OPERATIONAL SCIENCE ADVISORY TEAM

SUMMARY REPORT FOR FATE AND EFFECTS OF REMNANT OIL REMAINING IN THE BEACH ENVIRONMENT

Annex H: Sea Turtles

Anticipated Effects of Residual MC 252 Oil Deposits Remaining On or Near Sand Beaches to Sea Turtles

The Gulf Coast provides potential nesting habitat for five of the world's seven sea turtle species. All five of these sea turtle species are listed under the Endangered Species Act as either threatened or endangered. The sea turtle species that may utilize the Gulf's shores are the green, loggerhead, hawksbill, leatherback, and Kemp's Ridley. The loggerhead is the most common nesting species. Nesting in areas affected by the MC 252 spill usually occurs between May and September, and egg incubation is approximately 2 months. Turtles nest between the high tide line and the toe of the dune, and deposit their eggs approximately 1-3 feet deep below the sand surface (the depth varies by species).

Crude oils have been shown to be potentially toxic to sea turtles. Toxic effects can be caused by ingestion and/or physical contact with oil (Shigenaka et al. 2010). The focus of the OSAT-2 effort was to determine the potential effects of the residual subtidal oil mats, small surface residual oil balls (SSRBs), and supratidal oil deposits to potential receptors. This report discusses the potential effects of only these types of oil deposits to sea turtles. *It should be noted that this assessment is not considered to be a definitive assessment. Because of time constraints, this assessment was made using the literature and anecdotal information available, to answer specific questions to help inform a Net Environmental Benefit Analysis regarding the decision whether to continue to try to remove the residual oil mats, SSRBs and supratidal oil deposits on sandy beaches as part of the emergency response to the BP oil spill. Effects on sea turtles from the residual oil deposits not predicted to be occurring in this assessment could be found to be occurring or have occurred as a result of future studies, and conclusions that are contrary to the conclusions of this assessment that result from specific studies or observations are possible.*

Ingestion of oil by sea turtles can result in adverse effects on the turtle (Lutz et al. 1986, Shigenaka et al. 2010). For the OSAT 2 effort, however, the focus of the exposure is in the subtidal area, surf zone and on the beaches, and turtles occur in these areas when nesting (adults), incubating (eggs) or leaving the nest (hatchlings). Sea turtles are not known to feed when they approach and traverse the beach during nesting, nor do the hatchlings feed until they get offshore (S. MacPherson, pers. comm.). Turtles feed offshore, and floating oil can become a problem for turtles. The oil mat and associated tar ball residues currently do not float, and it is believed unlikely that they will become buoyant again in the future, so exposure to these residues by turtles feeding offshore is believed to be improbable. Therefore it is

believed that exposure to oil from ingestion of the shoreline oil deposits addressed by this OSAT-2 effort will not be significant, and the only exposure route discussed in this report for sea turtles will be physical contact. Physical contact with the oil could be a concern for adult females traversing the beach and digging in the sand to nest, hatchlings as they dig out of the nest and traverse the beach to the ocean, and for turtle eggs were they to be laid in and covered with oil-containing sands.

Discussions of "weathered" or "more weathered" oil in this section of the report refer to the weathered oil deposits found on and along the majority of the sandy beaches of Florida, Alabama, Mississippi and Louisiana. There are certain sandy areas that have oil deposits with fresher ("less weathered") characteristics, such as along Grand Isle in Louisiana. As a general rule, it is expected that the toxicity and other adverse effects from the "less weathered" oil would be greater than for the "more weathered" oil deposits. Because the more weathered oil deposits appear to be the types of oil found on the vast majority of the beaches, this discussion focuses on these types of deposits. Potential effects of the less weathered deposits are mentioned if they differ from the predictions for the more weathered deposits.

Risks to adult sea turtles from exposures to the majority of the weathered oil deposits remaining on the sandy beaches are believed to be low at this point. Dermal exposures of fresh or slightly weathered oil to adult sea turtles can cause skin inflammation and sloughing off of skin, particularly the sensitive areas of the skin such as in the neck and flipper areas (Shigenaka et al. 2010, Lutcavage et al. 1995, Lutz et al. 1986, Lutz 1987, Bossart 1986). Anecdotal reports regarding adult sea turtles oiled with relatively fresh oil during the MC 252 release, however, indicate that no adverse effects to the skin of the adult turtles were observed (G. Shigenaka, pers. comm.). Therefore, if dermal exposures to the relatively fresh crude did not cause observed acute adverse effects, it is believed unlikely that exposure to the weathered oil, which is now present as oil balls/mats on and near the beaches, will pose a significant dermal risk to adult sea turtles, due in part to the perceived low likelihood of physical transfer of the weathered oil from the deposit to the animal. Despite this general conclusion, there is some uncertainty around the potential that the nearshore subtidal oil mats or buried supratidal oil deposits could cause some potential contact hazard for adult turtles as the weather warms. Anecdotal information suggests that the exposed surfaces of the oil mats and supratidal deposits are fairly hardened at the time of the writing of this report (January 2011) and therefore would likely pose little contact risk currently. The uncertainty involves the potential softening of the mats and supratidal oil deposits/SSRBs as the temperatures warm during the summer months. No information was found that would allow a definitive prediction of how soft the mats or deposits may become during the summer months, and what hazard may be posed by physical contact with the mats. An educated guess suggests that mats and deposits likely would not become a physical contact hazard for adult turtles as they migrate to and from the shore for the purpose of laying eggs, which occurs in the late spring and summer months. An ameliorating factor is that beach sand will tend to coat "sticky" surfaces of oil masses, providing a measure of physical protection to incidental contact hazards. It would be of value to confirm this, however, by examining how much physical transfer of petroleum occurs from contact with mats in the summer months, or by warming mat material to simulate nesting season conditions to examine the potential for transfer of oil residue from physical contact. Anecdotal information regarding the less

weathered supratidal oil deposits, such as on the Grand Isle beaches, indicate that this oil still has enough fresh oiling characteristic that physical transfer to sea turtles coming into contact with it through digging could be substantial. What the long term (chronic) effect of contact with this oil may be is unknown, but it is anticipated that adverse effects would be possible.

A similar conclusion is made for hatchling sea turtles as they dig out of the nest and traverse the beach toward the surf. For the majority of the beaches, the hatchling turtles, which are light in weight compared to adult turtles, may be at less risk of having oil transfer from the weathered oil deposits to their skin compared to the adults. It is theorized however that hatchlings may be at a greater risk of injury from oil that does transfer due to toxicity and also due to the physical constraining effects from oily residues (Santos and Mariano 2007, Shigenaka et al. 2010). Given the degree of weathering observed in the supratidal deposits and the resulting generally solid ("packed brown sugar") consistency of the deposits on the majority of the beaches, an educated guess leans toward these deposits not posing a significant risk for the hatchling turtles. The subtidal oil mats visually appear less weathered than the supratidal deposits and are somewhat "sticky" but are still generally solid, as of the January 2011 writing of this document. Again, because of the light weight of the hatchlings, it is theorized that they would not exert sufficient pressure as they contact the subtidal oil mats to transfer significant amounts of oil to their skin. Not having transferability data and consistency estimates for the subtidal oil in summer conditions makes this conclusion difficult to verify at this time, and obtaining data examining the transferability of the oil from warmer oil mats to a skin-like surface would, as mentioned, be of value in reducing the uncertainty of this assessment. For the less weathered oil deposits such as those along Grand Isle, it is anticipated that hatchling contact with this oil while digging out from a nest or traversing the beach would result in significant oiling of the animals. It is anticipated that this could result in significant adverse effects to the hatchling turtles through either chemical toxicity or physical inhibitory effects.

Another potential impact from the weathered supratidal oil deposits for adult turtles is that if the deposits are large and are hardened, there is some concern about the loss of potential nesting area along the beaches, as the oil deposits may create obstacles for nesting turtles attempting to dig through the deposit. Nesting obstacles like oil mats may result in decreased nesting success due to a higher occurrence of false crawls, and increased false crawls may result in increased physiological stress to nesting females. The magnitude of this impact will be directly related to the frequency of occurrence and size of the deposits compared to the available nesting area for the turtles. The current (January 2011) estimate of the percentage of sandy beach area impacted by the spill that may still be underlain by buried oil mats ranges from 2% to 8% (see oil spatial distribution section of this report for more explanation of this estimate). This is likely a conservative (larger) estimate of the amount of sandy beach area that may be impacted. Additionally, some of this buried oil may be deposited as a very thin layer so not all of the buried oil may pose an impediment to nesting turtles. Because the sea turtle species along the Gulf are either threatened or endangered in status, however, any impediments to nesting would be a cause for concern. There are several organizations in the United States, such as the U.S. Fish and Wildlife Service, the National Park Service and the Sea Turtle Conservancy that monitor or coordinate volunteer groups who monitor the nesting activities of sea turtles in the Gulf. It may be that

educating those agencies and organizations on mitigation strategies to help prevent adverse effects from sea turtle/oil mat interactions would be valuable in lessening the potential impacts of the buried oil on the turtles.

Only a few studies were identified that examined the effects of oil on turtle eggs. Van Meter et al. (2006) reported teratogenic deformities in turtle embryos that were exposed to PAHs and fresh crude oils on the surface of the eggs. This would likely not apply to the majority of the weathered oil deposits, but could indicate potential adverse effects for nests laid in areas containing less weathered deposits. Rowe et al. (2009) developed water accommodated fractions (WAFs) of crude oils and poured the extracts over snapping turtle eggs incubating in sand. They reported no detectable effects on hatching rate or health of the hatchlings. This finding indicates a lack of acute effects from water (such as rain water) percolating down through the sand over oil deposits and onto turtle eggs. The only identified study looking at weathered oil effects on turtle eggs was reported by Fritts and McGehee (1982, 1989). The study examined primarily Ixtoc spill oil deposits that had weathered for several months up to one year, which is somewhat similar to the situation that sea turtles will encounter along the U.S. Gulf Coast in the 2011 nesting season. They also looked at effects of fresh oiling on the eggs. For the weathered oil, a comparison was made between turtle eggs incubated in sand from an oiled beach (0.0004% up to 0.3% oil by weight in the sand) and eggs incubated in clean sand (from sands behind the dunes that were not oiled). No difference was seen in the hatching success and observed hatchling vitality between the two groups. Experiments were also performed using fresh crude that was mixed with sand (7.5 mL to 30 mL of oil per kg sand) and then this sand used to incubate sea turtle eggs. Some effects on embryo size and incubation time were observed, but the effects were not correlated with oil dose. The main difference caused by the fresh oil treatments was in the scutellation (shape and size of the bony plates on the turtle shell) between hatchlings in clean versus oiled sand. No effect of the scutella differences on turtle health was mentioned. Fresh oil was also poured onto sand with eggs incubating underneath, and increased mortality was seen in the embryos. This was fresh oil and was not weathered oil, so the implication from this finding and other work presented in this study is that fresh oil, such as beach oiling during egg laying or incubation, can have negative effects on turtle eggs. Fritts and McGehee concluded that oil weathering of even a modest time frame (a month or two) could result in a large decrease in the toxicity of the oil to turtle eggs, and that significantly weathered oil should not cause notable adverse effects to turtle eggs. Given the authors' conclusions, it is anticipated that the weathered MC 252 supratidal oil is not likely to cause adverse effects on incubating turtle eggs. The potential effects of the less weathered oil is less clear, and although there are indications that even the less weathered MC 252 oil may be weathered enough to not cause adverse effects, the adverse effects noted in the study from fresh oil contact with the eggs may be pertinent to egg contact with the less weathered supratidal deposits.

CONCLUSIONS: The literature reviewed and the experts consulted seem to indicate that significant adverse effects on sea turtles from the more weathered oil deposits (supratidal, SSRBs and subtidal) are not expected. The potential for adverse impacts will depend largely on the consistency of these weathered deposits in warmer weather conditions during the late spring and summer months when egg laying and hatching occurs. If the deposits on the majority of beaches do not become notably more

viscous than was observed in January 2011, when this report was written, the adverse effects from the oil residues in these areas are anticipated to be minimal. The same cannot be said for the less weathered deposits of oil such as those found on Grand Isle, where the "fresher" characteristics of the deposits are anticipated to potentially cause injury to hatchling, embryonic, and potentially adult sea turtles if they were to come into contact with the deposits. Adverse effects are also possible from hardened oil mats in the supratidal areas of all affected beaches, because these hardened deposits could provide impediments to adult turtles excavating a nest. The likelihood of adverse impacts will depend on the size, character and number of such deposits remaining on the affected beaches after emergency response cleanup activities have ceased.

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