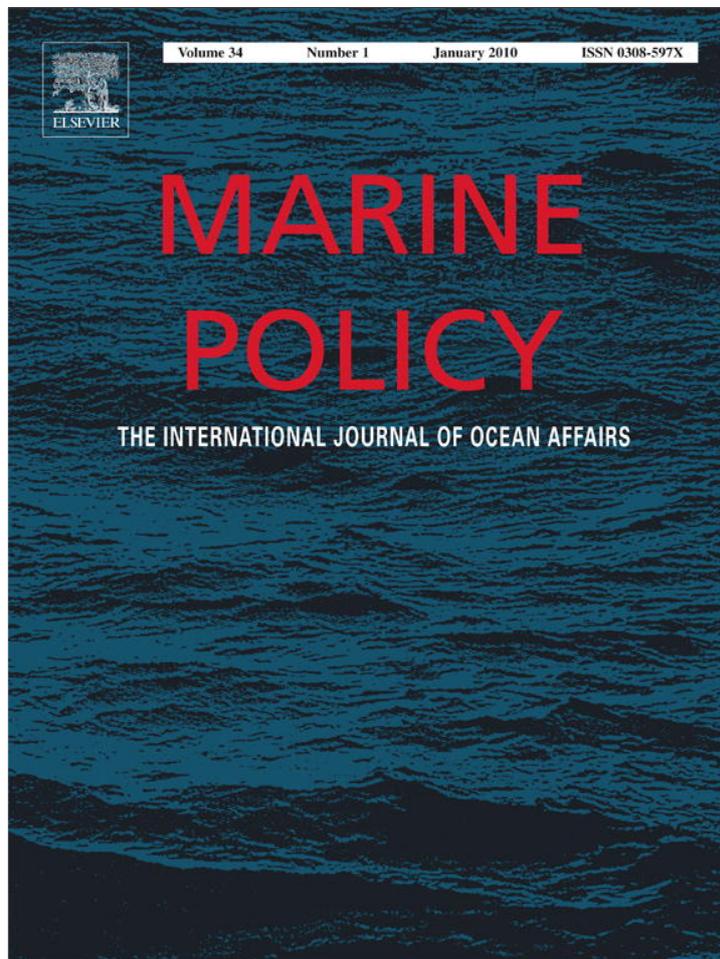


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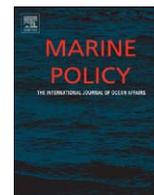
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## Rational noncompliance and the liquidation of Northeast groundfish resources

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### ABSTRACT

The results of a 2007 survey of fishers, managers, scientists, and enforcement officials indicate that noncompliance is a significant problem in the Northeast multispecies groundfish (NEGF) fishery, as it has been for at least 20 years. The percent of total harvest taken illegally is estimated to be 12–24%, which is significantly higher than estimates of 6–14% in the 1980s. Thirty-seven percent of fishers, 61% of fishery managers and 80% of fishery enforcement staff believe that “the combined adverse impact of all violations on the health and manageability of fish resources” is significant, highly significant, or extremely significant. Many fishers believe that illegal fishing will prevent them from ever benefiting from stock rebuilding programs.

The deterrence effect of the existing enforcement system in the NEGF fishery is weak because economic gains from violating fishing regulations are nearly 5 times the economic value of expected penalties. For example, by fishing illegally a midsize trawler in the NEGF fishery is estimated to increase expected earnings per trip by \$5,500. Fishing violations have a 32.5% probability of being detected, and enforcement data show that a detected violation has a 33.1% probability of being prosecuted and resulting in a penalty. The average penalty assessed for a violation is \$20,455 and the settlement amount averages 53% of the assessed penalty. The expected cost of a violation, therefore, is \$1,166. When compared with the illegal gain, the economic incentive not to comply is \$4,334 per trip.

Normative factors, such as moral obligation and peer and community pressure often induce fishers to be law-abiding despite potential illegal gains. However, normative factors favoring compliance in the NEGF fishery are weak because many fishers believe recent fishery management decisions were not justified and that planned stock rebuilding targets and schedules are arbitrary and unfair. Until this situation changes, more enforcement and more certain and meaningful penalties will be needed to improve compliance. Fishing restrictions will need to be tightened to achieve new legally mandated stock rebuilding targets. This will increase economic incentives for noncompliance in the fishery and require even more enforcement and more significant penalties to achieve adequate compliance rates.

This article recommends that a “smart compliance policy” be implemented in the NEGF fishery that employs different types of enforcement strategies and penalties with different groups of fishers identified based on their compliance histories. This should include aggressive targeting of frequent violators and criminal penalties and the forfeiture of all fishing privileges for certain types of violations. Funds should be redirected toward incentive programs to support collaborations between other fishers and enforcement staff to increase the number of violations that are detected, reported, and successfully prosecuted.

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### 1. Introduction

This article provides an overview of noncompliance in the Northeast multispecies groundfish (NEGF) fishery; presents an

assessment of how it contributes to overfishing and could prevent successful fish stock rebuilding plans in that fishery; and provides recommendations regarding what can be done to improve the situation.

This assessment is based primarily on the results of a recently completed study of enforcement and compliance in the NEGF fishery which draws on data from: (a) a mail survey of fishermen; (b) an online survey of federal and state enforcement staff, regulators, and scientists; (c) in-person and phone interviews

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with fishermen and fishery enforcement staff; and (d) analysis of 6 years of National Oceanic and Atmospheric Administration (NOAA) enforcement statistics (2001 through 2006) for the Northeast (NE) region.<sup>1</sup>

Study results are used to determine the extent and significance of noncompliance in the fishery and to test hypotheses about what can be done to improve compliance. The hypotheses are derived from what has become known as an “enriched theory of compliance” that is based on the influence of both deterrence and normative factors on fishers’ decisions to comply or not.<sup>2</sup> Deterrence factors are based on the difference between the expected benefits of noncompliance and the likelihood of detection and the expected penalty or sanction if detected. Normative factors include: fishers’ moral standards and perspectives about whether the fishery management regime is legitimate and competent, and developed fishing regulations in ways that are fair and equitable; and whether they believe that complying with fishing regulations is likely to make a difference. Based on this “enriched theory of compliance,” the level of enforcement required to achieve a given level of compliance is lower when normative factors have a positive effect on compliance and higher when they have a negative influence.

The research results indicate that noncompliance is a significant problem in the NEGF fishery. Whether used to test deterrence or normative factors influencing compliance, the research results further indicate that unless there is more enforcement and/or more certain and meaningful penalties facing violators, noncompliance problems in this fishery can be expected to increase in the years ahead.

These results confirm the outcomes of previous studies of enforcement and compliance in this fishery [4–6].<sup>3</sup> These studies, like the current study, show that the economic payoff to fishermen from noncompliance is relatively high and the expected likelihood of being detected, and the penalties if detected, are relatively low.<sup>4</sup> This more recent study, however, was conducted during a time when deteriorating biological conditions increase the adverse impacts of noncompliance on fish stocks; while simultaneously there are growing incentives for noncompliance due to deteriorating economic conditions in the fishery, more restrictive fishing regulations and more contentious fishery management targets and timetables.

<sup>1</sup> A complete description of the study and results are available from the study sponsor (Lenfest Ocean Program). A summary of the study and results is available from the authors.

<sup>2</sup> The conventional “theory of compliance” [1] focuses on economic incentives and how potential violators compare the relative costs and benefits of violating the law. The “enriched theory of compliance” [2,3] includes both economic incentives and “normative” factors associated with moral convictions of fishers, peer pressure, attitudes regarding the legitimacy of regulations, and other factors that result in most fishers complying with the law even when there are economic gains from not complying.

<sup>3</sup> Results from Sutinen et al. [5] indicate that potential illegal gains in the NEGF fishery are high and the expected penalties are low. The rates of noncompliance and the amounts of illegal harvests are similar to those reported here from our 2007 survey. The results of the Shaw [6] study were: “(1) fishermen do not perceive fishery management agencies and the fishery regulations to be holistically legitimate; (2) participants (fishers) maximize their personal benefits; and (3) the National Marine Fisheries Service (NMFS), United States Coast Guard (USCG), and NOAA General Council need to coordinate their data maintenance programs to provide for greater data consistency and integrity.”

<sup>4</sup> For example, Sutinen et al. [5] report that during 1987 in the Georges Bank portion of the NEGF fishery “a quarter to half of all groundfish vessels were identified as frequent violators, committing closed area violations on about one-third of their trips and using illegal mesh on nearly all trips [and] illegal earnings by a typical frequent violator...amounted to approximately \$225,000 per year.”

In most fisheries normative influences result in most fishers complying with fishing restrictions despite potential economic gains from doing otherwise. The survey results show this to be true in the NEGF fishery except that a significant number of fishers have formed an unfavorable and distrustful view of fishery management, which is having an adverse affect on their willingness to comply with fishing restrictions. One-third of fishermen in the fishery believe illegal fishing is already significant enough to prevent them from ever benefiting from fish stock rebuilding programs. From the perspective of these fishermen, the most “sustainable” strategy is to earn as much income as possible from fishing as soon as possible before the fishery collapses or is shut down. Under these circumstances, further tightening of restrictions on legal fishing increases the likelihood that normally law-abiding fishermen will engage in illegal fishing for economically rational reasons.

The policy implications of this research are significant because they indicate that: (1) strategies to meet new federal mandates to reduce overfishing and to meet fish stock rebuilding targets in this fishery<sup>5</sup> will not succeed until enforcement and compliance problems in the fishery are addressed and (2) a robust “smart compliance policy” [7] needs to be implemented to effectively control illegal fishing in the fishery.

Smart compliance policy deals explicitly with the fact that the influence of compliance drivers on behavior varies among fishers; and that compliance problems presented by those fishers who are not influenced by moral obligation and social influence need to be addressed differently than compliance problems presented by other fishers. Smart compliance policy involves developing strategies that: (a) target and meaningfully penalize frequent, routine violators; (b) provide adequate deterrence to discourage occasional violators; and (c) strengthen the basis for achieving voluntary compliance. Evidence regarding compliance in the NEGF fishery and the different factors that motivate compliance among different types of fishers strongly support developing and implementing a robust smart approach to compliance in this fishery.

Research results also indicate that it is important to address noncompliance problems soon. Fishermen know that additional fishing restrictions needed to meet new federal fish stock rebuilding mandates will create more economic incentives for fellow fishers to engage in illegal fishing. They also know that more illegal fishing may prevent stock rebuilding targets from being met and force regulators to tighten regulations further, or perhaps even shut down the fishery. Fishers also recognize that increases in the illegal harvest mean fishery scientists and managers receive less reliable catch and effort statistics with which to assess conditions in the fishery. As a result, fishers have less trust in the scientific basis and legitimacy of fishery management decisions. The stronger incentives to fish illegally, combined with the weaker legitimacy of the management process, indicate that a robust smart compliance and enforcement program needs to be implemented soon to prevent further economic and biological decline in the NEGF fishery.

The following sections include an overview of the NEGF fishery (Section 2) and the prevailing theories and models that can be used to assess enforcement and compliance in this fishery (Section 3). Section 4 provides an overview of the survey results and uses them to address three critical questions: Is

<sup>5</sup> The 2007 reauthorization of the Magnuson-Stevens Act (MSA), the US law that governs fishery management, mandates science-based definitions of “overfishing” for all fisheries and requires regional fishery management councils to set clear targets and timetables for “preventing and ending overfishing and rebuilding US fisheries.”

**Table 1**  
Size of the New England groundfish (NEGF) fleet.

State	Number of vessels <sup>a</sup>
Connecticut	182
Delaware	184
Maine	1,656
Maryland	32
Massachusetts	695
New Hampshire	109
New Jersey	397
New York	N/A
Rhode Island	344
Virginia	261
Total	3860

Source: NOAA, 2002, fisheries of the United States.

<sup>a</sup> Includes only permitted vessels greater than 5 net registered tons.

noncompliance a serious problem in the NEGF fishery? What factors affect noncompliance in the NEGF fishery? How does the current system of enforcement and penalties need to change to improve compliance? Section 5 provides conclusions and recommendations for improving compliance in this fishery.

## 2. The Northeast multispecies groundfish (NEGF) fishery

### 2.1. Fishery overview

The Northeast multispecies groundfish (NEGF) fishery consists of 24 species targeted by a fishing fleet of nearly 3,400 vessels that range from small hook-and-line vessels, operating in near-coast waters; to large offshore trawlers<sup>6</sup> (Table 1 and Fig. 1). The fishery has been the mainstay of New England's fishing industry for three centuries but overfishing over the past 50 years has resulted in an alarming decline in the abundance of fish resources and in the economic value of this fishery (Fig. 2).<sup>7</sup> A 2008 report to congress by the National Marine Fishery Service (NMFS) listed 13 of the 24 species in this multispecies complex as "already overfished," 8 as being "subject to overfishing," and 4 as experiencing "unknown" levels of overfishing.<sup>8</sup> For this reason, the NEGF fishery is generally considered to be one of the most mismanaged and seriously threatened fisheries in the country.<sup>9</sup>

Attempts by regulators to reduce overfishing in the fishery have involved frequently changing and increasingly complex combinations of gear restrictions, by-catch limits, days at sea restrictions and fishing area closures. These regulations have not reduced overfishing sufficiently to allow fish stocks to rebuild. They have imposed economic hardships on many fishers and resulted in a relatively hostile relationship between fishery regulators and some fishers. Currently, regulators are considering

<sup>6</sup> The 3,375 vessels had permits to operate in the NEGF fishery in 2007. Permit data are available at: <http://www.nero.noaa.gov/permits/data/2007/>. Discussions with NOAA economists at Woods Hole indicate that, based on permit type, approximately 1,665 of these vessels are active in the fishery and account for nearly all the harvest. We surveyed the permit holders associated with 708 of these 1,665 vessels and had a survey response rate of over 40%.

<sup>7</sup> A history of the NEGF fishery is available at: <http://www.nefsc.noaa.gov/history/stories/groundfish/grndfsh2.htm>.

<sup>8</sup> These figures are from the NMFS report to congress on the status of US fisheries [8].

<sup>9</sup> Fishery scientists and managers have written extensively about the various causes of fishery management problems in this fishery [9]. A 1996 report prepared for NOAA describes the perceptions of fishers about how fishery managers contributed to the decline of the fishery and is available at (<http://www.nefsc.noaa.gov/read/socialsci/cultural-aspects/50-DGNF-5-00008.pdf>).

entirely new ways of managing the fishery, including "sector based management" which involves granting dedicated access privileges to what are essentially fishermen cooperatives.<sup>10</sup> Sectors are favored by some fishers and opposed by others. However, as of early 2009, details have not yet been developed regarding how liability will be shared among fishers operating within sectors, how many fishers are likely to join sectors or how the allowable harvest from the NEGF fishery might be shared by sector and non-sector vessels.<sup>11</sup> Until these issues are resolved it is not clear how widespread sectors will be, or how they might affect enforcement and compliance in the fishery.

There is also increasing concern among fishery scientists that some fish stocks in the NEGF fishery do not appear to be increasing in response to forced reductions in fishing effort as quickly as their models predict.<sup>12</sup> Fishery scientists are searching for explanations that focus on possible structural changes in ocean ecosystems, imbalances in predator-prey relationships, ocean pollution, habitat loss, shifting ocean currents, ocean warming, etc. However, it is possible that forced reductions in legal overfishing are being offset by increases in illegal overfishing and unreported catches that are not taken into account in fishery models being used to predict fish stock improvements from forced reductions in (legal) fishing effort. Since deteriorating economic conditions and more restrictive regulations in the NEGF fishery strengthen economic incentives for fishermen not to comply, and normative influences on compliance are not strong in this fishery, this is clearly a hypothesis worth addressing.

### 2.2. Policy context

The 2007 reauthorization of the Magnuson-Stevens Act (MSA), the US law that governs fishery management, mandates science-based definitions of "overfishing" for all fisheries and requires regional fishery management councils to set clear targets and timetables for "preventing and ending overfishing and rebuilding US fisheries."<sup>13</sup> The NMFS, Northeast Fishery Center and New England Fishery Management Council (NEFMC) are now preparing to address three key challenges in implementing this law in the NEGF fishery: (1) how to establish scientifically defensible annual harvest limits that will meet mandated stock rebuilding targets for each of the 24 stocks; (2) how to find combinations of effort restrictions (e.g., days at sea limits and closed areas) and catch restrictions (e.g., fleetwide, sector, or individual harvest quotas and by-catch limits) that will minimize and equitably allocate the unavoidable and potentially catastrophic economic costs that achieving these harvest limits will impose on fishermen; and (3) how to reform fishery management institutions so they will respond to science and not to short-term economic and political pressures.<sup>14</sup>

<sup>10</sup> The New England Fishery Management Council (NEFMC) describes a sector as: "a group of persons holding limited access vessel permits who have voluntarily entered into a contract and agree to certain fishing restrictions for a specified period of time, and which has been granted a TAC(s) (total allowable catch) in order to achieve objectives consistent with applicable fishery management plan (FMP) goals and objectives."

<sup>11</sup> A description of how sectors are likely to operate in the NEGF fishery is provided in Turriss and McEldery [10]. Descriptions of how various fishers and fishing industry representatives view "sectors" appear frequently in fishing industry publications, such as *National Fisherman* and *Commercial Fishing News*.

<sup>12</sup> A recent article by Rosenberg et al., examines various explanations for why some fish stocks do not appear to be recovering quickly, as most fishery models predict, after forced reductions in fishing effort [11].

<sup>13</sup> Information about the 2006 amendments to the MSA and planned implementation strategies are available at [www.nmfs.noaa.gov/msa2007](http://www.nmfs.noaa.gov/msa2007).

<sup>14</sup> Discussion papers that describe new mandates for NMFS and the fishery management councils to implement "science-based" management are available at <http://www.nmfs.noaa.gov/msa2007/>

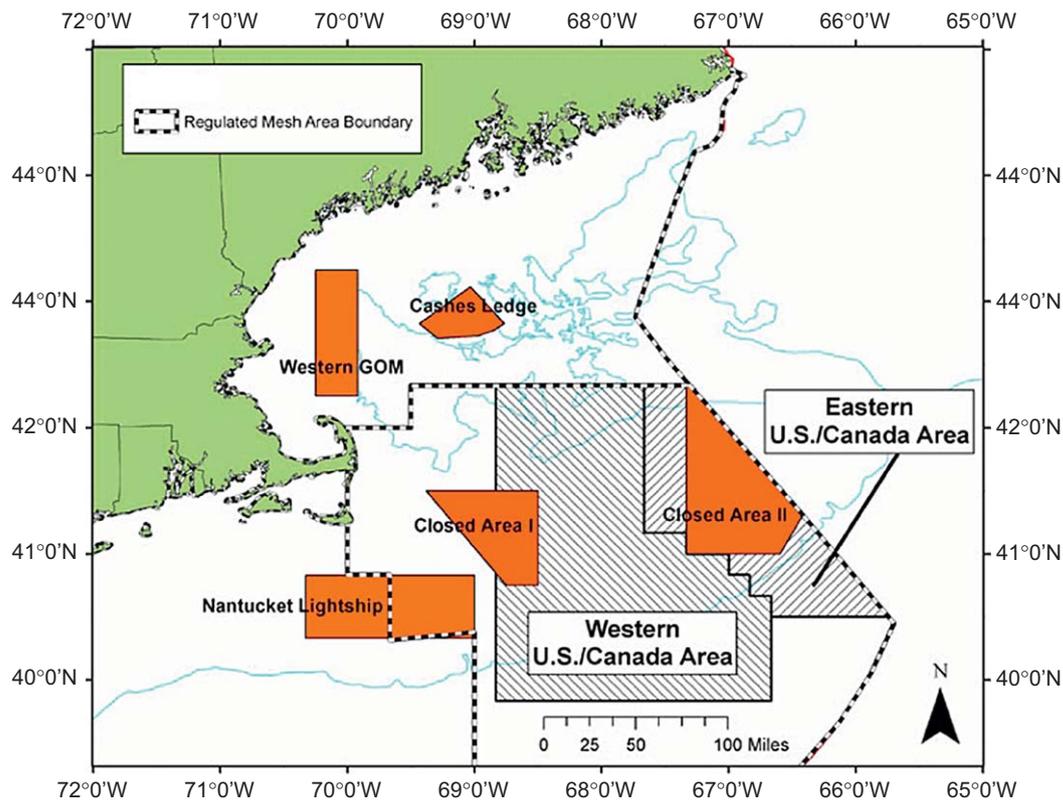


Fig. 1. Location of the NEGF Fishery. Source: NOAA, Northeast Regional Office.

Enforcement has always been recognized as an essential part of management in the NEGF fishery but it is not always a primary consideration when fishery managers make regulation decisions [12]. The NEFMC has a standing enforcement committee that meets regularly and provides the council with enforcement reports.<sup>15</sup> NMFS fishery enforcement staff and state fishery enforcement staff working with NMFS under Joint Enforcement Agreements (JEAs) also generate reports that summarize enforcement effort (e.g., number of enforcement man-hours, vessel-hours, or fishermen contacts) and the outcomes of that effort (e.g., number of citations, types and sizes of penalties, etc.). However, these reports only provide information about violations of fishing restrictions that are detected and reported.<sup>16</sup> Research focusing on the overall level of noncompliance in the fishery, detected and undetected, and how it may be affecting biological and economic conditions in this fishery, is rare. Also rare are studies that address whether the overall enforcement system that is in place in this fishery, including the combination of dock-side and at-sea inspections and associated procedures for prosecuting and penalizing violators, is adequate to deter illegal fishing.

The US coast guard (USCG) maintains records related to compliance in regional US fisheries that are based primarily on violations that are detected during at-sea boardings. However,

these records are not generally available, and the aggregate compliance rates that are reported by the USCG based on these records do not seem credible.<sup>17</sup> Other evidence based on surveys and interviews indicates that the high compliance rates reported routinely by the USCG to demonstrate the success of its at-sea fishery enforcement program actually reflect the failure of current USCG at-sea enforcement activities to detect violations [13].

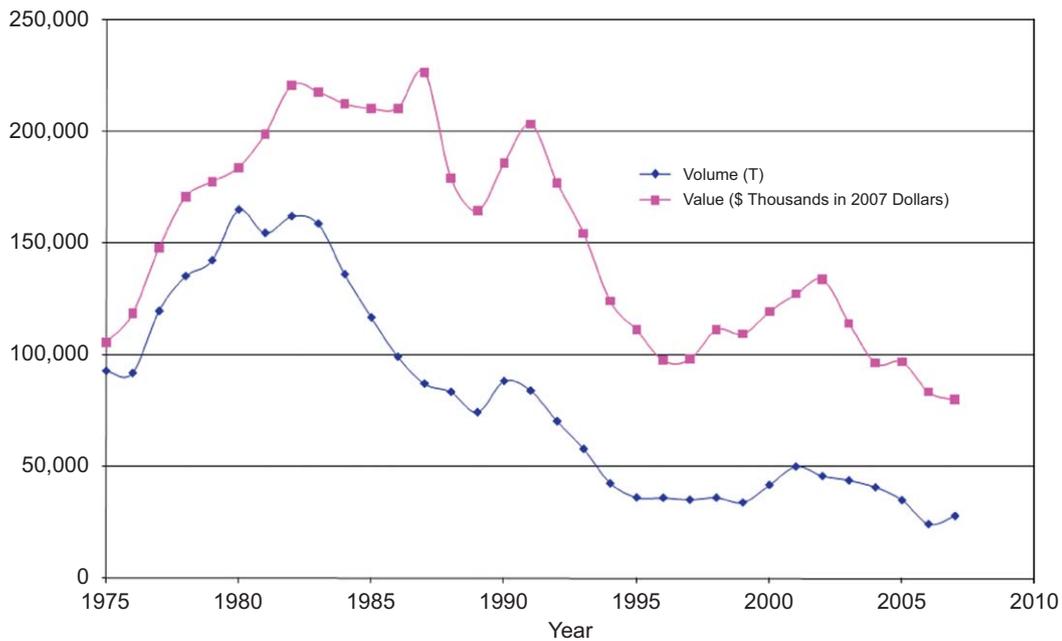
### 2.3. Compliance/Enforcement context

It is often reported that US fishermen who violate fishing restrictions fall into three general categories: chronic or frequent violators of fishing restrictions; those who usually comply but will violate fishing regulations occasionally when the economic incentive is high or the likelihood of detection is low; and those who fail to comply by accident because they misunderstand fishing restrictions, or have faulty electronics, etc. In a study of compliance and enforcement in the NEGF fishery during the 1980s, Sutinen et al. [5] determined that “passion, inadvertence,

<sup>15</sup> NOAA also maintains two enforcement databases, Enforcement Management Information System (EMIS) and Law Enforcement Accessible Database System (LEADS), which include records of reported violations. These databases are explained in the report cited in footnote 1. Summaries of EMIS data for years 2001 through 2006 are used in subsequent sections of this paper.

<sup>16</sup> A 2008 NOAA, Office of Inspector General, review of NMFS management of JEAs is available at [www.oig.doc.gov/oig/reports/2008/IPE-19050.pdf](http://www.oig.doc.gov/oig/reports/2008/IPE-19050.pdf). The study report cited in footnote 1 contains a summary of that report. A review of JEA data available for the Northeast region conducted as part of the study referenced in footnote 1 concluded that JEA data are not suitable for assessing or managing the performance of the JEAs in that region.

<sup>17</sup> The results of a 2006 review of USCG fishery enforcement by the Office of Management and Budget (OMB) are available at <http://georgewbush-whitehouse.archives.gov/omb/expectmore/detail/10001072.2003.html>. The USCG regularly reports compliance rates in US fisheries of 96–97% based on the percent of at-sea boardings where violations are detected. USCG notes in their reports, however, that since USCG targets likely violators, USCG observed and reported compliance rates probably overstate compliance rates that would be observed if the USCG were sampling randomly. The USCG uses these results to show that the USCG domestic fishery enforcement is highly successful at achieving the established USCG compliance goal of 97%. However, all other available evidence, including research results presented in this paper, indicates that the high compliance rates reported by USCG: (a) reflect the fact that USCG at-sea inspections fail to detect many actual fishing violations; (b) may actually reflect shortcomings of the USCG’s \$500 million per year fishery enforcement program rather than its success; and (c) may be preventing these shortcomings from being addressed and preventing the effective reallocation of fishery enforcement spending and effort [13].



**Fig. 2.** Volume and value of annual harvest from the NEGF Fishery (1975–2007). Source: NOAA, office of Science & Technology, Fisheries Statistics Division—Annual Commercial Landing Statistics. [http://www.st.nmfs.noaa.gov/st1/commercial/landings/annual\\_landings.html](http://www.st.nmfs.noaa.gov/st1/commercial/landings/annual_landings.html).

and accident rarely cause a fishery violation.” The conclusion of that study, in other words, was that most violations of fishing regulations in the NEGF fishery fall in the first two categories and are intentional.

However, in the 2007 survey conducted for this study, the portion of intentional violations in the NEGF fishery was estimated by fishermen to be 38%, by fishery regulators to be 44%, and by fishery enforcement staff to be 53%. These results indicate that as many as half of the violations in the NEGF fishery may be accidental. This relatively high portion of accidental violations recently reported is probably a result of more complex regulations and the decline in economic returns that has resulted in more part-time fishers and a high turnover rate.

However, earlier studies also determined that fishers who are chronic intentional violators contribute most significantly to the illegal harvest, so as that category grows there is a disproportionately higher increase in the illegal harvest. In the current survey, the percent of fishermen in this category is estimated by fishermen and regulators to be around 16% and by enforcement staff to be 35%. This is significantly higher than the roughly 12% of fishers estimated to be chronic violators in previous studies of this fishery [4].

Survey statistics presented in Section 3 show that the percent of the total harvest taken illegally in the NEGF fishery is estimated by fishermen to be about 12%, and by enforcement agents to be about 24%. If the actual percentage is somewhere between these two estimates, these results also indicate a significant increase in the illegal harvest compared with earlier surveys, which estimated the illegal harvest at 6–14% [4]. Because the size of the overall harvest has gone down, the size of the illegal harvest may have declined despite this percent increase. However, fish stocks are more depleted now which means the illegal harvest, although perhaps lower in terms of volume, can be expected to have more significant adverse effect on fish stocks than in previous years.

### 2.3.1. NOAA enforcement data

Table 2 lists the 1,689 violations of fishing regulations reported to NOAA in the NE region during the period of January 1, 2001

through May, 31, 2006.<sup>18</sup> Because the sources of some of these reports may not be reliable and some were never fully investigated and “proven,” these reported violations are generally referred to as “incidents.” Interviews with NOAA enforcement staff and others familiar with fishery enforcement indicate that government fishery enforcement agents often have “probable cause” to inspect for a violation, and if an inspection results in the decision to report a violation, give it a tracking number and enter it into the official NOAA enforcement database. That reported violation then probably reflects an actual violation.<sup>19</sup> Therefore, for the purpose of this analysis, only “incidents” where the reported violation source was NMFS, USCG, or state fishery enforcement staff were examined and were considered “probable violations.”<sup>20</sup> Based on this criterion, 1,614 of the 1,689 incidents (95.6%) reported during this period probably are actual violations and, for purposes of this analysis, will be treated as actual violations.

Table 2 lists violations in the Northeast region contained in the NOAA enforcement database and the percentage of them that resulted in a financial penalty, forfeited catch or property, permit sanction, or any type of penalty at all.<sup>21</sup> Overall, 33% of violations reported by law enforcement resulted in one or more types of penalties. The remaining 67% of these cases were dropped or for various other reasons resulted in the violator facing no penalty or sanction. A breakdown of the resolutions of violations in the

<sup>18</sup> Enforcement data from NOAA’s EMIS database were available to researchers only for violations reported from January 1, 2001 through May 31, 2006.

<sup>19</sup> For a variety of reasons, reported violations, whether they involve actual violations or not, may not be pursued by prosecutors and be “proven” or may not have resolutions that indicate that they were actual violations.

<sup>20</sup> Some of these were not fully investigated and “proven” to involve actual violations. However, interviews with NOAA enforcement staff and others familiar with this database indicate that in many cases enforcement officers have probable cause to inspect for a violation and, if after inspecting they decide to report a violation, it probably is a violation even though it may not be prosecuted or have a resolution that results in a penalty.

<sup>21</sup> These include only violations of commercial fishing restrictions, not safety or marine mammal violations or violations by recreational vessels. These commercial fishing violations in the NE region are not strictly limited to violations in the NEGF fishery.

**Table 2**  
Reported incidents and probable violations<sup>a</sup> in NOAA's EMIS database.

Source	Incident		Probable violations		Violations resulting in one or more type of penalty		
	#	%	#	%	#	% of all violations that resulted in one or more type of penalty	% of violations by source that resulted in one or more type of penalty
<i>Northeast region only (Jan 1, 2001 through May 31, 2006)</i>							
US coast guard <sup>b</sup>	291	17.2	291	18.0	167	31.2	57.4
NMFS <sup>c</sup>	979	58.0	979	60.7	203	37.9	20.7
State <sup>d</sup>	47	2.8	47	2.9	24	4.5	51.1
NMFS/State	297	17.6	297	18.4	141	26.4	47.5
F/EN IFQ clerk <sup>e</sup>	0	0.0	0	0.0	0	0.0	0.0
Canadian referral	0	0.0	0	0	0		
Complaint directly through region or agent	10	0.6	0		0		
Conservationist organization	1	0.0	0		0		
Hotline complaint	7	0.4	0		0		
Marine sanctuary contractor	0	0.0	0		0		
Member of the general public	26	1.5	0		0		
NOAA general counsel	0	0.0	0		0		
Other	5	0.3	0		0		
Other federal agency initiated report	1	0.1	0		0		
U.S. customs	0	0.0	0		0		
U.S. fish and wildlife service	4	0.2	0		0		
U.S. fishing vessel	21	1.2	0		0		
<b>Total</b>	<b>1689</b>	<b>99.9</b>	<b>1614</b>	<b>100.0</b>	<b>535</b>	<b>100.0</b>	<b>33.1</b>

Source: NOAA Enforcement Management Information System (EMIS) Database (closed cases reported during January 1, 2001 through May 31, 2006).

<sup>a</sup> Violations are reported violations where the source of the report was coast guard, NMFS or State enforcement staff. Since not all of these reported violations were pursued and/or proven, these violations are considered "probable".

<sup>b</sup> Total CG includes: coast guard surface, coast guard aerial, NMFS/coast guard surface, NMFS/coast guard aerial, and other source of coast guard initiated report.

<sup>c</sup> NMFS includes: NMFS surface, NMFS observer, NMFS initiated, and NMFS initiated VMS only.

<sup>d</sup> State includes: authorized state agency/official initiated and state or local government agency.

<sup>e</sup> F/EN IFQ clerk sources are NMFS sources, but are shown separately here for clarity.

**Table 3**  
Resolution of violations in NOAA's fishery enforcement database.

Year	Incidents #	Violations #	Violations resulting in payment of penalty		Violations resulting in forfeited property		Violations resulting in seized property		Violations resulting in permit sanction		Violations resulting in one or more type of penalty	
			#	%	#	%	#	%	#	%	#	%
<i>Percent of violations resulting in penalties<sup>a</sup></i>												
<i>Northeast region only</i>												
2001	295	272	50	18.38	34	12.50	7	2.57	12	4.41	84	30.88
2002	313	296	83	28.04	34	11.49	12	4.05	5	1.69	119	40.20
2003	394	382	59	15.45	36	9.42	13	3.40	6	1.57	108	28.27
2004	306	290	66	22.76	31	10.69	25	8.62	9	3.10	116	40.00
2005	313	306	54	17.65	23	7.52	26	8.50	1	0.33	88	28.76
2006 <sup>b</sup>	68	68	16	23.53	10	14.71	0	0.00	0	0.00	20	29.41
<b>Total</b>	<b>1689</b>	<b>1614</b>	<b>328</b>	<b>20.32</b>	<b>168</b>	<b>10.41</b>	<b>83</b>	<b>5.14</b>	<b>33</b>	<b>2.04</b>	<b>535</b>	<b>33.15</b>

<sup>a</sup> Penalties may include payment of fines, permit sanctions (e.g., loss of privileges) or forfeit of property (e.g., catch) or seizure of property (e.g., vessel or gear).

<sup>b</sup> Data ranges from Jan 1, 2001 through May 31, 2006.

Northeast region for each year during the study period is presented in Table 3 and shows a decline in the percentage of violations resulting in any type of penalty or sanction from 40% in 2004 to around 30% in 2005 and 2006.

Models of deterrence and compliance will be described and applied to the NEGF fishery in the following two sections. To put the above numbers in context, however, it is useful to point out here that within these models, when fishers consider violating a fishing regulation, they are assumed to consider both the probability of being detected and the probability of facing a penalty if they are detected. Survey results that will be presented later indicate that the probability of a violation being detected in the NEGF fishery is around 32%. If the likelihood that a violation of fishing regulations will be detected is 32%, and, as shown above,

the likelihood that a detected violation will result in a penalty is 33%, the likelihood of a violation resulting in a penalty is about 11% ( $0.33 \times 0.32$ ). Whether this provides adequate deterrence depends on which theories and concepts of compliance apply in this fishery and the size of the expected illegal gain compared with the size of the expected penalty. These two factors are addressed in the following two sections.

### 3. Theories and concepts of compliance in fisheries

Although the problem of enforcement and compliance in fisheries has been recognized for decades, Sutinen and Andersen [14] published the first rigorous theoretical analysis of the

problem in 1985. Sutinen and Andersen combined Becker's [1] general model of enforcement/deterrence with a bioeconomic fishery model to theoretically and empirically investigate the implications of different levels and types of fishery enforcement on the outcomes of fisheries management.<sup>22</sup>

### 3.1. Deterrence

The Becker model assumes that decision-makers, such as fishers, who are deciding to comply or not with a regulation, such as fishing restrictions, tend to make rational economic decisions. Following Smith [17,18] and Bentham [19], Becker's model focuses on criminals and assumes they behave like other individuals in their attempt to maximize their net benefits, subject to budget and other constraints.<sup>23</sup> In Becker's model, a potential criminal will commit a crime if the expected illegal gain exceeds the expected penalty of getting caught. The higher the expected penalty and the lower the illegal gain, the less illegal activity should be expected, and vice versa. Although fishers are not criminals, Becker's basic model also applies to potential violators of regulations. Several studies have empirically demonstrated the deterrent effect of enforcement in fisheries and illustrated that the basic deterrence model is correct: higher probabilities of detection and/or penalties result in fewer violations [2,22–25].

However, the basic deterrence model does not sufficiently explain the available evidence about compliance in fisheries. Evidence from several studies indicates that despite strong economic incentives to violate some fishing regulations (high potential illegal gain and low expected penalty), a high proportion of fishers (50–90%) normally comply with regulations [5,22,26]. Results from the 2007 survey of the NEGF fishery confirm the results of these earlier studies and indicate 65–84% of fishers normally comply with regulations in the NEGF fishery. This is in the typical range estimated previously in this fishery and in other regulated fisheries.

The illegal gain or benefit in a commercial fishery can be measured as the amount of additional income that can be earned from violating a regulation and can be quite large. In the NEGF fishery Sutinen et al. [5] found an unusually high percentage of fishers (25–50%) operating illegally with individuals earning about a quarter of a million dollars more per year by doing so. In some cases, illegal fishing trips earned three times the revenue of legal trips. In an earlier report, Sutinen et al. [4] estimated that in 1988 illegal landings by frequent violators in the US Atlantic scallop fishery ranged from \$75,000 to \$105,000 per year. In the Rhode Island quahog fishery, Bean [22] estimated that illegal catches by frequent violators ranged from one-third to one-half of an average fisherman's income. The economic incentive to violate, in other words can be very powerful and can be difficult for fishers to resist, especially those facing economic hardships or unable to succeed by fishing legally.

Offsetting the expected illegal gain is the potential cost if the illegal fishing is detected. This cost is measured by multiplying the dollar value of the expected financial penalty, forfeiture, or permit sanction if detected and convicted by the probability of being caught and convicted. If this expected cost is large enough and certain enough it can offset the expected illegal gain and remove the incentive to violate. However, penalties facing domestic fishers for violating fishing regulations in US waters are generally not large relative to illegal gains. In the NEGF fishery, for example,

Sutinen et al. [5] estimated flagrant violators grossed about \$15,000 *per trip* from violating closed area and mesh size regulations, resulting in illegal earnings per vessel of approximately \$225,000 during 1987.

Past studies estimated the probability of being caught violating a fishery regulation, in most fisheries, at near one percent, and often at or near zero [22,23,25,27]. Sutinen et al. [5] estimated that the typical penalty for a detected violation ranged from \$3,000 to \$15,000. With this range of potential penalty and an estimated likelihood of detection of close to 1%, these earlier studies concluded that the expected cost of violating fishing regulations during any given fishing trip is very small, perhaps in the hundreds of dollars, while illegal gains are relatively large, usually in the thousands or tens of thousands of dollars.

In the following section, the 2007 survey results and NOAA enforcement data are used to estimate that the net illegal earnings from violating fishing restrictions in the NEGF fishery are approximately \$5,500 per trip. For a variety of reasons, perhaps associated with declining fish abundance and limits on days at sea, this estimate for 2007 is about a third of the amount estimated for 1988 by Sutinen et al. [5]. However, the analysis indicates that once the low probability of being detected and penalized and the expected size of the penalty are taken into account, this level of illegal gain is still high enough to provide an economic incentive not to comply. Deterrence effects of the enforcement system in the NEGF fishery, while stronger than estimated previously, are still relatively weak.

### 3.2. An enriched model of compliance

In addition to comparing the expected illegal gain and expected penalty, most individuals also consider the moral and social consequences of their actions when deciding whether to comply with a law or regulation. When asked why they usually comply with fishing restrictions even though illegal gains are much larger than the expected penalties, many fishers refer to the need to “do the right thing” [28,29]. That is, they express an obligation to obey a set of rules (either their own or an authority's). A sense of moral obligation is as common among fishermen as other people and has been shown in many previous studies to be a significant motivation that explains a great deal of compliance behavior among fishers.<sup>24</sup>

However, an individual's moral obligation to comply is the result of two forces: the individual's standard of personal morality and the individual's perceptions about whether rules and regulations are just and moral and are being applied fairly and equitably [30]. Where possible, these factors are built into policy formulation and implementation to build compliance. In general, individuals who believe complying with the regulation is the “right thing to do” will feel a moral obligation to comply regardless of the potential illegal gain. Individuals who disagree with the basis of a regulation, the way it is being imposed, or question the credibility or legitimacy of management institutions and procedures may be inclined to violate the regulation regardless of the size of the expected illegal gain.

Peer pressure, or the sentiments of people who matter to an individual, also influence most individual decisions regarding whether to comply. These social influences are known to play a significant role in fisheries, often taking subtle forms of ostracism or withholding of fishing information or other favors [3]. A group of fishers can reward and punish those who violate group norms

<sup>22</sup> Also see Anderson and Lee [15] and Milliman [16].

<sup>23</sup> Becker's framework became the basis for a series of subsequent studies on the economics of crime. See Heineke [20] and Pyle [21] for an overview of the theoretical models used in the economic literature of criminal behavior.

<sup>24</sup> See Kuperan and Sutinen [2] and Sutinen and Kuperan [3] for a detailed derivation of these factors; also see Hatcher and Gordon [24] and Gezelius [27] for reviews of the fisheries compliance research literature.

(i.e., a tacit agreement not to violate a particular fishing restriction) by withholding signs of group status and respect or even by direct threats. Social influence in fisheries is often manifested in forms of verbal and physical abuse (e.g., fist fights, destruction of gear and vessels). In the Massachusetts lobster fishery, for example, a strong form of social influence, commonly called “self-enforcement,” is estimated to account for relatively high compliance in the fishery [26]. Other fisheries where social influence appears to be strong include the American lobster (Massachusetts and Maine), clam (Rhode Island), herring roe (Alaska, British Columbia, Oregon, and San Francisco Bay), saithe (Norway), and sakuri ebi (Japan). It is likely that there are several other fisheries where this phenomenon is operative [3].

Individuals tend to use the same standards to judge their own behavior and the behavior of others, so social influence and personal moral obligations are closely linked. The more widespread an individual sense of moral obligation is in the fishing population, the stronger the social influence to support that conviction. An important implication of this is that policies that strengthen the moral obligation to comply also strengthen social influence. Unfortunately, this works both ways; when normative factors begin to have an adverse effect on the moral commitments to comply among individuals it is often reflected in a corresponding decline in social obligations to comply.

This is important because individual moral influences and social influences can combine to create a situation where noncompliance is an accepted norm in a fishery. This was the case in the NEGF fishery during the late 1980s when pressure from crews and competition on the fishing grounds drove fishing captains to fish in closed areas and use illegal nets on most trips [5]. In such cases, compliance programs must not only strive to increase deterrence (i.e. the expected penalty), they must also attempt to build a stronger moral obligation to comply among fishers and to shift social influence to the side of supporting compliance.

### 3.3. Aggregate compliance behavior

Fishers are not all alike in their compliance behavior. For example, some fishers invest in methods to avoid detection and therefore face lower probabilities of detection than other fishers [15,22]. Others have a stronger moral obligation and face more social pressure to comply [28] but will violate when the expected gains are high or the probability of detection is low.

The available evidence suggests that within the typical population of fishers there is a small core subgroup of about 5–15% who tend to violate routinely, motivated primarily by the tangible financial gains from illegal fishing, and very little by moral obligation or social influence [4]. The only control mechanism that will influence the behavior of these fishers is changing the economic incentives. Aside from some kind of incentive program that involves paying them to comply (in which case they may take the money and still not comply), the only real option is increasing enforcement and the size and certainty of penalties.

At the other extreme is a small percentage of fishers, 5–15%, that is strongly influenced by moral obligation and comply most, if not all, of the time. In the middle is the large portion of fishers that normally comply and only occasionally violate. Their decision to comply or not depends largely on economic conditions and the degree of social influence they face. This group typically consists of about 70–90% of the fishing population.

The result is that a small number of fishers tend to account—directly and indirectly—for most of the noncompliance in a fishery and most of the risks that illegal fishing imposes on

fish stock protection and recovery programs. Routine violators can only be controlled by strict enforcement and other tangible incentives. Smart compliance policy recognizes and exploits this critical feature of compliance behavior, while employing other methods to promote voluntary compliance among occasional violators [5,7].

## 4. Enforcement and compliance in the NEGF fishery

This section applies the concepts described in the previous section using the results of the research in the NEGF fishery to address the following three questions:

1. Is noncompliance a significant problem in the NEGF fishery?
2. Are enforcement factors associated with the probability of detection and size of penalties adequate to deter noncompliance in the NEGF fishery?
3. Are the effects of normative factors associated with fishers' perceptions about their moral obligations and the legitimacy, fairness, and competency of fishery managers increasing or decreasing the need to use deterrence to reduce noncompliance?

Because most illegal fishing is not observed, it is reasonable to assume that much illegal fishing is not detected or reported. As a result, conclusions about noncompliance in most fisheries must be based on surveys and interviews.<sup>25</sup> The 2007 survey of fishermen, enforcement officers and others involved in the NEGF fishery addressed many issues related to the frequency and significance of various types of fishing violations, the effectiveness of dockside and at-sea inspections, most and least important types of violations, the size of penalties, and so on. The following sections summarize survey results that address the three questions listed above.

### 4.1. Noncompliance in the NEGF fishery

#### 4.1.1. What is the extent and nature of noncompliance in the NEGF fishery?

The survey results show that fishers and enforcement personnel had different views on the extent of noncompliance in the fishery, with fishermen estimating that about 12.5% of the commercial harvest is taken illegally and enforcement agents estimating that about 24.4% is taken illegally. For purposes of this analysis it is assumed that the actual level of noncompliance is reflected by the midpoint of these two estimates which means that 18.5% of total catch is due to fishing illegally. The estimate of illegal harvest provided by fishers in the survey is in the same range found in a survey of fishers by Sutinen et al. [4], suggesting that fishers believe the level of compliance today is similar to what it was in the fishery 20 years ago.

#### 4.1.2. How significant is the level of noncompliance in the NEGF fishery?

Actual landings from the NEGF fishery in 2006 were 28,110 mt with a dockside value of \$70.275 million. So at 18.5%, the illegal catch in that year amounted to about 5,202 mt, worth about \$13 million. As a first approximation of the

<sup>25</sup> In general, statistics based on observations are preferable to those based on survey results. However, the available evidence in the NEGF fishery indicates that fishing violations at sea are not observable, even by USCG surveillance aircraft and vessels. So in this case estimates of compliance and noncompliance rates based on surveys are more reliable than those based on at-sea observations. (See footnote 18).

potential impact of this illegal harvest, consider how those 5,202 mt of fish would contribute to the health and economic value of the NEGF fishery over time if left in the sea to spawn and grow, instead of being harvested illegally. At an annual net biomass growth rate of 2–5%, for example, eliminating an annual illegal groundfish harvest of 5,202 mt per year would result, over 5 years, in an increase in groundfish stock biomass of about 28,000–30,000 mt, or an increase of around 60,000–70,000 mt over ten years.

Respondents estimated that 18% of commercial fishers routinely violate fishery laws, and 24% occasionally violate such laws. This is similar to the results of Sutinen et al. [5] who estimated that approximately 14–38% of commercial fishers frequently violate conservation regulations.

A strong majority (69%) of survey respondents in the NEGF fishery believe that compliance with fishery regulations is better than it was 5 years ago. This finding, together with the estimates of illegal catch rates and percent of routine violators in our 2007 survey, suggests that compliance has been worse at times during the past 20 years. As mentioned in Section 2.1, however, the health of fish stocks has deteriorated over the past 20 years so the problems associated with noncompliance may be worse now than in previous years.

#### 4.1.3. What are the most common violations?

The survey asked respondents to estimate the percent of days at sea where particular types of violations took place. Overall (fishermen, enforcement, fishery managers, and others) estimated that the most common violations involve by-catch, possession limit, and catch reporting regulations (20–21% of days fished), followed by haddock separator trawl, mesh size and fish size violations (14–17%), and area closures, days at sea, and permit violations (10–11%). Sutinen et al. [5] reported much higher rates of noncompliance for area closures and mesh size regulations—the principal conservation regulations at the time. Respondents to the survey by Shaw [6] reported that violations of possession limits were the most common (72% of days at sea) during the fishing year of 2003, followed by violations of mesh size limits (45% of days at sea), area closures (38% of days at sea), and days at sea regulations (36% of vessels).<sup>26</sup> The rankings of most common violations in the 2007 survey were very similar to those in the Shaw survey; but the frequency of violations perceived by 2007 respondents is considerably lower than reported by Shaw's respondents in 2003. These findings support the claim by a strong majority of 2007 respondents that compliance has improved during the past 5 years.

Respondents who identified themselves as enforcement personnel reported very different perceptions about rates of compliance than fishers and others. For example, enforcement personnel, on average, estimated that 35% of commercial fishers routinely violate fishery laws, and that 38% occasionally violate the laws—higher rates than all respondents combined. Only 38% of enforcement personnel agree or strongly agree that compliance is better than 5 years ago—compared to 69% of all respondents and 73% of commercial fishers. Only 29% of fishery enforcement staff disagree or strongly disagree that compliance has improved. Enforcement personnel tended to rank the most common and most important violations similar to other respondents combined, but generally gave higher estimates of violation rates.

<sup>26</sup> The Shaw survey focused only on commercial fishers. Commercial fishers comprised approximately two-thirds of the respondents to our survey and their responses closely mirror the average rates reported by Shaw.

#### 4.2. Impacts of noncompliance on the NEGF fishery

Majorities of most types of respondents believe that one or more types of violations are having either a moderate, significant, or major adverse impacts on the fishery<sup>27</sup> (Table 4 and Fig. 3). Thirty-seven percent of fishers, 61% of fishery managers, and 80% of fishery enforcement staff believe that “the combined adverse impact of all violations on the health and manageability of fish resources” is significant, highly significant, or extremely significant.<sup>28</sup> And only 27% of fishers, 12% of fishery managers, and 2% of fishery enforcement staff believe that the combined impact of all violations is having no significant impact on the health and manageability of fish resources. Although groups provided different responses in terms of the significance of impacts, a strong majority of all groups believe that violations are having at least some adverse impact on the fishery which seems to reflect a consensus on this critical matter. In addition, strong majorities of all respondents agree about the ranking of specific types of violations in terms of the significance of their impacts (Tables 4a–c and Fig. 3).

While there is general agreement about the ranking of specific violations in terms of impact, there is some diversity of opinion among groups of respondents about the degree of the impacts of specific violations. For example, enforcement personnel tend to think adverse impacts of specific violations are more significant (i.e., highly and extremely significant) than other groups of respondents. Larger proportions (*not* numbers) of researchers think some specific violations are not significant compared to other groups of respondents. For example, 40% of researchers responding to the survey think that violations of closed areas are not having an adverse impact on the health and manageability of the resource; only 22% of fishers and 20% of regulators believe this is the case. Interestingly, fishers and regulators tend to agree on the significance of various impacts, in terms of the proportions of each group. If respondents think that violations are having a significant impact on the health and manageability of the resources, do respondents also think that the nature and extent of violations are jeopardizing the sustainability of stocks in the NEGF fishery? Although a majority (55%) of all respondents think that violations are not threatening sustainability, it is relevant that many respondents do. For example, 67% of enforcement personnel, 31% of regulators, 25% of researchers, and 20% of fishers agree or strongly agree that “violations of fishing regulations are jeopardizing the sustainability of fish stocks in the NE groundfish fishery.” Opinions are mixed about whether fishing violations are significant enough to “reduce long-term economic returns from fishing” and reduce fishers' expectations that they will gain in the future from stock rebuilding programs. A weak majority of fishers (51%) and of researchers (55%) disagree with these statements. However, it is significant that a strong majority of enforcement personnel (68%) agree, and many regulators (31%), researchers (30%), and even fishers (26%) agree or strongly agree that illegal fishing is reducing long-term economic returns and lowering fishers' expectations that they will benefit from rebuilding fish stocks.

<sup>27</sup> The types of violations include those related to mesh size, vessel upgrades, landing limits, fish size, closed areas, days at sea limits, reporting requirements, and fishing permits.

<sup>28</sup> Respondents could choose *not significant*, *barely significant*, *significant*, *highly significant*, or *extremely significant* in response to our questions about impacts of fishing violations.

**Table 4**  
Responses to selected survey questions by type of respondent.

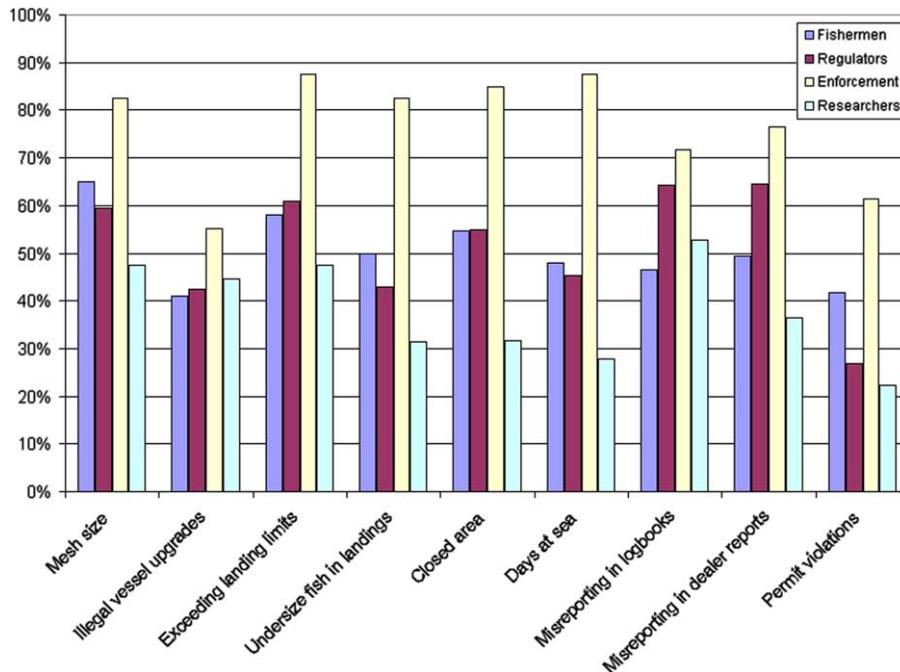
	29. What percent of fishing violations in the NE groundfish fishery are intentional as opposed to accidental?		33. What percent of commercial fishermen do you think routinely violate fishery laws?		35. What percent of violations of US fishery laws do you think are detected?		36. What percent of total catch is due to fishing in violation of fishery regulations?	
	Mean (%)	Median (%)	Mean (%)	Median (%)	Mean (%)	Median (%)	Mean (%)	Median (%)
Fishermen	37.7	30.0	16.4	10.0	41.7	40.0	12.5	10.0
Regulators	44.4	50.0	16.4	10.0	36.0	25.0	10.9	10.0
Enforcement	52.5	51.0	34.9	35.0	23.4	15.0	24.4	20.0
Researchers	46.1	50.0	12.2	10.0	41.1	50.0	9.3	10.0

	16. It is easy for those violating fishing laws and regulations to evade dockside detection by the NMFS and state agents	17. It is easy for those violating fishing laws and regulations to evade detection at sea by the coast guard	22. Too many detected violations that should have resulted in official notices of violation and assessment (NOVAs) and penalties result in warnings or other lesser sanctions	24. Penalties that are actually imposed for violating fishing restrictions in the NE groundfish fishery are sufficient to deter potential violators	41. Violations of fishery regulations are jeopardizing the sustainability of fish stocks in the NE groundfish fishery	47. The adverse effects of fishing violations on fish stocks are significant enough to reduce long-term economic returns from fishing	48. Violations of fishing regulations are significant enough to reduce fishermen's expectations that they will gain in the future from stock rebuilding programs	31. What impact do you think the frequency of all fishing violations combined has on the health and manageability of NE groundfish resources?
	Agree or strongly agree (%)	Agree or strongly agree (%)	Agree or strongly agree (%)	Agree or strongly agree (%)	Agree or strongly agree (%)	Agree or strongly agree (%)	Agree or strongly agree (%)	Significant, highly significant or extremely significant (%)
Fishermen	28.5	16.0	27.8	88.0	25.2	34.0	32.9	36.7
Regulators	56.7	30.5	45.2	63.6	38.3	40.6	44.5	61.0
Enforcement	81.8	72.7	32.3	51.5	78.3	82.8	67.7	80.5
Researchers	31.6	12.5	30.0	75.0	29.4	35.3	20.0	45.0

	Question 49: Percent of group responding that specific types of violations have a moderate, significant or major adverse impact on the NEGF fishery								
	49a. Mesh size (%)	49b. Illegal vessel upgrades (%)	49c. Exceeding landing limits (%)	49d. Undersize fish in landings (%)	49e. Closed area (%)	49f. Days at sea (%)	49g. Misreporting in logbooks (%)	49h. Misreporting in dealer reports (%)	49i. Permit violations (%)
Fishermen	65.0	40.9	58.1	49.8	54.7	48.0	46.5	49.3	41.7
Regulators	59.5	42.5	61.0	42.9	54.8	45.3	64.2	64.6	26.8
Enforcement	82.5	55.2	87.5	82.5	85.0	87.5	71.8	76.4	61.5
Researchers	47.4	44.5	47.4	31.5	31.6	27.8	52.7	36.4	22.3



**Fig. 3.** Responses to survey question #49 by type of respondent: Percent of respondents in each group answering that the adverse impacts of specific types of violations on the NEGF Fishery are: major, significant or moderate. Respondents were given option to answer: no impact, small impact, moderate impact, significant impact or major impact.

### 4.3. Enforcement and deterrence

As with compliance, a strong majority of all respondents (62%) believe that the overall enforcement program in the NEGF fishery is better now than 5 years earlier. Although this is encouraging, it does not imply that the adverse effects of noncompliance on fish stocks and economic conditions is better now than 5 years earlier, or that the enforcement program is adequate to achieve the rate of compliance that will be necessary to prevent overfishing and allow stock rebuilding programs to succeed.

#### 4.3.1. Do the respondents see weaknesses in dockside and at-sea enforcement and prosecution?

**4.3.1.1. Detection and prosecution—resources and effectiveness.** There is considerable divergence of opinion on some aspects of the dockside enforcement program. For example, 75.1% of fishers, but only 46.3% of regulators and 26.9% of enforcement officers believe that there are an adequate number of NMFS and state enforcement agents for detecting landings violations.

Fishers and enforcement personnel also have different opinions about whether it is easy for violators to evade dockside detection by enforcement agents. A majority of fishers (59%) think it is not easy to evade detection and a strong majority of enforcement personnel (64%) think it is.

Similar patterns of agreement and disagreement appear with respect to the number of dockside inspections and the presence and coverage of dockside enforcement. Majorities of all respondent groups and strong majorities of fishers view as adequate or more than adequate the number of dockside inspections and the presence and coverage of the dockside enforcement program. Regulators and enforcement personnel disagree or strongly disagree that these are adequate.

On other aspects of the dockside enforcement program, however, views are similar among groups of respondents. Strong majorities of each group view as adequate or more than adequate: the effectiveness of dockside inspections, methods and use of

equipment, response time to tips from fishers, follow through on investigations and dedication to effective enforcement.

With respect to *at-sea enforcement* by the USCG, strong majorities of all groups of respondents view as adequate or more than adequate the numbers of USCG equipment, personnel, at-sea boardings and inspections, presence and coverage, effective methods and use of equipment, response time to tips from fishers, and dedication to effective enforcement. Significant minorities of enforcement personnel and researchers (47% and 46%, respectively) believe that the USCG's follow through on investigations has been poor or less than adequate, a result also found by Shaw [6].

As with evasion of dockside detection, there are differences of opinion about how easy it is for fishers to avoid detection of violations at-sea. A strong majority of fishers (84%) do not believe that "it is easy for those violating fishing regulations to evade being detected by the USCG at-sea," while a strong majority of enforcement personnel (73%) believe that evasion is easy.

There is strong agreement among all groups of respondents that the use of *vessel monitoring systems* (VMS) is an effective means of enforcing area closures and effectively deters violations of area closures. Strong majorities of all groups agree or strongly agree with the effectiveness of VMS. However, a strong majority of enforcement personnel (67%) believe that fishers "tamper with or turn off their VMS to avoid detection of violations." Strong majorities of fishers and other groups believe this to be rare. Majorities of all groups except enforcement personnel agree, or strongly agree, that the presence of *observers* on fishing vessels, though not playing an enforcement role, reduces violations. A majority of enforcement personnel disagrees or strongly disagrees with this view.

Questions regarding the *prosecution* branch of the enforcement program elicited differences of opinion, especially between fishers and enforcement personnel. Majorities of fishers think that the number of attorneys prosecuting fishing violations is sufficient, that enforcement officials focus more on minor rather than major

violations, and that more violations should have resulted in warnings instead of penalties. Majorities of enforcement personnel are of the opposite opinion on those three issues.

Many fishers (42%) and majorities of the other groups (from 51% to 69%) believe that attorneys effectively prosecute fishery violations. Generally, there is strong agreement among groups of respondents that the General Counsel's performance is adequate or more than adequate in terms of case processing effectiveness, timely processing of violations, settlement policy and practice, administrative court trials, and dedication to effective deterrence. An important exception is that a strong majority of enforcement personnel (66%) and many fishers (47%) and regulators (44%) view the timely processing of violations as poor or less than adequate. Respondents to Shaw's [6] survey also reported long delays in processing cases where fishers were charged with violations. This result is important because delays in prosecution, especially when combined with relatively small penalties, can weaken incentives to comply and lead to more violations.

**4.3.1.2. Penalties and deterrence.** Strong majorities of all groups of respondents think that financial penalties, permit sanctions and confiscation of catch are effective (somewhat or very) deterrents against violating NE groundfish regulations. All groups also believe that lost fishing privileges (permit sanctions) are a more significant deterrent than financial penalties. Majorities of all groups—except enforcement personnel—agree or strongly agree that the penalties actually imposed are sufficient to deter potential violators. Enforcement personnel are about evenly split on this issue.

#### 4.4. Combined analysis of survey results and NOAA enforcement data

As an exercise to assess the effectiveness of deterrence in the fishery the 2007 survey results summarized above were combined with NOAA enforcement statistics for 2001 through 2006 in a "deterrence model" that compares the expected benefits of not complying with fishing restrictions on a typical trip with the expected costs.

##### 4.4.1. Expected benefits

Using the midpoint between the numerical estimates provided by fishermen and enforcement staff, as discussed in Section 4.1.1, the percent of the total harvest that is taken illegally in the fishery is 18.5%. A large trawler operating in this fishery during 2006 landed about \$30,000 per trip. If the added revenue from fishing illegally during this trip is estimated to be 18.5%, a first approximation of the expected benefits from noncompliance would be about \$5,500 ( $0.185 \times \$30,000$ ).<sup>29</sup>

This is approximately 1/3 of the \$15,000 in expected earnings per trip from illegal fishing estimated by Sutinen [31]. The difference is probably explained by declines in stock abundance and limits on days at sea that have significantly reduced actual and expected revenues per trip from illegal as well as legal fishing. Sutinen [31] may also have focused primarily on the large Georges bank trawlers, which tend to make longer trips and harvest more fish per trip than average vessels operating in NEGF fleet.

Expected benefits from noncompliance=\$5,500.

<sup>29</sup> Fishing illegally, in some instances, may reduce trip costs rather than, or in addition to, increasing trip revenues. It is assumed here that fishing illegally results in 18.5% in trip revenues that would not be earned otherwise, but does not affect fishing costs.

##### 4.4.2. Expected costs

A first approximation of expected costs of noncompliance can be estimated by using survey results and NOAA enforcement data to estimate the following equation:

Expected cost of noncompliance= $A \times B \times C \times D$  where:

A=Probability of being detected.

B=Probability of being prosecuted and having to face a penalty, if detected.

C=Average "assessed penalty" for this violation (e.g., Notice of Violation (NOVA), penalty assessment).

D=Average "final settlement" amount; the % of the average "assessed penalty" paid.

Based on survey results summarized above, the midpoint between the estimates provided by fishermen and enforcement staff of the likelihood of a violation being detected was 32.5%.

So,  $A=0.325$ .

Based on the summary statistics from the NOAA's EMIS database (Table 2), 33.1% of detected violations resulted in any type of penalty (e.g., NOVA, summary judgment, permit sanction).

So,  $B=0.331$ .

Data are not available to determine the nature of permit sanctions imposed on violators or their economic cost to them. However, NOAA enforcement data show that the average NOVA penalty assessment was \$20,455, and the average percent of NOVA penalty that was actually paid (settlement amount) was 53%.

For purposes of this exercise it is assumed that the average NOVA amount, adjusted by the average percent of the NOVA amount paid, reflects the dollar value of expected penalties and other sanctions for all violations,

So  $C=\$20,455$  and,  $D=0.53$ .

For purposes of estimating expected noncompliance costs, therefore, the following values are used:

$A = 0.325$ ,  $B = 0.331$ ,  $C = \$20,455$ , and  $D = 0.53$

This means the expected cost of noncompliance:

$$\begin{aligned} &= A \times B \times C \times D \\ &= 0.325 \times 0.331 \times \$20,455 \times 0.53 \\ &= \$1,166 \end{aligned}$$

Expected net payoff for noncompliance=expected benefits less expected costs

$$\begin{aligned} &= \$5,500 \text{ less } \$1,166 \text{ per fishing trip} \\ &= \$4,334 \text{ per fishing trip} \end{aligned}$$

Based on the above analysis, a typical fishing skipper in this fishery can expect to increase net earnings per trip by approximately \$4,300 by not complying with fishing restrictions.

##### 4.4.3. An illegal fishing deterrence index

This exercise can be carried one step further by using the ratio of the expected cost of noncompliance to the expected benefits as a metric of the cumulative deterrence effects in the NEGF fishery, called here the Illegal Fishing Deterrence (IFD) Index for the fishery.

- IFD Index > 1: *Strong deterrence*—conditions where the expected costs of noncompliance exceed the expected benefits.
- IFD Index=to 1: *Moderate deterrence*—conditions where the expected costs and benefits of noncompliance are more or less identical.
- IFD < 1: *Weak deterrence*—conditions where the expected cost of noncompliance is below expected benefits.

In the NEGF fishery the IFD is 0.21 (\$1,166/\$5,500) which is low and reflects benefits from noncompliance that are about 5 times higher than expected costs.

*4.4.3.1. Extraordinary deterrence challenges in the NEGF fishery.* In the modern NEGF fishery low catch rates and very restrictive fishing regulations mean that some fishers are facing significant economic hardships and may not be able to generate sufficient earnings to remain in business by fishing legally. For such fishermen the potential cost of compliance can be higher, more certain, and more permanent than the expected cost of non-compliance. Sutinen [31] reports, for example, that some crewmen, concerned about their ability to earn a decent livelihood, have refused to work on fishing vessels with skippers who are not willing to ignore fishing regulations. In such a situation, even otherwise law abiding skippers have powerful incentives to violate fishing regulations or, alternatively, to leave the fishery and sell their vessels to others who are willing to violate fishing regulations in order to remain solvent.

This conventional economic model of deterrence and the IFD index ignore the need for extraordinary enforcement to provide adequate deterrence in circumstances where the cost of complying is unusually high and, for some fishers, may include bankruptcy. The long-term costs of not being able to cover trip expenses and vessel payments by fishing legally may provide far more incentive to not comply than illegal gains themselves. If this condition exists or is expected in the NEGF fishery the above analysis may vastly understate the incentives that exist for fishers to not comply and understate the level of enforcement required to deter prospective violators.

#### 4.5. Social influence and moral obligation

As Section 3 described, fishers also consider the moral and social consequences when deciding whether or not to comply with fishery laws. Shaw [6] performed a survey of NEGF fishers that was designed to assess their attitudes towards NEGF fishery management and enforcement, and the extent to which moral and social considerations shape their compliance behavior. Her survey and analysis examined the theory [30] that, enforcement effects aside, people tend to comply with regulations when the regulatory authority is perceived to be legitimate.

Shaw organized the results of her survey around the four factors that determine perceptions of legitimacy: procedural fairness, procedural efficiency, outcome fairness, and outcome effectiveness. Her survey results showed that fishers in the NEGF fishery gave fishery management institutions low ratings on all of these factors. Fishers view management procedures in the NEGF fishery as both unfair and inefficient, and management outcomes to be both unfair and ineffective.

Possession limits are perceived to be both unfair and ineffective because fishers are required to discard fish that exceed the limit. In their view the discarded fish are dead and cannot contribute to rebuilding the stocks. Shaw quotes one fisher who wrote that “throwing dead fish overboard doesn't do anyone any good—not the fish stock and not the fishermen.” Answers to open ended questions in the 2007 survey support Shaw's results. A significant number of fishers, for example, reported that they viewed regulations that force them to throw back fish that will die anyway and could be used to feed people as “immoral.”

Shaw found that fishers feel managers victimize them with complex regulations that do not work and impose unnecessary hardships on them. The rule-making processes are also unfair in the views of fishers. As an example, fishers claim that regulations tend to favor larger vessels and impose disproportionate hard-

ships on smaller fishing operations. The 2007 survey confirms these perspectives—a number of fishers reported that regulations are designed to drive small boats out of the fishery because fewer larger vessels would be easier for fishery institutions to manage.

Fishers' views about the enforcement program in the NEGF fishery are somewhat better, but are not positive overall. The processing and prosecution of violations is inefficient in the opinion of fishers. Shaw reports fishers believe that, when they are charged with a violation, the case is not processed in a timely fashion. She quotes one respondent who claimed it took up to a year for the charges against him to be processed. In addition, many of her respondents felt that enforcement agents are not always fair and neutral, treating some fishers differently for similar violations. The analysis of NOAA enforcement data for years 2001 through 2006 confirm Shaw's findings. The average length of time between the date of a reported violation and a resolution that resulted in the payment of a penalty was 320 days.

Shaw concludes that NEGF fishers find the legitimacy of the management and enforcement programs weak. While this implies that more enforcement may be needed to achieve a given level of compliance, Shaw indicates that voluntary compliance also could be significantly strengthened by improving how fishery regulations are developed, implemented and enforced. Efforts to make such improvements to promote more compliance may be more cost-effective than investing in more surveillance and inspection resources to detect violations. For example, adding more attorneys to expedite enforcement case processing is expected to greatly improve the efficiency and effectiveness of the entire enforcement program.

## 5. Conclusions and recommendations

The survey results indicate that a significant number of fishers, managers, enforcement personnel and researchers believe that the extent and nature of noncompliance in the NEGF fishery is comparable now to 20 years ago. However, they also believe that illegal fishing is currently a serious problem because it: reduces the ability of the fish stocks to rebuild; jeopardizes sustainability; reduces long-term economic returns from legal fishing; and lowers fishers' expectations that they will benefit in the future by supporting and cooperating in fish stock rebuilding programs.

The results show that: (1) many fishers operating in the NEGF fishery cannot take a long-term economic perspective and are focused primarily on near-term economic returns from fishing; (2) fishers, on average, can earn higher economic returns by violating rather than complying with fishing regulations because the illegal gain exceeds the expected penalty for violating; and (3) the forces of moral obligation and social pressure that normally cause fishermen to comply, despite the economic incentives, are weak because fishers (and other survey respondents) view the fishery management process at work in the NEGF fishery to be unfair and ineffective.

Because stock rebuilding targets and schedules associated with new congressional mandates are viewed by some fishers as not being justified on scientific, economic, biological, or moral grounds; implementing them will further weaken normative factors that favor compliance. At the same time, expected changes in fishing restrictions aimed at achieving these new targets and mandates will increase fishers' economic hardships and generate more incentives for them to fish illegally. The enforcement program in the fishery needs to prepare to react to these challenges.

Respondents to the survey believe that the enforcement program—dockside and at-sea inspections and prosecutions—is

basically sound and has improved during the past 5 years. However, there are specific areas where they believe improvements should be made. For example, regulators and enforcement personnel believe improvements in compliance could be achieved by increasing the number of dockside enforcement agents, the number of dockside inspections and the presence and coverage of the dockside enforcement programs. In addition, they believe strengthening investigations associated with reported violations by the USCG, increasing the number of attorneys in the General Counsel's office and reducing case processing time would be helpful. Other improvements involve increasing the certainty and magnitude of penalties and making greater use of permit sanctions which are generally perceived to be a more effective deterrence against illegal fishing than financial penalties.

Many respondents questioned the effectiveness of USCG at-sea enforcement and the method the coast guard uses to measure its effectiveness. Survey results indicate that fishers are not in compliance during 10–20% of days at sea. Twelve to sixteen percent of fishers and regulators, and 35% of enforcement agents, agree or strongly agree that “it is easy for those violating fishing regulations to evade USCG at-sea detection.” Yet annual reports by the USCG to congress state that compliance rates, based on the number of violations observed during at sea boardings, are near or exceed 97%, the target rate used by the USCG as a measure of enforcement success. Instead, they may actually reflect the failure of at-sea boardings to detect most violations [13 and footnote 18]. In any case, these high compliance rates are generally viewed as being inaccurate, misleading and harmful because they prevent federal policymakers from appreciating the significance of non-compliance problems in the NEGF fishery and other fisheries.

This hypothesis should be examined to determine if insufficient data and data management and misinterpretations of data are preventing the effective allocation of effort and spending on dockside and at-sea enforcement.

Because economic incentives for noncompliance are increasing and normative factors favoring compliance are relatively weak, a robust “smart compliance policy” [7] needs to be implemented soon in the NEGF fishery to effectively control illegal fishing. Smart compliance policy deals explicitly with how the influence of compliance drivers on behavior varies among fishers. In particular, compliance problems presented by those fishers who are not influenced by moral obligation and social influence need to be addressed far more aggressively than compliance problems presented by other fishers. Smart compliance policy involves developing strategies that: (1) target and meaningfully penalize frequent, routine violators; (2) provide adequate deterrence to discourage occasional violators; and (3) strengthen the basis for achieving voluntary compliance. Evidence regarding compliance in the NEGF fishery and the different factors that motivate compliance among different types of fishers strongly supports developing and implementing a robust smart approach to compliance in this fishery.

It is possible that maximizing the deterrence effect of enforcement in the NEGF fishery can be achieved most effectively by applying the game theory-based “heaven, hell, and purgatory approach” to compliance [32,33]. This has been recommended for other types of environmental enforcement programs [7] and involves placing individual fishers in specific compliance categories with graduated sanctions (in terms of privileges and obligations). These graduated sanctions will produce more deterrence for a given probability of detection and penalty.<sup>30</sup>

Previous studies of fishery enforcement and compliance conclude that there are multiplier effects from aggressively controlling frequent violators [2,7,34]. When frequent violators appear to be immune to punishment, their behavior sends signals to fishers who normally comply that the regulations are unfair and will not have the intended effects on fish stocks. This, in turn, weakens their confidence in the legitimacy of the fishery management program and erodes their willingness to comply with fishing regulations. Targeting frequent violators, besides putting them at higher risk of facing penalties and providing a more potent deterrent to their violations, has a positive multiplier effect because it strengthens compliance among other fishers. Penalties for the routine, frequent violators should be severe, especially for those who have multiple citations. Chronic violators should also face more stringent reporting and monitoring requirements or be prohibited from fishing. On the other hand, Sutinen [34] determined that imposing severe penalties uniformly to all fishers, including those who violate only occasionally, can result in fishers questioning the legitimacy and fairness of fishery management and reduce voluntary compliance.

Unless enforcement effort is increased to achieve compliance rates high enough to allow fish stock rebuilding efforts to succeed, it is economically rational for an increasing number of fishers in the NEGF fishery not to comply with fishing restrictions. The “optimal” harvest strategy for an increasing number of fishermen will be to earn as much income as possible as soon as possible from fishing, either legally or illegally, before fish stocks collapse or the fishery is shut down.

Under these conditions increasing enforcement, especially against chronic or frequent violators, is necessary not only to deter violations, but to create fishing conditions and expectations that promote compliance and support for fish stock rebuilding programs. Recent MSA amendments will require tighter fishing restrictions that will impose additional costs on fishers. These restrictions are currently designed to achieve fish stock rebuilding targets that many fishers do not support on scientific, economic, and moral grounds. The economic and normative forces at work in the NEGF fishery, therefore, are trending against compliance. To prevent further biological and economic decline in the fishery these forces will need to be offset by more enforcement and more certain and meaningful penalties for all fishers; a special emphasis on identifying and penalizing chronic violators; and a dedicated effort to improve the fishery management institutions and processes so that they are viewed as being more legitimate.

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<sup>30</sup> See chapter III in Olsen et al. [7] for an explanation of how this approach can be used in fisheries.

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