# Creating a fertile ground for marine conservation: NGOs can influence people’s perceptions on local environmental issues

Main message: NGOs can influence the way local people perceive environmental issues towards a better-informed and more homogenous discourse aligning with scientists and decision-makers, potentially providing a more fertile ground for marine conservation.

Abstract:

## 1. Introduction

/Problem statement/

* Community-based management of natural resources has been praised as a way to tackle the degradation of ecosystems and improve human wellbeing (Delevaux et al., 2018).
* Many environmental NGOs are dedicated to foster the involvement of communities in such processes (Pomeroy & Carlos, 1997; Shackleton, Campbell, Wollenberg, & Edmunds, 2002). But these NGOs can also generate conflict over rights of use (REF -> terrestrial PAs?)
* The study of perceptions on environmental issues (e.g. threats, solutions, specific aspects of management) has been proven helpful in revealing how different actors engage, or can engage in natural resource management (Bennett, 2016; Choe & Schuett, 2020; Leisher et al., 2012; Mascia & Biology, 2003; Pelletier et al., 2005), as an indicator of MPAs’ performance (Leleu et al., 2012) and to foster co-management (Thiao et al., 2019) (+ “Social licence” for MPAs (Kelly, Fleming, Mackay, García, & Pecl, 2020)).

/Research gap/

* While we know the perceptions on management can diverge between stakeholders (Silva & Lopes, 2015; Suman, Shivlani, & Walter Milon, 1999), and while the efficiency of the measures undertaken depends on these perceptions, evidence is still lacking on how NGOs can influence them.
* The impact of specific outreach and education programs on knowledge and attitudes towards marine conservation has been studied in the Raja Ampat (Leisher et al., 2012). But the questions were close-ended and the study only focused on the knowledge about MPAs and perception of illegal activities. Studies have also been made on how engaging in specific activities can influence the perception of actors (Gelcich, Kaiser, Castilla, & Edwards-Jones, 2008).
* => In conservation, perception studies typically focus on specific aspects (e.g. ecosystem services, threats, tools), and lack to integrate multidimensional social-ecological interactions such as between the definition of issues and solutions, and perceptions on the value of nature (REF => Carcamo et al 2014 ??).
* Research on human-nature relationships, such as ecosystem services, tends to be top-down and not leave much space for locally-grounded definitions of these issues (Bennett & Dearden, 2014; Díaz, Demissew, Joly, Lonsdale, & Larigauderie, 2015; Sterling et al., 2017).
* There is a lack of “step zero” analyses of MPA implementation (Giraldi-Costa, Medeiros, & Tiepolo, 2020), limiting our understanding of the early social and ecological dynamics of conservation.

/Research questions/

* What influence can environmental NGOs have on the way local residents perceive environmental issues?
* Are these changes potentially encouraging or impeding conservation measures? (“positive attitudes” => Leisher et al. 2012).

/Filling the gap/

* Our case study focuses on the Shark Fin Bay of Palawan, Philippines. This area is characterized by a high level of pressure on ecosystems and a high reliance on fishing. The Sulubaai Environmental Foundation has undertaken actions there since 2012. Five villages are studied and separated in two groups: i) villages where Sulubaai has undertaken actions (Depla and Sandoval); and ii) nearby villages where no actions were undertaken (Batas, Mabini and Silanga).
* Based on open-ended interviews, we map and study the perception of local residents, decision-makers and scientists on these questions using network analysis.

## 2. Materials and methods

/Site selection/

* The Shark Fin Bay of Palawan, Philippines, is representative of this common situation of high reliance on marine ecosystems, and increasing threats towards them (REF Philippines, Taytay). Five villages (the most local administrative subdivision, locally called *Barangay*) were included to the study.
* Since 2012, the Sulubaai Environmental Foundation (SEF) is active in the area and promotes a range of actions involving local communities: implementation of marine protected areas, coral and mangrove restoration, sustainable local employment, environmental education in schools and beach cleanings. At the time of the study, SEF was mainly active in two villages: Depla and Sandoval, and was planning to extend its activities to another village: Silanga. Finally, two more villages were included to the study as other “control villages”: Batas and Mabini.

/Sampling/

* Open-ended interviews were conducted with random/snowball sampling. Usually, but not always, the first person questioned was the village’s mayor (locally known as “*Barangay Captain*”).
* Authorization asked beforehand to each village mayor and prior informed consent obtained from each respondent. Most interviews were conducted in Filipino, except for people who felt comfortable speaking English.

/Data collected/

* All interviews were recorded with the consent of respondents. Questions were asked regarding six categories: environmental issues, solutions to these issues, values associated with marine ecosystems, perception of MPAs, perception of the NGO, and perspectives for the future.
* 66 respondents: 59 residents, 5 decision-makers from the municipality and 2 local scientists.

/Analyses/

* Interviews were transcribed and translated to English when originally in Filipino. Thematic coding was performed to extract and classify people’s individual answers. These perceptions were coded in a matrix (SM).
* Bipartite networks to link each respondent with the answers they gave.
* Bipartite projections to link respondents with respondents, and perceptions with perceptions.
* Community detection to detect clusters of respondents, and responses.
* Chi-2 tests to study each answer’s repartition among the two groups studied.
* Measuring the diversity of answers given in each group to study the homogeneity of perceptions among each group.
* Text mining and semantic networks.
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*Fig 1. Conceptual diagram of the method designed to build networks of perception from open-ended interviews.*

## 3. Results

/3.1 Setting the scene: the most common perceptions of environmental issues/

* 174 individual perceptions were identified in the 66 interviews. Table 1 illustrates the most common ones per category of perception and the code used for each one.
* Issues identified were mostly related to illegal practices (e.g. dynamite and cyanide fishing), overfishing, as well as land-based and terrestrial issues.
* Solutions identified were diverse: law enforcement, designation of MPAs, etc. A number of respondents could not identify any solution.
* Values associated with the marine environment were almost exclusively linked to food security and livelihood. A few marginal respondents noted the importance of species and nature *per se*, and for the next generation.
* MPAs were generally perceived positively. Overall, 92% of respondents declared knowing what MPAs are. Their goal was perceived in diverse ways, yet mostly about fishing and local people. Some respondents perceived them as private areas, which is common in touristic areas (REF, Fabinyi?).
* The NGO was, as expected, mostly known in Depla and Sandoval. It was generally well perceived, and few comments were made on their actions. Mostly, their MPA was judged efficient (citation). The only recommendations made by a few respondents were to develop more their projects, better involve local actors and authorities, and help to enforce local laws (on illegal fishing).

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| **Category** | **Code** | **Perception** | **Number of respondents** |
| Issues | issue\_few\_fish | *An issue here is the decrease in fish stocks.* | 44 |
| issue\_illegal\_fishing | *An issue here is illegal fishing.* | 47 |
| issue\_no | *I cannot identify any environmental or fishery issue here.* | 15 |
| Solutions | solution\_alternative\_livelihood | *A solution to environmental issues here is alternative livelihoods.* | 11 |
| solution\_no\_idea | *I cannot identify any solution for environmental issues.* | 13 |
| solution\_patrolling | *A solution to environmental issues here is patrolling.* | 17 |
| Values | value\_food | *The marine environment is valuable for the food it brings us.* | 35 |
| value\_livelihood | *The marine environment is valuable for our livelihoods.* | 52 |
| MPAs | mpa\_benefit\_fish | *MPAs (can) produce benefits for fish.* | 44 |
| mpa\_benefit\_locals | *MPAs (can) produce benefits for local people.* | 45 |
| mpa\_goal\_fishery | *The goal of MPAs is to improve fisheries.* | 25 |
| mpa\_need\_patrol | *MPAs need patrolling to be efficient.* | 25 |
| NGO | ngo\_advice\_develop | *I would advise Sulubaai to develop more.* | 7 |
| ngo\_good\_opinion | *I have a good opinion on Sulubaai and their actions.* | 19 |
| Future | future\_alternative\_livelihood | *In the future, there will be other livelihood options.* | 11 |
| future\_development | *In the future, our community/area will develop.* | 14 |
| future\_no\_fish | *In the future, I am afraid that there are no more fish.* | 17 |
| future\_sustainability | *In the future, there will be more sustainability.* | 27 |

*Table 1. Examples of the most common perceptions and codes used for each category of question, and number of respondents that gave this answer (out of n=66 respondents).*

/3.2 Network of perception: analysis of groups/

* A bipartite network is constructed to link respondents and their perceptions.
* The two groups studied already appear separated on the network (fig. 2). “Test villages” are closer to decision-makers and scientists showing a possible appropriation by these residents of the scientific discourse on environmental issues and solutions.
* The most common answers (with the highest degree) appear at the center of the network. If an answer is closer to a group of respondents, it means it was generally more associated with this group.
* We can see some answers, though, have a relatively high degree, meaning they are common, yet they are far from the center, meaning they were cleaving.
* Next step is to study the potential clusters of respondents and perceptions using bipartite projections (fig. 4). Community detection algorithms detect two communities of respondents that generally correspond to the two groups we study. Three communities of answers are detected, though one community is very marginal; and these answers also correspond to the most common answers given by each group we study.
* After explaining how the structure of networks shows the existence of clusters of respondents and perceptions, we will then analyze the differences in the repartition of individual perceptions among the two groups.



*Fig 2. Network of perception linking respondents and their perceptions. Respondents are grouped in three categories: i) Residents of Depla, or Sandoval, villages where SEF has undertaken actions (brown); ii) Residents of Batas, Mabini or Silanga, villages where SEF has not undertaken actions (green); iii) Decision-makers and scientists, living in Taytay or Puerto Princesa City (blue).*

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*Fig 3. Bipartite projection showing the links between respondents. Two respondents are linked when they share an individual perception. The colors represent their residence: scientists are residents of Puerto Princesa City, decision-makers are residents of Taytay, Depla and Sandoval are the villages in which SEF has undertaken actions, and Batas, Mabini and Silanga, the villages where SEF has not undertaken any action. The size of nodes represents their degree, meaning the number of answers that each individual respondent gave.*

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*Fig 4. Bipartite projection showing the links between respondents, and results of a community detection algorithm (Clauset et al 2004). The algorithm detected two main communities which overlap with our two groups of study, showing people from the “test” villages tend to adopt the same discourse as scientists and decision-makers.*

/3.3 The repartition of perception shows the content of that shift in discourses: results from statistical analyses/

* Results of the chi-2 tests (table 2 & fig 5) of the most common answers per category, repartition per group, and p-value. All answers, codes, repartitions and p-values in appendix.
* In the “test” villages, a more constructed discourse especially on MPAs => more answers are generally given to the questions asked.
* Values stated do not seem to differ between villages. Strong association of marine ecosystems with food and livelihood security.
* The vision of future also seems quite similar.

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| **Category** | **Perception (code)** | **Control villages** | **Test villages** | **p-value** | **Number of respondents** |
| Issue | issue\_cyanide\_fishing | 33% | 59% | 0.099 | 31 |
| issue\_degraded\_ecosystems | 19% | 45% | 0.070 | 17 |
| issue\_few\_fish | 56% | 82% | 0.079 | 44 |
| issue\_illegal\_fishing | 58% | 86% | 0.052 | 47 |
| issue\_no | 42% | 0% | 0.001 | 15 |
| Solution | solution\_compliance | 3% | 23% | 0.048 | 6 |
| solution\_mpa | 0% | 23% | 0.012 | 9 |
| solution\_no\_idea | 36% | 0% | 0.004 | 13 |
| solution\_patrolling | 14% | 50% | 0.007 | 17 |
| MPA | mpa\_benefit\_fish | 56% | 86% | 0.033 | 44 |
| mpa\_benefit\_locals | 56% | 82% | 0.079 | 45 |
| mpa\_goal\_people | 0% | 23% | 0.012 | 7 |
| mpa\_need\_incnlusiveness | 8% | 32% | 0.052 | 14 |
| mpa\_need\_no\_outsiders | 0% | 14% | 0.096 | 4 |
| NGO | ngo\_advice\_develop | 0% | 23% | 0.012 | 7 |
| ngo\_advice\_enforcement | 0% | 14% | 0.096 | 3 |
| ngo\_conservation | 6% | 32% | 0.021 | 12 |
| ngo\_employment | 0% | 32% | 0.001 | 9 |
| ngo\_good\_opinion | 6% | 68% | 0.000 | 19 |
| ngo\_help | 0% | 59% | 0.000 | 15 |
| ngo\_mpa | 0% | 23% | 0.012 | 7 |
| ngo\_mpa\_agree | 3% | 82% | 0.000 | 22 |
| ngo\_mpa\_efficient | 0% | 41% | 0.000 | 10 |

*Table 2. Summary of all the perceptions with a significant difference among the two groups studied. “Control” villages include Batas, Mabini and Silanga, where SEF has not undertaken actions. “Test” villages include Depla and Sandoval where SEF has undertaken actions.*

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*Fig 5. Barplot representing the answers given by at least 20 people, the repartition among groups, and the significance of the difference observed based on chi-2 tests (\* = p<0.1, \*\* = p<0.05, \*\*\* = p<0.01). Most of these common answers are more frequent for the test groups which can be explained in two ways. First, test group respondents gave more answers on average (the average degree of nodes is significantly superior, based on a Student t-test). Second, answers were still heterogenous among respondents from test group, as showed by diversity indices.*

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*Fig 6. Bipartite projection of answers showing three different communities detected that correspond to the repartition of answers between the two groups we study.*

/3.4 Testing the diversity of answers among groups: homogenization of perceptions?/

* People in “test” villages have been more talkative, and each individual gave more answers on average (mean degree, and result from t-test). While taking this fact into consideration, we want to understand the relative homogeneity of perceptions between the two groups, and a way to do so is to study how diverse the answers given by each participant are.
* We are analyzing answers as individual species present in two distinct ecosystems, and the number of times this answer was given as abundances.
* Total number of perceptions for “test” villages is 105. For “control” villages, it is 119. But the sample size is bigger for “control” villages, justifying analyses using diversity indices.
* Shannon diversity index gives 4.23 for “test” villages, and 4.30 for “control” villages, and Simpson diversity index gives 0.9806 and 0.9810. Diversity of answers is hence slightly higher in control villages which could indicate there a relatively less homogenous discourse, or just as diverse despite the fact that people from “test” villages give more answers on average.

/3.5 Text mining and semantic analyses/



*Fig 7. Wordcloud of the most common words used by respondents during interviews.*



Fig 8. Semantic network showing the links between the words used by respondents. Computed using CorText V2 (ref).

## 4. Discussion

* Are there perceptions that can be considered as promoting conservation? If yes, can we say Sulubaai has a positive impact? => A better informed and homogenous discourse can be considered to be beneficial for conservation measures. BUT there might be a gap between “official discourse” and actual actions. People’s answers can vary depending on the person asking questions. For example, in villages where illegal fishing seems more common, people talked less about it, and tended to consider more often that there are no environmental issues here.
* But this bias was limited by going randomly to unknown people in all villages, whom had no direct interest in lying. + open-ended questions
* Risk of overstatement of MPA’s efficiency can deceive people. For example, many respondents said the goal of MPAs is to protect corals, which is not clear in the scientific literature (but can be expected if MPAs diminish blast fishing; though the opposite has been observed in other MPAs close by). => (Failler, Touron-Gardic, Sadio, & Traoré, 2020).
* What we may have missed => relatively small sample, many trends are understandable but not significant.
* Opportunities for further research => social networks to study the collaborations for CBRM (REF Bödin, Barnes, etc) ; study management outcome depending on the original perceptions (REFs) ; study changes in perception over time (Afonso et al., 2019; Pita, Antelo, Hyder, & Vingada, 2020) ; study the perception of different groups, especially the perception of the youth (Kamat, 2019; Silva & Lopes, 2015), or between every different villages (different cultures of fishing).

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