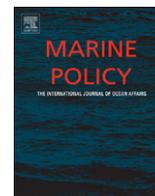




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## Management objectives of Queensland fisheries: Putting the horse before the cart

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### ABSTRACT

A review of future management arrangements for the Queensland East Coast Trawl fishery was undertaken in 2010 to develop a management plan for the next 10 years. A key question raised at the start of the review process was: what should the management plan achieve? As with fisheries management in most countries, multiple management objectives were implicit in policy statements, but were poorly specified in some areas (particularly social objectives) and strongly identified in others (e.g., an objective of sustainability). As a start to the management review process, an analysis of what objectives the management system should aim to achieve was undertaken. A review of natural resource management objectives employed internationally was used to develop a candidate list, and the objectives most relevant to the fishery were short-listed by a scientific advisory group. Additional objectives specific to Queensland fisheries management, but not identified in the international review, were also identified and incorporated into the objective set. The relative importance of the different objectives to different stakeholder groups was assessed using the Analytic Hierarchy Process. As with other studies, the relative importance of the different objectives varied both within and between the different stakeholder groups, although general trends in preferences were observed.

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### 1. Introduction

Management by objectives was a popular business management system in the latter decades of the last century, and has been demonstrated to increase productivity in a wide range of industries [1,2]. The traditional model of management by objectives involves a retrospective analysis of how different strategies (or individuals) performed against the agreed set of goals determined at the start of the process. The approach has been criticised in the business environment as it created incentives for unrealistic goals to be set by business managers (rather than agreed with staff), although in more recent years the advent of greater empowerment of stakeholders has created a renewed interest in this management system [3]. In the revised system, stakeholders are more directly involved in the development of both objectives and the strategies themselves with the aim of achieving the agreed goals.

The principles underlying management by objectives are as applicable to natural resource management as they are to a commercial business. Increased interest in developing co-management arrangements with the industry is giving stakeholders a substantially greater involvement in management decision making, particularly in fisheries [4,5]. Further, stakeholder involvement in the development of fisheries management objectives and assessment of their relative importance has been shown to be essential for the development of appropriate management plans [6]. However, in fisheries management, the stakeholder group can be defined as the industry, but more recently, as a broad group of industry and onshore facilities, other users of the resource (e.g., recreational fishers), and groups with a conservation interest.

While, fisheries management policy in most countries is largely concerned with achieving a similar set of objectives, namely biological, economic, social, political and environmental objectives [6–8], these are generally vague in both their definition and relative importance. Such was the case for the Queensland East Coast Trawl Fishery, the management of which was subject to review in 2010. The aim of the review was to develop a management plan for the fishery that would operate over the next decade. The overall management objective for Queensland's

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fisheries, as stated in the aims of Queensland Fisheries Strategy 2009–2014 [9], is to get the best possible economic and social benefits for society through effective management and sustainable exploitation of the fishery. Economic targets were specified as achieving the maximum economic yield from the fisheries [9], however the social objectives were undefined. Further, the revision of the fisheries management plan required broader consideration of other factors. Broader Queensland government objectives [10,11] included expanding employment in resource based industries, while pressures existed within the fisheries management agency to simplify management processes in order to reduce management costs [11]. Fishers themselves sought a greater role in management decision making and a direct involvement in the management review, and this was also supported by the Queensland Government's Fisheries Strategy [11]. Fisheries management in Queensland is also of interest to recreational fishing groups as well as conservation groups and agencies. In the case of the latter stakeholder group, parts of the fishery operate within the Great Barrier Reef Marine Park, and the Great Barrier Reef Marine Park Authority has an active interest in the management of the fishery as part of the agency's mandate to ensure use of the Great Barrier Reef is ecologically sustainable and consistent with long term protection of this World Heritage Area.

Given the complexity in terms of a number of vague but competing objectives, and the diversity of stakeholder groups with a direct interest in the review process, definition of explicit management objectives and an assessment of their relative importance by individual stakeholders was a critical first step in the review process. The preference for a particular management option by a particular stakeholder group depends on their perceptions of the overall net benefit (or cost) given the set of outcomes against each objective and priorities given to these objectives. Conflicts and disagreements between (and potentially within) stakeholder groups largely arise as a result of differing importance placed on different objectives. Making these objective preferences explicit assists in the reduction of conflicts and help to develop consensus, as different stakeholders can evaluate their own proposals from the other's perspective.

The purpose in this paper is to detail the process undertaken to identify the set of objectives deemed relevant to the management of Queensland fisheries and in the context of the review of the East Coast Trawl Fishery. Further, it discusses the relative objective preference structure of the different stakeholder groups influential in the development of a fisheries management plan. A previous study identified and weighted management objectives for Australian Commonwealth fisheries [6]. However, differences between State and Commonwealth fisheries policy (particularly in regard to social considerations) and environmental issues unique to Queensland (e.g., the involvement of commercial fishing activity within the Great Barrier Reef Marine Park) do not allow these objectives and weights to be transferred to the State fishery level. As with the previous study, preferences were derived using the Analytic Hierarchy Process (AHP) [12] across a range of different stakeholders. The coherency of the preference structures within the different stakeholder groups was also examined to determine the degree to which the stakeholder groups are uniform in their viewpoints.

## 2. The Queensland East Coast Trawl Fishery and management review

The Queensland East Coast Trawl Fishery is a multi-species fishery that primarily targets several prawns species, Moreton Bay bugs and scallops. The trawl fishery is Queensland's largest commercial fishery, with about 600 licensed vessels catching

product valued at approximately \$100 million in 2008–2009 [13]. While managed as one fishery, several distinct sub-fisheries (termed sectors) exist, with some fishers operating in several sectors while others specialise in just one sector. The fishery is currently managed through a transferable effort unit system, where vessels require a given number of effort units to operate each night based on their vessel size. Effort units can be deployed across any or all of the different sectors, with no effective cap on effort applied to any particular sector.

The fishery is currently managed under the Fisheries (East Coast Trawl) Management Plan 1999, which commenced in 2000 and established the effort control system currently in place. This plan formally expired at the end of 2009, and consultation with stakeholders in 2009 suggested a substantial revision of the management plan would be appropriate. The subsequent 2010 management review aimed to identify the objectives of the management plan (the subject of this paper) and assess a range of alternative management systems against these objectives with the aim of implementing a new management plan during 2011 (see Dichmont et al. [14], this volume).

The initial consultation and review process with a group of stakeholders identified a number of key issues. Falling prawn prices and increasing fuel costs have resulted in a substantial decrease in fishing effort in the fishery over recent years and a shift of effort to less remote areas. In 2010, only 345 boats (of the set of 600 licensed boats) were active and only 1.8 million effort units were used out of a total available pool of 2.9 million. The substantial latent effort in the fishery is of considerable concern to both managers and industry, the former in terms of their lack of ability to effectively control fishing effort in different sectors of the fishery (if required) and the latter in terms of the loss of asset values. With around 37% of the effort units being unutilised, unit trading values and the quantity traded have fallen to negligible levels.

The fishery also faces a number of environmental challenges in terms of ecological interactions, societal acceptability, complexity and uncertainty. Part of the fishery operates within the Great Barrier Reef Marine Park, where marine park managers work in partnership with fishery managers and the industry to protect the natural values of the Marine Park and World Heritage Area and ensure fishing activities are ecologically sustainable. The trawl fishery has an associated bycatch of sea-snakes and marine turtles, both protected species. While levels of turtle bycatch have been greatly reduced through the use of turtle excluder devices, the bycatch of sea-snakes is an ongoing area of concern [15], with managers and industry working to further improve bycatch reduction devices and practices to help mitigate this interaction. The fishery is also subject to considerable scrutiny by environmental groups that have questioned the appropriateness and acceptability of trawling in marine parks of world heritage significance.

While negative externalities associated with environmental impacts generally do not affect fishers' decision making processes, Australia has strong environmental legislation that links to export accreditation. Failure to adequately address environmental impacts of Australian fisheries could ultimately result in the fishery's permission to export its products being withdrawn<sup>1</sup> or potentially even stronger measures such as an outright closure being applied in some sectors. As a result, environmental issues are taken seriously by operators in the fishery.<sup>2</sup>

<sup>1</sup> Export licences for Australian fisheries products are subject to approval by the Department of Sustainability, Environment, Water, Population and Communities (SEWPA), under the Environment Protection and Biodiversity Conservation Act, 1999.

<sup>2</sup> A review of the use of trade instruments to provide incentives to reduce bycatch and environmental damage is given in Pascoe et al. [16].

### 3. Development of the management objectives hierarchy

Previous studies of fisheries management objectives (and natural resource management objectives in general) identify that generally a hierarchy of objectives is developed, with higher level objectives being the typical triple bottom line categories of economic, social and environmental objectives, and lower level objectives being more detailed or specific objectives for the fishery in question [6,7,17–19]. A similar approach was adopted for this study, although a fourth higher level objective – simplifying management – was identified early in the analysis.

The objectives hierarchy was developed initially through a comprehensive review of natural resource management objectives, including fisheries, forestry, water resources, agriculture and mining. The full set of objectives identified is presented in the supplementary information. The set of objectives were cross-referenced with existing policy documents relevant to the fishery and the Great Barrier Reef Marine Park [10,11,20,21], as well as key legislation,<sup>3</sup> and a preliminary objective hierarchy was developed by the project team. The project team itself consisted of a biologist, social scientist, economist, fisheries manager and marine park manager. The preliminary objective hierarchy was presented to a Scientific Advisory Group (SAG), which consisted of additional scientists, fisheries managers and industry members (both catching and processing sectors) established as part of the management review, and a revised objective hierarchy agreed through consensus. This in turn was presented to the policy group of the government department responsible for the management of the fishery (the Department of Employment, Economic Development and Innovation, or DEEDI) who, after some minor additional adjustments, accepted the final hierarchy (Fig. 1).

### 4. Weighting of management objectives

The Analytic Hierarchy Process (AHP) [12] was used to derive the individual objective weights. AHP has been used in a number of fisheries applications to determine management objective importance and assist in decision making [6,17,19,22–26]. AHP is based upon the construction of a series of pairwise comparison matrices which compare sub-objectives to one another. One of the advantages of the pairwise comparison method is it makes the process of assigning weights much easier for participants because only two elements or objectives are being compared at any one time rather than all objectives having to be compared with each other simultaneously.

#### 4.1. Collection of preferences

The most common (and generally recommended) means of eliciting preference structures for AHP studies is to use a nine-point “Intensity of Importance” scale [12,27]. The scale is based on psychological experiments and is designed to allow for, as closely as possible, a reflection of a person’s true feelings in making comparisons between two items whilst minimising any confusions or difficulties involved [12,28].

An interactive survey instrument was designed as an Excel spreadsheet that enabled immediate feedback to participants on the implications of their preferences on objective weights and their level of consistency (an example of part of which is presented in Fig. 2). The feedback enabled participants to re-assess their preferences if problems of inconsistency<sup>4</sup> were apparent or if the resultant

weightings were not as anticipated. The nine-point scale was not explicitly represented, but determined by the degree to which a slider could be moved one way or another.

The spreadsheet was trialled (and modified as necessary) by the SAG, and then applied to a larger and broader advisory group involved with the management review – the Technical Advisory Group (TAG) – that consisted of additional fisheries managers, conservation managers, conservation/environmental NGOs, compliance officers and additional industry representatives. The latter group included fishers (both commercial and recreational representatives), as well as marketing and processing representatives. TAG members were also asked to provide email addresses of potential survey respondents and to also encourage participation of these people in the survey. In addition, local councils in coastal regions were approached as representatives of the broader (general) community to provide an indication as to what they saw as important when revising the management plan for the trawl fishery.

A total of 220 surveys were distributed, mostly by email (i.e., except for those completed in session by the SAG and TAG members) and a response rate of around 50% was achieved (Table 1). Of the responses, several were unusable due to inconsistency problems not being resolved,<sup>5</sup> leaving a usable set of 90 responses.

#### 4.2. Derivation of weights

A matrix of scores can be developed from the individual survey responses for each set of comparisons, given by

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{bmatrix} \quad (1)$$

The scores are normalised by dividing through each element of the matrix by the sum of the column  $j$  (i.e., summed over  $i$ , such that  $\bar{a}_{ij} = a_{ij} / \sum_i a_{ij}$ ), and the weight associated with each objective can be estimated as the average of the normalised scores across the row  $i$ . That is,  $w_i = \sum_j \bar{a}_{ij} / n$ , where  $n$  is the number of objectives being compared.

The pair-wise comparisons and analyses are undertaken at the different levels of the hierarchy. That is, pair-wise comparison and analyses are made between the higher order objectives, and the weight  $w_i^1$  is estimated (the superscript 1 indicating the level of the objective in the hierarchy, in this case the first or highest level of the hierarchy). The analysis within each higher order objective is then undertaken, and initial weights for the lower order objectives estimated. For example,  $\hat{w}_{12}$  is the initial weight of a second order objective compared with other second order objectives within the same higher order objective. The overall weight of the lower order objectives are determined by the product of their initial weight estimate multiplied by the weight of the higher order objective. For example,  $w_i^2 = \hat{w}_{12} w_i^1$ , where  $w_i^2$  is the final weight of a second order objective, while  $w_i^3 = \hat{w}_{13} w_i^2 = \hat{w}_{13} \hat{w}_{12} w_i^1$  is the final weight of a third order objective. This reduces the number of direct comparisons that need to be made, as only objectives at the same level and within the same broader objective need to be compared in the survey.

As can be expected, it may be difficult for decision makers to have a mathematically exact and consistent set of weightings

<sup>3</sup> Fisheries Act 1994; Great Barrier Reef Marine Park Act 1975.

<sup>4</sup> The issue of inconsistency is addressed in further detail below.

<sup>5</sup> The surveys were not anonymous and attempts at resolving the inconsistencies were made with the individuals concerned.

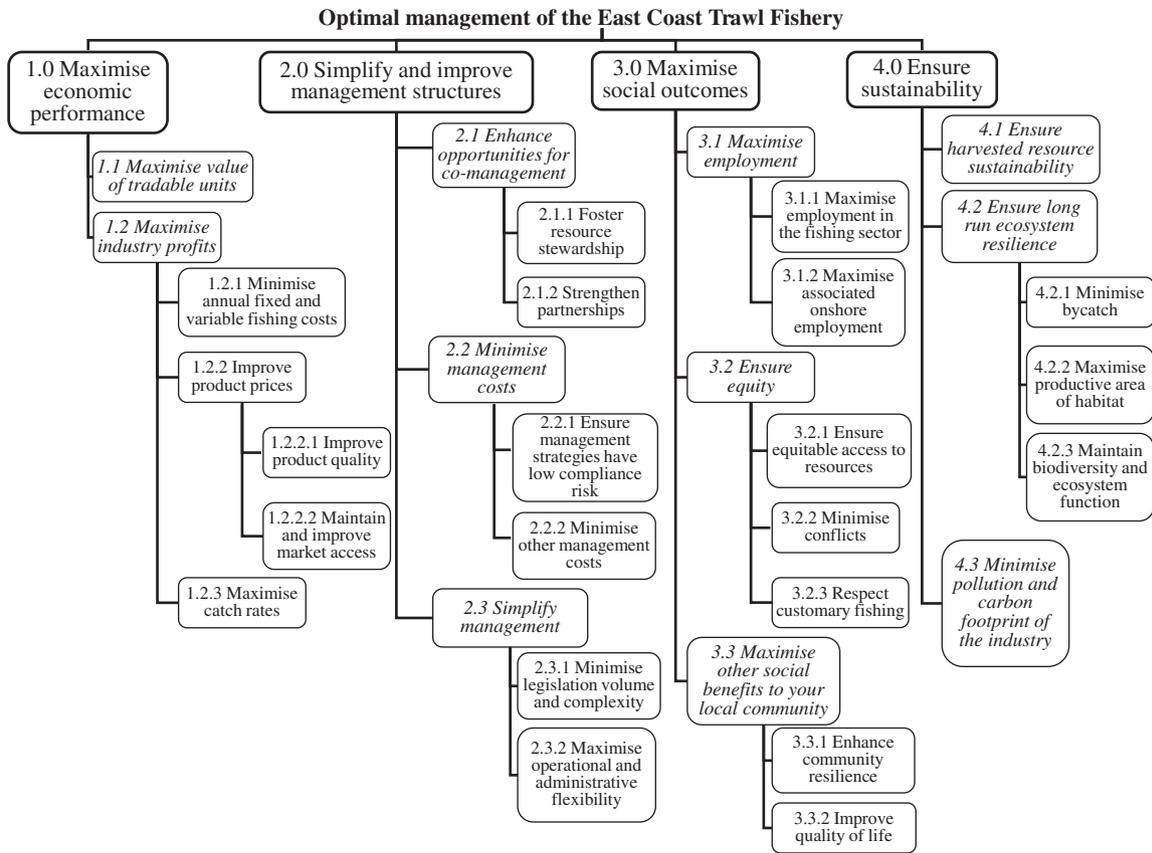


Fig. 1. Objective hierarchy for the Queensland East Coast Trawl fishery.

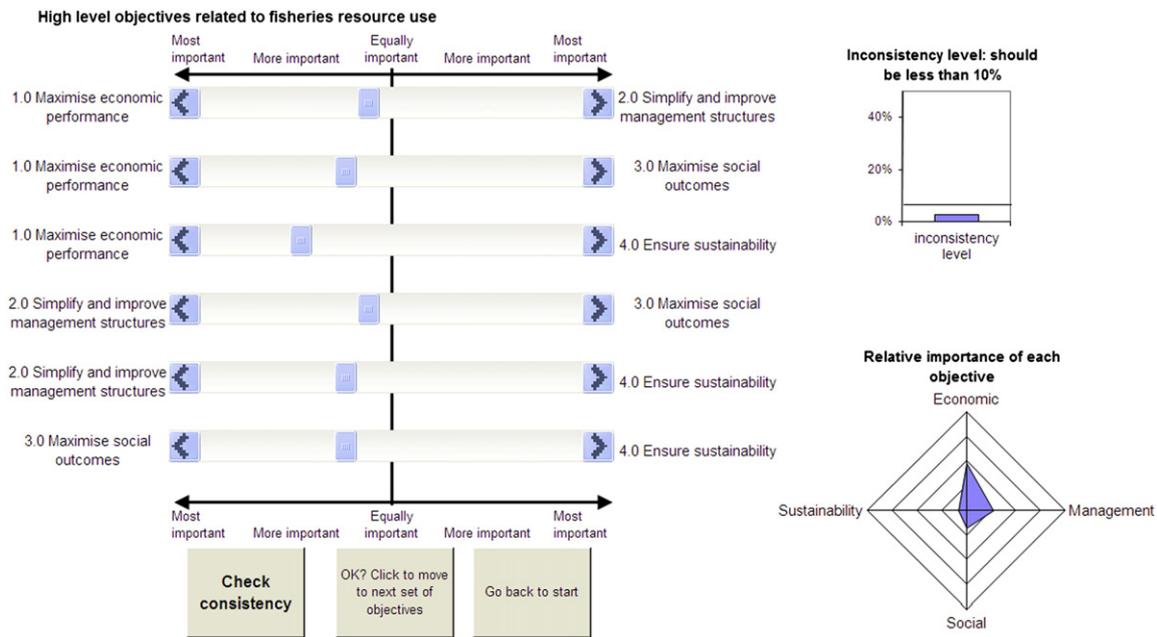


Fig. 2. Example of the survey instrument.

for all of the objectives. For example, if Objective 1 is strongly favoured over Objective 2 and Objectives 2 and 3 are considered the same, then Objective 1 should be strongly favoured

over Objective 3 as well. However, respondents do not necessarily cross check their responses, and even if they do, when many objectives are compared ensuring a perfectly consistent

**Table 1**  
Response rate from the email survey by stakeholder group.

|                      | Sent | Returned |          | Response rate |
|----------------------|------|----------|----------|---------------|
|                      |      | usable   | unusable |               |
| Industry             | 46   | 21       | 2        | 50%           |
| Management           | 33   | 24       | 0        | 73%           |
| Conservation         | 32   | 23       | 0        | 72%           |
| Recreational fishing | 23   | 9        | 0        | 39%           |
| Local communities    | 22   | 9        | 1        | 45%           |
| On-shore industry    | 46   | 4        | 9        | 28%           |
|                      | 202  | 90       | 12       | 50%           |

set of responses is difficult,<sup>6</sup> so some inconsistencies are common.

To check whether or not the weightings have been carefully considered and compared a consistency index (CI) is used, such that

$$CI = \frac{\lambda_{\max} - n}{n - 1} \quad (2)$$

where  $\lambda_{\max}$  is the maximum eigenvalue of the matrix A, given by  $\lambda_{\max} = \sum_i \sum_j a_{ij} w_i$  [29]. This is compared to a randomly generated value for an  $n \times n$  matrix (Random Indicator or RI) to derive a consistency ratio, CR, where  $CR = CI/RI$ . Values of  $CR \leq 0.1$  are generally considered acceptable [12], although higher measures are often accepted in fisheries analyses [22]. In cases where higher values are obtained, respondents are generally asked to review and revise their pair-wise comparison ratings. With the interactive Excel-based survey instrument, respondents were immediately fed back information on their level of consistency and, if the measure was greater than 10%, a message appeared asking them to reconsider their preferences. This resulted in a high return rate of usable preference sets. In some instances (less than half a dozen), respondents returned their survey spreadsheet with one or two groups of objectives with inconsistencies of less than 15% with a message that they could not get the score lower without substantially changing their preferences.<sup>7</sup> These were also accepted as usable as the respondents demonstrated that they at least had tried to reduce the inconsistency. Some survey spreadsheets were also returned with substantially higher inconsistencies and these were not used in the final results (Table 1).

### 4.3. Group coherence

The level of group coherence indicates the degree to which members of a given stakeholder group have similar or dissimilar objective preferences. Zahir [30,31] developed a measure of group coherence for use in AHP studies, given by

$$\bar{\rho} = \langle v_i \bullet v_j \rangle \quad i \neq j \quad (3)$$

where  $v_i$  and  $v_j$  are vectors comprising the square root of the objective weights of individuals  $i$  and  $j$ ;  $\bullet$  indicates the dot product of the two vectors, and  $\langle \rangle$  indicates the average of the set of dot products [30]. The coherence measure,  $\bar{\rho}$ , represents the average angle between the individual vectors ( $\cos \theta = \rho_{ij} = v_i \bullet v_j$  for a pair of individuals), such that  $\cos 0^\circ = 1$  implies identical preferences and  $\cos 90^\circ = 0$  implies orthogonal preferences. Hence,

<sup>6</sup> The discrete nature of the 1–9 scale also contributes to inconsistency, as a perfectly consistent response may require a fractional preference score.

<sup>7</sup> This was generally only a problem when there were four objectives being compared as this involved six pairwise comparisons, and deriving a consistent set of preferences was more difficult than when three or two objectives were compared.

the closer the value is to 1, the greater the average agreement in opinion of the individuals. While this has the appearance of a statistical measure, there is no generally accepted critical value. Some authors have adopted 99%, 95% and 90% as critical measures [23], in line with statistical definitions of significance levels, while others have developed other definitions of strong and weak coherence with wider intervals [22].

In contrast, Zahir [31] defines extreme cases, given Saaty's [12] nine point scale (i.e., 1–9), as those that have individual coherence measures  $\rho_{ij} < (n+4)/(n+8)$ , where  $n$  is the number of objectives being examined. These effectively indicate substantial differences of opinion between individuals within a group. Hence, the proportion of comparisons between individuals that are considered extreme is another indicator of group coherence.

## 5. Analysis and results

### 5.1. Objective weight rankings

Individual's weights for each objective were estimated as above, and group average priorities were calculated (Table 2). Economic objectives were weighted highly by industry groups (both fishers and on-shore) and fishery managers (Fig. 3). Fisheries policy in Queensland has an explicit objective of maximum economic yield [11], following the lead of Australia's Commonwealth harvest strategy policy [32], and this no doubt influences the objective weightings of fishery managers. The preferred mechanism by which economic performance is to be achieved, however, varies between stakeholders. Fishery managers' preference is to reduce costs of fishing, whereas industry prefer higher prices and catch rates.

The objective of simplifying management received fairly strong support from the fishing industry and on-shore industry, both of which are affected by management, but slightly less so from the fishery managers themselves who are responsible for implementing management. The preferences were distributed fairly evenly across the sub-objectives; although the on-shore industry had a stronger preference for ensuring management had a low compliance risk and reducing legislation complexity and volume.

The Queensland fisheries policy explicitly identifies the needs to consider social impacts, although which aspects to consider (other than employment) are less specific. The objectives identified in this study generally received a low weight by most stakeholder groups, the key exception being recreational fishers who align themselves more with social than economic benefits. For most stakeholder groups, the preferences were fairly equally distributed (on average) across the different sub-objectives, although recreational fishers had a strong preference for improving the quality of life.

The ecological sustainability objectives are strongly supported by all groups, and in most cases received the highest weighting on average. Sustainability objectives dominated the preferences of the conservation stakeholders, as might be expected, but also those of the local community (represented by the local councils). This latter result is more surprising as, *a priori*, it might be expected that this group would be more concerned with social objectives, particularly employment and improved quality of life. The result may reflect a community view that protection of the environment, particularly the Great Barrier Reef, is important [33,34], or a general negative attitude towards commercial fishing in Australia [35] in terms of its perceived environmental damage.

Link [36] suggests that an ethic of stewardship permeates society which involves a priority ordering of ensuring human existence; other species existence (e.g., biodiversity); individual stock/population health (sustainability of the exploited resource); persistence of

**Table 2**  
Average management objective weights by stakeholder group expressed as percentages.

| Objective  | Fishing industry |        | On-shore industry |        | Fisheries managers |        | Conservation |        | Recreational fishing |        | Local communities |        |
|--|------------------|--------|-------------------|--------|--------------------|--------|--------------|--------|----------------------|--------|-------------------|--------|
|  | Mean (%)         | CV (%) | Mean (%)          | CV (%) | Mean (%)           | CV (%) | Mean (%)     | CV (%) | Mean (%)             | CV (%) | Mean (%)          | CV (%) |
| <b>1. Maximise economic performance</b>                            | <b>35</b>        |        | <b>34</b>         |        | <b>26</b>          |        | <b>10</b>    |        | <b>10</b>            |        | <b>17</b>         |        |
| Maximise value of tradable units                                   | 13               | 64     | 6                 | 51     | 9                  | 64     | 5            | 58     | 5                    | 70     | 9                 | 95     |
| Minimise annual fixed and variable fishing costs                   | 4                | 67     | 8                 | 138    | 6                  | 119    | 2            | 101    | 2                    | 95     | 3                 | 85     |
| Improve product quality to improve product price                   | 4                | 95     | 5                 | 119    | 3                  | 110    | 1            | 74     | 1                    | 133    | 1                 | 85     |
| Maintain and improve market access to improve price                | 7                | 155    | 6                 | 102    | 2                  | 100    | 1            | 98     | 1                    | 85     | 1                 | 108    |
| Maximise catch rates   | 7                | 72     | 9                 | 155    | 5                  | 109    | 1            | 107    | 1                    | 124    | 2                 | 90     |
| <b>2. Simplify and improve management structures</b>               | <b>20</b>        |        | <b>26</b>         |        | <b>15</b>          |        | <b>13</b>    |        | <b>18</b>            |        | <b>15</b>         |        |
| Foster resource stewardship  | 3                | 122    | 1                 | 76     | 2                  | 76     | 3            | 56     | 4                    | 121    | 2                 | 39     |
| Strengthen partnerships between and within industry and government | 3                | 75     | 2                 | 81     | 2                  | 83     | 2            | 74     | 2                    | 89     | 4                 | 103    |
| Ensure management strategies have low compliance risk              | 3                | 153    | 9                 | 162    | 3                  | 123    | 2            | 64     | 1                    | 114    | 2                 | 71     |
| Minimise other management costs                                    | 3                | 122    | 2                 | 110    | 2                  | 122    | 1            | 184    | 1                    | 105    | 1                 | 95     |
| Minimise legislation volume and complexity                         | 5                | 144    | 7                 | 53     | 4                  | 96     | 3            | 111    | 7                    | 143    | 4                 | 100    |
| Maximise operational and administrative flexibility                | 4                | 85     | 6                 | 109    | 3                  | 72     | 2            | 58     | 2                    | 82     | 3                 | 82     |
| <b>3. Maximise social outcomes</b>                                 | <b>13</b>        |        | <b>9</b>          |        | <b>14</b>          |        | <b>16</b>    |        | <b>28</b>            |        | <b>18</b>         |        |
| Maximise employment in the fishing sector                          | 2                | 79     | 1                 | 61     | 3                  | 81     | 2            | 114    | 2                    | 95     | 2                 | 97     |
| Maximise associated onshore employment                             | 1                | 77     | 2                 | 73     | 2                  | 67     | 2            | 95     | 2                    | 101    | 2                 | 79     |
| Ensure equitable access to the resource                            | 3                | 76     | 2                 | 66     | 2                  | 63     | 2            | 71     | 3                    | 76     | 2                 | 66     |
| Minimise conflicts with competing users                            | 2                | 112    | 1                 | 44     | 1                  | 77     | 2            | 92     | 4                    | 68     | 2                 | 46     |
| Respect customary fishing  | 1                | 82     | 2                 | 162    | 1                  | 77     | 2            | 71     | 2                    | 97     | 1                 | 56     |
| Enhance community resilience                                       | 2                | 109    | 1                 | 120    | 3                  | 88     | 3            | 88     | 6                    | 63     | 5                 | 78     |
| Improve quality of life in coastal communities                     | 2                | 79     | 1                 | 86     | 1                  | 75     | 3            | 103    | 10                   | 49     | 3                 | 128    |
| <b>4. Ensure sustainability</b>                                    | <b>32</b>        |        | <b>31</b>         |        | <b>45</b>          |        | <b>61</b>    |        | <b>44</b>            |        | <b>51</b>         |        |
| Ensure harvested resource sustainability                           | 16               | 72     | 14                | 41     | 19                 | 43     | 13           | 67     | 23                   | 84     | 12                | 72     |
| Minimise bycatch   | 3                | 88     | 2                 | 111    | 7                  | 86     | 11           | 55     | 5                    | 93     | 7                 | 80     |
| Maximise productive area of habitat                                | 4                | 61     | 5                 | 40     | 5                  | 113    | 5            | 88     | 1                    | 91     | 4                 | 82     |
| Minimise impacts of fishing on biodiversity and ecosystem function | 3                | 63     | 2                 | 119    | 8                  | 104    | 20           | 52     | 4                    | 71     | 13                | 100    |
| Minimise pollution and carbon footprint of the industry            | 6                | 60     | 8                 | 99     | 8                  | 55     | 12           | 74     | 11                   | 117    | 15                | 64     |

Note: CV is coefficient of variation.

particular human cultures (i.e., cultural values); equity across individuals (i.e., fairness in competition); and, finally, profits of individuals as the lowest priority. This ranking is generally consistent with those groups who do not have a direct financial association (e.g., onshore and offshore industries) or policy mandate (e.g., fishery managers) involving the use of the resource.

## 5.2. Group coherence

The average coherence of the groups and the proportion of extreme comparisons are given in Table 3. As with the previous study of Commonwealth fisheries [6], average coherence of the groups was generally higher when considering only the higher order objectives compared to considering the lower level objectives. For the higher order objectives, no extreme cases were observed for any of the stakeholder groups, while all groups had at least some extreme differences in preference structures at the lower order objective level and in most cases a high proportion of stakeholder group members were in disagreement about the relative importance of the detailed objectives. This suggests that the groups are relatively in agreement when considering the relative importance of broader issues related to economic performance, simplifying management, social outcomes and sustainability issues, but less in agreement with regard to the more detailed sub-categories (e.g., “ensuring equitable access to the resource” compared with “minimising conflicts” under the broader social objective).

Although the lower level of consistency is often seen as a problem when assessing “average” objective weightings, this was less of a problem in this case as individual weightings were used

when assessing management options. Variability in objective preferences also allowed an assessment of the degree of variability in preference for one option over another. Details of this further analysis are provided by Dichmont et al. [14].

## 6. Discussion and conclusions

Although undertaken as a separate exercise with a completely different set of stakeholders and also a very different fishery management, economic and political environment, the results of the study were largely consistent with those undertaken at the Australian Commonwealth fisheries level in the previous study [6]. While the detailed sub-objectives varied between the two studies, there was general agreement in the relative importance of the economic and sustainability/environment objectives between fishers and fishery managers at both the Queensland State and Federal level. This suggests that, at least for these two levels of fisheries management, industry and fisheries managers are largely pursuing similar objectives with similar importance weightings when developing management strategies. This finding, in part, reflects the largely commercial nature of Australia's fisheries (excepting the recreational fishing sector).

The State level analysis explicitly included social objectives, although some of the lower level social objectives were present in the Commonwealth objective set as sub-objectives of maximising economic benefits (e.g., the employment objectives) or minimising externality (e.g., minimising conflicts). The State policy explicitly includes social considerations in the fisheries legislation, whereas the Federal policy includes only economic and

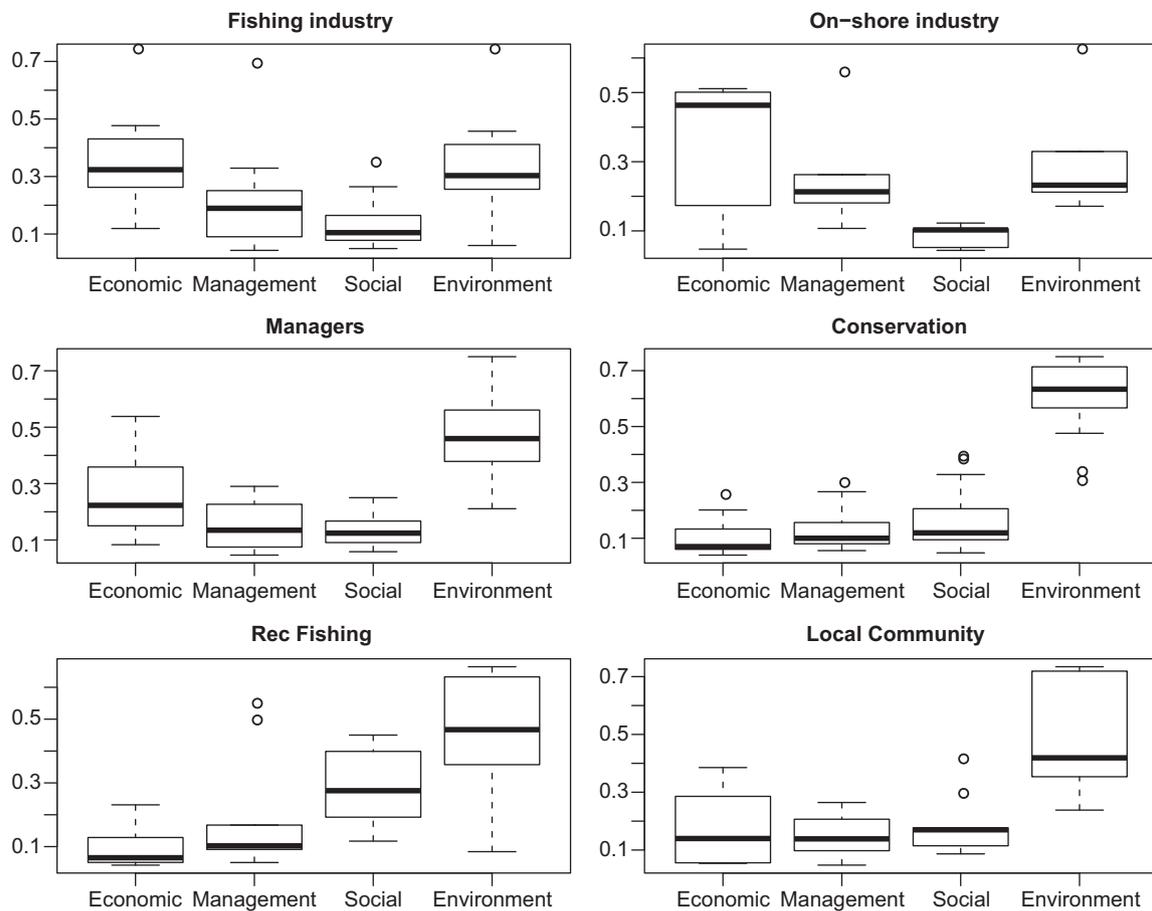


Fig. 3. Distribution of weightings for higher level objectives by stakeholder group.

**Table 3**  
Average group coherence and proportion of “extreme” cases.

| Stakeholder group    | Average coherence       |                        | Extreme cases (%)       |                        |
|----------------------|-------------------------|------------------------|-------------------------|------------------------|
|                      | Higher order objectives | Lower order objectives | Higher order objectives | Lower order objectives |
| Fishing industry     | 0.94                    | 0.83                   | 0                       | 59                     |
| On-shore industry    | 0.95                    | 0.85                   | 0                       | 57                     |
| Fisheries Managers   | 0.96                    | 0.88                   | 0                       | 34                     |
| Conservation         | 0.91                    | 0.82                   | 0                       | 73                     |
| Recreational fishers | 0.93                    | 0.84                   | 0                       | 58                     |
| Local community      | 0.90                    | 0.76                   | 0                       | 100                    |

sustainability objectives. Despite being explicit in the policy, social objectives were generally given a low importance, even by managers. Similarly, the industry (both on-shore and offshore) raised many concerns about the need to consider social impacts of management change during the consultation period, but also give these objectives the lowest weighting. Their ex-post justification for this (after the results had been presented to the TAG, SAG and at workshops involving additional industry members) was that getting the economics and the environment right would result in a beneficial social outcome (i.e., higher incomes, better employment conditions etc).

On average, the preferences of the stakeholder groups included in the study reflected what might be expected: industry were most concerned with maximising industry profits and the value of their assets, while conservation stakeholders were most concerned with

ensuring ecological sustainability of fisheries. The strongest weighting given to any high level objective was by the conservation stakeholders, who were most concerned with protecting the environment. This group included marine park managers, and the result is not surprising given their mandate under the *Great Barrier Reef Marine Park Act 1975*, which clearly identifies long term protection of the environment as the primary objective, and supports other objectives (e.g., ecologically sustainable use) only in so far as they are consistent with protecting the environment.

Variation in individual preferences within stakeholder groups is to be expected, and the levels of group coherence are similar to other studies in fisheries [6,22,23]. Greater coherence is achieved at the broader objective level than at the detailed sub-objective level as might also be expected. Fisheries managers had the highest degree of consistency, which is less surprising as they work in a common environment and within a firm legislative and policy framework. While these frameworks do not explicitly identify the relative importance of the objectives (and are also often vague about the objectives themselves), a corporate culture has developed that has implicitly weighted these objectives. Conversely, local councils had the lowest level of coherency. These are geographically disparate groups, with fisheries activities having differing levels of economic and social importance within their council boundaries. Councils also tend to see fisheries in a more multiple use context. For example, fisheries contribute only a very small proportion of the economic activity within the Brisbane City Council area, but a more significant role in the regional economies in central and northern Queensland.

The use of an Excel-based interactive survey instrument had both advantages and disadvantages. The key advantage was that respondents were able to obtain immediate feedback about the

implication of their choices on the relative importance of the objectives, and also a measure of their consistency. The returned spreadsheet also had the set of objective weights calculated, and these could be easily imported into other programs for analysis. There were several disadvantages also. Foremost of these was that a number of potential respondents were unable to either use or, in some cases, access Excel so were unable to complete the survey.<sup>8</sup> There were also some suspicions when a message about activating macros made some respondents think the file had viruses. Some others felt that the consistency index was trying to force them into some pre-defined (conspired) response, and therefore did not believe that the survey was truly trying to capture the preference structures of the individuals. These two problems were particularly prevalent for the industry members (both onshore and offshore).

The objective of this study was to examine the differences in management objective preferences between different stakeholder groups active in shaping Queensland fisheries management, and in particular the management of the East Coast Trawl Fishery. These objectives were used as a guide to both the development and analysis of a range of management governance structures [14]. The weighted objectives gave individuals within the SAG and TAG – who were responsible for developing these systems – an explicit framework around which they could understand what they were trying to achieve as well as an appreciation as to the importance of delivering (or attempting to deliver) certain outcomes to different stakeholder groups. By putting the horse before the cart, the groups were able to consider radically different management structures to what they currently had, and identify the key strengths and weaknesses in each.

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## Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.marpol.2012.02.016](https://doi.org/10.1016/j.marpol.2012.02.016).

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<sup>8</sup> This feedback was given during follow-ups of non-respondents.