Deepwater Horizon Oceanic Fish Restoration Project: Developing Novel Mechanisms to Restore Pelagic Fish

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I. Introduction

The 2010 *Deepwater Horizon* oil spill was the largest maritime oil spill in U.S. history, discharging 3.2 million of barrels of oil into the Gulf of Mexico over a period of 87 days. Approximately 7 million liters of chemical dispersants (products that break up oil into smaller particles) were applied to the spill area. Due to the vast scale of the disaster, all major coastal and marine ecosystems throughout the northern Gulf of Mexico were impacted. In particular, many pelagic fish species in the Gulf were injured and have yet to be restored, including tuna, billfish, sharks and mackerel, as well as deepwater fish such as lancetfish. Commercial fishermen and communities depend on these natural resources, which are also a critical component of the Gulf ecosystem.

While the injuries to oceanic resources are unambiguous, effective restoration strategies for open ocean and deep sea species and habitats are understudied, expensive, and logistically challenging (Van Dover et al. 2014). Despite these challenges, the Programmatic Damage Assessment and Restoration Plan[2] (DWH-NRDA 2016) was able to identify a portfolio of restoration approaches for water column injuries including coastal, nearshore, and offshore habitat restoration. However, for pelagic and highly migratory species habitat restoration requires innovative approaches to adequately restore injured resources. In response, and to help restore a portion of the injuries to pelagic fish, the National Oceanic and Atmospheric Administration (NOAA) developed the *Deepwater Horizon* Oceanic Fish Restoration Project, currently being implemented in partnership with the National Fish and Wildlife Foundation (NFWF).

The *Deepwater Horizon* Oceanic Fish Restoration Project seeks to reduce fishing mortality in the Gulf of Mexico Highly Migratory Species fishery through a temporary repose period where participating vessel owners voluntarily refrain from using pelagic longline gear for the first six months

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[2] Following the *Deepwater Horizon* oil spill, and under the authorities of the United States Oil Pollution Act of 1990, a council of federal and state trustees was established to assess the impact of the spill on natural resources and determine the type and extent of restoration needed to compensate for those injuries (DWH-NRDA, 2016; Barron 2012).

of the year (January – June). Since pelagic longline gear is known to result in bycatch and bycatch related mortality, a reduction in fishing effort through a voluntary repose period is expected to reduce bycatch by as much as 25% over the life of the project and contribute to over 11,000 discounted kilograms of biomass left in the water each year of the project (DWH-NRDA 2015). The project's target is to reach at least 60 vessel-years of participation, where a vessel-year is equal to participation of a single vessel during the repose period of a single calendar year. While there are less than 40 eligible pelagic longline fishing vessels in the Gulf of Mexico, participation will be limited annually to a small proportion of the overall fleet. In addition, project participants are encouraged to continue to harvest yellowfin tuna and swordfish during the repose period using alternative fishing gear, which results in low bycatch and bycatch mortality (Kerstetter et al. 2014). Providing vessel owners with alternative gear (including greenstick, buoy, and deep drop gear) is intended to offer harvest opportunities and help offset potential economic impacts of the repose. Importantly, the project is tailored to restore resources injured by the oil spill without affecting existing management practices or regulations.

To offset potential losses in revenue that would be expected among vessels participating in a six-month pelagic longline repose, various mechanisms were evaluated to financially compensate participating vessel owners. In addition to direct compensation for the repose, the project developed mechanisms to offset costs associated with the use of and experimentation with alternative fishing gear. To inform compensation design, NOAA and NFWF facilitated extensive industry outreach with vessel owners, fishermen, fish dealers, and other key industry stakeholders. The feedback received was critical to project design and implementation and helped support the decision to launch the project as a pilot in 2017. The pilot year included a shortened, four-month repose period from March 1 – June 30, 2017 and provided the opportunity to evaluate implementation, continue industry engagement, and make project adjustments and enhancements prior to the implementation of a full six-month repose period in 2018 and subsequent years.

The *Deepwater Horizon* Oceanic Fish Restoration Project adds to the policy toolbox by presenting a viable strategy to compensate participants for contributing to open ocean restoration targets by voluntarily decreasing fishing mortality via bycatch reduction. For this innovative project to be successful, however, it is critical that the design of the compensation ensures both harvesters' participation and efficient use of the project resources.

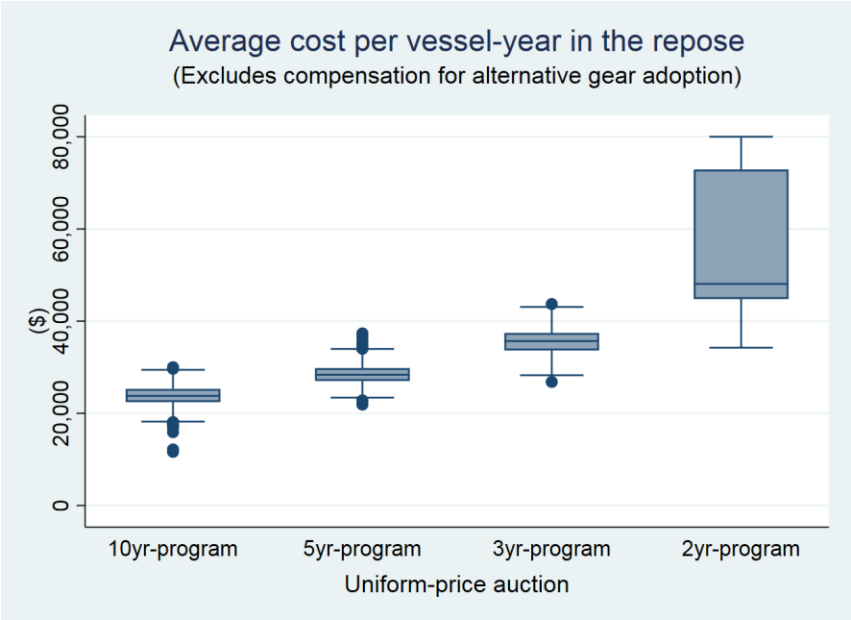
II. Compensation Design

One of the primary objectives of the compensation design is to minimize the costs of achieving the target of 60 repose-years, while inducing the greatest possible interest in the use of the alternative gear types available to project participants. While designing the compensation approach, several decisions were made regarding the length of the project, the mechanism to attract interest in the repose, and the additional incentives needed to encourage participants to willingly adopt and experiment with the alternative gear.

The following steps were investigated in order to determine the desired overall length for the project and the most suitable mechanism for attracting participation: (i) estimated the distribution of vessel owners' valuations, that is, the distribution of how much value harvesters attach to the right to use pelagic longline gear during the repose months; (ii) identified the candidate mechanisms; and, (iii)

simulated the implementation of the project under alternative compensation mechanisms and project lengths. Based on these analyses, the desired timeline and the preferred compensation mechanisms were determined based on simulated outcomes of the project's costs and efficiency. The following sections describe the rationale for the compensation mechanisms selected and how they were refined over the course of the first two years of implementing the *Deepwater Horizon* Oceanic Fish Restoration Project.

(a) Length of the project: An immediate result of the analysis is that increasing the duration of the project reduces the required number of yearly vessels needed to achieve the restoration goals. As a result, the longer the project, the lower the average cost per participant in the repose, regardless of the compensation mechanism adopted. This can be seen in the figure, which shows the cost comparisons over different project length scenarios for the case of one of the possible mechanisms, the uniform-price auction. The reason for this reduced cost is twofold. First, reducing the number of available slots each year effectively increases competition for each slot, which in turn translates into lower bids. Second, with a longer project timeline, a small number of participants is needed each year to meet the restoration targets, which means that the project manager only needs to recruit the vessel owners at the left-tail of the valuations' distribution. Additionally, a longer project has the added benefit of being able to incorporate lessons learned over time, indicating the length of the project can be revised if necessary. In these circumstances, the optimal length of the project must balance a reduction in the cost per participant due to increased competition, with the increase in administration costs associated with implementing a longer project. In line with this reasoning, it was decided that during the pilot year of the *Deepwater Horizon* Oceanic Fish Restoration Project only seven participants would be allowed into the project. This number was increased to 10 vessels in the second year. Recruiting an average of 11 participants yearly over the following four years would achieve the project target of 60 repose-years.



(b) Choice of repose compensation mechanism: Three candidate mechanisms were considered: posted-price offer, discriminatory auction (pays-as-bid), and uniform-price auction (the lowest rejected bid sets the price). The first two have been used previously in the context of fisheries management and conservation (Curtis and Squires 2007). On the other hand, and to the best of our knowledge, the uniform-price auction had not yet been employed in this context. Of these three mechanisms, the auctions are most cost effective in attracting participation. While in a posted-price offer the informational burden is on the project manager who must determine the correct compensation for participating in the repose, the auctions are market mechanisms that allow for price

discovery. Indeed, in a posted-offer, if the price is set too low, few participants will be attracted into the project. Conversely, if the price is too high, an excessive number of participants will attempt to enter the project and could exceed available funding. In both cases the posted offer may fail to contract enough repose-years.

The simulations for both auction formats – discriminatory and uniform-price – resulted in a similar expected cost per participant in the repose. Therefore, the selection of the auction format was determined based on additional considerations. One of the most important considerations raised during discussions with the industry, was the perceived fairness of the compensation, which for potential participants meant equal payment for the repose-year. The uniform-price auction was ultimately adopted because it compensates all participants equally while retaining cost-effectiveness. Since the possibility of collusion is a concern for this auction format, applicants were required to prepare their irrevocable bids (or "quotes") in the presence of a notary public and were required to sign a declaration certifying that they did not engage in any collusive behavior. While a uniform-price auction was utilized in both project years to-date, with the full implementation of the project in 2018 to include a full, 6-month repose, it was important that the project recruit participants from throughout the northern Gulf of Mexico. Therefore, to help ensure broad geographic participation and to account for regional variation in costs and earning across the Gulf, separate uniform-price auctions were run in the Western Gulf (TX, LA, MS, and AL) and the Eastern Gulf (Florida and the Atlantic Coast). In order to avoid overpaying participants, the design of each auction included a reserve price (i.e., the maximum, undisclosed, amount that the project manager is willing to pay for a repose-year).

In total, 22 eligible vessel owners submitted bids for participation in the 2017 repose (seven bids were accepted, all based in Louisiana). For participation in the 2018 repose, 16 bids were submitted, of which, 10 were accepted (three from the Eastern Gulf and seven from the Western Gulf). Bids submitted by vessel owners with a history of enforcement violations were dismissed. In the case of identical bids, ties were broken based on willingness to adopt the alternative gear and, in the 2018 repose, on the number of years enrolled in the project (i.e., if the vessel owner was participating for a second consecutive year).

For a uniform-price auction in which each participant offers a single item (i.e., participation in the repose), the optimal strategy is for participants to bid their private values. Most of the bids received follow this pattern. These results suggest that harvesters understood the repose compensation mechanism and bid optimally (i.e., the outreach and communications material were effective). Furthermore, this suggests that the data used to estimate private values —logbook reports and costs and earnings survey data periodically collected by NOAA Fisheries— are reliable. This was confirmed by potential participants during the meetings held prior to the start of the pilot. The fact that the available data seem reliable provides additional confidence in the results of the simulations, which were conducted, as indicated earlier, based on this self-reported information.

(c) Payment for adoption of alternative gear: Determining the right compensation for the alternative gear component of the project was challenging. At the time the pilot was implemented in 2017, there was very little information on the profitability of greenstick and buoy gear in the Gulf of Mexico. Previous projects that invested in the use of alternative gear in the Gulf of Mexico showed losses at the trip level for all participants due to the intensive fuel use (Kerstetter et al. 2014). While

only four vessels participated in the early pilot programs conducted in the east coast of Florida, the results suggested the need to subsidize the adoption of these gear types. One initial option considered was to compensate repose participants that selected the alternative gear option based on trip expenses via reimbursement. However, this option was later discarded as it could create perverse incentives for harvesters to overstate trips costs and discourage the use of small vessels (i.e., faster and more fuel efficient boats for which these gear types may be better suited). Instead, the project implemented a flat payment per day-at-sea with a ten sea-day per month cap, which aimed to encourage adoption of the alternative gear and generate data for the revision of these parameters in ensuing years. For the purposes of compensation, the day-at-sea was defined as a 24-hour period in which fishing for yellowfin tuna and/or swordfish occurs and gear is actively deployed and monitored for eight hours or more during times of day and in habitat where the targets are likely to occur.[3] To arrive at the appropriate payment, logbook reports combined with cost and earnings data for Florida east coast trips employing greenstick and buoy gear were used to estimate net revenue per day-at-sea. The mean estimate was $793 which, compared with a mean of $1,760 for vessels using pelagic longline gear, suggested a payment of roughly $1,000 per day-a-sea, in order to compensate for the forgone net revenue. The payment was set between $1,000 and $1,500 per day-at-sea dependent on the length of the repose period.

In the 2017 pilot repose, all seven participants selected the alternative gear component of the project, fished the maximum 40 days-at-sea using greenstick gear, and therefore, received an additional payment of $60,000. Over the shortened four-month repose, pilot participants took 20 fishing trips, 9 of which were observed, with an average trip length of 11 days. While the interest of participants in testing these alternative technologies is encouraging, overall catch rates of yellowfin tuna using the greenstick gear were limited compared to previous pilot efforts. For example, the mean catch for Florida East Coast vessels using greenstick gear from 2015-2016 was 8.7 fish/day-at-sea (median: 5 fish/day-at-sea), significantly higher than the mean of just 0.2 fish/day-at-sea (median: 0.13 fish/day-at-sea) observed in Louisiana during the 2017 pilot. During the 2018 repose, nine of the ten participants selected are not only participating in the alternative gear portion of the project, but are using all three gear options provided including greenstick, buoy, and deep drop gear. Catch data for the second year of the project are currently being collected.

III. Conclusion

There are a few lessons to be drawn from the first two years of the *Deepwater Horizon* Oceanic Fish Restoration Project that could help inform implementation of similar initiatives in different conservation settings.

Intensive industry outreach during the development of the compensation design proved invaluable. By gaining feedback and explaining how a uniform-price auction works prior to the beginning of the pilot allowed potential participants to become familiar with the workings of the

[3] In the pilot year of the project, the definition of a day-at-sea was slightly modified. A sea-day was defined as a 24-hour period in which fishing for yellowfin tuna and/or swordfish occurred and gear was deployed for four hours or more during in habitat where the targets are likely to occur.

auction format that was ultimately selected. As a result, the bidding process ran smoothly in 2017 and 2018. Furthermore, applicants appeared to employ bidding strategies consistent with the theory—i.e., bid the amount equal to the foregone profit during the repose—as attested by comments from participants themselves. A lesson from the first two years of the project is that the simplicity and perceived fairness of the compensation mechanism is critical for recruiting participation. Interestingly, in the second year perceived fairness appears to be circumscribed to comparisons within each region of the Gulf, since interest in the project did not appear to be influenced by the possibility that participants in the other region may receive a different payment for joining the repose. Additionally, for multi-period projects like the *Deepwater Horizon* Oceanic Fish Restoration Project, an added benefit of implementing a uniform-price auction early in the project implementation, is to learn about the reliability of the data used in the estimation of private values, since the optimal strategy is to bid one's own valuation. This information can be extremely useful in determining if future project changes are needed.

Regarding the experience with the alternative gear component of the project, a clear lesson is that while adoption of experimental technologies may be rapid, perfecting their use may require training and practices, which may take time. Thus, to assess the effectiveness of a given set of economic incentives (i.e., are meager catches due to weak incentives?, the need to learn to operate the new technology?, or the unsuitability of the gear in the Gulf of Mexico?), those incentives may need to remain in place unmodified for multiple years. This is the primary reason the flat payment per day-at-sea was continued in the second year. In future years of the project, other mechanisms may be explored to help improve target catch rates on alternative gear, such as additional training opportunities or a rank-order tournament.

More broadly, the experience during the first year highlights the benefits of building a pilot phase into the project. The pilot phase signals to potential participants that the project manager is flexible as to how the project is implemented and the manager plans to adapt if adjustments become necessary based on participant and industry feedback. In this way, the project is perceived as participatory and inclusive since feedback and suggestions are explicitly built into the design.

Finally, consideration may be given to possible adjustments to the project moving forward, including for example, consideration of multiple-year participant commitments, which would limit participants' turnover and eliminate the need to run yearly auctions. Given that the project is running smoothly after the modifications made in the first two years, it may be the right time to consider additional refinements.

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