

Viewpoint

Coral reefs in the Gulf are mostly dead now, but can we do anything about it?



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ABSTRACT

This article discusses two key issues: firstly, the demise of reefs in the Gulf which is happening probably more rapidly than elsewhere; and secondly, the reasons why this remains such an intractable problem. Most reasons for this decline are scientifically well understood, though clearly not by the region's managers. Several factors may cause people to ignore the problem, even though habitat loss is vastly costly to the region. About 70% of the Gulf's reefs have essentially disappeared in a few decades, and although scientific indicators confirm that this is happening, it is commonly discounted as even being a possibility. Management of human interactions with the Gulf's marine systems remains very inadequate, to the detriment of the Gulf's marine systems and its people. It is clear that this not a scientific issue any longer but rather it is a political problem and failure.

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1. Introduction

There is much evidence to suggest that a massive decline is occurring in the Gulf of all of its major marine systems including coral reefs, mangroves, seagrass beds and fish stocks, to the extent that it has been called a 'young sea, in decline' (Sheppard et al., 2010). There is no doubt about the ongoing, substantial degradation, as several scientists have been measuring it for many years (Sheppard et al., 2010, 2012 for reviews), and the extent of degradation in most cases is known both for the Gulf as a whole and for most of the surrounding countries individually (Burt, 2014; Burt et al., 2014). The history of the marine environment's deterioration and its management in this region is not good, so the questions are: why is this happening; what can be done about it in a biological or ecological sense; and what can be done about it in governmental or intergovernmental arenas?

There seems little doubt that the cost to the region of such extensive environmental damage is substantial. For example, it was estimated using 20 year old figures from Costanza et al. (1997), that the marine habitats of Bahrain were worth about \$2 billion per year to that Kingdom (Al Khuzai et al., 2009; Loughland and Zainal, 2009), yet development continued to go ahead that now has almost totally killed a significant proportion of that country's marine habitats. More recent figures (Costanza et al., 2014) suggest that the annual loss today should be valued many times higher, and the largest coral reef in that part of the Gulf, Fasht Adhm, is now totally killed by sediments (Fig. 1).

For the Gulf as a whole, figures of coral reef loss are very alarming (Fig. 2). Burt (2014) calculated that historically the Gulf contained 3800 km² of coral reef, about 70% of which are effectively dead (see next section). Using both this figure and the newer, revised values of habitats

from Costanza et al. (2014), this equates to an annual loss of the immense value of about \$94 billion. This is necessarily speculative: these values for reefs are global estimates and, for example, values attributed to tourism aspects of reefs will be less in the Gulf than in many other places. (By comparison, oil revenues from the region are about \$340 billion per year from the production of approximately 6.8 billion barrels per year at \$50 per barrel (Statistica, 2015; CNN, 2015)). But, speculative or not, the message nonetheless should be clear, the more so given that the land surrounding the Gulf is arid, and the loss of so much of the once rich reefs is loss of a significant part of the region's total biological richness.

Obviously, development takes place because of the gains and advantages accruing from it, but it is equally clear that the costs of losing habitats are almost invariably not taken into account sufficiently during development planning, so that inadequate efforts are made to maintain the healthy ecosystems which benefit the people of the region. The causes of loss have been known now for at least three decades, so the question instead becomes: why does action not take place sufficiently to try and achieve the development that the region desires along with maintaining the important and valuable ecosystems?

2. The evidence

Are reefs of the Gulf really dying, or is the alarmist view grossly exaggerated? We know that there is a very marked West to East gradient of effects both within the Gulf and within different parts of it too (Burt et al., 2011) so exceptions exist to any very generalised pattern. The two severe global warming events of the late 1990s caused major deterioration in a short time (Sheppard and Loughland, 2002) from which many places in the Gulf have not recovered at all. Recovery, however, did occur in a very patchy and sporadic way for a while in some parts such as in the UAE, though these subsequently became buried by

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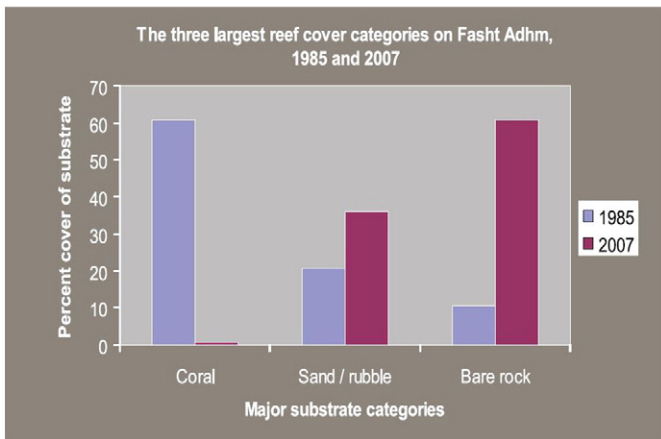


Fig. 1. Coral cover on Bahrain's Fasht Adhm in 1985 and 2007, using the same sites in each survey. From Al Khuzai et al. (2009) and Sheppard et al. (2010).

industrial activities (Burt et al., 2014). Even sites distant from shore that might have recovered still show a much degraded form when compared with historic descriptions (Burt et al., in this issue).

That recovery is often possible can be seen from many other places in the tropical world, a process attributed to a lack of local impacts such as sedimentation from coastal development, and an absence of other forms of pollution or overfishing (Ateweberhan et al., 2011). Wilkinson (2008) developed estimates of the degree to which reefs had deteriorated in particular ocean basins and for the world as a whole, and he divided the world's reefs into four major categories from low threat level (broadly equating to being in good condition), to reefs which are effectively lost (Fig. 2, left column). In very rough terms, in most ocean basins and in the world as a whole, each category occupies about a quarter of the total (which is bad enough!), but the same measures applied to coral reefs in the Gulf by Burt et al. (2014) show a very stark picture: no less than about three quarters of coral reefs in the Gulf are 'effectively lost', three times greater than the global estimate. The percentage of reefs classified as being in the best category now is only about 5%. It is not unreasonable therefore to conclude that the reefs are effectively not far from being lost, although of course examples can be found, especially by diving clubs and the like, of reefs that are worth visiting for recreational purposes. (It is commonly the case, though, that even these are covered with fish traps and lobster pots.) Reefs further from shore

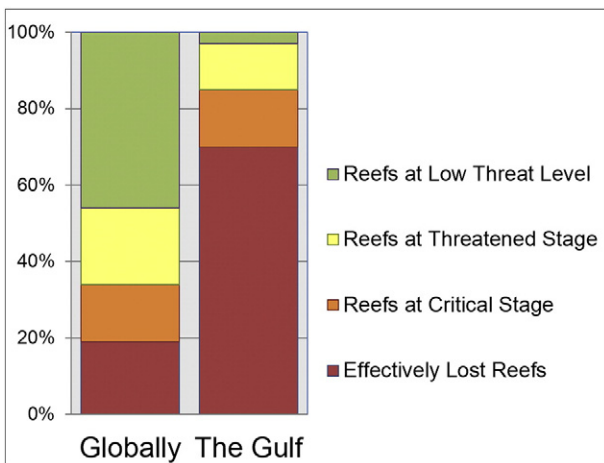


Fig. 2. Major categories of reef condition, for the world and for the Gulf. From Burt et al. (2014).

such as those around the islands of Saudi Arabia are less impacted than are reefs closer to mainland shores.

In the worst cases there remains no resemblance of coral reef at all over several square kilometres while in others (Fig. 3) the dead and heavily eroding structures can still be seen. A large site in north Qatar which was flagged up by Kinsman (1964) as having unexpectedly high richness and cover before much industrialisation had taken place was found, in 2000, to have no living coral at all and not a single fish was seen in several hectares, the entire place being covered by sedimented coral rubble with seaweed (personal observations). The second-biggest category in the Gulf, occupying about 15% of the remainder, are themselves termed as being at 'critical stage', and the present progression suggests that many of these may never recover.

Some comparable information is available too for seagrasses and mangroves (Burt, 2014). When it is considered that much of the shoreline landfill that is being done on the Arabian side is taking place in shallow waters with a gentle slope that can, and usually did, support mangrove and seagrass habitat, it is very likely that the declines in these habitats will be very similar to that of coral reefs.

3. Causes of damage in the Gulf

Environmental damage is commonly considered to come from two general classes of impact which can be called local and global (Table 1). Of the 'local' class some are commonly termed 'bottom-up' controls such as excess sewage or sediment, dredging and discharges, or 'top-down' controls which include overfishing or destructive fishing, in which removal of predators or grazers has an effect further down the food chain. The 'local' impacts increase with burgeoning populations and have synergistic effects, while global changes are those commonly attributed to climate change, particularly temperature extremes. All these impacts superimpose onto naturally elevated salinity and large temperature fluctuations resulting from the region's intense evaporation, its relatively shallow nature and its very restricted interchange with the Indian Ocean (Sheppard et al., 1992, 2000). While naturally warm and high salinity water has been the norm in the Gulf for thousands of years, it is not without consequence to overall biodiversity because only about a quarter or less of the corals that occur in the Indian Ocean have the natural tolerance to survive in the Gulf at all.

For coral reefs, interesting changes also take place that fall short of simply being killed (Fig. 4). Branching forms of corals have been particularly susceptible to warming events, and these provide (or provided) much of the extensive three-dimensional structure that is so important for increasing habitat diversity and niche structure. As a result of their selective elimination, reef areas where these branching forms used to thrive have sometimes changed to having a cover of more resistant, massive forms which have a far lower three-dimensional structure, something observed in many parts of the Gulf (Sheppard and Loughland, 2002 (in the UAE); Sheppard et al., 2010 (for Iran); Burt et al., 2011 (UAE); Burt et al., 2013 (Bahrain); Burt et al., in this issue (Qatar)). Even when coral cover remains fairly high or recovers measurably, the result is still an area with lower rugosity. Essentially the 3-D structure of the Gulf's reefs has largely changed into a more 2-D planar structure.

Overfishing is a global problem, and the Gulf is as susceptible to it as anywhere else (Grandcourt, 2012). Most fisheries have deteriorated to some degree, or have collapsed. Table 2 shows some results from the UAE, and Sheppard et al. (2010) present several histograms of more detailed declines in the western part of the Gulf. Approximately half to two thirds of fish caught are reef associated species (Grandcourt, 2012) so that, in addition to issues of overfishing, reef destruction has added additional consequences of habitat loss for fish. The overall consequences may already be being shown: Grandcourt (2012) shows that, over the last 30 years, overall fishing intensity has risen resulting in a rise in total fish catch, but not of reef-associated species for about the last 25 years (Fig. 5). Of the most commercially important reef fish

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