

Compliance with marine mammal protection: Focus groups reveal factors in commercial fishermen's decisions[☆]

Kathryn Bisack^{*,1}, Patricia M. Clay¹

National Marine Fisheries Service, Northeast Fisheries Science Center, Social Sciences Branch, 166, Water Street, Woods Hole, MA, 02543, USA



ARTICLE INFO

Keywords:
 Compliance
 Bycatch
 Marine mammals
 Social factors
 Economic factors
 Cultural norms
 Normative factors
 Sampling
 Focus group
 Governance

ABSTRACT

In researching non-compliance with use of an acoustical device (a pinger), required under the Marine Mammal Protection Act (MMPA) to protect harbor porpoise (*Phocoena phocoena*) in the Northeast U.S., focus group research provided insight on facets of non-compliance not previously considered. This method of group interview can reveal individuals' knowledge and perceptions of the legitimacy of a problem, process and solution along with social (including legitimacy) and economic factors, and cultural norms that can influence compliance or other decisions. In addition, each participant filled out a short survey on topics we already expected to be of interest. We investigate how these factors from the focus group discussion and the survey influence a fisherman's decision to comply with marine mammal regulations. Prior to the focus groups we expected participants to either fully comply or not comply at all with pinger requirements. By using multi-method research, we found that there was a third group that included fishermen that mostly complied but eliminated one mandatory pinger for safety reasons. Using harbor porpoise as a case study, we provide insight on approaches to improve compliance, a key component of a successful management plan designed to reduce marine mammal bycatch in commercial fisheries.

1. Introduction

In researching non-compliance with use of an acoustical device (a pinger), required under the Marine Mammal Protection Act (MMPA) to protect harbor porpoise (*Phocoena phocoena*) in the Northeast U.S., focus group research provided insight on issues not previously considered. The sink gillnet fishermen in the focus groups were a self-chosen subset of a representative sample of 123 sink gillnet fishing vessel captains who had fished in areas requiring pingers within the previous 12 months. This method of group interview can reveal individuals' knowledge and perceptions of the legitimacy of a problem, process and solution along with social factors, cultural norms, and economic factors that can influence compliance or other decisions. Focus group research provides insight into participants' daily decision-making [1]:233). For instance, our focus groups revealed distinct groups of violators. Apart from the standard rule-following and rule-breaking groups, a third group became apparent. These fishermen modified mandatory pinger requirements for operational safety reasons; it turns out that when pulling the gillnet out

of the water, the standard pinger on the end of the net, with no net behind it to weigh it down, often emerged swinging wildly and sometimes hit the nearest fisherman on the head. Multiple fishermen described sending a crewman off to the hospital after such an incident. These fishermen were by nature rule-followers, but felt that practical considerations required this slight modification to mandatory procedures. It seemed sensible and obvious to them and they felt that being fined over missing one pinger on several hundred feet of net was ridiculous (re. Dahl [2] on intentional vs. unintentional violations). We had heard of this practice, yet had been previously unaware how common it was; thus, we had not realized the need to account for this group in models.

The current NMFS data collection system for marine mammal regulations does not include data to investigate the role of social and cultural factors in fishermen's decision-making. Therefore, in 2012 and 2013, we set out to ground-truth the initial Bisack and Das [3] compliance model results by conducting focus group research with fishermen using pingers from Maine to Connecticut. Many factors can enter into an

[☆] "We are not funding your project because fishermen will never talk to you about compliance." Paraphrase of the response from the first funding source we approached.

* Corresponding author. Northeast Fisheries Science Center, Social Sciences Branch, 166 Water Street, Woods Hole, MA, 02543 USA.

E-mail address: Kathryn.Bisack@noaa.gov (K. Bisack).

¹ Authorship is equally shared.

individual's decision process and economic factors are only one important category. Understanding the influence of cultural norms and social factors, we believe, is a key component for incentivizing higher compliance. In our initial meetings we received feedback on the then recently revised Harbor Porpoise Take Reduction Plan (HPTRP) implemented in 2010, which created threats of consequence closures to deter pinger non-compliance – closures that had just recently been implemented. Simultaneously with the closures, groundfish sector management was introduced in 2010; sectors are similar to fishermen's harvest cooperatives. Our focus group findings encompass these 2010 regulatory shifts. We begin to investigate how economic and social factors, cultural norms, and legitimacy influence a fisherman's decision to comply with mandatory marine mammal regulations.

2. Background

2.1. Gillnet fishery and groundfish

Sink gillnet gear are used by vessels targeting commercially sought species such as Atlantic cod (*Gadus morhua*), spiny dogfish (*Squalus acanthias*), pollock (*Pollachius virens*), goosefish (*Lophius americanus*), and various flounders (*Pleuronectiform*). These vessels operate from Maine to North Carolina. The mix of species varies by season and area. Typically, sink gillnet vessels leave their port in the early morning, haul their catches, reset their nets, and return to port in the evening of the same day. Gear is set in the water to soak for 24–72 hrs, after which it is hauled and reset. During the long sink gillnet soaking period, harbor porpoise can become entangled and suffocate.

In 2004, the original sector allocation program was introduced for Atlantic cod. This program allocated a share of the Georges Bank cod stock to a group of vessel owners from the then-named Cape Cod Hook Fishermen's Association² (CCHFA) in Chatham, MA who voluntarily formed the Georges Bank Hook Sector (GBHS). In 2010, a revised voluntary sector allocation program was implemented for the entire groundfish fishery; it comprised 17 sectors, (including the CCHFA Fixed Gear Sector (which included the former GBHS)).³ Vessels that did not join a sector fished as part of the "common pool," under the prior effort controls (a limit on days-at-sea). Both sector and common pool are also under a set of Annual Catch Limits (ACLs) – or hard Total Allowable Catch limits (TACs) – for the various groundfish species (75 Federal Register 18356, April 9, 2010). About 55% of the Northeast sink gillnet vessels joined one of seventeen initial sectors under the revised program, and overall between 2010 and 2015 between 50 and 60% of all groundfish vessels have been in sectors [4]:19.

2.2. Harbor porpoise management

The MMPA established a long-term regime governing interactions between marine mammals and commercial fishing operations; the Potential Biological Removal (PBR) control rule under section 118 of the MMPA specifies the allowable level of human-induced mortality for a marine mammal stock (MMPA 1972 (as amended), section 1386). In the northeastern United States, the National Marine Fisheries Service (NMFS) is primarily responsible for protecting populations of harbor porpoise, northern right whales (*Eubalaena glacialis*), coastal bottlenose dolphins (*Tursiops truncates*) and loggerhead sea turtles (*Caretta caretta*) via the MMPA and Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531) [5–11]. One of the major threats to the survival of each of these species is lethal injuries from interactions with commercial fishing gear, including sink gillnet gear.

The MMPA states that when the 5-year average annual bycatch estimate is greater than PBR [12], a Take Reduction Team (TRT) must be

convened which has 6 months to develop a plan that will reduce bycatch below PBR within 6 months of implementation of the plan. After the 1994–1998 average bycatch rate exceeded PBR, closures and pingers (a gear standard) were the two primary policy instruments chosen by a 1999 HPTRP to reduce the harbor porpoise bycatch in the Northeast sink gillnet fishery to levels below PBR. The pinger requirement was implemented on January 1, 1999 (63 Federal Register 66464, December 2, 1998).

In 2007, harbor porpoise bycatch in the Gulf of Maine sink gillnet fishery (largely targeting groundfish) again exceeded the allowed rate of PBR [13], which required NMFS to take action once again. In December 2007, NMFS reconvened the TRT to consider additional modifications to the HPTRP in order to reduce bycatch in the New England and Mid-Atlantic sink gillnet fisheries to levels below the stock's PBR. Non-compliance with pinger regulations was as high as 65%, from 1999 to 2007 in some regulated areas in the northeast, based on data collected in the NMFS Northeast Fisheries Observer Program (NEFOP) [14]:22). The modified HPTRP in 2010 introduced consequence closures if pinger compliance did not meet target levels (see Figs. 2–8, [15]). If consequence closures were triggered (i.e., compliance did not reach the target level), these areas would be closed to sink gillnet fishing indefinitely (or until the Zero Mortality Rate Goal (ZMRG) was reached); ZMRG is defined by NMFS as less than 10% of PBR (69 Federal Register 43338, July 20, 2004).

2.3. Conceptual framework of compliance model

Recognizing the broad nature of enforcement, Keane et al. [16]:75 note:

Enforcement – monitoring adherence to rules and agreements and punishing infractions when they are detected – is an essential part of successful conservation and natural resource management (NRM) [17–21]. Punishments may take various forms, from fines and prison terms to social sanctioning, depending on the enforcement system.

This implies that multiple types of factors must be examined to understand compliance. Here we discuss 4 types of factors (economic, social, cultural, and legitimacy) in order to understand the Northeast U.S. gillnet fishery case study described above.

Economic theory suggests an individual will violate a regulation if the expected illegal gain exceeds the penalty, which is a function of the size of the fine for non-compliant behavior and the detection rate of a violation [22]. Becker's [22] basic deterrence framework assumes detection probabilities and fines can be set to improve compliance with regulations. Sutinen and Anderson's [23] seminal conceptual work on law enforcement then postulated, building on Becker, that the economic gain will often outweigh the penalty. Later empirical papers confirmed Becker's original hypothesis [24–30,67], and confirmed Sutinen and Anderson's [23] addition.

To understand cultural factors or *cultural norms* it is necessary to understand the concept of culture. The exact definition of "culture" is much debated within anthropology (see, e.g., the multiple variations in Kluckhohn [31]). But, in general, cultural norms are the beliefs, attitudes, and practices that characterize a cultural group and are considered normal, typical or average, the "right" way to think or behave (re [32]:1871:1). These are largely understood through what Geertz [33]:3–32 calls "thick description" or ethnographic observation and questioning in order to try to understand the underlying motivations behind particular actions or beliefs of a group of people. There are general norms of what "should" be done, but how those norms are implemented or interpreted in any given situation will vary based on the particulars of that situation. This tension between "the rules" and what people actually do is a key factor of interest to anthropologists and others.

Social factors can be defined in many ways. Two basic concepts are

² This group is now called the Cape Cod Fishermen's Alliance.

³ For more detail on the history of the groundfish sectors, see Ref. [66].

social structure and social organization. Here we focus on social structure, defined broadly by Radcliffe-Brown [34]:A2) as “the forms of association to be found amongst humans” or the “wide network of social relations” within a society. Others, such as Evans-Pritchard [35]:128 have defined social structure more narrowly, in terms specifically of institutions. It is that definition we use here when referring to “social factors.” Social factors here are about formal laws and rules,⁴ and institutions, including governments, fishing associations, TRTs, and sectors. We present these findings here, step two of a long-term compliance project, where Bisack and Das [3] was step one. Managing compliance with protected species bycatch regulations in commercial fisheries is a complex task. These types of data are critical to understand underlying behavioral responses to regulatory requirements that, in turn, can help managers to structure regulations that create incentives for desired behavior and support success in meeting management goals and objectives.

A final factor we examine is *legitimacy*, which we consider to be a cultural norm related to a social factor. The effectiveness of a regulation often depends on its perceived legitimacy [27,36–39]; see Ref. [40] on subjective (perceptual) vs. objective influences on behavior. As such, legitimacy is a key factor of compliance [27,38,39,41,42].

2.4. Our case study

Although pinger regulations have been in effect for over two decades, a way to monitor all vessels for compliance does not exist and, in practice, enforcement is difficult and expensive and the penalty for a violation is low. Under the current institutional structure, researchers detect and record pinger violations via NMFS’ NEFOP. However, observers are not enforcement officers. Therefore, the likelihood of an observed violation leading to punishment is low, a key factor in economic theory. Further, requests for more enforcement and higher penalties may not be cost-effective for monitoring pinger gear compliance. Subsequently, low detection rates – roughly 5% of fishing effort, for example [43], can lead to an extremely low probability of being caught and prosecuted; the economic incentive for pinger non-compliance is therefore theoretically high.

In this scenario, social factors (e.g. sector membership rules) and/or cultural norms (e.g. belief in following the law) may still motivate a fisherman to comply with the pinger regulation. Bisack and Das [3] follow Sutinen’s seminal work [23,24,27,28], along with others [29,44], in considering normative factors (including social factors and cultural norms), economic factors and perceived detection variables to explain compliance behavior. Through examination of the case of pinger regulations in the Northeast sink gillnet fishery, Bisack and Das [3] shed light on other approaches that can be pursued to improve compliance with gear standards. They consider both economic and normative factors within a probit framework to explain a fisherman’s compliance decision in relation to pinger use. Model results indicated that fishermen who previously violated pinger regulations, were not completely dependent on sink gillnet gear, and faced a lower than average chance of being sampled by an observer (i.e., lower detection rate) are more likely to violate pinger regulations. In this model, proxy variables are created to investigate normative behavior. Social factors and cultural norms are known to be important as they influence how situations are perceived and most people act on their perceptions of a situation over objective data [40].

3. Methods and data analysis

Between 2012 and 2013, eight focus group sessions were held from

⁴ The key rule here, leaving one pinger off a 10-net string of gillnets, is closer to what Schlager and Ostrom (1992) might call an operational activity than an operational rule, since it is not decided upon by a formal collective act.

Maine to Rhode Island with the objective of ground-truthing the Bisack and Das [3] compliance model results. NOAA Fisheries (NMFS) uses focus groups, oral histories, and cognitive and ethnographic interviews to gather perceptual data and local ecological knowledge (LEK). Focus groups are a type of group interview where the discussion is facilitated around a set of focused topics and materials. These groups are typically between 6 and 12 people. When discussing sensitive issues, like non-compliance, smaller-sized focus groups may be better [45]. Focus groups are ideal when seeking information about content – *why* people do or believe something [1]:233). Furthermore, focus groups have been shown to provide accurate data, even for sensitive topics. For instance, Ward et al. [46] conducted both surveys and focus groups on voluntary sterilization. They found that, while there were some differences in the results between the two methods, there was nonetheless substantial correspondence in results between survey respondents and focus group participants (p. 273). One potential pitfall of focus groups can occur when a small number of participants dominate the discussion, while others remain silent. This was generally not the case in our focus groups and any individuals not initially actively participating were specifically asked to voice their opinions. In addition, individual short surveys were filled out, providing input on specific topics from each person present. Each session was 2 h in length. Focus group participants were captains of sink gillnet vessels fishing in Pinger Management Areas (PMAs) from March 2012 to June 2013. All participants were native English speakers and there were no qualms evinced about taking the survey or participating in the focus group discussions.

3.1. Methods

The list of potential participants was identified using a combination of three databases to ascertain those fishing with sink gillnets in PMAs, differentiated by those targeting groundfish versus monkfish, and if groundfish whether they belonged to a sector, as well as to determine the owner’s name, home address, and telephone number. The Northeast Commercial Fisheries database and the Northeast Vessel Trip Report (VTR) database were used to identify gear type, target species, and whether or not they had fished in a PMA, as well as value of each trip’s landings. The NMFS Greater Atlantic Regional Office’s (GARFO) Vessel Permit database connects to the VTR via unique individual permit numbers and provided contact information for vessel owners. By calculating each vessel’s annual revenues and what percentage of their trips were in PMA vs non-PMA and by sector vessels, we were able to generate a representative sample. MQRS (a sector database) was used to determine which vessels targeting groundfish belonged to a sector. During the period May 2012 to June 2013, there were 176 sink gillnet vessels fishing north of the 40-degree latitude line, which is the southern limit of the area where pingers are required. According to the VTR, 70% (=123/176) of these vessels fished in areas that require pingers (PMAs). The owner information for these 123 vessels was our initial list for possible focus group participants. Of these 123, approximately 80% of the sector and 61% of the non-sector vessels fish in PMAs (Table 1). During recruitment, fishermen were also asked if they had fished in the previous 12 months.

A focus group coordination company was contracted by NMFS to provide administrative support for the sessions. For government agencies, this is usually the most efficient way to organize a focus group. The authors provided the list of individuals described above, sorted by

Table 1

Number of Vessels, sector and non-sector, fishing in pinger management areas and participating in our focus group according to the 2012-13 NMFS data.

	VTR	PMA	% in PMA	FG	% in FG
Sector	84	67	80%	12	18%
Non-sector	92	56	61%	14	25%
Total	176	123	70%	26	21%

port, to trained recruiters from the company, who then invited the participants and tracked acceptances. Recruiters were provided a script by the authors and a set of screening questions for selecting potential participants. Recruiters let the fishermen contacted know that: "The Social Sciences Branch at the Northeast Fisheries Science Center in Woods Hole, Massachusetts is interested in having a roundtable conversation on the usefulness of current regulations requiring pingers to protect harbor porpoise; how the fishery and regulations affect your life on the water and on land. We are looking to fishermen as the experts on this, since they are the ones out on the water and actually living with the regulations." The critical screening requirement was that participants needed to be vessel owners or captains that were currently using pingers (or had used them in the previous 12 months).

Some owners have several vessels; if the owner did not operate the vessel, we asked permission to speak to the captain of the vessel, to invite the captain to participate. We did not track how often this occurred; however, Murphy et al. [4] note that "for vessels less than 75' with a crew size (including the captain) less than three, it was assumed that the operator was the owner. If the crew size was three or more, it was assumed that the operator was a hired captain. For vessels 75' and greater, it was assumed that the operator was a hired captain regardless of the crew size." The vast majority of sink gillnet vessels are 40' or less in length. It is also assumed the individual making the pinger compliance decision is the vessel operator/captain since they are on the water and captains generally have a lot of leeway over activities at sea (e.g., Refs. [47–49]; they are hired specifically for their knowledge and ability to make decisions under constantly changing conditions. Second, we were looking for some fishermen from each sub-group (i.e., sector, common pool, non-groundfish). If possible, vessels with a high number of fishing trips in PMAs was preferred.

The company secured locations for the sessions, handled participant payment, and provided recording and transcription of the sessions. Due to federal regulations on collecting data from the public (44 U.S.C. § 3501 et seq.) no focus group could contain more than nine participants. The focus groups were facilitated by the authors.

A 15-min written survey was administered to kick off each meeting. The survey consisted of 36 questions which were grouped by the following categories: (1) general background information; (2) social interactions; (3) financial considerations; (4) outlook on management and regulations; (5) attitudinal questions; and (6) general comments or questions. Within these groups, questions were related to legitimacy, cultural norms, and social and detection factors that were thought likely to influence pinger compliance decisions. Following the survey, the participants were asked to discuss their experiences with pingers. Below, we describe the results of the written surveys and then review key themes that emerged from the focus group discussions.

3.2. Data analysis

Written survey results were attained for 35 individuals; however, only 26 are analyzed.⁵ Overall, our written survey results represent 21% (=26/123) of sink gillnet vessels fishing in PMAs during the 2012–13 fishing year according to NMFS VTR (Table 1); the written survey sample included 18% (=12/67) and 25% (=14/56) of the sector and non-sector vessels fishing in PMAs, respectively.

Surveys in Year 2 differed slightly from Year 1. The survey was modified to improve clarity of questions and responses based on information gained in earlier meetings. Written responses are analyzed for 12 questions that were common to both years and 3 additional questions of

interest on the 2013 survey. Responses are grouped as "Agree", "Disagree" and "No Response/Don't Know" (NR/DK). The NR/DK option was chosen on average 20% (CV = 86%) of the time.

Following the survey, the participants were asked to discuss their experiences with pingers. Both researchers were at all focus groups, read all the transcripts, developed a coding system and then coded the transcripts. Resource shortages and other priorities prevented a full analysis of the transcripts. We present the key themes that emerged from the transcripts in the findings section, below. Transcript themes, supplemented by quotes from the focus group discussion that are emblematic of key themes, are inter-woven with the written survey results to ground-truth the Bisack and Das [3] empirical model results.

4. Findings

4.1. Written surveys

A number of interesting findings emerged from the surveys that spoke to the themes of deterrence, legitimacy, governance, and reports of and responses to compliance/non-compliance. They are described below, by category, in relation to social and economic factors, cultural norms, and legitimacy.

Deterrence: Two factors are seen as primary deterrents to law violations: "the size of the fine for non-compliant behavior and the detection rate of a violation" [22]. Few participants were aware of, or knew the size of, an MMPA fine (12%), suggesting penalties (*economic factor*) do not enter these fishermen's daily decisions in relation to pinger compliance (Table 2, Question 14). Rate of observer coverage varies across vessels, but [50] found that vessels with lower observer coverage were more likely to violate pinger regulations. Meanwhile, many fishermen, in both the surveys and the focus group discussions, felt it unfair (violating a *cultural norm*) that the law-abiding group (as they saw themselves) were observed as often as or, indeed, (in their view) more often than the small group of "bad apples" they saw as consistently and repeatedly violating.

Legitimacy: Legitimacy is a key factor in fishermen's likelihood of complying with regulations [27,38,39,41,42]. Pinkerton and John [41] suggest that legitimacy is composed of fishermen's "perceptions of: (a) the fishing regulations, (b) the management system, and (c) the management authority." Here legitimacy (*cultural norm* related to a *social factor*) was measured by slightly different criteria, participants' survey responses to whether: (1) the agency (NMFS) has an obligation to manage protected species; (2) there really is a harbor porpoise bycatch problem, and; (3) the proposed solution, pingers, deter harbor porpoise. The majority of participants agreed the government has a duty to protect marine mammals (85%) (Table 2, Question 1) and that restricting fishing is sometimes necessary for protection (54%) (Table 2, Question 3). A majority also agreed that the sound made by pingers repels porpoise and pinger regulations are an effective solution for reducing porpoise bycatch in sink gillnets (62%) (Table 2, Question 4). Very few, however, believed the accidental take of harbor porpoise in the sink gillnet fishery is a real problem (4%) (Table 2, Question 2). And the majority of participants felt that pinger regulations are not fair, *cultural norms* (65%). (Table 2, Question 5).

Nonetheless, most participants believed even if regulations are not fair, they should be followed (65%) (Table 2, Question 8) (*cultural norms*). In 2013 we asked why they comply (Table 2, Question 9); half chose "I comply because I want a future in sink gillnetting and for the social good" (50%) – which also included *economic and social* components. However, a higher percentage of sector members agreed with this reason (86%) as compared to non-sector members (14%). This difference may represent an informal extension by sectors of existing joint and severable liability (for sector quota overages, illegally discarding of legal-sized fish, and the misreporting of landings and discards) to compliance with other regulations (*social and economic factors*). Some focus group participants shared that as sector members they receive

⁵ Nine surveys were eliminated for one or more of the following reasons: (1) three were repeat participants in 2012 and 2013; (2) five individuals were not currently fishing or not currently gillnetting at the time of the survey; and (3) one individual was absent from the NMFS reporting system, meaning his responses could not be linked to NMFS compliance data.

Table 2

Participant responses to the 2012 and 2013 written focus group survey questions (Agree, No Response/Don't Know, Disagree) by theme and group (all, sector and non-sector).

No.	Questions	All (n=26)			Sector (n=12)			Non-sector (n=14)		
		Agree	NR/ DK	Disagree	Agree	NR/ DK	Disagree	Agree	NR/ DK	Disagree
1	Federal government has a duty to protect marine mammals	85%	7%	8%	79%	7%	14%	92%	8%	0%
2	The take of harbor porpoise is a real problem	4%	19%	77%	8%	17%	75%	0%	21%	79%
3	Restricting fishing is necessary to protect marine mammals	54%	4%	42%	58%	0%	42%	58%	9%	33%
4	Pingers repel harbor porpoise	62%	11%	27%	58%	9%	33%	64%	15%	21%
5	Pinger regulations are fair	31%	4%	65%	25%	8%	67%	36%	0%	64%
6	I am involved with the TRT management process	12%	46%	42%	25%	42%	33%	0%	50%	50%
7	I received TRT information from the last 3 meetings	23%	42%	35%	50%	50%	0%	0%	33%	67%
8	Regulations should be followed even if they are not fair	65%	0%	35%	67%	0%	33%	64%	0%	36%
9	I comply because									
	(a) I do not break the rules	36%	0%		14%	0%		57%	0%	
	(b) I want a future in gillnetting and the greater social good	50%	0%		86%	0%		14%	0%	
	(c) Other	14%	0%		0%	0%		29%	0%	
10	Belonging to a group influence my decision to comply with harbor porpoise regulations	31%	11%	58%	67%	0%	33%	0%	21%	79%
11	I know the violation behavior of others in my peer group	62%	38%	0%	75%	25%	0%	50%	50%	0%
12	If I saw someone breaking the rules, I would:									
	(a) Contact the authorities	7%	0%		14%	0%		0%	0%	
	(b) Confront the individual	36%	0%		57%	0%		14%	0%	
	(c) Do nothing	57%	0%		29%	0%		86%	0%	
13	Pinger compliance will improve with more and stricter enforcement	29%	0%	71%	43%	0%	57%	14%	0%	86%
14	I am aware of MMPA violation fines	12%	0%	88%	17%	0%	83%	7%	0%	93%
15	Having financial support influences my pinger usage	31%	34%	35%	50%	25%	25%	14%	43%	43%

Questions 9, 12 and 13 appeared on the 2013 survey only (All n=14; Sector n=7; Non-sector=7).

threats of sector expulsion for non-compliance, as well as frequent compliance reminders. Some sectors, in fact, actively support pinger compliance by buying pingers in bulk at a discount and passing the savings along to fishermen. The second ranking reason was "I comply because I do not break the rules" (36%), which was more strictly related to *cultural norms*. Most non-sector members agreed with this reason (57%).

Governance: Participating in regulation design can lead to increased compliance [51–53]; the joint work creates a social group that engenders trust and creates common beliefs (*cultural norms*) about the science on which later regulation (*social factor*) is based. Having fishermen on the TRT should then, in theory, improve effective governance, both through their direct involvement in crafting regulations and as trusted conduits of information for other fishermen. However, this depends on a feeling of actual joint enterprise (*legitimacy*), and fishermen who had been on the TRTs told us in the focus groups that with two fishermen and more than a dozen scientists per group they do not feel included or listened to. At the time of our focus groups, the TRT had met 3 times since November 2012 and we learned that a minority of focus group participants had received information from any of the three previous TRT meetings (23%) (Table 2, Question 7), with 12% saying they were "involved with the TRT process" in some way (Table 2, Question 6). Interestingly, receipt of TRT information was bimodal (sector members (50%) vs. all others (0%)), suggesting that membership in a sector is a fairly effective way to provide TRT information to fishermen. Overall, however, only a minority agreed that belonging to a group (e.g., sector, fisherman's association, community supported fishery (CSF)) influences their decision to comply with harbor porpoise regulations (31%) (Table 2, Question 10), though a majority of those in sectors agreed that belonging to a group influenced their decision to comply (67%) and no non-sector members (0%) agreed (or 79% overall disagreed).

Reports of and Responses to Compliance/Non-Compliance: The majority of participants believed they know the violation behavior of others (62%) (Table 2, Question 11) in their communities (trust in others of their *social group* to follow *cultural norms*). The rate was slightly higher for sector (75%) versus non-sector (50%) members (perhaps related to sectors being a more formal *social institution* than the group of fishermen within a community). In 2013, we asked which of several

actions they would take if they observed another fisherman violating pinger regulations (Table 2, Question 12). A plurality of individuals chose "I would do nothing" (57%), followed by "confront the individual" (36%), and "contact the authorities" (7%). Sector members are more likely to "confront the individual" (57%), while non-sector members were more likely to "do nothing" (86%), suggesting again that sectors play a role in compliance behavior.

4.2. Focus group discussion transcripts

Our transcripts were coded by four general themes which again included economic and social factors, cultural norms, and legitimacy. The cost of pingers dominated the *economic factors* discussion in the focus groups. Participants spoke of the how pingers injure crew members as they come over the side (also a *social factor* and *cultural norm* related to caring for the well-being of co-workers and community). The expense of keeping up with the new technology (including batteries) was raised. Many participants reported that seals found pingers to be a dinner bell for warm cod belly dining in their nets, and that these literally gutted carcasses counted against a sector's cod quota. Other economic topics included factors that limited their fishing (e.g., small vessels like theirs have fewer alternative fishing options as compared to larger vessels) and that the future for sink gillnetting is questionable (e.g., the reduced and ageing fleet and lost infrastructure); however, there was a sense that fishermen want to stay fishing no matter what because it's a way of life for them, not just a job (see, e.g. Refs. [54–56], on fishing as a "way of life" – *cultural norms* and *social factors*).

The threat of consequent closures (a *deterrant*) dominated the focus group discussion of the first general topic in the survey, the *Legitimacy of agency's ability to manage*. Deterrents discussed included fines, increased observer coverage, and issuing warnings (e.g., provide a warning letter/call and require compliance within 24hrs). The *detection* discussion included issues the fishermen had with the U.S. Coast Guard (e.g., don't check pingers, board periodically but typically only for vessel safety checks), the feasibility of self-policing (e.g., never fish close enough to really see another fisherman's nets to tell whether they are in compliance), and the distribution of NEFOP observers (e.g., should be increased coverage in areas where there are harbor porpoise takes).

Another *legitimacy* issue raised was how the agency communicates science (e.g., explanations about how assessments are conducted) and incorporates updated information from science, management or stakeholders (e.g., regulations that are put in place and not revised in what fishermen felt was a timely fashion when conditions change).⁶ Finally, with regard to *legitimacy of the problem and solutions*, participants agreed pingers were a good solution to deterring harbor porpoise and shared some of their other questions (e.g., about whether porpoise habituate to the pinger sound) and the potential usefulness of other approaches (e.g., requiring pingers all-year-round).

Social factors shared were that sector members are responsible to each other for following the rules because the whole sector loses if one member doesn't have the required number of pingers. This is part of the governing rules for sectors as laid out by NMFS: the whole sector is responsible for specific behaviors of its individual members. In one sector, a TRT representative who is a member shares the rules with others. Trust is a large component and was often related to trust with "the guys you grew up with" in their sector or in their port. In general, the fishermen did not want to police each other and believed it's up to each guy to make his own decisions.

Most participants stated that sink gillnetting is the cleanest fishery, very size-selective, and the only problem is marine mammal bycatch. They say they know the rules and believe you need to follow them. The "bad apples" are those that are not in the fishery for the long-haul; they trust the guys they believe are "professional" because they do want to stay in business for the long haul. Sink gillnetters also talked about how they do not want to switch to dragging (bottom trawling) because "it hurts the habitat."

5. Discussion

We have seen that compliance decisions are based on a combination of factors, including economic, social, cultural, and regarding legitimacy; in this project, we focused primarily on social factors, cultural norms, and legitimacy, though these are sometimes intertwined with economic factors. (Fig. 1). *Deterrence* can be related to economic or social factors, or to cultural norms (re [22,27]). However, its effectiveness often depends on the *perceived legitimacy* of the rule in question [27, 36–39]; see Ref. [40] on subjective (perceptual) vs. objective influences on behavior. The role of *governance* is also critical, and involving fishermen directly in the process can often improve compliance [51–53,57], but only if fishermen feel they are truly involved and participating in the process on an equal footing with scientists and managers.

One assumption going into focus group meetings was that sector membership would improve compliance due to group *cultural norms or social factors*. In fact, it was more complex. Many focus group participants shared that as sector members they receive threats of sector expulsion for non-compliance (*economic and social factors*), as well as frequent compliance reminders (*social factor*). Members of some sectors also receive an additional compliance incentive in that they can offset upfront costs of pingers by participating in a sector-coordinated internal pinger finance pay-back program (*economic factor*). In some cases, the sectors purchased pingers in bulk for the entire sector, adding the additional financial boon of a lower per-unit cost (*economic factor*). The level of such financial support for pinger purchases varied across sectors from none to complete. Some of those not in sectors may belong to other fishing groups (e.g., cooperatives, Community Supported Fisheries) and have access to pingers through those, but these options were not specifically mentioned by any fishermen in the focus groups. Focus group participants were also asked if having/not having financial support for

pingers influenced how much gear they fished in areas that require pingers (Table 2, Question 15). A higher percentage of sector members agreed (50%) than non-sector individuals (14%).

Finally, to address the issue of whether fishermen will actually admit to non-compliance, Bernard (2006:243–244) reports that for sensitive topics, participants are more likely to provide accurate information on what other people do than on what they themselves do. And fishermen in the focus groups did report on the behavior of others, noting in one focus group, e.g., that:

Everybody in this room knows who the bad apples are. So does the Coast Guard; so does the state of Rhode Island. They've all been busted time and time again. You're wasting your time going out there policing every boat. They've got a list of the bad apples. It's got nothing to do with harbor porpoise. They just don't believe in any laws period.

Interestingly, we also found many people reporting *themselves* to be non-compliant – by one pinger, precisely, because they did not see this as actually being non-compliant. As noted earlier, individuals that removed one pinger for safety reasons did not see any reason to adjust their fishing behavior before or after 2010 when the threat of consequential closures and sector management were implemented, as they felt that by any reasonable assessment (*cultural norms*) they were already in compliance. Similarly, they noted that occasionally one pinger just falls off or remains attached but non-functioning because a battery died while the net was set. As one participant asked, echoing sentiments we heard consistently in all the focus groups: "*You wouldn't penalize a guy for one missing pinger, would you?*" For more on willingness to admit non-compliance in fisheries see, for example, Hauck [58]; Sundström [59].

In researching the history of pinger regulations, we now realize there can be a difference between regulation requirements and how compliance with regulations is measured. As early as 2007, Palka [60]:3) recognized that 90% pinger usage was very close to 100% in number of harbor porpoise takes per haul (0.011 vs. 0.008).⁷ Palka et al. [14]:45) assume compliance with the pinger requirements means 90% or more of the required number of pingers were on the net when it was hauled in (e.g., 11 pingers required per 10-net string), "thus, allowing for the possibility that the commonly used 10-net string is missing one pinger, which could have fallen off accidentally during the time the net was in the water." An individual sink gillnet fishing a 10-net string and missing one pinger would be fishing 91% of required pingers. Palka [61]:220) similarly define compliance as "observed hauls with more than 90% of the required number of pingers." However, Orphanides and Palka [62]:259) note that while compliance had been defined as 90% of required pingers from 1999 to the spring of 2008, "[i]n contrast, a 100% pinger use cutoff was used when determining compliance thereafter." Thus, fishermen who removed one pinger for safety reasons were once compliant but then became non-compliant – without any behavior change on their part. Obviously, regulations change, but the switch in definition of how compliance is measured for something seen as a safety requirement may be considered unfair (*cultural norm*) and illegitimate (*cultural norm* related to a *social factor*).

6. Conclusion

NMFS' standard response to non-compliance with marine mammal

⁷ Lower pinger usage rates, defined in Palka et al. (2008b:219, using data from Ref. [14] as (1) more than 50% but less than all of the required number of pingers on a string or (2) some pingers but less than or equal to 50% of the required number of pingers than required by regulations and some pingers had bycatch rates 2 to 3 times higher than those with the full complement of pingers (Orphanides and Palka (2013, discussing data from Ref. [14].) Harbor porpoise bycatch rates in hauls with an incomplete set of pingers had a much higher bycatch rate than hauls without pingers or hauls with the required number of pingers, no matter what the mesh size, area or year."

⁶ Participants were also interested in how harbor porpoise bycatch, population estimates, and compliance are calculated; however, these focus group topics were side tabled for after the meeting for those interested since this was not the motivation for the meeting.

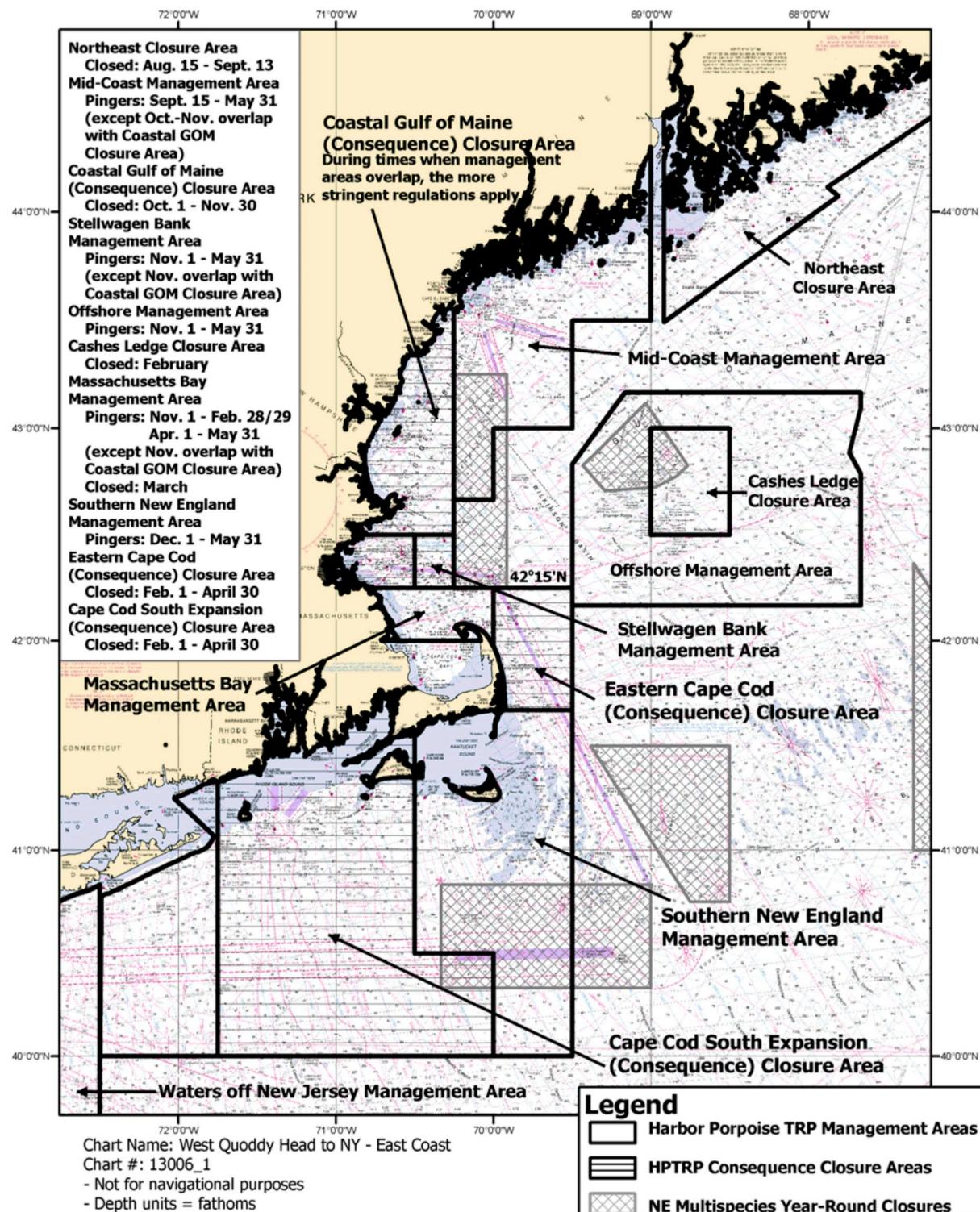


Fig. 1. New England Harbor Porpoise Management Areas for Gillnets including Consequence Closures (management measures depicted after target bycatch rate exceeded) [15]. HP TRP Management Areas = PMAs.

regulations is post-hoc application of penalties, in the form of fines or closures. Our findings suggest, in addition, the following may improve compliance:

- (1) Rethinking the governance structure of TRTs to create more space for fishermen to present their data – and feel it has been seriously taken into consideration. In the short surveys fishermen told us

they currently do not feel included or listened to in TRT meetings. Some also mentioned this in focus group discussions.

- (2) Providing more consistent and frequent information about the governing process, rules, and consequences (penalties) of marine mammal regulations – in fishermen-friendly fora such as sector or fishermen's association meetings or in local harbor/fisheries committees meetings. In the focus group discussions fishermen noted they would like more explanation of how NMFS conducts

its science and how updated information from science, management, or stakeholders is included in management decisions.

(3) Other communication avenues for the information requested by fishermen could include advertising the location on NMFS websites where fishermen could find marine mammal regulatory requirements (e.g., the North Atlantic Right Whale sighting app) – through marine radio or local/regional fishing-focused newspapers and newsletters.

(4) Increased or targeted observer coverage might also help to reach and maintain PBR, especially given that model results [3,50] show under-sampled vessels are more likely to violate pinger regulations. In focus group discussions, fishermen complained that observer sampling did not focus on “bad apples” but on law abiding (minus one pinger) fishermen. They wanted to see more evenly distributed observer coverage.

We recognize there are costs with these actions, particularly increased observer coverage. While King et al. [63] suggests USCG compliance rates are overestimated because at-sea inspections fail to detect many actual violations, suggesting support of increased observer coverage, Muench⁸ shows significant differences between the harvest location of observed and unobserved trips which can impact species stock assessments. Furthermore, Shaw's [30] study suggests fishery agencies do not have the data necessary to provide accurate measurements capable of indicating if enforcement programs are achieving their goals and further suggests NMFS, USCG, and NOAA General Counsel need to implement substantial changes in their record keeping systems. With that said, additional research seems necessary to address the benefit-cost tradeoffs of these changes if we expect management programs/actions to achieve their goals. Further, given the TRT process exists for all marine mammals, these findings are likely to be transferable to other MMPA species.

Understanding when violations are, or are not, impeding achieving goals is also critical. Technology changes, such as gear modifications, are the typical policy instruments regulators propose to reduce bycatch in commercial fisheries; gear modifications are preferred over closures since they allow fishing to continue. Therefore, compliance incentives are important to understand whether we need to add more and/or different protection instruments to reach take reduction goals. This raises questions such as: Would compliance rates with harbor porpoise regulations increase if pinger acquisition and financial assistance were more common and equitable across individuals and groups? Our results suggest this may be the case. Is it true that this opportunity is only available for a select few groundfish sectors, and why? This requires further research. Similarly, if fishermen are more widely involved in creating and testing gear modifications – and in creating implementation rules, will they be more likely to use them as designed? Previous research on participatory research suggests this would be the case. Future research includes implementing surveys to investigate these and other factors affecting compliance with both harbor porpoise regulations and regulations for other protected species such as large whales (e.g., right whales) and sea turtles.

Finally, we point out that this research is important in terms of both the findings and the method (i.e., focus groups plus short surveys). The short surveys provided useful data on topics we knew to ask about. But it was the focus group discussions with fishermen that gave us new insights into the complexities of the issue. Under the right circumstances, fishermen will discuss most topics, including compliance. An original proposal for this research was not funded because, we were told, “Fishermen will never talk to you about compliance.” Because some fisheries funding groups are still dominated by natural scientists who are

sometimes unfamiliar with the intricacies of social science methods, this is still an all-too-common assumption. Yet, decades of social science research has shown that people will talk even about difficult topics if the interview is handled skillfully and respectfully, and done individually or in small groups [1]:238. Specific examples of the successful use of interview data in fisheries compliance research include Hønneland [37]; Nielsen and Mathiesen [57]; Bose and Crees-Morris [64]; and Eggert and Lokina [65].

Short interview and focus group findings presented here set the stage for shaping a formal compliance model that examines whether increased compliance levels after 2010 were due to the threat of consequent closures, the onset of sectors or both. This allowed examination of compliance behavior for individuals with: (1) no violations, (2) only “safety” violations (i.e., one missing pinger), and (3) multiple violations [50]. Multi-method research that includes direct interviews with members of the regulated group is important in understanding human behavioral responses to regulatory changes.

Funding

Funding for this research was received from NOAA's Science and Technology, Economics and Social Analysis Division (ST5), Dr. Rita Curtis.

Acknowledgements

The authors would like to thank Dr. Rita Curtis for funding the focus group meetings and Dr. Chhandita Das for her work in developing an early version of the written survey. We also thank Dr. Eric Thunberg and two anonymous reviewers for their generous and useful suggestions on an earlier version that improved this paper.

References

- [1] H.R. Bernard, *Research Methods in Anthropology: Qualitative and Quantitative Approaches*, Altamira Press, New York, 2006.
- [2] Ø. Dahl, Safety compliance in a highly regulated environment: a case study of workers' knowledge of rules and procedures within the petroleum industry, *Saf. Sci.* 60 (2013) 185–195.
- [3] K.D. Bisack, C. Das, Understanding non-compliance with protected species regulations in the Northeast USA gillnet fishery, *Frontiers in Marine Science* 2 (2015) 91, <https://doi.org/10.3389/fmars.2015.00091>.
- [4] T. Murphy, G. Ardini, M. Vasta, A. Kitts, C. Demarest, J. Walden, D. Caless, 2015 Final Report on the Performance of the Northeast Multispecies (Groundfish) Fishery (May 2007 – April 2016), vols. 18–13, US Dept Commer, Northeast Fish Sci Cent Ref Doc, 2018, p. 128. Available from: <http://www.nfsc.noaa.gov/publications/>.
- [5] Resolve, A final draft Gulf of Maine/bay of fundy harbor porpoise take reduction Team take reduction plan - a consensus document, in: Prepared by Resolve Inc. For NOAA, National Marine Fisheries Service, Northeast Regional Office, Protected Resource Division, Gloucester, MA., 1996, p. 38. August.
- [6] National Marine Fisheries Service (NMFS), *Harbor Porpoise Take Reduction Plan (HPTRP)* Final Environmental Assessment and Final Regulatory Flexibility Analysis, National Marine Fisheries Service, Office of Protected Resources, Silver Spring, MD, 1998.
- [7] National Marine Fisheries Service (NMFS), sea turtle conservation; summer flounder trawling requirements, *Fed. Regist.* 67 (74) (2002), 18833.
- [8] National Marine Fisheries Service (NMFS), *Draft Environmental Impact Statement (DEIS) for Amending the Atlantic Right Whale Take Reduction Team Plan (ARWTRTP)*, February 2005. NOAA, NMFS, Northeast Regional Office, Protected Resource Division, Gloucester, MA, 2005.
- [9] National Oceanic Atmosphere Administration, Environmental Assessment, Regulatory Impact Review and Final Regulatory Flexibility Act Analysis for a Final Rule to Implement the Bottlenose Dolphin Take Reduction Team Plan and Revise the Large Mesh Size Restriction under the Mid-Atlantic Large Mesh Gillnet Rule. April 2006. NOAA, NMFS, Southeast Regional Office, Protected Resource Division, 2006, p. p240.
- [10] National Oceanic Atmosphere Administration, *Final Environmental Assessment and Regulatory Impact Review, Final Regulatory Flexibility Act Analysis Sea Turtle Conservation Measures for the Pound Net Fishery in Virginia Waters of the Chesapeake Bay*. June 2006. NOAA, National Marine Fisheries Service, Northeast Regional Office, Protected Resource Division, Gloucester, MA, 2006, p. p158.
- [11] National Oceanic Atmosphere Administration, *Final Environmental Assessment and Regulatory Impact Review, Final Regulatory Flexibility Act Analysis Sea Turtle Conservation Measures for the Mid-Atlantic Sea Scallop Dredge Fishery*. April

⁸ Muench, A. 2017. Observer effects in the Northeast- US multi-species sector. Presented at the North American Association of Fisheries Economists (NAAFE), PS061. La Paz, Baja California Sur, Mexico, March 22–24, 2017.

2006, NOAA, National Marine Fisheries Service, Northeast Regional Office, Protected Resource Division, Gloucester, MA, 2006, p. p140.

[12] P.R. Wade, R.P. Angliss, Guidelines for Assessing Marine Mammal Stocks: Report of the GAMMS Workshop, April 3-5, Seattle, WA, NOAA Technical Memorandum NMFS-OPR-12, Office of Protected Species, National Marine Fisheries Service, Silver Spring, MD, 1997.

[13] U.S. Department of Commerce, Taking of marine mammals incidental to commercial fishing operations incidental to commercial fishing operations; harbor porpoise take reduction plan regulations, Fed. Regist. 75:33 (19 February 2010) (2010) 7383–7402.

[14] D. Palka, C.D. Orphanides, M.L. Warden, Summary of Harbor Porpoise (*Phocoena phocoena*) Bycatch and Levels of Compliance in the Northeast and Mid-Atlantic Gillnet Fisheries after the Implementation of the Take Reduction Plan: 1 January 1999–31 May 2007. NOAA Technical Memorandum NMFS NE 212, 2008, p. 89. August 2008. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.

[15] U.S. Department of Commerce, Figure 2-8: Alternative 4 (Preferred) - New England Harbor Porpoise Management Areas for Gillnets (Management Measures Depicted after Target Bycatch Rate Exceeded), p.39. Modifications to the Harbor Porpoise Take Reduction Plan. Final Environmental Assessment (Includes Regulatory Impact Review and Final Regulatory Flexibility Analysis). National Oceanic and Atmospheric Administration. National Marine Fisheries Service. Northeast Region. September, 2009, p. 170. https://www.greateratlantic.fisheries.noaa.gov/nero/regs/frdoc/10/10HPTP_GOMBF_EA.pdf.

[16] A. Keane, J.P. Jones, G. Edwards-Jones, E.J. Milner-Gulland, The sleeping policeman: understanding issues of enforcement and compliance in conservation, *Anim. Conserv.* 11 (2) (2008) 75–82.

[17] E. Ostrom, Governing the Commons: the Evolution of Institutions for Collective Action, Cambridge University Press, Cambridge, 1990.

[18] S.S. Gezelius, Do norms count? State regulation and compliance in a Norwegian fishing community, *Acta Sociol.* 45 (2002) 305–314.

[19] P.D. Walsh, K.A. Abernethy, M. Bermejo, R. Beyers, P. DeWachter, M.E. Akou, B. Huijbregts, D.I. Mambounga, A.K. Toham, A.M. Kilbourn, S.A. Lahm, S. Latour, F. Maisels, C. Mbina, Y. Mihindou, S. Ndong Obiang, E.N. Effa, M.P. Starkey, P. Telfer, M. Thibault, C.E.G. Tutin, L.J.T. White, D.S. Wilkie, Catastrophic ape decline in western equatorial Africa, *Nature* 422 (2003) 611–614.

[20] J.M. Rowcliffe, E. de Merode, G. Cowlishaw, Do wildlife laws work? Species protection and the application of a prey choice model to poaching decisions, *Proc. Roy. Soc. Lond. Ser. B – Biol. Sci.* 271 (2004) 2631–2636.

[21] C.C. Gibson, J.T. Williams, E. Ostrom, Local enforcement and better forests, *World Dev.* 33 (2005) 273–284.

[22] G.S. Becker, Crime and Punishment: an economic approach, *J. Political Econ.* 76 (2) (1968) 169–217.

[23] J. Sutinen, P. Anderson, The economics of fisheries law enforcement, *Land Econ.* 61 (4) (1985) 387–397.

[24] J.G. Sutinen, J.R. Gauvin, Assessing compliance with fishery regulations, *Maritimes* 33 (1) (1989) 10–12.

[25] C. Bean, An Economic Analysis of Compliance and Enforcement in the Quahog Fishery of Narragansett Bay, University of Rhode Island, 1990. Unpublished Masters Thesis.

[26] W.J. Furlong, The deterrent effect of regulatory enforcement in the fishery, *Land Econ.* 67 (1) (1991) 116–129.

[27] K. Kuperan, Jon G. Sutinen, Blue Water Crime: Deterrence, Legitimacy, and Compliance in Fisheries, *Law Soc. Rev.* (1998) 309–338.

[28] J.G. Sutinen, A. Rieser, J.R. Gauvin, Measuring and explaining noncompliance in federally-managed fisheries, *Ocean Dev. Int. Law* 21 (3) (1990) 335–372.

[29] A. Hatcher, D. Gordon, Further investigations into the factors affecting compliance with U.K. fishing Quota, *Land Econ.* 81 (1) (2005) 71–86.

[30] R.L. Shaw, Enforcement and Compliance in the Northeast Groundfish Fishery: Perceptions of Procedural Justice in Fishery Management, the Effects of Regulatory Methods, and Prospects for Compliance, Ph.D. Thesis, University of Rhode Island, Paper AAI3206256, <https://digitalcommons.uri.edu/dissertations/AAI3206256>.

[31] C. Kluckhohn, Mirror for Man: Anthropology and Modern Life, McGraw-Hill Book Company, Incorporated, New York, 1949.

[32] E.B. Tylor, Primitive Culture: Researches into the Development of Mythology, Philosophy, Religion, Language, Art, and Custom (1871), G. P. Putnam's Sons, New York, 1920.

[33] C. Geertz, The Interpretation of Cultures, vol. 5019, Basic Books, New York, 1973.

[34] A.R. Radcliffe-Brown, On social structure, *J. R. Anthropol. Inst. G. B. Irel.* 70 (1) (1940) 1–12.

[35] E.E. Evans-Pritchard, Social Anthropology, Cohen & West, LTD, London, 1951.

[36] J.G. Sutinen, K. Kuperan, A Socio-economic theory of regulatory compliance, *Int. J. Soc. Econ.* 26 (1–3) (1999) 174–193.

[37] Hønneland, Geir Compliance in the Barents Sea fisheries, How fishermen account for conformity with rules, *Mar. Policy* 24 (1) (2000) 11–19.

[38] S. Jentoft, Legitimacy and disappointment in fisheries management, *Mar. Policy* 24 (2) (2000) 141–148.

[39] J.R. Nielsen, An analytical framework for studying: compliance and legitimacy in fisheries management, *Mar. Policy* 27 (5) (2003) 425–432.

[40] C. Smith, P.M. Clay, Measuring subjective and objective well-being: examples from five commercial fisheries, *Hum. Organ.* 69 (2) (2010) 158–168.

[41] E. Pinkerton, L. John, Creating local management legitimacy, *Mar. Policy* 32 (4) (2008) 680–691.

[42] R.A. Turner, J. Addison, A. Arias, B.J. Bergseth, N.A. Marshall, T.H. Morrison, R. C. Tobin, Trust, confidence, and equity affect the legitimacy of natural resource governance, *Ecol. Soc.* 21 (3) (2016).

[43] G.T. Waring, E. Josephson, K. Maze-Foley, P.E. Rosel (Eds.), U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments – 2011. NOAA Tech Memo NMFS NE 221, 2012, p. 319. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at, <http://www.nefsc.noaa.gov/nefsc/publications/>.

[44] A. Hatcher, S. Jaffry, O. Thébaud, E. Bennett, Normative and social influences affecting compliance with fishery regulations, *Land Econ.* 76 (3) (2000) 448–461.

[45] D.L. Morgan, Focus Groups as Qualitative Research, vol. 16, Sage Publications, 1996.

[46] V.M. Ward, J.T. Bertrand, L.F. Brown, The comparability of focus group and survey results, *Eval. Rev.* 15 (1991) 266–283.

[47] J.J. Cove, Hunters, trappers, and gatherers of the sea: a comparative study of fishing strategies, *J. of the Fisheries Board of Canada* 30 (2) (1973) 249–259.

[48] J.E. Kirkley, D. Squires, I.E. Strand, Assessing technical efficiency in commercial fisheries: the mid-Atlantic sea scallop fishery, *Am. J. Agric. Econ.* 77 (3) (1995) 686–697.

[49] J.K. Abbott, A.C. Haynie, M.N. Reimer, Hidden flexibility: institutions, incentives, and the margins of selectivity in fishing, *Land Econ.* 91 (1) (2015) 169–195.

[50] Bisack, K. and P. M. Clay. In review. Behavioral Responses to Competing Incentives and Disincentives: Compliance with Marine Mammal Protection.

[51] M. Wiber, F. Berkes, A. Charles, J. Kearney, Participatory research supporting community-based fishery management, *Mar. Policy* 28 (6) (2004) 459–468.

[52] C. Röckmann, C. Ulrich, M. Dreyer, E. Bell, E. Borodzicz, P. Haapasalo, K. H. Hauge, D. Howell, S. Mäntyniemi, D. Miller, G. Tserpes, The added value of participatory modelling in fisheries management—what has been learnt? *Mar. Policy* 36 (5) (2012) 1072–1085.

[53] M.R. Msomphora, Stakeholder participation and satisfaction in the process of developing management plans: the case of Scottish Inshore Fisheries Groups, *Ocean Coast Manag.* 116 (2015) 491–503.

[54] H.J. Mederer, Surviving the demise of a way of life: stress and resilience in Northeastern commercial fishing families, in: *The Dynamics of Resilient Families*, 1999, pp. 135–163.

[55] R. Van Ginkel, Inshore fishermen: cultural dimensions of a maritime occupation, in: *Inshore Fisheries Management*, Springer, Dordrecht, 2001, pp. 177–193.

[56] K. Brookfield, T. Gray, J. Hatchard, The concept of fisheries-dependent communities: a comparative analysis of four UK case studies: shetland, Peterhead, North Shields and Lowestoft, *Fish. Res.* 72 (1) (2005) 55–69.

[57] J.R. Nielsen, C. Mathiesen, Important factors influencing rule compliance in fisheries lessons from Denmark, *Mar. Policy* 27 (5) (2003) 409–416.

[58] M. Hauck, Rethinking Small-Scale Fisheries Compliance: from Criminal Justice to Social Justice, Ph.D. dissertation, University of Cape, Town, 2009.

[59] A. Sundström, Corruption and regulatory compliance: experimental findings from South African small-scale fisheries, *Mar. Policy* 36 (6) (2012) 1255–1264.

[60] D. Palka, Effect of pingers on harbor porpoise and seal bycatch, in: Prepared December 12, 2007. Presented as Background Material to the Harbor Porpoise Take Reduction Plan, November 27 - November 30, 2012, Providence, RI. Available at: <https://www.greateratlantic.fisheries.noaa.gov/protected/porptrpt/Meetings/2012meeting.html>.

[61] D. Palka, M.C. Rossman, A. Vanattan, C. Orphanides, Effect of pingers on harbour porpoise (*Phocoena phocoena*) bycatch in the US Northeast gillnet fishery, *J. Cetacean Res. Manag.* 10 (3) (2008) 217–226, 2008.

[62] C. Orphanides, D. Palka, Analysis of harbor porpoise gillnet bycatch, compliance, and enforcement trends in the US northwestern Atlantic, January 1999 to May 2010, *Endanger. Species Res.* 20 (2013) 251–269, <https://doi.org/10.3354/esr00499>, 2013.

[63] D. King, R. Porter, E. Price, Reassessing the value of U.S. Coast guard at-sea fishery enforcement, *Ocean Dev. Int. Law* 40 (2009) 350–372.

[64] S. Bose, A. Crees-Morris, Stakeholder's views on fisheries compliance: an Australian case study, *Mar. Policy* 33 (2) (2009) 248–253.

[65] H. Eggert, R.B. Lokina, Regulatory compliance in lake victoria fisheries, *Environ. Dev. Econ.* 15 (2) (2010) 197–217.

[66] P.M. Clay, A. Kitts, P.P. da Silva, Measuring the social and economic performance of catch share programs: definition of metrics and application to the US Northeast Region groundfish fishery, *Mar. Policy* 44 (2014) 27–36.

[67] J.G. Sutinen, J.R. Gauvin, D.V. Gordon, An econometric study of regulatory enforcement and compliance in the commercial inshore lobster fishery of Massachusetts, in: *Rights Based Fishing*, Springer, Dordrecht, 1989, pp. 415–431.