Updated catch reconstructions of Melanesia to 2018*

Rachel Whitea, Brittany Derrickb, Angie Coulterb, Ruby Polidoc, Tim Cashionb, Vina Parduchoe, Patricia Sorongon-Yapc, Selina De Leone, Luisa Abucayc, Simon-Luc Noëlb, Melanie Angb, Veronica Relanob and Dirk Zeller

a) Sea Around Us - Indian Ocean, School of Biological Sciences, University of Western Australia, 35 Stirling Hwy, Crawley 6009, WA, Australia
b) Sea Around Us, Institute for the Oceans and Fisheries, University of British Columbia, 2202 Main Mall, Vancouver, BC, V6T 1Z4, Canada
c) Quantitative Aquatics, Inc., IRRI Khush Hall, College, Los Baños, Laguna, Philippines

Abstract
The initial marine catch reconstructions for island entities in Melanesia were completed independently and covered the years 1950 to 2010. As documented in this contribution, these reconstructions were updated to 2018 for Micronesia, Fiji, Kiribati, Marshall Islands, Nauru, New Caledonia, Palau, Papua New Guinea, Solomon Islands, and Vanuatu. Domestic fisheries in the Melanesian region play a vital role in local food security. However, as they are primarily small-scale fisheries, their catches have tended to be underestimated in most official statistics. Data from governmental and independent studies were applied to complement those reported by the Food and Agriculture Organization of the United Nations (FAO), and allowed us to conservatively account for unreported domestic fishing in Melanesia. Descriptions of the methods used to reconstruct catches are presented in EEZ-specific sections.

Introduction
Small-scale fisheries, such as those generating the domestic catches of islands in Melanesia, are generally difficult to monitor and therefore often underrepresented in catch statistics (Zeller et al. 2015). The underestimation of small-scale fisheries, which play a vital role in food security and tradition in Melanesia, is slowly being addressed (Pauly and Charles 2015) through studies and catch reconstructions such as those presented here. The original marine catch reconstructions for the Exclusive Economic Zones (EEZs) of island entities in Melanesia, including Micronesia, Fiji, Kiribati, Marshall Islands, Nauru, New Caledonia, Palau, Papua New Guinea, Solomon Islands, and Vanuatu were completed independently by a variety of authors and covered the years 1950 to 2010; here, they are updated to 2018, based on data published by the Food and Agriculture Organization of the United Nations (FAO) and other secondary data sources. Industrial fisheries for large pelagic species in these waters, mainly managed by the Western and Central Pacific Fisheries Commission (WCPFC), were addressed in a separate study by Coulter et al. (2020), and are excluded here. Descriptions of the methods used to reconstruct catches are presented in country-specific sections.

Materials and Methods
Federated States of Micronesia
The marine fisheries of the Federated States of Micronesia were reconstructed for 1950-2010 by Vali et al. (2014, 2016); here, we document how this reconstructed catch was updated to 2018.

---

Fisheries in Micronesia were divided into large- and small-scale fishing sectors. Large-scale industrial fishing largely targets tuna and other large pelagic species and was excluded from this reconstruction, because it is addressed in a separate study (Coulter et al. 2020).

**Human population data**
Subsistence and artisanal per capita catch rates were determined by interpolating between the 1950 anchor point from Vali et al. (2014), the 1999 and 2014 anchor points from Gillett (2016) and discussions with in-country experts. The per capita catch rate was extrapolated to 2017 based on the interpolated rate between 1999 and 2014. These per capita catch rates by sector were applied to population data for the Federated States of Micronesia. Population data was taken from the World Bank\(^5\) for Micronesia and compared to population data from national censuses. Since the national censuses weren’t performed every year, the annual population numbers were linearly interpolated between census years. After comparing the World Bank and national census population data, the World Bank data was used because it was more conservative. The per capita catch rates for each sector were applied to the population data to calculate total annual artisanal and subsistence catches independently of FAO data.

**FAO baseline data**
This reconstruction was concerned only with the small-scale fisheries sectors in Micronesia. Therefore, taxa identified as large pelagics, including tuna (*Katsuwonus pelamis*, *Thunnus albacares*, *T. obesus* and *T. alalunga*), blue marlin (*Makaira mazara*), black marlin (*Istiompax indica*), striped marlin (*Tetrapturus audax*) and swordfish (*Xiphias gladius*) were removed from the FAO baseline data prior to use here as the reported data baseline. These large pelagic catches are addressed separately in Coulter et al. (2020). The FAO reported catch data for the taxonomic categories ‘Indo-pacific swamp crabs,’ ‘Tropical spiny lobsters,’ ‘Octopuses, etc., nei,’ ‘Trochus shells,’ and ‘Natantian decapods’ were assumed to be all subsistence catch. The annual totals for each category were subtracted from the calculated annual subsistence catches. The FAO taxa ‘Marine fishes nei’ was assumed to be artisanal and annual catches were subtracted from the annual artisanal catches. However, when FAO catches for ‘Marine fishes nei’ were greater than the calculated artisanal catches, the remainder was assumed to be reported subsistence catches and subtracted from the remaining calculated subsistence catches. From 2007 - 2018 the ‘Marine fishes nei’ catches were higher than our total catch estimates. Therefore, following previous work by the *Sea Around Us*, we assumed that the remainder of the ‘Marine fishes nei’ catches were from distant water fleets, and they were not considered in this catch reconstruction. Future research will need to carefully reconsider these assumptions.

**State breakdown**
The Household Income and Expenditure Survey (HIES) (FSM Office of Statistics 2014) determined the number of people involved in fishing labour as either a main or secondary activity in each state. This was divided by the total number of people participating in fishing as a main and/or secondary activity. This proportional state breakdown was applied to the artisanal and subsistence catch estimates to determine catches in each state.

**Taxonomic breakdowns**

*Subsistence sector*
Since there was no new information available on changes in the taxonomic composition of subsistence catches by state or over time, the subsistence taxonomic breakdown from Cuetos-Bueno et al. (2012) was held constant for the subsistence sector.

---

\(^5\) data.worldbank.org
**Artisanal sector**
In the state of Pohnpei, Rhodes et al. (2018) determined the taxonomic breakdown in 2006 and again in 2015. We interpolated the proportion of each taxa between these anchor points and then held the 2015 composition constant to 2018. Houk et al. (2018) examined the artisanal fishery changes in Guam from 1985 - 2012. Since no taxonomic information was available for FSM as far back as 1985, we applied the taxonomic composition in Guam in 1985 as an anchor point and interpolated between 1985 and 2006. No taxonomic information was available prior to 1985 so that taxonomic breakdown was held constant from 1950-1985.

Houk et al. (2011) found the state of Yap had no significant difference in catch composition from Pohnpei so the same taxonomic breakdown as Pohnpei was applied to Yap.

Houk et al. (2017) determined the taxonomic composition for Kosrae in 2014, which was held constant to 2018. Since this was the only taxonomic information specifically for Kosrae, Houk et al.’s (2018) breakdown for Guam in 1985 was applied and held constant back to 1950, and Rhodes et al.’s (2018) breakdown for 2006 was used as an anchor point. Interpolation between these anchor points in 1985, 2006 and 2014 was used to determine the taxonomic breakdown over time in Kosrae.

Cuetos-Bueno et al. (2018) determined the taxonomic composition for Chuuk in 2012, which was held constant to 2018. Since this was the only taxonomic information specifically for Chuuk, Houk et al.’s (2018) breakdown for Guam in 1985 was applied and held constant back to 1950, and Rhodes et al.’s (2018) breakdown for 2006 was used as an anchor point. Interpolation between these anchor points in 1985, 2006 and 2012 was used to determine the taxonomic breakdown over time in Chuuk.

**Artisanal gear**
Artisanal gear breakdowns by state were taken for Pohnpei and Yap from Houk et al. (2011), from Houk et al. (2017) for Kosrae, and from Cuetos-Bueno et al. (2018) for Chuuk. These gear breakdowns are summarized in Table 1.

**Table 1.** Proportion of each gear type applied to artisanal catches by state for the Federated States of Micronesia.

<table>
<thead>
<tr>
<th>Sea Around Us gear type</th>
<th>Reference gear type</th>
<th>Proportion of catch by gear type in each state</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hand or tools</td>
<td>Night-time spearfishing</td>
<td>Pohnpei: 0.75, Yap: 0.8, Kosrae: 0.65, Chuuk: 0.86</td>
</tr>
<tr>
<td>Gillnet</td>
<td>Gillnet fishing</td>
<td>Pohnpei: 0.05, Yap: 0.1, Kosrae: 0.15, Chuuk: 0.03</td>
</tr>
<tr>
<td>Artisanal gear</td>
<td>Shallow bottom fishing</td>
<td>Pohnpei: 0, Yap: 0, Kosrae: 0.11, Chuuk: 0.11</td>
</tr>
<tr>
<td>Small-scale lines</td>
<td>Hook and line</td>
<td>Pohnpei: 0.2, Yap: 0.1, Kosrae: 0, Chuuk: 0</td>
</tr>
<tr>
<td>Unknown</td>
<td>Unknown</td>
<td>Pohnpei: 0, Yap: 0, Kosrae: 0.09, Chuuk: 0</td>
</tr>
</tbody>
</table>

**Marine biodiversity protection**
The Federated States of Micronesia have agreed to protect their biodiversity through the international agreements of the Convention on Biological Diversity (Aichi), the United Nations Convention on the Law of the Sea, and the World Heritage Convention. They are also a signatory to regional treaties and agreements, such as the Regional Seas Convention, and are part of the international network of UNESCO Man and the Biosphere (Marine Conservation Institute 2020).

“Both the Micronesian Fisheries Authority and the national Fisheries Section of DEA maintain direct contact on technical issues with regional and international organizations dealing in fisheries. Policy and other matters are managed in the first instance through the Department of External Affairs. FSM is a member of the...
Secretariat of the Pacific Community (SPC), the South Pacific Forum Fisheries Agency (FFA) and the South Pacific Regional Environmental Programme (SPREP)” (FAO 2002).

The Federated States of Micronesia have four MPAs and three marine managed areas. The MPAs are the Nahmwen Na Stingray Sanctuary, the Orloluk Sanctuary Rumung Marine Conservation Area and the Federal States of Micronesia Marine Protected Area. The marine managed areas are: The Atoll UNESCO-MAB Biosphere Reserve, the Federated States of Micronesia Shark Sanctuary and the Utwe UNESCO-MAB Biosphere Reserve.

These areas cover 81,086 km² (Marine Conservation Institute 2020), corresponding to 2.71% of the EEZ of 2,992,415 km² (Vali et al. 2016). In 2014, the Federated States of Micronesia passed legislation to protect sharks and become part of the Micronesia Regional Shark Sanctuary together with the Northern Mariana Islands, FSM, Guam, Kiribati, Nauru, Palau, and the Marshall Islands. This sanctuary is nearly the size of the European Union (Marine Conservation Institute 2020). Clearly, enforcement remains a major challenge.

**Fiji**

Fiji’s marine fisheries catches were reconstructed for 1950-2010 by Zylich et al. (2012), see also Zylich et al. (2016). Here, we document how this reconstructed catch was updated to 2017, then carried forward to 2018.

**Subsistence and artisanal fisheries**

Gillett (2016) estimated that in 2014, 16,000 tonnes were landed from the subsistence fisheries and 11,000 tonnes were landed from the artisanal fisheries. These estimates by Gillett (2016) were divided by population data from the World Bank (2018) to estimate a subsistence catch rates of 18.1 kg ·person⁻¹·year⁻¹ and an artisanal catch rate of 12.4 kg·person⁻¹·year⁻¹. The catch rates derived by Zylich et al. (2012) for 2007 were interpolated to the catch rates derived for 2014 and the 2014 catch rate was carried forward to 2017. The catch rate time series was then multiplied by the population (World Bank 2018) to estimate catches from the subsistence and artisanal fisheries from 2008 to 2017. In cases where the reconstructed catch totals were higher than the totals reported by the FAO, the differences were assumed to be unreported catches. The unreported landings were disaggregated into the taxonomic composition outlined in Zylich et al. (2012).

**Shark fisheries**

Reported shark landings commenced in 2011, and, given that these landings were also included in WCPFC (2018), we assumed these relate to the industrial large pelagic fisheries which is covered in Coulter et al. (2020). Thus, these catches were excluded here.

**Transition from 2017 to 2018**

The catch reconstructed to 2017 was carried forward to 2018 using the semi-automated procedure outlined in Noël (2020), based on FAO landings data to 2018. Semi-automated reconstructed catch data will later be replaced by a more detailed, research-intensive update.

**Marine biodiversity protection**

Fiji has agreed to protect its biodiversity through the international agreements of the Convention on Biological Diversity (Aichi), the United Nations Convention on the Law of the Sea, the Ramsar Convention on Wetlands of International Importance, the International Coral Reef Initiative and the World Heritage Convention. It is also a signatory to regional treaties and agreements such as the Regional Seas Convention (Marine Conservation Institute 2020).
Fiji has 138 MPAs, which jointly cover 12,007 km² (Marine Conservation Institute 2020), i.e., less than 1% of the EEZ of 1,281,700 km² (Zylich et al. 2016). Fiji has no marine managed areas, although it has ‘locally managed marine areas’ (FLMMAs). “The unique nature of marine resources in the iqoliqoli [(inshore marine area)] contributed to the formation of Fiji Locally Managed Marine Areas (FLMMAs) (FLMMA 2015). FLMMA is a network of government, non-government and community partners linking villages with formal and informal marine management efforts (Govan et al. 2009; Aalbersberg et al. 2005). Accordingly, success of FLMMAs pays close attention to resource users being involved in MPA design, implementation and enforcement (Chirico et al. 2017). In line with MMAs, Fiji’s National Green Growth Framework and the National Biodiversity Strategies and Action Plan (NBSAP) (Ministry of Environment 2007) provide key linkages between national policy objectives and strategies to support an MPA network (Yap et al., 2016)” (Ison et al. 2018).

“The marine ecosystem and fisheries play a central economic and social role in Fiji (Gillett 2016) worth more than FJD2.6 bill (USD $13.04 bill) per year (Yap et al., 2016)” (Ison et al. 2018). A study from March to October 2017 documented the extent and scale to which ‘Marine Conservation Agreements’ (MCAs) between tourism operators and indigenous, resource owning communities are used in Fiji, and their contribution to biodiversity conservation and fisheries management. More than half of operators (69.1%) interviewed had been involved, were involved, or were becoming involved, in some form of MCA, focused on temporary or permanent no-take Marine Protected Areas (MPAs). MCAs are in place in Fiji with implied and not formal or explicit conditionality, they contribute to natural resource management and should be counted in global biodiversity targets” (Mangubhai et al. 2020).

Republic of Kiribati (Gilbert, Phoenix, and Line Islands groups)
The reconstruction of Kiribati’s marine catches was completed for 1950-2010 by Zylich et al. (2014); see also (Zylich et al. 2016a, 2016b, 2016c). The update of these reconstructions to 2017 are documented, along with their carry forward to 2018. Landings data from the FAO were utilized as the reported data baseline.

Tuna and associated fisheries
Although the Western and Central Pacific Fisheries Commission (WCPFC) releases annual reports on the status of tuna catches in Kiribati, artisanal catches have not been estimated since 2010. Since the reconstructed estimate of artisanal tuna catch in 2010 was lower than the artisanal estimate by the WCPFC, the reconstructed value was accepted to remain conservative, and artisanal tuna catch values were carried forward from 2010 to 2017. Despite not addressing industrial tuna fisheries in this update (see Coulter et al. 2020), pole and line tuna landings data from the WCPFC (2016) Statistical Yearbook for 2015 were used to estimate the amount of baitfish used. The amount of baitfish was estimated for 2011-2017 using the tuna to baitfish ratio of 20.23:1 determined by the original reconstruction (Zylich et al. 2014).

Coastal fisheries
Artisanal export fisheries were reconstructed for 2011-2017 using the original method of Zylich et al. (2014). Retroactive changes were made to the reported marine molluscs for 2008-2010, because these were retroactively changed in more recent FAO data. Since the completion of the reconstruction by Zylich et al. (2014), a new estimate of coastal catch in Kiribati’s waters has been released by Gillett (2016). Using these new data, along with population data from the World Bank (2018), a new consumption rate of 172 kg per person per year was calculated for 2014. The consumption rate was derived from an estimate of coastal catch in 2007 (Gillett 2009) in Zylich et al. (2014) and was linearly interpolated to the new consumption rate in 2014. Landings were updated for 2008-2017 by multiplying the new consumption rates by the updated population data. Tuna landings and artisanal exports were subtracted from the total estimated catch
consumed by Kiribati’s population to calculate remaining small-scale landings for domestic use. The 2010 ratio of Island EEZ, sector and taxa were held constant and assigned to reported landings.

**Unreported landings**
Because updated population data for the Phoenix Islands group was unavailable, the population was assumed to remain stable at 24 persons for 2010-2017. The calculated consumption rates for 2008-2017 as described above were applied to this population to estimate the subsistence catch of the Phoenix Islands. This catch was subtracted from the total estimated unreported catch, and the remaining catch was divided between the Gilbert Islands and Line Islands groups. The ratio split of catch between each island group and between fishing sectors was conserved from the original reconstruction (Zylich *et al.* 2014). Catch composition for the unreported landings from 2008 to 2017 was calculated by averaging the FAO reported catch from 2008 to 2014.

**Transition from 2017 to 2018**
The catch reconstructed to 2017 was carried forward to 2018 using the semi-automated procedure outlined in Noël (2020), based on FAO landings data to 2018. Semi-automated reconstructed catch data will later be replaced by a more detailed, research-intensive update.

**Marine biodiversity protection**
The Republic of Kiribati (Gilbert, Phoenix, and Line Islands groups) has agreed to protect its biodiversity through the international agreements of the Convention on Biological Diversity (Aichi), the United Nations Convention on the Law of the Sea, the Ramsar Convention on Wetlands of International Importance and the World Heritage Convention. It is also a signatory to regional treaties and agreements such as the Regional Seas Convention (Marine Conservation Institute 2020).

The Republic of Kiribati has 21 MPAs and two marine managed areas which jointly cover more than 400,000 km² (Marine Conservation Institute 2020) and correspond to 11.6% of the combined EEZ of 3,437,130 km² (Zylich *et al.* 2016a, 2016b, 2016c). One of the largest MPAs in these waters is the remote Phoenix Islands Protected Area, which was designated in 2006 with 99% of this EEZ as a no-take area, specifically to protect sharks and coconut crabs (Marine Conservation Institute 2020).

Even though “local community members are overall aware of the significance of resource conservation, they do not always support or participate in conservation projects. Indeed, the local community members’ motivation to participate in such projects are influenced by various factors, including their status in a household or community, village practices, the quality of community leadership, and their past experiences with similar projects. Our research also finds that community members become unsupportive with conservation projects when their daily livelihood activities are restricted by the projects” (Teuea and Nakamura 2020).

There are some other indirect activities, apart from wastewater discharges or coastal development, that boost marine ecosystems degradation and activities such as fishing. An example is “the 30% increase in the price of copra, which resulted in a 32% increase in copra labor and a 38% increase in fishing labor. Households with the largest amount of land in coconut production increased copra labor the most and households with the smallest amount of land in coconut production increased fishing the most. Our ecological data suggests that increased fishing labor may result in a 20% decrease in fish stocks and 4% decrease in coral reef-builders” (Reddy *et al.* 2014).
Marshall Islands
The Marshall Islands marine fisheries catches were first reconstructed to 2010 by Haas et al. (2014, 2016). These catches were updated to 2017 by Vianna et al. (2020), and carried forward using the method of Noël (2020) and FAO data to 2018. Artisanal catches were reconstructed using anchor points from Gillett (2009, 2016), while trochos and sea cucumber catches were reconstructed independently using FAO (2019) commodity trade and MIMRA (2014) production data and conversion factors. Subsistence catches were estimated by per capita demand and human population data, and recreational catches by tourist catch rates and number of tourists.

Marine biodiversity protection
The Marshall Islands have agreed to protect biodiversity through the international agreements of the Convention on Biological Diversity (Aichi), the United Nations Convention on the Law of the Sea, the Ramsar Convention on Wetlands of International Importance and the World Heritage Convention. They are also a signatory to regional treaties and agreements such as the Regional Seas Convention (Marine Conservation Institute 2020).

The Marshall Islands have 16 MPAs and three marine managed areas, which jointly cover 8,047 km² (Marine Conservation Institute 2020), corresponding to 0.4% of the EEZ of 1,992,020 km² (Haas et al. 2016).

Some of the MPAs with the largest no-take areas in these waters are the Rongelap (designated in 2002 with 2,787 km² of no-take area), the Bikini conservation area (designated in 2006 with 2,032 km² of no-take area), the Ailinginae (designated in 2002 with 1,024 km² of no-take area) and the Rongerik (designated in 2006 with 1,002 km² of no-take area) (Marine Conservation Institute 2020). On the other hand, it seems that most of the marine managed areas lack a management plan (Kobayashi 2018).

“...The fisheries management has changed dramatically over the years. In the past it was managed by traditional means, directed by chiefs in the form of ‘Mo’ areas. ‘Mo’s’, or taboo areas were set apart as reserves for harvesting food, while conserving a food resource, as a way of living in harmony with the environment (RMIBiodiversityProject 2000). This tradition has been lost but recently local people started asking the support of the national agencies – such as the Environmental Protection Agency and the Marshall Islands Marine Resource Authority – in order to regulate harvesting of resources in their atolls through re-introduction of the traditional fishing restriction zones. The Marshallese people believe the reactivation of a ‘mo’ would ensure natural resources not to be depleted while at the same time create a necessary sanctuary to safe guard areas for future generations (RMIBiodiversityProject 2000).

Nauru
The original reconstruction of Nauru’s marine catches was completed for 1950-2008 by Trujillo et al. (2011), see also Trujillo et al. (2016), and updated to 2010 by Zeller et al. (2015). Here it was corrected back to 1999 and updated to 2018 by utilizing new secondary data and information sources. Nauru’s fisheries are mainly subsistence in nature, with a few commercial activities which are active mostly on a part-time basis and with fish catches sold only if there is a surplus after subsistence needs (Gillett and Tauati 2018).

Estimates of total subsistence and artisanal catch for 1999, 2007, and 2014 by Gillett (2016) were accepted as total catch and were interpolated for each sector between each anchor point year. These catches were then extrapolated to 2017 using existing trends and updated population data (IMF 2017; Nauru Bureau of Statistics 2017).
Unreported catch components were derived by subtracting the values as reported by the FAO from the total catch estimated for artisanal and subsistence. Nauru’s two known longliners have not operated since the mid-2000s (FAO 2019); thus, it was assumed that there have been no domestic industrial catches since that time.

The catch reconstructed to 2017 was carried forward to 2018 using the semi-automated procedure outlined in Noël (2020), based on FAO landings data to 2018. Semi-automated reconstructed catch data will later be replaced by a more detailed, research-intensive update.

Marine biodiversity protection
Nauru has agreed to protect its biodiversity through the international agreements of the Convention on Biological Diversity (Aichi). However, there are no MPAs reported in its EEZ of 308,500 km² (Trujillo et al. 2016), and it seems there are no protected areas in Nauru, neither on land, nor in the sea (UNEP-WCMC and IUCN 2020).

“The state of Nauru has a very negative history of socio-ecological impacts of phosphate mining” (Clifford et al. 2019). “By the beginning of the twenty-first century, phosphate deposits on Nauru had been exhausted, and the lack of viable economic alternatives led to the nation agreeing to Australia’s ‘Pacific Solution’ deal” (Edisson-Cogan and Allon 2019). This deal made Nauru, as one commentator put it, “Australia’s dumping ground for refugees” (Doherty 2016). “For most of the 20th century, the resources of Nauru were depleted to support the economic growth of Australia and New Zealand” (Gale 2019). There have been huge ecological consequences affecting Nauruans and refugees, the latest also being in direct contact with harmful materials such as asbestos. Asbestos, now considered a threat to human health with short-term effects of immediate toxicity and the long durée of epigenetic change, was extracted in Nauru for decades because of Australian interest fueled by their housing boom (Eddison-Cogan and Allon 2019).

The long history of resources exploitation, colonialism and human rights violations in Nauru may be the cause for the absence of biodiversity protection.

New Caledonia
The reconstruction of marine fisheries catches for New Caledonia from 1950 to 2007 was completed by Harper et al. (2009), and was updated to 2010 by Harper et al. (2016). Here, we describe how these catches were updated to 2017, then carried forward to 2018.

Data reported by the FAO were utilized as the reported data baseline, and retroactive changes made to the FAO baseline data are reflected in the update.

Subsistence and artisanal fisheries
No recent population estimates by province were available. Therefore, total population estimates for 2016 from the Secretariat of the Pacific Community (SPC), Statistics for Development Division (Anon. 2016) were divided into province population numbers based on the last year of province population estimates from the 2011 annual report, which was based partly on data from the national statistics body (ISEE 2012). Estimates for 2010 were re-calculated based on these anchor points. The 2015 statistics for the declared commercial production compiled by the Direction des Affaires Maritimes (DAM 2015) included various reef-lagoon fishes which came directly from the provinces from the reports of the professional fishers; however, no data were found for updating the catches of coastal subsistence and recreational fisheries. Thus, the 2010 catch rates for subsistence and recreational fisheries were applied to population per year for 2011-2017.
Since the Dupont et al. (2004) study, fisheries officials have not observed substantial changes in coastal fisheries catches, but the total value of the declared reef and lagoon catches has increased (Gillett 2016). Subsistence catches were updated for each province by multiplying the interpolated population of North Province, South Province, and Loyalty Islands for each year by the 2014 subsistence catch rate for each province as described for 1991-2007 in the original reconstruction (Harper et al. 2009). Eighteen tuna longline vessels had license to fish in 2018, catching up to 3000 tonnes (WCPFC 2019). However, these data are not included here, since industrial tuna catches are covered in Coulter et al. (2020).

**Sea cucumber fishery**
A large difference in reported catches of sea cucumbers (145%) between FAO data versions 2014 and 2016 was observed for the year 1983; thus, the artisanal catches for this year were updated. One domestic vessel was reported to fish sea cucumbers from 2004-2018, catching between 4.5 and 16.5 tonnes annually (Léa Carron, Service de la pêche et de l’environnement marin, New Caledonia, pers. comm. May 2020). Sea cucumbers were also targeted by up to 37 illegal foreign vessels between 2016 and 2018, but most of these illegal fishing vessels have been seized (Léa Carron, pers. comm.).

**Recreational fishing**
Data collected and published by the Institute of Statistics and Economic Studies (ISEE) of New Caledonia (ISEE 2017) showed an increase in tourist arrivals in 2015 (114,000 visitors compared to 107,000 visitors in 2014); however, no published data were available to determine its impact on recreational fishing in the country (McNeil 2014). In addition, the government of New Caledonia established four new Marine Protected Areas in 2018 (Marine Conservation Institute 2019).

The 2009-2010 average per capita rate of recreational fishing in tonnes per person per year calculated by Harper et al. (2016) was applied to 2011-2016.

**Transition from 2016 to 2018**
The catch reconstructed to 2016 was carried forward to 2018 using the semi-automated procedure outlined in Noël (2020), based on FAO landings data to 2018. Semi-automated reconstructed catch data will later be replaced by a more detailed, research-intensive update.

**Marine biodiversity protection**
The government of France and New Caledonia have agreed to protect the biodiversity of New Caledonia through the international agreements of the Convention on Biological Diversity (Aichi), the United Nations Convention on the Law of the Sea, the Ramsar Convention on Wetlands of International Importance and the World Heritage Convention. It is also a signatory to regional treaties and agreements such as the Regional Seas Convention (Marine Conservation Institute 2020).

New Caledonia has six MPAs which jointly cover 91% of the EEZ of 1,422,596 km² (Harper et al. 2016). Efforts to protect New Caledonian waters date back to 1970, when a lagoon area was declared a marine reserve (Claudino-Sales 2019). In 2008, some marine sites/clusters were designated as World Heritage Sites. In 2014, when the governments of France and of New Caledonia decreed the creation of a ‘Coral Sea Natural Park’, which encompasses the entire EEZ of New Caledonia, they aimed at the protection of its ecosystems and preservation of cultural heritage that they represent (Marine Conservation Institute 2020).

Within the waters of this Natural Park, the president of New Caledonia, through the approval of the Decree on the management plan 2018-2022, committed to give full protection to 2% of the country’s EEZ in 2018.
of the Coral Sea Park regulations are: prohibition of shark fishing and turtle and whale hunting; limitation and monitoring of ships; and gathering information on catches and prohibition of towed gear such as trawls, seines, dredges, trolling lines (Marine Conservation Institute 2020). The sharing of powers between various territorial authorities with different mandates has led to difficulties regarding the implementation of this MPA (Payri et al. 2019), which are far from being resolved.

**Palau**
Palau’s marine fisheries catches were originally reconstructed for 1950-2008 by Lingard et al. (2011), updated to 2010 by Lingard et al. (2016), and have since been updated to 2016 utilizing national data on human population estimates, number of annual visitors, and average length of stay of visitors.

The resident population data obtained from the national census showed a noticeable 12% decrease from 2005 to 2012 that was associated with the increase in emigration (Republic of Palau 2013). After 2012, the population slightly increased. This increase was associated with an influx of foreign workers migrating to Palau (Appanaitis 2014). Following the original reconstruction methods (Lingard et al. (2011), tourist data were converted into full-time visitor equivalents (i.e., the product of number of annual visitors and average length of stay), which were added to the resident population.

**Subsistence and artisanal catches**
The per capita fish consumption rate was calculated for 2014 by using Gillett (2016) catch estimates of an estimated 865 tonnes of artisanal catch and 1250 tonnes of subsistence catch, and dividing this catch total by the total population, which resulted in a 2014 per capita consumption rate of 108.7 kg·person⁻¹·year⁻¹. This consumption rate was held constant to 2016 and was multiplied by the total population to derive the estimated total seafood demand. The 2010 fishing sector breakdown of 88.2% artisanal and 11.8% subsistence from Lingard et al. (2011) was applied to the reported miscellaneous fish category. Reported subsistence catch was derived from 11.8% of reported miscellaneous fishes, and unreported subsistence catch was calculated from the difference between total seafood demand and total FAO reported landings. Total artisanal catch was the total FAO reported landings minus reported subsistence catches.

**Industrial catch**
The Palau National Marine Sanctuary Act was enacted in 2015 to develop the domestic fishing industry and eliminate foreign commercial fishing in most of Palau’s waters (Gruby et al. 2017). However, remaining tuna catches are covered in Coulter et al. (2020).

**Transition from 2016 to 2018**
The catch was reconstructed to 2016 and was carried forward to 2018 using the semi-automated procedure outlined in Noël (2020), based on FAO landings data to 2018. Semi-automated reconstructed catch data will later be replaced by a more detailed, research-intensive update.

**Marine biodiversity protection**
Palau has agreed to protect its biodiversity through the international agreements of the Convention on Biological Diversity (Aichi), the United Nations Convention on the Law of the Sea, the Ramsar Convention on Wetlands of International Importance, the International Coral Reef Initiative and the World Heritage Convention. It is a signatory to regional treaties and agreements such as the Regional Seas Convention. Palau is also part of the international network of UNESCO Man and the Biosphere (Marine Conservation Institute 2020).
Palau has 47 MPAs and six marine managed areas, which jointly cover 499,464 km$^2$ (Marine Conservation Institute 2020), corresponding to 83% of the EEZ of 604,253 km$^2$ (Lingard et al. 2016).

“In 2003, the Palau Protected Areas Network (PAN) was created to conserve Palau’s unique biodiversity and culture, and is the country’s mechanism for achieving the goals of the Micronesia Challenge (MC), an initiative to conserve 30% or more of near-shore marine resources within the region by 2020” (Friedlander et al. 2017). The PAN network is formed by different MPAs, which vary in habitats, management, age, size and whether or not they allow fishing. The use of traditional knowledge in the establishment of PAN, along with the support of western management techniques, has boosted MPA effectiveness while improving the acceptance of the local communities who manage these MPAs (Friedlander et al. 2017).

“While Palau’s MPAs are doing well relative to nearby areas open to fishing, previous work on spawning aggregation closures (Golbuu and Friedlander 2011) and communications with fishermen indicate that fish abundance in Palau was much greater in the past. While in the ecosystem health of Palau’s MPAs are likely below historical baselines, they represent a step in the right direction towards recovery of the marine ecosystem, which is so critical to Palau and its people” (Friedlander et al. 2017).

Palau is a dive destination and “over the last two decades, Palau has experienced a surge in the number of tourists visiting the country. In 2015, a record 168,767 people visited Palau, an increase from 125,674 in 2014 and approximately 92,000 in the year 2007” (Dacks et al. 2020). These tourists consume more pelagic fish but fewer reef fish than Palauans (Dacks et al. 2020).

**Papua New Guinea**

The reconstruction of Papua New Guinea’s marine fisheries catches was completed for 1950-2010 by Teh et al. (2014, 2016). Using the original methods and new FAO and independent data, the reconstructed catch time series has been updated to 2018. Industrial fisheries for tuna and other large pelagic species were not addressed in this reconstruction and are included in Coulter et al. (2020).

**Shark fisheries**

The 2017 FAO data reflected some retroactive data changes when compared to the FAO data version used in the original reconstruction by Teh et al. (2014), including the reporting of ‘sharks, rays, skates, etc. nei’ catch back to 2009. The shark catch reported by FAO was compared to WCPFC estimates for the local longline fishery targeting sharks. WCPFC (2018) estimates for 2010-2014 were greater than FAO catch. Thus, the excess was assumed to be industrial and thus addressed in Coulter et al. (2020). The shark catch reported by the WCPFC (2018) decreased to one tonne in 2015 due to a ban on the retention of silky shark that it introduced in mid-2014, resulting in the closure of shark fishing operations (Vieira et al. 2017; Appleyard et al. 2018).

Unreported landings from industrial shark fisheries were carried forward from 2010 using WCPFC (2018) estimates for the longline fishery targeting sharks; however, the industrial shark longline fishery was closed in 2014 (Usu et al. 2015). Fisher anecdotes from Milne Bay, one of the main areas for artisanal shark fishers, report that shark catches appeared to be declining while fishing was increasing (Vieira et al. 2017; Appleyard et al. 2018). According to Gillett (2016), artisanal shark fishing increased considerably midway through 2014 when industrial shark fishing was banned and again increased when the sea cucumber fishery closed. Thus, FAO reported shark catch for 2016-2017 was considered fully artisanal. The reported catches in the ‘shark, skates, rays’ category were taxonomically disaggregated using the same taxonomic breakdown as used
previously for unreported artisanal sharks: Requiem sharks (Carcharhinidae), tiger shark (*Galeocerdo cuvier*), lemon shark (*Negaprion brevirostris*), and hammerheads (*Sphyrna* spp.).

**Shrimp and prawn trawl fishery**
The four decapod taxa: banana prawn (*Fenneropenaeus* spp.), giant tiger prawn (*Penaeus monodon*), various *Metapenaeus* spp. prawns, and Natantian decapods, as reported by the FAO, were accepted as the reported component of the prawn trawl fishery. Discards of non-target bycatch were calculated using the rates described by the original reconstruction by Teh *et al.* (2014).

**Recreational fisheries**
Recreational catch was calculated for the whole time series using participation and catch rates for expatriates as determined in the original reconstruction by Teh *et al.* (2014). Since there is no governing body that monitors the expatriate population in Papua New Guinea, a time series was generated. The US Bureau of Census statistics estimate of expatriates was available for 1971 (Upton 1998), and the ratio of expatriates in the population obtained from 1971 was applied from 1970 to 1975. Expatriate numbers from 1976 to 1979 were linearly interpolated between the 1975 estimate based on the ratio of expatriates in 1971 and a 1980 estimate from a census analysis by D’Sa (1986). It was reported that 2% of the 1995 total population were considered foreign residents (Upton 1998). Thus, this 0.02 fraction was used to derive the number of expatriates in 1995. The anchor point from 1980 (D’Sa 1986) was linearly interpolated to the 1995 expatriate estimate. The U.S. State Department (2007) stated that 1% of the population were considered foreign residents in 2007. Thus, the expatriate ratio for 1996–2006 were interpolated between 1995 (0.02) and 2007 (0.01). As there were no more recent data, the expatriate percentage of 1% was carried forward to 2017, as there are still a considerable number of expatriates in Papua Guinea.

**Artisanal fisheries**
The FAO reported ‘miscellaneous marine fishes’ catch was split into 40% artisanal and 60% subsistence sectors and was accepted as the reported reef fish component of the small-scale fisheries (Teh *et al.* 2014). The unreported artisanal reef fish catch was estimated as 50 tonnes and was conserved from 2003 to 2017 (Teh *et al.* 2014). The FAO landings of barramundi (*Lates calcarifer*), Indo-Pacific swamp crab (*Scylla serrata*), ‘marine fishes nei’, ‘pearl oyster shells nei’, ‘trochus shells nei’, and ‘tropical spiny lobsters nei’ were accepted as reported artisanal catch. Previously, spiny lobsters were 100% unreported (Teh *et al.* 2014); since reporting by FAO, reported landings were doubled to estimate the total catch.

Approximately 80 to 100 tonnes of barramundi were caught by artisanal fishers in 2014 (Gillett 2016). As a result, the average barramundi catches (90 tonnes) were estimated for 2014 and reported artisanal landings were subtracted in order to estimate unreported landings of barramundi. The percentage of barramundi unreported in 2014 was applied to reported landings from 2011 to 2013 and from 2015 to 2017 to estimate unreported landings of barramundi.

The reported landings of Indo-Pacific swamp crab (or ‘giant mud crab’) were accepted as total landings of that fishery. Estimates of pearl oyster shells prior to 1998 were conserved since these were quite comparable to the 1988 landings converted to wet weight using trochus shell-to-wet-weight ratios. Retroactive changes were made from 1988 to 2015 for reported pearl oyster shells with the 2013 FAO data version. Unreported pearl oyster shells catch was carried forward to 2017 directly from 2013 as was done for trochus shells. Total landings were calculated using the trochus shell to total mass ratio. Unreported green snail shell catch was carried forward to 2017 directly from 2010 as no new information was found.
Subsistence fisheries
Unreported subsistence catch was calculated for 2011-2015 by deriving the per capita rate of reconstructed unreported subsistence catch per person, because the per capita rate cited in Teh et al. (2014) produced a much higher catch than was reconstructed for 2010. To update the 2016 - 2017 total unreported subsistence, the 2015 per capita catch rate, given percent fish consumption, and percentage of the 2019 Papua New Guinea rural population from the World Bank (2018), were used.

Transition from 2017 to 2018
The catch reconstructed to 2017 was carried forward to 2018 using the semi-automated procedure outlined in Noël (2020), based on FAO landings data to 2018. Semi-automated reconstructed catch data will later be replaced by a more detailed, research-intensive update.

Marine biodiversity protection
Papua New Guinea has agreed to protect its biodiversity through the international agreements of the Convention on Biological Diversity (Aichi) and the Ramsar Convention on Wetlands of International Importance (Marine Conservation Institute 2020).

Papua New Guinea has 51 MPAs and two marine managed areas, which jointly cover 4,304 km² (Marine Conservation Institute 2020) and correspond to less than 0.2% of the EEZ of 2,396,575 km² (Teh et al. 2016).

“Recent exposure to the cash economy and access to global buyers, for instance, has led many residents to exploit their natural resources, including local fisheries, to generate income. Papua New Guinea’s population has increased from 2 million people in the early 1960s to over 8 million today, placing further pressure on fisheries and other natural systems to provide food. In recent decades, the impacts of these changes have become evident to many community elders, who speak of declines in both the abundance and size of fish on their reefs” (Booth 2019).

This decline affects other economic activities such as the shell-based handicraft production, which relies on marine resources. “This activity involves the transformation of mollusc shells and skeletal remains of other marine taxa into handicrafts, such as jewelry and decorative items (Chand et al. 2014) [...] a crucial role in poverty reduction (Béné et al. 2007) [...]” (Simard et al. 2019). [...] A total of 17 species of marine organisms were identified as the most important natural resources supporting shell-based handicraft production. Nearly all taxa were molluscs, the single exception being cartilage taken from the blacktip reef shark Carcharhinus melanopterus (Simard et al. 2019). The potential for shell-based handicraft to empower women was identified through the high percentage of female participants and the capacity for women to engage in production and sales from home” (Lombardini et al. 2017). A well-recognized benefit of income-generating opportunities for women is that the income they generate is typically spent on family and home development (Simard et al. 2019). Coastal aquaculture and improved training and education opportunities could improve the economic resilience of the people working in the sector and render them less vulnerable to price fluctuations (Simard et al. 2019).

Solomon Islands
The marine fisheries catches of the Solomon Islands were originally reconstructed for 1950-2009 by Doyle et al. (2012), were updated to 2010 by Doyle et al. (2016), and have since been updated to 2017, then carried forward to 2018. In the latest reconstruction, retroactive changes were made to the data from 1983 onwards because of new anchor point data. The marine fisheries of the Solomon Islands are important for food security and contribute 2-4% to its GDP (Gillett 2016).
Baseline data

The latest catch reconstruction continued to use FAO data as the reported baseline data but with some modifications, particularly in the reported catches of invertebrates. Reporting for sea cucumbers was corrected in the 2015 version of FAO data, which continued in the 2017 version, except for years 2013 and 2015 when the national reported export (Gillett 2016) exceeded the catch reported to FAO. Reporting for trochus was also corrected for the years 2005-2016 in the 2017 version of FAO data but remained underreported for some years. National reported catch in 2015 was held constant for 2016-2017.

Tuna fisheries

The country’s domestic industrial tuna fleet has grown substantially since 2010. The fleet is now made up almost entirely of purse seiners, with the pole-and-line vessels reporting only 649 tonnes (Gillett 2016). Longliners are now deployed only by foreign fleets, and therefore longline bycatch was not estimated as of 2014 (WCPFC 2015; Gillett 2016). The domestic tuna fleet operates inside and outside of its own EEZ, and the 2010 ratio for catches from outside of its EEZ were carried forward to 2014. Because there is a market for all bycatch of the tuna fisheries, tuna fisheries were assumed to have no discards. Industrial landings of large pelagic taxa and associated bycatch have since been estimated by Coulter et al. (2020) and therefore were not estimated here.

Artisanal catch

Artisanal landings continued to be estimated based on catch rates for the years from 1999 to 2014 (Gillett and Lightfoot 2001; Gillett 2005, 2007, 2009, 2016), with an updated catch estimate of 6,468 tonnes in 2014 (Gillett 2016). The artisanal fishery was linearly interpolated from its beginning in 1950 to the start of the pole-and-line fishery in 1972. Artisanal landings for years 1972-1998 were estimated based on the assumption that the baitfish fishery accounted for 47.3% of the total artisanal catch (Doyle et al. 2012). Retroactive changes were made for years 1989-1998 based on the reported baitfish catch from Barclay and Cartright (2007). The latter years showed a substantial decline in the baitfish fishery (mean annual value of 32.5 tonnes) in line with the decline in the number of domestic pole-and-line vessels (Gillett 2016). The 2014 catch rate was held constant for years 2015-2017 and was multiplied by the corresponding total population from the World Bank (2018).

Thus, total reported artisanal catch is comprised of the artisanal domestic consumption and baitfish fishery. Unreported artisanal catch is made up mostly of the artisanal shark fishery which operates to export shark fins. Landings were updated from 1999 onwards using the methods described for 1987-1998 by Doyle et al. (2012). Reported exports were updated using national data and were used as anchors for artisanal shark landings when in excess of total industrial shark landings in 2003 and 2011. As a result, artisanal shark landings were interpolated from 1999 to 2002 and 2004 to 2010 and held constant from 2011 to 2017.

Subsistence catches

Catch rates used to estimate total subsistence catch was updated for years 1983, 1989 and 1995 (Gillett and Lightfoot 2001), 1992 (Dalzell et al. 1996) and 2014 (Gillett 2016). The 2014 catch rate was held constant to 2017. Reported artisanal catch was subtracted from the ‘Marine fishes nei’ category of the FAO data to estimate reported subsistence catch. The difference between the total subsistence catch and assumed reported subsistence catch was deemed unreported subsistence catch.

54 http://www.fisheries.gov.sb/info-and-stats
Transition from 2017 to 2018
The catch reconstructed to 2017 was carried forward to 2018 using the semi-automated procedure outlined in Noël (2020), based on FAO landings data to 2018. Semi-automated reconstructed catch data will later be replaced by a more detailed, research-intensive update.

Marine biodiversity protection
The Solomon Islands have agreed to protect their biodiversity through the international agreements of the Convention on Biological Diversity (Aichi) and the World Heritage Convention (Marine Conservation Institute 2020).

The Solomon Islands have 86 MPAs and two marine managed areas, which jointly cover 958 km$^2$ (Marine Conservation Institute 2020), corresponding to 0.06% of the EEZ of 1,596,464 km$^2$ (Doyle et al. 2016). “When we [Government representative: 28-07-11] say Marine Protected Area, we use Locally Managed Marine Area definitions. We are saying what do the community really mean? How do they do marine protected areas? Let them define it. They are the resource owners. Let them decide on [the purpose] of setting aside an area … for food security, or food subsistence, or biodiversity or climate change adaptation activities. We have to recognize that (Government representative: 28-07-11)” (Evans et al. 2018).

“Since the 1990s, community-based resource management (CBRM) and community-based co-management approaches have been promoted to build on CMT [(customary marine tenure)] arrangements to manage small scale coral-reef fisheries, including reef sharks (Cohen et al., 2015; Richards et al. 1994)” (Goetze et al. 2018).

“In Solomon Islands, over 90% of the population live in coastal areas and depend on marine ecosystems for their livelihoods. In this context, it is critical that approaches effectively balance conservation and development. Solomon Islands’ environmental governance is characterized by strong and enduring customary tenure arrangements on land and sea […]” (Evans et al. 2018).

There are examples of community-based management, for example, of Leatherback Sea Turtles, a species that has been traditionally harvested by the locals in the Zaira community. “This community independently initiated a full closure over leatherbacks in 1999 as a response to reducing numbers. The community self-initiated the construction of a leatherback hatchery that was able to replicate the ideal nesting temperature for balanced sex ratios. Furthermore, the community developed a nest monitoring and satellite telemetry programme to provide a regional context to their conservation efforts” (Jino et al. 2018).

Vanuatu
A catch reconstruction for Vanuatu was first performed by Zylich et al. (2014, 2016) for the years 1950-2010; this was replaced by the reconstruction of Léopold et al. (2017) for 1950-2014, based on an extensive local dataset. Here, we document the updating of the reconstruction by Léopold et al. (2017) to 2016 and its subsequent carry-forward to 2018.

The reported data presented by Léopold et al. (2017) were compared to the most recent version of the FAO reported landings for Vanuatu in the Western Central Pacific. The FAO data were higher than the reconstructed landings; therefore, the excess reported catches of pelagic taxa were considered caught outside of Vanuatu’s EEZ.

Fisheries in Vanuatu were categorized into two major fisheries following Léopold et al. (2017): large-scale offshore and coastal small-scale. Large-scale offshore landings of tuna fisheries and associated bycatch have since been estimated by Coulter et al. (2020) and are not addressed here. Coastal small-scale fisheries were
divided into three categories: demersal finfish, pelagic fishing for export, and pelagic fishing for local use (Léopold et al. 2017). Coastal small-scale catches were all taken for subsistence purposes, except for the catches of demersal finfish and pelagic catches for export fisheries that are taken by artisanal fisheries. Subsequently, the reconstruction of demersal finfish fisheries was updated for 2015-2017 following the assumptions described for 1992-2014 by Léopold et al. (2017).

**Subsistence fisheries**
Subsistence fisheries catches were updated for 2015 and 2016 following the same methods described by Léopold et al. (2017) for 2014. The most recent estimate of subsistence fishing was 2800 tonnes in 2014 by Gillett (2016). Updated population estimates were obtained from the World Bank (2018) for 2015-2016, and the per capita consumption rate for marine fish and invertebrates was maintained at the 2014 amount for 2015 and 2016. Reported catch was subtracted from the total reconstructed subsistence catch to estimate unreported subsistence catch. The taxonomic breakdowns were maintained at the 2014 ratio.

**Sea cucumber fisheries**
The sea cucumber fisheries have been commercially important in recent years (Gillett and Tauati 2018), but stocks are now overexploited. As a result, a five-year ban of sea cucumber fishing was implemented and enforced in Vanuatu from 2008 to 2013 and extended to 2018 (Gillett and Tauati 2018). Sizes of illegally caught sea cucumbers were small at the start of the ban, which suggests that it may take a while for the stocks to recover (Pakoa et al. 2013). In March 2016, Pam, a strong tropical cyclone, destroyed the bulk of Vanuatu's fisheries infrastructure (Gillett and Tauati 2018). Thus, to assist fishers in earning income in Pam's wake, the ban on sea cucumber fisheries was lifted between September and December 2018 (Gillett and Tauati 2018). Sea cucumber catches were assumed to be fully reported for 2015 and 2016.

**Trochus fisheries**
Trochus fishing has long been a traditional fishery and is now an important commercial fishery (Gillett and Tauati 2018). Reported trochus amounts were greater than estimated catches, and thus trochus catches were assumed to be fully reported for 2015 and 2016.

**Recreational fisheries**
Sport fishing has been a licensed activity in Vanuatu since 2004 and recent estimates suggest that 20-30 game fishing boats actively fish for large pelagic species (Gillett and Tauati 2018). Recreational fisheries were therefore assumed to continue the 2011-2014 catch trends.

**Transition from 2016 to 2018**
The catch reconstructed to 2016 was carried forward to 2018 using the semi-automated procedure outlined in Noël (2020), based on FAO landings data to 2018. Semi-automated reconstructed catch data will later be replaced by a more detailed, research-intensive update.

**Marine biodiversity protection**
Vanuatu has agreed to protect its biodiversity through the international agreements of the Convention on Biological Diversity (Aichi) and the World Heritage Convention (Marine Conservation Institute 2020).

Vanuatu has 21 MPAs and no marine managed areas. Its MPAs jointly cover 18 km² (Marine Conservation Institute 2020), corresponding to 0.002% of the EEZ of 827,626 km² (Zylich et al. 2016e). Vanuatu has 1,367 km² (Marine Conservation Institute 2020) of unimplemented MPAs, which encompass much less than 1% of the EEZ protected.
In the small island of Tanna resources and ecosystems are protected without government intervention. “Swiss ethnographer Felix Speiser (1996), who traversed the archipelago between 1910 and 1912, reported: Anyone can impose a taboo [blocking community access to land, reef, or sea resources] but it depends on the mana [spiritual and political power] of the person concerned whether his taboo will be heeded or not. An important man who has quantities of mana can proclaim very effective taboos because everyone fears punishment. But the punishments threatened by a man possessing little mana can easily be neutralized by countermagic” (Flexner et al. 2018).

“The presence of MPAs has been shown to increase tourism in Vanuatu (Pascal et al. 2015) and there is a strong link between biological success and social success (legitimacy) (Christie 2004)” (Buckwell et al. 2019). However, the presence of tourism can threaten islands like Tanna where there is no official protection. Moreover, “recognizing the humanitarian value that well managed fisheries resources and skilled fishers can play to disaster relief adds another dimension to the imperative of improving management of coastal fisheries and aligning policies across sectors” (Eriksson et al. 2017).

**Results and Discussion**

The results of the reconstruction updates presented above for the Melanesian islands are available on the website of the Sea Around Us (www.seaaroundus.org).

Small-scale fisheries (artisanal, subsistence, and recreational) are dominant in the domestic fisheries of the Melanesian islands (Figure 1). The catches from these fisheries, and especially of subsistence fisheries, are usually underrepresented (Zeller et al. 2015), but this issue is slowly being addressed (Pauly and Charles 2015).
Updating to 2018 the 1950-2010 marine catch reconstructions of the Sea Around Us: Part II-The Americas and Asia-Pacific

Figure 1. Domestic catches in the Melanesian islands (Micronesia, Fiji, Kiribati, Marshall Islands, Nauru, New Caledonia, Palau, Papua New Guinea, Solomon Islands, and Vanuatu) for 1950-2018, by A) EEZ, and by B) fishing sector. The overlaid dashed line represents the reported catch. Industrial catches for large pelagic species are excluded, as they are addressed in Coulter et al. (2020).

Some of the islands of Melanesia covered here, such as Micronesia, Fiji, Kiribati, Marshall Islands, and Nauru showed improvements in data reporting over the time period considered; however, similar improvements were not seen in New Caledonia, Palau, Papua New Guinea, Solomon Islands or Vanuatu.

Acknowledgements
Funding for the work presented here was provided by the Minderoo Foundation, by the Marisla, Oak, and David and Lucille Packard Foundations, and by the Bloomberg Philanthropies through Rare.

References (for Melanesia, then by EEZ)
Melanesia
**Micronesia**


Fiji


**Fiji**


205


**Republic of Kiribati**


**Marshall Islands**


Nauru


UNEP-WCMC and IUCN. 2020. Protected Planet: Protected Area Profile for Nauru from the World Database of Protected Areas, June 2020. Available at: https://www.protectedplanet.net/country/NR

**New Caledonia**


**Palau**


### Papua New Guinea


U.S. State Department. 2007. Papua New Guinea Department of State Background. Country Profiles Department of State Background.


**Solomon Islands**


Vanuatu


