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Loved to pieces: Toward the sustainable management of the Waitematā Harbour and Hauraki Gulf

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ABSTRACT

The Waitematā Harbour is a drowned river valley in the south-west of the Hauraki Gulf, on the north east of New Zealand's North Island. The central business district for the city of Auckland is situated on the southern shore of the central Waitematā Harbour and is New Zealand's largest and fastest growing city. The Waitematā Harbour hosts a major international port, New Zealand's primary naval base and international cruise terminal, as well as a large and committed community of recreational users. In comparison with the marine ecosystems surrounding many of the world's coastal cities, the Waitematā Harbour and the Hauraki Gulf have experienced a relatively short period of human occupation. Nonetheless, rapid and widespread changes have occurred within these ecosystems. Habitat loss and declines in biodiversity as well as impacts on human activities such as safe swimming and recreational harvesting have motivated several conservation and restoration initiatives. Here, we review the natural and social context of the Waitematā Harbour and Hauraki Gulf, and summarise some of the pressures the region faces. Last, we present three case studies highlighting current participatory initiatives aimed at ensuring more sustainable management of the region's marine ecosystems. The Waitematā Harbour and Hauraki Gulf have provided considerable ecological, social and economic wealth for the people of Auckland; accordingly, conserving these ecosystems and preserving future prosperity should be a collective priority for all sectors of society.

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1. Introduction

The Waitematā Harbour and the Hauraki Gulf are arguably New Zealand's favourite marine playgrounds and our South Pacific nation's primary maritime connection to the world. The central business district for New Zealand's largest city, Auckland, is situated on the southern shore of the central Waitematā Harbour at the south-western end of the Hauraki Gulf on the North Island (Fig. 1). The wider Auckland metropolitan area straddles the isthmus of land that divides the Waitematā Harbour to the east from the Manukau Harbour to the west, and has a residential footprint that extends both north and south of the city. The Waitematā Harbour hosts New Zealand's busiest international port and ferry terminal, New Zealand's largest naval base and supports a diverse array of recreational activities. Importantly, these characteristics of a growing, cosmopolitan city build on the cultural significance of this region for Māori, New Zealand's indigenous people.

In this review, a selection of New Zealand researchers (Appendix) have contributed summaries on the historical and contemporary values, as well as the potential pressures facing the Waitematā Harbour and Hauraki Gulf. The three case studies we present, feature on-going initiatives and management actions that aim to preserve the biodiversity and resilience of this urbanised marine ecosystem. Although much is yet to be accomplished, the fundamental research and actions we review highlight the diverse values and interests which need to be navigated in future management of the Waitematā Harbour and Hauraki Gulf. For the remainder of this review, we refer to the Hauraki Gulf, the Waitematā Harbour and the Ports of Auckland as Gulf, Harbour, and Port respectively.

1.1. Social setting

Māori are the *tangata whenua* (people of the land) of New Zealand, and were the first humans to occupy land surrounding the Waitematā Harbour and Hauraki Gulf (ca. 13th century). The Waitematā Harbour, in particular, has a rich history of occupation by Māori. Various *iwi* (Māori tribes) waged wars of occupation over this land, which became known as “*Tāmaki Makaurau*” (Tāmaki of a thousand lovers). Key reasons for this are the valuable strategic location of this harbour and the abundant supply of seafood the harbour provided. Paramount among these marine resources was, and remains, the intertidal shellfish beds of tuangi (cockle, *Austrovenus stutchburyi*) and pipi (*Paphies australis*).

There are at least 13 *iwi* (tribes) with ancestral links to the lands surrounding the Waitematā Harbour and Hauraki Gulf. Prominent among these *iwi*, is Ngāti Whātua who hold *mana whenua*, *mana moana* (authority over land and sea) over the Tāmaki isthmus and Waitematā Harbour, as well as the southern shores of the Kaipara Harbour, and the north-western shores of the Manukau Harbour. Prior to the signing of New Zealand's founding document – The Treaty of Waitangi – in 1840, few Europeans had settled within the Tāmaki isthmus (Ngāti Whātua Ōrākei Claims Settlement Act, 2012). During the period prior to European colonisation, Ngāti Whātua villages were dispersed around the margins of the Harbour and subsistence fishing was strictly controlled by rotating fishing and collecting grounds according to seasonal calendars (*maramataka*) (Ngāti Whātua Ōrākei Claims Settlement Act, 2012).

Deforestation of the catchments surrounding the Waitematā Harbour and Hauraki Gulf in combination with subsistence fishing by Māori, represent the first human impacts on these ecosystems. The development of Auckland's central business district (CBD) began in the mid-1850s with the construction of the first commercial wharf (Ngāti Whātua Ōrākei Claims Settlement Act, 2012). Urban development ensued, including extensive land

reclamation, rail and road networks, and the installation of social services such as sewage systems. Typical early European sewage systems discharged untreated waste directly into the Harbour, causing widespread contamination (Ngāti Whātua Ōrākei Claims Settlement Act, 2012). Although there have been improvements, the land reclamation projects and wastewater systems continue to be a point of conflict between the local government and Māori because of the impacts these actions have on the Harbour ecosystem and shellfish harvesting (see case study: *Restoring the mauri of Ōkahu Bay via the principles of Mātauranga Māori and western science*).

Today, Auckland is New Zealand's largest and fastest-growing city, with a population of 1.4 million, comprising 33% of New Zealand's population (Statistics New Zealand, 2013). True to its name, Tāmaki Makaurau continues to attract migrants from around the world, with 39% of Auckland's residents being foreign-born (Statistics New Zealand, 2013). Embedded within the diversity of culture, race and religion that makes up modern-day Auckland is a strong sense of pride in the marine ecosystems surrounding the city. The corollary of all this diversity and the connection between people and the marine environment is conflict and the need to carefully manage the competing interests of Māori, commerce, industry and recreation (see case study: *Sea Change—Tai Timu Tai Pari: the project to produce a Marine Spatial Plan for the Hauraki Gulf/Tikapa Moana*).

1.2. Geomorphology

Earthquakes, volcanoes and sea level rise have been the key processes constructing the Hauraki Gulf and Waitematā Harbour. The Hauraki Gulf began to form approximately 7 million years ago (Ma), as continental rifting moved the Coromandel volcanoes eastward away from Auckland (Briggs et al., 2005; Searle, 1959). Faulting was particularly active between 2 Ma and 1.2 Ma (Briggs et al., 2005), sinking the Hauraki rift valley and constructing the coastline for the future site of the Harbour.

The incipient Waitematā Harbour was a broad, low-lying valley that drained eastward towards the Hauraki Gulf (Hayward and Smale, 1992; Searle, 1959). This valley drowned as sea levels rose after the last glacial maximum (Searle, 1959), and the coastal edge of the former valley is the present-day harbour entrance, delimited by North Head to the north and Bastion Point to the south. North Head is the remnant of a small volcano that was active between 128 and 116 thousand years ago (ka) and sits among similarly aged volcanic cones in the suburb of Devonport on the northern shore of the lower Harbour (Agustin-Flores et al., 2015). These volcanoes erupted through Miocene marine sediments (approximately 22–19 Ma) that had earlier been thrust up from depth (Hayward and Smale, 1992; Searle, 1959). These sediments now form the coastal cliffs and estuaries around the Harbour (Hayward and Smale, 1992).

The main channel of the Harbour, and the access to the Port, is a maximum of 30 m deep and follows the course of the drowned river. Smaller channels that anastomose with the former river are up to 8 m deep. Freshwater inputs to the Harbour are relatively small (greatest mean flow is $1.4 \text{ m}^3 \text{ s}^{-1}$ in the Rangitopuni Stream [measured at Walker's gauge monitoring station]). Nevertheless, there are three main freshwater tributaries that feed the Waitematā Harbour: the Rangitopuni Stream in the upper Harbour; and Henderson Creek and the Whau River in the south-west of the central Harbour. These tributaries deliver sediments to the Harbour particularly during periods of heavy rain (see section: *Sediments and contaminants*). The floor of the central Harbour is now mostly lined with muddy gravels, and the wide subtidal shallows flanking the main channel are floored with mud and sand (Morley and Hayward, 2007).

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