Article

Evaluating the Conservation Attitudes, Awareness and Knowledge of Residents towards Vieques National Wildlife Refuge, Puerto Rico

Ana Guzman1, Joel T. Heinen2,#, and Jay P. Sah1

1Department of Earth and Environment, Florida International University, Miami, FL, USA
2Southeast Environmental Research Center, Florida International University, Miami, FL, USA

#Corresponding author. E-mail: heinenj@fiu.edu

Abstract
Numerous studies have shown that conflicts between local people and Protected Areas (PA) can undermine conservation goals. This study explores attitudes towards Vieques National Wildlife Refuge (VNWR), Puerto Rico, USA, a former military site with a controversial political history, high ecological values and a toxic legacy including unexploded ordnances as a result of the area’s former use as a naval bombing range. Our objective is to evaluate how residents perceive VNWR and to elucidate conflicts associated with former and current uses of the area through semi-structured and key informant interviews. Socio-economic factors and misconceptions about management were among the variables influencing attitudes about the refuge. Overall, many residents did not express particularly strong attitudes, but there were many significant differences among demographic groups. Older and less educated individuals, and those living longer on Vieques Island, had poorer attitudes about the refuge and its management while younger, more educated, short-term residents, and those employed in the tourism sector, had more positive attitudes. The most common reasons for expressing discontent were restrictions on access and rules limiting resource extraction. Some negative concerns were false impressions of current restrictions (i.e. many resources can be legally removed from VNWR), while some others were issues not under the control of the Fish and Wildlife Service (i.e. fishing rules are set by the Commonwealth of Puerto Rico). The results suggest that much more public outreach and education are urgently needed. We recommend that VNWR expand public uses where feasible and better-publicise formal regulations and the reasons for them.

Keywords: Attitudes, awareness, conservation, Military to Wildlife (M2W) Refuges, park-people conflicts, Puerto Rico, Vieques National Wildlife Refuge

INTRODUCTION

Background
The concept of protecting natural areas has been around for thousands of years, with examples such as royal hunting reserves as early as 700 B.C. (Runte 1997) and sacred groves in India dating to 1500 B.C. (Heinen 1995; Briggs 2009). In the recent past, stricter forms of conservation have marginalised many rural people dependent on local natural resources (e.g., Liu et al. 2010; Vedeld et al. 2012; Sharma and Rajagopalan 2013) often resulting in park-people conflicts (e.g., Heinen and Shrivastava 2009; Htun et al. 2012; Heinen et al. 2019). This has ultimately driven a global shift in Protected Areas (PAs) management, along with associated research (e.g., Mascia et al. 2003; Voyer et al. 2012; Bragagnolo et al. 2016), more into the social sciences to address perceptions, attitudes, awareness and conflicts between residents and PAs (e.g., Agardy et al. 2003; Torn et al. 2008; Szell and Hallett 2013). In general, negative perceptions can complicate PA management (Anthony 2007). Positive perceptions can...
enhance conservation goals provided there are strategies in place to address conflict, benefits are relatively equitable and rules are known and equally enforced (Thomassin et al. 2010; Heberlein 2012; Pullin et al. 2013). In all cases, residents’ awareness of conservation policies and programs is needed.

American National Wildlife Refuges (NWRs) managed by the U.S. Fish and Wildlife Service (FWS) generally conform to IUCN Category IV reserves: i.e. wildlife reserves, refuges, or managed habitat reserves (Heinen 2012). The US refuge system follows a dominant-use policy where primary goals include conservation, management, and restoration of wildlife populations, habitats and related resources (Fischman 2002). Secondary uses such as cultural, recreational and economic activities can coexist so long as they don’t compromise on primary goals. It is thus important to understand the demand for secondary uses and the socio-economic dimensions of NWRs in the local context to assure that primary goals of conservation and management are met.

One type of NWR has been referred to elsewhere (e.g., Havlick 2011) as Military to Wildlife (M2W) refuges. These PAs are established on former military lands that were decommissioned primarily on the 1990s and 2000s after the end of the Cold War. M2W refuges are complex in their management needs because many are heavily contaminated sites that simultaneously harbour high biodiversity; they tend to have heavily impacted areas formerly used for military training and other, frequently large areas, with little to no human disturbance (Havlick 2014). Once decommissioned, former training areas can pose myriad health and safety hazards (e.g., EPA 2016) which frequently leads to restricted access and negative public perceptions. Social, economic, and political issues related to the former military presence and M2W conversion can further exacerbate negative perceptions (see below).

Here we consider the societal perceptions concerning one such M2W refuge: Vieques National Wildlife Refuge (VNWR) on Vieques Island, Puerto Rico (Figure 1; see below). This is the first large-scale social survey of which we are aware that explores residential attitudes about and conflicts with the management of any M2W refuge. The purpose of this research is to fill the void of knowledge regarding public perceptions of such reserves by using both semi-structured surveys of the general public and key informant interviews of the most knowledgeable individuals to assess the perceptions, awareness and attitudes of Vieques residents toward VNWR, and its governance. Previous studies (e.g., Moorman 2006; Sesabo et al. 2006) have shown the relevance of social science research tools in acquiring information about local perceptions, attitudes, knowledge and resource use patterns concerning PAs. In particular, semi-structured questionnaire surveys have been used by many researchers (e.g., Fiallo and Jacobson 1995; Sah and Heinen 2001) to study various aspects of park/people relations and natural resources uses. The present paper concentrates on results of semi-structured surveys and uses some key informant statements to back up those results. We are preparing another paper that assesses more fully the results of the key informant surveys using methods developed elsewhere (e.g., Bernard 2006) and tested for various natural resource management studies (Dongol and Heinen 2012; Krolloff et al. 2019).

Conflicts that may arise from perceptions are also elucidated to help make better managerial recommendations. Specific objectives are to: 1) assess perceptions and attitudes of residents towards VNWR, 2) analyse findings in relation to socio-economic and demographic factors that best explain them, 3) determine the local level of knowledge and awareness of VNWR, and 4) identify compliance issues and complaints.

The Political History and Site Description of VNWR

The US Navy expropriated two-thirds of Vieques Island in the 1940s - thereby displacing local residents - for the establishment of an ammunition depot and live fire training range (Barreto 2002; US Department of Health 2003). Many Viequenses and mainland Puerto Ricans opposed naval occupation and struggled for it to end (Langhorne 1987; McCaffrey 2002). In 2003, the US Navy ended all military operations (Baver 2006; 2012) but still maintains a presence to remove unexploded ordnances and toxic debris. Of the former military lands, 1,740 ha. were ceded to the Municipality of Vieques, 324 ha. to the Puerto Rico Conservation Trust and 7,192 ha. to the FWS for the creation of VNWR. As a result of six decades of practice bombings, Vieques was left with long-term contamination (Cruz Pérez 1988; Marques and Fernandez-Portes 2001) and was listed on the National Priorities List (i.e., a “Superfund site”) in 2005 (Bearden 2005; EPA 2016). Unexploded ordnances pose the biggest risk and, as a result, large parts of VNWR are closed to the public (USFWS 2013; Figure 2). FWS does not plan to implement management practices on those sites until ongoing decontamination is complete (USFWS 2007). Areas open to the public also have restrictions such as limited hours and some rules on resource extraction that are not well publicised (Davis et al. 2007; see below).

VNWR was designated under a Congressional Act (Public Law 106-398 and Public Law 107-107) without the involvement or input of local communities or the municipal government which complicates enforcement and creates a climate of conflict (Tissot et al. 2009; Heinen 2010). Large majorities of the population opposed naval occupation and, for many residents, the FWS became the focus of resentment because they viewed it as an extension of naval control (McCaffrey 2009). In interviews with nine households during a preliminary study, strong resentment to VNWR was expressed (McCaffrey 2006). In many news articles and interviews (e.g., CBS, El Nuevo Día) from 2003 to present, there has been resistance to VNWR. But there have been no broader studies about attitudes towards, or conflicts with, the refuge until this work.

Vieques Island, located seven miles off the southeast coast of Puerto Rico’s main island (Figure 1), had 9,301 residents
and 3,666 households in 2010 (U.S. Census Bureau 2010). For many residents, tourism is an important source of income and that sector decreased after naval departure (NBC News 2010). Vieques had an unemployment rate of 10.1% and approximately 43.2% of its population lived below the poverty line in 2013 (U.S. Census Bureau 2013).

VNWR has diverse terrestrial and surrounding marine ecosystems that support many native species, of which sixteen are federally listed (USFWS 2007). Aquatic habitats include expanses of seagrass, coral reefs including endangered staghorn and elkhorn corals (*Acropora cerviconis*, *Acropora palmate*), and three bioluminescent bays (Bauer and Kendall 2010). VNWR provides habitat for many biologically, commercially, and culturally important species such as queen conch (*Strombus gigas*), spiny lobster (*Panulirus argus*), blue land crab (*Cardisoma guanhumi*) and many sport fish (USFWS 2007). Green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*) and leatherback...
(Dermochelys coracea) turtles, all federally-listed, nest on its beaches (Bauer et al. 2008). In total, 174 bird species have been documented in VNWR (Gemmill 2015). VNWR thus provides conservation opportunities while offering a basis for sustainable socio-economic activities such as nature-based tourism and legal extraction of some natural resources (e.g., crabs, fish and coconuts; see below).

**METHODS**

**Data Collection**

Here we used a semi-structured survey adapted from previous research completed in 2012 (Heinen et al. 2017), edited for site-specificity and pre-tested with 12 Vieques residents not part of the main study, and key informant surveys (below) to add further, more specific information. The semi-structured survey, available upon request, included open- and closed-ended questions on household demographics, attitudes, awareness, and resource and recreational uses. Protocols for both the semi-structured and key informant surveys were approved by Florida International University’s Institutional Research Board and followed all Federal guidelines for the use of human subjects in research (below). The researcher first introduced herself as a non-Federal employee with university credentials, and informed respondents of the purposes of the study and the nature of the questions. She then requested consent to interview. The semi-structured survey was voluntary and completely anonymous in that no respondent names or addresses were requested, nor were they written down in cases in which respondents offered them.

After respondents were fully informed, guaranteed anonymity and consented to do the survey, they were first asked about what activities they conducted within VNWR. Responses were classified as Consumptive, Non-consumptive and No-use. Consumptive uses were those resulting in extraction of resources (e.g., fishing, collecting crabs, snails or coconuts) and non-consumptive uses were mostly recreational (e.g., hiking, snorkeling, kayaking and swimming). We also asked respondents whether they or family members had received a fine or reprimand from VNWR and whether they had participated in protests against the Navy.

As with similar studies (e.g., Heinen and Shrivastava 2009) we aimed to get a sample of at least 5% of households on the island. In total, we conducted 235 individual surveys, each from different households, between July 2014 and January 2015, which accounted for 6.41% of total households based on the most recent (2010) census, an acceptable sample size for these purposes (Turner 2003). Random sampling was done in all residential areas (per Heinen et al. 2017 for Puerto Morelos, Mexico). Survey respondents were also approached in public areas such as shops, restaurants and the ferry dock. Surveys were conducted of adult residents over the age of 18 in either Spanish or English, depending on respondent preference, by the first author (a native speaker of both languages). Locations were visited at different times of the day on both weekdays and weekends and some public space sampling was also done for both convenience and safety reasons. That is, some residents were reluctant to open their doors during house-to-house sampling, while others were rarely home during daylight hours. Public space sampling, in combination with house-to-house sampling, allowed for more participation.

Qualitative key informant surveys were also conducted after fully-informing respondents of the purpose and scope of the study, and obtaining consent. Here, key informants included refuge employees, local government officials, non-profit employees and members, and people in the fishing and tourism sectors. Since such surveys include knowledgeable individuals with some vested professional stake in the topic, they are widely used in resource management studies (e.g., Ter-Ghazaryan and Heinen 2006; Shrestha-Acharya and Heinen 2006). They are not anonymous to researchers but all informants interviewed here were guaranteed that their names would not appear in any published results. Key informants are useful in corroborating information obtained through other methods and in providing additional insights given that they tend to have more in-depth knowledge of the issues than does the general public (e.g., Garcia Lozano and Heinen 2016).

**Data analysis**

Quantitative data were analysed for patterns and relationships using the Statistical Package for Social Scientist (SPSS) version 22. To facilitate statistical analyses, an attitude score was calculated for each respondent based on replies to nine questions. For example, a question asking if the respondent is in favor of the rules and regulations in VNWR would receive a numerical value of 1 for YES, 0 for NO, and 0.5 for NEUTRAL or DO NOT KNOW (Table 1; e.g., following Baral and

Standardised attitude scores were then analysed against gender, age, education, occupation and time living on Vieques. The same was done for questions related to the level of knowledge to calculate an awareness score. Attitude and awareness scores are considered dependent variables, with all others serving as independent variables. We thus consider how, or to what extent, demographic variables, or those related to uses of or conflicts with the refuge, influenced attitudes and awareness of VNWR. Statistical tests included mean comparisons with one-way analyses of variance (ANOVA), Kruskal-Wallis (K-W) and Mann-Whitney (M-W) tests. To choose statistical tests, data were tested for normality and homogeneity of variance using the Shapiro-Wilk and Levene’s tests. Non-parametric tests were used for non-normal data sets. Effects of age and time living on Vieques on people’s attitude scores were analysed using simple and multiple linear regressions.

Here we also use some key informant results to back up or elaborate upon semi-structured survey results (see below).
We are preparing another manuscript that explores, much more fully, qualitative analyses of the key informant surveys resulting from this study, based on Bernard's (2006) framework (e.g., following Dongol and Heinen 2012). We plan to report that work elsewhere.

RESULTS

Descriptive statistics for Independent Variables

The total sample had a mean age of 48.2 yrs. (±17.0, Table 2), with 45.5% (n=107) female and 54.5% (n=128) male (Table 3). The majority (72.8%) were born on Vieques, while 23% had migrated from mainland PR or the incorporated USA (Table 3). Mean time living on Vieques was 37.8 (±21.9) years and ranged from <1 year to 84 years. Many respondents (39.5%) were not working including the retired, housewife and unemployed categories (Table 3). Tourism-related occupations were held by 17.9% of respondents. Occupations grouped into the Other category (18.7%) included health workers, hair stylists, clerks, equipment operators, security, maintenance and small business owners. The education level of respondents was divided into five categories: LessHS (less than a high school degree), HS (high school degree or equivalent), SOME (some college or post-secondary training), BA (bachelor’s degree) and GradDegree (graduate degree). Most individuals fell in the HS (30.6%) or SOME (31.1%) categories (Table 3).

Results showed that 54.1% of respondents used VNWR for non-consumptive activities, 35.3% for consumptive purposes (defined above), and 10.6% indicated no use. Follow-up questions revealed that some individuals fished to compensate for high food prices and/or low incomes. A total of 38.5% of respondents had participated in anti-Navy protests and 24.6% said that they or any family member had received a fine or warning.

Attitudes towards Vieques National Wildlife Refuge

Standardised attitude scores across all respondents fell between 0 and 1, with a mean of 0.58 and standard deviation of 0.28. While evaluating the responses to specific questions (Table 4), 57.4% agreed with the creation of VNWR and 51.5% were positive about former naval lands converting to VNWR. Over two thirds of respondents (68.9%) thought there are advantages to having a wildlife refuge on Vieques Island. Meanwhile, 55.3% also stated there were some disadvantages and 33.5% stated that there were both advantages and disadvantages of VNWR. Follow-up questions revealed that many considered conservation an advantage and restrictions on access or resource collection, a disadvantage. Almost half (48.1%) wanted the refuge to remain protected, but not necessarily under federal control, while about one-third (34.9%) wanted it to remain under FWS control. Fewer than half agreed that VNWR employees were courteous and professional (39.6%) or that the refuge was well managed (37.0%). But when asked about refuge rules and regulations, 25.5% could not respond because they were unaware of any (Table 4). Of those who did know at least some of the rules and regulations, 26% agreed with them and 20% disagreed. Most (53.7%) agreed with some but not others. Among the most

| Table 1 | Summary of attitude questions, variable name, and numerical values per response. The raw total score would be from 0-9. The final standardized attitude score could range from 0-1, and was calculated by dividing the raw total score by number of questions (9) |
| --- | --- |
| Attitude Questions | Attitude variable name | Value Per Response |
| Are you in favour of the rules and regulations? | AttitudeRR | Yes=1 No=0 Some=0.5 |
| Did you agree with the creation of the VNWR? | AgreeNWR | Yes=1 No=0 Neutral=0.5 |
| The refuge personnel are professional and courteous. | EmployesAttitude | Agree=1 Disagree=0 Neutral=0.5 Ignorant=0.5 |
| In general the refuge is well managed. | RefugeMgt | Agree=1 Disagree=0 Neutral=0.5 Ignorant=0.5 |
| In general, could you say you are happy that the former Naval lands in Vieques are now a NWR? | FavorNWR | Yes=1 No=0 Neutral=0.5 |
| Would you and your family prefer the NWR lands to remain under the control of the US federal government (FWS) or would you like the land to be ceded? | LandControl | Feds=1 Ceded=0 None=0.5 Other=0 |
| In the case of ceding the lands to another agency or institution, should the lands remain as a protected area or used another way? | LandDesig | PA=1 Another=0 Both=0.5 Other=0.5 |
| Are there advantages to having the VNWR? | AdvNRW | Yes=1 No=0 Neutral=0.5 |
| Are there disadvantages to having the VNWR? | DisadvNRW | Yes=0 No=1 Neutral=0.5 |

| Table 2 | Descriptive statistics for demographic variables. Includes independent variables of age, household numbers and time (years) that respondent has lived on Vieques |
| --- | --- |
| Demographic Variables | Minimum Value | Maximum Value | Mean | Standard Deviation |
| Age | 18 | 85 | 48.21 | 17.03 |
| Time on Vieques | 0 | 84 | 37.79 | 21.88 |
| Adults in Household | 1 | 7 | 2.30 | 1.19 |
| Minors in Household | 0 | 5 | 0.69 | 1.13 |
| Total Household | 1 | 12 | 2.99 | 1.81 |
common reasons for expressing discontent were regulations limiting resource extraction including fishing and collecting crabs, sea snails and coconuts.

There were no significant differences in mean attitude scores for the independent variables: gender (M-W test: U = 6354, p = 0.332), level of education (K-W test: H(3) = 4.611, p = 0.203) or occupation (K-W test: H(6) = 11.169, p = 0.083). Based on responses to a follow up question about occupation depending directly or indirectly on tourism, results showed that those working in tourism had higher attitude scores than those who did not (M-W test: U = 5172, p = 0.037). Birthplace also had an effect in that respondents born elsewhere had higher attitude scores (0.72) than those born on Vieques (0.53; M-W test: U = 7507.5, p < 0.001). Age and time on Vieques were analysed in 10-year intervals and both resulted in significant variance between mean attitude scores. Respondents 18 to 29 years old had higher attitude scores than those 60 to 69 years old (K-W test: H(5) = 13.187, p < 0.001; Figure 3a). Age and time on Vieques were intermediate. However, note that age only accounted for 4.7% of the variability in attitude score (R^2=0.047). When running the same analysis with time on Vieques, results were comparable (F_{2, 232} = 13.08, p < 0.001) yet they only accounted for 10.1% of the variability (R^2=0.101). The standard coefficient revealed that the linear regression is negative (b = -0.833), while the non-linear part of the model is positive (b = 0.587), which corresponded to the mean plot patterns and K-W test results (above).

Respondents indicating the three different use patterns within VNWR (i.e., non-consumptive, consumptive, and no use) did not differ in mean attitude scores (K-W test: H(2) = 2.885, p = 0.236). However, participation in anti-navy protests affected attitudes (M-W test: U = 9403.5, p < 0.001) in that those who participated had lower scores than those who did not. Similarly, those who had received a warning or fine for not complying with time on Vieques, results were comparable (F_{2, 232} = 13.08, p < 0.001). The standard coefficient revealed that the linear regression is negative (b = -0.833), while the non-linear part of the model is positive (b = 0.587), which corresponded to the mean plot patterns and K-W test results (above).

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### Table 3

| Demographic variables | Category | Frequency | Percent |
|-----------------------|----------|-----------|---------|
| Gender                | Female   | 107       | 45.5    |
|                       | Male     | 128       | 54.5    |
| Birthplace            | Vieques  | 171       | 72.8    |
|                       | Mainland, PR | 27       | 11.5    |
|                       | USA      | 27        | 11.5    |
|                       | Other    | 9         | 3.8     |
|                       | Missing  | 1         | 0.4     |
| Occupation            | Retired  | 45        | 19.1    |
|                       | Tourism  | 42        | 17.9    |
|                       | Housewife| 33        | 14.0    |
|                       | Government| 28      | 11.9    |
|                       | Self     | 28        | 11.9    |
|                       | Unemployed| 15      | 6.4     |
|                       | Other    | 44        | 18.7    |
| Education             | LessHS   | 47        | 20.0    |
|                       | HS       | 72        | 30.6    |
|                       | Some     | 73        | 31.1    |
|                       | BA       | 33        | 14.0    |
|                       | GradDegree| 10     | 4.3     |

### Table 4

| Attitude variables | Response | Frequency | Percent |
|--------------------|----------|-----------|---------|
| AttitudeRR         | No       | 35        | 14.9    |
|                    | Yes      | 94        | 19.6    |
|                    | Some     | 46        | 40.0    |
|                    | Not Applicable | 60 | 25.5    |
| AgreeNWR           | No       | 63        | 28.3    |
|                    | Yes      | 135       | 57.4    |
|                    | Neutral  | 25        | 10.6    |
|                    | Missing  | 12        | 5.1     |
| EmployeAttitude    | Agree    | 93        | 39.6    |
|                    | Disagree | 30        | 12.8    |
|                    | Ignorant | 66        | 28.1    |
|                    | Neutral  | 44        | 18.7    |
|                    | Missing  | 2         | 0.9     |
| RefugeMgmt         | Agree    | 87        | 37.0    |
|                    | Disagree | 33        | 14.0    |
|                    | Ignorant | 69        | 29.4    |
|                    | Neutral  | 43        | 18.3    |
|                    | Missing  | 3         | 1.3     |
| LandControl        | Cede     | 108       | 46.0    |
|                    | Feds     | 82        | 34.9    |
|                    | None     | 35        | 14.9    |
|                    | Other    | 9         | 3.8     |
|                    | Missing  | 1         | 0.4     |
| CedePA             | Another  | 61        | 26.0    |
|                    | Both     | 39        | 16.6    |
|                    | Other    | 14        | 6.0     |
|                    | PA       | 113       | 48.1    |
|                    | Missing  | 8         | 3.4     |
| FavorNWR           | No       | 72        | 30.6    |
|                    | Yes      | 121       | 51.5    |
|                    | Neutral  | 38        | 16.2    |
|                    | Missing  | 4         | 1.7     |
| AdvNRW             | Neutral  | 24        | 10.2    |
|                    | No       | 49        | 20.9    |
|                    | Yes      | 162       | 68.9    |
| DisadvNRW          | Neutral  | 22        | 9.4     |
|                    | No       | 81        | 34.5    |
|                    | Yes      | 130       | 55.3    |
|                    | Missing  | 2         | 0.9     |
had lower attitude scores than those who did not (M-W test: U = 6453, p = 0.001).

**Awareness of the Vieques National Wildlife Refuge**

The standardised awareness score for all respondents varied between 0 and 1, with a mean value of 0.486 and standard deviation of 0.239. Specific survey questions regarding awareness revealed that about one fourth of participants were unaware of any regulations; and half were only familiar with some. Most (83.33%) agreed that VNWR had ecological importance, although many could not articulate why. Responses ranged from specific environmental functions to less informed answers demonstrating a lack of basic ecological knowledge. Responses were assigned a point value ranging from 0 to 3, which was later added as part of the final standardised awareness score. Only 11.1% of respondents attained the maximum point value for this question. When asked about health and safety issues within the refuge, over two-thirds (71.8%) were aware of them and had not received information regarding the topic.

There were no differences in mean awareness scores between the sexes (M-W test: U = 6309.5; p = 0.297) or due to place of birth (K-W test: H(3) = 8.348, p = 0.039). Respondents born in the USA had higher scores than those born on Vieques and the level of education also had a significantly positive effect on awareness scores (F(3, 232) = 15.221, p < 0.001). Respondents in the LessHS and HS category had lower scores than those in both SOME and GradDegree category. Finally, those who worked directly or indirectly in tourism had higher awareness scores (M-W test: U = 4652, p = 0.002). The variables age and time on Vieques were examined to identify possible correlations with awareness scores. A simple linear regression revealed a negative correlation (p = 0.003) between age and awareness score (standard coefficient = -0.193). However, the R-squared (0.037) was very low. The same regression performed on time on Vieques was also significant (p < 0.001) and the standard coefficient (-0.259) showed that the relationship was negative but the R-squared value was similarly low (0.067).

Level of awareness was affected by the types of uses in VNWR (F(2, 232) = 4.391, p = 0.013). The no-use group had a lower mean awareness score than both the consumptive and non-consumptive use groups. Similarly, participants who had received a warning or fine in VNWR had lower awareness scores than others (M-W test: U = 4115.0, p = 0.046). Involvement in anti-naval protest did not affect awareness (M-W test: U = 5449.0, p = 0.210).

**DISCUSSION**

**Attitudes towards Vieques National Wildlife Refuge**

Our results showed little consensus among residents regarding attitudes based on the mean attitude score of 0.58 with values ranging from 0 to 1. Significant results showed that age, time on Vieques, involvement in tourism, birthplace, receiving fines and participating in protests all influenced attitudes. There are many potential reasons for these findings including historical, social, cultural and economic factors.

Lower attitude scores were associated with several related variables. Those with lower scores tended to be older, have longer residencies, have participated in anti-naval protests, and/or were native Viequenses. Presumably, these variables all tie in with the socio-political history of the island through individuals’ experiences. Longstanding social theories argue that individuals’ attitudes or beliefs are influenced by experiences that in turn guide future behavior (Forgas et al. 2010). Long-term residents were fully exposed to adverse impacts of military practices from 1941 to 2003. These impacts ranged from military personnel visits resulting in excess drinking and sexual harassment to restricted ocean access threatening anglers’ livelihoods (Enloe 1990); furthermore, frequent bombing practices damaged homes and spread contaminants beyond live-impact areas (Grusky 1992; Davis et al. 2007). One respondent stated, “the bombing would shake our home, crack our walls and awaken us at night”. Meanwhile contaminants were associated with many health and environmental hazards according to many sources (e.g., Nazario et al. 1998; Ortiz-Roque et al. 2000; Marques and Fernandez-Portes 2001; Massol-Deýa et al. 2005) and...
likely swayed attitudes of (especially) long-term residents.

The oldest residents, especially those born on Vieques, lived through the expropriation of land in the 1940’s or heard vivid recollections of it from family and neighbours. Long-term, middle-aged or older residents would have lived through what McCaffrey (2008) described as an intensification of live firing practices during the 1970s and the first anti-naval uprisings lead by fishermen at that time and later. Between 1999 and 2003, residents experienced, and many participated in, the anti-naval protests that advocated for demilitarisation, decontamination, land reform and development. Yet, most military lands were transferred to the FWS for VNWR. Much of the reason for such lands being turned over to the FWS has to do with liability. That is, contamination on those sites is such that, if they were turned over to civilian, private or municipal uses, the costs of cleanup would be much greater. The cheapest way out for the military was to turn over decommissioned areas (about 25 nation-wide to date) to a Federal agency to manage them for non-human purposes; hence FWS is an ideal choice (e.g., Havlick 2014).

The controversial military history in Vieques, and its effects on human health and well-being, has elicited distrust towards the federal government in general, as expressed by this comment— “It’s ironic, so many years bombing the environment and now they protect it.” These experiences, coupled with what some residents perceive as stricter regulations under the FWS, have all impacted attitudes. The following statements are from respondents who expressed low attitude scores:

“There are more restrictions now than when the Navy was here” (54-year-old male)
“We used to fish at night when the navy was here, but now it’s not allowed” (79-year-old male)
“I wish we could camp overnight as we used to in the past” (68-year-old female)
“They [FWS] take away our rights in our own land. I disagree with having a foreigner come to command here” (59-year-old male)

It [VNWR] was imposed, we wanted the lands to be returned to the government of Puerto Rico” (46-year-old female)

Several respondents used this saying: “FWS es el mismo perro con distinto collar.” A direct translation is: “FWS is the same dog with a different collar.”

Among the most common reasons for expressing discontent were the restrictions on resource extraction, a common complaint in many places (e.g., Cook and Heinen 2005; Shrivastava and Heinen 2007). Residents in Vieques pre-refuge would have had the opportunity to access more lands, camp and engage in other activities (e.g., crabbing, fishing) in the former naval grounds when maneuvers were not being conducted. Currently, these activities are either prohibited (e.g., camping) or regulated in VNWR.

The connection between the history of Vieques and some negative attitudes toward the FWS is also substantiated in newspaper articles. For example, El Nuevo Dia (2013) commemorated the 10-year anniversary of the US Naval departure and included statements by local stakeholders such as: “The Viequense feel harassed by the USFWS, a quasi-military entity… We understand that the USFWS is worse than the Navy.” That same year, Claridad (2013) published articles in which federal agencies including the Navy, EPA, and FWS were accused of creating economic, social, health and environmental crises in Vieques since the 1940s that still persisted. Of course, EPA did not exist until 1970 and FWS had no jurisdiction on the island until 2003, but such were the perceptions of some locals in 2013. Some scholarly publications (e.g., Shivlani 2007; Davis et al. 2007; McCaffrey 2006) have considered residents’ inherent distrust of FWS and perceptions that management actions do not favor their well-being. Overall, one can speculate that individuals who are older, have longer residencies and/ or are native Viequenses have stronger ties to the history and presumed injustices of the island. The low attitude scores among former anti-naval protesters found here suggest that some residents view the FWS as no more than an extension of the Navy.

Low attitude scores were also found among those subjected to fines or warnings, which is likely the simple result of resentment towards the agency for its imposition of authority (Heinen 2012). Additionally, when residents were asked a follow up question about the experience of receiving disciplinary action, some stated that the treatment by FWS law enforcement was unpleasant. More generally, many respondents expressed some discontent with regulations and with FWS employees.

Higher attitude scores were associated with younger respondents, shorter residency times, non-Vieques born residents and those working directly or indirectly in the tourism sector, similar to results found elsewhere (e.g., Sekhar 2003). USFWS (2015) considers public involvement to be vital for meeting conservation goals. In general, environmental education has been shown to influence individual’s attitudes towards conservation positively (e.g., Arcury 1990; Aminrad et al. 2013; Bradley et al. 1999). Key informant interviews with staff and some open-ended responses from survey participants revealed that younger residents of Vieques are targeted for many outreach and educational programmes, in addition to the refuge maintaining an accessible visitor’s center open during business hours. Activities include field trips, school visits and a paid summer youth programme, all of which may improve attitudes among younger residents.

The oldest respondents (≥70 years old) may also be positively influenced by outreach that is geared specifically toward them, as per several key informant surveys with refuge staff. These factors may explain the curvilinear relationship between age and attitude scores. The correlations between attitude scores and age can also be related to residency times, because younger individuals lived less time on Vieques and older individuals could have resided longer. However, this is not always the case; for example, some individuals moved to Vieques for retirement. Respondents who had lived on Vieques for 12 years or less (at the time surveys were done) would not have witnessed naval operations. Consequently, for them, it is
less likely that negative associations were made with federal control over the island.

Individuals born on mainland Puerto Rico, continental USA or elsewhere also tended to have lived less time on Vieques. In addition, non-native residents tended to work in the tourism sector, which depends on nature-based recreation (see conclusions). Presumably, individuals in the tourism sector perceived economic benefits from natural resource conservation, which others (e.g., Fiallo and Jacobson 1995) have shown to result in more positive attitudes. Moreover, respondents born in the USA tended to have more positive attitudes towards the federal government and several expressed that the Puerto Rican government lacked capacity to manage the site.

Independent of age and length of residency, respondents employed directly or indirectly in tourism had higher mean attitude scores than their counterparts, a finding supported in other studies (e.g., Sekhar 2003). Positive attitudes were further evident with statements such as: “It [VNWR] is one of the aspects that makes Vieques Island unique for a tourist destination”. Individuals in the tourism sector also had more knowledge about the importance of environmental protection. Another respondent stated: “[VNWR] protects an ecosystem that no longer exist in the Caribbean… and it is important to Vieques because it brings ecotourism”. As found in other studies (e.g., Heinen et al. 2017) perceived economic benefits of conservation resulted in higher attitude scores.

**Awareness of the Vieques National Wildlife Refuge**

Higher awareness scores also were associated with younger respondents, shorter residency times, more education, refuge users, and those working directly or indirectly in the tourism sector, all of which lead to higher exposure to information regarding VNWR. For example, refuge users or those working in tourism that may conduct activities within or near the refuge have more opportunities to learn regulations and interact with staff. Similarly, younger respondents would be expected to have higher awareness scores since FWS conducts educational and outreach activities that generally target youth. Younger respondents would also be expected to have shorter residencies due to their age, thus the correlation of residency time with awareness. Higher formal education also resulted in higher awareness scores. This is likely because of greater exposure to environmental concepts and has been shown elsewhere (e.g., Ostman and Parker 1987).

Not surprisingly, those who had received a fine or warning had lower attitude scores, likely because those unfamiliar with rules are more prone to violate them, and those who violate them are likely to have negative interactions with staff. Birthplace also influenced awareness; respondents born in continental USA had higher scores than those born on Vieques. However, they also tended to have more education and work experience in the tourism sector, both of which also correlated with higher scores.

Based on the mean awareness score of 0.486 (range 0 to 1), there are gaps in knowledge regarding VNWR among the general population. Particularly concerning was that many residents lacked basic information of the refuge’s ecological importance, which tends to diminish support for conservation (e.g., Heinen et al. 2017). When residents did provide knowledge on ecological importance, responses were mostly limited to coastal resources such as beaches or fisheries. Since most of the refuge contains upland habitat, this is an area of concern. Few residents were fully aware of the rules and regulations of VNWR. Of specific concern for this refuge was that 30% of residents lacked knowledge regarding health and safety issues in the non-entry areas. This percentage, although a minority, is troubling because unexploded ordnances present potential dangers for anyone who trespassers. Overall, much more outreach and education are needed to raise awareness and address these concerns.

**Misconceptions of the VNWR**

Misconceptions of PAs are likely to arise when local communities lack information, and this can lead to reduced willingness to support conservation (e.g., Allendorf et al. 2006; Liu et al. 2010; Htun et al. 2012). This study identified several misconceptions associated with negative attitudes. Limitations on access and resource extraction were the most common reasons for expressing discontent with VNWR. Some respondents thought incorrectly that all extraction of natural resources was completely prohibited. Many thought that fines were issued to anyone taking coconuts from the refuge, or that night fishing was prohibited, yet key informant interviews with staff clarified that certain nights and locations are open to fishing and taking coconuts for personal consumption – but not commercial use - is allowed whenever they are available. Another topic of complaint was the prohibition on sea snail or blue land crab extraction. In that case, staff expressed ambiguity and acknowledged there was no specific rule in place. Therefore, clear guidelines about extraction should be made and publicised.

Other major complaints concerning fishing regulations were seasonal closures and size restrictions. However, Puerto Rico’s Department of Natural and Environmental Resources has jurisdiction over marine fisheries and FWS only enforces those regulations in nearshore areas that abut the refuge. Likewise, many access restrictions are imposed by the Navy because of safety concerns, and not by the FWS. Our results show that many residents simply don’t know these facts and blame the FWS for all restrictions.

**CONCLUSION & RECOMMENDATIONS**

While the specific findings reported here are particular to VNWR, many conclusions could be generalised to other M2W reserves as well as to many types of PAs. We especially encourage more social research in M2W reserves due their uniqueness in many ways. For example, public outreach and consultation, completely omitted in this and other M2W cases, should have been done prior to Naval departure. The reasons
for turning land over for conservation should explained to residents in all PA cases (e.g., Thomasson et al. 2010). Very convincing arguments can be specifically made in M2W conversions given their legacies of hazardous wastes, and thus the high economic and health risks of developing them for more intensive human uses (Havlick 2014).

Given previous press releases about conflicts that resulted from naval practices, and the Navy’s subsequent departure, one could predict that negative attitudes would permeate Vieques. Our results are more mixed and nuanced in showing that the situation is highly complex. Many interrelated and opposing factors influence attitudes toward and awareness about VNWR, a general finding of studies that explore attitudes about PAs (e.g., Sesabo et al. 2006; Heberlein 2012). Experiences during naval occupation, current restrictions, and perceptions of the FWS as an extension of naval dominance, all affect attitudes towards VNWR. Yet some net economic benefits from the expansion of tourism, the cessation of destructive military activity and outreach and education conducted by the FWS to the school-age and elderly populations, have resulted in more positive attitudes among some segments of the population.

The study also shows that many people lack a clear understanding of the refuge’s ecological importance and its regulations, a common finding (e.g., Allendorf 2007). Perhaps the most surprising discovery - given the national and international press on the topic (e.g., US Department of Health and Human Services 2003) - was that some residents (30%) were unaware of safety issues associated with prior military occupation. Many of the variables that correlated with higher attitude scores also resulted in higher awareness scores. Restrictions on resource uses were associated with negative attitudes, but some of these perceptions were based on misconceptions (above). In general, more dissemination of information is needed to target all sectors of the community. Topics should include the importance and economic benefits of VNWR such as tourism, conservation of many native species and important habitats, and explicit rules about what natural resources can be collected freely by locals.

Outreach as to why some areas are closed and why regulations are in place is sorely needed. More awareness of what FWS staff do to safeguard natural resources and what naval personnel do to remove potentially lethal threats is also needed. These would appear essential to reduce the mistrust towards the federal government in general, as measured here. Management should consider expanding public access areas, visitation hours, and permissible resource uses where feasible, to increase economic or other benefits to residents. For example, an increase in some nighttime activities (e.g., camping in select places), at least seasonally, should be considered and, if approved, advertised so the public is aware of new recreational opportunities in VNWR.

Further research should also be conducted to identify any changes in attitude, perceptions and awareness through time, using this study as a baseline. Especially important would be studies that look, over time, at the direct economic values of resources legally removed from VNWR and estimates of the total value of the tourism sector and its multiplier effects to the island’s economy. While tourism is no panacea (Kruger 2005), and too much tourism can have markedly negative social and environmental impacts (Wittemeyer et al. 2008), it is an important revenue generator for many PAs worldwide (e.g., Baral et al. 2017). Additionally, population studies on species that are important economically, such as blue land crabs, should be conducted periodically to set appropriate guidelines for legal resource extraction.

Vieques took a direct hit from Hurricane Maria in 2017 and, like much of Puerto Rico, it was devastated. Crucial at present and into the future are studies that monitor the restoration of the natural communities within VNWR and human communities around it. The need for support to reestablish homes, infrastructure and basic needs for sustainable human communities is paramount. Research needs can be accomplished through collaboration with Puerto Rican universities and those in the incorporated United States or abroad. They should ideally involve the participation of local residents as another form of outreach and education, which can include citizen science programmes proven successful elsewhere (e.g., Silvertown 2009; Bonny et al. 2014). In general, the empowerment and involvement of the local community will be essential to improve awareness and reduce negative attitudes and perceptions towards VNWR and the FWS.

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