Appendix F. Initial proposal for ventless trap and larval survey

Project Summary:

The University of Massachusetts Dartmouth School for Marine Science and Technology (SMAST), in conjunction with the Massachusetts Lobstermen's Association (MLA), seek to establish a ventless lobster trap survey with a tagging component to assess the American lobster resource in the Vineyard Wind development area and adjacent control sites. Concurrently a black sea bass study will be conducted at the recommendation of the Massachusetts Division of Marine Fisheries (MADMF) to gather much need data on relative abundance, fecundity, feeding habits, as well as age and size structure. We will also determine relative abundance and distribution of larval lobster and fish using a towed neuston net. Substrate and habitat classification will be determined from data collected during a separate SMAST drop camera optical survey. Results from this study will provide a baseline for federal and state mandatory monitoring plans.

<u>Methodology:</u> SMAST will survey the northern development area and an adjacent control area; both areas are of similar size and depth. Each lease cell in the development area is divided into 16 sub-areas called aliquots; this design was transposed to the control area. Within each cell a randomly selected aliquot will serve as the center point for the study area; a total of 30 stations will be selected and split equally between the development and control areas. At each station a string of lobster pots will be sampled twice per month. All captured lobsters will be carefully recorded and appropriately sized samples will be tagged. Results will produce relative and absolute abundance, size and sex distribution, reproductive state, recruitment, and severity of epizootic shell disease. Bycatch from the traps will be recorded and assessed; particularly species of commercial interest such as Jonah crab. Adjacent to each sting, a single black sea bass trap will be collected and samples will be analyzed for age, diet, and population structure. The plankton sampling component of this study will utilize a towed neuston net to sample the top 0.5 meters of the water column. At each station three 7-minute tows will be conducted to assess pre-settlement abundance and distribution.

<u>Rationale:</u> The ideal method to assess the impact or change on an environment is through a Before-After-Control-Impact (BACI) study. The design of this experiment assumes that the development area and control area have similar environments and over time would change at the same levels. This study will provide a baseline on the American lobster and black sea bass as well as temporal abundance and distribution of lobster larvae in the neustonic layer of the water column. Results from this study will be able to be compared to follow up assessments after construction. Ventless trap surveys are widely accepted methods for relatively assessing populations (Courchene and Stokesbury, 2011). This methodology is utilized by New York and aside from Connecticut, every coastal state in New England as well (ASMFC, 2015). Ventless trap surveys have previously been used with success in the pre-construction monitoring in the Rhode Island/Massachusetts wind energy area (RI/MA WEA), located on Cox's Ledge lease area (Collie and King, 2016). The current Vineyard Wind monitoring plan calls for research on the adult lobster population as well as plankton sampling; this study will satisfy both components. As an additional component the black sea bass monitoring will be conducted at the request of the MADMF as part of their recommendation for environmental assessment in wind energy development areas (MA DMF, 2018).

Project Narrative

Rationale: The Vineyard Wind lease area begins roughly 15 nm south of Martha's Vineyard. The MA WEA has several major lease areas awarded to various companies for offshore wind development. As part of extensive pre- and post-construction research initiatives, School for Marine Science and Technology (SMAST) was asked to conduct ventless lobster trap, black sea bass pot, and plankton surveys to assess the impact of wind farm development on these species. Ventless lobster traps have been used by both MADMF and RIDEM to assess the status of the American lobster in southern New England (ASFMC, 2015) and implemented in several graduate student projects at the SMAST (Figure 1a) (Courchene and Stokesbury, 2011; Cassidy, 2018). This provided a strong baseline of the American lobster and Jonah crab resources within the RI/MA WEA around Cox's Ledge (Collie and King, 2016) and in the United Kingdom (Roach et al., 2018). Lobster stocks in the Gulf of Maine have increased to record highs (ASMFC, 2019), while Southern New England has declined to extreme low levels; effectively collapsing (Le Bris et al. 2018). The southern New England lobster resource and associated fishery have moved offshore areas where the stock has re-distributed (Figure 1b and 2) (Glenn et al., 2011; Cassidy, 2018). This is caused by increasing water temperatures inshore and the thermosensitivity of lobsters (Wahle et al., 2015).

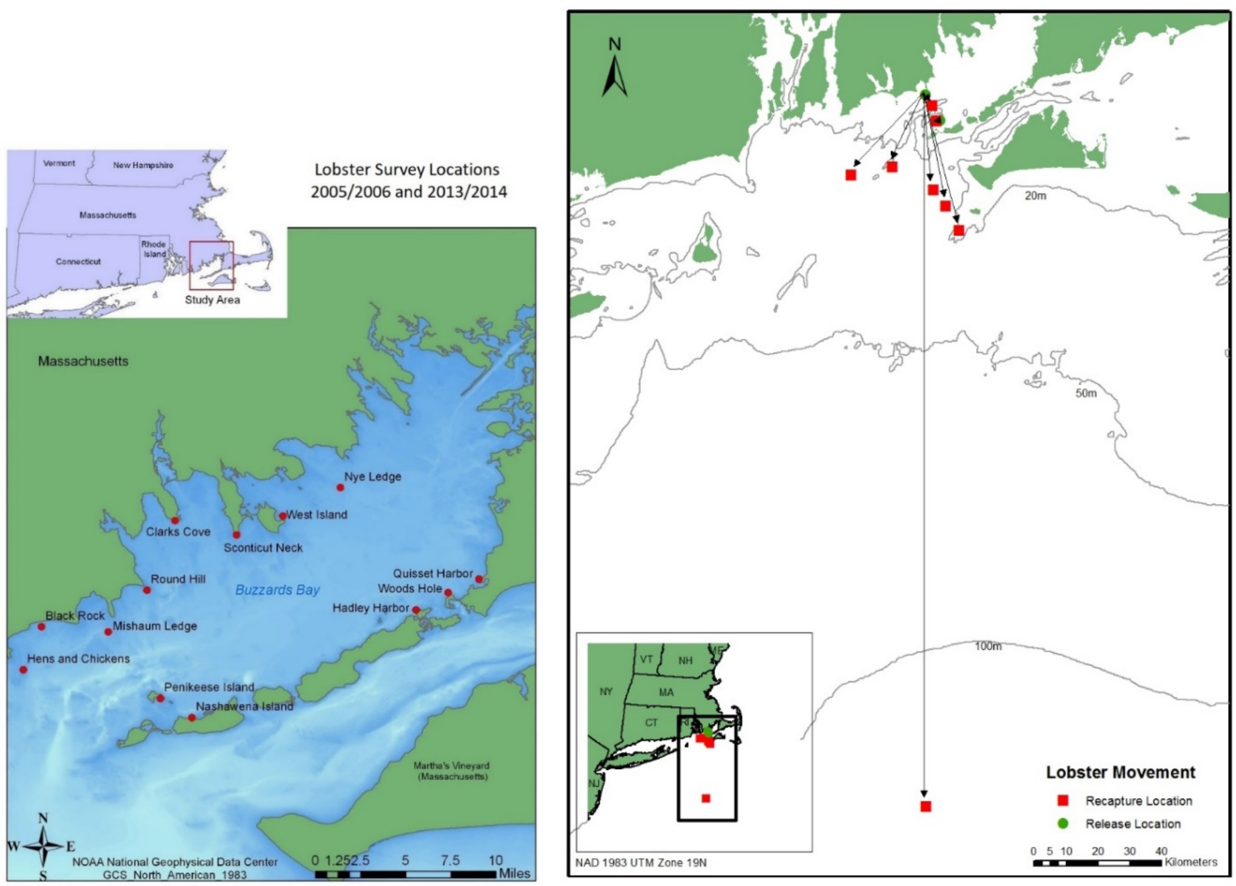

Figure 1a. (Left) Previous sampling locations of SMAST ventless trap survey in both 2005/2006 and 2013/2014. Figure 1b. (Right) Lobster recaptures reported by commercial fishermen from a tagging study in 2013/2014.

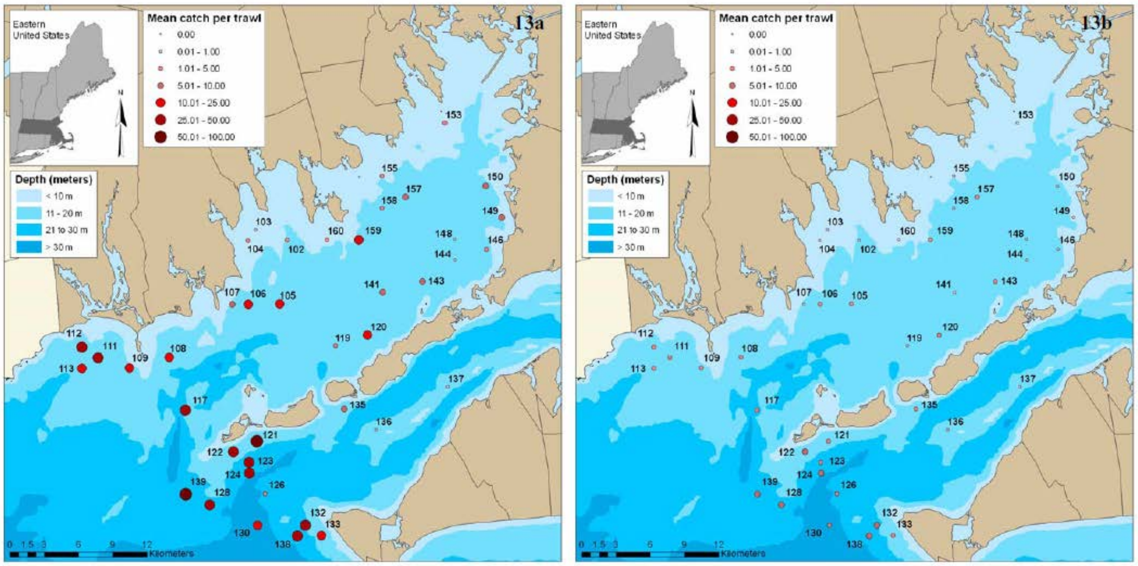

Figure 2. Catch distribution of DMF trawl survey for 2007 for sublegal and (b) legal sized lobsters, labels represent sampling station IDs (provide by B. Glenn).

Objectives and Methods: The goal of this project will be to provide a baseline for the environmental impact assessment for the Vineyard Wind development area and adjacent control areas (Figure 3). Our primary objectives are to 1) Estimate the size and distribution of lobster and black sea bass populations in the development and control areas, 2) Classify population dynamics of each species including, length, sex, reproductivity success, age, diet, and disease, 3) Estimate the relative abundance and distribution of planktonic species such as larval lobster and fish in the neustonic layer of each area, and 4) Obtain movement patterns and if possible meet the assumptions for a Jolly-Seber population estimate of lobsters through tagging.

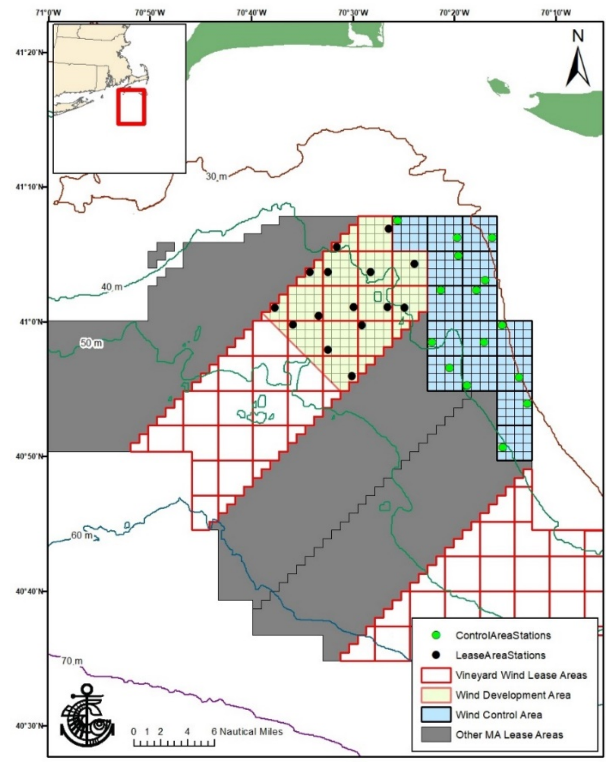

Figure 3. Proposed sampling sites (black and green dots) for 2019 in both the Vineyard Wind development area (yellow) and control area (blue).

Fisheries-dependent trap sampling data historically has been used very selectively to aid in relative abundance indices for American lobster (*Homarus americanus*) because of substantial spatial biases associated with the way these data are collected (ASMFC, 2015). The non-random fashion in which commercial traps are fished introduces a potential source of bias to CPUE estimates, as the fishery actively targets lobster. Instead, trawl survey relative abundance indices have been used for lobster stock assessment purposes because of the randomized sampling design and non-selective nature of trawl gear. However, trawl surveys have potential biases associated with their inability to fish in all productive lobster habitats, such as rock and ledge bottom, as well as in areas where static fishing gear is deployed (traps, gillnets, and bottom longlines) due to gear conflict (ASMFC, 2015).

To minimize the potential biases associated with standard abundance indices we have modified Collie and King's (2016) existing cooperative, random stratified ventless trap survey. This will generate robust estimates of lobster relative abundance and recruitment in the Vineyard Wind development area and control sites. Sampling sites were determined by dividing our strata into "lease blocks" (larger grid cells in Figure 3). Each lease block was then divided into 16 "aliquots." A randomly selected aliquot within each lease block will serve as the site location for the duration of the survey. A map of the study area was overlaid with a latitude/longitude grid in ArcGIS (Figure 3) and shows depth within the area to be relatively uniform. Depth within the lease area ranges from 37 to 49.5m (Vineyard Wind, 2018). This survey design combines the best aspects of both fishery dependent and independent surveys; random stratified sampling design and static fishing gear that can be deployed on any substrate type.

We will sample 30 strings of lobster traps, split equally between the development and control areas. The strings in each area are designed using the standard protocols demonstrated in previous SMAST, DMF, and coastwide ventless trap studies (ASFMC, 2015; Courchene and Stokesbury, 2011). Each string contains 6 pots total, alternating between vented and ventless traps (Figure 4). The dimensions for all traps are standardized (40” x 21” x 16”) throughout all survey areas and contain a single kitchen, parlor, and rectangular vent in the parlor of vented traps (size 1 $^{15}/_{16}$” x 5 ¾”) will be included. The gear will follow federal rigging regulations; the downlines of each string will utilize new weak link technology to deter whale entanglements. Temperature will be collected using methods described by Cassidy (2018). A Tidbit v2™ Temperature Logger will be placed on the first trap of each string to compare CPUE and bottom water temperature.

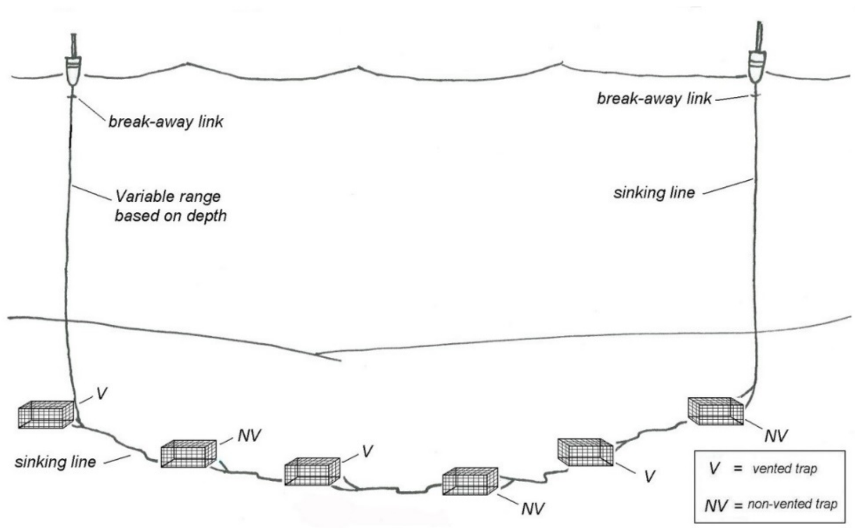

Figure 4. Diagram of the lobster trap array at each sampling location

Trap deployment, maintenance, and hauling are contracted to commercial lobstermen, but sampling will always be conducted by an SMAST researcher on board fishing vessels. To the degree possible, survey gear will be hauled on a three-day soak time, in the attempt to standardize catchability among trips. All trawls will be reset in the same assigned location after each haul. SMAST researchers will accompany fishermen on each sampling trip to record CPUE and biological data using the standard MADMF and RI DEM lobster trap sampling protocol, which enumerates lobsters per trap, number of trap hauls, soak time, trap and bait type, carapace length (to the nearest mm), sex, shell hardness, number of claws or shell damage, presence of shell disease, and egg stages on ovigerous females (ASMFC, 2015). A subset of this data will be collected from the first 5-10 Jonah crabs of each trawl, in addition to the recording of other bycaught species (Collie and King, 2016). Trawl location will be confirmed with the station’s original coordinates after each haul via GPS. Depth at mean low water for each trawl location will be recorded from NOAA navigational charts as a coastwide standard to avoid variability from tidal fluctuations. No lobsters or bycaught species will be landed during the survey.

A tagging study will be conducted using the methods described in Courchene and Stokesbury (2011). Lobsters with a carapace length greater than 40mm will be tagged using Floy™ anchor tags inserted with a hypodermic needle. The tag is inserted into the arthral muscle of the animal, so it is retained during molting. Each tag will display an individual identification number and include a phone number for reporting of recaptures by fishermen (Cassidy, 2018). Each tagged lobster will be released at the aliquot of capture, allowing for the spatial assessment of lobster use both within and outside the development area. In order to estimate abundance through tagging study a Jolly-Seber mark-recapture model will be implemented with the following assumptions: 1) Every lobster has the same probability (α_t) of being caught in sample *t,* 2) Every lobster has the same probability of survival from sample *t* to sample *t*+1, 3) Sampling time is negligible, and 4) Marks are not lost between sampling periods (Krebs, 1989). Utilization of the model is as follows:

First calculate the proportion of marked animals, which is called α, to correct for small sample sizes 1 can be added the variables (Krebs*,* 1989):

1) $$\hat{\alpha}_t = \frac{(r_t + 1)}{(c_t + 1)}$$

Next, calculate the size of the marked population prior to sample *t*:

2) $$\hat{P}_t = \frac{(s_t + 1)M_t}{(R_t + 1)} + r_t$$

Finally, a population estimate can then be derived using $\hat{P}_t$ and $\hat{\alpha}_t$:

3) $$\hat{N}_t = \frac{\hat{P}_t}{\hat{\alpha}_t}$$

To calculate the confidence limits and variance transform the estimates as follows:

4) $$\hat{N}_t^* = Ln(\hat{N}_t) + Ln\left[\frac{\sqrt{1 - \left(\left[c_t / \hat{N}_t\right] / 2\right) + \left(1 - \left(c_t / \hat{N}_t\right)\right)}}{2}\right]$$

Variance can be calculated as:

5) $$\delta_{\hat{N}_t^*} = \left(\frac{\hat{P}_t - r_t + s_t + 1}{\hat{P}_t + 1}\right)\left(\frac{1}{\hat{R}_t + 1} - \frac{1}{s_t + 1}\right) + \frac{1}{r_t + 1} - \frac{1}{c_t + 1}$$

Variance can be used to estimate the 95% confidence limits (*L)*, for the transformed values $\hat{N}_t^*$, where the upper limit is:

6) $$L_{\hat{N}_t^*(Lower)} = \hat{N}_t^* - 1.6\sqrt{\delta_{\hat{N}_t^*}}$$

and the lower is:

7) $$L_{\hat{N}_t^*(Upper)} = \hat{N}_t^* + 2.4\sqrt{\delta_{\hat{N}_t^*}}$$

Values can be re-transformed to estimate non-symmetrical confidence limits of the original population estimate:

$$8)\quad \frac{\left(4e^{L_{\hat{N}_t^*(Lower)}}+c_t\right)^2}{16e^{L_{\hat{N}_t^*(Lower)}}} < \hat{N}_t < \frac{\left(4e^{L_{\hat{N}_t^*(Upper)}}+c_t\right)^2}{16e^{L_{\hat{N}_t^*(Upper)}}}$$

This method has been successfully used to estimate lobster abundance in previous tagging studies (Dunnington et al, 2005; Bigelow, 2009).

This study will also aim to assess the black sea bass population. To achieve this, one un-baited fish pot will be set adjacent to each sting of lobster traps and naturally saturate over the soaking period. This will not only be important for collecting general information on this species, but also will allow us to examine relative predation rates on larval and year-of-young lobster (Figure 5). This will be accomplished through stomach content analysis as this species preys on lobster (Wahle, et al, 2013). Sampling of this gear will occur simultaneously with lobster trap hauling. Collections of black sea bass for biological analysis (aging, diet, and fecundity) will be taken at each hauling period; thirty from each area, sixty samples in total.

Photo Credit: Nate Gorry

Figure 5: A recreationally caught black sea bass with emphasis that it has recently consumed a lobster.

We will assess changes to larval lobster abundances. A towed neuston net will collect samples from the same survey aliquots as the traps. This will occur on the days set aside for baiting and setting gear from May through October. The sampling net will be deployed off the stern of the commercial fishing vessels; the frame is 2.4m x .6m x 6 m in size and the net is made of a 1320 micrometer mesh. At each location three tows at 4 knots of approximately 7 minutes each will be conducted. The contents from each tow will be washed into tubs, sorted, and stored in a mixture of 10% formalin: 90% seawater, as described by Cassidy (2018). Once back in the lab, samples will be transferred into 70% ethanol for preservation and lobster larvae will be staged according to Herrick (1911).

All results from the three major components of this study will be summarized in a final report and presented to stakeholders and Vineyard Wind LLC. This study will provide a strong baseline of data for the pre-construction phase of the wind farm development and control area and be utilized in the longer term Before-After-Control-Impact assessment. This research will also serve as a platform for a master's in science research project at the University of Massachusetts Dartmouth School for Marine Science and Technology.

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