ENVIRONMENTAL STUDIES PROGRAM: Ongoing Studies

Region: Headquarters

Planning Area(s): Atlantic, Gulf of Mexico, and Pacific

Title: Underwater Hearing Sensitivity in the Leatherback Sea Turtle (*Dermochelys coriacea*): Assessing the Potential Effect of Anthropogenic Noise (NT-10-x33)

Conducting Organization: Wider Caribbean Sea Turtle Conservation Network (Widecast)

BOEMRE Contact: Dr. Michael Rasser

Total Cost: $13,974 **Period of Performance:** FY 2010-2012

Description:

Background: Very little is understood about the hearing ability or behavioral responses of sea turtles to acoustic stimuli such as noise produced by offshore industrial activity. The proposed project will be the first determination of the hearing sensitivity of leatherback sea turtles (Dermochelys coriacea) which are classified as endangered under the U. S. Endangered Species Act. While primarily an oceanic turtle, this species forages throughout U. S. Pacific and Atlantic waters and in the Gulf of Mexico. They have been observed in shallow waters in the Atlantic, including in Nantucket Sound, (Martha's) Vineyard Sound, and Rhode Island Sound, where offshore wind energy projects may be sited. Knowing the susceptibility to construction and operational noise from such facilities on leatherback sea turtles will help determine if mitigation actions must be taken to prevent harm and in developing those mitigation methods. The information will also help determine susceptibility to other anthropogenic sounds such as those produced by seismic surveys, drilling, and commercial shipping.

Objectives: The primary objective is to measure the hearing sensitivity (develop auditory sensitivity curves) of leatherback sea turtles in air and under water, which can be used to determine if leatherbacks are able to hear, and therefore respond to, sounds produced by marine anthropogenic sources. Secondarily, this study will determine the overlap of the sounds that can be heard by leatherback sea turtles and the sounds produced seismic airguns, offshore drilling for oil and gas, commercial shipping, the construction and operation of offshore wind-powered electric generators, and other anthropogenic sounds.

Methods: This study will make auditory brainstem response (ABR) measurements by recording auditory evoked potentials (AEPs) from the central nervous systems of test animals following the in-water and in-air methods of Dow Piniak et al. (manuscripts in preparation) and Harms et al. (2009) studying green and hawksbill sea turtles. A Tucker-Davis Technologies Workstation run by a laptop computer will record evoked potentials and generate sound stimuli through the under-water speaker (Clark Synthesis AC339). The system will be calibrated with a hydrophone (High Tech, Inc.) at the location of the turtle's head when the turtle is not present and

background noise will be measured to make sure that thresholds are not masked by background noise. Pulsed Tonal Acoustic stimuli will be 100 ms in length, ramped with a 20 ms rise-fall time and shaped with a Hanning window. Measurements will be made at the following frequencies: 50, 100, 200, 300, 400, 600, 800, 1600, and 3,200Hz, at decreasing volumes until a response can no longer be detected. AEPs will also be measured in response to a broad-band click stimulus. The AEP signal will differentially amplified to reduce common electrical noise and signal averaging (up to 1000 signals) will be used to "pull" the evoked potential from the surrounding noise.

Test animals will be isolated from vibrations and lightly restrained to prevent swimming movement. For in-water experiments test animals will be placed in a round tank underwater at least 10cm beneath the surface to move away the air-water interface. Measurements will be taken at short intervals, between which the test animals will be brought to the surface to breathe and then returned to the same position before collecting further measurements. A three-electrode array to record evoked potentials will be used. Needle electrodes will be inserted subdermally on the top of the head above the pineal gland (recording electrode), the deltoid muscle in the shoulder (reference electrode). The third electrode (ground electrode) will be inserted in either the opposite deltoid muscle for in-air measurements or in the water for the in-water measurements. The system will be paused when the test animal lifts its head or moves in any way, so that all records are obtained from the turtle with its head in the same location in the acoustic field. Artifact rejection will also be used to reject sweeps containing electrical noise if the turtle moves during data acquisition.

Importance to BOEMRE: This information is needed to better assess the impacts of noise-producing offshore renewable energy projects on leatherback sea turtles in the Atlantic, which are an endangered species. This information will be used in environmental impact assessments and in consultations with the National Marine Fisheries Service.

Status: Awarded 9/16/10 and ongoing

Final Report Due: 9/15/12

Revised Date: February 17, 2011