



**REVIEW OF SURVEILLANCE AND ENFORCEMENT OF FEDERAL FISHERIES IN THE SOUTHEASTERN
US**

**REPORT TO THE SOUTH ATLANTIC FISHERY MANAGEMENT COUNCIL
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EXECUTIVE SUMMARY

Over the past several decades, there has been a significant increase in the number of marine protected areas including those that are remote from shore and cover large areas of the US Exclusive Economic Zone (EEZ). The large size of the areas and the complex assortment of regulations within them pose many challenges to policy-makers and resource managers. One of the greatest challenges is monitoring activity in these areas and enforcing regulations so that the designated areas are truly protecting the resources and are not merely ‘paper parks’.

The overarching objective of this project entitled ‘Review of surveillance and enforcement of federal fisheries in the southeastern US’ was to increase the effectiveness of resource protection within the South Atlantic Fishery Management Council (SAFMC) boundaries through identification of potential improvement of monitoring and enforcement. The Marine Conservation Institute, in collaboration with the law enforcement and management agencies within the SAFMC region, has identified surveillance and enforcement challenges and suggests a series of recommendations for addressing some of these problems. Selected recommendations are listed briefly below and are described in more detail in the full report.

For enforcement purposes, boundaries of protected or restricted areas should be kept as simple as possible. Whenever practical, boundaries should form rectangles that follow along lines of latitude and longitude. Regulations for Marine Protected Areas (MPAs) and Fishery Management Plans (FMPs) should be kept as clear and logical as possible for ease of enforceability and public understanding.

There are many different surveillance technologies that can be used to monitor vessel activity in the SAFMC area. Some potentially cost effective and useful technologies are listed below.

- Vessel Monitoring Systems (VMS): Implementation of VMS for commercial reef fish and larger chartered fishing operations (‘headboats’) would enable state and federal law

enforcement (LE) to monitor activity without the need for additional patrol assets. VMS would be the best approach to enforcing the new deep water snapper-grouper MPAs. The new Enhanced Mobile Transmitting Units (E-MTU) VMS systems should be considered for the golden crab fishery since they allow ship-shore communication. This would allow the golden crab fishers to inform the VMS station if they have to enter the closed zone for maneuvering purposes. VMS does not address the problems of illegal recreational fishing or small charter boats.

- Automatic Identification Systems (AIS): A new USCG rule is expected in late 2011 that would extend the requirement for AIS to all vessels >65 ft, including fishing vessels and those with >12 paying passengers (which would include head boats). This rule would open the possibility of using AIS for fisheries enforcement. The USCG has the capability to scale their data processing to cope with these additional needs. There is also the possibility of using AIS to track recreational vessels. There are small, inexpensive AIS units available that could be required as part of the federal fisheries permits. AIS expansion provides coverage out to 50 nm, range. This would be the most cost effective surveillance method to track activity in the southern section of the Miami-Stetson deep coral HAPCs, the Oculina Banks HAPC, GRNMS and FKNMS.
- Aerostats: These are expensive systems to purchase and operate, but if under military control the costs will not burden underfunded resource protection agencies. The data obtained from instruments on the aerostat platform, and the deterrence value they provide, make these technologies a useful option for monitoring vessel activity. Elevated platforms such as aerostats or towers extend the range of land based technologies such as radar or AIS.
- Buoys: These are potential platforms for passive acoustic technologies, which can be used to monitor the type and quantity of vessel traffic in an area, and to identify some types of activities. Acoustic technologies could be a useful surveillance tool if the information were transmitted in real time and rapidly communicated to field officers in a usable format.

- Unmanned Aerial Systems: UASs have significant advantages over manned aircraft. If funded, the UAS program could be one of the most significant surveillance assets for marine resource protection as they provide information on all maritime activity.
- Satellite surveillance: The high cost of satellite imagery and the lack of real time data, make this an inappropriate technology for general enforcement surveillance. However, if there were a need for intelligence on a target location during a specific time period, then satellite imagery might be the best approach.
- Data Fusion: Whichever surveillance or monitoring technology is chosen, there has to be a reliable system that takes raw data and delivers information to officers in a usable format.

Effective collaboration between agencies relies heavily on personal working relationships between officers. Informal meetings, joint trainings, etc., should be facilitated to foster these collaborations. Officers need to be well trained in federal fisheries enforcement in order to make a case that can be prosecuted. Federal fisheries enforcement is complicated, and requires more training than the officers currently receive at their academy and during their initial field training. Refresher sessions on preparation of federal case packets and updates on regulations, together with combined agency vessel patrols and targeted 'details', are needed to reinforce initial training, strengthen collaborations and show the public a unified enforcement presence. Inter-agency training opportunities should be better publicized within and between agencies. Information sharing should be facilitated through a single website rather than fragmented pathways.

Public outreach created a great deal of discussion during the workshop, and the participants formulated several approaches on how to reach out to the public.

- Create a central internet location that provides information on all protected area boundaries and regulations and federal fishing regulations.
- Use cell phones to disseminate information on regulations.
- Create a simplified system to summarize complex fishing regulations

- Closed areas should be included in NOAA nautical charts and electronic charting software.
- Provide regulation information through conduits regularly used by fishers such as NOAA weather radio stations or buoys.
- Utilize SAFMC annual scoping meetings and public events at the national marine sanctuaries to increase public outreach.

There is a critical shortage of NOAA Office of General Counsel (OGC) attorneys available to pursue civil cases. One suggested solution is to change civil violations within the Magnuson Stevens Fishery Conservation and Management Act (hereafter MSA) and make some of the regulations criminal rather than civil. There are many more federal criminal prosecutors than civil, and this change may relieve the burden on understaffed civil prosecutors. Another solution would be to increase the number of federal civil prosecutors to accommodate the MSA cases.

Publicizing results of successful prosecutions serves to inform the public that violations will be punished and also has the element of shame to the offender. Results of LE 'details' (short term, high intensity efforts that focus on specific location or regulation), should be publicized soon after they occur to let the public know that enforcement is active and there are consequences to violating regulations.

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Section I: Introduction

Project background

Faced with widespread decline in ocean health, depletion of fisheries, and a growing interest in place-based ecosystem management, US governing agencies are establishing different types of spatial protection to conserve marine habitats and resources. Over the past several decades, there has been a significant increase in the number of marine protected areas including those that are remote from shore and cover large areas of the US Exclusive Economic Zone (EEZ). The large size of the areas and the complex assortment of regulations within them pose many challenges to policy-makers and resource managers. One of the greatest challenges is monitoring activity in these areas and enforcing violations of regulations so that the designated areas are truly protecting the resources and are not merely 'paper parks'. The need for adequate enforcement of has been demonstrated many times, but the use of conventional enforcement methods such as small vessel patrols in large or remote areas is logistically and economically prohibitive, and new management areas are frequently established without increasing or changing enforcement capacity. Large remote areas require the application of far-reaching surveillance technologies to optimize the use of limited and expensive enforcement assets.

The overarching objective of this 'Review of surveillance and enforcement of federal fisheries in the southeastern US' is to increase the effectiveness of resource protection within the SAFMC management boundaries through identification of potential improvement of monitoring and enforcement. The Marine Conservation Institute, in collaboration with the law enforcement and management agencies, has identified some of the surveillance and enforcement challenges in the region and suggests a series of recommendations for addressing some of these problems. This is especially timely since in 2009 the SAFMC established five new deep water coral Habitat Areas of Particular Concern (HAPCs) (covering 23,000 square miles) and a series of small offshore MPAs to preserve deep water snapper and grouper stocks.

Protected areas in the southeastern US

The South Atlantic Fishery Management Council (SAFMC) is responsible for management of federal fisheries in the southeast region, which covers the coast of North Carolina, South Carolina, Georgia and Florida from the shoreline to the seaward boundary of the US EEZ. Within this vast area is a complex combination of spatial management zones and species-based regulations. Up to three nautical miles from shore these regulations are enforced by state law enforcement (LE) personnel, and beyond three nautical miles, both state and federal agencies are responsible for enforcing federal laws. There is an exception to this rule off the west coast of Florida where state waters extend to 9 nm. This report will focus on enforcement needs and challenges for federal waters in the southeast region, recognizing that many of these will also apply to state LE agencies. Below is a brief summary of spatially managed areas within the region, which describes the resources, regulations and LE challenges for each. Fishery management plans for individual species are too lengthy to list here, but can be found on the South Atlantic Fishery Management Council website (www.SAFMC.net).

Monitor National Marine Sanctuary

The Monitor National Marine Sanctuary (MNMS) was designated in 1975 and is the smallest of the sanctuaries, being only 1 nautical mile in diameter. It is located 16 miles from shore and protects the wreck of the USS Monitor, which lies in 70 m of water. The USCG enforces sanctuary regulations during offshore patrols in the area, but the sanctuary relies primarily on compliance to protect the wreck from physical damage and artifact theft. There are no specific fishery-related regulations so federal fishing rules apply; however sanctuary regulations prohibit anchoring, stopping, and drifting within the sanctuary, which precludes certain types of fishing

Gray's Reef National Marine Sanctuary (GRNMS)

Gray's Reef was designated as a sanctuary in 1981, and is the only protected natural reef area off the Georgia coast. This 22 square mile sanctuary is in water depths of 55-70 ft, and is located exclusively in federal waters 16.4 miles off the GA coast. In 2009-10, under a joint

enforcement agreement (JEA), NOAA OLE funded the Georgia State Department of Natural Resources (GDNR) officers to patrol the GRNMS, which does not have its own LE capabilities. Obtaining sufficient funding for the JEA is challenging, and since the GDNR LE officers do not have federal credentials, this also poses some credibility issues in the public mind. The USCG conducts periodic surveillance flights, but GDNR officers create the most important LE presence.

Gray's Reef includes a large area of emergent hard bottom supporting a rich assemblage of subtropical and temperate fauna. Its distance offshore presents challenges for enforcement patrols, and the area is small, so violators can move outside the boundaries when they see LE approach. There are however, clear, easily enforceable restrictions on activities within sanctuary boundaries. The only fishing gears allowed are handline or rod and reel, no bottom impact is permitted and vessel discharges are limited to sanitized water and fishing bait. The GRNMS priority enforcement issues are fishing and fishing gear violations, traffic routing or anchoring incidents, entanglement or marine debris, marine mammal injury or harm and permits. The most common violations occur with recreational vessel traffic, and occasional problems occur with commercial fishing, large commercial vessel traffic, anchoring, fishing gear violations, and mammal ship strikes and entanglements. In December 2011, the GRNMS established a 'research only' area in the southern third of the sanctuary, with no public diving or fishing allowed. Vessels can transit through the area but cannot stop (http://graysreef.noaa.gov/management/research/research_area.html). Additional outreach and enforcement effort will be required until the public is familiar with the new regulations.

Florida Keys National Marine Sanctuary (FKNMS)

Designated in 1990, the FKNMS covers 3,842 square miles of one of the most popular recreational areas in the US. Commercial and recreational fishing, scuba diving, boat and shipping and vessel activities within the sanctuary are all regulated through a complex series of spatial restrictions and fisheries management plans (FMP) with seasonal closures, size limits, bag limits and permitting requirements. FMPs are not established by the

sanctuaries, but are determined through discussion and collaboration with the SAFMC. In addition, the sanctuary has designated areas of restricted human use, with the objective of protecting ecosystem function and biodiversity. There are five types of marine zones that have various restrictions on human uses: ecological reserves (ERs), Special Preservation Areas (SPAs), Wildlife Management Areas (WMAs), Existing Management Areas (EMAs) and Special Use (research only) Areas (SUAs).

Much of the FKNMS overlaps with Florida State waters, which are governed by Florida Fish and Wildlife Conservation Commission (FWC) and Florida Department of Environmental Protection (FDEP) regulations. The remainder is outside Florida State jurisdiction where federal regulations apply. The FKNMS has overlapping jurisdiction with the US Fish and Wildlife Service (FWS) in certain matters, and part of the sanctuary is adjacent to areas managed by the National Park Service (NPS). The Florida Keys is the only sanctuary that currently has its own enforcement vessels (funded by NOAA's Office of National Marine Sanctuaries) including three small vessels (30 ft) and the *P/V Peter Gladding* (53 ft), which patrols the Tortugas Ecological Reserve. There are 6 dedicated FWC enforcement officers, a full time FWC Lieutenant, a part-time FWC Captain and two NOAA Office of Law Enforcement (OLE) special agents that operate in the FKNMS using the *Peter Gladding* and other smaller patrol boats. The USCG conducts air and sea patrols using their own vessels. The highest priority enforcement areas are the various marine zones, which are marked on navigational charts but some are also identified as sea using different types of buoys to inform the public that special regulations apply. Numerous small vessel groundings and several large (>50m) vessel groundings contributed to the justification for designating the Florida Keys as a National Marine Sanctuary. After the sanctuary was established the number dropped considerably. In 1997 the *Houston* ran aground in the FKNMS, and as part of the mitigation costs the ship's owners purchased and installed 8 radar beacons (RACON) buoys that were deployed at intervals to provide complete coverage of the keys reef tract. These buoys respond to vessel radar signal, notifying the vessel that they are close to an 'area to be avoided'. These beacons are still in operation today and are maintained by the USCG. There have not been any large vessel incidents since their

installation, although smaller vessels still run aground in the shallows and damage the reef. The most significant enforcement activities center on recreational vessel traffic, commercial fishing, search and rescue missions, groundings, anchoring, zoning violations, refugee/immigrant interdiction, and smuggling/drug traffic. Significant, but less frequent issues include large commercial vessel traffic, military traffic, and illegal salvage operations. The challenges of enforcing this large, multi-jurisdictional and heavily used area are compounded by complex zoning and fishing regulations within the FKNMS.

Oculina Habitat Area of Particular Concern (OHAPC)

The original OHAPC (122 square miles) was established in 1984 to protect unique coral habitat created by the branching coral *Oculina varicosa*. This area was originally closed to fishing methods that impacted the seafloor (bottom trawling, bottom longlines, dredges pots and traps) to protect the fragile corals. In 1994 anchoring and grappling was prohibited, and in 1995 the area was closed to bottom fishing to protect declining snapper and grouper populations, and grouper spawning aggregations. The OHAPC was expanded (from 122 to 397 square miles) in 2001 to include all known areas of *Oculina* habitat, but restrictions on snapper and grouper fishing remained only in the original area, which was re-named the Experimental Closed Area (ECA). In 2003, the SAFMC mandated that all vessels participating in the rock shrimp fishery must carry vessel monitoring systems (VMS) to prevent illegal trawling within the OHAPC; however reef fish populations continued to decline and the spawning aggregations have almost disappeared (Grant Gilmore pers. obs. 2008) due to poaching in the ECA. In 2004 the National Marine Fisheries Service (NMFS) funded the purchase and operation of a 65 ft cutter (the *CT Randall*) with the primary objective of patrolling the Oculina Banks. For various reasons, the *CT Randall* has not achieved as many patrol hours as originally envisioned, but is a fast vessel that can respond to surveillance intelligence from VMS or other sources. The enforcement challenges for this area are its size and distance offshore. Trawling activity in the rock shrimp fishery can be tracked remotely via VMS, and vessels tracks indicated that illegal incursions by rock shrimp vessels are minimal; however illegal bottom fishing for reef fish can only be monitored through patrols. A complication for enforcement is that

trolling for pelagic species is allowed throughout the OHAPC, and from a distance it is difficult to distinguish between trolling and dragging a weighted line along the bottom. Enforcing violations in the ECA (excluding rock shrimp vessels) requires expensive and time consuming vessel patrols, so surveillance is infrequent.

Deep Coral HAPC

In 2010, the SAFMC implemented five areas of deepwater Coral Habitat Areas of Particular Concern (C-HAPCs), totaling > 23,000 square miles of pristine deep coral reefs from North Carolina to south Florida. The two northernmost areas off Cape Lookout and Cape Fear enclose small but diverse deep coral areas. Another small area, the Blake Ridge Diapir off South Carolina, was also included under this amendment and protects unique chemosynthetic cold seep communities rather than deep corals. The largest of the five areas is the Stetson – Miami Terrace C-HAPC, which runs from South Carolina to the Miami Terrace. The southernmost area, the Pourtales Terrace C-HAPC, encompasses an area of hard bottom that runs parallel to the Florida Keys. Regulations in all C-HAPCs prohibit the use of bottom damaging fishing gear such as bottom trawls, bottom longlines and traps. However, the largest protected area (Stetson-Miami) includes allowable fishing zones for the golden crab and deepwater shrimp fisheries within their historical fishing grounds. Enforcement challenges for these areas include distance from shore (with the exception of parts of southern Florida) and the size of the managed area, and also enforcing the golden crab fishing zones. The fishery involves deploying a series of weighted traps on a single line that can extend out several hundreds of feet. In order to deploy and recover the traps in the high current conditions that commonly occur in these areas, the fishing vessel may need to maneuver into the closed area, even though the traps are in the allowable fishing zone. For this reason, VMS is not an appropriate surveillance technology, and it is almost impossible to know exactly where the traps are located on the seafloor. The SAFMC is working with the golden crab fishermen to address this problem. Another potential LE challenge is the complex shape and large number of waypoints that comprise the western boundary of the largest C-HAPC. This could create problems during prosecution in establishing that a vessel was within the protected area boundary. Both the

allowable fishing zones and the boundary coordinates could potentially be adjusted by the SAFMC if necessary.

Deepwater Marine Protected Areas

In 2009, the SAFMC implemented a series of eight deepwater marine protected areas (MPAs) in the South Atlantic region. The MPAs are designed to protect long-lived, deepwater snapper and grouper species from fishing pressure. Adults of most snapper and grouper species are demersal associates of hard-bottom habitat of moderate to high relief. These MPAs are supposed to represent areas of hard-bottom habitat that are important to the target snapper and grouper species. These closures are permanent and fishing for and/or possession of snapper grouper species is prohibited in the MPAs, but trolling is still allowed for pelagic species such as tuna, wahoo, and billfish. Vessels can transit the areas with snapper grouper species onboard as long as fishing gear is stowed. Additionally, the use of shark bottom longline gear is prohibited within the MPAs. The enforcement challenges of these areas are their distance from shore (all in Federal waters) and their small size, making it easy to move outside the area if LE patrol vessels are detected visually or by radar. The SAFMC Law enforcement advisory panel (LEAP) members rated the enforceability of these new MPAs as generally low (with two exceptions in Florida that are close to shore), and observed that patrols would probably only occur during organized enforcement details in conjunction with federal partners. As with the Oculina ECA, only bottom fishing is restricted within the MPAs, with trolling for pelagic species still permitted.

Surveillance and enforcement assets

NOAA's Office of Law Enforcement is the primary federal fisheries enforcement authority, with a geographical jurisdiction of over 3 million square miles of ocean and 85,000 miles of US coastline, plus the National Marine Sanctuaries and Marine National Monuments. The Agency is also responsible for enforcing US treaties and international law governing the high seas and international trade. NOAA OLE has only 146 special agents and 17 enforcement officers to fulfill this responsibility. For this reason it relies heavily on

cooperative partnerships with other federal (especially USCG) and state law enforcement agencies.

The USCG provides enforcement support for federal waters of the SAFMC management region and the three NMS; however the USCG has multiple demands and responsibilities, some of which take priority over fisheries enforcement. District 5 covers North Carolina and has two Island Class (33 m) cutters and numerous smaller vessels. District 7 jurisdiction includes South Carolina, Georgia and Florida to the western extent of the Florida Keys. District 7 has two high endurance cutters (>400ft), with each sector allocated a specific number of days per year, and 12 medium endurance cutters (210-270 ft) that can spend up to a week patrolling out to the US EEZ. Each station also has several smaller boats that have a more limited range (25-50 miles).

Below is a table of state assets that are potentially available to assist in the enforcement of federal regulations in the southeastern US through these agreements.

Asset	Florida	Georgia	South Carolina	North Carolina
Officers	220 ¹	24	5 ¹	48
Patrol boat (<29 ft)	201	28	Several vessels, unspecified size	Unspecified ³
Patrol boat (30-49 ft)	4	2		
Patrol boat (>50 ft)	1	0		
Fixed wing a/c	381 hrs marine fisheries ²	0	Several patrols/month	>1 patrol/week
Helicopter	207 hrs marine fisheries ²	> 1 patrol/week		
VMS	NOAA OLE - USCG and State have data access	NOAA OLE - USCG and State have data access	NOAA OLE - USCG and State have data access	NOAA OLE - USCG and State have data access
Radar	Yes	Yes	Yes	Yes
Forward-looking infra-red (FLIR)	Yes	Hand-held	Vessel and aircraft	
Night vision	Yes	Yes	Yes, hand-held	Yes
VHF radio	Yes	Yes	Yes	Yes

¹ Statistics apply to east coast counties only: Northeast (St John-Indian River) and South (St Lucie-Miami-Dade).

² Report did not specify time period, so assume 1 year (2010-2011).

³ NC reported > 100 assets but did not differentiate between types

Collaborations between agencies

NOAA OLE has formal Joint Enforcement Agreements (JEA) with South Carolina, Georgia and Florida. These agreements provide state law enforcement personnel and assets to patrol federal waters and issue warnings and citations on federal violations. State LE can issue a warning, a "fix it" notice (gives the individual a deadline to fix the problem), or a summary settlement (fine) but cannot process federal cases (except in certain cases that can be handled under state or federal laws). For more serious violations, they compile the paperwork (case packets) and forward to NOAA OLE special agents. The NOAA agent then decides whether to drop the case, or refer to OGC for issuance of a Notice of Violation and Assessment of a penalty (NOVA) Notice of Permit Sanction (NOPS), Notice of Intent to Deny Permit (NIDP), or any combination thereof. North Carolina does not have a JEA agreement but coordinates with NOAA agents when federal violations are observed. These agreements between state and federal agencies are an important component of federal fisheries enforcement as there are so few NOAA agents for each region. In 2009-10, Florida conducted over 23,200 hours of federal fisheries enforcement (which exceeded their contracted obligations), including dockside inspection, outreach and education, at sea patrols and administration. There were no contracted funds for aviation patrols; however FWC aircraft conducted 83 hours of aerial survey over federal waters. This effort resulted in a total of 75 documented cases for the east coast. Most of these were processed as state cases, with 6 being passed to federal special agents. In addition to personnel hours, NOAA provided funding for two patrol vessels. The agreement with South Carolina Department of Natural Resources conducted 2,050 hours of targeted federal marine law enforcement and related activities. These hours included offshore and near-shore patrols, dockside inspections, aerial surveillance, community oriented policing projects (COPP) and administration, resulting in 90 state/federal citations and 118 warnings. The JEA with Georgia Department of Natural Resources provided 2051 hours of patrol time and 943 hours of dockside inspection. Of these 129 hours were patrolling GRNMS. This total effort off Georgia resulted in 314 vessel inspections, with 56 violations.

The USCG is also responsible for enforcing federal fisheries regulations, and there are memoranda of understanding (MOU) between USCG and state LE agencies that allow them to work together on air and sea patrol, and for state LE to attend USCG training sessions. The effectiveness of these collaborations depends heavily on interpersonal relationships, rather than being defined by the formal MOU. The USCG has a high turnover in personnel due to their fixed two-year billet assignments. Collaborative relationships between USCG individuals and those from other agencies therefore change relatively frequently. USCG also has 11 statutory mission objectives, and in certain situations other missions may take priority over natural resource protection. Maintaining close collaboration with natural resource enforcement officers may help keep resource protection 'on the radar' for the USCG.

Prosecution process

As mentioned above, state LE officers and NOAA OLE agents in the field may issue fix-it notices, written warnings, and summary settlements, and larger cases are transferred to the OGC Enforcement Section for review and action. Additionally, unpaid summary settlement tickets may be referred to the NOAA OLE for a determination of further action. Case files generated by USCG are routed through the USCG Fisheries Training Center and then to NOAA OLE. The Enforcement Section's action may include declination of prosecution, issuance of a written warning, civil administrative penalty, or permit sanction, or commencing forfeiture proceedings against seized property. Issuance of monetary penalties and permit sanctions are guided by the Penalty Schedules and Policy found on the Office of General Counsel website at <http://www.gc.noaa.gov/enforce-office3.html>. The procedural regulations at 15 C.F.R. Part 904 detail administrative action and the rights of respondents, which include the right to appeal any action taken against them. Hearings before administrative law judges may be requested for cases in which monetary penalties or permit sanctions are issued by the Enforcement Section. Penalties that become final in accord with the procedural regulations and remain unpaid may be subject to collection action, including sanctioning of federal fishery permits and referral to the Department of

Treasury. Because there are few violations under the MSA that are subject to criminal penalties, most cases are subject to the civil administrative actions discussed above. Nationwide, the Enforcement Section has 11 staff attorneys to administratively prosecute federal fishery cases. Three of those attorneys are in the southeast office. With limited staff, priorities need to be established as to which cases to prosecute, which results in valid cases being dropped.

Surveillance and enforcement technologies

This section provides brief summaries of available and emerging surveillance technologies that are being used for natural resource enforcement. A more extensive treatment of these technologies can be found in a publication produced by the Marine Conservation Institute in 2009¹. Appendix I is a summary table of the different technologies with estimates of associated purchase and operating costs. The table represents a sampling of current and prospective tools to be used for surveillance and enforcement of maritime environments, and is not meant to be a comprehensive list of all technologies that could be used for surveillance and enforcement efforts. It is likely that the information on unmanned technologies will need updating frequently as this field is developing very rapidly.

Public education and Outreach

The SAFMC posts electronic copies of regulations by species on their website home page, as well as information on the deepwater MPAs and the OHAPC. They also produce color brochures on regulations, including one specifically on MPAs. The deep coral HAPC information is not as readily accessible, but for the most part fishers can find information quite easily. The ONMS places a lot of emphasis on outreach and generally does a good job of reaching out to the public through their websites and events throughout the year. Sanctuary regulations can be found on each sanctuary's website, but neither website has a link to the SAFMC site where the federal fishing regulations can be found. The GRNMS and MNMS websites have a printable summary of their regulations that are easy to find. The

¹ Brooke et al (2010) Surveillance and Enforcement of Remote Maritime Areas (SERMA): Surveillance technical Options. Available online at http://www.mcbi.org/publications/pub_pdfs/SERMA.pdf

FKNMS regulations are not on their home page, but can be found quite easily under the 'management' link. This information however is not in a user-friendly format but as extensive links with bulleted lists of information. There was nowhere on the FKNMS website that provided printable PDF files with maps of the different management zones with boundaries and regulations. It would be difficult for a visitor to the sanctuary to obtain a comprehensive user-friendly on-line version of the regulations. Considering that the FKNMS has more visitors annually than any other sanctuary, this is a significant gap in public outreach that could be changed relatively easily.

State LE outreach programs provide brochures on fishing regulations to local bait shops and other locations that are used by the fishing community. State LE officers attend local and state fairs, boat shows, school career days, fishing tournaments and other public events. They also hand materials out to the public on boating safety, manatee zones, fishing regulations etc. during their patrols. The FWC posts a weekly activity log on their website (<http://myfwc.com/about/inside-fwc/le/weekly-reports/>) to inform the public on cases made and their disposition. Most states also host a tip line with a reward for information on resource violations.

The USCG sponsor Public Safety Outreach days each year, where local law enforcement and public safety departments host information booths at the USCG station. These events allow the public to interact with LE from different agencies, and learn about fishing regulations, protected areas and other state and federal regulations. The USCG officers also provide information to boaters during their patrol periods. As with state LE officers, the USCG and NOAA OLE attend public events to provide information and educate the public about federal regulations and LE activities.

Section II: Workshop report

Overview

The project workshop was held in Orlando on 21st July 2011, and included 27 participants from federal and state law enforcement agencies, NOAA General Counsel, National Marine Sanctuary staff, SAFMC staff and other interested parties. The morning session consisted of short presentations to provide some background information for the subsequent discussions. These presentations addressed:

- Management and outreach in the southeast region (A. Martin, M. Brouwer and K. Iverson)
- Surveillance and enforcement in the Gray's Reef National Marine Sanctuary (G. Sedberry)
- Surveillance and enforcement in the Florida Keys National Marine Sanctuary (B. Causey)
- Use of Vessel Monitoring Systems for fisheries surveillance (P. O'Shaunessy)
- Overview of surveillance and enforcement technologies (S. Brooke).

After the presentations, participants were asked to list three critical needs and/or challenges to effective resource protection in their jurisdictions. This task was presented with the understanding that limited resources (officers, patrol vessels and other surveillance assets) is the primary obstacle to effective law enforcement, but participants were asked to consider additional challenges. These were discussed in plenary until the lunch break.

After lunch participants were divided between three breakout groups:

- Surveillance and enforcement operations: this group reviewed enforcement challenges, status and shortfalls in technologies, assets and response capabilities, critical needs.
- Interagency collaboration: this group was asked to assess the effectiveness of current collaboration (including officer training) between the various federal and state agencies tasked with federal fisheries enforcement.

- Compliance and outreach: this group discussed the current status of compliance, public perception of the federal fisheries regulations, interactions between officers the public and public education efforts.

In all of these groups, participants were tasked with not only identifying challenges, but also suggesting actions or efforts that could alleviate problems or close any gaps. Each group gave a summary presentation and their outcomes were then discussed in plenary. The workshop ended at 5:30 pm with a summary of conclusions.

Outcomes

The issues raised during the plenary discussion, for the most part fell under the three broad categories for the breakout groups. The following sections summarize discussions from both the plenary and the breakout sessions. The final section addresses those issues raised by the participants that do not fall easily within the breakout categories.

Surveillance and enforcement operations

Resources

Lack of funding and resources is a fundamental challenge to effective resource protection. More surveillance and response assets and additional law enforcement officers are needed to increase 1) patrol time, 2) ability to respond to suspicious activity with well-trained personnel, and 3) dockside inspections. With current funding levels, there are not enough trained officers to respond to all potential violations. More funding could improve the JEA program by increasing training programs and support for state LE officer hours. At the moment, NOAA OLE has too few field agents to effectively cover their areas of responsibility and maintain sufficient coordination with, and training of, state LE officers. Shortage of funding can also cause LE focus to follow the available funding, rather than resource protection priorities. For example, when funding became available to pursue boating safety violations, officers began to focus on those cases. Although boating safety is important, directed funding and the lack of unrestricted funds to support general LE can distort priorities and create gaps in resource protection. Lack of funding at the state level

results in open positions not being filled, creating obvious gaps in coverage. A more subtle consequence of low funding is high turnover in trained law enforcement personnel who leave for higher salaries in local police departments. This creates a critical shortage of experienced officers, and increases the need for frequent training to keep up with officer turnover. In the absence of sufficient LE assets and officers, agencies rely more heavily on compliance to protect resources. Metrics to assess compliance are either non-existent or inconsistent across agencies, which is a gap that should be addressed regardless of the funding environment.

Surveillance options discussed at workshop

Expanded use of surveillance technologies was considered important, particularly in a worsening budget environment where technologies can be used to focus the efforts of limited enforcement assets. Agencies need to coordinate their surveillance data to optimize field response by LE officers; data sharing between agencies would increase the efficiency of expensive surveillance technologies. A combined effort by MPA management and enforcement agencies was recommended to identify appropriate cost effective technologies for each area. Some technologies, such as passive acoustic monitoring or optical systems could be used for both surveillance of human activities for enforcement and biological observations for research and monitoring programs. Below are a series of surveillance technologies that were discussed at the workshop, noting that this is by no means a full list of currently available surveillance systems.

Vessel Monitoring System (VMS)

Vessel Monitoring Systems (VMS) technologies are the mostly widely used of the cooperative technologies described in Section I of this report. Although these systems are not foolproof, they are proven detection and deterrent tools for illegal fishing. In addition to providing a footprint of vessel activity, the newer VMS units have enhanced capabilities that allow better communication between the vessel owner, operator and law enforcement personnel. Regulations require that all new VMS units installed for fisheries monitoring in

the USA are Enhanced Mobile Transmitting Units (E-MTU), which will gradually replace the original VMS systems.

These enhanced units have the ability to:

- Send and receive email, which improves communication capability between vessel owners, vessel operators and NOAA OLE. This also allows NOAA to transmit information to vessels on closed areas, fishery closures etc.
- Transmit trip route, docking time and location and catch details to appropriate LE personnel (Federal and/or State) via email from the vessel while at sea. This allows LE to conduct dock inspections more efficiently as they have advanced notice of vessel arrival.
- These systems allow the owners to track their vessels and monitor the behavior of their operators. If owners see their vessels operating in closed areas, they can instruct the captains to leave before LE is involved.

All JEA partners can access VMS data by establishing a vTrack account through the NOAA OLE website; this accessibility is available to all state LE and USCG Operations Centers, Field Offices and Cutters. Since many state officers now have laptops in their patrol vehicles, vTrack accounts would provide hourly updates on the activities of every vessel with VMS capability, without the need for on-scene patrols. These monitoring data can be used by LE to alert the vessel of its illegal position, deploy patrol assets or conduct a dockside inspection. The VMS systems are also effective deterrents to illegal fishing activities as the operators know they can be observed by law enforcement agencies and the vessel owner, if applicable.

The cost of VMS transmitters ranges from \$3100 to \$3800, with monthly fees of \$30-\$55 for an hourly ping rate. The required ping rate is mandated by the management agency; higher ping rates increase surveillance data, but incur higher costs to the vessel operator. An increasing number of US fisheries are requiring the use of VMS systems, which places the responsibility of purchasing and operating the unit on the vessel owner. In 2006, NOAA

made federal funds available to the fishing community to offset the cost of mandatory VMS requirements for federal fisheries. As of 2011 there was approximately \$6 million remaining in the fund. Allowable reimbursement is up to \$3100 per unit, which would cover most or all of the cost of an E-MTU. This was a single appropriation with no renewal planned, so in cases where VMS would be an appropriate tool for fisheries surveillance, management agencies would best serve their fishing community by implementing their use while these funds are still available.

The VMS management team is part of the NOAA Fisheries Southeast Division, based in St Petersburg, FL. This small group of 5 technicians, under the supervision of a program manager (Pat O'Shaunessy) is responsible for receiving, processing and transmitting VMS data from the US Gulf of Mexico (GOM), east coast EEZ, and a closed fishing area off the northeast coast in international waters. There are three fisheries that require VMS within the SAFMC area; the Highly Pelagic Species (HPS) longline, shark longline and rock shrimp. The GOM reef fish fishery also requires VMS. There currently 1,172 vessels operating within these fisheries, with the vast majority (944) belonging to the GOM commercial and charter boat reef fish fishery. This technology has proven an extremely valuable tool for monitoring a fishery comprised of a large number of relatively small vessels, and has been instrumental in successfully prosecuting several cases.

Automatic Identification Systems (AIS)

This VHF radio technology is monitored by the USCG and is required on commercial vessels 65 ft and greater, with the exception of fishing vessels and passenger vessels. The receiving range for an AIS signal is limited to 'line of sight' (approximately 20 miles from the transceiver). In December 2008, the USCG proposed a new rule that has two amendments relevant to fisheries enforcement. The new rule would require AIS carriage on all vessels of 65 ft or more engaged in commercial service and vessels carrying 12 or more passengers. The proposed regulations would encompass many commercial fishing vessels and larger chartered fishing operations ('headboats'). The rule would also expand AIS coverage out to 50 nautical miles (57.5 miles), so it will provide vessel coverage over a

larger geographic area. The proposed AIS rule has now been submitted to the office of management and budget (OMB)/ office of information and regulatory affairs (OIRA) for review. In the latest Unified Regulatory Agenda, the Coast Guard lists the final rule as coming out in December 2011 (the 2011 Fall Regulatory Agenda will have an updated enactment date). The USCG has sufficient capacity to process the additional data and all AIS information can be accessed by state law enforcement through the USCG Navigation Center, Nationwide AIS (NAIS) website (<http://www.navcen.uscg.gov>).

Systems such as VMS and AIS are examples of cooperative technologies, which mean that they can only monitor those vessels that have agreed to carry these technologies on board (usually as a requirement for fishing or vessel operation rather than voluntary use). A greater challenge is monitoring those vessels that are not being tracked. These include all vessels, commercial, charter or recreational, which are less than 65 ft in length and are not active in a fishery that requires VMS. These categories account for most of the vessels operating in the southeastern US. The greatest challenge for LE in this region is monitoring activity of the large number of small recreational vessels, and apart from traditional manned patrols, current surveillance for this class of vessel is very limited. Since most MPAs allow some fishing activities, the presence of a vessel does not indicate a violation. Remote surveillance in these cases can provide information on intensity of vessel traffic, and some indication of what they may be doing (e.g. transiting vs bottom fishing). This enables patrol vessels to focus their attention on suspicious activity. Below are three types of surveillance approaches for 'non-cooperative' vessels that are either currently being used in the region or have been used in the past.

Tethered Aerostat Radar System (TARS)

The TARS is a radar system deployed on an aerostat (more commonly known as a 'blimp') which provides surveillance capability up to 230 miles to monitor low-flying aircraft and boat traffic, primarily in support of the Department of Defense Counterdrug Program. The first TARS was deployed off Cudjoe Key in Florida and was nicknamed 'Fat Albert'; it remained in commission until 2010 when it was damaged and had to be removed. The US

Air Force was planning on repairing the system, but the status is currently unknown. This unit, which flew at 10,000 ft and was highly visible across the keys, was not targeting fishing vessels but probably served as a deterrent to those who were not aware that the radar was deployed primarily for drug and immigrant interdiction.

Unmanned Aerial Systems (UAS)

Both land- and cutter-based UAS are still in the pre-acquisition phase for the USCG, with mission needs and operations in development. In 2008, U.S. Customs and Border Protection (CBP) and the USCG established a Joint Program Office to coordinate maritime land-based UAS policy and operations. In 2009, Customs and Border Patrol (CBP) acquired their first of two Predator UASs, called Guardians. CBP and USCG flight crews conduct joint maritime Guardian operations from Cape Canaveral, FL. This Guardian has multiple missions, with fisheries surveillance not necessarily the highest priority in an area that has significant problems with illegal immigration and drug trafficking. At the moment, access to data from these flyovers is limited to USCG personnel, but will hopefully be shared with other LE agencies in the future.

NOAA also partners with NASA on use of one high altitude long endurance and one medium altitude long endurance systems. NOAA also owns one low altitude long endurance and three low altitude short endurance systems and is in the process of procuring two additional low altitude short endurance systems (uas.noaa.gov). Unlike the CBP/USCG vehicles, these seem to be focused on environmental monitoring rather than maritime domain awareness.

Camera systems

Cameras have been used to monitor traffic in the Crystal River Manatee zone. If these are real-time or can provide data that can be used to prosecute a ticket, then they are useful for LE. If they are neither of the above, then their application is limited to gathering information on general vessel activity. Unlike road traffic citations where tickets can be issued using data collected from remote cameras, vessels cannot be prosecuted this way.

There are many potential existing and emerging surveillance technologies available; some are extremely expensive and are beyond the financial reach of most management and LE agencies. Even technologies that may be affordable pose potential problems when it comes to prosecuting violations if the data they produce are not accepted by judges and prosecutors. Ideally training on these systems would extend beyond the officers in the field to prosecutors and judges, so that everyone understands the functions and limitations of the technologies.

Prosecution

Most of the cases made in the SAFMC region are violations of regulations created under MSA and the National Marine Sanctuaries Act (NMSA). The majority of the provisions in MSA and the NMSA are civil and therefore are prosecuted by civil attorneys. There is a critical shortage of General Counsel attorneys to prosecute federal fisheries cases. The SAFMC region has three (which is more than any other region), but this is too few to cope with the large quantity of cases generated in this (very active) region. The lack of criminal provisions prevents violations being prosecuted by the far more numerous federal criminal attorneys. Because of the limitations in the number of cases that can be pursued, OGC's Enforcement Section must prioritize which cases it prosecutes and there is a concern that public confidence (and compliance) and officer initiative may be compromised. To address the understaffing issued, one step being taken by the Office of General Counsel is reviewing how to expand the summary settlement schedule without causing further complications in its workload. An expanded summary settlement schedule could allow for a larger volume of smaller violations to be addressed and authorizing state LE (and other agencies where appropriate) to grant federal summary settlements would reduce the burden on the under-capacity NOAA OLE. The penalty schedules for NMSA and MSA are currently under review by the Office of General Counsel for streamlining or restructuring. Alleviating some of the overload on the prosecution process was considered critical to effective enforcement.

Interagency collaboration and training

Inter-agency collaboration was another area identified during the workshop as needing improvement. In general, more coordination is needed among agencies to optimize enforcement personnel and assets. The Joint Enforcement Agreements (JEAs) between NOAA OLE and the state enforcement agencies are probably the most important mechanisms for interagency collaboration. These agreements allow state LE to enforce federal fisheries violations to make up the shortfall in the number of NOAA OLE patrol officers. A JEA currently exists with Florida, Georgia and South Carolina, but North Carolina has yet to resolve constitutional obstacles before it can formally create a JEA. Officers from North Carolina Department of Environment and Natural Resources do however work closely with federal fisheries enforcement agents. There are also JEA agreements between the FKNMS and FWC, and between the GRNMS and GDNR.

State LE officers receive training in federal fisheries enforcement during their training academy, and again shortly afterwards during field training. During both of these periods, the officers are new and are being exposed to a vast quantity of different materials. Federal case packages are perceived to be very time consuming and complicated, and there is limited training after these initial sessions. NOAA OLE is severely understaffed (although a pending budget review may authorize additional field officers). Unless there is follow-up training and continued interaction between NOAA and state LE, the JEA will not work as effectively as it could. Each state has JEA officers that can facilitate training, but training needs to be readily available, conducted regularly within each region, and should cover the basics of case package review and federal fisheries regulations, as well as supplemental training. The FWC created a coordinator for their large (offshore) vessel program to organize training in federal fisheries enforcement. This has created opportunities that have benefited the JEA program, but there is still a lack of basic training in federal enforcement. To increase support for this process, NOAA OLE should continue to explain why these data are needed to prosecute cases and continue to review the case packets for potential streamlining, with input from the Enforcement Section. The perceived lack of feedback on case disposition is another aspect of the federal enforcement process that should be

addressed. There are several different categories of JEA activities including offshore patrols, dock inspections, and details with other agencies, but the original intent was for state LE to primarily supplement patrol duties. Creating squads within state LE that primarily focus on federal enforcement would increase efficiency and improve officer expertise, but there are not enough state officers and patrol vessels for this model, so all marine officers are tasked with enforcement of both state and federal regulations.

Although there are official agreements on collaborations between agencies responsible for federal fisheries enforcement (state LE, USCG and NOAA OLE), interpersonal relationships are equally important to effective cooperation. The NOAA officers responsible for JEA liaison in Georgia work closely with the GDNR officers and have a good working relationship with them. Other regions are less collaborative. There are currently no conduits for creating personal relationships. High officer turnover within some state agencies and 2-year rotations of personnel within the USCG, means that working relationships can change relatively quickly. The workshop participants suggested that joint training sessions or informal multi-agency meetings would be more useful in fostering collaborative relationships than formal agreements. USCG annual training sessions are open to state LE, but there is no information conduit to inform state LE on training dates etc. It was suggested that the JEA liaisons for each state be added to the USCG training notification list so that state officers were aware of the training opportunity.

As funding becomes more limited, the importance of collaborative efforts involving multiple agencies increases. Targeted 'details' using combined assets which focus on a single location or regulation, often make several LE cases in a short period of time. This sends a strong message to the public that law enforcement is working effectively, especially if these cases are subsequently publicized.

With the turnover in USCG staff, training sessions for officers new to the region are held frequently (at least annually). As more regulations are implemented there is less time to thoroughly address each one, so the officer comfort level with the regulations is less than it

could be. NOAA OLE training for state LE is sporadic and inconsistent. Ideally training would include NOAA officers periodically patrolling with state LE, supplemented with classroom sessions on federal case packages, regulation updates, etc. Unfortunately there are too few NOAA OLE officers to accomplish this task in addition to their other duties.

There was also a recognized need for long term collaboration between MPA managers (SAFMC, ONMS) and law enforcement partners. As part of their meeting schedule, the GRNMS has an annual working group meeting that is an appropriate forum for officers from different agencies to meet and discuss enforcement challenges. GDNR officers are critical to enforcing GRNMS regulations, as are FWC for the FKNMS, and there should be close collaboration between the federal and state agencies, and sharing of surveillance and enforcement assets.

Compliance and outreach

Although there were a wide range of concerns presented by the participants, overall the greatest number of comments fell broadly under information dissemination. There was a recognized need for an effective and efficient way of providing information to the general public and to law enforcement officers. Information is currently available through a number of different conduits such as websites for the SAMFC, MNMS, GRNMS and FKNMS, as well as state LE; however; these sites vary greatly in their ease of use and access to relevant information. Brochures of state regulations are sometimes made available at bait shops or dock services but when regulations change, these are not always updated. Out of date brochures can cause fishers to make honest errors, but can also be used as an excuse to violate the law. NOAA distributes fisheries bulletins via a list-server, which provides notice of new regulations. These are posted late Friday afternoon, which means the fishing community may be aware of new regulations before LE is notified.

Although not everyone uses the internet, it is by far the most common source of information for the public. Posting regulations in clear, user-friendly and printable format on a single website, with links to related sites, would alleviate a lot of confusion. The most

common questions to the SAMFC pertain to fishing regulations. The average user does not want to search different websites to find the information they need. For example, the FKNMS and GRNMS websites do not have information on federal fisheries regulations, or links between the SAFMC website and those of the sanctuaries. These would be simple additions to make and would facilitate ready access to information. If official websites do not provide user-friendly comprehensive information, the public may rely on other sources such as blogs and unofficial sites, which can disseminate incorrect information.

Workshop participants proposed that a readily accessible internet location be identified to provide centralized information on protected area boundaries and fishing regulations. Such a web-based database (either national or regional) should be user-friendly and sufficiently flexible to keep pace with changing regulations. The most appropriate venue for this location would be the SAFMC website, and they would be responsible for maintaining the site and keeping information updated. Some information would be 'static', such as MPA boundaries, but fishing regulations are more dynamic and need to be updated regularly. In addition, the rapidly increasing use of social media should be exploited to inform the public. The Gulf of Mexico Fisheries Management Council provides an application with protected area boundaries and fishing regulations that can be downloaded to a cell phone. The SAFMC region has been investigating a similar application for the southeastern US region but has not yet implemented such an approach.

In addition to more public education on existing regulations, the implementation of new regulations needs to be followed by public outreach efforts to explain the management and conservation reasons behind them. In particular, MPA boundaries should be easy to chart (with a minimum number of coordinates), regulations should be straightforward, and the purpose of the MPA clear and easily justified. These principles would avoid public confusion and generate support, which in turn would lead to higher compliance and voluntary reports of violations to law enforcement.

Increasing public compliance is an ongoing challenge. Good education and outreach will increase compliance for those who want to do the right thing, but unintentionally violate the law out of confusion or ignorance. Informing the public of enforcement presence and publicizing successful case outcomes would highlight the consequences of breaking the law, would be a deterrent to intentional violators, and would increase public faith in law enforcement. Enforcement details involving multiple agencies, followed by publicizing violations in a timely manner, would have the deterrent effect of strong enforcement and the ‘shaming’ effect of public posting of the cases. Another recommendation was to educate prosecutors and judges on advances in technology so they could understand the limitations and applications and be less likely to reject evidence from surveillance technologies.

Other challenges

Simple rules (such as bag limits, prohibited species or no-take zones etc.) are easier to enforce than complex ones (bycatch quotas, gear deployment times, etc.), and law enforcement personnel should be involved in designing them. In 2009, the Atlantic States Marine Fisheries Commission law enforcement committee developed a document to help fisheries managers understand the enforceability of different types of regulations²; this would be a useful reference for regulation development. MPA boundaries should be as simple as possible to avoid any confusion among fishers, and also to reduce the likelihood of cases being dropped because of unclear boundary violations. Management agencies need to work with LE when formulating regulations to ensure they are enforceable. The recreational fishing sector is the most problematic to enforce as there are large numbers of small vessels that cannot be tracked remotely like (some of) the commercial vessels. Increasing voluntary compliance and community policing may be the best option for this sector, but will require a great deal of outreach by management and LE agencies.

² Guidelines for resource managers on the enforceability of fishery management measures (2009) Atlantic States Marine Fisheries Commission.

Section III: Surveillance and enforcement options and recommendations

A strong surveillance and enforcement program consists of the following elements:

1. Well-structured MPAs and FMPs, which have clear objectives and regulations that are easily enforceable.
2. A surveillance system that provides vessel detection in real-time.
3. Adequate number of well-trained officers to respond to suspicious activity.
4. Public outreach and education to increase acceptance and compliance with the regulations.
5. Sufficient prosecutors to process the cases made by LE
6. Media publicity and wide public dissemination of successful prosecutions.

1. Enforceable regulations

The easiest type of MPA to enforce is a large rectangular box with borders that run along lines of latitude and longitude, with no permitted access. This however, is usually not a feasible option. Most MPAs allow for multiple uses and just restrict activities that impact particular species or habitat types. Many MPAs are rectangles but those with more complicated shapes could pose challenges for LE; for example, one of the recently implemented C-HAPC boundaries has 200 waypoints with a very complex western border. Boundaries of protected or restricted areas should be kept as simple as practical for enforcement purposes, especially for those fishers that do not have sophisticated electronics that allow them to interpolate between a non-linear series of waypoints. Regulations for MPAs and FMPs should be kept as clear and logical as possible for ease of enforceability and public understanding.

2. Surveillance system options

There are many different surveillance technologies that can be used to monitor vessel activity. These technologies are summarized briefly in Section I. Not all of them are cost effective or practical with the current and expected levels of funding, and some only target a sub-section of the stakeholders. The greatest challenge is monitoring the recreational

sector, which consists of high numbers of small vessels that are not required to carry any type of tracking system. Cumulatively, this sector extracts a large proportion of the resource, but is very difficult to monitor. Below is a selection of potentially practical options for different types of vessel surveillance in the SAFMC region.

Vessel Monitoring Systems (VMS)

In 2010, the SAFMC implemented a series of offshore MPAs to protect deep reef-fish populations. Most of these MPAs were given a low enforceability rating when reviewed by LE personnel as they are small and far offshore. Implementation of VMS for reef fish commercial and head boat vessels would enable state and federal LE to monitor the activity of this popular fishery without the need for additional patrol assets. Traditional VMS was not considered appropriate to monitor the golden crab fishery as the vessels have to maneuver in the strong Gulf Stream currents to recover their traps, and occasionally cross the line into the closed area, even though their traps are in the allowable fishing zone. This would result in false alarms and problems of enforceability. The new Enhanced Mobile Transmitting Units (E-MTU) VMS systems should be considered for the golden crab fishery since they allow ship-shore communication. This would allow the golden crab fishers to inform the VMS station if they have to enter the closed zone for maneuvering purposes. The VMS office does not currently have capacity to monitor the additional vessel load, and would require additional VMS technical support; however use of this technology would be the most effective way of monitoring vessel activity. If implemented sooner rather than later, the fishing community would have the benefit of federal assistance to offset the cost of the units. VMS serves as a good surveillance tool and deterrent for illegal activity. If the SAMFC wished to implement further area-based regulations to protect the reef fish fishery, the surveillance infrastructure would already be in place. VMS does not address the problems of illegal recreational fishing or small charter boats, but if the other stakeholder groups were forced to comply with regulations through the use of VMS, they may be more inclined to inform on poaching by other groups. Cell phones now have integrated GPS tracking and cameras, so the public can capture GPS-tagged images of

other vessels. Although this alone cannot be used to prosecute in the US, it can provide LE with useful information on where violations might be occurring and by whom.

Automatic Identification Systems (AIS)

This technology is not as sophisticated as VMS, nor is its range as far, but it is a potentially useful tracking system, especially with the expanded coverage to 50 nm (57 miles) proposed by the USCG. As well as position, AIS equipped ships can broadcast navigational information (heading, speed, turn rate), ship identity (name, call-sign, type of ship), and more. This information can be received by land based stations (in the US, receiver stations are operated primarily by the USCG), aircraft, and other ships, and the data can be plotted on an electronic chart. The current USCG requirement is that vessels > 65ft have to carry class I AIS, but fishing vessels are exempt. For this reason, AIS has not been used for fisheries surveillance so far in the US. If the proposed new USCG rule is passed (which is expected in late 2011), the requirement for AIS class I transceivers would extend to all vessels >65 ft, including fishing vessels and those with >12 paying passengers (which would include head boats). This rule would open the possibility of using this technology for fisheries, and will entail tracking many more vessels. The USCG already has the capability to scale their data processing to cope with these additional needs. State LE can access these data by signing up through the USCG Navigation center (<http://www.navcen.uscg.gov/?pageName=NAISdisclaimer>). With the expanded rule, AIS systems could prove useful for federal fisheries enforcement in the US, especially if repeaters were placed on elevated structures or sea buoys to extend their range. This would be the most cost effective surveillance method to track activity in the southern section of the Miami-Stetson deep coral HAPCs, the Oculina Banks HAPC, GRNMS and FKNMS.

There is also the possibility of using AIS to track recreational vessels. There are small, inexpensive AIS units available that could be required as part of the federal fisheries permits. Use of small AIS units would place an additional burden on the USCG data processing, and would create a very crowded map of activities; however these problems could be overcome with modifications to the data fusion technologies. Monitoring

recreational vessels is one of the greatest surveillance challenges in this region, where recreational fishers far outweigh commercial vessels.

Aerostats

Aerostats are expensive to purchase and operate, but if these systems are under military control (as the TARS deployed in the Florida Keys), the costs will not burden the underfunded state and federal resource protection agencies. The TARS system in the Keys is not currently operational and it is unclear when it will be; however the Air Force has expressed the intention of repairing the aerostat. The data obtained from instruments on the aerostat platform, and the deterrence value they provide, make these technologies a useful option for monitoring vessel activity. Being a raised platform, aerostats also overcome the line of sight limitation of conventional patrol vessel technologies, as an aerial view provides a broader perspective on vessel activity.

Buoys

Sea buoys, many of which are already tended by the USCG, could be used as platforms for passive acoustic devices. Acoustic technologies can provide useful data to monitor the type and quantity of vessel traffic in an area and to identify some types of activities (eg bottom trawling). Acoustic technologies could be a useful surveillance tool if the data were delivered in real time and were processed in a way that information was rapidly communicated to field officers. Real-time data delivery can be achieved through satellite or cell phone transmission. Non real-time data would provide general information on levels and types of vessel activity, which could direct LE to focus their attention on specific locations when activity is highest.

Unmanned Aerial Systems (UAS) or Vehicles (UAV)

The USCG is currently in the assessment and planning stages of UAS acquisition (<http://www.uscg.mil/hq/cg9/uas/default.asp>). When (or if) they come online, their flight hours will be assigned to a variety of USCG missions, similarly to other aviation assets. Their use for living marine resource protection will have to be negotiated between LE

agencies and the USCG. UASs have significant advantages over manned aircraft (as outlined in section I). If funded, the UAS program could be one of the most significant surveillance assets for marine resource protection. Unlike VMS and AIS, these vehicles can provide information on all maritime activity, including the large numbers of recreational vessels that operate in the southeastern US. The Guardian UAS, which operates currently from Cape Canaveral, flies over the east coast, but the USCG is currently the only agency with access to the data. As the program develops, this will hopefully change into a more collaborative data-sharing situation that could contribute greatly to surveillance in the SAFMC region. NOAA also has UAS in operation and plan to have more online in the future (uas.noaa.gov), although their emphasis seems to be research and monitoring rather than surveillance for maritime domain awareness.

Satellite surveillance

The high cost of satellite imagery (whether optical or radar), and the lack of real time data, make this an inappropriate technology for general enforcement surveillance. However, if there were a need for intelligence on activity in the protected areas during a specific time period (grouper spawning for example), then satellite imagery might be the best approach. In some regions (Canada, US Pacific), agreements exist between military and civilian agencies where the military provides unclassified information received from satellite (and other) systems to civilian LE agencies. This allows resource protection agencies to access data from these assets at no cost.

Data Fusion

Each of the above surveillance systems generate information that needs to reach field officers in a useful format. This generally requires some kind of data processing station that takes the raw data and creates something intuitive such as an electronic map. These can then be delivered to patrol units as appropriate. Some of the data are available through websites that can be accessed directly via an officer's laptop. Other data are delivered through ground stations to officers in the field. In more complex surveillance systems, various data streams are fused (eg VMS plus AIS) to create a more comprehensive view of

vessel activity. In summary, whichever surveillance or monitoring technology is chosen, there has to be a reliable mechanism to deliver the information to the field in usable form.

3. Adequate number of well-trained officers

With very few exceptions, surveillance technologies can only provide information on suspicious activity; a response by LE is still required to make a case. It is unlikely that there will ever be enough LE to cover the high level of vessel activity in the region. In which case, optimizing limited assets (officers, vehicles, data) is very important. Although MOUs exist to create official cooperation between agencies, effective collaboration relies heavily on personal working relationships between officers. Working partnerships develop through field interactions, joint exercises and training sessions. Workshop participants suggested that facilitating informal meetings, joint training, etc., would be more effective at fostering collaborations between agencies than more formal MOUs. One potential venue for this would be the GRNMS annual meeting for LE, where management personnel and state and federal enforcement personnel can exchange ideas in an informal setting.

Officers need to be well trained in federal fisheries enforcement in order to make a case that can be prosecuted. As discussed in the workshop report (section II), there are various problems with officer training, particularly in the JEA program. Some of these are a result of inadequate numbers of NOAA OLE patrol officers, but others could be improved through better agency collaboration. Interaction between NOAA OLE and state LE varies by region, but in general there was a perceived need for improvement. Federal fisheries enforcement is complicated, and requires more training than the officers currently receive at their academy and during their initial field training. Refresher sessions on preparation of federal case packets and updates on regulations, together with combined agency vessel patrols and targeted ‘details’, are needed to reinforce initial training, strengthen collaborations and show the public a unified enforcement presence. Ensuring that state LE officers are adequately trained to accurately complete federal case packets is ultimately the responsibility of NOAA OLE, with the assistance of state JEA liaisons. NOAA OLE and

OGC could continue to review the case packet requirements to ensure that all the data are necessary; there may be some redundant information that could be removed to make the paperwork less burdensome. State LE officers also need to understand why the information is needed, as part of their training.

The USCG has annual training to accommodate their rapid turnover in staff (USCG relocates most field personnel every two years). This training is comprehensive, but with the multiple USCG missions, there is so much material to get through that there is limited time to focus on natural resource protection. The USCG is working on improvements to their natural resource training, including a live coral exhibit to assist officers with identification. Working with NOAA OLE on federal fisheries 'details' or joint patrols would increase the USCG experience and comfort level with the fisheries regulations. Other LE agencies can attend USCG training sessions, which would not only educate the officers, but foster relationships that could improve field collaborations. Inter-agency training opportunities should be better publicized within and between agencies, to make sure everyone is aware of their schedule well in advance. This information sharing should be facilitated through a single website rather than fragmented information pathways.

4. Public outreach and education

Public compliance is a critical element of resource protection. If the public understands the rationale for regulations they are more likely to support and comply with them. This subject created a great deal of discussion during the workshop, and the participants formulated several approaches on how to reach out to the public.

- Create a central internet location that provides information on all protected area boundaries and regulations (including the National Marine Sanctuaries) and federal FMPs. The most logical venue for this information would be the SAFMC website, with links to NMSs and other relevant, independently maintained information sources. A central location would help deliver information to the recreational fishing community. These occasional users are generally less familiar with regulations than the commercial

fishing sector. User-friendly software such as Google Earth would provide the platform for area-based management, and could incorporate not only regulations, but information on the resource being protected and the rationale for management actions. This website could include a FAQ on regulations and law enforcement.

- Use cell phones to disseminate information on regulations (particularly any changes). The Gulf of Mexico FMC uses cellphone applications that can be downloaded at no cost, to inform the fishing community about regulations. This would not replace more traditional methods, but would augment them.
- Use a simplified system to summarize complex fishing regulations – for example color-coding different types of restrictions.
- Make sure permanent closed areas are included in NOAA nautical charts and electronic charting software.
- Provide regulation information through conduits regularly used by fishers such as NOAA weather radio stations or buoys.
- Utilize SAFMC annual scoping meetings and public event at the NMS to increase outreach.

5. Sufficient prosecutors to process the cases

There is a critical shortage of NOAA Enforcement Section attorneys to pursue civil cases. This is causing significant problems at various levels of the enforcement process. There are limits to how many cases an understaffed Enforcement Section can deal with; consequently not all cases are prosecuted. Some violations can be dealt with through the less involved Summary Settlement process, but there are some legitimate cases that are dropped. This has a detrimental effect on officer morale. In addition to the extra burden of federal case paperwork, failure to prosecute reduces incentive to enforce federal fisheries. It also sends the wrong message to the public and fishermen: if there are no consequences to breaking the law, compliance will drop and poaching will increase.

One suggested solution to alleviate the shortage of civil prosecutors is to work with NOAA and the Department of Commerce to change the MSA and make violations criminal rather than civil penalties. Since there are many more federal criminal prosecutors than civil, this change would relieve the current burden on understaffed civil prosecutors. Although the Department of Commerce supports increased criminal provisions within the MSA, Congress has historically been resistant to criminalizing fishing violations. There is also a potential flaw with this solution that should be taken into consideration. In state legal systems some natural resource violations have criminal penalties, and these are handled by the same prosecutors and judges that deal with other (more serious) crimes. Under these circumstances, natural resource violations may not be taken seriously, or may be dropped, which would ultimately result in some of the same problems we have now. Another solution would be to increase the number of federal civil prosecutors to accommodate the MSA cases, which would require an increased budget. Under certain circumstances, state attorneys and judges can process federal cases. It may be possible to shift more federal cases to state courts, but there is likely to be resistance to this option as state courts are already working at capacity.

6. Public dissemination of successful prosecutions.

Publicizing results of successful prosecutions informs the public that violations are punished and also has the element of 'shaming' the offender. Results of LE 'details' (short term, high intensity efforts that focus on specific location or regulation), should be publicized soon after they occur. Agencies need to publicize arrests and convictions quickly and in readily available locations. The FWC publishes weekly activity notices on their activities in state and federal waters, including violations and previous case dispositions. NOAA often does not publish cases until they are complete which may take years; hence the impact is lost. The SAFMC also has to wait for NOAA approval before they can release this information. The USCG has more flexibility than NOAA regarding publicizing cases that they make, so the USCG could either publish independently or release information to SAFMC for posting on their website.

List of commonly used acronyms

AIS:	Automatic Identification System
EEZ:	Exclusive Economic Zone
FKNMS:	Florida Keys National Marine Sanctuary
FWC:	(Florida) Fish and Wildlife Commission
GCEL:	General Council for Enforcement and Litigation
GDNR:	Georgia Department of Natural Resources
GRNMS:	Gray's Reef National Marine Sanctuary
HAPC:	Habitat Area of Particular Concern
JEA:	Joint Enforcement Agreement
LE:	Law Enforcement
MOU:	Memorandum of Understanding
MPA:	Marine Protected Area
MSA:	Magnuson Stevens (Fishery Conservation and Management) Act
NMSA:	National Marine Sanctuaries Act
NOAA:	National Oceanographic and Atmospheric Administration
OGC:	Office of General Counsel
OLE:	Office of Law Enforcement
ONMS:	Office of National Marine Sanctuaries
SAFMC:	South Atlantic Fishery Management Council
SCDNR:	South Carolina Department of Natural Resources
USCG:	United States Coast Guard
VMS:	Vessel Monitoring System

Appendix I: Summary of technologies that can be used for maritime surveillance and enforcement

Technology	Information Provided	Reporting Frequency / Time	Resolution / Scale / Range	Current / Prospective Users	Cost / Availability	Remarks
Vessel Monitoring System (VMS)	Position, ID	Every hour; real-time	GPS resolution; global coverage	Most fishing vessels carry VMS; most nations have monitoring centers	\$1 -4,000 per unit, \$1-600 annual operation; \$50-500,000 for monitoring centre	VMS data is admissible evidence in court in several countries
Electronic Monitoring System (EMS)	Position, fishing activity, catch information	Continuous; data collected on vessel return	GPS resolution; range not applicable	Limited number of fisheries; coverage may expand as technology improves	\$8-10,000 per vessel, \$150 per diem operation	High manpower and time requirements for processing
Long Range Identification and Tracking (LRIT)	Position, ID	Every 0.25-6 hrs; near-real-time but non-continuous	GPS resolution; global coverage	Military/security agencies or governments	\$3-5,000 for LRIT ship hardware. The cost of operating the data system itself falls, for the most part, to the SOLAS contracting party requesting the LRIT data	LRIT carriage is mandatory on three categories of ships making international voyages: cargo ships over 300 GT, passenger ships, and mobile offshore drilling units
Automatic Identification System (AIS)	Position, ID, type, navigational information; also transmits geographical info	Continuous; real-time	GPS resolution; Radar range (~20-30 nm/40-55 km) from any given station	IMO requires all merchant vessels >300 GT to carry AIS; possibly fishing vessels >15 m; virtually all maritime nations monitor AIS	\$3,500 per Class A unit	Coverage is being expanded to more vessels and greater range. Only covers vessels with AIS equipment on-board.

Space based Automatic Identification System (AIS-S)	Position, ID, type, navigational information; also transmits geographical info	Every 0.25-1 hr; near-real-time. In the future the time lag will be less, as companies launch more satellites in order to close this time gap.	~5000 km radius per recording	Military/security agencies or governments.	An annual licensure fee. Prices can vary greatly, starting around \$30,000 and going into the millions depending on the scope	Many companies can combine the AIS satellite based info with other vessel tracking systems, such as VMS, LRIT, & SAR, for a more complete package.
High Frequency Surface Wave Radar (HFSWR)	Position	Continuous, real-time surveillance of cooperative and non-cooperative vessels in an area	13 nm - 200 nm	Military/security agencies or governments	\$3 - \$15,000 for a vessel-mounted unit, which uses X-band, has a 100' cable length, and sees ~13 nm out.	There are large HFSWR systems that are land-based, and can see out to 200 nm.
Marine Radar	Position	Continuous while patrolling; real-time	96-200 nm	Military, scientists, and civilian	\$20,000-1.5million	Equipment capabilities needed for remote surveillance includes high power technology that pulls 12kw or greater, runs in S-band, and has a 9-12' antennae array.
Synthetic Aperture Radar (SAR)	Position, slick detection	Varies; 2-4 hr lag/processing time	8-50 m resolution; 50-300 km width per image	Military/security agencies & a few fisheries agencies	\$4-5000 per image, \$6-7 million per ground station	Portable ground station has been used in Kerguelen Islands. SAR images are used in the Sandwich Islands.

Optical Systems	Visual ID, activity	Continuous; real-time or near-real-time	Varies widely	Military/security agencies or governments	\$100,000 -3 million, depending on the system	Range, resolution, and scale depend widely on sophistication of optics, and the platform used.
Buoys	Position, possibly ID and/or fishing activity	Continuous; real-time or near-real-time	20-30 nm/40-55 km detection range	Military, scientists; possibly security agencies	~\$5000 per unit	Limited commercial availability. Larger hydrophone arrays can have longer ranges; resolution depends on the size of array or positioning of buoys
Passive Acoustic Systems (Hydrophone Arrays, etc.)	Position, activity, and possibly ID	Varies based upon platform used.	Varies widely	Military, scientists, civilian	~\$5000 per unit	Possible to develop acoustic markers to identify individual ships, but not practical in high traffic areas.

Unmanned Aerial Vehicles (UAVs or 'Drones')	Position, visual ID, activity	Continuous while patrolling; real-time	GPS resolution; detection range depends on sensor equipment, usually line-of-sight. Flight time varies widely	Military, scientists; security agencies	\$300,000 - 35 million per unit; operating costs lower than manned aircraft	The UAV platform has many options available. Currently, smaller, more affordable UAVs are better suited to coastal surveillance due to their battery power. Like many technologies the rapid pace of development means improved surveillance vehicles may be available in the near future
Aerostats & Airships	Position, visual ID, activity	Continuous while patrolling; real-time	GPS resolution; detection range depends on sensor equipment, usually line-of-sight. Flight time varies widely.	Military, scientists, and security agencies	\$5 - \$100 million for the purchase of an aerostat, but operating costs are low (~\$600/hr). \$50,000 for a large Helikite which includes radar and optical equipment.	It is possible to implement a Helikite network, to establish a remote radio link (Netforce) to very remote areas.

Unmanned surface Vehicles (USVs)	Position, possibly ID and/or fishing activity	Continuous; real-time	Detection range and scale depends on sensor equipment. Operation time varies widely	Military, scientists, and civilian	USVs start at around \$8,000 including a sensor for a simple electric surfboard type design, and then they go up to about \$50,000 for a small boat, then on to about \$325,000 for ones with multi-spectral sensors.	A new type of USV platform has recently been developed by the Swedes, which involves a group of networked USVs that can be operated independently, or in conjunction with other land-based or seaborne system from a single operations console.
Autonomous Underwater Vehicles (AUVs)	Position, possibly ID and/or fishing activity	Continuous. Data collected on vessel return, or through Wifi upon surfacing; no real-time data feed.	Detection range and scale depends on sensor equipment. Operation time varies widely	Military, scientists, and civilian	Between \$15 - 20,000 for a small AUV with basic navigation and data-logging functionality. \$2-3 million for a fully-loaded AUV, with a large payload that can operate up to 40 hours before recharging.	As of this publication AUVs cannot be operated remotely without a direct data feed; they need to be pre-programmed to perform a search pattern, or to carry out an action in response to a predetermined situation.
Wave Gliders	Position, possibly ID and/or fishing activity	Data is transmitted continuously; real-time. Sound data is recorded and	Detection range and scale depends on sensor equipment.	Scientists and civilian	Between \$150 - \$500,000 depending on optional	Individual Wave Gliders have demonstrated voyages in adverse

		stored on board for periodic retrieval.			components	conditions of more than 15,500 miles and lasting more than 600 days
Submersible Gliders	Position, possibly ID and/or fishing activity	Continuous. Data collected on vessel return, or through Wi-Fi on surfacing; no real-time data feed.	Detection range and scale depends on sensor equipment. Battery life for sensors extends from 600-6,000 km	Military, scientists, and civilian	\$100 - \$150,000	Thermal engines can outlast traditional battery-powered submersible gliders. Projected range is 40,000 km and projected endurance is 3-5 years.