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Can we meet the Target? Status and future trends for fisheries sustainability

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We assess progress towards Aichi Biodiversity Target 6, which aims to achieve global fisheries sustainability by 2020. Current trends suggest that the proportion of fish stocks within safe ecological limits is likely to decline until 2020. While model projections show a considerable reduction in overexploited stocks by 2050 if climate change is not considered, there will be a substantial increase in the risk of overexploited fish stocks if climate change is taken into account. Overall, although there is progress toward rebuilding fisheries in some developed nations, this improvement is insufficient to meet the Aichi Target by 2020; there is a need for substantial changes to current fisheries policy and management if Target 6 is to be met.

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Introduction

The Strategic Plan for Biodiversity 2011–2020 was adopted by the Parties to the Convention on Biological Diversity (CBD) in 2010. It includes a set of 20 Targets (the Aichi Biodiversity Targets) which aim to reduce biodiversity loss, improve the status of biodiversity, and enhance biodiversity benefits and ecosystem services to society by 2020. Target 6 has the aim that 'By 2020 all fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying ecosystem based approaches, so that overfishing is avoided, recovery plans and measures are in place for all depleted species, fisheries have no significant adverse impacts on threatened species and vulnerable ecosystems and the impacts of fisheries on stocks, species and ecosystems are within safe ecological limits.'

With 3 years left to the Target deadline, it is timely to assess whether or not the Target is likely to be achieved by 2020. Understanding where we stand now and how this translates to potential future scenarios in the short (to 2020) and long term (2050) is important to inform policy makers about where actions are needed in order to achieve the Target. As such, this paper first assesses evidence about progress towards Target 6 by reviewing the current status and trends of marine fisheries sustainability worldwide. We focus on the impact of fisheries on marine biodiversity and habitats, and the factors that impact upon fisheries sustainability. The second part of this study involves scenario modelling for marine fisheries, in which we forecast biological outcomes of fisheries in the long term. While Target 6 covers a broad range of issues, we limit the scope of our analysis about future fisheries sustainability to commercially targeted fish species.

The main research questions we address are:

1. Are we on track to meet Target 6 by the 2020 deadline?
2. What are the short and long term implications of current trends for fisheries and marine biodiversity?
3. What needs to be done to achieve Target 6?

A suite of measurable indicators for monitoring progress towards Target 6 was compiled by the CBD [1]. These were grouped into broad categories covering trends in first, certified sustainable fisheries; second, proportion of depleted, target and bycatch species with recovery plans; third, population and extinction risk in target and bycatch species; fourth, fishing practices; fifth, proportion of fish stocks outside safe biological limits; and sixth, catch per unit effort.

Methods

Literature review

We conducted a review of published and grey literature to assess the current status and trends of marine fisheries as they relate to achieving Aichi Target 6. As this is a global review, the studies covered both regional and global

Table 1

Characterisation of Rio + 20 Pathways and how they will achieve 2050 target

Pathway	Main assumption
Decentralised Solutions	Focuses on decentralised solutions such as local energy production, agriculture that makes use of natural corridors, and national policies that regulate equitable access to food.
Global Technology	Focuses on large-scale technologically optimal solutions and a high level of international coordination, for example, intensive agriculture and trade liberalisation.
Consumption Change	Focuses on changes in human consumption patterns by limiting per capita meat intake and choosing less energy-intensive lifestyles.

Source: van Vuuren *et al.* [1]

scales, thereby minimising regional biases. However, it is noted that literature on certain topics, such as fish stock assessments, are predominantly based upon analyses conducted in developed countries. The scope of this review included impacts of marine capture fisheries on marine biodiversity and ecosystems (e.g. bycatch, habitat modification), climate change impacts on fisheries, and projections for different indicators and aspects of fisheries sustainability in the short and long term. We also identified policy or management approaches that can elucidate what governments can do to move towards sustainable fisheries. The temporal scope of this review was from 2010 onwards in order to coincide with the Strategic Plan for Biodiversity timeframe, which covers the period 2011–2020. However, earlier literature was used if no recent relevant studies were available.

Projecting fisheries trends to 2050

Scenarios

To investigate fisheries sustainability trends to 2050, we projected the proportion of fish stocks at risk of overexploitation in 2050. This projection incorporated climate change impacts on fish biomass and distribution in 2050, and are based on the underlying assumptions of the three Rio + 20 Pathways [2] (Table 1), a set of alternative socio-economic pathways along which the sustainable development goals set out in the 1992 Rio Declaration (eradicating poverty, halting climate change, and conserving ecosystems) may be achieved. Each of the three Rio + 20 Pathways (Decentralised Solutions, Global Technology, Consumption Change) describe the level of effort and changes in governance and socio-economic policies required to achieve these sustainable development goals by 2050.

The Rio + 20 Pathways tend to focus mainly on terrestrial sectors such as forestry, energy, and agriculture; we applied the same concept of the Rio + 20 Pathways to the marine realm. We adapted the governance and socio-economic conditions of the three Rio + 20 Pathways to potential scenarios for how sustainable marine fisheries (i.e. fisheries exploited at maximum sustainable yield (MSY)) may be achieved by 2050 (Table 2, with details in Supplementary Materials). Assumed changes in fishing effort for coastal and high seas fisheries, and governance and policy adjustments are consistent with the broader societal development trajectory in each of the Rio + 20 Pathways. Although not stated in Target 6, we use MSY as a reference point for sustainable fisheries because it is widely accepted as an objective for fisheries management, and is the measure used in international agreements and forums such as the United Nations Convention on the Law of the Sea[1] and the 2002 World Summit of Sustainable Development [3]. It is also used by various inter-governmental institutions such as the Food and Agriculture Organization of the United Nations and European Union Common Fisheries Policy. It is noted that fisheries can still be productive at levels below MSY [4].

Projecting future fisheries trends

Current global marine catch is around 81.5 million t [5], while estimated potential catch at maximum sustainable yield (MSY) is around 88.7 million t, ranging from 82.7 to 99.4 million t [6]. Therefore, global fisheries are currently at about 90% of MSY level. To investigate future fisheries trends (i.e. proportion of fish stocks at risk of overfishing), we used global fisheries catch data from the *Sea Around Us* project (www.seaaroundus.org) with a population dynamics model developed by Martell and Froese [7]. We defined fishery stocks by species and FAO (Food and Agriculture Organization of the United Nations) statistical area. The global ocean is divided into 27 major fishing areas for statistical purposes by the FAO. We only included stocks with catch data reported at the species level. Based on the combinations of fish stocks found within all FAO Areas from the *Sea Around Us* project database (www.seaaroundus.org), we obtained a total of 1343 stocks within Exclusive Economic Zones (EEZs) and 537 stocks in the high seas, inclusive of fishes and invertebrates.

We applied the Catch-MSY method [7] to simulate changes in fish stock biomass and exploitation rate. The Catch-MSY method is a biomass dynamic model that is run with time-series of catch removal (based on

[1] United Nations Convention on the Law of the Sea 10 December 1982 Overview and full text. http://www.un.org/Depts/los/convention_agreements/convention_overview_convention.htm.