A simple method for assessing the risk of disturbance to birds at coastal sites

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Summary

1. The levels of activity by people are unknown in four European Marine Sites (EMS) on the coast of Suffolk, UK, and are likely to intensify with increasing development and access. The authorities responsible for these EMS and the Area of Outstanding Natural Beauty that encompasses them (Natural England and Suffolk Coast and Heaths) wish to assess current levels and whether there is a risk that disturbance might be occurring to birds that are features of these protected areas. This assessment would also contribute to future monitoring of access and recreation in the AONB.

2. It is the intention that local user groups and other volunteers, many of which may be non-ornithologists, carry out these assessments in order to heighten awareness and for reasons of local knowledge and cost effectiveness.

3. A simple protocol for the assessment of disturbance risk has been developed through a review of literature and the methods used by other studies. This method is designed to be the first step in the assessment of disturbance risk and as a tool for monitoring the general levels and types of activities.

4. Key considerations in the design of the method were simplicity and ease of use for recorders. To cater for all recorder groups, and given the complexity of the relationship between human activity and its effects on birds, the method does not involve bird counts or observation of bird behaviour.

5. The method measures the level of activity by people in sections of coast or estuary and records the occurrence of specific activities that are known to be disruptive to birds. Means of selecting the distribution of survey sections in large sites such as estuaries are also described.

6. It is recommended that results that are generated by site surveys be compared with the current and historic distribution of birds to highlight whether activities and past or present concentrations of birds coincide. Thereafter, it may be necessary to undertake ornithological work to determine whether disturbance is an issue before action to mitigate the effects of activities at a particular site.

Contents

Foreword

This report was funded through Natural England's contribution to the Suffolk Coast and Heaths AONB Unit, which coordinated the project. Consultation for the Defra 2010 draft report on activities that could have an impact on features within European Marine Sites (EMS) identified the need for work to enable better monitoring of disturbance and potential mechanisms for addressing this where it occurs, following Natural England advice and as part of the UK's wider obligations to Europe under the Habitats Directive. Key regional stakeholders perceive recreational disturbance as a risk to EMS on the Suffolk coast.

1. Background

The disturbance of birds by people is an issue for conservationists and authorities (Hill et al 1997, Drewitt 2007). Assessing this disturbance, and trying to understand its impact, is a priority in the management of many protected areas as recreational activities and housing and other developments increase (e.g. Bathe 2007). A recent review indicated that disturbance poses a high risk to birds in eight European Marine Sites (EMS) (Defra 2010).

The effects of people on coastal birds have been studied at several scales – from individual species at single sites to bird communities in entire estuaries – and in varying levels of detail – from amateur surveys to academic research. Substantial literature is available. The presence of people and their activities has often been shown to affect the behaviour of birds, and occasionally reduce their densities, but this relationship is complicated by site-specific factors that affect the reaction of birds to people.

The bases of most practical studies are assessments of the levels and types of human activity and the associated behaviour of birds. Increasingly complex studies involve measuring the distribution and utilisation of food resources by birds and predicting the impacts of disturbance on individual birds and their populations. All of these require specialist knowledge of birds, and as yet there is not a simple, standardised method for measuring whether there is a risk that disturbance to birds from people might be occurring at a given site. Local volunteers might use such a method as the first step in determining whether people and their activities might be having an impact on coastal birds.

2. Introduction

In Suffolk, a study in the Stour-Orwell SPA in 2004-07 contributed to the development of a code of conduct for users of these estuaries (Suffolk Coast and Heaths 2010). But little is known about visitor levels, recreation and other pressures in other coastal sites in Suffolk. In particular, coastal birds in four European Marine Sites are thought to be at risk from disturbance: the Deben and Alde-Ore estuaries and the coastlines between Minsmere and Walberswick, and Benacre and Easton (Defra 2010).

Natural England and Suffolk Coast and Heaths (the organisation responsible for the Area of Outstanding Natural Beauty that incorporates all four EMS)

want to set up a voluntary system to measure and monitor disturbance risk at these sites. Volunteers have provided large amounts of useful data on disturbance and birds (e.g. Musgrove et al 2003) and continued use is recommended in preliminary assessments (Robinson & Cranswick 2003).

Using local user groups has several benefits:

- It will help raise awareness among these groups of the effects of disturbance and perhaps help ameliorate its impact.
- It is efficient, as local users invariably have greater knowledge of sites and the issues within them.
- Not least, it is cost-effective compared with professional surveys.

It also has limitations, as the user groups that will be involved are not necessarily anticipated to be ornithologists or have particular knowledge of birds. Examples may be members of parish councils, access groups or just interested residents. This sets a particular challenge, and requires an approach that is simple and easy to use, yet records parameters that are indicative of disturbance risk, and that can be used for its assessment and monitoring.

It is the intention that this method be tested on the Deben estuary EMS, where there has been little assessment of visitor levels or disturbance to birds. There is also the possibility of large developments of housing in its hinterland and potential increases of visitors to the estuary and the method will contribute to monitoring potential disturbance risk. It also intended, should trials of the method be successful, that the template be employed at other coastal sites in Suffolk and its use extended elsewhere as the first step in assessments of disturbance risk.

The design of the template that is recommended in this document has been shaped by a review of available literature. It has been guided by the methods and results of surveys and studies relating to the disturbance of birds in the UK and elsewhere, both in estuaries and on coasts.

3. People, birds and disturbance

The effects of people

People or their activities are regarded as threats by birds (Blumstein 2006) and birds react when the perceived risk of predation is large (Frid & Dill 2002). Birds wintering in estuaries or on coasts are sensitive to the threat of predators, as raptors such as peregrines, harriers and sparrowhawks are frequent in most British estuaries (Musgrove et al 2003) and take large numbers of wintering shorebirds (Cresswell & Whitfield 1994). Raptors are one of the primary influences on the distribution of birds in estuaries and similar habitats (Whitfield 1985, Madsen 1985, Cresswell 1994, Rehfisch et al 2003, Yasué 2006) and shorebirds avoid features that may shelter predators or mask their approach (Madsen 1985, Yasué 2006).

However, only some activities by people cause disturbance to birds and many may only illicit minor reactions, such as pauses in feeding or short flights

(Kirby et al 1993). Birds may habituate to frequent and relatively benign events and noises (Hill et al 1997). There are examples suggesting that human activity in coastal areas may actually discourage predators, facilitating the use of feeding areas that may otherwise be avoided (McKinney et al 2010) and tolerating people close to breeding grounds (Baudains & Lloyd 2007). But activities by people that cause major disturbance, such as the displacement of birds from a roost or mudflat, are usually considered highly disruptive to birds (Burger 1981, Kirby et al 1993).

The effects of people on birds in estuaries and other coastal sites are highly variable (Davidson & Rothwell 1993, Stillman & Goss-Custard 2002) and spatial factors such as mudflat width and adjacent landscapes that affect the sightlines of birds are important. Birds may be sensitive to routine activities such as baitdiggers or cyclists in some estuaries or coasts (Owens 1977, Madsen 1985, Kirby et al 1993, Townshend & O'Connor 1993, Klein et al 1995) but ignore them in others (Burger 1981, Owen 1993, Smit & Visser 1993, Fitzpatrick & Bouchez 1998).

The responses of birds may also vary temporally, and they are often more sensitive early in the winter (Owens 1977, Madsen 1985, Belanger & Bedárd 1989, Stillman & Goss-Custard 2002). This may be because birds take time to habituate to regular, non-threatening activities or noises (Owens 1977, Davidson & Rothwell 1993, Smit & Visser 1993, Madsen 1995, Hill et al 1997), and may explain why resident birds are less responsive to human activity than newly-arrived migrants (Koolhass et al 1993, Klein et al 1995).

The habits of some birds make them more vulnerable to disturbance e.g. those that feed in large flocks or that feed higher on the shore appear more sensitive (Madsen 1985, Smit & Visser 1993, Gill et al 1996). Some species take flight at larger distances (Burger 1981, Blumstein et al 2005), while those species that are primarily water-based are less prone to disturbance (Burger 1981).

The effects of disturbance

Whether disturbance to estuarine birds and their displacement actually impacts on individuals or the population is a complex issue. Indeed, birds may only respond readily to people because they are in better condition and able to avoid any risk posed by it (Beale & Monaghan 2004a). This is especially the case if there are large areas of habitat nearby (Gill et al 2001a). This partly explains why birds might appear more sensitive early in the winter, when resources are more widely and freely available. Disturbance may have larger impacts later in the winter when food is scarce (Goss-Custard et al 2006) and birds may be forced to feed in areas where high human activity interferes with feeding efficiency.

If feeding birds are displaced, they might be able to compensate by feeding at different times (for example at night, Belanger & Bedárd 1990), feeding for longer (Stillman & Goss-Custard 2002) or feeding elsewhere or in different habitats (Goss-Custard & Verboven 1993, Smart & Gill 2003). The risk of being disturbed is thought to be less important in the selection of roosting sites

by birds compared with environmental factors such as weather, substrate and site size (Peters & Otis 2007), or shelter, proximity to feeding areas and risk of predation (Rehfisch et al 2003).

If birds are displaced by disturbance, the effects may be temporary (fewer birds are present while there is disturbance – Burger 1981, Koolhaas et al 1993) or prolonged (numbers may be reduced for a day or so after disturbance – Belanger & Bedárd 1990). High rates of activity by people may lead to permanent reductions in the numbers of birds wintering in specific areas or entire estuaries (Madsen 1998a, Burton et al 2002). High rates of activity also have clear impacts on the distribution and success of birds breeding in coastal areas (Anderson & Keith 1980, Erwin 1980, Keller 1988, Verhulst et al 2001, Bolduc & Guillemette 2003, Beale & Monaghan 2004b).

Low levels of activity by people probably do not impact on populations of birds in estuaries if birds can compensate to an extent for any disturbance caused. However, even low levels of disturbance may affect bird survival if this is spread over large areas of an estuary (West et al 2002). Therefore, under certain circumstances, the impacts of disturbance may be equivalent to habitat loss (Madsen 1995, Hill et al 1997, Stillman et al 2007) that is known to reduce the survival of displaced birds and affect population size (Goss-Custard et al 1995, Burton et al 2006).

Unlike habitat loss, the effects of disturbance on the quality of an area for birds are reversible. Many studies have shown that bird numbers increase when the source of disturbance is removed or mitigated. The creation of refuges from shooting resulted in large influxes of wildfowl, both at the local (Madsen 1998b) and national scale (Mooji 1991). Numbers of feeding birds increased when baitdigging was restricted or stopped in a nature reserve (Townshend & O'Connor 1993).

4. Objective

The overall objective of this study was to design a straightforward and uncomplicated method for use by volunteers to measure and monitor levels of different activities by people, and to use this to assess the risk that disturbance might be an issue at individual sites, in estuaries, or along coasts. Given the complexity of the relationship between human activity and its effects on birds, the method makes no attempt to assess disturbance and its impacts on birds.

5. Approach

The study was undertaken in three steps:

1. a review of relevant studies;
2. identifying indicators of potential disturbance to birds;
3. the design of a simple method based on these.

The review incorporated studies on the relationship between people and disturbance to birds, and the recommendations of published reviews,

syntheses and articles on estuarine and coastal birds. It considered the methods of surveys (*what was recorded at how many sample sites and how long for?*), how sample sites were selected, as well as their results (*what were the most frequent activities, what usually caused disturbance and which were most disruptive?*). To demonstrate particular relationships relevant to developing the method, analyses of available or published data were undertaken after appropriate permissions were sought.

Many studies on the effects of people on birds have been experimental, focussing on single or restricted types of activity or on single or restricted numbers of locations or habitats. This document draws on these studies where appropriate but much of the most relevant information comes from surveys that have attempted to record the variety of activities that occur at bigger scales such as entire estuaries. In the UK, there have been a number of such assessments e.g. the Essex coast (Owens 1977), the Ythan (Keller 1988, Scott 1989), the Dee (Kirby et al 1993), the Norfolk Coast (Riddington et al 1996), the Stour and Orwell estuaries (Ravenscroft et al 2007), the Solent (Cox & Ravenscroft 2009, Liley et al 2010a), the Teesmouth and Cleveland Coast (Simpson 2010) and the north Kent coastline (Liley & Fearnley 2011), as well as assessments at national scales (Owen 1993, Musgrove et al 2003).

The following were the key considerations:
1. Observers may have limited knowledge of birds;
2. The method needs to be non-onerous - i.e. not too time-consuming. Observers will be volunteers and not all will be disposed to spending long periods on freezing mudflats or seawalls;
3. It needs to be simple i.e. easy to carry out and complete with simple and clear recording instructions such that anyone can participate;
4. It needs to be flexible and easy to apply in different locations and habitats if it is to be used on a variety of estuaries and coasts, as well as at small sites;
5. Variable amounts of manpower will be available at different sites, so the method cannot demand certain proportions of site coverage or particular frequencies of visits.
6. The method still needs to produce a measure of risk of disturbance to birds that is quantifiable and comparable.

6. Measuring the disturbance of birds

Compared with the amount of literature on the effects of people on birds, there is relatively little that sets thresholds or other measures of critical levels of activity. This is partly because there is still much debate about the impacts of disturbance (Gill et al 2001a). Most studies discuss disturbance in relation to numbers or the relative proportions of total activities present and few are presented in a context of actual rates or densities of activities or people.

Some studies have used the proximity of foci of human activity, such as roads, car parks, footpaths or marinas as surrogates for activity and disturbance and have not recorded people *per se* (e.g. Burton et al 2002, McKinney et al 2010); others have measured human activity and assumed that disturbance is

caused to birds (e.g. Burger 1981, Gill et al 2001b, Beale & Monaghan 2004b, Liley & Sutherland 2007); whilst others have measured disturbance via the

Table 1: Examples of methods used to assess the activities of people in studies of the disturbance of coastal birds.

Study	Habitat	Method of recording activity	Sampling intervals & intensity
Burger 1981	Coast	8 hour counts of people	4 days per week, 1 year, 17 sites
Stock 1993	Coast	Counts every 30 min of people	
Kirby et al 1993	Beach	3 hour patrols, counts of all activities	Five winters, entire site, variable intervals
Schulz & Stock 1993	Beach	Counts of people every 30 mins for one hour	Entire site, ?ha, 50 counts
Madsen 1998a	Estuary/coast	Counts from air and shore, area or time not stated	Weekly counts, plus all-day at 10 day intervals
Fitzpatrick & Bouchez 1998	Beach	Counts every 30 min of people	185 hours over 2 months, entire site (1km)
Marsden 2000	Inland	1 hour counts of most activities	One winter, 107 counts at two entire sites
Gill et al 2001b	Estuaries	Five counts over one hour (one per 15 mins) of most activities	One winter, one per fortnight at 20 sites (mean 7.5ha) (≈ 1% of area?)
Lafferty 2001a	Beach	4 hour counts of all activities	One count per week for one year at 11 sections covering entire site (2.85km)
Lafferty 2001b	Beach	30 min & 4 hour counts of all activities	As above
McKinney et al 2001	Estuary	Proportion of urban land and numbers of moorings	17 sites mean 4.9ha
Beale & Monaghan 2004b	Coast	Counts of number of people at viewing points	14 counts, one summer, 19 viewing points
Liley & Sutherland 2007	Coast	Counts of activities along transects of sections	47 transects of 92 120m sections over 8 months
Ravenscroft et al 2007	Estuaries	3 hour counts of all activities	3 winters, 10 counts per winter @ 18 500-1250m sections (mean 650m) ≈17% of shoreline
Cox & Ravenscroft 2009	Estuary/coast	3 hour counts of all activities	One winter, 9 counts @ 14 ≈500m sections ≈2% of shoreline
Liley et al 2010a	Estuary/coast	2 hour counts of most activities	One winter, 12 counts @ 20 ≤1000m sections ≈2% of shoreline
Simpson 2010	Coast	3 hour counts of people	One autumn, 2 counts @ 6 sites
Liley & Fearnley 2011	Estuary/coast	2 hour counts of all activities	One winter, 12 counts @ 21 ≤1000m sections ≈4% of shoreline

behavioural responses of birds to people or their activities (e.g. Burger 1986, Kirby et al 1993, Fitzpatrick & Bouchez 1998) (Table 1).

The method used for measuring activity by people has varied depending on study objective as well as site location and extent. Those studies that have measured the effect of generic activity by people in relation to the distribution, numbers or densities of birds have often used snapshot counts i.e. the number of people or activities at the location at a particular moment. When repeated several times over a defined period these can provide an index of overall activity (e.g. Stock 1993, Gill et al 2001b). This method can either be used at specific locations (e.g. Beale & Monaghan 2004b) or on longer sections of coast (e.g. Liley & Sutherland 2007).

If the objective is a measure of the relative presence of different activities at sites or over larger areas, such as entire estuaries, counts of the number of different events that occur in sections of coast over a period of time are more usual (e.g. Burger 1981, Kirby et al 1993, Marsden 2000). Most recent assessments in estuaries and on coasts have used such counts, as these surveys set out to record the variety of activities combined with measures of the effects that they had on birds (e.g. Ravenscroft et al 2007, Simpson et al 2010, Liley & Fearnley 2011).

7. Types of activity in coastal areas

The relative occurrence of activities within estuaries and on coasts is very similar in most detailed studies (Table 2). Walkers, with or without dogs, baitdiggers, boats and fishermen (and raptors), were the most common activities noted at low tide in 62 estuaries by surveyors in the Wetland Bird Survey (WeBS) between 1992 and 1999 (Musgrove et al 2003). (By contrast, boats and fishermen are by far the most prominent activities on inland waterbodies – Tuite 1984).

In estuaries, walkers and those with dogs generally form about half of all events, with most of the remaining activities composed of motor and sailing vessels or activities on the shore depending on site geography and access (such as motor vehicles, cyclists, baitdiggers, fishermen, joggers and horseriders) (Table 2). Dogs usually accompany about half of walkers in estuaries: 41% in the WeBS study (Musgrove et al 2003); 50% on the Stour (Musgrove et al 2000) and 47% on the Stour & Orwell (Ravenscroft et al 2007); and 36% and 58% in two studies on the Solent (Cox & Ravenscroft 2009, Liley et al 2010a).

Along open coasts, the variety of activities tends to be more restricted as boats are less frequent, and walkers are the dominant activities (e.g. Burger 1981, Smit & Visser 1993, Koolhaas et al 1993). Activities at the water's edge such as surfing, are also more prominent, especially on beaches (Kirby et al 1993, Lafferty 2001a). Three detailed studies that had large coastal components had high proportions of walkers compared with estuaries (84% on a beach on the Dee (Kirby et al 1993), 82% on the Cleveland coast (Simpson 2010) and 71% on the North Kent coast (Liley & Fearnley 2011)). Remaining

events were usually other people or vehicles on the shore. Whether walkers were actually more frequent in coastal areas compared with estuaries is not clear.

8. Causes of disturbance to birds

In general, the proportion of the total number of disturbance incidents caused by any particular activity is a reflection of the relative occurrence of that activity. In fact, the two are highly correlated (r^2 = 0.96, n = 22, p<0.0001, just from the data in Table 2). Therefore, where this has been measured, walkers generally cause most of the disturbance incidents recorded in estuaries or on coasts.

The presence of dogs is often regarded as disturbing to birds (e.g. Taylor et al 2005). Some studies have found high disturbance rates by walkers with dogs compared with walkers without dogs (e.g. Liley & Fearnley 2011) but others have reported no difference (e.g. Kirby et al 1993, Smit & Visser 1993, Fitzpatrick & Bouchez 1998, Rees et al 2006). Where data is available from the studies in Table 2, walkers with dogs generally caused a slightly greater proportion of disturbance incidents than walkers (mean occurrence of dogs 29%, mean proportion of disturbance incidents 36%; walkers 35% and 30% respectively, n = 6 for each). But these differences are not significant and greater proportions of disturbance incidents were usually caused by whichever was the more frequent activity (r^2 = 0.96, n = 12, p<0.0002).

Most disruptive activities

Most studies agree that although scarce activities may not cause many disturbance incidents, they usually disrupt birds and cause a relatively large amount of disturbance, such as the displacement of large numbers of birds from a mudflat. These events are often sudden, noisy or fast (Hill et al 1997). For these reasons, aircraft and helicopters, speedboats, shots and other loud noises usually cause major disturbance (Table 2). Boat type and speed are important factors in disturbance (Ronconi & St Clair 2002) and some relatively new forms of recreation such as kitesurfing are highly disruptive (D. Liley pers. comm.).

Other activities can be highly disruptive if they occur in the wrong place e.g. close to high tide roosts, or where birds are feeding on mudflats or close to the tideline e.g. dogs running loose, baitdiggers, windsurfers, surfers, rowers and off-road vehicles (Table 2). Liley & Fearnley (2011) observed that over half of major disturbances occurred on the inter-tidal.

Least disruptive activities

Most studies also agree that slow-moving or stationary people on the shore and slow and quiet boats on the water have little effect on birds. Birds can probably habituate to these activities as long as they are predictable and frequent (Hockin et al 1992) – even to high-noise environments (Fleming et al 2001). Sailing boats and other slow vessels, vehicles on roads (not on the

Table 2: The dominant activities in coastal areas and the causes of disturbance to shorebirds (walkers includes those with dogs).

Study	Location	Habitat	Dominant activities	Causes of disturbance to birds	Overall rate of disturbance	Most disruptive activities	Least disruptive activities
Owens 1977	UK, Essex	Coast/estuary		People (48%) aircraft (39%). Baitdiggers		Helicopters	Sailing, motorboats
Burger 1981	US	Coast	Aircraft, walkers	Joggers		Joggers, aircraft	
Burger 1986	US	Estuary	Walkers, fishermen	Walkers			Boats, joggers
Keller 1988	UK, Ythan	Estuary				Fishermen	
Belanger & Bedard 1989	Canada	Estuary		Transport	20%	Low-flying aircraft	
Scott 1989	UK, Ythan	Estuary	Walkers	Walkers		Baitdiggers, fishermen	Shots
Kirby et al 1993	UK, Dee	Beach	Walkers (84%), windsurfers (7%)	Raptors, walkers		Horses & riders, windsurfers, raptors	Walkers
Koolhaas et al 1993	Netherlands	Coast				Low-flying aircraft	
Owen 1993	UK	Coast /estuary		Walkers, baitdiggers		Shooting, light aircraft	
Smit & Visser 1993	Netherlands	Coast		Small aircraft, walkers		Helicopters, low-flying aircraft	Vehicles, walkers
Stock 1993	Germany	Coast		Walkers		Aircraft	People
Riddington et al 1996	UK, Norfolk	Coast	Walkers	Walkers		Aircraft, shots	
Fitzpatrick & Bouchez 1998	UK	Beach				“Fast” activities	Walkers
Madsen 1998a	Denmark	Coast				Windsurfers, shooting	Boats
Musgrove et al 2000	UK, Stour	Estuary	Walkers	Walkers		Power boats	
Lafferty 2001a	US	Beach				“Moving” activities	People
Ronconi & St Clair 2002	Canada	Coast				Powerboats	
Musgrove et al 2003	UK	Estuaries	Walkers (48%) raptors (16%) baitdiggers (14%) powerboats (5%)	Walkers (44%) baitdiggers (18%) raptors (12%) powerboats (7%)	28%	Vehicles, baitdiggers, shots, boats	Fishermen, walkers
Rees et al 2006	UK	Inland				Helicopters, aircraft, cars	

Table 2: contd.

Study	Location	Habitat	Dominant activities	Causes of disturbance to birds	Overall rate of disturbance	Most disruptive activities	Least disruptive activities
Ravenscroft et al 2007	UK, Stour & Orwell	Estuary	Walkers (56%) motor vessels (16%) vehicles (8%) cyclists & joggers (5%) baitdiggers (2%)	Walkers (56%) motor vessels (16%) baitdiggers (5%) cyclists & joggers (5%) vehicles (2%)	19%	Shooting, baitdigging, powerboats, raptors, helicopters	Sailing, vehicles
Cox & Ravenscroft 2009	UK, Solent	Estuary (& coast)	Walkers (57%) cyclists & joggers (17%) motor vessels (9%) other people (5%) raptors (2%)	Walkers (55%) other people (12%) raptors (10%) cyclists & joggers (4%) motor vessels (5%)	13%	Shooting, raptors, baitdiggers, kite-surfing, canoeing, car lay-by	Sailing, motor boats, cyclists & joggers, vehicles
Liley et al 2010a	UK, Solent	Estuary (& coast)	Walkers (71%) cyclists & joggers (15%) baitdigging (3%) motor vessels (3%)	Walkers (74%) cyclists & joggers (5%) baitdigging (5%) motor vessels (3%)	17%	Baitdigging, surfing, rowing, horseriding	Birdwatchers, cyclists & joggers, walkers
Simpson 2010	UK, Teesmouth & Cleveland	Coast	Walkers (82%)	Walkers (92%)	8%	Baitdigging, off-road vehicles, wind & kitesurfing	
Liley & Fearnley 2011	UK, North Kent	Coast/estuary	Walkers (71%) cyclists & joggers (9%) vehicles (8%)	Walkers (75%) cyclists & joggers (10%) vehicles (5%)	26%	Baitdigging, fishing, shots, powerboats	Motor boats, vehicles, cyclists & joggers, walkers

shore), and horses, birdwatchers and fishermen had little effect in most studies listed in Table 2. Gill et al (2001b) demonstrated that birds are not affected by the proximity of marinas. In an interesting study in a nature reserve on the coast of Lindisfarne, Townshend & O'Connor (1993) showed how bird numbers increased dramatically wherever baitdigging was restricted. Ordnance Survey maps of their study area show a multitude of footpaths, roads and car parks that continued, presumably, to give access to the reserve for other activities while birds numbers increased.

9. A simple method for measuring the risk of disturbance to birds

9.1 *Rationale*

The measurement of the behavioural response of birds is outside the stated scope of this study, as it requires ornithological knowledge. Besides, behavioural responses are not always indicative of negative effects on birds (Gill et al 2001a). There are also practical constraints to recording the responses of birds, as it is sometimes difficult to measure all the necessary information at busy sites, even for experienced surveyors of birds. The allocation of a single source of disturbance may also be speculative when there are several to choose from, or when successive activities may culminate in the disturbance of birds.

As both overall activity by people and the occurrence of specific activities contribute to the likelihood of disturbance occurring, two approaches are recommended for assessing and monitoring the risk of disturbance to birds:

1) A simple background measure of overall levels of activity in order to provide a baseline for monitoring the general use of a site;

2) More detailed recording of the occurrence of specific activities that are known to disrupt birds in order to provide an indication of disturbance risk.

This method can be used as a standalone assessment if there is concern about levels of activity by people at specific sites, or for the measurement of activity across an entire estuary or coast if the aim is an overall assessment of the distribution of risk of disturbance to birds.

9.2 *Measuring overall activity by people*

Counts over a given period provide a measure of the relative abundance of different activities, but they do not provide a measure of their intensity i.e. how long they are present for. For example, counts for an hour of the number of people at two sites may show identical site use, even though four people passed through site A briefly, whilst at site B four people were present for the entire hour. Counts over long periods have the added complication of requiring the observer to keep track of activities lest they be counted more than once.

It is recommended that the method use repeated spot counts to assess overall levels of activity by people and boats. Spot counts are quick, include only

those people or boats present at a particular moment, and provide both a measure of overall activity as well as its intensity. In the example above, perhaps only two people may have been recorded on one spot count at site A, whilst at site B all four people would have registered on all counts. Although the latter data are not independent, they do provide a better measure of disturbance risk (as four people present for an hour might present a higher risk of disturbance to birds than four people present for five minutes).

Each spot count will be a single sweep of a section of estuary or coast and will in effect be a head count of all people present on the shore and a count of all boats moving on the water within the survey section. It is recommended that sweeps are repeated four times over a period of one hour i.e. once at the beginning of observation, then every 20 minutes. The total of these four readings will give an index of activity for that section, and the index will be comparable with any other section once corrected for section length.

9.3 *Measuring specific activities*

Coupled with the spot counts, it is recommended that an assessment is made of the presence of those activities that, although relatively scarce in most studies, have been highlighted as the most disruptive to birds. As these activities are scarce, it is unlikely that spot counts will capture enough events to assess their occurrence and distribution. Furthermore, it cannot be assumed that these activities will occur in the same places as the overall activity of people, as many them are highly mobile e.g. helicopters, jet-skis and speedboats. In one study on the Solent, they did tend to occur in the same places as general activity, perhaps because of access (r^2 = 0.45, n = 13, p=0.001, data extracted from Cox & Ravenscroft 2009), but they did not on the Stour-Orwell (r^2 = 0.19, n = 15, ns, data in Ravenscroft et al 2007).

A running total of specific activities that occur within a section of estuary or coast (or adjacent to it, see the recording guide) should be kept over the course of one hour, to provide a rate of potentially disruptive activities per hour. This is unlikely to be sufficiently demanding for the observer such that it interferes with the spot counts every 20 minutes.

It is recommended that the following activities are recorded (see review above, and details in the recording guide in section 10): uncontrolled dog (or person) on the shore/mudflat/saltmarsh; shots or gas-guns; baitdiggers on the shore/mudflat; speeding boats and jet-skis; windsurfers and kitesurfers; helicopters; other aircraft; and micro-lights. The observer should also note any unusual activity that is not included and that they feel has the potential to cause major disturbance to birds.

9.4 *Size of survey sections*

Surveys of estuaries or other large areas

Counts should be performed in small sections of estuary or coast if the objective of the survey is to record the distribution and relative amounts of activity in a locality. As more activities will occur in larger sections, section

size should either be constant or measured in order that counts can be represented per unit area. Absolute counts of activities have usually used sections of 500m-1000m in length (Table 1), as these have proved manageable to observe. Therefore, a sensible target for section size is 500m, but this will depend on shore shape and field-of-view. Final choice is not critical as long as section length is known.

Boundaries of survey sections

Landmarks should be selected to aid visual demarcation of survey section extent and recorded on the survey sheet e.g. features on the shore or seawall and facilitate location of the section in subsequent surveys (especially if these will be carried out by someone else). Survey sections should encompass the channel, if in an estuary, and the observer should estimate the furthest extent of the survey section as the mid-way point to the opposite shore. The landward extent of the survey section should include only areas that are adjacent to the estuary or water's edge and that are accessed by people i.e. saltmarsh, the shore and mudflats, any seawall, and adjacent footpaths, tracks and roads.

In small estuaries with narrow channels, it may be possible to cover both shores from one vantage point (and hence two sections), but the observer should verify beforehand that all activities in the furthest section can be seen e.g. the seawall may mask a footpath.

Surveys of single sites of concern

If the objective is the measurement of activity at specific sites, perhaps those that may be affected by nearby development, or those that are known to support large numbers of birds, then no sub-set of survey sections is necessary if it is possible to observe the entire site. But a measure of site length will still be necessary to calculate and compare levels of activity.

9.5 *Distribution of survey sections*

Surveys have often chosen busy parts of estuaries in order to maximise information on disturbance to birds and their behaviour (e.g. Liley et al 2010a, Liley & Fearnley 2011). A survey of the distribution of disturbance risk needs to set visitor hotspots into the context of the whole estuary or coast and sample a range of sections that is representative of the whole system i.e. busy and quiet areas. After all, there may be high activity and disturbance risk at visitor hotspots but little in the remainder of an estuary.

Selection of "busy" and "quiet" areas is rather subjective and requires a degree of prior knowledge of visitor use (or inspection of a map showing access points) – but is something that might be achievable for local user groups with knowledge of the estuary or coast in question. What would be preferable is the division of the estuary or coast into sections using a 1km grid e.g. that provided Ordnance Survey maps, and the selection of a survey section at each intersection of this grid.

An alternative might be to target known hotspots for visitors, then select further sections for survey at increasing distances either side e.g. 1 and 2km. As the routes of most visitors to some estuaries do not extend much more than 1-2km from entry points (Fearnley et al 2010, Liley et al 2010b), this would provide measures of activity in "busy" and progressively "quiet" sections. It could be assumed that disturbance risk in areas further than 2km from "busy" sections will be similar to or less than "quiet" sections.

Using a grid is the most systematic method and is recommended if it does not result in an excessive number of survey sections (or the exclusion or particular areas of concern). Surveying at increasing distances from activity hotspots might be preferable at some locations such as a long estuaries with relatively few access points where a grid may result in many survey sections (and the possibility that none encompass busy areas). Final choice regarding site selection depends on the size of the site to be surveyed and the potential manpower that is available.

9.6 *Survey intensity*

No number of visits to sections is mandatory, but information provided by the method will be enhanced by repeated visits to sections under different conditions e.g. weekdays and weekends or high and low tides. It is recommended that user groups assess the likely manpower available and determine how often sections can be covered. Ideally, individual sections should be surveyed 3-4 times per month for the duration of the assessment. The method is simple and quick enough for a single observer to survey several sites in a day or an entire estuary over the course of a winter or summer, should this be necessary.

9.7 *Calculating measures of activity*

The method will produce two measures for each survey section describing:
1) overall activity by people;
2) a rate of specific activities.

The overall activity of people at each section will be represented by an index that will be a simple average of those produced by each survey of the section.[1] It will be necessary to correct the index for section length in order to compare different survey sections, and the recommended unit of length is 500m. So:

Activity index for a section = (Mean of the survey indices / section length) * 500

Similarly, the rate of activities that are potentially disruptive to birds for each section will be the average of the numbers counted from each visit, also corrected for section length to a standardised 500m.[1]

[1] Data from trials of the method on the Stour estuary in late summer and autumn 2012 are shown in the appendix 1 and example forms in appendix 2.

9.8 *Assessing the risk of disturbance to birds*

If conducted across a stretch of coastline or along an estuary, the method will produce data on the relative amounts of activity by people and the distribution and number of specific activities that are known to disturb birds.[1] This data can be compared with the distribution of birds to identify areas where high levels of activity and large numbers of birds coincide, or where activities might occur in sensitive areas. Of course, high levels of activity and an absence of birds may also be indicative of impacts from disturbance.

It may be necessary to conduct follow-up ornithological work to assess bird populations, but in most cases the current and historic distributions of birds in coastal areas will be available through data held by WeBS (the Wetland Bird Survey administered by the British Trust for Ornithology) or in their publications (e.g. Musgrove et al 2003 and the annual *Waterbirds in the UK*). It is recommended that this stage of the assessment be undertaken professionally.

Should areas or specific sites be identified where high levels of activity and/or disruptive activities coincide with significant current or past populations of birds, or areas of particular sensitivity, it is recommended that a professional assessment of activity, its effects on birds and any potential impact is undertaken.

10. Proformas

RECORDING GUIDE

A. Selection of sections

Although the general location of a section will have been selected, the precise location and size of the section will need to be fine-tuned on the ground. To do this, familiarise yourself with the stretch of the estuary or coast that is to be observed. 500m sections have proved to be good units in previous studies, but treat this as a guide as the shape of the shore will often determine the limits of a section. Equally, a good field of view of footpaths, seawalls and mudflats may make observing a larger area straightforward, but do not exceed 1km. Pick landmarks as boundaries to the section (such that the survey may be repeated by someone else). Failing that, map co-ordinates should be used.

Choose a spot to record from that has a good field of view of the chosen section (and of course does not disturb birds!) – this might be at one end sighting along the shore, sea wall or coast, or in the middle if one end of the section is obscured. It might be possible to record a section on the other side of an estuary simultaneously if visibility is good and you are sure that there are no hidden areas (e.g. paths behind sea walls).

Sketch a map of the features of the section onto the back of the recording form or just note landmarks at the boundaries of the section. *It is important to record the length of river or coastline that was observed, or for us to be able to measure this from the information that you provide.* We will need this for the calculation of an index of activity.

B. What to record

Conditions

Note the state of tide (low, high, rising or falling, plus time of high or low tide if known) and general attributes of the weather i.e. cold, warm, wet, sunny, windy, calm etc. These will be useful if we want to assess patterns of use of the estuary or coast.

Spot counts of overall activity

Record the start time. Make a single sweep of your section and count:
1) all the people within it i.e. those on the seawall, on the shore, on the footpath, on the beach or on the mudflat (not those on the water);
2) the number of boats or similar moving on the water (all watercraft).

Repeat this every twenty minutes, i.e. 20 minutes after the first count, then at 40 minutes and a final count after an hour. This is the finish time.

This data will provide a measure of the overall level of activity in your section and will act as a baseline for comparison with other sections, future surveys or data elsewhere.

Recording specific activities

Within the hour taken for the spot counts, more detailed recording of certain events is required. These are activities that have been shown by many studies to be

particularly disruptive to birds. We want to record the occurrence of these activities to provide an indication of the likelihood that disturbance might be occurring. **Counts of birds or disturbance to birds are not required – just counts of activities regardless of their effects on birds.**

Keep a log and record the total number of each of the activities listed below that occurs within the hour. Count each event only once and count only events that occur within your section (if an activity leaves your section, then returns, count it again). Shots or aircraft may occur inland or adjacent to the section and be difficult to ignore. Include them if considered prominent - your judgement will be required.

Uncontrolled dog (or person): walkers and those with dogs are the most frequent activities in coastal areas, but many cause little or no disturbance to birds. The events that we are interested in recording are those where the dog/s (or person) is clearly without control and away from usual access routes e.g. running down a mudflat, charging around on a saltmarsh or running along the beach at a group of birds, or is under control but is encouraged to stray by its handler e.g. a command or throwing sticks. It is not necessary to record walkers that keep their dog/s on a lead or under control, or dogs that are remote from their handler/s but not unruly. This may be a difficult distinction to make at times – use your discretion or if in doubt, record details on the form. Groups i.e. two or more dogs with one or more handler should be counted as a single event.

Shots or gas-guns: loud noises and in particular shots are especially disruptive to birds. Record those that occur within and adjacent to the study section (if it is loud enough to startle you is a good guide).

Baitdiggers: events on the intertidal cause a great deal of disturbance to birds – usually displacing them for long periods. Record the number of baitdiggers seen on the shore or mudflats.

Other people or events: use this category for events other than the above that are seen on the intertidal zone (e.g. people or vehicles) and describe it on the form.

Speeding boats / jet-skis: most sailboats or slow-moving motorboats cause little disturbance to birds. Disturbance is often caused by fast-moving, erratic or loud craft such as speedboats and jet-skis. These can also venture close to the tideline and birds.

Windsurfers & kitesurfers: for reasons of speed, visibility and proximity to the shore, these events can cause disturbance.

Helicopters: these are one of the most disruptive events to birds, especially those stationary over an area.

Other aircraft / micro-lights: aircraft passing overhead should be recorded if at low altitude and/or audible, such as micro-lights, slow-moving light aircraft or fast-moving military planes. Please distinguish them in the notes on the form. Planes at high altitude should not be recorded.

C. RECORDING FORMS

Name of recorder:	**Date:**
Estuary/Coastline:	**Section:** *(see over)*
Weather:	**State of tide:**
Time of start:	**& finish:**

Spot counts (every 20 minutes)				
	1 (start)	**2**	**3**	**4** (finish)
Number of people				
Number of boats				

Specific activities (total over one hour)		
	Number	**Notes**
Uncontrolled dog (or person)		
Shots / gas-guns		
Baitdigger		
Other		
Speeding boat / jet-ski		
Kite- / wind-surfer		
Helicopter		
Aircraft / microlight		
Other (please describe)		

Section map **Section:**	**Section length:**
Please indicate boundaries of section observed or provide a description such that it may be re-located.	
Additional information *(such as birds seen and other occurrences of interest)***:**	

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Appendix 1: Sample counts from the Stour estuary 2012.

	People index	Boat index	Disruptive activity count
Mistley			
16/08/2012	0	1.75	1
17/08/2012	0.5	0.25	0
22/08/2012	0.25	0.25	2
27/08/2012	2.75	0.25	1
19/09/2012	1.25	0	2
02/10/2012	0.5	0.5	2
Overall mean	**0.9**	**0.5**	**1.3**
Erwarton			
27/08/2012	1.25	0	0
19/10/2012	1.5	0.25	0
28/10/2012	1.25	2	8
30/10/2012	0.5	0.5	14
02/11/2012	1	0	1
05/11/2012	1	0.25	6
14/11/2012	1	0	5
19/11/2012	0.75	0	7
27/11/2012	2.75	0.75	2
28/11/2012	2	0	1
Overall mean	**1.3**	**0.4**	**4.4**

Appendix 2: Sample sheets from trial 2012.

Name of recorder: Maureen Gibson	**Date:** 02-Oct-12
Estuary/Coastline: Stour, Mistley	Newmill Lane to Stutton Mill from Mistley Walls
Weather:	**State of tide:** High
Time of start: 1100hrs	**Time of finish:** 1200hrs

Background Counts (every 20 minute)	**1 (start)**	**2**	**3**	**4 (finish)**
Number of people	1	1	0	0
Number of boats	1	1	0	0

Specific activities (one hour)	**Number**	**Notes**
Uncontrolled dog (or person)		
Shots / gas-guns		
Baitdigger		
Other people or events	2	Birder with 'scope on seawall, Digger on the northside of seawall
Speeding boat / jet-ski		
Kite- /Wind-surfer		
Helicopter		
Aircraft / Microlight		
Other (please describe)		

Additional information (such as birds seen and other occurrences of interest):
man in boat to west of study site during 3rd spot count.

Name of recorder:	Mark Nowers & Jane Crapnell	**Date:**	Sun 28 Oct 2012
Estuary/Coastline:	Stour, Erwarton Bay	Old Pill Box (250m west of picnic site) to west end of gabions	
Weather:	Grey, drizzly, F3SW, cold	**State of tide:**	High
Time of start:	1020	**Time of finish:**	1120

Background Counts (every 20 minutes)	**1 (start)**	**2**	**3**	**4 (finish)**
Number of people	1	2	2	0
Number of boats	2	1	4	1

Specific activities (one hour)	**Number**	**Notes**
Uncontrolled dog (or person)		
Shots / gas-guns	5	Probably on fields toward Erwarton Ness
Baitdigger		
Other people or events		
Speeding boat / jet-ski	1	RIB involved with setting out dinghy race
Kite- /Wind-surfer		
Helicopter		
Aircraft / Microlight	2	Both heading SE
Other (please describe)		

Additional information (such as birds seen and other occurrences of interest):
During the hour, five dog-walking parties (of 1 or 2 people) were seen along the footpath behind the gabions. Background count 3 involved the dinghy race.