Global Environmental Change 59 (2019) 101946

Contents lists available at ScienceDirect

Global Environmental Change

journal homepage: www.elsevier.com/locate/gloenvcha

Conservation, contraception and controversy: Supporting human rights to enable sustainable fisheries in Madagascar

Rebecca L. Singleton[a,b], Edward H. Allison[c], Charlotte Gough[b], Vinay Kamat[d], Philippe LeBillon[e], Laura Robson[b], U. Rashid Sumaila[a]

[a] Fisheries Economics Research Unit, Institute for the Oceans and Fisheries, University of British Columbia, AERL, 2202 Main Mall, Vancouver, V6T 1Z4, Canada
[b] Blue Ventures Conservation, Omnibus Business Centre, 39-41 North Road, London, N7 9DP, UK
[c] University of Washington, United States
[d] Department of Anthropology, University of British Columbia, Canada
[e] Department of Geography, University of British Columbia, Canada

ARTICLE INFO

Keywords:
Human rights
Small-scale fisheries
Gender equality
Sustainability
Marine conservation
PHE
Family planning
Madagascar

ABSTRACT

Environmental NGOs are increasingly called upon to respect human rights when undertaking conservation programs. Evaluating a family planning program running alongside marine management measures in Madagascar, we find that family planning services provided by an environmental NGO can support women's reproductive rights. Family planning services allow the option of smaller families, and give more time to work, increased income and better health. These benefits do not translate into increased support for, or participation in, marine management, however, and women who are able to work more are typically fishing more. We identify patriarchal norms as a key factor preventing the family planning programme from manifesting in improved resource stewardship, limiting opportunities for women to participate fully in resource management meetings and diversify their livelihood outside traditional tasks, including fishing. We propose that a successful human rights-based approach must be more comprehensive, targeting multiple rights and challenging existing institutions and power structures.

1. Introduction

Contraception and conservation have always been uncomfortable bedfellows. Although human population growth is a critical issue affecting biodiversity loss, it has been dealt with somewhat crudely by environmentalists, often portrayed as a problem of developing countries, with the significance of differing per capita consumption between developed and developing countries ignored (Bongaarts, 2016; Gray and Moseley, 2005; Hartmann, 2014; Meffe et al., 1993; Robbins, 2012). In marine conservation, the Malthusian over-fishing narrative is pervasive, but ill-used, miscited as support for a "universal truth" that population growth amongst the poor is to blame for fisheries degradation, without adequate exploration of other drivers (Finkbeiner et al., 2017). This insensitive handling of the issue has no doubt revived memories of coercive family planning in developing countries, and stoked lingering suspicions that aid programmes providing medicine, and particularly contraceptives, aim to control and oppress populations (Bongaarts, 2016; Harris et al., 2012; Kaler, 2009, 2004).

Against this background of controversy, and in the face of potential criticisms that they are disrespecting women's and reproductive rights, many international environmental NGOs ("ENGOS") have shied away from population issues. Whilst many have initiatives focused on women, family planning remains a rare inclusion alongside environmental programmes (Agarwal, 2009; Evans, 2016; Harris et al., 2012; Newman et al., 2014; Singleton et al., 2017). However, we argue here that truly people-centric conservation requires a more nuanced approach than blanket dismissal (or implementation) of certain interventions: As Newman et al. observe, it is deeply ironic that efforts to be more conscious of human rights and move away from coercive population control policies have actually resulted in a downgrading of women's reproductive and sexual health rights on the international agenda (Newman et al., 2014; Singleton et al., 2017). Indeed, those ENGOs who are implementing family planning initiatives suggest that, not only can they be implemented in a way that both respects and fulfils human rights, but also that this may have conservation benefits beyond Malthusian population control (Evans, 2016; Fraser, 1999; Hahn et al., 2011; Miller, 2009; Oldham, 2006; Robson et al., 2017). They describe how these benefits might arise using "theories of change" ("ToC") – causal chains which map out how an intervention (in this case, family planning services) is expected to affect biodiversity conservation (Baylis

E-mail address: rlsingleton@gmail.com (R.L. Singleton).

https://doi.org/10.1016/j.gloenvcha.2019.101946
Received 7 June 2018; Received in revised form 24 September 2018; Accepted 13 July 2019
Available online 08 November 2019
0959-3780/

et al., 2016; Salafsky, 2011).

Although enthusiastically promoted by advocates, the ToCs linking reproductive rights with conservation benefits remain largely untested and unsubstantiated (Yavinsky et al., 2015). As with all integrated conservation and development projects, this raises the spectre that a "win-win" scenario is wishful thinking, and support for people might undermine conservation (Salafsky, 2011). Poorly defined project mechanisms also leave ENGOs open to the allegation that, where goals conflict, they will prioritise conservation, and are secretly still pursuing Malthusian population control, regardless of what they say about rights (Oldham, 2006). ENGOs do not help themselves here: The linkage between increasing population and environmental degradation remains both dominant and assumed in most initiatives that combine reproductive rights and the environment, and family planning is a consistent feature of all "Population, Health and Environment" ("PHE") programmes (Honzak et al., 2012).

To move beyond blanket dismissal or implementation of family planning programmes by ENGOs, and enhance respect for, and fulfilment of, women's and reproductive rights, we need to understand better the links between strengthening these rights and conservation. To do so, we will test the most commonly cited alternative ToCs for combined family planning-environment projects, plus the more entrenched ToC that links population growth with environmental degradation. We use a case study from the field of marine conservation, where the relationship between human rights and sustainable fishing is currently under the spotlight due to the recent global adoption of the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries, which are based on human rights principles (Allison et al., 2012; FAO, 2015; Jentoft, 2014; Singleton et al., 2017). In doing so, we seek to comment on the broader human rights-sustainable fisheries relationship, contributing to the debate around implementation of the Guidelines. Our evaluation looks at the work of Blue Ventures ("BV") a British ENGO, with operations in Madagascar, Belize and Timor L'este, and partnerships with NGOs in other tropical coastal communities internationally (https://blueventures.org). BV integrates marine conservation with development work, and has been providing family planning services in Madagascar for 10 years (Harris et al., 2012).

After reviewing the most commonly stated ToCs in family planning-environment ("PHE") initiatives, we use them as a guide to evaluate:

(i) The extent to which BV's provision of family planning services respects and fulfils women's and reproductive rights;
(ii) The impact of this respect/fulfilment of rights on development and conservation;
(iii) Implications for the broader relationship between human rights and sustainable fishing, and the implementation of the Small-Scale Fisheries Guidelines.

2. Theories of change for PHE programmes

We set out below a synthesis of common PHE ToCs, and evidence to support or refute them. The models are based primarily on those of BV, which explicitly enunciates its programme goals using ToCs (Supplemental Material). However, they are sufficiently generic to capture, and enable testing of, hypotheses that are either expressly stated (see especially Honzak et al., 2012, pg. 6 and 7 in relation to WWF; and Stem and Margoluis (2004) summarizing PHE practice) or implicit across other PHE projects (as we demonstrate by reference to the literature). The ToCs are summarized in Fig. 1.

2.1. ToC 1: 'Goodwill effect'

Provision of vital health services increases community goodwill towards conservation NGOs and projects, encouraging communities to engage with the NGO and its initiatives

A major motivation for conservation NGOs to promote development initiatives is to overcome local opposition to, and generate engagement with, their conservation work. By providing family planning services to communities that would otherwise have limited access, ENGOs could engender goodwill towards themselves and their conservation activities, and/or create an entry point to talk about environmental issues (Gonsalves et al., 2015; Harris et al., 2012; Honzak et al., 2012, pp. 7 and 14; Lopez-carr and Ervin, 2017; Sinaga et al., 2015; Stem and Margoluis, 2004 (Pg.27)). However, target communities must first associate the family planning service with the ENGO (Honzak et al., 2012). It is also important that the provision of family planning does not trigger negative feelings and suspicion, as outlined in the introduction. Although ENGOs have observed anecdotally that the provision of family planning has generated goodwill for their environmental work, more rigorous assessment is required, including documentation of negative and ambivalent reactions (Honzak et al., 2012; Lopez-carr and Ervin, 2017).

2.2. ToC 2: 'Fertility effect'

Addressing unmet need for family planning services reduces the number of unintended pregnancies, leading to reduced population growth and comparatively less demand on natural resources

This link between family planning and environment is the most frequently cited in the literature and by project staff (D'Agnes et al., 2010; Hahn et al., 2011; Hoke et al., 2015; Honzak et al., 2012 pp. 6 & 10; Stem and Margoluis, 2004 (pp.6 and 7); Torell et al., 2012). The theory can be sub-divided into two different pathways:

a) Reduced population growth means comparatively less pressure on resources;
b) Longer-term impacts: With fewer children, parents invest more in the future of the children they have, making them healthier, better educated and, ultimately, less dependent on fishing.

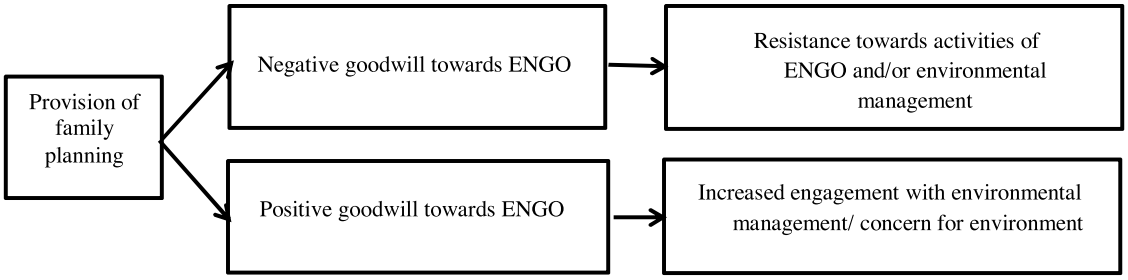
For most organizations implementing the PHE model, the assumption that fewer children equates to lower environmental impacts is rarely questioned and has not been tested (Finkbeiner et al., 2017; Harris et al., 2012; Honzak et al., 2012). Regarding the longer-term effects, most of the integrated initiatives have not operated and/or collected data over a sufficient period to test this and it is in any case difficult due to the number of potential confounding factors and intervening steps (e.g. lack of social mobility; capital; family or cultural ties to geographical area or livelihood).

2.3. ToC 3: 'Empowerment effect'

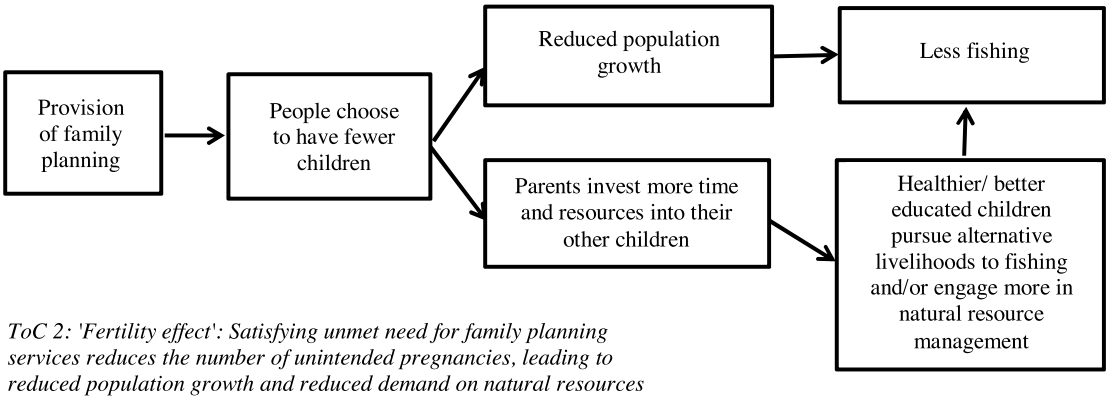
Users of family planning space or limit their births, with empowering results for women. Relieved of childcare burdens, they may gain time, education and confidence to pursue alternative employment outside of the resource extraction sector and/or participate in environmental management.

In PHE, "empowerment" is frequently equated with women having more time because they have fewer children to care for, although improvements in health, wealth and status are also cited (D'Agnes et al., 2010; Honzak et al., 2012, pp. 6 & 11; Stem and Margoluis, 2004, pp. 7 & 8). This is overly simplistic, and we will contrast it with the more conventional definition of Kabeer (2005), who suggests that empowerment is an increased ability to exercise choice, but notes that a genuine choice must exist and be seen to exist by the person experiencing empowerment. This perception of choice is heavily influenced by cultural norms and the internalization of existing power structures.

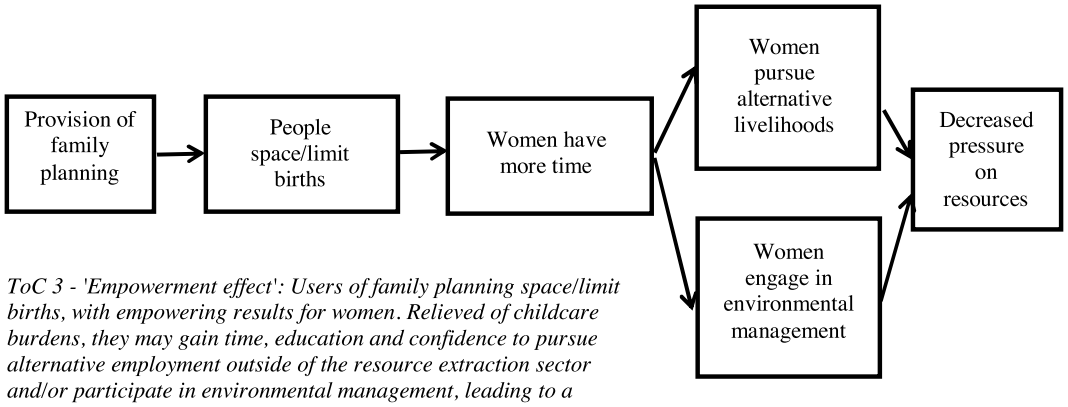
In PHE ToCs, women are assumed to spend their additional time on either: (1) alternative income generating activities to resource extraction; or (2) involvement in managing resources and conservation. The counter-theory that women may spend their additional time on resource extraction activities is rarely mentioned, and not explored.



ToC 1 -'Goodwill effect': Provision of vital health services increases community goodwill towards conservation NGOs and projects, encouraging communities to engage with the ENGO and its initiatives.



ToC 2: 'Fertility effect': Satisfying unmet need for family planning services reduces the number of unintended pregnancies, leading to reduced population growth and reduced demand on natural resources



ToC 3 - 'Empowerment effect': Users of family planning space/limit births, with empowering results for women. Relieved of childcare burdens, they may gain time, education and confidence to pursue alternative employment outside of the resource extraction sector and/or participate in environmental management, leading to a reduction in resource extraction.

Fig. 1. ToC 1 -'Goodwill effect': Provision of vital health services increases community goodwill towards conservation NGOs and projects, encouraging communities to engage with the ENGO and its initiatives. ToC 2: 'Fertility effect': Satisfying unmet need for family planning services reduces the number of unintended pregnancies, leading to reduced population growth and reduced demand on natural resources. ToC 3 - 'Empowerment effect': Users of family planning space/limit births, with empowering results for women. Relieved of childcare burdens, they may gain time, education and confidence to pursue alternative employment outside of the resource extraction sector and/or participate in environmental management, leading to a reduction in resource extraction.

Although some of the integrated projects cited above report increases in women's involvement in alternative livelihoods *and* improvements in environmental management, none have linked these improvements specifically to the provision of family planning (as opposed to the environmental initiatives being implemented in tandem).

The quick, tangible results of family planning may also give participants a greater sense of control over their lives, which translates into increased agency in other areas, including resource management (Harris et al., 2012; Mohan and Shellard, 2014; Pielemeier et al., 2007). By agency, we mean the processes through which choice is exercised. In relation to empowerment, this encompasses not only decision making, but also the means and motivation to make decisions in a way that may be contrary to existing power structures (Kabeer, 2005). We could not find any PHE evaluations that provide evidence, beyond the uptake of family planning services, that women are experiencing tangible benefits from family planning, nor of the consequences of this for empowerment and engagement in environmental management.

In summary, although pathways have been proposed to explain how integrated programmes simultaneously advance conservation and women's rights, the evidence supporting these ToC is limited, particularly in relation to environmental impacts and to the synergistic effects of providing health and environment programmes together, rather than separately.

3. Methods

3.1. Case study: Blue Ventures and the Velondriake Locally Managed Marine Area ("LMMA"), south-west Madagascar

This study evaluates the impacts of BV's family planning initiative in the Velondriake LMMA. The LMMA was designated in 2006 and covers 32 villages, with a total population of 7806 individuals (BV unpublished data). The Government of Madagascar has legally devolved management of the LMMA to a committee of elected local representatives, with BV as co-managers. Most local people are Vezo, a group defined by their close relationship with the sea (Astuti, 1995). Most are small-scale fishers (70% of the adult population) or work in related operations such as fish salting. The region is arid and isolated, with very limited access to health, education and other public services. At the time of this study, BV's activities included implementation of marine closures (temporary and permanent), gear restrictions and other fisheries regulations, a health programme (originally focusing on the provision of family planning services, but now expanded to address other health issues), education, alternative livelihoods (seaweed and sea cucumber aquaculture, eco-tourism), and a mangrove carbon credit scheme.

BV has been integrating the provision of family planning services with its environmental/ livelihood programming since 2007 (Harris et al., 2012). It started providing family planning services in one village, eventually expanding to cover the whole of the LMMA and other sites in Madagascar from 2013 (Mohan and Shellard, 2014; Robson et al., 2017; Robson and Rakotozafy, 2015). Family planning services are provided primarily by local women trained to offer counselling and contraceptives (condoms, combined oral contraceptive pills, and Depo-Provera injections). Long-acting reversible contraceptives (Implanon implants and copper intrauterine devices) are also offered in collaboration with mobile outreach teams from Marie Stopes International. Finally, condoms are distributed to men in bars, although community discussions suggest that the use of condoms by men is low and associated with prevention of STDs rather than 'family planning' (Robson, L and Reed-Krase, N – pers. comm). BV staff also conduct integrated outreach, combining messages about health and family planning with environmental education.

3.2. Gender relations, contraception and resource management in southwest Madagascar

An understanding of gender relations is critical to understanding contraceptive use and resource management by women. In theory, women's equality is respected in both traditional Malagasy culture and the modern legal framework, which includes human rights legislation and constitutional protection (Gastineau, 2005; Keller, 2009; Langley, 2006; OECD, 2018). In practice, women often have limited political and economic influence and occupy traditional gender roles, due to the combined influences of colonial rule (Gastineau, 2005) and the central importance of descendants in traditional Malagasy culture (Astuti, 1995; Keller, 2009). The latter brings societal pressure to have many children, with women typically shouldering the domestic and childcare burden (Feeley-Harnik, 1995; Gastineau, 2005; Keller, 2009; Skjortnes and Zachariassen, 2010).

In Velondriake, women supplement their domestic role with fishing (octopus, cucumber and sea urchin gleaning) and low-level economic activity such as coffee selling (Iida, 2005; Tucker et al., 2015; Westerman and Benbow, 2013). In recent years, the arrival of foreign buyers has transformed octopus and sea cucumber from subsistence to cash crops (Barnes-Mauthe et al., 2013; Westerman and Benbow, 2013). The marketisation of these fisheries has brought opportunities for women in the region, with the new source of income raising the prospect of greater financial independence, and providing an incentive to participate in management of the resource (Tucker et al., 2015; Westerman and Benbow, 2013). However, a number of gender-related challenges exist, including: (i) new competition for the resource from men using better fishing gear, which enables them to fish harder and longer (Tucker et al., 2015; Westerman and Benbow, 2013); (ii) the expectation that women will continue to fulfil their traditional gender role alongside new income-generating opportunities (Skjortnes and Zachariassen, 2010); (iii) management forums (large meetings) that are ill-suited to women's participation, both because domestic burdens prevent attendance, and because they do not have the appropriate political voice to speak (Hanson, 2012; Westerman and Benbow, 2013); and, (iv) limits on the financial independence of women, including control by husbands and/or demands from family (Skjortnes and Zachariassen, 2010).

Before analyzing the effectiveness of BV's family planning programme in overcoming these challenges we note that, despite the cultural emphasis on descendants, the use of contraception has steadily increased and fertility decreased across Madagascar over recent decades. Fertility has decreased from 5.2 births per woman in 2004 to 4.4 in 2015 (World Bank, 2015), and use of 'modern methods of contraception' reached about a third of women in 2016, compared to 14% in 2004 (FP2020, 2017FP2020, 2017; Randrianasolo et al., 2012). The uptake of contraception has been spurred on by economic necessity, and the support of their partners has been vital for women to overcome societal pressure to have more children (Binet and Gastineau, 2008; Gastineau, 2005). Even so, pressure remains to have the first child early, in order to demonstrate fertility (Binet and Gastineau, 2008; Gastineau, 2005).

3.3. Data collection and analysis

The primary data collection instrument was a combined household and individual survey, used to collect data on socioeconomic conditions and human rights in the Velondriake LMMA and the impact of BV's programmes on both. The survey incorporated quantitative and closed-answer qualitative questions, and was combined with a series of open, qualitative questions based on the Most Significant Change ("MSC") methodology (Davies and Dart, 2005). The latter was included in the survey as the main method to assess impact, given a deficit of baseline and control data for many variables.

The content of the survey was designed with input from: (i) villagers, on socioeconomic conditions, potential human rights issues and BV's impact on these, expressed during 12 focus groups conducted from March to May 2016; and (ii) BV's programme leads, expressed in individual interviews. Following translation, the survey instrument was pre-tested, firstly with local staff members and secondly with villagers (37 households/ individuals).

A representative sample of 297 households/ individuals was surveyed, being approximately 20% of the households in coastal Velondriake (1311 households total) and 9% of the adult population (3273 total). The sampling protocol is described in detail in the Supplemental Material. The survey was conducted in the period June to July 2016, in the local dialect, by a survey team composed primarily of local people. This aided respondents' understanding of questions and reduced the likelihood of positive bias associated with being interviewed by BV's staff about BV's projects. Further efforts were made to reduce positive bias by explaining carefully at the start of each interview that there were no "right" answers, and that BV was very interested in negative feedback to help improve its projects. Surveyors were also trained to probe answers that seemed illogical or without basis.

We analysed quantitative data by producing weighted summary statistics (using the Horvitz-Thompson estimator) and weighted models and statistical tests (conducted using the "Survey" package in R (Lumley, 2017; R core team, 2016). Answers to the open MSC questions were coded and analysed using NVIVO Pro 11 software (QSR International Pty. Ltd, 2016). Tables 1–3 and Figs. 5 and S3 represent summaries of data from the closed questions in the household/

individual survey, while Figs. 2–4 and S1 represent summaries of the coded responses to the open, MSC questions. Although all individuals who responded to the closed questions also answered the MSC questions, the number of respondents varies for each MSC summary, since the questions were open and some survey respondents may not have commented on the topic being summarized (e.g. positive and negative impacts of family planning). For statistical models comparing family planning users with non-users (Tables 2 and 3), we included only women of reproductive age (15 to 49 years) since they are the main beneficiaries of BV's family planning service. We also had insufficient data from men, since few (2% of respondents) consider themselves to be users of BV's family planning services, even if they are using condoms provided by BV's team or their partner is obtaining family planning services.

Finally, BV's Malagasy social scientist conducted two follow-up focus groups with women in November 2017 to discuss barriers to women participating in marine management meetings.

4. Results

4.1. ToC 1: 'Goodwill effect'

4.1.1. How is family planning received when provided by an ENGO?

Most of the reported impacts of BV's family planning programme were positive (Fig. 2).

The positive reception of BV's family planning services is also demonstrated by the uptake of contraception. BV reports the contraceptive prevalence rate ("CPR") for all women of reproductive age (irrespective of marital status) who are sexually active (Robson et al., 2017). As Robson et al. observe, use of contraception in Velondriake more than doubled from 2009 to 2013. The CPR is slightly lower in 2016 compared to 2013, although the change is not significant (Table 1). CPR is lower amongst younger women (51% for women aged 15 to 24, 53% for women aged 25 to 49) (not significant ($\chi^2 = 0.14$, $p = 0.71$)).

National CPR is reported only for women who are married or in union, with the assumption that this group is sexually active (United Nations, 2015). In Madagascar, CPR is 36.9% nationally (United Nations, 2015). In Velondriake, 33% of women of reproductive age (aged 15–49) who are married or in union, and who also reported being sexually active, are using contraception.

Most women make the decision to use contraception themselves (38%) or together with their partner (42%), with only 1% reporting that their partner made the decision.

4.1.2. Is family planning a point of introduction to, and/or selling point for, Blue Ventures?

Family planning serves as a more common point of introduction to BV for women (21%) than men (1%) (Fig. 3). For both, it ranks behind income-generating initiatives (short-term octopus closures and aquaculture).

When respondents were asked to discuss how their lives would be different without BV, 32% of men and 40% of women stated that BV projects had no impact on their life (Fig. 4). For those who had experienced significant impact, men highlighted income generating projects (aquaculture, octopus closures) and marine management measures. For women, income generating projects were important, but family planning equally so. The proportion citing family planning as important increased following a reminder that BV provided the service (Figure S1).

4.1.3. Is family planning use associated with improved environmental stewardship?

In Velondriake, few respondents reported worries over declining marine resources (9% in total, compared to 35% who were most concerned about having enough money to survive tomorrow). Family planning users were no more concerned about declining marine resources than non-users (Table 2). Family planning users also did not show a significantly different level of support for management measures than non-users (Table 2).

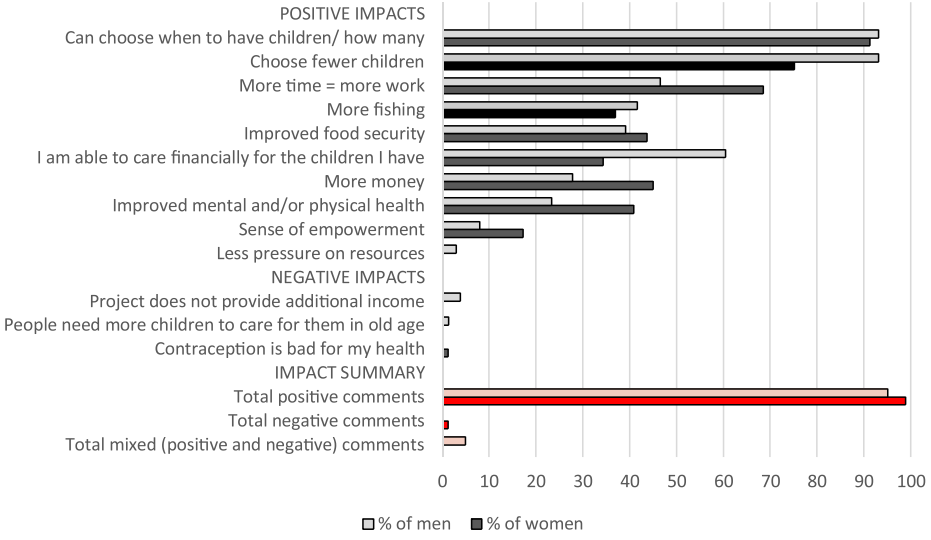


Fig. 2. Summary of positive and negative comments made about BV's family planning programme.
(Source: Open-answer interviews (n = 80 (women = 56, men = 24), weighted to represent % of total population of Velondriake). Although "choose fewer children" and "more fishing" are subcategories of "can choose when to have children" and "more time" respectively, the % still represent % of total respondents, not % of the parent category

Table 1
Contraceptive Prevalence Rate ("CPR") in the Velondriake LMMA.
Source for 2016 data: Individual, closed survey.

	2009	2011	2013	2016	% change 2009 to 2016	% change 2013 to 2016
Contraceptive prevalence rate (% of sexually active women, aged 15-49, using modern method of contraception)	24.9	34.4	58.9	51.7	26.8, $p = 5.7 \times 10^{-10}$	−7.2, p = 0.14

Contraceptive Prevalence Rate ("CPR") (weighted) in the Velondriake LMMA since 2009. CPR for 2009 to 2013 reproduced from Robson et al. (2017).

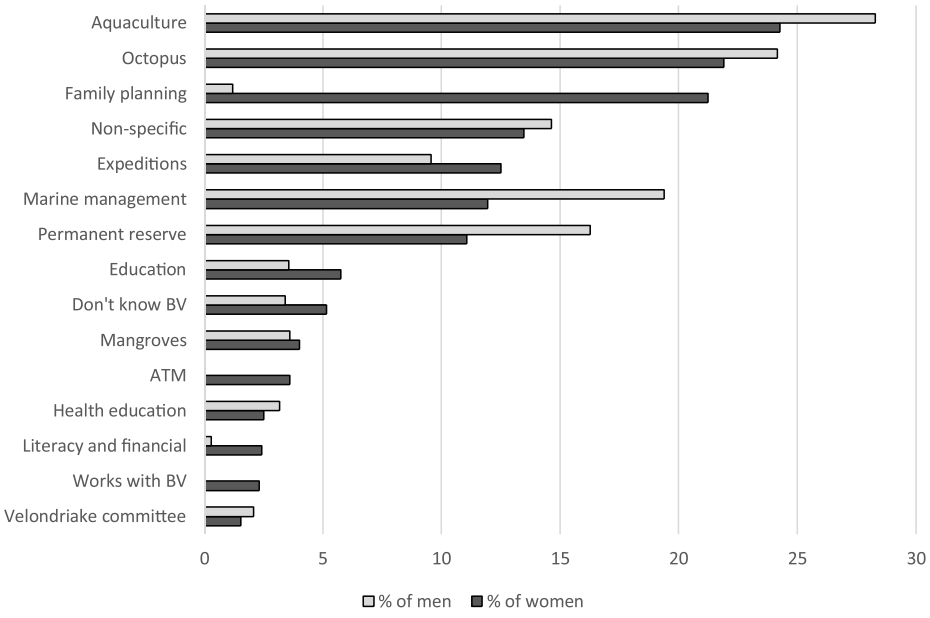


Fig. 3. Points of introduction to BV.
Respondents explained how they first came to know BV, with answers here categorized by the different BV initiatives referred to (Source: Open-answer interview, n = 297 (male = 139, female = 158) weighted to represent the population of Velondriake). % do not add to 100 as some participants mentioned more than one project.

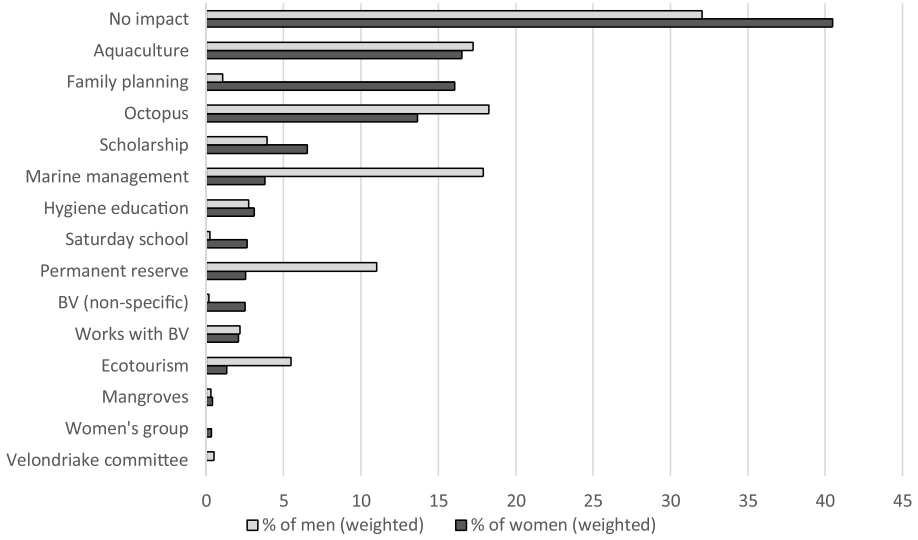


Fig. 4. BV projects with significant impacts on the lives of people in Velondriake.
(Source: Open-answer interviews, (n = 297 (male = 139, female = 158) weighted to represent the population of Velondriake)

People in Velondriake do blame population pressures (more people in the village or more people fishing) for declining marine resources (Fig. 5). However, this concern does not seem to motivate their use of family planning: Reducing pressure on resources did not feature as a commonly cited benefit of BV's family planning programme (Fig. 2). Only one respondent (a young man) describes the benefits of family planning in these terms:

"There would be more children in each household without family planning. The resources in the sea would disappear." (Teenage male, Antsatsamoroy)

Table 2
Relationship of family planning use with environmental stewardship.

Variable	Family planning		t-value[†] or χ-squared[‡]	p-value
	User	Non-user		
Proportion of group who say their priority concern is declining marine resources (%)	8	10	0.47[‡]	0.49
Average marine management approval score[a]	3	3	−0.49[†]	0.63

Results are for women of reproductive age (15–49 years) only (Source: Individual, closed survey. n = 131). ** Significant at the 95% level, * Significant at the 90% level.
[a]See Supplemental Methods.

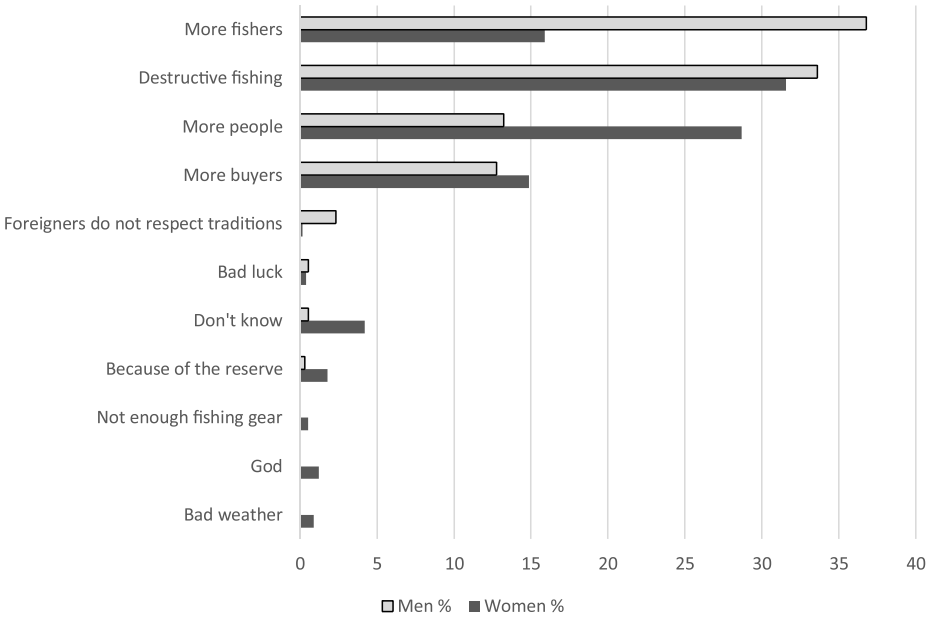


Fig. 5. Reasons for declining marine resources in Velondriake LMMA.
Overall, 61% of people in Velondriake perceived a decline in marine resources since they were a child (Source: individual, closed survey, n = 297 (male = 139, female = 158) weighted to represent the population of Velondriake). Of those who observed a decline, the % of men and women that attributed it to different causes is shown above.

4.2. ToC 2: 'Fertility effect'

4.2.1. Does the provision of family planning reduce population growth, and does this lead to comparatively less pressure on resources?

The census of Velondriake conducted by BV prior to this evaluation revealed an indented population pyramid, with fewer children under 5 than one would normally expect (Figure S2). Death rate was not measured in the census, so this indent could represent exceptionally high child mortality. However, the downward trend in fertility rate in Velondriake reported by Robson et al. (2017) supports a slowing of population growth rate.

Further, the most cited benefit of family planning is the ability to choose when to have children and how many to have, with most of these respondents specifying that family planning enables them to have fewer children (Fig. 2).

Many go on to discuss the improvement in their ability to provide for their families when they have fewer children, including feeding their families more easily (39% men, 44% women) and having more money available (28% men, 44% women) (Fig. 2):

> *"Without family planning I would have more children, and I would not have enough money to feed them all." (Adult female, Andavadoaka)*
> *(See also S4.2.1)*

Regarding the effect of these smaller families on resource use, no interviewees suggested that with family planning they have an excess of food or money available and can therefore fish less. Indeed, many participants suggested that, with more time available, they would fish more, as discussed in relation to ToC 3 below.

4.2.2. Does family planning promote investment in children, enabling them to "escape" the fishery?

Respondents do report that a major benefit of family planning and having fewer children is that this enables them to care better for the children that they have (60% men, 34% women) (Fig. 2):

> *"Family planning is important for me because it's good that we can care for the children we have. My wife can work." (Adult male, Belavenoke)*

Of the respondents who reported having more money available due to family planning use, 20% said they would spend some of that money on school fees:

> *"It is a little bit easier for me to pay my children's school fees because they are few; It would be difficult for me if they are more." (Adult female, Ambolimoke)*

This investment in education appears to be motivated by a desire for children to exit the fishery, which is seen as a hard life:

> *"My children are in high school. Work in the sea is very difficult, and they will get other work that gives them a salary." (Adult male, Nosy Andambatihy)*
> *(See also S.4.2.2)*

4.3. ToC 3: 'Empowerment effect'

4.3.1. Are women who use family planning "empowered" (more time, health, money) to pursue alternative livelihoods and engage in marine management?

The second most commonly reported benefit of using family planning and having fewer children is having more time to work (47% men, 69% women) (Fig. 2).

> *"Before I carried one child on the back, and one on the front. Now it is different because I can do other work." (Teenage female, Antserananangy)*

As well as more child-free time, women (41%) also report better mental and physical health as factors that contribute both to their overall wellbeing and their ability to do more:

> *"During 8 years, I have used [family planning] and it has made me stronger and I am healthier" (Adult female, Bevato).*
> *(See also S. 4.3.1)*

Being able to work more appears to lead to greater economic security: Family planning users have higher income than non-users, and this finding is robust when other factors such as age, education and access to markets are controlled for (Table 3).

However, emancipatory benefits of family planning do not necessarily translate into environmental stewardship gains, especially in the minds of men: Many respondents who stated they had more time to work specified that they (or their partners) could go fishing more (89% of men who discussed the benefit of having more time related this to more fishing, while 54% of women did so):

> *"I can work easily. I have peace of mind. I am keen to work. And I see that I am strong. And when I work there are no babies to bother me. I can*

Table 3
Empowerment of women to become better resource stewards.

Variable	Family planning		t-value[†] or χ-squared[‡]	p-value
	User	Non-user		
Average weekly individual income ($,PPP, 2015)	28	11	2.18[†a]	0.03**
			3.14[†b]	0.002**
Proportion of group that attends natural resource management meetings (%)	67	67	0.0039[‡]	0.95
Proportion of group that speaks at natural resource management meetings (%)	20	16	1.48[‡]	0.22
Proportion of group that feels they can influence decisions at natural resource management meetings (%)	30	24	2.31[‡]	0.13
Proportion of group with long-term priorities (%)[c]	41	33	2.97[‡]	0.08*

Results are for women of reproductive age (15–49 years) only (Source: Individual, closed survey. n = 131). ** Significant at the 95% level, * Significant at the 90% level.
[a] Wilcoxon rank sum comparison.
[b] Family planning use was also a significant predictor of higher individual income in a multi-variate GLM. The full model investigated the influence of the following variables on the individual income of women of reproductive age: Region (North, South, Central Velondriake); Habitat type (mangrove, coastal, island); Age; Education; Participant in BV's family planning programme (yes/no); BV participant (number of projects). Individual income was transformed before inclusion in the model: ln (income +1) used. Other significant predictors in the final reduced model were: Region; and age category. R^2 = 0.30.
[c] See Supplemental Methods.

go out to sea and work." (Adult female, Ankitambagna)
"Now my wife can work with me fishing because we don't have more children…We can wait to have more children, and in the meantime go on fishing migration to the North." (Adult male, Belavenoke).

Only 8% of women with more time, and no men, report increased participation in BV's aquaculture alternative livelihood project.

No respondents mention using their increased time to more actively engage with natural resource management. Further, women who use family planning are no more likely to attend, speak at or influence decisions at natural resource management meetings than women who don't (Table 3).

4.3.2. Does family planning truly empower women?

Generally, people in Velondriake have precarious existences focused on short-term needs, with 63% highlighting immediate problems as their priority concerns (including having enough food to feed their family, finding work and having enough money for immediate survival). There is some suggestion that family planning users have a longer-term outlook (an indicator of reduced vulnerability) compared to non-users (significant at the less stringent 10% level), although we cannot say if this is a consequence or determinant of family planning use (Table 3). Focus groups suggest that the decision to have fewer children may, in this context, be considered a short-sighted reaction to immediate needs which decreases certainty for the future: Although children are considered a burden in the short-term, in the long-term having more is seen to be beneficial.

"When they're still young they can be a hassle, but when they're older they can help you out." [Female focus group participant 2, Agnolignoly]. (See also S.4.3.2)

Gender inequalities persist despite the provision of family planning. Women earn significantly less than men: Average weekly income for women is $18.68 and for men is $50.39 (PPP, 2015) (Wilcoxon rank sum test: t = 7.12, p = 8.178e-12). Another common measure of the status of women in a community is attitudes to violence (Upadhyay and Karasek, 2010). In Velondriake, 43% of people approve of violence towards women. The figure is higher amongst women than men (52% vs. 32%).

Comments made by family planning users in interviews alluded to continued domestic duties and dependence on men for support and livelihoods:

"Now I can have less children and look after my household and help my husband with his work in the sea…Now, I spend my time working (in the sea), not caring for my children." (Teenage female, Belavenoke) (See also S4.3.2)

Women have apparently not overcome the cultural norms preventing them from participating in natural resource management, with older men dominating meetings (Figure S3). Whilst women may attend meetings, few voice opinions at them, and few are confident that they have influence, refuting any suggestion that men are representing them.

In follow-up focus groups, women stated three main reasons for their lack of active participation in natural resource management meetings: (i) their opinion is not respected in the presence of 'nahodas' (older men); (ii) they were too busy caring for their husband and children or working to attend; and, (iii) they did not understand the topics under discussion (due to dialect used by educated BV staff, as well as content).

5. Discussion

5.1. BV's provision of family planning: Respect for and fulfilment of reproductive rights

ENGOs providing family planning (including BV) stress their role in supporting women's and reproductive rights and avoid suggestions of population control. However, in a critical review of PHE projects, Oldham submits that this is merely rhetoric, disguising an underlying assumption that population growth is the root cause of environmental degradation and family planning is the answer (Oldham, 2006). This, he asserts, results in a pre-determined strategy to provide family planning to communities (albeit on a voluntary basis) rather than a willingness to explore other health and development options that the community might desire. This singular focus on family planning and health, with perhaps a cursory consideration of livelihoods, is likely to miss other human rights issues that are critical to understanding the human-environment link and addressing the real problems. We address these points here, with the latter considered in 5.3 below.

BV's family planning programme began at the suggestion of people in Velondriake, rather than as an externally conceived idea. In 2007, BV was a small organisation, focused primarily on eco-tourism. Community members approached BV's expedition medic for help with a suspected cholera outbreak, which sparked further discussions about health needs in the community. As well as family planning (which was articulated as the most pressing need), sanitation, hygiene and maternal and child health were flagged as priorities (V. Mohan – pers.comm). Family planning was originally provided by the expedition medic, and had no external funding (the first substantial grant was received in 2010 – V. Mohan, pers.comm). The initiative later expanded to the provision of other health services in Velondriake and is part of a broader programme addressing community needs such as livelihoods.

The unmet need for family planning identified by BV was clearly genuine, as demonstrated by uptake since the commencement of the programme. Prior to the introduction of BV's family planning programme in the Velondriake LMMA, women had at best limited, but more commonly no, access to family planning and reproductive health services (Mohan and Shellard, 2014). Access and uptake are now on a par with the rest of Madagascar. Without the involvement of an ENGO, it is highly unlikely that this service would have been provided by a health NGO or the Government in such a remote region at the time BV's programme first began, given the unstable political situation in Madagascar and the related decline in healthcare provision (Mohan and Shellard, 2014; Robson et al., 2017). Indeed, BV only took the decision to provide the service itself after potential healthcare partners had declined to do so (V. Mohan – pers.comm).

Participants in BV's family planning programme overwhelmingly talk about choice and the benefits of the programme, and there is no indication that they feel compelled to use contraception to service an environmental agenda of BV's. Indeed, few link their participation in family planning with environmental concerns, which is a separate challenge for BV that we address below. Although BV has not targeted a reduction in population by coercing families to use family planning, there has in the past been a Malthusian assumption in the organization that a reduced population might be a by-product of the programme, and that reduced population growth would reduce environmental pressure (Harris et al., 2012). However, BV staff have been fully supportive of this present evaluation, which challenges the simplistic link between population and environment and are taking steps to adapt programmes accordingly.

A final criticism that has been levelled at family planning provided by ENGOs is that it creates community dependency, which can undermine reproductive rights if the service is suddenly withdrawn at the end of a grant (Oldham, 2006). BV continues to secure funding for family planning provision, despite a downturn in international funding for PHE initiatives that has led to other environmental organisations losing interest (V. Mohan – pers. comm). It is also working actively with the Ministry of Public Health in Madagascar and local public health centre staff towards full government ownership and supervision of the programme. Its actions are consistent with the recognition of human rights in that, having taken the role of duty-bearer in providing a core service, BV is committed to continuing to do so.

5.2. Consequences for conservation and development of strengthening reproductive rights

5.2.1. ToC 1: 'Goodwill effect'

The uptake of contraception in Velondriake, and overwhelmingly positive reaction to BV's programme, demonstrates that family planning services provided by an ENGO can be well-received. BV built trust to overcome initial hostility and suspicions surrounding its motives for providing family planning (Harris et al., 2012). Others have been less successful: Lopez-carr and Ervin (2017) report a CPR of just 11% after several years of funding for another ENGO-led family planning programme in a similarly arid and remote region of Madagascar. As is the case elsewhere in Madagascar (Gastineau, 2005), the support of partners is likely to have been important in overcoming societal pressure to have more children, given that many women make decisions about family planning with their partners. It is interesting that, unlike other studies, interest in contraceptive use is not reserved to the young (Binet and Gastineau, 2008; D'Agnes et al., 2010). This may reflect increasing societal acceptance of family planning, and/or the cultural preference for having children at a young age, to demonstrate fertility and secure descendants.

The positive reception of BV's family planning programme may be generating goodwill towards BV. For some women, it has operated as a point of introduction to BV and had a significant impact on their lives, although for men the project barely registers. For both men and women, income generating projects are more likely than family planning services to act as a point of introduction to BV, and to have an important impact on their lives, echoing findings elsewhere (Lopez-carr and Ervin, 2017). Marine environmental initiatives are also common points of introduction and importance for men (less so women), although this and the renown of octopus closures could also reflect the earlier origins of these projects.

More interview participants (male and female) cited family planning as an important BV initiative once they were reminded that the programme was part of BV's portfolio. This could suggest that people do not immediately associate the service with BV - a potential barrier to family planning generating goodwill for the organization and its other projects – which may be a consequence of services being delivered primarily by local community health workers, not BV's staff.

Critically, whilst the family planning programme may have generated some goodwill for BV, particularly amongst women, there is no sign that family planning use is associated with increased support for conservation. Our results show that women who use family planning are no more concerned about the environment or supportive of marine management measures than those who do not. Although many women in Velondriake blame rising populations for declining resources, men blame competition from other fishers. Neither choose to use family planning because of a heightened concern for the environment, focusing instead on relief for more tangible, immediate concerns (lack of money, food and other basic needs). This echoes findings in other small-scale fishing communities where, despite high dependency on fish as a resource, factors such as poor health, poor access to capital, food insecurity and extreme weather events are of more concern to fishers than threats to fisheries resources (Barratt and Allison, 2014; Mills et al., 2011; Schwarz et al., 2011).

5.2.2. ToC 2: 'Fertility' effect

Our results suggest that couples are using family planning to have fewer children, reducing overall population growth. This has likely contributed to the lower proportion of children under-5 in the Velondriake population pyramid, compared to the pyramid for Madagascar. However, there is no evidence that this is lessening pressure on resources, at least not in the short-term. Respondents suggest that, with fewer children, they will continue to fish the same, at least until all of their basic needs are satisfied, and probably until they can establish a more lucrative livelihood and higher standard of living: Some note that the fishing they do is now "enough" for their smaller family, whilst others talk about having spare income to use for other things (including better houses and luxury items). Indeed, family planning use may be increasing fishing pressure in the short-term, with respondents saying that having fewer children frees up their time to fish more (see 'empowerment' discussion).

In the long-term, couples having fewer children overall are investing more in the children that they have, including their education, which may ultimately reduce fishing pressure by enabling children to pursue alternative livelihoods. However, to fulfil this long-term reduction in fishing pressure, and counter the short-term increase, BV will need to put increased effort into securing alternative livelihoods and food sources for fishers. Currently, in an arid region like Velondriake where fishing provides almost the only source of food and income, even if life becomes a little easier, people can still not necessarily afford the "luxury" of conservation (Lopez-carr and Ervin, 2017; Marcus, 2001). Finally, given the cultural significance of fishing to the Vezo people, it is far from certain that children will exit the fishery, even presented with the opportunity to do so.

5.2.3. ToC 3: 'Empowerment' effect

By enabling women in Velondriake to have fewer children, the provision of family planning is giving them more time and better health to work, and increased income (especially for older women). Such improvements in socioeconomic conditions can lead to reduced

vulnerability, greater life certainty and lower discount rates in individuals (Barratt, 2009; Becker and Mulligan, 1997; Holden et al., 1998; Keren and Roelofsma, 1995; Markandya and Pearce, 1988; Pender, 1996; Singleton and Sumaila - in prep). Lower discount rates indicate a willingness to invest in future benefits, and so can be associated with better environmental stewardship (Clark, 1973; Sumaila, 2004; Sumaila and Domínguez-Torreiro, 2010). They may be reflected in the apparent longer-term priorities of women using family planning in Velondriake, although the priorities cited are predominantly materialistic so could also indicate a tendency towards increasing per capita consumption and continued high discount rates.

Although family planning use is leading to quick, tangible benefits for women, after 10 years of service provision this does not appear to have translated into greater agency (means and motivation to participate) in public affairs and resource management: Women who use family planning are no more likely to actively participate in meetings than those who do not. Nor has it otherwise led to increased concern for marine resources or engagement with marine management, as discussed in the "goodwill" ToC. In fact, many women are using their increased time and better health to go fishing more.

Family planning may fall short of providing the motivation to manage resources sustainably because, although it provides the immediate alleviation of some of the symptoms of poverty, it is not addressing the underlying causes of vulnerability and fisheries dependence. Where this is the case, the improvements in socioeconomic conditions are unlikely to be associated with a lowering of discount rate or more sustainable fishing. Indeed, family planning use may be associated with increased vulnerability providing immediate poverty relief at the expense of long-term security: In regions such as this, where social security is absent, larger families have traditionally provided essential economic support and care for elders and sick relatives (Caldwell et al., 1992; Knodel et al., 1992; Walley, 2004).

Women also remain unempowered, and unengaged in resource management, despite the apparent benefits of family planning, because they are restricted in their ability to take advantage of these benefits. Gender inequality is entrenched in Velondriake: Women earn significantly less than men; have limited political influence; and, violence towards women is socially acceptable, even amongst women. Although women are supported by their husbands and society to use contraception, this represents a limited choice: They are still expected to have children, and to invest any increased time and income in caring for their husband, children and wider family group. These burdens, combined with a lack of political status, continue to undermine women's means and motivation to participate in environmental management, especially via large group meetings.

Like others involved in PHE, BV has found that conducting environmental outreach in fora that are organized primarily to discuss family planning, and primarily for women, can enable women to engage with natural resource management (D'Agnes et al., 2010; Gonsalves et al., 2015; Honzak et al., 2012; Pielemeier, 2005). Although this does not tackle inequality directly, it may negate some of its effects. However, given that BV's fisheries management efforts are primarily aimed at octopus, and given the relative importance of this fishery to women vs. men, continued efforts are needed to shift more management power to these women's forums (whilst being conscious that, in such a context, this can (and has) created social problems for women). Besides making progress towards equality, our results suggest that this may benefit conservation since women in Velondriake seem more open to resource management than men, who are perhaps more single-minded in their focus on fishing as a means to fulfil their responsibilities as primary breadwinner: Men blame fishing competition, rather than population increases per se, as the primary cause of declining catches; Are more likely to cite increased ease of providing for their families as a benefit of family planning; and are much more likely to suggest that, with more time, women should fish more.

Attention needs to be paid to other marginalized groups: Younger, poorer and less educated people may also be prevented from participating in natural resource management by power imbalances, which manifest not only in reluctance to express themselves at meetings, but also in very practical barriers such as being unable to afford time off work to attend, and/or to follow the discussions. An intersectional approach would point towards increased assistance for young women, who are most likely to experience pressure to have children, least likely to experience some of the tangible benefits of family planning (namely, increased income) and least likely to feel they have any influence over resource management, and therefore perhaps most likely to harvest resources unsustainably.

5.3. Towards a human rights-based approach to conservation?

This study forms part of a larger evaluation of BV's impacts on human rights, which was in part motivated by the SSF-Guidelines and their suggestion that support for the human rights of small-scale fishers will make them less vulnerable, and better able to be forward-thinking resource stewards (Allison et al., 2012; FAO, 2015; Jentoft, 2014; Singleton et al., 2017). We therefore conclude by considering the implications of this study for ENGOs implementing a human rights-based approach to fisheries management, as advocated by the Guidelines and their proponents.

In Fig. 6 we show the PHE ToCs as modified by our evaluation. Focusing only on the causal links in the pathways, the provision of family planning does not appear to lead directly to improved resource management, and can lead to increased fishing. Stark choices emerge: Either "trading off" the development benefits of family planning against its conservation costs (dropping the programme) (Wells and Mcshane, 2004); or promoting greater issue linkage (for example, by tying the use of contraception to improved conservation behaviour through conservation agreements) (Salafsky, 2011; Salafsky and Wollenberg, 2000). This is where theory of change analysis has proved unhelpful in integrating conservation and development, as its logical input-output-outcome reasoning promotes over-simplification: In particular, institutions (rules and norms) that influence how theories of change play out in practice are ignored (Béné et al., 2009; Leach et al., 1999, 1997, Scoones, 2009, 1998). This encourages unrealistic expectations of quick successes, and suggests limited options when these are not met, resulting in the kind of polarised, reactive decision making exhibited in the family planning-conservation debate that serves only to make fishers more vulnerable and less cooperative.

Respect for reproductive rights wards against the harsh "solutions" posed above, since they attempt to limit reproductive choice. However, as our evaluation shows, respect for and fulfilment of one right can only go so far to reduce the vulnerability of small-scale fishers, and therefore may have limited traction in enhancing resource stewardship. A true human rights-based approach requires consideration of other relevant rights, as defined in the international legal framework: In Velondriake, the right to food and decent work are likely to be at issue. Critically, the approach also re-frames the problems of conservation and development by re-directing attention to the underlying causes of poverty, which may lie outside small-scale fishing communities, as opposed to its symptoms that lie within (Cornwall and Nyamu-Musembi, 2004; Gready, 2009; Uvin, 2007). By targeting inequality and discrimination, and the power imbalances and institutions that propagate them, a human rights-based approach has the potential to address the deficits in the over-simplified past approaches to integrating conservation and development (Béné et al., 2009; Campese et al., 2009; DFID, 1997; Moser and Norton, 2001; Oviedo and Puschkarsky, 2012).

Applying this thinking to our evaluation (Fig. 6), we see that local institutions and inequalities in Velondriake have prevented key fisher groups (including women and young men) from accessing information about, and influencing decisions on, fisheries management. With agency thus limited, past experience shows they are unlikely to become fully-engaged resource stewards (Berkes, 2004; Blom et al., 2010;

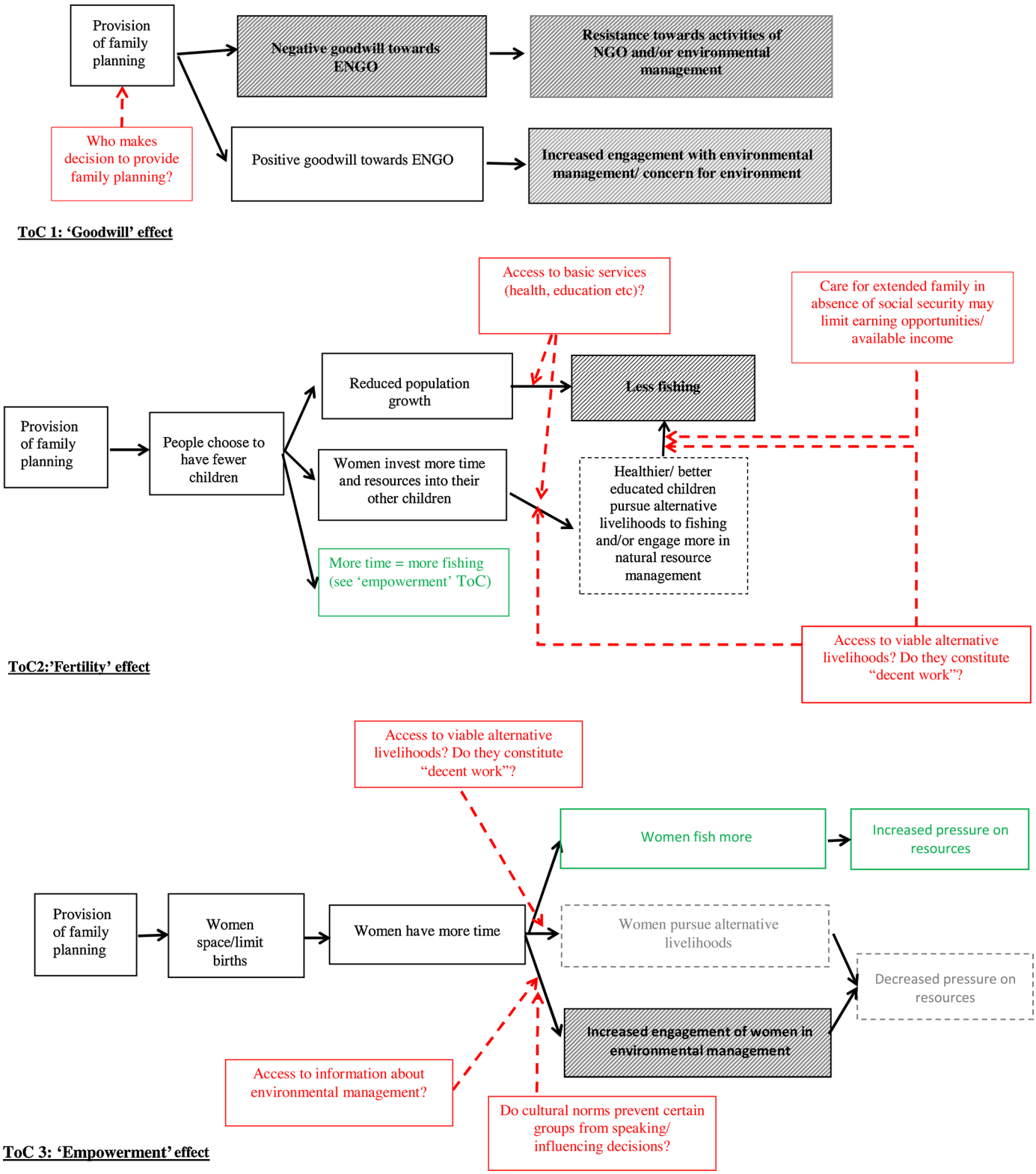


Fig. 6. The common family planning-environment Theories of Change ("ToC"s) modified to reflect the results of the evaluation.
Additional pathways identified shown in green, pathways contradicted by the evidence in this context are hatched, pathways for which we have insufficient evidence in grey/dashed line. We also note key points where a human rights-based approach has bearing in red.

Boissiere et al., 2009; Ferse et al., 2010; Wells and Mcshane, 2004; White, 1996; Williams, 2004). By examining the power-laden assumption that population growth amongst the poor is the main cause of resource degradation, we discover that it is not just mouths to feed that drive fishing, but lack of social security, education, health care and viable alternative livelihoods. We begin to identify other groups to hold to account or 'blame' (e.g. commercial buyers, the Government) and other potential solutions (e.g. measures to ensure that small-scale fishers receive a greater share of the profit from national fisheries and aquaculture) (Le Manach et al., 2013; Schuhbauer et al., 2017).

Finally, a human rights-based approach (as articulated by small-scale fishers' organisations) calls for ENGOs to re-examine their own position of power in relation to small-scale fishing communities (WFFP, 2017). This might mean modifying pre-determined strategies so that the most critical issues are addressed, regardless of their popularity with funders. It will mean discussing these strategies in an open, accessible manner, that encourages communities to challenge them, and again promotes greater agency. Ultimately, it will involve relinquishing control, and accepting that the realisation of human rights may not automatically *enhance* conservation, but can still *enable* it by focusing on the gradual removal of barriers to engagement, alongside management measures (Allison et al., 2012; FAO, 2015; Jentoft, 2014; Singleton et al., 2017).

A human rights-based approach to conservation, when properly applied, is not an easy option: In challenging established institutions and elites, ENGOS will encounter powerful opposition, including within their own ranks. This could undermine sources of funding and operational relationships with Governments and community leaders (Singleton et al., 2017). It does not promise simple, guaranteed outcomes, which could prove difficult in a funding landscape that has come to expect proof of concept and quick, cost-effective, and measurable results (Salafsky, 2011). However, it will help to move beyond empty rhetoric, community conflict and reactive decisions, and therefore represents progress towards truly people-centric conservation.

Funding (including role of funding source)

The John D. and Catherine T. MacArthur Foundation directly supports the implementation of Blue Ventures conservation work in the Velondriake LMMA including its monitoring and evaluation. The Balcombe Charitable Trust supports the monitoring and evaluation of Blue Ventures' projects across the organisation, including support for the fieldwork described in this paper. Finally, the Population Reference Bureau provided funding for the implementation of the fieldwork described. Blue Ventures shared the questionnaire used in this research at a workshop hosted by Population Reference Bureau prior to conducting fieldwork. Additional questions requested by the Population Reference Bureau were asked during these surveys, but none of the data arising from those questions is used in this paper.

R Singleton, C Gough and L Robson were employed by Blue Ventures Conservation (the NGO whose projects are evaluated in the paper) at the time the research was conducted.

R Singleton, C Gough and L Robson were employed by Blue Ventures Conservation (the NGO whose projects are evaluated in the paper) at the time the research was conducted.

Declaration of Competing Interest

R Singleton, C Gough and L Robson were employed by Blue Ventures Conservation (the NGO whose projects are evaluated in the paper) at the time the research was conducted.

Acknowledgements

The authors would like to thank: Vik Mohan for his comments on the manuscript, insights into the PHE field, and for recounting the history of Blue Ventures' provision of family planning services; Adrian Jones, a graduate student with UBC's Short Term Statistical Consulting service, who calculated weights for survey data and advised on the specific form of coding to be used with weighted data in the R statistical software package; Lucy Anderson, an independent consultant who provided comments on initial statistical models; Blue Ventures' staff and the residents of the Velondriake LMMA for their support in the field, especially Simonnette Rasoanantenaina, Thierry Nohasiarivelo, George 'Bic' Manahira, Michel 'Goff' Strongoff, Habrestok 'Bris' Naze Marie, Caroline Savitzky and Liz Day; and particular thanks go to the team who conducted the survey work, Lahiniriko François ('François'), Zafy Maharesy Dieu Donne, Victor Jean, Leopold Clement Andrianjohary, Jean-Luc Ramahavelo, Bemana Njara Jose Ranaivoson, Henriette Germaine, Joelinne Jeanbatiste, Bienvenue Ninah Donah and Dantese Takantera.

The authors are also grateful to the following funders who support Blue Ventures in monitoring and evaluating its projects, including support for the fieldwork described in this paper: Balcombe Charitable Trust; The John D. and Catherine T. MacArthur Foundation; Population Reference Bureau.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.gloenvcha.2019.101946.

References

Agarwal, B., 2009. Gender and forest conservation: the impact of women's participation in community forest governance. Ecol. Econ. 68, 2785–2799.
Allison, E.H., Ratner, B.D., Åsgård, B., Willmann, R., Pomeroy, R., Kurien, J., 2012. Rights-based fisheries governance: from fishing rights to human rights. Fish Fish. 13, 14–29.
Astuti, R., 1995. People of the Sea: Identity and Descent Among the Vezo of. Cambridge University Press, Madagascar.
Barnes-Mauthe, M., Oleson, K.L.L., Zafindrasilivonona, B., 2013. The total economic value of small-scale fisheries with a characterization of post-landing trends: an application in Madagascar with global relevance. Fish. Res. 147, 175–185.
Barratt, C., 2009. Netting the Benefits Now or Later? Exploring the Relationship Between Risk and Sustainability in Lake Victoria fisheries, Uganda. University of East Anglia.
Barratt, C., Allison, E.H., 2014. Vulnerable people, vulnerable resources? Exploring the relationship between people's vulnerability and the sustainability of community-managed natural resources. Dev. Stud. Res. 1, 16–27.
Baylis, K., Honey-Roses, J., Borner, J., Corbera, E., Ezzine-de-blas, D., Ferraro, P.J., Lapeyre, R., Persson, U.M., Pfaff, A., Wunder, S., 2016. Mainstreaming impact evaluation in nature conservation. Conserv. Lett. 9, 58–64. https://doi.org/10.1111/conl.12180.
Becker, G., Mulligan, C., 1997. The endogenous determination of time preference. Q. J. Econ. 9, 729–758.
Béné, C., Belal, E., Baba, M.O., Ovie, S., Raji, A., Malasha, I., Njaya, F., Na Andi, M., Russell, A., Neiland, A., 2009. Power struggle, dispute and alliance over local resources: analyzing "democratic" decentralization of natural resources through the lenses of Africa inland fisheries. World Dev. 37, 1935–1950. https://doi.org/10.1016/j.worlddev.2009.05.003.
Berkes, F., 2004. Rethinking community-based conservation. Conserv. Biol. 18, 621–630.
Binet, C., Gastineau, B., 2008. Mariage, Fécondité Et Autonomie Conjugale à Madagascar 47. Press. Sci. Po, pp. 43–56. https://doi.org/10.3917/autr.047.0043.
Blom, B., Sunderland, T., Murdiyarso, D., 2010. Getting REDD to work locally : lessons learned from integrated conservation and development projects. Environ. Sci. Policy 13, 164–172. https://doi.org/10.1016/j.envsci.2010.01.002.
Boissiere, M., Sheil, D., Basuki, I., Wan, M., Le, H., 2009. Can engaging local people's interests reduce forest degradation in Central Vietnam? International Centre for Environmental Management. Biodivers. Conserv. 18, 2743–2757. https://doi.org/10.1007/s10531-009-9627-1.
Bongaarts, J., 2016. Slow down population growth. Nature 530, 409–412.
Caldwell, J.C., Orubuloye, I.O., Caldwell, P., 1992. Fertility decline in Africa : a new type of transition? Popul. Dev. Rev. 18, 211–242.
Campese, J., Sunderland, T.C.H., Greiber, T., Oviedo, G., 2009. Rights-based Approaches: Exploring Issues and Opportunities for Conservation. CIFOR and IUCN, Bogor, Indonesia.
Clark, C.W., 1973. The economics of overexploitation. Science (80-.) 181, 630–634. https://doi.org/10.1126/science.181.4100.630.
Cornwall, A., Nyamu-Musembi, C., 2004. Putting the "rights-based approach" to development into perspective. Third World Q. 25, 1415–1437. https://doi.org/10.1080/0143659042000308447.
D'Agnes, L., D'Agnes, H., Schwartz, B., Amarillo, M.L., Castro, J., 2010. Integrated management of coastal resources and human health yields added value : a comparative study in Palawan (Philippines). Environ. Conserv. 37, 398–409. https://doi.org/10.1017/S0376892910000779.
Davies, R., Dart, J., 2005. The "most significant change" (MSC) technique. Change 1–104. https://doi.org/10.1104/pp.110.159269.
DFID, 1997. Eliminating World Poverty: A Challenge for the 21st Century. London. .
Evans, R., 2016. Conservation and Birth Control: A Controversial Mix [WWW Document]. Mongabay. URL https://news.mongabay.com/2016/03/conservation-and-birth-control-a-controversial-mix/ (Accessed 19 May 2017).
FAO, 2015. Voluntary Guidelines for Securing Sustainable Small-scale Fisheries in the Context of Food Security and Poverty Eradication. Rome. .
Feeley-Harnik, G., 1995. Plants and People, Children or Wealth : Shifting Grounds of "Choice" in Madagascar. Polit. Leg. Anthropol. Rev. 18, 45–64.

Ferse, S.C.A., Máñez Costa, M., Schwerdtner Máñez, K., Adhuri, D.S., Glaser, M., 2010. Allies, not aliens: increasing the role of local communities in marine protected area implementation. Environ. Conserv. 37, 23–34. https://doi.org/10.1017/S0376892910000172.

Finkbeiner, E.M., Bennett, N.J., Frawley, T.H., Mason, J.G., Briscoe, D.K., Brooks, C.M., Ng, C.A., Ourens, R., Seto, K., Switzer, S., Jose, S., Larry, U., 2017. Reconstructing overfishing : moving beyond Malthus for effective and equitable solutions. Fish Fish. 18, 1–12. https://doi.org/10.1111/faf.12245.

FP2020, 2017. FP 2020: Madagascar [WWW Document].

Fraser, A.S., 1999. Becoming human : the origins and development of women's human rights. Hum. Rights Q. 21, 853–906.

Gastineau, B., 2005. Devenir parents en milieu rural malgache. Évolutions dans la province d'Antananarivo. Rev. Tiers Monde 2, 307–327.

Gonsalves, L., Donovan, S.E., Ryan, V., Winch, P.J., 2015. Integrating population, health, and environment programs with contraceptive distribution in rural Ethiopia: a qualitative case study. Stud. Fam. Plann. 46, 41–54.

Gray, L.C., Moseley, W.G., 2005. A geographical perspective on poverty– environment interactions. Geogr. J. 171, 9–23.

Gready, P., 2009. Reasons to be cautious about evidence and evaluation: rights-based approaches to development and the emerging culture of evaluation. J. Hum. Rights Pract. 1, 380–401.

Hahn, S., Anandaraja, N., D'Agnes, L., 2011. Linking population, health, and the environment : an overview of integrated programs and a case study in Nepal. Mt. Sinai J. Med. 394–405. https://doi.org/10.1002/MSJ.

Hanson, P.W., 2012. Geoforum Toward a more transformative participation in the conservation of Madagascar's natural resources. Geoforum 43, 1182–1193. https://doi.org/10.1016/j.geoforum.2012.03.005.

Harris, A.R., Mohan, V., Flanagan, M., Hill, R., 2012. Integrating family planning service provision into community-based marine conservation. Oryx 46, 179–186.

Hartmann, B., 2014. Converging on disaster: climate security and the malthusian anticipatory regime for africa. Geopolitics 19, 757–783. https://doi.org/10.1080/14650045.2013.847433.

Hoke, T.H., Mackenzie, C., Vance, G., Boyer, B., Canoutas, E., Bratt, J., Mbulo, A., Waceke, N., 2015. Integrating family planning promotion into the work of environmental volunteers : a population, health and environment initiative in Kenya. Int. Perspect. Sex. Reprod. Heal. 41, 43–50.

Holden, S.T., Shiferaw, B., Wik, M., 1998. Poverty, market imperfections and time preferences: of relevance for environmental policy? Environ. Dev. Econ. 3, 105–130. https://doi.org/10.1017/S1355770X98000060.

Honzak, C., Oglethorpe, J., Lopez-Carr, D., 2012. Conservation and family planning: what is the value of integrating family planning into conservation projects? Papers of the Population Association of America Annual Meeting 1–26.

Iida, T., 2005. The past and present of the coral reef fishing economy in Madagascar: implications for self determination in resource use. Senri Ethnol. Stud. pp. 237–258.

Jentoft, S., 2014. Walking the talk: implementing the international voluntary guidelines for securing sustainable small-scale fisheries. Marit. Stud. 13, 14.

Kabeer, N., 2005. Gender equality and women's empowerment: a critical analysis of the third millennium development goal 1. Gend. Dev. 13, 13–24. https://doi.org/10.1080/13552070512331332273.

Kaler, A., 2009. Social Science & Medicine Health interventions and the persistence of rumour: the circulation of sterility stories in African public health campaigns. Soc. Sci. Med. 68, 1711–1719. https://doi.org/10.1016/j.socscimed.2009.01.038.

Kaler, A., 2004. The moral Lens of population control : southern Malawi. Stud. Fam. Plann. 35, 105–115.

Keller, E., 2009. The danger of misunderstanding "culture". Madag. Conserv. Dev. 4, 82–85.

Keren, G., Roelofsma, P., 1995. Immediacy and certainty in intertemporal choice. Organ. Behav. Hum. Decis. Process. 63, 287–297.

Knodel, J., Chayovan, N., Siriboon, S., 1992. The impact of fertility decline on familial support for the elderly : an illustration from Thailand. Popul. Dev. Rev. 18, 79–103.

Langley, J.M., 2006. Vezo knowledge: traditional ecological knowledge in Andavadoaka, southwest Madagascar. Blue Ventur. Conserv. Rep.

Leach, M., Mearns, R., Scoones, I., 1999. Environmental entitlements: dynamics and institutions in community-based natural resource management. World Dev. 27, 225–247.

Leach, M., Mearns, R., Scoones, I., 1997. Environmental entitlements: a framework for understanding the institutional dynamics of environmental change. IDS Discuss. Pap. 359, 1–39.

Le Manach, F., Andriamahefazafy, M., Harper, S., Harris, A.R., Hosch, G., Lange, G.-M., Zeller, D., Sumaila, U.R., 2013. Who gets what? Developing a more equitable framework for EU fishing agreements. Mar. Policy 38, 257–266.

Lopez-carr, D., Ervin, D., 2017. Population-health-Environment (PHE) synergies? Evidence from USAID-Sponsored programs in african and asian core conservation areas. Eur. J. Geogr. 8, 92–108.

Lumley, T., 2017. "Survey" Package.

Marcus, R.R., 2001. Seeing the forest for the trees : integrated conservation and development projects and local perceptions of conservation in Madagascar. Hum. Ecol. 29, 381–397.

Markandya, A., Pearce, D., 1988. Natural environments and the social rate of discount. Proj. Apprais. 3, 2–12. https://doi.org/10.1080/02688867.1988.9726647.

Meffe, G., Ehrlich, A.H., Ehrenfeld, D., 1993. Human population control : the missing agenda. Conserv. Biol. 1–3.

Miller, G., 2009. Contraception as development: new evidence from family planning in Colombia. Econ. J. 120, 709–736. https://doi.org/10.1111/j.1468-0297.2009.02306.x.

Mills, D., Béné, C., Ovie, S., Tafida, A., Sinaba, F., Kodio, A., Russell, A., Andrew, N., Morand, P., Lemoalle, J., 2011. Vulnerability in African small-scale fishing communities. J. Int. Dev. 23, 308–313.

Mohan, V., Shellard, T., 2014. Providing family planning services to remote communities in areas of high biodiversity through a Population-Health-Environment programme in Madagascar. Reprod. Health Matters 22, 93–103. https://doi.org/10.1016/S0968-8080(14)43766-2.

Moser, C., Norton, A., 2001. To Claim Our Rights: Livelihood Security, Human Rights and Sustainable Development. Overseas Development Institute, London.

Newman, K., Fisher, S., Mayhew, S., Stephenson, J., 2014. Population, sexual and reproductive health, rights and sustainable development : forging a common agenda. Reprod. Health Matters 22, 53–64. https://doi.org/10.1016/S0968-8080(14)43770-4.

OECD, 2018. Gender Index: Madagascar [WWW Document]. URL https://www.genderindex.org/country/madagascar/#_ftnref (Accessed 31 August 2018). .

Oldham, J., 2006. Rethinking the Link: A Critical Review of Population-Environment Programs. Population and Development Program at Hampshire College. Political Economy Research Institute at the University of Massachusetts, Amherst.

Oviedo, G., Puschkarsky, T., 2012. World Heritage and rights-based approaches to nature conservation. Int. J. Herit. Stud. 18, 285–296. https://doi.org/10.1080/13527258.2012.652146.

Pender, J.L., 1996. Discount rates and credit markets: theory and evidence from rural India. J. Dev. Econ. 50, 257–296. https://doi.org/10.1016/S0304-3878(96)00400-2.

Pielemeier, J., 2005. Review of Population-health-environment Programs Supported by the Packard Foundation and USAID. Washington, DC. .

Pielemeier, J., Hunter, L., Layng, R., 2007. Assessment of USAID'S Population and Environment Projects and Programming Options. Washington, DC. .

QSR International Pty. Ltd, 2016. NVIVO Qualitative Data Analysis Software.

R core team, 2016. R: A Language and Environment for Statistical Computing.

Randrianasolo, B., Swezey, T., Van Damme, K., Khan, M.R., Ravelomanana, N., Rabenja, N.L., Raharinivo, M., Bell, A.J., Jamieson, D., Mad STI Prevention Group, Behets, F., 2012. Barriers to the use of modern contraceptives and implications for woman-controlled prevention of sexually transmitted infections in Madagascar. J. Biosoc. Sci. 40, 879–893. https://doi.org/10.1017/S0021932007002672.Barriers.

Robbins, P., 2012. Political Ecology: A Critical Introduction, 2nd ed. Wiley.

Robson, L., Holston, M., Savitzky, C., Mohan, V., 2017. Integrating community-based family planning services with local marine conservation initiatives in Southwest Madagascar: changes in contraceptive use and fertility. Stud. Fam. Plann. 48, 73–82. https://doi.org/10.1111/sifp.12016.

Robson, L., Rakotozafy, F., 2015. The freedom to choose : integrating community- based reproductive health services with locally led marine conservation initiatives in southwest Madagascar. Madag. Conserv. Dev. 10, 6–12.

Salafsky, N., 2011. Integrating development with conservation: a means to a conservation end, or a mean end to conservation? Biol. Conserv. 144, 973–978. https://doi.org/10.1016/j.biocon.2010.06.003.

Salafsky, N., Wollenberg, E., 2000. Linking livelihoods and conservation: a conceptual framework and scale for assessing the integration of human needs and biodiversity. World Dev. 28, 1421–1438.

Schuhbauer, A., Chuenpagdee, R., Cheung, W.W.L., Greer, K., Sumaila, U.R., 2017. How subsidies affect the economic viability of small-scale fisheries. Mar. Policy 82, 114–121. https://doi.org/10.1016/j.marpol.2017.05.013.

Schwarz, A., Béné, C., Bennett, G., Boso, D., Hilly, Z., Paul, C., Posala, R., Sibiti, S., Andrew, N., 2011. Vulnerability and resilience of remote rural communities to shocks and global changes: empirical analysis from Solomon Islands. Glob. Environ. Chang. 21, 1128–1140. https://doi.org/10.1016/j.gloenvcha.2011.04.011.

Scoones, I., 2009. Livelihoods perspectives and rural development. J. Peasant Stud. 36, 171–196. https://doi.org/10.1080/03066150902820503.

Scoones, I., 1998. Sustainable Rural Livelihoods: A Framework for Analysis, IDS Working Paper 72.

Sinaga, M., Mohammed, A., Teklu, N., Stelljes, K., Belachew, T., 2015. Effectiveness of the population health and environment approach in improving family planning outcomes in the Gurage, Zone South Ethiopia. BMC Public Health 1–12. https://doi.org/10.1186/s12889-015-2484-9.

Singleton, R.L., Allison, E.H., Le Billon, P., Sumaila, U.R., 2017. Conservation and the right to fish: international conservation NGOs and the implementation of the Voluntary Guidelines for securing Sustainable Small- Scale Fisheries. Mar. Policy 84, 22–32. https://doi.org/10.1016/j.marpol.2017.06.026.

Skjortnes, M., Zachariassen, H.H., 2010. "Even with higher education you remain a woman": a gender perspective on higher education and social change in the Toliara region of Madagascar. Gend. Educ. 22, 193–207. https://doi.org/10.1080/09540250902749075.

Stem, C., Margoluis, R., 2004. Conventional wisdom on causal linkages among population, health, and environment interventions and targets. USAID Healthy People, Healthy Planet Workshop. Foundations of Success.

Sumaila, U.R., 2004. Intergenerational cost – benefit analysis and marine ecosystem restoration. Fish Fish. 5, 329–343. https://doi.org/10.1111/j.1467-2679.2004.00166.x.

Sumaila, U.R., Domínguez-Torreiro, M., 2010. Discount factors and the performance of alternative fisheries governance systems. Fish Fish. 11, 278–287. https://doi.org/10.1111/j.1467-2979.2010.00377.x.

Torell, E., Redding, C.A., Blaney, C.L., Hernandez, E., Sison, O., Dyegula, J., Robadue, D.D., 2012. Population, health, and environment situational analysis for the Saadani National Park Area, Tanzania. Ocean Coast. Manag. 66, 1–11. https://doi.org/10.1016/j.ocecoaman.2012.05.005.

Tucker, B., Lill, E., Tsiazonera, Tombo, J., Lahiniriko, R., Rasoanomenjanahary, L., Razafindravelo, P.M., Tsikengo, J.R., 2015. Inequalities beyond the Gini : subsistence, social structure, gender, Madagascar. Econ. Anthropol. 2, 326–342. https://

doi.org/10.1002/sea2.12034.
United Nations, 2015. Trends in Contraceptive Use Worldwide. New York. .
Upadhyay, U.D., Karasek, D., 2010. Women's Empowerment and Achievement of Desired Fertility in Sub-saharan Africa (No. 80), DHS Working Papers.
Uvin, P., 2007. From the right to development to the rights-based approach: how "human rights" entered development. Dev. Pract. 17, 597–606. https://doi.org/10.1080/09614520701469617.
Walley, C.J., 2004. Rough Waters: Nature and Development in an East African Marine Park. Princeton University Press.
Wells, M.P., Mcshane, T.O., 2004. Integrating protected area management with local needs and aspirations. Ambio 33, 513–519.
Westerman, K., Benbow, S., 2013. The role of women in community-based small-scale fisheries management: the case of the South West Madagascar Octopus Fishery. West. Indian Ocean. J. Mar. Sci. 12, 119–132.
WFFP, 2017. Delhi declaration. WFFP 7th General Assembly.
White, S.C., 1996. Depoliticising development: the uses and abuses of participation. Dev. Pract. 6, 6–15.
Williams, G., 2004. Evaluating participatory development : tyranny, power and (re) politicisation. Third World Q. 25, 557–578. https://doi.org/10.1080/0143659042000191438.
World Bank, 2015. Fertility Rate for Madagascar [WWW Document]. URL. https://data.worldbank.org/indicator/SP.DYN.TFRT.IN?locations=MG.
Yavinsky, R.W., Lamere, C., Patterson, K.P., Bremner, J., 2015. The Impact of Population, Health and Environment Projects: A Synthesis of the Evidence, The Evidence Project. Washington, DC. .

Update 1 of 2

Global Environmental Change

Volume 61, Issue , March 2020, Page

DOI: https://doi.org/10.1016/j.gloenvcha.2020.102031

Global Environmental Change 61 (2020) 102031

Contents lists available at ScienceDirect

Global Environmental Change

journal homepage: www.elsevier.com/locate/gloenvcha

Corrigendum

Corrigendum to "Conservation, contraception and controversy: Supporting human rights to enable sustainable fisheries in Madagascar" [Global Environmental Change Volume 59, November 2019, 101946]

Rebecca L. Singleton[a,b,*], Edward H. Allison[c], Charlotte Gough[b], Vinay Kamat[d], Philippe LeBillon[e], Laura Robson[b], U. Rashid Sumaila[a]

[a] Fisheries Economics Research Unit, Institute for the Oceans and Fisheries, University of British Columbia, AERL, 2202 Main Mall, Vancouver, V6T 1Z4, Canada
[b] Blue Ventures Conservation, Omnibus Business Centre, 39-41 North Road, London, N7 9DP, UK
[c] University of Washington, United States
[d] Department of Anthropology, University of British Columbia, Canada
[e] Department of Geography, University of British Columbia, Canada

The authors regret to inform readers that a correction to a few lines in the section "Funding (including role of funding source)" and to the "Acknowledgements" sections.

The sentence "Finally, the Population Reference Bureau provided funding for the implementation of the fieldwork described. Blue Ventures shared the questionnaire used in this research at a workshop hosted by Population Reference Bureau prior to conducting fieldwork. Additional questions requested by the Population Reference Bureau were asked during these surveys, but none of the data arising from those questions is used in this paper." has been removed at the request of the Population Reference Bureau.

And a correction to a few lines in the section "Acknowledgements".

"The authors are also grateful to the following funders who support Blue Ventures in monitoring and evaluating its projects, including support for the fieldwork described in this paper: Balcombe Charitable Trust; The John D. and Catherine T. MacArthur Foundation; Population Reference Bureau." should be "The authors are also grateful to the following funders who support Blue Ventures in monitoring and evaluating its projects, including support for the fieldwork described in this paper: Balcombe Charitable Trust; The John D. and Catherine T. MacArthur Foundation.".

The authors apologise for these errors and any consequent inconvenience to readers.

DOI of original article: https://doi.org/10.1016/j.gloenvcha.2019.101946
* Corresponding author.
E-mail address: rlsingleton@gmail.com (R.L. Singleton).

https://doi.org/10.1016/j.gloenvcha.2020.102031

Available online 09 February 2020

Update 2 of 2

Global Environmental Change

Volume 62, Issue , May 2020, Page

DOI: https://doi.org/10.1016/j.gloenvcha.2020.102033

Global Environmental Change 62 (2020) 102033

Contents lists available at ScienceDirect

Global Environmental Change

journal homepage: www.elsevier.com/locate/gloenvcha

Corrigendum to "Conservation, contraception and controversy: Supporting human rights to enable sustainable fisheries in Madagascar" [Global Environmental Change Volume 59, November 2019, 101946]

Rebecca L. Singleton[a,b,*], Edward H. Allison[c], Charlotte Gough[b], Vinay Kamat[d], Philippe LeBillon[e], Laura Robson[b], U. Rashid Sumaila[a]

[a] Fisheries Economics Research Unit, Institute for the Oceans and Fisheries, University of British Columbia, AERL, 2202 Main Mall, Vancouver, V6T 1Z4, Canada
[b] Blue Ventures Conservation, Omnibus Business Centre, 39-41 North Road, London, N7 9DP, UK
[c] University of Washington, United States
[d] Department of Anthropology, University of British Columbia, Canada
[e] Department of Geography, University of British Columbia, Canada

The authors regret to inform readers that a correction has been made in the "Funding (including role of funding source)" and "Acknowledgements" sections. The following changes have been made at the request of the Population Reference Bureau. The authors apologise for any inconvenience caused.

The following sentence has been removed in the "Funding (including role of funding source)" section:

"Finally, the Population Reference Bureau provided funding for the implementation of the fieldwork described. Blue Ventures shared the questionnaire used in this research at a workshop hosted by Population Reference Bureau prior to conducting fieldwork. Additional questions requested by the Population Reference Bureau were asked during these surveys, but none of the data arising from those questions is used in this paper."

And the Population Reference Bureau has been removed from the list of acknowledged funders in the section "Acknowledgements".

DOI of original article: https://doi.org/10.1016/j.gloenvcha.2019.101946
* Corresponding author: Rebecca Singleton.
E-mail address: rlsingleton@gmail.com (R.L. Singleton).

https://doi.org/10.1016/j.gloenvcha.2020.102033

Available online 09 February 2020