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Contemporary Rāhui: Placing Indigenous, Conservation, and Sustainability Sciences in Community-led Conservation

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Abstract

Resource sustainability requires recognizing and developing pathways to integrate local and Indigenous knowledges alongside conservation and sustainability sciences within management practices and governance. However, knowledge never occurs in a vacuum and is always mediated by the beliefs, values, or stances towards its possession or use within particular contexts. Focusing on the unprecedented renewal of a traditional practice of natural resource management in French Polynesia called rāhui, this article investigates the local conceptions, perceptions, and expectations (CPE) which mediate between community knowledges, plans, and actions, and inputs from conservation and sustainability sciences. Drawing on a multi-year ethnographic study focused on the CPE of two coastal communities around Tahiti's Taiarapu coast, our results show that the CPE which shape relationships between conservation sciences' inputs toward decision and policy-making and community governance and management over nearshore marine resources can differ meaningfully. Moreover, we suggest that evidence of such differences despite socioeconomic, cultural, or demographic similarities indicates that the specificities of local communities' CPE around conservation and sustainability sciences should be carefully considered before and alongside any conservation or management action.

Keywords: conservation science, community-led governance, conception, perception, Taiarapu, French Polynesia

Introduction

The neighboring district of Tautira rejected the rāhui for a long time. However, when I arrived in Taiarapu, I watched it being born. I saw trust building up over the meetings between local community and the team of scientists to which I still belong. And I met this resident. He was not a fisherman but a significant consumer of fish. He collected signatures, he explained to residents what the rāhui had to offer them. One day, he brought me to the church to chat with the community, residents of the Fenua

39 *'Aihere (the rural part of the island past the end of the road). As soon as I arrived a*
40 *fisherman lectured me: "I recognize you [from the rāhui meetings] ... how are we*
41 *going to feed our family if we can no longer fish? Who is going to do our job? This is*
42 *not good for us." He went on with his speech, "But I know what you do is for our*
43 *children. I am glad you are here with us." (Fabre, fieldnote excerpt)¹*
44

45 Accelerated global environmental change, including climate change, rapid loss of
46 biodiversity, scarcity of resources, and massive shifts in land and sea use, has ushered in a
47 new era, conventionally referred to as the Anthropocene (Norström *et al.* 2016, Berkes 2017,
48 Russell and Kueffer 2019), which calls for new tools towards the sustainable governance and
49 management of resources with a strident urgency. The problem is particularly critical in island
50 ecosystems. Where community well-being that depends on natural resources is directly
51 impacted, rapid solutions are needed (Graham *et al.* 2017, McMillen *et al.* 2017, Friedlander
52 2018). Among attempts to achieve sustainability in this new era of global changes, the
53 recognition and inclusion of Indigenous and local knowledge alongside or integrated with
54 conservation or sustainability sciences has increasingly become a key focus for work on
55 resource management process and governance systems (Moller *et al.* 2004, Plummer *et al.*
56 2013, McMillen *et al.* 2014, Lauer 2017, Bennett *et al.* 2019; Apetrei *et al.* 2021). Today, a
57 variety of Indigenous resource management systems, often rooted in locally deep histories of
58 engagement with island environments, are recognized for their critical role in responding to
59 contemporary conservation challenges. Across the Pacific Islands, sustainable management
60 and conservation of ecosystems increasingly involve strategies integrating ILK and deeper
61 engagement of local communities (Jupiter *et al.* 2014, Delevaux *et al.* 2018, Artelle *et al.*
62 2019), for instance by setting up culturally articulated restriction zones in order to better
63 regulate marine resources (Cinner and Aswani 2007) as is the case with Bul in Palau (Ueki
64 2000, Carlisle and Gruby 2018) or Reimaanlok in the Marshall Islands (Baker *et al.* 2011).
65 Such initiatives develop protected areas with the involvement of local communities to
66 integrate their specific needs, values and cultural heritages. However, research gaps remain
67 including how to navigate such developments given the risks of conflicts between or
68 accommodations of Indigenous and conservation and sustainability sciences within
69 management or governance actions and practices.

70
71 This synthesizing challenge is of material contemporary concern in French Polynesia where
72 the resurgence of a traditional management practice referred to as rāhui (Bambridge 2016),
73 has become centered for the work of communities to exert agency over their marine
74 resources' ecological futures (Mawyer and Jacka 2018). In this paper, we focus our attention
75 on contemporary rāhui in Tahiti's Tairapu peninsula, whose governance and management
76 has been informed both by Indigenous Mā'ohi expertise, values, and practices—which we
77 identify as a practice of Indigenous conservation—as well as by conservation and
78 sustainability sciences. By Indigenous conservation, we mean the historically empirical,
79 expert environmental and ecological practical knowledge of Tahitian and Mā'ohi peoples
80 culturally grounded in the worldview of their communities towards sustainable ecological
81 futures. In that sense, rāhui is a critical example of Indigenous conservation which reflects
82 local and place-based marine management practices, sometimes considered "traditional" in
83 comparison to universal/conventional conservation-based knowledge and expertise derived
84 from the biological and ecological disciplinary sciences common to management system
85 toolkits in Marine Protected Areas (MPAs).

¹ All the terms in Tahitian are written following the orthographical conventions of the Tahitian Academy with the exception of place names, which are written in their everyday representation.

87 Deeply rooted in the sociopolitical and religious dynamics of chiefly governance of marine
88 and terrestrial resources before the French colonial era (Nordhoff 1930; Bambridge, 2016),
89 rāhui has reemerged on the Tairapu coast as a potent tool for the conservation of marine
90 resources, especially in nearshore coral reef environments where intensive fishing pressure,
91 particularly in more populated areas, has led to substantial declines in many highly prized and
92 vulnerable species (Friedlander *et al.*, 2016; Thiault *et al.*, 2019). Historically, Mā'ohi
93 communities have established relations of continuity between land and marine tenure,
94 resulting in systems of priority and specialized control of territories and resources (Bambridge
95 2009, 2016, Le Meur *et al.* 2018). In the 19th and 20th century ethnographic literature, rāhui
96 was considered a fundamental institution in Tahiti with relational practices between different
97 individuals or groups within Tahitian society and with entities charged with sacredness inside
98 an environmental network (Rigo 2004) and closely linked to conceptions and practices of tapu
99 (Shore 1989, Rigo 2016). Today, the resurgence of Tahitian rāhui raises questions about the
100 place of ecological thinking, conservation and sustainability sciences, management and
101 governance, as ethos and as practice, within community-driven and community-led
102 conservation actions. As Indigenous peoples and local communities (IPLCs) negotiate 'us-
103 ness', relationships, and interactions with nature and its resources in a changing world upon a
104 foundation of culturally-grounded and place-based values (Whaanga and Wehi 2017), the
105 need to attend to community understandings including beliefs around, valuations of, feelings
106 about, or expectations and hopes for the role of conservation and sustainability sciences
107 within their planning, decision- and policy-making processes is an immediate concern.
108

109 Here, we assess how such synthesis should take into account the distinct conceptions,
110 perceptions, and expectations (CPE) of two Tairapu communities, Teahupo'o and Tautira,
111 around the role of conservation and sustainability sciences and scientists to support effective
112 community-based biodiversity conservation and natural resources management. By
113 demonstrating both the presence of, as well as differences between, local communities' CPE
114 mediating conservation sciences' role in a community's plans and actions, we suggest that
115 sensitive attention to CPE can help bridge the gap between science, management and
116 decision-making (Tadaki *et al.*, 2017; Van Riper *et al.*, 2020). To understand how both
117 Indigenous and conservation and sustainability practitioners can better understand one another
118 and work together, we ask the following questions: How do IPLC stakeholders feel about
119 Indigenous conservation approaches as related to approaches grounded in conservation and
120 sustainability sciences? How do they define the role of marine and environmental sciences in
121 the context of community-led governance? What is a community's sense of the place of
122 conservation in the planning and enactment of rāhui governance? Are local stances towards
123 science or conservation the same at different rāhui sites and what might differences say about
124 achieving sustainable management goals? To answer these questions, we explored how
125 conservation is materially dealt with *in situ* in contemporary rāhui governance on Tairapu.
126

127 **Methods**

128 *Fieldwork*

129 Teahupo'o and Tautira are two distinct districts on Tahiti's Tairapu coast (Figure 1). They
130 are respectively located on the western and eastern sides of the southern coastline but
131 converge on an area called Fenua 'Aihere (lit. uncultivated land, in French 'la brousse')
132 which has been under a conventional preservation law since 1952 dedicated to protection of
133 sites of cultural, archaeological, historical, and legendary interest. This remote area, nearly
134 2000 hectares with no roads and only accessible by boat, is also home to contemporary
135
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137 communities which primarily live by subsistence fishing and farming (Table 1). Both of the
138 rāhui areas we studied are located in the Fenua ‘Aihere. Though composed of the same
139 extended families, Tautira and Teahupo‘o have maintained a rivalry rooted in what Samoan
140 historian Damon Salesa refers to as a type of Indigenous deep time (Salesa 2014). Each has
141 composed and developed its own rāhui area with community-specific rules. Teahupo‘o was
142 the first district to re-establish rāhui, to address a decline in fishing productivity and protect
143 themselves from outsider fishermen (including from Tautira). The rāhui of Teahupo‘o was
144 officially implemented in 2014 and legally registered within the 6th category of French
145 Polynesia’s Environmental Code with the appellation “Marine Managed Natural Resource
146 Area.” Inside an area of 768 hectares, all activities (e.g. fishing, swimming, navigating,
147 collecting resources) were prohibited for three years (Figure 1). In 2017, the prohibition was
148 extended for three more years and the closure was renewed again in 2020. As a consequence,
149 the protected area has not been “opened” for seven years. Administratively, the rāhui of
150 Teahupo‘o is managed by the Department of Environment, the Territorial state agency that
151 oversees environmental domains including the preservation and management of natural
152 resources (through the Environmental Code). Somewhat differently, the nearby community of
153 Tautira implemented a rāhui in 2018 with a three year closure plan. In this case, the rāhui is
154 legally registered through the Fishery Code with the appellation “Controlled Fishing Area”. In
155 Tahiti’s post-colonized administration, fisheries have separate governance from other
156 environmental domains and the Department of Marine is the responsible state agency. The
157 rāhui at Tautira only prohibits fishing activities and is subdivided into three zones with a fully
158 closed central area—a puna (source)—as the heart of the functional system (Figure 1).
159 Notably, the rāhui at Teahupo‘o and Tautira were both locally conceived to be for a limited
160 period, but the legally established protection supported by the State appears to be a permanent
161 designation. That any opening plan will thus need to be validated by the State is a persistent
162 reminder of the governance tensions inherent in legal pluralisms around marine resource
163 management (Bambridge 2016).

164
165 Each state agency is responsible for scientific monitoring of its associated rāhui. However, a
166 collaboration between the European INTEGRE (INitiative des TErritoires pour la Gestion
167 Régionale de l’Environnement) program for the development of integrated management of
168 coastal environments, and the Fondation de France program on reef resilience, meant that
169 scientific ecological monitoring of reef species was undertaken around Taiarapu by
170 researchers from CRIOBE (Centre de Recherches Insulaires et Observatoire de
171 l’Environnement, French Polynesia) in July 2016, January 2017, and December 2019. These
172 periods of monitoring established visible feedback loops between disciplinary sciences
173 informing the communities in their rāhui governance and management and communities
174 informing scientists about place-based and culturally-grounded beliefs and values that support
175 the success of rāhui based marine protection.
176

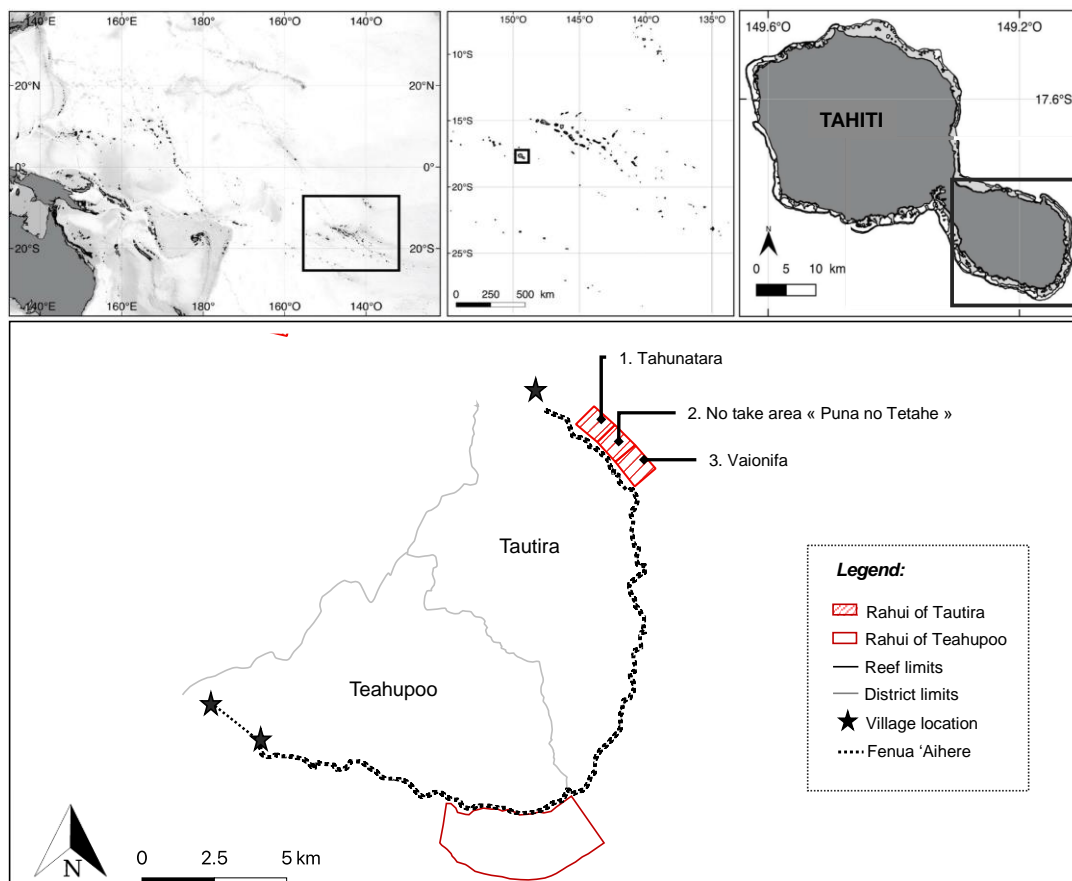


Figure 1 Fieldwork in Tairapu: location of the studied rāhui areas at Tautira and Teahupo‘o.

Table 1: Details of population, fishing dependence for local communities and rāhui at Tautira and Teahupo‘o^{1,2}.

	Tautira	Teahupo‘o
Total Population		
Number of inhabitants [% of Tairapu]	2,249 [10.8%]	1,419 [6.8%]
Population (>15 years)		
Number of inhabitants [% of Tairapu]	1,883 [11.7%]	1,120 [6.7%]
<i>Gender</i>		
Women [% of district]	940 [49.9%]	547 [48.8%]
Men [% of district]	943 [50.1%]	573 [51.2%]
<i>Fishing activities</i>		
Fishermen [% of Tairapu]	725 [30%]	195 [15%]
Fishermen [% of district]	725 [38.5%]	195 [17.4%]
<i>Other activities</i>		
Farming [% of district]	87 [4.6%]	60 [5.4%]
Others [% of district]	730 [38.7%]	421 [37.5%]
Without activity [% of district]	1,004 [53.3%]	585 [52.2%]
Rāhui		
Type	Periodic Harvested Closure	Periodic Harvested Closure
Surface	265 ha	767 ha
Official initiation time	Since 2018	Since 2014
Description	Area subdivided into 3 zones Prohibition of all fishing activities	One entire area Prohibition of all activities

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182 ¹ISPF 2012, 2017; ²Marines Resources Department of French Polynesia (DRMM); ³Environmental Department
183 of French Polynesia (DIREN).

184

185 Because the inhabitants of Fenua ‘Aihere live a subsistence lifestyle, they regularly fish by
186 the seaside and generally respect the rāhui which they have established. A distance of 50
187 meters (Teahupo‘o) and 100 meters (Tautira, due to important maritime traffic) offshore
188 allows community members to continue their activities on the coast. Beyond this distance,
189 rāhui rules come into effect. Governance and management of rāhui is carried out by a
190 management committee, the tōmite rāhui, which brings together all community stakeholders
191 including the mayors (tāvana), the representatives of local associations (environmental
192 protection, fishermen's cooperative, surf, culture, education, etc.), a representative of each
193 prominent religion, and representatives of the corresponding State protection agency
194 (Environmental or Fishery Department). The tōmite ensures functioning and surveillance of
195 the rāhui. In practice, it is the people of Fenua ‘Aihere who maintain local surveillance of the
196 area. They watch for rāhui infractions and alert the tōmite when action is warranted.

197

198 *Study framework*

199

200 Following Aswani *et al.* (2017) and Bennett *et al.* (2017), we approached the role of the social
201 sciences in advancing conservation science by applying methods drawn from anthropology,
202 psychology, and cognitive science to study the rāhui of Teahupo‘o and Tautira in the context
203 of near-shore community-led Indigenous resource management. Our methodology highlights
204 the idea of “conservation social science” (Mascia *et al.* 2003, Newing *et al.* 2011, Bennett *et*
205 *al.* 2017) to refer to diverse practices drawing upon social science epistemologies and
206 methods to understand Indigenous science (Morishige *et al.* 2018) and local conservation
207 policy, practice and outcomes (Bennett *et al.* 2017, Bennett 2019; Moon *et al.* 2019a).

208

209 To answer our questions, we drew on naturalistic inquiry (Guba and Lincoln 1982, Lincoln
210 2007) to develop a theoretical framework around Teahupo‘o and Tautira communities’ and
211 conservation or sustainability scientists’ concepts, perceptions and expectations (CPE) for the
212 rāhui tool. Perception is the ability to see, hear, or become aware of something through the
213 senses (Bonnet *et al.*, 1989). It is not an immediate image of the world (Barrow and
214 Tenenbaum 1986) but includes prior knowledge, expectations, experiences, and motivations
215 to help give meaning to sensory data. Prior work suggests that perceptions are useful
216 indicators of marine conservation goals (Gelcich *et al.* 2008, Abecasis *et al.* 2013, Bennett
217 and Dearden 2014, Jefferson *et al.* 2014, Beyerl *et al.* 2016, Bennett *et al.* 2019). However,
218 previous work in conservation science has rarely focused on conceptions. Conception loosely
219 refers to the ability to form an understanding in the mind of objects or processes in the world
220 (c.f. Moon *et al.* 2019b). While the literature engaging the relationships between perception
221 and conception is quite vast, with roots, trunks, and branches in numerous disciplines
222 including anthropology, cognitive science, linguistics, neuroscience, philosophy, and
223 psychology, a critical hinge rests in the observation that people do not perceive primarily with
224 their senses, but with their minds, famously about such apparently objective natural entities as
225 color (Berlin and Kay 1991) or biological kinds (Conklin 1998). Finally, we elicited
226 community members’ expectations for the rāhui. Expectations, we hypothesized, inform and
227 reflect community members’ hopes and desires but also their doubts, anxieties, and historical
228 wounds. Such information is crucial to develop adequate and appropriate conservation
229 measures well-linked to local scales including the practical achievement and success of
230 conservation and management actions.

231

232 Practically, we identified CPE in individual interviews by coding discursive moves that
233 indicated the speaker's conceptual, perspectival, or expectational stance vis-à-vis rāhui and
234 the seascape, conservation science, and coral reef management and conservation practices.
235 Since individuals live in a social environment characterized by interactions and relations, we
236 also wanted to be aware of the impact of social groups on CPE. In a sense, rāhui is a form of
237 social thinking and shared knowledge that guides different ways of interpretation toward
238 shared positions (Jodelet 1989) and reflects Indigenous science (Morishige *et al.* 2018) and
239 local values around and orientations toward the social. The social context of CPE was studied
240 through meeting participation and collective discussion. All the elements that inform CPE
241 according to sociogeographically situated stakeholders are represented on a diagram in Figure
242 2.

243 244 *Data collection*

245
246 Initial data collection took place during a 10-month research period from February to
247 November 2017. During this time, the science team in which we participated was responsible
248 for supporting and facilitating the contemporary rāhui projects around Tairapu in
249 collaboration with scientists from CRIOBE alongside the administrative support of the
250 government of French Polynesia. Because the rāhui of Teahupo'o was introduced in 2014, the
251 dynamic of rāhui management was already underway prior to the survey. Escorted by a key
252 partner—locally respected as a Tahu'a² (expert) across many areas such as navigation,
253 fishing, agriculture, medicine, among others—we interviewed 11 local stakeholders and
254 participated in three tōmite meetings. In Tautira, data-collection was different as there were
255 no rāhui in 2017. However, we were present for the emergence of a community-led push for
256 rāhui here as well due to the actions of several local tāvana (mayors) who invited CRIOBE
257 scientists and others involved in the rāhui at Teahupo'o to lead a series of meetings exploring
258 the possibility of a rāhui in this community. In this context, we interviewed 10 local
259 stakeholders and led nine meetings at Tautira village and communities in the Fenua 'Aihere
260 (the southernmost coast of Tahiti island beyond the end of the road—access here requires
261 travel by sea for visitors and community members alike) to share knowledge and address their
262 expectations. During a final meeting, the community decided to adopt a rāhui framework for
263 Tautira. In this context, the role of CPE in facilitating a better preparation for planning a rāhui
264 implementation was evident and it was clear that neglecting CPE would be a risk when
265 defining a management plan which depended on local buy-in.

266
267 Data collection continued from September 2018 through June 2019, a 10-month consecutive
268 research in place. This longer period allowed us to collect deeper information on the recent
269 rāhui implementation at Tautira with a new round of interviews. For each interview, we
270 brought a visual image of the rāhui area (with a flyer) to support the discussion and to
271 improve mutual understanding of individual CPE linking rāhui and engagements with
272 conservation and sustainability sciences and practitioners, sometimes also supporting the
273 State and its administrative agencies. In total, during this period we conducted 15 interviews
274 and participated in six meetings at Teahupo'o, and we conducted 21 interviews and observed
275 two meetings in Tautira. Across these contexts we sought to document the plurality and
276 diversity of views and the complexity of individual expectations evidenced in meeting and
277 interviews. Examples of local communities' CPE mediating Indigenous and conservation and
278 sustainability sciences approaches is presented in Table 2.

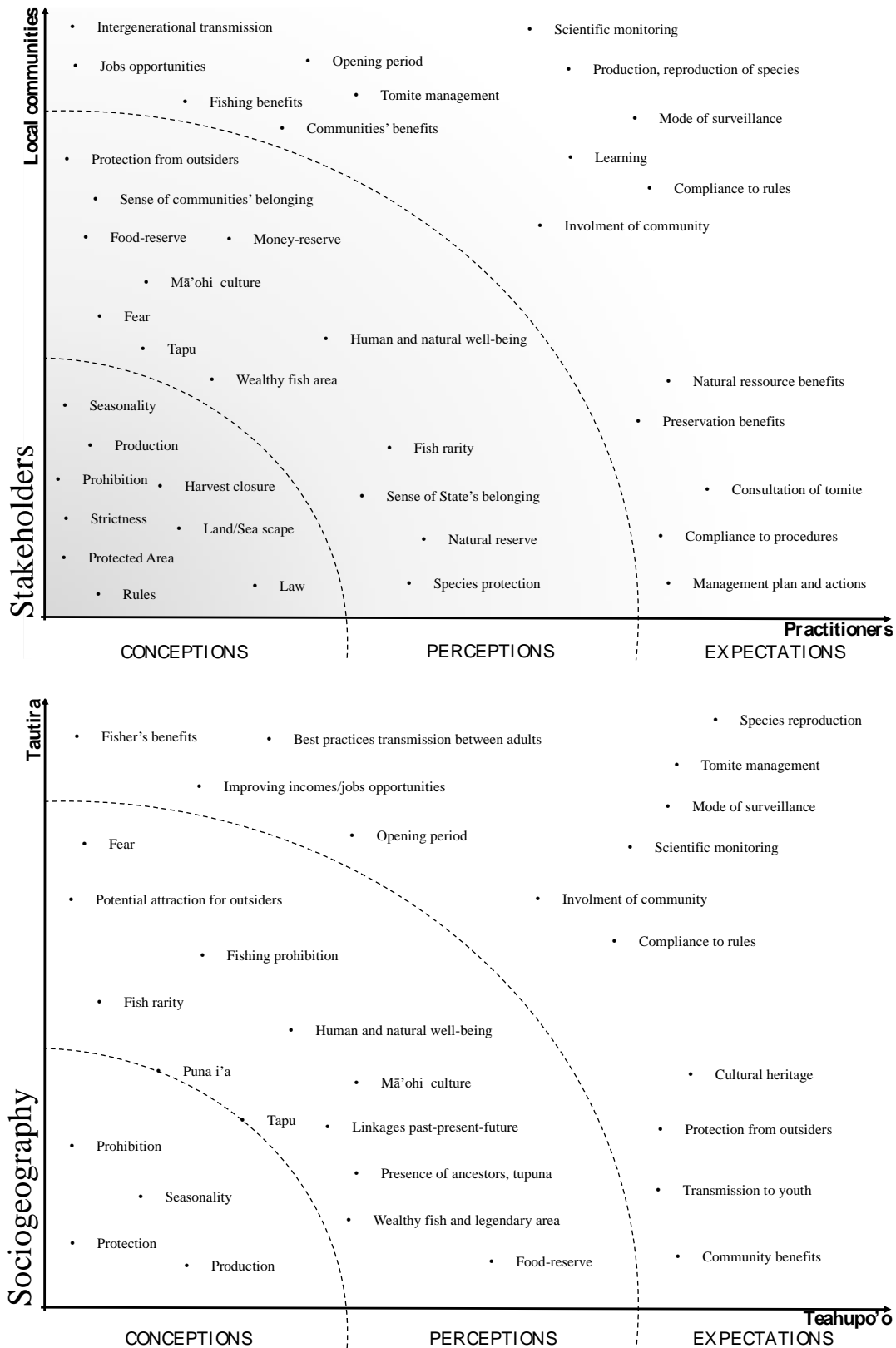
² Tahu'a: Specialist or expert in one domain. Example: tahu'a pure (priest), tahu'a tahutahu (sorcerer), tahu'a rā'au (traditional medicine man), etc., online dictionary of the Fare Vāna'a (Tahitian Academy).

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Results

According to stakeholders, conceptions, perceptions and expectations (CPE) progressively diverge between local community world views and values and administration representatives along a gradient of conceptions to perceptions and expectations. Conceptions observed highlighted the evolution and adaptation of rāhui as a cultural practice as evidenced in Indigenous approaches to seasonality, the continuum of the land/sea concept, harvest opening periods, and conventional approaches to fishing prohibition, rules and law (like any other MPA). When local community CPE align or do not align with the rāhui framework, the perceptions of who benefits or how the rāhui operates illuminate important facets of Indigenous and community roles in governance relative to other marine protection schemes. For instance, a reciprocal sense of belonging appears as a critical divergent element vis a vis other marine protections. As locally conceived, it is up to the communities who establish rāhui to determine who is targeted for benefits, for instance local fishermen, thus emphasizing a reciprocal identity between community and rāhui. Another divergent element is the role of tōmite management as a legitimate local community entity, versus the viewpoint of State agencies that members of tōmite only have a consultative opinion. Notably, though rāhui practice is deeply rooted in Mā'ohi culture, CPE also show common foundational perceptions around the intersection of human and environmental well-being and expectations about the efficiency of surveillance, compliance with rules and community involvement.

Sociogeographical conceptions that link rāhui to Indigenous science and conservation are similar in Tautira and Teahupo'o and include four key ideas: (i) restriction, especially of fishing activities, (ii) protection of coral habitats, (iii) the importance of seasonality, founded on knowledge, skill, or experience and (iv) the goal of (re)production for reef species. Those conceptual ideas and strategies are set up to achieve Indigenous conservation goals including asserting the legitimacy of the cultural practice and application of rāhui, sustainable fishing practice, and the maintenance of local maritime territoriality highlighted by local knowledge and authority over decisions regarding rāhui. The rāhui tool is used at both sites in a context of fish rarity and is tightly associated with the idea of the necessity of regenerating reef species by stopping fishing from outsiders and finding solutions to lagoon fishermen's difficulties; thus, the fishing ban. But such conceptions here lead to divergent perceptions and expectations about the rāhui at Tautira or Teahupo'o (Figure 2).



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Figure 2: Diagram of the CPE model of rāhui according to stakeholders (local communities vs administrative practitioners – *upper panel*) and the local sociogeographical situation (in Tautira vs Teahupo‘o – *lower panel*)

320 Results show that rāhui actions for conservation highlight the importance of culturally-
321 grounded and place-based values. Indeed, we observe that stakeholders in Tautira sometimes
322 compared rāhui as a protection tool to Marine Protected Areas (MPAs), a distinctly
323 contemporary and post-colonial form of permanent and unbroken conservation. But we
324 observe *in situ* that rāhui may be expected to feature open seasons for harvest or even the end
325 of a fishing ban.

326
327 Interestingly, stakeholders expressed some anxiety about their own relationships to the freshly
328 established rāhui. It was not clear if informants fear a permanent designation as an obstacle to
329 their own harvesting rights or if anxiety or fear around the term rāhui is due to its connections
330 with invisible and potentially dangerous spiritual or more-than-human presences in the Fenua
331 ‘Aihere (similar to dynamics seen in the Marquesas or elsewhere across Polynesia
332 (Donaldson, 2018; Donaldson, 2019). However, we observed from key informants that the
333 historical and cultural power of rāhui seemed less activated in Tautira, where people were
334 more concerned with the fishing implications. Others underlined the importance of
335 seasonality, and not just about opening and closing seasons but also ideas rooted in
336 Indigenous biological knowledge of reef species. In Teahupo‘o, the importance of legends,
337 ancestors, and history related to rāhui and its geographical place point to expectations strongly
338 geared towards cultural transmission, benefits to the community of Teahupo‘o, and protection
339 against outsiders. Nevertheless, at both sites, Mā‘ohi interest in biological conservation
340 appears to be read through a cultural framework wherein enhancing the resource goes hand in
341 hand with the development (tupu) of cultural agency and futurity. The CPE fronted a desire to
342 culturally-ground activities through tapu (in this case, sacred restriction as one of the
343 mechanisms of the rāhui) to preserve natural resources for transmission to future generations.
344 Notably, a stance toward protecting the community from outsiders by adapting the rāhui tool
345 to mobilize conventional conservation approaches—i.e. through a legal appellation of rāhui
346 based on existing legal frameworks that in reality do not adequately map onto pre-colonial
347 practices—was also evident within the CPE.

348
349 The different results in CPE in Tautira highlight the non-homogeneity of community-led
350 Indigenous resource management (Figure 2), where the most important activity is fishing and
351 30% of the population are professional lagoon fishers, versus 17% in Teahupo‘o (Table 1).
352 The rāhui ban on fishing therefore is perceived as risking decreased harvest and promising
353 further difficulties to come. As can be seen in Table 1, more than half of the inhabitants in
354 both districts are not employed in the formal labor sector. Thus, most of the informants in
355 Tautira expressed some worry about rāhui, from a fear that reopening marine areas for fishing
356 would be repeatedly deferred, as at Teahupo‘o, or that the area would attract more outsiders in
357 response to the productive (conceptual) nature of rāhui (puna, reproduction of species) which
358 would also be detrimental for local fishermen. Expectations here were therefore oriented
359 towards a better yield for the fishermen of Tautira and an improvement of their income. The
360 strict objective of natural resources conservation inscribed in the fisheries code and the ZPR
361 principle in the case of Tautira locally reads as a way to improve fishery yields. However, we
362 note common elements in Figure 2 (perceptions of human well-being, expectations of a
363 successful area for fish reproduction, surveillance and compliance with rules, monitoring of
364 results) that link rāhui to conventional approaches of conservation. As can be seen in Table 2,
365 local feelings about Indigenous and conservation sciences approaches strongly support the
366 development of pathways to better integrate approaches through sensitive alignment to local
367 CPE.

Table 2: CEP articulations of Indigenous and conservation sciences approaches at Tautira and Teahupo‘o, Tairarapu.

	Local feelings about Indigenous conservation approach	Local feelings about conservation and sustainability sciences approach
Selection of Quotations	“The rāhui, it has always existed since the ancestors, and all Tahitians know the rāhui ... If there are still grandparents who are living here, we are able to ask them to explain what is the rāhui.” (Pāpā‘ū, Teahupo‘o)	“Rāhui is rāhui. It is not a MPA.” (Teahupo‘o leader of Rāhui Tōmite)
	“Te ‘ōpani e tai’a te o tau... you have to stop when there are laying seasons, that’s the rāhui. There are seasons. Now, rāhui, people understand as something which lasts for a long time. No ... there are seasons, like before.” (Ancient Fisherman from Tairarapu)	“This is the Tahitians’ fault. Ah ‘aivāna‘a ... that means scientists ... understand ... you see, they don’t want to know ... after they say ... huh, looking for money for them ... No! They came to inform us, and maybe our children could work with them, in collaboration.” (Mama from Tairarapu)
	“The rāhui is to protect but also to produce.” (Tautira Fisherman).	“They are the ones who will inform their parents, so that they respect the lagoon, because here, almost all the parents are fishermen.” (local MEA referent, Tautira)
	“The rāhui is [for] the community’s engagement, it is required to open for the communities” (Teahupo‘o leader of Rāhui Tōmite)	“I can’t open if I don’t know about the reproduction inside the rāhui.” (President of Rāhui Tōmite of Teahupo‘o)
	“The rāhui belongs to the communities. Fenua ‘Aihere people are doing surveillance. Even Teahupo‘o fishing boats, when they go fishing. When they see people in the rāhui, they call the city hall, squarely at the city hall [...] Every day. There is a grandma who lives in Fenua ‘Aihere with her daughter, her children and her mo‘otua (grandchildren). When they see, they call the city hall.” (Tahu‘a, Teahupo‘o)	“We never see scientists coming from Environmental Department. You know the team here [from CRIOBE], they are in the field. And because I’m also in the field, you have to evolve like that. If not, what is the word you gave? Indeed, the word you gave to the fishermen, you have to support ... This is what the fishermen are expecting [...] The Environmental Department is the provider who comes without asking us and only they have the report. How can we evolve like that?” (Teahupo‘o leader of Rāhui Tōmite)
Local Understanding Objectives	Maintaining the spirit of the traditional rāhui, honoring the invisible presence of ancestors, preserving regular/occasional opening as an IRM practice, cultural conservation as integral to a local Tahitian subsistence lifestyle.	Developing productive collaboration with on-the-field scientists by taking advantage from scientific methodologies and monitoring to transmit rāhui practice, addressing conflicts around the legal administrative framework that uses the cultural appropriation of the term rāhui to suit State conservation or management interests that diverge from local CPE.
Implications	Better integrating Indigenous and non-Indigenous conservation approaches will benefit from attention to community CPE.	

369 **Discussion**

370

371 The CPE of the two Tairapu communities, Teahupo‘o and Tautira, suggests that the
372 integration of Indigenous conservation with conservation and sustainability sciences to
373 advance the success of rāhui implementation could be advanced by sensitive attention to local
374 communities’ specific and, at times, divergent CPE mediating that integration. Supporting
375 effective community-based conservation of biodiversity and management of natural resources
376 should vigorously take into account the non-homogeneity of Indigenous and local
377 communities’ CPE around the role of conservation and sustainability sciences and scientists
378 in decision-making and policy towards successful collaborations and desired outcomes. In
379 particular, our study addressed four important questions.

380

381 *How do IPLC stakeholders feel about Indigenous conservation approaches as related to*
382 *approaches grounded in conservation and sustainability sciences?*

383

384 Rāhui exemplifies a strong Indigenous, Oceanian, and Mā‘ohi approach to conservation
385 (Table 2). Its reemergence in French Polynesia, and particularly around the Tairapu coasts
386 provided a significant site for reflecting on how a conservation sciences approach to resource
387 management and governance integrated with an Indigenous and community-led approach as
388 long as the diverse conservation sciences practices support and align with local CPE. In the
389 case of the rāhui at Tairapu, conventional approaches to biological and ecological science
390 were mediated by social scientists who had previously worked on the comprehension of
391 place-based local needs with the communities in Teahupo‘o and Tautira and were thus
392 positioned to take into account not only the importance of ILK but the culturally-grounded
393 CPE of stakeholders in integrating ILK within conservation planning and enactments. Thus,
394 prior coordination between Indigenous and conservation and sustainability sciences
395 approaches to conservation played a fundamental role in rāhui conception, design, and
396 implementation. Over time, the mixed conservation approach grounded the practice of rāhui
397 as an adaptation aligned with local CPE. Indeed, in Teahupo‘o, the rāhui area embraced
398 Mā‘ohi culture and resulted in the perceived reimplementations of a Tahitian rāhui practice
399 (essentially different from MPAs), which valued the presence of ancestors at sites on the
400 cultural landscape like puna i‘a (stone sites associated with particular species’ seasonal
401 management and use, Nordhoff 1930), and supported the institution and agency of the local
402 rāhui tōmite. In Tautira, the rāhui implementation involved important relationships and
403 interactions between local communities and scientists, which ultimately took root as
404 arrangements defining the boundaries and design, objectives, expectations, and conditions of
405 the protected areas to improve fishermen incomes. In the literature, such interactions are the
406 foundation for tailoring coral reef management to local contexts in a way that acknowledges
407 the importance of people’s values (Kochalski *et al.* 2019, Thiault *et al.* 2020), local peer-to-
408 peer social networks (Christie *et al.* 2009), cultural ecosystems services (Chiesura and De
409 Groot, 2003; Hicks *et al.*, 2013; Satz *et al.*, 2013), customary management (Cinner and
410 Aswani 2007, McMillen *et al.* 2014, Delevaux *et al.* 2018), and local forms of territoriality
411 (Roué 2012, Bambridge 2013; Donaldson 2019). As Aswani *et al.* (2015) demonstrated, ILK
412 learning can inform and guide the requisite decision-making process and offer a practical way
413 for management efforts to become more efficient. Here, we note that the incorporation of
414 Indigenous and local knowledges with conservation and sustainability sciences can be further
415 advanced by taking into account the CPE which mediate between these distinct epistemic
416 cultures (Cetina 2009). Attention to the mediating roles of CPE at the local level can yield
417 positive results and outcomes, as happened at Tairapu. The most notable pessimistic feelings

418 about a conservation sciences approach rest on ongoing legal framework contradictions that
419 seem to categorize rāhui as MPAs whereas local community stakeholders do not agree.

420

421 *How do Mā'ohi and local communities understand and value marine and environmental*
422 *sciences in the context of community-led governance?*

423

424 In the context of community-led governance, sharing marine and environmental dynamics
425 such as monitoring or evaluation of rāhui with local communities is central to ensuring that
426 the measures taken are effective. Around Tairarapu, the scientific ecological monitoring
427 promised by researchers from CRIOBE is expected to produce useful knowledge. The distinct
428 expert role of scientists is thus well-perceived and understood to contribute evidence of the
429 (re)production of the conceptual function of rāhui for the rāhui tōmīte. According to local
430 communities, conservation and sustainability sciences require a strong emphasis on cross-
431 generational environmental education and awareness while training local users and officials in
432 reef monitoring and peer-to-peer enforcement frameworks (Aswani *et al.* 2015). In Tairarapu
433 IPLC stakeholders want to advance such environmental education through the rāhui practice
434 (Filous *et al.* 2021). The resurgent rāhui here supports both Indigenous and conservation
435 sciences approaches through cultural transmission to the young (Teahupo'o) and by
436 improving fishing practices and evolving CPE (Tautira). In this context, establishing
437 contemporary rāhui was followed by the recent implementation of Marine Educative Areas
438 (MEA) in Teahupo'o and Tautira to raise awareness of the importance of coral reef protection
439 and conservation among youths. The local MEA referents are actually local rāhui leaders who
440 have regular relationships with conservation scientists. But to be fully accepted, scientists
441 have to spend time on site with IPLC stakeholders to insure durability of rāhui co-
442 management development. Here, the legitimacy of scientists' approaches and ecological
443 monitoring was accepted because methodologies were adapted for IPLC stakeholders to
444 incorporate their beliefs and values. And yet, before rāhui implementation, conservation
445 sciences methods did not engender trust, but suspicion. In Teahupo'o and Tautira, it took
446 several years to inspire trust between scientists and local communities. Mistrust was partly
447 fueled, on one hand, by historical experiences and legacies of colonization, and on the other
448 hand, by the belief of some individuals and communities that they will be the ones who will
449 indirectly suffer the direct and indirect negative consequences of a protected area. Scientists
450 must be exceptionally careful in their actions and words to change local perceptions about the
451 social consequences of their interventions, but at the same time they should not hesitate to
452 fully engage the predictive capacity of disciplinary sciences to help people adapt to a
453 changing environment. In this case, direct threats to the sustainability of coral reefs were felt
454 to be confronted by the establishment of partnerships in which Indigenous communities and
455 scientists support each other's goals and share knowledge of biological and cultural resources
456 in a mutually beneficial manner. Even without perfectly tailored legal frameworks supporting
457 them, contemporary rāhui should be seen as an emerging, evolving community-based
458 approach to natural resources management where co-management and integration of
459 scientists' and users' CPE is an enabling condition for success (Di Franco *et al.* 2016, Bennett
460 *et al.* 2019, Silva *et al.* 2021). All stakeholders have to work on adapting themselves during
461 the different steps of rāhui implementation, management and monitoring.

462

463 *What is the community's sense of the place of an Indigenous conservation approach in the*
464 *planning and enactment of rāhui governance?*

465

466 Legally, the enactment of rāhui governance in Tairarapu aligned the practice with the MPA
467 goal of a permanently protected area to suit strong conservation interests. If the marriage of

468 Indigenous and conservation and sustainability sciences approaches leads to agreement on,
469 respectively, a rāhui ending at Teahupo‘o, and a regular rāhui opening at Tautira, this will
470 require changes to the ministerial decrees in which each rāhui is inscribed. During the
471 previous meetings at both sites, local communities had the choice to collaborate with the
472 State. As we can see in the recorded CPE, such a choice responds to important expectations of
473 communities from Teahupo‘o and Tautira who agree on respecting and complying with rāhui
474 rules because they lay the foundation for sustainable future areas for fishing and a robust food
475 reserve. This is only possible through developing efficient enforcement and surveillance of
476 rāhui. The legal framework was actually supposed to support and respond to IPLC goals
477 relative to CPE. However the absence of a specifically tailored law on rāhui or the State’s
478 official recognition of Indigenous management rights continues to be an obstacle to
479 understanding between Tairapu communities and conservation and sustainability science
480 practitioners including representatives of state agencies. Local authorities can react in case of
481 infractions but the outcomes of marine conservation and related management interventions
482 depend to a large extent on community-scale compliance with these rule systems (Rohe *et al.*
483 2017) and require community engagement and enforcement (Goetze *et al.* 2018). In Tairapu,
484 such engagement comes from an Indigenous approach by developing and applying local,
485 often informal, norms to protect rāhui. As shown in Table 2, despite conflictual relationships
486 between rāhui tōmite and State environmental agencies regarding rāhui surveillance and the
487 absence of an operational management plan, surveillance is locally organized for the rāhui of
488 Teahupo‘o by communities living at Fenua ‘Aihere. In practice, local norms connected with
489 rāhui prevail over State norms, including monitoring decisions between members of rāhui
490 tōmite. For example, the procedure in Teahupo‘o for reef monitoring is to request
491 authorization to access the rāhui area from the rāhui tōmite. This also requires separate
492 authorization from the Department of Environment as the administrative manager of rāhui
493 (and also members of tōmite). In accordance with CPE, ecological monitoring is locally used
494 to inform fishermen about the efficiency of the rāhui in accomplishing the goals of many
495 years of restriction.

496
497 Another example of the difficulties in considering Indigenous approaches to conservation is
498 linked to the management role of the tōmite, which is basically to develop rāhui surveillance.
499 Rāhui tōmite leaders argue that the presence of scientists doing fieldwork is important and has
500 value for local communities, yet highlight tensions with state practitioners regarding
501 monitoring. The tōmite, with the support and the involvement of the residents of Fenua
502 ‘Aihere, because of their attachment to rāhui, prefer to organize the entire surveillance by
503 themselves in their own way. Similarly, our interviews noted a series of misunderstandings
504 and discordances between scientists and rāhui tōmite members over lack of local financial
505 support, with problems of fuel reimbursement, leadership interventions, and the
506 disappearance of markers. Thus, the role of tōmite is at the heart of deeper social and cultural
507 issues including trust and power relationships, post-colonial trauma, or post-colonial CPE,
508 visible within contemporary rāhui contexts.

509
510 *Are local stances towards science or conservation the same at different rāhui sites and what*
511 *might differences indicate regarding achieving sustainable management goals?*

512
513 Communities’ stances towards Indigenous and conservation and sustainability sciences
514 approaches differ in Teahupo‘o and Tautira. In Teahupo‘o, rāhui conception and
515 implementation was the result of three years of deepening interrelationships between
516 communities, social scientists, and state practitioners. Social science methodologies were
517 used at first to understand how the territory was locally represented through exchanges on

518 toponyms, legends, and Mā‘ohi values around particular sites. This co-produced knowledge
519 between IPLC stakeholders and conservation sciences teams was used to support the
520 community’s own definition of rāhui boundaries and geography, grounded by a strong role for
521 Mā‘ohi culture. Thus the rāhui site is not just a protected area suiting foreign conservation
522 interests but actively reaffirms politically sensitive cultural and territorial roots through local
523 CPE about how to sustainably manage critical natural resources into the future, specifically,
524 for future generations. Moreover, rāhui establishment also connects conservation and
525 sustainability science practitioners to a set of informal norms and actions regarding local
526 communities’ values, e.g. those that strongly discourage fishing activity from fishers whose
527 homes lie outside the district.

528
529 In the case of Tautira, both Indigenous and conservation sciences have also been at the heart
530 of rāhui conception. The community was at first reluctant to implement any seascape
531 protection because of the importance of fishing activities (Table 1). Local CPE in Figure 2
532 show the fear engendered by the term “rāhui” for fishers faced with need to maintain and
533 improve their incomes. But to address the growing difficulties confronting nearshore
534 fishermen, the inhabitants gradually supported the idea of establishing a rāhui in part of the
535 lagoon. Based on recent experiences in Melanesia (Goetze *et al.* 2016, 2017, 2018, Carvalho
536 *et al.* 2019), scientists presented to community members a theoretical model of rāhui that was
537 in better alignment with local perceptions and expectations, with opening periods and
538 rotations to ultimately help fishermen improve their harvest. The model was based on a
539 central no-take area (puna no te Tetahee, Figure 1) which then feeds two other areas opened
540 alternatively on either side of the puna. The alternating open areas would always be supplied
541 by proximity to the no-take area. Communities in Fenua ‘Aihere finally accepted this
542 conceptual model of rāhui and the municipality of Tautira started a collection of signatures to
543 justify the adoption of rāhui according to the theoretical ecological model. In a sense, the
544 rāhui model in Tautira is an adaptation integrating Indigenous and conservation and
545 sustainability sciences approaches with a rotative closure within the permanent puna area. It
546 will concretely provide more local autonomy over fishing activities, which are expected to
547 improve the income of fishermen and, more broadly, help them cope with environmental
548 changes. In this context, bridging scientific and Indigenous knowledge highlighted the
549 importance of trust-building and community involvement in all stages of research (Bizzarri
550 and Czerny 2015, Silva *et al.* 2021), and the importance of shared interests in project
551 objectives, settings, and outcomes (Apetrei *et al.* 2021).

552
553 Though deployed in support of the application of public policies, conservation and
554 sustainability sciences thus become a tool serving the interests of IPLC stakeholders as well
555 as national, regional, or global conservation ecology interests. Fundamentally, the application
556 of the rāhui system, despite the evolution of culturally-grounded CPE, evidenced that
557 culturally-grounded Indigenous resource management is a highly valuable tool supporting
558 more balanced integration and exchange between stakeholders. At both sites, local
559 expectations include the means to carry out surveillance, such as boat access, fuel costs, and
560 job opportunities. Such local efforts for protection strongly produce better compliance with
561 rules and conservation in rāhui areas. Importantly, in Tautira efforts from the State agencies to
562 develop rāhui in collaboration with IPLCs is also envisioned as a springboard to introduce
563 management tōmite inside current legal frameworks and to highlight the need to establish
564 legal rights for local rāhui development. Regarding achieving sustainable management goals
565 and conservation planning in the Anthropocene, we observe an evolution from the pre-
566 colonial form of rāhui as an optimization of fish stock by “prohibition for postponed
567 consumption” that fed island societies for hundreds of years, towards the contemporary rāhui

568 as optimization of fish stock for sustainable resource management “not necessarily
569 postponed”. Critically, the contemporary practice also conserves potent cultural conceptions
570 about the sacred, about place, as well as responsibilities to maintain and transmit culture
571 itself.

572 573 **Conclusion**

574
575 Resurgent rāhui in French Polynesia are fostering new mechanisms as customary law and
576 traditional forms of marine resource management and governance are woven into
577 contemporary actions. By inviting social scientists, ecologists, and State resource managerial
578 institutions to assist in implementing rāhui, communities and local political initiatives are
579 hybridizing (Fabre *et al.*, in prep) Indigenous and conservation and sustainability values and
580 sciences. Such governance systems are meant to directly respond to local desires to develop
581 place-based, culturally-grounded and community-based management of marine resources,
582 supported by conventional conservation approaches (Aswani and Ruddle 2013, Aswani *et al.*
583 2017, Sterling *et al.* 2017, Morishige *et al.* 2018, Eckert *et al.* 2018). In this context, local
584 communities are emerging as leaders in contemporary resource management based on
585 Indigenous knowledge relative to rāhui (Bambridge *et al.* 2019).

586
587 By fostering new hybrid mechanisms, rāhui in Tairapu demonstrate the strengths of
588 integrating Indigenous and conservation and sustainability sciences approaches into resource
589 management and governance. The ways that resource management approaches are perceived,
590 conceived, expected, and experienced *in situ* by local and other stakeholders, concretely
591 mediates the integration pathways for disciplinary sciences and models within community-led
592 conservation actions. Moreover, examination of these dynamics through our CPE framework
593 shows and that the dynamics of community-led rāhui governance for resource management or
594 conservation action evidence the material importance of place-based and cultural values.
595 Importantly, our findings revealed the non-homogeneity of community-led Indigenous
596 resource management. In one instance we saw how a conservation sciences approach in
597 alignment with rāhui broadly addressed issues of culture and territoriality and, in the other, we
598 saw how rāhui was taken to primarily support the local fishing economy. However, in both
599 cases, contemporary rāhui involve conservation and sustainability sciences approaches in the
600 plans and actions of local communities, despite the foundational role of Indigenous
601 approaches to management. Such interactions produce an adaptive knowledge of nature as a
602 self-constructive activity based on the construction of a “we” (Bambridge, D'Arcy, and
603 Mawyer 2021) where all parties need to be understood to better align goals and social
604 contemporary expectations. This work further suggests the crucial role of the social sciences
605 in rāhui conception and implementation. We highlighted how contemporary rāhui led by local
606 communities can Indigenize and decolonize marine conservation efforts (Tuhiwai-Smith
607 1999) through ILK while conservation and sustainability sciences can still inform and guide
608 the decision-making process and offer practical ways to be more efficient and better
609 integration of all stakeholders. Community members’ sensitive, diverse, and potentially
610 shifting CEP around the ecological futures of their nearshore waters, offers distinct evidence
611 that Indigenous management systems are adaptable to changing environments, seasonal and
612 cyclical behaviors, and social conditions. Our analysis of the proposed synthesis between
613 Indigenous and conservation and sustainability sciences approaches to reemergent rāhui
614 practices in Tahiti thus highlights the importance of supporting, incorporating, and combining
615 Mā‘ohi science in Indigenous cultural renewal.

616
617

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619

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630

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