Table S1 – Key threats/ pressures impacting species within the GBR

Direct or indirect threat	Examples of consequences/ impacts	Implication for species	Example/ reference(s)
Climate change	Increasing ocean acidification	• Reduced calcification of corals and other calcifying organisms; reduced species diversity • Habitat destruction, food-web deterioration, disruption of physiological processes, species health and survival • Weakening of carbonate structure	Hannam et al 2007, Veron, et al 2009; Hoegh-Gulberg et al 2007b; Pandolfi et al 2011; Anthony et al 2011; De'ath et al 2013; Dixon et al 2010; Eyre et al 2018
	Rising sea temperatures	• Sea temperature anomalies leading to mass coral bleaching • Range shifts in species • Reduced foraging success for seabirds resulting in increased nesting failures • Impacts on health and reproduction of fishes	Berkelmans et al 2004; Lough 2000; Johnson and Marshall, 2007; Thompson and Dolman 2010; Smithers et al 2003; Donelson et al 2010; Ainsworth et al 2016; Hughes et al 2018
	Changing oceanographic patterns	• Increasing evidence in recent years of intensified flows and increased warming in the East Australian current transporting greater volumes of water southward, carrying larvae and juveniles	Steinberg 2007; Berkelmans et al 2010; Ridgway and Hill 2012; Williams and Crimp 2012
	Rising sand temperatures	• Increasing 'feminization' of Green turtle population already predicted	Fuentes et al 2011; Fuentes et al 2012
	Increased frequency of intense rainfall and increased intensity of severe cyclones	• Increased damage to Reef habitats (e.g. approx. 6% of GBR suffered severe damage during cyclone Yasi; seagrass vulnerable to the effects of reduced light during long periods of exposure to flood plumes); also damage to mangrove habitats (e.g. alter the community structure and productivity) • Increased strandings of species of conservation concern (e.g. dugong and turtle) following seagrass loss due to flooding • Reduced salinity causing bleaching and mortality in corals • Decreased time available for recovery between major disturbances	Done 1992; Lough 2007; Munday et al 2007; Fabricius et al 2008; GBRMPA 2011a; Berkelmans et al 2012
	Rising sea levels	• Even modest sea level rises may have implications for the shape of coastlines and islands • Increased erosion; and inundation leading to significant changes in estuarine habitats • Turtle nesting particularly vulnerable due to greater beach erosion and inundation of nests • Seabird nesting and shorebird roosting sites at risk	Fuentes et al 2010; Church et al 2011
	Ecological consequences due to a loss of a specific level in the food web, a specific species or a specific size class	• Trophic cascades, phase shifts and loss of functional diversity • Reduction in herbivorous species (e.g. herbivorous fish, but also turtles and dugongs) critical to limit macro-algae (seaweed) which otherwise overgrows corals resulting in coral mortality or reduced settlement/ growth of new coral	Marsh et al 2001; Hughes et al 2007; Hoey and Bellwood 2011

Declining water quality	Increased levels of sediments in river plumes	• Increasing sedimentation can smother seagrasses and coral reefs, reduce light penetration in the water column, and impede coral growth and reproduction • Increased turbidity can reduce light available for photosynthesis in seagrasses resulting in "senescence" (shedding of leaves on shoots, thus reducing abundance) and eventual mortality • Increase susceptibility to disease, and suppress subsequent recovery after other disturbances	Devlin et al 2012; McKergrow et al 2005; Wenger et al 2011; Wenger et al 2013; Collier et al 2012; Schroeder et al 2012; Fabricius 2005; Brodie and Pearson 2016
	Increased levels of nutrients in river plumes	• Corals exposed to high levels of nutrients have elevated bleaching susceptibility; nutrient-enriched fine-grained terrestrial silts being particularly detrimental as they are more difficult for corals to shed, causing a barrier to gas exchange and altering microbial communities leading to tissue mortality; dissolved inorganic nutrients can lead to significant physiological changes including decreased calcification • Increased outbreaks of Crown of Thorns seastars (COTs) due to increased phytoplankton (food source for platktonic larval stages of COTs); • Elevated water column nutrients can favour the growth of plankton blooms, macroalgae and epiphytic algae, all of which attenuate light availability to seagrass leaves • Dissolved inorganic nutrients can lead to significant physiological changes such as decreased calcification	Furnas et al 2005; Brodie et al 2005; 2008; 2013; De'ath et al 2012; Waterhouse et al 2013; Jones and Berkelmans 2014; Fabricius et al 2005; Wiedenmann et al 2013; Thompson et al 2014, Brodie and Pearson 2016,; Davis et al 2016
	increased levels of herbicides or pesticides in river plumes	• Chronic herbicide exposure can influence species composition; reduce the efficiency of photosynthesis in seagrasses; in the longer term can cause damage to photosynthesis processes in corals and reduced reproductive output	Lewis et al 2009; Kroon et al 2012; Lewis et al 2012; Smith et al 2012; Turner et al 2013; Shaw et al 2010
	Increased levels of pharmaceuticals and urban pollutants	• Stormwater receives little if any treatment (unlike sewerage) so any chemicals (e.g. fertilizers) enter the GBR without treatment	Harrington, et al 2005; Costanzo et al 2005
	Increased levels of industrial contaminants	• Release of heavy metals, metalloids and non-metalic inorganics • Release of toxic contaminants like mercury, cadmium from old tailings dams; these accumulate up the food chain	Brodie et al 2012; Haynes and Johnson 2000; Angel et al 2010
Unsustainable coastal development *(this may occur as part of port activities like dredging or sea dumping, reclamation; or*	Dams, weirs and drainage altering freshwater flows into the GBR	• Construction of artificial barriers or modifications to natural water flows can lead to greater runoff and less water retention on the land. • Modified hydrological processes and alteration of natural coastal processes e.g. changes in the shape and size of river deltas or sand spits	Hyland 2002; Brodie et al 2013; GBRMPA 2013b; Sheaves et al 2014
	Reclamation of marine habitat	• Modifying coastal processes and altering groundwater levels; • Localised impacts on habitats including exposure of acid sulphate soils and changing sediment movement and deposition	Meynecke et al 2007; Sinclair Knight Merz Pty Ltd 2013
	Exposure of acid sulphate soils	• Removal of coastal vegetation can result in the mobilisation of large quantities of iron and aluminium leading to algal blooms • Combination off high acidity waters with heavy metals will affect many species and habitats – often long term impacts that are difficult to reverse	Powell and Martens 2005

from urban or industrial expansion)	Sea dumping	• Burial or smothering of benthic fauna and flora; loss and modification of habitat • Degradation of water quality • Resuspension of sediment deposits by waves and tidal currents leading to burial of seagrass or smothering of coral (previous modelling has seriously underestimated the direction and dispersal; and therefore the potential magnitude and extent of the impacts • Impacts can be exacerbated by the timing and frequency of disposal (e.g. during key spawning times)	Wolanski and Gibbs 1992; Smith et al 2007; Sinclair Knight Merz 2013
	Dredging (both capital and maintenance dredging)	• Loss of species, including benthic organisms; smothering of marine life both at disposal site and in surrounding areas after resuspension • Modifying coastal processes and changing hydrodynamics • Removal or modification of existing habitat like seagrass (which are also huge carbon sinks) • Increase turbidity; changes in species behaviour • Increased underwater noise • Increased sediment affect fish health and survival	Smith et al 2006; Erftemeijer and Lewis 2006; ; Erftemeijer et al 2012; Smith et al 2007; Cagnazzi et al 2013; Pollock et al 2014; Wenger et al 2013; Hess et al 2015
	Increased light pollution and visual disturbance	• Altered light regimes impacting nocturnal orientation of both adult marine turtles and hatchlings • Artificial lighting can cause impacts on seabird hatchlings and some pelagic fish	Kamrowski et al 2012; Santos et al 2010
	Increase in noise	• Noise now considered to be a significant stressor of marine life, particularly marine mammals • Can lead to significant behavioural changes; hearing loss, physical injury and mortality	Slade and Dunlop2014; Ellison et al 2011
	Increase in atmospheric pollution	• Eg. coal dust around port loading facilities, vehicle emissions, ash clouds • Reducing the amount of sunlight reaching the benthos and reduce photosynthetic activity and growth rates	Johnson and Bustin 2006
	Hardening of surfaces	• Increased runoff due to increased roads/hardening	Wong et al 2000
Shipping impacts	Noise impacts on marine wildlife	• Direct or indirect fitness costs relation to behavioural and physiological responses to noise pollution	Richardson, et al 1995; UNEP 2012; Francis & Barber 2013
	Vessel strikes on marine wildlife	• Strikes often result in injury or death of marine mammals and turtles	
	Ship-sourced pollution	• Waste discharge • Leaching of biocides from ship's anti-foulants	Grech et al 2013; Konstantinou and Albanis 2003
	Introductions of invasive marine pest species	• Consumption of and competition with native coral reef animals • Phase shifts and losses in ecosystem functionality	Worley Parson 2009
	Damage to benthic habitats from ship grounding	• Can significantly impact habitats like coral reefs through either physical damage (scar from breaking coral) and consequent impacts from anti-foulant paint embedded in coral and paint flakes in sediment	ATSB 2011; GBRMPA 2011b; Turner 2010
	Oil spill/chemical spill from ship grounding or collision	• Apart from the physical smothering of plants and animals, oil toxicity and its chemical reactions means a large spill would have persistent effects on the health, growth, reproduction and survival of many marine species for years, even decades	Aston 2006; Anderson et al 2008

	Increased turbidity from maintenance dredging and large ships transiting shallow shipping channels	• Fine material from maintenance dredging can be readily transported and resuspended, impacting corals and seagrass many kilometres away from any dumpsite. • Deep-draft ships transiting shallow shipping channels on low tides can be seen from the air as leading to propeller scouring causing resuspension of fine sediments, often onto adjacent areas.	McCook et al. 2015 Garel et al, 2008
	Damage from repeated ship anchoring eg. close to ports	• Localised chronic effects which can impact biodiversity and cause habitat changes.	GHD P/l 2013;
Unsustainable fishing impacts	Extraction of top order predators (e.g. sharks) with potential flow-on impacts on habitats and other species in the food web	• Predators play a key role in maintaining healthy ecosystems' reduction in predators can lead to direct and indirect impacts elsewhere in the food chain	Heithaus et al 2008
	Incidental catch of protected species and other species of conservation concern	• Entanglement and/or death of species of high conservation concern	Tobin et al 2010; Courtney et al 2010: GBRMPA and Qld 2013
	Death of non-targeted or discarded (by-catch) species due to size or catch restrictions	• Injure or kill species of conservation concern leading to population declines or compromising the ability of depleted populations to recover	Hall et al 2000; Courtney et al 2007: Pears et al 2012;
	Fishing unprotected spawning aggregations of some species	• Declines in fish populations with negative social, economic and ecological consequences	Russell et al 2012; Sadovy and Domeier 2005; Tobin and Currey 2013
	Localised physical damage	• Benthic damage from trawling • Anchor damage and fishing line damage at popular fishing spots eg fringing reefs	Burridge et al 2006; Pitcher et al 2009; Asoh et al 2004
Disease and pest species	Outbreaks of COTs	• Major cause of coral mortality when COTS are in outbreak proportions	Furnas et al 2013; Fabricius et al 2010;
	Introductions through ballast discharge	• While many such introductions are relatively harmless, some have become aggressive pests	Department of Agriculture, 2013
	Disease outbreaks	• Disease is a clear indicator of stress, especially in species or habitats already under threat from other disturbances (eg. fabropapillomas in turtles already subject to water quality pressures)	Bruno, et al. 2007; Haapkylä et al 2011; Pollock et al 2014; Heron et al 2010
	Toxic blooms	• Can smother seagrass or expose marine species to tumour-producing compounds produced by the cyanobacteria.	Jones 1992; Arthur et al 2006
	Outbreaks of pest species e.g. *Drupella*	• Consumption of benthic organisms with cascading effects including biodiversity loss. Impaired ecosystem functioning, loss of aesthetic value	Cumming 2009

Marine debris	Smother coral or entangle wildlife	• Compromising the ability to capture and digest food, compromising locomotion, including migration and the ability to sense and escape from predators	Reisser et al 2013
	Ingestion causing death or injury	• Decreasing body condition and compromising locomotion and reproduction • Species can absorb persistent, bio-accumulative and toxic substances (eg persistent organic pollutants - POPs), leading to toxicological effects on fish, mammals and molluscs	Andrady 2011; Simmonds 2012; Caron et al 2018
	Discarded fishing gear	• e.g. 'ghost' fishing caused by discarded nets	Laist 1996

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