Marine recreation evidence briefing: drones

This briefing note provides evidence of the impacts and potential management options for marine and coastal recreational activities in Marine Protected Areas (MPAs). This note is an output from a study commissioned by Natural England and the Marine Management Organisation to collate and update the evidence base on the significance of impacts from recreational activities. The significance of any impact on the Conservation Objectives for an MPA will depend on a range of site specific factors. This note is intended to provide an overview of the evidence base and is complementary to Natural England's *Conservation Advice* and *Advice on Operations* which should be referred to when assessing potential impacts. This note relates to the activity of drones used in coastal areas and over the sea. Other notes are available for other recreational activities, for details see *Further information* below.

Drones

Definition

Unmanned aircraft systems (UASs) or unmanned aerial vehicles (UAVs), commonly known as drones, are aircraft without a human pilot aboard. This note relates to the recreational use of drones rather than commercial operation or military use of drones.

Distribution of activity

To the best of our knowledge there is no central repository of data or information regarding the distribution or level of recreational drone use over coastal and marine areas. Most recreational drone activity is currently restricted to operating from land rather than from vessels. It has been assumed that this activity can occur from any location when weather conditions permit.

Sales statistics may be a good indicator of the number of recreational drones being used. A report from one commercial retailer, which used sales data and surveyed 274 UK drone owners, reported that the South of England had the highest per capita drone sales. The same report stated that the majority of users used the drones in public spaces (dronesdirect, 2016).

While the level of current recreational drone activity may be considered relatively low at the moment, for example, compared to the number of people participating in other activities (expert judgement), several stakeholders consulted for the study provided anecdotal information that recreational drone use at the coast is increasing.

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Pressures

This note summarises the evidence on the pressures and impacts arising from recreational drone use. The direct pressures considered to arising from the activity are shown in Table 1 and the potential biological receptor groups affected by these pressures are shown in Table 2. The information presented on pressures associated with the activity builds upon, and is complementary to, Natural England's Conservation Advice and Advice on Operations which should be referred to for MPA specific information and sensitivities of specific MPA features to those pressures[1].

The main pressure-receptor impact pathways arising from this activity are considered to be:

- Potential above water noise and visual disturbance of hauled out seals and birds.

The pressure arising from participants (operating drones) walking across the shore has been considered to be negligible, for example, compared to the larger numbers of people undertaking general beach leisure activities (see General beach recreation note EIN034). Although there is potential for abrasion/disturbance of the intertidal substratum, at the surface and sub-surface, if the drone crashes into the foreshore, this pressure has also been considered to be negligible, due to the relatively low incidence and small area of foreshore which would be affected compared to other activities such as general beach leisure (expert judgement). This approach would appear to be supported by the anecdotal evidence provided by some stakeholders that whilst drone crashes did occur, it was considered to be more of a safety issue than a disturbance issue (disturbance to seals or birds will be addressed via the noise and visual impact pathways).

As the activity is aerial, no changes in underwater noise will occur and hence this impact pathway has been scoped out.

For Tables 1 & 2 see page 10.

Impacts

Where an impact pathway has been identified between the pressures arising from the activity and a biological receptor group, a summary of the evidence of impacts has been presented below.

Marine mammals

Above water noise changes and visual disturbance

Relatively few studies have documented the effects of drones on marine mammals. Noise levels from drones are considered to be less than from manned aircraft and are also typically at or below ambient noise levels (Smith *et al*., 2016). Existing research has not distinguished between disturbance from noise and visual cues. Therefore, these pressures are reviewed collectively.

[1] https://www.gov.uk/government/collections/conservation-advice-packages-for-marine-protected-areas

UASs are generally considered to elicit less disturbance and avoidance behaviours than manned aerial survey in marine mammals. Smith *et al*., (2016) undertook a detailed review of UAS disturbance in marine mammal species (cetaceans, sirenians (manatees and dugongs) and pinnipeds (seals and sea lions). The study found a general lack of marine mammal response to UAS presence when the aircraft are operated above certain altitudes and that flight altitude is considered to be key factor in determining the level of disturbance response animals.

In general, cetaceans do not appear to be acoustically disturbed by UAS, which can be attributed to the loss of acoustic energy at the air/water interface (Smith *et al*., 2016).

Pinniped species have been observed to flush into the water as a result of low-level UAS use near colonies. Research into the disturbance of both grey and common seals as a result of UAS in Scotland found that the response in both species varied between different colonies. This is likely to be due to existing tolerance levels through habituation to existing anthropogenic disturbance pressures. Disturbance responses were also found to vary considerably with the elevation of the UAS and also the type (model) of UAS being used (Pomeroy *et al.,* 2015).

Birds

Above water noise changes and visual disturbance

The disturbance response of birds to drones is considered to be dependent on a range of factors, particularly flying altitude, the type (model) of drone and level of habituation to existing disturbance pressure (Vas *et al.,* 2015; Drever *et al*., (2015), McEvoy *et al*., 2016). Existing research has not distinguished between disturbance from noise and visual cues. Therefore, these pressures are reviewed collectively.

Vas *et al*., (2015) investigated the impacts of drone disturbance on wild and semi-wild waterbirds. The study tested the impact of drone colour, speed and flight angle on the behavioural responses of birds. The study performed 204 approach flights with a quadricopter drone and found that the drone could approach within 4 m without visibly modifying the birds' behaviour during 80 % of approaches. In another recent study, little or no obvious disturbance effects on wild, mixed-species flocks of waterfowl when UAVs were flown at least 60 m above the water level (fixed wing models) or 40 m above individuals (multirotor models). However, disturbance (in the form of swimming or flying away from the UAV) was visible at lower altitudes and when fixed-wing UAVs either approached subjects directly or rapidly changed altitude and/or direction near animals.

The level of response will vary depending on a range of factors including the frequency of disturbance and the level of habituation as a result of existing activity (IECS, 2009).

Some disturbance effects may have more direct negative impacts, such as loss or failure of eggs or chicks leading to decreased breeding productivity, to birds than others for example temporary displacement from feeding or roosting areas leading to increased but non-lethal energetic expenditure.

Repetitive disturbance events can result in possible long-term effects such as loss of weight, condition and a reduction in reproductive success, leading to population impacts (Durell *et al.,* 2005; Gill, 2007; Goss-Custard *et al*., 2006; Belanger and Bedard, 1990).

Assessment of significance of activity pressure

The following assessment uses the evidence base summarised above, combined with generic information about the likely overlap of the activity with designated features and the sensitivity range of the receptor groups, to provide an indication of the likelihood of:

i) an observable/measurable effect on the feature group; and

ii) significant impact on Conservation Objectives based on the effect on the feature group.

The assessment of significance of impacts has been based on the potential risk to the achievement of the conservation objectives for the features for which a site has been designated. The assessment is made using expert judgement and is designed to help identify those activities that are likely to be of greatest or least concern, and, where possible, suggest at what point impacts may need further investigation to determine potential management requirements within MPAs to reduce the risk of an adverse effect on the integrity of the site. Note, the assessment only considers the impact pathways considered in the evidence section, pressures which were considered negligible in Tables 1 and 2 are not considered in this assessment.

The outputs are shown in Table 3. The relative ratings of likelihood of significant impact on Conservation Objectives (COs) are defined as:

- Low – possible observable/measurable effect on the feature group but unlikely to compromise COs.
- Medium – observable/measurable effect on the feature group that potentially could compromise COs.
- High – observable/measurable effect on the feature group that almost certainly would compromise COs.

The relative risk ratings are based on the activity occurring without any management options, which would be considered current good practice, being applied. The influence that such management may have on the risk rating is discussed in the *Management options* section below.

It must be noted that the above assessment only provides a generic indication of the likelihood of significant impacts, as site-specific factors, such as the frequency and intensity of the activity, will greatly influence this likelihood. As such, further investigation of the risk to achieving COs will need to be done on a site specific basis, considering the following key site-specific factors:

- The spatial extent of overlap between the activity/pressure and the feature, including whether this is highly localised or widespread.

- The frequency of disturbance eg rare, intermittent, constant etc.
- The severity/intensity of disturbance.
- The sensitivity of specific features (rather than the receptor groups assessed in Table 3) to pressure, and whether the disturbance occurs when the feature may be most sensitive to the pressure (eg when feeding, breeding etc).
- The level of habituation of the feature to the pressure.
- Any cumulative and in-combination effects of different recreational activities.

For Table 3 see page 11.

Management options

Potential management options for marine recreational activities, note, not specific to recreational drone activity, include:

On-site access management, for example:

- designated areas for particular activities (voluntary agreements or underpinned by byelaws);
- provision of designated access points eg slipways, in locations likely to be away from nature conservation access (voluntary or permit condition or underpinned by byelaw).

Education and communication with the public and site users, for example:

- signs, interpretation and leaflets;
- voluntary codes of conduct and good practice guidance;
- wardening;
- provision of off-site education/information to local clubs/training centres and/or residents.

Legal enforcement of, for example:

- byelaws which can be created by a range of bodies including regulators, Local Authorities and landowners (collectively referred to as Relevant Authorities);
- permitting or licence conditions.

Specific examples of management measures which have been applied to recreational drone activity are described further in a Management Toolkit which can be accessed from **Marine evidence > Marine recreational activities** and include:

- National Regulating Body Code of Conduct (relating to safety and remaining within the law).
- Use of a byelaw by a landowner to prohibit UAV use without a required qualification and licence.

Based on expert judgement, it is considered that where management measures, which would be considered current good practice, are applied to recreational drone activity, adhered to and enforced, the likely risk of significant impact on a site's Conservation Objectives would be **Low** in relation to all activity/pressure impact pathways.

For further information regarding management measures, good practice messaging dissemination and uptake, refer to the accompanying project report which can be accessed from **Marine evidence > Marine recreational activities**.

National regulating body and good practice messages for recreational drone activities

National Governing Body

The Civil Aviation Authority (CAA) is the National Aviation Regulator in the UK. In relation to drones, the CAA's primary aim is to enable the full and safe integration of all UAS operations into the UK's total aviation system.

The statutory instrument regulating civil aviation in the UK is the Air Navigation Order 2016. Article 94 relates to the use of small unmanned aircraft which would include recreational drones. Formal guidance material on unmanned aircraft and drone use (which includes recreational drone use) is provided in the publication CAP 722 (Unmanned Aircraft System Operations in UK Airspace), however, this guidance has been simplified further and issued as The Drone Code (a Code of Conduct), available on the Drone safe website developed by the CAA and the National Air Traffic Service (NATS). The Code of Conduct provides instructions for recreational drone users , for example, the users legal responsibilities, keeping the drone in the line of sight, height distances to stay below (400ft) and distances that drones should be kept away from people, properties, built up areas and crowds of people (150ft) for the purpose of avoiding collisions. The Code of Conduct is available here: **http://dronesafe.uk/drone-code/.**

There is also an educational video on the basic drone regulations 'Drone flying: A short guide', (which contains the same good practice messages as the Drone Code), on the DroneSafe UK website: **http://dronesafe.uk/resources/**.

A similar code of conduct is available on the Drone Aware website (a joint initiative between the CAA and the British Model Flying Association): **http://droneaware.org/wp-content/uploads/2015/10/Drone-Aware-Leaflet.pdf** .

Good practice messaging

The Drone Code for recreational drone use encourages responsible use through not endangering anyone or anything by keeping safe separation distances between the drone, people and property. However, the code does not include messaging related to minimising noise or visual disturbance to wildlife and hence does not address the key pressures arising from this activity.

This activity was reported by numerous stakeholders to be increasing at coastal locations. In many instances, the primary concern from these stakeholders related to safety and privacy, although wildlife disturbance was also highlighted. As such, this is considered to be a gap, and the need to develop and promote good practice messaging to minimise potential impacts from recreational drone use, particularly noise and visual disturbance of birds and/or hauled out seals, is likely to be desirable. A potential example to draw on may be the 'Guidance for recreational use of drones in Pembrokeshire'[2], which was drafted in March 2017 and is anticipated to be finalised by summer 2017.

[2] http://www.pembrokeshirecoastalforum.org.uk/guidance-recreational-use-drones-pembrokeshire/

Further information

Further information about the National Aviation Regulator, good practice messaging resources, site specific conservation advice and management of marine recreational activities can be found through the following links:

- CAA: **https://www.caa.co.uk/home/**
- Drone Safe: **http://dronesafe.uk/**
- Conservation Advice - Advice on Operations
- For site specific information, please refer to Natural England's conservation advice for each English MPA which can be found on the Designated Sites System **https://designatedsites.naturalengland.org.uk/** This includes Advice on Operations which identifies pressures associated with the most commonly occurring marine activities, and provides a broad scale assessment of the sensitivity of the designated features of the site to these pressures.
- For further species specific sensitivity information a database of disturbance distances for birds (Kent et al, 2016) is available here: **http://www.fwspubs.org/doi/abs/10.3996/082015-JFWM-078?code=ufws-site**
- Some marine species are protected by EU and UK wildlife legislation from intentional or deliberate disturbance. For more information on the potential requirement for a wildlife licence: **https://www.gov.uk/guidance/understand-marine-wildlife-licences-and-report-an-incident**
- The Management Toolkit which can be accessed from **Marine evidence > Marine recreational activities**.

Notes for other marine recreational activities can be accessed from **Marine evidence > Marine recreational activities** and include:

- boardsports with a sail
- boardsports without a sail
- coasteering
- diving and snorkelling
- drones
- general beach leisure
- hovercraft
- motorised and non-motorised land vehicles
- light aircraft
- non-motorised watercraft
- personal watercraft
- wildlife watching
- the Management Toolkit which can be accessed from **Marine evidence > Marine recreational activities**.

Natural England Evidence Information Notes are available to download from the Natural England Access to Evidence Catalogue **http://publications.naturalengland.org.uk/** For information on Natural England contact the Natural England Enquiry Service on 0300 060 3900 or e-mail **enquiries@naturalengland.org.uk**.

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References

BELANGER, L. & BEDARD, J., (1990). Energetic cost of man-induced disturbance to staging snow geese. *Journal of Wildlife Management*, 54, 36-41.

DURELL, S.E.A. LE V. DIT, STILLMAN, R.A., TRIPLET, P., AULERT, C., BIO, D.O. DIT, BOUCHET, A., DUHAMEL, S., MAYOT, S. & GOSS-CUSTARD, J.D. (2005).Modelling the efficacy of proposed mitigation areas for shorebirds: a case study on the Seine estuary, France. *Biol. Conserv*. 123:67–77.

DREVER MC, CHABOT D, O'HARA PD, THOMAS JD, BREAULT A, MILLIKIN RL. (2015). Evaluation of an unmanned rotorcraft to monitor wintering waterbirds and coastal habitats in British Columbia, Canada. *Journal of Unmanned Vehicle Systems* 3:256–267

DRONESDIRECT (2016). *The UK drone users report.* Available at: **https://www.dronesdirect.co.uk/files/pdf/dronesreport.pdf**

GILL, J. A. (2007). Approaches to measuring the effects of human disturbance on birds. *Ibis*, 149(s1), 9-14.

GOSS-CUSTARD, J. D., TRIPLET, P., SUEUR, F., & WEST, A. D. (2006). Critical thresholds of disturbance by people and raptors in foraging wading birds. *Biological Conservation*, 127(1), 88-97.

IECS (2009). Construction and Waterfowl: *Defining Sensitivity, Response, Impacts and Guidance*. Institute of Estuarine and Coastal Studies Report to Humber INCA.

KENT B. LIVEZEY, ESTEBAN FERNÁNDEZ-JURICIC, & DANIEL T. BLUMSTEIN (2016) Database of Bird Flight Initiation Distances to Assist in Estimating Effects from Human Disturbance and Delineating Buffer Areas. *Journal of Fish and Wildlife Management*: June 2016, Vol. 7, No. 1, pp. 181-191.

MCEVOY, J. F., HALL, G. P., & MCDONALD, P. G. (2016). *Evaluation of unmanned aerial vehicle shape, flight path and camera type for waterfowl surveys*: *disturbance effects and species recognition*. PeerJ, 4, e1831.

POMEROY, P., O'CONNOR, L., & DAVIES, P. (2015). Assessing use of and reaction to unmanned aerial systems in gray and harbor seals during breeding and molt in the UK. *J. Unmanned Veh*. Syst. 3: 102–113. dx.doi.org/10.1139/juvs-2015-0013.

SMITH, C. E., SYKORA-BODIE, S. T., BLOODWORTH, B., PACK, S. M., SPRADLIN, T. R., & LEBOEUF, N. R. (2016). Assessment of known impacts of unmanned aerial systems (UAS) on marine mammals: data gaps and recommendations for researchers in the United States 1. *Journal of Unmanned Vehicle Systems*, 4(1), 31-44.

VAS, E., LESCROËL, A., DURIEZ, O., BOGUSZEWSKI, G., & GRÉMILLET, D. (2015). Approaching birds with drones: first experiments and ethical guidelines. *Biology letters*, 11(2), 20140754

Table 1 Potential direct pressures arising from recreational drone use

	Abrasion/disturbance of the substrate surface	Abrasion/disturbance below substrate surface	Underwater noise changes	Above water noise changes	Visual disturbance
Activity	Negligible	Negligible	X	✓[1]	✓[2]

X - No impact pathway

1 – Pressure relates to potential changes in air-borne noise arising from operation of the drone

2 – Pressure relates to potential visual disturbance from the presence and movement of the drone

Table 2 Biological receptors potentially affected by the pressures arising from recreational drone use

	Abrasion/disturbance of the substrate surface	Abrasion/disturbance below substrate surface	Underwater noise changes	Above water noise changes	Visual disturbance
Intertidal Habitats	Negligible	Negligible	Impact pathways scoped out	Impact pathways scoped out	Impact pathways scoped out
Subtidal Habitats	Impact pathways scoped out	Impact pathways scoped out			
Fish					
Marine Mammals				✓ (hauled out seals)	✓ (hauled out seals)
Birds				✓	✓

Table 3 Assessment of indicative likelihood of significant impacts from recreational drone activity at the coast

Pressure	Likely overlap between activity and feature (confidence)	Evidence of impact (confidence)	Sensitivity of feature to pressure (confidence)	Likelihood of observable/measurable effect on the feature	Likelihood of significant impact on Conservation Objectives
Above water noise changes and visual disturbance – marine mammals (hauled out seals)	Low – Medium depending on geographical location. Low for most established seal colonies on rocky coastline which are generally remote with difficult access. Possibly higher for seal colonies in more accessible locations, depending on potential range of drone operating system (expert judgement)	Evidence of seals 'flushing' into the sea as a result of flying UAS at low levels above seal colonies in Scotland (one study). Additional evidence of relative lack of response of various marine mammal species (from cetaceans, sirenians and pinnipeds) when UAS operated above certain altitudes (medium)	Medium (expert judgement)	**Low-Medium** based on the relatively low likelihood of overlap (recognising some colonies may be particularly vulnerable), and the sensitivity of feature. Additional risk arises from the potential for the drone to crash if flown beyond the range of the operating system	**Low-Medium**
Above water noise changes and visual disturbance – birds	**Low-High** depending on geographical location of activity (expert judgement)	Evidence from one study of relatively little impact on wild and semi-wild waterbirds; evidence from another study that visible disturbance of wild waterfowl when UAV flown below a certain altitude (low)	**Low–High** (medium) Based difference in sensitivity to these pressures between some species e.g. red-throated diver, curlew, are highly sensitive to disturbance; other species e.g. gulls, have high thresholds (low sensitivity) to disturbance. Certain behavioural activities are considered more susceptible to disturbance e.g. nesting seabirds or breeding birds (expert judgement)	**Low - Medium** based on wide range of likely overlap between pressure and feature**.** Where overlap occurs mixed evidence regarding impact from drones. Strong evidence base for impact from analogous pressure (i.e. noise or visual disturbance caused by other anthropogenic activities), especially if high feature sensitivity	**Low - Medium**