MEMORANDUM FOR RECORD

From: Troy Baker and Sandra Arismendez, NOAA, Office of Response and Restoration

Subject: Conversion factor between offshore benthic habitat and marsh habitat in the DBL 152 Oil Spill

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This memorandum describes NOAA's determination of a conversion factor for scaling marsh restoration to an offshore benthic injury.

The assessed benthic resource losses in the DBL 152 oil spill are for benthic injuries occurring in soft, un-vegetated bottom sediments in an offshore marine environment, also referred to as open water habitat. The restoration project proposed to compensate for these losses involves, among other elements, creation of salt marsh. To determine the amount or scale of restoration needed to offset losses, it was necessary to compare the Discounted Service Acre Years (DSAYs) lost due to the injuries with those DSAYs gained through salt marsh creation. The comparison required the consideration of differences in functions or ecological productivity levels between these habitats. To translate the habitat losses into their 'equivalent' in the target restoration habitat, it was necessary to identify a conversion factor or ratio to be used to adjust for the differences in relative productivity across these habitat types. To accomplish this, the habitat productivity of the injured open water habitat was first compared to the habitat productivity of a natural marsh. NOAA reviewed available literature and similar case histories (Texas Natural Resource Trustees, 2000) to derive a marsh equivalency factor, accepting a ratio of 4.5 acres of offshore benthic habitat to 1 acre of tidal wetland. NOAA determined that this ratio could be used as a conversion factor for the habitats under consideration in the DBL 152 case based on an extensive review of literature relevant to the specific geographic areas impacted by the Incident and targeted for restoration. As part of this literature review, NOAA investigated whether this conversion factor would need to be further adjusted based on potential differences between the productivity of offshore and nearshore benthic communities.

Benthic macrofaunal productivity has been shown to increase along a gradient from the deep waters of the Gulf of Mexico to estuaries and marshes along the Texas coast (Table 1). Reasons for this phenomenon may include changes in the presence or absence of sunlight, temperature, pressure, water masses, structural complexity, freshwater inflows, and the availability of food sources. In Texas' estuaries, benthic macrofaunal densities and biomass have been shown to increase in areas exhibiting decreased salinities near freshwater inflows (Montagna and Kalke 1992). Coastal marshes in estuarine environments provide higher levels of ecosystem services than offshore open water habitats primarily due to their structural complexity (Mitsch and Gosselink 2007). To further support the marsh habitat equivalency factor used in the restoration scaling for the DBL 152 oil spill (i.e., 4.5 acres of offshore benthic habitat to 1 acre of tidal wetland habitat), NOAA first gathered and standardized a range of benthic macrofaunal biomass

values reported in published scientific literature from the Gulf of Mexico and along the Texas coast. Next NOAA estimated benthic macrofaunal productivity values using the method described by Peterson et al. (2007) (Table 1). Finally, we calculated ratios of productivity between habitat types similar to that of Peterson et al. (2007) (Table 2).

The productivity ratios comparing offshore Gulf of Mexico habitat to both estuary and marsh habitat along the Texas coast collectively produced an average of 5.26 g C m^{-2} and ranged from a high of 11.86 g C m^{-2} to a low of 0.99 g C m^{-2} (Table 2). The average of only the offshore to marsh produced a value of 4.9 g C m^{-2}, a ratio only slightly higher than that produced by Peterson et al. (2007) (4.5 g C m^{-2}). The work presented by Peterson et al. (2007), although much more extensive than that presented here, covered a much broader geographical area, whereas the work presented here only includes pertinent studies from the areas where the injury occurred and where restoration has been proposed. Factors that may have contributed to the wide range in ratios include differences in field and laboratory methods used in the collection and analysis of benthic samples, substrate composition, season/year sampled, population dynamics, measurement and experimental errors, etc. Upon consideration of this range of ratios and noting that the 4.5:1 lies within this range of values (Fig. 1), NOAA concluded that this ratio is appropriate to use in scaling offshore benthic injury to marsh creation in this case.

Table 1. Benthic macrofaunal productivity (g C m-2) at varying sample depths (m) by habitat (e.g., offshore, estuary, and marsh). Standard deviations are provided in parentheses.

Habitat	Estimated Productivity (g C m^{-2})	Sample Depth (m)	Source
Offshore – Gulf of Mexico	3.67 (0.41)	-482	Rowe et al. 2008
Offshore – Gulf of Mexico	3.27(3.02)	-85.33	Escobar-Briones and Soto 1997
Offshore – Gulf of Mexico	1.53 (1.40)	-20.2	Rowe et al. 2002
Offshore – Gulf of Mexico	15.11 (14.35)	-8	Palmer et al. 2008
Estuary – Nueces	15.42 (17.23)	-2.4	Montagna and Kalke 1992
Estuary – Guadalupe	18.15 (26.90)	-1.7	Montagna and Kalke 1992
Marsh – Galveston Island	15.03 (9.17)	4.5	Whaley and Minello 2002

Table 2. Ratios of productivity comparing offshore - Gulf of Mexico habitat with estuary and marsh habitat. Standard deviations are provided in parentheses.

Habitat	[5]Estuary - Nueces	[5]Estuary – Guadalupe	[6]Marsh – Galveston Island
[1]Offshore – Gulf of Mexico	4.95(42.02)	4.20 (65.61)	4.09 (22.37)
[2]Offshore – Gulf of Mexico	5.55 (5.71)	4.72 (8.91)	4.60 (3.04)
[3]Offshore – Gulf of Mexico	11.86 (12.31)	10.08 (19.21)	9.82 (6.55)
[4]Offshore – Gulf of Mexico	1.20 (1.20)	1.02 (1.87)	0.99 (0.64)

[1] Rowe et al. 2008
[2] Escobar-Briones and Soto 1997
[3] Rowe et al. 2002
[4] Palmer et al. 2008
[5] Montagna and Kalke 1992
[6] Whaley and Minello 2002

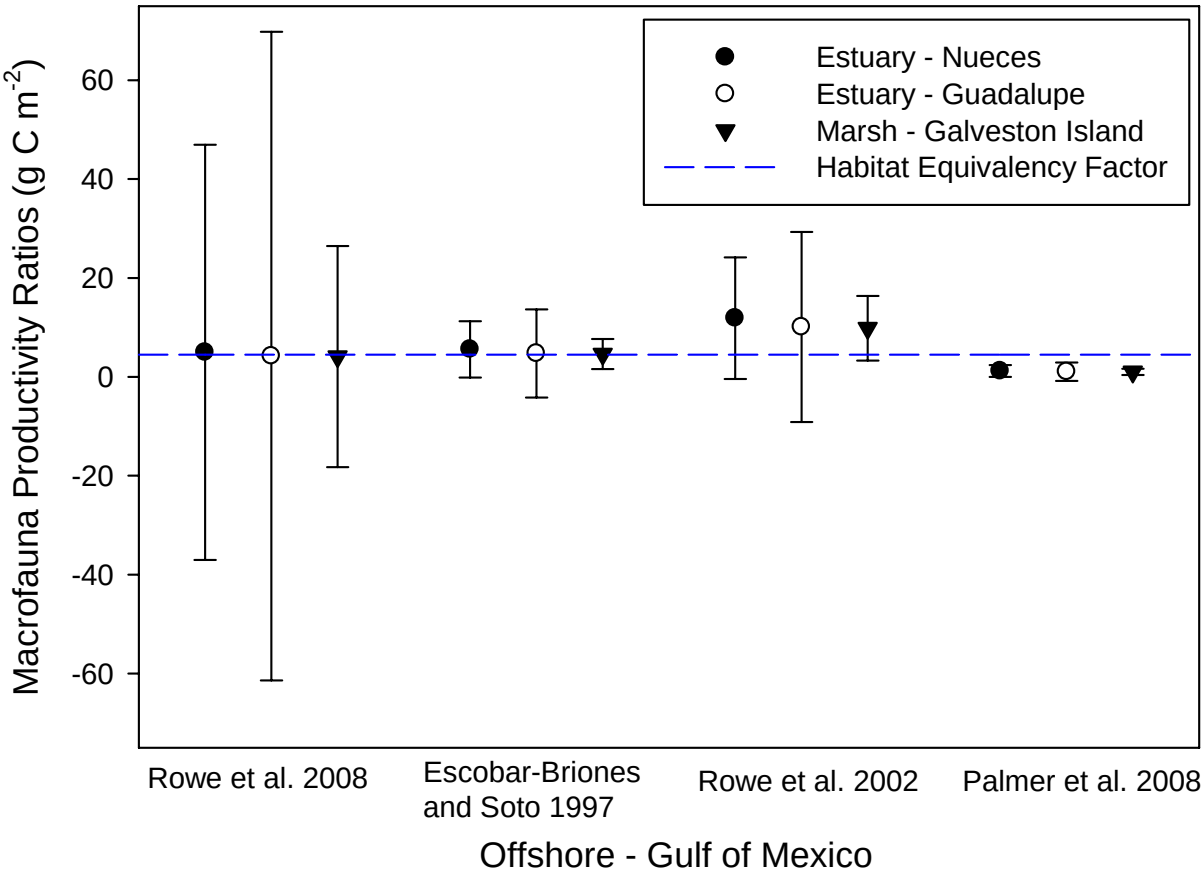

Figure 1. Macrofaunal productivity ratios from Gulf of Mexico and Texas estuary and marsh habitats as compared to the marsh habitat equivalency factor recommended by Peterson et al. (2007). Data values are provided in Table 2.

References

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