using the site in the absence of disturbance is required.

Without some form of experimental control, the results of these types of studies are flawed. In an attempt to overcome these problems, Madsen (1998b) was able to vary the levels of hunting disturbance experimentally in Denmark and recorded the reactions of waterbirds in terms of displacement and redistribution.

2.16 To understand the impacts of disturbance on waterbird populations it is necessary to know not only whether a species avoids sites where humans are present, but also the consequent costs of moving to another site (Gill *et al.* 1998). Gill *et al.* (1996) described a method of quantifying the impacts of disturbance, based on the trade-off between resource use and risk of disturbance. The approach follows a similar technique used to study the effects of predation risk on patch use (Lima & Dill 1990). In effect, waterbirds perceive humans as potential predators. The technique proposed by Gill *et al.* (1996) measures the reduction in the use of a resource in response to disturbance. The approach allows both quantification of the effect of disturbance on numbers at a local scale, and exploration of the potential consequences of changes in disturbance on the size of populations. The approach has recently been used to investigate seasonal changes in the response to human disturbance (Stillman & Goss-Custard 2002).

2.17 Individuals-based population models have focused on the impacts of habitat loss on waterbird populations and provide a conceptual framework for predicting its consequences (Goss-Custard 1985, 1993; Goss-Custard *et al.* 1995a, b; Sutherland 1996a, b; Pettifor *et al.* 2000). Disturbance can be equated to habitat loss because both factors act to reduce the carrying capacity of a site. In simplistic terms, disturbance and habitat loss give rise to a reduction in food availability leading to movements of birds to other sites and therefore increased density (Goss-Custard 1977; 1993; Sutherland & Goss-Custard 1991). Increased density, in turn, results in increased food depletion and/or competitive interference so that food intake is affected,

reducing the optimality of the habitat and hence its 'carrying capacity' (Goss-Custard *et al.* 1995c, d; Stillman *et al*. 2000). The consequence of this at the metapopulation scale is to increase mortality as birds drop below a critical body mass threshold for survival, leading to flyway-scale population declines as habitat is increasingly lost through disturbance. As habitat is removed or disturbance levels are increased there may be no effects on bird numbers until a threshold density is reached. Beyond this density, density-dependent mortality occurs (Zwarts 1976; Goss-Custard 1977).

2.18 In some species, individuals may have to compete strongly to gain access to resources, perhaps because resources are uncommon, are depleted rapidly, because birds are near to the limits of their energy budget, because density is already high or because few suitable alternative sites are available. Therefore, these species are the most likely to be adversely affected by disturbance and habitat loss. Since density-dependent effects operate largely through interference competition between individuals on the feeding grounds in these species, and hence food competition, a method of measuring this density dependence is deemed to be the most appropriate method for estimating parameter values of density-dependent functions.

2.19 Density-dependence models can be used to predict the movements and mortality of birds in response to disturbance or habitat loss at a range of spatial scales, from individual-site to global levels. Clearly, the accuracy of such models relies on the accuracy of the parameter values used and therefore intensive studies of the demography, foraging behaviour, intake rates and physiological condition of the waterbirds involved (Goss-Custard 1995c). The intensity of the studies required means that the demonstration of the impact of disturbance at population level is rarely possible.

The effects of different recreational activities on waterbirds at inland waterbodies

Angling

2.21 The effects of angling on the behaviour of waterbirds have been studied at many sites (Ward 1990). Most of the conflict between anglers and waterbirds has come from the extension of the game fishing season into the winter months when waterbird numbers are at their highest on enclosed inland waterbodies. However, the coarse fishing season, which is generally closed between mid-March and mid-June, also coincides with the period of peak numbers of most wintering waterbirds in the UK.

2.22 At Grafham Water, counts indicated that 11 out of 14 species of waterbird increased in number after the end of the fishing season (Cooke 1976, 1977, 1987). Studies of the spatial distribution of birds at this site indicated that for the many of the species present, over half of the total numbers present were found in the refuge, where there was no fishing, during the fishing season. Movements away from the refuge after the fishing season were noted for many species, including Mallard, Gadwall and Tufted Duck. In general, anglers cause the most disturbance when in large numbers at small and normally undisturbed areas of inland waters (Cooke 1975; Tuite 1982; Cryer *et al.* 1987).

2.23 At most sites, disturbance effects at the start of the fishing season are difficult to measure given that many migratory species are leaving their wintering grounds at that time. However,, at Llandegfedd Reservoir, notable declines in the numbers of Wigeon, Teal, Mallard and Pochard were recorded just after the start of the fishing season (Bell *et al.* 1984; Bell & Austin 1985).

2.24 Although there is a paucity of convincing data available, studies have shown that breeding ducks tend to avoid sites with intense levels of game fishing (Watmough 1983). The numbers and densities of Tufted Duck and Mallard

were negatively correlated with the numbers of anglers present at the reservoirs in the mid-Trent valley.

Sailing

2.25 Compared to other human activities, unpowered and motor-driven boats are the most disturbing human activities at inland wetlands relative to their occurrence (Robinson & Pollitt 2002). Numerous studies have attempted to assess the effects of sailing on waterbirds (Parr 1974; Batten 1977; Tuite 1982; Watmough 1983; Tuite *et al.* 1984; O'Brien 1987). Sailing boats compete with waterbirds for available space and are used in mid winter when waterbird numbers are often at their highest. This competition is greatest for diving duck species that feed and roost in the same deep areas of water as those used by sailing boats. Waterbirds that use marginal habitats, e.g. Mallard, Wigeon and Teal, have also been shown to decline at sites with sailing boat activity but no refuge area (Atkinson-Willes 1964; Batten 1977).

2.26 The effects of sailing boats on breeding birds are less clear. However, Great Crested Grebes stopped breeding on the northern arm of Brent Reservoir and the densities of breeding waterbirds declined at Stanstead Abbots after the introduction of sailing at these sites (Batten 1977; Tydeman 1978).

Windsurfing

2.27 Even a few windsurfers have been shown to cause declines in the numbers of waterbirds using a site (Tapken 1982; White 1986). The boards used can access shallow at water and the activity occurs during the winter months when waterbird numbers are often at their highest.

Powered boats

2.28 Waterbirds were shown to leave Llangorse Lake in response to the presence of powerboats (Cundale 1980). Goldeneye were particularly sensitive to the use of power boats; after leaving the site during weekend disturbance, numbers recovered up to a week afterwards. When the disturbance occurred during the week as well, numbers never recovered.

2.29 Breeding densities of five species of waterbirds at a gravel pit used for power boating were about a third of those at sites used for sailing, and Coot failed to nest (Tydeman 1978). Great Crested Grebes abandoned Brent Reservoir during the breeding season after power boat racing was allowed (Batten 1977). Power boats also have more indirect consequences, eroding bank-sides, stirring sediment, destroying vegetation and releasing toxic oil-based chemicals (Phillips & Sparke 1961).

Birdwatchers and walkers

2.30 Walking and dog-walking are the most frequently recorded human activities at wetland sites in the UK (Robinson & Pollitt 2002). However, there are few data indicating the effects of walkers, and especially birdwatchers on the numbers of waterbirds using a site or their behavioural responses.

Previous studies on the effects of recreational disturbance on waterbirds at the SW London Waterbodies

2.31 The Wetlands Advisory Service (WAS) was contracted by Thames Water Utilities Ltd. and English Nature to study the use made by waterbirds of the complex of waterbodies in the southwest of London. Three reports were produced as a result of this work. The first two focused on reviewing relevant literature and analysing count data (Underhill & Kirby 1993; Underhill & Robinthwaite 1993). The third report presented the results of studies investigating the differences between mid-week and weekend counts in the numbers of humans and birds

using individual waterbodies, an examination of within-day patterns of distribution, movements and behaviour, a description of the environmental characteristics of these wetlands and an investigation into the influence on the waterbird community composition (Underhill *et al.* 1993).

2.32 A variety of human activities were identified during the study with walking and angling being the moist numerous. The highest levels of human activity were recorded at the weekend,, accounting for 72% of all activity recorded during the weekend and weekdays. Yeoveney Centre Lake supported the most activity overall. Shore-based activity was particularly intense at Bedfont Angling, Staines Moor and Staines Reservoir, whilst Queen Mother Reservoir supported the most water-based activity.

2.33 More waterbirds were present on the counted sites at weekends compared to midweek, with an average difference of 19.1%. Thus there was an influx of birds onto the counted sites at weekends. The species contributing most to the influx were Tufted Duck, with Gadwall and Great Crested Grebe also regular contributors to the effect. This result indicated the use of this complex site as a 'refuge' to a large number of waterbirds at weekends.

2.34 The size of the weekend influx varied markedly between sites. The sites gaining the most birds at weekends were Wraysbury II North, King George VI Reservoir and Wraysbury II South, whilst the sites losing birds were Lambeth I-IV, Sheepwalk West, Staines Reservoir North, Wraysbury I North, Yeoveney Centre Lake and Old Slade. The size of a site, measured by the surface area of water, seemed to be an important factor in that the changes in waterbird numbers occurred at the largest sites. The suspected reason for the influx of birds at the weekend was thought to be increased recreational pressure on sites outside the area.

2.35 Waterbirds were counted and their activities recorded three times per day and 54 of the 92 waterbodies in the study area. There were no obvious patterns of site phenology through the day.

2.36 Sites with the most and least stable daytime counts were identified and this was related to collated environmental statistics. Counts at the larger and more complex shaped sites were the most variable, whilst a more stable pattern was apparent for well vegetated sites. The species contributing most to the instability of numbers at particular sites were Coot, Tufted Duck an, to a lesser extent, Teal, although in proportion to overall abundance, Coot were relatively the most stable species. In relative terms Goosander, Lapwing, Grey Heron and Canada Geese were the most volatile species, whilst Coot, Great Crested Grebe and Wigeon were the most stable in the study area.

2.37 The main diurnal activity at the majority of sites was feeding, with roosting being recorded only rarely. Only four waterbodies supported a relatively high proportion of roosting birds: Blenheim Angling, Staines Reservoir South, Kempton Park East and Sunnyside Reservoir.

2.38 Waterbirds were counted and their activities recorded five times per day at 34 of the 92 waterbodies in the study area. King George VI Reservoir was considered to be unique in that relatively large numbers of waterbirds were recorded roosting at this site during the surveys.

2.39 Multivariate analyses were used to examine the bird assemblages at sites relative to their environmental features. The environmental characteristics of each waterbody were described. Over 50% of the total variation in the waterbird community was explained by the two axes using Principal Components Analyses.

2.40 The first axis represented abundance and diversity of waterbirds which was highly correlated with site area and perimeter length. However, this was also correlated with a disturbance index indicating that the larger sites with abundant waterbirds were also the most used by humans. The second principal axis appeared to reflect a gradient from large, deep waterbodies with little surrounding or bank-side vegetation, to small, shallow waterbodies with complicated, well-vegetated shores and islands.

2.41 Principal component scores for each site were compared to the collated environmental variables. Axis one was highly correlated with site size and diversity and also with disturbance index. Axis two was positively correlated with large simple sites, with few islands and little bank-side vegetation.

2.42 The results indicated that whilst human activity will modify waterbird distribution and abundance in the area, one is not necessarily mutually exclusive of the other. The effects depend on the species involved, their use of the waterbody, the type of activity, the diversity of the waterbody and the presence of other waterbodies nearby.

2.43 The effects of coarse fishing on the breeding waterbirds at Wraysbury 1 and Yateley gravel pits were measured in the mid 1970s (Tydeman 1977, 1978). In 1974, a close season was imposed so that the angling pressure could be removed and the effects on the waterbirds measured by comparing the situation with the previous year. The numbers of breeding birds was highest in the year without fishing whereas a control site (Yeoveney) showed no change. The physical presence of the anglers was considered to be the driver of lower breeding numbers.

3. Background to this study

3.1 This report summarises data collected over the first winter of fieldwork (2001/2002) on the Wraysbury and Thorpe Park Gravel Pits Overwintering ducks contract with English Nature. During the first winter, fieldwork was restricted to Wraysbury 1 and Wraysbury 2 Gravel Pits (see Figures 1 & 2). Data are being collected at Thorpe Park 1 in 2002/2003. Later in 2003, a final report will be produced detailing the results of work undertaken in both winters. This report will also present long-term trends in the numbers of Gadwall, Shoveler, Smew and Tufted Duck in the SW London Waterbodies over recent decades as identified by Wetland Bird Survey (WeBS) data. In light of the results of the study, recommendations for future research and management of the site will be made in the final report.

3.2 These gravel pits are part of the SW London Waterbodies SPA. Gadwall and Shoveler are the qualifying species on the SPA under Article 4.2 of the EU Birds Directive (79/409/EEC). Wraysbury Gravel Pits consolidated WeBS site (which includes Wraysbury 1 and 2 Gravel Pits) holds internationally important numbers of Gadwall and nationally important numbers of Smew, Shoveler and Tufted Duck during the winter.

3.3 RMC Aggregates Ltd. own Wraysbury 1 (North and South) and also Wraysbury 2 (North) and Three Valleys Water own Wraysbury 2 (South). Operational activities on Wraysbury Gravel Pits are minimal since there is no active gravel extraction occurring on site, and are therefore limited to site maintenance type activities. Sailing and Angling clubs operate on both Wraysbury 1 and 2 (see below), but theoretically there should be no walkers\bird-watchers\dog-walkers on the sites since these activities would constitute trespass. In reality it is known that these activities do take place on both sites.

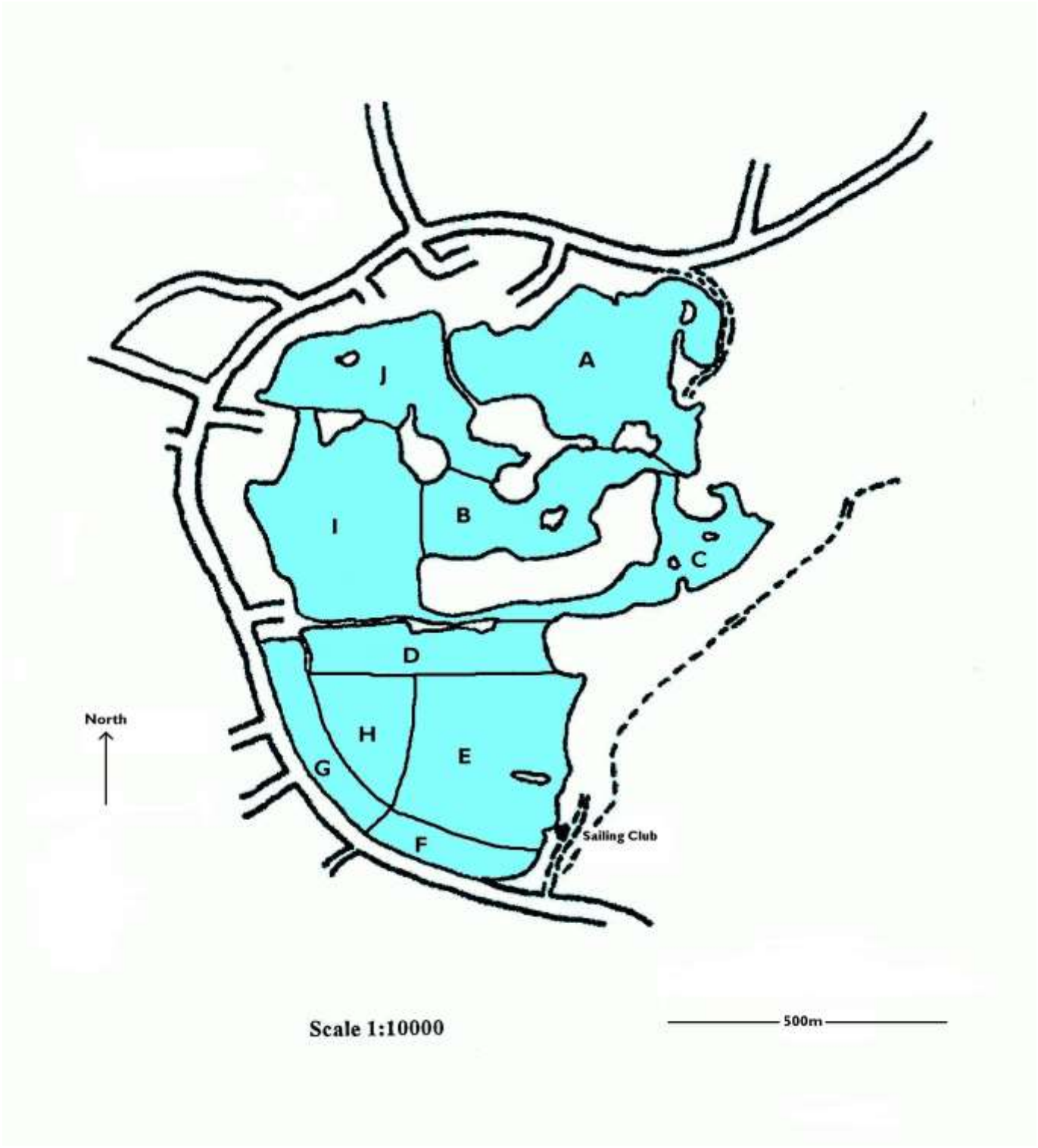
3.4 Wraysbury Sailing Club sails on Wraysbury 1 (South) and there is a clubhouse on the edge of sector D (see Figure 1). Sailing takes place on Sundays

between 1000 hrs and 1600 hrs during the winter. There are also occasional Saturday and midweek sessions during the winter (one or two). RMC Anglers fish on Wraysbury 1 (North and South).

3.5 British Airways Sailing Club use Wraysbury 2 (South) and there is a clubhouse on the edge of Sector E (see Figure 2). Sailing takes place on Sundays between 1100 hrs and 1530 hrs. There are usually about 15 boats out in the winter months with two races held each Sunday (one at 1100 hrs and one at 1330 hrs). RMC Anglers fish on Wraysbury 2 (North) and Blenheim Anglers fish on Wraysbury 2 (South). On Wraysbury 2 anglers are only permitted to use unpowered or electric boats for activities such as baiting, clearing lines etc. Anglers are not permitted to fish from islands or from boats on the site.

Figure 1. Wraysbury 1 Gravel Pit, showing the different recording sectors used.

Figure 2. Wraysbury 2 Gravel Pit, showing the different recording sectors used.



4. Aims

4.1 The broad aim of this work is to quantify the effect of human recreational activity on the key species of waterbird wintering on Wraysbury 1, Wraysbury 2 and Thorpe Park Gravel Pits.

Objectives of fieldwork in year one of study.

- Quantify the frequency and distribution of human recreational activity on Wraysbury 1 and Wraysbury 2 Gravel Pits, September to March inclusive;

- Determine the distribution and numbers of key waterbird species on Wraysbury 1 and Wraysbury 2 Gravel Pits, September to March inclusive;

- Provide information on the reaction of waterfowl to human recreational activity – in particular to identify refuge areas within the study pits and flight lines of birds leaving the pits in response to human recreational disturbance where possible;

4.2 The methods used aimed to provide a repeatable index of human recreational activity on the sites that will enable future monitoring of the relative levels of activity on the sites. The constraints of one weekend and one midweek visit once a month will not necessarily provide a representative picture of human recreational activity on the sites, but provided that there is not a shift in the weekly pattern of activities on the site, should provide a repeatable index. For the purpose of this study only data on Gadwall *Anas strepera*, Shoveler *Anas clypeata*, Tufted Duck *Aythya fuligula* and Smew *Mergus albellus* on the sites was required. The study also aims to provide information on the interaction between the above four species and different human recreational activities on the sites. The identification of 'refuge areas' during periods of recreational activity was limited to identifying areas within the specific lake under

observation at the time and on which the recreation was taking place. Identification of refuge sites/destinations away from the lake under observation at the time of human recreational activity was not possible. However, any descriptive information suggesting possible destinations of birds leaving the study site in response to recreational activity was recorded.

4.3 A review of previous work on recreational activity and bird distribution on Wraysbury 1, 2 and Thorpe Park 1 Gravel Pits will be included in the final report (due 2003).

5. Methods

5.1 During the first winter of the contract, fieldwork was carried out at Wraysbury 1 Gravel Pit (North & South) and Wraysbury 2 Gravel Pit (North and South) (see Figure 2). Fieldwork was undertaken on one weekend (Sunday) and one midweek day (Wednesday) during each winter month September to March inclusive (14 fieldwork days (98 hours total) on each site).

5.2 Four key species of duck were monitored on each visit: Gadwall *Anas strepera*, Shoveler *Anas clypeata*, Tufted Duck *Aythya fuligula* and Smew *Mergus albellus*.

5.3 On Wraysbury 1 Gravel Pit (North and South) where it was possible to scan the whole waterbody from one vantage point, scan counts of the key species were made every ten minutes from 0900hrs to 1600hrs on each visit. On each scan individuals of the four key species were assigned to the following behavioural categories: 'feed', 'roost', 'loaf', 'swim', 'alert', 'fly', 'preen', 'aggressive interaction', 'other' (see Appendix 1 for recording proforma). [A problem with recording the scan counts in February (both midweek and weekend) resulted in scans taking place at greater than ten minute intervals during that month.]

5.4 Any human recreational activity occurring on the site 0900hrs to 1600 hrs was also recorded, including the time the activity commenced, the time the activity finished and the number of individuals or craft involved (see Appendix 2 for human activity proforma). The site was also divided into five sectors and the sectors where the activity was occurring were also recorded on the proforma.

5.5 If human recreational activity resulted in a reaction by any of the key species a 'Disturbance Proforma' was completed (see Appendix 3). The instantaneous reaction of the birds to the recreational activity was recorded by counting the number of individuals of each key species in the following categories: 'no reaction', 'alert', 'swim away', 'fly within site', 'fly off site', 'other'. If birds flew off site the direction was also recorded. Normal ten minute interval scan counts were resumed once the birds had either all left the site or had returned to their normal pre-disturbance pattern of behaviour.

5.6 On Wraysbury 2 Gravel Pit (North and South) it was not possible to view the whole waterbody from a single vantage point. It was therefore not possible to adopt the scan sampling methodology employed on Wraysbury 1. Instead a mapping approach was adopted. The waterbody was divided into ten sectors based on natural features e.g. islands or on known zones where recreational activities occurred e.g. sailing. Each sector was visited four times a day in the following time slots: 0900-1100hrs, 1100-1300hrs, 1300-1500hrs and 1500-1700hrs. On each visit the number of individuals of the four key species engaged in the following activities was recorded: 'feed', 'roost', 'loaf', 'swim' and 'other' (Appendix 4). Human recreational activity occurring in each sector was also recorded four times a day in the same time periods (Appendix 5). The number of individuals involved in the activity and any effect on the key species was also recorded.

5.7 High water levels on Wraysbury 2 on 24 October 2001 meant that no access was possible to Sector I on that date so no data were collected.

5.8 For Wraysbury 1 and 2 boat type was split into three categories for data recording purposes: sailing boats; powered boats and unpowered boats. Powered boats were defined as boats with any form of internal or outboard motor, but on Wraysbury 1 and 2 only small boats with outboard motors or electrically powered boats were in use (i.e. there were no large jet-powered type boats).

Fieldwork dates winter 2001-2002

September (Sunday 30th September & Wednesday 3rd October)
October (Wednesday 24th & Sunday 28th)
November (Wednesday 21st & Sunday 25th)
December (Sunday 16th & Wednesday 19th)
January (Wednesday 16th & Sunday 20th)
February (Wednesday 13th & Sunday 17th)
March (Sunday 10th (Wraysbury 2); Sunday 17th (Wraysbury 1) & Wednesday 13th

5.9 An additional count on Wraysbury 2 was made on Thursday November 8th 2001 (following bonfire night fireworks at the Sailing Club) to determine if the additional activity on the weekend had an effect on bird numbers during the subsequent week.

Additional data

5.10 Both Wraysbury 1 (North and South) and Wraysbury 2 (North and South) are counted as part of the Wetland Bird Survey (WeBS) counts on a weekend in each month September to March inclusive. Both Wraysbury 1 and Wraysbury 2 are split into two separate count units for the purpose of WeBS coverage (North and South parts of each waterbody being counted separately, often by different observers). It is not compulsory to collect data on recreational activities as part of the WeBS count but the counters for Wraysbury 1 and 2 agreed to collect additional data on the number of people and type of any recreational activity occurring at the time of their WeBS count. Additionally, the

WeBS counter on Wraysbury 2 (South) conducted a number of night-time counts on the site during January and February. These data will be available for use in the final report in 2003.

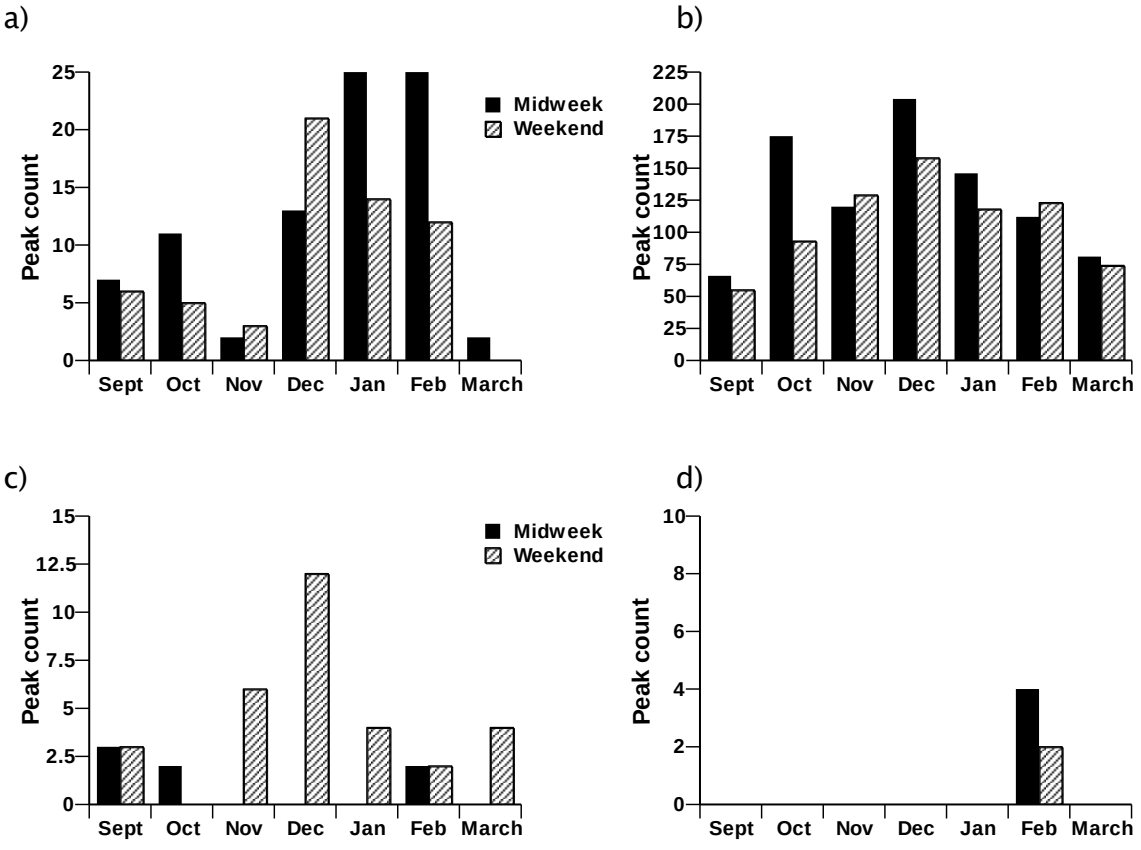
6. Results

Wraysbury 1

Seasonal Phenology of the Key species

6.1 The maximum number of Gadwall recorded on any one day was 25 birds (midweek count in both January and February), Shoveler was 12 birds (weekend count in December), Tufted Duck was 204 birds (midweek count in December) and Smew was 4 birds (midweek count in February) (Figure 3).

Figure 3. Peak count in each month on midweek versus weekend days for a) Gadwall; b) Tufted Duck; c) Shoveler; d) Smew.

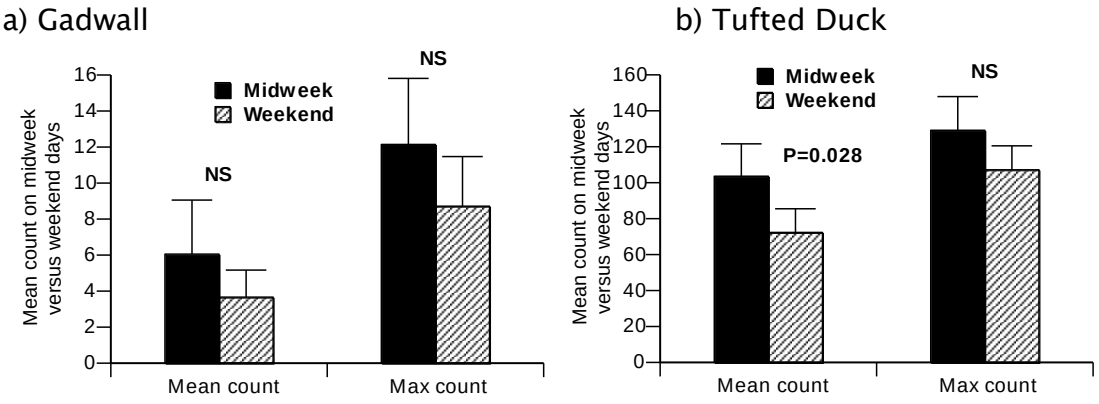


6.2 Generally, throughout the winter higher numbers of both Gadwall and Tufted Duck were recorded on the midweek count compared to the weekend count.

The average peak for Tufted Duck was 129 (±18.7) birds midweek and 107 (±13.3) birds at the weekend.

6.3 Bird count data are generally not normally distributed, and coupled with the small sample sizes for some of the analyses, non-parametric tests have been used for analysing the count data. Midweek and weekend counts were compared using the non-parametric Wilcoxon's signed-ranks test. Based on the 14 counts available there was no significant difference between the midweek and weekend peak numbers of Tufted Duck (T_s =5.50, P(2-tailed)=0.150, NS) (Figure 4). Although, if the average number of birds over the whole day is calculated (rather than the peak) then the midweek mean is 104 birds versus 72.3 at weekend for Tufted Duck which is a significant difference, T_s=1.00, P(2-tailed)=0.028. Similarly peak numbers of Gadwall were generally higher midweek compared to the weekend with an average peak for Gadwall of 12.1 birds (±3.67) midweek versus 8.71 (±2.76) birds at weekends, although this was not a significant difference, (T_s =6.50, P(2-tailed)=0.204, NS) (Figure 4). There was also no significant difference between the mean counts midweek versus weekend for Gadwall (T_s = 7.00, P(2-tailed)=0.237, NS).

Figure 4. Graphs showing the average winter count for a) Gadwall and b) Tufted Duck based on the mean count calculated over the whole day and the maximum count recorded per day for midweek days versus weekend days.



6.4 Due to the low numbers of Shoveler and Smew recorded, analyses of these data were limited. Generally for Shoveler more birds were recorded at the weekend than during midweek.

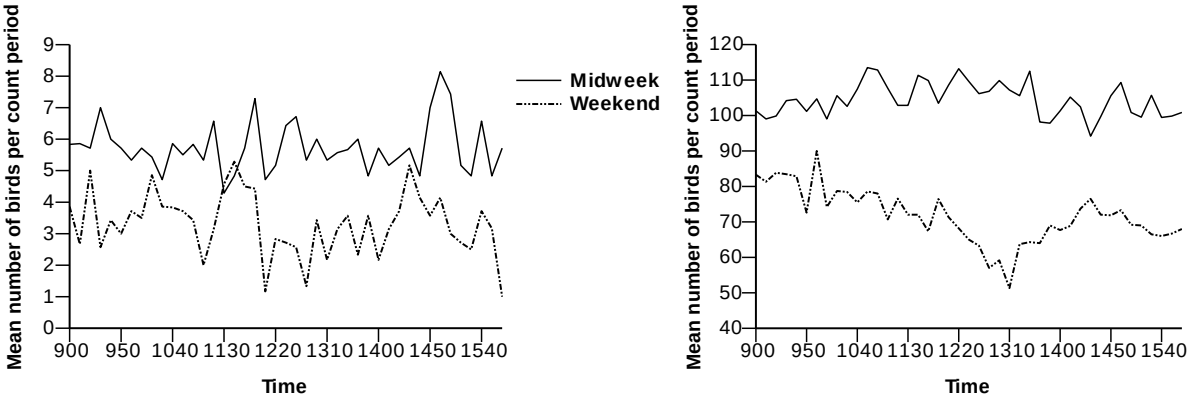
Patterns of site usage throughout the day

6.5 The numbers of both Gadwall and Tufted Duck were relatively constant throughout the day for midweek counts. In contrast, numbers of both species showed a decrease in the early afternoon on weekends. This was particularly pronounced for Tufted Duck with numbers declining throughout the morning and gradually increasing again from mid-afternoon at weekends (Figure 5).

6.6 Both Gadwall and Tufted Duck spent a surprisingly low percentage of the time feeding on Wraysbury 1 during the period 0900-1600hrs (Figure 6). On average Gadwall spent 3.48% (±1.99%) of the day feeding during the midweek (equivalent to 15 minutes a day between 0900 and 1600 hrs) and 1.34% (±0.868%) of the day feeding at the weekend (6 minutes), although this does not represent a significant difference (arcsine transformed data; $t_{7,7}$ =1.01, P(2-tailed)=0.353, NS). There was also no significant difference in the percentage of time Tufted Duck spent feeding midweek compared to the weekend (6.48% (±1.39%) midweek (on average 27 minutes a day) compared to 7.23% (±0.836%) at the weekend (30 minutes) (arcsine transformed data; $t_{7,7}$ =0.629, P(2-tailed)=0.552, NS).

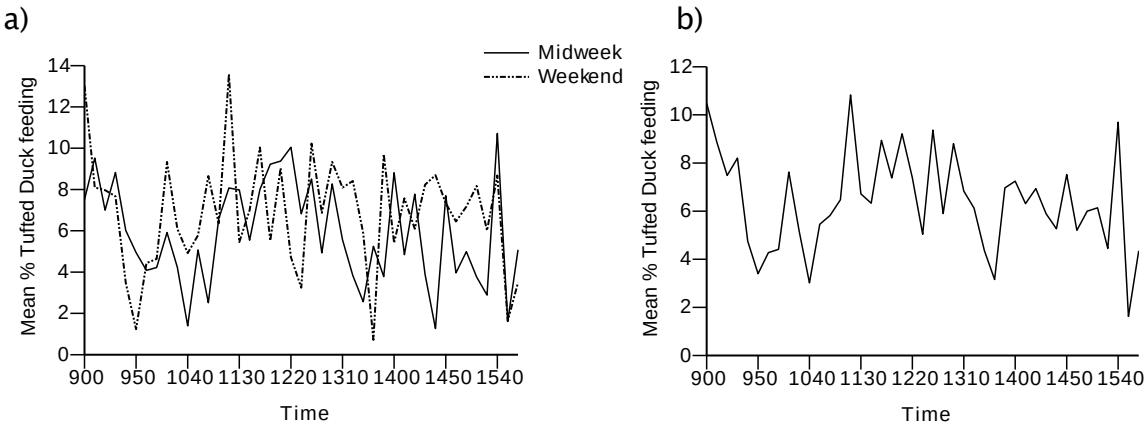
Figure 5. Diurnal variation (0900 hrs to 1600 hrs) in average bird numbers September to March for midweek days versus weekend days.

a) Gadwall b) Tufted Duck



6.7 There was no obvious difference in the Tufted Duck feeding activity between midweek and weekend days during the period 0900-1600hrs. Overall, feeding activity tended to be higher early in the recording day and also around midday with lowest levels of feeding during mid-morning and late afternoon.

Figure 6. Diurnal patterns of feeding by Tufted Duck a) midweek and weekend and b) all days.



Patterns of human recreational activity

6.8 While bird numbers were not likely to be independent between the weekend and adjacent midweek count each month, it was considered that there was no reason to expect human recreational events to be dependent on the events on the adjacent count date in the same way. Therefore the number of recreational events midweek compared to weekend was analysed using the non-parametric Mann-Whitney U Test. The total number of human recreational activities recorded was higher during midweek than at the weekend. The total number of human recreational events recorded during midweek over the whole winter was 47 and at the weekend it was 35 events. On average there were 6.71 recreational events per midweek day and 5.0 per weekend day, although this difference is not statistically significant (U =19.0, P(2-tailed)=0.522).

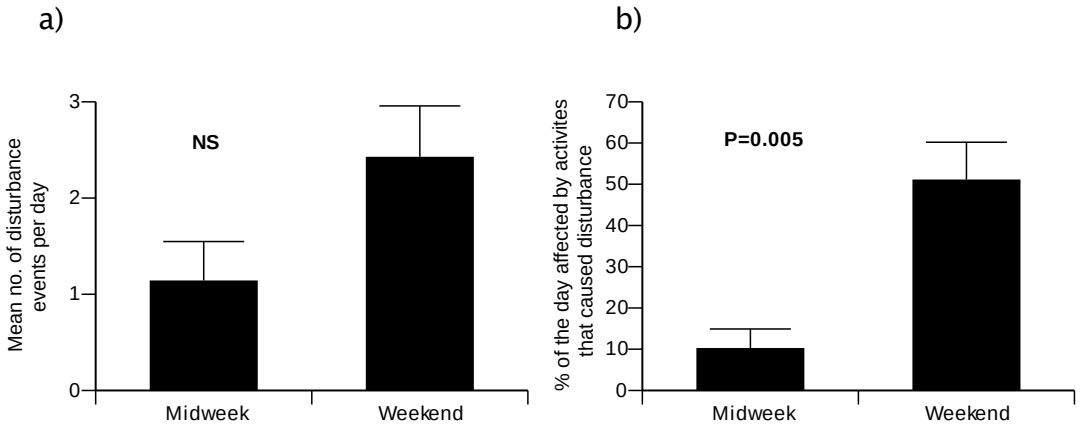
6.9 However the number of human recreation events that resulted in disturbance (defined as any reaction to the human activity from 'alert' to 'fly off site') to the key species was higher at the weekend compared to midweek. A total of 8 events resulted in disturbance to at least one key species during midweek compared to 17 events at the weekend. On average over the winter there were 1.14 'disturbing' events per day on midweek days (±0.404) compared to 2.43 'disturbing' events per day at the weekend (±0.528), although this is not significant for a non-directional test (U =37.5, P(2-tailed)=0.110, NS, but is almost significant as a directional test, (P(1-tailed)=0.055)) (Figure 7).

6.10 Out of 82 recreational events recorded over the whole winter, 30.5% resulted in disturbance to one or more of the key species. Only 17% of the midweek recreational events resulted in disturbance compared to 48.6% of weekend recreational events.

6.11 For activities that resulted in disturbance to the key species, a significantly higher percentage of the day was affected by the activities (although not

necessarily by disturbance, as for example all birds might leave within five minutes of the activity commencing, even if the activity then went on for another hour) at weekends compared to midweek (arcsine transformed data, $t_{7,7}$=3.88, P(2-tailed) = 0.005). The percentage of the day affected ranged from 16.3% of the day to 79.1 % of the day at weekends (mean 51.2% (±9.02%) of the day, or 215 minutes ±74 minutes (95 % CL, n=7)) and between 0 and 32.6% of the day during midweek (mean 10.3% (±4.62%) of the day, or 43 minutes ±38 minutes (95% CL, n=7)).

Figure 7. a) Average number of events resulting in a reaction by any of the four key species on midweek versus weekend days; b) mean % of the day that was affected by activities that resulted in a reaction by the key species midweek versus weekend.



Seasonal phenology of recreational activities on Wraysbury 1

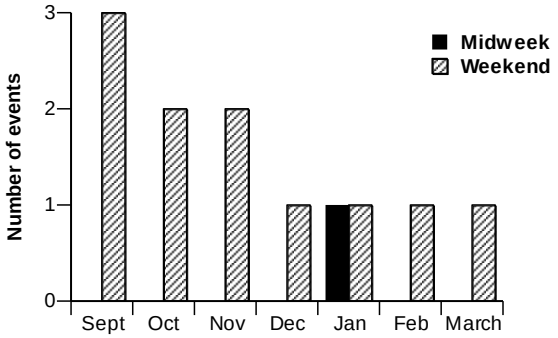
6.12 The seasonal phenology of the main recreational activities recorded is shown in Figure 8. Vehicle events are not shown as most activity involved vehicles on the sailing club lane and it was difficult to identify separate events (for example on sailing club days cars were 'coming and going all day'). Other activities that were recorded but not shown were birdwatchers (1 event); shooters (1) and 'person lighting fire in oil drum' (2).

6.13 The majority of powered boat use on Wraysbury 1 was by anglers, so the recording categories 'angling from boats' and 'powered boats' were combined as in many instances events entered as 'angling from boats' appeared to be anglers using boats and not necessarily angling from them. There was also powered boat use by the sailing club, coinciding with sailing events on Wraysbury 1 (South).

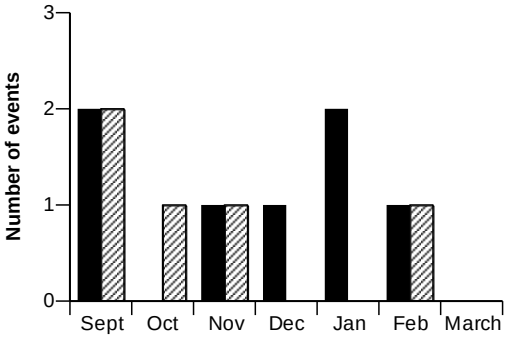
6.14 Sailing was almost entirely restricted to weekends with very little midweek activity recorded September to March. There was also more sailing activity in the early season (September to November) compared to later in the winter. There was little seasonal pattern in the use of powered boats or angling on the site. However most angling was recorded on midweek sessions compared to the weekend, and there was also slightly more powered boat use midweek compared to the weekend.

Figure 8. Number of events occurring midweek/weekend in each winter month for each of the main recreational activities recorded on Wraysbury 1.

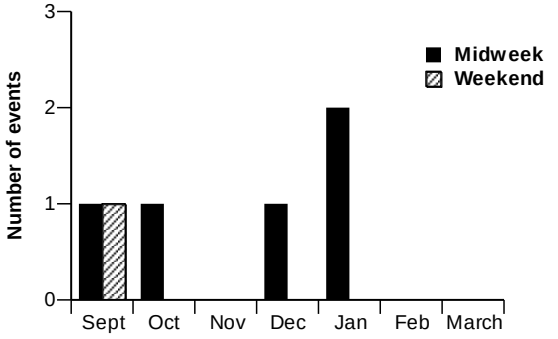
Sailing



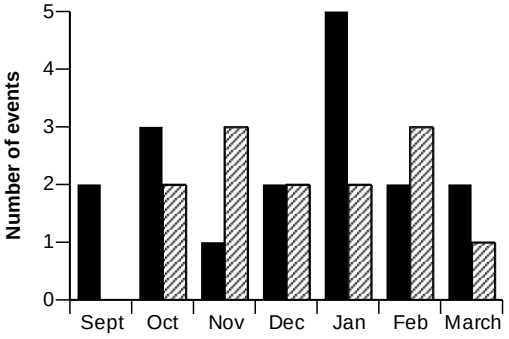
Powered Boats (including angling from boats)



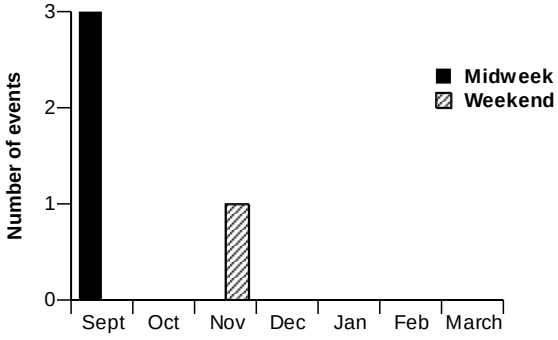
Angling from shore or islands



Dog-walkers

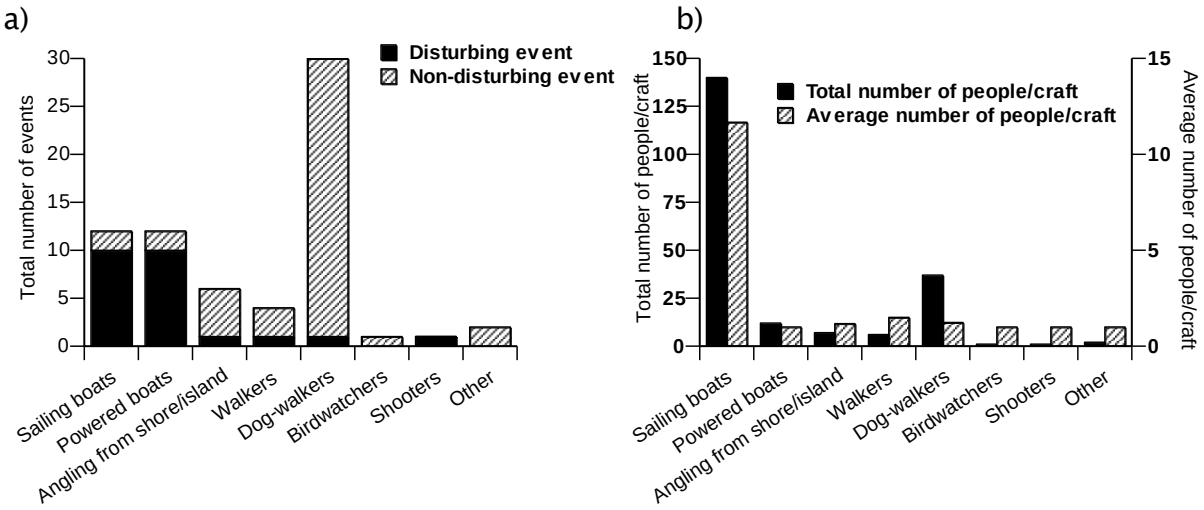


Walkers



6.15 Dog-walkers were prevalent in all months, with slightly more events recorded midweek compared to the weekend. Only four instances of walkers were recorded and three of these were recorded in September.

Figure 9. a) Graph showing the total number of recreational events occurring over the whole winter in each category plus the number of these events that resulted in a disturbance to the key species. Disturbance is defined as any reaction to the human activity by individuals of the key species, as recorded on the 'Disturbance Proforma', from 'alert' to 'fly off site'. One disturbance was also caused by vehicles (not shown) - this involved quad bikes and not cars going to sailing club. b) Total number of people or craft engaged in each activity and the average number of people or craft per recreational event over the whole winter.



6.16 In terms of the disturbance effect of different activities, 'Shooters' and the use of boats (either sailing or powered boat use) were the most likely activities to result in a reaction by the key species (Figure 9a). 100% of 'Shooter' events and more than 80% of boat events resulted in a reaction by the key species. However, since there was only one Shooter recorded over the 14 recording days, but more than ten powered boat events and more than ten sailing events recorded, the use of boats on the site was the most frequent recreational cause of disturbance. In contrast the incidence of dog-walkers on the site was

high (30 events in total over the winter), but only one of these resulted in any reaction by the key species (when a dog jumped into the water).

6.17 The majority of human recreational activities involved on average only one or two people at any one time (Figure 9b). The exception to this was sailing where on average more than ten boats would be engaged in the activity at any one time.

Reaction of Key Species to Human recreational activities

6.18 A total of 25 human recreational events resulted in a reaction (from 'alert' to 'fly off site') by one or more of the key species over the course of the winter (although data on reaction by the birds was not collected on one of these occasions). On average, 25% of the birds present on site flew off the site in response to a human activity causing disturbance (Figure 10). On all occasions when birds left the site as a result of human recreational activity they flew off in a Southerly direction. On average 34% of the birds present reacted to the human activity but remained on site, and just over 40% of birds did not react at all.

Figure 10. The mean percentage of all birds present on Wraysbury 1 in each 'reaction' category during disturbance events (n=24). A disturbance event is defined as any human recreational activity that caused a reaction by individuals of one or more of the key species.

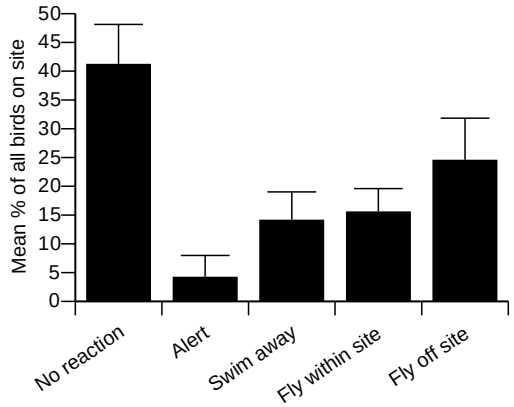
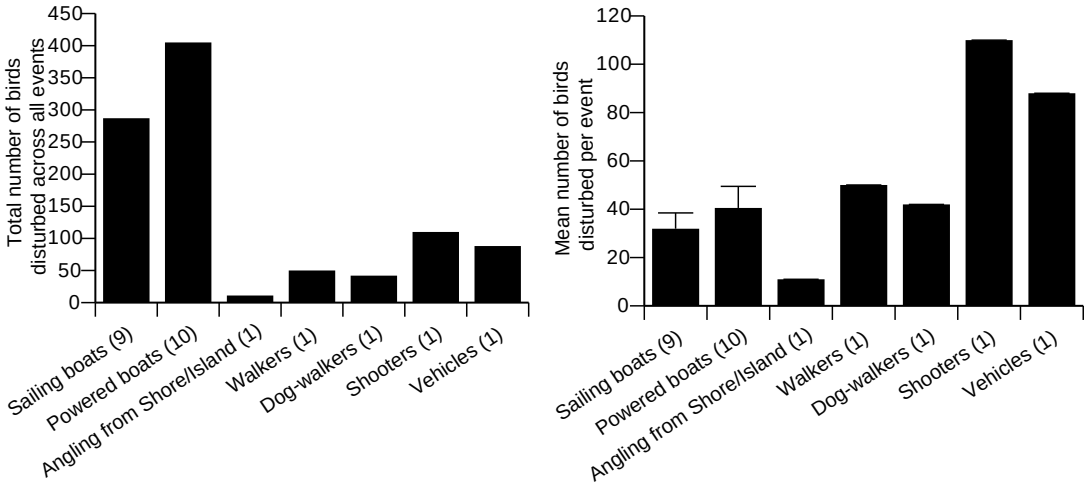


Figure 11. a) Total numbers of Tufted Duck that responded during events that caused disturbance. Number in brackets after activities indicate the number of disturbance events that occurred over the winter. (Note that there were 10 'disturbance' events involving sailing boats, but on one of these occasions the number of birds affected was not recorded and so data from only nine of the events is presented here). b) Mean number of Tufted Duck that reacted per event.



6.19 Over the course of the winter, boat-based activities resulted in disturbance to the largest numbers of individuals of Tufted Duck (Figure 11a). However the number of birds that reacted was in fact higher for the Shooter event and vehicle disturbance event (people on quad bikes) than the mean number of birds that reacted per boat event (Figure 11b).

6.20 The disturbance event caused by Angling from the shore/island resulted in the smallest proportion of the birds on site being disturbed, whereas the Walkers, Dog-walkers and Shooter events all resulted in a reaction by all birds present on the site. Sailing boats on average cause a reaction in just over 40% of birds present and powered boats just over 60% (Figure 12).

Figure 12. Graph showing the mean percentage of Tufted Duck present on the site that were disturbed per disturbance event by type of event. Note that there was only one disturbance event for five of the recreational types.

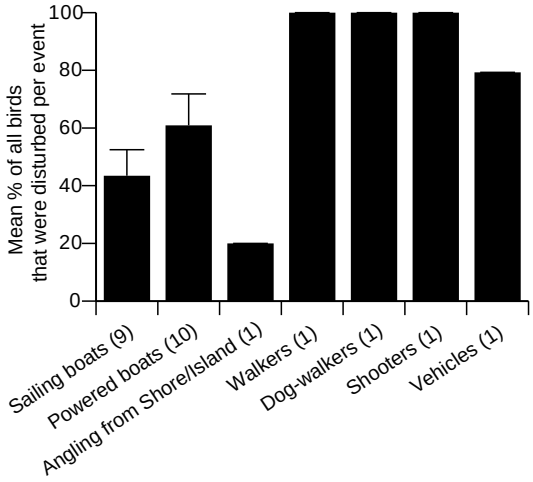
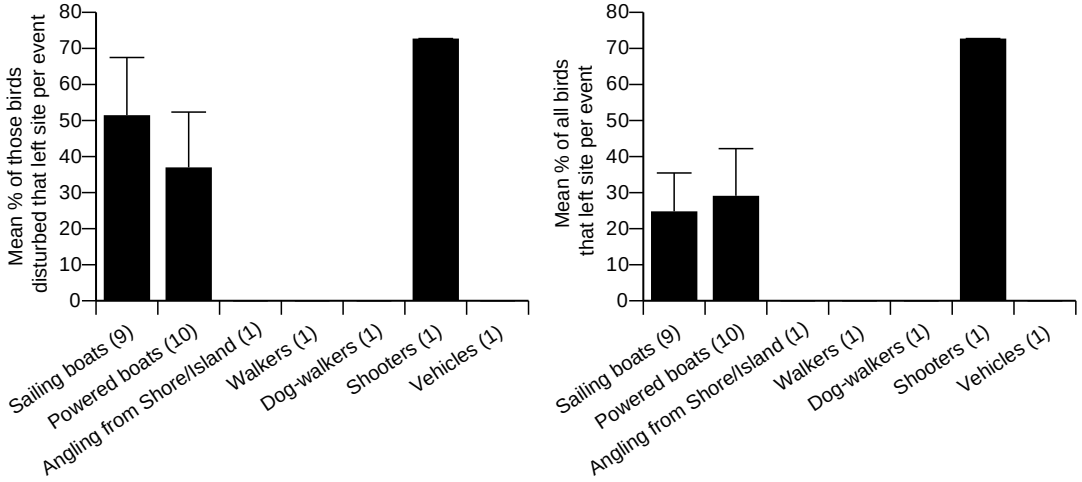


Figure 13. a) Mean percentage (per recreational type) of the Tufted Duck that reacted to a disturbance event that actually departed from the site altogether and b) the mean percentage of all Tufted Duck present on the site that actually departed.

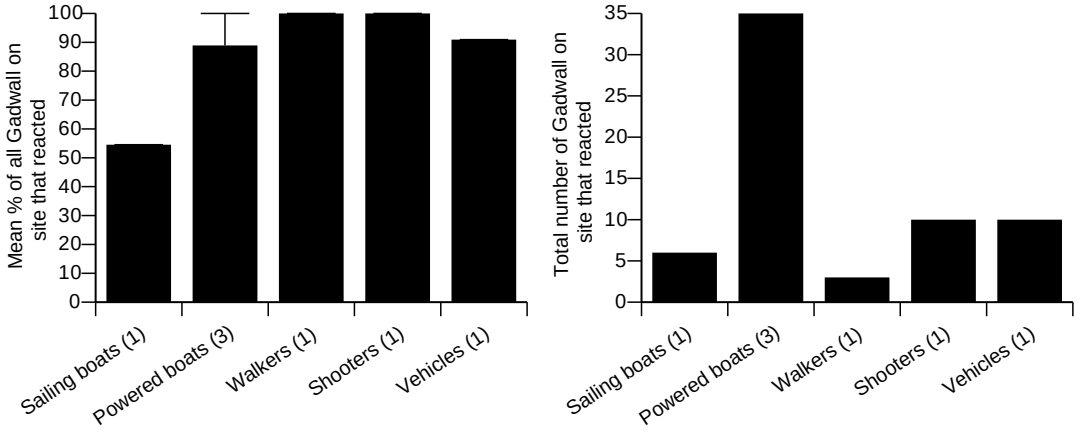


6.21 Only sailing boats, powered boats and Shooters resulted in Tufted Duck leaving the site completely (Figure 13). On average sailing events that caused disturbance resulted in 50% of those birds that reacted leaving the site

completely and powered boat use 35% of those birds disturbed. In the one Shooter event, more than 70% of the birds that reacted left the site completely. In terms of the percentage of all Tufted Duck present on the site that departed as a result of a human activity, boat-based activities on average resulted in between 25 and 30% of all birds leaving and Shooters more than 70%.

6.22 Only ten of the total 24 events (excluding the one sailing event when the number of birds that reacted was not recorded) which caused disturbance to the key species occurred when there were any Gadwall present on the site. On seven of these occasions there was a reaction to the activity by the Gadwall present. Three events resulted in disturbance to one or more of the other key species, but no Gadwall reacted – these were an angler, an angler crossing a channel in a boat, and sailing activity. In all instances there were ten or fewer Gadwall present on the site.

Figure 14. a) Mean percentage of the Gadwall present on site that reacted to events resulting in disturbance to the species for different recreational activities; b) Total number of Gadwall on site that reacted to different activities over the whole winter.

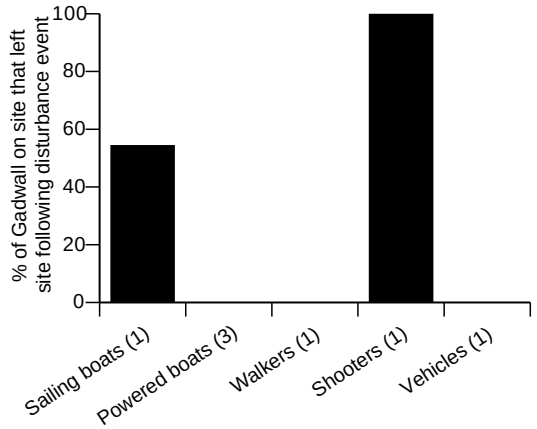


6.23 Numbers of Gadwall on Wraysbury 1 were generally low throughout the winter and less than half the recreational events that caused a reaction to other species actually occurred when Gadwall were present on the site. Six of these

events resulted in a reaction by more than 85% of the Gadwall present on the site, however the actual number of birds disturbed was typically less than 10 birds per event (Figure 14).

6.24 Only two recreational events resulted in Gadwall leaving the site (Figure 15). The 'Shooter' event flushed all the Gadwall off site, while the one sailing event that caused a reaction to Gadwall caused 55% of the Gadwall on site to leave. Whilst the walkers, powered boats and quad bike events all caused a higher proportion of the Gadwall present to react compared to the sailing event, none of these activities actually resulted in any birds leaving the site.

Figure 15. Percentage of the Gadwall present on the site that left the site following a disturbance event.

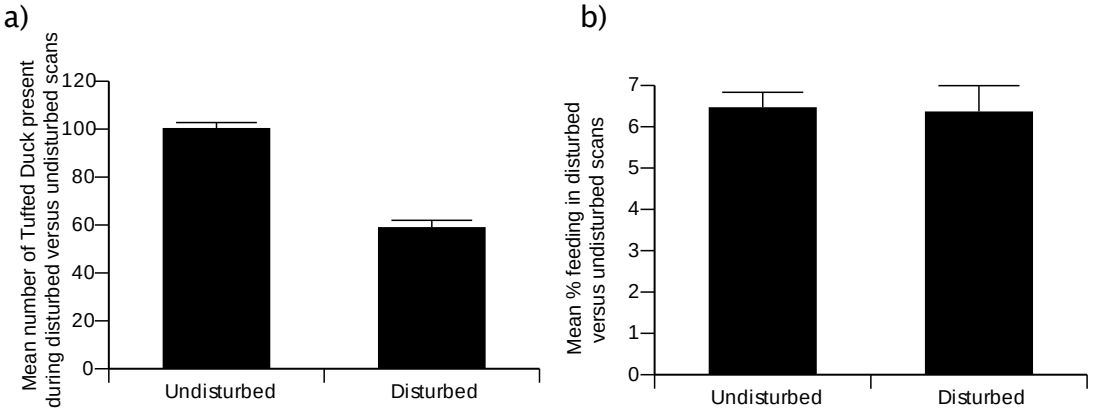


6.25 There were no records of disturbance to Shoveler, but it should be noted that no Shoveler were ever present on the site during an event which resulted in disturbance to any of the other key species.

6.26 On the two occasions when Smew were present during an event which resulted in disturbance to one of the other key species there was a reaction by all (2) of the Smew on the site. On one occasion both birds left the site as a result of

the disturbance event (Shooter), and on the other occasion the birds swam away from the disturbance (Quad bikes).

Figure 16. a) Mean number of Tufted Duck that were on Wraysbury 1 during scans where human activities resulted in disturbance (169 scans) versus those where no disturbing activities occurred (398 scans); b) % of time spent feeding in disturbed versus undisturbed scans.

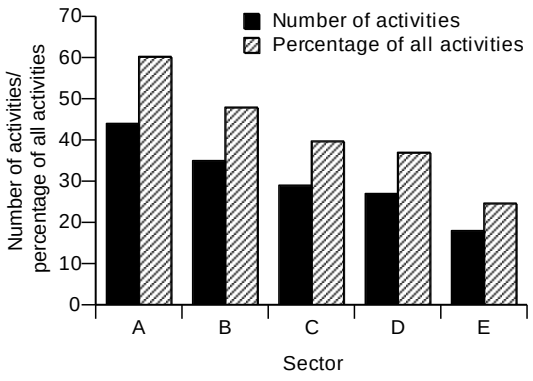


6.27 Figure 16 illustrates the differences in a) the mean number of Tufted Duck present and b) the mean proportion feeding during disturbed versus undisturbed scans. While it is not valid to test the significance of these differences since the individual scans are not independent, it is interesting to note that while fewer birds were present on site during the disturbed scans, there was no difference in the percentage of time that birds spent feeding.

Distribution of recreational activities on Wraysbury 1.

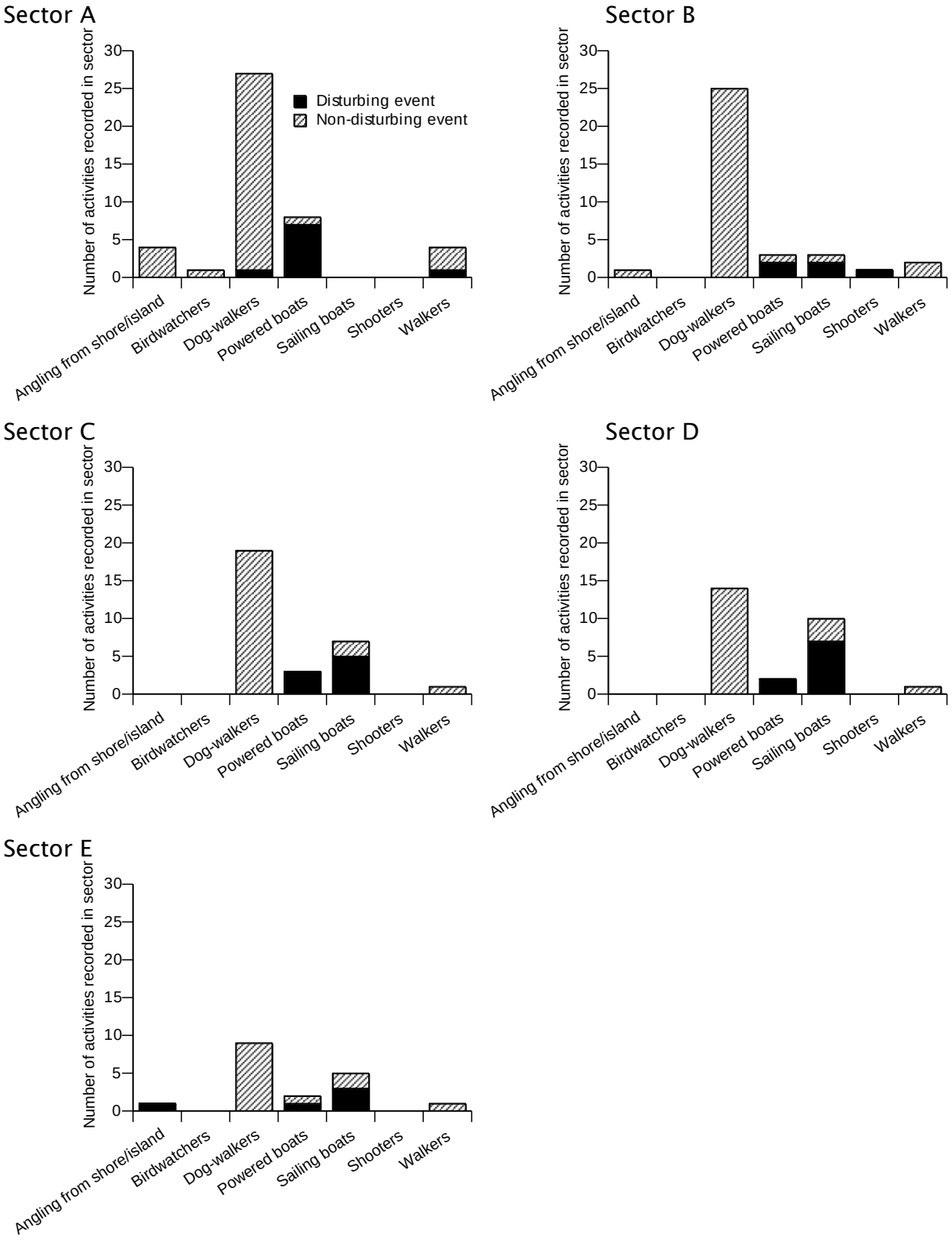
6.28 Seventy-three out of the total 82 activities recorded over the winter were attributed to one or more sectors (see Figure 1 for sectors) (Figure 17). Of the nine activities that were not attributed to a sector, six were vehicles using the sailing club lane, two were of activity in the sailing club grounds, and one was a dog-walker where the sector/s affected was not recorded.

Figure 17. Total number and percentage of all activities recorded in each sector of Wraysbury 1 (n=73).



6.29 Sector A experienced the heaviest recreational use in terms of the number of activities that were recorded, while Sector E was the least used sector (Figure 17). Sector A was predominantly used by Dog-walkers and Anglers (the latter accounted for the high level of powered boat use in this sector) (Figure 18). The powered boat use resulted in the majority of events causing a reaction by the key species in Sector A. Sector B was also had a large number of Dog-walking events, although none of these resulted in any reaction by the key species. Sectors C, D and E experienced fewer Dog-walking events and again none of these resulted in any reaction. The majority of events resulting in disturbance in these three sectors involved sailing boats or powered boat use (by sailing club).

Figure 18. Distribution of recreational activities by sector on Wraysbury 1.



Wraysbury 2.

Seasonal phenology of the key species.

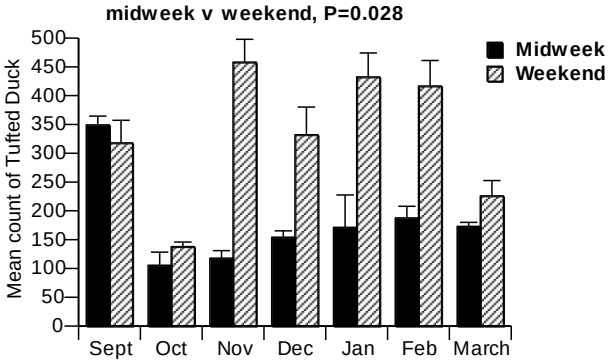
6.30 A total of four counts of the key species were made on each of the 14 fieldwork days (one count for each time period).

Tufted Duck

6.31 Tufted Duck phenology did not show the same pattern as on Wraysbury 1 (Figure 19). Numbers on Wraysbury 2 were high in September presumably due to the moulting flock that is known to congregate on the site in late summer. Numbers then dropped in the October counts. From October onwards midweek numbers showed a gradual increase to a peak in February, however weekend numbers did not follow this pattern suggesting that there are influxes of birds from other sites at the weekend, especially during the period November through to February. This phenomenon makes it extremely difficult to look at the effects of human recreational activity on Wraysbury 2, since the site obviously does not function as a discrete unit for Tufted Duck.

6.32 Midweek and weekend counts were compared using the non-parametric Wilcoxon's signed-ranks test. Based on the 14 counts available, weekend numbers of Tufted Duck (using the daily mean count) were significantly higher than midweek numbers for the whole Wraysbury 2 site (T_s =1.00, P(2-tailed)=0.028) (Figure 19).

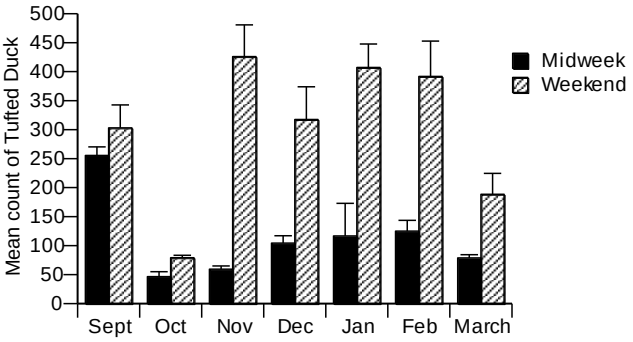
Figure 19. Mean Tufted Duck numbers on midweek versus weekend days on Wraysbury 2.



6.33 However, this overall trend does not reflect the pattern on the North and South sections of Wraysbury 2 (Figure 20). Numbers on Wraysbury 2 (North) do show the same patterns as overall numbers with higher numbers recorded at the weekend compared to midweek (Figure 20). However, numbers on Wraysbury 2 (South) are higher midweek compared to the weekend – the average weekend peak count on Wraysbury 2 South was 60 (±9.7) birds compared to 82 (±7.5) birds midweek. However there were much greater increases in the number of birds on Wraysbury 2 (North) at the weekend than could can be attributed to redistribution from Wraysbury 2 (South). The average weekend peak on Wraysbury 2 (North) was 385 (±61) birds compared to 154 (±36) birds midweek.

Figure 20. Mean Tufted Duck number midweek versus weekend for Wraysbury 2 North and South separately (note the different scales).

a) Wraysbury 2 (North)



b) Wraysbury 2 (South)

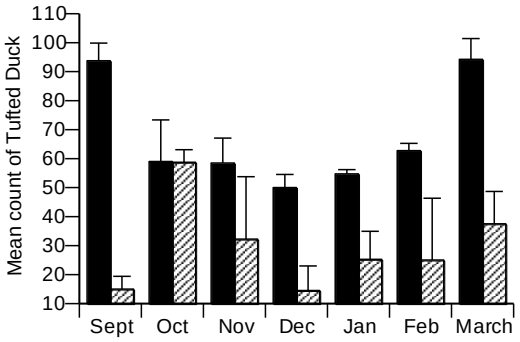
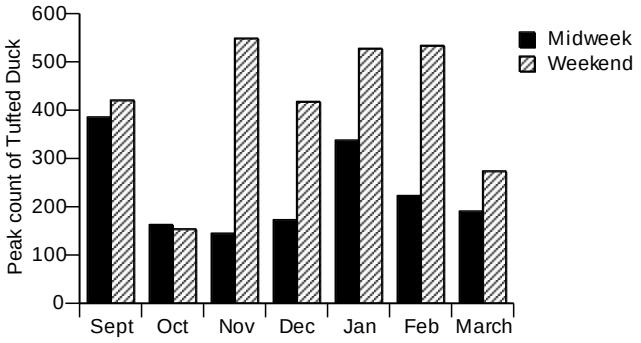


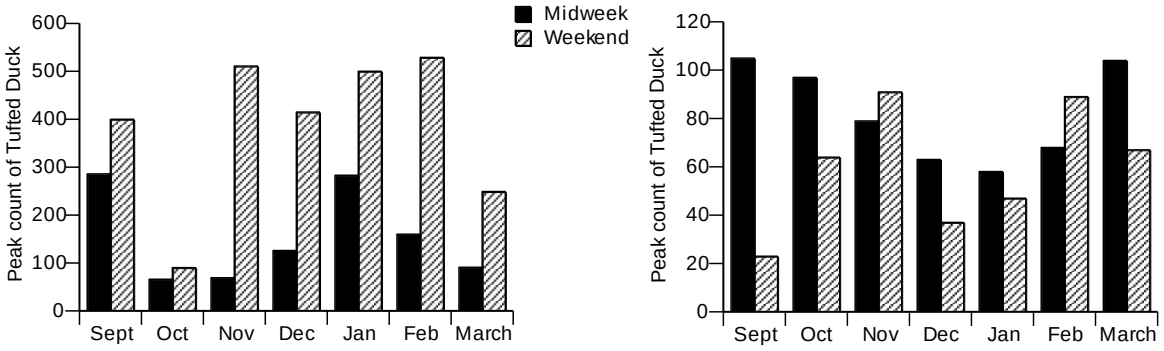
Figure 21. Maximum daytime count of Tufted Duck on Wraysbury 2, midweek versus weekend.



6.34 The same pattern was evident for maximum daily counts. The average weekend peak count was 411 (±56) birds compared to 231 (±35) during midweek (Figures 21 & 22).

Figure 22. Maximum daytime count of Tufted Duck on Wraysbury 2 North and South, midweek versus weekend.

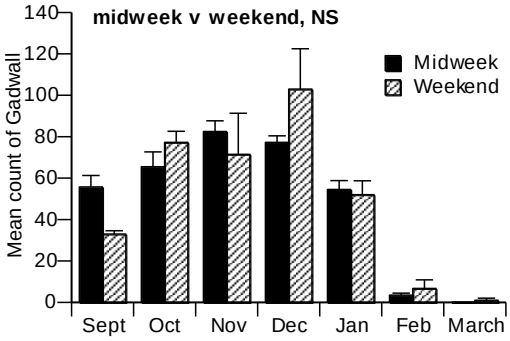
Wraysbury 2 (North) Wraysbury 2 (South)



Gadwall

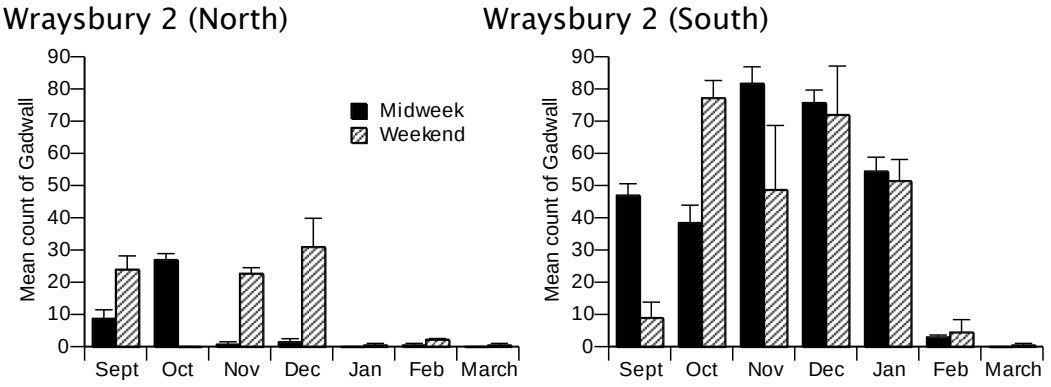
6.35 Unlike Tufted Duck there was no consistent midweek versus weekend pattern in numbers of Gadwall on the site as a whole (Figure 23).

Figure 23. Mean numbers of Gadwall in each month on Wraysbury 2 (North and South), midweek versus weekend.



6.36 Unlike Tufted Duck, Wraysbury 2 (South) held higher numbers of Gadwall than the North section (Figure 24). As with the whole site counts there was no consistent difference between midweek and weekend counts on the North or South sections of Wraysbury 2.

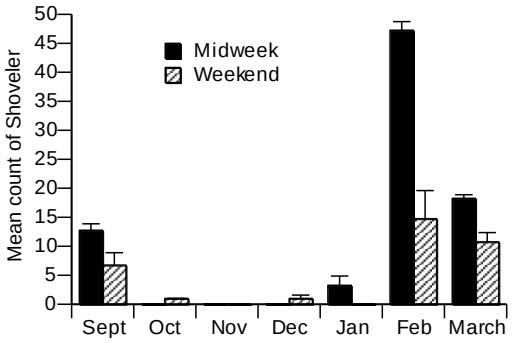
Figure 24. Mean numbers of Gadwall on Wraysbury 2 North and South separately.



Shoveler.

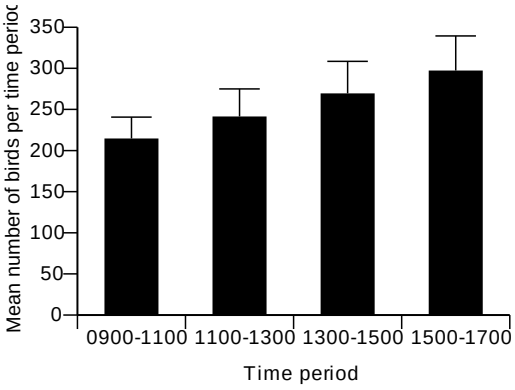
6.37 Shoveler numbers show an interesting phenology at the site with highest numbers recorded in February and March, in particular on midweek days (Figure 25). Interestingly, the highest WeBS count for Wraysbury 2 during the winter was only 23 birds in November, however up to 260 Shoveler were counted on the site during night-time counts conducted on the North part of the site during February (V. Chambers data). This compares to only six Shoveler counted on the whole of Wraysbury 2 during the February WeBS count. No other sites in the Wraysbury Gravel Pits WeBS count unit held high numbers of Shoveler during the WeBS counts of 2001/2002 so the influx of Shoveler in February may have originated from outside the site complex.

Figure 25. Mean numbers of Shoveler recorded on Wraysbury 2 in each month, midweek versus weekend.


Mean count of Shoveler
50
45
40
35
30
25
20
15
10
5
0
Midweek
Weekend
Sept
Oct
Nov
Dec
Jan
Feb
March

Daily patterns in the numbers of key species.

Figure 26. Average numbers of Tufted Duck on Wraysbury 2 in the four different time periods.

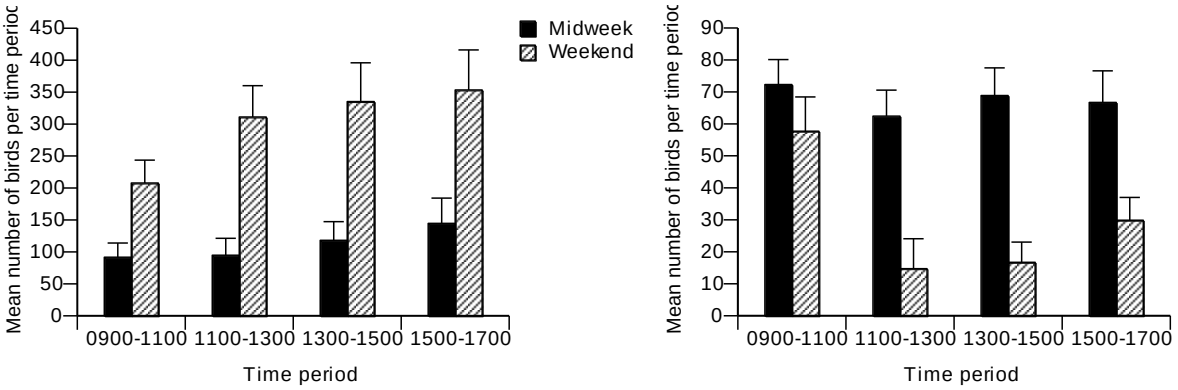


6.38 The general pattern over the whole site was an increase in Tufted Duck numbers throughout the day (Figure 26). This pattern was also evident on both midweek and weekend days, but not for the South and North sections of the gravel pit (Figure 27).

6.39 On Wraysbury 2 (North), numbers of Tufted Duck increased as the day progressed and this was evident for both weekend days and midweek days (although more pronounced at weekends), However, on Wraysbury 2 (South) numbers at the weekend were highest between 0900 and 1100 hrs, with lowest numbers in the middle of the day 1100-1500 hrs. Midweek numbers on Wraysbury 2 (South) were relatively stable throughout the day.

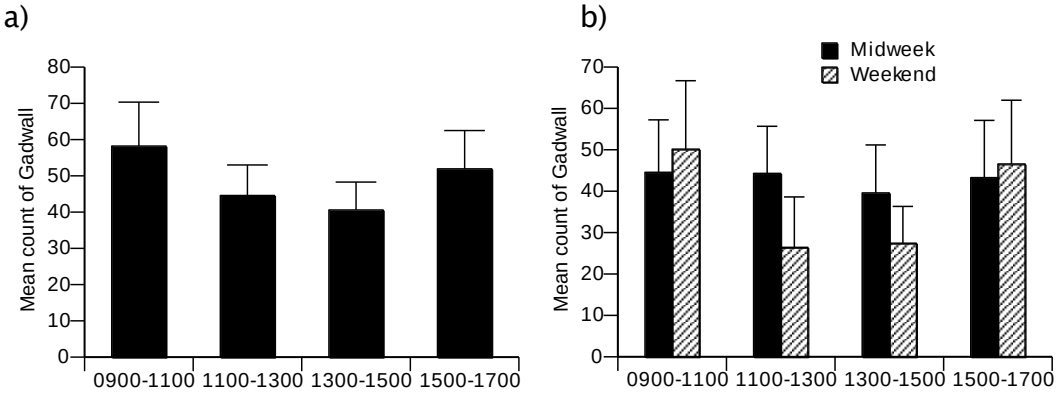
Figure 27. Mean numbers of Tufted Duck on the North and South sections of Wraysbury 2 at different times of the day. Note the different scales.

Wraysbury 2 (North) Wraysbury 2 (South)



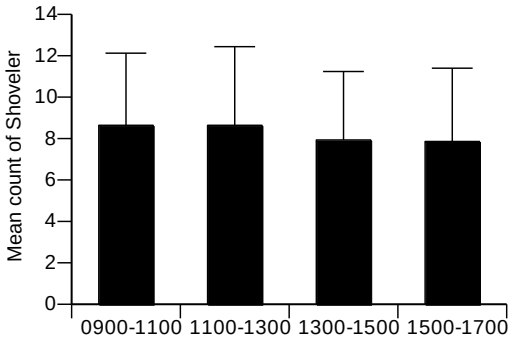
6.40 Gadwall numbers were generally lower during the middle period of the day than early in the morning and late in the afternoon (Figure 28, a). This effect was most pronounced at weekends on Wraysbury 2 South (Figure 28, b).

Figure 28. a) Variation in Gadwall numbers on Wraysbury 2 at different times of the day; b) variation in numbers on Wraysbury 2 South only, midweek versus weekend.



6.41 Shoveler numbers on the site were generally low and showed little diurnal variation (Figure 29).

Figure 29. Variation in Shoveler numbers at different times of the day on Wraysbury 2.



6.42 Sectors A,B,C,I and J are in Wraysbury 2 (North) and sectors D,E,F,G and H in Wraysbury 2 (South) (Figure 2). Taking midweek and weekend days together, Gadwall predominantly occurred in the South part of Wraysbury 2 with all five sectors in the South being used by birds. A high proportion of the birds present were also feeding in these sectors (Figure 30). Sector B in the North of Wraysbury 2 was also used by Gadwall – only slightly less than the South sectors, but a smaller proportion of the birds were recorded feeding in this sector. The other four sectors in the North were used considerably less (Figure 30).

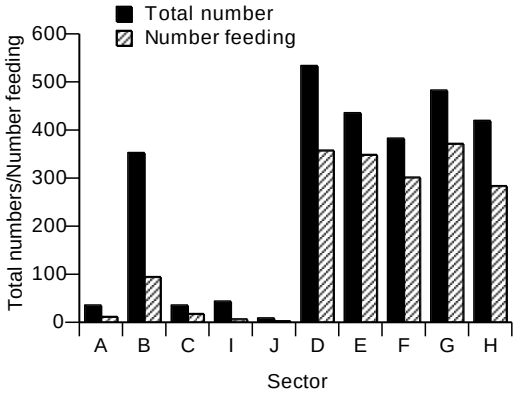
6.43 Tufted Duck showed a different pattern of site usage compared to Gadwall. Sector I in the North section was by far the most important area for Tufted Duck, with smaller numbers using sectors A, B and J (all in the North also). The South sectors were less favourable for Tufted Duck as was Sector C in the North. A much smaller proportion of the birds present were recorded feeding and there was little difference between any of the sectors (North or South) in terms of number of birds recorded feeding. As a consequence the majority of birds recorded in the North were not feeding.

6.44 Virtually all the Shoveler usage of the site was restricted to sector B in the North and a high proportion of the Shoveler time spent in sector B was engaged in feeding. Although there were relatively few records of Smew on the

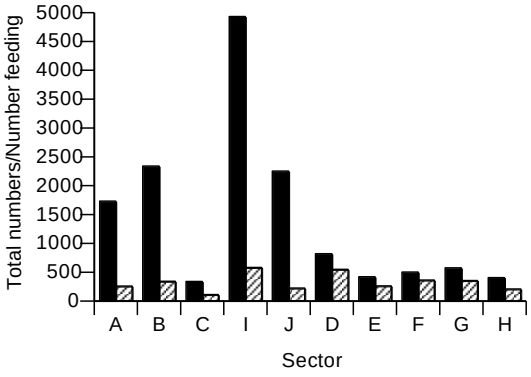
site, usage was also concentrated in the North of the site, in particular in sector B.

Figure 30. Total number of individuals counted over the whole winter (with the totals from all four recording sessions each day summed), and total numbers feeding by sector.

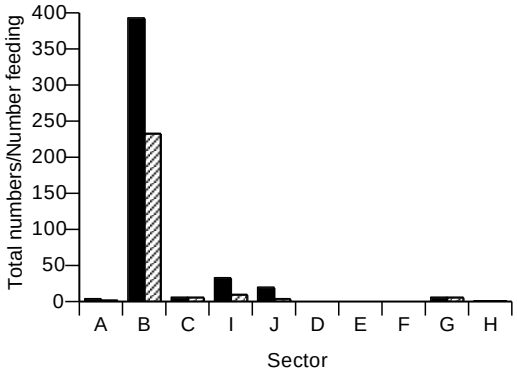
a) Gadwall



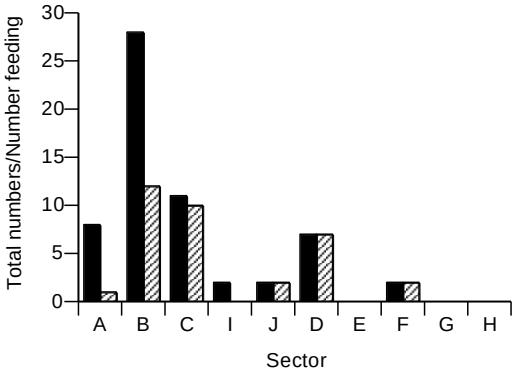
b) Tufted Duck



c) Shoveler



d) Smew



Redistribution of birds within Wraysbury 2

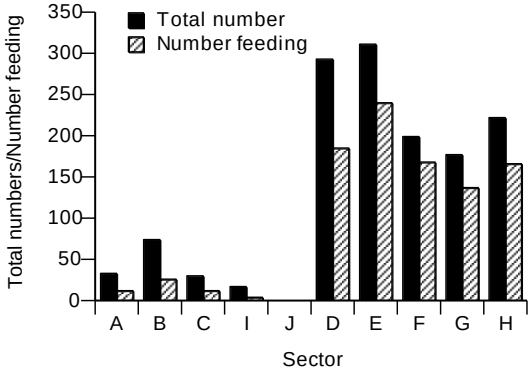
6.45 Considering patterns of sector usage midweek versus weekend it is clear that Sector B in the North section is much more important for Gadwall at weekends, although birds spend a relatively small proportion of the time feeding in this

sector (Figure 31). Sector E in the South section of the site shows a marked decline in Gadwall numbers at the weekend compared to midweek (when it has the highest usage of any sector). In terms of the numbers of birds involved it would appear that the declines at the weekend in sector E and to a lesser extent D are the result of birds moving into sectors G (in the South) and B (in the North).

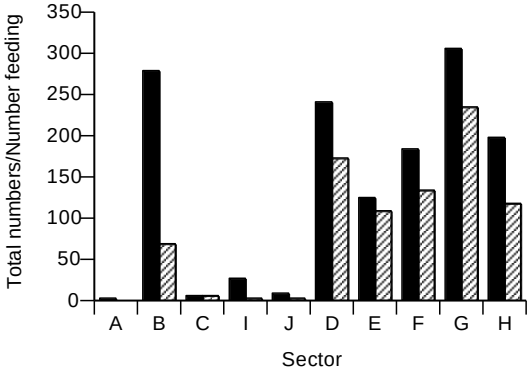
6.46 For Tufted Duck there is a dramatic influx of roosting birds in to Sectors I and J in the North of the site at weekends (Figure 31). There was very little redistribution of Shoveler within the site between midweek and weekends. Birds were predominantly using sector B on both midweek and weekends with a high proportion of birds feeding in the Sector. However, overall numbers were lower at weekends compared to midweek, suggesting that birds were leaving the site altogether at the weekend.

Figure 31. Total bird usage of each sector midweek and weekend for each species.

a) Gadwall – Midweek



b) Gadwall – Weekend



c) Tufted Duck – Midweek

d) Tufted Duck – Weekend

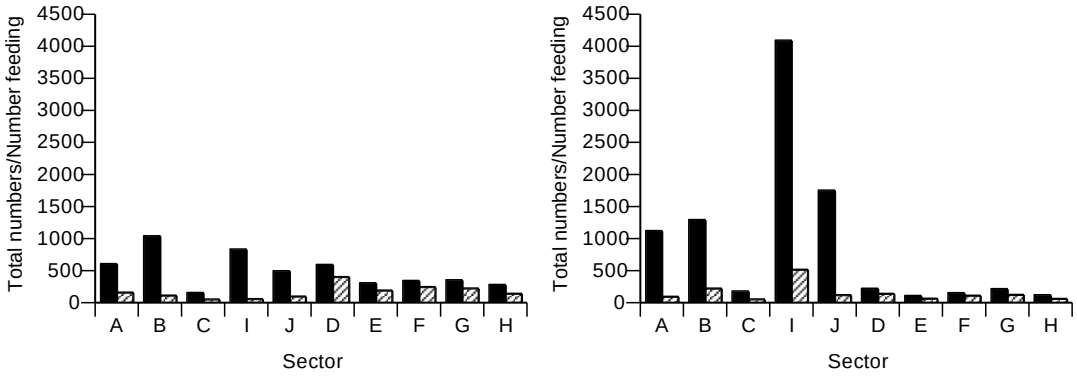
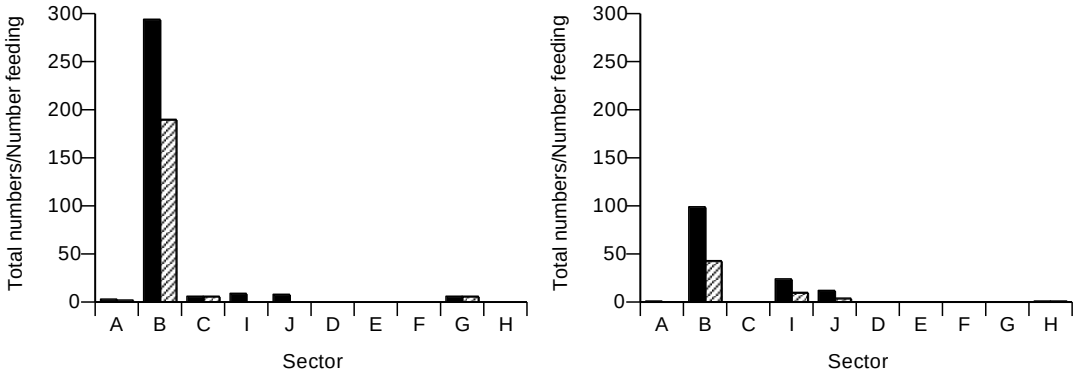


Figure 31 cont. Total bird usage of each sector midweek and weekend for each species.

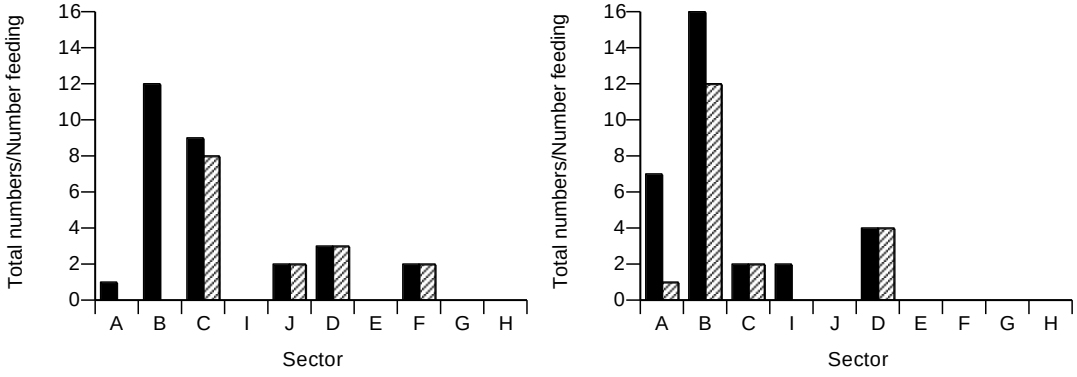
e) Shoveler – Midweek

f) Shoveler – Weekend



g) Smew – Midweek

h) Smew – Weekend



6.47 Gadwall numbers in Wraysbury 2 South sectors generally declined at the weekend after 1100hrs, increasing again after 1500hrs (Figure 32). This pattern was most noticeable on Sector E where the majority of sailing activity

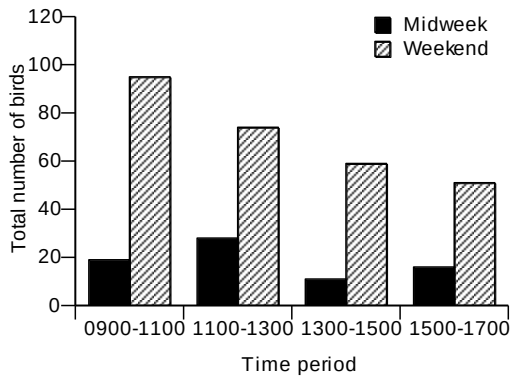
takes place at the weekend. Weekend numbers in Sector G were high between 1300 and 1500 hrs suggesting that birds were moving into this sector from those most affected by sailing activity.

6.48 Tufted Duck numbers in Sectors I and J in the North section of the site showed a general increase through the day and this was particularly noticeable at weekends (Figure 32). Numbers of Tufted Duck on Southern sectors showed weekend declines between 1100 and 1500 hrs, presumably again as a result of the sailing activity in Wraysbury 2 South.

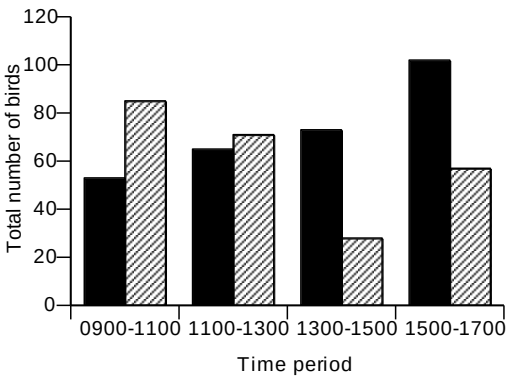
Figure 32. Diurnal variation in numbers in the key sectors for each species.

Gadwall

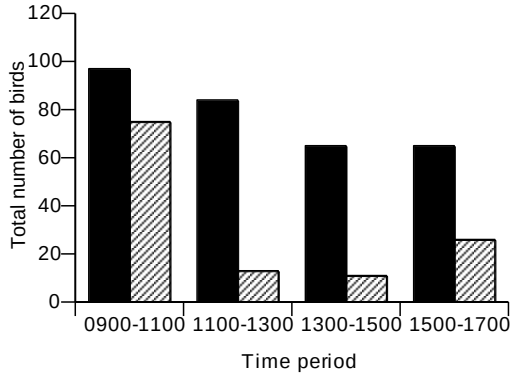
Sector B



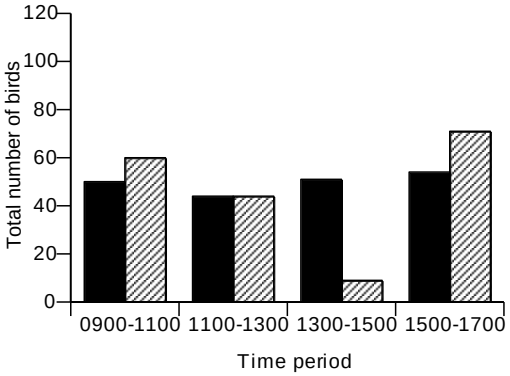
Sector D



Sector E



Sector F



Sector G

Sector H

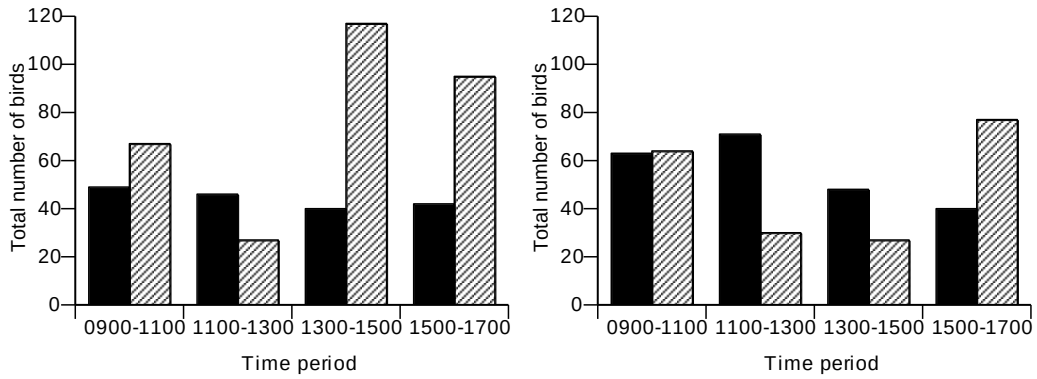
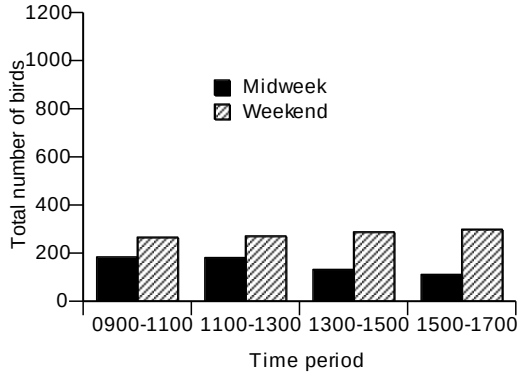


Figure 32 cont. Diurnal variation in numbers in the key sectors for each species.

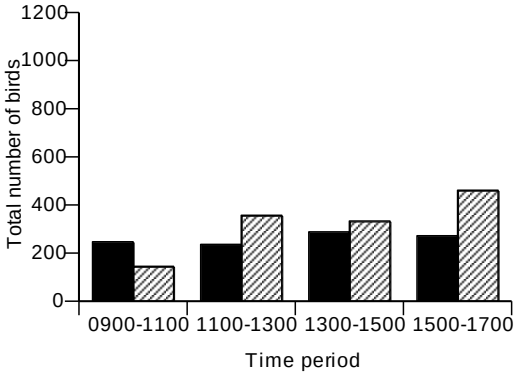
Tufted Duck

North

Sector A

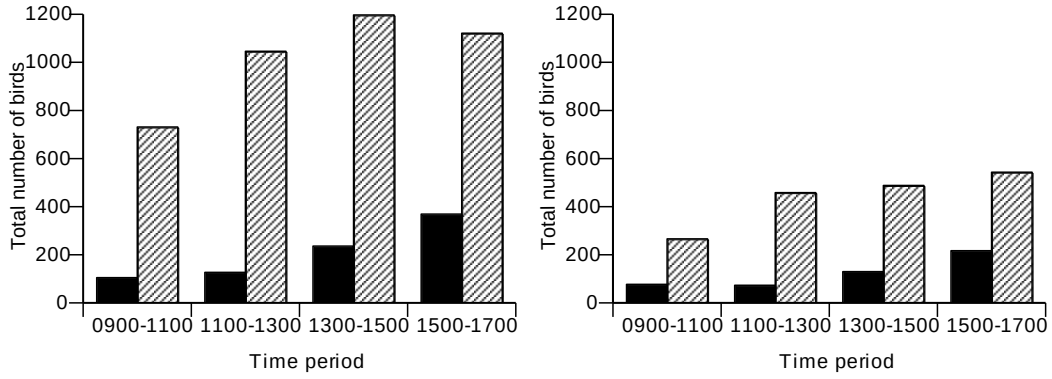


Sector B



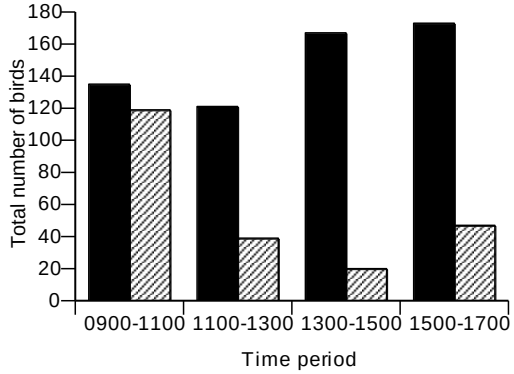
Sector I

Sector J



South

Sector D



Sector E

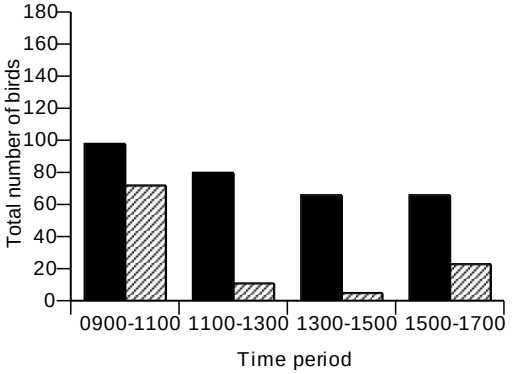
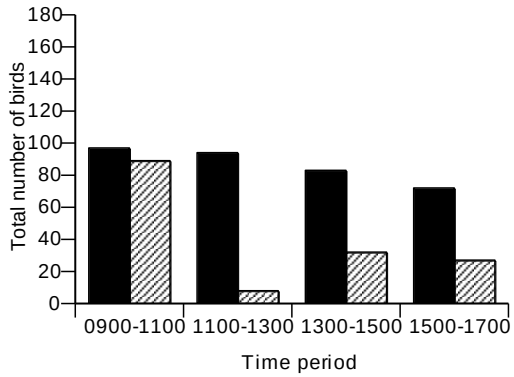


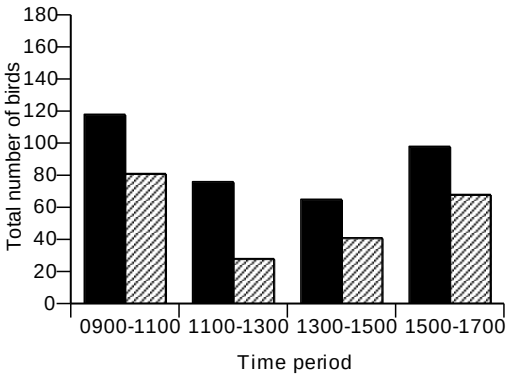
Figure 32 cont. Diurnal variation in numbers in the key sectors for each species.

Tufted Duck.

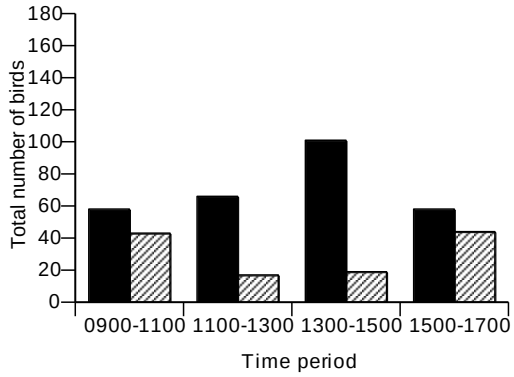
Sector F



Sector G



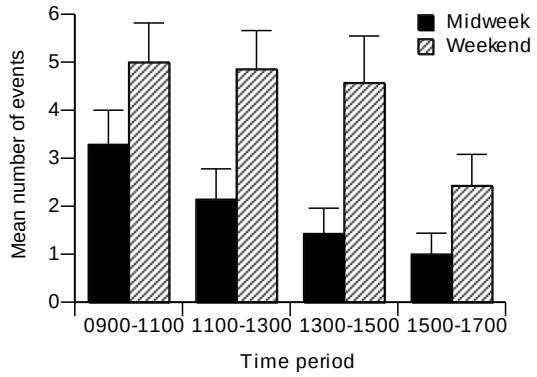
Sector H



Human recreational activities on Wraysbury 2

6.49 Over the site as a whole recreational activities were recorded in 82.1% of the recording periods midweek and 96.4% of the sessions at weekends. The average number of individuals/craft present on Wraysbury 2 per 120 minute recording session was 3.04 (±0.61) on midweek days, compared to 13.8 (±2.33) individuals/craft per session at weekends. Considering the North and South parts of the site separately there were 2.68 (±0.59) individuals/craft on Wraysbury 2 (North) per session midweek, and 5.11 (±0.78) at weekends. On Wraysbury 2 (South) there were 0.5 (±0.12) individuals/craft per session midweek compared to 9.29 (±1.24) at weekends.

Figure 33. Number of recreational 'events' recorded in different time periods midweek versus weekend.



6.50 Note that ten sailing boats in one sector in one time period is treated as one event, likewise three anglers in one sector in one time period would be treated as one event, but 3 anglers in one sector and 2 anglers in another sector during the same time period would be treated as two events.

Figure 34. Graph showing the total events recorded in each month (i.e. over 4 sessions and 2 days per month). It gives an indication of total site use over the day since for example an angler present all day would be recorded 4 times.

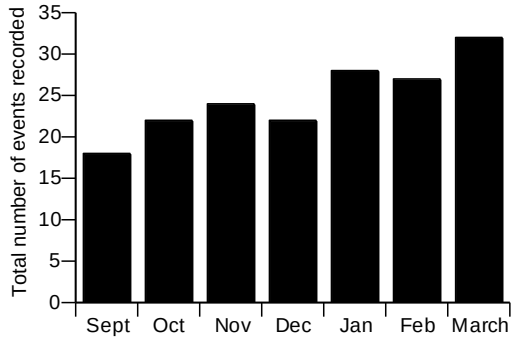
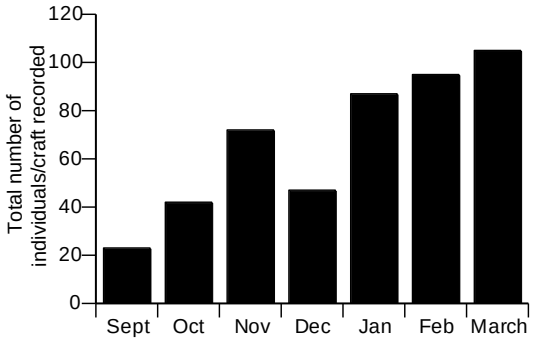


Figure 35. Total numbers of individuals/craft recorded on Wraysbury 2 during the 14x4 recording sessions.



6.51 Recreational site usage increased over the course of the winter with highest levels recorded in March (Figures 34 & 35).

6.52 Sectors A, J and E experience the heaviest usage during the winter (Figure 36). Sectors E and J are mostly used at the weekend, whereas sector A has heavy usage on both midweek days and weekends. Sectors B and I have moderate usage, although B is predominantly used midweek and I at the weekend.

Figure 36. Distribution of recreational events on Wraysbury 2 by sector, midweek and weekend.

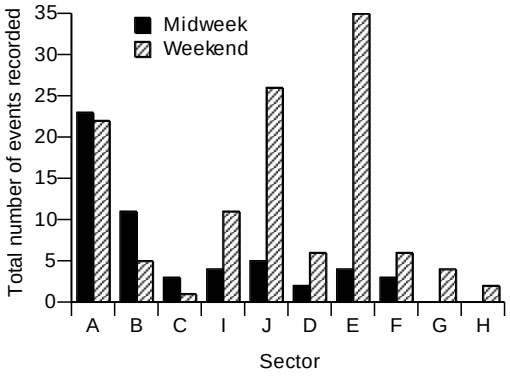
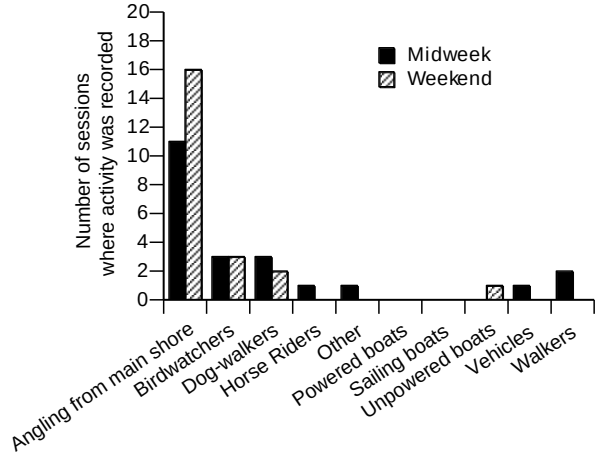


Figure 37. Total number of recording sessions midweek and weekend (total 28 in each case) when different activities were recorded in each sector of Wraysbury 2 (North).

Sector A



Sector B

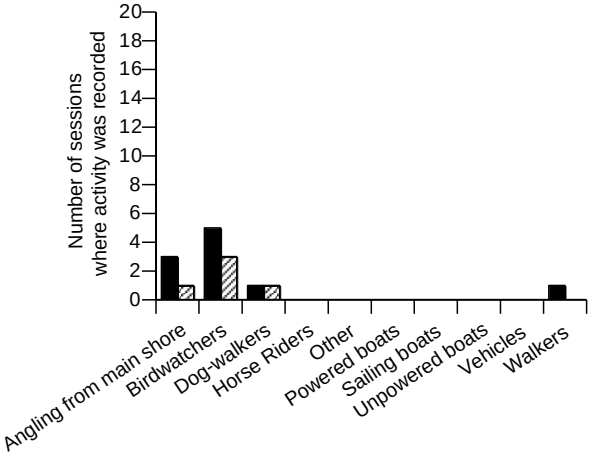
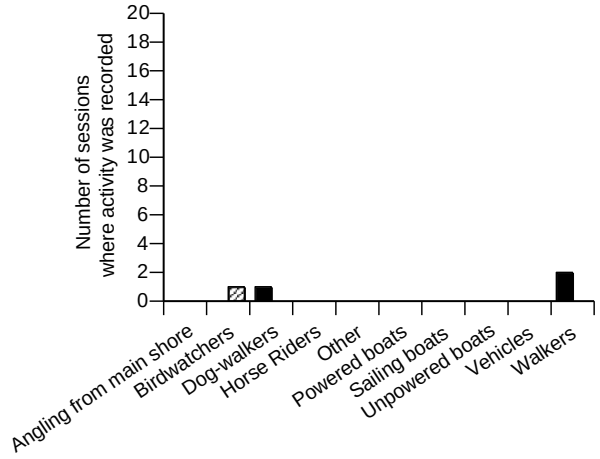
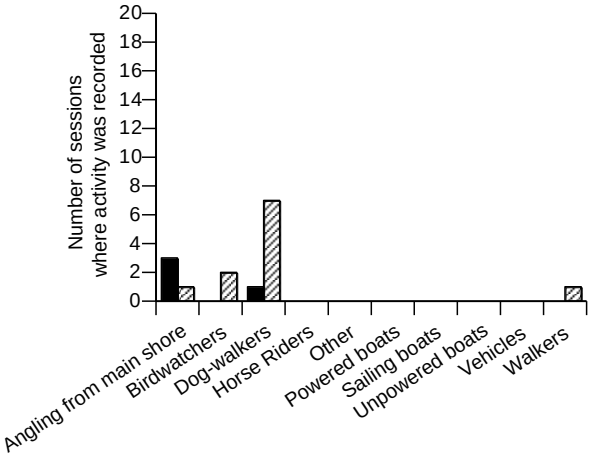


Figure 37 cont. Total number of recording sessions midweek and weekend (total 28 in each case) when different activities were recorded in each sector of Wraysbury 2 (North).

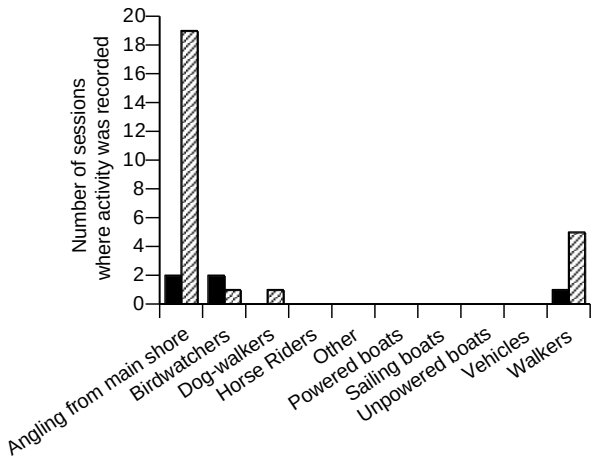
Sector C



Sector I



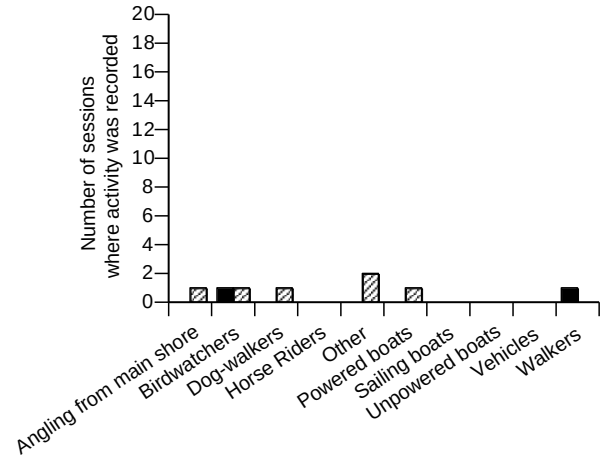
Sector J



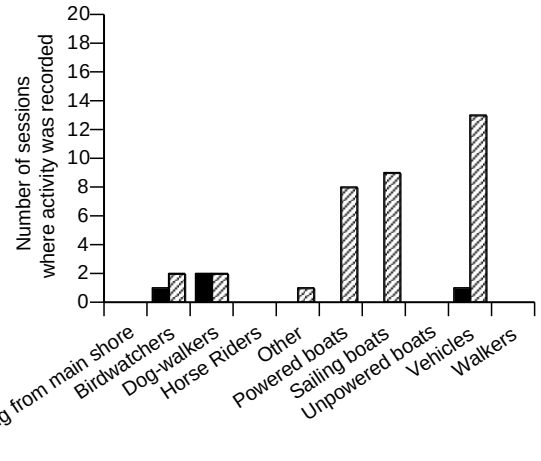
6.53 The North part of Wraysbury 2 is used predominantly for shore-based activities (Figure 37). Sectors A and J are the most frequently used by anglers which account for the main recreational use on the North section. Sector J had particularly high usage by anglers at the weekends over the winter. Sector I is the most popular sector with dog-walkers. Birdwatchers and anglers account for most of the activity on Sector B and this occurs mainly on midweek days.

Figure 38. Total number of recording sessions midweek and weekend (total 28 in each case) when different activities were recorded in each sector of Wraysbury 2 (South)

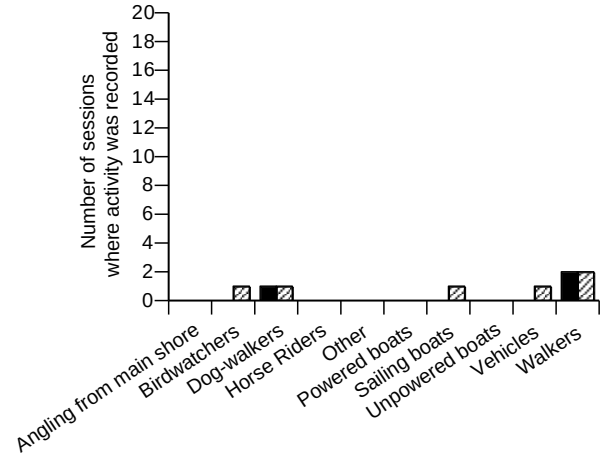
Sector D



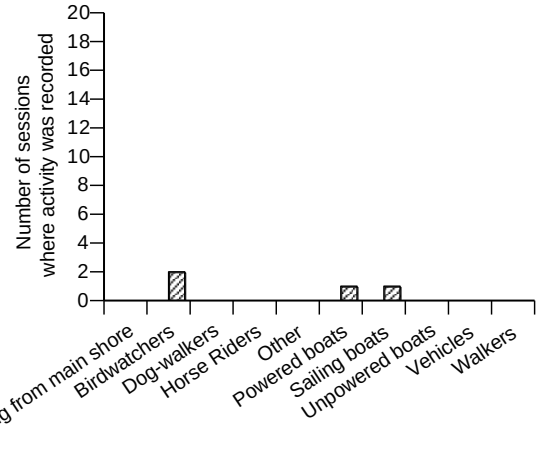
Sector E



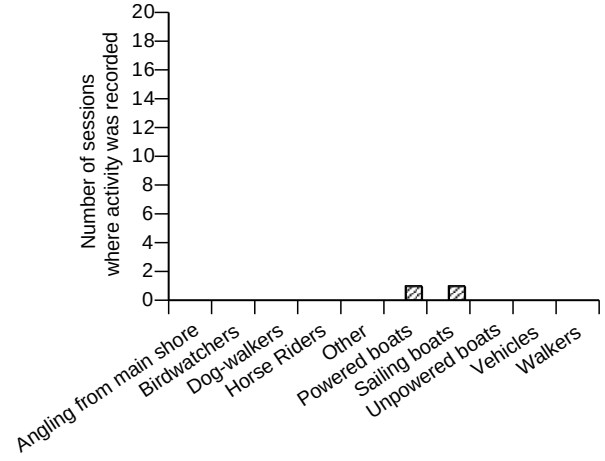
Sector F



Sector G



Sector H



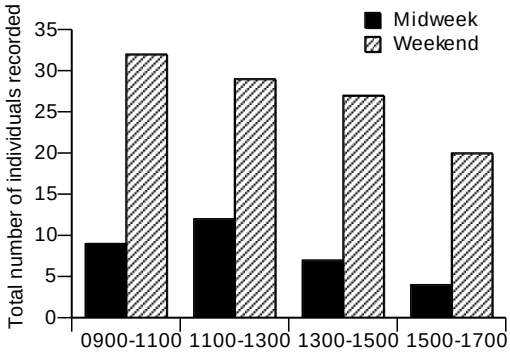
6.54 In contrast, the South part of Wraysbury 2 is used predominantly by water-based activities (Figure 38). Sector E is the main zone where sailing occurs and there is also some powered boat use in this sector. Additionally sector E has the sailing clubhouse and so experiences vehicle activity. Some boat activity also occurs in sectors F, G and H, but these are not the main areas for sailing. All the water-based activity occurs at the weekend on the South part of Wraysbury 2.

Time of day and human recreational activity.

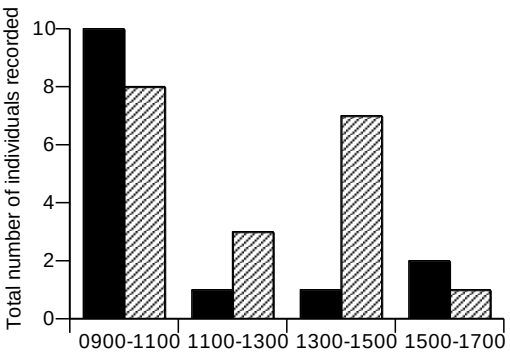
6.55 The most notable pattern in activity is that sailing, powered boat use and vehicle activity are all concentrated in the period 1100 hrs to 1500 hrs on weekends (Figure 39).

Figure 39. Total number of individuals/craft recorded in each of the four time periods midweek versus weekend. Only main activities are shown.

a) Angling from main shore

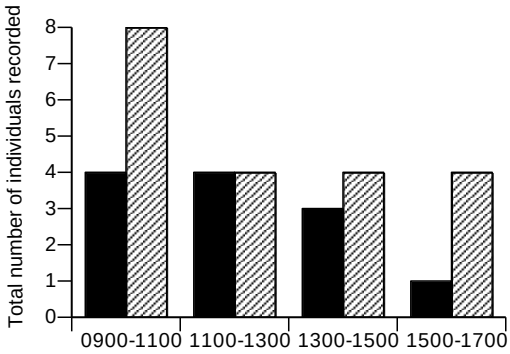


b) Birdwatchers



c) Dog-walkers

d) Powered Boats


Total number of individuals recorded
0
1
2
3
4
5
6
7
8
0900-1100
1100-1300
1300-1500
1500-1700

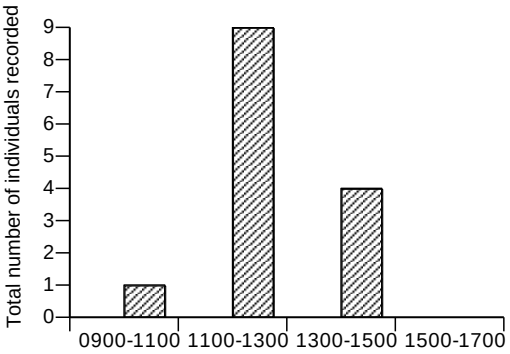
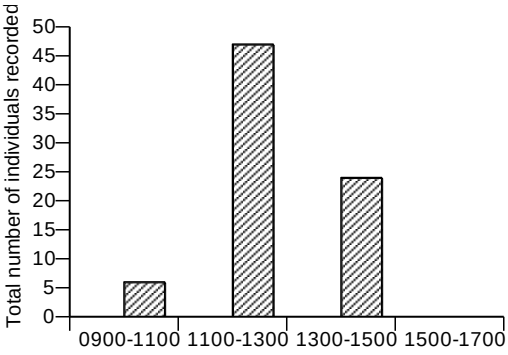
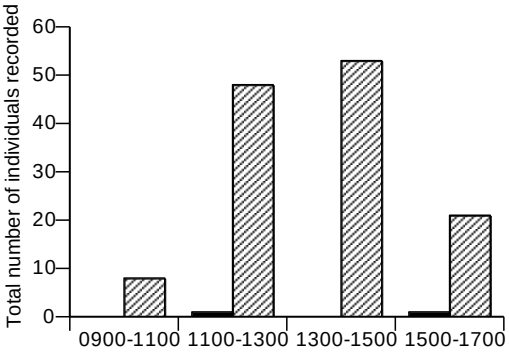

Total number of individuals recorded
0
1
2
3
4
5
6
7
8
9
0900-1100
1100-1300
1300-1500
1500-1700

Figure 39 cont. Total number of individuals/craft recorded in each of the four time periods midweek versus weekend. Only main activities are shown.

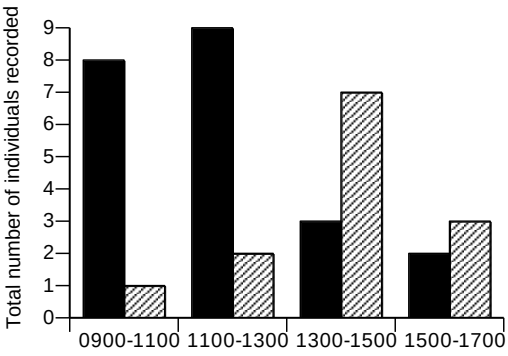
e) Sailing Boats



f) Vehicles



g) Walkers



Effect of Bonfire Night activities on bird numbers at Wraysbury 2

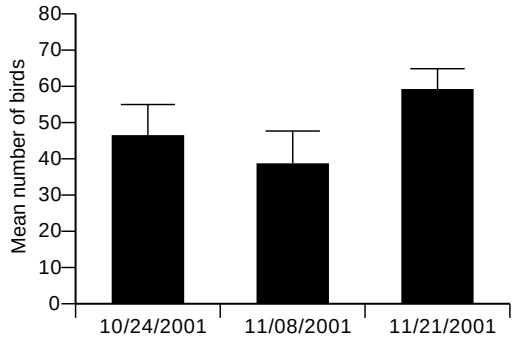
6.56 As a separate contract with English Nature, an additional count was made midweek on Wraysbury 2 in the week following a firework event in the sailing club grounds. The aim of this additional count was to determine if the firework events had had an effect on overall bird numbers on the site for the four key species.

6.57 The additional count was made on Thursday 8th November following the same methodology as the other counts on Wraysbury 2. Tufted Duck and Gadwall were the only key species present on the site during November. The counts from 8th November were compared with those from the preceding midweek count (24th October) which took place two weeks earlier and the following midweek count (21st November), which was two weeks later.

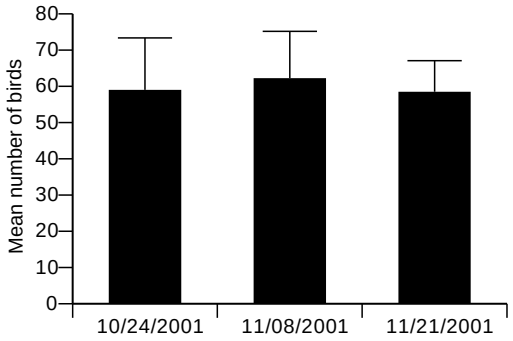
Figure 40. Mean count of Tufted Duck and Gadwall on Wraysbury 2 North and South on three midweek dates in late October and November.

Tufted Duck

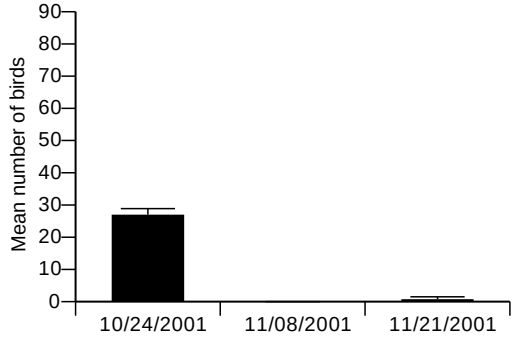
a) Wraysbury 2 (North)

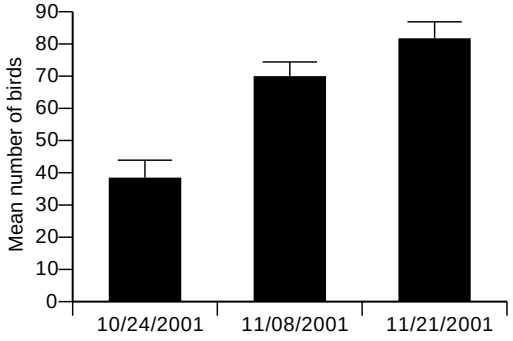


b) Wraysbury 2 (South)



Gadwall





6.58 The sailing club is situated on the edge of Sector E in the South part of Wraysbury 2. There was no difference in Tufted Duck numbers on either

Wraysbury 2 North or South between the count following Bonfire night and either the preceding or subsequent midweek count (Figure 40). On Wraysbury 2 South, Gadwall numbers were higher on the 8th November count compared to the preceding midweek count, and were higher again on the late November count. On Wraysbury 2 North, which holds fewer Gadwall generally, there were no Gadwall present on the 8th November compared to a daily mean of more than 25 birds on the preceding midweek count. The 21st November count also recorded very few Gadwall on Wraysbury 2 North, as in fact did the remaining midweek counts during the winter. Numbers of Gadwall on Wraysbury 2 as a whole did not reflect this pattern in the North section, which does not appear to be related to Bonfire night activities on Wraysbury 2.

7. Discussion

7.1 The results of this study suggest that Wraysbury 1 and 2 do not function as discrete sites for the key species. For example, Tufted Duck use Wraysbury 2 primarily as a roost site during the day with large influxes of individuals at the weekend from outside of the site. Similarly on Wraysbury 1, Tufted Duck spent a surprisingly low proportion of time feeding during the day, suggesting that birds are either feeding on the site at other times (before 0900 and after 1600 hrs) or are feeding elsewhere. Additionally, the lower numbers of Tufted Duck at weekends on Wraysbury 1 compared to midweek suggests an interchange of birds between sites. Shoveler numbers also indicate a complex pattern of site usage. Daytime numbers on Wraysbury 2 were low throughout the winter 2001/02- the maximum WeBS count was 23 birds and the maximum count in this study was 50 birds - however a flock of up to 260 feeding Shoveler were recorded between 26th January and 7th February during the night between 0230 and 0400 hrs (V. Chambers pers comm). These birds apparently left following a major angling competition involving more than 100 anglers on the site.

7.2 Both sites experience a relatively high level of recreational activities, both organised (e.g. angling and sailing) and 'un-permitted' (e.g. dog-walkers, shooters, quad bikes, horse-riders). Due to only being able to cover sites on one midweek day (Wednesday) and one weekend day (Sunday) each month, the assessment of recreational activity will only provide a repeatable index of recreational intensity if the weekly pattern of activities on site stays the same in subsequent years. If for example, sailing changed to a Saturday then obviously a repeat of the Sunday counts might indicate that sailing intensity had falsely declined. Similarly the study was unable to determine the level of recreational activities on the sites outside of the period 0900 hrs to 1600 hrs.

Angling, dog-walking, birdwatching etc. are all activities that are likely to occur before 0900 hrs, especially during midweek days.

7.3 Overall, water-based activities (sailing and powered boat use) resulted in the greatest reaction by the key species on both sites. Tufted Duck frequently left Wraysbury 1 altogether in response to boat use on the site, and on Wraysbury 2 sailing and powered boat use on the South section resulted in a temporary displacement of birds either into the North section of the site (Tufted Duck in particular) or into peripheral sectors of the South section (Gadwall).

7.4 Generally angling and other shore-based activities did not result in birds leaving the sites – more often activities resulted in a gradual redistribution of birds within the site. However, use of powered boats by anglers on Wraysbury 1 was a major cause of 'disturbance' on the site.

7.5 Some of the unpermitted activities resulted in a large proportion of the key species leaving the sites, for example a shooter event and quad bike activity on Wraysbury 1, although these activities occurred much less frequently than permitted activities and their overall effect was therefore lower.

7.6 While it is evident from this study that human recreational activity does have an effect on the numbers and distribution of waterbirds on Wraysbury 1 and 2, it is not possible to determine if disturbance on the site results in any impact on the birds that use them. Without measuring resource use at a site it is not possible to determine if disturbance is actually limiting the number of birds that a site can support or if this ultimately leads to a population level effect. Certainly on Wraysbury 1 there was no difference in the proportion of time birds spent feeding during disturbed periods compared to un-disturbed periods, however there were fewer birds present on the site during the disturbed periods. On Wraysbury 2 disturbance resulted much more in a redistribution of birds within the site and in fact numbers of Tufted Duck were

considerably higher at the weekend, when recreational disturbance was higher. Given that most Tufted Duck on Wraysbury 2 were roosting during the day, any impact is potentially greater for Gadwall since they predominantly fed in South sectors of Wraysbury 2. At weekends disturbance resulted in many of these birds redistributing to the North of Wraysbury 2 where they spent less time feeding.

7.7 To determine the impact of recreational disturbance on Wraysbury 1 and 2 it is necessary to consider all sites that individual waterbirds are regularly using in the area. It may be the case that human recreational activities are causing a redistribution of birds across sites, but that this is not having an impact on numbers at the SPA level or at the population level. Information on how the waterbodies in the area function as a complex site for waterbirds is as important as looking at the effects of human activity on waterbirds at individual waterbodies. Additionally, given the high levels of recreational activity at all times in the SW London Waterbody SPA it is difficult to determine the number of birds that would use the sites in the absence of any disturbance. If it were possible to remove human recreational activities from one or more waterbodies for the course of a winter this would provide a valuable insight into the numbers of birds that are being displaced due to recreational disturbance.

8. Acknowledgements

8.1 Many thanks to Adam Salmon and John Gowland at WWT Wetland Centre, London for carrying out the fieldwork on this project and John Arbon for facilitating this. Dr Mark O'Connell commented on an earlier draft of this report.

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APPENDIX 1. Scan Proforma for Wraysbury 1.

Site: Wraysbury 1. Date: Observer: Weather:

TIME	SPECIES	NUMBER OF INDIVIDUALS ENGAGED IN ACTIVITY										DISTURBED SCAN?
		FEED	ROOST	LOAF	FLY	SWIM	ALERT	PREEN	AGGR	OTHER	TOTAL	
0900	GAD											
0900	SHOV											
0900	TD											
0900	SMEW											
0910	GAD											
0910	SHOV											
0910	TD											
0910	SMEW											
0920	GAD											
0920	SHOV											
0920	TD											
0920	SMEW											
0930	GAD											
0930	SHOV											
0930	TD											

0930	SMEW											

APPENDIX 2. Human Activity Proforma for Wraysbury 1

HUMAN ACTIVITY CODE	TIME ACTIVITY STARTED	TIME ACTIVITY FINISHED	NUMBER OF PEOPLE/CRAFT INVOLVED	SECTOR WHERE ACTIVITY OCCURRING

Human activity codes

HUMAN ACTIVITY CODE	HUMAN ACTIVITY
A	Sailing boats
B	Unpowered boats (excluding sailing boats)
C	Powered boats (including boat based waterskiing)
D	Jetskiing
E	Windsurfing
F	Angling from main shore
G	Angling from island
H	Angling from boats
J	Walkers
K	Dog-walkers
L	Birdwatchers
M	Horse Riders
N	Shooters
P	Vehicles
Q	Model Boats
S	Waterskiing using tow-track

R	Other (please specify)

APPENDIX 3. Disturbance Proforma For Wraysbury 1

Instantaneous reaction of birds at time disturbance commences:						
SPECIES	NUMBER OF INDIVIDUALS ENGAGED IN ACTIVITY					
	NO REACTION	ALERT BUT NO ESCAPE MOVEMENT	SWIM AWAY	FLY WITHIN SITE	FLY OFF SITE	NOT RECORDED
GAD						
SHOV						
TD						
SMEW						

✶ Date:
✸ Observer:
✹ Time human activity(disturbance) started:
❋ Time human activity (disturbance) finished:
⌗ Disturbance code (see HUMAN ACTIVITY PROFORMA for codes):
⌖ Brief description of disturbance (position and extent marked on map):
✧ Approx distance of disturbance from birds in metres:

FOR DISTURBANCES WHICH CAUSE BIRDS TO FLY:Plot direction of flight on map and final location (or where they left the map). **Record time at which all birds have all left site or all landed back on site**: Resume scan form once disturbance event is over i.e. return to a normal behavioural scan once all the birds have either left site or have returned to their pre-disturbed behaviour. Continue normal scans thereafter.

APPENDIX 4. Bird Mapping Proforma for Wraysbury 2.

Date:

Observer:

Weather:

Time:

SECTOR	SPECIES	NUMBER OF INDIVIDUALS ENGAGED IN ACTIVITY				
		FEED	ROOST	LOAF	OTHER	TOTAL
C	GAD					
A	SHOV					
A	TD					
A	SMEW					
B	GAD					
B	SHOV					
B	TD					
B	SMEW					
C	GAD					
C	SHOV					
C	TD					
C	SMEW					

APPENDIX 5. Human Activity Mapping Proforma for Wraysbury 2

Date:
Observer:
Weather:
Time:

SECTOR	ACTIVITY	NUMBER OF INDIVIDUALS/CRAFT ENGAGED IN ACTIVITY	CODE
A	Sailing boats		A
A	Unpowered boats (excluding sailing boats)		B
A	Powered boats (including boat based waterskiing)		C
A	Jetskiing		D
A	Windsurfing		E
A	Angling from main shore		F
A	Angling from island		G
A	Angling from boats		H
A	Walkers		J
A	Dog-walkers		K
A	Birdwatchers		L
A	Horse Riders		M
A	Shooters		N
A	Vehicles		P
A	Model Boats		Q
A	Waterskiing using tow-track		S
A	Other (please specify)		R

If any of these activities result in disturbance to the birds, please indicate the sectors affected.

APPENDIX 6. Summary of reactions of birds to human recreational activities on Wraysbury 2.

DATE	MID/WK	SECTOR	ACTIVITY	NO. OF INDS	DISTURBANCE
10/28/2001	W	J	Angling	2	PUSHED 6 TD TOWARDS SECTOR I
10/28/2001	W	J	Angling	2	TD HAVE MOVED TO NORTH SHORE OF SECTOR A
11/08/2001	M	A	Angling	1	PUSHED TD DOWN TO OTHER (EAST) END OF SECTOR A
11/08/2001	M	A	Angling	1	DUCKS REMAIN ON WEST SIDE OF SECTOR A
11/21/2001	M	A	Angling	4	NO BIRDS NEARBY
11/21/2001	M	A	Angling	1	NO DUCK IN VICINITY
11/21/2001	M	A	Angling	2	FEW BIRDS. MOST TO EAST OF SECTOR
11/25/2001	W	J	Angling	7	2 FISHING TO NORTH PUSHED ALL TD SOUTH
11/25/2001	W	A	Angling	5	ALL DUCKS GRADUALLY MOVED TO EAST OF SECTOR
12/16/2001	W	D	Angling	3	MOVED DUCK TO WEST OF SECTOR D
12/16/2001	W	J	Angling	1	MOST TD COLLECTED TO WEST OF SECTOR
12/19/2001	M	A	Angling	1	FISHING IN OPEN SPOT – NOT MUCH DUCK ACTIVITY IN HIS VICINITY
12/19/2001	M	A	Angling	2	PROMINENT FISHING POSITIONS ON EAST SHORE OF SECTOR. NOT MANY BIRDS IN SECTOR.
01/20/2002	W	J	Angling	3	ALL 260+ td SITTING TO THE WEST OF SECTOR I AS A RESULT
01/20/2002	W	A	Angling	5	DUCKS PUSHED TO SOUTH SHORE OF SECTOR
01/20/2002	W	A	Angling	6	DUCKS STILL STAYING IN SOUTH OF SECTOR A
01/20/2002	W	A	Angling	6	NO CHANGE FROM BEFORE
02/17/2002	W	A	Angling	3	MOST TD STAYING ONSOUTH SIDE OF SECTOR A.
02/17/2002	W	A	Angling	4	ANGLERS ON N AND NE SHORE AS USUAL. MOST OF DUCK REMAIN ON SOUTH SIDE OF SECTOR A.
02/17/2002	W	A	Angling	5	NO DISTURBANCE APART FROM 1 ANGLER SPINNING OUT IN THE OPEN WHICH FLUSHED 3 TD INTO SECTOR B
09/30/2001	W	J	Birdwatchers	1	FLUSHED 2 BIRDS FROM ZONE J TO ZONE I
09/30/2001	W	G	Birdwatchers	1	FLUSHED 4 TD & 2 GAD
10/03/2001	M	E	Birdwatchers	1	DISTURBED 6 GAD FROM LOAFING AREA
10/03/200	M	D	Birdwatchers	1	MOVED 4 GAD AND 18 WIG WEST

10/03/2001	M	A	Birdwatchers	1	FLUSHED 1 SHOV TO OTHER SIDE OF SECTOR
10/03/2001	M	A	Birdwatchers	1	FLUSHED 5 WIG FROM PATH SHORELINE TO EAST OF SECTOR A
10/28/2001	W	E	Birdwatchers	1	GRADUAL MOVEMENT OF ALL DUCKS NORTH OF E SECTOR
11/08/2001	M	E	Birdwatchers	2	FLUSHED 4 GAD INTO SECTOR D
11/21/2001	M	J	Birdwatchers	2	FLUSHED 2 GOLDENEYE FROM J TO I
11/21/2001	M	A	Birdwatchers	2	PUSHED 20+ TD EAST TO CENTRE OF SECTOR
11/25/2001	W	E	Birdwatchers	1	FLUSHED 1 GAD OUT OF SECTOR
11/25/2001	W	I	Birdwatchers	3	PUSHED DUCK INTO MIDDLE OF SECTOR
11/25/2001	W	A	Birdwatchers	1	FLUSHED CA. 40 TD TO EAST OF SECTOR
11/25/2001	W	B	Birdwatchers	1	FLUSHED 2 GOLDENEYE INTO SECTOR I
11/25/2001	W	A	Birdwatchers	1	AGAIN MOVED 40+ TD AWAY FROM SHORE TO CENTRE OF SECTOR
12/16/2001	W	B	Birdwatchers	1	FLUSHED 20+ GADWALL FROM SECTOR - MOVED NORTH TOWARDS SECTOR A
12/16/2001	W	B	Birdwatchers	1	FLUSHED 2 GOLDENEYE INTO SECTORS H/E
12/19/2001	M	B	Birdwatchers	1	FLUSHED 3 TD INTO SECTOR I
01/16/2002	M	B	Birdwatchers	1	FLUSHED 8 SHOVELER AND 2 SMEW WHICH FLEW EAST TOWARDS SECTOR A
01/16/2002	M	J	Birdwatchers	1	FLUSHED 1 SMEW TOWARDS SECTOR B BUT THEN SETTLED BACK INTO SECTOR J
02/13/2002	M	B	Birdwatchers	1	FLUSHED 16 SHOVELER FROM ZONE B WHICH FLEW NORTH OUT OF SECTOR
02/17/2002	W	G	Birdwatchers	1	CAUSED TD TO MOVE TOWARDS SECTORS D AND H. GADWALL STAYED PUT.
02/17/2002	W	C	Birdwatchers	1	FLUSHED 2 TEAL OUT TOWARDS SECTOR A
03/10/2002	W	I	Birdwatchers	1	SHIFTED TD RAFT EASTWARDS AWAY FROM SHORE
03/13/2002	M	B	Birdwatchers	1	FLUSHED 15 SHOVELER NORTH OUT OF SECTOR
03/13/2002	M	B	Birdwatchers	1	FLUSHED 10 SHOVELER BRIEFLY FROM SECTOR, BUT BIRDS RETURNED IMMEDIATELY TO SECTOR B.
09/30/2001	W	I	Dog-walkers	1	FLUSHED 14 TD IN ZONE I
10/28/2001	W	I	Dog-walkers	1	MINIMAL DISTURBANCE
12/16/2001	W	I	Dog-walkers	1	FLUSHED 30 TD AWAY FROM SHORE INTO SECTOR A
01/20/200	W	J	Dog-walkers	1	PUSHED TD AWAY FROM SHORE TOWARDS SECTOR I

2					
01/20/200	W	I	Dog-walkers	1	SAME DOG-WALKER AS IN SECTOR J. DUCKS UNSETTLED BUT
2					STAYING IN SECTOR
01/20/200	W	A	Dog-walkers	1	DUCKS PUSHED TO SOUTH SHORE OF SECTOR
2					
01/20/200	W	D	Dog-walkers	2	SLIGHT MOVEMENT OF TD IN SECTOR I TOWARDS THE CENTRE
2					OF SECTOR I
02/17/200	W	I	Dog-walkers	2	KEEPING TD RAFT AWAY FROM THE WEST SHORE
2					
03/10/200	W	B	Dog-walkers	1	FLUSHED 4 TD WEST TOWARDS SECTOR I. TD AND SHOV ALL
2					MOVING SLOWLY W OF SECTOR B.
03/10/200	W	I	Dog-walkers	3	DUCKS STAYING AWAY FROM WEST SHORE
2					
10/24/200	M	A	Other	1	PLANE (PASSENGER JET) FLUSHED 15+ TD
1					
10/28/200	W	D	Other	2	CYCLISTS CAUSED BIG MOVEMENT OF DUCK INTO H & E
1					
09/30/200	W	G	Powered boats	1	FLUSHED 1 TD, 4 WIGEON (2 RETURNED)
1					
11/25/200	W	E	Powered boats	2	FREQUENT HORN USE. FEW BIRDS LEFT. ALSO USED SECTOR H
1					
12/16/200	W	E	Powered boats	2	SAME EVENT AS ABOVE
1					
12/16/200	W	E	Powered boats	1	SAME AS ABOVE
1					
01/20/200	W	E	Powered boats	2	GAD REMAIN IN SECTORS F AND G. NO TD LEFT
2					
02/17/200	W	E	Powered boats	1	NO DUCK PRESENT ON PIT
2					
03/10/200	W	E	Powered boats	1	1110HRS FLUSHED ALL DUCK FROM SECTORS E, F AND H
2					
03/10/200	W	D	Powered boats	1	1020HRS 10 TD FLEW OFF TOWARDS SECTOR A. BY 1030 ONLY
2					4 TD LEFT IN SECTORS D AND G.
03/10/200	W	E	Powered boats	1	NO DUCKS PRESENT
2					
11/25/200	W	E	Sailing boats	12	MOST DUCKS FLEW NORTH WHEN BOATS ARRIVED. ALSO IN
1					SECTOR H
12/16/200	W	E	Sailing boats	9	95% OF DUCK LEFT SITE. PROBABLY STARTED AT APPROX 1040
1					JUDGING BY 100+ DUCK SEEN FLYING OVER SECTORS I AND J
					AT THIS TIME. 30+ GAD AND 40+ TD FLUSHED INTO SECTOR B
02/17/200	W	E	Sailing boats	9	ALL DUCK HAD VACATED THE WHOLE PIT AT THE START OF
2					THE SESSION. THIS MOST PROBABLY CONTRIBUTED TO THE
					SURGE IN BIRD NUMBERS ON SECTOR I EARLIER
02/17/200	W	E	Sailing boats	3	NO DUCK PRESENT ON PIT
2					
03/10/200	W	E	Sailing boats	10	1125HRS NO DUCK LEFT
2					
03/10/200	W	E	Sailing boats	8	NO DUCKS PRESENT
2					
10/28/200	W	E	Vehicles	1	PUSHED 5 GAD OFF ROOST SITES BY CARPARK
1					
11/25/200	W	E	Vehicles	1	CAR IN CAR PARK CAUSED GENERAL MOVEMENT OF ALL SPP

1					WEST
11/25/2001	W	E	Vehicles	9	CAR NOISE AND LIGHTS AT SAILING CLUB . DUCKS STAY IN SECTOR H
12/16/2001	W	E	Vehicles	4	ARRIVED IN CAR PARK CAUSING GENERAL MOVEMENT OF ALL DUCK INTO WEST OF SECTOR E
12/16/2001	W	F	Vehicles	4	LIGHTS ON CARS LEAVING CAUSED SOME FLIGHT IN SECTORS F AND H
01/20/2002	W	E	Vehicles	2	CARS ARRIVED PUSHING BIRDS INTO SECTORS F AND G
01/20/2002	W	E	Vehicles	14	CARS IN CAR PARK. ALL DUCKS TO FAR WEST OF LAKE IN SECTOR G. NO TD LEFT
01/20/2002	W	E	Vehicles	12	ACTIVITY IN CAR PARK KEEPING SECTOR E EMPTY
02/17/2002	W	E	Vehicles	1	ARRIVED AT SAILING CLUB, PUSHING 11 TD TO NE OF SECTOR E
10/03/2001	M	F	Walkers	1	FLUSHED MOST DUCK FROM SECTOR NORTHWARDS
01/20/2002	W	J	Walkers	1	PUSHED TD AWAY FROM SHORE TOWARDS SECTOR I
02/13/2002	M	D	Walkers	2	CAUSED A SHIFT OF DUCKS AWAY FROM SHORELINE SOUTH IN SECTOR D AND ALSO INTO E
02/17/2002	W	J	Walkers	2	FLUSHED ABOUT 40 TD SOUTH IN SECTOR J