

**National Science Foundation  
Geosciences Directorate  
Division of Ocean Sciences  
Arlington, Virginia**

**DRAFT NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) ANALYSIS  
PURSUANT TO  
EXECUTIVE ORDER 12114**

**Marine Geophysical Survey by the R/V *Marcus G. Langseth*  
in the Pacific Ocean off Costa Rica,  
April–May 2011**

**OCE# 0851380**

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**Project Title:** Collaborative Research: A 3D seismic investigation of the transition to seismogenic behavior along the southern Costa Rica subduction zone

This constitutes a draft environmental analysis prepared by the National Science Foundation (NSF) for a marine seismic survey proposed to be conducted in April - May 2011 on board the research vessel (R/V) *Marcus G. Langseth* in the Eastern Tropical Pacific off the coast of Costa Rica. This analysis is based, in part, on an Environmental Assessment report prepared by LGL Limited environmental research associates (LGL) on behalf of NSF, entitled, “Environmental Assessment of a Marine Geophysical Survey by the R/V *Marcus G. Langseth* in the Pacific Ocean off Costa Rica, April–May 2011” (Report #TA4926-1) (Attachment 1). The conclusions from the LGL report were used to inform the Division of Ocean Sciences (OCE) management of potential environmental impacts of the cruise. OCE has reviewed and concurs with the report’s findings. Accordingly, the LGL report is incorporated into this analysis by reference as if fully set forth herein.

**Project Objectives and Context**

The purpose of the survey is to use the 3D seismic reflection capability of the R/V *Langseth* to image the structures along a major plate-boundary fault off Costa Rica that has a history of generating large earthquakes and tsunamis. The 3D seismic reflection data will be used to determine the fault structure and the properties of the rocks that lie along the fault zone. These properties evolve with depth into the subduction zone and change the earthquake behavior of the fault. The main goal of the survey is to map the down dip variation in the properties to assess the property changes along the fault and determine where the large stress accumulations that lead to large earthquakes occur along the fault zone.

The target depths to the seismogenic zone are 2–9 km below the seafloor, which makes these earthquake generating zones very inaccessible; the only feasible means to assess the physical characteristics of deep fault zones where earthquakes are generated is by remote sensing using seismic techniques. This subduction zone setting is typical of numerous locations around the world, and the results of the proposed survey will have broad application. These are settings that

generate the world's largest and most destructive earthquakes and tsunamis, and the results of this study will have broad implications for geohazards studies and societal benefit. The Costa Rica survey site is a location accessible by the R/V *Langseth* whereas other similar subduction zone sites pose operational challenges and may not be feasible to survey by research vessels.

The project would be an international collaborative effort and would provide support to US scientists, technicians, graduate and undergraduate students, and other support personnel.

### **Summary of Proposed Action and Alternatives**

The procedures to be used for the survey would be similar to those used during previous seismic surveys and would involve conventional seismic methodology. The proposed survey would take place from April through May 2011 within the Exclusive Economic Zones (EEZ) of Costa Rica (See Attachment 1, Figure 1). The seismic survey would consist of approximately 2500 km of transect lines (including turns) in water depths ranging from less than 100 meters to greater than 1000 meters, with the majority being in depths between 100-1000 meters. During the survey, a 36-airgun array would be deployed from the R/V *Langseth* as an energy source; it would be operated with alternating subarrays consisting of 18 airguns each, with a maximum discharge volume of 3300 in<sup>3</sup>. A towed hydrophone streamer would receive the returning acoustic signals and transfer the data to the on-board processing system. In addition to the airgun array, a multibeam echosounder (MBES) and a sub-bottom profiler (SBP) would be used continuously throughout the cruise. Seismic operations would be carried out for approximately 25-28 days. Some minor deviation from proposed cruise dates may be required, depending on logistics, weather conditions, and the need to repeat some lines if data quality were substandard.

One alternative to the proposed action would be to issue an IHA at an alternative time and conduct the survey at that alternative time. Constraints for vessel operations and availability of equipment (including the vessel) and personnel would need to be considered for alternative cruise times. Limitations on scheduling the vessel include the additional research studies planned on the vessel for 2011 and beyond. Other research activities planned within the region also would need to be considered.

Another alternative to conducting the proposed activities would be the "No Action" alternative, i.e. do not issue an IHA and do not conduct the operations. If the planned research were not conducted, the "No Action" alternative would result in no disturbance to marine mammals attributable to the proposed activities, but geophysical data of considerable scientific value that would increase our understanding of ocean faults and geohazards such as earthquakes and tsunamis would not be acquired and the project objectives as described above would not be met. The "No Action" alternative would result in a lost opportunity to obtain important scientific data and knowledge relevant to a number of research fields and to society in general. The collaboration, involving investigators, students, and technicians, would be lost along with the collection of new data, interpretation of these data, and introduction of new results into the greater scientific community and applicability of this data to other similar settings. Loss of NSF support often represents a significant negative impact to the academic infrastructure.

## **Summary of environmental consequences**

The potential effects of sounds from airguns on marine species, including mammals and turtles of particular concern, are described in detail in Attachment 1 (pages 42-72 and Appendices B-D) and might include one or more of the following: tolerance, masking of natural sounds, behavioral disturbance, and at least in theory, temporary or permanent hearing impairment, or non-auditory physical or physiological effects. It is unlikely that the project would result in any cases of temporary or especially permanent hearing impairment, or any significant nonauditory physical or physiological effects. Some behavioral disturbance is expected, if animals are in the general area during seismic operations, but this would be localized, short-term, and involve limited numbers of animals.

The proposed activity would include a mitigation program to further minimize potential impacts on marine mammals that may be present during the conduct of the research to a level of insignificance. As detailed in Attachment 1 (pages 5-13; and 56) monitoring and mitigation measures would include: ramp ups, minimum of one dedicated observer maintaining a visual watch during all daytime airgun operations, two observers for 30 minutes before and during ramp ups during the day and at night (and when possible at other times), no start ups during poor visibility or at night unless at least one airgun has been operating, passive acoustic monitoring (PAM) via towed hydrophones during both day and night to complement visual monitoring, and power downs (or if necessary shut downs) when marine mammals or sea turtles are detected in or about to enter designated exclusion zones. The fact that the airguns, as a result of their design, direct the majority of the energy downward, and less energy laterally, would also be an inherent mitigation measure.

With the planned monitoring and mitigation measures, unavoidable impacts to each species of marine mammal and turtle that could be encountered would be expected to be limited to short-term, localized changes in behavior and distribution near the seismic vessel. At most, effects on marine mammals may be interpreted as falling within the U.S. Marine Mammal Protection Act (MMPA) definition of “Level B Harassment” for those species managed by the National Marine Fisheries Service. No long-term or significant effects would be expected on individual marine mammals, sea turtles, or the populations to which they belong or on their habitats.

A survey at an alternative time would result in few net benefits. As described in Attachment 1, marine mammals and sea turtles are expected to be found throughout the proposed region of study. Many cetaceans are widespread in the survey area throughout the year. Others (some baleen whales) are present in winter and possibly migrate through during spring and fall. Humpback whales occupy Drake Bay throughout the winter, but most if not all will have migrated north before the proposed survey. Some leatherback, green, and olive ridley nesting beaches occur near the proposed survey area, but the biggest are located more than 150 kilometers to the north. The survey is scheduled after the peak nesting periods for leatherbacks (October–March), green turtles (October–November), and olive ridleys (September–December). Foraging or migrating individuals could be encountered at any time of year.

The “no action” alternative would remove the potential for disturbance to marine mammals or sea turtles attributable to the proposed activities as described. It would however preclude important scientific research from going forward that has distinct potential to address geological processes of concern.

**Conclusions**

NSF has reviewed and concurs with the conclusions of the LGL report (Attachment 1) that implementation of the proposed activity will not have a significant impact on the environment.