Conservation Biology

Contributed Paper

Applying a values-based decision process to facilitate comanagement of threatened species in Aotearoa New Zealand

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Abstract: Ko koe ki tēnā, ko ahau ki tēnai kīwai o te kete (you at that, and I at this handle of the basket). This Māori (New Zealanders of indigenous descent) saying conveys the principle of cooperation—we achieve more through working together, rather than separately. Despite decades of calls to rectify cultural imbalance in conservation, threatened species management still relies overwhelmingly on ideas from Western science and on top-down implementation. Values-based approaches to decision making can be used to integrate indigenous peoples' values into species conservation in a more meaningful way. We used such a values-based method, structured decision making, to develop comanagement of pekapeka (*Mystacina tuberculata*) (short-tailed bat) and tara iti (*Sternula nereis davisae*) (Fairy Tern) between Māori and Pākehā (New Zealanders of European descent). We implemented this framework in a series of workshops in which facilitated discussions were used to gather expert knowledge to predict outcomes and make management recommendations. For both species, stakeholders clearly stated their values as fundamental objectives from the start, which allowed alternative strategies to be devised that naturally addressed their diverse values, including mātauranga Māori (Māori knowledge and perspectives). On this shared basis, all partners willingly engaged in the process, and decisions were largely agreed to by all. Most expectations of conflicts between values of Western science and Māori culture were unfounded. Where required, positive compromises were made by jointly developing alternative strategies. The values-based process successfully taha wairua taha tangata (brought both worlds together to achieve the objective) through codeveloped recovery strategies. This approach challenges the traditional model of scientists first preparing management plans focused on biological objectives, then consulting indigenous groups for approval. We recommend values-based approaches, such as structured decision making, as powerful methods for development of comanagement conservation plans between different peoples.

Keywords: conservation planning, endangered species, inclusivity, indigenous values, mātauranga Māori, species recovery, structured decision making

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***Article impact statement**: Values-based approaches like structured decision making successfully enable participation and inclusive conservation practice.*
Paper submitted April 30, 2020; revised manuscript accepted October 4, 2020.

Conservation Biology, Volume 0, No. 0, 1–12

DOI: 10.1111/cobi.13651

Aplicación de un Proceso de Decisiones Basadas en Valores para Facilitar el Comanejo de Especies Amenazadas en Aotearoa Nueva Zelanda

Resumen: *Ko koe ki tēnā, ko ahau ki tēnai kīwai o te kete* (tú en ésa y yo en esta asa de la cesta). Este dicho Māori (neozelandeses con ascendencia indígena) expresa el principio de la cooperación - logramos más trabajando juntos que por separado. A pesar de las décadas de peticiones para rectificar el desbalance ambiental que existe en la conservación, el manejo de especies amenazadas todavía depende abrumadoramente de ideas tomadas de la ciencia occidental y en la implementación de arriba-abajo. Los enfoques para la toma de decisiones basados en valores pueden usarse para integrar de manera más significativa los valores de los pueblos indígenas dentro de la conservación de especies. Usamos un método basado en valores, la toma estructurada de decisiones, para desarrollar una estrategia de comanejo del *pekapeka* (*Mystacina tuberculata*) (murciélago de cola corta) y el *tara iti* (*Sternula nereis davisae*) (charrancito australiano) entre los Māori y los Pākehā (neozelandeses de ascendencia europea). Implementamos este marco de trabajo en una serie de talleres en los cuales se usaron discusiones facilitadas para recabar el conocimiento de los expertos para pronosticar los resultados y realizar recomendaciones de manejo. Para ambas especies, los actores sociales mencionaron claramente a sus valores como objetivos fundamentales desde el inicio, lo que permitió el diseño de estrategias alternativas que consideraran naturalmente estos diferentes valores, incluyendo el *mātauranga Māori* (conocimiento y perspectivas Māori). Sobre esta base compartida, todos los colaboradores participaron voluntariamente en el proceso y la mayoría estuvo de acuerdo con las decisiones. La mayoría de los conflictos esperados entre la ciencia occidental y la cultura Māori no tuvieron fundamentos. En donde fueron requeridos, se realizaron concesiones positivas mediante el desarrollo conjunto de estrategias alternativas. El proceso basado en valores logró exitosamente *taha wairua taha tangata* (juntó a ambos mundos para conseguir el objetivo) por medio de estrategias de recuperación desarrolladas en conjunto. Esta estrategia desafía el modelo tradicional de los científicos preparando primero los planes de manejo enfocados en objetivos biológicos para después consultar a los grupos indígenas para que los aprueben. Recomendamos estos enfoques basados en valores, como la toma estructurada de decisiones, como métodos poderosos para el desarrollo de planes de conservación que incluyan el comanejo entre diferentes pueblos y personas.

Palabras Clave: especie en peligro, inclusión, mātauranga Māori, planeación de la conservación, recuperación, toma estructurada de decisiones, valores indígenas

摘要: *Ko koe ki tēnā, ko ahau ki tēnai kīwai o te kete*(你提篮子的一个把手, 我提另一个把手)。这句毛利人(新西兰原住民)的谚语传达了合作的原则——通过共同努力而不是各自为先来实现更高的目标。尽管几十年来人们都在呼吁纠正保护中的文化不平衡, 但濒危物种管理仍然主要依赖于西方科学理念和自上而下的管理措施。应用基于价值观的决策方法可以通过更有意义的方式将原住民的价值观纳入物种保护之中。本研究采用基于价值观的结构化决策方法, 设计了毛利人与欧洲裔的新西兰人对短尾蝠(*Mystacina tuberculata*)和眼斑燕鸥(*Sternula nereis davisae*)的共同管理。我们在一系列研讨会中实施了这一框架, 并在这些研讨会中利用促进协商讨论来收集专家知识, 以预测结果和提出管理建议。对这两个物种来说, 利益相关者可以从一开始就清楚地根据其价值观提出基本目标, 这样有助于制定替代策略来自然地处理不同的价值观, 包括毛利文化和观点。以共享为基础使所有合作者都愿意参与这个过程, 且所有决策基本都得到了同意。大多数关于西方科学与毛利文化价值观之间存在冲突的假想都是没有根据的。双方在必要时通过共同制定替代策略来做出了积极和解。这个基于价值观的过程成功地将两个世界结合在一起, 通过共同制定物种恢复战略来实现目标。这一方法挑战了科学家首先准备好生物目标的管理计划, 然后再与原住民群体商议以获得批准的传统模式。我们推荐基于价值观的方法, 如结构化决策, 作为不同民族之间制定管理保护计划的有效方法。**【翻译:胡怡思;审校:聂永刚】**

关键词: 保护规划, 濒危物种, 包容性, 本土价值观, 毛利文化, 物种恢复, 结构化决策

Introduction

Historically, conservation actions have been overwhelmingly inspired by biological insights and implemented top-down. Despite over 2 decades of calls for more equal and inclusive conservation, where agencies work with communities and indigenous groups (United Nations 1992; Wright et al. 1995; Tallis & Lubchenco 2014; Lyver et al. 2018), inclusivity remains the exception (Mascia et al. 2003; Gregory 2016). Many indigenous groups feel marginalized by, or will not engage in, processes that do not recognize and account for their values significantly (Gregory 2016; Wheeler et al. 2020). Changing ingrained practices requires deep engagement between partners and interdisciplinary facilitation methods (Brown 2003; Bennett et al. 2017), but practical examples of how to achieve such a change remain scarce.

Most Western conservationists are trained as biologists and so focus on understanding and mitigating population declines (Fox et al. 2006). Therefore, biology dominates the drive for evidence-based conservation, based on use of systematically collected data to choose management (Sutherland et al. 2004). Evidence-based conservation is a much-needed improvement of current practice, but it

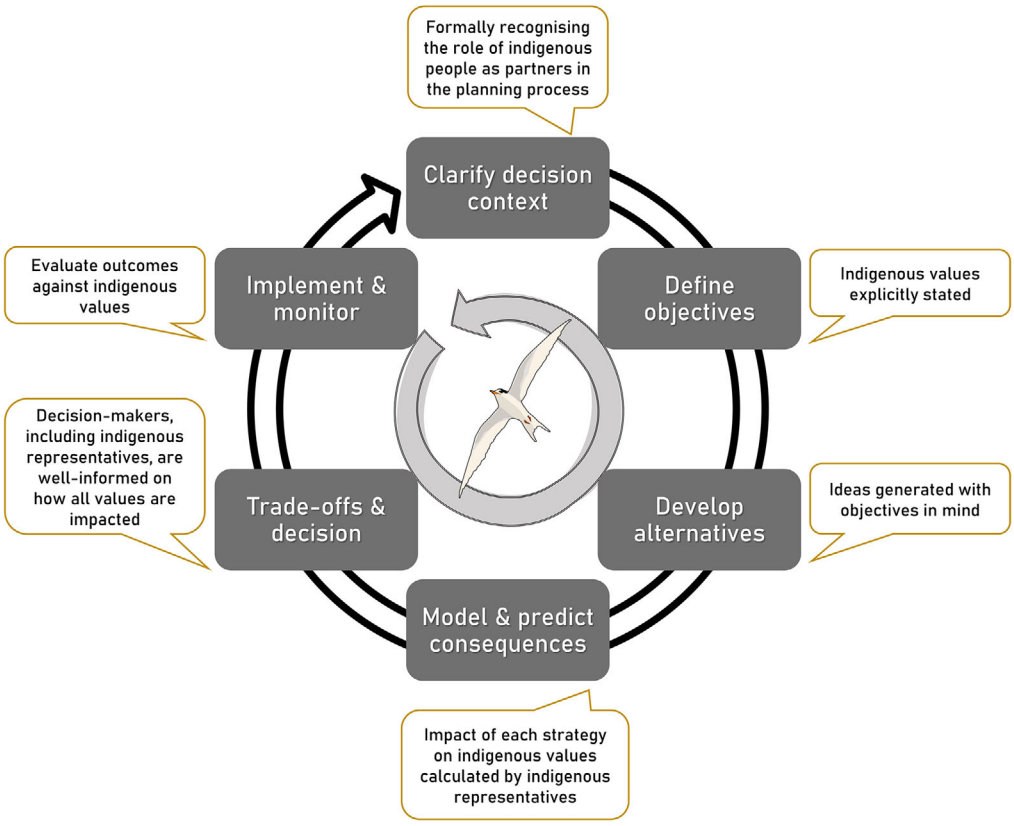

Figure 1. The decision-making cycle (adapted from Gregory et al. [2012a]) (counter clockwise arrow, steps may be reiterated if required; bubbles, interpretation of integration of indigenous values relative to Māori as an example, transferable to any indigenous group as that group culture demands). Illustration by J. Wold.

does not need to clash with inclusivity. Exclusive focus on biological evidence fails to acknowledge the complexity of decision making, particularly the diverse values involved (Evans et al. 2017; Toomey et al. 2017), making assumptions about what those values are or explicitly excluding them (Gregory et al. 2012*a*). Furthermore, evidence-based conservation itself is not objective because it is embedded in Western science beliefs about how to correctly interact with the environment (Giles et al. 2016; Salomon et al. 2018).

Because conservation is never value neutral, evidence can only play a support role, albeit a crucial one (Brown 2003; Gregory et al. 2012*b*; Peterson et al. 2013; Evans et al. 2017). Conservationists must first understand that the objectives of recovery plans reflect values, including, but not limited to, ecological values of nature. Then, they can gather the right information about all objectives, including scientific evidence, to generate long-term solutions that are widely accepted (Gregory et al. 2012*a*). The centrality of objectives is recognized by many decision-making approaches (Schwartz et al. 2018). Among those, structured decision making (SDM) is a framework that originates from decision theory and risk analysis (Gregory et al. 2012*a*). Structured decision making is an iterative process with 6 steps: set the decision context; clearly define objectives; develop possible management alternatives; predict performances of alternatives against the objectives; find the best decision across objectives; and monitor to track outcomes (Fig. 1) (Gregory et al. 2012*b*). Because SDM acknowledges that values (objectives) are the main driver of decisions (Keeney 1996), it is ideal for diverse stakeholder groups. Planners have used SDM in many environmental decisions, from controlling invasive willow in Australia (Moore & Runge 2012) to improving resilience of tidal marshes to climate change (Thorne et al. 2015).

Structured decision making offers opportunities to legitimately integrate indigenous values into conservation decisions. It emphasizes transparency and inclusion of multiple partners, allowing for shared solutions and their implementation (Bennett et al. 2019). Crucially, values are meaningfully described and integrated into each step of a decision (Fig. 1). Structured decision making has been used in this way to conserve boreal woodland caribou (*Rangifer tarandus caribou*) in western Canada (Hayek et al. 2016), to control non-native fish below Glen Canyon Dam in Arizona (U.S.A.), (Runge et al. 2011) and to devise water-use plans in British Columbia (Canada) (Gregory et al. 2008). In these examples, SDM successfully increased process transparency, participation, and

shared solutions. However, published examples beyond the United States and Canada are scarce (but see Arvai & Post [2012]).

Structured decision making could be particularly useful in a country like Aotearoa New Zealand, where there is a strong desire to rectify a history of cultural bias in environmental management (Wright et al. 1995; Department of Conservation 2000). Te Tiritiri o Waitangi (The Treaty of Waitangi, 1840) is an agreement between representatives of Māori (the indigenous people of Aotearoa New Zealand) and the British Crown. Its second article and its subsequent interpretation in the Conservation Act (New Zealand Government 1975) and Resource Management Act (New Zealand Government 1991) mandate that decision making considers both *mātauranga Māori* (Māori knowledge, perspective, and culture) and Pākehā (New Zealander of European descent) values. This has led to some positive steps. For example, *iwi* (tribe) management plans support valid influence of iwi on planning processes (Thompson-Fawcett et al. 2017), yet consideration of mātauranga Māori remains largely unfulfilled and invisible in conservation practice (McAllister et al. 2019; Wehi et al. 2019; Rayne et al. 2020). For example, in our experience, partners, such as iwi, are commonly asked to endorse proposals only after they have been developed.

We examined how SDM provides a way forward from current problematic practice to provide a tool for developing comanagement of threatened species' recovery plans, integrating mātauranga Māori and promoting *ako* (teaching and learning through knowledge exchange) through open and transparent definition and assessment of management objectives, alternatives, and trade-offs. We use the term *comanagement* to mean meaningful "partnerships between Māori and Crown agencies in the management of biodiversity, consistent with the principles of the Treaty of Waitangi," as defined by the Aotearoa New Zealand government's Department of Conservation (DOC) (Department of Conservation 2000). We applied SDM to 2 *taonga* (culturally valuable) species' recovery programs.

Methods

Case Studies in Recovery Planning for Taonga Species

The *pekapeka* (*Mystacina tuberculata*) (short-tailed bat) is endemic to Aotearoa New Zealand and comprises 3 subspecies (northern, central, and southern) (Lloyd 2003). Translocations have been suggested as a potential recovery strategy but have been unsuccessful to date. A first attempt failed when all translocated pekapeka left the release site within minutes. A second attempt was aborted after translocated bats developed an unidentified infectious disease (Gartrell 2007). No further translocations have been attempted. In 2014, DOC chose to use SDM to plan a translocation of the northern pekapeka subspecies from their only remnant population on *Te Hauturu-o-Toi* (Little Barrier Island) in the *rohe* (territory) of the iwi Ngāti Manuhiri.

The *tara iti* (*Sternula nereis davisae*) (New Zealand Fairy Tern) is Aotearoa New Zealand's rarest indigenous breeding bird, breeding at only a few beaches across the rohe of iwi Te Uri o Hau, Ngāti Whātua o Kaipara, and Ngāti Manuhiri in the Auckland and Northland regions. Despite intensive management with close community involvement, in 2020, fewer than 12 tara iti breeding pairs remain. In 2017, an internal review reported a communication breakdown between DOC and the wider community involved in tara iti recovery, including iwi partners. Although many partners' thoughts were recorded, all field management recommendations in the report came from the 4 scientist authors and focused on a single biological value (tara iti population recovery). Recognizing these problems, and after the successful pekapeka process, DOC suggested using SDM to restart tara iti recovery planning and implementation.

Preparing for Structured Decision Making

We applied the same SDM process for both examples unless otherwise stated. To select participants, we consulted DOC on known stakeholders engaged with or affected by pekapeka and tara iti conservation, including DOC managers, scientists, and field staff, iwi who were *kaitiaki* (guardians) to the pekapeka and tara iti populations involved, community volunteer groups, trusts, landowners, and researchers, and asked them all to send a representative to workshops ($n = 16$ people for pekapeka; $n = 37$ people for tara iti). Participants committed to working together to seek a feasible solution (Gregory et al. 2012*a*). Meetings were held in nonacademic spaces, such as *marae* (Māori meeting houses or complexes), iwi offices, and a sports complex (except for 2 rounds of expert elicitation run at a local DOC office). Ground rules were in place to ensure all voices were heard. Our first step was to develop a shared description of the decision context, identifying scale, scope, and roles in the process.

Elicitation of Values and Alternatives

To identify fundamental objectives, we started by asking participants individually about their values in the decision context (Appendix S1). Anonymous responses were collected by the facilitators, then summarized and shared with the group. Participants then worked in small subgroups to refine and structure their objectives, isolating those objectives that were fundamentally important (Gregory et al. 2012*a*). Subgroups edited these into concise statements describing the objective and desired direction of change and developed ideas of how the

Table 1. Fundamental objectives and their performance measures as defined by the stakeholders involved in pekapeka translocation planning from Te Hauturu-o-Toi and tara iti recovery planning and data sources and analyses used to predict consequences for each objective.

Objective	*Performance measure*	*Data source and analysis*
Pekapeka translocation planning		
increase persistence of the translocated subspecies	probability of extinction in 50 years	Probabilities derived from an age-structured population model (Dennis 2019) based on expert elicited vital rate parameter estimates.
reduce impact on the source bat population	probability of extinction in 50 years	Elicitation followed a modified Delphi approach as recommended by Hemming et al. (2018).
minimize cost of translocation	total cost of translocation (NZ$)	Costs were obtained from experts with prior experience with different components of bat monitoring and translocation.
enhance mātauranga Māori (Māori knowledge and perspectives)	subjective scale (from bad to much better)	Assessment of alternatives with regard to mātauranga Māori was carried out by iwi (Māori tribe) experts representing Ngāti Manuhiri.
increase advocacy for species	number of visitors to site per year	Participant knowledge and internet searches of visitor numbers to proposed sites in the 12 months before the workshop.
Tara iti recovery planning		
increase viability of wild tara iti population	probability of extinction in 50 years (extinction defined as number of adult females is ≤ 2) population size of tara Iti in wild	Probabilities and population sizes derived from an age-structured population model developed by T.M.H. using expert-elicited vital-rate parameter estimates. Elicitation followed a modified Delphi approach as recommended by Hemming et al. (2018).
integrate mātauranga Māori	How well incorporated, and therefore how acceptable (not acceptable, acceptable if certain actions removed [partly acceptable], acceptable)	Assessment of alternatives with regard to mātauranga Māori as interpreted by iwi experts representing Te Uri o Hau, Ngāti Whātua o Kaipara, and Ngāti Manuhiri.
increase wider ecosystem benefits from tara iti management	number of breeding pairs of local key bird species	Estimates derived from expert-elicited data. Elicitation followed a modified Delphi approach as before and with wider ecosystem experts.
reduce cost of management	NZ$ per annum	Costs were obtained from an expert group with prior experience costing tara iti and species management.
increase awareness/respect of tara iti among New Zealanders	media stories count	Expert group concluded that strategies (and thus consequences) would be common across all alternatives, so this objective was not pursued.

objectives might be measured using natural, constructed, or proxy metrics (Gregory et al. 2012*a*). Subgroups provided feedback on their candidate objectives and performance measures to the entire group; similar objectives were combined to generate a final agreed list.

To elicit alternative management strategies, the groups brainstormed possible actions with an influence diagram to show key relationships between threats and management (Gregory et al. 2012*a*). Participants then worked in small subgroups to combine individual actions into complex strategies. Subgroups described their chosen strategies to the entire group, which discussed them and developed a set of comprehensive strategies. Facilitators further consulted stakeholders about strategies afterward.

Prediction of Consequences and Evaluation of Trade-Offs

To predict the consequences of alternative strategies, expert working groups for each objective self-identified. Facilitators and expert groups used multiple data sources and analyses to estimate consequences (Table 1). To estimate biological consequences, we used empirical data and formal expert elicitation to parameterize demographic models. For economic and social objectives, expert groups shared knowledge, conducted research, and finalized outcomes through deliberation. For detailed methods, see Appendix S1.

For the mātauranga Māori objective, Ngāti Manuhiri representatives led a *kōrero* (conversation) with facilitators during the initial pekapeka workshop, whereas nominated representatives from Te Uri o Hau, Ngāti Whātua

Table 2. Indicative consequence with expected outcomes of a subset of proposed strategies for 3 of final 10 Pekapeka translocation strategies.

Strategy	*Objective*					
	persistence of sub-species P(*ext*) t = *50 years*[a]	*persistence of source* P(*ext*) t = *50 years*[a]	*cost* *Total NZ$*	*advocacy* n *of annual visitors*	*aggregate score (SMART excluding mātauranga Māori)*	*mātauranga Māori* *scale (see text)*
1. Hen Island (Hauturu-o-Toi to Taranga): capture pregnant females and pup in captivity at source, release females at source, move juveniles to destination, and hold for a period plus supplementary feed to anchor them	0.000[b]	0.006[b]	124,540.00	811	0.57[b]	good
2. Codfish Island to Secretary Island (southern subspecies[c]). Capture pre and postflight juveniles, move and release at destination as in 1	0.000[b]	0.007	103,620.00	235	0.55	much better[b]
3. Hauturu-o-Toi to Hunua Ranges: capture preflight juveniles and move and release as destination as in 1	0.007	0.007	96,540.00[b]	70,775[b]	0.22	bad

[a] *Probability of population extinction after 50 years.*
[b] *Best outcome for each objective, respectively, and for the aggregate score weighted by objective preferences (based on simple multiattribute rating technique).*
[c] *Strategy ultimately supported by the group.*

o Kaipara, and Ngāti Manuhiri hosted an expert meeting at the Ngāti Whātua o Kaipara office for kōrero about tara iti. Kōrero sought to address linguistic and biological uncertainties: first, that mātauranga Māori in the respective decision contexts had been captured appropriately, second, that all elements in the proposed strategies were clear to all. Then, iwi representatives explained how they saw each alternative strategy affecting mātauranga Māori and how they would like to compare the alternatives and communicate this to the wider group.

The predicted outcomes for each strategy against all objectives were then summarized in a consequence table for evaluation. There are multiple tools to assist trade-off choices (Gregory et al. 2012*a*). The pekapeka group decided to use simple multiattribute rating technique (Keeney & Raiffa 1993; Appendix S1) to identify the strategy that provided the best outcomes across objectives. All participants expressed their preferences as 0–100 weights on individual objectives. Quantitative predictions for each action (Table 2) were normalized and weighted by the elicited preferences of objectives to obtain an aggregate score across all objectives for each representative and an aggregate group score based on the average of the group weights (the group agreed this would only be used to help the discussion). Because Ngāti Manuhiri preferred to express their assessment of mātauranga Māori verbally rather than numerically, their qualitative judgments for different strategies could not be included in the aggregate scores; instead, they were placed alongside the numerical analysis, and the group then discussed results. The tara iti group chose a simpler approach, simplifying the consequence table with hard constraints that the group agreed on. Alternatives that did not meet certain criteria or fell below certain thresholds were eliminated, leaving a few alternatives to be selected.

Results

Decision Context

The pekapeka group agreed that 4 decisions were needed regarding pekapeka translocation: which subspecies to translocate, where to source individuals, where to release individuals, and what methods to employ. Decisions made during the SDM process would form the basis of a permit application to DOC. The working group tasked with developing the decisions included the key stakeholders normally approached during permit evaluation and consultation by DOC and as such provides a collective view to submit for approval. This process

would allow the DOC director to make decisions based on advice provided by a wider group of stakeholders.

The tara iti group agreed a decision was needed about which management strategy to employ for tara iti within the current range of the remnant population. Like the pekapeka example, the SDM process included the key stakeholders normally approached by DOC for management strategy consultation and approvals (detailed in Methods above). In this way, the group viewed the process as empowering and efficient, allowing DOC (the decision maker) to fully endorse the recovery plans recommended by the group and all stakeholders to coordinate action as quickly as possible.

Objectives and Values

The pekapeka group identified 5 fundamental objectives (Table 1). They recognized the importance of establishing a new population while avoiding harm to the source population. They also recognized 3 nonbiological fundamental objectives: minimize management costs, increase advocacy for the species, and enhance mātauranga Māori values. Mātauranga Māori, as viewed by Ngāti Manuhiri, was shared with Pākehā participants through kōrero, to ensure understanding across the group. Through this process of ako, the group learned that Ngāti Manuhiri values of mātauranga Māori are centered around *mauri*, a life principle that reflects vital essence of life or well-being. Mauri is influenced by at least 4 major factors, *whakapapa* (genealogy), *tapu* (the sacred or prohibited), *noa* (the ordinary or unrestricted, opposite of tapu), and *kaitiakitanga* (guardianship). This kōrero clarified links between these values and conservation management actions. For example, whakapapa is about connections and location: translocations that move animals within the rohe of an iwi would be viewed as better than those that move them outside. Moves outside of the rohe could also be good if they enhanced known ties between *hapū* (subtribes) and iwi. Alternatively, they could be good as a form of *utu* (paying it forward) by creating ties between hapū or iwi (i.e., *toro mai, toro atū* [reciprocity where good actions encourage an appropriate response for balance]). Similarly, whakapapa influenced the view of alternative methods of moving individual animals. For example, keeping family units together may be viewed as better than splitting parents from young or males from females. Tapu and noa were presented as rules of good behavior, and the group learned to see them as advice for health and safety, normally with binary (i.e., yes or no) answers. For example, some translocation options may be tapu if entry to destination sites is forbidden.

The tara iti group recognized mātauranga Māori as a fundamental objective of tara iti recovery planning, alongside 4 other environmental, economic, and social objectives (Table 1). Iwi representatives outlined cornerstone values of mātauranga Māori to the whole group, described the Māori view for tara iti, and defined key terms relevant to recovery planning (Table 4). We found that this recognition set a positive tone for workshop conversations among all partners, providing opportunities at each step for meaningful, open kōrero of ideas against all values to build (or renew) relationships and promote ako. Participants at the workshop noted it was "the first time they had shared information" in almost a decade.

Alternative Strategies and Consequences

The pekapeka group developed 10 alternative translocation strategies, each with a source population, destination site, and translocation method (a subset shown in Table 2). When filling the consequence table, Ngāti Manuhiri representatives chose a subjective scale, from bad to much better to formally assess the strategies. For example, a strategy was viewed as bad (relative to others) because animals would be moved outside of the rohe to a release site without close ties to the receiving iwi. By comparison, good alternatives would release juveniles and mothers together (enhancing whakapapa by keeping family units together) at destinations within the rohe or with close ties to neighboring hapū.

The tara iti group initially developed 6 alternative strategies (a subset shown in Table 3). As with the pekapeka example, iwi partners preferred a qualitative description of how well the alternatives integrated with mātauranga Māori. They explained that the way they think about them is more of a feeling and cannot be ranked on a scale. In this case, they stated that most alternatives were acceptable, except the ones that contained disagreeable actions. If disagreeable actions were removed, however, then the strategies would become acceptable. For example, they explained that use of herbicides was of concern because "everything is connected," and there could be unknown negative impacts on other living things. Breaking up pairs and bringing infertile individuals into captivity permanently was not agreeable because it obstructed whakapapa (e.g., alternative 1, Table 3). In contrast, use of foster pairs aligned well due to its similarity with *whāngai* (adoption) in Māori culture.

Trade-offs and Decision Making

The pekapeka group used the weights and aggregate scores as a guide to stimulate kōrero and rank alternatives across objectives, except mātauranga Māori, and then to compare them to this latter objective. We found no major trade-offs between mātauranga Māori and the aggregate score (Table 2). Therefore, the discussion was relatively straightforward; no further analysis was required. The alternative with the highest aggregate score was to

Table 3. Indicative consequence with expected outcomes of a subset of proposed strategies for 3 of 7 final tara iti recovery strategies.

Alternative	*Objectives*				
	Persistence of tara iti in wild P*(ext)* t = *50 years*[a]	*Population size of tara iti in wild* *Mean* n *(females)* t = *50 years*[b]	*Cost* *Annual NZ$ spent (millions)*	*Change in northern NZ dotterel breeding population* *% change in number of breeding pairs*	*Mātauranga Māori* *scale (see text)*
1. Field 1 + captive 2: low-intensity field management, low-intensity harvest, captive rear and release within current range, infertile males brought into captivity	0.12	20	0.78	+15	partially acceptable
2. Field 2 + captive 3 + keeping infertile males: high-intensity field management, high-intensity harvest, captive rear and release inside and outside current range, infertile males remain available as foster parents	0.04	31[c]	1.29	+36[c]	acceptable[c]
3. Field 2 + OZFT[d]: high-intensity field management, single and infertile clutches supplemented with Australian Fairy Tern eggs	0.02[c]	31[c]	0.47[c]	+27	not acceptable

[a] *Probability of population extinction after 50 years.*
[b] *Mean number of adult females in population after 50 years.*
[c] *Best outcome for each objective, respectively.*
[d] *Australian Fairy Tern.*

translocate the northern subspecies from Te Hauturu-o-Toi. However, risk aversion by iwi and other representatives meant the group did not select this alternative. Instead, they selected the action with the second highest aggregate score (alternative 2, Table 2), which was the preferred choice in terms of mātauranga Māori and focused on a more abundant subspecies. Translocation would still benefit this subspecies but incur less disease-related risk, while further developing translocation techniques that would eventually benefit the northern subspecies. This shift from the initial focus means the SDM process must be repeated with additional iwi who are kaitiaki for the suggested subspecies.

The tara iti group agreed to use acceptability as a hard constraint on mātauranga Māori to simplify the decision. For example, when it became apparent that removing infertile males was biologically favorable yet was deemed unacceptable by iwi, the entire group agreed to add a modified strategy that left infertile males in place (all other actions were unchanged) in the consequence table (alternative 2, Table 3). Partners acknowledged that Western science and mātauranga Māori had not always worked well together previously but would if the group continued in this way. Critically, iwi partners were able to have input in the decision-making process at each step (Fig. 1), leading to shared understanding of objectives, codevelopment of alternatives, and simple resolution of trade-offs. This process is ongoing but has initiated a lot of positive kōrero and through this, ako. All partners have demonstrated a willingness to work together in a *mana*-enhancing way (enhancing authority, prestige, and influence) that addresses cultural imbalance.

Discussion

In our case studies, SDM helped the planning process move away from traditional unilateral methods, overcome barriers to inclusivity, and explicitly include diverse value systems, such as mātauranga Māori, in decision making for conservation of threatened species. This makes for fairer, inclusive decisions, which realizes the legal mandate set out in the Treaty of Waitangi and the Conservation Act (New Zealand Government 1975). We thoroughly recommend SDM for providing the space and support for meaningful kōrero and ako, vital components of good relationships and inclusive decision making.

Simply collaborating with indigenous people or recognizing indigenous values does not mean their values are automatically incorporated in decisions as effectively as others (Jackson 2006; Wheeler et al. 2020; Zafra-Calvo et al. 2020). In resource management, progressive steps are being taken to recognize mātauranga Māori, such as iwi management plans as starting points for

engagement (Thompson-Fawcett et al. 2017) and the legal personhood granted to the Whanganui River, reflecting its relation to Māori (*Ko au te Awa, ko te Awa ko au*, [I am the river, and the river is me]) (Whanganui River Maori Trust Board 2014). Yet, these still address indigenous values separately from scientific or Pākehā ones. We found SDM helpful because it required a clear, initial expression of values as objectives. In both case studies, the articulation and discussion of iwi values allowed us to codevelop a set of alternatives that already considered scientific, social, and cultural values. This contrasts with the traditional model of scientists preparing alternatives to be judged a posteriori. Ignoring fundamental values at the outset risks developing a set of alternatives, and ultimately decisions, that may be insensitive to social or cultural values. In this sense, during kōrero, the pekapeka group realized that it was critically important not only which plan was developed, but also how it was developed. Ngāti Manuhiri viewed the SDM methods as enhancing mana and enabling people to enact their responsibilities as kaitiaki. All partners involved expressed hope that future steps would continue the mana-enhancing process.

A major challenge in our case studies was to express spiritual or cultural feelings to allow comparison with science-based metrics. Facilitators and groups listened to iwi and codeveloped qualitative, verbal expressions to judge how well alternative strategies incorporated mātauranga Māori (Tables 2 & 3). Similarly, Ngāi Tahu and Aotearoa New Zealand's Ministry for the Environment developed a cultural health index to evaluate river health that encompasses both physical and spiritual values in land and water to be integrated into decision making with water managers (Tipa & Teirney 2006). Taking time to develop performance measures with partners is critical to inclusivity because it allows cultural values to be described appropriately and treated in the same way as common values, such as species persistence or cost (Gregory et al. 2012*a*).

In both case studies, we assessed alternatives against all objectives in parallel. This helped eliminate the implicit sense of ranking that would result if, for example, actions were first selected based on biological analyses and then submitted for approval from indigenous groups. Instead, our decision making clearly presented the impacts of each alternative on all stakeholder values (Tables 2 & 3). Scientific evidence predicting biological consequences of management was presented alongside, not before, consequence assessments for the other objectives. Done this way, evidence-based conservation is much more inclusive.

Codevelopment and parallel assessment of alternatives yielded another considerable benefit. Before engaging in SDM, some biological experts presumed that opening the comanagement process might require considerable compromises, such as accepting suboptimal biological outcomes to accommodate mātauranga Māori. In the pekapeka case, such conflict did not materialize because the assessment based on mātauranga Māori largely overlapped the aggregate scores based on more traditional Western science-dominated values. For example, sustainability, valued by both conservation science and mātauranga Māori perspectives, was captured in biological viability models and kaitiaki principles of sustainable use. For tara iti, some compromise was necessary, and was facilitated by codevelopment of alternatives. Again, the process provided a secure platform for all stakeholders to grow in understanding and seek shared vision despite different backgrounds. Considering both value systems like this improves long-term planning and highlights the nuances of their complementarity. This was captured well in the statement taha wairua taha tangata (bringing both worlds together to achieve the objective) (Table 4). It echoes the sentiment of the Mi'kmaq people of Eastern Canada when they found the "two-eyed seeing" (i.e., "learning to use both these eyes together, for the benefit of all") approach to decision making to be beneficial (Giles et al. 2016).

Through its focus on values, SDM also encourages recognition of context-specific differences, rather than a one-size-fits all approach. Mātauranga Māori is a dynamic belief system, with diverse values among and within hapū and iwi (Whaanga et al. 2017). We already found slightly different interpretations and emphasis of elements of mātauranga Māori between the pekapeka and tara iti cases. We encourage managers not to make broad assumptions about how mātauranga Māori, or any indigenous belief system, is expressed or judged within a given decision.

Structured decision making provides a space for kōrero and ako. This openness improves alignment and inclusivity (Gregory 2016) and improves thinking about threatened species by enabling distillation of the best information available. Comanagement meant partners could ask and answer each other's questions, as opposed to simply presenting information. This could be a nonexpert Pākehā asking for clarity on the mātauranga Māori objective from iwi experts or a nonexpert DOC representative asking a population ecologist to explain extinction probability. In the tara iti case, discussions helped break down long-standing relationship barriers. For example, expressing concerns about negative impacts of tara iti egg management on whakapapa resolved confusion around language used between DOC and other partners. Such relationship building and shared language use are known critical components of successful resource management (Thompson-Fawcett et al. 2017; Boiral et al. 2020).

The relevance and utility to conservationists of the benefits brought about from values-focused decision frameworks cannot be understated. More conservationists across many realms are adopting these tenets and

Table 4. Descriptions and interpretations (right column) of the mātauranga Māori (Māori knowledge and perspective) view for tara iti (left column) defined by Te Uri o Hau, Ngāti Whātua o Kaipara, and Ngāti Manuhiri participants at the first Tara iti recovery planning workshop.

Te Ao Māori	*Holistic Māori world view*
Mauri	The binding force or essence that holds together the physical and spiritual components of a being or thing. The mauri of tara iti is diminished and needs to be rebalanced.
Whakapapa	The spiritual connections, lineage, genealogy, and direction. It is the connection between humans and the natural world, ecosystems, all flora and fauna, etc. We are part of the system, not separate. Everything has whakapapa, our world is built on it. Everything comes from somewhere. It is holistic and integrated and applied to many aspects of life.
Kotahitanga	The oneness, unity of relationships. For tara iti, it means support and connection with community, schools, and conservation groups (planned activities). It is collaborating to achieve objectives.
Kaitiakitanga	A combination of kaitiaki and tikanga and the processes and practices of protecting and looking after the natural environment, the taonga. It involves a set of obligations and responsibilities to those who come before you and those who come after. Kaitiaki are the guardians and the caregivers––everyone has the role of kaitiaki.
Maramataka	To restore systems and knowledge of agricultural productivity, marine and forest gathering, resource management, health, healing, and daily practices that provide sustenance for well-being.
Rāhui	A form of *tapu* (sacredness), the practice of protecting or applying restrictions to an area to let resources recover.
Ako	A 2-way learning relationship, transmission of knowledge. Combining science and education with mātauranga Māori (knowledge of both tangible and intangible). Emerging ideas are shared, both are learning and teaching for the benefit of tara iti.
Taha wairua taha tangata	Bringing both worlds together to achieve the objective, the survival of the tara iti.
Urutau	The earth is shifting, things are changing, and we must change with it (i.e., climate change). Evolving the practice––create new *karakia* (prayer) for tara iti with the new unity, upgrades and changes within our time. Acknowledge our relationship with the tara iti.

finding them to be fair and effective and to deliver robust outcomes for conservation (Bennett et al. 2019; Collier-Robinson et al. 2019; Rayne et al. 2020; Wheeler & Root-Bernstein 2020). Despite this, challenges remain. Well-meaning managers may be confused about what stakeholder values are or how they could be integrated (Jackson 2006) or may be afraid of upsetting partners and so avoid action or become overcautious (Meek et al. 2015). At worst, managers may consider others' values irrelevant or unnecessary hurdles to species recovery or ignore them completely (Fox et al. 2006; Chapman et al. 2020).

There is still a need for "transformative change" (Wheeler et al. 2020), and although more researchers are recognizing and eliciting values, there is still a scarcity of examples demonstrating their integration in decision making outside North America (Dam Lam et al. 2019; Zafra-Calvo et al. 2020). We encourage managers to recognize the complexity of decision making in conservation and embrace value pluralism by using relevant expertise because it generates a much deeper understanding of a system and promotes shared, well-supported decisions (Bennett et al. 2019). Our results highlight that inclusivity need not compromise use of the best available scientific evidence. However, relationships with indigenous groups require time to be built (or mended), to share information and accommodate different ways of working together. Financially supporting indigenous representatives and allowing time to participate is essential (Cisternas et al. 2019; Wheeler et al. 2020) and was echoed by iwi representatives. Both would improve capacity for communities to engage meaningfully in decision-making processes (Thompson-Fawcett et al. 2017). Finally, comanagement is an ongoing process and in some cases will require continual dialogue and participation from all partners to maintain relationships and efficacy (Gorris 2019).

Conservation continually seeks to become fairer and better, giving indigenous communities more defined, prominent roles in decision making (Turner et al. 2008; Augustine & Dearden 2014). It also increasingly recognizes that to improve decision making, meaningful, values-led approaches are needed (Gregory 2016; Mukherjee et al. 2019). Achieving this requires an interdisciplinary approach to clearly express values and identify the best way of achieving them. We are finding that SDM provides such a framework. Although there is still far to go in reaching widespread successful comanagement in Aotearoa New Zealand and elsewhere, there are reasons to be optimistic. The result will be better outcomes both for species and all interested partners.

Acknowledgments

The pekapeka work was supported by the Zoological Society of London and DOC. The tara iti work was

supported by The Te Arai and Mangawhai Shorebirds Trust. We thank everyone who attended the pekapeka and tara iti workshops and contributed their time, values, and expertise. We acknowledge the insight and contributions of K.C., who passed away in 2019, and we dedicate this paper to her. T.M.H. is supported by a Natural Environment Research Council PhD Studentship (grant award number NE/L002485/1). S.C. was supported by the Research Foundation Flanders (FWO16/PDO/019).

Supporting Information

Additional information is available online in the Supporting Information section at the end of the online article. The authors are solely responsible for the content and functionality of these materials. Queries (other than absence of the material) should be directed to the corresponding author.

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