Natural England Evidence Information Note EIN036

Marine recreation evidence briefing: diving and snorkelling

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 diving and snorkelling. Other notes are available for other recreational activities, for details see *further information* below.

Diving and snorkelling

Definition

Swimming either underwater or on the surface, using Self Contained Underwater Breathing Apparatus (Scuba) or snorkelling equipment.

Distribution of activity

Scuba diving and snorkelling activity can be broadly split into shore and boat based activity. Most shore diving or snorkelling occurs in relatively discrete areas which have suitable public access.

In general, there are dive sites all around the coastline and these activities are undertaken along sections of the coast that have suitable water clarity and interesting underwater features such as rocky reefs, wrecks and wildlife. Particularly popular spots in England including the Farne Islands, the South West (Plymouth, Cornwall, Weymouth, Swanage), Lundy Island and Sussex.

Levels of activity

As highlighted above, diving and snorkelling activity is typically focused on discrete sites with the intensity highest at established, popular sites such as Chesil Beach and Babbacombe. In 2015, approximately 350,000 people were involved in SCUBA diving activity in the UK (Arkenford, 2015). No statistics were available for snorkelling, but the activity is widely undertaken.

In 2012, the Professional Association of Diving Instructors (PADI), estimated that there were about 200,000 PADI certified divers participating in the activity in the UK (an indicative estimate from certification numbers, data from dive sites and estimated numbers of divers who continue diving after certification) (Suzanne Smith, PADI, pers. comm. 03.02.17).

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In 2012, there were an estimated 30,000 British Sub Aqua Club (BSAC) members around the UK and overseas, and around 900 BSAC clubs in the UK. It was estimated that between 200,000-250,000 dives per year were being made in the UK by BSAC divers (New Economics Foundation, 2014).

Pressures

This note summarises the evidence on the pressures and impacts of diving and snorkelling created by access to the dive or snorkel site (eg off the beach or from a motorised watercraft) and through participating in the activity in the marine environment.

The direct pressures considered to arise from each functional aspect of the activity are shown in Table 1 and the potential biological receptor groups affected by the 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:

- Abrasion/disturbance of surface sediments in intertidal habitats and shallow subtidal habitats from participants crossing the foreshore to enter the sea.
- Abrasion/disturbance of the surface and sub-surface sediment in shallow subtidal habitats through propeller/engine wash when accessing sites by motorised watercraft. However, this is considered unlikely to be a frequent pressure as many dive vessels depart from marinas through specific boat channels and dive sites will not be located in shallow water where this pressure would be expected to occur.
- Abrasion/ disturbance of surface (including epifauna and flora) and sub-surface substratum related to diver/equipment contact with subtidal benthic habitats during diving or snorkelling activities.
- Underwater noise disturbance of fish (basking sharks specifically) or marine mammals (seals or cetaceans), related to engine operation when accessing sites by motorised watercraft.
- Above water noise and visual disturbance of hauled-out seals or birds from participants crossing the foreshore to enter the sea.
- Above water noise and visual disturbance of hauled-out seals and birds related to engine operation and/or vessel movement through waves (ie craft striking waves or 'hull slap' when accessing sites by motorised watercraft.
- Visual disturbance of fish (basking sharks specifically) and marine mammals related to the presence of people and vessel when accessing sites by motorised watercraft.
- Visual disturbance of basking sharks related to the presence of snorkelers in the water.

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

Any surface abrasion/disturbance to the substrate surface in intertidal and shallow subtidal habitats arising from participants entering the sea (for shore diving/snorkelling) with their equipment has been considered to be negligible. This is based on participants carrying their equipment into the sea and the number of participants being relatively low compared to the larger numbers of people undertaking general leisure activities at a beach. Underwater noise changes associated with the activities has also been considered to be negligible, in relation to ambient underwater noise. Hence both of these pressures have been considered to be negligible and are not considered further.

Note: Assessing potential species removal pressures through collection/hand gathering where not within the scope of this project and are therefore not considered here.

For Table 1 see page 16 and for Table 2 see page 17.

Impacts

For each of the receptor groups below, a high level summary of the evidence of impacts is provided. Within each summary the features of high sensitivity and site-specific factors, which may influence the significance of the impact are noted.

Intertidal habitats

Abrasion/disturbance of substratum surface - from participants accessing the sea on foot

No evidence of the impacts of trampling specifically associated with scuba divers or snorkelers accessing the marine environment was sourced. Hence, the evidence of potential impacts to intertidal habitats from this pressure relates to trampling associated with general 'trampling' on the shore.

In a review of the literature on trampling impacts, Tyler-Walters and Arnold (2008) noted that there were relatively few studies of the effects of trampling on intertidal communities, and fewer studies of the effects on trampling in sedimentary shores (which it has been assumed using expert judgement are more likely to be crossed by divers and snorkelers accessing the sea) than on intertidal rocky shores.

The review concluded that the impacts of trampling on intertidal shores depend on the nature of the receiving habitat and the intensity, duration and frequency of trampling, with increasing trampling resulting in reduced biodiversity, abundance or biomass of affected species; increased bare space and in some cases, clear paths (eg across rocky shores and through *Sabellaria alveolata* reefs; Tyler-Walters and Arnold, 2008 and references therein). Trampling impacts were also dependent on the type of footwear worn.

In relation to sedimentary habitats (in this note it has been assumed that divers and snorkelers may be more likely to cross to access the sea, based on expert judgement), Tyler-Walters and Arnold (2008) summarised that:

- Trampling of intertidal muddy sands and muds was shown to reduce the abundance of some infauna while increasing the abundance of presumably opportunistic infaunal polychaetes and meiofauna, while bivalves were adversely affected (judged by the authors to have high sensitivity at high levels of trampling and medium sensitivity at moderate and low levels of trampling[2]).

- Seagrass beds were damaged by trampling (judged by the authors to have high sensitivity at high levels of trampling and medium sensitivity at moderate and low levels of trampling).

Subtidal habitats

Penetration/disturbance below surface – from engine/propeller wash when accessing sites by motorised watercraft

In general, motorised vessels can cause propeller damage to the seabed when they operate in shallow water. Boat wash may cause localised erosion of marine features, but its impact is generally minimal in the context of natural effects (UK CEED, 2000).

Seagrass (*Zostera* species) can be damaged when motorised vessels are piloted across meadows during low water conditions. Turbulence from propeller wash and boat wakes can break off leaves, dislodge sediments and uproot plants. Repeated shearing of leaves may reduce the productivity of meadows and in severe cases, propellers cutting into the bottom may completely denude an area (McCarthy and Preselli, 2007; study from the USA). In areas where boat traffic is relatively frequent, permanent reductions of abundances of macroinvertebrates in seagrass may occur (Bishop, 2008; study in Australia).

Abrasion/disturbance of surface/sub-surface substratum - from diving and snorkelling activities

No evidence was sourced relating specifically to the impacts of diving or snorkelling on subtidal habitats in the UK. A study by Di Franco *et al*. (2009) on scuba diver behaviour and its effects on the biota of a Mediterranean marine protected area (MPA) found that each diver made 2.5 contacts every seven minutes, and no differences were detected among the levels of diver scuba certification. Scuba diving may result in the deterioration of benthic communities, because divers can easily damage marine organisms through physical contact with their hands, body, equipment, and fins. Although the damage produced by individuals is usually minor, there is some evidence that the cumulative effects of the disturbances can cause significant localized destruction of sensitive organisms. Most contacts are unintentional and caused by factors, such as poor swimming technique and incorrect weighting that in general, indicate a poor diving proficiency (Luna *et al*. 2009).

Scuba diving activities can also cause localised turbidity through the effects of ‘finning’, the kicking action of the feet which can cause sediments to rise into the water column. This effect is likely to be only temporary in nature and mainly related to novice divers – experienced divers usually fin in a manner which does not cause disturbance (UK CEED, 2000).

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[2] Intensity definitions for foot access (in this instance to fishing grounds) in Tyler-Walters and Arnold were adapted from Hall *et al.* 2008 and defined as: Heavy – access by > 10 people per hectare per day; large numbers of individuals mainly concentrated in one area; Moderate – access by 3-9 people per hectare per day; Light – access by 1-2 people per hectare per day; Single – access on a single occasion.

Fish

Underwater noise changes and visual disturbance – when accessing sites by motorised watercraft

Small motorised craft (including diving boats) produce relatively low levels of noise (75-159 dB re 1µPa m) with the output characteristics highly dependent on speed and other operational characteristics (OSPAR, 2009). Many of these sources have greater sound energy in higher frequency bands (ie above 1,000 Hz) than large ships.

With respect to recreational vessel movements, few specific scientific studies have been undertaken on the impacts of vessel noise on fish, although vessels have been shown to increase stress response and potentially mask vocalizations (Celi *et al*., 2015; Neenan *et al.,* 2016). The response of fish will be dependent on sensitivity of these species. Fish with a swimbladder are generally considered to have better hearing than those without (Nedwell *et al.,* 2004).

In general, fish species are not considered sensitive to visual disturbance. However, an exception may be the basking shark, which displays foraging and courtship behaviour at the sea surface in UK waters (particularly South West England, the Isle of Man and Hebrides) seasonally in the spring and summer (Sims, 2008). This makes them potentially sensitive to the visual presence of a motorised vessel (such as a diving boat) as well as disturbance due to noise stimuli. Therefore, these pressures on basking sharks are reviewed collectively.

Compared with cetaceans, basking sharks are considered to be less easily disturbed (Speedie and Johnson, 2008). However, specific research on the impacts of vessel related disturbance on basking sharks is limited. One study documented that short-term displacement responses occurred when a basking shark was in the vicinity of a small motorised boat. The observations only recorded a reaction to the approach of a vessel at a maximum distance of approximately 10 m. The study also found that the angle of approach and engine noise were contributory factors to disturbance. In addition, repeated approaches appeared to increase the disturbance response (Wilson, 2000).

Visual disturbance – from snorkelers in the water

Basking sharks are also potentially sensitive to disturbance through people in the water snorkelling. Anecdotal observations generally suggest that a single snorkeler often elicits no reaction or only minor changes in direction when in close proximity to a feeding shark. However, the effects are likely to be more pronounced when large groups of people are actively approaching basking sharks very close to interact with the species or through repeated disturbance events. Such interactions could cause a startle response in sharks with persistent disturbance potentially disrupting foraging or courtship behaviour.

Marine mammals

Underwater noise changes and visual disturbance - when accessing sites by motorised watercraft

It is considered difficult to disentangle the combined effects of noise and boat physical/visual presence which could in combination or separately cause disturbance (Pirotta *et al.,* 2015). Therefore, these pressures are reviewed collectively.

Small motorised craft (including recreational craft) produce relatively low levels of noise (75-159 dB re 1µ Pa m) with the output characteristics being highly dependent on speed and other operational characteristics (OSPAR, 2009). Many of these sources have greater sound energy in higher frequency bands (ie above 1,000 Hz) than large ships. Noise injury at these levels is considered unlikely although a range of studies have demonstrated that vessels can cause behavioural responses in marine mammals and also mask important acoustic cues (Pirotta *et al*., 2015).

Typical adverse behavioural responses are associated with evasion and include changes in travel direction (Nowacek *et al*., 2001), dive duration (Janik and Thompson, 1996; Lusseau, 2003) and changes in behavioural state such as decrease in feeding or resting activity (Lusseau, 2003; Constantine, *et al*., 2004). These responses may interrupt social interactions, carry energetic costs and in the long term could affect individual fitness (Lundquist *et al.,* 2012).

Vessel speed, manoeuvring and approach angle are all important factors in cetacean responses with high impact approaches (crossing path of the animals and boats approaching closely and with high speed generally resulting in increased disturbance of the animals (Peters *et al*., 2013). The effects are typically most pronounced when boats deliberately seek direct interactions (eg whale watching).

Responses towards vessels that are not considered adverse (typically involving moving towards a vessel to bow ride) are also regularly observed in a range of cetacean species. For example, monitoring of bottlenose dolphins in Cardigan Bay, Wales found that the species generally showed a neutral or positive response to vessels (primarily tourist boats) (Gregory and Rowden, 2001).

Visual disturbance – from snorkelers and divers in the water

Due to the naturally inquisitive nature of grey seals, diving or snorkelling with this species is regularly undertaken at a number of established colonies such as the Lundy Island and the Farne Islands. This is both on a commercial and non-commercial basis. Seals at these sites are habituated to human presence and will often actively approach and interact within close proximity to divers or snorkelers (Wilson, 2014). Such interactions may not necessarily be considered adverse although research on the long term impact of these activities on grey seals is limited.

Common seals are much more cautious than grey seals and typically do not interact with divers or snorkelers in UK waters (Wilson, 2014).

Diving or snorkelling interactions with cetaceans in the UK are generally rare and sporadic with no dedicated commercial tours currently in operation. While there is evidence to suggest that dolphins and other species will sometimes actively seek out human interactions (particularly solitary bottlenose dolphins), research on the long-term exposure of dolphins to established ‘swim with’ dolphin tourism in other countries suggests that such activities can cause stress and short-term behavioural changes (such as avoidance) which may have long-term consequences (eg decreased reproductive success and increased mortality rates for individuals and populations (Constantine, 2001; Courbis and Timmel, 2009).

Above water noise changes and visual disturbance (hauled out seals only) – when accessing sites by motorised watercraft

Seals which are hauled out on land, either resting or breeding, are considered particularly sensitive to visual disturbance (Hoover-Miller *et al*., 2013). Therefore, scuba diving boats operating near seal colonies could potentially cause a disturbance response in hauled out seals. The level of response of seals is dependent on a range of factors, such as the species at risk, age, weather conditions and the degree of habituation to the disturbance source.

Hauled-out seals have been recorded becoming alert to powered craft at distances of up to 800 m although seals generally only disperse into the water at distances <150-200m (Wilson, 2014; Young, 1998; Suryan and Harvey, 1999; Henry and Hammill, 2001).

Birds

Above water noise and visual disturbance – from accessing the sea across the foreshore or when accessing sites by motorised watercraft

Diving birds are generally rarely encountered underwater while scuba diving or snorkelling. Disturbance impacts to birds therefore relate to the presence of people on the shoreline undertaking shore dives or from diving boats.

It is very difficult to separate out the relative contribution of noise and visual stimuli in causing a disturbance response in birds and the available literature generally makes no distinction. Therefore, these pressures are reviewed collectively.

Bird species nesting or foraging on rocky coastline or beaches will be most susceptible to disturbance from scuba diving and snorkelling. The primary responses observed are likely to include increased vigilance, avoidance walking and flight responses. These responses typically occur at approach distances of a vessel or person on the foreshore within 100 m although distances over 200 m have been recorded for some sensitive species. The level of any response will vary depending on a range of factors including the speed, randomness and distance of approach and also the level of habituation as a result of existing activity (IECS, 2009; McLeod, *et al.,* 2013; Guay *et al*., 2014; Dwyer, 2010; Rodgers and Schwikert, 2002; Chatwin *et al.,* 2013).

Some disturbance effects may have more direct negative impacts (loss or failure of eggs or chicks leading to decreased breeding productivity) to birds than others (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 that would be considered as 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 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. To identify the impacts for a specific site/feature investigate 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 18.

Management options

Potential management options for marine recreational activities (note, not specific to diving and snorkelling) 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); and
- permitting or licence conditions.

The only example of management measures applied to diving or snorkelling activities in the UK provided by stakeholders were in relation to codes of conduct to minimise impacts on the marine environment (see the Wildlife Watching Information Note in relation to management of noise and visual disturbance of mobile features during wildlife watching from vessels). These good practice guidelines for divers and snorkelers are described further in the section below.

Based on expert judgement, it is considered that where management measures, which would be considered current good practice (in this instance Codes of Conduct), are applied to diving and snorkelling activities and adhered to by participants, the likely risk of significant impact on a site's Conservation Objective's would be **Low** in relation to all activity/pressure impact pathways. For further information and recommendations 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 governing body and good practice messages for diving and snorkelling activities

National Governing Body

BSAC is the National Governing Body for scuba diving in the UK, providing a diver training and development programme via a network of clubs and centres across the country and overseas. BSAC has a Diver Code of Conduct, which includes a section on conservation which encourages divers to comply with seasonal access restrictions to avoid disturbance to seals and seabirds, to avoid damage to the seabed and associated biota and not to collect ‘souvenirs’. The code of conduct is available here: **www.bsac.com/news/dive_code.pdf**.

PADI is a diver training organisation. Although PADI does not have a specific Code of Conduct, the organisation integrates good practice and environmental sustainability messages developed by the environmental charity Project Aware throughout the PADI training courses and materials for recreational divers qualifying through the PADI certification scheme.

Project Aware was originally formed as an environmental initiative by PADI to increase environmental awareness through diver education. However, Project Aware is now a non-profit (charitable) organisation which champions policy change and volunteer involvement in conservation work. With regard to good practice messaging, project Aware provides '10 tips to divers to protect the ocean planet', which are also shown on a PADI blog site (with links to Project Aware). The Project Aware good practice messaging is available here: **http://www.projectaware.org/action/pledge-follow-project-awares-10-tips-divers-protect-ocean-planet**.

Good practice messaging

The Codes of Conduct referred to above promote conduct to minimise the main pressures arising from diving and snorkelling activity (abrasion/damage to seabed habitats, noise and visual disturbance of marine mammals and birds). Hence it is not considered that there are any major gaps in the messaging.

Key messages to minimise impacts from the existing resources include (those relevant to the pressures of interest selected from the existing resources):

Abrasion/disturbance of habitats and associated flora/fauna:

- Be conservation conscious. Avoid damage to weeds and the sea bed. Do not bring up sea-fans, corals, starfish or sea urchins.
- Be a buoyancy expert – to avoid contact with the natural environment.
- Be a role model – set a good example for others when interacting with the environment while underwater and on land.
- Take photographs and notes - not specimens (also ‘Take only photos, leave only bubbles’).
- Protect underwater life – choose not to touch, feed, handle, chase or ride anything underwater. Understand and respect underwater life and follow all local laws and regulations.

Noise (above and below water) and visual disturbance:

- Avoid driving through rafts of seabirds or in close proximity to seal colonies etc on the way to the dive site.
- Ascertain and comply with seasonal access restrictions established to protect seabirds and seals from disturbance. During the seabird breeding season (1st March-1st August) reduce noise and speed near seabird breeding sites. Do not approach seal breeding or haul-out sites. Do not approach dolphins or porpoises in the water.

Further information

Further information about the National Governing Body, other diver training organisations, good practice messaging resources, site specific conservation advice and management of marine recreational activities can be found through the following links:

- BSAC: **https://www.bsac.com/**
- PADI: **https://www.padi.com/**
- Project Aware: **http://www.projectaware.org/**
- 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 **Marine evidence > Marine recreational activities**.

Evidence briefings 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
- Drones (recreational use at the coast)
- General beach leisure
- Hovercraft
- Motorised and non-motorised land vehicles
- Motorised watercraft
- Light aircraft
- Non-motorised watercraft
- Personal watercraft
- Wildlife watching

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Table 1 Potential direct pressures arising from diving and snorkelling

	Abrasion/disturbance of the substrate surface	Abrasion/disturbance below substrate surface	Underwater noise changes	Above water noise changes	Visual disturbance
Access from the shore	✓[1]	Negligible	Negligible	✓[2]	✓[2]
Access from a motorised vessel	✓[3]	✓[3]	✓[4]	✓[5]	✓[6]
Activity (diving or snorkelling)	✓[7]	✓[7]	Negligible	X	✓[8]

X – No Impact Pathway

1 – Pressure relates to the potential abrasion/disturbance of the substratum surface through people walking across the intertidal carrying heavy equipment to access the sea (ie trampling)

2 – Pressure relates to potential noise and visual disturbance of birds or hauled out seals, relating to the presence of people when accessing dive or snorkel sites

3 – Pressure relates to the potential abrasion/disturbance of the substratum surface and sub-surface through scour created by the propeller/engine wash in shallow water (where dive site accessed via boat)

4 – Pressure relates to changes in underwater noise created by engine/propeller operation (where dive site accessed via boat)

5 – Pressure relates to changes in air-borne noise created by people, the engine operation and the vessel moving through waves (craft striking waves or ‘hull slap’) (where dive site accessed via boat)

6 – Pressure relates to the presence of people and the vessel (where dive site accessed via boat)

7 – Pressure relates to the potential abrasion/disturbance of the substrate surface and associated epiflora and epifauna, or sub-surface disturbance (for sediment habitats), through contact with the diver/snorkeler (eg if buoyancy poorly controlled, or participant standing on or holding onto seabed/associated biological structures) and/or contact from diver’s equipment (eg fins, trailing gauges etc)

8 – Pressure relates to potential visual disturbance relating to the presence of divers/snorkelers participating in the activity in the marine environment

Table 2 Biological receptors potentially affected by the pressures arising from diving or snorkelling

	Abrasion/disturbance of the substrate surface	Abrasion/disturbance below substrate surface	Underwater noise changes	Above water noise changes	Visual disturbance
Intertidal Habitats	✓[1]	Negligible	Impact pathways scoped out	Impact pathways scoped out	Impact pathways scoped out
Subtidal Habitats	✓ [2]	✓[2]			
Fish	Impact pathways scoped out	Impact pathways scoped out	✓[3] (basking sharks)		✓[3,4] (basking sharks)
Marine Mammals			✓[3]	✓[3] (hauled out seals)	✓[3,4]
Birds			Impact pathway scoped out	✓[1]	✓[1, 3]

1 – Participants accessing dive or snorkel sites from shore

2 – From participants making contact with benthic habitats and associated epiflora and epifauna

3 – From operation of motorised vessel during access to dive/snorkel site (underwater noise changes during activity considered negligible)

4 – From snorkelers at the surface

Table 3 Assessment of indicative likelihood of significant impacts from diving and snorkelling (access from shore or from motorised vessel)

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
Surface sediment disturbance – intertidal and shallow subtidal habitats (shore diving)	**Med - High** as this activity requires divers to access the sea on foot. However, divers are likely to minimise the distance they need to walk while carrying heavy equipment, especially over topographically difficult terrain, which may act to minimise overlap to a degree (low as expert judgement)	No direct evidence relating specifically to the activity of shore diving. General trampling impacts will vary in relation to habitat sensitivity, with some communities more vulnerable than others (medium)	**Low-High** Sensitivity will depend on habitat type and therefore will be site-specific. An example of a feature of relatively high sensitivity is seagrass (medium)	**Low – Med** based on potential for overlap of pressure with sensitive habitats (eg seagrass, which at many popular dive sites in England is a predominately subtidal habitat which may minimise exposure to this pressure, depending on the tide level))	**Low**
Sub-surface sediment disturbance in shallow subtidal habitats (from engine/propeller wash when boat diving)	**Low** for larger vessels – as required to stay within navigational channels within shallow water environments (high) **Low** for smaller vessels with a shallow draft (eg Rigid Inflatable Boats). Whilst such boats can access very shallow water, this is generally avoided to prevent grounding. Furthermore dive sites will not be located in shallow water where this pressure is relevant (medium)	Direct evidence of impact on seagrass habitats (medium)	**Low–High** Sensitivity will depend on habitat type and therefore will be site- specific. An example of a feature with high sensitivity is seagrass	**Low-** based on relatively low potential for pressure and shallow subtidal features to overlap	**Low**

Surface and sub-surface abrasion/disturbance in subtidal habitat due to diver/snorkeler contact (eg resulting from fin kicks, trailing equipment or incorrect buoyancy)	**Low-High** for snorkelers – eg depending on participant proficiency/awareness, state of tide, sea conditions etc. **High –** for divers as purpose of activity is to view benthic habitats and associated biological communities	Little direct evidence of impacts in UK waters (the majority of evidence relates to studies in the tropics, particularly on coral reefs) If there is a high numbers of divers visiting a site there is a potential for cumulative effects of impacts from individual diver contact (if poor technique/buoyancy/awareness) on sensitive features (low)	**Low-High** depending on habitats diving/snorkelling over Highly sensitive habitats to abrasion pressure are ones that may be most appealing to snorkelers (eg seagrass) or divers (eg fragile sponge and anthozoan communities on rocky subtidal habitat) (low)	**Low – Medium** for snorkelers, based on the range of potential for overlap with features and lack of evidence of this impact in the UK. However, where there are popular snorkel sites with high levels of visitors (eg in the summer), depending on habitat sensitivity the likelihood of effect may at the higher end of this range **Low - Medium** for divers based on the potential for overlap with features and the high sensitivity of the habitats most likely to attract divers	**Low- snorkelers** **Low - Medium - divers**
Underwater noise changes and visual disturbance – Fish (boat diving)	**Low–High** (fish general) depending on location of activity and timing of activity (low) **Low-Medium** (basking shark) depending on location and season (high). Likelihood of overlap highest in South West England in spring and summer when foraging and courtship behaviour occurring at sea surface	Little direct evidence of vessel noise on fish, although some evidence of increased stress response and masking of vocalisations from this pressure (medium) Direct evidence of impact on basking sharks is limited. Evidence of short-term displacement response to small motorised vessel from one study (low)	**Low–High** (fish general) depending on species (low) **Medium** (basking shark) during sensitive periods (low)	**Low–Medium** (fish general) based on known vessel noise and predicted responses **Medium** (basking shark) based on the potential of overlap between pressure and feature (in some locations) during periods of important feature behaviour	**Low (fish general)** **Low (basking shark)**

Underwater noise changes and visual disturbance – marine mammals (seals and cetaceans) (boat diving)	**Low-Medium** depending on geographical location of activity (high)	Evidence of pressure causing 'evasive' behavioural responses, changes in behavioural state (eg decreased feeding or resting activity) and masking acoustic cues, with potential to interrupt social interactions and affect individual fitness in the long term (high) However, neutral or positive responses to pressure also observed in some locations (high)	**Medium–High** depending on species	**Medium–High** based on high confidence in evidence base showing disturbance effects and sensitivity to pressure. Impact likely to be most pronounced when boats deliberately seek direct interaction with feature	**Low-Medium**
Above water noise changes and visual disturbance – seals (hauled out only) (boat diving)	**Low–High** depending on geographical location of activity eg high overlap where seals likely to be present (eg Farne Islands) (expert judgement)	Evidence of seals dispersing into sea (flushing) when motorised vessels generally within 150-200m and response being more influenced by boat speed of approach rather than distance (high)	**High** - hauled out seals sensitive to visual disturbance (medium) Evidence suggests common seals more sensitive to pressure than grey seals (high)	**Medium–High** based on wide range of likely overlap between pressure and feature. Where overlap occurs, strong evidence base for impact and high feature sensitivity	**Low-Medium**

Above water noise changes and visual disturbance – Birds (shore diving)	**Low** - popular snorkeling or shore diving locations generally do not overlap with nesting seabird colonies or large numbers of birds roosting/loafing on the foreshore or coastal infrastructure. Such beaches are generally utilised by low numbers of waterbirds compared with other habitats (eg mudflats and estuaries) (expert judgement)	No direct evidence of visual disturbance from snorkelers/divers accessing sea. Evidence of disturbance (increased vigilance, avoidance walking and flight responses) from general human presence on the foreshore (analogue pressure; high confidence)	**Low–High** (medium) Sensitivity will differ between species. Some species eg red-throated diver, curlew, are highly sensitive to disturbance; other species eg gulls, have high thresholds (low sensitivity) to disturbance Certain behavioural activities are considered more susceptible to disturbance eg nesting seabirds or breeding birds (expert judgement)	**Low –** based on low likelihood of overlap of pressure and feature	**Low**
Above water noise changes and visual disturbance – Birds (boat diving)	**Low–High** depending on geographical location of activity (high)	Evidence of disturbance to birds by motorised vessels (not dive boats specifically) with greater disturbance caused by vessels approaching at higher speeds (high). However, once a dive boat is on site, it is likely to moor up and hence disturbance is unlikely In general, vessels consistently using defined routes likely to cause less disturbance due to habituation (high)	**Low-High** Sensitivity will differ between species. Some species eg red-throated diver, curlew, are highly sensitive to disturbance; other species eg gulls, have high thresholds (low sensitivity) to disturbance Certain behavioural activities are considered more susceptible to disturbance eg nesting seabirds or breeding birds (expert judgement)	**Low-Medium** based on potential for overlap between pressure and feature, but considering that dive boat is in transit to dive site and will then most likely moor up	**Low**