

Reassessing the Value of U.S. Coast Guard At-Sea Fishery Enforcement

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The U.S. Coast Guard (USCG) is responsible for enforcing federal fisheries laws at sea. The USCG routinely reports high compliance rates and uses them as evidence that its program is successful at deterring fisheries violations. Research presented in this article indicates that high USCG-reported compliance rates vastly overestimate the actual rates and enforcement success because USCG at-sea inspections fail to detect many actual violations. Using high USCG-observed compliance rates as an indicator of successful enforcement is misleading, adversely influencing voluntary compliance with fishing regulations, and prevents fishery managers from recognizing illegal fishing as a significant problem and creating strategies for addressing it.

Keywords at-sea boardings, compliance, deterrence, fishery enforcement, U.S. Coast Guard

Introduction

The Magnuson-Stevens Fishery Conservation and Management Act (MSA) governs federal fishery management in the United States.¹ The MSA tasks regional fishery management councils with creating a fishery management plan (FMP) for each fishery and specifies 10 national standards for goals and actions that must be included in each FMP.² In practice, FMPs contain a variety of restrictions on fishing activity that include, but are not limited to: catch quotas, days at sea limits, limited access permit programs, gear restrictions, and

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time or area closures. The National Marine Fisheries Service (NMFS) approves FMPs that comply with the MSA and promulgates them as binding federal regulations that are enforced by NMFS, the U.S. Coast Guard (USCG), and state fisheries agencies.

Of the federal agencies, NMFS enforcement focuses primarily on violations that can be detected dockside after a vessel has returned to port while the USCG has primary responsibility for enforcing regulations at sea. The USCG cooperates closely with the NMFS to facilitate the detection and prosecution of fisheries violations. USCG officers are trained to identify fishing violations during at-sea boardings and NMFS agents occasionally assist by accompanying USCG staff during at-sea boardings. In most cases, however, USCG officers independently board and inspect fishing vessels at sea.³ During 2003 through 2006, the average annual USCG budget for at-sea enforcement in domestic fisheries was \$397 million, which constituted 90.5% of total annual federal spending on domestic fishery enforcement during that period.⁴

The USCG can issue minor sanctions for violations detected during at-sea vessel inspections, but must refer violations that warrant more serious penalties to the National Oceanic and Atmospheric Administration (NOAA) General Counsel for Enforcement and Litigation (GCEL) for prosecution. The GCEL independently determines whether and how to prosecute fishing violations reported by the USCG. The GCEL can choose not to prosecute a violation or can choose to prosecute and seek a variety of potential penalties, including, but not limited to: fines; permit sanctions; and catch, gear, or vessel forfeitures. The GCEL assessments of penalties, summary settlements, and “fix-it” tickets⁵ are based on schedules that establish escalating fines and sanctions for repeat violators. The GCEL prosecutes civil violations before administrative law judges. The Department of Justice (DOJ) prosecutes fisheries cases in federal courts, including appeals of administrative decisions and cases involving criminal sanctions. However, it is relatively rare that violations of fishing regulations reported by the USCG are handled by any entity other than the GCEL.

Despite having a statutory mandate to end overfishing, fisheries managers have had difficulty conserving and rebuilding many fish stocks. MSA amendments in 1996 and 2007 strengthened fishery management requirements by creating legally binding stock rebuilding targets and timetables designed to “prevent and end overfishing and rebuild depleted stocks,” among other things.⁶

As of December 2008, however, the NMFS reported to Congress that it has established “overfished” thresholds for only 173 of the roughly 230 economically significant U.S. fish stocks and that, of those 173 stocks, 45 are overfished.⁷ Additionally, the NMFS reported that “overfishing” thresholds had been established for 188 of the 230 stocks and that 40 of these stocks are currently “experiencing overfishing.”⁸ Considering fish stocks that are already overfished, those experiencing overfishing, and those that are both overfished and experiencing overfishing, regulators are required under the recent MSA amendments to significantly tighten regulations governing fishing for roughly 26% of the economically significant fish stocks in U.S. waters for which overfished and overfishing thresholds have been established.⁹

A significant amount of research has attempted to explain why the regulatory process has failed to curb overfishing, even for overfished stocks for which rebuilding is statutorily mandated.¹⁰ Most of this work attributes chronic overfishing to problems with fishery management institutions, including: (1) a lack of political will to restrict fishing, (2) the structure of U.S. fishery management institutions, (3) the composition of regional fishery management councils, (4) scientific uncertainty and economic disagreements about what constitutes overfishing, (5) past laws that do not require science-based fishery management, and (6) the short-sighted economic priorities of powerful fishing interests.¹¹

Fishery scientists are also increasingly concerned that, even where forced reductions in fishing effort have been successful, they have not always resulted in depleted fish stocks recovering as quickly as fishery models predict.¹² Studies have identified reductions in subpopulation diversity, undermined fish stock resilience and reproductive capacity, altered ecosystem structure and function, and changing ocean conditions caused by global warming as potential reasons for the deviation between observed and model-predicted fish stock recovery rates.¹³ A few observers have noted that illegal fishing, which results in catches that are not usually accounted for correctly in fishery models, may also be contributing to this problem.¹⁴ However, because noncompliance with fisheries regulations is understudied in the United States, this hypothesis has not been tested. Therefore, undocumented illegal fishing could be adversely affecting the resource stock assessments and projections on which fish stock rebuilding programs are based, in addition to explaining the lack of success in ending overfishing and rebuilding fish stocks.

The contribution of “illegal, unreported, and unregulated” (IUU) fishing to overfishing problems has been studied significantly in the international context,¹⁵ and a few studies have pointed to noncompliance as a potential factor contributing to overfishing in domestic U.S. fisheries.¹⁶ However, few published studies have attempted to use survey and interview results, analyses of enforcement statistics, or both to determine the extent to which noncompliance is contributing to fishery management failures in U.S. fisheries.¹⁷

The dearth of published studies of illegal or unreported fishing in U.S. domestic fisheries is due to three factors. First, it is difficult for researchers to obtain data about violations of fishing regulations that take place mostly offshore and out of sight. Second, data on illegal fishing in U.S. waters that are available are collected in an inconsistent manner among the enforcement agencies, making data identification and public access difficult and leading to questions about the reliability, accuracy, and completeness of datasets. Third, official reports by the USCG, based on its at-sea enforcement program, indicate that compliance rates are extremely high, which implies illegal fishing probably is not a problem that deserves research.¹⁸

In most cases, the only source of information about at-sea compliance other than those based on observations by the USCG are enforcement/compliance surveys of fishers, enforcement officials, and others. In general, the extremely high observed compliance rates reported by the USCG indicate that illegal fishing is not a significant problem¹⁹ while survey results reported primarily by universities and other nongovernmental sources suggest that noncompliance is relatively high and is a significant problem.²⁰ Data based on observations are generally viewed as being more reliable than data based on survey estimates, so there is a tendency to accept the validity of compliance rates observed by the USCG over compliance rates estimated by others via surveys.²¹ However, the inherent difficulty of observing violations at sea and the consistent results of surveys showing much higher noncompliance rates than those observed by the USCG provide reason to suspect that this situation may be an exception.

The initial analytical context for most studies of enforcement and compliance is based on a conventional “theory of compliance” that focuses on economic incentives and how potential violators compare the relative benefits of violating the law with the likelihood of being detected, prosecuted and penalized, and the size of the expected penalty.²² Early studies in fisheries, however, indicated that this theory did not explain why compliance rates were relatively high despite potentially large illegal gains and low expected rates of detection and prosecution.²³ As a result, this simple economic theory of compliance was replaced, in fisheries, by an enriched theory of compliance that includes both economic incentives and “normative” (noneconomic) factors associated with moral convictions of fishers, peer

and community pressure, attitudes regarding the competency of regulators, the fairness and legitimacy of regulations, and others.²⁴ This enriched theory of compliance did a better job of explaining why many previous studies showed that most fishermen operating in U.S. domestic fisheries comply with fishing regulations even when cost-benefit comparisons favor noncompliance.²⁵ Besides explaining why most fishers usually comply, normative influences²⁶ also explain why only a limited amount of enforcement has been required to achieve relatively high levels of compliance in U.S. commercial fisheries.

In recent years, however, a combination of deteriorating economic conditions in and outside of fisheries and the imposition of highly restrictive, sometimes controversial and often ineffective, fishing regulations in many U.S. fisheries have simultaneously strengthened economic incentives for noncompliance and weakened the normative factors that favor compliance.²⁷ Based on these trends, noncompliance can be expected to become increasingly important, especially in fisheries where fish stocks are depleted and fishermen are economically stressed and losing trust in fishery managers and fishery management institutions.

These conditions are not uniform across all groups of fishers in all fisheries. According to previous work, violators of commercial fishing regulations tend to separate into three general categories: (1) chronic or frequent violators who are motivated by economic incentives and have little moral commitment to comply; (2) occasional violators who normally obey the law, but will violate fishing regulations when the benefits of noncompliance significantly outweigh the likely costs; and (3) accidental violators who unintentionally fail to comply due to misunderstanding fishing regulations, faulty electronics, or other reasons.²⁸ Previous studies in the United States and elsewhere have suggested that, in most fisheries under normal circumstances, chronic violators comprise 5% to 15% of the population, another 5% to 15% of fishers never intentionally violate regulations because of their moral convictions, and the remaining 70% to 90% percent of fishers occasionally violate regulations.²⁹ Past studies also indicate that chronic or frequent violators account for a disproportionately high percentage of the illegal harvest, so changes in that segment of the fleet are most important.³⁰

As economic incentives for noncompliance increase and normative factors favoring compliance decline, more occasional violators can be expected to take advantage of opportunities to increase their gains, or limit their losses, by fishing illegally, unless enforcement provides some countervailing deterrence. In these fisheries, more enforcement effort is needed to deter occasional violators from becoming chronic violators and also to catch and penalize chronic violators. However, the research described below shows that existing fisheries enforcement resources that were once adequate may no longer be adequate and, combined with limited prosecution of detected violations and relatively small penalties, are insufficient to effectively deter many fishing violations.

USCG Fisheries Enforcement Performance

The 2004 USCG report, "Ocean Guardian," presents goals, standards, and performance metrics for evaluating the success of the USCG at-sea domestic fishery enforcement program.³¹ Based on that report, the overall goal of the USCG domestic fishery enforcement program is to "effectively enforce federal regulations that provide stewardship of living marine resources and their environments."³² The USCG attempts to achieve this goal each year by boarding and inspecting a large number fishing vessels. One target for achieving this goal is a performance standard of detecting 80% of all significant violations in "high-threat

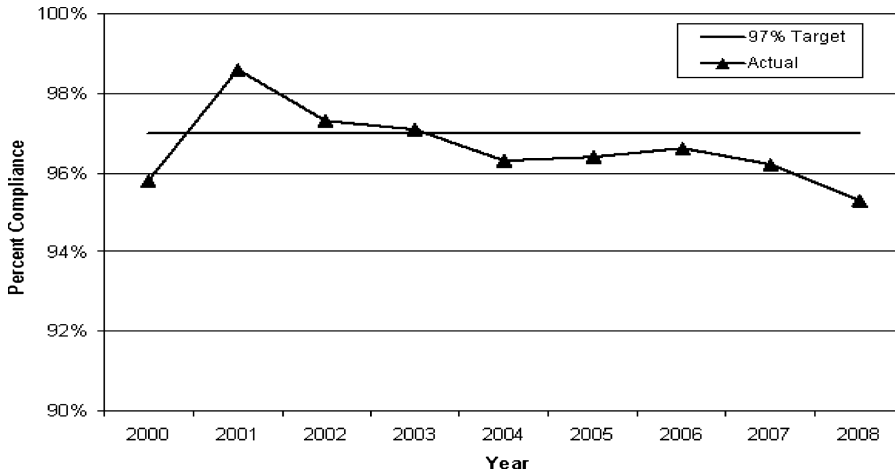


Figure 1. U.S. Coast Guard (USCG)-reported compliance rates, 2000–2008 (*Source:* Office of Management and Budget, “Detailed Information on the Coast Guard Fisheries Enforcement Assessment” [2003, amended in 2009], available at www.whitehouse.gov/omb/expectmore/detail/10001072.2003.html [accessed on 23 March 2009]).

areas” of the U.S. exclusive economic zone (EEZ) and 20% of all significant violations in “low-threat areas” of the EEZ.³³ The USCG defines “significant” violations as those that “result in significant damage to the fisheries resource or management plan; that provide a significant monetary advantage for the violator over the competition; or that are of high national or regional interest.”³⁴

In practice, however, a performance standard based on the percent of violations detected is not very useful because the USCG does not know how many violations it does not detect and, therefore, cannot know what percent of violations it is detecting. As a result, the USCG focuses on compliance rather than detection and uses the rate of observed compliance during at-sea boardings of domestic fishing vessels as its primary annual performance metric (APM). High observed compliance rates, in other words, are used as a metric that shows how successful the USCG at-sea enforcement program is at deterring domestic fishing violations. The USCG performance target under this APM is 97%. The USCG considers its at-sea enforcement program to be successful at deterring domestic fishing violations if it detects “significant” violations on 3% or less of the fishing vessels it boards.³⁵

Figure 1 shows that, from 2000 to 2008, the USCG-reported annual average observed compliance rates ranged from 95.3% to 98.6% (or noncompliance rates from 1.4% to 4.7%).³⁶ On this basis, the USCG consistently reports that its at-sea enforcement program meets or approaches its performance target of 97% compliance. In fact, the USCG asserts that the actual compliance rate being achieved is higher than the compliance rates they observe during at-sea boardings because, as reported by the Office of Management and Budget (OMB), “USCG boardings are not random; vessels deemed a higher likelihood of being in violation receive a higher boarding priority.”³⁷ Because the USCG targets frequent violators, it expects that vessels chosen for boarding will be out of compliance more often than if vessels were selected randomly. As a result, the USCG asserts that actual compliance rates are higher than rates observed during at-sea boardings.

The USCG’s choice and interpretation of the compliance rate APM is supported by two independent reviews of the program. In 2003, the OMB reviewed USCG’s fishery

enforcement program, accepted the USCG compliance rate APM, and used it to evaluate the USCG effectiveness by comparing the USCG's reported compliance rates with similarly calculated rates reported by other fishery enforcement programs around the world.³⁸ The OMB concluded that the USCG program is effective because it achieves compliance rates that are higher than those reported in other countries using similar compliance metrics. The assessment also noted that the use of vessel-monitoring systems (VMS) makes targeting violators more effective and can be expected to reduce the observed compliance rate, and concluded that, even a constant observed compliance rate in recent years, would signal the USCG's increased success at deterring potential violators.³⁹ Despite a positive overall review of the USCG performance and performance metrics, the OMB criticized the USCG program for its "lack of comprehensive, independent program evaluations."⁴⁰

In 2003, the USCG responded to the OMB's criticism by commissioning the Center for Naval Analysis (CNA) to review the USCG's fishery enforcement program. The 2006 CNA report contained many recommendations for improving the administration of the USCG at-sea fishery enforcement program.⁴¹ However, that study determined that the USCG observed compliance rate is an appropriate APM because it "is a reasonable outcome measure at the right level of detail" and "depends solely on measured quantities, eliminating the potential uncertainty or instability introduced by estimates."⁴² The report did point out several potential weaknesses in the metric, including its potential to reward poor performance and potential subjectivity.⁴³ However, the CNA report concurred with the USCG's interpretation that the compliance rate APM understates actual compliance because the USCG targets suspected violators and that, based on interviews with USCG enforcement staff, "USCG units did not always report boardings . . . if there was no violation which further skew(s) this efficiency calculation toward being falsely low."⁴⁴ In other words, the CNA report concluded that two factors, the targeting of suspected violators and the underreporting of boardings where no violations are detected, result in actual compliance rates that can be expected to exceed annual observed compliance rates reported by the USCG that averaged 96.8% between 2003 and 2006.⁴⁵ Based on this assessment, the USCG is clearly exceeding its APM and is deterring violations so successfully that compliance seems to be nearly 100%.

In addition to evaluating the compliance rate APM, the CNA report also considered other performance metrics, including cost-efficiency. Table 1 shows a variety of performance metrics related to the USCG's fishery enforcement program, including boardings detected per million dollars of spending. We extended this analysis to consider some additional performance metrics, including cost per violation detected by the USCG, and, by using the NOAA Enforcement Management Information System (EMIS) database,⁴⁶ cost per USCG-reported violation that resulted in some type of penalty such as a financial payment, seizure, forfeiture, or permit sanction. Table 1 shows that USCG cost per boarding during the period was \$61,700 to \$97,100, cost per detected violation was \$1.7 million to \$3.6 million, and cost per detected violation that resulted in a penalty was \$5.5 million to \$6.9 million.⁴⁷

Deterrence Impacts of USCG At-Sea Enforcement

The goal of fishery enforcement is to deter illegal fishing. It therefore is true that, if USCG at-sea enforcement is deterring violations, it will result in few violations being detected during at-sea boardings. This could mean that a high observed compliance rate is an index of enforcement success. On the other hand, the detection of few violations may also reflect the inability of USCG at-sea boardings to detect many actual violations, which could be

Table 1
USCG enforcement metrics

	FY2003 ^a	FY2004	FY2005	FY2006
USCG fishery enforcement budget (millions) ^b	\$316.4	\$331.3	\$378.2	\$563.9
Boardings ^b	3, 265	4, 446	6, 134	5, 810
Significant violations detected ^b	88	163	220	198
Violations resulting in penalty ^{c, d}	58	59	55	NA
Boardings per \$M budget ^b	10.3	13.4	16.2	10.3
Significant violations detected per \$M budget ^b	0.28	0.49	0.58	0.35
Penalized violations per \$M budget ^{c, d}	0.18	0.18	0.15	NA
Cost/boardings (millions) ^d	\$0.097	\$0.075	\$0.062	\$0.097
Cost/violation detected (millions) ^d	\$3.60	\$2.03	\$1.72	\$2.85
Cost/violation penalized (millions) ^{c, d}	\$5.46	\$5.62	\$6.88	NA

Abbreviations: USGC, U.S. Coast Guard; FY, fiscal year; \$M, millions of dollars; EMIS, Enforcement Management Information System.

^aFiscal years are from 1 October of the previous year through 30 September of the listed year (e.g., FY2003 is 1 October 2002 through 30 September 2003).

^bFrom Center for Naval Analysis, *Is the U.S. Coast Guard's Fisheries Enforcement Program Working?* Final Report CRM D0014618.A2 (2006).

^cThese metrics are based on USCG-reported violations data in the EMIS database, which may or may not correspond directly with USCG-reported significant violations in Center for Naval Analysis, *Is the U.S. Coast Guard's Fisheries Enforcement Program Working?* Final Report CRM D0014618.A2 (2006). In the EMIS database, 2006 data were incomplete.

^dThese metrics were calculated by the authors for this study.

viewed as an index of failure. Violations of most laws result in victims or losses that can be identified, reported, and used to compare detected (observed) and actual (reported) violations. While this is not the case with at-sea fishing violations, understanding and managing the effectiveness of USCG at-sea enforcement requires some examination of whether high rates of observed compliance reflect a high rate of USCG success at detecting violations or a high rate of fishing violators' success at eluding detection by the USCG. Unfortunately, none of the program evaluations carried out by the CNA, OMB, or USCG itself adequately considers this question.

In the following section, we examine the available evidence to determine how closely the observed USCG compliance rates reflect actual compliance rates. We also examine evidence as to whether the likelihood of detection and likelihood of prosecution, when combined with the typical penalties imposed for violations reported by the USCG, provide a sufficient enough deterrent to effectively control illegal domestic fishing.

Evidence Regarding Compliance and Detection

In 2007, we undertook a survey of fishers, fishery enforcement staff,⁴⁸ scientists, managers, and others involved in three representative domestic U.S. fisheries.⁴⁹ The survey results support the conclusions of previous surveys that noncompliance is a significant problem in U.S. domestic fisheries. (See Table 2.) For example, fishers and federal/state enforcement staff estimated, respectively, that illegal fishing accounts for 12% and 24% of the annual

Table 2
Selected survey results

Survey question	Fishers mean response (N)	Enforcement mean response (N)
What percent of total catch is due to fishing in violation of fishery regulations?	11.8% (494)	24.0% (60)
What percent of commercial fishers do you think <i>routinely</i> violate fishery laws?	15.2% (513)	31.0% (66)
What percent on fishers do you think <i>occasionally</i> violate fishery laws?	21.1% (510)	35.6% (65)
Percent of days fished when specific violations occur in your area:		
Area/time/gear restrictions	11.4% (468)	38.7% (48)
Bycatch violations	18.9% (305)	28.6% (34)
Permit violations	9.7% (463)	15.4% (48)
What percent of violations of U.S. fishery laws do you think are detected?	34.6% (507)	23.9% (65)
Percent who agree or strongly agree that:		
It is easy for those violating fishing regulations to evade USCG at-sea detection.	18.3% (518)	69.0% (70)
Violations of fishery regulations are jeopardizing the sustainability of fish stocks in your fishery.	20.3% (528)	70.4% (70)
The adverse effects of fishing violations on fish stocks are significant enough to reduce long-term economic returns from fishing.	26.2% (523)	76.2% (69)
Violations of fishing regulations are significant enough to reduce fishers' expectations that they will gain in the future from stock rebuilding programs.	23.9% (524)	53.8% (69)

harvest. Fishers and enforcement staff also estimated, respectively, that 15% and 31% of fishers are chronic violators of fishing regulations (higher than the 10% to 15% estimated in previous surveys), and that an additional 21% and 36%, respectively, are occasional violators of fishing regulations. Based on these estimates, 36% to 67% of fishers are frequent or occasional violators of fishing regulations.

When asked about specific at-sea violations, fishers and enforcement agents, respectively, estimated that the percent of days at sea when specific violations occur are: 11% and 39% for violations of area/time/gear restrictions, 19% and 29% for violations of by-catch restrictions, and 10% and 15% for permit violations. Fishers and fishery enforcement staff, respectively, estimated that only 35% and 24% of violations of U.S. fishery laws are detected, and 18% of fishers and 69% of enforcement personnel agreed or strongly agreed that it is easy for violators to evade detection by USCG enforcement.⁵⁰

In addition to asking about the extent of noncompliance, the survey asked respondents about the adverse effects of illegal fishing on fishery sustainability. Twenty percent of fishers and 70% of enforcement personnel agreed or strongly agreed that violations of fishing regulations are significant enough to jeopardize the sustainability of fish stocks. Similarly,

Table 3

Annual USCG fishery enforcement effort, performance, and outcome metrics, 2003 to 2006

	FY 2003	FY 2004	FY 2005	FY 2006
Boardings	3, 265	4, 446	6, 134	5, 810
Significant violations detected	88	163	220	198 ^a
Reported compliance rate	97.3%	96.3%	96.4%	96.6%

Abbreviations: USGC, U.S. Coast Guard; FY, fiscal year.

^aCenter for Naval Analysis, *Is the U.S. Coast Guard's Fisheries Enforcement Program Working?* Final Report CRM D0014618.A2 (2006) indicates that boardings data are through FY2006, but significant violations and compliance rates are through July 2006 only. Data from the above-mentioned report and Office of Management and Budget, "Detailed Information on the Coast Guard Fisheries Enforcement Assessment" (2003, amended in 2009), available at www.whitehouse.gov/omb/expectmore/detail/10001072.2003.html (accessed on 23 March 2009) show the FY2006 compliance rate as 96.6%, indicating that the USCG must have detected 198 significant violations.

26% of fishers and 76% of enforcement agreed or strongly agreed that the adverse effects of fishing violations on fish stocks are significant enough to reduce long-term economic returns from fishing. Twenty-four percent of fishers and 54% of enforcement personnel agreed or strongly agreed that violations of fishing regulations are significant enough to reduce fishers' expectations that they will gain in the future from stock rebuilding. This is significant because it implies that noncompliance rates are high enough to adversely affect both economic and normative factors that influence compliance.

Perspectives about noncompliance reflected in these survey results substantially differ from perspectives based on compliance rates reported by the USCG. In the "Ocean Guardian," the USCG reported that, "[a]lthough [the] observed compliance rate will not perfectly indicate the actual industry-wide compliance rate, it should serve as a reasonable indicator of the actual compliance rate when enforcement resource effort is sufficient to make performance tracking possible."⁵¹ The USCG, in other words, was asserting that, if its at-sea boardings result in an observed compliance rate of 97%, the actual compliance rate is approximately 97% as well. This contradicts the survey results where even fishers estimated that one in three of their peers violate regulations at least occasionally, and some frequently. The comparison of results suggests that the USCG assumption that actual compliance rates are as high as observed compliance rates is incorrect because the USCG employs an unrealistically optimistic assumption about the portion of actual violations that it detects.

To put the extent of the difference in perspective, consider that between fiscal years 2003 and 2006 USCG personnel boarded between 3,265 and 6,134 fishing vessels annually and each year detected only 88 to 220 significant violations.⁵² (See Table 3.) Using survey results and actual numbers of fishing days at sea, we extrapolated the number of likely violations that take place each year in a single U.S. fishery, the northeast multispecies groundfish (NEGF) fishery. The NMFS reported that, from 2004 to 2007, the NEGF fishers averaged 31,616 days at sea.⁵³ Survey results showed that fishers and enforcement staff, respectively, believe that vessels in the fishery engage in one or more types of noncompliance during 10% and 28% of days at sea. Using the more conservative (10%) estimate provided by commercial fishers suggests that there are approximately 3,100 violations each year in the NEGF fishery alone. This is 18 times higher than the average of 167 significant violations the USCG detected and reported each year *in all U.S. fisheries combined*.

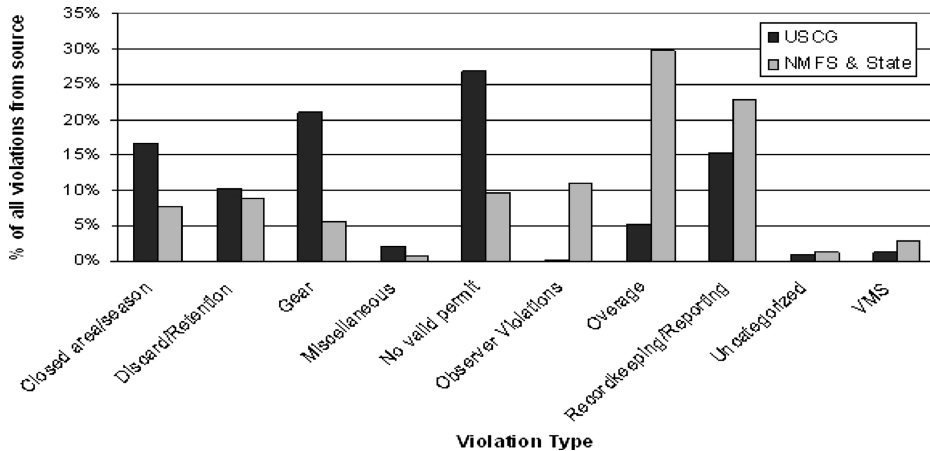


Figure 2. Types of commercial fishing violations in NOAA's EMIS database. Abbreviations: NOAA, National Oceanic and Atmospheric Administration; EMIS, Enforcement Management Information System; USCG, U.S. Coast Guard; NMFS, National Marine Fisheries Service.

Some fishing violations do not occur at sea or cannot be detected during USCG boardings while other types of violations can be detected only at sea.⁵⁴ We used NOAA's EMIS database to analyze what types of violations the USCG detects. The EMIS data showed that valid permit, gear, and area closure/season violations make up 65% of reported violations by the USCG. (See Figure 2.) Permit violations included fishing with no permit, fishing without a permit onboard, fishing with an expired permit, and being in possession of a target species without a permit. Gear violations detected during USCG boardings focus on use of illegal mesh size or gear types, bycatch reduction device (BRD) infractions, and improper construction of traps or exclusion/avoidance gear (e.g., for turtles, seabirds). Types of area closure and season violations included fishing within a closed area, transiting a closed area with gear improperly stowed, and possession of a target species outside its legal season. By contrast, NMFS and state enforcement, whose focus is mostly dockside, tended to detect landings overages, such as trip limit violations, which are impossible to detect at sea.

Prosecution of Violations

From an economic perspective, the deterrent effect of the USCG's fisheries enforcement program depends not only on how fishers view the likelihood of detection by the USCG, but also how they view the likelihood of detected violations being effectively prosecuted and resulting in a penalty and the significance of the expected penalty. The deterrent effect of USCG enforcement is increased, therefore, not only by increasing the detection rate, but also by increasing the rate at which detected violations are penalized, increasing the size of expected penalties, or both.⁵⁵ This is important because the USCG normally refers fishing violations observed during at-sea boardings to NOAA's GCEL for prosecution and so has no direct control over the resolution of these cases.⁵⁶ However, although the USCG has no direct control over decisions to pursue or not pursue a case, these decisions may be based, in part, on the types of violations being reported by the USCG or the way the USCG

is documenting them, which can clearly affect whether the GCEL believes they should be prosecuted or can be prosecuted successfully.

We used NOAA's EMIS database to analyze enforcement and prosecution data related to the USCG reports of violations. The EMIS database indicates whether cases were resolved through: (1) a determination that no violation occurred, (2) a prosecutorial determination not to prosecute, (3) unsuccessful prosecution, or (4) successful prosecution with or without a penalty assessed and imposed. When successfully prosecuted, the EMIS also reports the types of penalties imposed, which may include, but are not limited to: permit sanctions; vessel, gear, or catch seizures; catch forfeitures; verbal and written warnings; fix-it tickets; summary settlements; and financial penalties stemming from Notices of Violation and Assessment (NOVAs). GCEL policy provides for increased penalty assessments for repeat offenders, and any violation that results in a final judicial or administrative decision constitutes a prior violation.⁵⁷ For example, the GCEL's penalty schedule provides that, in most cases, detection of a violation will result in issuance of a NOVA if a summary settlement has previously been assessed.⁵⁸ By contrast, fix-it tickets technically constitute a waiver of penalty and, thus, do not increase future penalties.⁵⁹

In general, penalties provide an economic incentive not to violate in the future if they include a financial payout, permit sanction (i.e., limiting future gains from the fishery), forfeiture (e.g., of a vessel or all or a portion of the catch), or if they upwardly adjust the amount of future penalties (e.g., written warnings). Violations that do not carry such consequences, including fix-it tickets and seizure of illegal catch, provide little economic disincentive for noncompliance.⁶⁰ However, such violations may be reported in fishery enforcement blotters published in industry and local publications, which may result in community and peer pressure and other noneconomic disincentives to continued noncompliance.

The EMIS database includes information regarding 8,015 violations of fishing regulations reported by NMFS fishery enforcement staff, the USCG, state fishery enforcement staff, and others (e.g., other fishers, general public) between 2001 and May 2006.⁶¹ During this period, the USCG reported 1,001 incidents, or 12.5% of the total. By contrast, the NMFS reported 5,345 incidents, or almost 67% of all incidents. (See Table 4.) The most frequent resolution for USCG-sourced cases was a written warning or fix-it ticket (21.5% of cases). (See Table 5.) Only 28.7% of violations reported by the USCG resulted in a resolution that carried a financial penalty. Written warnings, which count as prior violations, constitute another 18.6% of cases.⁶² On average, 28.4% of violations reported by the USCG based on at-sea enforcement resulted in the assessment of a final penalty or seized or forfeited property (see Table 6), which is slightly lower than the 30.8% of fishing violations reported by all sources that resulted in such resolutions (see Table 4).

Analysis of USCG Noncompliance Rates

The preceding assessment suggests that the high observed compliance rates reported by the USCG reflect low success at detecting violations rather than successful deterrence. There are four main reasons the USCG may be underdetecting violations and observing extremely high compliance rates.

1. The USCG is using flawed intelligence to identify vessels as "suspected violators" and is targeting mostly law-abiding fishers rather than frequent violators.
2. The USCG's intelligence is correct and most boarded vessels are frequent violators, but evidence of violations does not exist at the time of boarding.

Table 4

Reported fishing violations in NOAA's EMIS database, by source and resolution (1 January 2001 through 31 May 2006)

Source	Reported violations		Violations resulting in one or more types of penalty	
	No.	% of total	No.	% of violations from source
Total USCG	1,001	12.5	284	28.4
NMFS	5,345	66.7	1,481	27.7
State	589	7.3	238	40.4
NMFS/state	366	4.6	176	48.1
Member of the general public	279	3.5	87	31.2
Other	435	5.4	205	47.1
Total	8,015	100.0	2,471	30.8

Abbreviations: NOAA, National Oceanic and Atmospheric Administration; EMIS, Enforcement Management Information System; USCG, U.S. Coast Guard; NMFS, National Marine Fisheries Service.

3. The intelligence is correct, boarded vessels are frequent violators, and USCG personnel fail to detect evidence of violations that exist during the boarding.
4. Evidence of violations exists and is detected during boarding, but the violations are considered by the USCG not to be "significant" and so are either not reported or not included in USCG measures of compliance rates.

The following sections address each of these possible explanations.

Table 5

Resolution types and financial penalties for USCG-sourced cases in NOAA's EMIS database

Resolution type	Cases		Average financial penalty
	No.	%	
Written warning (fix-it)	215	21.5	NA
Settlement agreement conditions satisfied	193	19.3	\$10,329
Written warning	186	18.6	NA
Case closed, declined, or dismissed	167	16.7	NA
Summary settlement paid	94	9.4	\$651
Case/count merged	58	5.8	NA
Miscellaneous	45	4.5	NA
Case transferred to another region or agency	23	2.3	NA
Verbal warning	20	2.0	NA

Abbreviations: USCG, U.S. Coast Guard; NOAA, National Oceanic and Atmospheric Administration; EMIS, Enforcement Management Information System.

Table 6
Overview of fishing violations reported by the USCG in NOAA's EMIS database (1 January 2001 through 31 May 2006)

FY	USCG-reported violations No.	USCG-reported violations resulting in one or more type of financial penalty	
		No.	%
2001 ^a	174	46	26.4
2002	163	46	28.2
2003	217	58	26.7
2004	234	59	25.2
2005	172	55	32.0
2006 ^a	41	20	48.8
Total	1,001	284	28.4

Abbreviations: USCG, U.S. Coast Guard; EMIS, Enforcement Management Information System; FY, fiscal year.

^aFY2001 and FY2006 data are not complete because the EMIS data are from 1 January 2001 through 31 May 2006.

Targeting of Frequent Violators

The research on which this article is based does not attempt to measure how well the USCG targets frequent violators. However, it seems unlikely that the high USCG-observed compliance rates are due to flawed intelligence resulting in the USCG targeting law-abiding fishers and missing chronic and occasional violators. For example, the USCG reported an average of 4,914 annual boardings which yielded an average of 167 annual violations detected from 2003 to 2006, a noncompliance rate of 3.4%.⁶³ Based on our survey, fishers estimated the percent of routine violators to be 15%, and enforcement personnel estimated 31%. So, even if the USCG were selecting fishing vessels for boarding on a random basis, the survey results suggest that 737 to 1,523 (15% to 31%) of annual boardings would have been on vessels operated by frequent violators. However, they are detecting only 167 violations annually. Although by no means conclusive, this exercise suggests that, even if the USCG were unsuccessful at targeting frequent violators, it would be boarding a significant number of them by chance and, all other things equal, would be observing much higher noncompliance rates.

Timing of Boardings ("Localized Deterrence")

The USCG may be underdetecting violations because the boardings are taking place when vessels are not in violation or when evidence of prior violations is not detectable. In this case, the discrepancy between the relatively high compliance rates observed by the USCG and the much lower compliance rates estimated by fishers and fishery enforcement is the result of "localized deterrence." It is reasonable to assume that all fishers, even chronic violators, rationally refrain from violating fishing regulations when they know USCG assets are in the vicinity (which can easily account for the high USCG observed compliance rates), and then resume whatever level of compliance is normal for them when they know the USCG

is not in the vicinity (which can easily account for lower overall compliance rates reported in surveys).

If localized deterrence explains the difference between the USCG observed compliance and other estimates, it is logical to assume that the rate of observed compliance by the USCG will exceed the rate of actual compliance by a factor that depends on the ability of fishers to know when and where the USCG is in a position to detect a violation. This “gaming” relationship between fishing vessels and the USCG enforcement vessels can be depicted using a simple model.

On any given fishing day, the population of fishers (P) consists of two subpopulations, P1 and P2, where P1 includes vessels that are knowingly operating where the USCG is present and P2 includes fishers who are knowingly operating where the USCG is not present.⁶⁴ For a fishing vessel to be in P1, it must believe that a USCG asset is close enough that the fishing vessel would have difficulty stopping an ongoing violation or hiding evidence of that violation (or a previously completed violation) to prevent a violation being detected should the USCG target the vessel for boarding. Where P1 conditions do not exist, which may be over most of the fishing area in some fisheries, vessels are members of P2 and are not deterred from illegal fishing by the USCG because, by definition, they believe they are not vulnerable to being boarded by the USCG. As fishing vessels and USCG assets move from one area to another, fishing vessels transition between P1 and P2, sometimes consciously, based on their intentions to fish legally or illegally and the intelligence they have about the location of USCG vessels. Based on this model, high compliance rates reported on vessels boarded by the USCG reflect the fact that the USCG is sampling vessels that are part of P1 and not the broader population of potential violators (P).⁶⁵

Fishers’ ability to hide violations differs by the violation category (as noted below), so the USCG presence in an area not only increases localized compliance, but also affects the types of violations committed. For example, a vessel in P2 may choose to retain undersized fish in the hold even though it is evidence of a violation whereas a vessel in P1 might deem that violation too risky and instead choose to engage in “high-grading”—tossing fish overboard to make room in the hold because that usually leaves no solid evidence.

Many types of at-sea violations (e.g., high-grading, exceeding bycatch limits, or using certain types of gear in certain areas) are detectable only when the violation is actively occurring because they leave no evidence aboard the vessel. Evidence of other violations is more persistent. For example, evidence of violations of minimum fish size regulations may exist in the hold until the vessel returns to port and, therefore, is highly detectable. In general, the types of violations that the USCG discovers most often—such as closures, bycatch, and gear usage—are more transient than those that can be detected dockside.⁶⁶

Substantial real-world evidence supports the above-described localized deterrence model. For example, 18% of fishers and 69% of state/federal enforcement staff either agreed or strongly agreed with the statement that “it is easy for those violating fishing regulations to evade USCG at-sea detection.”⁶⁷ One reason evading detection by the USCG may be relatively easy is that USCG fishery surveillance and enforcement vessels are usually well marked and visible by the naked eye over water for several miles in clear weather; and, under most conditions, are detectable via radar from around 40 miles away. Interviews with fishers indicated that, when radar shows a vessel approaching at high speed from as far away as 40 miles, it is “a sure bet” that it is USCG or state fishery enforcement.⁶⁸ Previous research and interviews with fishers also indicated that fishing vessels operating in the same general area frequently share information via very high frequency (VHF) radio and cell phones or, further offshore, via single-sideband radio, and that such communications routinely include information about the location of USCG surveillance/enforcement assets.

These interviews suggest that most vessels know with a high degree of certainty when they are in group P1 and the risk of boarding is high (and the benefit-cost ratio related to illegal fishing is low), and when they are in group P2 where the benefit-cost ratio associated with illegal fishing may be high.

This localized deterrence theory can explain why even vessels suspected of being frequent violators are found to be in compliance during approximately 97% of USCG boardings, even though survey evidence indicated that they violate fishing regulations during 20% or more of their days at sea.⁶⁹ If this theory and our survey evidence are correct, the 97% USCG compliance rate APM is not a meaningful measure of compliance because the USCG is boarding and inspecting a nonrepresentative sample of vessels. In this case, whether or not the USCG is successful at targeting suspected violators may be largely irrelevant.⁷⁰

Detecting Violations During Boardings

Even if evidence of a violation exists aboard a fishing vessel when it is boarded and inspected by the USCG, it may not be detected. Boarding and inspecting fishing vessels at sea is inherently difficult, particularly during challenging weather and sea conditions, and inspecting fish holds and gear for evidence of significant violations may not always be possible for safety or other reasons. Also, each FMP includes a wide variety of gear, catch, logbook, and other fishing regulations, and those regulations may differ by vessel type and size, time of year, location, and other factors. Multiple FMPs may also apply in each geographic region, and each FMP has its own rules and peculiarities. In addition to performing their other missions (e.g., national security, search and rescue), USCG enforcement agents need to be familiar with all of the applicable regulations, when and where they apply, and how they may have been modified to be able to confidently and effectively detect noncompliance and enforce violations. Interviews and previous studies indicated that there is a relatively high turnover rate among USCG at-sea fishery enforcement officers and that the training they receive to help them detect violations during at sea boardings is limited.⁷¹

Another factor that may influence detection rates is the established APM for successful USCG at-sea deterrence. With high observed compliance rates (low incidence of violation detection) as the established success metric, there is an incentive for the USCG to increase the number of boardings and disincentives for taking extreme measures to detect significant violations.

Some USCG agents may also be compromised in their ability to effectively detect violations because of limited opportunities for training in how to look for and identify physical evidence. The USCG has created five regional fisheries training centers to train agents for boarding and inspecting fishing vessels. The NMFS cooperates in this effort by providing instruction to USCG agents.⁷² However, the amount of training that USCG agents receive is limited in comparison to the complexity of their at-sea enforcement tasks and the difficulty of finding and assessing physical evidence of fishing violations aboard a vessel at sea.⁷³ The USCG fleet is also highly mobile and moves between geographic regions and fisheries, generating a potential need for continuing education about fishery regulations and the types of evidence and documentation the NOAA GCEL needs to successfully prosecute cases. However, given the USCG enforcement mission in fisheries and other areas, the opportunity cost of lost time at sea to receive training is high and may often be prohibitive.

Determining “Significant” Violations

The broad definition of “significant” violations used by the USCG allows considerable discretion in determining which detected violations to use when calculating annual compliance

rates and reporting USCG success. Under the USCG system, each violation determined to be significant makes it more difficult for the agency to meet its compliance performance goal of 97%. Besides providing a perverse incentive for USCG officers to avoid searching aggressively for significant violations, this APM also provides an incentive for the USCG to classify fewer detected violations as significant.⁷⁴

The USCG's annual reports include the number of "significant" violations detected during at-sea boardings, but NOAA maintains the EMIS database, which includes violations the USCG reports to NOAA each year. Presumably, the USCG reports both significant and nonsignificant violations to NOAA for inclusion in the EMIS database. A comparison of USCG-reported violations in the EMIS database with the significant violations reported by the USCG, therefore, provides an opportunity to assess how the USCG's discretion in this area may be affecting reported USCG compliance rates. The USCG reported an average of 167 significant violations per year from 2003 to 2006.⁷⁵ (See Table 3.) Over the same period, the EMIS data showed an average of 238 USCG-reported domestic fishing violations annually.⁷⁶ These data suggest that, on average, the USCG considered roughly 70% of the violations it reported to NOAA to be significant enough to use when calculating compliance rates and 30% annually, about 71 observed violations, not to be significant. Excluding this small number of violations from the USCG noncompliance statistics would result in a change of only 1% or so in the USCG estimates of noncompliance, which would not explain more than a very small fraction of the substantial difference between the USCG and survey-based estimates of compliance rates in U.S. domestic fisheries.

Conclusions and Recommendations

At present, the USCG is the only agency capable of enforcing fisheries regulations in offshore areas beyond the access of the NMFS and state enforcement personnel. This makes USCG at-sea domestic fishery enforcement a critical component of the federal fisheries enforcement system. The USCG routinely uses its roughly 97% observed compliance rates as an indicator that its at-sea domestic fishery enforcement program is successful at deterring violations. The research presented here, however, indicates that the high rates of compliance reported by the USCG do not so much reflect the ability of the at-sea enforcement program to deter violations, as the failure of the program to detect most violations.

Our analysis suggests that several factors contribute to USCG reporting rates of observed compliance that are so much higher than estimates based on other research. Most importantly, "localized deterrence" may produce high compliance rates within a small zone of likely detection around each USCG vessel whereas other estimates are based on lower compliance rates in other areas, which may include most fishing areas. Established performance success metrics that are based on compliance, rather than detection, also result in perverse incentives that may discourage USCG boarding parties from aggressively searching for violations.

We conclude that the USCG-observed compliance rate APM is seriously flawed and should not be used as an indicator of the success of the USCG fishery enforcement program. Use of this flawed measure of success masks, rather than clarifies, where improvements should be made in domestic fishery enforcement. In particular, reliance on this measure may result in an underestimation of area and season closure violations, bycatch, gear violations, and permit violations that are difficult or impossible to detect by dockside enforcement staff. Reliance on the established USCG APM may also mislead fishery managers about the extent of illegal fishing in domestic fisheries, the adverse impacts of illegal fishing on

fish stocks and fishing communities, and how illegal fishing, if not addressed adequately, might cause fish stock rebuilding programs to fail.

While USCG at-sea enforcement detects few violations, it does so at great cost to American taxpayers. During fiscal years 2003 through 2006, for example, the budget for the USCG at-sea enforcement program averaged \$397 million per year, 90.5% of all federal spending on domestic fishery enforcement, and resulted in an average of 167 significant fishing violations detected annually in all U.S. fisheries combined.⁷⁷ This reflects a cost per reported violation of about \$2.4 million. However, our research into the resolution of USCG-reported violations indicates that only 28% are successfully prosecuted and result in some type of penalty.⁷⁸ Therefore, the cost per USCG-reported violation that resulted in a penalty during this period was approximately \$8.4 million. The average financial penalty associated with those violations was \$7,153.⁷⁹

Overall, we conclude that relatively low detection rates and relatively small levels of expected penalties are preventing USCG at-sea enforcement from having a significant deterrent effect on illegal fishing outside the zone of localized deterrence. The USCG-reported success at deterring illegal fishing based on sampling within this zone has prevented noncompliance problems from being fully recognized and adequately addressed.

However, compliance in fisheries depends on more than just the likelihood of detection and the expected penalty. Normative factors associated with fishers' sense of moral obligation and community pressure and belief in the legitimacy and credibility of fishery managers also affect compliance. Our research shows that noncompliance is significant enough to be weakening normative factors that normally support compliance. In our study, surveyed fishers, on average, estimated that illegal fishing accounts for 12% of the harvest in U.S. domestic fisheries and enforcement staff, on average, estimated the illegal harvest to be 24% of the total.⁸⁰ Most fishers and enforcement personnel also reported believing that illegal fishing is contributing significantly to economic, biological, and management problems in many fisheries and many fishers reported that illegal fishing is significant enough that they do not expect to gain from planned fish stock rebuilding programs.⁸¹ The combined adverse effects of deteriorating economic and normative influences on compliance indicate that more attention needs to be paid to the effectiveness of enforcement and the problems with compliance statistics.

The research presented here indicates that there are important biological and economic reasons why changes should be made in how USCG at-sea enforcement is carried out and how its success is measured and managed.

Recommendations regarding specific changes that should be made need to be based on careful economic, political, and technical assessments that are beyond the scope of our research. Fishery enforcement experts who agree with our conclusions are likely to recommend a mix of changes that may include: improved cooperation between the NMFS and USCG, improved use of VMS and other technologies, better training of USCG enforcement agents, more effective and aggressive targeting of chronic violators, more certain and meaningful penalties, and new incentive programs to support collaborations between law-abiding fishers and enforcement staff to target chronic violators and increase the number of violations that are detected, reported, and successfully prosecuted.

Notes

1. Magnuson-Stevens Fishery Conservation and Management Act, 1976, as amended, 16 U.S.C. § 1801 et seq.

2. The 10 national standards are set out at 16 U.S.C. § 1851: (1) Prevent overfishing while achieving optimum yield; (2) Be based upon the best scientific information available; (3) Manage individual stocks as a unit throughout their range, to the extent practicable; interrelated stocks shall be managed as a unit or in close coordination; (4) Not discriminate between residents of different states; any allocation of privileges must be fair and equitable; (5) Where practicable, promote efficiency, except that no such measure shall have economic allocation as its sole purpose; (6) Take into account and allow for variations among and contingencies in fisheries, fishery resources, and catches; (7) Minimize costs and avoid duplications, where practicable; (8) Take into account the importance of fishery resources to fishing communities to provide for the sustained participation of, and minimize adverse impacts to, such communities (consistent with conservation requirements); (9) Minimize by-catch or mortality from by-catch; and (10) Promote safety of human life at sea.

3. J. K. Randall, "Improving Compliance in U.S. Federal Fisheries: An Enforcement Agency Perspective," *Ocean Development and International Law* 35 (2004): 287–317.

4. During fiscal years 2003, 2004, 2005, and 2006, the USCG annual budget for domestic fisheries enforcement was \$316.4 million, \$331.3 million, \$378.2 million, and \$563.9 million. The NMFS/NOAA Office for Law Enforcement (OLE) fishery enforcement budgets were \$15.5 million, \$30.8 million, \$29.1 million, and \$33.7 million; and federal/state fishery enforcement budgets (funded via Joint Enforcement Agreements) were \$9.4 million, \$16.5 million, \$16.8 million, and \$15.8 million. See Center for Naval Analysis, *Is the U.S. Coast Guard's Fisheries Enforcement Program Working?* Final Report CRM D0014618.A2 (2006); and U.S. Department of Commerce Office of Inspector General, Alexandria, VA "NOAA's Management of the Joint Enforcement Agreement Program Needs to Be Strengthened," 2008 Final Report No. IPE-19050-1 (2008).

5. "Fix-it" tickets are written warnings for minor violations of permit conditions, vessel markings, reporting requirements, and so forth, that are easily remedied and do not result in penalties or count as prior violations.

6. See the Sustainable Fisheries Act, 1996, Pub. L. 104-297, 110 Stat. 3617; and Magnuson-Stevens Reauthorization Act of 2006, Pub. L. 109-479, 120 Stat. 3575.

7. See National Marine Fisheries Service, "2008 Status of US Fisheries" (2009), available at www.nmfs.noaa.gov/sfa/statusoffisheries/SOSmain.htm (accessed on 19 March 2009). Of the 500 or so fish stocks monitored and managed by NMFS, 230 fish stocks that are important to commercial and/or recreational fisheries are classified as "economically significant."

8. *Ibid.* Two characteristics are used to characterize the status of a fishery: the level of exploitation and the level of fish stock abundance. "Overfished" refers to a measure of fish stock abundance that indicates that overfishing has already caused a fish stock to become depleted. "Overfishing" refers to a measure of exploitation that indicates fishing pressure is exceeding the level determined to be required to prevent fish stocks from becoming depleted. A fish stock can be overfished and experiencing overfishing, not overfished and not experiencing overfishing, and so on.

9. *Ibid.*

10. The 2007 MSA amendments, *supra* note 6, should eliminate some types of regulatory overfishing, but it is too early to determine the effects of these new requirements on regulatory decision making.

11. For assessment and comparisons of these factors, see J. G. Sutinen and H. F. Upton, "Economic Perspectives on New England Fisheries Management," *Northeast Naturalist* 7 (2000): 361–372; M. Sissenwine and P. Mace, "Governance for Responsible Fisheries: An Ecosystem Approach," in *Responsible Fisheries in the Marine Ecosystem*, ed. M. Sinclair and G. Valdimarsson (Rome: Food and Agriculture Organization of the United Nations, 2003), 363–392; D. C. Wilson and P. Degnbol, "The Effects of Legal Mandates on Fisheries Science Deliberations: The Case of Atlantic Bluefish in the United States," *Fisheries Research* 58 (2002): 1–14; J. Eagle, S. Newkirk, and B. H. Thompson Jr., *Taking Stock of the Regional Fishery Management Councils*, Pew Ocean Science Series (2003); A. A. Rosenberg, "Managing to the Margins: The Overexploitation of Fisheries," *Frontiers in Ecology and the Environment* 1 (2003): 102–106; J. G. Sutinen and M. Soboil, "The Performance of Fisheries Management Systems and the Ecosystem Challenge," in *Responsible Fisheries in the Marine Ecosystem*, ed. M. Sinclair and G. Valdimarsson (Rome: Food and Agriculture Organization

of the United Nations, 2003), 291–310; J. R. Beddington, D. J. Agnew, and C. W. Clark, “Current Problems in Management of Marine Fisheries,” *Science* 316 (2007): 1713–1716; and R. Hilborn, “Defining Success in Fisheries and Conflicts in Objectives,” *Marine Policy* 31 (2007): 153–158.

12. A. A. Rosenberg, J. H. Swasey, and M. Bowman, “Rebuilding US Fisheries: Progress and Problems,” *Frontiers in Ecology and the Environment* 4 (2006): 303–308.

13. See K. T. Frank et al., “Trophic Cascades in a Formerly Cod-Dominated Ecosystem,” *Science* 308 (2005): 1621–1623; C. Safina et al., “U.S. Ocean Fish Recovery: Staying the Course,” *Science* 309 (2005): 707–708; and Rosenberg, Swasey, and Bowman, *supra* note 12.

14. R. M. Peterman, “Possible Solutions to Some Challenges Facing Fisheries Scientists and Managers,” *ICES Journal of Marine Science* 61(2004): 1331–1343.

15. See P. A. Bernal et al., “New Regulations in Chilean Fisheries and Aquaculture: ITQ’s and Territorial Users’ Rights,” *Ocean and Coastal Management* 42 (1999): 119–142; C. Chavez and H. Salgado, “Individual Transferable Quota Markets Under Illegal Fishing,” *Environmental and Resource Economics* 31 (2005): 303–324; Marine Resources Assessment Group, “Review of Impacts of Illegal, Unreported and Unregulated Fishing on Developing Countries” (London: Marine Resources Assessment Group, Ltd., 2005); and Organization for Economic and Cooperative Development, “Why Fish Piracy Persists: The Economics of Illegal, Unreported and Unregulated (IUU) Fishing” (Paris: Organization for Economic Co-operation and Development, 2005).

16. See Randall, “Improving Compliance in U.S. Federal Fisheries,” *supra* note 3; J. G. Sutinen, A. Rieser, and J. R. Gauvin, “Measuring and Explaining Noncompliance in Federally Managed Fisheries,” *Ocean Development and International Law* 21 (1990): 335–372; and H. Eggert and A. Ellegård, “Fishery Control and Regulation Compliance: A Case for Co-management in Swedish Commercial Fisheries,” *Marine Policy* 27 (2003): 525–533.

17. Exceptions include: Sutinen, Rieser, and Gauvin, “Measuring and Explaining Noncompliance,” *supra* note 16; J. G. Sutinen and J. R. Gauvin, “A Study of Law Enforcement and Compliance in the Commercial Inshore Lobster Fishery of Massachusetts: Volumes I and II” (Boston, MA: Environmental Enforcement Division, Massachusetts, 1988); and C. Bean, “An Economic Analysis of Compliance and Enforcement in the Quahaug Fishery of Narragansett Bay” (master’s thesis, South Kingston: University of Rhode Island, 1990).

18. U.S. Coast Guard, “Ocean Guardian: Fisheries Enforcement Strategic Plan” (2004), available at www.uscg.mil/hq/cg5/cg531/LMR.asp#Ocean%20Guardian%20Strategic%20Plan (accessed on 23 March 2009).

19. . *Ibid.*

20. See Sutinen, Rieser, and Gauvin, “Measuring and Explaining Noncompliance,” *supra* note 16; Sutinen and Gauvin, “A Study of Law Enforcement and Compliance,” *supra* note 17; and Bean, “An Economic Analysis of Compliance and Enforcement,” *supra* note 17.

21. For example, a 2006 Center for Naval Analysis review of the USCG domestic fishery enforcement program discussed later in this article asserts that the USCG-observed compliance rate is a reliable metric because it “depends solely on measured quantities, eliminating potential uncertainty or instability introduced by estimates.” Center for Naval Analysis, *Is the U.S. Coast Guard’s Fisheries Enforcement Program Working?* *supra* note 4.

22. G. Becker, “Crime and Punishment: An Economic Approach,” *Journal of Political Economy* 76 (1968): 169–217.

23. See K. Kuperan and J. G. Sutinen, “Blue Water Crime: Legitimacy, Deterrence and Compliance in Fisheries,” *Law and Society Review* 32 (1998): 309–338; and J. G. Sutinen and K. Kuperan, “A Socioeconomic Theory of Regulatory Compliance in Fisheries,” *International Journal of Social Economics* 26 (1999): 174–193.

24. See Kuperan and Sutinen, “Blue Water Crime,” *supra* note 23; and Sutinen and Kuperan, “A Socioeconomic Theory,” *supra* note 23.

25. See Sutinen, Rieser, and Gauvin, “Measuring and Explaining Noncompliance,” *supra* note 16; and Sutinen and Kuperan, “A Socioeconomic Theory,” *supra* note 23.

26. See A. Hatcher et al., “Normative and Social Influences Affecting Compliance with Fishery Regulations,” *Land Economics* 76 (2000): 448–486; S. Gezelius, “Do Norms Count? State Regulation

and Compliance in a Norwegian Fishing Community,” *Acta Sociologica* 45 (2002): 305–314; A. Hatcher and D. Gordon, “Further Investigations into the Factors Affecting Compliance with U.K. Fishing Quotas,” *Land Economics* 81 (2005) 71–86; and Kuperan and Sutinen, “Blue Water Crime,” supra note 23.

27. D. M. King and J. G. Sutinen, “Rational Noncompliance and the Liquidation of New England Groundfish Resources,” *Marine Policy*, in press.

28. See J. G. Sutinen, “Fisheries Compliance and Management: Assessing Performance” (Canberra: Australian Fisheries Management Authority, 1996); and Sutinen and Kuperan, “A Socioeconomic Theory,” supra note 23.

29. See Sutinen, “Fisheries Compliance and Management,” supra note 28; and Sutinen and Kuperan, “A Socioeconomic Theory,” supra note 23.

30. Sutinen and Kuperan, “A Socioeconomic Theory,” supra note 23.

31. “Ocean Guardian,” supra note 18. “Ocean Guardian” is used for compliance with the Government Performance and Results Act (GPRA) 31 U.S.C. § 1115. The GPRA requires the Office of Management and Budget (OMB) to mandate that each federal agency create and submit an annual performance plan as part of the budget process. The performance plan must establish objective, quantifiable, and measurable program performance goals, and it must both describe how the agency plans to achieve the goals and identify “performance indicators” to be used in assessing performance. Agencies must also submit annual performance reports detailing their program results during the prior year. See also OMB, “Detailed Information on the Coast Guard Fisheries Enforcement Assessment” (2003, amended in 2009), available at www.whitehouse.gov/omb/expectmore/detail/10001072.2003.html (accessed on 23 March 2009).

32. “Ocean Guardian,” supra note 18.

33. *Ibid.*

34. *Ibid.* The USCG defines high-threat areas as “[a]rea[s], defined by both time and locations, where illegal activity is likely to occur. For LMR enforcement, illegal activity is: (1) activity meeting the ‘significant violation’ definition; (2) foreign fishing vessel encroachment into the U.S. EEZ (both significant and non-significant); or (3) violation of international agreements.” In “Ocean Guardian,” three high-threat areas for incursions into the EEZ have been identified: the central Bering Sea, the Western and Central Pacific, and the Gulf of Mexico. The document does not identify high-threat areas for domestic fisheries enforcement.

35. *Ibid.*

36. OMB, “Detailed Information,” supra note 31.

37. *Ibid.*

38. *Ibid.*

39. In the years following the 2003 analysis, compliance rates have in fact declined, resulting in an observed compliance rate of 95.3% in fiscal year 2008. *Ibid.*

40. Overall, the 2003 review gave the program high grades in terms of Purpose and Design (100%), Strategic Planning (75%), and Program Management (100%), but a low grade (53%) for Results and Accountability. *Ibid.*

41. Center for Naval Analysis, supra note 4.

42. *Ibid.*

43. *Ibid.* The report notes that the APM would reward bad performance if the USCG ceased fisheries enforcement in a high violation area, thus resulting in an increased APM. Potential bias stems from nonrandom sampling. The broad definition of significant violations enables subjective enforcement and requires USCG personnel to take care to enforce regulations in a consistent manner.

44. *Ibid.* According to the report, a 2004 analysis of cutter patrols records “found that fewer than one-quarter of boardings were being recorded . . . although this finding was for all boardings, not just fisheries.”

45. This low noncompliance rate is based on all types of detected violations of fishing regulations, marine mammal violations, safety violations, and so forth. If the focus were only on violations of fishing regulations, therefore, the observed noncompliance rate (number of significant fishing violations detected per boarding) would be lower.

46. The NOAA EMIS database was used by the NOAA Office for Law Enforcement (OLE) and GCEL offices to track cases of reported fishing violations until 31 May 2006. EMIS is still used for some purposes by the GCEL, but the OLE and GCEL offices now track cases using the Law Enforcement Accessible Database System (LEADS). In September 2007, we received a version of the EMIS database from the NOAA OLE that contained 11,373 records of closed cases from 1 January 2001 through 31 May 2006. After eliminating records dealing with violations other than commercial fishing (e.g., marine mammals, sport fishing), 8,015 records remained. The analysis presented here is based on commercial fishing violations only, except as noted.

47. The cost per violation resulting in a penalty was estimated for each year by dividing the USCG domestic fishery enforcement budget for the year by the number of USCG-reported violations in the EMIS database that resulted in any type of financial penalty or permit sanction. Our version of the EMIS database includes only cases that were closed before September 2007. Therefore, if any USCG reported violations during fiscal year 2003 through fiscal year 2005 were not closed by September 2007, they were not included in this calculation.

48. Although a limited number of USCG enforcement staff responded to our survey, most responses from enforcement staff were from the NMFS and state enforcement officers.

49. Case study fisheries included the northeast multispecies groundfish trawl fishery, the Gulf of Mexico commercial red snapper individual fish quota (IFQ) fishery, and the Pacific groundfish limited entry trawl fishery. A total of 1,295 fishers were surveyed, including 708 from the northeast, 396 from the Gulf of Mexico, and 191 from the Pacific. Response rates ranged from 40.4% (northeast) to 47.6% (Pacific). Fishery enforcement staff, managers, and researchers completed an online version of the survey. For complete survey results, see Lenfest Ocean Program, "An Economic, Legal and Institutional Assessment of Enforcement and Compliance in Federally Managed U.S. Commercial Fisheries," 2009 Draft Report.

50. This figure includes detection by all agencies, including the NMFS and state agencies.

51. "Ocean Guardian," supra note 18.

52. Center for Naval Analysis, *Is the U.S. Coast Guard's Fisheries Enforcement Program Working?* supra note 4.

53. National Marine Fisheries Service, *Draft Environmental Assessment for Secretarial Interim Action to Implement Measures to Reduce Overfishing in the Northeast Multispecies Fishery Complex*, 2009, reference table 149, Appendix D.

54. For example, some fishing regulations prohibit the landing of certain fish that cannot be detected during at-sea boardings while other fishing regulations, such as those that prohibit disposing of illegal bycatch, may leave no evidence that can be detected during at-sea boardings. At the other extreme, use of illegal fishing methods or gear may only be detectable at sea.

55. See Becker, "Crime and Punishment," supra note 22; and Sutinen, "Fisheries Compliance and Management," supra note 28.

56. It is possible that the portion of fishing violations reported by the USCG to the GCEL that are prosecuted and result in penalties or sanctions would increase if the USCG focused on different types of violations or improved the way it documents violations or supports the prosecution of the cases it reports. These possibilities are beyond the scope of this study.

57. NOAA, "Penalty Schedules" (2009), available at www.gc.noaa.gov/enforce-office3.html (accessed on May 5, 2009).

58. Center for Naval Analysis, *Is the U.S. Coast Guard's Fisheries Enforcement Program Working?* supra note 4.

59. See NOAA, "Penalty Schedules," supra note 57; and "Enforcing U.S. Marine Protected Areas: Synthesis Report" (2006), available at mpa.gov/pdf/publications/enforcement.pdf (accessed on 5 May 2009)

60. It is generally accepted in fishery economics that, because the violator does not legally own it, forfeiting only the portion of the catch that was taken illegally should not be viewed as a penalty. Catch forfeitures that include the entire vessel load, which may include some legally caught fish, may be considered a penalty.

61. Lenfest Ocean Program, "An Economic, Legal and Institutional Assessment of Enforcement and Compliance," supra note 49.

62. Although 287 cases were resolved in such a way that financial penalties could be imposed, the EMIS data do not indicate that financial penalties were imposed in all these cases, which explains why only 284 cases resulted in one or more penalties.

63. Center for Naval Analysis, *Is the U.S. Coast Guard's Fisheries Enforcement Program Working?* supra note 4.

64. There are vessels operating at any given time that do not know whether the USCG is nearby or not and may constitute a third subcategory. Adding a third subcategory or simply ignoring vessels in this category does not change the results of this illustration.

65. Surveys by J. G. Sutinen and P. Andersen, "The Economics of Fisheries Law Enforcement," *Land Economics* 61 (1985): 387-397, indicate that fishing vessels also "game" at-sea enforcement by cooperating to expose one fishing vessel to a boarding while other vessels flee. We did not address this issue in the surveys or interviews performed as part of this study.

66. Some types of regulations, such as landing prohibited fish species (but not catching or retaining them per se), do not technically become violations until the vessel offloads the species. As a result, the USCG can never detect these violations at sea. This factor explains some of the disparity between observed and survey-derived compliance rates.

67. When told that the USCG reports compliance rates of around 97% based on at-sea inspections, one knowledgeable fishing industry expert (in the northeast region) responded that the number "merely shows that 3% of fishers are really stupid." Although clearly a joke, this comment reflects the general sense among most groups surveyed that it is relatively easy for violating fishers to avoid being detected at sea by the USCG.

68. During interviews, some fishermen were asked direct questions about how easy it is to identify USCG vessels at sea and how frequently fishing vessels communicate information about the location and activities of USCG vessels. The consensus was that most fishing vessels know, through direct observation or via communication from other vessels, when a USCG vessel is within 30 or 40 nautical miles. If a USCG vessel approached a fishing vessel at 20 knots from 40 nautical miles away, it would reach the vessel in 2 hours.

69. We note that 20% of days at sea refers to the fleet as a whole and that it includes violations that are undetectable at sea. Given a low rate of noncompliance by the approximately 50% of fishers who survey respondents indicated rarely violate the regulations, chronic violators can be assumed to violate on far more than 20% of their fishing days.

70. This conclusion holds except in the unlikely event that the USCG is so omnipresent on the fishing grounds that local and overall deterrence effects are equal (i.e., the USCG is in detection range of the vast majority of the fishing fleet). However, both prior evidence and our survey results indicate that USCG asset coverage is not sufficient to drive uniform rates of compliance across fisheries. On the other hand, there have been reports that the USCG undertakes tactics to increase the zone of deterrence around USCG vessels. Referring specifically to USCG at-sea domestic fishery enforcement, for example, Randall, "Improving Compliance in U.S. Federal Fisheries," supra note 3, reported that "enforcement efforts must be randomly distributed across spatial and temporal dimensions to minimize the fisher's ability to predict when an inspection may occur" (p. 308). See also Center for Naval Analysis, *Is the U.S. Coast Guard's Fisheries Enforcement Program Working?* supra note 4; and Lenfest Ocean Program, "An Economic, Legal and Institutional Assessment of Enforcement and Compliance," supra note 49.

71. Randall, "Improving Compliance in U.S. Federal Fisheries," supra note 3.

72. OMB, "Detailed Information," supra note 31.

73. Randall, "Improving Compliance in U.S. Federal Fisheries," supra note 3.

74. Although research has provided no evidence that these perverse incentives have any effect on USCG compliance rates, they are embedded in the current USCG reporting system and should be addressed, perhaps via surveys of USCG staff, whenever existing or new annual performance metrics are being considered.

75. Center for Naval Analysis, *Is the U.S. Coast Guard's Fisheries Enforcement Program Working?* supra note 4.

76. Average annual USCG-reported violations were calculated from the entire EMIS database. See supra note 46.

77. Other research has illustrated that spending on USCG at-sea fishery enforcement not only accounts for a large part of the federal fishery enforcement budget, but constitutes a significant share of overall federal spending on fishery management, including research, enforcement, and administration. See P. Wallis and O. Flaaten, "Fisheries Management Costs: Concepts and Studies," in *The Cost of Fisheries Management*, ed. W. E. Schrank, R. Arnason, and R. Hannesson (England: Ashgate Publishing Ltd., 2003), 211–223.

78. The EMIS data from 1 January 2001 through 31 May 2006 indicated that 28% of USCG-reported violations resulted in some type of penalty. Applying this successful prosecution rate to the 167 average annual significant violations reported by the USCG provides an estimate of 47 annual successfully prosecuted USCG violations.

79. This average financial penalty is based on the final penalty amount field in the EMIS database and does not include the economic value of any permit sanctions or forfeited catches or gear that may have resulted from USCG-reported violations.

80. Lenfest Ocean Program, "An Economic, Legal and Institutional Assessment of Enforcement and Compliance," supra note 49.

81. *Ibid.*