

# Reefs invertebrates: sustainable resources for local populations in New Caledonia?

Pascal Dumas, Marc Léopold and Loïc Bourguine



In New Caledonia, the giant triton (*Charonia tritonis*) is used to gather or warn the inhabitants of a village. © ADCK/CCT/P.-A. Pantz

## Octopus, shellfish and crustaceans... the great diversity of reef resources

The use of reef species by Pacific island populations is not new, as evidenced by the abundance and variety of fishing related artifacts (hooks, pirogues, tools, shellfish, etc.) found in the geological strata associated with the settlement of the Lapita populations in the region. Although the diets of coastal populations have diversified considerably since antiquity, these resources are still an essential component of the Pacific islands' food security and a central element of their cultural traditions.

While the diversity of harvestable reef species is high - almost 100 species in a typical South Pacific island about 30 years ago - the range of species that are actually taken from the environment varies widely according to geographical areas and their environmental, economic and cultural context. Studies show that island populations generally collect a large diversity of invertebrates, and that they particularly target bivalve mollusks (giant clams, cardium, oysters, mussels, clams, etc.), gastropods (trochus, green snails, cones, strombus, spider conch, etc.), cephalopods (octopus), crustaceans (crabs, shrimps, rock and slipper lobsters, hermit crabs - including the large coconut crab *Birgus latro*) and echinoderms (sea urchins and, more recently, holothurians). These artisanal practices usually operate at small

spatial scales (one or several adjacent reefs, an island, etc.) for subsistence, and have gradually evolved, for some species with high market value, towards commercial fisheries.

Most of the species are harvested primarily for consumption, sometimes after transiting through various traditional channels of exchange or sale. Some others are emblematic and still play a role in the social and cultural practices of the region. These species are, for example, the giant triton (*Charonia tritonis*, Triton's trumpet or "toutoute" in New Caledonia) used as a wind instrument for gathering or warning the inhabitants of a village; cowries or cones used to make seashell currencies; pearl oysters and giant clams used to embellish prestigious objects for customary exchange ceremonies, not to mention the many species used in jewelry or those that end up in craft markets for visitors.

## Exploitation of reef resources in New Caledonia

In New Caledonia, as in many other islands in the region, coastal ecosystems - including coral reefs, mangroves and seagrass beds - contribute to food, income and, more importantly, to the self-sufficiency of coastal and island populations. In this respect, the territory benefits from particularly favorable conditions: over 4,500 km<sup>2</sup> of reefs with a high level of structural variability (fringing, intermediate, and barrier reefs - sometimes double or triple -, atoll reefs, etc.). Furthermore, the territory's location at the interface between tropical and temperate zones, means it is responsible for a wide variety of potential ecological niches for benthic species. With nearly 10,000 officially recorded marine invertebrate species, including more than 2,150 marine mollusks, 2,000 arthropods and 250 echinoderms, New Caledonia's coral reef ecosystems are



Coconut crabs (*Birgus latro*), cooked and ready to eat. © P.-A. Pantz



Green snail (*Turbo marmoratus*), Vanuatu. © IRD/P. Dumas



recognized as a "hotspot" of global biodiversity. A study carried out by the IRD revealed that over 60 species of macroinvertebrates - mainly mollusks - are harvested by fishers from the fringing reef flats around Nouméa (zone of Grand Nouméa). According to the available statistics, invertebrate catches frequently reach between 150 and 200 tons per year (excluding trochus shells), throughout the territory. However, these values are most certainly underestimated due to the informal and dispersed nature of these activities, particularly recreational and subsistence fishing, which makes them difficult to assess.

The majority of species are traditionally kept for local consumption, including mangrove crabs, lobsters, octopus, giant clams, and the numerous shellfish species collected at low tide such as clams (*Anadara scapha*), ribbed Venus clams (*Gafrarium Tumidum*), mussels (*Modiolus auriculatus*), tiger conch (*Strombus luhuanus*), and other spider conchs (*Lambis* spp.). Others are exported, including holothurians (bêche-de-mer) and trochus, with a cumulative export value ranging between XFP 400 and 500 million/yr in recent years. Scallops (*Ylistrum japonicum*) have recently been added to the list of exports: they are highly sought-after for the quality and delicate flavor of their flesh and 30 tons were exported to the Asian markets in 2016.

## Opportunistic overexploitation of sea cucumbers: a major challenge

The exploitation of holothurians (sea cucumbers) was developed in New Caledonia exclusively for the export of "bêche-de-mer" or "trepan" (the name of the product once the animal has been eviscerated, boiled and dried) to Asian markets. As in neighboring countries, fishing for sea cucumbers began in the early 19th century with commercial expeditions establishing precarious and temporary installations in isolated fishing areas. However, globalization and the boom in demand from the Chinese market since the 1980s have had a profound and lasting impact on exploitation throughout the Pacific.



Sea cucumber (bêche-de-mer, *Holothuria atra*), New Caledonia. © IRD/P. Dumas

Many countries have put in place national moratoria following the rapid collapse of catches after a short development period in these fisheries. Sea cucumbers are very easily collected by hand in shallow waters, or by free-diving, and are therefore very vulnerable to fishing. In the absence of effective restrictions, intensive exploitation of spawners generally leads to a depletion of the resource in 10 to 20 years, or even less for high-value species such as the sandfish (*Holothuria scabra*), white teatfish (*H. fuscogilva*) and black teatfish (*H. whitmaei*).

Unlike its neighbors, New Caledonia was relatively spared from overexploitation until 2010. Fishing is restricted to less than ten species and is limited to the western and northern lagoons, the coastal reef flats and the barrier reef down to 20 meters (the use of scuba gear or compressors is also prohibited). Catch varies between a few tens and a hundred tons of *bêche-de-mer* per year and is a source of income for more than 200 professional fishers (export value in 2016: XFP 425 million). However, the country is now facing major market pressure, which threatens the sustainability of these fisheries and requires authorities to rapidly adapt regulations (especially the effective implementation of minimum catch sizes and fishing licenses). A system of co-management by quota was successfully developed by provincial and customary authorities as well as fishers in a pilot project, but its large-scale implementation poses difficulties. Sandfish aquaculture is another development alternative that has been experimented over the last ten years. Restocking trials of this species are underway since 2014, but they produced mixed results. It is not yet possible to consider such operations as a remedy for overexploitation because they are expensive, and their success is uncertain.

## The steady exploitation of trochus

Like giant tritons, helmet shells, tiger conchs and other cowries, the trochus (*Tectus niloticus*) is a marine gastropod mollusk found on coral reefs in the Indo-Pacific region. Trochus build fairly large shells (the largest specimens are over 15 cm in diameter), which are highly sought-after for the quality of their nacre or mother-of-pearl layer, exported from the beginning of the 20th century to Europe and Asia for the luxury button industry and artisanal jewelry. Its high value and non-perishable quality (shells can be stored for several months before being sold) make it an attractive source of income for isolated island communities.

As a result of its rapid geographical expansion in the Pacific from translocations carried out in the 1930s and 1940s, growing demand on the world market soon raised serious concerns about resource sustainability. Despite increasingly restrictive fishing regulations and improved measures for restocking from aquaculture, trochus is

overfished in the majority of Pacific countries. This generally results in stock decline, which can even lead to local extirpation in some regions.

In New Caledonia, trochus exploitation began in the 1900s and exports soon peaked at around 1,000 tons of shells per year between 1910 and 1920. After a sharp fall in activity during the Second World War, the first regulations were introduced in the 1950s to protect a resource whose vulnerability was detected by scientists. Trochus individuals have a highly heterogeneous spatial distribution: they are not randomly distributed on the reefs but aggregate in very specific and rather accessible "microhabitats" (particularly eroded hard bottoms on reef flats and reef crests with low structural complexity and low coral cover).

Although its rapid growth and early sexual maturity makes it relatively resilient, trochus is particularly vulnerable to overfishing, especially since they move slowly. In New Caledonia, however, the resource does not seem to be threatened in the short term. With a decline in demand for mother-of-pearl in favor of synthetic materials, trochus is no longer actively sought-after: volumes exported in the last 10 years range from 150 to 200 tons per year for a turnover of between XFP 40 and 80 million, far behind that of reef fish catches. In addition to a catch size limit set between 9 and 12 cm to protect the reproductive potential of the species, the management of this resource benefits from the existence of numerous marine reserves distributed throughout the territory.

With diverse status (marine protected areas, sustainable resource management areas, customary reserves, etc.), these protected areas can be considered as refuges for broodstock, and therefore eventually support the regeneration of impoverished populations in the surrounding areas. A recent study indicates that adult trochus populations are twice as dense within the marine protected areas of the Southwestern Lagoon, and that they are made up of specimens 10 to 20% larger, on average, than those observed in the surrounding fished areas.

Very similar results are observed in neighboring Vanuatu, where reserves have very different characteristics (size, regulation,

governance regime). In addition to protection and status, the effectiveness of marine reserves to maintain or restore heavily exploited populations mostly depends on the presence of suitable environmental conditions: for trochus and other benthic species that are highly dependent on substratum, resource management cannot be planned independently of habitat characteristics.

## Harvesting mangrove crab for the local market

In New Caledonia, as in other Pacific islands, mangrove crab (*Scylla serrata*) is a major resource for the populations living near mangroves. Catches have increased steadily in recent decades to exceed 40,000 tons throughout the entire Pacific region. On the west and north coast of New Caledonia, the mangrove crab fishery gradually evolved from an active subsistence and traditional fishery to a commercial fishery, following the introduction of more sophisticated fishing techniques (such as folding traps) in the early 2000s. Mangrove crab catches doubled in the last 10 years, from about 20 tons (as officially declared) in 2006, to over 40 tons in 2015, with a peak of nearly 80 tons in 2010. However, these figures represent only part of the reality: a study conducted by the IRD revealed the importance of the catch sold in the municipality of Voh, which alone reached nearly 100 tons of crab in 2006.

Due to its socio-cultural and economic importance, the sustainable management of this resource is a real challenge: the first regulation governing the crab fishery dates back to 1963, and already established a minimum catch size and a temporary (two-year) ban on catching soft-shell crabs (i.e., during the molting period<sup>22</sup>). Substantial research efforts on the biology, ecology and prospects for aquaculture of the species in New Caledonia have since led to changes in regulations, which are currently based on four main measures:

- an annual closure of the fishery between December 1<sup>st</sup> and January 31<sup>st</sup>, during which any form of capture is strictly prohibited, in order to protect individuals during the peak breeding season of the species;

- a legal catch size of 14 cm (total width of the animal) aimed at limiting fishing pressure on individuals which have not yet spawned;
- a total ban on the consumption or sale of soft-shell crabs, and the marketing of crabs other than whole living crabs (crabmeat is prohibited, with special exceptions);<sup>23</sup>
- a ban on crab traps with a mesh size smaller than 65 mm.

As a result of these measures, the resource does not currently show signs of overexploitation throughout the territory.

While the biology of the species is now well known, some gaps in our knowledge - including the difficulty of observing and capturing juveniles in their natural habitat - still hamper our detailed understanding of how harvesting affects stocks. Some studies also highlight the marked variability in catch rates at small spatial scales (kilometers), given that legal-sized crab densities may vary by more than one order of magnitude between different habitats. From one mangrove to another, fishing can be less productive, particularly in areas where sedimentary conditions, salinity, temperature, vegetation cover, etc., will naturally be less favorable to the species. This highly heterogeneous distribution of the resource has strong socio-economic implications in New Caledonia, where customary land tenure generally prevents fishers from freely selecting their fishing areas. As in other Pacific countries, they depend mainly on traditional access rights rather than on the actual availability of the resource. Even if this practice evolves with the modernization of fishing techniques and the development of on-board fishing, these informal rules largely determine the areas accessible to fishers. These results highlight the importance of a conservation strategy that encompasses habitat, particularly at small spatial scales; they also raise questions about New Caledonia's fishery regulations and the optimal management of such a spatially heterogeneous resource. The congruence between ecological scales (shaping the natural structure of populations) and harvest scales (structuring fishing activities) is thus a strong argument in favor of the spatial management of mud crab fisheries.

<sup>22</sup> Arrêté du Journal officiel de la Nouvelle-Calédonie, June 25th 1963.

<sup>23</sup> "Fishing, transportation, marketing, display for sale, sale and purchase of mangrove crabs are prohibited from December 1st to January 31st. Fishing, transportation marketing, display for sale, sale and purchase, possession and consumption of soft-shell crabs and crabs smaller than 14 cm in the largest dimension are prohibited at all times. Only live whole crab may be marketed. The display for commercial purposes of crabmeat in any form whatsoever is prohibited at all times, except exclusively for restaurateurs and caterers, and only in the premises where they carry on their activity, which are certified or approved for hygienic purposes" (Extract from the North Province Fishery regulations, 2006).





Mud crab or mangrove crab (*Scylla serrata*) ready for sale, New Caledonia. © P.-A. Pantz

While the decline of reef resources is a global issue, it is of particular significance to the islands of the Pacific region. In fact, the vast majority of macrobenthic reef species are of interest to fisheries at some point in their life cycle: their depletion represents a major risk for the economy and the livelihoods of coastal populations, whose dependence on seafood products is generally inversely proportional

to the level of economic development. The implementation of a fishery policy for the sustainable management of coastal ecosystems and their resources is a major challenge for New Caledonia, given the current economic context which is deeply affected by the nickel crisis and the political challenges of the future.

# New Caledonia World of corals

*Scientific direction: Claude E. Payri*

*IRD Editions*

*French National Research Institute for Sustainable Development, Marseilles, 2018*

*Editions Solaris*

Translation: Lydiane Mattio  
Editorial coordination: Claude E. Payri  
Page and cover layout : Pierre-Alain Pantz - Editions Solaris  
Printing: Winson Press, Singapour

### Cover illustrations

Cover page 1 (from top to bottom):

Bay of Upi, Isle of Pines. © P.-A. Pantz

Coral biodiversity of Larégnère reef. © IRD/S. Andréfouët

Cover page 4 (from left to right):

Loading of a mikwaa net on a decked pirogue at Pwadèwia, St. Joseph Bay,  
Isle of Pines, 2017. © M. Juncker

Clown fish eggs. © G. Boussarie

Incubation of coral colonies in benthic chambers. © CNRS/E. Amice

Flying Red-footed booby (*Sula sula*). © M. Juncker

The law of 1st July 1992 (intellectual property code, first part), under paragraphs 2 and 3 of article L122-5, only authorizes, on the one hand, "copies and reproductions strictly reserved for the private use of the copyist and not destined for collective use," and, on the other hand, analyses and short quotations for the purpose of example and illustration, therefore "any representation or complete or partial reproduction, made without the approval of the author or the entitled parties or the legal claimant, is prohibited (paragraph 1 of article L. 122-4). Such representation or reproduction, by any means whatsoever, would therefore constitute an infringement punishable by the penalties provided for in Title III of the aforementioned law.

© IRD/SOLARIS 2018

ISBN : 978-2-7099-2677-5

Recommended citation:

Payri, C.E. (dir.), 2018 – New Caledonia: world of corals. IRD Editions/Solaris, Marseilles/Nouméa, 288 pp.