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RESEARCH ARTICLE

Setting priorities in biodiversity conservation: An exercise with students, recent graduates, and environmental managers in Brazil

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Abstract Facing a global biodiversity conservation crisis, urgent decisions are needed but prioritization is challenging. We analyzed how students, recent graduates of Biology, Law, and Engineering, and environmental managers in Brazil ranked ten conservation actions. Reduction in habitat loss and in overexploitation, and in situ protection were consensual top priorities. Freshmen students have similar priorities, which change as their courses advance. Biologists, engineers, and lawyers agree about only two priorities, but not in a consensual order. Biologists gave little importance to financial resources; managers much higher, and lower to action plans. Flagship species and ex situ protection were least priorities for all. Prioritization was influenced by educational level and experience and some priorities are counterintuitive. Our study reinforces the need to assess inter-groups differences, so conservationists could anticipate tendencies of single group decisions. Gaps in the conservation-oriented education of potential decision-makers must be filled, so their decisions could be more effective.

Keywords Analytic hierarchy process · Conservation attitudes · Conservation education · Conservation preferences · Decision-making preferences · Participatory approach

INTRODUCTION

Facing a mass species extinction, biodiversity conservation experiences a crisis situation (De Vos et al. 2015; Ceballos et al. 2015). Effective conservation decisions are needed, and waiting for opportune moments or more information sometimes is not an option (Martin et al. 2012; Taylor et al. 2017). Given the urgency of this process, identifying priorities for species conservation is a scientific and practical challenge (Bottrill et al. 2009; Wilson and Law 2016), which is aggravated by a scenario of diminishing resources (e.g., McCarthy et al. 2012; Larson et al. 2016).

Decision making in biodiversity conservation frequently requires the participation of different stakeholders, either with an education in conservation or not, and their involvement in this process is frequently necessary to improve conservation effectiveness (Meuser et al. 2009; Simpfendorfer et al. 2011; Shapiro et al. 2016). Considering that our society is composed of members with different perspectives, educations, and interests, by having a better understand on how choices are made and what factors affect them, conservationists could in some cases identify critical points and improve their approach to decision-makers, so their efforts could be more efficient, and less time and money-consuming.

Biologists, environmental managers, lawyers and engineers are among the diverse set of professionals frequently involved with the decision-making process in biodiversity conservation (e.g., Vogler et al. 2017). There is no such a basic curriculum or a list of formal disciplines a student must attend to become a better decision-maker in biodiversity conservation. Moreover, different universities and courses have different approaches on how to shape a conservation-oriented professional. However, previous studies have shown that investments in conservation-oriented education in specific moments of professional's training can change their priorities (see Caro et al. 2003). During their courses, Biology students usually have several classes focused directly (e.g., Conservation Biology) or

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indirectly on biodiversity conservation (e.g., Basic Ecology, Population Ecology, Community Ecology, Environmental Education, Introduction to Environmental Law, and Policy and Environmental Management), while in Law and Engineering such classes tend to be scarcer (e.g., Environmental Law, for the first, and Applied Ecology or Environmental Impact Assessment, for the second). In this sense, one could expect that priorities from a biologist's perspective tend to be different when compared to those from other professionals. But how different?

There are different alternative approaches to examining social preferences (Mukherjee et al. 2015). Among them, there are multicriteria techniques, which are considered promising because they take into account conflictual, multidimensional, incommensurable, and uncertain effects of decisions (Ananda and Herath 2003). These techniques provide transparent forms to support decision making, and they clarify and communicate individual preferences. Therefore, they are valuable tools for conflict management (e.g., Rossetto et al. 2015). The analytic hierarchy process (hereafter AHP) provides a structure for the selection of a preferred alternative among a set of possible solutions for a problem (Saaty 1990). It has been used in the most diverse areas as a participative management tool, including natural resources and environment, choice of priority areas for conservation, and forest and watershed management (e.g., Duke and Aull-Hyde 2002; Ananda and Herath 2003; Moffett et al. 2006; Yavuz and Baycan 2013).

Here, we used AHP to investigate the process of choice and establishment of priorities in conservation by students, young and experienced professionals from different areas, educations, and experiences. We invited students and recent graduates of Biology, Law, and Engineering, as well as active environmental managers in Brazil, to rank ten conservation actions according to their priority. This approach allowed us (a) to analyze the process of environmental decision making by people who are or may be potentially directly or indirectly involved in biodiversity conservation in a megadiverse country that faces severe threats, (b) check whether the prioritization in biodiversity conservation is influenced by their academic education and professional experience, (c) recognize a set of consensual actions, and (d) identify last priorities for all groups analyzed. Considering course choices (Biology vs. Law vs. Engineer) or experience (freshmen students vs. recent graduate vs. managers), our prediction was that the ranking of the decisions would differ depending on the group sampled and their experience. Moreover, we expected that managers—who are directly involved in conservation and, therefore, have practical experience in the area—would also differ in their priorities compared to the other groups.

MATERIALS AND METHODS

Choice of actions and planning of the AHP

First, we identified ten actions considered important, useful, or efficient by the conservationist community for biodiversity conservation (see Table S1 in the Electronic Supplementary Material for definitions, detailed descriptions, and rationale). These actions are supported by scientific and practical studies, are used worldwide, and are directly or indirectly related to guiding question in Conservation Biology (e.g., Sutherland et al. 2009) and supported by the Brazilian legislation (e.g., Brasil 2000, 2002; ICMBio 2012, 2018; MMA 2014). The chosen actions were: (1) ex situ protection, (2) reduction in habitat loss, (3) reintroduction into the wild, (4) specific protection law, (5) in situ protection, (6) reduction in capture/consumption/kill, (7) community or environmental education initiative, (8) financial resources available, (9) flagship species, and (10) ongoing action plans.

These ten actions should be ranked according to their priority for biodiversity conservation (in this case, avoid the extinction of a species) and used to feed an AHP in an electronic worksheet (Goepel 2017). In the AHP, the options are presented to a decision-maker in pairs, and this person should choose which one is more important and how much more important it is. This way, the AHP simulates the choice among all possible pairing options, indicating, as a final result, which are the actions considered priority and how much priority they are in comparison with the others.

Pilot tests of this AHP were applied to publics external to the research to check the understanding of the exercise. To facilitate understanding, an appendix, with the basic instructions for filling out the worksheet and a brief description of each action to the judged, was added to the questionnaire presented to the respondents.

Choice of the participant groups

Biologists, environmental managers, lawyers, and engineers are among the diverse set of professionals frequently involved with the decision-making process in biodiversity conservation (e.g., Vogler et al. 2017). An exhaustive list of other professionals could be included (e.g., government agents and civil servants, veterinarians, architects, and teachers, among others). Here, we focused our analysis on four professional groups we identified as our target public, considering their academic formation field, formation level, and experience in the environmental management area: biologists, environmental managers, lawyers, and engineers. Hence, the Group 1 represents incoming students (freshmen—1st and 2nd terms of 2015, and the 1st term of 2016) into Biological Sciences (hereafter Group B1), Engineering (Group E1), Law courses (Group L1) of the Federal University of Pernambuco (UFPE), located in Recife, Pernambuco state, Brazil (Table 1). The UFPE is among the ten largest federal universities of Brazil, and its courses of Biology, Law, and Engineering are acknowledged as excellence courses in the country (RUF 2017a; INEP 2018). The number of incoming students varies per term: ∼ 90 in Biology, 100–150 in Law, and 100–120 students in each engineering course. The age of these students varied from 17 to 22 years old, and they come from different states and municipalities, had different social origins, basic educations, and economic realities, but in common all passed the selective process of the National High School Examination in 2015, carried out by Brazil´s Ministry of Education.

Table 1 Description of the groups chosen to participate in a prioritization exercise in Brazil involving the ranking of ten biodiversity conservation actions. Using the analytic hierarchy process, participants had to choose, for each pair of actions, the most important alternative and classified importance in a linear scale

Group	Composition	*n*	Profile
B1	Freshmen students in Biology courses in Universidade Federal de Pernambuco—UFPE (Bachelor and Environmental Sciences), started between the 1st and 2nd semesters of 2015 and the 1st semester of 2016	84	Age: 17–22 Highest graduation level: High School
L1	Freshmen students in the Law course in UFPE who had started between the 1st and 2nd semesters of 2015 and the 1st semester of 2016	70	Age: 17–22 Highest graduation level: High School
E1	Freshmen students in Engineering courses in UFPE, started between the 1st and 2nd semesters of 2015 and the 1st semester of 2016	92	Age: 17–22 Highest graduation level: High School
B2	Recent graduated in Biology courses in UFPE (Bachelor and Environmental Sciences categories), finished between the 1st and 2nd semester of 2015 and the 1st semester of 2016	45	Age: 23–28 Highest graduation level: Graduated (4–5 years at university)
L2	Recent graduated in the Law course in UFPE, finished between the 1st and 2nd semesters of 2015 and the 1st semester of 2016	20	Age: 23–28 Highest graduation level: Graduated (5–6 years at university).
E2	Recent graduated in Civil Engineering course in UFPE, finished between the 1st and 2nd semesters of 2015 and the 1st semester of 2016	12	Age: 23–28 Highest graduation level: Graduated (5–6 years at university).
M	Environmental Managers, working with federal or state protected areas and institutions related to conservation	13	Management experience time: > 7 years Expertise: majority Biologists (exception: tourism)
Total		336	

The Group 2 was composed of newly graduated students (1st and 2nd terms of 2015, and 1st term of 2016) in the same courses: Biological Sciences (hereafter B2), Engineering (E2), and Law (L2), of the same university (Table 1). The predicted graduation time for these students is 4 years for Biology, and five for Engineering and Law. During graduation, these students should obligatorily complete a minimum course load of 3300 h, on average, for the Law and Biology and, approximately 4000 h for some Engineering courses (e.g., Civil Engineering). When they graduate, these students are between 23 and 28 years old.

The Group 3 (hereafter M) represents experienced professionals in environmental management in Brazil and was composed of managers of Federal and State Protected Areas as well as other institution involved in conservation (Table 1). Most professionals had academic formation in Biological Sciences and at least seven years of professional experience in their practice area.

Sampling and data collection

Our total projected sample size was 1724 people: L1 = 350, E1 = 330, B1 = 270, L2 = 200, E2 = 134, B2 = 120, and M = 324. In order to respect a 5% error margin and 95% confidence interval, we had to interview 315 people (18.2% of the total projected sample size). So, our goal was to interview at least 18.2% of each stratum. Data collection occurred from April 2015 to September 2016. The selected participants were contacted and invited to take part in the research, which was presented to them succinctly. Data collection of the groups B1, B2, L1, L2, E1, and E2 was carried out either in person, on the campus of the UFPE using a laptop computer fed with the electronic worksheet with the AHP, or remotely, with the worksheet sent by e-mail together with instructions to fill it out. The contact with group M occurred exclusively by e-mail. In both cases, authors were available to clarify doubts about the methodology, without influencing their responses. Managers of federal protected areas were accessed with SISBIO authorization #52980-1. The Ethics Committee in Research on Humans (CEP-CCS-UFPE) authorized data collection under the permit #2019571, and

Table 2 Rankings assigned (Rk) and respective weights (in %) given by seven groups of students and professionals in Brazil to ten conservation actions. These groups were composed by freshmen and recent graduated in Biology (B1 and B2, respectively), Engineering (E1 and E2), and Law (L1 and L2) from the Universidade Federal de Pernambuco, plus environmental managers working with federal or state protected areas and related conservation institutions. Using the analytic hierarchy process, participants had to choose, for each pair of actions, the most important alternative and classified importance in a linear scale from 1 to 9 (1—same importance, 3—moderate importance, 5—strong importance, 7—very strong importance, and 9—extreme importance; 2, 4, 6, and 8 are intermediate values). Based on a consolidated matrix with the results of each group, the relative importance of each alternative is obtained, allowing a priority ranking per group

Actions	Groups													
	B1		L1		E1		B2		L2		E2		M	
	Weight	Rk	Weight	Rk	Weight	Rk	Weight	Rk	Weight	Rk	Weight	Rk	Weight	Rk
Ex situ protection	3.4	10	4.4	10	3.7	10	3.0	10	4.6	9	3.6	10	2.6	10
Reduction in habitat loss	13.8	2	12.5	2	11.8	3	17.4	1	17.9	1	13.7	2	20.2	1
Reintroduction into the wild	7.8	7	8.6	7	8.5	8	6.5	8	10.3	5	6.4	8	4.8	8
Specific protection law	10.8	5	12.0	5	9.3	6	9.8	6	8.1	7	8.4	7	9.3	6
In situ protection	10.2	6	13.0	1	13.6	2	11.7	4	12.4	3	11.3	6	19.6	2
Reduction in capture/consumption/kill	14.7	1	12.2	3	16.6	1	11.8	3	10.1	6	11.9	4	13.2	3
Community or environmental education initiative	13.1	4	11.6	6	11.7	4	11.0	5	7.5	8	11.6	5	6.6	7
Financial resources available	7.6	8	7.8	8	8.8	7	8.9	7	11.4	4	12.5	3	9.7	5
Flagship species	5.3	9	5.7	9	5.3	9	5.1	9	4.1	10	4.8	9	4.2	9
Ongoing action plans	13.2	3	12.1	4	10.9	5	14.8	2	13.8	2	15.9	1	9.9	4

each interviewee filled out an informed consent form, agreeing taking part in the research. All subsequent analyses preserve the identity of the participants.

Statistical analysis

To build a reciprocal matrix, the participants chose, for each pair of actions, the most important alternative and classified importance in a linear scale from 1 to 9 (1—same importance, 3—moderate importance, 5—strong importance, 7—very strong importance, and 9—extreme importance; the values 2, 4, 6, and 8 are intermediate weighs). The diagonal of the matrix was always filled with 1, as it represents the comparison between an element and itself. The judgment of each participant, according to the scale, completed the other elements of the matrix, so that the values in the lower left corner of the matrix were reciprocal to the values in its upper right corner. In each reciprocal matrix generated by paired comparison of each participant, the data were analyzed using the eigenvalue technique. Based on the properties of reciprocal matrices, we can calculate the consistency ratio (CR), which, according to the rule, is acceptable when smaller than or equal to 10% (Ananda and Herath 2003).

We put together the matrix generated by individual AHP, which resulted in a consolidated matrix composed of the weights of the participants of each group, i.e., a matrix for the group B1 (Biology freshmen), one for E1 (Engineering freshmen), and so on. Based on this consolidated matrix with the results of each group, we obtained the relative importance of each alternative (in percentage) in relation to the other alternatives, which allowed the creation of a ranking per group.

Raw data were tested for normality using the Shapiro–Wilk test and showed a non-normal distribution. Therefore, we used the nonparametric Kruskal–Wallis test to test for differences in the weights given to actions between groups. In cases of significant results, we used the Mann–Whitney test to check where the main differences between groups were to allow an intergroup analysis.

RESULTS

A total of 336 participants responded to the research. Our overall participation was 19.5% of the total projected sample size, and participation per stratum was: L1 = 20.0%, E1 = 27.8%, B1 = 31.1%, L2 = 10.0%, E2 = 8.9%, B2 = 37.5%, and M = 4.0%. Based on the weights attributed to each action, the rankings generated by each group formed different ordination configurations (Table 2). Reduction in habitat loss was among the first three positions in all rankings, whereas the reduction in capture/consumption/kill was in the first position in five out of seven groups (except for L2 and E2—6th and 4th positions, respectively). Other actions that stood out were ongoing action plans and in situ protection. Two actions remained in the last positions in all rankings: flagship species (frequently in the 9th position) and ex situ protection (frequently in the 10th position).

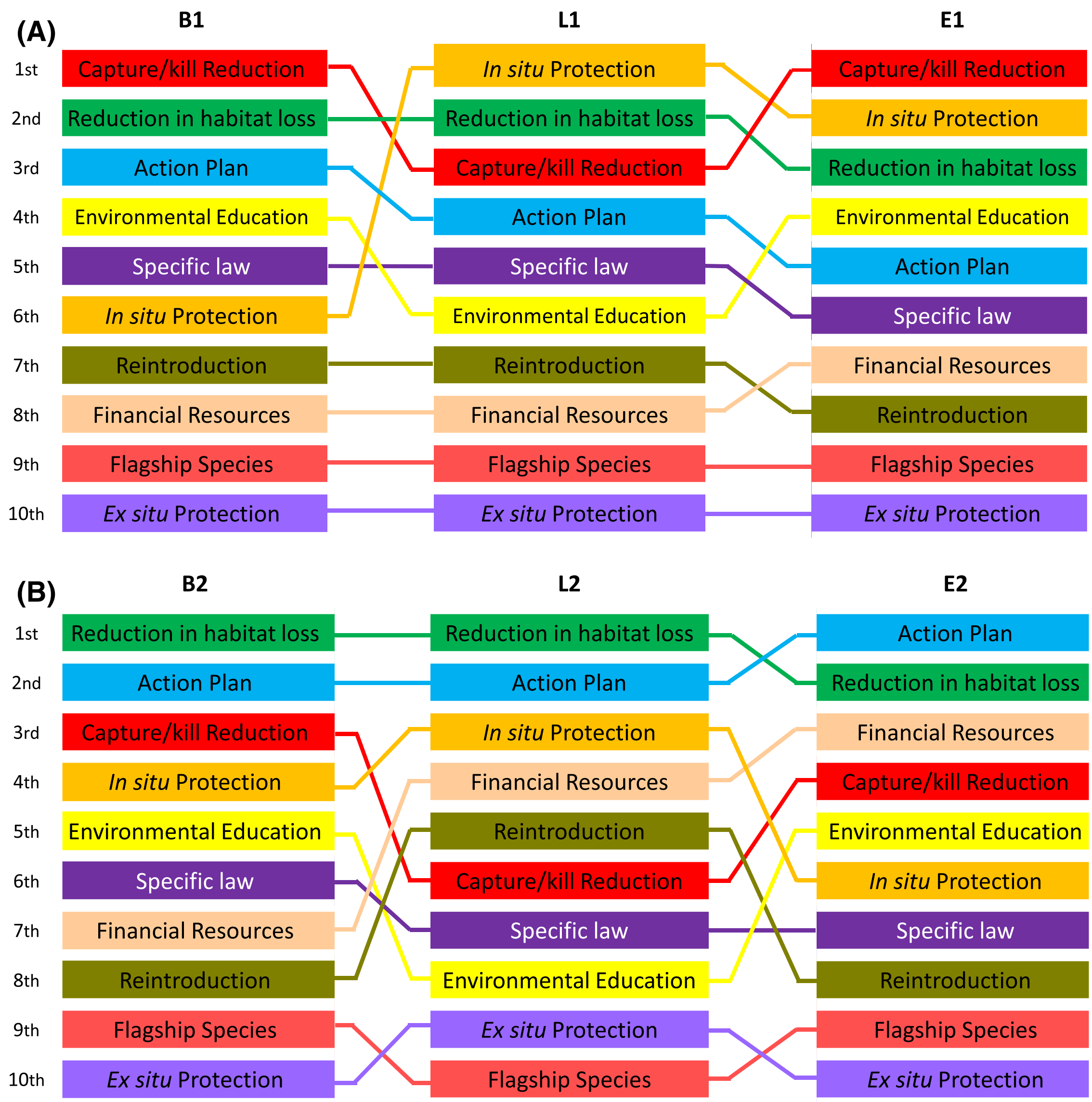

Fig. 1 Priority rankings of ten conservation actions assigned by freshmen students (**a**) and recent graduated (**b**) in Biology (B1 and B2, respectively), Law (L1 and L2), and Engineering (E1 and E2), all from the Universidade Federal de Pernambuco, Brazil

In an intergroup analysis, the comparison between freshmen (B1 vs. L1 vs. E1) showed relatively little divergence among rankings (Fig. 1a), as the last four positions were always the same actions: reintroduction into the wild, financial resources available, flagship species, and ex situ protection. Despite the difference in the position of several actions (e.g., in situ protection), the only actions whose weights showed significant differences among these groups were reduction in capture/consumption/kill, for which the group E1 gave significantly more value than the group L1 ($H = 7.537$; $p < 0.05$), and the *ongoing action plans*, which was significantly more important for B1 than E1 ($H = 4.373$; $p < 0.05$).

The groups B2, E2, and L2 ranked the reduction in habitat loss and the ongoing action plans in the first two positions. Divergences in the positions of some actions became evident (e.g., reduction in capture/consumption/kill, financial resources available, community or environmental education initiative, and in situ protection; (Fig. 1b), but only the reintroduction into the wild showed significant differences and a smaller value for B2 than for L2 ($H = 7.37$; $p < 0.05$). The group B2 also valued this action as significantly less important than group B1, L1, and E1 ($H = 15.91$, $p < 0.005$) (Fig. 2a).

When we compared pairs of the same academic area with different academic formation levels (B1 vs. B2; L1 vs. L2; E1 vs. E2), the ranking generated by L1 showed an

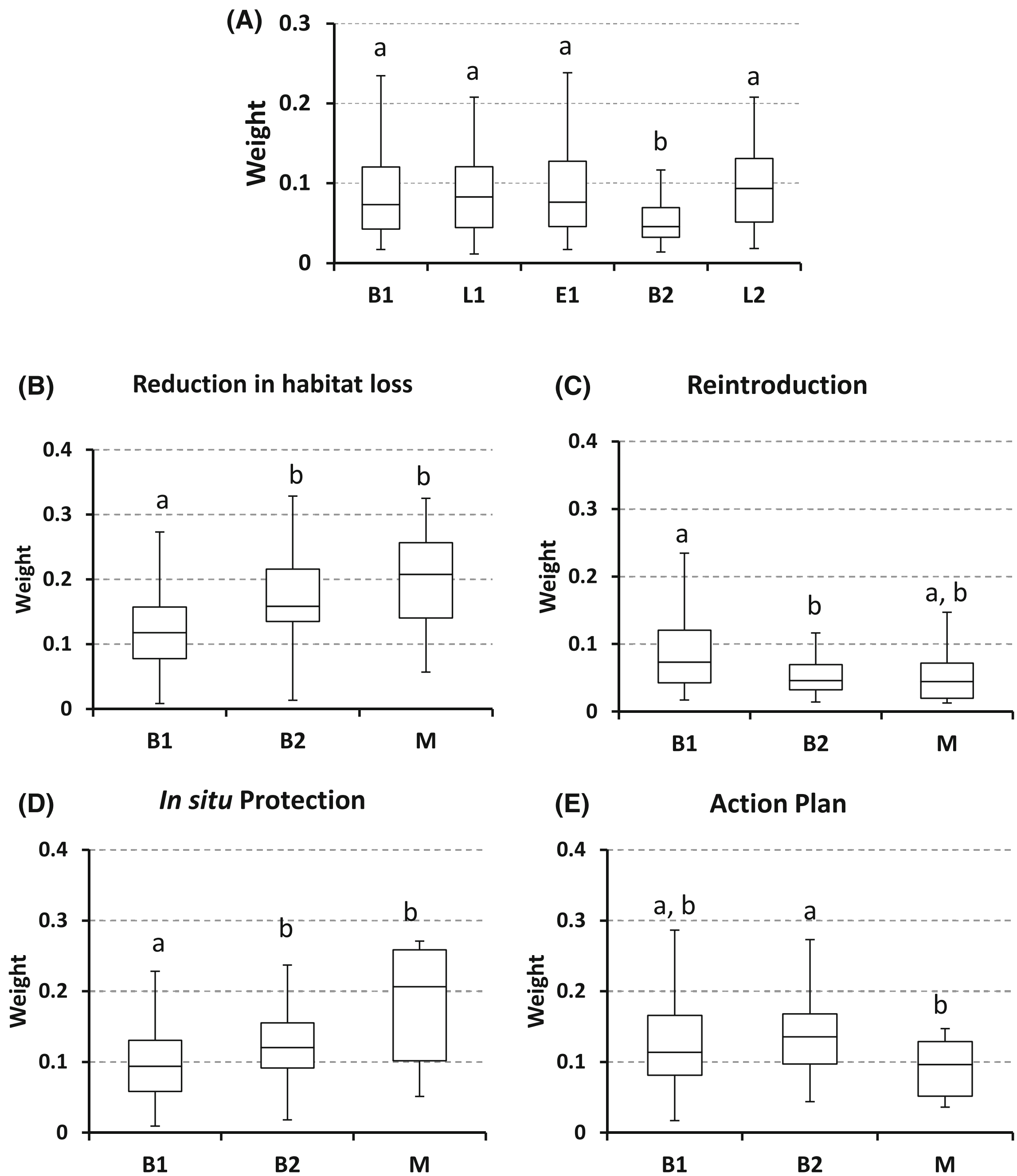

Fig. 2 Boxplot of the weights given to 10 conservation actions in a prioritization exercise with freshmen in Biology (B1), Law (L1), and Engineering (E1), recent graduated in Biology (B2) and Law (L2) from Universidade Federal de Pernambuco, and environmental managers (M) working in Brazil. In panel **a** freshmen and recent graduated from the three courses evaluated the action reintroduction into the wild. Different letters indicate significant differences (Kruskal–Wallis, $H = 15.91$, $p < 0.005$). In the other panels, B1, B2, and M evaluated reduction in habitat loss (**b**), reintroduction into the wild (**c**), in situ protection (**d**), and ongoing action plans (**e**). Different letters indicate significant differences at $p < 0.001$

ordination very different from L2 (Fig. 3a), with the action financial resources available four positions higher in the latter than in the former group and significant differences among the weights given by each group ($H = 4.154$; $p < 0.05$).

The rankings of groups E1 and E2 were the most alike (Fig. 3b), though some actions underwent rise or fall in up to five positions from one group to the other (e.g., reduction in capture/consumption/kill, in situ protection, ongoing action plans, and financial resources available). We

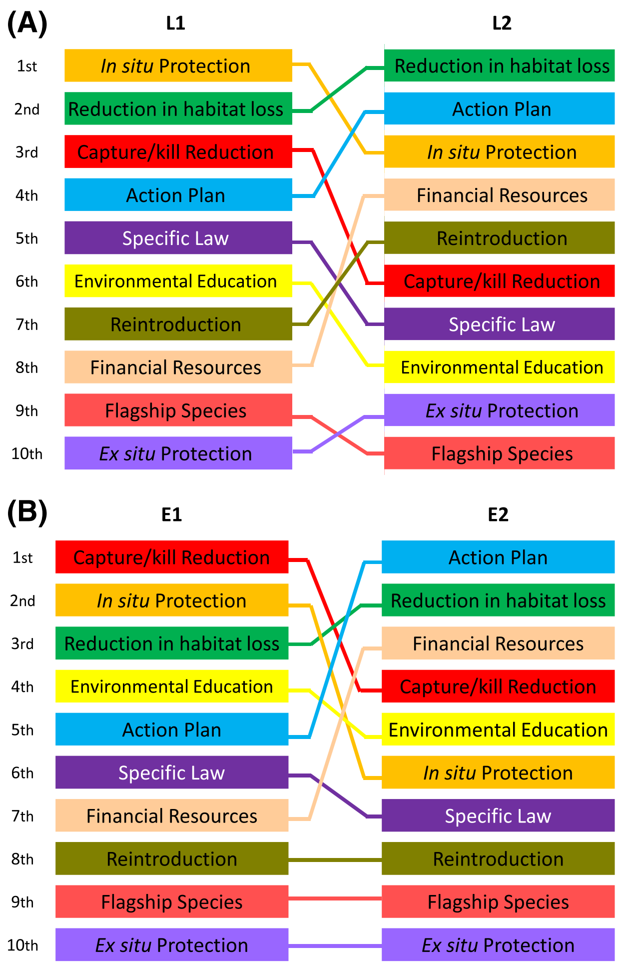

Fig. 3 Priority rankings of ten conservation actions assigned by freshmen students and recent graduated in **a** Law (L1 and L2, respectively), and **b** Engineering (E1 and E2), from the Universidade Federal de Pernambuco, Brazil

observed a significant difference between the values attributed to the action reduction in capture/consumption/kill ($H = 3.896$; $p < 0.05$).

In the comparison among B1 vs. B2 vs. M, the main differences were observed between B1 and the other two groups (Fig. 4), and four of the values attributed by the groups to the 10 actions showed significant differences (Fig. 2b–e). Two actions separated clearly B1 from B2 and M: reduction in habitat loss (H = 15.24; $p < 0.0005$), and in situ protection ($H = 14.61$, $p < 0.005$; Fig. 2b and 2d). The reintroduction into the wild emphasized the difference between B2 vs. B1 (Fig. 2c), whereas the alternative ongoing action plans was significantly less valued by M than B2 (Fig. 2e).

DISCUSSION

Our study showed that prioritization in biodiversity conservation is influenced by the academic education and professional experience of interviewees. In general, Biology, Law, and Engineering freshmen have very similar conservation priorities, with consensus on the importance to reduce overexploitation and habitat loss and safeguard in situ conservation as top three priorities. However, students changed their priorities as they advanced in their courses, indicating that investments in conservation-oriented education in specific moments of their graduation can change their prioritization (see Caro et al. 2003). When they graduate, biologists, engineers, and lawyers agree that the reduction in habitat loss and having action plans are the two most important actions. However, priority order is not consensual among them after the third position in the ranking. Compared to freshmen and graduated in Biology, managers who are directly involved in conservation and, therefore, have practical experience in the area, also recognized the reduction in overexploitation and habitat loss, and in situ protection as top priorities, but gave much higher priority to the availability of financial resources, and lower to the action plans.

Although we cannot guarantee that a first-term student will become a decision-maker in the future, we cannot discard that possibility either. Therefore, students and recent graduates should be considered as potential future decision-makers and also treated alike. In fact, the level of education and academic formation is an important variable to set priorities in conservation, as the education about conservation and the way this knowledge is transmitted have a strong influence on the level of commitment of professionals to biodiversity conservation (Caro et al. 2003). Studies show this influence from school education (Frew et al. 2017) to higher education (Meuser et al. 2009) and even demonstrate the change in opinion generated by the mere fact of one student attend or not a class related to conservation (Caro et al. 2003). Our results corroborate the hypothesis that education level can influence the choice of priorities for conservation within the academic formation in Biology, Engineering, and, in particular, within the formation in Law. In these three groups, there was a clear tendency of a higher valuation of action plans, and mainly of the availability of financial resources by graduates when compared to freshmen, as well as a lower valuation of reduction in overexploitation. The latter option always appears well divulged as a biodiversity threat in basic education and, when associated with the image of injury or damage to the animal, increases the empathy and activates motivation in people to protect it (Cheng and Monroe 2012).

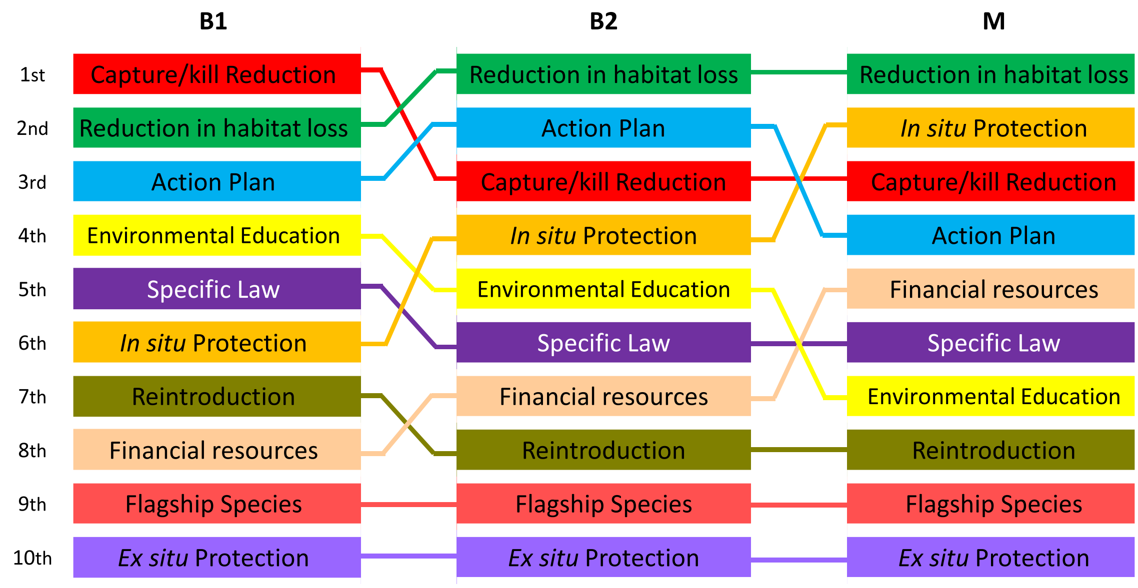

Fig. 4 Priority rankings of ten conservation actions assigned by freshmen students (B1) and recent graduated (B2) in Biology from the Universidade Federal de Pernambuco, Brazil, and environmental managers (M) working in the country

Our results also pointed out a consensus between Biology graduates and managers about the importance to reduce habitat loss, which is at a higher position in these groups than in Biology freshmen. On the one hand, freshmen showed relatively few differences from one another, which proves that when arrive at the university, they probably come from a common basic and relatively standard education, corroborated by similar rankings in the three groups. On the other hand, the area of academic formation influenced the ranking order among graduates. Biology graduates gave higher importance to reduce overexploitation and to environmental education initiatives, whereas Law and Engineering graduates highlighted more practical actions, such as the availability of financial resources. It is worth mentioning the low importance Biology graduates gave to the availability of financial resources, placed in the seventh position in the ranking of priorities. This undervaluation is worrisome, considering that money is frequently pointed out as crucial for conservation efficiency (e.g., Restani and Marszluff 2002; Hanson and McNair 2014; Larson et al. 2016).

Species reintroduction was poorly valued by Biology graduates, maybe due to its more specific nature, the lack of practical examples, or because despite successful cases, some reintroduction attempts fail (Armstrong and Seddon 2008). The specificity of this action may also have made this type of information more accessible to biologists than other professionals. A study that investigated the best practices for shark conservation among professionals that work with this group revealed that the practice area of the professional could influence his/her choice for conservation more than the academic level (Shiffman and Hammerschlag 2016). That study showed that the participants contrary to the banishment of the shark fin trade had higher probability to have published a paper in the fishing management area than in the conservation area. However, there was no relationship between the academic level of the participants and their opinion about the banishment of the shark fin trade (Shiffman and Hammerschlag 2016).

Handling the natural environment can shape the priorities of a given specific public, as the closer vision can make easier the identification of the main problems (Chawla and Cushing 2007; Cheng and Monroe 2012). In a study with kids on the Island of Andros, Bahamas, Shapiro et al. (2016) suggested a positive relationship between the previous experience of kids with fishing and their preferences of species for biodiversity conservation. Interestingly, our results support that the familiarity with the subject can make that some actions considered priority are ranked in a counterintuitive way. This fact was evidenced when action plans were significantly poorly valued by managers than by Biology graduates. As managers handle more closely with action plans, and most of them are employees of the institution responsible for these plans (in this case, the Brazilian Instituto Chico Mendes de Conservação da Biodiversidade), we expected that managers would give greater importance to this action. This result may indicate a possible concern or distrust about the efficiency of this tool, probably due to the low percentage of actions effectively carried out by those plans (E. Bernard, personal observation), or due to the precarious conditions experienced by some protected areas in the country (e.g., Oliveira and Bernard 2017). However, such distrust can bring harmful consequences to biodiversity, as action plans are one of the bases of conservation planning (CBD 2018). If the employees who deal with the action plans do not appreciate them, we question the real value of this tool and whether its conception and execution has been done in the most suitable way to obtain good results.

Consensual priorities

We identified a set of actions consensually recognized as priority. The reduction in habitat loss and in situ protection were two of those actions. Such a finding meets the increasing global concern about habitat loss and fragmentation (Wilson et al. 2016). In a recent study, the reduction in habitat loss was identified as one of the greatest threats to biodiversity, putting at risk 62% of a set of 8688 endangered species (Maxwell et al. 2016). In the two past decades, the remnants of intact habitats ($\sim$ 27% of the lands on the planet, except for Antarctica) underwent a decrease of 9.3% and are progressively more scarce and remote, whereas 71% of the ecoregions of the planet underwent increases of over 20% of human pressure (Venter et al. 2016). The increase in the human ecological footprint is particularly evident in tropical regions (Venter et al. 2016). The Amazon Forest, for example, lost 17% of its area in the past 50 years to give place to mostly cattle farming (WWF 2017). In addition, the Brazilian *Cerrado* are among the biomes most affected by human pressure between 1993 and 2009 (Venter et al. 2016). Therefore, the deceleration of habitat loss becomes one of the most urgent and important measures for the conservation of endangered species not only in Brazil but also worldwide, probably explaining why this action was considered so important by interviewees in our research. Besides, the significant greater valuation given by Biology graduates (group B2) and managers (group M) when compared to freshmen (groups B1, E1, and L1) seems to evidence that the communication about habitat loss was undervalued in high school. If this subject had received more attention by freshmen, the ranking of these groups wouldn't probably have been so discrepant. In a complementary manner, the attention given to in situ protection can indicate that this action is a joint strategy to the reduction in habitat loss. Brazil has one of the largest systems of protected areas in the world, with approximately 150 million hectares. However, like in several countries, in the past years, many of these areas were declassified, reduced or even extinct (Bernard et al. 2014; www.padddtracker.org). Anyway, the creation or maintenance of parks and reserves stood out in the first positions in all groups, reinforcing the believe in in situ protection.

The reduction in overexploitation, also identified as a consensual priority, is the most prevailing threat to the species, affecting 72% of the endangered species worldwide (Maxwell et al. 2016), mainly due to commercial overexploitation or illegal trade (e.g., Darimont et al. 2015). In a study carried out with specialists about preferred practices for the conservation of sharks, Shiffman and Hammerschlag (2016) observed that most participants that supported in situ protection through sanctuaries were also against shark fishing. This result evidences the relationship between creation of protected areas and reduction in capture. Again, we notice that the consensual actions seem to be interrelated to some extent.

Action plans were also among consensual priority actions. Action plans are part of the National Biodiversity Strategies and Action Plans and are important tools for the implementation of the objectives of the Convention on Biological Diversity (CBD 2018). In Brazil, the action plans are instruments of public policies to identify and guide priority actions to fight threats to populations and natural habitats and protect them (ICMBio 2018). The good classification of the action plans in the rankings indicates that the consulted public somehow acknowledges their utility. In fact, action plans frequently comprise several other actions ranked in the present study. However, it is worth mentioning a contradiction observed: the environmental managers (group M) gave a lower valuation to action plans than other participants. This result is contradictory and can reflect the disbelief of these professionals in the success of action plans, maybe due to the long time they require, or due to the frequent budget cuts that this tool undergoes—in particular, in recession periods like the one faced by Brazil currently—or even because they are seen as complex and bureaucratic documents. A deeper investigation why environmental managers do not prioritize action plans would be an excellent suggestion of further study.

Deferred actions

Ex situ protection and the use of flagship species remained among the last priorities. The alternative of making a flagship species to a cause works proportionately to the popularity or charisma of the animal so that in the cases in which there are no such characteristics, the action becomes limited (Williams et al. 2000; Veríssimo et al. 2014). This type of intervention should also consider many other essential specific points, such as the local acknowledgment of the species, its cultural meaning, and the traditional knowledge (Bowen-Jones and Entwistle 2002), as well as evaluations of its efficiency (Veríssimo et al. 2014).

However, it is surprising that all groups, except for newly graduated Law students (group L2), placed the ex situ protection in the last position. The explanations for this result should be better investigated. Despite many important examples of successful programs of breeding in captivity and reintroduction into the wild (e.g., Conde et al.

2011; Harding et al. 2015), ex situ programs tend to require many resources and can be applied to only a few species, which restricts its use (Rahbek 1993). Possible explanations to such a low valuation can be linked to some interconnected factors: (1) low visibility and propaganda of those actions in Brazil; (2) poor knowledge about what they are and how important they are; (3) a perception of a more applied or restricted character of these actions; (4) a possible disbelief in its success; or (5) there can be a contamination of perception in function of the association of ex situ strategies to negative examples, in particular, outdated zoos. This is a research opportunity that should be approached in the future. However, it is already possible to see a clear message: for a greater public support, the promoters of ex situ conservation actions urgently need to improve the communication about the importance and efficiency of these actions.

CONCLUSION

Our study showed that different backgrounds may result in different priorities, and if properly adopted, such prioritization would result in different scenarios for conservation. From this observation comes a practical step: In situations where environmental management should be participative, investments in the basic standardization of concepts among the participants of decision-making groups from different backgrounds can ease the reach of a consensus in biodiversity conservation. In addition, the present study reinforces the need to assess differences in conservation priorities between potential decision-makers, in order to understand how people see environmental issues and to anticipate what could be the consequences of a decision-making process made by narrow groups. This approach can also point to gaps in the conservation-oriented education of future professionals who make the decisions in conservation—especially non-biologists. And by help filling those gaps, their decisions could be more effective for biodiversity conservation. Besides, our results show that tools that make standardization possible, such as AHP, should be considered to minimize biases that put conservation in jeopardy. Although our sampled universe was restricted to Brazil, we strongly believe that our findings can and should be applied elsewhere in situations where priorities have to be established and decisions must be made by people coming from different groups.

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