THE MARINE LABORATORY
Institute of Marine Science
University of Miami

FINAL REPORT

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AMBIENT NOISE AND SOUND TRANSMISSION IN TROPICAL WATERS

to

U. S. Department of the Navy
Bureau of Ships
Contract Nobsr 72626

1 Rickenbacker Causeway
Miami 49, Florida

F. G. Walton Smith
Director

ML 62144
8882

AMBIENT NOISE AND SOUND TRANSMISSION IN TROPICAL WATERS

SUMMARY

Measurements of ambient noise were carried out in the Tongue of the Ocean during cruises of the R/V GERDA in 1958 and 1959. Data were obtained on the spectrum levels of ambient noise in relation to windspeed, sea state and water depth at various locations. In 1960 and 1961, exploratory studies of the contributions of surface waves to ambient noise were made at the Bimini Hydrophone Installation. In 1959, sound propagation tests in the Tongue of the Ocean employing a series of explosive charges, showed the existence of a surface channel and indicated the possibilities using such tests to determine its properties. Other work under contract included the measurement of noise radiated by the oceanographic vessel USNS GIBBS and the ultrasonic absorption of natural suspensions of calcium carbonate and other substances. Major items of sound recording, measuring and analyzing equipment amounting to more than $30,000 were purchased with contract funds.

INTRODUCTION

The work performed and results obtained will be presented in condensed form by listing technical reports of the results with short abstracts of their contents. The subject contract has been replaced by contract Nobs 84540, Noise from Surface Waves, Bureau of Ships, Code 342-C.

EXPERIMENTAL PROCEDURES AND RESULTS

1. Observations in the Tongue of the Ocean

OCEANOGRAPHIC SURVEY OF THE TONGUE OF THE OCEAN, VOLUME II Technical Report ML-2112, The Marine Laboratory, University of Miami, 26 September 1958, (CONFIDENTIAL)*

This report presents data in graphical and tabular form on sound velocity versus depth and on the spectrum levels of ambient noise at various locations in the Tongue of the Ocean. The observations were made during the period 6 August to 26 September 1958.

Equipment and personnel for the noise measurements and analysis were furnished under the subject contract.

ACOUSTIC AMBIENT NOISE IN THE TONGUE OF THE OCEAN Technical Report ML59180, The Marine Laboratory, University of Miami, Elliot Rhian, July 1959 (CONFIDENTIAL)

This report presents data on the spectrum levels of ambient noise and related factors for various stations in the Tongue of the Ocean. The observations were made during August 1958 and April 1959 and furnished basic information on noise at a critical time. The report extends considerably. the results noted above under report ML-2112.

SURFACE LAYER TRANSMISSI0N IN THE TONGUE OF THE OCEAN Technical Report ML611068, The Marine Laboratory, University of Miami. Elliot Rhian and Roger Dann, July 1960.*

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* The work described in reports marked with an asterisk was partially supported by the subject contract.

Signals from a series of explosive shots are analyzed in the report, in order to determine the effect of the surface channel sound duct in the Tongue of the Ocean. A simple technique is described for determining sound arrivals via this channel. The frequency spectrum of the sound transmitted through the surface channel is in good agreement with that predicted by normal mode theory.

The analysis of the observations and preparation of the report was carried out under the subject contract.

2. Ambient Noise Measurements

THE BIMINI INSTALLATION
Technical Report T-61202, The Marine Laboratory, University of Miami, June 1961.*

The report describes a two hydrophone cable assembly that was installed on the ocean bottom off the west coast of Bimini, Bahamas on 9 November, 1960 by The Marine Laboratory, University of Miami. The cable was terminated in the Lerner Marine laboratory. Bimini, by magnetic tape recording and analyzing equipment. The installation was made in order to study marine animal sounds under natural conditions, ambient noise, and sound propagation across the Straits of Florida. Preliminary results of the studies are given in the report.

The installation includes magnetic tape and graphical recording equipment obtained under the subject contract.

A HYDROPHONE INSTALLATION FOR THE STUDY OF SONIFEROUS MARINE ANIMALS. John C. Steinberg, Morton Kronengold and William C. Cummings, Institute of Marine Sciences, University of Miami.*

The above paper was presented before the Acoustical Society of America, November 1961. It describes the Bimini Hydrophone Installation and presents the results of studies of the sounds produced by marine animals. More than twenty-five categories of sounds were observed during the initial period from November 1960 to July 1961. A number of the categories showed repetitive, diurnal patterns and possible seasonal patterns of soniferous activity. Some tentative identifications have been made.

Preparation of the paper involved the use of sound recording and analyzing equipment obtained under the subject contract.

3. Other Results

UNDERWATER RADIATED NOISE MEASUREMENTS
USNS GIBBS T-AGOR-1
Technical Report ML----, The Marine Laboratory, University of Miami, Joseph D. Richard, (In preparation).

This report gives the results of measurements in deep water, of noise radiated by the oceanographic vessel USNS GIBBS. The data are presented in the form of spectrum levels for various ship speeds and ranges,

ULTRASONIC ABSORPTION IN NATURAL SUSPENSIONS
Joseph D. Richard, The Marine Laboratory, University of Miami.

The above paper which is in preparation for publication gives the results of ultrasonic absorption measurements of natural suspensions, particularly calcium carbonate, over the frequency range from 100 KC/sec. to 2 mc/sec.

DISCUSSION

Results of the ambient noise measurements in the Tongue of the Ocean indicated that noise in the 1000 cps region increased considerably more than noise in adjacent frequency regions with increase of wind speed. To investigate this further, studies of capillary waves were initiated and noise measurements with the fixed hydrophones of the Bimini Hydrophone Installation were undertaken. It was concluded that the principal contributions of surface waves to ambient noise can be accounted for quantitatively from measurements on a continuous basis, of noise levels and significant environmental factors. These include wind speed and direction, surface wave spectra, surface current speed and direction and sound velocity versus depth. The Bimini location which provides two hydrophone sites that are only one mile apart with depth difference of 1100 feet, winds across, against and with the Gulf Stream direction, and a seasonally variable surface channel, appears to be advantageous for such a study and it is currently being carried on under the replacement contract. It will be necessary to make measurements over extended periods, to employ statistical techniques and equipment for the automatic logging and storage data in forms suitable for computer operation.

During the five year period of the contract, an underwater sound capability has been established involving the efforts of several faculty members and of one to three graduate students. About $35,000 of a total expenditure of $148,000 has been spent for acoustic equipment.

The major items are a Panoramic sonic, subsonic and ultrasonic analyzer, a four track Ampex FM and several two track direct tape recorders, a Visicorder (four track recording oscillograph) and two dual amplifier oscilloscopes.

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J. D. Richard
John C. Steinberg

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