MARINE MAMMAL COMMISSION

2 June 2021

Louisiana Trustee Implementation Group
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U.S. Army Corps of Engineers
New Orleans District
Attn: CEMVN-ODR-E; MVN-2012-2806-EOO
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Delivered via email to: CEMVN-Midbarataria@usace.army.mil

Dear Louisiana Trustee Implementation Group Members and U.S. Army Corps of Engineers:

The Marine Mammal Commission (the Commission), in consultation with its Committee of Scientific Advisors on Marine Mammals, has reviewed the Louisiana Trustee Implementation Group's (Louisiana TIG) draft Phase II Restoration Plan #3.2: Mid-Barataria Sediment Diversion (draft RP #3.2) and the U.S. Army Corps of Engineers (USACE) New Orleans District's (CEMVN) Draft Environmental Impact Statement (DEIS)[1]. The draft RP #3.2 evaluates the Louisiana TIG's alternatives for restoring Louisiana's wetland, coastal, and nearshore habitats injured by the *Deepwater Horizon* (DWH) oil spill. The DEIS analyzes the potential impacts of the proposed Mid-Barataria Sediment Diversion (MBSD) project and a range of alternatives, including no action, on the natural and human environment.

Project background

Large-scale sediment diversions are intended to transport sediment, freshwater, and nutrients via high-discharge volumes from the Mississippi River as a land-building tool. The proposed MBSD project would reconnect the Mississippi River to the Barataria Basin with the goal of rebuilding and stabilizing the delta marshes to protect against further erosion and land loss due to ongoing and future sea level rise, subsidence, and storm events. The MBSD would be constructed in Plaquemines Parish, Louisiana, on the right bank of the Mississippi River at mile 60.7. The project would involve the construction of a sediment intake system, a 2-mile long concrete conveyance channel, and an outfall transition feature. The intake system is designed to capture a high concentration of sediments and larger grain sizes from the lower portion of the water column, which would be delivered during the river's annual flood cycle. Nutrients introduced into the basin as part of the river flow are expected to enhance primary productivity. The introduction of fresh water is intended to maintain

[1] See notice of availability at 86 Fed. Reg. 12915 (5 March 2021), and extension of public comment period at 86 Fed. Reg. 22397 (28 April 2021).

the estuarine salinity gradients that are projected to be altered as a result of sea level rise and associated land loss.

The amount of sediment and fresh water that would be discharged through the MBSD is dependent in part on sediment levels in the Mississippi River, upstream flow conditions (i.e., the diversion would be operating only during flow rates exceeding 450,000 cubic feet per second (CFS) at the Belle Chasse water gage), and the maximum discharge flow rate for the MBSD considered under each alternative. The amount of land expected to be built or maintained varies with each alternative, and is dependent on Mississippi River flow rates as well as other factors, such as continued sea level rise, storms, subsidence, and other marsh restoration activities.

In 2016, the *Deepwater Horizon* (DWH) Natural Resource Damage Assessment (NRDA) Trustees determined that diversions of Mississippi River water into adjacent wetlands would provide large-scale benefits to coastal habitats injured by the DWH oil spill (DWH NRDA Trustees 2016). In its Strategic Plan and Environmental Assessment (SRP/EA) #3: Restoration of Wetlands, Coastal, and Nearshore Habitats in the Barataria Basin, Louisiana, the Louisiana TIG selected the MBSD as the specific sediment diversion project to move forward for further analysis.

Available scientific literature indicates considerable ongoing debate about the effectiveness of large-scale sediment diversions as a land-building strategy (Turner et al. 2019, Blaskey 2020). The amount and type of sediment in the Mississippi River available for land building (Blum and Roberts 2009), sea level rise, large storm events, subsidence, and other natural events may negate any land building over the long-term (DeLaune et al. 2013; Suir et al. 2014; Chamberlain et al. 2018). These issues and uncertainties surrounding them were not, but should have been, fully addressed in the DEIS.

The Commission provided extensive comments[2] on the draft SRP/EA #3 in February 2018, notably raising concerns that a large-scale sediment diversion would have significant adverse impacts on bottlenose dolphins that are resident to the Barataria Basin. Despite those concerns, the Louisiana TIG finalized the SRP/EA #3 in March 2018, selecting as its preferred alternative a suite of restoration approaches that included the MBSD.

Restoration alternatives

The DEIS follows on the analyses from the SRP/EA #3 to evaluate alternatives for restoring injured marsh resources in Barataria Bay, each of which included the MBSD but with different flow scenarios and with or without marsh terrace outfall features. The alternatives were based on a specific purpose and need statement that included only the implementation of a large-scale sediment diversion into Barataria Bay. The alternatives are as follows—

- Alternative 1: Variable flow up to 75,000 CFS maximum sediment diversion (applicant's preferred alternative, or APA)
- Alternative 2: Variable flow up to 75,000 CFS maximum sediment diversion including marsh terrace outfall features

[2] See the Commission's 5 February 2018 letter.

- Alternative 3: Variable flow up to 50,000 CFS maximum sediment diversion (A3)
- Alternative 4: Variable flow up to 50,000 CFS maximum sediment diversion including marsh terrace outfall features
- Alternative 5: Variable flow up to 150,000 CFS maximum sediment diversion (A5)
- Alternative 6: Variable flow up to 150,000 CFS maximum sediment diversion including marsh terrace outfall features
- No Action Alternative (NAA)

The draft DEIS concluded that there were negligible to minor differences in the impacts when terrace features were included. For that reason, the following comments focus only on the impacts associated with the action alternatives under the three selected flow scenarios (i.e., APA, with 75,000 CFS; AP3, with 50,000 CFS; and AP5, with 150,000 CFS), as compared to the NAA. The comments also focus primarily on direct impacts of MBSD operation under each alternative on bottlenose dolphins in Barataria Bay and their estuarine habitat, given that the MBSD is expected to operate for at least 50 years, and that impacts resulting from the operation of the MBSD would outweigh those resulting from construction activities. The Commission notes that operation of the MBSD will also have significant adverse impacts on dolphin prey species, such as spotted sea trout, and other important marine resources, such as submerged aquatic vegetation, benthic algae and other benthic fauna, brown shrimp, southern flounder, and eastern oyster. It will also have significant, long-term impacts on commercial and recreational fishermen and local communities.

Projected impacts of the MBSD project on Barataria Bay bottlenose dolphins

Of primary concern to the Commission are the direct, permanent, and significant adverse impacts from MBSD operations on common bottlenose dolphins in Barataria Bay. Those impacts are expected to occur once the project is constructed (scheduled for 2027) as a result of large, frequent, and/or sustained influxes of fresh water into the dolphin's estuarine habitat. The common bottlenose dolphins identified as belonging to the Barataria Bay stock are year-round residents, inhabiting estuarine and Gulf coastal waters out to an average distance of 1.75 km from shore, with highest densities north of the barrier islands (Wells et al. 2017). The most recent abundance estimate for the stock is 2,071 dolphins (95% CI: 1,832 – 2,309), derived from a basin-wide capture-mark-recapture (photo-identification) survey conducted in March 2019 (Garrison et al. 2020). Additional background on the stock's preferred habitat, residency patterns, foraging, prey species, and DWH oil spill-related injuries were included in the Commission's 5 February 2018 letter, noting in particular an estimated 51 percent mean proportional decrease of the stock as a result of spill-related exposure (Schwacke et al. 2017). Follow-up studies conducted from 2016 to 2019 in Barataria Bay included health assessments in 2016, 2017, and 2018, photo-identification studies from 2017 to 2019, and the 2019 capture-mark-recapture study noted above. A scoring system was developed by marine mammal veterinarians to compare the health of the pre- and post-spill cohorts, based on a number of health factors (Schwacke et al. 2020). The results of that study showed an overall "guarded to worse" prognosis for the pre-spill cohort compared to the post-spill one, with continued evidence of chronic lung disease, impaired adrenal function, inflammation, and anemia. The researchers concluded that the health of the pre-spill cohort has not improved over time, and likely has worsened, compared to the post-spill cohort. The initial population recovery model developed for the NRDA studies (Schwacke et al. 2017) was subsequently revised based on the more recent data, indicating that the population is currently at its lowest abundance since the spill occurred 10 years ago. The projected time to recovery[3] estimated by the revised model is 32 years. However, the population's recovery is still uncertain because that recovery trajectory does not account for the effects of various restoration efforts (whether positive or negative) or a changing climate, either or both of which could have a significant impact on the population's recovery (Schwacke 2021).

As discussed in the Commission's 2018 letter and demonstrated in other recent studies (Duignan et al. 2020; McClain et al. 2020), estuarine bottlenose dolphins known to have been exposed to low-salinity conditions or flooding events are prone to disease outbreaks and higher rates of stranding, mortality, and morbidity due to compromised epidermal integrity and/or physiological stress, which increases susceptibility to secondary infection. An Unusual Mortality Event (UME) in the northern Gulf of Mexico from February to November 2019[4] provided additional insights into the impacts of low-salinity exposure on bottlenose dolphins. The UME involved strandings of at least 337 bottlenose dolphins, with the majority reported from Mississippi, followed by Louisiana[5], Alabama, and Florida. Although histologic examination of stranded animals was not always possible due to the advanced decomposition state of many of the dolphins, scientists noted that a large percentage of the dolphins exhibited mild to severe skin lesions consistent with prolonged exposure to low-salinity water (Deming and Garrison 2021). The increased strandings coincided with record rainfall in watersheds draining into the Gulf of Mexico during the 2019 winter, spring, and summer months, and the opening of the Bonnet Carre spillway in Louisiana[6] to prevent flooding. The influx of freshwater into dolphin estuarine habitat in Barataria Bay and other northern Gulf bays, sounds, and estuaries resulted in prolonged low-salinity conditions (less than 5 parts per thousand; ppt) throughout the Gulf for several months (Deming and Garrison 2021). Other factors that might have contributed to elevated stranding rates (such as cold or disease) have since been ruled out as causal factors for the UME (Deming and Garrison 2021).

Despite information gained from previous low-salinity events, our understanding of how different durations of varying salinity exposures affect the health and survival of bottlenose dolphins remains unclear. Therefore, an expert elicitation[7] was conducted to assess the possible thresholds at which adverse, permanent impacts of low-salinity exposure are expected to occur (Booth and

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[3] Defined as the number of years for the stock to recover to at least 95 percent of baseline abundance. The originally estimated time to recovery for the Barataria Bay stock was 39 years (Schwacke et al. 2017).

[4] From February to November 2019, at least 337 bottlenose dolphins stranded from Florida to Louisiana, with the peak of strandings occurring from February to June. Scientists investigating the strandings attributed the deaths to prolonged exposure to low salinity waters, less than 10 parts per thousand (ppt), stemming from large amounts of precipitation (rain and snow) draining into watersheds that flow into the northern Gulf during the 2019 winter, spring, and summer months. (https://www.fisheries.noaa.gov/national/marine-life-distress/2019-bottlenose-dolphin-unusual-mortality-event-along-northern-gulf)

[5] The Louisiana Department of Wildlife and Fisheries (LDWF) stopped responding to dolphin strandings in early 2019 and completely withdrew from the state's stranding response program in September 2019, which affected the detection, reporting, and examination of dolphins that stranded in Louisiana during the UME. The number of stranded dolphins reported in Louisiana during the timeframe of the UME is therefore likely biased low.

[6] The Bonnet Carre spillway was opened twice in 2019, from 27 February to 11 April, and again from 10 May to 27 July, for a total of 123 days (https://www.mvn.usace.army.mil/Missions/Mississippi-River-Flood-Control/Bonnet-Carre-Spillway-Overview/Spillway-Operation-Information/).

[7] Expert elicitation is a formal, structured process in which expert knowledge of an uncertain quantity is captured in the form of a probability distribution (O'Hagan 2019).

Thomas 2021). Specifically, the expert elicitation was designed to assess the relationship between the number of days a dolphin spends in water with salinity levels less than 5 ppt and its survival probability, based on the professional judgment of relevant experts. The expert elicitation produced a dose-response function that integrated salinity and time as the specified "dose" (Booth and Thomas 2021). The experts believed that dolphins can endure some periods of exposure to salinity levels below 5 ppt before their health is compromised (median value of 62 days for dolphins exposed to other environmental stressors as well; 77 days for dolphins exposed to few other stressors). The period of tolerable exposure is shorter for dolphins exposed to acute changes in salinity, with a median time to death of 22 days of continuous exposure to water with salinity levels below 5 ppt. The experts also believed that once the survival probability begins to decrease, it decreases rapidly, especially in the presence of other environmental or health stressors.

As stated in section 4.11.5 of the DEIS, **operation of the MBSD under each of the alternatives is expected to have immediate, permanent, and major adverse impacts on the health, survival, and reproduction of the Barataria Bay stock of bottlenose dolphins due to prolonged exposure to low-salinity conditions.** The DEIS used a quantitative model to determine the projected impacts of MBSD operations associated with each flow-rate alternative (Garrison et al. 2020). The model assumed strong site fidelity by dolphins, based on telemetry data collected from tagged dolphins in Barataria Bay during the 2010-2014 NRDA surveys (Hornsby et al. 2017; Wells et al. 2017), a subsequent health assessment in 2018 (Cloyed et al. 2021), and the 2019 capture-mark-recapture study (Garrison et al. 2020). These and other studies summarized in the Commission's 2018 letter suggest that dolphins exposed to low-salinity conditions would not be expected to move to other, more saline portions of the bay or gulf, or to neighboring estuaries, during an extended freshwater discharge event. The model integrated (1) spatial distribution data from the 2019 capture-mark-recapture study to simulate movements of animals, (2) projected salinity fields from a representative salinity year based on the high-resolution hydrodynamic Delft3D model used in the DEIS (corrected for retrospective and future salinity-prediction biases and uncertainties), and (3) the expert elicitation dose-response curves to determine individual survival rates based on a projection of continuous salinity exposure (consistent with the scenario considered by the expert elicitation). The model predicted changes in population survival rates under each alternative for dolphins inhabiting each of four strata in the bay – southeast, central, western, and island – as well as overall.

The model estimated a 34 percent reduction in the mean annual survival rate of dolphins due to projected freshwater inputs under the APA, relative to the NAA. In fact, all three alternatives considered here are expected to have a statistically significant reduction in mean annual survival rate relative to the NAA. The greatest reductions under the APA would be in the central and western strata (66 and 42 percent, respectively), where salinity gradients are the steepest, with lesser reductions in the island and southeast strata (7 and 15 percent, respectively). Higher flow years would presumably result in more significant reductions in survival relative to the NAA. The model projected a substantial decline in survival rates in the first few years of the project, particularly for dolphins in the central and western strata. The projected survival rates were determined to be insufficient to sustain the stock.

The model generated a projection of survival rates for a fairly constrained set of parameters, and so may represent a simplified "best-case scenario" for the dolphins in Barataria Bay. Shortcomings in the model, as identified in the DEIS and Garrison et al. (2020), are as follows—

- The model is limited to generating survival rates for only one year of operation, rather than a time series representing the planned operational period of the project (50 years).
- The model is based on the longest continuous number of days of low salinity exposure rather than the number of exposure events or days of exposure in a year. A second exposure event separated from the first by more than two days[8] would not be considered when evaluating impacts on survival.
- The projected salinity field is based on a hydrograph from a single "representative" year, in this case 1970 (cycle 0), rather than incorporating annual variability in hydrological conditions.
- The model does not account for future hydrological or climate conditions.
- The model does not account for potential changes in prey-species abundance and/or distribution, as well as other stressors experienced by dolphins in Barataria Bay, such as noise, fishery interactions, illegal feeding and/or harassment, vessel disturbance and/or strikes, pollution, and large storm events.

Based on the projected reductions in mean annual survival in the DEIS, the Commission requested that the National Marine Mammal Foundation and the National Marine Fisheries Service (NMFS) conduct additional analyses to determine (1) the projected effects of the MBSD project on dolphin recovery over time, and (2) how the MBSD project could delay recovery of the Barataria Bay bottlenose dolphin stock. As noted previously, the population trajectory model developed by Schwacke et al. (2017) and subsequently revised (Schwacke 2021) did not account for the effects of restoration activities (whether positive or negative). Those analyses were provided in the form of the enclosed report by Thomas et al. (2021) for two MBSD operational scenarios — the APA and the NAA. Using the Schwacke (2021) revised population trajectory model, the authors concluded that implementation of the APA would not only prevent recovery of the Barataria Bay stock (as predicted under the NAA), but it would also result in a precipitous decline in survival in the western and central strata within the first year of MBSD operation (consistent with the Garrison et al. (2020) model results). Within ten years of operation, bottlenose dolphins in the island strata are predicted to be reduced by 38 percent, in the southeast strata by 82 percent, and in the western and central strata by 100 percent; overall the Barataria Bay dolphin stock would be reduced by 78 percent. Within 50 years, dolphins in the island strata are predicted to be reduced by 85 percent and in the southeastern strata by 100 percent; overall, the Barataria Bay dolphin stock is predicted to be reduced by 96 percent.

The near total loss of the Barataria Bay bottlenose dolphin stock due to MBSD project operations, or even losing the stock completely, appears inevitable if the project goes forward as planned. The Commission recognizes that this outcome could be consistent with Public Law 115-123 and the waiver issued under the Marine Mammal Protection Act if alternatives to avoid this result are not available. However, the Commission believes that there are alternative actions and additional measures that the state of Louisiana can take

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[8] The assumption of a physiological "reset" after 48 hours would require further research to validate.

that would reduce the impacts on dolphins, while still allowing the purposes of the project to be achieved.

Marine mammal take waiver

In 2018, NMFS, at the direction of Congress, issued a waiver[9] to the state of Louisiana under the Marine Mammal Protection Act, authorizing the taking of marine mammals during the construction, operation, and maintenance of the MBSD and two other projects[10] included in Louisiana's 2017 Comprehensive Master Plan for a Sustainable Coast (Coastal Protection and Restoration Authority; CPRA 2017). The statutory language directing the Secretary of Commerce to issue the waiver requires the state of Louisiana to consult with the Secretary (through NMFS) to ensure that impacts on marine mammal species and stocks would be minimized to the extent practicable and consistent with the purpose of the project. It is unclear from the DEIS what effort was made by the state of Louisiana to meet this statutory responsibility in its selection of alternatives.

Section 6.3.6 of the draft RP #3.2 Appendix B: Mitigation and Stewardship Plan states that "CPRA will examine operational strategies to minimize (to the extent practicable consistent with the purpose and performance of the project) the Project's impacts on bottlenose [dolphins]. Given the dynamic conditions of any estuarine system, and the uncertainty around future conditions, the minimization measures will rely on the MBSD Monitoring and Adaptive Management Plan to inform future implementation." The Monitoring and Adaptive Management (MAM) Plan for bottlenose dolphins (section 3.7.3.19 of the draft RP #3.2 Appendix A) states that "adaptive management strategies include a framework for coordinating during operations, and a *post-operational* commitment to evaluate the ability of diversion operations to be modified to meet project goals while reducing impacts to marine mammals." Although these statements recognize the ongoing responsibility of the state to minimize impacts on dolphins and other marine mammals under the terms of Public Law 115-123, it appears to be limiting its review only to how operations can be adjusted once construction is complete. The state also should be reviewing whether the design and construction of the project can be modified to minimize impacts on marine mammals and whether there are alternatives with lesser impacts on marine mammals that would still satisfy the purposes of the project. Waiting to adapt MBSD operations until *after* dolphins are exposed to dangerously low salinity conditions is not a practicable or effective means to minimize those impacts or prevent freshwater exposure-related mortality.

The DEIS evaluated three alternative flow scenarios for the MBSD, but did not specifically discuss whether there were other sediment diversion-related alternatives that could be adopted that would minimize impacts on dolphins (including alternative design, construction, or operational features), and if so, whether any of the other alternatives were practicable and could be implemented consistent with meeting the purposes of the project. Therefore, <u>the Commission recommends</u> that the Louisiana TIG and the USACE expand the EIS to include a much more thorough identification and vetting of possible alternatives that could reduce impacts on dolphin stocks, along with a

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[9] Section 20201 of Public Law 115-123 (the Bipartisan Budget Act of 2018).
[10] The Mid-Breton Sound Sediment Diversion and the Calcasieu Ship Channel Salinity Control Measures project.

discussion of whether each such alternative is practicable and would be consistent with meeting the purposes of the project.

If the proposed MBSD project were to move forward under the APA, as currently drafted, the Commission recommends that the Louisiana TIG and the USACE operate the MBSD in a way that minimizes the duration and amount of freshwater entering Barataria Bay via the MBSD so as to avoid adverse impacts on dolphins and other marine resources. This might be achieved through less frequent diversion openings or shorter duration diversion openings. It might also be achieved through a change in the trigger for opening the diversion from one based on exceeding a specific upriver flow rate (proposed as 450,000 CFS at the Belle Chasse water gage, which would result in an estimated 177 days of diversion openings annually, with the largest number of days open during the months from January and June) to one designed to avoid exceeding the dose-response threshold recommended by the expert elicitation (Booth and Thomas 2020), i.e., not allowing salinity levels of less than 5 ppt to persist for more than 21 days.

Another operational alternative that should be considered is management of the timing of freshwater influxes to minimize impacts on dolphin reproductive success. Bottlenose dolphins give birth to a single calf that remains with its mother generally for the first three to six years of its life (Wells et al. 1987). A study of Fiordland bottlenose dolphins exposed to freshwater discharge in New Zealand showed a higher prevalence of lesions in females and smaller-sized calves, suggesting that females and calves are particularly susceptible to health disorders in low-salinity conditions (Rowe et al. 2010). Although calves can be born at any time during the year, newborn calf sightings in the northern Gulf of Mexico are highest in spring and summer (Urian et al. 1996; Mattson et al. 2006; Miller et al. 2010, 2013), indicating that these may be periods when freshwater influxes should be minimized. The estimated bioenergetic requirements of lactating females are ~72 percent greater than non-lactating adult females, meaning that disruptions to prey availability during this crucial period of early calf rearing could adversely impact both the mother and new calf (Bejarano et al. 2017).

Avoiding collateral injury

The projected near-loss of the stock anticipated under any of the alternatives considered in the DEIS would be inconsistent with the screening criteria for restoration projects under section 990.54(a)(4) of the Oil Pollution Act, which provides that evaluation of the proposed restoration alternatives must be based on, at a minimum, the extent to which each alternative will prevent future injury, and *avoid collateral injury*, as a result of implementing the alternative. Recognizing that collateral injury would occur to bottlenose dolphins, the Louisiana TIG has proposed to implement three stewardship measures to benefit dolphins in Louisiana: (1) support of a statewide stranding program for 20 years to improve the survival and health outcomes of marine mammals injured by the DWH oil spill, especially coastal and estuarine stocks of bottlenose dolphins; (2) support of activities to reduce stressful interactions between dolphins and humans (e.g., recreational fishery interactions, illegal "fishing" of dolphins, and impacts of marine vessels, noise, and other threats in Barataria Bay), and (3) funding to support stranding response surge capacity during UMEs.

Although these stewardship measures would normally be welcome, and would serve as critical supplements to a broader restoration plan to address injuries to dolphins caused by the

DWH oil spill, they do not alleviate in any appreciable way the immediate, or the even more severe long-term, deleterious impacts on the Barataria Bay dolphins expected to occur for the 50-year life of the project under each of the alternatives being considered for operation of the MBSD. Increased stranding response capacity directed at rescuing dolphins in poor health as a result of low-salinity exposure is unlikely to be effective, even with the proposed support for additional stranding response capacity in the event of a UME. This is due to the vast area expected to be inundated by fresh water, the distance between freshwater-exposed dolphin habitat in Barataria Bay and potential response facilities (once established), and the large number of dolphins expected to be acutely and continuously impacted by operation of the MBSD project (as predicted by the Garrison et al. 2020 and Thomas et al. 2021 models). Given that the stranding program in Louisiana is minimally functional at present, and efforts to rebuild the program will take several years[11], the likelihood is low that a significant portion of stranded animals would be detected, let alone rescued and successfully treated, once operations commence in 2027. Even if animals were rescued in a timely manner, rehabilitation facilities in the Gulf of Mexico are extremely limited, as are options for release of rehabilitated animals into other habitats[12]. Rehabilitated dolphins from Barataria Bay could not be released back to their original habitat, due to ongoing low salinity conditions, and so would need to be released into adjacent estuaries or coastal waters. That is likely to prompt competition with established long-term resident bottlenose dolphins for prey, space, and other resources, and potentially lead to disruptions of multi-decadal, multi-generational dolphin community social systems (Wells 2014). Few studies have been carried out on the survivorship of estuarine bottlenose dolphins that have been rescued, rehabilitated, and released into other habitat (Mazzoil et al. 2008; Wells et al. 2013; McHugh et al. 2021), and even fewer studies involving dolphins that have experienced prolonged exposure to, and deleterious effects from, freshwater have been conducted (Deming et al. 2020). The published results of these studies make it clear that the rescue, rehabilitation, and release of hundreds of freshwater-exposed dolphins such that they remain functioning members of what now is a discrete population is neither feasible nor practical. To date, there has only been one successful release of a rehabilitated bottlenose dolphin back into the wild in Louisiana[13]. The proposed support of activities to reduce stressful interactions between dolphins and humans would also be largely ineffective in the long term given that impacts of MBSD operations are expected to result in significant, widespread, and immediate mortality, thereby negating any possible benefits resulting from such efforts.

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[11] Marine mammal stranding networks are largely implemented by volunteer organizations, along with local, tribal, state, and federal government agencies. Given LDWF's 2019 decision to no longer participate in marine mammal stranding response activities, and the limited capacity for stranding response by the Audubon Nature Institute (the only other stranding network member currently authorized in Louisiana), NMFS recently hired a stranding coordinator in Louisiana to increase stranding response capacity by identifying and recruiting new potential stranding response partners. Funding alone is not likely to result in immediate capacity increases; staffing, training, and infrastructure requirements are expected to take several years before sufficient capacity is available for effective response to marine mammal strandings throughout Barataria Bay as well as in other parts of Louisiana where gaps in stranding response capabilities are a long-standing issue (Fougeres 2015).

[12] Issues associated with release of rehabilitated marine mammals include conflict with fisheries for resources; inadequate knowledge regarding the demography, behavior, and ecology of the recipient population; supporting survival of genetically not-so-fit individuals; introduction of novel or antibiotic-resistant pathogens into the marine environment; harm to human health; and cost (Moore et al. 2007). NMFS estimated that the cost of rehabilitating a cetacean may range from $50,000-$120,000 depending on the period that the animal must be captive and the type of care it requires (as cited in Gluch 2004).

[13] By the Audubon Coastal Wildlife Network in 2016 (http://auduboncwn.org/octavius/).

Given the direct, long-term, adverse impacts of MBSD operations on Barataria Bay bottlenose dolphins and other marine resources, the Commission recommends that the Louisiana TIG reject the identified action alternatives and instead revise the purpose and need statement such that alternatives other than operation of a large-scale sediment diversion at various flow rates are considered. Those alternatives should include land-building approaches that have proven to be effective at combating land loss in other coastal areas and that are less harmful to marine resources, including bottlenose dolphins. Functional alternatives for land building could include, for example, (1) the creation of barrier islands and marshes using dredged material, (2) the use of smaller-scale diversions, and (3) the backfilling of canals and spoil banks (Turner and McClenachan 2018). The last would directly mitigate and reverse some of the adverse results from previous engineering efforts that have contributed to the current land loss situation (Olea and Coleman 2014; Turner and McClenachan 2018; Turner et al. 2019). Those types of projects have been or are currently being implemented for habitat restoration elsewhere in Louisiana. The Commission recommends that the Louisiana TIG and the USACE further evaluate these and other functional alternatives to the MBSD as a means of reducing impacts and avoiding collateral injury to bottlenose dolphins and other marine resources.

Monitoring measures

The DEIS states that five years prior to operations, several methods will be used to collect baseline information on the abundance, distribution, density, health, stranding rates/types/causes, survival and fecundity of the resident bottlenose dolphin population to be able to identify changes needed to the project once it is operational. The Commission agrees with the pre-operations sampling plan outlined for marine mammals in the DEIS Appendix R: Mitigation & Monitoring and Adaptive Management (MAM) Plans, which includes enhanced stranding response and investigations, capture-mark-recapture surveys, visual assessment surveys, health assessments, tagging, remote biopsy sampling, prey assessment, and collection of habitat data. However, the Commission is not aware of any pre-operation monitoring that has been initiated to date, beyond the studies that were conducted through 2019 and discussed herein. The Commission recommends that, if the MBSD project goes forward, the Louisiana TIG and CPRA work with NMFS to initiate the pre-operations sampling program for marine mammals in Barataria Bay by the end of 2021 to ensure a minimum five years of baseline information is collected on bottlenose dolphins and their prey species and habitat, prior to the implementation of the MBSD, as outlined in the MAM plan.

Inadequate restoration planning for marine mammals

The Commission is concerned that the Louisiana TIG has yet to fully implement restoration activities that would facilitate recovery of bottlenose dolphins from the DWH oil spill. To date, the Louisiana TIG has implemented only one marine mammal project from its $50 million budget for restoring marine mammals. That project would increase capacity and expand partnerships along the Louisiana coastline for marine mammal stranding response.

Other projects submitted to the NRDA portal that should be considered for restoration of marine mammals include—

- Reducing bycatch in state-based commercial and recreational fisheries[14];
- Research on dolphin prey species and their availability;
- Support for the Gulf of Mexico Dolphin Identification System (to share information from photo-identification studies among researchers and stranding network members throughout the Gulf);
- Development and testing of alternative survey techniques (i.e., unmanned aerial vehicles (e.g., drones) and passive acoustic monitoring);
- Removal of debris and other harmful materials from high-use habitat;
- Documenting and preventing illegal feeding and harassment, and enhancing enforcement of protection measures;
- Increasing resources for responding to, and caring for, out-of-habitat or injured dolphins; and
- Developing and distributing appropriate outreach materials for commercial fishermen, anglers, and recreational boaters[15].

Although we recognize the enormity of the impact of the oil spill on Louisiana's natural resources, and acknowledge that the Louisiana TIG is continuing to work on marine mammal restoration planning, that process seems unnecessarily slow, restrictive, and inefficient. It has delayed funding of projects to facilitate restoration of marine mammals in an area that suffered significant injury. The Commission recommends that the Louisiana TIG immediately (1) identify which of the restoration approaches for marine mammals identified in the PDARP are priorities for restoration in Louisiana and (2) prepare and publish a restoration plan to address high-priority restoration projects that can be implemented without delay.

The Commission appreciates the opportunity to review the draft RP #3.2/DEIS and hopes that the Louisiana TIG and the USACE consider these comments carefully before moving forward to approve this project. Please contact me if you have any questions concerning any issues raised in this letter.

Sincerely,

Peter O. Thomas, Ph.D.,
Executive Director

Enclosure: Thomas et al. (2021)

Cc: Mel Landry, NMFS Restoration Center; Brian Lezina, Louisiana CPRA; latig@la.gov, gulfspill.restoration@noaa.gov

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[14] Including the shrimp trawl, menhaden purse seine, coastal gillnet, pelagic longline, trap/pot, and charter boat/headboat fisheries.
[15] The Louisiana Sea Grant office could be a useful partner in the development of outreach materials for the public and specifically commercial and recreational fishermen.

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Predicted population consequences of low salinity associated with the proposed Mid-Barataria Sediment Diversion project on bottlenose dolphins in the Barataria Bay Estuarine System Stock

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13th May 2021

Summary

1. The proposed Mid-Barataria Sediment Diversion (MBSD) project will result in decreased levels of salinity in Barataria Bay, Louisiana. This decreased salinity has been predicted by the National Oceanographic and Atmospheric Administration (NOAA) to cause increased mortality of bottlenose dolphins in the Barataria Bay Estuarine System (BBES) Stock.

2. We used an existing model for the population dynamics of this stock to predict the population consequences of the increased mortality. We compared population projections under two scenarios (described in the Draft Environmental Impact Statement for the proposed project), "Applicants Preferred Alternative" (APA) and "No Action Alternative" (NAA), using the same four geographic regions ("strata") as NOAA and assuming no movement of animals among strata.

3. The model predicts an immediate and severe population-level decline under the APA. In the first year of operation under the APA (2027), median predicted excess mortality under the APA is 585 dolphins (95% confidence interval [CI] 131-1459), leading to a median stock decline of 23% (95% CI 3-55). By contrast, under the NAA the stock is predicted to increase by 3% (95% CI 1-5) − the increase is because the stock is estimated to still be in recovery from the *Deepwater Horizon* oil spill. Therefore, after one year of operation, the stock is predicted to be 25% smaller (95% CI 6-56) under the APA than under the NAA.

4. After 10 years of operation, the parts of the stock in the Central and West strata are predicted to be functionally extinct (probability of < 30 animals remaining is 1 in the Central stratum and 0.99 in the West stratum). The part in the Southeast stratum, while not extinct, is predicted to be 82% lower (95% CI 44-96) under the APA than under the NAA. The Island stratum is less severely affected with a median predicted decline of 38% (95% CI 9-84).

5. After the planned 50 years of operation, dolphins in three out of the four strata are predicted to be functionally extinct under the APA, with the remaining Island stratum being severely reduced relative to the NAA (median predicted population size of Island stratum is 85% lower [95% CI 28-99] under the APA than under the NAA). Overall, by the year 2076, the median predicted stock size across all of Barataria Bay under the APA is 143 dolphins (95% CI 11-706) compared to 3363 (95% CI 2831-4289) under the NAA. In other words, the stock is predicted to be 96% smaller (95% CI 80-100) under the APA than then NAA.

Introduction

The Barataria Bay Estuarine System (BBES) Stock of bottlenose dolphins was heavily impacted by the *Deepwater Horizon* (DWH) oil spill. A population model (Schwacke et al. 2017) was developed to quantify the impact, and this model has recently been updated as part of a Gulf of Mexico Research Institute consortium project (CARMMHA) to collect additional information and refine the impact quantification (Schwacke et al. in preparation).

One proposed habitat restoration effort is the proposed Mid-Barataria Sediment Diversion (MBSD) project, which proposes to intermittently release water from the Mississippi River into the upper Barataria Basin. This will result in decreased levels of salinity in the basin that, in turn, will cause mortality of dolphins in the BBES Stock. The potential extent of this mortality was examined in a recent report by the National Oceanographic and Atmospheric Administration (NOAA; Garrison et al. 2020). That report gave predictions of annual survival rates in four geographic regions ("strata") within the Barataria Basin (Island, Southeast, Central and West) under two scenarios presented in the Draft Environmental Impact Statement for the proposed project: the "Applicants Preferred Alternative", where the MBSD is constructed and begins operation in 2027, and the "No Action Alternative", where the MBSD is not constructed.

In this report, we integrate the annual survival of dolphins in each of the four strata from the two scenarios of Garrison et al. (2020) into the population model developed under the CARMMHA project, and use this to predict the consequences of the proposed MBSD project for the dolphin stock.

Methods

Impact on survival from NOAA analysis

We obtained from NOAA 1,000 replicate predictions of estimated annual survival under APA and NAA scenarios in each of the four strata, derived from the model of Garrison et al. (2020). The replicate predictions represent the range of scientific uncertainty on possible impacts, accounting for factors such as uncertainty on the salinity field for a given set of hydrographic conditions, uncertainty on animal movement and hence exposure, and uncertainty on the effect of low salinity on dolphin survival (see Garrison et al. 2020 for details). Note that all predictions are based on a single assumed annual hydrograph, that for 1970 (Garrison et al. 2020), and so do not account for uncertainty in future hydrographic conditions (see Discussion).

For each replicate prediction and stratum, we calculated the percentage difference in survival between the APA and the NAA as follows:

$$\% \text{ difference in survival} = \frac{\text{survival under APA - survival under NAA}}{\text{survival under NAA}} \times 100$$

The resulting distribution of percentage difference in survival in each stratum is shown in Figure 1, with associated summary statistics in Table 1. For the Island stratum, the median prediction is of a 2% decline in survival under the APA relative to the NAA, although in 10% of replicates the predicted survival decline is greater than 20%. For the Southeast stratum, the median prediction is of a 14% decline in survival with 40% of replicates predicting a survival decline of greater than 20%. Note, however, that 24% of replicates in this stratum predict an increase in survival under APA relative to the NAA. For the Central and West strata there is a large predicted decline in survival under almost all replicates.

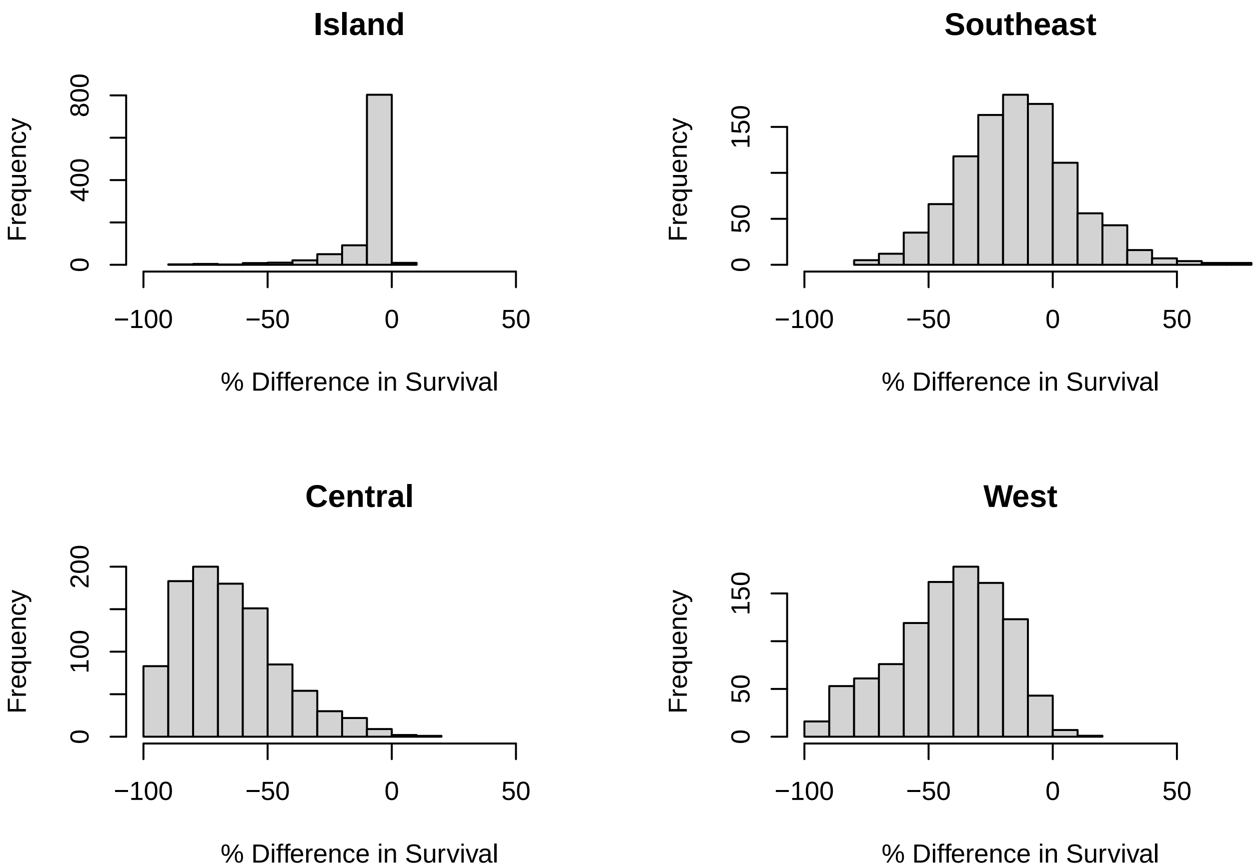

Figure 1: Predicted percentage difference in dolphin annual survival under the Applicant Preferred Alternative (APA) compared with the No Action Alternative (NAA). One thousand predicted survival rates were provided by NOAA and were derived from the model of Garrison et al. (2020).

Table 1: Summary statistics on predicted percentage difference in dolphin annual survival under the APA relative to the NAA. First column is median predicted percentage difference, second is percentage of replicates that predict a decline in survival of 20% or more, third is percentage of replicates that predict an increase in survival.

Stratum	median % diff	% (diff < -20%)	% (diff > 0)
Island	-2	10	1
Southeast	-14	40	24
Central	-68	97	0
West	-39	83	1

Population consequences

The population model of Schwacke et al. (in prep.) gives estimates of the population trajectory of BBES dolphins from 2010 onwards, accounting for the estimated effect of the DWH oil spill. We used this model as the basis to predict the estimated effect of the proposed MBSD project (APA) on the dolphin population. Like the APA survival predictions from Garrison et al. (2020), the population model accounts for scientific uncertainty in predictions by allowing multiple replicates to be drawn. We therefore based our predictions on 1,000 replicate samples.

For each sample, we partitioned the BBES dolphin population into the same four strata as Garrison et al. (2020), using estimates of the proportion of the total population with home range centers in each of the four strata. These estimates come from a spatial capture recapture analysis (Glennie et al. in prep.) that forms part of the inputs to the Schwacke et al. model. For the purposes of this analysis, we assumed that each stratum is demographically independent – i.e., that dolphins in the BBES stock do not move from one stratum to another. For each stratum, we ran the Schwacke et al. model for 75 years (2010-2076), under two scenarios. In the first scenario, representing the APA, for each year after the proposed MBSD project begins in 2027 we adjusted the survival values from the Schwacke et al. model using a random draw from the 1,000 values of percentage difference in survival for that stratum. In the second scenario, representing the NAA, we ran the Schwacke et al. model without modification.

We calculated the following metrics to summarize outcomes from the population model:

- In the first year of operation of the MBSD (i.e., 2027-2028)
  - Excess mortality: the total number of dolphins that are expected to die this year under the APA minus the number that are expected to die in the same year under the NAA.
  - Change in population size under the APA and under the NAA.
  - Percentage difference in population size in 2028 between APA and NAA.
- After 10 years of operation of the MBSD (i.e., in 2037)
  - Probability of functional extinction, where functional extinction is defined as < 30 animals.
  - Percentage difference in population size in 2037 between the APA and NAA.
- In the final year of operation the MBSD operations planning horizon (i.e., 2076)
  - Probability of funtional extinction.
  - Population size under the APA and under the NAA.

In each case, we report the median value from the 1,000 replicate simulations, together with the lowest 2.5th and highest 97.5th percentile – these latter values represent a 95% confidence interval on the prediction.

Results

We first present graphical representations and a qualitative description of the results, before presenting the summary metrics described in the Methods.

Figure 2 summarizes the population trajectories over all 1,000 realizations under APA (red) and NAA (black) scenarios. The populations follow the same trajectory under both scenarios up until 2027, when proposed MBSD operations start. During this period (2010-2027) the populations experience the negative effect of the DWH oil spill and, starting around 2020, begin to recover. After 2027 under the NAA, the populations continue to recover and reach a steady state long before the end of the simulation time period. Under the APA the median prediction for the Island stratum is of a steady decline, while the other strata experience rapid declines to extinction. The prediction at stock level, i.e., summing across strata, is shown in Figure 3. Under the APA, the stock is predicted to decline precipitously at first and then more gradually, reaching very low levels relative to the NAA by the end of the simulation time period.

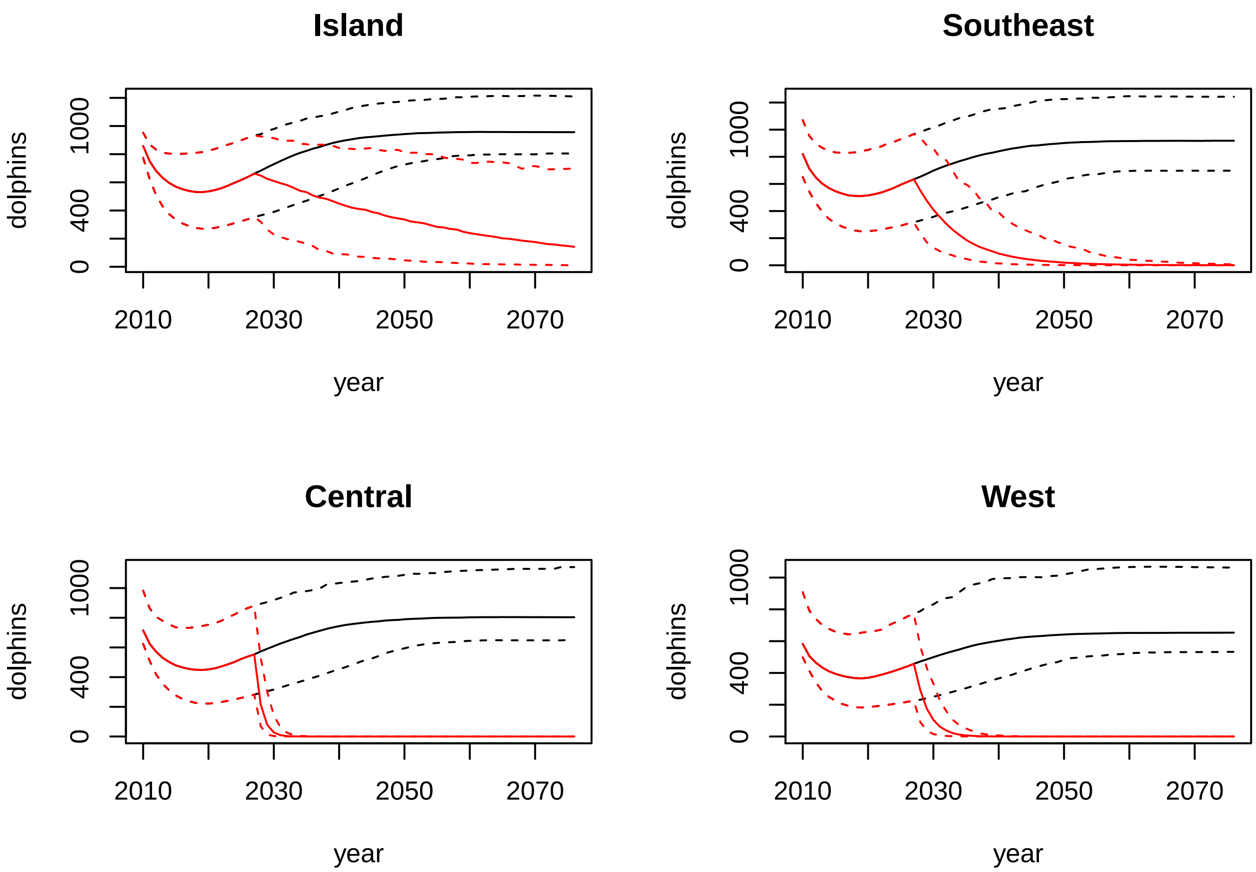

Figure 2: Summary of predicted population trajectories by stratum under the Applicant Preferred Alternative (red) and No Action Alternative (black) scenarios. Solid line shows median; dashed lines show 95% confidence limits.

The summaries given in Figures 2 and 3 are computed from 1,000 random realizations of the model. Figure 4 shows 10 example realizations. The part of the stock in the Island stratum experiences occasional large population decreases associated with years where there is a large decline in survival under the APA; in most years, however, there is little or no decline. After 50 years of operation, all realizations have experienced an overall decline and none are at the level of the corresponding NAA. The part of the stock in the Southeast stratum experiences frequent stronger declines, but also occasional increases associated with survival increase under the APA. Nevertheless, after 50 years of operation, all realizations are at or close to zero. The parts of the stock in the Central and West strata experience rapid declines towards zero in all realizations.

Quantitative summaries of the results are given in Tables 2-6[1]. Table 2 shows the predicted mortalities in the first year of the proposed MBSD operation (2027) under APA, NAA and the difference between the

[1] Note that in all these tables, the median shown in the "Total" row is calculated by first aggregating the strata and then calculating the median. This is not the same as simply summing the stratum medians. The same is true for the confidence limits.

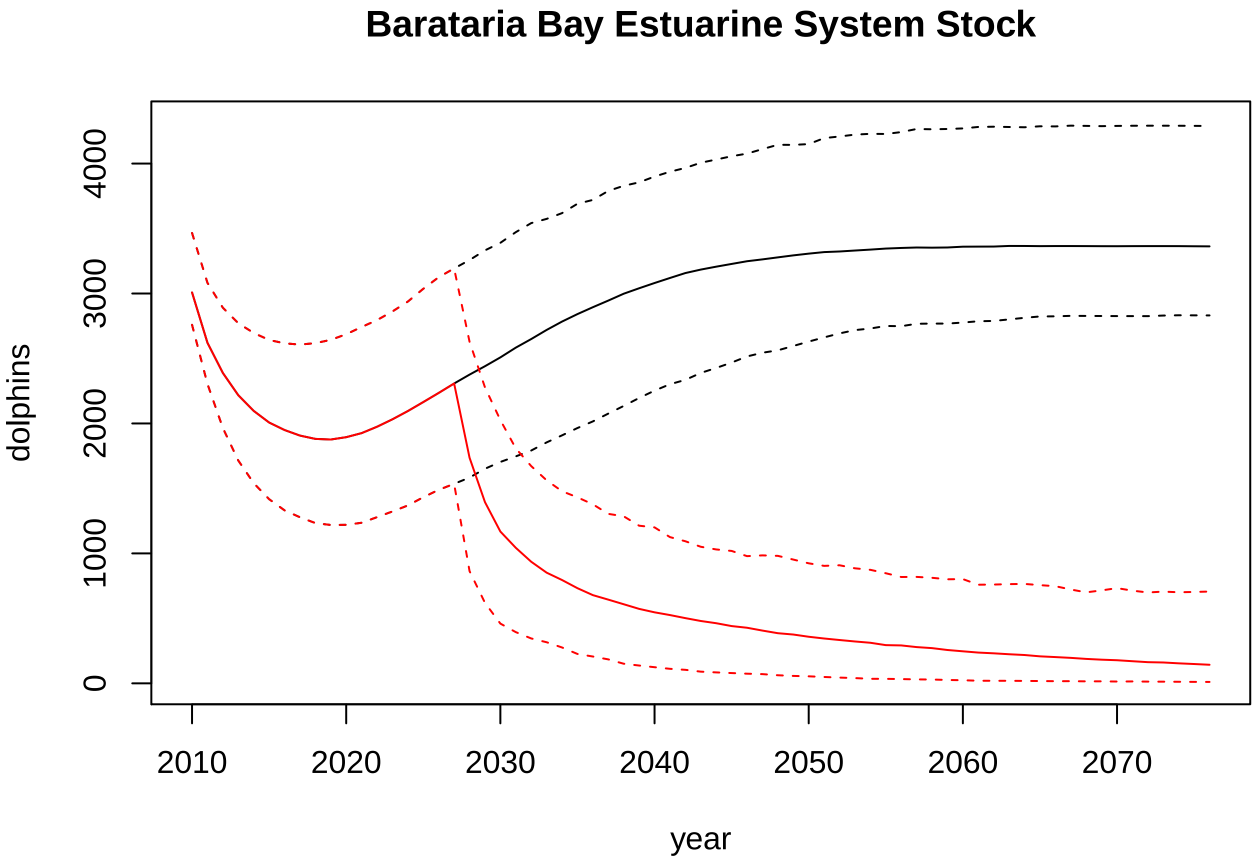

Figure 3: Summary of predicted stock trajectory under the Applicant Preferred Alternative (red) and No Action Alternative (black) scenarios. Solid line shows median; dashed lines show 95% confidence limits.

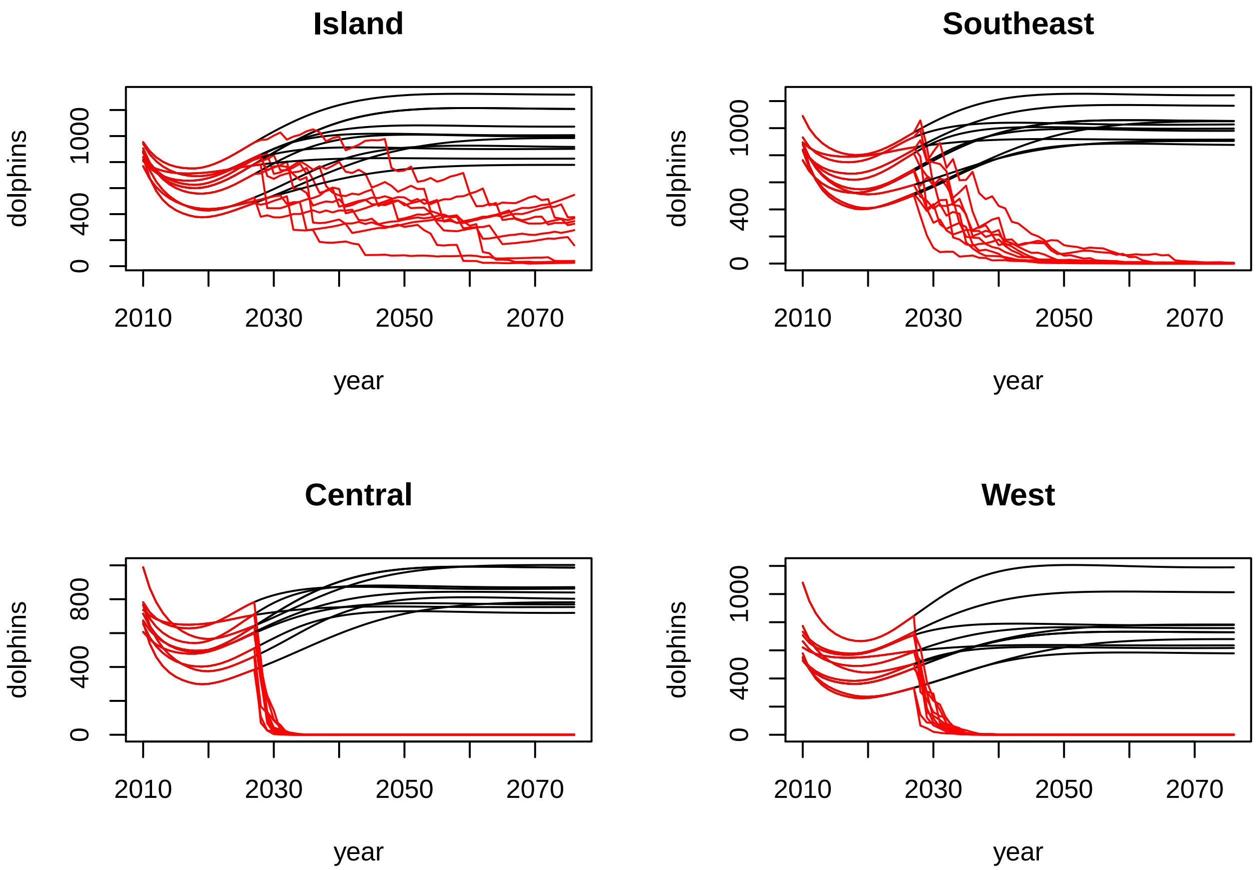

Figure 4: Ten example realizations of the population simulation under the Applicant Preferred Alternative (red) and No Action Alternative (black) scenarios.

two, which represents the predicted excess mortalities under the APA scenario. In this first year of MBSD operation, the median predicted excess mortality under the APA is 585 dolphins with 95% CI 131-1459. This excess mortality represents a median of 26% of the stock (95% CI 6-58) killed by the MBSD in its first year of operation.

Table 2: Predicted dolphin mortality in 2027 under APA and NAA scenarios. Last column shows excess mortality – i.e., mortality under APA minus mortality under NAA. Values are medians from the model simulations, with 95% confidence intervals in brackets.

Stratum	APA mortality	NAA mortality	excess mortality (APA-NAA)
Island	59 (26 — 261)	44 (23 — 64)	12 (0 — 217)
Southeast	111 (0 — 424)	42 (22 — 66)	69 (-50 — 367)
Central	364 (120 — 715)	37 (19 — 59)	326 (92 — 656)
West	186 (53 — 461)	30 (15 — 52)	154 (31 — 420)
Total	740 (26 — 261)	156 (23 — 64)	585 (131 — 1459)

Estimated stock size in the 2027, before operation of the proposed MBSD, was 2307 animals (95% CI 1535-3193). Estimated stock sizes in 2028 under the APA and NAA are shown in Table 3. Under the APA, the stock is predicted to decline by 23% (95% CI 3-55) due to mortalities caused by the MBSD operation. By contrast, under the NAA the stock is predicted to increase by 3% (95% CI 1-5) – the increase is because the stock is estimated be still in recovery from the DWH oil spill. Therefore, by the end of the first year of MBSD operations, the stock is predicted to be 25% smaller (95% CI 6-56) under the APA than under the NAA (Table 3).

Table 3: Predicted number of dolphins in 2028 (after 1 year of operation of the MBSD) by stratum and overall under APA and NAA scenarios, and percentage difference between scenarios. Values are medians with 95% confidence intervals in brackets.

Stratum	APA dolphins	NAA dolphins	% difference
Island	648 (320 — 926)	683 (366 — 942)	-2 (-31 — 0)
Southeast	551 (237 — 939)	653 (330 — 983)	-12 (-49 — 7)
Central	214 (68 — 528)	573 (294 — 894)	-61 (-87 — -17)
West	291 (90 — 567)	472 (232 — 789)	-35 (-79 — -7)
Total	1736 (864 — 2629)	2376 (1584 — 3258)	-25 (-56 — -6)

Tables 4 and 5 show the predicted population size in 2038 and 2076 respectively (i.e., after 10 years of operation of the MBSD and at the end of the 50 year planning horizon) under APA and NAA, as well as the difference between the two scenarios.

Table 4: Predicted number of dolphins in 2038 (after 10 years of operation of the MBSD) by stratum and overall under APA and NAA scenarios, and percentage difference between scenarios. Values are medians with 95% confidence intervals in brackets.

Stratum	APA dolphins	NAA dolphins	% difference
Island	491 (118 — 868)	852 (503 — 1070)	-38 (-84 — -9)
Southeast	137 (28 — 497)	810 (457 — 1126)	-82 (-96 — -44)
Central	0 (0 — 0)	712 (409 — 997)	-100 (-100 — -100)
West	2 (0 — 21)	581 (328 — 964)	-100 (-100 — -97)
Total	644 (184 — 1304)	2946 (2076 — 3790)	-78 (-93 — -59)

Table 5: Predicted number of dolphins in 2076 (at the end of the planning horizon for the MBSD) by stratum and overall under APA and NAA scenarios, and percentage difference between scenarios. Values are medians with 95% confidence intervals in brackets.

Stratum	APA dolphins	NAA dolphins	% difference
Island	142 (11 — 700)	956 (805 — 1210)	-85 (-99 — -28)
Southeast	0 (0 — 7)	918 (698 — 1243)	-100 (-100 — -99)
Central	0 (0 — 0)	804 (650 — 1141)	-100 (-100 — -100)
West	0 (0 — 0)	654 (533 — 1063)	-100 (-100 — -100)
Total	143 (11 — 706)	3363 (2831 — 4289)	-96 (-100 — -80)

Table 6 shows the predicted probability of functional extinction (i.e., proportion of simulation runs where the number of dolphins is less than 30) in each stratum in 2038 and 2076.

Table 6: Predicted probability of functional extinction (i.e., fewer than 30 dolphins remaining) by stratum in 2038 (after 10 years of operation of the MBSD under APA) and 2076 (at the end of the planning horizon for the MBSD)

Stratum	p(extinct) in 2038	p(extinct) in 2076
Island	0.00	0.1
Southeast	0.03	1.0
Central	1.00	1.0
West	0.99	1.0

Discussion

Under the assumptions of this model, there is predicted to be a severe decline in stock size caused by the MBSD under the APA scenario. The stock is predicted to become functionally extinct in three out of four strata and severely reduced in the fourth. The declines are more severe than those estimated to have been caused by the DWH oil spill and will take place just as the stock is starting to recover from the oil spill. While the stock is estimated to recover fully from the DWH oil spill under the NAA scenario, this will not happen under the APA scenario.

We set a limit for "functional extinction" of 30 animals. To our knowledge there is no agreed threshold, and other reasonable values could have been used to indicate the point at which there are so few animals they no longer form a functioning part of the ecosystem. Regardless of the value used, the above findings would be qualitatively the same

These results were generated by combining two separate analyses: the survival predictions from Garrison et al. (2020) and the population model of Schwacke et al. (in prep., updating Schwacke et al. 2017). These use some overlapping information – the photo-ID surveys undertaken in Barataria Bay from 2010-2019. Hence it would be possible, with more modelling effort, to integrate the two more closely by building components of the Garrison et al. model into the population model. However, this is not expected to make a qualitative difference to the population predictions.

The analysis undertaken here sampled values at random each year from the predicted survival effects under the APA and NAA generated by Garrison et al. (2020). This is equivalent to assuming the factors driving the uncertainty in predicted survival effects vary each year. While this is correct for some sources of uncertainty (e.g., uncertainty in salinity field given hydrography; animal movement and hence exposure), it is not fully correct for others (e.g., uncertainty on dolphin survival response given exposure). Ideally, the different components of uncertainty in the Garrison et al. model would be separated and then we could sample as appropriate at the annual level or just once per population projection. This reduction in annual variability would be expected to produce a somewhat more positive population projection, particularly in the Island stratum. However, one very important source of annual variability was neglected in these simulations: annual change in hydrography. The predictions we used from Garrison et al. model were based on a single annual hydrograph, from 1970 (cycle0, Garrison et al. 2020), when in reality hydrography is expected to vary substantially between years. This variability will mean that there are years of worse survival than predicted by Garrison et al. and years of better survival. The overall effect of this on the dolphin population will be to produce a more negative trajectory, because years of poor survival produce large decreases in population size, but in years of good survival the population can only increase by a small amount as it is constrained by the birth rate. The population can decline by 25% in a bad year but it cannot increase by 25% in a good year. Given this, we anticipate that addressing all of the issues related to uncertainty discussed in this paragraph will lead overall to more negative population predictions.

Another factor that makes our projections optimistic is that the population dynamics model is deterministic – it does not account for the random nature of births and deaths, and also allows non-integer population counts. Incorporating demographic stochasticity in the model, and restricting population sizes to be whole numbers will produce more negative predictions, although the difference will not be significant until the populations become small.

The analysis also assumed that the four strata are demographically independent. If dolphins move away from the three more affected strata into the Island stratum in response to low salinity then the stock-level effects may be lower; on the other hand, if dolphins disperse between strata without regard to salinity changes then more animals will move into the strongly-affected strata from the less-affected Island stratum and the stock-level effects may be greater. Genetic analyses have supported spatial structure within the Barataria Basin population, and have identified genetically distinct dolphin groups in the Western, East/Central, and Island portions of the basin (Rosel et al. 2017, Speakman et al. in prep.). Tracking of Barataria Basin dolphin movement patterns via satellite-linked tags has shown multi-year site fidelity to small home ranges (Wells et al. 2017), and have not shown changes in movement that are coincident with fluctuating salinity (Takeshita et al. submitted).

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