Abstract

There is a well-established scientific field – decision science - that can be used to rigorously set conservation priorities. Despite their well-documented shortcomings, additive scoring approaches to conservation prioritization are still prevalent. This paper discusses the shortcomings and advantages of both approaches applied in Fiji to identify priorities for terrestrial protected areas. The two main shortcomings of using a scoring approach (discussed in Keppel et al 2014) that are resolved with decision science approaches (presented in Klein et al 2014) in Fiji were: 1) priorities did not achieve one of the most important stated conservation goals of representing ~40% of Fiji's major vegetation types; and 2) the weighting of different selection criteria used was arbitrary. Both approaches considered expert knowledge and land-sea connections important to decision makers in Fiji, but only decision science can logically consider both, in addition to other important considerations. Thus, decision makers are urged to use decision science and avoid additive scoring systems when prioritizing places for conservation. Fiji has the opportunity to be a global leader in using decision science to support integrated land-sea planning decisions.

Keywords

Decision science, expert knowledge, Fiji, integrated land-sea planning, prioritization, protected area, representation

Highlights

- Prioritization approaches in the decision science field that can incorporate expert knowledge
- Planners should use decision science, not scoring systems, in conservation prioritization
- Fiji is one of few countries striving towards integrated land-sea planning

1.1 Response to Keppel (2014)

The use of expert knowledge is critical in conservation planning, especially in places with limited spatial information. Keppel [1] praises the performance of a particular terrestrial protected area network proposal developed by Fiji's Protected Area Committee (FPAC) that used expert knowledge. Using an approach where conservation values are simply added together (an additive scoring system approach), FPAC used expert knowledge to help identify places with high species endemism, among other criteria, for which no spatial data were available.

Expert knowledge is critical in conservation planning [2], but decision makers are urged to use decision science and avoid additive scoring systems when prioritizing places for conservation. There are many prioritization approaches in the decision science field that can incorporate expert knowledge without adding scores, and Klein et al. [1] features one such approach applied to protected area planning in Fiji.

There is a well-established scientific field – decision science - that can be used to rigorously set conservation priorities. The approach is well-established in economics and applied mathematics [3] and used for rigorous decision support in almost all quantitative problem-solving, including fields like health and defense. The field of decision science has provided information and tools to ensure that prioritisations deliver objective, defensible, and ultimately efficient conservation decisions. Game et al. [3] identified five weaknesses of conservation prioritization approaches that do not use decision science. Here, we discuss two of the weaknesses in the FPAC approach for identifying priorities. Further, we demonstrate how the priority setting approach used in Klein et al. [1] avoids making these short-comings.

1.1 Scoring System Weakness 1

The first common weakness of the FPAC approach to identifying priority sites is that resulting priorities did not achieve one of the most important stated conservation goals. The Fiji Department of Forestry has set a policy target to increase the protected area estate to cover 40% of all extant natural forest [4], which is equivalent to approximately 20% of Fiji's land area. Two associated ecological goals are consistently discussed, including (1) comprehensively representation of Fiji's major vegetation types; and (2) protection of endemic, threatened, and culturally important species [4–6].

In the FPAC priority places, the extent of five (out of seven) major vegetation types (Fig 3 Klein et al. [1]: Dry Forest, Karst Forest, Lowland Rainforest, Mangoves, Wetlands) had less than 40% represented in a protected area, and three of these had less than 10% of their extent represented in a priority area. Keppel (2014) makes the case that the FPAC scoring approach is advantageous as it resulted in areas with high endemism. Although this is true, it neglected other key goals (e.g., representation of vegetation types) and did so using an arbitrary approach (see weakness 2). As an aside, the flaws of the goal to prioritise areas of high endemic species richness are well documented in the literature (citation on hotspots critique), as it does not consider the core principle of complementarity (i.e., the extent to which an area contributes unrepresented species/habitats to other areas, such as current protected areas) [7,8].

In contrast, the approach used by Klein et al. [1] used decision science to represent 40% of all major vegetation types on each of Fiji's main islands for which there are available data, and hence is consistent with policy goals. Further, Klein et al. [1] used the same expert knowledge on species endemism as that considered by the FPAC from Olson et al. (2010) to bias the selection of priority areas towards forests known to contain endemic species.

1.2 Scoring System Weakness 2

The second common weakness of the FPAC approach to identifying priority sites is that the weighting of different selection criteria used was arbitrary [9]. Using a scoring system, the FPAC ranked 40 different forest areas across Fiji based on nine criteria: endemic biodiversity richness, number (as opposed to extent) of vegetation types, economic importance, size, degradation, scarcity/replicability, conservation practicality, cultural importance, and relative intactness of connectivity between terrestrial and marine areas (based on Jenkins et al. [10]). As shown in Klein et al. [1; Table S1], each area was assigned a score based on each criteria, which were weighted and combined: constructed ordinal scales were created for each criteria (e.g., for degradation, 1- High; 2- Medium; 3- Low) and treated as a set of regular numbers in prioritization arithmetic (e.g. adding and multiplying 9 variables together). This is mathematically incorrect, and as mentioned in *weakness 1,* will not ensure that the objectives are achieved. If the output of a scoring system performs well on any metric, as indicated in Keppel (2014), it is likely only due so by chance [11], and a randomly selected set of priority areas could perform just as well, or better. In contrast, the approach used by Klein et al. [1] is mathematically correct and uses a well documented, transparent, and commonly used approach to identify priority places for protection [12].

1.3 Informing protected area design in Fiji

The work presented in Klein et al. [1] was not just an academic exercise: it was done to support decisions made by FPAC to improve on the location of proposed terrestrial protected areas so that they would better achieve terrestrial conservation targets as well as provide benefits to downstream coral reef ecosystems. Co-author S. Jupiter is on the FPAC and communicated the preliminary results of protected area network scenario assessments to the terrestrial working group. The FPAC understood the shortcomings of the scoring approach with respect to adequate representation of vegetation types and were interested in seeing alternative options designed using decision support science. Thus, Klein et al. [1] provided some recommendations of which forests could be added to the proposed network by running additional scenarios in Marxan to identify places which would be optimal to achieve both terrestrial targets for vegetation types and benefit downstream systems. In doing so, Klein et al. [1] deliberately biased the selection in Marxan to areas within the priority forests selected by Olson et al. [5] in recognition of the enormous body of expert knowledge and data that went in to selecting those areas.

As an outcome, the FPAC added additional priority forests to to a register (map) of sites that the National Environment Council endorsed in October 2013. It is the hope of the FPAC that when additional funding is made available to Fiji for forest conservation, it will be first directed to sites at the top of this list. In making these changes, the FPAC demonstrated its commitment to approaches that consider the benefits of protecting land not only for terrestrial biodiversity, but for marine biodiversity. Fiji is a global leader as it is one of few countries striving towards integrated land-sea planning recognizing the influence land-based activities have on marine ecosystems [13].

Although Klein et al. [1]'s approach did consider expert knowledge, it acknowledges that decision support tools are only as good as their data inputs and thus cannot consider all important aspects of protected area design in relatively data-poor countries such as Fiji, as discussed in Keppel (2014). Keppel et al (2014) provides important information on the range of matters than need to be considered and that vegetation types are one of a number of important factors that should be considered, but there are more or less logical ways to combine that information into a set of rational priorities. As with any other protected area design processes, some important aspects of protected area planning must be considered outside of, or in other, decision support tools. Decision support software was always meant to support, not make, final decisions [14].

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