Effects of dredging on filter feeder communities, with a focus on sponges

Christine H. L. Schönberg[1,2,3,4]

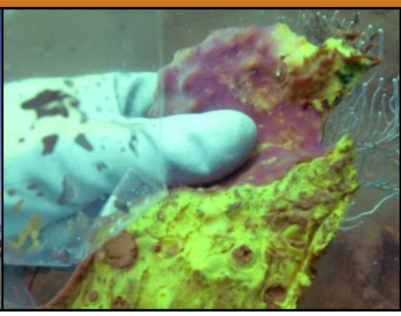
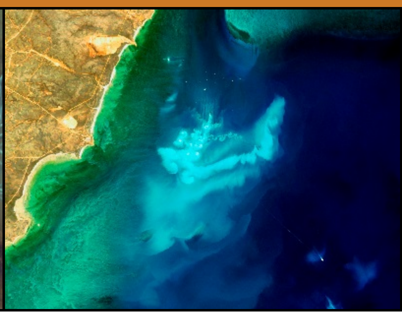
[1] Australian Institute of Marine Science, Perth, Western Australia, Australia
[2] University of Western Australia, Perth, Western Australia, Australia
[3]Western Australian Museum, Perth, Western Australia, Australia
[4]Western Australian Marine Science Institution, Perth, Western Australia, Australia

WAMSI Dredging Science Node

Report

Theme 6 |Project 6.1

June 2016


western australian
marine science institution

Australian Government

Australian Institute of Marine Science

WAMSI Dredging Science Node

The WAMSI Dredging Science Node is a strategic research initiative that evolved in response to uncertainties in the environmental impact assessment and management of large-scale dredging operations and coastal infrastructure developments. Its goal is to enhance capacity within government and the private sector to predict and manage the environmental impacts of dredging in Western Australia, delivered through a combination of reviews, field studies, laboratory experimentation, relationship testing and development of standardised protocols and guidance for impact prediction, monitoring and management.

Ownership of Intellectual property rights

Unless otherwise noted, any intellectual property rights in this publication are owned by the Western Australian Marine Science Institution and the Australian Institute of Marine Science.

Funding Sources

The $20 million Dredging Science Node is delivering one of the largest single issue environmental research programs in Australia. This applied research is funded by **Woodside Energy, Chevron Australia, BHP Billiton and the WAMSI Partners** and designed to provide a significant and meaningful improvement in the certainty around the effects, and management, of dredging operations in Western Australia. Although focussed on port and coastal development in Western Australia, the outputs will also be broadly applicable across Australia and globally.

This remarkable **collaboration between industry, government and research** extends beyond the classical funder-provider model. End-users of science in regulator and conservation agencies, and consultant and industry groups are actively involved in the governance of the node, to ensure ongoing focus on applicable science and converting the outputs into fit-for-purpose and usable products. The governance structure includes clear delineation between end-user focussed scoping and the arms-length research activity to ensure it is independent, unbiased and defensible.

And critically, the trusted across-sector collaboration developed through the WAMSI model has allowed the sharing of hundreds of millions of dollars worth of environmental monitoring data, much of it collected by environmental consultants on behalf of industry. By providing access to this usually **confidential data,** the **Industry Partners** are substantially enhancing WAMSI researchers' ability to determine the real-world impacts of dredging projects, and how they can best be managed. Rio Tinto's voluntary data contribution is particularly noteworthy, as it is not one of the funding contributors to the Node.

Funding and critical data | **Critical data**

Legal Notice

Year of publication: 2016

Metadata: http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=164d4f2f-9039-430a-9be6-2fbbfcf5098e

Citation: Schönberg CHL 2016. Effects of dredging on filter feeder communities, with a focus on sponges. Report of Theme 6 – Project 6.1 prepared for the Dredging Science Node, Western Australian Marine Science Institution, Perth, Western Australia. 139 pp.

Author Contributions: CS compiled and wrote the review

Corresponding author and Institution: C. Schönberg (AIMS).

Competing Interests: The commercial investors and data providers had no role in the data analysis, data interpretation, the decision to publish or in the preparation of the manuscript. The authors have declared that no competing interests exists.

Acknowledgements: The significant support from AIMS librarians Jenny Lee and Lisa Capps, who unearthed literature that could not be obtained through the usual channels, and numerous authors who sent their publications upon request are acknowledged. Evy Büttner, Flora Siebler, James Colquhoun and Julian Gutt gave permission to use photographs from other projects. Alan Duckworth, Mari Carmen Pineda, Nicole Webster, Muhammad Azmi Abdul Wahab and Ross Jones proofread and edited parts of the manuscript. Andrew Hosie from the Western Australian Museum identified and provided biological information on porcelain crabs. Dr Ray Masini, Dr Ross Jones and Mr. Kevin Crane (WAMSI Dredging Science Node, Node Leadership Team) for their advice and assistance.

Collection permits/ethics approval: No collection occurred in the production of this report.

Publications coming from this study:

Schönberg CHL (2015) Self-cleaning surfaces in sponges. Mar Biodiv 45:623-624 DOI: 10.1007/s12526-014-0302-8

http://link.springer.com/article/10.1007/s12526-014-0302-8

Schönberg CHL (2016) Happy relationships between marine sponges and sediments – a review and some observations from Australia. J Mar Biol Ass UK 96(2):493-514 doi:10.1017/S0025315415001411.

https://www.cambridge.org/core/journals/journal-of-the-marine-biological-association-of-the-united-kingdom/article/happy-relationships-between-marine-sponges-and-sediments-a-review-and-some-observations-from-australia/A8E927A56D5F7C0D16D6BF1B9DC4AE50

Front cover images (L-R)

Image 1: Trailer Suction Hopper Dredge *Gateway* in operation during the Fremantle Port Inner Harbour and Channel Deepening Project. (Source: OEPA)

Image 2: A sample of the verongimorph sponge *Pseudoceratina* cf. *verrucosa* collected near Onslow, Pilbara, Western Australia with significant accumulations of fine brown sediments blocking its internal canal system (yellow surface represents internal section through the sponge), while surface pores were free of sediment (pink surface). (Source: C. Schönberg)

Image 3: Dredge Plume at Barrow Island. Image produced with data from the Japan Aerospace Exploration Agency (JAXA) Advanced Land Observing Satellite (ALOS) taken on 29/08/2010.

Image 4: A psammobiotic sponge, cf. *Oceanapia* sp., *in situ* at Onslow with its main body buried under sediment, and fistules (finger-like projections) protruding clear off the substrate. (Source: C. Schönberg)

Contents

Executive summary

Marine filter feeders are important components of benthic environments providing a range of critical ecological functions including habitat provision, filtration of large quantities of water and consolidation/erosion of sediments and hard substrates. To inform future field- and laboratory-based research on the environmental effects of capital and maintenance dredging on filter feeders, a detailed review of available literature was undertaken. Over 900 peer-reviewed, journal and grey literature articles, technical reports and student theses containing information on the relationship between filter feeders and sediments were examined. Although the primary focus of most studies was not on the environmental effects of dredging, the literature synthesis provided useful information for impact prediction and monitoring and management purposes. This review generated an enhanced understanding of shorter-term physiological and longer-term ecological responses of filter feeders to sediment and mechanical effects of dredging gear, and has identified physiological and ecological indicators for use in future work. Given the size of the topic, and given their significance in northern Australia waters, the review concentrated on sponges.

In general, most studies examined the response of single species to sediments, and there is a conspicuous lack of published data related to dose of exposure (i.e. concentration and time), particle sizes of sediments or other sediment characteristics such as organic content. Overall, effects were found to be (1) greater with increasing sediment concentration, duration and frequency, as well as with contamination, (2) more pronounced for finer and more terrestrial (siliciclastic) sediment than for coarser and more biogenic (carbonate) sediments, and (3) more important for the larval and juvenile stages than the adult populations.

From a physiological perspective, responses to acute and chronic sediment stress included elevated respiration, reduced or arrested pumping, pore closure, tissue retraction and changes in sponge morphology. Other responses included changes in choanocytes (flagellated cells that drive the water current through the sponge), pore size and pore density, bleaching, necrosis, disease and maceration. However, it is important to note that not all of these responses occurred in all species or specimens examined. These physiological changes in response to sediment exposure may present a substantial energy drain that could lead to lower growth rates, a reduced proportion of organic to inorganic components, decreased reproductive output, and impaired defence and recovery processes. Whilst nutrient content of ingested sediments could potentially offset these effects, responses differed considerably between taxa. Certain growth forms enable sponges to cope with moderate sediment stress, and the use of passive and active cleaning mechanisms could further reduce the impact of sediment deposition and risk of clogging of the sponge's internal canal system (for feeding, excretion, respiration etc.). These mechanisms include self-cleaning surfaces, sediment removal by epibionts, mucus production, tissue sloughing, selective rejection of inhaled particles and phagocytosis, and the use of water jets to unblock surface pores and parts of the canal system. Not all of these mechanisms occurred in all species examined.

From an ecological perspective, sedimentation and turbidity are clearly significant selective forces that are likely to alter the structure of filter feeding communities by reducing fitness and hence competitive advantage and survival. Species that have special adaptations with respect to sediments may persist at dredging sites and these could include endopsammic sponges (living partially buried within sediments), fast growing species with morphological plasticity, erect growth forms and growth forms with exhalant openings on apical body parts. Resilience may also be related to species that are more capable of keeping their surfaces sediment-free. Whilst little is known of responses to cumulative pressures, sponge vulnerability will likely be exacerbated during certain periods, e.g. when struggling to satisfy high energy demand for growth or reproduction, during thermal stress events or after tissue damage from e.g. spongivory, storms or reduced salinity.

In summary, sediment associated with dredging activity can affect the physiology of filter feeders in very complex ways, which are not yet adequately understood. The responses are manifold, difficult to quantify and can vary significantly between taxa, life stages, and with other environmental factors. It is thus very difficult to recognise trends and patterns from fieldwork or even from controlled experiments. At a community or ecological level it is also difficult to predict how filter feeders would respond to dredging-related pressures when considering the

wide range of responses to sediments, the large variability in sensitivity between taxa and the large range of interacting environmental variables, which cannot always be separately assessed. Nevertheless, the high diversity and endemic nature of filter feeder communities in Australia, and especially in Western Australia, combined with the paucity of knowledge about their biology suggests two critical information needs: (1) experimental research to improve the understanding of the ecophysiology of filter feeders and determine cause:effect pathways and dose:response relationships to dredging pressures, and (2) identification of the dominant and habitat forming filter feeder species and their local and regional significance at possible future dredging locations.

Considerations for predicting and managing the impacts of dredging

Given the general lack of information on the effects of dredging sediments on filter feeder communities, it is difficult to make specific recommendations for management. However, given the high biodiversity, endemism and sometimes rarity of benthic organisms in northern Australia, sponge-dominated habitats should be recognised as important communities and be fully considered in future environmental impact assessments associated with dredging projects.

A large number of physiological stress symptoms were identified in this review, including mucus production, tissue sloughing, increased respiration rates, changes in pumping behaviour, changes in colour, development of disease and necrosis. These symptoms could be employed as physiological stress indicators in future research programs, especially in aquarium-based studies. A large number of ecological indicators (e.g. changes in community composition and/or structure) were also identified in the review. These include shifts from filter-feeder- to predator-dominated communities, shifts in the ratio of phototrophic to heterotrophic species, and shifts in the ratio of morphologies with large surface areas to erect growth forms or those that have exhalant openings on apical parts of their bodies. Other ecological indicators include changes in abundances of endopsammic forms and other sediment-tolerant morphologies and taxa. These symptoms could be used as ecological stress indicators in future field-based research programs.

Early life-history stages of sponges (including the motile larval phase) appear to be more sensitive than adults, although the health and fecundity of adults may also be significantly impaired by sediments released by dredging during gametogenesis. A common management practice in Australia is to stop all turbidity-generating events during periods when local species are most sensitive to sediments (such as spawning). However, without a better understanding of the reproductive biology of filter feeders it is difficult to provide recommendations on the use of a similar approach. In addition, many sponge species have prolonged reproductive and spawning periods and thus a defined period of cessation to dredging activity is likely to be less practical and effective than for species that release gametes during very discrete periods or ‘windows’ (i.e. the multispecific, synchronous mass spawning of broadcast-spawning coral species which occurs over a few days each year).

In terms of other preventative or mitigating actions of dredging, the best management practices typically used around sensitive environments such as coral reefs equally apply to filter-feeder communities. These include, amongst others, impact minimisations (i.e. dredging with reduced or no overflow from the dredge or hopper barges), use of barriers that localise the potential damage by containment, the selection of dredge material placement sites of low biological value and/or examining options for dredge material placement in bunded areas as opposed to offshore marine disposal.

Future aquarium-based research should be conducted with species encompassing different morphologies and nutritional modes (i.e. phototrophic *versus* heterotrophic) with a view in establishing dose-response relationships. Interactive effects such as water flow and temperature etc., should be examined, and ideally experiments should be multifactorial and designed to identify the most relevant cause-effect pathway or pathways. Long-term experiments (weeks to months) should be undertaken and if possible include contrasting grain sizes, mineralogies, nutrient content (and contaminants if relevant). Oxygen regimes and chemical gradients within and between sediment layers could also be examined using microsensor technology to provide early identification of any effects. Assessments of biomass and reproductive success could also provide insights into longer-term sub-lethal effects and be used for generating dose-response relationships. Standardised protocols easily implemented in different laboratories should be developed for experimental research and monitoring purposes to make results comparable across future studies.

Future field-based studies should assess stress symptoms listed above and changes in community structure in response to different degrees of dredging-related pressure. For example, communities should be examined at increasing distances from dredging activities and preferably include ecological surveys before dredging and after dredging. Quantifying the proportions of heterotrophic to phototrophic organisms and changes in symbiosis (including photosynthetic efficiency and chlorophyll content) could provide useful physiological endpoints. *In situ* respirometry and measurements of sponge pumping rates (i.e. water flow through the sponge) with microthermistors could also generate valuable data on stress responses of filter feeders. Following dredging, sampling of sponge tissue for electron microscopy and histology may also reveal information on changes in pore and choanocyte size and density, and analysis of epoxy casts could help to determine if suspended materials have had an effect on the sponges' internal aquiferous system. Microcomputed tomography could be employed to localise and quantify sediment accumulation in different areas of the sponge matrix. Consistent with the recommendation for experimental research, standardised protocols should be developed to facilitate greater comparability between studies.

1. Background

In coastal regions worldwide, dredging of marine sediments is conducted to maintain, expand and create ports, shipping lanes and waterways, plant pipelines and cables, aid in land reclamation and to extract various resources (e.g. Dillon et al. 1995, Morton 1977, Anchor Environmental 2003, EPA WA 2011). Some dredging projects are massive in scale, involving the excavation of millions of tonnes of sediment over many years (e.g. Morton 1977). Dredging projects in northwestern (NW) Australia are numerous and of significant size compared to those conducted in other parts of the world (EPA WA 2011), potentially applying significant environmental pressure to marine ecosystems (e.g. Bonvicini Pagliai et al. 1985). However, when compared to other anthropogenic activities, such as fisheries, there is little scientifically reliable information on the environmental impacts associated to dredging (e.g. Airoldi 2003). This eminent knowledge gap hampers the development of effective monitoring programs, reduces our ability to predict environmental impacts, and causes delays in approval processes, potentially resulting in unnecessary regulatory protocols (EPA WA 2011, Masini et al. 2011, Styan and Hanley 2013).

Dredging projects can employ multiple types of dredges and can have direct and indirect impacts on marine ecosystems, with the severity of these impacts varying with distance from the operation and specific parts of the process (e.g. Morton 1977, Anchor Environmental 2003, PIANC 2010, EPA WA 2011, Chevron Australia 2012). The dredging equipment directly damages and dislodges benthic organisms along the dredge path (e.g. Anchor Environmental 2003, EPA WA 2011, Chevron Australia 2012) and resuspends massive amounts of sediment (e.g. Morton 1977). Typically, dredged materials are then placed onto carrier vessels which hold all the sediment or are designed to overflow, mostly retaining coarser materials while releasing fine sediment back into the water and later disposing of the majority of the material at dredge material placement sites (spoil grounds e.g. Morton 1977, Anchor Environmental 2003, EPA WA 2011, Chevron Australia 2012). The resulting fine, suspended sediments from dredging plumes can disperse over many kilometres and extend throughout the water column (e.g. Morton 1977). Plumes may disrupt biological activities in various ways, e.g. by suffocating or clogging body parts, or shading phototrophic organisms (e.g. Anchor Environmental 2003). Eventually the sediments will fall out of suspension from the water column, with settling rates and smothering effects dependent on particle size and local hydrodynamic conditions (e.g. Anchor Environmental 2003). However, in some instances, levels of suspended materials, and sediment and habitat conditions of an entire region are altered over longer durations from years to decades (e.g. De Jonge et al. 2014). Additionally, dredging near harbours and intensively urbanised areas can release toxic or contaminated sediments into the water or deplete oxygen levels, further degrading marine habitats (e.g. Williamson & Nelson 1977, Anchor Environmental 2003, EPA WA 2011).

The dredging pressures described above can result in a wide range of responses by different organism groups, subject to their specific ecological demands and physiologies, also depending on the type of dredging pressure, and the intensity and duration of the dredging operations. Long-lived, sessile organisms, which are unable to move away from *in situ* conditions associated to dredging, are expected to best reflect their impacts and show the most pronounced stress responses over extended durations (e.g. Alcolado 2007). These stress responses are further enhanced if the main functions of these organisms strongly depend on unobstructed passage of water over breathing and feeding structures and on water clarity and purity for photosynthesis. Sessile filter feeders fall into this category and may be impaired to levels that rapidly lead to mortality in intense or long-lasting exposures (e.g. Morton 1977). Notwithstanding, filter feeder habitats were only recently identified as vulnerable marine ecosystems, mainly in response to reducing impacts of fishing operations (e.g. Kenchington et al. 2009).

Many filter feeder communities are dominated by sponges, regardless of climate zones (tropical, temperate or polar) or depths (shallow or deep waters; e.g. Flach et al. 1998). In cold-water habitats, in the deep sea and commonly around Australia's coasts they can form 'sponge reefs' or 'sponge gardens' that can locally build high levels of biomass, ground cover and diversity (e.g. Schönberg & Fromont 2012 and references therein). Sponge gardens, and sponges in general, are less well studied compared to other ecological groups and habitats such as corals reefs (e.g. Hutchings 1990, Beck et al. 2001, Becerro 2008, Przeslawski et al. 2008, Schönberg & Fromont

2012). This bias contrasts their ecological importance and the many vital bioservices that sponges provide (e.g. Wulff 2001 and 2006, Bell 2008, Pawlik 2011). Damaging effects from dredging on sponges, particularly to sponge gardens, could therefore have cascading effects on the surrounding marine community. Unfortunately, sponge habitats typically lack effective management and have been poorly researched in Australia except for a few studies (e.g. Heyward et al. 2010, Wörheide et al. 2011, Schönberg & Fromont 2012, Przeslawski et al. 2014). Worldwide, only a few monitoring projects or technical reports have included sponges (e.g. Anchor Environmental 2003), and related surveys that reported on filter feeders rarely ventured beyond listing approximate abundances of sponges as a group, not distinguishing sponges in any more detail (e.g. Al-Zibdah 2007, Bridge et al. 2011, Table 6.7 in Chevron Australia 2012).

Nevertheless, sponges are an essential component of Australia’s biodiversity, with dense sponge gardens reported from the southern half of the continent (e.g. Currie et al. 2010) and sponge biodiversity hotspots with 250+ recorded species and often over 500 expected species per bioregion around the top half of Australia (Schönberg & Fromont 2012 and references therein). These sponge gardens are unique and do not compare to other enigmatic sponge habitats elsewhere, at least not in shallow, tropical waters (e.g. Bett 2001). Available knowledge on Australian macrobenthos decreases from east to west and from south to north, so that there is the least knowledge on NW Australian biodiversity and biota (Schönberg & Fromont 2012, Fromont et al. 2015). However, recent sponge collections from NW Australia have generated an unusually high rate of endemic and new species, with undescribed species presently estimated to represent a third of the total number of sponge species in the area (Hutchings 1990, Butler et al. 2002, Schönberg & Fromont 2012, Fromont et al. 2015). Many of these new sponges remain undescribed due to the large effort required (Hooper et al. 2013, Fromont et al. 2015). Owing to the important role of sponges in Australia, the present paper will have a large focus on them.

This review aims to extract and summarise information from peer-reviewed and grey literature in the context of dredging-related sediment stress on filter feeders, and to assist in future environmental impact assessments (e.g. Duinker & Greig 2007). Information presented will include some understanding on how filter feeders and sediments interact under normal, natural conditions (Schönberg 2015), but also how they will potentially recover after damage. It is necessary to relate responses to specific impacts and whether they are detrimental in the extreme and often prolonged conditions at a given dredging site. In addition, it is crucial to recognise which factors may have the worst consequences at community level and will require more intensive management and control. Lastly, it is critical to estimate the extent of putative damage and how long it may take for the habitat to recover and how to increase the recovery potential. This review will identify bioindicator taxa and presently known signs and symptoms that will prove useful for monitoring. In developing this review some remedial approaches are proposed for consideration, gaps in knowledge are identified and suitable research strategies are suggested to address them.

2. Information sources

The present work is based on literature searches conducted through Web of Science (Thomson Reuters 2014) and Google Scholar (2014). After a keyword search, articles were screened for information pertaining to the present problem, and references within were checked for additional publications. As information was extremely scattered and often ‘between the lines’ it was initially collated in table form (see Appendices 1-7), then sub-grouped by themes that allowed the synthesis presented in this review. Aiming at a concise topic focus and a good flow, the outcome of the literature search will be distributed over more than one publication, and the present report will concentrate more on putatively negative sediment effects and responses. However, recognising sponges that naturally live with sediments is also necessary, enabling the distinction between natural adaptation and stress responses (Schönberg 2015). To date only one review paper exists that summarises relationships between sediments and filter feeders, i.e. for sponges (Bell et al. 2015), but the present work relates directly to effects of dredging. Otherwise, information directly relating to responses by filter feeders to dredging pressures is patchy and scarce. The information compiled in this report will help choose experimental species and recognise symptoms, as well as identify gaps in the present knowledge.

In order to better structure the widely distributed and unrelated observations on many different species and from many different environments and situations, this review will touch on natural interactions with sediments then move towards increasingly negative effects, using the zonation scheme for assessing and managing dredging projects in Western Australia (EPA WA 2011). This concept depends on the distance from the dredging site, with severity of sedimentation and turbidity, and thus of biological impacts, decreasing when moving away from the centre of disturbance (Figure 1). At the very edges of a dredging plume, resuspended particles may represent an additional source of nutrition for filter feeders, but may also have toxic effects through contamination that is often associated with port sediments (Figure 1 D, e.g. Anchor Environmental 2003, EPA WA 2011). Here, the sediments will have the finest grain size. Intermediate sediment effects may additionally include shading through high levels of turbidity, possibly also a change in light quality (Figure 1 C). Further into the dredging plume, these effects may be joined by clogging or interference of the feeding apparatus (Figure 1 B), then, in the zone of high impact, these consequences will be increasingly over-ridden by sediment deposition that may cause necrosis or mortality through sediment cover, smothering and burial (Figure 1 A). Here, the coarsest materials will settle out, while finer sediments remain in suspension and will be transported towards the outer edges of the plume. Finally, at the excavation site, all sessile benthos will be removed and sacrificed. While all putative impacts of dredging are here regarded as significant and biologically important and will be discussed, the present focus will be on shading effects and sediment deposition, because these are most likely to generate recommendations for thresholds and guidelines for implementation at dredging sites.

As ecological and physiological responses are often highly species-specific, care was taken to crosscheck every species name used in this publication and to provide taxon authorities and allocations in the Appendices to clarify exactly which species was meant, even if any part of this information had changed since the observations here referred to. Validity of all species and their original authors were verified on the World Porifera Database (Van Soest et al. 2014 for sponges) and in the World Register of Marine Species for all other marine invertebrates (WoRMS Editorial Board 2014). Grouping by increasingly higher taxon level may allow recognition of response patterns that may have developed by evolution. Terminology for sponges follows Boury-Esnault & Rützler (1997).

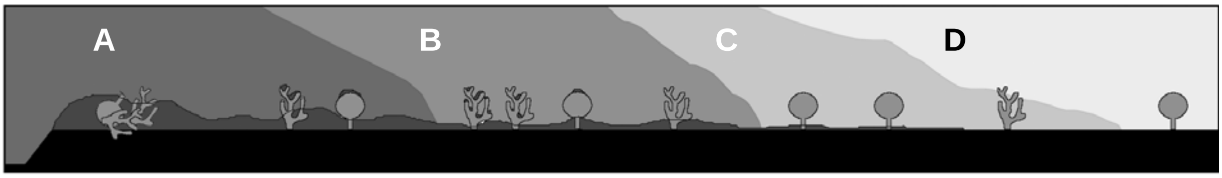


Figure 1. Schematic cross-section through assumed impact zones of a dredging site. Black – undisturbed ground, with section through dredged channel on the left. Dark grey layer on black ground – sediment deposition near the dredging site. Lighter grey shades in the background – representation for different turbidity levels. Sponges represented by a branching and a stalked-globular or fan-shaped growth form. Impact zones: (A) Severe physical damage and potential total burial in dredging sediments. (B) High levels of sediment deposition and partial burial, intensive turbidity. (C) Decreasing levels of sediment deposition and cover of upper surfaces, but still high turbidity levels causing significant shading and containing predominantly fine sediments that may impair filter feeder functions. (D) Decreasing levels of turbidity that may resemble recurring natural exposure levels.

3. Natural relationships between filter feeders and sediments

3.1 Endopsammic sponges

Some sponges are naturally adapted to live endopsammically, i.e. partially buried in sediments of different grain size and qualities (Ilan & Abelson 1995, Rützler 1997, Cerrano et al. 2007a, Schönberg 2015). This ability is especially common in the genus *Oceanapia* and in clionaid and phloeodictyid bioeroding sponges, but can also occur in other taxa (Figure 2 A-F; Schönberg 2015).

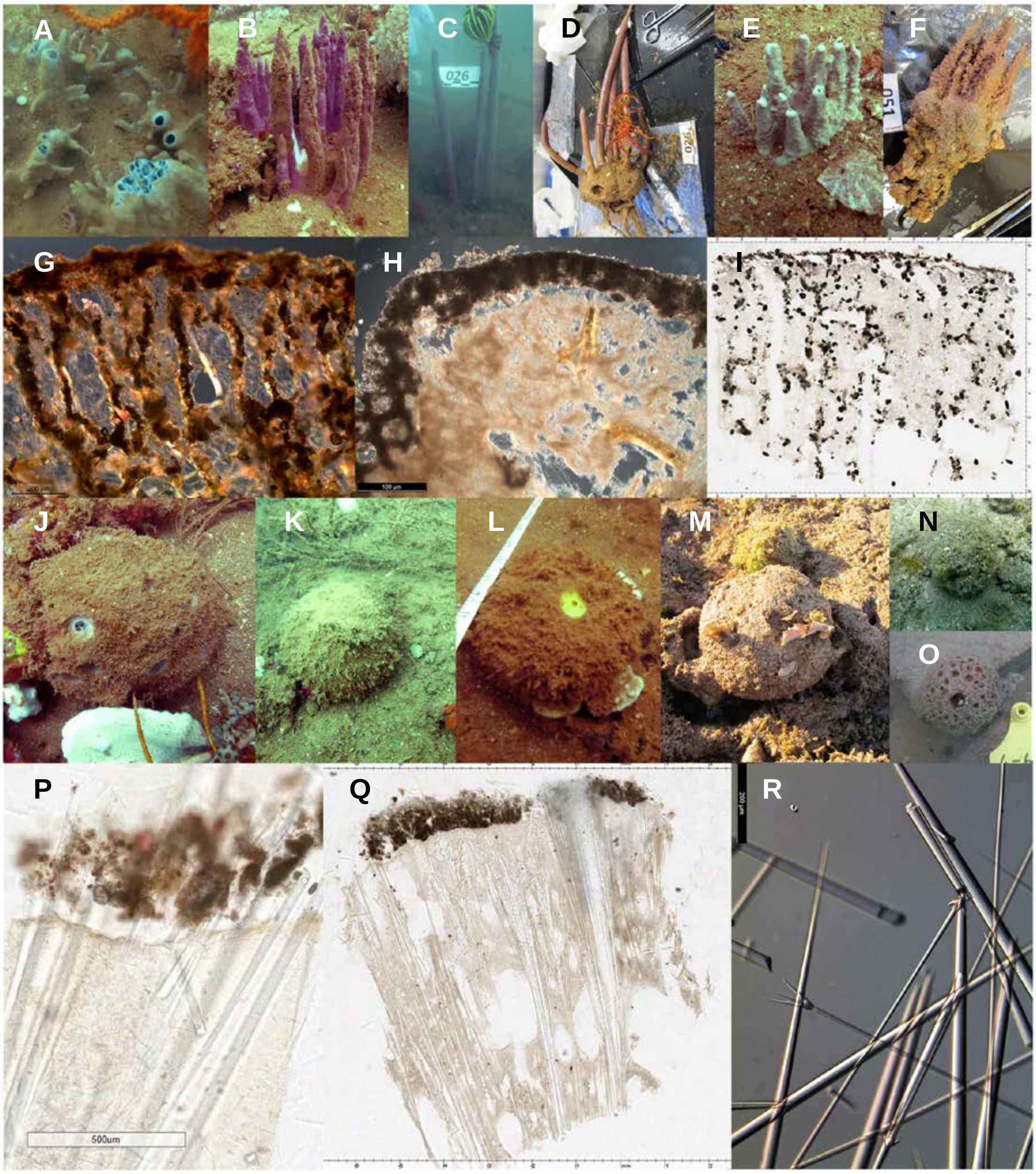


Figure 2 (A-R). Sponge-sediment associations. (A-F) Endopsammic sponges. (A) *Spheciospongia* sp. PB1 at Onslow (where it was not possible to identify material as a known species, it was distinguished from other species with a temporary species number, in this case 'PB1'). (B) cf. *Oceanapia* sp. at Onslow. (C-D) Underwater and benchtop photographs of *Oceanapia* cf. sp. 7, at Onslow. (E-F) Underwater and benchtop photograph of *Psammocinia* cf. *bulbosa* at Onslow. (C-F) The exposed parts such as fistules were photosynthetic, likely due to symbiotic cyanobacteria. (G-H) Hand sections through keratose sponges that embed sediment grains as spicule surrogates, (G) *Carteriospongia foliascens* from Orpheus Island and (H) cf. *Thorecta* sp. from Ningaloo Reef. (I) Microtome section through the keratose sponge *Psammocinia halmiformis* from Ningaloo Reef. In cf. *Thorecta* sp. (H), the sediment is enclosed in the surface tissue, which is thus reinforced or 'armoured'. (J-O) *In situ* photographs of tetractinellid sponges at different sites in Australia, showing the sediment crust that camouflages them and partly includes algae. Note that pore areas remain clean. (J-L) Images of tetractinellids taken while conducting SCUBA transects at Onslow. (M) Intertidal tetractinellid at Ashburton Island (near Onslow) at low tide. The sediment coat shelters it from desiccation. (N-O) *Paratetilla* spp. from Orpheus Island. (P-Q) Microtome sections of *Cinachyrella* sp. from Ningaloo Reef, showing how protruding spicules trap sediments, but also leave a slim gap between the crust and the sponge surface. (R) Typical tetractinellid spicules (triaenes) with triforked terminations, from a tetillid sponge from Ningaloo Reef. Photographs courtesy of: C. Schönberg, F. Siebler and E. Büttner. Images P and Q are of virtual slides produced with ScanScope through the University of Western Australia Centre of Microscopy, Characterisation and Analysis. Images in A, C and D are from Schönberg (2016), and used with permission by Cambridge University Press.

Psammobiosis is a response to environmental selection, it lessens many life-threatening risks by sediments and removes or reduces otherwise energy-draining processes such as predation, dislodgement by storms, desiccation and damage by irradiation (Cerrano et al. 2002, Schönberg 2001, 2015, Schönberg & Fromont 2014), but requires special morphological adaptations to avoid smothering by sediments and sediment intake. As a rule, such sponges have either inhalants or exhalants or both on elevated structures such as fistules, conical or columnar body parts, while pores within the sediments are often large to avoid clogging (Ilan & Abelson 1995, Cerrano et al. 2007a). Sponges that draw water in through buried pores live in coarser sediments (Rützler 1997), while sponges known to live in fine sediments often have both in- and exhalants high enough in the water column to avoid particle inhalation during normal levels of re-suspension (e.g. Schönberg 2000, 2001, 2015). Some endopsammic sponges have phototrophic symbionts, but as a rule restrict them to exposed body parts that are not covered by sediment (e.g. Rützler 1997).

Sponges that are already intimately associated with local sediments are expected to be best adapted to dredging pressures, to do well in dosage experiments using local sediments, to be least affected by increased TSS and sediment smothering and to show the highest survival rates. Dredging pressures may shift the species composition towards sediment-adapted sponges of the orders Haplosclerida and Tetractinellida, and towards bioeroding sponges (Schönberg 2015). Any filter feeders remaining behind near a dredging site will help to retain some of the habitat qualities and will facilitate recovery processes. Observations of a high proportion of psammobiotic sponges in the field may represent a good indicator that sedimentation is already a key selective force in the study area, and sponges of this group would be good reference organisms for threshold experiments.

3.2 Active incorporation of sediments

Filter feeders such as ascidians and many sponge species across very different orders are known to incorporate sediment, often for a specific purpose, e.g. to supplement an otherwise spicule-free body with spicule-like materials or to strengthen an existing skeleton with additional elements (e.g. Kott 1963, Cerrano et al. 2007a, De Voogd 2012, Schönberg 2015). This is thought to reduce energy expenses for skeletogenesis, generating increased stability and protection of the surface (Schönberg 2015). If particles are incorporated basally they weigh the sponge down, anchor it and lessen the risk of dislodgement (e.g. Sim & Lee 1999, Cerrano et al. 2002, Schönberg 2015). Sediment uptake can be highly regulated and selective and would be affected by dredging activities (grain size, mineralogy, crystallography, e.g. Bavestrello et al. 2002, Cerrano et al 2004a, 2007b). Incorporation involves directed movement of cells to transport the grains, e.g. away from surface pores which could be clogged, and towards fibres of organic skeleton that need strengthening (Figure 2 G-I; Teragawa 1986 a and b). Growth rates and overall skeleton formation can depend on sediment availability and quality (Teragawa 1986 a and b, Cerrano et al. 2007).

Sabellariid polychaetes are another group of filter feeders known to actively use sediments to form skeleton surrogates – worm reefs constructed of tubes made of ambient sediment. In this case the process is highly selective as well, as the worms usually prefer and accumulate calcium carbonate grains of a comparatively large diameter in the mm range (Gram 1968, Main & Nelson 1988, Naylor & Viles 2000, Schönberg 2002). Worm reefs can grow to considerable sizes, and due to the utilisation of preferred grain sizes, their occurrence has an impact on the local sediment structure and substrate stability (Multer & Milimann 1967, Gram 1968, Chen & Dai 2008), enhancing local abundance, biomass, species richness and diversity of other benthic biota (Posey et al. 1984, McCarthy et al. 2008, Godet et al. 2008, 2011).

Interactions with sediments are species-specific, and sponges that do not usually incorporate fine sediments could potentially be used as bioindicators at dredging sites (Schönberg 2015), by sampling at intervals to monitor their behaviour towards sediments. Ali (1960) found that sediment incorporation in sponges can increase along environmental gradients with no other obvious changes to the sponges. However, Bakus (1968) observed that during long exposures to light sedimentation some specimens of *Halisarca* sp. strongly accumulated sediments, while others died. Elevated sediment concentrations in the water column as associated with dredging activities may adversely affect those sponge species that rely on incorporating a specific choice of sediments into their tissues, particularly if the resuspended sediments largely belong to the wrong size class or mineralogy. Exceeding a threshold concentration the sponge may lack mechanisms to block unwanted sediments and to select for the required sediments, which is likely to incur significant energy costs. This may especially concern keratose and verongimorph sponges, as well as some sponges that also incorporate coarser materials such as ‘sand sponges’ (De Voogd 2012, Schönberg 2015), which may be vulnerable to increases of fine sediments even though these sponges can occur in areas of high turbidity and sedimentation. Other filter feeders that depend on sediments with larger grain size, such as reef-building worms, may be disadvantaged to such a degree that they will vanish from the site impacted by dredging.

3.3 Passive sediment accumulation on the surfaces

Some filter feeders have a heavily sediment-encrusted surface that provides them with a protective barrier against desiccation and irradiation where they occur in the intertidal, and otherwise with camouflage and protection against predation and scouring in subtidal habitats (Figure 2 J-O; Schönberg 2015). Within the sponges, globular Tetractinellida are best known for their tolerance to sedimentation and their often thick layers of sediment and algae surrounding them, as well as their ability to agglutinate coarser particles to their surfaces (e.g. De Voogd & Cleary 2007, Schönberg 2015). In the Tetractinellida long spicules often extend beyond the sponges’ surfaces, but instead of repelling sediment by having pointed ends (see ‘lotus effect’ in Section 5), they often have triforked terminations that are designed to catch particles and hold them in place in a burr- or Velcro-like fashion, commonly with algal growth in or on this crust (Figure 2 P-R; Schönberg 2015). While the layer can easily build up to several mm in thickness, the triforked ends of the spicules are sufficiently far removed from the spirophorid ectosome to retain a thin space between the sponge and the sediment layer, allowing some circulation and preventing smothering (De Voogd & Cleary 2007). Pores can be kept free by slightly longer spicule ‘fences’ around them (Figure 2 J, L, O).

Accounts of sediment armour in keratose sponges are part of species descriptions and taxon revisions (e.g. De C Cook & Bergquist 2002), but there appear to be no published data with the purpose to describe the quality of sediment crusts on tetractinellids. From personal observations thicker crusts are more often built from sandy materials rather than from very fine sediments, but fine sediments are more commonly found forming external crusts than representing embedded materials. External sediment crusts in sponges that usually have clean surfaces can indicate stress and a failure of cleaning (see Sections 5 and 6).

4. Avoidance of sediments

4.1 Settling in the right spot

Sponge distributions and sediment qualities can be intimately linked (e.g. Battershill & Bergquist 1990, Briggs et al. 1996). For most sponge species, high sedimentation levels can result in mortalities or avoidance responses during settlement, commonly reflected by distributions and abundances specific for a given location (Appendix 1). Settlement avoidance can be controlled by sediment type, usually with biogenic sediments preferred over terrigenous sediments (e.g. Cerrano et al. 1999). In settlement experiments with filter feeders the highest rates of colonisation were found on panels with reduced siltation levels (Doochin & Walton Smith 1951). Sponges that are sediment-intolerant often occur underneath algal canopies or overhangs or are attached to vertical cliffs to reduce the risk of sediment deposition onto their surfaces (Appendix 1; Carballo et al. 1996, Bell & Barnes 2000a, 2000b, Balata et al. 2005), and biodiversity of filter feeders and fitness of sponges was found to be enhanced with lower sedimentation (Carney et al. 1999, Núñez Flores et al. 2010). Field studies comparing turbid to clear water sites found most sponge species prevailed in clear water (e.g. Rice 1984, Macdonald & Perry 2003, Mercurio et al. 2006, Bannister et al. 2010). In contrast, McClanahan & Obura (1997) noted an increase of soft coral and sponge cover with increased river sediment discharge, but they pointed out that flow also increased along with sedimentation, which improves ventilation and the nutrient transport towards filter feeders (e.g. Carney et al. 1999).

Habitat conditions will be altered for the duration of dredging activities (e.g. Morton 1977, Anderson & Meyer 1986), with otherwise suitable substrate now covered with sediments and resuspended fine sediments possibly affecting larval fitness and reducing the availability of 'escape-niches'. Pre-dredging conditions to 'settle in the right spot' may no longer be available to sediment-intolerant recruits, thus creating selective pressure while dredging proceeds that may affect the community structure (Appendices 1 and 2 list observations on distribution patterns with respect to sediment characteristics).

4.2 Morphological adaptations

Inhalation of sediments is a risk that can morphologically be controlled by inhalant sizes or complicated inhalant sieves. The smaller the ostia (pores), the less material can be taken up that may end up blocking the smaller ducts in the canal system (e.g. Göbel 1993). A similar effect is achieved by breaking up a single opening into several smaller ones or by having irregularities protruding into the lumen of that opening, effectively creating a sieve while retaining the ability to take up a larger volume of water with the same ostium. For example, clionaid sponges commonly have tiny inhalant pores or fine inhalant sieves and significantly larger exhalant oscules (e.g. Schönberg 2000). This strategy is widespread in sponges and can be encountered in all orders (e.g. De Vos et al. 1991).

Level of stress by sediment deposition varies with morphology and is a product of surface irregularity, area, angle and concavity (Figure 3; see also e.g. De Voogd & Cleary 2007, Schönberg & Fromont 2012). Compared to smooth vertical surfaces, irregular, horizontal and concave surfaces will increase the amount of sediment that can accumulate (e.g. Divine 2011), and environments with naturally high levels of sedimentation are likely to select for growth forms that are erect (Appendix 1; Alcolado 2007, Bell & Barnes 2000a and b, Schönberg & Fromont 2014).

Another strategy to reduce build-up of sediments on body surfaces is to have exhalant openings on surfaces otherwise prone to sediment deposition, preferably large openings (Appendix 1; Bell 2004). The best adaptation in this case is having a tubular body, with the majority of surface being vertically oriented and the apical part of the body bundling the exhalant water into a wide jet (Bell 2004, Mendola et al. 2008). If concave surfaces are present, they will collect sediments (Figure 3 A-G), but exhalant sieves located on these surfaces will wash out the fine material that could potentially form a solid plug to block the exhalant stream (Figure 3 A-F). On wide concave surfaces with small exhalant openings coarser sediments will remain behind, through which the water movement can be retained, however (Schönberg pers. obs. for e.g. *Xestospongia testudinaria*, Figure 3 A, B). Unless the exhalants are located at the bottom of deep chimneys, storm generated currents will occasionally clean out the concave parts. Sponges in curled fan-, funnel- or cup-shaped morphologies sometimes have a hole at the bottom by incomplete curling or perforation by necrosis through which sediments can fall (Figure 3 H-J). This process is aided by developing a stalk (Figure 3 K, L).

Long stalks are commonly seen in deep sea filter feeders (Figure 3 K). This is thought to be an adaptation to prevailing fine sediments that exert selective pressure. In shallow water environments stalked morphologies are less obvious (Figure 3 L), but also thought to be indicative of fine sediments.

Using the above information and the concept of 'sponge functional growth forms' (Schönberg & Fromont, 2014), dredging sites can be assessed for predominant morphologies that may relate to environmental factors, generating information about local selective processes. It is expected that before dredging the morphologies will reflect prevailing natural conditions such as erect-laminar and erect-palmate sponges in laminar flow, tubes, barrels and cups with separated in- and exhalant streams in stagnant waters (e.g. Mendola et al. 2008, Schönberg & Fromont 2014) and stalked, erect, tubular and endopsammic forms at sites with high sedimentation (e.g. Mendola et al. 2008, Schönberg & Fromont 2014, Schönberg 2015). After dredging the proportion of the latter group is expected to be higher. Dose-response experiments should contain a variety of such morphologies to reflect a variety of different tolerance levels.

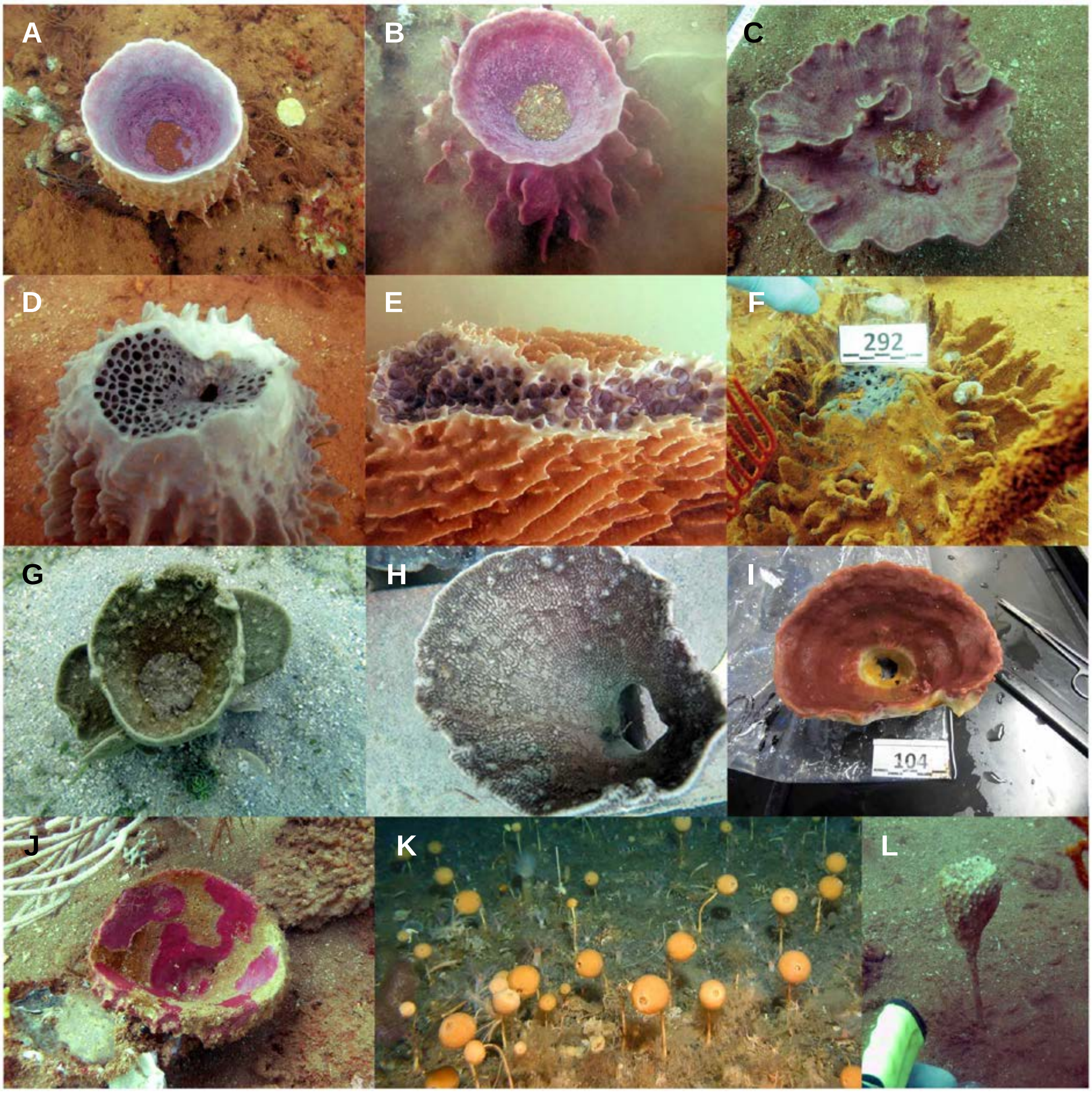


Figure 3 (A-I). Morphological adaptations reducing sedimentation stress. (A-E) Barrels and cup sponges at Onslow, a naturally very turbid site, had surprisingly little sediment and only coarse material on their concave surfaces. Located on these surfaces were the exhalant openings that washed out fine materials and reduced the amount of accumulated sediments. (A-B) *Xestospongia testudinaria*. (C) Unidentified sponge, cf. *Cymbastela stipitata*. (D-F) Sponges at Onslow with apical exhalant areas that bundle the outflow. Fine sediments attached to the inhalant surfaces on the outside of the sponges indicated stress, which was likely caused by a thermal event in the area. External sediment crusts gave the sponges a brown colour, but the exhalant areas were clean. In *Sarcotragus* sp. PB1 this area was also unbleached (see E). (D and F) *Spheciospongia* spp. (G-H) *Carteriospongia foliascens* can grow erect-laminar or curl into a fan (central Great Barrier Reef, GBR). As exhalants are not separated from inhalants in this species, sediments easily accumulate in funnel-shaped specimens. Frequently, this build-up is reduced by holes occurring at the bottom of the funnel (see H). (I) This also occurs in other species, here *Xestospongia* sp. 5. The discolouration at the bottom of this cup suggests that sediments had still collected in this specimen, which may well be the reason for such a hole to develop. (J) Unidentified cup sponge at Onslow with patches of macerated skeleton resulting from necrosis, which can eventually result in holes in the sponge's walls. (K) Stalked 'lollipop' sponges such as *Stylocordyla chupachups* are common in deep sea environments. (L) Occasionally, stalked growth forms such as this *Thorectandra* sp. PB1 also occur in shallow habitats, here at Onslow, possibly to avoid fine sediments. Photographs courtesy of: C. Schönberg E. Büttner and F. Siebler. Image K is copyright of AWI/ Marum, University of Bremen, Germany, with permission by J. Gutt.

5. Passive sediment cleaning processes

Some species of filter feeders are able to maintain clean surfaces even in areas with high sedimentation rates (Figure 4, Appendix 3; Barthel & Gutt 1992, Tompkins-MacDonald & Leys 2008, Schönberg 2014), while other species become entirely covered with sediments and sometimes even with algal turfs (Figure 2 J-Q; Tompkins-MacDonald & Leys 2008, Schönberg 2014). This may relate to growth form, as horizontal surfaces will hold sediments better than vertical surfaces (Figure 4 A-B), and e.g. in corals branching appears to increase the effect of passive cleaning (Divine 2011). For the demosponge *Crambe crambe* seasonal differences were reported, with clean surfaces alternating with times of being covered in debris (Turon et al. 1999). The reason for this is unknown but Bell (2004) and Schönberg (2014) suggested that rough, microhispid surfaces (i.e. where spicules protrude from the sponge surface) may have self-cleaning properties that repel debris in a similar way as rugose, hydrophobic plant surfaces repel water (e.g. as in the lotus leaf, the principle is hereafter referred to as 'lotus effect'; Figure 4 C-G; Cheng et al. 2006, Hassel et al. 2007, Solga et al. 2007). Densely set spicules that only protrude slightly from the surface will create this effect (Figure 4 H-J), while long, bristle-like spicules significantly emerging from the sponge surface usually have the opposite result (Figure 2 J-Q; Turon et al. 1999).

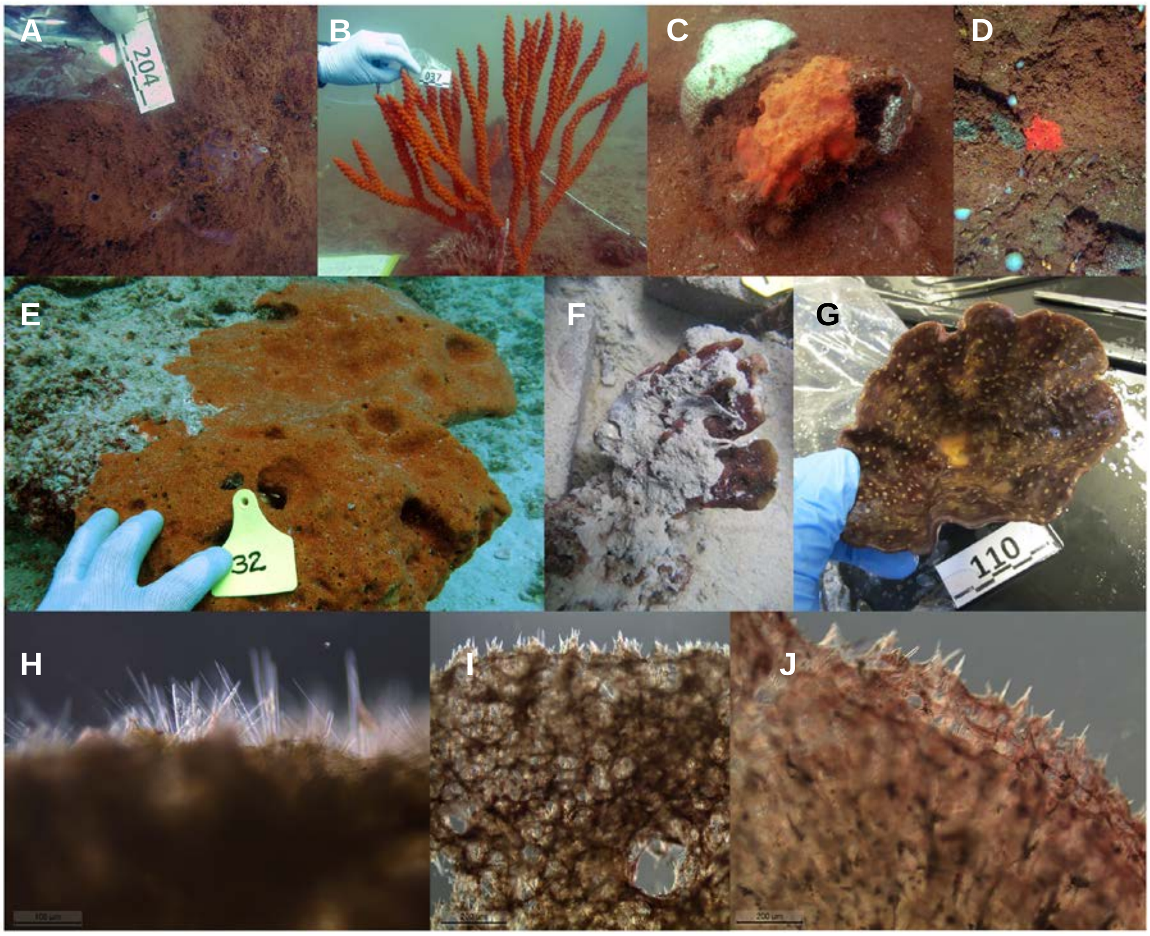


Figure 4 (A-J). Self-cleaning surfaces. Vertical surfaces stay cleaner than horizontal surfaces. (A) *Oceanapia* sp. SS9 at Onslow inundated with sediments. (B) *Axos flabelliformis* is an erect-palmate sponge and was almost always clean at Onslow, even though the surface structure was conulose. (C-E) *Cliona* sp. cf. PB1 with clean surfaces, (C-D) at Onslow, (E) at Ningaloo Reef. (F) *Neopetrosia exigua* at Orpheus Island on the GBR experimentally loaded with sediment, already falling off or being removed from the apical portions of the sponge. (G) Apart from small amounts of sediment at the bottom, *Cymbastela stipitata* had clean surfaces at Onslow despite being cup-shaped. Note that this sponge is associated with contractile zoanthids. Species of *Oceanapia*, *Cliona* and *Cymbastela* at Onslow were photosymbiotic, and the latter two were regularly found with clean surfaces, even in the prevailing highly turbid environments (although *Cliona orientalis* can have an external layer of debris, see Schönberg 2000). (H-J) In *Cliona* (H), *Neopetrosia* (I) and *Cymbastela* (J) the skeleton is microhispid, i.e. spicules slightly protrude from the surface. Photographs courtesy of: C. Schönberg, E. Büttner, P. Speare, J. Colquhoun and F. Siebler. Images in I, and J are from Schönberg (2015), and used with permission by Springer.

Sedimentation stress can also be reduced by symbiotic relationships with epibionts. Sponges and other filter feeders provide habitat for a wealth of organisms from a large variety of taxa, many of which reside on their surfaces or in the canal system (e.g. Westinga & Hoetjes 1981, Voultsiadou-Koukoura et al. 1987, Koukouras et al. 1996, Çinar et al. 2002, Schönberg et al. 2015). Organisms inhabiting internal areas, grazers and other organisms moving or migrating across and through filter feeders may provide a cleaning function by their movements and detritus feeding (e.g. Dayton et al. 1974), and a selection of examples is provided below.

Non-selective deposit-feeding taxa such as brittle stars can remove detrital particles from the surface of sponges and other filter feeders, particles which may be too large to be used by the sponges as food and which may otherwise clog the filtering apparatus (Hendler 1984, Stewart 1998, Henkel & Pawlik 2005, Wulff 2006). These associations can be very specific (Hendler 1984, Wulff 2006), and densities of epibiotic brittle stars on sponges can be enormous (e.g. Chou & Wong 1986, Koukouras et al. 1996, Turon et al. 2000). Within a sponge species, individuals that host brittle stars have been observed with clean surfaces, whereas individuals without brittle stars can be fouled and visibly unhealthy (Figure 5 A-B; Schönberg et al. 2015).

Apodid holothurians are usually deposit-feeders and commonly associate with marine sponges (Hammond & Wilkinson 1985, Butler et al. 1991). Where sponges at Onslow were observed with *Synaptula* spp., their surfaces were clean where the holothurians were feeding, whereas other surfaces still had a dusting of sediments (Figure 5 C-D). Like brittle stars, sea cucumbers can occur in remarkable densities on individual hosts (Figure 5 E-G). Holothuroid-sponge associations are not restricted to, but most often described for verongimorph sponges (e.g. *Ianthella* spp., Figure 5 D). Holothuroids were often observed on *Dendrilla* sp. EG 1 at Onslow, a species that had very clean surfaces despite the high-turbidity environment (Figure 5 E-F; where it was not possible to identify material as a known species, it was distinguished from other species with a temporary species number, in this case 'EG1').

Various crustaceans can be found on and in sponges, and they are often parasitic, e.g. by feeding on the sponge tissue (e.g. Westinga & Hoetjes 1981, Schönberg & Wisshak 2012). Decapod porcelain crabs are known to associate with benthic organisms, including sponges (Prakash et al. 2013, Schönberg et al. 2015), and while their role in those associations is not understood the colouration of the crabs often exactly matches that of their hosts suggesting mutual relationships (Figure 5 H). Where feeding habits are known porcelain crabs are described as filter feeders, catching plankton from the water column with feathery mouthparts (Wild Singapore 2014), but aquarists have also observed them to scavenge for particular material (Live Aquaria 2014), and some species may feed on detritus adhering to surfaces of filter feeders.

Some sponges are associated with symbiotic zoanthids (e.g. Crocker & Reiswig 1981, Swain & Wulff 2007). In NW Australia this association is often represented by the 'spider sponge' *Trikentrion flabelliforme* (Hooper 1991, Wijgwerde 2012), a blade-shaped, laminar to erect-palmate sponge that was never observed with sediment-covered surfaces (Figure 5 I-J). Another example is *Cymbastela stipitata* (Figure 4 G, with contracted zoanthids), also with remarkably clean surfaces. While it is hispid and probably self-cleaning (see above), its cup shape increases the risk of accumulating sediments, but it was never found with more than a light dusting of fine sediments and a small amount of sediments at the bottom of the cup. It is possible that the feeding activities of associated zoanthids in combination with contraction and expansion will remove and dislodge adhering materials. Contractions of the sponge itself was found to clean *Polymastia invaginata* of surface debris (Barthel & Gutt 1992), and contractions of symbionts with extended surface areas should lead to similar results.

Mutualistic functions of such associations remain largely unknown, but are assumed to save considerable maintenance costs. During dredging projects it is therefore critical to monitor organisms associated to filter feeders, because they may be able to keep their hosts healthier or even alive by cleaning them. Filter feeders that lose their cleaner epibionts will suffer more significantly from dredging pressures, and the absence of epibionts on sponges such as the cup-shaped *Echinodictyum clathrioides*, the fan-shaped *Ianthella flabellata* and the harp-shaped, palmate *Dendrilla* sp. EG1 should raise alarm. It would be interesting to conduct experiments on responses to sedimentation with and without such epibionts, gaining further insights into the importance of their presence.

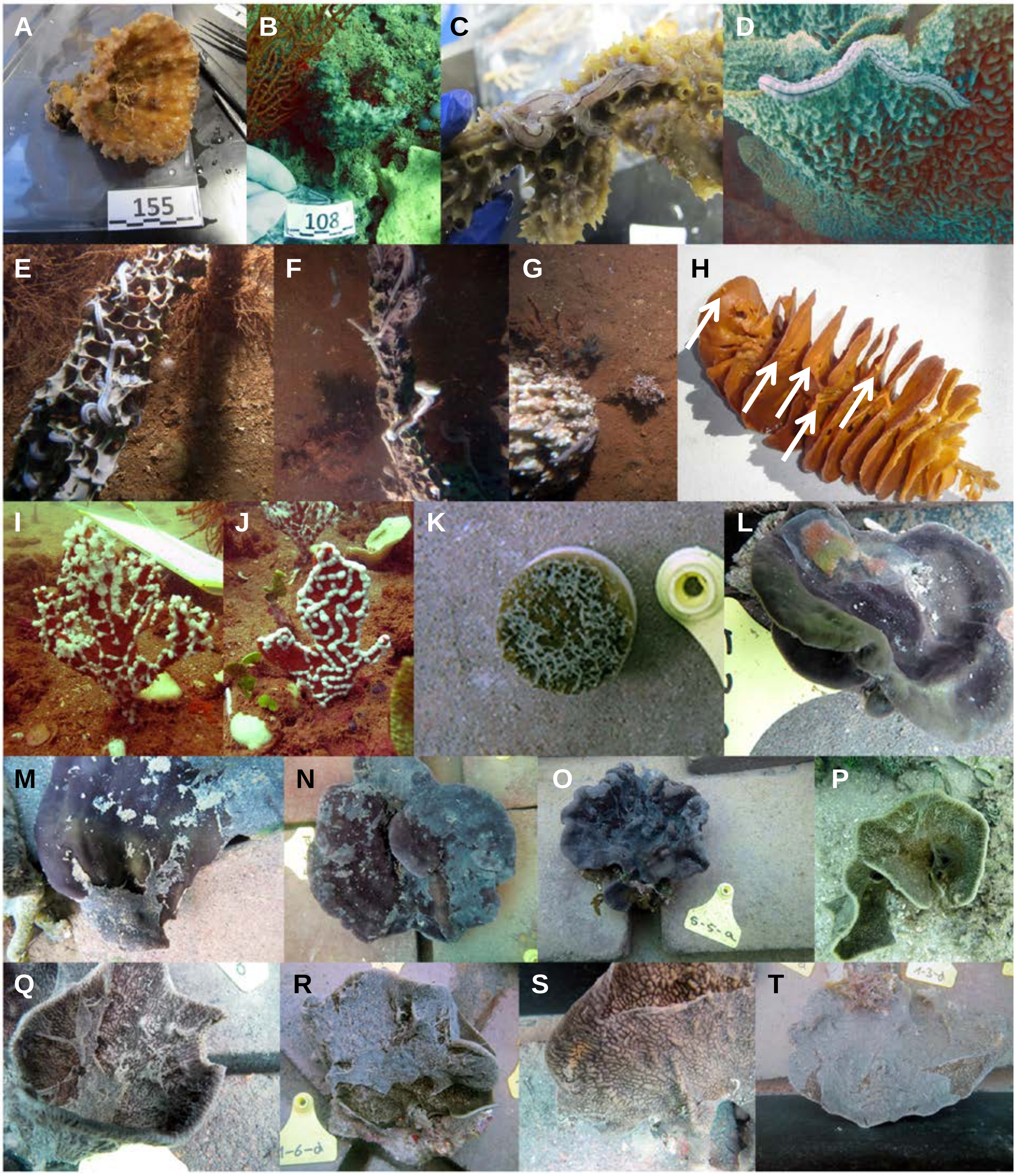


Figure 5 (A-T). Cleaning processes in sponges. (A) The cup-shaped sponge *Echinodictyum clathrioides* (Onslow) was cleaner when occupied with brittle stars and (B) discoloured and overgrown with algae when abandoned by brittle stars. (C-G) Sponges with synaptulid holothurians at Onslow. (C) *Callyspongia* sp. EG3 (D) *Ianthella flabelliformis* with a holothurian feeding on adhering sediments. Densities of these holothurians could be quite high. (E-F) *Dendrilla* sp. EG 1, and (G) unidentified sponge. (H) 'Kebab sponge' *Caulospongia pennatula* from Ningaloo Reef with at least one porcelain crab per tier (arrows, crabs partly removed for identification; Schönberg et al. 2015). Crabs had almost the same colour as the sponge tissue. (I, J) 'Spider sponge' *Trikentrion flabelliforme* in association with a zoanthid, (I) extended zoanthids, (J) contracted zoanthids. (K) Core sample of the coral-eroding sponge *Cliona orientalis* from the central GBR with spider web-like accumulation of detritus compacted in mucus. (L) *Cymbastela coralliophila* from the central GBR reacting to a piece of another sponge, *Neopetrosia exigua*, by closing it off in a mucus bag. The fragment of *N. exigua* is dying. (M-T) Examples of sponges displaying tissue and mucus sloughing under flow through conditions in raceway aquaria and *in situ* at Orpheus and Fantome Island, central GBR. (M-O) *C. coralliophila*. (P-T) *Carteriospongia foliascens*. Photographs courtesy of: E. Büttner, F. Siebler, C. Schönberg and P. Speare.

All passive cleaning processes are expected to quickly fail in intensive sediment deposition and thick dredging plumes typical for sites close to dredging. In encrusting species the 'lotus effect' will be overridden by sediments collecting around the sides, then moving in and finally covering all surfaces. In moderate regimes of sedimentation, however, e.g. densely hispid sponges will have a selective advantage compared to other species and may represent interesting candidates for dose-response experiments.

6. Active sediment cleaning processes

Not much is published on filter feeder cleaning processes in general, but depending on species, filter feeders can remove unwanted particulate materials by surface cleaning, backflushing, phagocytosis, cell migration and selective expulsion of particles into the exhalant water stream, bypassing digestion, and possibly by morphological reorganisation (Appendix 4). However, all these processes require significant amounts of energy (e.g. Leys et al. 2011), thus depending on the levels and durations of pressures applied. In a dredging scenario, the described cleaning mechanisms would be in constant demand, causing a large energy drain that is unlikely to be sustainable. In addition to the energy drain spent on cleaning, sedimentation may reduce or incapacitate filtering efficiency and thus impact on feeding ability and energy capture, further reducing high levels of physiological functionality. If the filter feeders do not quickly succumb, they are likely to show signs of extreme physiological stress and starvation (e.g. Hill & Hill 2012, Fang et al. 2013).

6.1 Mucus production

Many marine filter feeders are able to produce mucus in significant quantities e.g. for feeding processes, to protect against adverse conditions or to clean surfaces (e.g. Flood & Fiala-Medoni 1981, Nielsen & Riisgård 1998, Bavington et al. 2004, Wotton 2005). In echinoderms, mucus contains lytic substances which can block attachment of bacteria and supports non-stick properties of the surfaces (Bavington et al. 2004). In sponges, mucus production is understood to be primarily a means of antibiosis rather than a bona fide cleaning tool (Kelman et al. 2009). In reproductive sponges that had interrupted waste removal a 'veil' developed that was interpreted as a protective mucus sheath that can be sloughed off together with accumulated adhering materials (Turon et al. 1999, López-Lengentil & Turon 2010). Mucus can also be employed more directly to remove sediments and other unwanted debris from the surface or from the aquatic system (e.g. Storr 1976a, Becerro et al. 1994, Schönberg & Wilkinson 2001). A number of workers found that heavy sediment deposition onto deep sea and coral reef sponges resulted in mucus secretion, leading to compacting and removing the debris (Gerrodette & Flechsig 1979, Barthel & Gutt 1992, Barthel & Tendal 1993, Kunzmann 1996, Bannister 2008, Bannister et al. 2012). Similar behaviour was also observed in ascidians and sea anemones (Armsworthy 1993, Armsworthy et al. 2001, Airoldi 2003), but in the ascidians the mucus velocity was slowed down to reduce the risk of clogging. Schönberg (2000) described aggregations on the surface of the encrusting, phototrophic sponge *Cliona orientalis* as compacted by mucus (Figure 5 K). Mucus as means for defence and cleaning was further seen by Büttner & Siebler (2013) for *Cymbastela coralliophila* after tissue was damaged and diseased. Moreover, when a fragment of a different sponge (*Neopetrosia exigua*) fell onto *C. coralliophila*, this fragment was encapsulated in mucus and eventually rejected (Figure 5 L). *Chondrosia reniformis*, in contrast, uses mucus to trap sediments on its surface and to incorporate them into the sponge (Bavestrello et al. 2003).

Mucus production can be a valuable indicator for sediment stress during experiments, but impacts provoking mucus excretion can be unrelated to sediments and can also involve tissue sloughing (Airoldi 2003, Turon et al. 1999). Sometimes it can be difficult to separate these processes without involving detailed analyses (Figure 5 M-T). It will also be complicated to quantify the strength or duration of mucus production or tissue sloughing, but their occurrence by itself can represent a response to sediment stress. Surface cleaning through mucus excretion is a more general reaction and more continuous than periodic tissue sloughing that appears to be the more direct response, but wearing and likely limited (Barthel & Wolfrath 1989). With chronically elevated suspended sediment loads, both processes could rapidly become overwhelmed and may be unable to keep up with ongoing pressures.

6.2 Tissue sloughing

Tissue sloughing is often related to foreign, unwanted material on sponge surfaces. Barthel & Wolfrath (1989) were the first to report tissue sloughing of the ectosome in marine sponges. They found that in response to fouling, sedimentation and enrichment with unwanted microbes under experimental conditions *Halichondria panicea* can 'moult' every three weeks, the process itself lasting two weeks. *Crambe crambe* cleans its surfaces by the rejection of surface cuticles including debris that had accumulated throughout a seasonal period of lowered activity (Turon et al. 1999). Some glass sponges seasonally slough outer spicule coats together with a thick layer of debris and detritus, which may be a means of cleaning or simply a response to starvation (Leys & Lauzon 1998). Putative tissue sloughing was also observed by Büttner & Siebler (2013) for the tropical reef sponges *Cymbastela coralliophila*, *Neopetrosia exigua* and *Carteriospongia foliascens* after handling and translocation from sandy reef environments into flow-through conditions with finer than usual materials settling onto their surfaces, and during sediment treatments (Figure 5 M-T). In *Petrosia ficiformis* sloughing occurred after freshwater inundation (Cerrano et al. 2001). However, there is very little information on sloughing to date, and it is not known how sustainable this process is over longer periods of time or with increasing exposure levels (Barthel & Wolfrath 1989).

Tissue sloughing appears to be a mechanism that is unsustainable in artificially and chronic sedimentation environments such as in areas affected by large scale dredging and construction. It is not a process that can be continued at all times and appears to require significant amounts of energy (Barthel & Wolfrath 1989, Büttner & Siebler 2013), as do cleaning processes in general (Storr 1976b). The loss of the ability of tissue sloughing would thus be a sign of extreme stress and damage to sponges and a likely precursor to mortality.

6.3 Water jets and backflushing

Some filter feeders such as ascidians can increase squirting frequency to remove sediments (e.g. Armsworthy 1993, Armsworthy et al. 2001). For sponges only one published account exists providing a similar observation for the clionaid loggerhead sponge in the Gulf of Mexico (Storr 1976b). It is not clear whether this ability is shared among other sponge taxa, but internal obstructions or sediment blockage can be removed with strong water currents in this sponge, ejecting particles from the inhalant pores. Storr (1976b) was not sure whether this was achieved by reversing the entire water stream through the sponge or by sudden contractions, which appears to be more likely because clionaids can be highly contractile (e.g. Grant 1826, Emson 1966). In any case, he clearly described clouds of turbid water being expelled from inhalant orifices with considerable force, driving the material a distance of 7-10 cm away from the sponge moments after applying sediments to the inhalants.

If this behaviour involves reversal of the choanocyte-driven current, it may not be something a sponge can repeatedly use, because even driving the normal water current consumes high levels of energy (Jørgensen 1966, Leys et al. 2011). Moreover, Vogel (1978) reasoned that a principle of one-way valves must exist in sponges to enable effective flow through their bodies, which he tested by drawing or pushing water from or into a sponge exhalant opening and found a higher resistance when pushing the water in. This thought is supported by the finding that in sponges the canal system can be very highly evolved and polarised (e.g. Bavestrello et al. 2002, Calcinai et al. 2007, Windsor & Leys 2010).

6.4 Selective retention and rejection of material during filter feeding

Many filter feeders are capable of distinguishing between 'good' and 'bad' food items and in this way can sort inhaled materials and expel unwanted particles such as sediments. Some sponge feeding studies identified which particle size their experimental species selectively filtered from the water (Appendix 4). Göbel (1993) could clearly show that solid excrements of marine demosponges of the Kiel Bight only contained particles across the range of diameters of 0.15-6 µm. Larger particles of 9.6-21.1 µm appeared in faeces of a calcarean and a freshwater sponge, but not in the other species. She reasoned that larger particles became entrapped in the narrowing canal system and were removed by motile cells before the particles could reach the choanocyte chambers, where food particles are processed for digestion, as observed by Cheng et al. (1968a and b). More recent studies often employed the comparison between sponge exhalant and ambient water. These studies suggested that a range of undigested particles can be directly expelled without detour through motile cells, including larger inorganic particles than used by Göbel (e.g. Turon et al. 1997, Yahel et al. 2007, Topçu et al. 2010). Especially in sponges this ability to discriminate between 'suitable food' and other 'non-food particles' appears to be highly evolved, because they can even distinguish ambient bacteria – which are digested – from symbiotic bacteria – which are not digested (Wilkinson et al. 1984). Similar processes were observed for bivalves. *Arca zebra* for example selectively rejected material with higher carbon content in favour of material with higher nitrogen content thus increasing the food quality (Ward & MacDonald 1996). This ability presents a very good means to directly reject inorganic resuspended sediments in favour of digestible food and to minimise the energy drain associated with the processing of unwanted materials. However, even this mechanism will fail under sediment concentrations associated with dredging, because some filter feeders were shown to reduce clearance rates or arrest pumping as a response to increased TSS, especially as reaction to fine materials (e.g. Loosanoff & Tommers 1948, Reiswig 1971, 1973, Gerrodette & Flechsig 1979, Bricelj & Malouf 1984, Wilber & Clarke 2001, Tompkins-MacDonald & Leys 2008), and oysters were reported to reduce pumping when the ratio of sediments : living cells increased (e.g. Loosanoff & Tommers 1948). With the high suspended sediment levels associated with dredging, filter feeders may have significantly reduced pumping rates to avoid canal obstruction, but may still eventually clog, because pumping drives cleaning by selective retention (Yahel et al. 2007). Oysters appeared to be the only filter feeders published as tolerant of particle concentrations at dredging sites as long as not becoming entirely buried (Morton 1977).

6.5 Phagocytosis followed by removal or digestion

Phagocytosis can be used for the removal of unwanted materials. Most sponge cell types have the ability to take up particular material by phagocytosis and to break it down. Bavestrello et al. (1995) found that *Chondrosia reniformis* cells are able to etch diatom frustules and interpreted the observation as a cleaning process. Diatoms in Antarctic sponges remained on the external sponge surfaces during winter, but were taken into the sponges during phytoplankton bloom in summer, with evidence that they were used as food (Gaino et al. 1994, Cerrano et al. 2004b and c). Cheng et al. (1968a and b) observed that particles caught in choanocytes, obstructing narrow passages of the canal system or entering the endosome will be taken up into cells, which then either digest the particles or migrate and transport them to parts of the aquiferous system with wider channels. Here, the cells egest particles or waste products and release them into the exhalant stream to be ejected from the osculae. This process depends on the particle size.

Particle removal at cellular level requires amoeboid cell movement. Using time-lapse video Bond (1992) provided detailed insights on sponge cell motility, observing the behaviour of different cell types in sponges. He and other workers determined that sponge cells moved at speeds of 2-22 µm min^{-1} (Kilian & Wintermann-Kilian 1979, Teragawa 1986a and b, Bond 1992, Bavestrello et al. 2003, Custódio et al. 2002). However, cell inclusions slowed cell movement down. Therefore, the process is limited by particle concentration and expected to be impaired under the extreme conditions at dredging sites.

6.6 Re-organisation of the canal system

All main physiological functions in sponges depend on an operative canal system (feeding, excretion, respiration, reproduction). Clogging of the canal system is expected to severely impact on the sponges' functioning and survival, and retaining an open passage is vital. Some of the mechanisms described above can be used to remove particles from the canal system (mucus, backflushing, phagocytosis), but they may not be sufficient to counteract substantial blockages. McDonald et al. (2003) reported on the re-organisation of a sponge's canal system. They reasoned that this can be used to avoid particle uptake or to re-establish flow after severe obstruction, a suggestion that was shared by Ilan & Abelson (1995). Presumably, this process would require a significant amount of energy and a temporal disruption of the main water current through the sponge and may thus only be feasible at rare occasions or for localised blockage, as a last resort or in combination with sponge seasonal resting phases. However, Bond (1992) observed that continuous restructuring processes occur in the freshwater sponges

Ephydatia fluviatis and *Spongilla lacustris*, and the marine *Chalinula loosanoffi* (as *Haliclona*), thus re-organisation may be more common than expected. This may occasionally include reversal of body polarity, which is a highly regulated feature in sponges enabling e.g. unidirectional flow (Bavestrello et al. 1998, Calcinai et al. 2007, Windsor & Leys 2010).

7. Resuspended sediments

Trawling and dredging significantly contribute to sediment resuspension (e.g. Morton 1977, Williamson & Nelson 1977, Churchill 1989), which remains challenging to measure (e.g. Bloesch 1995). Trawling-related resuspension of sediments is comparatively short-lived unless it is repetitive or involves larger fleets, while sediment plumes due to dredging from a capital dredging project could be sustained for months or even years, thus creating more severe conditions (e.g. Churchill 1989). Filter feeder responses to sediment resuspension may be easier to monitor than responses to some other effects (see below). Rapid, measurable feedback to elevated TSS includes: increased respiration, changed pumping behaviour, arrested pumping, closed pores and clogged canal systems. Mid- to long-term responses can be recognised by bleaching, changes in pore and choanocyte size and density, altered morphologies and a changed species composition that may display a reduced number of phototrophic species. This provides a large range of possible control and a potential for early recognition of stress caused by turbidity. The response values also develop in a gradual fashion, which should enable assessments of effect severity, i.e. contrasting minor against sublethal, potentially reversible against substantial, permanently damaging responses. Many responses will be chiefly regulated by respiration intensity, pumping speed and compositions of microbial communities, the former two of which may be measured directly *in situ*, the latter requiring laboratory analyses.

7.1 Resuspension of sediments providing additional nutrients

Resuspending sediments can release nutrients into the water column that would otherwise not be accessible to sessile filter feeders (e.g. Morton 1977, Williamson & Nelson 1977, Bloesch 1995, Flach et al. 1998), and increased nutrient concentrations are generally thought to have positive or even stress-reducing effects on filter feeders, especially on sponges (e.g. Wilkinson & Cheshire 1989, Wilkinson & Evans 1989). However, nutrients added into the system by sediment resuspension will be accompanied by inorganic particles that cannot be digested, and organisms will have to rely on their abilities to select between ‘edible’ and ‘inedible’ or to remove and excrete surplus materials, which may cost considerable amounts of energy (see Section 6.4). Moreover, resuspended sediments are not necessarily nutritious, but at the same time tend to be of relatively fine grain size (Anderson & Meyer 1986), which increases the negative effects for filter feeders and further elevates the costs of excretion and cleaning. Responses and effective benefits will strongly vary case by case.

Related processes are perhaps best studied in bivalves (selection of references in Appendix 4), where the balance between benefit of increased nutrition versus energy loss e.g. through accelerated or selective production of pseudofaeces is dependent on species and life stage (Morton 1977, Bricelj et al. 1984, Ward & MacDonald 1996, Wilber & Clarke 2001). Oysters in particular appear to be comparatively tolerant against unwanted particles of various nature and can thus continue to feed in turbid waters, even in close vicinity to dredging projects (Loosanoff & Tommers 1948, Morton 1977, Ward & MacDonald 1996). Clearance rates declined with higher concentrations of bottom sediments for *Mercenaria mercenaria* as a means to control ingestion (Bricelj & Malouf 1984), but in ascidians absorption rate increased together with reduced absorption efficiency (Armsworthy 1993, Armsworthy et al. 2001).

Trade-off scenarios between increased nutrients *versus* increased costs via excretion and cleaning are not well studied in sponges, but the verongid sponge *Aiolochroia crassa* was observed to spend more energy in cleaning with increased sediment availability in the field (Storr 1976b), and elevated respiration in *Rhopaloeides odorabile* treated with sediment suspensions also suggested increased energy demand (Bannister 2008, Bannister et al. 2012). A number of sponge species displayed very efficient selectivity for choice of food items and were able to avoid or immediately reject unwanted particles, reducing maintenance costs (e.g. Wilkinson et al. 1984, Pile 1999, Yahel et al. 2007).

Overall, added nutrients from resuspended sediments via dredging are thought to be only beneficial for filter feeders at low turbidity levels, because at increasingly higher turbidity the nutrient gain could rapidly be outweighed by maintenance costs. Dredging is most often performed in nearshore areas where eutrophication may increase the margin of beneficial effects, however terrigenous sediments predominate, which have previously been identified as detrimental to feeding and settlement in sponges (Bannister 2008, Bannister et al. 2012).

Bioeroding sponges are thought to be good biomonitors for studies investigating the nutrient value of resuspended sediments and the trade-off with energy loss by unwanted particles. On one hand many bioeroding sponges appear to be sediment tolerant or even endopsammic (Schönberg pers. obs.), on the other hand, clear relationships have been identified between bioeroding sponge abundances and diversities and levels of eutrophication (e.g. Muricy 1991, Carballo et al. 1994, Holmes 1997, 2000). They are also excellent candidates for aquarium studies (e.g. Wisshak et al. 2013, 2014, Fang et al. 2013, 2014).

7.2 Contamination, release of toxins and oxygen depletion by sediment resuspension

Resuspension of bottom sediments near harbours and industrialised sites may release toxic materials (e.g. Morton 1977, Williamson & Nelson 1977, De Groot 1979, Bloesch 1995, Anchor Environmental 2003). Dredging for enlargement or deepening of existing harbours and ports bears a high risk of dispersing accumulated contaminants including metals, carcinogenic compounds such as dioxin and other herbicides and pesticides, organochlorine compounds such as polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs), especially petroleum-derived PAHs (Coleman et al. 1999, Dillon et al. 1995, Turner et al. 1997) and even radioactive material (e.g. Bloesch 1995). Any drilling activities will produce contamination contained within fine drilling mud (Glover & Smith 2003). Contaminants will be gradually stripped from the water column by natural processes, will be biologically concentrated and accumulated (Appendix 5, see e.g. Dillon et al. 1995, Anchor Environmental 2003), with filter feeders entering this process at an early stage. Sponges are not as extensively studied in this context as for example molluscs (e.g. Morton 1977), but along environmental gradients species richness and heterogeneity of sponges and other filter feeders decrease towards the polluted sites (see also Muricy 1991, Carballo et al. 1996, Turner et al. 1997, Ammar et al. 2007), while physiological biomarkers increase (e.g. Berthet et al. 2005). Heavy metal contamination can cause a shift from solitary ascidian-dominated communities to domination by colonial ascidians, sponges, erect bryozoans and hydroids (Turner et al. 1997). Long-lived sessile filter feeders are thought to be good biomonitors for metal contamination (Saby et al. 2009). Physiological functions may be changed or impaired by toxic effects from metal pollution (Morton 1977, Saby et al. 2009), e.g. sponges may exhibit reduced clearance rates (Cebrian et al. 2006, 2007) and ascidians lowered reproduction success (Bellas et al. 2001). PAHs and certain metals can decrease cell motility in sponges, speed up or inhibit settlement of sponges or incur mortality of sponge recruits (Cebrian & Uriz 2007a, b and c). Most metals, pesticides, herbicides and fungicides especially affected filter feeder early development and may inhibit their growth (e.g. Morton 1977, Wilber & Clarke 2001, Bellas et al. 2004, Blidberg 2004). Some sponges can selectively accumulate certain trace elements, especially heavy metals, and where this can be linked to environmental conditions they can be used as pollution indicators (e.g. Araújo et al. 2003, Cebrian et al. 2006, 2007, Gomes et al. 2006). Good bioindicators for various metals include the sponges *Clathria (Axosuberites)* sp., *Cliona viridis*, *Crambe crambe, Dysidea avara, Homaxinella balfourensis, Mycale* spp., *Phorbas tenacior, Rossella* sp., *Sarcotragus fasciculatus, Sphaerotylus antarcticus, Spheciospongia vagabunda*, *Spongia* spp., *Tedania* sp. (Bargagli et al. 1996, Araújo et al. 2003, Cebrian et al. 2003, 2007, Negri et al. 2006, De Mestre et al. 2012, Padovan et al. 2012), for arsenic *Erylus discophorus, Sarcotragus* spp., *Scalarispongia scalaris, Spongia* spp., *Stelletta anancora* (Araújo et al. 2003), and for halogens *Sarcotragus fasciculatus* and *Spongia* spp. (Araújo et al. 2003).

Construction work in or near existing harbours clearly carries the risk of contaminant release (e.g. Coleman et al. 1999), which could add to the pressure exerted by the sediments themselves and is thought to impact on vital physiological functions. For example, contaminants can cause reduced filtering efficiency, but this is presently not adequately understood (Cebrian et al. 2006, 2007). Morton (1977) recommends prevention of contaminant dispersal into the marine environment by the spoil being placed into dyke enclosures, where the particles can settle out, or to use the material to create new wetlands and marshes, for agricultural enhancement, or as building material.

Resuspending fine bottom materials may also mix anoxic sediment layers into the water column which can result in short-term depletion of oxygen (e.g. Morton 1977, Williamson & Nelson 1977), occasionally causing the death of vulnerable life stages (e.g. Jones 1992). However, Hoffman et al. (2008) reported that sponges can shut down pumping and tolerate anoxic conditions within their tissues, which may allow them to cope with temporary anoxia in the water column. Bell and Barnes (2000b) identified a number of sponge species that appear to be very anoxia tolerant as they occur at sites that experience seasonal anoxia by the formation of thermoclines. Some bivalves can also tolerate low oxygen concentrations or remain closed for limited periods of time (e.g. Boyd 1999). Shutting down during phases of anoxia means arrested pumping, with affected filter feeders unable to replenish resources or to keep up with sediment build-ups through activities related to pumping.

7.3 Shading

Resuspension of fine sediments causes turbidity, which affects light penetration, light quality and heat radiation in the water column (Morton 1977, Williamson & Nelson 1977). Sponges as well as other filter feeders harbour unique communities of microbes not usually found in the water column or ambient sediments, which are vital to their wellbeing (e.g. Hentschel et al. 2002, Fang et al. 2013 and 2014). For example, the common and prominent barrel sponge *Xestospongia muta* was able to experience and survive cyclic bleaching as long as it retained its sponge-specific symbiont composition of ammonia-oxidising Archaea, but when its microbial community became more similar to that of the environment, the sponge died (López-Lengentil et al. 2010). Many sponge symbionts are phototrophic (Fromont et al. 2015), and symbioses with cyanobacteria appear to be by far the most common and predominant (Wilkinson 1980, Vacelet 1981, Rützler 1990, Díaz et al. 2007). Every sponge order has at least a few species of so-called 'cyanosponges' (Usher 2008, Fromont et al. 2015), and Lemloh et al. (2009) stated that these would usually make up >60% of a given sponge community. Dinoflagellate symbioses with *Symbiodinium* spp. predominantly occur in the Clionaida (e.g. Schönberg & Loh 2005, Schönberg & Suwa 2007, Hill et al. 2011). Resuspended particles and a sediment cover on the surfaces of sponges and other filter feeders will cause shading, which may negatively impact on the phototrophic symbionts of filter feeders and in consequence on their physiology (e.g. Olson 1986, Arillo et al. 1993, Thacker 2005, Schönberg & Suwa 2007). However, in Taiwan abundances of *Haliclona* sp. associated with rhodophytes increased hundredfold during a three year dredging project and then returned to earlier levels (Su et al. 2009). Many photosymbiotic filter feeders appear to have an optimum light environment in which they preferentially occur or perform better, with ascidians distributed in microhabitats suitable to their light adaptation, and *Didemnum molle* producing a denser skeleton in shallow, more light-diffused water (e.g. Hernández-Mariné et al. 1990, Hirose et al. 2006). Field transplanting experiments of sponges with respect to light resulted in reduction of chlorophyll concentration when brought deeper (e.g. Becerro & Paul 2004) and bleaching when brought into shallow water (e.g. Hill & Wilcox 1998). The reduction in chlorophyll or symbiont concentrations can occur through host digestion during times of increased energy demands during seasonal events or illness associated stress (e.g. Rosell 1993, Cebrian et al. 2011, Hill & Hill 2012), circumstances that may also apply to increased turbidities. One of the most extreme examples published on light relationships of sponges describes shrinking, metabolic collapse and mortality in the cyanosponge *Chondrilla nucula* when transplanted into dark caves (Arillo et al. 1993).

Regardless of whether they harbour photosymbionts or not, many sponge species are known to exist or even be more abundant in turbid waters (see tolerances/intolerances listed for separate species in Appendix 2; e.g. Wilkinson & Cheshire 1989, Azzini et al. 2007). Keratose and verongimorph sponges tend to be less tolerant of sediment resuspension, whereas numerous sponges with spicular skeleton appear to better tolerate turbid conditions (Wulff 2001). However, turbidity levels near dredging sites are significantly higher than natural turbidity levels and last longer than extreme turbidity events such as caused by storms (Morton 1977). Shading due to dredging is expected to strongly affect photosymbiotic sponges, to cause shifts in the microbial composition and ultimately lead to loss of photopigments (bleaching), with significant implications to the sponges' physiologies and their survival (e.g. Cebrian et al. 2011). While many sponges appear to be obligately mutualistic, few sponges may be able to shift their feeding strategy from phototrophic to purely heterotrophic filter feeding, which may not necessarily recover required energy budgets (Arillo et al. 1993, Fang et al. 2014). Consequences will be reversible and less severe if part of the symbiont community can be retained or recovered.

Dredging plumes are thus likely to have a strong selective effect on communities with phototrophic organisms. Natural turbidity from river run-off was noted in different environments to affect the occurrence or zonation of various benthic biota. While coral, mollusc and algal diversities and abundances can be observed to decrease with turbidity, effects on sponge distributions were not always as obvious (e.g. Adjeroud 2000), which can sometimes be explained with co-occurring, favourable conditions such as strong currents (e.g. McDonald et al. 2002). In other studies natural turbidity gradients were found to affect sponge distributions, with more phototrophic sponges offshore or in shallower water (e.g. Wilkinson & Cheshire 1989, Bannister et al. 2010). A cold-water study in Alaska showed an inverse correlation between amount of suspended sediment and benthic species richness, including sponges, which were more common and diverse in clearer waters (e.g. Carney et al. 1999).

7.4 Resuspended particles interfering with the feeding apparatus

High loads of resuspended sediments are thought to obstruct the feeding apparatus of filter feeders (Appendix 4) and can lead to the embedment of large pockets of sediments within the sponge body (cover photograph), either requiring energy to remove obstructions or effectively inactivating parts of the canal system (see Section 6.4; Bakus 1968, Barthel & Tendal 1993, Tompkins-MacDonald & Leys 2008). The sponge canal system is vital to sponges and highly regulated (Windsor & Leys 2010). It controls feeding, oxygen supply, waste removal and the transport of gametes. Sponges cannot survive if large parts of the canal system are incapacitated.

Bannister et al. (2012) showed that high levels of TSS are stressful for *Rhopaloeides odorabile* and that differences in particle quality or possibly grain size may have different effects on its physiology. During a 7 h exposure, clay and carbonate particles caused a steady trend, elevating respiration over time, with the smaller clay particles having a slightly more pronounced effect. Using clay in a 4 d exposure, respiration increased by 43% after 24 h and remained high for 2 d, possibly showing signs of partial acclimatisation after that and fully recovering to low respiration rates after termination of the treatment. Overall, the feeding efficiency of sponges appears to be significantly reduced by suspended sediments. Kowalke (2000) studied *Mycale acerata* and *Isodictya kerguelensis* in naturally turbid environments and argued that the sponges avoided clogging of their filter systems by reducing particle retention to less than 100%. Gerrodette & Flechsig (1979) found that levels of suspended clay as low as 11.1 mg L^{-1} caused a reduction in pumping activity in *Verongia lacunosa*, which dropped to 60% efficiency at 95 mg L^{-1}. Reiswig (1971, 1973) observed lowered *in situ* pumping rates in *Verongula gigantea* and a *Mycale* sp. when sediments were resuspended after storms. Tompkins-MacDonald & Leys (2008) noted that glass sponges responded to very low concentrations of fine, inorganic sediments with immediate arrest of pumping. The above studies indicate that reduced or arrested pumping was likely a means to avoid clogging. Another strategy to lower the risk of clogging is the reduction in the number of choanocyte chambers (Luter et al. 2012), but this is achieved over a longer period of time, while pumping can be switched off and back on within minutes to days (e.g. Reiswig 1971, Pile et al. 1997, Tompkins-MacDonald & Leys 2008).

During arrested pumping the tissue quickly becomes anoxic, with the exception of a thin surface layer, which receives oxygen from molecular diffusion (Hoffmann et al. 2008). Hoffmann et al. (2008) described the case of *Aplysina aerophoba*, which can refrain from pumping for hours to days, reducing the oxygen consumption by a third to a fourth of the normal rate. Considering that pumping activity may cost sponges as much as 30% of their total respiration (Leys et al. 2011), the occasional switch to arrested pumping may be of advantage to those sponges that can benefit from their association with anaerobic microbes (Hoffmann et al. 2008 and 2009), but extended or repetitive periods of reduced or arrested pumping in sponges without such a microbial community will result in disadvantages such as stunted growth, possibly in partial necrosis due to anaerobic tissue portions, and lower reproductive output (Gerrodette & Flechsig 1979). If this behaviour is furthermore coupled with a layer of sediment interrupting the remaining oxygenation via diffusion across the surface (Hoffmann et al. 2008), then the problem is aggravated. Pumping cannot be stopped for the duration of a dredging project, and sponges near dredging sites are expected to experience clogging when they have to resume pumping (e.g. Tompkins-MacDonald & Leys 2008). Once clogging occurs it requires energy to be removed (e.g. Storr 1976b). Due to reduced or arrested pumping rates, however, such an increased energy need cannot be met.

7.5 Scouring

Under natural conditions abrasion or scouring results from strong currents that grate resuspended sediments against sessile biota, a process that can remove entire organisms or may cause significant loss of their surface tissues, and in consequence exposes the organisms to disease (Appendix 6; e.g. Airoldi 2003, Stevely et al. 2011). This risk is especially large during severe storms, when the particle size of agitated material is larger than usual and waves can smash coarse debris and boulders across existing habitats, sometimes erasing entire reefs (e.g. Schönberg & Burgess 2013). Chronic scouring can induce responses in sponges such as reinforcement of the inorganic skeleton throughout or especially at surface layers (Palumbi 1984, 1986, Schönberg & Barthel 1997, McDonald et al. 2002, Schönberg 2015) or firmer attachment and a more flattened morphology (e.g. Mercurio et al. 2006 for *Geodia cydonium*). Recurrent or sustained scouring may reduce species diversity and abundance of benthic organisms (Zühlke & Reise 1994).

However, some sponges are assumed to be more resistant against scouring than others, e.g. *Cliona varians* and *Spheciospongia vesparium* (Alcolado 2007, Stevely et al. 2011), which suggests that if scouring occurs over longer periods of time the community structure may be affected. However, as sediments resuspended during dredging projects are mostly of a very fine grain size they are not thought to cause as severe scouring effects as from larger particles and are less likely to incur the described changes.

8. Sediment deposition

Under any natural setting, the direct influence of sediment deposition is difficult to recognise and to separate from co-varying factors (e.g. McDonald et al. 2002), and methods to measure separate factors may at times be challenging (e.g. Bloesch & Burns 1980, Butman et al. 1986, Baker et al. 1988). Natural episodes of high sedimentation and sediment resuspension in the marine environment are either co-occurring with reduced salinity and increased nutrient levels (river plume or coastal runoff during the rainy season; e.g. McClanahan & Obura 1997, Airoldi 2003, Hutchings et al. 2005), are accompanied by herbicide runoff or the release of toxic contaminants into the water column (e.g. Lovell & Trego 2003, Vianello et al. 2005), or are coupled with increased wave action and water movement, incurring scouring and other damage (storms; e.g. Stevely et al. 2011). Due to all these circumstance there are generally no applicable baseline data on how sponges react to naturally occurring fine sedimentation, although approximate separation and appraisal of various factors is possible in experimental conditions (e.g. Connell 2003, 2005).

8.1 Light to heavy sediment deposition resulting in partial sediment cover

Major concerns during dredging and drilling operations revolve around smothering effects by large amounts of sediments settling out of the water column and collecting on the surfaces of sessile macrobenthos or even burying them (e.g. Jones & Candy 1981, Poiner & Kennedy 1984). The few results available from impact studies directly related to dredging often remained inconclusive. Crowe et al. (2010) assessed whether dumping of dredging-generated sediments affected bottom fauna at the dumping site and found decreases of macrobenthos at both the affected and the control sites. Their data were gleaned from underwater video and were not further analysed for signs and symptoms such as necrosis, and the reasons for the overall reduction in benthos remained unexplained. Carballo (2006) and Carballo et al. (2008) found natural sediment deposition of medium and coarse sand to affect the composition of a sponge community where diversity and abundance was reduced and large morphologies were replaced with small, mainly encrusting or bioeroding forms. In a separate study, Venezuelan sponge densities, coverage, growth and survival were found to be highest with lowest sedimentation rate and highest substrate heterogeneity (Núñez Flores et al. 2010).

Responses to sediment cover strongly vary between species (Appendix 6). Sponges that are expected to be more resilient to sediment deposition are endopsammic sponges, erect sponges with a low amount of horizontal tissue area and those with pores on elevated body parts (e.g. Bell 2004), those that can tolerate or even actively accumulate sediment on their surfaces (e.g. tetractinellids), and those that can keep their surfaces free of sediments with comparatively little effort (e.g. by the 'lotus effect' or by epibionts; see Section 5; Schönberg 2014). In any scenario terrestrial sediments often cause more serious effects than marine sediments (e.g. Bannister et al. 2012), fine sediments are more deleterious than coarse sediments that still allow fluxes to and from the organism's surface and can more easily be cleaned off (Weber et al. 2006, Büttner & Siebler 2013), and responses can differ with nutrient content (e.g. Weber et al. 2006, Maldonado et al. 2008). This was supported by observations during fieldwork at a shallow, very turbid site at Onslow, NW Australia, characterised by very fine fluvial sediments (Semeniuk 1993), where a high proportion of the sponge community was patchily covered with fine sediments and was strongly represented by endopsammic sponges (Schönberg pers. obs.).

Natural observations of sediment cover are usually due to storm-generated sediment deposition onto the surfaces of sponges. The few available experimental results were almost never based on dosage and threshold approaches. Rapid responses to sediment cover in sponges included closure of pores (e.g. Gerrodette & Flechsig 1979), tissue retraction (e.g. Luter et al. 2012) and a large variety of cleaning processes (Appendix 3). These responses were temporary and usually reversible within hours to days. Chronic sediment cover led to closure of surface pores (e.g. Wulff 2008), changes in overall morphology (e.g. Bakus 1968, McDonald et al. 2002), could cause paling in sponges with phototrophic symbionts (e.g. Büttner & Siebler 2013), disease, necrosis and rapid tissue rot (Fenner 1991, Wulff 2008, Bannister et al. 2012, Büttner & Siebler 2013), also leading to maceration, mortality and disintegration within days in fragile species (e.g. Fenner 1991, Bett 2000, Wulff 2008). Recovery is possible if mortality is partial. *Tethya aurantium* was able to reject portions of tissue that died due to sediment deposition, retaining the healthy parts (Connes 1967, Fenner 1991 as *T. lyncurium*). This was also observed by Büttner & Siebler (2013) for different species of coral reef sponges.

8.2 Burial

Burial is the most extreme form of sediment cover. The gorgonian *Leptogorgia virgulata* grew faster when buried in sand (Airoldi 2003). Responses by sponges, however, varied in severity depending on grain size, depth and duration of burial (Wulff 2008), and with any condition that allows more ventilation reducing the damage. It is expected that sponges that can tolerate extended periods of arrested pumping and anoxia in their tissues may survive temporal burial (e.g. Hoffmann et al. 2008), but most commonly sponges will perish within hours to days due to smothering and lack of oxygen (e.g. Bakus 1968, Wulff 2008; Appendix 6), especially when buried in fine sediments generated by dredging. Some tetractinellids can withstand burial for a few weeks. For example, *Cinachyrella apion* survived over two weeks of burial in reefal sediments, but culturing this species in suspensions of 49, 101, 165, and 199 mg L^{-1} of clay-like sediments resulted in discoloured tissue under 1 mm thick sediment layers deposited onto the sponge (Rice 1984).

Sediment deposition will thus cause a range of measurable responses in filter feeder communities such as: discolouration (caused by bleaching or disease), necrosis, tissue maceration and mortality, proportional mortality per taxon or growth form, amount of embedded sediment in organisms (in species that do not usually embed sediments, or change of grain size of embedded materials in species that do). Observations of cleaning strategies may provide an indication how much energy will have to be expended to sustain the community, species or individual during the dredging impacts, processes which may be monitored with respirometry.

9. Direct effects of dredging equipment

9.1 Partial damage

Dredging involves the use of heavy equipment that will inflict mechanical damage to local benthos (Appendix 7; see e.g. Anchor Environmental 2003, Chevron Australia 2012). However, due to their considerable healing properties, sponges are often not as badly affected by fragmentation as other benthic organisms (e.g. Boulcott & Howell 2011). Trailer suction hopper dredges and cutter suction dredges are likely to cause most damage by their 'wear pads', reducing habitat complexity and destroying 75-100% of the benthos (Blair et al. 1990). To sponges, squashing and squeezing apparently has the worst consequences and leads to rapid tissue death and disease, with following loss of the affected part and scarring, or with mortality of the entire sponge if the sponge is small or highly organised (Büttner & Siebler 2013). Effects of breakage and clean cuts are significantly less severe and can heal within a few days (Büttner & Siebler 2013). Highly organised and soft-bodied sponges, or those with low spongin content are often the most vulnerable to be physically damaged by heavy equipment and will suffer greater losses (e.g. Barthel & Gutt 1992, Freese et al. 1999, Austin et al. 2007, Boulcott & Howell 2011, Büttner & Siebler 2013). Concave wounds on upper surfaces of sponges will quickly fill up with sediments, and although some species can encapsulate and embed such materials, it is not known whether this is a general response or whether it is restricted to only a few species (Hoffmann et al. 2004). While regeneration capabilities of partially damaged sponges also depend on favourable environmental conditions and the organism's regeneration abilities (e.g. Henry & Hart 2005), many sponges have an enormous potential for rapid healing and regrowth as long as they do not become afflicted with disease or parasites (e.g. Ayling 1983, Henry & Hart 2005, Wulff 2010, Schönberg & Wisshak 2012, Büttner & Siebler 2013). In addition, some sponge species can benefit from fragmentation, leading to enhanced dispersal and increased abundance (e.g. Alcolado 2007). The survival of a given fragment strongly depends on whether it remains attached or can quickly reattach. Attached basal portions of sponges can often recover, regenerating into functional sponges (Fenner 1991, Schmahl 1999, Ávila et al. 2011). However, reattachment of loose fragments at dredging sites is very unlikely to occur, as suitable substrates will be covered in sediments. In this case, loose fragments have a high risk of being washed around, which will cause abrasion and reduced health (see Section 7.5), unless they are adapted to these living conditions. Without the ability to right themselves in time and to orient their pores in a way that minimises uptake of unwanted particles, these fragments will eventually be covered and smothered by sediments settling out. This is likely to select for fast-growing, weedy species. There are no recommendations for mitigation.

9.2 Removal and mortality of entire organisms, dislodgement

Damage and removal of entire organisms can cause loss in habitat complexity and biodiversity at community level (Appendix 7; Auster et al. 1996, Pitcher et al. 1999, Conway et al. 2001, Beazley et al. 2013). Not much is known about dredging-related damage to sponge habitats, however, publications on effects of trawling are comparatively well documented (e.g. Conway et al. 2001, Krautter et al. 2001, Jamieson & Chew 2002, Ardron et al. 2007, Austin et al. 2007 and references in these publications). These publications suggest that sponges together with soft corals are easily removed as whole specimens by trawling equipment, while branching gorgonians were at intermediate risk and sea whips resisted removal. Total removal of sponges results when they are detached together with the substrate they used as an anchor (e.g. Jaap 2000, Ávila et al. 2011), a situation that is likely to lead to survival if not removed from the water. However, most sponges sampled from the subtidal will not tolerate exposure to air, even when quickly returned to the sea. They have a very low chance of survival, because they draw in air and develop air embolisms that efficiently interrupt their pumping abilities (Göbel 1993). When eventually sinking back to the bottom, sponges rapidly die from such embolisms or from disease, decompose or are eaten by scavengers (Hill & Wassenberg 1990, Hutchings 1990). Unattached filter feeders can be swept into unfavourable environments and are exposed to the same risks as unattached fragments (see Section 9.1 above; Wulff 2006). Even healthy unattached sponges in their original environment sometimes grow slower than attached sponges and have a higher risk of mortality (Bell & Barnes 2002). In the order Tetractinellida, however, several species are known that commonly live unattached and that are protected by a crust of pebble-sized, agglutinated particles, and these will have a large chance to survive if dredging equipment would dislodge them (Schönberg 2015).

Partial and total removal of benthos and alteration of sediment conditions will ultimately change entire benthic communities (e.g. Auster et al. 1996, Tudela 2000, Ardron et al. 2007, Ash & Collie 2008). There is only limited information about direct effects of dredging equipment, but assuming damage is similar to that caused by trawling, the community effect will be localised but significant. Depending on the equipment used, between 15 and 89% of the benthos can be destroyed, particularly reducing the abundance of sponges (e.g. Hutchings 1990, Moran & Stephenson 2000, Kollmann & Stachowitsch 2001, Gaspar et al. 2009), and in consequence the abundance of organisms associated to sponge habitats, including commercial fish (e.g. Du Preez & Tunnicliffe 2011, Sainsbury et al. 1992, 1997). Any specimens surviving physical damage and dislodgment will then have to resist burial, smothering and abrasion by mobile sediments. These loose specimens may be washed around and will need to arrive on suitable substrate and have the capacity to reattach rapidly. Re-attachment of sponges is facilitated by coarser sediments and the occurrence of firm substrates (Mercurio et al. 2006), an unlikely benthic environment at dredging sites.

10. Recovery processes

Recovery of filter feeders in denuded areas can be very slow, especially when the original substrate conditions have been changed (Appendix 7; Pitcher et al. 1999). Reports and publications available on damage by fishing gear suggest that even a decade after such impact, not all habitats recovered to their original state (Appendix 7; e.g. Van der Veer et al. 1985). While fishing damage represents a short-term, but often recurring pressure, thus preventing continuous recovery, dredging for construction work may concern a smaller area, but may extend over months to years. Moreover, subsequent maintenance dredging is often required (e.g. Chevron Australia 2012), and dredging impacts may thus generate significantly different trends in habitat recovery than those are known from fisheries studies.

Within the guild of filter feeders, sponges may be more resilient than other taxa, because many species have enormous healing and regrowth abilities (Appendix 7), and some sponges can outlast adverse conditions with environmentally tolerant resting bodies, the gemmules (e.g. Schönberg 2002). However, growth rates are extremely variable between species (Appendix 7; e.g. Wulff 2005). Tubular sponges were observed to grow faster than vasiform sponges (Walters & Pawlik 2005), and demosponges grow faster on average than hexactinellids, which in turn grow faster than calcarean sponges or sclerosponges (Appendix 7). Species predominance at disturbed sites will thus depend on early re-establishment of the species that grow fastest.

Where tissue remnants cannot regrow and dislodged sponges cannot reattach, the scarred seabed will have to be recolonised from neighbouring populations, which is a slow process, especially if this population is affected by the spreading dredging sediments (e.g. Morton 1977, Van der Veer et al. 1985). Recolonisation will thus be strongly influenced by the resulting water quality and altered substrate conditions (e.g. Jaap 2000, Henry & Hart 2005). Even though the process is slow (1-2 years for reef sponges, e.g. Jaap 2000; few decades in the deep sea, e.g. Jones 1992), basic re-colonisation is usually quicker than returning to a situation that resembles original conditions, including functional and ecological recovery (McCauley et al. 1977).

Overall, the progress of recovery is expected to be slow, less due to growth and dispersal capabilities of the filter feeders and more so because of altered habitat conditions and reduced pool of reproductive specimens. The community structure may change in a measurable way, favouring weedy species with fast growth and species that can tolerate high levels of sedimentation.

Suitable bioindicator species for experimental work and field assessments should be sought within slow-growing filter feeders that are susceptible to fragmentation or other physical damamge. For example, spirophorine sponges would be excellent indicators for squeeze damage (Büttner & Siebler 2013).

Mitigation may include the restoration of representative and habitat-forming parts of the community by moving explants to a neighbouring site sheltered from sedimentation to act as reservoir for resettlement. However, this is considered to be an unjustifiable effort not usually feasible, especially not if the dredging will take place in depths below SCUBA diving.

11. Ecological windows

As discussed above, dredging may have a large number of effects on filter feeders. Such effects will vary over time, either with life stage or seasonal fitness of the filter feeders, and through seasonal environmental conditions that can aggravate or ease the situation. It would be desirable to recognise and identify some of these interactions, allowing a safer and more efficient way to develop recommendations and guidelines (EPA WA 2011).

Sponge reproduction will very likely be significantly affected by the expected shift in water quality (e.g. see Whalan et al. 2007, Abdul Wahab et al. 2014). Reproduction is a costly physiological process, requiring much energy at the expense of other physiological processes (e.g. Sidri et al. 2005, Rosell 1993). If a sponge is struggling with environmental conditions or if its feeding process is impaired, it is unlikely that the full scope of reproductive output can be reached. In NW Australia, sponges predominantly reproduce between February and March (Fromont 1999, Fromont et al. pers. obs. for Onslow), a period when heat may become an additional stress factor (NOAA 2013). Light reduction by elevated TSS may impact on brooding sponges that appear to favour sunrise for larval release (Maldonado 2006 and references therein). Sponges that spawn gametes can base the timing of release on lunar cycles which may also be hampered by high turbidity (Maldonado 2006 and references therein).

Larvae do not yet filter feed, and sediments are thought to be more relevant for their mobility, orientation or settling abilities. Sponge larvae swim with the aid of ciliae that may become clogged with the fine dredging sediments (Maldonado 2006 and references therein). During their swimming phase, sponge larvae are often phototactic (Maldonado 2006 and references therein), a sense that may be impaired by light reduction in dredging plumes. Most sponges need solid substrate to settle on, others have a higher settlement success on coarser than on finer sediments, and a cover of fine sediments typically developing at a dredging site is regarded as unsuitable for settlement (e.g. Maldonado & Uriz 1999, Hutchings et al. 2005).

Once settled, juvenile sponges are critically vulnerable against smothering, as metamorphosis involves flattening and spreading of the larva, forming a small patch that best resembles a very small encrusting sponge (Maldonado 2006 and references therein). Just a low level of sediment deposition or a motile animal pushing some fine sediment onto their surfaces may kill juvenile sponges, as their entire surface is likely to be covered. Their only chance for survival is to grow fast, to attain a size large enough to withstand smothering and a suitable growth form that helps them to survive in such environments. Fresh explants of *Scopalina lophyropoda* displayed high mortality rates related to siltation for two months, after which survival markedly increased (Maldonado et al. 2008).

Resuspension of contaminated sediments will also have a more severe effect on larvae and juveniles and can directly lead to mortality. On the other hand, adults more often exhibit sublethal effects such as reduced reproductive success (e.g. Cebrian et al. 2003). In *Crambe crambe* PAHs – as often found in resuspended sediments in or near harbours – are significantly more toxic to larvae than copper and cadmium and inhibit settlement (Cebrian & Uriz 2007b).

It appears that physiological processes related to sexual reproduction and early life stages are thus at greatest risk. However, adult sponges can have reduced filter feeder function during gametogenesis (e.g. Sidri et al. 2005). It may be interesting to assess whether the resulting reduced risk of clogging may balance some of the increased risk by dredging pressures.

Regardless of reproductive processes, seasonal variation of environmental conditions can play a significant role in many physiological processes e.g. in recovery (e.g. Henry & Hart 2005). If dredging is conducted during a vulnerable season, the damage at community level will be larger and more prolonged. As mentioned above, dredging during a heating event may have more disastrous effects than under cooler conditions. Dredging during the rainy season may aggravate responses if salinities are reduced in shallow habitats. Storms can keep sediments longer in suspension and multiply the effects of shading, scouring and clogging, while effects of smothering may be reduced.

Seasonal changes in physiology will also play a considerable role. Sponges grow faster and are physiologically more active in favourable temperatures and when food is plentiful (e.g. Barthel 1986, 1988). During these times they may be able to better cope with dredging stress. In colder climates sponges may undergo resting phases during which they initiate reduction and enter an inactive stage (e.g. Pomponi & Meritt 1990). Currently, it is unclear whether dredging when sponges are in these inactive phases would be beneficial or detrimental to the sponges; filtering apparatus cannot be affected under these phases, but at the same time inactive sponges would be at risk of smothering due to their incapacity for maintenance responses.

12. Conclusions

In summary, sediments associated with dredging activity can affect filter feeders in very complex ways, which are not yet adequately understood. Responses are manifold, difficult to quantify and can vary significantly between taxa, life stages, and with environmental factors. It is thus very difficult to recognise trends and patterns from fieldwork or even from controlled experiments. The present review summarises a large range of information suitable to provide a basis to develop research into dredging pressures on filter feeders.

13. References

Abdo DA, McDonald JI, Harvey ES, Fromont J, Kendrick GA (2008) Neighbour and environmental influences on the growth patterns of two temperate haliclonid sponges. Mar Freshw Res 59:304–312

Abdul Wahab MA, de Nys R, Abdo D, Webster N, Whalan S (2014) The influence of habitat on post-settlement processes, larval production and recruitment in a common coral reef sponge. J Exp Mar Biol Ecol 461:162-172

Adjeroud M (2000) Zonation des communautés macrobenthiques le long de deux baies d'un écosystème corallien insulaire (Moorea, Polynésie française). CR Acad Sci Paris, Life Sciences 323:305–313

Agell G, Uriz MJ, Cebrian E, Martí R (2001) Does stress proteins induction by copper modify natural toxicity in sponges? Environ Toxicol Chem 20:2588–2593

Airoldi L (2003) The effects of sedimentation on rocky coast assemblages. Oceanogr Mar Biol Annu Rev 41:161–236

Alcolado PM (1990) General features of Cuban sponge communities. In: Rützler K (ed) New perspectives in sponge biology. Smithsonian Institution Press, Washington DC, pp 351–357

Alcolado PM (2007) Reading the code of coral reef sponge community composition and structure for environmental biomonitoring: some experiences from Cuba. In: Custódio MR, Hajdu E, Lôbo-Hajdu G, Muricy G (eds) Porifera research: biodiversity, innovation and sustainability. Museu Nacional, Rio de Janeiro, pp 3–10

Alcolado PM, Gotera GG (1985) Estructura de las comunidades de esponjas en los arrecifes cubanos. Simp Cienc Mar VII J Cient Inst Oceanol. XX Aniversario Contrib 1, Habana:11–15

Alcolado PM, Herrera A (1987) Efectos de la contaminación sobre las comunidades de esponjas en el litoral de la Habana, Cuba. Rep Invest Inst Oceanol 68:1–17, 1 table, 4 figures.

Ali MA (1960) Influence of environment on the distribution and form of sponges. Nature 186:177–178

Al-Zibdah MK, Damhoureyeh SA, Badran MI (2007) Temporal variations in coral reef health at a coastal industrial site on the Gulf of Aqaba, Red Sea. Oceanologia 49:565–578

Ammar MSA, Ghobashi AA, Omran MA, Shaaban AM (2007) Status of coral reef affected by different impacts in some sites of the Red Sea. Egypt J Aquat Res 33:224–237

Anchor Environmental CA L.P (2003) Literature review of effects of resuspended sediments due to dredging operations. Los Angeles Contaminated Sediments Task Force, Los Angeles, 140 pp

Anderson FE, Meyer LM (1986) The interaction of tidal currents on a disturbed intertidal bottom with a resulting change in particulate matter quantity, texture and food quality. Estuar Coast Shelf Sci 22:19–29

Annibaldi A, Truzzi C, Illuminati S, Bassotti E, Finale C, Scarponi G (2011) First systematic voltammetric measurements of Cd, Pb, and Cu in hydrofluoric acid-dissolved siliceous spicules of marine sponges: application to Antarctic specimens. Anal Lett 44:2792–2807

Araújo MF, Conceição A, Barbosa T, Lopes MT, Humanes M (2003) Elemental composition of marine sponges from the Berlengas natural park, western Portuguese coast. X-ray Spectrom 32:428–433

Ardron JA, Jamieson DS, Hangaard D (2007) Spatial identification of closures to reduce the by-catch of corals and sponges in the groundfish trawl fishery, British Columbia, Canada. In: George RY, Cairns SD (eds) Conservation and adaptive management of seamount and deep-sea coral ecosystems. Rosenstiel School of Marine and Atmospheric Science, University of Miami, Miami, p 157–167

Arillo A, Bavestrello G, Burlando B, Sarà M (1993) Metabolic integration between symbiotic cyanobacteria and sponges: a possible mechanism. Mar Biol 177:159–162

Armsworthy SL (1993) Effects on suspended bottom sediment on the feeding activity of the ascidian, *Halocynthia pyriformis* (Rathke). MSc thesis University of New Brunswick, Canada, 109 pp

Armsworthy SL, MacDonald BA, Ward JE (2001) Feeding activity, absorption efficiency and suspension feeding processes in the ascidian, *Halocynthia pyriformis* (Stolidobranchia: Ascidiacea): responses to variations in diet quantity and quality. J Exp Mar Biol Ecol 260:41–69

Arntz WE, Rumohr H (1982) An experimental study of macrobenthic colonization and succession, and the importance of seasonal variation in temperate latitudes. J Exp Mar Biol Ecol 64:17–45

Ash RG, Collie JS (2008) Changes in a benthic megafaunal community due to disturbance from bottom fishing and the establishment of a fishery closure. Fish Bull 106:438–456

Auster PJ, Malatesta RJ, Langton RW, Watling L, Valentine PC, Donaldson CLS, Langton EW, Shepard AN, Babb IG (1996) The impacts of mobile fishing gear on seafloor habitats in the Gulf of Maine (Northwest Atlantic): implications for conservation of fish populations. Rev Fish Sci 4:185–202

Austin WC, Conway KW, Barrie JV, Krautter M (2007) Growth and morphology of a reef-forming glass sponge, *Aphrocallistes vastus* (Hexactinellida), and implications for recovery from widespread trawl damage. In: Custódio MR, Hajdu E, Lôbo-Hajdu G, Muricy G (eds) Porifera research: biodiversity, innovation and sustainability. Museu Nacional, Rio de Janeiro, p 139–145

Ávila E, Carballo JL, Vega C, Camacho L, Barrón-Álvarez JJ, Padilla-Verdín C, Yáñez-Chávez B (2011) Deposition of shallow water sponges in response to seasonal changes. J Sea Res 66:172–180

Ayling AL (1983) Growth and regeneration rates in thinly encrusting Demospongiae from temperate waters. Biol Bull 165:343–352

Ayling AM (1981) The role of biological disturbance in temperate subtidal encrusting communities. Ecology 63:830–847

Azzini F, Calcinai B, Cerrano C, Bavestrello G, Pansini M (2007) Sponges of the marine karst lakes and of the coast of the islands of Ha Long Bay (North Vietnam). In: Custódio MR, Hajdu E, Lôbo-Hajdu G, Muricy G (eds) Porifera research: biodiversity, innovation and sustainability. Museu Nacional, Rio de Janeiro, p 157–164

Baker ET, Milburn HB, Tennant DA (1988) Field assessment of sediment trap efficiency under varying flow conditions. J Mar Res 46:573–592

Bakus GJ (1968) Sedimentation and benthic invertebrates of Fanning Island, central Pacific. Mar Geol 6:45–51

Balata D, Piazzi L, Cecchi E, Cinelli F (2005) Variability of Mediterranean coralligenous assemblages subject to local variation in sediment deposition. Mar Environ Res 60:403–421

Bannister R (2008) The ecology and feeding biology of the sponge *Rhopaloeides odorabile*. PhD thesis James Cook University Townsville, 140 pp. Available at http://researchonline.jcu.edu.au/5667/ (accessed 22 Feb 2014)

Bannister RJ, Battershill CN, De Nys R (2010) Demographic variability and long-term change in a coral reef sponge along a cross-shelf gradient of the Great Barrier Reef. Mar Freshw Res 61:389–396

Bannister RJ, Battershill CN, De Nys R (2012) Suspended sediment grain size and mineralogy across the continental shelf of the Great Barrier Reef: impacts on the physiology of a coral reef sponge. Cont Shelf Res 32:86–95

Bannister RJ, Brinkman R, Wolff C, Battershill CN, De Nys R (2007) The distribution and abundance of dictyoceratid sponges in relation to hydrodynamic features: identifying candidates and environmental conditions for sponge aquaculture. Mar Freshwater Res 58:624–633

Bannister RJ, Hoogenboom MO, Anthony KRN, Battershill CN, Whalan S, Webster NS, De Nys R (2011) Incongruence between the distribution of a common coral reef sponge and photosynthesis. Mar Ecol Prog Ser 423:95–100

Bargagli R, Nelli L, Ancora S, Focardi S (1996) Elevated cadmium accumulation in marine organisms from Terra Nova Bay (Antarctica). Polar Biol 16:513–520

Barnes DKA, Bell JJ (2002) Coastal sponge communities of the West Indian Ocean: taxonomic affinities, richness and diversity. Afr J Ecol 40:337–349

Barthel D (1986) On the ecophysiology of the sponge *Halichondria panicea* in Kiel Bight. I. Substrate specificity, growth and reproduction. Mar Ecol Prog Ser 32:291–298

Barthel D (1988) On the ecophysiology of the sponge *Halichondria panicea* in Kiel Bight. I. Biomass, production, energy budget and integration in environmental processes. Mar Ecol Prog Ser 43:87–93

Barthel D, Gutt J (1992) Sponge associations in the eastern Weddell Sea. Antarct Sci 4:137–150

Barthel D, Tendal OS (1993) The sponge associations of the abyssal Norwegian-Greenland Sea: species composition, substrate relationships and distribution. Sarsia 78:83–96

Barthel D, Wolfrath B (1989) Tissue sloughing in the sponge *Halichondria panicea*: a fouling organism prevents being fouled. Oecologia 78:357–360

Basile G, Cerrano C, Radjasa O, Povero P, Zocchi E (2009) ADP-ribosyl cyclase and abscisic acid are involved in the seasonal growth and in post-traumatic tissue regeneration of Mediterranean sponges. J Exp Mar Biol Ecol 381:10–17

Battershill CN, Bergquist PR (1990) The influence of storms and asexual reproduction, recruitment, and survivorship of sponges. In: Rützler K (ed) New perspectives in sponge biology. Smithsonian Institution Press, Washington DC, p 397–403

Bavestrello G, Arillo A, Benatti U, Cerrano C, Cattaneo-Vietti R, Cortesogno L, Gaggero L, Giovine M, Tonetti M, Sarà M (1995) Quartz dissolution by the sponge *Chondrosia reniformis* (Porifera, Demospongiae). Nature 378:374–376

Bavestrello G, Benatti U, Calcinai B, Cattaneo-Vietti R, Cerrano C, Favre A, Giovine M, Lanza S, Pronzato R, Sarà M (1998) Body polarity and mineral selectivity in the demosponge *Chondrosia reniformis*. Biol Bull 195:120–125

Bavestrello G, Benatti U, Cattaneo-Vietti R, Cerrano C, Giovine M (2003) Sponge cell reactivity to various forms of silica. Microsc Res Techniq 62:327–335

Bavestrello G, Calcinai B, Boyer M, Cerrano C, Pansini M (2002) The aquiferous system of two *Oceanapia* species (Porifera, Demospongiae) studied by corrosion casts. Zoomorphology 121:195–201

Bavestrello G, Cerrano C, Zanzi D, Cattaneo-Vietti R (1997) Damage by fishing activities to the gorgonian coral *Paramuricea clavata* in the Ligurian Sea. Aquat Conserv-Mar Freshw Ecosyst 7:253–262

Bavington CD, Lever R, Mulloy B, Grundy MM, Page CP, Richardson NV, McKenzie JD (2004) Anti-adhesive glycoproteins in echinoderm mucus secretions. Comp Biochem Physiol B-Biochem Mol Biol 139:607–617

Beaman RJ, Daniell JJ, Harris PT (2005) Geology-benthos relationships on a temperate rocky bank, eastern Bass Strait, Australia. Mar Freshw Res 56:943–958

Beazley LI, Kenchington EL, Murillo FJ, del Mar Sacau M (online 2013) Deep-sea sponge grounds enhance diversity and abundance of epibenthic megafauna in the Northwest Atlantic. ICES J Mar Sci 70:1471–1490

Becerro MA (2008) Quantitative trends in sponge ecology research. Mar Ecol 29:167–177

Becerro MA, Lopez NI, Turon X, Uriz MJ (1994) Antimicrobial activity and surface bacterial film in marine sponges. J Exp Mar Biol Ecol 179:195–205

Becerro MA, Paul VJ (2004) Effects of depth and light on secondary metabolites and cyanobacterial symbionts of the sponge *Dysidea granulosa*. Mar Ecol Prog Ser 280:115–128

Beck MW, Heck Jr KL, Able KW, Childers DL, Eggleston DB, Gillanders BM, Halpern B, Hays CG, Hoshino K, Minello TJ, Orth RJ, Sheridan PF, Weinstein MP (2001) The identification, conservation, and management of estuarine and marine nurseries for fish and invertebrates. BioScience 51:633-641

Bégin C, Wurzbacher J, Côte IM (2013) Variation in benthic communities of eastern Caribbean coral reefs in relation to surface sediment composition. Mar Biol 160:343–353

Bell JJ (2004) Evidence for morphology-induced sediment settlement prevention on the tubular sponge *Haliclona urceolus*. Mar Biol 146:29–38

Bell JJ (2008) The functional roles of marine sponges. Estuar Coast Shelf Sci 79:341-353

Bell JJ, Barnes DKA (2000a) The distribution and prevalence of sponges in relation to environmental gradients within a temperate sea lough: vertical cliff surfaces. Divers Distrib 6:283–303

Bell JJ, Barnes DKA (2000b) The distribution and prevalence of sponges in relation to environmental gradients within a temperate sea lough: inclined cliff surfaces. Divers Distrib 6:305–323

Bell JJ, Barnes DKA (2000c) A Sponge diversity centre within a marine 'island'. Hydrobiologia 440:55–64

Bell JJ, Barnes DKA (2000d) The influence of bathymetry and flow regime upon the morphology of sublittoral sponge communities. J Mar Biol Assoc UK 80:707–718

Bell JJ, Barnes DKA (2002) Density, distribution and decline of two species of unattached demosponges. Sarsia 87:110–118

Bell JJ, Barnes DKA, Turner JR (2002) The importance of micro and macro morphological variation in the adaptation of a sublittoral demosponge to current extremes. Mar Biol 140:75–81

Bell JJ, Berman J, Jones T, Hepburn LJ (2010) Variability in the spatial association patterns of sponge assemblages in response to environmental heterogeneity. Mar Biol 157:2503–2509

Bell JJ, McGrath E, Biggerstaff A, Bates T, Bennett H, Marlow J, Shaffer M (2015) Sediment impacts on marine sponges. Mar Pollut Bull 94:5–13

Bell JJ, Smith D (2004) Ecology of sponge assemblages (Porifera) in the Wakatobi region, south-east Sulawesi, Indonesia: richness and abundance. J Mar Biol Ass UK 84:581–591

Bellas J, Vázquez E, Beiras R (2001) Toxicity of Hg, Cu, Cd, and Cr on early developmental stages of *Ciona intestinalis* (Chordata, Ascidiacea) with potential application in marine water quality assessment. Water Res 35:2905–2912

Bellas J, Vázquez E, Beiras R (2004) Sublethal effects of trace metals (Cd, Cr, Cu, Hg) on embryogenesis and larval settlement of the ascidian *Ciona intestinalis.* Arch Environ Contam Toxicol 46:61–66

Berthet B, Mouneyrac C, Perez T, Amiard-Triquet C (2005) Metallothionein concentration in sponges (*Spongia officinalis*) as a biomarker of metal contamination. Comp Biochem Physiol C-Toxicol Pharmacol 141:306–313

Bett BJ (2001) UK Atlantic Margin Environmental Survey: introduction and overview of bathial benthic ecology. Cont Shelf Res 21:917–956

Biggs BC (2013) Harnessing natural recovery processes to improve restoration outcomes: an experimental assessment of sponge-mediated coral reef restoration. PLoS ONE 8:e64945

Blair SM, Flynn BS, Markley S (1990) Characteristics and assessment of dredge related mechanical impact to hard-bottom reef areas of northern Dade County, Florida. In: Japp WC (ed) Proc Amer Acad Underwater Sci 10th Ann Sci Diving Symp, October 4-7, 1990. University of South Florida, St. Petersburg, Florida, p 5–20

Blidberg E (2004) Effects of copper and decreased salinity on survival rate and development of *Tridacna gigas* larvae. Mar Environ Res 58:793–797

Bloesch J (1995) Mechanisms, measurement and importance of sediment resuspension in lakes. Mar Freshw Res 46:295–304

Bloesch J, Burns NM (1980) A critical review of sedimentation trap technique. Schweizerische Z Hydrol 42:15–55

Boaventura D, Moura A, Leitão F, Carvalho S, Cúrdia J, Pereira P, Cancela da Fonseca L, Neves dos Santos M, Costa Monteiro C (2006) Macrobenthic colonisation of artificial reefs on the southern coast of Portugal (Ancão, Algarve). Hydrobiologia 555:335–343

Bolam SG, Rees HL, Somerfield P, Smith R, Clarke KR, Warwick RM, Atkins M, Garnacho E (2006) Ecological consequences of dredged material disposal in the marine environment: a holistic assessment of activities around the England and Wales coastline. Mar Pollut Bull 52:415–426

Bolam SG, Whomersley P (2005) Development of macrofaunal communities on dredged material used for mudflat enhancement: a comparison of three beneficial use schemes after one year. Mar Pollut Bull 50:40– 47

Bond C (1992) Continuous cell movements rearrange anatomical structures in intact sponges. J Exp Zool 263:284–302

Bonsdorff E (1983) Recovery potential of macrozoobenthos from dredging in shallow brackish waters. Oceanol Acta, Special issue Available at http://archimer.ifremer.fr/doc/00247/35776/ (accessed 26 Jul 2015)

Bonvicini Pagliai AM, Cognetti Varriale AM, Crema R, Curini Galletti M, Vandini Zunarelli R (1985) Environmental impact of extensive dredging in a coastal marine area. Mar Pollut Bull 16: 483–488

Boulcott P, Howell TRW (2011) The impact of scallop dredging on rocky-reef substrata. Fish Res 110:415–420

Boury-Esnault N, Rützler K (1997) Thesaurus of sponge morphology. Smithsonian Contrib Zool 596:1–55

Boyd S (1999) The introduced Mollusca of Port Philipp Bay. In: Hewitt CL, Campbell ML, Thresher RE, Martin RB (eds) Marine biological invasions of Port Philipp Bay, Victoria. Centre for Research on Introduced Pests Technical Report 20, CSIRO, Melbourne, pp 129–149

Boyd SE, Limpenny DS, Rees HL, Cooper KM (2005) The effects of marine sand and gravel extraction on the macrobenthos at a commercial dredging site (results 6 years post-dredging). ICES J Mar Sci 62:145–162

Boyd SE, Limpenny DS, Rees HL, Cooper KM, Campbell S (2003) Preliminary observations of the effects of dredging intensity on the re-colonization of dredged sediments off the south-east coast of England (Area 222). Estuar Coast Shelf Sci 57:209–223

Boyd SE, Rees HL (2003) An examination of the spatial scale of impact on the marine benthos arising from marine aggregate extraction in the Central English Channel. Estuar Coast Shelf Sci 57:1–16

Brewer D, Eayrs S, Mounsey R, Wang Y-G (1996) Assessment of an environmentally friendly, semi-pelagic fish trawl. Fish Res 26:225-237

Bridge TCL, Done TJ, Beaman RJ, Friedman A, Williams SB, Pizarro O, Webster JM (2011) Topography, substratum and benthic macrofaunal relationships on a tropical mesophotic shelf margin, central Great Barrier Reef, Australia. Coral Reefs 30:143–153

Bricelj VM, Malouf RE (1984) Influence of algal and suspended sediment concentrations on the feeding physiology of the hard clam, *Mercenaria mercenaria*. Mar Biol 84:155–165

Briggs KB, Richardson MD, Young DK (1996) The classification and structure of megafaunal assemblages in the Venezuela Basin, Caribbean Sea. J Mar Res 54:705–730

Bryan PG (1973) Growth rate, toxicity and distribution of the encrusting sponge *Terpios* sp. (Hadromerida: Subertidae) in Guam, Marianas Islands. Micronesica 9:237–242

Burridge CY, Pitcher CR, Wassenberg TJ, Poiner IR, Hill BJ (2003) Measurement of the rate of depletion of benthic fauna by prawn (shrimp) otter trawls: an experiment in the Great Barrier Reef, Australia. Fish Res 60:237–253

Butler A, Althaus F, Furlani D, Ridgway K (2002) Assessment of the conservation values of the Bass Strait sponge bed area. A component of the Commonwealth Marine Conservation Assessment Program 2002-2004. Report to Environment Australia December 2002. CSIRO Marine Research Hobart, Tasmania, 64 pp

Butler MS, Lim TK, Capon RJ, Hammond LS (1991) The bastadins revisited: new chemistry from the Australian marine sponge *Ianthella basta.* Aust J Chem 44:287–296

Butman CA, Grant WD, Stolzenbach KD (1986) Predictions of sediment trap biases in turbulent flows: a theoretical analysis based on observations from the literature. J Mar Res 44:601–644

Büttner E, Siebler F (2013) The impact of simulated dredging on sponges of the East Australian coastline. Semester report, University of Stuttgart, Germany, 66 pp

Caballero H, González-Ferrer S, Cobián D, Álvarez S, Alcolado-Prieto P (2007) Evaluación AGGRA del bentos en diez sitios de buceo de 'María la Gorda', Bahía de Corrientes, Cuba. Rev Invest Mar 28:131–138

Calcinai B, Cerrano C, Bavestrello G (2007) Three new species and one re-description of *Aka*. J Mar Biol Ass UK 87:1355–1365

Carballo JL (2006) Effect of natural sedimentation on the structure of tropical rocky sponge assemblages. Ecoscience 13:119–130

Carballo JL, Naranjo SA, García-Gómez JC (1996) Use of marine sponges as stress indicators in marine ecosystems at Algeciras Bay (southern Iberian Peninsula). Mar Ecol Prog Ser 135:109–122

Carballo JL, Sanchez-Moyano JE, Garcia-Gomez JC (1994) Taxonomic and ecological remarks on boring sponges (Clionidae) from the Straits of Gibraltar (southern Spain): tentative bioindicators? Zool J Linn Soc-Lond 112:407–424

Carballo JL, Vega C, Cruz-Barraza JA, Yáñez B, Nava H, Ávila E, Wilson M (2008) Short- and long-term patterns of sponge diversity on a rocky tropical coast: evidence of large-scale structuring factors. Mar Ecol 29: 216–236

Carbines G, Cole RG (2009) Using a remote drift underwater video (DUV) to examine dredge impacts on demersal fishes and benthic habitat complexity in Foveaux Strait, Southern New Zealand. Fish Res 96:230–237

Carney D, Oliver JS, Armstrong C (1999) Sediment and composition of wall communities in Alaskan fjords. Polar Biol 22:38–49

Cebrian E, Agell G, Martí R, Uriz MJ (2006) Response of the Mediterranean sponge *Chondrosia reniformis* Nardo to heavy metal pollution. Environ Pollut 141:452–458

Cebrian E, Martí R, Uriz MJ, Turon X (2003) Sublethal effects of contamination on the Mediterranean sponge *Crambe crambe*: metal accumulation and biological responses. Mar Pollut Bull 46:1273–1284

Cebrian E, Uriz MJ (2007a) Do heavy metals play an active role in sponge cell behavious in the absence of calcium? Consequences in larval settlement. J Exp Mar Biol Ecol 346:60–65

Cebrian E, Uriz MJ (2007b) Contrasting effects of heavy metals and hydrocarbons on larval settlement and juvenile survival in sponges. Aquat Toxicol 81:137–143

Cebrian E, Uriz MJ (2007c) Contrasting effects of heavy metals on sponge cell behavior. Arch Environ Contam Toxicol 53:552–558

Cebrian E, Uriz MJ, Garrabou J, Ballesteros E (2011) Sponge mass mortalities in a warming Mediterranean Sea: Are cyanobacteria-harboring species worse off? PLoS ONE 6: e20211

Cebrian E, Uriz MJ, Turon X (2007) Sponges as biomonitors of heavy metals in spatial and temporal surveys in northwestern Mediterranean: multispecies comparison. Environ Toxicol Chem 26:2430–2439

Çelik İ, Cirik Ş, Altınağaç U, Ayaz A, Çelik P, Tekeşoğlu H, Yılmaz H, Ötztekin A (2011) Growth performance of bath sponge (*Spongia officinalis* Linnaeus, 1759) farmed on suspended ropes in the Dardanelles (Turkey). Aquac Res 42:1807–1815

Cerrano C, Arillo A, Bavestrello G, Benatti U, Calcinai B, Cattaneo-Vietti R, Cortesogno L, Gaggero L, Giovine M, Puce S, Sarà M (1999) Organism-quartz interactions in structuring benthic communities: towards a marine bio-mineralogy? Ecol Lett 2:1–3

Cerrano C, Bavestrello G, Boyer M, Calcinai B, Lalamentik LTX, Pansini M (2002) Psammobiontic sponges from the Bunaken Marine Park (North Sulawesi, Indonesia): interactions with sediments. Proc 9th Int Coral Reef Symp Bali 2002 1:279–282

Cerrano C, Calcinai B, Cucchiari E, Di Camillo CG, Nigo M, Regoli F, Sarà A, Schiaparelli S, Totti C, Bavestrello G (2004c) Are diatoms a food source for Antarctic sponges? Chem Ecol 20:S57–S64

Cerrano C, Calcinai B, Cucchiari E, Di Camillo C, Totti C, Bavestrello G (2004b) The diversity of relationships between Antarctic sponges and diatoms: the case of *Mycale acerata* Kirkpatrick, 1907 (Porifera, Demospongiae). Polar Biol 27:231–237

Cerrano C, Calcinai B, Di Camillo CG, Valisano L, Bavestrello G (2007a) How and why do sponges incorporate foreign material? Strategies in Porifera. In: Custódio MR, Hajdu E, Lôbo-Hajdu G, Muricy G (eds) Porifera research: biodiversity, innovation and sustainability. Museu Nacional, Rio de Janeiro:239–246

Cerrano C, Magnino G, Sarà M, Bavestrello G, Gaino E (2001) Necrosis in a population of *Petrosia ficiformis* (Porifera, Demospongiae) in relation with environmental stress. Ital J Zool 68:131–136

Cerrano C, Pansini M, Valisano L, Calcinai B, Sarà M, Bavestrello G (2004a) Lagoon sponges from Carrie Bow Cay (Belize): ecological benefits of selective sediment incorporation. Boll Mus Ist Biol Univ Genova 68:239–252

Cerrano C, Sambolino P, Azzini F, Calcinai B, Bavestrello G (2007b) Growth of the massive morph of *Cliona nigricans* (Schmidt, 1862) (Porifera, Clionaidae) on different mineral substrata. Italian J Zool 74:13–19

Chávez-Fonnegra A, Zea S, Gómez ML (2007) Abundance of the excavating sponge *Cliona delitrix* in relation to sewage discharge at San Andrés Island, SW Caribbean, Colombia. Bol Invest Mar Cost 36:63–78

Chen C, Dai C-F (2008) Subtidal sabellarid reefs in Hualien, eastern Taiwan. Coral Reefs 2009:275

Cheng TC, Rifkin E, Yee HWF (1968a) Studies on the internal defense mechanisms of sponges: II. Phagocytosis and elimination of India ink and carmine particles by certain parenchymal cells of *Terpios zeteki*. J Invertebr Pathol 11:302–309

Cheng TC, Rifkin E, Yee HWF (1968b) Studies on the internal defense mechanisms of sponges: III. Cellular reactions in *Terpios zeteki* to implanted heterologous biological materials. J Invertebr Pathol 12:29–35

Cheng YT, Rodak DE, Wong CA, Hayden CA (2006) Effects of micro- and nano-structures on the self-cleaning behaviour of lotus leaves. Nanotechnology 17:1359

Chevron Australia Pty Ltd (2012) Wheatstone Project. Dredging and dredge spoil placement environmental monitoring and management plan. Document no. WS0-0000-HES-RPT-CVX-000-00086-000. Chevron Australia Pty. Ltd., Perth, 223 pp

Chou LM, Wong FJ (1986) Ecological distribution of reef organisms at Pulau Salu. J Singapore Nat Acad Sci 15:12–17

Churchill JH (1989) The effect of commercial trawling on sediment resuspension and transport over the Middle Atlantic Bight continental shelf. Cont Shelf Res 9:841–864

Çinar ME, Katağan T, Ergen Z, Sezgin M (2002) Zoobenthos-inhabiting *Sarcotragus muscarum* (Porifera: Demospongiae) from the Aegean Sea. Hydrobiologia 482:107–117

Coleman N, Parry GD, Cohen BF, Fabris G, Longmore AR (1999) Port Philipp Bay: biology, habitats and disturbance history. In: Hewitt CL, Campbell ML, Thresher RE, Martin RB (eds) Marine biological invasions of Port Philipp Bay, Victoria. Centre for Research on Introduced Pests technical Report 20, CSIRO, Melbourne, p 32–44

Collie JS, Escanero GA, Valentine PC (2000) Photographic evaluation of the impacts of bottom fishing on epibenthic fauna. ICES J Mar Sci 57:987–1001

Collie JS, Hermsen JM, Valentine PC (2009) Recolonization of gravel habitats on Georges Bank (northwest Atlantic). Deep-Sea Res II 56:1847–1855

Connell SD (2003) The monopolization of understorey habitat by subtidal encrusting coralline algae: a test of the combined effects of canopy-mediated light and sedimentation. Mar Biol 142: 1065–1071

Connell SD (2005) Assembly and maintenance of subtidal habitat heterogeneity: synergistic effects of light penetration and sedimentation. Mar Ecol Prog Ser 289:53–61

Conner WG, Simon JL (1979) The effects of oyster shell dredging on an estuarine benthic community. Estuar Coast Mar Sci 9:749–758

Connes R (1967) Réactions de défense de l'éponge *Tethya lyncurium* Lamarck, vis-á-vis des micro-organismes et de l'amphipode *Leucothoe spinicarpa* Abildg. Vie Milieu 18A:281–289

Conway KW, Krautter M, Barrie JV, Neuweiler M (2001) Hexactinellid sponge reefs on the Candian continental shelf: a unique 'living fossil'. Geosci Can 28:71–78

Cooper K, Boyd S, Eggleton J, Limpenny D, Rees H, Vanstaen K (2007) Recovery of the seabed following marine aggregate dredging on the Hastings Shingle Bank off the southeast coast of England. Estuar Coast Shelf Sci 75:547–558

Corriero G, Longo C, Mercurio M, Nonnis Marzano C, Lembo G, Spedicato MT (2004) Rearing performance of *Spongia officinalis* on suspended ropes off the Southern Italian Coast (Central Mediterranean Sea). Aquaculture 238:195–205

Crocker LA, Reiswig HM (1981) Host specificity in sponge-encrusting Zoanthidea (Anthozoa: Zoantharia) of Barbados, West Indies. Mar Biol 65:231–236

Crowe SE, Gayes PT, Viso RF, Bergquist DC, Jutte PC, Van Dolah RF (2010) Impact of the Charleston ocean dredged material disposal site on nearby hard bottom reef habitats. Mar Pollut Bull 60:679–691

Currie DR, Dixon CD, Roberts SD, Hooper GE, Sorokin SJ, Ward TM (2010) Relative importance of environmental gradients and historical trawling effort in determining the composition and distribution of benthic macro-biota in a large inverse estuary. Fish Res 107:184–195

Currie DR, Parry GD (1996) Effects of scallop dredging on a soft sediment community: a large-scale experimental study. Mar Ecol Prog Ser 134: 131–150

Custódio MR, Hadju E, Muricy G (2002) *In vivo* study of microsclere formation in sponges of the genus *Mycale* (Demospongiae, Poecilosclerida). Zoomorphology 121:203–211

Dayton PK, Robilliard GA, Paine RT, Dayton LB (1974) Biological accommodation in the benthic community at McMurdo Sound, Antarctica. Ecol Monogr 44:105–128

De Caralt S, Uriz MJ, Wijffels RH (2008) Grazing, differential size-class dynamics and survival of the Mediterranean sponge *Corticium candelabrum*. Mar Ecol Prog Ser 360:97–106

De C Cook S, Bergquist PR (2002) Order Dictyoceratida Minchin, 1900. In: Hooper JNA, Van Soest RWM (eds) Systema Porifera: a guide to the classification of sponges. Kluwer Academic/Plenum Publishers, New York, p1021–1066

De Grave S, Whitaker A (1999) Benthic community re-adjustment following dredging of a muddy-maerl matrix. Mar Pollut Bull 38:102–108

De Groot SJ (1979) An assessment of the potential environmental impact of large-scale sand-dredging for the building of artificial islands in the North Sea. Ocean Manage 5:211–232

De Jonge VN, Schuttelaars HW, Van Beusekom JEE, Talke SA, De Swart HE (2014) The influence of channel deepening on estuarine turbidity levels and dynamics, as exemplified by the Ems estuary. Estuar Coast Shelf Sci 139:46–59

De Laubenfels MW (1954) The sponges of the West-Central Pacific. Oregon State Monogr Studies Zool 7:1–320

De Mestre C, Maher W, Roberts D, Broad A, Krikowa F, Davis AR (2012) Sponges as sentinels: patterns of spatial and intra-individual variation in trace metal concentration. Mar Pollut Bull 64:80–89

Desprez M (2000) Physical and biological impact of marine aggregate extraction along the French coast of the eastern English Channel: short- and long-term post-dredging restoration. ICES J Mar Sci 57:1428–1438

De Voogd NJ (2012) On sand-bearing myxillid sponges, with a description of *Psammochela tutiae* sp. nov. (Poecilosclerida, Myxillina) from the northern Moluccas, Indonesia. Zootaxa 3155:21–28

De Voogd NJ, Cleary DFR (2007) Relating species traits to environmental variables in Indonesian coral reef sponge assemblages. Mar Freshw Res 58:240–249

De Vos L, Rützler K, Boury-Esnault N, Donadey C, Vacelet J (1991) Atlas of sponge morphology. Smithsonian Institution Press, Washington DC, 117 pp

Di Camillo CG, Coppari M, Bartolucci I, Bo M, Betti F, Bertolino M, Calcinai B, Cerrano C, De Grandis G, Bavestrello G (2012) Temporal variations in growth and reproduction of *Tedania anhelans* and *Chondrosia reniformis* in the North Adriatic Sea. Hydrobiologia 687:299–313

Díaz MC, Thacker RW, Rützler K, Piantoni C (2007) Two new haplosclerid sponges from Caribbean Panama with symbiotic filamentous cyanobacteria, and an overview of sponge-cyanobacteria associations. In: Custódio MR, Hajdu E, Lôbo-Hajdu G, Muricy G (eds) Porifera research: biodiversity, innovation and sustainability. Museu Nacional, Rio de Janeiro, p 31–39

Dillon TM, Suedel BC, Peddicord RK, Clifford PA, Boraczek JA, Engler RM (1995) Environmental effects of dredging. Technical notes. US Army Engineer Waterways Experiment Station Technical Note EEDP-01-33, Vicksburg, 12 pp

Divine LM (2011) Effects of sediment on growth and survival of various juvenile morphologies of the scleractinian coral, *Oculina arbuscula* (Verrill). MSc thesis at the Georgia Southern University, Statesboro, 79 pp

Doochin H, Walton Smith FG (1951) Marine boring and fouling in relation to velocity of water currents. Bull Mar Sci 1:196–208

Driscoll EG (1967) Attached epifauna-substrate relations. Limnol Oceanogr 12:633–641

Duckworth AR (2003) Effect of wound size on the growth and regeneration of two temperate subtidal sponges. J Exp Mar Biol Ecol 287:139–153

Duckworth AR, Battershill CN, Bergquist PR (1997) Influence of explant procedures and environmental factors on culture success of three sponges. Aquaculture 156:251–267

Duckworth AR, Battershill CN, Schiel DR (2004) Effects of depth and water flow on growth, survival and bioactivity of two temperate sponges cultured in different seasons. Aquaculture 242:237–250

Duckworth AR, Wolff CW (2007) Bath sponge aquaculture in Torres Strait, Australia: Effect of explant size, farming method and the environment on culture success. Aquaculture 271:188–195

Duckworth AR, Wolff CW (2011) Population dynamics and growth of two coral reef sponges on rock and rubble substrates. J Exp Mar Biol Ecol 402:49–55

Duinker PN, Greig LA (2007) Scenario analysis in environmental impact assessment: improving explorations of the future. Environ Impact Assess Rev 27:206–219

Du Preez C, Tunnicliffe V (2011) Shortspine thornyhead and rockfish (Scorpaenidae) distribution in response to substratum, biogenic structures and trawling. Mar Ecol Prog Ser 425:217–231

Eckman JE, Duggins DO (1991) Life and death beneath macrophyte canopies: effects of understory kelps on growth rates and survival of marine, benthic suspension feeders. Oecologia 87:473–487

Eleftheriou A, MR Robertson (1992) The effects of experimental scallop dredging on the fauna and physical environment of a shallow sandy community. Neth J Sea Res 30:289–299

Elvin DW (1976) Seasonal growth and reproduction of an intertidal sponge, *Haliclona permollis* (Bowerbank). Bio Bull 151:108–125

Emson RH (1966) The reactions of the sponge *Cliona celata* to applied stimuli. Comp Biochem Physiol 18:805–827

Eno NC, MacDonald DS, Kinnear JAM, Amos CS, Chapman CJ, Clark RA, Bunker F St PD, Munro C (2001) Effects of crustacean traps on benthic fauna. ICES J Mar Sci 58:11–20

EPA WA (2011) Environmental Assessment Guideline 7 for marine dredging Proposals. Environmental Protection Authority Western Australia, Perth, September 2011:1–31

Fang JKH, Mello-Athayde MA, Schönberg CHL, Kline DI, Hoegh-Guldberg O, Dove S (2013) Sponge biomass and bioerosion rates increase under ocean warming and acidification. Glob Change Biol 19:3581–3591

Fang JHK, Schönberg CHL, Mello-Athayde MA, Hoegh-Guldberg O, Dove S (2014) Effects of ocean warming and acidification on the energy budget of an excavating sponge. Glob Change Biol 20:1043–1054

Fell PE, Lewandrowski KB (1981) Population dynamics of the estuarine sponge, *Halichondria* sp., within a New England eelgrass community. J Exp Mar Biol Ecol 55:49–63

Fenner DP (1991) Effects of Hurricane Gilbert on coral reefs, fishes, and sponges at Cozumel, Mexico. Bull Mar Sci 42:133–144

Flach E, Lavaleye M, De Stigter H, Thomsen L (1998) Feeding types of the benthic community and particle transport across the slope of the N.W. European continental margin (Goban Spur). Prog Oceanogr 42:209–231

Flood PR, Fiala-Medoni A (1981) Ultrastructure and histochemistry of the food trapping mucous film in benthic filter-feeders (ascidians). Acta Zool 62:53–65

Freese JL (2001) Trawl-induced damage to sponges observed from a research submersible. Mar Fish Rev 63:7–13

Freese L, Auster PJ, Heifetz J, Wing BL (1999) Effects of trawling on seafloor habitat and associated invertebrate taxa in the Gulf of Alaska. Mar Ecol Prog Ser 182:119–126

Fromont J (1999) Reproductionof some demosponges in a temperate Australian shallow water habitat. Mem Queensland Mus 44:185–192

Fromont J, Gomez O, Schönberg CHL, Eakin M, Hooper JNA (2015) Muesum records made public: biodiversity, biogeography and some ecological aspects of northwestern Australian sponge communities. Report of theme 6 project 6.2 of the Western Australian Marine Science Institution (WAMSI) Dredging Science Node, Perth, 76 pp

Gaino E, Bavestrello G, Cattaneo-Vietti R, Sarà M (1994) Scanning electron microscope evidence for diatom uptake by two Antarctic sponges. Polar Biol 14:55–58

Gaspar MB, Carvalho S, Constantino R, Tata-Regala J, Cúrdia J, Monteiro CC (2009) Can we infer dredge fishing effort from macrobenthic community structure? ICES J Mar Sci 66:2121–2132.

Gerrodette T, Flechsig AO (1979) Sediment-induced reduction in the pumping rate of the tropical sponge *Verongia lacunosa*. Mar Biol 55:103–110

Gili J-M Arntz WE, Palanques A, Covadonga Orejas C, Clarke A, Dayton PK, Isla E, Teixidó N, Rossi S, López-González PJ (2006) A unique assemblage of epibenthic sessile suspension feeders with archaic features in the high-Antarctic. Deep-Sea Res II 53:1029–1052

Gilliam DS, Walker BK, Saelens SJ, Fahy DP, Kosmynin VN (2009) Recovery of injured giant barrel sponges, *Xestospongia muta*, offshore southeast Florida. Proc 11th Int Coral Reef Symp, Ft. Lauderdale 2008, 5 pp

Glover AG, Smith CR (2003) The deep-sea floor ecosystem: current status and prospects of anthropogenic change by the year 2025. Environ Conserv 30:219–241

Göbel Y (1993) Gibt es Unterschiede in den Größenspektren der von verschiedenen Schwammarten aufgenommenen Partikel? Diploma thesis, Intitute for Marine Science, Christian-Albrechts-University Kiel, 60 pp, 6 app

Godet L, Toupoint N, Olivier F, Fournier J, Retrière C (2008) Considering the functional value of common marine species as a conservation stake: the case of sandmason worm *Lanice conchilega* (Pallas 1766) (Annelida, Polychaeta) beds. Ambio 37:347–355

Godet L, Fournier J, Jaffre M, Desroy N (2011) Influence of stability and fragmentation of a worm-reef on benthic macrofauna. Estuar Coast Shelf Sci 92:472–479

Gomes TCM, Serafim MA, Company RS, Bebianno MJ (2006) Bioaccumulation of metals in the genus *Cinachyra* (Porifera) from the Mid-Atlantic Ridge. In: Alpoim MC, Morais PV, Santos MA, Crístovão AJ, Centeno JA, Collery P (eds) Metal ions in biology and medicine 9, John Libbey Eurotext, Paris, p 175–180

Google Scholar (2014) Stand on the shoulders of giants. http://scholar.google.com.au/schhp?hl=en&as_sdt=1,5 (accessed 26. April 2014)

Gotelli N J (1988) Determinants of recruitment, juvenile growth, and spatial distribution of a shallow water gorgonian. Ecology 69:157–166

Gram R (1968) A Florida Sabellariidae reef and its effects on sediment distribution. J Sediment Res 38:863–868

Grant RE (1826) Notice of a new zoophyte (*Cliona celata*, Gr.) from the Firth of Forth. Edinb New Phil J 1:78–81

Guerra-García JM, Corzo J, García-Gómez JC (2003) Short-term benthic recolonization after dredging in the harbour of Ceuta, North Africa. Mar Ecol 24:217–229

Hall SJ, Basford DJ, Robertson MR (1990) The impact of hydraulic dredging for razor clams *Ensis* sp. on an infaunal community. Neth J Sea Res 27:119–125

Hammond LS, Wilkinson CR (1985) Exploitation of sponge exudates by coral reef holothuroids. J Exp Mar Biol Ecol 94:1–9

Hassel AW, Milenkovic S, Schürmann U, Greve H, Zaporojtchenko V, Adelung R, Faupel F (2007) Model systems with extreme aspect ratio, tunable geometry, and surface functionality for a quantitative investigation of the lotus effect. Langmuir 23:2091–2094

Hendler G (1984) The association of *Ophiothrix lineata* and *Callyspongia vaginalis*: a brittlestar-sponge cleaning symbiosis? Mar Ecol 5:9–27

Henkel TP, Pawlik JR (2005) Habitat use by spongedwelling brittlestars. Mar Biol 146:301–313

Henry KR, Andersen MB (2013) The zinc isotopic composition of siliceous marine sponges: investigating nature's sediment traps. Chem Geol 354:33–41

Henry L-A, Hart M (2005) Regeration from injury and resource allocation in sponges and corals – a review. Int Rev Hydrobiol 90:125–158

Hentschel U, Hopke J, Horn M, Friedrich AB, Wagner M, Hacker J, Moore BS (2002) Molecular evidence for a uniform microbial community in sponges from different oceans. Appl Environ Microbiol 68:4431–4440

Hernández-Mariné M, Turon X, Catalan J (1990) A marine *Synechocystis* (Chroococcales, Cyanophyta) epizoic on didemnid ascidians from the Mediterranean Sea. Phycologia 29:275–284

Heyward A, Fromont J, Schönberg CHL, Colquhoun J, Radford B, Gomez O (2010) The sponge gardens of Ningaloo Reef, Western Australia. Open Mar Biol J 4:3–11

Hill BJ, Wassenberg T J (1990) Fate of discards from prawn trawlers in Torres Strait. Australian J Mar Freshw Res 41:53–64

Hill MS, Allenby A, Ramsby B, Schönberg CHL, Hill A (2011) *Symbiodinium* diversity among host clionaid sponges from Caribbean and Pacific reefs: evidence of heteroplasmy and putative host-specific symbiont lineages. Mol Phyl Evol 59:81–88

Hill MS, Hill A (2012) The magnesium inhibition and arrested phagosome hypotheses: new perspectives on the evolution and ecology of *Symbiodinium* symbioses. Biol Rev 87:804–821

Hill MS, Wilcox T (1998) Unusual mode of symbiont repopulation after bleaching in *Anthosigmella varians*: acquisition of different zooxanthellae strains. Symbiosis 25:279–289

Hirose E, Hirabayashi S, Hori K, Kasai F, Watanabe MM (2006) UV protection in the photosymbiotic ascidian *Didemnum molle* inhabiting different depths. Zool Sci 23:57–63

Hoffmann F Radax R, Woebken D, Moritz Holtappels M, Lavik G, Rapp HT, Schläppy ML, Schlepel C, Kuypers MMM (2009) Complex nitrogen cycling in the sponge *Geodia barretti.* Environ Microbiol 11:2228–2243

Hoffmann F, Rapp HT, Pape T, Peters H, Reitner J (2004) Sedimentary inclusions in the deep-water sponge *Geodia barretti* (Geodiidae, Demospongiae) from the Korsfjord, western Norway. Sarsia 89:245–252

Hoffmann F, Røy H, Bayer K, Hentschel U, Pfannkuche M, Brümmer F, De Beer D (2008) Oxygen dynamics and transport in the Mediterranean sponge *Aplysina aerophoba*. Mar Biol 153:1257–1264

Hogg MM, Tendal OS, Conway KW, Pomponi SA, Van Soest RWM, Gutt J, Krautter M, Roberts JM (2010) Deep-sea sponge grounds: reservoirs of biodiversity. UNEP-WCMC Biodiversity Series No. 32. UNEP-WCMC, Cambridge, UK, 84 pp

Holmes KE (1997) Eutrophication and the effect on bioeroding sponge communities. Proc 5th Int Coral Reef Symp, vol 2, Panama, p 1411–1415

Holmes KE (2000) Effects of eutrophication on bioeroding sponge communities with the description of new West Indian sponges, *Cliona* spp. Invertebr Biol 119:125–138

Holmes KE, Edinger EN, Hariyadi, Limmon GV, Risk MJ (2000) Bioerosion of live massive corals and branching coral rubble on Indonesian coral reefs. Mar Pollut Bull 40:606–617

Hooper JNA (1991) Revision of the Family Raspailiidae (Porifera: Demospongiae), with description of Australian species. Invert Taxon 5:1179–1415

Hooper JNA, Hall KA, Ekins M, Erpenbeck D, Wörheide G, Jolley-Rogers G (2013) Managing and sharing the escalating number of sponge ‘unknowns: the SpongeMaps Project. Integr Comp Biol 53:473–483

Humphrey C, Weber M, Lott C, Cooper T, Fabricius K (2008) Effects of suspended sediments, dissolved inorganic nutrients and salinity on fertilisation and embryo development in the coral *Acropora millepora* (Ehrenberg, 1834). Coral Reefs 27:837–850

Hutchings P (1990) Review of the effects of trawling on macrobenthic epifaunal communities. Aust J Mar Freshw Res 41:111–120

Hutchings P, Peyrot-Clausade M, Osnorno A (2005) Influence of land runoff on rates and agents of bioerosion of coral substrates. Mar Pollut Bull 51:438–447

Ilan M, Abelson A (1995) The life of a sponge in a sandy lagoon. Biol Bull 189:363–369

Jaap WC (2000) Coral reef restoration. Ecol Eng 15:345–364

James PSBR, Pillai CSG, Thomas PA, James DB, Koya S (1989) Environmental damage and consequences. Marine living resources of the union territory of Lakshadweep – an indicative survey with suggestions for development. CMFRI Bull 43:212–227

Jamieson GS, Chew L (2002) Hexactinellid sponge reefs: areas of interest as marine protected areas in the north and central coast areas. Canadian Science Advisory Secretariat Research Document 2002/122, Pacific Biological Station, Nanaimo, 77 pp

Jones AR (1986) The effects of dredging and spoil disposal on macrobenthos, Hawkesbury Estuary, N.S.W. Mar Pollut Bull 17:17–20

Jones G, Candy S (1981) Effects of dredging on the macrobenthic infauna of Botany Bay. Aust J Mar Freshw Res 32:379–398

Jones JB (1992) Environmental impact of trawling on the seabed: a review. New Zeal J Mar Freshw Res 26:59–67

Jørgensen CB (1966) Biology of suspension feeding. Pergamon Press, Oxford, 357 pp

Kaplan EH, Welker JR, Kraus MG, McCourt S (1975) Some factors affecting the colonization of a dredged channel. Mar Biol 32:193–204

Kefalas E, Castritsi-Catharios J, Miliou H (2003) The impacts of scallop dredging on sponge assemblages in the Gulf of Kalloni (Aegean Sea, northeastern Mediterranean). ICES J Mar Sci 60:402–410

Kelman D, Kashman Y, Hill RT, Rosenberg E, Loya Y (2009) Chemical warfare in the sea: the search for antibiotics from Red Sea corals and sponges. Pure Appl Chem 81:1113–1121

Kenchington E, Cogswell A, Lirette C, Murillo-Perez FL (2009) The use of density analyses to delineate sponge grounds and other benthic VMEs from trawl survey data. Northwest Atlantic Fisheries Organization Serial N5626 Scientific Council Meeting Document 09/6, p 1–16

Kenny AJ, Rees HL (1996) The effects of marine gravel extraction on the macrobenthos: results 2 years post-dredging. Mar Pollut Bull 32:615–622

Kilian EF, Wintermann-Kilian G (1979) Movement cellulaire et contraction chez *Spongilla lacustris* et *Ephydatia fluviatilis*. In: Lévi C, Boury-Esnault N (eds) Biologie des Spongiaires. Coll Int CNRS 291:137–143

Klitgaard A, Tendal OS (2004) Distribution and species composition of mass occurrences of large-sized sponges in the Northeast Atlantic. Prog Oceanogr 61:57–98

Kollmann H, Stachowitsch M (2001) Long-term changes in the benthos of the northern Adriatic Sea: a phototransect approach. Mar Ecol 22:135–154

Kott P (1963) The ascidians of Australia. IV. Aplousobranchiata Lahille: Polyclinidae Verril (continued). Aust J Mar Freshw Res 14:70–118

Koukouras A, Russo A, Voultsiadou-Koukoura E, Arvanitidis C, Stefanidou D (1996) Macrofauna associated with sponge species of different morphology. Mar Ecol 17:569–582

Kowalke J (2000) Ecology and energetics of two Antarctic sponges. J Exp Mar Biol Ecol 247:85–97

Krautter M, Conway KW, Barrie JV, Neweiler M (2001) Discovery of a 'living dinosaur': globally unique modern hexactinellid sponge reefs off British Columbia, Canada. Facies 44:265–282

Kunzmann K (1996) Die mit ausgewählten Schwämmen (Hexactinellida und Demospongiae) aus dem Weddellmeer, Antarktis, vergesellschaftete Fauna. Ber Polarforsch 210:1–93

Lemloh M-L, Fromont J, Brümmer F, Usher KM (2009) Diversity and abundance of photosynthetic sponges in temperate Western Australia. BMC Ecology 9:4

Leys SP, Lauzon NRJ (1998) Hexactinellid sponge ecology: growth rates and seasonality in deep water sponges. J Exp Mar Biol Ecol 230:111–129

Leys SP, Yahel G, Reidenbach MA, Tunnicliffe V, Shavit U, Reiswig HM (2011) The sponge pump: the role of current induced flow in the design of the sponge body plan. PLoS ONE 6:e27787

Live Aquaria (2014) Porcelain crab (*Petrolisthes galathinus*). Available at http://www.liveaquaria.com/product/prod_display.cfm?c=497+501+1963&pcatid=1963 (accessed 28 Apr 2014)

Loosanoff VL, Tommers FD (1948) Effect of suspended silt and other substances on rate of feeding of oysters. Science 107:69–70

López-Lengentil S, Erwin PM, Pawlik JR, Song B (2010) Effects of sponge bleaching on ammonia-oxidizing *Archaea*: distribution and relative expression of ammonia monooxygenase genes associated with the barrel sponge *Xestospongia muta*. Microb Ecol 60:561–571

López-Lengentil S, Turon X (2010) Pumping water or producing larvae? Oscula occlusion during the reproductive period of the sponge *Svenzea zeai*. Zool Stud 50:395

Lovell LL, Trego KD (2003) The epibenthic megafaunal and benthic infaunal invertebrates of Port Foster, Deception Island (South Shetland Islands, Antarctica). Deep-Sea Res II 50:1799–1819

Luter HM, Whalan S, Webster NS (2012) The marine sponge *Ianthella basta* can recover from stress-induced tissue regression. Hydrobiologia 687:227–235

Macdonald IA, Perry CT (2003) Biological degradation of coral framework in a turbid lagoon environment, Discovery Bay, north Jamaica. Coral Reefs 22:523–535

Main MB, Nelson WG (1988) Sedimentary characteristics of sabellariid worm reefs (*Phragmatopoma lapidosa* Kinberg). Estuar Coast Shelf Sci 26:105–109

Maldonado M (2006). The ecology of the sponge larva. Can J Zool 84:175–194

Maldonado M, Giraud K, Carmona C (2008) Effects of sediment on the survival of asexually produced sponge recruits. Mar Biol 154:631–641

Maldonado M, Uriz MJ (1999) An experimental approach to the ecological significance of microhabitat-scale movement in an encrusting sponge. Mar Ecol Prog Ser 185:239–255

Masini R, Jones R, Sim C (2011) Node 1 – Dredging Science: Science Plan. Western Australian Marine Science Institution, Perth, Australia, 23 pp

Maughan BC (2001) The effects of sedimentation and light on recruitment and development of a temperate, subtidal, epifaunal community. J Exp Mar Biol Ecol 256:59–71

Maurer D, Keck RT, Tinsman JC, Leathem WA (1980-81) vertical migration and mortality of benthos in dredged material. – Part I: Mollusca. Mar Environ Res 4:299–319

McCarthy DA, Kramer P, Price JR, Donato CL (2008) The ecological importance of a recently discovered intertidal sabellariid reef in St. Croix, U.S. Virgin Islands. Caribb J Sci 44:223-227

McCauley J, Parr RA, Hancock DR (1977) Benthic infauna and maintenance dredging: a case study. Water Res 11:233–247

McClanahan TR, Obura D (1997) Sedimentation effects on shallow coral communities in Kenya. J Exp Mar Biol Ecol 209:103–122

McDonald JI, Hooper JNA, McGuinness KA (2002) Environmentally influenced variability in the morphology of *Cinachyrella australiensis* (Carter 1886) (Porifera: Spirophorida: Tetillidae). Mar Freshw Res 53:79–84

McDonald JI, McGuinness KA , Hooper JNA (2003) Influence of re-orientation on alignment to flow and tissue production in a *Spongia* sp. (Porifera: Demospongiae: Dictyoceratida). J Exp Mar Biol Ecol 296:13–22

McLean EL Lasker HR (2013) Height matters: position above the substratum influences the growth of two demosponge species. Mar Ecol 34:122–129

McMurray SE, Blum JE, Pawlik JR (2008) Redwood of the reef: growth and age of the giant barrel sponge *Xestospongia muta* in the Florida Keys. Mar Biol 155:159–171

Mendola D, De Caralt S, Uriz MJ, Van den End F, Van Leeuwen JL, Wijffels RH (2008) Environmental flow regimes for *Dysidea avara* sponges. Mar Biotechnol 10:622–630

Mercurio M, Corriero G, Gaino E (2006) Sessile and non-sessile morphs of *Geodia cydonium* (Jameson) (Porifera, Demospongiae) in two semi-enclosed Mediterranean bays. Mar Biol 148:489–501

Moran MJ, Stephenson PC (2000) Effects of otter trawling on macrobenthos and management of demersal scalefish fisheries on the continental shelf of north-western Australia. ICES J Mar Sci 57: 510–516

Morrow C, Cárdenas P (2015) Proposal for a revised classification of the Demospongiae (Porifera). Frontiers in Zoology 12:7

Morton JW (1977) Ecological effects of dredging and dredge spoil disposal. Technical papers of the US Fish and Wildlife Service 94. United States department of the Interior. Fish and Wildlife Service, Washington DC, 33 pp

Multer HG, Millimann JD (1967) Geologic aspects of sabellarian reefs, southeastern Florida. Bull Mar Sci 17:257-267

Muricy G (1989) Sponges as pollution bio-monitors at Arraial do Cabo, Southeastern Brazil. Rev Bras Biol 49:347–354

Muricy G (1991) Structure des peuplements des spongiaires autour de l'égout the Cortiou (Marseille, France). Vie Milieu 51:205–221

Naylor LA, Viles HA (2000) A temperate reef builder: an evaluation of the growth, morphology and composition of *Sabellaria alveolata* (L.) colonies on carbonate platforms in South Wales. Geol Soc London Special Pub 178:9-19

Negri A, Burns K, Boyle S, Brinkman D, Webster N (2006) Contamination in sediments, bivalves and sponges of McMurdo Sound, Antarctica. Environ Pollut 143:456–467

Neira C, Levin LA, Mendoza G, Zirino A (2013) Alteration of benthic communities associated with copper contamination linked to boat moorings. Mar Ecol 35:46–66

Newell RC, Seiderer LJ, Simpson NM, Robinson JE (2004) Impacts of marine aggregate dredging on benthic macrofauna off the south coast of the United Kingdom. J Coast Res 20:115–125

Nielsen C, Riisgård HU (1998) Tentacle structure and filter-feeding in *Crisia ebournea* and other cyclostomatous bryozoans, with a review of upstream-collecting mechanisms. Mar Ecol Prog Ser 168:163–186

NOAA (2013) Monthly global SST anomaly plot archive. Available at http://www.emc.ncep.noaa.gov/research/cmb/sst_analysis/ (accessed 30 Sep 2013)

Núñez Flores M, Rodríguez-Quintal JG, Díaz MC (2010) Distribución de esponjas (Porifera) a lo largo de un gradiente de profundidad en un arrecife coralino, Parque Nacional San Esteban, Carabobon, Venezuela. Int J Trop Biol 58 (suppl 3):175–187

Olson RR (1986) Photoadaptations of the Caribbean colonial ascidian-cyanophyte symbiosis *Tridemnum solidum*. Biol Bull 170:62–74

Padovan A, Muksgaard N, Alvarez B, Mc Guiness K, Parry D, Gibb K (2012) Trace metal concentrations in the tropical sponge *Spheciospongia vagabunda* at a sewage outfall: synchrotron X-ray imaging reveals the micron-scale distribution of accumulated metals. Hydrobiologia 687:275–288

Palumbi SR (1984) Tactics of acclimation: morphological changes of sponges in an unpredictable environment. Science 225:1478–1480

Palumbi SR (1986) How body plans limit acclimation: responses of a demosponge to wave force. Ecology 67:208–214

Pang RK (1973) The ecology of some Jamaican excavating sponges. Bull Mar Sci 23:227–243

Pawlik JR (2011) The chemical ecology of sponges on Caribbean reefs: natural products shape natural systems. BioScience 61:888–898

PIANC (2010) Dredging and port construction around coral reefs. PIANC Environment Commission Report No.108 – 2010. World Association for Waterbourne Transport Infrastructure, Brussels, Belgium, 2010, 75 pp

Pile AJ (1999) Resource particioning by Caribbean coarl reef sponges: Is there enough food for everyone? Mem Queensland Mus 44:457–461

Pile AJ, Patterson MR, Savarese M, Chernykh VI, Fialkov VA (1997) Trophic effects of sponge feeding within the Lake Baikal's littoral zone. 2. Sponge abundance, diet, feeding efficiency, and carbon flux. Limnol Oceanogr 42:178–184

Pitcher CR, Burridge CY, Wassenberg TJ, Smith GP (1999) The impact of trawling on some tropical sponges and other sessile fauna. Mem Queensland Mus 44:455

Poiner IR, Kennedy R (1984) Complex patterns of change in the macrobenthos of a large sandbank following dredging. 1. Community analysis. Mar Biol 78:335–352

Pomponi SA, Meritt DW (1990) Distribution and life history of the boring sponge *Cliona truitti* in the upper Chesapeake Bay. In: Rützler K (ed) New perspectives in sponge biology. Smithsonian Intitution Press, Washington DC, p 384–390

Posey MH, Pregnall AM, Graham RA (1984) A brief description of a subtidal sabellariid (Polychaeta) reef on the southern Oregon coast. Pac Sci 38:28–33

Prakash S, Kumar TTA, Khan SA (2013) Checklist of the Porcellanidae (Crustacea: Decapoda: Anomura) of India. Check List 9:1514–1518

Przeslawski R, Ahyong S, Byrne M, Wörheide G, Hutchings P (2008) Beyond corals and fish: the effects of climate change on noncoral benthic invertebrates of tropical reefs. Glob Change Biol 14:2773–2795

Przeslawski R, Alvarez B, Battershill C, Smith (2014) Sponge biodiversity and ecology of the Van Diemen Rise and eastern Joseph Bonaparte Gulf, northern Australia. Hydrobiologia 730:1–16

Reeson P, Cowell L, Narinesingh D, Campbell G, Shirley S (2002) Environmental impact assessment. Proposed dredging works at West Harbor, Port Antonio, Jamaica. Environmental Solutions Ltd. Report, Kingston, p 1-66, pls

Reiswig HM (1971) *In situ* pumping activities of tropical Demospongiae. Mar Biol 9:38–50

Reiswig HM (1973) Population dynamics of three Jamaican Demospongiae. Bull Mar Sci 23:191–226

Rice SA (1984) Effects of suspended sediment and burial upon survival and growth of Eastern Gulf of Mexico corals. Mote Marine Lab Tech Rep 87, p 58 Available at https://dspace.mote.org/dspace/bitstream/2075/12/1/86.pdf (accessed 2 Sept 2013)

Robinson JE, Newell RC, Seiderer LJ, Simpson NM (2005) Impacts of aggregate dredging on sediment composition and associated benthic fauna at an offshore dredge site in the southern North Sea. Mar Environ Res 60:51–68

Rooper CN, Wilkins ME, Rose CS, Coon C (2011) Modeling the impacts of bottom trawling and the subsequent recovery rates of sponges and corals in the Aleutian Islands, Alaska. Cont Shelf Res 31:1827–1834

Rose CS, Risk MJ (1985) Increase in *Cliona delitrix* infestation of *Montastrea cavernosa* heads on an organically polluted portion of the Grand Cayman fringing reef. PSZN Mar Ecol 6:345–363

Rosell D (1993) Effects of reproduction in *Cliona viridis* (Hadromerida) on zooxanthellae. Sci Mar 57:405–413

Rützler K (1990) Associations between Caribbean sponges and photosynthetic organisms. In: K. Rützler (ed) New perspectives in sponge biology. Smithsonian Institution Press, Washington, DC, p 455–466

Rützler K (1997) The role of psammobiontic sponges in the reef community. Proc 8th Int Coral Reef Symp, Balboa 2, p 1393–1398

Rützler K (2002a) Family Clionaidae d'Orbigny, 1851. In: Hooper JNA, Van Soest RWM (eds) Systema Porifera. A guide to the classification of sponges. Volume 1. Kluwer Academic/ Plenum Publishers, New York, p 173–185

Rützler K (2002b) Imapct of crustose clionid sponges on Caribbean reef corals. Acta Geol Hisp 37:61–72

Saby E, Justesen J, Kelve M, Uriz MJ (2009) *In vitro* effects of metal pollution on Mediterranean sponges: species-specific inhibition of 2', 5'-oligoadenylate synthetase. Aquat Toxicol 94:204–210

Sainsbury KJ, Campbell RA, Lindholm R, Whitelaw AW (1997). Experimental management of an Australian multispecies fishery: examining the possibility of trawl-induced habitat modification. In: Pikitch EK, Huppert DD, Sissenwine MP (eds) Global trends: fisheries. Proc Symp Global Trends Fisheries Managem, Seattle 1994, p 107–112

Sainsbury KJ, Campbell RA, Whitelaw AW (1992) Effects of trawling on the marine habitat on the North West Shelf of Australia and implications for sustainable fisheries management. In: Hancock DA (ed) Sustainable fisheries through sustaining fish habitat. Australian Society for Fish Biology Workshop. Australian Government Publishing Service, Canberra, p 137–145

Schmahl GP (1990) Community structure and ecology of sponges associated with four Southern Florida coral reefs. In: Rützler K (ed) New perspectives in sponge biology. Smithsonian Intitution Press, Washington DC, p 376–383

Schmahl GP (1999) Recovery and growth of the giant barrel sponge (*Xestospongia muta*) following physical injury from a vessel grounding in the Florida Keys. Mem Queensland Mus 44:532

Sheild CJ, Witman JD (1993) The impact of *Henricia sanguinolenta* (O.F. Müller) (Echinodermata: Asteroidea) predation on the finger sponges, *Isodictya* spp. J Exp Mar Biol Ecol 166:107–133

Schönberg CHL (2000) Bioeroding sponges common to the central Australian Great Barrier Reef: descriptions of three new species, two new records, and additions to two previously described species. Senckenbergiana marit 30:161–221

Schönberg CHL (2001) Small-scale distribution of Great Barrier Reef bioeroding sponges in shallow water. Ophelia 55:39–54

Schönberg CHL (2002) *Pione lampa*, a bioeroding sponge in a worm reef. Hydrobiologia 482:49–68

Schönberg CHL (2015) Self-cleaning surfaces in sponges. Mar Biodiv 45:623-624

Schönberg CHL (2016) Happy relationships between marine sponges and sediments – a review and some observations from Australia. J Mar Biol Ass UK 96(2):493-514 doi:10.1017/S0025315415001411.

Schönberg CHL, Barthel D (1997) Inorganic skeleton of the demosponge *Halichondria panicea*. Seasonality in spicule production in the Baltic Sea. Mar Biol 130:133–140

Schönberg CHL, Burgess H (2013) Storm damage after cyclone Yasi: bioeroding sponges survived. Available at http://f1000.com/posters/browse/summary/1094699 (accessed 12 Dec 2013)

Schönberg CHL, Fromont J (2012) Sponge gardens of Ningaloo Reef (Carnarvon Shelf, Western Australia) are biodiversity hotspots. Hydrobiologia 687:143–161

Schönberg CHL, Fromont J (2014) Sponge functional growth forms as a means for classifying sponges without taxonomy. In: Radford B, Ridgway T (eds) The Ningaloo Atlas. Available at http://ningaloo-atlas.org.au/content/sponge-functional-growth-forms-means-classifying-spo (accessed 26 Jul 2015)

Schönberg CHL, Hosie A, Fromont J, Marsh L (2016) Apartment-style living on a kebab sponge. Mar Biodiv 46:331-332

Schönberg CHL, Loh WKW (2005) Molecular identity of the unique symbiotic dinoflagellates found in the bioeroding demosponge *Cliona orientalis*. Mar Ecol Prog Ser 299:157–166

Schönberg CHL, Suwa R (2007) Why bioeroding sponges may be better hosts for symbiotic dinoflagellates than many corals. In: Custódio MR, Lôbo-Hajdu G, Hajdu E, Muricy G (eds) Sér Livros Mus Nacional Rio de Janeiro 28. Porifera Research. Biodiversity, innovation and sustainability, p 569–580

Schönberg CHL, Wilkinson CR (2001) Induced colonization of corals by a clionid bioeroding sponge. Coral Reefs 20:69–76

Schönberg CHL, Wisshak M (2012) The perks of being endolithic. Aquat Biol 17:1–5

Semeniuk V (1993) The Pilbara coast: a riverine coastal plain in a tropical arid setting, northwestern Australia. Sediment Geol 83:235–256

Sidri M, Milanese M, Brümmer F (2005) First observations on egg release in the oviparous sponge *Chondrilla nucula* (Demospongiae, Chondrosida, Chondrillidae) in the Mediterranean Sea. Invertebr Biol 124:91–97

Sim CJ, Lee KJ (1999) Relationship of sand and fibre in the horny sponge *Psammocinia*. Mem Queensland Mus 44:551–557

Solga A, Cerman Z, Striffler BF, Spaeth M, Barthlott M (2007) The dream of staying clean: lotus and biomimetic surfaces. Bioinspir Biomim 2:S126

Stevely JM, Sweat DE, Bert TM, Sim-Smith C, Kelly M (2011) Sponge mortality at Marathon and Long Key, Florida: patterns of species response and population recovery. Proc 63rd Gulf Caribbean Fisheries Inst 2010 San Juan, Puerto Rico, p 384–400

Stewart B (1998) Can a snake-star earn its keep? Feeding and cleaning behaviour in *Astrobrachion constrictum* (Farquhar) (Echinodermata: Ophiuroidea), a euryalid brittle-star living in association with the black coral, *Antipathes fiordensis* (Grange, 1990). J Exp Mar Biol Ecol 221:173–189

Storr JF (1976a) Biological factors controlling sponge distribution in the Gulf of Mexico and the resulting zonation. In: Harrison FW, Cowden RR (eds) Aspects of sponge biology. Academic Press, New York, p 261–276

Storr JF (1976b) Field observations of sponge reactions as related to their ecology. In: Harrison FW, Cowden RR (eds) Aspects of sponge biology. Academic Press, New York, p 277–282

Styan CA, Hanley JR (2013) Mudying the waters: the science of protecting the environment during dredging. Australian J Mar Ocean Affairs 5(4):137-144

Su S-W, Chung I-C, Li T-M (2009) Temporal dynamics of rocky-shore macroalgal assemblage structures in relation to coastal construction threats in Orchard Island (Taiwan): impacts of turbidity and nutrients on the blooms of *Galaxaura oblongata* and a red alga-sponge symbiose *Ceratodictyon/Haliclona*. Kuroshio Sci 3:63–80

Svane I, Hammett Z, Lauer P (2009) Impacts of trawling on benthic macro-fauna and -flora of the Spencer Gulf prawn fishing grounds. Fish Res 90:158–169

Swain TD, Wulff JL (2007) Diversity and specificity of Caribbean sponge-zoanthid symbioses: a foundation for understanding the adaptive significance of symbioses and generating hypotheses about higher-order systematics Biol J Linnean Soc 92:695–711

Tanner JE (2003) The influence of prawn trawling on sessile benthic assemblages in Gulf St. Vincent, South Australia. Can J Fish Aquat Sci 60: 517–526

Teragawa CK (1986a) Particle transport and incorporation during skeleton formation in a keratose sponge: *Dysidea etheria*. Biol Bull 170:321–334

Teragawa CK (1986b) Sponge dermal membrane morphology: histology of cell-mediated particle transport during skeletal growth. J Morphol 190:335–347

Thacker RW (2005) Impacts of shading on sponge-cyanobacteria symbioses: a comparison between host-specific and generalist associations. Integr Comp Biol 45:369–376

Thoms C, Hentschel U, Schmitt S, Schupp P (2008) Rapid tissue reduction and recovery in the sponge *Aplysinella* sp. Mar Biol 156:141–153

Thomson Reuters (2014) Web of Science. Available at http://apps.webofknowledge.com/UA_GeneralSearch_input.do?product=UA&search_mode=GeneralSearch&SID=R2YsgmpnjVU9fWgqcgA&preferencesSaved=. (accessed 26 Apr 2014)

Tompkins-MacDonald GJ, Leys SP (2008) Glass sponges arrest pumping in response to sedimentation: implications for the physiology of the hexactinellid conduction system. Mar Biol 154: 973–984

Topçu NE, Pérez T, Grégori G, Harmelin-Vivien M (2010) *In situ* investigation of *Spongia officinalis* (Demospongiae) particle feeding: coupling flow cytometry and stable isotope analysis. J Exp Mar Biol Ecol 389:61–69

Tudela S (2000) Ecosystem effects of fishing in the Mediterranean: an analysis of the major threats of fishing gear and practices to biodiversity and marine habitats. Rep FAO Fisheries Dep (EP/INT/759/GEF), Rome, Italy, p 45

Turner SJ, Thrush SF, Cummings VJ, Hewitt JE, Wilkinson MR, Williamson RB, Lee D J (1997) Changes in epifaunal assemblages in response to marina operations and boating activities. Mar Environ Res 43:181–199

Turon X, Codina M, Tarjuelo I, Uriz MJ, Becerro MA (2000) Mass recruitment of *Ophiotrix fragilis* (Ophiuroidea) on sponges: settlement patterns and post-settlement dynamics. Mar Ecol Prog Ser 200:201–212

Turon X, Galera MJ, Uriz MJ (1997) Clearance rates and aquiferous system in two sponges with contrasting life-history strategies. J Exp Zool 278:22–36.

Turon X, Tarjuelo I, Uriz M-J (1998) Growth dynamics and mortality of the encrusting sponge *Crambe crambe* (Poecilosclerida) in contrasting habitats: correlation with population structure and investment in defense. Funct Ecol 12:631–639

Turon X, Uriz MJ, Willenz P (1999) Cuticular linings and remodelisation processes in *Crambe crambe* (Demospongiae: Poecilosclerida). Mem Queensland Mus 44:617–625

Usher KM (2008) The ecology and phylogeny of cyanobacterial symbionts in sponges. Mar Ecol 29:178–192

Uriz M-J, Turon X, Becerro MA, Galera J, Lozano M (1995) Patterns of resource allocation to somatic, defensive, and reproductive functions in the Mediterranean encrusting sponges *Crambe crambe* (Demospongiae, Poecilosclerida). Mar Ecol Prog Ser 124:159–170

Vacelet J (1981) Algal–sponge symbiosis in the coral reefs of New Caledonia: a morphological study. Proc 4th Int Coral Reef Symp, Manila. 2, p 713–719

Vacelet J (2002) Family Astroscleridae Lister, 1900. In: Hooper JNA, Van Soest RWM (eds) Systema Porifera. A guide to the classification of sponges. Volume 1. Kluwer Academic/ Plenum Publishers, New York, p 824–830

Van der Veer HW, Bergman MJN, Beukema JJ (1985) Dredging activities in the Dutch Wadden Sea: effects on macrobenthic infauna. Neth J Sea Res 19:183–190

Van Soest RWM, Boury-Esnault N, Hooper JNA, Rützler K, De Voogd NJ, Alvarez de Glasby B, Hajdu E, Pisera AB, Manconi R, Schönberg CHL, Janussen D, Tabachnick KR, Klautau M, Picton B, Kelly M, Vacelet J, Dohrmann M, Díaz CM (2014) World Porifera Database. Available at http://www.marinespecies.org/porifera (accessed 15 Sept 2013)

Van Soest RWM, Rützler K (2002) Family Tetillidae Sollas, 1886. In: Hooper JNA, Van Soest RWM (eds) Systema Porifera. A guide to the classification of sponges. Volume 1. Kluwer Academic/ Plenum Publishers, New York, p 85–98

Vianello M, Vischetti C, Scarponi L, Zanin G (2005) Herbicide losses in runoff events from a field with a low slope: role of a vegetative filter strip. Chemosphere 61:717–725

Vicente VP (1989) Regional commercial sponge extinctions in the West Indies: Are recent climatic changes responsible? Mar Ecol 10:179–191

Vogel S (1978) evidence for one-way valves in the water-flow system of sponges. J Exp Biol 76:137–148

Voultsiadou-Koukoura HE, Koukouras A, Eleftheriou A (1987) Macrofauna associated with the sponge *Verongia aerophoba* in the North Aegean Sea. Estuar Coast Shelf Sci 24:265–278

Walters KD, Pawlik JR (2005) Is there a trade-off between wound-healing and chemical defenses among Caribbean reef sponges? Integr Comp Biol 45:352–358

Ward JE, MacDonald BA (1996) Pre-ingestive feeding behaviours of two sub-tropical bivalves (*Pinctada imbricata* and *Arca zebra*): responses to an acute increase in suspended sediment concentration. Bull Mar Sci 59:417–432

Ward-Paige CA, Risk MJ, Sherwood OA, Jaap WC (2005) Clionid sponge surveys on the Florida Reef Tract suggest land-based nutrient inputs. Mar Pollut Bull 51:570–579

Wareham VE, Ollerhead LMN, Gilkinson K (2010) Spatial analysis of coral and sponge densities with associated fishing effort in proximity to Hatton Basin (NAFO Divisions 2G-0B). Research Document 2010/058 for the Canadian Science Advisory Secretariat. Northwest Atlantic Fisheries Centre, Department of Fisheries and Oceans Science Branch, St. John's, Canada, 34 pp

Wassenberg TJ, Hill BJ (1990) Partitioning of material discarded from prawn trawlers in Moreton Bay. Aus J Mar Freshw Res 41:27–36

Weber M, Lott C, Fabricius KE (2006) Sedimentation stress in a scleractinian coral exposed to terrestrial and marine sediments with contrasting physical, organic and geochemical properties. J Exp Mar Biol Ecol 336:18–32

Webster NS, Webb RI, Ridd MJ, Hill RT, Negri AP (2001) The effects of copper on the microbial community of a coral reef sponge. Environ Microbiol 3:19–31

Westinga E, Hoetjes PC (1981) The intrasponge fauna of *Spheciospongia vesparia* (Porifera, Demospongiae) at Curaçao and Bonaire. Mar Biol 62:139–150

Whalan S, Battershill C, De Nys R (2007) Variability in reproductive output across a water quality gradient for a tropical marine sponge. Mar Biol 153:163–169

Wijgwerde T (2012) Feature Article: Improved husbandry of marine invertebrates using an innovative filtration technology - part two: results with two 12 cubic meter DyMiCo systems. Advanced Aquarist 11. Available at http://www.advancedaquarist.com/2012/3/aafeature2 (accessed 26 Oct 2013)

Wilber DH, Clarke DG (2001) Biological effects of suspended sediments: a review of suspended sediment impacts on fish and shellfish with relation to dredging activities in estuaries. North Am J Fish Manage 21:855–875

Wild Singapore (2014) Wild fact sheets. Porcelain crabs. Family Porcellanidae. Available at http://www.wildsingapore.com/wildfacts/crustacea/othercrust/anomura/porcellanidae/porcellanidae.htm (accessed 28 Apr 2014)

Wilkinson CR (1980) Cyanobacteria symbiotic in marine sponges. In: Schwemmler W, Schenk HEA (eds) Endocytobiology, endosymbiosis and cell biology. Walter de Gruyter, Berlin, p 553–563

Wilkinson CR, Cheshire AC (1988) Growth rate of Jamaican coral reef sponges after Hurricane Allen. Biol Bull 175:175–179

Wilkinson CR, Cheshire AC (1989) Patterns in the distribution of sponge populations across the central Great Barrier Reef. Coral Reefs 8:127–134

Wilkinson CR, Evans E (1989) Sponge distribution across Davies Reef, Great Barrier Reef, relative to location, depth, and water movement. Coral Reefs 8:1–7

Wilkinson CR, Garrone R, Vacelet J (1984) Marine sponges discriminate between food bacteria and bacterial symbionts: electromicroscope radioautography and *in situ* evidence. Proc R Soc Lond B 220:519–528

Willenz P, Hartman WD (1999) Growth and regeneration rates of the calcareous skeleton of the Caribbean coralline sponge *Ceratoporella nicholsoni*: a long term survey. Mem Queensland Mus 44:675–685

Williamson EA, Strychar KB, Withers K, Sterba-Boatwright B (2011) Effects of salinity and sedimentation on the gorgonian coral, *Leptogorgia virgulata* (Lamarck 1815). J Exp Mar Biol Ecol 409:331–338

Williamson KJ, Nelson PO (1977) 3. Environmental quality. In: Schroeder WL (ed) Dredging in estuaries. Technical manual. Guide for review of environmental impact statements. Oregon State University, Corvallis, p 39-98

Windsor PJ, Leys SP (2010) *Wnt* signaling and induction in the sponge aquiferous system: evidence for an ancient origin of the organizer. Evol Dev 12:484–493

Wisshak M, Schönberg CHL, Form A, Freiwald A (2013) Effects of ocean acidification and global warming on bioerosion – lessons from a clionaid sponge. Aquatic Biol 19:111–127

Wisshak M, Schönberg CHL, Form A, Freiwald A (2014) Sponge bioerosion accelerated by ocean acidification across species and latitudes? Helgoland Mar Res 68:252–262

Wörheide G, Vargas S, Lüter C, Reitner J (2011) Precious coral and rock sponge gardens on the deep aphotic fore-reef of Osprey Reef (Coral Sea, Australia). Coral Reefs 30: 901

WoRMS Editorial Board (2014). World Register of Marine Species. Available at http://www.marinespecies.org at VLIZ. (accessed 12 Oct 2014)

Wotton RS (2005) The essential role of exopolymers (EPS) in aquatic systems. In: Gibson RN, Atkinson RJA, Gordon JDM (eds) Oceanography and marine biology: an annual review 42, CRC Press LLC, Boca Raton, Florida, p 57–94

Wulff JL (1994) Sponge-feeding by Caribbean angelfishes, trunkfishes, and filefishes. In: Sponges in space and time. Van Soest RWM, Van Kempen TMG, Braekman J-C (eds) Balkema, Rotterdam, p 265–271

Wulff JL (2001) Assessing and monitoring coral reef sponges: why and how? Bull Mar Sci 69: 831–846

Wulff JL (2005) Trade-offs in resistance to competitors and predators, and their effects of the diversity of tropical marine sponges. J Anim Ecol 74:313–321

Wulff JL (2006a) Ecological interactions of marine sponges. Can J Zool 84:146–166

Wulff JL (2006b) Rapid diversity and abundance decline in a Caribbean coral reef sponge community. Biol Conserv 127:167 –176

Wulff JL (2006c) Resistance *vs.* recovery: morphological strategies of coral reef sponges. Funct Ecol 20:699–708

Wulff JL (2008) Collaboration among sponge species increases sponge diversity and abundance in a seagrass meadow. Mar Ecol 29:193–204

Wulff JL (2010) Regeneration of sponges in ecological context: Is regeneration an integral part of life history and morphological strategies? Integr Comp Biol 50:494–505

Xavier JR, Rachello-Dolmen PG, Parra-Velandia FJ, Schönberg CHL, Breeuwer JAJ, van Soest RWM (2010) Molecular evidence of cryptic speciation in the 'cosmopolitan' excavating sponge *Cliona celata* (Porifera, Clionaidae). Mol Phylogenet Evol 56:13–20

Xue L, Zhang W (2009) Growth and survival of early juveniles of the marine sponge *Hymeniacidon perlevis*

(Demospongiae) under controlled conditions. Mar Biotechnol 11:640–649

Yahel G, Whitney F, Reiswig HM, Eerkes-Medrano DI, Leys SP (2007) *In situ* feeding and metabolism of glass sponges (Hexactinellida, Porifera) studied in a deep temperate fjord with a remotely operated submersible. Limnol Oceanogr 52:428–440

Yáñyez B, JL Carballo, Olabarria C, Barrón JJ (2008) Recovery of macrobenthic assemblages following experimental sand burial. Oceanologia 50:391–420

Yoshioka PM (2009) Sediment transport and the distribution of shallow-water gorgonians. Caribb J Sci 45:254–259

Zarrouk S, Ereskovsky AV, Mustapha KB, El Abed A, Pérez T (2013) Sexual reproduction of *Hippospongia communis* (Lamarck, 1814) (Dictyoceratida, Demospongiae): comparison of two populations living under contrasting environmental conditions. Mar Ecol 34:432–442

Zea S (1994) Patterns of coral and sponge abundance in stressed coral reefs at Santa Marta, Colombian Caribbean. In: Van Soest RWM, van Kempen TMG, Braekman J-C (eds) Sponges in time and space. Biology, chemistry, paleontology. Balkema, Rotterdam, p 257–264

Zühlke R, Reise K (1994) Response of macrofauna to drifting tidal sediments. Helgol Meeresunters 48:277–289

14. Appendices

Summarised literature information on sponge-sediment relationships. Taxon examples for any given observation listed alphabetically by genus and species name, ignoring the subgenus, with more accurately identified taxa listed before less accurately identified ones. Higher taxon sequence is phylum: class: order: family to the system prior to Morrow & Cárdenas (2015). Taxon allocations, validities and authorities were confirmed with WoRMS Editorial Board (2014) and van Soest et al. (2014), where references for original descriptions can be found and often downloaded.

Abbreviations:

- Methods and technical terms: BACI – before, after, control, impact, MAA – mycosporine-like amino acid (has sun-protective functions among other things), SEM – scanning electron microscopy, TEM – transmission electron microscopy, TSS – total suspended solids.
- Taxonomic affiliations. Phyla: An – Annelida, Ar – Arthopoda, Bp – Brachiopoda. Bz – Bryozoa, Ch – Chordata, Cn – Cnidaria, Ed – Echinodermata, Ent – Enteropneusta, Mo – Mollusca, Po – Porifera. Classes: Ant – Anthozoa, Asc – Ascidiacea, Biv – Bivalvia, Cal – Calcarea, Cri – Crinoidea, Dem – Demospongiae, Ech – Echinoidea, He – Hemichordata, Gas – Gastropoda, Gym – Gymnolaemata, Hex – Hexactinellida, Hom – Homoscleromorpha, Hyd – Hydrozoa, Mal – Malacostraca, Max – Maxillopoda, Oph – Ophiuriodea, Pol – Polychaeta.
- Elements and contaminants: Ag – silver, Al – aluminum, As – arsenic, Ba – barium, Br – bromine, C – carbon, Ca – calcium, Cd – cadmium, Cu – copper, Fe – iron, Hg – mercury, I – iodine, Mn – manganese, N – nitrogen, Ni – nickel, PAH – polyaromatic hydrocarbons, Pb – lead, PCB – polychlorinated biphenyls, POM – particulate organic matter, Sc – scandium, Si – silicon, THC - total hydrocarbons, Ti – titanium, V- vanadium, Zn - zinc.

Appendix 1. Filter feeder passive relationships with sediments: natural selection, avoidance of sediments by morphology, settlement and distributions (latter item interrelating with tolerances/intolerances listed in Appendix 2). For abbreviations see above.

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
DISTRIBUTION: Sponges were surveyed in the field. In comparison to hard substrate habitats, on soft substrates sponges were not as diverse and more dissimilar between and within habitats. *Aaptos* sp. was only found on sand.	*Aaptos* sp.	W Indian Ocean, 0, 5, 10, 15, 20 m	Po: Dem: Hadromerida: Suberitidae	Gray, 1867	Barnes & Bell 2002
DISTRIBUTION: Field study. *A. acuta* occurred only at one site, an area with low levels of siltation and under an overhang.	*Acanthella acuta*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Halichondrida: Dictyonellidae	(Schmidt, 1862)	Carballo et al. 1996
SETTLEMENT: Field settlement experiment. All barnacles with the exception of *A. eburneus* attached more commonly to upper panels rather than to lower panels with heavy siltation. *A. improvisus* and *A. eburneus* settled more commonly on vertical plates than horizontal plates.	1 - *Amphibalanus amphitrite* 2 - *Amphibalanus improvisus* 3 - *Amphibalanus eburneus*	Miami Beach, Florida, USA, W Atlantic, depth not stated	Ar: Max: Sessilia: Balanidea	1-2 - (Darwin, 1854) 3 - (Gould, 1841)	Doochin & Walton Smith 1951 (all *Amphibalanus* spp. as *Balanus*)

DISTRIBUTION: Field study. *A. fucorum* was found to be most abundant at a site with fast flow and little sedimentation of which it appears to be intolerant. It was missing at the site with the highest sedimentation and grew on vertical and inclined surfaces.	*Amphilectus fucorum*	S Ireland, Atlantic, 0-30 m	Po: Dem: Poecilosceleridae (Mycalina): Esperiopsidae	(Esper, 1794)	Bell & Barnes 2000a, 2000b (as *Esperiopsis*)
DISTRIBUTION: Faunistic account of Cuba. This sponge was observed to occur in areas with soft, muddy bottom sediments.	*Amphimedon viridis*	Cuba, Caribbean, 0-30 m	Po: Dem: Haplosclerida (Haplosclerina): Niphatidae	Duchassaing & Michelotti, 1864	Alcolado 1990
DISTRIBUTION: Sponges were surveyed in the field. In comparison to hard substrate habitats, on soft substrates sponges were not as diverse and more dissimilar between and within habitats. *A. foetida* was only found on sand.	*Amorphinopsis foetida*	W Indian Ocean, 0, 5, 10, 15, 20 m	Po: Dem: Halichondrida: Halichondriidae	(Dendy, 1889)	Barnes & Bell 2002 (as *Prostylissa*)
DISTRIBUTION: *A. transversa* was more abundant on bottoms with low silt-clay content and a mean grain diameter in the medium sand range, and most abundant on bottoms rich in dead shell material. Higher abundances on coarser sediments were explained with co-occurring stronger currents that were assumed to provide nutrients.	*Anadara transversa*	Buzzards Bay, Massachussetts, NW Atlantic, 2-10 m	Mo: Biv: Arcoida: Arcidae	(Say, 1822)	Driscoll 1967
SETTLEMENT: A panel experiment was conducted to estimate settlement under inverted panels, under opaque roofs, under transparent roof and on exposed surfaces. '*Anomia ephippium* showed no preference for treatment.'	*Anomia ephippium*	S Ireland, Atlantic, 6 m	Mo: Biv: Pectinoida: Anomiidae	Linnaeus, 1758	Maughan 2001
DISTRIBUTION: *A. simplex* was more abundant on bottoms with low silt-clay content and a mean grain diameter in the medium sand range, and most abundant on bottoms rich in dead shell material. Higher abundances on coarser sediments were explained with co-occurring stronger currents that were assumed to provide nutrients.	*Anomia simplex*	Buzzards Bay, Massachussetts, NW Atlantic, 2-10 m	Mo: Biv: Pectinoida: Anomiidae	D'Orbigny, 1853	Driscoll 1967
DISTRIBUTION: Field study. *A. rosea* only occurred in areas with low levels of siltation and occurred on vertical surfaces and under overhangs and stones, thus reducing sedimentation stress.	*Aplysilla rosea*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Dendroceratida: Darwinellidae	(Barrois, 1876)	Carballo et al. 1996
MORPHOLOGY: *A. cauliformis* commonly occurs in areas with strong waves, frequent exposure to storms and sedimentation (see App. 7). Alcolado (2007) explains this tolerance with 'branching morphology, flexibility and elasticity'.	*Aplysina cauliformis*	Cuba, Caribbean, depth not stated, assumed shallow	Po: Dem: Verongida: Aplysinidae	(Carter, 1882)	Alcolado 2007
DISTRIBUTION: Faunistic account of Cuba. This sponge was observed to occur in areas with soft, muddy bottom sediments.	*Aplysina fistularis*	Cuba, Caribbean, 0-30 m	Po: Dem: Verongida: Aplysinidae	(Pallas, 1766)	Alcolado 1990
DISTRIBUTION: The scattered pore rope sponge is usually associated with deep water and high water clarity.	*Aplysina fulva*	Jamaica, Caribbean, 3-43 m	Po: Dem: Verongida: Aplysinidae	(Pallas, 1766)	Reeson et al. 2002
DISTRIBUTION: *A. lacunosa* appears to be sensitive to sedimentation, which may affect the abundance of this species on turbid patch reefs.	*Aplysina lacunosa*	N Florida Keys, W Atlantic, 3-6, 7-11, 12-21 m	Po: Dem: Verongida: Aplysinidae	(De Lamarck, 1814)	Schmahl 1990

DISTRIBUTION: Sponges were surveyed in the field. In comparison to hard substrate habitats, on soft substrates sponges were not as diverse and more dissimilar between and within habitats. *Aplysina* sp. was only found on sand.	*Aplysina* sp.	W Indian Ocean, 0, 5, 10, 15, 20 m	Po: Dem: Verongida: Aplysinidae	Nardo, 1834	Barnes & Bell 2002
SETTLEMENT: *A. islandica* is a successful coloniser of soft sediments.	*Arctica islandica*	W Baltic Sea, 20 m	Mo: Biv: Veneroida: Arcticidae	(Linnaeus, 1767)	Arntz & Rumohr 1982 (as *Cyprina*)
DISTRIBUTION: *A. poculata* was more abundant on bottoms with low silt-clay content and a mean grain diameter in the medium sand range, and most abundant on bottoms rich in dead shell material. Higher abundances on coarser sediments were explained with co-occurring stronger currents that were assumed to provide nutrients.	*Astrangia poculata*	Buzzards Bay, Massachussetts, NW Atlantic, 2-10 m	Cn: Ant: Scleractinia: Rhizangiidae	(Ellis & Solander, 1786)	Driscoll 1967 (as *A. danae*)
MORPHOLOGY, DISTIBUTION: Field observations. These erect-branching sponges occurred at high sedimentation sites, growing on inclined as well as on vertical surfaces.	1 – *Axinella damicornis* 2 – *Axinella dissimilis*	S Ireland, Atlantic, 0-30 m	Po: Dem: Halichondrida: Axinellidae	1 – (Esper, 1794) 2 – (Bowerbank, 1866)	Bell & Barnes 2000a, 2000b
DISTRIBUTION: Sponges were surveyed in the field. In comparison to hard substrate habitats, on soft substrates sponges were not as diverse and more dissimilar between and within habitats. *Biemna* spp. were only found on sand.	1 – *Biemna fortis* 2 – *Biemna* sp.	W Indian Ocean, 0, 5, 10, 15, 20 m	Po: Dem: Poecilosclerida (Mycalina): Desmacellidae	1 – (Topsent, 1897) 2 – Gray, 1867	Barnes & Bell 2002
DISTRIBUTION: Sponges were surveyed in the field. In comparison to hard substrate habitats, on soft substrates sponges were not as diverse and more dissimilar between and within habitats. *C. foliascens* was only found on sand.	*Carteriospongia foliascens*	W Indian Ocean, 0, 5, 10, 15, 20 m	Po: Dem: Dictyoceratida: Thorectidae	(Pallas, 1766)	Barnes & Bell 2002 (as *Phyllospongia*)
MORPHOLOGY: The sponge lives in deep sea mud environments, is usually fixed on stones in the mud, has a stalk and a disc-shaped, elevated body, on which inhalants point downwards and exhalants are on the upper surface.	*Caulophacus (Caulophacus) arcticus*	Svalbard Basin, Arctic Ocean, 2000-3296 m	Po: Hex (Hexasterophora): Lyssacinosida: Rosselidae (Rosselinae)	(Hansen, 1885)	Barthel & Tendal 1993
DISTRIBUTION: Occurs in habitats with sand and shell grit sediment, which may suggest that it cannot tolerate fine sediments.	*Ceratopsion palmatum*	N Australia, NW shelf to Wessel Island, Indian Ocean, 5.5-76 m	Po: Dem: Poecilosclerida (Microcionina): Raspailiidae	Hooper, 1991	Hooper 1991
DISTRIBUTION: Faunistic account of Cuba. This sponge was observed to occur in areas with soft, muddy sediments.	*Chondrilla caribensis?*	Cuba, Caribbean, 0-30 m	Po: Dem: Chondrosida: Chondrillidae	Rützler et al. 2007	Alcolado 1990 (as *Chondrilla nucula*)
SETTLEMENT: Field settlement experiment. All barnacles with the exception of *A. eburneus* attached more commonly to upper panels rather than to lower panels with heavy siltation.	*Chtamalus fragilis*	Miami Beach, Florida, USA, W Atlantic, depth not stated	Ar: Max: Sessilia: Balanidea	1-2 - (Darwin, 1854) 3 - (Gould, 1841)	Doochin & Walton Smith 1951 (as *Chthalamus*)
DISTRIBUTION: *C. barbata* occurs on 'sediment-rich bottoms'.	*Cinachyra barbata*	general account	Po: Dem: Spirophorida: Tetilldae	Sollas, 1886	Van Soest & Rützler 2002
MORPHOLOGY, DISTRIBUTION: *C. australiensis* is adapted to perturbed sites and high sedimentation levels. It occurs in areas with high turbidity and strong flushing. The sponge formed thicker spicules in environments with the largest sediment size, smaller sediments induced flattened growth forms	*Cinachyrella australiensis*	Darwin Habour, Australia, Timor Sea, shallow depth	Po: Dem: Spirophorida: Tetillidae	(Carter, 1886)	McDonald et al. 2002

DISTRIBUTION: Sponges were surveyed in the field. In comparison to hard substrate habitats, on soft substrates sponges were not as diverse and more dissimilar between and within habitats. *C. arabica* was only found on sand.	*Cinachyrella arabica*	W Indian Ocean, 0, 5, 10, 15, 20 m	Po: Dem: Spirophorida: Tetillidae	(Carter, 1869)	Barnes & Bell 2002 (as *C. voeltzkowii*)
DISTRIBUTION: Sponges were surveyed in the field. In comparison to hard substrate habitats, on soft substrates sponges were not as diverse and more dissimilar between and within habitats. *Ciocalypta* sp. was only found on sand.	*Ciocalypta* sp.	W Indian Ocean, 0, 5, 10, 15, 20 m	Po: Dem: Halichondrida: Halichondriidae	Bowerbank, 1862	Barnes & Bell 2002
DISTRIBUTION: Field study comparing benthic assemblages to sedimentation levels. While anthozoans were generally only found on vertical surfaces, *C. caespitosa* was able to tolerate sedimentation on horizontal surfaces.	*Cladocora caespitosa*	Ligurian Sea, Mediterranean, 32-35 m	Cn: Ant: Scleractinia: Scleractinia *incertae sedis*	(Linnaeus, 1767)	Balata et al. 2005
DISTRIBUTION: *C. prolifera* was more abundant on bottoms with low silt-clay content and a mean grain diameter in the medium sand range and most abundant on bottoms rich in dead shell material. Higher abundances on coarser sediments were explained with co-occurring stronger currents that were assumed to provide nutrients.	*Clathria (Clathria) prolifera*	Buzzards Bay, Massachussetts, NW Atlantic, 2-10 m	Po: Dem: Poecilosclerida (Microcionina): Microcionidae	(Ellis & Solander, 1786)	Driscoll 1967 (as *Microciona*)
DISTRIBUTION: Sponges were surveyed in the field. In comparison to hard substrate habitats, on soft substrates sponges were not as diverse and more dissimilar between and within habitats. *C. vulpina* was only found on sand.	*Clathria (Thalysias) vulpina*	W Indian Ocean, 0, 5, 10, 15, 20 m	Po: Dem: Poecilosclerida (Microcionina): Microcionidae	(De Lamarck, 1814)	Barnes & Bell 2002 (as *C. frondifera*)
DISTRIBUTION: Sponges were surveyed in the field. In comparison to hard substrate habitats, on soft substrates sponges were not as diverse and more dissimilar between and within habitats. *Clathria* sp. 1 and 2 were only found on sand.	*Clathria (Microciona)* sp. 1 and 2	W Indian Ocean, 0, 5, 10, 15, 20 m	Po: Dem: Poecilosclerida (Microcionina): Microcionidae	Bowerbank, 1862	Barnes & Bell 2002 (as *Microciona*)
DISTRIBUTION: Sponges were surveyed in the field. In comparison to hard substrate habitats, on soft substrates sponges were not as diverse and more dissimilar between and within habitats. *Clathria* sp. was only found on sand.	*Clathria (Thalysias)* sp.	W Indian Ocean, 0, 5, 10, 15, 20 m	Po: Dem: Poecilosclerida (Microcionina): Microcionidae	Duchassaing & Michelotti, 1864	Barnes & Bell 2002 (as *Thalysias*)
DISTRIBUTION: Sponges were surveyed in the field. In comparison to hard substrate habitats, on soft substrates sponges were not as diverse and more dissimilar between and within habitats. *Clathrina* sp. was only found on sand.	*Clathrina* sp.	W Indian Ocean, 0, 5, 10, 15, 20 m	Po: Cal (Calcinea): Clathrinida: Clathrinidae	Gray, 1867	Barnes & Bell 2002
DISTRIBUTION: *C.* cf. *celata* was more abundant on bottoms with low silt-clay content and a mean grain diameter in the medium sand range. The gamma form was most abundant on bottoms poor in dead shell material. Higher abundances on coarser sediments were explained with co-occurring stronger currents that were assumed to provide nutrients.	*Cliona* cf. *celata*	Buzzards Bay, Massachussetts, NW Atlantic, 2-10 m	Po: Dem: Hadromerida: Clionaidae	Grant, 1826	Driscoll 1967
DISTRIBUTION: Field observations. The sponge occurs at high sedimentation sites, growing on inclined (fewer, larger specimens) and on vertical surfaces (more, smaller specimens).	*Cliona celata*	S Ireland, Atlantic, 0-30 m	Po: Dem: Hadromerida: Clionaidae	Grant, 1826	Bell & Barnes 2000a, 2000b
MORPHOLOGY: Study on growth forms of *C. celata*. At sites with higher sedimentation encrusting and endolithic growth forms of *C. celata* were more common, also developing fistules and more oscules per unit surface area.	*Cliona* cf. *celata*	S Ireland, E Atlantic, 12-18 m	Po: Dem: Hadromerida: Clionaidae	Grant, 1826	Bell et al. 2002

DISTRIBUTION: *C. schmidti* is a clearwater species susceptible to sedimentation, and it tolerates a suspension of POM <1 g m^{-2}. It occurs on vertical or inclined surfaces, unless sedimentation is very low.	*Cliona schmidti*	Algeciras Bay, Straits of Gibraltar, 1-4 m	Po: Dem: Hadromerida: Clionaidae	(Ridley, 1881)	Carballo et al. 1994
MORPHOLOGY: The club-shaped *C. varians* with broad base withstands hurricanes and prevails in habitats with coarse sediment and strong waves.	*Cliona varians*	Florida Keys, Gulf of Mexico, 2.5-2.7 m	Po: Dem: Hadromerida: Clionaidae	Duchassaing & Michelotti, 1864	Stevely et al. 2011
DISTRIBUTION: Field study. *C. crambe* was less common at sites with high compared to low levels of siltation and mostly occurred on vertical surfaces and under overhangs, rarely on horizontal surfaces.	*Crambe crambe*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Poecilosclerida (Myxillina): Crambeidae	(Schmidt, 1862)	Carballo et al. 1996
DISTRIBUTION: *Crepidula* spp. were more abundant on bottoms with high silt-clay content, and the author reasoned that the snails avoided clogging by moving onto objects raised above the bottom.	1 – *Crepidula convexa* 2 – *Crepidula fornicata* 3 – *Crepidula plana*	Buzzards Bay, Massachussetts, NW Atlantic, 2-10 m	Mo: Gas: Littorinimorpha: Calyptraeidae	1 & 3 – Say, 1822 2 – (Linnaeus, 1758)	Driscoll 1967
DISTRIBUTION: Sponge densities, coverage, growth and survival were highest with lowest sedimentation rate and highest substrate heterogeneity. The bathymetric distribution of *D. anchorata* showed an opposite trend to the level of sedimentation.	*Desmapsamma anchorata*	San Esteban National Park, Venezuela, Caribbean, 1-18 m	Po: Dem: Poecilosclerida (Myxillina): Desmacididae	(Carter, 1882)	Núñez Flores et al. 2010
DISTRIBUTION: Sponges were surveyed in the field. In comparison to hard substrate habitats, on soft substrates sponges were not as diverse and more dissimilar between and within habitats. *Discodermia* sp. 2 was only found on sand.	*Discodermia* sp. 2	W Indian Ocean, 0, 5, 10, 15, 20 m	Po: Dem: 'Lithistida': Theonellidae	Du Bocage, 1869	Barnes & Bell 2002
MORPHOLOGY: *D. avara* has different growth forms depending on water flow, with encrusting forms in high flow to more erect, tube-forming morphologies in low flow environments, where organic matter builds up on the surface between erect parts with pores.	*Dysidea avara*	Costa Brava, Spain NW Mediterranean, 4.5-14.3 m	Po: Dem: Dictyoceratida: Dysideidae	(Schmidt, 1862)	Mendola et al. 2008
DISTRIBUTION: Faunistic account of Cuba. This sponge was observed to occur in areas with soft, muddy bottom sediments.	*Dysidea etheria*	Cuba, Caribbean, 0-30 m	Po: Dem: Dictyoceratida: Dysideidae	De Laubenfels, 1936	Alcolado 1990
DISTRIBUTION: Field observations. This massive sponge occurred at high sedimentation sites, growing on inclined and on vertical surfaces.	*Dysidea fragilis*	S Ireland, Atlantic, 0-30 m	Po: Dem: Dictyoceratida: Dysideidae	(Montagu, 1814)	Bell & Barnes 2000a, 2000b
DISTRIBUTION: The sponge occurs on 'shallow coastal and shallow offshore rock reefs, in mud or areas with high sedimentation'.	*Echinodictyum cancellatum*	S Indonesia and all northern coasts of Australia, Indo-Pacific, subtidal, 5-108 m	Po: Dem: Poecilosclerida (Microcionina): Raspailiidae	(De Lamarck, 1814)	Hooper 1991
DISTRIBUTION: The sponge is 'usually associated with soft substrates, attached to hard objects embedded in the sediment'.	*Echinodictyum conulosum*	Northern coasts of Australia, Indo-Pacific, 8-84 m	Po: Dem: Poecilosclerida (Microcionina): Raspailiidae	Kieschnick, 1900	Hooper 1991

DISTRIBUTION: Sponges were surveyed in the field. In comparison to hard substrate habitats, on soft substrates sponges were not as diverse and more dissimilar between and within habitats. *E. acervus* was only found on sand.	*Ecionemia acervus*	W Indian Ocean, 0, 5, 10, 15, 20 m	Po: Dem: Astrophorida: Ancorinidae	Bowerbank, 1864	Barnes & Bell 2002 (as *E. rotundum*)
DISTRIBUTION: Occurs in areas with high sedimentation.	*Endectyon (Endectyon) fructicosum* var. *aruense*	Gulf of Mannar, Bay of Bengal, Andaman Sea, Indian Ocean, 8-18 m	Po: Dem: Poecilosclerida (Microcionina): Raspailiidae	species: Dendy, (1887), variety: (Hentschel, 1912)	Hooper 1991
DISTRIBUTION: Field observations. The sponge occurred at the site with the highest sedimentation, growing on vertical surfaces and was virtually absent from inclined surfaces, suggesting sediment intolerance.	*Eurypon major*	S Ireland, Atlantic, 0-30 m	Po: Dem: Poecilosclerida (Microcionina): Raspailiidae	Sarà & Siribelly, 1960	Bell & Barnes 2000a, 2000b
DISTRIBUTION: *Eurypon* spp. were rare at clear-water sites and occurred at sites with high sedimentation levels, growing on vertical cliffs and inclined surfaces, abundances increasing with depth.	*Eurypon* sp. 1 and 2	S Ireland, Atlantic, 0-30 m	Po: Dem: Poecilosclerida (Microcionina): Raspailiidae	Gray, 1867	Bell & Barnes 2000a, 2000b
DISTRIBUTION: Field observations. The sponge occurred on inclined (low abundance) and vertical surfaces (much larger abundance), partly in areas with high sedimentation, rare at clear-water site. Abundances increased with depth.	*Eurypon* sp. 4	S Ireland, Atlantic, 0-30 m	Po: Dem: Poecilosclerida (Microcionina): Raspailiidae	Gray, 1867	Bell & Barnes 2000a, 2000b
DISTRIBUTION: Sponges were surveyed in the field. In comparison to hard substrate habitats, on soft substrates sponges were not as diverse and more dissimilar between and within habitats. *Gelliodes* sp. 1 was only found on sand.	*Gelliodes* sp. 1	W Indian Ocean, 0, 5, 10, 15, 20 m	Po: Dem: Haplosclerida (Haplosclerina): Niphatidae	Ridley, 1884	Barnes & Bell 2002
DISTRIBUTION: Sponges were surveyed in the field. In comparison to hard substrate habitats, on soft substrates sponges were not as diverse and more dissimilar between and within habitats. *G. crustosa* was only found on sand.	*Geodia crustosa*	W Indian Ocean, 0, 5, 10, 15, 20 m	Po: Dem: Astrophorida: Geodiidae (Geodiinae)	Bösraug, 1913	Barnes & Bell 2002
DISTRIBUTION: Field observations. The sponge occurs at the site with the highest sedimentation, but grows on vertical surfaces. It is more common in shallow water.	*Halichondria (Halichondria) bowerbanki*	S Ireland, Atlantic, 0-30 m	Po: Dem: Halichondrida: Halichondriidae	Burton, 1930	Bell & Barnes 2000a
DISTRIBUTION: Faunistic account of Cuba. This sponge was observed to occur in areas with soft, muddy bottom sediments.	*Halichondria (Halichondria) melanadocia*	Cuba, Caribbean, 0-30 m	Po: Dem: Halichondrida: Halichondriidae	De Laubenfels, 1936	Alcolado 1990
DISTRIBUTION: Field study. *H. cinerea* commonly occurred in areas with high siltation, but commonly occurred in cryptic habitats (caves, crevices, under rocks), under overhangs or on vertical surfaces, which may reduce the sedimentation stress.	*Haliclona (Reniera) cinerea*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Haplosclerida (Haplosclerina): Chalinidae	(Grant, 1826)	Carballo et al. 1996
DISTRIBUTION: Sponges were surveyed in the field. In comparison to hard substrate habitats, on soft substrates sponges were not as diverse and more dissimilar between and within habitats. The listed *Haliclona* spp. were only found on sand.	1 – *Haliclona (Gellius) cymaeformis* 2 – *Haliclona* sp. 1 3 – *Haliclona* sp. 2	W Indian Ocean, 0, 5, 10, 15, 20 m	Po: Dem: Haplosclerida (Haplosclerina): Chalinidae	1 – (Esper, 1794) 2-3 – Grant, 1836	Barnes & Bell 2002 (as *Gellius cymiformis*)
DISTRIBUTION: Field study. The two *Haliclona* spp. only occurred at sites with low levels of sedimentation and under overhangs and in small caves.	1 – *Haliclona (Haliclona) fulva*	Algeciras Bay, S Spain,	Po: Dem: Haplosclerida (Haplosclerina): Chalinidae	1 – (Topsent, 1893)	Carballo et al. 1996

	1 – *Haliclona (Soestella) mucosa*	W Mediterranean, 5-30 m		2 – (Griessinger, 1971)	
MORPHOLOGY: 2000a and b – Field observation. 2004 – Experimental evidence that *H. (H.) urceolus* is adapted to high sedimentation by being tube-shaped, tapering towards the ground, with an apical osculum and a bundled exhalant jet, thus preventing sediments from settling on surfaces passively (reduced amount of horizontal surfaces and shelter of inhalants by wider upper body) and actively (jet). The sponge is also stalked and occurs at the site in single or double tubes, while it can have multiple tubes at other sites. Comment: Please note that our images from Onslow show that sponges can accumulate fine sediments on vertical surfaces.	*Haliclona (Haliclona) urceolus*	S Ireland, Atlantic, 0-30 m	Po: Dem: Haplosclerida (Haplosclerina): Chalinidae	(Rathke & Vahl, 1806)	Bell & Barnes 2000a, 2000b, Bell 2004
DISTRIBUTION: 2000a – The sponge occurred at high sedimentations sites, growing on inclined and vertical surfaces, becoming more abundant with depth. The highest abundances of *H. urceolus* occurred on inclined surfaces, where it was presumed to have a competitive advantage against sediment-sensitive species through its tube-shape.	*Haliclona (Haliclona) urceolus*	S Ireland, Atlantic, 0-30 m	Po: Dem: Haplosclerida (Haplosclerina): Chalinidae	(Rathke & Vahl, 1806)	Bell & Barnes 2000a, 2000b, Bell 2004
DISTRIBUTION: *Haliclona* spp. was the most dominant species at a high sedimentation sites, growing on vertical cliffs and inclined surfaces, and was more common on shallower areas. Comment: It is not clear which species of the sp. 1-5 is meant.	*Haliclona* sp.	S Ireland, Atlantic, 0-30 m	Po: Dem: Haplosclerida (Haplosclerina): Chalinidae	Grant, 1836	Bell & Barnes 2000a, 2000b
DISTRIBUTION: Field observations. The sponge occurs at high sedimentation sites, on inclined surfaces.	*Halicnemia patera*	S Ireland, Atlantic, 0-30 m	Po: Dem: Halichondrida: Heteroxyidae	Bowerbank, 1864	Bell & Barnes 2000b
MORPHOLOGY: Sediment layers established naturally on experimental blocks and became about 3-5 mm thick, consisting of grains of variable size (0.5-225 µm). *Halisarca* sp. reacted to sediment cover by rearranging its growth form into clusters of wart-like protruberances, thus keeping its surface clean.	*Halisarca* sp.	Fanning Island, central Pacific, 0.2-1.5 m	Po: Dem: Chondrosida: Halisarcidae	Johnston, 1842	Bakus 1968
DISTRIBUTION: Field study. *H. pansa* did not occur at sites with high siltation and grew under stones or on vertical surfaces.	*Hymedesmia (Hymedesmia) pansa*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Poecilosclerida (Myxillina): Hymedesmiidae	Bowebank, 1882	Carballo et al. 1996
DISTRIBUTION: Field study. *H. versicolor* was more common in areas with high siltation, but was overall rare and only occurred under overhangs, reducing sedimentation stress.	*Hymedesmia (Hymedesmia) versicolor*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Poecilosclerida (Myxillina): Hymedesmiidae	(Topsent, 1893)	Carballo et al. 1996
DISTRIBUTION: Sponges were surveyed in the field. In comparison to hard substrate habitats, on soft substrates sponges were not as diverse and more dissimilar between and within habitats. *Hymedesmia* sp. 1 was only found on sand.	*Hymedesmia* sp. 1	W Indian Ocean, 0, 5, 10, 15, 20 m	Po: Dem: Poecilosclerida (Myxillina): Hymedesmiidae	Bowerbank, 1864	Barnes & Bell 2002

DISTRIBUTION: Field observations. This encrusting sponge occurs at high sedimentation sites, on inclined and vertical surfaces (latter in low densities), and can tolerate sediment crusts. Its abundance increased with depth.	*Hymeraphia stellifera*	S Ireland, Atlantic, 0-30 m	Po: Dem: Poecilosclerida (Microcionina): Raspailiidae	Bowerbank, 1864	Bell & Barnes 2000a, 2000b
EXCLUSION: Field settlement experiment. Presence of sand on settlement substrates reduced recruitment by 50%. But when transplanted, juvenile specimens buried in sand grew faster than unburied ones, which may increase chances of survival, bringing polyps out of the sand. Recruitment was highest and least variable on clean natural limestone patches.	*Leptogorgia virgulata*	Florida, USA, Gulf of Mexico, 1.5 m	Cn: Ant: Alcyonacea: Gorgoniidae	(De Lamarck, 1815)	Gotelli 1988
DISTRIBUTION: Sponge communities were compared between a site with high loads of fine, slow settling, and a site with coarser, fast-settling sediments. At both sites sponge numbers, percentage cover and richness were reduced on the reef flats, but abundances were higher on the reef flat with fine sediments, while richness, cover and density in general was lower. *L. granularis* was covered with a fine layer of silt, the most conspicuous species at the site with fine sediments and absent from the site with the coarser sediments.	*Liosina granularis*	Sulawesi, Indonesia, Banda Sea, 0-15 m	Po: Dem: Halichondrida: Dictyonellidae	Kelly-Borges & Bergquist, 1988	Bell & Smith 2004
DISTRIBUTION: Sponges were surveyed in the field. In comparison to hard substrate habitats, on soft substrates sponges were not as diverse and more dissimilar between and within habitats. Except for one single exception *L. arenaria* was only found on sand.	*Lissodendoryx (Ectyodoryx) arenaria*	W Indian Ocean, 0, 5, 10, 15, 20 m	Po: Dem: Poecilosclerida (Myxillina): Coelosphaeridae	Burton, 1936	Barnes & Bell 2002
DISTRIBUTION: Field study investigating the effect of sediment transport on gorgonians. Reciprocal averaging showed that gorgonian abundance decreased with slope angle (not depth) and thus with sediment transport. *M. pinnata* was missing from the most sloped site.	*Muricea pinnata*	La Parguera, Puerto Rico, Caribbean, 2-22 m	Cn: Ant: Alcyonacea: Plexauridae	Bayer, 1961	Yoshioka 2009
SETTLEMENT: *M. truncata* is a successful coloniser of soft sediments.	*Mya truncata*	W Baltic Sea, 20 m	Mo: Biv: Myoida: Myidae	Linnaeus, 1758	Arntz & Rumohr 1982
SETTLEMENT: *M. acerata* can settle on small pieces of gravel and survive in very muddy areas, and it can keep its surface sediment-free.	*Mycale (Oxymycale) acerata*	Wedell Sea, Antarctic, 100-1200 m	Po: Dem: Poecilosclerida (Mycalina): Mycalidae	Kirkpatrick, 1907	Barthel & Gutt 1992
DISTRIBUTION: Faunistic account of Cuba. This sponge was observed to occur in turbid areas with soft bottom sediments. Basal parts anchored in the mud were dead.	*Mycale (Zygomycale) angulosa*	Cuba, Caribbean, 0-30 m	Po: Dem: Poecilosclerida (Mycalina): Mycalidae	(Duchassaing & Michelotti, 1864)	Alcolado 1990
DISTRIBUTION: Field study. *M. micranthoxea* commonly occurred in areas with high siltation, but occurs on vertical surfaces, which may reduce the amount of sediments building up on the surface.	*Mycale (Carmia) micranthoxea*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Poecilosclerida (Mycalina): Mycalidae	Buizer & Van Soest, 1977	Carballo et al. 1996
DISTRIBUTION: Sponges were surveyed in the field. In comparison to hard substrate habitats, on soft substrates sponges were not as diverse and more dissimilar between and within habitats. *Mycale* sp. was only found on sand.	*Mycale* sp.	W Indian Ocean, 0, 5, 10, 15, 20 m	Po: Dem: Poecilosclerida (Mycalina): Mycalidae	Gray, 1867	Barnes & Bell 2002

DISTRIBUTION: The pink vase sponge is usually associated with deep water and high water clarity.	*Niphates digitalis*	Jamaica, Caribbean, 8-25 m	Po: Dem: Haplosclerida (Haplosclerina): Niphatidae	(De Lamarck, 1814)	Reeson et al. 2002
DISTRIBUTION: Faunistic account of Cuba. This sponge was observed to occur in turbid areas with soft bottom sediments. Basal parts anchored in the mud were dead.	*Niphates erecta?*	Cuba, Caribbean, 0-30 m	Po: Dem: Haplosclerida (Haplosclerina): Niphatidae	Duchassaing & Michelotti, 1864	Alcolado 1990 (as *N. ramosa*)
DISTRIBUTION: Faunistic account of Cuba. This sponge was observed to occur in areas with soft, muddy bottom sediments.	*Oceanapia peltata*	Cuba, Caribbean, 0-30 m	Po: Dem: Haplosclerida (Petrosina): Phloeodictyidae	(Schmidt, 1870)	Alcolado 1990 (as *Foliolina*)
DISTRIBUTION: Sponges were surveyed in the field. In comparison to hard substrate habitats, on soft substrates sponges were not as diverse and more dissimilar between and within habitats. *Oceanapia* sp. was only found on sand.	*Oceanapia* sp.	W Indian Ocean, 0, 5, 10, 15, 20 m	Po: Dem: Haplosclerida (Petrosina): Phloeodictyidae	Norman, 1869	Bell & Barnes 2002a (as *Rhizochalina*)
DISTRIBUTION: Field study. *O. lobularis* was more common in areas with high siltation, but occurred on vertical surfaces and under overhangs, potentially reducing sedimentation stress.	*Oscarella lobularis*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Hom: Homosclerophorida: Oscarellidae	(Schmidt, 1862)	Carballo et al. 1996
DISTRIBUTION: Field observations. This encrusting sponge occurs at high sedimentation sites, on inclined and on vertical surfaces (latter higher abundances), but can tolerate sediment crusts. Its abundance increased with depth.	*Paratimea constellata*	S Ireland, Atlantic, 0-30 m	Po: Dem: Hadromerida, Hemiasterellidae	Topsent, 1893	Bell & Barnes 2000a, 2000b
DISTRIBUTION: Sponges were surveyed in the field. In comparison to hard substrate habitats, on soft substrates sponges were not as diverse and more dissimilar between and within habitats. The listed *Plectroninia* spp. were only found on sand.	*Plectroninia* sp. 1 *Plectroninia* sp. 2 *Plectroninia* sp. 4	W Indian Ocean, 0, 5, 10, 15, 20 m	Po: Cal (Calcaronea): Lithonida: Minchinellidae	Hinde, 1900	Barnes & Bell 2002
SETTLEMENT: *P. invaginata* can settle on small pieces of gravel and survive in very muddy areas, and it can keep its surface sediment-free.	*Polymastia invaginata*	Wedell Sea, Antarctic, 100-1200 m	Po: Dem: Hadromerida: Polymastiidae	Kirkpatrick, 1907	Barthel & Gutt 1992
MORPHOLOGY: Field observations. The sponges' 'surfaces are covered in a thick layer of sediment' and 'may be exploiting interstitial water', with exhalant papillae keeping above the sediment, preventing smothering. It was rare at clear-water site and occurred at high sedimentation sites, growing on inclined surfaces and on vertical cliffs.	*Polymastia* spp. 1-8	S Ireland, Atlantic, 0-30 m	Po: Dem: Hadromerida: Polymastiidae	Bowerbank, 1864	Bell & Barnes 2000a, 2000b
DISTRIBUTION: Field study investigating the effect of sediment transport on gorgonians. Reciprocal averaging showed that gorgonian abundance decreased with slope angle (not depth) and thus with sediment transport. *A. bipinnata* was missing from the most sloped site.	*Antillogorgorgia bipinnata*	La Parguera, Puerto Rico, Caribbean, 2-22 m	Cn: Ant: Alcyonacea: Gorgoniidae	(Verrill, 1864)	Yoshioka 2009 (as *Pseudopterogorgia*)
DISTRIBUTION: Sponges were surveyed in the field. In comparison to hard substrate habitats, on soft substrates sponges were not as diverse and more dissimilar between and within habitats. *P. andrewsi* was only found on sand.	*Pseudosuberites andrewsi*	W Indian Ocean, 0, 5, 10, 15, 20 m	Po: Dem: Hadromerida: Suberitidae	Kirkpatrick, 1900	Barnes & Bell 2002

SETTLEMENT: A panel experiment was conducted to estimate settlement under inverted panels, under opaque roofs, under transparent roof and on exposed surfaces. The fan worm *Spirobranchus* sp. dominated under inverted panels followed by under opaque roofs.	*Spirobranchus* sp.	S Ireland, Atlantic, 6 m	An: Pol: Sabellida: Serpulidae	Blainville, 1818	Maughan 2001 (as *Pomatoceros* sp.)
DISTRIBUTION: Occurs in muddy-sand habitats and 'in areas of extremely high sedimentation'.	*Raspailia (Clathriodendron) darwinensis*	Darwin and NW shelf, N Australia, intertidal to 44 m	Po: Dem: Poecilosclerida (Microcionina): Raspailiidae	Hooper, 1991	Hooper 1991
DISTRIBUTION: Field observations. This branching sponge occurs at high sedimentation sites, growing on vertical and inclined surfaces, abundances increasing with depth.	*Raspailia (Raspailia) ramosa*	S Ireland, Atlantic, 0-30 m	Po: Dem: Poecilosclerida (Microcionina): Raspailiidae	(Montagu, 1814)	Bell & Barnes 2000a, 2000b
DISTRIBUTION: *R. odorabile* is not photosynthetic. Nevertheless, it is more abundant at offshore sites with cleaner water, reduced natural sedimentation, higher illumination and where high energy hydrodynamic conditions prevail. There was also a non-consistent depth-effect (deeper occurrence in clearer water). Specimens were slightly larger at outer-shelf reef sites. Sampled suspended sediments were represented by fine clays (24 µm; inner-shelf up to 32%, mid- and outer shelf <3%) and coarse biogenic material (means of 127 and 214 µm respectively mid- and outer-shelf).	*Rhopaloeides odorabile*	central Great Barrier Reef, Pacific, 0-20 m	Po: Dem: Dictyoceratida: Spongiidae	Thompson et al., 1987	Bannister 2008, Bannister et al. 2007, 2010, 2011, 2012
DISTRIBUTION: Field study. The two *Sarcotragus* spp. did not occur at sites with high siltation and mostly grew on vertical surfaces and under overhangs.	1 - *Sarcotragus foetidus* 2 - *Sarcotragus spinosulus*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Dictyoceratida: Irciniidae	1 & 2 - Schmidt, 1862	Carballo et al. 1996 (1 as *Sarcotragus muscarum*)
DISTRIBUTION: Field study. *S. lophyropoda* did not occur at sites with high siltation and mostly grew on vertical surfaces and under overhangs.	*Scopalina lophyropoda*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Halichondrida: Scopalinidae	Schmidt, 1862	Carballo et al. 1996
DISTRIBUTION: *S. brevitubulatum* appears to be susceptible to sedimentation and turbidity and is more common at sites without these environmental conditions.	*Siphonodictyon brevitubulatum*	Jamaica, Caribbean, 5-25 m in 5 m intervals	Po: Dem: Haplosclerida (Petrosina): Phloeodictyidae	Pang, 1973	Macdonald & Perry 2003
DISTRIBUTION: Sponges were surveyed in the field. In comparison to hard substrate habitats, on soft substrates sponges were not as diverse and more dissimilar between and within habitats. *S. florida* was only found on sand.	*Spheciospongia florida*	W Indian Ocean, 0, 5, 10, 15, 20 m	Po: Dem: Hadromerida: Clionaidae	(Von Lendenfeld, 1897)	Barnes & Bell 2002
DISTRIBUTION: 'Sponges in the genus *Spheciospongia*, which excavate rock substrata initially and live on sandy bottoms with high sedimentation rate, are distinguished by pore sieves.'	*Spheciospongia* spp.	general account	Po: Dem: Hadromerida: Clionaidae	Marshall, 1892	Rützler 2002a
DISTRIBUTION: Sponges were surveyed in the field. In comparison to hard substrate habitats, on soft substrates sponges were not as diverse and more dissimilar between and within habitats. *Spirastrella* sp. was only found on sand.	*Spirastrella* sp.	W Indian Ocean, 0, 5, 10, 15, 20 m	Po: Dem: Hadromerida: Spirastrellidae	Schmidt, 1868	Barnes & Bell 2002

DISTRIBUTION: Sponges were surveyed in the field. In comparison to hard substrate habitats, on soft substrates sponges were not as diverse and more dissimilar between and within habitats. *S. ceylonensis* was only found on sand.	*Spongia (Spongia) ceylonensis*	W Indian Ocean, 0, 5, 10, 15, 20 m	Po: Dem: Dictyoceratida: Spongiidae	Dendy, 1905	Barnes & Bell 2002
DISTRIBUTION: *Stelligera* spp. occurred at sites with high sedimentation levels, growing on vertical cliffs and inclined surfaces. They are branching sponges. Their abundances increased with depth. *S. stuposa* occurred in low energy areas.	1 - *Stelligera rigida* 2 - *Stelligera stuposa*	S Ireland, Atlantic, 0-30 m	Po: Dem: Hadromerida: Stelligeridae	1 - (Montagu, 1814) 2 - (Ellis & Solander, 1786)	Bell & Barnes 2000a, 2000b
DISTRIBUTION: Faunistic account of Cuba. This sponge was observed to occur in turbid areas with soft bottom sediments.	*Suberites aurantiacus*	Cuba, Caribbean, 0-30 m	Po: Dem: Hadromerida: Suberitidae	(Duchassaing & Michelotti, 1864)	Alcolado 1990 (as *Terpios zeteki*)
DISTRIBUTION, MORPHOLOGY: Field observations. The sponges' pedunculate body with a short stalk is assumed to prevent sediment accumulation and thus can use this as competitive strength to be more common on inclined than on vertical surfaces of high sedimentation sites.	*Suberites carnosus*	S Ireland, Atlantic, 0-30 m	Po: Dem: Hadromerida, Suberitidae	(Johnston, 1842)	Bell & Barnes 2000a, 2000b
DISTRIBUTION: Sponges were surveyed in the field. In comparison to hard substrate habitats, on soft substrates sponges were not as diverse and more dissimilar between and within habitats. *T. anhelans* was only found on sand.	*Tedania (Tedania) anhelans*	W Indian Ocean, 0, 5, 10, 15, 20 m	Po: Dem: Poecilosclerida: Tedaniidae	(Vio in Olivi, 1792)	Bell & Barnes 2002a (part of the specimens as *T. digitata*)
DISTRIBUTION: Faunistic account of Cuba. This sponge was observed to occur in areas with soft, muddy bottom sediments.	*Tedania (Tedania) ignis*	Cuba, Caribbean, 0-30 m	Po: Dem: Poecilosclerida (Myxillina): Tedaniidae	(Duchassaing & Michelotti, 1864)	Alcolado 1990
SETTLEMENT: *T. vanhoeffeni* can settle on small pieces of gravel and survive in very muddy areas, and it can keep its surface sediment-free.	*Tedania (Tedaniopsis) vanhoeffeni*	Wedell Sea, Antarctic, 100-1200 m	Po: Dem: Poecilosclerida (Myxillina): Tedaniidae	Hentschel, 1914	Barthel & Gutt 1992
SETTLEMENT: While being a hard bottom species, *T. paillatum* can settle and survive in very muddy areas as long as there are boulders, and it can keep its surface sediment-free.	*Tentorium papillatum*	Wedell Sea, Antarctic, 100-1200 m	Po: Dem: Hadromerida: Polymastiidae	(Kirkpatrick, 1908)	Barthel & Gutt 1992
DISTRIBUTION: Field study. *T. aurantium* only occurred at sites with low levels of siltation and under overhangs or in small caves and crevices.	*Tethya aurantium*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Hadromerida: Tethyidae	(Pallas, 1766)	Carballo et al. 1996
DISTRIBUTION: Field observations. The sponge occurs at high sedimentation sites, growing on vertical and inclined surfaces, abundance increasing with depth.	*Tethya aurantium*	S Ireland, Atlantic, 0-30 m	Po: Dem: Hadromerida: Tethyidae	(Pallas, 1766)	Bell & Barnes 2000a
DISTRIBUTION: 'Tetillids have a preference for sedimented habitats and some species possess a root of long spicule bundles to attach them to the substrate.'	Tetillidae	general account	Po: Dem: Spirophorida: Tetilldae	Sollas, 1886	Van Soest & Rützler 2002
MORPHOLOGY: The sponge lives in embedded mud and is anchored with a ray-like spicule tuft. In- and excurrent openings are on the sides of the body on the upper half of the body and just above the sediment, with the inhalants having a screen of spicules. Asexual reproduction via buds proceeds mostly on the surface of the lower, buried part of the body (1/3 of the specimens).	*Thenea abyssorum*	Svalbard Basin, Arctic Ocean, 2527-3296 m	Po: Dem: Astrophorida: Theneidae	Koltun, 1964	Barthel & Tendal 1993

DISTRIBUTION: Field study. *T. unistellata* only occurred at sites with low levels of siltation and under stones or overhangs.	*Timea unistellata*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Hadromerida, Timeidae	(Topsent, 1892)	Carballo et al. 1996
DISTRIBUTION: Faunistic account of Cuba. This sponge was observed to occur in turbid areas with soft bottom sediments.	*Columnitis squamata?*	Cuba, Caribbean, 0-30 m	Po: Dem: Hadromerida: Tethyidae	(Duchassaing & Michelotti, 1864)	Alcolado 1990 (as *Timea squamata*)
SETTLEMENT: A panel experiment was conducted to estimate settlement under inverted panels, under opaque roofs, under transparent roof and on exposed surfaces. 'Solitary ascidian species […] quickly came to dominate 30% of space on the [inverted] panels but showed a steady decline with time. No solitary ascidians were recorded on [the other] panels.'	solitary ascidians 1 - *Ascidiella aspersa* 2 - *Ciona intestinalis* 3 - *Molgula* sp.	S Ireland, Atlantic, 6 m	Ch: Asc: 1 - Phlebobranchia: Asciidae 2 - Phlebobranchia: Cionidae 3 - Stolidobranchia: Molgulidae	1 - (Müller, 1776) 2 - (Linnaeus, 1767) 3 - Forbes, 1848	Maughan 2001
SETTLEMENT: Field settlement experiment. Encrusting bryozoans attached more commonly to upper panels rather than to lower panels with heavy siltation and more commonly on vertical plates than horizontal plates.	bryozoans: 1 - *Schizoporella unicornis* 2 - *Microporella* sp.	Miami Beach, Florida, USA, W Atlantic, depth not stated	Br: Gym: Cheilostomatida: 1 - Schizoporellidae 2 - Microporellidae	1 - (Johnston in Wood, 1844) 2 - Hincks, 1877	Doochin & Walton Smith 1951
SETTLEMENT: A field panel experiment was conducted to estimate settlement under inverted panels, under opaque roofs, under transparent roof and on exposed surfaces. Bryozoa favoured darker conditions, where settled species were more diverse. 'The cheilostome bryozoan, *Aetea* sp. was the only species found on all four treatments.'	bryozoans	S Ireland, Atlantic, 6 m	Br	Ehrenberg, 1831	Maughan 2001
DISTRIBUTION: Field study investigating the effect of sediment transport on gorgonians. Reciprocal averaging showed that gorgonian abundance decreased with slope angle (not depth) and thus with sediment transport.	gorgonians (Alcyonacea)	La Parguera, Puerto Rico, Caribbean, 2-22 m	Cn: Ant	Lamouroux, 1812	Yoshioka 2009
DISTRIBUTION: Sponges were surveyed in the field noting their growth forms. In comparison to hard substrate habitats, on soft substrates sponge morphologies were not as diverse and foliaceous sponges were missing and encrusting forms prevailed. In the intertidal globular or encrusting forms occurred on soft substrate (sand), in the subtidal lobate, papillate or repent forms.	sponges	W Indian Ocean, 0, 5, 10, 15, 20 m	Po	Grant, 1863	Barnes & Bell 2002
DISTRIBUTION: Underwater survey linking geologic features to distributional patterns of macrobenthos. Sponges were mostly associated with granite and hard substrate outcrops or ripples and elevated structures. They were missing from muddy areas in which infauna was prevalent.	sponges	New Zealand Star Bank, S of Victoria, Australia, Pacific, 46-120 m	Po	Grant, 1863	Beaman et al. 2005
DISTRIBUTION: Field survey on the abundance of sponges on vertical and inclined surfaces, along a flow and sedimentation gradient and over depth. Species composition of sponge communities on 40º inclined surfaces varied,	sponges	S Ireland, Atlantic, 0-30 m	Po	Grant, 1863	Bell & Barnes 2000a, 2000b, 2000c

with a distinct zonation in high sedimentation. While encrusting sponges occurred everywhere, erect sponges were common in high sedimentation.					
DISTRIBUTION: Distribution patterns of macrobenthic organisms were surveyed along a silicate gradient from river mouths to the bay entrance. In contrast to other organisms, no clear patterns were observed for sponges (based on only 9 sponge species and not separating the influence of sediments from those of freshwater and nutrients).	sponges	Moorea, French Polynesia, central Pacific, 10 m	Po	Grant, 1863	Adjeroud 2000
DISTRIBUTIION: Sponge densities, coverage, growth and survival were highest with lowest sedimentation rate and highest substrate heterogeneity.	sponges	San Esteban National Park, Venezuela, Caribbean, 1-18 m	Po	Grant, 1863	Núñez Flores et al. 2010
NATURAL SELECTION favouring certain MORPHOLOGIES: Long-term field study (6 years). The area is formed by wind and sediments (sedimentation and scouring), and the habitat is dominated by encrusting and cushion-shaped sponges	sponges	Bay of Mazatlán, Mexico, E Pacific, beach	Po	Grant, 1863	Carballo et al. 2008
NATURAL SELECTION: Keratose sponges (Dictyoceratida, Dendroceratida, and Verongida) tend to be less tolerant of sediment, whereas many members of the Poecilosclerida, Haplosclerida, and Halichondrida appear to better tolerate turbid conditions.	sponges	San Blas, Panama, Caribbean, 2.5-2.8 m	Po	Grant, 1836	Wulff 2001
DISTRIBUTION: 'Sponge populations on the outer (fore- and back-) reef slopes are comparable with each other but different from those on lagoon slopes where currents are reduced and fine sediment loads are higher.'	reef sponges	central Great Barrier Reef, Coral Sea, Pacific, 1.3 -40 m	Po	Grant, 1863	Wilkinson & Evans 1989
DISTRIBUTION: Field study. Sponge distributions depended on sediment type and depth, very few species occurred on sediment layers deeper than 4 cm, most occurred on 0.5-1 cm sediment layers (*Aaptos aaptos* and *Cinachyra* sp. occurred in slightly deeper sediments). Sponge densities depended on sediment grain size, with medium grain size being favourable (0.5-0.25 mm).	sponges	N of Auckland, New Zealand, Pacific, 20 m	Po	Grant, 1863	Battershill & Bergquist 1990
DISTRIBUTION, MORPHOLOGY: Field survey comparing sponge growth forms to habitat conditions. Tubular and flabellate sponges were very rare, and 'pedunculated, papillate and arborescent types dominated at low current sites as these shapes may help to prevent the settlement of sediment on sponge surfaces.'	sponges	S Ireland, Atlantic, 0-18 m (in 3 m intervals)	Po	Grant, 1863	Bell & Barnes 2000d
DISTRIBUTION: Sponge communities were compared between a site with high loads of fine, slow settling, and a site with coarser, fast-settling sediments. At both sites sponge numbers, percentage cover and richness were reduced on the reef flats, but abundances were higher on the reef flat with fine sediments, while richness, cover and density in general was lower. Comment: Fine, terrestrial sediments are usually coupled with increased nutrient loads, and the few sponges that can tolerate the fine sediments will be likely to exhibit increased abundances and densities.	sponges	Sulawesi, Indonesia, Banda Sea, 0-15 m	Po	Grant, 1863	Bell & Smith 2004

SETTLEMENT: The observed glass sponges all required spicule mats for larval attachment. No evidence could be found that some of them were able to settle on soft sediments.	glass sponges including: 1 - *Heterochone calyx* 2 - *Aphrocallistes vastus* 3 - *Farrea occa* 4 - *Rhabdocalyptus dawsoni* 5 - *Acanthascus platei* 6 - *Acanthascus cactus* 7 - *Staurocalyptus dowlingi*	British Columbia, Canada, Hectate Strait, N Pacific, ca. 200 m	Po: Hex: 1-2 Hexactinosida: Aphrocallistidae 3 - Haxctinosida: Farreidae 4-7 Lyssacinosida: Rossellidae	1 - (Schulze, 1886) 2 - Schulze, 1886 3 - Bowebank, 1862 4 - (Lambe, 1893) 5 - Schulze, 1886 6 - Schulze, 1886 7 - (Lambe, 1893)	Conway et al. 2001
DISTRIBUTION: Taxonomic assemblages and distributions coincided with sediment characteristics of the bottom. Sponges dominated turbidite and hemipelagic provinces. Sponges themselves and anthropogenic debris (coal, clinker, tar balls) served as attachment substrate for suspension feeders, especially anemones. Concentration of organic matter was given as the most important factor for distribution patterns of filter feeders.	megafauna, incl. 1 - sponges and 2 - anemones	Venezuelan Basin, Caribbean Sea, 3411-5062 m	1 - Po 2 - Cn: Ant	1 - Grant, 1863 2 - Ehrenberg, 1834	Briggs et al. 1996
DISTRIBUTION: Benthos community study. Relative abundance of suspension and interface feeders decreased with water depth, while deposit feeders increased. Absolute biomass of suspension feeders dominated clearly at station II at 1470 m water depth, where the highest flow speeds and the lowest sediment accumulation rates were observed, but high resuspension levels were interpreted as providing good feeding conditions. The resuspended material was not characterised.	e.g. megafauna incl. 1 - sponges 2 - molluscs 3 - echinoderms	European continental margin of the Goban Spur, NE Atlantic, 208-4406 m	1 - Po 2 - Mo 3 - Ec	1 - Grant, 1863 2 - Linnaeus, 1758 3 - Bruguière, 1791 [ex Klein, 1734]	Flach et al. 1998
DISTRIBUTION: Antarctic sediments are mostly renewed by melting ice. They contain 3-30% fine particles, occasionally up to 50%, and they are rich in organic content. Input of terrigenous sediments is scarce and bioturbation poor. The authors 'argue that the composition of the modern communities in the Weddell Sea, and other high-Antarctic areas, is the result of a low-sedimentation environment. […] Factors such as input of fine sediment or the presence of bioturbating organisms can result in the clogging of filtering organs and/or instability of the substratum, and thereby interfere with the development of sessile suspension-feeding assemblages'. Filter feeders of the Antarctic consolidate the substrate thereby creating a more favourable habitat.	epibenthic sessile suspension feeders	Wedell Sea, Antarctica	-	-	Gili et al. 2006
DISTRIBUTION: '[…] highly reproductive macroinvertebrates (e.g. *Tetraclita rubescens*, *Chthamalus fissus/dalli* and *Phragmatopoma californica*) dominated areas routinely buried by sand; long-lived species (e.g. *Mytilus californianus* […] and *Lottia gigantea*) dominated areas where rock contours provided a refuge from sand deposition, and sand tolerant species (e.g. *Anthopleura elegantissima* […]) dominated areas with greatest sediment deposition.'	rocky coast benthos, e.g. 1 - *Tetraclita rubescens*, 2 - *Chthamalus fissus* 3 - *Chtamalus dalli,* 4 - *Phragmatopoma californica,*	New Hampshire, USA, W Atlantic, intertidal	1-3 - Ar: Max: Sessilia: 1 - Tetraclitidae 2-3 - Chtamalidae 4 - An: Pol: Sabellida: Sabellariidae 5 - Mo: Biv: Mytiloida: Mytilidae 6 - Mo: Gas: Lotiidae	1-2 - Darwin, 1854 3 - Pilsbry, 1916 4 - (Fewkes, 1889) 5 - Conrad, 1837 6 - Gray in Soweby, 1834 7 - Brandt, 1835	Airoldi 2003

	5 - *Mytilus californianus*, 6 - *Lottia gigantea,* 7 - *Anthopleura elegantissima*		7 - Cn: Ant: Actinaria: Actiniidae		
DISTRIBUTION: Field surveys on Alaskan fjord wall communities relative to sediment suspension gradients. Number of species and % cover was inversely proportional to sedimentation. Richer communities in clearer waters contained algae, sponges, hydroids, bryozoans, tunicates and brachiopods, while communities in sediment-rich waters were dominated by sparse serpulid worms.	wall communities incl. 1 - sponges 2 - hydroids 3 - bryozoans 4 - tunicates 5 - brachiopods 6 - serpulid worms	SE Alaska, E Pacific, 18.5 and 25 m	1 - Po 2 - Cn: Hyd 3 - Br 4 - Ch: Asc 5 - Bp 6 - An: Pol: Sabellida: Serpulidae	1 - Grant, 1863 2 - Owen, 1843 3 - Ehrenberg, 1831 4 - De Lamarck, 1816 5 - Duméril, 1805 6 - Rafinesque, 1815	Carney et al. 1999
DISTRIBUTION: One-month settlement experiment on carbonate *versus* quartz sediments. With increasing amounts of quartz less benthos settled.	meio- (mainly nematodes and harpacticoids) and macrozoobenthos (mainly polychaetes)	Ligurian Sea, Mediterranean, 5 m	-	-	Cerrano et al. 1999
DISTRIBUTION: Field study. Proportion of fine sediments could not be shown to have significant effects on benthos ditribution patterns. Cover of gorgionians, filamentous cyanobacteria and crustose coralline algae appeared to be independent of terrigeneous sediments. Amount of terrigeneous sediment varied with site and had an effect of coral percent cover (reduced), turf and macroalga cover (reduced), sponge percent cover (enhanced). Comment: Sponge distributions may not necessarily be directly affected by occurrence of terrigeneous sediment, but may rather be a result of the co-variable anthropogenic eutrophication.	reef benthos	Islands in the E Caribbean, 10-15 m	-	-	Bégin et al. 2013
EXCLUSION: Dredging and spoil disposal changes existing sediment and substrate conditions so much that previously occurring benthic organisms can no longer settle and will vanish from the site.	marine benthos	not stated	-	-	Morton 1977
DISTRIBUTION: Field study comparing benthic assemblages to sedimentation levels. Species composition varied with sedimentation levels, and encrusting algae reached higher cover with lower sedimentation. In high sedimentation percent cover of bryozoans was higher on vertical substrata, and sponges were mostly distributed on vertical substrata. Anthozoans were comparatively rare and generally restricted to vertical substrata.	marine benthos	Ligurian Sea, Mediterranean, 32-35 m	-	-	Balata et al. 2005

Appendix 2. Responses of filter feeders to increased levels of suspended sediments and resulting shading, listing possible tolerances and intolerances (also relating to distribution patterns listed in Appendix 1). For abbreviations see top of Appendix 1 on pg 38.

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
TOLERANCE: Field study in coastal marine karst lakes that have muddy bottoms, are very turbid and experience a wide range of environmental fluctuation. The sponge occurs in these lakes.	*Aaptos pernucleata*	Gulf of Tonkin, South China Sea, N Vietnam, 1-3 and 7-8 m	Po: Dem: Hadromerida: Suberitidae	(Carter, 1870)	Azzini et al. 2007
POSSIBLE INTOLERANCE: Field study. *A. acuta* occurred only at one site, an area with low levels of suspended material.	*Acanthella acuta*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Halichondrida: Dictyonellidae	(Schmidt, 1862)	Carballo et al. 1996
TOLERANCE: Field study in coastal marine karst lakes that have muddy bottoms, are very turbid and experience a wide range of environmental fluctuation. The sponge occurs in these lakes.	*Amphimedon* sp.	Gulf of Tonkin, South China Sea, N Vietnam, 1-3 and 7-8 m	Po: Dem: Haplosclerida (Haplosclerina): Niphatidae	Duchassaing & Michelotti, 1864	Azzini et al. 2007
INTOLERANCE: Field study. *A. rosea* only occurred in areas with low levels of suspended material.	*Aplysilla rosea*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Dendroceratida: Darwinellidae	(Barrois, 1876)	Carballo et al. 1996
POSSIBLE INTOLERANCE, THRESHOLDS: Field observations on benthic organisms after cyanobacteria *Synechococcus* blooms: Sponge die-offs caused redistribution of associated spiny lobsters. The bloom reduced visibility from ca. 8 to <0.5 m. After the first bloom 80% of the horny sponges were dead. In the bloom centre over 70% of all sponges died (30 mg L^{-1} chlorophyll), 5% were damaged in the periphery of the bloom (<2 mg L^{-1}). During a second, more prolongued bloom, at one site 100% sponge mortality was observed. Comment: It is not clear whether shading or algal toxins may have caused the die-off.	*Aplysina cauliformis*	Florida Bay, USA, depths accessible by SCUBA	Po: Dem: Verongida: Aplysinidae	(Carter, 1882)	Butler IV et al. 1995 (as *Vergangia longissima*)
POSSIBLE INTOLERANCE: *A. fistularis* thrives in good water quality	*Aplysina fistularis*	Cuba, Caribbean, shallow depth	Po: Dem: Verongida: Aplysinidae	(Pallas, 1766)	Alcolado 2007
POSSIBLE INTOLERANCE: Cross shelf survey. *A. elegans* appears to be a clear-water species, as it only occurred offshore at Myrmidon Reef in notable biomass.	*Aplysinopsis elegans*	Great Barrier Reef, Coral Sea, Pacific, 2.5-20 m	Po: Dem: Verongida: Aplysinidae	Von Lendenfeld, 1888	Wilkinson & Cheshire 1989
INTOLERANCE: Field study. *A. damicornis* only occurred at sites with low levels of suspended material.	*Axinella damicornis*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Halichondrida: Axinellidae	(Esper, 1794)	Carballo et al. 1996

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
TOLERANCE: Description. *A. mertoni* was found 'in muddy, discoloured water'.	*Axinyssa mertoni*	Palau, Pacific, 2 m	Po: Dem: Halichondrida: Halichondriidae	(Hentschel, 1912)	De Laubenfels 1954 (as *Pseudaxinyssa pitys*
TOLERANCE: Field survey. Sponges had a clear bathymetric distribution with peak abundances 15-30 m, and slope and lagoonal populations being different, latter dealing with higher sediment loads. *Axinyssa* sp. 1 was found in high biomass and medium abundance in the lagoon, typical for deeper lagoonal locations.	*Axinyssa* sp. 1	Davies Reef, central Great Barrier Reef, Pacific, 1-20 m	Po: Dem: Halichondrida: Halichondriidae	(Von Lendenfeld, 1897)	Wilkinson & Evans 1989 (as *Pseudaxinyssa* sp.)
TOLERANCE: Description. *B. fortis* was found inhabiting areas with fine sediments and in 'muddy water'.	*Biemna fortis*	Micronesia and Palau, Pacific, 30 cm to 3 m	Po: Dem: Poecilosclerida (Mycalina): Desmacellidae	(Topsent, 1897)	De Laubenfels 1954
POSSIBLE INTOLERANCE, THRESHOLDS: Field observations on benthic organisms after cyanobacteria *Synechococcus* blooms: Sponge die-offs caused redistribution of associated spiny lobsters. The bloom reduced visibility from ca. 8 to <0.5 m. After the first bloom 80% of the horny sponges were dead, >40% of the loggerhead sponges killed and further 23% damaged, all mostly quickly disintegrating. Some of the partially damaged loggerheads recovered, but many still died in the next 6 months. In the bloom centre over 70% of all sponges died (30 mg L^{-1} chlorophyll), 5% were damaged in the periphery of the bloom (<2 mg L^{-1}). During a second, more prolongued bloom, at one site 100% sponge mortality was observed. Comment: It is not clear whether shading or algal toxins may have caused the die-off.	*Callyspopngia (Cladochalina) vaginalis*	Florida Bay, USA, depths accessible by SCUBA	Po: Dem: Haplosclerida (Haplosclerina): Callispongiidae	(De Lamarck, 1814)	Butler IV et al. 1995 (as *Spinosella vaginalis*)
POSSIBLE INTOLERANCE: Cross shelf survey. *Callyspongia* sp. appears to be a clear-water species, as it only occurred offshore at Myrmidon Reef.	*Callyspongia* sp. 'CL'	Great Barrier Reef, Coral Sea, Pacific, 2.5-20 m	Po: Dem: Haplosclerida (Haplosclerina): Callispongiidae	Duchassaing & Michelotti, 1864	Wilkinson & Cheshire 1989
PHOTOTROPHY: *C. foliascens* contains cyanobacteria and photopigments. In an experiment using light intensities of 0-900 µmol photon m^{-2} s^{-1}, increased photosynthesis and oxygen production occurred with increased light intensities, saturating at about 700 m^{-2} s^{-1}.	*Carteriospongia foliascens*	central Great Barrier Reef, Pacific, 9 m	Po: Dem: Dictyoceratida: Spongiidae	(Pallas, 1766)	Bannister et al. 2011
POSSIBLE INTOLERANCE: Cross shelf survey. *C. silicata* appears to be a clear-water species, as it only occurred offshore in the Coral Sea.	*Carteriospongia silicata*	Great Barrier Reef, Coral Sea, Pacific, 2.5-20 m	Po: Dem: Dictyoceratida: Thorectidae	(Von Lendenfeld, 1889)	Wilkinson & Cheshire 1989
TOLERANCE: Field study in coastal marine karst lakes that have muddy bottoms, are very turbid and experience a wide range of environmental fluctuation. The sponge occurs in these lakes.	*Chondrilla australiensis*	Gulf of Tonkin, South China Sea, N Vietnam, 1-3 and 7-8 m	Po: Dem: Chondrosida: Chondrillidae	Carter, 1873	Azzini et al. 2007

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
PHOTOTROPHY, INTOLERANCE: Studies on sponges containing cyanobacteria. Biochemical analyses were conducted on specimens sampled from illuminated habitats and dark caves, sponges were aposymbiotic in caves. Transplantation into caves for 6 months resulted in size reduction and metabolic collapse.	*Chondrilla nucula*	Ligurian Sea, Mediterranean, 15 m	Po: Dem: Chondrosida: Chondrillidae	Schmidt, 1862	Arillo et al. 1993
TOLERANCE: Description. *C. australiensis* was found in muddy water.	*Cinachyrella australiensis*	Saipan, Guam and Palau, Pacific, 1-2 m	Po: Dem: Spirophorida: Tetillidae	(Carter, 1886)	De Laubenfels 1954 (as *Cinachyra porosa*)
TOLERANCE: Field study in coastal marine karst lakes that have muddy bottoms, are very turbid and experience a wide range of environmental fluctuation. The sponge occurs in these lakes and is comparatively common.	*Cladocroce* sp.	Gulf of Tonkin, South China Sea, N Vietnam, 1-3 and 7-8 m	Po: Dem: Haplosclerida: Chalinidae	Topsent, 1892	Azzini et al. 2007
TOLERANCE: Field study in coastal marine karst lakes that have muddy bottoms, are very turbid and experience a wide range of environmental fluctuation. The sponge occurs in these lakes.	*Clathria* sp.	Gulf of Tonkin, South China Sea, N Vietnam, 1-3 and 7-8 m	Po: Dem: Poecilosclerida (Microcionina): Microcionidae	Schmidt, 1862	Azzini et al. 2007
TOLERANCE: Field study in coastal marine karst lakes that have muddy bottoms, are very turbid and experience a wide range of environmental fluctuation. The sponge occurs in these lakes.	*Cliona* cf. *celata*	Gulf of Tonkin, South China Sea, N Vietnam, 1-3 and 7-8 m	Po: Dem: Hadromerida: Clionaidae	Grant, 1826	Azzini et al. 2007
TOLERANCE: The aphotosynthetic *C.* cf. *celata* is tolerant to reduced salinities and high turbidity and withstands a suspension of POM >38 g m^{-2}. Comment: Please note that results can only be used for Gibraltar specimens, because the name *C. celata* is used for a species complex, see Xavier et al. (2010).	*Cliona* cf. *celata*	Spanish side of Gibraltar, 0-40 m	Po: Dem: Hadromerida: Clionaidae	Grant, 1826	Carballo et al. 1994
TOLERANCE: Field study. *C.* cf. *celata* was about equally common in areas with high compared to low levels of suspended material.	*Cliona* cf. *celata*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Hadromerida: Clionaidae	Grant, 1826	Carballo et al. 1996
TOLERANCE: Study on growth forms of *C.* cf. *celata*. Sponge specimen sizes were largest at the site with the lowest flow, which was interpreted as a consequence of reduced stress by sediments being washed around and in suspension. At sites with higher sedimentation encrusting and endolithic growth forms of *C.* cf. *celata* were more common, also developing fistules and more oscules per unit surface area.	*Cliona* cf. *celata*	S Ireland, E Atlantic, 12-18 m	Po: Dem: Hadromerida: Clionaidae	Grant, 1826	Bell et al. 2002
INTOLERANCE, THRESHOLDS: *C. rhodensis* is described as a species that requires strong flow and needs suspension levels of <8 g m^{-2}.	*Cliona rhodensis*	Spanish side of Gibraltar, 0-40 m	Po: Dem: Hadromerida: Clionaidae	Rützler & Bromley, 1981	Carballo et al. 1994

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
INTOLERANCE: *C. rhodensis* occurred only at sites with low levels of suspended material, but was comparatively rare.	*Cliona rhodensis*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Hadromerida: Clionaidae	Rützler & Bromley, 1981	Carballo et al. 1996
INTOLERANCE, THRESHOLDS: *C. schmidti* is described as a clearwater species susceptible to sedimentation, tolerating a suspension of POM <1 g m^{-2}.	*Cliona schmidti*	1 & 3 - Jamaica, Caribbean, 1993; 1 - 0-52 m, 2003; 3 - 5-25 m, 1994; 2 - Spanish side of Gibraltar, 0-40 m	Po: Dem: Hadromerida: Clionaidae	(Ridley, 1881)	1 - Pang 1973; 2 - Carballo et al. 1994; 3 - Macdonald & Perry 2003
TOLERANCE: Field study in coastal marine karst lakes that have muddy bottoms, are very turbid and experience a wide range of environmental fluctuation. The sponge occurs in these lakes.	*Cliona* cf. *orientalis*	Gulf of Tonkin, South China Sea, N Vietnam, 1-3 and 7-8 m	Po: Dem: Hadromerida: Clionaidae	Thiele, 1900	Azzini et al. 2007
PHOTOTROPHY: Field experiment on a zooxanthellate bioeroding sponge. Chlorophyll concentrations, growth and bioerosion rates were higher in specimens in natural light compared to experimentally shaded ones, and higher in vertical rather than in horizontal blocks that were additionally exposed to sedimentation. Depending on local turbidity *C. orientalis* occurs at different depth to optimise the required light regime.	*Cliona orientalis*	central Great Barrier Reef, Coral Sea, Pacific, 0-25 m	Po: Dem: Hadromerida: Clionaidae	Thiele, 1900	Schönberg 2006, pers. obs.
POSSIBLE INTOLERANCE, THRESHOLDS: *C. vermifera* is described as a clearwater species which tolerates a suspension of POM <1 g m^{-2}.	*Cliona vermifera*	Spanish side of Gibraltar, 0-40 m	Po: Dem: Hadromerida: Clionaidae	Hancock, 1867	Carballo et al. 1994
TOLERANCE: The zooxanthellate *C. viridis* can tolerate high turbidity despite being photosynthetic, withstood a suspension of POM >38 g m^{-2}, and the larger, encrusting growth form was more common in turbid waters with high sedimentation levels.	*Cliona viridis*	Spanish side of Gibraltar, 0-40 m	Po: Dem: Hadromerida: Clionaidae	(Schmidt, 1862)	Carballo et al. 1994
TOLERANCE: Field study. *C. viridis* was about equally common in areas with high compared to low levels of suspended material.	*Cliona viridis*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Hadromerida: Clionaidae	(Schmidt, 1862)	Carballo et al. 1996
TOLERANCE: Field study in coastal marine karst lakes that have muddy bottoms, are very turbid and experience a wide range of environmental fluctuation. The sponge occurs in these lakes.	*Cliona* sp.	Gulf of Tonkin, South China Sea, N Vietnam, 1-3 and 7-8 m	Po: Dem: Hadromerida: Clionaidae	Grant, 1826	Azzini et al. 2007

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
TOLERANCE: Field study in coastal marine karst lakes that have muddy bottoms, are very turbid and experience a wide range of environmental fluctuation. The sponge occurs in these lakes.	*Cliothosa aurivillii*	Gulf of Tonkin, South China Sea, N Vietnam, 1-3 and 7-8 m	Po: Dem: Hadromerida: Clionaidae	(Lindgren, 1897)	Azzini et al. 2007 (as *Cliona*)
TOLERANCE: Field study in coastal marine karst lakes that have muddy bottoms, are very turbid and experience a wide range of environmental fluctuation. The sponge occurs in these lakes.	*Cliothosa hancocki*	Gulf of Tonkin, South China Sea, N Vietnam, 1-3 and 7-8 m	Po: Dem: Hadromerida: Clionaidae	(Topsent, 1888)	Azzini et al. 2007
POSSIBLE INTOLERANCE: The encrusting, heterotrophic *C. crambe* invests more into reproduction and matrix formation and builds more biomass and thicker specimens in bright environments; in dark environments it has more collagen and a higher Si content per area. No differences in the canal system were observed between sites.	*Crambe crambe*	Blanes, NW Mediterranean, SCUBA accessible depth	Po: Dem: Poecilosclerida (Myxillina): Crambeidae	(Schmidt, 1862)	Uriz et al. 1995
INTOLERANCE: Field study. *C. crambe* was less common at sites with high levels of suspended material compared to low levels.	*Crambe crambe*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Poecilosclerida: Crambeidae	(Schmidt, 1862)	Carballo et al. 1996
INTOLERANCE, THRESHOLDS: 'The effects of suspended sediments on bivalve egg survival have been investigated for the eastern oyster *C. virginica* […] The egg stages last only several hours for oysters […] Negative impacts to oyster egg development occurred at a silt concentration of 188 mg L^{-1}.'	*Crassostrea virginica*	review, citing other work	Mo: Biv: Ostreoida: Ostreidae	(Gmelin, 1791)	Wilber & Clarke 2001
TOLERANCE: Field study. *O. lobularis* was more common in areas with high levels of suspended material.	*Oscarella lobularis*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Hom: Homosclerophorida: Oscarellidae	(Schmidt, 1862)	Carballo et al. 1996
PHOTOTROPHY: Studies on sponges containing cyanobacteria. Biochemical analyses were conducted on specimens sampled from illuminated habitats and dark caves, sponges were aposymbiotic and white in caves. The sponges activated a heterotrophic metabolism and made up for the energy loss otherwise supplied by the symbionts.	*Petrosia (Petrosia) ficiformis*	Ligurian Sea, Mediterranean, 15 m	Po: Dem: Haplosclerida (Petrosina): Petrosiidae	(Poiret, 1789)	Arillo 1993
TOLERANCE: Field study in coastal marine karst lakes that have muddy bottoms, are very turbid and experience a wide range of environmental fluctuation. The sponge occurs in these lakes.	*Petrosia (Petrosia) nigricans*	Gulf of Tonkin, South China Sea, N Vietnam, 1-3 and 7-8 m	Po: Dem: Haplosclerida (Petrosina): Petrosiidae	Lindgren, 1897	Azzini et al. 2007
TOLERANCE: Field study. *P. fictitutus* was equally common in areas with high and low levels of suspended material.	*Phorbas fictitus*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Poecilosclerida (Myxillina): Hymedesmiidae	(Bowerbank, 1866)	Carballo et al. 1996

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
TOLERANCE: Field study in coastal marine karst lakes that have muddy bottoms, are very turbid and experience a wide range of environmental fluctuation. The sponge occurs in these lakes.	*Pione carpenteri*	Gulf of Tonkin, South China Sea, N Vietnam, 1-3 and 7-8 m	Po: Dem: Hadromerida: Clionaidae	(Hancock, 1867)	Azzini et al. 2007
INTOLERANCE: Field study. *P.* cf. *vastifica* only occurred at sites with low levels of suspended material.	*Pione* cf. *vastifica*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Hadromerida, Clionaidae	Hancock, 1849	Carballo et al. 1996 (as *Cliona*)
TOLERANCE: Field study in coastal marine karst lakes that have muddy bottoms, are very turbid and experience a wide range of environmental fluctuation. The sponge occurs in these lakes.	*Protosuberites* sp. 1	Gulf of Tonkin, South China Sea, N Vietnam, 1-3 and 7-8 m	Po: Dem: Hadromerida: Suberitidae	Swartchewsky, 1905	Azzini et al. 2007
TOLERANCE: Cross shelf survey. *Psammocinia* sp. abundances and biomass decreased away from the more turbid inshore reefs.	*Psammocinia* sp. 'IB'	Great Barrier Reef, Coral Sea, Pacific, 2.5-20 m	Po: Dem: Dictyoceratida: Irciniidae	Von Lendenfeld, 1889	Wilkinson & Cheshire 1989
POSSIBLE INTOLERANCE: Cross shelf survey. *P. durissima* appears to be a clear-water species, as it only occurred offshore at Myrmidon Reef in notable biomass.	*Pseudoceratina durissima*	Great Barrier Reef, Coral Sea, Pacific, 2.5-20 m	Po: Dem: Verongida: Pseudoceratinidae	Carter, 1885	Wilkinson & Cheshire 1989
PHOTOTROPHY: As evidenced by experiments with light intensities between 0-900 µmol photons m^{-2} s^{-1} *R. odorabile* is not photosynthetic and does not contain photopigments.	*Rhopaloeides odorabile*	central Great Barrier Reef, Pacific, 9 m	Po: Dem: Dictyoceratida: Spongiidae	Thompson et al., 1987	Bannister 2008, Bannister et al. 2011
POSSIBLE INTOLERANCE: Field study. *S. fasciculatus* was about equally common or slightly less common in areas with high compared to low levels of suspended material.	*Sarcotragus fasciculatus*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Dictyoceratida: Irciniidae	(Pallas, 1766)	Carballo et al. 1996 (as *Ircinia*)
PHOTOTROPHY: Large-scale field study on mass mortalities on Mediterranean sponges during thermal stress. While the cyanosponge *S. fasciculatus* bleached in patches, had necroses and sometimes died (80-100% affected), the heterosymbiotic *S. spinosulus* did not display such symptoms, but sometimes had 'bacterial veils' (10-30% ill = baseline for *S. fasciculatus*). Cyanobacteria at the margins of affected tissue areas showed degradation and were enlarged.	1 - *Sarcotragus fasciculatus* 2 - *Sarcotragus spinosulus*	NW Mediterranean, 10-15 m	Po: Dem: Dictyoceratida: Irciniidae	1 - (Pallas, 1766) 2 - Schmidt, 1862	Cebrian et al. 2011 (*S. fasciculatus* as *Ircinia fasciculata* (Esper, 1794))
INTOLERANCE: Field study. The two *Sarcotragus* spp. did not occur at sites with high levels of suspended material.	1 - *Sarcotragus foetidus* 2 - *Sarcotragus spinosulus*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Dictyoceratida: Irciniidae	1 & 2 - Schmidt, 1862	Carballo et al. 1996 (1 as *Sarcotragus muscarum*)
INTOLERANCE: Field study. *S. lophyropoda* did not occur at sites with high levels of suspended material.	*Scopalina lophyropoda*	Algeciras Bay, S Spain,	Po: Dem: Halichondrida: Scopalinidae	Schmidt, 1862	Carballo et al. 1996

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
		W Mediterranean, 5-30 m			
POSSIBLE INTOLERANCE: *S. brevitubulatum* appears to be susceptible to sedimentation and turbidity.	*Siphonodictyon brevitubulatum*	Jamaica, Caribbean, 5-25 m	Po: Dem: Haplosclerida (Petrosina): Phloeodictyidae	Pang, 1973	Macdonald & Perry 2003
TOLERANCE: Field study in coastal marine karst lakes that have muddy bottoms, are very turbid and experience a wide range of environmental fluctuation. The sponge occurs in these lakes.	*Siphonodictyon mucosum*	Gulf of Tonkin, South China Sea, N Vietnam, 1-3 and 7-8 m	Po: Dem: Haplosclerida (Petrosina): Phloeodictyidae	Bergquist, 1965	Azzini et al. 2007 (as *Aka*)
TOLERANCE: Field study in coastal marine karst lakes that have muddy bottoms, are very turbid and experience a wide range of environmental fluctuation. The sponge occurs in these lakes and is comparatively common.	*Spheciospongia tentorioides*	Gulf of Tonkin, South China Sea, N Vietnam, 1-3 and 7-8 m	Po: Dem: Hadromerida: Clionaidae	(Dendy, 1905)	Azzini et al. 2007
TOLERANCE: Description. *S. vagabunda* can occur at sites with muddy water.	*Spheciospongia vagabunda*	Palau, Pacific, 2 m	Po: Dem: Hadromerida: Clionaidae	(Ridley, 1884)	De Laubenfels 1954 (as *Anthosigmella*)
POSSIBLE INTOLERANCE: Field observations on benthic organisms after cyanobacteria *Synechococcus* blooms: Sponge die-offs caused redistribution of associated spiny lobsters. The bloom reduced visibility from ca. 8 to <0.5 m. After the first bloom >40% of the loggerhead sponges killed and further 23% damaged, all mostly quickly disintegrating. Some of the partially damaged loggerheads recovered, but many still died in the next 6 months. In the bloom centre over 70% of all sponges died (30 mg L^{-1} chlorophyll), 5% were damaged in the periphery of the bloom (<2 mg L^{-1}). During a second, more prolonged bloom, at one site 100% sponge mortality was observed. Comment: It is not clear whether shading or algal toxins may have caused the die-off.	*Spheciospongia vesparium*	Florida Bay, USA, depths accessible by SCUBA	Po: Dem: Hadromerida: Clionaidae	(De Lamarck, 1815)	Butler IV et al. 1995 (as *Speciospongia*)
TOLERANCE: Field study in coastal marine karst lakes that have muddy bottoms, are very turbid and experience a wide range of environmental fluctuation. The sponge occurs in these lakes.	*Spirastrella* cf. *cunctatrix*	Gulf of Tonkin, South China Sea, N Vietnam, 1-3 and 7-8 m	Po: Dem: Hadromerida: Spirastrellidae	Schmidt, 1868	Azzini et al. 2007
TOLERANCE: Field study in coastal marine karst lakes that have muddy bottoms, are very turbid and experience a wide range of environmental fluctuation. The sponge occurs in these lakes.	*Spirastrella decumbens*	Gulf of Tonkin, South China Sea, N Vietnam, 1-3 and 7-8 m	Po: Dem: Hadromerida: Spirastrellidae	Ridley, 1884	Azzini et al. 2007
TOLERANCE: The clam showed increased growth rates in high algal concentrations after the addition of silt.	*Spisula subtruncata*	Review, citing other work	Mo: Biv: Veneroida: Mactridae	(Da Costa, 1778)	Wilber & Clarke 2001
INTOLERANCE: Field study. The three *Spongia* spp. were less common at sites with high compared to low levels of suspended material.	*1 - Spongia (Spongia) agaricina*	Algeciras Bay, S Spain,	Po: Dem: Dictyoceratida: Spongiidae	1 - Pallas, 1766 2 - Linnaeus, 1759	Carballo et al. 1996

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
	2 - Spongia (Spongia) officinalis *3 - Spongia (Spongia) virgultosa*	W Mediterranean, 5-30 m		3 - (Schmidt, 1868)	
TOLERANCE: Field study in coastal marine karst lakes that have muddy bottoms, are very turbid and experience a wide range of environmental fluctuation. The sponge occurs in these lakes.	*Spongia (Spongia) irregularis*	Gulf of Tonkin, South China Sea, N Vietnam, 1-3 and 7-8 m	Po: Dem: Dictyoceratida: Spongiidae	(Von Lendenfeld, 1889)	Azzini et al. 2007
TOLERANCE: Description. 'It thrives in water discolored by emanations from adjacent mangrove swamps, and it endures more mud and silt in the water than do many other sponges.'	*Spongia (Spongia) zimocca*	Micronesia and Palau, Pacific, intertidal to 5 m	Po: Dem: Dictyoceratida: Spongillidae	Linnaeus, 1759	De Laubenfels 1954
TOLERANCE: Field study. *S. domuncula* was about equally common in areas with high compared to low levels of suspended material.	*Suberites domuncula*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Hadromerida: Suberitidae	(Olivi, 1792)	Carballo et al. 1996
TOLERANCE: Field study in coastal marine karst lakes that have muddy bottoms, are very turbid and experience a wide range of environmental fluctuation. The sponge occurs in these lakes.	*Suberites* sp. 1-2	Gulf of Tonkin, South China Sea, N Vietnam, 1-3 and 7-8 m	Po: Dem: Hadromerida: Suberitidae	Nardo, 1833	Azzini et al. 2007
TOLERANCE: Field study in coastal marine karst lakes that have muddy bottoms, are very turbid and experience a wide range of environmental fluctuation. The sponge occurs in these lakes.	*Tedania (Tedania) brevispiculata*	Gulf of Tonkin, South China Sea, N Vietnam, 1-3 and 7-8 m	Po: Dem: Poecilosclerida (Myxillina): Tedaniidae	Thiele, 1903	Azzini et al. 2007
TOLERANCE: Field study in coastal marine karst lakes that have muddy bottoms, are very turbid and experience a wide range of environmental fluctuation. The sponge occurs in these lakes.	*Terpios cruciata*	Gulf of Tonkin, South China Sea, N Vietnam, 1-3 and 7-8 m	Po: Dem: Hadromerida: Suberitidae	(Dendy, 1905)	Azzini et al. 2007
TOLERANCE: Field study. *T. fugax* was equally or slightly more common in areas with high compared to low levels of suspended material.	*Terpios fugax*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Hadromerida: Suberitidae	Duchassaing & Michelotti, 1864	Carballo et al. 1996
INTOLERANCE: Field study. *T. aurantium* only occurred at sites with low levels of suspended material.	*Tethya aurantium*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Hadromerida: Tethyidae	(Pallas, 1766)	Carballo et al. 1996
TOLERANCE: Field study in coastal marine karst lakes that have muddy bottoms, are very turbid and experience a wide range of environmental fluctuation. The sponge occurs in these lakes and is comparatively common.	*Tethya seychellensis*	Gulf of Tonkin, South China Sea,	Po: Dem: Hadromerida: Tethyidae	(Wright, 1881)	Azzini et al. 2007

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
		N Vietnam, 1-3 and 7-8 m			
TOLERANCE: Description. *T. cervicornis* was found in muddy, discoloured water.	*Thrinacophora cervicornis*	Palau, Pacific, 2 m	Po: Dem: Poecilosclerida (Microcionina): Raspailiidae	Ridley & Dendy, 1886	De Laubenfels 1954 (as *Dictyonella dasiphylla*)
INTOLERANCE: Field study. *T. unistellata* only occurred at sites with low levels of suspended material.	*Timea unistellata*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Hadromerida, Timeidae	(Topsent, 1892)	Carballo et al. 1996
INTOLERANCE: Specimens in stronger light are thicker and far better calcified and distribute their symbionts more evenly throughout and deeper in the body than in lower light conditions, where the symbionts have a greater amount of phycoerythrin relative to phycocyanin than in stronger light. Further light reduction led to increased mortality.	*Trididemnum solidum*	Panama, Caribbean, intertidal to 8 m	Ch: Asc: Aplousobranchia: Didemnidae	(van Name, 1902)	Olson 1986
TOLERANCE: Description. *X. emphasis* was found in muddy water.	*Xestospongia emphasis*	Palau, Pacific, 2 m	Po: Dem: Haplosclerida (Petrosina): Petrosiidae	(De Laubenfels, 1954)	De Laubenfels 1954 (as *Sigmadocia*)
TOLERANCE: Field study in coastal marine karst lakes that have muddy bottoms, are very turbid and experience a wide range of environmental fluctuation. The sponge occurs in these lakes.	*Xestospongia* cf. *testudinaria*	Gulf of Tonkin, South China Sea, N Vietnam, 1-3 and 7-8 m	Po: Dem: Haplosclerida (Petrosina): Petrosiidae	(De Lamarck, 1815)	Azzini et al. 2007
TOLERANCE: Cross shelf survey. *Xestospongia* spp. only occurred on the more turbid inshore reefs and displayed high biomass levels compared to the other sponges.	1 – *Xestospongia testudinaria* 2 – *Xestospongia* sp. 'EL'	Great Barrier Reef, Coral Sea, Pacific, 2.5-20 m	Po: Dem: Haplosclerida (Petrosina): Petrosiidae	1 – (De Lamarck, 1815) 2 – De Laubenfels, 1932	Wilkinson & Cheshire 1989
TOLERANCE: Distribution patterns of macrobenthic organisms were surveyed along a turbidity gradient from river mouths to the bay entrance. In contrast to other organisms, no clear patterns were observed for sponges (based on only 9 sponge species and not separating the influence of sediments from those of freshwater and nutrients).	sponges	Moorea, French Polynesia, central Pacific, 10 m	Po	Grant, 1863	Adjeroud 2000
PHOTOTROPHY, TOLERANCE: Field survey. Phototrophic sponges were more abundant and had higher biomass on the more turbid inshore reefs, but per site had more biomass in shallower waters than in greater depth.	reef sponges	Great Barrier Reef, Coral Sea, Pacific, 2.5-20 m	Po	Grant, 1863	Wilkinson & Cheshire 1989
INTOLERANCE: Field survey. Sponges had a clear bathymetric distribution with peak abundances 15-30 m, and slope and lagoonal populations being different, latter dealing with higher sediment loads (see above). Many (cyanobacterial) phototrophic sponges occur, which explains the reduced distribution at 30 m	reef sponges	Davies Reef, central Great Barrier Reef, Coral Sea, Pacific, 1-40 m	Po	Grant, 1863	Wilkinson & Evans 1989

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
down. The largest populations were found at the back reef with strong currents and possibly better nutrient conditions.					
INTOLERANCE: Field study on benthic communities and habitat mapping. Photosynthetic organisms were restricted to less than 60 m water depth, with a transitional community at 60-75 m still containing some photosynthetic benthos. The distribution of zooxanthellate corals and the cyanosponge *Carteriospongia* was shallower than expected and explained with resuspended sediments or a consequence of upwelling.	benthos in mesophotic habitats, e.g. *Carteriospongia* sp.	central Great Barrier Reef, Pacific, 51-145 m	Po: Dem: Dictyoceratida: Thorectidae	Hyatt, 1877	Bridge et al. 2011
INTOLERANCE: Field survey on benthic organisms along gradients of suspended sediments in fjords with and without glaciers. High sedimentation occurs at the glacier end, with depositions of >8 m $year^{-1}$, decreasing to about 0.7 m $year^{-1}$ at the mouth of the fjord. Abundances and species richness increased away from the fjord heads that had glaciers, and glacier fjords had an overall lower abundance and richness of benthos (10-20%) than the others (100%). Species compositions differed significantly, with tubeworms dominating in glacier fjords and reduced bryozoans, barnacles and macroalgae. Sponges were only found at the mouths of glacier fjords.	benthos	S Alaskan fjords, NE Pacific, 18.5-25 m	-	-	Carney et al. 1999

Appendix 3. Cleaning reactions in filter feeders in response to sediments. For abbreviations see top of Appendix 1 on pg 38.

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
EFFORT: Field observations that with increasing availability of sediments sponges invested more energy in cleaning, and canals were more often clogged, reducing circulation. In the sandiest zone only *A. crassa* was found.	*Aiolochroia crassa*	Gulf of Mexico, Florida, 2-20 m	Po: Dem: Verongida: Aplysinidae	(Hyatt, 1875)	Storr 1976a (as *Ianthella ardis*)
MUCUS, SLOUGHING: The anemone compacted silt with mucus and sloughed it off.	*Alcyonium antarcticum*	Ross Island, Antarctica, 'along the shoreline'	Cn: Ant: Alcyonacea: Alcyoniidae	Wright & Studer, 1889	Airoldi 2003 (as *A. paessleri*)
CLEAN SURFACE: The surface of this glass sponge is always clean, despite habitat sedimentation and marine snow.	*Aphrocallistes vastus*	Barkley Sound British Columbia, Canada, NE Pacific, 160 m	Po: Hex (Hexasterophora): Hexactinosida (Sceptrulophora): Aphrocallistidae	Schulze, 1886	Tompkins-MacDonald & Leys 2008
MUCUS: Accidentally inhaled fine materials are cleaned out of the ostia by mucus secretion.	*Chondrilla nucula*	assumed: Florida coast, Gulf of Mexico, 2-20 m depth (see Storr 1976a)	Po: Dem: Chondrosida: Chondrillidae	Schmidt, 1862	Storr 1976b
CLEAN SURFACE: In *Cliona* spp. densely distributed spicules slightly protrude from the surface, creating a dirt-repellent surface.	*Cliona* spp.	central Great Barrier Reef, Coral Sea, Pacific, 2 m	Po: Dem: Hadromerida: Clionaidae	Grant, 1863	Schönberg 2015
MUCUS, SLOUGHING: The sponge seasonally changes its surface properties. Mid-August to end of October the sponges appear inactive and contracted and have a glassy, hispid (spicules widely spaced) cuticle without pore openings and are covered with debris by the end of this phase. The cuticle is rejected with the accumulated materials. During the active phase the sponge has a clean surface that is thickly covered in acid mucopolysaccharides.	*Crambe crambe*	Costa Brava, NW Mediterranean, littoral	Po: Dem: Poecilosclerida (Myxillina): Crambeidae	(Schmidt, 1862)	Turon et al. 1999
CLEAN SURFACE: In *Cymbastela* spp. densely distributed spicules slightly protrude from the surface, creating a dirt-repellent surface.	*Cymbastela* spp.	central Great Barrier Reef, Coral Sea, Pacific, 2 m	Po: Dem: Halichondrida: Axinellidae	Hooper & Bergquist, 1992	Schönberg 2015
MUCUS: Field experiment, daily application of sediments on sponges *in situ* for 7 d resulted in mucus production in *H. ferox* that sloughed that layer off.	*Ectyoplasia ferox*	Bahamas, W Atlantic, 14 m	Po: Dem: Poecilosclerida (Microcionina): Raspailiidae	(Duchassaing & Michelotti, 1864)	Gerrodette & Flechsig 1979 (as *Hemectyon*)
SLOUGHING: Sloughing of the outer tissue layer starts at the oscula and occurs every 3 weeks in flow-through aquaria-kept specimens, the process taking 2 weeks and producing delicate flakes with adhering foreign materials. This was interpreted as a reaction to sedimentation and fouling as it did not occur when sponges were cultured in filtered water in a closed system.	*Halichondria (Halichondria) panicea*	Kiel Bight, German Baltic Sea, shallow depths	Po: Dem: Halichondrida: Halichondriidae	(Pallas, 1766)	Barthel & Wolfrath 1989

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
BACKFLUSHING, MUCUS: Bottom sediments were applied in concentrations of 0-47 mg L^{-1}. Squirting frequency increased with sediment concentration to clean out unwanted material, and mucus velocity was slowed down to reduce the risk of clogging.	*Halocynthia pyriformis*	Bay of Fundy, N Atlantic, Canada, 6-20 m	Ch: Asc: Stolidobranchia: Pyuridae	(Rathke, 1806)	Armsworthy 1993, Armsworthy et al. 2001
MUCUS: This encrusting sponge colonises sandy sediments and binds them. It produces mucus, which the authors interpreted as a strategy for cleaning.	*Hymedesmia (Hymedesmia) stylata*	Svalbard Basin, Arctic Ocean, 2538-2609 m	Po: Dem: Poecilosclerida (Myxillina): Hymedesmiidae	Lundbeck, 1910	Barthel & Tendal 1993
MUCUS: The acidic mucus of some invertebrates contains potent lytic substances and can block adhesion of e.g. some bacteria or select for adhesion of others. Mucus film augments non-stick properties of cuticle.	1 - *Marthasterias glacialis* 2 - *Ophiocomina nigra* 3 - *Porania (Porania) pulvillus*	W Scotland, North Atlantic, depth mostly shallow, sampling partly by trawling	1 - Ed: Ast: Forcipulatida: Asteriidae 2 - Ed: Oph: Ophiurida: Ophiocomidae 3 - Ed: Ast: Valvatida: Poraniidae	1 - (Linnaeus, 1758) 2 - (Abildgaard, in O.F. Müller, 1789) 3 - (O.F. Müller, 1776)	Bavington et al. 2004
MUCUS: Production of large amounts of mucus was here interpreted as means to clean the surface and the canal system. Comment: It is not clear if mucus production occurred as consequence of sampling.	*Mycale (Oxymycale) acerata*	Wedell Sea, Antarctic, 100-1200 m	Po: Dem: Poecilosclerida (Mycalina): Mycalidae	Kirkpatrick, 1907	Barthel & Gutt 1992
CLEAN SURFACE: In *Neopetrosia* spp. densely distributed spicules slightly protrude from the surface, creating a dirt-repellent surface.	*Neopetrosia* spp.	central Great Barrier Reef, Coral Sea, Pacific, 2 m	Po: Dem: Haplosclerida (Petrosina): Petrosiidae	De Laubenfels, 1949	Schönberg 2015
PASSIVE SHEDDING: Experimental study on sedimentation effects on *O. arbuscula*. Passive sediment shedding (dead skeleton) was improved in more branching morphologies, but active shedding was independent of morphology.	*Oculina arbuscula*	South Atlantic Bight, Georgia, USA, Atlantic, 18-20 m	Cn: Ant: Scleractinia: Oculinidae	Agassiz, 1864	Divine 2011
SLOUGHING: Tissue sloughing was observed in the cyanosponge *P. ficiformis* as extreme stress reaction. After freshwater inundation sponges in patches lost exopinacoderm and became white, then necrotic. Over 2 weeks patches spread over entire specimens, which however could recover over 5 months, regaining colour. Loss of the protective exopinacoderm allowed adverse material to enter the inner tissue, including microbes (mostly ciliates) and sediments.	*Petrosia (Petrosia) ficiformis*	Italy, Ligurian Sea, Mediterranean, 0-5 m	Po: Dem: Haplosclerida (Petrosina): Petrosiidae	(Poiret, 1789)	Cerrano et al. 2001
CONTRACTIONS: The ability to strongly contract was interpreted as a possible means to clean surfaces of debris caused by sedimentation.	*Polymastia invaginata*	Wedell Sea, Antarctic, 100-1200 m	Po: Dem: Hadromerida: Polimastiidae	Kirkpatrick, 1907	Barthel & Gutt 1992
SLOUGHING: During winter (November-February) the sponges seasonally shed their outer layer, which becomes heavily debris-covered over the course of the year. Sloughing coincided with the end of seasonal phytoplankton blooms, and surfaces were rebuilt March-October.	*Rhabdocalyptus dawsoni*	Saanich Inlet, Barkley Sound, British Columbia,	Po: Hex (Hexasterophora): Lyssacinosida: Rossellidae (Acanthascinae)	(Lambe, 1893)	Leys & Lauzon 1998

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
		Canada, NE Pacific, 30 m			
MUCUS: Tank experiment with clay. 3.1 µm grain size in a suspension of 35-64 mg L^{-1}, for 4 d resulted in mucus production.	*Rhopaloeides odorabile*	central Great Barrier reef, 5-15 m	Po: Dem: Dictyoceratida: Spongiidae	Thompson et al. 1987	Bannister 2008, Bannister et al. 2012
BACKFLUSHING: *In situ* induced reaction of backwashing by placing fine materials on inhalant surfaces so that this material is drawn into the sponge. Moments later the fine material is forcefully ejected by either reverse flow or contraction driving a cloud as far as 7-10 cm away from the sponge.	*Spheciospongia vesparium*	assumed: Florida coast, Gulf of Mexico, 2-20 m depth (see Storr 1976a)	Po: Dem: Hadromerida: Clionaidae	(De Lamarck, 1815)	Storr 1976b
PHAGOCYTOSIS: Sponges were subjected to 1:10 suspensions of ink and carmine and were examined at intervals. Within 1 h clumps of particles were observed in the sponge tissue, then archaeo- and collencytes ingested particles by phagocytosis, migrated to exhalant canals and released the particles. Carmine was completely eliminated after 24 h, ink after 96 h.	*Suberites aurantiacus*	Hawaii, Pacific, very shallow (from pilings)	Po: Dem: Hadromerida: Suberitidae	(Duchassaing & Michelotti, 1864)	Cheng et al. 1968 (as *Terpios zeteki*)
MUCUS: Sponges that arrested pumping and thus waste removal when reproductive; were covered with a thin 'veil' that was interpreted to be mucus.	*Svenzea zeai*	Bahamas, W Atlantic, depth not stated	Po: Dem: Halichondrida: Scopalinidae	(Alvarez et al., 1998)	López-Legentil & Turon 2010
MUCUS: *T. trirhaphis* exudes mucus after sampling, which suggests that it is likely to use mucus for surface cleaning.	*Tedania (Tedania) trirhaphis*	Wedell Sea, Antarctic, 185-705 m	Po: Dem: Poecilosclerida (Myxillina): Tedaniidae	Koltun, 1964	Kunzmann 1996
MUCUS: Production of large amounts of mucus were here interpreted as means to clean the surface and the canal system. Comment: it is not clear if mucus production occurred as consequence of sampling	*Tedania (Tedaniopsis) vanhoeffeni*	Wedell Sea, Antarctic, 100-1200 m	Po: Dem: Poecilosclerida (Myxillina): Tedaniidae	Hentschel, 1914	Barthel & Gutt 1992
EFFORT: Field observations that with increasing availability of sediments sponges invested more energy in cleaning, and canals were more often clogged, reducing circulation.	sponges	Gulf of Mexico, Florida, 2-20 m	Po	Grant, 1863	Storr 1976a
CLEAN SURFACE: Author lists 'spicule protrusion' as a factor that keeps sponge surfaces clean.	sponges	-	Po	Grant, 1863	Bell 2004

Appendix 4. Sediment effects on feeding processes, respiration and other important physiological functions. For abbreviations see top of Appendix 1 on pg 38.

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
REDUCED FITNESS: Resuspended sediments may interfere with reproduction. Dose-response experiments on corals showed that fertilisation was reduced, which was synergistically enhanced by elevated nutrients or lowered salinity.	*Acropora millepora*	Great Barrier Reef, Coral Sea, Pacific, Australia, 5-8 m	Cn: Ant: Scleractinia: Acroporidae	(Ehrenberg, 1834)	Hymphrey et al. 2008
REDUCED FITNESS & ENERGY DRAIN: Field observations showed that with increasing availability of sediments sponges invested more energy in cleaning, and canals were more often clogged, reducing circulation. In the sandiest zone only *A. crassa* was found.	*Aiolochroia crassa*	Gulf of Mexico, Florida, 2-20 m	Po: Dem: Verongida: Aplysinidae	(Hyatt, 1875)	Storr 1976a (as *Ianthella ardis*)
BIOINDICATOR: Field observations. *A. viridis* appears to benefit from moderate organic pollution (e.g. sewage). This may mean it could increase in abundance at sites with resuspended sediments releasing nutrients into the water column.	*Amphimedon viridis*	Arraial do Cabo, SE Brazil, Atlantic, SCUBA depth; Cuba, Caribbean, depth not stated, assumed shallow	Po: Dem: Haplosclerida (Haplosclerina): Niphatidae	Duchassaing & Michelotti, 1864	Muricy 1989, Alcolado 2007
PUMPING: The surface of this glass sponge is always clean, despite habitat sedimentation and marine snow. Aquarium experiments confirmed that fine, inorganic sediment <25 µm even in low concentrations led to immediate arrest of pumping (within min, resumed within seconds). Prolonged, gradually increasing exposures >4 h caused acclimation with gradual reduction in pumping and clogging of the canal system (after 40 min exposure). Different species have different threshold sensitivities, but showed neither diurnal rhythmicity nor sensitivity to light changes.	*Aphrocallistes vastus*	Barkley Sound British Columbia, Canada, NE Pacific, 160 m	Po: Hex (Hexasterophora): Hexactinosida (Sceptrulophora): Aphrocallistidae	Schulze, 1886	Tompkins-MacDonald & Leys 2008
FILTRATION & SELECTIVITY: *In situ* study of sponge feeding. >60% of local suspended materials >5 µm diameter were inorganic, aggregated clays with attached bacteria and 40% were free-living bacteria and ultra-plankton. Glass sponges selectively removed up to 95% of the free-living bacteria (*A. vastus* at a mean of 74%), with no indication of thresholds or saturation if concentrations increased, but rejected larger bacteria. Heterotrophic bacteria were also selectively eaten if present (removal efficiency 95%). Inorganic particles – 97% of the seston (<125 µm) – could not accurately be quantified, but it appeared that in- and exhalant streams contained the same amounts, i.e. clays were not retained, but rejected.	*Aphrocallistes vastus*	Barkley Sound British Columbia, Canada, NE Pacific, 120-160 m	Po: Hex: Hexactinosida: Aphrocallistidae	Schulze, 1886	Yahel et al. 2007
FILTERING & SELECTIVITY: The sponge can distinguish between different particles it inhaled, digesting bacteria from the water column, but not bacteria it lives in symbiosis with.	1 - *Aplysina aerophoba* 2 - *Aplysina cavernicola*	Gulf of Lion, W Mediterranean, depth not stated, assumed shallow	1 & 1 - Po: Dem: Verongida: Aplysinidae	1 - (Nardo, 1833) 2 - (Vacelet, 1959)	Wilkinson et al. 1984

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
RESPIRATION: For the exception of a 1 mm surface layer, where molecular diffusion acts, arrested pumping in *A. aerophoba* causes anoxic tissues within 15 min and can last several hours or even days.	*Aplysina aerophoba*	Limski Canal, Adriatic Sea, Mediterranean, 5-15 m	Po: Dem: Verongida: Aplysinidae	(Nardo, 1833)	Hoffmann et al. 2008
BIOINDICATOR: Field observations. *A. fistularis* appears to be excluded from sites with organic pollution (e.g. sewage). This may mean it could suffer negative effects from resuspended sediments releasing nutrients into the water column.	*Aplysina fistularis*	1 - Arraial do Cabo, SE Brazil, Atlantic, SCUBA depth; 2 - Cuba, Caribbean, depth not stated, assumed shallow	Po: Dem: Verongida: Aplysinidae	(Pallas, 1766)	1 - Muricy 1989, 2 - Alcolado 2007
PUMPING: During tank experiments involving 4 h and 4 d treatments with clay suspensions of 0, 3, 11, 95 mg L^{-1} *A. lacunosa* displayed reduced pumping rates at 11 mg L^{-1} and is possibly a species very sensitive to fine sediments.	*Aplysina lacunosa*	Bahamas, W Atlantic, 14 m	Po: Dem: Verongida: Aplysinidae	(De Lamarck, 1814)	Gerrodette & Flechsig 1979 (as *Verongia*)
FILTRATION & SELECTIVITY: Simulated resuspension experiment, increasing suspended particulate matter about x4. *A. zebra* selectively rejected material with higher carbon content in favour of material with higher nitrogen content, increasing the food quality by about 31%, with slight increase in retention efficiency and significant reduction in clearance rates, but elevated ingestion rates.	*Arca zebra*	Bermuda, Atlantic, SCUBA depth	Mo: Biv: Arcoida: Arcidae	(Swainson, 1833)	Ward & MacDonald 1996
ENERGY DRAIN: Accidentally inhaled fine materials are cleaned out of the ostia by mucus secretion.	*Chondrilla nucula*	assumed: Florida coast, Gulf of Mexico, 2-20 m depth (see Storr 1976a)	Po: Dem: Chondrosida: Chondrillidae	Schmidt, 1862	Storr 1976b
BIOINDICATOR: Field observations. *C.* aff. *nucula* is abundant at sites with organic pollution (polluted coastal lagoon) and tolerates muddy environments. This means this sponge could benefit from resuspended sediments releasing nutrients into the water column.	*Chondrilla* aff. *nucula*	Arraial do Cabo, SE Brazil, Atlantic, SCUBA depth; Cuba, Caribbean, depth not stated, assumed shallow	Po: Dem: Chondrosida: Chondrillidae	Schmidt, 1862	Muricy 1989, Alcolado 2007
FILTRATION: The proportion of spongin in *C. reniformis* was higher in the harbour than elsewhere. Clearance rates of *Synechococcus* sp. and picoeukaryotes were higher in the transplanted controls than in the sponges transplanted to the harbour environment.	*Chondrosia reniformis*	Costa Brava, NW Mediterranean, Spain, 3-10 m	Po: Dem: Chondrosida: Chondrillidae	Nardo, 1847	Cebrian et al. 2006, 2007
BIOINDICATOR: Review, field observations. *C. venosa* dominates sites with organic pollution (stenotopic). This means this sponge could benefit from resuspended sediments releasing nutrients into the water column.	*Clathria (Thalysias) venosa*	Cuba, Caribbean, 10-20 m	Po: Dem: Poecilosclerida (Microcionina): Microcionidae	(Alcolado, 1984)	Alcolado & Herrera 1987, Alcolado 2007

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
BIOINDICATOR: Field observations. *C. caribbaea* appears to be excluded from sites with organic pollution (e.g. sewage). This may mean it could suffer negative effects from resuspended sediments releasing nutrients into the water column.	*Cliona caribbaea*	Caribbean (e.g. Cuba), shallow depths	Po: Dem: Hadromerida: Clionaidae	Carter, 1882	Alcolado 2007
BIOINDICATOR: Field observations. *C. delitrix* occurs in increased abundance at sites with organic pollution (e.g. sewage, bacterial blooms) and tolerates muddy environments. The sponge's ability to benefit from eutrophication has been widely reported and means it could benefit from resuspended sediments releasing nutrients into the water column.	*Cliona delitrix*	various sites in the Florida keys and the Caribbean, shallow depths	Po: Dem: Hadromerida: Clionaidae	Pang, 1973	Rose & Risk 1985, Ward-Paige et al. 2005, Chávez-Fonnegra et al. 2007, Alcolado 2007
BIOINDICATOR: Field observations. *C. varians* occurs is abundant at sites with organic pollution (e.g. sewage), but potential as bioindicator may be inconsistent as it also commonly occurs at unpolluted sites. This means this sponge could tolerate resuspended sediments releasing nutrients into the water column.	*Cliona varians*	Caribbean (e.g. Cuba), depths not stated, assumed shallow	Po: Dem: Hadromerida: Clionaidae	(Duchassaing & Michelotti, 1864)	Alcolado 2007
BIOINDICATOR: Field observations. Bioeroding sponges occur in increased abundances and diversities with increasing eutrophication. This means they could benefit from resuspended sediments releasing nutrients into the water column.	*Cliona* spp.	1-2 – Barbados, Caribbean, 0-6.5 m; 3 – Indonesia, Java Sea, Ambon, 3 m; 4-5 – Caribbean, shallow depths	Po: Dem: Hadromerida: Clionaidae	D'Orbigny, 1851	1 – Holmes 1997, 2 – 2000, 3 – Holmes et al. 2000, 4 – Rützler 2002b, 5 – Alcolado 2007
FILTRATION: *C. crambe* is able to clear 15 L of water with 10^6 particles per mL in <4 h, with filtering efficiency for larger particles 0.5-1 µm better (ca. 15 min to clear 70-80%) than smaller particles of 0.2 µm. Ostiae had a diameter of about 12 µm and choanocytes of about 200 µm (fewer per area than in *D. avara*). Pinacocytes also took up smaller and larger particles.	*Crambe crambe*	Costa Brava, Mediterranean, 9-13 m	Po: Dem: Poecilosclerida (Myxillina): Crambeidae	(Schmidt, 1862)	Turon et al. 1997
PUMPING: Feeding suspensions for oysters were mixed with different sediments to dilute the concentration of living cells: fine silt, clay-like kaolin, powdered chalk (0.1-4 g L^{-1}) and Fuller's earth (0.5 g L^{-1}). Pumping rate decreased with addition of sediments, but majority of oysters stayed open and still pumped. Cleaning proceeded via pseudofaeces.	*Crassostrea virginica*	Connecticut, NW Atlantic, intertidal	Mo: Biv: Osteroida: Ostreidae	Rafinesque, 1815	Loosanoff & Tommers 1948 (as *Ostrea*)
FILTRATION: *D. avara* is able to clear 15 L of water with 10^6 particles per mL within ca. 2 h, with filtering efficiency for larger particles 0.5-4 µm better (ca. 15 min to clear 80-90%) than smaller particles of 0.2 µm. Ostiae had a diameter of about 30 µm and choanocytes of about 3200 µm (more per area than in *C. crambe*). Pinacocytes took up larger particles up to 6 µm.	*Dysidea avara*	Costa Brava, Mediterranean, 9-13 m	Po: Dem: Dictyoceratida: Dysideidae	(Schmidt, 1862)	Turon et al. 1997
FILTRATION: Bottom sediments were applied in concentrations of 0-47 mg L^{-1}. Clearance rate remained stable, but ingestion and adsorption rates increased with increasing sediment concentrations, while adsorption efficiency	*Halocynthia pyriformis*	Bay of Fundy, N Atlantic, Canada, 6-20 m	Ch: Asc: Stolidibranchia: Pyuridae	(Rathke, 1806)	Armsworthy 1993, Armsworthy et al. 2001

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
decreased. Retention of small particles increased (2-5 µm), of larger particles decreased (6-15 µm).					
BIOINDICATOR: Review, field observations. *I. birotulata* dominates sites with organic pollution (inconsistent occurrences). This means this sponge could benefit from resuspended sediments releasing nutrients into the water column.	*Iotrochota birotulata*	Cuba, Caribbean, 10-20 m	Po: Dem: Poecilosclerida (Myxillina): Iotrochotidae	(Higgin, 1877)	Alcolado & Herrera 1987, Alcolado 2007
FILTRATION, PUMPING & RESPIRATION: Sponge retention efficiencies, pumping and respiration rates were measured. None of the species reached 100% retention efficiency for any given particle size, which was interpreted to be caused by high suspension loads, i.e. it was interpreted as a mechanism to avoid clogging. Pumping rate for *I. kerguelenensis* was 220 mL h^{-1} and oxygen consumption was 0.04 mL O_2 h^{-1} per g ash free dry weight at 1C°.	*Isodictya kerguelenensis*	Potter Cove, King George Island, Antarctica, SCUBA depths	Po: Dem: Poecilosclerida (Mycalina): Isodictyidae	(Ridley & Dendy, 1886)	Kowalke 2000
REDUCED FITNESS: Small concentrations of silt retarded the development of *M. mercenaria eggs*, and stronger than large concentrations of clay. But larvae were more tolerant of silt than of clay, which clogged their feeding apparatus.	*Mercenaria mercenaria*	not stated	Mo: Biv: Veneroida: Veneridae	(Linnaeus, 1758)	Morton 1977 (as *Venus*)
FILTRATION & SELECTIVITY: *M. mercenaria* was fed mixed suspensions of algae (50 and 150 cells µL^{-1}) and bottom sediments (0 to 44 mg L^{-1}). Algal ingestion rate and clearance rate declined with increasing sediment loads, at low rates of pseudofacies production that contained a maximum of 18% algae as loss. Adsorption rate remained constant. At moderate to high algal concentrations (≧300 µg Cl^{-1}) growth improvement by the addition of silt, as observed in other bivalves, is unlikely to occur in *M. mercenaria*. Regulation of particle selection by pseudofacies is more efficient than be reduction of clearance rate as in *M. mercenaria*.	*Mercenaria mercenaria*	USA, W Atlantic	Mo: Biv: Veneroida: Veneridae	(Linnaeus, 1758)	Bricelj & Malouf 1984
FILTRATION, PUMPING & RESPIRATION: Sponge retention efficiencies, pumping and respiration rates were measured. None of the species reached 100% retention efficiency for any given particle size, which was interpreted to be caused by high suspension loads, i.e. a mechanism to avoid clogging. Pumping rate for *M. acerata* was 180 mL h^{-1} and oxygen consumption was 0.09 mL O_2 h^{-1} per g ash free dry weight at 1.8°C.	*Mycale (Oxymycale) acerata*	Potter Cove, King George Island, Antarctica, SCUBA depths	Po: Dem: Poecilosclerida (Mycalina): Mycalidae	Kirkpatrick, 1907	Kowalke 2000
BIOINDICATOR: Field observations. *M. microsigmatosa* dominates sites with organic pollution (domestic sewage) and tolerates muddy environments. This means this sponge could benefit from resuspended sediments releasing nutrients into the water column.	*Mycale (Carmia) microsigmatosa*	Arraial do Cabo, SE Brazil, Atlantic, SCUBA depth; Cuba, Caribbean, depth not stated, assumed shallow	Po: Dem: Poecilosclerida (Mycalina): Mycalidae	Arndt, 1927	Muricy 1989, Alcolado 2007
PUMPING: Field observation. Increased turbidity after a storm resulted in reduced pumping rates in *Mycale* sp.	*Mycale* sp.	Jamaica, Caribbean, SCUBA depth	Po: Dem: Poecilosclerida (Mycalina): Mycalidae	Gray, 1867	Reiswig 1971

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
CANAL SYSTEM: Both endopsammic species have a complex, strongly polarised canal system, taking in water through their elevated fistules and ejecting it underground.	1 - *Oceanapia amboinensis* 2 - *Oceanapia fistulosa*	Bunaken, Celebes Sea, Sulawesi, Indonesia, 1 - 0.5-1 m, 2 - 30 m	Po: Dem: Haplosclerida (Petrosina): Phloeodictyidae	1 - Topsent, 1897 2 - (Bowerbank, 1873)	Bavestrello et al. 2002
FILTRATION & SELECTIVITY: The sponge can distinguish between different particles it inhaled, digesting bacteria from the water column, but not bacteria it lives in symbiosis with.	*Pericharax heterorhaphis*	Gulf of Lion, W Mediterranean, depth not stated, assumed shallow	Po: Cal (Calcinea): Clathrinida: Leucettidae	Poléjaeff, 1883	Wilkinson et al. 1984
FILTRATION & SELECTIVITY: Simulated resuspension experiment, increasing suspended particulate matter about x4. *P. imbricata* indiscriminately rejected material in the pseudofaeces, thus regulating total intake, with slight reduction in retention efficiency and significant reduction in clearance rates, but elevated ingestion rates.	*Pinctada imbricata*	Bermuda, Atlantic, SCUBA depth	Mo: Biv: Pterioida: Pteriidae	(Röding, 1798)	Ward & MacDonald 1996
PUMPING: The surface of this glass sponge is always covered in detritus, and arrested pumping was observed in the field. Aquarium experiments confirmed that fine, inorganic sediment <25 µm even in low concentrations led to immediate (within min, resumed within seconds), often prolonged arrest of pumping (up to 6 h). Prolonged, gradually increasing exposures >4 h caused acclimation with gradual reduction in pumping and clogging of the canal system (after 40 min exposure). Different species have different threshold sensitivities, but showed neither diurnal rhythmicity nor sensitivity to light changes.	*Rhabdocalyptus dawsoni*	Barkley Sound British Columbia, Canada, NE Pacific, 30 m	Po: Hex (Hexasterophora): Lyssacinosida: Rossellidae (Acanthascinae)	(Lambe, 1893)	Tompkins-MacDonald & Leys 2008
FILTRATION & SELECTIVITY: *In situ* study of sponge feeding. >60% of local suspended materials >5 µm diameter were inorganic, aggregated clays with attached bacteria and 40% were free-living bacteria and ultra-plankton. Glass sponges selectively removed up to 95% of the free-living bacteria (mean of 68% for *R. dawsoni)*, with no indication of thresholds or saturation if concentrations increased, but rejected larger bacteria. Heterotrophic bacteria were also selectively eaten if present (removal efficiency 100%). Inorganic particles – 97% of the seston (<125 µm) – could not accurately be quantified, but it appeared that in- and exhalant streams contained the same amounts, i.e. clays were not retained, but rejected.	*Rhabdocalyptus dawsoni*	Barkley Sound British Columbia, Canada, NE Pacific, 120-160 m	Po: Hex (Hexasterophora): Lyssacinosida: Rossellidae (Acanthascinae)	(Lambe, 1893)	Yahel et al. 2007
REDUCED FITNESS & RESPIRATION: Compared to inner-shelf sites, where *R. odorabile* is less abundant and its specimens are somewhat smaller, it assimilated 1.5x less C and N at mid-shelf sites and 3x less at outer-shelf sites, which may be due to a higher concentration of suspended clay, which resulted in a higher energy demand. Respiration of *R. odorabile* increased by up to 40% when exposed to terrigenous sediments. Tank experiments with either clay: 3.1 µm grain size and 35-64 mg L^{-1} over 7 h or 4 days carbonate: 8.2 µm grain size and 34-57 mg L^{-1} over 4 days caused increased respiration. Tank experiment	*Rhopaloeides odorabile*	central Great Barrier reef, 5-15 m	Po: Dem: Dictyoceratida: Spongiidae	Thompson et al., 1987	Bannister 2008, Bannister et al. 2010, 2012

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
with clay: 3.1 µm grain size and 35-64 mg L^{-1}, over 4 days caused a reduction in ocular diameter or closure.					
BIOINDICATOR: Field observations. *S. ruetzleri* appears to benefit from moderate organic pollution (e.g. sewage). This may mean it could increase in abundance at sites with resuspended sediments releasing nutrients into the water column.	*Scopalina ruetzleri*	1 – Arraial do Cabo, SE Brazil, Atlantic, SCUBA depth; 2 –Colombian Caribbean, 17-22 m; 3 – Cuba, Caribbean, depth not stated, assumed shallow	Po: Dem: Halichondrida: Scopalinidae	(Wiedenmayer, 1977)	1 – Muricy 1989 (as *Ulosa*) 2 – Zea 1994 3 – Alcolado 2007
PUMPING: *In situ* induced reaction of backwashing by placing fine materials on inhalant surfaces so that this material is drawn into the sponge. Moments later the fine material is forcefully ejected by either reverse flow or contraction driving a cloud as far as 7-10 cm away from the sponge.	*Spheciospongia vesparium*	assumed: Florida coast, Gulf of Mexico, 2-20 m depth (see Storr 1976a)	Po: Dem: Hadromerida: Clionaidae	(De Lamarck, 1815)	Storr 1976b
FILTRATION: For sponges, *S. officinalis* feeds on comparatively large particles, nanoeukaryotic cells (low retention efficiency for nano- and picoplankton, latter most abundant source). Comment: This may mean that its feeding apparatus may be more resistant to clogging, because it handles larger food particles.	*Spongia (Spongia) officinalis*	Gulf of Lion, Mediterranean, 5-20 m	Po: Dem: Dictyoceratida: Spongiidae	Linnaeus, 1759	Topçu et al. 2010
FILTRATION & SELECTIVITY: The sponge can distinguish between different particles it inhaled, digesting bacteria from the water column, but not bacteria it lives in symbiosis with.	*Spongia* sp.	Gulf of Lion, W Mediterranean, depth not stated, assumed shallow	Po: Dem: Dictyoceratida: Spongiidae	Linnaeus, 1759	Wilkinson et al. 1984
BIOINDICATOR: Field observations. *S. aurantiacus* is abundant at sites with organic pollution (polluted coastal lagoon) and tolerates muddy environments. This means this sponge could benefit from resuspended sediments releasing nutrients into the water column.	*Suberites aurantiacus*	Cuba, Caribbean, depth not stated, assumed shallow	Po: Dem: Hadromerida: Suberitidae	(Duchassiang & Michelotti, 1864)	Alcolado 2007
PUMPING: Field experiment. Daily application of sediments on sponges *in situ* for 7 d resulted in closure of oscules in *T.* cf. *ignis*.	*Tedania* cf. *(Tedania) ignis*	Bahamas, W Atlantic, 14 m	Po: Dem: Poecilosclerida (Myxillina): Tedaniidae	(Duchassaing & Michelotti, 1864)	Gerrodette & Flechsig 1979
BIOINDICATOR: Field observations. *M. microsigmatosa* dominates sites with organic pollution (domestic sewage) and tolerates muddy environments. This means this sponge could benefit from resuspended sediments releasing nutrients into the water column.	*Tedania* cf. *(Tedania) ignis*	Arraial do Cabo, SE Brazil, Atlantic, SCUBA depth;	Po: Dem: Poecilosclerida (Myxillina): Tedaniidae	(Duchassaing & Michelotti, 1864)	Muricy 1989

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
		Cuba, Caribbean, depth not stated, assumed shallow			
PUMPING: Field observation. Increased turbidity after a storm resulted in reduced pumping rates in *V. gigantea*.	*Verongula gigantea*	Jamaica, Caribbean, SCUBA depth, 24-52 m	Po: Dem: Verongida: Aplysinidae	(Hyatt, 1875)	Reiswig 1971 (as *Verongia*)
REDUCED FITNESS: Sediment layers established naturally on experimental blocks and became about 3-5 mm thick, consisting of grains of variable size (0.5-225 µm). Most species shrank or died, which was explained by burial and clogging effects.	reef sponges and ascidians	Fanning Island, central Pacific, 0.2-1.5 m	-	-	Bakus 1968
REDUCED FITNESS & ENERGY DRAIN: Field observations that with increasing availability of sediments sponges invested more energy in cleaning, and canals were more often clogged, reducing circulation.	sponges	Gulf of Mexico, Florida, 2-20 m	Po	Grant, 1863	Storr 1976a
FILTRATION & REDUCED FITNESS: Adult bivalves are silt-tolerant, but react with reduced filtration activity or by rejecting excess materials in form of pseudofaeces. 'When suspended sediment concentrations exceed the threshold at which bivalves can effectively filter material, the available food is diluted. […] The responses of suspension-feeding bivalves to relatively low concentrations of suspended sediment are varied [depending on species].' In high algal concentrations after the addition of silt 1-2 and 4 show increase growth rates, 5 decrease their algal ingestion and show no differences in growth. 20 mg L^{-1} suspended clay interferes with the selection ability of 4 for algae, but does not reduce the amount of ingested algae. Low concentrations of resuspended sediment increased summer growth of 5, but inhibited it at higher concentrations. High silt-clay concentrations reduce growth and survival of 3 and 4. Oysters near dredged material displayed reduced bushel yield and increased mortality, likely due to contamination and changed water quality. 100-200 mg L^{-1} suspensions cause reduced gape width and partial siphon and mantle retraction in 6 after 7 d and reduced response to mechanical stimuli after 15 d, excessive extension of siphons after 30 d. The authors give the following thresholds for adult bivalves: No effect to about 200 mg L^{-1}, sublethal effects to about 4000 mg L^{-1}, with increasing occurrence of mortality above that (their Fig. 7).	bivalves 1 - *Mytilus edulis* 2 - *Spisula subtruncata* 3 - *Mercenaria mercenaria* 4 - *Crassostrea virginica* 5 - *Ostrea edulis* 6 - *Mya arenaria*	Review, citing other work	Mo: Biv 1 - Mytiloida: Mytilidae 2-3 - Veneroida: Mactridae 4-5 - Ostreoida: Ostreidae 6 - Myioda: Myoidae	Linnaeus, 1758 1, 3 & 5-6 - Linnaeus, 1758 2 - (Da Costa, 1778) 4 - (Gmelin, 1791)	Wilber & Clarke 2001
PUMPING: Oysters can survive in close vicinity of dredging activities. They were not killed by increased turbidity from dredging, but died when buried. A suspension of 700 ppm had little effect on oyster survival or feeding rates.	oysters	review summarising other publications	Mo: Biv: Ostreoida	Férussac, 1822	Morton 1977
REDUCED FITNESS: Surface and suspended sediments were sampled after sediment disturbance. Surface sediments became coarser and poorer in nutrient content. Suspended sediments increased, especially the fines, and had a relatively low content of organics. Recovery of original conditions was slow	-	Maine, NW Atlantic,	-	-	Anderson & Meyer 1986

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
(weeks to months). The amount of bioaggregates decreased after digging, which was interpreted as biological inactivity due to disturbance and burial.		depth not stated, shallow			

Appendix 5. Responses of filter feeders to contamination, toxicity and oxygen depletion, as residual effects of resuspended sediments. For abbreviations see top of Appendix 1 on pg 38.

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
INDUSTRIAL POLLUTION: Field survey in relation to anthropogenic deterioration of habitats. *A. suberitoides* was abundant at but restricted to the control site without oil and phosphate pollution or recreational and crown-of-thorns starfish impact.	*Aaptos suberitoides*	N Red Sea, 1-20 m	Po: Dem: Hadromerida: Suberitidae	(Brøndsted, 1934)	Ammar et al. 2007
INDUSTRIAL POLLUTION: Field observations. The sponge is common at sites with oil pollution.	*Aplysina fistularis*	Arraial do Cabo, SE Brazil, Atlantic, SCUBA depth	Po: Dem: Verongida: Aplysinidae	(Pallas, 1766)	Muricy 1989
INDUSTRIAL POLLUTION: Field observations. The sponge is common at sites with oil pollution.	*Amphimedon viridis*	Arraial do Cabo, SE Brazil, Atlantic, SCUBA depth	Po: Dem: Haplosclerida (Haplosclerina): Niphatidae	Duchassaing & Michelotti, 1864	Muricy 1989
ANOXIA: 'This species is tolerant of low oxygen concentrations and low salinities.'	*Arcuatula senhousia*	from review: Australasia, invasive in Port Philipp Bay, Bass Strait, Pacific, intertidal to shallow subtidal	Mo: Biv: Mytiloida: Mytilidae	(Benson in Cantor, 1842)	Boyd 1999 (as *Musculista*)
INDUSTRIAL POLLUTION: Field observations. The sponge is common at sites with oil pollution.	*Chondrilla nucula*	Arraial do Cabo, SE Brazil, Atlantic, SCUBA depth	Po: Dem: Chondrosida: Chondrillidae	Schmidt, 1862	Muricy 1989
METALS: The thickly encrusting *C. reniformis* was analysed for Cu, Pb, Cd, Hg, and V. Only Cu and Pb were present in the samples at reliably detectable concentrations. Compared to other sponges, *C. reniformis* had the highest Pb values, but accumulated Cu at a low rate. The proportion of spongin was higher in the harbour than elsewhere. Clearance rates of *Synechococcus* sp. and picoeukaryotes were higher in the transplanted controls than in the sponges transplanted to the harbour environment.	*Chondrosia reniformis*	Costa Brava, NW Mediterranean, Spain, 3-10 m	Po: Dem: Chondrosida: Chondrillidae	Nardo, 1847	Cebrian et al. 2006, 2007
METALS: Sessile long-lived filter feeders are good biomonitors for metal contamination. Trace metals predominant in the Mediterranean (Cu, Fe, Zn, Mn) can alter cell functions and influence the immune system evidenced by the activity of 2',5'-oligoadenylate synthetase. In *C. reniformis* the enzyme activity was either activated or inhibited by the studied metals, depending on their concentrations.	*Chondrosia reniformis*	Costa Brava, NW Mediterranean, depth not stated	Po: Dem: Chondrosida: Chondrillidae	Nardo, 1847	Saby et al. 2009
METALS: Sponges exposed to waters at hydrothermal vent that are enriched in metal sulphides were analysed with differential pulse polarography. The	*Cinachyra* sp.	hydrothermal vent Monte Saldanha,	Po: Dem: Spirophorida: Tetillidae	Sollas, 1886	Gomes et al. 2006

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
metallothionein concentration in *Cinachyra* sp. was found to be 224.5 µg g^{-1} dry weight, with accumulation per ion being Zn>Fe>Mn>Ni>V>Cu>Cd>Ag.		Mid-Atlantic Ridge, >2000 m			
METALS: Toxicity of Cd, Cr, Cu and Hg on early life stages of *C. intestinalis* were tested. 2001: Fertilisation rate only slightly decreased, even at high dosages, and effects on larvae were more pronounced. 2004: Increased metal concentrations decreased the proportion of normally hatched larvae and decreased larval attachment. In the present case and on a molar basis Hg was 3x more toxic than Cu, 20–30x more than Cd, and 700–1000x more toxic than Cr, for both responses.	*Ciona intestinalis*	Galicia, NW Spain, Atlantic, depth not stated	Ch: Asc: Phlebobranchia: Cionidae	(Linnaeus, 1767)	Bellas et al. 2001, 2004
METALS: *C. viridis* selectively accumulates transition metals Fe, Ni and Zn and the metalloid arsenic, even if they are at normal levels in the environment.	*Cliona viridis*	Berlengas, W Portugal, E Atlantic, 0-13 m	Po: Dem: Hadromerida: Clionaidae	(Schmidt, 1862)	Araújo et al. 2003
POLLUTION, ANOXIA: 'Populations of this species in Denmark are often in polluted areas. […] Laboratory studies show that this species is able to survive long periods in near-anoxic conditions.'	*Corbula* cf. *gibba*	from review: Atlanto-Mediterranean, invasive in Port Philipp Bay, Bass Strait, Pacific, 'shallow water to great depth'	Mo: Biv: Myoida: Corbulidae	(Olivi, 1792)	Boyd 1999
METALS: *C. crambe* occurs in Cu contaminated habitats, and 2 heat shock proteins occurred in higher concentrations in sponges at more contaminated sites, one occurring in higher concentrations than the other and the second one reacting faster, being less persistent. Sponges with higher shock protein levels were less toxic than controls, showing that sponges likely invested more in cell repair than in the production of the toxic compound.	*Crambe crambe*	Costa Brava, NW Mediterranean, Spain, 4-10 m	Po: Dem: Poecilosclerida (Myxillina): Crambeidae	(Schmidt, 1862)	Agell et al. 2001
METALS: *C. crambe* is a reliable biomonitor for Cu (low accumulation), Pb (high accumulation) and V (latter not significant), which it accumulates over spatial and temporal scales and reflects seasonal availability. Sponges at the control site grew, while they shrank at the contaminated site and increased irregularity, e.g. by increased fission. No polycyclic aromatic hydrocarbons were detected at the sample site.	*Crambe crambe*	Costa Brava, NW Mediterranean, Spain, 0-10 m	Po: Dem: Poecilosclerida (Myxillina): Crambeidae	(Schmidt, 1862)	Cebrian et al. 2003, 2007
METALS: Oysters exposed to 0.025 to 0.05 mg L^{-1} Cu grew very well, but exhibited slightly elevated mortality compared to the control. 0.1 to 0.2 mg L^{-1} Cd resulted in starved oysters that did not properly grow, lost their pigmentation and suffered high mortalities.	*Crassostrea virginica*	review citing other publications	Mo: Biv: Ostreoida: Ostreidae	(Gmelin, 1791)	Morton 1977
METALS: Sessile long-lived filter feeders are good biomonitors for metal contamination. Trace metals predominant in the Mediterranean (Cu, Fe, Zn, Mn) can alter cell functions and influence the immune system evidenced by the	*Crella (Crella) elegans*	Costa Brava, NW Mediterranean, depth not stated	Po: Dem: Poecilosclerida (Myxillina): Crellidae	(Schmidt, 1862)	Saby et al. 2009

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
activity of 2',5'-oligoadenylate synthetase. In *C. elegans* the enzyme activity was inhibited by all studied metals.					
METALS: The encrusting to massive *D. avara* was analysed for were analysed for Cu, Pb, Cd, Hg, and V. Only Cu and Pb were present in the samples at reliably detectable concentrations. Compared to other sponges, *D. avara* strongly accumulated Cu, but only low amounts of Pb, which appeared to be regulated. *D. avara* has a high volume of choanocyte chambers and a high clearance rate.	*Dysidea avara*	Costa Brava, NW Mediterranean, Spain, 3-10 m	Po: Dem: Dictyoceratida: Dysideidae	(Schmidt, 1862)	Cebrian et al. 2007
TOXINS: *E. discophorus* selectively accumulates As, even if it is at normal levels in the environment.	*Erylus discophorus*	Berlengas, W Portugal, E Atlantic, 0-13 m	Po: Dem: Astrophorida: Geodiidae (Erylinae)	(Schmidt, 1862)	Araújo et al. 2003
ANOXIA: Field observations. The sponges occur in depths at which seasonal anoxia through thermoclines can occur, i.e. the sponge must be hardy against reduced oxygen levels.	*Eurypon* sp. 4	S Ireland, Atlantic, 0-30 m	Po: Dem: Poecilosclerida Microcionina): Raspailiidae	Gray, 1867	Bell & Barnes 2000b
INDUSTRIAL POLLUTION: Field survey in relation to anthropogenic deterioration of habitats. *Gelliodes* sp. was scarce and only occurred at the site impacted by recreational activities and crown-of-thorns starfish, not where oil and phosphate pollution occurred, nor at the control site.	*Gelliodes* sp.	N Red Sea, 1-20 m	Po: Dem: Hadromerida: Suberitidae	Ridley, 1884	Ammar et al. 2007
METALS: Sessile long-lived filter feeders are good biomonitors for metal contamination. Trace metals predominant in the Mediterranean (Cu, Fe, Zn, Mn) can alter cell functions and influence the immune system evidenced by the activity of 2',5'-oligoadenylate synthetase. In *G. cydonium* the enzyme activity was inhibited by all studied metals.	*Geodia cydonium*	Adriatic Sea, Mediterranean, depth not stated	Po: Dem: Astrophorida: Geodiidae (Geodiinae)	(Jameson, 1811)	Saby et al. 2009
INDUSTRIAL POLLUTION: Field survey in relation to anthropogenic deterioration of habitats. *Haliclona* sp. was scarce and only occurred at the site where oil pollution occurred, not with phosphate pollution, nor if the habitat was impacted by recreational activities and crown-of-thorns starfish or at the control site.	*Haliclona* sp.	N Red Sea, 1-20 m	Po: Dem: Haplosclerida (Haplosclerina): Chalinidae	Grant, 1836	Ammar et al. 2007
METALS: Cd, Pb, and Cu can be quantified to high accuracy in siliceous spicules of marine sponges by using ultrasensitive square wave anodic stripping voltammetry (concentration ranged between species and replicates: 0.038-0.93 μg g^{-1} dry weight for Cd, 0.024-0.52 μg g^{-1} dry weight for Pb, and 0.32-1.3 μg g^{-1} dry weight for Cu). Siliceous spicules of Antarctic sponges showed higher concentrations of Cd and Pb and lower concentrations of Cu than those from the Mediterranean.	*Haliclona* sp.	Ross Sea, Antarctica	Po: Dem: Haplosclerida (Haplosclerina): Chalinidae	Grant, 1836	Annibaldi et al. 2011
METALS, INDUSTRIAL POLLUTION: *H. balfourensis* bioaccumulated Cd, but not any of the other substances tested. Analysed were THC, PCB, PAH and trace metals (Cu, Zn, Cd, Pb, Hg and As).	*Homaxinella balfourensis*	McMurdo Sound, Antarctica, 18-25 m	Po: Dem: Hadromerida: Suberitidae	(Ridley & Dendy, 1886)	Negri et al. 2006

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
ANOXIA: Field observations. The sponges occur in depths at which seasonal anoxia through thermoclines can occur, i.e. the sponge must be hardy against reduced oxygen levels.	*Hymeraphia stellifera*	S Ireland, Atlantic, 0-30 m	Po: Dem: Poecilosclerida (Microcionina): Raspailiidae	Bowerbank, 1864	Bell & Barnes 2000b
METALS: Cd, Pb, and Cu can be quantified to high accuracy in siliceous spicules of marine sponges by using ultrasensitive square wave anodic stripping voltammetry (concentration ranged between species and replicates: 0.038-0.93 µg g^{-1} dry weight for Cd, 0.024-0.52 µg g^{-1} dry weight for Pb, and 0.32-1.3 µg g^{-1} dry weight for Cu). Siliceous spicules of Antarctic sponges showed higher concentrations of Cd and Pb and lower concentrations of Cu than those from the Mediterranean.	*Inflatella belli*	Ross Sea, Antarctica	Po: Dem: Poecilosclerida (Myxillina): Coelosphaeridae	(Kirkpatrick, 1907)	Annibaldi et al. 2011
METALS: Cd, Pb, and Cu can be quantified to high accuracy in siliceous spicules of marine sponges by using ultrasensitive square wave anodic stripping voltammetry (concentration ranged between species and replicates: 0.038-0.93 µg g^{-1} dry weight for Cd, 0.024-0.52 µg g^{-1} dry weight for Pb, and 0.32-1.3 µg g^{-1} dry weight for Cu). Siliceous spicules of Antarctic sponges showed higher concentrations of Cd and Pb and lower concentrations of Cu than those from the Mediterranean.	*Kirkpatrickia coulmani*	Ross Sea, Antarctica	Po: Dem: Poecilosclerida (Myxillina): Hymedesmiidae	(Kirkpatrick, 1907)	Annibaldi et al. 2011
METALS: Antarctic filter feeders exhibit different levels of bioaccumulation; many environmentally occurring metals and especially Cu and Cd were enriched in molluscs.	*Laternula elliptica*	McMurdo Sound, Antarctica, 18-25 m	Mo: Biv: Anomalodesmata: Laternulidae	(King, 1832)	Negri et al. 2006
METALS, INDUSTRIAL POLLUTION: *M. acerata* bioaccumulated Cd, but not any of the other substances tested. Analysed were THC, PCB, PAH and trace metals (Cu, Zn, Cd, Pb, Hg and As).	*Mycale (Oxymycale) acerata*	McMurdo Sound, Antarctica, 18-25 m	Po: Dem: Poecilosclerida (Mycalina): Mycalidae	Kirkpatrick, 1907	Negri et al. 2006
INDUSTRIAL POLLUTION: Field observations. The sponge is common at sites with oil pollution.	*Mycale (Carmia) microsigmatosa*	Arraial do Cabo, SE Brazil, Atlantic, SCUBA depth	Po: Dem: Poecilosclerida (Mycalina): Mycalidae	Arndt, 1927	Muricy 1989
METALS: Sponges were analysed for trace metals, which varied little within sponge species, but samples from Lake Macquarie had the highest levels for almost all trace metals. Concentrations of trace metals per dry weight of sponge were about 50-100 µg g^{-1} Zn, 10-60 µg g^{-1} Cu, 0.7-1.5 Cd µg g^{-1}, 2-6 µg g^{-1} Se, 1-6 µg g^{-1} Pb. *Mycale* may be a good biomonitor.	*Mycale* sp. (encrusting)	marine coastal lakes, N & s of Sydney, Australia, Pacific, 0.2-2 m	Po: Dem: Poecilosclerida (Mycalina): Mycalidae	Gray, 1867	De Mestre et al. 2012
ANOXIA: Field observations. The sponges occur in depths at which seasonal anoxia through thermoclines can occur, i.e. the sponge must be hardy against reduced oxygen levels.	*Paratimea constellata*	S Ireland, Atlantic, 0-30 m	Po: Dem: Hadromerida, Hemiasterellidae	Topsent, 1893	Bell & Barnes 2000b
METALS: Cd, Pb, and Cu can be quantified to high accuracy in siliceous spicules of marine sponges by using ultrasensitive square wave anodic stripping voltammetry (concentration ranged between species and replicates: 0.038-0.93 µg g^{-1} dry weight for Cd, 0.024-0.52 µg g^{-1} dry weight for Pb, and 0.32-1.3 µg g^{-1} dry weight for Cu). Siliceous spicules of Antarctic sponges showed	*Petrosia (Petrosia) ficiformis*	Italian Mediterranean	Po: Dem: Haplosclerida (Petrosina): Petrosiidae	(Poiret, 1789)	Annibaldi et al. 2011

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
higher concentrations of Cd and Pb and lower concentrations of Cu than those from the Mediterranean.					
METALS: The encrusting *P. tenacior* was analysed for were analysed for Cu, Pb, Cd, Hg, and V. Only Cu and Pb were present in the samples at reliably detectable concentrations. Compared to other sponges, *P. tenacior* had mid-range concentrations of Pb and Cu. It was a weak bioaccumulator for Pb which was probably regulated to a fixed level, and a stronger bioaccumulator for Cu.	*Phorbas tenacior*	Costa Brava, NW Mediterranean, Spain, 3-10 m	Po: Dem: Poecilosclerida (Myxillina): Hymedesmiidae	(Topsent, 1925)	Cebrian et al. 2007
INDUSTRIAL POLLUTION: Field survey in relation to anthropogenic deterioration of habitats. *Phyllospongia* sp. was scarce and only occurred at the site impacted by recreational activities and crown-of-thorns starfish, not where oil and phosphate pollution occurred, nor at the control site.	*Phyllospongia* sp.	N Red Sea, 1-20 m	Po: Dem: Hadromerida: Suberitidae	Ridley, 1884	Ammar et al. 2007
METALS: Assessment of effects of Cu on sponge microbial communities. Mean Cu concentration in Great Barrier Reef *R. odorabile* was 25.1 ± 1.8 (SE) mg kg^{-1} dry weight. Sponge explants of the same individual were exposed to different Cu regimes. After 2 weeks sponges contained 28.6 (controls), 84.8 (low) and 306 mg kg^{-1} dry weight (medium, with some surface necrosis; more evidence by examining sponge cells). The sponges in the high treatment contained 142 mg kg^{-1} dry weight after 2 days, but disintegrated and became necrotic. Total culturable bacterial counts were lower with Cu concentrations and over time in Cu treatments.	*Rhopaloeides odorabile*	Davies Reef, Great Barrier Reef, Coral Sea, Pacific, 8 m	Po: Dem: Dictyoceratida: Spongiidae	Thompson et al. 1987	Webster et al. 2001
METALS, HALOGENS, TOXINS: *S. fasciculatus* selectively accumulates the halogens Br and I, even if they are at normal levels in the environment; it also accumulates As and Fe and sometimes Ti.	*Sarcotragus fasciculatus*	Berlengas, W Portugal, E Atlantic, 0-13 m	Po: Dem: Dictyoceratida: Irciniidae	(Pallas, 1766)	Araújo et al. 2003 (as *Ircinia*)
TOXINS: *S. spinosulus* selectively accumulates As, even if it is at normal levels in the environment.	*Sarcotragus spinosulus*	Berlengas, W Portugal, E Atlantic, 0-13 m	Po: Dem: Dictyoceratida: Irciinidae	Schmidt, 1862	Araújo et al. 2003
TOXINS: *S. scalaris* selectively accumulates As, even if it is at normal levels in the environment.	*Scalarispongia scalaris*	Berlengas, W Portugal, E Atlantic, 0-13 m	Po: Dem: Dictyoceratida: Thorectidae	(Schmidt, 1862)	Araújo et al. 2003 (as *Cacospongia*)
METALS, INDUSTRIAL POLLUTION: Testing effects of Cu, Cd, PAHs and PAHs+Cu on larval settlement at 10 day exposures. Cu and Cd did not affect settlement rates or survival of recruits. PAHs and especially PAHs+Cu inhibited settlement.	*Scopalina lophyropoda*	Costa Brava, NW Mediterranean, Spain, sublittoral	Po: Dem: Halichondrida: Scopalinidae	Schmidt, 1862	Cebrian & Uriz 2007b
METALS: Testing effects of moderate levels of Cu and Cd on sponge cell aggregation and larval settlement. The metals play a role in Ca cycles, as cell aggregation took place in Ca-free seawater with metals, but not without. Metals increased the speed of larval settlement during short exposures (3 days), but incurred mortality of recruits at longer exposures (5 days).	*Scopalina lophyropoda*	Costa Brava, NW Mediterranean, Spain, sublittoral	Po: Dem: Halichondrida: Scopalinidae	Schmidt, 1862	Cebrian & Uriz 2007a

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
METALS, INDUSTRIAL POLLUTION: Testing effects of Cu, Cd, PAHs and PAHs+Cu on larval settlement at 10 day exposures. Cu and Cd enhanced settlement. This time, mortality was not affected, but PAHs and especially PAHs+Cu inhibited settlement.	*Scopalina lophyropoda*	Costa Brava, NW Mediterranean, Spain, sublittoral	Po: Dem: Halichondrida: Scopalinidae	Schmidt, 1862	Cebrian & Uriz 2007b
METALS: Dissociated cells were treated with Cd, Cu and Hg. Hg inhibited cell movement and pseudopod formation, while moderate amounts of Cd and Cu enhanced pseudopod formation and motility. All metals facilitate cell aggregation.	*Scopalina lophyropoda*	Costa Brava, NW Mediterranean, Spain, sublittoral	Po: Dem: Halichondrida: Scopalinidae	Schmidt, 1862	Cebrian & Uriz 2007c
INDUSTRIAL POLLUTION: Field observations. The sponge is common at sites with oil pollution.	*Scopalina ruetzleri*	Arraial do Cabo, SE Brazil, Atlantic, SCUBA depth	Po: Dem: Halichondrida: Scopalinidae	Wiedenmayer, 1977	Muricy 1989 (as *Ulosa*)
METALS, INDUSTRIAL POLLUTION: *S. antarcticus* bioaccumulated Cd, but not any of the other substances tested. Analysed were THC, PCB, PAH and trace metals (Cu, Zn, Cd, Pb, Hg and As).	*Sphaerotylus antarcticus*	McMurdo Sound, Antarctica, 18-25 m	Po: Dem: Hadromerida: Polymastiidae	Kirkpatrick, 1907	Negri et al. 2006
METALS, HALOGENS, TOXINS: *Spongia* spp. selectively accumulates the halogens Br and I, even if they are at normal levels in the environment; it also accumulate As and Fe and sometimes Ti.	1 - *Spongia (Spongia) nitens* 2 - *Spongia (Spongia) agaricina* 3 - *Spongia (Spongia) officinalis*	Berlengas, W Portugal, E Atlantic, 0-13 m	Po: Dem: Dictyoceratida: Spongiidae	1 - (Schmidt, 1862) 2 - Pallas, 1766 3 - Linnaeus, 1759	Araújo et al. 2003
METALS: Biomarker study. The synthesis of metallothioneins (MTs) was interpreted as reaction to heavy metal exposure and to suggest a detoxification system, and compounds that matched characters of MTs were found in *S. officinalis*, binding Ag, Cu and Zn. MTs in the sponges were correlated to environmental gradients of metals (Cu, Hg, Zn).	*Spongia (Spongia) officinalis*	French Mediterranean, SCUBA depth	Po: Dem: Dictyoceratida: Spongiidae	(Linnaeus, 1759)	Berthet et al. 2005
METALS: Cd, Pb, and Cu can be quantified to high accuracy in siliceous spicules of marine sponges by using ultrasensitive square wave anodic stripping voltammetry (concentration ranged between species and replicates: 0.038-0.93 µg g^{-1} dry weight for Cd, 0.024-0.52 µg g^{-1} dry weight for Pb, and 0.32-1.3 µg g^{-1} dry weight for Cu). Siliceous spicules of Antarctic sponges showed higher concentrations of Cd and Pb and lower concentrations of Cu than those from the Mediterranean.	*Sphaerotylus antarcticus*	Ross Sea, Antarctica	Po: Dem: Hadromerida: Polymastiidae	Kirkpatrick, 1907	Annibaldi et al. 2011
TOXINS: *S. anancora* selectively accumulates As, even if it is at normal levels in the environment.	*Stelletta anancora*	Berlengas, W Portugal, E Atlantic, 0-13 m	Po: Dem: Astrophorida: Ancorinidae	(Sollas, 1886)	Araújo et al. 2003 (as *Myriastra*)
METALS: Sponges were analysed for trace metals, which varied little within sponge species, but samples from Lake Macquarie had the highest levels for almost all trace metals. Concentrations of trace metals per dry weight of sponge	*Suberites* cf. *diversicolor*	marine coastal lakes, N & s of	Po: Dem: Hadromerida: Suberitidae	Becking & Lim, 2009	De Mestre et al. 2012

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
were about 100-200 µg g^{-1} Zn, 5-20 µg g^{-1} Cu, 1-10 Cd µg g^{-1}, 0.5-5 µg g^{-1} Se, 0.5-1.7 µg g^{-1} Pb. *S.* cf. *diversicolor* may be a good biomonitor.		Sydney, Australia, Pacific, 0.2-2 m			
INDUSTRIAL POLLUTION: Field observations. The sponge is common at sites with oil pollution.	*Tedania (Tedania) ignis*	Arraial do Cabo, SE Brazil, Atlantic, SCUBA depth	Po: Dem: Poecilosclerida (Myxillina): Tedaniidae	(Duchassaing & Michelotti, 1864)	Muricy 1989
ANOXIA: 'Population density of the species was reported as reduced in areas of reduced oxygen concentration […]. The species is considered a biological indicator species for anoxic conditions.'	*Theora lubrica*	from review: Japan, invasive in Port Philipp Bay, Bass Strait, Pacific, low tide mark to 100 m	Mo: Biv: Veneroida: Semelidae	Gould, 1861	Boyd 1999
METALS: Experiments testing effects of Cu and reduced salinity on larval survival and development. Development did not differ, but survival was reduced with lowered salinity, an effect that was synergistically enhanced by Cu stress. Cu by itself slightly lowered larval survival, but was not significant.	*Tridacna gigas*	Philippines, Pacific, depth not stated	Mo: Biv: Veneroida: Cardiidae	(Linnaeus, 1758)	Blidberg 2004
METALS: Zn is built into spicules, but hardly any Al, Sc or Mn. 'Hexactinellids have a higher, and more variable, Zn content than demosponges', and the demosponge Zn isotopic composition was more fractionated, which is thought to reflect different feeding strategies.	1 - Demospongiae 2 - Hexactinellida	Drake Passage and Scotia Sea, Southern Ocean, deep sea	1 - Po: Dem 2 - Po: Hex	1 - Sollas, 1885 2 - Schmidt, 1870	Henry & Andersen 2013
AGRICULTURAL POLLUTION: Most pesticides, herbicides and fungicides affect the embryonic development of bivalves. Survival and growth of larvae are not as strongly affected, but some pesticides inhibited their growth at concentrations that did not affect the embryos.	bivalves: oysters clams	review citing other publications	Mo: Biv: Ostreoida Mo: Biv: Veneroida	Férussac, 1822 Gray, 1854	Morton 1977
TOXINS: Oysters near dredged material displayed reduced bushel yield and increased mortality, likely due to contamination with As, lowered salinity and oxygen concentrations.	bivalves oysters	review, citing other work	Mo: Biv: Ostreoida: Ostreidae	Rafinesque, 1815	Wilber & Clarke 2001
METALS: Field sampling, comparing Cd concentrations in different materials and assessing whether levels were elevated compared to normal. Sediments had normal levels of Cd. Sponges (10-80 µg g^{-1} dry weight) and molluscs (up to 345 µg g^{-1}) contained very high levels of Cd, as compared to other seas.	epifauna, incl. molluscs, echinodermatas and sponges 1 - *Rossella* sp. 2 - *Clathria (Axosuberites)* sp. 3 - *Tedania* sp.	Ross Sea, Antarctic, 20-200 m	1 - Po: Hex: Lyssacinosida: Rosselidae 2-3 - Po: Dem: Poecilosclerida: 2 - Microcionidae 3 - Tedaniidae	1 - Carter, 1872 2 - Topsent, 1893 3 - Gray, 1867	Bargagli et al. 1996 (*Clathri*a as *Axociella*)
METALS, INDUSTRIAL POLLUTION: Antarctic filter feeders exhibit different levels of bioaccumulation; many environmentally occurring metals and especially Cu were enriched in molluscs, but sponges did not exhibit a clear spatial pattern. Analysed were THC, PCB, PAH and trace metals (Cu, Zn, Cd, Pb, Hg and As). Trace metal concentration in sponges rarely rose above what was	various filter feeders, e.g. 1 - *Laternula elliptica* 2 - *Homaxinella balfourensis*	McMurdo Sound, Antarctica, 18-25 m	1 - Mo: Biv: Anomalodesmata: Laternulidae 2-4 - Po: Dem: 2 - Hadromerida: Suberitidae 3 - Poecilosclerida: Mycalidae	1 - (King, 1832) 2 - (Ridley & Dendy, 1886) 3 and 4 - Kirkpatrick, 1907	Negri et al. 2006

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
found in the sediments. However, Cd was significantly accumulated in the bivalve and in the sponges.	3 - *Mycale (Oxymycale) acerata* 4 - *Sphaerotylus antarcticus*		4 - Hadromerida: Polymastiidae		
METALS: Panels with pre-established communities were distributed across sites with different harbour/boating activities. Heavy metal contamination caused community shift: The originally dominant organisms, solitary ascidians, were replaced by colonial ascidians, sponges, erect bryozoans and hydroids.	various filter feeders, e.g. 1 - *Ascidiella aspersa* 2 - *Corella eumyota* 3 - *Asterocarpa coerulea* 4 - *Cnemidocarpa bicornuta* 5 - *Styela plicata* 6 - *Botrylloides leachii* 7 - *Botryllus schlosseri* 8 - *Aplidium* spp. 1-3 9 - *Didemnum* cf. *candidum* 10 - *Pseudodistoma* sp. 11 - *Beania plurispinosa* 12 - *Watersipora subtorquata* 13 - *Bugula flabellata* 14 - *Bugula neritina* 15 - *Bugula stolonifera* 16 - *Tricellaria occidentalis* 17 - *Bowerbankia imbricata* 18 - *Bougainvillia muscus* 19 - *Pennaria disticha* 20 - *Turritopsis nutricula* 21 - *Obelia dichotoma* 22 - *Sulculeolaria* sp. 23 - *Megabalanus tintinnabulum* 24 - poecilosclerids	Hauraki Gulf, New Zealand, 1 m	Ch: Asc: 1-2 - Phlebobranchia: 1 - Ascidiidae 2 - Corellidae 3-7 - Stolidobranchia: Styelidae 8-10 - Aplousobranchia: 8 - Polyclinidae 9 - Didemnidae 10 - Pseudodistomidae 11-15 - Br: Gym: Cheilostomatida: 11 - Baeniidae 12 - Watersiporidae 13-15 - Bugulidae 16 - Candidae 17 - Ctenostomatida: Vesiculariidae 18-22 - Cn: Hyd: 18-20 - Anthoathecata: 18 - Bougainvilliidae 19 - Pennariidae 20 - Oceaniidae 21 - Leptothecata: Campanulariidae 22 - Siphonophorae: Diphyidae 24 - Po: Dem: Poecilosclerida	1 - (Müller, 1776) 2 - Traustedt, 1882 3 - (Quoy & Gaimard, 1834 4 - (Sluiter, 1900) 5 - (Lesueur, 1823) 6 - (Savigny, 1816) 7 - (Pallas, 1766) 8-9 - Savigny, 1816 10 - Michaelsen, 1924 11 - Uttley & Bullivat, 1972 12 - (D'Orbigny, 1852) 13 - (Thompson in Gray, 1848) 14 - (Linnaeus, 1758) 15 - Ryland, 1960 16 - (Trask, 1857) 17 - (Adams, 1798) 18 - (Allman, 1863) 19 - Goldfuss, 1820 20 - McCrady, 1857 21 - (Linnaeus, 1758) 22 - Blainville, 1830 23 - (Linnaeus, 1758) 24 - Topsent, 1928	Turner et al. 1997 (*Ascidiella* as *Ascidia*, *Sulculeolaria* as *Galeolaria*, *Megabalanus* as *Balanus*)

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
METALS, INDUSTRIAL POLLUTION: Antarctic filter feeders exhibit different levels of bioaccumulation; many environmentally occurring metals and especially copper were enriched in molluscs, but sponges did not exhibit a clear spatial pattern. Analysed were THC, PCB, PAH and trace metals (Cu, Zn, Cd, Pb, Hg and As). Trace metal concentration in sponges rarely rose above what was found in the sediments. However, Cd was significantly accumulated in the bivalve and in the sponges.	various filter feeders, e.g. 1 - *Laternula elliptica* 2 - *Homaxinella balfourensis* 3 - *Mycale (Oxymycale) acerata* 4 - *Sphaerotylus antarcticus*	McMurdo Sound, Antarctica, 18-25 m	1 - Mo: Biv: Anomalodesmata: Laternulidae Po: Dem: 2 - Hadromerida: Suberitidae 3 - Poecilosclerida: Mycalidae 4 - Hadromerida: Polymastiidae	1 - (King, 1832) 2 - (Ridley & Dendy, 1886) 3 and 4 - Kirkpatrick, 1907	Negri et al. 2006
INDUSTRIAL POLLUTION: Environmental monitoring. Oil and gas industries were active in that area for a significant duration. No Ba contamination could be shown, but elevated levels of hydrocarbons were present at a small number of sites (local, and spatially patchy), affecting the benthos at one site. Contamination stemmed from oil-based drill-mud.	benthos, e.g. 1 - large demosponges 2 - *Lophelia pertusa* 3 - acorn worms	NW Scotland, NW of Shetland and NE Rockall Trough, North Sea, <200 to >200 m	1 - Po: Dem 2 - Cn: Ant: Scleractinia: Caryophylliidae 3 - He: Ent	1 - Sollas, 1885, 2 - (Linnaeus, 1758) 3 - Gegenbaur, 1870	Bett 2001
METALS: Recreational boats treated with antifouling caused Cu contamination of sediments in the harbour. There was a clear spatial gradient of Cu contamination, and highly polluted sites amphipods, bivalves and some species of polychaetes were less abundant. Several macrobenthic species exhibited Cu bioaccumulation in their tissues (annelid, amphipod), while two polychaetes had lower Cu concentrations in their tissues than in the surrounding sediments and acted as bioregulators.	benthos, endo- and epifauna	San Diego Bay, California, USA, E Pacific, 4 m	-	-	Neira et al. 2013

Appendix 6. Responses of filter feeders to direct effects of sediment, including scouring, sediment deposition (here called 'sedimentation or siltation') and burial. For abbreviations see top of Appendix 1 on pg 38.

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
SEDIMENTATION: Field study. *A. acuta* occurred only at one site, an area with low levels of siltation and under an overhang.	*Acanthella acuta*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Halichondrida: Dictyonellidae	(Schmidt, 1862)	Carballo et al. 1996
BURIAL, SCOURING: Localised sediment slides caused extensive die-offs of the anemones. Sediment intolerance was confirmed by laboratory experiments (100 g of sediments were added every 4 h for either 24 or 96 h). While fine sediments could be cleaned off, scour caused necrosis and mortality, matching field observations.	*Alcyonium antarcticum*	review paper, Ross Island, Antarctica	Cn: Ant: Alcyonacea: Alcyoniidae	Wright & Studer, 1889	Airoldi 2003 (as *A. paessleri*)
BURIAL: Experimental assessment of tolerance of large-bodied sponges to burial in reef sediment, results variable due to unintended sediment shifting by biological activity. Shallow burial resulted in sealing of surface perforations followed by complete recovery, deep burial caused discolouration and death.	*Amphimedon erina*	coastal Belize Cay system, Caribbean, 2.5 m	Po: Dem: Haplosclerida: Niphatidae	(De Laubenfels, 1936)	Wulff 2008
SEDIMENTATION: Field study. *A. rosea* only occurred in areas with low levels of siltation and occurred on vertical surfaces and under overhangs and stones, thus reducing sedimentation stress.	*Aplysilla rosea*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Dendroceratida: Darwinellidae	(Barrois, 1876)	Carballo et al. 1996
SEDIMENTATION: *A. cauliformis* commonly occurs in areas with strong waves, frequent exposure to storms and sedimentation (see App. 7). Alcolado (2007) explains this tolerance with 'branching morphology, flexibility and elasticity'.	*Aplysina cauliformis*	Cuba, Caribbean, shallow depth	Po: Dem: Verongida: Aplysinidae	(Carter, 1882)	Alcolado 2007
SEDIMENTATION: *A. lacunosa* appears to be sensitive to sedimentation, which may affect the abundance of this species on turbid patch reefs.	*Aplysina lacunosa*	N Florida Keys, W Atlantic, 3-6, 7-11, 12-21 m	Po: D: Verongida: Aplysinidae	(De Lamarck, 1814)	Schmahl 1990
SEDIMENTATION: Field study. *A. damicornis* only occurred at sites with low levels of siltation.	*Axinella damicornis*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Halichondrida: Axinellidae	(Esper, 1794)	Carballo et al. 1996
SEDIMENTATION: Study to assess how kelp forests affect benthic suspension feeders underneath. More intense particle deposition in kelp forests was experimentally tested on four benthic organisms, and it reduced growth rates for all of them, but reduced flow rates (serpulid polychaete) and lack of algal turfs under kelp were positive for some (cheilostome bryozoan, myxillid sponge). Of non-experimental organisms *B. glandula* grew faster *in situ* when in kelp forests.	*Balanus glandula*	San Juan Archipelago, Washington State, NE Pacific, 7-11 m	Ar: Max: Sessilia: Balanidae	Darwin, 1854	Eckman & Duggins 1991

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
SEDIMENTATION: Natural sediment cover (medium and coarse sand) and especially winds and swells had a significant effect on sponge community composition and dominant morphologies, with small, mainly encrusting or boring forms replacing large, mainly massive forms, but not shifting towards smaller individuals per species. Number of species was reduced by 50%, along with number of individuals and density and surface coverage. The cushion-shaped *C. californica* fluctuated. It vanished and later reappeared at lower densities.	*Callyspongia californica*	Bay of Mazatlán, Mexico, E Pacific, 4.5 m on average	Po: Dem: Haplosclerida (Haplosclerina): Callispongiidae	Dickinson, 1945	Carballo 2006, Carballo et al. 2008
SEDIMENTATION: *C. foliascens* is a phototrophic sponge with fan- to funnel-shaped morphology that contains cyanobacteria, occurs on the sand flats of the intertidal of the Palm Islands, often with small sand build-ups at the bottom of the funnels that can be incomplete with holes at the bottom to allow drainage of sediments. In an 8 d flow-through tank experiment sponges were subjected to simulated dredging pressures, e.g. daily application of a handful of mud or sand onto the sponges. In *C. foliascens* mud treatment could cause smothering and necrosis. Areas covered with sand turned paler than the original colour, and the sponge often reacted with tissue and mucus sloughing. Tissue under sand had a slightly reduced, under mud a strongly reduced chlorophyll a concentration compared to the controls. Mud effects were thus more serious than sand effects. All experiments were conducted in unfiltered seawater causing some accumulation of fine sediments on the sponges' surfaces. This sediment was removed by tissue or mucus sheath sloughing throughout the experiment in the controls.	*Carteriospongia foliascens*	Palm Islands, central Great Barrier Reef, Coral Sea, Pacific, intertidal, 0.5-1.5 m	Po: Dem: Dictyoceratida: Thorectidae	(Pallas, 1766)	Büttner & Siebler 2013 (incl. Schönberg pers. obs.)
SEDIMENTATION: Study to assess how kelp forests affect benthic suspension feeders underneath. More intense particle deposition in kelp forests was experimentally tested on four benthic organisms, and it reduced growth rates for all of them, but reduced flow rates (serpulid polychaete) and lack of algal turfs under kelp were positive for some (cheilostome bryozoan, myxillid sponge). *C. praeloga* also grew better in shade, and had higher mortality away from kelp.	*Cheilopora praelonga*	San Juan Archipelago, Washington State, NE Pacific, 7-11 m	Br: Gym: Cheilostomatida: Cheiloporinidae	(Hincks, 1884)	Eckman & Duggins 1991
SEDIMENTATION: Natural sediment cover (medium and coarse sand) and especially winds and swells had a significant effect on sponge community composition and dominant morphologies, with small, mainly encrusting or boring forms replacing large, mainly massive forms, but not shifting towards smaller individuals per species. Number of species was reduced by 50%, along with number of individuals and density and surface coverage. The encrusting *C. violacea* appeared at the end of the study period.	*Chelonaplysilla violacea*	Bay of Mazatlán, Mexico, E Pacific, 4.5 m on average	Po: Dem: Dendroceratida: Darwinellidae	(Von Lendenfeld, 1883)	Carballo 2006
BURIAL: Experimental assessment of tolerance of large-bodied sponges to burial in reef sediment, results variable due to unintended sediment shifting by biological activity. Burial caused tissue rot within the first 24 h, with complete disintegration after 3 days.	*Chondrilla caribensis*	Coastal Belize Cay system, Caribbean, 2.5 m	Po: Dem: Chondrosida: Chondrillidae	Rützler et al., 2007	Wulff 2008

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
BURIAL: *C. apion* survived > 15 days of burial in ventilated reefal sediment.	*Cinachyrella apion*	E Gulf of Mexico, Florida, shallow depth (sampled by SCUBA)	Po: Dem: Spirophorida: Tetillidae	(Uliczka, 1929)	Rice 1984 (as *Cinachyra*)
SEDIMENTATION: *C. australiensis* is adapted to perturbed sites and high sedimentation levels. The sponge formed thicker spicules in environments with the largest sediment size, smaller sediments induced flattened growth forms.	*Cinachyrella australiensis*	Darwin Habour, Australia, Timor Sea, shallow depth	Po: Dem: Spirophorida: Tetillidae	(Carter, 1886)	McDonald et al. 2002
BURIAL: Experimental assessment of tolerance of large-bodied sponges to burial in reef sediment, results variable due to unintended sediment shifting by biological activity. Maceration of these dense-tissued sponges to 25-80% of their body.	1 - *Clathria (Thalysias) schoenus* 2 - *Clathria* sp.	coastal Belize Cay system, Caribbean, 2.5 m	Po: Dem: Poecilosclerida (Microcionina): Microcionidae	1 - (De Laubenfels, 1936) 2 – Schmidt, 1862	Wulff 2008
SEDIMENTATION: Natural sediment cover (medium and coarse sand) and especially winds and swells had a significant effect on sponge community composition and dominant morphologies, with small, mainly encrusting or boring forms replacing large, mainly massive forms, but not shifting towards smaller individuals per species. Number of species was reduced by 50%, along with number of individuals and density and surface coverage. *Clathria* sp. persisted throughout the two studies.	*Clathria (Microciona)* sp.	Bay of Mazatlán, Mexico, E Pacific, 4.5 m on average	Po: Dem: Poecilosclerida (Microcionina): Microcionidae	Bowerbank, 1862	Carballo 2006, Carballo et al. 2008 (as *Microciona*)
SEDIMENTATION: Field study. *C.* cf. *celata* was about equally common in areas with high compared to low levels of siltation and occurred on horizontal as well as vertical surfaces and under overhangs.	*Cliona* cf. *celata*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Hadromerida: Clionaidae	Grant, 1826	Carballo et al. 1996
SEDIMENTATION, SCOURING: Study on growth forms of *C.* cf. *celata*. Sponge specimen sizes were largest at the site with the lowest flow, which was interpreted as a consequence of reduced stress by sediments being washed around and in suspension. At sites with higher sedimentation encrusting and endolithic growth forms of *C.* cf. *celata* were more common, also developing fistules and more oscules per unit surface area.	*Cliona* cf. *celata*	S Ireland, E Atlantic, 12-18 m	Po: Dem: Hadromerida: Clionaidae	Grant, 1826	Bell et al. 2002
SEDIMENTATION: Natural sediment cover (medium and coarse sand) and especially winds and swells had a significant effect on sponge community composition and dominant morphologies, with small, mainly encrusting or boring forms replacing large, mainly massive forms, but not shifting towards smaller individuals per species. Number of species was reduced by 50%, along with number of individuals and density and surface coverage. The endolithic, encrusting *Cliona* spp. persisted throughout the two studies.	1 - *Cliona* cf. *euryphylle* (here labelled 'cf', as sp. does not occur in tropical E Pacific, see Van Soest et al. 2014) 2 - *Cliona papillae*	Bay of Mazatlán, Mexico, E Pacific, 4.5 m on average	Po: Dem: Hadromerida: Clionaidae	1 - Topsent, 1888 2 - Carballo et al., 2004	Carballo 2006, Carballo et al. 2008
SEDIMENTATION: *C. orientalis* is a phototrophic sponge containing dinoflagellates with cryptic-endolithic and encrusting morphology, occurring in calcium carbonate materials on the sand flats of the intertidal of the Palm Islands to the shallow subtidal. In nature it often has a light layer of sediments	*Cliona orientalis*	Palm Islands, central Great Barrier Reef, Coral Sea, Pacific,	Po: Dem: Hadromerida: Clionaidae	Thiele, 1900	Büttner & Siebler 2013 (incl. Schönberg pers. obs.)

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
on the surface that it can compact to aggregations. In an 8 d flow-through tank experiment sponges were subjected to simulated dredging pressures, e.g. daily application of a handful of mud or sand onto the sponges. In *C. orientalis* mud cover caused widespread loss of symbionts, smothering and beginning necrosis. Areas covered with sand turned slightly paler than the original colour or displayed some patchy symbiont loss, and the sponge often reacted with compacting grains with the aid of mucus. No difference in chlorophyll a concentrations could be found between controls and under sand, but under mud concentrations were lower. Mud effects were thus more serious than sand effects. All this was performed in unfiltered seawater, and active cleaning from light natural sediment cover with the aid of mucus was observed in control cores throughout the experiment.		shallow subtidal, 1-2 m			
SEDIMENTATION: 1 - *C. rhodensis* requires strong flow, it tolerates sedimentation <2 g m^{-2}. 2 - *C. rhodensis* occurred only at sites with low levels of siltation, but was comparatively rare.	*Cliona rhodensis*	Algeciras Bay, S Spain, Strait of Gibraltar, W Mediterranean, 5-30 m	Po: Dem: Hadromerida: Clionaidae	Rützler & Bromley, 1981	1 - Carballo et al. 1994, 2 - Carballo et al. 1996
SEDIMENTATION: *C. schmidti* is a clearwater species susceptible to sedimentation, and it tolerates a suspension of POM <1g m^{-2}. It occurs on vertical or inclined surfaces, unless sedimentation is very low.	*Cliona schmidti*	Algeciras Bay, Straits of Gibraltar, 1-4 m	Po: Dem: Hadromerida: Clionaidae	(Ridley, 1881)	Pang 1973, Carballo et al. 1994, Macdonald & Perry 2003
SCOURING: The club-shaped *C. varians* with broad base withstands hurricanes and prevails in habitats with coarse sediment and strong waves.	*Cliona varians*	Florida Keys, Gulf of Mexico, 2.5-2.7 m	Po: Dem: Hadromerida: Clionaidae	Duchassaing & Michelotti, 1864	Stevely et al. 2011
SEDIMENTATION: *C. vermifera* appears to be a clearwater species susceptible to sedimentation.	*Cliona vermifera*	Algeciras Bay, Straits of Gibraltar, 1-4 m	Po: Dem: Hadromerida: Clionaidae	Hancock, 1867	Carballo et al. 1994
SEDIMENTATION: 1 – *C. viridis* withstood sedimentation >7 g m^{-2}, and the larger, encrusting growth form was more common in turbid waters with high sedimentation levels. 2 – Field study. *C. viridis* was about equally common in areas with high compared to low levels of siltation and occurred equally commonly on horizontal and vertical surfaces and under overhangs.	*Cliona viridis*	Algeciras Bay, S Spain, Strait of Gibraltar, W Mediterranean, 5-30 m	Po: Dem: Hadromerida: Clionaidae	(Schmidt, 1862)	1 – Carballo et al. 1994, 2 – Carballo et al. 1996
SEDIMENTATION: Field study. *C. crambe* was less common at sites with high compared to low levels of siltation and mostly occurred on vertical surfaces and under overhangs, rarely on horizontal surfaces.	*Crambe crambe*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Poecilosclerida (Myxillina): Crambeidae	(Schmidt, 1862)	Carballo et al. 1996
SEDIMENTATION: Field study. *C. elegans* was more common in areas with high compared to low levels of siltation and occurred on horizontal and vertical surfaces.	*Crella (Crella) elegans*	Algeciras Bay, S Spain,	Po: Dem: Poecilosclerida (Myxillina): Crellidae	(Schmidt, 1862)	Carballo et al. 1996

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
		W Mediterranean, 5-30 m			
SEDIMENTATION: *Cymbastela* sp. was green *in situ*, flat to flat to shallow cup-shaped phototrophic sponge containing cyanobacteria, and it occurred in very shallow depths on sandflats, where it can be partially covered with sand. In a 8 d flow-through tank experiment sponges were subjected to simulated dredging pressures, e.g. daily application of a handful of mud or sand onto the sponges. In *Cymbastela* sp. mud typically accumulated most heavily in the central dip, where it caused smothering and necrosis in 2 out of 5 specimens. Areas covered with sand did not appear to be affected. Mud effects appeared more serious than sand effects, but chlorophyll a concentrations under the sediments were not clearly different from the controls. Control sponges changed from the original rich green to dark brown-purple in the tanks just like the treatment sponges. When a piece of *Neopetrosia exigua* fell onto one *Cymbastela* sp. and was not removed, the loose piece was enclosed in mucus, died and decomposed.	*Cymbastela coralliophila*	Palm Islands, central Great Barrier Reef, Coral Sea, Pacific, intertidal to shallow subtidal, 0.5-1 m	Po: Dem: Halichondrida: Axinellidae	Hooper & Bergquist, 1992	Büttner & Siebler 2013 (incl. Schönberg pers. obs.)
SEDIMENTATION: Natural sediment cover (medium and coarse sand) and especially winds and swells had a significant effect on sponge community composition and dominant morphologies, with small, mainly encrusting or boring forms replacing large, mainly massive forms, but not shifting towards smaller individuals per species. Number of species was reduced by 50%, along with number of individuals and density and surface coverage. The encrusting *D. incrustans* appeared at the end of the study period in low densities.	*Desmanthus incrustans*	Bay of Mazatlán, Mexico, E Pacific, 4.5 m on average	Po: Dem: 'Lithistida': Desmanthidae	(Topsent, 1889)	Carballo 2006
SEDIMENTATION: Sponge densities, coverage, growth and survival were highest with lowest sedimentation rate and highest substrate heterogeneity. The bathymetric distribution of *D. anchorata* showed an opposite trend to the level of sedimentation.	*Desmapsamma anchorata*	San Esteban National Park, Venezuela, Caribbean, 1-18 m	Po: Dem: Poecilosclerida (Myxillina): Desmacididae	(Carter, 1882)	Núñez Flores et al. 2010
SEDIMENTATION: Field study. *D. incisa* only occurred at one site with low levels of siltation, and under overhangs.	*Dictyonella incisa*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Halichondrida: Dictyonellidae	(Schmidt, 1880)	Carballo et al. 1996
SEDIMENTATION: Field study. *D. fragilis* was about equally common in areas with high compared to low levels of siltation and occurred on horizontal as well as on vertical surfaces.	*Dysidea fragilis*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Dictyoceratida: Dysideidae	(Montagu, 1818)	Carballo et al. 1996
SEDIMENTATION: Field study. *D. tupha* was more common in areas with high siltation, but was overall rare. However, as it mainly occurred on horizontal surfaces, sedimentation tolerance appears likely.	*Dysidea tupha*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Dictyoceratida: Dysideidae	(Martens, 1824)	Carballo et al. 1996

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
SEDIMENTATION: This species occurs in areas with mud or high levels of sedimentation.	*Echinodictyum conulosum*	NW Australia to Great Barrier Reef, Indo-Pacific, 8-84 m	Po: Dem: Poecilosclerida (Microcionina): Raspailiidae	Kieschnick, 1900	Hooper 1991
SEDIMENTATION: This species occurs in areas with high levels of sedimentation.	*Endectyon (Endectyon) fructicosum* var. *aruense*	Aru Island, Arafura Sea, 8-18 m	Po: Dem: Poecilosclerida (Microcionina): Raspailiidae	Hentschel, 1912	Hooper 1991
SEDIMENTATION: Natural sediment cover (medium and coarse sand) and especially winds and swells had a significant effect on sponge community composition and dominant morphologies, with small, mainly encrusting or boring forms replacing large, mainly massive forms, but not shifting towards smaller individuals per species. Number of species was reduced by 50%, along with number of individuals and density and surface coverage. The massive *H. caerulea* vanished and later reappeared at lower densities, or fluctuated.	*Haliclona (Soestella) caerulea*	Bay of Mazatlán, Mexico, E Pacific, 4.5 m on average	Po: Dem: Haplosclerida (Haplosclerina): Chalinidae	(Hechtel, 1965)	Carballo 2006, Carballo et al. 2008
SEDIMENTATION: Field study. *H. cinerea* commonly occurred in areas with high siltation, but commonly occurred in cryptic habitats (caves, crevices, under rocks), under overhangs or on vertical surfaces, which may reduce the sedimentation stress.	*Haliclona (Reniera) cinerea*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Haplosclerida (Haplosclerina): Chalinidae	(Grant, 1826)	Carballo et al. 1996
SEDIMENTATION: Field study. The two *Haliclona* spp. only occurred at sites with low levels of sedimentation and under overhangs.	1 - *Haliclona (Haliclona) fulva* 1 - *Haliclona (Soestella) mucosa*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Haplosclerida (Haplosclerina): Chalinidae	1 - (Topsent, 1893) 2 - (Griessinger, 1971)	Carballo et al. 1996
SEDIMENTATION: Natural sediment cover (medium and coarse sand) and especially winds and swells had a significant effect on sponge community composition and dominant morphologies, with small, mainly encrusting or boring forms replacing large, mainly massive forms, but not shifting towards smaller individuals per species. Number of species was reduced by 50%, along with number of individuals and density and surface coverage. *A. turquoisia* spp. vanished and later reappeared patchily and at lower densities, or fluctuated.	*Haliclona turquoisia*	Bay of Mazatlán, Mexico, E Pacific, 4.5 m on average	Po: Dem: Haplosclerida (Haplosclerina): Chalinidae	(De Laubenfels, 1954)	Carballo 2006 (as Adocia) , Carballo et al. 2008
SEDIMENTATION: Sediment layers established naturally on experimental blocks and became about 3-5 mm thick, consisting of grains of variable size (0.5-225 µm). *Halisarca* sp. reacted to sediment cover by rearranging its growth form into clusters of wart-like protruberances, thus keeping its surface clean. Longer exposure to sedimentation could result in mortality, but some specimens survived this, grew and incorporated sediments ('packed'), while other species shrank or died.	*Halisarca* sp.	Fanning Island, central Pacific, 0.2-1.5 m	Po: Dem: Chondrosida: Halisarcidae	Johnston, 1842	Bakus 1968
SEDIMENTATION: Field study. *H. coriacea* commonly occurred in areas with high siltation. This species occurred on horizontal as well as on vertical surfaces, suggesting that it is tolerant against sedimentation stress.	*Hymedesmia (Stylopus) coriacea*	Algeciras Bay, S Spain, W	Po: Dem: Poecilosclerida (Myxillina): Hymedesmiidae	(Fristedt, 1885)	Carballo et al. 1996 (as *Stylopus dujardini*)

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
		Mediterranean, 5-30 m			
SEDIMENTATION: Field study. *H. pansa* did not occur at sites with high siltation and grew under stones or vertical surfaces.	*Hymedesmia (Hymedesmia) pansa*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Poecilosclerida (Myxillina): Hymedesmiidae	Bowebank, 1882	Carballo et al. 1996
SEDIMENTATION: Field study. *H. senegalensis* commonly occurred in areas with high siltation.	*Hymedesmia (Hymedesmia) senegalensis*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Poecilosclerida (Myxillina): Hymedesmiidae	Lévi, 1956	Carballo et al. 1996
SEDIMENTATION: Field study. *H. versicolor* was more common in areas with high siltation, but was overall rare and only occurred under overhangs, reducing sedimentation stress.	*Hymedesmia (Hymedesmia) versicolor*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Poecilosclerida (Myxillina): Hymedesmiidae	(Topsent, 1893)	Carballo et al. 1996
SEDIMENTATION: Field observations. This encrusting sponge occurs at high sedimentation sites, on inclined and vertical surfaces, and can tolerate sediment crusts.	*Hymeraphia stellifera*	S Ireland, Atlantic, 0-30 m	Po: Dem: Poecilosclerida (Microcionina): Raspailiidae	Bowerbank, 1864	Bell & Barnes 2000a, 2000b
BURIAL: Experimental assessment of tolerance of large-bodied sponges to burial in reef sediment, results variable due to unintended sediment shifting by biological activity. Shallow burial resulted in sealing of surface perforations followed by complete recovery, deep burial caused maceration.	*Hyrtios proteus*	coastal Belize Cay system, Caribbean, 2.5 m	Po: Dem: Dictyoceratida: Thorectidae	Duchassaing & Michelotti, 1864	Wulff 2008
SCOURING, BURIAL: The abundance of the small, broad-based *H. proteus* with low profile and strong attachment decreased to scouring and burial caused by a hurricane. It did not recover during the study period.	*Hyrtios proteus*	Florida Keys, Gulf of Mexico, 2.5-2.7 m	Po: Dem: Dictyoceratida: Thorectidae	Duchassaing & Michelotti, 1864	Stevely et al. 2011
BURIAL: Three different molluscs were tested in simulated dredge spoil burial experiments in tanks. *I. obsoleta* regained the surface in a short period of time and was more successful in silt-clay than in sand. *I. obsoleta* naturally burrows diurnally or seasonally into soft sediments.	*Ilyanassa obsoleta*	Cape Henlopen, Delaware, Atlantic, depth not stated	Mo: Gas: Neogastropoda: Nassariidae	(Say, 1822)	Maurer et al. 1980-81
BURIAL: Field settlement experiment. Presence of sand on settlement substrates reduced recruitment by 50%. But when transplanted, juvenile specimens buried in sand grew faster than unburied ones, which may increase chances of survival, bringing polyps out of the sand. Recruitment was highest and least variable on clean natural limestone patches.	*Leptogorgia virgulata*	Florida, USA, Gulf of Mexico, 1.5 m	Cn: Ant: Alcyonacea: Gorgoniidae	(De Lamarck, 1815)	Gotelli 1988
BURIAL: Field observations and experiments. Recruitment of *L. virgulata* was reduced by 50% on sand-buried stones compared to stones raised above sand, but buried gorgonians grew better than exposed ones, an effect that may enhance survival.	*Leptogorgia virgulata*	Florida, USA, W Atlantic, shallow	Cn: Ant: Alcyonacea: Gorgoniidae	(De Lamarck, 1815)	Airoldi 2003 (as *A. paessleri*)

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
SEDIMENTATION: Experimental assessment of tolerance for lower or higher salinity and sedimentation (autoclaved, dried; mean TSS values for each treatment were 66.67 (0 mg L^{-1}), 58 33 (100 mg L^{-1}), 64.17 (1000 mg L^{-1}), 334.17 (10,000 mg L^{-1}), and 1074.56 (20,000 mg L^{-1}), kept in suspension). More extreme salinities caused increased tissue loss. Some minor tissue loss was observed in TSS treatments 1000 and higher, and polyp activity decreased at most extreme salinities and TSS levels. Authors also provided overview over present knowledge in this context.	*Leptogorgia virgulata*	Corpus Christi, Texas, USA, Gulf of Mexico, 3 m	Cn: Ant: Alcyonacea: Gorgoniidae	(De Lamarck, 1815)	Williamson et al. 2011
SEDIMENTATION: Sponge communities were compared between a site with high loads of fine, slow settling, and a site with coarser, fast-settling sediments. *L. granularis* was covered with a fine layer of silt, the most conspicuous species at the site with fine sediments and absent from the site with the coarser sediments and thus obviously tolerant of siltation.	*Liosina granularis*	Sulawesi, Indonesia, Banda Sea, 0-15 m	Po: Dem: Halichondrida: Dictyonellidae	Kelly-Borges & Bergquist, 1988	Bell & Smith 2004
BURIAL: Experimental assessment of tolerance of large-bodied sponges to burial in reef sediment, results variable due to unintended sediment shifting by biological activity. Shallow burial resulted in sealing of surface perforations followed by complete recovery, deep burial caused maceration.	*Lissodendoryx (Lissodendoryx) colombiensis*	coastal Belize Cay system, Caribbean, 2.5 m	Po: Dem: Poecilosclerida (Myxillina): Coelospaeridae	Zea & Van Soest, 1986	Wulff 2008
SEDIMENTATION: Study to assess how kelp forests affect benthic suspension feeders underneath. More intense particle deposition in kelp forests was experimentally tested on four benthic organisms, and it reduced growth rates for all of them, but reduced flow rates (serpulid polychaete) and lack of algal turfs under kelp were positive for some (cheilostome bryozoan, myxillid sponge). With the exception of one site *M. membranacea* grew much better under kelp.	*Membranipora membranacea*	San Juan Archipelago, Washington State, NE Pacific, 7-11 m	Br: Gym: Cheilostomatida: Membraniporidae	(Linnaeus, 1767)	Eckman & Duggins 1991
BURIAL: Three different molluscs were tested in simulated dredge spoil burial experiments in tanks. The deeper *M. mercenaria* was buried the faster it was migrating upwards and appeared to be able to regain the surface in a short period of time. In colder temperatures and deeper burial depths and longer burial times increased mortality occurred, and some clams died even within 4 days of burial.	*Mercenaria mercenaria*	Cape Henlopen, Delaware, Atlantic, depth not stated	Mo: Biv: Veneroida: Veneridae	(Linnaeus, 1758)	Maurer et al. 1980-81
SEDIMENTATION: Effects of 10 different natural sediment types were investigated experimentally by characterising 19 different sediment properties. Grain size, nutrient content and microbial activity were key factors. Highest stress levels resulted from short-term exposure (20-44 h) to nutrient-rich silts, no stress from sands or pure silt. Sediment layers in natural environments caused bleaching. Recovery was not yet complete after 4 days. Cleaning mechanisms (e.g. mucus) were more efficient with sands.	*Montipora peltiformis*	Great Barrier Reef, Australia, Pacific, 0-10 m	Cn: Ant: Scleractinia: Acroporidae	Bernard, 1897	Weber et al. 2006

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
SEDIMENTATION: Natural sediment cover (medium and coarse sand) and especially winds and swells had a significant effect on sponge community composition and dominant morphologies, with small, mainly encrusting or boring forms replacing large, mainly massive forms, but not shifting towards smaller individuals per species. Number of species was reduced by 50%, along with number of individuals and density and surface coverage. Occurrences of *Mycale* aff. *parishii* fluctuated, while the other 2 massive to massive-branching spp. were comparatively persistent, but could vanish and later reappear at lower densities.	1 - *Mycale (Carmia) cecilia* 2 - *Mycale (Carmia) magnirhaphidifera* 3 - *Mycale* aff. *parishii*	Bay of Mazatlán, Mexico, E Pacific, 4.5 m on average	1-2 - Po: Dem: Poecilosclerida (Mycalina): Mycalidae	1 - De Laubenfels, 1936 2 - Van Soest, 1984 3 - (Bowerbank, 1875)	Carballo 2006, Carballo et al. 2008
SEDIMENTATION: Field study. *M. micranthoxea* commonly occurred in areas with high siltation, but occurs on vertical surfaces, which may reduce the amount of sediments building up on the surface.	*Mycale (Carmia) micranthoxea*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Poecilosclerida (Mycalina): Mycalidae	Buizer & Van Soest, 1977	Carballo et al. 1996
SEDIMENTATION: Study to assess how kelp forests affect benthic suspension feeders underneath. More intense particle deposition in kelp forests was experimentally tested on four benthic organisms, and it reduced growth rates for all of them, but reduced flow rates (serpulid polychaete) and lack of algal turfs under kelp were positive for some (cheilostome bryozoan, myxillid sponge). Of the non-experimental species *M. edulis* grew faster *in situ* when in kelp forests.	*Mytilus edulis*	San Juan Archipelago, Washington State, NE Pacific, 7-11 m	Mo: Biv: Mytiloida: Mytilidae	Linnaeus, 1758	Eckman & Duggins 1991
SEDIMENTATION: Study to assess how kelp forests affect benthic suspension feeders underneath. More intense particle deposition in kelp forests was experimentally tested on four benthic organisms, and it reduced growth rates for all of them, but reduced flow rates (serpulid polychaete) and lack of algal turfs under kelp were positive for some (cheilostome bryozoan, myxillid sponge).	*Myxilla (Myxilla) incrustans*	San Juan Archipelago, Washington State, NE Pacific, 7-11 m	Po: Dem: Poecilosclerida (Myxillina): Myxillidae	(Johnston, 1842)	Eckman & Duggins 1991
SEDIMENTATION: *N. exigua* is a brittle, phototrophic sponge containing cyanobacteria, and has a basally encrusting and apically erect-branching morphology. In an 8 d flow-through tank experiment sponges were subjected to simulated dredging pressures, e.g. daily application of a handful of mud or sand onto the sponges. In *N. exigua* mud treatment caused paler colouration where mud settled, but leaving turret-like branches unaffected. Areas covered with sand also turned paler than the original colour, and the sponge often reacted with tissue and mucus sloughing, compacting and removing the sediments. Tissue under sand had a strongly reduced, under mud a slightly reduced chlorophyll a concentration compared to the controls. All experiments were conducted in unfiltered seawater that caused some accumulation of fine sediments on the sponges' surfaces. The control specimens removed this by compacting this with mucus.	*Neopetrosia exigua*	Palm Islands, central Great Barrier Reef, Coral Sea, Pacific, shallow subtidal, 1-2 m	Po: Dem: Haplosclerida (Petrosina): Petrosiidae	(Kirkpatrick, 1900)	Büttner & Siebler 2013 (incl. Schönberg pers. obs.)

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
BURIAL: Three different molluscs were tested in simulated dredge spoil burial experiments in tanks. *N. proxima* regained the surface in a short period of time when buried shallow, but could not overcome burial in 32 cm. Mortalities increased with burial depth and burial time.	*Nucula proxima*	Cape Henlopen, Delaware, Atlantic, depth not stated	Mo: Biv: Nuculida: Nuculidae	Say, 1822	Maurer et al. 1980-81
SEDIMENTATION: Experimental study on sedimentation effects on *O. arbuscula*. Mortality of coral recruits was positively correlated to sedimentation and branched juveniles survived better than flat morphologies.	*Oculina arbuscula*	South Atlantic Bight, Georgia, USA, Atlantic, 18-20 m	Cn: Ant: Scleractinia: Oculinidae	Agassiz, 1864	Divine 2011
SEDIMENTATION: Field study. *O. lobularis* was more common in areas with high siltation, but occurred on vertical surfaces and under overhangs, potentially reducing sedimentation stress.	*Oscarella lobularis*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Hom: Homosclerophorida: Oscarellidae	(Schmidt, 1862)	Carballo et al. 1996
SEDIMENTATION: *P. corrugata* is adapted to perturbed sites and high sedimentation levels, and has a bristly surface that catches sediments and keeps pores free.	*Paratetilla corrugata*	Spermonde Archipelago, Indonesia, 3-15 m	Po: Dem: Spirophorida: Tetillidae	Dendy, 1922	De Voogd & Cleary 2007 (as *P. bacca*)
SEDIMENTATION: *Paratetilla* sp. is a heterotrophic globular sponge with a natural crust of sediments and algae, and it occurs in very shallow depths on sandflats. In an 8 d flow-through tank experiment sponges were subjected to simulated dredging pressures, e.g. daily application of a handful of mud or sand onto the sponges. In *Paratetilla* sp. mud and sand treatments had no visible effect at all. Most sediment slid off and what remained on top of the sponge did not cause any change. The control sponges did not show any signs of tank effects.	*Paratetilla* sp.	Palm Islands, central Great Barrier Reef, Coral Sea, Pacific, intertidal to shallow subtidal, 0.5-1 m	Po: Dem: Spirophorida: Tetillidae	Dendy, 1905	Büttner & Siebler 2013 (incl. Schönberg pers. obs.)
SEDIMENTATION: Field observations. This encrusting sponge occurs at high sedimentation sites, on inclined and vertical surfaces, and can tolerate sediment crusts.	*Paratimea constellata*	S Ireland, Atlantic, 0-30 m	Po: Dem: Hadromerida, Hemiasterellidae	Topsent, 1893	Bell & Barnes 2000a, 2000b
SEDIMENTATION: Field study. *P. fictitus* was equally common in areas with high and low levels of siltation, occurring on horizontal and vertical surfaces and under overhangs.	*Phorbas fictitus*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Poecilosclerida: Hymedesmiidae	(Bowerbank, 1866)	Carballo et al. 1996
SEDIMENTATION: *P.* cf. *vastifica* can tolerate silty environments as long as there is strong flow, otherwise requires sedimentation <2.5 g m^{-2}.	*Pione* cf. *vastifica*	Algeciras Bay, Straits of Gibraltar, 3-10 m	Po: Dem: Hadromerida: Clionaidae	(Hancock, 1849)	Carballo et al. 1994 (as *Cliona*)
SEDIMENTATION: Field study. *P.* cf. *vastifica* only occurred at sites with low levels of siltation, on vertical as well as on horizontal surfaces and under overhangs.	*Pione* cf. *vastifica*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Hadromerida, Clionaidae	Hancock, 1849	Carballo et al. 1996 (as *Cliona*)

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
SEDIMENTATION: Natural sediment cover (medium and coarse sand) and especially winds and swells had a significant effect on sponge community composition and dominant morphologies, with small, mainly encrusting or boring forms replacing large, mainly massive forms, but not shifting towards smaller individuals per species. Number of species was reduced by 50%, along with number of individuals and density and surface coverage. The encrusting *P. carinata* appeared during the study period in low densities.	*Placospongia carinata*	Bay of Mazatlán, Mexico, E Pacific, 4.5 m on average	Po: Dem: Hadromerida: Placospongiidae	(Bowebank, 1858)	Carballo 2006
SEDIMENTATION: Field observations. The sponges' 'surfaces are covered in a thick layer of sediment', with exhalant papillae keeping above the sediment, preventing smothering.	*Polymastia* sp.	S Ireland, Atlantic, 0-30 m	Po: Dem: Hadromerida: Polymastiidae	Bowerbank, 1864	Bell & Barnes 2000a, 2000b
SEDIMENTATION: Study to assess how kelp forests affect benthic suspension feeders underneath. More intense particle deposition in kelp forests was experimentally tested on four benthic organisms, and it reduced growth rates for all of them, but reduced flow rates (serpulid polychaete) and lack of algal turfs under kelp were positive for some (cheilostome bryozoan, myxillid sponge). *P. occidentalis* still grew faster *in situ* when in kelp forests and suffered less mortality.	*Pseudochitinopoma occidentalis*	San Juan Archipelago, Washington State, NE Pacific, 7-11 m	An: Pol: Sabellida: Serpulidae	(Bush, 1905)	Eckman & Duggins 1991
SEDIMENTATION: This species occurs intertidally on reefs with muddy-sandy substrate and can tolerate extremely high levels of sedimentation.	*Raspailia (Clathriodendron) darwinensis*	Darwin, N Australia and NW Shelf, Timor Sea, intertidal to 11 m	Po: Dem: Poecilosclerida (Microcionina): Raspailiidae	Hooper, 1991	Hooper 1991
SEDIMENTATION: Tank experiment with clay: 3.1 µm grain size and 35-64 mg L^{-1}, 4 d caused partial necrosis. Correspondingly, *R. odorabile* is more common offshore, where fewer terrestrial sediments occur.	*Rhopaloeides odorabile*	central Great Barrier Reef, Pacific, 9 m	Po: Dem: Dictyoceratida: Spongiidae	Thompson et al., 1987	Bannister et al. 2012
SEDIMENTATION: Field study. *S. fasciculatus* was about equally common or slightly less common in areas with high compared to low levels of siltation and occurred on horizontal as well as on vertical surfaces.	*Sarcotragus fasciculatus*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Dictyoceratida: Irciniidae	(Pallas, 1766)	Carballo et al. 1996 (as *Ircinia*)
SEDIMENTATION: Field study. The two *Sarcotragus* spp. did not occur at sites with high siltation and mostly grew on vertical surfaces and under overhangs.	1 - *Sarcotragus foetidus* 2 - *Sarcotragus spinosulus*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Dictyoceratida: Irciniidae	1 & 2 - Schmidt, 1862	Carballo et al. 1996 (1 as *Sarcotragus muscarum*)
SEDIMENTATION: Field study. *S. lophyropoda* did not occur at sites with high siltation and mostly grew on vertical surfaces and under overhangs.	*Scopalina lophyropoda*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Halichondrida: Scopalinidae	Schmidt, 1862	Carballo et al. 1996

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
SEDIMENTATION and SCOURING: The massive, broad-based *S. vesparium* withstands hurricanes, tolerates strong waves and sedimentation.	*Spheciospongia vesparium*	1 - Cuba, Caribbean, shallow, 2 - Florida Keys, Gulf of Mexico, 2.5-2.7 m	Po: Dem: Hadromerida: Clionaidae	(De Lamarck, 1815)	1 - Alcolado 2007 (as *Cliona*), 2 - Stevely et al. 2011
SEDIMENTATION: Natural sediment cover (medium and coarse sand) and especially winds and swells had a significant effect on sponge community composition and dominant morphologies, with small, mainly encrusting or boring forms replacing large, mainly massive forms, but not shifting towards smaller individuals per species. Number of species was reduced by 50%, along with number of individuals and density and surface coverage. The encrusting *S. decumbens* persisted throughout the study, but disappeared end of 2004.	*Spirastrella decumbens*	Bay of Mazatlán, Mexico, E Pacific, 4.5 m on average	Po: Dem: Hadromerida: Spirastrellidae	Ridley, 1884	Carballo 2006, Carballo et al. 2008
SEDIMENTATION: Field study. The three *Spongia* spp. were less common at sites with high compared to low levels of siltation, but did not show a clear preference for substrate inclination.	I - *Spongia (Spongia) agaricina* 2 - *Spongia (Spongia) officinalis* 3 - *Spongia (Spongia) virgultosa*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Dictyoceratida: Spongiidae	1 - Pallas, 1766 2 - Linnaeus, 1759 3 - (Schmidt, 1868)	Carballo et al. 1996
SEDIMENTATION: Field study. *S. domuncula* was about equally common in areas with high compared to low levels of siltation and occurred mainly epibiotic.	*Suberites domuncula*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Hadromerida: Suberitidae	(Olivi, 1792)	Carballo et al. 1996
SEDIMENTATION, SCOURING: *T. crypta* can tolerate strong sedimentation and effects of storms and is usually covered with sediments.	*Tectitethya crypta*	1 – Cuba, Caribbean, shallow, 2 – Florida Keys, Gulf of Mexico, 2.5-2.7 m	Po: Dem: Hadromerida: Tethyidae	(De Laubenfels, 1949)	1 – Alcolado & Gotera 1985, Alcolado 2007, 2 – Stevely et al. 2011
BURIAL: Experimental assessment of tolerance of large-bodied sponges to burial in reef sediment, results variable due to unintended sediment shifting by biological activity. Maceration of this dense-tissued sponge to 25-80% of the body.	*Tedania (Tedania) klausi*	coastal Belize Cay system, Caribbean, 2.5 m	Po: Dem: Poecilosclerida (Myxillina): Tedaniidae	Wulff, 2006	Wulff 2008
SEDIMENTATION: Natural sediment cover (medium and coarse sand) and especially winds and swells had a significant effect on sponge community composition and dominant morphologies, with small, mainly encrusting or boring forms replacing large, mainly massive forms, but not shifting towards smaller individuals per species. Number of species was reduced by 50%, along with number of individuals and density and surface coverage. The massive (with vertical projections) *Tedania* sp. vanished, but later re-occurred.	*Tedania* sp.	Bay of Mazatlán, Mexico, E Pacific, 4.5 m on average	Po: Dem: Poecilosclerida (Myxillina): Tedaniidae	Gray, 1867	Carballo 2006, Carballo et al. 2008

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
SEDIMENTATION: Field study. *T. fugax* was equally or slightly more common in areas with high compared to low levels of siltation, occurring on horizontal and vertical surfaces and under stones.	*Terpios fugax*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Hadromerida: Suberitidae	Duchassaing & Michelotti, 1864	Carballo et al. 1996
SEDIMENTATION: Field study. *T. aurantium* only occurred at sites with low levels of siltation and under overhangs or in small caves and crevices, suggesting a low threshold for sedimentation stress.	*Tethya aurantium*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Hadromerida: Tethyidae	(Pallas, 1766)	Carballo et al. 1996
SEDIMENTATION: Field study. *T. unistellata* only occurred at sites with low levels of siltation and under stones or overhangs, suggesting a low threshold for sedimentation stress.	*Timea unistellata*	Algeciras Bay, S Spain, W Mediterranean, 5-30 m	Po: Dem: Hadromerida, Timeidae	(Topsent, 1892)	Carballo et al. 1996
SEDIMENTATION: Hurricane Gilbert impact study. Sponges suffered some damage by being covered with a thin layer of sand, causing smothering. Necroses formed that were 'peeled off', or entire potions were rejected, but leading to healing and recovery.	reef sponges	Cozumel, Yucatan, Mexico, W Caribbean, 5-25 m	Po	Grant, 1836	Fenner 1991
BURIAL: Deepwater surveys showed that trawling disturbed the seabed. Discarded gear and marks were observed. In core samples buried sponges that had died and rotted were found in black, foul sediment (fans). Other sponges may have been detached from the firm substrate base (spicule mats) but survived on the surface of the sediment (spirophorids?)	sponges	N and W of Scotland, Atlantic Margin, 260-1250 m	Po	Grant, 1836	Bett 2000
SEDIMENTATION and possibly SCOURING: Long-term field study (6 years). Inter-annual variation was explained with wind and sediment deposition (60% of variance explained). Sponge diversity decreased with sedimentation (88% correlation with wind speed, 69% with sediment deposition).	sponges	Bay of Mazatlán, Mexico, E Pacific, mean depth of 5 m	Po	Grant, 1836	Carballo et al. 2008
SEDIMENTATION: Sponge community compositions, associations and interactions between sponges were different at a clear-water compared to a high-sedimentation site with deposition rates of 20.16 ± 1.76 g day m^{-2} d^{-1} (fishing- and mining-degraded reef, light-limited, experiences high levels of fine sediments), with percent cover and number of interactions being reduced. Species found at sedimented site were comparatively rare.	sponges	Wakatobi National Marine Park, SE Sulawesi, Indonesia, Indo-Pacific, 10-15 m	Po	Grant, 1863	Bell et al. 2010
SEDIMENTATION: Sponge densities, coverage, growth and survival were highest with lowest sedimentation rate and highest substrate heterogeneity.	sponges	San Esteban National Park, Venezuela, Caribbean, 1-18 m	Po	Grant, 1863	Núñez Flores et al. 2010
SEDIMENTATION: Sediment layers established naturally on experimental blocks and became about 3-5 mm thick, consisting of grains of variable size (0.5-225 µm). Most observed species shrank or died.	reef benthos on settlement plates: 1 - sponges	Fanning Island, central Pacific, 0.2-1.5 m	1 - Po 2 - Ch: Asc	1 - Grant, 1836 2 - Nielsen, 1995	Bakus 1968

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
	2 - ascidians				
BURIAL, ANOXIA: Burial by dredging spoil will cause mortality in benthic organisms, an effect that is aggravated by anoxia. Some bivalves and polychaetes can build up an oxygen debt or reduce their metabolism so that they can dig themselves out of > 20 cm of sediments without suffocating.	benthos, e.g. 1 - oysters 2 - mussels 3 - barnacles	not stated	1 - Mo: Biv: Ostreoida 2 - Mo: Biv: Mytiloida 3 - Ar: Max: Sessilia: Balanomorpha	1 & 2 - Férussac, 1822 3 - Pilsbry, 1916	Morton 1977
SEDIMENTATION: Reef surveys were conducted with AGGRA methods, showing that natural sedimentation did not significantly influence rates of mortality of reef benthos, especially corals.	reef benthos, with focus on hard corals	Cuba, Caribbean, 2-20 m	Cn: Ant: Scleractinia	Bourne, 1900	Caballero et al. 2007
SEDIMENTATION: '…lower limits of distribution of some species (e.g. *Mytilus edulis, Semibalanus balanoides* (as *Balanus balanoides*), and *Porphyra umbilicalis*) appeared to be related to the historical sequences of sand inundations in the area, as they approximated the zone of highest summer elevations of sand…'	filter feeders, e.g. 1 - *Mytilus edulis,* 2 - *Semibalanus balanoides*	New Hampshire, USA, W Atlantic, intertidal	1 - Mo: Biv: Mytiloida: Mytilidae 2 - Ar: Max: Sessilia: Archaeobalanidae	1 - Linnaeus, 1758 2 - (Linnaeus, 1757)	Airoldi et al. 2003
BURIAL: *In situ* manipulative experiment. Sediment deposition resulted in burial and catastrophic mortality due to smothering.	various benthic biota, mostly seaweeds, 3 molluscs, 1 urchin (details for invertebrates, see above)	Mazatlán Bay, S Gulf of California, intertidal, swell area	-	-	Yáñyez et al. 2008
SCOURING: *In situ* observations at Sylt Island, North Sea. Macrobenthos - especially juveniles - declined in species diversity and abundance with increased sediment mobility and experimentally increased sediment erosion resembling effects during a storm reduced communities.	infaunal invertebrates: mostly polychaete worms, some oligochaetes and one bivalve, one snail	Sylt Island, North Sea, intertidal sandflat	-	-	Zühlke & Reise 1994
BURIAL: Mussels and barnacles suffered severe mortality from burial in sand. '…both partial and total burial by sediments reduced survival of mussels. In particular, *M. californianus* was not able to survive total burial longer than 2 months, and in most cases mortality occurred within 12-18 days.'	barnacles and mussels, e.g. *Mytilus californianus*	review paper	Mo: Biv: Mytiloida: Mytilidae	Conrad, 1837	Airoldi 2003
BURIAL: 'Burial by sediments was accounted to be the major cause of mortality of oysters and other sessile organisms in subtidal oyster reefs.'	molluscs	review paper	Mo: Biv: Ostreoida	Férussac, 1822	Airoldi 2003
SCOURING: '…recurrent abrasion caused by shifting sediments was severe enough to remove most sessile organisms from local intertidal areas ranging in size from a few square metres to hectares.'	benthos	review paper	benthos	-	Airoldi 2003
SEDIMENTATION: In a decreasing number of studies sedimentation was thought to be responsible for: changes in species composition and contribution, inhibition of settlement and recruitment, mortality/decline of species, prevalence of specific morphologies or life history traits, reduced diversity/monopolisation of space, changed interaction/association between	rocky coast organisms or assemblages	Review paper	-	-	Airoldi 2003

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
species, inhibition of growth or fertility, no or positive effects, changes in morphology.					

Appendix 7. Observations on responses of filter feeders to physical damage as likely to occur during dredging, susceptibilities, and recovery potential. For abbreviations see top of Appendix 1 pg 38.

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
RECOVERY POTENTIAL: The tropical, fan-shaped sponge grew <1% per month.	*Agelas clathrodes*	summary of results of other workers	Po: Dem: Agelasida: Agelasidae	(Schmidt, 1870)	Abdo et al. 2008
RECOVERY SPEED: After-hurricane study. Sponge biomass doubled in about 230-300 days (250 for *A. dispar*), with exponential growth appearing to slow down after 4 years. Fastest growth was observed in cyanosponges.	*Agelas dispar*	Jamaica, Caribbean, 20 m	Po: Dem: Agelasida: Agelasidae	Duchassaing & Michelotti, 1864	Wilkinson & Cheshire 1988
RECOVERY PROCESS: Monitoring of adenine di-phosohate ribosyl cyclase concentrations and the hormone abscisic acid during stressful conditions and tissue regeneration in sponges after injury. Cyclase activity was highest during heat stress and 2-3 weeks after injury when healing was near complete.	*Agelas oroides*	Ligurian Sea, Mediterranean, 10-35 m	Po: Dem: Agelasida: Agelasidae	(Schmidt, 1864)	Basile et al. 2009
RECOVERY POTENTIAL: Hurricane Gilbert impact study. The rope sponge suffered from necrosis and fragmentation, which led to smaller average individual size but more numerous individuals. This observation suggests that this sponge would benefit from fragmentation by vegetative reproduction.	*Agelas sceptrum*	Cozumel, Yucatan, Mexico, W Caribbean, 5-25 m	Po: Dem: Agelasida: Agelasidae	(De Lamarck, 1815)	Fenner 1991
RECOVERY SPEED: After-hurricane study. Sponge biomass doubled in about 230-300 days (232 and 257 for *A. crassa*), with exponential growth appearing to slow down after 4 years. Fastest growth was observed in cyanosponges.	*Aiolochroia crassa*	Jamaica, Caribbean, 20 m	Po: Dem: Verongida: Aplysinidae	(Hyatt, 1875)	Wilkinson & Cheshire 1988 (partly as *Pseudoceratina*

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
					crassa, partly as *Verongula ardis*)
SUSCEPTIBILITY: For assessment of damage by scallop dredging, 4 experimental trawls were made. *A. digitatum* was abundant, but not usually visibly damaged, unless single colonies were detached or boulders overturned.	*Alcyonium digitatum*	SW Scotland, NE Atlantic, 15-36 m	Cn: Ant: Alcyonacea: Alcyoniidae	Linnaeus, 1758	Boulcott & Howell 2011
RECOVERY SPEED: Field study comparing benthic assemblages to sedimentation levels. *A. fucorum* is fast-growing and regenerates quickly if damaged.	*Amphilectus fucorum*	S Ireland, Atlantic, 0-30 m	Po: Dem: Poecilosclerida (Mycalina): Esperiopsidae	(Esper, 1794)	Picton pers. comm. in Bell & Barnes 2000b (as *Esperiopsis*)
RECOVERY SPEED: Record of *in situ* growth rates, at original site and after transplantation (using coral reef and mangrove root species). *A. compressa* grew in the original habitat (reef) a unit-free relative rate of ~1-3 per year, and more than twice that when transplanted to the mangrove environment.	*Amphimedon compressa*	coastal Belize Cay system, Caribbean, shallow	Po: Dem: Haplosclerida (Haplosclerina): Niphatidae	Duchassaing & Michelotti, 1864	Wulff 1994, 2005
RECOVERY SPEED: *A. compressa* grew at an average annual rate of 17.7 cm^3, and it grew better at 60 cm elevation than closer to the ground. This was explained by accessing different food sources and by an improved flow regime.	*Amphimedon compressa*	Bahamas, Atlantic, 20 m	Po: Dem: Haplosclerida (Haplosclerina): Niphatidae	Duchassaing & Michelotti, 1864	McLean & Lasker 2013
RECOVERY POTENTIAL: The abundance of the firm, branching *A. viridis* with weak attachment decreased at one site due to severe fragmentation and off-site transport caused by a hurricane, but can quickly recover to original abundances.	*Amphimedon viridis*	Florida Keys, Gulf of Mexico, 2.5-2.7 m	Po: Dem: Haplosclerida (Haplosclerina): Niphatidae	Duchassaing & Michelotti, 1864	Stevely et al. 2011
RECOVERY SPEED: Record of *in situ* growth rates of mangrove root sponges. *Amphimedon* sp. grew a unit-free relative rate of almost 7 per year, a moderately high growth rate in comparison.	*Amphimedon* sp.	coastal Belize Cay system, Caribbean, shallow	Po: Dem: Haplosclerida (Haplosclerina): Niphatidae	Duchassaing & Michelotti, 1864	Wulff 2005
RECOVERY POTENTIAL: The polar, tubular sponge grew <1% per month.	*Anoxycalyx (Scolymastra) joubini*	summary of results of other workers	Po: Hex (Hexasterophora): Lyssacinosida: Rossellidae	(Topsent, 1916)	Abdo et al. 2008 (as *Scolymastra*)
SUSCEPTIBILITY: This hexactinellid is fragile and has a high profile, and is at risk of fragmentation, which mostly causes death. It has a growth rate of 300 cm^2 $year^{-1}$ in surface area, which is comparable to other species, but has low recruitment. Growth rate increased modestly with size of the sponge. Overall, this species appears to have a low recolonisation and recovery potential.	*Aphrocallistes vastus*	Georgia and Queen Charlotte Basins, British Columbia, Canada, 100-240 m	Po: Hex (Hexasterophora): Hexactinosida (Sceptrulophora): Aphrocallistidae	Schulze, 1886	Austin et al. 2007
RECOVERY SPEED: The undisturbed *in situ* growth rate of this encrusting sponge is 0.28 mm^2 cm^{-1} border day-*1*, and this large species grew faster than species that usually have smaller specimen sizes. Regeneration rates after damage were 22-fold with 6.18 mm^2 cm^{-1} border day^{-1} and belonged to the fastest among the studied sponges.	*Aplysilla rosea*	New Zealand, 12 m	Po: Dem: Dendroceratida: Darwinellidae	(Barrois, 1867)	Ayling 1983, Wulff 2006a

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
SUSCEPTIBILITY: *A. cauliformis* increases in abundance when fragmented during storms.	*Aplysina cauliformis*	Cuba, Caribbean, shallow depth	Po: Dem: Verongida: Aplysinidae	(Carter, 1882)	Alcolado 2007
RECOVERY POTENTIAL: Field experiment observing attachment and growth of sponge fragments to coral rubble to investigate options of sustainable harvest. 54% of *A. cauliformis* and 21% of *Aplysina* sp. fragments were attached after 2 days. Sampled donor sponges still showed negative growth after 1 year, but of those with positive growth excised tissue volume was replaced to about 100% after 1 year. Especially *A. cauliformis* has a high recovery potential.	*Aplysina cauliformis* *Aplysina* sp.	Curaçao, Caribbean, 2-8 m	Po: Dem: Verongida: Aplysinidae	(Carter, 1882)	Biggs 2013
RECOVERY POTENTIAL: The thinly branching, tough, elastic *A. fulva* with weak attachment can withstand hurricanes by fragmentation and re-attachment and increased in abundance. It is a weedy species with good colonisation and recovery potentials.	*Aplysina fulva*	Florida Keys, Gulf of Mexico, 2.5-2.7 m	Po: Dem: Verongida: Aplysinidae	(Pallas, 1766)	Stevely et al. 2011
RECOVERY SPEED: Record of *in situ* growth rates, at original site and after transplantation (using coral reef and mangrove root species). *A. fulva* grows in the original habitat (reef) a unit-free relative rate of ~2-3 per year, and about twice that when transplanted to the mangrove environment.	*Aplysina fulva*	coastal Belize Cay system, Caribbean, shallow	Po: Dem: Verongida: Aplysinidae	(Pallas, 1766)	Wulff 1994, 2005, Wulff 2006a
RECOVERY SPEED: Tissue reduction and regeneration within 7 h to few weeks was observed in *Aplysinella* sp.	*Aplysinella* sp.	Guam, W Pacific, ca. 15 m	Po: Dem: Verongida: Aplysinellidae	Bergquist, 1980	Thoms et al. 2008
RECOVERY SPEED: Growth rate of skeleton ca. 0.2 mm per year.	*Astrosclera willeyana*	Indo-Pacific, Red Sea, 1-185 m	Po: Dem: Agelasida: Astroscleridae	Lister, 1900	Vacelet 2002
RECOVERY PROCESS: Monitoring of adenine di-phosphate ribosyl cyclase concentrations and the hormone abscisic acid during stressful conditions and tissue regeneration in sponges after injury. Cyclase activity was highest during heat stress and 2-3 weeks after injury when healing was near complete.	1 - *Axinella damicornis* 2 - *Axinella verrucosa*	Ligurian Sea, Mediterranean, 10-35 m	1 & 2 - Po: Dem: Halichondrida: Axinellidae	1 & 2 - (Esper, 1794)	Basile et al. 2009
RECOVERY SPEED: Record of *in situ* growth rates of mangrove root sponges. *T. ignis* grew a unit-free relative rate of ~14.5 per year, a high growth rate in comparison.	*Biemna caribea*	coastal Belize Cay system, Caribbean, shallow	Po: Dem: Poecilosclerida (Mycalina): Desmacellidae	Pulitzer-Finali, 1986	Wulff 1994, 2005
RECOVERY SPEED: Experimental wounding (16x9x3 mm) and observation of healing process (after 0, 2, 6, 10, 14, 18 days). Ectosome formed first, usually within 2 days. In the encrusting to branching *B. caribea* the wound initially filled in fast, then slowing down so that only 20-30% of the individuals had fully repaired the damage by day 18. This sponge healed comparatively slowly. When holes were cut through to the substrate they were immediately covered with a thin skin, but this did not thicken much.	*Biemna caribea*	Twin Cays, Belize, Caribbean, shallow (on mangrove prop roots)	Po: Dem: Poecilosclerida (Mycalina): Desmacellidae	Pulitzer-Finali, 1986	Wulff 2010

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
RECOVERY SPEED: Experimental comparison of healing rates. Tubular sponges healed faster than vasiform sponges. With 6-8% area regenerated per day. Chemically undefended *Callypongia* spp. healed faster than defended sponges.	1 - *Callyspongia (Cladochalina) plicifera* 2 - *Callyspongia (Cladochalina) vaginalis*	N Florida Keys, 10 m and Bahamas, W Atlantic, 5 and 15 m	Po: Dem: Haplosclerida (Haplosclerina): Callispongiidae	1 and 2 - (De Lamarck, 1814)	Walters & Pawlik 2005, Wulff 2006a
SUSCEPTIBILITY: The abundance of the tubular *C. vaginalis* with weak attachment was unaffected by a hurricane.	*Callyspongia (Cladochalina) vaginalis*	Florida Keys, Gulf of Mexico, 2.5-2.7 m	Po: Dem: Haplosclerida (Haplosclerina): Callispongiidae	(De Lamarck, 1814)	Stevely et al. 2011
RECOVERY SPEED: Field study. Sponges dominant. Except for *Mycale acerata*, growth rates of sponges too slow to be measurable in 1 year. Comment: *C. arcuarius* grows very slowly and would not easily recover after dredging.	*Calyx arcuarius*	McMurdo Sound, Antarctic, 30-60 m	Po: Dem: Haplosclerida (Petrosina): Phloeodictyidae	(Topsent, 1913)	Dayton et al. 1974
RECOVERY POTENTIAL: *C. foliascens* is a phototrophic sponge containing cyanobacteria, with fan to funnel-shaped morphology. Applying a single treatment of simulated physical dredging disturbance (squeeze, cut, abrasion) resulted in the following observations over 8 days: An application with a clamp and scraping off the ectosome caused a dark rust-coloured discolouration that faded within 3 days. Clean cuts with a scalpel had no visible effect and resulted in rapid healing, macroscopically completed at the end of the experiment.	*Carteriospongia foliascens*	Palm Islands, central Great Barrier Reef, Coral Sea, Pacific, intertidal, 0.5-1.5 m	Po: Dem: Dictyoceratida: Thorectidae	(Pallas, 1766)	Büttner & Siebler 2013 (incl. Schönberg pers. obs.)
RECOVERY SPEED: *In situ* staining experiment on the reef showed that this sclerosponge has a mean growth rate of ~230 µm year^{-1}, but can grow considerably slower, and regeneration of damage was also slower than mean growth for one year.	*Ceratoporella nicholsoni*	Jamaica, Caribbean, 25-29 m	Po: Dem: Agelasida: Astrosceridae	(Hickson, 1911)	Willenz & Hartman 1999, Vacelet 2002
RECOVERY POTENTIAL: The abundance of the fragile *C. molitba* with weak attachment decreased at one site due to severe fragmentation caused by a hurricane, where recovery was slow.	*Chalinula molitba*	Florida Keys, Gulf of Mexico, 2.5-2.7 m	Po: Dem: Haplosclerida (Haplosclerina): Chalinidae	(De Laubenfels, 1949)	Stevely et al. 2011
RECOVERY SPEED: The undisturbed *in situ* growth rate of this encrusting sponge is 0.06 mm^2 cm^{-1} border day^{-1}, and this large species grew faster than species that usually have smaller specimen sizes. Regeneration rates after damage were 68-fold with 4.08 mm^2 cm^{-1} border day^{-1}.	*Chelonaplysilla* sp.	New Zealand, 12 m	Po: Dem: Dendroceratida: Darwinellidae	De Laubenfels, 1948	Ayling 1983, Wulff 2006a
SUSCEPTIBILITY, RECOVERY POTENTIAL: Field experiment testing the effect of scallop dredging gear on sponge communities. Like for all but one sponge species, abundance of the cushion-shaped *C. nucula* decreased, and the community did not recover within 1 year, regardless of growth form.	*Chondrilla nucula*	Gulf of Kalloni, Aegean Sea, Mediterranean, 5-15 m	Po: Dem: Chondrosida: Chondrillidae	Schmidt, 1862	Kefalas et al. 2003
RECOVERY PROCESS: Monitoring of adenine di-phosphate ribosyl cyclase concentrations and the hormone abscisic acid during stressful conditions and tissue regeneration in sponges after injury. Cyclase activity was highest during heat stress and 2-3 weeks after injury when healing was near complete.	*Chondrilla nucula*	Ligurian Sea, Mediterranean, 10-35 m	Po: Dem: Chondrosida: Chondrillidae	Schmidt, 1862	Basile et al. 2009

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
RECOVERY SPEED: The undisturbed *in situ* growth rate of this encrusting sponge is 0.13 $mm^2 cm^{-1}$ border day^{-1}. Regeneration rates after damage were 44-fold with 5.70 mm^2 cm^{-1} border day^{-1} and belonged to the fastest among the studied sponges.	*Chondropsis* sp.	New Zealand, 12 m	Po: Dem: Poecilosclerida (Myxillina): Chondropsidae	Carter, 1886	Ayling 1983, Wulff 2006a
RECOVERY POTENTIAL: The temperate, massive sponge grew 2.2% per month.	*Chondrosia reniformis*	summary of results of other workers	Po: Dem: Chondrosida: Chondrillidae	Nardo, 1847	Abdo et al. 2008
RECOVERY PROCESS: Monitoring of adenine di-phosphate ribosyl cyclase concentrations and the hormone abscisic acid during stressful conditions and tissue regeneration in sponges after injury. Cyclase activity was highest during heat stress and 2-3 weeks after injury when healing was near complete.	*Chondrosia reniformis*	Ligurian Sea, Mediterranean, 10-35 m	Po: Dem: Chondrosida: Chondrillidae	Nardo, 1847	Basile et al. 2009
RECOVERY POTENTIAL: Population dynamics study in eutrophic waters and a high rate of sedimentation. *C. reniformis* regresses tissue in colder temperatures, reproduces sexually and asexually perennially, but there is little change in % cover, irrespective of temperature, irradiance and chlorophyll concentration.	*Chondrosia reniformis*	Adriatic Sea, Mediterranean, 5-10 m	Po: Dem: Chondrosida: Chondrillidae	Nardo, 1847	Di Camillo et al. 2012
RECOVERY SPEED: Field study. Sponges dominant. Except for *Mycale acerata*, growth rates of sponges too slow to be measurable in 1 year. Comment: *C. antarctica* grows very slowly and would not easily recover after dredging.	*Cinachyra antarctica*	McMurdo Sound, Antarctic, 30-60 m	Po: Dem: Spirophorida: Tetillidae	(Carter, 1872)	Dayton et al. 1974, Abdo et al. 2008
RECOVERY SPEED: Experimental wounding (16x9x3 mm) and observation of healing process (after 0, 2, 6, 10, 14, 18 days). Ectosome formed first, usually within 2 days. Holes cut through to the substrate in the thinly encrusting *C. campecheae* were immediately covered with a thin skin, but this did not thicken, while *C. venosa* gradually grew into the hole from the sides.	1 - *Clathria (Microciona) campecheae* 2 - *Clathria (Thalysias) venosa*	Twin Cays, Belize, Caribbean, shallow (on mangrove prop roots)	Po: Dem: Poecilosclerida (Microcionina): Microcionidae	1 - Hooper, 1996 2 - (Alcolado, 1984)	Wulff 2010
RECOVERY PROCESS: Monitoring of adenine di-phosohate ribosyl cyclase concentrations and the hormone abscisic acid during stressful conditions and tissue regeneration in sponges after injury. Cyclase activity was highest during heat stress and 2-3 weeks after injury when healing was near complete.	*Clathrina clathrus*	Ligurian Sea, Mediterranean, 10-35 m	Po: Cal (Calcinea): Clathrinida: Clathrinidae	(Schmidt, 1864)	Basile et al. 2009
RECOVERY POTENTIAL: The authors found that *C.* cf. *celata* recovers quickly when damaged, but they do have no information about growth rates.	*Cliona* cf. *celata*	S Ireland, E Atlantic, 12-18 m	Po: Dem: Hadromerida: Clionaidae	Grant, 1826	Bell et al. 2002
SUSCEPTIBILITY, RECOVERY POTENTIAL: Field experiment testing the effect of scallop dredging gear on sponge communities. Like for all but one sponge species, abundance of the endolithic *C.* cf. *celata* decreased, and the community did not recover within 1 year, regardless of growth form.	*Cliona* cf. *celata*	Gulf of Kalloni, Aegean Sea, Mediterranean, 5-15 m	Po: Dem: Hadromerida: Clionaidae	Grant, 1826	Kefalas et al. 2003
RECOVERY POTENTIAL: *C. orientalis* is a phototrophic sponge containing dinoflagellates and occurring in cryptic-endolithic and encrusting morphology, in calcium carbonate materials on the sand flats of the intertidal of the Palm Islands	*Cliona orientalis*	Palm Islands, central Great Barrier Reef, Coral	Po: Dem: Hadromerida: Clionaidae	Thiele, 1900	Büttner & Siebler 2013 (incl.

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
to the shallow subtidal. Applying a single treatment of simulated physical dredging disturbance (squeeze, cut, abrasion) resulted in the following observations over 8 days: An application with a clamp had no visible effect at all. Deep scraping off the ectosome healed entirely within 3 days. Clean cuts had no marked effect and resulted in rapid healing, even if less than 1/3 of the explant remained, and healing was macroscopically completed at the end of the experiment.		Sea, Pacific, shallow subtidal, 1-2 m			Schönberg pers. obs.)
RECOVERY POTENTIAL: *C. varians* is a 'weedy' species and increased in abundance despite disturbance.	*Cliona varians*	Florida Keys, Gulf of Mexico, 2.5-2.7 m	Po: Dem: Hadromerida: Clionaidae	Duchassaing & Michelotti, 1864	Stevely et al. 2011
COMMUNITY CHANGES: Lagoonal dredging and spoil dumping killed a large number of corals or reduced their growth rates. The authors assumed that construction work on the reef, such as the building of shipping channels, will enhance local bioerosion rates because bioeroding sponges temporarily grow faster when fragmented.	Clionaidae, bioeroding sponges	Lakshadweep, Indian Ocean, shallow	Po: Dem: Hadromerida: Clionaidae	D'Orbigny, 1851	James et al. 1989
RECOVERY SPEED: Growth rate (as original area divided by new area, result subtracted from new area) of this encrusting sponge is variable, having a monthly mean of 0.19 per month, and with strongest growth in summer. Mortality can occur in the cold season or during exceptionally hot summers. Small individuals had the lowest survival rate but the fastest growth. Partial damage by e.g. predation resulted in fission.	*Corticium candelabrum*	Costa Brava, NW Mediterranean, Spain, 10-12 m	Po: Hom: Homosclerophorida: Plakinidae	Schmidt, 1862	De Caralt et al. 2008
RECOVERY POTENTIAL: 27 months field survey to test the effect of substrate stability on sponge population dynamics. On rubble compared to coral rock growth rates and abundances were lower, with numbers decreasing during windy periods in summer and recruitment peaking in summer. Anthropogenic activities that change the substrate will thus have an effect on benthic communities. RECOVERY SPEED: On coral rock the sponges grew to 163-385% of the initial volume over 27 months, which translates into an addition of 28-127% volume per year.	*Coscinoderma matthewsi*	Australia, Yorke Islands, Torres Strait, 10-12 m	Po: Dem: Dictyoceratida: Spongiidae	(Von Lendenfeld, 1886)	Duckworth & Wolff 2011
RECOVERY SPEED: Explants were cut for trials on farming success. In 6 months 45-80% survived. They grew to 125-225% of their original size in 9 months or to 130-230% in 9 months, translating to annual growth of ca. 170-450% of the original size, with growth being 'highest for explants transplanted at the end of winter.' This translates to an annual growth of ca. 300% growth in summer explants and ca. 400% in winter explants. Success depended on size, and 'medium sized' explants (∼100 cm^3) have good growth and survival.'	*Coscinoderma* sp.	Australia, Yorke Islands, Torres Strait, 12 m	Po: Dem: Dictyoceratida: Spongiidae	Carter, 1883	Duckworth & Wolff 2007
SUSCEPTIBILITY, RECOVERY POTENTIAL: Field experiment testing the effect of scallop dredging gear on sponge communities. Like for all but one sponge species,	*Crambe crambe*	Gulf of Kalloni, Aegean Sea,	Po: Dem: Poecilosclerida (Myxillina): Crambeidae	(Schmidt, 1862)	Kefalas et al. 2003

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
abundance of the encrusting *C. crambe* decreased, and the community did not recover within 1 year, regardless of growth form.		Mediterranean, 5-15 m			
RECOVERY SPEED: *C. crambe* grows to 2.5x its original size in 2 years, this slow rate was explained by encrusting growth form. Growth rates were in inverse relationship to investment into chemical and physical defence. Regeneration rates of damaged tissue were faster, halving damaged area in 3 weeks. This translates into a growth rate of 7% per month.	*Crambe crambe*	NW Mediterranean, Spain, 6-12 m	Po: Dem: Poecilosclerida (Myxillina): Crambeidae	(Schmidt, 1862)	Turon et al. 1998, Abdo et al. 2008
RECOVERY POTENTIAL: The temperate, encrusting sponge grew 9% per month.	*Crambe crambe*	summary of results of other workers	Po: Dem: Poecilosclerida (Myxillina): Crambeidae	(Schmidt, 1862)	Abdo et al. 2008
RECOVERY SPEED: Experimental comparison of healing rates. Tubular sponges healed faster than vasiform sponges. With 2% area regenerated per day chemically defended *C. vasculum* healed slower than undefended sponges.	*Cribrochalina vasculum*	N Florida Keys, 10 m and Bahamas, W Atlantic, 15 m	Po: Dem: Haplosclerida: Niphatidae	(De Lamarck, 1814)	Walters & Pawlik 2005, Wulff 2006a
RECOVERY POTENTIAL: *In situ Cymbastela* sp. was green. It is a cup-shaped phototrophic sponge containing cyanobactera, and it occurred in very shallow depths on sandflats. The sponges turned dark, almost eggplant-coloured in the tanks. Applying a single treatment of simulated physical dredging disturbance (squeeze, cut, abrasion) resulted in the following observations over 8 days: An application with a clamp usually resulted in a patch of lighter, green colour, but adjusting back to the background colour within days. Abrasions and clean cuts were visibly healed within 3 days.	*Cymbastela coralliophila*	Palm Islands, central Great Barrier Reef, Coral Sea, Pacific, intertidal to shallow subtidal, 0.5-1 m	Po: Dem: Halichondrida (Haplosclerina): Axinellidae	Hooper & Bergquist, 1992	Büttner & Siebler 2013 (incl. Schönberg pers. obs.)
RECOVERY SPEED: Field study. Sponges dominant. Except for *Mycale acerata*, growth rates of sponges too slow to be measurable in 1 year. Comment: *D. membranosa* grows very slowly and would not easily recover after dredging.	*Dendrilla membranosa*	McMurdo Sound, Antarctic, 30-60 m	Po: Dem: Dendroceratida: Darwinellidae	(Pallas, 1766)	Dayton et al. 1974, Abdo et al. 2008
RECOVERY SPEED: Record of *in situ* growth rates, at original site and after transplantation (using coral reef and mangrove root species). *D. anchorata* grew in the original habitat (reef) as fast as after transplantation to the mangrove habitat, with very high growth rates of a unit-free relative rate of ~13 per year.	*Desmapsamma anchorata*	coastal Belize Cay system, Caribbean, shallow	Po: Dem: Poecilosclerida (Myxillina): Desmacididae	(Carter, 1882)	Wulff 2005
RECOVERY POTENTIAL: Revisiting site of experimental trawling and control site. No recolonization was evident, and 30-60% of dominant species showed damage, but no obvious repair or regrowth 1 year afterwards (ca. 30% torn, ca. 70% upended, latter more so for *Geodia* and *Rhabdocalyptus*). Upon nudging with the submersible, *Esperiopsis* and *Mycale* were comparatively resistant to fragmentation because flexible, but showed necrosis due to bruising, found as skeleton remaining behind after 1 year, while rigid *Geodia* broke or was turned over. Loose sponges appeared to be alive.	*Esperiopsis* sp.	Gulf of Alaska, NE Pacific, 206-209 m	Po: Dem: Poecilosclerida (Mycalina): Esperiopsidae	Carter, 1882	Freese 2001

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
SUSCEPTIBILITY: Study into potential damage caused by placement of crustacean fishing traps. 'The slow-growing, long-lived, pink sea fan *E. verrucosa* was observed to flex under the weight of pots as they passed and then returned back to an upright position.'	*Eunicella verrucosa*	N and S United Kingdom, Channel, The Minch, Atlantic, 23 m	Cn: Ant:alcyonacea: Gorgoniidae	(Pallas, 1766)	Eno et al. 2001
RECOVERY SPEED: The undisturbed *in situ* growth rate of this encrusting sponge is 0.0003 mm^2 cm^{-1} border day^{-1}, and this small species grew slower than species that usually have a larger specimen sizes. Regeneration rates after damage were 2900-fold with 0.88 mm^2 cm^{-1} border day^{-1}.	*Eurypon* sp.	New Zealand, 12 m	Po: Dem: Poecilosclerida Microcionina): Raspailiidae	Gray, 1867	Ayling 1983, Wulff 2006a
RECOVERY POTENTIAL: Revisiting site of experimental trawling and control site. No recolonization was evident, and 30-60% of dominant species showed damage, but no obvious repair or regrowth 1 year afterwards (ca. 30% torn, ca. 70% upended, latter more so for *Geodia* and *Rhabdocalyptus*). Upon nudging with the submersible, *Esperiopsis* and *Mycale* were comparatively resistant to fragmentation because flexible, but showed necrosis due to bruising, found as skeleton remaining behind after 1 year, while rigid *Geodia* broke or was turned over. Loose sponges appeared to be alive.	*Geodia* sp.	Gulf of Alaska, NE Pacific, 206-209 m	Po: Dem: Astrophorida: Geodiidae (Geodiinae)	De Lamarck, 1815	Freese 2001
RECOVERY SPEED: Ostur communities of the NW Atlantic are dominated by *Geodia* spp. that are thought to reproduce infrequently and to be slow growing; they need several decades to regain pre-disturbance sizes.	*Geodia* spp.	NE Atlantic, deep	Po: Dem: Astrophorida: Geodiidae (Geodiinae)	De Lamarck, 1815	Klitgaard & Tendal 2004
RECOVERY SPEED: *H. bowebanki* is a fast growing species with good recovery potential.	*Halichondria (Halichondria) bowerbanki*	S Ireland, Atlantic, 0-30 m	Po: Dem: Halichondrida: Halichondriidae	Burton, 1930	Bell & Barnes 2000a
RECOVERY SPEED: Record of *in situ* growth rates of mangrove root sponges. *H. magniconulosa* grew a unit-free relative rate of ~26.5 per year, a very high growth rate in comparison.	*Halichondria (Halichondria) magniconulosa*	coastal Belize Cay system, Caribbean, shallow	Po: Dem: Halichondrida: Halichondriidae	Hechtel, 1965	Wulff 1994, 2005
RECOVERY SPEED: Experimental wounding (16x9x3 mm) and observation of healing process (after 0, 2, 6, 10, 14, 18 days). Ectosome formed first, usually within 2 days. In the massive or compound-mound *H. magniconulosa* the wound initially widened and smoothed, then the depression was infilled, with all individuals having fully repaired the damage by day 18. This sponge is a comparatively fast healer.	*Halichondria (Halichondria) magniconulosa*	Twin Cays, Belize, Caribbean, shallow (on mangrove prop roots)	Po: Dem: Halichondrida: Halichondriidae	Hechtel, 1965	Wulff 2010
RECOVERY POTENTIAL: The abundance of the small, fragile *H. melanadocia* with weak attachment decreased at one site due to scouring, burial and severe fragmentation caused by a hurricane. Abundances followed a 'boom and bust' pattern, suggesting opportunism.	*Halichondria (Halichondria) melanadocia*	Florida Keys, Gulf of Mexico, 2.5-2.7 m	Po: Dem: Halichondrida: Halichondriidae	De Laubenfels, 1936	Stevely et al. 2011

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
RECOVERY POTENTIAL: The temperate, encrusting sponge grew 2% per month.	*Halichondria (Halichondria) okadai*	summary of results of other workers	Po: Dem: Halichondrida: Halichondriidae	(Kadota, 1922)	Abdo et al. 2008
SUSCEPTIBILITY, RECOVERY POTENTIAL: Field experiment testing the effect of scallop dredging gear on sponge communities. Like for all but one sponge species, abundance of the lobose *H. panicea* decreased, and the community did not recover within 1 year, regardless of growth form.	*Halichondria (Halichondria) panicea*	Gulf of Kalloni, Aegean Sea, Mediterranean, 5-15 m	Po: Dem: Halichondrida: Halichondriidae	(Pallas, 1766)	Kefalas et al. 2003
RECOVERY POTENTIAL: The smallest and largest sponge patches of *Halichondria* sp. grew the most slowly.	*Halichondria* sp.	New England, W Atlantic, shallow	Po: Dem: Halichondrida: Halichondriidae	Fleming, 1828	Fell & Lewandrowski 1981
RECOVERY SPEED: Depending on season, this sponge grows with a rate of 0.6-2.2 $mm^2\,cm^{-1}$ border day^{-1}.	*Haliclona (Reniera) cinerea*	Oregon, NE Pacific, intertidal	Po: Dem: Haplosclerida (Haplosclerina): Chalinidae	(Grant, 1826)	Elvin 1976 (as *H. permollis*)
SUSCEPTIBILITY: Judging from dead sponges washed up on the beach, *H. caerulea* is very susceptible to detachment.	*Haliclona (Soestella) caerulea*	Bay of Mazatlán, Mexico, E Pacific, beach	Po: Dem: Haplosclerida (Haplosclerina): Chalinidae	(Hechtel, 1965)	Carballo et al. 2008
RECOVERY SPEED: Field study. Sponges dominant. Except for *Mycale acerata*, growth rates of sponges too slow to be measurable in 1 year. Comment: *H. dancoi* grows very slowly and would not easily recover after dredging.	*Haliclona (Rhizoniera) dancoi*	McMurdo Sound, Antarctic, 30-60 m	Po: Dem: Haplosclerida (Haplosclerina): Chalinidae	(Topsent, 1913)	Dayton et al. 1974
RECOVERY POTENTIAL: The abundance of the stringy, fragile *H. implexiformis* with high profile and weak attachment decreased at one site due to severe fragmentation caused by a hurricane. Populations were variable, but had a very good recovery potential.	*Haliclona (Reniera) implexiformis*	Florida Keys, Gulf of Mexico, 2.5-2.7 m	Po: Dem: Haplosclerida (Haplosclerina): Chalinidae	(Hechtel, 1965)	Stevely et al. 2011 (as *Adocia*)
RECOVERY SPEED: Record of *in situ* growth rates of mangrove root sponges. *H. implexiformis* grew a unit-free relative rate of ~7 per year, a moderately high growth rate in comparison.	*Haliclona (Reniera) implexiformis*	coastal Belize Cay system, Caribbean, shallow	Po: Dem: Haplosclerida (Haplosclerina): Chalinidae	(Hechtel, 1965)	Wulff 2005
RECOVERY SPEED: Experimental wounding (16x9x3 mm) and observation of healing process (after 0, 2, 6, 10, 14, 18 days). Ectosome formed first, usually within 2 days. In the massive *H. implexiformis* the wound initially filled in fast, then slowing down so that only 20-30% of the individuals had fully repaired the damage by day 18. This sponge healed comparatively slowly. Holes cut through to the substrate remained the same size as most individuals only regenerated ectosome over the cut surfaces but did not cover the exposed surface. Holes cut through to the substrate in the encrusting *H. manglaris* remained the same size as the sponge only regenerated ectosome over the cut surfaces. Holes cut	1 - *Haliclona (Reniera) implexiformis* 2 - *Haliclona (Reniera) manglaris.* 3 - *Haliclona (Rhizoniera) curacaoensis*	Twin Cays, Belize, Caribbean, shallow (on mangrove prop roots)	1-3 - Po: Dem: Haplosclerida (Haplosclerina): Chalinidae	1 - (Hechtel, 1965) 2 - Alcolado, 1984 3 - (Van Soest, 1980)	Wulff 2010

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
through to the substrate in the encrusting *H. curacaoensis* were immediately covered with a thin skin, but this did not thicken much.					
RECOVERY SPEED: Field study. Sponges dominant. Except for *Mycale acerata*, growth rates of sponges too slow to be measurable in 1 year. Comment: *H. tenella* grows very slowly and would not easily recover after dredging.	*Haliclona (Gellius) tenella*	McMurdo Sound, Antarctic, 30-60 m	Po: Dem: Haplosclerida (Haplosclerina): Chalinidae	(Topsent, 1916)	Dayton et al. 1974
RECOVERY POTENTIAL: Field experiment. Both spp. contained low levels of photosymbionts that were thought not to significantly contribute to nutrition. However, the brown sp. displayed seasonal growth. The green sp. grew 3.4% per month, the brown one 6% with benthic neighbours and 4.1% without.	*Haliclona* sp. 'green' and 'brown'	Hamelin Bay, SW Australia, SCUBA depth	Po: Dem: Haplosclerida (Haplosclerina): Chalinidae	Grant, 1836	Abdo et al. 2008
RECOVERY POTENTIAL: The temperate, encrusting sponge grew 20% per month.	*Hemimycale columella*	summary of results of other workers	Po: Dem: Poecilosclerida (Myxillina): Hymedesmiidae	(Bowebank, 1874)	Abdo et al. 2008
RECOVERY SPEED: Lower temperatures could potentially slow sponge recovery processes. In cooler areas reproductive effort is lower, onset of sexual reproduction is later, larval development was slower for *H. communis*.	*Hippospongia communis*	E Tunisia in 5 m and Gulf of Lion in 10-25 m, W Mediterranean	Po: Dem: Dictyoceratida: Spongiidae	(De Lamarck, 1814)	Zarrouk et al. 2013
RECOVERY POTENTIAL: Literature review since 1864, communication with fishermen and scientists, and inspection of museum specimens. Bath sponges experienced a mass mortality in the Lesser Antilles around 1900-1950 and did not recover until about 40 years later. The species vanished from a large region and across different depths. The die-off was explained with thermal stress.	*Hippospongia gossypina*	Lesser Antilles, West Indian Region, Caribbean	Po: Dem: Dictyoceratida: Spongiidae	(Duchassaing & Michelotti, 1864))	Vicente 1989 (partly as *Spongia lapidescens*)
RECOVERY POTENTIAL: The massive, squat *H. lachne* with a broad base withstands hurricanes. Where it is removed, it is slow to recover (decade).	*Hippospongia lachne*	Florida Keys, Gulf of Mexico, 2.5-2.7 m	Po: Dem: Dictyoceratida: Spongiidae	(De Laubenfels, 1936)	Stevely et al. 2011
RECOVERY POTENTIAL: This species responds to iceberg scouring and anchor ice with fast recruitment.	*Homaxinella* spp.	Antarctic, >1000 m	Po: Dem: Hadromerida: Suberitidae	Topsent, 1916	Hogg et al. 2010
RECOVERY POTENTIAL: The thinly encrusting sponge grew with a lateral extension rate of 0.02 $mm^2\ cm^{-1}$ border day^{-1} if undisturbed. If damaged, the growth rate increased 200-fold.	*Hymedesmia (Stylopus)* sp.	NE New Zealand, Pacific, shallow	Po: Dem: Poecilosclerida (Myxillina): Hymedesmiidae	Fristedt, 1885	Ayling 1981 (as *Stylopus*)
RECOVERY SPEED: The undisturbed *in situ* growth rate of this encrusting sponge is 0.08 $mm^2\ cm^{-1}$ border day^{-1}. Regeneration rates after damage were 66-fold with 4.60 $mm^2\ cm^{-1}$ border day^{-1} and belonged to the fastest among the studied sponges and recovered even from very small remnant tissue patches.	*Hymedesmia (Stylopus)* sp.	New Zealand, Pacific, 12 m	Po: Dem: Poecilosclerida (Myxillina): Hymedesmiidae	Fristedt, 1885	Ayling 1983 (as *Stylopus*), Wulff 2006a
RECOVERY SPEED: The undisturbed *in situ* growth rate of this encrusting sponge is 0.23 $mm^2\ cm^{-1}$ border day^{-1}. Regeneration rates after damage were 30-fold with	*Hymedesmia (Stylopus)* sp. pink	New Zealand, Pacific, 12 m	Po: Dem: Poecilosclerida (Myxillina): Hymedesmiidae	Fristedt, 1885	Ayling 1983

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
6.98 $mm^2\ cm^{-1}$ border day^{-1} and belonged to the fastest among the studied sponges.					(as *Stylopus*), Wulff 2006a
RECOVERY SPEED: The undisturbed *in situ* growth rate of this encrusting sponge is 0.02 $mm^2\ cm^{-1}$ border day^{-1}, and this small species grew slower than species that usually have a larger specimen sizes. Regeneration rates after damage were 26.5-fold with 0.53 $mm^2\ cm^{-1}$ border day^{-1}.	*Hymedesmia* sp. orange	New Zealand, Pacific, 12 m	Po: Dem: Poecilosclerida (Myxillina): Hymedesmiidae	Bowerbank, 1864	Ayling 1983, Wulff 2006a
RECOVERY SPEED: The undisturbed *in situ* growth rate of this encrusting sponge is 0.05 $mm^2\ cm^{-1}$ border day^{-1}.	*Hymedesmia* sp. red	New Zealand, Pacific, 12 m	Po: Dem: Poecilosclerida (Myxillina): Hymedesmiidae	Bowerbank, 1864	Ayling 1983, Wulff 2006a
SURVIVAL POTENTIAL: Field survey. Unattached specimens had restricted distribution and lower densities compared to attached specimens, and seasonally unattached specimen densities can decline or grow faster compared to attached specimens.	*Hymeniacidon perlevis*	S Ireland, Atlantic, <30 m	Po: Dem: Halichondrida: Halichondriidae	(Montagu, 1818)	Bell & Barnes 2002
RECOVERY SPEED: Environmental factors may have a significant effect on recovery speed. Growth of juveniles is faster when in an environment warmer than ambient or at ambient, rather than in cooler water. Periodic rather than constant light and water flow was also enhancing growth rates.	*Hymeniacidon perlevis*	Lingshui Bay, Dalian, China, Yellow Sea, intertidal	Po: Dem: Halichondrida: Halichondriidae	(Montagu, 1818)	Xue & Zhang 2009
RECOVERY POTENTIAL: 27 months field survey to test the effect of substrate stability on sponge population dynamics. On rubble compared to coral rock growth rates and abundances were lower, with recruitment peaking in summer. Anthropogenic activities that change the substrate will thus have an effect on benthic communities.	*Hyrtios erectus*	Australia, Yorke Islands, Torres Strait, 10-12 m	Po: Dem: Dictyoceratida: Spongiidae	(Keller, 1889)	Duckworth & Wolff 2011
RECOVERY SPEED: On coral rock the sponges grew to 114-375% of the initial volume over 27 months, which translates into an addition of 6-122% volume per year. On rubble the sponges shrank or vanished entirely.	*Hyrtios erectus*	Australia, Yorke Islands, Torres Strait, 10-12 m	Po: Dem: Dictyoceratida: Spongiidae	(Keller, 1889)	Duckworth & Wolff 2011
RECOVERY SPEED: Tissue regression occurred 12 h after being transferred to experimental tanks, but full recovery was then achieved after 72 h.	*Ianthella basta*	central Great Barrier Reef, sampling depth not stated, experiments in tanks	Po: Dem: Verongida: Ianthellidae	(Pallas, 1766)	Luter et al. 2012
RECOVERY SPEED: Record of *in situ* growth rates, at original site and after transplantation (using coral reef and mangrove root species). *I. birotulata* grew in the original habitat (reef) a unit-free relative rate of ~2-5 per year, and more than twice that when transplanted to the mangrove environment.	*Iotrochota birotulata*	coastal Belize Cay system, Caribbean, shallow	Po: Dem: Poecilosclerida (Myxillina): Iotrochotidae	(Higgin, 1877)	Wulff 1994, 2005

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
RECOVERY SPEED: *I. birotulata* grew at an average annual rate of 8.9 cm^3, and it grew better at 60 cm elevation than closer to the ground. This was explained by accessing different food sources and by an improved flow regime.	*Iotrochota birotulata*	Bahamas, Atlantic, 20 m	Po: Dem: Poecilosclerida (Myxillina): Iotrochotidae	(Higgin, 1877)	McLean & Lasker 2013
RECOVERY SPEED: Experimental comparison of healing rates. Tubular sponges healed faster than vasiform sponges. With 2% area regenerated per day chemically defended *I. campana* healed slower than undefended sponges.	*Ircinia campana*	N Florida Keys, 10 m and Bahamas, W Atlantic, 15 m	Po: Dem: Dictyoceratida: Irciinidae	(De Lamarck, 1814)	Walters & Pawlik 2005, Wulff 2006a
RECOVERY POTENTIAL: The vase-shaped *I. campana*, the branching *I. felix* and the weakly attached, massive *I. strobilina* can be detached by hurricanes and transported off-site, and due to that abundances can decrease. While *I. campana* was slow to recover, the other two species had fast recovery rates.	1 - *Ircinia campana* 2 - *Ircinia felix* 3 - *Ircinia strobilina*	Florida Keys, Gulf of Mexico, 2.5-2.7 m	Po: Dem: Dictyoceratida: Irciinidae	1 - (De Lamarck, 1814) 2 - (Duchassaing & Michelotti, 1864) 3 - (De Lamarck, 1816)	Stevely et al. 2011
RECOVERY SPEED: After-hurricane study. Sponge biomass doubled in about 230-300 days (235 for *I. felix*), with exponential growth appearing to slow down after 4 years. Fastest growth was observed in cyanosponges.	*Ircinia felix*	Jamaica, Caribbean, 20 m	Po: Dem: Dictyoceratida: Irciinidae	(Duchassaing & Michelotti, 1864)	Wilkinson & Cheshire 1988
RECOVERY SPEED: *In situ* study of healing. Cutting of sponge is followed by contraction, within few hours a smooth surface results. Within 24 h some of the darker surface colour is re-established and most of the open canals are sealed. On the second day the new surface was nearly undistinguishable from, on the third day identical to the other surface areas. Repeated cutting of the same area does not slow the process.	*Ircinia strobilina*	assumed: Florida coast, Gulf of Mexico, 2-20 m depth (see Storr 1976a)	Po: Dem: Dictyoceratida: Irciinidae	(De Lamarck, 1816)	Storr 1976b
RECOVERY POTENTIAL: The tropical, massive sponge grew <1% per month.	*Ircinia strobilina*	summary of results of other workers	Po: Dem: Dictyoceratida: Irciinidae	(De Lamarck, 1816)	Abdo et al. 2008
SUSCEPTIBILITY, RECOVERY POTENTIAL: 1.5 year field study. Size and location of sea star feeding lesions influenced recovery success, with only 16% of the lesions recovering. Basal lesions caused fragmentation. Weakened branches were more likely to break by water movement, resulting in ultimate losses from the sponges far exceeding the amount of tissue actually consumed. Growth appeared to be seasonal, with summer values highest.	1 - *Isodictya deichmannae* 2 - *Isodictya palmata*	N Massachussetts, USA, W Atlantic, subtidal hardbottom	1 & 2 - Po: Dem: Poecilosclerida (Mycalina): Isodictyidae	1 - (De Laubenfels, 1949) 2 - (Ellis & Solander, 1786)	Sheild & Witman 1993
RECOVERY SPEED: Field study. Sponges dominant. Except for *Mycale acerata*, growth rates of sponges too slow to be measurable in 1 year. Comment: *I. setifera and I. erinacea* grow very slowly and would not easily recover after dredging.	1 - *Isodictya erinacea* 2 - *Isodictya setifera*	McMurdo Sound, Antarctic, 30-60 m	1 & 2 - Po: Dem: Poecilosclerida (Mycalina): Isodictyidae	1 - (Topsent, 1916) 2 - (Topsent, 1901)	Dayton et al. 1974
RECOVERY SPEED: Field study. Sponges dominant. Except for *Mycale acerata*, growth rates of sponges too slow to be measurable in 1 year.	*Kirkpatrickia variolosa*	McMurdo Sound, Antarctic, 30-60 m	Po: Dem: Poecilosclerida (Myxillina): Hymedesmiidae	(Kirkpatrick, 1907)	Dayton et al. 1974, Abdo et al. 2008

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
Comment: *K. variolosa* grows very slowly and would not easily recover after dredging (less than 1% growth per month).					
RECOVERY POTENTIAL: Assessing *in situ* sponge recovery after removing 0, 50, 75 and 90% of the volume of their biomass, monitoring biofouling and survival over 203 days. All damaged sponges survived, and recovery was faster in 90% than in 50%, but the rest did not differ. Good regeneration in 90% damaged sponges demonstrated a remarkable recovery potential. The highly organised *Polymastia crocea* had a somewhat slower regeneration rate than the less highly organised *L. wellingtonensis*.	*Latrunculia (Biannulata) wellingtonensis*	Wellington, New Zealand, Pacific, 12-15 m	Po: Dem: Poecilosclerida (Latrunculina): Latrunculiidae	Alvarez et al., 2002	Duckworth 2003
RECOVERY POTENTIAL: Assessing *in situ* sponge culturing over 2 months. Survival was lowest in summer and best in winter, and growth best in winter and lowest in autumn, which may be related to food availability. Growth was better in higher flow, whereas at the 2 lower flow sites the explants shrank.	*Latrunculia (Biannulata) wellingtonensis*	Wellington, New Zealand, Pacific, 5 and 10 m	Po: Dem: Poecilosclerida (Latrunculina): Latrunculiidae	Alvarez et al., 2002	Duckworth et al. 2004
RECOVERY POTENTIAL: The temperate, encrusting to massive sponge grew 2.6% per month.	*Latrunculia* sp.	summary of results of other workers	Po: Dem: Poecilosclerida (Latrunculina): Latrunculiidae	Du Bocage, 1869	Abdo et al. 2008
RECOVERY SPEED: Field study. Sponges dominant. Except for *Mycale acerata*, growth rates of sponges too slow to be measurable in 1 year. Comment: *L. leptoraphis* grows very slowly and would not easily recover after dredging.	*Leucascus leptoraphis*	McMurdo Sound, Antarctic, 30-60 m	Po: Cal (Calcinea): Clathrinida: Leucascidae	(Jenkin, 1908)	Dayton et al. 1974 (as *Leucetta leptorhapsis*)
RECOVERY SPEED: Caged *L. colombiensis* grew at a mean rate of 6.9 cm^3 (+/- 0.8 standard error). Exposed *L. colombiensis* could not keep up with sea star feeding.	*Lissodendoryx (Lissodendoryx) colombiensis*	coastal Belize Cay system, Caribbean, 2.5 m	Po: Dem: Poecilosclerida (Myxillina): Coelospaeridae	Zea & Van Soest, 1986	Wulff 2008
RECOVERY POTENTIAL: The abundance of the small, fragile *L. isodictyalis* with low profile and weak attachment decreased at one site due to severe fragmentation caused by a hurricane, recovery was moderate.	*Lissodendoryx (Lissodendoryx) isodictyalis*	Florida Keys, Gulf of Mexico, 2.5-2.7 m	Po: Dem: Poecilosclerida (Myxillina): Coelospaeridae	(Carter, 1882)	Stevely et al. 2011
RECOVERY SPEED: Record of *in situ* growth rates of mangrove root sponges. *L. isodictyalis* grew a unit-free relative rate of almost 7 per year, a moderately high growth rate in comparison.	*Lissodendoryx (Lissodendoryx) isodictyalis*	coastal Belize Cay system, Caribbean, shallow	Po: Dem: Poecilosclerida (Myxillina): Coelospaeridae	(Carter, 1882)	Wulff 2005
RECOVERY SPEED: Experimental wounding (16x9x3 mm) and observation of healing process (after 0, 2, 6, 10, 14, 18 days). Ectosome formed first, usually within 2 days. In the large-tubular *L. isodictyalis* the wound filled in slowly, but at a steady rate, so that only 50-70% of the individuals had fully repaired the damage by day 18. This sponge healed comparatively slowly. Holes cut through to the substrate remained the same size as most individuals only regenerated ectosome over the cut surfaces but did not cover the exposed surface.	*Lissodendoryx (Lissodendoryx) isodictyalis*	Twin Cays, Belize, Caribbean, shallow (on mangrove prop roots)	Po: Dem: Poecilosclerida (Myxillina): Coelospaeridae	(Carter, 1882)	Wulff 2010

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
RECOVERY SPEED: Record of *in situ* growth rates of coral reef sponges. *M. arbuscula* grew a unit-free relative rate of >3 per year.	*Monanchora arbuscula*	coastal Belize Cay system, Caribbean, shallow	Po: Dem: Poecilosclerida (Myxillina): Crambeidae	(Duchassaing & Michelotti, 1864)	Wulff 1994, 2005
RECOVERY SPEED: The undisturbed *in situ* growth rate of this encrusting sponge is -0.01 mm^2 cm^{-1} border day^{-1}. Regeneration rates after damage were 0.63 mm^2 cm^{-1} border day^{-1}, but no recovery occurred when remnant patch size was very small.	*Microciona* sp.	New Zealand, 12 m	Po: Dem: Poecilosclerida (Microcionina): Microcionidae	Bowerbank, 1862	Ayling 1983 (as *Anchinoe*), Wulff 2006a
SUSCEPTIBILITY: Soft-bodied species that will easily be damaged by gear.	*Mycale (Oxymycale) acerata*	Antarctic, 390-1125 m	Po: Dem: Poecilosclerida (Mycalina): Mycalidae	Kirkpatrick, 1907	Barthel & Gutt 1992
RECOVERY POTENTIAL: Field study. Sponges dominant. Except for *Mycale acerata*, growth rates of sponges too slow to be measurable in 1 year. *Mycale* increased its mass by 43-67% per year (or 1.1% per month according to Abdo et al. 2008) and is an aggressive space competitor. *Mycale* densities are kept low by predation, and rosselid glass sponges dominate the sponges (esp. *Rossella racovitzae* with 46% cover).	*Mycale (Oxymycale) acerata*	McMurdo Sound, Antarctic, 30-60 m	Po: Dem: Poecilosclerida (Mycalina): Mycalidae	Kirkpatrick, 1907	Dayton et al. 1974, Wulff 2006a, Abdo et al. 2008
SUSCEPTIBILITY, RECOVERY POTENTIAL: Field experiment testing the effect of scallop dredging gear on sponge communities. Like for all but one sponge species, abundance of the cushion-shaped *M. contarenii* decreased, and the community did not recover within 1 year, regardless of growth form.	*Mycale (Aegogropila) contarenii*	Gulf of Kalloni, Aegean Sea, Mediterranean, 5-15 m	Po: Dem: Poecilosclerida (Mycalina): Mycalidae	(Lieberkühn, 1859)	Kefalas et al. 2003
RECOVERY SPEED: Record of *in situ* growth rates of coral reef sponges. *M. laevis* grew a unit-free relative rate of ~2.5 per year.	*Mycale (Mycale) laevis*	coastal Belize Cay system, Caribbean, shallow	Po: Dem: Poecilosclerida (Mycalina): Mycalidae	(Carter, 1882)	Wulff 1994, 2005
RECOVERY SPEED: Experimental wounding (16x9x3 mm) and observation of healing process (after 0, 2, 6, 10, 14, 18 days). Ectosome formed first, usually within 2 days. Holes cut through to the substrate in the encrusting *Mycale* spp. were immediately covered with a thin skin, which then thickened.	1 - *Mycale (Carmia) magnirhaphidifera* 2 - *Mycale (Carmia) microsigmatosa*	Twin Cays, Belize, Caribbean, shallow (on mangrove prop roots)	Po: Dem: Poecilosclerida (Mycalina): Mycalidae	1 - Van Soest, 1984 2 - Arndt, 1927	Wulff 2010
SUSCEPTIBILITY, RECOVERY POTENTIAL: Field experiment testing the effect of scallop dredging gear on sponge communities. Like for all but one sponge species, abundance of the massive *M. massa* decreased, and the community did not recover within 1 year, regardless of growth form.	*Mycale (Mycale) massa*	Gulf of Kalloni, Aegean Sea, Mediterranean, 5-15 m	Po: Dem: Poecilosclerida (Mycalina): Mycalidae	(Schmidt, 1862)	Kefalas et al. 2003
SUSCEPTIBILITY: Judging from dead sponges washed up on the beach, *M.* cf. *parishii* is very susceptible to detachment.	*Mycale (Zygomycale)* cf. *parishii*	Bay of Mazatlán, Mexico, E Pacific, beach	Po: Dem: Poecilosclerida (Mycalina): Mycalidae	(Bowerbank, 1875)	Carballo et al. 2008

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
RECOVERY POTENTIAL: The tropical, tubular sponge grew 5% per month.	*Mycale* sp.	summary of results of other workers	Po: Dem: Poecilosclerida (Mycalina): Mycalidae	Gray, 1867	Abdo et al. 2008
RECOVERY POTENTIAL: Revisiting site of experimental trawling and control site. No recolonisation was evident, and 30-60% of dominant species showed damage, but no obvious repair or regrowth 1 year afterwards (ca. 30% torn, ca. 70% upended, latter more so for *Geodia* and *Rhabdocalyptus*). Upon nudging with the submersible, *Esperiopsis* and *Mycale* were comparatively resistant to fragmentation because flexible, but showed necrosis due to bruising, found as skeleton remaining behind after 1 year, while rigid *Geodia* broke or was turned over. Loose sponges appeared to be alive.	*Mycale* sp.	Gulf of Alaska, NE Pacific, 206-209 m	Po: Dem: Poecilosclerida (Mycalina): Mycalidae	Gray, 1867	Freese 2001
RECOVERY POTENTIAL: The tropical, massive sponge grew 1.6% per month.	*Neofibularia nolitangere*	summary of results of other workers	Po: Dem: Poecilosclerida (Mycalina): Desmacellidae	(Duchassaing & Michelotti, 1864)	Abdo et al. 2008
RECOVERY POTENTIAL: *N. exigua* is a brittle, phototrophic sponge containing cyanobacteria, and has a basally encrusting and apically erect-branching morphology. Applying a single treatment of simulated physical dredging disturbance (squeeze, cut, abrasion) resulted in the following observations over 8 days: An application with a clamp usually resulted in breaking off the afflicted part of the sponge. Where it remained in place, it was seriously damaged, changed colour and became enveloped in mucus at the 3rd day, while at the 7th day damaged parts were rejected by the recovering sponge and washed off from the paler coloured scar tissue. Abrasions healed within 5 days,, and clean cuts caused even less changes, healing very quickly.	*Neopetrosia exigua*	Palm Islands, central Great Barrier Reef, Coral Sea, Pacific, intertidal, 0.5-1.5 m	Po: Dem: Haplosclerida (Petrosina): Petrosiidae	(Kirkpatrick, 1900)	Büttner & Siebler 2013 (incl. Schönberg pers. obs.)
RECOVERY POTENTIAL: The firm, brittle, branching to massive *N. subtriangularis* with weak attachment can withstand hurricanes by fragmentation and re-attachment and increased in abundance after the disturbance.	*Neopetrosia subtriangularis*	Florida Keys, Gulf of Mexico, 2.5-2.7 m	Po: Dem: Haplosclerida (Petrosina): Petrosiidae	(Duchassaing, 1850)	Stevely et al. 2011 (as *Xestospongia*)
RECOVERY SPEED: Experimental comparison of healing rates. Tubular sponges healed faster than vasiform sponges. With 6% area regenerated per day chemically undefended *N. digitalis* healed faster than defended sponges.	*Niphates digitalis*	N Florida Keys, 10 m and Bahamas W Atlantic, 15 m	Po: Dem: Haplosclerida (Haplosclerina): Niphatidae	(De Lamarck, 1814)	Walters & Pawlik 2005, Wulff 2006a
RECOVERY POTENTIAL: The abundance of the firm, branching *N. erecta* with weak attachment decreased at one site due to severe fragmentation and off-site transport caused by a hurricane. This species has a good recovery potential.	*Niphates erecta*	Florida Keys, Gulf of Mexico, 2.5-2.7 m	Po: Dem: Haplosclerida (Haplosclerina): Niphatidae	Duchassaing & Michelotti, 1864	Stevely et al. 2011
RECOVERY POTENTIAL: Field experiment observing attachment and growth of sponge fragments to coral rubble to investigate options of sustainable harvest. 50% of *N. erecta* fragments were attached after 2 days, sampled donor sponges still showed negative growth after 1 year, but of those with positive growth	*Niphates erecta*	Curaçao, Caribbean, 2-8 m	Po: Dem: Haplosclerida (Haplosclerina): Niphatidae	Duchassaing & Michelotti, 1864	Biggs 2013

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
excised tissue volume was replaced to 50% after 1 year. This species has a high recovery potential.					
RECOVERY POTENTIAL: The temperate, encrusting sponge grew 15% per month.	*Oscarella lobularis*	summary of results of other workers	Po: Hom: Homoscleromorpha: Oscarellidae	(Schmidt, 1862)	Abdo et al. 2008
RECOVERY PROCESS: Monitoring of adenine di-phosohate ribosyl cyclase concentrations and the hormone abscisic acid during stressful conditions and tissue regeneration in sponges after injury. Cyclase activity was highest during heat stress and 2-3 weeks after injury when healing was near complete.	*Oscarella lobularis*	Ligurian Sea, Mediterranean, 10-35 m	Po: Hom: Homoscleromorpha: Oscarellidae	(Schmidt, 1862)	Basile et al. 2009
SUSCEPTIBILITY: For assessment of damage by scallop dredging, 4 experimental trawls were made. *P. johnstonia* was one of the most vulnerable species (69% of observations).	*Pachymatisma johnstonia*	SW Scotland, NE Atlantic, 15-36 m	Po: Dem: Astrophorida: Geodiidae (Erylinae)	(Bowerbank in Johnston, 1842)	Boulcott & Howell 2011
RECOVERY POTENTIAL and SPEED: Field study on anchor and fishing line damage of the gorgonian *P. clavata.* Clean cuts were not so deleterious (regrowth within 1 mo at growth rates of 0.15 ± 0.2 cm day^{-1}), but continuous chafing by discarded fishing gear caused tissue removal, areas of which were colonised by epibionts that caused extra drag and further deterioration and damage. Recolonisation was very slow, and after 4 years only 2 new colonies were found.	*Paramuricea clavata*	Ligurian Sea, Mediterranean, 20-35 m	Cn: Ant: Alcyonacea: Plexauridae	(Risso, 1826)	Bavestrello et al. 1997
RECOVERY POTENTIAL: *Paratetilla* sp. is a highly organised, globular sponge with radially arranged skeleton and a natural crust of sediments and algae, and it occurs in very shallow depths on sandflats. Applying a single treatment of simulated physical dredging disturbance (squeeze, cut, abrasion) resulted in the following observations over 8 days: An application with a clamp usually resulted in severe deformation and necrosis within 2 days, with all except 2 specimens dead at the end of the experiment. Application of abrasions caused tearing in the sponges, splitting areas vertically open almost to the core. These contracted, were quickly mended and were almost entirely healed at the end of the experiment. Clean cuts healed in a similar fashion.	*Paratetilla* sp.	Palm Islands, central Great Barrier Reef, Coral Sea, Pacific, intertidal to shallow subtidal, 0.5-1 m	Po: Dem: Spirophorida: Tetillidae	Dendy, 1905	Büttner & Siebler 2013 (incl. Schönberg pers. obs.)
RECOVERY POTENTIAL: The abundance of the fragile *P.* cf. *pellasarca* with weak attachment decreased at one site due to severe fragmentation and off-site transport caused by a hurricane.	*Petrosia (Petrosia)* cf. *pellasarca*	Florida Keys, Gulf of Mexico, 2.5-2.7 m	Po: Dem: Haplosclerida (Petrosina): Petrosiidae	(De Laubenfels, 1934)	Stevely et al. 2011
RECOVERY SPEED: The undisturbed *in situ* growth rate of this encrusting sponge is 0.01 mm^2 cm^{-1} border day^{-1}. Regeneration rates after damage were 365-fold with 3.65 mm^2 cm^{-1} border day^{-1}.	*Phorbas* sp.	New Zealand, 12 m	Po: Dem: Poecilosclerida (Myxillina): Hymedesmiidae	Duchassaing & Michelotti, 1864	Ayling 1983 (as *Anchinoe*), Wulff 2006a
RECOVERY PROCESS: Monitoring of adenine di-phosphate ribosyl cyclase concentrations and the hormone abscisic acid during stressful conditions and	*Pleraplysilla spinifera*	Ligurian Sea, Mediterranean, 10-35 m	Po: Dem: Dictyoceratida: Dysideidae	(Schulze, 1879)	Basile et al. 2009

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
tissue regeneration in sponges after injury. Cyclase activity was highest during heat stress and 2-3 weeks after injury when healing was near complete.					
RECOVERY POTENTIAL: Assessing *in situ* sponge recovery after removing 0, 50, 75 and 90% of the volume of their biomass and monitoring survival over 203 days. All damaged sponges survived, and regeneration in form of volume added and % total volume growth was faster in sponges with more damage (average 5 cm^3 added -80 to 200% of original volume; translation into annual growth difficult as growth was levelling off over time). Good regeneration in 90%-damaged sponges demonstrated a remarkable recovery potential. The highly organised *P. crocea* had much slower regeneration rates (growth, oscule numbers) than the less highly organised *Latrunculia wellingtonensis*, but variation between replicates was high.	*Polymastia crocea*	Wellington, New Zealand, Pacific, 12-15 m	Po: Dem: Hadromerida: Polymastiidae	Kelly-Borges & Bergquist, 1997	Duckworth 2003
RECOVERY POTENTIAL: Assessing *in situ* sponge culturing over 2 months. Survival was lowest in summer and best in spring (>90% overall survival), but was not influenced by depth or flow. Growth was best in spring and lowest in autumn, which may be related to food availability. Growth was enhanced in higher flow, but water depth did not make much difference.	*Polymastia crocea*	Wellington, New Zealand, Pacific, 5 and 10 m	Po: Dem: Hadromerida: Polymastiidae	Kelly-Borges & Bergquist, 1997	Duckworth et al. 2004
RECOVERY POTENTIAL: The temperate, massive sponge grew 8.3% per month.	*Polymastia crocea*	summary of results of other workers	Po: Dem: Hadromerida: Polymastiidae	Kelly-Borges & Bergquist, 1997	Abdo et al. 2008
RECOVERY SPEED: Field study. Sponges dominant. Except for *Mycale acerata*, growth rates of sponges too slow to be measurable in 1 year. Comment: *P. invaginata* grows very slowly and would not easily recover after dredging.	*Polymastia invaginata*	McMurdo Sound, Antarctic, 30-60 m	Po: Dem: Hadromerida: Polymastiidae	Kirkpatrick, 1907	Dayton et al. 1974
RECOVERY POTENTIAL: Experiment testing sponge explants for their performance in cultures. 77% of *P. hawere* explants survived. Growth was poor, and 2/3 lost weight. Survivorship, growth and healing increased with explant size, water depth and were better in winter compared to summer and slightly better at the more sheltered site. Explants only survived if they contained ectosome and recovered faster with more intact ectosome.	*Psammocinia hawere*	NE New Zealand, Pacific, 5, 10 and 17 m	Po: Dem: Dictyoceratida: Irciniidae	De C Cook & Bergquist, 1996	Duckworth et al. 1997
RECOVERY POTENTIAL: Experiment testing sponge explants for their performance in cultures. 44% of the *R. arbuscula* explants grew in the more sheltered location, translating into an annual addition to volume of 35% (84% survival). In the sheltered location the sponges shrank (56% survival). Growth was better at shallower depths.	*Raspailia (Clathriodendron) arbuscula*	NE New Zealand, Pacific, 5, 10 and 17 m	Po: Dem: Poecilosclerida (Microcionina): Raspailiidae	(Von Lendenfeld, 1888)	Duckworth et al. 1997 (as *R. agminata*)
RECOVERY POTENTIAL: Experiment testing sponge explants for their performance in cultures. Only 18% of *R. topsenti* explants survived, 10% had stable weight and	*Raspailia (Raspaxilla) topsenti*	NE New Zealand, Pacific, 5, 10 and 17 m	Po: Dem: Poecilosclerida (Microcionina): Raspailiidae	Dendy, 1924	Duckworth et al. 1997

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
only 5% grew. Explant survivorship was better at the more sheltered site and best in 10 m water depth.					
SUSCEPTIBILITY, RECOVERY POTENTIAL: Field experiment testing the effect of scallop dredging gear on sponge communities. Like for all but one sponge species, abundance of the erect-branching *R. viminalis* decreased, and the community did not recover within 1 year, regardless of growth form.	*Raspailia (Raspailia) viminalis*	Gulf of Kalloni, Aegean Sea, Mediterranean, 5-15 m	Po: Dem: Poecilosclerida (Microcionina): Raspailiidae	Schmidt, 1862	Kefalas et al. 2003
RECOVERY POTENTIAL and VULNERABILITY: The temperate, tubular sponge grew 1.3-1.7% per month, extending by 1.98 cm or increasing by 167 mL year^{-1}. The rate of wound repair was around 0.5 cm^{2} d^{-1}. Age estimates based on growth rates made average sized specimens 35 years old, larger ones 220 years.	*Rhabdocalyptus dawsoni*	Saanich Inlet, Barkley Sound, British Columbia, Canada, NE Pacific, 30 m	Po: Hex (Hexasterophora): Lyssacinosida: Rossellidae (Acanthascinae)	(Lambe, 1893)	Leys & Lauzon 1998, Abdo et al. 2008
RECOVERY POTENTIAL: Revisiting site of experimental trawling and control site. No recolonisation was evident, and 30-60% of dominant species showed damage, but no obvious repair or regrowth 1 year afterwards (ca. 30% torn, ca. 70% upended, latter more so for *Geodia* and *Rhabdocalyptus*). Upon nudging with the submersible, *Esperiopsis* and *Mycale* were comparatively resistant to fragmentation because flexible, but showed necrosis due to bruising, found as skeleton remaining behind after 1 year, while rigid *Geodia* broke or was turned over. Loose sponges appeared to be alive.	*Rhabdocalyptus* sp.	Gulf of Alaska, NE Pacific, 206-209 m	Po: Hex (Hexasterophora): Lyssacinosida: Rossellidae (Acanthascinae)	Schulze, 1886	Freese 2001
RECOVERY POTENTIAL: The polar, massive to tubular sponge grew <1% per month.	*Rossella nuda*	summary of results of other workers	Po: Hex (Hexasterophora): Lyssacinosida: Rossellidae (Rosselinae)	Topsent, 1901	Abdo et al. 2008
RECOVERY POTENTIAL: The polar, massive to tubular sponge grew 2.4-3% per month.	*Rossella racovitzae*	summary of results of other workers	Po: Hex (Hexasterophora): Lyssacinosida: Rossellidae (Rosselinae)	Topsent, 1901	Abdo et al. 2008
RECOVERY POTENTIAL: Large-scale field study on mass mortalities on Mediterranean sponges during thermal stress. Partially necrotic *S. fasciculatus* were able to heal within few weeks after cessation of stress.	*Sarcotragus fasciculatus*	NW Mediterranean, 10-15 m	Po: Dem: Dictyoceratida: Irciniidae	(Pallas, 1766)	Cebrian et al. 2011 (as *Ircinia fasciculata* (Esper, 1794))
RECOVERY SPEED: After-hurricane study. Sponge biomass doubled in about 230-300 days (304 for *S. aurea*), with exponential growth appearing to slow down after 4 years. Fastest growth was observed in cyanosponges.	*Smenospongia aurea*	Jamaica, Caribbean, 20 m	Po: Dem: Dictyoceratida: Thorectidae	(Hyatt, 1875)	Wilkinson & Cheshire 1988
RECOVERY POTENTIAL: Literature review since 1864, communication with fishermen and scientists, and inspection of museum specimens. Bath sponges experienced a mass mortality in the Lesser Antilles around 1900-1950 and did not recover until about 40 years later. The species vanished from a large region and across different depths. The die-off was explained with thermal stress.	*Smenospongia cerebriformis*	Lesser Antilles, West Indian Region, Caribbean	Po: Dem: Dictyoceratida: Thorectidae	(Duchassaing & Michelotti, 1864)	Vicente 1989 (as *Spongia sterea*)

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
RECOVERY SPEED: Field study. Sponges dominant. Except for *Mycale acerata*, growth rates of sponges too slow to be measurable in 1 year Comment: *S. antarcticus* grows very slowly and would not easily recover after dredging.	*Sphaerotylus antarcticus*	McMurdo Sound, Antarctic, 30-60 m	Po: Dem: Hadromerida: Polymastiidae	Kirkpatrick, 1907	Dayton et al. 1974
RECOVERY POTENTIAL: Where it is removed it is slow to recover to original abundances (13 year, for 6 year after disturbance apparently only by asexual reproduction and remnant regrowth), it appears to be long-lived and slow-growing.	*Spheciospongia vesparium*	Florida Keys, Gulf of Mexico, 2.5-2.7 m	Po: Dem: Hadromerida: Clionaidae	(De Lamarck, 1815)	Stevely et al. 2011; see also entry for Butler et al. 1995 in App. for 2 shading
RECOVERY POTENTIAL: Except for specimens with columnar growth and weak attachment, the massive *S. barbara* and *S. graminea* withstand hurricanes. If detached they can be carried off-site, causing a reduction in the abundance. The species had moderate to good recovery rates through recruitment.	1 - *Spongia (Spongia) barbara* 2 - *Spongia (Spongia) graminea*	Florida Keys, Gulf of Mexico, 2.5-2.7 m	Po: Dem: Dictyoceratida: Spongiidae	1 – Duchassaing & Michelotti, 1864 2 – Hyatt, 1877	Stevely et al. 2011 (*S. barbara* partly reported as *S. barbara dura*)
RECOVERY POTENTIAL: Literature review since 1864, communication with fishermen and scientists, and inspection of museum specimens. Bath sponges experienced a mass mortality in the Lesser Antilles around 1900-1950 and did not recover until about 40 years later. The species vanished from a large region and across different depths. The die-off was explained with thermal stress.	1 - *Spongia (Spongia) barbara* 2 - *Spongia lacinulosa* 3 - *Spongia (Spongia) obliqua* 4 - *Spongia (Spongia) tubulifera* 5 - *Spongia utilis*	Lesser Antilles, West Indian Region, Caribbean	1-5 - Po: Dem: Dictyoceratida: Spongiidae	1, 3 & 5 - Duchassaing & Michelotti, 1864 2 & 4 - De Lamarck, 1814	Vicente 1989 (2 as *S. tubulifera*)
RECOVERY SPEED: Experimental wounding (16x9x3 mm) and observation of healing process (after 0, 2, 6, 10, 14, 18 days). Ectosome formed first, usually within 2 days. In the massive *S. obscura* the wound initially widened and smoothed, then the depression was infilled, with all individuals having fully repaired the damage by day 18. This sponge is a comparatively fast healer.	*Spongia (Spongia) obscura*	Twin Cays, Belize, Caribbean, shallow (on mangrove prop roots)	Po: Dem: Dictyoceratida: Spongiidae	Hyatt, 1877	Wulff 2010
RECOVERY POTENTIAL: Trials to cultivate pieces of wild sponges in horizontal and vertical systems. There were no significant differences between the systems (75% survival). Larger explants reached commercial size after 3 years. Sponges displayed exponential growth.	*Spongia (Spongia) officinalis*	Lecce, Apulia, S Adriatic Sea, Mediterranean, 30 m	Po: Dem: Dictyoceratida: Spongiidae	Linnaeus, 1759	Corriero et al. 2004 (as *S. officinalis* var. *adriatica*)
RECOVERY POTENTIAL: Cut explants in field rope cultures had growth rates of 5-17% (by wet weight) in 21 months, i.e about 3-10% per year. Survival rates were 82-88%.	*Spongia (Spongia) officinalis*	Dardanelles, E Mediterranean, cultivation in 3-10 m	Po: Dem: Dictyoceratida: Spongiidae	Linnaeus, 1759	Çelik et al. 2011
SUSCEPTIBILITY, RECOVERY POTENTIAL: Field experiment testing the effect of scallop dredging gear on sponge communities. Like for all but one sponge species, abundance of the massive *S. domuncula* decreased. The only sponge that increased in abundance was the lobose *S. massa*. The community did not recover within 1 year, regardless of growth form.	1 - *Suberites domuncula* 2 - *Suberites massa*	Gulf of Kalloni, Aegean Sea, Mediterranean, 5-15 m	Po: Dem: Hadromerida: Suberitidae	(Olivi, 1792) Nardo, 1847	Kefalas et al. 2003

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
SURVIVAL POTENTIAL: Field survey. Unattached specimens had restricted distribution and lower densities compared to attached specimens, and seasonally unattached specimen densities can decline or grow faster compared to attached specimens.	*Suberites ficus*	S Ireland, <30 m	Po: Dem: Hadromerida: Suberitidae	(Johnston, 1842)	Bell & Barnes 2002
SUSCEPTIBILITY: *T. crypta* is large, has a low profile and strong attachment and can tolerate effects of storms.	*Tectitethya crypta*	Florida Keys, Gulf of Mexico, 2.5-2.7 m	Po: Dem: Hadromerida: Tethyidae	(De Laubenfels, 1949)	Stevely et al. 2011
SUSCEPTIBILITY, RECOVERY POTENTIAL: Field experiment testing the effect of scallop dredging gear on sponge communities. Like for all but one sponge species, abundance of the lobose *T. anhelans* decreased, and the community did not recover within 1 year, regardless of growth form.	*Tedania (Tedania) anhelans*	Gulf of Kalloni, Aegean Sea, Mediterranean, 5-15 m	Po: Dem: Poecilosclerida (Myxillina): Tedaniidae	(Vio in Olivi, 1792)	Kefalas et al. 2003
RECOVERY POTENTIAL: Population dynamics study in eutrophic waters and a high rate of sedimentation. *T. anhelans* growth and % cover were temperature and irradiance dependant and exhibited tissue regression over winter. The sponge reproduces sexually and asexually over summer.	*Tedania (Tedania) anhelans*	Adriatic Sea, Mediterranean, 5-10 m	Po: Dem: Poecilosclerida (Myxillina): Tedaniidae	(Vio in Olivi, 1792)	Di Camillo et al. 2012
SUSCEPTIBILITY: The abundance of the small, soft *T. ignis* with low profile and weak attachment can withstand hurricanes, but continuously declined at the sample area without apparent recovery.	*Tedania (Tedania) ignis*	Florida Keys, Gulf of Mexico, 2.5-2.7 m	Po: Dem: Poecilosclerida (Myxillina): Tedaniidae	(Duchassaing & Michelotti, 1864)	Stevely et al. 2011
RECOVERY SPEED: Record of *in situ* growth rates of mangrove root sponges. *T. ignis* grew a unit-free relative rate of ~19 per year, a high growth rate in comparison.	*Tedania (Tedania) ignis*	coastal Belize Cay system, Caribbean, shallow	Po: Dem: Poecilosclerida (Myxillina): Tedaniidae	(Duchassaing & Michelotti, 1864)	Wulff 1994, 2005
RECOVERY SPEED: Experimental wounding (16x9x3 mm) and observation of healing process (after 0, 2, 6, 10, 14, 18 days). Ectosome formed first, usually within 2 days. In the massive *T. ignis* the wound filled in slowly, but at a steady rate, so that only 50-70% of the individuals had fully repaired the damage by day 18. This sponge healed comparatively slowly. Holes cut through to the substrate reduced in size as *T. ignis* gradually grew into the hole from the sides. In the massive *T. klausi* the wound initially widened and smoothed, then the depression was infilled, with all individuals having fully repaired the damage by day 18. This sponge is a fast healer.	1 - *Tedania (Tedania) ignis* 2 - *Tedania (Tedania) klausi*	Twin Cays, Belize, Caribbean, shallow (on mangrove prop roots)	Po: Dem: Poecilosclerida (Myxillina): Tedaniidae	1 - (Duchassaing & Michelotti, 1864) 2 - Wulff, 2006	Wulff 2010
RECOVERY POTENTIAL: *T. tantula* is a fast recruiter and can recover e.g. after iceberg scouring and anchor ice.	*Tedania (Tedaniopsis) tantula*	Antarctic, >1000 m	Po: Dem: Poecilosclerida (Myxillina): Tedaniidae	(Kirkpatrick, 1907)	Hogg et al. 2010
SUSCEPTIBILITY: *T. vanhoeffeni* is a soft-bodied species that will easily be damaged by heavy equipment.	*Tedania (Tedaniopsis) vanhoeffeni*	Antarctic, 390-1125 m	Po: Dem: Poecilosclerida (Myxillina): Tedaniidae	Hentschel, 1914	Barthel & Gutt 1992

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
RECOVERY SPEED: The sponge regenerates tissue with a rate of 1.6 mm^2 cm^{-1} border day^{-1}.	*Tedania* sp.	NE New Zealand, Pacific, shallow	Po: Dem: Poecilosclerida (Myxillina): Tedaniidae	Gray, 1867	Ayling 1981
RECOVERY SPEED: The undisturbed *in situ* growth rate of this encrusting sponge is 0.08 mm^2 cm^{-1} border day^{-1}. Regeneration rates after damage were 52-fold with 4.18 mm^2 cm^{-1} border day^{-1}.	*Tedania* sp. orange	New Zealand, Pacific, 12 m	Po: Dem: Poecilosclerida (Myxillina): Tedaniidae	Gray, 1867	Ayling 1983, Wulff 2006a
RECOVERY SPEED: The thinly encrusting sponge grew over bare substrate at a rate of 0-0.02 mm^2 cm^{-1} border day^{-1}, but with 0.08-0.10 mm^2 when growing over live coral.	*Terpios* sp.	Guam, Pacific, shallow	Po: Dem: Poecilosclerida (Myxillina): Tedaniidae	Duchassaing & Michelotti, 1864	Bryan 1973
SUSCEPTIBILITY, RECOVERY POTENTIAL: Field experiment testing the effect of scallop dredging gear on sponge communities. Like for all but one sponge species, abundance of the massive *T. citrina* decreased, and the community did not recover within 1 year, regardless of growth form.	*Tethya citrina*	Gulf of Kalloni, Aegean Sea, Mediterranean, 5-15 m	Po: Dem: Hadromerida: Tethyidae	Sarà & Melone, 1965	Kefalas et al. 2003
RECOVERY POTENTIAL: The tropical, globular sponge grew <1% per month.	*Tethya crypta*	summary of results of other workers	Po: Dem: Hadromerida: Tethyidae	(De Laubenfels, 1949)	Abdo et al. 2008
RECOVERY SPEED: Field study. Sponges dominant. Except for *Mycale acerata*, growth rates of sponges too slow to be measurable in 1 year. Comment: *T. leptoderma* grows very slowly and would not easily recover after dredging.	*Tetilla leptoderma*	McMurdo Sound, Antarctic, 30-60 m	Po: Dem: Spirophorida: Tetillidae	Sollas, 1886	Dayton et al. 1974
RECOVERY POTENTIAL: The tropical, massive sponge grew <1% per month.	*Verongula gigantea*	summary of results of other workers	Po: Dem: Verongida: Aplysinidae	(Hyatt, 1875)	Abdo et al. 2008 (as *Verongia*)
RECOVERY SPEED: Experimental comparison of healing rates. Tubular sponges healed faster than vasiform sponges. Chemically defended *V. gigantea* did not show significant healing over 3 days.	*Verongula gigantea*	N Florida Keys, 10 m and Bahamas, W Atlantic, 15 m	Po: Dem: Verongida: Aplysinidae	(Hyatt, 1875)	Walters & Pawlik 2005, Wulff 2006a
SUSCEPTIBILITY: Assessment of damage caused by hopper dredge harvesting sediments for beach restauration. Mechanical damage was largely caused by 'wear pads' and reduced habitat quality and structural complexity, organism density and productivity and injured corals and sponges, with 75-100% destruction to the benthos, including about 2000 barrel sponges.	*Xestospongia muta*	E Florida, W Atlantic, 11-19 m	Po: Dem: Haplosclerida (Petrosina): Petrosiidae	De Laubenfels, 1932	Blair et al. 1990
RECOVERY POTENTIAL: Hurricane Gilbert impact study. Barrel sponges were broken off the base, fragmented and carried away to be lodged in depressions. Tissue remaining behind from the bases showed regrowth.	*Xestospongia muta*	Cozumel, Yucatan, Mexico, W Caribbean, 5-25 m	Po: Dem: Haplosclerida (Petrosina): Petrosiidae	De Laubenfels, 1932	Fenner 1991

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
RECOVERY SPEED: Observing damage and specimen recovery after a vessel grounding. *X. muta* has a high recovery potential if remaining tissue does not become diseased and resumes vertical growth (at an average rate of nearly 2 cm in growing sponges).	*Xestospongia muta*	Florida Keys National Marine Sanctuary, shallow	Po: Dem: Haplosclerida (Petrosina): Petrosiidae	De Laubenfels, 1932	Schmahl 1999
RECOVERY SPEED: Experimental comparison of healing rates. Tubular sponges healed faster than vasiform sponges. With 6.5% area regenerated per day chemically undefended *X. muta* healed faster than defended sponges.	*Xestospongia muta*	N Florida Keys and Bahamas, W Atlantic, 15 m	Po: Dem: Haplosclerida (Petrosina): Petrosiidae	De Laubenfels, 1932	Walters & Pawlik 2005, Wulff 2006a
RECOVERY SPEED: *In situ* measurements of growth rates revealed that there was much variation (specific growth rate of 0.02-4.04 $year^{-1}$ or an average volume of 1,955.37 ± 2,221.09 cm^3 year-1), but larger sponges grew slower. Sponges at shallower depths grew faster, but not significantly so, and they grew faster in summer than in winter, when some individuals even shrank. Estimated ages of the largest individuals were over 50 years.	*Xestospongia muta*	N Florida Keys, W Atlantic, 15, 20 and 30 m	Po: Dem: Haplosclerida (Petrosina): Petrosiidae	De Laubenfels, 1932	McMurray et al. 2008
RECOVERY POTENTIAL: Study of the recovery process after accidental damage of barrel sponges by dredging. After 3 months 93% of the individuals showed signs of healing, after 3 years 90% showed ongoing recovery. Vertical growth from injury scars ranged from 0.7 to 6.0 cm $year^{-1}$. Fragments can reattach.	*Xestospongia muta*	S Florida Keys Keys, Caribbean, depth not stated	Po: Dem: Haplosclerida (Petrosina): Petrosiidae	De Laubenfels, 1932	Gilliam et al. 2009
SUSCEPTIBILITY: Study into potential damage caused by placement of crustacean fishing traps. 'Video observations showed that the pressure wave created by the creels was sufficient to bend sea pens away from the descending creel just before contact. The results of three separate experiments on the effects of dragging, uprooting and smothering showed that all sea pens were able to recover fully from creel impact. All sea pens recovered from the effects of dragging creels over them in 24–72 h […] Both *Pennatula* and *Funiculina* reinserted after being uprooted, provided the peduncle gained contact with the mud surface. Following experimental smothering for 24 and 48 h, it took 72–96 h and 96–144 h for all species to fully recover an upright position.'	sea pens: 1 - *Funiculina quadrangularis* 2 - *Pennatula phosphorea* 3 - *Virgularia mirabilis*	N and S United Kingdom, Channel, The Minch, Atlantic, 23 m	Cn: Ant: Pennatulacea: 1 - Funiculinidae 2 - Pennatulidae 3 - Virgulariidae	(Pallas, 1766) Linnaeus, 1758 (Müller, 1776)	Eno et al. 2001
SUSCEPTIBILITY, RECOVERY: Field experiment testing the effect of scallop dredging gear on sponge communities. 'Total abundance, number of species, species diversity, species richness and evenness of sponge assemblages reduced significantly […] This comparative study demonstrated that the time interval [of 1 year] was between two consecutive scallop-fishing periods insufficient for the recovery of sponge assemblages.'	sponges	Gulf of Kalloni, Aegean Sea, Mediterranean, 5-15 m	Po	Grant, 1836	Kefalas et al. 2003
RECOVERY SPEED: Most studied species of encrusting sponges would need >10 years to recover large specimen diameters if damaged.	demosponges	New Zealand, 12 m	Po: Dem	Sollas, 1885	Ayling 1983
RECOVERY SPEED, RECOVEY POTENTIAL: Monitoring sponge communities after hurricane damage by grouping 67 species according to their growth form. Sponges with smaller base suffered larger damage, those with the lowest profile	demosponges	Jamaica, Caribbean, 12-15 m	Po: Dem	Sollas, 1885	Wulff 2006c

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
the least. Growth forms were damaged differently, erect branching, small-base and soft and brittle sponges were torn off, encrusting species were battered, cryptic, large-base and tough sponges were macerating. 'Of the 291 damaged sponges, 41% had completely regenerated their surfaces and were pumping within 4 weeks after the hurricane, but the other 59% of damaged individuals continued to deteriorate or had completely died.' Recovery of minor damage was not, but serious damage was related to growth form. 'Abrasion wounds due to battering healed within a week, as did basal portions of sponges left behind when erect portions were broken off. By contrast, necrotic patches often continued to spread, killing sponges by progressive rotting.' Ability to recover was inversely related to resistance. 'During the first 1–3 weeks after the hurricane, 70% of the unattached sponge fragments found on the reef became reattached to solid substrata, and survival' continued. Reattachment rate was higher for erect branching species (74%) than for tubes and vases (33%), no other morphological types reattached. Morphology-dependent transport of fragments off the reef resulted in fewer pieces of unattached massive sponges after the storm, while pieces of erect sponges were retained at higher rates. There was an inverse relationship between recovery versus severity of damage and morphological complexity, and physiological responses varied widely between species.					
RECOVERY SPEED: Their slow growth makes glass sponges particular susceptible to disturbance.	glass sponges	Antarctica, >1000 m	Po: Hex	Schmidt, 1870	Hogg et al. 2010
SUSCEPTIBILITY: United Nations General Assembly Resolution 61/105 2006 requires fishing vessels to move 2-5 nautical miles when 800 kg of sponge bycatch are reached; but the common understanding is that this limit is set too high, the distance too low.	deep sea sponges	world seas, >1000m	Po	Grant, 1836	Hogg et al. 2010
SUSCEPTIBILITY: 14 year census with repeated surveys evaluating sponge biodiversity and abundance. Number of species dropped to 51% and total sponge volume to 43% of the initial survey. This was especially pronounced in keratose and massive sponges and could not be explained, but disease may have played a role.	reef sponges	San Blas, Panama, Caribbean, 2.5-2.8 m	Po	Grant, 1836	Wulff 2006b
SUSCEPTIBILITY: Study into potential damage caused by placement of crustacean fishing traps. Increases after potting were noted for axinellid spp., *Dysidea* spp., *Hemimycale* spp., *Phorbas* spp., *Raspailia/Stelligera* spp., *Tethya* spp., decreases for *Halichondria* spp., suggesting that potting did not have a negative effect on sponges.	sponges, axinellid spp., *Dysidea* spp., *Halichondria* spp., *Haliclona simulans*, *Hemimycale* spp., *Phorbas* spp., *Raspailia/Stelligera* spp., *Tethya* spp.	N and S United Kingdom, Channel, The Minch, Atlantic, 23 m	Po	Grant, 1836	Eno et al. 2001

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
RECOVERY POTENTIAL: In general older sponges regenerate better than juveniles, but long-lived species grow slower, smaller wounds heal better than larger ones, habitat recovery functions in a significantly different way than recovery of individuals (see also their Table 12.1 summarising different pathways of damage and disturbance).	sponges	world seas, >1000 m	Po	Grant, 1836	Hogg et al. 2010
RECOVERY POTENTIAL: Study into recovery processes after vessel grounding on a coral reef habitat. Comparing damaged and control habitats, 3 years after the impact corals had still lower cover at the damaged site, but no differences were detected for sponges. Comment: Reef sponges are largely cryptic and may not be easy to detect, judging from the pictured scar, nothing much recovered at all.	reef organisms, including sponges	Biscayne National Park, Florida, Atlantic, 3 m	Po	Grant, 1836	Lirman et al. 2010
SUSCEPTIBILITY: Testing different trawling gear and its performance and effect on bycatch levels. By moving the gear off the ground, catch rates did not decrease, but bycatch rates were drastically lowered, which was especially apparent in sponge bycatch (tested: 0, 0.4 and 0.8 m above ground).	sponges and other benthic invertebrates	Gulf of Carpenteria, Australia, 41-58 m	Po	Grant, 1836	Brewer et al. 1996
RECOVERY SPEED: Recognising that fishing grounds depend on benthic communities, modelling the recovery trajectories for sponges and corals showed that both groups are unlikley to recover over short periods of time. 'Mortality of 67% of the initial sponge biomass would recover to 80% of the original biomass after 20 years, while mortality of 67% of the coral biomass would recover to 80% of the original biomass after 34 years.'	benthos: sponges and corals	Aleutian Islands, Alaska, Pacific, 100-300 m	Po	Grant, 1836	Rooper et al. 2011
SUSCEPTIBILITY: Experimental trawling to assess possible damage. Sponges dominated in the area in biomass and density. Trawling reduced the densities of *Esperiopsis*, *Mycale*, *Geodia,* 'morel' sponges (which were easily damaged), and anthozoans. 'Finger' sponges were only dislodged. Half of the *Styela* were broken or pulled out of the substrate, but *Actinauge* did not appear affected.	benthos, sessile e.g. 1 - *Esperiopsis* sp. 2 - *Mycale* sp. 3 - *Geodia* sp. 4 - *Actinauge verrillii* 5 - *Styela* sp.	Gulf of Alaska, NE Pacific, 206-209 m	1 - Po: Dem: Poecilosclerida: Esperiopsidae 2 - Po: Dem: Poecilosclerida: Mycalidae 3 - Po: Dem: Astrophorida: Geodiidae 4 - Cn: Ant: Actinaria: Hormathiidae 5 - Ch: Asc: Stolidobranchia: Styelidae	1 - Carter, 1882 2 - Gray, 1867 3 - De Lamarck, 1815 4 - McMurrich, 1893 5 - Fleming, 1822	Freese et al. 1999 (*A. verrillii* as *A. verelli*, *Styela* as *Stylea*)
RECOVERY POTENTIAL: Discarded bycatch from trawling often floats, and large proportions of it are then eaten by scavengers. This means that only a portion is returned to the bottom, and much of it is beyond repair due to air exposure. Comment: Materials brought up in dredging spoil would likely have a similar fate, and sponges are especially vulnerable to air exposure.	miscellaneous bycatch: fish, elasmobranchs, echinderms, crustaceans, cephalopods, others	Moreton Bay, Queensland, Australia, Pacific	-	-	Wassenberg & Hill 1990
RECOVERY POTENTIAL: Several years (1980-1994) of industrial extraction for sand and gravel caused a serious impact, with 5 m deep furrows filling up with sand, sedimentology inhomogeneous and shift towards finer materials. Substrate	in- and epifauna	Dieppe coast, English Channel, 15 m	-	-	Desprez 2000

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
instabilities masked effects at some sites, but species richness was partially reduced by 80% and densities by 90% in the 1980s, and polychaetes became the dominant fauna, replacing crustaceans, echinoderms and bivalves. 1993 for the whole dredging area species richness was decreased by 63%, abundances by 86% and biomass by 83%. The values were 60%, 53-86% and 3-28% respectively in 1996, with areas of sand deposition representing the worse values. Species richness and abundances had recovered by 1997, but biomass only reached 75%, and species composition of the recovered community reflected sediment conditions.					
RECOVERY POTENTIAL: Investigation of short-term macrofaunal recovery of three dredge disposal sites recharged with 60–80 cm of fine grained (88 to nearly 100% silt and clay), maintenance dredged material. While physical parameters attained control values species compositions differed. Only one site developed expected trophic groups. Abundances and diversities were negatively correlated to redox potential at 4 cm and % silt/clay.	macrofauna (polychaetes, crustaceans, molluscs)	SE England, North Sea, 0.5-1.9 m	-	-	Bolam & Whomersley 2005
COMMUNITY CHANGE: Dredged and undredged areas were compared. Average density of individuals did not differ, but species composition and richness did, obviously an effect of changed sediment conditions ('Species richness in particular was generally higher in areas characterised by sand than in those characterised by mud.'). Observations on the benthos were assumed to be indirect results of changed physical conditions, and significant decrease of species diversity in the area is expected.	infaunal macrobenthos	Botany Bay, New South Wales, Australia, Pacific, depth not stated, assumed shallow	-	-	Jones & Candy 1981
RECOVERY SPEED: Recolonisation with macrozoobenthos after bay and channel dredging and sand suction may take up to 5 years, with diversity recovering faster than dominances, abundances and biomass. Major structuring factors were species stock and immigration distance. Gregarious and opportunistic worms recolonised dredged habitats fastest, followed by crustacean and *M. balthica*. However, latter species was better able to deal with oxygen reduction due to sand suction. A change in species composition occurred.	infaunal macrozoobenthos, including crustacean, bivalves, priapulida, nemerteans, poly- and oligochaetes *Macoma balthica*	SW Finland, Baltic Sea, 5-12 m	 Mo: Biv: Veneroida: Tellinidae	- (Linnaeus, 1758)	Bonsdorff 1983
RECOVERY POTENTIAL: Observations on recovery processes after dredging. Pits on tidal flat took 13-16 years to fill in again, in tidal channels with high sedimentation 1-4 years. Refills represented finer materials than the original situation. Biomass recovery in tidal channels was fast (1-3 years), but on tidal flats no infauna had recovered after 13-15 years. Biodiversity was reduced in all pits, even where biomass was re-established.	various benthic biota, mainly bivalves and polychaetes, largely infauna 1 - *Macoma balthica* 2 - *Mya arenaria* 3 - *Cerastoderma edule* 4 - *Petrocolaria pholadiformis* 5 - *Abra alba*	Netherland Wadden Sea, intertidal to several m below water level	Mo: Biv: 1 - Veneroida: Tellinidae 2 - Myoida: Myidae 3 - Veneroida: Cardiidae 4 - Veneroida: Veneridae 5 - Veneroida: Semelidae 6 - Mytiloida: Mytilidae An: Pol: 7 - Arenicolidae	1 - (Linnaeus, 1758) 2 - Linnaeus, 1758 3 - (Linnaeus, 1758) 4 - (De Lamarck, 1818) 5 - (Wood, 1802) 6 - Linnaeus, 1758	Van der Veer et al. 1985 (*Petricolaria* as *Petricola*, *Hediste* and *Alitta* as *Nereis*, *Scolelepis* as *Scolecolepis*)

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
	6 - *Mytilus edulis* 7 - *Arenicola marina* 8 - *Scoloplos (Scoloplos) armiger* 9 - *Hediste diversicolor* 10 - *Alitta virens* 11 - *Nephtys hombergii* 12 - *Harmothoe* sp. 13 - *Eteone longa* 14 - *Heteromastus filiformis* 15 - *Lanice conchilega* 16 - *Scolelepis* sp. 17 - *Magelona papillicornis*		8 - Orbiniidae 9 - Phyllodocida: Nereididae 10 - Phyllodocida: Nereididae 11 - Phyllodocida: Nephtyidae 12 - Phyllodocida: Polynoidae 13 - Phyllodocida: Phyllodocidae 14 - Capitellidae 15 - Terebellida: Terebellidae 16 - Spionida: Spionidae 17 - Spionida: Magelonidae	7 - (Linnaeus, 1758) 8 - (Müller, 1776) 9 - (Müller, 1776) 10 - (Sars, 1835) 11 - Savigny in de Lamarck, 1818 12 - (Claparède, 1864) 13 - (Fabricius, 1780) 14 - (Pallas, 1766) 15 - Kinberg, 1856 16 - Blainville, 1828 17 - F. Müller, 1858	
RECOVERY POTENTIAL: Effects of maintenance dredging were assessed in the Hawkesbury River Estuary. Diversities and abundances were larger at the control site compared to the disposal site and were significantly reduced after dredging, except for the two most dominant species, a polychaete and an amphipod.	macrobenthos, e.g. 1 - *Terebellides stroemii* 2 - *Grandidierella gilesi*	Brooklyn, New South Wales, Australia, Pacific, depth not stated, assumed shallow	1 - An: Pol: Terebellida: Trichobranchidae 2 - Ar: Mal: Amphipoda: Aoridae	1 - Sars, 1835 2 - Chilton, 1921	Jones 1986
RECOVERY POTENTIAL: Review of an archive of monitoring data on spoil grounds and new data, concerning sediments of very different properties. Impact and recovery need to be monitored along with various physical factors. Hg contamination was higher at historically contaminated sites. Three years after the impact 65 taxa were more abundant at spoil sites relative to reference stations, including crustaceans, polychaetes and molluscs. 'Maximum tidal flow and % mean solids of dredged material disposed during the 3 years prior to survey were significantly correlated with dredged material disposal impact'. Therefore, the greatest effect was observed with deposition of coarser material, i.e., high % solids, and with high tidal flow, but latter observation may be an artefact as these areas were depauperate anyway.	infauna 1 - *Iphinoe trispinosa* 2 - *Magelona* sp. 4 - *Aphelochaeta* sp. 5 - *Scoloplos (Scoloplos) amiger* 6 - *Notomastus* sp. 7 – *Mysella bidentata* 8 – *Abra alba* 9 – *Tellina fabula* 10 – *Nucula nitidosa*	England and Wales coastlines, Channel, North and Irish Sea, intertidal to 65 m	1 - Ar: Mal: Cumacea: Bodotriidae 2-3 - An: Pol: 2 - Spionida: Magelonidae, 3 - Spionidae 4 - Terebellida: Cirratulidae, 5 - Orbiniidae, 6 - Capitellidae 7-9 - Mo: Biv: Veneroida: 7 - Montacutidae, 8-9 – Tellinidae 10 – Mo: Biv: Nuculida: Nuculidae	1 - (Goodsir, 1843) 2 - Müller, 1858 3 - Claparède, 1870 4 - Blake, 1991 5 - Müller, 1776 6 – Sars, 1850 7 – Montagu, 1803 8 – Wood, 1802 9 – Gmelin, 1791 10 – Winckworth, 1930	Bolam et al. 2006 (*Kuritella* as *Mysella*, *Tellina* as *Fabulina*)
SUSCEPTIBILITY, RECOVERY SPEED: Fisheries-related trawling and dredging generally reduced cover and richness of colonial and noncolonial benthos, but *F. implexa* and encrusting bryozoans were sometimes enhanced, and there was no clear effect on hydroids. Sponges and bushy bryozoans were most severely affected. Affected biota commonly displayed emergent growth forms, soft body parts, low motility, use of complex microhabitats, long life spans, slow growth, and larval dispersal over short distances. After closure to fishing, colonial and	various benthic biota: hydroids, colonial ascidians, bushy bryozoans, sponges, lacy tubeworm (*Filograna implexa*)	USA, Georges Bank, NW Atlantic, 40-50 m and 80-90 m	An: Pol: Sabellida: Serpulidae	Berkeley, 1835	Ash & Collie 2008

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
noncolonial biota increased again, but populations needed 2 years or more to recover.					
SUSCEPTIBILITY: Field depletion experiment with repeated shrimp trawls. Sponges dominated in the area. 'Gastropods suffered the greatest impact (an estimated 95% removed, on average). Ascidians, sponges, echinoids, crustaceans and gorgonians were depleted by an estimated 74-86%, and all other taxonomic groups except algae (27% removed) were reduced by at least 54%.' Depletion rates for sessile filter feeders were highest for gorgonians and sponges, and they ranked highly vulnerable.	megabenthos: e.g. 1 – sponges 2 – gorgonians 3 – crustaceans 4 – gastropods 5 – echinoids 6 – ascidians	far northern Great Barrier Reef, Pacific, ca. 20 and ca. 35 m	1 – Po 2 – Cn: Ant: Alcyonacea 3 – Ar: Mal 4 – Mo: Gas 5 – Ed: Ech 6 – Ch: Asc	1 – Grant, 1836 2 – Lamouroux, 1812 3 – Latreille, 1802 4 – Cuvier, 1795 5 – Leske, 1778 6 – Nielsen, 1995	Burridge et al. 2003
SUSCEPTIBILITY: Assessment of amounts of bycatch in Canadian trawl fisheries indicated that sensitive biota were strongly impacted. Sponges were dominant in weight and numbers. Gorgonian weights were underestimated, because of their catchability, they also tend to fragment and slip the nets. Gorgonians, sea pens and sponges contributed significant amounts as bycatch. 337 sponge species were distinguished but not identified, soft corals were slightly more diverse, none of the other groups reached 100 species.	various benthic biota, e.g. 1 – sponges 2 – soft corals 3 – gorgonians 4 – sea pens	Hatton Basin, N Atlantic, 123-1428 m	1 – Po 2 & 3 – Cn: Ant: Alcyonacea 4 – Cn: Ant: Pennatulacea	1 – Grant, 1836 2 & 3 – Lamouroux, 1812 4 – Verrill, 1865	Wareham et al. 2010
RECOVERY POTENTIAL: *In situ* manipulative experiment, causing catastrophic mortality by burial in sediments. Recovery after mortality relatively fast by vegetative growth (e.g. seaweeds), more quickly by species at sheltered compared to exposed sites, more quickly by biomass at exposed compared to sheltered sites, by day 95 both sites had recovered to >80%.	various benthic biota, mostly seaweeds, 3 molluscs, 1 urchin (details for other invertebrates, see above by species)	Mazatlán Bay, S Gulf of California, intertidal, swell area	-	-	Yáñyez et al. 2008
SUSCEPTIBILITY, RECOVERY POTENTIAL: Effects of prawn trawling were assessed in Spencer Gulf with historic prawning data and present surveys. Biomass, cover and abundance of macrobenthic fauna and flora were inversely correlated with prawning effort and habitats significantly changed since the 1960s, especially the razor clam and hammer oyster largely disappeared.	epibenthic organisms, e.g. 1 – *Pinna* sp. 2 – *Malleus* sp.	Spencer Gulf, S Australia, 21-26 m	1 – Mo: Biv: Pterioida: Pinnidae 1 – Mo: Biv: Pterioida: Malleidae	1 – Linnaeus, 1758 2 – De Lamarck, 1799	Svane et al. 2009
SUSCEPTIBILITY, RECOVERY POTENTIAL: *In situ* study involving experimental trawling, recording mortality and recovery. Within 2 weeks of treatment epifauna decreased by 28% compared to control and a further 8% in the following 2-3 months (e.g. sponges and bryozoans were affected). Benthos persistence declined and seagrass recruited less, but recruitment of other taxa increased (sponges and ascidians). Results were not consistent at all sites, *Pinna* and sponges declined at trawl sites, bryozoans declined everywhere, ascidians nowhere.	epibenthic organisms, e.g. 1– *Pinna bicolor* 2 – sponges 3 – bryozoans 4 – ascidians	Gulf of St. Vincent, S Australia, 20 m	1 – Mo: Biv: Pterioida: Pinnidae 2 – Po 3 – Bz 4 – Ch: Asc	1 – Gmelin, 1791 2 – Grant, 1836 3 – Ehrenberg, 1831 4 – Nielsen, 1995	Tanner 2003
RECOVERY POTENTIAL: Field study on the colonisation of an artificial reef. Barnacles, bryozoans and serpulids quickly dominated after 3 months, with barnacles being the single most common group during the first 6 months. Barnacles were especially common on the inside of the experimental cubes,	macrobenthos: 1 – serpulid worms 2 – cirriped barnacles 3 – bryozoans	Algarve, Portugal, E Atlantic, 20 m	1 – An: Pol: Sabellida: Serpulidae 2 – Ar: Max: Cirripedia 3 – Bz	1 – Rafinesque, 1815 2 – Burmeister, 1834	Boaventura et al. 2006

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
which was interpreted as a result of reduced sedimentation. Other invertebrates groups, such as sponges, hydrozoans, anthozoans, other sessile polychaetes, decapods, gastropods and bivalves were more abundant after 6 months of colonisation. Comment: It is not properly explained, but it seems that the experimental substrates are tubular cubes, i.e. the roof can be colonised and shelters the bottom, but front and back are open.	4 – ascidians 5 – sponges 6 – hydrozoans 7 – anthozoans 8 – polychaete worms 9 – decapod crustaceans 10 – gastropods 11 – bivalves		4 – Ch: Asc 5 – Po 6 – Cn: Hyd 7 – Cn: Ant 8 – An: Pol 9 – Ar: Mal: Decapoda 10 – Mo: Gas 11 – Mo: Biv	3 – Ehrenberg, 1831 4 – Nielsen, 1995 5 – Grant, 1836 6 – Owen, 1843 7 – Ehrenberg, 1834 8 – Grube, 1850 9 – Latreille, 1803 10 – Cuvier, 1795 11 – Linnaeus, 1758	
RECOVERY POTENTIAL: Field study comparing a recently dredged against a recovering site by underwater video (oyster fishery). The recovering area had 7 fish species and was more complex, with more cover (sponges, macroalgae), while at the recently dredged site with 3 fish species more tunicates and ophiuroids were seen and sponges were absent. Sponge cover was correlated with the abundance to some fish species.	epibenthos, e.g. 1 – sponges 2 – tunicates	Foveaux Strait, S New Zealand, Pacific, 32-38 m	1 – Po 2 – Ch: Tunicata	1 – Grant, 1836 2 – De Lamarck, 1816	Carbines & Cole 2009
SUSCEPTIBILITY, RECOVERY POTENTIAL: Experimental dredging to assess the impact of scallop fisheries. Infaunal bivalves and crustaceans did not show significant effects in abundance or biomass. Sessile biota such as polychaetes and burrowing urchins decreased. Epifaunal and large infaunal organisms were most affected, e.g. the razor clam *Ensis* sp. Dredging thus resulted in selective elimination.	epibenthos and infauna, e.g. *Ensis* sp.	Loch Ewe, E Atlantic, NW Schottland, <10 m	Mo: Biv: Euheterodonta: Pharidae	Schumacher, 1817	Eleftheriou & Robertson 1992
RECOVERY SPEED: Before/after dredging study. 11 months after dredging biomass, abundances and diversities had not yet recovered to original values. Sites with finer sediments recovered slower than with coarser sediments, and sediment characters per site had changed.	benthos	Long Island, New York, W Atlantic, 0-3.5 m	-	-	Kaplan et al. 1975
RECOVERY SPEED: Experimental suction-trailer dredging for sediment extraction was used in a BACI design to estimate recovery of the macrofauna through annual surveys. During the first 2 years post-dredging sediment transport was significant, and while dominant species quickly recolonised, rare species did not. 2 years after dredging biomass was still significantly reduced.	macrofauna, mostly worms and crustaceans	E United Kingdom, North Sea, shallow depth	-	-	Kenny & Rees 1996
RECOVERY POTENTIAL, RECOVERY SPEED: A BACI study was conducted in a small patch of hopper-dredged habitat with regular sampling over 180 days. It revealed that through dredging bottom sediments became coarser and the organic content poorer. Immediately after dredging species richness was reduced by 65% and abundance by 75%. Within 1 mo some species recovered (molluscs *Parvicardium exiguum* and *Retusa obtusa* and the polychaete *Pseudomalacoceros tridentata*).	macrobenthos, e.g. 1 – *Parvicardium exiguum* 2 – *Retusa obtusa*	Ceuta, Strait of Gibraltar, N Africa, 3-3.5 m	1 – Mo: Bivalvia: Veneroida: Cardiidae 2 – Mo: Gas: Cephalaspidea: Retusidae 3 – An: Pol: Spionida: Spionidae	1 – (Gmelin, 1791) 2 – (Montagu, 1803) 3 – (Southern, 1914)	Guerra-García et al. 2003 (*Scolelepis* as *Pseudomalacoceros*)

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
After 6 months the sediment quality and the macrobenthic community was similar to the undisturbed control.	3 – *Scolelepis (Parascolelepis) tridentata*				
RECOVERY POTENTIAL: Sites of hydraulic dredging for razor clams were assessed 1 and 40 days after the impact. Immediately after fishing a reduction in biodiversity was observed, which had recovered after 40 days and hydraulic dredging was thought to have no persistent effects.	infauna	Loch Gairloch, E Atlantic, NW Schottland, 7 m	-	-	Hall et al. 1990
RECOVERY SPEED: The effect of scallop dredging was experimentally assessed in a BACI design. Most infauna abundances were reduced (6 out of 10 species) by 20-30%, but after 3.5 months differences to controls were unrecognisable for most. Species that still had not recruited after 14 months caused a lasting community change in the area. Overall, changes caused by dredging were judged smaller than natural seasonal changes.	infauna (e.g. crustaceans, molluscs, worms)	Port Philipp Bay, Victoria, Australia, Bass Straight, Pacific, 12-15 m	-	-	Currie & Parry 1996
RECOVERY POTENTIAL: A fine-sediment and maerl area subjected to extractive dredging (1000 t year^{-1}) was compared to similar fallow area that was not impacted since 6 months. Abundances of 9 out of 60 taxa differed between the sites. At community level the sites did not differ, but the dredged area exhibited signs of stress and had a higher diversity. Filter feeder communities at the fallow area were replaced with omnivores at the dredged area. The changes were explained with sediment and nutrient mobilisation.	mostly infauna (e.g. crustaceans, molluscs, worms)	SW Ireland, NE Atlantic, 1-20 m	-	-	De Grave & Whitaker 1999
RECOVERY POTENTIAL: Benthic recolonisation at a sand and gravel extraction site with static and mobile hopper dredges was observed in the field. Extraction caused a significant difference in the community structure, with reduction of non-colonial macro-organisms, species richness and diversity, within the extraction site and at its boundaries. Fauna remained perturbed 6 years after dredging. Abundance of a number of spp. was reduced at disturbed sites, including worms, crabs and brittle stars, or they were missing entirely (compared to control sites).	mostly infaunal macrobenthos, sessile biota incl. the worms 1 – *Spirobranchus lamarcki* 2 – *Hilbigneris gracilis* 3 – *Lanice conchilega*	SE England, North Sea, 27-35 m	1 – An: Pol: Sabellida: Serpulidae 2 – An: Pol: Ecinida: Lumbrineridae 3 – An: Pol: Terebellida: terebellidae	1 – (Quatrefages, 1866) 2 – (Ehlers, 1868) 3 – (Pallas, 1766)	Boyd et al. 2003, 2005, Boyd & Rees 2003 (*Spirobranchus* as *Pomatoceros*, *Hilbigneris* as *Lumbrineris*)
RECOVERY SPEED: Field surveys to monitor benthic communities before, during and after dredging to construct a shipping channel. Predominant organisms were polychaetes and molluscs. Dredging originally completely eliminated the macrobenthos and reduced biodiversity and evenness. *C. gibba* was one of the first re-colonisers. Recovery was rapid, with observations after 6 months resembling conditions pre-dredging, but recovery was not yet complete, and uniform distributions were not yet re-established. Neighbouring areas remained unaffected, and severity of dredging effects also depends on concomitant occurrence of contamination.	macrobenthos, e.g. polychaetes and molluscs: 1 – *Hilbigneris gracilis* 2 – *Micronephthys sphaerocirrata* 3 – *Prionospio malmgreni* 4 – *Malacoceros fuliginosa* 5 – *Corbula gibba* 6 – *Abra alba* 7 – *Abra prismatica*	Tyrrhenian Sea, Mediterranean, 15-20 m	1-4 – An: Pol: 1 – Eunicida: Lumbrineridae 2 – Phyllodocida: Nephtyidae 3-4 – Spionida: Spionidae 5-8 – Mo: Biv: 5 – Myoida: Myoidae 6-7 – Veneroida: Tellinoidea 8 – Veneroida: Montacutidae	1 – (Ehlers, 1868) 2 – (Wesenberg-Lund, 1949) 3 – Claparède, 1869 4 – (Claparède, 1870) 5 – (Olivi, 1792) 6 – (Wood, 1802) 7 – (Montagu, 1808) 8 – (Montagu, 1803)	Bonvicini Pagliai et al. 1985 (*Hilbigneris* as *Lumbrinereis*, *Micronephtys* as *Nephtys*, *Malacoceros* as *Scolelepis* and *Kurtiella* as *Mysella*)

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
	8 – *Kurtiella bidentata*				
SUSCEPTIBILITY, RECOVERY POTENTIAL: Experimental field study to assess damage by harvesting of dead oyster shells. Compared to 'before', 'after' surveys showed that macrobenthos was much reduced in terms of numbers, densities and biomass: polychaetes (30, 59 and 85%), bivalves (54, 85 and 89%), amphipods (26, 81 and 71%), ophiuroids (40, 85 and 85% loss), making a total of 40, 66 an 87% loss across the groups, with bivalves the most affected. After 6 months there was still a significant reduction noticeable in comparison to control sites, but after a year this difference disappeared. Using a hopper dredge made no clear difference. Comment: Except maybe for amphipods – less loss, and ophiuroids – more loss.	macrobenthos, e.g. groups that contain filter feeders: 1 – polychaetes 2 – bivalves	Tampa Bay, Florida, Gulf of Mexico, 7 m	1 – An: Pol 2 – Mo: Biv	1 – Grube, 1850 2 – Linnaeus, 1758	Conner & Simon 1979
SUSCEPTIBILITY: Documentation of disturbance from otter trawling and scallop dredging by underwater imagery. Disturbance reduced % cover and abundance of *F. implexa*, colonial hydroids and bryozoans, thereby reducing habitat complexity and diversity of associated fauna. Sponges only occurred at undisturbed sites, one disturbed site was dominated by burrowing anemones or *Astarte* spp.	macrobenthos, e.g. 1 – sponges 2 – hydroids 3 – *Urticina felina* 4 – *Filograna implexa* 5 – *Astarte* spp.	Georges Bank, NE America, NW Atlantic, 45-90 m	1 – Po 2 – Cn: Hyd 3 – Cn: Ant: Actinaria: Actiniidae 4 – An: Pol: Serpulida: Sabellidae 5 – Mo: Biv: Carditoida: Astartidae	1 – Grant, 1836 2 – Owen, 1843 3 – (Linnaeus, 1761) 4 – Ehrenberg, 1831 5 – De C Sowerby, 1816	Collie et al. 2000
SUSCEPTIBILITY, RECOVERY SPEED: Impact assessment of aggregate dredging. 'In all, a total of 316 taxa were recorded. The assemblage as a whole was dominated by Polychaeta and Crustacea, although hydroids, Mollusca and Bryozoa were also important.' Trailer dredging had no impact, but dredging on anchor reduced biodiversity, population density and biomass and a change in species composition within 100 m from the dredging site. In contrast, biodiversity, population density, biomass and body size was enhanced as far as 2 km in direction of the tidal stream. Biomass recovered slower (> 80 days) than biodiversity and population density (after ca. 80 days).	macrobenthos: 1 – Polychaeta 2 – Crustacea 3 – Mollusca 4 – Bryozoa	E of the isle of Wight, UK, English Channel, >10 m	1 – An: Pol 2 – Ar: Max 3 – Mo 4 – Br	1 – Grube, 1850 2 – Brünnich, 1772 3 – Linnaeus, 1758 4 – Ehrenberg, 1831	Newell et al. 2004
SUSCEPTIBILITY: Material extraction resulted in the removal of 800,000 t year^{-1} by trailer dredging, and a rejection of an estimated 200,000–500,000 t year^{-1} by screening, settling out fine, sorted sands in the area. The impact appeared lower than at other sites, with mobile opportunistic worms and crustaceans dominating, but species evenness was significantly reduced at dredged sites.	infauna: worms and crustaceans	E of Humber estuary, UK, North Sea, ca. 20-30 m	-	-	Robinson et al. 2005
RECOVERY SPEED: 3-year (5-8 years after cessation of dredging) monitoring to study recovery periods after aggregate dredging, respective to dredging intensity, and effects of immediate dredging. Dredging reduced biodiversity. Although recolonisation was rapid at high intensity site with intensive settlement of *B. crenatus* (apparently an opportunistic coloniser) and *S. spinulosa* (taking	macrobenthos. largely infauna, e.g. 1 – *Sabellaria spinulosa* 2 – *Balanus crenatus*	Hastings Shingle Bank, SW England, North Sea, 14-40 m	1 – An: Pol: Sabellida: Sabellariidae 2 – Ar: Max: Sessilia: Balanidae	1 – Leuckart, 1849 2 – Bruguière, 1789	Cooper et al. 2007

Observation, environmental condition	Species	Location	Taxonomic allocation	Taxon authority	Reference
advantage of a shift in sediment composition?), tracks were still visible after 8 years. At low intensity site recovery took 7 years.					
RECOVERY SPEED: Field experiment with trays of gravel offered for colonisation. Tray recolonisation was rapid and reached control levels after 2 years, while neighbouring experimental sites required 4.5 years. Tray biomass also increased, but at a lower rate than in nature, especially of structure-forming biota (x8; see next column), but scavenger biomass was x32 in trays. Reduced settlement success of structure-forming biota was explained by intermittent burial by sand and effects of scavengers.	macrobenthos, e.g. 1 – sponges 2 – hydroids 3 – *Urticina felina* 4 – bryozoans 5 - *Filograna implexa*	Georges Bank, NE America, NW Atlantic, 45-90 m	1 – Po 2 – Cn: Hyd 3 – Cn: Ant: Actinaria: Actiniidae 4 – Bz 5 - An: Pol: Serpulida: Sabellidae	1 – Grant, 1836 2 – Owen, 1843 3 – (Linnaeus, 1761) 4 – Ehrenberg, 1831 5 – De C Sowerby, 1816	Collie et al. 2009
RECOVERY POTENTIAL: Field surveys were conducted at 120 sites and compared to history of trawling. At community level biomass and abundances appeared to be mainly influenced by nutrient influx and could not be correlated with trawling effort. Trawling, however, significantly increased (6 species) and decreased (5 species) the abundance of the 20 most common species. Especially sponges, bryozoans and fish were significantly less prevalent in trawled areas.	macrobiota, including benthos	Spencer Gulf, Great Australian Bight, <10 to <90 m	e.g. Po	Grant, 1863	Currie et al. 2011