

# The Relevance of Traditional Ecological Knowledge for Modern Management of Coral Reef Fisheries in Melanesia

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**Abstract** - Traditional ecological knowledge (TEK) has received great attention in respect to coral reef associated fisheries as a way to adapt modern management strategies to local environmental and cultural conditions. We analysed the social and cultural roles of TEK for resource management in traditional Melanesian communities in New Caledonia. A multidisciplinary survey of customary marine tenure and fishing regulations on Ouvéa, a raised limestone island in New Caledonia, was carried out in 2006. Informants from the main chiefdoms and clans were questioned about past and present fishing activities, maritime territory rights, taboo areas and place names, customary authority, socio-cultural practices and belief related to marine resources, and vernacular knowledge and taxonomy of marine organisms. Results showed that customary fishing rules were primarily related to cultural events and social organization rather than to ecological patterns or economic interests. The relationships between TEK, population needs and uses of the environment were still strong, but have changed since the 1860s. An unquantifiable loss of indigenous knowledge has also occurred. Nowadays, to satisfy food and economic needs, modern users often abandon TEK and behave in relation to their own individual economic perceptions and needs. Better consideration of social and cultural aspects in resource management issues may therefore directly help to increase awareness of resource depletion and biodiversity loss as a basis for achieving long-term ecosystem and economic sustainability in Melanesian islands.

Key words: coral reef, fisheries management, traditional ecological knowledge, New Caledonia, South Pacific

## Introduction

Marine traditional ecological knowledge (TEK) is part of the larger body of indigenous knowledge. It is defined as a complex of knowledge of sea (i.e. reefs, lagoons and target species), livelihood activities (fishing techniques and practices, management rules), and related magic, beliefs and legends of social and cultural values (Berkes and Folke 1998). This knowledge constitutes a user-based accumulation of experience and observations that has been improved and transmitted orally through generations (Ruddle 1993; Turner and Berkes 2006a).

A large part of the literature about marine TEK has addressed the local knowledge of the environment or the taxonomy, the biology and the ecology of marine organisms (Aswani and Hamilton 2004; Lauer and Aswani 2008; Fraser et al. 2006) as well as the sustainability of indigenous practices (Johannes 2002; Lobes and Berkes 2004). Zooarchaeological evidence has also shown that not all practices were conservative and that early human settlement in many remote Oceanic islands led to sharp depletions of virgin terrestrial and marine resources, such as birds and shellfishes (Kirch and

Hunt 1997; Steadman 1995). On the other hand, there is increasing evidence that TEK can improve the understanding of resource use patterns and the monitoring and the adaptive management of coastal fisheries (Danielsen et al. 2005; Turner and Berkes 2006b). This case study of Ouvéa Island (New Caledonia), a raised limestone island with Melanesian and Polynesian communities, is an empirical evaluation of the relationships between TEK and the modern management of coral reef fisheries. Here we provide an interpretation of the social and cultural significance of TEK for indigenous populations and the roles that it could play in the sustainability of contemporary fisheries in Melanesia.

## Materiel and methods

### *The functions of TEK within the Melanesian socio-political organization*

In the traditional Melanesian cultural system, intrinsic interactions between humans and nature gave TEK a key role in regulating subsistence fisheries (Leblic 1989): the fishing system was driven by a dynamic linkage between community needs, TEK and uses

(Fig. 1a). Traditional socio-political organization resulted in a complex management system of fishing activities that were broadly controlled by TEK, but did not fully succeed in preventing overexploitation. The co-evolution of TEK with the surrounding environment was necessary to respond to both gradual and rapid change and to meet basic food and other subsistence needs. These needs were also linked to an array of social and cultural factors that determined formal and informal rules, codes of conduct, stories, and local taxonomies, among others. Particularly important factors related to TEK included the legitimacy of knowledge holders and territory owners, competition for leadership, the differentiation of the socio-political roles among people, and clan identity within the Melanesian society (Bensa 1995; Guiart 1992).

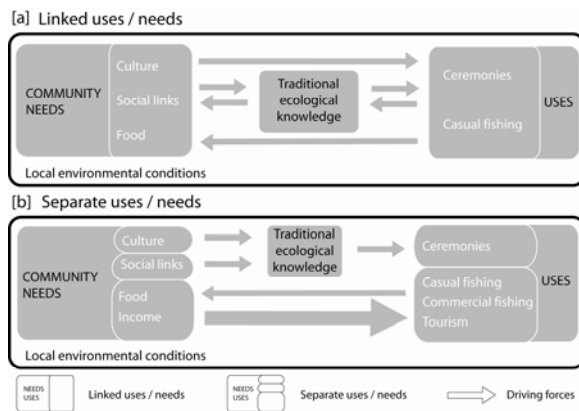


Figure 1. Relationships between traditional ecological knowledge, needs, and uses of marine resources in the traditional Melanesian cultural system [a] and in modern fisheries [b].

These roles were usually linked to the skills and totems of many successive migrants from different origins. As in many other Pacific islands, over the last few centuries, several waves of settlement by groups of both Melanesian and Polynesian origin are documented for Ouvéa since the first occupants arrived from Vanuatu or the Solomon Islands 4000 years ago (Guiart 1952; Sand 1998). These include settlers from the nearby islands of Lifou and Grande Terre (the main island of New Caledonia) and from Polynesia (Samoa, Wallis or West Uvea, and Tonga). The latter Polynesian groups settled in the northern and southern parts of the island in the 18<sup>th</sup> century. The body of Ouvéa TEK has, thus, been shaped by the importation, aggregation, synthesis and transformation of different sources of knowledge, including the Melanesian (*Iaai*) and Polynesian (*Faga Uvea*) languages or techniques (e.g. the distinctive construction of wooden canoes or sailing boats).

#### Study site and survey design

Ouvéa is a crescent-shaped raised limestone atoll-like island with a total land area of about 50 km<sup>2</sup>, which extends some 51 km from the northwest to the southwest and is about 7 km wide at its widest point (Fig. 2). The island encircles a large 836 km<sup>2</sup> lagoon with depths up to 25 m deep that is enclosed by barrier reefs and islets along its northern and the southern shores. The inner lagoon coast is lined with an almost continuous 30 km-long white sand beach, whereas the outer Ocean side coast has raised limestone terraces and fringing coral reefs along most of its extent.

The local population (4400 inhabitants 97 % of whom are Melanesian) is distributed in 20 traditional tribes, who have *de facto* collective control over Ouvéa waters. This customary system is contradictory to New Caledonia law that stipulates that lagoon and shoreline are public property and thus open to all.

Available quantitative data on fish resources and catches are included in the analysis. The annual catch of fish was estimated to be 200 t and was mainly composed of Lethrinidae and Serranidae (Léopold et al. 2004). More than 90 % of this catch was harvested in the lagoon area (about 95 % of the fishing grounds). About 15 % was sold on the local market; commercial fish exports were very low. This low fishing pressure has markedly preserved the fish biomass of the island (Kulbicki et al. 1995).

Using open-ended and qualitative interviews, we conducted a multidisciplinary survey in the northern and the southern Districts in 2006 to explore the traditional relationships between Kanak residents and their reefs and lagoon. The methodology consisted of interviews of all customary leaders of the different clans and chiefdoms of both Districts, who were questioned about social and cultural practises and stories related to the marine environment, customary authorities, local knowledge on marine life, fishing activities, territory rights, taboo areas and place names. High resolution aerial photography was used to localize sites and related data when appropriate.

#### Results

Fifty-one interviews of knowledgeable people were completed. We found that resident fishers have open access to the entire lagoon area, whereas outsiders coming from neighbouring islands for recreational activities or professional fishing are vigorously prosecuted.

All emerged areas and adjacent reefs are owned by the first settlers who have sometimes granted their guardianship to another social group. Interestingly, there are no local place names or traditional uses mentioned for the lagoon area, which suggests that there has been little need to depend on these

resources and areas for traditional purposes. Well-defined clan or tribal fishing grounds or territories are defined in reef and lagoon areas of the Northern and Southern Pleiads (about 40 km<sup>2</sup>), and along the windward fringing reef (about 4 km<sup>2</sup>) (Fig. 3). These are identified by vernacular place names of reefs, coral heads, passes, beaches, cliffs, etc. that remind people of the itineraries and myths of clans' ancestors. Species and gear restrictions are applied in a number of taboo sites where stories have recorded mythic relationships between people and marine animals (sharks, the humphead wrasse *Cheilinus undulatus*, morays, sea turtles, etc.). Specific customary rules also apply to sea turtles and large jacks (e.g. *Caranx ignobilis*) that are killed and shared according to ritual ceremonies.

No no-take zones were recorded but two types of reserved areas are present (Fig. 3):

i) Four marine areas are controlled as customary temporary reserves: 1) Lékiine-Faiava reserve in the east, which extends into a shallow lagoon marked by strong tidal influence; 2) Mouli reserve in the southeast and 3) Teuta reserve located inside the lagoon alongside a coral cliff and a sandy beach respectively; and 4) Ognat reserve, which extends over the windward fringing reef. Their surface areas range between 0.2 and 1.5 km<sup>2</sup> and total about 2.5 km<sup>2</sup>. Openings of the reserves to fishing are not implemented for a defined period but rather depend on social agendas and resource availability that may not be predictable. Interestingly, the protection status inside all taboo areas encompasses the physical environment and protects the reef habitats from direct human disturbances (e.g. wharf building).

Castnet and handline subsistence fishing is allowed in the four taboo sites because, according to local perceptions, such activities do not impact as negatively on fish resources as more effective methods (e.g. spearfishing, poisoning, and gillnetting). Significant fishing effort is only deployed during collective fishing trips to celebrate major social events (e.g. marriages, funerals, church ceremonies, etc.), which occur once to several times a year. Successful fishing is associated with abundant catches over a period of only a few hours, during when numerous fishers use nets hundreds of meters in length. Schooling species, such as the Indian mackerel (*Rastrelliger kanagurta*) and mullets (Mugilidae) are specifically targeted in Mouli and Teuta reserves respectively, whereas mainly reef species (Acanthuridae, Scaridae, Siganidae, etc.) are targeted in the two other taboo areas. The catches occasionally exceed a ton per day.

The main reason for the establishment of temporary reserves is to maximize catches during collective fishing trips. However this utilitarian

pursuit for food should not hide its fundamental social and cultural importance. Such events remind fishers of their distinct customary roles based on traditional sociopolitical organization and their TEK. Such fishing activities are deeply embedded in social arenas where gifts of fish are used to strengthen and legitimize the hierarchical structure of the chiefdoms. Consequently traditional fishing rules may not survive the weakening of the social structure and the loss of TEK. For instance the ban on mullet net fishing in the Teuta taboo area is linked to the tribe's allegiance to the Weneki chiefdom, which is no longer enforced since the custodians have contested the authority of the land and marine resource owners on the site. As a result, the mullet fishery was recently opened to commercial harvest.

Similar clan-based political strategies and territory rights drive other collective fishing events on the windward fringing reef of the main island. The same net fishing techniques are used to target reef species, particularly the fork-tail rabbitfish *Siganus argenteus*.

ii) The Kanak of Mouli and Saint-Joseph Districts are historically and culturally attached to the Southern and Northern Pleiads respectively, where there are traditional plantations on all islets, and two of them (namely Bagaat and Unyee) were inhabited until the early 1900s. The nearby reefs, passes, and lagoons are also reserved for the collective benefit of the local residents as a food source though fishing rights are not exclusive. Fishers from Fayaoué District are allowed to use trawling and bottom lines in the areas for subsistence and commercial activities, and spear guns once they have formally gained the land owners' or the custodians' permission.

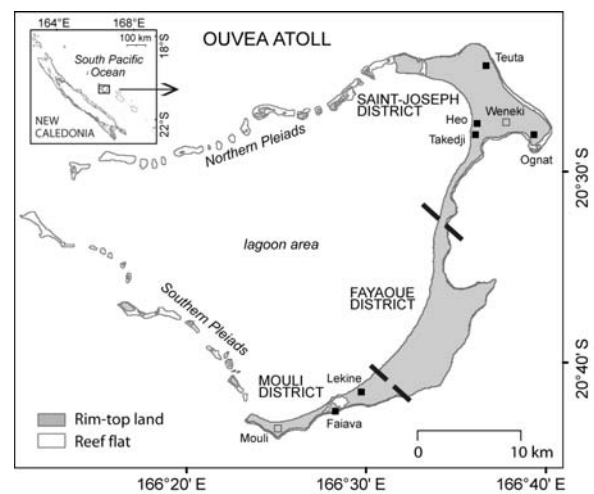


Figure 2. Ouvéa atoll (New Caledonia, South Pacific). Squares: Melanesian tribes in the survey area (Mouli and Saint-Joseph Districts). Unfilled squared: main chiefdom of both Districts.

Spear fishing was recently banned in the southern coastal waters to prevent shark attacks near the main tribal villages. This is the only locally-based decision that is not linked to Ouvéa social and cultural organization.

### Discussion

Our results show that on Ouvéa fishers rarely used TEK and referred to recent experiences of the use of modern fishing gear when looking for food and income. European settlement and economic development have indeed changed the relationships between Melanesian people and their marine environment due to technical, geographical, socio-political and educational developments since the 1860s (Izoulet 2005). Similar trends occur in traditional societies in other Pacific Islands and countries (Murray et al. 2006; Wittersheim 2006; Sillitoe 2000; Johannes 1978). On Ouvéa boats with outboard engines have given fishers access to new and more-distant fishing grounds inside the lagoon area rather than having to depend nearby surrounding fringing reefs and beaches off the main island and the Pleiads (Léopold et al. 2004), where traditional territories are located. More efficient fishing gear (e.g. nylon nets, spear guns) has also made fishing less uncertain, even for inexperienced fishers. More globally, progressive changes in population needs have finally marginalized fisheries-related TEK (Fig. 1b).

We found that TEK still has an important role in the Melanesian sociopolitical structures on Ouvéa. It now mainly addresses the social and cultural need to maintain traditional links between people, clans and chiefdoms rather than to protect the fishing economy or the environment *per se* (Fig. 1b). It is therefore a major part of the Kanak cultural heritage, as are marine resources and landscapes. Importantly sociocultural needs seem to be the driving force behind almost all existing local fishing regulations. Specific rules have been designed to protect coral reef habitats in many sites of social and cultural importance, which have in turn mitigated fishing pressure on certain resources.

This case study suggests that cultural considerations can contribute to the design of management projects: they may be the main objectives of local fishing rules and the primary incentive for participative initiatives and modern management of fisheries. Revitalizing TEK would thus be central to an efficient culture-based strategy for fishery management. The strengthening of TEK and its social and cultural underpinnings may help to lever up ecological awareness because of its significance for local people and their customary values (Berkes 2008). This would indirectly increase

the non-use and conservation value of the marine ecosystem of Ouvéa and help to balance economic and conservation interests in the future. Following various authors, our observations confirm that resource management in Oceania should rely on local socioeconomic conditions (Cinner 2007; Cinner et al. 2005) and customary marine tenure systems (Aswani 2005) and social structures (Horowitz 2008; Leblie 2008).

There may also be an important role for TEK and traditional values to play in fisheries management at scales beyond the community level on Ouvéa (Berkes 2006). Whereas, in the past, passive conservation of Ouvéa marine resources was ensured by the low human population density, limited commercialization of marine resources, and simple fishing technology, these are now changing. As a result fishers are now increasingly targeting the lagoon area that had not been traditionally managed. Such activities have not been controlled by public authorities because of a lack of enforcement of official regulations. Thus up-scaled measures are now required to regulate new emerging uses threats to marine resources (e.g. cruise ship tourism, developing commercial small-scale fisheries, and ciguatera poisoning), which could complement the existing small locally-managed areas. Such up-scaling of management and the application of TEK would require a change in governance to involve customary as well as public authorities in a collaborative management framework (Cinner and Aswani 2007). In this context, the addition of Ouvéa to the UNESCO World Heritage List in July 2008 provides a unique opportunity to use TEK as a tool for an innovative management of coral reef fisheries and ecosystems at the island scale. It would also engage traditional leadership in the linked conservation of the island's natural and cultural heritage. In this sense this nomination has formally and internationally recognized the strong linkage between culture and fisheries sustainability in Melanesia.

### Acknowledgement

This study was funded by the CRISP programme (Coral Reef Initiative for the South Pacific – [www.crisponline.net](http://www.crisponline.net)) as part of the collaboration between the French Institute of Research for Development (IRD) and The University of the South Pacific. The authors want to particularly thank Joseph Baly for his help in conducting the interviews of customary leaders.

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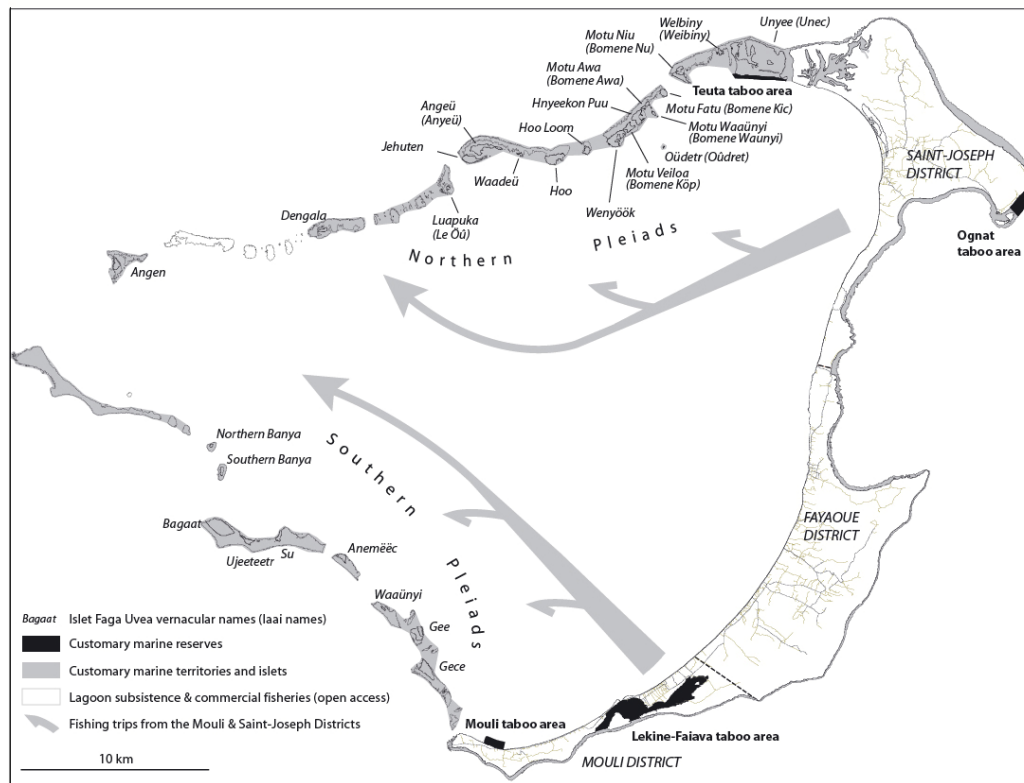


Figure 3. Spatial distribution of community-managed and open access fisheries of Mouli and Saint-Joseph Districts in Ouvéa atoll