No. 142, Original

In the

Supreme Court of the United States

STATE OF FLORIDA,

Plaintiff,

v.

STATE OF GEORGIA,

Defendant.

Before the Special Master

Hon. Ralph I. Lancaster

UPDATED PRE-FILED DIRECT TESTIMONY OF FLORIDA WITNESS MARK BERRIGAN

PAMELA JO BONDI
ATTORNEY GENERAL, STATE OF FLORIDA

JONATHAN L. WILLIAMS
DEPUTY SOLICITOR GENERAL
JONATHAN GLOGAU
SPECIAL COUNSEL
OFFICE OF THE ATTORNEY GENERAL

FREDERICK L. ASCHAUER, JR.
GENERAL COUNSEL
FLORIDA DEPARTMENT OF
ENVIRONMENTAL PROTECTION

GREGORY G. GARRE
Counsel of Record
PHILIP J. PERRY
CLAUDIA M. O'BRIEN
ABID R. QURESHI
JAMIE L. WINE
LATHAM & WATKINS LLP
555 11th Street, NW
Suite 1000
Washington, DC 20004
Tel.: (202) 637-2207
gregory.garre@lw.com

PAUL N. SINGARELLA
LATHAM & WATKINS LLP

CHRISTOPHER M. KISE
JAMES A. MCKEE
ADAM C. LOSEY
FOLEY & LARDNER LLP

MATTHEW Z. LEOPOLD
CARLTON FIELDS JORDEN BURT P.A.

ATTORNEYS FOR THE STATE OF FLORIDA

October 26, 2016

INTRODUCTION

1. My name is Mark Berrigan. I am currently employed as the owner of a consulting firm, Applied Aquaculture, LLC, which is primarily directed toward oyster resource management, oyster habitat restoration, and oyster aquaculture; as well as providing technical assistance and consultation to develop and advance aquaculture businesses. I am also a paid consultant for the State of Florida, advising on oyster issues related to this case.

2. From 1983 until April 2013, I was an employee of the State of Florida. One of my responsibilities during this time was monitoring and managing the oyster resources in Apalachicola Bay. I am not aware of any other employee with the State of Florida who has more experience over the last thirty years with oyster resources in Apalachicola Bay than I do. My personal experience with and knowledge of the Apalachicola Bay oyster fishery is both extensive and unmatched. I have logged more than 2,000 hours in the water in Apalachicola Bay over the past 30+ years and I am not aware of anyone having more personal involvement with the state's oyster resource.

3. Based on my personal observations, experience, and scientific training, I identified a fishery failure among oyster populations in the Bay, and concluded that the cause of the Apalachicola oyster fishery failure was high salinity caused by a lack of fresh water inflows from the Apalachicola River.

4. I expressed this conclusion publicly in 2012, and I continue to believe that it is true.

5. I understand that the State of Georgia and scientist Dr. Rom Lipcius have interpreted my testimony and particular documents I wrote as indicating that the 2012 oyster fishery failure in Apalachicola Bay was caused by poor resource management, as well as

overharvesting, harvesting of under-size oysters, or degradation of oyster reefs through hand-tonging. I strongly disagree with such an interpretation. As I describe in my testimony below, the clearest evidence that harvesting was not to blame for depleting oyster populations is that in 2012, oysters were not removed from the bars, but rather remained dead on the reefs, with the reef substrate intact and silted over. These conditions point to natural mortality, from predation, disease, and stress associated with prolonged high salinity conditions, and not commercial harvesting. When oysters are harvested, living oysters are removed from the reef, and the surface of the reef has a different appearance than either a normal, unharvested reef, or a reef suffering significant mortality. While harvesting pressure may have existed on Cat Point Bar and East Hole Bar, I conclude this pressure was not a cause of the fishery failure, but rather the result.

6. I understand Georgia has cited an article published by Dr. William E. Pine at the University of Florida entitled, "The Curious Case of the Eastern Oyster."[1] I am listed as a co-author of this article because Dr. Pine utilized data I had gathered, but I did not participate in the drafting of this article or any associated research. My conclusions herein are based not just on that data (which is primarily focused only on the number of oysters in the Bay and not the causes of the decline), but also my personal observations and research gathered over a career on the water in Apalachicola Bay. To my knowledge, Dr. Pine has never conducted any actual oyster research in Apalachicola Bay or logged any hours in the water. Moreover, Dr. Pine points out he "did not study or reach any conclusions about any effect of water withdrawals affecting the Apalachicola River Basin or oyster populations in Apalachicola Bay."

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[1] Pine, W. E., III, et al., The curious case of eastern oyster *Crassostrea virginica* stock status in Apalachicola Bay, Florida. *Ecology and Society* 20(3):46.

7. Apalachicola Bay's oyster populations have demonstrated an ability to thrive following varied and challenging natural environmental conditions. Even in the wake of devastating hurricanes and droughts, the oyster fishery has recovered. The more recent decrease in fresh water inflows, however, created unfavorable environmental conditions that lead to extensive mortalities among oyster populations throughout the Bay. The oyster resources in the Bay will only recover if and when adequate river flows are restored.

EDUCATION AND PROFESSIONAL BACKGROUND

8. I have a Bachelor of Science in Marine Science from the University of West Florida (1969) and a Master's Degree in Marine Sciences from the University of West Florida (1979).

9. After I obtained my degrees, I went to work for the Marine Research Institute. My background with the Marine Research Institute provided the scientific training and statistical expertise for my work with oyster populations and the oyster fishery. Together with my colleagues and bio-statisticians at the Marine Research Institute, I developed a statistically valid method to assess and analyze oyster population data and gained a greater understanding of oyster population dynamics in Apalachicola Bay ("Apalachicola Bay" or "Bay").

10. In 1983, I was hired as a senior biologist at the Florida Department of Natural Resources, where my primary responsibility was being the oyster biologist for the State of Florida. My duties involved the development and maintenance of data on population dynamics and resource assessment of the oysters in the Apalachicola Bay. For 30 years, through my tenure working for the State of Florida (with the Department of Natural Resources, which later merged into the Department of Environmental Protection, and later my duties were transferred to the Department of Agricultural and Consumer Services – "DACS"), until my retirement from the State in April of 2013, I continued in this role and with those responsibilities.

11. I have a broad range of experience in shellfisheries, multi-dimensional resource management, and habitat restoration. I provided technical, scientific, and administrative support to the Governor, Cabinet, Legislature, Boards of County Commissioners, local municipalities, numerous fisheries commissions and councils, and various state and federal agencies related to oyster resource and habitat management.

OYSTER ASSESSMENTS

12. DACS has conducted annual oyster resource surveys on the principle oyster-producing reefs, including Cat Point Bar, East Hole Bar and St. Vincent Bar, in Apalachicola Bay since 1982. These assessments are not meant to assess the cause of what is occurring on the reefs, but only intended as a resource management tool. The information from the annual assessments is used to predict trends in oyster production; to monitor oyster population dynamics, including recruitment, natural mortality, standing stocks; to determine its impact of climatic events, such as hurricanes, floods, and droughts on oyster resources; and to determine if the oyster reefs in Apalachicola Bay are capable of sustaining commercial harvest.

13. I personally participated on most sampling excursions over the first 25 years, involving thousands of hours of both bottom-time and surface-time as well as data analyses. I reviewed all of the data, edited and/or wrote all of the resource assessment reports during that time, including JX-30, FX-442, JX-34, FX-444, FX-446, FX-447, FX-448, FX-449, JX-67, JX-50, JX-60, and JX-67, all of which are official State of Florida records and which were created and maintained in the regular course of business. These exhibits are true and accurate copies of those resource assessments. Throughout my career I was actively engaged in all aspects of oyster data collection, analyses and reporting.

14. The methodology that I developed eventually led to the adoption of a predictive index that later became codified as the Standard Oyster Resource Management Protocol for the

State of Florida ("SORMP"). I used this analytical protocol throughout my tenure to determine whether the oyster reefs in the Apalachicola Bay were capable of sustaining commercial harvest. This information would then be utilized to make management decisions, including establishing the number of harvesting days during the Winter Harvesting Season in Apalachicola Bay.

15. Oyster resource assessments begin with samples of the oyster populations. Samples are collected from historically productive oyster reefs (commonly referred to as oyster bars). Long experience has established that oyster samples from 0.25 meter square quadrats are statistically valid, readily replicated, and practical for field application.

16. Sampling stations are located on historically productive reefs, and five quadrats are sampled at each sample station. Quadrats are semi-randomly selected by tossing the quadrat (a weighted 0.25 meter PVC grid) from the sampling vessel. The number of sampling stations on individual reefs range from one to four. Additional sampling stations have been added on other reefs, as the assessment program has expanded. New stations were established on restored reefs to monitor recovery of oyster populations. More than twelve individual reefs were monitored at various times.

17. Samples are collected by divers. Live oysters, shell, and associated fauna are removed to a depth of about 10-15 cm, placed in mesh bags, and delivered to the survey vessel. Samples are placed on a culling board, and live oysters are separated and measured. Substrate characteristics, predators, and freshly dead oysters are also noted and recorded. An array of values were calculated from the quadrat samples, including: the number of live oysters; mean oyster length (height, longest dimension); oyster density per square meter; the percentage of oysters greater than 50 mm; the percentage of oysters greater than 75 mm; the number of oysters greater than 75 mm per square meter; the number of oysters greater than 75 mm per acre; and the

number of bags of oysters greater than 75 mm per acre. Important population parameters, such as number of oysters, size and density were used to estimate potential production levels and develop comparisons between and among oyster populations.

18. SORMP data analyses has been used by resource managers to reliably predict trends in oyster population dynamics. These data have formed the basis of a predictive index which is used to estimate oyster production; monitor oyster recruitment, growth, natural mortality, standing stocks; and to determine the impacts of climatic events such as hurricanes, floods, and droughts on oyster resources. Initially, sampling was conducted on a quarterly basis, which provided an excellent sequence of data and knowledge of oyster population dynamics. Over time, with the goal of increasing our ability to predict potential production on reefs for the following oyster harvesting season, sampling intervals were adjusted to become aligned with oyster harvesting seasons. For example, Cat Point Bar in the Winter Harvesting Area would be sampled in August or September before harvesting was permitted. Samples collected prior to harvesting provided a better estimate of available standing stocks and more accurate predictions of potential production.

19. Continuous monitoring and data analyses of oyster reefs in Apalachicola Bay allowed for development of a scale to determine estimated oyster production. Estimated production exceeding 400 bags of oysters per acre is an indicator of healthy oyster reefs capable of sustaining commercial harvesting. Limited commercial harvesting is possible when stocks exceed 200 bags per acre, and commercial harvesting is not supported when stocks fall below 200 bags per acre. The oyster population is considered depleted when marketable stocks are below 100 bags per acre (Berrigan, 1990 (JX-3)).

20. The SORMP, codified in Subsection 68B-27.017, Florida Administrative Code, has been used by DACS and FWC to establish the number of harvesting days in the Winter Harvesting Season in Apalachicola Bay. The SORMP is also a useful index to predict oyster production on reefs throughout the Bay, and to identify events that adversely affect oyster populations.

21. The SORMP is a method for predicting fishery trends, so that the oyster industry can be informed about future harvest potential, including expected increases and decreases in production on historically productive reefs. Assessment data provides the best available, continuing source of information about oyster production on specific reefs.

22. Results from seasonal sampling were analyzed and published in reports that were available to the oyster industry. Reports containing the results of the sampling prior to the opening of the Winter Harvesting Season were the most comprehensive and informative, and were considered to be the most valuable to local harvesters and processors. Often, the local newspaper would publish the entire report.

23. Sampling occurs just prior to the harvesting seasons, so that the oyster industry is apprised of the likely productivity of the fishery. Additional sampling is conducted when specific data was needed in response to special circumstances, such as hurricanes, floods, and droughts when extensive mortality or reef destruction was suspected.

24. Important population parameters, such as number of oysters, size and density are used to estimate potential production levels and develop comparisons between and among oyster populations. Estimates of density, standing stocks, and yields are calculated from the sample data. Oysters equal to or greater than 1 inch in length are used in population estimates, while

changes in size frequency distributions are used to predict growth rates, mortality, and recruitment into the legal, marketable size, which is 3 inches in length or greater.

25. Based on my involvement with the SORMP and the periodic oyster resource assessments in Apalachicola Bay since their inception, and my direct observations of the oyster fishing industry over 30 years, I have specific personal knowledge of the condition of the oyster reefs in Apalachicola Bay and the impact of river flows, harvesting and predation on those reefs.

THE OYSTER FISHERY IN APALACHICOLA BAY AND THE FISHERY FAILURE IN 2012

26. While the oyster population in Apalachicola Bay has always been subject to fluctuations, particularly following events such as hurricanes, droughts, and floods, I have never seen a fishery failure as severe, extensive and of such a long duration as the event that occurred in 2012.

27. Prior to 2009, oyster stocks in Apalachicola Bay were plentiful. Analysis of oyster landings data for 2008, 2009 and 2010 (JX-30, FX-442, JX-34 and FX-444) indicated that environmental conditions were favorable and oyster populations were productive and stable. However, when I assessed the same bars two years later, most oyster populations were severely depleted.

28. I initially observed depletion of oysters on the south end of St. Vincent Bar in western Apalachicola Bay. This reef complex is often exposed to the highest salinities in the Bay as it is located furthest from fresh water flows from the Apalachicola River.

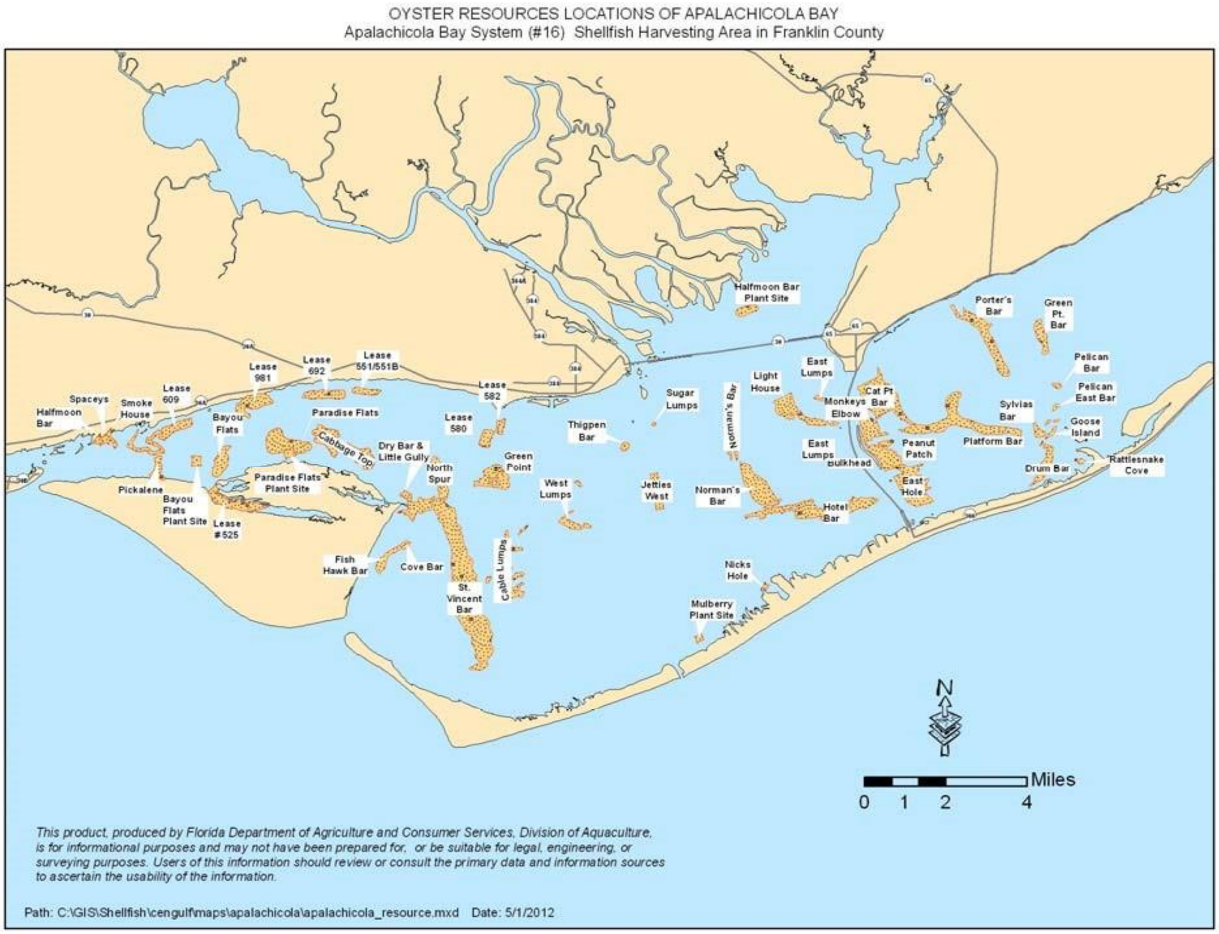

Figure 1 - This is a map from the Florida Department of Agriculture and Consumer Services from May 2012 showing the public oyster bars and private leases in Apalachicola Bay. A larger version of this map may be found below.

29. I observed depletion of oysters progressing northward along St. Vincent Bar and into the northern part of western Apalachicola Bay, including Little Gully and North Spur Bars, and into St. Vincent Sound.

30. Assessments on commercially important oyster reefs, including Cat Point Bar, East Hole Bar, St. Vincent Bar, and Dry Bar, were conducted during July 2012. These July 2012 assessments revealed production estimates that were the lowest reported in twenty years. Observations and sampling indicated that oyster populations were almost totally depleted over most of the reef areas sampled, and that surviving oyster populations were severely stressed.

31. By October 2012, I observed extensive depletion of oysters on all of the major reef complexes in western Apalachicola Bay and St. Vincent Sound, impacting both subtidal and intertidal bars. At this time, the major bars in the eastern portion of Apalachicola Bay and St. George Sound were experiencing degrading water quality as the high salinity regime adversely affected the entire bay system. Oyster populations on the bars in St. George Sound showed substantial losses of oyster populations, with severe declines in oyster densities, standing stocks and production estimates, while the depletion event, evidenced by mass mortalities, encompassed all of the western portions of Apalachicola Bay. Following Tropical Storm Debby in June 2012, DACS conducted routine monitoring to determine the impacts of the storm on oyster resources. Preliminary reconnaissance following T.S. Debby did not indicate severe disruption of oyster reef structure. Examination of shells and live oysters did not display the effects of severe scouring (*e.g.*, polished shell surfaces, abrasion, dead oysters) and observations by divers did not demonstrate extensive disruption of the reef's surface (*e.g.*, suspension and deposition of reef shell and sediments, concretion of reef material, or burial of shell and living oysters). Scouring and wave action may have impacted reef surfaces and oyster resources in some isolated areas, but widespread damage to reef structure was not observed.

32. Reports from oystermen during the first week of the 2012/13 Winter Harvesting Season confirmed the assessments and predicted production estimates. Many called to advise DACS that oyster standing stocks would not be adequate to support commercial harvesting through the winter.

33. Our observations reflected poor recruitment (i.e. low levels of oyster growth), as well as a severely reduced number of juvenile oysters. Indeed it was evident from divers' observations that many reefs in Apalachicola Bay were showing the negative effects of

decreased rainfall and freshwater flow rates from the Apalachicola River, including depressed recruitment and increased natural oyster mortality due to the predation, disease and stress associated with a higher salinity regimes.

34. While the western portions of the Bay were almost completely depleted prior to the start of the 2012/13 Winter Harvesting Season, bars in the eastern portion of the Bay had standing stocks of market size oysters at various levels. Some reefs still held adequate stocks to support limited commercial harvesting. As a result, fishing in the western portions of the Bay stopped, and fishers concentrated their efforts on Cat Point Bar and East Hole Bar in the eastern portion of the Bay.

35. By the beginning of 2013, all of the reefs in Apalachicola Bay and St. Vincent Sound were considered depleted and not capable of sustaining commercial harvesting.

LACK OF FRESHWATER WAS THE PRIMARY CAUSE OF THE FAILURE OF THE OYSTER FISHERY IN 2012

36. Depletion of oyster populations in Apalachicola Bay in 2012 was directly associated with high salinity in the Bay, resulting from reduced freshwater inflows from the Apalachicola River.

37. Adverse environmental conditions can have a devastating effect on oyster populations, and high salinity is among the most detrimental. Because oysters are sessile animals, they are not capable of moving when environmental conditions become poor, or even lethal.

38. Rainfall and concomitant river discharge are essential for productive oyster populations in Apalachicola Bay, and provide three critical requirements for survival. First, survival depends upon salinity regimes that are suitable for oysters to reproduce, grow and survive. Rainfall in the drainage basin and discharge into the Bay are essential, as productive

oyster populations require a combination of fresh water and marine waters. Fluctuating salinity regimes, within the oyster's tolerance limits, is the single most important factor influencing oyster populations in Apalachicola Bay. While oysters can tolerate a range of salinities, prolonged exposure to high salinity will adversely impact affected populations.

39. Second, rainfall, flooding in the flood plain, and river discharge into the Bay are essential for supplying the nutrients and detritus necessary to nourish and sustain the food web that supports oyster populations, and the estuary more generally.

40. Third, rainfall and river discharge are critical factors driving fluctuations in salinity levels that prevent destructive marine predators from becoming established in the Bay.

41. The beginning and progression of the extensive oyster population depletion in Apalachicola Bay provided ample evidence that this mortality event was directly associated with high salinity and the lack of freshwater inflow. From direct water testing, we know that abnormally high salinity conditions persisted in Apalachicola Bay in 2012.

42. The presence of marine predators was likewise telling. For example, the presence and establishment of snail populations also correlate with prolonged high salinity waters. Observations and sampling confirmed the presence and abundance of the Florida rock snail, Stramonita haemastoma, (formerly Thais haemastoma), a destructive snail commonly referred to as an oyster drill.

43. Oyster drills are considered as one of the most serious oyster predators along Florida's Gulf Coast, and became established in Apalachicola Bay during the mortality event. Reports from oystermen suggested that drills were more abundant than at any time in recent memory. It was observed that drill populations were moving farther into the estuary as oyster populations in the more marine portions of the Bay were depleted. The increased abundance of

snail predators was obvious, as high numbers of drills were found wherever viable oyster populations were observed, and depletion occurred rapidly after those snails appeared.

44. Snails passed across entire reefs, devouring every oyster and then moving on to the next reef. In all of my experience, I had never encountered such an abundance of snails or the devastation they left behind. A clear sign of continued high salinity was confirmed by observations that oyster drills were completing their life cycles within the estuary. Egg cases, juvenile, subadult and adult snails were abundant on oyster reefs.

45. Additionally, divers noted abundant stone crabs, Menippe mercenaria, on the primary oyster reefs in Apalachicola Bay. Stone crab burrows were easy to recognize and the appetite of these destructive predators was obvious. Stone crab burrows were surrounded by living and dead oysters; the result of crabs actively foraging and bringing live oysters to their burrows. The shells of devoured oysters were also present and formed a ring around burrows. Examining dead oyster shell provided confirmation of the crushing action of stone crabs on the shell of oysters. Stone crabs are considered primary predators of oysters when salinities remain high for extended periods and crab populations become established on oyster reefs.

46. The Florida crown conch, Melongena corona, was also commonly observed on oyster reefs. These conchs are also known to be serious oyster predators with marine affinities. Mud crabs of various species are also common predators on oyster reefs, generally attacking spat and smaller juvenile oysters.

47. Beyond the mere presence of marine predators, increased stress associated with high salinity also weakens oysters, which exacerbates the level and intensity of predation. Both the abundance of marine predators on oyster reefs in Apalachicola Bay, as well as the impact of

those predators on the oyster population, confirm the long duration of high salinity conditions within the estuary.

48. In addition to predation, the manner of the depletion event points to salinity as the cause. My observations and analyses of oyster reefs in Apalachicola Bay in 2012 identified a progression of reef depletion from locations farthest from the Apalachicola River moving towards the ever diminishing freshwater source. Surveys of subtidal and intertidal reefs in September and October 2012 confirmed the extent of depletion in western Apalachicola Bay and St. Vincent Sound, as well as providing evidence of increased, but less pronounced, mortality on reefs nearer the river. The depletion continued to progress, with oyster reefs at the mouth of the Apalachicola River eventually showing depletions of 80 to 90 percent.

49. I concluded that the 2012 fishery failure was driven by low river flows. In a public meeting of the Franklin County Commission I detailed this conclusion and discussed the impact that prolonged high salinity would have on the oyster industry. These Commission meetings are often recorded by video and these recordings are publically available. I viewed a true and accurate copy the Commission meeting at which I presented (Exhibit FX-608), and it is an accurate representation of what occurred during this meeting.

HARVESTING DID NOT CAUSE THE FAILURE OF THE OYSTER FISHERY

50. The oyster fishery failure in 2012 was the most extensive mortality that I have observed, other than under catastrophic conditions following Hurricane Elena, and has been by far the most prolonged in duration. As discussed above, the failure was primarily the result of mortality associated with high salinity in the Bay. In my judgement, and based upon the available evidence, harvesting intensity and practices can be discounted as a significant cause of the fishery failure.

51. The clearest evidence that harvesting was not to blame for depleting oyster populations is that oysters were not removed from the bars, but rather remained dead on the reefs, with the reef substrate intact and silted over. These conditions point to natural mortality, from predation, disease, and stress associated with prolonged high salinity conditions, and not commercial harvesting. When oysters are harvested, living oysters are removed from the reef, and the surface of the reef has a different appearance than either a normal, unharvested reef, or a reef suffering significant mortality.

52. Observations of subtidal reefs in 2012 clearly demonstrated the difference between reefs where dead shell was present and reefs where live oysters had been removed. Harvesting was discounted on the reefs observed in western portions of the Bay, based on the presence and abundance of dead shell. In these cases, the reef substrate was intact, but oysters were dead and a silt overburden was apparent. Based on my observations, the depletion events observed in western Apalachicola Bay and St. Vincent Sound were clearly not the result of over-harvesting.

53. My observations during the winter of 2012 provide additional support for this conclusion. Extreme depletion, where mortality approached nearly 100 percent, was observed on many reefs in the western portions of the Bay, where harvesting for commercial purposes had ceased months before the observations were made. I observed similar depletion on unharvested shellfish leases in the vicinity of natural reefs in September and October of 2012. Predators on those leases, areas with no public commercial harvesting activity at all, had devastated the oyster population.

54. In my opinion, it would be incorrect to blame the overall depletion event in Apalachicola Bay on harvesting, when clearly harvesting had little to do with the onset of

depletion that occurred on public reefs and private shellfish leases in the western portions of the Bay system.

55. In the eastern portion of the Bay, harvesting effort became almost exclusively concentrated on Cat Point Bar, and to a lesser extent on East Hole Bar. These reefs received diminishing amounts of fresh water from the river and its distributaries. The livelihood of hundreds of oyster harvesters and associated seafood workers depended upon the surviving oysters on these reefs. Unfortunately, while high fishing effort was not unusual for Cat Point Bar, which had previously showed remarkable resiliency, the remaining stocks of oysters were also under severe stress from unfavorable environmental conditions, and high predation rates.

56. Oyster assessments indicated marked declines in oyster standing stocks on Cat Point and East Hole Bars and predicted that oyster production on these reefs would not support increased harvesting effort. The depletion event was completed on Cat Point and East Hole Bars as harvesting targeted the remaining surviving oysters. Harvesting the surviving oysters from these two reefs was the result or climax of the depletion event, not the cause or the origin. As a consequence of extensive depletion throughout the Bay and the lack of alternative reefs for harvesting, concentrated harvesting on Cat Point Bar and East Hole was inevitable.

57. Just as harvesting intensity cannot be blamed for the collapse of the oyster fishery, neither can poor harvesting practices. For instance, the harvesting of sublegal oyster stocks did not lead to the population depletion I observed in 2012. The 3-inch size limit for oysters is a regulatory restriction enforced to maintain a market standard, and there is no substantial biological significance to harvesting undersize oysters. It should be noted, that harvesting sub-legal sized oysters is not an uncommon practice by oyster fishers. This practice has been a concern in the fishery for decades, and surveys conducted by myself in the mid-1980s, indicated

that harvesting sub-legal sized oysters was common practice at that time. Although the practice is regulated and illegal. During thirty years of observations and analyses, no significant impact on population dynamics, reproductive potential, or resource sustainability could be attributed to taking sublegal oysters. The establishment of a 3-inch size limit is somewhat arbitrary and was not set to maintain or increase reproductive potential, but rather is the size supposedly preferred in the marketplace. Based on my observations, the fishery failure throughout the Bay did not result from the harvesting of undersized oysters.

58. Harvesting sublegal size oysters on Cat Point Bar may have had an impact on landings and values; but it is highly unlikely that the practice contributed substantially to the depletion of the oyster population. It is clear that harvesting sublegal size oysters from other reefs in western Apalachicola Bay and St. Vincent Sound did not contribute to the depletion event. Harvesting was discontinued as the depletion event proceeded. Simply put, harvesting of sublegal oysters did not present a biological or reproductive challenge that resulted in the collapse of the oyster fishery in Apalachicola Bay in 2012.

59. Similarly, the collapse of the oyster fishery in Apalachicola Bay in 2012 was not as a result of harvesters taking unculled oysters and dead shell off the reefs when harvesting. This practice is commonly called "tonging trash." Observations suggest that this practice is uncommon, and only practiced by a small group of unskilled oystermen. This type of harvesting results in a vastly degraded product, and is meant to deceive the processor and consumer. The concern with this harvesting practice in that the oystermen are "hauling off the bay."

60. Concerns about this practice are commonly expressed and have been repeated for decades. It is highly unlikely from a physical, labor and volumetric perspective, however, that this practice results in significant damage to reef structure. The removal of cultch by tonging

would amount to perhaps 10 to 20 bags per trip. At this rate, the few tongers who engage in this practice could remove about one or two cubic yards. By comparison, restoration efforts to mitigate reef damage deposit thousands of cubic yards. In my opinion, we can discount the notion that a few tongers could "haul away the Bay," or contribute substantially to the depletion of oyster populations leading to the depletion of oyster resources in Apalachicola Bay in 2012.

RESTORATION

61. Restoration efforts of the oyster reefs in Apalachicola Bay fell under my responsibilities while I was employed by the State of Florida. Oyster restoration is a practical and effective practice for resource management and restoring reef functionality. Basically, it involves building a substrate or providing a substrate on the sea floor. Typically, the structure is composed of processed oyster shell, mined oyster shell or fossil oyster shell. During my tenure with the State of Florida, DACS restored oyster reefs annually by depositing processed oyster shells on public oyster reefs as part of an ongoing resource development program. This process is known as "shell planting or shelling."

62. Where conditions are favorable, shelling or substrate restoration can dramatically increase oyster productivity. Where high salinity conditions persist, however, no amount of shelling or substrate restoration will bring oysters back.

63. Faced with unfavorable environmental conditions, like prolonged high salinity, it would be incorrect to assume that any management practice would have been effective in slowing the progression of the depletion event, or accelerating resource recovery. Increased freshwater input and increased river discharge rates are the only factors that will bring the depletion event to an end and allow the resource to recover. Restoration and recovery will be ineffective until the high salinity conditions in the bay are ameliorated.

CONCLUSION

64. The depletion of oyster stocks in Apalachicola Bay resulted from prolonged high salinity conditions associated with the lack of freshwater due to low river discharges from the Apalachicola River. This situation was exacerbated by an overall decline in nutrients provided by the river; extensive predation from animals with marine affinities that thrived in the high salinity conditions, and environmental stress. While these conditions persisted, the functionality of oyster populations and oyster reefs was severely impaired, progressing to a point of mass depletion. The circumstances surrounding the fishery failure in 2011 through 2012 were clearly associated with a combination of factors related to prolonged high salinity and predation. Harvesting pressure was a consequence of the depletion, not a cause.

65. This pressure only made an impact when standing stocks were severely reduced in isolated locations. Under circumstances that prevailed in the Bay from 2011 through 2012, there were no resource management decisions or actions that could have circumvented the end result and the eventual consequences. In my opinion, it would be incorrect to assume that any management practice would have been effective in slowing the depletion event. Increased freshwater input and increased river discharge rates are the only factors that will bring the depletion event to an end and allow the resource to recover. Restoration and recovery will be ineffective until the high salinity conditions in the bay are ameliorated. The Apalachicola Bay oyster population has for years demonstrated its ability to thrive in varied and natural environmental conditions. Even in the wake of devastating hurricanes, flooding and droughts, including Hurricane Elena in 1985; Hurricane Opal in 1995; Hurricane Earl in 1998; tropical storm Alberto and tropical storm Beryl in 1994; freshwater flooding in 1993, 1994, and 1996, and droughts in 1988-89, 2001-2002, 2008, the oyster fishery always recovered. The difference

with the fishery failure in 2012 was the lack of freshwater inflows from the Apalachicola River. Until those flows are restored, the oyster fishery cannot recover.

Figure 1 – Map of Oyster Resources in Apalachicola Bay