



**UNITED STATE DEPARTMENT OF COMMERCE**  
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August 31, 2016

MEMORANDUM TO: Luiz Barbieri, Chair SSC,  
Gulf of Mexico Fisheries Management Council

FROM: Bonnie Ponwith, Ph.D.  
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SUBJECT: Response to Request for Risk Assessment of Exceeding the  
Effort Threshold Associated with Sea Turtles in Support of  
Amendment 17B, Action 3, to the Gulf of Mexico Shrimp  
Fishery Management Plan

### **Request**

On July 14, 2016 the Gulf of Mexico Fisheries Management Council requested an analysis of the Gulf of Mexico (Gulf) shrimp fishery data to determine the probability of exceeding the effort threshold (as set in the 2014 biological opinion) associated with sea turtles under each of the alternatives in Amendment 17B, Action 3. If a quantitative analysis is not possible, the Council requested a qualitative assessment of the relative risk of exceeding the effort cap for each alternative.

### **Quantitative Analysis**

For the purposes of Gulf shrimp fisheries effort estimation, the COLREGS line refers to the specific political line that divides inland and coastal waterways. The Gulf shrimp fishery operates within the inshore area, which is defined as the area from the COLREGS line shoreward; and the offshore area, which is designated as being from the COLREGS line seaward. Total effort is the combination of inshore effort and offshore effort.

We concluded that determining the probability of exceeding the effort cap associated with turtles under each of the alternatives in Action 3 of Gulf Shrimp Amendment 17B is not feasible. First, no statistical relationship exists between the number of federally permitted vessels and total effort (Figure 1, Table 1). Our regression analysis was conducted using the number of vessels with federal moratorium permits and total effort in each year from 2008, the first full year of the moratorium, to 2014. This result is not unexpected because: (1) the number of federal permits does not limit the number of vessels that can operate in inshore

waters, and thus in turn does not determine the amount of inshore effort, and (2) many federally permitted vessels are not active in the fishery during any given year (i.e., they have no landings), and only active vessels generate effort.

While this is a small sample size, even if a relationship did exist, we would not be able to reasonably predict expected total effort in the fishery because of the high level of uncertainty regarding future developments in the fishery, most importantly changes in shrimp prices, and fuel prices. These factors drive vessel owners' decisions regarding whether to participate in the fishery in a given year and to what extent (i.e., how much effort to exert). Without this information and a defensible quantitative relationship between the number of vessels with federal moratorium permits and total effort in the Gulf, we are not able to determine the probability of exceeding the effort cap associated with sea turtles under each of the alternatives in Action 3 of Gulf Shrimp Amendment 17B.

These results are unlike previous analyses done in support of Amendment 17B that examined the relationship between offshore effort and various measures of active vessels. For example, those analyses demonstrated a strong positive relationship between the number of federally permitted vessels active in offshore waters and offshore effort (see Appendix A in Amendment 17B).

### **Qualitative Analysis**

We conducted a qualitative analysis, described below, to determine the relative risk of exceeding the turtle effort cap across the alternatives in Action 3. Results are presented in Table 2.

#### Background information

The moratorium on permits was introduced in March 2007, primarily due to economic concerns, after several years of consolidation in the fishery. To evaluate potential future developments, we only considered annual data starting in 2008, the first full year of the moratorium, because both open access and moratorium permits were valid for certain parts of 2007, and the number of permits and thus permitted vessels dropped significantly from 2007 and 2008 due to the moratorium's implementation rather than economic or biological factors related to effort.

In order to relate total effort to federal permits, it is necessary to: (1) link offshore effort to all vessels active in offshore waters (i.e., vessels that had at least one pound of shrimp landings from offshore waters), and (2) establish the fraction of these active vessels that have federal permits. We must also consider "latent" permitted vessels in our assessment. The number of "latent" permitted vessels is the difference between the total number of federally permitted vessels and the number of permitted vessels active in offshore waters, i.e., permitted vessels that did not use their permit to shrimp in federal waters in a given year. Given the right external circumstances (high shrimp prices, low fuel prices, etc.), it is likely that many of these latent vessels would become active in the shrimp fishery.

The turtle-related effort threshold has been set at approximately 133 thousand nominal days of fishing (i.e., the 2009 level), where a "day fished" equals 24 hours of towing time. Between 2008 and 2014, the effort in inshore waters ranged from 35.6 to 56.4 thousand days

fished, with an average of 46.9 thousand days fished. The effort in offshore waters ranged from 60.5 to 76.5 thousand days fished, with an average of 67.9 thousand days fished.

### Analysis

Below we provide a qualitative assessment of three different scenarios based on fishing effort observed over the last seven years that could also exist in the future, including the potential effect of latent vessels entering the fishery. It is important to note that total effort can also increase or decrease due to changes in inshore effort. The scenarios considered below were used to inform the qualitative assessment of the relative risk (low, moderate, high) of exceeding the effort threshold under the various permit levels associated with alternatives in Amendment 17B, Action 3 (Table 2).

#### **Scenario 1, based on average effort from 2008-2014**

The inshore and offshore fishery generated an average annual total effort of 114.8 thousand days fished per year from 2008-2014, which is about 18.2 thousand days below the 2009 sea turtle-related effort threshold. The average number of active vessels (permitted and non-permitted) and active permitted vessels in the offshore fishery were 1657 and 1010, respectively. Given an average annual offshore effort of 67.9 thousand days fished, average annual offshore effort was 41 days per active offshore vessel during this time. An additional 445 “average offshore” vessels would need to become active in order to exceed the effort threshold. Hence, any federal permit level above 1455 could, mathematically, lead to the effort threshold being exceeded, with all else being equal (i.e., if the “average” economic and biological conditions seen during this time are experienced in the future). Because it is relatively likely “average” conditions will be experienced again in the future, and thus these average effort levels will also be experienced, the likelihood of exceeding the sea turtle effort related threshold is relatively high at any federal permit level above 1455.

#### **Scenario 2, based on maximum annual total effort (observed in 2009)**

The inshore and offshore fishery generated a total of 133 thousand days fished in 2009, which in turn has effectively become the turtle-related threshold on effort. There were 1891 vessels active in offshore waters that year, which is the highest number of active vessels in the offshore fishery during the 2008-2014 time period. Of these vessels, only 1075 had a federal permit and hence could legally harvest shrimp in the EEZ. Thus, all other things being equal, any federal permit level above 1075 could lead to the threshold being exceeded if economic and biological conditions in this year are experienced in the future. However, because the threshold was not exceeded in 2009 under relatively favorable economic and biological conditions (e.g., fuel prices were relatively low and shrimp abundance was relatively high), it is only moderately likely that the sea turtle effort related threshold would be exceeded at a permit level at or near 1075 (for example, the 1074 permits under alternative 2). In turn, because it is unlikely economic and biological conditions will be markedly improved in the future relative to 2009 conditions, it is also relatively unlikely that the sea turtle effort related threshold would be exceeded under alternatives with permit levels below 1074.

#### **Scenario 3, based on effort in the most recent year (2014)**

The inshore and offshore fishery generated approximately 109,300 days fished in 2014, of which 35.6 thousand days fished was in inshore waters and 73.7 thousand days was in

offshore waters. The number of active vessels in offshore waters was 1616, of which 987 had federal permits. Thus, the average offshore vessel generated 46 days fished in 2014. It would take an additional 516 “average offshore” vessels entering the fishery to exceed the threshold. Hence, any federal permit number greater than 1503 could enable this to happen. Because it is relatively likely these recent conditions will be experienced again in the future, and thus these average effort levels will also be experienced, the likelihood of exceeding the sea turtle effort related threshold is relatively high under any federal permit level above 1503. This result is fairly consistent with the results of Scenario 1 based on average effort from 2008 to 2014.

### **Additional Caveats**

It is critical to note that these are “back-of-the-envelope” calculations to illustrate the general implications and scope of these decisions. In fact, there are multiple critical countervailing caveats to be aware of:

1. Not all latent effort can be realized, as some latency is impossible to avoid, e.g., engine breakdowns. Further, some vessels hold moratorium permits for non-shrimping reasons (e.g., speculation, lending institutions have asked some vessels active in other fisheries to keep their moratorium permits for collateral purposes, and some vessels involved in oil industry work need permits for “bycatch” reasons). Accounting for these unused permits would increase the number of permits that the fishery can support without exceeding the sea turtle-related effort threshold.
2. If economic and/or biological factors improve and cause shrimping to become more profitable, we expect federally-permitted latent vessels to enter the fishery as noted above. However, it is also likely that improvement in these factors would lead to additional increases in effort by vessels that are already active in the three components of the harvesting sector (i.e., inshore, state offshore, and EEZ waters), and additional vessels are likely to take up shrimping in state waters because state water fisheries are generally open access. Accounting for these relationships suggests the number of federal permits would need to be lower to avoid exceeding the effort threshold.
3. Measuring, let alone predicting, effort partitioned into state and federal waters in the Gulf (food) shrimp fishery is difficult because the fishery is conducted in politically bounded state-managed inshore and offshore waters and federally-managed offshore waters (i.e., the EEZ). The moratorium on permits only limits potential effort in the EEZ. Effort in state waters is not limited because most states have generally not placed limits on the number of shrimp licenses they issue. In fact, only the number of federal permits, and hence federally permitted vessels, is limited, not the amount of effort expended by each vessel or the amount of total effort in the fishery.

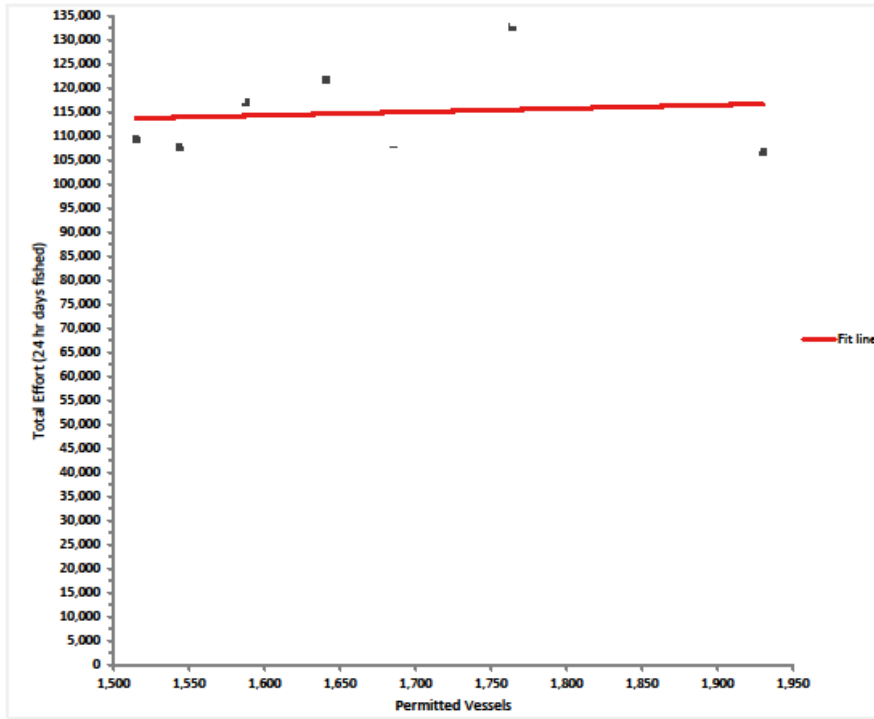


Figure 1. Relationship between federally permitted vessels and total fishing effort in the Gulf of Mexico 2008-2014.

Table 1. Regression analysis of federally permitted vessels and total fishing effort in the Gulf of Mexico 2008-2014.

N	7			
Equation	Total Effort = 1.028e+05 + 7.228 Permitted Vessels			
R <sup>2</sup>	0.011			
R <sup>2</sup> adjusted	-0.186			
SE of fit (RMSE)	10573.8614			
Parameter	Estimate	95% CI	SE	p-value
Constant	102830	-26112 to 231772	50161	0.0956
Permitted Vessels	7.228	-69.90 to 84.35	30.002	0.8192

H0:  $\beta = 0$   
 The parameter is equal to 0.  
 H1:  $\beta \neq 0$   
 The parameter is not equal to 0.

**Effect of Model**

Source	SS	DF	MS	F	p-value
Difference	6488377.947	1	6488377.947	0.06	0.8192
Error	5.590327 E+08	5	1.118065 E+08		
Null model	5.655211 E+08	6	94253517.523		

H0:  $E(Y|X=x) = \mu$   
 The model is no better than a null model  $Y=\mu$ .  
 H1:  $E(Y|X=x) = \alpha + \beta x$   
 The model is better than the null model.

**Effect of Terms**

Term	SS	DF	MS	F	p-value
Permitted Vessels	6488377.947	1	6488377.947	0.06	0.8192

H0:  $\beta_{term} = 0$   
 The term does not contribute to the model.  
 H1:  $\beta_{term} \neq 0$   
 The term contributes to the model.

Table 2. Relative risk of exceeding the turtle effort threshold for each alternative under Action 3 in Amendment 17B to the Gulf of Mexico Shrimp Fishery Management Plan.

<b>Alternative</b>	<b>Number of permits</b>	<b>Relative Risk of exceeding sea turtle related effort threshold</b>
1	1,295	Moderate/High
2	1,074	Moderate
3	938	Low
4	882	Low
5a	1,133	Moderate
5b	990	Low
6a	1,501	High
6b	1,470	High
6c	~1,440	High