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A generic method of engagement to elicit regional coastal management options

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1 **1. Abstract**

2 Stakeholder engagement is important for successful management of natural
3 resources, both to make effective decisions and to obtain support. However, in
4 the context of coastal management, questions remain unanswered on how to
5 effectively link decisions made at the catchment level with objectives for marine
6 biodiversity and fisheries productivity. Moreover, there is much uncertainty on
7 how to best elicit community input in a rigorous manner that supports
8 management decisions. A decision support process is described that uses the
9 adaptive management loop as its basis to elicit management objectives, priorities
10 and management options using two case studies in the Great Barrier Reef,
11 Australia. The approach described is then generalised for international interest.
12 A hierarchical engagement model of local stakeholders, regional and senior
13 managers is used. The result is a semi-quantitative generic elicitation framework
14 that ultimately provides a prioritised list of management options in the context
15 of clearly articulated management objectives that has widespread application for
16 coastal communities worldwide.

17 The case studies show that demand for local input and regional management is
18 high, but local influences affect the relative success of both engagement
19 processes and uptake by managers. Differences between case study outcomes
20 highlight the importance of discussing objectives prior to suggesting
21 management actions, and avoiding or minimising conflicts at the early stages of
22 the process. Strong contributors to success are a) the provision of local
23 information to the community group, and b) the early inclusion of senior

24 managers and influencers in the group to ensure the intellectual and time
25 investment is not compromised at the final stages of the process.
26 The project has uncovered a conundrum in the significant gap between the way
27 managers perceive their management actions and outcomes, and community's
28 perception of the effectiveness (and wisdom) of these same management actions.

29 **2. Keywords**

30 Regional management; community engagement; generic framework;
31 management strategies; objective weights

32 **3. Introduction**

33 Pressure on ecosystems in the coastal zone has increased with time due to
34 population growth and the social and economic importance of these areas
35 (Halpern et al., 2009). Effective management of this zone is important as they
36 contain many iconic and threatened species (such as dugongs, water birds,
37 turtles) and also key habitats (wetlands, seagrasses, mangroves).

38 The coastal zone of the Great Barrier Reef in Australia experiences the impacts of
39 cumulative effects, most notably inputs of sediment, nutrient and contaminants
40 from rural and urban land sources (Kroon et al., 2013). However, managing
41 cumulative impacts can be seen as a "wicked" problem because interactions
42 within and among the social, economic and ecological systems are highly
43 complex, non-linear and mostly unknown, which has often led to management
44 failure (Ludwig, 2001; Rittel and Webber, 1973). Science is categorised as only
45 being able to solve "tame" problems (Rittel and Webber, 1973).

46 Two solutions have been put forward to address this dilemma: a) Adaptive
47 management, which involves iterative decision making, via evaluating the
48 outcomes from previous decisions and adjusting subsequent actions on the basis
49 of this evaluation (Sainsbury et al., 2000; Walters and Hilborn, 1976), and b)
50 effective stakeholder engagement to facilitate social learning improving
51 outcomes (Muro and Jeffrey, 2008). If these two processes are combined, they
52 form essential foundational steps to achieve effective environmental
53 management, through good information, development of identity, and
54 institutions and incentives (Van Vugt, 2009).

55 In the coastal zone, governance is complex with many organisations and
56 associated institutions designated to manage the system (local, regional, national
57 and international) and many forms of “ownership” models (government, semi-
58 government, public open access, private). To some, the solution to the complex
59 governance situation is to create boundary organisations either through a non-
60 government organisation (NGO) or develop collaborative efforts between
61 scientists and government organisations. Boundary organisations cross the
62 boundary between science and government as a network which draws on both
63 sides to facilitate evidence-based decisions (Guston, 2001). These organisations
64 attempt to solve problems by meeting three criteria, which are: a) creating
65 opportunities and incentives for boundary products, b) facilitating participation
66 of actors from different sides of the boundary and c) establishing or
67 strengthening links between politics and science (amongst others). Boundary
68 organisations are effective, for instance, in the health sector (Drimie and Quinlan,
69 2011) and in waterway management (Abal et al., 2005).

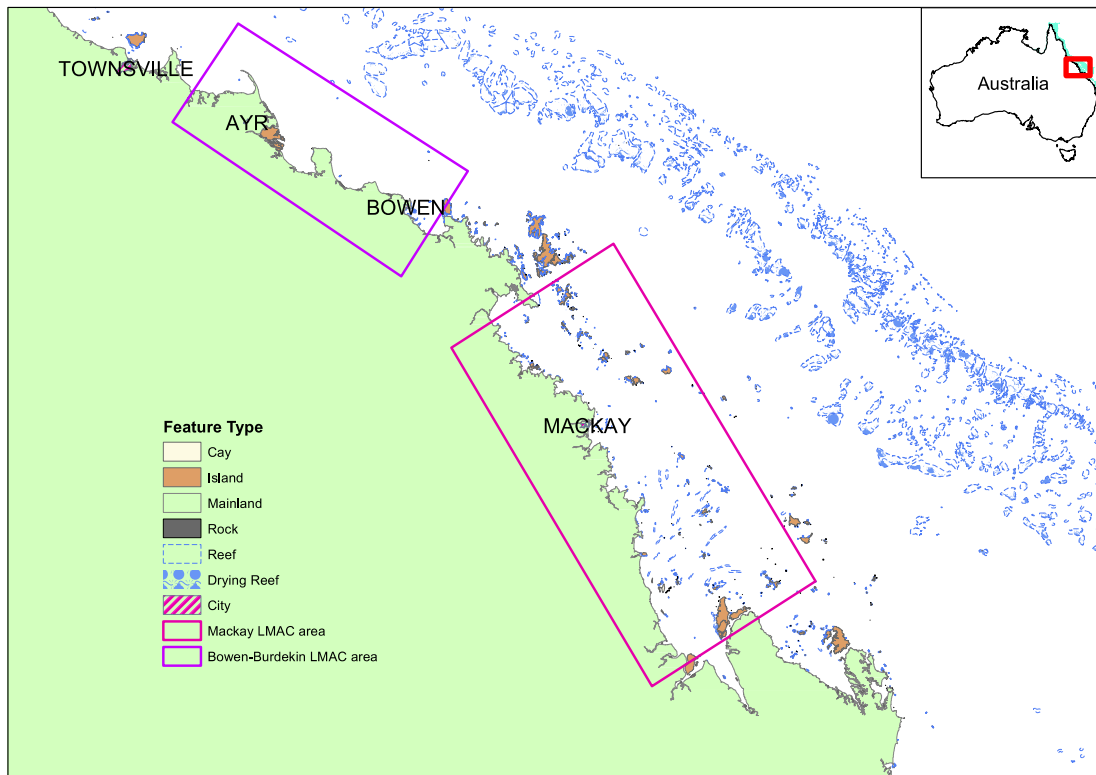
70 Whether attempting management with or without these boundary organisations,
71 stakeholder or community engagement is seen as crucial to management success
72 (Dietz et al., 2003; Ostrom, 2009; Van Vugt, 2009). Similarly, the scale of
73 management should include local input into regional management rather than
74 only distant high level and scale management (Ostrom, 2009). Stakeholder
75 engagement has been successfully applied in many single use applications such
76 as fisheries. Often engagement has been established through technical and
77 management boundary organisation (Smith et al., 1999) or various forms of
78 devolved management such as through Territorial User Rights (Chandra, 2011),
79 community based special marine protected areas (Ma et al., 2013) or self
80 management in fisheries (Townsend et al., 2008). However, moving from
81 stakeholder engagement to community engagement has generally not been
82 undertaken as many scholars have presumed that these resource users could not
83 self organise nor be representative (Cox et al., 2011). In this review by Cox et al.
84 (2011) of “self-organised regimes”, their findings supported Ostrom’s (2009)
85 eight design principles of local stable common pool resource management, which
86 includes well defined boundaries, institutions that are adapted to local
87 conditions, participatory decision-making processes, effective monitoring, scaled
88 sanctions for those who violate rules, mechanisms for conflict resolution,
89 recognition of community self-determination by higher-level authorities, and
90 nested enterprises for large common pool resources.

91 4.1. Study area

92 The Great Barrier Reef World Heritage Area (GBRWHA) includes the world’s
93 largest coral reef system, the Great Barrier Reef (GBR), stretching over 2,300 km

94 of the coastline of Queensland, Australia (Fig. 1). The Australian
95 Commonwealth's Great Barrier Reef Marine Park Authority (GBRMPA) manages
96 much of the reef. Although GBRMPA manages the biodiversity assets and most
97 activities therein, fisheries and much of the coastal zone inshore of 3 nm are
98 managed by various other agencies such as the Queensland State Department of
99 Agriculture and Fisheries (DAF), and local councils. There is growing interest and
100 success in engaging local coastal communities to achieve reef management goals.
101 NGOs have played a key role through engaging especially with the farming
102 community to minimise the effects of agricultural runoff (sediments, nutrients
103 and pesticides) (<http://reefcatchments.com.au/>). Although these NGOs are in
104 many aspects boundary organisations, they have until recently only
105 concentrated on a few impacts areas.

106 The communities who live in the coastal zone of the GBR value the GBR highly
107 (Marshall et al., 2013) and as such there is a significant desire to be involved in
108 local management. It is generally understood by managers that a) it is difficult to
109 regulate all impacts that affect the GBR coast and reef so stakeholder support is
110 essential, and b) given the size of the area and its complexity, it is not possible to
111 have both regional and local knowledge without local input.



112

113 **Fig. 1: Location of the two case studies shown in the context of the Great Barrier Reef in Queensland,**
 114 **Australia. Inset Map of Australia showing the Great Barrier Reef region (shaded) and the study**
 115 **region (box outline).**

116 In a perfect world, high values attributed by a community to an area would
 117 generate voluntary compliance and regulation. However, the challenge remains
 118 on how to include community input in determining objectives for marine
 119 biodiversity and fisheries productivity and effectively link these objectives to
 120 decisions made by multiple management authorities, and to do this in a safe and
 121 cooperative manner. In an increasingly connected community in Queensland,
 122 social media has become a progressively useful medium to focus public opinion
 123 (for example the 2014 GetUp campaign against a port development –
 124 <https://www.getup.org.au/campaigns/great-barrier-reef-3/protect-our-reef/protect-our-reef>). However, these forums are seen as not engaging science,
 125 management and community in a non-adversarial long-term framework as
 126

127 described in Cox et al. (2011). There are several case studies and suggestions of
128 what constitutes successful engagement. For example, a successful case study
129 (reviewed by Vural-Arslan and Cahantimur (2011)) in Turkey showed that that
130 community intelligence could be influential to the decision making process.
131 However, there are practical considerations when engaging the community over
132 a longer timeframe, including scheduling and other time commitments. Many
133 emphasise the importance of gaining trust and respect (Vural-Arslan and
134 Cahantimur, 2011), and provide models of engagement (Rowbottom and Bueno,
135 2009) and move beyond simple models of socio-ecological systems and the
136 perception that most resource users are the same (the “panacea”) (Ostrom et al.,
137 2007).

138 **4. Method**

139 **4.1. Case studies**

140 Two coastal regions within the GBRWHA area were chosen as case studies.
141 Mackay was chosen as it represented a growing city of about 167,000 people
142 (Australian Bureau of Statistics, 2013) and a large associated Fly-In and Fly-Out
143 (FIFO) community servicing the local mining industry (Fig. 1). It also has an
144 active port, Hay Point, just south of Mackay with the main export being coal.
145 Another major economic driver and employer in the region is sugar cane, where
146 the cane is locally grown and refined into sugar. In terms of natural assets it has
147 national parks, many beaches, offshore islands, inshore and offshore reefs that
148 are part of the GBR. The environment is tropical with the marine environment
149 characterised by very large tidal ranges, key habitats such as mangroves and

150 seagrass, and threatened, endangered and protected (TEP) species groups such
151 as dugongs, turtles and inshore dolphins.

152 In contrast, for the second case study the Bowen-Burdekin Shire has a
153 population of about 26,000 people (Australian Bureau of Statistics, 2013) and is
154 approximately 60 km south of a major city Townsville (and about 350 km north
155 of Mackay) with Ayr and Home Hill as its main towns (Fig. 1). It is a region
156 characterised as being mainly rural with sugar cane farming as the major source
157 of economic development and employment.

158 These two case studies were chosen for what they have in common while
159 recognising their differences. Both case studies are in rural areas where farming
160 is very important for the areas' wealth generation and employment. A lot of
161 management effort has gone into reducing the amount of sediment, nutrient and
162 pesticide runoff to the GBR in both case study areas. However, the two regions'
163 ports are distinct in size and activity and importantly in terms of active
164 development and extension proposals. During the study period, a major port
165 upgrade in the Abbott Point area (just south of Burdekin), with associated
166 dredging, was proposed. This port upgrade was a source of conflict in the local
167 region and also created great controversy in wider Australia. Whereas the
168 Mackay port was well established with no upgrades happening at the time this
169 research was undertaken and therefore activities in the Mackay port was not as
170 controversial as the Abbott Point development. The population size was also
171 very different with Mackay having a far larger urban footprint with a growing
172 city although this may have slowed down in recent years due to the general
173 downturn in mining activity.

174 **4.2. Engagement process**

175 A hierarchical system of engagement was attempted in both regions. At the
176 highest level, a community group, the Local Marine Advisory Committee (LMAC)
177 run by GBRMPA was already established in each of the regions; although the one
178 in the Bowen-Burdekin was more recently established than the one in Mackay.
179 Their charters are to advise GBRMPA on local management issues
180 (<http://www.gbrmpa.gov.au/about-us/local-marine-advisory-committees>).
181 Although the chair is elected and paid a nominal fee, the members are volunteers
182 sourced from the community. LMACs have a 3-year term and calls for
183 nominations are made normally to stakeholder groups, although a nominee can
184 be independent. There is some vetting based on experiences GBRMPA (or a
185 referee) has had with individuals and their ability to contribute constructively.
186 Membership of the LMACs in our case studies included representatives from
187 GRBMPA, cane growers, commercial and recreational fishers, and local Port and
188 Council employees. The LMACs aim is to achieve a balanced representation,
189 although this is not always achieved. The quality of participation and ‘team’
190 output can be highly variable.

191 Since the LMACs met every quarter with a full agenda, a sub-committee was
192 formed and called the LMAC Reference Group (RG). This was made up of LMAC
193 members who volunteered for the group and additional members (i.e. people
194 who were previously on the LMAC) that would cover a broader skill set. The
195 project lead facilitated the RG meetings, with a member elected as the RG chair.

196 In addition to the project team, who facilitated and attended the RG meetings,
197 “managers” (defined as people that either directly or indirectly influence

198 management decisions) from DAF and GBRMPA, and social, economic,
199 mathematical and environmental scientists from State and Commonwealth
200 agencies participated in the RG meetings.

201 Within a few months of project engagement in the Bowen-Burdekin area,
202 historical and present issues (such as the Abbott Point port development
203 controversy; members of the LMAC being stretched over two distinct regions
204 meaning members often had to travel long distances to attend meetings,
205 previous poor engagement processes) meant that participation was minimal. An
206 alternative approach was undertaken described in detail in Dichmont et al.
207 (2014), but generally it meant the project team engaged with individuals directly
208 and separately instead of in a group. Outside this one-to-one engagement
209 interactions between the different RG and LMAC members were minimal. In
210 Mackay, the RG was very successful and there was engagement with this group
211 throughout the process. However, the indigenous member resigned from the
212 group due to circumstances external to the RG.

213 At various stages in the process (described further below) community and senior
214 level managers' input was sought. All documentation was kept in a traceable
215 format, i.e. iterations of all steps could be traced through the various meetings to
216 its original source.

217 A local Mackay GBRMPA person devoted an enormous amount of time on
218 support and engagement in-between meetings. This support was essential and
219 provided local continuity.

220 A sequence of steps were undertaken – see Dichmont et al. (2014) for more
221 details. Steps 3 to 12 were undertaken in the Mackay case study only:

222 1. Qualitative modelling (Dambacher et al., 2003; Dambacher and Ramos-
223 Jiliberto, 2007) of the Mackay coastal system was carried out (Dichmont
224 et al., 2014) (both case studies). The RG was asked to list assets of
225 importance to them in the region and identify the impacts on these assets.
226 They were then asked to select their priority asset for which the impacts
227 and feedback were modelled in more details. An introduction on
228 terminology and how the method works were also provided to the group
229 (see Dichmont et al. (2014));

230 2. A review of existing objectives from government organisations, NGOs and
231 Natural Resource Management (NRM) bodies that were directly or
232 indirectly relevant to the region was undertaken (both case studies). This
233 was then combined into a hierarchical tree format using input from a
234 series of workshops attended by the RG and LMAC (Dichmont et al.,
235 2014; Van Putten et al., 2015). After this stage, the Bowen-Burdekin case
236 study was discontinued given the controversy around the Port
237 development and its overwhelming impact on the issues being discussed.

238 3. A survey of the RG, LMAC and Mackay public was undertaken to ascertain
239 the relative importance of different objectives. Dichmont et al. (2014)
240 describe the analysis details and survey methods in detail but two
241 approaches were undertaken – the recommended Analytical Hierarchical
242 Process (Pascoe et al., 2013; Saaty, 1980) and a new Point Allocation
243 method at each level of the objective tree and called the Hierarchical Point
244 Allocation method (Dichmont et al., 2014). The survey form is provided
245 for illustration in Supplementary Material (SM) Section 1;

246 4. Managers gave presentations to the RG about existing management
247 actions that were being undertaken in the Mackay coastal zone so that
248 they could subsequently discuss any remaining management actions that
249 needed to be addressed for the different assets;

250 5. Topics relevant to the focal question of management of biodiversity and
251 fisheries in the coastal zone were developed in session (see SM Section 2).
252 These described both key assets (such as mangroves and seagrass) and
253 key issues (such as development).

254 6. Over a period of just over 12 months, the RG undertook a series of
255 workshops that discussed management options for these topics. Each
256 workshop included:

257 a. Presentation by an expert of background information pertinent to
258 Mackay about the specific topic being discussed at the workshop;

259 b. The RG, project team and invited expert workshopped an issues
260 register, direct and indirect management options, and responsible
261 agencies for each issue (Dichmont et al., 2014) (see SM Section 2).
262 The discussions were held either in small groups or as a whole
263 group, depending on the number of workshop participants. Direct
264 management options were defined as a management action that is
265 undertaken directly by the agency responsible for managing the
266 issue and could include proposing legislative changes, whereas
267 indirect management options were those that could have the same
268 impact as the direct option, but undertaken indirectly through a
269 non-responsible agency or the community. Issues or management
270 options could be geo-located using a Google™ map of the study

271 region. Relevant qualitative models were also made available to
272 assist with highlighting past discussions on the relationships
273 within the system on that topic.

274 c. Initially, the issues list was developed separately from the
275 management actions, but this was seen as inefficient. The meeting
276 length was increased from a couple of hours to half a day and all
277 aspects of a topic (i.e. issues and actions) were covered together as
278 described above.

279 d. The topic sequence was generally down the catchment (i.e.
280 geographically in direction of flow from source to river mouth and
281 then into near-shore domain), but most of the contentious topics
282 (port and urban development, fisheries) were addressed as the last
283 topic.

284 7. The project team combined all the management options into management
285 strategies (see SM Section 3), which were presented to the RG and these
286 were subsequently modified during two workshops. In order to articulate
287 the pathway of combining management options, the project team used the
288 well-known United Nations Environment Program risk assessment
289 framework known as DPSIR (Drivers, Pressures, States, Impacts and
290 Response) (Pirrone et al., 2005; Smeets and Weterings, 1999). A more
291 simplified form of Pressure-State-Response –was ultimately used. The
292 results were presented with an associated storyline for each Management
293 Strategy that provided background and a list of the relevant management
294 options (see example SM Section 4).

- 295 8. An impact assessment was undertaken in two phases (with the analysis
296 method described in Dichmont et al. (2014):
- 297 a. The RG was asked to rate each management strategy from -3
298 (“considerably worse than current situation”) to +3 (“considerably
299 better than current situation”) against the low level objectives.
 - 300 b. They were also asked to score their level of confidence in their
301 ability to answer question a) for each objective from a score of 1
302 (“very unsure”) to 5 (“certain”).
 - 303 c. A subsequent workshop was then held where the RG, Mackay
304 coastal managers and NRMs were asked to undertake the same
305 impact assessment scoring. However, due to time constraints
306 scores were made during the meeting against the high level goals
307 only (although well-being was split into social and economic
308 goals).
- 309 9. The overall priority list and final set of management strategies (SM
310 Section 3) were provided to the RG for comment, and thereafter to the
311 management workshop.
- 312 10. Storylines in the form of report cards were developed that described the
313 management strategies and actions for use by RG and LMAC members.
314 These were made available online for the community.
- 315 11. Letters to the two management agencies most affected were also written,
316 but drafted in language more appropriate for this target audience.
- 317 12. All documentation was always approved by RG members before release.

318 A review of the successes and failures of the two case studies by the project team
319 were undertaken through questionnaires to the Mackay RG and managers. A
320 final framework was developed for future engagement.

321 **5. Results and Discussion**

322 **5.1. Comparing the case studies**

323 The progress of the different case studies was heavily impacted by external
324 factors, in the case of Bowen-Burdekin a contentious port development proposal
325 and previous unsuccessful engagement processes, amongst others. The Bowen-
326 Burdekin LMAC was also split over two reasonably different regions and was
327 also the newest formed committee of the LMACs. This case study also did not
328 have a local GBRMPA member (as opposed to the Mackay case), which helped
329 build trust and continuity. The level of distrust and at times acrimony divided the
330 volunteers from the Bowen-Burdekin RG and LMAC such that the engagement
331 process was not completed in this case study. In that context, however, it was
332 still possible to complete the objective review and hierarchy through individual
333 or smaller group interactions that produced a useful product (Van Putten et al.,
334 2015). In contrast, the RG in Mackay was highly functional and delivered more
335 than 150 hours of volunteer time (not including the project team time). Given the
336 time and energy they put in, ownership of the output by the Mackay RG
337 increased over time with members controlling the final product (in terms of both
338 content and detailed wording). This was not the case in the Bowen-Burdekin
339 where the project team was more influential on the final product. However,

340 despite these differences in approach the final objective trees from each case
341 study were quite similar which allowed generic objectives to be developed.
342 A further issue in the Bowen-Burdekin case study was stakeholder fatigue.
343 Previous studies had used several of the members for other strategy discussions
344 especially on fisheries. There had been significant progress in developing
345 regional management strategies for the Burdekin area, with genuine interest and
346 support by the then Minister for Fisheries, but which failed to be progressed
347 because of poor overall project management and poor communication of the
348 objectives of the project to the community. Vocal opposition to the project by a
349 particular influential stakeholder group also influenced this outcome, but who
350 were not resident in the area. This meant that some of the members felt the
351 project was repeating previous work and were worried that the end result would
352 be the same. The Mackay case demonstrated that the process followed as part of
353 this project could in fact lead to avoiding conflict and that a rigorous semi-
354 quantitative sequential approach contributes to a successful completion and
355 overall outcomes.

356 Interestingly, as the Mackay RG increased in confidence and realised the value of
357 their contribution and increased knowledge due to access to experts, the link
358 between the RG and LMAC became more tenuous. RG members expressed their
359 frustration with the LMAC and developed a perception that they only discussed
360 small-scale issues compared to RG discussion.

361 Aspects that contributed most to the successes in Mackay were that:

- 362 • There were a large number of highly dedicated local volunteers within the
363 local community, scientific community, and amongst the managers.

- 364 • The scientific input was of an excellent standard with well-pitched
365 presentations due to verbal or written communications indicating what
366 was required provided beforehand. These presentations were very
367 motivational to RG members who indicated they valued them and that they
368 influenced the way they understood both management and biophysical
369 processes.
- 370 • Of key importance in terms of generating interest and knowledge was the
371 dedication to provide mostly local content. In addition RG members (and
372 managers) also gained immense local knowledge through visits to local
373 examples of good and bad management practices.
- 374 • There were strong links established between managers and RG members.
375 Discussions about contentious issues occurred, but debates over these
376 occurred in a climate of mutual respect and understanding.

377 However, senior management support for the uptake of the final
378 management strategies was variable. Lack of uptake of the final outcome by
379 some agencies were because:

- 380 • The RG had no broad official mandate to represent Mackay, as they were
381 not elected, which makes management action perceived as being more
382 risky.
- 383 • There was basic resistance on behalf of management to change and lack of
384 enthusiasm to undertake the effort that would be required to effect any
385 change. This is related to the conundrum that as part of the project the
386 managers needed to be open and or empathetic to community input (as
387 presented through the RG) despite this input being given by a community

388 group that by nature was not representative of a large region. This meant
389 that there was a perception that it would be difficult or less attractive to
390 act on the basis of their advice.

- 391 • Managers' perception of what was happening on the ground was
392 considerably different from that of the RG. This was due to a mixture of
393 managers not being aware of local issues and RG members not being
394 aware of what work management agencies were, or were not,
395 undertaking.
- 396 • The final management strategies were seen as "wishy-washy" and not
397 radical, and also managers perceived that many of the strategies had
398 already been implemented. However, this again highlighted differences in
399 manager's perception about what had been implemented and what had
400 actually happened on the ground as understood by the RG. Evidence of
401 bad and good practices and of the discrepancy between management
402 decisions and on-ground actions was shown to the project team and to
403 some of the managers. These demonstrated that manager's perception
404 that issues had already been addressed was not always borne out by the
405 evidence and therefore their developed management strategies still had
406 great significance to the RG members.

407 The process followed was accepted as comprehensive, but required significant
408 volunteer input. Some of this time commitment was due to the test case nature of
409 the work where several approaches were trialled by RG members. A shorter, less
410 time consuming version is suggested below as a refinement based on the
411 outcomes of our work.

412 **5.2. Review of process**

413 The qualitative modelling was used as an introduction for the members to
414 discuss their present knowledge of the area, for their views were valued and to
415 inform the project team on key issues that needed to be addressed and which
416 assets needed to be protected. Although the project team provided the
417 qualitative models to the RG at the time of management strategy development,
418 the RG members did not use the models. Since the process of qualitative model
419 development is quite extensive – in this case partly due to the fact that different
420 methods were trialled – and because the models were not used later in the
421 process, this step could be removed from the process. Alternatively it could be
422 enhanced, or further value could be added to the models, by developing them
423 into Bayesian Belief Networks (Hosack et al., 2008). This enhanced approach
424 may be more useful to developing management strategies and the additional
425 effort thus beneficial.

426 Undertaking the objective development process before discussing management
427 options was essential to encourage group cohesion and trust. This sequence of
428 events was based on the adaptive management loop (Sainsbury et al., 2000;
429 Walters and Hilborn, 1976), where objectives are defined so that management
430 strategies can be contextualised and actions can be reviewed once they are
431 implemented. Conflict is reduced because all objectives can be included in the
432 objectives setting process (i.e. there is no need to exclude any specific objective).
433 In addition, each participants' individual weightings are preserved in the
434 objectives scoring process giving each participant a sense that their opinions are
435 considered and important. In summary, at this early stage of the process, the

436 group is new and trust has yet to be developed. The objective stage does not
437 need consensus or agreement as a person can down weight an objective they
438 disagree with and highlight those they feel are most important. For this reason,
439 undertaking the objective process first builds trust. Conflicts are diffused and
440 informal feedback from the group indicated that generally participants found
441 this aspect interesting and unique, particularly given that their past experiences
442 mostly bypassed this part and instead moved straight to the management
443 strategies.

444 The objective review was surprisingly quick and easy (given that most of the
445 agencies had a strong online presence and documents were therefore easily
446 obtainable). In addition, the process followed with the Mackay RG to develop the
447 hierarchy led to increased group cohesion and the process was generally
448 enjoyed. However, a successful review was also achieved in the other case study
449 site through a more individual approach although perhaps with not as much
450 attachment to the final product.

451 Several approaches were trialled when developing the management strategies
452 with the RG in Mackay. Group input in the process highlighted that discussing the
453 each asset in conjunction with the issues that pertain to as one topic, and
454 covering only one topic per meeting, worked best. At each meeting, access to an
455 expert with local knowledge on each topic was essential. Undertaking the 'Issues
456 Register', and listing direct and indirect management options at the same time
457 was the most productive and produced a more cohesive product.

458 The sequence by which topics were discussed roughly reflected a progression
459 from the top of the catchment, down along the catchment to the ocean. This

460 sequence made intuitive sense, reduced overlap and highlighted the connectivity
461 of the system. The most controversial topics arose at the end of the discussion
462 process (at the bottom of the catchment) and by this stage the group was very
463 familiar with each other's views and therefore more open to opposing proposal
464 for management actions. The motive for undertaking the most controversial
465 topics towards the end is that the investment of the RG by this stage was high
466 thereby reducing the incentive to abandon the process but rather to remain
467 engaged in finding a solution. Members were also aware of the different weights
468 given to the various objectives, so many of the contentious views were already
469 generally known and were often discussed out of session. In other words,
470 members were more prepared to "agree to differ" or accommodate their ideas
471 rather than increase conflict and risk breaking the process, which was now more
472 than a year long. In the Burdekin the group was unable to progress past the
473 objectives stage. In this case study, extant conflict in the community already
474 existed due to past experiences and the controversial Port development. This
475 indicates that existing conflicts may not be easily be resolved by the process
476 proposed in this research, but that the process is better at deferring potential
477 future conflicts as was evident from the Mackay case study.

478 Traceability about where the objectives and management options came from was
479 an essential component that maintained trust between participants and trust in
480 the process. The RG feedback emphasised this point and that they felt their views
481 were listened to through having this transparency.

482 Explicitly making the relative importance of the defined objectives to the whole
483 group helped highlight that there was in fact quite a lot of consistency in the RG's

484 view and their attribution of the relative importance for each goal. In session
485 discussion of the results allowed general articulation of RG member's values and
486 opinions in a more factual manner.

487 By embedding managers in the project team and RG was an extremely important
488 component of linking the community with the management system and, as such,
489 was successfully implemented. However, connection to more senior
490 management and leaders in strategic thinking which has been shown to be very
491 influential in other studies, for example Dutra et al. (2014), was weak in our
492 process partly due to the project team's work load and other commitments of the
493 participants and managers. The lack of connection to senior management made it
494 more difficult to get traction (with regard to implementation) at the end of the
495 process. However, senior managers were approached at the early stages of the
496 process and the project team was told to wait until the end when there was more
497 substance. Some of the reason for this was that senior managers wanted to stay
498 at arms length from the process so they could wait to pick and choose options
499 that are possible to implement without having directly or indirectly endorsed
500 them by being involved in the process. As a consequence, the final manager
501 meeting was destructive for some RG members even though the project team
502 warned the RG that some negative response from managers could be expected.
503 As a result, a balance between the RG and managers' needs is required, where
504 more regular contact is made rather than using the manager's approach of
505 'connecting towards the end'. Closing this engagement and timing gap between
506 managers and the RG (highlighted in the Mackay example) throughout the
507 process is a priority. If these gaps were addressed this may assist in solving the
508 conflict in perception such that managers felt much work is already being

509 undertaken in some areas whereas the RG believe these were ineffective or
510 absent in the ground actions.

511 Managers suggested the most useful part of the process was the impact
512 assessment. This provided them with a list of relative priorities for each
513 management strategy they could use for funding purposes. It also uncovered a
514 significant gap between what managers thought was a priority and this same
515 perception by the community, in addition to the mismatch in the eyes of the
516 community of the effectiveness (and wisdom) of the management action(s) that
517 addressed the managers perceived priorities.

518 After the managers meeting, the final set of management strategies was
519 separated into products specific to the two major agencies relevant to the coastal
520 zone (fisheries management – DAF and local government arrangements –
521 Regional Council) and these were much more successful in terms of uptake.
522 These included letters to each agency that highlighted the possible management
523 solutions to specific issues highlighted by the RG. These two letters were also
524 promoted behind the scenes by key members of the project team and were
525 worded in the language used in the bureaucratic system of government agencies
526 rather than those of the RG. Both products were needed for the process, as there
527 was a demonstrated disconnect between local and manager's views.

528 Disputes (potential or actual) were resolved with the aid of very clear ethics
529 guidance processes, by the sequence of the stepwise process allowing open and
530 transparent discourse, by the independence of the project team, and imbedding a
531 local in the project team. In Burdekin, adapting the process to one based on an
532 individual rather than workshop format reduced additional conflict in that area

533 (where conflict was already extant). In Burdekin, the LMAC and other
534 participants agreed to stop half way through. The acceptance that circumstances
535 were too difficult and stopping the process was an important learning outcome
536 that can be drawn from this project. In Mackay, a RG member was the chair but
537 the facilitator was from the project team, which meant that these two were able
538 to control any conflict without compromising the local or the research team.
539 Clear guidance on workshop behaviour has been provided at the start of the
540 process to all participants, and these were consistently adhered to.

541 **5.3. Generic process**

542 The following describes a generic community engagement process. However, it is
543 not a recipe for engagement, but more a guide that helps outline what is possible.

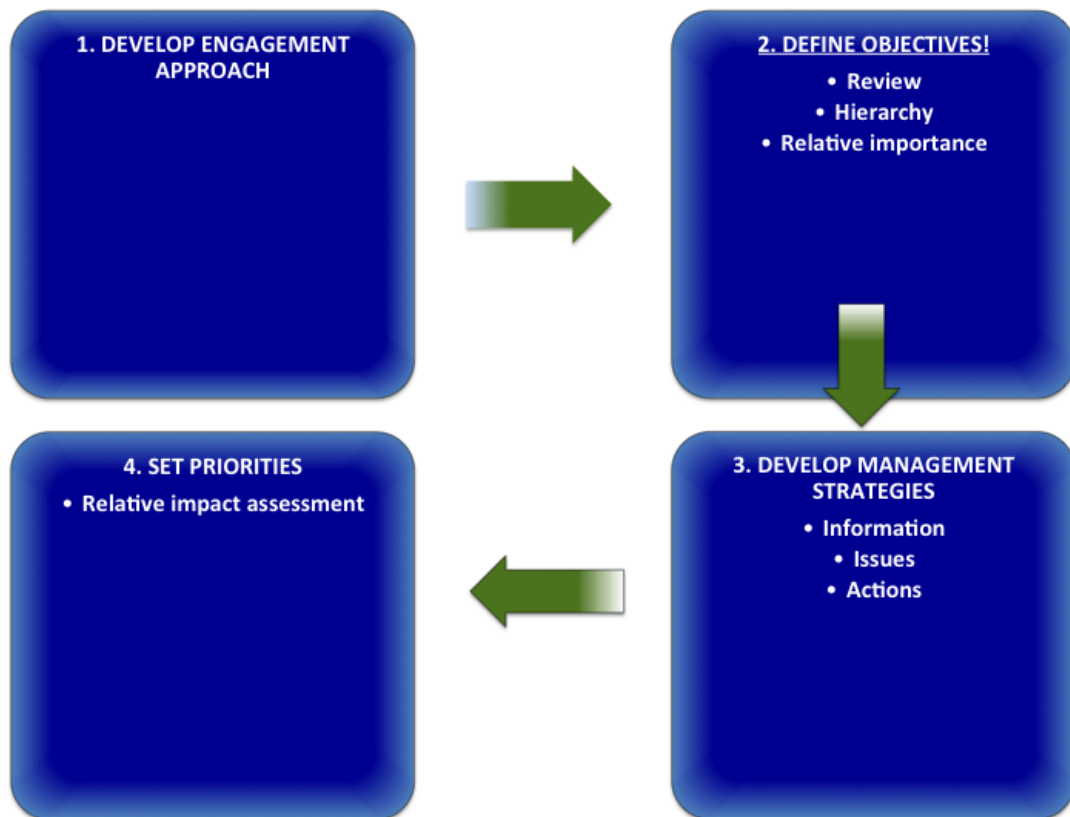
544 The community engagement process can be simplified into four steps (Fig. 2):

- 545 i) developing the engagement process;
- 546 ii) defining objectives (which includes the review of existing objectives, creating
547 the hierarchy and obtaining their relative importance);
- 548 iii) developing the management strategies (provide information, define issues
549 and develop actions); and
- 550 iv) setting the priorities through a relative impact assessment.

551 It is recommended that community engagement be conducted following the
552 approach in the Mackay RG but with enhanced LMAC (generically called the
553 Header Group) involvement where the header group gives direction by defining
554 the RGs tasks and timelines (Fig. 3). The header group should meet less
555 frequently than the RG. Managers should be embedded in the RG. The header

556 group should preferably have some authority and representativeness, whereas
557 the RG membership should maintain some representation but mainly consists of
558 volunteers willing to generously provide their time. Important influencers
559 should be identified at an early stage in the process so that they can be included
560 in the discussions as much as possible. The RG chair should be elected from the
561 RG membership but facilitation should be provided by the project team to allow
562 all RG members equal access to the discussion, but also for the chair to be able to
563 contribute to the discussion. A local person that is a member of the project team
564 is a huge advantage as this person can be a conduit for out of session
565 conversations.

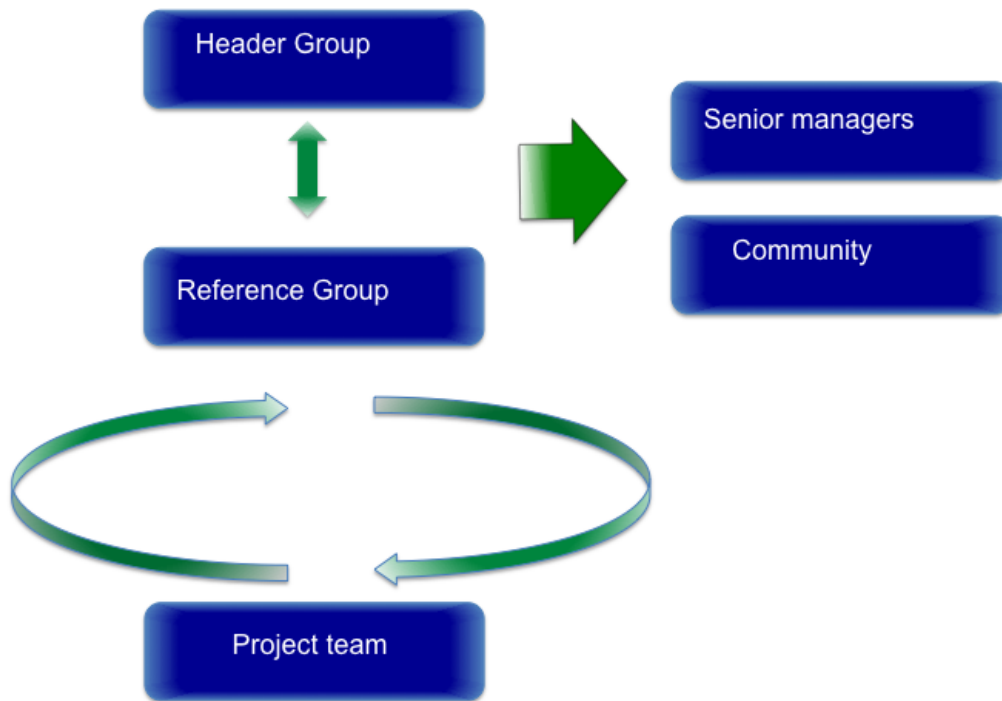
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567

568 Fig. 2: Generic process of developing management strategies using local community input

569

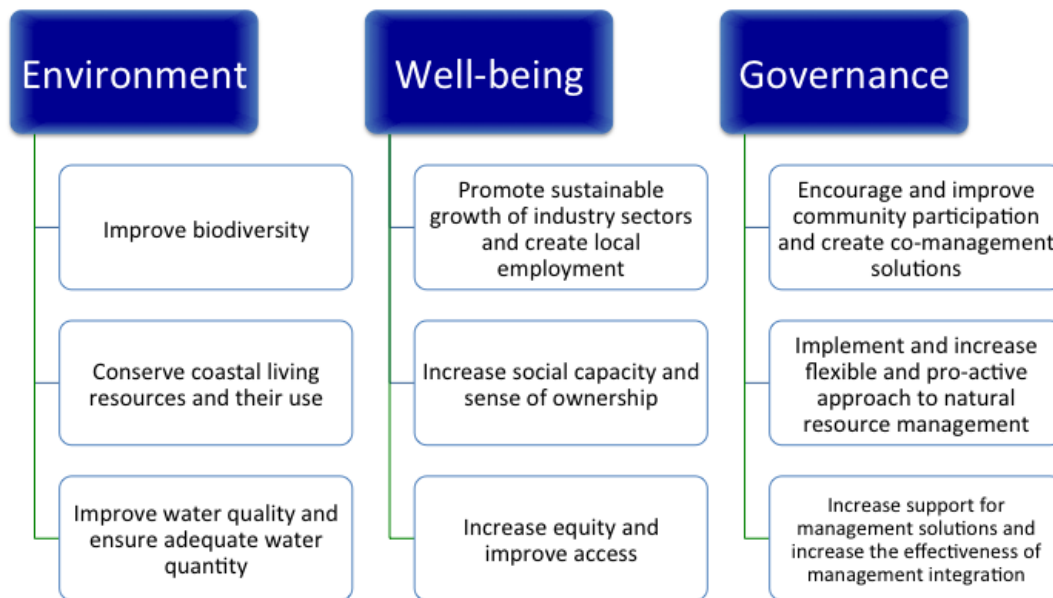


570

571 **Fig. 3: Generic engagement process**

572

573 A very important aspect of building trust is for the objectives review to maintain
574 links to source documents and also to keep track of versions when the RG and
575 Header Group input is obtained. If there is a need to speed up the process, a
576 generic objective tree to develop management strategies for coastal zone
577 fisheries and biodiversity can be used and the lower level (the objectives) can be
578 subsequently added for more local content (Fig. 4).



579

580 **Fig. 4: Generic objectives hierarchy for the management of the coastal zone fisheries and**
 581 **biodiversity (Van Putten et al., 2015).**

582 Determining the objective relative weighting can be kept within the Header

583 Group and RG (rather than going to the community as well), as this data will be

584 used when the management strategies are created by the Header Group and RG.

585 Obtaining objectives weightings from the community is time consuming.

586 However, if a community survey is part of the project plan can be obtained,

587 doing local radio interviews in which the link to online surveys is publicised

588 seems to work well in obtaining participation (Dichmont et al., 2014). A paper

589 backup survey available from a local office is also needed for those people who

590 wish to participate but are not able to access the internet. There should be a

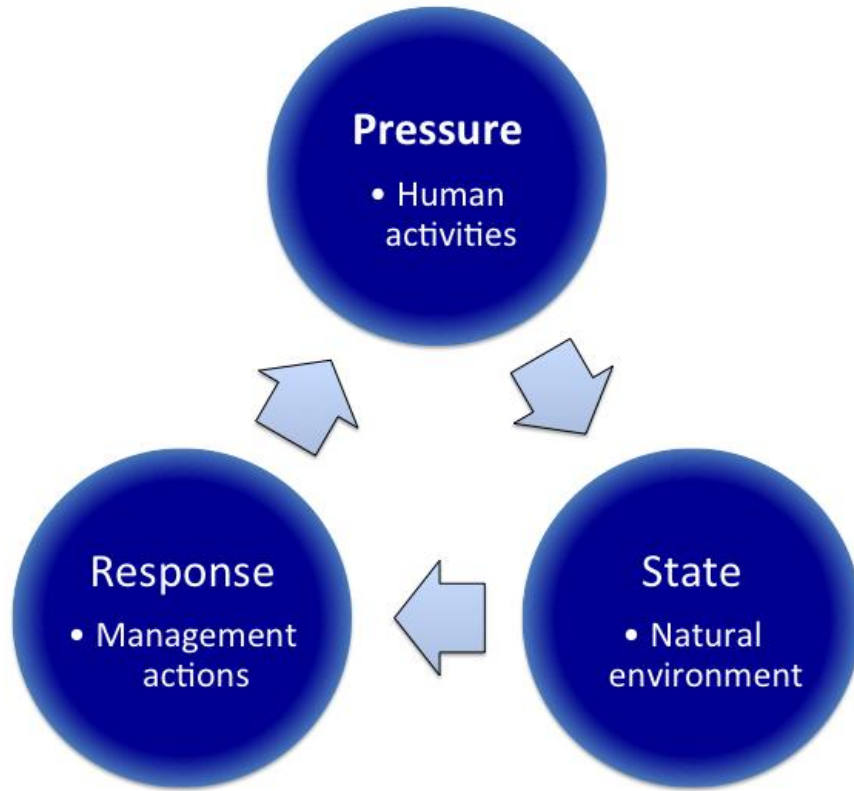
591 preference for the simplest cognitive method to obtaining relative objective

592 weightings. More confusing and controversial approaches such as the Analytical

593 Hierarchical Process as described in Dichmont et al. (2014) should be used only
594 in appropriate circumstances. An example of the simple survey using the generic
595 objectives approach is provided (Supplementary materials Section 1).

596 To ensure that the existing management situation can be adequately described
597 before the management strategies are fleshed out, it is suggested that this part of
598 the process starts with a meeting between managers and the RG and Header
599 Group in which existing management measures are comprehensively described.

600 The management strategy question should be divided into topics that combine
601 key assets and with the relevant issues that pertain to them. The topic sequence
602 should allow for connectivity in the system to be highlighted but controversial
603 topics should be raised toward the end of the process when trust and awareness
604 have already been established. For each topic, an expert with local knowledge on
605 that topic should attend. Using the simpler Pressure-State-Response framework
606 (Fig. 5) – the precursor to the Driver-Pressure-State-Impact-Response approach
607 (Pirrone et al., 2005; Smeets and Weterings, 1999) – an issues register can be
608 developed with direct and indirect management actions (Table 1). Some
609 flexibility on the day is needed in terms of whether discussions are made in small
610 groups or the whole. The project team should collate these using a database and
611 provide these to the RG for input. The Header Group should support the final
612 product.



613

614 Fig. 5: A drawing that could be provided to explain the Pressure-State-Response framework

615 Table 1: Generic management action table for use in RG discussions

Topic		
Issue	Direct management action	Indirect management action
Issue 1	Action 1a	Action 1b
Issue 2	Action 2a	Action 2b
	Action 3a	Action 3b

616

617

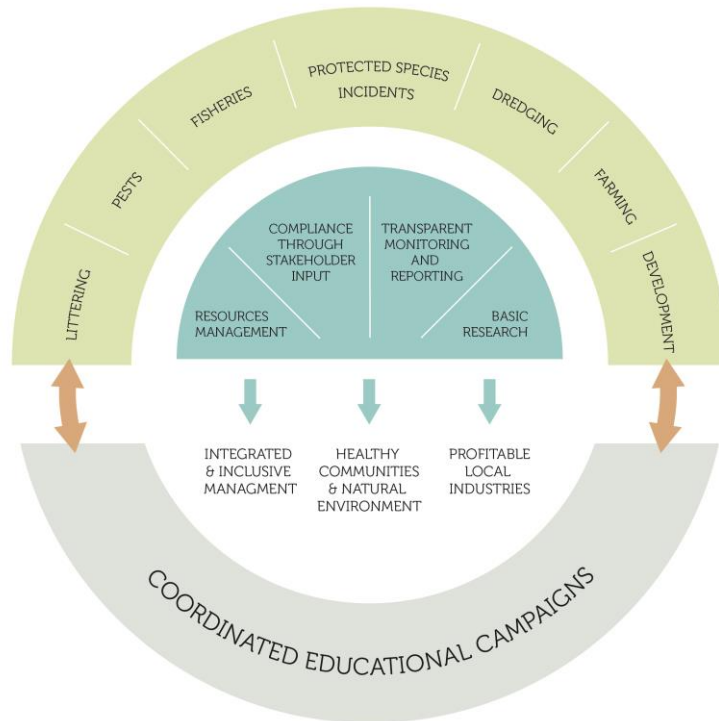
618 Given the time usually available, particularly to senior managers, the impact
 619 assessment should be undertaken for the highest level objectives by both the RG
 620 and the Header Group prior to the key managers meeting. It can be repeated in

621 session at the managers meeting to obtain information on influence – see
622 example tables in Dichmont et al. (2014). Undertaking the impact assessment at
623 these two separate meetings highlights relative priorities and the difference
624 between managers and RG members. The analysis method is provided in
625 Dichmont et al. (2013) and Dichmont et al. (2014).

626 At least one managers meeting between senior managers, embedded managers,
627 the Header Group and RG should be undertaken. In order to increase the chance
628 of implementation, it is likely that follow up meetings with managers are
629 essential and documents specific to their needs and communication style will
630 need to be produced.

631 A generic strategy communication tool (Fig. 6) can be used for each of the
632 different management strategies to ensure that all bases are covered. All
633 management actions can be the result of either direct actions on individual
634 impacts, such as reducing littering and runoff from farms and development
635 (outer ring at top), or responses by means of resource management, added
636 compliance, and basic research (inner top semi-circle). Coordinated educational
637 campaigns targeted at the local community, industries and government agencies
638 (bottom ring) are a key action that can help influence positive behaviour and
639 attitudes towards inshore resources. The final outcomes expected from the
640 management strategies are:

- 641 1. Healthy communities and natural environment
- 642 2. Integrated and inclusive management
- 643 3. Profitable local industries



644

645 **Fig. 6: Generic classes of management strategies as a communication tool with which to explain the**
 646 **management strategies. Graphic design: Dr Manuela B. Taboada, Queensland University of**
 647 **Technology**

648 A clear ethics approval process that includes the stage at which further
 649 engagement with communities or an individual member of the group is deemed
 650 as potentially damaging is important. The steps described in the ethics
 651 application used for this research was in fact used for one of the two case studies
 652 where engagement was discontinued. A flexible approach is therefore still
 653 important to keep in mind, as each situation is likely to bring its own
 654 idiosyncrasies.

655 **6. Conclusions**

656 A generic approach to developing management strategies based on two case
 657 studies is outlined. The case study experience highlights that embedding

658 managers and person from a local government agency within the community
659 group that develops the objectives and prioritises the management actions is
660 essential to successful implementation. In addition, senior managers and thought
661 leaders should be part of the process from the start rather than coming in only at
662 the end at which time a more tangible but less controversial product is available.
663 Continuous engagement by senior managers and thought leaders is important
664 because failure is most likely to occur at the implementation phase. Throughout
665 the process steps are needed to ensure reduced risk of conflict. The most
666 important step in risk reduction is to discuss objectives prior to management
667 strategies. This allows the group to value and understand each other's
668 perspective. The gap between the perception of managers that their
669 management actions are in place and outcomes are achieved, and the
670 community's perception of the effectiveness of the same actions needs to be at
671 least narrowed but preferably closed. This is particularly important as the
672 significant volunteer time required to support the process evident in this project,
673 showed the wish for local scientists and community members to be part of
674 regional management.

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679 Mackay LMAC RG. We developed a survey in Mackay to gauge residents' opinions
680 of what mattered to them with regard to coastal management, and more than
681 140 completed what was a taxing survey. These respondents also helped recruit

682 other survey participants. Some of the participants attended in-person sessions
683 held in Mackay and stayed to give us robust advice on the survey design. These
684 comments were instrumental when developing a new method. Special mention
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695 **8. References**

696 Abal, E.G., Dennison, W.C., Bunn, S.E., 2005. Healthy waterways healthy
697 catchments: making the connection in South East Queensland, Australia. Moreton
698 Bay Waterways and Catchment Partnership, Brisbane, p. 222.
699 Australian Bureau of Statistics, 2013. State and territory statistical indicators.,
700 Technical Report 1367.0. Australian Bureau of Statistics.
701 Chandra, A., 2011. A Deliberate Inclusive Policy (DIP) Approach for Coastal
702 Resources Governance: A Fijian Perspective. *Coastal Management* 39, 175–197.
703 Cox, M., Arnold, G., Tomás, S.V., 2011. A Review of Design Principles for
704 Community-based Natural Resource Management. *Ecology and Society* 15, 38.
705 Dambacher, J.M., Luh, H.K., Li, H.W., Rossignol, P.A., 2003. Qualitative stability
706 and ambiguity in model ecosystems. *American Naturalist* 161, 876–888.

707 Dambacher, J.M., Ramos-Jiliberto, R., 2007. Understanding and predicting effects
708 of modified interactions through a qualitative analysis of community structure.
709 Quarterly Review of Biology 82, 227–250.

710 Dichmont, C.M., Dutra, L.X.C., van Putten, I., Deng, R.A., Owens, R., Jebreen, E.,
711 Thompson, C., Pascual, R., Warne, M.S.J., Quinn, R., Thébaud, O., Bennett, J., Read,
712 M., Wachenfeld, D., Davies, J., Garland, A., Dunning, M., Waycott, M., Collier, C., J.,
713 D., Playford, J., Harm, R., Gribble, N., Pitcher, R., 2014. Design and implementation
714 of Management Strategy Evaluation for the Great Barrier Reef inshore (MSE-
715 GBR). Report to the National Environmental Research Program, and Reef and
716 Rainforest Research Centre Limited Cairns, pp. 284 pp.
717 [http://www.nerptropical.edu.au/publication/project-292-final-report-design-](http://www.nerptropical.edu.au/publication/project-292-final-report-design-and-implementation-management-strategy-evaluation-great)
718 [and-implementation-management-strategy-evaluation-great.](http://www.nerptropical.edu.au/publication/project-292-final-report-design-and-implementation-management-strategy-evaluation-great)

719 Dichmont, C.M., Pascoe, S., Jebreen, E., Pears, R., Brooks, K., Perez, P., 2013.
720 Choosing a fishery's governance structure using data poor methods. Marine
721 Policy 37, 123–131.

722 Dietz, T., Ostrom, E., Stern, P.C., 2003. The struggle to govern the commons.
723 Science 302, 1907–1912.

724 Drimie, S., Quinlan, T., 2011. Playing the role of a 'boundary organisation': getting
725 smarter with networking. Health research policy and systems / BioMed Central 9
726 Suppl 1, S11.

727 Dutra, L.X., Ellis, N., Perez, P., Dichmont, C.M., de la Mare, W., Boschetti, F., 2014.
728 Drivers influencing adaptive management: a retrospective evaluation of water
729 quality decisions in South East Queensland, Australia. Ambio 43, 1069–1081.

730 Guston, D.H., 2001. Boundary Organizations in Environmental Policy and
731 Science: An Introduction. Special Issue: Boundary Organizations in
732 Environmental Policy and Science (Autumn, 2001) 26, 399–408.

733 Halpern, B.S., Kappel, C.V., Selkoe, K.A., Micheli, F., Ebert, C.M., Kontgis, C., Crain,
734 C.M., Martone, R.G., Shearer, C., Teck, S.J., 2009. Mapping cumulative human
735 impacts to California Current marine ecosystems. Conservation Letters 2, 138–
736 148.

737 Hosack, G.R., Hayes, K.R., Dambacher, J.M., 2008. Assessing model structure
738 uncertainty through an analysis of system feedback and bayesian networks.
739 Ecological Applications 18, 1070–1082.

740 Kroon, F., Turner, R.E., Smith, R., Warne, M., Hunter, H., Bartley, R., Wilkinson, S.,
741 Lewis, S., Waters, D., Carroll, C., 2013. Sources of sediment, nutrients, pesticides
742 and other pollutants in the Great Barrier Reef catchment. Queensland State
743 Government, Reef Water Quality Protection Plan Secretariat, Brisbane.

744 Ludwig, D., 2001. The era of management is over. *Ecosystems* 4, 758–764.

745 Ma, C., Zhang, X., Chen, W., Zhang, G., Duan, H., Ju, M., Li, H., Yang, Z., 2013. China's
746 special marine protected area policy: Trade-off between economic development
747 and marine conservation. *Ocean & Coastal Management* 76, 1-11.

748 Marshall, N.A., Bohensky, E., Curnock, M., Goldberg, J., Gooch, M., Pert, P., Scherl,
749 L., Stone-Jovicich, S., Tobin, R.C., 2013. A Social and Economic Long Term
750 Monitoring Program for the Great Barrier Reef. Key Findings 2013., Report to the
751 National Environmental Research Program. Reef and Rainforest Research Centre
752 Limited, Cairns, p. 52 pp.

753 Muro, M., Jeffrey, P., 2008. A critical review of the theory and application of social
754 learning in participatory natural resource management processes. *Journal of*
755 *Environmental Planning and Management* 51, 325-344.

756 Ostrom, E., 2009. *Governing the Commons: The Evolution of Institutions for*
757 *Collective Action*. Cambridge University Press.

758 Ostrom, E., Janssen, M.A., Anderies, J.M., 2007. Going beyond panaceas.
759 *Proceedings of the National Academy of Sciences of the United States of America*
760 104, 15176–15178.

761 Pascoe, S., Mary Dichmont, C., Brooks, K., Pears, R., Jebreen, E., 2013.
762 Management objectives of Queensland fisheries: Putting the horse before the
763 cart. *Marine Policy* 37, 115–122.

764 Pirrone, N., Trombino, G., Cinnirella, S., Algieri, A., Bendoricchio, G., Palmeri, L.,
765 2005. The Driver-Pressure-State-Impact-Response (DPSIR) approach for
766 integrated catchment-coastal zone management: preliminary application to the
767 Po catchment-Adriatic Sea coastal zone system. *Regional Environmental Change*
768 5, 111–137.

769 Rittel, H.W.J., Webber, M.M., 1973. Dilemmas in a general theory of planning.
770 *Policy Sciences* 4, 155–169.

771 Rowbottom, D.P., Bueno, O., 2009. How to change it: modes of engagement,
772 rationality, and stance voluntarism. *Synthese* 178, 7–17.

773 Saaty, T.L., 1980. The Analytic Hierarchy Process. McGraw-Hill, New York.

774 Sainsbury, K.J., Punt, A.E., Smith, A.D.M., 2000. Design of operational management
775 strategies for achieving fishery ecosystem objectives. ICES Journal of Marine
776 Science 57, 731–741.

777 Smeets, E., Weterings, R., 1999. Environmental indicators: Typology and
778 overview., European Environment Agency Technical Report No. 25. European
779 Environment Agency Technical Report No. 25, Copenhagen. 19pp., p. 19 pp.

780 Smith, A.D.M., Sainsbury, K.J., Stevens, R.A., 1999. Implementing effective
781 fisheries-management systems - management strategy evaluation and the
782 Australian partnership approach. Ices Journal of Marine Science 56, 967–979.

783 Townsend, R., Shotton, R., Uchida, H., 2008. Case studies in fisheries self-
784 governance, FAO Fisheries Technical Paper. FAO, Rome, p. 451.

785 Van Putten, I.E., Dichmont, C.M., Dutra, L.X.C., Thébaud, O., Deng, R.A., Jebreen, E.,
786 Owens, R., Pascual, R., Read, M., Thompson, C., 2015. Objectives for management
787 of socio-ecological systems in the Great Barrier Reef region, Australia. Regional
788 Environmental Change.

789 Van Vugt, M., 2009. Averting the Tragedy of the Commons: Using Social
790 Psychological Science to Protect the Environment. Current Directions in
791 Psychological Science 18, 169–173.

792 Vural-Arslan, T., Cahantimur, A., 2011. Revival of a traditional community
793 engagement model for the sustainable future of a historical commercial district:
794 Bursa/Turkey as a case. Futures 43, 361–373.

795 Walters, C.J., Hilborn, R., 1976. Adaptive control of fishing systems. Journal of the
796 Fisheries Research Board of Canada 33, 145–159.

797

A generic method of engagement to elicit regional coastal management options

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1 Survey approaches to objective weighting

Two survey approaches were undertaken – the Analytical Hierarchical Process (AHP) (Pascoe et al., 2013; Saaty, 1980) and a new approach based on the Point Allocation method, but applied at all levels of the Hierarchy rather than only at the bottom level (see Dichmont et al. (2014)). This new approach, called here the Hierarchical Point Allocation (HPA), mathematically is the same as the HPA once the Saaty values are converted to proportions, but is easier and more intuitive to fill in by a general audience such as the broader community or a community group. An example of the form for the Mackay region is provided below.



Your details

Name:

Email:

Please choose the group that you mostly associate with by checking (✓) the appropriate stakeholder group

Stakeholder groups	Please tick ✓ only one
Commercial Fishing	
Charter Fishing	
Commercial seafood processing	
Recreational Fishing	
Diving	
Tourism	
Fisheries Management	
Fisheries Compliance	
Tackleshops, Recreational Service	
Industry	
Marine Services Industry	
Mining	
Port Authority	
Farmer	
Grazier	
Conservation organisation	
Great Barrier Reef Marine Park Authority	
Queensland Parks and Wildlife Service	
NRM group	
Local Government Councillors	
State Government	
Aboriginal & Torres Strait Islander	
Local Resident	
Scientists	
Student - High School	
Student - Tertiary	
Other	

Please indicate the region where you are located

Region	Please tick ✓ only one
Torres Strait to Cairns	
South of Cairns to Bowen	
South of Bowen to Repulse Bay	
Repulse Bay to Clairview (Mackay)	
South of Yeppoon to Baffle Creek	
South of Baffle Creek to Double Island Point	
South of Double Island Point to Caloundra	
Caloundra to the NSW Border	
Other	

Example

Please indicate the relative importance of three different objectives for playing sports.

The total score should be **equal to 100**.

The indicator score for the individual objective has to be **at least one** (1) and CANNOT be zero (0)

Objective		100 points	Explanation of objective
1	Get fit	30	You want to maintain a level of fitness to stay healthy
2	Interact with your friends	10	This is an important opportunity to be with your friends every week
3	Have fun	60	The physical activity provides a high level of necessary fun in your otherwise busy life
		TOTAL 100	

OR

If you rate two the same please give them the same number of points

Objective		100 points	Explanation of objective
1	Get fit	1	You want to maintain a level of fitness to stay healthy
2	Interact with your friends	1	This is an important opportunity to be with your friends every week
3	Have fun	98	The physical activity provides a high level of necessary fun in your otherwise busy life
		TOTAL 100	

High Level Objectives

Please indicate the relative importance of three different high level objectives. The total score should be equal to 100.

	Objective	100 points	Explanation of objective
1	Protect and restore inshore environmental assets		Overarching environmental objective for the region
2	Improve governance systems (i.e. leadership, institutions, rules and decision-making processes involved in managing inshore biodiversity)		Improve leadership, institutions, rules and decision-making processes involving government, citizens, public associations, private businesses, and non-governmental organisation, for the management of inshore biodiversity and its uses
3	Improve regional economic and social well-being		Improve the long-term well-being of the region's people by promoting economic growth, increasing social cohesion and increasing social capital
		TOTAL 100	

Protect environmental assets

Please indicate the relative importance of three different objectives for protecting environmental assets. The total score should be equal to 100.

Objective		100 points	Explanation of objective
1.1	Improve ecosystem connectivity	100	Connectivity between catchment, fresh- and salt-water habitats
1.2	Improve water quality		Reduce sediment and nutrient runoff into waterways and reefs
1.3	Conserve inshore living resources		Ensure long-term conservation of the inshore living resources and their support systems

Objective		100 points	Explanation of objective
1.1.1	Reduce direct impacts of infrastructure and development	100	Minimise the negative impacts to biodiversity associated with the strong development currently occurring in the region
1.1.2	Minimise human induced changes in water flow regimes		Maintain water flow regimes to allow for catchment to coast connectivity

Objective		100 points	Explanation of objective
1.2.1	Ensure Reef Plan water quality targets are met	100	Meet regional water quality targets
1.2.2	Increase feral animal control and environmental friendly weed control strategies		Control invasive species to improve water quality. When possible weed control should avoid/minimise the use of chemicals
1.2.3	Reduce influx of pollutants		Reduce the use of chemicals used in agriculture and industry and its disposal in waterways. Also involves reduction of sediment and nutrient runoff

Objective		100 points	Explanation of objective
1.3.1	Sustainable human use of marine resources	100	Ensure sustainable harvesting of living resources; Reduce waste and human footprint of extractive activities, and improve re-use of by-products
1.3.2	Maintain habitat function and structure		Maintain/restore habitats for their biodiversity values
1.3.3	Reduce impacts on Threatened, Endangered, Protected (TEP) species		Minimise accidental strikes and kills of fauna and flora (e.g. dugongs, turtles, quolls)

Improve governance systems

Please indicate the relative importance of three different objectives for improving governance systems. The total score should be equal to 100.

Objective		100 points	Explanation of objective
2.1	Increase management effectiveness		Increase the effectiveness of management systems by removing barriers to flexibility
2.2	Increase management support		Increase support towards inshore biodiversity management systems through increased management acceptability, increased stakeholder engagement, ensuring that management costs are sustainable and increase compliance with environmental and resource use regulations
2.3	Increase management integration		Improve integration of management in policy, regulation & implementation, at Local, State & Comm. levels

100

Objective		100 points	Explanation of objective
2.1.1	Remove regulatory barriers to flexibility (alternative harvesting techniques, zoning, diversification in the economy)		Remove regulatory barriers that impede creativity in the development of alternative techniques to harvest natural resources, to increase flexibility in zoning arrangements and remove regulatory barriers that impede the diversification of the economy
2.1.2	Increase compliance with environmental and resource use regulations		Discourage illegal, unreported & unregulated activities, & encourage compliance with existing regulations

100

Objective		100 points	Explanation of objective
2.2.1	Increase management acceptability		Increase management acceptability through rational & proportional legislation, & increased info dissemination
2.2.2	Increase stakeholder engagement and community ownership/stewardship		Increase stakeholder engagement through involvement of private developers / corporate responsibility and community involvement in management to foster community ownership/stewardship
2.2.3	Sustainable financial costs		Minimise industry compliance costs & govt enforcement costs, including recoverable and non-recoverable total management costs and infrastructure costs

100

Objective		100 points	Explanation of objective
2.3.1	Increase policy integration		Coherent & integrated policies across Local, State and Commonwealth levels
2.3.2	Increase regulatory integration		Coherent & integrated regulations across Local, State and Commonwealth levels
2.3.3	Increase implementation integration		Coherent & integrated management implementation across Local, State and Commonwealth levels

100

Improve regional well-being

Please indicate the relative importance of three different objectives for improving regional well-being. The total score should be equal to 100.

Objective		100 points	Explanation of objective
3.1	Increase economic growth	100	Promotion of regional economic development, incl. natural resource based industries, to maintain / improve family livelihoods
3.2	Increase social cohesion		Increase regional community cohesion through minimising conflicts between stakeholders, conserving traditional activities & cultures and ensuring equitable access to inshore areas and resources
3.3	Increase social capacity		Increase social capacity to act, through health improvement and investment in social capital development

Objective		100 points	Explanation of objective
3.1.1	Improve regional economic development and industry diversity	100	Increase the regional flow of human & financial resources, develop efficient & integrated infrastructure, increase local market opportunities for local foods
3.1.2	Improve family livelihoods in the region		Enhancement of quality of life via increasing employment opportunities and family income
3.1.3	Ensure that natural resource based industries are profitable and sustainable		Maximise industry value, economic profits and productivity, and minimise price variability

Objective		100 points	Explanation of objective
3.2.1	Minimise conflicts between stakeholders	100	Minimise conflicts between different users of the inshore marine area and resources
3.2.2	Conserve traditional activities and cultures		Preserve the traditional and cultural relationships between natural resources and areas and local human cultures (aboriginal and non-aboriginal)
3.2.3	Ensure community equity		Ensure equitable access to inshore areas and resources

Objective		100 points	Explanation of objective
3.3.1	Improve workplace and family health and safety in the region		Improve safety in the workplaces, as well as physical and mental family health and safety in the region
3.3.2	Improve education, training, social infrastructure and networks		Improve social capital at both individual (education, training, ...) and collective level (physical infrastructure – hospitals, schools, ... - as well as networks and community groups) providing the regional community with the capacity to address development challenges and take advantage of emerging opportunities

100

2 List of topics discussed and issues register: Mackay

A series of presentations were provided as a transitional meeting between the objectives weighting and management options sessions:

- An overview of the catchment to coast framework concentrating on the Reef Catchment Plan;
- Upper and middle catchment statistics, issues, plans and existing management measures;
- Coastal statistics, issues, plans and existing management measures;
- Biodiversity statistics, issues, plans and existing management measures; and
- Fisheries statistics, issues, plans and existing management measures.

Seven topics were chosen that were relevant to the coastal zone and of interest to the group:

- Coastal water quality;
- Seagrass and associated ecosystem;
- Mangroves and associated megafauna;
- Inshore corals;
- Urban development;
- Port development; and
- Fisheries.

Since upper catchment water quality was out of scope in the project, the RG decided to bundle coastal water quality and seagrass into a single session. The two were seen as very interrelated.

An issue register was created on butchers paper or as a group on the whiteboard. Each issue under a topic being discussed required a related direct management actions and indirect management action, and the responsible agency of person that would need to drive this action.

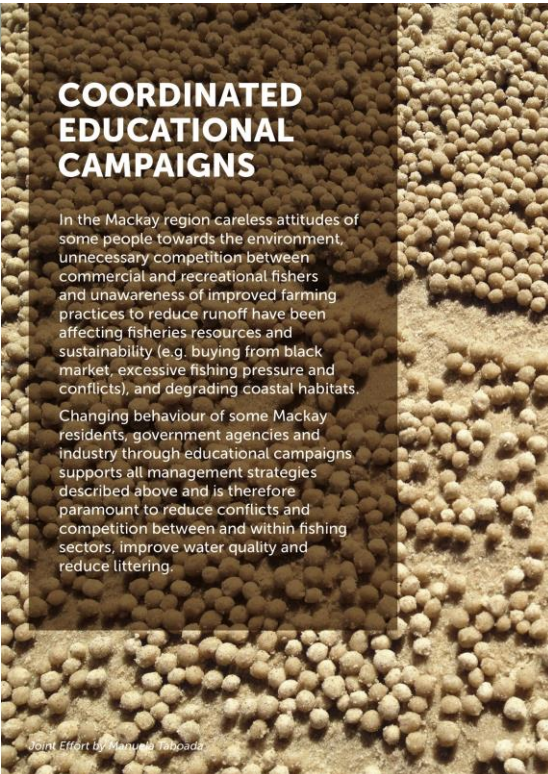
3 Management Strategies: Mackay

The final set of broad management strategies were developed. Underneath these were more detailed responses as detailed in the storylines (see Section 4 below).

1. Address littering through education, legislation and operating procedures
2. Develop and implement weed and pest management plans for regions
3. Education - best development practices
4. Education – on farm best practices
5. Education - fishery campaign
6. Education - improving governance
7. Improve compliance by obtaining local stakeholder input
8. Improve resource management through better planning, assessment and regulation
9. Legislation changes to allocation and sustainability of fishery issues
10. Management for protected species
11. Reduce impacts of dredging
12. Support, facilitate and coordinate basic research
13. Transparent (to public) and coordinated monitoring reporting

4 Example storyline: Mackay

DIRECT ACTIONS	INDIRECT RESPONSES	EDUCATIONAL CAMPAIGNS
<p>WHAT CAN WE DO TOGETHER TO EDUCATE THE COMMUNITY?</p>		
<p>■ Promote change in cultural attitude</p> <p>Emphasise that recreational fishing is about enjoyment through, for example, fishing shows and the Reef Guardian program.</p> <p>Use regional radio for local stories about enjoyment in recreational fishing and importance of commercial fisheries.</p> <p>Stimulate the use of bike paths, walkways and alternative modes of transport as ways of reducing traffic and the need to build new bridges and roads.</p> <p>Promote the Council online system already in place for car-pooling: mackayregioncarpool.com</p> <p>Develop an education program to change attitudes of society toward littering.</p> <p>Produce education newsletters and editorials about adequate disposal of litter.</p>	<p>■ Educate public, especially youth, about the need for responsible resource allocation</p> <p>Provide educational material to students from across different domains (engineering, planning, natural resources management etc) on existing understandings about downstream impacts of management actions and their consequences on natural systems; provide case studies of major failures and successes for discussion.</p> <p>Start education programs at schools about the importance of seafood and fishing.</p> <p>Educate fishers and the broader community about the need for different allocation for different fishing sectors as a way of reducing competition for fish resources.</p> <p>Educate the recreational sector and public about the commercial fishery and the extent of fishing controls already in place.</p>	<p>■ Create education campaigns to reduce accidental deaths of protected species</p> <p>Use Reef Guardian program to facilitate education campaign focusing on improved fishing practices to minimise accidental deaths of protected species.</p> <p>Educate population about new technologies to minimise injury/deaths from boat strikes— such as plastic propellers— and develop a funding program to test these.</p> <p>■ Undertake an education and information program targeted at the local community to explain the activities of the Port and how these are being managed</p> <p>Provide greater transparency to the community by providing greater access to information and data collected by the Port.</p> <p>■ Integrated educational and communication campaigns using traditional and social media</p>



COORDINATED EDUCATIONAL CAMPAIGNS

In the Mackay region careless attitudes of some people towards the environment, unnecessary competition between commercial and recreational fishers and unawareness of improved farming practices to reduce runoff have been affecting fisheries resources and sustainability (e.g. buying from black market, excessive fishing pressure and conflicts), and degrading coastal habitats.

Changing behaviour of some Mackay residents, government agencies and industry through educational campaigns supports all management strategies described above and is therefore paramount to reduce conflicts and competition between and within fishing sectors, improve water quality and reduce littering.

Joint Effort by Manuella Tsakozis

5 References

1. Dichmont, C.M., Dutra, L.X.C., van Putten, I., Deng, R.A., Owens, R., Jebreen, E., Thompson, C., Pascual, R., Warne, M.S.J., Quinn, R., Thébaud, O., Bennett, J., Read, M., Wachenfeld, D., Davies, J., Garland, A., Dunning, M., Waycott, M., Collier, C., J., D., Playford, J., Harm, R., Gribble, N., Pitcher, R., 2014. Design and implementation of Management Strategy Evaluation for the Great Barrier Reef inshore (MSE-GBR). Report to the National Environmental Research Program, and Reef and Rainforest Research Centre Limited Cairns, p. 284 pp.
2. Pascoe, S., Mary Dichmont, C., Brooks, K., Pears, R., Jebreen, E., 2013. Management objectives of Queensland fisheries: Putting the horse before the cart. *Marine Policy* 37, 115–122.
3. Saaty, T.L., 1980. *The Analytic Hierarchy Process*. McGraw-Hill, New York.