2015 Maryland FMP Report (July 2016)
Section 7. Blue Crab (*Callinectes sapidus)*

The overall blue crab population showed another year of growth based on the results from the 2015-2016 winter dredge survey (WDS). The estimated abundance of spawning age females increased for the second year in a row, nearly doubling to 194 million. Mature female harvest remained at a sustainable level for the eighth consecutive year. Based on the female-specific biological reference points adopted in 2011 the Chesapeake Bay blue crab population is not depleted and overfishing is not occurring. Even with continued population growth conservative management efforts have been continued because the abundance of spawning age females is below the recommended target abundance of 215 million crabs.

Status of Chesapeake Bay Blue Crab Management

The Chesapeake Bay Program (CBP) adopted a Blue Crab Fishery Management Plan (CBBC FMP) in 1989. The plan was revised in 1997 with the following objectives: provide long-term protection for the blue crab stock and maintain a stable stock; establish quantitative targets (such as abundance, biomass, or other indices) and biological reference points. In 2003, Amendment 1 to the 1997 CBP Blue Crab FMP was adopted. The purpose of Amendment 1 was to formally adopt biological reference points for managing the resource; to reaffirm strategies for reducing fishing effort; and to recognize the importance of biological monitoring, habitat protection and ecosystem processes. Amendment 2 was developed in 2011 to formally adopt the new female-specific reference points and to recognize the importance of fishery-independent and fishery-dependent monitoring. Amendment 2 was incorporated by reference into Maryland regulation in September 2012. The CBBC FMP and amendments are scheduled for an in-depth review once the next stock assessment is completed (2017).

Stock Status

The Chesapeake Bay blue crab stock is currently not overfished and overfishing is not occurring. A full stock assessment was completed and peer reviewed in 2011. The 2011 stock assessment used an integrated estimate of management reference points and stock status. Previous stock assessments did not directly link the two parameters. The female-specific biological reference points (BRPs) are based on estimates of age 0+ female crabs (the exploitable stock) and the abundance of age 1+ female crabs (an index of the spawning stock). Recruitment (the estimated number of age 0 crabs – crabs that are less than 60mm or 2.4 inches) increased from 269 million in 2015 to 271 million crabs in 2016. The estimated abundance of spawning age female crabs was 194 million, an increase from 2015. The exploitation fraction was 15% in 2016, below the target (25.5%). The status of the stock from 2011-2016 based on the female-specific target and threshold is found on Table 1. A stock assessment update is scheduled for 2017.

In order to ensure that male abundance does not drop below a critical level relative to female abundance, the Bay jurisdictions developed conservation points of reference for male crabs. The points of reference were updated in 2014 to include a scaling factor that is consistent with the way female BRPs are calculated. The Chesapeake Bay Stock Assessment Committee (CBSAC) recommended the following conservation triggers for male crabs. If the male exploitation rate exceeds 33% or if the female exploitation rate is below 34% and the combined male/female rate exceeds 53%, the Bay jurisdictions should consider conservation measures for male crabs. The male conservation triggers are based on the second highest exploitation value in the time series of data and does not represent a biologically significant parameter. The 2015 estimate of male exploitation was 22% and no management action is recommended for male crabs at this time.[1] Estimates of male exploitation for 2016 cannot be calculated until the completion of the 2016 fishery (December).

The Baywide winter dredge survey (WDS) is the primary indicator of blue crab stock status in Chesapeake Bay. The WDS provides an annual estimate of over-wintering blue crab abundance by age and gender. The abundance of female spawning age crabs (age 1+) is used to determine if the population is overfished. The number of spawning age female crabs increased by 92% in 2016.

Management Measures

A control rule for the blue crab stock has been used to assess the status of the stock since 2001. Control rules describe a variable as a function of another variable that management can influence or have some control over.[2] Determining the variables depends on the characteristics of the stock and the fishery. These variables are then used to develop definitions of biological reference points, i.e., targets and thresholds. In developing a control rule, the selection of a target is risk-averse even though it is expected that the target may be exceeded because of natural annual variability. Currently, the control rule for blue crabs is based on female spawning stock biomass and exploitation.

In Maryland, catch limits and closed periods are implemented to maintain an allowable female harvest that is associated with the 25.5% exploitation target. The allowable female harvest changes with estimated annual abundance. Maryland DNR determines the allowable harvest and then develops a suite of limits designed to achieve but not exceed the allowable harvest. The crabbing industry provides input on which combinations of limits work best for the industry via the Blue Crab Industry Advisory Committee.

New regulations for recreational crabbing that went into effect in 2013 are still in place. Waterfront property owners must register their crab pots in order to use them from their piers. Anyone using collapsible traps or net rings must obtain a recreational license. A person can use a hand-line or dip net to catch crabs without a license. Refer to the Maryland DNR webpage for more details http://dnr2.maryland.gov/fisheries/Pages/regulations/blue-crab.aspx

In 2015 the estimated abundance of spawning females increased and was above the minimum safe threshold of 70 million crabs. The additional vessel bushel limits implemented in 2014 to provide additional protection for spawning-age females were effective through April 2015. The increase in the size limit for female peelers was effective until July 14 making the minimum size 3½ inches for the entire 2015 season. With an increase in estimated abundance of spawning age females and harvest below the recommended target, the daily mature female bushel limits were increased starting July 2015.

The Fishery

As population levels change, maintaining the exploitation target may result in either an increase or a decrease in harvest. The 2015 baywide (Maryland, Virginia and Potomac River) commercial harvest was approximately 49.6 million pounds (Figure 2). The percentage of females removed by harvest in 2015 was approximately 15% which was below the recommended target (25.5%) and threshold (34%) (Table 1). Prior to 2008, recreational harvest was assumed to be approximately 8% of the total harvest. Since recreational crabbers can no longer harvest female crabs in Maryland the estimated harvest is now based on 8% of the bay wide male harvest plus 8% of Virginia female harvest for a total of 3.5 million pounds baywide in 2015. Adding up the harvest from each fraction of the harvesting sectors and across the entire Chesapeake Bay, the 2015 total harvest was approximately 53.1 million pounds.[1]

Issues/Concerns

Although management measures have successfully kept the exploitation of female crabs below the target and kept abundance above the threshold, conservation measures need to remain in place to ensure that the population continues to increase. The blue crab population is subject to high natural variability from year to year due to overwintering mortality, recruitment (the number of juveniles >60mm), and other unknown variables. These factors emphasize the need to determine an appropriate margin of conservation to account for environmental variability.

Since 2012 a pilot study led by an industry-based group has been testing a new way to accurately report commercial harvest data in a more timely fashion using electronic technology. This is a co-management approach between the crab harvesters and MDNR. The electronic reporting program includes a “hail-in, hail out” protocol and random catch verification which should provide improved and timely commercial harvest data. A report on the results of the pilot study can be found after the implementation table.

Maryland has continued with a text messaging system to help watermen stay abreast of blue crab regulations and any seasonal changes that may occur. Watermen can subscribe to receive text message reminders a day or two before a regulation change goes into effect.

Latent effort refers to the number of people holding fishing licenses that have not been actively harvesting crabs but could return to the fishery at any time. This part of the fishery continues to be a management concern. Maryland and Virginia have been successful at reducing the number of people holding crabbing licenses through a federally funded license buy-back program in 2009 and 2010. The number of inactive licenses needs to be monitored and additional recommendations formulated. New methods for calculating recreational catch and effort is also needed to fully characterize total removals by the fishery.

As part of the Sustainable Fisheries goals in the Chesapeake Watershed Agreement (June 2014), a blue crab abundance and management outcome was developed. It states: “Maintain a sustainable blue crab population based on the current 2012 target of 215 million adult females. Refine population targets through 2025 based on best available science.” The bay jurisdictions developed a management strategy to achieve the outcome and recently developed a work plan for 2016 and 2017. http://www.chesapeakebay.net/managementstrategies/strategy/blue_crab_abundance_and_management

Enforcement

The enforcement of commercial and recreational fishing regulations is critical to management success. There has been an initiative towards improving enforcement of blue crab conservation/management measures. In Maryland, the Natural Resource Police (NRP) hired additional officers to provide a dedicated enforcement effort for crab management. The NRP has successfully increased the total number of enforcement hours and initiated a targeted enforcement protocol through a program called “Don’t Get Pinched.” In addition, there have been increased penalties for offenses and improved judicial action.

Conclusion

The Bay jurisdictions will continue to investigate alternative strategies to improve management of the blue crab resource in 2016. In preparation for the stock assessment update the jurisdictions have determined terms of reference. The state jurisdictions will take the lead on addressing topics for the stock assessment update.

Although steps have been made to improve harvest accountability and reporting for both the commercial and recreational fisheries, more improvements are needed. Since female abundance is not at target levels, the jurisdictions need to maintain conservative management measures and make adjustments to ensure that harvest levels are commensurate with abundance indices.

References

[1] Chesapeake Bay Stock Assessment Committee (CBSAC). 2016 Chesapeake Bay Blue Crab Advisory Report, June 2016.

[2] Miller, T., Wilberg, M., Davis, G., Sharov, A., Colton, A., Lipcius, R., Ralph, G., Johnson, E., and Kaufman, A. 2011. Stock Assessment of the Blue Crab in Chesapeake Bay. Tech. Rept. Series No. TS-614-11 of the University of Maryland Center for Environmental Science

[3] Restrepo, V. and J. Powers. 1999. Precautionary control rules in US fisheries management: specification and performance. ICES Journal of Marine Science, 56:846-852

Table 1. Female-specific biological reference points and status of the blue crab stock, 2011-2016

Reference Points			Stock Status					
	Target	**Threshold**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Female-specific Exploitation Fraction	25.5%	34% (max)	24%	10%	23%	17%	15%	TBD*
Abundance (millions of female crabs)	215	70 (min)	190	97	147	68.5	101	194

(2016 Chesapeake Bay Blue Crab Advisory Report)
*Exploitation fraction cannot be calculated until the 2016 harvest data is complete

Figure 1. Estimated abundance of spawning age female crabs (age 1+) in Chesapeake Bay, 1990-2016

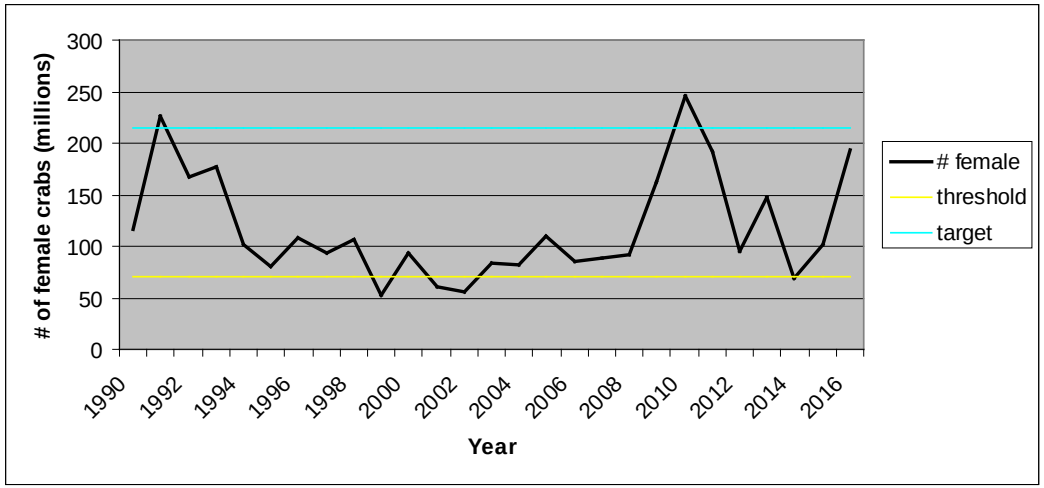
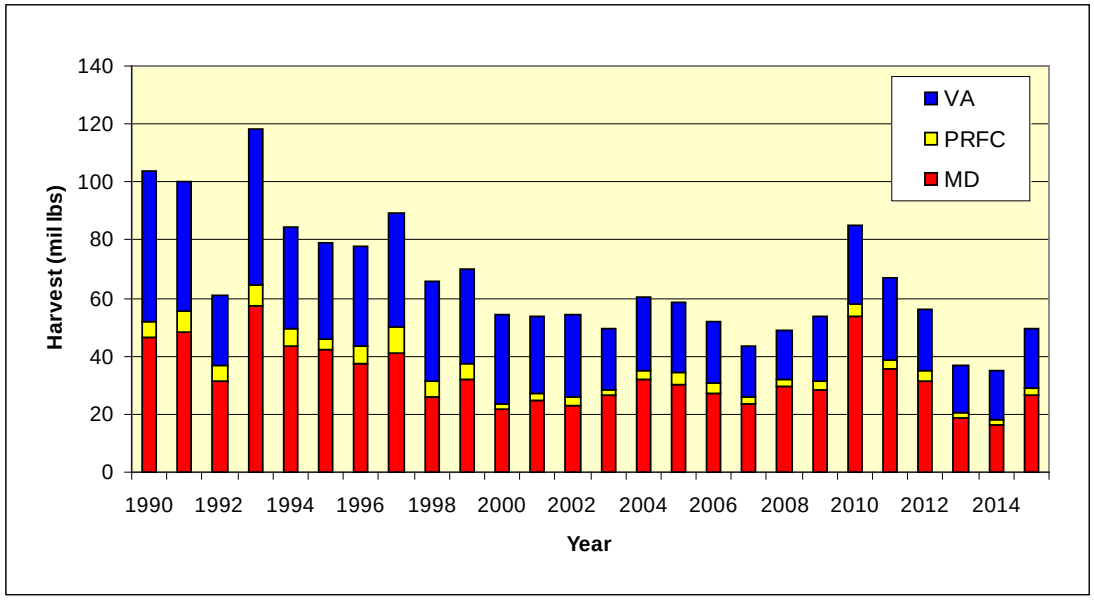


Figure 2. Chesapeake Bay Commercial Blue Crab Harvest, 1980-2015



2003 Chesapeake Bay Program Blue Crab Fishery Management Plan Amendment 1 (updated 07/2016**)**			
Problem Area	**Action**	**Date**	**Comments**
Stock Status Strategy Chesapeake Bay stock has stabilized at historically low levels but continues to be at risk for recruitment failure.	Action 1 CBP jurisdictions will adopt a threshold fishing mortality rate that preserves 10% of the blue crab spawning potential, relative to an unfished stock, and a minimum stock size threshold.	Began in 2001; formally adopted in 2003 2011 Continue **2016**	The 2005 Stock Assessment recommended using the exploitation fraction (the proportion of the vulnerable population that is harvested each year) instead of F for evaluating BRPs. The 2010 exploitation estimate was below the threshold and has been below the threshold since 2008. As a result of the 2011 stock assessment, new female-specific targets and thresholds were adopted. The new female target and threshold are 215 million female crabs and 70 million female crabs, respectively. **Female abundance (194 million crabs) is currently above the threshold level but below the target level. A stock assessment update is scheduled in 2017.**
	Action 2 CBP jurisdictions will adopt a target fishing mortality of F_{20}, which if achieved, will increase the blue crab spawning potential from 10% to 20% relative to that of an unfished stock.	Began in 2001; formally adopted in 2003 Continue **2015**	The target fishing mortality (F) was replaced by the exploitation target of 46%. As a result of the 2011 stock assessment results, the female-specific exploitation target and threshold are 25.5% and 34%, respectively. **The 2015 female-specific exploitation was 15%, below the target level. An exploitation fraction for 2016 cannot be calculated until the completion of the 2016 fishery (December 2016).**
	Action 3 CBP jurisdictions will develop control rules based on the biological reference points (BRPs) for managing the blue crab resource. (The control rule was adopted in 2001 and updated in the 2005 stock assessment. It represents the relationship between adult crab abundance, exploitation and management reference points. **The 2011 control rule is a major improvement over the previous model because it integrated the calculation of reference points within the model rather than using two separate processes as in the 2005 assessment.)**	2003 2005 2006 2008 2011 On-going	In 2006 the overfishing limit was defined as 86 million age 1+crabs (threshold value). An interim target of 200 million age 1+ crabs was established in 2008. The blue crab stock was not overfished in 2010. **In 2016, based on the female-specific BRPs adopted in 2011, the blue crab stock is not overfished and overfishing is not occurring.**

2003 Chesapeake Bay Program Blue Crab Fishery Management Plan Amendment 1 (updated 07/2016)

Problem Area	Action	Date	Comments
	Action 4 CBP jurisdictions will utilize the results of fishery-independent surveys to determine stock status.	On going	**Results of the 2015-2016 Winter Dredge Survey (WDS) indicated the abundance of female age 1+ crabs was 194 million crabs. Spawning-age crab abundance was above the threshold and considered not overfished.**
Fishing Effort Strategy CBP jurisdictions will adjust fishing effort to achieve the adopted BRPs.	Action 5 CBP jurisdictions will reduce the exploitation rate of legal-sized blue crabs to meet the target BRPs.	Began in 2001; continue 2008 2011 **2016**	The Bay jurisdictions implemented new regulations in 2008 & 2009 to reduce exploitation on female crabs. Harvest regulations have been adjusted as needed to meet the target exploitation rate. In 2011, exploitation rates were changed to female-specific rates. Exploitation rates have been below the target since 2010 (Table 1). **The 2015 baywide harvest was 53.1 million lbs.** There is a large amount of latent effort in the blue crab fishery (latent effort = fishing effort not currently utilized). In MD there are approximately 6,000 individuals with commercial crab licenses but only about 2,000 are actively crabbing. MD implemented a buy-back program for LCC (limited crab catcher) licensees. VA has also implemented a buy-back program and utilized a reverse auction system. Between 2009 and 2010, MD reduced the LLC by about 700 licensees resulting in about a 35,000 pot reduction in effort. **The 2016 Chesapeake Bay Blue Crab Advisory Report recommended further evaluation of latent and active effort.** **http://www.chesapeakebay.net/documents/CBSAC_2016_Report_6-30-16_FINAL.pdf**
Monitoring Strategy CBP jurisdictions will collect fishery -dependent and fishery-independent data on blue crab resources.	Action 6 CBP jurisdictions will continue to monitor blue crab resources in the bay and work towards developing a baywide monitoring approach	On going	In 2010/2011, recruitment, as measured by the abundance of age 0 crabs in the WDS, remained low and was below the average recruitment of 258 million crabs. Although the number of juveniles had declined, it was one of the largest juvenile abundance indices since 1998. In 2011/2012, recruitment was the highest on

2003 Chesapeake Bay Program Blue Crab Fishery Management Plan Amendment 1 (updated 07/2016)			
Problem Area	**Action**	**Date**	**Comments**
			record but declined by almost 50% the following year (2012-2013). **WDS results indicate that recruitment increased from 269 million age 0 crabs in 2015 to 271 million crabs in 2016.**
Habitat Strategy CBP jurisdictions will identify and protect critical blue crab habitat.	Action 7 MD and VA will consider designating additional sanctuary areas to protect blue crab habitat based on new research data.	Continue	Closure of the VA blue crab spawning sanctuary (928 square miles) was extended an additional month (May-Sept) to protect female crabs. The EBFM life history brief indicates that blue crabs occupy a wide range of estuarine habitats and utilize a series of habitats sequentially along a salinity gradient.
	Action 8 CBP jurisdictions will continue to protect SAV in potential, post-larval settlement areas.	Continue	Sav beds in near shore habitats provide essential habitat for blue crabs, especially during their post larval and juvenile stages. SAVs provide critical shelter for many key species besides crabs. SAVs help improve water clarity, add oxygen to the water, and reduce shoreline erosion.

2003 Chesapeake Bay Program Blue Crab Fishery Management Plan Amendment 1 (updated 07/2016)

Problem Area	Action	Date	Comments
	Action 9 CBP jurisdictions will restore and protect SAV in the Chesapeake Bay to achieve the new goal of 185,000 acres by 2010.	Continue **2015**	Actions have been identified by CBP jurisdictions to achieve this goal, including the attainment of water quality in shallow-water bay grass designated use areas. In the Chesapeake Watershed Agreement (June 2014), the SAV goal/outcome was adjusted to reflect a more reasonable timeframe. The outcome states: "Sustain and increase the habitat benefits of SAV in the Chesapeake Bay. Achieve and sustain the ultimate outcome of 185,000 acres of SAV bay-wide necessary for a restored Bay. Progress toward this ultimate outcome will be measured against a target of 90,000 acres by 2017 and 130,000 acres by 2025." **In 2015, there were an estimated 91,621 acres of underwater grasses in the Chesapeake Bay, an increase by 21%. SAVs were mapped using 4 salinity zones rather than geographic zones. The change to salinity zones better reflects SAV community types and species composition. For a more detailed description of current and historic status, go to: http://web.vims.edu/bio/sav/sav15/exec_summary.html**
	Action 10 CBP jurisdictions recognize the value of salt marsh-fringed habitats and will promote the protection and restoration of marsh-fringed shorelines, creeks and coves	Continue	Salt marsh habitats protect molting blue crabs and support many other prey species. These areas are susceptible to shoreline development and should be protected.

2003 Chesapeake Bay Program Blue Crab Fishery Management Plan Amendment 1 (updated 07/2016)			
Problem Area	**Action**	**Date**	**Comments**
Ecosystem strategy CBP jurisdictions will incorporate information on ecosystem processes relating to blue crabs as it becomes available and utilize the information to determine management actions as necessary	Action 11 Utilize the guidelines from the Fisheries Ecosystem Plan (FEP) to incorporate multi-species and ecosystem considerations into existing CBP fishery management plans.	Began 2005 Continue 2014 On-going	A new EBFM operational structure was facilitated through MSG. An EBFM blue crab species team was formed in late 2008. The team completed biological briefs on important blue crab issues. This information is available at **http://www.mdsg.umd.edu/programs/policy/ebfm/** The recommendation from the group is to use the briefs when the Blue Crab FMP is revised. In 2014, the Chesapeake Bay Program developed the Chesapeake Watershed Agreement. The document includes two outcomes for blue crabs. **A biannual work plan was developed for 2016/2017 to address the outcomes.**
	Action 12 As data becomes available on food web dynamics, adjust fishing mortality rates on the blue crab population to include predator and prey needs.	On-going	Blue crabs play an important role in the food web of the bay. They are prey for important species of finfish and are predators on other species such as mollusks. Blue crabs play a key role in the trophic dynamics of the Bay & are considered the foremost benthic consumer in the Bay foodweb.
	Action 13 Evaluate the impact of non-native crab introductions on the blue crab population and develop recommendations accordingly.	On-going	There is concern over the interaction of blue crabs with non-native species of crabs, which include the green, mitten and Japanese shore crab. In 2006 MD adopted regulations that prohibit the transport of green or Japanese crabs. MD also adopted regulations to prohibit the import, transport, purchase, possession, sale or release of mitten crabs. The states have implemented education and outreach programs to highlight the problems associated with invasive species.

Acronyms:
BRP= biological reference points
CBSAC= Chesapeake Bay Stock Assessment Committee
CBP= Chesapeake Bay Program
EBFM = Ecosystem based fisheries management
FMP = Fishery Management Plan
MSG = Maryland Sea Grant
QET = Quantitative Ecosystem Team

Final Report

Aspects of Commercial Crabbing Activity and Harvest Reported Electronically by the Maryland Blue Crab Industry

Prepared for:

The Maryland Department of Natural Resources
Fisheries Service
Maryland Department of Natural Resource
580 Taylor Ave. B-2
Annapolis, MD 21401

Prepared by:

Oyster Recovery Partnership
1805 Virginia Street
Annapolis, MD 21401

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OYSTER RECOVERY PARTNERSHIP
CHESAPEAKE APPRECIATION, INC.

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EXECUTIVE SUMMARY

In 2012, Maryland blue crab managers, fishing industry representatives and other stakeholders implemented a pilot project with a goal to evaluate if daily reporting using an electronic reporting system could improve the reliability of harvest information reported by the blue crab fishery. The pilot project was the outcome of discussions between Maryland fisheries managers and the Blue Crab Design Team that focused on identifying opportunities where industry and management could work together to improve industry accountability and enhance overall blue crab management (Slacum et al. 2013). To achieve the goal of the pilot project, two specific objectives had to be met: (1) provide industry with access to an electronic reporting system and evaluate if industry had the capability to report fishery information daily using mobile phone or personal computing technology; and (2) develop and implement methods to verify (i.e. dealer, dockside, and system monitoring) reported fishery information and use those methods to evaluate the accuracy of reported fishing activity. The results of the 2012 Pilot Project demonstrated that industry had the capability to use an electronic reporting system daily, and reported fishing activity could be successfully verified for accuracy. Based on these results, the Blue Crab Industry Design Team and Department of Natural Resources endorsed the final project recommendations which included some system and reporting modifications and the continuation of the Pilot Project through the 2013 crabbing season.

The 2013 Pilot Project was conducted for an entire crabbing season with a goal of recruiting more fishermen who would use their own mobile devices for reporting in order to evaluate the system on a scale and scenario similar to the entire fishery. The Project also evaluated the ability for participant's to choose their day off from fishing and the effectiveness of multiple harvest verification techniques. The outcome of the 2013 Pilot Project showed that industry had the ability to use their own mobile devices to report using the electronic system, the system could effectively monitor the participants' choice of day taken off and harvest monitoring techniques worked at near optimal levels with a few possible improvements. Based on these results, it was recommended that the system continue during the 2014 crabbing season with the exception of limiting the level of effort placed on monitoring and evaluating the system due to reduced financial resources to maintain these services.

The goals of the 2014 Pilot Project were to maintain the system's availability to allow for the entire blue crab industry's use on a voluntary basis while increasing watermen participation using various outreach methods. This year monitoring efforts were also limited and targeted to gather additional specific industry information. Three components of electronic harvest reporting were monitored and assessed during the 2014 Pilot Project:

(1) Industry Participation
(2) System Use by Participants
(3) Harvest Monitoring Techniques

INDUSTRY PARTICIPATION

Various outreach techniques were used to increase watermen use in the electronic reporting system including advertisement from previous and current Pilot Project participants and Design Team members to express the availability of the system to other commercial crabbers, an informational booth set up at the 2014 Watermen's Expo in Ocean City, MD to further advertise availability of the system and train interested watermen and posted information on the Maryland DNR commercial fishing webpage where watermen could also submit a request to use the system through a web form. Any new 2014 recruits were trained through one-on one in person training sessions, over the phone, or by watermen who had participated in the Pilot Project during the past two years.

Over 150 watermen expressed interest in participating in the 2014 Pilot Project and the majority of these were trained to report hails and harvest electronically, however, several watermen who were trained to use the system did not report their harvest electronically, leaving a total of 98 watermen that continued to use and evaluate the system during the 2014 Pilot year. Reasons for watermen who were trained not reporting their harvest electronically include their harvest being reported by other watermen who they were working with or deciding to drop out of the Pilot Project for reasons such as selling or transferring a license.

Industry Participation and System Use Highlights

2014 Participation:
- 98 watermen reported harvest
- Crab Pots and Trotline were the most frequently used gear types

System Use:
- 3,603 crabbing trips reported
- Watermen used full system functionality
- 36% of watermen revised hails and 22% revised harvest information showing they used the flexibility of the system

Conclusions:
- Industry has the ability to access and report daily fishing activity and harvest using industry owned mobile devices
- Watermen using the system effectively participated in a dockside and dealer monitoring system
- Interested participants required little training and had few problems over the course of the Pilot

Participants of the 2014 Pilot Project crabbed throughout the Maryland tributaries and main stem regions of the Maryland portion of the Chesapeake Bay. In order to enforce the harvest verification component of the program, watermen were grouped into seven large geographic regions encompassing several coastal counties and parts of counties based on the number of offload locations in each region. Watermen participating in the 2014 Pilot Project used nearly all types of commonly deployed gear in the State of Maryland including crab pots, trotlines, peeler pots, dip nets, collapsible traps and scrapes/dredges with the majority of participants using crab pots or trotlines. A few watermen used multiple gear types throughout the project to harvest crabs.

Watermen participating in the Pilot Project had an option to report using one of four reporting platforms or a combination of multiple of the following reporting platforms: texting, mobile website, portal website or a call center. The call center platform was used for to report harvest throughout all seven reporting regions. The remaining platforms were used in the majority of the regions with each platform not being used in only one or two of the regions.

PARTICIPANT USE AND PERSPECTIVES ON THE CALL CENTER

Two series of calls were made to watermen using the call center during the 2014 Pilot Project. The first series of calls was made in order to establish if a connectivity issue had been resolved after numerous complaints to the help line were made stating that the call center not answering was preventing them from reporting. The second series helped to gather the watermen's perspectives of the call center,

why they chose to use the call center and whether any provided incentives would persuade them to switch to another reporting platform. The connectivity issue was able to be identified and resolved after numerous calls between Pilot Project staff, participating watermen using the call center and the call center representative and it was established that participants could successfully reach the call center to report. The feedback collected from the second series of calls established that the majority of watermen felt this reporting platform was sufficient for their reporting needs, they chose to use the call center because they felt they were not very tech savvy and it was all they could use, they had phones with other capabilities (i.e. texting), and they felt there was nothing that could be done to persuade them to switch reporting devices.

SYSTEM USE BY PARTICIPANTS

The Maryland 2014 crabbing season extended from April 1, 2014 to December 15, 2014. The first electronic crabbing trip was submitted on April 3, 2014 and there were a total of 3,603 crabbing trips reported by all participating watermen through September 28, 2014. The peak week of operation throughout the season was the week of August 3, 2014.

Reporting by watermen was compared by month, gear type, and day of week. July and August had the highest percentage of participant use with nearly all watermen trained to use the system, reporting hails and harvest. April had the least number of watermen reporting harvest and hail information. Watermen using crab pots had the highest number of trips reported, however, the number of watermen reporting harvest using trotlines was higher than those reporting harvest with crab pots. The highest amount of trips occurred during weekdays, however, the number of watermen reporting on weekends was similar to that on weekdays.

After submitting a start hail, end hail or harvest report the watermen had the option and ability to revise that hail or report in order to verify their data entry or correct a previously made estimate. About a third of watermen made a revision to one of their hails throughout the 2014 Pilot Project and less than a quarter of the participants revised their harvest information, totaling to an even smaller percentage of the total trips that had revisions. Over the course of the program, almost half of the watermen forgot to submit at least one end hail and over half forgot to submit at least one harvest report.

Harvest Verification Highlights

Operations:
- 151 crabbing trips were targeted for dockside monitoring (Spot Checks) by roving monitors
- 1 dealer submitted 152 dealer reports from harvest purchased from 3 watermen
- 111 successful spot checks had the potential for harvest report comparisons

Performance:
- 75% of all attempted spot checks were successful
- 28% of harvest comparisons had discrepancies
- Dockside monitoring performed optimally when watermen adhered to recommended "Best Reporting Practices"
- Dockside monitoring and dealer reporting were effective at providing critical information to develop approaches for identifying potential typographical errors associated with electronic reporting and for verifying harvest report accuracy

HARVEST VERIFICATION

The 2014 harvest verification program followed the basic design that was implemented during 2012 and 2013 Pilot Projects. Roving monitors were hired to perform "spot checks" of individual watermen's harvest when it was offloaded from their vessels between August 10 and September 28, 2014. Two different methods were used to conduct "spot checks". One method was used to target watermen of higher priority or those who crabbed less than 40 days throughout the season. These "Priority List" days were scheduled randomly on weekends within each region based on monitoring 10% of trips made by high priority watermen as reported in July. The second method

"Targeted Monitoring" focused on scheduling monitoring at as many different offload locations as possible when monitoring occurred. Targeted spot checks were also scheduled randomly but during the week days and within each region based on monitoring 5% of the trips made by all watermen except high priority watermen as reported in July. All watermen landing within a roving monitors region on a "Target" day had the potential to be monitored.

EFFECTIVENESS OF DOCKSIDE MONITORING

A total of 1,394 trips occurred between August 10 and September 28, 2014, when spot checks were conducted, therefore having the potential to be monitored. Spot checks were only attempted on 11% of all scheduled trips and were successful on 75% of those attempted. A spot check was defined as successful when a roving monitor was able to intercept a waterman and document the entire harvest offloaded from the vessel. The main reason for unsuccessful spot checks was due to offloads not occurring when scheduled (37 attempted spot checks, 97%).

ROVING MONITOR AND WATERMEN REPORT COMPARISONS

Harvest information reported by watermen was compared to roving monitor reports (spot checks) to evaluate the accuracy of reported harvest (Table 4-2). Discrepancies between reports were identified by comparing the six reported crab harvest grades (#1's, #2's mixed males, females, peelers, and soft crabs) between watermen and roving monitor reports. The accuracy of a waterman's harvest was determined using a two-step process. The first step determined the accuracy of roving monitor reports and the second step involved screening discrepancies identified between reports and evaluating the source of the discrepancy to determine if the discrepancy was a legitimate difference between monitoring data and the harvest report. Harvest report accuracy was then quantified as the percentage of differences between reports. There were a total of 31 trips with roving monitor reports that could be compared to watermen harvest reports where data entry discrepancies occurred (28% out of the 111 trips with successful roving monitor spot checks) resulting in 56 harvest grade discrepancies. In 2014, harvest reported in bushels was limited to reporting in increments of quarter bushels which resulted in a 5% decrease in the number of discrepancies caused by rounding from 2013 to 2014.

EFFECTIVENESS OF DEALER REPORTING AND DEALER AND WATERMEN REPORT COMPARISONS

A total of 152 dealer reports were submitted into the electronic reporting system concurrent with harvest reports from these three watermen from May 14 to September 27, 2014 during which dealer reporting was conducted. These dealer reports were also used to determine data discrepancies for reported harvest. Only four grades of the harvest could be compared (#1's, #2's mixed males, and females) between watermen and dealer reports because the participating dealer did not purchase peelers or soft crabs.

Harvest accuracy was determined by screening discrepancies identified between dealer and watermen harvest reports and evaluating the source of the discrepancy to determine if there was a difference between the harvest reports. Harvest report accuracy was then quantified as the percentage of differences between reports. There were 134 trips out of a total of 146 trips with report comparison discrepancies and a total of 442 harvest grade comparisons with discrepancies. Two common groups of

discrepancies were identified as harvest reporting with different units and data entry error. The majority of the discrepancies were due to a harvest reporting unit difference whereas the watermen and the dealer reported harvest each with different units (either bushels or pounds).

SYSTEM MONITORING

Currently the reporting system has no option for watermen to acknowledge when they do not intend to actively crab during specific time periods. The system assumes that a waterman is not fishing when no trip reports are submitted by watermen. However, since the use of the system was voluntary, some effort was required to contact watermen during the season that had been trained to use the system, but for whom no trips had been reported.

System Monitoring Highlights

System Monitoring:
- Multiple system reports and other monitoring tools were implemented during 2014 to monitor and assess information submitted to the electronic reporting system

Performance:
- Few issues were encountered with the system's ability to process trip data which were minimal and quickly resolved
- Harvest information was immediately available to managers
- System reports identified data outliers
- System reports identified instances when reporting did not follow "Best Reporting Practices"
- System reports identified occasions when harvest was not reported allowing managers the opportunity to immediately follow-up and retrieve the missing harvest
- Harvest information obtained through follow-up was less accurate than harvest reported on the day of the crabbing trip
- Some areas of poor cellular service were documented, but watermen still found ways to report in those areas
- System effectively monitored watermen's choice of day off

Two series of calls were made during the crabbing season. The first series of calls were conducted mid-season to determine if watermen who had not reported for an extended period of time were either not crabbing or were not intending to use the electronic system to report. The second series of calls were made near the end of the season to follow-up with watermen who intended to use the system, but had not reported for the entire season, and determine when individual watermen expected to stop crabbing for the year.

The first series of calls was directed towards 31 watermen that were considered to be inactive in the electronic reporting system (had not reported any trips throughout the crabbing season) to determine whether or not they had been crabbing for the year. If they had been crabbing, it then had to be determined if they were still reporting using the paper method or if they were using the electronic system and therefore needed their harvest reports to be back-entered into the FACTS system. Out of the 31 participants that were called, 20 were reached leaving 11 who were unable to be contacted. Eighteen out of the 20 crabbers that were contacted indicated that they had not yet been crabbing or did not plan on going crabbing for the entire season. The remaining 2 participants did report that they had been crabbing; one who had been reporting using the paper reports and the other who was only using his recreational license to crab.

The second series of calls were conducted in the month of October, to determine if watermen who had been inactive in the system for an extended period of time (meaning they had not reported since August, if not earlier in the year) were still crabbing or intended to crab before the season was over. Previously, participants were given a check box that they were able to check during their reporting process when they determined that it would be their last day of crabbing for the season. This function was later removed from the reporting system so that it then had to be assumed that when no trip reports were submitted

for an extended period of time, the waterman was no longer crabbing. The follow up calls were made to confirm these assumptions and establish whether or not the watermen had been crabbing since their last crabbing trip or determine if they were finished crabbing for the season. There were 20 watermen that were identified for these calls, of which only 12 were reached. All 12 watermen who were reached reported that they had not been crabbing since their last date reported and the majority of these watermen also claimed that they were finished or most likely finished crabbing for the season.

SYSTEM MONITORING OF BEST PRACTICES

System reports and other monitoring tools were implemented during 2014 to assess information submitted to the electronic reporting system. Assessing system performance was based on the ability of the system to remain operational for reporting during the season and being able to identify and track reporting inconsistencies along with sources of error. Reporting inconsistencies were considered to be deviations from the established reporting "Best Reporting Practices" that were established based on recommendations from the 2012 and 2013 Assessment and have the potential to increase the amount of effort required to verify reported harvest as well as undermine the ability of the system to acquire timely and accurate harvest information. Additional monitoring of system performance, such as feedback through the help line and cellular service problems, were conducted manually by Pilot Project staff.

The ability of participants to follow the "Best Reporting Practices" was evaluated by comparing the submission times of hails and harvest logs and through monitoring of other reporting process behaviors. If a waterman submitted an end hail prior to 8 A.M., it was flagged as atypical due to the majority of watermen typically finishing crabbing after 10 A.M. Instances such as this suggest the end hail was not submitted at the end of a crabbing trip. Seven percent of watermen submitted trip end hails before 8 A.M. for a total of 17 trips. The second type of atypical behavior was based on the interval of time between start and end hails. If a trip had a start and end hail submitted within 15 minutes, it could be assumed that either the start hail was not submitted at the beginning of a crabbing trip or the end hail was not submitted at the end of a crabbing trip due a typical crabbing trip lasting longer than 15 minutes. Forty-eight percent of watermen submitted at least one start and end hail within a 15 minute interval which generated a total of 575 flagged trips. The last atypical trip identifier focuses on watermen sending harvest reports after 5 P.M. If a harvest report was submitted after 5 P.M., it was assumed to be an instance where harvest was not reported while the waterman was still on the water at the end of their crabbing day. Harvest reports submitted after 5 P.M. occurred on 516 trips by 63% of the watermen.

SYSTEM MONITORING OF MISSING HARVEST REPORTS

A total of 3,603 harvest reports were submitted by watermen from all reporting platforms. A total of 185 (5%) crabbing trips had missing harvest reports. The trips missing harvest reports submitted to the electronic reporting system had a hail but no harvest report, suggesting occasions when a waterman forgot to submit harvest after a crabbing trip. These instances were noted during the Pilot Project and either the watermen contacted the Maryland DNR to provide them with the harvest or the Maryland DNR followed up with the watermen.

Starting the week of August 3, 2013, the system was modified to include an automated text message which was sent to watermen that hailed in the morning and had not sent a harvest report by 5 P.M. Three additional text message reminders were sent at 6 P.M., 7 P.M., and 8 P.M. if harvest was still not received by those times. The text message reminders made a marked improvement in harvest log reporting with a decrease in missing harvest reporting from 11% to 2%

The majority of watermen using the electronic reporting system always reported harvest. When missing harvest did occur, it accounted for only a small fraction of a waterman's total trips but required nearly three phone calls to recover the harvest. A trend showed that those watermen who reported more trips throughout the season also had more missing harvest reports.

ELECTRONIC REPORTING SYSTEM AND MOBILE DEVICE SUPPORT

Over the course of the 2014 Pilot Project, a toll-free help line was available to the watermen 24-hours a day to assist in troubleshooting any technical issues with the mobile device or reporting system and to provide an outlet for watermen to submit feedback on the 2014 Pilot Project. A log recorded the description of each call, date, and type of device the caller was using to report. Nineteen calls were logged from watermen throughout the 2014 Pilot Project. The most common call to the help line was watermen reporting that they could not get through to the call center and/or that there were long wait times to speak to a call center operator. Some of these calls pertain to the June 19th call center issue (Appendix A) which was quickly resolved. The next most common call type made to the help line was watermen calling to report harvest when they had forgotten to submit it using the system.

The Pilot Project was continued in 2014 with a goal to maintain the system and expand its use by the blue crab industry. Although participation increased from previous Pilot years, the number of watermen using the system is still a fraction of the total number of active license holders. Watermen who have decided to use the system have required limited training and have had few problems over the course of the Pilot Project. In addition, watermen using the system have also effectively participated in a dockside and dealer monitoring system. These techniques have been successful at verifying harvest and identifying important variables required to assess accuracy of reported information. As in 2013, the results from system monitoring during the 2014 Pilot Project demonstrated that the FACTS™ system can meet the Maryland DNR commercial harvest reporting standards of timeliness, accuracy and data verifiability with the exception that the level of effort required to recover missing harvest will need further assessment.

OYSTER RECOVERY PARTNERSHIP
CHESAPEAKE APPRECIATION, INC.

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Figures and Tables

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LIST OF PROJECT COLLABORATORS

Maryland Department of Natural Resources, Fisheries Service
Steve Early
Brenda Davis
Lynn Fegley

Oyster Recovery Partnership Program
Ward Slacum
Kara Muzia
Jennifer Walters
Stephan Abel
Penny Jurick

Coastal Monitoring and Assessment Program
Jodi Dew-Baxter
Ryan Corbin

Electric Edge Systems Group
Bryan Stevenson

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1.0 INTRODUCTION

In 2012, Maryland blue crab managers, fishing industry representatives and other stakeholders implemented a pilot project with a goal to evaluate if daily reporting using an electronic reporting system could improve the reliability of harvest information reported by the blue crab fishery. The pilot project was the outcome of discussions between Maryland fisheries managers and the Blue Crab Design Team that focused on identifying opportunities where industry and management could work together to improve industry accountability and enhance overall blue crab management (Slacum et al. 2013). To achieve the goal of the pilot project, two specific objectives had to be met: (1) provide industry with access to an electronic reporting system and evaluate if industry had the capability to report fishery information daily using mobile phone or personal computing technology; and (2) develop and implement methods to verify (i.e. dealer, dockside, and system monitoring) reported fishery information. These methods would then be used to evaluate the accuracy of reported fishing activity. The results of the 2012 Pilot Project demonstrated that industry had the capability to use an electronic reporting system daily, and reported fishing activity could be successfully verified for accuracy. Based on these results, the Blue Crab Design Team and Department of Natural Resources endorsed the final project recommendations which included some system and reporting modifications and the continuation of the Pilot Project through the 2013 crabbing season.

The 2013 Pilot Project was conducted for an entire crabbing season with a goal of recruiting more fishermen who would use their own mobile devices for reporting in order to evaluate the system on a scale similar to the entire fishery while also evaluating a variety of reporting devices.. In addition, the system's ability to allow participants to take any day of the week off from fishing was evaluated along with harvest verification techniques. The outcome of the 2013 Pilot Project showed that industry had the ability to use their own mobile devices to report using the electronic system, the system could effectively monitor the participants choice of day taken off and harvest monitoring techniques worked at near optimal levels with a few possible improvements. Based on these results it was recommended that the system continue during the 2014 crabbing season. However, the level of effort for monitoring and evaluating system components needed to be limited due to reduced financial resources to maintain these services.

The goals of the 2014 Pilot Project were to:

- Maintain the systems availability for the entire blue crab industry to use;
- Increase watermen participation through various outreach methods;
- Conduct targeted harvest monitoring techniques to gather additional industry specific information;
- Conduct limited system monitoring.

Information gathered during the 2014 Pilot Project is presented in this final report under three main project components, (1) Industry Participation, (2) System Use by Participants, and (3) Harvest Monitoring Techniques.

2.0 INDUSTRY PARTICIPATION

Recruiting waterman to use the electronic reporting system and participate in the 2014 Pilot Project was accomplished using various outreach techniques. Watermen who previously participated in the Pilot Project and Design Team members were also encouraged to advertise the availability of the system to other commercial crabbers. An informational booth was also set up at the 2014 Watermen's Expo in Ocean City, MD (January 17 to January 19, 2014) to advertise availability of the system and train interested watermen. Information was posted on the Maryland DNR commercial fishing webpage where watermen could submit a request to use the system through a web form. New watermen who had not previously used the system were trained through one-on-one in person training sessions, over the phone, or by watermen who had participated in the Pilot Project during the past two years.

Of the 168 watermen who expressed interest in participating in the 2014 Pilot Project, a total of 142 were trained to report hails and harvest electronically. Forty-one watermen who were trained to use the system did not report their harvest electronically. Three watermen that were trained to use the system did not report electronically because their harvest was reported by other watermen they were working with. Six watermen were trained to use the system but decided to drop out of the 2014 Pilot Project for reasons including selling or transferring their license (three watermen), never sending in the Pilot permit (two watermen), or becoming frustrated with the call center and their mobile device (one waterman). Two of these six watermen that dropped, out did report electronically while they were participating in the project. All results in this section are based on the participation and activities of the 98 watermen that reported using the electronic reporting system.

Watermen participating in the 2014 Pilot Project crabbed throughout the Maryland portion of the Chesapeake Bay, in tributaries and in the mainstem (Table 2-1; Figure 2-1). For planning purposes related to the harvest verification program component, watermen were grouped into seven large geographic regions encompassing several coastal counties and parts of counties based on the number of offload locations occurring in each region. Nearly all types of commonly deployed gear in the State of Maryland were used by Pilot Project participants (Table 2-1). Watermen used hard crab pots, trotlines, peeler pots, dip nets, collapsible traps, and scrapes/dredges. The majority (88%) of watermen used crab pots or trotlines to harvest blue crabs. A small number of watermen (seven) used multiple gear types to harvest crabs. Crab pots are the only gear type that were used in all seven regions.

Participating watermen used one of four reporting platforms or a combination of multiple reporting platforms to hail and report harvest throughout the 2014 Pilot Project (Table 2-2). All reporting regions had participating watermen who reported using the call center platform. The mobile website was used for reporting in all regions except region seven, and no watermen used the texting platform in regions one or seven. Reporting through the website on a personal computer did not occur in regions one and five.

Table 2-1. Numbers of watermen, harvest offload regions, types of commercial gear used and areas fished for the 2014 Pilot Project. Regions encompassing several coastal counties were based on a waterman's harvest offload locations. Each waterman was assigned to a region based on their primary offload location.

Region #	Maryland Counties	Total # Watermen*	Number of Watermen by Gear Type**					Crabbing Area**	
			Crab Pot	Trotline	Scrape/ Dredge	Peeler Pot	Dip-net	Mainstem	Tributary
1	Somerset, C. and S. Dorchester, Wicomico, Worchester	12	9	3	0	0	0	9	3
2	N. Dorchester, Talbot	17	2	15	0	0	0	2	15
3	Kent, Queen Anne, S. Cecil	20	9	10	0	0	0	9	10
4	Baltimore, N. and C. Cecil, Harford	13	7	4	0	0	0	6	5
5	Anne Arundel, N. Calvert	19	12	9	0	0	0	11	10
6	C. and S. Calvert, Charles, Prince George's, St Mary's	28	4	21	1	2	2	7	23
7	Smith Island	7	2	0	6	1	0	9	3
Total		98	41	51	7	3	2	49	55

*Multiple watermen indicated that they fished in multiple areas.
**Multiple watermen indicated that they used multiple gear types and fished in multiple areas.

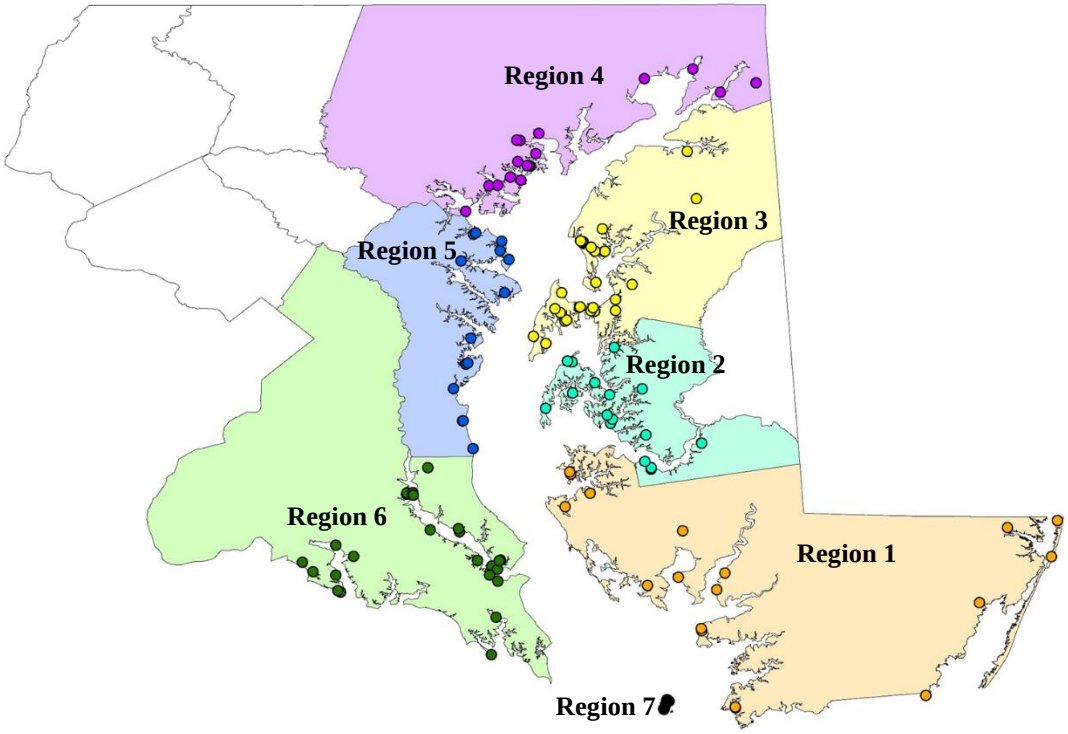

Figure 2-1. Map of Maryland Coastal Counties showing the harvest offload locations for commercial watermen participating in the 2014 Pilot Project.

Table 2-2. The number of watermen in each 2014 Pilot Project region, reporting group, and the distribution of mobile devices among regions and reporting groups.

Region #	Total # Watermen	Mobile Platform Used								
		Mobile Website	Call Center	PC Website	Texting	Mobile Web & Call Center	Mobile Web & PC Web	Call Center & PC Web	Call Center & Texting	PC Website & Texting
1	12	7	4	0	0	1	0	0	0	0
2	17	9	5	0	1	1	1	0	1	0
3	20	5	10	2	0	2	0	1	0	0
4	13	7	2	0	2	0	1	0	0	1
5	18	11	6	0	1	0	0	0	0	0
6	27	11	11	3	1	0	2	1	0	0
7	7	0	6	0	0	0	1	0	0	0
Total	98	37	38	5	5	4	5	2	1	1

Multiple watermen used multiple platforms and reported from multiple regions throughout the Pilot Project.

2.1 PARTICIPANT USE OF AND PERSPECTIVES ON THE CALL CENTER

Watermen using the call center were contacted by phone twice during the 2014 Pilot Project. The first series of phone calls were made after an issue with connectivity to the call center was identified by watermen. On June 19, 2014 watermen using the call center began calling the help line stating that they were unable to report using the call center because the calls were never answered. After numerous calls between the Pilot Project staff, participating watermen using the call center, and the call center representative, the problem was identified and resolved. The complete case study of this connectivity issue is provided in the Appendix A.

The second series of calls was conducted to gather information about the watermen's perspectives of the call center, and to determine why they chose to use the call center for reporting, and to determine what incentives might cause them to switch to another reporting platform (e.g. text messaging or web-based reporting). This effort was initiated on September 3, 2014 and phone calls were made over a three week period. Of the 43 watermen who were contacted, only 27 provided feedback to the survey; reasons for watermen not providing feedback included disconnected phone lines, not returning messages, and declining to answer any questions.

Twenty-one (78%) watermen indicated that the call center was sufficient for their reporting needs. When asked if there was a specific reason why they chose to use the call center, the most common response was that they were not very tech savvy and felt that the call center was all they could use (11 waterman, 41%); 9 watermen (33%) indicated that it was more convenient, 2 watermen (7%) indicated that they used it before and liked it, 1 waterman (4%) indicated that they did not know there were other options, and 4 (15%) gave other responses. Twenty-one (78%) watermen indicated that they owned cell phones capable of sending and receiving text messages, but only 10 (37%) indicated that their phones had the capability to access the internet. Lastly, the watermen were asked if potential incentives such as provided training would persuade them to switch reporting devices and therefore increase the use of web-based and text-message reporting. Thirteen watermen (48%) said that there was nothing that could be done, 4 (15%) answered that better training needs to be provided, 4 (15%) answered that hardware and/or service plans need to be provided, and 6 (22%) gave other responses, such as having already switched to the other reporting platforms.

3.0 SYSTEM USE BY PARTICIPANTS

The Maryland 2014 crabbing season began April 1, 2014 and the first electronic crabbing trip was submitted on April 3, 2014. Data presented in this report consists of trips submitted until September 28, 2014 although the crabbing season continues until December 15, 2014. The total number of trips reported by all participating watermen was 3,603 (Table 3-1; Figure 3-1). After the first full week of operation the number of reports increased steadily and peaked during the week of August 3, 2014.

Reporting by watermen was compared by month, gear type, and day of week. Nearly all the watermen trained to use the electronic reporting system reported hails and harvest in July and August (Table 3-1; Figure 3-2). April had the least number of watermen reporting harvest and hail information. Watermen using crab pots had the highest number of trips reported and those crabbing with trotlines had the second highest number of trips reported; however, the number of watermen reporting harvest using trotlines was higher than crab pots. The number of watermen reporting on both weekends and weekdays was similar; however there were substantially more trips during the weekday.

Table 3-1. The total number of watermen and trips by month, gear type, and day of the week for the 2014 Pilot Project.

		Total # watermen	**Total # Trips**
Month	April	5	20
	May	44	262
	June	73	744
	July	83	879
	August	81	994
	September	74	704
Gear Type	Crab Pot	41	1895
	Dip Net	2	32
	Peeler Pot	3	10
	Scrape/Dredge	7	500
	Trotline	51	1153
Day of the Week	Weekday	91	2711
	Weekend	89	891

Multiple watermen used multiple gear types throughout the Pilot Project.

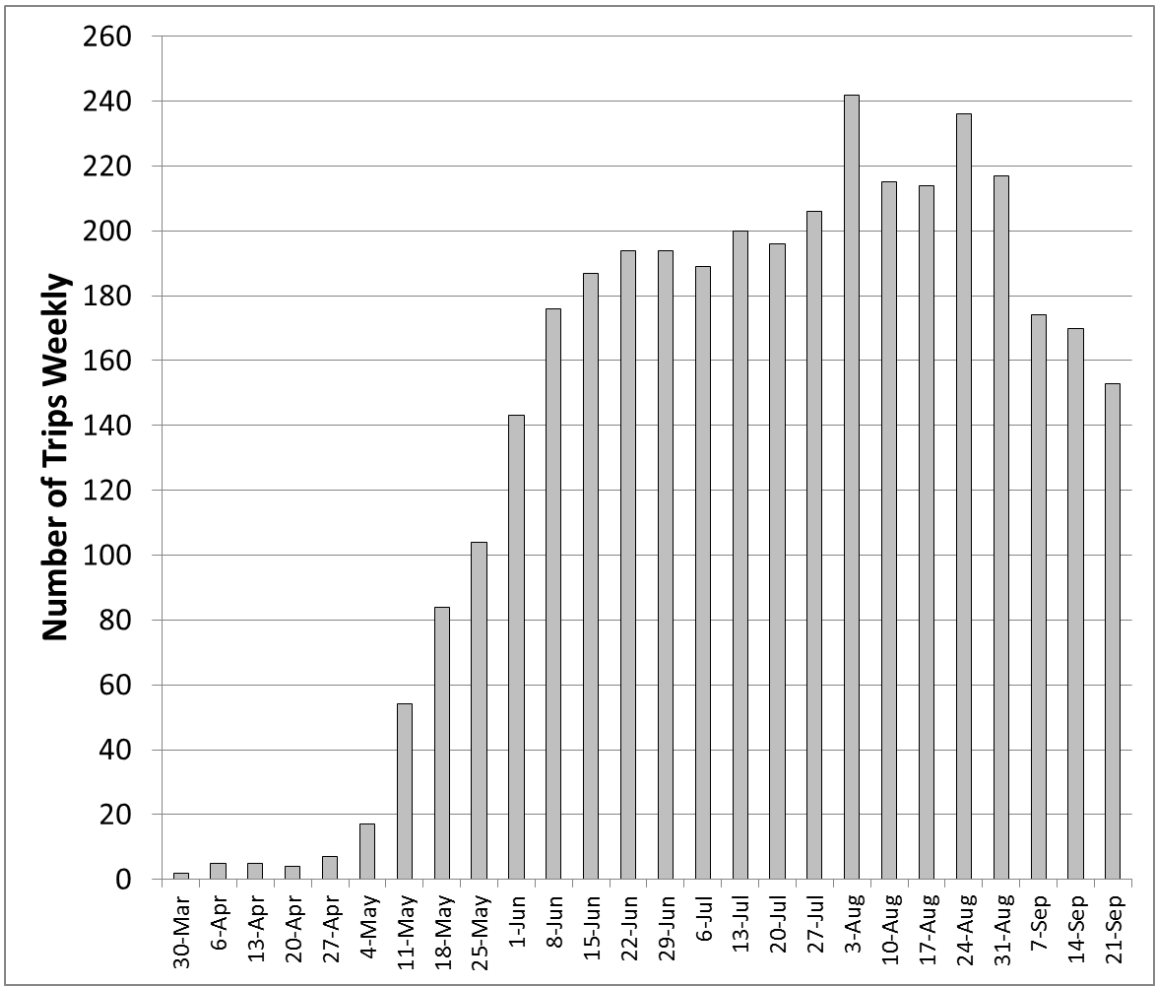

Figure 3-1. The number of crabbing trips reported weekly during the 2014 crabbing season in Maryland.

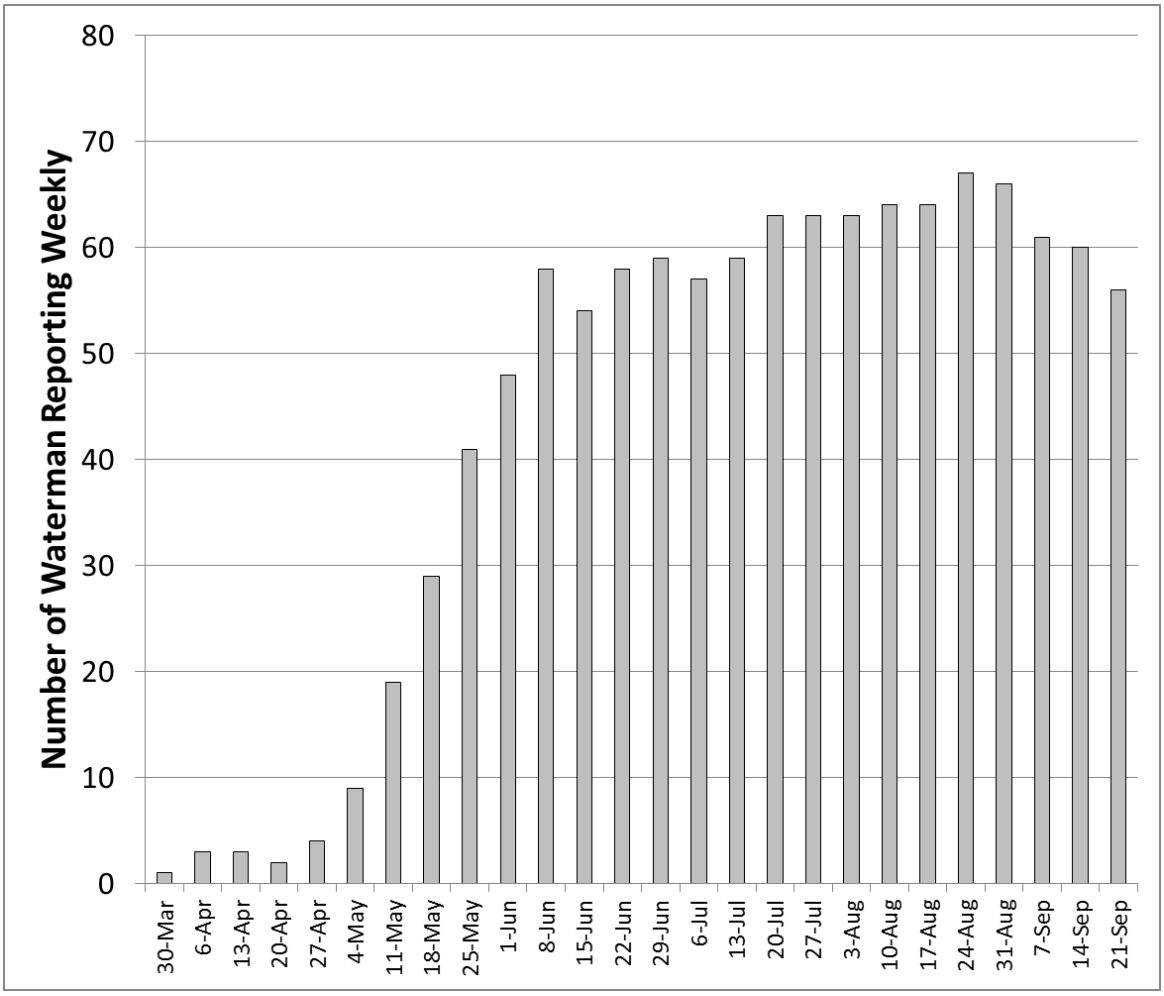

Figure 3-2. The number of waterman reporting crabbing trips weekly during the 2014 crabbing season in Maryland.

Three percent of trips had revisions to the start hail and 1% of the trips had revised end hails and harvest reports (Table 3-2). Reasons for watermen submitting a revised harvest report without actually changing harvest information include instances when a waterman wanted to verify their data entry or if they estimated the number of peelers while on the water and then revised harvest after actually counting the number of peelers. Thirty-six percent of watermen revised their hails and 22% revised harvest information (Table 3-3). Over the course of the program, 40% of watermen forgot to submit at least one end hail and 52% forgot to submit at least one harvest report.

Table 3-2. The total number of hails and harvest reports submitted, revised, and cancelled by region during the 2014 Pilot Project.

Region #	Total # Water-men	Type of Electronic Report							
		# Start Hails Submitted	# Start Hail Revised	# End Hails Submitted	# End Hail Revised	# Harvest Report Submitted	# Harvest Report Revised	# End Hail Not Submitted	# Harvest Report Not Submitted
1	12	551	4	527	5	524	8	24	27
2	17	439	5	402	3	382	6	37	57
3	20	597	14	589	7	589	3	8	8
4	13	176	10	171	7	169	2	5	7
5	19	733	11	678	10	672	5	55	60
6	28	536	65	527	4	521	3	9	15
7	7	571	5	562	10	560	5	9	11
Total	98	3,603	114	3,456	46	3,417	32	186	185

Multiple watermen reported from multiple regions throughout the Pilot Project.

Table 3-3. The total number of watermen that revised and cancelled hails and harvest reports by region during the 2014 Pilot Project.

Region #	Total # Watermen	Type of Electronic Report				
		# Start Hail Revised	# End Hail Revised	# Harvest Report Revised	# End Hail Not Submitted	# Harvest Report Not Submitted
1	12	3	3	3	6	7
2	17	2	3	3	5	8
3	20	6	4	2	4	5
4	13	4	2	2	4	9
5	19	7	9	5	9	6
6	28	12	4	3	5	10
7	7	4	6	4	5	6
Total	98	35	30	22	39	50

Multiple watermen reported from multiple regions throughout the Pilot Project.

4.0 HARVEST VERIFICATION

The 2014 harvest verification program followed the basic design that was implemented during 2012 and 2013 Pilot Projects (Slacum et al. 2014; Slacum et al. 2013). Harvest was verified by roving monitors that conducted "spot checks" of individual watermen's harvest when it was offloaded from their vessels. Monitoring occurred between August 10 and September 28, 2014 using these two scheduling approaches:

- Method 1 (Priority List) – All Pilot Project participants were ranked based on previous levels of crabbing activity (provided by DNR). Two categories were used: high priority watermen crabbed between 0-40 days and low priority watermen crabbed more than 41 days. Watermen with low levels of crabbing activity were considered the highest priority for monitoring and higher levels of activity were lower priority.

- Method 2 (Targeted Monitoring) – The goal of targeted monitoring was to schedule monitoring at as many different offload locations as possible when monitoring occurred.

Priority list spot checks were scheduled randomly, and the number of days scheduled in each region was based on monitoring 10% of trips made by high priority watermen as reported in July. These "Priority" days were conducted on Saturdays and Sundays, and focused only on the high priority watermen. Targeted spot checks were also scheduled randomly, and the number of days scheduled in each region was based on monitoring 5% of the trips made by all watermen except high priority watermen as reported in July. These "Targeted" days were conducted on week days (Monday through Friday), and focused on all watermen landing in a roving monitor region.

4.1 EFFECTIVENESS OF DOCKSIDE MONITORING

Spot checks were conducted between August 10 and September 28, 2014, over which time a total of 1,394 trips that could be monitored were reported by watermen. Spot checks were attempted on 151, or 11%, of all scheduled trips (Table 4-1). A spot check was defined as successful when a roving monitor was able to intercept a waterman and document the entire harvest offloaded from the vessel. Of the 151 spot checks, 75% were conducted successfully (Figure 4-1). The main reason for unsuccessful spot checks was due to offloads not occurring when scheduled (37 attempted spot checks, 97%). Other reasons for unsuccessful spot checks included roving monitors being unable to find the vessel (1 attempted spot check, 3%).

Table 4-1. The total number of crabbing trips that coincided with dockside monitoring in each region and the number of spot checks attempted and successfully completed in each region during the 2014 Pilot Project.

Region #	Total # Crabbing Trips	# of Trips a Spot Check was Attempted	% of Trips a Spot Check was Attempted	# of Successful Spot Checks	% Successful Spot Checks
1	150	21	14%	18	86%
2	189	17	9%	11	65%
3	276	32	12%	23	72%
4	86	11	13%	10	91%
5	282	37	13%	27	73%
6	189	18	10%	9	50%
7	222	15	7%	15	100%
Total	1,394	151	11%	113	75%

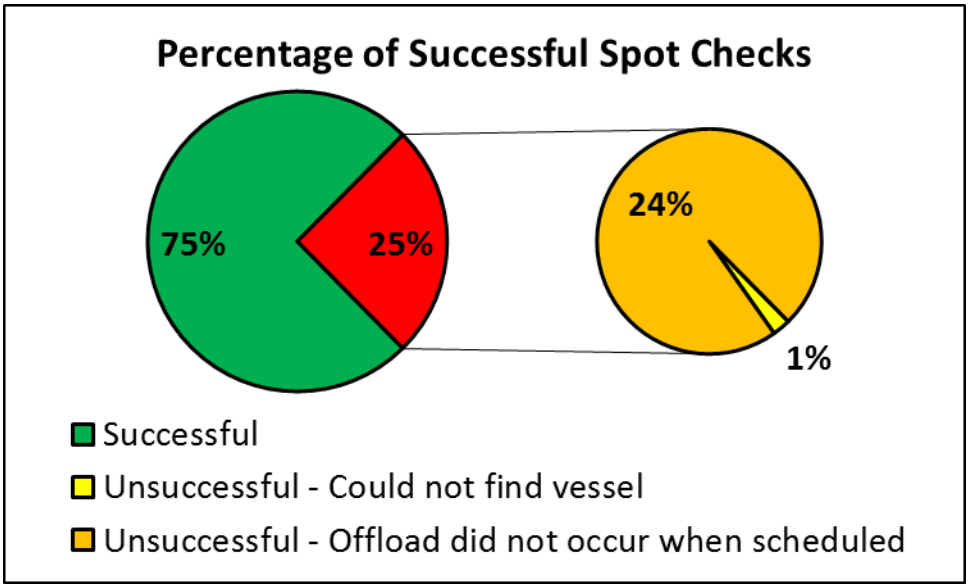

Figure 4-1. Percentage of all successful and unsuccessful spot checks conducted in the 2014 Pilot Project on Maryland commercial blue crab harvest.

During the 2014 monitoring period there was one waterman who was not spot checked after multiple attempts. After the third consecutive unsuccessful monitoring attempt the watermen was contacted to determine if the waterman was reporting landing locations correctly. Upon talking with the waterman, it was determined that the problem was that the waterman was entering the wrong landing location code in the text message string when hailing. This incorrect code would then direct the roving monitor to the wrong offload location. In reviewing the original preference sheet of the watermen, his primary landing location was coded as "LL1" however the locations were reordered in FACTS, resulting in his primary landing location re-assigned as "LL2." The correct codes were given to the waterman and the problem was resolved.

4.2 ROVING MONITOR AND WATERMEN REPORT COMPARISONS

Harvest information reported by watermen was compared to roving monitor reports (spot checks) to evaluate the accuracy of reported harvest (Table 4-2). Discrepancies between reports were identified by comparing the six reported crab harvest grades (#1's, #2's mixed males, females, peelers, and soft crabs) between watermen and roving monitor reports.

Table 4-2. Number of comparisons conducted by roving monitor with corresponding waterman harvest report during the 2014 Pilot Project.

	#
Total number of trips with report comparisons	111
Total # of trips with report comparisons with discrepancies	44
Total # of harvest grade comparisons	666
Total # of harvest grade comparisons with discrepancies	89

2 trips were missing watermen harvest information but had roving monitor harvest information.

Harvest accuracy was determined using a two-step process. The first step determined the accuracy of roving monitor reports and the second step involved screening discrepancies identified between reports and evaluating the source of the discrepancy to determine if the discrepancy was a legitimate difference between monitoring data and the harvest report. Harvest report accuracy was then quantified as the percentage of differences between reports. This process only quantified the amount of discrepancies between roving monitor and watermen reports and was not applied to reported harvest to determine overall reporting error. Additional methods must be developed in order to apply the error to overall harvest.

Harvest unit discrepancies occurred a total of 10 times, rounding differences occurred 4 times, and 19 discrepancies from revising harvest grade counts were identified (Table 4-3). There were a total of 31 trips with roving monitor reports that could be compared to watermen

harvest reports where data entry discrepancies occurred (28% out of the 111 trips with successful roving monitor spot checks) resulting in 56 harvest grade discrepancies. In 2014, harvest reported in bushels was limited to reporting in increments of quarter bushels. This data validation rule contributed to decreasing the number of discrepancies caused by rounding as compared to 2013. In 2013, 12% (20 out of 168) of the discrepancies were caused by rounding compared to 7% in 2014.

Table 4-3. Causes of data discrepancies between watermen and roving monitor reports during the 2014 Pilot Project.

Discrepancy Type	# Trips	# Harvest Grade Reports						
		Total	#1s	#2s	Female	Mixed Male	Peeler	Soft Shell
Harvest reporting unit difference	4	10	2	2	4	2	0	0
Rounding difference	2	4	3	1	0	0	0	0
Revising harvest grade counts difference	15	19	0	0	0	0	8	11
Data entry error	31	56	13	6	9	13	6	9

The number of crabs reported by watermen versus those reported byroving monitors was plotted per trip to visually compare the relationship between reports (Figure 4-2). The r-square regressions of watermen reports compared to roving monitor reports ranged from 93 to 98% in reporting for male crabs, female crabs, and peelers. The relationship of watermen reports compared to roving monitor reports of soft crabs was weaker at 57% due mostly to 5 large discrepancies between reports.

4.3 EFFECTIVENESS OF DEALER REPORTING AND DEALER AND WATERMEN REPORT COMPARISONS

Dealer reporting was conducted between May 14, 2014 and September, 27, 2014, over which time a total of 152 dealer reports were submitted into the electronic reporting system concurrent with the harvest reports from these three watermen. The dealer reports were used to determine data discrepancies for reported harvest.

Harvest information reported by watermen was also compared to dealer reports to evaluate if the accuracy of reported harvest was quantifiable (Table 4-4). Only four grades could be compared (#1's, #2's mixed males, and females) between watermen and dealer reports because the participating dealer did not purchase peelers or soft crabs.

Harvest accuracy was determined by screening discrepancies identified between dealer and watermen harvest reports and evaluating the source of the discrepancy to determine if there was a difference between the harvest reports. Harvest report accuracy was then quantified as the percentage of differences between reports. This process only quantified the amount of discrepancies between dealer and watermen reports and was not applied to reported harvest to determine overall reporting error. Additional methods must be developed in order to apply the error to overall harvest.

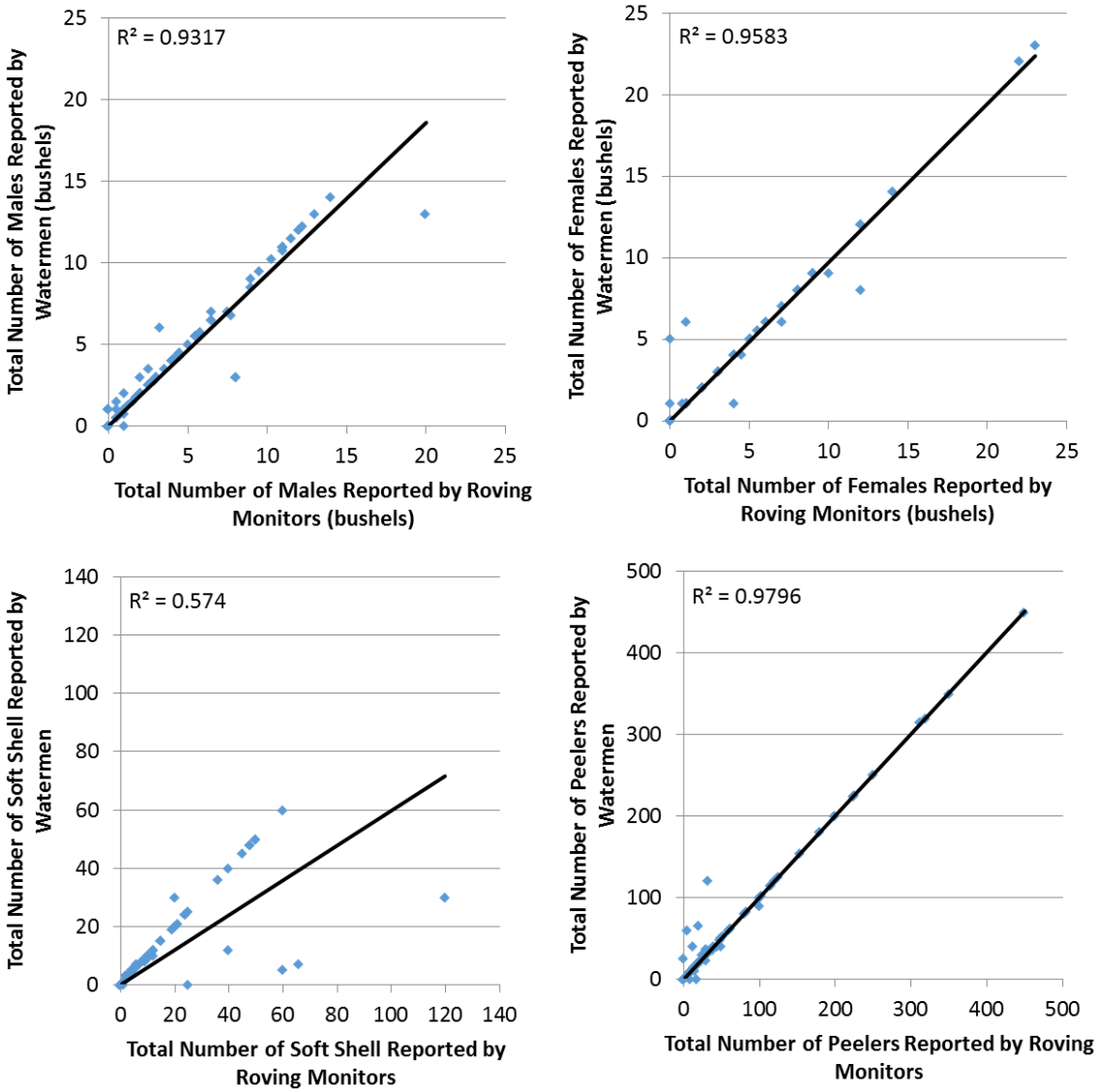

Figure 4-2. Number of crabs by grade reported by watermen and roving monitors per crabbing trip in the 2014 Pilot Project on Maryland commercial blue crab harvest.

Table 4-4. Number of comparisons conducted by dealers with corresponding waterman harvest report during the 2014 Pilot Project.

	#
Total number of trips with report comparisons	146
Total # of trips with report comparisons with discrepancies	134
Total # of harvest grade comparisons	584
Total # of harvest grade comparisons with discrepancies	442

6 trips were missing watermen harvest information but had dealer harvest information

Reports identified with discrepancies were tagged and reviewed to determine the source of each discrepancy. Two common groups of discrepancies were identified as harvest reporting with different units and data entry error. Three trips had data entry error discrepancies occurring in one harvest grade each. Ninety-four percent of the trips had a harvest reporting unit difference whereas the watermen and the dealer reported harvest each with different units (either bushels or pounds).

5.0 SYSTEM MONITORING

5.1 SYSTEM MONITORING OF WATERMEN NOT REPORTING

Currently the reporting system has no option for watermen to acknowledge when they do not intend to actively crab during specific time periods. The system assumes that a watermen is not fishing when no trip reports are submitted by watermen. However, since the use of the system was voluntary, some effort was required to contact watermen during the season who had been trained to use the system, but for whom no trips had been reported.

Two series of calls were made during the crabbing season. The first series of calls were conducted mid-season to determine if watermen who had not reported for an extended period of time were either not crabbing or were not intending to use the electronic system to report. The second series of calls were made near the end of the season to follow-up with watermen who intended to use the system, but had not reported for the entire season, and determine when individual watermen expected to stop crabbing for the year.

For the first series of calls, the system was monitored to establish which pilot participants were inactive and therefore had not reported any trips. This included a total of 31 watermen. These watermen were called to determine if they were or were not crabbing and if they were, whether they were still reporting using the paper reporting method or if they were using the electronic system to report and therefore needed their harvest reports back-entered into the FACTS system. Out of the 31 participants that were called, 20 were reached leaving 11 who were unable to be contacted. In three of these cases the line was disconnected and in the remaining 8 cases, voicemails were left and not returned. Eighteen out of the 20 crabbers that were contacted indicated that they had not yet been crabbing or did not plan on going crabbing for the entire season. There were 2 participants that did report that they had been crabbing; one who was still using the paper method of reporting due to not realizing that he was signed up for the program and the other who was only crabbing using his recreational license because of the status of the blue crab population during the past season.

The second series of calls were conducted in the month of October, to determine if watermen who had been inactive in the system for an extended period of time (meaning they had not reported since August, if not earlier in the year) were still crabbing or intended to crab before the season was over. Previously, participants were given a check box that they were able to check during their reporting process when they determined that it would be their last day of crabbing for the season. This function was later removed from the reporting system so that it then had to be assumed that when no trip reports were submitted for an extended period of time, the waterman was no longer crabbing. Follow up calls were then made to confirm these assumptions.. These follow up calls established whether or not the watermen had been crabbing since their last crabbing trip and verified whether or not they were finished crabbing for the season. Twenty watermen were identified for these calls and 12 were reached, and 8 were left messages or could not be reached. All 12 watermen who were reached reported that they had not been

crabbing since their last date reported and the majority of these watermen also claimed that they were finished or most likely finished crabbing for the season.

5.2 SYSTEM MONITORING OF BEST PRACTICES

System reports and other monitoring tools were implemented during 2014 to assess information submitted to the electronic reporting system. Assessing system performance was based on the ability of the system to remain operational for reporting during the season and being able to identify and track reporting inconsistencies along withsources of error. Reporting inconsistencies were considered to be deviations from the established reporting "Best Reporting Practices" that were established based on recommendations from the 2012 and 2013 Assessment. Reporting inconsistencies have the potential to increase the amount of effort required to verify reported harvest and to undermine the ability of the system to acquire timely and accurate harvest information. Sources of error were identified as discrepancies and data outliers observed in reported data. Additional monitoring of system performance, such as feedback through the help line and cellular service problems, were conducted manually by Pilot Project staff.

The ability of participants to follow the "Best Reporting Practices" was evaluated by comparing the submission times of hails and harvest logs and through monitoring of other reporting process behaviors (Table 5-1). If a waterman submitted an end hail prior to 8 A.M., it was flagged as atypical due to the majority of watermen typically finishing crabbing after 10 A.M. Instances such as this suggest the end hail was not submitted at the end of a crabbing trip. Seven percent of watermen submitted trip end hails before 8 A.M. for a total of 17 trips. The majority of end hails submitted before 8 A.M. occurred from April to June (11 of the 17 trips). Follow up phone calls made by Pilot Project staff to reiterate the reporting process contributed to the decrease in these types of instances over time. The second type of atypical behavior was based on the interval of time between start and end hails. If a trip had a start and end hail submitted within 15 minutes, it could be assumed that either the start hail was not submitted at the beginning of a crabbing trip or the end hail was not submitted at the end of a crabbing trip due a typical crabbing trip lasting longer than 15 minutes. Forty-eight percent of watermen submitted at least one start and end hail within a 15 minute interval which generated a total of 575 flagged trips. Further review found 327 of these trips (57%) occurred by Smith Island watermen that had trouble with cell signal strength. The last atypical trip identifier focuses on watermen sending harvest reports after 5 P.M. If a harvest report was submitted after 5 P.M., it was assumed to be an instance where harvest was not reported while the waterman was still on the water at the end of their crabbing day. Harvest reports submitted after 5 P.M. occurred on 516 trips by 63% of the watermen.

Table 5-1. The total number of watermen and reported trips that did not follow the recommended "Best Reporting Practices."

	Total # Watermen	Total # Trips
Submitted an End Hail Before 8 A.M. Majority of watermen do not finish crabbing until after 10 A.M. thus this could be assumed to be an instance where an end hail was not submitted at the end of a crabbing trip	7	17
Submitted a Start and End Hail within 15 minutes Majority of watermen crab longer than 15 minutes thus this could be assumed to be an instance when either a start hail was not submitted in the morning before crabbing begins or at the end of the day when crabbing is finished	47	575
Harvest Submitted After 5 P.M. Majority of watermen have finished crabbing before 5 P.M. thus this could be assumed to be an instance where a waterman did not report harvest at the end of the crabbing day while still on the water	62	516

5.3 SYSTEM MONITORING OF MISSING HARVEST REPORTS

A total of 3,603 harvest reports were submitted by watermen from all reporting platforms. A total of 185 (5%) crabbing trips were missing harvest reports. The trips missing harvest reports submitted to the electronic reporting system had a hail but no harvest report, suggesting occasions when a waterman forgot to submit harvest after a crabbing trip. These instances were noted during the Pilot Project and either the watermen by the Maryland DNR to provide them with the harvest or the Maryland DNR followed up with the watermen.

Starting the week of August 3, 2013, the system was modified to include an automated text message which was sent to watermen that hailed in the morning and had not sent a harvest report by 5 P.M. If the system had not received a waterman's harvest log by 5 P.M., a text message was sent to them at that time. Three additional text message reminders were sent at 6 P.M., 7 P.M., and 8 P.M. if harvest was still not received by those times. The text message reminders made a marked improvement in harvest log reporting with a decrease in missing harvest reporting from 11% to 2% (Figure 5-1). After August 3rd, the percentage of trips with missing harvest reports decreased to 2%.

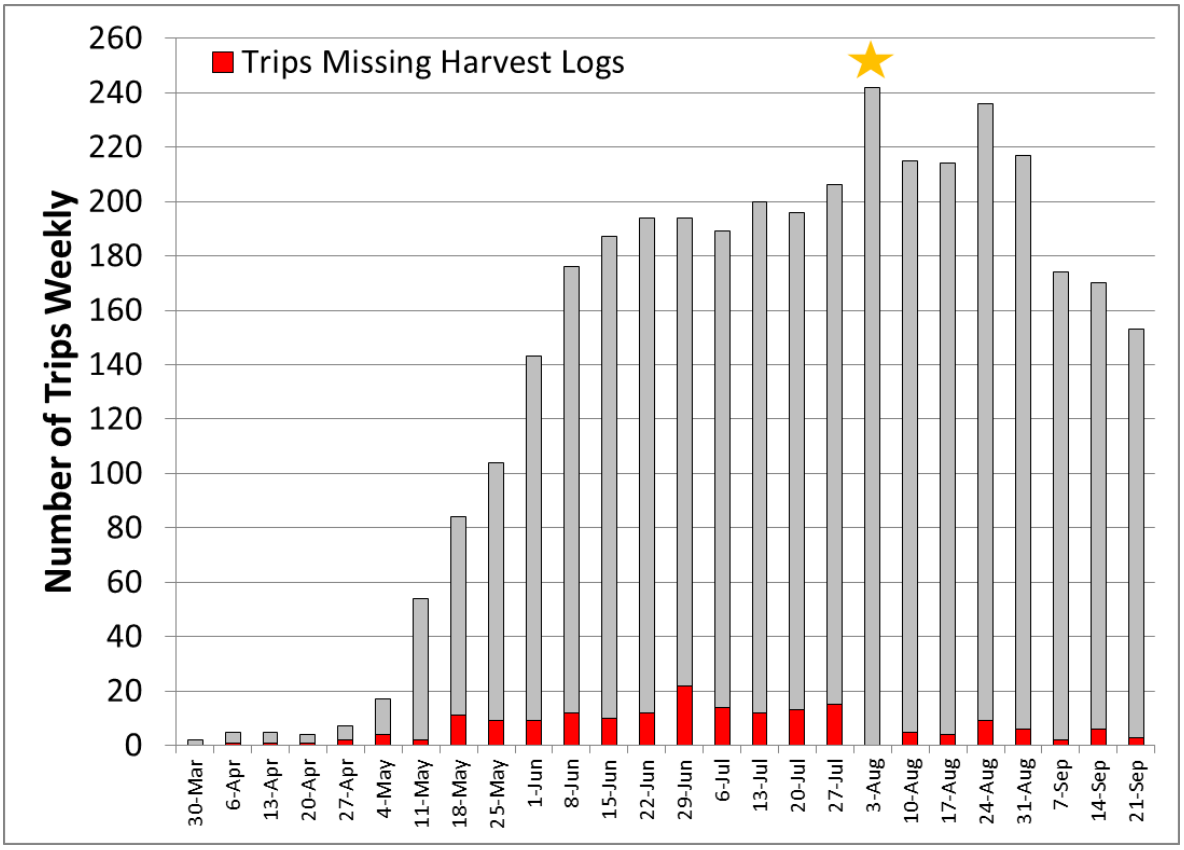

Figure 5-1. Number of weekly trips and trips with missing harvest logs (as shown in red) by watermen during the 2014 Maryland blue crab commercial harvest season. A text message reminder to submit harvest was implemented on August 3th (yellow star).

5.4 EFFORT TO RECOVER MISSING HARVEST REPORTS

When a missing harvest report was identified, the specific trip was flagged and the Maryland DNR was required to follow-up with the watermen to recover the missing harvest. Watermen were immediately called to recover the information and if the waterman could not be reached on the first call, a voice message was left and if a return call was not received, the waterman received an additional call the following week. This process was continued until the missing harvest report was retrieved or the season ended.

During the time period of August through November, 90 watermen forgot to submit a harvest report on at least one crabbing trip. Some watermen forgot to submit harvest reports for multiple trips causing there to be a total of 113 trips with missing harvest reports throughout the season (Table 5-2). A total of 83 watermen were able to be contacted and 96 missing harvest reports were recovered. It required ninety-eight phone calls to recover missing harvest reports that were able to be retrieved. However, missing harvest could not be recovered for 17 trips reported by 7 watermen because those watermen were unable to be contacted, although 22 calls were attempted (Table5.2).

Table 5-2 The number of missing harvest reports that were unable to be retrieved in comparison to those that were and the effort (shown in cumulative number of calls) that it took to retrieve these reports.

	Number of Watermen	Number of Reports	Cumulative Number of Calls Made
Reports Retrieved	83	96	98
Reports Not Retrieved	7	17	22
Total	**90**	**113**	**120**

Most of the watermen using the reporting system always reported harvest (Table 5-3). When missing harvest did occur, it accounted for only a small fraction of a waterman's total trips, but required nearly three phone calls to recover the harvest. There was however an increasing trend of more missing harvest reports for watermen with large numbers of trips reported during the season (Figure 5-2).

Table 5-3 Percent of Watermen's total crabbing trips with missing harvest reports and the effort required (number of calls on average) to collect these missing reports per watermen.

% of Watermen's Total Crabbing Trips with Missing Harvest Reports	Number of Watermen	Effort Required to Collect Missing Reports (Average # of calls made)	Range of Calls Made to Individual Waterman
0	47	0	0
1 - 10	21	2.6	1 - 6
11 - 20	5	2.5	1 - 4
21 -30	3	1.33	1 - 2
31 - 40	2	4	3 - 5
41 - 50	1	2	2
51 - 60	1	2	2
61 - 70	1	2	2
71 - 80	0	0	0
81 - 90	0	0	0
100	2	1	1
Total	83	17.43	

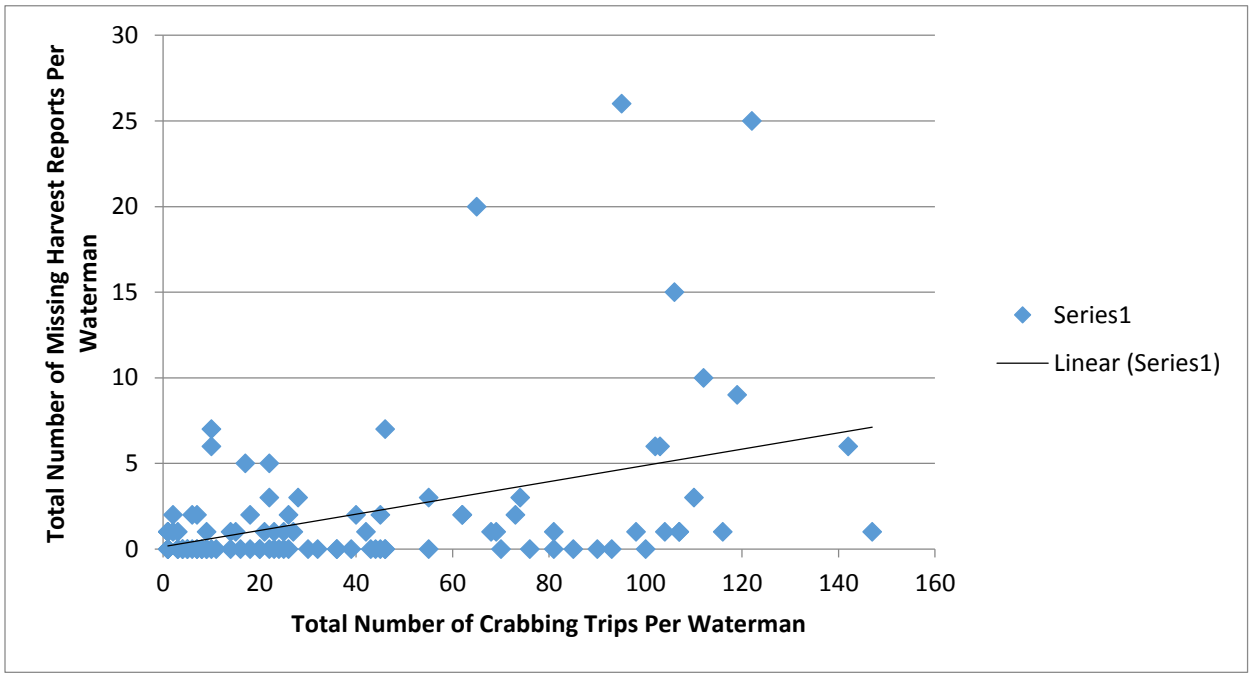

Figure 5-2 Total number of missing harvest reports per watermen in relation to their total number of crabbing trips.

5.5 ELECTRONIC REPORTING SYSTEM AND MOBILE DEVICE SUPPORT

Over the course of the 2014 Pilot Project, a toll-free help line was available to the watermen 24-hours a day to assist in troubleshooting any technical issues with the mobile device or reporting system and to provide an outlet for watermen to submit feedback on the 2014 Pilot Project. A log recorded the description of each call, date, and type of device the caller was using to report.

Nineteen calls were logged from watermen throughout the 2014 Pilot Project. The most common call to the help line was watermen reporting that they could not get through to the call center and/or that there were long wait times to speak to a call center operator (Table 5-4). Some of these calls pertain to the June 19th call center issue (Appendix A) which was quickly resolved. The next most common call type made to the help line was watermen calling to report harvest when they had forgotten to submit it using the system. Additional issues included a call pertaining to a waterman being unable to report female crab harvest. This issue arose from a change in the system coding and after immediately contacting Electric Edge Systems Group, the issue was resolved within 3 hours.

Table 5-4. Reasons for calls to the help line by watermen for troubleshooting questions based on 19 calls during the 2014 Pilot Project.

Call Type	Overall	Call Center	Texting	Website
Unable to get through to Call Center or long wait/hold times	7	7	0	0
Reporting harvest	5	3	0	2
Training on using system	2	0	0	2
Turned off data mode or cookies on mobile device	2	0	0	2
Changing preferences	2	0	0	2
Electronic system issue	1	0	0	1

6.0 CONCLUSIONS AND RECOMMENDATIONS

The Pilot Project was continued in 2014 with a goal to maintain the system and expand its use by the blue crab industry. Although participation increased from previous Pilot years, the number of watermen using the system is still a fraction of the total number of active license holders. Watermen who have decided to use the system have required limited training and have had few problems over the course of the Pilot Project. In addition, watermen using the system have also effectively participated in a dockside and dealer monitoring system. These techniques have been successful at verifying harvest and identifying important variables required to assess accuracy of reported information. One aspect of the reporting system that requires further assessment is the level of effort required to recover missing harvest reports, would has the potential to be extremely time consuming if the entire industry used the system to report harvest.

Based on the limited participation and system monitoring conducted during the 2014 Pilot Project, we make the following recommendation:

- Continue to maintain the system so that it is available for the entire blue crab industry;
- Increase outreach to publicize the systems availability for industry use;
- Increase training opportunities and tools to train watermen how to access and report following “Best Reporting Practices”;
- Educate industry on the benefits of using the system;
- Increase efforts to work with dealers to evaluate the effects of reporting on their business practices;
- Continue to evaluate harvest verification techniques;
- Evaluate and quantify the level of effort required to provide user support and recover trip level information not reported electronically.

APPENDIX A

CASE STUDY TO RESOLVE CALL CENTER CONNECTIVITY ISSUE IN 2014 BLUE CRAB PILOT PROJECT

Starting on Thursday, June 19, 2014, Versar staff began receiving phone calls from watermen participating in the Blue Crab Electronic Harvest Reporting Pilot Project who report using the call center. These watermen indicated that when calling the toll free number, 1-855-390-2722, they were unable to reach the call center to submit hail and harvest information. Various Versar staff tried calling the toll free number to confirm this issue however all attempts were successful in reaching the call center without problems. Without any definitive cause for this difficulty in reporting, Versar staff took two courses of action to try and rectify the problem.

First, Versar staff contacted the representative from the call center, Ryan Smith, on Monday, June 23, 2014 to determine if their system was properly functioning. The call center performed an analysis of their system, and the analysis did not return any issues, meaning that the call center was and is performing properly. Second, Versar staff made an attempt to contact all participants using the call center to determine the extent of the problem, and for how long the issue had been occurring. From the calls to participants, there seemed to be a 50/50 split between those having problems reporting and those who were able to report without flaw. Of those watermen who were not able to connect to the call center via the toll free number, they all indicated that the phone would either not ring at all or the ring would be a different sound than usual, with an end result from both scenarios of not being able to connect to the call center. Regardless of whether reporting difficulties were encountered by the participants using the call center, all were provided a direct line, 410-553-8979, to the call center to use as a back-up until the problem could be fixed. One waterman in particular called stating that he could not get through to the call center and had been trying for 3 hours until that point in time. After receiving the direct line, he called back indicating that he had no issues connecting to the call center and was able to report. The majority of watermen also indicated during these calls that the call center operators were proficient at recording hail and harvest information and that all the different operators were consistent in the way that they recorded the information.

From the calls to participants and the initial conversation with the call center, two problems became apparent. First, the issue of connecting to the call center appeared to possibly be linked to the toll free carrier service since the direct line worked when the toll free line did not. Ryan Smith contacted the carrier service to run an analysis to try and diagnose if the problem was occurring on the carriers end. After speaking with the toll free carrier service on July 3, 2014, Versar learned that the toll free carrier uses several carriers to route the calls from participating watermen to the call center for reporting. The toll free carrier stated that they had been having troubles with one of the routing services, and identified that this routing service was used for the one watermen Versar provided as an example. This routing service has been excluded from use by the toll free carrier for routing call center calls in an attempt to fix the connectivity issues.

Another issue regarding connectivity to the call center arose through watermen feedback, indicating that they were unable to get through to the call center or were put on hold for long periods of time when calling before 6:00 A.M. Regarding this complaint, Ryan Smith was

contacted and he stated that there was a lack of staff support during this time frame but that they would add more operators in the early morning to resolve this issue.

Of the watermen reporting using the call center who were surveyed in June, those who reported negative feedback were called back on July 21, 2014 for a follow-up. A total of 11 watermen were called and Versar staff was able to survey 8 of these watermen while messages were left for the remaining three. All 8 of the watermen who were contacted for the follow-up survey indicated that they had been able to reach the call center since the first survey, and that the connectivity issue had gotten much better. They also indicated that when calling before 6:00AM, they were now able to get through to the call center more frequently without being put on hold. Only 2 of the watermen indicated that they still received the hold message from the call center, but stated that these instances were infrequent and that overall they are happy with the way the call center is working. The call center connectivity problem seems to be remedied, and Versar staff will continue to monitor the situation to ensure that all participants can report with as few problems as possible.