FISHERIES LANDINGS AND DISASTERS IN THE GULF OF MEXICO

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Coastal and ocean ecosystems provide benefits to people, including clean water, protection from storms, and food. Fishery resources are an essential part of those ecosystems and are considered to be common property. Thus, fisheries, or all of the activities involved in catching fish and shellfish, are managed by government for the benefit of all citizens. To manage and conserve fisheries resources, especially in the face of oil spill disasters, science is key.

Commercial fishermen have been harvesting shrimp in the Gulf since the early 1800s. Three commercially important types of shrimp are landed—browns, pinks and whites. (UF/IFAS photo)

In recent years, the Gulf of Mexico fishing industry has been negatively impacted by several disasters. Record-breaking hurricanes—Katrina and Rita in 2005 and Gustav and Ike in 2008—demolished infrastructure such as fish houses, boats, and supplies.[1] The Deepwater Horizon oil spill of 2010 continued the devastation to both humans and natural resources, and the extent of the damage is still being investigated today. These disasters and their consequences have become significant in understanding **fisheries**, especially from a management perspective.

Thus, the Gulf of Mexico Research Initiative (GoMRI; see sidebar) has funded scientists to investigate oil spill impacts, so that managers, as well as emergency responders, policy-makers, fishermen, and others can make informed decisions.

THE SEA GRANT and GOMRI PARTNERSHIP

The mission of Sea Grant is to enhance the practical use and conservation of coastal, marine and Great Lakes resources in order to create a sustainable economy and environment. There are 33 university-based Sea Grant programs throughout the coastal U.S. These programs are primarily supported by the National Oceanic and Atmospheric Administration and the states in which the programs are located.

In the immediate aftermath of the Deepwater Horizon spill, BP committed $500 million over a 10-year period to create the Gulf of Mexico Research Institute, or GoMRI. It is an independent research program that studies the effect of hydrocarbon releases on the environment and public health, as well as develops improved spill mitigation, oil detection, characterization and remediation technologies. GoMRI is led by an independent and academic 20-member research board.

The Sea Grant oil spill science outreach team identifies the best available science from projects funded by GoMRI and others, and only shares peer-reviewed research results.

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	Number of Jobs	Landings Revenue	Sales	Income	Value Added
Alabama	9,947	$46,340	$460,514	$172,314	$229,316
Louisiana	33,391	$331,165	$1,927,986	$659,974	$920,873
Mississippi	8,532	$49,295	$377,374	$149,147	$193,349
Texas	25,911	$194,044	$2,499,832	$677,391	$1,036,657
Florida	82,141	$141,671	$16,553,480	$3,092,392	$5,532,209
Gulf Total	**159,922**	**$762,515**	**$21,819,186**	**$4,751,218**	**$7,912,404**

TABLE 1. *Gulf of Mexico seafood industry economic impacts (multiply by thousands) in 2012. Commercial fishermen landed 1.7 billion pounds of finfish and shellfish, making $763 million in landings revenue.* [1]

This publication summarizes historical fisheries landings data for several significant Gulf of Mexico species within the context of manmade and natural disasters, and explores why this data is important for fisheries management. Emerging GoMRI-funded fisheries science is also introduced. Further fisheries science related to oil spills will be detailed in other publications within this series.

LANDINGS

Landings are the quantities, in number or weight, of seafood unloaded at a dock by commercial fishermen or brought to shore by recreational fishermen, as reported to biologists, resource managers, or seafood dealers. Landings information can include quantity and value of seafood products caught and sold to seafood dealers.[2] Landings data are essential for interpreting harvest trends and gauging changes in fish stocks over time. A **fish stock** is a group of fish of the same species living in the same geographic area and reproducing with each other.[3]

Landings are a type of **fishery-dependent data**, that is, information collected directly from the commercial and recreational harvest. Conversely, fisheries data collected by scientists who catch the fish themselves, rather than depending on fishermen and seafood dealers, is referred to as **fishery-independent data**. Fishery-independent data enables scientists to study specific factors influencing fish populations. Factors such as growth rate of a species, predator and prey interactions, environmental conditions, time of year, fishing regulations, type of gear used in catching fish, market prices and fishing **effort** (how much time, gear size, boat size and horsepower, used to harvest fish) are all some of the important considerations made in understanding landings trends and fisheries overall.[2] Both fishery-independent and fishery-dependent methods contribute valuable information to population assessments, but scientists rarely have enough resources to collect vast quantities of data over large geographic areas. Thus, scientists and resource managers rely on fishery-dependent data for management planning.[2]

Ultimately, it is important for managers to analyze all aspects of fisheries, such as economics, in order to improve the long-term environmental health of the Gulf of Mexico, and the health of the people who depend on the Gulf for their livelihood. The seafood industry is economically important to Gulf of Mexico communities and to the nation. Healthy and productive fisheries provide jobs for both fishermen and the numerous support industries such as seafood processing, marketing, and monitoring, and vessel maintenance businesses like repair shops, marinas, and supply companies. In 2012, the overall economic impact of the Gulf of Mexico seafood industry, expressed in terms of dollars generated from landings revenue, jobs, sales, income, and value-added impacts, totaled $35 billion (Table 1).[1] Total Gulf **landings revenue**—income from bringing fish and shellfish to shore for sale—was $763 million in 2012.[1] This puts the Gulf in third place in the nation for landings revenue alone, out of total national landings

	Landings (Pounds)	Landings (Revenue)
North Pacific	5,261,421	$1,703,726
New England	664,243	$1,191,363
Gulf of Mexico	1,652,446	$762,514
Pacific	1,068,691	$661,994
Mid–Atlantic	751,144	$488,316
South Atlantic	107,802	$170,938
Western Pacific	29,289	$91,513
U.S. Total	**9,637,821**	**$5,099,456**

TABLE 2. *2012 total landings and total landings revenue of U.S. fisheries, by region (in thousands).[1]*

revenue of more than $5 billion (Table 2).[1] In terms of pounds of landings, the top 10 commercial fishing ports in the United States, in both 2012 and 2013, included four from the Gulf: Empire–Venice, La.; Intracoastal City, La.; Cameron, La.; and Pascagoula–Moss Point, Miss.[4] These and other Gulf of Mexico fishing ports are crucial to a thriving seafood industry; thus, natural resource managers utilize landings and landings revenue data to make decisions that impact fishermen and the environmental health of the Gulf of Mexico.

Fishing regulations and management actions are a factor impacting landings and landings revenue. For example, federal and state agencies set **quotas,** or the maximum amount of fish that can be caught in a specified time period, for a fishery.[3] **Annual Catch Limits**, or ACLs, are a type of quota, where fishermen can catch a certain amount of fish in one year.[3] In addition to harvest limits, fishing areas may be closed temporarily, as they often are after natural or manmade disasters, out of concern for the health of the fish stock or seafood safety. For example, as a precautionary measure to ensure public safety during and after the Deepwater Horizon oil spill, large areas of the Gulf were closed to fishing from May through October 2010.[5] In making management decisions such as these, scientists and managers incorporate multiple types of fishery–dependent and fishery independent data into **stock assessment models**. These models integrate the processes of natural death, growth, and fishery catch that affect a fish stock over time.[3] Thus, if in a given year landings data are low, it may not be a lack of fish in the sea, but that a management action, environmental condition, or other factor is influencing population numbers.

Researchers dissect fish to look for evidence of Deepwater Horizon oil contamination, an example of fishery-independent data collection. (USF/C-IMAGE photo)

LANDINGS AND DISASTERS

Many people have questions about the impacts disasters have had on fishery populations, and consequently, fisheries as a livelihood. Landings data are used by natural resource managers, fishermen, and others interested in the future of fisheries, to monitor change in populations. When managers incorporate landings trends into stock assessment models—models that include other potential influential factors, such as environmental conditions or regulations—they can determine if or how disasters impact fishery populations over time. For example, Figure 1 provides a snapshot of two Gulf of Mexico commercial fisheries landings from 1991 through 2013, including blue crab and the Eastern oyster.[1,6,7] The timeline also shows the occurrence of major disasters during that time, highlighting a pos-

Blue Crab and Eastern Oyster in the Gulf of Mexico: Commercial Landings (millions of pounds), 1991-2013

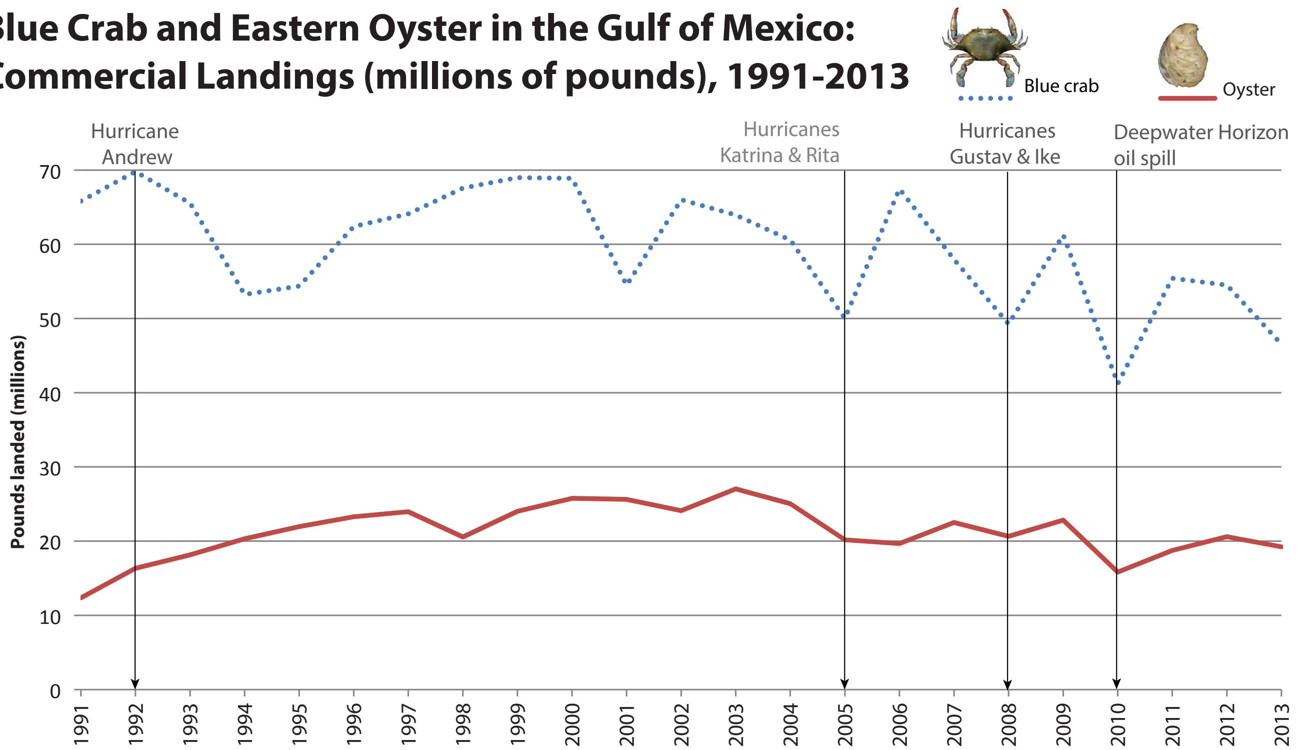

FIGURE 1. *Recent disasters show some relationship to landings of blue crab and oysters, but the picture is incomplete. Managers must depend on additional indicators when assessing the health of the fisheries.[6] Images credit: Gulf FINFO[6]*

Red Snapper in the Gulf of Mexico: Commercial and Recreational Landings (millions of pounds), 1991-2013

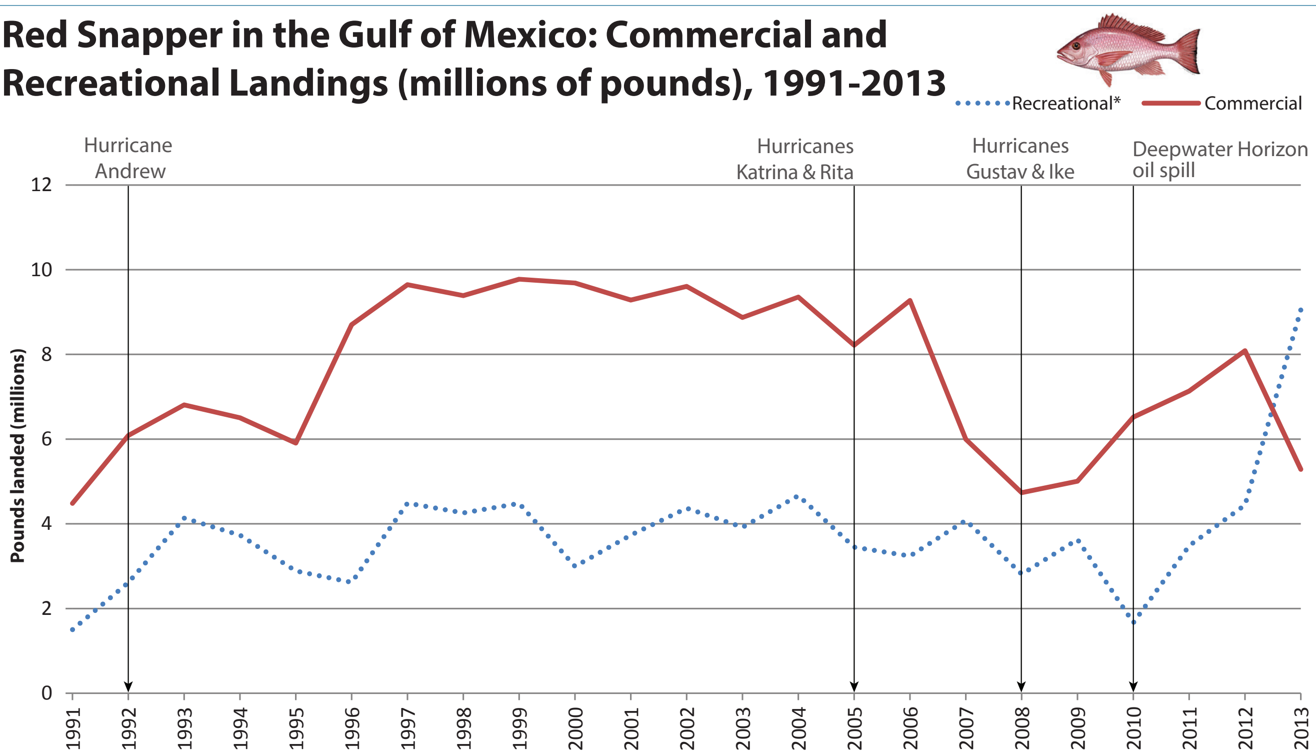

FIGURE 2. *Both commercial and recreational red snapper landings are influenced by disasters, but managers must consider other factors influencing fish population numbers, such as management actions.[7] Image credit: Gulf FINFO[6]*

*Amount harvested, defined by NMFS as catch brought back to the dock in a form that can be identified by trained interviewers, plus catch used for bait, released dead, or filleted.[7]

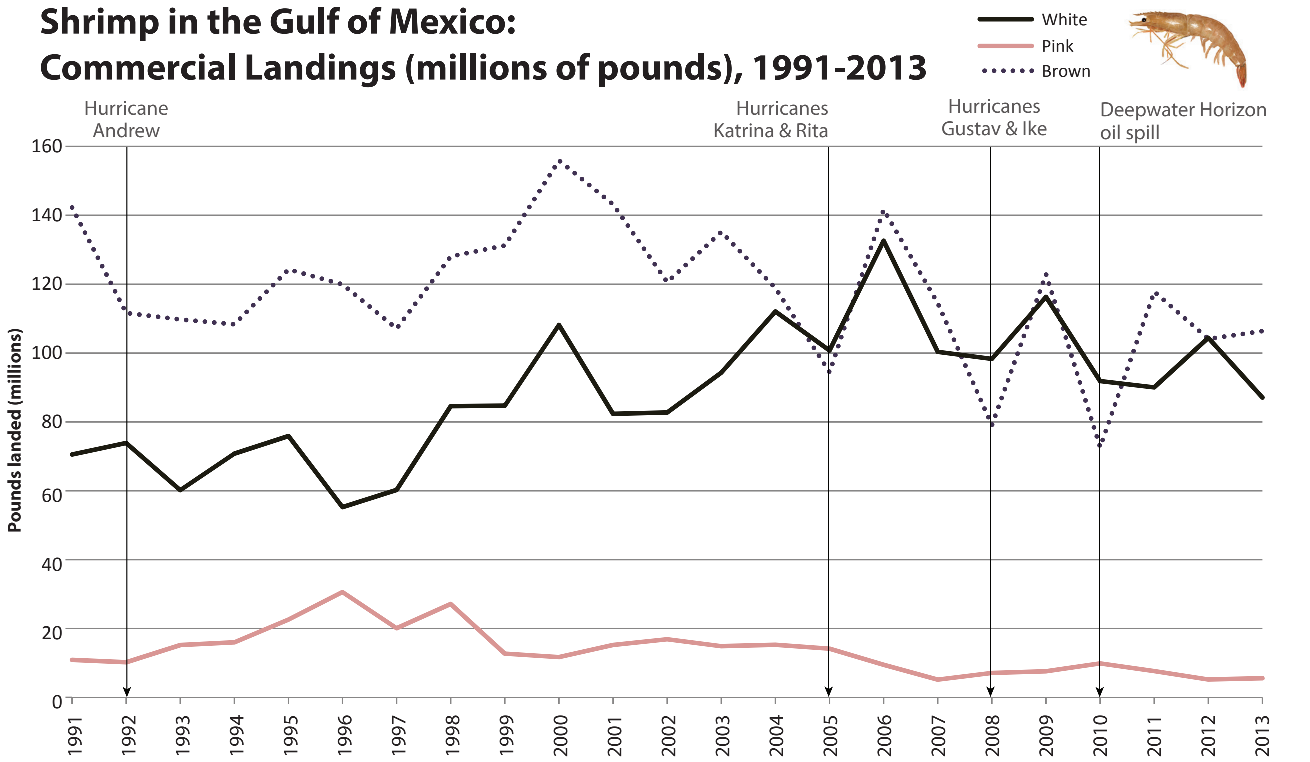

FIGURE 3. *Landings of the three main Gulf shrimp species can be affected by disasters, but fisheries managers consider other factors known to influence shrimp stocks, like weather, when making management decisions.[7] Image credit: Gulf FINFO[6]*

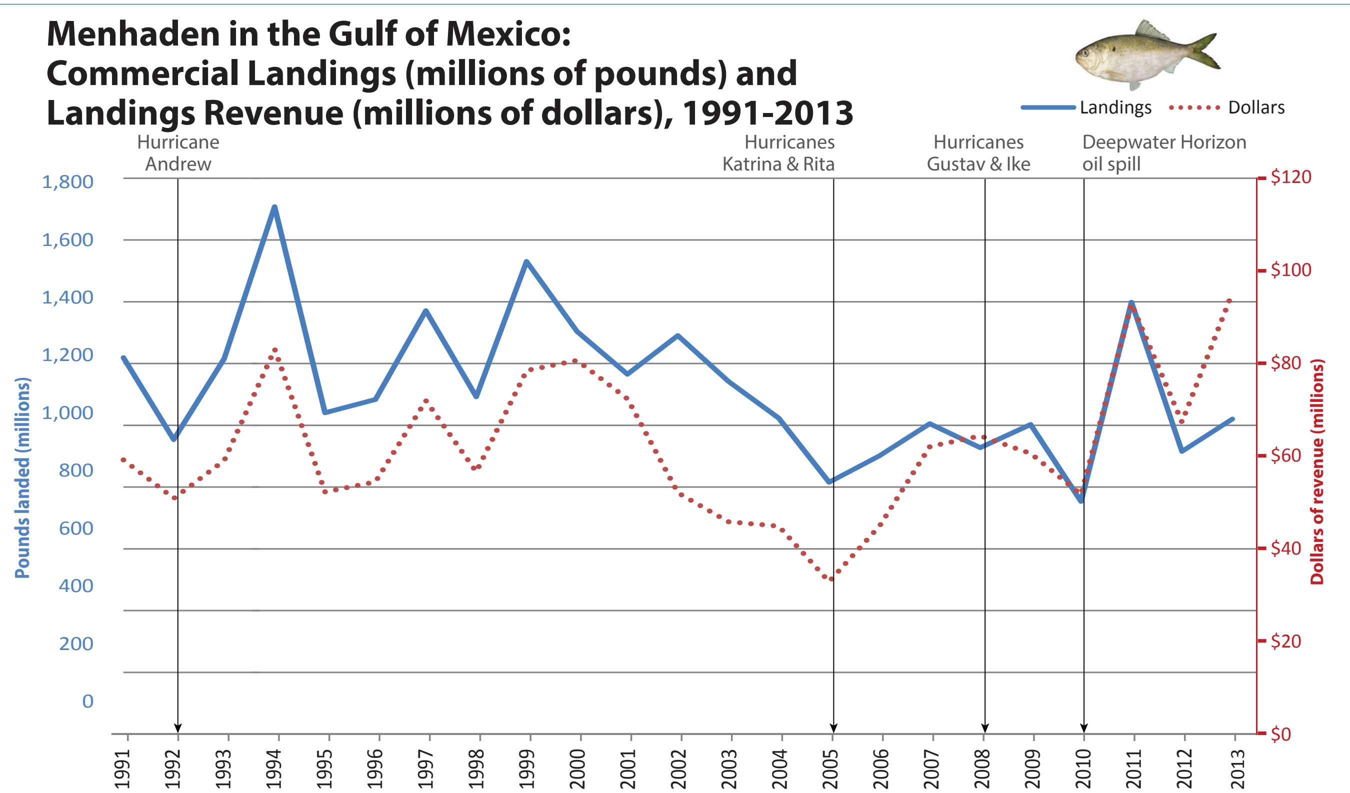

FIGURE 4. *Swings in Gulf menhaden landings happen frequently. Fisheries managers consider many factors, like changing seafood market prices, when drawing conclusions about disaster impacts.[7] Image credit: Gulf FINFO[6]*

sible relationship between landings and disasters. In Figure 1, reported blue crab landings had decreased in 2010, the year the Deepwater Horizon oil spill disaster occurred. In 2011, after the oil spill, blue crab landings were reported to increase, which suggests a potential for recovery after the spill. However, events like oil spills or hurricanes are only some factors to consider when interpreting landings data.

Figure 2, for example, provides red snapper landings data for both the commercial and recreational sectors.[1,6,7] This figure shows changes to this important Gulf of Mexico fishery over 23 years and includes, again, potential influential factors like storms and the Deepwater Horizon spill. From the graph, it appears that commercial red snapper landings rise and fall relative to such events. Red snapper landings, however, are also heavily impacted by annual catch limits. At first glance, the decrease in red snapper landings illustrated in Figure 2 would appear to be tied to the 2008 hurricanes. Yet, this is only part of the story; in 2007, a new **Individual Fishing Quota Program** ("IFQ," a type of catch–share program that dedicates a secure share of fish to fishermen) was implemented for red snapper, and the annual catch limit under this program was significantly reduced in 2008. So, the decrease in 2008 landings could be due to the annual catch limit quota, and not necessarily the hurricane.

Another example of interpreting landings data within the framework of disasters is in Figure 3, which focuses on landings trends of three commercially important shrimp species in the Gulf of Mexico: brown (*Farfantepenaeus aztecus*), white (*Litopenaeus setiferus*) and pink (*Farfantepenaeus duorarum*) shrimp. It appears that shrimp landings drop when disasters strike but recover quickly; however, there are also dramatic drops and rises in landings in years when major disasters did not occur. Understanding shrimp life cycles, as well as environmental or climatic factors, may shed some light on the landings trends. Shrimp are short-lived and produce an abundance of offspring, which are dependent on nursery areas for survival. They are also unique as a fishery in that they can be caught almost year round (some Gulf states briefly close shrimping to allow for growth and spawning).[6] Thus, shrimp are susceptible to environmental and climatic changes year round, such as heavy rainfall in late spring, or northers in winter (a strong, cold, north wind blowing over the Gulf) (G.Graham, personal communication, May 13, 2015). These conditions can impact shrimp productivity, and subsequently, landings can be impacted. Disaster impacts must be considered alongside factors like these when interpreting landings trends.

The fishing industry is well aware that when landings are at risk of being impacted by disaster, then revenue from landings is also at risk. One example is the menhaden fishing industry, which has experienced negative impacts over its lifetime, mostly attributed to hurricanes.[8] This fishery is one of the oldest and most valuable fisheries in the United States, and a significant component of the overall Gulf economy.[8] Menhaden are used primarily for fish meal and oil, and small quantities are used for bait. In 2013, Gulf menhaden landings were valued at $95.3 million.[4] Figure 4 depicts landings and landings revenue for menhaden, and how it has changed over time, relative to some disasters. Again, several factors must be considered when interpreting disaster impacts to landings

Blue crab is fished in shallow coastal waters almost exclusively by traps. Much of the meat is sold as a fresh, ice-packed product. (Florida Sea Grant photo by Bryan Fluech)

Scientists use a seine net to collect fish near a marsh, another instance of fishery-independent data that contributes to our understanding of fisheries in the Gulf of Mexico. (LUMCON/CWC photo)

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revenue, because annual trends vary depending on the changing state of seafood markets and the overall global economic market. However, as shown in Figure 4, menhaden landings and revenue dropped significantly in 2005 during Hurricane Katrina, and fishery managers have since attributed that drop to major loss in, and damage to, infrastructure such as seafood processing plants and fishing vessels.[8] Conclusions like these are made using many years of fishery–dependent and fishery–independent data.

EMERGING SPILL SCIENCE

While landings data are significant monitoring tools, and are baselines for evaluating changes to fishery populations, they have limitations. As shown in the previous diagrams, landings data can help identify when changes occur, and identify potential relationships between significant events and landings numbers, but landings data alone cannot identify the exact cause of change. To better control for biological, ecological, and other factors involved with population studies, scientists must conduct fishery–independent studies to make reliable conclusions about impacts to fisheries. In doing so, GoMRI scientists are conducting catch studies as one step in the long-term process of understanding oil spill impacts to fisheries. For example, scientists compared data from **trawls** (fishing using a custom-made net behind a boat) conducted before (2006–2009) and after (2010) the Deepwater Horizon spill.[9] **Catch rate** is the total number or poundage of fish captured from an area over a set period of time. They concluded that post–spill, an immediate loss of young, seagrass–dependent fish, such as spotted sea trout, pipefish, and gray snapper, among others, did not occur.[9] The scientists noted that the higher catch rates in 2010 for typically fished species, such as gray snapper and spotted sea trout, might have resulted from post–spill fishery closures, a management action that occurred during the spill.[9] Because fishing was not allowed after the spill, these scientists speculated that fish populations may have flourished, making oil spill impacts difficult to identify in catch rate studies such as theirs.[9] If in the long term any impacts from disasters like Deepwater Horizon are to be revealed, then it is essential that research and the practice of monitoring landings continue. Comprehensive ecological and biological research, bolstered by landings data, is just beginning to reveal the more complete story on oil spills and fisheries—and the challenges in understanding the complex Gulf of Mexico ecosystem as time goes on.

GLOSSARY

Annual Catch Limits
A type of quota in which fishermen are allowed to catch a certain amount of fish in one year.

Catch rate
The total number or poundage of fish captured from an area over a set period of time.

Effort
The amount of time, gear size, boat size, and horse-power used to harvest fish.

Fish stock
A group of fish of the same species, living in the same geographic area, and reproducing with each other.

Fisheries
All of the activities involved in catching finfish, shellfish or seafood.

Fishery–dependent data
Fisheries data collected directly from the commercial and recreational harvest.

Fishery–independent data
Fisheries data collected by scientists who catch the fish themselves, rather than depending on fishermen and seafood dealers.

Individual Fishing Quota Program
A type of catch–share program that dedicates a secure share of fish to fishermen.

Landings
The quantities, in number or weight, of seafood unloaded at a dock by commercial fishermen or brought to shore by recreational fishermen, as reported to biologists, resource managers, or seafood dealers.

Landings revenue
The income from bringing fish and shellfish to shore for sale.

Norther
A strong, cold, north wind blowing over the Gulf.

Quota
The maximum amount of fish that can be caught in a specified time period, for a fishery.

Stock assessment models
Models that integrate the processes of natural death, growth, and fishery catch that affect a fish stock over time.

Trawl
A form of fishing where a net is typically pulled behind a boat to catch multiple species of fish and sea animals.

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SUGGESTED CITATION

Hale, C., Graham, L., Maung-Douglass, E., Sempier, S., Swann, L., and Wilson, M. (2015). Oil Spill Science: Fisheries Landings and Disasters in the Gulf of Mexico. TAMU-SG-15-504.

This work was made possible in part by a grant from BP/The Gulf of Mexico Research Initiative, and in part by the Sea Grant programs of Texas, Louisiana, Florida and Mississippi-Alabama. The statements, findings, conclusions and recommendations do not necessarily reflect the views of these organizations.

TAMU-SG-15-504 GOMSG-G-15-005 September 2015