Appendix E. Summary of Monitoring Options

Onboard Observers

Onboard observers are used in several fisheries nationally to collect biological data. Usually a portion of the trips conducted by the fleet are required to have observers on them. Some international fisheries have required 100% observer coverage and in some cases, the observers have been responsible for reporting any violations of regulations. Onboard observers are typically the most expensive means of collecting biological data. At-sea observers have typically been paid for through NMFS or fishermen or through a cost sharing arrangement.

South Atlantic Snapper Grouper Pilot Program (4/06-5/07 and ongoing)

In 2006, the Gulf and South Atlantic Fisheries Foundation was funded to conduct a pilot study to characterize the catch and fate of discards within the Snapper Grouper vertical hook and line fishery of the South Atlantic. The project has been highly successful with cooperation of the snapper grouper fleet throughout the South Atlantic. The major goals of this program were to gather catch, effort, and disposition data. Beginning in late 2006, two fishery observers were trained and began onboard observation. So far, this research has placed observers on board over 19 different commercial fishing vessels and accumulated over 130 observed sea days. Although formal data analysis has not begun, preliminary analysis shows an average of 7 days per trip and 55 sets per trip. However, there was considerable variance depending upon the size of the vessel with a range of trip length from 2 to 11 days and number of sets from 14 to 113. Analysis of catch and discard fate will most likely begin in Fall of 2007 at the end of onboard observation. The project is currently slated to end in May 2008 and results will be presented to the South Atlantic Council. The intent of this project was not to form a stand alone dataset, but to augment currently available datasets (Jepson, 2007).

Dockside Monitoring

Dockside monitoring in LAP fisheries typically consists of state agency staff, federal agency staff, or a contracted entity checking to see if landings match logbooks, trip tickets, or other means of tracking catch. They may also check to see if landings exceed ACP (annual pounds). In non-LAP fisheries, there is no need to see if landings exceed annual poundage since individual pounds are not allocated. However, biological sampling is typically conducted to collect biological data. While the South Atlantic snapper grouper fishery does not have a dockside monitoring program in place exclusively for the purpose of checking trip ticket or logbook data, the SE Science Center does conduct biological sampling of landings for collection of data needed in stock assessments and for other purposes.

Biological sampling (SE Center – Trip Interview Program)

The Trip Interview Program (TIP) was developed by the Southeast Fisheries Science Center (SEFSC) as a shore-based sampling program. The primary focus of the TIP is the collection of random size-frequency data and biological samples from commercial marine fisheries. Biological samples include age, reproductive, prey, and genetic data. In addition to collecting biological data, the TIP serves as a quality assurance on catch and effort data. It validates species composition of catch and type and quantity of gear through first hand, trained observation. Other important information, obtained through personal interviews with the fishermen and dealers, also serves the quality assurance purpose. The TIP is a major component of the Atlantic Coastal

Cooperative Statistics Program (ACCSP) in the southeastern U.S. Atlantic coastal region and the Commercial Fisheries Information Network (COMFIN) in the U.S. Gulf of Mexico coastal region. It also collects data from Puerto Rico and the U.S. Virgin Islands.

The goal of TIP is to obtain representative samples from targeted fisheries. A representative sample is a sample that meets sound statistical criteria for (at minimum) describing a population. The populations are defined by fishery-time-area strata. For practical reasons area is defined here by area of landing, not the fishing area. Agents are assigned target numbers of measurements needed for stock assessment. Sampling targets are assigned according to the historical landings within the fisheries**.**

An initial step in the data collection procedures is to identify fisheries which regularly land species that are the subject of current stock assessments or for which stock assessments are planned. Of course, it is desirable to obtain data on all fisheries, but fisheries for stock assessment species must be prioritized until sampling targets are met. Partners in the ACCSP and COMFIN will have their own lists of ‘priority fisheries’. Ultimately, prioritization for sampling of all fisheries will be coordinated by these two organizations.

The location where sampling takes place will vary trip by trip. In the TIP, there are typically two locations involved; the landing dock and the dealer site. Vessels will not always land at the same dock or sell to the same dealer. Dealers may handle landings differently from day to day. The preferred method is to sample the catch at the initial point of off-loading. This is really the only way the samplers can be sure at the time of sampling that they are seeing the entire catch. Sometimes the dealer is this initial point. In other cases, dealer sites can be used as back-up locations only if the sampler has access to the entire catch of a particular species/market category from the trip. Trip level sampling data by state is incorporated into the TIP program about twice a year.

Electronic Monitoring (EM)

Electronic monitoring (video monitoring) has been used in the British Columbia LAP fisheries, some Alaskan fisheries (crab), the Pacific Whiting fishery, and other places. Pilot programs to determine the feasibility of using EM in general and the feasibility of using EM as a replacement for at-sea observers have been conducted in various places and reports on these pilot programs are summarized below in the literature summary section. In general, electronic monitoring has been used or tested in trawl, longline, and hook and line fisheries. Electronic monitoring is sometimes used in place of at-sea observers, to supplement at-sea observers, and/or as a means to audit electronic logbook data. Use varies depending on the objectives of the fishery with regards to discarding and individual catch tracking. Pilot programs have shown electronic monitoring systems (this includes data review) to be less expensive than at-sea observers and to be capable of identifying discard occurrences and species-specific identification.

Literature Summary of Pilot Programs

1) In “Discussion Paper on Issues Associated with Large Scale Implementation of Video Monitoring”, Kinsolving (2006) assesses what current electronic monitoring (EM) technology can and cannot do well for the Alaska rockfish trawl fishery. He writes,

> Video, either alone or in conjunction with other data gathering equipment (electronic monitoring, or EM), is becoming an increasingly viable technology for monitoring some types of fishing activity or enhancing the ability of observers to gather fisheries data. The technologies associated with EM are in a state of rapid development. The combination of increasingly effective data compression algorithms, increased computer processing power, and the rapidly decreasing cost of data storage have reached a point where, on a technology level, electronic monitoring is ready for large scale implementation for some fisheries monitoring applications. However, while many of the technical issues associated with the collection of EM data have been addressed, neither NMFS nor the fishing industry have fully addressed many of the infrastructural and cost related issues associated with larger scale EM program implementation.
>
> **Based on studies conducted to date, it appears that EM technology is able to:**
> • Function sufficiently reliably in the marine environment.
> • Identify fishing events (e.g. net deployment, line retrieval) and the location where those events took place.
> • Determine when and if discard events take place on trawl catcher vessels.
> • Verify compliance with seabird avoidance measures on longliners.
> • Assist an observer in monitoring activities in otherwise unobservable areas of catcher/processors.
>
> **On the other hand, EM systems are only moderately able to:**
> • Quantify the amount of discards on trawl vessels.
> • Detect and identify seabird bycatch to species on longliners.
> • Estimate the species composition and number of fish in longline catch.
>
> The at-sea portion of the technology, while the focus of most research to date, is only one component of an effective EM system. For an EM system to function properly, the data collected at-sea must undergo some degree of methodical review. In the studies conducted to date, this review has been fairly meticulous, with the assumption being that most missed events have been due to technology and data collection issues rather than data review issues. While such an approach is necessary when testing the applicability of a given technology, it does serve to possibly over-inflate the total cost of an effective EM program.

The document by Kinsolving includes an overview of the 2005 Kodiak electronic monitoring project where two video monitoring systems are compared. Cost projections were based on the assumption of 18 boats, where each boat fishes an average of 7 trips, and trip length will average 3 days, of which there is 24 hours of activity to review. Total minimum and maximum costs are laid out in the document. Total equipment costs (including installation and maintenance) per vessel ranged from $5,875 to $13,325 per year. The cost of maintenance and storage was estimated at $100 per trip. Although data review costs could vary enormously depending on how much data is reviewed, the document assumes that a full review would cost approximately $50,000 per year for all vessels together (see table below).

2) McElderry et al. (2003) conducted a large scale deployment of electronic monitoring systems on the 2002 BC halibut longline fishery to evaluate the feasibility of EM as an alternative to observer based at-sea monitoring. Two cameras per vessel were used for this project. In some cases, at-sea observers were deployed on the same vessels as the EM system. In these cases, comparisons could be made between observer and reviewed EM video to determine accuracy of recorded information. The authors note that overall, EM and observer catch estimates agreed within 2% and individual identifications by hook agreed in over 90% of the catch records. The also note that there was close agreement between EM and observers regarding whether a fish was kept or discarded and the time, location, and depth at the set start and finish. The authors concluded that EM is a promising tool for at-sea monitoring applications depending on specific fishery management objectives regarding monitoring. They also note it would have a

substantially lower cost than at-sea observers. They suggest two ways to use EM for the BC longline fishery: 1) an integrated EM-observer program using both methods in a complimentary fashion to achieve fleet sampling objectives; and 2) using EM and an electronic fishing log as an at-sea monitoring audit tool. While at-sea observers cost CA$320 per vessel per day for fishermen and CA$130 per day for the federal government, EM cost about CA$210 per vessel per day (see table below).

3) McElderry et al. (2004) assessed the feasibility of electronic monitoring for the Cape Cod longline haddock fishery where bycatch rates of cod must be closely monitored. The primary objectives of the project were to evaluate the effectiveness of electronic monitoring in estimating the at-sea catch of haddock and cod, assess the suitability of EM systems for various components of the fleet, obtain skipper and crew feedback on EM suitability, and foster fleet education on EM monitoring as well as verify EM derived catch information by comparison with like data from observers. Two cameras per vessel were used for this pilot program. Costs were estimated at $1,200 per vessel per day for the pilot project (see table below). A full EM program cost per vessel is suspected to be much less. In general, McElderry (2003) estimated that EM programs run between 20-60% of the cost of an at-sea observer program.

McElderry et al. (2004) provide information on an EM program for the British Columbia groundfish longline fishery that involves less than full data review requirements. They write,

> One possible fleet monitoring design might involve large-scale deployment of EM systems on the fleet with image data selectively analyzed according to a specific sample design. In this way, the analysis effort changes from full interpretation of all imagery from a fishing trip to sampling the fleet, monitoring imagery for sets or portions of sets. British Columbia's groundfish longline fishery is adopting this approach to provide full catch accountability in their 17,000-seaday fishery. Fishing vessels will carry EM systems on a fishing trip and fishers will keep a careful record of catch in an electronic fishing log (included as part of the EM system). The logbook data will be audited with catch data from EM imagery and the level of agreement will prescribe the amount of image viewing required. This unique monitoring approach provides cost effective monitoring, more actively engages industry in data collection, and, when analysis cost is applied individually, provides a positive stimulus for accurate catch accounting by industry.

Table Summarizing Pilot Program Evaluation of the Use of Electronic Monitoring (EM) for Various Fisheries.

Type of fishery	Discard concerns?	Equipment costs	Data review costs
Alaska Rockfish Trawl	Yes	$5,900-$13,300 per vessel annually	$50,000 for all vessels per year
Cape Cod Longline for Haddock	Yes, cod	(two cameras) $1,200 per vessel per day for pilot project, developed EM program would be less costly	Not specified, paid for by federal government
BC Halibut Longline Fishery (LAP fishery)	Yes, various rockfish species	(two cameras) CA$210 per vessel per day	Not specified, paid for by federal government

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Paper Logbooks

Approximately 100% of permit holders in the commercial snapper grouper fishery each year are required to participate in a paper logbook program for a 12 month period. Another 20% are required to participate each year in a paper logbook program that specifically requires information on costs and earnings for a 12 month period. Yet another 20% are required to participate each year in a paper logbook program that specifically requires information on discarded fish for a 12 month period.

Electronic Logbooks

South Atlantic Electronic Logbook Pilot Project

Electronic logbooks have been used in several fisheries in the U.S. including fisheries in New England. As required by Amendment 4 to the South Atlantic Fishery Management Council's (SAFMC) Snapper Grouper Fishery Management Plan, commercial fishermen fishing for South Atlantic snapper grouper have been required to fill out a paper logbook since 1992. In 2002, the SAFMC and Technology Planning and Management Corporation (TPMC) (now Perot Systems Government Services [PSGS]) tested the use of electronic logbook reporting using the Thistle Marine™ electronic logbook. This device is "ruggedized" for small boat fisheries and is designed specifically for fisheries logbook recording and biological sampling during fishing operations. The project examined the proposition that an electronic logbook can collect all of the data elements presently required by the paper logbook program and can collect more accurate and comprehensive bycatch and catch location information. The 2002 project was implemented on two commercial snapper/grouper vessels in South Carolina and North Carolina from May, 2002 through November, 2002. The electronic logbook pilot program recorded

- Number of fish caught (although pounds can be recorded instead, number of fish was more expeditious in this case)
- Number of fish discarded
- Number of crew
- Number of lines
- Number of hooks per line
- Date (when interfaced with vessel's GPS)
- Time (when interfaced with vessel's GPS)

- Location (when interfaced with vessel's GPS)

The second major goal of this project was to examine the feasibility of using an electronic logbook to record biological information on the catch that is retained and on the component that is discard. A final presentation was given to the Council and Snapper Grouper Advisory Panel at their December 2002 meeting and the results were well received by the fishermen involved, members of the Snapper Grouper Advisory Panel, and by Council members[1].

The objectives of the electronic logbook project undertaken in 2005 was to expand the initial electronic logbook pilot program in the South Atlantic Snapper Grouper fishery to determine whether electronic reporting is an effective method of data collection for all vessels and gear types in the fishery. Vessels were selected to participate in the project based on gear and size of the vessel. Vessels were also selected throughout the entire geographic range of the fishery to examine the demographics regarding electronic reporting at the effort level and the trip level, and if the system is best suited for mandatory census or strategic "study fleet" sampling in a full implementation. The goal of the project is to improve fishery dependent data collection in the South Atlantic Snapper Grouper fishery by collecting data that will be more accurate, timely and useful to scientists and managers in the decision making process; to ease the burden of reporting on fishermen; and to provide the information collected back to fishermen for their own use in making better business decisions.

By using the electronic logbook unit tied into a vessel's global positioning system (GPS), managers will have access to more detailed spatial resolution that will assist in identifying and addressing the impacts of management measures such as MPAs. Electronic logbooks will also improve the accuracy of data collection at the species level by allowing fishermen to report catch data at sea throughout a fishing day rather than reporting pounds of fish as determined by the dealer. The electronic logbook will also enable the collection of more accurate bycatch information by allowing the reporting of bycatch while at sea at the time of the actual discard. The electronic logbook also offers practical business benefits for the user (fishermen) in that all data that are recorded are available for the fishermen to analyze and see their data overlaid on nautical charts by species, by area, and by time period. They will also have the ability to see their own catch per unit effort statistics for different time periods.

This pilot program was funded again in 2004 and 2005 and applied to a larger number of vessels. Details regarding the best software and hardware to use for the snapper grouper fleet are still being determined. Thus far, several options have been tested[2].

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[1] The pilot project collected over four thousand data points representing nineteen commercial snapper grouper trips aboard two bandit vessels. Thirteen hundred catch observations were recorded representing just over five hundred anchor sets. Both landed catch and discards were recorded in numbers of fish for twenty-nine different species. In addition, the electronic logbook recorded nearly twice as many species landed per trip than the paper logs. The reason for this is most likely a result of recall error when filling out paper logs and the seafood dealer's practice of combining smaller quantities of fish of different species and reporting them as one.

[2] Boatracs and Skymate VMS units were used for electronic submission. Shoreside testing revealed that the Skymate unit had a transmission success rate of only 50% while the Boatracs unit had a 100% success rate. The cost for a Skymate unit is $1599 plus installation and activation costs compared to $3195 plus installation costs for the Boatracs unit.

It should be noted that all participants have found the charting capabilities of the P-Sea WindPlot software to be an excellent addition to their standard electronic navigation equipment. However, the use of these computer systems has not been without a few minor issues, considering the corrosive environment in which they have been deployed. There have been a number of hardware/software developments such as:

- 1 failed hard drive with a GoBook computer. The boot sector of the drive was faulty which was corrected by replacement of the drive by the manufacturer and re-installation of the operating system and software.
- 2 system crashes; one Comark system was short circuited and repaired by Comark, and one GoBook system failed due to faulty wiring. The GoBook was brought back online after a reinstallation of the operating system and software.
- 3 vehicle mount USB failures. Problem corrected by manually removing the back left bracket of the vehicle mount, which covered the GoBook USB port. This allowed access to the USB port on the laptop itself for the P-Sea WindPlot USB security key. The vehicle mounts continued to provide stability, security and power for the GoBook systems.
- 3 USB flash drive failures resulting in corrupted XML data files. New USB drives were issued to participants and data was re-submitted to PSGS staff.
- 2 P-Sea WindPlot USB security key failures. The USB keys were returned to P-Sea WindPlot and replaced with working keys.
- Many of these issues were minor and corrected quickly (within days). Troubleshooting of these issues was handled by PSGS staff, in conjunction with as needed support from system and software manufacturers. The most extensive technical issue caused by a power surge to the Comark system which was repaired within 2 weeks (Perot Systems, 2005).

Although not yet developed for the electronic logbook pilot programs in the South Atlantic, it has been suggested that electronic logbook data could be submitted via a VMS satellite transmission. This would enable real-time data collection.

Vessel Monitoring Systems (VMS)

Several laptop and tablet PCs were tested, but the best option for the money seemed to be Dell laptops (Dell Inspiron 2600, Latitude D505 and C640). Although susceptible to glare problems, there were no failures of these units during two year deployments in open and closed wheelhouses.

Of the e-logbook software considered (Thistle, Windplot, UNH) the UNH was used on a greater proportion of vessels as the Windplot software could not track simultaneous effort in fixed gear fisheries. The UNH software could capture simultaneous effort, but could not dissociate effort from trips (setting a trap on one trip and retrieving on another trip). This was dealt with by allowing manual entry of set times and haul durations. The Thistle software could not handle multiple species records for a haul, as it was developed for lobster fishing and only accommodated one species record.

Data were transmitted off the vessel and to an email address by VMS, and loaded to Oracle tables using a PLSQL script.

VMS is required in the South Atlantic rock shrimp fishery. Also, VMS has been considered an alternative under Amendment 14 (MPAs), Amendment 15, the FEP Comprehensive Amendment. The Literature Summary on VMS (below) contains reasons for considering VMS in an LAP fishery as well as conditions necessary to minimally support a LAP-VMS.

Literature Summary on VMS

In the Enforcement section of the NMFS draft document "Design and Use of Limited Access Privilege Programs", the authors state the following regarding usage of VMS in LAP fisheries:

> Another tool that can be used in tandem with a real time data reporting system is to require a vessel monitoring system. VMS is an essential requirement to show the vessel was at sea, how long it was out, where it docked when it came to port, and the present vessel location. VMS is capable of understanding and recording small details of the ship's evolutions. It can document, for instance, specific course changes and engine speed changes by a vessel. Collectively, this pattern is termed a signature. At present there is not enough data to make a signature admissible in court as an indicator of fishing. Regardless, VMS technicians are trained to look at positioning data and other factors indicating potential fishing activity. An investigator can be dispatched to the landing site intercepting the vessel as it comes into port or even anchors in a remote area. If the captain and crew are believed to have illegally harvested a LAP species, the agent or officer can intercept the vessel. If, during the course of an initial investigation, a violation surfaces the agent or officer will bring the vessel to port, seize the catch and cite the errant fisherman.
>
> …Tracking locations of vessels via VMS is not unique to LAP-managed fisheries. Many other management strategies also have to deal with fishermen attempting to evade detection of illegal acts. Whether LAPS with VMS is superior in discouraging or mitigating the occurrence of evading detection of a landing without complementary AHP for the event is the correct question to be evaluated.

The authors summarize the conditions necessary to minimally support a LAP-VMS program:

1. All participant vessels are equipped with NMFS authorized VMS units;
2. The system must be operated 24/7 for 365 days a year;
3. Fishermen must present documented proof VMS is fully operational prior to receiving annual allocation;
4. Participants agree to return to port if VMS is dysfunctional as a condition of participation; and
5. Tampering with the VMS or power source supporting VMS must be prohibited.

<u>Literature Summary for Monitoring</u>

In the NMFS draft document "Design and Use of Limited Access Privilege Programs", the authors state that the effective management of LAP programs requires development and implementation of a highly accurate, timely, and well-documented catch accounting system.

The authors envision that the data would show a permanent record of an individual's landings and that these records would be entered, maintained, and fully accessible to authorized users. The landings data would show the "balance" available to land on the LAP permit, and the permit holder will therefore have a permanent record of his/her landings. They state that, at the same time, landing rates can be monitored and the system can be set to notify OLE if an overage is detected. In addition, they assert that the simpler the program design, the less complex its implementation will be. For example, restrictive eligibility and transferability rules can make it more complex to issue and keep track of LAP ownership.

LAP fisheries typically use some method to check that landings are being recorded accurately onto trip tickets or other landings recording method. Current NMFS methodology uses either shore side monitoring efforts which oversees landings and offloads by percentages (some percentage of vessel landings is observed) or as designed in the Gulf by electronic profile. In Alaska and New England, for instance, the goal is to check 15-20% of all offloads for accuracy. This is labor intensive, industry-wide, and performed by uniformed officers. In the Gulf, they have taken a different approach. The electronic IFQ system has a series of checks and balances incorporated into the process. Collectively, the information develops a profile. While any officer is free to check any vessel landing, its catch, and monitor the offload, there are no mandatory percentages. Rather the profiles themselves notify enforcement if something is potentially amiss. That way, a very limited number of law enforcement personnel can operate in what is essentially a “target rich environment” but the industry as a whole is not subjected to countless boardings which only confirm compliance. Sometimes, checking offloads for accuracy is conducted by a third party contracted by the management agency or fishermen, as is the case in the British Columbia LAPs.

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Discussion

However, it is recorded, this type of monitoring helps to ensure that landings do not exceed AHP holdings and that this information is recorded accurately. Currently, there is no monitoring type effort that does this for the South Atlantic commercial snapper grouper fishery. However, this may be a desirable design aspect to have built into a LAP. The background on current biological sampling, paper logbook, electronic logbook, and video monitoring (see above) can provide the Workgroup with some sense of capability and possible cost.